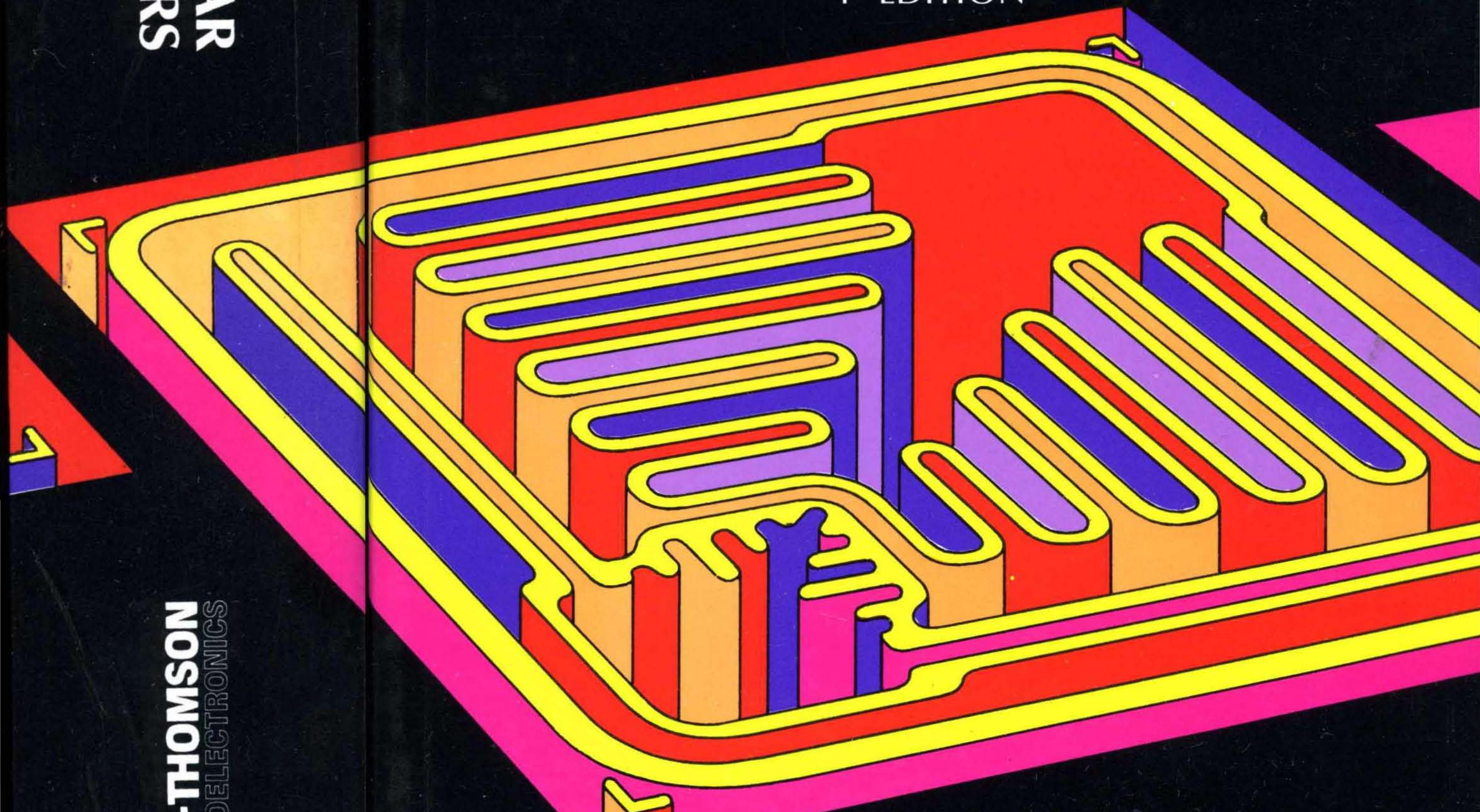
POWER BIPOLAR TRANSISTORS

DATABOOK

1st EDITION



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JUNE 1989

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1. Life support devices to systems are devices or systems which, are intended for surgical implant into the body to support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.

2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

TABLE OF CONTENTS

INTRODUCTION

This Power Bipolar Transistor DATABOOK contains data on the range of the Company's discrete BIPOLAR POWER devices for applications in industrial, automotive, computer, telecommunication, professional, and consumer equipment.

Introduced for the first time are ETD transistors for high voltage, high reliability applications, that are made using a new cellular emitter technology. Also introduced for many devices is the option of an ISOLATED PACKAGE, either ISOWATT220, ISOWATT218, or TOP 3I.

Selection guides are provided in the following pages to facilitate rapid identification of the most suitable device for the intended use.

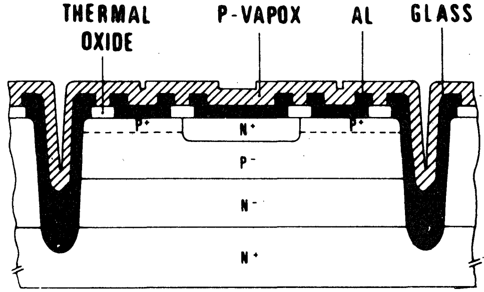
The extensive information makes it easy to evaluate the performance of the product within any required equipment design.

This DATABOOK is complemented by the POWER TRANSISTOR APPLICATION MANUAL (order code AMPOWTRANST/1) which is a collection of technical notes concerning POWER TRANSISTORS.

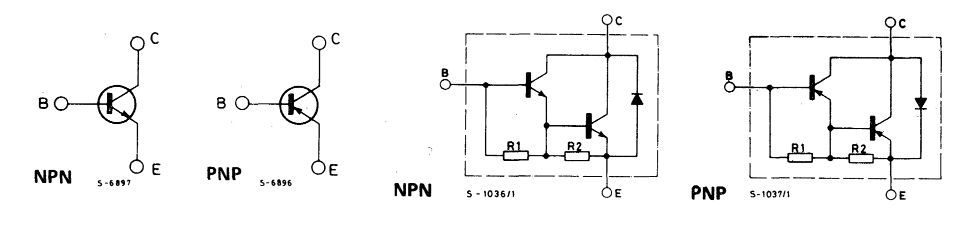
EPITAXIAL BASE - I_{CM} UP TO 30A; V_{CEO} UP TO 100V

MAIN FEATURES

- NPN and PNP types (perfect complementary pairs)
- Medium switching speed
- Medium f_T (2 to 20 MHz)
- High ruggedness



INTERNAL SCHEMATIC DIAGRAMS

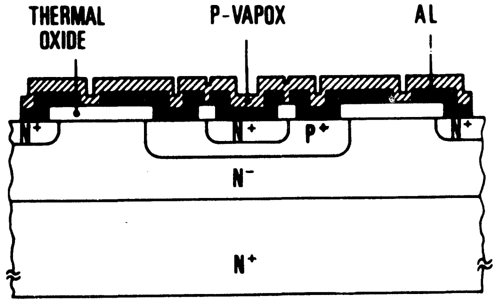


Epitaxial Base Technology is a general purpose low voltage technology for NPN/PNP transistors and monolithic Darlingtons.
This low voltage complementary technology consists of epitaxial layers of N and P type silicon.
The emitter efficiency is maximized by the appropriate choice of emitter geometry.
In this technology the base is obtained by an epitaxial growth.
The thickness of the base epitaxy and the impurity level control obtained during the process enables the production of perfect complementary devices.
This makes them ideally suited for applications where a V_{CEO} rating of up to 100 V is required with breakown voltages of 200V, and transition frequencies up to 20 MHz.
Due to the base obtained by epitaxial growth, a mesa channel is then etched that defines the base-collector junction and allows the devices to be separated from each other. The mesa channel is then passivated with glass.
While epitaxial base transistors give high ruggedness to forward secondary breakdown, their switching speed makes epitaxial base transistors the ideal choice for general purpose uses.
Applications include amplifiers, regulators, switches and drivers produced in a wide ragnge of packages, such as the TIP, BD, 2N and MJE series transistors and Darlingtons.

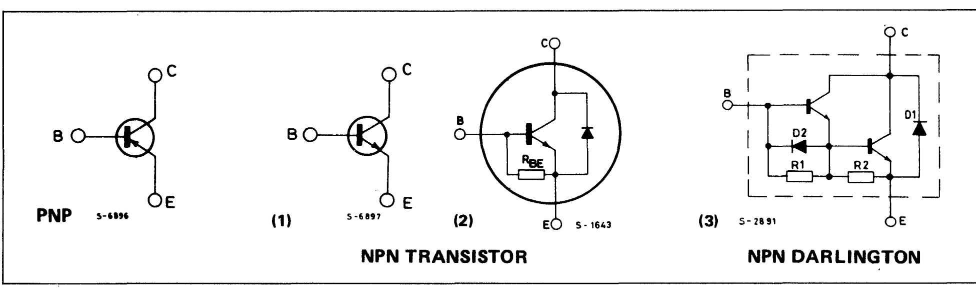
EPITAXIAL PLANAR - I_{CM} UP TO 70A; V_{CEO} UP TO 350V

MAIN FEATURES

- NPN and PNP types
- Good voltage capability (V_{CES} up to 450V)
- Good h_{FE} linearity
- Low saturation voltage
- Low leakage
- Very high f_T (up to 100 MHz)
- Very high speed
- Rugged
- Total base-collector passivation



INTERNAL SCHEMATIC DIAGRAMS

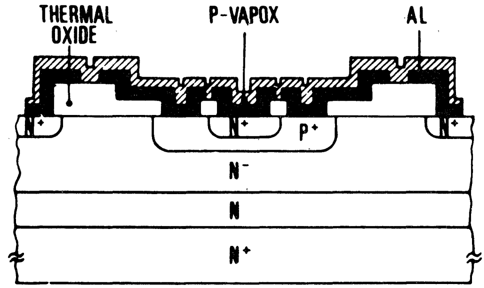


Epitaxial planar is a medium voltage fast switching technology for NPN/PNP transistors and monolithic NPN Darlingtons. This medium voltage technology consists of epitaxial layers of N or P type silicon whose planar construction method permits very high speed switching, a low saturation voltage, and low leakage. The emitter efficiency is maximized by an appropriate choice of emitter geometry.
The base is obtained by a planar diffusion into the epitaxially grown collector.
These features make it ideally suited for applications where a V_{CEO} rating of up-to 200 V is required and cut-off frequencies up to 100 MHz; the breakdown voltage can be as high as 450V. Epitaxial planar transistors are characterized by high speed, and are generally produced for medium power applications in SOT-32 and TO-220 packages.
Applications include drivers. DC-DC converters and general fast switching uses. A family of NPN Darlingtons and transistors are produced for monochrome deflection applications.

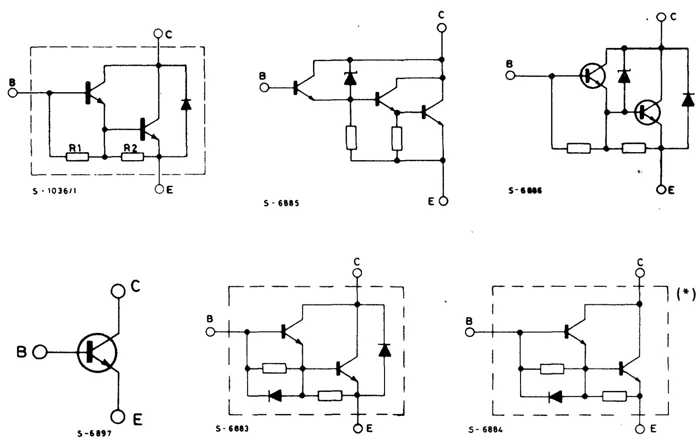
MULTIEPITAXIAL PLANAR - I_{CM} UP TO 70A; V_{CEO} UP TO 450V

MAIN FEATURES

- NPN types
- I_C range up to 70A
- Good h_{FE} linearity
- Low leakage
- High switching speed
- Total base-collector passivation



INTERNAL SCHEMATIC DIAGRAMS



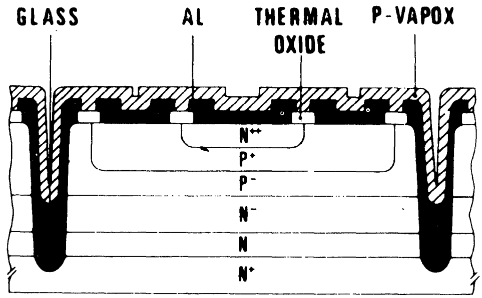
Multiepitaxial planar technology is a medium voltage, rugged, high switching speed technology for NPN transistors and Darlingtons, with or without collector-emitter protective diodes.
This medium voltage technology consists of epitaxial layers of N type silicon: an additional energy layer of N type silicon in the collector region increases the ruggedness of the device while operating in the RBSOA. The emitter efficiency is maximized by the appropriate choice of emitter geometry.

The base is obtained by a planar diffusion inside the epitaxial collector.
These features make this technology ideally suited for applications where a V_{EO} rating of up to 450 V is required at high switching speeds. The breakdown voltage boundary is around 800V. Applications include high power DC-DC converters and motor controls. A very high gain Trilington is also produced for automotive applications.

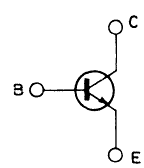
MULTIEPITAXIAL MESA - I_{CM} UP TO 30A; V_{CEO} UP TO 700V

MAIN FEATURES

- NPN type
- High voltage (V_{CES} UP TO 1500V)
- High power
- Very good $I_{s/b}$ and $E_{s/b}$ performance)
- High switching speed
- High f_T (20MHz)



INTERNAL SCHEMATIC DIAGRAM



The multiepitataxial mesa technology is used to produce high voltage and fast switching NPN transistors, and NPN Dalingtons. NPN medium voltage devices, with V_{CES} up to 500V are also produced.

While in the epitaxial base technology the base is obtained by an epitaxial layer, in the multiepitaxial mesa it is made up of two parts. Firstly an epitaxial base is grown as in the epibase technology. Then inside it a masked diffusion takes place. As a result, two different base regions are created: the epitaxial P^- region close to the mesa channel and the active region that consist of a P^+ diffusion plus the underlying residual P^- epitaxial region. This base structure allows the reduction of the electric field both at the die surface and in the mesa channel zone, with an excellent effect on the reliability.

The intermediate energy layer N between the N^- collector and the N^+ substrate strongly improve the RBSOA characteristics. The high power density generated in the crystal during switching transients is safely dispersed in the thickness of the energy layer avoiding risky hot spots.

A deep mesa channel is then etched to allow the separation of devices and to define the base-collector junction.

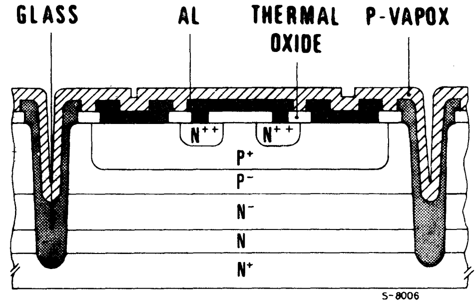
Additionally, as well as passivating the mesa channel with glass, an aluminium equipotential ring (EQR) is deposited around the upper outer edge of the mesa channel. This EQR is at the same potential as the collector to provide a well defined and controlled boundary for the electric field.

Applications for this high voltage and very rugged technology include: off-line switching power supplies, lamp ballast, CTV deflection and motor control.

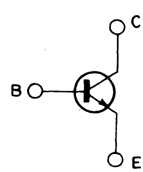
MULTIEPITAXIAL MESA HOLLOW EMITTER - I_{CM} UP TO 12A; V_{CEO} UP TO 450V

MAIN FEATURES

- Suitable for high frequency switching power supplies
- NPN types
- High voltage (V_{CBO} up to 1300V)
- High power
- Very good $I_{s/b}$ and $E_{s/b}$ performance
- Very high switching speed up to 70 KHz



INTERNAL SCHEMATIC DIAGRAM

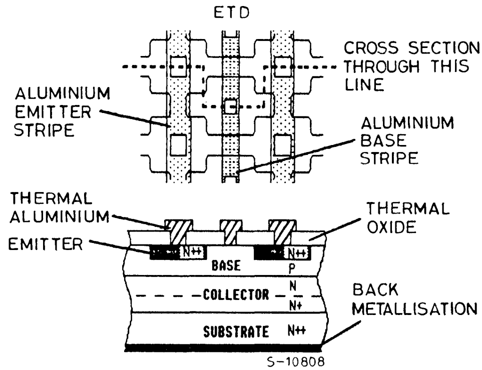


The Multiepitaxial Mesa FASTSWITCH technology is an improdement of the established and proven multiepitaxial mesa process. This new technology is used to produce high voltage and very fast switching NPN transistors.
Multiepitaxial Mesa FASTWITCH technology consists of epitaxial layers of N and P type silicon, a thin intermediate energy layer and a glass filled mesa around the edge of the chip.
A hollow emitter geometry reduces charge crowding under the emitter and improves turn-off time. This features and a thinner energy layer, which lowers the saturation voltage, optimize the performance of this technology for high voltage and very fast switching applications.
Low dynamic saturation, very fast switching and high voltage capability make this technology ideal for off-line switching power supplies, lamp ballast and high line rate CTV deflection applications.

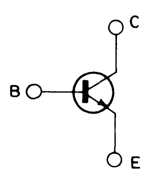
MULTIEPITAXIAL PLANAR ETD™ - I_{CM} UP TO 30A; V_{CEO} UP TO 450V

MAIN FEATURES

- Suitable for high efficiency power conversion
- NPN types
- High voltage (V_{CEV} UP TO 1000V)
- High power (switching up to 12kVA)
- Optimised multicellular emitter design
- Excellent RBSOA
- Very high switching speed - up to 100kHz
- Simplified base drive



INTERNAL SCHEMATIC DIAGRAM



The Multiepitaxial planar ETD technology is an optimisation of the multiepitaxial planar process. This new technology is used to produce high voltage, very fast switching transistors with very low losses. The intermediate energy layer N, between the N^+ substrate and the N collector layer, improves the RBSOA. The P^- base ring diffusion allows to reach the bulk avalanche limit: this in turn allows the N collector layer thickness to be optimised, and improves the device's reliability.

The planar diffused base and multicellular emitter structure provides very high switching speeds and avoids charge crowding under the emitter area. The low dynamic and static losses together with the very fast switching and high voltage rating make this technology ideal for professional and industrial equipment such as off-line power supplies, power conversion and motor controls.

GENERAL PURPOSE TRANSISTORS

Type	Complementary	V_{CEO} (V)	V_{CBO} (V)	I_C (A)	h_{FE}	@ I_C (A)	V_{CE} (V)	V_{CEsat} (V)	@ I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Case	Page
2N3055	**MJ2955**	60	100	15	20	4.00	4.0	1.10	4.00	400	1.5	TO - 3	1399
2N3715	**2N3791**	60	80	10	30	3.00	2.0	0.80	5.00	500	1.17	TO - 3	1047
2N3716	**2N3792**	80	100	10	30	3.00	2.0	0.80	5.00	500	1.17	TO - 3	1047
2N3771		40	50	15	15	15.00	4.0	2.00	15.00	1500	1.17	TO - 3	1053
2N3772		60	100	15	15	10.00	4.0	1.40	10.00	1000	1.17	TO - 3	1053
2N3791	2N3715	60	80	10	30	3.00	2.0	0.80	5.00	500	1.17	TO - 3	1047
2N3792	2N3716	80	100	10	30	3.00	2.0	0.80	5.00	500	1.17	TO - 3	1047
2N4234		40	40	3	20	0.50	1.0	0.60	1.00	100	29	TO - 39	1057
2N4398	2N5301	40	40	30	15	15.00	2.0	1.00	15.00	1500	0.875	TO - 3	1083
2N4399	2N5302	60	60	30	15	15.00	2.0	1.00	15.00	1500	0.875	TO - 3	1083
2N4918	2N4921	40	40	1	30	0.50	1.0	0.60	1.00	100	4.16	SOT - 32	1063
2N4919	2N4922	60	60	1	30	0.50	1.0	0.60	1.00	100	4.16	SOT - 32	1063
2N4920	2N4923	80	80	1	30	0.50	1.0	0.60	1.00	100	4.16	SOT - 32	1063
2N4921	**2N4918**	40	40	1	30	0.50	1.0	0.60	1.00	100	4.16	SOT - 32	1063
2N4922	**2N4919**	60	60	1	30	0.50	1.0	0.60	1.00	100	4.16	SOT - 32	1063
2N4923	**2N4920**	80	80	1	30	0.50	1.0	0.60	1.00	100	4.16	SOT - 32	1063
2N5151	2N5152	80	100	5	30	2.50	5.0	0.70	2.50	250	15	TO - 39	1073
2N5152	**2N5151**	80	100	5	30	2.50	5.0	0.70	2.50	250	15	TO - 39	1075
2N5153	2N5154	80	100	5	70	2.50	5.0	0.70	2.50	250	15	TO - 39	1073
2N5154	**2N5153**	80	100	5	70	2.50	5.0	0.70	2.50	250	15	TO - 39	1075
2N5190	**2N5193**	40	40	4	25	1.50	2.0	0.60	1.50	150	3.12	SOT - 32	1077
2N5191	**2N5194**	60	60	4	25	1.50	2.0	0.60	1.50	150	3.12	SOT - 32	1077
2N5192	**2N5195**	80	80	4	20	1.50	2.0	0.60	1.50	150	3.12	SOT - 32	1077
2N5193	2N5190	40	40	4	25	1.50	2.0	0.60	1.50	150	3.12	SOT - 32	1077
2N5194	2N5191	60	60	4	25	1.50	2.0	0.60	1.50	150	3.12	SOT - 32	1077
2N5195	2N5192	80	80	4	20	1.50	2.0	0.60	1.50	150	3.12	SOT - 32	1077
2N5301	**2N4398**	40	40	30	15	15.00	2.0	1.00	15.00	1500	0.875	TO - 3	1083
2N5302	**2N4399**	60	60	30	15	15.00	2.0	1.00	15.00	1500	0.875	TO - 3	1083
2N5303	**2N5745**	80	80	20	15	10.00	2.0	1.50	15.00	1500	0.875	TO - 3	1083
2N5336		80	80	5	20	5.00	2.0	1.20	5.00	500	29	TO - 39	1089
2N5337		80	80	5	40	5.00	2.0	1.20	5.00	500	29	TO - 39	1089
2N5338		100	100	5	20	5.00	2.0	1.20	5.00	500	29	TO - 39	1089
2N5339		100	100	5	40	5.00	2.0	1.20	5.00	500	29	TO - 39	1089
2N5629	**2N6029**	100	100	16	25	8.00	2.0	1.00	10.00	1000	0.875	TO - 3	1097
2N5679	2N5681	100	100	1	40	0.25	2.0	1.00	0.50	50	17.5	TO - 39	1111
2N5680	2N5682	120	120	1	40	0.25	2.0	1.00	0.50	50	17.5	TO - 39	1111
2N5681	**2N5679**	100	100	1	40	0.25	2.0	1.00	0.50	50	17.5	TO - 39	1113
2N5682	**2N5680**	120	120	1	40	0.25	2.0	1.00	0.50	50	17.5	TO - 39	1113
2N5745	2N5303	80	80	20	15	10.00	2.0	1.50	15.00	1500	0.875	TO - 3	1083
2N5875	2N5877	60	60	10	20	4.00	4.0	1.00	5.00	500	1.17	TO - 3	1115
2N5876	2N5878	80	80	10	20	4.00	4.0	1.00	5.00	500	1.17	TO - 3	1115
2N5877	**2N5875**	60	60	10	20	4.00	4.0	1.00	5.00	500	1.17	TO - 3	1115
2N5878	**2N5876**	80	80	10	20	4.00	4.0	1.00	5.00	500	1.17	TO - 3	1115
2N5883	2N5885	60	60	25	20	10.00	4.0	1.00	15.00	1500	0.875	TO - 3	1121
2N5884	2N5886	80	80	25	20	10.00	4.0	1.00	15.00	1500	0.875	TO - 3	1121

PNP Type in bold.

GENERAL PURPOSE TRANSISTORS (cont'd)

Type	Complementary	V_{CEO} (V)	V_{CBO} (V)	I_C (A)	h_{FE}	@ I_C (A)	V_{CE} (V)	V_{CEsat} (V)	@ I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Case	Page
2N5885	**2N5883**	60	60	25	20	10.00	4.0	1.00	15.00	1500	0.875	TO - 3	1121
2N5886	**2N5884**	80	80	25	20	10.00	4.0	1.00	15.00	1500	0.875	TO - 3	1121
2N6029	2N5629	100	100	16	25	8.00	2.0	1.00	10.00	1000	0.875	TO - 3	1097
2N6034	2N6037	40	40	4	500	0.50	3.0	2.00	2.00	8	3.12	SOT - 32	1131
2N6035	2N6038	60	60	4	500	0.50	3.0	2.00	2.00	8	3.12	SOT - 32	1131
2N6036	2N6039	80	80	4	500	0.50	3.0	2.00	2.00	8	3.12	SOT - 32	1131
2N6037	**2N6034**	40	40	4	500	0.50	3.0	2.00	2.00	8	3.12	SOT - 32	1131
2N6038	**2N6035**	60	60	4	500	0.50	3.0	2.00	2.00	8	3.12	SOT - 32	1131
2N6039	**2N6036**	80	80	4	500	0.50	3.0	2.00	2.00	8	3.12	SOT - 32	1131
2N6042	2N6045	100	100	8	1000	3.00	4.0	2.00	3.00	12	1.56	TO - 220	1135
2N6045	**2N6042**	100	100	8	1000	3.00	4.0	2.00	3.00	12	1.56	TO - 220	1135
2N6050	2N6057	60	60	12	750	6.00	3.0	2.00	6.00	24	1.17	TO - 3	1137
2N6051	2N6058	80	80	12	750	6.00	3.0	2.00	6.00	24	1.17	TO - 3	1137
2N6052	2N6059	100	100	12	750	6.00	3.0	2.00	6.00	24	1.17	TO - 3	1137
2N6053	2N6055	60	60	8	750	4.00	3.0	2.00	4.00	16	1.75	TO - 3	1139
2N6055	**2N6053**	60	60	8	750	4.00	3.0	2.00	4.00	16	1.75	TO - 3	1139
2N6057	**2N6050**	60	60	12	750	6.00	3.0	2.00	6.00	24	1.17	TO - 3	1137
2N6058	**2N6051**	80	80	12	750	6.00	3.0	2.00	6.00	24	1.17	TO - 3	1137
2N6059	**2N6052**	100	100	12	750	6.00	3.0	2.00	6.00	24	1.17	TO - 3	1137
2N6107	2N6292	70	80	7	30	4.00	2.0	1.00	2.00	200	3.12	TO - 220	1141
2N6109	2N6290	50	60	7	30	4.00	2.5	1.00	2.50	250	3.12	TO - 220	1141
2N6111	2N6288	30	40	7	30	4.00	3.0	1.00	3.00	300	1.92	TO - 220	1141
2N6121	**2N6124**	45	45	4	25	1.00	2.0	0.60	1.50	150	3.12	TO - 220	1143
2N6122	**2N6125**	60	60	4	25	1.50	2.0	0.60	1.50	150	3.12	TO - 220	1143
2N6123	**2N6126**	80	80	4	20	1.50	2.0	0.60	1.50	150	3.12	TO - 220	1143
2N6124	2N6121	45	45	4	25	1.00	2.0	0.60	1.50	150	3.12	TO - 220	1143
2N6125	2N6122	60	60	4	25	1.50	2.0	0.60	1.50	150	3.12	TO - 220	1143
2N6126	2N6123	80	80	4	20	1.50	2.0	0.60	1.50	150	3.12	TO - 220	1143
2N6282	**2N6285**	60	60	20	750	10.00	3.0	3.00	20.00	200	1.09	TO - 3	1149
2N6283	**2N6286**	80	80	20	750	10.00	3.0	3.00	20.00	200	1.09	TO - 3	1149
2N6284	**2N6287**	100	100	20	750	10.00	3.0	3.00	20.00	200	1.09	TO - 3	1149
2N6285	2N6282	60	60	20	750	10.00	3.0	3.00	20.00	200	1.09	TO - 3	1149
2N6286	2N6283	80	80	20	750	10.00	3.0	3.00	20.00	200	1.09	TO - 3	1149
2N6287	2N6284	100	100	20	750	10.00	3.0	3.00	20.00	200	1.09	TO - 3	1149
2N6288	**2N6111**	30	40	7	30	4.00	3.0	1.00	3.00	300	1.92	TO - 220	1141
2N6290	**2N6109**	50	60	7	30	4.00	2.5	1.00	2.50	250	3.12	TO - 220	1141
2N6292	**2N6107**	70	80	7	30	4.00	2.0	1.00	2.00	200	3.12	TO - 220	1141
2N6386		40	40	8	1000	3.00	3.0	2.00	3.00	6	1.92	TO - 220	1153
2N6387		60	60	10	1000	5.00	3.0	2.00	5.00	10	1.92	TO - 220	1153
2N6388		80	80	10	1000	5.00	3.0	2.00	5.00	10	1.92	TO - 220	1153
2N6486	**2N6489**	50	50	15	20	5.00	4.0	1.30	5.00	500	1.67	TO - 220	1157
2N6487	**2N6490**	70	70	15	20	5.00	4.0	1.30	5.00	500	1.67	TO - 220	1157
2N6488	**2N6491**	90	90	15	20	5.00	4.0	1.30	5.00	500	1.67	TO - 220	1157
2N6489	2N6486	50	50	15	20	5.00	4.0	1.30	5.00	500	1.67	TO - 220	1157
2N6490	2N6487	70	70	15	20	5.00	4.0	1.30	5.00	500	1.67	TO - 220	1157

PNP Type in bold.

GENERAL PURPOSE TRANSISTORS (cont'd)

Type	Comple-mentary	V_{CEO} (V)	V_{CBO} (V)	I_C (A)	h_{FE}	@ I_C (A)	V_{CE} (V)	V_{CEsat} (V)	@ I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Case	Page
2N6491	2N6488	90	90	15	20	5.00	4.0	1.30	5.00	500	1.67	TO - 220	1157
BD135	**BD136**	45	45	1.5	25	0.50	2.0	0.50	0.50	50	10	SOT - 32	133
BD136	BD135	45	45	1.5	25	0.50	2.0	0.50	0.50	50	10	SOT - 32	137
BD137	**BD138**	60	60	1.5	25	0.50	2.0	0.50	0.50	50	10	SOT - 32	133
BD138	BD137	60	60	1.5	25	0.50	2.0	0.50	0.50	50	10	SOT - 32	137
BD139	**BD140**	80	80	1.5	25	0.50	2.0	0.50	0.50	50	10	SOT - 32	133
BD140	BD139	80	80	1.5	25	0.50	2.0	0.50	0.50	50	10	SOT - 32	137
BD175	**BD176**	45	45	3	15	1.00	2.0	0.80	1.00	100	4.16	SOT - 32	143
BD176	BD175	45	45	3	15	1.00	2.0	0.80	1.00	100	4.16	SOT - 32	143
BD177	**BD178**	60	60	3	15	1.00	2.0	0.80	1.00	100	4.16	SOT - 32	143
BD178	BD177	60	60	3	15	1.00	2.0	0.80	1.00	100	4.16	SOT - 32	143
BD179	**BD180**	80	80	3	15	1.00	2.0	0.80	1.00	100	4.16	SOT - 32	143
BD180	BD179	80	80	3	15	1.00	2.0	0.80	1.00	100	4.16	SOT - 32	143
BD233	**BD234**	45	45	2	25	1.00	2.0	0.60	1.00	100	5	SOT - 32	149
BD234	BD233	45	45	2	25	1.00	2.0	0.60	1.00	100	5	SOT - 32	149
BD235	**BD236**	60	60	2	25	1.00	2.0	0.60	1.00	100	5	SOT - 32	149
BD236	BD235	60	60	2	25	1.00	2.0	0.60	1.00	100	5	SOT - 32	149
BD237	**BD238**	80	100	2	25	1.00	2.0	0.60	1.00	100	5	SOT - 32	149
BD238	BD237	80	100	2	25	1.00	2.0	0.60	1.00	100	5	SOT - 32	149
BD239	**BD240**	45	45	2	15	1.00	4.0	0.70	1.00	200	4.16	TO - 220	153
BD239A	**BD240A**	60	60	2	15	1.00	4.0	0.70	1.00	200	3.12	TO - 220	153
BD239B	**BD240B**	80	80	2	15	1.00	4.0	0.70	1.00	200	4.16	TO - 220	153
BD239C	**BD240C**	100	100	2	15	1.00	4.0	0.70	1.00	200	4.16	TO - 220	153
BD240	BD239	45	45	2	15	1.00	4.0	0.70	1.00	200	4.16	TO - 220	153
BD240A	BD239A	60	60	2	15	1.00	4.0	0.70	1.00	200	3.12	TO - 220	153
BD240B	BD239B	80	80	2	15	1.00	4.0	0.70	1.00	200	4.16	TO - 220	153
BD240C	BD239C	100	100	2	15	1.00	4.0	0.70	1.00	200	4.16	TO - 220	153
BD241	**BD242**	45	45	3	25	1.00	4.0	1.20	3.00	600	4.16	TO - 220	155
BD241A	**BD242A**	60	60	3	25	1.00	4.0	1.20	3.00	600	3.12	TO - 220	155
BD241B	**BD242B**	80	80	3	25	1.00	4.0	1.20	3.00	600	3.12	TO - 220	155
BD241C	**BD242C**	100	100	3	25	1.00	4.0	1.20	3.00	600	3.12	TO - 220	155
BD242	BD241	45	45	3	25	1.00	4.0	1.20	3.00	600	4.16	TO - 220	155
BD242A	BD241A	60	60	3	25	1.00	4.0	1.20	3.00	600	3.12	TO - 220	155
BD242B	BD241B	80	80	3	25	1.00	4.0	1.20	3.00	600	3.12	TO - 220	155
BD242C	BD241C	100	100	3	25	1.00	4.0	1.20	3.00	600	3.12	TO - 220	155
BD243	**BD244**	45	45	6	15	3.00	4.0	1.50	6.00	1000	4.16	TO - 220	157
BD243A	**BD244A**	60	60	6	15	3.00	4.0	1.50	6.00	1000	3.12	TO - 220	157
BD243B	**BD244B**	80	80	6	15	3.00	4.0	1.50	6.00	1000	1.92	TO - 220	157
BD243C	**BD244C**	100	100	6	15	3.00	4.0	1.50	6.00	1000	3.12	TO - 220	157
BD244	BD243	45	45	6	15	3.00	4.0	1.50	6.00	1000	4.16	TO - 220	157
BD244A	BD243A	60	60	6	15	3.00	4.0	1.50	6.00	1000	3.12	TO - 220	157
BD244B	BD243B	80	80	6	15	3.00	4.0	1.50	6.00	1000	1.92	TO - 220	157
BD244C	BD243C	100	100	6	15	3.00	4.0	1.50	6.00	1000	3.12	TO - 220	157
BD331	**BD332**	60	60	6	750	3.00	3.0	2.00	3.00	12	2.08	SOT - 82	159
BD332	BD331	60	60	6	750	3.00	3.0	2.00	3.00	12	2.08	SOT - 82	159

PNP Type in bold.

GENERAL PURPOSE TRANSISTORS (cont'd)

Type	Comple-mentary	V_{CEO} (V)	V_{CBO} (V)	I_C (A)	h_{FE}	@ I_C (A)	V_{CE} (V)	V_{CEsat} (V)	@ I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Case	Page
BD333	**BD334**	80	80	6	750	3.00	3.0	2.00	3.00	12	2.08	SOT - 82	159
BD334	BD333	80	80	6	750	3.00	3.0	2.00	3.00	12	2.08	SOT - 82	159
BD335	**BD336**	100	100	6	750	3.00	3.0	2.00	3.00	12	2.08	SOT - 82	159
BD336	BD335	100	100	6	750	3.00	3.0	2.00	3.00	12	2.08	SOT - 82	159
BD433	**BD434**	22	22	4	50	2.00	1.0	0.50	2.00	200	3.5	SOT - 32	163
BD434	BD433	22	22	4	50	2.00	1.0	0.50	2.00	200	3.5	SOT - 32	163
BD435	**BD436**	32	32	4	50	2.00	1.0	0.50	2.00	200	3.5	SOT - 32	163
BD436	BD435	32	32	4	50	2.00	1.0	0.50	2.00	200	3.5	SOT - 32	163
BD437	**BD438**	45	45	4	40	2.00	1.0	0.60	2.00	200	3.5	SOT - 32	163
BD438	BD437	45	45	4	40	2.00	1.0	0.60	2.00	200	3.5	SOT - 32	163
BD439	**BD440**	60	60	4	25	2.00	1.0	0.80	2.00	200	3.5	SOT - 32	169
BD440	BD439	60	60	4	25	2.00	1.0	0.80	2.00	200	3.5	SOT - 32	169
BD441	**BD442**	80	80	4	15	2.00	1.0	0.80	2.00	200	3.5	SOT - 32	169
BD442	BD441	80	80	4	15	2.00	1.0	0.80	2.00	200	3.5	SOT - 32	169
BD533	**BD534**	45	45	8	25	2.00	2.0	0.80	2.00	200	2.5	TO - 220	171
BD534	BD533	45	45	8	25	2.00	2.0	0.80	2.00	200	2.5	TO - 220	171
BD535	**BD536**	60	60	8	25	2.00	2.0	0.80	2.00	200	2.5	TO - 220	171
BD536	BD535	60	60	8	25	2.00	2.0	0.80	2.00	200	2.5	TO - 220	171
BD537	**BD538**	80	80	8	15	2.00	2.0	0.80	2.00	200	2.5	TO - 220	171
BD538	BD537	80	80	8	15	2.00	2.0	0.80	2.00	200	2.5	TO - 220	171
BD675	**BD676**	45	45	4	750	1.50	3.0	2.50	1.50	30	3.12	SOT - 32	175
BD675A	**BD676A**	45	45	4	750	2.00	3.0	2.80	2.00	40	3.12	SOT - 32	175
BD676	BD675	45	45	4	750	1.50	3.0	2.50	1.50	30	3.12	SOT - 32	175
BD676A	BD675A	45	45	4	750	2.00	3.0	2.80	2.00	40	3.12	SOT - 32	175
BD677	**BD678**	60	60	4	750	1.50	3.0	2.50	1.50	30	3.12	SOT - 32	175
BD677A	**BD678A**	60	60	4	750	2.00	3.0	2.80	2.00	40	3.12	SOT - 32	175
BD678	BD677	60	60	4	750	1.50	3.0	2.50	1.50	30	3.12	SOT - 32	175
BD678A	BD677A	60	60	4	750	2.00	3.0	2.80	2.00	40	3.12	SOT - 32	175
BD679	**BD680**	80	80	4	750	1.50	3.0	2.50	1.50	30	3.12	SOT - 32	175
BD679A	**BD680A**	80	80	4	750	2.00	3.0	2.80	2.00	40	3.12	SOT - 32	175
BD680	BD679	80	80	4	750	1.50	3.0	2.50	1.50	30	3.12	SOT - 32	175
BD680A	BD679A	80	80	4	750	2.00	3.0	2.80	2.00	40	3.12	SOT - 32	175
BD681	**BD682**	100	100	4	750	1.50	3.0	2.50	1.50	30	3.12	SOT - 32	175
BD682	BD681	100	100	4	750	1.50	3.0	2.50	1.50	30	3.12	SOT - 32	175
BD705	**BD706**	45	45	12	20	4.00	4.0	1.00	4.00	400	1.67	TO - 220	179
BD706	BD705	45	45	12	20	4.00	4.0	1.00	4.00	400	1.67	TO - 220	179
BD707	**BD708**	60	60	12	15	4.00	4.0	1.00	4.00	400	1.67	TO - 220	179
BD708	BD707	60	60	12	15	4.00	4.0	1.00	4.00	400	1.67	TO - 220	179
BD709	**BD710**	80	80	12	15	4.00	4.0	1.00	4.00	400	1.67	TO - 220	179
BD710	BD709	80	80	12	15	4.00	4.0	1.00	4.00	400	1.67	TO - 220	179
BD711	**BD712**	100	100	12	15	4.00	4.0	1.00	4.00	400	1.4	TO - 220	179
BD712	BD711	100	100	12	15	4.00	4.0	1.00	4.00	400	1.4	TO - 220	179
BD905	**BD906**	45	45	15	15	5.00	4.0	1.00	5.00	500	1.4	TO - 220	185
BD906	BD905	45	45	15	15	5.00	4.0	1.00	5.00	500	1.4	TO - 220	185
BD907	**BD908**	60	60	15	15	5.00	4.0	1.00	5.00	500	1.4	TO - 220	185

PNP Type in bold.

GENERAL PURPOSE TRANSISTORS (cont'd)

Type	Comple-mentary	V_{CEO} (V)	V_{CBO} (V)	I_C (A)	h_{FE}	@ I_C (A)	V_{CE} (V)	V_{CEsat} (V)	@ I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Case	Page
BD908	BD907	60	60	15	15	5.00	4.0	1.00	5.00	500	1.4	TO - 220	185
BD909	**BD910**	80	80	15	15	5.00	4.0	1.00	5.00	500	1.4	TO - 220	185
BD910	BD909	80	80	15	15	5.00	4.0	1.00	5.00	500	1.4	TO - 220	185
BD911	**BD912**	100	100	15	15	5.00	4.0	1.00	5.00	500	4.2	TO - 220	185
BD912	BD911	100	100	15	15	5.00	4.0	1.00	5.00	500	4.2	TO - 220	185
BDV64	BDV65	60	60	12	1000	5.00	4.0	2.00	5.00	20	1	TO - 218	189
BDV64A	BDV65A	80	80	12	1000	5.00	4.0	2.00	5.00	20	1	TO - 218	189
BDV64B	BDV65B	100	100	12	1000	5.00	4.0	2.00	5.00	20	1	TO - 218	189
BDV65	**BDV64**	60	60	12	1000	5.00	4.0	2.00	5.00	20	1	TO - 218	189
BDV65A	**BDV64A**	80	80	12	1000	5.00	4.0	2.00	5.00	20	1	TO - 218	189
BDV65B	**BDV65B**	100	100	12	1000	5.00	4.0	2.00	5.00	20	1	TO - 218	189
BDW51	**BDW52**	45	45	15	20	5.00	4.0	1.00	5.00	500	1.4	TO - 3	193
BDW51A	**BDW52A**	60	60	15	20	5.00	4.0	1.00	5.00	500	1.4	TO - 3	193
BDW51B	**BDW52B**	80	80	15	20	5.00	4.0	1.00	5.00	500	1.4	TO - 3	193
BDW51C	**BDW52C**	100	100	15	20	5.00	4.0	1.00	5.00	500	1.4	TO - 3	193
BDW52	BDW51	45	45	15	20	5.00	4.0	1.00	5.00	500	1.4	TO - 3	193
BDW52A	BDW51A	60	60	15	20	5.00	4.0	1.00	5.00	500	1.4	TO - 3	193
BDW52B	BDW51B	80	80	15	20	5.00	4.0	1.00	5.00	500	1.4	TO - 3	193
BDW52C	BDW51C	100	100	15	20	5.00	4.0	1.00	5.00	500	1.4	TO - 3	193
BDW83A	**BDW84A**	60	60	15	750	6.00	3.0	2.50	6.00	12	0.96	TO - 218	199
BDW83B	**BDW84B**	80	80	15	750	6.00	3.0	2.50	6.00	12	0.96	TO - 218	199
BDW83C	**BDW84C**	100	100	15	750	6.00	3.0	2.50	6.00	12	0.96	TO - 218	199
BDW84A	BDW83A	60	60	15	750	6.00	3.0	2.50	6.00	12	0.96	TO - 218	199
BDW84B	BDW83B	80	80	15	750	6.00	3.0	2.50	6.00	12	0.96	TO - 218	199
BDW84C	BDW83C	100	100	15	750	6.00	3.0	2.50	6.00	12	0.96	TO - 218	199
BDW91	**BDW92**	180	180	4	1000	2.00	5.0	2.00	2.00	4	17.5	TO - 39	201
BDW92	BDW91	180	180	4	1000	2.00	5.0	2.00	2.00	4	17.5	TO - 39	201
BDW93	**BDW94**	45	45	12	750	5.00	3.0	2.00	5.00	20	1.56	TO - 220	205
BDW93A	**BDW94A**	60	60	12	750	5.00	3.0	2.00	5.00	20	1.56	TO - 220	205
BDW93B	**BDW94B**	80	80	12	750	5.00	3.0	2.00	5.00	20	1.56	TO - 220	205
BDW93C	**BDW94C**	100	100	12	750	5.00	3.0	2.00	5.00	20	1.56	TO - 220	205
BDW94	BDW93	45	45	12	750	5.00	3.0	2.00	5.00	20	1.56	TO - 220	205
BDW94A	BDW93A	60	60	12	750	5.00	3.0	2.00	5.00	20	1.56	TO - 220	205
BDW94B	BDW93B	80	80	12	750	5.00	3.0	2.00	5.00	20	1.56	TO - 220	205
BDW94C	BDW93C	100	100	12	750	5.00	3.0	2.00	5.00	20	1.56	TO - 220	205
BDX33	**BDX34**	45	45	10	750	4.00	3.0	2.50	4.00	8	1.78	TO - 220	211
BDX33A	**BDX34A**	60	60	10	750	4.00	3.0	2.50	4.00	8	1.78	TO - 220	211
BDX33B	**BDX34B**	80	80	10	750	3.00	3.0	2.50	3.00	6	1.78	TO - 220	211
BDX33C	**BDX34C**	100	100	10	750	3.00	3.0	2.50	3.00	6	1.78	TO - 220	211
BDX34	BDX33	45	45	10	750	4.00	3.0	2.50	4.00	8	1.78	TO - 220	211
BDX34A	BDX33A	60	60	10	750	4.00	3.0	2.50	4.00	8	1.78	TO - 220	211
BDX34B	BDX33B	80	80	10	750	3.00	3.0	2.50	3.00	6	1.78	TO - 220	211
BDX34C	BDX33C	100	100	10	750	3.00	3.0	2.50	3.00	6	1.78	TO - 220	211
BDX53	**BDX54**	45	45	8	750	3.00	3.0	2.00	3.00	12	2.08	TO - 220	217
BDX53A	**BDX54A**	60	60	8	750	3.00	3.0	2.00	3.00	12	2.08	TO - 220	217

PNP Type in bold.

GENERAL PURPOSE TRANSISTORS (cont'd)

Type	Complementary	V_{CEO} (V)	V_{CBO} (V)	I_C (A)	h_{FE}	@ I_C (A)	V_{CE} (V)	V_{CEsat} (V)	@ I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Case	Page
BDX53B	**BDX54B**	80	80	8	750	3.00	3.0	2.00	3.00	12	2.08	TO - 220	217
BDX53C	**BDX54C**	100	100	8	750	3.00	3.0	2.00	3.00	12	2.08	TO - 220	217
BDX53E	**BDX54E**	140	140	6	500	2.00	5.0	2.00	2.00	10	2.08	TO - 220	219
BDX53F	**BDX54F**	160	160	6	500	2.00	5.0	2.00	2.00	10	2.08	TO - 220	219
BDX53S	**BDX54S**	150	150	6	500	2.00	5.0	2.00	2.00	8	11.66	TO - 39	223
BDX54	BDX53	45	45	8	750	3.00	3.0	2.00	3.00	12	2.08	TO - 220	217
BDX54A	BDX53A	60	60	8	750	3.00	3.0	2.00	3.00	12	2.08	TO - 220	217
BDX54B	BDX53B	80	80	8	750	3.00	3.0	2.00	3.00	12	2.08	TO - 220	217
BDX54C	BDX53C	100	100	8	750	3.00	3.0	2.00	3.00	12	2.08	TO - 220	217
BDX54E	BDX53E	140	140	6	500	2.00	5.0	2.00	2.00	10	2.08	TO - 220	219
BDX54F	BDX53F	160	160	6	500	2.00	5.0	2.00	2.00	10	2.08	TO - 220	219
BDX54S	BDX53S	150	150	6	500	2.00	5.0	2.00	2.00	8	11.66	TO - 39	223
BDX85	**BDX86**	45	45	10	1000	3.00	3.0	2.00	4.00	16	1.75	TO - 3	227
BDX85A	**BDX86A**	60	60	10	1000	3.00	3.0	2.00	4.00	16	1.75	TO - 3	227
BDX85B	**BDX86B**	80	80	10	1000	3.00	3.0	2.00	4.00	16	1.75	TO - 3	227
BDX85C	**BDX86C**	100	100	10	1000	3.00	3.0	2.00	4.00	16	1.17	TO - 3	227
BDX86	BDX85	45	45	10	1000	3.00	3.0	2.00	4.00	16	1.75	TO - 3	227
BDX86A	BDX85A	60	60	10	1000	3.00	3.0	2.00	4.00	16	1.75	TO - 3	227
BDX86B	BDX85B	80	80	10	1000	3.00	3.0	2.00	4.00	16	1.75	TO - 3	227
BDX86C	BDX85C	100	100	10	1000	3.00	3.0	2.00	4.00	16	1.17	TO - 3	227
BDX87A	**BDX88A**	60	60	12	1000	5.00	3.0	2.00	6.00	24	1.75	TO - 3	223
BDX87B	**BDX88B**	80	80	12	1000	5.00	3.0	2.00	6.00	24	1.45	TO - 3	223
BDX87C	**BDX88C**	100	100	12	1000	5.00	3.0	2.00	6.00	24	1.45	TO - 3	223
BDX88A	BDX87A	60	60	12	1000	5.00	3.0	2.00	6.00	24	1.75	TO - 3	223
BDX88B	BDX87B	80	80	12	1000	5.00	3.0	2.00	6.00	24	1.45	TO - 3	223
BDX88C	BDX87C	100	100	12	1000	5.00	3.0	2.00	6.00	24	1.75	TO - 3	223
BFX34		60	100	5	40	2.00	2.0	1.00	5.00	500	35	TO - 39	243
BSS44		60	65	5	40	2.00	2.0	1.00	5.00	500	35	TO - 39	247
BU911		450	400	6	20	4.00	1.8	1.80	2.50	50	2.08	TO - 220	329
BU921		450	400	10	50	7.00	1.8	1.80	5.00	50	1.25	TO - 3	329
BU921P		450	400	10	50	7.00	1.8	1.80	5.00	50	1.2	TO -218	329
BU921PFI		450	400	10	50	7.00	1.8	1.80	5.00	50	2.27	ISOWATT218	329
BU921T		450	400	10	50	7.00	1.8	1.80	5.00	50	1.2	TO - 220	329
BU921TFI		450	400	10	50	1.00	1.8	1.80	5.00	50	3.12	ISOWATT220	✶
BU931R		450	400	15	300	5.00	10.0	1.60	7.00	70	1	TO - 3	337
BU931RP		450	400	15	300	5.00	10.0	1.60	7.00	70	1	TO - 218	337
BU931RPFI		450	400	15	300	5.00	10.0	1.60	7.00	70	2.08	ISOWATT218	337
BU931Z		350	350	15	80	8.00	1.8	1.60	7.00	70	1	TO - 3	343
BU931ZP		350	350	15	80	8.00	1.8	1.60	7.00	70	1	TO - 218	343
BU931ZPFI		350	350	15	80	8.00	1.8	1.60	7.00	70	2.08	ISOWATT218	343
BUY68		60	100	7	40	1.00	1.0	1.00	5.00	500	17.5	TO - 39	795
D44C1		30	40	4	10	1.00	1.0	0.50	1.00	100	4.2	TO - 220	801
D44C2		30	40	4	20	1.00	1.0	0.50	1.00	50	4.2	TO - 220	801
D44C3		30	40	4	20	2.00	1.0	0.50	1.00	50	4.2	TO - 220	801
D44C4		45	55	4	10	1.00	1.0	0.50	1.00	100	4.2	TO - 220	801

PNP Type in bold. ✶ Datasheet available on request

GENERAL PURPOSE TRANSISTORS (cont'd)

Type	Complementary	V_{CEO} (V)	V_{CBO} (V)	I_C (A)	h_{FE}	@ I_C (A)	V_{CE} (V)	V_{CEsat} (V)	@ I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Case	Page
D44C5		45	55	4	20	1.00	1.0	0.50	1.00	50	4.2	TO - 220	801
D44C6		45	55	4	20	2.00	1.0	0.50	1.00	50	4.2	TO - 220	801
D44C7		60	70	4	10	1.00	1.0	0.50	1.00	100	4.2	TO - 220	801
D44C8		60	70	4	20	1.00	1.0	0.50	1.00	50	4.2	TO - 220	801
D44C9		60	70	4	20	2.00	1.0	0.50	1.00	50	4.2	TO - 220	801
D44C10		80	90	4	10	1.00	1.0	0.50	1.00	100	4.2	TO - 220	801
D44C11		80	90	4	20	1.00	1.0	0.50	1.00	50	4.2	TO - 220	801
D44C12		80	90	4	20	2.00	1.0	0.50	1.00	50	4.2	TO - 220	801
D44H1	**D45H1**	30	30	10	20	4.00	1.0	1.00	8.00	800	2.5	TO - 220	803
D44H2	**D45H2**	30	30	10	40	4.00	1.0	1.00	8.00	400	2.5	TO - 220	803
D44H4	**D45H4**	45	45	10	20	4.00	1.0	1.00	8.00	800	2.5	TO - 220	803
D44H5	**D45H5**	45	45	10	40	4.00	1.0	1.00	8.00	400	2.5	TO - 220	803
D44H7	**D45H7**	60	60	10	20	4.00	1.0	1.00	8.00	800	2.5	TO - 220	803
D44H8	**D45H8**	60	60	10	40	4.00	1.0	1.00	8.00	400	2.5	TO - 220	803
D44H10	**D45H10**	80	80	10	20	4.00	1.0	1.00	8.00	800	2.5	TO - 220	803
D44H11		80	80	10	40	4.00	1.0	1.00	8.00	400	2.5	TO - 220	803
D45H1	D44H1	30	30	10	20	4.00	1.0	1.00	8.00	800	2.5	TO - 220	807
D45H2	D44H2	30	30	10	40	4.00	1.0	1.00	8.00	400	2.5	TO - 220	807
D45H4	D44H4	45	45	10	20	4.00	1.0	1.00	8.00	800	2.5	TO - 220	807
D45H5	D44H5	45	45	10	40	4.00	1.0	1.00	8.00	400	2.5	TO - 220	807
D45H7	D44H7	60	60	10	20	4.00	1.0	1.00	8.00	800	2.5	TO - 220	807
D45H8	D44H8	60	60	10	40	4.00	1.0	1.00	8.00	400	2.5	TO - 220	807
D45H10	D44H10	80	80	10	20	4.00	1.0	1.00	8.00	800	2.5	TO - 220	807
MJ802	**MJ4502**	90	100	30	25	7.50	2.0	0.80	7.50	750	0.875	TO - 3	809
MJ900	MJ1000	60	60	8	1000	3.00	3.0	2.00	3.00	12	1.94	TO - 3	815
MJ901	MJ1001	80	80	8	1000	3.00	3.0	2.00	3.00	12	1.94	TO - 3	815
MJ1000	**MJ900**	60	60	8	1000	3.00	3.0	2.00	3.00	12	1.94	TO - 3	815
MJ1001	**MJ901**	80	80	8	1000	3.00	3.0	2.00	3.00	12	1.94	TO - 3	815
MJ2500	MJ3000	60	60	10	1000	5.00	3.0	2.00	5.00	20	1.17	TO - 3	817
MJ2501	MJ3001	80	80	10	1000	5.00	3.0	2.00	5.00	20	1.17	TO - 3	817
MJ2955	2N3055	60	100	15	20	4.00	4.0	1.10	4.00	400	1.5	TO - 3	819
MJ3000	**MJ2500**	60	60	10	1000	5.00	3.0	2.00	5.00	20	1.17	TO - 3	817
MJ3001	**MJ2501**	80	80	10	1000	5.00	3.0	2.00	5.00	20	1.17	TO - 3	817
MJ4030	MJ4033	60	60	16	1000	10.00	3.0	4.00	16.00	80	1.17	TO - 3	821
MJ4031	MJ4034	80	80	16	1000	10.00	3.0	4.00	16.00	80	1.17	TO - 3	821
MJ4032	MJ4035	100	100	16	1000	10.00	3.0	4.00	16.00	80	1.17	TO - 3	821
MJ4033	**MJ4030**	60	60	16	1000	10.00	3.0	4.00	16.00	80	1.17	TO - 3	821
MJ4034	**MJ4031**	80	80	16	1000	10.00	3.0	4.00	16.00	80	1.17	TO - 3	821
MJ4035	**MJ4032**	100	100	16	1000	10.00	3.0	4.00	16.00	80	1.17	TO - 3	821
MJ4502	MJ802	90	100	30	25	7.50	2.0	0.80	7.50	750	0.875	TO - 3	809
MJ11011	MJ11012	60	60	30	1000	20.00	5.0	4.00	30.00	300	0.875	TO - 3	825
MJ11012	**MJ11011**	60	60	30	1000	20.00	5.0	4.00	30.00	300	0.875	TO - 3	825
MJ11013	MJ11014	90	90	30	1000	20.00	5.0	4.00	30.00	300	0.875	TO - 3	825
MJ11014	**MJ11013**	90	90	30	1000	20.00	5.0	4.00	30.00	300	0.875	TO - 3	825
MJ11015	MJ11016	120	120	30	1000	20.00	5.0	4.00	30.00	300	0.875	TO - 3	825

PNP Type in bold.

GENERAL PURPOSE TRANSISTORS (cont'd)

Type	Complementary	V_{CEO} (V)	V_{CBO} (V)	I_C (A)	h_{FE}	@ I_C (A)	V_{CE} (V)	V_{CEsat} (V)	@ I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Case	Page
MJ11016	**MJ11015**	120	120	30	1000	20.00	5.0	4.00	30.00	300	0.875	TO - 3	825
MJE170	MJE180	40	60	3	30	0.50	1.0	0.90	1.50	150	10	SOT - 32	829
MJE171	MJE181	60	80	3	30	0.50	1.0	0.90	1.50	150	10	SOT - 32	829
MJE172	MJE182	80	100	3	30	0.50	1.0	0.90	1.50	150	10	SOT - 32	829
MJE180	**MJE170**	40	60	3	30	0.50	1.0	0.90	1.50	150	10	SOT - 32	829
MJE181	**MJE171**	60	80	3	30	0.50	1.0	0.90	1.50	150	10	SOT - 32	829
MJE182	**MJE172**	80	100	3	30	0.50	1.0	0.90	1.50	150	10	SOT - 32	829
MJE200	**MJE210**	25	40	5	70	0.50	1.0	0.30	0.50	50	8.34	SOT - 32	833
MJE210	MJE200	25	40	5	70	0.50	1.0	0.30	0.50	50	8.34	SOT - 32	833
MJE370	MJE520	30	30	3	25	1.00	1.0				5	SOT - 32	841
MJE371	MJE521	40	40	4	40	1.00	1.0				3.12	SOT - 32	845
MJE520	**MJE370**	30	30	3	25	1.00	1.0				5	SOT - 32	841
MJE521	**MJE371**	40	40	4	40	1.00	1.0				3.12	SOT - 32	845
MJE700	MJE800	60	60	4	750	1.50	3.0	3.00	4.00	40	3.12	SOT - 32	849
MJE701	MJE801	60	60	4	750	2.00	3.0	3.00	4.00	40	3.12	SOT - 32	849
MJE702	MJE802	80	80	4	750	1.50	3.0	3.00	4.00	40	3.12	SOT - 32	849
MJE703	MJE803	80	80	4	750	2.00	3.0	3.00	4.00	40	3.12	SOT - 32	849
MJE800	**MJE700**	60	60	4	750	1.50	3.0	3.00	4.00	40	3.12	SOT - 32	849
MJE801	**MJE701**	60	60	4	750	2.00	3.0	3.00	4.00	40	3.12	SOT - 32	849
MJE802	**MJE702**	80	80	4	750	1.50	3.0	3.00	4.00	40	3.12	SOT - 32	849
MJE803	**MJE703**	80	80	4	750	2.00	3.0	3.00	4.00	40	3.12	SOT - 32	849
MJE2955T	MJE3055T	60	70	10	20	4.00	4.0	1.10	4.00	400	1.66	TO - 220	853
MJE3055T	**MJE2955T**	60	70	10	20	4.00	4.0	1.10	4.00	400	1.66	TO - 220	853
SGS110	**SGS115**	60	60	4	1000	1.00	4.0	2.50	2.00	8	2.5	SOT - 82	1017
SGS111	**SGS116**	80	80	4	1000	1.00	4.0	2.50	2.00	8	2.5	SOT - 82	1017
SGS112	**SGS117**	100	100	4	1000	1.00	4.0	2.50	2.00	8	2.5	SOT - 82	1017
SGS115	SGS110	60	60	4	1000	1.00	4.0	2.50	2.00	8	2.5	SOT - 82	1017
SGS116	SGS111	80	80	4	1000	1.00	4.0	2.50	2.00	8	2.5	SOT - 82	1017
SGS117	SGS112	100	100	4	1000	1.00	4.0	2.50	2.00	8	2.5	SOT - 82	1017
SGS130	**SGS135**	60	60	8	1000	4.00	4.0	2.00	4.00	16	1.78	SOT - 82	1029
SGS131	**SGS136**	80	80	8	1000	4.00	4.0	2.00	4.00	16	1.78	SOT - 82	1029
SGS132	**SGS137**	100	100	8	1000	4.00	4.0	2.00	4.00	16	1.78	SOT - 82	1029
SGS135	SGS130	60	60	8	1000	4.00	4.0	2.00	4.00	16	1.78	SOT - 82	1029
SGS136	SGS131	80	80	8	1000	4.00	4.0	2.00	4.00	16	1.78	SOT - 82	1029
SGS137	SGS132	100	100	8	1000	4.00	4.0	2.00	4.00	16	1.78	SOT - 82	1029
SGSD100	**SGSD200**	80	80	25	300	20.00	3.0	1.75	10.00	40	0.96	TO - 218	885
SGSD200	SGSD100	80	80	25	300	20.00	3.0	1.75	10.00	40	0.96	TO - 218	885
SGSD93E		140	160	12	1000	3.00	3.0	2.00	10.00	20	1.56	TO - 220	881
SGSD93F		160	180	12	1000	3.00	3.0	2.00	10.00	20	1.56	TO - 220	881
SGSD93FFI		160	180	12	1000	3.00	3.0	2.00	10.00	20	4.16	ISOWATT220	✶
SGSD93G		180	200	12	1000	3.00	3.0	2.00	10.00	20	1.56	TO - 220	881
TIP31	**TIP32**	40	80	3	25	1.00	4.0	1.20	3.00	375	3.12	TO - 220	995
TIP31A	**TIP32A**	60	100	3	25	1.00	4.0	1.20	3.00	375	3.12	TO - 220	995
TIP31B	**TIP32B**	80	120	3	25	1.00	4.0	1.20	3.00	375	3.12	TO - 220	995
TIP31C	**TIP32C**	100	140	3	25	1.00	4.0	1.20	3.00	375	3.12	TO - 220	995

PNP Type in bold. ✶ Datasheet available on request

GENERAL PURPOSE TRANSISTORS (cont'd)

Type	Complementary	V_{CEO} (V)	V_{CBO} (V)	I_C (A)	h_{FE} @	I_C (A)	V_{CE} (V)	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Case	Page
TIP32	TIP31	40	80	3	25	1.00	4.0	1.20	3.00	375	3.12	TO - 220	995
TIP32A	TIP31A	60	100	3	25	1.00	4.0	1.20	3.00	375	3.12	TO - 220	995
TIP32B	TIP31B	80	120	3	25	1.00	4.0	1.20	3.00	375	3.12	TO - 220	985
TIP32C	TIP31C	100	140	3	25	1.00	4.0	1.20	3.00	375	3.12	TO - 220	995
TIP33A	**TIP34A**	60	100	10	20	3.00	4.0	1.00	3.00	300	1.39	TO - 218	999
TIP33B	**TIP34B**	80	120	10	20	3.00	4.0	1.00	3.00	300	1.39	TO - 218	999
TIP33C	**TIP34C**	100	140	10	20	3.00	4.0	1.00	3.00	300	1.39	TO - 218	999
TIP34A	TIP33A	60	100	10	20	3.00	4.0	1.00	3.00	300	1.39	TO - 218	999
TIP34B	TIP33B	80	120	10	20	3.00	4.0	1.00	3.00	300	1.39	TO - 218	999
TIP34C	TIP33C	100	140	10	20	3.00	4.0	1.00	3.00	300	1.39	TO - 218	999
TIP35A	**TIP36A**	60	100	25	10	15.00	4.0	1.80	15.00	1500	1	TO - 218	1001
TIP35B	**TIP36B**	80	120	25	10	15.00	4.0	1.80	15.00	1500	1	TO - 218	1001
TIP35C	**TIP36C**	100	140	25	10	15.00	4.0	1.80	15.00	1500	1	TO - 218	1001
TIP36A	TIP35A	60	100	25	10	15.00	4.0	1.80	15.00	1500	1	TO - 218	1001
TIP36B	TIP35B	80	120	25	10	15.00	4.0	1.80	15.00	1500	1	TO - 218	1001
TIP36C	TIP35C	100	140	25	10	15.00	4.0	1.80	15.00	1500	1	TO - 218	1001
TIP41	**TIP42**	40	80	6	15	3.00	4.0	1.50	6.00	600	1.92	TO - 220	1003
TIP41A	**TIP42A**	60	100	6	15	3.00	4.0	1.50	6.00	600	1.92	TO - 220	1003
TIP41B	**TIP42B**	80	120	6	15	3.00	4.0	1.50	6.00	600	1.92	TO - 220	1003
TIP41C	**TIP42C**	100	140	6	15	3.00	4.0	1.50	6.00	600	1.92	TO - 220	1003
TIP42	TIP41	40	80	6	15	3.00	4.0	1.50	6.00	600	1.92	TO - 220	1003
TIP42A	TIP41A	60	100	6	15	3.00	4.0	1.50	6.00	600	1.92	TO - 220	1003
TIP42B	TIP41B	80	120	6	15	3.00	4.0	1.50	6.00	600	1.92	TO - 220	1003
TIP42C	TIP41C	100	140	6	15	3.00	4.0	1.50	6.00	600	1.92	TO - 220	1003
TIP100	**TIP105**	60	60	8	1000	3.00	4.0	2.00	3.00	6	1.56	TO - 220	1011
TIP101	**TIP106**	80	80	8	1000	3.00	4.0	2.00	3.00	6	1.56	TO - 220	1011
TIP102	**TIP107**	100	100	8	1000	3.00	4.0	2.00	3.00	6	1.56	TO - 220	1011
TIP105	TIP100	60	60	8	1000	3.00	4.0	2.00	3.00	6	1.56	TO - 220	1011
TIP106	TIP101	80	80	8	1000	3.00	4.0	2.00	3.00	6	1.56	TO - 220	1011
TIP107	TIP102	100	100	8	1000	3.00	4.0	2.00	3.00	6	1.56	TO - 220	1011
TIP110	**TIP115**	60	60	4	1000	1.00	4.0	2.50	2.00	8	2.5	TO - 220	1017
TIP111	**TIP116**	80	80	4	1000	1.00	4.0	2.50	2.00	8	2.5	TO - 220	1017
TIP112	**TIP117**	100	100	4	1000	1.00	4.0	2.50	2.00	8	2.5	TO - 220	1017
TIP115	TIP110	60	60	4	1000	1.00	4.0	2.50	2.00	8	2.5	TO - 220	1017
TIP116	TIP111	80	80	4	1000	1.00	4.0	2.50	2.00	8	2.5	TO - 220	1017
TIP117	TIP112	100	100	4	1000	1.00	4.0	2.50	2.00	8	2.5	TO - 220	1017
TIP120	**TIP125**	60	60	5	1000	3.00	3.0	2.00	3.00	12	1.92	TO - 220	1023
TIP121	**TIP126**	80	80	5	1000	3.00	3.0	2.00	3.00	12	1.92	TO - 220	1023
TIP122	**TIP127**	100	100	5	1000	3.00	3.0	2.00	3.00	12	1.92	TO - 220	1023
TIP125	TIP120	60	60	5	1000	3.00	3.0	2.00	3.00	12	1.92	TO - 220	1023
TIP126	TIP121	80	80	5	1000	3.00	3.0	2.00	3.00	12	1.92	TO - 220	1023
TIP127	TIP122	100	100	5	1000	3.00	3.0	2.00	3.00	12	1.92	TO - 220	1023
TIP130	**TIP135**	60	60	8	1000	4.00	4.0	2.00	4.00	16	1.78	TO - 220	1029
TIP131	**TIP136**	80	80	8	1000	4.00	4.0	2.00	4.00	16	1.78	TO - 220	1029
TIP132	**TIP137**	100	100	8	1000	4.00	4.0	2.00	4.00	16	1.78	TO - 220	1029

PNP Type in bold.

GENERAL PURPOSE TRANSISTORS (cont'd)

Type	Comple-mentary	V_{CEO} (V)	V_{CBO} (V)	I_C (A)	h_{FE}	@ I_C (A)	V_{CE} (V)	V_{CEsat} (V)	@ I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Case	Page
TIP135	TIP130	60	60	8	1000	4.00	4.0	2.00	4.00	16	1.78	TO - 220	1029
TIP136	TIP131	80	80	8	1000	4.00	4.0	2.00	4.00	16	1.78	TO - 220	1029
TIP137	TIP132	100	100	8	1000	4.00	4.0	2.00	4.00	16	1.78	TO - 220	1029
TIP140	**TIP145**	60	60	10	1000	5.00	4.0	3.00	10.00	40	1	TO - 218	1031
TIP140T	**TIP145T**	60	60	15	1000	5.00	4.0	3.00	10.00	40	1.25	TO - 220	1035
TIP141	**TIP146**	80	80	10	1000	5.00	4.0	3.00	10.00	40	1	TO - 218	1031
TIP141T	**TIP146T**	80	80	15	1000	5.00	4.0	3.00	10.00	40	1.25	TO - 220	1035
TIP142	**TIP147**	100	100	10	1000	5.00	4.0	3.00	10.00	40	1	TO - 218	1031
TIP142T	**TIP147T**	100	100	15	1000	5.00	4.0	3.00	10.00	40	1.25	TO - 220	1035
TIP145	TIP140	60	60	10	1000	5.00	4.0	3.00	10.00	40	1	TO - 218	1031
TIP145T	TIP140T	60	60	15	1000	5.00	4.0	3.00	10.00	40	1.25	TO - 220	1035
TIP146	TIP141	80	80	10	1000	5.00	4.0	3.00	10.00	40	1	TO - 218	1031
TIP146T	TIP141T	80	80	15	1000	5.00	4.0	3.00	10.00	40	1.25	TO - 220	1035
TIP147	TIP142	100	100	10	1000	5.00	4.0	3.00	10.00	40	1	TO - 218	1031
TIP147T	TIP142T	100	100	15	1000	5.00	4.0	3.00	10.00	40	1.25	TO - 220	1035
TIP2955	TIP3055	60	100	15	20	4.00	4.0	1.10	4.00	400	1.39	TO - 218	1037
TIP3055	**TIP2955**	60	100	15	20	4.00	4.0	1.10	4.00	400	1.39	TO - 218	1037

PNP Type in bold.

SWITCHING TRANSISTORS

Type	Comple-mentary	V_{CBO} (V)	V_{CEO} (V)	I_C (A)	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (µs)	t_f (µs)	R_{thj-c} (°C/W)	Case	Page
2N3439		450	350	1	0.50	0.05	4			17.5	TO - 39	1043
2N3440		300	250	1	0.50	0.05	4			17.5	TO - 39	1043
2N4895		120	60	5	1.00	5.00	500	0.35	0.3	25	TO - 39	1059
2N4896		120	60	5	1.00	5.00	500	0.35	0.3	25	TO - 39	1059
2N4897		150	80	5	1.00	5.00	500	0.35	0.3	25	TO - 39	1059
2N5038		150	90	20	1.00	12.00	1200	1.5	0.5	1.25	TO - 3	1067
2N5039		120	75	20	1.00	10.00	1000	1.5	0.5	1.25	TO - 3	1067
2N5415		200	200	1	2.50	0.05	5	0.3	0.2	17.5	TO - 39	1093
2N5416		350	300	1	2.50	0.05	5	0.3	0.2	17.5	TO - 39	1093
2N5655		275	250	0.5	1.00	0.10	10			6.25	SOT - 32	1103
2N5656		325	300	0.5	1.00	0.10	10			6.25	SOT - 32	1103
2N5657		375	350	0.5	1.00	0.10	10			6.25	SOT - 32	1103
2N5671		120	90	30	0.75	15.00	1200	1.5	0.5	1.25	TO - 3	1107
2N5672		150	120	30	0.75	15.00	1200	1.5	0.5	1.25	TO - 3	1107
2N6032		120	90	50	1.30	50.00	5000	1.5	0.5	1.25	TO - 3	1127
2N6033		150	120	40	1.00	40.00	4000	1.5	0.5	1.25	TO - 3	1127
2N6497		350	250	5	1.00	2.50	500	1.8	0.8	1.56	TO - 220	1159
2N6498		400	300	5	1.25	2.50	500	1.8	0.8	1.56	TO - 220	1158
2N6499		450	350	5	1.50	2.50	500	1.8	0.8	1.56	TO - 220	1159
2N6544		650	300	8	1.5	5.00	1000	4	0.9	1.4	TO - 3	1163
2N6545		850	400	8	1.5	5.00	1000	4	0.9	1.4	TO - 3	1163
2N6671		450	300	8	1.00	5.00	1000	2.5	0.4	1.17	TO - 3	1167
2N6672		550	350	8	1.00	5.00	1000	2.5	0.4	1.17	TO - 3	1167
2N6673		650	400	8	1.00	5.00	1000	2.5	0.4	1.17	TO - 3	1167
2N6674		450	300	15	1.00	10.00	2000	2.5	0.5	1	TO - 3	1171
2N6675		650	400	15	1.00	10.00	2000	2.5	0.5	1	TO - 3	1171
2N6676		450	300	15	1.00	15.00	3000	2.5	0.5	1	TO - 3	1175
2N6677		550	350	15	1.00	15.00	3000	2.5	0.5	1	TO - 3	1175
2N6678		650	400	15	1.00	15.00	3000	2.5	0.5	1	TO - 3	1175
2N6702		140	90	7	0.80	5.00	500	1	0.5	2.5	TO - 220	1179
2N6928		450	300	8	1.00	8.00	1600	2.5	0.4	1.25	TO - 220	✶
2N6929		550	350	8	1.00	8.00	1600	2.5	0.4	1.25	TO - 220	✶
2N6930		650	400	8	1.00	8.00	1600	2.5	0.4	1.25	TO - 220	✶
2N6931		450	300	10	1.00	10.00	2000	2.5	0.5	0.83	SOT - 93	1181
2N6932		650	400	10	1.00	10.00	2000	2.5	0.5	0.83	SOT - 93	1181
2N6933		450	300	15	1.00	15.00	3000	2.5	0.5	0.71	SOT - 93	1185
2N6934		550	350	15	1.00	15.00	3000	2.5	0.5	0.71	SOT - 93	1185
2N6935		650	400	15	1.00	15.00	3000	2.5	0.5	0.71	SOT - 93	1185
2SC3412		1300	500	8	5.0	5.00	1000				TO - 3	✶
2SD818		1500	600	2.5	8.0	2.00	600				TO - 3	✶
2SD819		1500	600	3.5	8.0	3.00	800				TO - 3	✶
2SD869		1500	600	3.5	8.0	3.00	800				TO - 3	✶
2SD1425FI		1500	600	2.5	8.0	2.00	600				ISOWATT218	✶
2SD1426FI		1500	600	3.5	8.0	3.00	800				ISOWATT218	✶
2SD1427FI		1500	600	5	5.0	4.00	800				ISOWATT218	✶

PNP Type in bold. ✶ Datasheet available on request

SWITCHING TRANSISTORS (cont'd)

Type	Comple-mentary	V_{CBO} (V)	V_{CEO} (V)	I_C (A)	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (μs)	t_f (μs)	R_{thj-c} (°C/W)	Case	Page
2SD1428FI		1500	600	6	5.0	5.00	1000				ISOWATT218	✶
2SD1429FI		1500	600	2.5	8.0	2.00	600				ISOWATT218	✶
2SD1430FI		1500	600	3.5	8.0	3.00	800				ISOWATT218	✶
2SD1431FI		1500	600	5	5.0	4.00	800				ISOWATT218	✶
2SD1432FI		1500	600	6	5.0	5.00	1000				ISOWATT218	✶
2SD1441		1500	700	4	1.0	3.00	1000				TO - 218	✶
2SD1453		1500	700	3	5.0	2.50	800				TO - 218	✶
2SD1455		1500	700	5	5.0	4.50	1200				TO - 218	✶
2SD1577FI		1500	700	5	2.0	4.50	2000				ISOWATT218	✶
2SD1650FI		1500	700	3.5	8.0	2.50	800				ISOWATT218	✶
2SD1730		1500	700	5	8.0	4.00	1000				TO - 218	✶
2SD1910FI		1500	700	3	5.0	2.50	800				ISOWATT218	✶
2ST1396		1500	700	2.5	8.0	2.00	600				TO - 218	✶
2ST1651FI		1500	700	5	5.0	4.00	800				ISOWATT218	✶
2ST1877FI		1500	700	4	5.0	2.50	800				ISOWATT218	✶
2ST1942		1500	700	3	5.0	2.50	800				TO - 3	✶
2ST2000		1500	700	7.5	1.0	4.00	2000				TO - 218	✶
2ST2000FI		1500	700	7	1.0	4.00	2000				ISOWATT218	✶
2ST3153		1000	550	6	2.0	3.00	600				TO - 218	✶
2ST3412		1200	600	8	5.0	5.00	1000				TO - 3	✶
2ST3460		1500	700	6	2.0	3.00	600				TO - 218	✶
2ST3461		1500	700	8	2.0	4.00	800				TO - 218	✶
2ST3485		1500	700	5	5.0	4.00	1000				TO - 218	✶
2ST3485FI		1500	700	5	5.0	4.00	1000				ISOWATT218	✶
2ST3552		1200	600	12	2.0	6.00	1200				TO - 218	✶
2ST3642		1200	600	6	5.0	4.00	800				TO - 218	✶
2ST3679FI		1000	500	5	0.5	2.00	400				ISOWATT218	✶
BD157		275	250	0.5						6.25	SOT - 32	141
BD158		325	300	0.5						6.25	SOT - 32	141
BD159		375	350	0.5						6.25	SOT - 32	141
BDY57		120	80	25	1.40	10.00	1000	1.5	0.5	1	TO - 3	239
BDY58		160	125	25	1.40	10.00	1000	1.5	0.5	1	TO - 3	239
BDY90		100	120	10	0.50	5.00	500	1.3	0.2	2.5	TO - 3	241
BDY91		80	100	10	0.50	5.00	500	1.3	0.2	2.5	TO - 3	241
BDY92		60	80	10	0.50	5.00	500	1.3	0.2	2.5	TO - 3	241
BSW67		120	120	1.5	1.00	1.00	150	0.7●	0.22●	35	TO - 39	251
BSW68		150	150	1.5	1.00	1.00	150	0.7●	0.22●	35	TO - 39	251
BU125		130	60	6	1.00	5.00	500			15	TO - 39	255
BU125S		250	150	3	1.50	0.50	50			17.5	TO - 39	259
BU184		400	200	8	1.50	5.00	50	0.5	0.44●	2.08	TO - 220	263
BU189		330	150	8	1.50	5.00	50	0.5	0.44●	2.08	TO - 220	263
BU208		1500	700	8	5.0	4.50	2000	7●	0.55●	1	TO - 3	267
BU208A		1500	700	8	1.0	4.50	2000	7●	0.55●	1	TO - 3	267
BU208D		1500	700	8	1.0	4.50	2000	7●	0.55●	1	TO - 3	271
BU325		200	200	3	1.50	0.50	50	0.75●	0.20●	5	SOT - 32	277

● Typical value ✶ Datasheet available on request

SWITCHING TRANSISTORS (cont'd)

Type	Comple-mentary	V_{CBO} (V)	V_{CEO} (V)	I_C (A)	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (µs)	t_f (µs)	R_{thj-c} (°C/W)	Case	Page
BU326A		900	400	6	1.5	2.50	500	3.5	0.5	2.33	TO - 3	281
BU406		400	200	7	1.00	5.00	500	0.9●	0.3●	2.08	TO - 220	285
BU406D		400	200	7	1.00	5.00	650	0.9●	0.3●	2.08	TO - 220	291
BU407		330	150	7	1.00	5.00	500	0.9●	0.3●	2.08	TO - 220	297
BU407D		330	150	7	1.00	5.00	650	0.9●	0.3●	2.08	TO - 220	291
BU426		800	375	6	1.5	2.50	500	3.5	0.5	1.16	TO - 218	303
BU426A		900	400	6	1.5	2.50	500	3.5	0.5	1.1	TO - 218	303
BU426AFI		900	400	6	1.5	2.50	500	3.5	0.5	2.5	ISOWATT218	303
BU426FI		800	375	6	1.5	2.50	500	3.5	0.5	2.5	ISOWATT218	303
BU508		1500	700	8	5.0	4.50	2000	7●	0.55●	1	TO - 218	267
BU508A		1500	700	8	1.0	4.50	2000	7●	0.55●	1	TO - 218	267
BU508AFI		1500	700	8	1.0	4.50	2000	7●	0.55●	2.08	ISOWATT218	267
BU508D		1500	700	8	1.0	4.50	2000	7●	0.55●	1	TO - 218	271
BU508DFI		1500	700	8	1.0	4.50	2000	7●	0.55●	2.08	ISOWATT218	271
BU508FI		1500	700	8	5.0	4.50	2000	7●	0.55●	2.08	ISOWATT218	267
BU706		1500	700	5	5.0	3.00	1330				TO - 218	305
BU801		600	400	3	2.20	1.00	15	1	0.5	3.12	SOT - 32	307
BU806		400	200	8	1.50	5.00	50	0.55●	0.2●	2.08	TO - 220	311
BU806FI		400	200	8	1.50	5.00	50	0.55●	0.22●	4.16	ISOWATT220	311
BU807		330	150	8	1.50	5.00	50	0.55●	0.2●	2.08	TO - 220	311
BU807FI		330	150	8	1.50	5.00	50	0.55●	0.2●	2.08	ISOWATT220	311
BU808FI		1400	700	10	1.6	5.00	500			2.5	ISOWATT218	317
BU808TFI		1400	700	10	1.6	5.00	500			2.5	ISOWATT218	317
BU810		600	400	7	2.50	4.00	200	1.5	0.5	1.66	TO - 220	321
BU999		160	140	25	0.80	10.00	1000	1.5	0.25	1.17	TO - 218	347
BUF405		850	450	7.5	0.5●	5.00	1000			1.56	TO - 220	349
BUF405A		1000	450	7.5	0.5●	5.00	1000			1.56	TO - 220	349
BUF410		850	450	15	0.5●	10.00	2000			1	TO - 218	353
BUF410A		1000	450	15	0.5●	10.00	2000			1	TO - 218	353
BUF410AI		1000	450	15	0.5●	10.00	2000			1.47	TOP - 3I	353
BUF410I		850	450	15	0.5●	10.00	2000			1.47	TOP - 3I	353
BUF420		850	450	30	0.5●	20.00	4000			0.63	TO - 218	357
BUF420A		1000	450	30	0.5●	20.00	4000			0.63	TO - 218	357
BUF420AI		1000	450	30	0.5●	20.00	4000			1.09	TOP - 3I	357
BUF420AM		1000	450	30	0.5●	20.00	4000			0.63	TO - 3	357
BUF420M		850	450	30	0.5●	20.00	4000			0.63	TO - 3	357
BUF420I		850	450	30	0.5●	20.00	4000			1.09	TOP - 3I	357
BUF460(V)		850	450	90	2.0#	60	12000	3.5▲■	0.12▲■	0.41	ISOTOP	✶
BUF460A(V)		1000	450	90	2.0#	60	12000	3.5▲■	0.12▲■	0.41	ISOTOP	✶
BUR20		200	125	50	1.00	25.00	2000			0.7	TO - 3	361
BUR21		300	200	40	0.60	12.00	1200				TO - 3	363
BUR22		350	250	40	1.00	10.00	1000				TO - 3	365
BUR50		200	125	70	1.00	35.00	2000	2	0.5	0.5	TO - 3	367
BUR50S		200	125	70	1.00	35.00	2000	2	0.5	0.5	TO - 3	367
BUR51		300	200	60	1.00	35.00	2000	2	0.6	0.5	TO - 3	371

▲ Inductive load ● Typical value # Tj = 125°C ■ Tj = 100°C ✶ Datasheet available on request

SWITCHING TRANSISTORS (cont'd)

Type	Comple-mentary	V_{CBO} (V)	V_{CEO} (V)	I_C (A)	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (µs)	t_f (µs)	R_{thj-c} (°C/W)	Case	Page
BUR52		350	250	60	1.80	25.00	2000	2	0.6	0.5	TO - 3	375
BUT11		850	400	5	1.5	3.00	600	4	0.8	1.5	TO - 220	379
BUT11A		1000	450	5	1.5	2.50	500	4	0.8	1.5	TO - 220	379
BUT11AFI		1000	450	5	1.5	2.50	500	4	0.8	3.57	ISOWATT220	379
BUT11FI		850	400	5	1.5	3.00	600	4	0.8	3.57	ISOWATT220	379
BUT12AFI		1000	450	10	1.5	5.00	1000				ISOWATT220	∗
BUT12FI		850	400	10	1.5	6.00	1200				ISOWATT220	∗
BUT13		600	400	28	2.00	10.00	500	1.5	0.6	1	TO - 3	385
BUT13P		600	400	28	2.00	10.00	500	1.5	0.6	1	TO - 218	385
BUT13PFI		600	400	28	2.00	10.00	500	1.5	0.6	2.08	ISOWATT218	385
BUT30(V)		200	125	100	0.9	100	10000	2▲■	0.2▲■	0.5	ISOTOP	∗
BUT32(V)		400	300	80	0.9	40	4000	3▲■	0.4▲■	0.5	ISOTOP	∗
BUT60		200	125	16	0.90	12.00	600	1.5▲	0.2▲	1	TO - 220	∗
BUT62		400	300	16	0.90	10.00	1000	2.2▲	0.4▲	1	TO - 220	∗
BUT70		200	125	40	0.90	35.00	1750	1.8▲	0.2▲	0.63	TO - 218	∗
BUT72		400	300	40	0.90	30.00	3000	3▲	0.4▲	0.63	TO - 218	∗
BUT90		200	125	50	0.90	35.00	1750	1.5	0.4	0.7	TO - 3	391
BUT91		300	200	50	1.20	40.00	4000	1.2	0.3	0.7	TO - 3	397
BUT92		350	250	50	1.20	35.00	3500	3▲	0.4▲	0.7	TO - 3	405
BUT92A		400	300	50	0.90	30.00	3000	3▲	0.4▲	0.7	TO - 3	411
BUT100		200	125	50	0.90	50.00	2500	2▲	0.2▲	0.58	TO - 3	417
BUT102		400	300	50	0.90	40.00	4000	3▲	0.4▲	0.7	TO - 3	421
BUT230(V)		200	125	200	0.9	200	20000	2▲■	0.2▲■	0.41	ISOTOP	∗
BUV18		60	120	50	0.60	40.00	4000	1.1	0.3	0.7	TO - 3	425
BUV19		80	160	50	0.60	30.00	3000	1.1	0.25	0.7	TO - 3	425
BUV20		160	125	50	0.60	25.00	2500	1.2	0.25	0.7	TO - 3	433
BUV21		250	200	40	0.60	12.00	1200	1.8	0.4	0.7	TO - 3	433
BUV22		300	250	40	1.00	10.00	1000	2	0.5	0.7	TO - 3	433
BUV23		400	325	30	1.00	16.00	3200	2.5	1.2		TO - 3	437
BUV24		450	400	20	1.00	12.00	2400	3	1.4	0.7	TO - 3	437
BUV25		500	500	15	1.00	8.00	1600	5	1.6	0.7	TO - 3	437
BUV26		180	90	14	0.60	6.00	600	1	0.25	1.76	TO - 220	441
BUV27		240	120	12	0.70	4.00	400	1.2	0.25	1.76	TO - 220	447
BUV28		400	200	10	1.50	6.00	600	1.5	0.25	1.76	TO - 220	453
BUV39		160	90	25	1.20	20.00	2500	1	0.25	1.46	TO - 3	459
BUV40		250	125	20	0.90	11.00	1100	1	0.3	1.46	TO - 3	467
BUV41		300	200	15	0.90	6.00	600	1.2	0.3	1.46	TO - 3	475
BUV42		350	250	12	0.90	4.00	400	1.6	0.3	1.46	TO - 3	483
BUV42A		400	300	12	0.90	4.00	400	3▲	0.4▲	1.46	TO - 3	491
BUV46		850	400	5	1.5	2.50	500	3	0.8	1.76	TO - 220	495
BUV46A		1000	450	5	1.5	2.00	400	3	0.8	1.76	TO - 220	495
BUV46AFI		1000	450	5	1.5	2.00	400				ISOWATT220	495
BUV46FI		850	400	5	1.5	2.50	500	3	0.8	4.16	ISOWATT220	495
BUV47		850	400	9	1.5	6.00	1200	2.5	0.8	1.25	TO - 218	735
BUV47A		1000	450	9	1.5	5.00	1000	3	0.8	1.25	TO - 218	735

▲ Inductive load ■ Tj = 100°C ∗ Datasheet available on request

SWITCHING TRANSISTORS (cont'd)

Type	Comple-mentary	V_{CBO} (V)	V_{CEO} (V)	I_C (A)	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (μs)	t_f (μs)	R_{thj-c} (°C/W)	Case	Page
BUV47AFI		1000	450	9	1.5	5.00	1000	3	0.8	2.27	ISOWATT218	735
BUV47FI		850	400	9	1.5	6.00	1200	2.5	0.8	2.27	ISOWATT218	735
BUV48		850	400	15	1.5	10.00	2000	3	0.8	1	TO - 218	745
BUV48A		1000	450	15	1.5	8.00	1600	3	0.8	1	TO - 218	745
BUV48AFI		1000	450	15	1.5	8.00	1600	3	0.8	1.92	ISOWATT218	745
BUV48B		1200	600	15	1.5	6.00	1500	3	0.7	1	TO - 218	755
BUV48BFI		1200	600	15	1.5	6.00	1500	3	0.7	1.92	ISOWATT218	755
BUV48C		1200	700	15	1.5	6.00	1500	3	0.7	1	TO - 218	755
BUV48CFI		1200	700	15	1.5	6.00	1500	3	0.7	1.92	ISOWATT218	745
BUV48FI		850	400	15	1.5	10.00	2000	3	0.8	1.92	ISOWATT218	745
BUV50		250	125	25	0.90	20.00	2000	1.2	0.3	1.17	TO - 3	497
BUV51		300	200	20	0.90	10.00	1000	1.4	0.3	1.17	TO - 3	505
BUV52		350	250	20	0.90	8.00	800	1.6	0.3	1.17	TO - 3	513
BUV52A		400	300	20	0.90	7.00	700	3▲	0.4▲	1.17	TO - 3	521
BUV56		850	450	9	1.2	5.00	1000	3▲	0.4▲	1.76	TO - 220	525
BUV60		250	125	50	0.90	50.00	5000	1.1	0.2	0.7	TO - 3	529
BUV61		300	200	50	0.90	25.00	2500	1.2	0.3	0.7	TO - 3	537
BUV62		350	250	40	0.90	16.00	1600	1.8	0.35	0.7	TO - 3	545
BUV62A		400	300	40	0.90	15.00	1500	3▲	0.4▲	0.7	TO - 3	553
BUV66		850	450	15	1.2	8.00	1600	3▲	0.4▲	1.25	TO - 220	557
BUV98(V)		850	450	30	1.5	20	4000	5▲■	0.4▲■	0.83	ISOTOP	✶
BUV98A(V)		1000	450	30	1.5	16	3200	5▲■	0.4▲■	0.83	ISOTOP	✶
BUV98C(V)		1200	700	30	1.5	12	3000	6▲#	0.6▲#	0.83	ISOTOP	✶
BUV298(V)		850	450	60	1.2	40	8000	4.5▲■	0.4▲■	0.5	ISOTOP	✶
BUV298A(V)		1000	450	50	1.2	32	6400	4.5▲■	0.4▲■	0.5	ISOTOP	✶
BUW12		850	400	8	1.5	6.00	1200	4	0.8	1.2	TO - 218	561
BUW12A		1000	450	8	1.5	6.00	1200	4	0.8	1.2	TO - 218	561
BUW22AP		450	400	6	1.50	2.50	1000	1.5	0.7	2	TO - 220	563
BUW22P		400	350	6	1.50	2.50	1000	1.5	0.7	2	TO - 220	563
BUW32		400	350	10	1.50	5.00	1500	1.5	0.6	1.2	TO - 3	569
BUW32A		450	400	10	1.50	5.00	1500	1.5	0.6	1.2	TO - 3	569
BUW32AP		450	400	10	1.50	5.00	1500	1.5	0.6	1.2	SOT - 93	569
BUW32APFI		450	400	10	1.50	5.00	1500	1.5	0.6	2.27	ISOWATT218	569
BUW32P		400	350	10	1.50	5.00	1500	1.5	0.6	1.2	SOT - 93	569
BUW32PFI		400	350	10	1.50	5.00	1500	1.5	0.6	2.27	ISOWATT218	569
BUW34		500	400	10	1.50	5.00	1000	3	0.8	1.4	TO - 3	575
BUW35		800	400	10	1.50	5.00	1000	3	0.8	1.4	TO - 3	575
BUW36		900	450	10	1.50	5.00	1000	3	0.8	1.4	TO - 3	575
BUW38		120	60	30	0.60	20.00	2000	1.1	0.39	1.17	TO - 3	583
BUW39		160	80	30	0.50	15.00	1500	1.1	0.39	1.17	TO - 3	583
BUW42		400	350	15	1.50	10.00	3000	1.5	0.6	1	TO - 3	593
BUW42A		450	400	15	1.50	10.00	3000	1.5	0.6	1	TO - 3	593
BUW42AP		450	400	15	1.50	10.00	3000	1.5	0.5	1.2	SOT - 93	593
BUW42APFI		450	400	15	1.50	10.00	3000	1.5	0.6	1.92	ISOWATT218	593
BUW42P		400	350	15	1.50	10.00	3000	1.5	0.6	1.2	SOT - 93	593

PNP Type in bold. ▲ Inductive load # Tj = 125°C ■ Tj = 100°C ✶ Datasheet available on request

SWITCHING TRANSISTORS (cont'd)

Type	Comple-mentary	V_{CBO} (V)	V_{CEO} (V)	I_C (A)	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (µs)	t_f (µs)	R_{thj-c} (°C/W)	Case	Page
BUW42PFI		400	350	15	1.50	10.00	3000	1.5	0.6	1.92	ISOWATT218	593
BUW44		500	400	15	3.00	10.00	2000	3	0.8	1	TO - 3	597
BUW45		800	400	15	1.50	10.00	2000	3	0.8	1	TO - 3	597
BUW46		900	450	15	1.50	10.00	2000	3	0.8	1	TO - 3	597
BUW48		120	60	30	0.60	20.00	2000	1.1	0.25	1	TO - 218	601
BUW49		160	80	30	0.50	15.00	1500	1.1	0.25	1	TO - 218	601
BUW50		250	125	25	0.90	20.00	2000	1.2	0.3	1	TO - 218	609
BUW51		300	200	20	0.90	10.00	1000	1.4	0.3	1	TO - 218	617
BUW52		350	250	20	0.80	4.00	260	1.6	0.3	1	SOT - 93	625
BUW89		160	90	25	0.90	15.00	1500	1	0.25	1.2	TO - 218	633
BUW90		250	125	20	0.90	11.00	1100	1	0.3	1.2	TO - 218	641
BUW91		300	200	15	0.90	6.00	600	1.2	0.3	1.2	TO - 218	649
BUW92		350	250	12	0.80	2.00	130	1.6	0.3	1.2	TO - 218	657
BUX10		160	125	25	0.60	10.00	1000	1.2	0.3	1.17	TO - 3	665
BUX10P		160	125	25	0.60	10.00	1000	1.2	0.3	1.17	TO - 218	669
BUX11		250	200	20	0.60	6.00	600	1.8	0.4	1.17	TO - 3	671
BUX11N		220	160	20	0.60	8.00	800	1.5	0.5	1.17	TO - 3	675
BUX12		300	250	20	1.00	5.00	500	2	0.5	1.17	TO - 3	679
BUX13		400	325	15	1.50	8.00	1600	3	1.2	1.17	TO - 3	683
BUX14		450	400	10	1.60	6.00	1200	3	1.2	1.17	TO - 3	685
BUX20		160	125	50	0.60	25.00	2500	1.2	0.3	0.5	TO - 3	687
BUX21		250	200	40	0.60	12.00	1200	1.8	0.4	0.5	TO - 3	691
BUX22		300	250	40	1.00	10.00	1000	2	0.5	0.5	TO - 3	695
BUX23		400	325	30	1.00	16.00	3200	2.5	1.2	0.5	TO - 3	699
BUX24		450	400	20	1.00	12.00	2400	3	1.4	0.7	TO - 3	705
BUX25		500	500	30	1.00	8.00	1600	5	1.2	0.5	TO - 3	711
BUX40		160	125	20	1.20	10.00	1000	1	0.4	1.46	TO - 3	715
BUX41		250	200	15	1.20	4.00	400	1.7	0.8	1.46	TO - 3	719
BUX41N		220	160	18	1.20	8.00	800	1.5	0.8	1.46	TO - 3	723
BUX42		300	250	12	1.20	4.00	400	2	1.2	1.46	TO - 3	727
BUX43		400	325	10	2.00	5.00	1000	2.2	1.2	1.46	TO - 3	731
BUX44		450	400	8	1.50	4.00	800	2.5	1.2	1.46	TO - 3	733
BUX47		850	400	9	1.5	6.00	1200	2.5	0.8	1.2	TO - 3	735
BUX47A		1000	450	9	1.5	5.00	1000	2.5	0.8	1.2	TO - 3	735
BUX48		850	400	15	1.5	10.00	2000	3	0.8	1	TO - 3	745
BUX48A		1000	450	15	1.5	8.00	1600	3	0.8	1	TO - 3	745
BUX48B		1200	600	15	1.5	6.00	1500	3	0.7	1	TO - 3	755
BUX48C		1200	700	15	1.5	6.00	1500	3	0.7	1	TO - 3	755
BUX80		800	400	10	1.5	5.00	1000	3.5	0.5	1.75	TO - 3	761
BUX84		800	400	2	3.0	1.00	200	3.5	0.4●	3.12	TO - 220	765
BUX85		1000	450	2	1.0	1.00	200	3.5	0.4●	2.5	TO - 220	✶
BUX98		850	400	30	1.5	20.00	4000	3	0.8	0.7	TO - 3	767
BUX98A		1000	450	30	1.5	16.00	3200	3	0.8	0.7	TO - 3	767
BUX98B		1200	600	30	1.5	12.00	3000	3	0.8	0.7	TO - 3	769
BUX98C		1200	700	30	1.5	12.00	3000	3	0.8	0.7	TO - 3	769

PNP Type in bold. ● Typical value ✶ Datasheet available on request

SWITCHING TRANSISTORS (cont'd)

Type	Comple-mentary	V_{CBO} (V)	V_{CEO} (V)	I_C (A)	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (μs)	t_f (μs)	R_{thj-c} (°C/W)	Case	Page
BUX98P		850	450	30	0.9	20.00	4000	3	0.8	0.63	TO - 218	773
BUX348		850	450	45	0.9	30.00	6000			0.58	TO - 3	779
BUY47		150	120	7	1.00	5.00	500	0.7	0.04	15	TO - 39	785
BUY48		200	170	7	1.00	5.00	500	0.7	0.04●	15	TO - 39	785
BUY49P		250	200	3	0.20	0.50	50	0.75	0.20	8.33	SOT - 32	789
BUY49S		250	200	3	0.20	0.50	50	0.75	0.30	17.5	TO - 39	791
BUY69A		1000	400	10	3.3	8.00	2500	1.7●	0.3●	1.75	TO - 3	799
BUY69B		800	325	10	3.3	8.00	2500	1.7●	0.3●	1.75	TO - 3	799
BUY69C		500	200	10	3.3	8.00	2500	1.7●	0.3●	1.75	TO - 3	799
D44Q1		200	125	4	1.00	2.00	200	2	1.7	4	TO - 220	805
D44Q3		250	175	4	1.00	2.00	200	2	1.7	4	TO - 220	805
D44Q5		300	225	4	1.00	2.00	200	2	1.7	4	TO - 220	805
ESM2012D(V)		150	125	120	1.5#	70	250	2▲■	0.4▲■	0.7	ISOTOP	✶
ESM2030D(V)		400	300	67	2.0#	56	1600	3.5▲■	0.7▲■	0.83	ISOTOP	✶
ESM3030D(V)		400	300	100	1.7#	60	600	3.5▲■	0.7▲■	0.83	ISOTOP	✶
ESM3045A(V)		1000	450	24	2.0#	18	720	4.5▲■	0.5▲■	1	ISOTOP	✶
ESM3045D(V)		600	450	24	2.0#	15	300	4▲■	0.4▲■	1	ISOTOP	✶
ESM4045A(V)		1000	450	42	2.0#	30	1200	5▲■	0.6▲■	0.83	ISOTOP	✶
ESM4045D(V)		600	450	42	2.0#	25	500	4.5▲■	0.5▲■	0.83	ISOTOP	✶
ESM5045D(V)		600	450	60	2.0#	35	700	5▲■	0.5▲■	0.71	ISOTOP	✶
ESM6045A(V)		1000	450	84	2.0#	60	2400	6▲■	0.6▲■	0.5	ISOTOP	✶
ESM6045D(V)		600	450	84	2.0#	50	1000	5.5▲■	0.5▲■	0.5	ISOTOP	✶
ESM7545D(V)		600	450	75	2.5	75	1500	5▲●	1▲●	0.41	ISOTOP	✶
ESMT5070D(V)		1000	700	50	3.0	50	500	15▲■	3▲■	0.41	ISOTOP	✶
MJ10004		400	350	20	1.90	10.00	400	1.5	0.5	1	TO - 3	823
MJ10004P		400	350	20	1.90	10.00	400	1.5	0.5	1	TO - 218	823
MJ10004PFI		400	350	20	1.90	10.00	400	1.5	0.5	2.08	ISOWATT218	823
MJ10005		450	400	20	1.90	10.00	400	1.5	0.5	1	TO - 3	823
MJ10005P		450	400	20	1.90	10.00	400	1.5	0.5	1	TO - 218	823
MJ10005PFI		450	400	20	1.90	10.00	400	1.5	0.5	2.08	ISOWATT218	823
MJ13335		800	500	20	1.8	10.00	2000				TO - 3	✶
MJE340	**MJE350**	300	300	0.5						6	SOT - 32	837
MJE340T	**MJE350T**	300	300	0.5						6	TO - 220	837
MJE350	MJE340	300	300	0.5						6	SOT - 32	837
MJE350T	MJE340T	300	300	0.5						6	TO - 220	837
MJE3439		450	350	0.3	0.50	0.05	4			8.33	SOT - 32	855
MJE3440		350	250	0.3	0.50	0.05	4			8.33	SOT - 32	855
MJE13004		600	300	4	1.00	4.00	1000	4	0.9	1.67	TO - 220	859
MJE13005		700	400	4	1.0	4.00	1000	4	0.9	1.67	TO - 220	859
MJE13006		600	300	8	1.50	5.00	1000	3	0.7	1.56	TO - 220	863
MJE13007		700	400	8	1.5	5.00	1000	3	0.7	1.56	TO - 220	863
MJE13007A		850	400	8	1.5	5.00	1000	3	0.7	1.56	TO - 220	863
MJE13008		600	300	12	1.50	8.00	1600	3	0.7	1.25	TO - 220	871
MJE13009		700	400	12	1.5	8.00	1600	3	0.7	1.25	TO - 220	871
MJH16006		850	450	8	3.0	5.00	660				TO - 218	✶

PNP Type in bold. ▲ Inductive load ● Typical value #Tj = 125°C ■ Tj = 100°C ✶ Datasheet available on request

SWITCHING TRANSISTORS (cont'd)

Type	Comple-mentary	V_{CBO} (V)	V_{CEO} (V)	I_C (A)	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (μs)	t_f (μs)	R_{thj-c} (°C/W)	Case	Page
MJH16008		850	450	8	3.0	5.00	500				TO - 218	∗
MJH16010		850	450	15	3.0	10.00	1300				TO - 218	∗
MJH16012		850	450	15	3.0	10.00	1000				TO - 218	∗
S2000FI		1500	700	7.5	5.0	4.50	2000				ISOWATT218	∗
S2056FI		1500	700	2.5	5.0	2.00	1000				ISOWATT218	∗
SGS340	**SGS350**	300	300	0.5						6	SOT - 82	837
SGS350	SGS340	300	300	0.5						6	SOT - 82	837
SGS3439		450	350	0.3	0.50	0.05	4			8.33	SOT - 82	855
SGS3440		350	250	0.3	0.50	0.05	4			8.33	SOT - 82	855
SGS13002		600	300	1.5	1.00	1.00	250	2.5	0.5	2.5	SOT - 82	877
SGS13002T		600	300	1.5	1.00	1.00	250	2.5	0.5	2.5	TO - 220	877
SGS13003		700	400	1.5	1.0	1.00	250	2.5	0.5	2.5	SOT - 82	877
SGS13003T		700	400	1.5	1.0	1.00	250	2.5	0.5	2.5	TO - 220	877
SGSD00020		650	400	8	4.00	3.00	3				TO - 220	895
SGSD00030		650	400	28	2.50	12.00	100	1.5	0.5	1	TO - 218	897
SGSD00030FI		650	400	28	2.50	12.00	100	1.5	0.5	2.08	ISOWATT218	897
SGSD00031		650	400	28	2.50	12.00	100	1.5	0.5	1	TO - 3	897
SGSD00055		1000	400	7	2.5	3.00	200	0.8	0.15	1.66	TO - 220	905
SGSD310		600	400	28	2.50	18.00	1800	1.5	0.5	1	TO - 3	889
SGSD311		600	400	28	2.50	18.00	1800	1.5	0.5	1	TO - 218	889
SGSD311FI		600	400	28	2.50	18.00	1800	1.5	0.5	2.08	ISOWATT218	889
SGSF321		850	400	5	1.5	3.50	700	2.5	0.3	1.78	TO - 220	907
SGSF323		1000	450	5	1.5	2.50	500	2.5	0.3	1.78	TO - 220	913
SGSF324		1200	600	4	1.5	1.75	350	4.5	0.35	1.78	TO - 220	919
SGSF341		850	400	10	1.5	6.00	1200	2.5	0.3	1.47	TO - 220	931
SGSF343		1000	450	8	1.5	4.50	900	2.5	0.35	1.47	TO - 220	937
SGSF344		1200	600	7	1.5	3.50	700	3.5	0.3	1.47	TO - 220	943
SGSF421		850	400	5	1.5	3.50	700	2.5	0.3	1.56	TO - 218	907
SGSF423		1000	450	5	1.5	2.50	500	2.5	0.3	1.56	TO - 218	913
SGSF424		1200	600	4	1.5	1.75	350	4.5	0.35	1.56	TO - 218	919
SGSF425		1300	600	4	1.5	1.25	250	4.5	0.35	1.56	TO - 218	925
SGSF441		850	400	10	1.5	6.00	1200	2.5	0.3	1.31	TO - 218	931
SGSF443		1000	450	8	1.5	4.50	900	2.5	0.35	1.31	TO - 218	937
SGSF444		1200	600	7	1.5	3.50	700	3.5	0.3	1.31	TO - 218	943
SGSF445		1300	600	7	1.5	3.00	600	3.5	0.3	1.31	TO - 218	949
SGSF461		850	400	15	1.5	10.00	2000	2.3	0.5	1	TO - 218	955
SGSF463		1000	450	12	1.5	7.00	1400	2.3	0.5	1	TO - 218	961
SGSF464		1200	600	10	1.5	6.00	1200	3.5	0.4	1	TO - 218	967
SGSF465		1300	600	10	1.5	5.00	1000	3.5	0.4	1	TO - 218	973
SGSF541		850	400	10	1.5	6.00	1200	2.5	0.35	1.3	TO - 3	931
SGSF543		1000	450	8	1.5	4.50	900	2.5	0.35	1.3	TO - 3	937
SGSF544		1200	600	7	1.5	3.50	700	3.5	0.3	1.3	TO - 3	943
SGSF561		850	400	15	1.5	10.00	2000	2.3	0.5	1	TO - 3	955
SGSF563		1000	450	12	1.5	7.00	1400	2.3	0.5	1	TO - 3	961
SGSF564		1200	600	10	1.5	6.00	1200	3.5	0.4	1	TO - 3	967

PNP Type in bold. ∗ Datasheet available on request

SWITCHING TRANSISTORS (cont'd)

Type	Comple-mentary	V_{CBO} (V)	V_{CEO} (V)	I_C (A)	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (µs)	t_f (µs)	R_{thj-c} (°C/W)	Case	Page
SGSF565		1300	600	10	1.5	5.00	1000	3.5	0.4	1	TO - 3	973
SGSF661		850	400	30	1.5	20.00	4000	2.3	0.5	0.6	TO - 3	979
SGSF663		1000	450	24	1.5	14.00	2800	2.3	0.5	0.6	TO - 3	983
SGSF664		1200	600	20	1.5	12.00	2400	3.5	0.4	0.6	TO - 3	987
SGSF665		1300	600	20	1.5	10.00	2000	3.5	0.4	0.6	TO - 3	991
SGSIF321		850	400	5	1.5	3.50	700	2.5	0.3	3.57	ISOWATT220	907
SGSIF323		1000	450	5	1.5	2.50	500	2.5	0.3	3.57	ISOWATT220	913
SGSIF324		1200	600	4	1.5	1.75	350	4.5	0.35	3.57	ISOWATT220	919
SGSIF341		850	400	10	1.5	6.00	1200	2.5	0.3	3.12	ISOWATT220	931
SGSIF343		1000	450	8	1.5	4.50	900	2.5	0.35	3.12	ISOWATT220	937
SGSIF344		1200	600	7	1.5	3.50	700	3.5	0.3	3.12	ISOWATT220	943
SGSIF421		850	400	5	1.5	3.50	700	2.5	0.3	2.77	ISOWATT218	907
SGSIF423		1000	450	5	1.5	2.50	500	2.5	0.3	2.77	ISOWATT218	913
SGSIF424		1200	600	4	1.5	1.75	350	4.5	0.35	2.77	ISOWATT218	919
SGSIF425		1300	600	4	1.5	1.25	250	4.5	0.35	2.77	ISOWATT218	925
SGSIF441		850	400	10	1.5	6.00	1200	2.5	0.3	2.77	ISOWATT218	931
SGSIF443		1000	450	8	1.5	4.50	900	2.5	0.35	2.77	ISOWATT218	937
SGSIF444		1200	600	7	1.5	3.50	700	3.5	0.3	2.77	ISOWATT218	943
SGSIF445		1300	600	7	1.5	3.00	600	3.5	0.3	2.77	ISOWATT218	949
SGSIF461		850	400	15	1.5	10.00	2000	2.3	0.5	1.92	ISOWATT218	955
SGSIF463		1000	450	12	1.5	7.00	1400	2.3	0.5	1.92	ISOWATT218	961
SGSIF464		1200	600	10	1.5	6.00	1200	3.5	0.4	1.92	ISOWATT218	967
SGSIF465		1300	600	10	1.50	1.50	5000	3.5	0.4	1.92	ISOWATT218	973
TIP47		350	250	1	1.00	1.00	200	1.2●	0.45●	3.12	TO - 220	1005
TIP48		400	300	1	1.00	1.00	200	1.3●	0.45●	3.12	TO - 220	1005
TIP49		450	350	1	1.00	1.00	200	1.3●	0.45●	3.12	TO - 220	1005
TIP50		500	400	1	1.00	1.00	200	1.3●	0.45●	3.12	TO - 220	1005
TIP51		350	250	5	1.50	3.00	600	2.5●	0.2●	1.25	SOT - 93	1009
TIP52		400	300	5	1.50	3.00	600	2.5●	0.2●	1.25	SOT - 93	1009
TIP53		450	350	5	1.50	3.00	600	2.5●	0.2●	1.25	SOT - 93	1009
TIP54		500	400	5	1.50	3.00	600	2.5●	0.2●	1.25	SOT - 93	1009

● Typical value

GENERAL PURPOSE TRANSISTORS

V_{CEO} (V)	V_{CBO} (V)	I_C (A)	TYPE NPN	PNP	h_{FE}	@ I_C (A)	V_{CE} (V)	V_{CEsat} (V)	@ I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Case	Page
22	22	4	BD433	BD434	50	2.00	1.0	0.50	2.00	200	3.5	SOT- 32	163
25	40	5	MJE200	MJE210	70	0.50	1.0	0.30	0.50	50	8.34	SOT - 32	833
30	30	3	MJE520	MJE370	25	1.00	1.0				5	SOT - 32	841
30	30	10	D44H1	D45H1	20	4.00	1.0	1.00	8.00	800	2.5	TO - 220	803
30	30	10	D44H2	D45H2	40	4.00	1.0	1.00	8.00	400	2.5	TO - 220	803
30	40	4	D44C1		10	1.00	1.0	0.50	1.00	100	4.2	TO - 220	801
30	40	4	D44C2		20	1.00	1.0	0.50	1.00	50	4.2	TO - 220	801
30	40	4	D44C3		20	2.00	1.0	0.50	1.00	50	4.2	TO - 220	801
30	40	7	2N6288	2N6111	30	4.00	3.0	1.00	3.00	300	1.92	TO - 220	1140
32	32	4	BD435	BD436	50	2.00	1.0	0.50	2.00	200	3.5	SOT - 32	163
40	40	1	2N4921	2N4918	30	0.50	1.0	0.60	1.00	100	4.16	SOT - 32	1063
40	40	3		2N4234	20	0.50	1.0	0.60	1.00	100	29	TO - 39	1057
40	40	4	2N5190	2N5193	25	1.50	2.0	0.60	1.50	150	3.12	SOT - 32	1077
40	40	4	2N6037	2N6034	500	0.50	3.0	2.00	2.00	8	3.12	SOT - 32	1131
40	40	4	MJE521	MJE371	40	1.00	1.0				3.12	SOT - 32	845
40	40	8	2N6386		1000	3.00	3.0	2.00	3.00	6	1.92	TO - 220	1153
40	40	30	2N5301	2N4398	15	15.00	2.0	1.00	15.00	1500	0.875	TO - 3	1083
40	50	15	2N3771		15	15.00	4.0	2.00	15.00	1500	1.17	TO - 3	1053
40	60	3	MJE180	MJE170	30	0.50	1.0	0.90	1.50	150	10	SOT - 32	829
40	80	3	TIP31	TIP32	25	1.00	4.0	1.20	3.00	375	3.12	TO - 220	995
40	80	6	TIP41	TIP42	15	3.00	4.0	1.50	6.00	600	1.92	TO - 220	1003
45	45	1.5	BD135	BD136	25	0.50	2.0	0.50	0.50	50	10	SOT - 32	133
45	45	2	BD233	BD234	25	1.00	2.0	0.60	1.00	100	5	SOT - 32	149
45	45	2	BD239	BD240	15	1.00	4.0	0.70	1.00	200	4.16	TO - 220	153
45	45	3	BD175	BD176	15	1.00	2.0	0.80	1.00	100	4.16	SOT - 32	143
45	45	3	BD241	BD242	25	1.00	4.0	1.20	3.00	600	4.16	TO - 220	155
45	45	4	2N6121	2N6124	25	1.00	2.0	0.60	1.50	150	3.12	TO - 220	1143
45	45	4	BD437	BD438	40	2.00	1.0	0.60	2.00	200	3.5	SOT - 32	163
45	45	4	BD675	BD676	750	1.50	3.0	2.50	1.50	30	3.12	SOT - 32	175
45	45	4	BD675A	BD676A	750	2.00	3.0	2.80	2.00	40	3.12	SOT - 32	175
45	45	6	BD243	BD244	15	3.00	4.0	1.50	6.00	1000	4.16	TO - 220	157
45	45	8	BD533	BD534	25	2.00	2.0	0.80	2.00	200	2.5	TO - 220	171
45	45	8	BDX53	BDX54	750	3.00	3.0	2.00	3.00	12	2.08	TO - 220	217
45	45	10	BDX33	BDX34	750	4.00	3.0	2.50	4.00	8	1.78	TO - 220	211
45	45	10	BDX85	BDX86	1000	3.00	3.0	2.00	4.00	16	1.75	TO - 3	227
45	45	10	D44H4	D45H4	20	4.00	1.0	1.00	8.00	800	2.5	TO - 220	803
45	45	10	D44H5	D45H5	40	4.00	1.0	1.00	8.00	400	2.5	TO - 220	803
45	45	12	BD705	BD706	20	4.00	4.0	1.00	4.00	400	1.67	TO - 220	179
45	45	12	BDW93	BDW94	750	5.00	3.0	2.00	5.00	20	1.56	TO - 220	205
45	45	15	BD905	BD906	15	5.00	4.0	1.00	5.00	500	1.4	TO - 220	185
45	45	15	BDW51	BDW52	20	5.00	4.0	1.00	5.00	500	1.4	TO - 3	193
45	55	4	D44C4		10	1.00	1.0	0.50	1.00	100	4.2	TO - 220	801
45	55	4	D44C5		20	1.00	1.0	0.50	1.00	50	4.2	TO - 220	801
45	55	4	D44C6		20	2.00	1.0	0.50	1.00	50	4.2	TO - 220	801
50	50	15	2N6486	2N6489	20	5.00	4.0	1.30	5.00	500	1.67	TO - 220	1157

GENERAL PURPOSE TRANSISTORS (cont'd)

V_{CEO} (V)	V_{CBO} (V)	I_C (A)	TYPE NPN	TYPE PNP	h_{FE}	@ I_C (A)	V_{CE} (V)	V_{CEsat} (V)	@ I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Case	Page
50	60	7	2N6290	2N6109	30	4.00	2.5	1.00	2.50	250	3.12	TO - 220	1140
60	60	1	2N4922	2N4919	30	0.50	1.0	0.60	1.00	100	4.16	SOT - 32	1063
60	60	1.5	BD137	BD138	25	0.50	2.0	0.50	0.50	50	10	SOT - 32	133
60	60	2	BD235	BD236	25	1.00	2.0	0.60	1.00	100	5	SOT - 32	149
60	60	2	BD239A	BD240A	15	1.00	4.0	0.70	1.00	200	3.12	TO - 220	153
60	60	3	BD177	BD178	15	1.00	2.0	0.80	1.00	100	4.16	SOT - 32	143
60	60	3	BD241A	BD242A	25	1.00	4.0	1.20	3.00	600	3.12	TO - 220	155
60	60	4	2N5191	2N5194	25	1.50	2.0	0.60	1.50	150	3.12	SOT - 32	1077
60	60	4	2N6038	2N6035	500	0.50	3.0	2.00	2.00	8	3.12	SOT - 32	1131
60	60	4	2N6122	2N6125	25	1.50	2.0	0.60	1.50	150	3.12	TO - 220	1143
60	60	4	BD439	BD440	25	2.00	1.0	0.80	2.00	200	3.5	SOT - 32	169
60	60	4	BD677	BD678	750	1.50	3.0	2.50	1.50	30	3.12	SOT - 32	175
60	60	4	BD677A	BD678A	750	2.00	3.0	2.80	2.00	40	3.12	SOT - 32	175
60	60	4	MJE800	MJE700	750	1.50	3.0	3.00	4.00	40	3.12	SOT - 32	849
60	60	4	MJE801	MJE701	750	2.00	3.0	3.00	4.00	40	3.12	SOT - 32	849
60	60	4	SGS110	SGS115	1000	1.00	4.0	2.50	2.00	8	2.5	SOT - 82	1017
60	60	4	TIP110	TIP115	1000	1.00	4.0	2.50	2.00	8	2.5	TO - 220	1017
60	60	5	TIP120	TIP125	1000	3.00	3.0	2.00	3.00	12	1.92	TO - 220	1023
60	60	6	BD243A	BD244A	15	3.00	4.0	1.50	6.00	1000	3.12	TO - 220	157
60	60	6	BD331	BD332	750	3.00	3.0	2.00	3.00	12	2.08	SOT - 82	159
60	60	8	2N6055	2N6053	750	4.00	3.0	2.00	4.00	16	1.75	TO - 3	1139
60	60	8	BD535	BD536	25	2.00	2.0	0.80	2.00	200	2.5	SOT - 82	171
60	60	8	BDX53A	BDX54A	750	3.00	3.0	2.00	3.00	12	2.08	SOT - 82	217
60	60	8	MJ1000	MJ900	1000	3.00	3.0	2.00	3.00	12	1.94	TO - 3	815
60	60	8	SGS130	SGS135	1000	4.00	4.0	2.00	4.00	16	1.78	SOT - 82	1029
60	60	8	TIP100	TIP105	1000	3.00	4.0	2.00	3.00	6	1.56	TO - 220	1011
60	60	8	TIP130	TIP135	1000	4.00	4.0	2.00	4.00	16	1.78	TO - 220	1029
60	60	10	2N5877	2N5875	20	4.00	4.0	1.00	5.00	500	1.17	TO - 3	1115
60	60	10	2N6387		1000	5.00	3.0	2.00	5.00	10	1.92	TO - 220	1153
60	60	10	BDX33A	BDX34A	750	4.00	3.0	2.50	4.00	8	1.78	TO - 220	211
60	60	10	BDX85A	BDX86A	1000	3.00	3.0	2.00	4.00	16	1.75	TO- 3	227
60	60	10	D44H7	D45H7	20	4.00	1.0	1.00	8.00	800	2.5	TO - 220	803
60	60	10	D44H8	D45H8	40	4.00	1.0	1.00	8.00	400	2.5	TO - 220	803
60	60	10	MJ3000	MJ2500	1000	5.00	3.0	2.00	5.00	20	1.17	TO- 3	817
60	60	10	TIP140	TIP145	1000	5.00	4.0	3.00	10.00	40	1	TO - 218	1031
60	60	12	2N6057	2N6050	750	6.00	3.0	2.00	6.00	24	1.17	TO- 3	1137
60	60	12	BD707	BD708	15	4.00	4.0	1.00	4.00	400	1.67	TO - 220	179
60	60	12	BDV65	BDV64	1000	5.00	4.0	2.00	5.00	20	1	TO - 218	189
60	60	12	BDW93A	BDW94A	750	5.00	3.0	2.00	5.00	20	1.56	TO - 220	205
60	60	12	BDX87A	BDX88A	1000	5.00	3.0	2.00	6.00	24	1.75	TO- 3	233
60	60	15	BD907	BD908	15	5.00	4.0	1.00	5.00	500	1.4	TO - 220	185
60	60	15	BDW51A	BDW52A	20	5.00	4.0	1.00	5.00	500	1.4	TO- 3	193
60	60	15	BDW83A	BDW84A	750	6.00	3.0	2.50	6.00	12	0.96	TO - 218	199
60	60	16	MJ4033	MJ4030	1000	10.00	3.0	4.00	16.00	80	1.17	TO- 3	821
60	60	20	2N6282	2N6285	750	10.00	3.0	3.00	20.00	200	1.09	TO- 3	1149

GENERAL PURPOSE TRANSISTORS (cont'd)

V_{CEO} (V)	V_{CBO} (V)	I_C (A)	TYPE NPN	TYPE PNP	h_{FE} @	I_C (A)	V_{CE} (V)	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Case	Page
60	60	25	2N5885	2N5883	20	10.00	4.0	1.00	15.00	1500	0.875	TO - 3	1121
60	60	30	2N5302	2N4399	15	15.00	2.0	1.00	15.00	1500	0.875	TO - 3	1083
60	60	30	MJ11012	MJ11011	1000	20.00	5.0	4.00	30.00	300	0.875	TO - 3	825
60	60	15	TIP140T	TIP145T	1000	5.00	4.0	3.00	10.00	40	1.25	TO - 220	1035
60	65	5		BSS44	40	2.00	2.0	1.00	5.00	500	35	TO - 39	247
60	70	4	D44C7		10	1.00	1.0	0.50	1.00	100	4.2	TO - 220	801
60	70	4	D44C8		20	1.00	1.0	0.50	1.00	50	4.2	TO - 220	801
60	70	4	D44C9		20	2.00	1.0	0.50	1.00	50	4.2	TO - 220	801
60	70	10	MJE3055T	MJE2955T	20	4.00	4.0	1.10	4.00	400	1.66	TO - 220	853
60	80	3	MJE181	MJE171	30	0.50	1.0	0.90	1.50	150	10	SOT - 32	829
60	80	10	2N3715	2N3791	30	3.00	2.0	0.80	5.00	500	1.17	TO - 3	1047
60	100	3	TIP31A	TIP32A	25	1.00	4.0	1.20	3.00	375	3.12	TO - 220	995
60	100	5	BFX34		40	2.00	2.0	1.00	5.00	500	35	TO - 39	243
60	100	6	TIP41A	TIP42A	15	3.00	4.0	1.50	6.00	600	1.92	TO - 220	1003
60	100	7	BUY68		40	1.00	1.0	1.00	5.00	500	17.5	TO - 39	795
60	100	10	TIP33A	TIP34A	20	3.00	4.0	1.00	3.00	300	1.39	TO - 218	999
60	100	15	2N3055	MJ2955	20	4.00	4.0	1.10	4.00	400	1.5	TO - 3	1039
60	100	15	2N3772		15	10.00	4.0	1.40	10.00	1000	1.17	TO - 3	1053
60	100	15	TIP3055	TIP2955	20	4.00	4.0	1.10	4.00	400	1.39	TO - 218	1037
60	100	25	TIP35A	TIP36A	10	15.00	4.0	1.80	15.00	1500	1	TO - 218	1001
70	70	15	2N6487	2N6490	20	5.00	4.0	1.30	5.00	500	1.67	TO - 220	1157
70	80	7	2N6292	2N6107	30	4.00	2.0	1.00	2.00	200	3.12	TO - 220	1140
80	80	1	2N4923	2N4920	30	0.50	1.0	0.60	1.00	100	4.16	SOT - 32	1063
80	80	1.5	BD139	BD140	25	0.50	2.0	0.50	0.50	50	10	SOT - 32	133
80	80	2	BD239B	BD240B	15	1.00	4.0	0.70	1.00	200	4.16	TO - 220	155
80	80	3	BD179	BD180	15	1.00	2.0	0.80	1.00	100	4.16	SOT - 32	143
80	80	3	BD241B	BD242B	25	1.00	4.0	1.20	3.00	600	3.12	TO - 220	155
80	80	4	2N5192	2N5195	20	1.50	2.0	0.60	1.50	150	3.12	SOT - 32	1077
80	80	4	2N6039	2N6036	500	0.50	3.0	2.00	2.00	8	3.12	SOT - 32	1131
80	80	4	2N6123	2N6126	20	1.50	2.0	0.60	1.50	150	3.12	TO - 220	1143
80	80	4	BD441	BD442	15	2.00	1.0	0.80	2.00	200	3.5	SOT - 32	169
80	80	4	BD679	BD680	750	1.50	3.0	2.50	1.50	30	3.12	SOT - 32	175
80	80	4	BD679A	BD680A	750	2.00	3.0	2.80	2.00	40	3.12	SOT - 32	175
80	80	4	MJE802	MJE702	750	1.50	3.0	3.00	4.00	40	3.12	SOT - 32	849
80	80	4	MJE803	MJE703	750	2.00	3.0	3.00	4.00	40	3.12	SOT - 32	849
80	80	4	SGS111	SGS116	1000	1.00	4.0	2.50	2.00	8	2.5	SOT - 82	1017
80	80	4	TIP111	TIP116	1000	1.00	4.0	2.50	2.00	8	2.5	TO - 220	1017
80	80	5	2N5336		20	5.00	2.0	1.20	5.00	500	29	TO - 39	1089
80	80	5	2N5337		40	5.00	2.0	1.20	5.00	500	29	TO - 39	1089
80	80	5	TIP121	TIP126	1000	3.00	3.0	2.00	3.00	12	1.92	TO - 220	1023
80	80	6	BD243B	BD244B	15	3.00	4.0	1.50	6.00	1000	1.92	TO - 220	157
80	80	6	BD333	BD334	750	3.00	3.0	2.00	3.00	12	2.08	SOT - 82	159
80	80	8	BD537	BD538	15	2.00	2.0	0.80	2.00	200	2.5	TO - 220	171
80	80	8	BDX53B	BDX54B	750	3.00	3.0	2.00	3.00	12	2.08	TO - 220	217
80	80	8	MJ1001	MJ901	1000	3.00	3.0	2.00	3.00	12	1.94	TO - 3	815

GENERAL PURPOSE TRANSISTORS (cont'd)

V_{CEO} (V)	V_{CBO} (V)	I_C (A)	TYPE NPN	TYPE PNP	h_{FE}	@ I_C (A)	V_{CE} (V)	V_{CEsat} (V)	@ I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Case	Page
80	80	8	SGS131	SGS136	1000	4.00	4.0	2.00	4.00	16	1.78	SOT - 82	1029
80	80	8	TIP101	TIP106	1000	3.00	4.0	2.00	3.00	6	1.56	TO - 220	1011
80	80	8	TIP131	TIP136	1000	4.00	4.0	2.00	4.00	16	1.78	TO - 220	1029
80	80	10	2N5878	2N5876	20	4.00	4.0	1.00	5.00	500	1.17	TO - 3	1115
80	80	10	2N6388		1000	5.00	3.0	2.00	5.00	10	1.92	TO - 220	1153
80	80	10	BDX33B	BDX34B	750	3.00	3.0	2.50	3.00	6	1.78	TO - 220	211
80	80	10	BDX85B	BDX86B	1000	3.00	3.0	2.00	4.00	16	1.75	TO - 3	227
80	80	10	D44H10	D45H10	20	4.00	1.0	1.00	8.00	800	2.5	TO - 220	803
80	80	10	D44H11		40	4.00	1.0	1.00	8.00	400	2.5	TO - 220	803
80	80	10	MJ3001	MJ2501	1000	5.00	3.0	2.00	5.00	20	1.17	TO - 3	817
80	80	10	TIP141	TIP146	1000	5.00	4.0	3.00	10.00	40	1	TO - 218	1031
80	80	12	2N6058	2N6051	750	6.00	3.0	2.00	6.00	24	1.17	TO - 3	1137
80	80	12	BD709	BD710	15	4.00	4.0	1.00	4.00	400	1.67	TO - 220	179
80	80	12	BDV65A	BDV64A	1000	5.00	4.0	2.00	5.00	20	1	TO - 218	189
80	80	12	BDW93B	BDW94B	750	5.00	3.0	2.00	5.00	20	1.56	TO - 220	205
80	80	12	BDX87B	BDX88B	1000	5.00	3.0	2.00	6.00	24	1.45	TO - 3	233
80	80	15	BD909	BD910	15	5.00	4.0	1.00	5.00	500	1.4	TO - 220	185
80	80	15	BDW51B	BDW52B	20	5.00	4.0	1.00	5.00	500	1.4	TO - 3	193
80	80	15	BDW83B	BDW84B	750	6.00	3.0	2.50	6.00	12	0.96	TO - 218	199
80	80	16	MJ4034	MJ4031	1000	10.00	3.0	4.00	16.00	80	1.17	TO - 3	821
80	80	20	2N5303	2N5745	15	10.00	2.0	1.50	15.00	1500	0.875	TO - 3	1083
80	80	20	2N6283	2N6286	750	10.00	3.0	3.00	20.00	200	1.09	TO - 3	1149
80	80	25	2N5886	2N5884	20	10.00	4.0	1.00	15.00	1500	0.875	TO - 3	1121
80	80	25	SGSD100	SGSD200	300	20.00	3.0	1.75	10.00	40	0.96	TO - 218	885
80	80	15	TIP141T	TIP146T	1000	5.00	4.0	3.00	10.00	40	1.25	TO - 220	1035
80	90	4	D44C10		10	1.00	1.0	0.50	1.00	100	4.2	TO - 220	801
80	90	4	D44C11		20	1.00	1.0	0.50	1.00	50	4.2	TO - 220	801
80	90	4	D44C12		20	2.00	1.0	0.50	1.00	50	4.2	TO - 220	801
80	100	2	BD237	BD238	25	1.00	2.0	0.60	1.00	100	5	SOT - 32	149
80	100	3	MJE182	MJE172	30	0.50	1.0	0.90	1.50	150	10	SOT - 32	829
80	100	5	2N5152	2N5151	30	2.50	5.0	0.70	2.50	250	15	TO - 39	1075
80	100	5	2N5154	2N5153	70	2.50	5.0	0.70	2.50	250	15	TO - 39	1075
80	100	10	2N3716	2N3792	30	3.00	2.0	0.80	5.00	500	1.17	TO - 3	1047
80	120	3	TIP31B	TIP32B	25	1.00	4.0	1.20	3.00	375	3.12	TO - 220	995
80	120	6	TIP41B	TIP42B	15	3.00	4.0	1.50	6.00	600	1.92	TO - 220	1003
80	120	10	TIP33B	TIP34B	20	3.00	4.0	1.00	3.00	300	1.39	TO - 218	999
80	120	25	TIP35B	TIP36B	10	15.00	4.0	1.80	15.00	1500	1	TO - 218	1001
90	90	15	2N6488	2N6491	20	5.00	4.0	1.30	5.00	500	1.67	TO - 220	1157
90	90	30	MJ11014	MJ11013	1000	20.00	5.0	4.00	30.00	300	0.875	TO - 3	825
90	100	30	MJ802	MJ4502	25	7.50	2.0	0.80	7.50	750	0.875	TO - 3	809
100	100	1	2N5681	2N5679	40	0.25	2.0	1.00	0.50	50	17.5	TO - 39	1113
100	100	2	BD239C	BD240C	15	1.00	4.0	0.70	1.00	200	4.16	TO - 220	153
100	100	3	BD241C	BD242C	25	1.00	4.0	1.20	3.00	600	3.12	TO - 220	155
100	100	4	BD681	BD682	750	1.50	3.0	2.50	1.50	30	3.12	SOT - 32	175
100	100	4	SGS112	SGS117	1000	1.00	4.0	2.50	2.00	8	2.5	SOT - 82	1017

GENERAL PURPOSE TRANSISTORS (cont'd)

V_{CEO} (V)	V_{CBO} (V)	I_C (A)	TYPE NPN	TYPE PNP	h_{FE} @	I_C (A)	V_{CE} (V)	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Case	Page
100	100	4	TIP112	TIP117	1000	1.00	4.0	2.50	2.00	8	2.5	TO - 220	1017
100	100	5	2N5338		20	5.00	2.0	1.20	5.00	500	29	TO - 39	1089
100	100	5	2N5339		40	5.00	2.0	1.20	5.00	500	29	TO - 39	1089
100	100	5	TIP122	TIP127	1000	3.00	3.0	2.00	3.00	12	1.92	TO - 220	1023
100	100	6	BD243C	BD244C	15	3.00	4.0	1.50	6.00	1000	3.12	TO - 220	157
100	100	6	BD335	BD336	750	3.00	3.0	2.00	3.00	12	2.08	SOT - 82	159
100	100	8	2N6045	2N6042	1000	3.00	4.0	2.00	3.00	12	1.56	TO - 220	1135
100	100	8	BDX53C	BDX54C	750	3.00	3.0	2.00	3.00	12	2.08	TO - 220	217
100	100	8	SGS132	SGS137	1000	4.00	4.0	2.00	4.00	16	1.78	SOT - 82	1029
100	100	8	TIP102	TIP107	1000	3.00	4.0	2.00	3.00	6	1.56	TO - 220	1011
100	100	8	TIP132	TIP137	1000	4.00	4.0	2.00	4.00	16	1.78	TO - 220	1029
100	100	10	BDX33C	BDX34C	750	3.00	3.0	2.50	3.00	6	1.78	TO - 220	211
100	100	10	BDX85C	BDX86C	1000	3.00	3.0	2.00	4.00	16	1.17	TO - 3	227
100	100	10	TIP142	TIP147	1000	5.00	4.0	3.00	10.00	40	1	TO - 218	1031
100	100	12	2N6059	2N6052	750	6.00	3.0	2.00	6.00	24	1.17	TO - 3	1137
100	100	12	BD711	BD712	15	4.00	4.0	1.00	4.00	400	1.4	TO - 220	179
100	100	12	BDV65B	BDV64B	1000	5.00	4.0	2.00	5.00	20	1	TO - 218	189
100	100	12	BDW93C	BDW94C	750	5.00	3.0	2.00	5.00	20	1.56	TO - 220	205
100	100	12	BDX87C	BDX88C	1000	5.00	3.0	2.00	6.00	24	1.45	TO - 3	233
100	100	15	BD911	BD912	15	5.00	4.0	1.00	5.00	500	4.2	TO - 220	185
100	100	15	BDW51C	BDW52C	20	5.00	4.0	1.00	5.00	500	1.4	TO - 3	193
100	100	15	BDW83C	BDW84C	750	6.00	3.0	2.50	6.00	12	0.96	TO - 218	199
100	100	16	2N5629	2N6029	25	8.00	2.0	1.00	10.00	1000	0.875	TO - 3	1097
100	100	16	MJ4035	MJ4032	1000	10.00	3.0	4.00	16.00	80	1.17	TO - 3	821
100	100	20	2N6284	2N6287	750	10.00	3.0	3.00	20.00	200	1.09	TO - 3	1149
100	100	15	TIP142T	TIP147T	1000	5.00	4.0	3.00	10.00	40	1.25	TO - 220	1035
100	140	3	TIP31C	TIP32C	25	1.00	4.0	1.20	3.00	375	3.12	TO - 220	995
100	140	6	TIP41C	TIP42C	15	3.00	4.0	1.50	6.00	600	1.92	TO - 220	1003
100	140	10	TIP33C	TIP34C	20	3.00	4.0	1.00	3.00	300	1.39	TO - 218	999
100	140	25	TIP35C	TIP36C	10	15.00	4.0	1.80	15.00	1500	1	TO - 218	1001
120	120	1	2N5682	2N5680	40	0.25	2.0	1.00	0.50	50	17.5	TO - 39	1113
120	120	30	MJ11016	MJ11015	1000	20.00	5.0	4.00	30.00	300	0.875	TO - 3	825
140	140	6	BDX53E	BDX54E	500	2.00	5.0	2.00	2.00	10	2.08	TO - 220	219
140	160	12	SGSD93E		1000	3.00	3.0	2.00	10.00	20	1.56	TO - 220	881
150	150	6	BDX53S	BDX54S	500	2.00	5.0	2.00	2.00	8	11.66	TO - 39	223
160	160	6	BDX53F	BDX54F	500	2.00	5.0	2.00	2.00	10	2.08	TO - 220	219
160	180	12	SGSD93F		1000	3.00	3.0	2.00	10.00	20	1.56	TO - 220	881
180	180	4	BDW91	BDW92	1000	2.00	5.0	2.00	2.00	4	17.5	TO - 39	201
180	200	12	SGSD93G		1000	3.00	3.0	2.00	10.00	20	1.56	TO - 220	881
350	350	15	BU931Z		80	8.00	1.8	1.60	7.00	70	1	TO - 3	343
350	350	15	BU931ZP		80	8.00	1.8	1.60	7.00	70	1	TO - 218	343
350	350	15	BU931ZPFI		80	8.00	1.8	1.60	7.00	70	2.08	ISOWATT218	343
450	400	6	BU911		20	4.00	1.8	1.80	2.50	50	2.08	TO - 220	325
450	400	10	BU921		50	7.00	1.8	1.80	5.00	50	1.25	TO - 3	329
450	400	10	BU921P		50	7.00	1.8	1.80	5.00	50	1.2	TO - 218	329

GENERAL PURPOSE TRANSISTORS (cont'd)

V_{CEO} (V)	V_{CBO} (V)	I_C (A)	TYPE NPN	TYPE PNP	h_{FE}	@ I_C (A)	V_{CE} (V)	V_{CEsat} (V)	@ I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Case	Page
450	400	10	BU921PFI		50	7.00	1.8	1.80	5.00	50	2.27	ISOWATT218	329
450	400	10	BU921T		50	7.00	1.8	1.80	5.00	50	1.2	TO-220	329
450	400	10	BU921TFI		50	1.00	1.8	1.80	5.00	50	3.12	ISOWATT220	✶
450	400	15	BU931R		300	5.00	10.0	1.60	7.00	70	1	TO-3	337
450	400	15	BU931RP		300	5.00	10.0	1.60	7.00	70	1	TO-218	337
450	400	15	BU931RPFI		300	5.00	10.0	1.60	7.00	70	2.08	ISOWATT218	337

✶ Datasheet available on request

SWITCHING TRANSISTORS

V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE NPN	PNP	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (µs)	t_f (µs)	R_{thj-c} (°C/W)	Case	Page
60	80	10	BDY92		0.50	5.00	500	1.3	0.2	2.5	TO - 3	241
60	120	50	BUV18		0.60	40.00	4000	1.1	0.3	0.7	TO - 3	425
80	100	10	BDY91		0.50	5.00	500	1.3	0.2	2.5	TO - 3	241
80	160	50	BUV19		0.60	30.00	3000	1.1	0.25	0.7	TO - 3	425
100	120	10	BDY90		0.50	5.00	500	1.3	0.2	2.5	TO - 3	241
120	60	5	2N4895		1.00	5.00	500	0.35	0.3	25	TO - 39	1059
120	60	5	2N4896		1.00	5.00	500	0.35	0.3	25	TO - 39	1059
120	60	30	BUW38		0.60	20.00	2000	1.1	0.39	1.17	TO - 3	583
120	60	30	BUW48		0.60	20.00	2000	1.1	0.25	1	TO - 218	601
120	75	20	2N5039		1.00	10.00	1000	1.5	0.5	1.25	TO - 3	1067
120	80	25	BDY57		1.40	10.00	1000	1.5	0.5	1	TO - 3	239
120	90	30	2N5671		0.75	15.00	1200	1.5	0.5	1.25	TO - 3	1107
120	90	50	2N6032		1.30	50.00	5000	1.5	0.5	1.25	TO - 3	1127
120	120	1.5	BSW67		1.00	1.00	150	0.7●	0.22●	35	TO - 39	251
130	60	6	BU125		1.00	5.00	500			15	TO - 39	255
140	90	7	2N6702		0.80	5.00	500	1	0.5	2.5	TO - 220	1179
150	80	5	2N4897		1.00	5.00	500	0.35	0.3	25	TO - 39	1059
150	90	20	2N5038		1.00	12.00	1200	1.5	0.5	1.25	TO - 3	1067
150	120	7	BUY47		1.00	5.00	500	0.7	0.04	15	TO - 39	785
150	120	30	2N5672		0.75	15.00	1200	1.5	0.5	1.25	TO - 3	1107
150	120	30	2N6033		1.00	40.00	4000	1.5	0.5	1.25	TO - 3	1127
150	125	120	ESM2012D(V)		1.5#	70	250	2▲■	0.4▲■	0.7	ISOTOP	✶
150	150	1.5	BSW68		1.00	1.00	150	0.7●	0.22●	35	TO - 39	251
160	80	30	BUW39		0.50	15.00	1500	1.1	0.39	1.17	TO - 3	583
160	80	30	BUW49		0.50	15.00	1500	1.1	0.25	1	TO - 218	601
160	90	25	BUV39		1.20	20.00	2500	1	0.25	1.46	TO - 3	459
160	90	25	BUW89		0.90	15.00	1500	1	0.25	1.2	TO - 218	633
160	125	20	BUX40		1.20	10.00	1000	1	0.4	1.46	TO - 3	715
160	125	25	BDY58		1.40	10.00	1000	1.5	0.5	1	TO - 3	239
160	125	25	BUX10		0.60	10.00	1000	1.2	0.3	1.17	TO - 3	665
160	125	25	BUX10P		0.60	10.00	1000	1.2	0.3	1.17	TO - 218	669
160	125	50	BUV20		0.60	25.00	2500	1.2	0.25	0.7	TO - 3	433
160	125	50	BUX20		0.60	25.00	2500	1.2	0.3	0.5	TO - 3	687
160	140	25	BU999		0.80	10.00	1000	1.5	0.25	1.17	TO - 218	347
180	90	14	BUV26		0.60	6.00	600	1	0.25	1.76	TO - 220	441
200	125	4	D44Q1		1.00	2.00	200	2	1.7	4	TO - 220	805
200	125	16	BUT60		0.90	12.00	600	1.5▲	0.2▲	1	TO - 220	✶
200	125	40	BUT70		0.90	35.00	1750	1.8▲	0.2▲	0.63	TO - 218	✶
200	125	50	BUR20		1.00	25.00	2000			0.7	TO - 3	361
200	125	50	BUT100		0.90	50.00	2500	2▲	0.2▲	0.58	TO - 3	417
200	125	50	BUT90		0.90	35.00	1750	1.5	0.4	0.7	TO - 3	991
200	125	70	BUR50		1.00	35.00	2000	2	0.5	0.5	TO - 3	367
200	125	70	BUR50S		1.00	35.00	2000	2	0.5	0.5	TO - 3	367
200	125	100	BUT30(V)		0.9	100	10000	2▲■	0.2▲■	0.5	ISOTOP	✶
200	125	200	BUT230(V)		0.9	200	20000	2▲■	0.2▲■	0.41	ISOTOP	✶

▲ Inductive load ● Typical value # Tj = 125°C ■ Tj = 100°C ✶ Datasheet available on request

SWITCHING TRANSISTORS (cont'd)

V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE NPN	TYPE PNP	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (µs)	t_f (µs)	R_{thj-c} (°C/W)	Case	Page
200	170	7	BUY48		1.00	5.00	500	0.7	0.04●	15	TO - 39	785
200	200	1		2N5415	2.50	0.05	5	0.3	0.2	17.5	TO - 39	1093
200	200	3	BU325		1.50	0.50	50	0.75●	0.20●	5	SOT - 32	227
220	160	18	BUX41N		1.20	8.00	800	1.5	0.8	1.46	TO - 3	723
220	160	20	BUX11N		0.60	8.00	800	1.5	0.5	1.17	TO - 3	675
240	120	12	BUV27		0.70	4.00	400	1.2	0.25	1.76	TO - 220	447
250	125	20	BUV40		0.90	11.00	1100	1	0.3	1.46	TO - 3	467
250	125	20	BUW90		0.90	11.00	1100	1	0.3	1.2	TO - 218	641
250	125	25	BUV50		0.90	20.00	2000	1.2	0.3	1.17	TO - 3	497
250	125	25	BUW50		0.90	20.00	2000	1.2	0.3	1	TO - 218	607
250	125	50	BUV60		0.90	50.00	5000	1.1	0.2	0.7	TO - 3	529
250	150	3	BU125S		1.50	0.50	50			17.5	TO - 39	259
250	175	4	D44Q3		1.00	2.00	200	2	1.7	4	TO - 220	805
250	200	3	BUY49P		0.20	0.50	50	0.75	0.20	8.33	SOT - 32	789
250	200	3	BUY49S		0.20	0.50	50	0.75	0.30	17.5	TO - 39	791
250	200	15	BUX41		1.20	4.00	400	1.7	0.8	1.46	TO - 3	719
250	200	20	BUX11		0.60	6.00	600	1.8	0.4	1.17	TO - 3	671
250	200	40	BUV21		0.60	12.00	1200	1.8	0.4	0.7	TO - 3	433
250	200	40	BUX21		0.60	12.00	1200	1.8	0.4	0.5	TO - 3	691
275	250	0.5	2N5655		1.00	0.10	10			6.25	SOT - 32	1103
275	250	0.5	BD157							6.25	SOT - 32	141
300	200	15	BUV41		0.90	6.00	600	1.2	0.3	1.46	TO - 3	475
300	200	15	BUW91		0.90	6.00	600	1.2	0.3	1.2	TO - 218	647
300	200	20	BUV51		0.90	10.00	1000	1.4	0.3	1.17	TO - 3	505
300	200	20	BUW51		0.90	10.00	1000	1.4	0.3	1	TO - 218	617
300	200	40	BUR21		0.60	12.00	1200				TO - 3	363
300	200	50	BUT91		1.20	40.00	4000	1.2	0.3	0.7	TO - 3	397
300	200	50	BUV61		0.90	25.00	2500	1.2	0.3	0.7	TO - 3	537
300	200	60	BUR51		1.00	30.00	2000	2	0.6	0.5	TO - 3	371
300	225	4	D44Q5		1.00	2.00	200	2	1.7	4	TO - 220	805
300	250	1	2N3440		0.50	0.05	4			17.5	TO - 39	1043
300	250	12	BUX42		1.20	4.00	400	2	1.2	1.46	TO - 3	727
300	250	20	BUX12		1.00	5.00	500	2	0.5	1.17	TO - 3	679
300	250	40	BUV22		1.00	10.00	1000	2	0.5	0.7	TO - 3	433
300	250	40	BUX22		1.00	10.00	1000	2	0.5	0.5	TO - 3	695
300	300	0.5	MJE340	MJE350						6	SOT - 32	837
300	300	0.5	MJE340T	MJE350T						6	TO - 220	837
300	300	0.5	SGS340	SGS350						6	SOT - 82	837
325	300	0.5	2N5656		1.00	0.10	10			6.25	SOT - 32	1103
325	300	0.5	BD158							6.25	SOT - 32	141
330	150	7	BU407		1.00	5.00	500	0.9●	0.3●	2.08	TO - 220	297
330	150	7	BU407D		1.00	5.00	650	0.9●	0.3●	2.08	TO - 220	291
330	150	8	BU189		1.50	5.00	50	0.5	0.44●	2.08	TO - 220	263
330	150	8	BU807		1.50	5.00	50	0.55●	0.2●	2.08	TO - 220	311
330	150	8	BU807FI		1.50	5.00	50	0.55●	0.2●	2.08	ISOWATT220	311

● Typical value

SWITCHING TRANSISTORS (cont'd)

V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE NPN	TYPE PNP	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (µs)	t_f (µs)	R_{thj-c} (°C/W)	Case	Page
350	250	0.3	MJE3440		0.50	0.05	4			8.33	SOT - 32	855
350	250	0.3	SGS3440		0.50	0.05	4			8.33	SOT - 82	855
350	250	1	TIP47		1.00	1.00	200	1.2●	0.45●	3.12	TO - 220	1005
350	250	5	2N6497		1.00	2.50	500	1.8	0.8	1.56	TO - 220	1159
350	250	5	TIP51		1.50	3.00	600	2.5●	0.2●	1.25	TO - 218	1009
350	250	12	BUV42		0.90	4.00	400	1.6	0.3	1.46	TO - 3	483
350	250	12	BUW92		0.80	2.00	130	1.6	0.3	1.2	TO - 218	657
350	250	20	BUV52		0.90	8.00	800	1.6	0.3	1.17	TO - 3	513
350	250	20	BUW52		0.80	4.00	260	1.6	0.3	1	TO - 218	625
350	250	40	BUR22		1.00	10.00	1000				TO - 3	365
350	250	40	BUV62		0.90	16.00	1600	1.8	0.35	0.7	TO - 3	545
350	250	50	BUT92		1.20	35.00	3500	3▲	0.4▲	0.7	TO - 3	405
350	250	60	BUR52		1.80	25.00	2000	2	0.6	0.5	TO - 3	375
350	300	1		2N5416	2.50	0.05	5	0.3	0.2	17.5	TO - 39	1093
375	350	0.5	2N5657		1.00	0.10	10			6.25	SOT - 32	1103
375	350	0.5	BD159							6.25	SOT - 32	141
400	200	7	BU406		1.00	5.00	500	0.9●	0.3●	2.08	TO - 220	285
400	200	7	BU406D		1.00	5.00	650	0.9●	0.3●	2.08	TO - 220	291
400	200	8	BU184		1.50	5.00	50	0.5	0.44●	2.08	TO - 220	263
400	200	8	BU806		1.50	5.00	50	0.55●	0.2●	2.08	TO - 220	305
400	200	8	BU806FI		1.50	5.00	50	0.55●	0.22●	4.16	ISOWATT220	311
400	200	10	BUV28		1.50	6.00	600	1.5	0.25	1.76	TO - 220	453
400	300	1	TIP48		1.00	1.00	200	1.3●	0.45●	3.12	TO - 220	1005
400	300	5	2N6498		1.25	2.50	500	1.8	0.8	1.56	TO - 220	1159
400	300	5	TIP52		1.50	3.00	600	2.5●	0.2●	1.25	TO - 218	1009
400	300	12	BUV42A		0.90	4.00	400	3▲	0.4▲	1.46	TO - 3	491
400	300	16	BUT62		0.90	10.00	1000	2.2▲	0.4▲	1	TO - 220	✶
400	300	20	BUV52A		0.90	7.00	700	3▲	0.4▲	1.17	TO - 3	521
400	300	40	BUT72		0.90	30.00	3000	3▲	0.4▲	0.63	TO - 218	✶
400	300	40	BUV62A		0.90	15.00	1500	3▲	0.4▲	0.7	TO - 3	553
400	300	50	BUT102		0.90	40.00	4000	3▲	0.4▲	0.7	TO - 3	421
400	300	50	BUT92A		0.90	30.00	3000	3▲	0.4▲	0.7	TO - 3	411
400	300	67	ESM2030D(V)		2.0#	56	1600	3.5▲■	0.7▲■	0.83	ISOTOP	✶
400	300	80	BUT32(V)		0.9	40	4000	3▲■	0.4▲■	0.5	ISOTOP	✶
400	300	100	ESM3030D(V)		1.7#	60	600	3.5▲■	0.7▲■	0.83	ISOTOP	✶
400	325	10	BUX43		2.00	5.00	1000	2.2	1.2	1.46	TO - 3	731
400	325	15	BUX13		1.50	8.00	1600	3	1.2	1.17	TO - 3	683
400	325	30	BUV23		1.00	16.00	3200	2.5	1.2		TO - 3	437
400	325	30	BUX23		1.00	16.00	3200	2.5	1.2	0.5	TO - 3	699
400	350	6		BUW22P	1.50	2.50	1000	1.5	0.7	2	TO - 220	563
400	350	10		BUW32	1.50	5.00	1500	1.5	0.6	1.2	TO - 3	569
400	350	10		BUW32P	1.50	5.00	1500	1.5	0.6	1.2	TO - 218	569
400	350	10		BUW32PFI	1.50	5.00	1500	1.5	0.6	2.27	ISOWATT218	569
400	350	15		BUW42	1.50	10.00	3000	1.5	0.6	1	TO - 3	593
400	350	15		BUW42P	1.50	10.00	3000	1.5	0.6	1.2	TO - 218	593

▲ Inductive load ● Typical value ✶ Datasheet available on request

SWITCHING TRANSISTORS (cont'd)

V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE NPN	TYPE PNP	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (μs)	t_f (μs)	R_{thj-c} (°C/W)	Case	Page
400	350	15		BUW42PFI	1.50	10.00	3000	1.5	0.6	1.92	ISOWATT218	593
400	350	20	MJ10004		1.90	10.00	400	1.5	0.5	1	TO - 3	823
400	350	20	MJ10004P		1.90	10.00	400	1.5	0.5	1	TO - 218	823
400	350	20	MJ10004PFI		1.90	10.00	400	1.5	0.5	2.08	ISOWATT218	823
450	300	8	2N6671		1.00	5.00	1000	2.5	0.4	1.17	TO - 3	1167
450	300	8	2N6928		1.00	8.00	1600	2.5	0.4	1.25	TO - 220	✶
450	300	10	2N6931		1.00	10.00	2000	2.5	0.5	0.83	TO - 218	1181
450	300	15	2N6674		1.00	10.00	2000	2.5	0.5	1	TO - 3	1171
450	300	15	2N6676		1.00	15.00	3000	2.5	0.5	1	TO - 3	1175
450	300	15	2N6933		1.00	15.00	3000	2.5	0.5	0.71	TO - 218	1185
450	350	0.3	MJE3439		0.50	0.05	4			8.33	SOT - 32	855
450	350	0.3	SGS3439		0.50	0.05	4			8.33	SOT - 82	855
450	350	1	2N3439		0.50	0.05	4			17.5	TO - 39	1043
450	350	1	TIP49		1.00	1.00	200	1.3●	0.45●	3.12	TO - 220	1005
450	350	5	2N6499		1.50	2.50	500	1.8	0.8	1.56	TO - 220	1159
450	350	5	TIP53		1.50	3.00	600	2.5●	0.2●	1.25	TO - 218	1005
450	400	6		BUW22AP	1.50	2.50	1000	1.5	0.7	2	TO - 220	563
450	400	8	BUX44		1.50	4.00	800	2.5	1.2	1.46	TO - 3	733
450	400	10		BUW32A	1.50	5.00	1500	1.5	0.6	1.2	TO - 3	569
450	400	10		BUW32AP	1.50	5.00	1500	1.5	0.6	1.2	TO - 218	569
450	400	10		BUW32APFI	1.50	5.00	1500	1.5	0.6	2.27	ISOWATT218	569
450	400	10	BUX14		1.60	6.00	1200	3	1.2	1.17	TO - 3	685
450	400	15		BUW42A	1.50	10.00	3000	1.5	0.6	1	TO - 3	593
450	400	15		BUW42AP	1.50	10.00	3000	1.5	0.5	1.2	TO - 218	593
450	400	15		BUW42APFI	1.50	10.00	3000	1.5	0.6	1.92	ISOWATT218	593
450	400	20	BUV24		1.00	12.00	2400	3	1.4	0.7	TO - 3	437
450	400	20	BUX24		1.00	12.00	2400	3	1.4	0.7	TO - 3	705
450	400	20	MJ10005		1.90	10.00	400	1.5	0.5	1	TO - 3	823
450	400	20	MJ10005P		1.90	10.00	400	1.5	0.5	1	TO - 218	823
450	400	20	MJ10005PFI		1.90	10.00	400	1.5	0.5	2.08	ISOWATT218	823
500	200	10	BUY69C		3.3	8.00	2500	1.7●	0.3●	1.75	TO - 3	799
500	400	1	TIP50		1.00	1.00	200	1.3●	0.45●	3.12	TO - 220	1005
500	400	5	TIP54		1.50	3.00	600	2.5●	0.2●	1.25	TO - 218	1009
500	400	10	BUW34		1.50	5.00	1000	3	0.8	1.4	TO - 3	575
500	400	15	BUW44		3.00	10.00	2000	3	0.8	1	TO - 3	597
500	500	15	BUV25		1.00	8.00	1600	5	1.6	0.7	TO - 3	437
500	500	30	BUX25		1.00	8.00	1600	5	1.2	0.5	TO - 3	711
550	350	8	2N6672		1.00	5.00	1000	2.5	0.4	1.17	TO - 3	1167
550	350	8	2N6929		1.00	8.00	1600	2.5	0.4	1.25	TO - 220	✶
550	350	15	2N6677		1.00	15.00	3000	2.5	0.5	1	TO - 3	1175
550	350	15	2N6934		1.00	15.00	3000	2.5	0.5	0.71	TO - 218	1185
600	300	1.5	SGS13002		1.00	1.00	250	2.5	0.5	2.5	SOT - 82	877
600	300	1.5	SGS13002T		1.00	1.00	250	2.5	0.5	2.5	TO - 220	877
600	300	4	MJE13004		1.00	4.00	1000	4	0.9	1.67	TO - 220	859
600	300	8	MJE13006		1.50	5.00	1000	3	0.7	1.56	TO - 220	863

● Typical value ✶ Datasheet available on request

SWITCHING TRANSISTORS (cont'd)

V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE NPN	TYPE PNP	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (µs)	t_f (µs)	R_{thj-c} (°C/W)	Case	Page
600	300	12	MJE13008		1.50	8.00	1600	3 •	0.7	1.25	TO - 220	871
600	400	3	BU801		2.20	1.00	15	1	0.5	3.12	SOT - 32	307
600	400	7	BU810		2.50	4.00	200	1.5	0.5	1.66	TO - 220	321
600	400	28	BUT13		2.00	10.00	500	1.5	0.6	1	TO - 3	385
600	400	28	BUT13P		2.00	10.00	500	1.5	0.6	1	TO - 218	385
600	400	28	BUT13PFI		2.00	10.00	500	1.5	0.6	2.08	ISOWATT218	385
600	400	28	SGSD310		2.50	18.00	1800	1.5	0.5	1	TO - 3	889
600	400	28	SGSD311		2.50	18.00	1800	1.5	0.5	1	TO - 218	889
600	400	28	SGSD311FI		2.50	18.00	1800	1.5	0.5	2.08	ISOWATT218	889
600	450	24	ESM3045D(V)		2.0#	15	300	4▲■	0.4▲■	1	ISOTOP	✶
600	450	42	ESM4045D(V)		2.0#	25	500	4.5▲■	0.5▲■	0.83	ISOTOP	✶
600	450	60	ESM5045D(V)		2.0#	35	700	5▲■	0.5▲■	0.71	ISOTOP	✶
600	450	75	ESM7545D(V)		2.5	75	1500	5▲●	1▲●	0.41	ISOTOP	✶
600	450	84	ESM6045D(V)		2.0#	50	1000	5.5▲●	0.5▲●	0.5	ISOTOP	✶
650	300	8	2N6544		1.5	5.00	1000	4	0.9	1.4	TO - 3	1163
650	400	8	2N6673		1.00	5.00	1000	2.5	0.4	1.17	TO - 3	1167
650	400	8	2N6930		1.00	8.00	1600	2.5	0.4	1.25	TO - 220	✶
650	400	8	SGSD00020		4.00	3.00	3				TO - 220	895
650	400	10	2N6932		1.00	10.00	2000	2.5	0.5	0.83	TO - 218	1181
650	400	15	2N6675		1.00	10.00	2000	2.5	0.5	1	TO - 3	1171
650	400	15	2N6678		1.00	15.00	3000	2.5	0.5	1	TO - 3	1175
650	400	15	2N6935		1.00	15.00	3000	2.5	0.5	0.71	TO - 218	1185
650	400	28	SGSD00030		2.50	12.00	100	1.5	0.5	1	TO - 218	897
650	400	28	SGSD00030FI		2.50	12.00	100	1.5	0.5	2.08	ISOWATT218	897
650	400	28	SGSD00031		2.50	12.00	100	1.5	0.5	1	TO - 3	897
700	400	1.5	SGS13003		1.0	1.00	250	2.5	0.5	2.5	SOT - 82	877
700	400	1.5	SGS13003T		1.0	1.00	250	2.5	0.5	2.5	TO - 220	877
700	400	4	MJE13005		1.0	4.00	1000	4	0.9	1.67	TO - 220	859
700	400	8	MJE13007		1.5	5.00	1000	3	0.7	1.56	TO - 220	863
700	400	12	MJE13009		1.5	8.00	1600	3	0.7	1.25	TO - 220	871
800	325	10	BUY69B		3.3	8.00	2500	1.7●	0.3●	1.75	TO - 3	799
800	375	6	BU426		1.5	2.50	500	3.5	0.5	1.16	TO - 218	303
800	375	6	BU426FI		1.5	2.50	500	3.5	0.5	2.5	ISOWATT218	303
800	400	2	BUX84		3.0	1.00	200	3.5	0.4●	3.12	TO - 220	765
800	400	10	BUW35		1.50	5.00	1000	3	0.8	1.4	TO - 3	575
800	400	10	BUX80		1.5	5.00	1000	3.5	0.5	1.75	TO - 3	761
800	400	15	BUW45		1.50	10.00	2000	3	0.8	1	TO - 3	597
800	500	20	MJ13335		1.8	10.00	2000				TO - 3	✶
850	400	5	BUT11		1.5	3.00	600	4	0.8	1.5	TO - 220	379
850	400	5	BUT11FI		1.5	3.00	600	4	0.8	3.57	ISOWATT220	379
850	400	5	BUV46		1.5	2.50	500	3	0.8	1.76	TO - 220	495
850	400	5	BUV46FI		1.5	2.50	500	3	0.8	4.16	ISOWATT220	495
850	400	5	SGSF321		1.5	3.50	700	2.5	0.3	1.78	TO - 220	907
850	400	5	SGSF421		1.5	3.50	700	2.5	0.3	1.56	TO - 218	907
850	400	5	SGSIF321		1.5	3.50	700	2.5	0.3	3.57	ISOWATT220	907

▲ Inductive load ● Typical value # Tj = 125°C ■ Tj = 100°C ✶ Datasheet available on request

SWITCHING TRANSISTORS (cont'd)

V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE NPN	TYPE PNP	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (µs)	t_f (µs)	R_{thj-c} (°C/W)	Case	Page
850	400	5	SGSIF421		1.5	3.50	700	2.5	0.3	2.77	ISOWATT218	907
850	400	8	2N6545		1.5	5.00	1000	4	0.9	1.4	TO - 3	1163
850	400	8	BUW12		1.5	6.00	1200	4	0.8	1.2	TO - 218	561
850	400	8	MJE13007A		1.5	5.00	1000	3	0.7	1.56	TO - 220	863
850	400	9	BUV47		1.5	6.00	1200	2.5	0.8	1.25	TO - 218	735
850	400	9	BUV47FI		1.5	6.00	1200	2.5	0.8	2.27	ISOWATT218	735
850	400	9	BUX47		1.5	6.00	1200	2.5	0.8	1.2	TO - 3	735
850	400	10	BUT12FI		1.5	6.00	1200				ISOWATT220	✶
850	400	10	SGSF341		1.5	6.00	1200	2.5	0.3	1.47	TO - 220	931
850	400	10	SGSF441		1.5	6.00	1200	2.5	0.3	1.31	TO - 218	931
850	400	10	SGSF541		1.5	6.00	1200	2.5	0.35	1.3	TO-3	931
850	400	10	SGSIF341		1.5	6.00	1200	2.5	0.3	3.12	ISOWATT220	931
850	400	10	SGSIF441		1.5	6.00	1200	2.5	0.3	2.27	ISOWATT218	931
850	400	15	BUV48		1.5	10.00	2000	3	0.8	1	TO - 218	745
850	400	15	BUV48FI		1.5	10.00	2000	3	0.8	1.92	ISOWATT218	745
850	400	15	BUX48		1.5	10.00	2000	3	0.8	1	TO - 3	745
850	400	15	SGSF461		1.5	10.00	2000	2.3	0.5	1	TO - 218	955
850	400	15	SGSF561		1.5	10.00	2000	2.3	0.5	1	TO - 3	955
850	400	15	SGSIF461		1.5	10.00	2000	2.3	0.5	1.92	ISOWATT218	955
850	400	30	BUX98		1.5	20.00	4000	3	0.8	0.7	TO - 3	767
850	400	30	SGSF661		1.5	20.00	4000	2.3	0.5	0.6	TO - 3	979
850	450	7.5	BUF405		0.5●	5.00	1000				TO - 220	349
850	450	8	MJH16006		3.0	5.00	660				TO - 218	✶
850	450	8	MJH16008		3.0	5.00	500				TO - 218	✶
850	450	9	BUV56		1.2	5.00	1000	3▲	0.4▲	1.76	TO - 220	525
850	450	15	BUF410		0.5●	10.00	2000				TO - 218	353
850	450	15	BUF410I		0.5●	10.00	2000				TOP - 3I	353
850	450	15	BUV66		1.2	8.00	1600	3▲	0.4▲	1.25	TO - 220	557
850	450	15	MJH16010		3.0	10.00	1300				TO - 218	✶
850	450	15	MJH16012		3.0	10.00	1000				TO - 218	✶
850	450	30	BUF420		0.5●	20.00	4000				TO - 218	357
850	450	30	BUF420I		0.5●	20.00	4000				TOP - 3I	357
850	450	30	BUF420M		0.5●	20.00	4000				TO - 3	357
850	450	30	BUX98P		0.9	20.00	4000	3	0.8	0.63	TO - 218	773
850	450	30	BUV98(V)		1.5	20	4000	5▲■	0.4▲■	0.83	ISOTOP	✶
850	450	45	BUX348		0.9	30.00	6000			0.58	TO - 3	779
850	450	60	BUV298(V)		1.2	40	8000	4.5▲■	0.4▲■	0.5	ISOTOP	✶
850	450	90	BUF460(V)		2.0#	60	12000	3.5▲■	0.12▲■	0.41	ISOTOP	✶
900	400	6	BU326A		1.5	2.50	500	3.5	0.5	2.33	TO - 3	281
900	400	6	BU426A		1.5	2.50	500	3.5	0.5	1.1	TO - 218	303
900	400	6	BU426AFI		1.5	2.50	500	3.5	0.5	2.5	ISOWATT218	303
900	450	10	BUW36		1.5	5.00	1000	3	0.8	1.4	TO - 3	575
900	450	15	BUW46		1.5	10.00	2000	3	0.8	1	TO - 3	597
1000	400	7	SGSD00055		2.5	3.00	200	0.8	0.15	1.66	TO - 220	905
1000	400	10	BUY69A		3.3	8.00	2500	1.7●	0.3●	1.75	TO - 3	799

▲ Inductive load ● Typical value # Tj = 125°C ■ Tj = 100°C ✶ Datasheet available on request

SWITCHING TRANSISTORS (cont'd)

V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE NPN	TYPE PNP	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (µs)	t_f (µs)	R_{thj-c} (°C/W)	Case	Page
1000	450	2	BUX85		1.0	1.00	200	3.5	0.4●	2.5	TO - 220	✶
1000	450	5	BUT11A		1.5	2.50	500	4	0.8	1.5	TO - 220	379
1000	450	5	BUT11AFI		1.5	2.50	500	4	0.8	3.57	ISOWATT220	379
1000	450	5	BUV46A		1.5	2.00	400	3	0.8	1.76	TO - 220	495
1000	450	5	BUV46AFI		1.5	2.00	400				ISOWATT220	495
1000	450	5	SGSF323		1.5	2.50	500	2.5	0.3	1.78	TO - 220	913
1000	450	5	SGSF423		1.5	2.50	500	2.5	0.3	1.56	TO - 218	913
1000	450	5	SGSIF323		1.5	2.50	500	2.5	0.3	3.57	ISOWATT220	913
1000	450	5	SGSIF423		1.5	2.50	500	2.5	0.3	2.77	ISOWATT218	913
1000	450	7.5	BUF405A		0.5●	5.00	1000				TO - 220	349
1000	450	8	BUW12A		1.5	6.00	1200	4	0.8	1.2	TO - 218	561
1000	450	8	SGSF343		1.5	4.50	900	2.5	0.35	1.47	TO - 220	937
1000	450	8	SGSF443		1.5	4.50	900	2.5	0.35	1.31	TO - 218	937
1000	450	8	SGSF543		1.5	4.50	900	2.5	0.35	1.3	TO - 3	937
1000	450	8	SGSIF343		1.5	4.50	900	2.5	0.35	3.12	ISOWATT220	937
1000	450	8	SGSIF443		1.5	4.50	900	2.5	0.35	2.27	ISOWATT218	937
1000	450	9	BUV47A		1.5	5.00	1000	3	0.8	1.25	TO - 218	735
1000	450	9	BUV47AFI		1.5	5.00	1000	3	0.8	2.27	ISOWATT218	735
1000	450	9	BUX47A		1.5	5.00	1000	2.5	0.8	1.2	TO - 3	735
1000	450	10	BUT12AFI		1.5	5.00	1000				ISOWATT220	✶
1000	450	12	SGSF463		1.5	7.00	1400	2.3	0.5	1	TO - 218	961
1000	450	12	SGSF563		1.5	7.00	1400	2.3	0.5	1	TO - 3	961
1000	450	12	SGSIF463		1.5	7.00	1400	2.3	0.5	1.92	ISOWATT218	961
1000	450	15	BUF410A		0.5●	10.00	2000				TO - 218	353
1000	450	15	BUF410AI		0.5●	10.00	2000				TOP - 3I	353
1000	450	15	BUV48A		1.5	8.00	1600	3	0.8	1	TO - 218	745
1000	450	15	BUV48AFI		1.5	8.00	1600	3	0.8	1.92	ISOWATT218	745
1000	450	15	BUX48A		1.5	8.00	1600	3	0.8	1	TO - 3	745
1000	450	24	ESM3045A(V)		2.0#	18	720	4.5▲■	0.5▲■	1	ISOTOP	✶
1000	450	24	SGSF663		1.5	14.00	2800	2.3	0.5	0.6	TO - 3	983
1000	450	30	BUF420A		0.5●	20.00	4000				TO - 218	357
1000	450	30	BUF420AI		0.5●	20.00	4000				TOP - 3I	357
1000	450	30	BUF420AM		0.5●	20.00	4000				TO - 3	357
1000	450	30	BUV98A(V)		1.5	16	3200	5▲■	0.4▲■	0.83	ISOTOP	✶
1000	450	30	BUX98A		1.5	16.00	3200	3	0.8	0.7	TO - 3	767
1000	450	42	ESM4045A(V)		2.0#	30	1200	5▲■	0.6▲■	0.83	ISOTOP	✶
1000	450	50	BUV298A(V)		1.2	32	6400	4.5▲■	0.4▲■	0.5	ISOTOP	✶
1000	450	84	ESM6045A(V)		2.0#	60	2400	6▲■	0.6▲■	0.5	ISOTOP	✶
1000	450	90	BUF460A(V)		2.0#	60	12000	3.5▲■	0.12▲■	0.41	ISOTOP	✶
1000	700	50	ESMT5070D(V)		3.0	50	500	15▲■	3▲■	0.41	ISOTOP	✶
1000	500	5	2ST3679FI		0.5	2.00	400				ISOWATT218	✶
1000	550	6	2ST3153		2.0	3.00	600				TO - 218	✶
1200	600	4	SGSF324		1.5	1.75	350	4.5	0.35	1.78	TO - 220	919
1200	600	4	SGSF424		1.5	1.75	350	4.5	0.35	1.56	TO - 218	919
1200	600	4	SGSIF324		1.5	1.75	350	4.5	0.35	3.57	ISOWATT220	919

▲ Inductive load ● Typical value # Tj = 125°C ■ Tj = 100°C ✶ Datasheet available on request

SWITCHING TRANSISTORS (cont'd)

V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE NPN	TYPE PNP	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (μs)	t_f (μs)	R_{thj-c} (°C/W)	Case	Page
1200	600	4	SGSIF424		1.5	1.75	350	4.5	0.35	2.77	ISOWATT218	919
1200	600	6	2ST3642		5.0	4.00	800				TO - 218	✶
1200	600	7	SGSF344		1.5	3.50	700	3.5	0.3	1.47	TO - 220	344
1200	600	7	SGSF444		1.5	3.50	700	3.5	0.3	1.31	TO - 218	943
1200	600	7	SGSF544		1.5	3.50	700	3.5	0.3	1.3	TO - 3	943
1200	600	7	SGSIF344		1.5	3.50	700	3.5	0.3	3.12	ISOWATT220	943
1200	600	7	SGSIF444		1.5	3.50	700	3.5	0.3	2.27	ISOWATT218	943
1200	600	8	2ST3412		5.0	5.00	1000				TO - 3	✶
1200	600	10	SGSF464		1.5	6.00	1200	3.5	0.4	1	TO - 218	967
1200	600	10	SGSF564		1.5	6.00	1200	3.5	0.4	1	TO - 3	967
1200	600	10	SGSIF464		1.5	6.00	1200	3.5	0.4	1.92	ISOWATT218	967
1200	600	12	2ST3552		2.0	6.00	1200				TO - 218	✶
1200	600	15	BUV48B		1.5	6.00	1500	3	0.7	1	TO - 218	755
1200	600	15	BUV48BFI		1.5	6.00	1500	3	0.7	1.92	ISOWATT218	755
1200	600	15	BUX48B		1.5	6.00	1500	3	0.7	1	TO - 3	755
1200	600	20	SGSF664		1.5	12.00	2400	3.5	0.4	0.6	TO - 3	987
1200	600	30	BUX98B		1.5	12.00	3000	3	0.8	0.7	TO - 3	769
1200	700	15	BUV48C		1.5	6.00	1500	3	0.7	1	TO - 218	755
1200	700	15	BUV48CFI		1.5	6.00	1500	3	0.7	1.92	ISOWATT218	755
1200	700	15	BUX48C		1.5	6.00	1500	3	0.7	1	TO - 3	755
1200	700	30	BUV98C(V)		1.5	12	3000	6▲#	0.6▲#	0.83	ISOTOP	✶
1200	700	30	BUX98C		1.5	12.00	3000	3	0.8	0.7	TO - 3	769
1300	500	8	2SC3412		5.0	5.00	1000				TO - 3	✶
1300	600	4	SGSF425		1.5	1.25	250	4.5	0.35	1.56	TO - 218	925
1300	600	4	SGSIF425		1.5	1.25	250	4.5	0.35	2.77	ISOWATT218	925
1300	600	7	SGSF445		1.5	3.00	600	3.5	0.3	1.31	TO - 218	949
1300	600	7	SGSIF445		1.5	3.00	600	3.5	0.3	2.27	ISOWATT218	949
1300	600	10	SGSF465		1.5	5.00	1000	3.5	0.4	1	TO - 218	973
1300	600	10	SGSF565		1.5	5.00	1000	3.5	0.4	1	TO - 3	973
1300	600	10	SGSIF465		1.5	5.00	1000	3.5	0.4	1.92	ISOWATT218	973
1300	600	20	SGSF665		1.5	10.00	2000	3.5	0.4	0.6	TO - 3	991
1400	700	10	BU808FI		1.6	5.00	500			2.5	ISOWATT218	317
1400	700	10	BU808DFI		1.6	5.00	500			2.5	ISOWATT218	317
1500	600	2.5	2SD1425FI		8.0	2.00	600				ISOWATT218	✶
1500	600	2.5	2SD1429FI		8.0	2.00	600				ISOWATT218	✶
1500	600	2.5	2SD818		8.0	2.00	600				TO - 3	✶
1500	600	3.5	2SD819		8.0	3.00	800				TO - 3	✶
1500	600	3.5	2SD869		8.0	3.00	800				TO - 3	✶
1500	600	3.5	2SD1426FI		8.0	3.00	800				ISOWATT218	✶
1500	600	3.5	2SD1430FI		8.0	3.00	800				ISOWATT218	✶
1500	600	5	2SD1427FI		5.0	4.00	800				ISOWATT218	✶
1500	600	5	2SD1431FI		5.0	4.00	800				ISOWATT218	✶
1500	600	6	2SD1428FI		5.0	5.00	1000				ISOWATT218	✶
1500	600	6	2SD1432FI		5.0	5.00	1000				ISOWATT218	✶
1500	700	2.5	2ST1396		8.0	2.00	600				TO - 218	✶

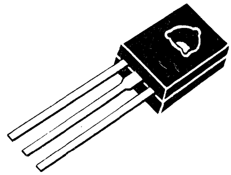
▲ Inductive load # Tj = 125°C ✶ Datasheet available on request

SWITCHING TRANSISTORS (cont'd)

V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE NPN	TYPE PNP	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (μs)	t_f (μs)	R_{thj-c} (°C/W)	Case	Page
1500	700	2.5	S2056FI		5.0	2.00	1000				ISOWATT218	✶
1500	700	3	2SD1453		5.0	2.50	800				TO - 218	✶
1500	700	3	2SD1910FI		5.0	2.50	800				ISOWATT218	✶
1500	700	3	2ST1942		5.0	2.50	800				TO - 3	✶
1500	700	3.5	2SD1650FI		8.0	2.50	800				ISOWATT218	✶
1500	700	4	2SD1441		1.0	3.00	1000				TO - 218	✶
1500	700	4	2ST1877FI		5.0	2.50	800				ISOWATT218	✶
1500	700	5	2SD1455		5.0	4.50	1200				TO - 218	✶
1500	700	5	2SD1577FI		2.0	4.50	2000				ISOWATT218	✶
1500	700	5	2SD1730		8.0	4.00	1000				TO - 218	✶
1500	700	5	2ST1651FI		5.0	4.00	800				ISOWATT218	✶
1500	700	5	2ST3485		5.0	4.00	1000				TO - 218	✶
1500	700	5	2ST34851FI		5.0	4.00	1000				ISOWATT218	✶
1500	700	5	BU706		5.0	3.00	1330				TO - 218	305
1500	700	6	2ST3460		2.0	3.00	600				TO - 218	✶
1500	700	7	2ST2000FI		1.0	4.00	2000				ISOWATT218	✶
1500	700	7.5	2ST2000		1.0	4.00	2000				TO - 218	✶
1500	700	7.5	S2000FI		5.0	4.50	2000				ISOWATT218	✶
1500	700	8	2ST3461		2.0	4.00	800				TO - 218	✶
1500	700	8	BU208		5.0	4.50	2000	7●	0.55●	1	TO - 3	267
1500	700	8	BU208A		1.0	4.50	2000	7●	0.55●	1	TO - 3	267
1500	700	8	BU208D		1.0	4.50	2000	7●	0.55●	1	TO - 3	271
1500	700	8	BU508		5.0	4.50	2000	7●	0.55●	1	TO - 218	267
1500	700	8	BU508A		1.0	4.50	2000	7●	0.55●	1	TO - 218	267
1500	700	8	BU508AFI		1.0	4.50	2000	7●	0.55●	2.08	ISOWATT218	267
1500	700	8	BU508D		1.0	4.50	2000	7●	0.55●	1	TO - 218	271
1500	700	8	BU508DFI		1.0	4.50	2000	7●	0.55●	2.08	ISOWATT218	271
1500	700	8	BU508FI		5.0	4.50	2000	7●	0.55●	2.08	ISOWATT218	267

● Typical value ✶ Datasheet available on request

GENERAL PURPOSE TRANSISTORS
SOT-32



V_{CEO} (V)	V_{CBO} (V)	I_C (A)	TYPE	Complementary	h_{FE}	@ I_C (A)	V_{CE} (V)	V_{CEsat} (V)	@ I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Page
22	22	4	BD433	BD434	50	2.00	1.0	0.50	2.00	200	3.5	163
25	40	5	MJE200	MJE210	70	0.50	1.0	0.30	0.50	50	8.34	833
30	30	3	MJE520	MJE370	25	1.00	1.0				5	841
32	32	4	BD435	BD436	50	2.00	1.0	0.50	2.00	200	3.5	163
40	40	1	2N4921	2N4918	30	0.50	1.0	0.60	1.00	100	4.16	1063
40	40	4	2N5190	2N5193	25	1.50	2.0	0.60	1.50	150	3.12	1077
40	40	4	2N6037	2N6034	500	0.50	3.0	2.00	2.00	8	3.12	1131
40	40	4	MJE521	MJE371	40	1.00	1.0				3.12	845
40	60	3	MJE180	MJE170	30	0.50	1.0	0.90	1.50	150	10	829
45	45	1.5	BD135	BD136	25	0.50	2.0	0.50	0.50	50	10	133
45	45	2	BD233	BD234	25	1.00	2.0	0.60	1.00	100	5	149
45	45	3	BD175	BD176	15	1.00	2.0	0.80	1.00	100	4.16	143
45	45	4	BD437	BD438	40	2.00	1.0	0.60	2.00	200	3.5	163
45	45	4	BD675	BD676	750	1.50	3.0	2.50	1.50	30	3.12	175
45	45	4	BD675A	BD676A	750	2.00	3.0	2.80	2.00	40	3.12	175
60	60	1	2N4922	2N4919	30	0.50	1.0	0.60	1.00	100	4.16	1063
60	60	1.5	BD137	BD138	25	0.50	2.0	0.50	0.50	50	10	133
60	60	2	BD235	BD236	25	1.00	2.0	0.60	1.00	100	5	149
60	60	3	BD177	BD178	15	1.00	2.0	0.80	1.00	100	4.16	143
60	60	4	2N5191	2N5194	25	1.50	2.0	0.60	1.50	150	3.12	1077
60	60	4	2N6038	2N6035	500	0.50	3.0	2.00	2.00	8	3.12	1131
60	60	4	BD439	BD440	25	2.00	1.0	0.80	2.00	200	3.5	169
60	60	4	BD677	BD678	750	1.50	3.0	2.50	1.50	30	3.12	175
60	60	4	BD677A	BD678A	750	2.00	3.0	2.80	2.00	40	3.12	175
60	60	4	MJE800	MJE700	750	1.50	3.0	3.00	4.00	40	3.12	849
60	60	4	MJE801	MJE701	750	2.00	3.0	3.00	4.00	40	3.12	849
60	80	3	MJE181	MJE171	30	0.50	1.0	0.90	1.50	150	10	829
80	80	1	2N4923	2N4920	30	0.50	1.0	0.60	1.00	100	4.16	1063
80	80	1.5	BD139	BD140	25	0.50	2.0	0.50	0.50	50	10	133
80	80	3	BD179	BD180	15	1.00	2.0	0.80	1.00	100	4.16	143
80	80	4	2N5192	2N5195	20	1.50	2.0	0.60	1.50	150	3.12	1077
80	80	4	2N6039	2N6036	500	0.50	3.0	2.00	2.00	8	3.12	1131
80	80	4	BD441	BD442	15	2.00	1.0	0.80	2.00	200	3.5	169
80	80	4	BD679	BD680	750	1.50	3.0	2.50	1.50	30	3.12	175
80	80	4	BD679A	BD680A	750	2.00	3.0	2.80	2.00	40	3.12	175

GENERAL PURPOSE TRANSISTORS (cont'd)

SOT-32 (cont'd)

V_{CEO} (V)	V_{CBO} (V)	I_C (A)	TYPE	Complementary	h_{FE}	@ I_C (A)	V_{CE} (V)	V_{CEsat} (V)	@ I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Page
80	80	4	MJE802	MJE702	750	1.50	3.0	3.00	4.00	40	3.12	849
80	80	4	MJE803	MJE703	750	2.00	3.0	3.00	4.00	40	3.12	849
80	100	2	BD237	BD238	25	1.00	2.0	0.60	1.00	100	5	149
80	100	3	MJE182	MJE172	30	0.50	1.0	0.90	1.50	150	10	829
100	100	4	BD681	BD682	750	1.50	3.0	2.50	1.50	30	3.12	175

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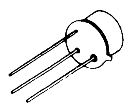

V_{CEO} (V)	V_{CBO} (V)	I_C (A)	TYPE	Complementary	h_{FE}	@ I_C (A)	V_{CE} (V)	V_{CEsat} (V)	I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Page
40	40	3		2N4234	20	0.50	1.0	0.60	1.00	100	29	1057
60	65	5		BSS44	40	2.00	2.0	1.00	5.00	500	35	247
60	100	5	BFX34		40	2.00	2.0	1.00	5.00	500	35	243
60	100	7	BUY68		40	1.00	1.0	1.00	5.00	500	17.5	795
80	80	5	2N5336		20	5.00	2.0	1.20	5.00	500	29	1089
80	80	5	2N5337		40	5.00	2.0	1.20	5.00	500	29	1089
80	100	5	2N5152	2N5151	30	2.50	5.0	0.70	2.50	250	15	1075
80	100	5	2N5154	2N5153	70	2.50	5.0	0.70	2.50	250	15	1075
100	100	1	2N5681	2N5679	40	0.25	2.0	1.00	0.50	50	17.5	1113
100	100	5	2N5338		20	5.00	2.0	1.20	5.00	500	29	1089
100	100	5	2N5339		40	5.00	2.0	1.20	5.00	500	29	1089
120	120	1	2N5682	2N5680	40	0.25	2.0	1.00	0.50	50	17.5	1163
150	150	6	BDX53S	BDX54S	500	2.00	5.0	2.00	2.00	8	11.66	223
180	180	4	BDW91	BDW92	1000	2.00	5.0	2.00	2.00	4	17.5	201

GENERAL PURPOSE TRANSISTORS (cont'd)

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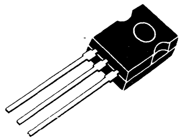

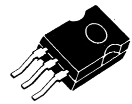

OPTION SOT-194

V_{CEO} (V)	V_{CBO} (V)	I_C (A)	TYPE	Complementary	h_{FE} @	I_C (A)	V_{CE} (V)	V_{CEsat} (V)	I_C @ (A)	I_B (mA)	R_{thj-c} (°C/W)	Page
60	60	4	SGS110	SGS115	1000	1.00	4.0	2.50	2.00	8	2.5	1017
60	60	6	BD331	BD332	750	3.00	3.0	2.00	3.00	12	2.08	159
60	60	8	SGS130	SGS135	1000	4.00	4.0	2.00	4.00	16	1.78	1029
80	80	4	SGS111	SGS116	1000	1.00	4.0	2.50	2.00	8	2.5	1017
80	80	6	BD333	BD334	750	3.00	3.0	2.00	3.00	12	2.08	159
80	80	8	SGS131	SGS136	1000	4.00	4.0	2.00	4.00	16	1.78	1029
100	100	4	SGS112	SGS117	1000	1.00	4.0	2.50	2.00	8	2.5	1017
100	100	6	BD335	BD336	750	3.00	3.0	2.00	3.00	12	2.08	159
100	100	8	SGS132	SGS137	1000	4.00	4.0	2.00	4.00	16	1.78	1029

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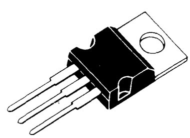


V_{CEO} (V)	V_{CBO} (V)	I_C (A)	TYPE	Complementary	h_{FE} @	I_C (A)	V_{CE} (V)	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Page
30	30	10	D44H1	D45H1	20	4.00	1.0	1.00	8.00	800	2.5	803
30	30	10	D44H2	D45H2	40	4.00	1.0	1.00	8.00	400	2.5	803
30	40	4	D44C1		10	1.00	1.0	0.50	1.00	100	4.2	801
30	40	4	D44C2		20	1.00	1.0	0.50	1.00	50	4.2	801
30	40	4	D44C3		20	2.00	1.0	0.50	1.00	50	4.2	801
30	40	7	2N6288	2N6111	30	4.00	3.0	1.00	3.00	300	1.92	1140
40	40	8	2N6386		1000	3.00	3.0	2.00	3.00	6	1.92	1153
40	80	3	TIP31	TIP32	25	1.00	4.0	1.20	3.00	375	3.12	995
40	80	6	TIP41	TIP42	15	3.00	4.0	1.50	6.00	600	1.92	1003
45	45	2	BD239	BD240	15	1.00	4.0	0.70	1.00	200	4.16	153

GENERAL PURPOSE TRANSISTORS (cont'd)

TO-220 (cont'd)

V_{CEO} (V)	V_{CBO} (V)	I_C (A)	TYPE	Complementary	h_{FE}	@ I_C (A)	V_{CE} (V)	V_{CEsat} (V)	@ I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Page
45	45	3	BD241	BD242	25	1.00	4.0	1.20	3.00	600	4.16	155
45	45	4	2N6121	2N6124	25	1.00	2.0	0.60	1.50	150	3.12	1143
45	45	6	BD243	BD244	15	3.00	4.0	1.50	6.00	1000	4.16	157
45	45	8	BD533	BD534	25	2.00	2.0	0.80	2.00	200	2.5	171
45	45	8	BDX53	BDX54	750	3.00	3.0	2.00	3.00	12	2.08	217
45	45	10	BDX33	BDX34	750	4.00	3.0	2.50	4.00	8	1.78	211
45	45	10	D44H4	D45H4	20	4.00	1.0	1.00	8.00	800	2.5	803
45	45	10	D44H5	D45H5	40	4.00	1.0	1.00	8.00	400	2.5	803
45	45	12	BD705	BD706	20	4.00	4.0	1.00	4.00	400	1.67	179
45	45	12	BDW93	BDW94	750	5.00	3.0	2.00	5.00	20	1.56	205
45	45	15	BD905	BD906	15	5.00	4.0	1.00	5.00	500	1.4	185
45	55	4	D44C4		10	1.00	1.0	0.50	1.00	100	4.2	801
45	55	4	D44C5		20	1.00	1.0	0.50	1.00	50	4.2	801
45	55	4	D44C6		20	2.00	1.0	0.50	1.00	50	4.2	801
50	50	15	2N6486	2N6489	20	5.00	4.0	1.30	5.00	500	1.67	1157
50	60	7	2N6290	2N6109	30	4.00	2.5	1.00	2.50	250	3.12	1140
60	60	2	BD239A	BD240A	15	1.00	4.0	0.70	1.00	200	3.12	153
60	60	3	BD241A	BD242A	25	1.00	4.0	1.20	3.00	600	3.12	155
60	60	4	2N6122	2N6125	25	1.50	2.0	0.60	1.50	150	3.12	1143
60	60	4	TIP110	TIP115	1000	1.00	4.0	2.50	2.00	8	2.5	1017
60	60	5	TIP120	TIP125	1000	3.00	3.0	2.00	3.00	12	1.92	1023
60	60	6	BD243A	BD244A	15	3.00	4.0	1.50	6.00	1000	3.12	153
60	60	8	BD535	BD536	25	2.00	2.0	0.80	2.00	200	2.5	171
60	60	8	BDX53A	BDX54A	750	3.00	3.0	2.00	3.00	12	2.08	217
60	60	8	TIP100	TIP105	1000	3.00	4.0	2.00	3.00	6	1.56	1011
60	60	8	TIP130	TIP135	1000	4.00	4.0	2.00	4.00	16	1.78	1029
60	60	10	2N6387		1000	5.00	3.0	2.00	5.00	10	1.92	1153
60	60	10	BDX33A	BDX34A	750	4.00	3.0	2.50	4.00	8	1.78	211
60	60	10	D44H7	D45H7	20	4.00	1.0	1.00	8.00	800	2.5	803
60	60	10	D44H8	D45H8	40	4.00	1.0	1.00	8.00	400	2.5	803
60	60	12	BD707	BD708	15	4.00	4.0	1.00	4.00	400	1.67	179
60	60	12	BDW93A	BDW94A	750	5.00	3.0	2.00	5.00	20	1.56	205
60	60	15	BD907	BD908	15	5.00	4.0	1.00	5.00	500	1.4	185
60	60	15	TIP140T	TIP145T	1000	5.00	4.0	3.00	10.00	40	1.25	1035
60	70	4	D44C7		10	1.00	1.0	0.50	1.00	100	4.2	801
60	70	4	D44C8		20	1.00	1.0	0.50	1.00	50	4.2	801
60	70	4	D44C9		20	2.00	1.0	0.50	1.00	50	4.2	801
60	70	10	MJE3055T	MJE2955T	20	4.00	4.0	1.10	4.00	400	1.66	853
60	100	3	TIP31A	TIP32A	25	1.00	4.0	1.20	3.00	375	3.12	995
60	100	6	TIP41A	TIP42A	15	3.00	4.0	1.50	6.00	600	1.92	1003
70	70	15	2N6487	2N6490	20	5.00	4.0	1.30	5.00	500	1.67	1157
70	80	7	2N6292	2N6107	30	4.00	2.0	1.00	2.00	200	3.12	1140
80	80	2	BD239B	BD240B	15	1.00	4.0	0.70	1.00	200	4.16	153
80	80	3	BD241B	BD242B	25	1.00	4.0	1.20	3.00	600	3.12	155

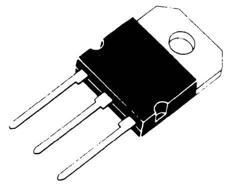
GENERAL PURPOSE TRANSISTORS (cont'd)

TO-220 (cont'd)

V_{CEO} (V)	V_{CBO} (V)	I_C (A)	TYPE	Complementary	h_{FE}	@ I_C (A)	V_{CE} (V)	V_{CEsat} (V)	@ I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Page
80	80	4	2N6123	2N6126	20	1.50	2.0	0.60	1.50	150	3.12	1143
80	80	4	TIP111	TIP116	1000	1.00	4.0	2.50	2.00	8	2.5	1017
80	80	5	TIP121	TIP126	1000	3.00	3.0	2.00	3.00	12	1.92	1023
80	80	6	BD243B	BD244B	15	3.00	4.0	1.50	6.00	1000	1.92	157
80	80	8	BD537	BD538	15	2.00	2.0	0.80	2.00	200	2.5	171
80	80	8	BDX53B	BDX54B	750	3.00	3.0	2.00	3.00	12	2.08	271
80	80	8	TIP101	TIP106	1000	3.00	4.0	2.00	3.00	6	1.56	1011
80	80	8	TIP131	TIP136	1000	4.00	4.0	2.00	4.00	16	1.78	1029
80	80	10	2N6388		1000	5.00	3.0	2.00	5.00	10	1.92	1153
80	80	10	BDX33B	BDX34B	750	3.00	3.0	2.50	3.00	6	1.78	211
80	80	10	D44H10	D45H10	20	4.00	1.0	1.00	8.00	800	2.5	803
80	80	10	D44H11		40	4.00	1.0	1.00	8.00	400	2.5	803
80	80	12	BD709	BD710	15	4.00	4.0	1.00	4.00	400	1.67	179
80	80	12	BDW93B	BDW94B	750	5.00	3.0	2.00	5.00	20	1.56	205
80	80	15	BD909	BD910	15	5.00	4.0	1.00	5.00	500	1.4	185
80	80	15	TIP141T	TIP146T	1000	5.00	4.0	3.00	10.00	40	1.25	1035
80	90	4	D44C10		10	1.00	1.0	0.50	1.00	100	4.2	801
80	90	4	D44C11		20	1.00	1.0	0.50	1.00	50	4.2	801
80	90	4	D44C12		20	2.00	1.0	0.50	1.00	50	4.2	801
80	120	3	TIP31B	TIP32B	25	1.00	4.0	1.20	3.00	375	3.12	995
80	120	6	TIP41B	TIP42B	15	3.00	4.0	1.50	6.00	600	1.92	1003
90	90	15	2N6488	2N6491	20	5.00	4.0	1.30	5.00	500	1.67	1157
100	100	2	BD239C	BD240C	15	1.00	4.0	0.70	1.00	200	4.16	153
100	100	3	BD241C	BD242C	25	1.00	4.0	1.20	3.00	600	3.12	155
100	100	4	TIP112	TIP117	1000	1.00	4.0	2.50	2.00	8	2.5	1017
100	100	5	TIP122	TIP127	1000	3.00	3.0	2.00	3.00	12	1.92	1023
100	100	6	BD243C	BD244C	15	3.00	4.0	1.50	6.00	1000	3.12	157
100	100	8	2N6045	2N6042	1000	3.00	4.0	2.00	3.00	12	1.56	1135
100	100	8	BDX53C	BDX54C	750	3.00	3.0	2.00	3.00	12	2.08	217
100	100	8	TIP102	TIP107	1000	3.00	4.0	2.00	3.00	6	1.56	1011
100	100	8	TIP132	TIP137	1000	4.00	4.0	2.00	4.00	16	1.78	1029
100	100	10	BDX33C	BDX34C	750	3.00	3.0	2.50	3.00	6	1.78	211
100	100	12	BD711	BD712	15	4.00	4.0	1.00	4.00	400	1.4	179
100	100	12	BDW93C	BDW94C	750	5.00	3.0	2.00	5.00	20	1.56	205
100	100	15	BD911	BD912	15	5.00	4.0	1.00	5.00	500	4.2	185
100	100	15	TIP142T	TIP147T	1000	5.00	4.0	3.00	10.00	40	1.25	1035
100	140	3	TIP31C	TIP32C	25	1.00	4.0	1.20	3.00	375	3.12	995
100	140	6	TIP41C	TIP42C	15	3.00	4.0	1.50	6.00	600	1.92	1003
140	140	6	BDX53E	BDX54E	500	2.00	5.0	2.00	2.00	10	2.08	219
140	160	12	SGSD93E		1000	3.00	3.0	2.00	10.00	20	1.56	881
160	160	6	BDX53F	BDX54F	500	2.00	5.0	2.00	2.00	10	2.08	219
160	180	12	SGSD93F		1000	3.00	3.0	2.00	10.00	20	1.56	881
180	200	12	SGSD93G		1000	3.00	3.0	2.00	10.00	20	1.56	881
400	450	6	BU911		20	4.00	1.8	1.80	2.50	50	2.08	325
400	450	10	BU921T		50	7.00	1.8	1.80	5.00	50	1.2	329

GENERAL PURPOSE TRANSISTORS (cont'd)

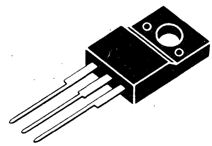
TO-218



V_{CEO} (V)	V_{CBO} (V)	I_C (A)	TYPE	Complementary	h_{FE}	@ I_C (A)	V_{CE} (V)	V_{CEsat} (V)	@ I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Page
60	60	10	TIP140	TIP145	1000	5.00	4.0	3.00	10.00	40	1	1031
60	60	12	BDV65	BDV64	1000	5.00	4.0	2.00	5.00	20	1	189
60	60	15	BDW83A	BDW84A	750	6.00	3.0	2.50	6.00	12	0.96	199
60	100	10	TIP33A	TIP34A	20	3.00	4.0	1.00	3.00	300	1.39	999
60	100	15	TIP3055	TIP2955	20	4.00	4.0	1.10	4.00	400	1.39	1037
60	100	25	TIP35A	TIP36A	10	15.00	4.0	1.80	15.00	1500	1	1001
80	80	10	TIP141	TIP146	1000	5.00	4.0	3.00	10.00	40	1	1031
80	80	12	BDV65A	BDV64A	1000	5.00	4.0	2.00	5.00	20	1	189
80	80	15	BDW83B	BDW84B	750	6.00	3.0	2.50	6.00	12	0.96	199
80	80	25	SGSD100	SGSD200	300	20.00	3.0	1.75	10.00	40	0.96	885
80	120	10	TIP33B	TIP34B	20	3.00	4.0	1.00	3.00	300	1.39	999
80	120	25	TIP35B	TIP36B	10	15.00	4.0	1.80	15.00	1500	1	1001
100	100	10	TIP142	TIP147	1000	5.00	4.0	3.00	10.00	40	1	1031
100	100	12	BDV65B	BDV64B	1000	5.00	4.0	2.00	5.00	20	1	189
100	100	15	BDW83C	BDW84C	750	6.00	3.0	2.50	6.00	12	0.96	199
100	140	10	TIP33C	TIP34C	20	3.00	4.0	1.00	3.00	300	1.39	999
100	140	25	TIP35C	TIP36C	10	15.00	4.0	1.80	15.00	1500	1	1001
350	350	15	BU931ZP		80	8.00	1.8	1.60	7.00	70	1	343
400	450	10	BU921P		50	7.00	1.8	1.80	5.00	50	1.2	329
400	450	15	BU931RP		300	5.00	10.0	1.60	7.00	70	1	337

GENERAL PURPOSE TRANSISTORS (cont'd)

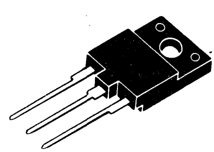
ISOWATT220



V_{CEO} (V)	V_{CBO} (V)	I_C (A)	TYPE	Complementary	h_{FE} @	I_C (A)	V_{CE} (V)	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Page
400	450	10	BU921TFI		50	1.00	1.8	1.80	5.00	50	3.12	✶

✶ Datasheet available on request

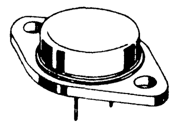
ISOWATT218



V_{CEO} (V)	V_{CBO} (V)	I_C (A)	TYPE	Complementary	h_{FE} @	I_C (A)	V_{CE} (V)	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Page
350	350	15	BU931ZPFI		80	8.00	1.8	1.60	7.00	70	2.08	343
400	450	10	BU921PFI		50	7.00	1.8	1.80	5.00	50	2.27	329
400	450	15	BU931RPFI		300	5.00	10.0	1.60	7.00	70	2.08	337

GENERAL PURPOSE TRANSISTORS (cont'd)

TO-3



V_{CEO} (V)	V_{CBO} (V)	I_C (A)	TYPE	Complementary	h_{FE} @	I_C (A)	V_{CE} (V)	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Page
40	40	30	2N5301	2N4398	15	15.00	2.0	1.00	15.00	1500	0.875	1083
40	50	15	2N3771		15	15.00	4.0	2.00	15.00	1500	1.17	1053
45	45	10	BDX85	BDX86	1000	3.00	3.0	2.00	4.00	16	1.75	227
45	45	15	BDW51	BDW52	20	5.00	4.0	1.00	5.00	500	1.4	193
60	60	8	2N6055	2N6053	750	4.00	3.0	2.00	4.00	16	1.75	1139
60	60	8	MJ1000	MJ900	1000	3.00	3.0	2.00	3.00	12	1.94	815
60	60	10	2N5877	2N5875	20	4.00	4.0	1.00	5.00	500	1.17	1115
60	60	10	BDX85A	BDX86A	1000	3.00	3.0	2.00	4.00	16	1.75	227
60	60	10	MJ3000	MJ2500	1000	5.00	3.0	2.00	5.00	20	1.17	817
60	60	12	2N6057	2N6050	750	6.00	3.0	2.00	6.00	24	1.17	1137
60	60	12	BDX87A	BDX88A	1000	5.00	3.0	2.00	6.00	24	1.75	233
60	60	15	BDW51A	BDW52A	20	5.00	4.0	1.00	5.00	500	1.4	193
60	60	16	MJ4033	MJ4030	1000	10.00	3.0	4.00	16.00	80	1.17	821
60	60	20	2N6282	2N6285	750	10.00	3.0	3.00	20.00	200	1.09	1149
60	60	25	2N5885	2N5883	20	10.00	4.0	1.00	15.00	1500	0.875	1121
60	60	30	2N5302	2N4399	15	15.00	2.0	1.00	15.00	1500	0.875	1083
60	60	30	MJ11012	MJ11011	1000	20.00	5.0	4.00	30.00	300	0.875	825
60	80	10	2N3715	2N3791	30	3.00	2.0	0.80	5.00	500	1.17	1047
60	100	15	2N3055	MJ2955	20	4.00	4.0	1.10	4.00	400	1.5	1037
60	100	15	2N3772		15	10.00	4.0	1.40	10.00	1000	1.17	1053
80	80	8	MJ1001	MJ901	1000	3.00	3.0	2.00	3.00	12	1.94	815
80	80	10	2N5878	2N5876	20	4.00	4.0	1.00	5.00	500	1.17	1115
80	80	10	BDX85B	BDX86B	1000	3.00	3.0	2.00	4.00	16	1.75	227
80	80	10	MJ3001	MJ2501	1000	5.00	3.0	2.00	5.00	20	1.17	817
80	80	12	2N6058	2N6051	750	6.00	3.0	2.00	6.00	24	1.17	1137
80	80	12	BDX87B	BDX88B	1000	5.00	3.0	2.00	6.00	24	1.45	233
80	80	15	BDW51B	BDW52B	20	5.00	4.0	1.00	5.00	500	1.4	193
80	80	16	MJ4034	MJ4031	1000	10.00	3.0	4.00	16.00	80	1.17	821
80	80	20	2N5303	2N5745	15	10.00	2.0	1.50	15.00	1500	0.875	1083
80	80	20	2N6283	2N6286	750	10.00	3.0	3.00	20.00	200	1.09	1149
80	80	25	2N5886	2N5884	20	10.00	4.0	1.00	15.00	1500	0.875	1121
80	100	10	2N3716	2N3792	30	3.00	2.0	0.80	5.00	500	1.17	1047
90	90	30	MJ11014	MJ11013	1000	20.00	5.0	4.00	30.00	300	0.875	825
90	100	30	MJ802	MJ4502	25	7.50	2.0	0.80	7.50	750	0.875	809
100	100	10	BDX85C	BDX86C	1000	3.00	3.0	2.00	4.00	16	1.17	227

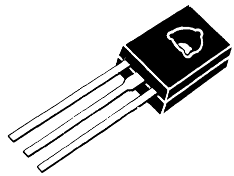
GENERAL PURPOSE TRANSISTORS (cont'd)

TO-3 (cont'd)

V_{CEO} (V)	V_{CBO} (V)	I_C (A)	TYPE	Complementary	h_{FE} @	I_C (A)	V_{CE} (V)	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	R_{thj-c} (°C/W)	Page
100	100	12	2N6059	2N6052	750	6.00	3.0	2.00	6.00	24	1.17	1137
100	100	12	BDX87C	BDX88C	1000	5.00	3.0	2.00	6.00	24	1.45	233
100	100	15	BDW51C	BDW52C	20	5.00	4.0	1.00	5.00	500	1.4	193
100	100	16	2N5629	2N6029	25	8.00	2.0	1.00	10.00	1000	0.875	1097
100	100	16	MJ4035	MJ4032	1000	10.00	3.0	4.00	16.00	80	1.17	821
100	100	20	2N6284	2N6287	750	10.00	3.0	3.00	20.00	200	1.09	1149
120	120	30	MJ11016	MJ11015	1000	20.00	5.0	4.00	30.00	300	0.875	825
350	350	15	BU931Z		80	8.00	1.8	1.60	7.00	70	1	343
450	400	10	BU921		50	7.00	1.8	1.80	5.00	50	1.25	329
450	400	15	BU931R		300	5.00	10.0	1.60	7.00	70	1	337

SWITCHING TRANSISTORS

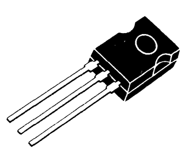
SOT-32

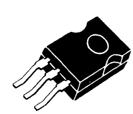


V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE	Complementary	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (μs)	t_f (μs)	R_{thj-c} (°C/W)	Page
200	200	3	BU325		1.50	0.50	50	0.75●	0.20●	5	277
250	200	3	BUY49P		0.20	0.50	50	0.75	0.20	8.33	789
275	250	0.5	2N5655		1.00	0.10	10			6.25	1103
275	250	0.5	BD157							6.25	141
300	300	0.5	MJE340	MJE350						6	837
325	300	0.5	2N5656		1.00	0.10	10			6.25	1103
325	300	0.5	BD158							6.25	141
350	250	0.3	MJE3440		0.50	0.05	4			8.33	855
375	350	0.5	2N5657		1.00	0.10	10			6.25	1103
375	350	0.5	BD159							6.25	141
450	350	0.3	MJE3439		0.50	0.05	4			8.33	855
600	400	3	BU801		2.20	1.00	15	1	0.5	3.12	307

● Typical value

SOT-82



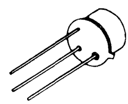


OPTION
SOT-194

V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE	Complementary	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (μs)	t_f (μs)	R_{thj-c} (°C/W)	Page
300	300	0.5	SGS340	SGS350						6	837
350	250	0.3	SGS3440		0.50	0.05	4			8.33	855
450	350	0.3	SGS3439		0.50	0.05	4			8.33	855
600	300	1.5	SGS13002		1.00	1.00	250	2.5	0.5	2.5	877
700	400	1.5	SGS13003		1.0	1.00	250	2.5	0.5	2.5	877

SWITCHING TRANSISTORS (cont'd)

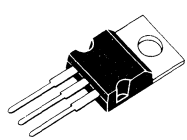
TO-39



V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE	Complementary	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (μs)	t_f (μs)	R_{thj-c} (°C/W)	Page
120	60	5	2N4895		1.00	5.00	500	0.35	0.3	25	1059
120	60	5	2N4896		1.00	5.00	500	0.35	0.3	25	1059
120	120	1.5	BSW67		1.00	1.00	150	0.7●	0.22●	35	651
130	60	6	BU125		1.00	5.00	500			15	255
150	80	5	2N4897		1.00	5.00	500	0.35	0.3	25	1059
150	120	7	BUY47		1.00	5.00	500	0.7	0.04	15	785
150	150	1.5	BSW68		1.00	1.00	150	0.7●	0.22●	35	651
200	170	7	BUY48		1.00	5.00	500	0.7	0.04●	15	785
200	200	1		2N5415	2.50	0.05	5	0.3	0.2	17.5	1093
250	150	3	BU125S		1.50	0.50	50			17.5	259
250	200	3	BUY49S		0.20	0.50	50	0.75	0.30	17.5	791
300	250	1	2N3440		0.50	0.05	4			17.5	1043
350	300	1		2N5416	2.50	0.05	5	0.3	0.2	17.5	1093
450	350	1	2N3439		0.50	0.05	4			17.5	1043

● Typical value

TO-220



V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE	Complementary	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (μs)	t_f (μs)	R_{thj-c} (°C/W)	Page
140	90	7	2N6702		0.80	5.00	500	1	0.5	2.5	1179
180	90	14	BUV26		0.60	6.00	600	1	0.25	1.76	441
200	125	4	D44Q1		1.00	2.00	200	2	1.7	4	805
200	125	16	BUT60		0.90	12.00	600	1.5▲	0.2▲	1	✶
240	120	12	BUV27		0.70	4.00	400	1.2	0.25	1.76	447

▲ Inductive load ✶ Datasheet on request

SWITCHING TRANSISTORS (cont'd)

TO-220 (cont'd)

V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE	Complementary	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (µs)	t_f (µs)	R_{thj-c} (°C/W)	Page
250	175	4	D44Q3		1.00	2.00	200	2	1.7	4	805
300	225	4	D44Q3		1.00	2.00	200	2	1.7	4	805
300	300	0.5	MJE340T	MJE350T						6	837
330	150	7	BU407		1.00	5.00	500	0.9●	0.3●	2.08	297
330	150	7	BU407D		1.00	5.00	650	0.9●	0.3●	2.08	291
330	150	8	BU189		1.50	5.00	50	0.5	0.44●	2.08	263
330	150	8	BU807		1.50	5.00	50	0.55●	0.2●	2.08	311
350	250	1	TIP47		1.00	1.00	200	1.2●	0.45●	3.12	1005
350	250	5	2N6497		1.00	2.50	500	1.8	0.8	1.56	1159
400	200	7	BU406		1.00	5.00	500	0.9●	0.3●	2.08	285
400	200	7	BU406D		1.00	5.00	650	0.9●	0.3●	2.08	291
400	200	8	BU184		1.50	5.00	50	0.5	0.44●	2.08	263
400	200	8	BU806		1.50	5.00	50	0.55●	0.2●	2.08	311
400	200	10	BUV28		1.50	6.00	600	1.5	0.25	1.76	453
400	300	1	TIP48		1.00	1.00	200	1.3●	0.45●	3.12	1005
400	300	5	2N6498		1.25	2.50	500	1.8	0.8	1.56	1159
400	300	16	BUT62		0.90	10.00	1000	2.2▲	0.4▲	1	✶
400	350	6		BUW22P	1.50	2.50	1000	1.5	0.7	2	563
450	300	8	2N6928		1.00	8.00	1600	2.5	0.4	1.25	✶
450	350	1	TIP49		1.00	1.00	200	1.3●	0.45●	3.12	1005
450	350	5	2N6499		1.50	2.50	500	1.8	0.8	1.56	1159
450	400	6		BUW22AP	1.50	2.50	1000	1.5	0.7	2	563
500	400	1	TIP50		1.00	1.00	200	1.3●	0.45●	3.12	1005
550	350	8	2N6929		1.00	8.00	1600	2.5	0.4	1.25	✶
600	300	1.5	SGS13002T		1.00	1.00	250	2.5	0.5	2.5	877
600	300	4	MJE13004		1.00	4.00	1000	4	0.9	1.67	859
600	300	8	MJE13006		1.50	5.00	1000	3	0.7	1.56	863
600	300	12	MJE13008		1.50	8.00	1600	3	0.7	1.25	871
600	400	7	BU810		2.50	4.00	200	1.5	0.5	1.66	321
650	400	8	2N6930		1.00	8.00	1600	2.5	0.4	1.25	✶
650	400	8	SGSD00020		4.00	3.00	3				895
700	400	1.5	SGS13003T		1.0	1.00	250	2.5	0.5	2.5	877
700	400	4	MJE13005		1.0	4.00	1000	4	0.9	1.67	859
700	400	8	MJE13007		1.5	5.00	1000	3	0.7	1.56	863
700	400	12	MJE13009		1.5	8.00	1600	3	0.7	1.25	871
800	400	2	BUX84		3.0	1.00	200	3.5	0.4●	3.12	765
850	400	5	BUT11		1.5	3.00	600	4	0.8	1.5	379
850	400	5	BUV46		1.5	2.50	500	3	0.8	1.76	195
850	400	5	SGSF321		1.5	3.50	700	2.5	0.3	1.78	907
850	400	8	MJE13007A		1.5	5.00	1000	3	0.7	1.56	863
850	400	10	SGSF341		1.5	6.00	1200	2.5	0.3	1.47	931
850	450	7.5	BUF405		0.5●	5.00	1000				349
850	450	9	BUV56		1.2	5.00	1000	3▲	0.4▲	1.76	525
850	450	15	BUV66		1.2	8.00	1600	3▲	0.4▲	1.25	557

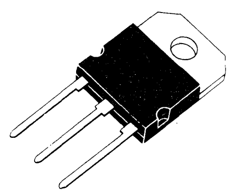
▲ Inductive load ● Typical value # Tj = 125°C ✶ Datasheet on request

SWITCHING TRANSISTORS (cont'd)

TO-220 (cont'd)

V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE	Complementary	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (µs)	t_f (µs)	R_{thj-c} (°C/W)	Page
1000	400	7	SGSD00055		2.5	3.00	200	0.8	0.15	1.66	905
1000	450	2	BUX85		1.0	1.00	200	3.5	0.4●	2.5	✶
1000	450	5	BUT11A		1.5	2.50	500	4	0.8	1.5	379
1000	450	5	BUV46A		1.5	2.00	400	3	0.8	1.76	495
1000	450	5	SGSF323		1.5	2.50	500	2.5	0.3	1.78	913
1000	450	7.5	BUF405A		0.5●	5.00	1000				349
1000	450	8	SGSF343		1.5	4.50	900	2.5	0.35	1.47	937
1200	600	4	SGSF324		1.5	1.75	350	4.5	0.35	1.78	919
1200	600	7	SGSF344		1.5	3.50	700	3.5	0.3	1.47	943

TO-218



V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE	Complementary	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (µs)	t_f (µs)	R_{thj-c} (°C/W)	Page
120	60	30	BUW48		0.60	20.00	2000	1.1	0.25	1	601
160	80	30	BUW49		0.50	15.00	1500	1.1	0.25	1	601
160	90	25	BUW89		0.90	15.00	1500	1	0.25	1.2	633
160	125	25	BUX10P		0.60	10.00	1000	1.2	0.3	1.17	669
160	140	25	BU999		0.80	10.00	1000	1.5	0.25	1.17	347
200	125	40	BUT70		0.90	35.00	1750	1.8▲	0.2▲	0.63	✶
250	125	20	BUW90		0.90	11.00	1100	1	0.3	1.2	641
250	125	25	BUW50		0.90	20.00	2000	1.2	0.3	1	609
300	125	15	BUW91		0.90	6.00	600	1.2	0.3	1.2	649
300	200	20	BUW51		0.90	10.00	1000	1.4	0.3	1	617
350	250	5	TIP51		1.50	3.00	600	2.5●	0.2●	1.25	1009
350	250	12	BUW92		0.80	2.00	130	1.6	0.3	1.2	657
350	250	20	BUW52		0.80	4.00	260	1.6	0.3	1	625
400	300	5	TIP52		1.50	3.00	600	2.5●	0.2●	1.25	1009
400	300	40	BUT72		0.90	30.00	3000	3▲	0.4▲	0.63	✶

▲ Inductive load ● Typical value ✶ Datasheet on request

SWITCHING TRANSISTORS (cont'd)

TO-218 (cont'd)

V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE	Complementary	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s @ (µs)	t_f (µs)	R_{thj-c} (°C/W)	Page
400	350	10		BUW32P	1.50	5.00	1500	1.5	0.6	1.2	569
400	350	15		BUW42P	1.50	10.00	3000	1.5	0.6	1.2	593
400	350	20	MJ10004P		1.90	10.00	400	1.5	0.5	1	823
450	300	10	2N6931		1.00	10.00	2000	2.5	0.5	0.83	1181
450	300	15	2N6933		1.00	15.00	3000	2.5	0.5	0.71	1185
450	350	5	TIP53		1.50	3.00	600	2.5●	0.2●	1.25	1009
450	400	10		BUW32AP	1.50	5.00	1500	1.5	0.6	1.2	569
450	400	15		BUW42AP	1.50	10.00	3000	1.5	0.5	1.2	593
450	400	20	MJ10005P		1.90	10.00	400	1.5	0.5	1	823
500	400	5	TIP54		1.50	3.00	600	2.5●	0.2●	1.25	1009
550	350	15	2N6934		1.00	15.00	3000	2.5	0.5	0.71	1185
600	400	28	BUT13P		2.00	10.00	500	1.5	0.6	1	385
600	400	28	SGSD311		2.50	18.00	1800	1.5	0.5	1	889
650	400	10	2N6932		1.00	10.00	2000	2.5	0.5	0.83	1181
650	400	15	2N6935		1.00	15.00	3000	2.5	0.5	0.71	1185
650	400	28	SGSD00030		2.50	12.00	100	1.5	0.5	1	897
800	375	6	BU426		1.5	2.50	500	3.5	0.5	1.16	303
850	400	5	SGSF421		1.5	3.50	700	2.5	0.3	1.56	907
850	400	8	BUW12		1.5	6.00	1200	4	0.8	1.2	561
850	400	9	BUV47		1.5	6.00	1200	2.5	0.8	1.25	735
850	400	10	SGSF441		1.5	6.00	1200	2.5	0.3	1.31	931
850	400	15	BUV48		1.5	10.00	2000	3	0.8	1	745
850	400	15	SGSF461		1.5	10.00	2000	2.3	0.5	1	955
850	450	8	MJH16006		3.0	5.00	660				✶
850	450	8	MJH16008		3.0	5.00	500				✶
850	450	15	BUF410		0.5*	10.00	2000				353
850	450	15	MJH16010		3.0	10.00	1300				✶
850	450	15	MJH16012		3.0	10.00	1000				✶
850	450	30	BUF420		0.5*	20.00	4000				357
850	450	30	BUX98P		0.9	20.00	4000	3	0.8	0.63	773
900	400	6	BU426A		1.5	2.50	500	3.5	0.5	1.1	303
1000	450	5	SGSF423		1.5	2.50	500	2.5	0.3	1.56	913
1000	450	8	BUW12A		1.5	6.00	1200	4	0.8	1.2	561
1000	450	8	SGSF443		1.5	4.50	900	2.5	0.35	1.31	937
1000	450	9	BUV47A		1.5	5.00	1000	3	0.8	1.25	735
1000	450	12	SGSF463		1.5	7.00	1400	2.3	0.5	1	961
1000	450	15	BUF410A		0.5*	10.00	2000				353
1000	450	15	BUV48A		1.5	8.00	1600	3	0.8	1	745
1000	450	30	BUF420A		0.5*	20.00	4000				357
1000	550	6	2ST3153		2.0	3.00	600				✶
1200	600	4	SGSF424		1.5	1.75	350	4.5	0.35	1.56	919
1200	600	6	2ST3642		5.0	4.00	800				✶
1200	600	7	SGSF444		1.5	3.50	700	3.5	0.3	1.31	943
1200	600	10	SGSF464		1.5	6.00	1200	3.5	0.4	1	967

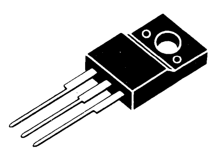
✶ Datasheet on request ● Typical value

SWITCHING TRANSISTORS (cont'd)

TO-218 (cont'd)

V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE	Complementary	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (µs)	t_f (µs)	R_{thj-c} (°C/W)	Page
1200	600	12	2ST3552		2.0	6.00	1200				✶
1200	600	15	BUV48B		1.5	6.00	1500	3	0.7	1	755
1200	700	15	BUV48C		1.5	6.00	1500	3	0.7	1	755
1300	600	4	SGSF425		1.5	1.25	250	4.5	0.35	1.56	925
1300	600	7	SGSF445		1.5	3.00	600	3.5	0.3	1.31	949
1300	600	10	SGSF465		1.5	5.00	1000	3.5	0.4	1	973
1500	700	2.5	2ST1396		8.0	2.00	600				✶
1500	700	3	2SD1453		5.0	2.50	800				✶
1500	700	4	2SD1441		1.0	3.00	1000				✶
1500	700	5	2SD1455		5.0	4.50	1200				✶
1500	700	5	2SD1730		8.0	4.00	1000				✶
1500	700	5	2ST3485		5.0	4.00	1000				✶
1500	700	5	BU706		5.0	3.00	1330				305
1500	700	6	2ST3460		2.0	3.00	600				✶
1500	700	7.5	2ST2000		1.0	4.00	2000				✶
1500	700	8	2ST3461		2.0	4.00	800				✶
1500	700	8	BU508		5.0	4.50	2000	7●	0.55●	1	267
1500	700	8	BU508A		1.0	4.50	2000	7●	0.55●	1	267
1500	700	8	BU508D		1.0	4.50	2000	7●	0.55●	1	271

ISOWATT220



V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE	Complementary	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s @ (µs)	t_f (µs)	R_{thj-c} (°C/W)	Page
330	150	8	BU807FI		1.5	5.00	50	0.55●	0.2●	2.08	311
400	200	8	BU806FI		1.5	5.00	50	0.55●	0.22●	4.16	311
850	400	5	BUT11FI		1.5	3.00	600	4	0.8	3.57	379
850	400	5	BUV46FI		1.5	2.50	500	3	0.8	4.16	495
850	400	5	SGSIF321		1.5	3.50	700	2.5	0.3	3.57	907
850	400	10	BUT12FI		1.5	6.00	1200				✶
850	400	10	SGSIF341		1.5	6.00	1200	2.5	0.3	3.12	931
1000	450	5	BUT11AFI		1.5	2.50	500	4	0.8	3.57	379
1000	450	5	BUV46AFI		1.5	2.00	400				495
1000	450	5	SGSIF323		1.5	2.50	500	2.5	0.3	3.57	913

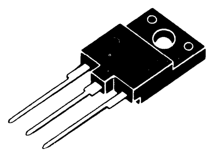
✶ Datasheet on request ● Typical value

SWITCHING TRANSISTORS (cont'd)

ISOWATT220 (cont'd)

V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE	Complementary	V_{CEsat} (V) @	I_C (A)	I_B (mA)	t_s (µs)	t_f (µs)	R_{thj-c} (°C/W)	Page
1000	450	8	SGSIF343		1.5	4.50	900	2.5	0.35	3.12	937
1000	450	10	BUT12AFI		1.5	5.00	1000				✶
1200	600	4	SGSIF324		1.5	1.75	350	4.5	0.35	3.57	919
1200	600	7	SGSIF344		1.5	3.50	700	3.5	0.3	3.12	943

ISOWATT218



V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE	Complementary	V_{CEsat} (V) @	I_C (A)	I_B (mA)	t_s (µs)	t_f (µs)	R_{thj-c} (°C/W)	Page
400	350	10		BUW32PFI	1.50	5.00	1500	1.5	0.6	2.27	569
400	350	15		BUW42PFI	1.50	10.00	3000	1.5	0.6	1.92	593
400	350	20	MJ10004PFI		1.90	10.00	400	1.5	0.5	2.08	823
450	400	10		BUW32APFI	1.50	5.00	1500	1.5	0.6	2.27	569
450	400	15		BUW42APFI	1.50	10.00	3000	1.5	0.6	1.92	593
450	400	20	MJ10005PFI		1.90	10.00	400	1.5	0.5	2.08	823
600	400	28	BUT13PFI		2.00	10.00	500	1.5	0.6	2.08	385
600	400	28	SGSD311FI		2.50	18.00	1800	1.5	0.5	2.08	889
650	400	28	SGSD00030FI		2.50	12.00	100	1.5	0.5	2.08	897
800	375	6	BU426FI		1.5	2.50	500	3.5	0.5	2.5	303
850	400	5	SGSIF421		1.5	3.50	700	2.5	0.3	2.77	907
850	400	9	BUV47FI		1.5	6.00	1200	2.5	0.8	2.27	303
850	400	10	SGSIF441		1.5	6.00	1200	2.5	0.3	2.27	931
850	400	15	BUV48FI		1.5	10.00	2000	3	0.8	1.92	745
850	400	15	SGSIF461		1.5	10.00	2000	2.3	0.5	1.92	955
900	400	6	BU426AFI		1.5	2.50	500	3.5	0.5	2.5	303
1000	450	5	SGSIF423		1.5	2.50	500	2.5	0.3	2.77	913
1000	450	8	SGSIF443		1.5	4.50	900	2.5	0.35	2.27	937
1000	450	9	BUV47AFI		1.5	5.00	1000	3	0.8	2.27	735
1000	450	12	SGSIF463		1.5	7.00	1400	2.3	0.5	1.92	961
1000	450	15	BUV48AFI		1.5	8.00	1600	3	0.8	1.92	745
1000	500	5	2ST3679FI		0.5	2.00	400				✶
1200	600	4	SGSIF424		1.5	1.75	350	4.5	0.35	2.77	919
1200	600	7	SGSIF444		1.5	3.50	700	3.5	0.3	2.27	943
1200	600	10	SGSIF464		1.5	6.00	1200	3.5	0.4	1.92	967
1200	600	15	BUV48BFI		1.5	6.00	1500	3	0.7	1.92	755

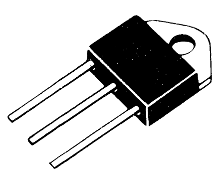
✶ Datasheet on request

SWITCHING TRANSISTORS (cont'd)

ISOWATT218 (cont'd)

V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE	Complementary	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (µs)	t_f (µs)	R_{thj-c} (°C/W)	Page
1200	700	15	BUV48CFI		1.5	6.00	1500	3	0.7	1.92	755
1300	600	4	SGSIF425		1.5	1.25	250	4.5	0.35	2.77	925
1300	600	7	SGSIF445		1.5	3.00	600	3.5	0.3	2.27	949
1300	600	10	SGSIF465		1.5	5.00	1000	3.5	0.4	1.92	973
1400	700	10	BU808FI		1.6	5.00	500			2.5	317
1400	700	10	BU808DFI		1.6	5.00	500			2.5	317
1500	600	2.5	2SD1425FI		8.0	2.00	600				✶
1500	600	2.5	2SD1429FI		8.0	2.00	600				✶
1500	600	3.5	2SD1426FI		8.0	3.00	800				✶
1500	600	3.5	2SD1430FI		8.0	3.00	800				✶
1500	600	5	2SD1427FI		5.0	4.00	800				✶
1500	600	5	2SD1431FI		5.0	4.00	800				✶
1500	600	6	2SD1428FI		5.0	5.00	1000				✶
1500	600	6	2SD1432FI		5.0	5.00	1000				✶
1500	700	2.5	S2056FI		5.0	2.00	1000				✶
1500	700	3	2SD1910FI		5.0	2.50	800				✶
1500	700	3.5	2SD1650FI		8.0	2.50	800				✶
1500	700	4	2ST1877FI		5.0	2.50	800				✶
1500	700	5	2ST1577FI		2.0	4.50	2000				✶
1500	700	5	2ST1651FI		5.0	4.00	800				✶
1500	700	5	2ST3485FI		5.0	4.00	1000				✶
1500	700	7	2ST2000FI		1.0	4.00	2000				✶
1500	700	7.5	S2000FI		5.0	4.50	2000				✶
1500	700	8	BU508AFI		1.0	4.50	2000	7●	0.55●	2.08	267
1500	700	8	BU508DFI		1.0	4.50	2000	7●	0.55●	2.08	271
1500	700	8	BU508FI		5.0	4.50	2000	7●	0.55●	2.08	267

TO-3I

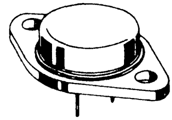


V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE	Complementary	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s (µs)	t_f (µs)	R_{thj-c} (°C/W)	Page
850	450	15	BUF410I		0.5●	10.00	2000			1.47	353
850	450	30	BUF420I		0.5●	20.00	4000			1.09	357
1000	450	15	BUF410AI		0.5●	10.00	2000			1.47	353
1000	450	30	BUF420AI		0.5●	20.00	4000			1.09	357

✶ Datasheet on request ● Typical value

SWITCHING TANSISTORS (cont'd)

TO-3



V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE	Complementary	V_{CEsat} (V) @	I_C (A)	I_B (mA)	t_s (µs)	t_f (µs)	R_{thj-c} (°C/W)	Page
60	80	10	BDY92		0.50	5.00	500	1.3	0.2	2.5	241
60	120	50	BUV18		0.60	40.00	4000	1.1	0.3	0.7	425
80	100	10	BDY91		0.50	5.00	500	1.3	0.2	2.5	241
80	160	50	BUV19		0.60	30.00	3000	1.1	0.25	0.7	425
100	120	10	BDY90		0.50	5.00	500	1.3	0.2	2.5	241
120	60	30	BUW38		0.60	20.00	2000	1.1	0.39	1.17	583
120	75	20	2N5039		1.00	10.00	1000	1.5	0.5	1.25	1067
120	80	25	BDY57		1.40	10.00	1000	1.5	0.5	1	239
120	90	30	2N5671		0.75	15.00	1200	1.5	0.5	1.25	1107
120	90	50	2N6032		1.30	50.00	5000	1.5	0.5	1.25	1127
150	90	20	2N5038		1.00	12.00	1200	1.5	0.5	1.25	1067
150	120	30	2N5672		0.75	15.00	1200	1.5	0.5	1.25	1107
150	120	40	2N6033		1.00	40.00	4000	1.5	0.5	1.25	1127
160	80	30	BUW39		0.50	15.00	1500	1.1	0.39	1.17	583
160	90	25	BUV39		1.20	20.00	2500	1	0.25	1.46	459
160	125	20	BUX40		1.20	10.00	1000	1	0.4	1.46	715
160	125	25	BDY58		1.40	10.00	1000	1.5	0.5	1	239
160	125	25	BUX10		0.60	10.00	1000	1.2	0.3	1.17	665
160	125	50	BUV20		0.60	25.00	2500	1.2	0.25	0.7	433
160	125	50	BUX20		0.60	25.00	2500	1.2	0.3	0.5	687
200	125	50	BUR20		1.00	25.00	2000			0.7	361
200	125	50	BUT100		0.90	50.00	2500	2#	0.2#	0.58	417
200	125	50	BUT90		0.90	35.00	1750	1.5	0.4	0.7	391
200	125	70	BUR50		1.00	35.00	2000	2	0.5	0.5	367
200	125	70	BUR50S		1.00	35.00	2000	2	0.5	0.5	367
220	160	18	BUX41N		1.20	8.00	800	1.5	0.8	1.46	723
220	160	20	BUX11N		0.60	8.00	800	1.5	0.5	1.17	675
250	125	20	BUV40		0.90	11.00	1100	1	0.3	1.46	467
250	125	25	BUV50		0.90	20.00	2000	1.2	0.3	1.17	497
250	125	50	BUV60		0.90	50.00	5000	1.1	0.2	0.7	529
250	200	15	BUX41		1.20	4.00	400	1.7	0.8	1.46	719
250	200	20	BUX11		0.60	6.00	600	1.8	0.4	1.17	671
250	200	40	BUV21		0.60	12.00	1200	1.8	0.4	0.7	433
250	200	40	BUX21		0.60	12.00	1200	1.8	0.4	0.5	691
300	200	15	BUV41		0.90	6.00	600	1.2	0.3	1.46	475

Tj = 125°C

SWITCHING TRANSISTORS (cont'd)

TO-3 (cont'd)

V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE	Complementary	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s @ (µs)	t_f (µs)	R_{thj-c} (°C/W)	Page
300	200	20	BUV51		0.90	10.00	1000	1.4	0.3	1.17	505
300	200	40	BUR21		0.60	12.00	1200				363
300	200	50	BUT91		1.20	40.00	4000	1.2	0.3	0.7	397
300	200	50	BUV61		0.90	25.00	2500	1.2	0.3	0.7	537
300	200	60	BUR51		1.00	30.00	2000	2	0.6	0.5	371
300	250	12	BUX42		1.20	4.00	400	2	1.2	1.46	727
300	250	20	BUX12		1.00	5.00	500	2	0.5	1.17	679
300	250	40	BUV22		1.00	10.00	1000	2	0.5	0.7	433
300	250	40	BUX22		1.00	10.00	1000	2	0.5	0.5	695
350	250	12	BUV42		0.90	4.00	400	1.6	0.3	1.46	483
350	250	20	BUV52		0.90	8.00	800	1.6	0.3	1.17	513
350	250	40	BUR22		1.00	10.00	1000				365
350	250	40	BUV62		0.90	16.00	1600	1.8	0.35	0.7	545
350	250	50	BUT92		1.20	35.00	3500	3▲	0.4▲	0.7	405
350	250	60	BUR52		1.80	25.00	2000	2	0.6	0.5	375
400	300	12	BUV42A		0.90	4.00	400	3▲	0.4▲	1.46	491
400	300	20	BUV52A		0.90	7.00	700	3▲	0.4▲	1.17	521
400	300	40	BUV62A		0.90	15.00	1500	3▲	0.4▲	0.7	553
400	300	50	BUT102		0.90	40.00	4000	3▲	0.4▲	0.7	421
400	300	50	BUT92A		0.90	30.00	3000	3▲	0.4▲	0.7	411
400	325	10	BUX43		2.00	5.00	1000	2.2	1.2	1.46	731
400	325	15	BUX13		1.50	8.00	1600	3	1.2	1.17	683
400	325	30	BUV23		1.00	16.00	3200	2.5	1.2		437
400	325	30	BUX23		1.00	16.00	3200	2.5	1.2	0.5	699
400	350	10		BUW32	1.50	5.00	1500	1.5	0.6	1.2	569
400	350	15		BUW42	1.50	10.00	3000	1.5	0.6	1	593
400	350	20	MJ10004		1.90	10.00	400	1.5	0.5	1	823
450	300	8	2N6671		1.00	5.00	1000	2.5	0.4	1.17	1167
450	300	15	2N6674		1.00	10.00	2000	2.5	0.5	1	1171
450	300	15	2N6676		1.00	15.00	3000	2.5	0.5	1	1175
450	400	8	BUX44		1.50	4.00	800	2.5	1.2	1.46	733
450	400	10		BUW32A	1.50	5.00	1500	1.5	0.6	1.2	569
450	400	10	BUX14		1.60	6.00	1200	3	1.2	1.17	685
450	400	15		BUW42A	1.50	10.00	3000	1.5	0.6	1	593
450	400	20	BUV24		1.00	12.00	2400	3	1.4	0.7	437
450	400	20	BUX24		1.00	12.00	2400	3	1.4	0.7	705
450	400	20	MJ10005		1.90	10.00	400	1.5	0.5	1	823
500	200	10	BUY69C		3.3	8.00	2500	1.7●	0.3●	1.75	799
500	400	10	BUW34		1.50	5.00	1000	3	0.8	1.4	575
500	400	15	BUW44		3.00	10.00	2000	3	0.8	1	597
500	500	15	BUV25		1.00	8.00	1600	5	1.6	0.7	437
500	500	30	BUX25		1.00	8.00	1600	5	1.2	0.5	711
550	350	8	2N6672		1.00	5.00	1000	2.5	0.4	1.17	1167
550	350	15	2N6677		1.00	15.00	3000	2.5	0.5	1	1175

▲ Inductive load ● Typical value

SWITCHING TRANSISTORS (cont'd)

TO-3(cont'd)

V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE	Complementary	V_{CEsat} @ (V)	I_C (A)	I_B (mA)	t_s @ (µs)	t_f (µs)	R_{thj-c} (°C/W)	Page
600	400	28	BUT13		2.00	10.00	500	1.5	0.6	1	385
600	400	28	SGSD310		2.50	18.00	1800	1.5	0.5	1	889
650	300	8	2N6544		1.5	5.00	1000	4	0.9	1.4	1163
650	400	8	2N6673		1.00	5.00	1000	2.5	0.4	1.17	1167
650	400	15	2N6675		1.00	10.00	2000	2.5	0.5	1	1171
650	400	15	2N6678		1.00	15.00	3000	2.5	0.5	1	1175
650	400	28	SGSD00031		2.50	12.00	100	1.5	0.5	1	897
800	325	10	BUY69B		3.3	8.00	2500	1.7●	0.3●	1.75	799
800	400	10	BUX80		1.5	5.00	1000	3.5	0.5	1.75	761
800	400	10	BUW35		1.50	5.00	1000	3	0.8	1.4	575
800	400	15	BUW45		1.50	10.00	2000	3	0.8	1	597
800	500	20	MJ13335		1.8	10.00	2000				✶
850	400	8	2N6545		1.5	5.00	1000	4	0.9	1.4	1163
850	400	9	BUX47		1.5	6.00	1200	2.5	0.8	1.2	735
850	400	10	SGSF541		1.5	6.00	1200	2.5	0.35	1.3	931
850	400	15	BUX48		1.5	10.00	2000	3	0.8	1	745
850	400	15	SGSF561		1.5	10.00	2000	2.3	0.5	1	955
850	400	30	BUX98		1.5	20.00	4000	3	0.8	0.7	767
850	400	30	SGSF661		1.5	20.00	4000	2.3	0.5	0.6	979
850	450	30	BUF420M		0.5●	20.00	4000				357
850	450	45	BUX348		0.9	30.00	6000			0.58	779
900	400	6	BU326A		1.5	2.50	500	3.5	0.5	2.33	281
900	450	10	BUW36		1.50	5.00	1000	3	0.8	1.4	575
900	450	15	BUW46		1.50	10.00	2000	3	0.8	1	597
1000	400	10	BUY69A		3.3	8.00	2500	1.7●	0.3●	1.75	799
1000	450	8	SGSF543		1.5	4.50	900	2.5	0.35	1.3	937
1000	450	9	BUX47A		1.5	5.00	1000	2.5	0.8	1.2	735
1000	450	12	SGSF563		1.5	7.00	1400	2.3	0.5	1	961
1000	450	15	BUX48A		1.5	8.00	1600	3	0.8	1	745
1000	450	24	SGSF663		1.5	14.00	2800	2.3	0.5	0.6	983
1000	450	30	BUF420AM		0.5●	20.00	4000				357
1000	450	30	BUX98A		1.5	16.00	3200	3	0.8	0.7	767
1200	600	7	SGSF544		1.5	3.50	0.70	3.5	0.3	1.3	943
1200	600	8	2ST3412		5.0	5.00	1.00				✶
1200	600	10	SGSF564		1.5	6.00	1.20	3.5	0.4	1	967
1200	600	15	BUX48B		1.5	6.00	1.50	3	0.7	1	755
1200	600	20	SGSF664		1.5	12.00	2.40	3.5	0.4	0.6	987
1200	600	30	BUX98B		1.5	12.00	3.00	3	0.8	0.7	769
1200	700	15	BUX48C		1.5	6.00	1.50	3	0.7	1	755
1200	700	30	BUX98C		1.5	12.00	3.00	3	0.8	0.7	769
1300	500	8	2SC3412		5.0	5.00	1.00				✶
1300	600	10	SGSF565		1.5	5.00	1.00	3.5	0.4	1	973
1300	600	20	SGSF665		1.5	10.00	2.00	3.5	0.4	0.6	991
1500	600	2.5	2SD818		8.0	2.00	0.60				✶

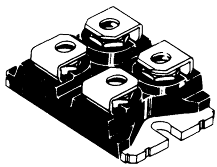
✶ Datasheet on request ● Typical value

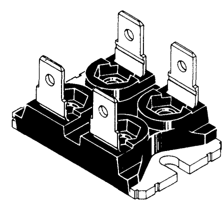
SWITCHING TRANSISTORS (cont'd)

TO-3(cont'd)

V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE	Complementary	V_{CEsat} (V) @	I_C (A)	I_B (mA)	t_s (µs)	t_f (µs)	R_{thj-c} (°C/W)	Page
1500	600	3.5	2SD819		8.0	3.00	0.80				✶
1500	600	3.5	2SD869		8.0	3.00	0.80				✶
1500	700	3	2ST1942		5.0	2.50	0.80				✶
1500	700	8	BU208		5.0	4.50	2.00	7●	0.55●	1	267
1500	700	8	BU208A		1.0	4.50	2.00	7●	0.55●	1	267
1500	700	8	BU208D		1.0	4.50	2.00	7●	0.55●	1	267

ISOTOP





V_{CBO} (V)	V_{CEO} (V)	I_C (A)	TYPE	Complementary	V_{CEsat} (V) @	I_C (A)	I_B (mA)	t_s (µs)	t_f (µs)	R_{thj-c} (°C/W)	Page
150	125	120	ESM2012D(V)		1.5#	70	250	2▲■	0.4▲■	0.7	✶
200	125	100	BUT30(V)		0.9	100	10000	2▲■	0.2▲■	0.5	✶
200	125	200	BUT230(V)		0.9	200	20000	2▲■	0.2▲■	0.41	✶
400	300	67	ESM2030D(V)		2.0#	56	1600	3.5▲■	0.7▲■	0.83	✶
400	300	80	BUT32(V)		0.9	40	4000	3▲■	0.4▲■	0.5	✶
400	300	100	ESM3030D(V)		1.7#	60	600	3.5▲■	0.7▲■	0.83	✶
600	450	24	ESM3045D(V)		2.0#	15	300	4▲■	0.4▲■	1	✶
600	450	42	ESM4045D(V)		2.0#	25	500	4.5▲■	0.5▲■	0.83	✶
600	450	60	ESM5045D(V)		2.0#	35	700	5▲■	0.5▲■	0.71	✶
600	450	75	ESM7545D(V)		2.5	75	1500	5▲●	1▲●	0.41	✶
600	450	84	ESM6045D(V)		2.0#	50	1000	5.5▲■	0.5▲■	0.5	✶
850	450	30	BUV98(V)		1.5	20	4000	5▲■	0.4▲■	0.83	✶
850	450	60	BUV298(V)		1.2	40	8000	4.5▲■	0.4▲■	0.5	✶
850	450	90	BUF460(V)		2.0#	60	12000	3.5▲■	0.12▲■	0.41	✶
1000	450	24	ESM3045A(V)		2.0#	18	720	4.5▲■	0.5▲■	1	✶
1000	450	30	BUV98A(V)		1.5	16	3200	5▲■	0.4▲■	0.83	✶
1000	450	42	ESM4045A(V)		2.0#	30	1200	5▲■	0.6▲■	0.83	✶
1000	450	50	BUV298A(V)		1.2	32	6400	4.5▲■	0.4▲■	0.5	✶
1000	450	84	ESM6045A(V)		2.0#	60	2400	6▲■	0.6▲■	0.5	✶
1000	450	90	BUF460A(V)		2.0#	60	12000	3.5▲■	0.12▲■	0.41	✶
1000	700	50	ESMT5070D(V)		3.0	50	500	15▲■	3▲■	0.41	✶
1200	700	30	BUV98C(V)		1.5	12	3000	6▲■	0.6▲■	0.83	✶

▲ Inductive load ● Typical value # Tj = 125°C ■ Tj = 100°C ✶ Datasheet available on request

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BD179	BD179		143
BD180	BD180		143
BD181		2N3715	1047
BD182		2N3715	1047
BD183		2N3716	1047
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BD237	BD237		149
BD238	BD238		149
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BD239A	BD239A		153
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BD245B	TIP33B		999
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BD246	TIP34A		999
BD246A	TIP34A		999
BD246B	TIP34B		999
BD246C	TIP34C		999
BD249	TIP35A		1001
BD249A	TIP35A		1001
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BD250A	TIP36A		1001
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BDX66A		MJ2501	817
BDX66B		MJ4032	821
BDX67		MJ3000	817
BDX67A		MJ3001	817
BDX67B		MJ4035	821
BDX68		MJ11011	825
BDX68A		MJ11013	825
BDX68B		MJ11015	825
BDX68C		MJ11015	825
BDX69		MJ11012	825
BDX69A		MJ11014	825
BDX69B		MJ11016	825
BDX69C		MJ11016	825
BDX71		2N6487	1157
BDX77		BD709	179
BDX78		BD710	179
BDX83		BDX87	233
BDX83A		BDX87A	233
BDX83B		BDX87B	233
BDX83C		BDX87C	233
BDX84		BDX88	233
BDX84A		BDX88A	233
BDX84B		BDX88B	233
BDX84C		BDX88C	233
BDX85	BDX85		227
BDX85A	BDX85A		227
BDX85B	BDX85B		227
BDX85C	BDX85C		227
BDX86	BDX86		227
BDX86A	BDX86A		227
BDX86B	BDX86B		227
BDX86C	BDX86C		227
BDX87	BDX87		233
BDX87A	BDX87A		233
BDX87B	BDX87B		233
BDX87C	BDX87C		233
BDX88	BDX88		233
BDX88A	BDX88A		233
BDX88B	BDX88B		233
BDX88C	BDX88C		233
BDX91		BDW51A	193
BDX92		BDW52A	193
BDX93		BDW51B	193
BDX94		BDW52B	193
BDX95		BDW51C	193
BDX96		BDW52C	193
BDY45		BDX48	✶
BDY46		BDX48	✶
BDY47		BDX48	✶
BDY53		BDY57	239
BDY54		BDY58	239
BDY55		BDY57	239
BDY56		BDY58	239
BDY57	BDY57		239
BDY58	BDY58		239
BDY76		2N3772	1053
BDY80		BD241	155
BDY81		BD241A	155
BDY82		BD242	155
BDY83		BD242A	155

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BDY90	BDY90		241
BDY91	BDY91		241
BDY92	BDY92		241
BDY93		BU326	281
BDY94		BU326	281
BDY95		BU326	281
BDY96		BUX47	735
BDY87		2N6672	1167
BDY98		2N6671	1167
BFX34	BFX34		243
BSS44	BSS44		247
BSW67	BSW67		251
BSW68	BSW68		251
BU104		BU606	✶
BU104D		BU606D	✶
BU104DP		BU406D	291
BU106		BU607	✶
BU107		BU607	✶
BU109		BU607	✶
BU109D		BU607D	✶
BU109DP		BU407D	291
BU110		BU607	✶
BU111		BUW24	✶
BU125	BU125		255
BU125S	BU125S		259
BU126		BU326	281
BU129		BU606	✶
BU133		BU326	281
BU134		BU326	281
BU137		BUY69A	799
BU208	BU208		267
BU208A	BU208A		267
BU208D	BU208D		271
BU310		BU607	✶
BU311		BU607	✶
BU312		BU607	✶
BU322		BU920	329
BU322A		BU922	329
BU323		BU931R	337
BU323A		BU932R	337
BU325	BU325		277
BU326	BU326		281
BU326A	BU326A		281
BU326S	BU326S		✶
BU361		BUW35	575

INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
BU406	BU406		285
BU406D	BU406D		291
BU406H	BU406H		285
BU407	BU407		297
BU407D	BU407D		291
BU407H	BU407H		297
BU408	BU408		285
BU408D	BU408D		291
BU411		BU607D	✶
BU412		BU607D	✶
BU426	BU426		303
BU426A	BU426A		303
BU508	BU508		267
BU508A	BU508A		267
BU508D	BU508D		271
BU606	BU606		✶
BU606D	BU606D		✶
BU607	BU607		✶
BU607D	BU607D		✶
BU608	BU608		✶
BU608D	BU608D		✶
BU801	BU801		307
BU806	BU806		311
BU807	BU807		311
BU810	BU810		321
BU910	BU910		325
BU911	BU911		325
BU912	BU912		325
BU920	BU920		329
BU920P	BU920P		329
BU920T	BU920T		329
BU921	BU921		329
BU921P	BU921P		329
BU921T	BU921T		329
BU922	BU922		329
BU922P	BU922P		329
BU922T	BU922T		329
BU930		BU930R	✶
BU930P		BU930RP	✶
BU930Z		BU931Z	343
BU930ZP		BU931ZP	343
BU931		BU931R	337
BU931P		BU931RP	337
BU931R	BU931R		337
BU931RP	BU931RP		337

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INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
BU932		BU932R	337
BU932P		BU932RP	337
BU932R	BU932R		337
BU932RP	BU932RP		337
BU999	BU999		347
BUR20	BUR20		361
BUR21	BUR21		363
BUR22	BUR22		365
BUR23	BUR23		*
BUR24	BUR24		*
BUR50	BUR50		367
BUR50S	BUR50S		367
BUR51	BUR51		371
BUR52	BUR52		375
BUS12		BUW35	575
BUS13		BUX48	*
BUS13A		BUW46	597
BUT11	BUT11		379
BUT11A	BUT11A		379
BUT13	BUT13		385
BUT13P	BUT13P		385
BUT55		BUT921T	*
BUT57		BUT931RP	*
BUT60	BUT60		*
BUT62	BUT62		*
BUT70	BUT70		*
BUT72	BUT72		*
BUT90	BUT90		391
BUT91	BUT91		397
BUT92	BUT92		405
BUT92A	BUT92A		411
BUT100	BUT100		417
BUT102	BUT102		421
BUV18	BUV18		425
BUV19	BUV19		425
BUV20	BUV20		433
BUV21	BUV21		433
BUV22	BUV22		433
BUV23	BUV23		437
BUV24	BUV24		437
BUV25	BUV25		437
BUV26	BUV26		441
BUV27	BUV27		447
BUV28	BUV28		453
BUV37	BUV37		*

INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
BUV39	BUV39		*
BUV40	BUV40		467
BUV41	BUV41		475
BUV42	BUV42		483
BUV42A	BUV42A		491
BUV46	BUV46		495
BUV47	BUV47		735
BUV47A	BUV47A		735
BUV48	BUV48		745
BUV48A	BUV48A		745
BUV48B	BUV48B		755
BUV48C	BUV48C		755
BUV50	BUV50		497
BUV51	BUV51		505
BUV52	BUV52		513
BUV56	BUV56		525
BUV60	BUV60		529
BUV61	BUV61		537
BUV62	BUV62		545
BUV62A	BUV62A		553
BUW11	BUW11		*
BUW11A	BUW11A		*
BUW12	BUW12		561
BUW12A	BUW12A		561
BUW13	BUW13		*
BUW13A	BUW13A		*
BUW22		BUW22P	563
BUW22A		BUW22AP	563
BUW22AP	BUW22AP		563
BUW22P	BUW22P		563
BUW24	BUW24		*
BUW25	BUW25		*
BUW26	BUW26		*
BUW32	BUW32		569
BUW32A	BUW32A		569
BUW32AP	BUW32AP		569
BUW32P	BUW32P		569
BUW34	BUW34		575
BUW35	BUW35		575
BUW36	BUW36		575
BUW38	BUW38		583
BUW39	BUW39		583
BUW42	BUW42		593
BUW42A	BUW42A		593
BUW42AP	BUW42AP		593

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INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
BUW42P	BUW42P		593
BUW44	BUW44		597
BUW45	BUW45		597
BUW46	BUW46		597
BUW48	BUW48		601
BUW49	BUW49		601
BUW50	BUW50		609
BUW51	BUW51		617
BUW52	BUW52		625
BUW57		BUX10	665
BUW58		BUX11N	675
BUW60	BUW60		*
BUW61	BUW61		*
BUW62	BUW62		*
BUW66	BUW66		*
BUW67	BUW67		*
BUW73		BUX11	671
BUW89	BUW89		633
BUW90	BUW90		641
BUW91	BUW91		649
BUW92	BUW92		657
BUX10	BUX10		665
BUX10P	BUX10P		669
BUX10S		BUX10	665
BUX11	BUX11		671
BUX11N	BUX11N		675
BUX11S		BUX11	671
BUX12	BUX12		679
BUX13	BUX13		683
BUX14	BUX14		685
BUX15		BUW44	597
BUX16		BUW24	*
BUX16A		BUW24	*
BUX16B		BUW24	*
BUX16C		BUW24	*
BUX17		BUX41N	723
BUX17A		BUX42	727
BUX17B		BUW44	597
BUX17C		BUW44	597
BUX18		BUX41	719
BUX18A		BUX42	727
BUX18B		BUW35	575
BUX18C		BUW35	575
BUX20	BUX20		687
BUX20S	BUX20S		*

INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
BUX22	BUX22		695
BUX23	BUX23		699
BUX24	BUX24		705
BUX25	BUX25		711
BUX28		BU920	329
BUX29		BU921	329
BUX37		BU931R	337
BUX40	BUX40		715
BUX41	BUX41		719
BUX41N	BUX41N		723
BUX41S		BUX41	719
BUX42	BUX42		727
BUX43	BUX43		731
BUX44	BUX44		733
BUX46		BU236	*
BUX47	BUX47		735
BUX47A	BUX47A		735
BUX48	BUX48		745
BUX48A	BUX48A		745
BUX48B	BUX48B		755
BUX48C	BUX48C		755
BUX77	BUX77		*
BUX78	BUX78		*
BUX80	BUX80		761
BUX82	BUX82		*
BUX84	BUX84		765
BUX84A	BUX84A		765
BUX85	BUX85		*
BUX97B	BUX97B		*
BUX98	BUX98		767
BUX98A	BUX98A		767
BUX98B	BUX98B		769
BUX98C	BUX98C		769
BUX348	BUX348		779
BUY18S	BUY18S		*
BUY47	BUY47		785
BUY48	BUY48		785
BUY49P	BUY49P		789
BUY49S	BUY49S		791
BUY57	BUX40		715
BUY58	BUX41N		723
BUY68	BUY68		795
BUY69A	BUY69A		799
BUY69B	BUY69B		799
BUY69C	BUY69C		799

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INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
D44C1	D44C1		801
D44C2	D44C2		801
D44C3	D44C3		801
D44C4	D44C4		801
D44C5	D44C5		801
D44C6	D44C6		801
D44C7	D44C7		801
D44C8	D44C8		801
D44C9	D44C9		801
D44C10	D44C10		801
D44C11	D44C11		801
D44H1	D44H1		803
D44H2	D44H2		803
D44H4	D44H4		803
D44H5	D44H5		803
D44H7	D44H7		803
D44H8	D44H8		803
D44H10	D44H10		803
D44H11	D44H11		803
D44Q1	D44Q1		805
D44Q3	D44Q3		805
D44Q5	D44Q5		805
D45H1	D45H1		807
D45H2	D45H2		807
D45H4	D45H4		807
D45H5	D45H5		807
D45H7	D45H7		807
D45H8	D45H8		807
D45H10	D45H10		807
MJ424		BUW35	575
MJ425		BUW35	575
MJ802	MJ802		809
MJ900	MJ900		815
MJ901	MJ901		815
MJ1000	MJ1000		815
MJ1001	MJ1001		815
MJ2500	MJ2500		817
MJ2501	MJ2501		817
MJ2955	MJ2955		819
MJ3000	MJ3000		817
MJ3001	MJ3001		817
MJ3029		BUW24	✶
MJ3030		BUW25	✶
MJ3040		BU920	329
MJ3041		BU920	329

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MJ3042		BU922	329
MJ4030	MJ4030		821
MJ4031	MJ4031		821
MJ4032	MJ4032		821
MJ4033	MJ4033		821
MJ4034	MJ4034		821
MJ4035	MJ4035		821
MJ4502	MJ4502		809
MJ10000		BU931R	337
MJ10000		MJ10004	823
MJ10001		BU931R	337
MJ10001		MJ10005	823
MJ10002		BU920P	329
MJ10003		BU921P	329
MJ10004	MJ10004		823
MJ10004P	MJ10004P		823
MJ10005	MJ10005		823
MJ10005P	MJ10005P		823
MJ10012		BU931R	337
MJ11011	MJ11011		825
MJ11012	MJ11012		825
MJ11013	MJ11013		825
MJ11014	MJ11014		825
MJ11015	MJ11015		825
MJ11016	MJ11016		825
MJ13014		BUW34	575
MJ13015		BUW34	575
MJ13015		BUW34	575
MJ13330		BUX41	719
MJ13331		BUX42	727
MJ13332		BUV23	437
MJ13333		BUV24	437
MJ13334		BUV24	437
MJE170	MJE170		829
MJE171	MJE171		829
MJE172	MJE172		829
MJE180	MJE180		829
MJE181	MJE181		829
MJE182	MJE182		829
MJE200	MJE200		833
MJE210	MJE210		833
MJE340	MJE340		837
MJE350	MJE350		837
MJE371	MJE371		845
MJE520	MJE520		841

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MJE521	MJE521		845
MJE700	MJE700		849
MJE701	MJE701		849
MJE702	MJE702		849
MJE703	MJE703		849
MJE800	MJE800		849
MJE801	MJE801		849
MJE802	MJE802		849
MJE803	MJE803		849
MJE2955T	MJE2955T		853
MJE3055T	MJE3055T		853
MJE3439	MJE3439		855
MJE3440	MJE3440		855
MJE13002		SGS13002	877
MJE13003		SGS13003	877
MJE13004	MJE13004		859
MJE13005	MJE13005		859
MJE13006	MJE13006		863
MJE13007A	MJE13007A		863
MJE13008	MJE13008		871
MJE13009	MJE13009		871
SE9300		BDW93A	205
SE9301		BDW93B	205
SE9302		BDW93C	205
SE9303		BDX87A	233
SE9304		BDX87B	233
SE9305		BDX87C	233
SE9400		BDW94A	205
SE9401		BDW94B	205
SE9402		BDW94C	205
SE9403		BDX88A	233
SE9404		BDX88B	233
SE9405		BDX88C	233
SGS110	SGS110		1017
SGS111	SGS111		1017
SGS112	SGS112		1017
SGS115	SGS115		1017
SGS116	SGS116		1017
SGS117	SGS117		1017
SGS120	SGS120		✶
SGS121	SGS121		✶
SGS122	SGS122		✶
SGS125	SGS125		✶
SGS126	SGS126		✶
SGS127	SGS127		✶

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SGS130	SGS130		1029
SGS131	SGS131		1029
SGS132	SGS132		1029
SGS135	SGS135		1029
SGS136	SGS136		1029
SGS137	SGS137		1029
SGS910	SGS910		✶
SGS911	SGS911		✶
SGS912	SGS912		✶
SGS3055	SGS3055		✶
SGS3439		MJE3439	855
SGS3440		MJE3440	855
SGS6386	SGS6386		✶
SGS6387	SGS6387		✶
SGS6388	SGS6388		✶
SGS10004	SGS10004		✶
SGS10004P	SGS10004P		✶
SGS10005	SGS10005		✶
SGS10005P	SGS10005P		✶
SGS13002	SGS13002		877
SGS13002T	SGS13002T		877
SGS13003	SGS13003		877
SGS13003T	SGS13003T		877
SGSD100	SGSD100		855
SGSD200	SGSD200		855
SGSD310	SGSD310		889
SGSD311	SGSD311		889
SGSD00020	SGSD00020		895
SGSD00030	SGSD00030		897
SGSD00031	SGSD00031		897
SGSD000055	SGSD000055		905
SGSF321	SGSF321		907
SGSF323	SGSF323		913
SGSF324	SGSF324		919
SGSF341	SGSF341		931
SGSF343	SGSF343		937
SGSF344	SGSF344		943
SGSF421	SGSF421		907
SGSF423	SGSF423		913
SGSF424	SGSF424		919
SGSF425	SGSF425		925
SGSF441	SGSF441		931
SGSF443	SGSF443		937
SGSF444	SGSF444		943
SGSF445	SGSF445		949

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SGSF461	SGSF461		955
SGSF463	SGSF463		961
SGSF464	SGSF464		967
SGSF465	SGSF465		973
SGSF541	SGSF541		931
SGSF543	SGSF543		937
SGSF544	SGSF544		943
SGSF545	SGSF545		949
SGSF561	SGSF561		955
SGSF563	SGSF563		961
SGSF564	SGSF564		967
SGSF565	SGSF565		973
SGSF661	SGSF661		979
SGSF663	SGSF663		983
SGSF664	SGSF664		987
SGSF665	SGSF665		991
SGSIF321	SGSIF321		907
SGSIF323	SGSIF323		913
SGSIF324	SGSIF324		919
SGSIF325	SGSIF325		925
SGSIF341	SGSIF341		931
SGSIF343	SGSIF343		937
SGSIF344	SGSIF344		943
SGSIF345	SGSIF345		949
SGSIF421	SGSIF421		907
SGSIF423	SGSIF423		913
SGSIF424	SGSIF424		919
SGSIF425	SGSIF425		925
SGSIF441	SGSIF441		931
SGSIF443	SGSIF443		937
SGSIF444	SGSIF444		943
SGSIF445	SGSIF445		949
SGSIF461	SGSIF461		955
SGSIF463	SGSIF463		961
SGSIF464	SGSIF464		967
SGSIF465	SGSIF465		973
TIP29	TIP29		✶
TIP29A	TIP29A		✶
TIP29B	TIP29B		✶
TIP29C	TIP29C		✶
TIP30	TIP30		✶
TIP30A	TIP30A		✶
TIP30B	TIP30B		✶
TIP30C	TIP30C		✶
TIP31	TIP31		995

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TIP31A	TIP31A		995
TIP31B	TIP31B		995
TIP31C	TIP31C		995
TIP32	TIP32		995
TIP32A	TIP32A		995
TIP32B	TIP32B		995
TIP32C	TIP32C		995
TIP33	TIP33		✶
TIP33A	TIP33A		999
TIP33B	TIP33B		999
TIP33C	TIP33C		999
TIP34	TIP34		✶
TIP34A	TIP34A		999
TIP34B	TIP34B		999
TIP34C	TIP34C		999
TIP35	TIP35		1001
TIP35A	TIP35A		1001
TIP35B	TIP35B		1001
TIP35C	TIP35C		1001
TIP36A	TIP36A		1001
TIP36B	TIP36B		1001
TIP36C	TIP36C		1001
TIP41	TIP41		1003
TIP41A	TIP41A		1003
TIP41B	TIP41B		1003
TIP41C	TIP41C		1003
TIP42	TIP42		1003
TIP42A	TIP42A		1003
TIP42B	TIP42B		1003
TIP42C	TIP42C		1003
TIP47	TIP47		1005
TIP48	TIP48		1005
TIP49	TIP49		1005
TIP50	TIP50		1005
TIP51	TIP51		1009
TIP52	TIP52		1009
TIP53	TIP53		1009
TIP54	TIP54		1009
TIP73		BD905	185
TIP73A		BD907	185
TIP73B		BD909	185
TIP73C		BD911	185
TIP74		BD906	185
TIP74A		BD908	185
TIP74B		BD910	185

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INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
TIP74C		BD912	185
TP100	TIP100		1011
TIP101	TIP101		1011
TIP102	TIP102		1011
TIP105	TIP105		1011
TIP106	TIP106		1011
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TIP110	TIP110		1017
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TIP112	TIP112		1017
TIP115	TIP115		1017
TIP116	TIP116		1017
TIP117	TIP117		1017
TIP120	TIP120		1023
TIP121	TIP121		1023
TIP122	TIP122		1023
TIP125	TIP125		1023
TIP126	TIP126		1023
TIP127	TIP127		1023
TIP130	TIP130		1029
TIP131	TIP131		1029
TIP132	TIP132		1029
TIP135	TIP135		1029
TIP136	TIP136		1029
TIP137	TIP137		1029
TIP140	TIP140		1031
TIP140T	TIP140T		1035
TIP141	TIP141		1031
TIP141T	TIP141T		1035
TIP142	TIP142		1031
TIP142T	TIP142T		1035
TIP145	TIP145		1031
TIP145T	TIP145T		1035
TIP146	TIP146		1031
TIP146T	TIP146T		1035
TIP147	TIP147		1031
TIP147T	TIP147T		1035
TIP150		BU910	325
TIP151		BU910	325
TIP152		BU911	325
TIP660		BU920	329
TIP661		BU920	329
TIP662		BU921	329
TIP2955	TIP2955		1037
TIP3055	TIP3055		1037

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2N3055	2N3055		1039
2N3418	2N3418		✶
2N3419	2N3419		✶
2N3420	2N3420		✶
2N3421	2N3421		✶
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2N3446		BDW51B	193
2N3553		BUY68	795
2N3554		BUY68	795
2N3713	2N3713		1047
2N3714	2N3714		1047
2N3715	2N3715		1047
2N3716	2N3716		1047
2N3719		BSS44	247
2N3720		BSS44	247
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2N4235	2N4235		1057
2N4236	2N4236		1057
2N4398	2N4398		✶
2N4399	2N4399		✶
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2N4896	2N4896		1059
2N4897	2N4897		1059
2N4918	2N4918		1063
2N4919	2N4919		1063
2N4920	2N4920		1063
2N4921	2N4921		1063
2N4922	2N4922		1063
2N4923	2N4923		1063
2N5038	2N5038		1067
2N5039	2N5039		1067
2N5151	2N5151		1073
2N5252	2N5252		1075
2N5153	2N5153		1073

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INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
2N5154	2N5154		1075
2N5157		BUW35	575
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2N5191	2N5191		1077
2N5192	2N5192		1077
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2N5301	2N5301		1083
2N5302	2N5302		1083
2N5303	2N5303		1083
2N5333		BSS44	247
2N5334		BUY68	795
2N5335		BUY47	785
2N5336	2N5336		1089
2N5337	2N5337		1089
2N5338	2N5338		1089
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2N5415	2N5415		1093
2N5416	2N5416		1093
2N5490		BD705	179
2N5492		BD707	179
2N5494		BD705	179
2N5496		BD709	179
2N5629	2N5629		1097
2N5655	2N5655		1103
2N5656	2N5656		1103
2N5657	2N5657		1103
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2N5682	2N5682		1113
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2N5782		BSS44	247
2N5783		BSS44	247
2N5784		BUY68	795
2N5785		BUY68	795
2N5875	2N5875		1115
2N5876	2N5876		1115
2N5877	2N5877		1115
2N5878	2N5878		1115
2N5879		BDW52A	193

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2N5880		BDW52B	193
2N5881		BDW51A	193
2N5882		BDW51B	193
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2N6040	2N6040		✶
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2N6125	2N6125		1143
2N6126	2N6126		1143
2N6226		BDW52C	193
2N6246		BDW52A	193
2N6247		BDW52B	193
2N6249		BUX41	719

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INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
2N6250		BUX42	727
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2N6275		BUV20	433
2N6276		BUV21	433
2N6277		BUV21	433
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2N6308		BUW35	575
2N6338		BUX10	665
2N6339		BUX10	665
2N6340		BUX11N	675
2N6341		BUX11N	675
2N6383		BDX87	233
2N6384		BDX87A	233
2N6385		BDX87B	233
2N6386	2N6386		1153
2N6387	2N6387		1153
2N6388	2N6388		1153
2N6470		BDW51	193
2N6471		BDW51A	193
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2N6473		BD711	179
2N6475		BD712	179
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2N6649		BDX88A	233
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2N6667		BDX54A	217
2N6668		BDX54B	217
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2SA496		2N4918	1063
2SA505		2N4919	1063
2SA626		BDW52B	193
2SA627		BDW52B	193
2SA657		BDW52C	193
2SA658		BDW52B	193
2SA663		BDW52C	193
2SA671		BD242A	155
2SA680		BDW52B	193
2SA682		BD180	143
2SA699		TIP30	✶
2SA699A		TIP30A	✶
2SA700		TIP30	✶
2SA715		MJE170	829
2SA738		MJE170	829
2SA743		BD238	149
2SA748		BD240B	153
2SA755		BD240A	153
2SA756		BDW52C	193
2SA768		BD242A	155
2SA769		BD242B	155
2SA770		2N6109	1140
2SA771		2N6107	1140
2SA775		TIP30C	✶

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INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
2SA779		BD438	169
2SA780		BD440	169
2SA780A		BD442	169
2SA795		MJE350	837
2SA807		2N3789	1047
2SA808		2N3790	1047
2SA815		TIP30C	✶
2SA816		TIP30B	✶
2SA837		BDW52C	193
2SA877		2N5876	1115
2SA885		BD438	163
2SA886		BD438	163
2SA887		BD242B	155
2SA898		MJE350	837
2SA899		MJE350	837
2SA900		MJE210	833
2SA922		2N4918	1063
2SA939		MJE350	837
2SA963		MJE171	829
2SA966		TIP32	995
2SA1008		TIP32C	995
2SA1010		TIP42C	1003
2SA1012		TIP42A	1003
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2SA1046		2N6052	1137
2SA1069		TIP42B	1003
2SA1110		MJE350	837
2SB434		BD244A	157
2SB435		BD244	157
2SB507		BD242A	155
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2SB587		2N6050	1137
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2SB595		BD712	179
2SB596		BD244B	157
2SB604		BD244B	157
2SB631		2N4920	1063
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2SB638		BDX88C	233
2SB639		BDX88C	233
2SB648		MJE350	837
2SB655		BUW42	593
2SB668		TIP32A	995
2SB669		TIP32B	995
2SB673		BDW94C	205
2SB674		BDW94B	205
2SB675		BDW94A	205
2SB676		TIP127	1023
2SB677		TIP125	1023
2SB679		TIP117	1017
2SB681		BUW42	593
2SB686		TIP36C	1001

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INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
2SB689		TIP42C	1003
2SB690		TIP42C	1003
2SB693		2N6287	1149
2SB694		MJ11015	825
2SB696		BUW42	593
2SB697		BUW42	593
2SB707		2N6107	1140
2SB708		2N6107	1140
2SB711		2N6041	✶
2SB712		2N6042	1135
2SB717		MJE350	837
2SB718		MJE350	837
2SB722		BUW42	593
2SB724		TIP32A	995
2SB743		MJE170	829
2SB744		MJE172	829
2SB750		TIP115	1017
2SB751		BDX54B	217
2SB753		BD912	185
2SB754		TIP36A	1001
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2SB833		MJ11013	825
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2SB855		TIP32A	995
2SB856		TIP32A	995
2SC407		BUX41	719
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2SC411		BUX43	731
2SC412		BUX43	731
2SC431		BUX21	691
2SC432		BUX21	691
2SC433		BUX22	695
2SC434		BUX22	695
2SC495		2N4923	1063
2SC496		2N4921	1063
2SC558		BUW24	✶
2SC646		2N3055	1039
2SC647		BDW51B	193
2SC664		BDW51C	193
2SC675		BUW34	575
2SC676		BUW34	575
2SC677		BUW34	575
2SC678		BUW34	575

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2SC681		BUW34	575
2SC758		BUW34	575
2SC759		BUW34	575
2SC760		BUW34	575
2SC768		2N3055	1039
2SC789		TIP31B	995
2SC790		TIP31A	995
2SC791		TIP31C	995
2SC793		BDW51C	193
2SC794		BDW51C	193
2SC861		BUW25	✶
2SC885		BU326	281
2SC886		BU326	281
2SC887		BU326	281
2SC901		BU326	281
2SC901A		BU326	281
2SC902		BU326	281
2SC931		BD241A	155
2SC932		BD241	155
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2SC939		BU326	281
2SC940		BU326	281
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2SC999		BU208	267
2SC1004		BU208	267
2SC1004A		BU208	267
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2SC1050		BU236	✶
2SC1060		TIP31A	995
2SC1061		TIP31A	995
2SC1080		BDW51C	193
2SC1086		BU208	267
2SC1088		MJE3439	855
2SC1089		MJE3439	855
2SC1099		BU208	267
2SC1100		BU208	267
2SC1101		BU208	267
2SC1106		BU326	281
2SC1107		BD243B	157
2SC1108		BS243C	157
2SC1109		BD243B	157
2SC1110		BD243C	157
2SC1114		BU326	281

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2SC1130		BU326	281
2SC1131		BU326	281
2SC1132		BU208	267
2SC1133		BU208	267
2SC1140		BUW45	597
2SC1141		BUW45	597
2SC1142		BUW35	575
2SC1143		BUW35	575
2SC1151		BU208	267
2SC1153		BU208	267
2SC1154		BU208	267
2SC1162		MJE180	829
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2SC1171		BU208	267
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2SC1308		BU208	267
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2SC1382		MJE182	829
2SC1398		BD239B	153
2SC1409		TIP47	1005
2SC1410		TIP47	1005
2SC1413		BU208	267
2SC1413A		BU208	267

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2SC1418		TIP31A	995
2SC1419		TIP31A	995
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2SC1440		BUW44	597
2SC1441		BUW44	597
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2SC1469		BUW34	999
2SC1477		BUW34	999
2SC1501		MJE3439	855
2SC1505		TIP48	1005
2SC1506		TIP48	1005
2SC1507		TIP48	1005
2SC1514		MJE3439	855
2SC1516		BD437	163
2SC1517		BD439	169
2SC1517A		BD441	169
2SC1565		MJE340	837
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2SC1578		BUW35	575
2SC1579		BUW44	597
2SC1580		BUW45	597
2SC1584		BUX41	719
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2SC1586		BUX42	727
2SC1617		BU326	281
2SC1618		BDW51B	193
2SC1619		BDW51C	193
2SC1625		TIP29C	*
2SC1626		TIP29B	*
2SC1667		BDW51C	193
2SC1669		TIP47	1005
2SC1672		BUX11N	675
2SC1683		TIP47	1005
2SC1722		TIP48	1005
2SC1723		TIP48	1005
2SC1749		MJE340	837
2SC1768		BU931R	337
2SC1777		2N3055	1039
2SC1785		BUX41	719

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INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
2SC1786		BUX42	727
2SC1818		BUX11N	675
2SC1826		TIP41B	1003
2SC1827		TIP41C	1003
2SC1829		BU931R	337
2SC1831		2N6056	✶
2SC1832		BU932R	337
2SC1846		MJE180	829
2SC1847		MJE181	829
2SC1848		BD241B	155
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2SC1880		TIP112	1017
2SC1881		TIP110	1017
2SC1883		TIP122	1023
2SC1891		BU208	267
2SC1892		BU208	267
2SC1893		BU208	267
2SC1894		BU208	267
2SC1922		BU208	267
2SC1929		TIP48	1005
2SC1942		BU208	267
2SC1983		TP111	1017
2SC1984		TIP112	1017
2SC1985		TIP41B	1003
2SC1986		TIP41C	1003
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INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
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2SD52		BDW51C	193
2SD68		BDW51C	193
2SD73		BDW51C	193
2SD80		BDW51C	193
2SD81		BDW51C	193

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INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
2SD88		BDW51C	193
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2SD108		MJ1001	815
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2SD119		BDW51C	193
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∗ Datasheet available on request

INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
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2SD570		BD241B	155
2SD574		MJ11016	825
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INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
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2SD687		TIP121	1023
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2SD731		BUW44	597

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INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
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2SD761		TIP47	1005
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2SD823		BU408	285
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2SD1061		D44H8	803
2SD1062		D44H8	803
2SD1069		BU407D	291
2SD1131		D44H8	863
2SD1132		D44H8	803
2SD1163		BU406	285
2SD1163A		BU406	285
2SD1201		BU932R	337
2SD1203		BU930Z	✶

✶ Datasheet available on request

B	Bandwidth
C_{CBO}	Collector-base capacitance (emitter open to a.c. and d.c.)
d	Distortion
$E_{s/b}$	Second breakdown energy (with base-emitter junction reverse biased)
f	Frequency
f_T	Transition frequency
G_v	Voltage gain
h_{fe}	Common emitter, small-signal value of the short-circuit forward current transfer ratio
h_{FE}	Common emitter, static value of the forward current transfer ratio
h_{FE1}/h_{FE2}	Common emitter, static value of the forward current transfer matched pair ratio
I_B	Base current
I_{B1}	Turn-on current
I_{B2}	Turn-off current
I_{BF}	Base forward current
I_{BFM}	Base forward peak current
I_{BM}	Base peak current
I_{BR}	Base reverse current
I_{BRM}	Base reverse peak current
I_C	Collector current
I_{CBO}	Collector cut-off current with emitter open
I_{CEO}	Collector cut-off current with base open
I_{CER}	Collector cut-off current with specified resistance between emitter and base
I_{CES}	Collector cut-off current with emitter short-circuited to base
I_{CEV}	Collector cut-off current with specified reverse voltage between emitter and base
I_{CEX}	Collector cut-off current with specified circuit between emitter and base
I_{CM}	Collector peak current
I_{CRMS}	RMS collector current
I_d	Drain current
I_E	Emitter current
I_{EBO}	Emitter cut-off current with collector open
I_F	Continuous DC forward current
I_{FM}	Peak forward current
I_R	Continuous DC reverse current
I_{RM}	Peak reverse current
I_{RSM}	Surge non-repetitive reverse current
$I_{s/b}$	Second breakdown collector current (with base-emitter junction forward biased)
P_o	Output power of a specified circuit
P_{tot}	Total power dissipation
R_{BB}	Base dropping resistance
R_{BE}	Resistance between base and emitter
R_{CC}	Collector dropping resistance
R_{EE}	Emitter dropping resistance
R_L	Load resistance
r_s	Series resistance
R_{th}	Thermal resistance
$R_{th\ j\text{-}amb}$	Thermal resistance junction-to-ambient
$R_{th\ j\text{-}case}$	Thermal resistance junction-to-case
T_{amb}	Ambient temperature
T_{case}	Case temperature
T_j	Junction temperature
T_{stg}	Storage temperature
t	Time
t_c	Crossover time
t_d	Delay time
t_f	Fall time

t_{off}	Turn-off time
t_{on}	Turn-on time
t_p	Pulse width
t_r	Rise time
r_{rr}	Reverse recovery time of a diode
t_s	Storage time
V_{BE}	Base-emitter voltage
$V_{BE\ (sat)}$	Base-emitter saturation voltage
$V_{(BR)\ CBO}$	Collector-base breakdown voltage with emitter open
$V_{(BR)\ CEO}$	Collector-emitter breakdown voltage with base open
$V_{(BR)\ CER}$	Collector-emitter breakdown voltage with specified resistance
$V_{(BR)\ CES}$	Collector-emitter breakdown voltage with emitter short-circuited to base
$V_{(BR)\ CEV}$	Collector-emitter breakdown voltage with specified reverse voltage between emitter and base, $r_s = 0$
$V_{(BR)\ CEX}$	Collector-emitter breakdwon voltage with specified circuit between emitter and base
$V_{(BR)EBO}$	Emitter-base breakdown voltage with collector open
V_{CB}	Collector-base voltage
V_{CBO}	Collector-base voltage with emitter open
V_{CC}	Collector DC voltage supply
V_{CE}	Collector-emitter voltage
V_{CEK}	Knee voltage at specified condition
V_{CEO}	Collector-emitter voltage with base open
$V_{CEO(sus)}$	Collector-emitter sustaining voltage with base open
V_{CER}	Collector-emitter voltage with specified resistance between emitter and base
$V_{CER(sus)}$	Collector-emitter sustaining voltage with specified resistance between emitter and base
$V_{CE(sat)}$	Collector-emitter saturation voltage
V_{CES}	Collector-emitter voltage with emitter short-circuited to base
V_{CEV}	Collector-emitter voltage with specified reverse voltage between emitter and base
$V_{CEV(sus)}$	Collector-emitter sustaining voltage with specified reverse voltage between emitter and base
V_{CEW}	Maximum collector-emitter voltage at turn-off with a specified current without snubber
$V_{CEX(sus)}$	Collector-emitter sustaining voltage with specified circuit between emitter and base
V_{EB}	Emitter-base voltage
V_{EBO}	Emitter-base voltage with collector open
V_F	Continuous DC forward voltage
V_{FM}	Forward transient voltage
V_I	Input voltage of a specified circuit
V_R	Continuous DC reverse voltage
V_{RM}	Peak reverse voltage
V_{RRM}	Repetitive peak reverse voltage
Z_{BE}	Impedance between base and emitter
Z_I	Input impedance
ΔT	Temperature variation
δ	Duty cycle
ω	Angular frequency

A. DEFINITIONS OF TERMS USED

a. **Electronic device.** An electronic tube or valve, transistor or other semiconductor device.
Note: This definition excludes inductors, capacitors, resistors and similar components.

b. **Characteristic.** A characteristic is an inherent and measurable property of a device. Such a property may be electrical, mechanical, thermal, hydraulic, electro-magnetic, or nuclear and can be expressed as a value for stated or recognized conditions. A characteristic may also be a set of related values, usually shown in graphical form.

c. **Bogey electronic device.** An electronic device whose characteristics have the published nominal values for the type. A bogey electronic device for any particular application can be obtained by considering only those characteristics which are directly related to the application.

d. **Rating.** A value which establishes either a limiting capability or a limiting condition for an electronic device. It is determinate for specified values of environment and operation, and may be stated in any suitable terms.
Note: Limiting conditions may be either maxima or minima.

e. **Rating system.** The set of principles upon which ratings are established and which determines their interpretation.
Note: The rating system indicates the division of responsibility between the device manufacturer and the circuit designer, with the object of ensuring that the working conditions do not exceed the ratings.

B. ABSOLUTE MAXIMUM RATING SYSTEM

Absolute maximum ratings are limiting values of operating and environmental conditions applicable to any electronic device of a specified type as defined by its published data, which should not be exceeded under the worst probable conditions.
These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environmental variations, and the effects of changes in operating conditions due to variations in the characteristcs of the device under consideration and of all other electronic devices in the equipment
The equipment manufacturer should design so that, initially and throughout life, no absolute maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, equipment control adjustment, load variations, signal variation, environmental conditions, and variation in characteristics of the device under consideration and of all other electronic devices in the equipment.

C. DESIGN - MAXIMUM RATING SYSTEM

Design-maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.
These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in the characteristics of the electronic device under consideration.
The equipment manufacturer should design so that, initially and throughout life, no design-maximum value for the intended service is exceeded with a bogey device under the worst probable operating conditions with respect to supply-voltage variation equipment, component variation, variation in characteristics of all other devices in the equipment, equipment control adjustment, load variation, signal variation and environmental conditions.

D. DESIGN - CENTRE RATING SYSTEM

Design-centre ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under normal conditions.
These values are chosen by the device manufacturer to provide acceptable serviceability of the device in average applications, taking responsibilty for normal changes in operating conditions due to rated supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in the characteristics of all electronic devices.
The equipment manufacturer should design so that, initially, no design-centre value for the intended service is exceeded with a bogey electronic device in equipment operating at the stated normal supply-voltage.

The Absolute Maximum Rating System is commonly used for semiconductor devices.

PRECAUTIONS FOR PHYSICAL HANDLING OF POWER PLASTIC TRANSISTOR [TO-220, ISOWATT220, TO-218 (SOT-93), ISOWATT218, TO-126 (SOT-32), SOT-82, SOT-194]

When mounting power transistors certain precautions must be taken in operations such as bending of leads, mounting of heatsink, soldering and removal of flux residue. If these operations are not carried out correctly, the device can be damaged or reliability compromised.

1. **Bending and cutting leads**
The bending or cutting of the leads requires the following precautions:

1.1. When bending the leads they must be clamped tightly between the package and the bending point to avoid strain on the package (in particular in the area where the leads enter the resin) (fig. 1). This also applies to cutting the leads (fig. 2).

1.2. The leads must be bent at a minimum distance of 3 mm from the package (fig. 3a).

1.3. The leads should not be bent at an angle of more than 90° and they must be bent only once (fig. 3b).

1.4. The leads must never be bent laterally (fig. 3c).

1.5. Check that the tool used to cut or form the leads does not damage them or ruin their surface finish.

2. **Mounting on printed circuit**
During mounting operations be careful not to apply stress to the power transistor.

2.1. Adhere strictly to the pin spacing of the transistor to avoid forcing the leads.

2.2. Leave a suitable space between printed circuit and transistor, if necessary use a spacer.

2.3. When fixing the device to the printed circuit do not put mechanical stress on the transistor. For this purpose the device should be soldered to the printed circuit board after the transistor has been fixed to the heatsink and the heatsink to the printed circuit board.

Figure 1 - Bending the Leads

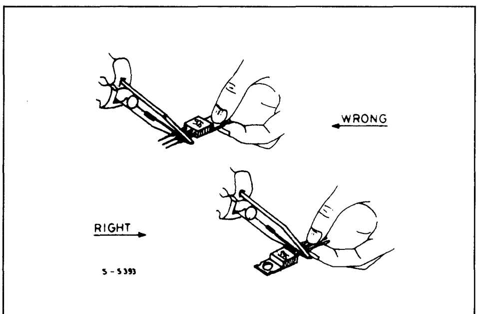


Figure 2 - Lead Forming or Cutting Mechanism

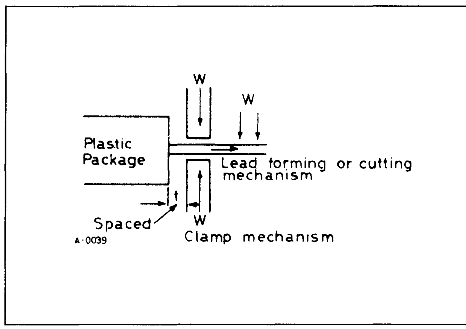
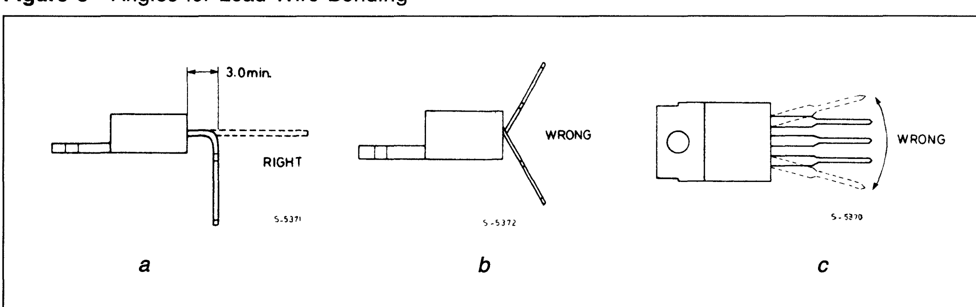


Figure 3 - Angles for Lead Wire Bending



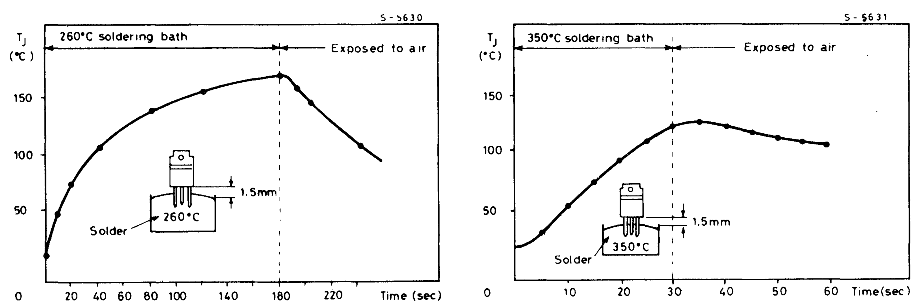
3. Soldering

In general a transistor should never be exposed to high temperature for any length of time. It is therefore preferable to use soldering methods where the transistor is exposed to the lowest possible temperatures for a short time.

3.1. Tolerable conditions are 260°C for 10 sec or 350° for 3 sec. The graphs in fig. 4 give an idea of the excess junction temperature during the soldering process for a TO-220 (Versawatt). It is also important to use suitable fixes for the tin baths to avoid deterioration of the leads or of the package resin.

3.2. An excess of residual flux between the pins of the transistor or in contact with the resin can reduce the long-term reliability of the device. The solvent for removing excess flux must be chosen with care. The use of solvents derived from trichloroethylene is not recommended on plastic packages because the residue can cause corrosion.

Figure 4 - Junction Temperatures During Soldering



4. Mounting at heatsink

To exploit best the performance of power transistor a heatsink with R_{th} suitable for the power that the transistor will dissipate must be used.

4.1. The plastic packages used by SGS-THOMSON for its power transistor (SOT-32, SOT-82, SOT-194, TO-220, ISOWATT220, TO-218, ISOWATT218) provide for the use of a single screw to fix the package to the heatsink. A compression spring (clip) can be sufficient as an alternative (fig. 5).

The screw should be properly tightened to ensure good contact between the back of the package and the heatsink but should not be too tight to avoid deformation of the copper part (tab) of the package causing breaking of the die or separation of the resin from the tab.

4.2. The contact R_{th} between device and heatsink can be improved by inserting a thin layer of silicone grease with fluidity sufficient to guarantee perfectly uniform distribution on the surface of the tab. The thermal resistance with and without silicone grease is given in fig. 6. An excessively thick layer or an excessive viscosity of the grease can degrade the R_{th}.

Figure 5 - SOT-93 mounting examples

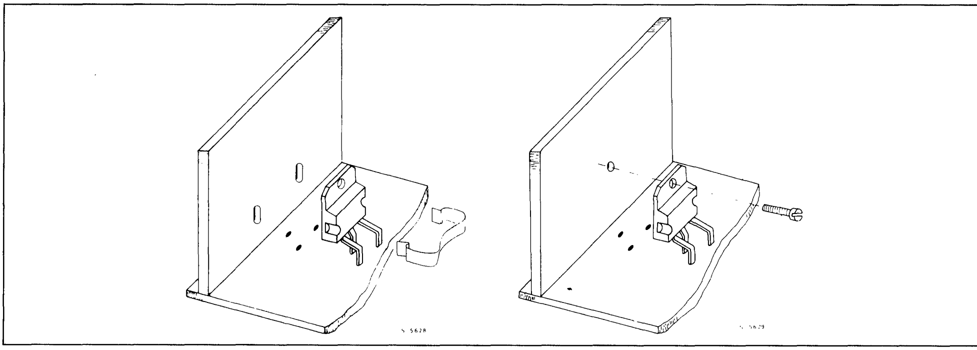
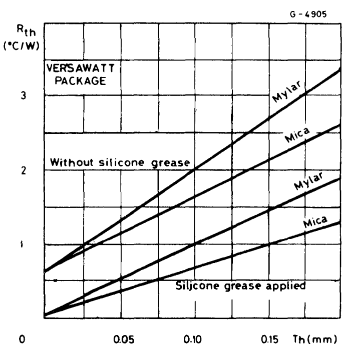


Figure 6 - Contact thermal resistance vs. insulator thickness.



5. Heatsink problems

The most important aspect from the point of view of reliability of a power transistor is that the heatsink should be dimensioned to keep the T_j of the device as low as possible. From the mechanical point of view, however, the heatsink must be realized so that it does not damage the device.

5.1. The planarity of the contact surface between device and heatsink must be $<25\mu m$ for TO-220, ISOWATT220, TO-218, ISOWATT218, TO-126 (SOT-32), SOT-82, SOT-194.

5.2. If self threading screws are used there must be an outlet for the material that is deformed during formation of the thread. The diameter ∅ 1 (fig. 7) must be large enough to avoid distortion of the tab during tightening. For this purpose it may be useful to insert a washer or use of the type shown in fig. 8 where the pressure on the tab is distributed on a much larger surface. Sometimes when the hole in the heatsink is formed with a punch, around the hole or hollow there may be a ring which is lower than the heatsink surface.
This is dangerous because it may lead to distortion of the tab as mentioned before.

5.3. A very serious problem is that of the rigidity between heatsink, device and printed circuit board. Once the device and the heatsink are mechanically connected, and the heatsink is fixed to the apparatus frame, the device and the PCB are bound together by the leads of the devices. A solution of this type is extremely dangerous.

Figure 8 - Suggested Screw

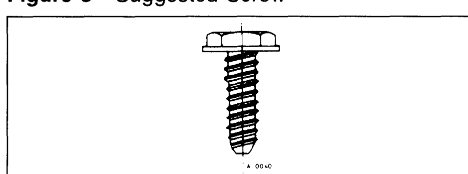
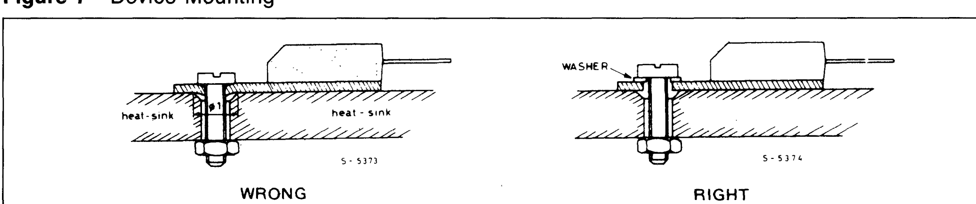
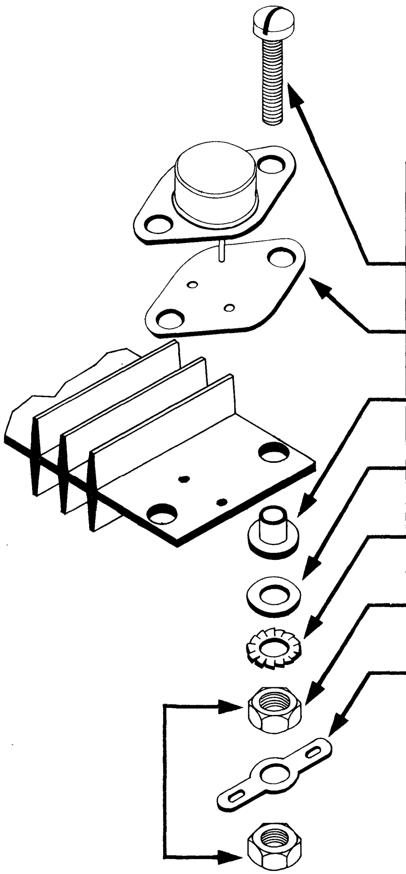


Figure 7 - Device Mounting



TO-3

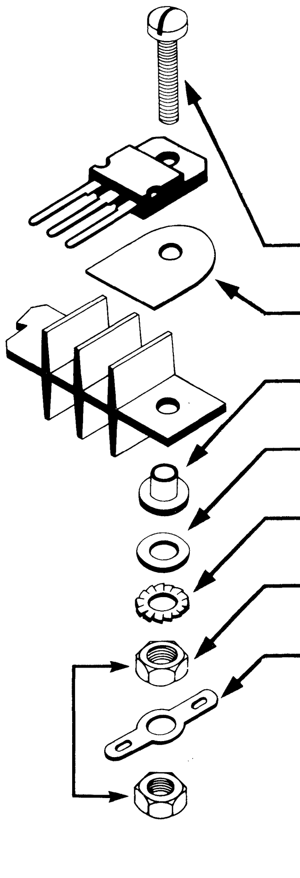


ACCESSORY TYPE	Q.ty	ASSEMBLY NUMBER	MATERIAL	MECH. DATA Page
CHEESE HEAD SCREWS SLOTTED	2	NOT AVAILABLE FROM SGS-THOMSON		
MICA WASHER	1	CDA 3126 A*	MICA	105
INSULATING BUSHES	2	CDA 3155 A	NYLON	106
WASHERS	2	NOT AVAILABLE FROM SGS-THOMSON		
LOCK WASHERS	2	NOT AVAILABLE FROM SGS-THOMSON		
HEXAGON NUTS	4	NOT AVAILABLE FROM SGS-THOMSON		
SOLDER LUG	1	NOT AVAILABLE FROM SGS-THOMSON		

CDA 3126 B FOR MODIFIED TO-3

Maximum torque (applied to mounting flange)
Recommended: 0.55 Nm
Maximum: 1 Nm.

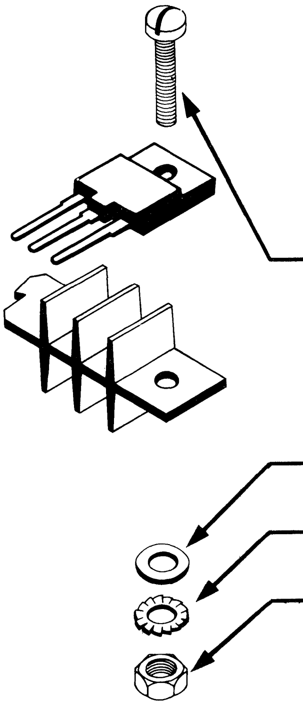
TO-218 (SOT-93)



ACCESSORY TYPE	Q.ty	ASSEMBLY NUMBER	MATERIAL	MECH. DATA Page
CHEESE HEAD SCREWS SLOTTED	1	NOT AVAILABLE FROM SGS-THOMSON		
MICA WASHER	1	CDA 3154	MICA	106
INSULATING BUSHES	1	CDA 3155 C	NYLON	106
WASHERS	1	NOT AVAILABLE FROM SGS-THOMSON		
LOCK WASHERS	1	NOT AVAILABLE FROM SGS-THOMSON		
HEXAGON NUTS	2	NOT AVAILABLE FROM SGS-THOMSON		
SOLDER LUG	1	NOT AVAILABLE FROM SGS-THOMSON		

Maximum torque (applied to mounting flange)
Recommended: 0.55 Nm
Maximum: 1 Nm.

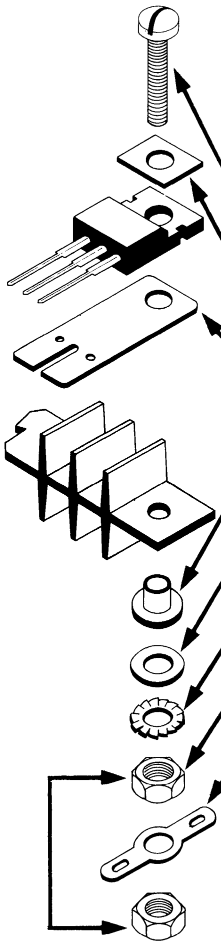
ISOWATT218 - TOP-3I



ACCESSORY TYPE	Q.ty	ASSEMBLY NUMBER	MATERIAL	MECH. DATA Page
CHEESE HEAD SCREWS SLOTTED	1	NOT AVAILABLE FROM SGS-THOMSON		
WASHERS	1	NOT AVAILABLE FROM SGS-THOMSON		
LOCK WASHERS	1	NOT AVAILABLE FROM SGS-THOMSON		
HEXAGON NUTS	1	NOT AVAILABLE FROM SGS-THOMSON		

Maximum torque (applied to mounting flange)
Recommended: 0.55 Nm
Maximum: 1 Nm.

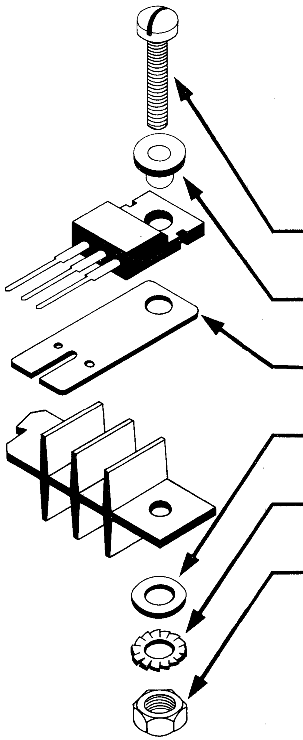
TO-220



ACCESSORY TYPE	Q.ty	ASSEMBLY NUMBER	MATERIAL	MECH. DATA Page
CHEESE HEAD SCREWS SLOTTED	1	NOT AVAILABLE FROM SGS-THOMSON		
RECTANGULAR WASHER	1	CDA 3163		107
MICA WASHER	1	CDA 3159	MICA	107
INSULATING BUSHES	1	CDA 3155 B	NYLON	106
WASHER	1	NOT AVAILABLE FROM SGS-THOMSON		
LOCK WASHER	1	NOT AVAILABLE FROM SGS-THOMSON		
HEXAGON NUTS	2	NOT AVAILABLE FROM SGS-THOMSON		
SOLDER LUG	1	NOT AVAILABLE FROM SGS-THOMSON		

Maximum torque (applied to mounting flange)
Recommended: 0.55 Nm
Maximum: 0.7 Nm.

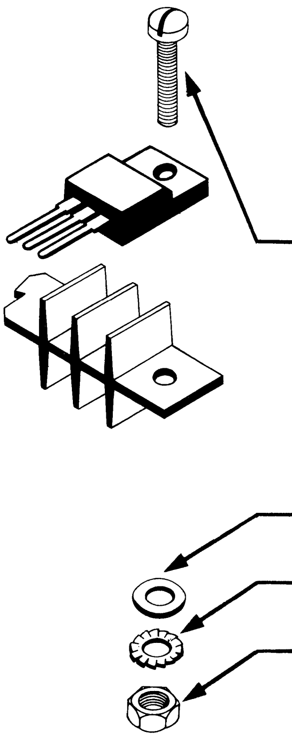
TO-220



ACCESSORY TYPE	Q.ty	ASSEMBLY NUMBER	MATERIAL	MECH. DATA Page
CHEESE HEAD SCREWS SLOTTED	1	NOT AVAILABLE FROM SGS-THOMSON		
INSULATING BUSHES	1	CDA 3155 B	NYLON	106
MICA WASHER	1	CDA 3159	MICA	107
WASHER	1	NOT AVAILABLE FROM SGS-THOMSON		
LOCK WASHER	1	NOT AVAILABLE FROM SGS-THOMSON		
HEXAGON NUTS	1	NOT AVAILABLE FROM SGS-THOMSON		

Maximum torque (applied to mounting flange)
Recommended: 0.55 Nm
Maximum: 0.7 Nm.

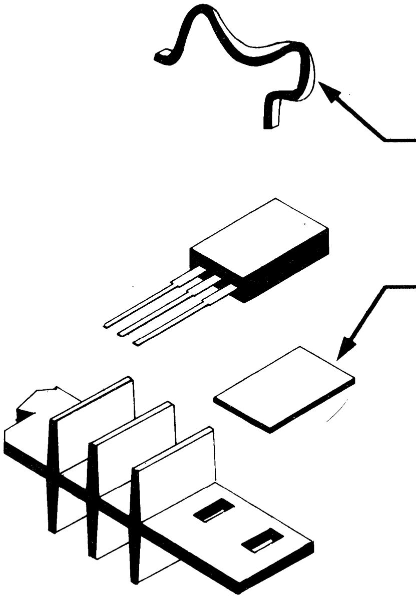
ISOWATT220



ACCESSORY TYPE	Q.ty	ASSEMBLY NUMBER	MATERIAL	MECH. DATA Page
CHEESE HEAD SCREWS SLOTTED	1	NOT AVAILABLE FROM SGS-THOMSON		
WASHER	1	NOT AVAILABLE FROM SGS-THOMSON		
LOCK WASHER	1	NOT AVAILABLE FROM SGS-THOMSON		
HEXAGON NUTS	1	NOT AVAILABLE FROM SGS-THOMSON		

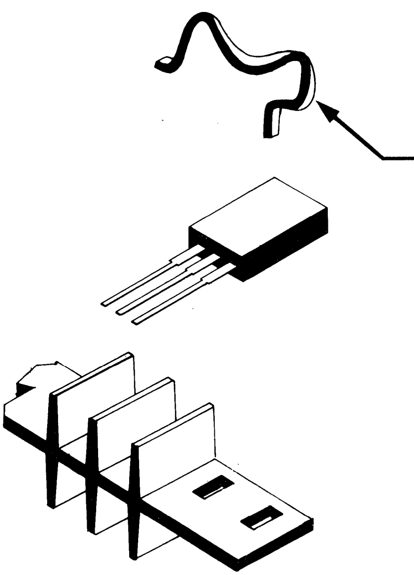
Maximum torque (applied to mounting flange)
Recommended: 0.55 Nm
Maximum: 0.7 Nm.

TO-126, SOT-82, SOT-194, TO-220, TO-218



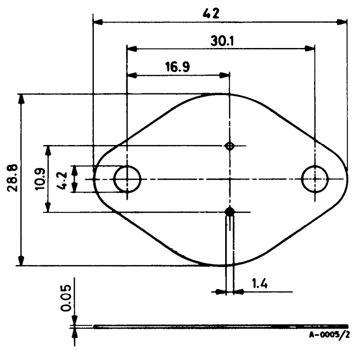
ACCESSORY TYPE	Q.ty	ASSEMBLY NUMBER	MATERIAL	MECH. DATA Page
SPRING CLIP	1	NOT AVAILABLE FROM SGS-THOMSON		
MICA WASHER	1	TO-126, SOT-82, SOT-194: NOT AVAILABLE FROM SGS-THOMSON TO-220: CDA3159 TO-218: CDA3154	MICA	 107 106

ISOWATT220, ISOWATT218, TOP-3I

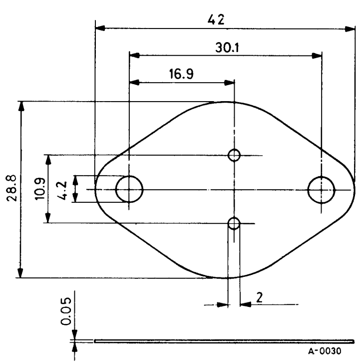


ACCESSORY TYPE	Q.ty	ASSEMBLY NUMBER	MATERIAL	MECH. DATA Page
SPRING CLIP	1	NOT AVAILABLE FROM SGS-THOMSON		

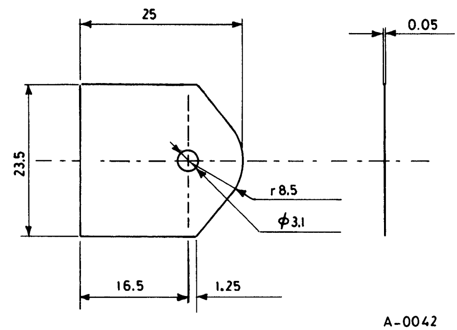
CDA 3126A



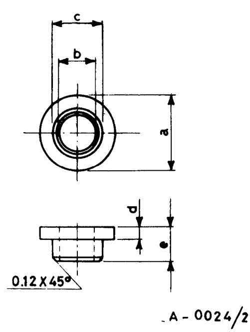
CDA 3126B



CDA 3154



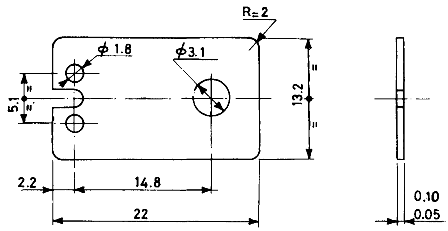
CDA 3155



Suffix	Package	a	b	c	d	e
A	TO-3	6.40 to 6.60	3.00 to 3.10	4.00 to 4.05	1.1 max	1.55 to 1.65
B	TO-220	5.30 to 5.50	3.00 to 3.10	3.83 to 3.88	0.60 to 0.65	1.70 to 1.80
C	SOT-93	6.40 to 6.60	3.00 to 3.10	4.00 to 4.05	1.3 to 1.4	2.7 to 2.9

Material: Nylon   Dimensions: mm

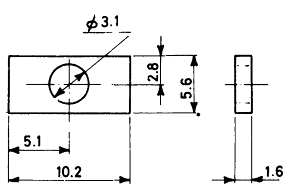
CDA 3159



A-0026/ 3

TYPE	MATERIAL	NOTE
CDA3159	MICA	

CDA 3163



A-0023/3

TYPE	MATERIAL	NOTE
CDA3163	Steel nickel plated	

ISOWATT218 AND ISOWATT220
EASY TO USE ISOLATED POWER PACKAGES

General

SGS-THOMSON has developed two isolated packages, the ISOWATT218 and the ISOWATT220 for use in place of the standard SOT-93/TO-218 and TO-220 respectively. These packages have been designed to be produced with high volume automated equipment. They are easy to mount and fully isolated which reduces overall costs and improves reliability compared with conventional packages. The isolation of the collector from the heatsink is achieved by molding the package with a high thermal conductivity epoxy resin. The thickness of the resin is closely controlled over the back surface of the internal copper heat spreader.

Figure 1a: The ISOWATT218 Construction.

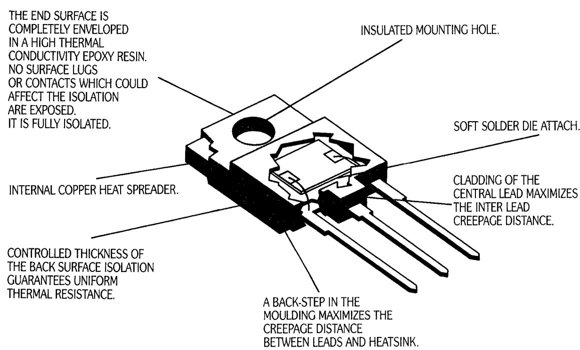
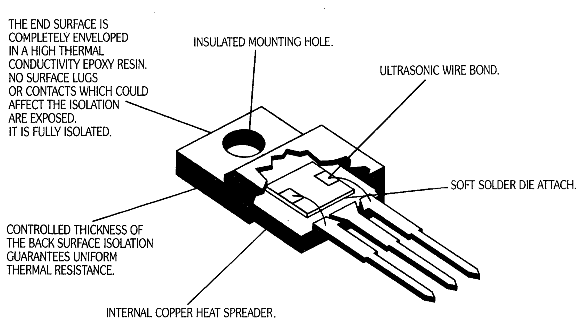


Figure 1b: The ISOWATT220 Construction.



INSULATION CHARACTERISTICS

	ISOWATT218	ISOWATT220
Insulation voltage between connection and heat sink	≥2500V AC for 1 minute ≥4000V DC for 1 second	≥1500V AC for 1 minute ≥2000V DC for 1 second
Creepage distance over the surface	≥4 mm	≥2.28 mm
Clearance distance	≥3 mm	≥2.28 mm

THERMAL RESISTANCE OF STANDARD AND ISOWATT PACKAGES

The evaluation of thermal resistance is difficult for the equipment designer as no easy method of measurement is available. This task is made more difficult as power semiconductor suppliers publish thermal resistance data for the junction to case which in most pratical situations becomes small compared with the total impedance from junction to ambient.

Considering applications where the popular medium power plastic encapsulated devices will be used, with small to medium size heatsinks, the thermal resistance from the package case to the heatsinks via any intermediate isolation becomes an important consideration. In the majority of applications of high voltage devices in off-line switching power supplies, CRT deflection or motor controls, some form of isolation must be employed which can vary from 800V DC up to 2500V AC (3500V DC) depending on the application environment and safety regulations which must be met.

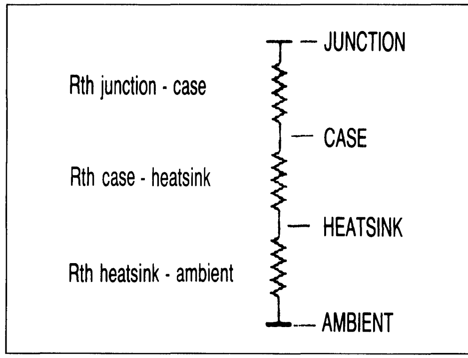
Examining this subject using various power semiconductor suppliers recommendations only adds some confusion which appears to be due to variations in test conditions and mounting torques which are not clearly specified. It should be added that the difficult nature of R_{th} measurement can easily cause a 10% uncertainty in the results.

The ISOWATT218 and ISOWATT220 offer many advantages over the conventional SOT-93/TO-218 and TO-220 packages when isolation from the heatsink is required. However the question is how does their thermal resistance compare in different conditions of mounting? The following notes and evaluations were made to try to offer an understanding of this together with some practical advice.

MAXIMUM POWER DISSIPATION

In equipment, the maximum power dissipation of a transistor is limited by the thermal resistance junction-heatsink plus thermal resistance heatsink - ambient and not only by the thermal resistance junction - case.

$P_{Dmax} = T_{jmax} / R_{th\ j\text{-}hs} + R_{th\ hs\text{-}a}$

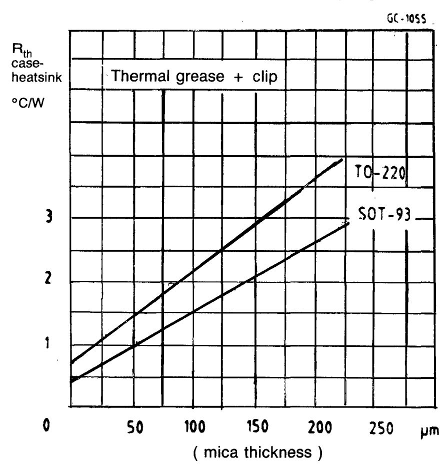


Thermal resistance case to heatsink

The very best which can be achieved with direct mounting is about 0.5°C/W with thermal grease and clip mounting. (If no thermal grease is used, this value will range about 1.4°C/W).

When an isolation layer is used between the package and heatsink the thermal resistance will depend on the desired insulation properties and may vary by about 2°C/W.

This is summarized by the following figure:



MAXIMUM POWER DISSIPATION (Cont'd)

For the conventional package, thermal compound is applied both sides of the isolation washer for the best heat transfer. Mounting with a screw, the thermal resistance may vary by about 0.3°C/W for torque variations - higher torque than 0.8 - 1.0Nm (≈8 - 10kg * cm) are not recommended with insulating washers due to the risk of damaging them. If a clip is used over the centre of the package a limited force is necessary for spring clips which can easily be assembled.
For the ISOWATT218 and ISOWATT220 package, mounted with thermal grease, the effect of torque or clip force is less noticable as there is only one layer of compound to compress. Also there is no fragile isolation washer so the torque or the clip force are less critical. Also the temperature gradient between the case and heatsink is very low and the thermal resistance between the case and heatsink lies between 0.1 to 0.2 °C/W.

RESULTING THERMAL RESISTANCE JUNCTION - HEATSINK.

The tables 1A and 1B give an idea of the various possibilities.

COST COMPARISON

The ISOWATT218 and ISOWATT220 packages save both time and the cost of accessories for mounting.
The cost savings are:
1. Direct cost of materials
2. Cost of ordering, storing and issuing the materials to the assembly department
3. The time taken to mount these materials.

Productivity of mounting a conventional plastic power transistor on a heatsink with isolating bush, isolating washer and screw is estimated at 0.02 hours. For TO-3 style packages the figure will be much longer, while with the ISOWATT218 or ISOWATT220 the productivity should be increased by about 50%. Using a clip or partially isolated device the difference is probably 0.05 hours. The total labour time saving can be roughly approximated as 0.005h to 0.01h per unit.
There are other factors to consider such as the long term reliability of the isolation and the much reduced chances of failure at isolation testing of equipment where the associated cost of rectifying these defects is very high.
By comparison the ISOWATT218 and ISOWATT220 use a more expensive plastic molding compound to achieve good thermal conductivity and a more complex molding process than the standard SOT-93/TO-218 and TO-220 packages. Consequently the price of an ISOWATT218 or ISOWATT220 device is slightly higher than the equivalent standard non-isolated device.
Even with this cost adder most users will benefit from a direct cost saving by using ISOWATT218 or ISOWATT220 devices.

CONCLUSIONS

Tests have shown that the ISOWATT218 and ISOWATT220, when mounted on a heatsink with thermal compound, have an R_{th} very close to that of the equivalent standard package with an isolation washer. When mounted with a screw, the torque used is not so critical as for the conventional packages.
Even considering a worst case situation, any slight increase in R_{th} due to the ISOWATT218 or ISOWATT220 package is negligible compared with the overall R_{th} from junction to ambient which with moderate heatsinks will be greater than 10°C/W. Any small increase is more than compensated for by the convenience of the ISOWATT package. From an overall cost point of view the ISOWATT218 and ISOWATT220 represent a saving compared with the conventional packages. The construction of the ISOWATT218 makes it much easier for the equipment to respect the safety standards which may be required.

Table 1A

SOT-93/TO-218		SOT-93 + mica	ISOWATT218	
R_{th} °C/W junction-case	R_{th} °C/W junction-heatsink	R_{th} °C/W junction-heatsink	R_{th} °C/W junction-case	R_{th} °C/W junction-heatsink
1	1.4	2.5	1.9	2.1
1.2	1.6	2.7	2.5	2.7

mica = 0.1 mm

Table 1B

TO-220		TO-220 + mica	ISOWATT220	
R_{th} °C/W junction-case	R_{th} °C/W junction-heatsink	R_{th} °C/W junction-heatsink	R_{th} °C/W junction-case	R_{th} °C/W junction-heatsink
1.2	1.9	2.9	3.1	3.3
1.8	2.5	3.5	4.1	4.3

mica = 0.07 mm

TOP-3I: Low R_{th} junction - case Insulated Package

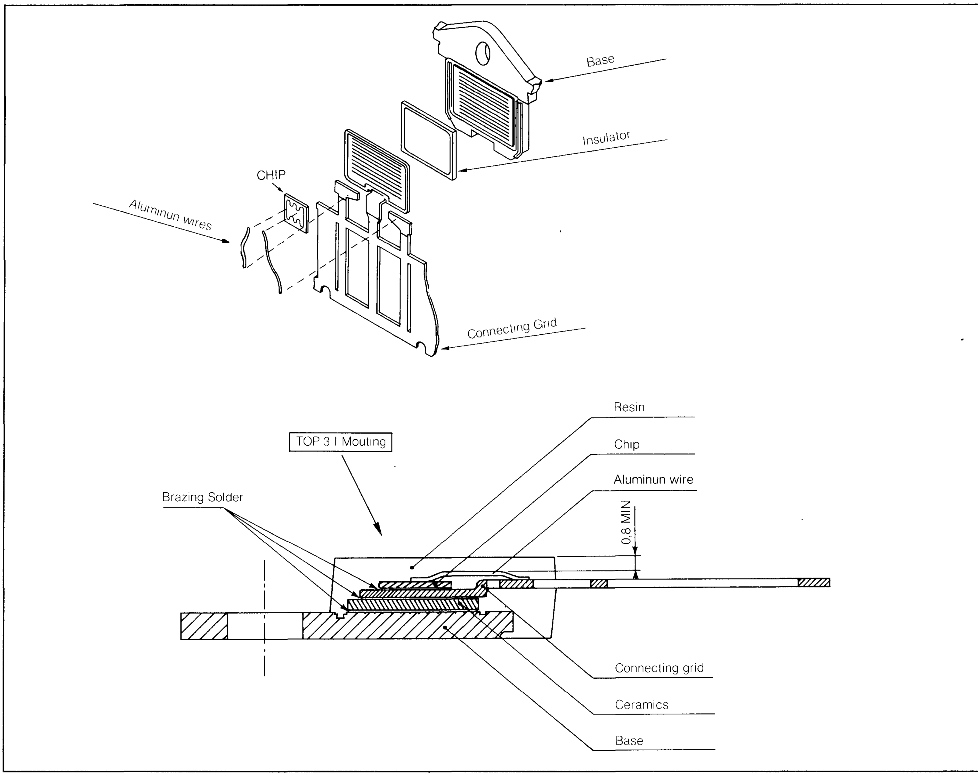
Industrial and professional switching applications often require

- high voltages
- high speed switching with its associated high dV/dt
- high power dissipation

At the equipment level, this gives rise to a number of problems, mainly related to electromagnetic and thermodynamic problems that are specific to power electronics, due to the isolation between die, package and heatsink.
SGS-THOMSON has introduced a special package for these applications the TOP 3I.

CONSTRUCTION AND DIMENSIONS

The dimensions of the TOP 3I package are fully compatible with TO-218 devices and are fully mechanically interchangeable.



MAIN CHARACTERISTICS OF TOP-3I PACKAGE

Insulation voltage:	> = 2500V AC for 1 minute
Voltage between chip and heat spreader (tab):	> = 3500V DC for 1 second
R_{th} junction-case:	1.1 — 2.0 °C/W
R_{th} junction-heatsink:	1.4 — 2.3 °C/W
Stray capacitance collector-heatsink:	13pF

INTRODUCTION

This note analyses the behaviour of FASTWITCH transistors during turn-on with a collector voltage greater than the BV_{CEO}.

In a switching power supply, as shown in fig. 1, the power device is subject to a high collector voltage and a high current during turn-on and the duration of crossover depends on the reverse recovery time "t_{rr}" of the diode. An extension of the forward bias safe operating area beyond the BV_{CEO} point allows the switching power supply designer to choose a power device most suited for the applicaiton.

The simplified application shown in fig. 1 illustrates a flyback converter and associated waveforms.

In the continuous mode of operation the transformer imposes the voltage $V_{CE} = V_{IN} + n \cdot V_O$ on the collector of the power device. This voltage is applied to the collector during turn-on, and as stated previously its duration depends on the reverse recovery time, t_{rr} of the diode.

n = the transformer turns ratio N1/N2

Using the classic FBSOA a power device with a BV_{CEO} greater than $V_{IN} + n \cdot V_O$ would be necessary. For example, in photo 1 the turn-on behaviour of on SGSF464 FASTSWITCH transistor mounted in an off-line flyback converter is shown. In order to simulate the worst case conditions a very slow diode was used for this example.

G-6194

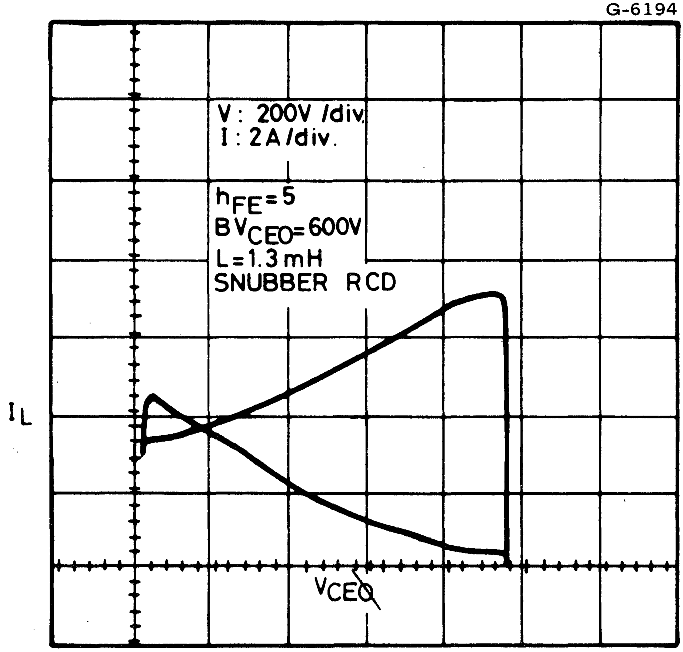
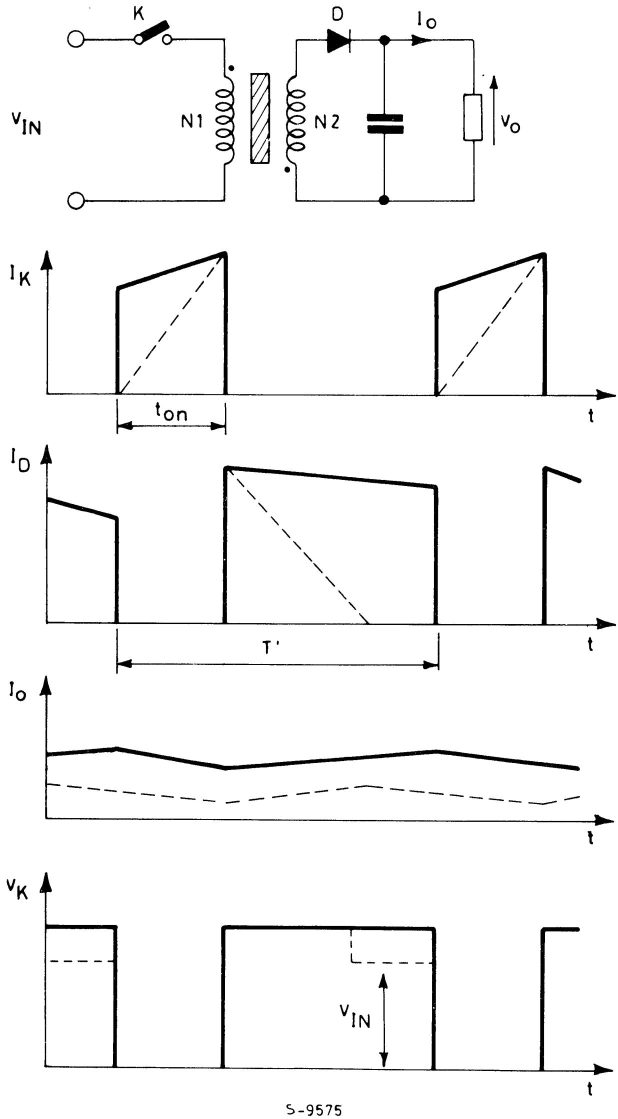


Figure 1: Isolated Flyback Converter and Associated Waveforms.



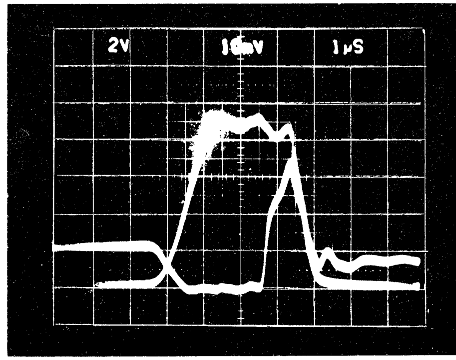
The device turns on when the collector voltage is greater than BV_{CEO} and the high voltage, high current crossover lasts about 1.5 s; this time is very long with respect ot the t_{rr} of the diodes normally used in a switching power supply.

Under these conditions the normal FBSOA does not guarantee the safe operation of the device and the importance of providing the power supply designer with an FBSOA extended beyond the BV_{CEO}, usable only during turn-on, can be very useful.

In order to evaluate the FBSOA beyond BV_{CEO}, the following difficulties were encountered:
- Measurement parameter control (T.U.T. collector voltage and current, I_C max - V_{CE} max crossover duration)
- T.U.T. failure caused by E_s/b.

These difficulties were solved by using the test circuit, whose principal schematic is shown in fig. 2. The complete schematic is shown in fig. 3. Measurements were recorded under the conditions of controlled I_C, V_{CE} and I_C max - V_{CE} max crossover duration.

Photo 1: SGSF464 Turn-off Waveforms for a Flyback Converter with a Slow Diode.



I_C = 5A/div; V_{CE} = 200 V/div; BV_{CEO} = 600 V

Figure 2: Measurement Circuit.

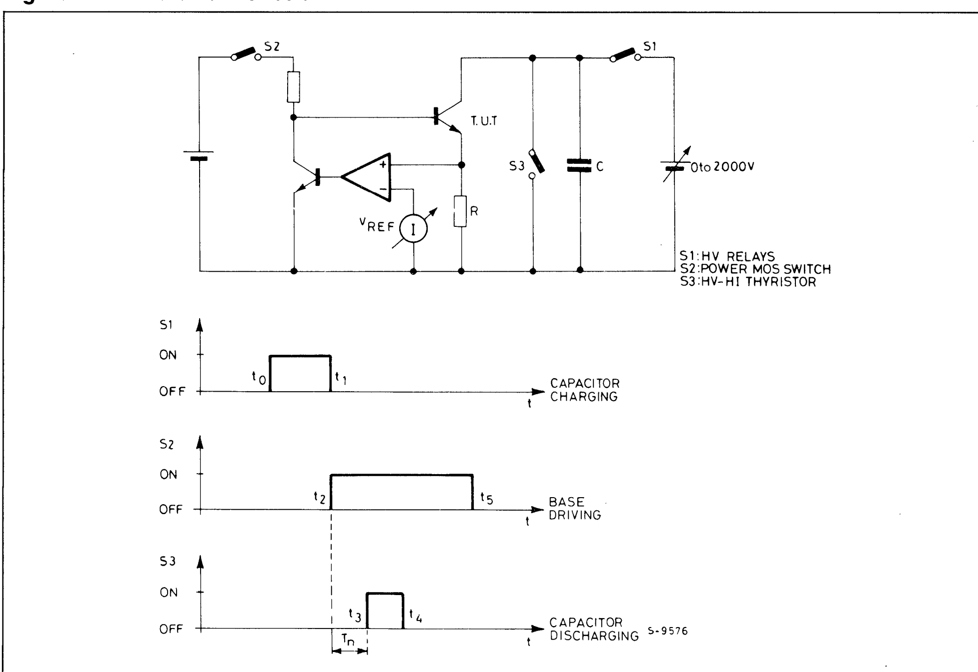


Figure 3: Schematic Diagram and Clock Signals.

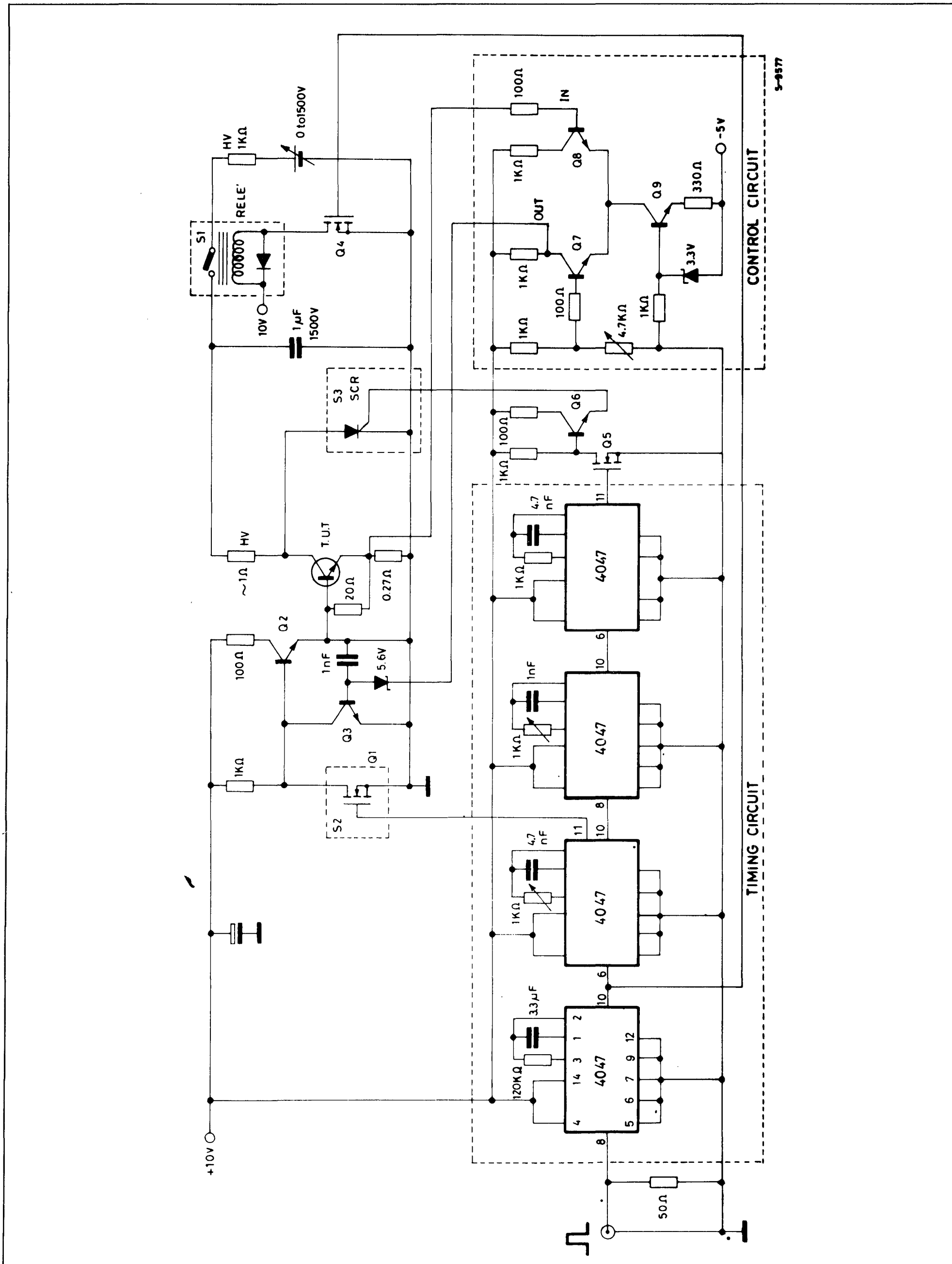
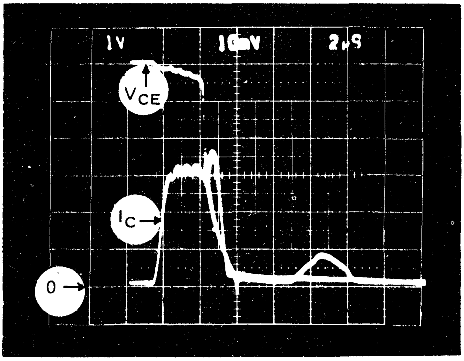


Photo 2: Collector Voltage and Current Waveforms of the Transistor Under Test.



t= 2 ms/div; I_C= 2/div; V_{CEO}= 100 V/div.

The high slew-rate comparator controls the base current by sensing the voltage across the resistance 'R'. V_{CE} falls very quickly, while the base is still forward biased, and so avoiding $E_{s/b}$ breakdown. The BV_{CEO} of the SGSF461 is about 400 V.

Photo 2 shows the typical waveforms obtained by using this test circuit. In a real case, even considering normal collector voltages, turn-on times are much shorter.

The device turn-on was further investigated by using the test circuit shown in fig. 4, in this circuit the worst case conditions were simulated by using slow diodes.

Figure 4: Application Circuit.

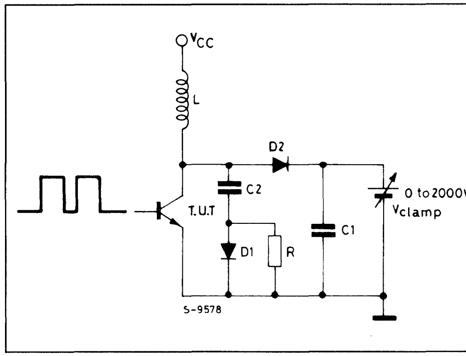
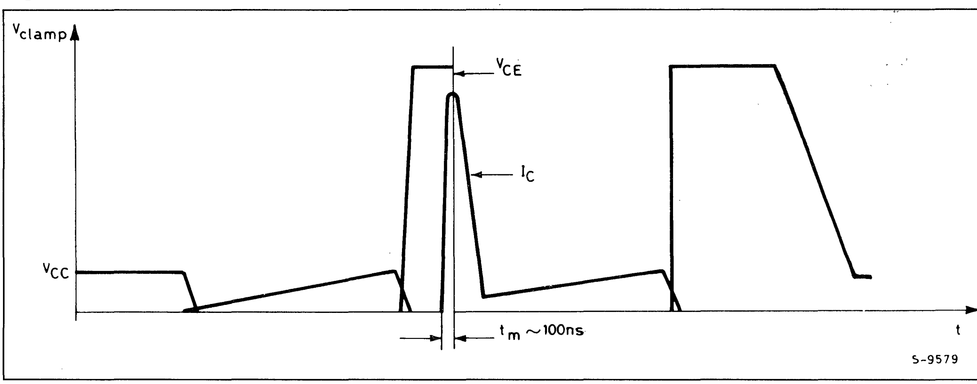


Figure 5: Current Voltage and Collector Waveforms.



During its recovery, the diode behaves as a short circuit between the collector and V_{CLAMP}. The collector current then rises with a constant voltage (V_{CLAMP}) until the charge in the diode is completely recovered. (fig. 6).

After recovery the diode blocks the voltage supply to the collector. The collector is independent of V_{CLAMP} and it is connected to the inductor only which behaves as a current generator (Fig. 7). Consequently the initial value of collector current is the same as the current in the inductor. The voltage on the collector decreases to the V_{CEsat} value. This phenomenon can be seen clearly from the load line in fig. 8, the operating point moves from right to left on the locus.

In the same figure the snubbered turn off is shown.

Figure 6: Diode in Reverse Recovery.

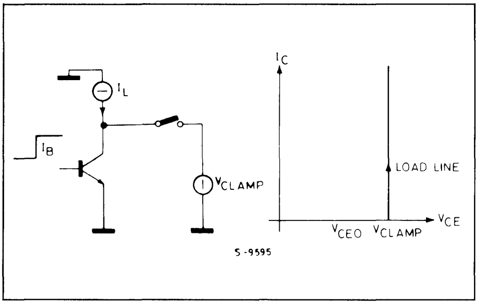


Figure 7: Blocked Diode.

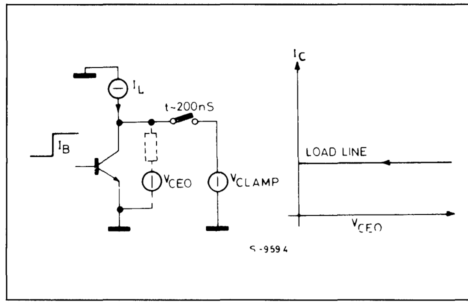
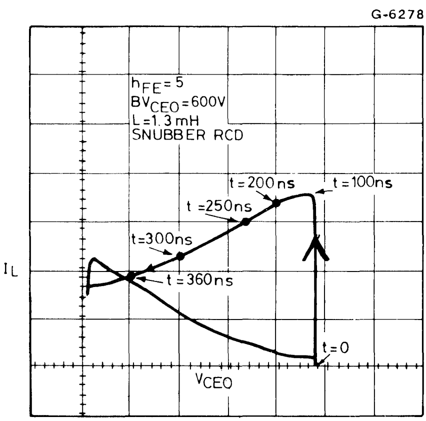


Figure 8: Load Line Shaping for SGSIF414 and SGSF444



V = 200V/div. I = 2A/div.

CONCLUSION

Characterization of FASTWITCH transistors beyond the BV_{CEO} point permits better use in switching power supply designs, since in most cases the load line shape and switching times allow the designer to use the devices beyond the BV_{CEO}. This way devices with a lower voltage rating can be used giving a larger saving in cost plus the other well known advantages of the FASTSWITCH family such as shorter switching times and lower power dissipation.

Figure 9: Extension of Safe Operating Area for SGSF425.

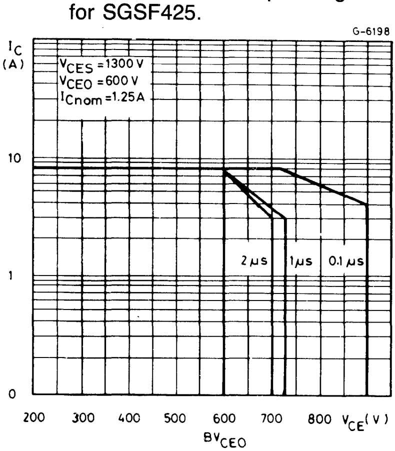


Figure 10: Safe Operating Area for SGS F425.

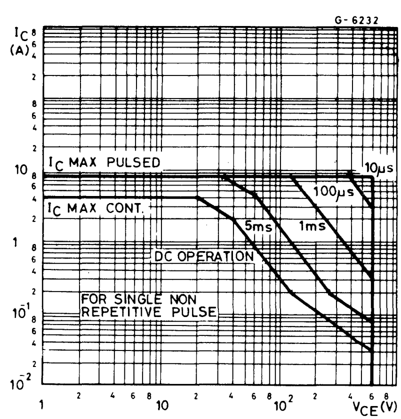


Figure 11: Extension of Safe Operating Area for SGSF422.

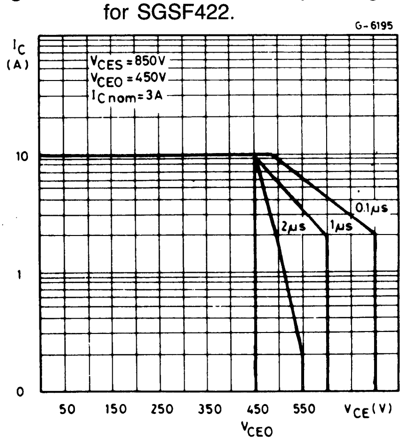


Figure 12: Safe Operating Area for SGSF422

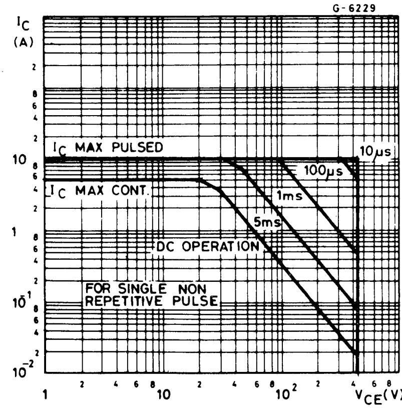


Figure 13: Extension of Safe Operating Area for SGSF442.

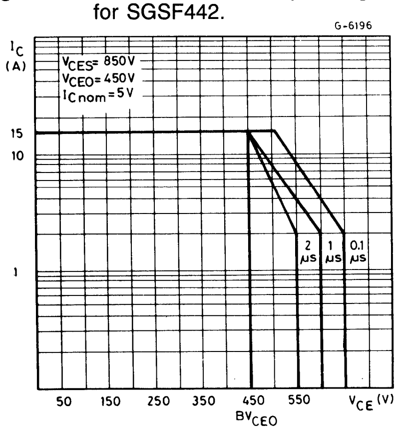


Figure 14: Safe Operating Area for SGSF442.

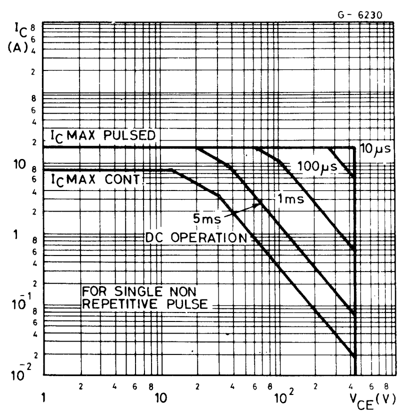
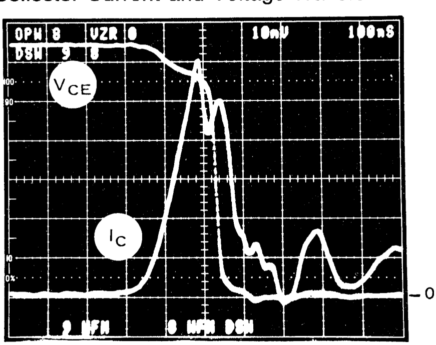


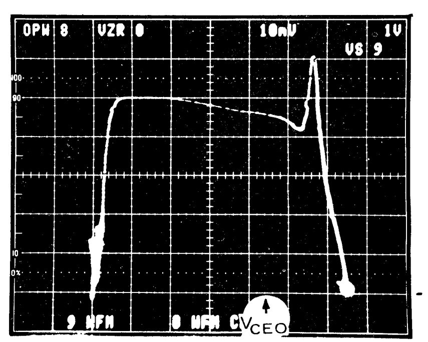
Figure 15: Turn-on for SGSF442.

a) Collector Current and Voltage Waveform



$I_C = 2A/div.$; $V_{CE} = 100V/div.$; $I_B = 1A$

b) Load Line.



$I_C = 2A/div.$; $V_{CE} = 100V/div.$; $BV_{CEO} = 450V$

Figure 16: Extension of Safe Operating Area for SGSF462

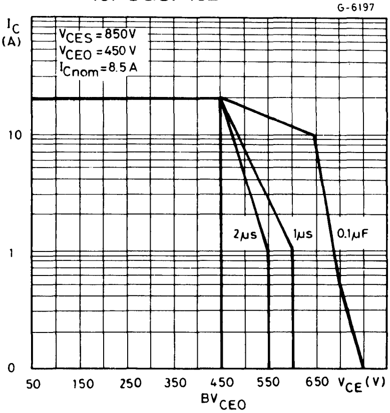


Figure 17: Safe Operating Area for SGSF462.

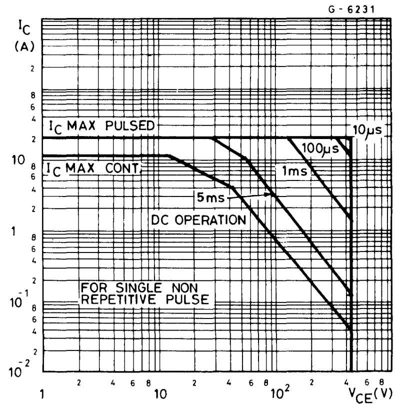
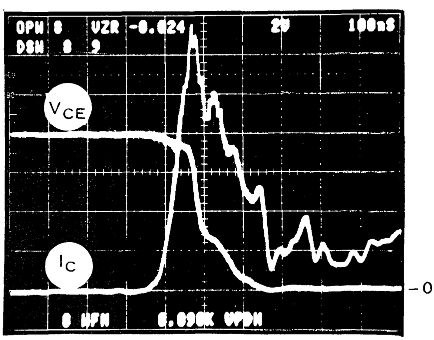
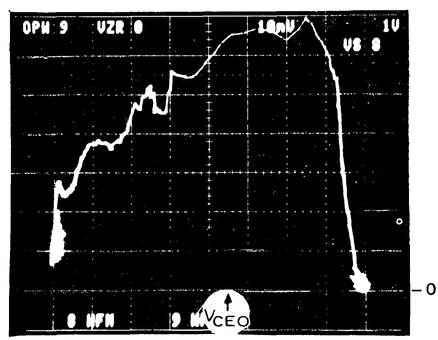


Figure 18: Turn-on for SGSF462.
a) Collector Current and Voltage Waveform



I_C = 2A/div.; V_{CE} = 200V/div.; I_B = 1.5A

b) Load Line.



I_C = 2A/div.; V_{CE} = 100V/div.; BV_{CEO} = 450V

Figure 19: Extension of Safe Operating Area for SGSF444

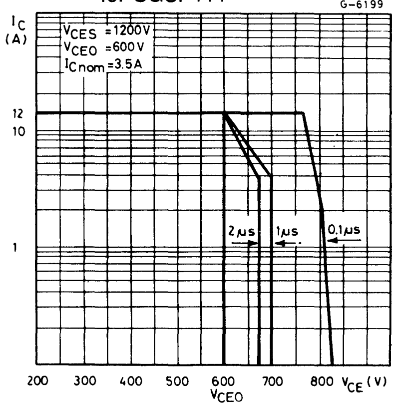


Figure 20: Safe Operating Area for SGSF444.

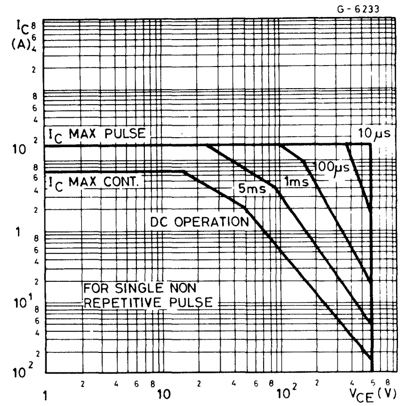
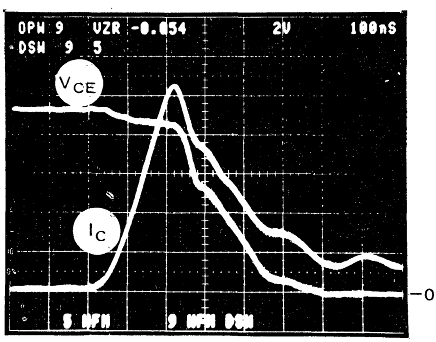


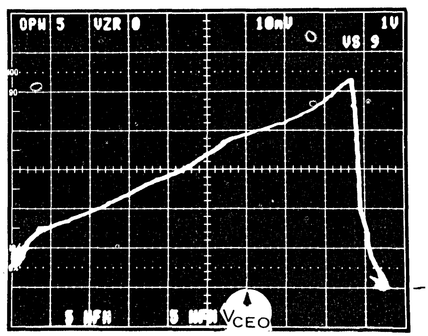
Figure 21: Turn-on for SGSF444.

a) Collector Current and Voltage Waveform



I_C = 2A/div.; V_{CE} = 200V/div.; I_B = 1A; V_{CEO} = 600V

b) Load Line.



I_C = 2A/div.; V_{CE} = 100V/div.

Figure 22: Extension of Safe Operating Area for SGSF464

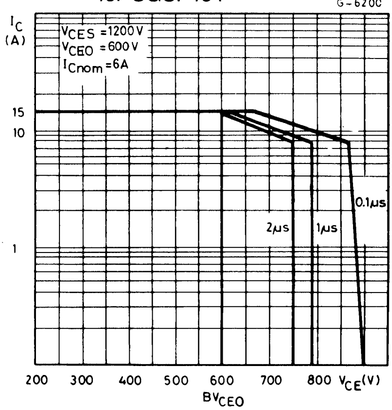


Figure 23: Safe Operating Area for SGSF464.

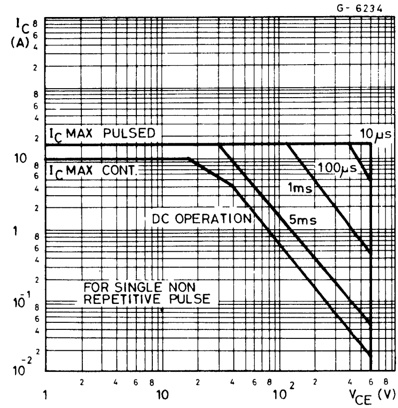
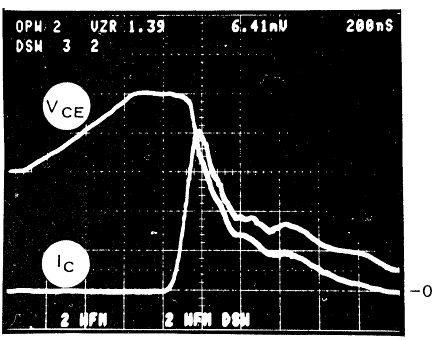
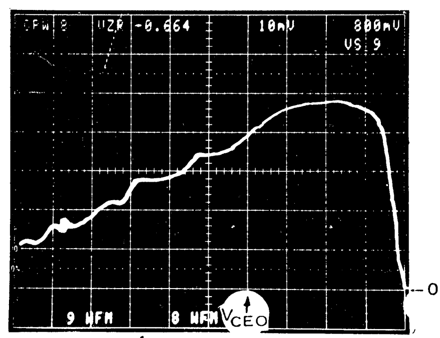


Figure 24: Turn-on for SGSF464.
a) Collector Current and Voltage Waveform



I_C=2A/div.; V_{CE}=200V/div.; I_B=1A

b) Load Line.



I_C = 2A/div.; V_{CE} = 100V/div.; BV_{CEO} = 600V

A designer using switching transistors needs an answer to the following questions:

What are the current sharing requirements between paralleled transistors?

What base current is necessary if the transistor is used with a reduced collector current?

What are the transistor conduction losses?

How robust is the transistor in case of overload?

The conventional data sheets often do not give the data necessary to answer these questions. For many years, SGS-THOMSON have strived to specify the "SUPERSWITCH 1" series of transistors in a manner that gives the maximum information necessary for the efficient development of circuits. The data sheets of the new FASTSWITCH family are even more complete.
The principal characteristics of switching transistors are the blocking voltages V_{CEOsus} and V_{CEX}, the nominal collector current I_{Csat}, the safe operating area for switching, the switching times and the "robustness" as specified by the "accidental overload areas".
A switching transistor normally operates with a junction temperature above 25°C. Hence circuit designers require transistor characteristics at higher temperature such as a junction temperature (T_j) of 100°C. Before considering the technical details of the new FASTSWITCH transistor series, it is necessary to examine the most important characteristics of switching transistors. In examining these characteristics a low voltage transistor, the BUW 48, is used as an example.

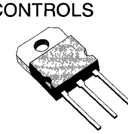
THE BLOCKING VOLTAGE

Figure 1 is part of the BUW 48 data sheet. This figure provides information for a preliminary appreciation of the transistor characteristics: since the voltage V_{CEOsus} is given as 60 V, this transistor should be capable of switching a voltage of about 50 to 60 V in applications where switching aid networks (snubbers) are not used (this case will be described in greater detail in the paragraph "safe operating area"). In most circuits which are operating from a low voltage supply, the voltage V_{CEOsus} of the transistor is chosen to be slightly above the supply voltage V_A.
Since the voltage V_{CEX} is specified at 120 V, the transistor is able to support a collector-emitter voltage of up to 120 V. However, it will be shown later that the collector current at turn-off must be zero before the collector-emitter voltage can exceed the specified V_{CEOsus} value. A switching aid circuit (RCD, etc...) connected between the collector and emitter, allows the collector current to decay to zero before the voltage has exceeded the V_{CEOsus} value. If one does not to decay to zero before the voltage has exceeded the V_{CEOsus} value. If one does not wish to use a switching aid circuit, the voltage between the collector and emitter must remain below the V_{CEOsus} value; (i.e. 60 V in the example).

Figure 1 - An extract from the BUW 48 data sheet. The principal characteristics are specified on the upper right hand side.

NPN HIGH CURRENT
SWITCHING TRANSISTORS

- HIGH CURRENT CAPABILITY
- VERY LOW SATURATION VOLTAGE AT $I_C = 20A$
- FAST TURN-ON AND TURN-OFF APPLICATION
- HIGH FREQUENCY AND EFFICENCY
- SWITCHING REGULATORS
- MOTOR CONTROLS



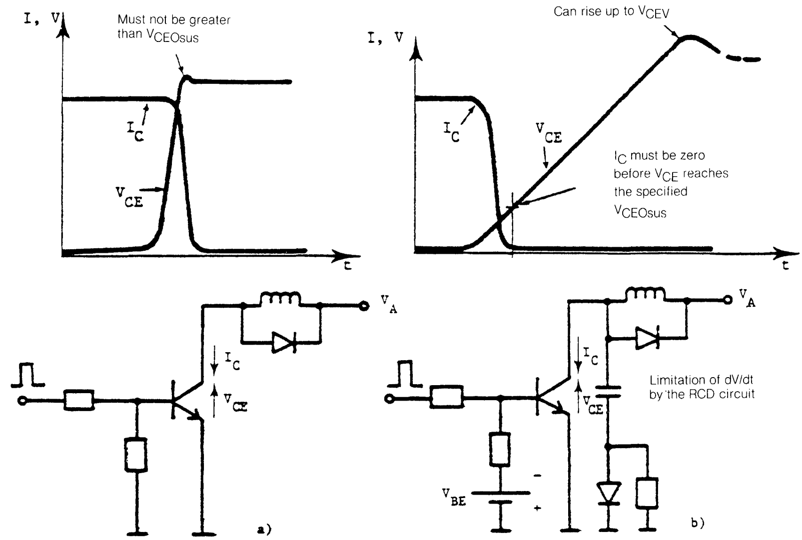
ABSOLUTE MAXIMUM RATINGS

Symbol	Value		Unit
	BUW48	BUW49	
V_{CBO}	120	160	V
V_{CEO}	60	80	V
V_{EBO}	7	7	V
I_C	30	30	A
I_{CM}	45	40	A
I_B	8	6	A
I_{BM}	12	10	A
P_{tot}	150		W
T_{stg}	– 65 to 175		°C
T_j	175		°C

THE COLLECTOR CURRENT

While operating at its nominal current level I_{Csat}, the transistor has a normal gain and a normal saturated collector-emitter saturation voltage. The voltage V_{CEsat} of transistor BUW 48 is 1.4 V for a collector current of 40 A, provided the base current is not less than 4 A. These details are given in figure 3. In contrast, at a collector current equal in value to I_{CM}, neither the gain nor the saturation voltage is specified. It is thus recommended to use the transistor with a collector current of th same order of magnitude ad I_{Csat} or below.

Figure 2 - The collector - emitter voltage at turn-off



a) Without limiting of dV/dt
b) Limiting dV/dt

Figure 3 provides guaranteed maximum saturation voltage data (see "MAX" column of figure 3). However it is necessary to treat this data with caution: in fact, on closer inspection of figure 3, it can be seen that all the data are specified at a junction temperature T_j of 25°C "except where specified otherwise". Since no exceptions are stated in the figure the data is specified uniquely at 25°C.
Figure 4 provides an indication of the behaviour of the transistor saturation voltages at a realistic operating temperature.
The curve of V_{CEsat} as a function of I_C shows that the collector-emitter voltage is 0.83 V (typically) at a collector current I_C of 40 A with a base current of not less than 4 A. For a junction temperature T_J, of 125°C, (see dotted line in figure 4), the saturation voltage becomes 0,93 V (typically). If it is assumed that the worst sample of this type of transistor has the same temperature coefficient as the typical sample, the saturation voltage V_{CEsat} at T_J equal to 125°C can be evaluated in the following manner:

$$V_{CEsat} \text{ max } (125°C) = 1.4V \frac{0.93 \text{ V}}{0.83 \text{ V}} = 1.7 \text{ V at } 40 \text{ A}$$

The improved data sheets of the "FASTSWITCH 2" series of transistors specify all the saturation voltages at 25 and 100°C as shown in figure 5.

Figure 3 - The specification of saturated voltages of the BUW 48.

ELECTRICAL CHARACTERISTICS* *

On-state characteristics

Symbol		Test Conditions	Min	Typ	Max	Unit
V_{CEsat}*	BUW 48	I_C = 20 A I_B = 2.0 A			0.6	V
		I_C = 49 A I_B = 4.0 A			1.4	V
	BUW 49	I_C = 15 A I_B = 1.5 A			0.5	V
		I_C = 30 A I_B = 3.0 A			1.2	V
V_{BEsat}*	BUW 48	I_C = 40 A I_B = 4.0 A			2.1	V
	BUW 49	I_C = 30 A I_B = 3.0 A			2.0	V

* Mesured with a pulse t_p = 300 μs * * T_j = 25°C except otherwise stated. The asterisks specify that the data is valid only at T_j 25°C

DEVICES IN PARALLEL

On examining the temperature coefficient of the collector-emitter and the base-emitter voltages, it is established that these coefficients become positive at high current levels.

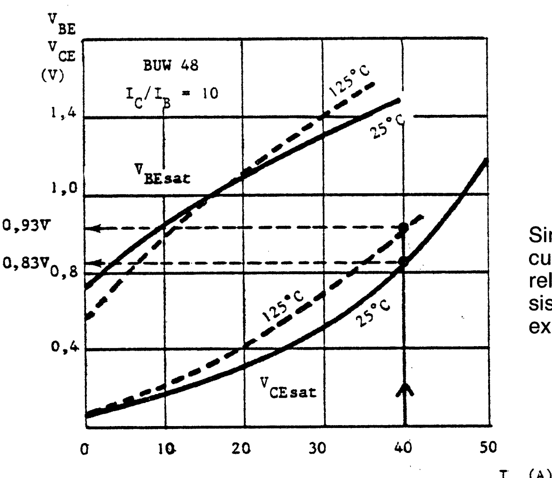
The collector-emitter junction of a saturated transistor behaves like a low value resistance with a positive temperature coefficient. At high currents the base-emitter voltage also has a positive temperature coefficient.

This may be surprising at first thought, since text book physics dictates that this coefficient is negative. A closer examination of the base-emitter junction of power transistors provides an explanation of this apparent contradiction: the base-emitter junction behaves like a resistance connected in series with a diode.

The temperature coefficient of the diode is negative, whereas that of the resistance is positive: with relatively high currents, the positive temperature coefficient of the resistance dominates. Thus, when considering "devices in parallel" without the use of external compensating resistances, the current sharing between the transistors in parallel improves at high collector currents.

The maximum spread of the base-emitter voltage is also given in figure 4. It is thus possible to evaluate the current sharing between transistors in parallel.

Figure 4 - The collector-emitter saturation voltage of the BUW 48



SATURATION VOLTAGE-GAIN

The nominal collector current I_{Csat} must not be considered as an absolute limit. At a collector current of I_{Csat}, the transistor still has a high gain and a low saturation voltage. "Forced gain" is defined as the collector current divided by the base current which are determined by the collector and the base circuits, respectively. For the BUV 50, the nominal collector current I_{Csat} is 20 A as stated in figure 5. A base current of 2 A is necessary to obtain a saturation voltage of 0.6 V. Thus with a collector current of 20 A, the transistor is in saturation with a forced gain of 10. If the same transistor needs to be used at 24 A, it is necessary to increase the base current to 3 A.

The collector-emitter voltage then reaches 0.8 V. Thus the gain decreases when the transistor is used with the collector current greater than I_{Csat}. In the example, it is reduced from 10 at 20 A to 8 at 24 A.

When using the BUV 50 at a collector current of only 10 A instead of 20 A, the collector-emitter voltage is reduced to 0.4 V and the gain increases to 20, (see figure 5).

As a result there are two interesting alternatives for circuit designers:

1) When, for cost effectiveness, the transistor must be exploited to the maximum, it can be used with a collector current greater than I_{Csat}. The base current must be increased as a consequence.

2) When the objective is to improve the reliability and efficiency of the equipment, the transistors may be under-rated. In using the BUV 50, at half its nominal collector current:
   a) The collector-emitter saturation voltage decreases by 20 to 30%.
   b) The forced gain doubles.
   c) The base drive circuit losses are decreased by 75%.
   d) The switching losses are reduced.

Since the switched current is defined by the circuit and its load, the second alternative ("better reliability and efficiency") leads one to use a transistor with a higher nominal collector current, (for example, the BUV 60).

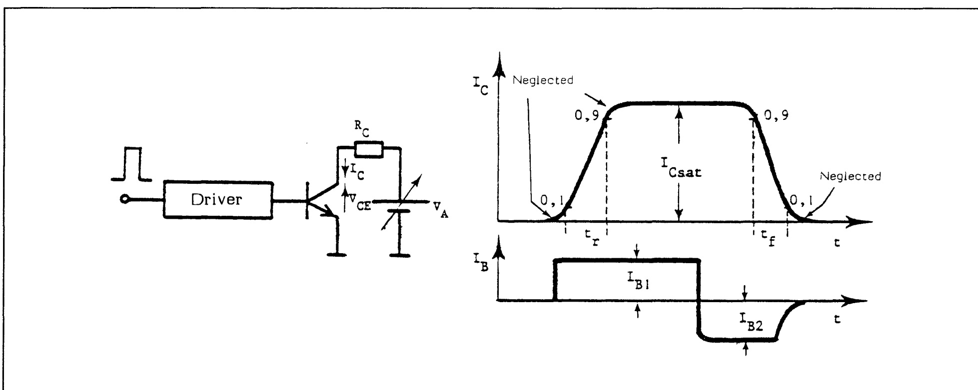
Figure 5 - BUV 50

ELECTRICAL CHARACTERISTICS

Symbol	Test Conditions	Min	Typ	Max	Unit
Characteristics during conduction					
V_{CEsat}	T_j = 25°C I_C = 24 A I_B = 3.0 A T_j = 100°C		0.7 0.9	1.2 1.8	V V
V_{CEsat}	T_j = 25°C I_C = 20 A I_B = 2.0 A T_J = 100°C		0.6 0.75	0.9 1.5	V V
V_{CEsat}	T_j = 25°C I_C = 10 A I_B = 0.5 A T_J = 100°C		0.4 0.5	0.8 0.9	V V
V_{BEsat}	T_j = 25°C I_C = 24 A I_B = 3.0 A T_J = 100°C		1.35 1.45	1.7 1.9	V V
V_{BEsat}	T_j = 25°C I_C = 20 A I_B = 2.0 A T_J = 100°C		1.25 1.25	1.6 1.7	V V

Note.: All the saturation voltages are specified at T_j = 25°C and at T_j = 100°C

Figure 6 - Measurement of switching times with a resistive load. The measurement is read, between 10 and 90% of the current.



SPECIFICATION OF SWITCHING TIMES

The specified switching times for power transistors are traditionally measured at a junction temperature of 25°C with a resistive load in the collector circuit (figure 6). In applications, transistors are used with inductive loads with free-wheeling diodes and operate at a higher junction temperature.

Two transistors having identical performances under the specified conditions in the data sheet, can give very different performances when operating in an equipment. For this reason, the switching times of the transistors should be specified in a way close to the real world operating conditions.

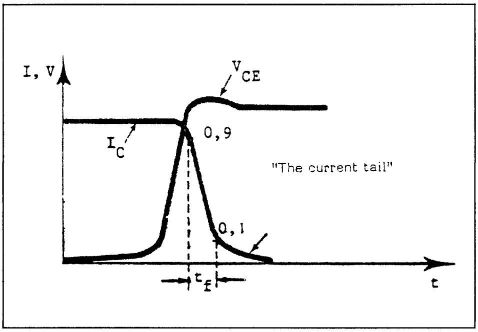
How to explain these differences in switching performance?

A critical examination of the measurement conditions gives part of the answer. The rise and fall times of the collector current are measured as the time between 10% and 90% of the changing current (figure 6). What happens before and after these measurement points is neglected. But in the case of operating with an inductive load, it is before and after the these measurement points that the situation becomes interesting (fig. 7). The current "tail" which can appear towards the end of the fall time t_f of the collector current, can generate a large per-

SPECIFICTION OF SWITCHING TIMES (Cont'd)

centage of the turn-off losses. But when the measurement is taken with a resistive load, this tail often becomes invisible or disappears below the 10% measurement limit. A similar situation exists a turn-on. In this case there can often be enormous differences between the presently defined specifications and the real operating conditions due to the dynamic turn-on saturation voltage V_{CEsat} dyn*.

Figure 7 - The turn-off with a current tail: although the fall time t_f may be small, the supplementary losses due to the current tail may not be negligible.



NEW SPECIFICATION FOR TURN-ON SWITCHING

When a transistor turns on with a resistive load, the collector current rises while there is a corresponding reduction in the collector-emitter voltage. In the case of switching an inductive load with a free-wheeling diode, the conditions are different. At the start of transistor conduction, the free-wheeling diode becomes at first a short-circuit while the collector current rises at a specific dI_C/dt rate (figure 8). During this phase, the collector-emitter voltage V_{CE} is equal to the voltage V_A, less the voltage drop across the parasitic inductance L_P. At this instant the collector-emitter voltage is given by:

$$V_{CE\,(t_{sc})} = V_A - L_P\, dI_C/dt$$

It is thus preferable to specify the grandient dI_C/dt which can occur during the transistor turn-on, rather the rise-time t_r with a resistive load.

The gradient dI_C/dt is specified for the FAST-SWITCH series of transistors in their data sheets. The second phase of the turn-on period of the transistor occurs after the time t_{sc} has elapsed. The collector-emitter voltage decreases rapidly in this phase. However, it does not reach a minimum steady state saturation value immediately. It first goes through a phase defined as the "dynamic collector-emitter saturation voltage" or "V_{CEsat} dyn".

This phase is particularly noticeable in the case of high voltage transistors. The losses due to the V_{CEsat} dyn voltage must be taken into account when operating at high voltages and high frequencies. As regards to the new transistors, the dynamic saturation voltage is specified at two precise instants, for example 2 and 4 μs after the start of conduction (figure 9).

Thus the specified values for dI_C/dt and V_{CEsat} dyn allow more accurate calculation of the switching losses at turn-on.

Figure 8 - The turn-on of a transistor with a conducting free-wheeling diode. The transistor constraints are different in comparison to the resistive load case. The voltage V_{CE} remains high during the time t_{sc}.

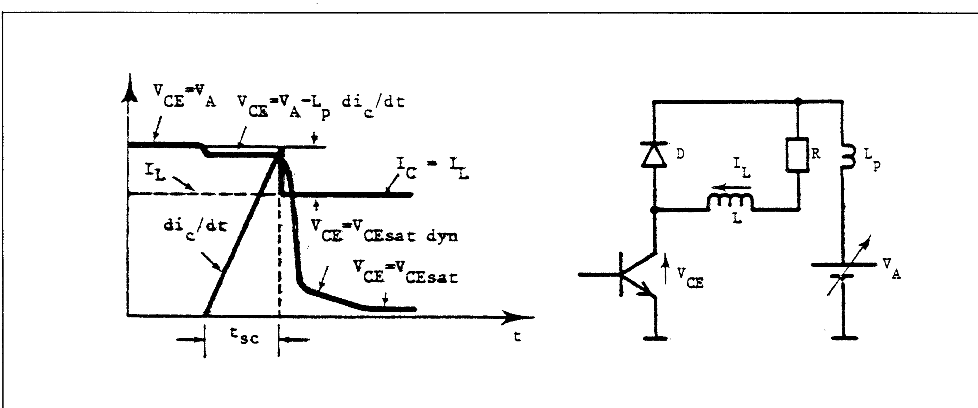
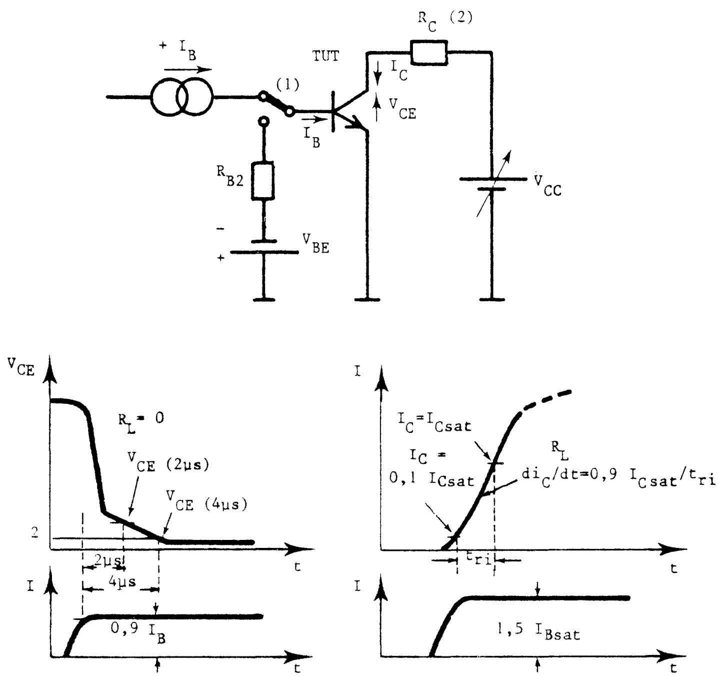


Figure 9 - Method of measurement for the determination of switching losses. V_{CEsat} dyn is measured with a resistive load (the current source). dI_C/dt is measured with the resistive load short-circuited.



IMPROVED SPECIFICATION OF THE TURN-OFF SWITCHING

The turn-off switch is more critical than the turn-on switching. When the transistor is working without switching aid circuits - which is possible with the new transistors - the switching losses at turn-off must be accurately predicted. In the past, the equation $E_{off} = 0.5 \cdot I_C \cdot V_A \cdot t_f$ has been used to approximately calculate the switching losses at turn-off. A more precise method of predicting switching losses is essential at high powers. When using an equation the following effects have been neglected:

a) During the storage time the collector-emitter voltage V_{CE} becomes greater than the saturation voltage V_{CEsat}.

b) The parasitic inductances present in the circuit cause supplementary losses.

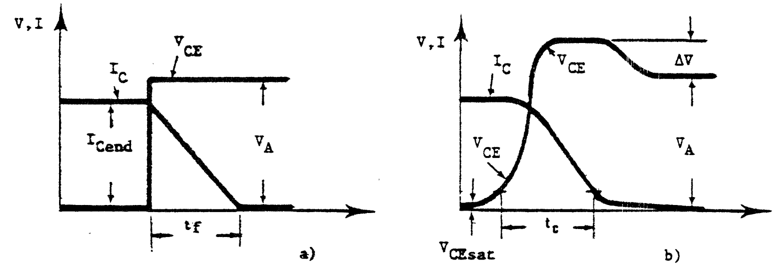
When considering fast transistors where a 10 A current is being switched off in less than 10 ns, the slope dI_C/dt has a value of 1000 A/µs. This gradient would cause a voltage of 100 V across a parasitic inductance of only 0,1 µH. A similar problem exists in the use of transistors at high power (such as 400 A switched in 300 ns).

It can be seen from figure 10, that the voltage V_{CE} rises from V_{CEsat} to a value $V_A + \Delta V$ gradually rather than instantaneously. Hence the time t_c has been specified in the data sheets of the FAST-SWITCH transistors.

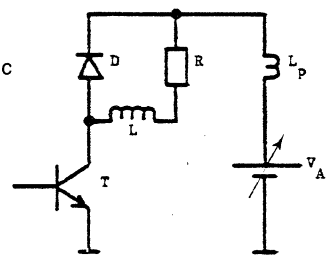
Hence it is possible to calculate accurately the turn-off losses of a transistor operating without switching aid circuits. The turn-off losses can be calculated using equation (1).

$$E_{off} = \underbrace{0.5\, I_{Cend}\, V_A\, t_c}_{\text{"A"}} + \underbrace{0.5\, t_{ti}\, 0.1\, I_{Cend}\, V_A}_{\text{"B"}} + \underbrace{0.5\, L_p\, I^2_{Cend}}_{\text{"C"}} \quad (1)$$

Figure 10



The ideal and the actual turn-off
a) the ideal turn-off
b) the actual turn-off with parasitic inductance L_p and a phase of desaturation.



The terms A and B depend on the transistor, on its operation, on the junction temperature and on its drive circuit. The term C is a function of the collector current and the parasitic inductances of the circuit. Thus this term is principally dependent on the physical lay-out of the circuit. The times t_c and t_{ti} are specified in the new data sheets.

TRANSISTOR FAILURE

Secondary breakdown may occur when the transistor is subjected simultaneously to a high current and a high voltage for a certain amount of time. This condition causes localised heating of the die followed by a current concentration and finally transistor failure. Thus it should be re-stated that transistor failure due to secondary breakdwon occurs when the following three conditions exist simultaneously: high voltage and high current during a prolonged time. It is necessary to consider the operating constraints of modern transistors.

If a high voltage transistor such as the BUX 98 is operated in the linear mode with a collector voltage of 400 V and a collector current of 40 A simultaneously, secondary breakdown occurs after about 80 to 100 μs. However, while operating the transistor in the switching mode, secondary breakdown does not occur since the transistor is subjected to the full voltage and current rating for only a fraction of a microsecond. Nevertherless, the transistor can fail in a very short period of time if the collector-emitter voltage increases above the limit specified in the RBSOA. If the base current of a switching transistor is insufficient, the transistor desaturates and the collector-emitter voltage increases while a high collector current continues to flow.

Hence the transistor is accidentally operated in the linear mode. This leads to over-heating and second breakdown. A base drive circuit that protects the transistor against accidental desaturation is called a "self protecting driver". If the circuit is well designed, it is possible to detect this fault condition rapidly: show the turn-off cycle on a scope operating in the x-y mode. Compare with the specified turn-on SOA "FBSOA". If the switching cycle remains within the specified area, the transistor is operating safely. The turn-off cycle can be verified in a similar manner. The following would then remain to be checked:

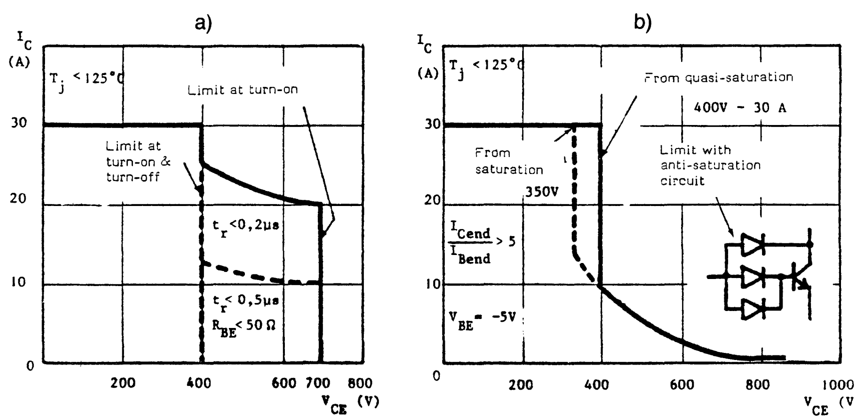
a) the state of the saturation before turn-off: (the transistor is more "robust" if turn-off is started from quasi-saturation, (figure 11).

b) The junction temperature which can be calculated with the losses and the thermal resistance. The safe operating area is specified at a junction temperature of 125°C. If the calculated temperature is below this value, "derating" is not necessary.

OVERLOAD CAPABILITY OF SWITCHING TRANSISTORS

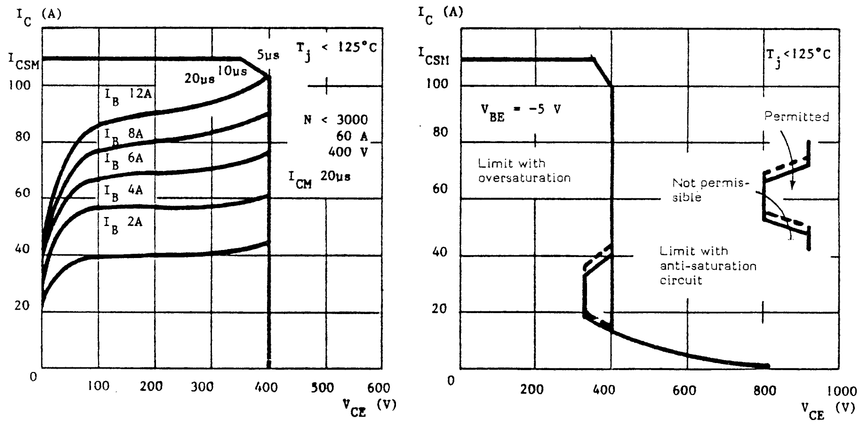
The overload capability of a transistor, (which is a meausre of its "robustness"), is important from the point of view of economic considerations. A converter must be capable of withstanding overloads and short-circuit conditions. The precise measure of the "robustness" of transistors is necessary in order to decide whether inductances should be used to limit the rate of rise of current under overload conditions.
If the transistor is capable of supporting the supply voltage and the over-rated current, it is possible to avoid using such inductances. The "accidental overload area" can be seen in figure 12: the astonishing "robustness" of modern switching transistors can be seen in this figure. The BUX 98, (I_{Csat} = 20 A, V_{CEOsus} = 400 V), is capable of operating with a collector current of 60 A and a voltage of 400 V for a period of 20 μs. This impulse of 24 kW can be applied at a junction temperature of 125°C. The margin of security is comfortable if it is assumed that the transistor is operating at a collector current of 20 A and that the response time for the detection of the overload is about 2 μs.
It should be noted that for currents greater than the I_{CM} value of 60 A, the number of overloads is limited to 3000 since pulses of 110 A 350 V 5 μs can cause irreversible damage to the transistor after a certain number of pulses. The overload capability of the transistor has been discussed thus far. It is now necessary to determine the importance of overload capability when a fault occurs. The answer can be found in the accidental overload area (FBAOA): The duration between turn-on, the detection of a fault and the turn-off may be around 3 μs by operating the transistor with an "auto-regulated, auto-protected" driver circuit or with the integrated, circuit UAA 4002, (figure 13).
The FBAOA gives the value of the current that the transistor can be subjected to during overload. However it does not state whether the specified current can be safely cut-off without damage. That specification is given in the RBAOA, (figure 12). The junction temperature must return to less than 125°C before the next overload.

Figure 11



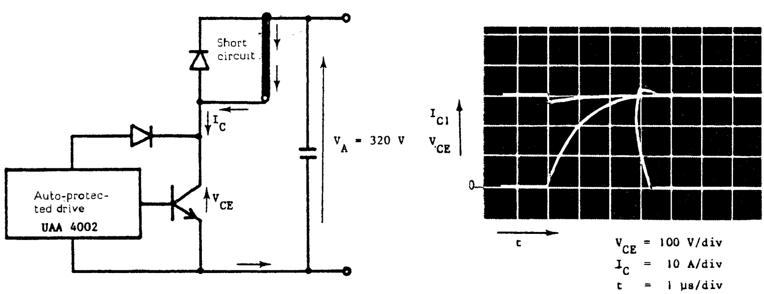
The switching safe operating areas of the BUX 98, (FBSOA and RBSOA). The areas are specified at a junction temperature of 125°C. It is thus unnecessary to specify deratings as a function of the junction temperature.
Figure a) specifies the safe operating area for turn-on.
Figure b) specifies the safe operating area for turn-off.

Figure 12



The accidental overload area. The area FBAOA, (on the left), specifies the transistor ''robustness''. This specification can be used to reduce the number of components in the protection circuitry against overload.

Figure 13



Turn-on and turn-off of the BUX 98 with the free-wheeling diode short-circuited. The collector voltage remains around 320 V while the collector current rises to around 27 A. The driver stage turns the transistors after about 3 μs off.

CONCLUSION

The very complete specification of the Fastswich - Transistor enables a prediction of switching losses under ''real world'' conditions. The lay-out of protection circuits, of the base drive and of parallel ing is greatly simplified. The cost/performance compromise of converters with Fastswich - Transistors can be predicted and optimised thanks to these specifications.

DATASHEETS

SGS-THOMSON
MICROELECTRONICS

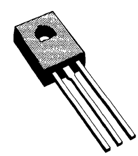
BD135
BD137-BD139

MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

DESCRIPTION

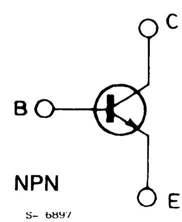
The BD135, BD137, BD139 are silicon epitaxial planar NPN transistors in Jedec TO-126 plastic package, designed for audio amplifiers and drivers utilizing complementary or quasi complementary circuits.

The complementary PNP types are the BD136, BD138 and BD140 respectively.



TO-126

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	BD135	BD137	BD139	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	45	60	80	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	45	60	80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5			V
I_C	Collector Current	1.5			A
I_{CM}	Collector Peak Current	3			A
I_B	Base Current	0.5			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$ $T_{amb} \leq 25°C$	12.5 1.25			W W
T_{stg}	Storage Temperature	– 55 to 150			°C
T_j	Junction Temperature	150			°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	10	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

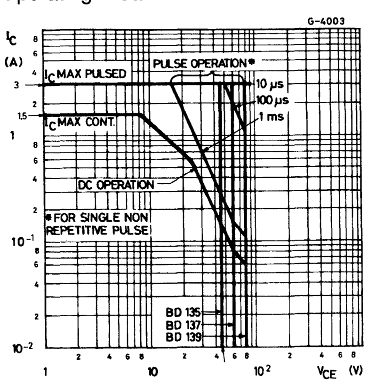
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 30V T_{case} = 125°C V_{CB} = 30V			0.1 10	μA μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			10	μA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 30mA for **BD135** for **BD137** for **BD139**	 45 60 80			 V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 500mA I_B = 50mA			0.5	V
V_{BE}*	Base-emitter on Voltage	I_C = 0.5A V_{CE} = 2V			1	V
h_{FE}*	DC current Gain	I_C = 5mA V_{CE} = 2V I_C = 0.5A V_{CE} = 2V All Types I_C = 150mA V_{CE} = 2V for **BD135** for **BD137, BD139**	25 25 40 40		 250 160	

* Pulsed : pulse duration = 300μs, duty cycle ≤ 2%.

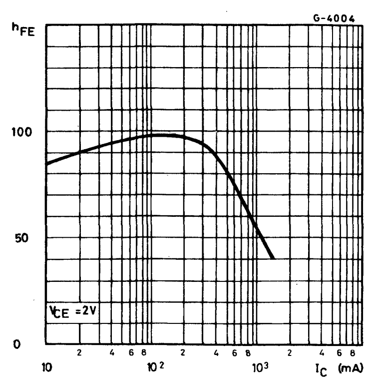
Available in h_{FE} groups (I_C = 150mA ; V_{CE} = 2V)

	Min.	Max.
h_{FE} group 6	40	100
10	63	160
16	100	250

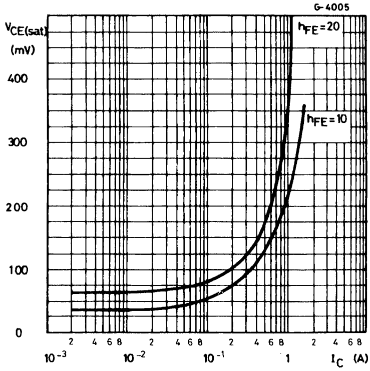
Safe Operating Area



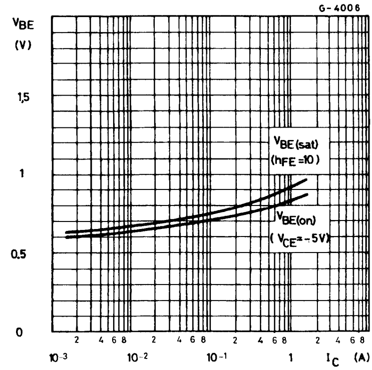
DC Current Gain



Collector-emitter Saturation Voltage.



Base-emitter Voltage.



SGS-THOMSON MICROELECTRONICS

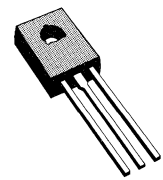
BD136
BD138-BD140

MEDIUM POWER GENERAL PURPOSE TRANSISTORS

DESCRIPTION

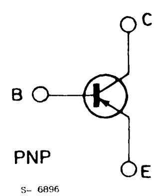
The BD136, BD138, BD140 are silicon epitaxial planar PNP transistors in Jedec TO-126 plastic package, designed for audio amplifiers and drivers utilizing complementary or quasi-complementary circuits.

The complementary NPN types are respectively the BD135, bd137 and BD139.



TO-126

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	BD136	BD138	BD140	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	– 45	– 60	– 80	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	– 45	– 60	– 80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	– 5			V
I_C	Collector Current	– 1.5			A
I_{CM}	Collector Peak Current	– 3			A
I_B	Base Current	– 0.5			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$ $T_{amb} \leq 25°C$	12.5 1.25			W W
T_{stg}	Storage Temperature	– 55 to 150			°C
T_j	Junction Temperature	150			°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	10	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

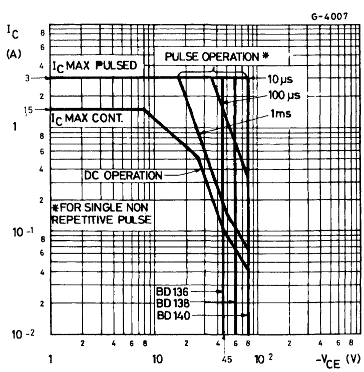
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = – 30V T_{case} = 125°C V_{CB} = – 30V			– 0.1 – 10	µA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = – 5V			– 10	µA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = – 30mA for **BD136** for **BD138** for **BD140**	 – 45 – 60 – 80			 V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 0.5A I_B = – 0.05A			– 0.5	V
V_{BE}*	Base-emitter Voltage	I_C = – 0.5A V_{CE} = – 2V			– 1	V
h_{FE}*	DC current Gain	I_C = – 5mA V_{CE} = – 2V I_C = – 0.5A V_{CE} = – 2V All Types I_C = – 150mA V_{CE} = – 2V for **BD136** for **BD138, BD140**	25 25 40 40		 250 160	

* Pulsed : pulse duration = 300µs, duty cycle ≤ 2%.

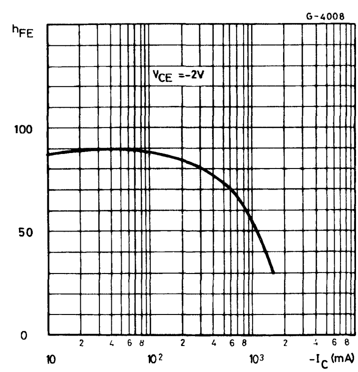
Available in h_{FE} groups

			Min.	Max.
(IC = – 0.15A V_{CE} = – 2V)	h_{FE} group	6	40	100
		10	63	160
		16	100	250

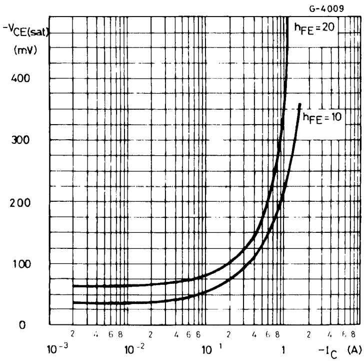
Safe Operating Areas.



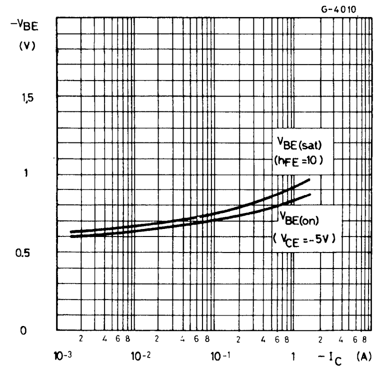
DC Current Gain.



Collector-emitter Saturation Voltage.



Base-emitter Voltage.

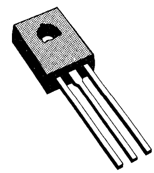


BD157/8/9

LOW POWER FAST SWITCHING

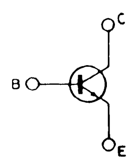
DESCRIPTION

The BD157, BD158 and BD159 are silicon epitaxial planar NPN transistors in TO-126 plastic package, intended for applications in low power linear and switching.



TO-126 (SOT-32)

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		BD157	BD158	BD159	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	275	325	375	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	250	300	350	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5			V
I_C	Collector Current	0.5			A
I_{CM}	Collector Peak Current	1			A
I_B	Base Current	0.25			A
P_{tot}	Total Power Dissipation at $T_{case} < 25$ °C	20			W
T_{stg}	Storage Temperature	– 65 to 150			°C
T_j	Junction Temperature	150			°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	6.25	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = rated V_{CBO}			100	µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			100	µA
V_{CEO}*	Collector-emitter Voltage	I_C = 1 mA for **BD157** for **BD158** for **BD159**	250 300 350			V V V
h_{FE}*	DC Current Gain	I_C = 50 mA V_{CE} = 10 V	30		240	

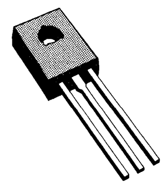
* Pulsed : pulse duration = 300 µs, duty cycle = 1.5 %.

MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

DESCRIPTION

The BD175, BD177 and BD179 are silicon epitaxial-base NPN power transistors in Jedec TO-126 plastic package intended for use in medium power linear and switching applications.

The complementary PNP types are the BD176, BD178 and BD180.



TO-126 (SOT-32)

INTERNAL SCHEMATIC DIAGRAMS

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
	NPN PNP*	BD175 BD176	BD177 BD178	BD179 BD180	
V_{CBO}	Collector-base Voltage (I_E = 0)	45	60	80	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	45	60	80	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5			V
I_C	Collector Current	3			A
I_{CM}	Collector Peak Current	7			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	30			W
T_{stg}	Storage Temperature	– 65 to 150			°C
T_j	Junction Temperature	150			°C

* For PNP types voltage and current values are negative.

THERMAL DATA

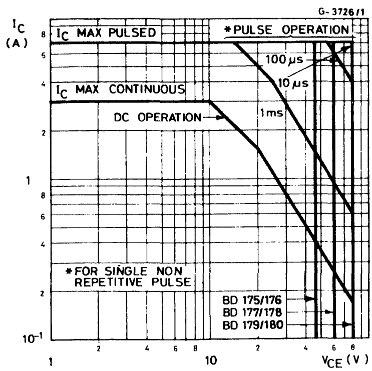
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	4.16	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

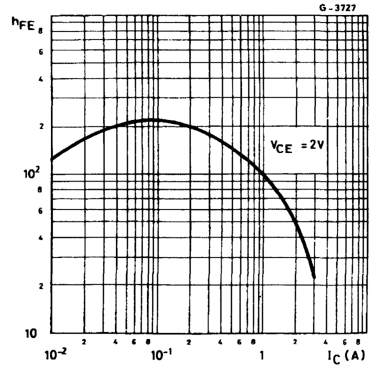
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **BD175/76** V_{CB} = 45 V for **BD177/78** V_{CB} = 60 V for **BD179/80** V_{CB} = 80 V			100 100 100	μA μA μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 100 mA for **BD175/76** for **BD177/78** for **BD179/80**	45 60 80			V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 1 A I_B = 0.1 A			0.8	V
V_{BE}*	Base-emitter Voltage	I_C = 1 A V_{CE} = 2 V			1.3	V
h_{FE}*	DC Current Gain	I_C = 150 mA V_{CE} = 2 V I_C = 1 A V_{CE} = 2 V	40 15			
h_{FE}	Groups** 6 10 (only BD175/6) 16	I_C = 150 mA V_{CE} = 2 V	40 63 100		100 160 250	
f_T	Transition Frequency	I_C = 250 mA V_{CE} = 10 V	3			MHz

* Pulsed : pulse duration = 300μs, duty cycle ≤1.5%.
** Only on request.
For PNP types voltage and current values are negative.

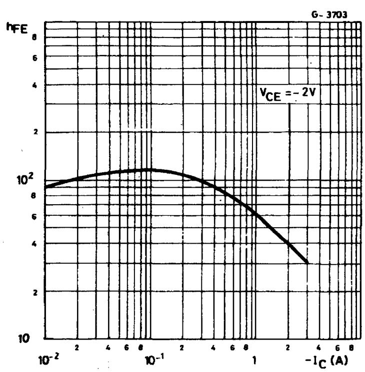
Safe Operating Areas.



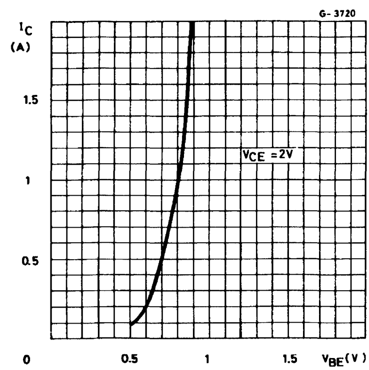
DC Current Gain (NPN types).



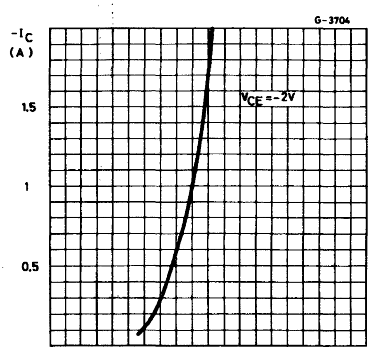
DC Current Gain (PNP types)



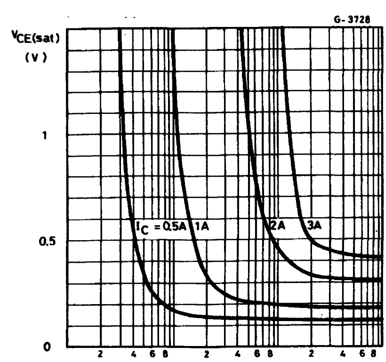
DC Transconductance (NPN types).



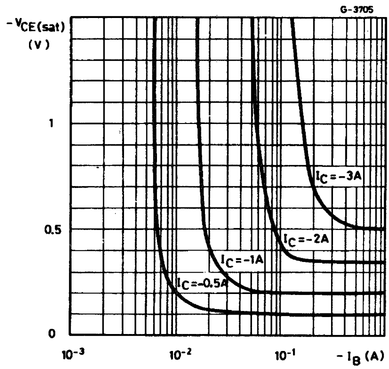
DC Transconductance(PNP types)



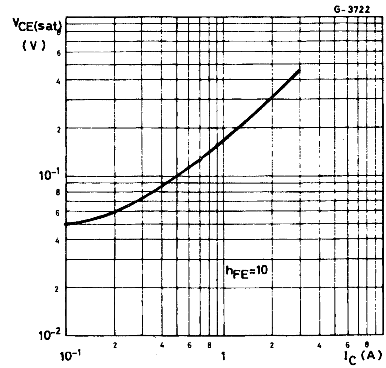
Collector-emitter Saturation Voltage (NPN types).



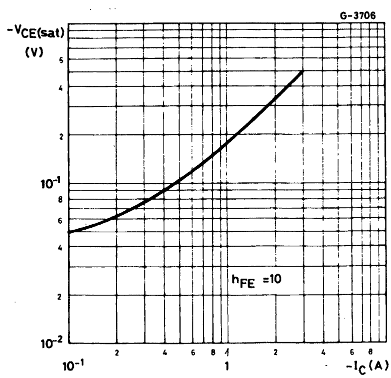
Collector-emitter Saturation Voltage (PNP types).



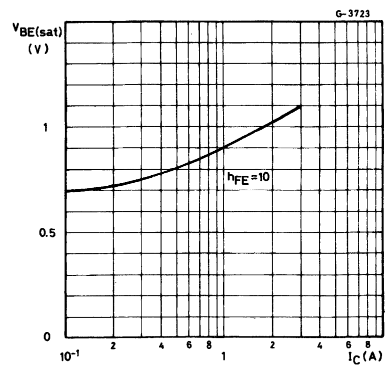
Collector-emitter Saturation Voltage (NPN types).



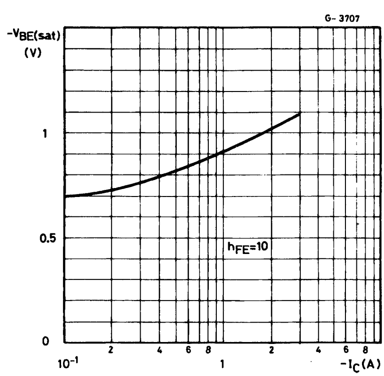
Collector-emitter Saturation Voltage (PNP types).



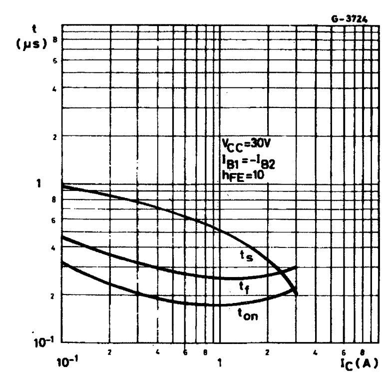
Basc-emitter Saturation Voltage (NPN types).



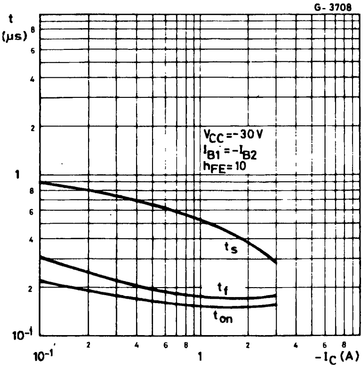
Basc-emitter Saturation Voltage (PNP types).



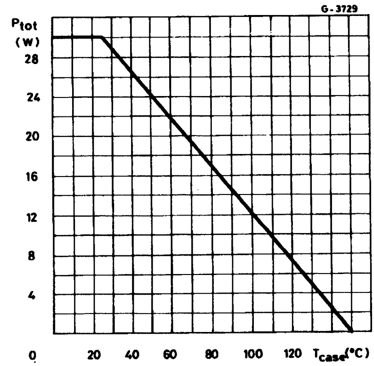
Saturated Switching Characteristics (NPN types).



Saturated Switching Characteristics (PNP types).



Power Derating Chart.

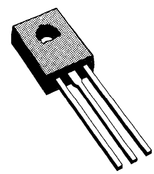


MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

DESCRIPTION

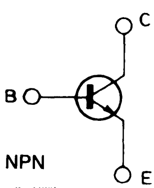
The BD233, BD235 and BD237 are silicon epitaxial-base NPN power transistors in Jedec TO-126 plastic package intended for use in medium power linear and switching applications.

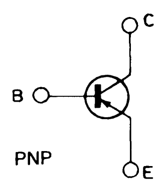
The complementary PNP types are the BD234, BD236 and BD238 respectively.



TO-126

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
	NPN / PNP*	BD233 / BD234	BD235 / BD236	BD237 / BD238	
V_{CBO}	Collector-base Voltage (I_E = 0)	45	60	100	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	45	60	80	V
V_{CER}	Collector-emitter Voltage (R_{BE} = 1 KΩ)	45	60	100	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5			V
I_C	Collector Current	2			A
I_{CM}	Collector Peak Current	6			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	25			W
T_{stg}	Storage Temperature	– 65 to 150			°C
T_j	Junction Temperature	150			°C

* For PNP types voltage and current values are negative.

THERMAL DATA

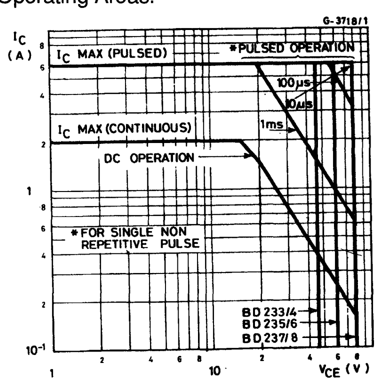
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

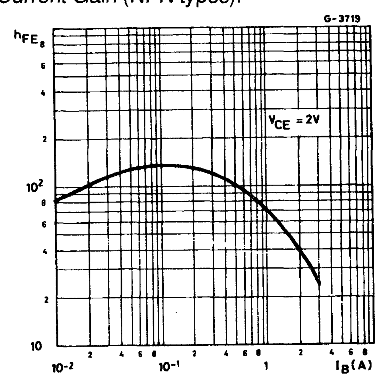
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **BD233/34** for **BD235/36** for **BD237/38** T_{case} = 150 °C for **BD233/34** for **BD235/36** for **BD237/38**	V_{CB} = 45 V V_{CB} = 60 V V_{CB} = 100 V V_{CB} = 45 V V_{CB} = 60 V V_{CB} = 100 V			100 100 100 2 2 2	μA μA μA mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V				1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 100 mA	for **BD233/34** for **BD235/36** for **BD237/38**	45 60 80			V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 1 A	I_B = 0.1 A			0.6	V
V_{BE}*	Base-emitter Voltage	I_C = 1 A	V_{CE} = 2 V			1.3	V
h_{FE}*	DC Current Gain	I_C = 150 mA I_C = 1 A	V_{CE} = 2 V V_{CE} = 2 V	40 25			
f_T	Transition Frequency	I_C = 250 mA	V_{CE} = 10 V	3			MHz
h_{FE1}/h_{FE2}*	Matched Pairs	I_C = 150 mA	V_{CE} = 2 V		1.6		

* Pulsed : pulse duration = 300 μs, duty cycle ≤ 1.5 %.
For PNP types voltage and current values are negative.

Safe Operating Areas.

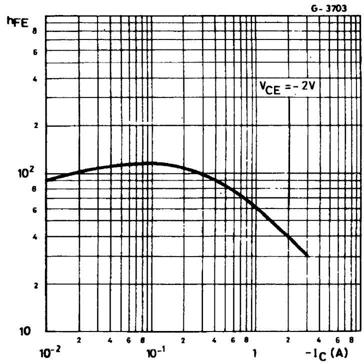


DC Current Gain (NPN types).

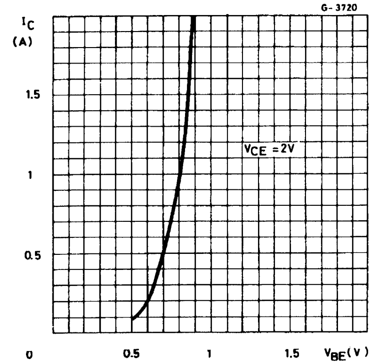


SGS-THOMSON MICROELECTRONICS

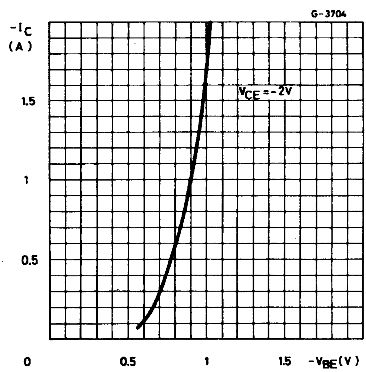
DC Current Gain (PNP types).



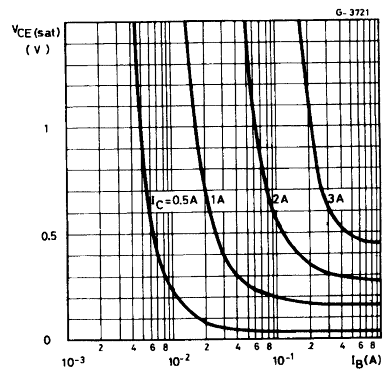
DC Transconductance (NPN types).



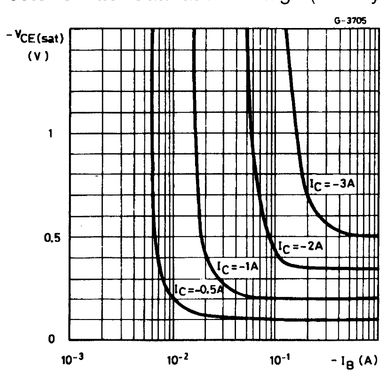
DC Transconductance (PNP types).



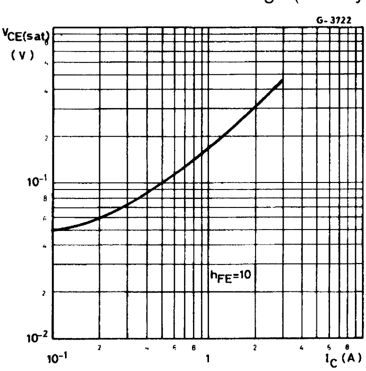
Collector-emitter Saturation Voltage (NPN types).



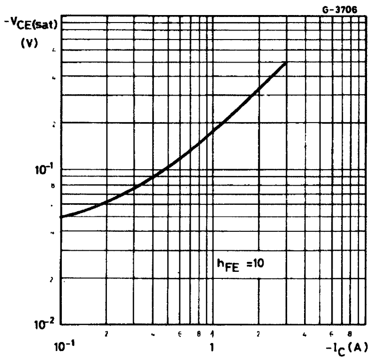
Collector-emitter Saturation Voltage (PNP types).



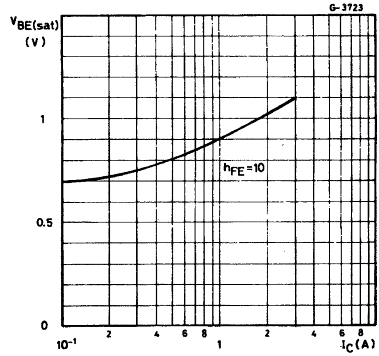
Collector-emitter Saturation Voltage (NPN types).



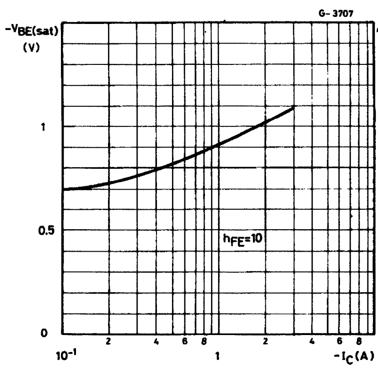
Collector-emitter Saturation Voltage (PNP types).



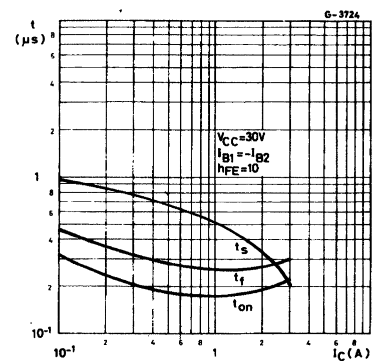
Base-emitter Saturation Voltage (NPN types).



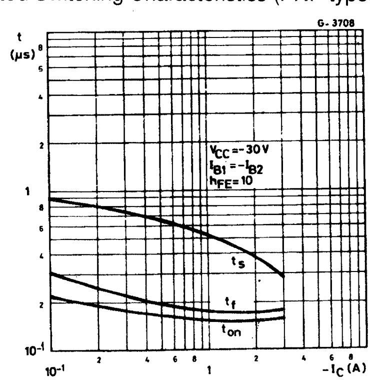
Base-emitter Saturation Voltage (NPN types).



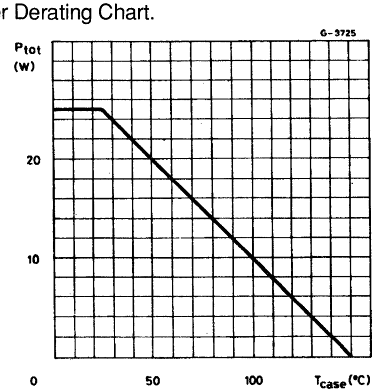
Saturated Switching Characteristics (NPN types).



Saturated Switching Characteristics (PNP types).



Power Derating Chart.



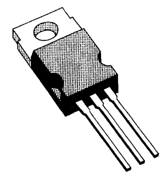
BD239/A/B/C
BD240/A/B/C

MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

DESCRIPTION

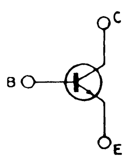
The BD239, BD239A, BD239B and BD239C are silicon epitaxial-base NPN power transistors in Jedec TO-220 plastic package, intended for use in medium power linear and switching applications.

The complementary PNP types are the BD240, BD240A, BD240B and BD240C respectively.

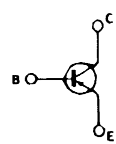


TO-220

INTERNAL SCHEMATIC DIAGRAMS



NPN



PNP

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter NPN / PNP*	Value				Unit
		BD239 BD240	BD239A BD240A	BD239B BD240B	BD239C BD240C	
V_{CER}	Collector-emitter Voltage (R_{BE} = 100 Ω)	55	70	90	115	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	45	60	80	100	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5				V
I_C	Collector Current	2				A
I_{CM}	Collector Peak Current	4				A
I_B	Base Current	0.6				A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C $T_{amb} \leq 25$ °C	30 2				W W
T_{stg}	Storage Temperature	– 65 to 150				°C
T_j	Junction Temperature	150				°C

* For PNP types voltage and current values are negative.

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THERMAL DATA

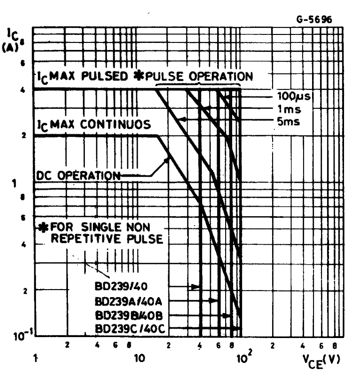
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	4.17	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	62.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **BD239/40/39A/40A** V_{CE} = 30 V for **BD239B/40B/39C/40C** V_{CE} = 60 V			0.3 0.3	mA mA
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	for **BD239/40** V_{CE} = 45 V for **BD239A/40A** V_{CE} = 60 V for **BD239B/40B** V_{CE} = 80 V for **BD239C/40C** V_{CE} = 100 V			0.2 0.2 0.2 0.2	mA mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 30 mA for **BD239/40** for **BD239A/40A** for **BD239B/40B** for **BD239C/40C**	45 60 80 100			V V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 1 A I_B = 0.2 mA			0.7	V
$V_{BE(on)}$*	Base-emitter Voltage	I_C = 1 A V_{CE} = 4 V			1.3	V
h_{FE}*	DC Current Gain	I_C = 0.2 A V_{CE} = 4 V I_C = 1 A V_{CE} = 4 V	40 15			
h_{fe}	Small Signal Current Gain	I_C = 0.2 A V_{CE} = 10 V f = 1 KHz I_C = 0.2 A V_{CE} = 10 V f = 1 MHz	20 3			

* Pulsed : pulse duration = 300 µs, duty cycle ≤ 2 %.

Safe Operating Areas.



For the others characteristics curves see TIP31/TIP32 series.

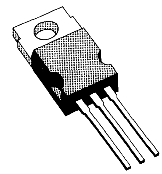
BD241/A/B/C
BD242/A/B/C

MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

DESCRIPTION

The BD241, BD241A, BD241B and BD241C are silicon epitaxial-base NPN power transistors in Jedec TO-220 plastic package, intended for use in medium power linear and switching applications.

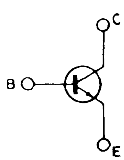
The complementary PNP types are the BD242, BD242A, BD242B and BD242C respectively.



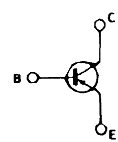
TO-220

INTERNAL SCHEMATIC DIAGRAM

NPN



PNP



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter NPN PNP*	Value				Unit
		BD241 BD242	BD241A BD242A	BD241B BD242B	BD241C BD242C	
V_{CER}	Collector-emitter Voltage (R_{BE} = 100 Ω)	55	70	90	115	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	45	60	80	100	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5				V
I_C	Collector Current	3				A
I_{CM}	Collector Peak Current	5				A
I_B	Base-Current	1				A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C $T_{amb} \leq 25$ °C	40 2				W W
T_{stg}	Storage Temperature	– 65 to 150				°C
T_j	Junction Temperature	150				°C

* For PNP types voltage and current values are negative.

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	3.13	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	62.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **BD241/42/41A/42A** V_{CE} = 30 V for **BD241B/42B/41C/42C** V_{CE} = 60 V			 0.3 0.3	 mA mA
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	for **BD241/42** V_{CE} = 45 V for **BD241A/42A** V_{CE} = 60 V for **BD241B/42B** V_{CE} = 80 V for **BD241C/42C** V_{CE} = 100 V			0.2 0.2 0.2 0.2	mA mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 30 mA for **BD241/42** for **BD241A/42A** for **BD241B/42B** for **BD241C/42C**	45 60 80 100			V V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 3 A I_B = 0.6 A			1.2	V
$V_{BE(on)}$*	Base-emitter Voltage	I_C = 3 A V_{CE} = 4 V			1.8	V
h_{FE}*	DC Current Gain	I_C = 1 A V_{CE} = 4 V I_C = 3 A V_{CE} = 4 V	25 10			
h_{fe}	Small Signal Current Gain	I_C = 0.5 A V_{CE} = 10 V f = 1 KHz I_C = 0.5 A V_{CE} = 10 V f = 1 MHz	20 3			

* Pulsed : pulse duration = 300 µs, duty cycle ≤ 2 %.
For PNP types voltage and current values are negative.
For the characteristics curves see TIP31/TIP32 series.

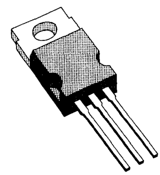
BD243/A/B/C
BD244/A/B/C

POWER LINEAR AND SWITCHING APPLICATIONS

DESCRIPTION

The BD243, BD243A, BD243B and BD243C are silicon epitaxial-base NPN power transistors in Jedec TO-220 plastic package, intended for use in medium power linear and switching applications.

The complementary PNP types are the BD244, BD244A, BD244B and BD244C respectively.



TO-220

INTERNAL SCHEMATIC DIAGRAMS

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value NPN: BD243 / PNP*: BD244	BD243A / BD244A	BD243B / BD244B	BD243C / BD244C	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	45	60	80	100	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	45	60	80	100	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5				V
I_C	Collector Current	6				A
I_{CM}	Collector Peak Current	10				A
I_B	Base Current	2				A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	65				W
T_{stg}	Storage Temperature	– 65 to 150				°C
T_j	Junction Temperature	150				°C

* For PNP types voltage and current values are negative.

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.92	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	62.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **BD243/44/43A/44A** V_{CE} = 30 V for **BD243B/44B/43C/44C** V_{CE} = 60 V			0.7 0.7	mA mA
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	for **BD243/44** V_{CE} = 45 V for **BD243A/44A** V_{CE} = 60 V for **BD243B/44B** V_{CE} = 80 V for **BD243C/44C** V_{CE} = 100 V			0.4 0.4 0.4 0.4	mA mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 30 mA for **BD243/44** for **BD243A/44A** for **BD243B/44B** for **BD243C/44C**	45 60 80 100			V V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 6 A I_B = 1 mA			1.5	V
V_{BE}*	Base-emitter Voltage	I_C = 6 A V_{CE} = 4 V			2	V
h_{FE}*	DC Current Gain	I_C = 0.3 A V_{CE} = 4 V I_C = 3 A V_{CE} = 4 V	30 15			
h_{fe}	Small Signal Current Gain	I_C = 0.5 A V_{CE} = 10 V f = 1 KHz I_C = 0.5 A V_{CE} = 10 V f = 1 MHz	20 3			

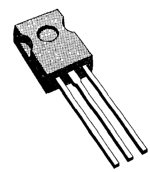
* Pulsed : pulse duration = 300 µs, duty cycle ≤ 2 %.
For PNP types voltage and current values are negative.

BD331/33/35 BD332/34/36

COMPLEMENTARY POWER DARLINGTONS

DESCRIPTION

The BD331, BD333, BD335 (NPN types) and BD332, BD334, BD336 (PNP types) are complementary epitaxial-base Darlingtons in SOT-82 plastic package. They are intended for use in audio output stages, general amplifier and switching applications.



SOT-82

INTERNAL SCHEMATIC DIAGRAMS

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value NPN BD331 / PNP BD332	Value NPN BD333 / PNP BD334	Value NPN BD335 / PNP BD336	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	60	80	100	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	60	80	100	V
V_{EBO}	Base-emitter Voltage ($I_C = 0$)	5			V
I_C	Collector Current	6			A
I_{CM}	Collector Peak Current (tp < 10 ms)	10			A
I_B	Base Current	0.15			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	60			W
T_{stg}	Storage Temperature	– 65 to 150			°C
T_j	Junction Temperature	150			°C

For PNP types voltage and current values are negative.

THERMAL DATA

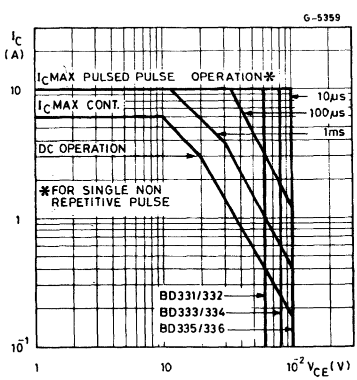
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	2.08	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

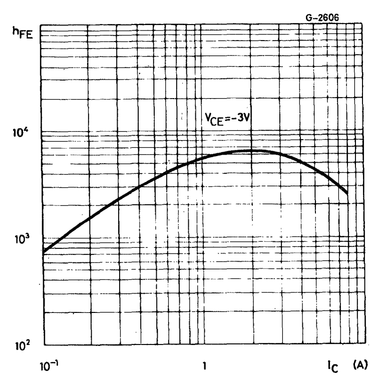
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = rated V_{CBO} T_{case} = 150 °C			0.2 2	mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 1/2 V_{CEO} max			0.5	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			5	mA
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 3 A I_B = 12 mA			2	V
V_{BE}*	Base-emitter Voltage	I_C = 3 A V_{CE} = 3 V			2.5	V
h_{FE}*	DC Current Gain	I_C = 0.5 A V_{CE} = 3 V for **BD331, BD333, BD335** for **BD332, BD334, BD336** I_C = 3 A V_{CE} = 3 V for **BD331, BD333, BD335** for **BD332, BD334, BD336** I_C = 6 A V_{CE} = 3 V for **BD331, BD333, BD335** for **BD332, BD334, BD336**	 750 750	 1900 2700 3000 400		
V_F*	Parallel Diode Forward Voltage	I_F = 3 A		1.8		V
h_{fe}	Small Signal Current Gain	I_C = 3 A V_{CE} = 3 V f = 1 MHz for **BD331, BD333, BD335** for **BD332, BD334, BD336**		 50 150		
t_{on}	Turn-on Time	I_C = 3 A V_{CC} = 30 V		1	2	μs
t_{off}	Turn-off Time	I_{B1} = − I_{B2} = 12 mA		5	10	μs

* Pulsed : pulse duration = 300 μs, duty cycle ≤ 1.5 %.
For PNP types voltage and current values are negative.

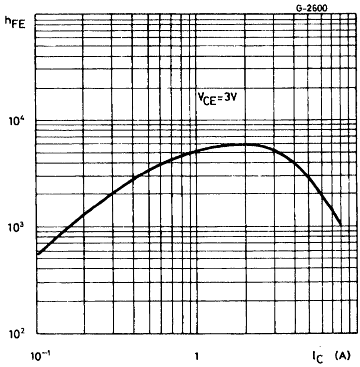
Safe Operating Areas.



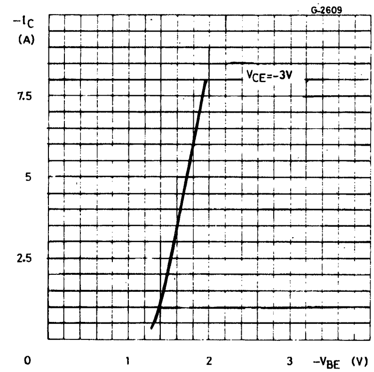
DC Current Gain (NPN types).



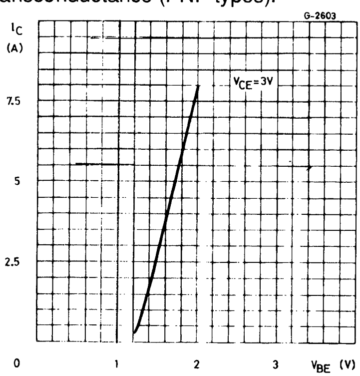
DC Current gain (PNP types).



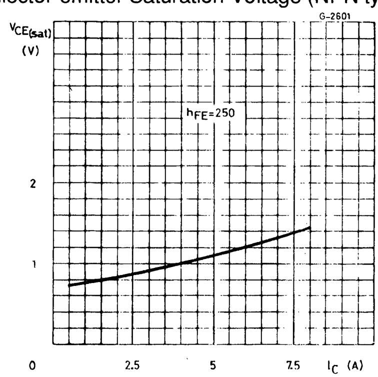
DC Transconductance (NPN types).



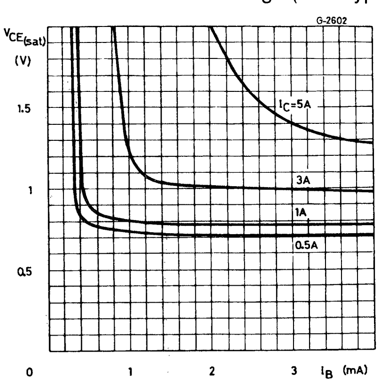
DC Transconductance (PNP types).



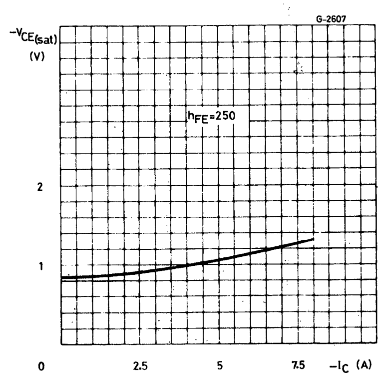
Collector-emitter Saturation Voltage (NPN types).



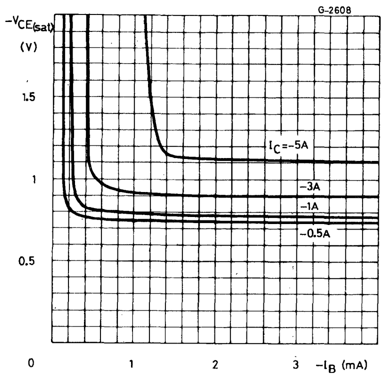
Collector-emitter Saturation Voltage (NPN types).



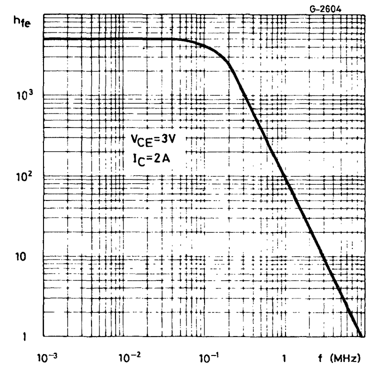
Collector-emitter Saturation Voltage (PNP types).



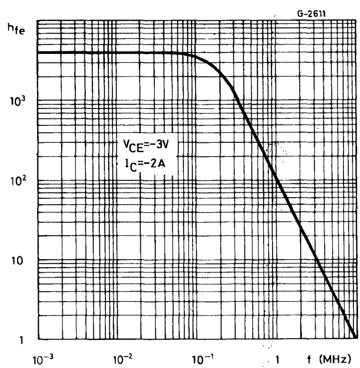
Collector-emitter Saturation Voltage (PNP types).



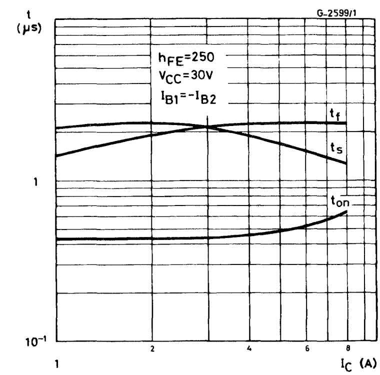
Small Signal Current Gain (NPN types).



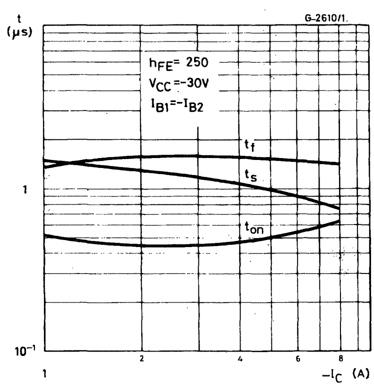
Small Signal Current Gain (PNP types).



Saturated Switching Characteristics (NPN types).



Saturated Switching Characteristics (PNP types).



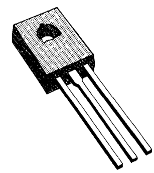
MEDIUM POWER LINEAR AND SWITCHING APPLICATION

DESCRIPTION

The BD433, BD435 and BD437 are silicon epitaxial-base NPN power transistors in Jedec TO-126 plastic package, intended for use in medium power linear and switching applications.

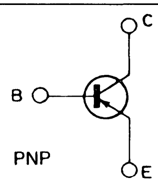
The BD433 is especially suitable for use in car-radio output stages.

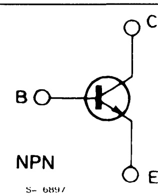
The complementary PNP types are the BD434, BD436 and BD438 respectively.



TO-126 (SOT-32)

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter NPN / PNP*	Value			Unit
		BD433 BD434	BD435 BD436	BD437 BD438	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	22	32	45	V
V_{CES}	Collector-emitter Voltage ($V_{BE} = 0$)	22	32	45	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	22	32	45	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5			V
I_C	Collector Current	4			A
I_{CM}	Collector Peak Current ($t \leq 10$ ms)	7			A
I_B	Base Current	1			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	36			W
T_{stg}	Storage Temperature	– 65 to 150			°C
T_j	Junction Temperature	150			°C

* For PNP types voltage and current values are negative.

THERMAL DATA

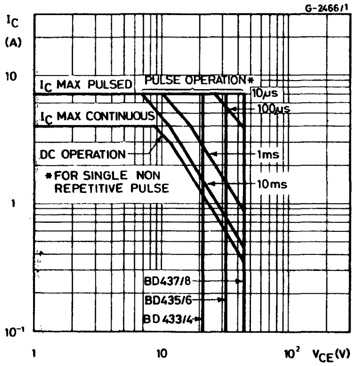
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	3.5	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	100	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

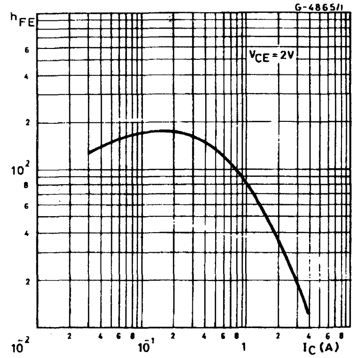
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **BD433/34**	V_{CB} = 22 V			100	µA
		for **BD435/36**	V_{CB} = 32 V			100	µA
		for **BD437/38**	V_{CB} = 45 V			100	µA
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	for **BD433/34**	V_{CE} = 22 V			100	µA
		for **BD435/36**	V_{CE} = 32 V			100	µA
		for **BD437/38**	V_{CE} = 45 V			100	µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V				1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA	for **BD433/34**	22			V
			for **BD435/36**	32			V
			for **BD437/38**	45			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 2 A	I_B = 0.2 A				
			for **BD433/34**		0.2	0.5	V
			for **BD435/36**		0.2	0.5	V
			for **BD437/38**		0.2	0.6	V
V_{BE}*	Base-emitter Voltage	I_C = 10 mA	V_{CE} = 5 V		0.58		V
		I_C = 2 A	V_{CE} = 1 V				
			for **BD433/34**			1.1	V
			for **BD435/36**			1.1	V
			for **BD437/38**			1.2	V
h_{FE}*	DC Current Gain	I_C = 10 mA	V_{CE} = 5 V				
			for **BD433/34**	40	130		
			for **BD435/36**	40	130		
			for **BD437/38**	30	130		
		I_C = 500 mA	V_{CE} = 1 V	85	140		
		I_C = 2 A	V_{CE} = 1 V				
			for **BD433/34**	50			
			for **BD435/36**	50			
			for **BD437/38**	40			
h_{FE1}/h_{FE2}*	Matched Pair	I_C = 500 mA	V_{CE} = 1 V			1.4	
f_T	Transition Frequency	I_C = 250 mA	V_{CE} = 1 V	3			MHz

* Pulsed : pulse duration = 300 µs, duty cycle = 1.5 %.
For PNP types voltage and current values are negative.

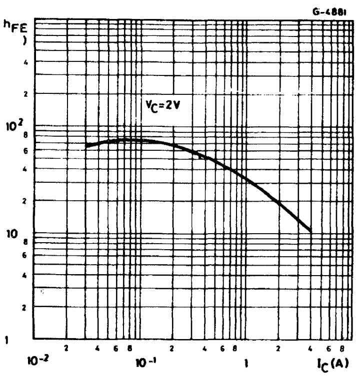
Safe Operating Areas.



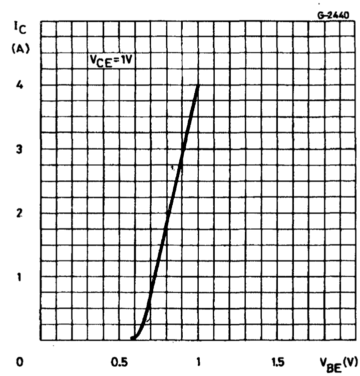
DC Current Gain (NPN types).



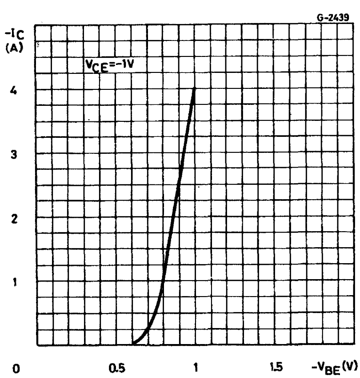
DC Current gain (PNP types).



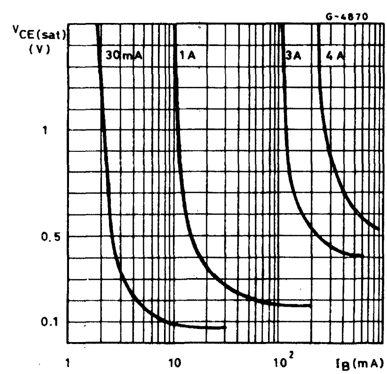
DC Transconductance (NPN types).



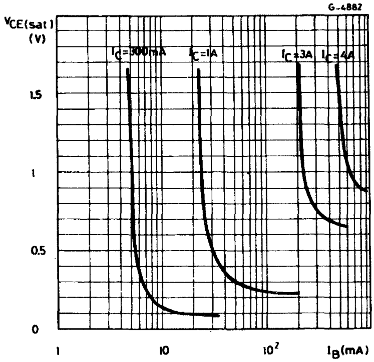
DC Transconductance (PNP types).



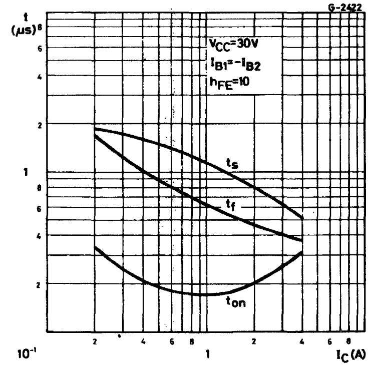
Collector-emitter Saturation Voltage (NPN types).



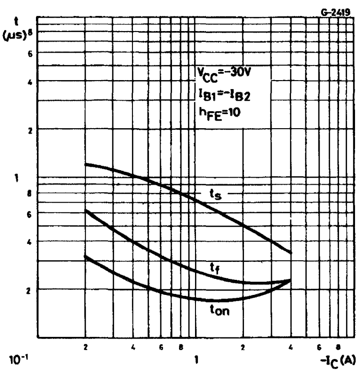
Collector-emitter Saturation Voltage (PNP types).



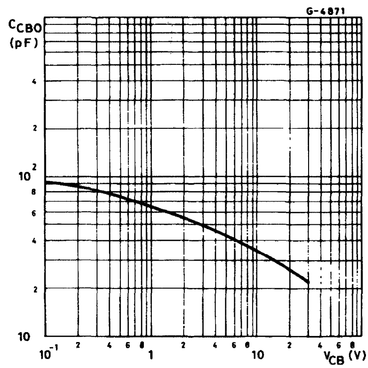
Saturated Switching Characteristics (NPN types).



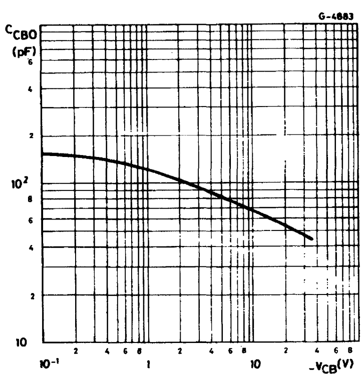
Saturated Switching Characteristics (PNP types).



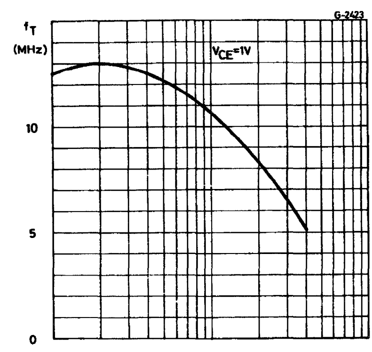
Collector-base Capacitance (NPN types).



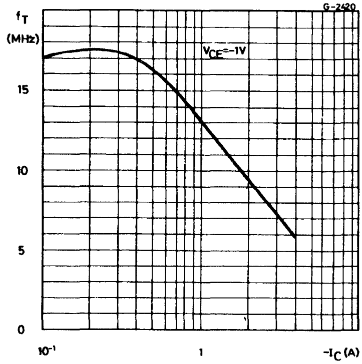
Collector-base Capacitance (PNP types).



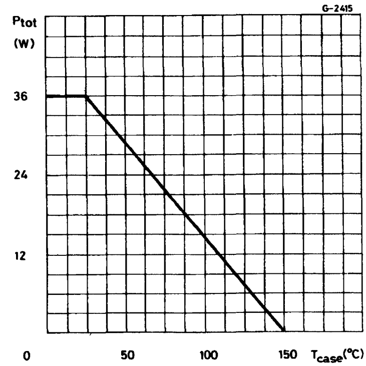
Transition Frequency (NPN types).



Transition Frequency (PNP types).



Power Rating Chart.

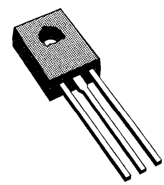


MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

DESCRIPTION

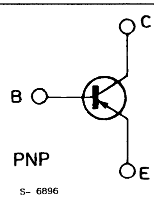
The BD439 and BD441 are silicon epitaxial-base NPN power transistors in Jedec TO-126 plastic package, intended for use in power linear and switching applications.

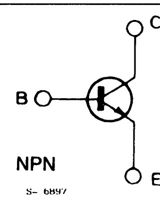
The complementary PNP types are the BD440 and BD442 respectively.



TO-126

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter NPN / PNP*	Value		Unit
		BD439 / BD440	BD441 / BD442	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	60	80	V
V_{CES}	Collector-emitter Voltage ($V_{BE} = 0$)	60	80	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	60	80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5		V
I_C	Collector Current	4		A
I_{CM}	Collector Peak Current ($t \leq 10$ ms)	7		A
I_B	Base Current	1		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	36		W
T_{stg}	Storage Temperature	– 65 to 150		°C
T_j	Junction Temperature	150		°C

* For PNP types voltage and current values are negative.

THERMAL DATA

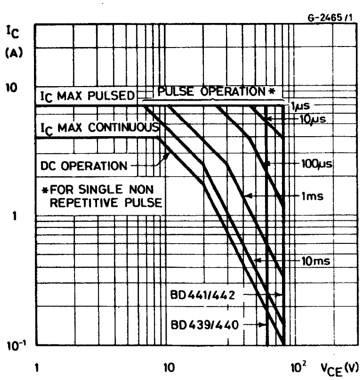
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	3.5	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	100	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **BD439/40** V_{CB} = 60 V for **BD441/42** V_{CB} = 80 V			100 100	µA µA
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	for **BD439/40** V_{CE} = 60 V for **BD441/42** V_{CE} = 80 V			100 100	µA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA for **BD439/40** for **BD441/42**	60 80			V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 2 A I_B = 0.2 A			0.8	V
V_{BE}*	Base-emitter Voltage	I_C = 10 mA V_{CE} = 5 V I_C = 2 A V_{CE} = 1 V		0.58	 1.5	V V
h_{FE}*	DC current Gain	I_C = 10 mA V_{CE} = 5 V for **BD439/40** for **BD441/42** I_C = 500 mA V_{CE} = 1 V for **BD439/40** for **BD441/42** I_C = 2 A V_{CE} = 1 V for **BD439/40** for **BD441/42**	 20 15 40 40 25 15	 130 130 140 140		
h_{FE1}/h_{FE2}*	Matched Pair	I_C = 500 mA V_{CE} = 1 V			1.4	
f_T	Transition Frequency	I_C = 250 mA V_{CE} = 1 V	3			MHz

* Pulsed : pulse duration = 300 µs, duty cycle ≤ 1.5 %.
For PNP types voltage and current values are negative.

Safe Operating Areas.



For the others characteristics curve see the BD433/BD434 series.

SGS-THOMSON MICROELECTRONICS

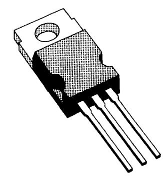
BD533/BD534 BD535/BD536 BD537/BD538

EPITAXIAL-BASE NPN/PNP

DESCRIPTION

The BD533, BD535 and BD537 are silicon epitaxial-base NPN power transistors in Jedec TO-220 plastic package, intended for use in medium power linear and switching applications.

The complementary PNP types are the BD534, BD536 and BD538 respectively.



TO-220

INTERNAL SCHEMATIC DIAGRAMS

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter NPN / PNP*	Value BD533 / BD534	BD535 / BD536	BD537 / BD538	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	45	60	80	V
V_{CES}	Collector-emitter Voltage ($V_{BE} = 0$)	45	60	80	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	45	60	80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5			V
I_C, I_E	Collector and Emitter Current	8			A
I_B	Base Current	1			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	50			W
T_{stg}	Storage Temperature	– 65 to 150			°C
T_j	Junction Temperature	150			°C

* For PNP types voltage and current values are negative.

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	2.5	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	70	°C/W

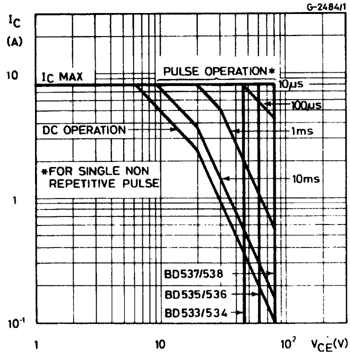
ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **BD533/34** V_{CB} = 45 V for **BD535/36** V_{CB} = 60 V for **BD537/38** V_{CB} = 80 V			100 100 100	µA µA µA
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	for **BD533/34** V_{CE} = 45 V for **BD535/36** V_{CE} = 60 V for **BD537/38** V_{CE} = 80 V			100 100 100	µA µA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA for **BD533/34** for **BD535/36** for **BD537/38**	45 60 80			V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 2 A I_B = 0.2 A I_C = 6 A I_B = 0.6 A		 0.8	0.8 	V V
V_{BE}*	Base-emitter Voltage	I_C = 2 A V_{CE} = 2 V			1.5	V
h_{FE}*	DC Current Gain	I_C = 10 mA V_{CE} = 5 V for **BD533/34** for **BD535/36** for **BD537/38** I_C = 500 mA V_{CE} = 2 V I_C = 2 A V_{CE} = 2 V for **BD533/34** for **BD535/36** for **BD537/38**	 20 20 15 40 25 25 15			
f_T	Transition Frequency	I_C = 500 mA V_{CE} = 1 V	3	12		MHz
h_{FE} groups** :	J K	I_C = 2 A V_{CE} = 2 V I_C = 3 A V_{CE} = 2 V I_C = 2 A V_{CE} = 2 V I_C = 3 A V_{CE} = 2 V	30 15 40 20		75 100 	

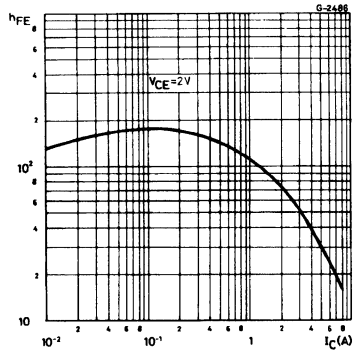
* Pulsed : pulse duration = 300 µs, duty cycle = 1.5 %.

For PNP types voltage and current values are negative.

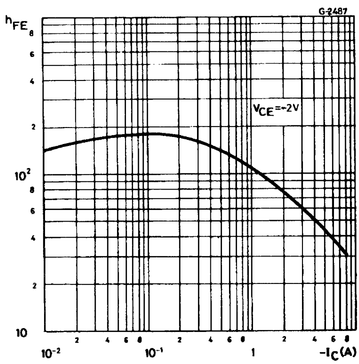
Safe Operating Areas.



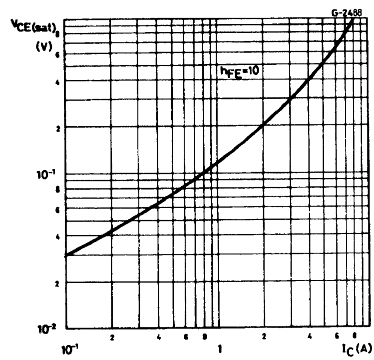
DC Current Gain (NPN types).



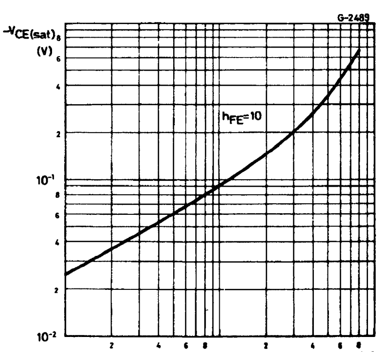
DC Current Gain (PNP types).



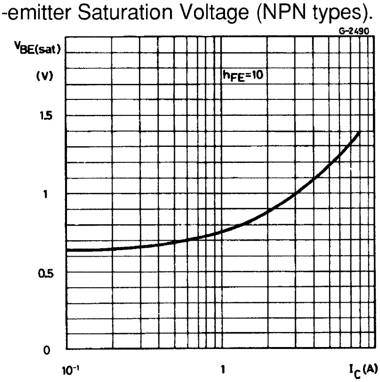
Collector-emitter Saturation Voltage (NPN types).



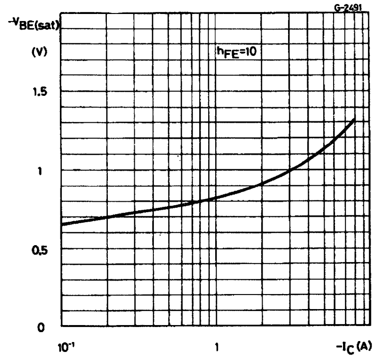
Collector-emitter Saturation Voltage (PNP types).



Base-emitter Saturation Voltage (NPN types).



Base-emitter Saturation Voltage (PNP types).

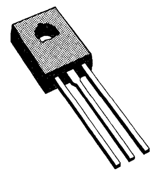


MEDIUM POWER DARLINGTONS

DESCRIPTION

The BD675, BD675A, BD677, BD677A, BD679, BD679A and BD681 are silicon epitaxial-base NPN power transistors in monolithic Darlington configuration and are mounted in Jedec TO-126 plastic package. They are intended for use in medium power linear and switching applications.

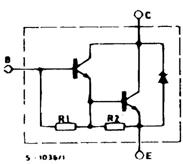
The complementary PNP types are the BD676, BD676A, BD678, BD678A, BD680, BD680A and BD682 respectively.



TO-126

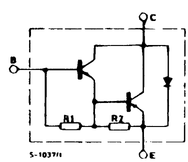
INTERNAL SCHEMATIC DIAGRAMS

NPN



R1 Typ. 10kΩ
R2 Typ. 150Ω

PNP



R1 Typ. 10kΩ
R2 Typ. 150Ω

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter NPN / PNP*	Value				Unit
		BD675/A BD676A	BD677/A BD677/A	BD679/A BD680A	BD681 BD682	
V_{CBO}	Collector-emitter Voltage (I_E = 0)	45	60	80	100	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	45	60	80	100	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5				V
I_C	Collector Current	4				A
I_{CM}	Collector Peak Current (repetitive)	6				A
I_B	Base Current	100				mA
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$	40				W
T_{stg}	Storage Temperature	– 65 to 150				°C
T_j	Junction Temperature	150				°C

For PNP types voltage and current values are negative.

THERMAL DATA

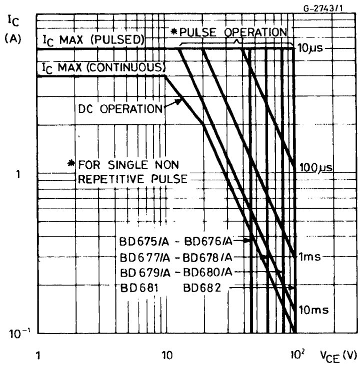
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	3.12	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	100	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

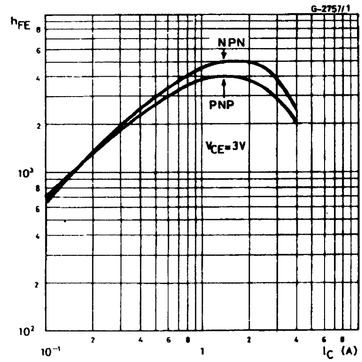
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = rated V_{CBO} V_{CB} = rated V_{CBO} T_{case} = 100°C			200 2	µA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = half rated V_{CEO}			500	µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			2	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 50mA for **BD675/75A/76/76A** for **BD677/77A/78/78A** for **BD679/79A/80/80A** for **BD681/82**	45 60 80 100			V V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	for **BD675/76/77/78/79/80/81/82** I_C = 1.5A I_B = 30mA for **BD675A/76A/77A/78A/79A/80A** I_C = 2A I_B = 40mA			2.5 2.8	V V
V_{BE}*	Base-emitter Voltage	for **675/76/77/78/79/80/81/82** I_C = 1.5A V_{CE} = 3V for **675A/76A/77A/78A/79A/80A** I_C = 2A V_{CE} = 3V			2.5 2.5	V V
h_{FE}*	DC current Gain	for **675/76/77/78/79/80/81/82** I_C = 1.5A V_{CE} = 3V for **675A/76A/77A/78A/79A/80A** I_C = 2A V_{CE} = 3V	750 750			
h_{fe}	Small Signal Current Gain	I_C = 1.5A V_{CE} = 3V f = 1MHz	1			

* Pulsed : pulse duration = 300

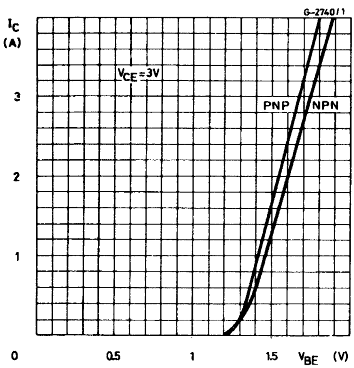
Safe Operating Areas.



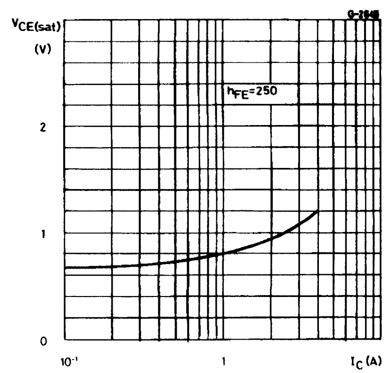
DC Current Gain.



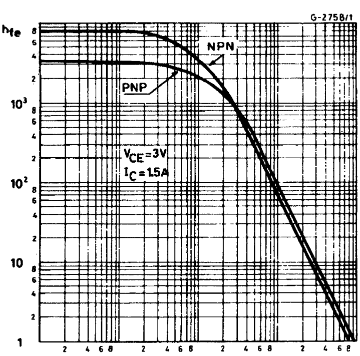
DC Transconductance.



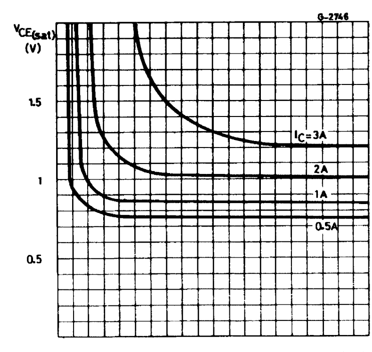
Collector-emitter Saturation Voltage.



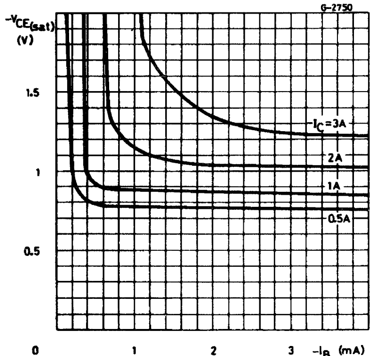
Small Signal Current gain.



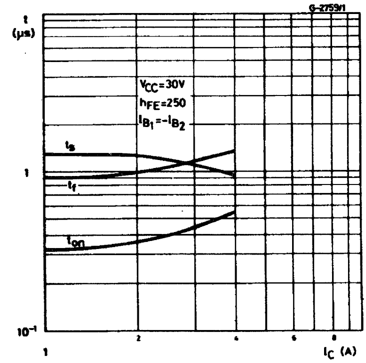
Collector-emitter Saturation Voltage (NPN types).



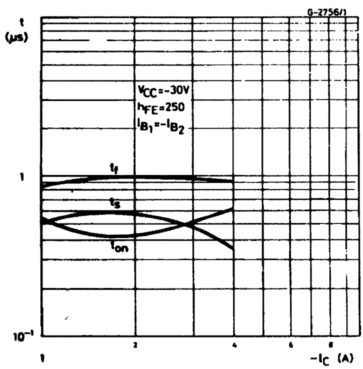
Collector-emitter Saturation Voltage (PNP).



Saturated Switching Characteristics (NPN).



saturated Switching Characteristrics (PNP).

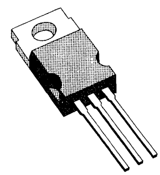


BD705/706/707/708 BD709/710/711/712

POWER LINEAR AND SWITCHING APPLICATIONS

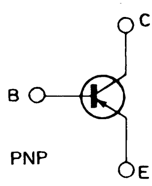
DESCRIPTION

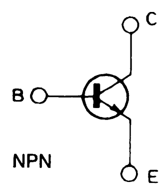
The BD705, BD707, BD709 and BD711 are silicon epitaxial-base NPN power transistors in Jedec TO-220 plastic package intended for use in power linear and switching applications. The complementary PNP types are the BD706, BD708, BD710 and BD712 respectively.



TO-220

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	NPN / PNP*	Value				Unit
			BD705 BD706	BD707 BD708	BD709 BD710	BD711 BD712	
V_{CBO}	Collector-emitter Voltage ($I_E = 0$)		45	60	80	100	V
V_{CES}	Collector-emitter Voltage ($V_{BE} = 0$)		45	60	80	100	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)		45	60	80	100	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)		5				V
I_C	Collector Current		12				A
I_B	Base Current		5				A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C		75				W
T_{stg}	Storage Temperature		– 65 to 150				°C
T_j	Junction Temperature		150				°C

* For PNP types voltage and current values are negative.

THERMAL DATA

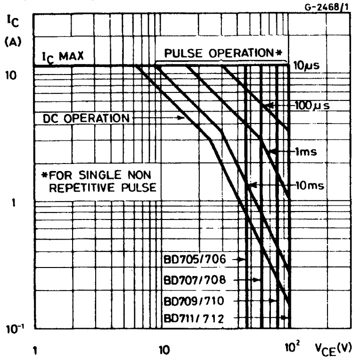
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.67	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	70	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

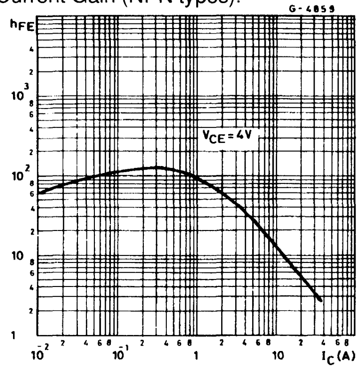
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **BD705/706** V_{CB} = 45 V			100	µA
		for **BD707/708** V_{CB} = 60 V			100	µA
		for **BD709/710** V_{CB} = 80 V			100	µA
		for **BD711/712** V_{CB} = 100 V			100	µA
		T_{case} = 150 °C				
		for **BD705/706** V_{CB} = 45 V			1	mA
		for **BD707/708** V_{CB} = 60 V			1	mA
		for **BD709/710** V_{CB} = 80 V			1	mA
		for **BD711/712** V_{CB} = 100 V			1	mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **BD705/706** V_{CE} = 22 V			1	mA
		for **BD707/708** V_{CE} = 30 V			1	mA
		for **BD709/710** V_{CE} = 40 V			1	mA
		for **BD711/712** V_{CE} = 50 V			1	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA for **BD705/706**	45			V
		for **BD707/708**	60			V
		for **BD709/710**	80			V
		for **BD711/712**	100			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 4 A I_B = 0.4 A			1	V
V_{CEK}*	Knee Voltage	I_C = 3 A I_B = **			0.4	V
V_{BE}*	Base-emitter Voltage	I_C = 4 A V_{CE} = 4 V			1.5	V
h_{FE}*	DC Current Gain	I_C = 0.5 A V_{CE} = 2 V	40	120	400	
		I_C = 2 A V_{CE} = 2 V				
		for **BD705/706**	30			
		for **BD707/708**	30			
		for **BD709/710**	30			
		I_C = 4 A V_{CE} = 4 V				
		for **BD705/706**	20	30	150	
		for **BD707/708**	15		150	
		for **BD709/710**	15		150	
		for **BD711/712**	15		150	
		I_C = 10 A V_{CE} = 4 V				
		for **BD705/706**	5	10		
		for **BD707/708**	5	10		
		for **BD709/710**		8		
		for **BD711/712**		8		
f_T	Transition Frequency	I_C = 300 mA V_{CE} = 3 V	3			MHz

* Pulsed : pulse duration = 300 µs, duty cycle = 1.5 %.
** Value for which I_C = 3.3A at V_{CE} = 2V.
For PNP types voltage and current values are negative.

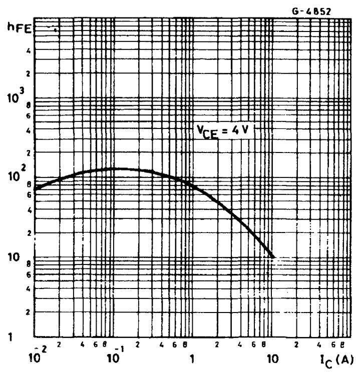
Safe Operating Areas.



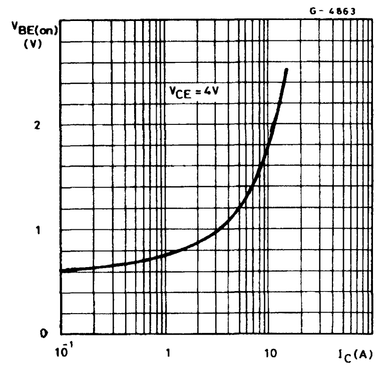
DC Current Gain (NPN types).



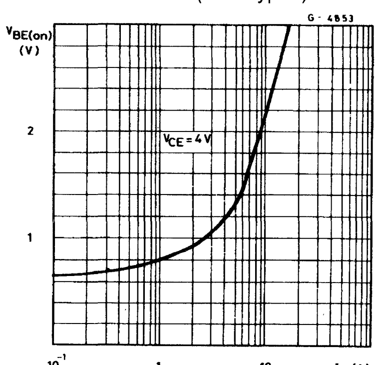
DC Current Gain (PNP types).



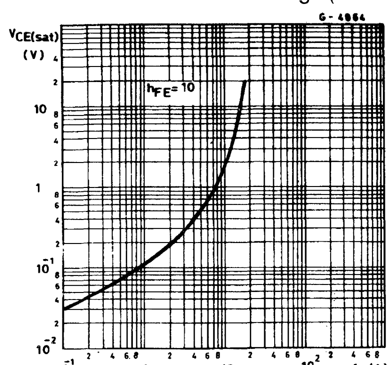
DC Transconductance (NPN types).



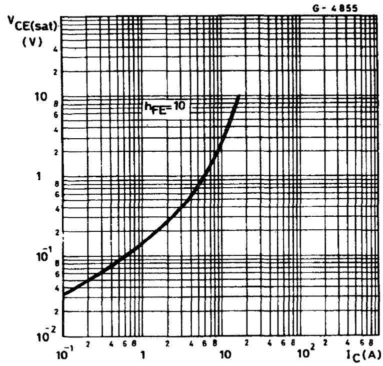
DC Transconductance (PNP types).



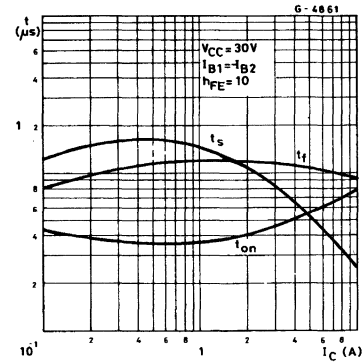
Collector-emitter Saturation Voltage (NPN types).



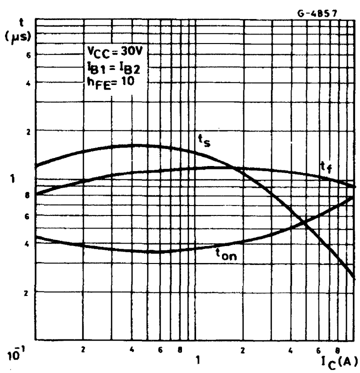
Collector-emitter Saturation Voltage (PNP types).



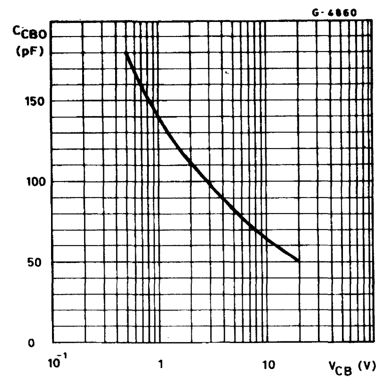
Saturated Switching Characteristics (NPN types).



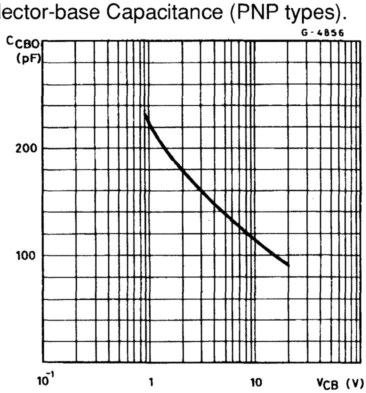
Saturated Switching Characteristics (PNP types).



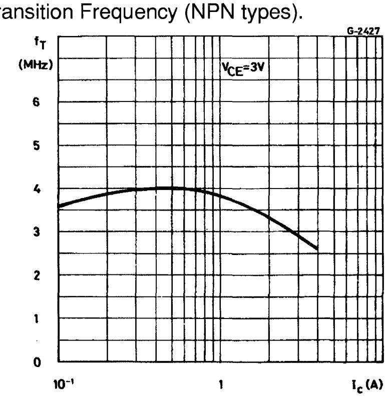
Collector-base Capacitance (NPN types).



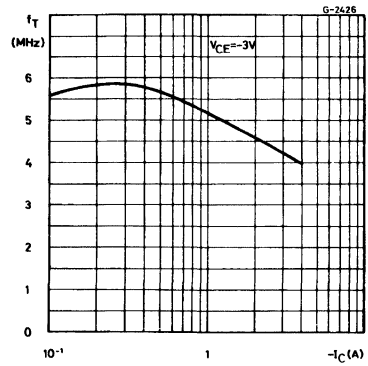
Collector-base Capacitance (PNP types).



Transition Frequency (NPN types).



Transition Frequency (PNP types).



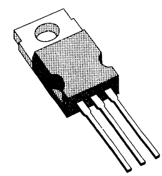
BD905/906/907/908 BD909/910/911/912

POWER LINEAR AND SWITCHING APPLICATIONS

DESCRIPTION

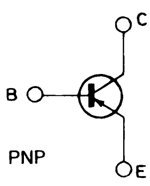
The BD905, BD907, BD909, BD911 are silicon epitaxial-base NPN power transistors in Jedec TO-220 plastic package. They are intended for use in power linear and switching applications.

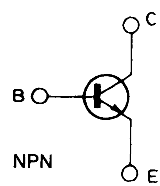
The complementary PNP types are the BD906, BD908, BD910 and BD912 respectively.



TO-220

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	NPN / PNP*	Value				Unit
		NPN	BD905	BD907	BD909	BD911	
		PNP*	BD906	BD908	BD910	BD912	
V_{CBO}	Collector-emitter Voltage (I_E = 0)		45	60	80	100	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)		45	60	80	100	V
V_{EBO}	Emitter-base Voltage (I_C = 0)		5				V
I_E, I_C	Emitter and Collector Current		15				A
I_B	Base Current		5				A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C		90				W
T_{stg}	Storage Temperature		– 65 to 150				°C
T_j	Junction Temperature		150				°C

* For PNP types voltage and current values are negative.

THERMAL DATA

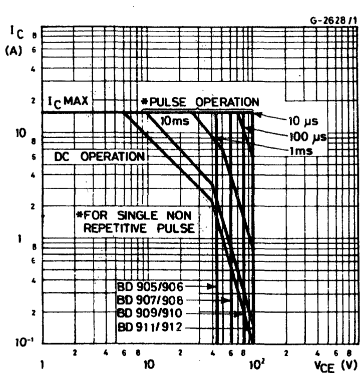
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.4	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

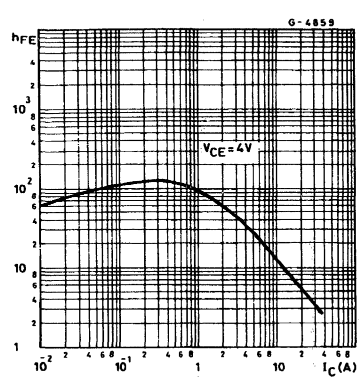
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **BD905/906** V_{CB} = 45 V for **BD907/908** V_{CB} = 60 V for **BD909/910** V_{CB} = 80 V for **BD911/912** V_{CB} = 100 V T_{case} = 150 °C for **BD905/906** V_{CB} = 45 V for **BD907/908** V_{CB} = 60 V for **BD909/910** V_{CB} = 80 V for **BD911/912** V_{CB} = 100 V			500 500 500 500 5 5 5 5	µA µA µA µA mA mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **BD905/906** V_{CE} = 30 V for **BD907/908** V_{CE} = 30 V for **BD909/910** V_{CE} = 40 V for **BD911/912** V_{CE} = 50 V			1 1 1 1	mA mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA for **BD905/906** for **BD907/908** for **BD909/910** for **BD911/912**	45 60 80 100			V V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5 A I_B = 0.5 A I_C = 10 A I_B = 2.5 A			1 3	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 10 A I_B = 2.5 A			2.5	V
V_{BE}*	Base-emitter Voltage	I_C = 5 A V_{CE} = 4 V			1.5	V
h_{FE}*	DC Current Gain	I_C = 0.5 A V_{CE} = 4 V I_C = 5 A V_{CE} = 4 V I_C = 10 A V_{CE} = 4 V	40 15 5		250 150	
f_T	Transition Frequency	I_C = 0.5 A V_{CE} = 4 V	3			MHz

* Pulsed : pulse duration = 300 µs, duty cycle = 1.5 %.
For PNP types voltage and current values are negative.

Safe Operating Areas.

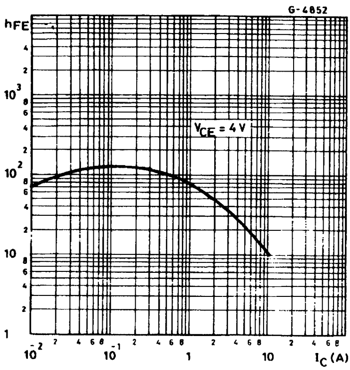


DC Current Gain (NPN types).

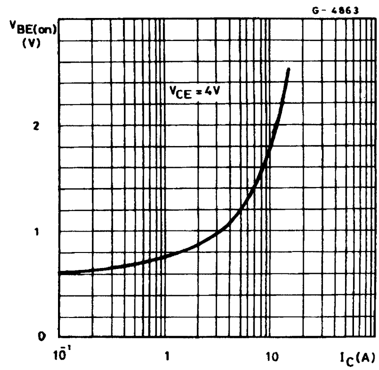


SGS-THOMSON MICROELECTRONICS

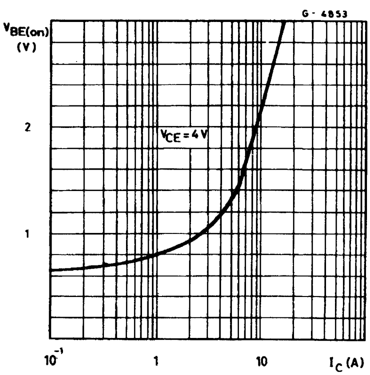
DC Current Gain (PNP types).



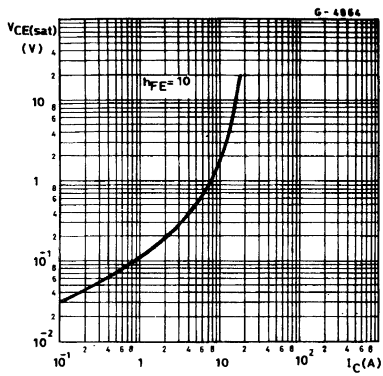
DC Transconductance (NPN types).



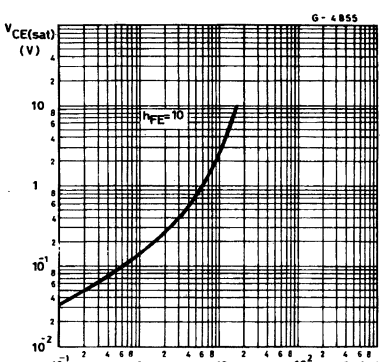
DC Transconductance (PNP types).



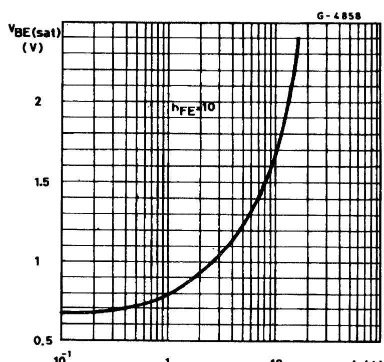
Collector-emitter Saturation Voltage (NPN types).



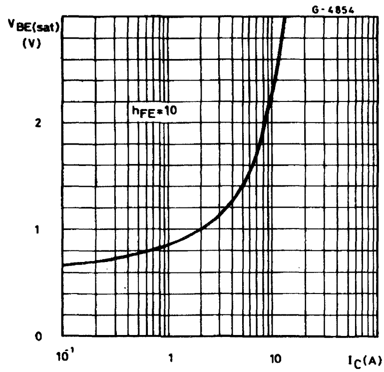
Collector-emitter Saturation Voltage (PNP types).



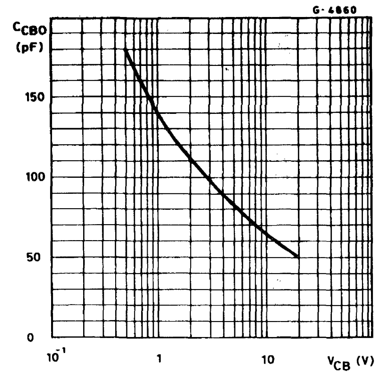
Base-emitter Saturation Voltage (NPN types).



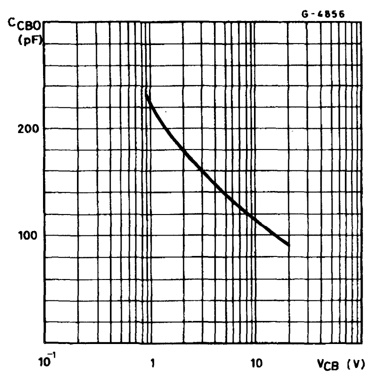
Base-emitter Saturation Voltage (PNP types).



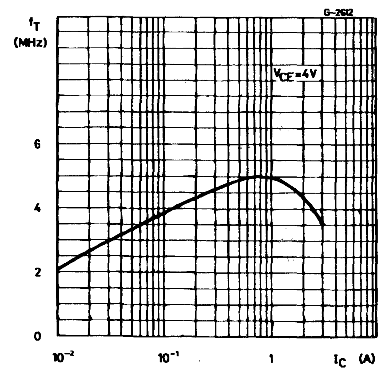
Collector-base Capacitance (NPN types).



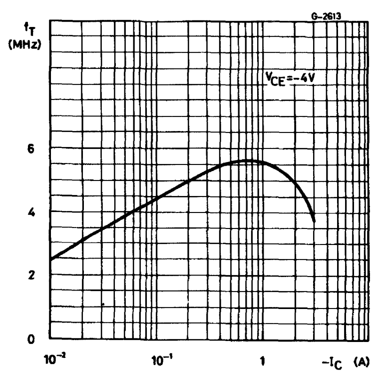
Collector-base Capacitance (PNP types).



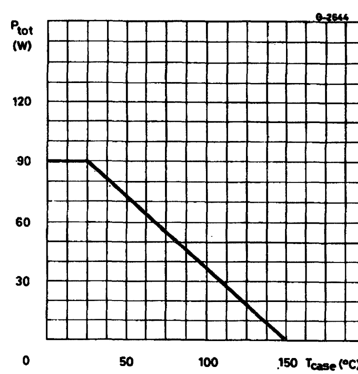
Transition Frequency (NPN types).



Transition Frequency (PNP types).



Power Rating Chart.



SGS-THOMSON MICROELECTRONICS

SGS-THOMSON MICROELECTRONICS

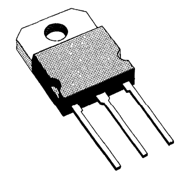
BDV64/A/B
BDV65/A/B

POWER DARLINGTONS

DESCRIPTION

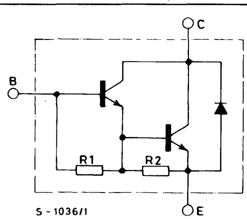
The BDV65, BDV65A, BDV65B, are silicon epitaxial-base NPN transistors in monolithic Darlington configuration and are mounted in SOT-93 plastic package. They are intended for use in power linear and switching applications.

The complementary PNP types are BDV64, BDV64A, BDV64B respectively.

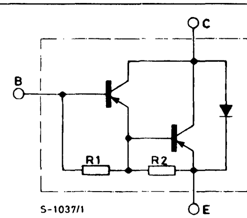


SOT-93

INTERNAL SCHEMATIC DIAGRAMS



R1 ≅ 5 KΩ
R2 ≅ 150 Ω



R1 ≅ 5 KΩ
R2 ≅ 150 Ω

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	* PNP / NPN	Value BDV64 / BDV65	Value BDV64A / BDV65A	Value BDV64B / BDV65B	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)		60	80	100	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)		60	80	100	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)			5		V
I_C	Collector Current			12		A
I_{CM}	Collector Peak Current (repetitive)			20		A
I_B	Base Current			0.5		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C			125		W
T_{stg}	Storage Temperature			– 65 to 150		°C
T_j	Junction Temperature			150		°C

* For PNP types voltage and current values are negative.

THERMAL DATA

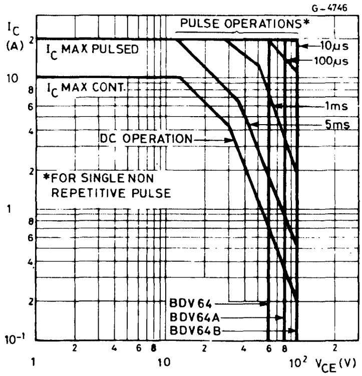
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

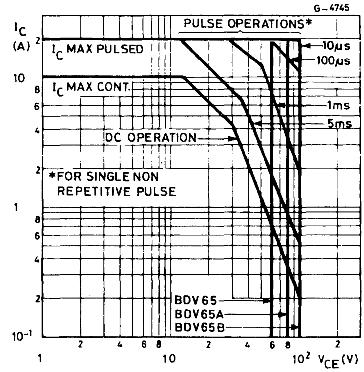
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **BDV64/5** V_{CB} = 60 V for **BDV64A/5A** V_{CB} = 80 V for **BDV64B/5B** V_{CB} = 100 V T_{case} = 150 °C for **BDV64/65** V_{CB} = 30 V for **BDV64A/5A** V_{CB} = 40 V for **BDV64B/5B** V_{CB} = 50 V			400 400 400 2 2 2	μA μA μA mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **BDV64/65** V_{CE} = 30 V for **BDV64A/5A** V_{CE} = 40 V for **BDV64B/5B** V_{CE} = 50 V			1 1 1	mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EBO} = 5 V			5	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 30 mA for **BDV64/65** for **BDV64A/5A** for **BDV64B/5B**	 60 80 100			 V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5 A I_B = 20 mA			2	V
V_{BE}*	Base-emitter Voltage	I_C = 5 A V_{CE} = 4 V			2.5	V
h_{FE}*	DC Current Gain	I_C = 1 A V_{CE} = 4 V I_C = 5 A V_{CE} = 4 V I_C = 10 A V_{CE} = 4 V	 1000 	2500 500		
V_F	Parallel Diode Forward Voltage	I_F = 5 A		1.2		V
h_{fe}	Small Signal Current Gain	I_C = 5 A V_{CE} = 4 V f = 1 MHz		60		
C_{CBO}	Collector–base Capacitance	V_{CB} = 10 V I_E = 0 f = 1 MHz		100		pF
t_{on}	Turn-on Time	I_C = 5 A I_{B1} = 20 mA I_{B2} = 20 A V_{CC} = 16 V		0.5		μs
t_s	Storage Time			1.1** 1.3		μs μs
t_f	Fall Time			2.5** 1.0		μs μs

* Pulsed : pulse duration = 300μs duty cycle = 1.5%.
** For PNP types,
For PNP types voltage and current values are negative.

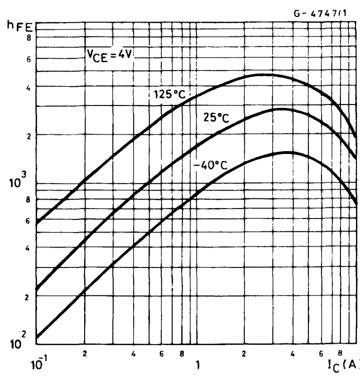
Safe Operating Areas.



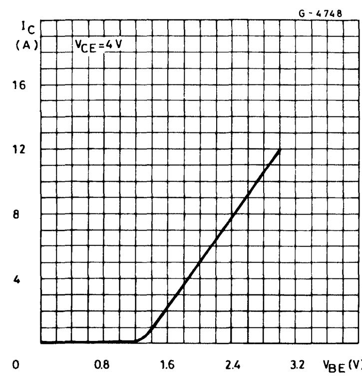
Safe Operating Areas.



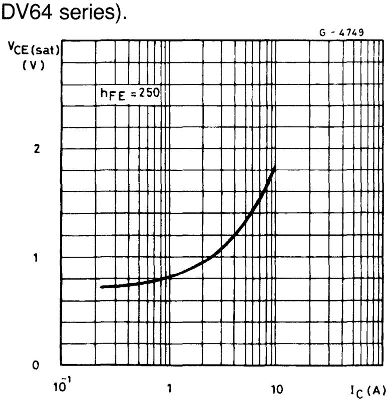
DC Current Gain (BDV64 series).



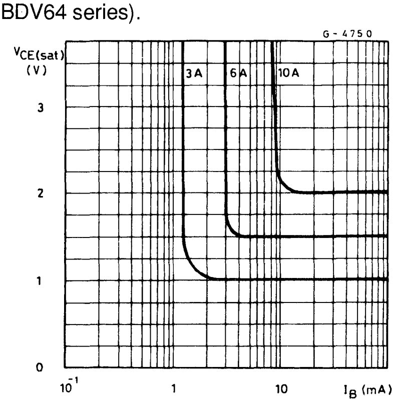
DC Transconductance (BDV64 series).



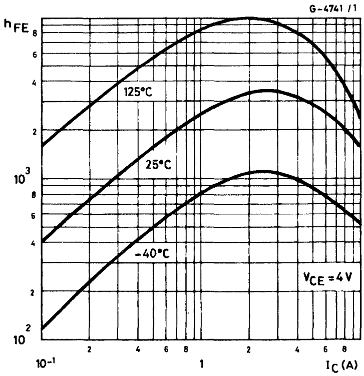
Collector-emitter Saturation Voltage (BDV64 series).



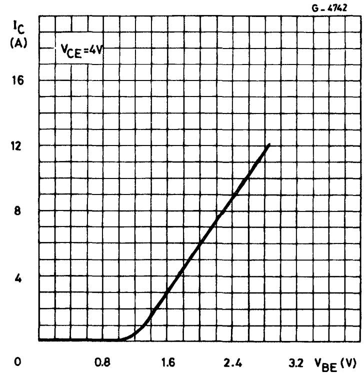
Collector-emitter Saturation Voltage (BDV64 series).



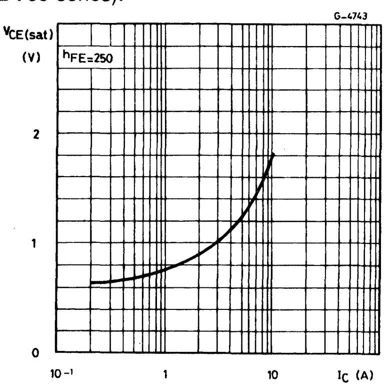
DC Current Gain (BDV65 series).



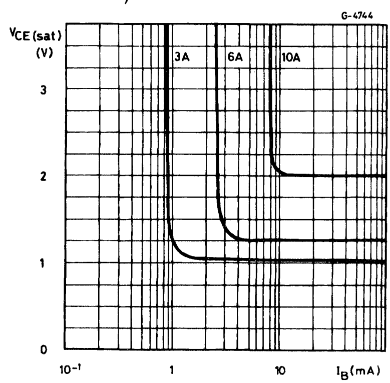
DC Transconductance (BDV65 series).



Collector-emitter Saturation Voltage (BDV65 series).



Collector-emitter Saturation Voltage (BDV65 series).



SGS-THOMSON
MICROELECTRONICS

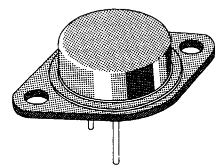
BDW51/A/B/C
BDW52/A/B/C

POWER LINEAR AND SWITCHING APPLICATIONS

DESCRIPTION

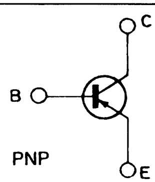
The BDW51, BDW51A, BDW51B and BDW51C are silicon epitaxial-base NPN power transistors in Jedec TO-3 metal case. They are intended for use in power linear and switching applications.

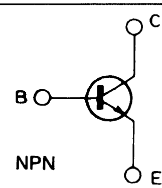
The complementary PNP types are the BDW52, BDW52A, BDW52B and BDW52C respectively.



TO-3

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter NPN / PNP*	Value BDW51 / BDW52	BDW51A / BDW52A	BDW51B / BDW52B	BDW51C / BDW52C	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	45	60	80	100	V
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	45	60	80	100	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	45	60	80	100	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5				V
I_C	Collector Current	15				A
I_{CM}	Collector Peak Current (repetitive)	20				A
I_B	Base Current	7				A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	125				W
T_{stg}	Storage Temperature	– 65 to 200				°C
T_j	Junction Temperature	200				°C

For PNP types voltage and current values are negative

THERMAL DATA

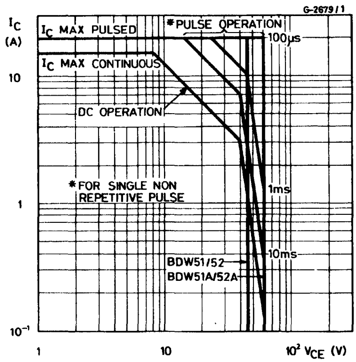
$R_{thj-case}$	Thermal Resistance Junction-case	Max	1.4	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

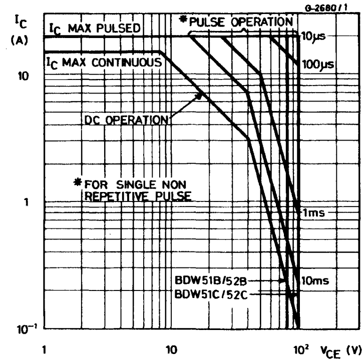
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **BDW51/52** V_{CB} = 45 V for **BDW51A/52A** V_{CB} = 60 V for **BDW51B/52B** V_{CB} = 80 V for **BDW51C/52C** V_{CB} = 100 V T_{case} = 150 °C for **BDW51/52** V_{CB} = 45 V for **BDW51A/52A** V_{CB} = 60 V for **BDW51B/52B** V_{CB} = 80 V for **BDW51C/52C** V_{CB} = 100 V			500 500 500 500 5 5 5 5	µA µA µA µA mA mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **BDW51/52** V_{CE} = 22 V for **BDW51A/52A** V_{CE} = 30 V for **BDW51B/52B** V_{CE} = 40 V for **BDW51C/52C** V_{CE} = 50 V			1 1 1 1	mA mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			2	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA for **BDW51/52** for **BDW51A/52A** for **BDW51B/52B** for **BDW51C/52C**	45 60 80 100			V V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5 A I_B = 0.5 A I_C = 10 A I_B = 2.5 A			1 3	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 10 A I_B = 2.5 A			2.5	V
V_{BE}*	Base-emitter Voltage	I_C = 5 A V_{CE} = 4 V			1.5	V
h_{FE}*	DC Current Gain	I_C = 5 A V_{CE} = 4 V I_C = 10 A V_{CE} = 4 V	20 5		150	
f_T	Transition Frequency	I_C = 0.5 A V_{CE} = 4 V	3			MHz

* Pulsed : pulse duration = 300 µs, duty cycle = 1.5 %.
For PNP types voltage and current values are negative.

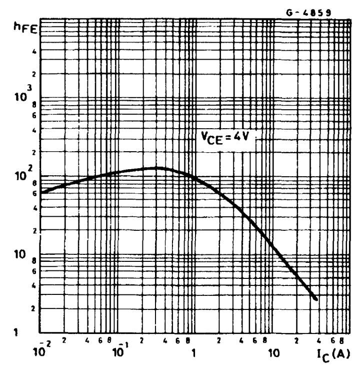
Safe Operating Areas (for **BDW51, BDW51A, BDW52, BDW52A**).



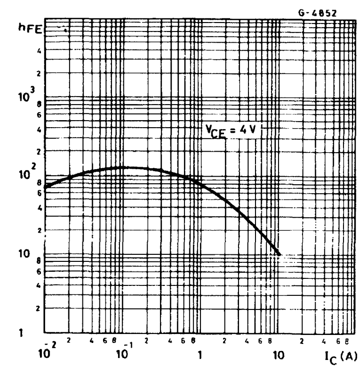
Safe Operating Areas (for **BDW51B, BDW51C, BDW52B, BDW52C**).



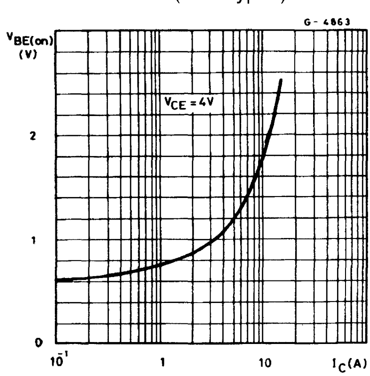
DC Current Gain (NPN types).



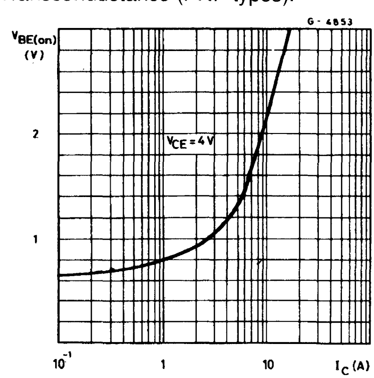
DC Current Gain (PNP types).



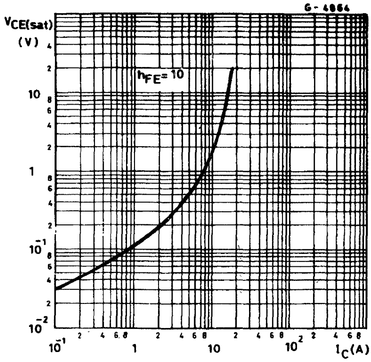
DC Transconductance (NPN types).



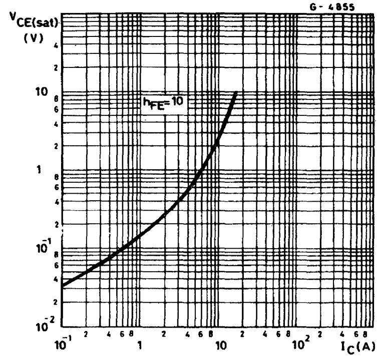
DC Transconductance (PNP types).



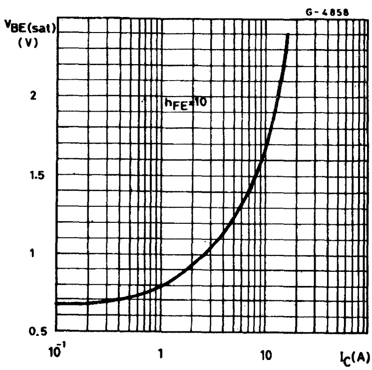
Collector–emitter Saturation Voltage (NPN types).



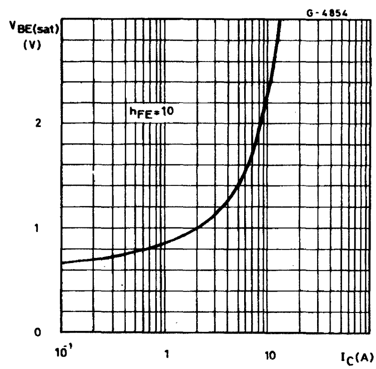
Collector–emitter Saturation Voltage (PNP types).



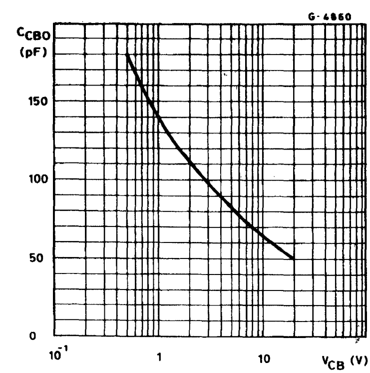
Base–emitter Saturation Voltage (NPN types).



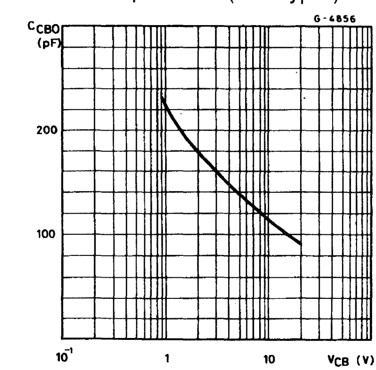
Base –emitter Saturation Voltage (PNP types).



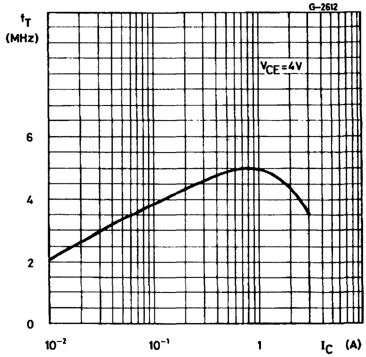
Collector–base Capacitance (NPN types).



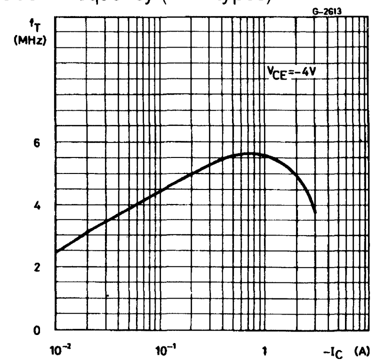
Collector–base Capacitance (PNP types).



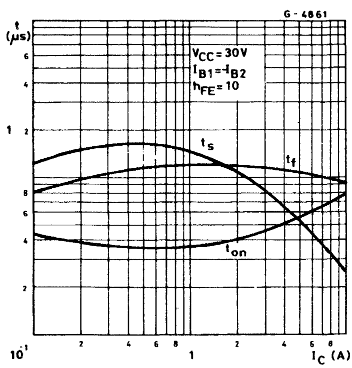
Transition Frequency (NPN types).



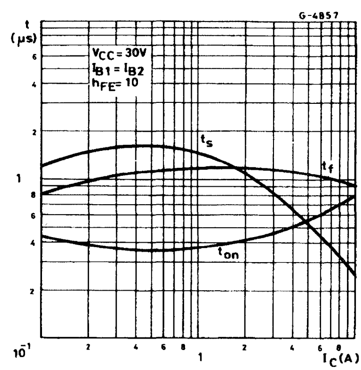
Transition Frequency (PNP types).



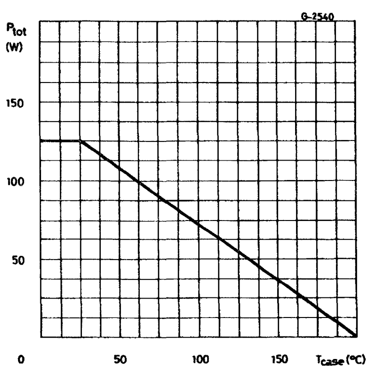
Saturated Switching Characteristics (NPN types).



Saturated Switching Characteristics (PNP types).

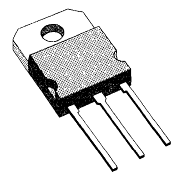


Power Rating Chart.



HIGH CURRENT POWER DARLINGTON

- HIGH CURRENT
- HIGH GAIN



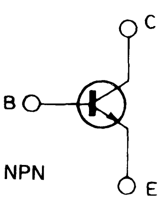
TO-218

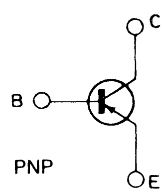
DESCRIPTION

The BDW83A/B/C are silicon epitaxial base NPN power monolithic Darlington mounted in TO-218 plastic package. They are intended for use in power linear and switching applications.

The complementary PNP types are BDW84A/B/C respectively.

INTERNAL SCHEMATIC DIAGRAM





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
	NPN / PNP	BDW83A / BDW84A	BDW83B / BDW84B	BDW83C / BDW84C	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	60	80	100	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	60	80	100	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5			V
I_C	Collector Current	15			A
I_{CM}	Collector Peak Current	40			A
I_B	Base Current	0.5			A
P_{tot}	Total Dissipation at $T_c < 25°C$	130			W
T_{stg}	Storage Temperature	– 65 to 150			°C
T_j	Max. Operating Junction Temperature	150			°C

For PNP types voltage and current values are negative.

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	0.96	°C/W

ELECTRICAL CHARACTERISTICS (T_j = 25°C unless otherwise specified)

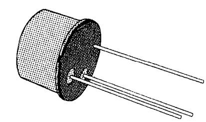
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 60V V_{CB} = 80V V_{CB} = 100V T_c = 150°C V_{CB} = 60V V_{CB} = 80V V_{CB} = 100V	for **BDW83A/84A** for **BDW83B/84B** for **BDW83C/84C** for **BDW83A/84A** for **BDW83B/84B** for **BDW83C/84C**			0.5 0.5 0.5 5 5 5	mA mA mA mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 30V V_{CE} = 40V V_{CE} = 40V	for **BDW83A/84A** for **BDW83B/84B** for **BDW83C/84C**			1 1 1	mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V				2	mA
Space !	Collector Emitter Sustaining Voltage	I_C = 30mA	for **BDW83A/84A** for **BDW83B/84B** for **BDW83C/84C**	60 80 100			V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 6A I_C = 15A	I_B = 12mA I_B = 150mA			2.5 4	V V
$V_{BE(on)}$*	Base-emitter Voltage	I_C = 6A	V_{CE} = 3V			2.5	V
h_{FE}*	DC Current Gain	I_C = 6A I_C = 15A	V_{CE} = 3V V_{CE} = 3V	750 100		20K	
V_f*	Diode Forward Voltage	I_F = 10A				4	V
t_{on} t_{off}	Turn-on Time Turn-off Time	V_{CC} = 30V R_{B1} = 300Ω I_{B1} = − I_{B2} = 40mA	I_C = 10A R_{B2} = 150Ω		0.9 6		µs µs

* Pulsed : Pulse duration = 300µs, duty cycle = 1.5%.
For PNP types voltage and current values are negative.

MEDIUM POWER DARLINGTON

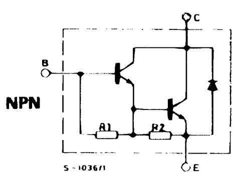
DESCRIPTION

The BDW91 is a silicon epitaxial base NPN transistor in monolithic Darlington configuration mounted in Jedec TO-39 metal case. It is intended for use in switching and linear applications. The complementary PNP type is the BDW92.

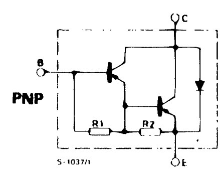


TO-39

INTERNAL SCHEMATIC DIAGRAMS



R1 Typ. 10kΩ
R2 Typ. 150Ω



D

R1 Typ. 10kΩ
R2 Typ. 150Ω

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	180	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	180	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	6	V
I_C	Collector Current	4	A
I_B	Base Current	100	mA
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C $T_{amb} \leq 25$ °C	10 1	W W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

For PNP type voltage and current values are negative.

THERMAL DATA

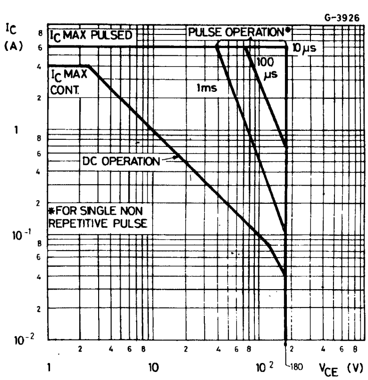
$R_{thj-case}$	Thermal Resistance Junction-case	Max	17.5	°C/W
$R_{thj-amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

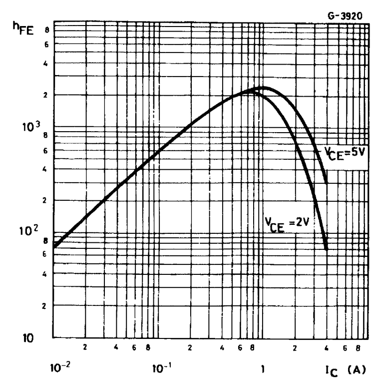
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 180 V			50	μA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 90 V			50	μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 6 V	0.4		2	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 50 mA	180			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 2 A I_B = 4 mA			2	V
V_{BE}*	Base-emitter Voltage	I_C = 2 A V_{CE} = 2 V			2.5	V
h_{FE}*	DC Current Gain	I_C = 2 A V_{CE} = 5 V I_C = 50 mA V_{CE} = 5 V	1000 150	3000 300		
V_F*	Parallel Diode Forward Voltage	I_F = 2 A			2.5	V
h_{fe}	Small Signal Current Gain	I_C = 0.5 A V_{CE} = 2 V f = 1 MHz		20		

* Pulsed : pulse duration = 300 μsec, duty cycle = 1 %.
For PNP type voltage and current values are negative

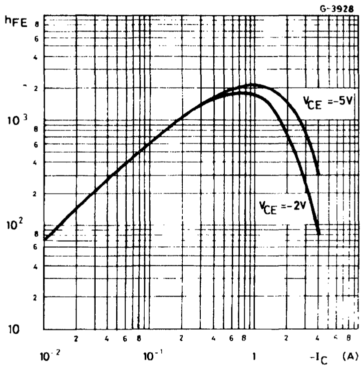
Safe Operating Area.



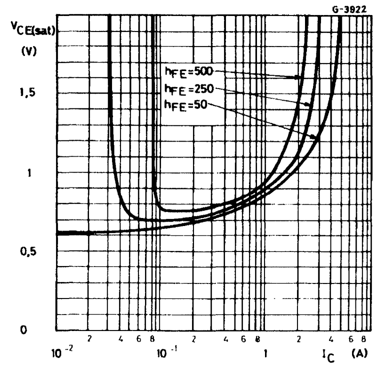
DC Current Gain (BDW91).



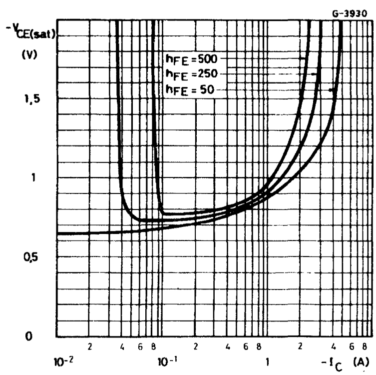
DC Current Gain (BDW92)



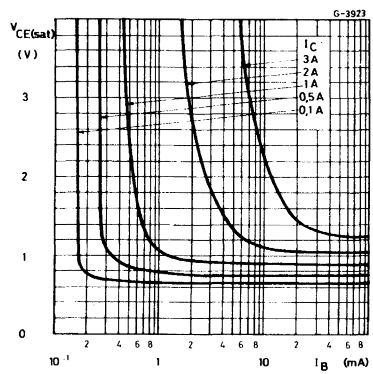
Collector–emitter Saturation Voltage (BDW91)



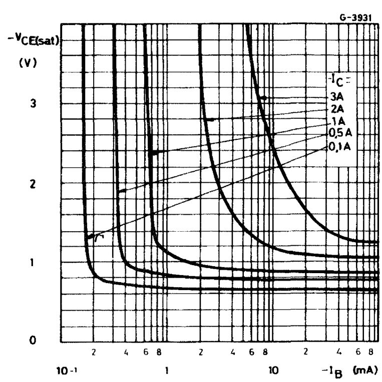
Collector–emitter Saturation Voltage (BDW92)



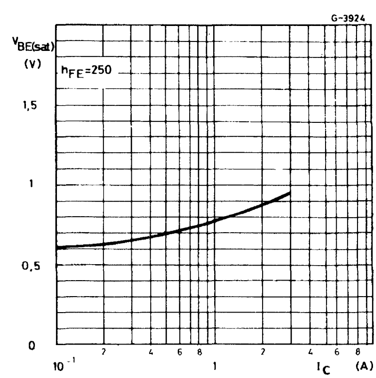
Collector–emitter Saturation Voltage (BDW91)



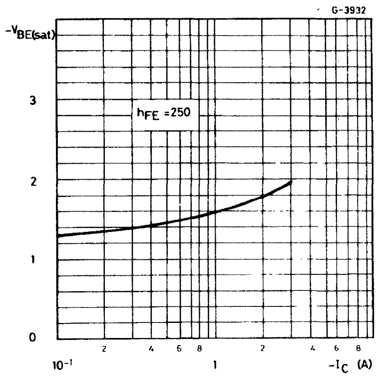
Collector–emitter Saturation Voltage (BDW92)



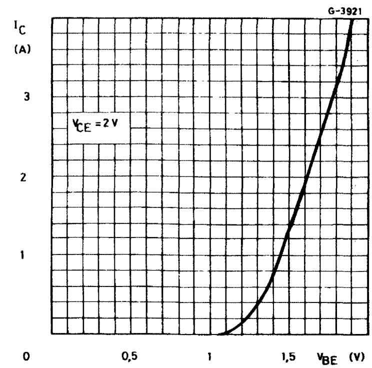
Base–emitter Saturation Voltage (BDW91)



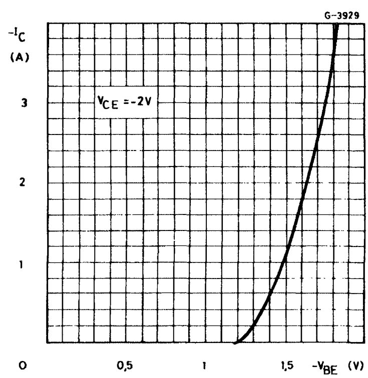
Base–emitter Saturation Voltage (BDW92)



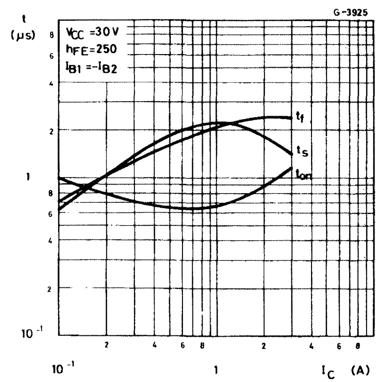
DC Transconductance (BDW91)



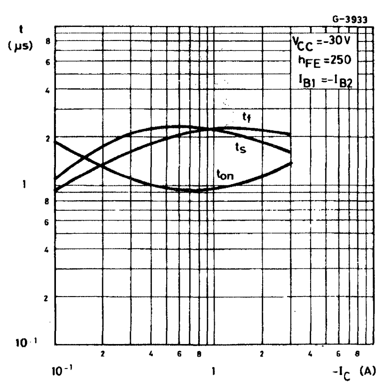
DC Transconductance (BDW92)



Saturated Switching Characteristics (BDW91)



Saturated Switching Characteristics (BDW92)

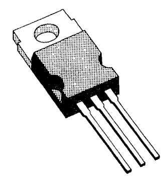


BDW93/A/B/C
BDW94/A/B/C

NPN/PNP POWER DARLINGTONS

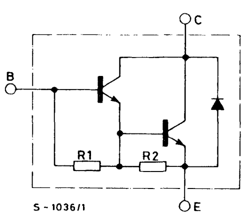
DESCRIPTION

The BDW93, BDW93A, BDW93B and BDW93C are silicon epitaxial-base NPN transistors in monolithic Darlington configuration and are mounted in Jedec TO-220 plastic package. They are intended for use in power linear and switching applications. The complementary PNP types are the BDW94, BDW94A, BDW94B and BDW94C respectively.



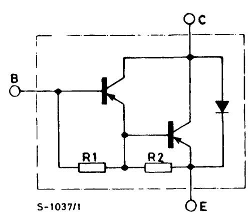
TO-220

INTERNAL SCHEMATIC DIAGRAM



NPN

R_1 Typ. 10 kΩ
R_2 Typ. 150 Ω.



PNP

R_1 Typ. 10 kΩ
R_2 Typ. 150 Ω.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter NPN / PNP*	BDW93 / BDW94	BDW93A / BDW94A	BDW93B / BDW94B	BDW93C / BDW94C	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	45	60	80	100	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	45	60	80	100	V
I_C	Collector Current	12				A
I_{CM}	Collector Peak Current	15				A
I_B	Base Current	0.2				A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	80				W
T_{stg}	Storage Temperature	– 65 to 150				°C
T_j	Junction Temperature	150				°C

* For PNP types voltage and current values are negative.

THERMAL DATA

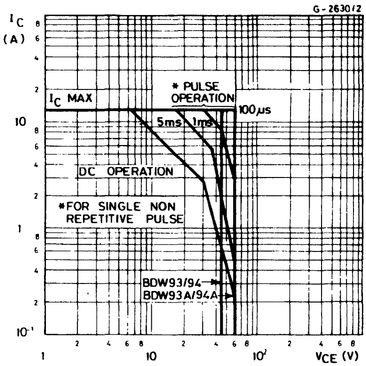
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.56	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

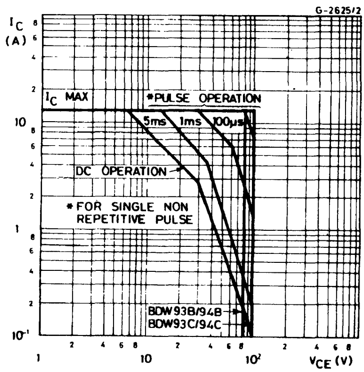
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **BDW93/94** V_{CB} = 45 V for **BDW93A/94A** V_{CB} = 60 V for **BDW93B/94B** V_{CB} = 80 V for **BDW93C/94C** V_{CB} = 100 V T_{case} = 150 °C for **BDW93/94** V_{CB} = 45 V for **BDW93A/94A** V_{CB} = 60 V for **BDW93B/94B** V_{CB} = 80 V for **BDW93C/94C** V_{CB} = 100 V			100 100 100 100 5 5 5 5	µA µA µA µA mA mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **BDW93/94** V_{CE} = 40 V for **BDW93A/94A** V_{CE} = 60 V for **BDW93B/94B** V_{CE} = 80 V for **BDW93C/94C** V_{CE} = 80 V			1 1 1 1	mA mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			2	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA for **BDW93/94** for **BDW93A/94A** for **BDW93B/94B** for **BDW93C/94C**	45 60 80 100			V V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5 A I_B = 20 mA I_C = 10 A I_B = 100 mA			2 3	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 5 A I_B = 20 mA I_C = 10 A I_B = 100 mA			2.5 4	V V
h_{FE}*	DC Current Gain	I_C = 3 A V_{CE} = 3 V I_C = 5 A V_{CE} = 3 V I_C = 10 A V_{CE} = 3 V	1000 750 100		20000	
V_F*	Parallel-diode Forward Voltage	I_F = 5 A I_F = 10 A		1.3 1.8	2 4	V V
h_{fe}	Small Signal Current Gain	I_C = 1 A V_{CE} = 10 V f = 1 MHz	20			

* Pulsed : pulse duration = 300 µs, duty cycle = 1.5 %.
For PNP types voltage and current values are negative.

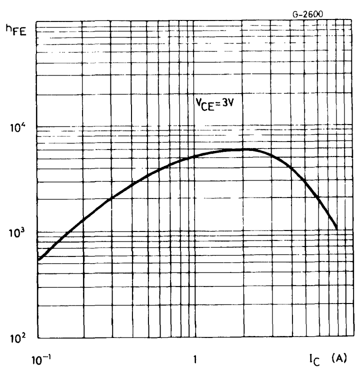
Safe Operating Areas (for **BDW93**, **BDW93A**, **BDW94**, **BDW94A**).



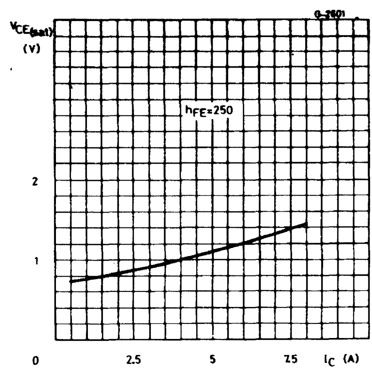
Safe Operating Areas (for **BDW93B**, **BDW93C**, **BDW94B**, **BDW94C**).



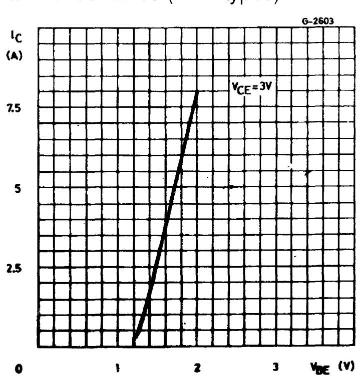
DC Current Gain (NPN types).



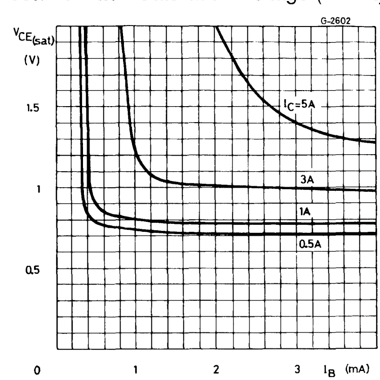
Collector-emitter Saturation Voltage (NPN types).



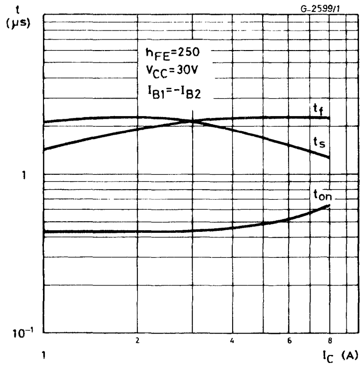
DC Transconductance (NPN types).



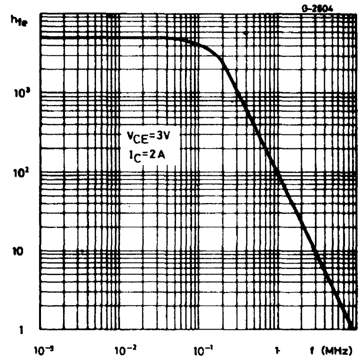
Collector-emitter Saturation Voltage (NPN types).



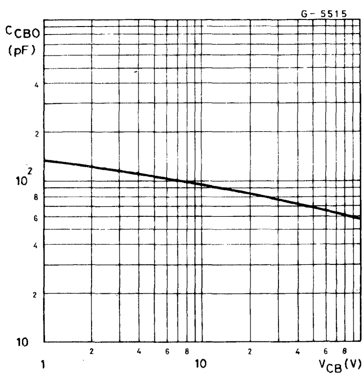
Saturated Switching Characteristics (NPN types).



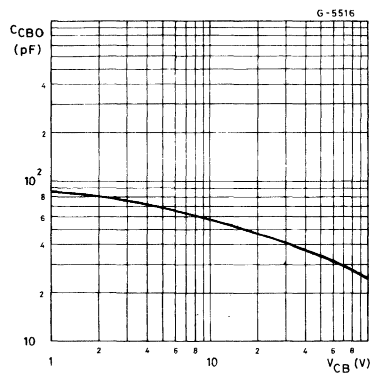
Small Signal Current Gain (NPN types).



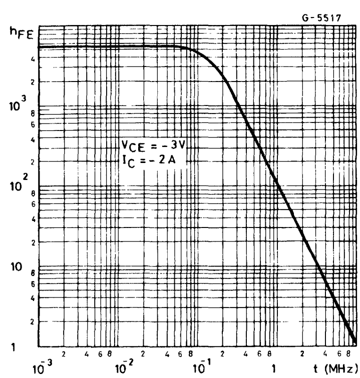
Collector-base Capacitance (PNP types).



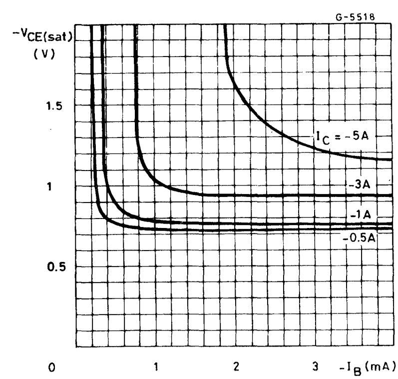
Collector-base Capacitance (NPN types).

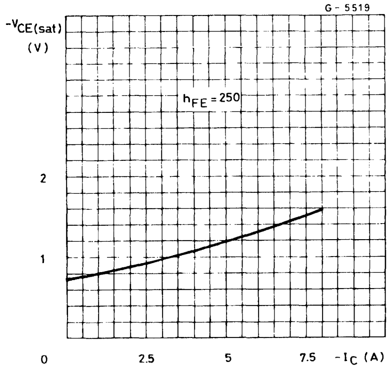


Small Signal Current Gain (PNP types).

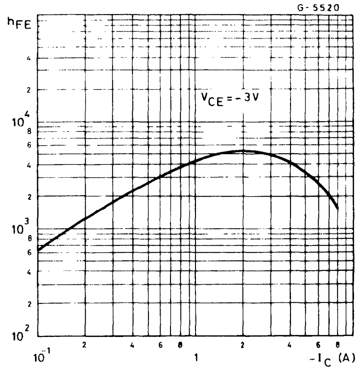


Collector-emitter Saturation Voltage (PNP types).

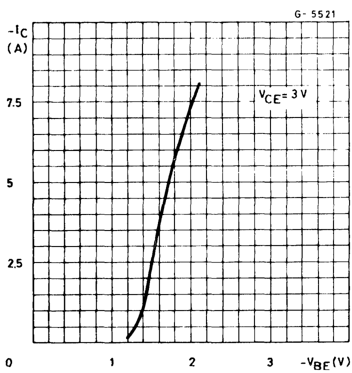




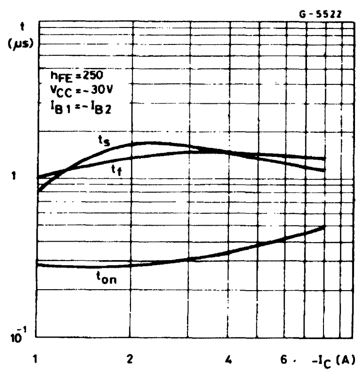
Collector-emitter Saturation Voltage (PNP types).



DC Transconductance (PNP types).



Saturated Switching Characteristics (PNP types).

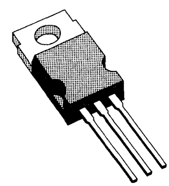


BDX33/33A/33B/33C BDX34/34A/34B/34C

HIGH GAIN GENERAL PURPOSE

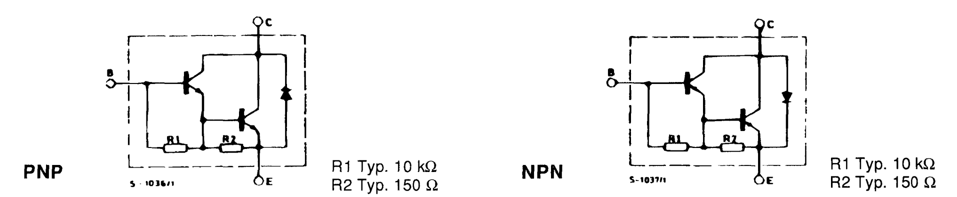
DESCRIPTION

The BDX33, BDX33A, BDX33B and BDX33C are silicon epitaxial-base NPN transistors in monolithic Darlington configuration and are mounted in Jedec TO-220 plastic package. They are intended for use in power linear and switching applications. This complementary PNP types are the BDX34, BDX34A, BDX34B and BDX34C respectively.



TO-220

INTERNAL SCHEMATIC DIAGRAMS



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter NPN / *PNP	Value				Unit
		BDX33 BDX34	BDX33A BDX34A	BDX33B BDX34B	BDX33C BDX34C	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	45	60	80	100	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	45	60	80	100	V
I_C	Collector Current	10				A
I_{CM}	Collector Peak Current	15				A
I_B	Base Current	0.25				A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	70				W
T_{stg}	Storage Temperature	– 65 to 150				°C
T_j	Junction Temperature	150				°C

* For PNP types voltage and current values are negative.

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.78	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

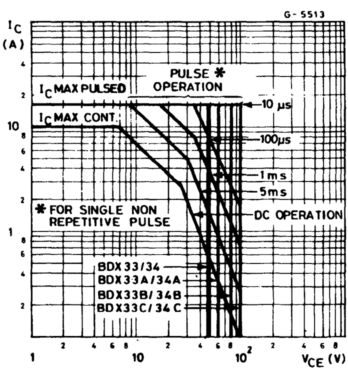
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **BDX33/34** V_{CB} = 45 V			0.2	mA
		for **BDX33A/34A** V_{CB} = 60 V			0.2	mA
		for **BDX33B/34B** V_{CB} = 80 V			0.2	mA
		for **BDX33C/X34C** V_{CB} = 100 V			0.2	mA
		T_{case} = 100 °C				
		for **BDX33/34** V_{CB} = 45 V			5	mA
		for **BDX33A/34A** V_{CB} = 60 V			5	mA
		for **BDX33B/34B** V_{CB} = 80 V			5	mA
		for **BDX33C/X34C** V_{CB} = 100 V			5	mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **BDX33/34** V_{CB} = 22 V			0.5	mA
		for **BDX33A/34A** V_{CB} = 30 V			0.5	mA
		for **BDX33B/34B** V_{CB} = 40 V			0.5	mA
		for **BDX33C/X34C** V_{CB} = 50 V			0.5	mA
		T_{case} = 100 °C				
		for **BDX33/34** V_{CB} = 22 V			10	mA
		for **BDX33A/34A** V_{CB} = 30 V			10	mA
		for **BDX33B/34B** V_{CB} = 40 V			10	mA
		for **BDX33C/X34C** V_{CB} = 50 V			10	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			5	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA for **BDX33/34**	45			V
		for **BDX33A/34A**	60			V
		for **BDX33B/34B**	80			V
		for **BDX33C/X34C**	100			V
$V_{CER(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0 R_{BE} = 100 Ω)	I_C = 100 mA for **BDX33/34**	45			V
		for **BDX33A/34A**	60			V
		for **BDX33B/34B**	80			V
		for **BDX33C/34C**	100			V
$V_{CEV(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0 V_{BE} = − 1.5 V)	I_C = 100 mA for **BDX33/34**	45			V
		for **BDX33A/34A**	60			V
		for **BDX33B/34B**	80			V
		for **BDX33C/34C**	100			V

ELECTRICAL CHARACTERISTICS (continued)

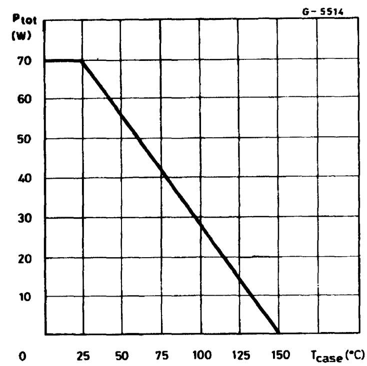
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	for **BDX33/33A/34/34A** $I_C = 4$ A $I_B = 8$ mA for **BDX33B/33C/34B/34C** $I_C = 3$ A $I_B = 6$ mA			2.5 2.5	V V
V_{BE}*	Base-emitter Voltage	for **BDX33/33A/34/34A** $I_C = 4$ A $V_{CE} = 3$ V for **BDX33B/33C/34B/34C** $I_C = 3$ A $V_{CE} = 3$ V			2.5 2.5	V V
h_{FE}*	DC Current Gain	for **BDX33/33A/34/34A** $I_C = 4$ A $V_{CE} = 3$ V for **BDX33B/33C/34B/34C** $I_C = 3$ A $V_{CE} = 3$ V	750 750			
V_F*	Parallel-diode Forward Voltage	$I_F = 8$ A			4	V
h_{fe}	Small Signal Current Gain	$I_C = 1$ A $V_{CE} = 5$ V f = 1 KHz	100			

* Pulsed : pulse duration = 300 ms, duty cycle = 1.5 %.
For PNP types voltage and current values are negative.

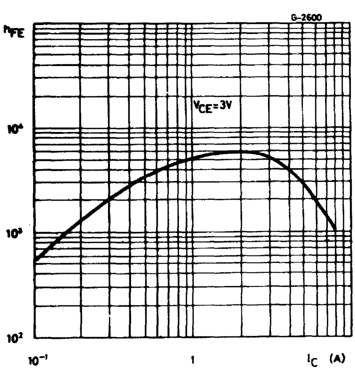
Safe Operating Areas.



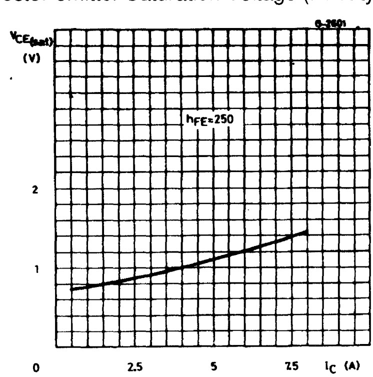
Case Temperature Dissipation Derating Curve.



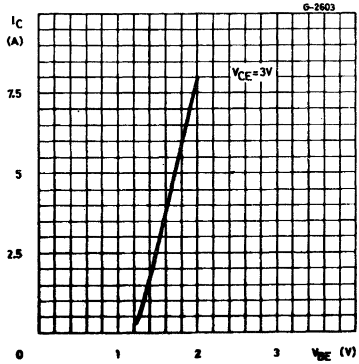
DC Current Gain (NPN types).



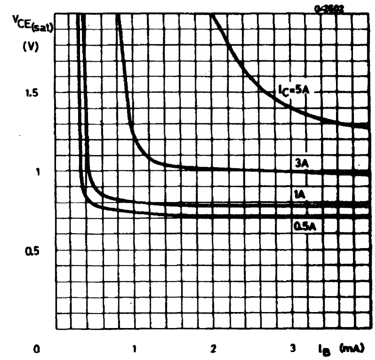
Collector-emitter Saturation Voltage (NPN types).



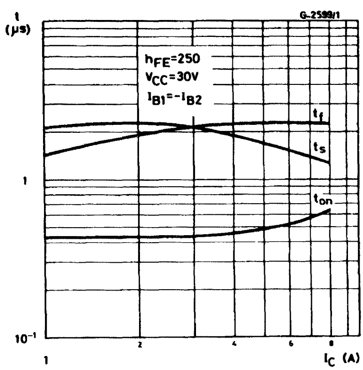
DC Transconductance (NPN types).



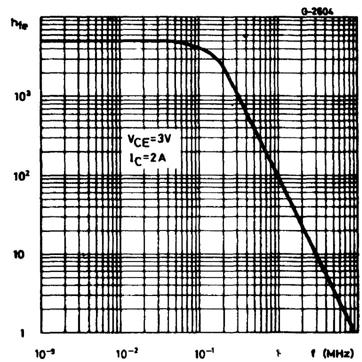
Collector-emitter Saturation Voltage (NPN types).



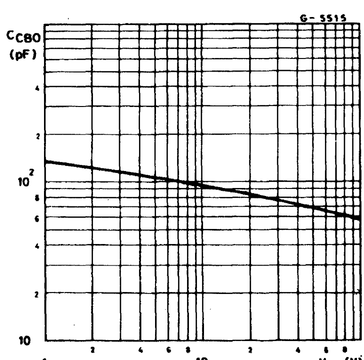
Saturated Switching Characteristics (NPN types).



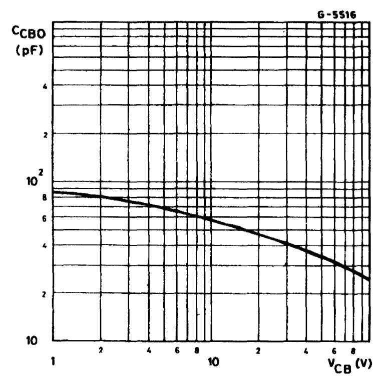
Small Signal Current Gain (NPN types).



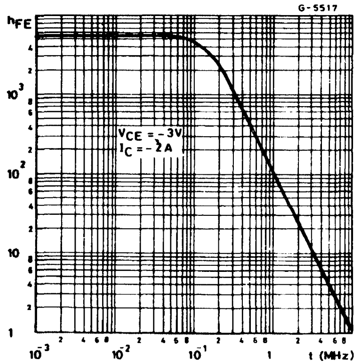
Collector-base Capacitance (PNP types).



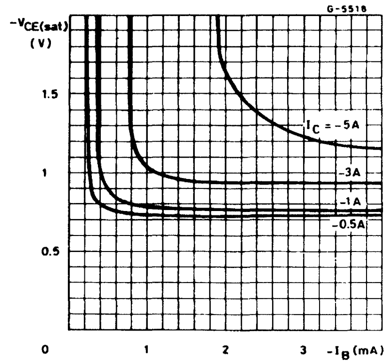
Collector-base Capacitance (NPN types).



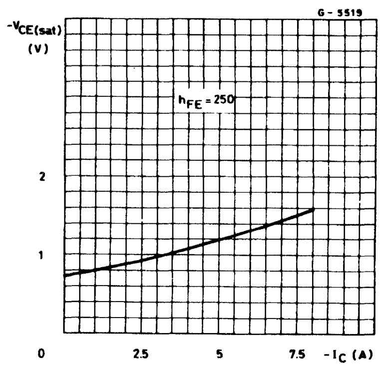
Small Signal Current Gain (PNP types).



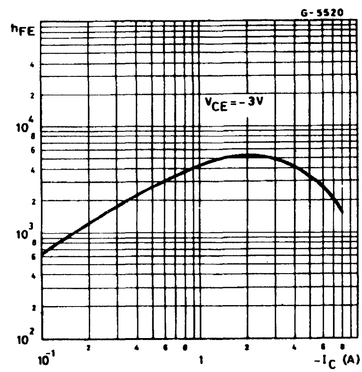
Collector-emitter Saturation Voltage (PNP types).



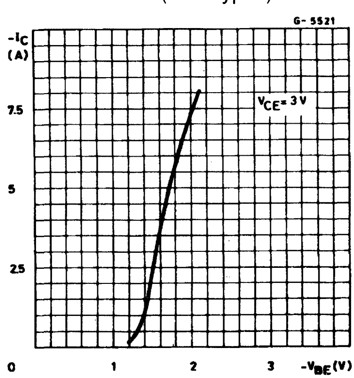
Collector-emitter Saturation Voltage (PNP types).



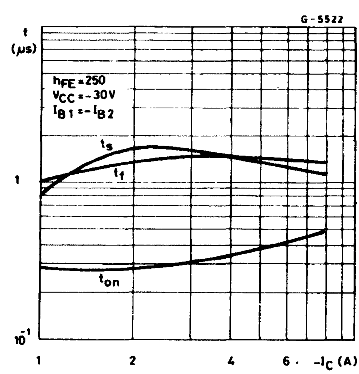
DC Current Gain (PNP types).



DC Transconductance (PNP types).



Saturated Switching Characteristics (PNP types).



SGS-THOMSON MICROELECTRONICS

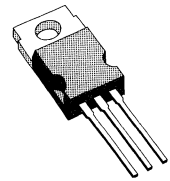
BDX53/53A/53B/53C
BDX54/54A/54B/54C

POWER DARLINGTONS

DESCRIPTION

The BDX 53, BDX 53A, BDX 53B and BDX 53C are silicon epitaxial-base NPN transistors in monolithic Darlington configuration and are mounted in Jedec TO-220 plastic package, intended for use in hammer drivers, audio amplifiers and other medium power linear and switching applications.

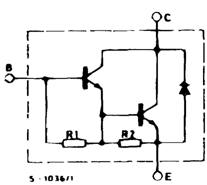
The complementary PNP types are the BDX 54, BDX 54A, BDX 54B and BDX 54C respectively.



TO-220

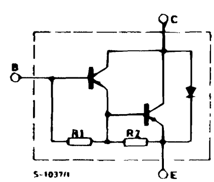
INTERNAL SCHEMATIC DIAGRAMS

NPN



R1 Typ. 10 kΩ
R2 Typ. 150 Ω

PNP



R1 Typ. 10 kΩ
R2 Typ. 150 Ω

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	NPN / PNP*	Value				Unit
			BDX53 / BDX54	BDX53A / BDX54A	BDX53B / BDX54B	BDX53C / BDX54C	
V_{CBO}	Collector-base Voltage ($I_E = 0$)		45	60	80	100	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)		45	60	80	100	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)		5				V
I_C	Collector Current		8				A
I_{CM}	Collector Peak Current (repetitive)		12				A
I_B	Base Current		0.2				A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C		60				W
T_{stg}	Storage Temperature		– 65 to 150				°C
T_j	Junction Temperature		150				°C

* For PNP types voltage and current values are negative.

THERMAL DATA

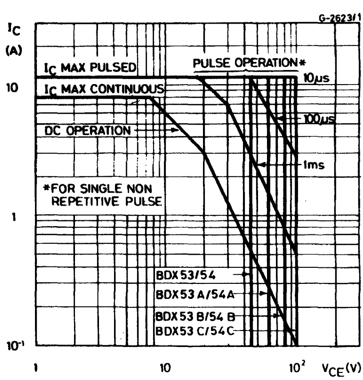
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	2.08	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	70	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **BDX53/54** V_{CB} = 45 V for **BDX53A/54A** V_{CB} = 60 V for **BDX53B/54B** V_{CB} = 80 V for **BDX53C/54C** V_{CB} = 100 V			200 200 200 200	µA µA µA µA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **BDX53/54** V_{CE} = 22 V for **BDX53A/54A** V_{CE} = 30 V for **BDX53B/54B** V_{CE} = 40 V for **BDX53C/54C** V_{CE} = 50 V			500 500 500 500	µA µA µA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			2	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA for **BDX53/54** for **BDX53A/54A** for **BDX53B/54B** for **BDX53C/54C**	45 60 80 100			V V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 3 A I_B = 12 mA			2	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 3 A I_B = 12 mA			2.5	V
h_{FE}*	DC Current Gain	I_C = 3 A V_{CE} = 3 V	750			
V_F	Parallel-diode Forward Voltage	I_F = 3 A I_F = 8 A		1.8 2.5	2.5	V V

* Pulsed : pulse duration = 300 µs, duty cycle = 1.5 %.
For PNP types voltage and current values are negative.

Safe Operating Area.



SGS-THOMSON MICROELECTRONICS

SGS-THOMSON MICROELECTRONICS

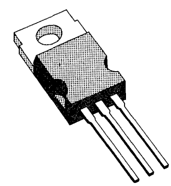
BDX53E/BDX53F BDX54E/BDX54F

POWER DARLINGTONS

DESCRIPTION

The BDX53E, BDX53F are silicon epitaxial base NPN transistors in monolithic Darlington configuration and are mounted in Jedec TO-220 plastic package. They are intended for use in power linear and switching applications.

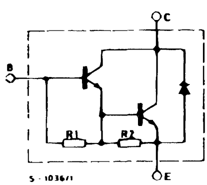
The complementary PNP types are the BDX54E and BDX54F respectively.



TO-220

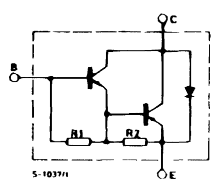
INTERNAL SCHEMATIC DIAGRAMS

NPN



R1 Typ. 10 kΩ
R2 Typ. 150 Ω

PNP



R1 Typ. 10 kΩ
R2 Typ. 150 Ω

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	NPN / PNP*	Value BDX53E / BDX54E	Value BDX53F / BDX54F	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)		140	160	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)		140	160	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)		5		V
I_C	Collector Current		8		A
I_{CM}	Collector Peak Current		12		A
I_B	Base Current		0.2		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C		60		W
T_{stg}	Storage Temperature		– 65 to 150		°C
T_j	Junction Temperature		150		°C

* For PNP types voltage and current values are negative.

THERMAL DATA

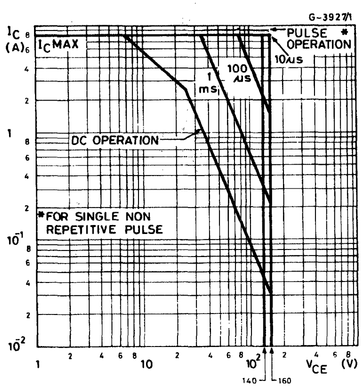
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	2.08	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	70	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

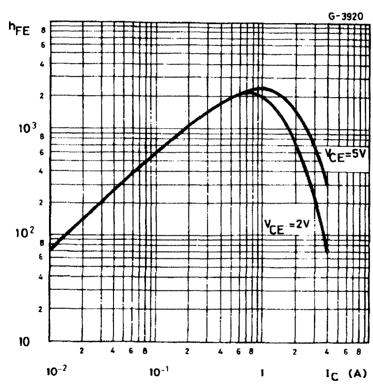
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **BDX53E/4E** V_{CE} = 70 V for **BDX53F/4F** V_{CE} = 80 V			0.5 0.5	mA mA
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **BDX53E/4E** V_{CB} = 140 V for **BDX53F/4F** V_{CB} = 160 V			0.2 0.2	mA mA
I_{EBO}	Emitter Cutoff Current (I_E = 0)	V_{EB} = 5 V			5	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 50 mA for **BDX53E/BDX54E** for **BDX53F/BDX54F**	140 160			V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 2 A I_B = 10 mA			2	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 2 A I_B = 10 mA			2.5	V
h_{FE}*	DC Current Gain	I_C = 2 A V_{CE} = 5 V I_C = 3 A V_{CE} = 5 V	500 150			
V_F*	Parellel Diode Forward Voltage	I_F = 2 A			2.5	V
h_{fe}	Small Signal Current Gain	I_C = 0.5 A V_{CE} = 2 V f = 1 MHz		20		

* Pulsed : pulse duration = 300 μs, duty cycle = 1 %.
For PNP types voltage and current values are negative.

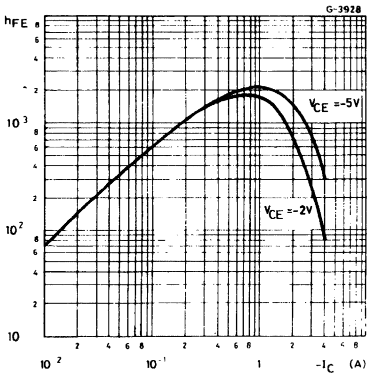
Safe Operating Areas.



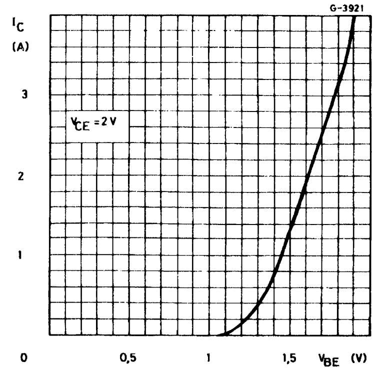
DC Current Gain (NPN types).



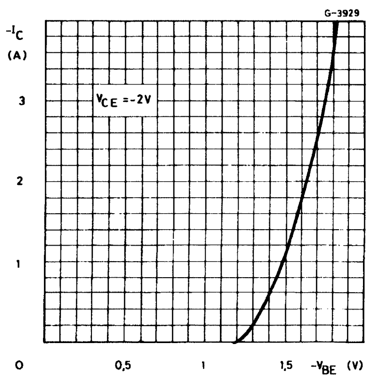
DC Current Gain (PNP types).



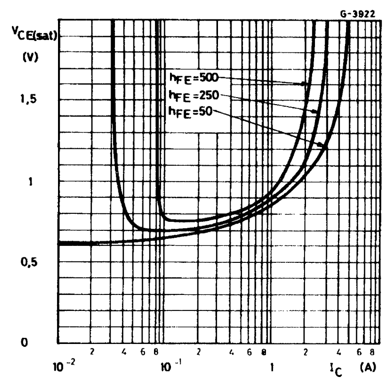
DC Transconductance (NPN types).



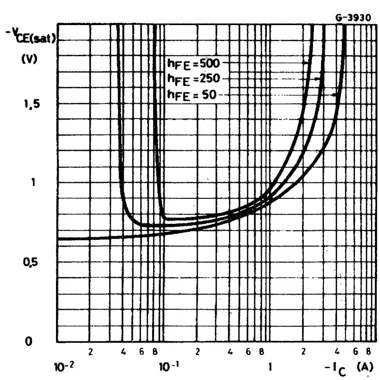
DC Transconductance (PNP types).



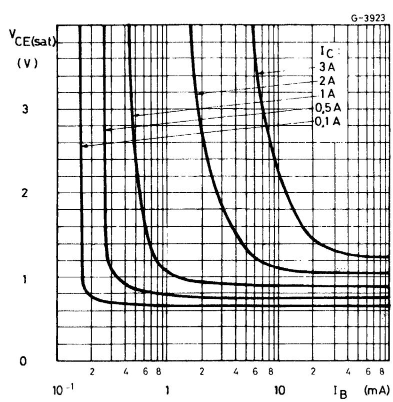
Collector-emitter Saturation Voltage (NPN types).



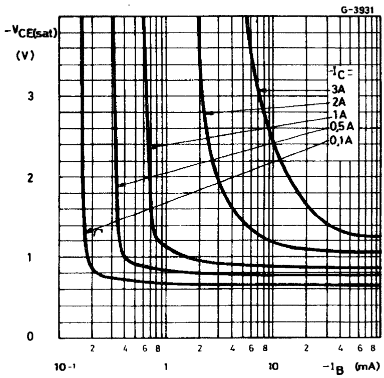
Collector-emitter Saturation Voltage (PNP types).



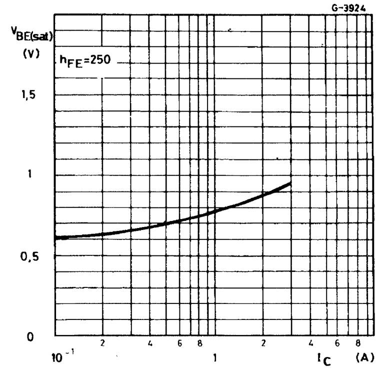
Collector-emitter Saturation Voltage (NPN types).



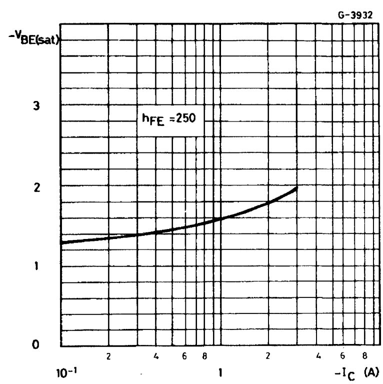
Collector-emitter Saturation Voltage (PNP types).



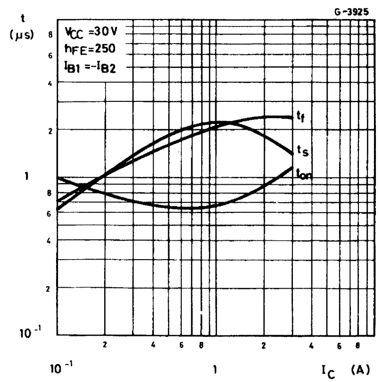
Base-emitter Saturation Voltage (NPN types).



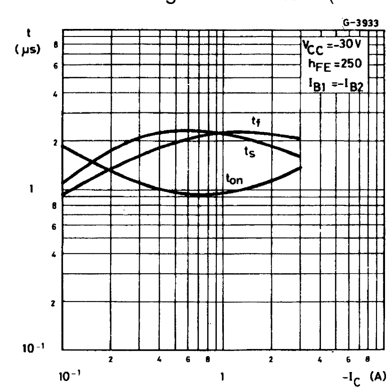
Base-emitter Saturation Voltage (PNP types).



Saturated Switching Characteristics (NPN types).



Saturated Switching Characteristics (NPN types).



SGS-THOMSON
MICROELECTRONICS

BDX53S
BDX54S

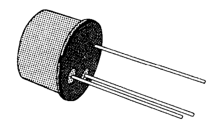
MEDIUM POWER DARLINGTONS

DESCRIPTION

The BDX53S is a silicon epitaxial-base NPN transistor in monolithic Darlington configuration and is mounted in Jedec TO-39 metal case.

It is intended for use in medium in power linear and switching applications.

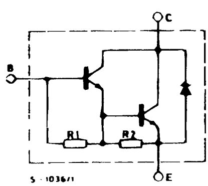
The complementary PNP type is the BDX54S.



TO-39

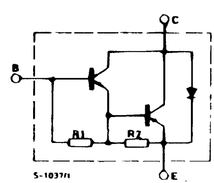
INTERNAL SCHEMATIC DIAGRAMS

NPN



R1 Typ. 10 kΩ
R2 Typ. 150 Ω

PNP



R1 Typ. 10 kΩ
R2 Typ. 150 Ω

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	150	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	150	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5	V
I_C	Collector Current	6	A
I_{CM}	Collector Peak Current	10	A
I_B	Base Current	0.2	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C $T_{amb} \leq 25$ °C	15 1	W W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

* For PNP types voltage and current values are negative.

THERMAL DATA

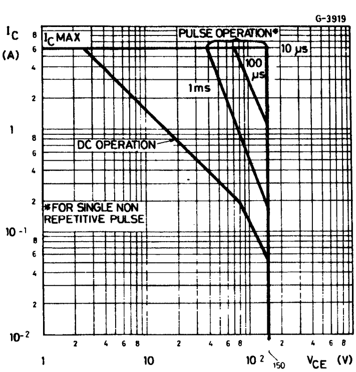
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	11.66	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

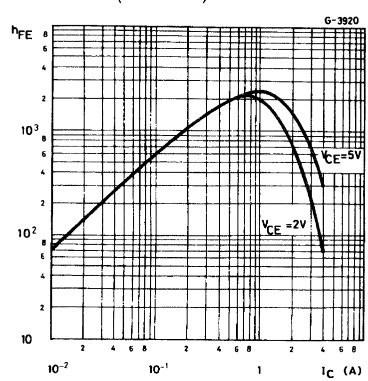
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 150 V V_{CB} = 150 V T_{case} = 125 °C			0.2 2	mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 75 V			0.2	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			5	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 50 mA	150			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 2 A I_B = 8 mA			2	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 2 A I_B = 8 mA			2.5	V
h_{FE}*	DC Current Gain	I_C = 100 mA V_{CE} = 5 V I_C = 2 A V_{CE} = 5 V	100 500			
V_F*	Parallel Diode Forward Voltage	I_F = 2 A			2.5	V
h_{fe}	Small Signal Current Gain	I_C = 0.5 A V_{CE} = 2 V f = 1 MHz		20		

* Pulsed : pulse duration = 300 ms, duty cycle = 1 %.
For PNP type voltage and current values are negative.

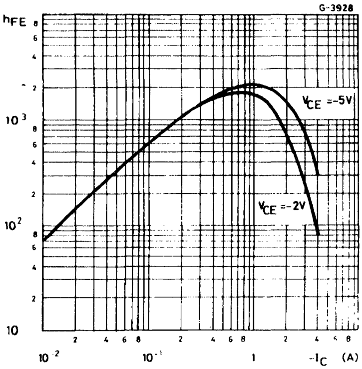
Safe Operating Area.



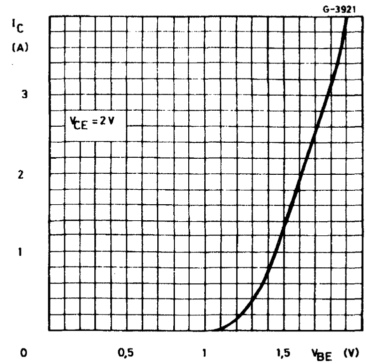
DC Current Gain (BDX53S).



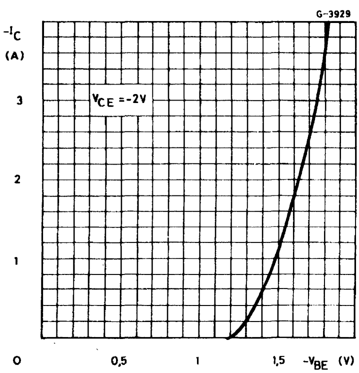
DC Current Gain (BDX54S).



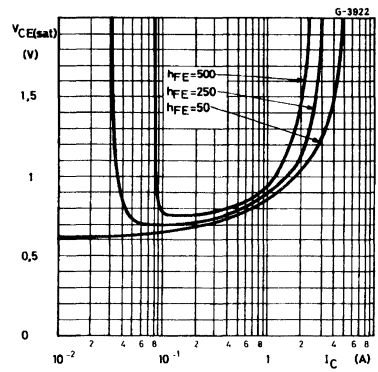
DC Transconductance (BDX53S).



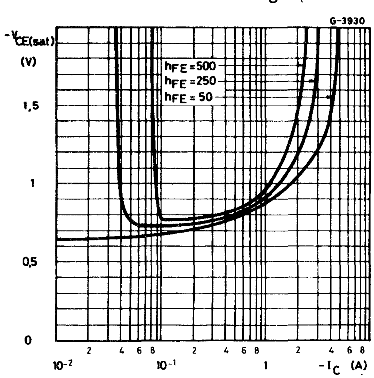
DC Transconductance (BDX54S).



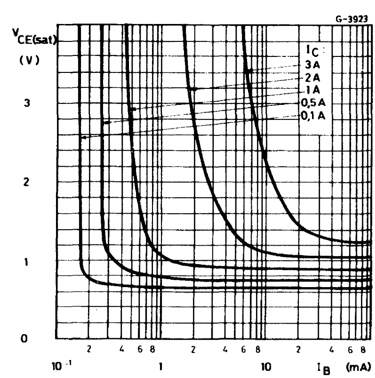
Collector-emitter Saturation Voltage (BDX53S).



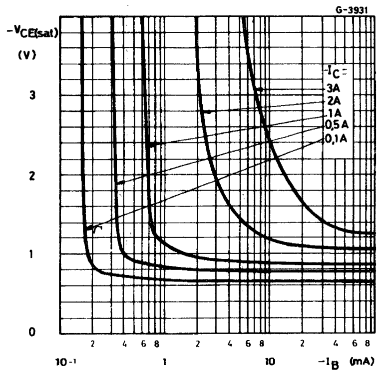
Collector-emitter Saturation Voltage (BDX54S).



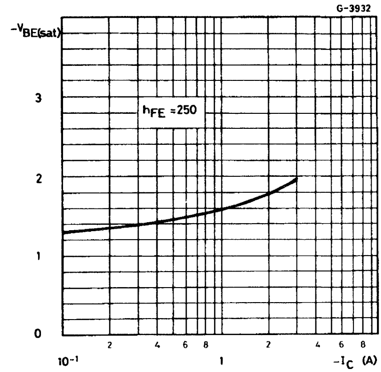
Collector-emitter Saturation Voltage (BDX53S).



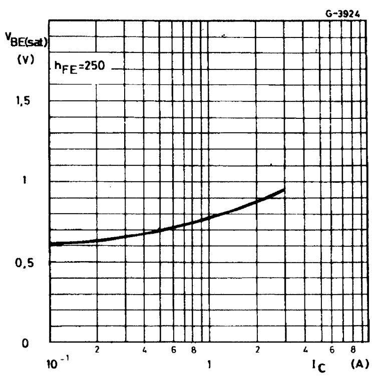
Collector-emitter Saturation Voltage (BDX54S).



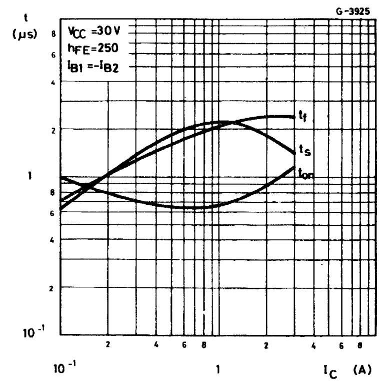
Base-emitter Saturation Voltage (BDX53S).



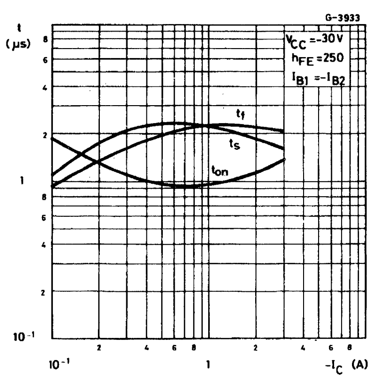
Base-emitter Saturation Voltage (BDX54S).



Saturated Switching Characteristics (BDX53S).



Saturated Switching Characteristics (BDX54S).



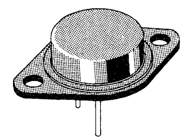
BDX85/85A/85B/85C
BDX86/86A/86B/86C

POWER DARLINGTONS

DESCRIPTION

The BDX 85, BDX 85A, BDX 85B and BDX 85C are silicon epitaxial-base NPN power transistors in monolithic Darlington configuration and are mounted in Jedec TO-3 metal case. They are intended for use in power linear and switching applications.

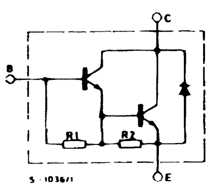
The complementary PNP types are the BDX 86, BDX 86A, BDX 86B and BDX 86C respectively.



TO-3

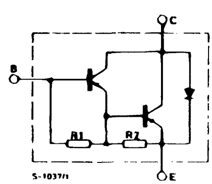
INTERNAL SCHEMATIC DIAGRAMS

NPN



R1 Typ. 10 kΩ
R2 Typ. 150 Ω

PNP



R1 Typ. 10 kΩ
R2 Typ. 150 Ω

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter NPN / PNP*	Value BDX85 / BDX86	BDX85A / BDX86A	BDX85B / BDX86B	BDX85C / BDX85C	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	45	60	80	100	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	45	60	80	100	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5				V
I_C	Collector Current	10				A
I_{CM}	Collector Peak Current (repetitive)	15				A
I_B	Base Current	0.1				A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	100				W
T_{stg}	Storage Temperature	– 65 to 200				°C
T_j	Junction Temperature	200				°C

* For PNP types voltage and current values are negative.

THERMAL DATA

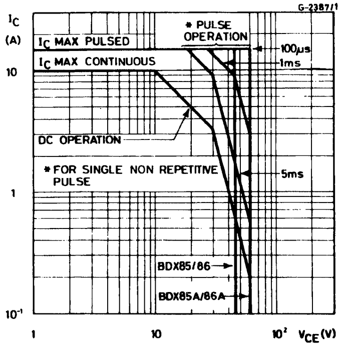
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.75	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

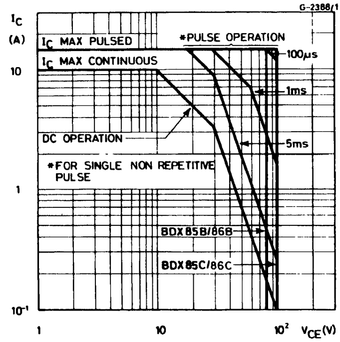
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **BDX85/86** V_{CB} = 45 V for **BDX85A/86A** V_{CB} = 60 V for **BDX85B/86B** V_{CB} = 80 V for **BDX85C/86C** V_{CB} = 100 V T_{case} = 150 °C for **BDX85/86** V_{CB} = 45 V for **BDX85A/86A** V_{CB} = 60 V for **BDX85B/86B** V_{CB} = 80 V for **BDX85C/86C** V_{CB} = 100 V			500 500 500 500 5 5 5 5	µA µA µA µA mA mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **BDX85/86** V_{CE} = 22 V for **BDX85A/86A** V_{CE} = 30 V for **BDX85B/86B** V_{CE} = 40 V for **BDX85C/86C** V_{CE} = 50 V			1 1 1 1	mA mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			2	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA for **BDX85/86** for **BDX85A/86A** for **BDX85B/86B** for **BDX85C/86C**	45 60 80 100			V V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 4 A I_B = 16 mA I_C = 8 A I_B = 40 mA			2 4	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 8 A I_B = 80 mA			4	V
V_{BE}*	Base-emitter Voltage	I_C = 4 A V_{CE} = 3 V			2.8	V
h_{FE}*	DC Current Gain	I_C = 3 A V_{CE} = 3 V I_C = 4 A V_{CE} = 3 V I_C = 8 A V_{CE} = 4 V	1000 750 200		 18000 	
V_F	Parallel-diode Forward Voltage	I_F = 3 A I_F = 8 A		 2.5	1.8 	V V
h_{fe}	Small Signal Current Gain	I_C = 3 A V_{CE} = 3 V f = 1 MHz		10		

* Pulsed : pulse duration = 300 ms, duty cycle = 1.5 %.
For PNP type voltage and current values are negative.

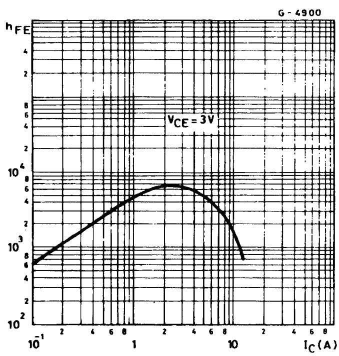
Safe Operating Areas (for **BDX85, BDX85A, BDX86, BDX86A**).



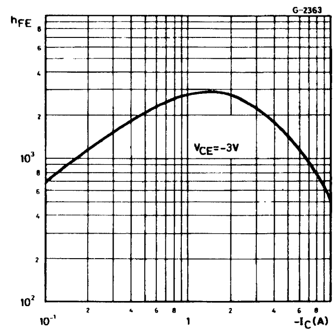
Safe Operating Areas (for **BDX85B, BDX85C, BDX86B, BDX86C**).



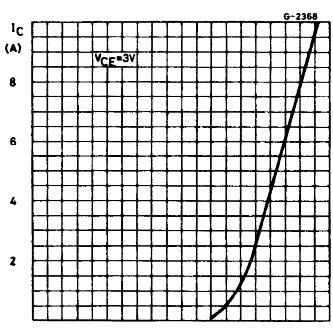
DC Current Gain (NPN types).



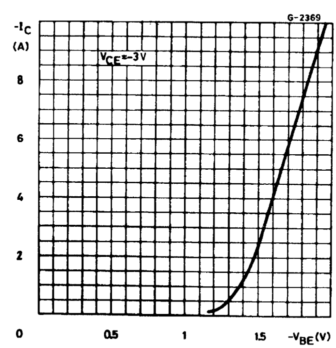
DC Current Gain (PNP types).



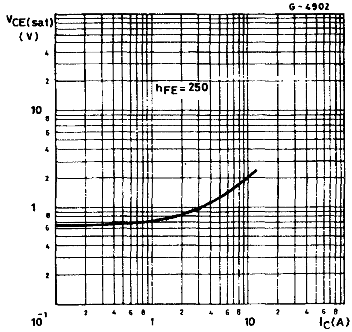
DC Transconductance (NPN types).



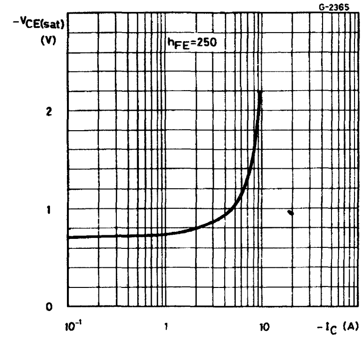
DC Transconductance (PNP types).



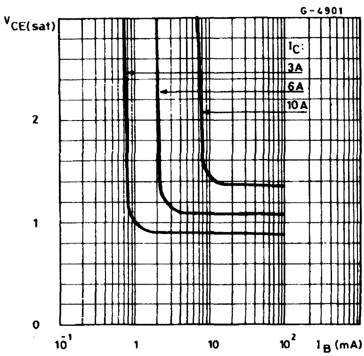
Collector-emitter Saturation Voltage (NPN types).



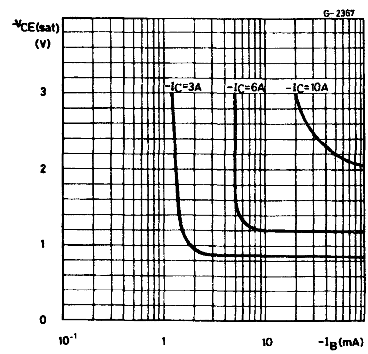
Collector-emitter Saturation Voltage (PNP types).



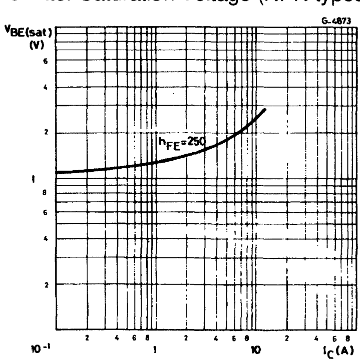
Collector-emitter Saturation Voltage (NPN types).



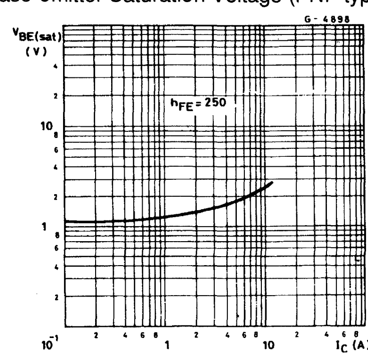
Collector-emitter Saturation Voltage (PNP types).



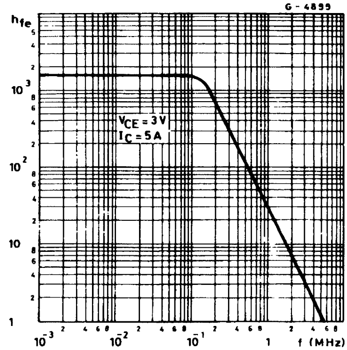
Base-emitter Saturation Voltage (NPN types).



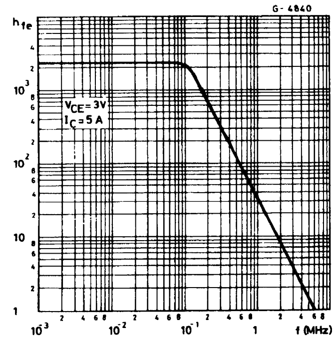
Base-emitter Saturation Voltage (PNP types).



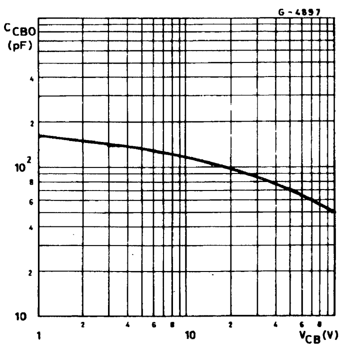
Small Signal Current Gain (NPN types).



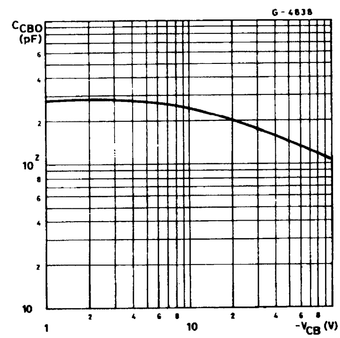
Small Signal Current Gain (PNP types).



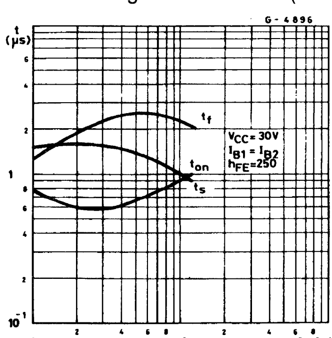
Collector-base Capacitance (NPN types).



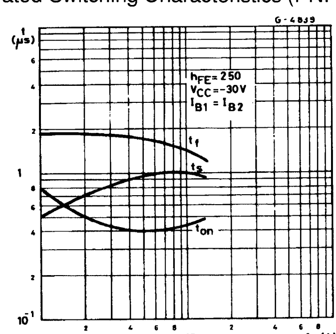
Collector-base Capacitance (PNP types).



Saturated Switching Characteristics (NPN types).



Saturated Switching Characteristics (PNP types).



SGS-THOMSON MICROELECTRONICS

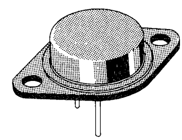
BDX87/87A/87B/87C BDX88/88A/88B/88C

POWER DARLINGTONS

DESCRIPTION

The BDX87, BDX87A, BDX87B and BDX87C are silicon epitaxial-base NPN power transistors in monolithic Darlington configuration and are mounted in Jedec TO-3 metal case. They are intended for use in power linear and switching applications.

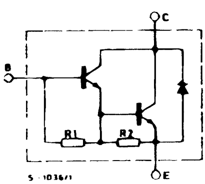
The complementary PNP types are the BDX88, BDX88A, BDX88B and BDX88C respectively.



TO-3

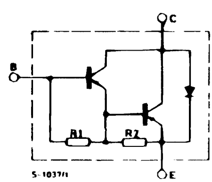
INTERNAL SCHEMATIC DIAGRAMS

NPN



R1 Typ. 10 kΩ
R2 Typ. 150 Ω

PNP



R1 Typ. 10 kΩ
R2 Typ. 150 Ω

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter NPN / PNP*	Value				Unit
		BDX87 BDX88	BDX87A BDX88A	BDX87B BDX88B	BDX87C BDX88C	
V_{CBO}	Collector-base Voltage (I_E = 0)	45	60	80	100	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	45	60	80	100	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5				V
I_C	Collector Current	12				A
I_{CM}	Collector Peak Current (repetitive)	18				A
I_B	Base Current	0.2				A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	120				W
T_{stg}	Storage Temperature	– 65 to 200				°C
T_j	Junction Temperature	200				°C

* For PNP types voltage and current values are negative.

THERMAL DATA

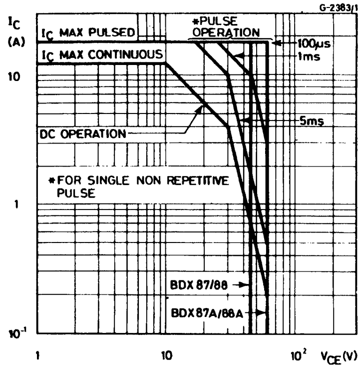
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.45	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

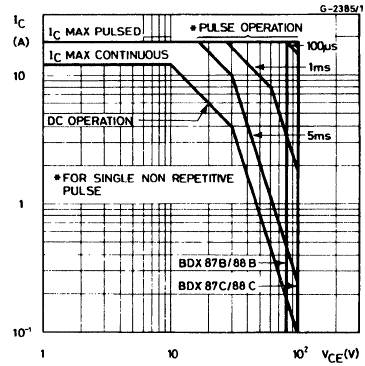
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **BDX87/8** V_{CB} = 45 V for **BDX87A/8A** V_{CB} = 60 V for **BDX87B/8B** V_{CB} = 80 V for **BDX87C/8C** V_{CB} = 100 V T_{case} = 150 °C for **BDX87/8** V_{CB} = 45 V for **BDX87A/8A** V_{CB} = 60 V for **BDX87B/8B** V_{CB} = 80 V for **BDX87C/8C** V_{CB} = 100 V			500 500 500 500 5 5 5 5	µA µA µA µA mA mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **BDX87/8** V_{CE} = 22 V for **BDX87A/8A** V_{CE} = 30 V for **BDX87B/8B** V_{CE} = 40 V for **BDX87C/8C** V_{CE} = 50 V			1 1 1 1	mA mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA for **BDX87/88** for **BDX87A/88A** for **BDX87B/88B** for **BDX87C/88C**	45 60 80 100			V V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 6 A I_B = 24 mA I_C = 12 A I_B = 120 mA			2 3	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 12 A I_B = 120 mA			4	V
V_{BE}*	Base-emitter Voltage	I_C = 6 A V_{CE} = 3 V			2.8	V
h_{FE}*	DC Current Gain	I_C = 5 A V_{CE} = 3 V I_C = 6 A V_{CE} = 3 V I_C = 12 A V_{CE} = 3 V	1000 750 100		 18000 	
V_F	Parallel-diode Forward Voltage	I_F = 3 A I_F = 8 A		 2.5	1.8 	V V
h_{fe}	Small Signal Current Gain	I_C = 5 A V_{CE} = 3 V f = 1 MHz		25		

* Pulsed : pulse duration = 300µs, duty cycle = 1.5%.
For PNP type voltage and current values are negative.

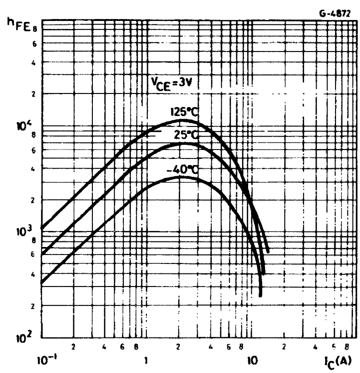
Safe Operating Areas (for **BDX87, BDX87A, BDX88, BDX88A**).



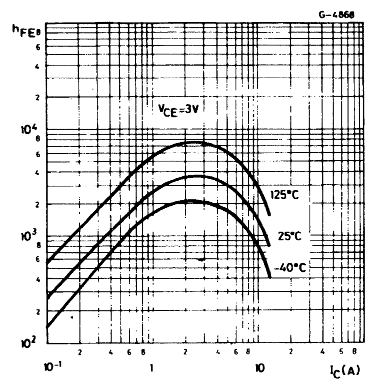
Safe Operating Areas (for **BDX87A, BDX87C, BDX88B, BDX88C**).



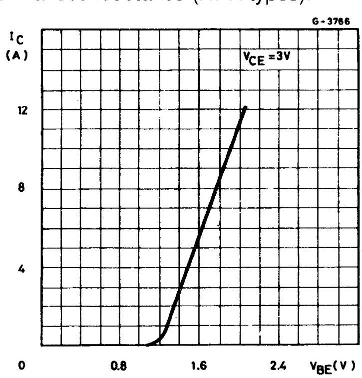
DC Current Gain (NPN types).



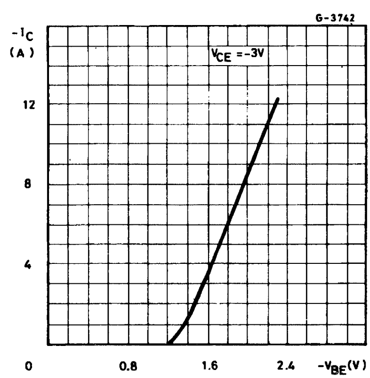
DC Current Gain (PNP types).



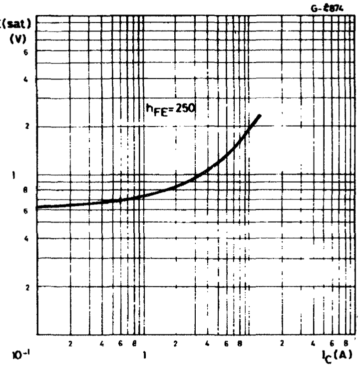
DC Transconductance (NPN types).



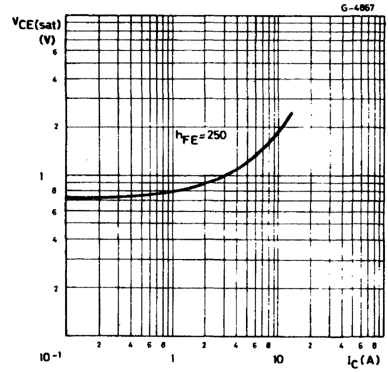
DC Transconductance (PNP types).



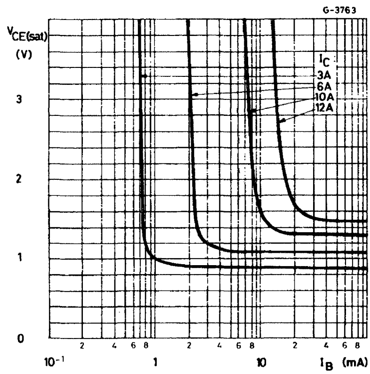
Collector-emitter Saturation Voltage (NPN types).



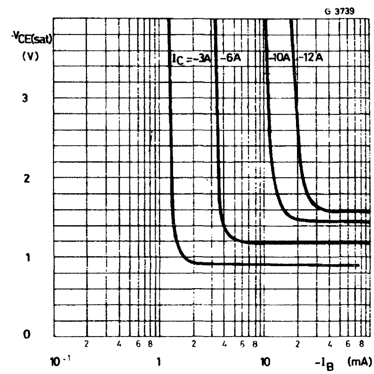
Collector-emitter Saturation Voltage (PNP types).



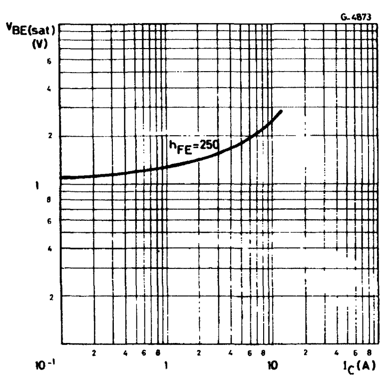
Collector-emitter Saturation Voltage (NPN types).



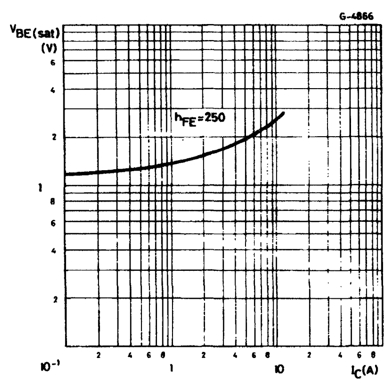
Collector-emitter Saturation Voltage (PNP types).



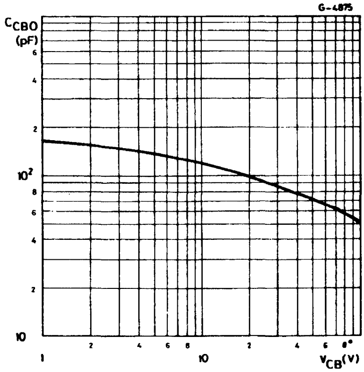
Base-emitter Saturation Voltage (NPN types).



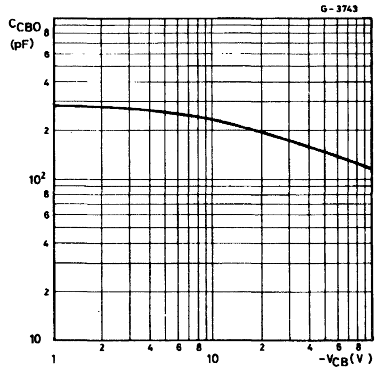
Base-emitter Saturation Voltage (PNP types).



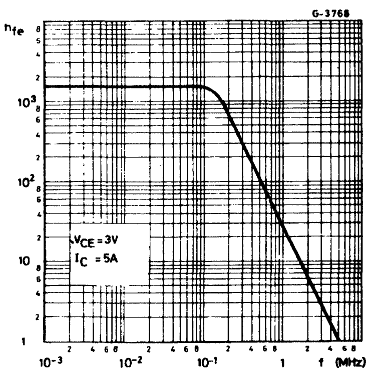
Collector-base Capacitance (NPN types).



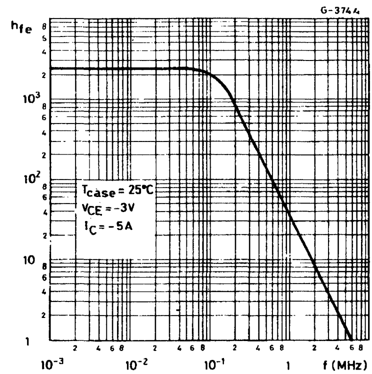
Collector-base Capacitance (PNP types).



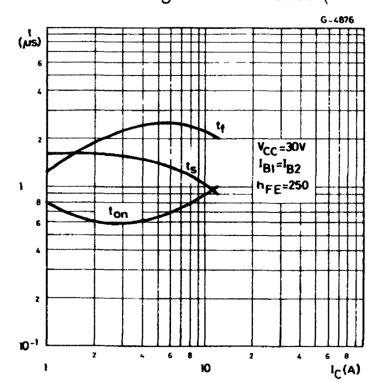
Small Signal Current Gain (NPN types).



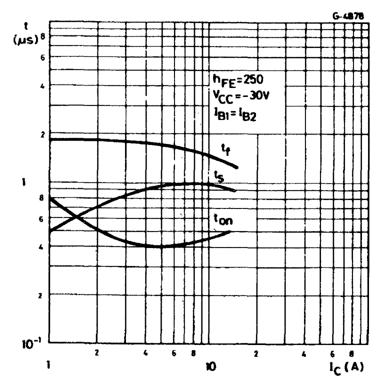
Small Signal Current Gain (PNP types).



Saturated Switching Characteristics (NPN types).



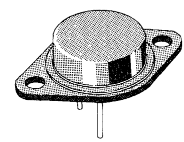
Saturated Switching Characteristics (PNP types).



HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTORS

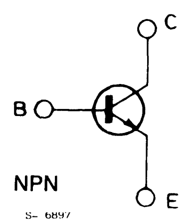
DESCRIPTION

The BDY57 and BDY58 are silicon multiepitaxial planar NPN transistors in Jedec TO-3 metal case, intended for use in switching and linear applications in military and industrial equipment.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BDY57	BDY58	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	120	160	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	80	125	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	10		V
I_C	Collector Current	25		A
I_B	Base Current	6		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	175		W
T_{stg}	Storage Temperature	– 65 to 200		°C
T_j	Junction Temperature	200		°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

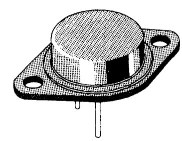
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 120 V			1	mA
I_{CER}	Collector Cutoff Current	V_{CE} = 80 V R_{BE} = 10 Ω T_{case} = 100 °C			10	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 10 V			0.5	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 100 mA for **BDY57** for **BDY58**	 80 125			 V V
$V_{(BR)CBO}$*	Collector-base Breakdown Voltage	I_C = 5 mA for **BDY57** for **BDY58**	 120 160			 V V
$V_{(BR)EBO}$*	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 5 mA	10			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10 A I_B = 1 A		0.5	1.4	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 10 A I_B = 1 A		1.4	2	V
h_{FE}*	DC Current Gain	I_C = 10 A V_{CE} = 4 V I_C = 20 A V_{CE} = 4 V T_{case} = – 30 °C I_C = 10 A V_{CE} = 4 V	20 10	 15	60	
f_T	Transition Frequency	I_C = 1 A V_{CE} = 15 V f = 10 MHz	7			MHz
t_{on}	Turn-on Time	I_C = 15 A I_{B1} = 1.5 A			1	μs
t_{off}	Turn-of Time	I_C = 15 A I_{B1} = – I_{B2} = 1.5 A			2	μs
	Clamped $E_{s/b}$ Collector Current	$V_{(clamp)}$ = 125 V L = 500 μH	15			A

* Pulsed : pulse duration = 300 μs, duty cycle ≤ 2 %.

HIGH CURRENT, HIGH SPEED TRANSISTORS

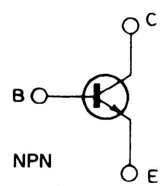
DESCRIPTION

The BDY90, BDY91, BDY92 are silicon multiepitaxial planar NPN transistors in Jedec TO-3 metal case intended for use in switching and linear applications in military and industrial equipment.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		BDY90	BDY91	BDY92	
V_{CBO}	Collector-base Voltage (I_E = 0)	120	100	80	V
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5 V)	120	100	80	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	100	80	60	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	6			V
I_C	Collector Current	10			A
I_{CM}	Collector Peak Current	15			A
I_B	Base Current	2			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	60			W
T_{stg}	Storage Temperature	– 65 to 175			°C
T_j	Junction Temperature	175			°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	2.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CE} = V_{CBO}			1	mA
I_{CEV}	Collector Cutoff Current (V_{BE} = − 1.5 V)	V_{CE} = V_{CEV} T_{case} = 150 °C V_{CE} = V_{CEV}			1 3	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 6 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA for **DBY90** for **BDY91** for **BDY92**	 120 100 80			 V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5 A I_B = 0.5 A I_C = 10 A I_B = 1 A for **BDY90**, **BDY91** for **BDY92**			0.5 1.5 1	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 5 A I_B = 0.5 A I_C = 10 A I_B = 1 A			1.2 1.5	V V
h_{FE}*	DC current Gain	I_C = 1 A V_{CE} = 2 V I_C = 5 A V_{CE} = 5 V I_C = 10 A V_{CE} = 5 V	30 30 20		 120 	
f_t	Transition Frequency	I_C = 0.5 A V_{CE} = 5 V f = 5 MHz		70		MHz
t_{on}	Turn-on Time	I_C = 5 A I_{B1} = 0.5 A V_{CC} = 30 V			0.35	µs
t_s	Storage Time	I_C = 5 A I_{B1} = − I_{B2} = 0.5 A V_{CC} = 30 V			1.3	µs
t_f	Fall Time				0.2	µs

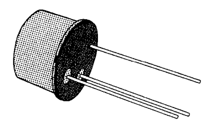
* Pulsed : pulse duration = 300µs, duty cycle ≤ 2%.

HIGH CURRENT, GENERAL PURPOSE TRANSISTOR

DESCRIPTION

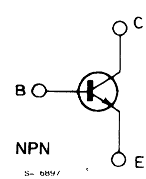
The BFX 34 is a silicon epitaxial planar NPN transistor in Jedec TO-39 metal case, intended for high current applications.

Very low saturation voltage and high speed at high current levels make it ideal for power drivers, power amplifiers, switching power supplies and relay drivers inverters.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	120	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	60	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	6	V
I_C	Collector Current	5	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C $T_{case} \leq 25$ °C	0.87 5	W W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

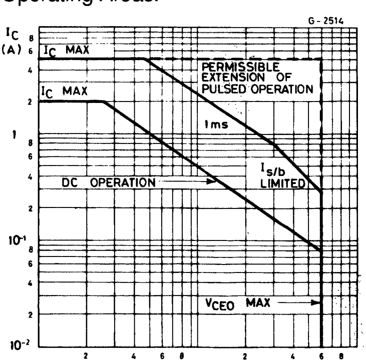
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	35	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction–ambient	Max	200	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

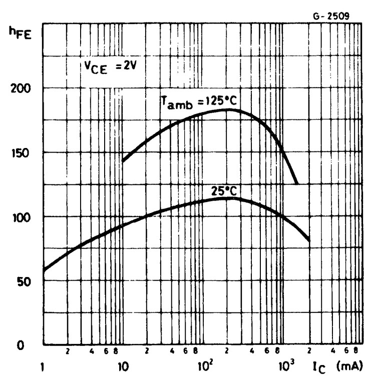
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 60 V			0.02	10	μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 4 V			0.05	10	μA
$V_{(BR)CBO}$*	Collector–base Breakdown Voltage (I_E = 0)	I_c = 5 mA		120			V
$V_{CEO(sus)}$*	Collector–emitter Sustaining Voltage (I_B = 0)	Ic = 100 mA		60			V
V_{EBO}*	Emitter-base Voltage (I_C = 0)	I_E = 1 mA		6			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5 A	I_B = 0.5 A		0.4	1	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 5 A	I_B = - 0.5 mA		1.3	1.6	V
h_{FE}*	DC Current Gain	I_C = 1 A I_C = 1.5 A I_C = 2 A	V_{CE} = 2 V V_{CE} = 0.6 V V_{CE} = 2 V	 40	100 75 80	 150	
f_T	Transition Frequency	I_C = 0.5 A f = 20 MHz	V_{CE} = 5 V	70	100		MHz
CEBO	Emitter–base Capacitance	Ic = 0 f = 1 MHz	V_{EB} = 0.5 V		300	500	pF
C_{CBO}	Collector–base Capacitance	I_E = 0 f = 1 MHz	V_{CB} = 10 V		40	100	pF
t_{on}	Turn-on Time	I_C = – 0.5 A I_{B1} = – I_{B2} = – 50 mA	V_{CC} = – 20 V		0.6	0.25	μs
t_{off}	Turn–off Time				0.6		1.2

* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.

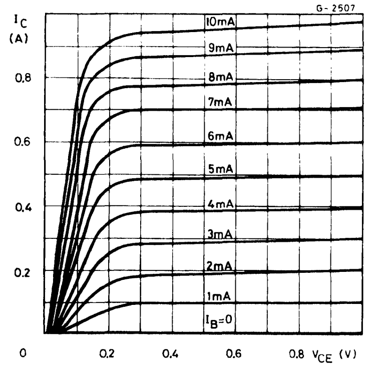
Safe Operating Areas.



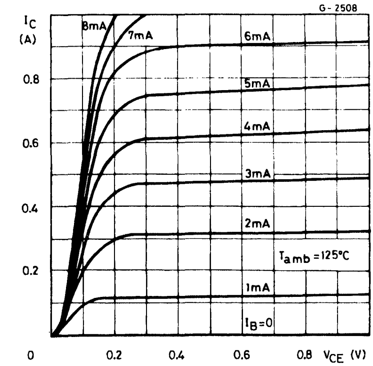
DC Current Gain.



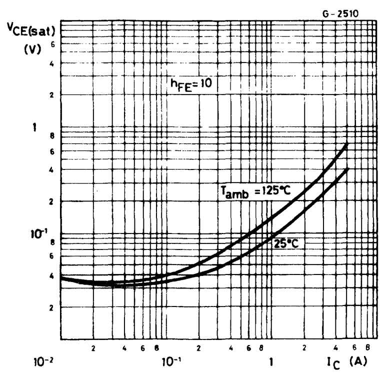
Output Characteristics.



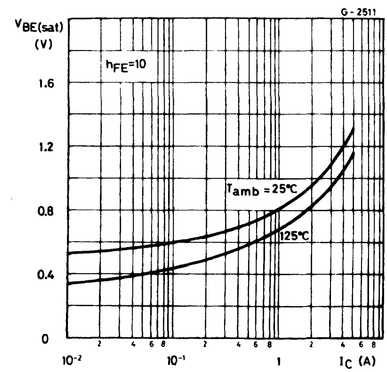
Output Characteristics.



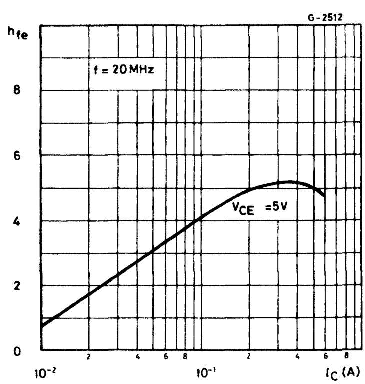
Collector-emitter Saturation Voltage.



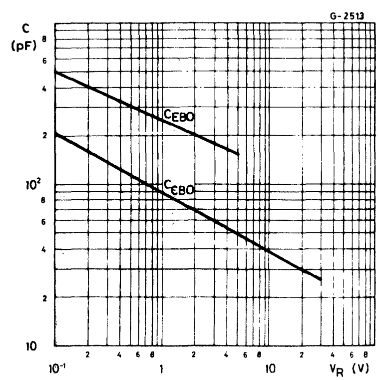
Base-emitter Saturation Voltage.



Small Signal Current Gain.



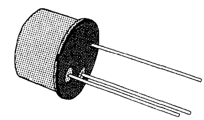
Emitter-base and Collector-base Capacitances.



HIGH CURRENT, GENERAL PURPOSE TRANSISTOR

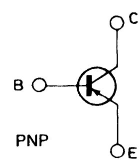
DESCRIPTION

The BSS44 is a silicon epitaxial planar PNP transistor in Jedec TO-39 metal case. It is used for high-current switching and power amplifier applications up to 5A.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	– 65	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 60	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 6	V
I_C	Collector Current	– 5	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C $T_{case} \leq 25$ °C	0.87 5	W W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

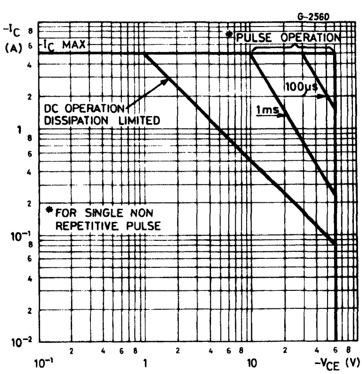
$R_{th\ j-case}$	Thermal Resistance Junction-case	Max	35	°C/W
$R_{th\ j-amb}$	Thermal Resistance Junction–ambient	Max	200	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

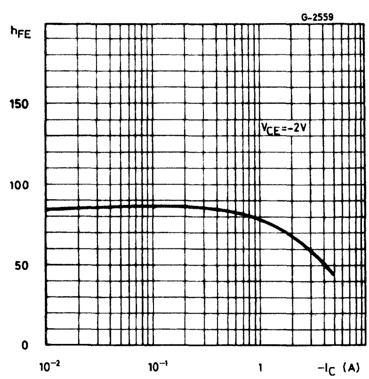
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (I_E = 0)	V_{CE} = – 60 V			– 0.5	μA
$V_{(Br)CBO}$	Collector–base Breakdown Voltage (I_E = 0)	Ic = – 1 mA	– 65			V
$V_{CEO(sus)}$*	Collector–emitter Sustaining Voltage (I_B = 0)	Ic = – 50 mA	– 60			V
V_{EBO}*	Emitter-base Voltage (I_C = 0)	I_E = – 1 mA	– 6			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 0.5 A I_B = – 50 mA I_C = – 5 A I_B = – 0.5 A		– 0.1 – 0.4	 – 1	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 0.5 A I_B = - 50 mA I_C = – 5 A I_B = - 0.5 mA		– 0.8 – 1.1	 – 1.6	V V
h_{FE}*	DC Current Gain	I_C = – 0.5 A V_{CE} = – 2 V I_C = – 2 A V_{CE} = – 2 V I_C = – 5 A V_{CE} = – 2 V	30 40 	 70 45		
If_T	Transition Frequency	I_C = – 0.5 A V_{CE} = – 5 V		80		MHz
C_{CBO}	Collecotr–base Capacitance	I_E = 0 V_{CB} = – 10 V f = 1 MHz			100	pF
t_{on}	Turn-on Time	I_C = – 0.5 A V_{CC} = – 20 V I_{B1} = – I_{B2} = – 50 mA		0.065		μs
t_{off}	Turn–off Time			0.45		μs

* Pulsed : pulse duration = 300 μs, duty cycle = 1.5 %.

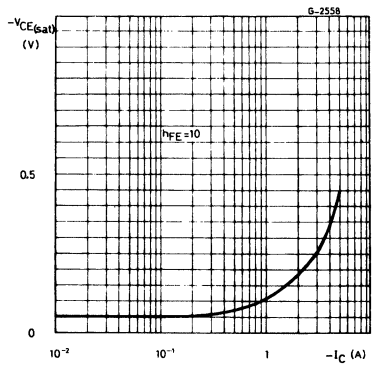
Safe Operating Areas.



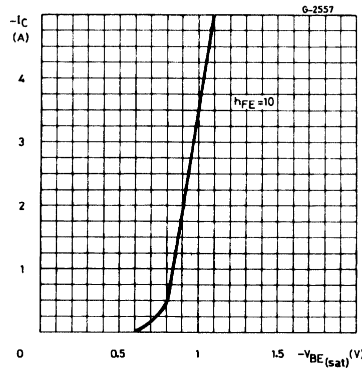
DC Current Gain.



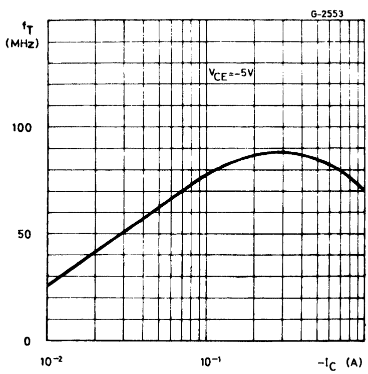
Collector-emitter Saturation Voltage.



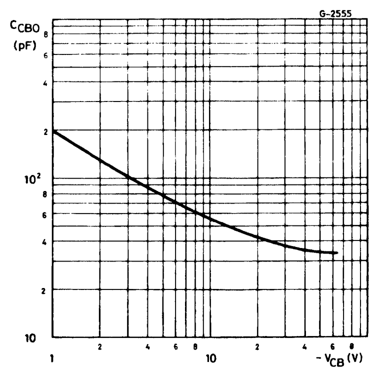
Base-emitter Saturation Voltage.



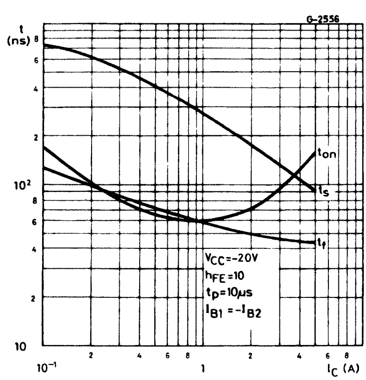
Transition Frequency.



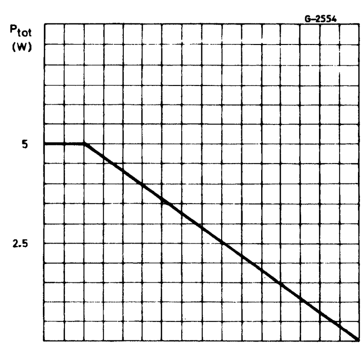
Collector-base Capacitance.



Saturated Switching Characteristics.



Power Rating Chart.

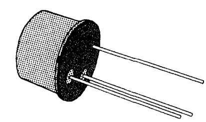


BSW67 BSW68

HIGH VOLTAGE SWITCH

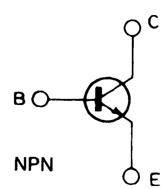
DESCRIPTION

The BSW 67 and BSW 68 are silicon epitaxial planar NPN transistors in Jedec TO-39 metal case. They are intended for high voltage inductive load switching applications.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BSW67	BSW68	
V_{CBO}	Collector-base Voltage (I_E = 0)	120	150	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	120	150	V
I_C	Collector Current	1.5		A
I_{CM}	Collector Peak Current	2		A
P_{tot}	Total Power Dissipation at $T_{amb} \le 45$ °C $T_{case} \le 25$ °C $T_{case} \le 100$ °C	0.7 5 2.85		W W W
T_{stg}	Storage Temperature	– 65 to 200		°C
T_j	Junction Temperature	200		°C

THERMAL DATA

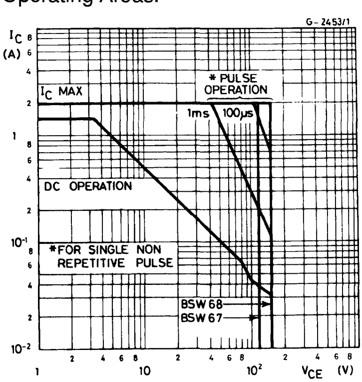
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	35	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	220	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

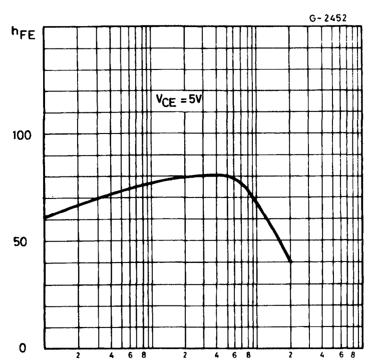
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **BSW67** V_{CB} = 60 V V_{CB} = 60 V T_{case} = 150 °C for **BSW68** V_{CB} = 75 V V_{CB} = 75 V T_{case} = 150 °C			 100 50 100 50	 nA μA nA μA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 μA for **BSW67** for **BSW68**	120 150			V V
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA for **BSW67** for **BSW68**	120 150			V V
V_{EBO}*	Emitter-base Voltage (I_C = 0)	I_E = 100 μA	6			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 0.1 A I_B = 0.01 A I_C = 0.5 A I_B = 0.05 A I_C = 1 A I_B = 0.15 A			0.15 0.5 1	V V V
$V_{BE(sat)}$*	Base-emitter Voltage	I_C = 0.1 A I_B = 0.01 A I_C = 0.5 A I_B = 0.05 A I_C = 1 A I_B = 0.15 A			0.9 1.1 1.2	V V V
h_{FE}*	DC Current Gain	I_C = 0.1 A V_{CE} = 5 V I_C = 0.5 A V_{CE} = 5 V I_C = 1 A V_{CE} = 5 V	40 30 15			
f_T	Transition Frequency	I_C = 100 mA V_{CE} = 20 V		80		MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz			35	pF
t_{on}	Turn-on Time	I_C = 0.5 A V_{CC} = 20 V I_{B1} = − I_{B2} = 0.05 A		0.3		μs
t_{off}	Turn-off Time			1		μs

* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.

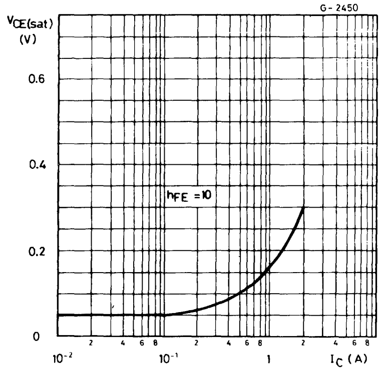
Safe Operating Areas.



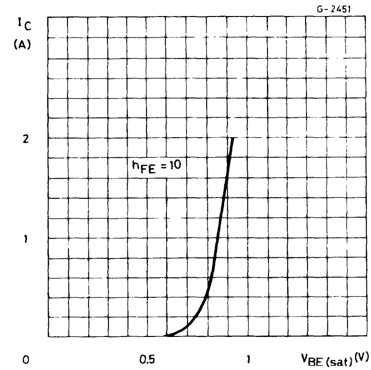
DC Current Gain.



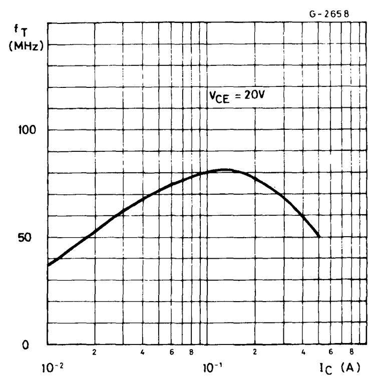
Collector-emitter Saturation Voltage.



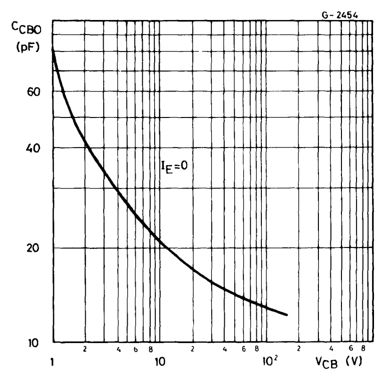
Base-emitter Saturation Voltage.



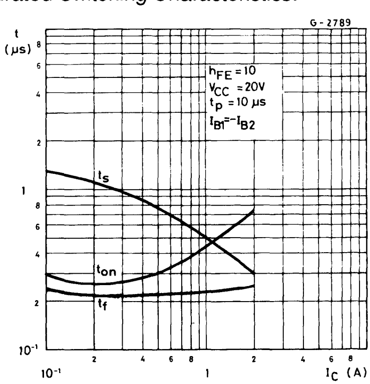
Transition Frequency.



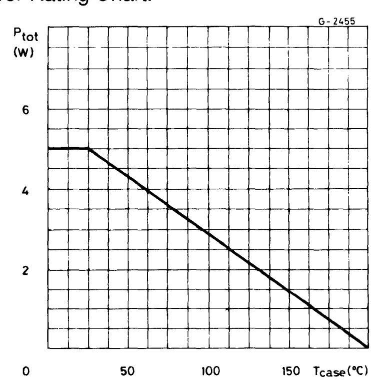
Collector-base Capacitance.



Saturated Switching Characteristics.



Power Rating Chart.



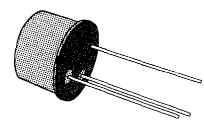
SGS-THOMSON
MICROELECTRONICS

BU125

HIGH CURRENT, GENERAL PURPOSE TRANSISTOR

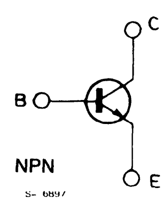
DESCRIPTION

The BU125 is a silicon epitaxial planar NPN transistor in Jedec TO–39 metal case. It is used in switching output and general purpose applications.



TO–39

INTERNAL SHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	130	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	60	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	6	V
I_C	Collector Current	7	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C $T_{amb} \leq 50$ °C	1 10	W W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

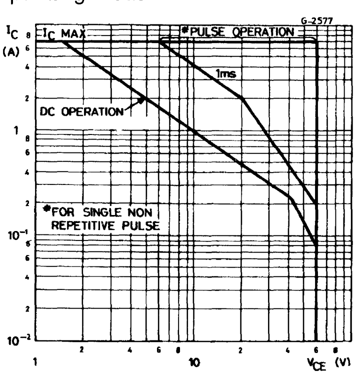
$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	15	°C/W
$R_{thj\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

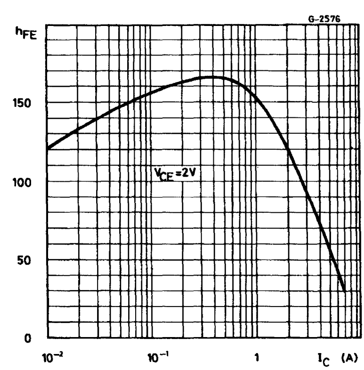
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 100 V			0.02	10	μA
$V_{(BR)CBO}$*	Collector-base Breakdown Voltage (I_E = 0)	I_C = 1 mA		130			V
$V_{(BR)CES}$*	Collector-emitter Breakdown Voltage (V_{BE} = 0)	I_C = 1 mA		130			V
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 50 mA		60			V
V_{EBO}*	Emitter-base Voltage (I_C = 0)	I_E = 1 mA		5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 1 A I_C = 5 A	I_B = 0.1 A I_B = 0.5 A			0.25 1.2	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 1 A I_C = 5 A	I_B = 0.1 A I_B = 0.5 A		0.9 1.3	1 1.6	V V
h_{FE}*	DC Current Gain	I_C = 0.1 A I_C = 5 A	V_{CE} = 2 V V_{CE} = 2 V	40 15	155 60		
f_T	Transition Frequency	I_C = 0.5 A	V_{CE} = 5 V	50			MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 f = 1 MHz	V_{CB} = 10 V			80	pF
t_{off}	Turn-off Time	I_C = 5 A I_{B1} = − I_{B2} = 0.5 A	V_{CC} = 20 V			0.65	μs

* Pulsed : pulse duration = 300 μs, duty cycle = 1.5 %

Safe Operating Areas

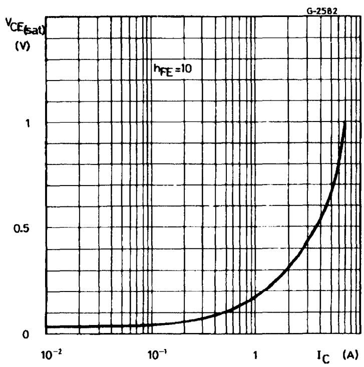


DC Current Gain

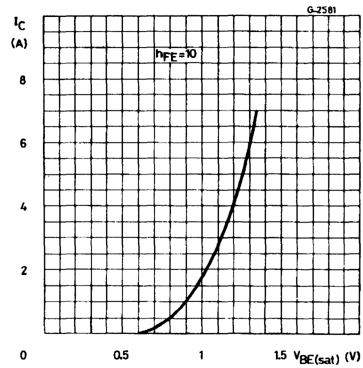


SGS-THOMSON MICROELECTRONICS

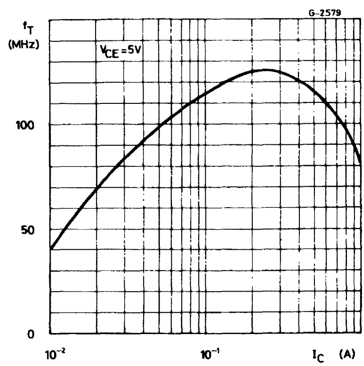
Collector–emitter Saturation Voltage



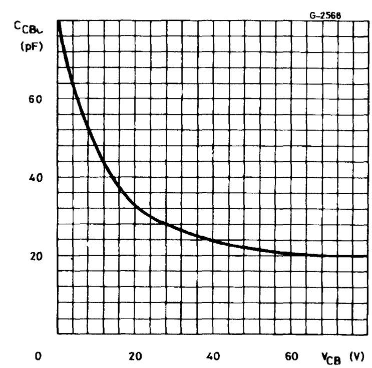
Base–emitter Saturation Voltage



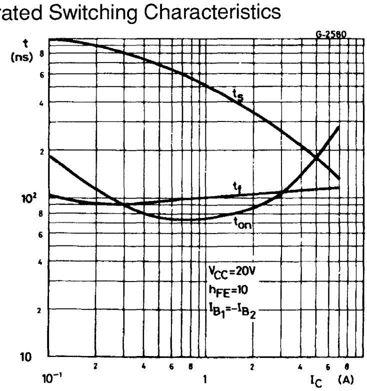
Transition Frequency



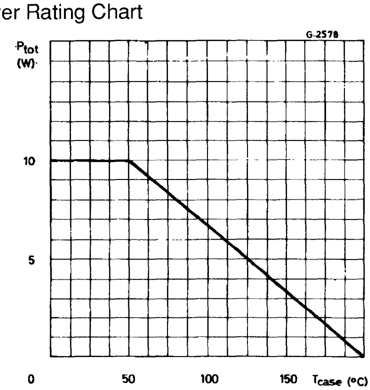
Collector–base Capacitance



Saturated Switching Characteristics



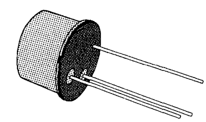
Power Rating Chart



HIGH VOLTAGE POWER AMPLIFIER

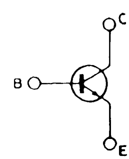
DESCRIPTION

The BU125S is a silicon epitaxial planar NPN transistor in Jedec TO–39 metal case. It is intended for general purpose, linear and switching applications.



TO–39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	250	V
V_{CEV}	Collector-emitter Voltage ($V_{BE} = -1.5$ V)	250	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	150	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	6	V
I_C	Collector Current	3	A
I_{CM}	Collector Peak Current (repetitive)	5	A
I_B	Base Current	0.5	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C $T_{amb} \leq 50$ °C	1 10	W W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

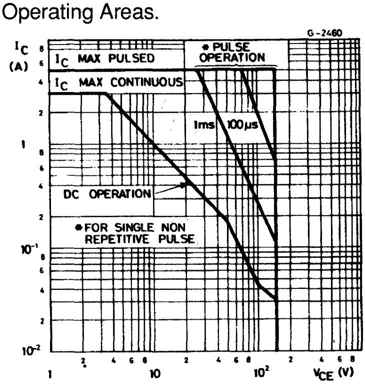
$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	15	°C/W
$R_{thj\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

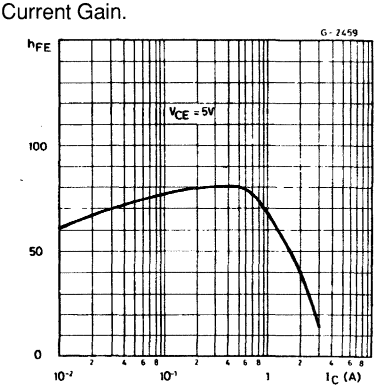
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 200 V			10	µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 6 V			1	mA
V_{CBO}	Collector-base Voltage (I_E = 0)	I_C = 1 mA	250			V
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 20 mA	150			V
$V_{CE(sat)}$	Collector-emitter Saturation Voltage	I_C = 500 mA I_B = 50 mA			1.5	V
h_{FE}	DC Current Gain	I_C = 5 mA V_{CE} = 10 V I_C = 250 mA V_{CE} = 3 V	30 30			
f_T	Transition Frequency	I_C = 100 mA V_{CE} = 10 V	15			MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 f = 1 MHz V_{CB} = 20 V			35	pF
t_{on}	Turn-on Time	I_C = 0.5 A I_{B1} = − I_{B2} = 0.05 A V_{CC} = 20 V		0.3		µs
t_{off}	Turn-off Time			1		µs

* Pulsed : pulse duration = 300 µs, duty cycle = 1.5 %.

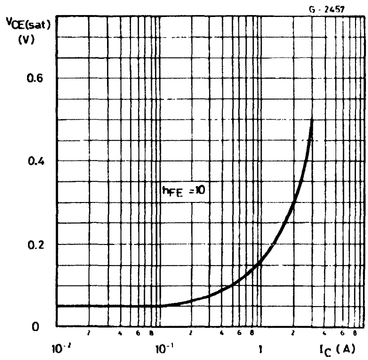
Safe Operating Areas.



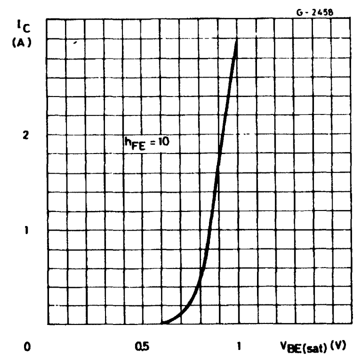
DC Current Gain.



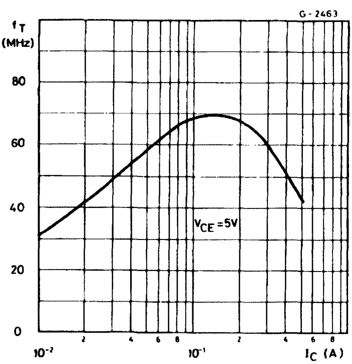
Collector–emitter Saturation Voltage.



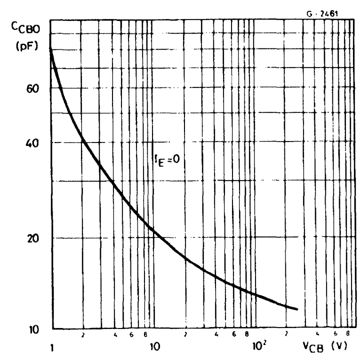
Base–emitter Saturation Voltage.



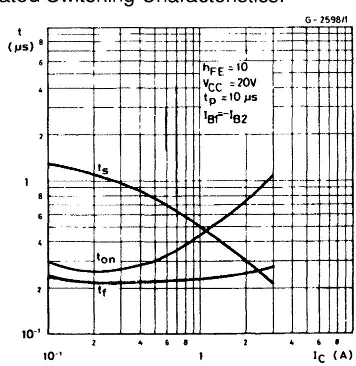
Transition Frequency.



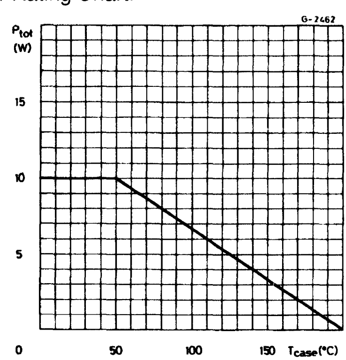
Collector–base Capacitance.



Saturated Switching Characteristics.



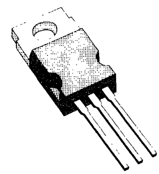
Power Rating Chart.



NPN SWITCHING DARLINGTONS

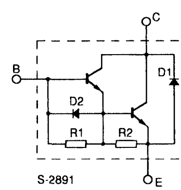
DESCRIPTION

Monolithic Darlingtons with integrated speed-up and damper diode, suited for TV applications.



TO-220

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BU184	BU189	
V_{CBO}	Collector-base Voltage (I_F = 0)	400	330	V
V_{CEX}	Collector-emitter Voltage	400	330	V
V_{CEO}	Collector-emitter Voltage (I_B =0)	200	150	V
V_{EBO}	Emitter-base Voltage (I_C =0)	8		V
I_C	Collector Current	8		A
I_{CM}	Collector Peak Current (t_p < 10ms)	15		A
I_B	Base Current	2		A
I_{BM}	Base Peak Current (t_p < 10ms)	4		A
P_{tot}	Total Dissipation at T_c < 25°C	60		W
T_{stg}	Storage Temperature	– 65 to + 150		°C
T_j	Max. Operating Junction Temperature	150		°C

THERMAL DATA

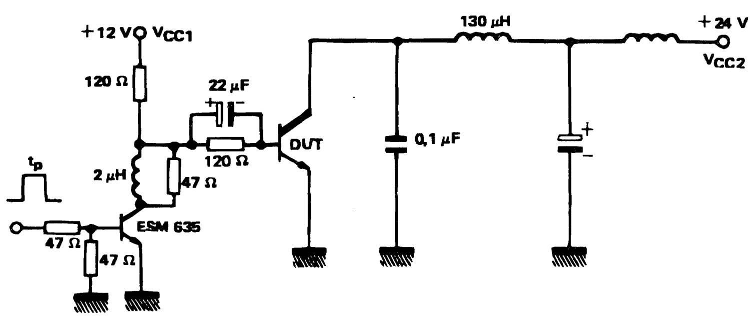
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	2.08	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEX}	Collector Cutoff Current	$V_{CE} = V_{CEX}$ $V_{BE} = -6V$			100	µA
I_{EBO}	Emitter Cutoff Current (I_C =0)	$V_{EB} = -8V$			10	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 3A L = 15mH for **BU184** for **BU189**	 200 150			 V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5A I_B = 50mA			1.5	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 5A I_B = 50mA			2.2	V
V_F*	Diode Forward Voltage	I_F = 4A		1.8	2.3	V
 t_s t_f	RESISTIVE LOAD Storage Time Fall Time	See Test Circuit		 0.44 0.3	 0.5	 µs µs

* Pulse test t_p < 300 µs δ < 2 %.

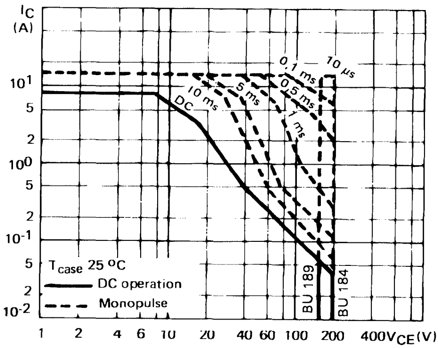
TEST CIRCUIT



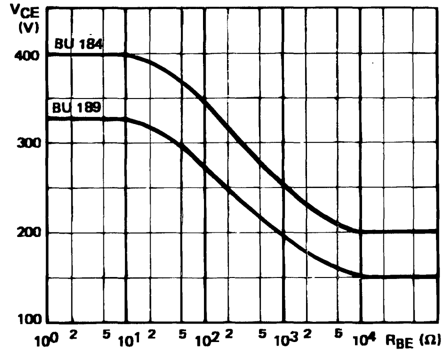
Adjust V_{CC1} for I_{Bend} = 50 mA
Adjust V_{CC2} for I_{Cend} = 5 A

Generator: f = 15 625 Hz (T = 64 µs); $t_p \cong$ 20 µs; Amplitude 10 Volts

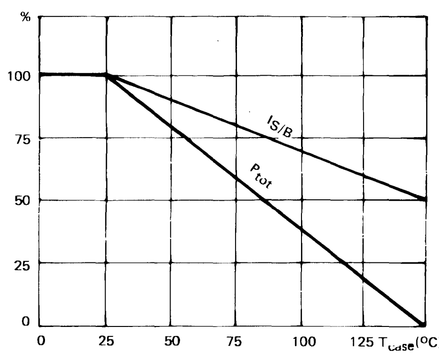
DC and Pulse Area.



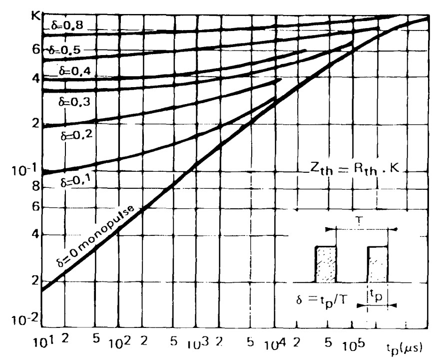
Collector-emitter Voltage vs Base-emitter Resistance.



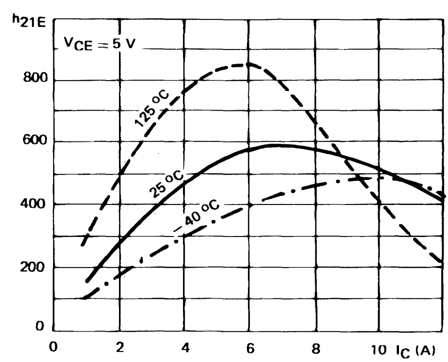
Power and IS/B Derating vs Case Temperature.



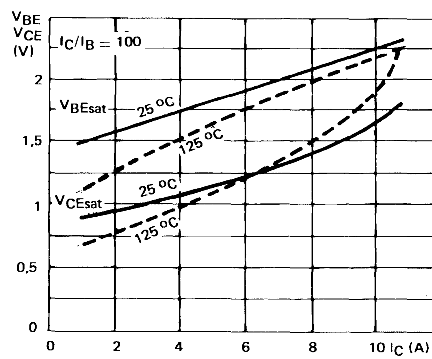
Transient Thermal Response.



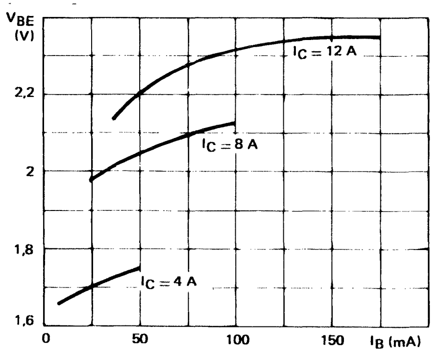
DC Current Gain.



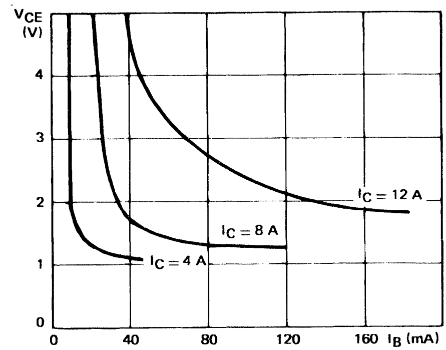
Saturation Voltage.



Base Characteristics.



Collector Saturation Region.

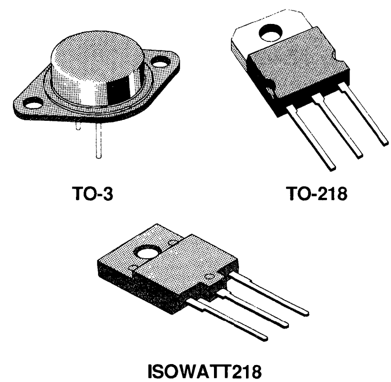


SGS-THOMSON
MICROELECTRONICS

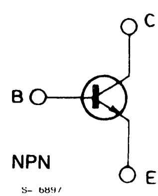
BU208/508/508FI
BU208A/508A/508AFI

HORIZONTAL TVC DEFLECTION

- HIGH VOLTAGE
- HIGH POWER
- HIGH SWITCHING SPEED
- GOOD STABILITY
- CONSUMER
- POWER SUPPLY
- TV COLOR HORIZONTAL DEFLECTION



INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

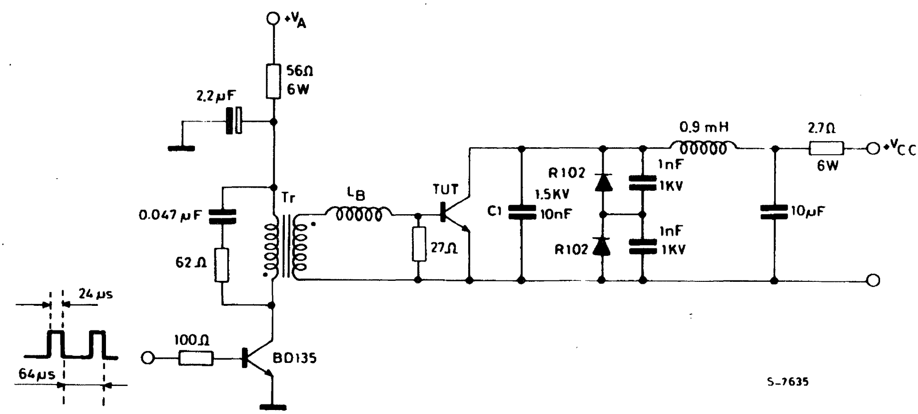
The BU208/A, BU508/A and the BU508FI/AFI are silicon multiepitaxial mesa NPN transistors.

They are respectively in Jedec TO-3 metal case in TO-218 plastic case and in ISOWATT218 fully isolated package.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	1500			V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	700			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	10			V
I_C	Collector Current	8			A
I_{CM}	Collector Peak Current	15			A
		TO-3	**TO-218**	**ISOWATT218**	
P_{tot}	Total Dissipation at T_c = 25°C	150	125	60	W
T_{stg}	Storage Temperature	– 65 to 175	– 65 to 150	– 65 to 150	°C
T_j	Max. Operating Junction Temperature	175	150	150	°C

Figure 1 : Switching Times Test Circuit on Inductive Load.



ISOWATT218 PACKAGE CHARACTERISTICS AND APPLICATION

ISOWATT218 is fully isolated to 4000V dc. Its thermal impedance, given in the data sheet, is optimised to give efficient thermal conduction together with excellent electrical isolation. The structure of the case ensures optimum distances between the pins and heatsink. These distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 package eliminates the need for external isolation so reducing fixing hardware.

The package is supplied with leads longer than the standard TO-218 to allow easy mounting on pcbs. Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

ISOWATT218 thermal performance is equivalent to that of the standard part, mounted with a 0.1mm mica washer.

The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets.

Power derating for ISOWATT218 packages is determined by :

$$P_D = \frac{T_J - T_C}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT218 PACKAGE

Figure 2 illustrates the elements contributing to the thermal resistance of a transistor heatsink assembly, using ISOWATT218 package.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements.

The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1-For a short duration power pulse of less than 1 ms :

$$Z_{th} < R_{thJ\text{-}C}$$

2-For an intermediate power pulse of 5ms seconds :

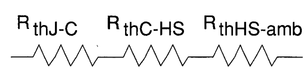
$$Z_{th} = R_{thJ\text{-}C}$$

3-For long power pulses of the order of 500ms seconds or greater :

$$Z_{th} = R_{thJ\text{-}C} + R_{thC\text{-}HS} + R_{thHS\text{-}amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 2.



THERMAL DATA

		TO-3	TO-218	ISOWATT218	
$R_{thj-case}$	Thermal Resistance Junction-case Max	1	1	2.08	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

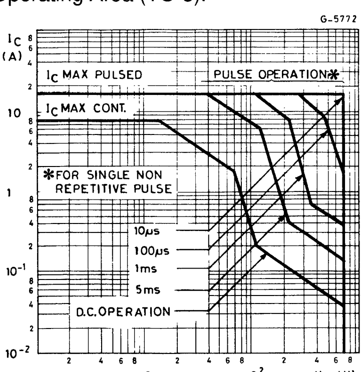
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	$V_{CE} = V_{CES}$ $V_{CE} = V_{CES}$ T_C = 125°C			1 2	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			100	μA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 100mA	700			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 10mA	10			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 4.5A I_B = 2A for **BU208A/508A/508AFI** for **BU208/508/508FI**			 1 5	 V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 4.5A I_B = 2A			1.3	V
f_T	Transition Frequency	I_C = 0.1A V_{CE} = 5V f = 5MHz		7		MHz

INDUCTIVE LOAD

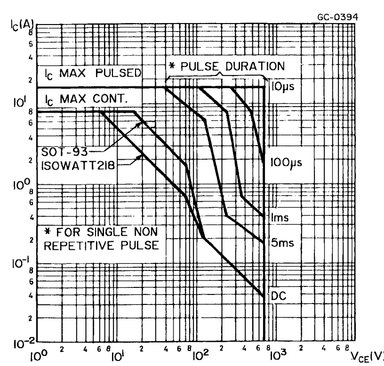
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit.
t_s	Storage Time	I_C = 4.5A h_{FE} = 2.5 V_{CC} = 140V		7		μs
t_f	Fall Time	L_C = 0.9mH L_B = 3μH		0.55		μs

* Pulsed : pulse duration = 300 μs, duty cycle = 1.5 %.

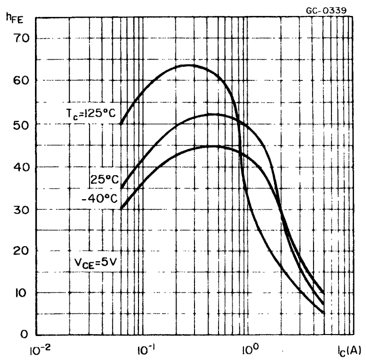
Safe Operating Area (TO-3).



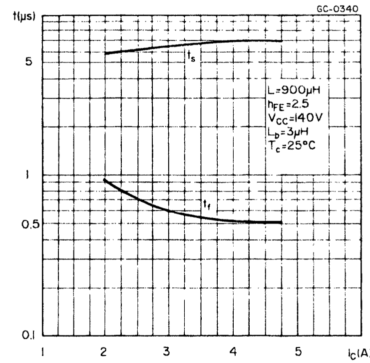
Safe Operating Area (TO-218/ISOWATT218).



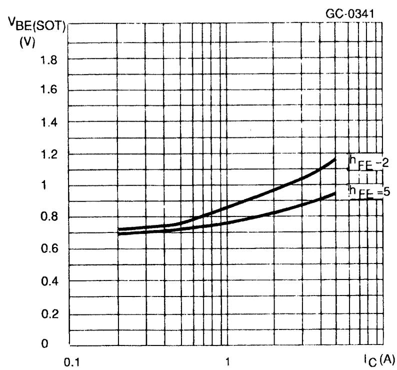
DC Current Gain.



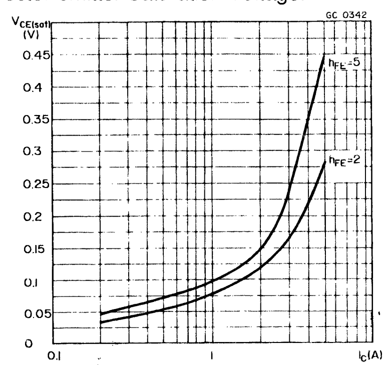
Switching Time Inductive Load.



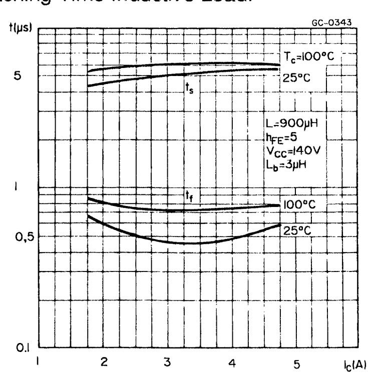
Base-emitter Saturation Voltage.



Collector-emitter Saturation Voltage.



Switching Time Inductive Load.



SGS-THOMSON MICROELECTRONICS

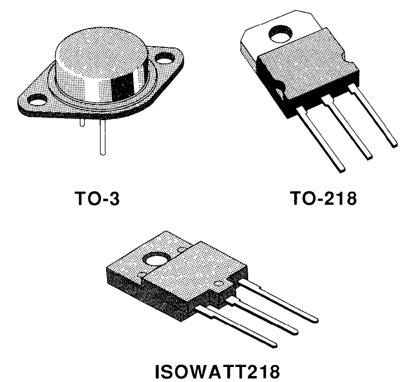
BU208D/508D/508DFI

HORIZONTAL TVC DEFLECTION

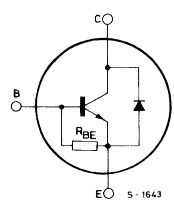
- HIGH VOLTAGE
- HIGH POWER
- HIGH SWITCHING SPEED
- GOOD STABILITY

CONSUMER

- TV COLOR HORIZONTAL DEFLECTION



INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

The BU208D, BU508D and BU508DFI are silicon multiepitaxial mesa NPN transistors.

They are mounted respectively in Jedec TO-3 metal case, in TO-218 plastic case and ISOWATT218 fully isolated package.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	1500			V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	700			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	10			V
I_C	Collector Current	8			A
I_{CM}	Collector Peak Current	15			A
		TO-3	TO-218	ISOWATT218	
P_{tot}	Total Power Dissipation at T_C = 25 °C	150	125	60	W
T_{stg}	Storage Temperature	– 65 to 175	– 65 to 150	– 65 to 150	°C
T_j	Max. Operating Junction Temperature	175	150	150	°C

THERMAL DATA

		TO-3	TO-218	ISOWATT218	
$R_{thj\text{-}case}$	Thermal Resistance Junction-case Max	1	1	2.08	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

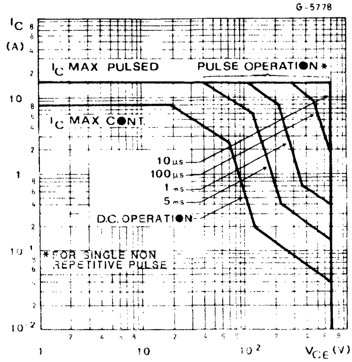
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	$V_{CE} = V_{CES}$ T_C = 125°C $V_{CE} = V_{CES}$			1 2	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			300	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 100mA	700			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 4.5A I_B = 2A			1	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 4.5A I_B = 2A			1.3	V
V_F	Diode Forward Voltage	I_F = 4A			2	V
f_T	Transition Frequency	I_C = 0.1A V_{CE} = 5V f = 5MHz		7		MHz

INDUCTIVE LOAD

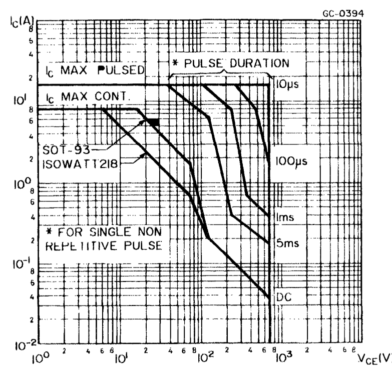
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit.
t_s	Storage Time	I_c = 4.5A h_{FE} = 2.5 V_{CC} = 140V		7		µs
t_f	Fall Time	L_C = 0.9mH L_B = 3µH		0.55		µs

* Pulsed : Pulse duration = 300µs, duty cycle = 1.5%.

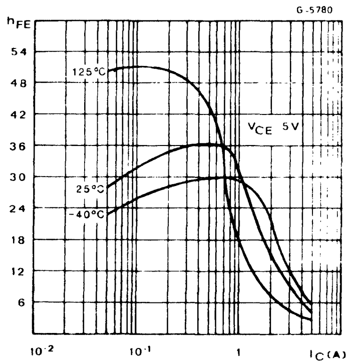
Safe Operating Area (TO-3).



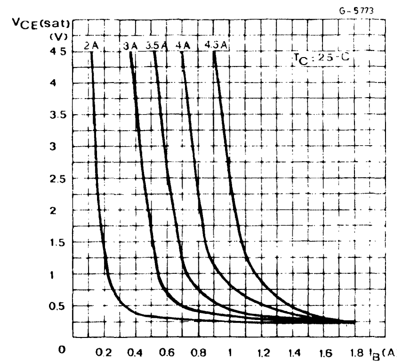
Safe Operating Area (TO-218/ISOWATT218).



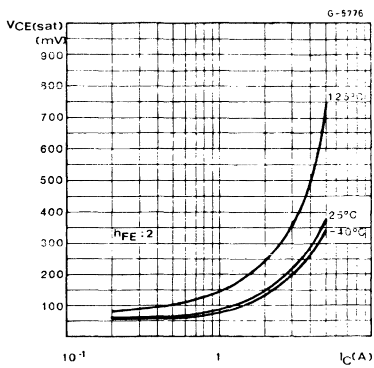
DC Current Gain.



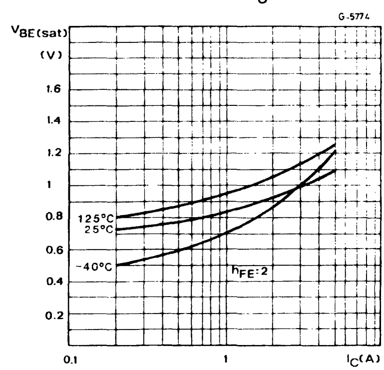
Collector Saturation Region.



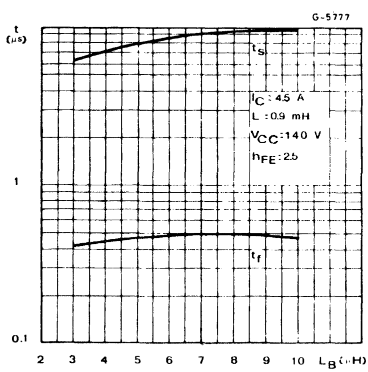
Collector-emitter Saturation Voltage.



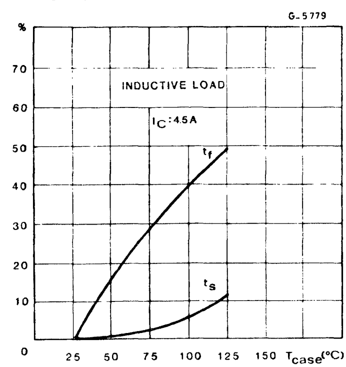
Base-emitter Saturation Voltage.



Switching Times Inductive Load (see fig. 1).



Switching Times Percentage vs. Case Temperature (see fig. 1).



DC Current Gain.

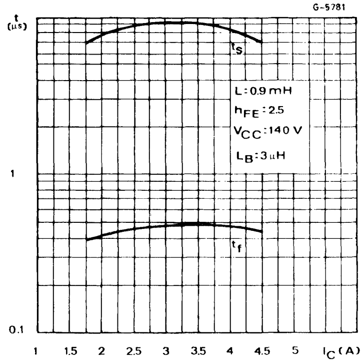
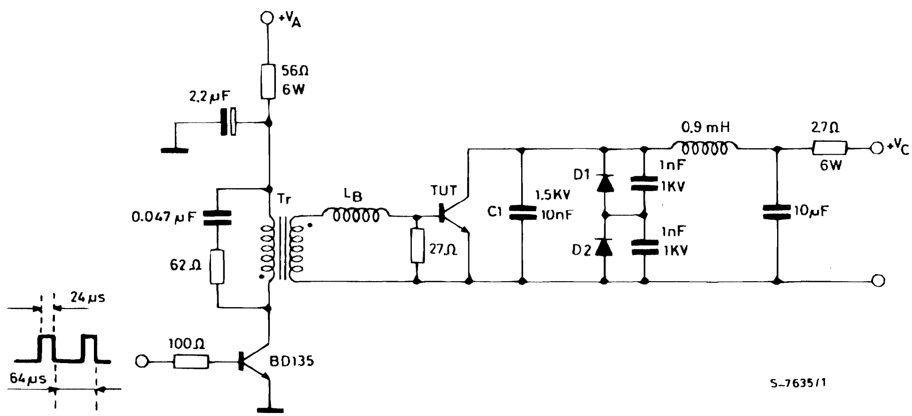


Figure 1 : Switching Times Test Circuit on Inductive Load.



ISOWATT218 PACKAGE CHARACTERISTICS AND APPLICATION

ISOWATT218 is fully isolated to 4000V dc. Its thermal impedance, given in the data sheet, is optimised to give efficient thermal conduction together with excellent electrical isolation. The structure of the case ensures optimum distances between the pins and heatsink. These distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 package eliminates the need for external isolation so reducing fixing hardware.

The package is supplied with leads longer than the standard TO-218 to allow easy mounting on pcbs. Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

ISOWATT220 thermal performance is equivalent to that of the standard part, mounted with a 0.1mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for ISOWATT218 packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT218 PACKAGE

Figure 2 illustrates the elements contributing to the thermal resistance of a transistor heatsink assembly, using ISOWATT218 package.

The total thermal resistance Rth(tot) is the sum of each of these elements.

The transient thermal impedance, Zth for different pulse durations can be estimated as follows :

1-for a short duration power pulse less than 1ms :

$$Z_{th} < R_{thJ\text{-}C}$$

2-for an intermediate power pulse of 5ms to 50ms :

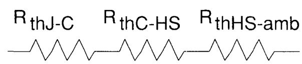
$$Z_{th} = R_{thJ\text{-}C}$$

3-for long power pulses of the order of 500ms or greater :

$$Z_{th} = R_{thJ\text{-}C} + R_{thC\text{-}HS} + R_{thHS\text{-}amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

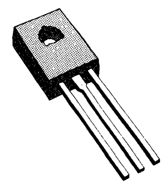
Figure 2.



HIGH VOLTAGE SWITCH

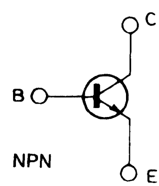
DESCRIPTION

The BU325 is a silicon planar epitaxial NPN transistor in Jedec TO-126 plastic case. It is intended for high voltage, high current linear and switching applications.



TO-126

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	200	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	200	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5	V
I_C	Collector Current	3	A
I_B	Base Current	1	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C $T_{case} \leq 25$ °C	1.25 25	W W
T_{stg}	Storage Temperature	– 65 to 150	°C
T_j	Junction Temperature	150	°C

THERMAL DATA

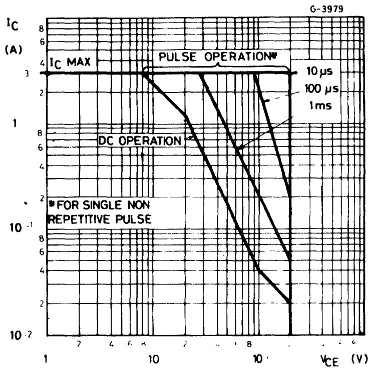
$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	5	°C/W
$R_{thj\text{-}amb}$	Thermal Resistance Junction-amb.	Max	100	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

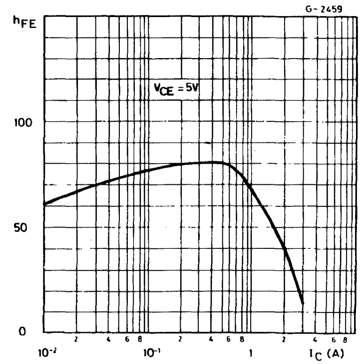
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 200 V			100	μA
V_{CBO}	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 μA	200			V
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 10 mA	200			V
V_{EBO}*	Emitter-base Voltage (I_C = 0)	I_E = 1 mA	5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA I_C = 500 mA I_B = 50 mA		0.06 0.10	1.0 1.5	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA I_C = 500 mA I_B = 50 mA		0.73 0.80	1.0 1.2	V V
h_{FE}*	DC Current Gain	I_C = 50 mA V_{CE} = 5 V I_C = 150 mA V_{CE} = 5 V I_C = 500 mA V_{CE} = 5 V	30 30 30		200 200 200	
f_T	Transition Frequency	I_C = 500 mA V_{CE} = 5 V		40		MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz			50	pF
t_{on}	Turn-on Time	I_C = 0.5 A I_{B1} = 50 mA V_{CC} = 20 V		0.3		μs
t_{off}	Turn-off Time	I_C = 0.5 A I_{B1} = − I_{B2} = 50 mA V_{CC} = 20 V		1		μs

* Pulsed : pulse duration = 300 μs, duty cycle = 1.5 %.

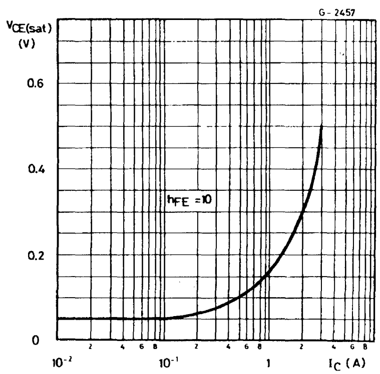
Safe Operating Area.



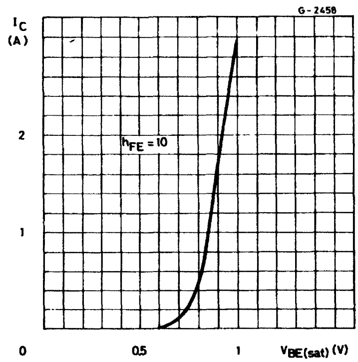
DC Current Gain.



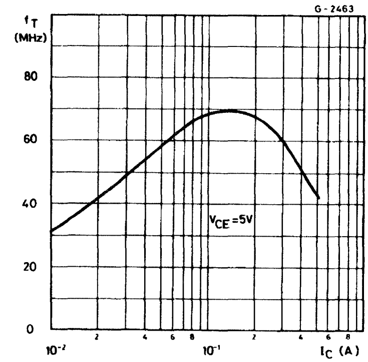
Collector–emitter Saturation Voltage.



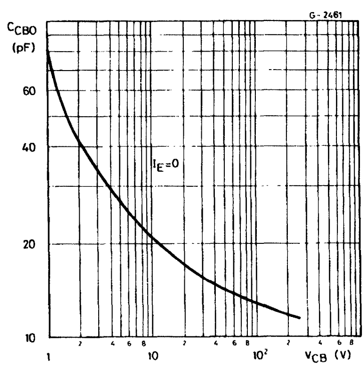
Base–emitter Saturation Voltage.



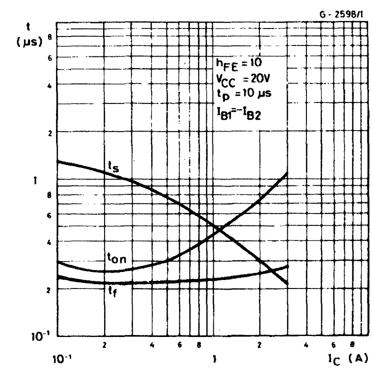
Transition Frequency.



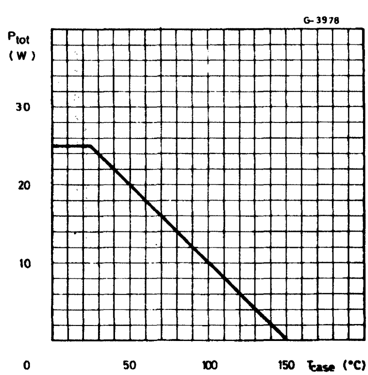
Collector–emitter Saturation Voltage.



Saturated Switching Characteristics .



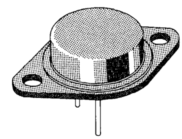
Power Rating Chart.



HIGH VOLTAGE POWER SWITCH

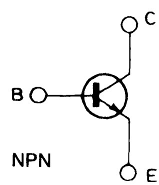
DESCRIPTION

The BU326 and BU326A are silicon multiepitaxial mesa NPN transistors in Jedec TO-3 metal case particularly intended for switch-mode CTV supply system.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BU326A	BU326	
V_{CES}	Collector-emitter Voltage ($V_{BE} = 0$)	900	800	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	400	325	V
V_{EBO}	Base-emitter Voltage ($I_C = 0$)	10		V
I_C	Collector Current	6		A
I_{CM}	Collector Peak Current	8		A
I_B	Base Current	3		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$	75		W
T_{stg}	Storage Temperature	– 65 to 200		°C
T_j	Junction Temperature	200		°C

THERMAL DATA

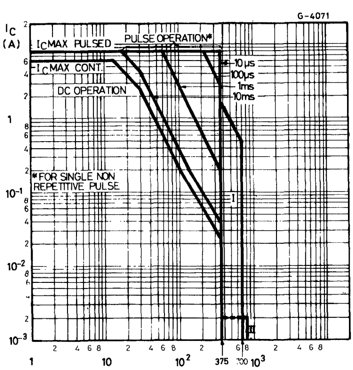
$R_{thj-case}$	Thermal Resistance Junction-case	Max	2.33	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 900V for **BU326A** V_{CE} = 900V for **BU326** V_{CE} = 900V T_{case} = 125°C for **BU326** V_{CE} = 900V T_{case} = 125°C for **BU326A**			1 1 2 2	mA mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 10V			10	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100mA for **BU326** for **BU326A**	325 400			V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 2.5A I_B = 0.5A I_C = 4A I_B = 1.25A			1.5 3	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 2.5A I_B = 0.5A I_C = 4A I_B = 1.25A			1.4 1.6	V V
h_{FE}*	DC Current Gain	I_C = 1A V_{CE} = 5V		25		
t_{on}	Turn-on Time	I_C = 2.5A I_{B1} = 0.5A V_{CC} = 250V			0.5	μs
t_s	Storage Time	I_C = 2.5A I_{B1} = 0.5A I_{B2} = − 1A V_{CC} = 250V			3.5	μs
t_f	Fall Time	I_C = 2.5A I_{B1} = 0.5A I_{B2} = − 1A V_{CC} = 250V			0.5	μs

* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.

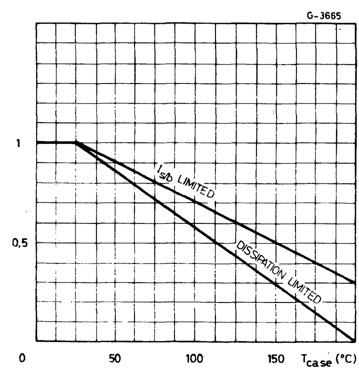
Safe Operating Areas.



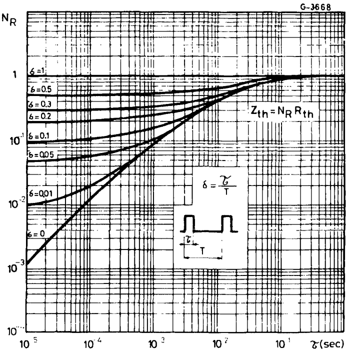
I – Area of permissible operation during turn-on provided $R_{BE} \le 100\Omega$ and $t_p \le 0.6$

II - Area of permissible operation with $V_{BE} \le 0$ and $t_p \le 2\mu s$

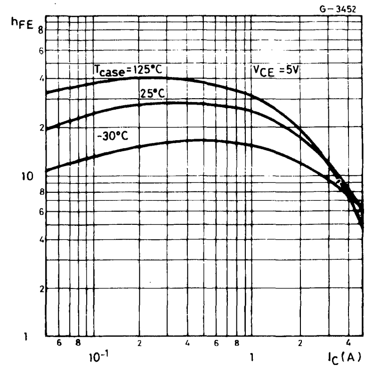
Derating Curves.



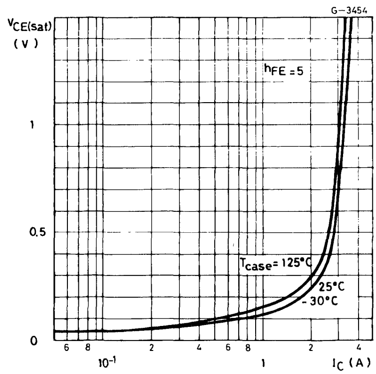
Thermal Transient Response.



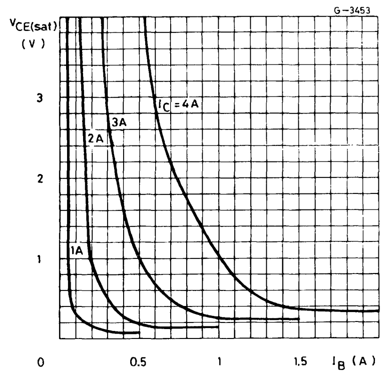
DC Current Gain.



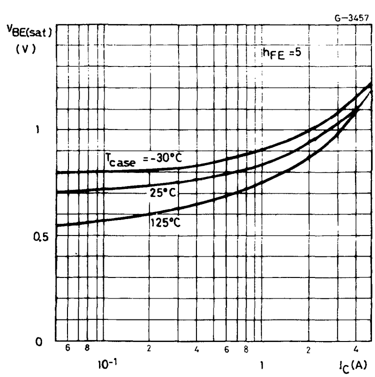
Collector-emitter Saturation Voltage.



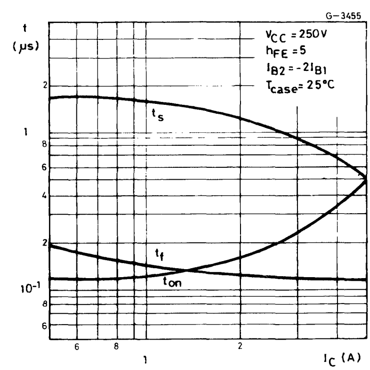
Collector-emitter Saturation Voltage.



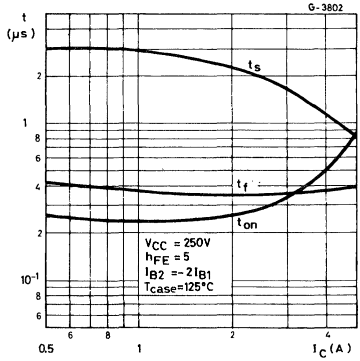
Base-emitter Saturation Voltage.



Saturated Switching Characteristics.



Saturated Switching Characteristics.

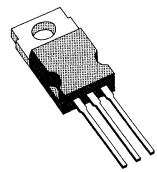


BU406
BU406H/BU408

HORIZONTAL TV DEFLECTORS

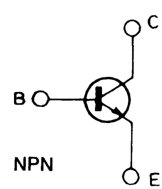
DESCRIPTION

The BU406, BU406H, and BU408 are silicon epitaxial planar NPN transistors in Jedec TO-220 plastic package. They are fast switching, high voltage devices for use in horizontal deflection output stages of large screen MTV receivers with 110° CRT.



TO-220

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	400	V
V_{CEV}	Collector-emitter Voltage ($V_{BE} = -1.5V$)	400	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	200	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	6	V
I_C	Collector Current	7	A
I_{CM}	Collector Peak Current (repetitive)	10	A
I_{CM}	Collector Peak Current ($t_p = 10ms$)	15	A
I_B	Base Current	4	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$	60	W
T_{stg}	Storage Temperature	– 65 to 150	°C
T_j	Junction Temperature	150	°C

THERMAL DATA

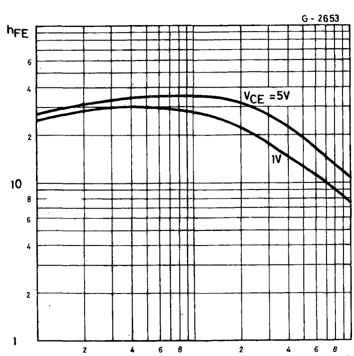
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	2.08	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	70	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

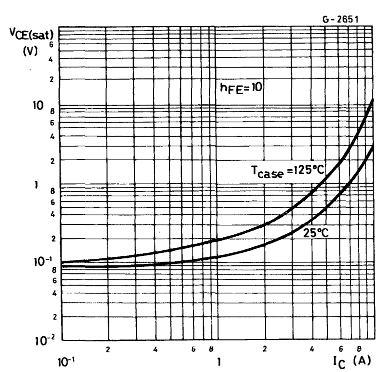
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 400V V_{CE} = 250V T_{case} = 150°C V_{CE} = 250V			5 100 1	mA μA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 6V			1	mA
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	for **BU406** I_C = 5A I_B = 0.5A for **BU406H** I_C = 5A I_B = 0.8A for **BU408** I_C = 6A I_B = 1.2A			 1 1 1	 V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	for **BU406** I_C = 5A I_B = 0.5A for **BU406H** I_C = 5A I_B = 0.8A for **BU408** I_C = 6A I_B = 1.2A			 1.2 1.2 1.5	 V V V
f_T	Transition Frequency	I_C = 0.5A V_{CE} = 10V	10			MHz
t_{off}**	Turn-off Time	for **BU406** I_C = 5A I_{Bend} = 0.5A for **BU406H** I_C = 5A I_{Bend} = 0.8A for **BU408** I_C = 6A I_{Bend} = 1.2A			 0.75 0.4 0.4	 μs μs μs
$I_{s/b}$	Second Breakdown Collector Current	V_{CE} = 40V t = 10ms		4		A

* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.
** See test circuit.

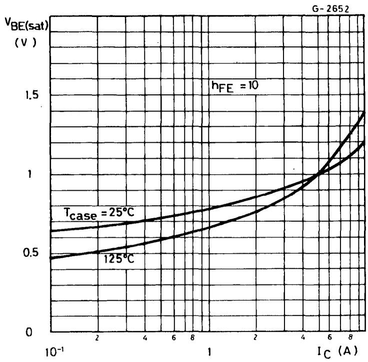
DC Current Gain.



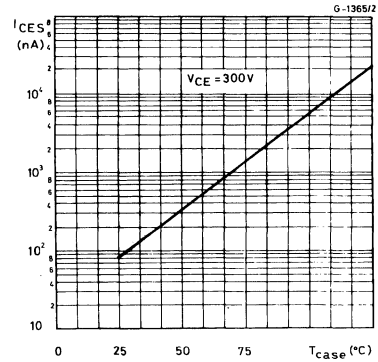
Collector-emitter Saturation Voltage.



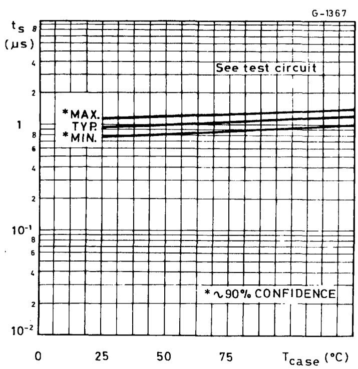
Base-emitter Saturation Voltage.



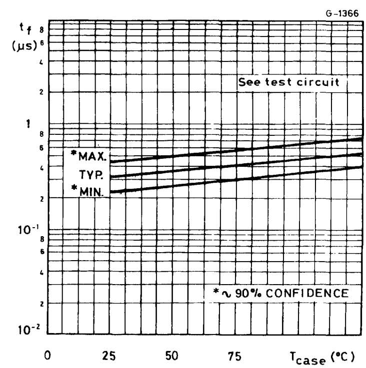
Collector cutoff Current.



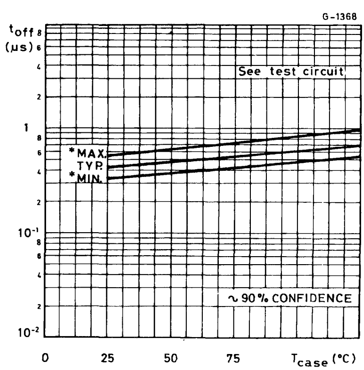
Storage Time.



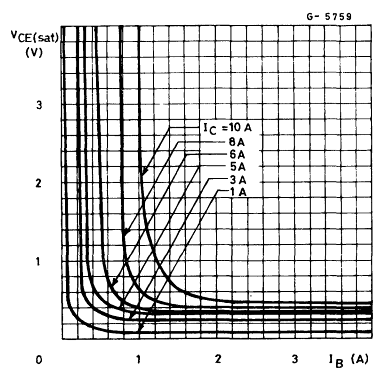
Fall Time.



Turn-off Time.

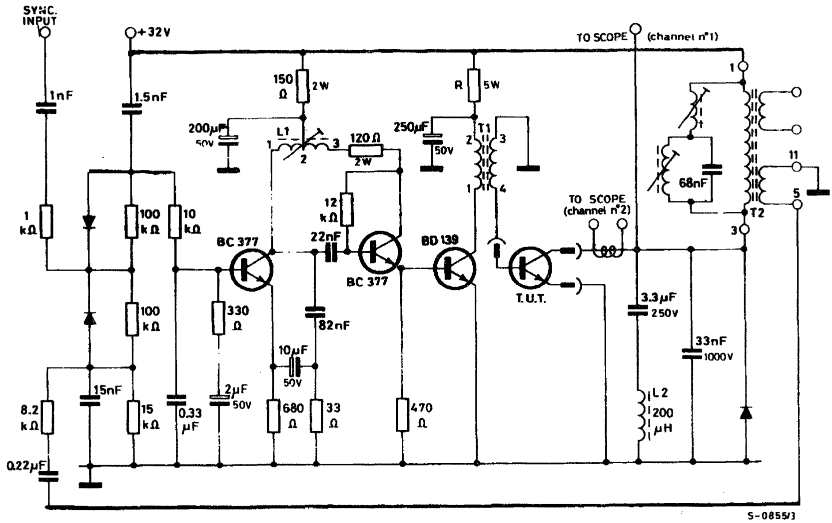


Collector-emitter Saturation Voltage.



SWITCHING TIMES

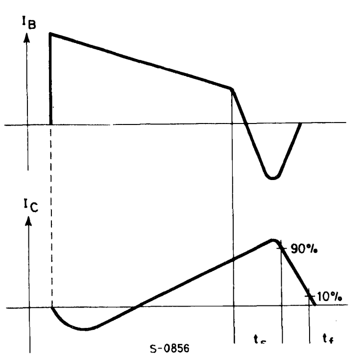
TEST CIRCUIT (FALL, STORAGE AND TURN-OFF TIME)



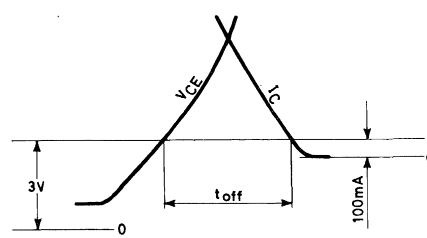
L1 Horizontal hold coil : Pins 1–2 = 75 turns Ø 0.2mm ; R = 1.5Ω ; L min = 0.62mH
Core = siferrit B 62120 25x4x2
Pins 2–3 = 293 turns Ø 0.2mm ; R = 4.8Ω ; L max = 4.1H
L2 Horizontal yoke = 200µH
T1 Driver transformer : Pins 1–2 = 125 turns Ø 0.2mm ;
Gap = 0.12mm ; Core = 3E3 double E 19x15x5
Pins 3–4 = 25 turns Ø 0.4mm ;
T2 EHT transformer manufacturer ARCO type 249.065/035

R = 330Ω for BU406
R = 220Ω for BU406H
R = 180Ω for BU408

WAVEFORMS



Fall and storage time



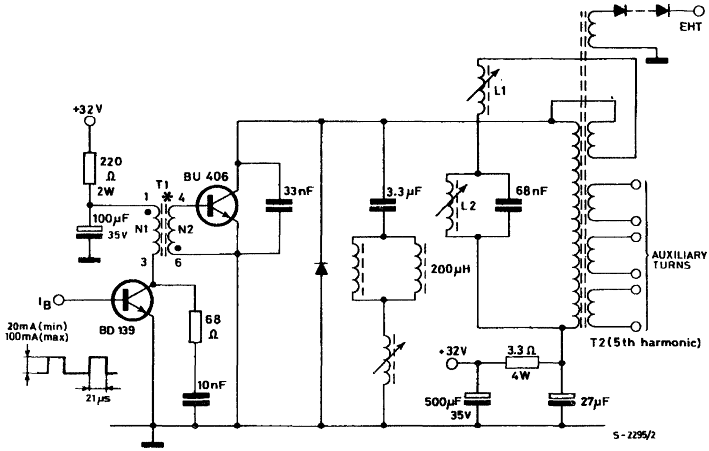
Turn-off time is the time for the collector current I_C to decrease to 100mA after the collector to emitter voltage V_{CE} has risen 3V into its flyback excursion

S-0857

Turn-off time

APPLICATION INFORMATION

BU406 - APPLICATION CIRCUIT FOR 17" TO 24" - 110° - 28 MM NECK PICTURE TUBES



* N1 = 125 turns Ø 0.3mm ; N2 = 30 turns Ø 0.6mm ; GAP = 0.12mm ; CORE = DOUBLE E 19x5x8mm ; FERRITE 3E1 TYPE

SGS-THOMSON
MICROELECTRONICS

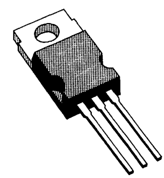
BU406D
BU407D/BU408D

HORIZONTAL TV DEFLECTORS

DESCRIPTION

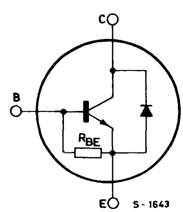
The BU406D, BU407D, and BU408D are silicon planar epitaxial NPN transistors with integrated damper diode, in Jedec TO-220 plastic package. They are fast switching, high voltage devices for use in horizontal deflection output stages of MTV receivers with 110° CRT.

The BU406D and BU408D are primarily intended for large screen, while the BU407D is for medium and small screens.



TO-220

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		BU406D	BU407D	BU408D	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	400	330	400	V
V_{CEV}	Collector-emitter Voltage ($V_{BE} = -1.5V$)	400	330	400	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	6			V
I_C	Collector Current	7			A
I_{CM}	Collector Peak Current (repetitive)	10			A
I_{CM}	Collector Peak Current ($t_p = 10ms$)	15			A
I_B	Base Current	4			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$	60			W
T_{stg}	Storage Temperature	– 65 to 150			°C
T_j	Junction Temperature	150			°C

THERMAL DATA

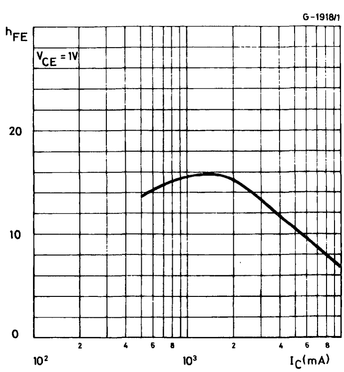
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	2.08	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	70	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

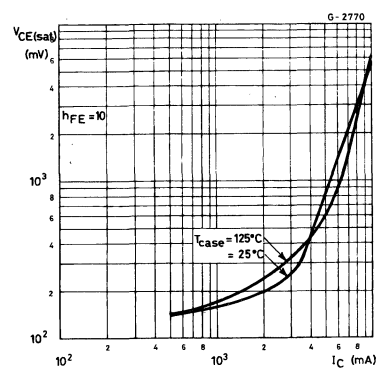
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector Cutoff Current (V_{BE} = – 1.5V)	for **BU406D** and **BU408D** V_{CE} = 400V for **BU407D** V_{CE} = 330V			 15 15	 mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 6V			400	mA
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	for **BU406D** and **BU407D** I_C = 5A I_B = 0.65A for **BU408D** I_C = 6A I_B = 1.2A			 1 1	 V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	for **BU406D** and **BU407D** I_C = 5A I_B = 0.65A for **BU408D** I_C = 6A I_B = 1.2A			 1.3 1.5	 V V
f_T	Transition Frequency	I_C = 0.5A V_{CE} = 10V	10			MHz
t_{off}	Turn-off Time	for **BU406D** and **BU407D** I_C = 5A I_{Bend} = 0.65A for **BU408D** I_C = 6A I_{Bend} = 1.2A			 0.75 0.5	 μs μs
$I_{s/b}$	Second Breakdown Collector Current	V_{CE} = 40V t = 10ms		4		A
V_F	Diode Forward Voltage	I_F = 5A			1.5	V

* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.

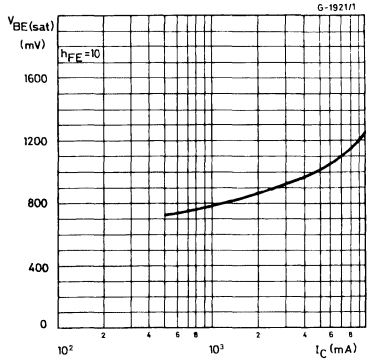
DC Current Gain.



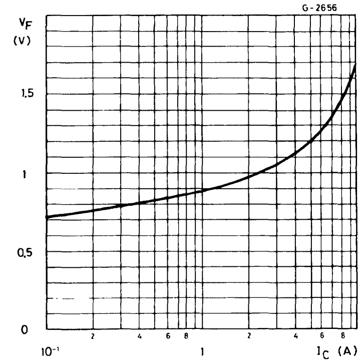
Collector-emitter Saturation Voltage.



Base-emitter Saturation Voltage.

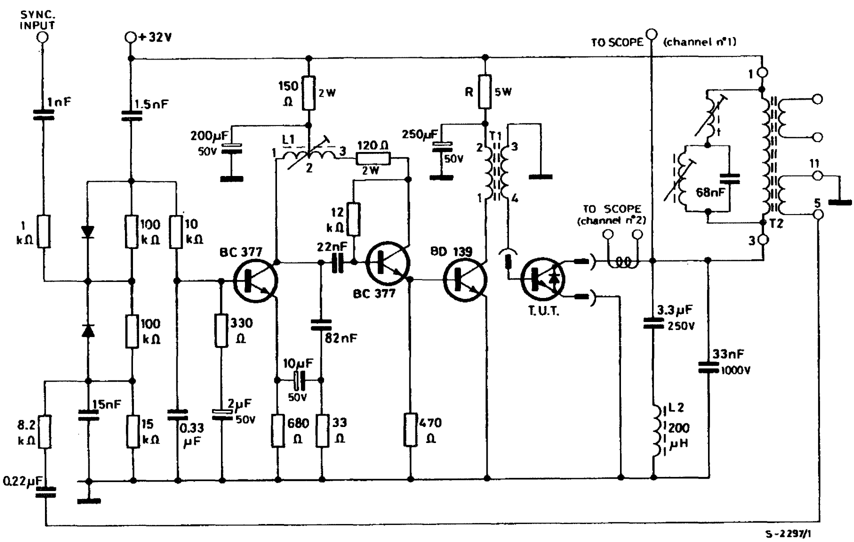


Forward Voltage.



SWITCHING TIMES

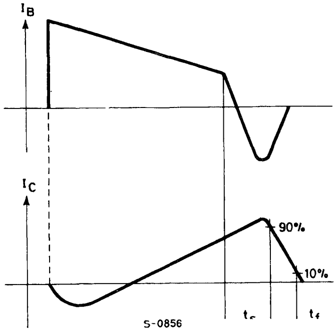
TEST CIRCUIT (FALL, STORAGE AND TURN-OFF TIME)



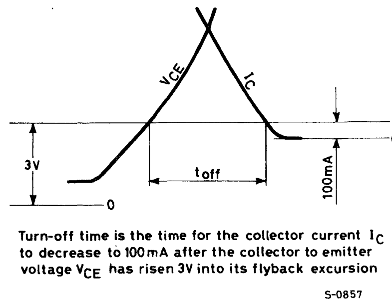
L1 Horizontal hold coil : Pins 1–2 = 75 turns Ø 0.2mm ; R = 1.5Ω ; L min = 0.62mH
Core = siferrit B 62120 25x4x2
Pins 2–3 = 293 turns Ø 0.2mm ; R = 4.8Ω ; L max = 4.1mH
L2 Horizontal yoke = 200μH
T1 Driver transformer : Pins 1–2 = 125 turns Ø 0.2mm ;
Gap = 0.12mm ; Core = 3E3 double E 19x15x5
Pins 3–4 = 25 turns Ø 0.4mm ;
T2 EHT transformer manufacturer ARCO type 249.065/035

R = 270Ω for BU406D and BU407D
R = 180Ω for BU408D

Waveforms



Fall and storage time

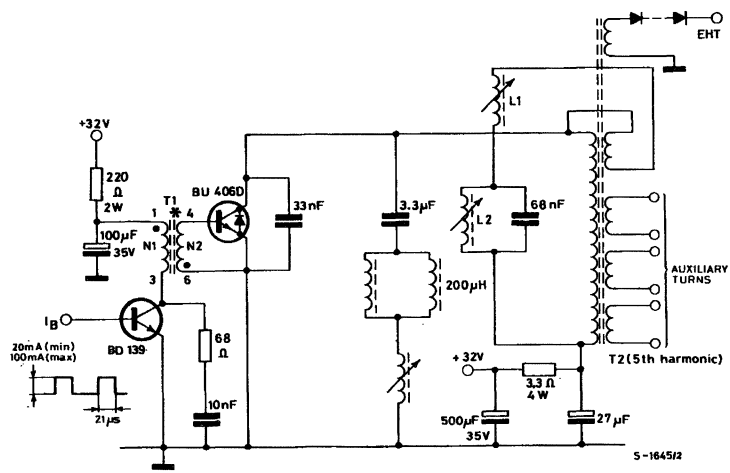


Turn-off time

APPLICATION INFORMATION

Two examples are given of the BU406D and BU407D in conventional MTV horizontal deflection circuits.

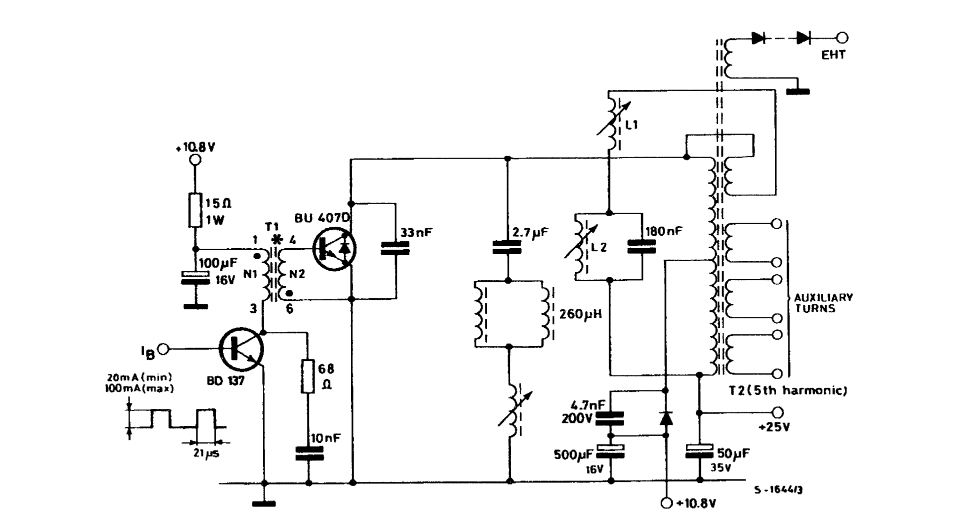
BU406D - application circuit for 17" to 24" - 110° - 28 mm neck picture tubes.



* N1 = 125 turns Ø 0.3mm ; N2 = 25 turns Ø 0.6mm ; GAP = 0.12mm ; CORE = DOUBLE E 19x5x8 mm ; FERRITE 3E1 TYPE

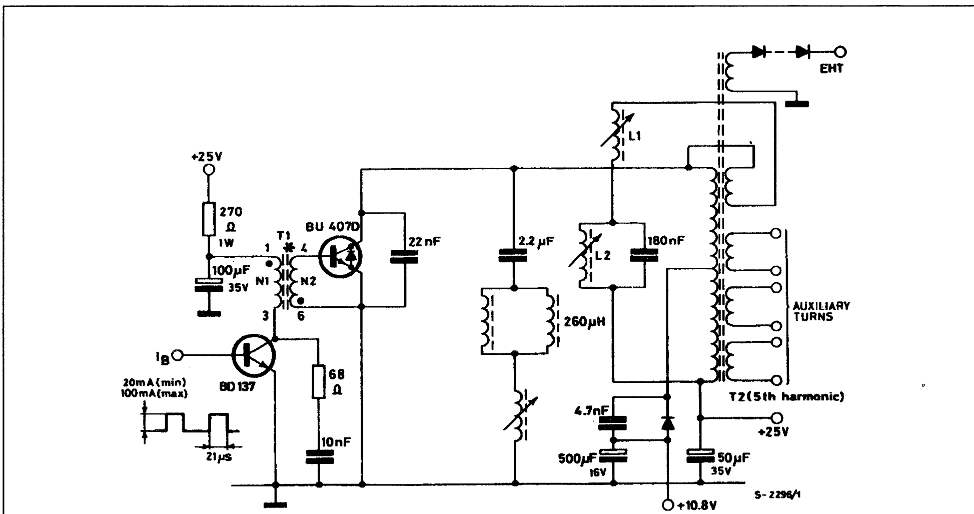
APPLICATION INFORMATION (continued)

BU407D - application circuit for 12" to 17" - 110° - 28mm neck picture tubes
(drive supply voltage = 10.8V).



* N1 = 90 turns Ø 0.3mm ; N2 = 30 turns Ø 0.6mm ; GAP = 0.12mm ; CORE = DOUBLE E 19x5x8 mm ; FERRITE 3E1 TYPE

BU407D - application circuit for 12" to 17" - 110° - 28mm neck picture tubes.
(driver supply voltage = 10.8V).



* N1 = 90 turns Ø 0.3mm ; N2 = 30 turns Ø 0.6mm ; GAP = 0.12mm ; CORE = DOUBLE E 19x5x8mm ; FERRITE 3E1 TYPE

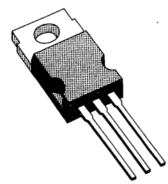
BU407
BU407H

HORIZONTAL TV DEFLECTORS

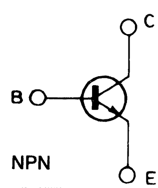
DESCRIPTION

The BU407 and BU407H are silicon epitaxial planar NPN transistors in Jedec TO–220 plastic package.

They are fast switching, high voltage devices for use in horizontal deflection output stages of medium and small screens MTV receivers with 110° CRT as monochrome computer terminals.



INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	330	V
V_{CEV}	Collector-emitter Voltage ($V_{BE} = -1.5$ V)	330	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	150	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	6	V
I_C	Collector Current	7	A
I_{CM}	Collector Peak Current (repetitive)	10	A
I_{CM}	Collector Peak Current (t = 10 ms)	15	A
I_B	Base Current	4	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	60	W
T_{stg}	Storage Temperature	– 65 to 150	°C
T_j	Junction Temperature	150	°C

THERMAL DATA

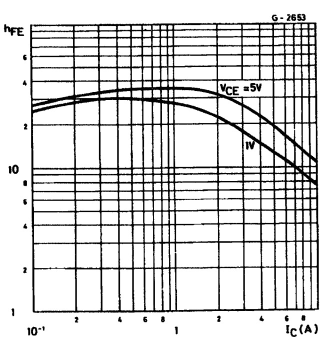
$R_{thj-case}$	Thermal Resistance Junction-case	Max	2.08	°C/W
$R_{thj-amb}$	Thermal Resistance Junction-ambient	Max	70	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

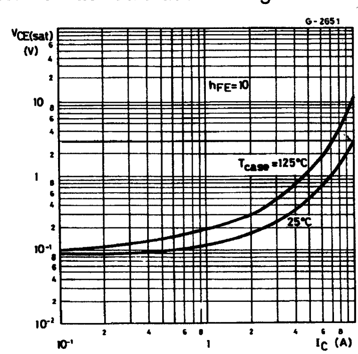
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 330 V V_{CE} = 200 V V_{CE} = 200 V T_{case} = 150 °C			5 100 1	mA μA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 6 V			1	mA
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	for **BU407** I_C = 5 A I_B = 0.5 A for **BU407H** I_C = 5 A I_B = 0.8 A			1 1	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	for **BU407** I_C = 5 A I_B = 0.5 A for **BU407H** I_C = 5 A I_B = 0.8 A			1.2 1.2	V V
f_T	Transition Frequency	I_C = 0.5 A V_{CE} = 10 V	10			MHz
t_{off}**	Turn-off Time	for **BU407** I_C = 5 A I_{Bend} = 0.5 A for **BU407H** I_C = 5 A I_{Bend} = 0.8 A			0.75 0.4	μs μs
$I_{s/b}$	Second Breakdown Collector Current	V_{CE} = 40 V t = 10 ms		4		A

* Pulsed : pulse duration = 300 μs, duty cycle = 1.5 %.
* * See Test Circuit.

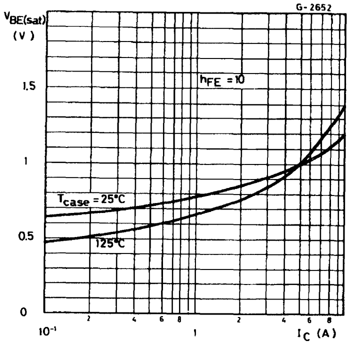
DC Current Gain.



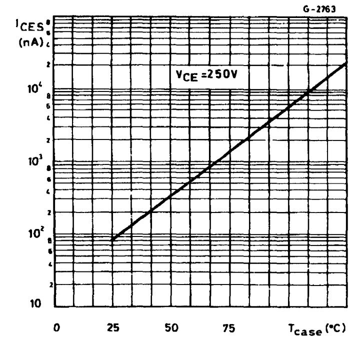
Collector–emitter Saturation Voltage.



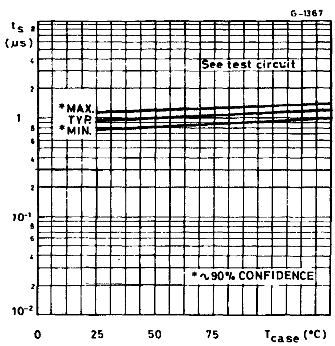
Base–emitter Saturation Voltage.



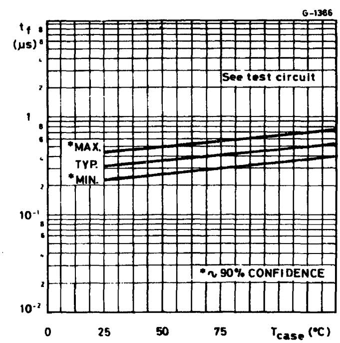
Collector Cutoff Current.



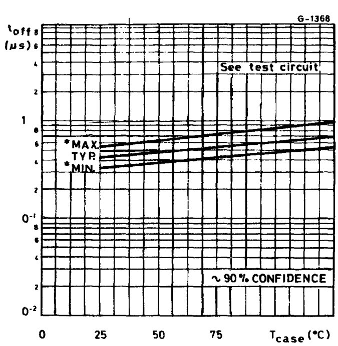
Storage Time.



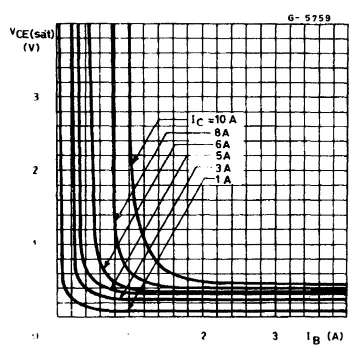
Fall Time.



Turn–off Time.

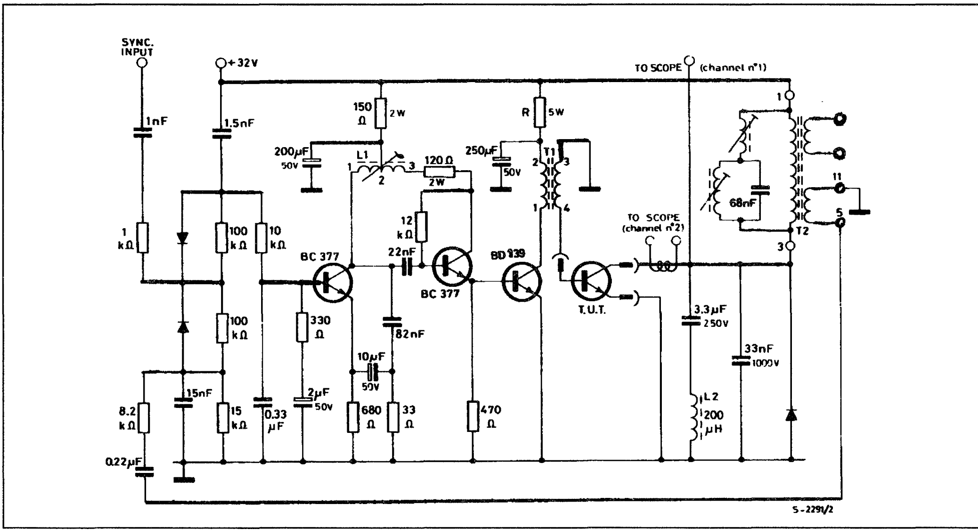


Collector–emitter Saturation Voltage.



SWITCHING TIMES

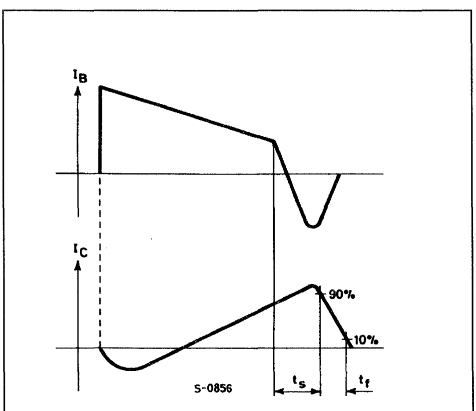
TEST CICUIT (fall, storage and turn–off time)



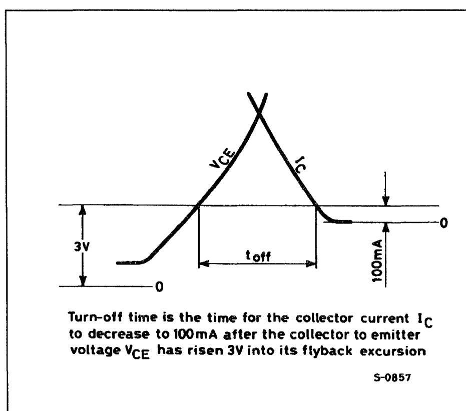
L1 Horizontal hold coil : Pins 1–2 = 75 turns ϕ 0.2 mm ; R = 1.5 Ω ; L min = 0.62mH
Pins 2–3 = 293 turns ϕ 0.2 mm ; R = 4.8 Ω ; L max = 4.1 mH Core = siferrit B 62120 25x4x2
L2 Horizontal yoke = 200 µH
T1 Driver transformer : Pins 1–2 = 125 turns ϕ 0.2 mm ;
Pins 3–4 = 25 turns ϕ 0.4 mm ; Gap = 0.12 mm ; Core = 3 E 3 double E 19x15x5
T2 EHT transformer manufacturer ARCO type 249.065/035
R = 330 Ω for BU407
R = 220 Ω for BU 407H.

WAVEFORMS

Fall and Storage Time.



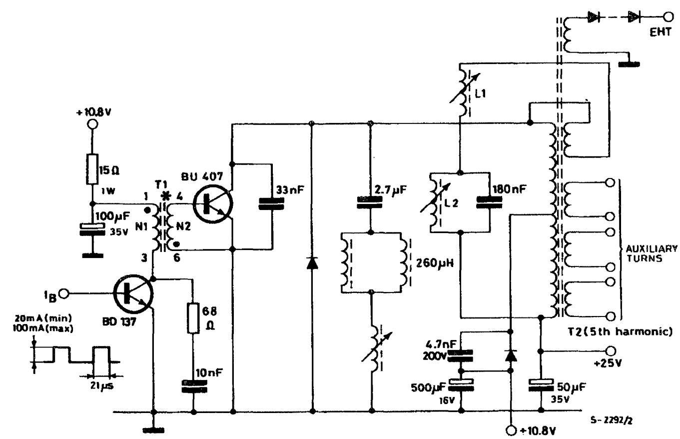
Turn–off Time.



APPLICATION INFORMATION

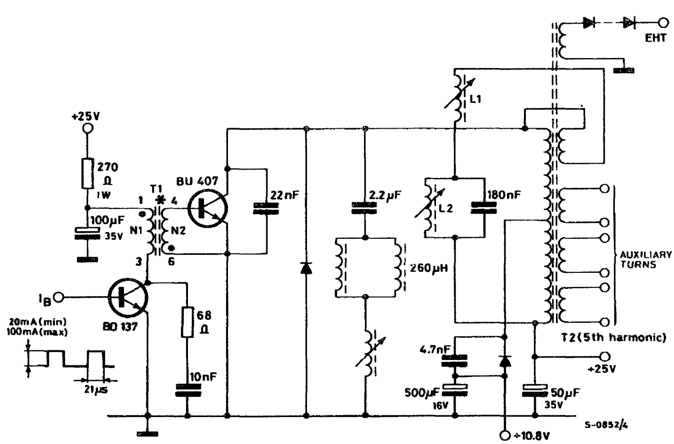
Two examples are given of the BU407 in conventional MTV horizontal deflection circuits

BU407 : Application Circuit for 12" to 17" – 110° – 20 mm neck picture tubes
(driver supply voltage = 10.8 V).



* N1 = 125 turns ϕ 0.3 mm ; N2 = 30 turns ϕ 0.6 mm ; GAP = 0.12 mm ; CORE DOUBLE E 19x5x8 mm ; FERRITE 3E1 TYPE.

BU407 : Application Circuit for 12" to 17" – 110° – 20 mm neck picture tubes
(driver supply voltage = 25 V).



* N1 = 125 turns ϕ 0.3 mm ; N2 = 25 turns ϕ 0.6 mm ; GAP = 0.12 mm ; CORE DOUBLE E 19x5x8 mm ; FERRITE 3E1 TYPE.

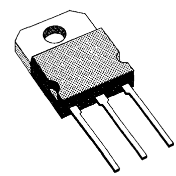
SGS-THOMSON
MICROELECTRONICS

BU426
BU426A

HIGH VOLTAGE POWER SWITCH

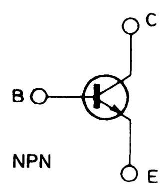
DESCRIPTION

The BU426 and BU426A are silicon multiepitaxial mesa NPN transistors in SOT-93 plastic package, particularly intended for switch-mode CTV supply systems.



TO-218

INTERNAL SCHEMATIC DIAGRAMS



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BU426	BU426A	
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	800	900	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	375	400	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	10		V
I_C	Collector-current	6		A
I_{CM}	Collector-peak Current (t_p = 2 ms)	8		A
I_B	Base Current	3		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	113		W
T_{stg}	Storage Temperature	– 65 to 150		°C
T_j	Junction Temperature	150		°C

THERMAL DATA

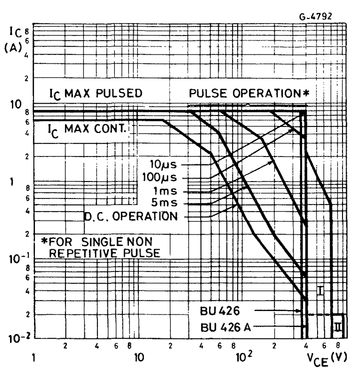
$R_{thj-case}$	Thermal Resistance Junction-case	Max	1.1	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	for **BU426** for **BU426A** T_{case} = 125 °C for **BU426** for **BU426A**	V_{CE} = 800 V V_{CE} = 900 V V_{CE} = 800 V V_{CE} = 900 V			1 1 2 2	mA mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 10 V				10	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	for **BU426** for **BU426A**	I_C = 100 mA I_C = 100 mA	375 400			V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 2.5 A I_C = 4 A	I_B = 0.5 A I_B = 1.25 A			1.5 3	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 2.5 A I_C = 4 A	I_B = 0.5 A I_B = 1.25 A			1.4 1.6	V V
h_{FE}*	DC Current Gain	I_C = 0.6 A	V_{CE} = 5 V		30	60	
t_{on}	Turn-on Time	I_C = 2.5 A I_{B1} = 0.5 A	V_{CC} = 250 V		0.25	0.5	µs
t_s	Storage Time	I_C = 2.5 A I_{B2} = − 1 A	I_{B1} = 0.5 A V_{CC} = 250 V		2.5	3.5	µs
t_f	Fall Time				0.2	0.5	µs
t_f	Fall Time	I_C = 2.5 A I_{B2} = − 1 A T_{case} = 100 °C	I_{B1} = 0.5 A V_{CC} = 250 V			0.75	µs

* Pulsed : pulse duration = 300 µs, duty cycle = 1.5 %.

Safe Operating Areas.

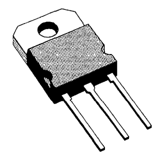


I = Area of permissible operation driving turn-on provided R_{BE} = 100Ω and $t_p \le 0.6$µs.
II = Area of permissible operation with $V_{BE} \le 0$; $t_p \le 2$µs.

HIGH VOLTAGE NPN TRANSISTOR

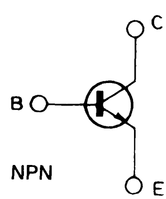
ADVANCE DATA

- HIGH VOLTAGE
- HIGH SPEED SWITCHING



TO-218

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

The BU706 is a high voltage, high speed switching silicon multiepitaxial NPN transistor in TO-218 plastic package intended for use in horizontal deflection circuits of colour television receivers and in off-line SMPS.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	1500	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	700	V
I_C	Collector Current	5	A
I_{CM}	Collector Peak Current (t_p < 20μs)	8	A
I_B	Base Current	3	A
I_{BM}	Base Peak Current (t_p < 20μs)	5	A
P_{tot}	Total Dissipation at T_c < 25°C	100	W
T_{stg}	Storage Temperature	– 65 to 150	°C
T_j	Max. Operating Junction Temperature	150	°C

This is advanced information on a new product now in development or undergoing evaluation. Details are subject to change without notice.

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	max	1.25	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 1500V V_{CE} = 1500V T_c = 125°C			500 1	μA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 6V			10	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 0.1A L = 25mH	700			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 3A I_B = 1.33A			5	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 3A I_B = 1.33A			1.3	V
t_f	INDUCTIVE LOAD Fall Time	IN LINE DEFLECTION CIRCUIT I_C = 3A I_B = 1A L_B = 12μH		0.7		μs

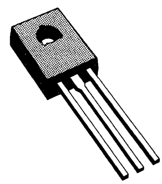
* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.

BU801

HIGH VOLTAGE FAST DARLINGTON

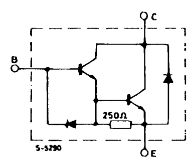
DESCRIPTION

The BU801 is a silicon epitaxial planar NPN Darlington transistor with integrated base-emitter speed-up diode, mounted in Jedec TO-126 plastic package. It is particularly suitable as output stage in medium power and driver stage in high power, fast switching applications.



TO-126

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	600	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	400	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C,I_E	Collector and Emitter Currents	3	A
I_B	Base Current	1	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	40	W
T_{stg}	Storage Temperature	– 65 to 150	°C
T_j	Junction Temperature	150	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	3.12	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector-cutoff Current (V_{BE} = 0)	V_{CE} = 600 V			200	μA
I_{CEO}	Collector-cutoff Current (I_B = 0)	V_{CE} = 400 V			1	mA
I_{EBO}*	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7 V			100	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 10 mA	400			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 200 A I_B = 2 mA I_C = 1 A I_B = 20 mA I_C = 2 A I_B = 200 mA		1.0 1.2 1.8	1.5 2.0 3.0	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 200 A I_B = 2 mA I_C = 1 A I_B = 20 mA I_C = 2 A I_B = 200 mA			2 2.5 3	V V V
h_{FE}*	DC Current Gain	I_C = 200 mA V_{CE} = 3 V	100			
V_F*	Diode Forward Voltage	I_F = 1 A			4	V

RESISTIVE SWITCHING TIMES

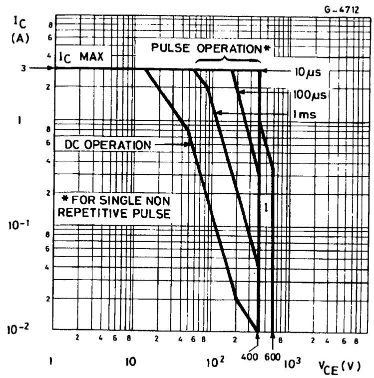
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit.
t_{on}	Turn-on Time	V_{CC} = 250 V I_C = 200 mA I_{B1} = 2 mA V_{BEoff} = − 5 V		0.17	0.8	μs
t_s	Storage Time			0.37	1	μs
t_f	Fall Time			0.13	0.5	μs
t_{on}	Turn-on Time	V_{CC} = 250 V I_C = 1 A I_{B1} = 20 mA V_{BEoff} = − 5 V		0.18	0.8	μs
t_s	Storage Time			0.38	1	μs
t_f	Fall Time			0.09	0.5	μs

INDUCTIVE SWITCHING TIMES

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit.
t_s	Storage Time	V_{Clamp} = 250 V I_C = 200 mA I_{B1} = 2 mA V_{BEoff} = − 5 V		0.35	1	μs
t_f	Fall Time			0.09	0.4	μs
t_s	Storage Time	V_{Clamp} = 250 V I_C = 1 A I_{B1} = 20 mA V_{BEoff} = − 5 V		0.5	1	μs
t_f	Fall Time			0.06	0.4	μs

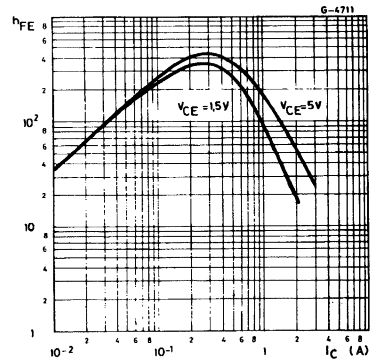
* Pulsed : pulse duration = 300 μs, duty cycle = 1.5 %.

Safe Operating Area.

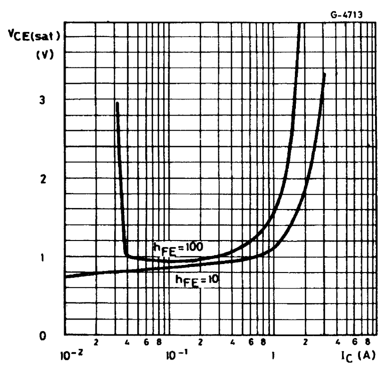


I = Area of permissible operation during turn–on with $t_p \leq 1$ ms.

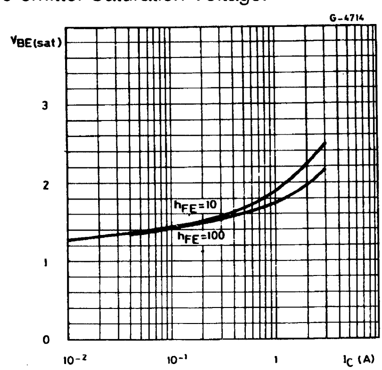
DC Current Gain.



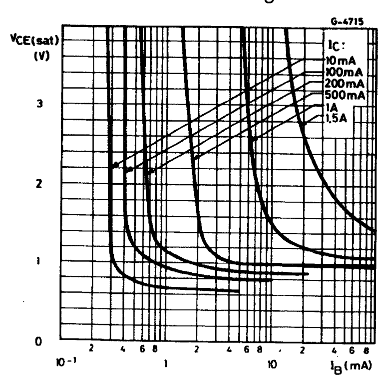
Collector-emitter Saturation Voltage.



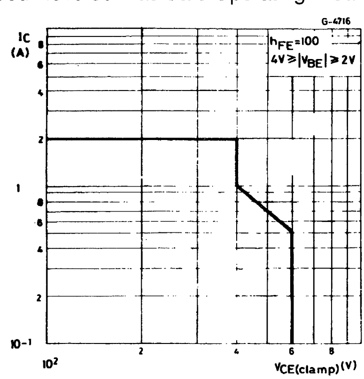
Base-emitter Saturation Voltage.



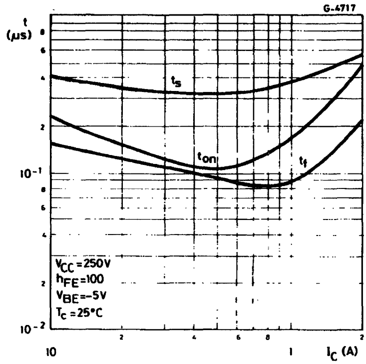
Collector-emitter Saturation Voltage.



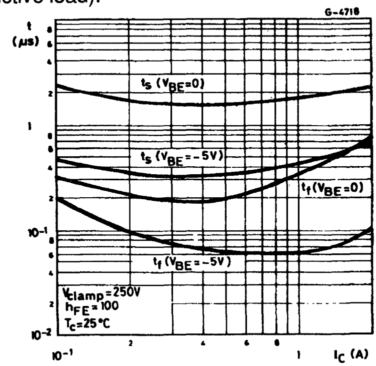
Clamped Reverse Bias Safe Operating Area.



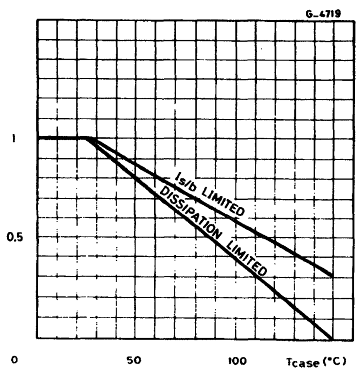
Saturated Switching Characteristics (resistive load).



Saturated Switching Characteristics (inductive load).



Derating Curves.



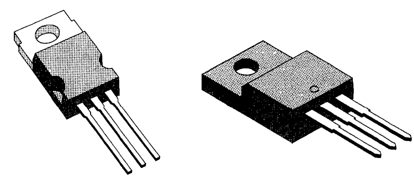
SGS-THOMSON
MICROELECTRONICS

BU806/FI
BU807/FI

FAST SWITCHING DARLINGTON TRANSISTORS

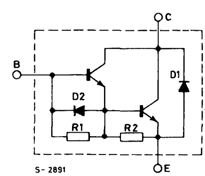
DESCRIPTION

The BU806/807 and BU806FI/807FI are silicon epitaxial planar NPN power transistors in Darlington configuration with integrated base-emitter speed-up diode, mounted respectively in TO-220 plastic package and ISOWATT220 fully isolated package. They are high voltage, high current devices for fast switching applications. In particular they can be used in horizontal output stages of 110°CRT video displays. The BU806/FI are primarily intended for large screen, while the BU807/FI are for medium and small screens.



TO-220 ISOWATT220

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	BU806/FI	BU807/FI	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	400	330	V
V_{CEV}	Collector-emitter Voltage ($V_{BE} = -6V$)	400	330	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	200	150	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	6		V
I_C	Collector Current	8		A
I_{CM}	Collector Peak Current	15		A
I_{DM}	Damper Diode Peak Forward Current	10		A
I_B	Base Current	2		A
		TO-220	**ISOWATT220**	
P_{tot}	Total Power Dissipation at $T_c < 25°C$	60	30	W
T_{stg}	Storage Temperature	– 65 to 150		°C
T_j	Max. Operating Junction Temperature	150		°C

THERMAL DATA

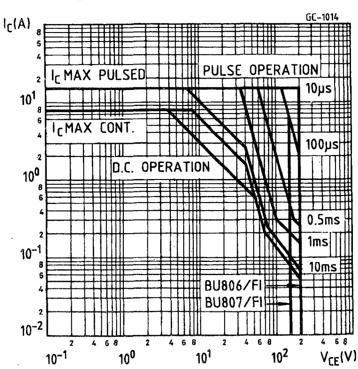
			TO-220	ISOWATT220	
$R_{thj-case}$	Thermal Resistance Junction-case	Max	2.08	4.16	°C/W
$R_{thj-amb}$	Thermal Resistance Junction-ambient	Max	70		°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

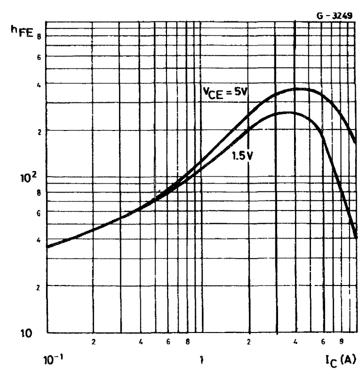
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	for **BU807/FI** V_{CE} = 330V for **BU806/FI** V_{CE} = 400V			100 100	μA μA
I_{CEV}	Collector Cutoff Current (V_{BE} = – 6V)	for **BU807/FI** V_{CE} = 330V for **BU806/FI** V_{CE} = 400V			100 100	μA μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 6V			3.5	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100mA for **BU807/FI** for **BU806/FI**	150 200			V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5A I_B = 50mA			1.5	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 5A I_B = 50mA			2.4	V
V_F*	Damper Diode Forward Voltage	I_F = 4A			2	V
t_{off}**	Turn-off Time	I_C = 5A I_{B1} = 50mA		0.4	1	μs
t_{on}	Turn-on Time	**RESISTIVE LOAD**		0.35		μs
t_s	Storage Time	I_C = 5A I_{B1} = 50mA		0.55		μs
t_f	Fall Time	I_{B2} = – 500mA V_{CC} = 100V		0.2		μs

* Pulsed : pulse duration = 300 μs, duty cycle = 1.5 %.
* * See Test Circuit.

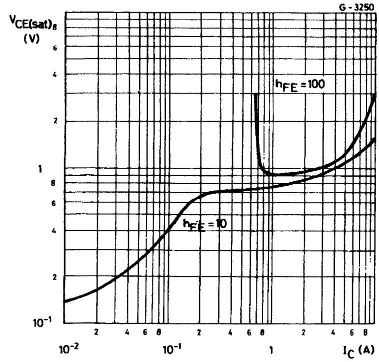
Safe Operating Areas.



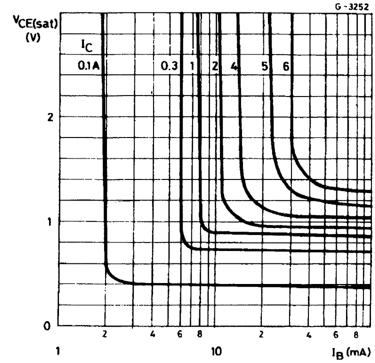
DC Current Gain.



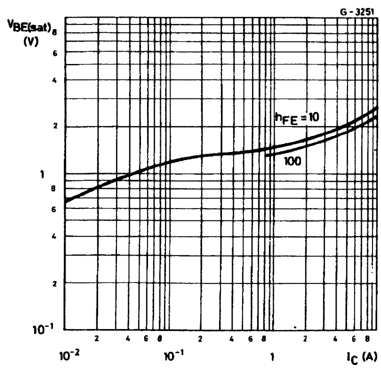
Collector–emitter Saturation Voltage.



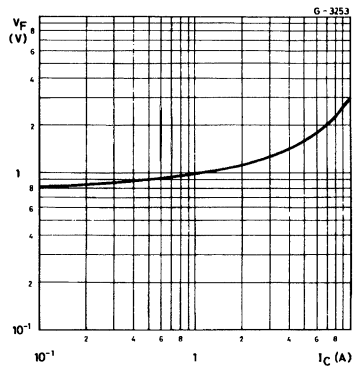
Collector–emitter Saturation Voltage.



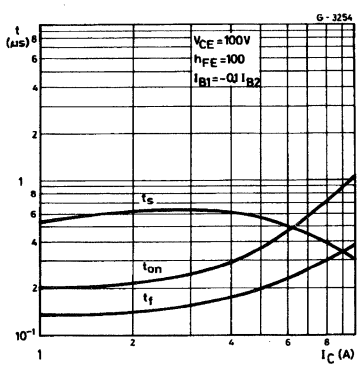
Base–emitter Saturation Voltage.



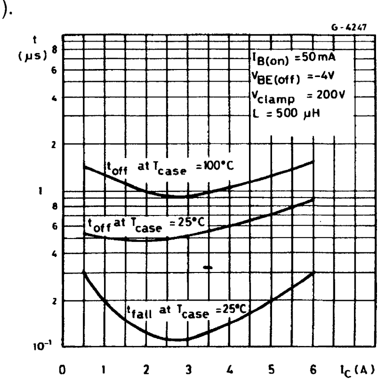
Damper Diode.



Saturated Switching Characteristics (resistive load).

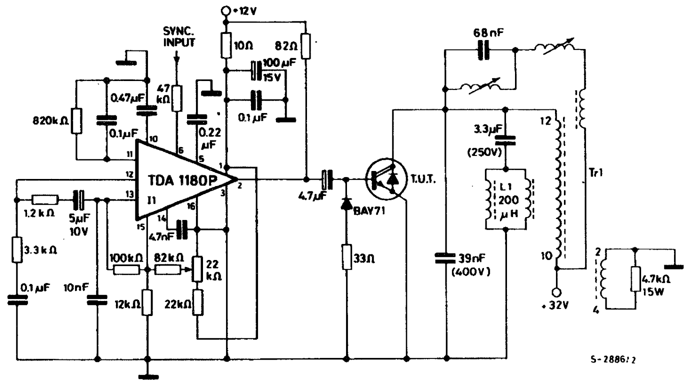


Saturated Switching Characteristics (inductive load).



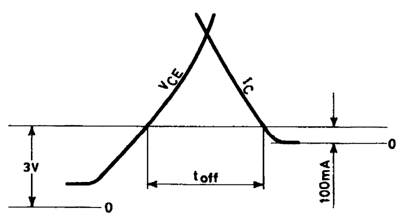
HORIZONTAL DEFLECTION TURN–OFF TIME

TEST CIRCUIT



L1 = Horizontal yoke = 200 µH.
Tr1 = EHT Transformer SAREAtype 900914 or equivalent.
I1 = Horizontal oscillator linear I. C. TDA 1180P.

TURN–OFF TIME WAVEFORM

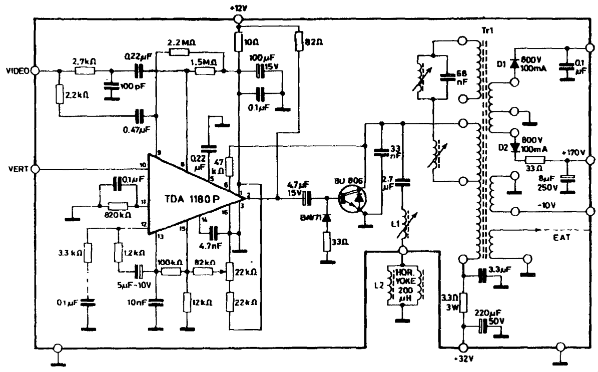


Turn-off time is the time for the collector current I_C to decrease to 100mA after the collector to emitter voltage V_{CE} has risen 3V into its flyback excursion

S-0857

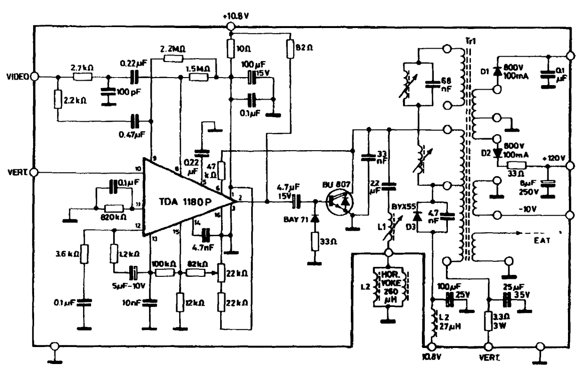
APPLICATION INFORMATION

Horizontal deflection circuit using the darlington BU806 directly driven by the TDA1180 (B & W TV set : large screen solution).



L_l = Linearity inductance 19 ÷ 39 µH.

Horizontal deflection circuit using the darlington BU807 directly driven by the TDA1180 (B & W TV set : small screen solution).



L_l = Linearity inductance 37 ÷ 67 µH.

ISOWATT220 PACKAGE CHARACTERISTICS AND APPLICATION

ISOWATT220 is fully isolated to 2000V dc. Its thermal impedance, given in the data sheet, is optimised to give efficient thermal conduction together with excellent electrical isolation.

The structure of the case ensures optimum distances between the pins and heatsink. The ISOWATT220 package eliminates the need for external isolation so reducing fixing hardware.

Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

ISOWATT220 thermal performance is equivalent to that of the standard part, mounted with a 0.1mm mica washer.

The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for ISOWATT220 packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT220 PACKAGE

Figure 1 illustrates the elements contributing to the thermal resistance of a transistor heatsink assembly, using ISOWATT220 package.

The total thermal resistance Rth(tot) is the sum of each of these elements.

The transient thermal impedance, Zth for different pulse durations can be estimated as follows :

1-for a short duration power pulse less than 1ms :

$$Z_{th} < R_{thJ\text{-}C}$$

2-for an intermediate power pulse of 5ms to 50ms :

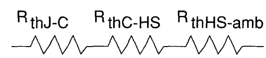
$$Z_{th} = R_{thJ\text{-}C}$$

3-for long power pulses of the order of 500ms or greater :

$$Z_{th} = R_{thJ\text{-}C} + R_{thC\text{-}HS} + R_{thHS\text{-}amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 1.



SGS-THOMSON MICROELECTRONICS

BU808FI
BU808DFI

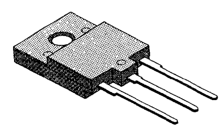
VERY HIGH VOLTAGE FAST SWITCHING POWER DARLINGTON

PRELIMINARY DATA

- HIGH VOLTAGE
- HIGH POWER
- HIGH SWITCHING SPEED
- EXCELLENT STABILITY

CONSUMER APPLICATION

- TV COLOR HORIZONTAL DEFLECTION



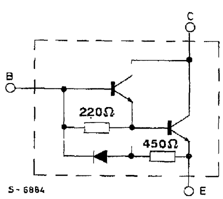
ISOWATT218

DESCRIPTION

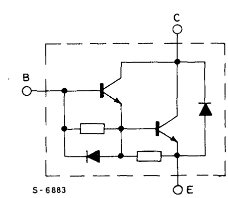
The BU808FI and BU808DFI are silicon multiepitaxial mesa NPN transistors in monolithic Darlington configuration. An integrated base-emitter speed-up diode is included in the BU808DFI. They are fast switching, high voltage devices designed for use in colour television horizontal deflection circuits.

Both devices are packaged in the fully isolated ISOWATT218.

INTERNAL SCHEMATIC DIAGRAM



BU808FI



BU808DFI

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	1400	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	700	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5	V
I_C	Collector Current	5	A
I_{CM}	Collector Peak Current (t_p < 10ms)	10	A
I_B	Base Current	3	A
I_{BM}	Base Peak Current (t_p < 10ms)	6	A
P_{tot}	Total Dissipation at T_{amb} 25°C	50	W
T_{stg}	Storage Temperature	– 65 to 150	°C
T_j	Max. Operating Junction Temperature	150	°C

THERMAL DATA

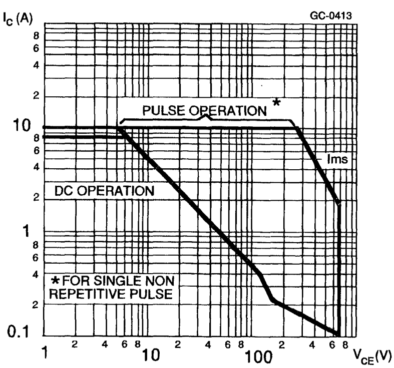
$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max.	2.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

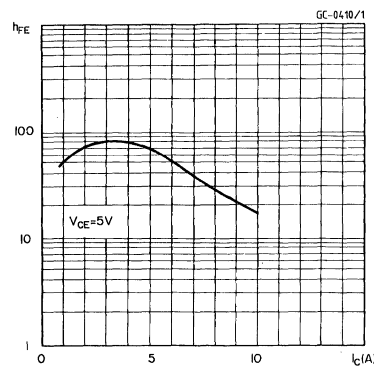
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 1400V			400	μA
I_{CEX}	Collector Cutoff Current	V_{CE} = 1000V V_{BE} = – 5V			400	μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			100	mA
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5A I_B = 0.5A			1.6	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 5A I_B = 0.5A			2	V
h_{FE}*	DC Current Gain	I_C = 5A V_{CE} = 5V I_C = 5A V_{CE} = 5V T_C = 100°C	25 15			
V_F*	Diode Forward Voltage	I_F = 5A for **BU808DFI**			3	V
 t_s t_f t_s t_f	INDUCTIVE LOAD Storage Time Fall Time Storage Time Fall Time	 I_C = 5A I_{B1} = 0.5A V_{CC} = 150V V_{BEoff} = - 5V I_C = 5A I_{B1} = 0.5A V_{CC} = 150V V_{BEoff} = - 5V T_C = 100°C		 2 0.8	 3 0.8	 μs μs μs μs

* Pulsed : Pulse duration = 300μs, duty cycle = 1.5%.

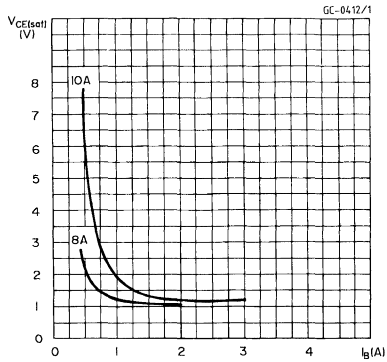
Safe Operating Areas.



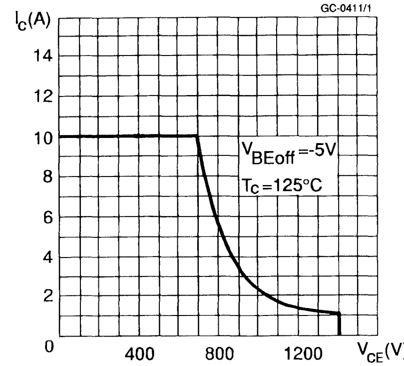
DC Current Gain.



Collector Saturation Region.



Reverse biased SOA.



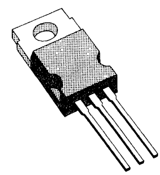
SGS-THOMSON
MICROELECTRONICS

BU810

MEDIUM POWER FAST SWITCHING DARLINGTON

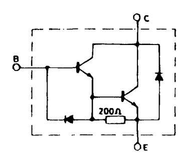
DESCRIPTION

The BU810 is a silicon epitaxial planar NPN Darlington transistor with integrated base-emitter speed-up diode, mounted in Jedec TO-220 plastic package. It is particularly suitable as output stage in medium power, fast switching applications.



TO-220

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	600	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	400	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5	V
I_C	Collector Current	7	A
I_{CM}	Collector Peak Current	10	A
I_B	Base Current	2	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	75	W
T_{stg}	Storage Temperature	– 65 to 150	°C
T_j	Junction Temperature	150	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	1.66	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 600 V			200	μA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 400 V			1	mA
I_{EBO}*	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			150	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 100 mA	400			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 2 A I_B = 20 mA I_C = 4 A I_B = 200 mA I_C = 7 A I_B = 0.7 A			2 2.5 3	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 2 A I_B = 20 mA I_C = 4 A I_B = 200 mA			2.2 3	V V
V_F*	Diode Forward Voltage	I_F = 7 A			3	V

RESISTIVE SWITCHING TIMES

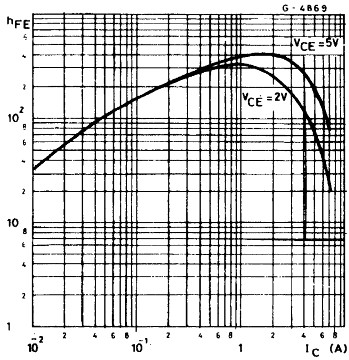
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit.
t_{on}	Turn-on Time	V_{CC} = 250 V I_C = 2 A I_{B1} = 20 mA $V_{BE(off)}$ = − 5 V			0.6	μs
t_s	Storage Time				1.5	μs
t_f	Fall Time				0.5	μs

INDUCTIVE SWITCHING TIMES

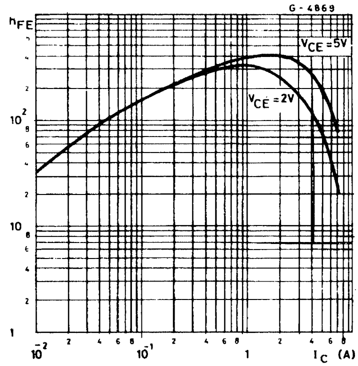
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit.
t_s	Storage Time	V_{Clamp} = 250 V I_C = 7 A I_{B1} = 0.7 A $V_{BE(off)}$ = − 5 V			1.5	μs
t_f	Fall Time				0.4	μs
t_s	Storage Time				1.5	μs
t_f	Fall Time				0.7	μs

* Pulsed : pulse duration = 300 ms, duty cycle = 1.5 %

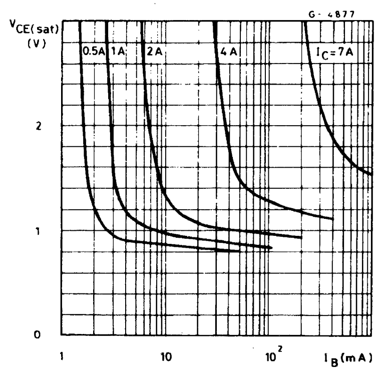
Safe Operating Areas.



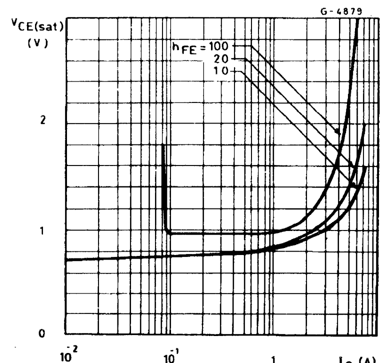
DC Current Gain.



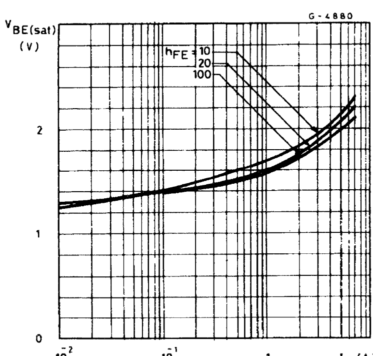
Collector–emitter Saturation Voltage.



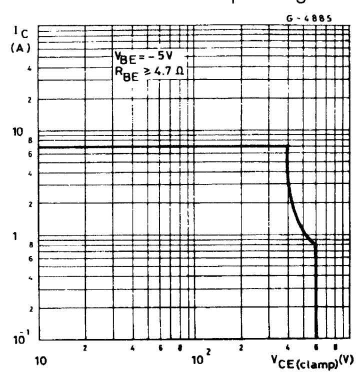
Collector–emitter Saturation Voltage.



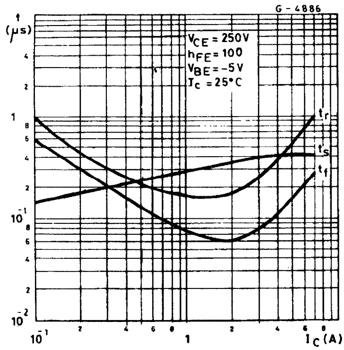
Base–emitter Saturation Voltage.



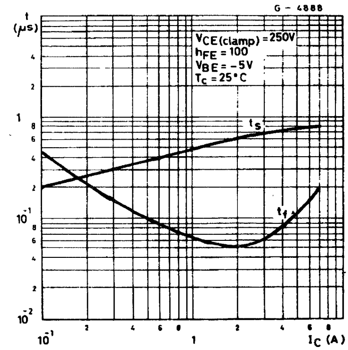
Clamped Reverse Bias Safe Operating Areas.



Saturated Switching Characteristics (resistive load).



Saturated Switching Characteristics.

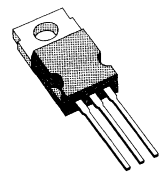


BU910/911
BU912

HIGH VOLTAGE POWER DARLINGTON

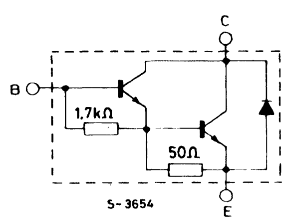
DESCRIPTION

The BU910, BU911, and BU912 are high voltage, silicon NPN transistors in monolithic Darlington configuration in JEDEC TO-220 plastic package, designed for applications such as electronic ignition, DC and AC motor controls, solenoid drivers, etc.



TO-220

INTERNAL SHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		BU910	BU911	BU912	
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	400	450	500	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	350	400	450	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5			V
I_C	Collector Current	6			A
I_{CM}	Collector Peak Current	10			A
I_B	Base Current	1			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$	60			W
T_{stg}	Storage Temperature	– 65 to 150			°C
T_j	Junction Temperature	150			°C

THERMAL DATA

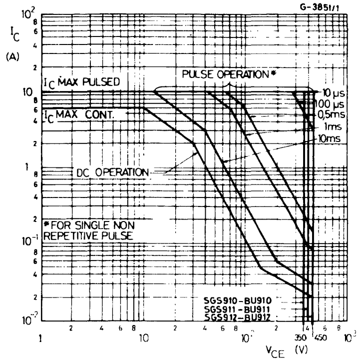
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	2.08	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

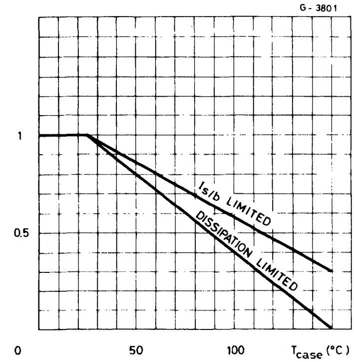
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	for **BU910** V_{CE} = 400V for **BU911** V_{CE} = 450V for **BU912** V_{CE} = 500V T_{case} = 125°C for **BU910** V_{CE} = 400V for **BU911** V_{CE} = 450V for **BU912** V_{CE} = 500V			1 1 1 5 5 5	mA mA mA mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **BU910** V_{CE} = 350V for **BU911** V_{CE} = 400V for **BU912** V_{CE} = 450V			1 1 1	mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			5	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100mA for **BU910** for **BU911** for **BU912**	 350 400 450			 V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	for **BU910** and **BU911** I_C = 2.5A I_B = 50mA for **BU912** I_C = 2A I_B = 50mA All Types I_C = 4A I_B = 200mA			 1.8 1.8 1.8	 V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	for **BU910** and **BU911** I_C = 2.5A I_B = 50mA for **BU912** I_C = 2A I_B = 50mA All Types I_C = 4A I_B = 200mA			 2.2 2.2 2.5	 V V V
V_F*	Diode Forward Voltage	I_F = 4A			2.5	V

* Pulsed : pulse duration = 300μs, duty cycle = 1.5%

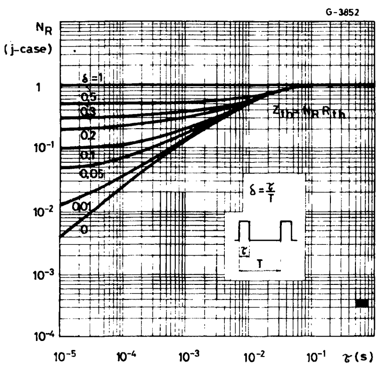
Safe Operating Area.



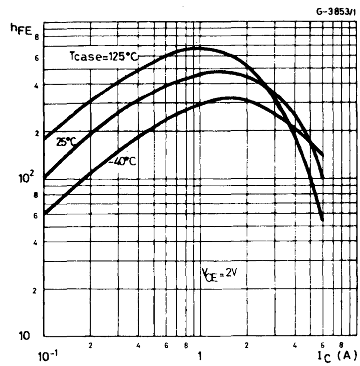
Derating Curves.



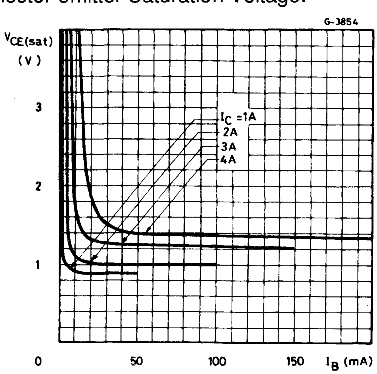
Thermal Transient Response.



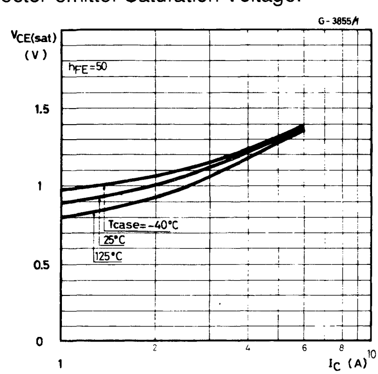
DC Current Gain.



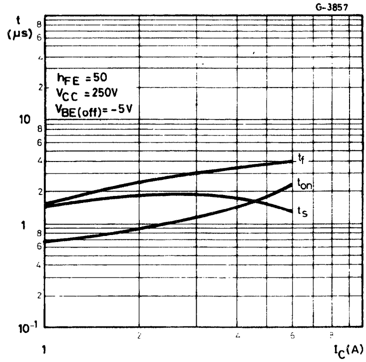
Collector-emitter Saturation Voltage.



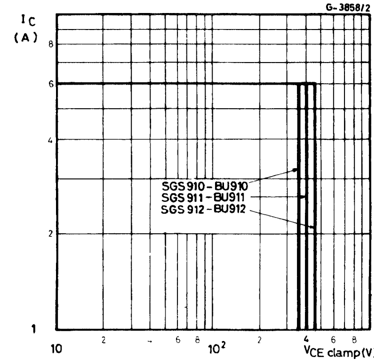
Collector-emitter Saturation Voltage.



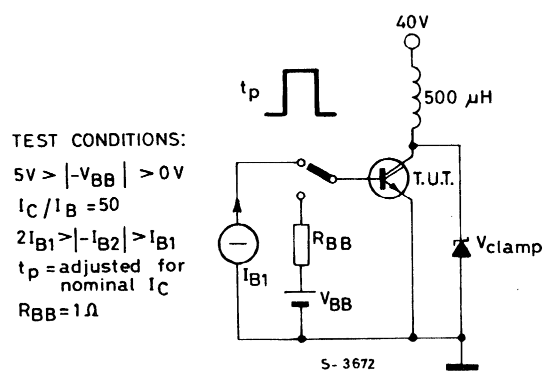
Saturated Switching Characteristics.



Clamped Reverse bias Safe Operating Areas.



Clamped $E_{s/b}$ Test Circuit.

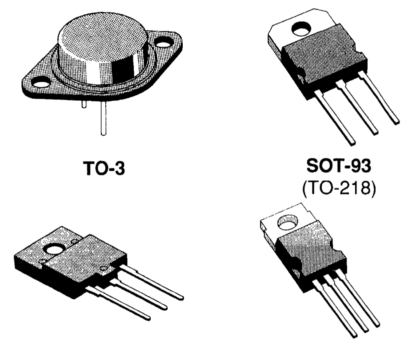


SGS-THOMSON MICROELECTRONICS

BU920/P/PFI/T
BU921/P/PFI/T
BU922/P/PFI/T

HIGH VOLTAGE POWER DISSIPATION

- HIGH VOLTAGE POWER DARLINGTON
- AUTOMOTIVE IGNITION APPLICATIONS
- HIGH CURRENT



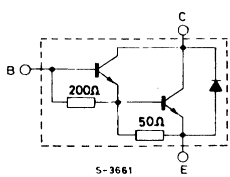
TO-3 **SOT-93** (TO-218) **ISOWATT 218** **TO-220**

DESCRIPTION

The BU920/921/922, BU920P/921P/922P, BU920-PFI/BU921PFI/BU922PFI and BU920T/921T/922T are silicon multiepitaxial planar NPN transistors in monolithic darlington configuration mounted respectively in Jedec TO-3 metal case, SOT-93 plastic package, ISOWATT218 fully isolated package and TO-220 plastic package.

They are particularly intended for automative ignition applications and inverter circuits for motor control.

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value				Unit
	TO-3 SOT-93 ISOWATT218 TO-220	BU920 BU920P BU920PFI BU920T		BU921 BU921P BU921PFI BU921T	BU922 BU922P BU922PFI BU922T	
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	400		450	500	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	350		400	450	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5				V
I_C	Collector Current	10				A
I_{CM}	Collector Peak Current	15				A
I_B	Base Current	5				A
		TO-3	SOT-93	ISOWATT218	TO-220	
P_{tot}	Total Dissipation at $T_c \leq 25$ °C	120	105	55	105	W
T_{stg}	Storage Temperature – 65 to	175	150	150	150	°C
T_j	Max. Operating Junction Temperature	175	150	150	150	°C

THERMAL DATA

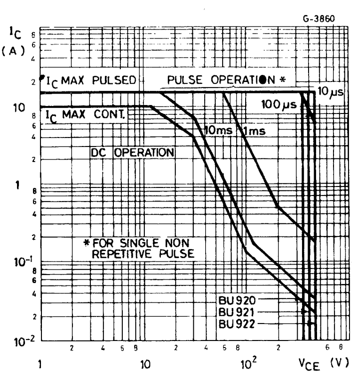
			TO-3	SOT-93	ISOWATT218	TO-220	
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.25	1.2	2.27•	1.2	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

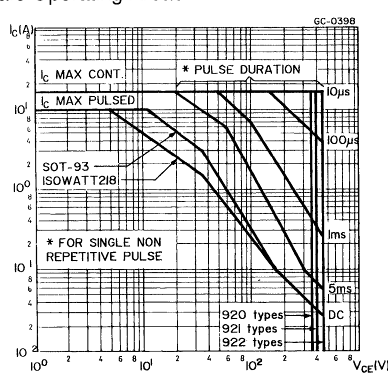
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 400 V for **920 Types** V_{CE} = 450 V for **921 Types** V_{CE} = 500 V for **922 Types** V_{CE} = 400 V for **920 Types** V_{CE} = 450 V for **921 Types** V_{CE} = 500 V for **922 Types** T_c = 150 °C			250 250 250 0.5 0.5 0.5	µA µA µA mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 350 V for **920 Types** V_{CE} = 400 V for **921 Types** V_{CE} = 450 V for **922 Types**			250 250 250	µA µA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			50	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 100 mA for **920 Types** for **921 Types** for **922 Types**	350 400 450			V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5 A I_B = 50 mA I_C = 7 A I_B = 140 mA			1.8 1.8	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 5 A I_B = 50 mA I_C = 7 A I_B = 140 mA			2.2 2.5	V V
V_F	Diode Forward Voltage	I_F = 7 A			2.5	V
	Functional Test (see test circuit Fig.2 and 3)	for **920 Types** V_{CE} = 350 V L = 7 mH for **921 and 922 Types** V_{CE} = 400 V L = 7 mH	 7 7			 A A

* Pulsed : pulse duration = 300 µs, duty cycle = 1.5 %.

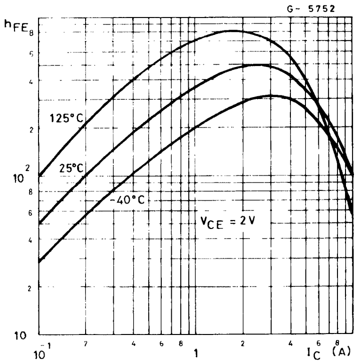
Safe Operating Areas.



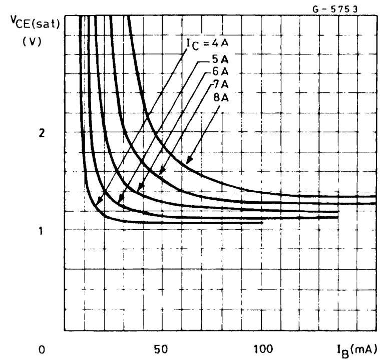
Safe Operating Areas.



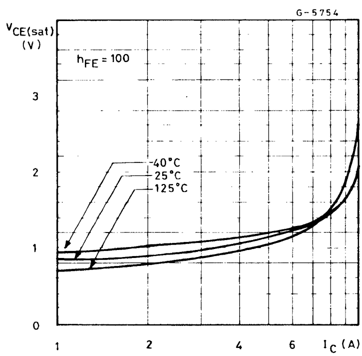
DC Current Gain.



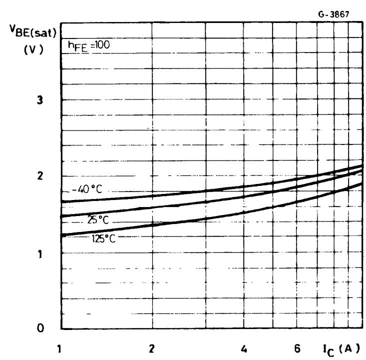
Colltector-emitter Saturation Voltage.



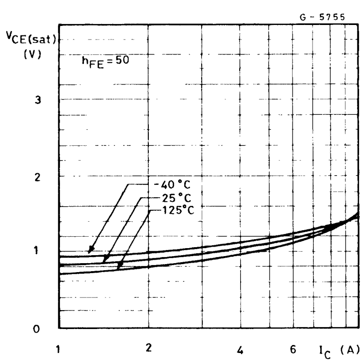
Collector-emitter Saturation Voltage.



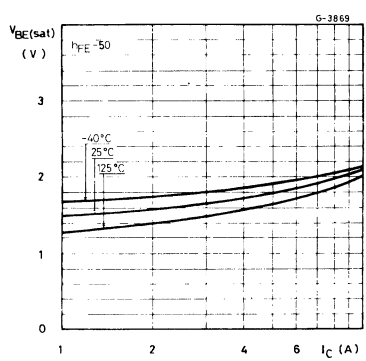
Base-emitter Saturation Voltage.



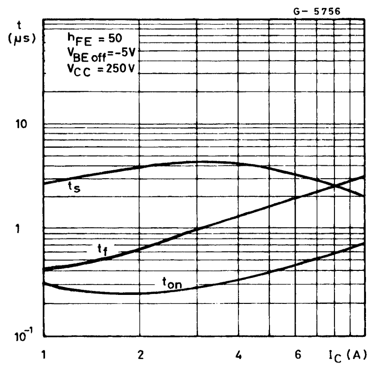
Collector-emitter Saturation Voltage.



Base-emitter Saturation Voltage.



Saturated Switching Characteristics.



Clamped Reverse Bias Safe Operating Areas.

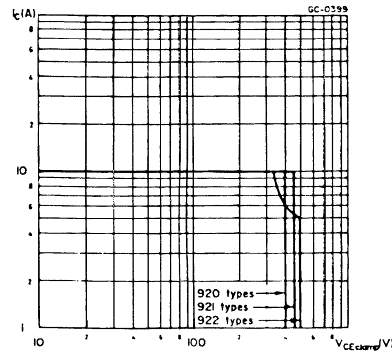
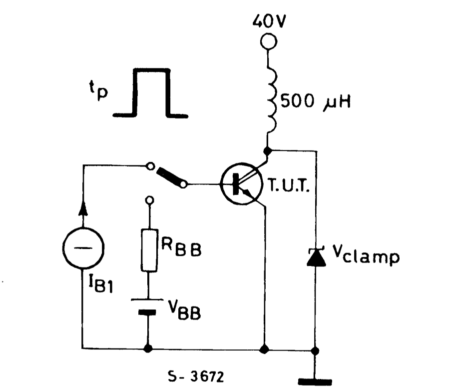


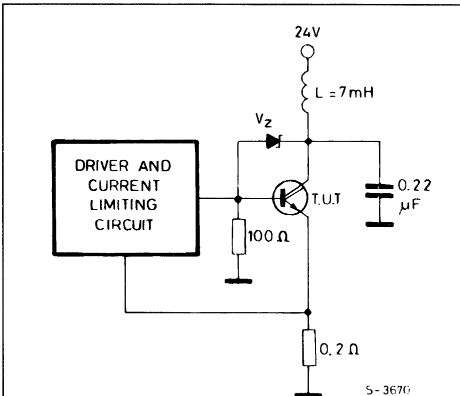
Figure 1 : Clamped $E_{s/o}$ Test Circuit.



Test conditions :
5 V > | - V_{BB} | > 0 V
I_C/I_B = 50

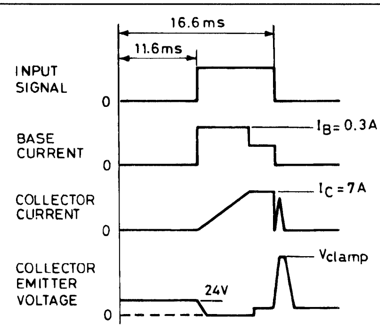
$2I_{B1}$ > | - I_{B2} | > I_{B1}
t_p = adjusted for nominal I_C
R_{BB} = 1 Ω.

Figure 2 : Functional Test Circuit.



Test duration : 2 sec
for BU920 V_Z = 350 V
for BU921 and Bu922 V_Z = 400 V.

Figure 3 : Functional Test Waveforms.



ISOWATT 218 PACKAGE CHARACTERISTICS AND APPLICATION

ISOWATT218 is fully isolated to 4000 V dc. Its thermal impedance, given in the data sheet, is optimized to give efficient thermal conduction together with excellent electrical isolation.

The structure of the case ensures optimum distances between the pins and heatsink. These distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 package eliminates the need for external isolation so reducing fixing hardware.

The package is supplied with leads longer than the standard TO-218 to allow easy mounting on pcbs. Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

ISOWATT218 thermal performance is better than that of the standard part, mounted with a 0.1 mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for ISOWATT218 packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT 218 PACKAGE

Fig. 4 illustrates the elements contributing to the thermal resistance of transistor heatsink assembly, using ISOWATT218 package.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements.

The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1 - for a short duration power pulse less than 1 ms ;

$$Z_{th} \quad R_{thJ-C}$$

2 - for an intermediate power pulse of 5 ms to 50 ms :

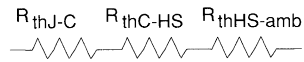
$$Z_{th} = R_{thJ-C}$$

3 - for long power pulses of the order of 500 ms or greater :

$$Z_{th} = R_{thJ-C} + R_{thC-HS} + R_{thHS-amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 4.



BU921ZP/ZPFI
BU921ZT/ZTFI

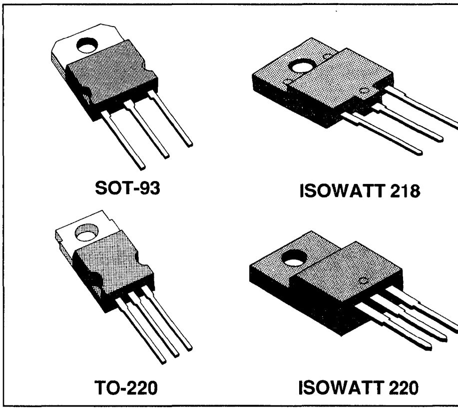
NPN POWER DARLINGTON

ADVANCE DATA

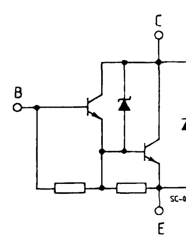
- HIGH RUGGEDNESS
- INTEGRATED HIGH VOLTAGE ZENER

AUTOMOTIVE MARKET

- APPLICATION IN HIGH PERFORMANCE ELECTRONIC CAR IGNITION



INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

The BU921ZP, BU921ZT, BU921ZPFI and BU921ZTFI are silicon multiepitaxial biplanar NPN transistors in monolithic darlington configuration mounted respectively in SOT-93, TO-220 plastic packages and ISOWATT218, ISOWATT220 fully isolated packages.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value				Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	350				V
V_{CER}	Collector-emitter Voltage (R_{BE} = 100 Ω)	350				V
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	350				V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	350				V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5				V
I_C	Collector Current	16				A
I_B	Base Current	5				A
		SOT-93	ISOWATT218	TO-220	ISOWATT220	
P_{tot}	Total Dissipation at T_c < 25 °C	125	60	100	40	W
T_{stg}	Storage Temperature	– 40 to 150				°C
T_j	Max. Operating Junction Temperature	150				°C

October 1988

This is advanced information on a new product now in development or undergoing evaluation. Details are subject to change without notice.

THERMAL DATA

		SOT-93	ISOWATT218	TO-220	ISOWATT220	
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case Max	1	2.08	1.25	3.12	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

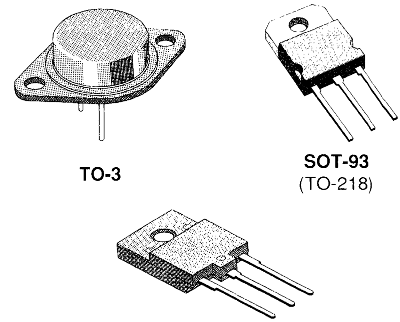
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cut-off Current (I_B = 0)	V_{CE} = 350 V				250	μA
I_{EBO}	Emitter Cut-off Current (I_C = 0)	V_{BE} = – 5 V				50	mA
V_{CL}	Clamping Voltage	either and same	I_B = 0 or V_{BE} = 0 I_C = 100 mA T_j = 125 °C	 350 350		 500 500	 V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5 A I_C = 6 A I_C = 8 A T_j = 125 °C I_C = 5 A I_C = 6 A I_C = 8 A	I_B = 50 mA I_B = 75 mA I_B = 120 mA I_B = 50 mA I_B = 75 mA I_B = 120 mA		1.03 1.08 1.17 0.98 1.04 1.17	1.4 1.5 1.6	V V V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 6 A I_C = 8 A	I_B = 75 mA I_B = 120 mA			2.2 2.3	V V
h_{FE}	DC Current Gain	I_C = 5 A	V_{CE} = 10 V	300			
V_F*	Diode Forward Voltage	I_F = 10 A				2.5	V
	USE TEST	V_{CC} = 24 V	L = 8 mH	8			A

* Pulsed : pulsed duration = 300 μs, duty cycle = 1.5 %.

BU931R/RP/RPFI
BU932R/RP/RPFI

NPN POWER DARLINGTON

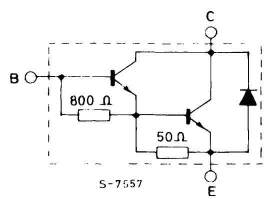
- AUTOMOTIVE MARKET
- HIGH PERFORMANCE ELECTRONIC IGNITION DARLINGTON
- HIGH RUGGEDNESS



DESCRIPTION

These devices are multiepitaxial biplanar NPN transistors in monolithic darlington configuration mounted in TO-3, SOT-93 and ISOWATT218 packages. They are specially intended for automotive ignition applications and invertes circuits for motor controls. Controlled performances in the linear region make them particularly suitable for car ignitions where current limiting is achieved desaturing the darlington.

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
	TO-3 SOT-93 ISOWATT218	BU931R BU931RP BU931RPFI		BU932R BU932RP BU932RPFI	
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	450		500	V
V_{CEO}	Collector-emitter Voltage (I_{BE} = 0)	400		450	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5			V
I_C	Collector Current	15			A
I_{CM}	Collector Peak Current ($t_p \leq 10$ ms)	30			A
I_B	Base Current	1			A
I_{BM}	Base Peak Current ($t_p \leq$ 10 ms)	5			A
		TO-3	SOT-93	ISOWATT218	
P_{tot}	Total Dissipation at $T_C \leq 25°C$	175	125	60	W
T_{stg}	Storage Temperature	− 40 to 200	− 40 to 150	− 40 to 150	°C
T_J	Max. Operating Junction Temperature	200	150	150	°C

THERMAL DATA

			TO-3	SOT-93	ISOWATT218	
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1	1	2.08•	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

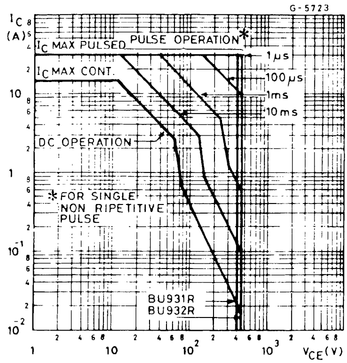
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	for **BU931R/BU931RP/BU931RPFI** V_{CE} = 450 V V_{CE} = 450 V T_c = 125 °C for **BU932R/BU932RP/BU932RPFI** V_{CE} = 500 V V_{CE} = 500 V T_c = 125 °C			 1 5 1 5	 mA mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **BU931R/BU931RP/BU931RPFI** V_{CE} = 400 V for **BU932R/BU932RP/BU932RPFI** V_{CE} = 450 V			 1 1	 mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			50	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 100 mA for **BU931R/BU931RP/BU931RPFI** for **BU932R/BU932RP/BU932RPFI**	 400 450			 V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	for **BU931R/BU931RP/BU931RPFI** I_C = 7 A I_B = 70 mA I_C = 8 A I_B = 100 mA I_C = 10 A I_B = 250 mA for **BU932R/BU932RP/BU932RPFI** I_C = 8 A I_B = 150 mA		 1.05 1.09 1.13 1.09	 1.6 1.8 1.8 1.8	 V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	for **BU932R5BU932RP/BU932RPFI** I_C = 8 A I_B = 100 mA I_C = 10 A I_B = 250 mA for **BU932R/BU932RP/BU932RPFI** I_C = 8 A I_B = 150 mA		 1.75 1.92 1.77	 2.2 2.5 2.2	 V V V
h_{FE}*	DC Current Gain	I_C = 5 A V_{CE} = 10 V	300			
V_F*	Diode Forward Voltage	I_F = 10 A		1.43	2.8	V
	USE TEST (see fig. 2)	V_{CC} = 24 V V_{clamp} = 400 V L = 7 mH	8			A

INDUCTIVE LOAD

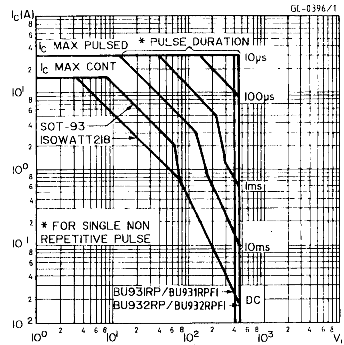
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
  t_s t_f	 (see fig. 3) Storage Time Fall Time	V_{CC} = 12 V V_{clamp} = 300 V L = 7 mH I_C = 7 A I_B = 70 mA V_{BE} = 0 R_{BE} = 47 Ω		 15 0.5		 µs µs

* Pulsed : pulse duration = 300 µs, duty cycle = 1.5 %.

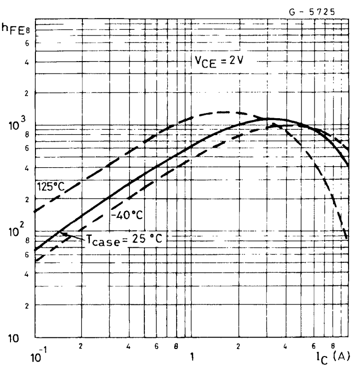
Safe Operating Areas.



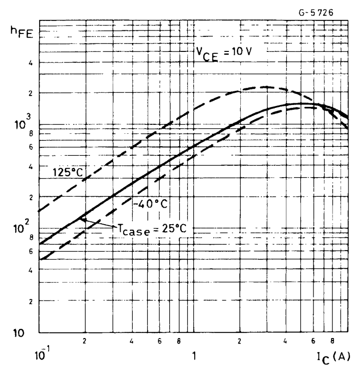
Safe Operating Areas.



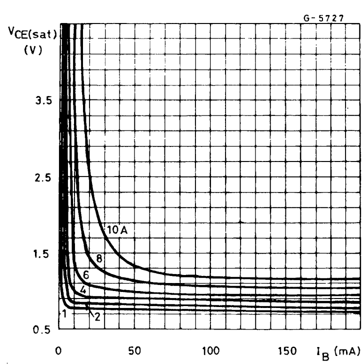
DC Current Gain.



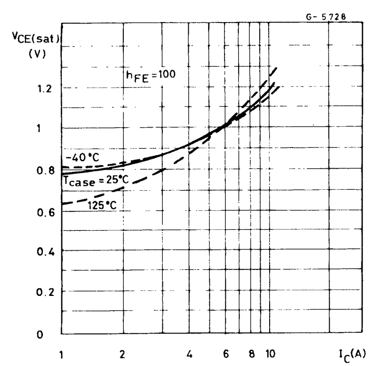
DC Current Gain.



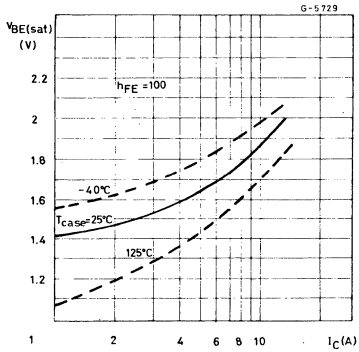
Collector-emitter Saturation Voltage.



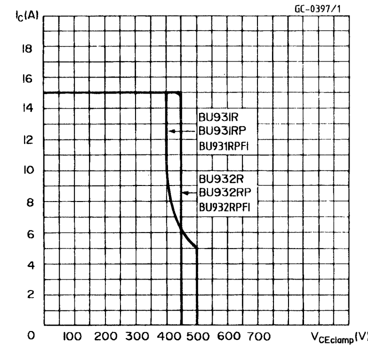
Collector-emitter Saturation Voltage.



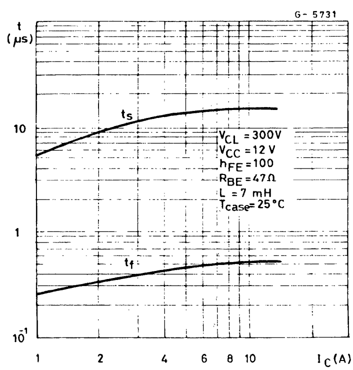
Base-emitter Saturation Voltage.



Clamped Reverse Bias Safe Operating Areas (see fig. 4).



Saturated Switching Characteristics (inductive load) (see fig. 3).



Switching Times Percentage Variation vs. T_{case} Inductive Load.

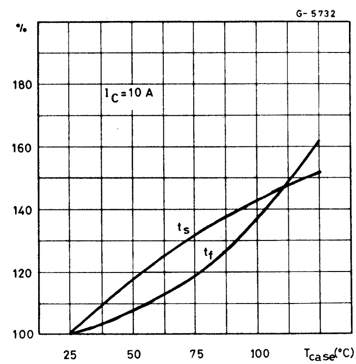


Figure 1: Functional Test Circuit.

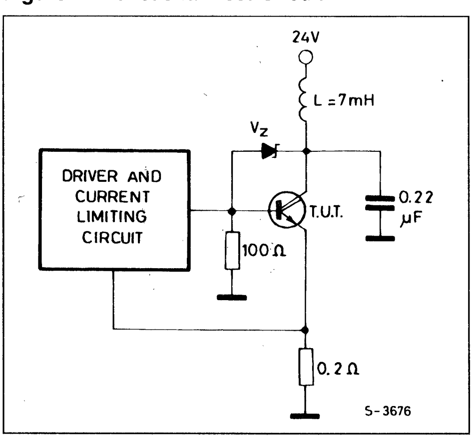


Figure 2 : Functional Test Waveforms.

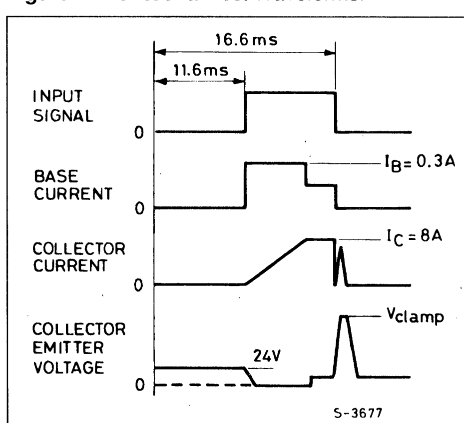


Figure 3 : Switching Times Test Circuit.

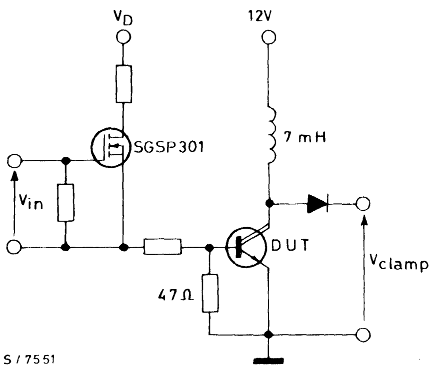
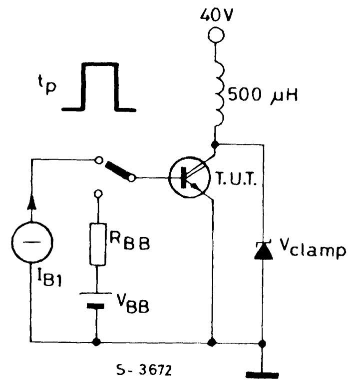


Figure 4 : Clamped $E_{s/b}$ Test Circuit.



Test conditions :
$5\,V > |-V_{BB}| > 0$
$I_C/I_B = 40$
$2\,I_{B1} > |-I_{B2}| > I_{B1}$
t_p = adjusted for nominal I_C
$R_{BB} = 1\,\Omega$

ISOWATT 218 PACKAGE CHARACTERISTICS AND APPLICATION

ISOWATT218 is fully isolated to 4000 V dc. Its thermal impedance, given in the data sheet, is optimised to give efficient thermal conduction together with excellent electrical isolation.

The structure of the case ensures optimum distances between the pins and heatsink. These distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 package eliminates the need for external isolation so reducing fixing hardware.

The package is supplied with leads longer than the standard TO-218 to allow easy mounting on pcbs. Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

ISOWATT218 thermal performance is better than that of the standard part, mounted with a 0.1 mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for ISOWATT218 packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT 218 PACKAGE

Fig. 5 illustrates the elements contributing to the thermal resistance of transistor heatsink assembly, using ISOWATT218 package.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements.

The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1. for a short duration power pulse less than 1 ms ;

$$Z_{th} < R_{thJ\text{-}C}$$

2. for an intermediate power pulse of 5 ms to 50 ms ;

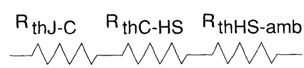
$$Z_{th} = R_{thJ\text{-}C}$$

3. for long power pulses of the order of 500 ms or greater :

$$Z_{th} = R_{thJ\text{-}C} + R_{thC\text{-}HS} + R_{thHS\text{-}amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 5



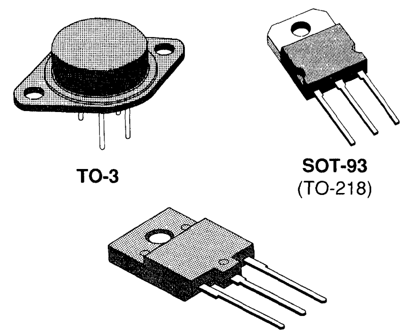
BU931Z/ZP/ZPFI

NPN POWER DARLINGTON

- HIGH RUGGEDNESS
- INTEGRATED HIGH VOLTAGE ZENER

AUTOMOTIVE MARKET

- APPLICATION IN HIGH PERFORMANCE ELECTRONIC CAR IGNITION

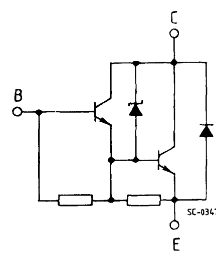


TO-3

SOT-93 (TO-218)

ISOWATT 218

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

The BU931Z, BU931ZP and BU931ZPFI are silicon multiepitaxial biplanar NPN transistors in monolithic darlington configuration mounted respectively in TO-3 metal case, SOT-93 plastic package and ISOWATT218 fully isolated package.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	350			V
V_{CER}	Collector-emitter Voltage ($R_{BE} = 100\ \Omega$)	350			V
V_{CES}	Collector-emitter Voltage ($V_{BE} = 0$)	350			V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	350			V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5			V
I_C	Collector Current	20			A
I_B	Base Current	5			A
		TO-3	SOT-93	ISOWATT218	
P_{tot}	Total Dissipation at $T_c \leq 25$ °C	175	125	60	W
T_{stg}	Storage Temperature	– 40 to 200	– 40 to 150	– 40 to 150	°C
T_j	Max. Operating Junction Temperature	200	150	150	°C

THERMAL DATA

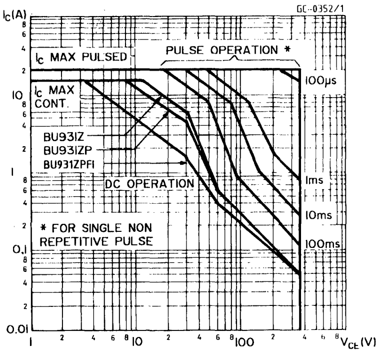
			TO-3	SOT-93	ISOWATT218	
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1	1	2.08•	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

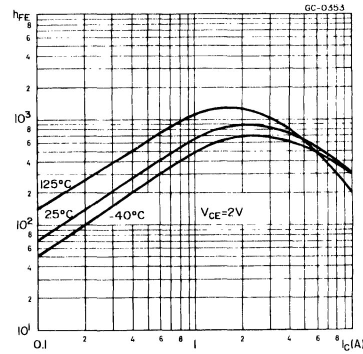
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CL}	Clamping Current	V_{CE} = 350 either I_B = 0 or V_{BE} = 0			 250 250	 μA μA
$I_{CE(off)}$	Collector-emitter off State Current (I_B = 0)	V_{CC} = 16 V T_j = 125 °C V_{BE} = 300 mV			0.5	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			50	mA
V_{CL}	Clamping Voltage	either I_B = 0 or V_{BE} = 0 and I_C = 100 mA same T_j = 125 °C	 350 350		 500 500	 V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 7 A I_B = 70 mA I_C = 8 A I_B = 100 mA I_C = 10 A I_B = 150 mA T_j = 125 °C I_C = 7 A I_B = 70 mA I_C = 8 A I_B = 100 mA I_C = 10 A I_B = 150 mA		1.25 1.45 1.65 1.6 1.8 2	1.6 1.8 2	V V V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 8 A I_B = 100 mA I_C = 10 A I_B = 250 mA			2.2 2.5	V V
$V_{BE(on)}$*	Base-emitter Voltage	I_C = 5 A V_{CE} = 2 V T_j = – 40 °C T_j = 125 °C I_C = 10 A V_{CE} = 2 V T_j = – 40 °C T_j = 125 °C	 1.1 1.4	1.67 2	 2.1 2.4	V V V V V V
V_F*	Diode Forward Voltage	I_F = 10 A			2.5	V
$E_{s/b}$	Second Breakdown Energy Unclamped	L = 10 mH I_C = 10 A		500		mJ
$I_{s/b}$	Second Breakdown Collector Current	V_{CE} = 30 t = 500 ms for **BU931Z** t = 250 ms for **BU931ZP** t = 250 ms for **BU931ZPFI**	 6 4 1.7			 A A A
	USE TEST (see fig. 2)	V_{CC} = 24 V L = 7 mH	8			A

* Pulsed : pulse duration = 300 μs, duty cycle = 1.5 %.

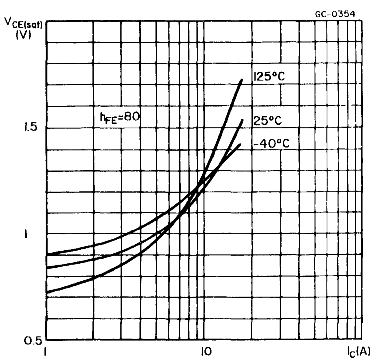
Safe Operating Areas.



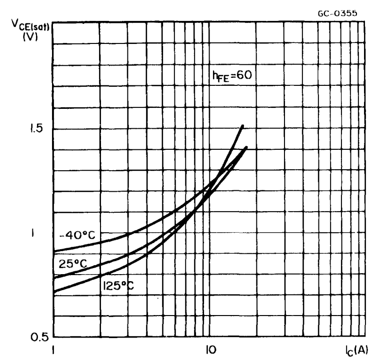
DC Current Gain.



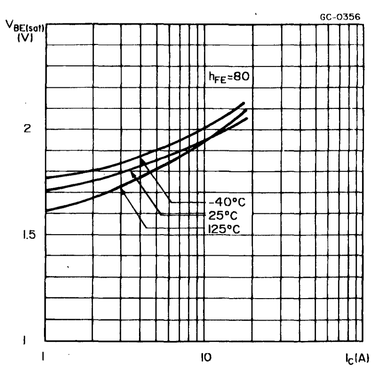
Collector-emitter Saturation Voltage.



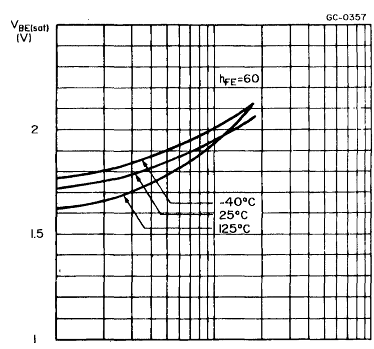
Collector-emitter Saturation Voltage.



Base-emitter Saturation Voltage.



Base-emitter Saturation Voltage.



Collector-emitter Saturation Voltage.

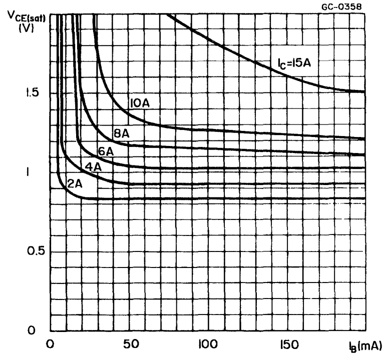


Figure 1 : Functional Test Circuit.

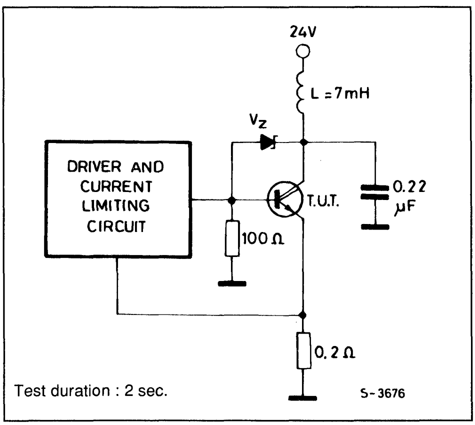
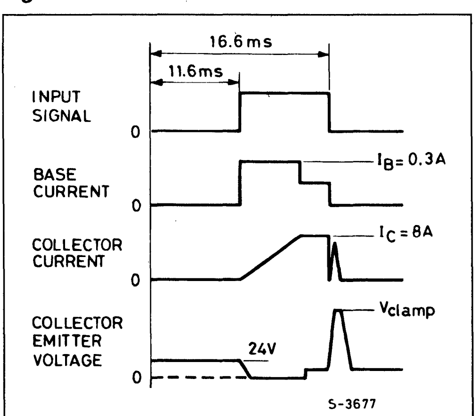


Figure 2 : Functional Test Waveforms.



ISOWATT 218 PACKAGE CHARACTERISTICS AND APPLICATION

ISOWATT218 is fully isolated to 4000 V dc. Its thermal impedance, given in the data sheet, is optimized to give efficient thermal conduction together with excellent electrical isolation.

The structure of the case ensures optimum distances between the pins and heatsink. These distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 package eliminates the need for external isolation so reducing fixing hardware.

The package is supplied with leads longer than the standard TO-218 to allow easy mounting on pcbs. Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

ISOWATT218 thermal performance is better than that of the standard part, mounted with a 0.1 mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for ISOWATT218 packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT 218 PACKAGE

Fig. 3 illustrates the elements contributing to the thermal resistance of transistor heatsink assembly, using ISOWATT218 package.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements.

The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1. for a short duration power pulse less than 1 ms ;

$$Z_{th} \quad R_{thJ-C}$$

2. for an intermediate power pulse of 5 ms to 50 ms :

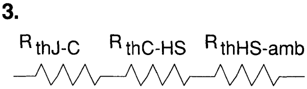
$$Z_{th} = R_{thJ-C}$$

3. for long power pulses of the order of 500 ms or greater :

$$Z_{th} = R_{thJ-C} + R_{thC-HS} + R_{thHS-amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 3.

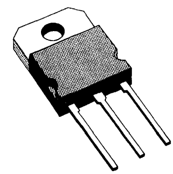


HIGH POWER FAST SWITCHING

ADVANCE DATA

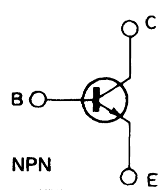
DESCRIPTION

The BU1999 type is a silicon multiepitaxial planar NPN transistor and is mounted in SOT-93 plastic package. It is intended for use in switching and linear applications, and industrial equipments.



(sim. to **TO-218**) **SOT-93**

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	160	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	140	V
V_{EBO}	Emitter base Voltage ($I_C = 0$)	6	V
I_C	Collector Current	25	A
I_{CM}	Collector Peak Current	40	A
I_B	Base Current	10	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	106	W
T_{stg}	Storage Temperature	– 65 to 150	°C
T_j	Junction Temperature	150	°C

This is advanced information on a new product now in development or undergoing evaluation. Details are subject to change without notice.

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.17	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current ($I_E = 0$)	$V_{CB} = 160$ V			100	µA
I_{CEO}	Collector Cutoff Current ($I_B = 0$)	$V_{CE} = 70$ V			50	µA
I_{CEX}	Collector Cutoff Current	$V_{CE} = 140$ V $V_{BE} = -1.5$ V			10	µA
I_{EBO}	Emitter Cutoff Current	$V_{EB} = 6$ V $I_C = 0$			100	µA
$V_{CEO(sus)}$	Collector-emitter Sustaining Voltage	$I_C = 50$ mA $I_B = 0$	140			V
$V_{CE(sat)}$*	Collector–emitter Saturation Voltage	$I_C = 10$ A $I_B = 1$ A $I_C = 25$ A $I_B = 2.5$ A			0.8 1.5	V V
$V_{BE(sat)}$*	Base–emitter Saturation Voltage	$I_C = 10$ A $I_B = 1$ A $I_C = 25$ A $I_B = 2.5$ A			1.8 2.5	V V
$V_{BE(on)}$	Base-emitter on Voltage	$I_C = 10$ A $V_{CE} = 2$ V			1.8	V
h_{FE}*	DC Current Gain	$I_C = 0.5$ A $V_{CE} = 2$ V $I_C = 10$ A $V_{CE} = 2$ V $I_C = 25$ A $V_{CE} = 2$ V	35 25 12		 100 	
t_r	Rise Time	$V_{CC} = 80$ V			0.3	µs
t_s	Storage Time	$I_C = 10$ A			1.5	µs
t_f	Fall Time	$I_{B1} = I_{B2} = 1$ A			0.25	µs

* Pulsed : pulse duration = 300 µs, duty cycle = 1.5 %.

FASTSWITCH EASY-TO-DRIVE (ETD) NPN TRANSISTORS

PRELIMINARY DATA

- HIGH SWITCHING SPEED NPN POWER TRANSISTORS
- EASY TO DRIVE
- HIGH VOLTAGE FOR OFF-LINE APPLICATIONS
- 100KHz SWITCHING SPEED
- LOW COST DRIVE CIRCUITS
- LOW DYNAMIC SATURATION

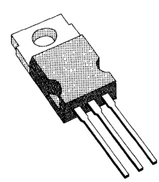
APPLICATIONS

- SMPS
- MOTOR DRIVES

DESCRIPTION

These Easy-to-Drive FASTSWITCH NPN power transistors are specially designed for high reliability industrial and professional power driving applications such as motor drives and off-line switching power supplies. ETD transistors will operate using easy drive circuits at up to 100KHz ; this helps to simplify designs and improve reliability. The superior switching performance and low crossover losses reduce dissipation and consequently lowers the equipment operating temperature. These ETD transistors are suitable for application in high reliability, low power, motor drives and in flyback and forward converters, 100W to 250W.

These EASY-TO-DRIVE FASTSWITCH transistors are available in the TO-220 package.



TO-220

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BUF405	BUF405A	
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	850	1000	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	450		V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7		V
I_C	Collector Current	7.5		A
I_{CM}	Collector Peak Current	15		A
I_B	Base Current	3		A
I_{BM}	Base Peak Current	4.5		A
P_{tot}	Total Dissipation at T_c < 25°C	80		W
T_{stg}	Storage Temperature	– 65 to 150		°C
T_j	Max. Operating Junction Temperature	150		°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	1.56	°C/W

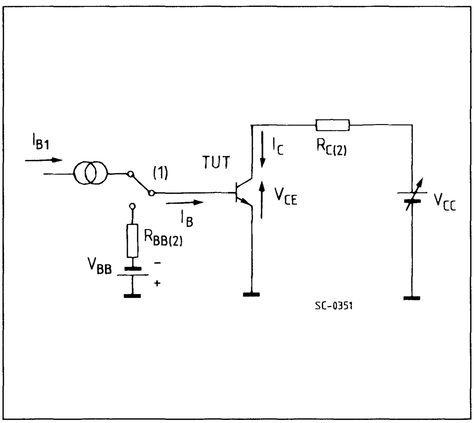
ELECTRICAL CHARACTERISTICS (T_j = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 5Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			0.1 0.5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = – 1.5V $V_{CE} = V_{CEV}$ V_{BE} = – 1.5V T_c = 100°C			0.1 0.5	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	450			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 2.5A I_B = 0.25A I_C = 2.5A I_B = 0.25A T_c = 100°C I_C = 5A I_B = 1A I_C = 5A I_B = 1A T_c = 100°C		0.8 0.5 	 2.8 2	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 2.5A I_B = 0.25A I_C = 2.5A I_B = 0.25A T_c = 100°C I_C = 5A I_B = 1A I_C = 5A I_B = 1A T_c = 100°C		0.9 1.1 	 1.5 1.5	V V V V
di_c/dt	Rate of Rise of on-state Collector Current	V_{CC} = 300V R_C = 0 t_p = 3μs I_{B1} = 0.375A T_j = 25°C I_{B1} = 0.375A T_j = 100°C I_{B1} = 1.5A T_j = 100°C	 30 60	 40 		 A/μs A/μs A/μs
$V_{CE}(3μs)$	Collector-emitter Dynamic Voltage	V_{CC} = 300V R_C = 120Ω I_{B1} = 0.375A T_j = 25°C T_j = 100°C		 2.1 	 8	 V V
$V_{CE}(5μs)$	Collector-emitter Dynamic Voltage	V_{CC} = 300V R_C = 120Ω I_{B1} = 0.375A T_j = 25°C T_j = 100°C		 1.1 	 4	 V V
t_s t_f t_c	Storage Time Fall Time Cross Over Time	I_C = 2.5A V_{CC} = 50V V_{BB} = – 5V R_{BB} = 2.4Ω V_{clamp} = 400V I_{B1} = 0.25A L = 1mH		0.8 0.05 0.08		μs μs μs
t_s t_f t_c	Storage Time Fall Time Cross Over Time	I_C = 2.5A V_{CC} = 50V V_{BB} = – 5V R_{BB} = 2.4Ω V_{clamp} = 400V I_{B1} = 0.25A L = 1mH T_j = 100°C			1.8 0.1 0.18	μs μs μs
V_{CEW}	Maximum Collector Emitter Voltage without Snubber	I_C = 2.5A V_{CC} = 50V V_{BB} = – 5V R_{BB} = 2.4Ω V_{clamp} = 400V I_{B1} = 0.25A L = 1mH T_j = 125°C	500			V
t_s t_f t_c	Storage Time Fall Time Cross Over Time	I_C = 2.5A V_{CC} = 50V V_{BB} = 0 R_{BB} = 0.6Ω V_{clamp} = 400V I_{B1} = 0.25A L = 1mH		1.5 0.04 0.07		μs μs μs

ELECTRICAL CHARACTERISTICS (continued)

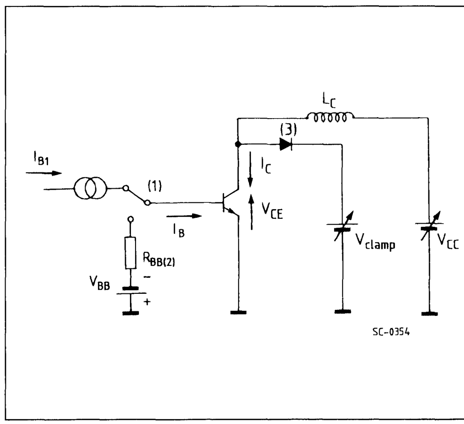
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
t_s t_f t_c	Storage Time Fall Time Cross Over Time	$I_C = 2.5A$ $V_{BB} = 0$ $V_{clamp} = 400V$ $L = 1mH$	$V_{CC} = 50V$ $R_{BB} = 0.6\Omega$ $I_{B1} = 0.25A$ $T_j = 100°C$			3 0.15 0.25	µs µs µs
V_{CEW}	Maximum Collector Emitter Voltage without Snubber	$I_C = 2.5A$ $V_{BB} = 0$ $V_{clamp} = 400V$ $L = 1mH$	$V_{CC} = 50V$ $R_{BB} = 0.6\Omega$ $I_{B1} = 0.25A$ $T_j = 125°C$	500			V
t_s t_f t_c	Storage Time Fall Time Cross Over Time	$I_C = 5A$ $V_{BB} = -5V$ $V_{clamp} = 400V$ $L = 0.5mH$	$V_{CC} = 50V$ $R_{BB} = 2.4\Omega$ $I_{B1} = 1A$		1.9 0.06 0.12		µs µs µs
t_s t_f t_c	Storage Time Fall Time Cross Over Time	$I_C = 5A$ $V_{BB} = -5V$ $V_{clamp} = 400V$ $L = 0.5mH$	$V_{CC} = 50V$ $R_{BB} = 2.4\Omega$ $I_{B1} = 1A$ $T_j = 100°C$			3.2 0.12 0.3	µs µs µs
V_{CEW}	Maximum Collector Emitter Voltage without Snubber	$I_{CWoff} = 7.5A$ $V_{BB} = -5V$ $L = 0.33mH$ $T_j = 125°C$	$I_{B1} = 1.5A$ $V_{CC} = 50V$ $R_{BB} = 2.4\Omega$	400			V

Turn-on Switching Test Circuit.



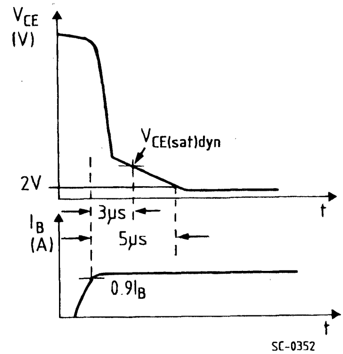
(1) Fast electronic switch
(2) Non-inductive Resistor

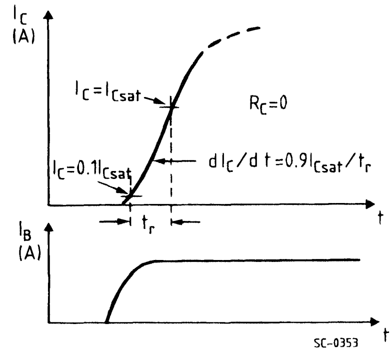
Turn-off Switching Test Circuit.



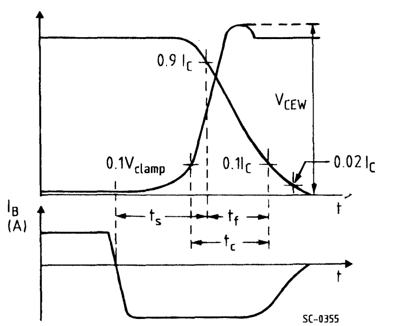
(1) Fast electronic switch
(2) Non-inductive Resistor
(3) Fast recovery rectifier

Turn-on Switching Test Waveforms.

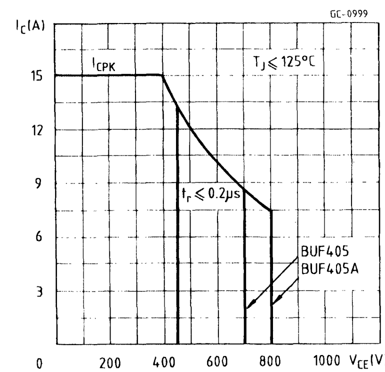




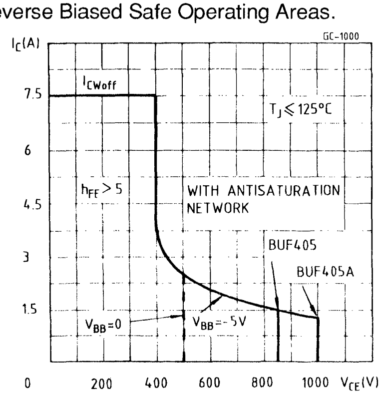
Turn-off Switching Waveforms (inductive load).



Forward Biased Safe Operating Areas.



Reverse Biased Safe Operating Areas.



FASTSWITCH EASY-TO-DRIVE (ETD) NPN TRANSISTORS

PRELIMINARY DATA

- HIGH SWITCHING SPEED NPN POWER TRANSISTOR
- EASY TO DRIVE
- HIGH VOLTAGE FOR OFF-LINE APPLICATIONS
- 100KHz SWITCHING SPEED
- LOW COST DRIVE CIRCUITS
- LOW DYNAMIC SATURATION

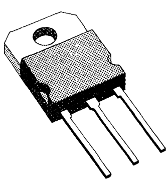
APPLICATIONS

- SMPS
- MOTOR DRIVES

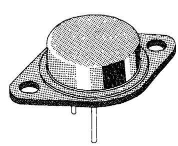
DESCRIPTION

These Easy-to-Drive FASTSWITCH NPN power transistors are specially designed for high reliability industrial and professional power driving applications such as motor drives and off-line switching power supplies. ETD transistors will operate using easy drive circuits at up to 100KHz ; this helps to simplify designs and improve reliability. The superior switching performance and low crossover losses reduce dissipation and consequently lower the equipment operating temperature. These ETD transistors are suitable for applications in high reliability medium power motors drives and half bridge and full bridge converters.

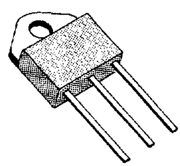
These Easy-to-Drive FASTSWITCH transistors are available in TO-218 and TO-3 packages. Additionally, the alumina isolated version is available in the TOP-3I package.



TO-218



TO-3



TOP-3I

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter (TO-218, TOP-3I)	Value: BUF410 BUF410I	Value: BUF410A BUF410AI	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	850	1000	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	450		V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7		V
I_C	Collector Current	15		A
I_{CM}	Collector Peak Current	30		A
I_B	Base Current	3		A
I_{BM}	Base Peak Current	4.5		A
		TO-218	**TOP-3I**	
P_{tot}	Total Dissipation at T_c < 25°C	125	85	W
T_{stg}	Storage Temperature	– 65 to 150		°C
T_j	Max. Operating Junction Temperature	150		°C

THERMAL DATA

			TO-218	TOP-3I	
$R_{thj-case}$	Thermal Resistance Junction-case	Max	1	1.47	°C/W

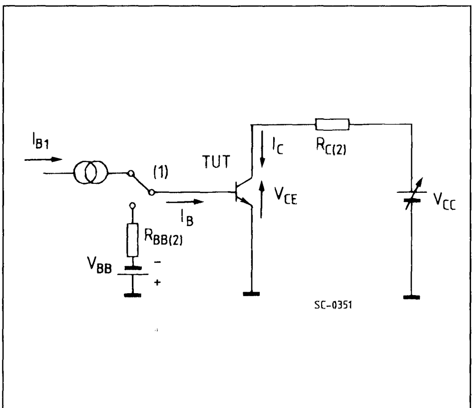
ELECTRICAL CHARACTERISTICS (T_j = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			0.2 1	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = – 1.5V $V_{CE} = V_{CEV}$ V_{BE} = – 1.5V T_c = 100°C			0.2 1	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	450			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5A I_B = 0.5A I_C = 5A I_B = 0.5A T_c = 100°C I_C = 10A I_B = 2A I_C = 10A I_B = 2A T_c = 100°C		0.8 0.5 	 2.8 2	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 5A I_B = 0.5A I_C = 5A I_B = 0.5A T_c = 100°C I_C = 10A I_B = 2A I_C = 10A I_B = 2A T_c = 100°C		0.9 1.1 	 1.5 1.5	V V V V
di_c/dt	Rate of Rise of on-state Collector Current	V_{CC} = 300V R_C = 0 t_p = 3µs I_{B1} = 0.75A T_j = 25°C I_{B1} = 0.75A T_j = 100°C I_{B1} = 3A T_j = 100°C	 45 100	 60 		 A/µs A/µs A/µs
V_{CE}(3µs)	Collector-emitter Dynamic Voltage	V_{CC} = 300V R_C = 60Ω I_{B1} = 0.75A T_j = 25°C T_j = 100°C		 2.1 	 8	 V V
V_{CE}(5µs)	Collector-emitter Dynamic Voltage	V_{CC} = 300V R_C = 60Ω I_{B1} = 0.75A T_j = 25°C T_j = 100°C		 1.1 	 4	 V V
t_s t_f t_c	Storage Time Fall Time Cross Over Time	I_C = 5A V_{CC} = 50V V_{BB} = – 5V R_{BB} = 1.2Ω V_{clamp} = 400V I_{B1} = 0.5A L = 0.5mH		0.8 0.05 0.08		µs µs µs
t_s t_f t_c	Storage Time Fall Time Cross Over Time	I_C = 5A V_{CC} = 50V V_{BB} = – 5V R_{BB} = 1.2Ω V_{clamp} = 400V I_{B1} = 0.5A L = 0.5mH T_j = 100°C			1.8 0.1 0.18	µs µs µs
V_{CEW}	Maximum Collector Emitter Voltage without Snubber	I_C = 5A V_{CC} = 50V V_{BB} = – 5V R_{BB} = 1.2Ω V_{clamp} = 400V I_{B1} = 0.5A L = 0.5mH T_j = 125°C	500			V
t_s t_f t_c	Storage Time Fall Time Cross Over Time	I_C = 5A V_{CC} = 50V V_{BB} = 0 R_{BB} = 0.3Ω V_{clamp} = 400V I_{B1} = 0.5A L = 0.5mH		1.5 0.04 0.07		µs µs µs

ELECTRICAL CHARACTERISTICS (continued)

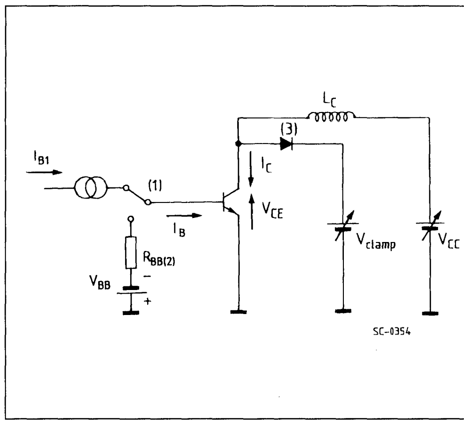
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
t_s t_f t_c	Storage Time Fall Time Cross Over Time	I_C = 5A V_{BB} = 0 V_{clamp} = 400V L = 0.5mH	V_{CC} = 50V R_{BB} = 0.3Ω I_{B1} = 0.5A T_j = 100°C			3 0.15 0.25	μs μs μs
V_{CEW}	Maximum Collector Emitter Voltage without Snubber	I_C = 5A V_{BB} = 0 V_{clamp} = 400V L = 0.5mH	V_{CC} = 50V R_{BB} = 0.3Ω I_{B1} = 0.5A T_j = 125°C	500			V
t_s t_f t_c	Storage Time Fall Time Cross Over Time	I_C = 10A V_{BB} = − 5V V_{clamp} = 400V L = 0.25mH	V_{CC} = 50V R_{BB} = 1.2Ω I_{B1} = 2A		1.9 0.06 0.12		μs μs μs
t_s t_f t_c	Storage Time Fall Time Cross Over Time	I_C = 10A V_{BB} = − 5V V_{clamp} = 400V L = 0.25mH	V_{CC} = 50V R_{BB} = 1.2Ω I_{B1} = 2A T_j = 100°C			3.2 0.12 0.3	μs μs μs
V_{CEW}	Maximum Collector Emitter Voltage without Snubber	I_{CWoff} = 15A V_{BB} = − 5V L = 0.17mH T_j = 125°C	I_{B1} = 3A V_{CC} = 50V R_{BB} = 1.2Ω	400			V

Turn-on Switching Test Circuit.



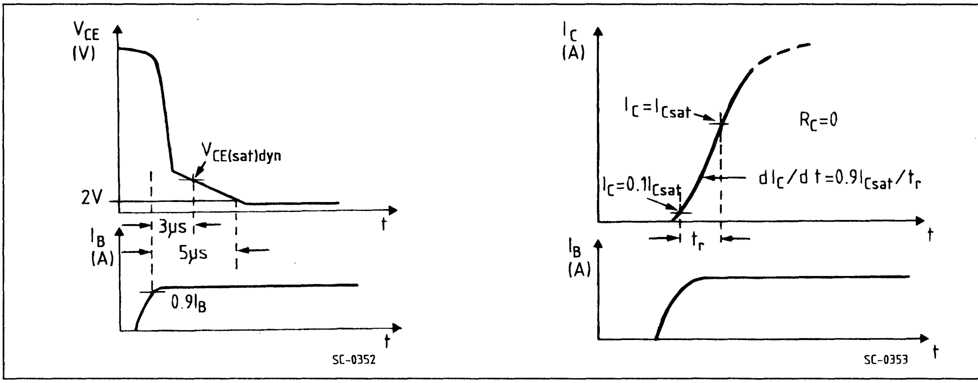
(1) Fast electronic switch
(2) Non-inductive Resistor

Turn-off Switching Test Circuit.

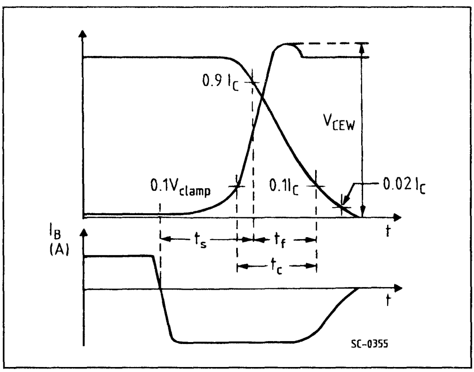


(1) Fast electronic switch
(2) Non-inductive Resistor
(3) Fast recovery rectifier

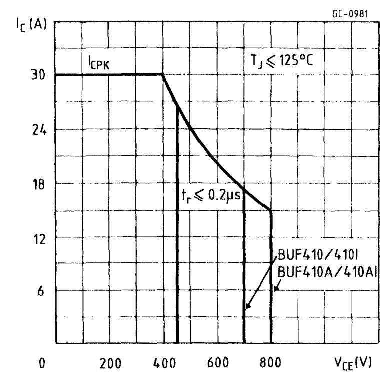
Turn-on Switching Test Waveforms.



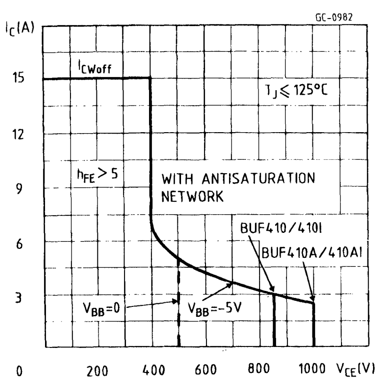
Turn-off Switching Waveforms (inductive load).



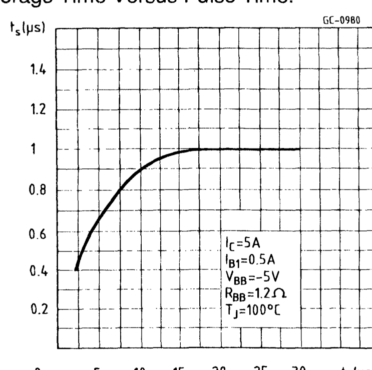
Forward Biased Safe Operating Areas.



Reverse Biased Safe Operating Areas.



Storage Time Versus Pulse Time.



SGS-THOMSON MICROELECTRONICS

FASTSWITCH EASY-TO-DRIVE (ETD) NPN TRANSISTORS

PRELIMINARY DATA

- HIGH SWITCHING SPEED NPN POWER TRANSISTORS
- EASY TO DRIVE
- HIGH VOLTAGE FOR OFF-LINE APPLICATIONS
- 100KHz SWITCHING SPEED
- LOW COST DRIVE CIRCUITS
- LOW DYNAMIC SATURATION

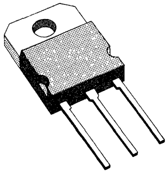
APPLICATIONS

- SMPS
- MOTOR DRIVES

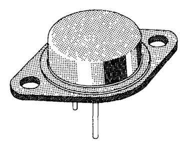
DESCRIPTION

These Easy-to-Drive FASTSWITCH NPN power transistors are specially designed for high reliability industrial and professional power driving applications such as motor drives and off-line switching power supplies. ETD transistors will operate using easy drive circuits at up to 100KHz ; this helps to simplify designs and improve reliability. The superior switching performance and low crossover losses reduce dissipation and consequently lower the equipment operating temperature. These ETD transistors are suitable for application in high power, high reliability, motor drives and half bridge and full bridge converters.

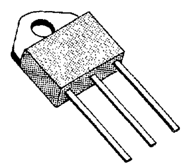
These Easy-To-Drive FASTSWITCH transistors are available in TO-218 and TO-3 packages. Additionally, the alumina isolated version is available in the TOP-3I package.



TO-218



TO-3



TOP-3I

ABSOLUTE MAXIMUM RATINGS

<table>
<tr><th rowspan="2">Symbol</th><th rowspan="2">Parameter</th><th rowspan="2">TO-218
TOP-3I
TO-3</th><th colspan="3">Value</th><th rowspan="2">Unit</th></tr>
<tr><th colspan="2">BUF420
BUF420I
BUF420M</th><th>BUF420A
BUF420AI
BUF420AM</th></tr>
<tr><td>V_{CEV}</td><td colspan="2">Collector-emitter Voltage (V_{BE} = – 1.5V)</td><td colspan="2">850</td><td>1000</td><td>V</td></tr>
<tr><td>V_{CEO}</td><td colspan="2">Collector-emitter Voltage (I_B = 0)</td><td colspan="3">450</td><td>V</td></tr>
<tr><td>V_{EBO}</td><td colspan="2">Emitter-base Voltage (I_C = 0)</td><td colspan="3">7</td><td>V</td></tr>
<tr><td>I_C</td><td colspan="2">Collector Current</td><td colspan="3">30</td><td>A</td></tr>
<tr><td>I_{CM}</td><td colspan="2">Collector Peak Current</td><td colspan="3">60</td><td>A</td></tr>
<tr><td>I_B</td><td colspan="2">Base Current</td><td colspan="3">6</td><td>A</td></tr>
<tr><td>I_{BM}</td><td colspan="2">Base Peak Current</td><td colspan="3">9</td><td>A</td></tr>
<tr><td></td><td colspan="2"></td><td>TO-3</td><td>TO-218</td><td>TOP-3I</td><td></td></tr>
<tr><td>P_{tot}</td><td colspan="2">Total Dissipation at T_c < 25°C</td><td>200</td><td>200</td><td>115</td><td>W</td></tr>
<tr><td>T_{stg}</td><td colspan="2">Storage Temperature</td><td colspan="3">– 65 to 150</td><td>°C</td></tr>
<tr><td>T_j</td><td colspan="2">Max. Operating Junction Temperature</td><td colspan="3">150</td><td>°C</td></tr>
</table>

THERMAL DATA

			TO-3	TO-218	TOP-3I	
$R_{thj-case}$	Thermal Resistance Junction-case	Max	0.63	0.63	1.09	°C/W

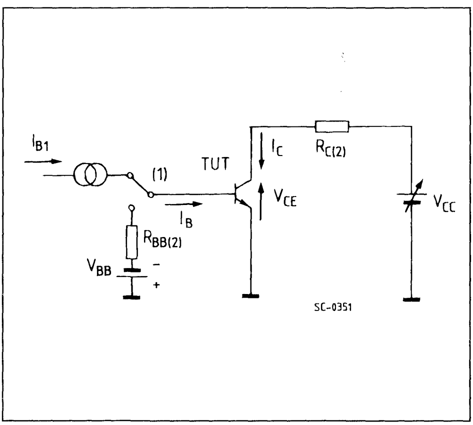
ELECTRICAL CHARACTERISTICS (T_j = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 5Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			0.2 1	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = – 1.5V $V_{CE} = V_{CEV}$ V_{BE} = – 1.5V T_c = 100°C			0.2 1	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	450			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10A I_B = 1A I_C = 10A I_B = 1A T_c = 100°C I_C = 20A I_B = 4A I_C = 20A I_B = 4A T_c = 100°C		0.8 0.5 	 2.8 2	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 10A I_B = 1A I_C = 10A I_B = 1A T_c = 100°C I_C = 20A I_B = 4A I_C = 20A I_B = 4A T_c = 100°C		0.9 1.1 	 1.5 1.5	V V V V
di_c/dt	Rate of Rise of on-state Collector Current	V_{CC} = 300V R_C = 0 t_p = 3μs I_{B1} = 1.5A T_j = 25°C I_{B1} = 1.5A T_j = 100°C I_{B1} = 6A T_j = 100°C	 70 150	 100 		 A/μs A/μs A/μs
$V_{CE}(3μs)$	Collector-emitter Dynamic Voltage	V_{CC} = 300V R_C = 30Ω I_{B1} = 1.5A T_j = 25°C T_j = 100°C		 2.1 	 8	 V V
$V_{CE}(5μs)$	Collector-emitter Dynamic Voltage	V_{CC} = 300V R_C = 30Ω I_{B1} = 1.5A T_j = 25°C T_j = 100°C		 1.1 	 4	 V V
t_s t_f t_c	Storage Time Fall Time Cross Over Time	I_C = 10A V_{CC} = 50V V_{BB} = – 5V R_{BB} = 0.6Ω V_{clamp} = 400V I_{B1} = 1A L = 0.25mH		1 0.05 0.08		μs μs μs
t_s t_f t_c	Storage Time Fall Time Cross Over Time	I_C = 10A V_{CC} = 50V V_{BB} = – 5V R_{BB} = 0.6Ω V_{clamp} = 400V I_{B1} = 1A L = 0.25mH T_j = 100°C			2 0.1 0.18	μs μs μs
V_{CEW}	Maximum Collector Emitter Voltage without Snubber	I_C = 10A V_{CC} = 50V V_{BB} = – 5V R_{BB} = 0.6Ω V_{clamp} = 400V I_{B1} = 1A L = 0.25mH T_j = 125°C	500			V
t_s t_f t_c	Storage Time Fall Time Cross Over Time	I_C = 10A V_{CC} = 50V V_{BB} = 0 R_{BB} = 0.15Ω V_{clamp} = 400V I_{B1} = 1A L = 0.25mH		1.5 0.04 0.07		μs μs μs

ELECTRICAL CHARACTERISTICS (continued)

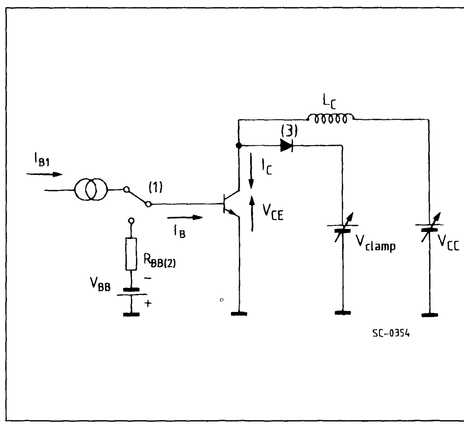
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
t_s t_f t_c	Storage Time Fall Time Cross Over Time	I_C = 10A V_{BB} = 0 V_{clamp} = 400V L = 0.25mH	V_{CC} = 50V R_{BB} = 0.15Ω I_{B1} = 1A T_j = 100°C			3 0.15 0.25	µs µs µs
V_{CEW}	Maximum Collector Emitter Voltage without Snubber	I_C = 10A V_{BB} = 0 V_{clamp} = 400V L = 0.25mH	V_{CC} = 50V R_{BB} = 0.15Ω I_{B1} = 1A T_j = 125°C	500			V
t_s t_f t_c	Storage Time Fall Time Cross Over Time	I_C = 20A V_{BB} = − 5V V_{clamp} = 400V L = 0.12mH	V_{CC} = 50V R_{BB} = 0.6Ω I_{B1} = 4A		2.2 0.06 0.12		µs µs µs
t_s t_f t_c	Storage Time Fall Time Cross Over Time	I_C = 20A V_{BB} = − 5V V_{clamp} = 400V L = 0.12mH	V_{CC} = 50V R_{BB} = 0.6Ω I_{B1} = 4A T_j = 125°C			3.5 0.12 0.3	µs µs µs
V_{CEW}	Maximum Collector Emitter Voltage without Snubber	I_{CWoff} = 30A V_{BB} = − 5V L = 0.08mH T_j = 125°C	I_{B1} = 6A V_{CC} = 50V R_{BB} = 0.6Ω	400			V

Turn-on Switching Test Circuit.



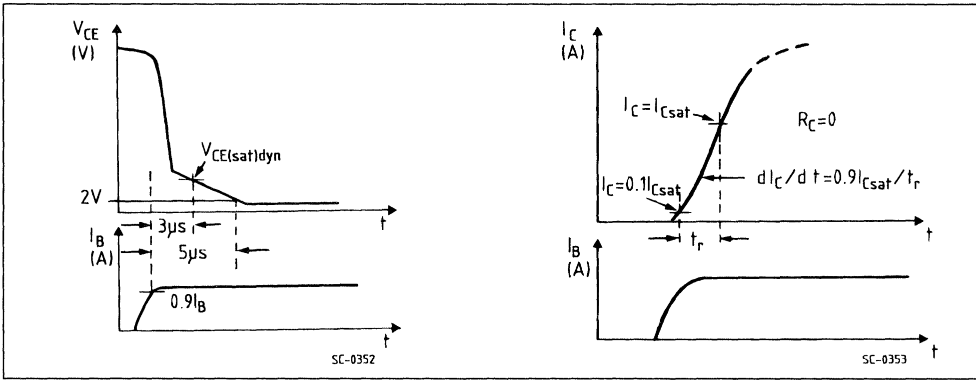
(1) Fast electronic switch
(2) Non-inductive Resistor

Turn-off Switching Test Circuit.

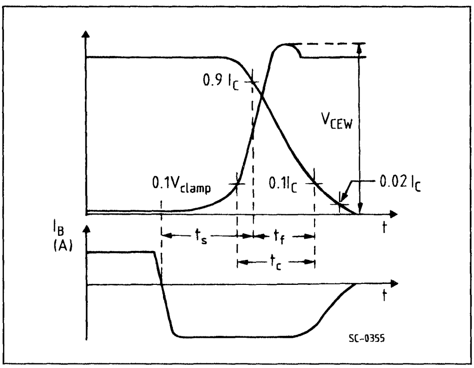


(1) Fast electronic switch
(2) Non-inductive Resistor
(3) Fast recovery rectifier

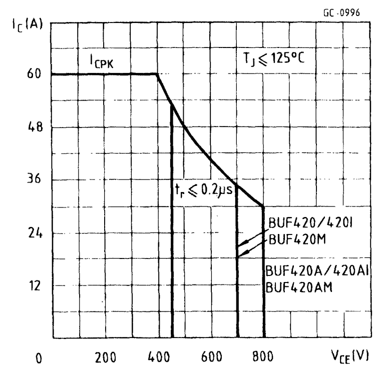
Turn-on Switching Test Waveforms.



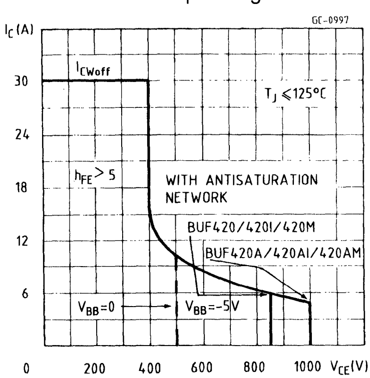
Turn-off Switching Waveforms (inductive load).



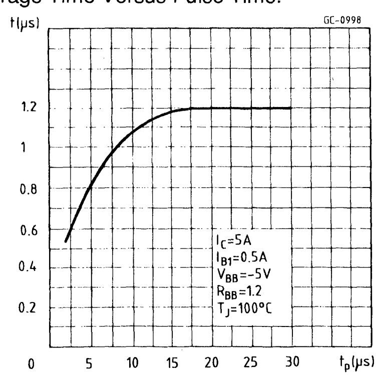
Forward Biased Safe Operating Areas.



Reverse Biased Safe Operating Areas.



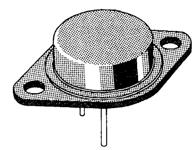
Storage Time Versus Pulse Time.



HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

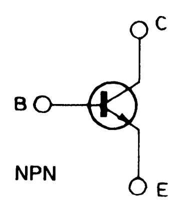
ADVANCE DATA

- HIGH CURRENT
- HIGH SWITCHING SPEED
- HIGH POWER
- GOOD SOA
- GOOD RBSOA



TO-3

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

The BUR20 is a silicon multiepitaxial planar NPN transistor in modified Jedec TO-3 metal case, intended for use in switching and linear low voltage, high current applications in military and industrial equipments.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	200	V
V_{CEX}	Collector-emitter Voltage ($V_{BE} = -1.5V$)	200	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	125	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	50	A
I_{CM}	Collector Peak Current ($t_p < 10ms$)	75	A
I_B	Base Current	15	A
P_{tot}	Total Dissipation at $T_c < 25°C$	250	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

This is advanced information on a new product now in development or undergoing evaluation. Details are subject to change without notice.

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case max	0.7	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

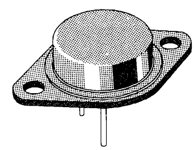
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEX}	Collector Cutoff Current	V_{CE} = 200V V_{BE} = – 1.5V V_{CE} = 200V V_{BE} = – 1.5V T_c = 125°C			500 6	μA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 125V			1	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	125			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 25A I_B = 2A I_C = 50A I_B = 5A			1 1.5	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 25A I_B = 2A I_C = 50A I_B = 5A			2 2.5	V V
h_{FE}*	DC Current Gain	I_C = 25A V_{CE} = 2V I_C = 50A V_{CE} = 4V	15 10		60	
f_T	Transition Frequency	I_C = 1A V_{CE} = 15V f = 10MHz		20		MHz
 t_{on} t_s t_f	RESISTIVE LOAD Turn-on Time Storage Time Fall Time	 I_C = 50A I_{B1} = – I_{B2} = 5A V_{CC} = 60V V_{BB} = – 6V t_p = 10μs			 1.5 1.2 0.3	 μs μs μs

* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.

HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

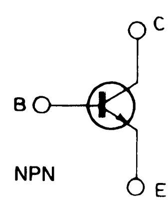
ADVANCE DATA

- HIGH CURRENT
- HIGH SWITCHING SPEED
- HIGH POWER
- GOOD SOA
- GOOD RBSOA



TO-3

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

The BUR21 is a silicon multiepitaxial planar NPN transistor in modified Jedec TO-3 metal case, intended for use in switching and linear low voltage, high current applications in military and industrial equipments.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	300	V
V_{CEX}	Collector-emitter Voltage ($V_{BE} = -1.5V$)	300	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	200	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	40	A
I_{CM}	Collector Peak Current ($t_p < 10ms$)	50	A
I_B	Base Current	10	A
P_{tot}	Total Dissipation at $T_c < 25°C$	250	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

This is advanced information on a new product now in development or undergoing evaluation. Details are subject to change without notice.

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case max	0.7	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEX}	Collector Cutoff Current	V_{CE} = 300V V_{BE} = − 1.5V V_{CE} = 300V V_{BE} = − 1.5V T_c = 125°C			500 6	µA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 200V			1	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	200			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 12A I_B = 1.2A I_C = 25A I_B = 3A I_C = 30A I_B = 5A			0.6 1.5 1.5	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 25A I_B = 3A I_C = 50A I_B = 5A			1.8 2.2	V V
h_{FE}*	DC Current Gain	I_C = 12A V_{CE} = 2V I_C = 25A V_{CE} = 4V	15 10		60	
f_T	Transition Frequency	I_C = 1A V_{CE} = 15V f = 10MHz		20		MHz
 t_{on} t_s t_f	RESISTIVE LOAD Turn-on Time Storage Time Fall Time	 I_C = 25A I_{B1} = − I_{B2} = 3A V_{CC} = 100V V_{BB} = − 6V t_p = 10µs			 1 1.8 0.4	 µs µs µs

* Pulsed : pulse duration = 300µs, duty cycle = 1.5%.

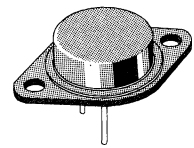
SGS-THOMSON MICROELECTRONICS

BUR22

HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

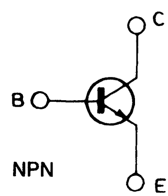
ADVANCE DATA

- HIGH CURRENT
- HIGH SWITCHING SPEED
- HIGH POWER
- GOOD SOA
- GOOD RBSOA



TO-3

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

The BUR22 is a silicon multiepitaxial planar NPN transistor in modified Jedec TO-3 metal case, intended for use in switching and linear low voltage, high current applications in military and industrial equipments.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	350	V
V_{CEX}	Collector-emitter Voltage ($V_{BE} = -1.5V$)	350	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	250	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	40	A
I_{CM}	Collector Peak Current ($t_p < 10ms$)	50	A
I_B	Base Current	10	A
P_{tot}	Total Dissipation at $T_c < 25°C$	250	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

This is advanced information on a new product now in development or undergoing evaluation. Details are subject to change without notice.

THERMAL DATA

$R_{thj-case}$	Thermal Resistance Junction-case	max	0.7	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEX}	Collector Cutoff Current	V_{CE} = 350V V_{BE} = – 1.5V V_{CE} = 350V V_{BE} = – 1.5V T_c = 125°C			500 6	μA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 250V			1	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	250			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10A I_B = 1A I_C = 20A I_B = 2.5A I_C = 25A I_B = 4A			1 1.5 1.5	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 20A I_B = 2.5A I_C = 25A I_B = 4A			1.8 2.2	V V
h_{FE}*	DC Current Gain	I_C = 10A V_{CE} = 4V I_C = 20A V_{CE} = 4V	15 10		60	
f_T	Transition Frequency	I_C = 1A V_{CE} = 15V f = 10MHz		20		MHz
 t_{on} t_s t_f	RESISTIVE LOAD Turn-on Time Storage Time Fall Time	 I_C = 20A I_{B1} = – I_{B2} = 2.5A V_{CC} = 100V V_{BB} = – 6V t_p = 10μs			 1 2 0.5	 μs μs μs

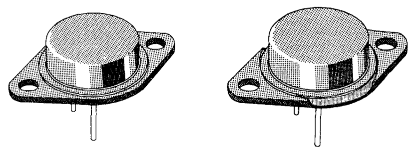
* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.

BUR50
BUR50S

HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

DESCRIPTION

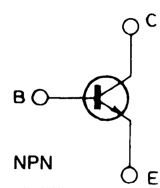
The BUR50 is a silicon multiepitaxial planar NPN transistor in modified Jedec TO-3 metal case, the BUR50S is the same type in Jedec TO-3 metal case, intended for use, in switching and linear applications in military and industrial equipment.



TO-3 — BUR50S

TO-3 (modified) — BUR50

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	200	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	125	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	10	V
I_C	Collector Current	70	A
I_{CM}	Collector Peak Current ($t_p = 10$ ms)	100	A
I_B	Base Current	20	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	350	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

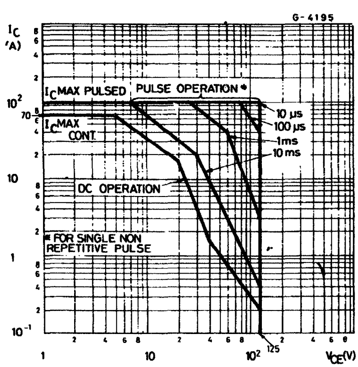
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	0.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

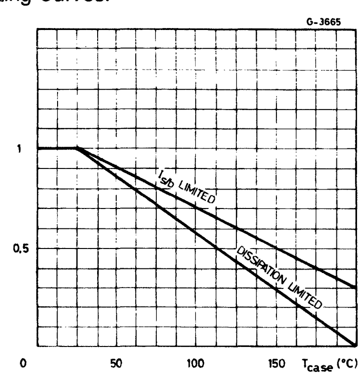
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 200 V V_{CB} = 200 V T_{case} = 125 °C				0.2 2	mA mA
I_{CEO}	Collector cutoff Current (I_B = 0)	V_{CE} = 125 V				1	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7 V				0.2	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 200 mA		125			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 10 mA		10			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 35 A I_C = 70 A	I_B = 2 A I_B = 7 A		0.8	1 1.5	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 35 A I_C = 70 A	I_B = 2 A I_B = 7 A		1.6	1.8 2	V V
h_{FE}*	DC Current Gain	I_C = 5 A I_C = 50 A	V_{CE} = 4 V V_{CE} = 4 V	20 15		100	
$I_{s/b}$	Second Breakdown Collector Current	V_{CE} = 20 V	t = 1 s	17.5			A
f_T	Transition Frequency	I_C = 1 A f = 1 MHz	V_{CE} = 5 V	10	16		MHz
t_{on}	Turn-on Time (fig. 2)	I_C = 70 A V_{CC} = 60 V	I_{B1} = 7 A		0.5	1.2	μs
t_s	Storage Time (fig. 2)	I_C = 70 A I_{B2} = − 7 A	I_{B1} = 7 A V_{CC} = 60 V		0.82	2	μs
t_f	Fall Time (fig. 2)				0.1	0.5	μs
	Clamped $E_{s/b}$ Collector Current (fig. 1)	V_{clamp} = 125 V	L = 500 μH	70			A

* Pulsed : pulse duration = 300μs, duty cycle ≤ 2%.

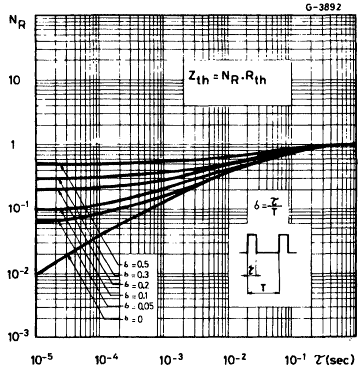
Safe Operating Areas.



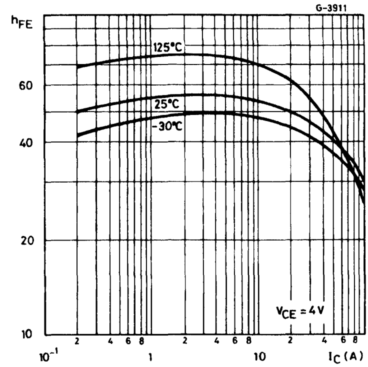
Derating Curves.



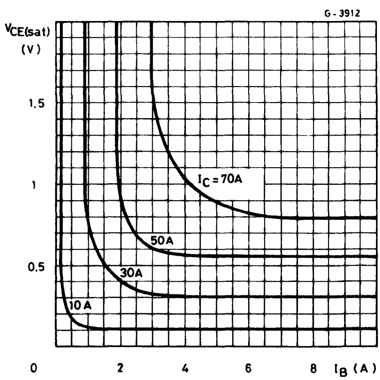
Thermal Transient Response.



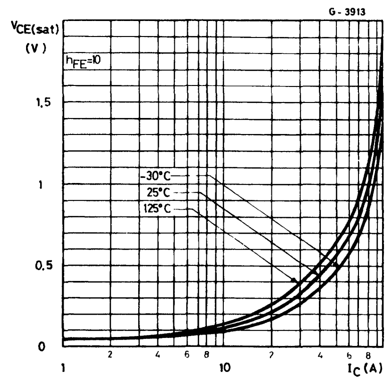
DC Current Gain.



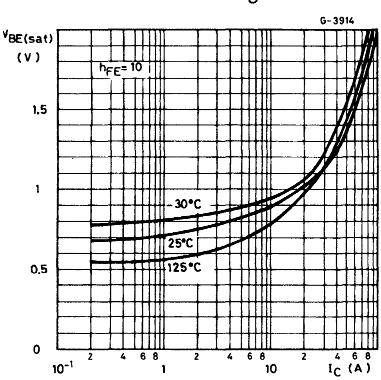
Collector-emitter Saturation Voltage.



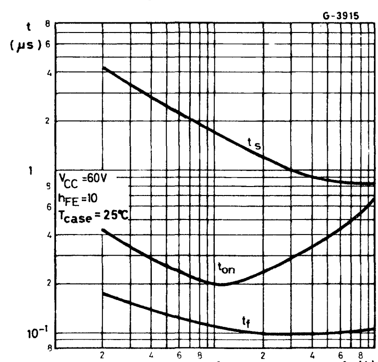
Collector-emitter Saturation Voltage.



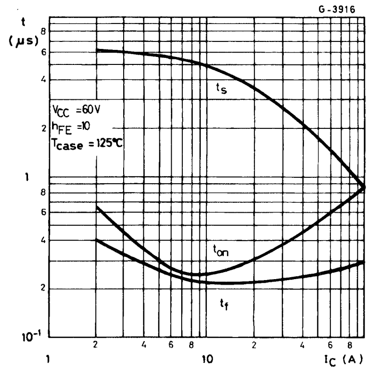
Base-emitter Saturation Voltage.



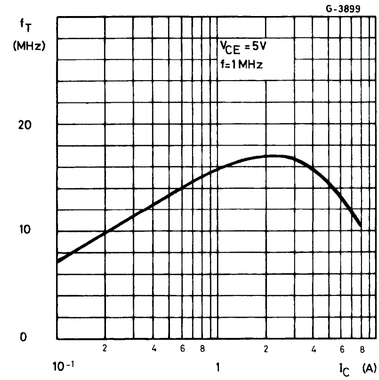
Saturated Switching Characteristics.



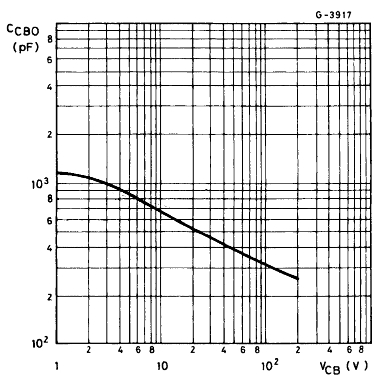
Saturated Switching Characteristics.



Transition Frequency.



Collector-base Capacitance.



Clamped Reverse Bias Safe Operating Areas.

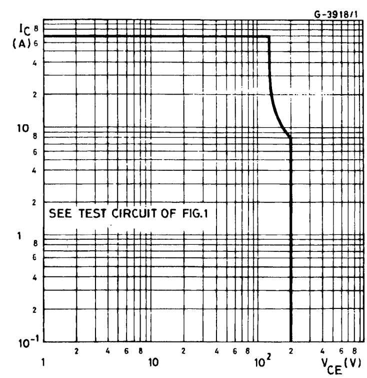


Figure 1 : Clamped $E_{s/b}$ Test Circuit.

TEST CONDITIONS

$7V \geq |-V_{BB}| \geq 2V$
$I_C / I_B = 10$

t_p = adjusted for nominal I_C

$R_{BB} \geq 1\ \Omega$

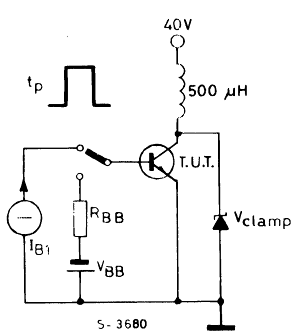


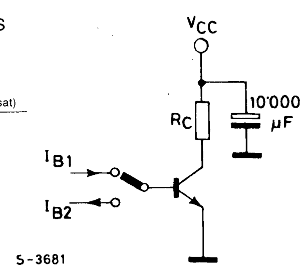
Figure 2 : Switching Times Test Circuit (resistive load).

TEST CONDITIONS

V_{CC} = 60V

$$R_C = \frac{V_{CC} - V_{CE(sat)}}{I_C}$$

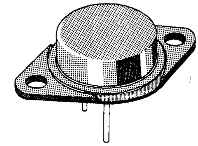
INPUT PULSE
pulse width = 10μs
t_r , $t_f \leq$ 50ns
duty cycle = 1%



HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

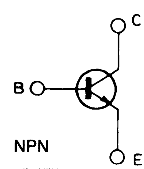
DESCRIPTION

The BUR51 is a silicon multiepitaxial planar NPN transistor in modified Jedec TO-3 metal case, intended for use in switching and linear applications in military and industrial equipment.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	300	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	200	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	10	V
I_C	Collector Current	60	A
I_{CM}	Collector Peak Current (t_p = 10 ms)	80	A
I_B	Base Current	16	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	350	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

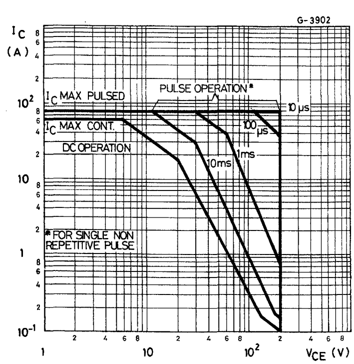
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	0.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

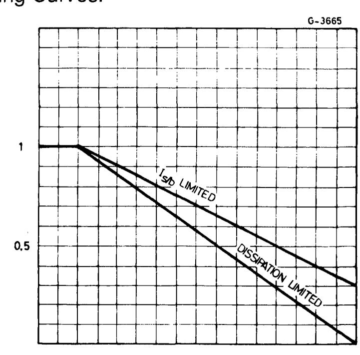
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 300 V V_{CB} = 300 V T_{case} = 125 °C				0.2 2	mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 200 V				1	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7 V				0.2	μA
$V_{CEO(sus)}$*	Collector–emitter Sustaining Voltage	I_C = 200 mA		200			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 10 mA		10			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 30 A I_C = 50 A	I_B = 2 A I_B = 5 A		 0.9	1 1.5	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 30 A I_C = 50 A	I_B = 2 A I_B = 5 A		 1.55	1.8 2	V V
h_{FE}*	DC Current Gain	I_C = 5 A I_C = 50 A	V_{CE} = 4 V V_{CE} = 4 V	20 15		100	
$I_{s/b}$	Second Breakdown Collector Current	V_{CE} = 20 V	t = 1 s	17.5			A
f_T	Transition Frequency	I_C = 1 A f = 1 MHz	V_{CE} = 5 V	10	16		MHz
t_{on}	Turn-on Time (fig. 2)	I_C = 50 A V_{CC} = 100 V	I_{B1} = 5 A		0.35	1	μs
t_s	Storage Time (fig. 2)	I_C = 50 A I_{B2} = − 5 A	I_{B1} = 5 A V_{CC} = 100 V		0.9	2	μs
t_f	Fall Time (fig. 2)				0.24	0.6	μs
	Clamped $E_{s/b}$ Collector Current (fig. 1)	V_{clamp} = 200 V	L = 500 μH	50			A

* Pulsed : pulse duration = 300μs, duty cycle ≤ 2%.

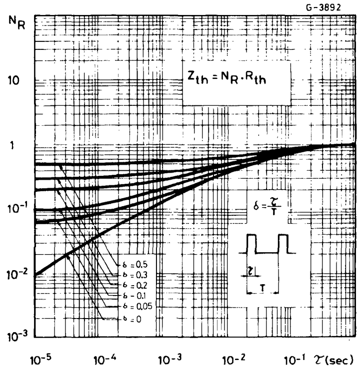
Safe Operating Areas.



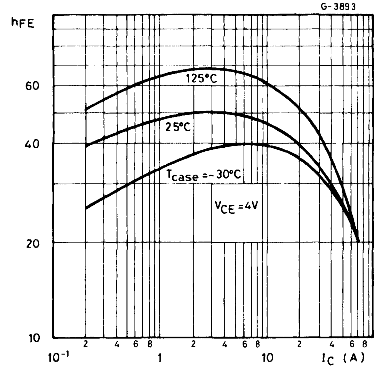
Derating Curves.



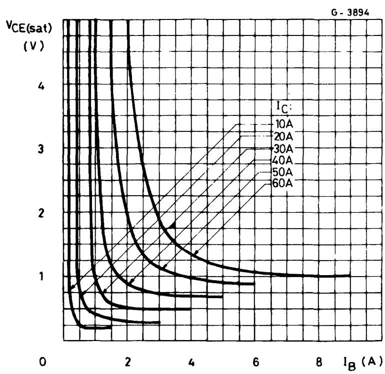
Thermal Transient Response.



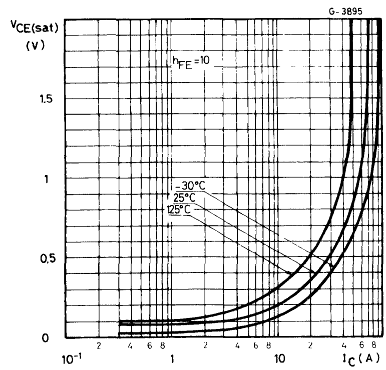
DC Current Gain.



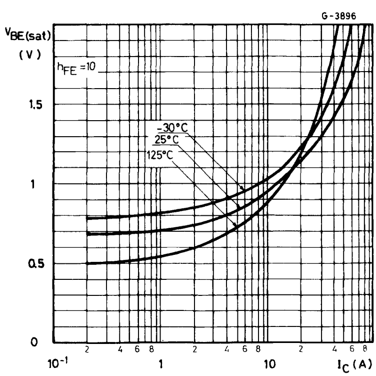
Collector-emitter Saturation Voltage.



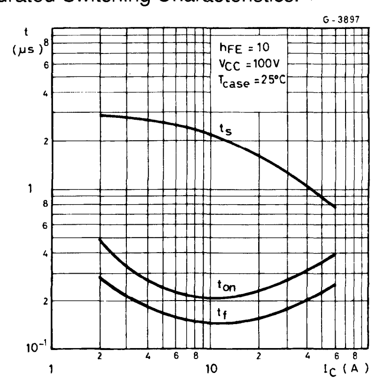
Collector-emitter Saturation Voltage.



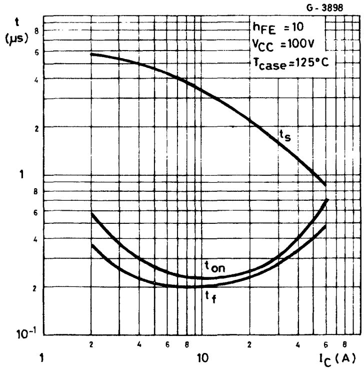
Base-emitter Saturation Voltage.



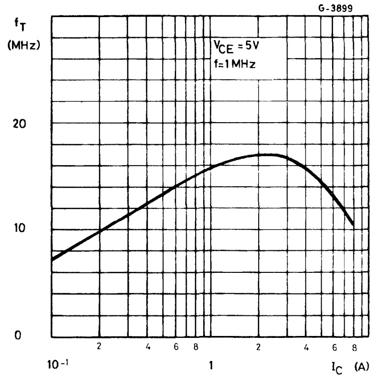
Saturated Switching Characteristics.



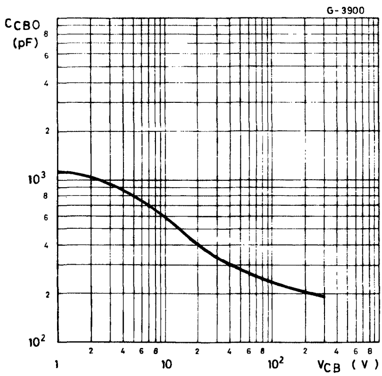
Saturated Switching Characteristics.



Transition Frequency.



Collector-base Capacitance.



Clamped Reverse Bias Safe Operating Areas.

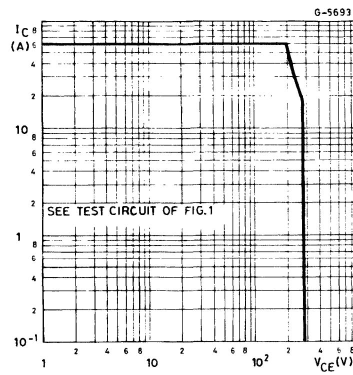


Figure 1 : Clamped Es/b Test Circuit.

TEST CONDITIONS :

$7V \geq |-V_{BB}| \geq 2V$
$I_C/I_B = 10$

t_p = adjusted for nominal I_C
$R_{BB} \geq 1\ \Omega$

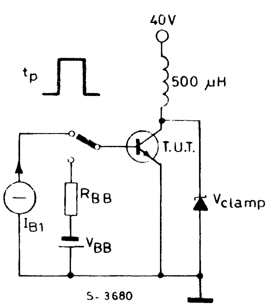


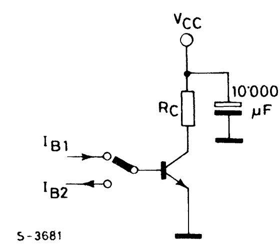
Figure 2 : Switching Times Test Circuit (resistive load).

TEST CONDITIONS :

V_{CC} = 100V

$R_C = \frac{V_{CC} - V_{CE(sat)}}{I_C}$

INPUT PULSE
pulse width = 10μs
t_r t_f ≤ 50ns
duty cycle = 1%.



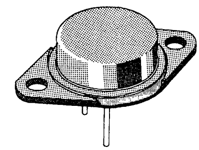
SGS-THOMSON MICROELECTRONICS

BUR52

HIGH CURRENT HIGH SPEED, HIGH POWER DARLINGTONS

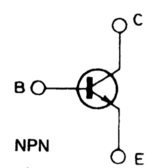
DESCRIPTION

The BUR52 is a silicon multiepitaxial planar NPN transistor in modified Jedec TO-3 metal case, intended for use in switching and linear applications in military and industrial equipment.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	350	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	250	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	10	V
I_C	Collector Current	60	A
I_{CM}	Collector Peak Current (t_p = 10 ms)	80	A
I_B	Base Current	16	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	350	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

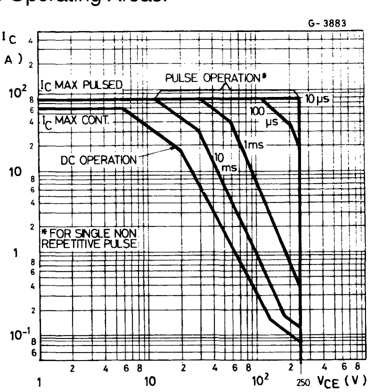
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	0.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

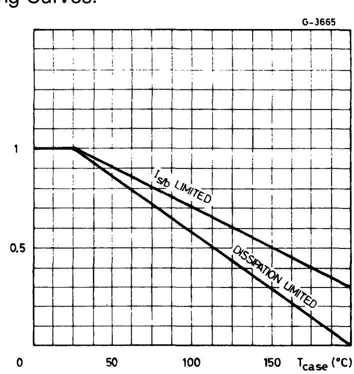
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 350 V V_{CB} = 350 V T_{case} = 125 °C				0.2 2	mA mA
I_{CEO}	Emitter–cutoff Current (I_B = 0)	V_{CE} = 250 V				1	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7 V				0.2	µA
$V_{CEO(sus)}$*	Collector–emitter Sustaining Voltage	I_C = 200 mA		250			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 10 mA		10			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 25 A I_C = 40 A	I_B = 2 A I_B = 4 A		 0.7	1 1.5	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 25 A I_C = 40 A	I_B = 2 A I_B = 4 A		 1.5	1.8 2	V V
h_{FE}*	DC Current Gain	I_C = 5 A I_C = 40 A	V_{CE} = 4 V V_{CE} = 4 V	20 15		100	
$I_{s/b}$	Second Breakdown Collector Current	V_{CE} = 20 V	t = 1 s	17.5			A
f_T	Transition Frequency	I_C = 1 A f = 1 MHz	V_{CE} = 5 V		10	16	MHz
t_{on}	Turn-on Time (fig. 2)	I_C = 40 A V_{CC} = 100 V	I_{B1} = 4 A		0.3	1	µs
t_s	Storage Time (fig. 2)	I_C = 40 A I_{B2} = – 4 A	I_{B1} = 4 A V_{CC} = 100 V		1.2	2	µs
t_f	Fall Time (fig. 2)				0.20	0.6	µs
	Clamped $E_{s/b}$ Collector Current (fig. 1)	V_{clamp} = 250 V	L = 500 µH	40			A

* Pulsed : pulse duration = 300µs, duty cycle ≤ 2%.

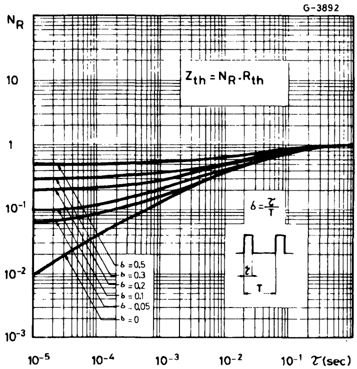
Safe Operating Areas.



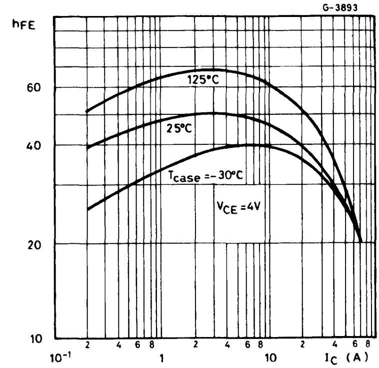
Derating Curves.



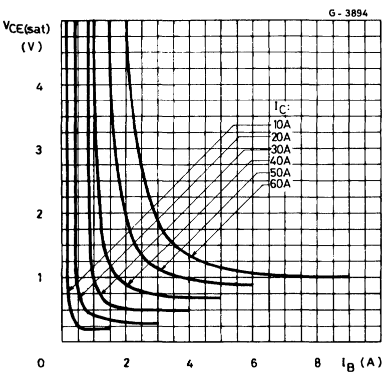
Thermal Transient Response.



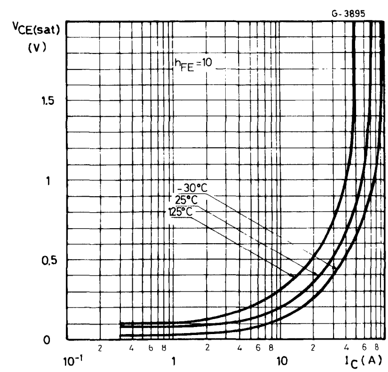
DC Current Gain.



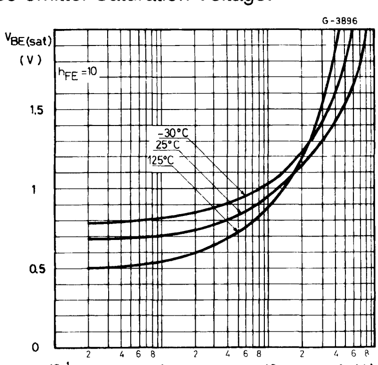
Collector-emitter Saturation Voltage.



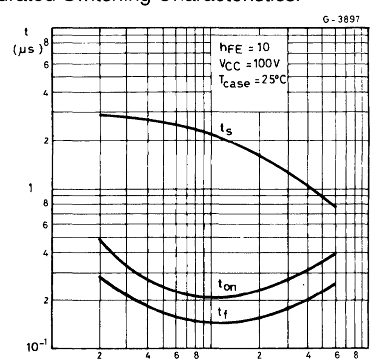
Collector-emitter Saturation Voltage.



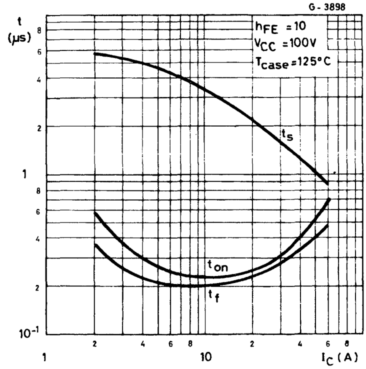
Base-emitter Saturation Voltage.



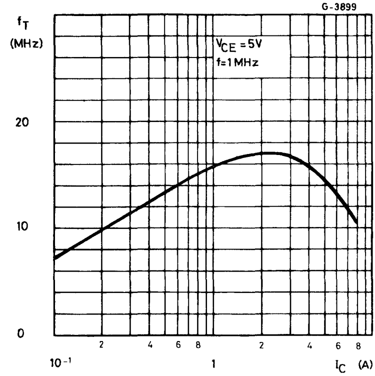
Saturated Switching Characteristics.



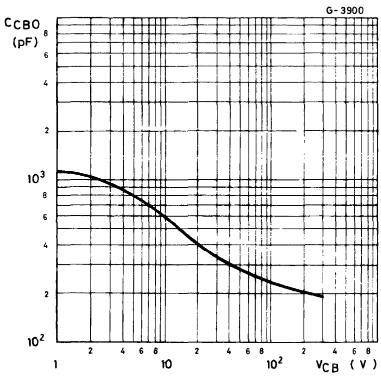
Saturated Switching Characteristics.



Transition Frequency.



Collector-base Capacitance.



Clamped Reverse Bias Safe Operating Areas.

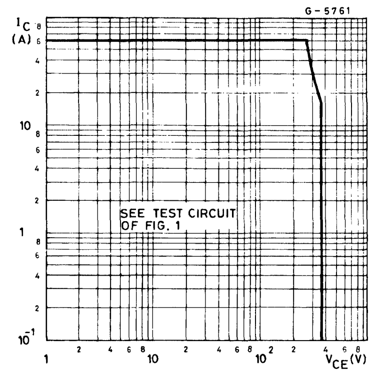


Figure 1 : Clamped Es/b Test Circuit.

TEST CONDITIONS :

$7V \geq |-V_{BB}| \geq 2V$
$I_C/I_B = 10$

t_p = adjusted for nominal I_C
$R_{BB} \geq 1\ \Omega$

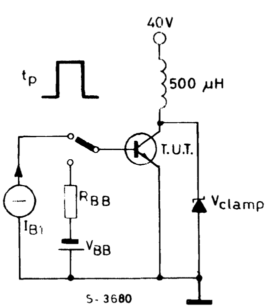


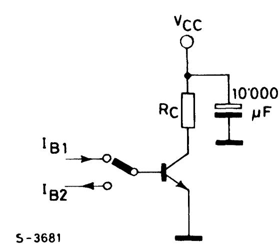
Figure 2 : Switching Times Test Circuit (resistive load).

TEST CONDITIONS :

V_{CC} = 100V

$R_C = \frac{V_{CC} - V_{CE(sat)}}{I_C}$

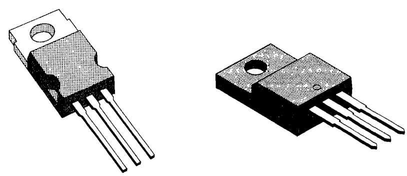
INPUT PULSE
pulse width = 10µs
t_r t_f ≤ 50ns
duty cycle = 1%.



HIGH VOLTAGE SWITCH

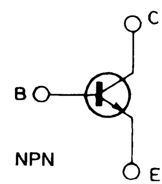
DESCRIPTION

The BUT11/A and BUT11FI/AFI are silicon miltiepitaxial mesa NPN transistors respectively in Jedec TO-220 plastic package and ISOWATT220 fully isolated package, particularly intended for switching application.



TO-220 ISOWATT220

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BUT11/FI	BUT11A/AFI	
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	850	1000	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	400	450	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	9		V
I_C	Collector Current	5		A
I_{CM}	Collector Peak Current	10		A
I_B	Base Current	2		A
I_{BM}	Base Peak Current	4		A
		TO-220	ISOWATT-220	
P_{tot}	Total Power Dissipation at $T_c \leq 25°C$	83	35	W
T_{stg}	Storage Temperature	– 65 to 150		°C
T_j	Max. Operating Junction Temperature	150		°C

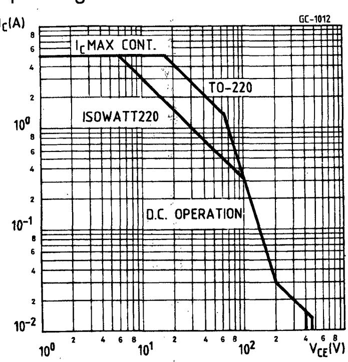
THERMAL DATA

			TO-220	ISOWATT220	
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.5	3.57	°C/W

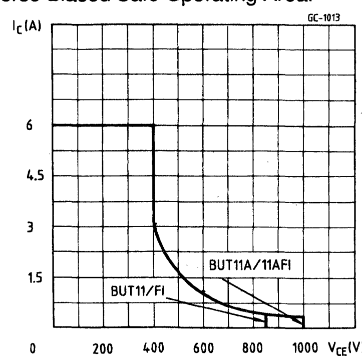
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = rated V_{CES} at T_{case} = 125°C			1 2	mA mA
I_{EBO}	Emitter Cuttoff	I_C = 0 V_{EB} = 9V			10	mA
V_{CEO}	Collector–emitter Sustaining Voltage	$I_{B\ (off)}$ = 0 I_C = 100mA for **BUT11/FI** for **BUT11A/AFI**	 400 450			 V V
$V_{CE(sat)}$	Collector–emitter Saturation Voltage	I_C = 3A I_B = 0.6A for **BUT11/FI** I_C = 2.5A I_B = 0.5A for **BUT11A/AFI**			1.5 1.5	V V
$V_{BE(sat)}$	Base–emitter Saturation Voltage	I_C = 3A I_B = 0.6A for **BUT11/FI** I_C = 2.5A I_B = 0.5A for **BUT11A/AFI**			1.3 1.3	V V
t_{on}	Turn on Time	I_C = 2.5A V_{CC} = 250V I_B = I_{B2} = 0.5A			1	µs
t_s	Storage Time				4	µs
t_f	Fall Time				0.8	µs

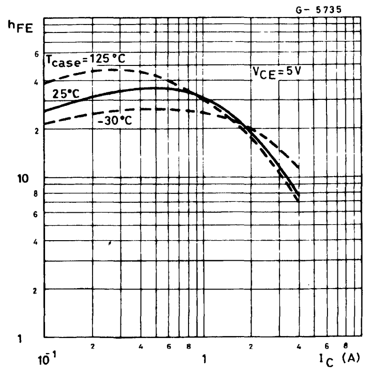
Safe Operating Area.



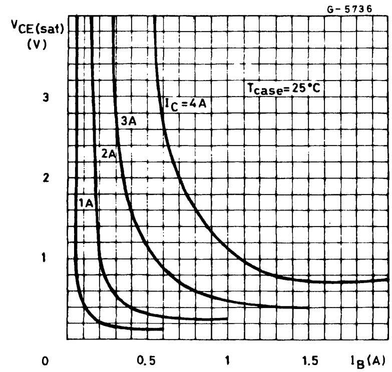
Reverse Biased Safe Operating Area.



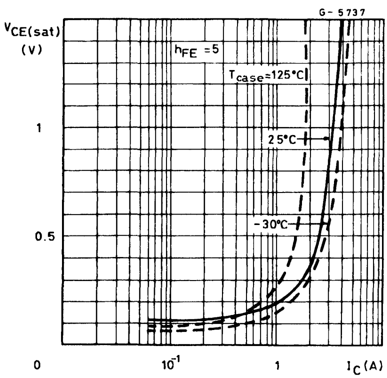
DC Current Gain.



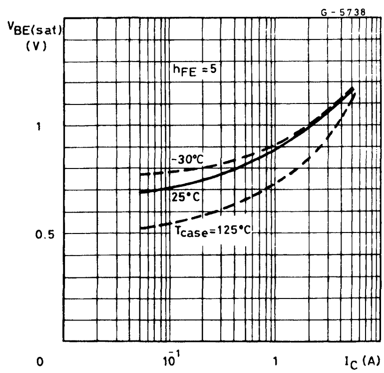
Collector-emitter Saturation Voltage.



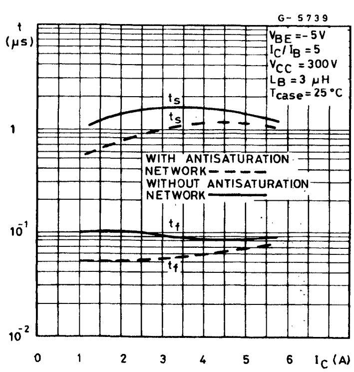
Collector-emitter Saturation Voltage.



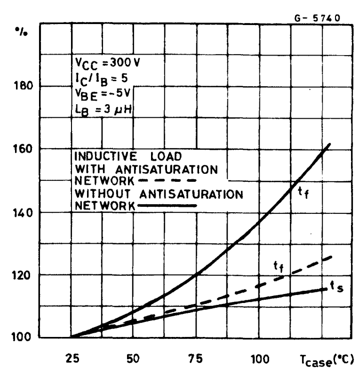
Base-emitter Saturation Voltage.



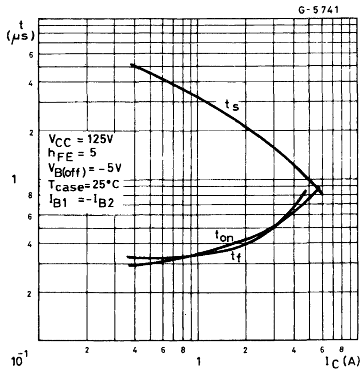
Switching Times Inductive Load
(test circuit fig. 2).



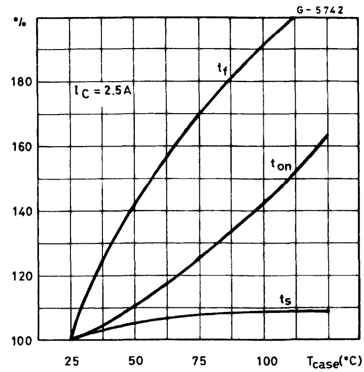
Switching Times Percentage Variation vs. T_{case}.



Saturated Switching Characteristics (test circuit fig. 1).



Switching Time Percentage Variation vs. T_{case} Resistive Load.



TEST CIRCUITS

Figure 1.

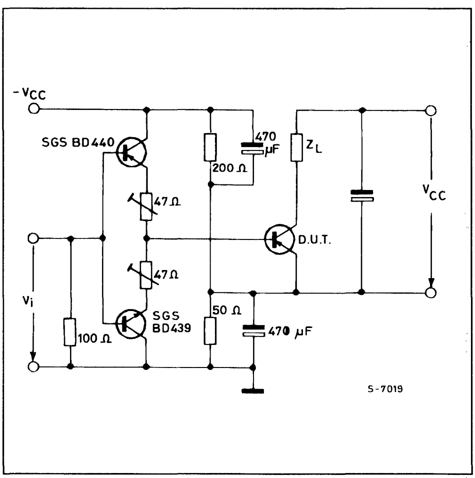
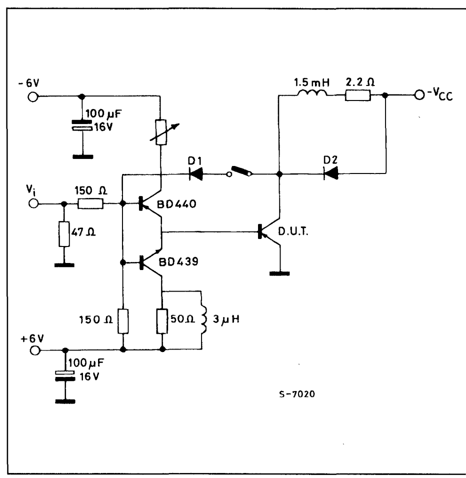


Figure 2.



ISOWATT220 PACKAGE CHARACTERISTICS AND APPLICATION

ISOWATT220 is fully isolated to 2000V dc. Its thermal impedance, given in the data sheet, is optimised to give efficient thermal conduction together with excellent electrical isolation.

The structure of the case ensures optimum distances between the pins and heatsink. The ISOWATT220 package eliminates the need for external isolation so reducing fixing hardware. Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

ISOWATT220 thermal performance is equivalent to that of the standard part, mounted with a 0.1mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for ISOWATT220 packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT220 PACKAGE

Fig. 3 illustrates the elements contributing to the thermal resistance of a transistor heatsink assembly, using ISOWATT220 package.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements.

The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1 - for a short duration power pulse less than 1ms :

$$Z_{th} < T_{thJ\text{-}C}$$

2 - for an intermediate power pulse of 5ms to 50ms :

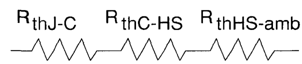
$$Z_{th} = T_{thJ\text{-}C}$$

3 - for long power pulses of the order of 500ms or greater :

$$Z_{th} = R_{thJ-C} + R_{thC-HS} + R_{thHS-amb}$$

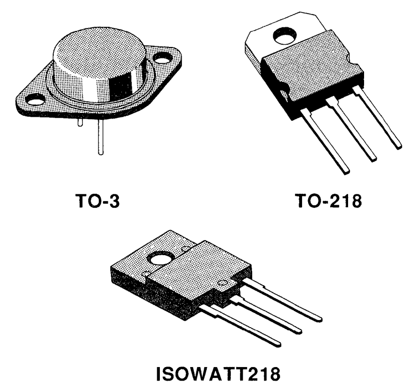
It is often possible to discern these areas on transient thermal impedance curves.

Figure 3.

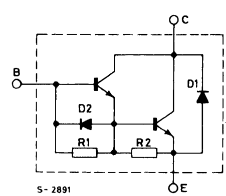


HIGH VOLTAGE POWER SWITCH

- HIGH POWER
- INTEGRATED SPEED-UP DIODE



INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

The BUT13 , BUT13P and BUT13PFI are silicon multiepitaxial planar NPN transistors in monolithic darlington configuration with integrated base-emitter speed-up diode, mounted respectively in TO-3 metal case, TO-218 plastic package and ISOWATT218 fully isolated package.

They are particularly suited for output stages in power, fast switching applications.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	600			V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	400			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	10			V
I_C	Collector Current	28			A
I_{CM}	Collector Peak Current	35			A
I_B	Base Current	6			A
		TO-3	**TO-218**	**ISOWATT218**	
P_{tot}	Total Dissipation at T_c < 25°C	175	125	60	W
T_{stg}	Storage Temperature	– 65 to 200	– 65 to 150	– 65 to 150	°C
T_j	Max. Operating Junction Temperature	200	150	150	°C

THERMAL DATA

		TO-3	TO-218	ISOWATT218	
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case Max	1	1	2.08	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector Cutoff Current	V_{CE} = 600 V V_{CE} = 600 V T_{case} = 100 °C			100 2	μA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 400 V			1	mA
I_{EBO}	Emitter Cuttoff Current (I_C = 0)	V_{EB} = 2 V			20	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 100 mA	400			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10 A I_B = 0.5 A I_C = 18 A I_B = 1.8 A I_C = 22 A I_B = 2.2 A I_C = 28 A I_B = 5.6 A		1.3 1.7 2 2.35	2 2.5 3 5	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 10 A I_B = 0.5 A I_C = 18 A I_B = 1.8 A I_C = 22 A I_B = 2.2 A		 2.5 	2.5 3 3.3	V V V
h_{FE}*	DC Current Gain	I_C = 10 A V_{CE} = 5 V I_C = 18 A V_{CE} = 5 V	30 30	300 90		
V_F*	Diode Forward Voltage	I_F = 22 A		2.2	4	V

RESISTIVE SWITCHING TIMES

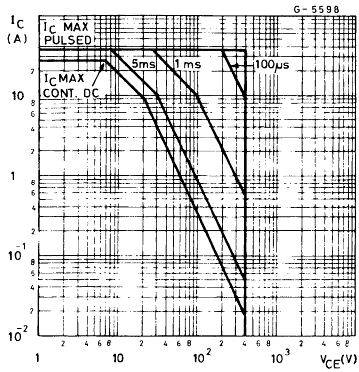
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	V_{CC} = 250 V I_C = 10 A I_{B1} = 0.5 A $V_{BE(off)}$ = − 5 V		0.5	0.6	μs
t_s	Storage Time			1.1	1.5	μs
t_f	Fall Time			0.3	0.6	μs

INDUCTIVE SWITCHING TIMES

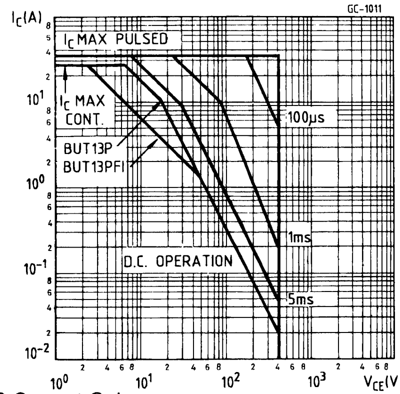
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	V_{clamp} = 250 V I_C = 10 A I_{B1} = 0.2 A ; $V_{BE(off)}$ = − 5 V		1.3	2	μs
t_f	Fall Time			0.11	0.5	μs
t_c	Crossover Time			0.4	0.8	μs
t_s	Storage Time	V_{clamp} = 250 V I_C = 20 A I_{B1} = 0.4 A ; $V_{BE(off)}$ = − 5 V		1.4	2.6	μs
t_f	Fall Time			0.4	0.7	μs
t_c	Crossover Time			0.8	1.5	μs

* Pulsed : pulse duration = 300 μs, duty cycle = 1.5 %.

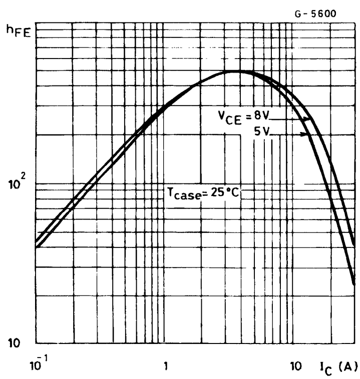
Safe Operating Areas (for BUT13).



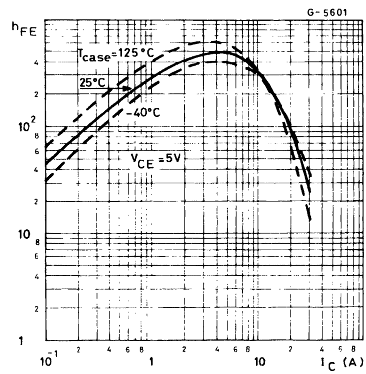
Safe Operaging Areas (for BUT13P and BUT13PFI).



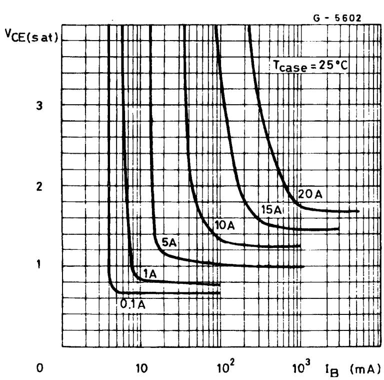
DC Current Gain.



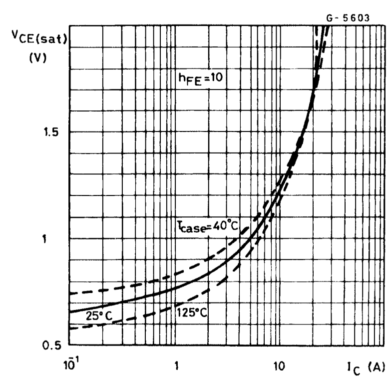
DC Current Gain.



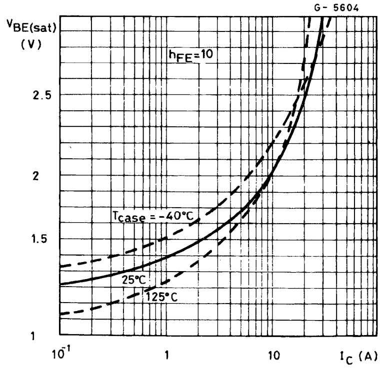
Collector-emitter Saturation Voltage.



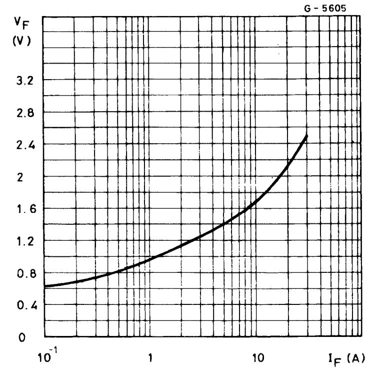
Collector-emitter Saturation Voltage.



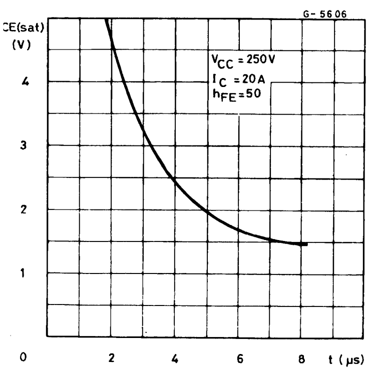
Base-emitter Saturation Voltage.



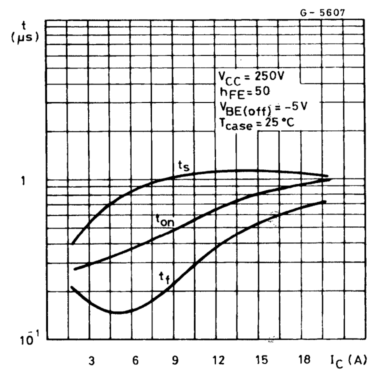
Freewheel Diode Forward Voltage.



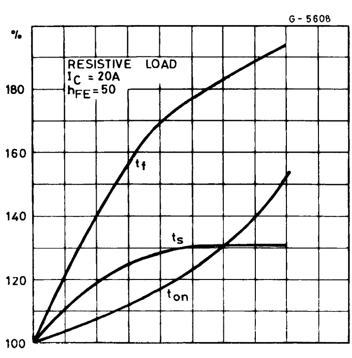
Collector-emitter Saturation Voltage Dynamic.



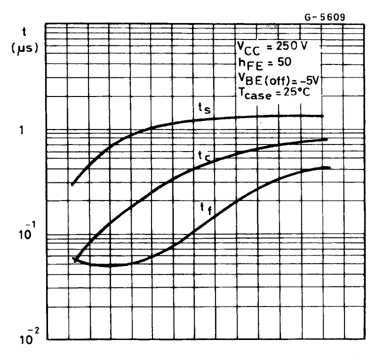
Switching Times Resistive Load (test circuit fig. 1).



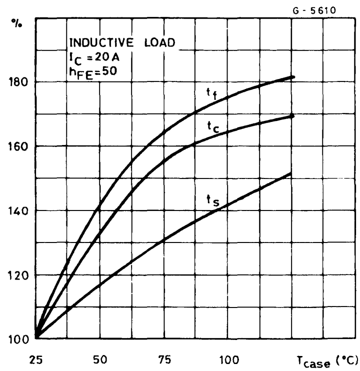
Switching Times Percentage Variation vs. T_{case}.



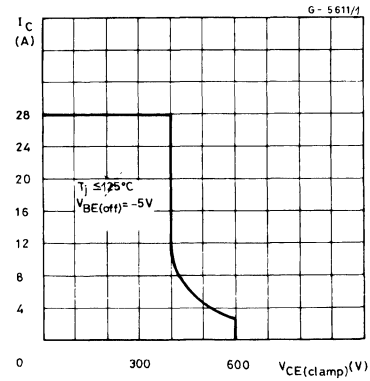
Switching Times Inductive Load Test (test circuit fig. 1).



Switching Times Percentage Variation vs. T_{case}.

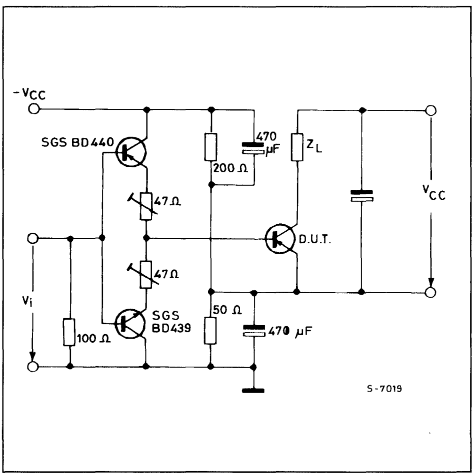


Clamped Reverse Bias Safe Operating Area.



TEST CIRCUITS

Figure 1.



ISOWATT218 PACKAGE CHARACTERISTICS AND APPLICATION

ISOWATT218 is fully isolated to 4000V dc. Its thermal impedance, given in the data sheet, is optimised to give efficient thermal conduction together with excellent electrical isolation.

The structure of the case ensures optimum distances between the pins and heatsink. These distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 package eliminates the need for external isolation so reducing fixing hardware.

The package is supplied with leads longer than the standard TO-218 to allow easy mounting on pcbs.

Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

ISOWATT218 thermal performance is equivalent to that of the standard part, mounted with a 0.1mm mica washer.

The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for ISOWATT218 packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT218 PACKAGE

Figure 2 illustrates the elements contributing to the thermal resistance of a transistor heatsink assembly, using ISOWATT218 package.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements.

The transient thermal impedance, Zth for different pulse durations can be estimated as follows :

1-For a short duration power pulse of less than 1ms :

$$Z_{th} < R_{thJ\text{-}C}$$

2-For an intermediate power pulse of 5ms to 50ms seconds :

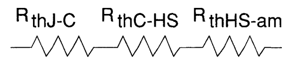
$$Z_{th} = R_{thJ\text{-}C}$$

3-For long power pulses of the order of 500ms seconds or greater :

$$Z_{th} = R_{thJ\text{-}C} + R_{thC\text{-}HS} + R_{thHS\text{-}amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 2.

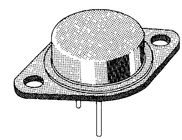


BUT90

FAST SWITCHING POWER TRANSISTOR

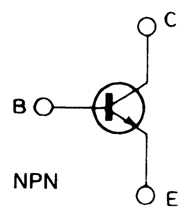
DESCRIPTION

High current, high speed transistor suited for power conversion applications high efficiency converters motors controls.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	200	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	125	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	10	V
I_C	Collector Current	50	A
I_{CM}	Collector Peak Current	120	A
I_B	Base Current	12	A
I_{BM}	Base Peak Current	32	A
P_{tot}	Total Dissipation at T_c < 25°C	250	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

$R_{thj-case}$	Thermal Resistance Junction-case	Max	0.7	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			0.4 4	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = − 1.5V $V_{CE} = V_{CEV}$ V_{BE} = − 1.5V T_c = 100°C			0.2 2	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	125			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	10			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 35A I_B = 1.75A I_C = 70A I_B = 7A I_C = 35A I_B = 1.75A T_j = 100°C I_C = 70A I_B = 7A T_j = 100°C		0.55 0.8 0.75 1.2	0.9 0.9 1.2 1.5	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 35A I_B = 1.75A I_C = 70A I_B = 7A I_C = 35A I_B = 1.75A T_j = 100°C I_C = 70A I_B = 7A T_j = 100°C		1 1.45 1 1.65	1.3 1.8 1.4 2	V V V V

RESISTIVE LOAD

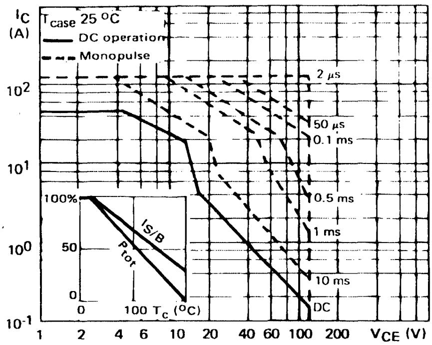
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_r t_s t_f	Rise Time Storage Time Fall Time	V_{CC} = 100V I_C = 70A I_{B1} = − I_{B2} = 7A t_p = 30μs		0.8 0.9 0.2	1.2 1.5 0.4	μs μs μs
t_r t_s t_f	Rise Time Storage Time Fall Time	V_{CC} = 100V I_C = 70A I_{B1} = − I_{B2} = 7A t_p = 30μs T_j = 100°C		1.1 1.2 0.3	1.6 2 0.6	μs μs μs

INDUCTIVE LOAD

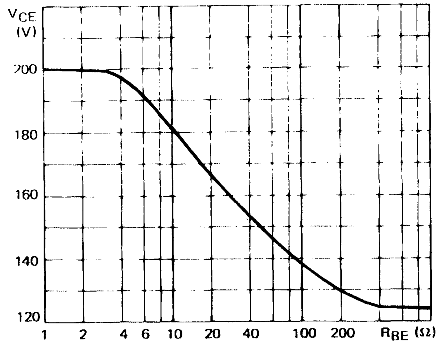
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s t_f	Storage Time Fall Time	V_{CC} = 100V V_{clamp} = 125V I_C = 70A I_{B1} = − I_{B2} = 7A L_C = 70μH		1.25 0.16	2 0.3	μs μs
t_s t_f	Storage Time Fall Time	V_{CC} = 100V V_{clamp} = 125V I_C = 70A I_{B1} = − I_{B2} = 7A L_C = 70μH T_j = 100°C		1.5 0.25	2.3 0.5	μs μs

* Pulsed : Pulse duration = 300μs, duty cycle = 2%.

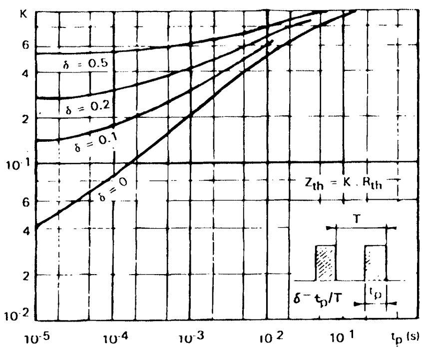
DC and Pulse Area.



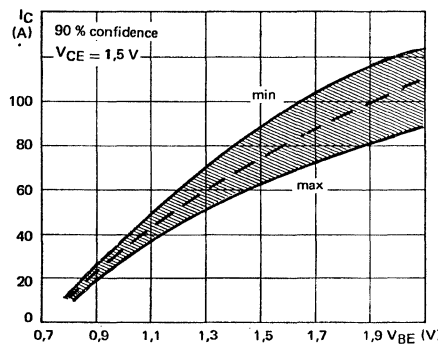
Collector-emitter vs. Base Emitter Resistance.



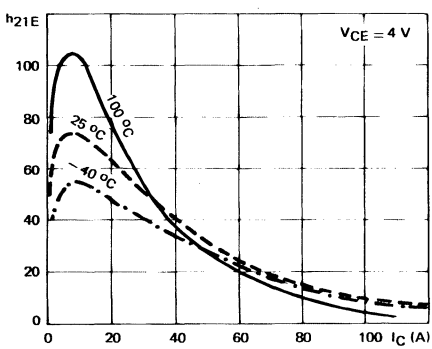
Transient Thermal Response.



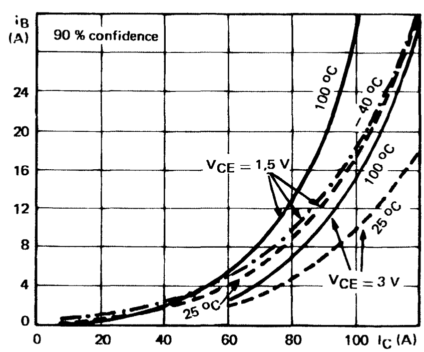
Collector-current Spread vs. Base-emitter Voltage.



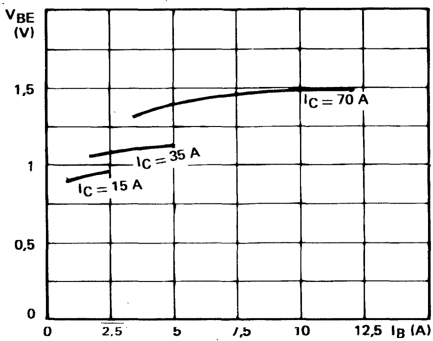
DC Current Gain.



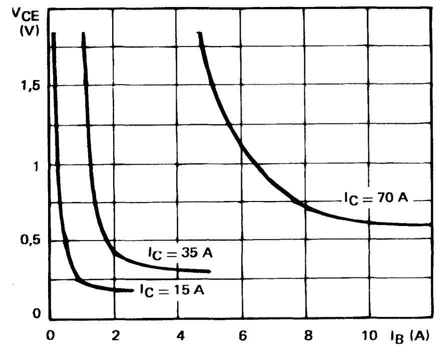
Minimum Base Current to saturate the Transistor.



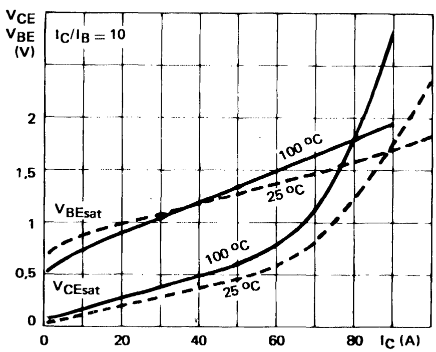
Base Characteristics.



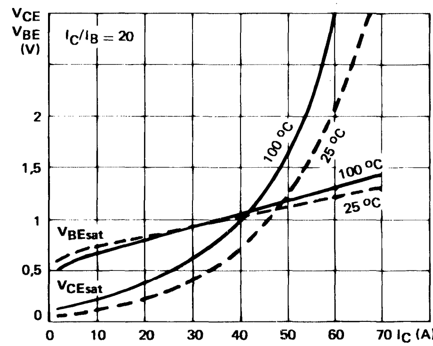
Collector Saturation Region.



Saturation Voltage Low Gain.



Saturation Voltage High Gain.



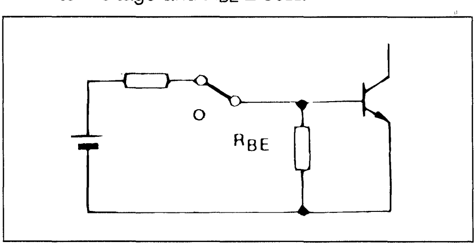
SWITCHING OPERATING AND OVERLOAD AREAS

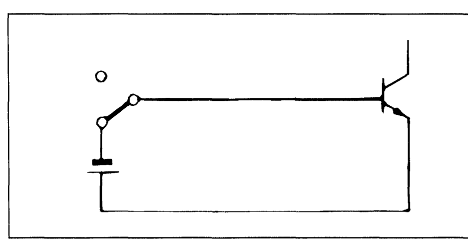
TRANSISTOR FORWARD BIASED

- During the turn on
- During the turn off without negative base emitter voltage and $R_{BE} \leq 50\Omega$.

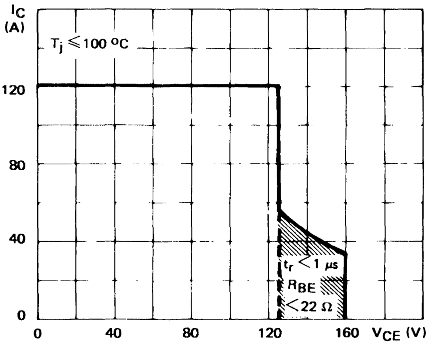
TRANSISTOR REVERSE BIASED

- During the turn off with negative base-emitter voltage.

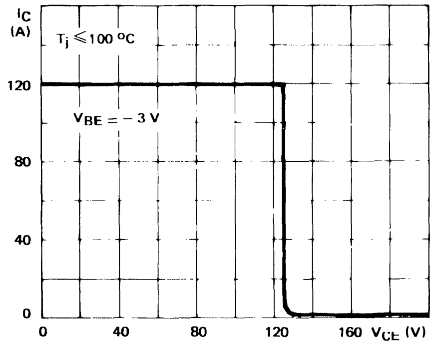




Forward biased Safe Operating Area (FBSOA).

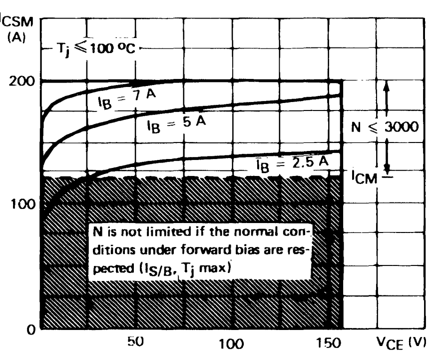


Reverse biased Safe Operating Area (RBSOA).

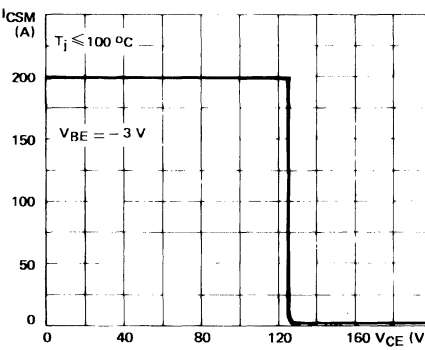


The hatched zone can only be used for turn on.

Forward biased Accidental Overload Area (FBAOA).



Reverse biased Accidental Overload Area (RBAOA).

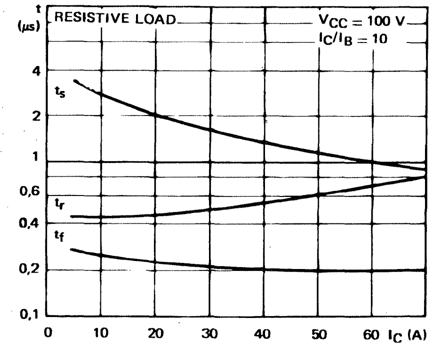


The Kellog network (heavy point) allows the calculation of the maximum value of the short-circuit current for a given base current I_B (90% confidence).

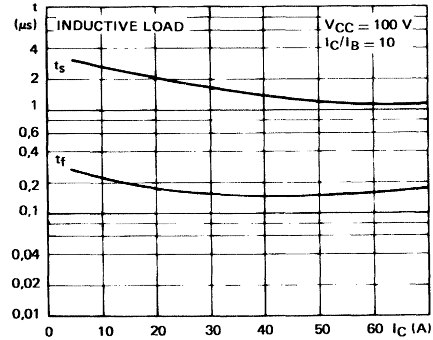
After the accidental overload current, the RBAOA has to be used for the turn off.

High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

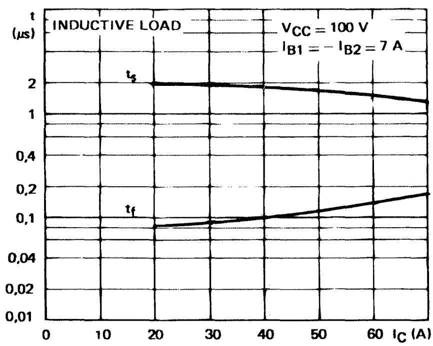
Switching Times vs. Collector Current (resistive load).



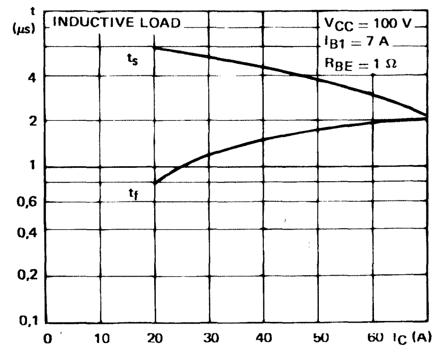
Switching Times vs. Collector Current (inductive load).



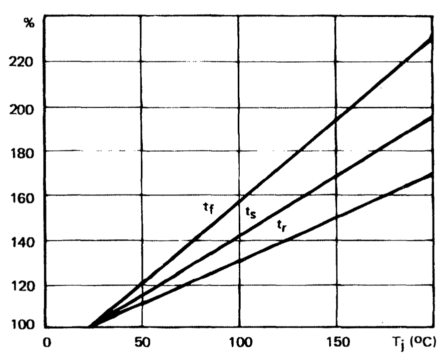
Inductive Load with Negative Base Drive.



Inductive Load without Negative Base Drive.



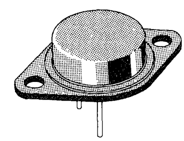
Switching Times vs. Junction Temperature.



BUT91

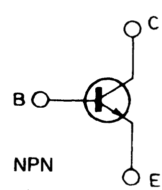
FAST SWITCHING POWER TRANSISTOR

- HIGH CURRENT CAPABILITY
- LOW SATURATION VOLTAGE
- FAST TURN-ON AND TURN-OFF



TO-3

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

High current, high speed transistor suited for low voltage application.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	300	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	200	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	10	V
I_C	Collector Current	50	A
I_{CM}	Collector Peak Current	70	A
I_B	Base Current	10	A
I_{BM}	Base Peak Current	15	A
P_{tot}	Total Dissipation at T_C < 25°C	250	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

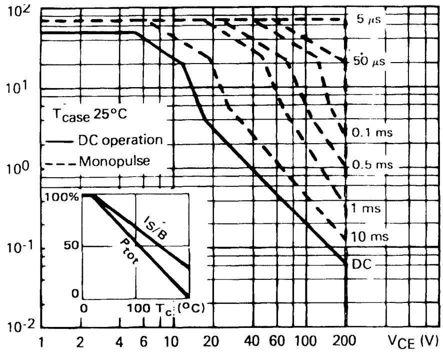
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	0.7	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

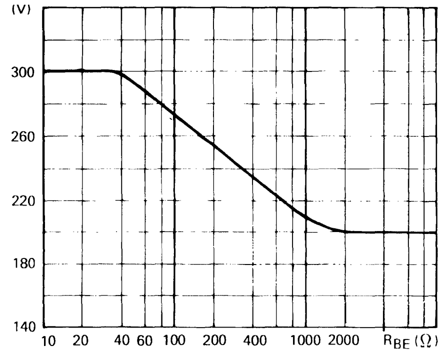
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_C = 100°C			0.4 4	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = - 1.5V $V_{CE} = V_{CEV}$ V_{BE} = - 1.5V T_C = 100°C			0.2 2	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	200			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	10			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 20A I_B = 1A I_C = 40A I_B = 4A I_C = 20A I_B = 1A T_j = 100°C I_C = 40A I_B = 4A T_j = 100°C		0.55 0.7 0.7 0.95	0.9 1.2 1.2 1.8	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 20A I_B = 1A I_C = 40A I_B = 4A I_C = 20A I_B = 1A T_j = 100°C I_C = 40A I_B = 4A T_j = 100°C		0.95 1.25 0.9 1.3	1.3 1.8 1.4 1.9	V V V V
 t_r t_s t_f	**RESISTIVE LOAD** Rise Time Storage Time Fall Time	V_{CC} = 150V I_C = 40A I_{B1} = − I_{B2} = 4A t_p = 30µs		0.5 0.65 0.15	0.8 1.2 0.3	µs µs µs
t_r t_s t_f	Rise Time Storage Time Fall Time	V_{CC} = 150V I_C = 40A I_{B1} = − I_{B2} = 4A t_p = 30µs T_j = 100°C		0.7 0.85 0.32	1.2 1.5 0.65	µs µs µs
 t_s t_f	**INDUCTIVE LOAD** Fall Time Storage Time	V_{CC} = 150V V_{clamp} = 200V I_C = 40A I_{B1} = − I_{B2} = 4A L_C = 70µH		0.7 0.08	1.5 0.2	µs µs
t_s t_f	Storage Time Fall Time	V_{CC} = 150V V_{clamp} = 200V I_C = 40A I_{B1} = − I_{B2} = 4A L_C = 70µH T_j = 100°C		1.1 0.18	1.8 0.4	µs µs

* Pulsed : Pulse duration = 300µs, duty cycle = 2%.

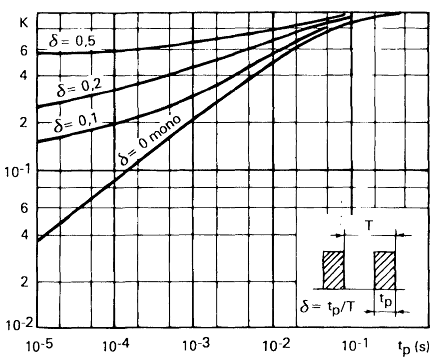
DC and AC Pulse Area.



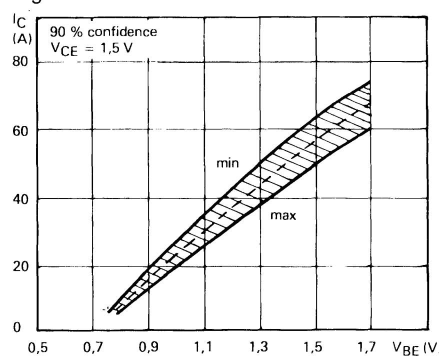
Collector-emitter vs. Base-emitter Resistance.



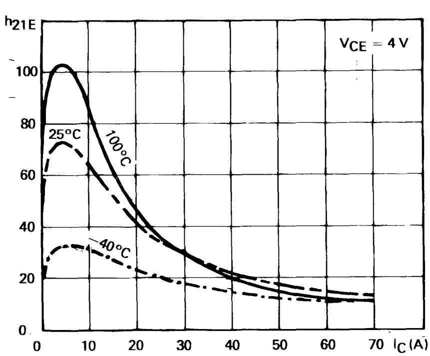
Transient Thermal Response.



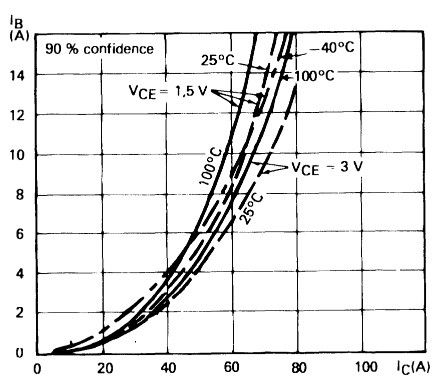
Collector Current Spread vs. Base-emitter Voltage.



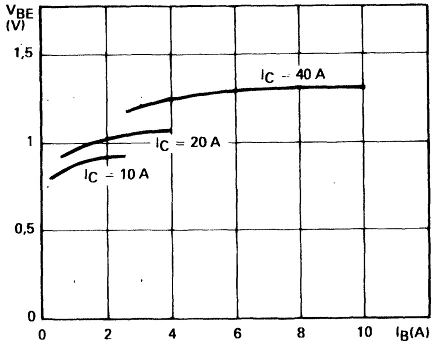
DC Current Gain.



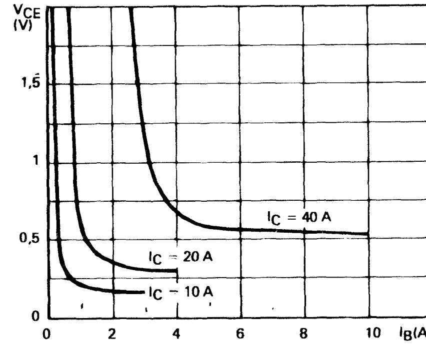
Minimum Base Current to saturate the Transistor.



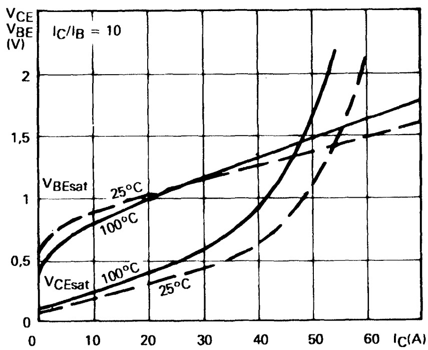
Base Characteristics.



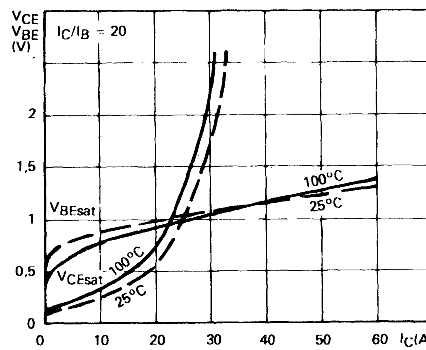
Collector Saturation Region.



Saturation Voltage Low Gain.



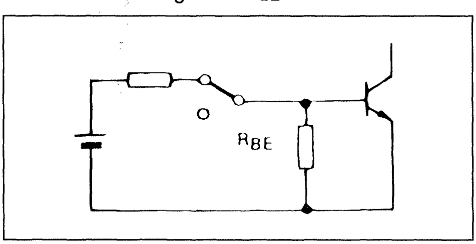
Saturation Voltage High Gain.



SWITCHING OPERATING AND OVERLOAD AREAS

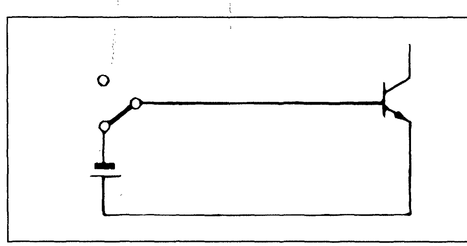
TRANSISTOR FORWARD BIASED

- During the turn-on
- During the turn-off without negative base emitter voltage and $R_{BE} \leq 50\Omega$.

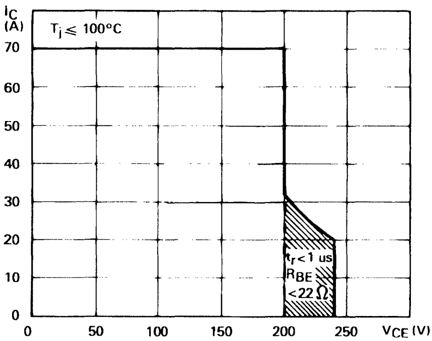


TRANSISTOR REVERSE BIASED

- During the turn-off with negative base-emitter voltage.

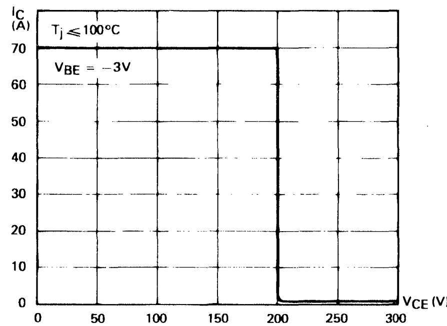


Forward biased Safe Operating Area (FBSOA).

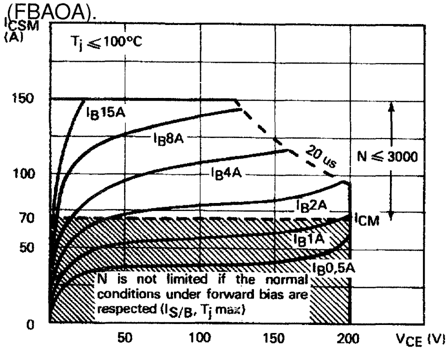


The hatched zone can only be used for turn-on.

Reverse biased Safe Operating Area (RBSOA).

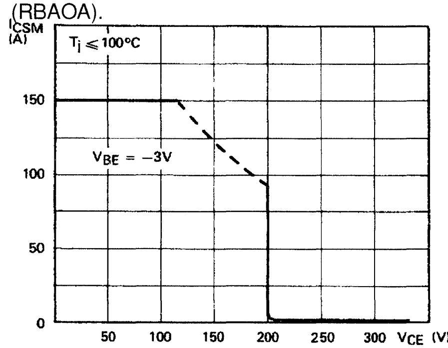


Forward biased Accidental Overload Area (FBAOA).



The Kellog network (heavy point) allows the calculation of the maximum value of the short-circuit current for a given base current IB (90% confidence).

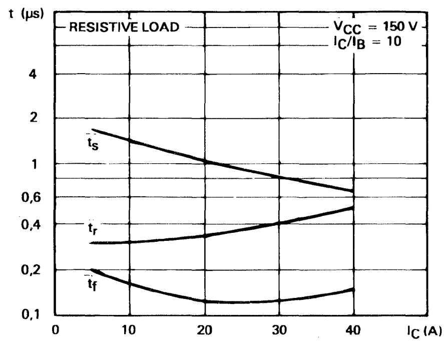
Reverse biased Accidental Overload Area (RBAOA).



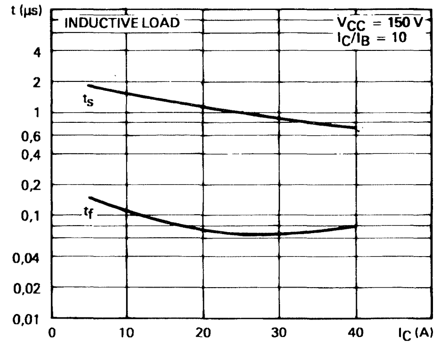
After the accidental overload current, the RBAOA has to be used for the turn-off.

High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

Switching Times vs. Collector Current (resistive load).

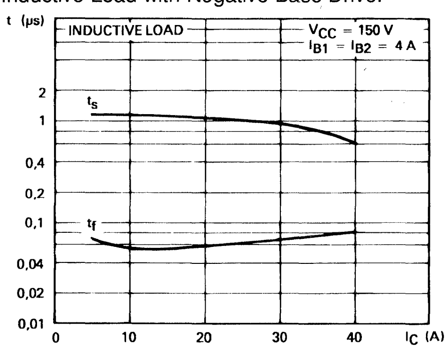


Switching Times vs. Collector Current (inductive load).

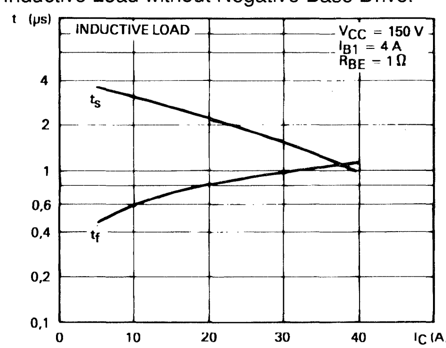


SWITCHING TIMES AT CONSTANT GAIN

Inductive Load with Negative Base Drive.

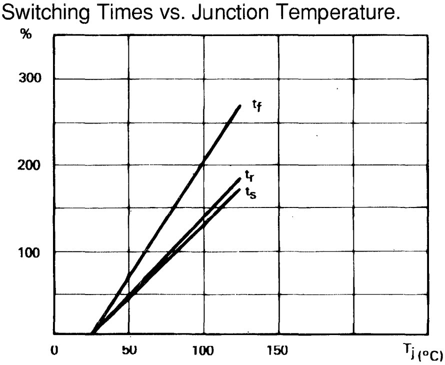


Inductive Load without Negative Base Drive.

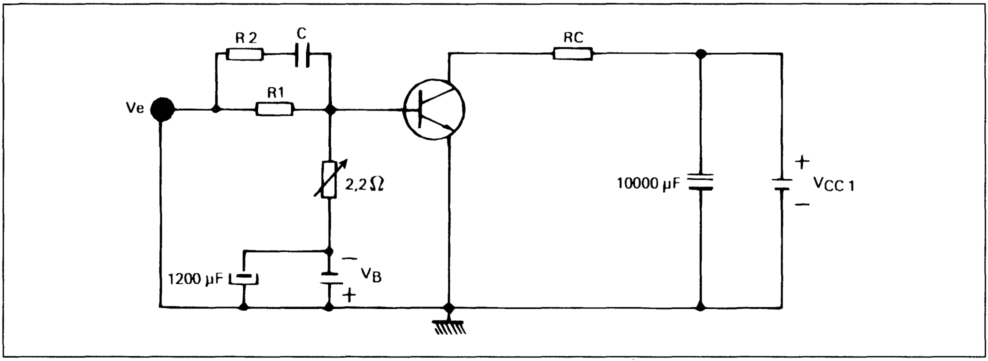


SWITCHING TIMES AT CONSTANT DRIVE

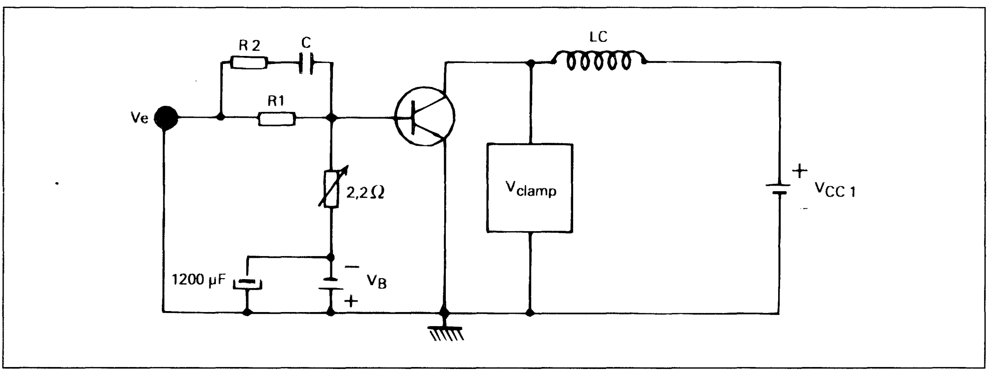
Switching Times vs. Junction Temperature.



SWITCHING ON RESISTIVE LOAD



SWITCHING ON INDUCTIVE LOAD



$R_C = 37{,}5\Omega$
$R1 = 2{,}2\Omega$
$R2 = 3{,}3\Omega$
$C = 60nF$
} Resistance non inductive

I_C	= 40A
I_{B1}	$= -I_{B2} = 4A$
V_{CC1}	= 150V
$V_{CCclamp}$	= 200V
V_B	= 6V
V_e	= 25V
L_C	= 190μH
D_1	

$$\frac{dI_{B1}}{dt} \geq 10A/\mu s$$

$$\frac{dI_{B2}}{dt} \geq 40A/\mu s$$

Switching on resistive load

$t_p \approx 20\mu s$

$\delta \leq 1\%$

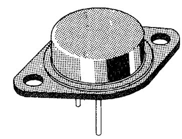
Switching on inductive load

$t_p \approx 50\mu s$

$\delta \leq 1\%$

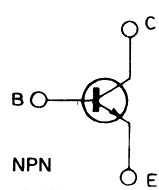
FAST SWITCHING POWER TRANSISTOR

- $h_{FE} > 10$ AT $I_C = 35A$
- HIGH EFFICIENCY SWITCHING
- VERY LOW SATURATION VOLTAGE
- RECTANGULAR SAFE OPERATING AREA
- WIDE ACCIDENTAL OVERLOAD AREA



TO-3

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

Suitable for motor-drives, S.M.P.S. converters, uninterruptible power supply operating medium low voltage supply.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	350	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	250	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_E	Emitter Current	50	A
I_{EM}	Emitter Peak Current	75	A
I_B	Base Current	10	A
I_{BM}	Base Peak Current	15	A
P_{tot}	Total Dissipation at T_c < 25°C	250	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

$R_{thj-case}$	Thermal Resistance Junction-case	max	0.7	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			0.4 4	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = – 1.5V $V_{CE} = V_{CEV}$ V_{BE} = – 1.5V T_c = 100°C			0.2 2	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	250			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 35A I_B = 3.5A I_C = 35A I_B = 3.5A T_j = 100°C		0.8 1.25	1.2 1.9	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 35A I_B = 3.5A I_C = 35A I_B = 3.5A T_j = 100°C		1.2 1.2	1.5 1.5	V V
di_C/dt	Rated of Rise of on-state Collector Current	V_{CC} = 200V R_C = 0 I_{B1} = 5.25A t_p = 3μs T_j = 100°C See fig. 1 and 2	125	200		A/μs
$V_{CE(3\mu s)}$	Collector Emitter Dynamic Voltage	V_{CC} = 200V I_{B1} = 5.25A R_C = 5.7Ω T_j = 100°C See fig. 1 and 2		3	6	V
$V_{CE(5\mu s)}$	Collector Emitter Dynamic Voltage	V_{CC} = 200V I_{B1} = 5.25A R_C = 5.7Ω T_j = 100°C See fig. 1 and 2		1.8	3	V
 t_s t_f t_c	INDUCTIVE LOAD Storage Time Fall Time Crossover Time	V_{CC} = 200V V_{clamp} = 250V I_C = 35A I_{B1} = 3.5A V_{BB} = – 5V L_C = 0.28mH R_{B2} = 0.7Ω T_j = 100°C See fig. 3a and 3b		1.4 0.15 0.3	3 0.4 0.7	μs μs μs
V_{CEW}	Maximum Collector Emitter Voltage without Snubber	V_{CC} = 50V I_{CWoff} = 52A V_{BB} = – 5V I_{B1} = 3.5A L_C = 48μH R_{B2} = 0.7Ω T_j = 125°C See fig. 3a and 3b	250			V

* Pulsed : Pulse duration = 300 μs, duty cycle = 2%.

Figure 1 : Turn-on Switching Test Circuit.

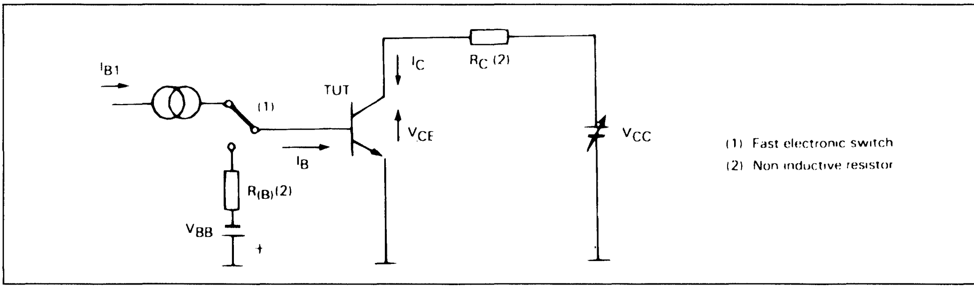


Figure 2 : Turn-off Switching Waveforms.

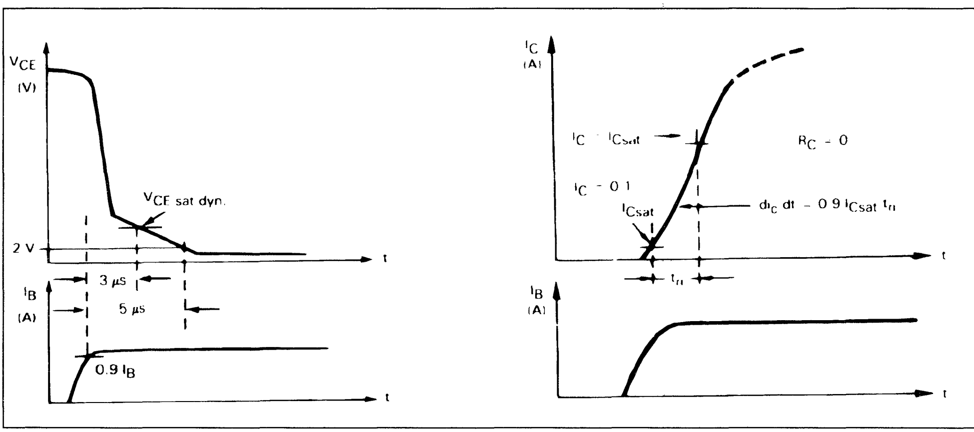


Figure 3a : Turn-off Switching Test Circuit.

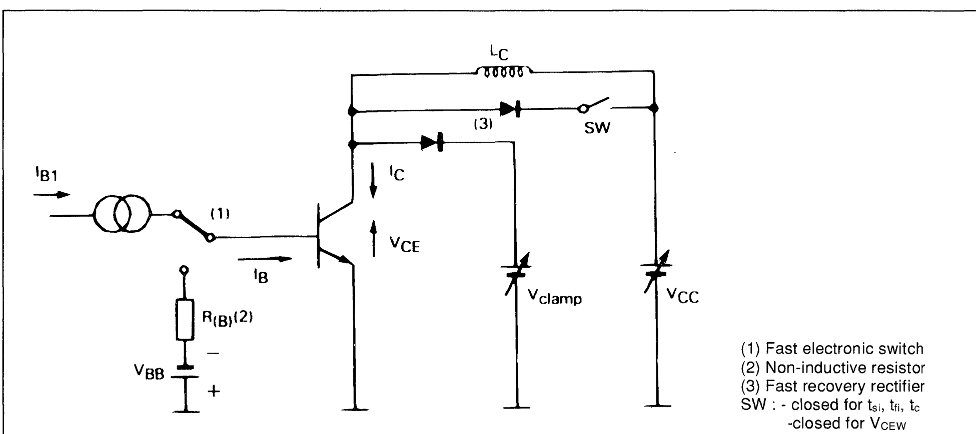
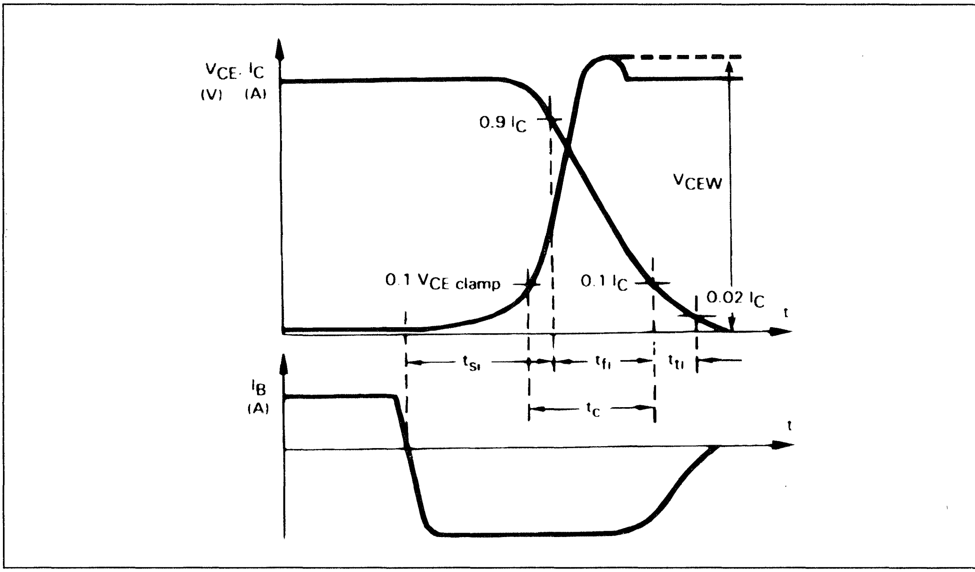
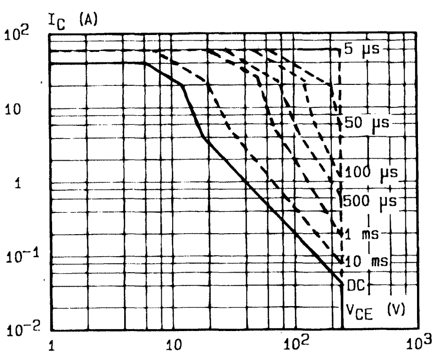


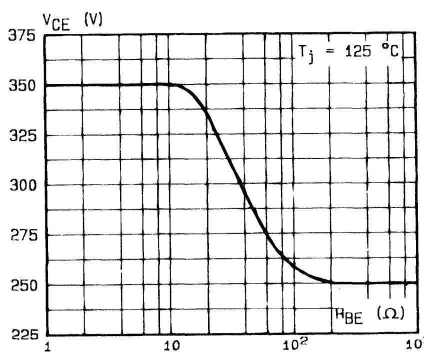
Figure 3b : Turn-off Switching Waveforms (inductive load).



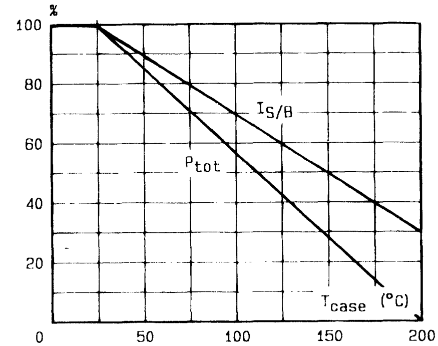
DC and AC Pulse Area.



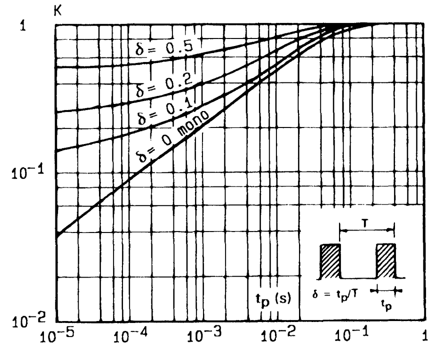
Collector-emitter Voltage vs. Base emitter Resistance.



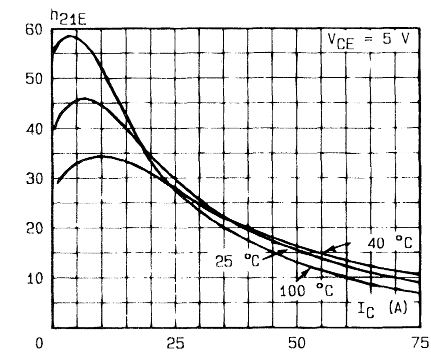
Power and $I_{S/B}$ Derating versus Case Temperature.



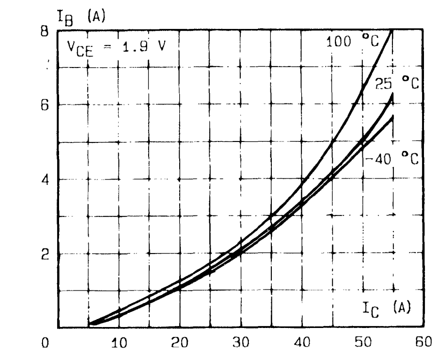
Transient Thermal Response.



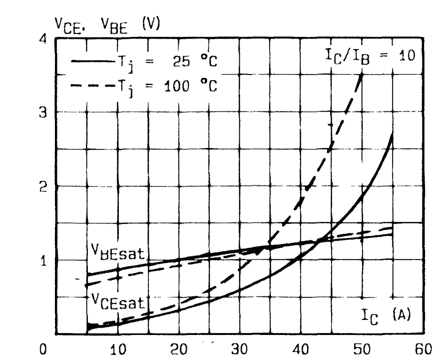
DC Current Gain.



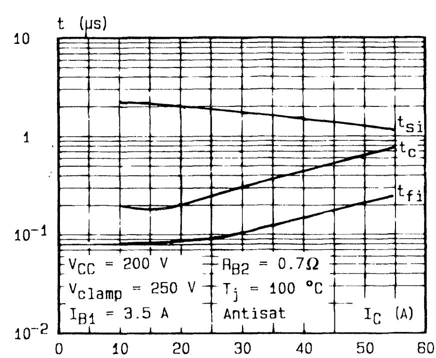
Minimum Base Current to saturate the Transistor.



Saturation Voltage.

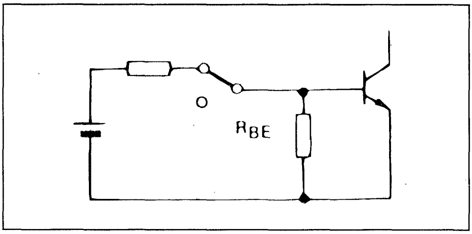


Switching Times versus Collector Current (inductive load).

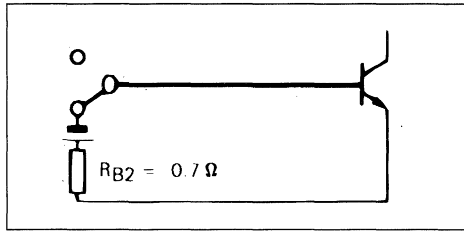


SWITCHING OPERATING AND OVERLOAD AREAS

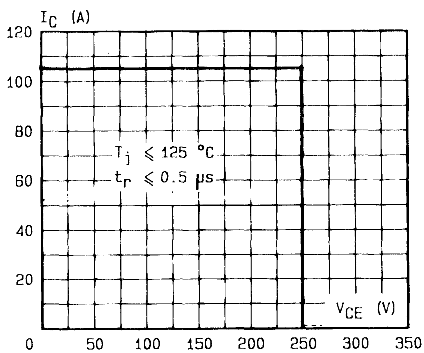
TRANSISTOR FORWARD BIASED
- During the turn-on
- During the turn-off without negative base-emitter voltage.



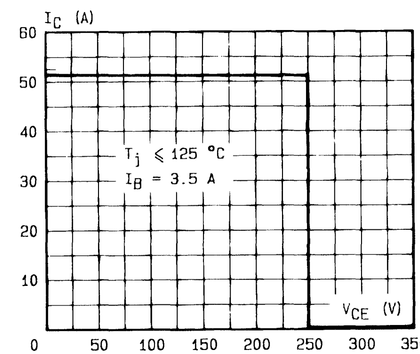
TRANSISTOR REVERSE BIASED
- During the turn-off with negative base-emitter voltage.



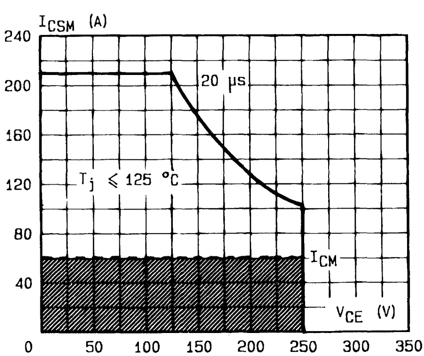
Forward biased Safe Operating Area (FBSOA).



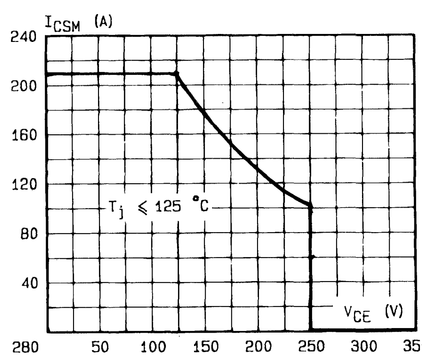
Reverse biased Safe Operating Area (RBSOA).



Forward biased Accidental Overload Area (FBAOA).



Reverse biased Accidental Overload Area (RBAOA).

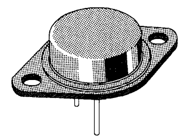


High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

BUT92A

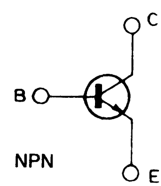
FAST SWITCHING POWER TRANSISTOR

- $h_{FE} > 10$ AT $I_C = 35A$
- HIGH EFFICIENCY SWITCHING
- VERY LOW SATURATION VOLTAGE
- RECTANGULAR SAFE OPERATING AREA
- WIDE ACCIDENTAL OVERLOAD AREA



TO-3

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

Suitable for motor-drives, S.M.P.S. converters, uninterruptable power supply operating medium low voltage supply.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	400	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	300	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_E	Emitter Current	50	A
I_{EM}	Emitter Peak Current	75	A
I_B	Base Current	10	A
I_{BM}	Base Peak Current	15	A
P_{tot}	Total Dissipation at T_c < 25°C	250	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	0.7	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			1 5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = – 1.5V $V_{CE} = V_{CEV}$ V_{BE} = – 1.5V T_c = 100°C			1 4	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	300			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 30A I_B = 3A I_C = 30A I_B = 3A T_j = 100°C		0.5 0.8	0.9 1.9	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 30A I_B = 3A I_C = 30A I_B = 3A T_j = 100°C		1.1 1.05	1.3 1.3	V V
di_C/dt	Rated of Rise of on-state Collector Current	V_{CC} = 250V R_C = 0 I_{B1} = 4.5A t_p = 3μs T_j = 100°C See fig. 1 and 2	125	190		A/μs
$V_{CE(3\mu s)}$	Collector Emitter Dynamic Voltage	V_{CC} = 250V I_{B1} = 4.5A T_j = 100°C R_C = 8.3Ω See fig. 1 and 2		3	6	V
$V_{CE(5\mu s)}$	Collector Emitter Dynamic Voltage	V_{CC} = 250V I_{B1} = 4.5A T_j = 100°C R_C = 8.3Ω See fig. 1 and 2		1.5	3	V
 t_s t_f t_c	INDUCTIVE LOAD Storage Time Fall Time Crossover Time	V_{CC} = 250V V_{clamp} = 300V I_C = 30A I_{B1} = 3A V_{BB} = – 5V L_C = 0.4mH R_{B2} = 0.83Ω T_j = 100°C See fig. 3a and 3b		 1.7 0.11 0.35	 3 0.4 0.7	 μs μs μs
V_{CEW}	Maximum Collector Emitter Voltage without Snubber	V_{CC} = 50V I_{CWoff} = 45A V_{BB} = – 5V I_{B1} = 3A L_C = 55μH R_{BB} = 0.83Ω T_j = 125°C See fig. 3a and 3b	300			V

* Pulsed : Pulse duration = 300μs , duty cycle = 2%.

Figure 1 : Turn-on Switching Test Circuit.

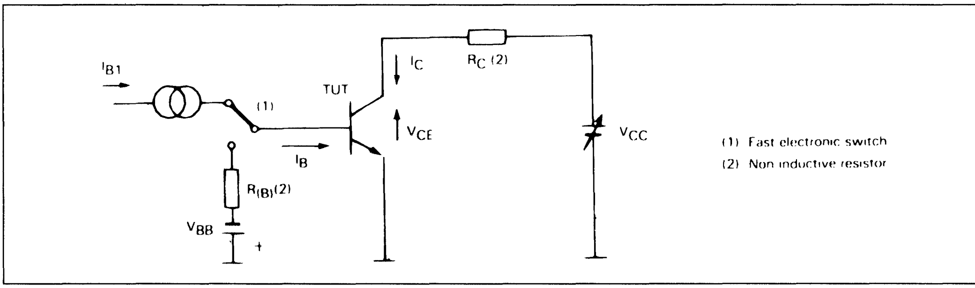


Figure 2 : Turn-off Switching Waveforms.

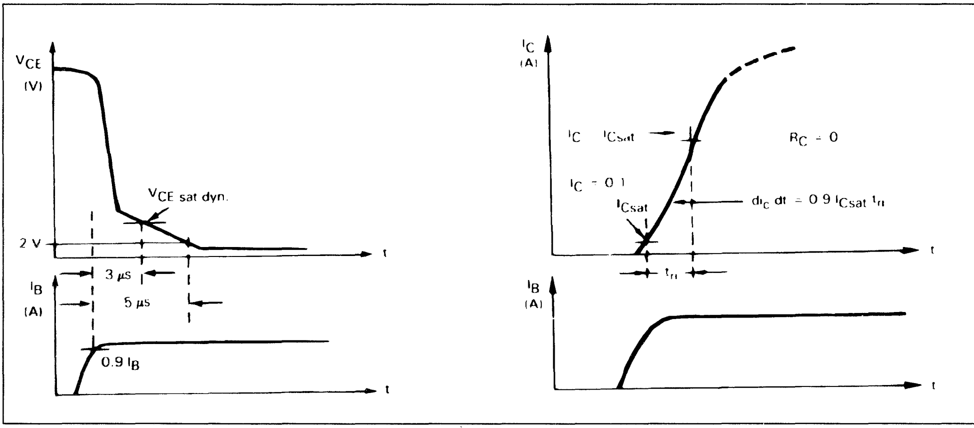


Figure 3a : Turn-off Switching Test Circuit.

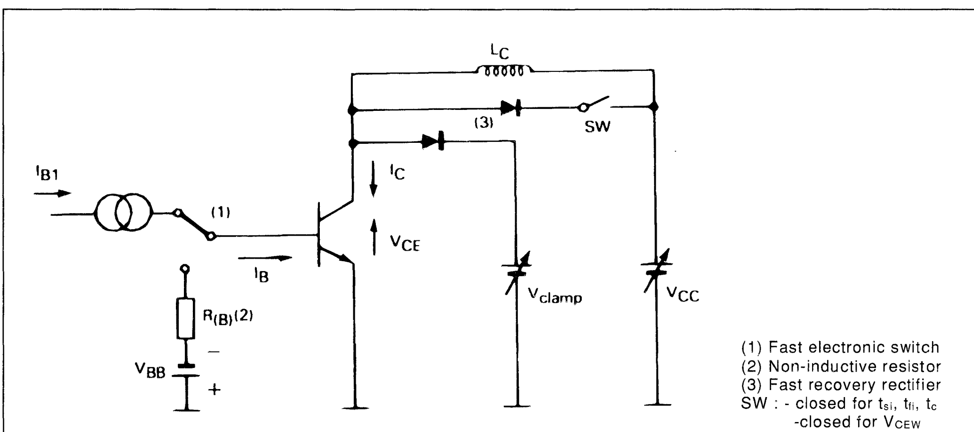
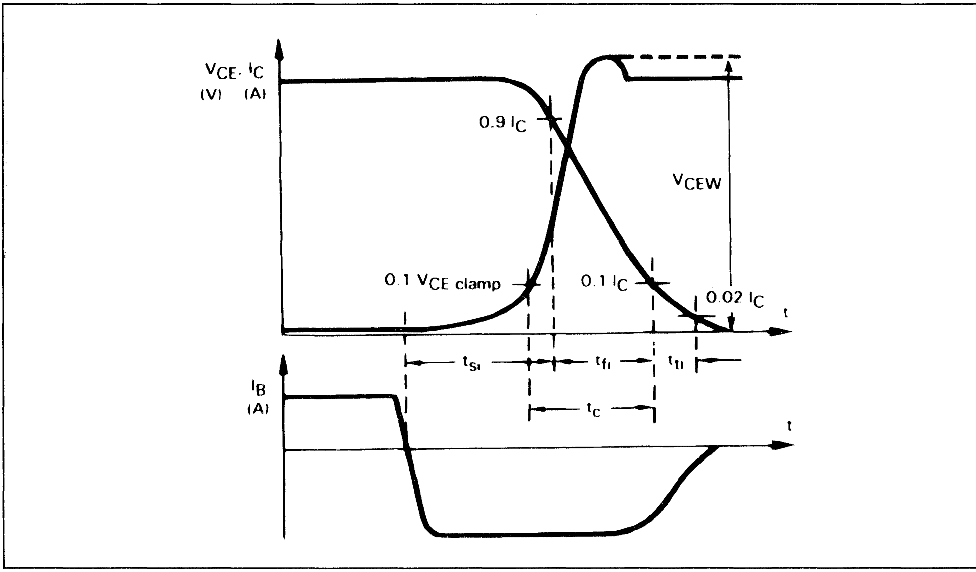
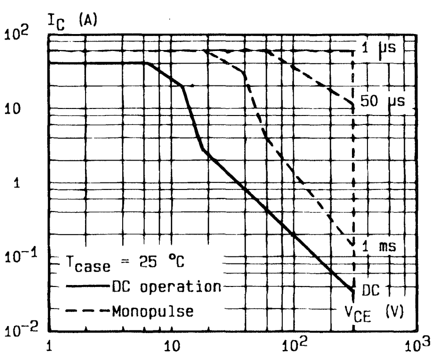


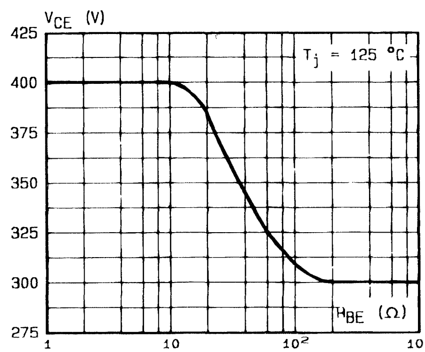
Figure 3b : Turn-off Switching Waveforms (inductive load).



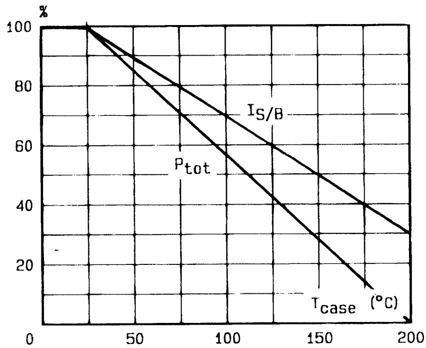
DC and Pulse Area.



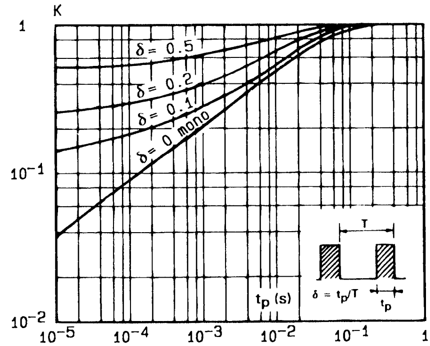
Collector-emitter vs. Base Emitter Resistance.



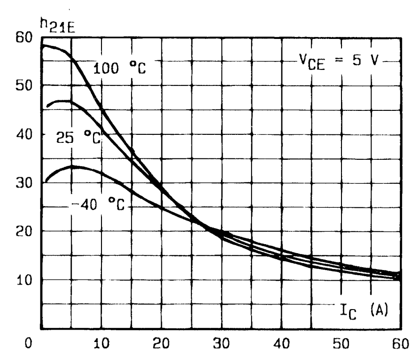
Power and $I_{S/B}$ Derating versus Case Temperature.



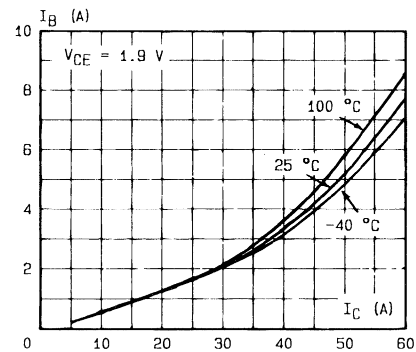
Transient Thermal Response.



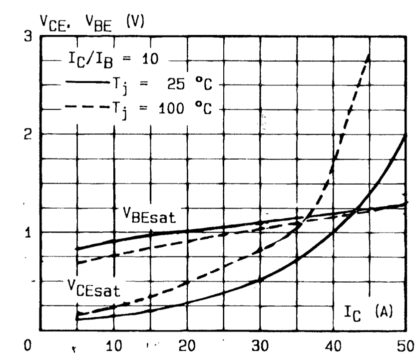
DC Current Gain.



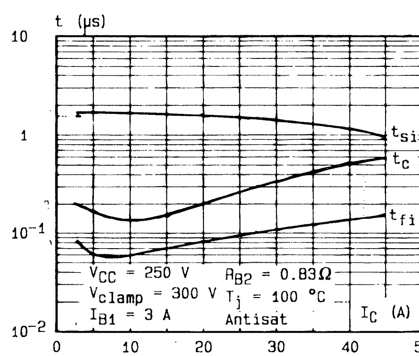
Minimum Base Current to saturate the Transistor.



Saturation Voltage.



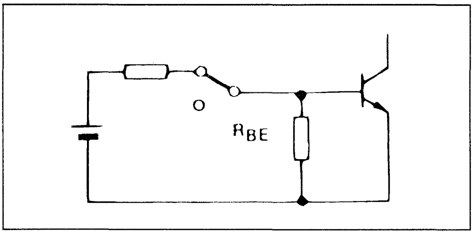
Switching Times versus Collector Current (inductive load).



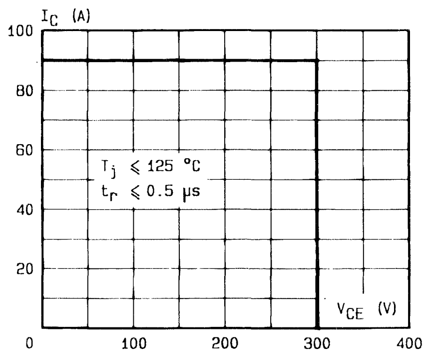
SWITCHING OPERATING AND OVERLOAD AREAS

TRANSISTOR FORWARD BIASED

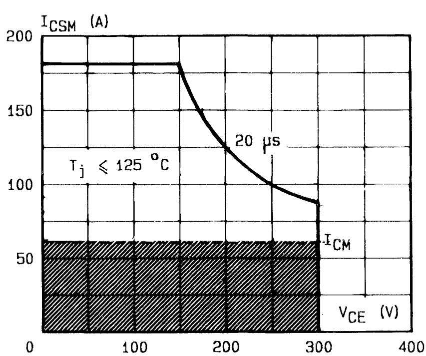
- During the turn-on
- During the turn-off without negative base-emitter voltage.



Forward biased Safe Operating Area (FBSOA).

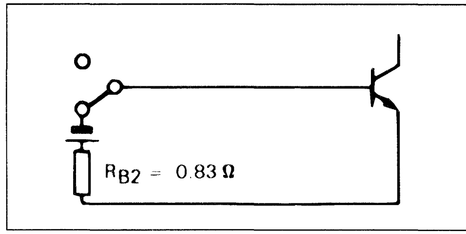


Forward biased Accidental Overload Area (FBAOA).

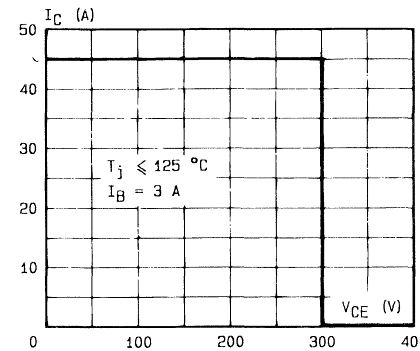


TRANSISTOR REVERSE BIASED

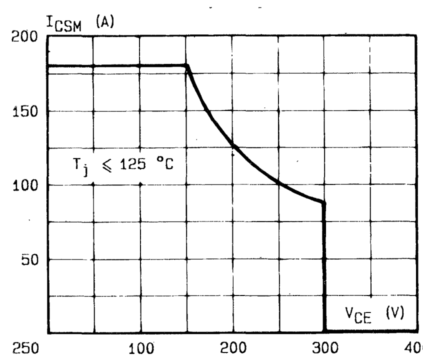
- During the turn-off with negative base-emitter voltage.



Reverse biased Safe Operating Area (RBSOA).



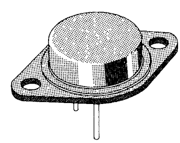
Reverse biased Accidental Overload Area (RBAOA).



High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

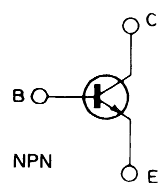
FAST SWITCHING POWER TRANSISTOR

- HIGH EFFICIENCY SWITCHING
- VERY LOW SATURATION VOLTAGE
- RECTANGULAR SAFE OPERATING AREA
- WIDE ACCIDENTAL OVERLOAD AREA



TO-3

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

Suitable for motor drives, SMPS converters, uninterruptable power supply operating low voltage supply.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage ($V_{BE} = -1.5V$)	200	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	125	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_E	Emitter Current	50	A
I_{EM}	Emitter Peak Current	150	A
I_B	Base Current	10	A
I_{BM}	Base Peak Current	30	A
P_{tot}	Total Dissipation at $T_c < 25°C$	300	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	0.58	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 5Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			1 5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = – 1.5V $V_{CE} = V_{CEV}$ V_{BE} = – 1.5V T_c = 100°C			1 4	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	125			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 50A I_B = 2.5A I_C = 100A I_B = 10A I_C = 50A I_B = 2.5A T_j = 100°C I_C = 100A I_B = 10A T_j = 100°C			0.9 0.9 1.2 1.5	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 50A I_B = 2.5A I_C = 100A I_B = 10A I_C = 50A I_B = 2.5A T_j = 100°C I_C = 100A I_B = 10A T_j = 100°C			1.4 2 1.4 2.1	V V V V
di_C/dt	Rate of Rise of on-state Collector Current	V_{CC} = 100V R_C = 0 I_{B1} = 5A t_p = 3µs T_j = 100°C See fig. 1	180			A/µs
 t_s t_f t_c	INDUCTIVE LOAD Storage Time Fall Time Crossover Time	V_{CC} = 90V V_{clamp} = 125V I_C = 50A I_{B1} = 2.5A V_{BB} = – 5V L_C = 80µH R_{B2} = 1Ω T_j = 100°C See fig. 2			 2 0.2 0.35	 µs µs µs
V_{CEW}	Maximum Collector Emitter Voltage without Snubber	V_{CC} = 90V I_{CWoff} = 150A V_{BB} = – 5V I_{B1} = 10A L_C = 30µH R_{B2} = 1Ω T_j = 125°C See fig. 2	125			V

* Pulsed : Pulse duration = 3µs, duty cycle = 2 %.

Figure 1 : Turn-on Switching Characteristics of the Transistor.

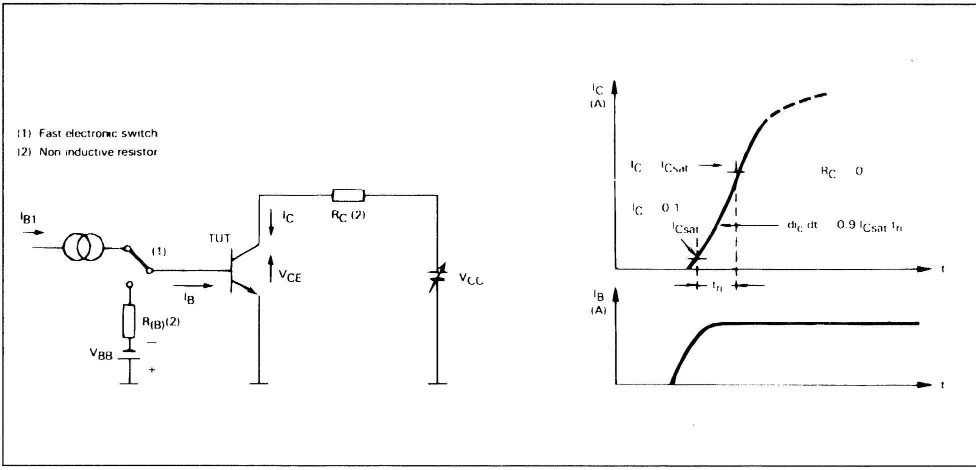
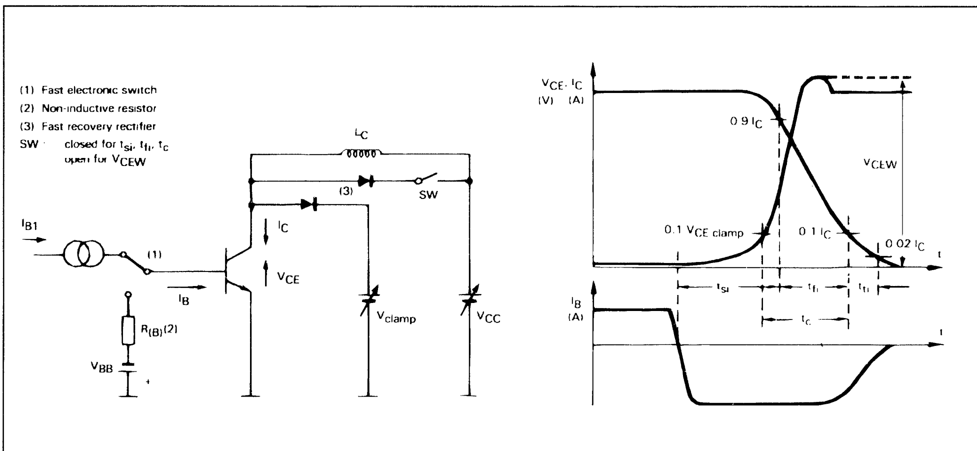
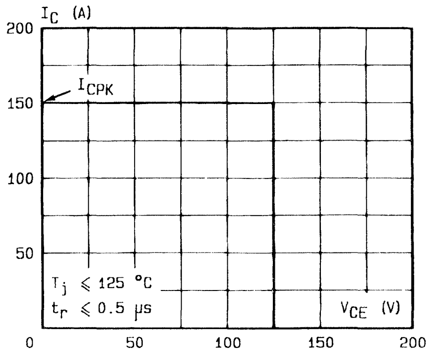


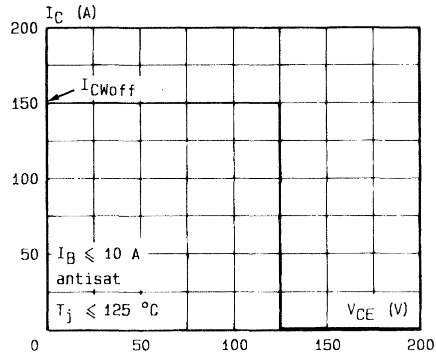
Figure 2 : Turn-off Switching Characteristics of the Transistor.



Forward biased Safe Operating Area (FBSOA).

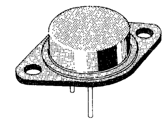


Reverse biased Safe Operating Area (RBSOA).



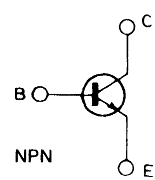
FAST SWITCHING POWER TRANSISTOR

- HIGH EFFICIENCY SWITCHNG
- VERY LOW SATURATION VOLTAGE
- RECTANGULAR SAFE OPERATING AREA
- WIDE ACCIDENTAL OVERLOAD AREA



TO-3

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

Suitable for motor drives, SMPS converters, uninterruptable power supply operating low voltage supply.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	400	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	300	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_E	Emitter Current	50	A
I_{EM}	Emitter Peak Current	75	A
I_B	Base Current	10	A
I_{BM}	Base Peak Current	15	A
P_{tot}	Total Dissipation at T_C < 25°C	300	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	0.58	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_C = 100°C			1 5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = - 1.5V $V_{CE} = V_{CEV}$ V_{BE} = - 1.5V T_C = 100°C			1 4	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	300			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 40A I_B = 4A I_C = 40A I_B = 4A T_j = 100°C			0.9 1.9	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 40A I_B = 4A I_C = 40A I_B = 4A T_j = 100°C			1.4 1.4	V V
di_C/dt	Rated of Rise of On-state Collector Current	V_{CC} = 250V R_C = 0 I_{B1} = 6A t_p = 3μs T_j = 100°C See fig. 1	120			A/μs
 t_s t_f t_c	INDUCTIVE LOAD Storage Time Fall Time Crossover Time	V_{CC} = 250V V_{clamp} = 300V I_C = 40A I_{B1} = 4A V_{BB} = − 5V L_C = 0.3mH R_{B2} = 0.60Ω T_j = 100°C See fig. 2			 3 0.4 0.7	 μs μs μs
V_{CEW}	Maximum Collector Emitter Voltage without Snubber	V_{CC} = 50V I_{CWoff} = 60A V_{BB} = − 5V I_{B1} = 4A L_C = 42μH R_{B2} = 0.6Ω T_j = 125°C See fig. 2	300			V

* Pulsed : Pulse duration = 300 μs, duty cycle = 2%.

Figure 1 : Turn-on Switching Characteristics of the Transistor.

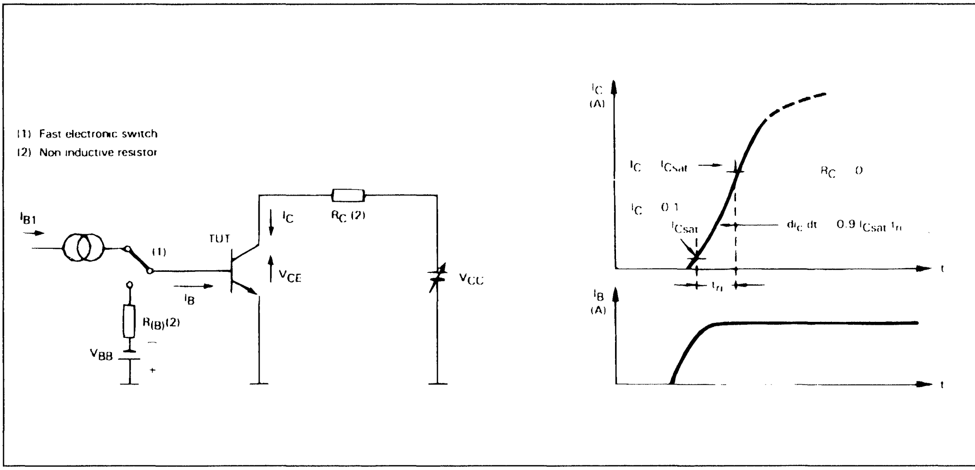
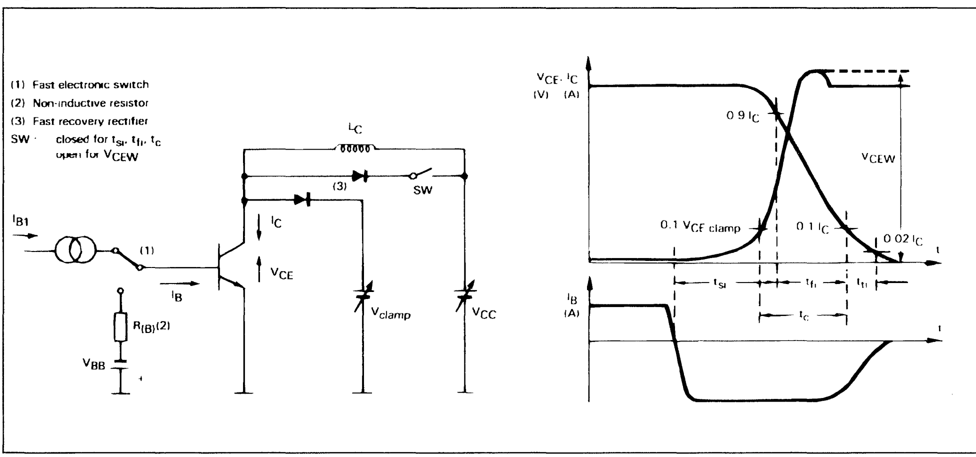
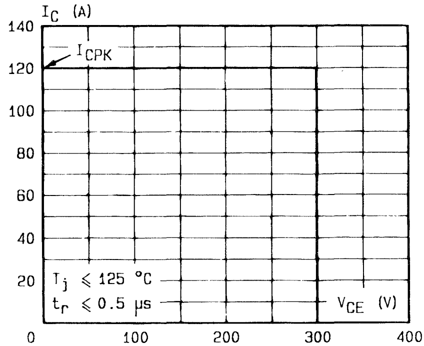


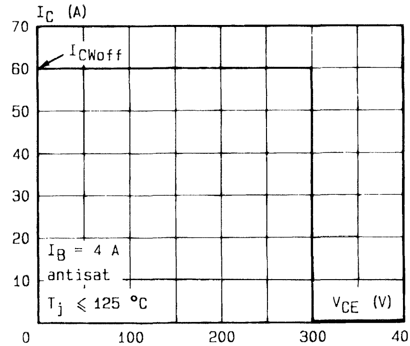
Figure 2 : Turn-off Switching Characteristics of the Transistor.



Forward biased Safe Operating Area (FBSOA).

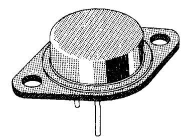


Reverse biased Safe Operating Area (RBSOA).



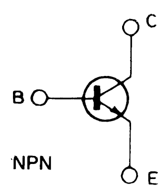
NPN HIGH CURRENT SWITCHING TRANSISTORS

- HIGH EFFICIENCY SWITCHING
- VERY LOW SATURATION VOLTAGE AT 40A
- FAST TURN-OFF AND TURN-ON



TO-3

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

High current, high speed transistors suited for low voltage applications : high efficiency converters, motor controls.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BUV18	BUV19	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	120	160	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	60	80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	7	V
I_C	Collector Current	50	50	A
I_{CM}	Collector Peak Current ($t_p < 5ms$)	90	70	A
I_B	Base Current	16	12	A
I_{BM}	Base Peak Current ($t_p < 5ms$)	40	30	A
P_{tot}	Total Dissipation at $T_c < 25°C$	250		W
T_{stg}	Storage Temperature	– 65 to 200		°C
T_j	Max. Operating Junction Temperature	200		°C

THERMAL DATA

$R_{thj-case}$	Thermal Resistance Junction-case	max	0.7	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

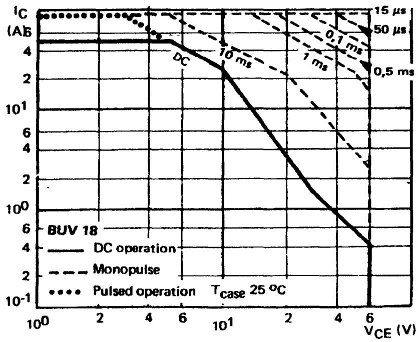
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEX}	Collector Cutoff Current	$V_{CE} = V_{CEX}$ $V_{BE} = -1.5V$ $V_{CE} = V_{CEX}$ $V_{BE} = -1.5V$ $T_c = 100°C$			1 3	mA mA
I_{EBO}	Emitter Cutoff Current ($I_C = 0$)	$V_{EB} = 5V$			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	$I_C = 0.2A$ L = 25mH for **BUV18** for **BUV19**	60 80			V V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	$I_E = 50mA$	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	$I_C = 40A$ $I_B = 4A$ for **BUV18** $I_C = 80A$ $I_B = 8A$ for **BUV18** $I_C = 30A$ $I_B = 3A$ for **BUV19** $I_C = 60A$ $I_B = 6A$ for **BUV19**			0.6 1.5 0.6 1.2	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	$I_C = 80A$ $I_B = 8A$ for **BUV18** $I_C = 60A$ $I_B = 6A$ for **BUV19**			2.2 2	V V
f_T	Transition Frequency	f = 10MHz $V_{CE} = 15A$ $I_C = 2A$	8			MHz

RESISTIVE LOAD

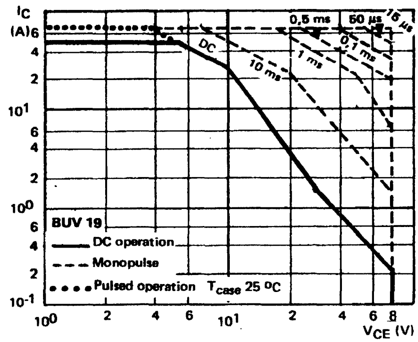
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on} t_s t_f	Turn-on Time Storage Time Fall Time	for **BUV18** $V_{CC} = 60V$ $I_C = 80A$ $I_{B1} = -I_{B2} = 8A$		1.2 0.6 0.18	1.5 1.1 0.25	µs µs µs
t_s t_f	Storage Time Fall Time	for **BUV18** $V_{CC} = 60V$ $I_C = 80A$ $I_{B1} = -I_{B2} = 8A$ $T_c = 125°C$			1.7 0.5	µs µs
t_{on} t_s t_f	Turn-on Time Storage Time Fall Time	for **BUV19** $V_{CC} = 80V$ $I_C = 60A$ $I_{B1} = -I_{B2} = 6A$		0.9 0.6 0.17	1.3 1.1 0.25	µs µs µs
t_s t_f	Storage Time Fall Time	for **BUV19** $V_{CC} = 80V$ $I_C = 60A$ $I_{B1} = -I_{B2} = 6A$ $T_c = 125°C$			1.7 0.5	µs µs

* Pulsed : Pulse duration = 300µs, duty cycle = 2%

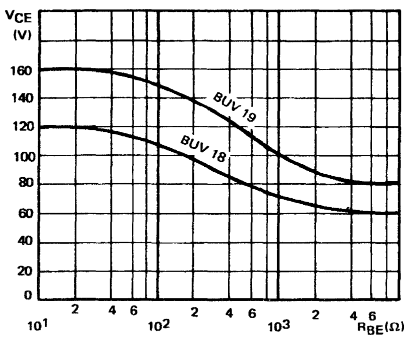
DC and AC Pulse Area.



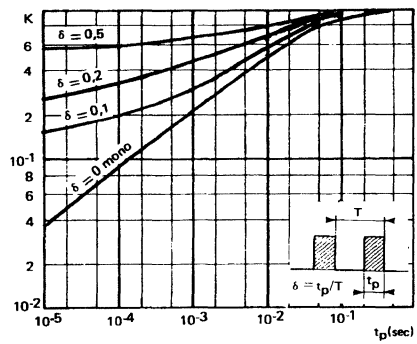
DC and AC Pulse Area.



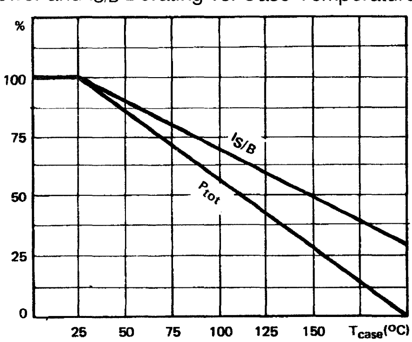
Collector-emitter Voltage vs. Base-emitter Resistance.



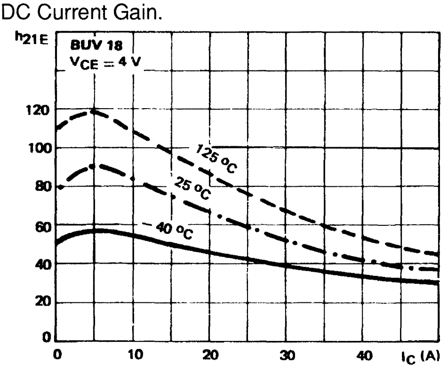
Transient Thermal Response.



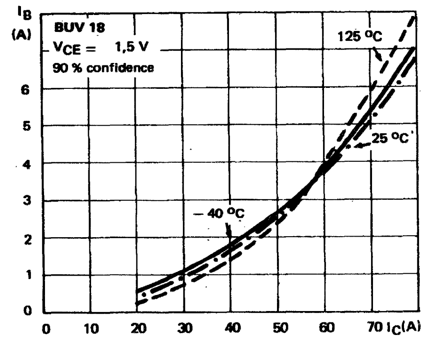
Power and $I_{S/B}$ Derating vs. Case Temperature.



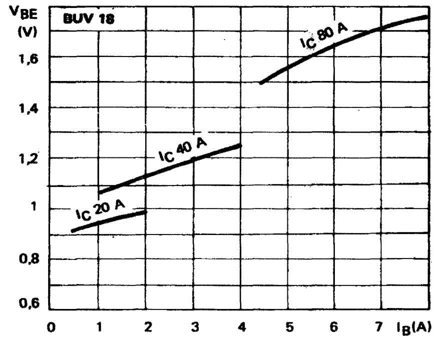
DC Current Gain.



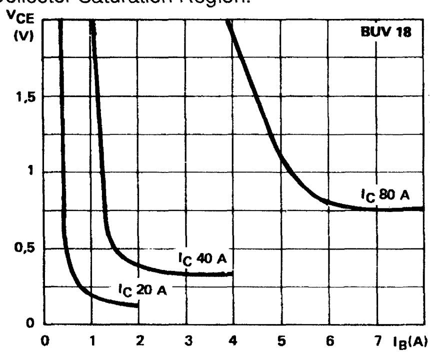
Minimum Base Current to Saturate the Transistor.



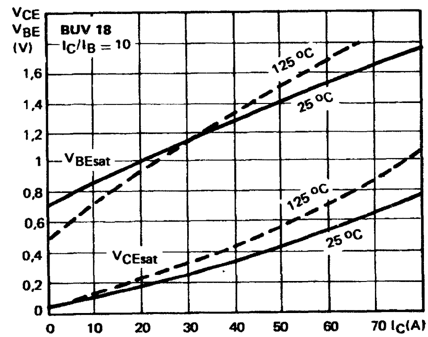
Base Characteristics.



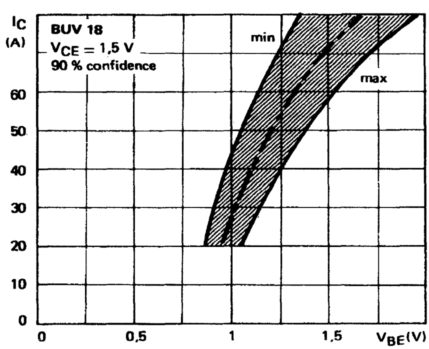
Collector Saturation Region.



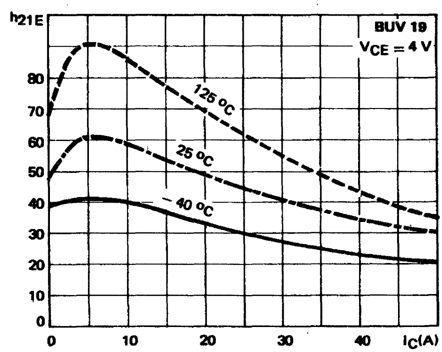
Saturation Voltage.



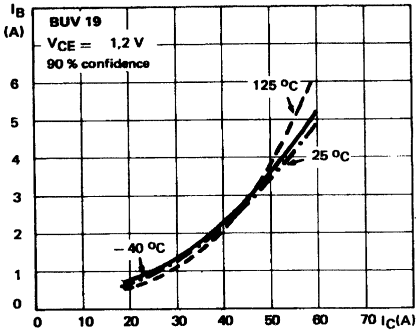
Collector Current Spread vs Base Emitter Voltage.



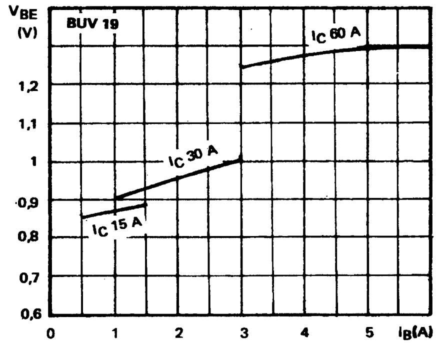
DC Current Gain.



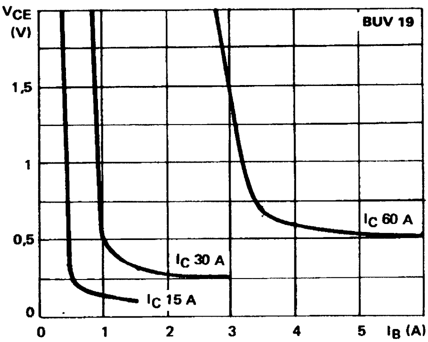
Minimum Base Current to Saturate the Transistor.



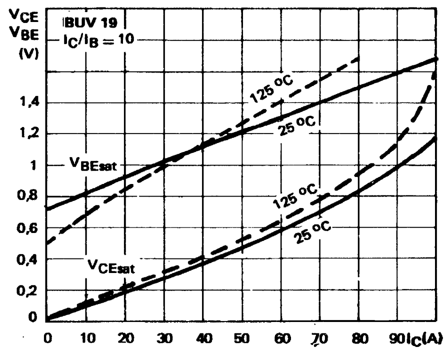
Base Characteristics.



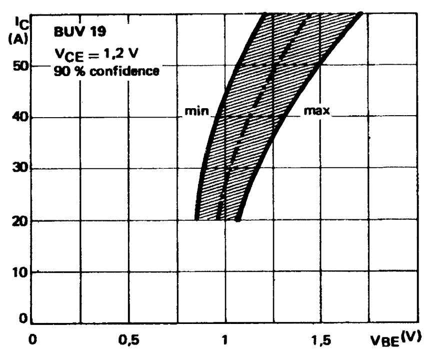
Collector Saturation Region.



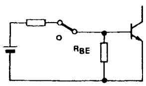
Saturation Voltage.



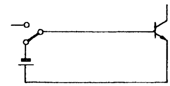
Collector Current Spread vs Base Emitter Voltage.



SWITCHING OPERATING AND OVERLOAD AREAS

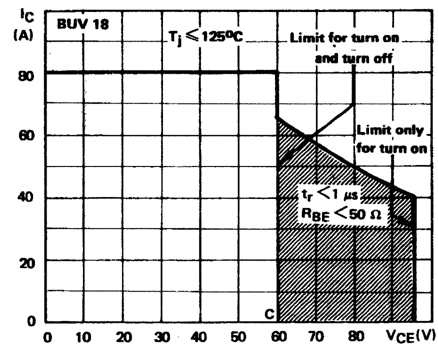


Transistor Forward Biased
- During the turn on
- During the turn off without negative base-emitter voltage and $R_{BE} \geq 3\ \Omega$



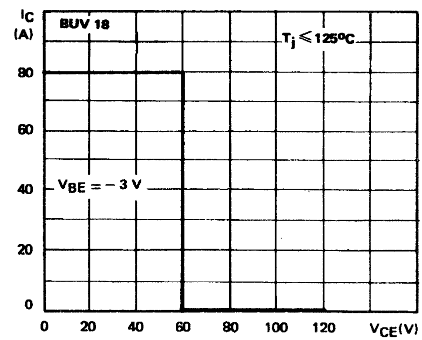
Transistor Reverse Biased
- During the turn off with negative base emitter voltage

Forward Biased Safe Operating Area (FBSOAR).

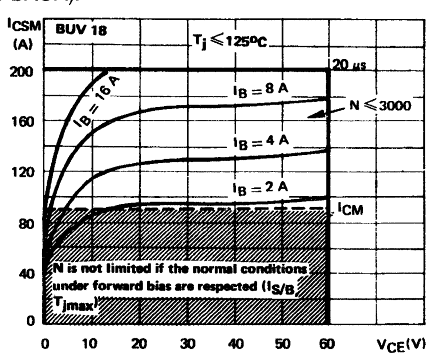


The hatched zone can only be used for turn on.

Reverse Biased Safe Operating Area (RBSOAR).

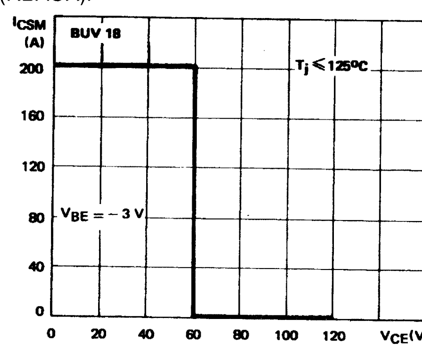


Forward Biased Accidental Overload Area (FBAOA).



The Kellog network (heavy print) allows the calculation of the maximum value of the short-circuit current for a given base current **IB** (90 % confidence).

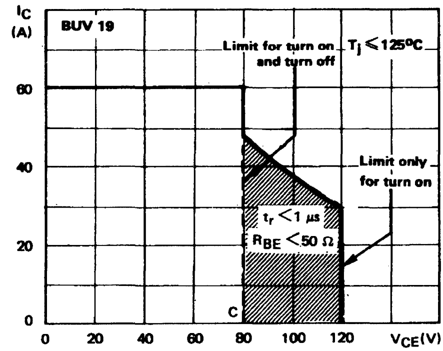
Reverse Biased Accidental Overload Area (RBAOA).



After the accidental overload current, the RBAOA has to be used for the turn off.

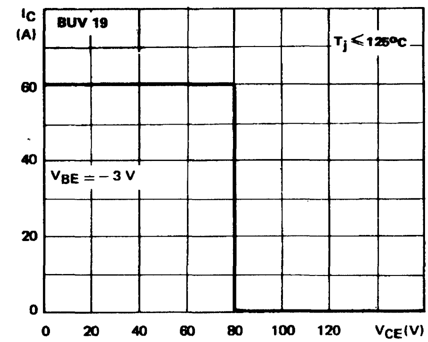
High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

Forward Biased Safe Operating Area (FBSOAR).

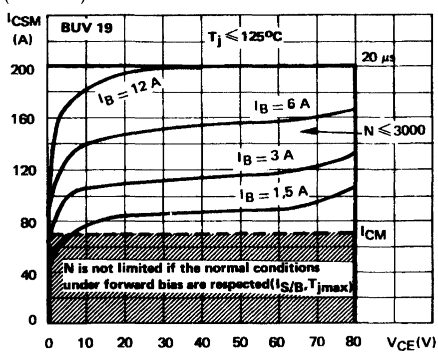


The hatched zone can only be used for turn on.

Reverse Biased Safe Operating Area (RBSOAR).

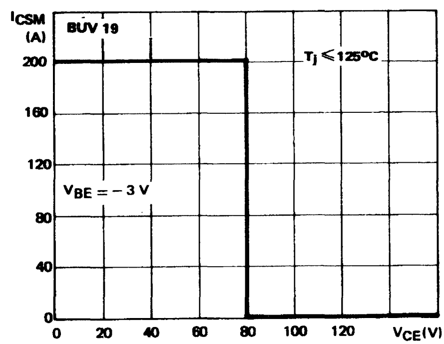


Forward Biased Accidental Overload Area (FBAOA).



The Kellog network (heavy print) allows the calculation of the maximum value of the short-circuit current for a given base current I_B (90 % confidence).

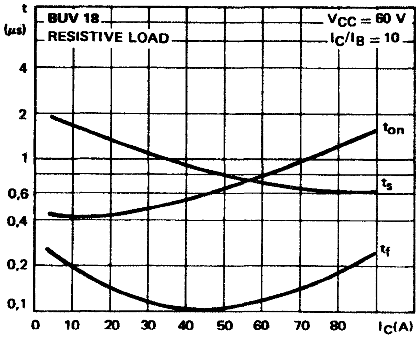
Reverse Biased Accidental Overload



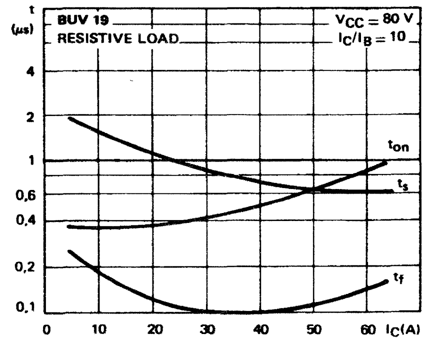
After the accidental overload current, the RBAOA has to be used for the turn off.

High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

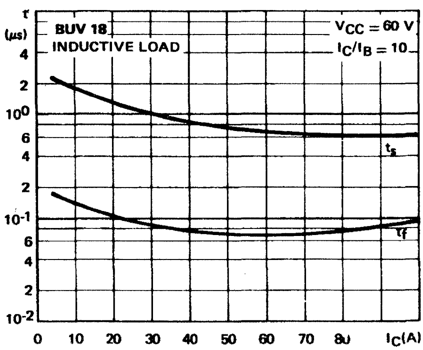
Switching Times vs Collector Current (resistive load).



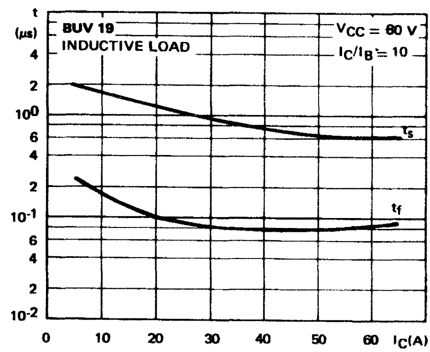
Switching Times vs Collector Current (resistive load).



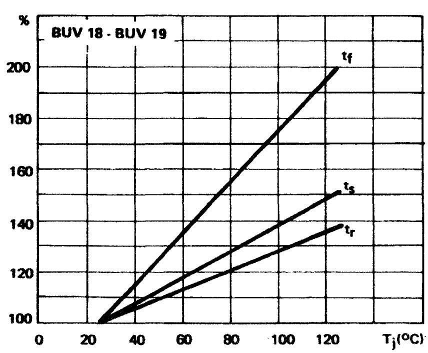
Switching Times vs Collector Current.



Switching Times vs Collector Current.



Switching Times vs Junction Temperature.



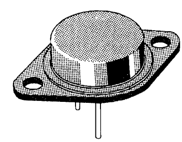
SGS-THOMSON MICROELECTRONICS

BUV20/BUV21 BUV22

HIGH CURRENT POWER SWITCH

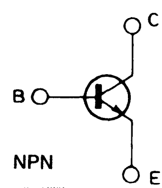
DESCRIPTION

The BUV20, BUV21 and BUV22 are silicon multiepitaxial planar NPN transistor in jedec TO-3 metal case, intended for use in switching and linear applications in military and industrial equipment.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		BUV20	BUV21	BUV22	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	160	250	300	V
V_{CER}	Collector-emitter Voltage ($R_{BE} = 100\ \Omega$)	150	240	290	V
V_{CEX}	Collector-emitter Voltage ($V_{BE} = -1.5$ V)	160	250	300	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	125	200	250	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	7	7	V
I_C	Collector Current	50	40	40	A
I_{CM}	Collector Peak Current	60	50	50	A
I_B	Base Current	10	8	8	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	250			W
T_{stg}	Storage Temperature	– 65 to 200			°C
T_j	Junction Temperature	200			°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	0.7	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **BUV20** V_{CE} = 100 V for **BUV21** V_{CE} = 160 V for **BUV22** V_{CE} = 200 V			3 3 3	mA mA mA
I_{CEX}	Collector Cutoff Current (V_{BE} = − 1.5 A)	V_{CE} = V_{CEX} for **BUV20** for **BUV21** for **BUV22** at T_{case} = 125 °C for **BUV20** for **BUV21** for **BUV22**			 3 3 3 12 12 12	 mA mA mA mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 200 mA L = 25 mH for **BUV20** for **BUV21** for **BUV22**	 125 200 250			 V V V
$V_{(BR)EBO}$*	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 50 mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	for **BUV20** I_C = 25 A I_B = 2.5 A I_C = 50 A I_B = 5 A for **BUV21** I_C = 12 A I_B = 1.2 A I_C = 25 A I_B = 3 A for **BUV22** I_C = 10 A I_B = 1 A I_C = 20 A I_B = 2.5 A		 0.3 0.7 0.2 0.9 0.2 0.5	 0.6 1.2 0.6 1.5 1 1.5	 V V V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	for **BUV20** I_C = 50 A I_B = 5 A for **BUV21** I_C = 25 A I_B = 3 A for **BUV22** I_C = 40 A I_B = 4 A		 1.4 1.2 1.2	 2 1.5 1.5	 V V V
h_{FE}*	DC Current Gain	for **BUV20** V_{CE} = 2 V I_C = 25 A V_{CE} = 4 V I_C = 50 A for **BUV21** V_{CE} = 2 V I_C = 12 A V_{CE} = 4 V I_B = 25 A for **BUV22** V_{CE} = 4 V I_C = 10 A V_{CE} = 4 V I_C = 20 A	 20 10 20 10 20 10		 60 60 60 	
f_T	Transition Frequency	V_{CE} = 15 V I_C = 2 A f = 100 MHz	8			MHz

* Pulsed . pulse duration = 300 µs, duty cycle ≤ 2 %.

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	for **BUV20**				
		I_C = 50 A I_B = 5 A			1.5	μs
		for **BUV21**				
		I_C = 25 A I_B = 3 A			1.2	μs
		for **BUV22**				
		I_C = 20 A I_B = 2.5 A			1.3	μs
t_f	Fall Time	for **BUV20**				
		I_C = 50 A I_{B1} = − I_{B2} = 5 A			0.3	μs
		for **BUV21**				
		I_C = 25 A I_{B1} = − I_{B2} = 3 A			0.4	μs
		for **BUV22**				
		I_C = 20 A I_{B1} = − I_{B2} = 2.5 A			0.5	μs
t_s	Storage Time	for **BUV20**				
		I_C = 50 A I_{B1} = − I_{B2} = 5 A			1.2	μs
		for **BUV21**				
		I_C = 25 A I_{B1} = − I_{B2} = 3 A			1.8	μs
		for **BUV22**				
		I_C = 20 A I_{B1} = − I_{B2} = 2.5 A			2	μs

* Pulsed. pulse duration = 300 μs, duty cycle ≤ 2 %.

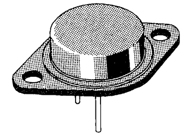
SGS-THOMSON MICROELECTRONICS

BUV23/BUV24 BUV25

POWER SWITCH

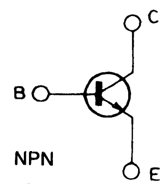
DESCRIPTION

The BUV23, BUV24 and BUV25 are silicon multi-epitaxial mesa NPN transistors in Jedec TO-3 metal case, intended for use in power switching applications in military and industrial equipments.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		BUV23	BUV24	BUV25	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	400	450	500	V
V_{CER}	Collector-emitter Voltage ($R_{BE} = 100\ \Omega$)	390	440	500	V
V_{CEX}	Collector-emitter Voltage ($V_{BE} = -1.5$ V)	400	450	500	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	325	400	500	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	7	7	V
I_C	Collector Current	30	20	15	A
I_{CM}	Collector Peak Current ($t_p = 10$ ms.)	40	30	20	A
I_B	Base Current	6	4	3	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	250			W
T_{stg}	Storage Temperature	– 65 to 200			°C
T_j	Junction Temperature	200			°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	max	0.7	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 260 V for **BUV23** V_{CE} = 320 V for **BUV24** V_{CE} = 400 V for **BUV25**			3 3 3	mA mA mA
I_{CEX}	Collector Cutoff Current (V_{BE} = – 1.5 V)	V_{CE} = V_{CEX} T_{case} = 125 °C V_{CE} = V_{CEX}			3 12	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	for **BUV23** I_C = 8 A I_B = 1.6 A I_C = 16 A I_B = 3.2 A for **BUV24** I_C = 6 A I_B = 1.2 A I_C = 12 A I_B = 2.4 A for **BUV25** I_C = 4 A I_B = 0.8 A I_C = 8 A I_B = 1.6 A		 0.2 0.35 0.15 0.3 0.2 0.6	 0.8 1 0.6 1 0.6 1	 V V V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	for **BUV23** I_C = 16 A I_B = 3.2 A for **BUV24** I_C = 12 A I_B = 2.4 A for **BUV25** I_C = 8 A I_B = 1.6 A		 1.15 1 1.2	 1.5 1.15 1.5	 V V V
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 200 mA L = 25 mH for **BUV23** for **BUV24** for **BUV25**	 325 400 500			 V V V
$V_{(BR)EBO}$*	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 50 mA	7			V
h_{FE}*	DC Current Gain	V_{CE} = 4 V for **BUV23** I_C = 8 A I_C = 16 A V_{CE} = 4 V for **BUV24** I_C = 6 A I_C = 12 A V_{CE} = 4 V for **BUV25** I_C = 4 A I_C = 8 A	 15 8 15 8 15 8		 60 60 60 	
f_T	Transition Frequency	V_{CE} = 15 V I_C = 2 A f = 10 MHz	 8			 MHz
t_{on}	Turn-on Time	for **BUV23** I_C = 16 A I_B = 3.2 A for **BUV24** I_C = 12 A I_B = 2.4 A for **BUV25** I_C = 8 A I_B = 1.6 A		 0.55 0.6 0.9	 1.3 1.6 1.8	 µs µs µs

* Pulsed : pulse duration = 300 µs, duty cycle ≤ 2 %.

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_f	Fall Time	for **BUV23**				
		I_C = 16 A $I_{B1} = -I_{B2}$ = 3.2 A		0.26	1.2	µs
		for **BUV24**				
		I_C = 12 A $I_{B1} = -I_{B2}$ = 2.4 A		0.6	1.4	µs
		for **BUV25**				
		I_C = 8 A $I_{B1} = -I_{B2}$ = 1.6 A		0.9	1.6	µs
t_s	Storage Time	for **BUV23**				
		I_C = 16 A $I_{B1} = -I_{B2}$ = 3.2 A		1.7	2.5	µs
		for **BUV24**				
		I_C = 12 A $I_{B1} = -I_{B2}$ = 2.4 A		1.5	3	µs
		for **BUV25**				
		I_C = 8 A $I_{B1} = -I_{B2}$ = 1.6 A		3.5	5	µs

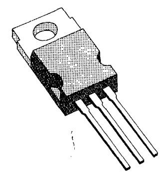
* Pulsed : pulse duration = 300 µs, duty cycle ≤ 2 %.

SGS-THOMSON
MICROELECTRONICS

BUV26

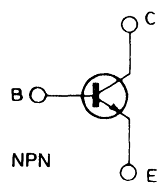
NPN FAST SWITCHING TRANSISTOR

- LOW SATURATION VOLTAGE
- FAST TURN-ON AND TURN-OFF
- BASE DRIVE SPECIFIED FOR DIFFERENT VALUES OF I_C
- WIDE SURGE AREA



TO–220

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

High speed transistor suited for low voltage applications.

High frequency and efficiency converters switching regulators motor control.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	180	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	90	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	14	A
I_{CM}	Collector Peak Current (t_p < 10ms)	25	A
I_B	Base Current	4	A
I_{BM}	Base Peak Current (t_p < 10ms)	6	A
P_{tot}	Total Dissipation at T_c < 25°C	85	W
P_{tot}	Total Dissipation at T_c < 60°C	65	W
T_{stg}	Storage Temperature	– 65 to + 175	°C
T_j	Max. Operating Junction Temperature	175	°C

THERMAL DATA

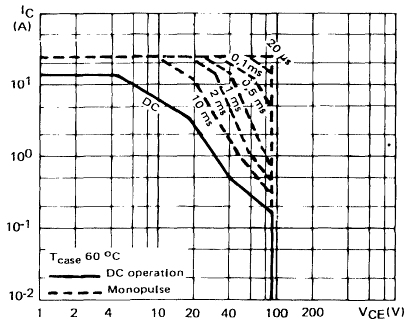
$R_{thj-case}$	Thermal Resistance Junction-case	Max	1.76	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

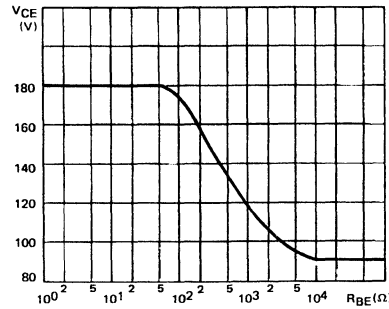
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 50Ω)	V_{CE} = 180V T_c = 125°C			3	mA
I_{CEX}	Collector Cutoff Current	V_{CE} = 180V V_{BE} = − 1.5V T_c = 125°C			1	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	90			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7		30	V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 6A I_B = 0.6A I_C = 12A I_B = 1.2A			0.6 1.5	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 12A I_B = 1.2A			2	V
 t_{on} t_s t_f	RESISTIVE LOAD Turn-on Time Storage Time Fall Time	 V_{CC} = 50V I_C = 12A V_{BE} = − 6V I_{B1} = 1.2A R_{BB} = 2.5Ω		 0.4 0.45 0.12	 0.6 1 0.25	 µs µs µs
 t_s t_f t_s t_f	INDUCTIVE LOAD Storage Time Fall Time Storage Time Fall Time	 V_{CC} = 50V I_C = 12A V_{BE} = − 5V I_{B1} = 1.2A L_B = 0.5µH V_{CC} = 50V I_C = 12A V_{BE} = −5V I_{B1} = 1.2A L_B = 0.5µH T_j = 125°C		 0.5 0.04	 2 0.15	 µs µs µs µs

* Pulsed : Pulse duration = 300µs, duty cycle = 1.5%

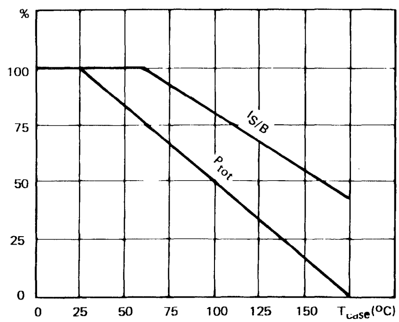
DC and Pulse Area.



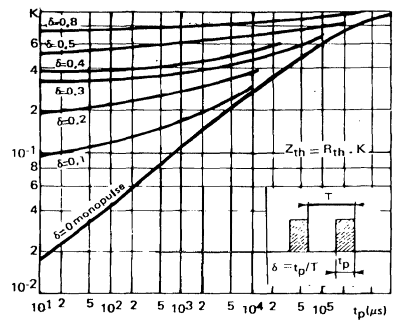
Collector-emitter Voltage vs Base-emitter Resistance.



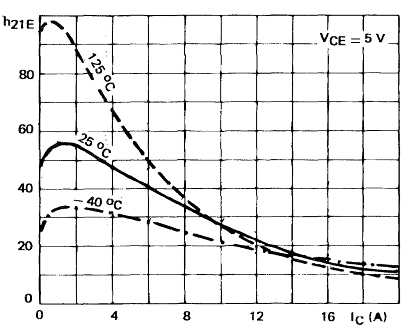
Power and $I_{S/B}$ Derating vs Case Temperature.



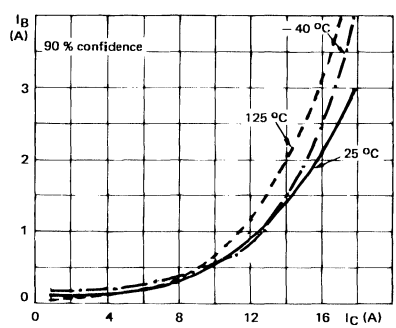
Transient Thermal Response.



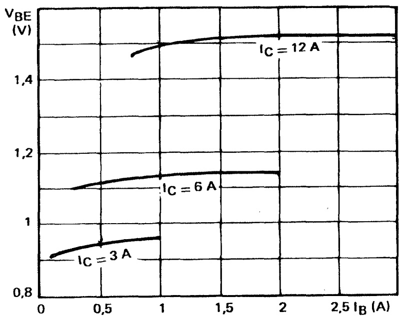
DC Current Gain.



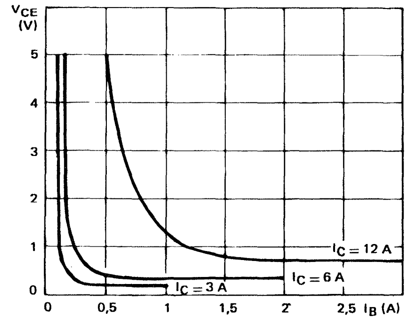
Minimum Base Current to saturate the transistor.



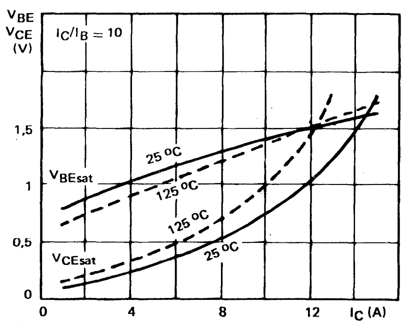
Base Characteristics.



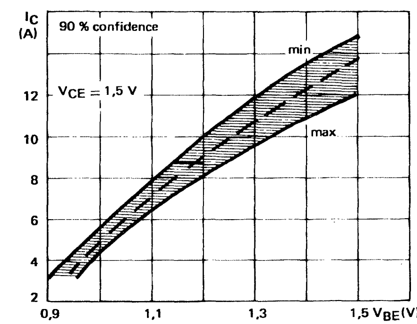
Collector Saturation Region.



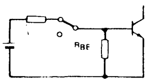
Saturation Voltage.



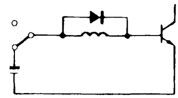
Collector Current Spread vs. Base-emitter Voltage.



SWITCHING OPERATING AND OVERLOAD AREAS

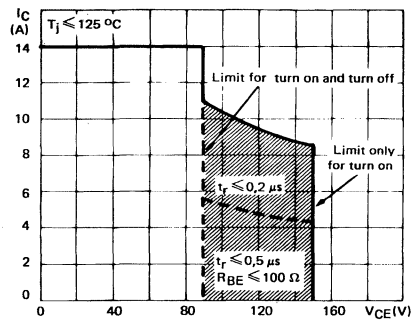


Transistor Forward Biased
- During the turn on
- During the turn off without negative base-emitter voltage and $R_{BE} \leq 100\ \Omega$



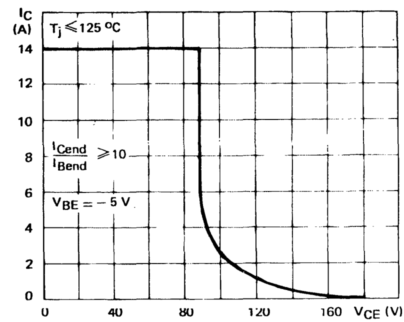
Transistor Reverse Biased
- During the turn off with negative base emitter voltage

Forward Biased Safe Operating Area (FBSOA).

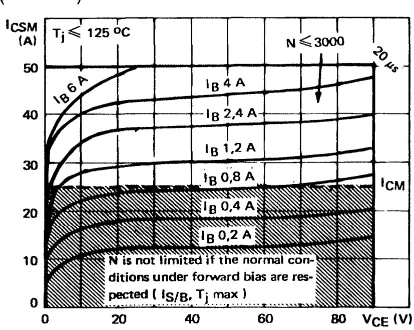


The hatched zone can only be used for turn on.

Reverse Biased Safe Operating Area (RBSOA).

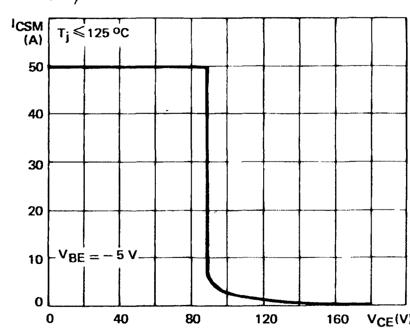


Forward Biased Accidental Overload Area (FBAOA).



The Kellog network (heavy point) allows the calculation of the maximum value of the short-circuit current for a given base current I_B (90 % confidence).

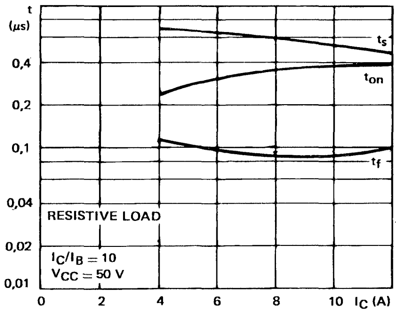
Reverse Biased Accidental Overload Area (RBAOA).



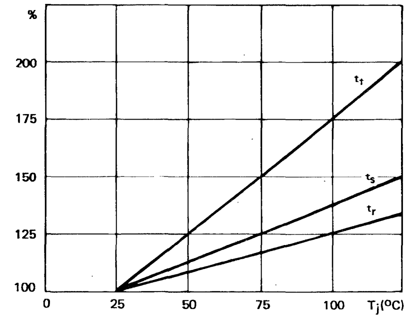
After the accidental overload current, the RBAOA has to be used for the turn off.

High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

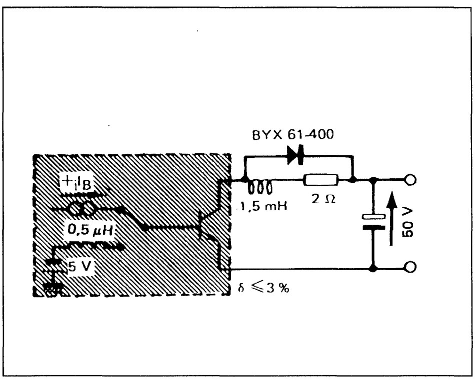
Switching Times vs. Collector Current (resistive load).



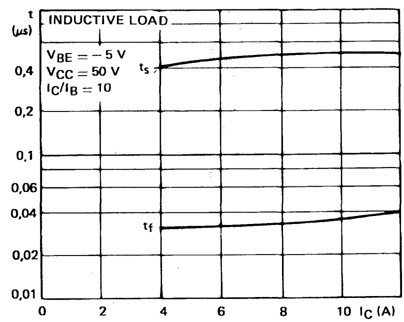
Switching Times vs. Junction Temperature.



Switching Times Test Circuit on inductive load.

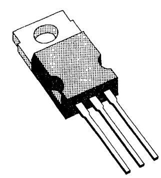


Switching Times vs. Collector Current.



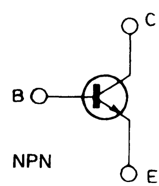
FAST NPN SWITCHING TRANSISTOR

- VERY LOW SATURATION VOLTAGE
- FAST TURN-OFF AND TURN-ON



TO-220

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

High speed transistor suited for low voltage applications.

High frequency and efficiency converters switching regulators motor control.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	240	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	120	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	12	A
I_{CM}	Collector Peak Current	20	A
I_B	Base Current	4	A
I_{BM}	Base Peak Current	6	A
P_{tot}	Total Dissipation at $T_c < 25°C$	85	W
P_{tot}	Total Dissipation at $T_c < 60°C$	65	W
T_{stg}	Storage Temperature	– 65 to 175	°C
T_j	Max. Operating Junction Temperature	175	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	max	1.76	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit.
I_{CER}	Collector Cutoff Current (R_{BE} = 50Ω)	V_{CE} = 240V T_c = 125°C			3	mA
I_{CEX}	Collector Cutoff Current	V_{CE} = 240V V_{BE} = – 1.5V T_c = 125°C			1	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	120			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7		30	V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 4A I_B = 0.4A I_C = 8A I_B = 0.8A			0.7 1.5	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 8A I_B = 0.8A			2	V

RESISTIVE LOAD

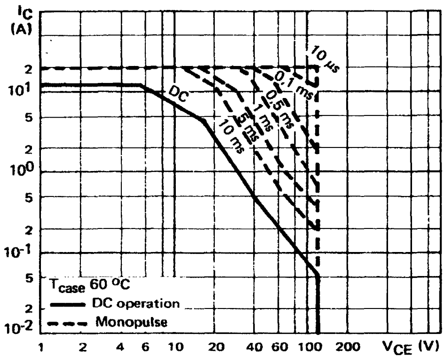
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit.
t_{on} t_s t_f	Turn-on Time Storage Time Fall Time	V_{CC} = 90V I_C = 8A V_{BE} = – 6V I_{B1} = 0.8A R_{BB} = 3.75Ω		0.4 0.5 0.12	0.8 1.2 0.25	µs µs µs

INDUCTIVE LOAD

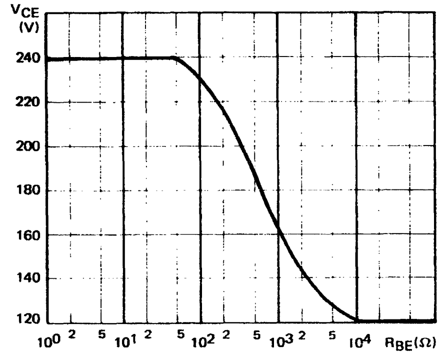
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit.
t_s t_f	Storage Time Fall Time	V_{CC} = 90V I_C = 8A I_{B1} = 0.8A V_{BE} = – 5V L_B = 1µH		0.6 0.04		µs µs
t_s t_f	Storage Time Fall Time	V_{CC} = 90V I_C = 8A I_{B1} = 0.8A V_{BE} = – 5V L_B = 1µH T_j = 125°C			2 0.15	µs µs

Pulsed : Pulse duration = 300 µs, duty cycle = 2 %.

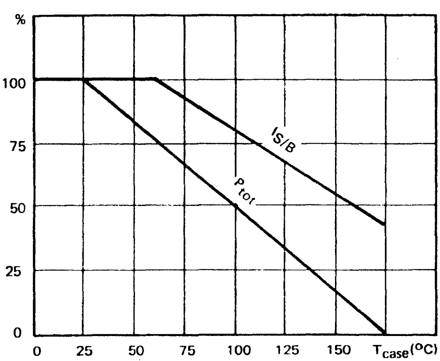
DC and Pulse Area.



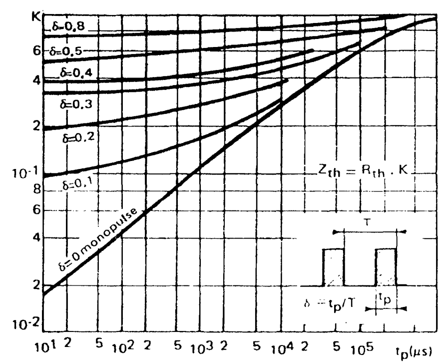
Collector-emitter Voltage vs. Base-emitter Resistance.



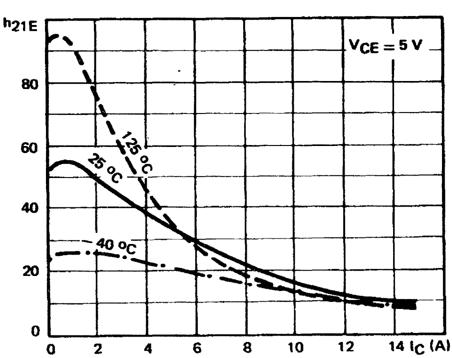
Power and $I_{S/B}$ Derating vs. Case Temperature.



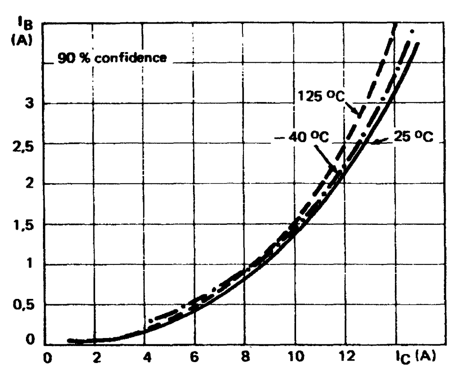
Transient Thermal Response.



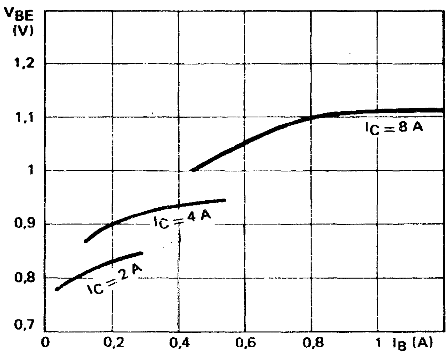
DC Current Gain.



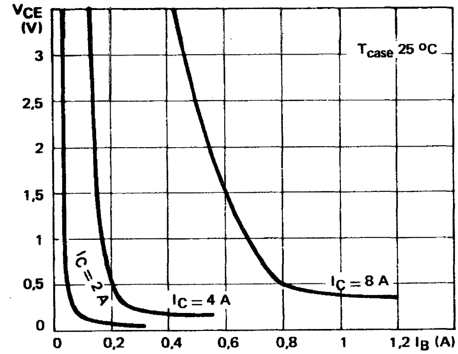
Minimum Base Current to saturate the Transistor.



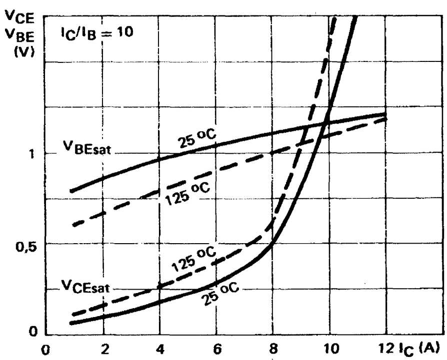
Base Characteristics.



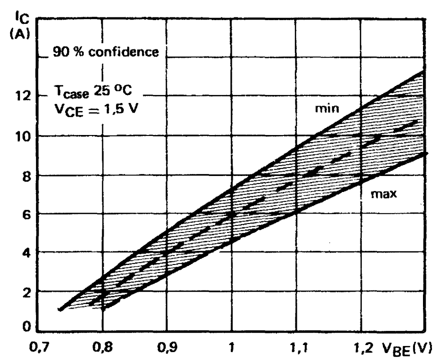
Collector Saturation Region.



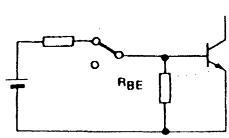
Saturation Voltage.



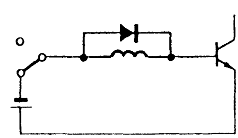
Collector Current Spread vs Base-emitter Voltage.



SWITCHING OPERATING AND OVERLOAD AREAS

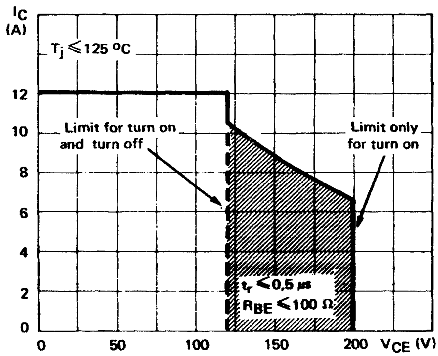


Transistor Forward Biased
- During the turn on
- During the turn off without negative base-emitter voltage and $R_{BE} \geq 100\ \Omega$



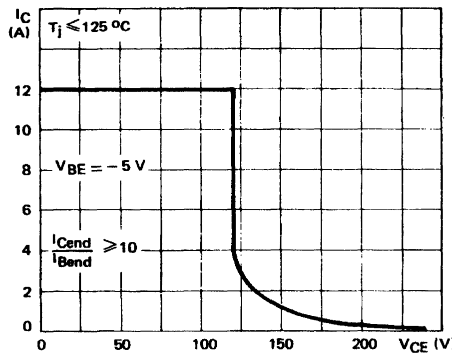
Transistor Reverse Biased
- During the turn off with negative base-Semitter voltage

Forward Biased Safe Operating Area (FBSOA).

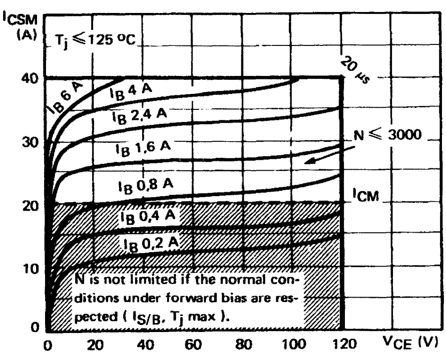


The hatched zone can only be used for turn on.

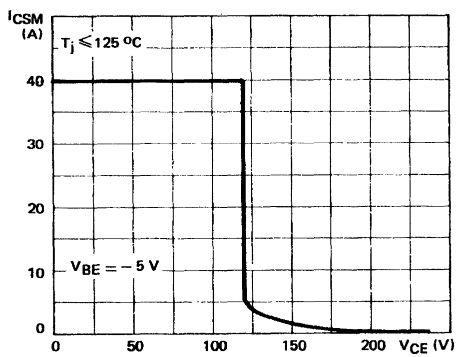
Reverse Biased Safe Operating Area (RBSOA).



Forward Biased Accidental Overload Area (FBAOA).



Reverse Biased Accidental Overload Area (RBAOA).

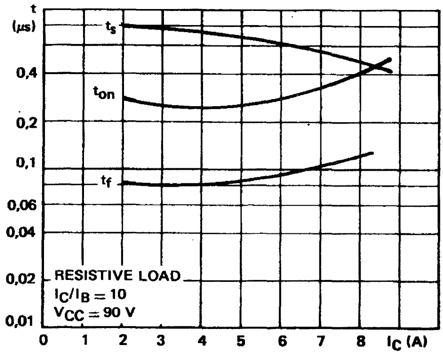


High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

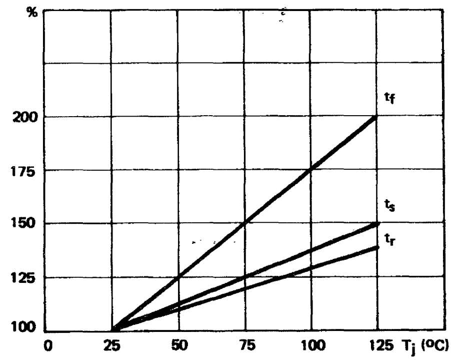
The Kellog network (heavy point) allows the calculation of the maximum value of the short-circuit current for a given base current I_B (90 % confidence).

After the accidental overload current, the RBAOA has to be used for the turn off.

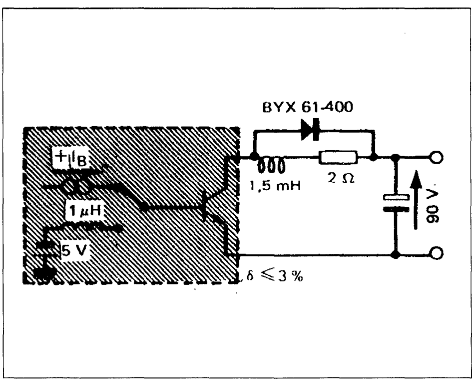
Switching Times vs Collector Current (resistive load).



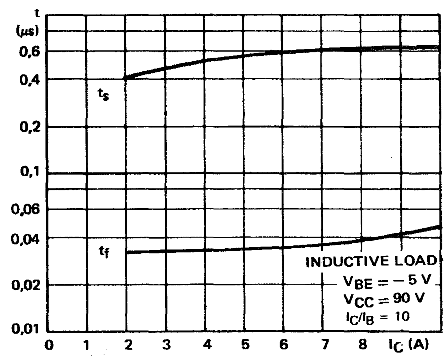
Switching Times vs Junction Temperature.



Switching Times Test Circuit on Inductive Load.



Switching Times vs Junction Temperature (inductive load).

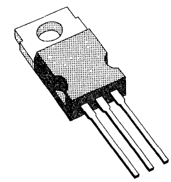


SGS-THOMSON MICROELECTRONICS

BUV28

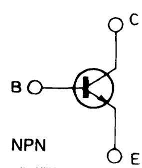
FAST NPN SWITCHING TRANSISTOR

- VERY LOW SATURATION VOLTAGE
- FAST TURN-OFF AND TURN-ON



TO-220

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

High speed transistor suited for low voltage applications.

High frequency and efficiency converters switching regulators motor control.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	400	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	200	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	10	A
I_{CM}	Collector Peak Current	15	A
I_B	Base Current	2	A
I_{BM}	Base Peak Current	4	A
P_{tot}	Total Dissipation at $T_c < 25°C$	85	W
P_{tot}	Total Dissipation at $T_c < 60°C$	65	W
T_{stg}	Storage Temperature	– 65 to 175	°C
T_j	Max. Operating Junction Temperature	175	°C

THERMAL DATA

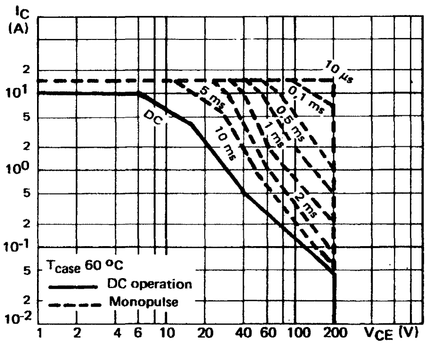
$R_{thj-case}$	Thermal Resistance Junction-case	Max	1.76	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

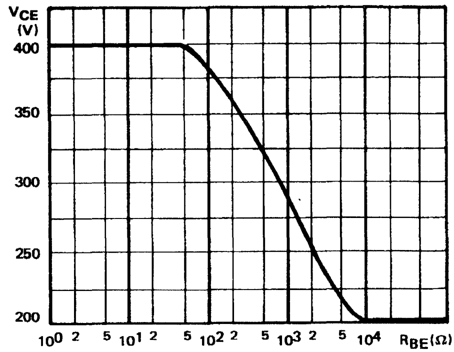
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 50Ω)	V_{CE} = 400V T_c = 125°C			3	mA
I_{CEX}	Collector Cutoff Current	V_{CE} = 400V V_{BE} = – 1.5V T_c = 125°C			1	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	200			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7		30	V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 3A I_B = 0.3A I_C = 6A I_B = 0.6A			0.7 1.5	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 6A I_B = 0.6A			2	V
 t_{on} t_s t_f	**RESISTIVE LOAD** Storage Time Fall Time Turn-on Time	V_{CC} = 150V I_C = 6A V_{BE} = – 6V I_{B1} = 0.6A R_{BB} = 5Ω		0.3 0.5 0.1	1 1.5 0.25	µs µs µs
 t_s t_f	**INDUCTIVE LOAD** Storage Time Fall Time	V_{CC} = 150V I_C = 6A I_{B1} = 0.6A V_{BE} = – 5V L_B = 1µH		1 0.04		µs µs
t_s t_f	Storage Time Fall Time	V_{CC} = 150V I_C = 6A I_{B1} = 0.6A V_{BE} = – 5V L_B = 1µH T_j = 125°C			3 0.2	µs µs

* Pulsed : Pulse duration = 300µs, duty cycle = 2%.

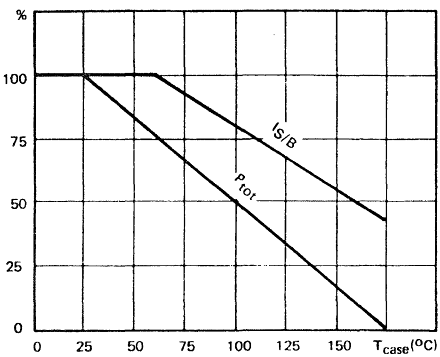
DCand Pulse Area.



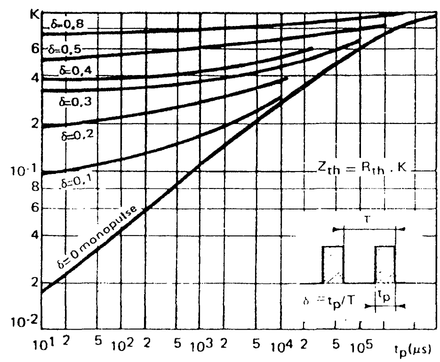
Collector-emitter Voltage vs. Base-emitter Resistance.



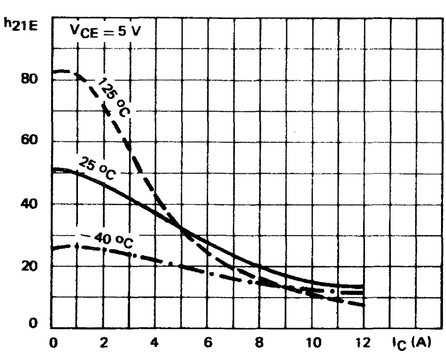
Power and $I_{S/B}$ Derating vs. Case Temperature.



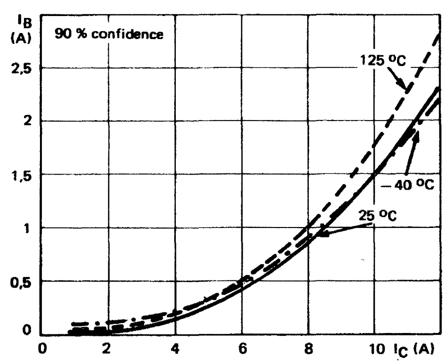
Transient Thermal Response.



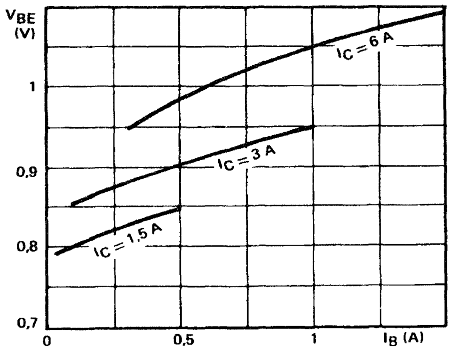
DC Current Gain.



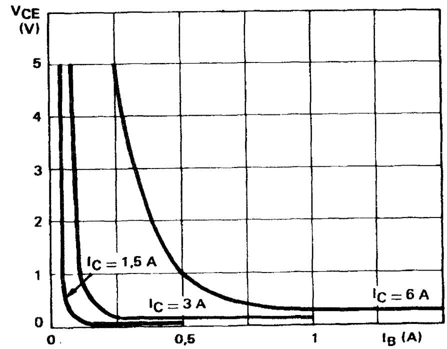
Minimum Base Current to saturate the Transistor.



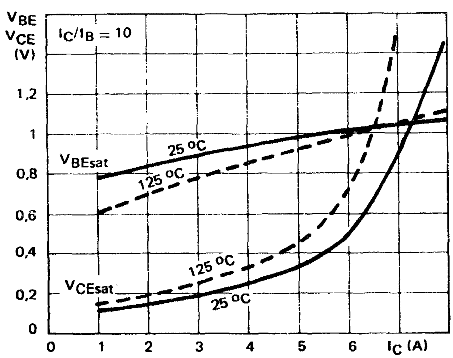
Base Characteristics.



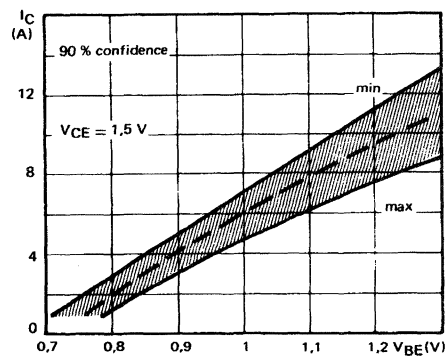
Collector Saturation Region.



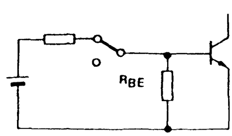
Saturation Voltage.



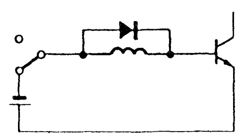
Collector Current Spread vs Base-emitter Voltage.



SWITCHING OPERATING AND OVERLOAD AREAS

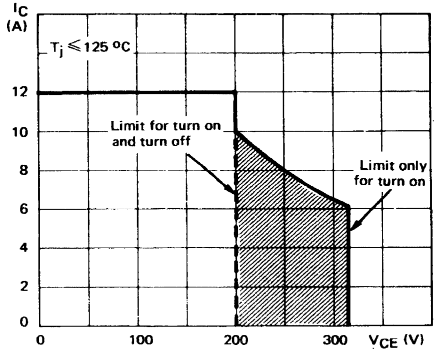


Transistor Forward Biased
- During the turn on
- During the turn off without negative base-emitter voltage and $R_{BE} \geq 100\ \Omega$



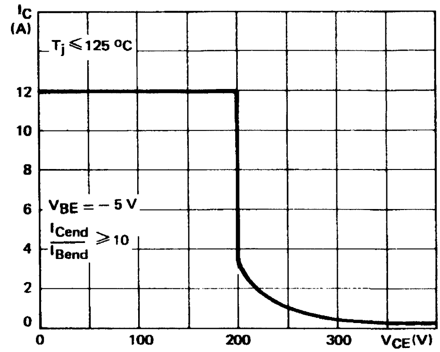
Transistor Reverse Biased
- During the turn off with negative base emitter voltage

Forward Biased Safe Operating Area (FBSOA).

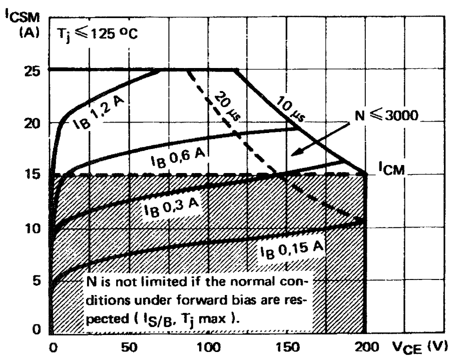


The hatched zone can only be used for turn on.

Reverse Biased Safe Operating Area (RBSOA).

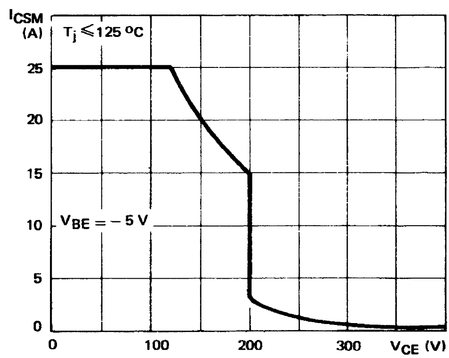


Forward Biased Accidental Overload Area (FBAOA).



The Kellog network (heavy point) allows the calculation of the maximum value of the short-circuit current for a given base current I_B (90 % confidence).

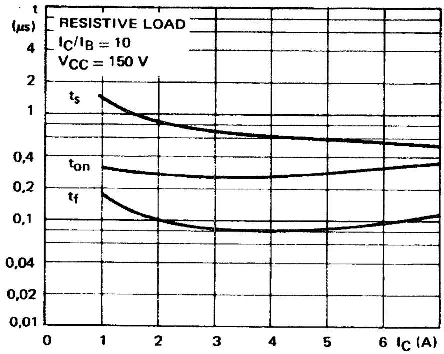
Reverse Biased Accidental Overload Area (RBAOA).



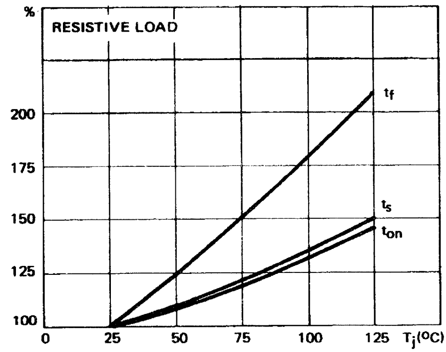
After the accidental overload current, the RBAOA has to be used for the turn off.

High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

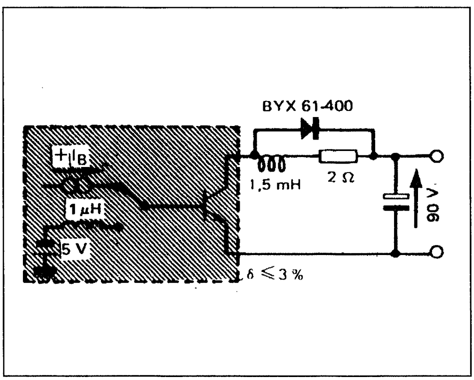
Switching Times vs Collector Current (resistive load).



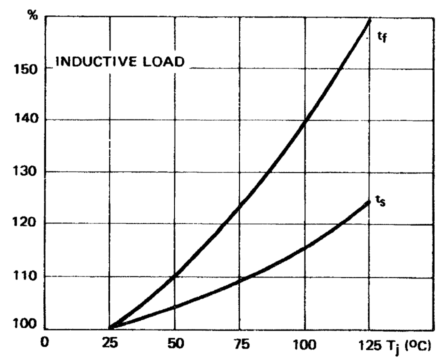
Switching Times vs Junction Temperature (resistive load).



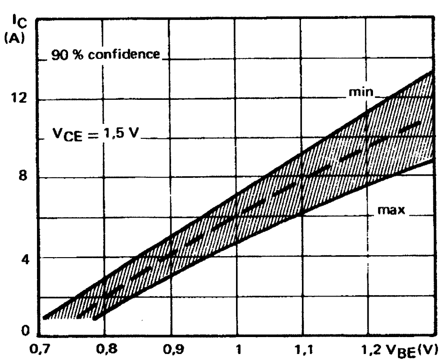
Switching Times Test Circuit on Inductive Load.



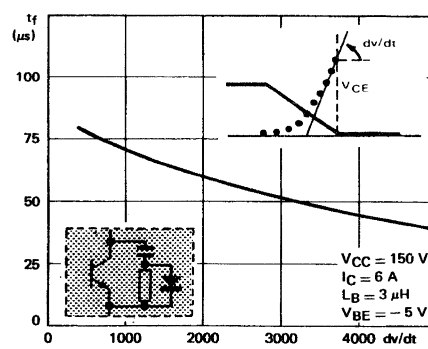
Switching Times vs Junction Temperature (inductive load).



Switching Times vs Collector Current.



Fall Times vs rapplied Voltage Slope.



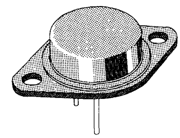
SGS-THOMSON MICROELECTRONICS

SGS-THOMSON
MICROELECTRONICS

BUV39

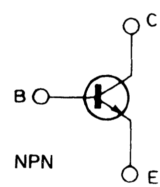
FAST SWITCHING POWER TRANSISTOR

- FAST SWITCHING TIMES
- LOW SWITCHING LOSSES
- VERY LOW SATURATION VOLTAGE AND HIGH GAIN FOR REDUCED LOAD OPERATION



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = - 1.5V)	160	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	90	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	25	A
I_{CM}	Collector Peak Current	45	A
I_B	Base Current	6	A
I_{BM}	Base Peak Current	9	A
P_{base}	Reverse Bias Base Dissipation (B.E. junction in avalanche)	1	W
P_{tot}	Total Dissipation at T_c < 25°C	120	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

$R_{thj-case}$	Thermal Resistance Junction-case	Max	1.46	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit.
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			1 5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = − 1.5V $V_{CE} = V_{CEV}$ V_{BE} = − 1.5V T_c = 100°C			1 5	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	90			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 7.5A I_B = 0.375A I_C = 15A I_B = 1.5A I_C = 20A I_B = 2.5A I_C = 7.5A I_B = 0.375A T_j = 100°C I_C = 15A I_B = 1.5A T_j = 100°C I_C = 20A I_B = 2.5A T_j = 100°C		0.5 0.65 0.85 0.5 0.8 1.1	0.8 0.9 1.2 0.9 1.5 1.8	V V V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 15A I_B = 1.5A I_C = 20A I_B = 2.5A I_C = 15A I_B = 1.5A T_j = 100°C I_C = 20A I_B = 2.5A T_j = 100°C		1.4 1.6 1.45 1.7	1.7 1.9 1.8 2.1	V V V V
di_C/dt	Rated of Rise of on-state Collector Current	V_{CC} = 72V R_C = 0 I_{B1} = 2.25A T_j = 25°C See fig.2 T_j = 100°C	 35 30	 50 45		 A/µs A/µs
$V_{CE(2\mu s)}$	Collector Emitter Dynamic Voltage	V_{CC} = 72V I_{B1} = 1.5A R_C = 4.8Ω T_j = 25°C See fig.2 T_j = 100°C		 1.7 2	 2.5 4	 V V
$V_{CE(4\mu s)}$	Collector Emitter Dynamic Voltage	V_{CC} = 72V I_{B1} = 1.5A R_C = 4.8Ω T_j = 25°C See fig.2 T_j = 100°C		 1 1.5	 2 3	 V V

RESISTIVE LOAD

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_r t_s t_f	Rise Time Storage Time Fall Time	V_{CC} = 72V I_C = 20A V_{BB} = − 5V I_{B1} = 2.5A R_{B2} = 1Ω t_p = 30µs See fig.1		0.55 0.55 0.12	1.1 1 0.25	µs µs µs

ELECTRICAL CHARACTERISTICS (continued)

INDUCTIVE LOAD

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
t_s t_f t_t t_c	Storage Time Fall Time Tail Time in Turn-on Crossover Time	V_{CC} = 72V I_C = 15A V_{BB} = − 5V L_C = 0.25mH	V_{clamp} = 90V I_B = 1.5A R_{B2} = 1.7Ω See fig.3		0.75 0.09 0.03 0.14	1.2 0.2 0.05 0.3	µs µs µs µs
t_s t_f t_t t_c	Storage Time Fall Time Tail Time in Turn-on Crossover Time	V_{CC} = 72V I_C = 15A V_{BB} = − 5V L_C = 0.25mH See fig.3	V_{clamp} = 90V I_B = 1.5A R_{B2} = 1.7Ω T_j = 100°C		0.95 0.15 0.06 0.3	1.7 0.3 0.1 0.5	µs µs µs µs
t_s t_f t_t	Storage Time Fall Time Tail Time in Turn-on	V_{CC} = 72V I_C = 15A V_{BB} = 0 L_C = 0.25mH	V_{clamp} = 90V I_B = 1.5A R_{B2} = 3.9Ω See fig.3		1.4 0.7 0.22		µs µs µs
t_s t_f t_t	Storage Time Fall Time Tail Time in Turn-on	V_{CC} = 72V I_C = 15A V_{BB} = 0 L_C = 0.25mH See fig.3	V_{clamp} = 90V I_B = 1.5A R_{B2} = 3.9Ω T_j = 100°C		1.85 1 0.44		µs µs µs

* Pulsed : Pulse duration = 300µs, duty cycle = 2%.

Figure 1 : Switching Times Test Circuit (resistive load).

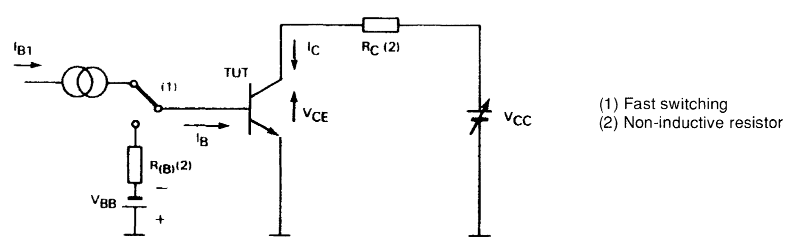


Figure 2 : Turn-on Switching Waveforms.

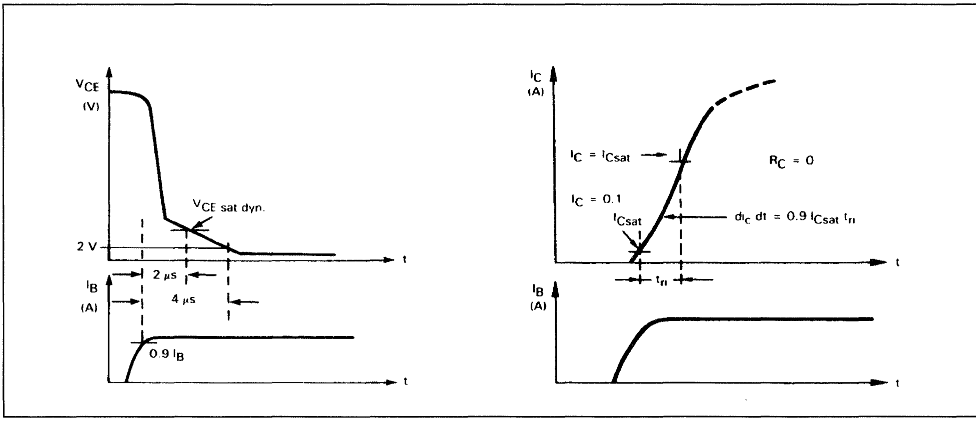
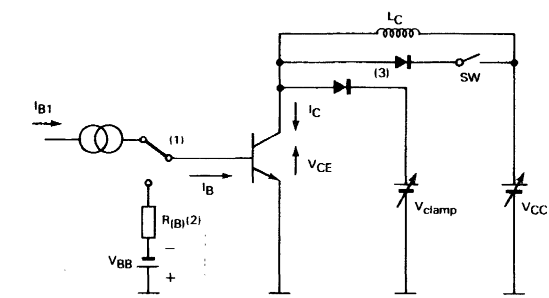
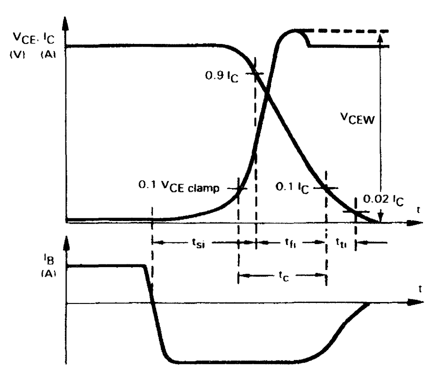


Figure 3a : Turn-off Switching Test Circuit.



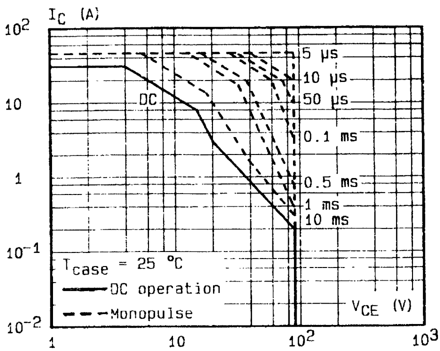
(1) Fast electronic switch
(2) Non-inductive resistor
(3) Fast recovery rectifier
SW : – closed for t_{si}, t_{fi}, t_c
– open for V_{CEW}

Figure 3b : Turn-off Switching Waveforms (inductive load).

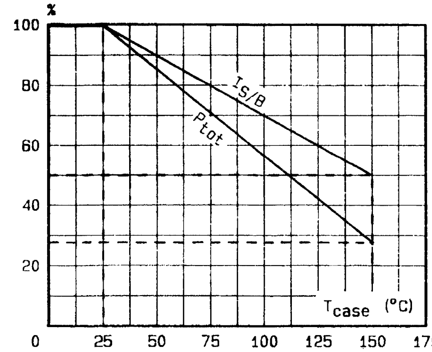


SGS-THOMSON MICROELECTRONICS

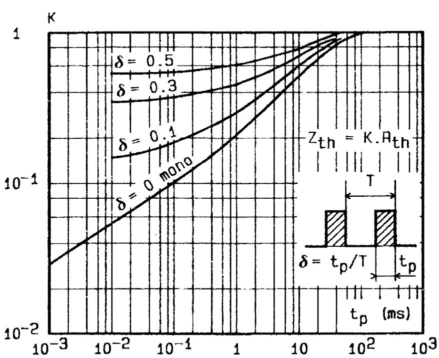
DC and AC Pulse Area.



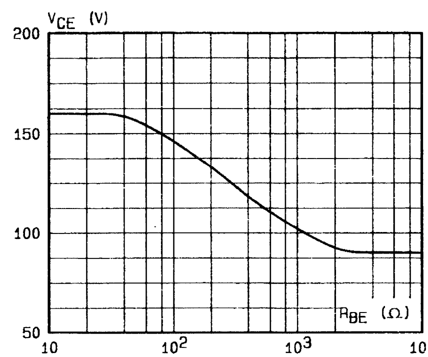
Power and $I_{S/B}$ Derating versus Case Temperature.



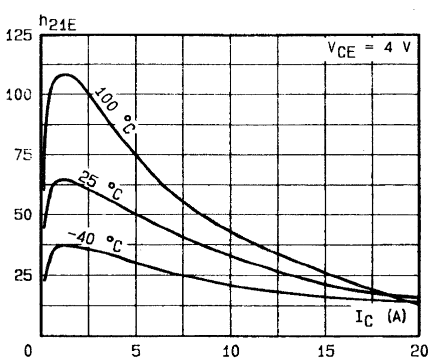
Transient Thermal Response.



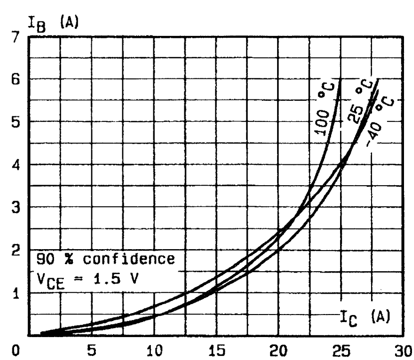
Collector-emitter Voltage versus Base-emitter Resistance.



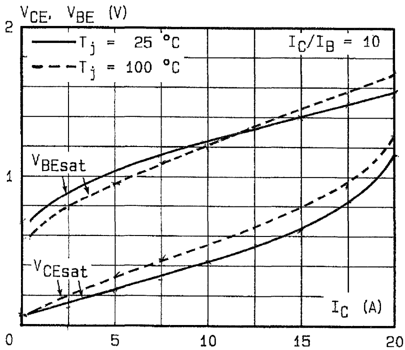
DC Current Gain.



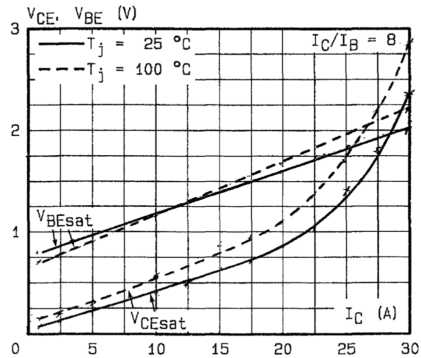
Minimum Base Current to saturate the transistor.



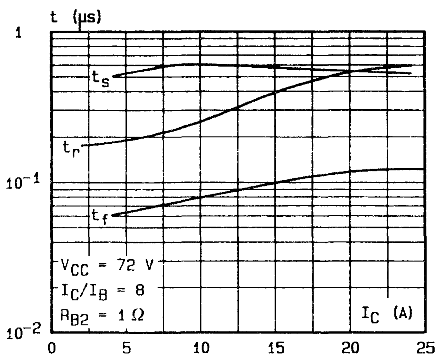
Saturation Voltage.



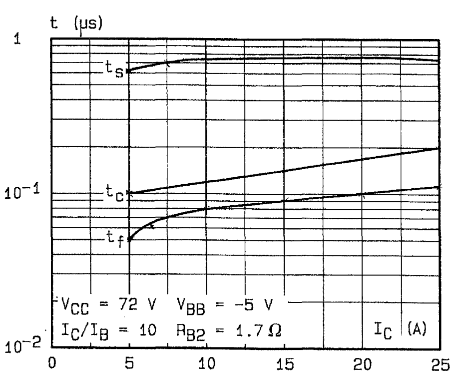
Saturation Voltage.



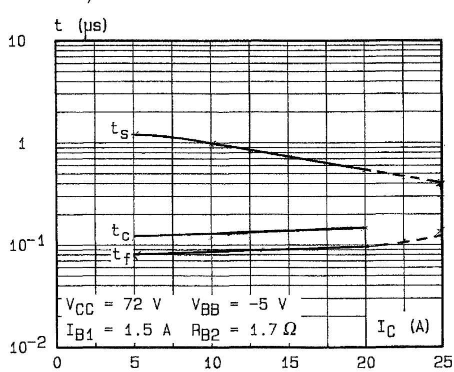
Switching Times versus Collector Current (resistive load).



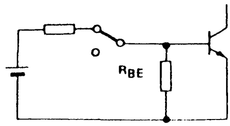
Switching Times versus Collector Current (inductive load).



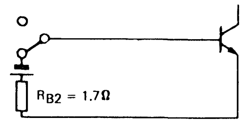
Switching Times versus Collector Current (inductive load).



SWITCHING OPERATING AND OVERLOAD AREAS

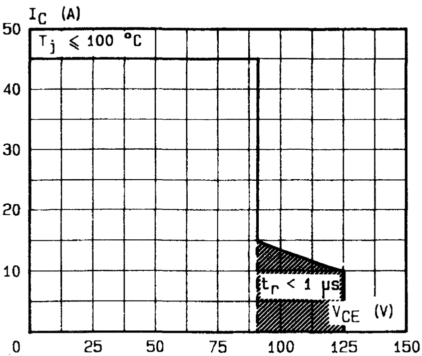


Transistor Forward Biased
- During the turn-on
- During the turn- off without negative base-emitter voltage and 3.9Ω ≤ R_{BE} ≤ 50 Ω



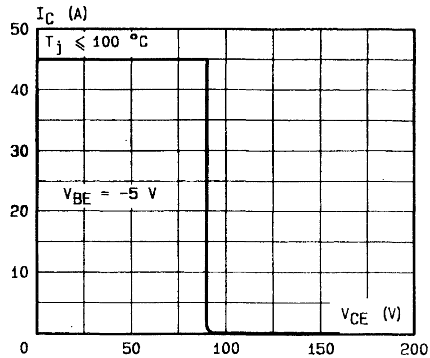
Transistor Reverse Biased
- During the turn-off with negative base emitter voltage

Forward Biased Safe Operating Area (FBSOA).

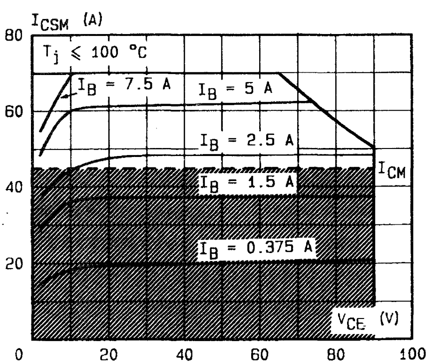


The hatched zone can only be used for turn-on

Reverse Biased Safe Operating Area (RBSOA).

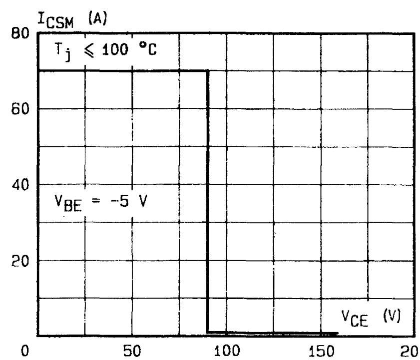


Forward Biased Accidental Overload Area (FBAOA).



The Kellog network (heavy point) allows the calculation of the maximum value of the short-circuit for a given base current I_B (90 % confidence).

Reverse Biased Accidental Overload Area (RBAOA).



After the acidental overload current the RBAOA has to be used for the turn-off.

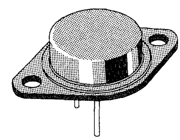
High accidental surge currents (I I_{CM}) are allowed if they are non repetitive and applied less than 3000 times during the component life.

SGS-THOMSON MICROELECTRONICS

BUV40

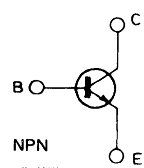
FAST SWITCHING POWER TRANSISTOR

- FAST SWITCHING TIMES
- LOW SWITCHING LOSSES
- VERY LOW SATURATION VOLTAGE AND HIGH GAIN FOR REDUCED LOAD OPERATION



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5 V)	250	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	125	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	20	A
I_{CM}	Collector Peak Current	30	A
I_B	Base Current	4	A
I_{BM}	Base Peak Current	6	A
P_{base}	Reverse Bias Base Dissipation (B.E. junction in avalanche)	1	W
P_{tot}	Total Dissipation at T_c < 25°C	120	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

$R_{thj-case}$	Thermal Resistance Junction-case	max	1.46	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			1 5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = − 1.5V $V_{CE} = V_{CEV}$ V_{BE} = − 1.5V T_c = 100°C			1 5	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	125			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5.5A I_B = 0.275A I_C = 11A I_B = 1.1A I_C = 15A I_B = 1.875A I_C = 5.5A I_B = 0.275A T_j = 100°C I_C = 11A I_B = 1.1A T_j = 100°C I_C = 15A I_B = 1.875A T_j = 100°C		0.5 0.65 0.9 0.5 0.8 1.1	0.8 0.9 1.2 0.9 1.2 1.8	V V V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 11A I_B = 1.1A I_C = 15A I_B = 1.875A I_C = 11A I_B = 1.1A T_j = 100°C I_C = 15A I_B = 1.875A T_j = 100°C		1.3 1.5 1.35 1.6	1.6 1.9 1.7 2	V V V V
di_C/dt	Rated of Rise of on-state Collector Current	V_{CC} = 100V R_C = 0 I_{B1} = 1.65A T_j = 25°C See fig. 2 T_j = 100°C	 35 30	 45 40		 A/µs A/µs
$V_{CE(2µs)}$	Collector Emitter Dynamic Voltage	V_{CC} = 100V I_{B1} = 1.1A R_C = 9Ω T_j = 25°C See fig. 2 T_j = 100°C		 2 2.6	 2.5 4	 V V
$V_{CE(4µs)}$	Collector Emitter Dynamic Voltage	V_{CC} = 100V I_{B1} = 1.1A R_C = 9Ω T_j = 25°C See fig. 2 T_j = 100°C		 1.1 1.6	 2 2.5	 V V

RESISTIVE LOAD

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_r t_s t_f	Rise Time Storage Time Fall Time	V_{CC} = 100V I_C = 15A V_{BB} = − 5V I_{B1} = 1.8A R_{B2} = 1.3Ω t_p = 30µs See fig. 1		0.4 0.6 0.14	1 1 0.3	µs µs µs

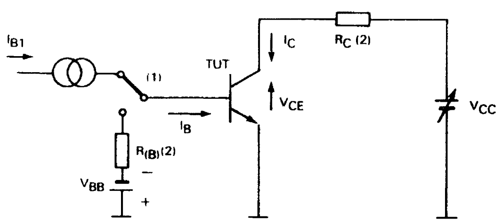
ELECTRICAL CHARACTERISTICS (continued)

INDUCTIVE LOAD

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
t_s t_f t_t t_c	Storage Time Fall Time Tail Time in Turn-on Crossover Time	V_{CC} = 100V I_C = 11A V_{BB} = – 5V L_C = 0.25mH	V_{clamp} = 125V I_B = 1.1A R_{B2} = 2.3Ω See fig. 3		0.75 0.08 0.02 0.15	1.4 0.2 0.05 0.3	µs µs µs µs
t_s t_f t_t t_c	Storage Time Fall Time Tail Time in Turn-on Crossover Time	V_{CC} = 100V I_C = 11A V_{BB} = – 5V L_C = 0.25mH See fig. 3	V_{clamp} = 125V I_B = 1.1A R_{B2} = 2.3Ω T_j = 100°C		0.95 0.14 0.04 0.3	1.7 0.3 0.1 0.5	µs µs µs µs
t_s t_f t_t	Storage Time Fall Time Tail Time in Turn-on	V_{CC} = 100V I_C = 11A V_{BB} = 0 L_C = 0.25mH	V_{clamp} = 125V I_B = 1.1A R_{B2} = 4.7Ω See fig. 3		1.8 0.7 0.2		µs µs µs
t_s t_f t_t	Storage Time Fall Time Tail Time in Turn-on	V_{CC} = 100V I_C = 11A V_{BB} = 0 L_C = 0.25mH See fig. 3	V_{clamp} = 125V I_B = 1.1A R_{B2} = 4.7Ω T_j = 100°C		2.5 1 0.4		µs µs µs

Pulsed : Pulse duration = 300µs, duty cycle = 2%.

Figure 1 : Switching Times Test Circuit (resistive load).



(1) Fast electronic switch
(2) Non-inductive resistor

Figure 2 : Turn-on Switching Waveforms.

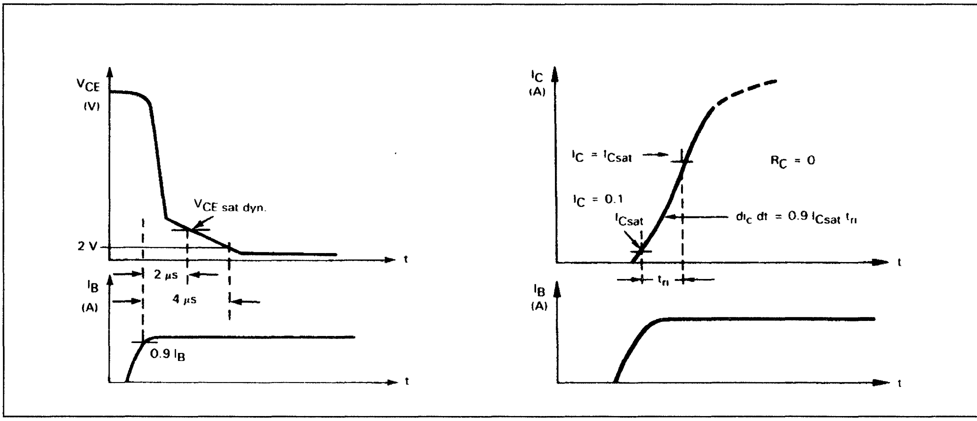


Figure 3a : Turn-off Switching Test Circuits.

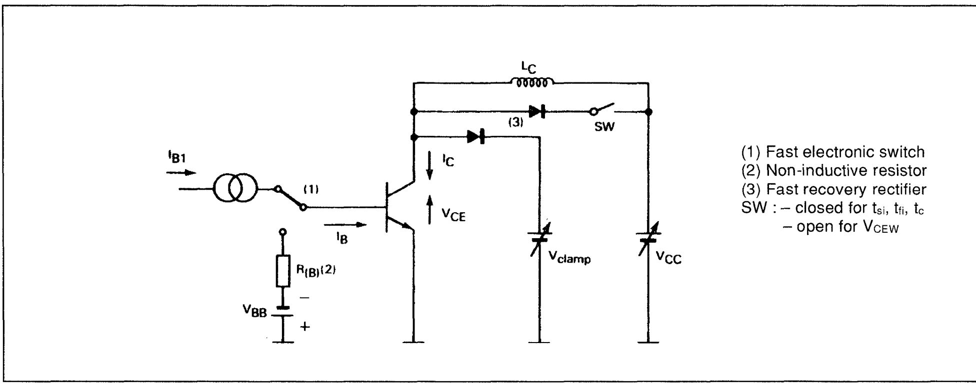
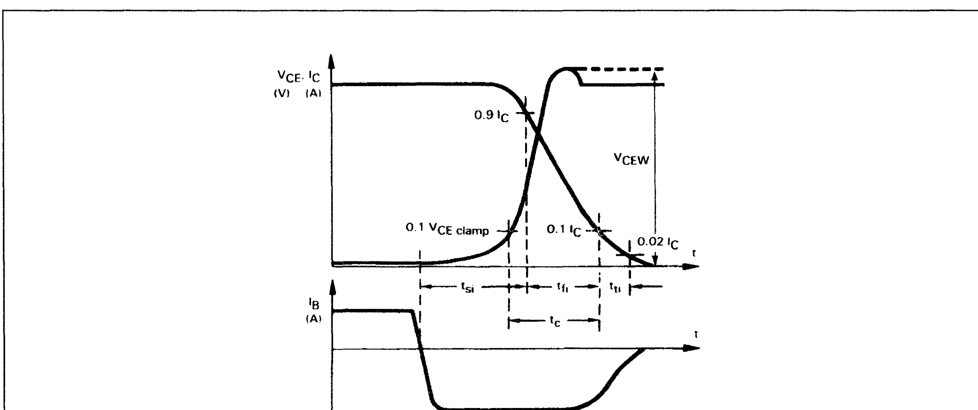
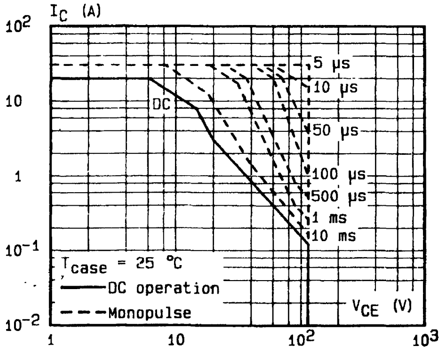


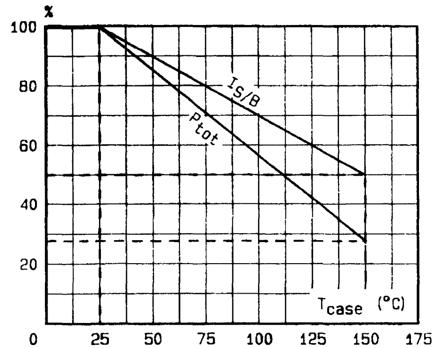
Figure 3b : Turn-off Switching Waveforms (inductive load).



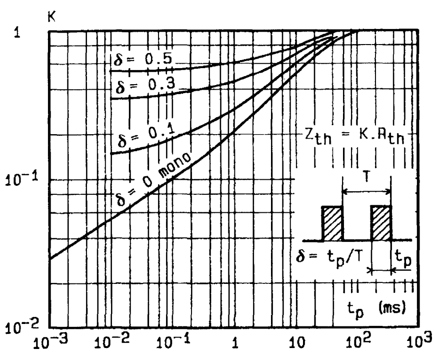
DC and AC Pulse Area.



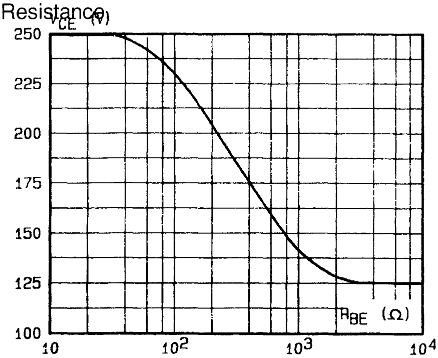
Power and $I_{S/B}$ Derating vs. Case Temperature.



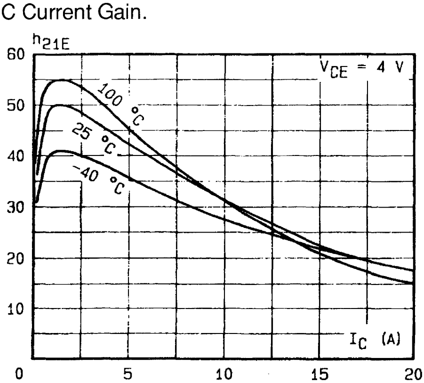
Transient Thermal Response.



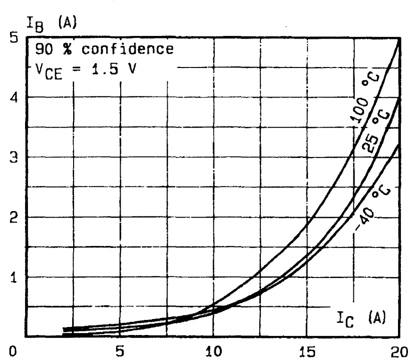
Collector-emitter Voltage vs. Base-emitter Resistance.



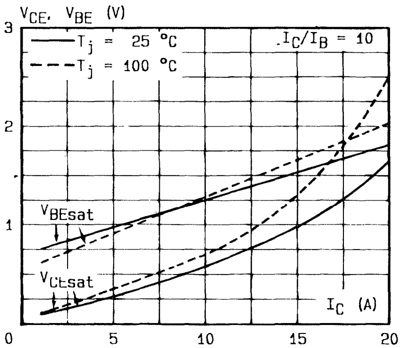
DC Current Gain.



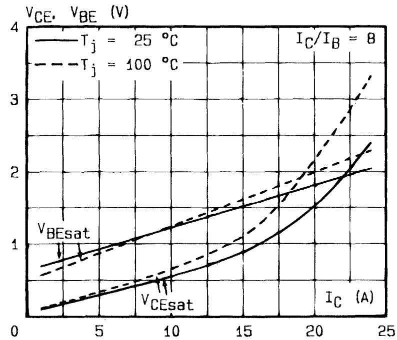
Minimum Base Current to saturate the Transistor.



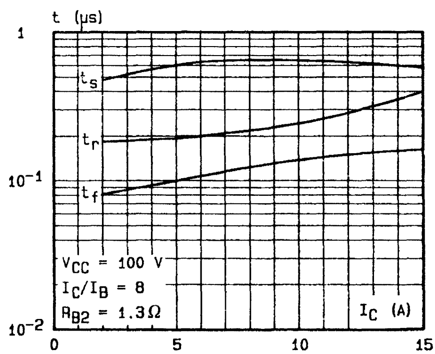
Saturation Voltage.



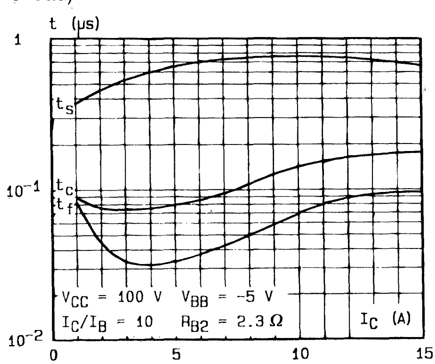
Saturation Voltage.



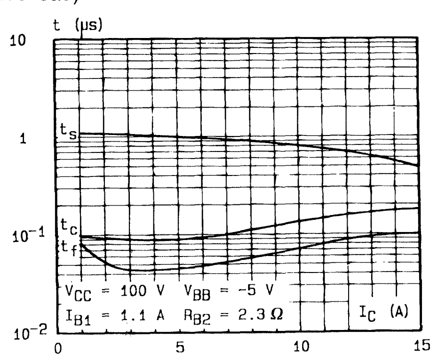
Switching Times versus Collector Current (resistive load).



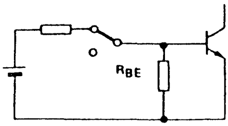
Switching Times versus Collector Current (inductive load).



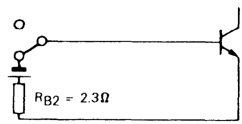
Switching Times versus Collector Current (inductive load).



SWITCHING OPERATING AND OVERLOAD AREAS

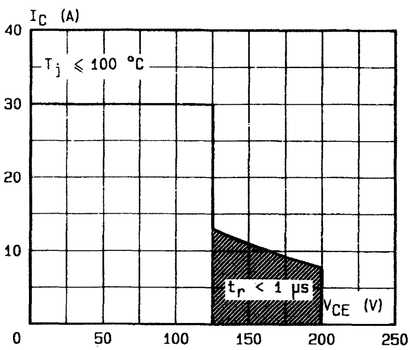


Transistor Forward Biased
- During the turn-on
- During the turn-off without negative base-emitter voltage and 4.7 Ω ≤ R_{BE} ≤ 50 Ω



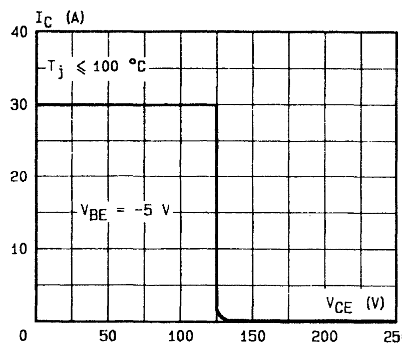
Transistor Reverse Biased
- During the turn-off with negative base emitter voltage

Forward Biased Safe Operating Area (FBSOA).

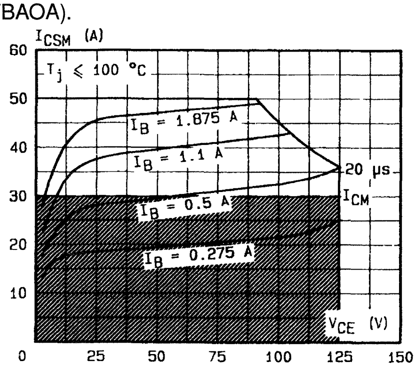


The hatched zone can only be used for turn-on.

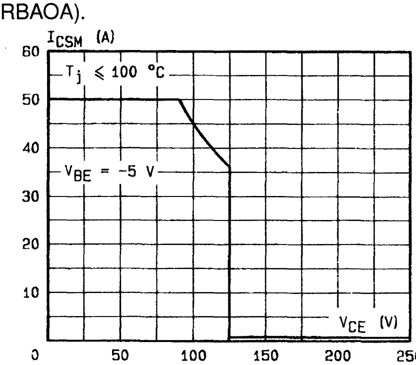
Reverse Biased Safe Operating Area (RBSOA).



Forward Biased Accidental Overload Area (FBAOA).



Reverse Biased Accidental Overload Area (RBAOA).



High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

The Kellog network (heavy point) allows the calculation of the maximum value of the short-circuit for a given base current I_B (90 % confidence).

After the acidental overload current the RBAOA has to be used for the turn-off

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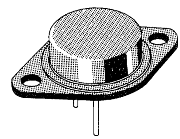
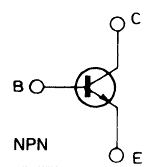
FAST SWITCHING POWER TRANSISTOR

- FAST SWITCHING TIMES
- LOW SWITCHING LOSSES
- VERY LOW SATURATION VOLTAGE AND HIGH GAIN FOR REDUCED LOAD OPERATION



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5 V)	300	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	200	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	15	A
I_{CM}	Collector Peak Current	20	A
I_B	Base Current	3	A
I_{BM}	Base Peak Current	5	A
P_{base}	Reverse Bias Base Dissipation (B.E. junction in avalanche)	1	W
P_{tot}	Total Dissipation at T_c < 25°C	120	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

$R_{thj-case}$	Thermal Resistance Junction-case	max	1.46	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit.
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			0.5 2.5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = − 1.5V $V_{CE} = V_{CEV}$ V_{BE} = − 1.5V T_c = 100°C			0.5 2	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	200			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 3A I_B = 0.15A I_C = 6A I_B = 0.6A I_C = 8A I_B = 1A I_C = 3A I_B = 0.15A T_j = 100°C I_C = 6A I_B = 0.6A T_j = 100°C I_C = 8A I_B = 1A T_j = 100°C		0.3 0.45 0.55 0.3 0.55 0.65	0.8 0.9 1.2 0.9 1.2 1.5	V V V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 6A I_B = 0.6A I_C = 8A I_B = 1A I_C = 6A I_B = 0.6A T_j = 100°C I_C = 8A I_B = 1A T_j = 100°C		1.15 1.3 1.15 1.3	1.6 1.8 1.6 1.8	V V V V
di_C/dt	Rated of Rise of on-state Collector Current	V_{CC} = 160V R_C = 0 I_{B1} = 0.9A T_j = 25°C See fig. 2 T_j = 100°C	 30 25	 33 28		 A/μs A/μs
$V_{CE(2μs)}$	Collector Emitter Dynamic Voltage	V_{CC} = 160V I_{B1} = 0.6A R_C = 27Ω T_j = 25°C See fig. 2 T_j = 100°C		 1.05 1.53	 2.5 4	 V V
$V_{CE(4μs)}$	Collector Emitter Dynamic Voltage	V_{CC} = 160V I_{B1} = 0.6A R_C = 27Ω T_j = 25°C See fig. 2 T_j = 100°C		 0.75 0.95	 1.7 2	 V V

RESISTIVE LOAD

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_r t_s t_f	Rise Time Storage Time Fall Time	V_{CC} = 160V I_C = 8A V_{BB} = − 5V I_{B1} = 1A R_{B2} = 2.5Ω t_p = 30μs See fig. 1		0.3 0.6 0.12	0.5 1.2 0.3	μs μs μs

Pulsed : Pulse duration = 300μs, duty cycle = 2%.

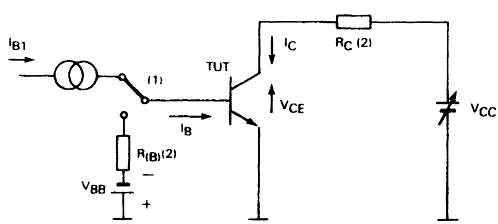
ELECTRICAL CHARACTERISTICS (continued)

INDUCTIVE LOAD

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
t_s t_f t_t t_c	Storage Time Fall Time Tail Time in Turn-on Crossover Time	V_{CC} = 160V I_C = 6A V_{BB} = – 5V L_C = 1.3mH	V_{clamp} = 200V I_B = 0.6A R_{B2} = 4.2Ω See fig. 3		0.75 0.08 0.01 0.12	1.5 0.2 0.07 0.3	µs µs µs µs
t_s t_f t_t t_c	Storage Time Fall Time Tail Time in Turn-on Crossover Time	V_{CC} = 160V I_C = 6A V_{BB} = – 5V L_C = 1.3mH See fig. 3	V_{clamp} = 200V I_B = 0.6A R_{B2} = 4.2Ω T_j = 100°C		1.2 0.12 0.03 0.22	2 0.3 0.15 0.5	µs µs µs µs
t_s t_f t_t	Storage Time Fall Time Tail Time in Turn-on	V_{CC} = 160V I_C = 6A V_{BB} = 0 L_C = 1.3mH	V_{clamp} = 200V I_B = 0.6A R_{B2} = 6.8Ω See fig. 3		1.8 0.45 0.15		µs µs µs
t_s t_f t_t	Storage Time Fall Time Tail Time in Turn-on	V_{CC} = 160V I_C = 6A V_{BB} = 0 L_C = 1.3mH See fig. 3	V_{clamp} = 200V I_B = 0.6A R_{B2} = 6.8Ω T_j = 100°C		3.3 0.8 0.44		µs µs µs

Pulsed : Pulse duration = 300µs, duty cycle = 2%.

Figure 1 : Switching Times Test Circuit (resistive load).



(1) Fast electronic switch
(2) Non-inductive resistor

Figure 2 : Turn-on Switching Waveforms.

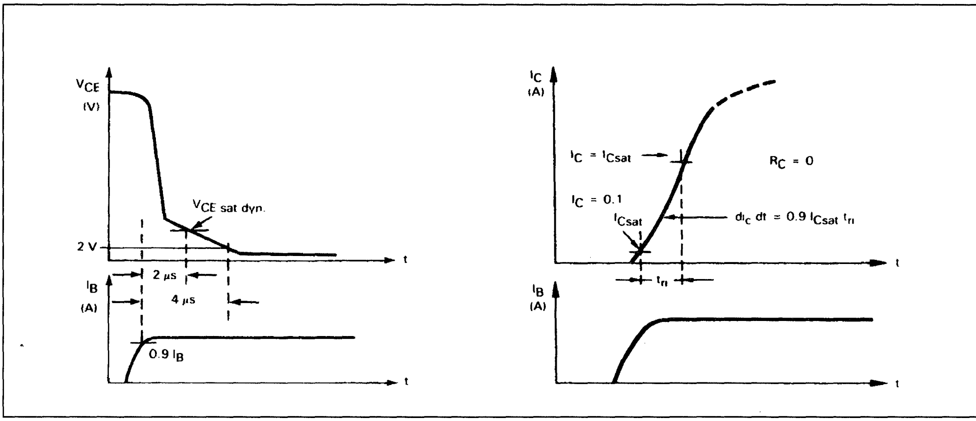


Figure 3a : Turn-off Switching Test Circuits.

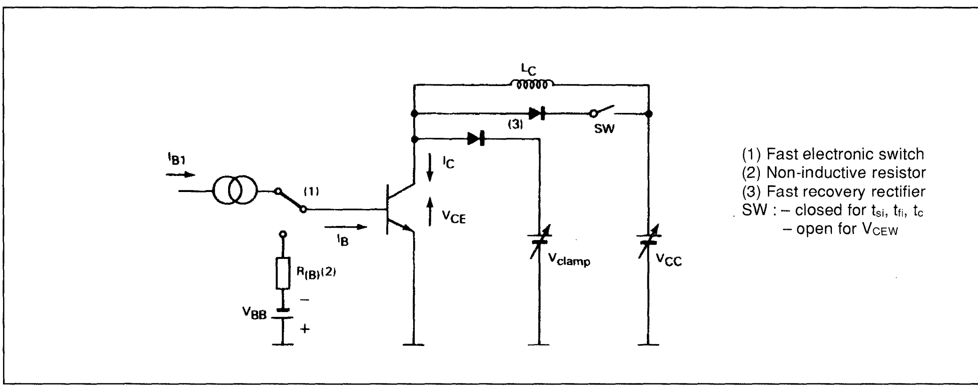
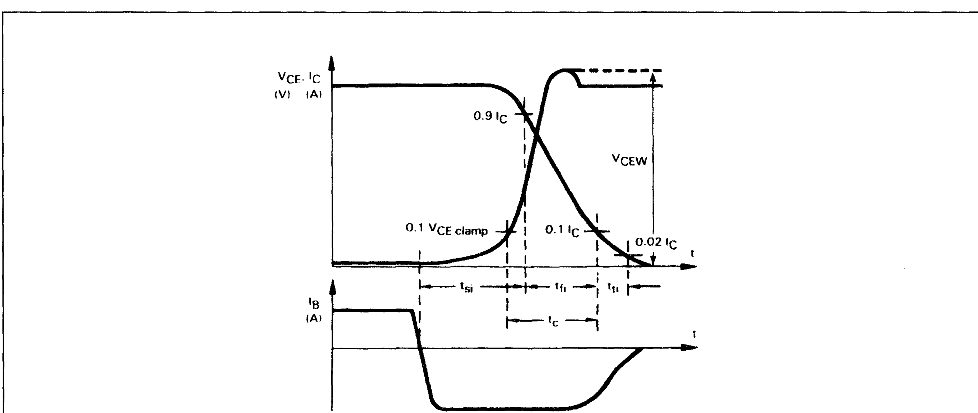
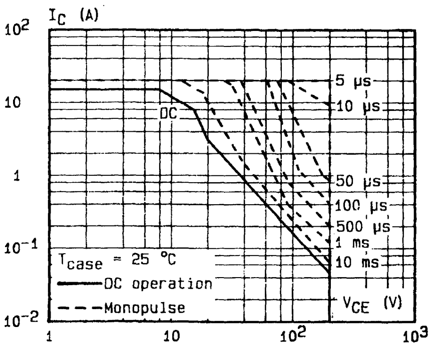


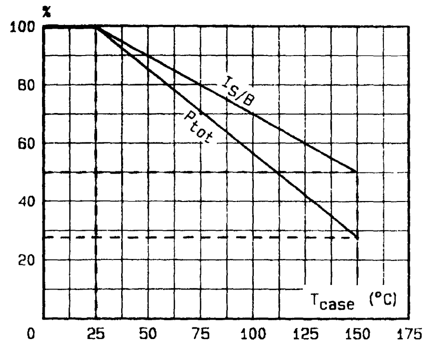
Figure 3b : Turn-off Switching Waveforms (inductive load).



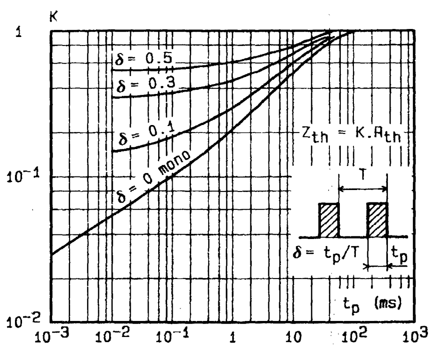
DC and Pulse Area.



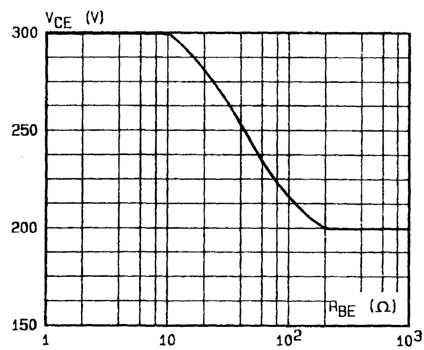
Power and $I_{S/B}$ Derating vs. Case Temperature.



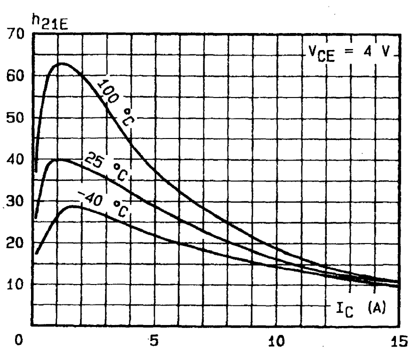
Transient Thermal Response.



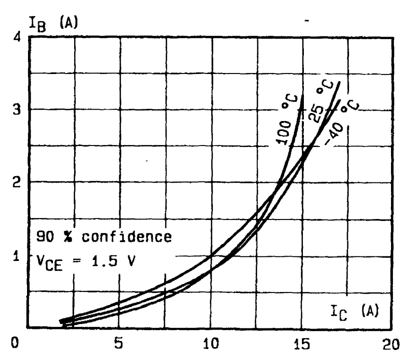
Collector-emitter Voltage vs. Base-emitter Resistance.



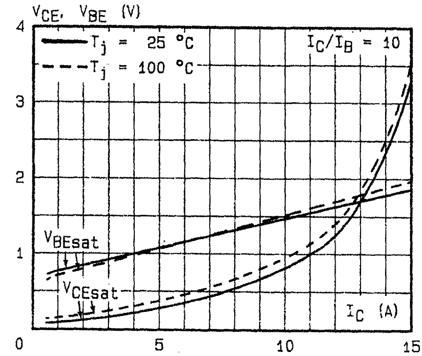
DC Current Gain.



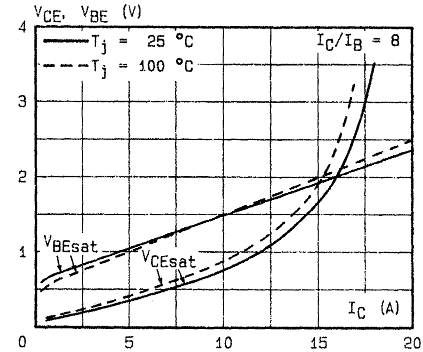
Minimum Base Current to saturate the Transistor.



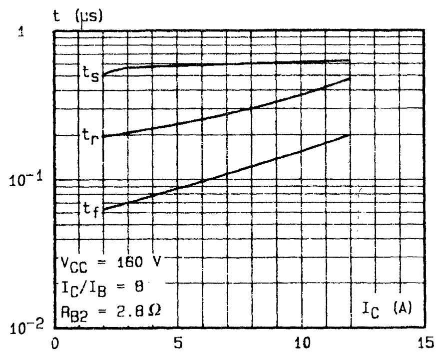
Saturation Voltage.



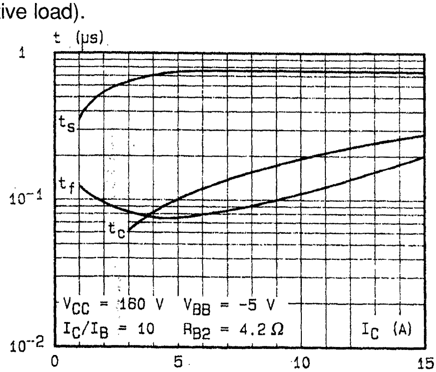
Saturation Voltage.



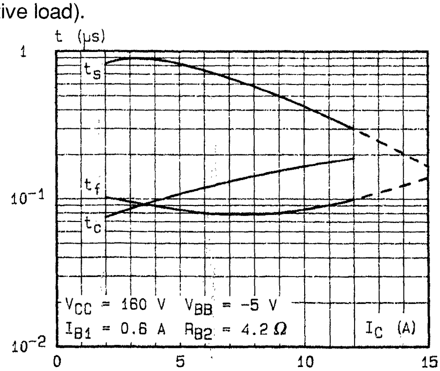
Switching Times versus Collector Current (resistive load).



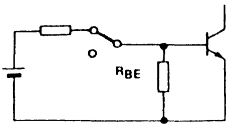
Switching Times versus Collector Current (inductive load).



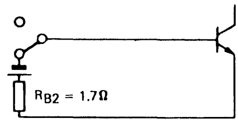
Switching Times versus Collector Current (inductive load).



SWITCHING OPERATING AND OVERLOAD AREAS

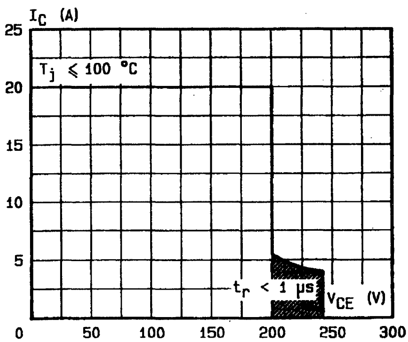


Transistor Forward Biased
- During the turn-on
- During the turn-off without negative base-emitter voltage and $6.8\Omega \leq R_{BE} \leq 50\ \Omega$



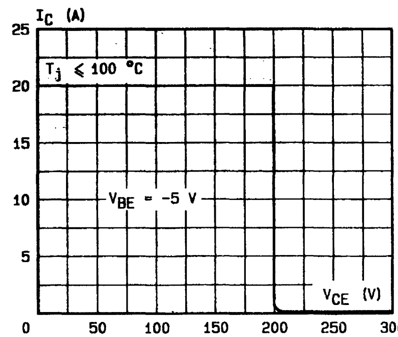
Transistor Reverse Biased
- During the turn-off with negative base emitter voltage

Forward Biased Safe Operating Area (FBSOA).

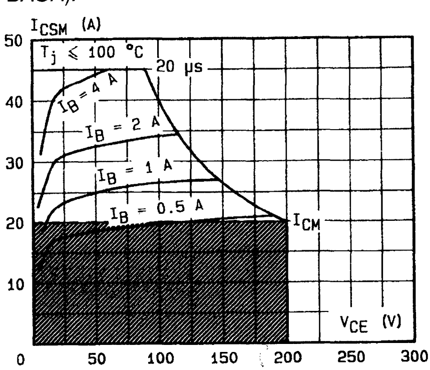


The hatched zone can only be used for turn-on

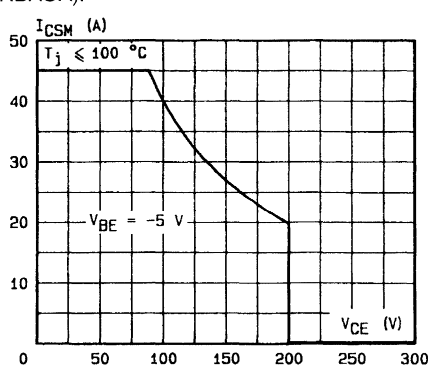
Reverse Biased Safe Operating Area (RBSOA).



Forward Biased Accidental Overload Area (FBAOA).



Reverse Biased Accidental Overload Area (RBAOA).



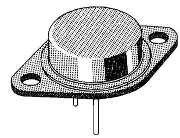
High accidental surge currents (I > ICM) are allowed if they are non repetitive and applied less than 3000 times during the component life

The Kellog network (heavy point) allows the calculation of the maximum value of the short-circuit for a given base current I_B (90 % confidence).

After the accidental overload current the RBAOA has to be used for the turn-off

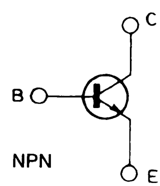
FAST SWITCHING POWER TRANSISTOR

- FAST SWITCHING TIMES
- LOW SWITCHING LOSSES
- VERY LOW SATURATION VOLTAGE AND HIGH GAIN FOR REDUCED LOAD OPERATION



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	350	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	250	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	12	A
I_{CM}	Collector Peak Current	18	A
I_B	Base Current	2.5	A
I_{BM}	Base Peak Current	4	A
P_{base}	Reverse Bias Base Dissipation (B. E. junction in avalanche)	1	W
P_{tot}	Total Dissipation at T_c < 25°C	120	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case Max	1.46	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			0.5 2.5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = – 1.5V $V_{CE} = V_{CEV}$ V_{BE} = – 1.5V T_c = 100°C			0.5 2	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	250			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 2A I_B = 0.13A I_C = 4A I_B = 0.4A I_C = 6A I_B = 0.75A I_C = 2A I_B = 0.13A T_j = 100°C I_C = 4A I_B = 0.4A T_j = 100°C I_C = 6A I_B = 0.75A T_j = 100°C		0.25 0.4 0.5 0.25 0.45 0.6	0.8 0.9 1.2 0.9 1.2 1.5	V V V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 4A I_B = 0.4A I_C = 6A I_B = 0.75A I_C = 4A I_B = 0.4A T_j = 100°C I_C = 6A I_B = 0.75A T_j = 100°C		1 1.1 0.9 1.1	1.3 1.5 1.3 1.5	V V V V
di_c/dt	Rated of Rise of on-state Collector Current	V_{CC} = 200V R_C = 0 I_{B1} = 0.6A T_j = 25°C See fig. 2 T_j = 100°C	 25 20	 40 35		 A/μs A/μs
$V_{CE\ (2\mu s)}$	Collector Emitter Dynamic Voltage	V_{CC} = 200V I_{B1} = 0.4A R_C = 50Ω T_j = 25°C See fig. 2 T_j = 100°C		 1.7 2.5	 2.5 4	 V V
$V_{CE\ (4\mu s)}$	Collector Emitter Dynamic Voltage	V_{CC} = 200V I_{B1} = 0.4A R_C = 50Ω T_j = 25°C See fig. 2 T_j = 100°C		 0.9 1.1	 1.7 2	 V V

RESISTIVE LOAD

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_r t_s t_f	Rise Time Storage Time Fall Time	V_{CC} = 200V I_C = 6A V_{BB} = – 5V I_{B1} = 0.75A R_{B2} = 3.3Ω t_p = 30μs See fig 1		0.3 1 0.15	0.4 1.6 0.3	μs μs μs

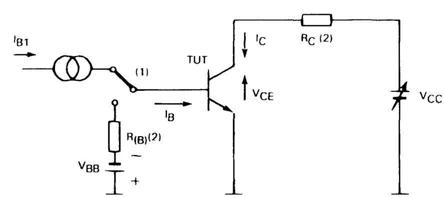
ELECTRICAL CHARACTERISTICS (continued)

INDUCTIVE LOAD

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
t_s t_f t_t t_c	Storage Time Fall Time Tail Time in Turn-on Crossover Time	V_{CC} = 200V I_C = 4A V_{BB} = – 5V L_C = 2.5mH	V_{clamp} = 250V I_B = 0.4A R_{B2} = 6.3Ω See fig. 3		1.2 0.08 0.03 0.15	1.8 0.2 0.12 0.35	µs µs µs µs
t_s t_f t_t t_c	Storage Time Fall Time Tail Time in Turn-on Crossover Time	V_{CC} = 200V I_C = 4A V_{BB} = – 5V L_C = 2.5mH See fig. 3	V_{clamp} = 250V I_B = 0.4A R_{B2} = 6.3Ω T_j = 100°C		1.8 0.2 0.08 0.4	2.4 0.4 0.2 0.7	µs µs µs µs
t_s t_f t_t	Storage Time Fall Time Tail Time in Turn-on	V_{CC} = 200V I_C = 4A V_{BB} = 0 L_C = 2.5mH	V_{clamp} = 250V I_B = 0.5A R_{B2} = 7.5Ω See fig. 3		2.5 0.4 0.15		µs µs µs
t_s t_f t_t	Storage Time Fall Time Tail Time in Turn-on	V_{CC} = 200V I_C = 4A V_{BB} = 0 L_C = 2.5mH See fig. 3	V_{clamp} = 250V I_B = 0.4A R_{B2} = 7.5Ω T_j = 100°C		4.8 0.7 0.4		µs µs µs

* Pulsed : Pulse duration = 300µs, duty cycle = 2 %.

Figure 1 : Switching Times Test Circuit (resistive load).



(1) Fast electronic switch
(2) Non-inductive resistor

Figure 2 : Turn-on Switching Waveforms.

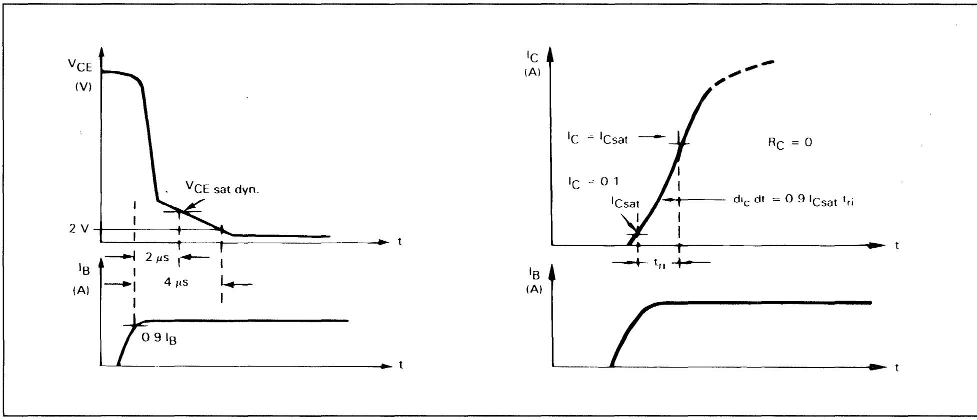


Figure 3a : Turn-off Switching Test Circuits.

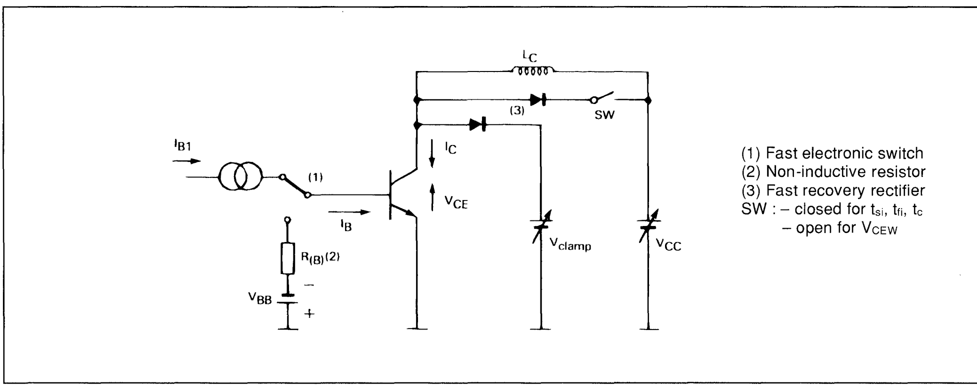
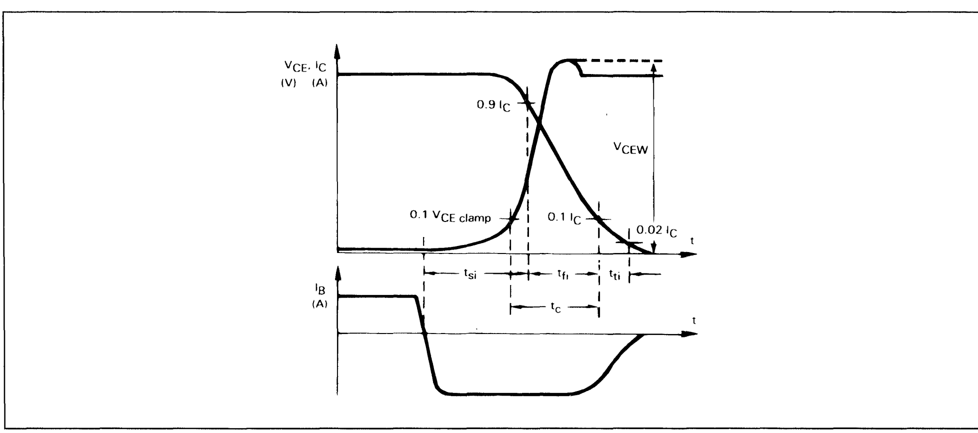
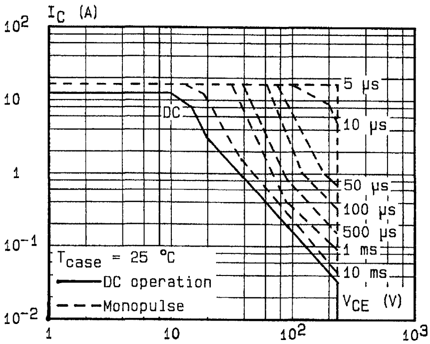


Figure 3b : Turn-off Switching Waveforms (inductive load).

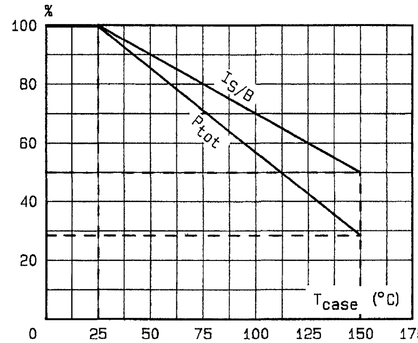


SGS-THOMSON MICROELECTRONICS

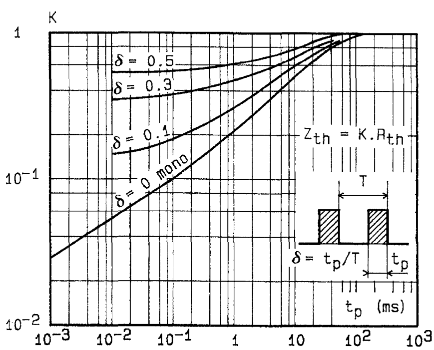
DC and Pulse Area.



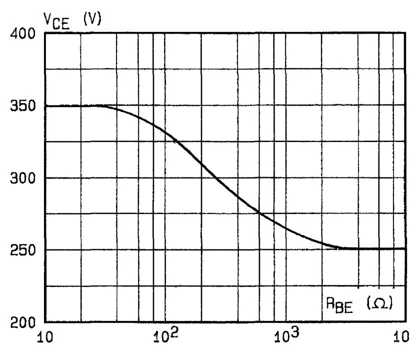
Power and $I_{S/B}$ Derating vs. Case Temperature.



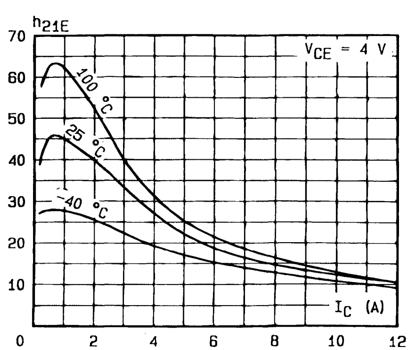
Transient Thermal Response.



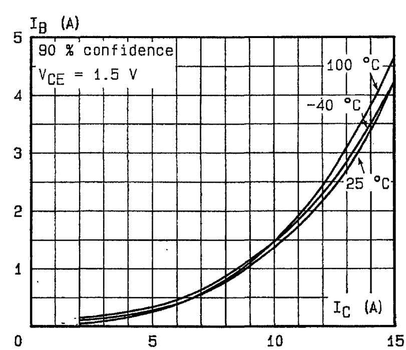
Collector-emitter Voltage vs. Base-emitter Resistance.



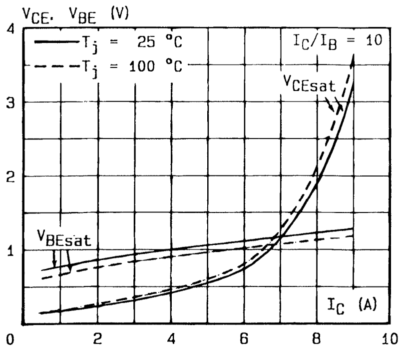
DC Current Gain.



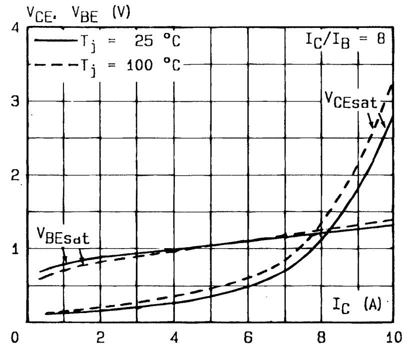
Minimum Base Current to saturate the Transistor.



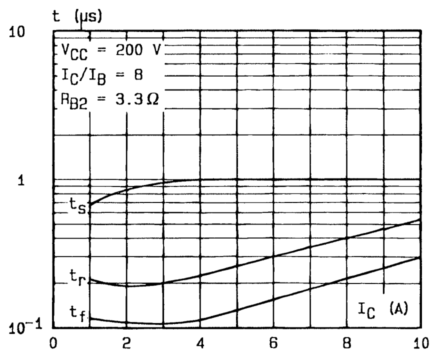
Saturation Voltage.



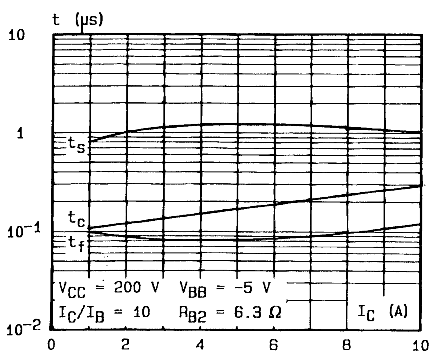
Saturation Voltage.



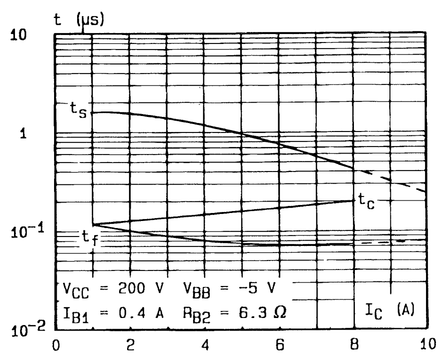
Switching Times versus Collector Current (resistive load).



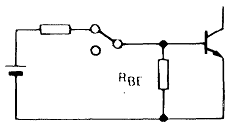
Switching Times versus Collector Current (inductive load).



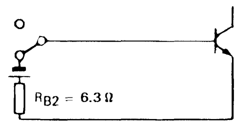
Switching Times versus Collector Current (inductive load).



SWITCHING OPERATING AND OVERLOAD AREAS

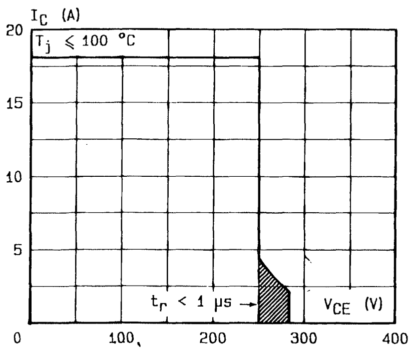


TRANSISTOR FORWARD BIASED
- During the turn-on
- During the turn-off without negative base-emitter voltage and $7.5\,\Omega \leq R_{BE} \leq 50\,\Omega$.



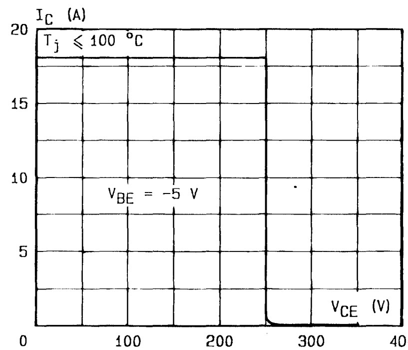
TRANSISTOR REVERSE BIASED
- During the turn-off with negative base-emitter voltage.

Forward Biased Safe Operating Area (FBSOA).

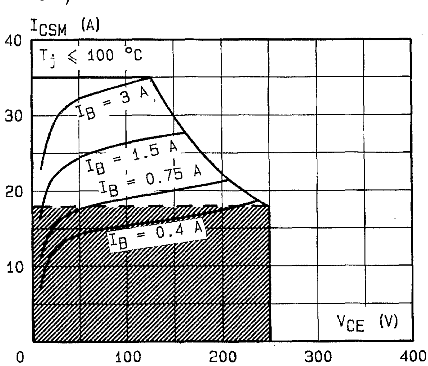


The hatched zone can only be used for turn-on.

Reverse Biased Safe Operating Area (RBSOA).

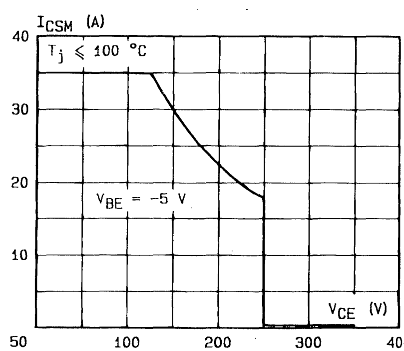


Forward Biased Accidental Overload Area (FBAOA).



The Kellog network (heavy point) allows the calculation of the maximum value of the short-circuit for a given base current I_B (90% confidence).

Reverse Biased Accidental Overload Area (RBAOA).

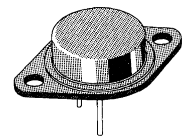


After the accidental overload current the RBAOA has to be used for the turn-off.

High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

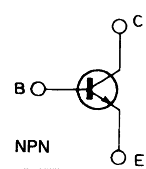
FAST SWITCHING POWER TRANSISTOR

- FAST SWITCHING TIMES
- LOW SWITCHING LOSSES
- VERY LOW SATURATION VOLTAGE AND HIGH GAIN FOR REDUCED LOAD OPERATION



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	400	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	300	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	12	A
I_{CM}	Collector Peak Current	18	A
I_B	Base Current	2.5	A
I_{BM}	Base Peak Current	4	A
P_{tot}	Total Dissipation at T_c < 25°C	120	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	1.46	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			0.5 2.5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = − 1.5V $V_{CE} = V_{CEV}$ V_{BE} = − 1.5V T_c = 100°C			0.5 2	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	300			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 4A I_B = 0.4A I_C = 4A I_B = 0.4A T_j = 100°C			0.9 1.9	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 4A I_B = 0.4A I_C = 4A I_B = 0.4A T_j = 100°C			1.3 1.5	V V
di_c/dt	Rate of Rise of on-state Collector Current	V_{CC} = 250V R_C = 0 I_{B1} = 0.6A t_p = 3μs T_j = 100°C See fig. 1	25			A/μs

INDUCTIVE LOAD

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s t_f t_c	Storage Time Fall Time Crossover Time	V_{CC} = 250V V_{clamp} = 300V I_C = 4A I_B = 0.4A V_{BB} = − 5V R_{B2} = 6.25Ω L_C = 3.1mH T_j = 100°C see fig. 2			3 0.4 0.7	μs μs μs
V_{CEW}	Maximum Collector Emitter Voltage without Snubber	V_{CC} = 50V I_{CWoff} = 6A V_{BB} = − 5V I_{B1} = 0.4A L_C = 0.42mH R_{BB} = 6.25Ω T_j = 125°C See fig. 2	300			V

Figure 1 : Turn-on Switching Characteristics of the Transistor.

(1) Fast electronic switch
(2) Non-inductive resistor

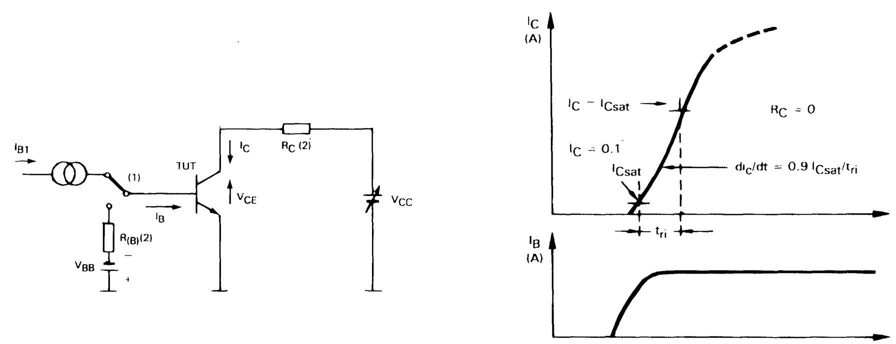
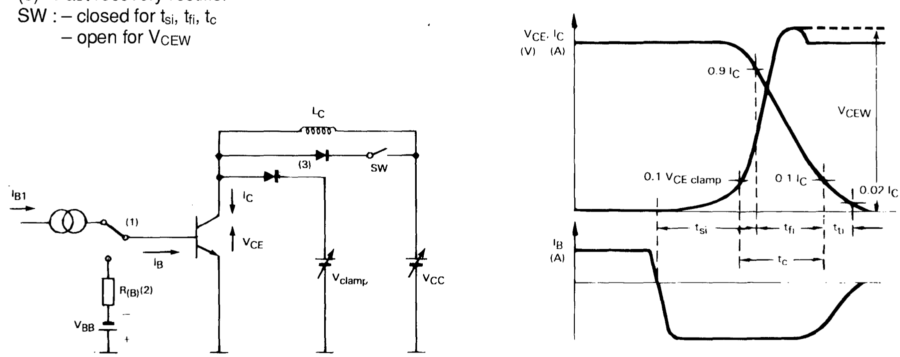
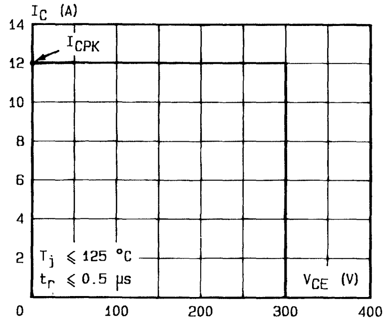


Figure 2 : Turn-off Switching Characteristics of the Transistor.

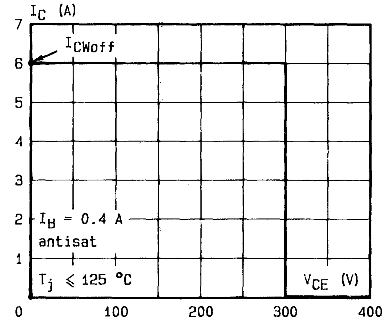
(1) Fast electronic switch
(2) Non-inductive resistor
(3) Fast recovery rectifier
SW : – closed for t_{si}, t_{fi}, t_c
– open for V_{CEW}



Forward Biased Safe Operating Area (FBSOA).



Reverse Biased Safe Operating Area (RBSOA).

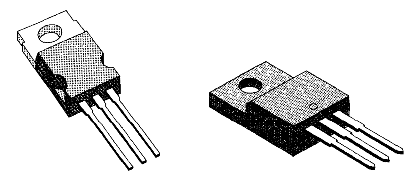


BUV46/FI
BUV46A/AFI

HIGH VOLTAGE POWER SWITCH

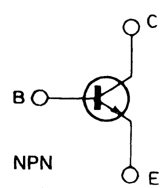
DESCRIPTION

The BUV46/A and BUV46FI/AFI are silicon multi-epitaxial mesa NPN transistors in the jedec TO-220 plastic package and ISOWATT220 fully isolated package respectively, intended for high voltage, fast switching applications.



TO-220 ISOWATT220

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter TO-220 ISOWATT220	BUV46 BUV46FI	BUV46A BUV46AFI	Unit
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	850	1000	V
V_{CEX}	Collector-emitter Voltage (V_{BE} = – 2.5V)	850	1000	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	400	450	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7		V
I_C	Collector Current	5		A
I_B	Base Current	3		A
		TO-220	**ISOWATT220**	
P_{tot}	Total Power Dissipation at T_c < 25°C	70	30	W
T_{stg}	Storage Temperature	– 65 to 150		°C
T_j	Max. Operating Junction Temperature	150		°C

THERMAL DATA

		TO-220	ISOWATT220	
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case max	1.76	4.12	°C/W

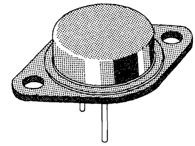
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEX}$ $V_{CE} = V_{CEX}$ T_c = 125°C			0.1 1	mA mA
I_{CEX}	Collector Cutoff Current	$V_{CE} = V_{CEX}$ V_{BE} = – 2.5V $V_{CE} = V_{CEX}$ V_{BE} = – 2.5V T_c = 125°C			0.3 2	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 100mA for **BUV46/FI** for **BUV46A/AFI**	400 450			V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	for **BUV46/FI** I_C = 2.5A I_B = 0.5A I_C = 3.5A I_B = 0.7A for **BUV46A/AFI** I_C = 2A I_B = 0.4A I_C = 3A I_B = 0.6A			 1.5 5 1.5 5	 V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	for **BUV46/FI** I_C = 2.5A I_B = 0.5A for **BUV46A/AFI** I_C = 2A I_B = 0.4A			 1.3 1.3	 V V
t_{on} t_s t_f	Turn-on Time Storage Time Fall Time	I_C = 2.5A V_{CC} = 150V I_{B1} = – I_{B2} = 0.5A for **BUV46/FI**			1 3 0.8	μs μs μs
t_{on} t_s t_f	Turn-on Time Storage Time Fall Time	I_C = 2A V_{CC} = 150V I_{B1} = – I_{B2} = 0.4A for **BUV46A/AFI**			1 3 0.8	μs μs μs

* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.

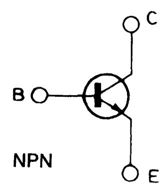
FAST SWITCHING POWER TRANSISTOR

- FAST SWITCHING TIMES
- LOW SWITCHING LOSSES
- VERY LOW SATURATION VOLTAGE AND HIGH GAIN FOR REDUCED LOAD OPERATION



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	250	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	125	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	25	A
I_{CM}	Collector Peak Current	50	A
I_B	Base Current	6	A
I_{BM}	Base Peak Current	12	A
P_{base}	Reverse Bias Base Power Dissipation (B.E. junction in avalanche)	2	W
P_{tot}	Total Dissipation at T_c < 25°C	150	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	150	°C

THERMAL DATA

$R_{thj-case}$	Thermal Resistance Junction-case	Max	1.17	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			1 5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = − 1.5V $V_{CE} = V_{CEV}$ V_{BE} = − 1.5V T_c = 100°C			1 5	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	125			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10A I_B = 0.5A I_C = 20A I_B = 2A I_C = 24A I_B = 3A I_C = 10A I_B = 0.5A T_j = 100°C I_C = 20A I_B = 2A T_j = 100°C I_C = 24A I_B = 3A T_j = 100°C		0.4 0.6 0.7 0.5 0.75 0.9	0.8 0.9 1.2 0.9 1.5 1.8	V V V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 20A I_B = 2A I_C = 24A I_B = 3A I_C = 20A I_B = 2A T_j = 100°C I_C = 24A I_B = 3A T_j = 100°C		1.25 1.35 1.25 1.45	1.6 1.7 1.7 1.9	V V V V
di_c/dt	Rate of Rise of On-state Collector Current	V_{CC} = 100V R_C = 0 I_{B1} = 3A T_j = 25°C See fig. 2 T_j = 100°C	 50 45	 100 85		 A/µs A/µs
$V_{CE(2µs)}$	Collector-emitter Dynamic Voltage	V_{CC} = 100V I_{B1} = 2A R_C = 5Ω T_j = 25°C See fig. 2 T_j = 100°C		 1.4 2.1	 3 4	 V V
$V_{CE(4µs)}$	Collector-emitter Dynamic Voltage	V_{CC} = 100V I_{B1} = 2A R_C = 5Ω T_j = 25°C See fig. 2 T_j = 100°C		 1.1 1.5	 2 2.5	 V V

ELECTRICAL CHARACTERISTICS (continued)

TURN-OFF SWITCHING CHARACTERISTICS
On Inductive Load (with negative bias)

Symbol	Test Conditions		Min.	Typ.	Max.	Unit
t_{si}	T_j = 25 °C	I_C = 20 A, I_B = 2 A, V_{BB} = – 5 V V_{CC} = 100 V, V_{clamp} = 125 V L_C = 0.25 mH, R_{B2} = 1.3 Ω See fig. 3		0.85	1.4	μs
	T_j = 100 °C			1.2	1.7	
t_{fi}	T_j = 25 °C			0.09	0.2	
	T_j = 100 °C			0.17	0.3	
t_{ti}	T_j = 25 °C			0.04	0.05	
	T_j = 100 °C			0.07	0.1	
t_c	T_j = 25 °C			0.16	0.3	
	T_j = 100 °C			0.3	0.5	

TURN-OFF SWITCHING CHARACTERISTICS
On Inductive Load (without negative bias)

Symbol	Test Conditions		Min.	Typ.	Max.	Unit
t_{si}	T_j = 25 °C	I_C = 20 A, I_B = 2 A, V_{BB} = 0 V V_{CC} = 100 V, V_{clamp} = 125 V L_C = 0.25 mH, R_{B2} = 4.7 Ω See fig. 3		2.1		μs
	T_j = 100 °C			3.2		
t_{fi}	T_j = 25 °C			0.7		
	T_j = 100 °C			1.2		
t_{ti}	T_j = 25 °C			0.28		
	T_j = 100 °C			0.55		

* Pulsed : Pulse duration = 300μs, duty cycle = 2 %.

Figure 1 : Switching Times Test Circuit (resistive load).

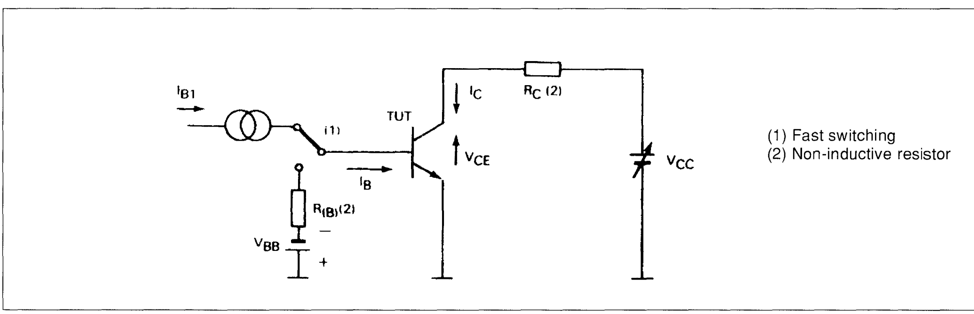


Figure 2 : Turn-on Switching Waveforms.

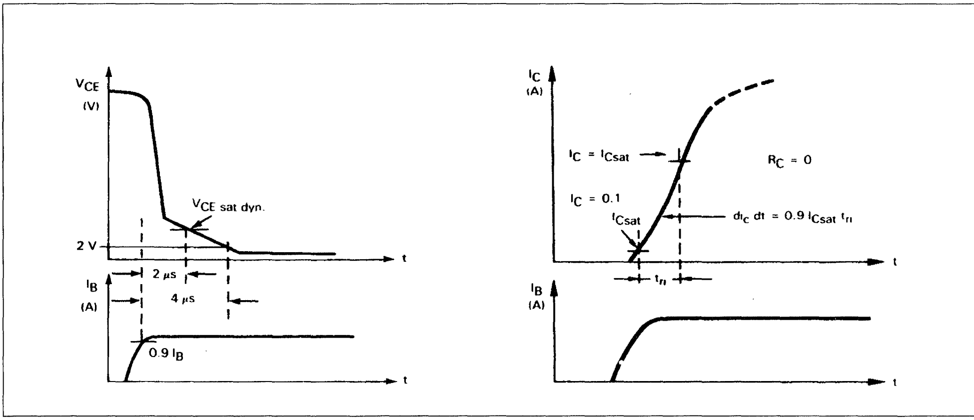


Figure 3a : Turn-off Switching Test Circuit.

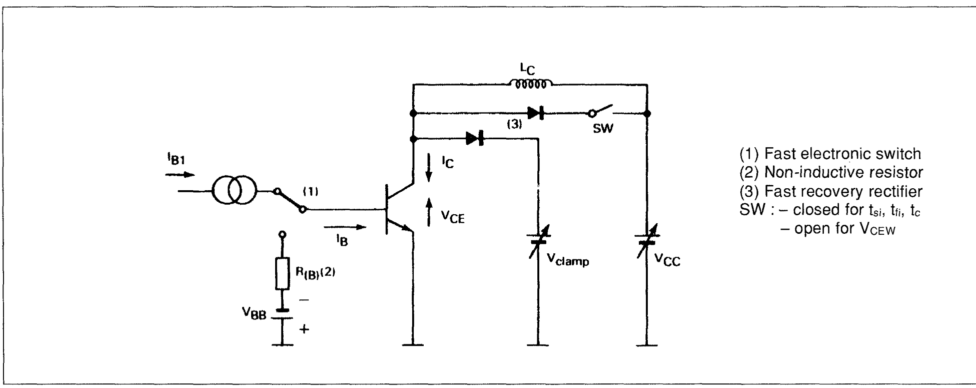
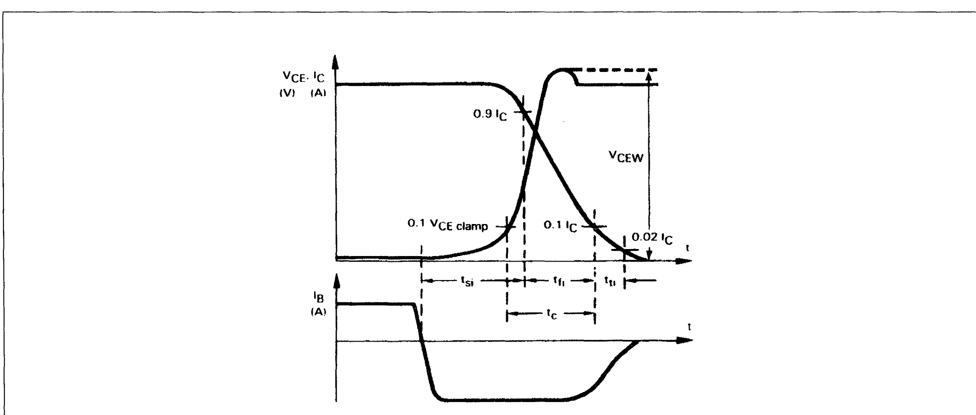
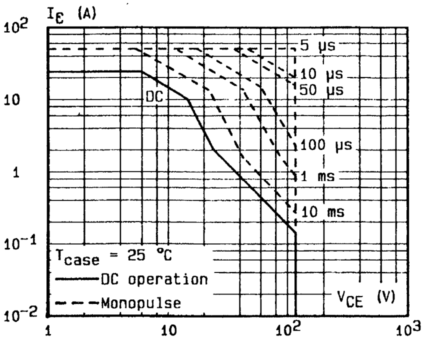


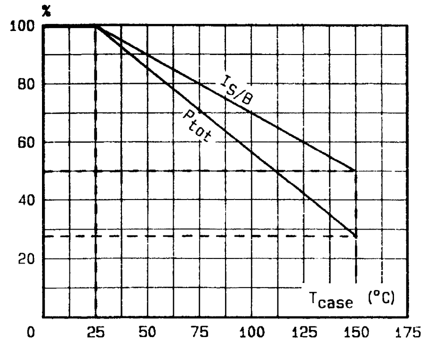
Figure 3b : Turn-off Switching Waveforms (inductive load).



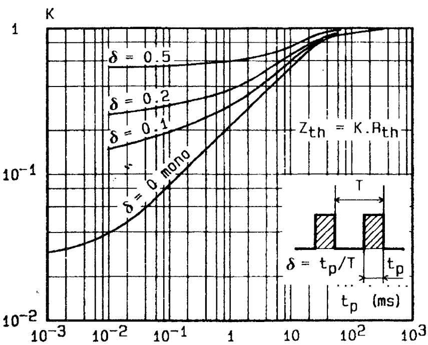
DC and AC Pulse Area.



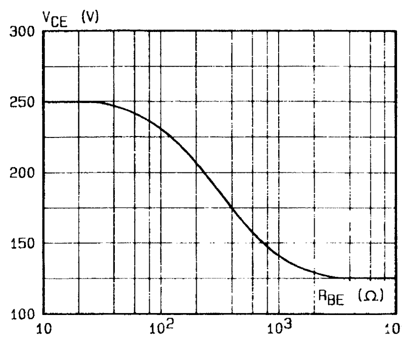
Power and $I_{S/B}$ Derating versus Case Temperature.



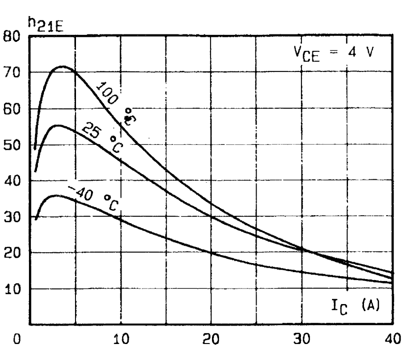
Transient Thermal Response.



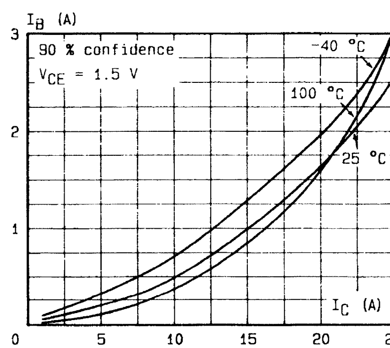
Collector-emitter Voltage versus Base-emitter Resistance.



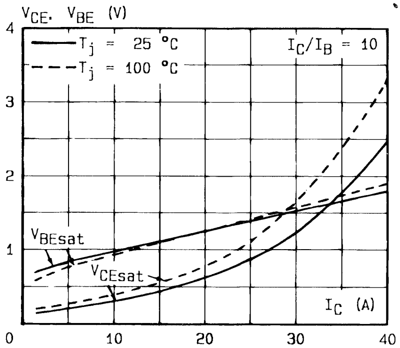
DC Current Gain.



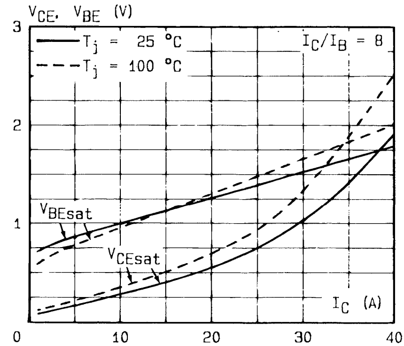
Minimum Base Current to saturate the Transistor.



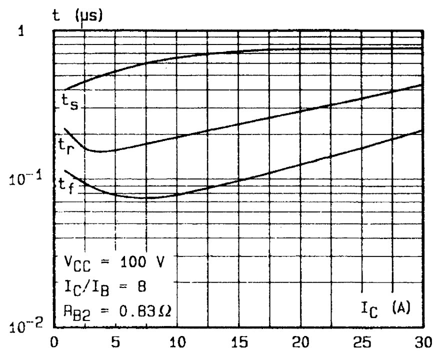
Saturation Voltage.



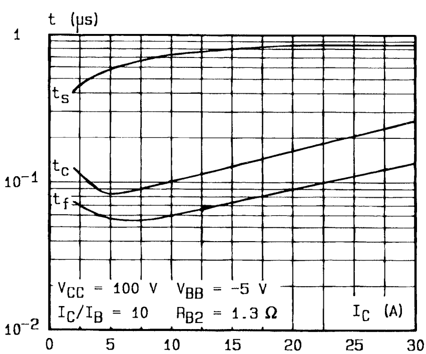
Saturation voltage



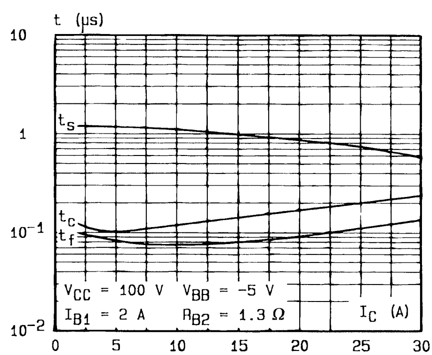
Switching Times versus Collector Current (resistive load).



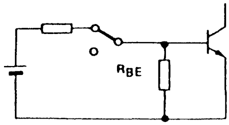
Switching Times versus Collector Current (inductive load).



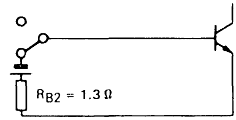
Switching Times versus Collector Current (inductive load).



SWITCHING OPERATING AND OVERLOAD AREAS

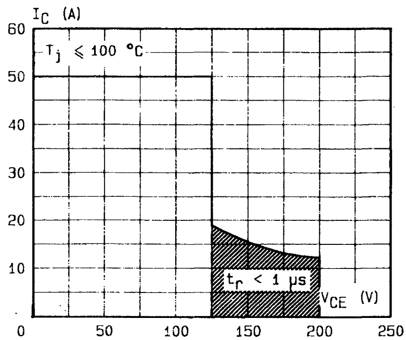


Transistor Forward Biased
- During the turn-on
- During the turn-off without negative base-emitter voltage and $4.7\Omega \leq R_{BE} \leq 50\ \Omega$



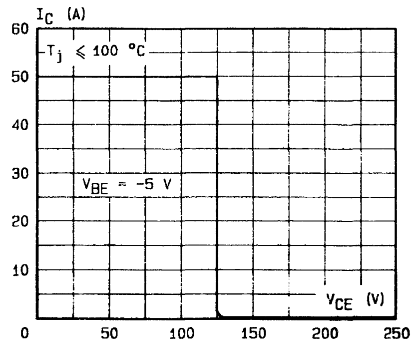
Transistor Reverse Biased
- During the turn-off with negative base emitter voltage

Forward Biased Safe Operating Area (FBSOA).

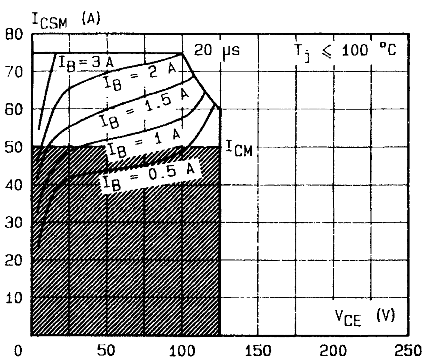


The hatched zone can only be used for turn-on.

Reverse Biased Safe Operating Area (RBSOA).

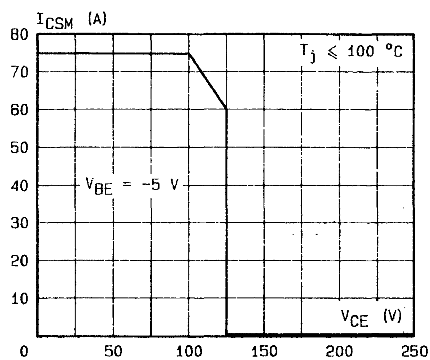


Forward Biased Accidental Overload Area (FBAOA).



The Kellog network (heavy point) allows the calculation of the maximum value of the short-circuit for a given base current I_B (90 % confidence).

Reverse Biased Accidental Overload Area (RBAOA).

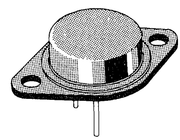


After the accidental overload current the RBAOA has to be used for the turn-off.

High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

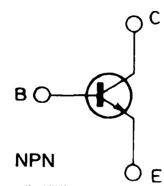
FAST SWITCHING POWER TRANSISTOR

- FAST SWITCHING TIMES
- LOW SWITCHING LOSSES
- VERY LOW SATURATION VOLTAGE AND HIGH GAIN FOR REDUCED LOAD OPERATION



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5 V)	300	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	200	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	20	A
I_{CM}	Collector Peak Current	28	A
I_B	Base Current	4	A
I_{BM}	Base Peak Current	7	A
P_{base}	Reverse Bias Base Dissipation (B.E. junction in avalanche)	1	W
P_{tot}	Total Dissipation at T_c < 25°C	150	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case max	1.17	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			0.5 2.5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = − 1.5V $V_{CE} = V_{CEV}$ V_{BE} = − 1.5V T_c = 100°C			0.5 2	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	200			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5A I_B = 0.25A I_C = 10A I_B = 1A I_C = 14A I_B = 1.75A I_C = 5A I_B = 0.25A T_j = 100°C I_C = 10A I_B = 1A T_j = 100°C I_C = 14A I_B = 1.75A T_j = 100°C		0.4 0.45 0.68 0.4 0.6 0.9	0.8 0.9 1.2 0.9 1.5 1.9	V V V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 10A I_B = 1A I_C = 14A I_B = 1.75A I_C = 10A I_B = 1A T_j = 100°C I_C = 14A I_B = 1.75A T_j = 100°C		1.1 1.3 1 1.2	1.4 1.7 1.4 1.7	V V V V
di_C/dt	Rated of Rise of on-state Collector Current	V_{CC} = 160V R_C = 0 I_{B1} = 1.5A T_j = 25°C See fig. 2 T_j = 100°C	 35 30	 75 65		 A/µs A/µs
$V_{CE(2µs)}$	Collector Emitter Dynamic Voltage	V_{CC} = 160V I_{B1} = 1A R_C = 16Ω T_j = 25°C See fig. 2 T_j = 100°C		 1.8 3	 3 5	 V V
$V_{CE(4µs)}$	Collector Emitter Dynamic Voltage	V_{CC} = 160V I_{B1} = 1A R_C = 16Ω T_j = 25°C See fig. 2 T_j = 100°C		 1.1 1.4	 1.7 2.5	 V V

ELECTRICAL CHARACTERISTICS (continued)

RESISTIVE LOAD

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
t_r t_s t_f	Rise Time Storage Time Fall Time	V_{CC} = 160V V_{BB} = – 5V R_{B2} = 1.4Ω See fig. 1	I_C = 14A I_{B1} = 1.7A t_p = 30µs		0.3 0.6 0.12	0.6 1.4 0.3	µs µs µs

INDUCTIVE LOAD

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
t_s t_f t_t t_c	Storage Time Fall Time Tail Time in Turn-on Crossover Time	V_{CC} = 160V I_C = 10A V_{BB} = – 5V L_C = 0.8mH	V_{clamp} = 200V I_B = 1A R_{B2} = 2.5Ω See fig. 3		0.7 0.06 0.01 0.13	1.5 0.2 0.07 0.3	µs µs µs µs
t_s t_f t_t t_c	Storage Time Fall Time Tail Time in Turn-on Crossover Time	V_{CC} = 160V I_C = 10A V_{BB} = – 5V L_C = 0.8mH See fig. 3	V_{clamp} = 200V I_B = 1A R_{B2} = 2.5Ω T_j = 100°C		1.1 0.12 0.03 0.24	2 0.3 0.15 0.5	µs µs µs µs
t_s t_f t_t	Storage Time Fall Time Tail Time in Turn-on	V_{CC} = 160V I_C = 10A V_{BB} = 0 L_C = 0.8mH	V_{clamp} = 200V I_B = 1A R_{B2} = 4.7Ω See fig. 3		1.5 0.5 0.12		µs µs µs
t_s t_f t_t	Storage Time Fall Time Tail Time in Turn-on	V_{CC} = 160V I_C = 10A V_{BB} = 0 L_C = 0.8mH See fig. 3	V_{clamp} = 200V I_B = 1A R_{B2} = 4.7Ω T_j = 100°C		2.7 0.85 0.25		µs µs µs

* Pulsed : Pulse duration = 300µs, duty cycle = 2 %.

Figure 1 : Switching Times Test Circuit (resistive load).

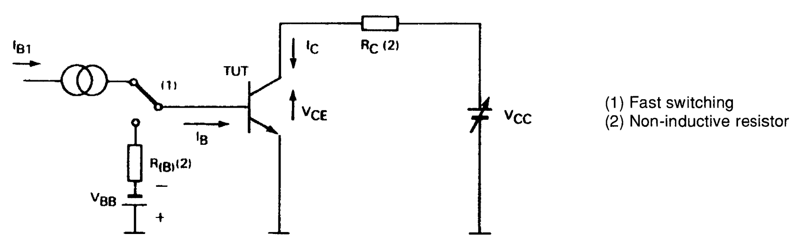


Figure 2 : Turn-on Switching Waveforms.

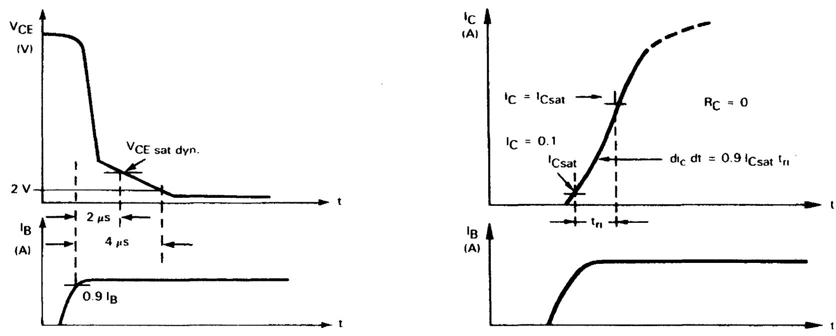


Figure 3a : Turn-off Switching Test Circuit.

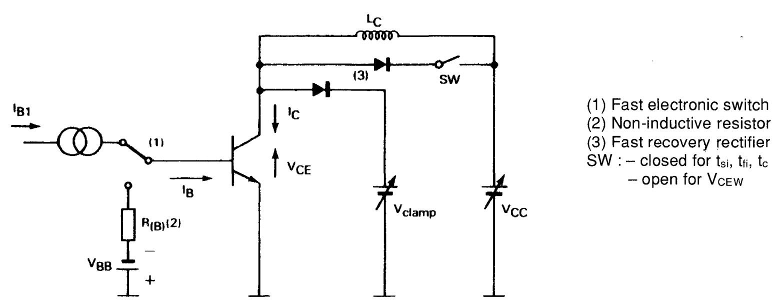
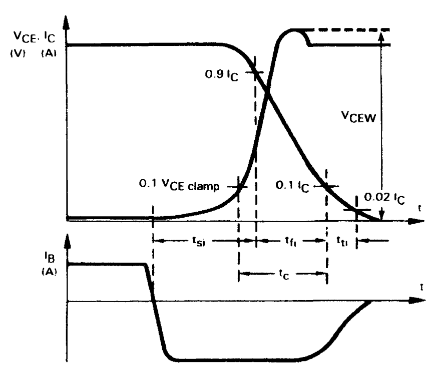
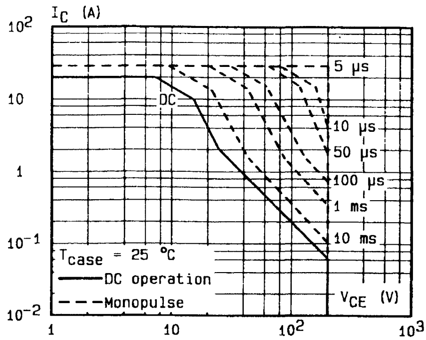


Figure 3b : Turn-off Switching Waveforms (inductive load).

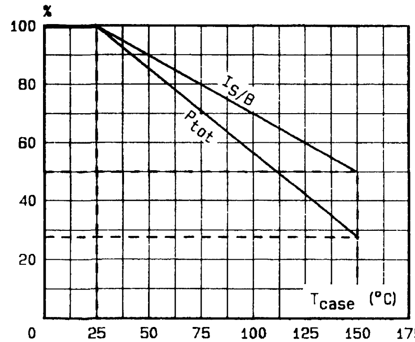


SGS-THOMSON MICROELECTRONICS

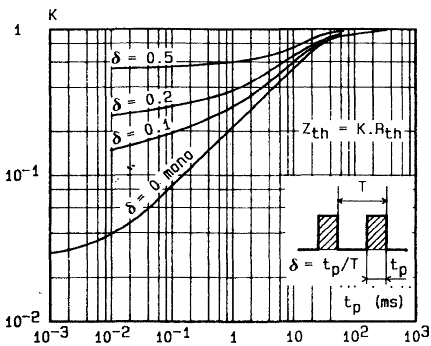
DC and AC Pulse Area.



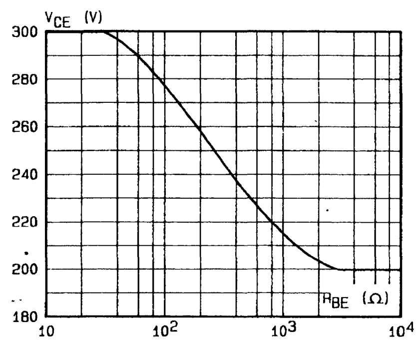
Power and $I_{S/B}$ Derating versus Case Temperature.



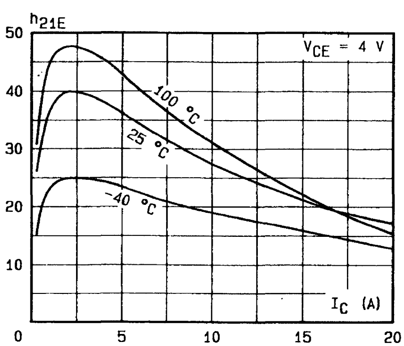
Transient Thermal Response.



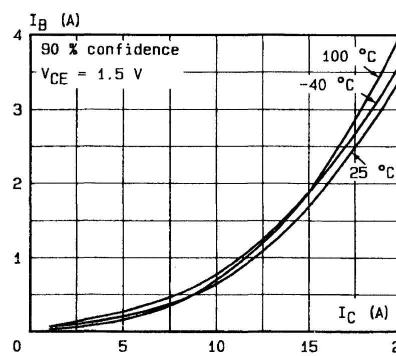
Collector-emitter Voltage versus Base-emitter Resistance.



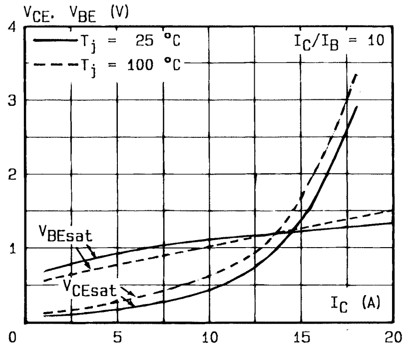
DC Current Gain.



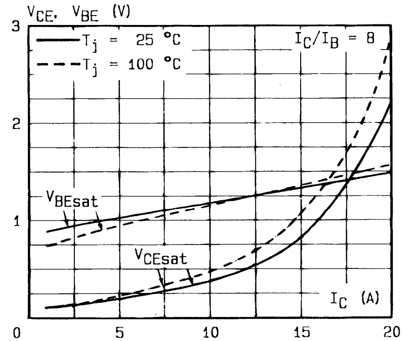
Minimum Base Current to saturate the Transistor.



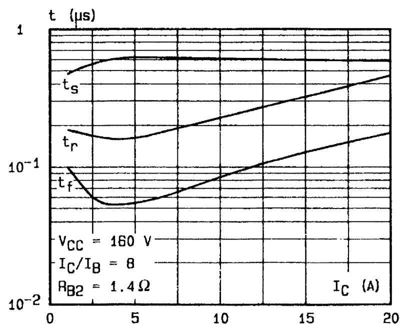
Saturation Voltage.



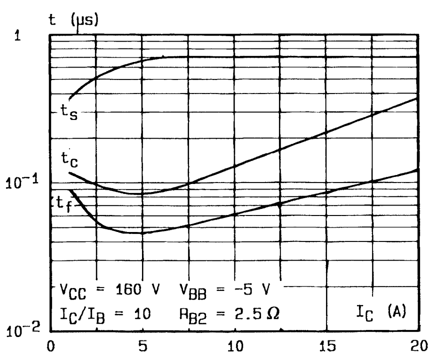
Saturation Voltage.



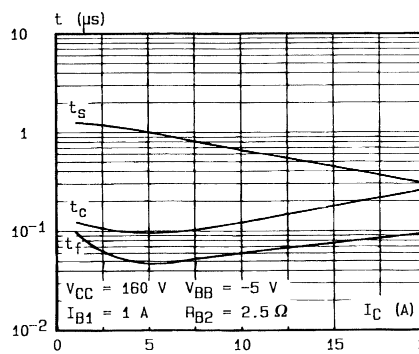
Switching Times versus Collector Current (resistive load).



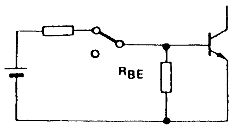
Switching Times versus Collector Current (inductive load).



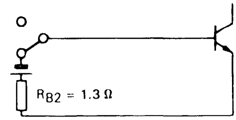
Switching Times versus Collector Current (inductive load).



SWITCHING OPERATING AND OVERLOAD AREAS

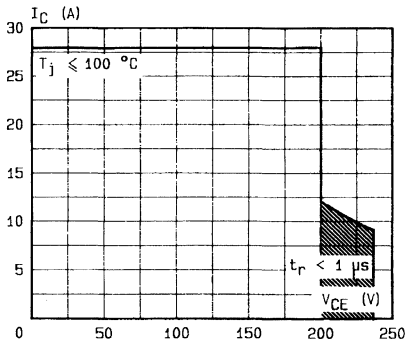


Transistor Forward Biased
- During the turn-on
- During the turn-off without negative base-emitter voltage and $4.7\Omega \leq R_{BE} \leq 50\ \Omega$



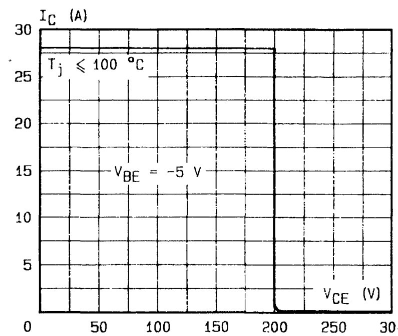
Transistor Reverse Biased
- During the turn-off with negative base emitter voltage

Forward Biased Safe Operating Area (FBSOA).

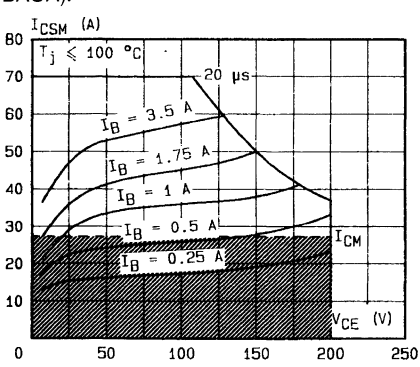


The hatched zone can only be used for turn-on.

Reverse Biased Safe Operating Area (RBSOA).

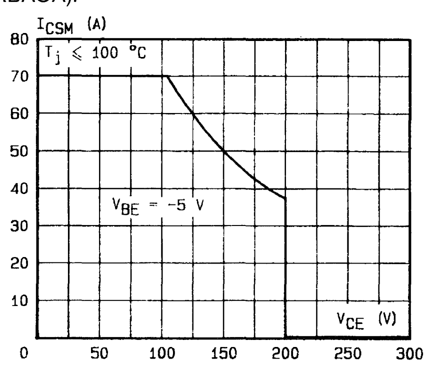


Forward Biased Accidental Overload Area (FBAOA).



The Kellog network (heavy point) allows the calculation of the maximum value of the short-circuit for a given base current I_B (90 % confidence).

Reverse Biased Accidental Overload Area (RBAOA).

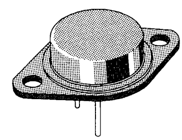


After the accidental overload current the RBAOA has to be used for the turn-off.

High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

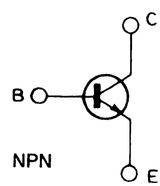
FAST SWITCHING POWER TRANSISTOR

- FAST SWITCHING TIMES
- LOW SWITCHING LOSSES
- VERY LOW SATURATION VOLTAGE AND HIGH GAIN FOR REDUCED LOAD OPERATION



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	350	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	250	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	20	A
I_{CM}	Collector Peak Current	30	A
I_B	Base Current	4	A
I_{BM}	Base Peak Current	6	A
P_{base}	Reverse Bias Base Dissipation (B.E. junction in avalanche)	1	W
P_{tot}	Total Dissipation at T_c < 25°C	150	W
T_{stg}	Storage Temperature	— 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	1.17	°C/W

ELECTRICAL CHARACTERISTIC (T_{case} = 25°C unless otherwise Specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			0.5 2.5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = − 1.5V $V_{CE} = V_{CEV}$ V_{BE} = − 1.5V T_c = 100°C			0.5 2	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	250			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 4A I_B = 0.27A I_C = 8A I_B = 0.8A I_C = 12A I_B = 1.5A I_C = 4A I_B = 0.27A T_j = 100°C I_C = 8A I_B = 0.8A T_j = 100°C I_C = 12A I_B = 1.5A T_j = 100°C		0.35 0.45 0.6 0.35 0.6 0.9	0.8 0.9 1.2 0.9 1.5 1.9	V V V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 8A I_B = 0.8A I_C = 12A I_B = 1.5A I_C = 8A I_B = 0.8A T_j = 100°C I_C = 12A I_B = 1.5A T_j = 100°C		1 1.2 0.9 1.2	1.3 1.5 1.3 1.5	V V V V
di_C/dt	Rated of Rise of On-state Collector Current	V_{CC} = 200V R_C = 0 I_{B1} = 1.2A T_j = 25°C See fig. 2 T_j = 100°C	 30 25	 70 60		 A/µs A/µs
$V_{CE(2\mu s)}$	Collector Emitter Dynamic Voltage	V_{CC} = 200V I_{B1} = 0.8A R_C = 25Ω T_j = 25°C See fig. 2 T_j = 100°C		 1.8 2.8	 3 5	 V V
$V_{CE(4\mu s)}$	Collector Emitter Dynamic Voltage	V_{CC} = 200V I_{B1} = 0.8A R_C = 25Ω T_j = 25°C See fig. 2 T_j = 100°C		 1.1 1.5	 1.7 2.5	 V V

ELECTRICAL CHARACTERISTIC (continued)

RESISTIVE LOAD

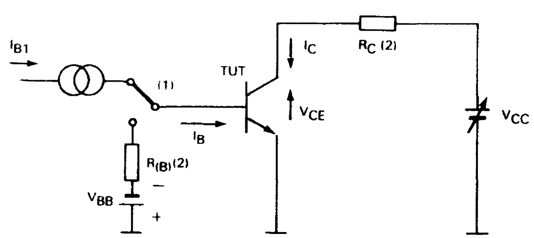
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_r t_s t_f	Rise Time Storage Time Fall Time	V_{CC} = 200V I_C = 12A V_{BB} = – 5V I_{B2} = 1.5A R_{B2} = 1.7Ω t_p = 30μs See fig. 1		0.3 1 0.15	0.6 1.6 0.3	μs μs μs

INDUCTIVE LOAD

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s t_f t_t t_c	Storage Time Fall Time Tail Time in Turn-on Crossover Time	V_{CC} = 200V V_{clamp} = 250V I_C = 8A I_B = 0.8A V_{BB} = – 5V R_{B2} = 3.1Ω L_C = 1.3mH See fig. 3		1.2 0.08 0.03 0.15	1.8 0.2 0.12 0.35	μs μs μs μs
t_s t_f t_t t_c	Storage Time Fall Time Tail Time in Turn-on Crossover Time	V_{CC} = 200V V_{clamp} = 250V I_C = 8A I_B = 0.8A V_{BB} = – 5V R_{B2} = 3.1Ω L_C = 1.3mH T_j = 100°C See fig. 3		1.8 0.2 0.08 0.35	2.4 0.4 0.2 0.7	μs μs μs μs
t_s t_f t_t	Storage Time Fall Time Tail Time in Turn-on	V_{CC} = 200V V_{clamp} = 250V I_C = 8A I_B = 0.8A V_{BB} = 0 R_{B2} = 5.6Ω L_C = 1.3mH See fig. 3		2.8 0.5 0.15		μs μs μs
t_s t_f t_t	Storage Time Fall Time Tail Time in Turn-on	V_{CC} = 200V V_{clamp} = 250V I_C = 8A I_B = 0.8A V_{BB} = 0 R_{B2} = 5.6Ω L_C = 1.3mH T_j = 100°C See fig. 3		4.5 0.8 0.4		μs μs μs

* Pulsed : Pulse duration = 300μs, duty cycle = 2%.

Figure 1 : Switching Times Test Circuit (resistive load).



(1) Fast switching
(2) Non-inductive resistor

Figure 2 : Turn-on Switching Waveforms.

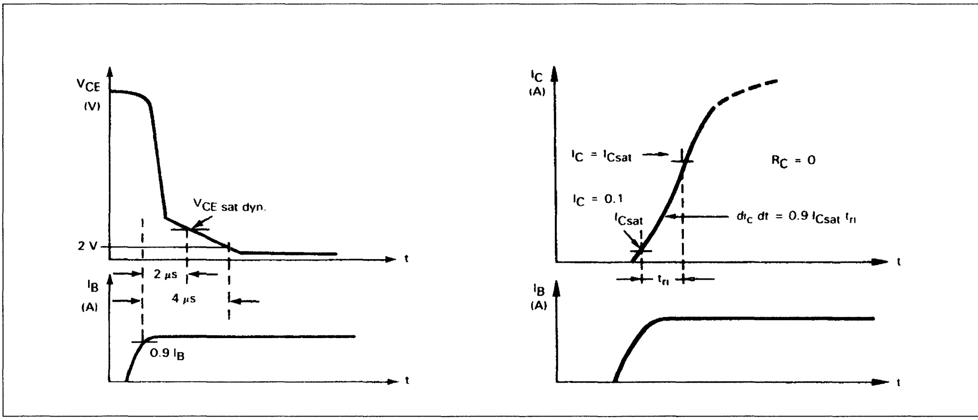


Figure 3a : Turn-on Switching Test Circuits.

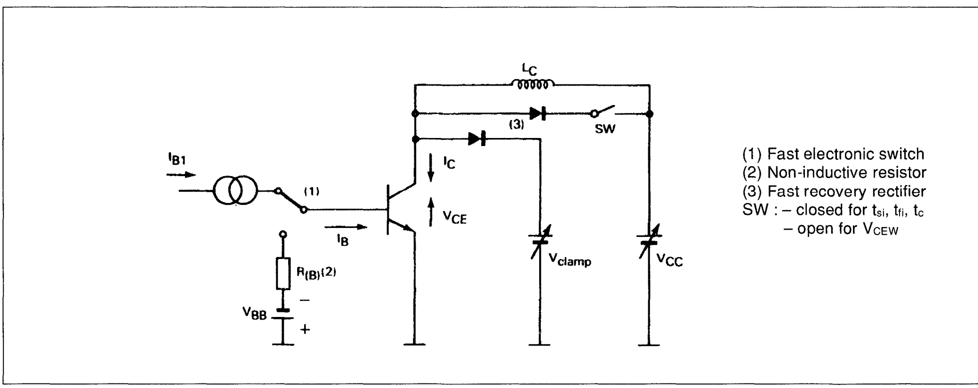
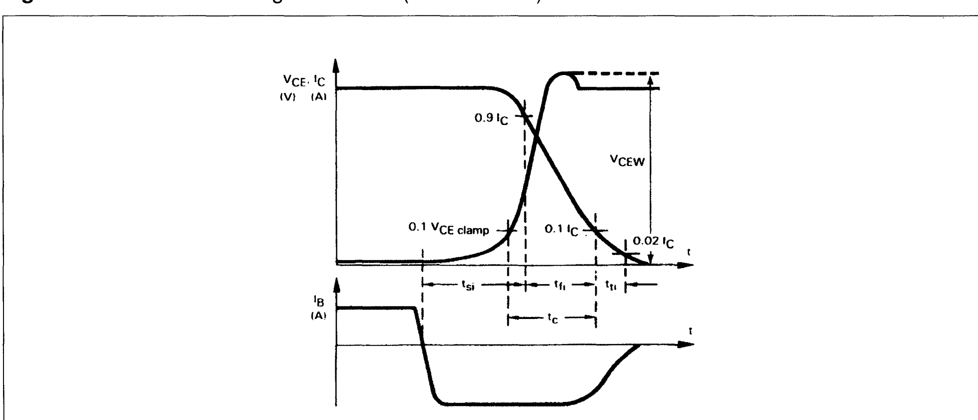
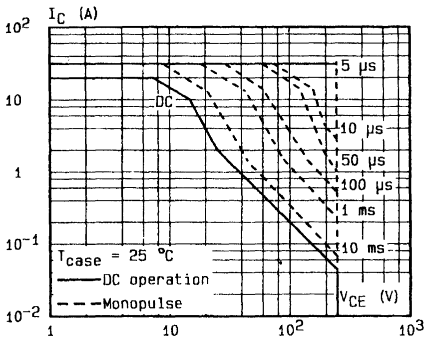


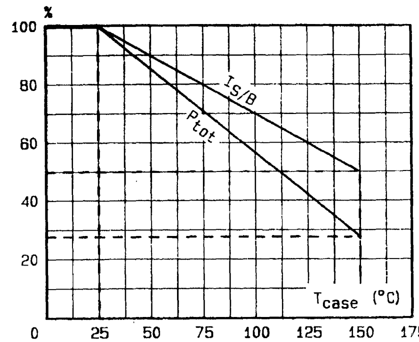
Figure 3b : Turn-on Switching Waveforms (inductive load).



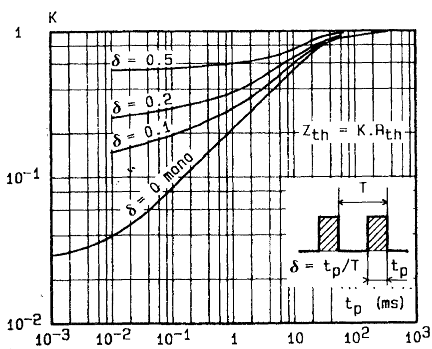
DCand AC Pulse Area.



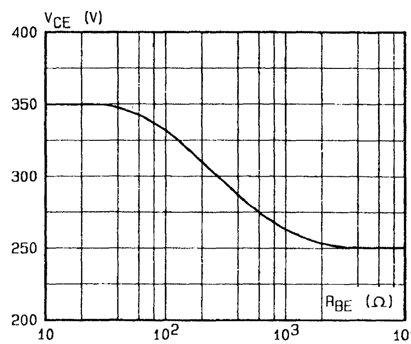
Power and $I_{S/B}$ Derating versus Case Temperature.



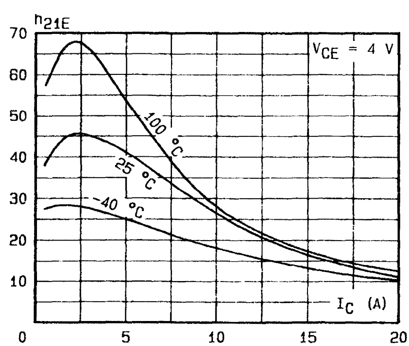
Transient Thermal Response.



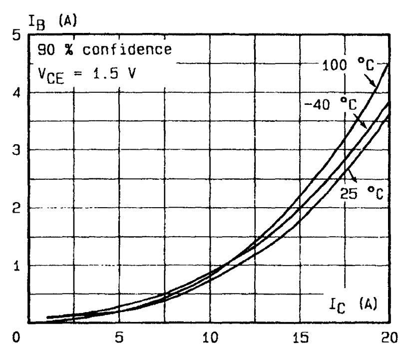
Collector-emitter Voltage versus Base-emitter Resistance.



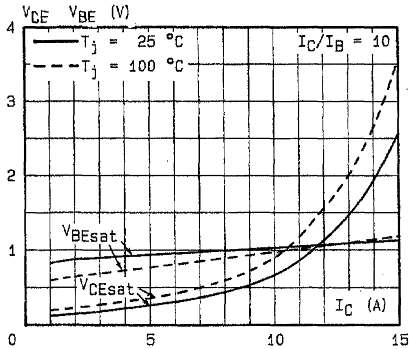
DC Current Gain.



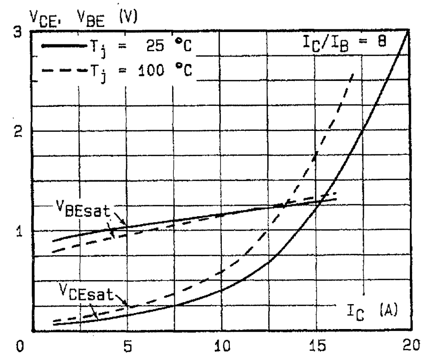
Minimum Base Current to Saturate the transistor.



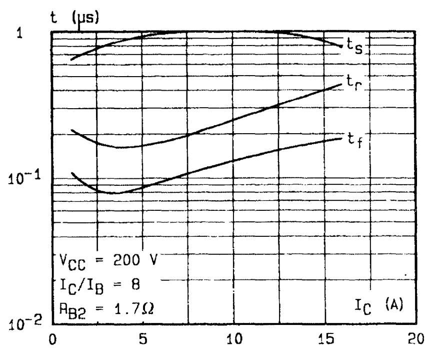
Saturation Voltage.



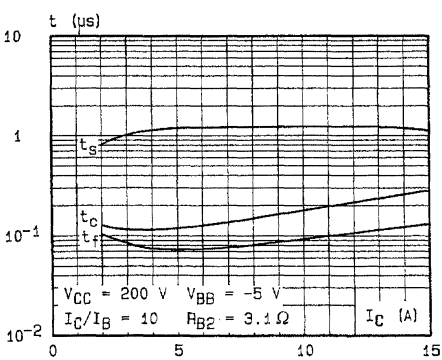
Saturation Voltage.



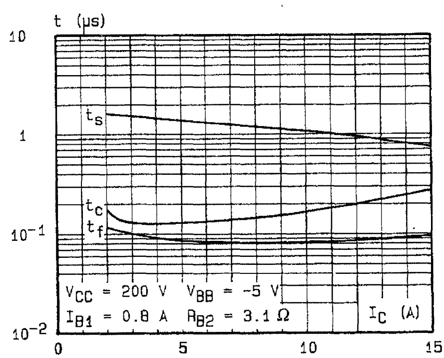
Switching Times versus Collector Current (resistive load).



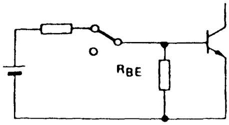
Switching Times versus Collector Current (inductive load).



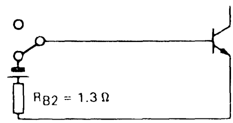
Switching Times versus Collector Current (inductive load).



SWITCHING OPERATING AND OVERLOAD AREAS

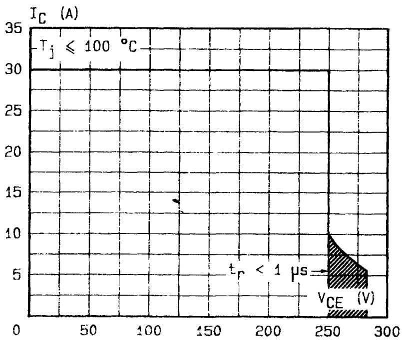


Transistor Forward Biased
- During the turn-on
- During the turn-off without negative base-emitter voltage and $5.6\Omega \leq R_{BE} \leq 50\ \Omega$



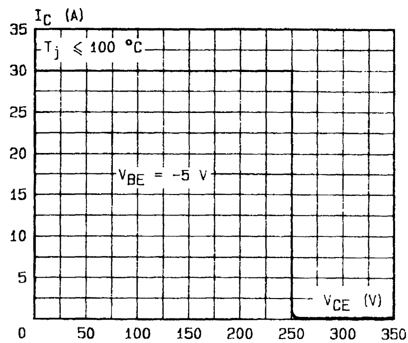
Transistor Reverse Biased
- During the turn-off with negative base emitter voltage

Forward Biased Safe Operating Area (FBSOA).

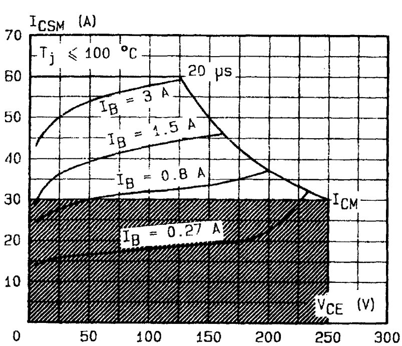


The hatched zone can only be used for turn-on.

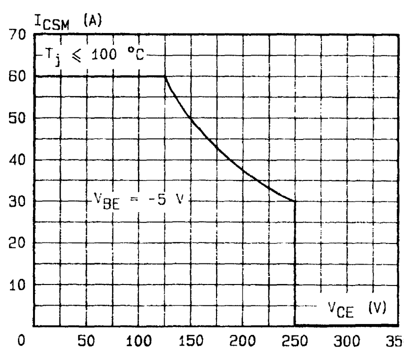
Reverse Biased Safe Operating Area (RBSOA).



Forward Biased Accidental Overload Area (FBAOA).



Reverse Biased Accidental Overload Area (RBAOA).



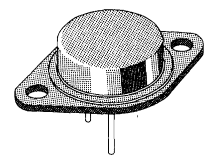
The Kellog network (heavy point) allows the calculation of the maximum value of the short-circuit for a given base current I_B (90 % confidence).

After the accidental overload current the RBAOA has to be used for the turn-off.

High accidental surge currents (I I_{CM}) are allowed if they are non repetitive and applied less than 3000 times during the component life.

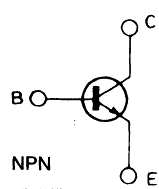
FAST SWITCHING POWER TRANSISTOR

- FAST SWITCHING TIMES
- LOW SWITCHING LOSSES
- LOW BASE CURRENT REQUIREMENTS
- VERY LOW SATURATION VOLTAGE AND HIGH GAIN



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	400	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	300	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	20	A
I_{CM}	Collector Peak Current	30	A
I_B	Base Current	4	A
I_{BM}	Base Peak Current	6	A
P_{tot}	Total Dissipation at T_c < 25°C	150	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

$R_{thj-case}$	Thermal Resistance Junction-case	Max	1.17	°

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	V_{CE} = V_{CEV} V_{CE} = V_{CEV} T_c = 100°C			0.5 2.5	mA mA
I_{CEV}	Collector Cutoff Current	V_{CE} = V_{CEV} V_{BE} = − 1.5V V_{CE} = V_{CEV} V_{BE} = − 1.5V T_c = 100°C			0.5 2	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	300			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 7A I_B = 0.7A I_C = 7A I_B = 0.7A T_j = 100°C			0.9 1.9	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 7A I_B = 0.7A I_C = 7A I_B = 0.7A T_j = 100°C			1.3 1.3	V V
di_c/dt	Rate of Rise of On-state Collector Current	V_{CC} = 250V R_C = 0 I_{B1} = 1.05A t_p = 3μs T_j = 100°C See fig. 1	40			A/μs

INDUCTIVE LOAD

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	V_{CC} = 250V V_{clamp} = 300V I_C = 7A I_B = 0.7A V_{BB} = − 5V R_{B2} = 3.6Ω L_C = 1.8mH T_j = 100°C see fig. 2			3	μs
t_f	Fall Time				0.4	μs
t_c	Crossover Time				0.7	μs
V_{CEW}	Maximum Collector Emitter Voltage without Snubber	V_{CC} = 50V I_{CWoff} = 10A V_{BB} = − 5V I_{B1} = 0.7A L_C = 0.25mH R_{BB} = 3.6Ω T_j = 125°C See fig. 2	300			V

Figure 1 : Turn-on Switching Characteristics of the Transistor.

(1) Fast electronic switch
(2) Non-inductive resistor

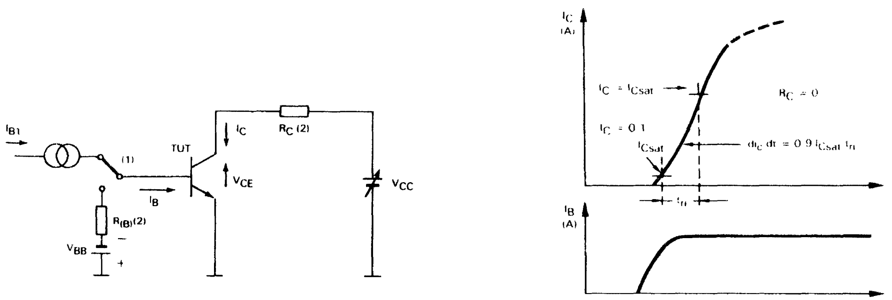
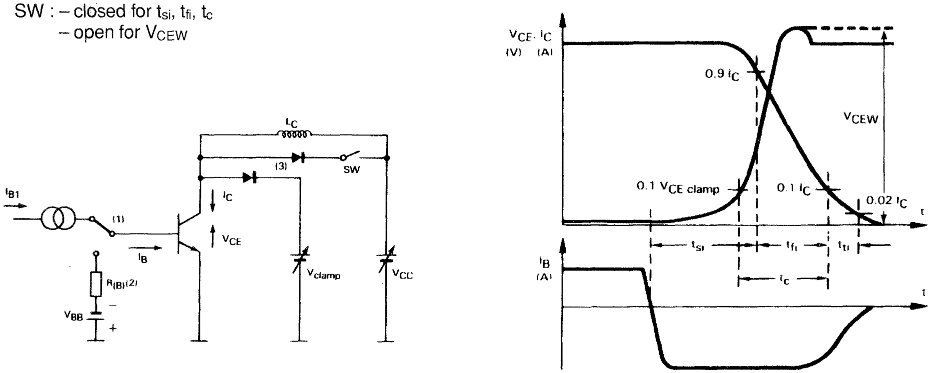
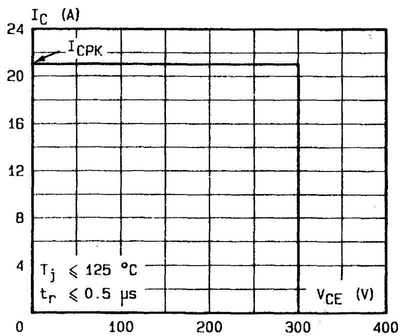


Figure 2 : Turn-off Switching Characteristics of the Transistor.

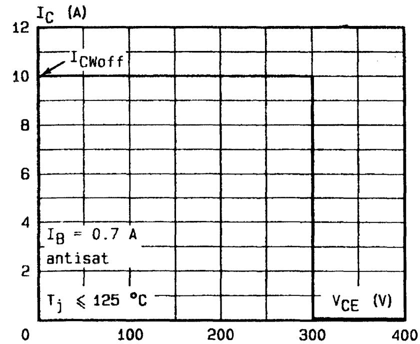
(1) Fast electronic switch
(2) Non-inductive resistor
(3) Fast recovery rectifier
SW : – closed for t_{si}, t_{fi}, t_c
– open for V_{CEW}



Forward Biased Safe Operating Area (FBSOA).

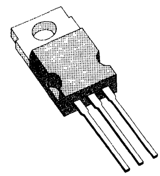


Reverse Biased Safe Operating Area (RBSOA).



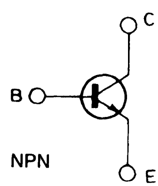
FAST SWITCHING POWER TRANSISTOR

- SUITABLE FOR SWITCH MODE POWER SUPPLY, UPS, DC AND AC MOTOR CONTROL



TO-220

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

High voltage, high speed transistor suited for use on the 220 and 380V mains.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	850	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	450	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	9	A
I_{CM}	Collector Peak Current	14	A
I_B	Base Current	3	A
I_{BM}	Base Peak Current	4.5	A
P_{tot}	Total Dissipation at T_c < 25°C	70	W
T_{stg}	Storage Temperature	– 65 to 150	°C
T_j	Max. Operating Junction Temperature	150	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	1.76	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_C = 100°C			0.2 1.5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = − 1.5V $V_{CE} = V_{CEV}$ V_{BE} = − 1.5V T_C = 100°C			0.2 1.5	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	450			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5A I_B = 1A I_C = 5A I_B = 1A T_j = 100°C			1.2 2	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 5A I_B = 1A I_C = 5A I_B = 1A T_j = 100°C			1.3 1.3	V V
di_C/dt	Rated of Rise of on-state Collector Current	V_{CC} = 300V R_C = 0 I_{B1} = 1.5A t_p = 3μs T_j = 100°C See fig. 1	45			A/μs

INDUCTIVE LOAD

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s t_f t_c	Storage Time Fall Time Crossover Time	V_{CC} = 400V V_{clamp} = 450V I_C = 5A I_B = 1A V_{BB} = − 5V R_{BB} = 2.5Ω L_C = 4mH T_j = 100°C See fig.2			3 0.4 0.7	μs μs μs
V_{CEW}	Maximum Collector Emitter Voltage without Snubber	V_{CC} = 50V I_{CWoff} = 7.5A V_{BB} = − 5V I_{B1} = 1A L_C = 0.33mH R_{BB} = 2.5Ω T_j = 125°C See fig.2	450			V

Figure 1 : Turn-on Switching Characteristics of the Transistor.

(1) Fast electronic switch
(2) Non-inductive resistor

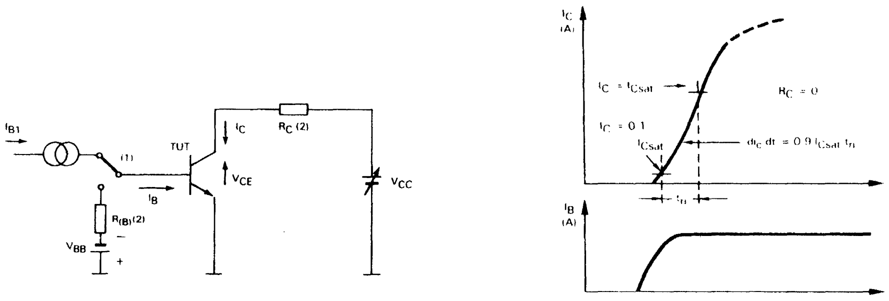
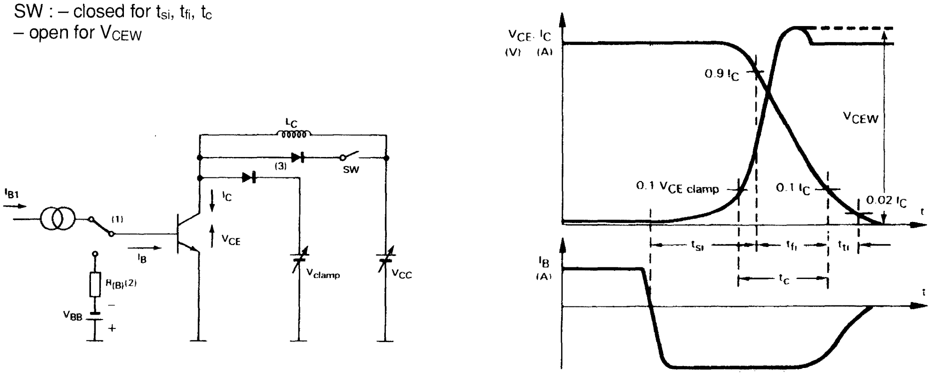
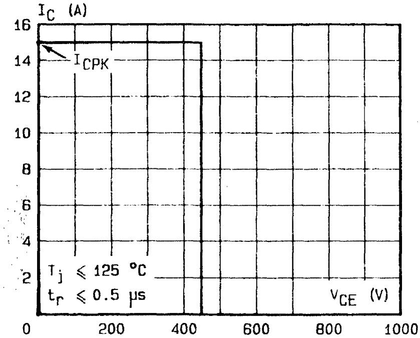


Figure 2 : Turn-off Switching Characteristics of the Transistor.

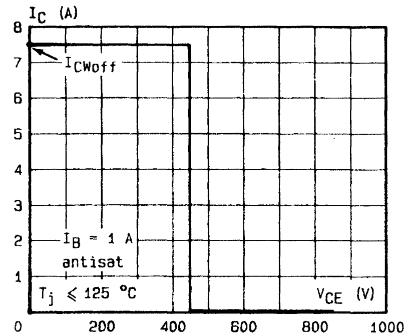
(1) Fast electronic switch
(2) Non-inductive resistor
(3) Fast recovery rectifier
SW : – closed for t_{si}, t_{fi}, t_c
– open for V_{CEW}



Forward Biased Safe Operating Area (FBSOA).

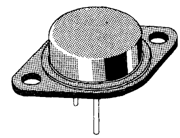


Reverse Biased Safe Operating Area (RBSOA).



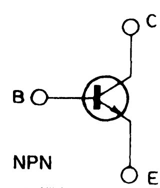
FAST SWITCHING POWER TRANSISTOR

- FAST SWITCHING TIMES
- LOW SWITCHING LOSSES
- VERY LOW SATURATION VOLTAGE AND HIGH GAIN FOR REDUCED LOAD OPERATION



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	250	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	125	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	50	A
I_{CM}	Collector Peak Current	80	A
I_B	Base Current	10	A
I_{BM}	Base Peak Current	18	A
P_{base}	Reverse Bias Base Dissipation (B.E. junction in avalanche)	3	W
P_{tot}	Total Dissipation at T_c < 25°C	250	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	0.7	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			1 5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = − 1.5V $V_{CE} = V_{CEV}$ V_{BE} = − 1.5V T_c = 100°C			1 4	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	125			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 25A I_B = 1.25A I_C = 50A I_B = 5A I_C = 60A I_B = 7.5A I_C = 25A I_B = 1.25A T_j = 100°C I_C = 50A I_B = 5A T_j = 100°C I_C = 60A I_B = 7.5A T_j = 100°C		0.45 0.65 0.75 0.45 0.7 0.9	0.9 0.9 1.2 1.2 1.5 1.8	V V V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 50A I_B = 5A I_C = 60A I_B = 7.5A I_C = 50A I_B = 5A T_j = 100°C I_C = 60A I_B = 7.5A T_j = 100°C		1.4 1.55 1.45 1.65	1.6 1.8 1.7 1.9	V V V V
di_C/dt	Rated of Rise of On-state Collector Current	V_{CC} = 100V R_C = 0 I_{B1} = 7.5A T_j = 25°C See fig. 2 T_j = 100°C	 100 90	 160 150		 A/μs A/μs
$V_{CE(2\mu s)}$	Collector-emitter Dynamic Voltage	V_{CC} = 100V I_{B1} = 5A R_C = 2Ω T_j = 25°C See fig. 2 T_j = 100°C		 2.5 3	 3 4.5	 V V
$V_{CE(4\mu s)}$	Collector-emitter Dynamic Voltage	V_{CC} = 100V I_{B1} = 5A R_C = 2Ω T_j = 25°C See fig. 2 T_j = 100°C		 1.8 1.9	 2.2 3	 V V

RESISTIVE LOAD

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_r t_s t_f	Rise Time Storage Time Fall Time	V_{CC} = 100V I_C = 60A V_{BB} = − 5V I_{B1} = 7.5A R_B = 0.33Ω t_p = 30μs See fig. 1		0.5 0.6 0.06	0.8 1.1 0.2	μs μs μs

ELECTRICAL CHARACTERISTICS (continued)

INDUCTIVE LOAD

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
t_s	Storage Time	V_{CC} = 100V	V_{clamp} = 125V		0.5	1.2	µs
t_f	Fall Time	I_C = 50A	I_B = 5A		0.05	0.15	µs
t_t	Tail Time in Turn-on	V_{BB} = − 5V	R_{B2} = 0.5Ω		0.01	0.05	µs
t_c	Crossover Time	L_C = 0.1mH	see fig. 3		0.1	0.3	µs
t_s	Storage Time	V_{CC} = 100V	V_{clamp} = 125V		0.85	1.5	µs
t_f	Fall Time	I_C = 50A	I_B = 5A		0.12	0.25	µs
t_t	Tail Time in Turn-on	V_{BB} = − 5V	R_{B2} = 0.5Ω		0.04	0.1	µs
t_c	Crossover Time	L_C = 0.1mH	T_j = 100°C		0.2	0.5	µs
		see fig. 3					
t_s	Storage Time	V_{CC} = 100V	V_{clamp} = 125V		1.5		µs
t_f	Fall Time	I_C = 50A	I_B = 5A		1.3		µs
t_t	Tail Time in Turn-on	V_{BB} = 0	R_{B2} = 1.5Ω		0.4		µs
		L_C = 0.1mH	see fig. 3				
t_s	Storage Time	V_{CC} = 100V	V_{clamp} = 125V		2.7		µs
t_f	Fall Time	I_C = 50A	I_B = 5A		1.8		µs
t_t	Tail Time in Turn-on	V_{BB} = 0	R_{B2} = 1.5Ω		0.6		µs
		L_C = 0.1mH	T_j = 100°C				
		see fig. 3					

* Pulsed : Pulse duration = 300µs, duty cycle = 2%.

Figure 1 : Switching Times Test Circuit (resistive load).

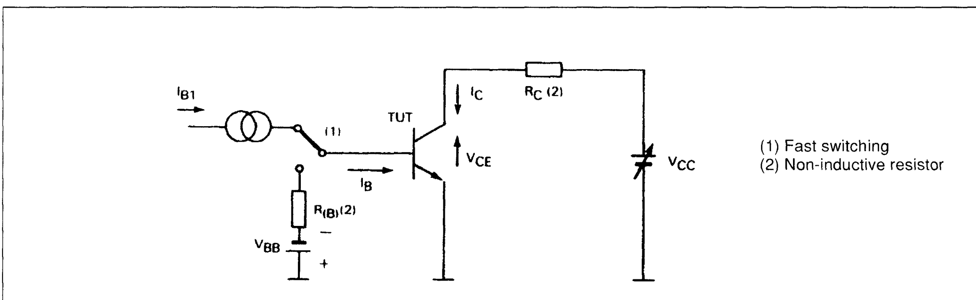


Figure 2 : Turn-on Switching Waveforms.

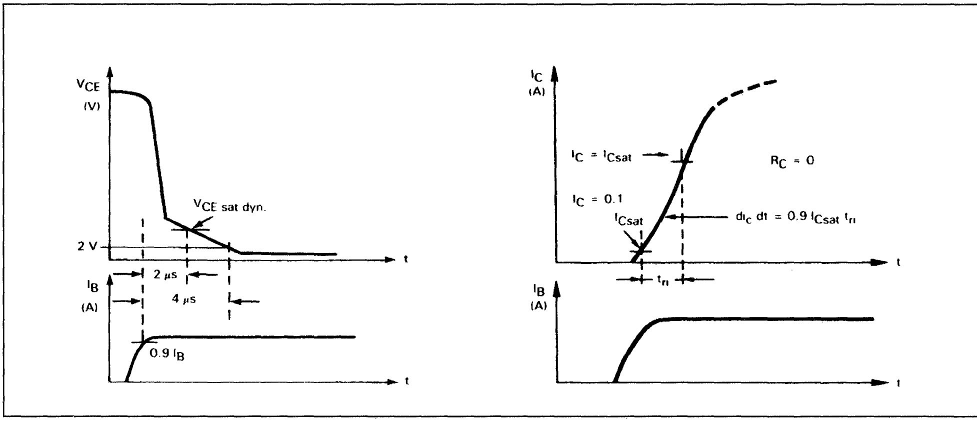


Figure 3a : Turn-off Switching Test Circuit.

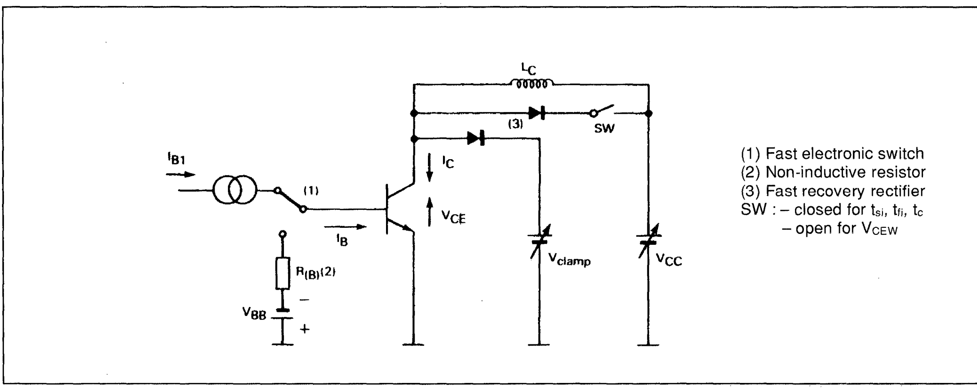
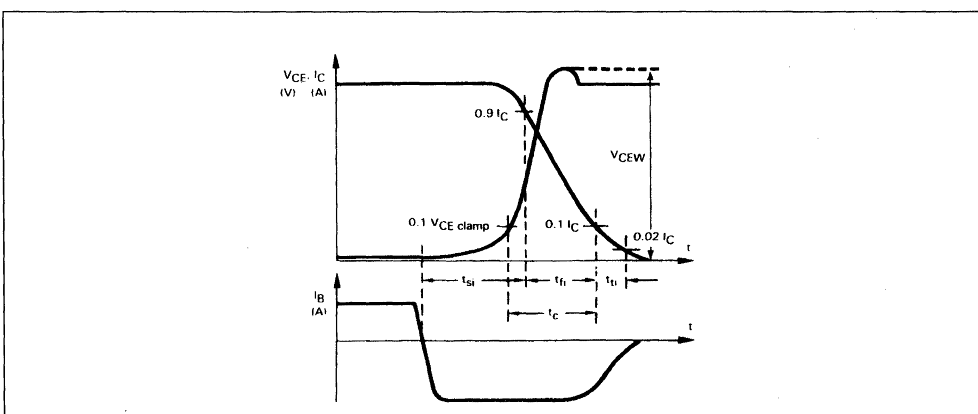
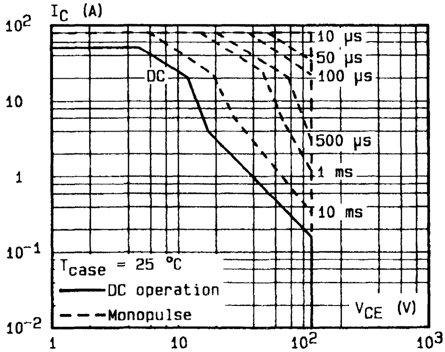


Figure 3b : Turn-off Switching Waveforms (inductive load).

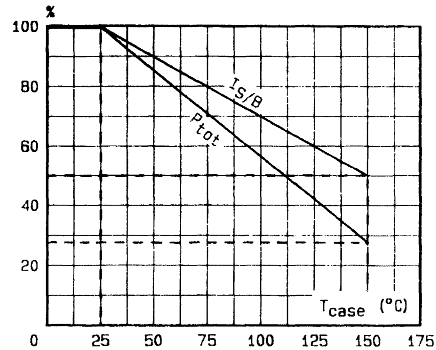


SGS-THOMSON MICROELECTRONICS

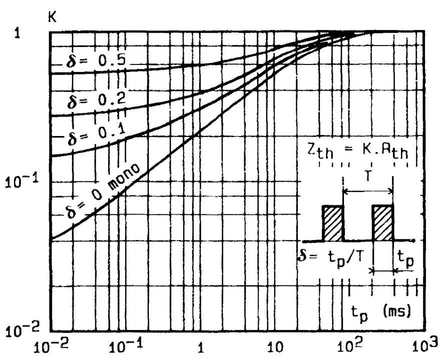
DC and AC Pulse Area.



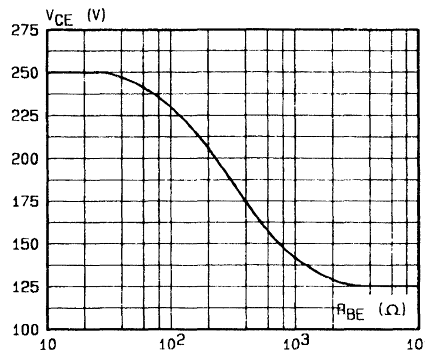
Power and $I_{S/B}$ Derating versus Case Temperature.



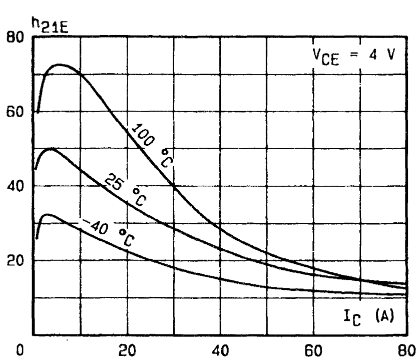
Transient Thermal Response.



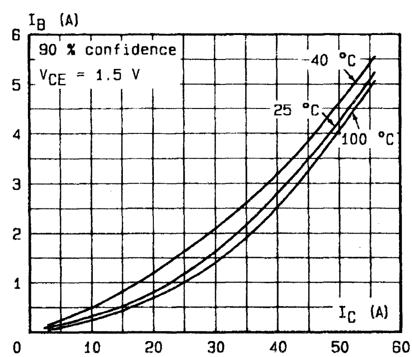
Collector-emitter Voltage versus Base-emitter Resistance.



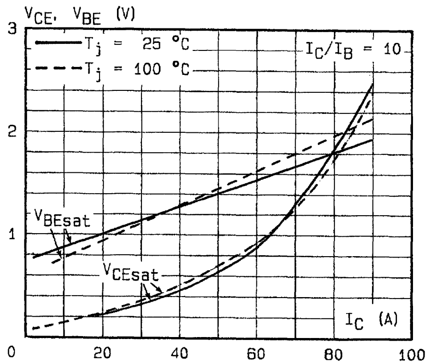
DC Current Gain.



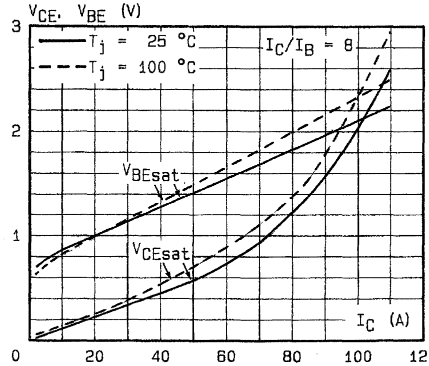
Minimum Base Current to saturate the Transistor.



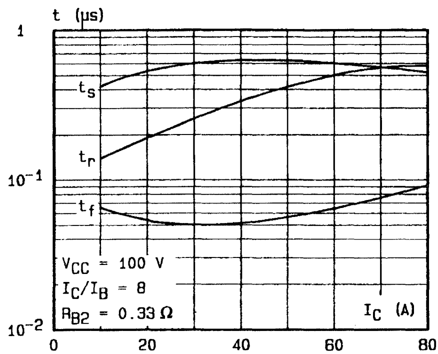
Saturation Voltage.



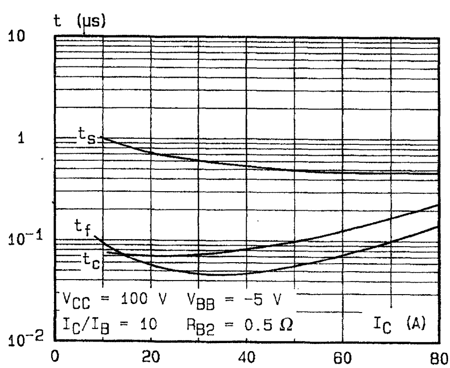
Saturation Voltage.



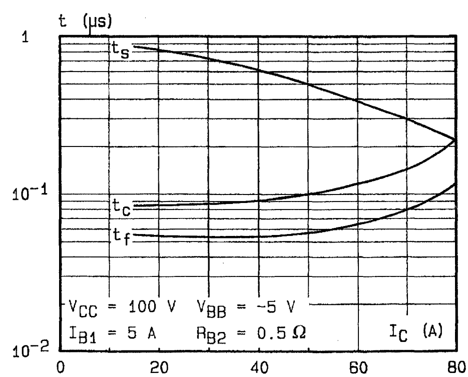
Switching Times versus Collector Current (resistive load).



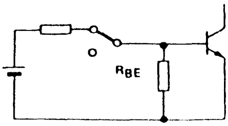
Switching Times versus Collector Current (inductive load).



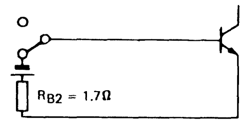
Switching Times versus Collector Current (inductive load).



SWITCHING OPERATING AND OVERLOAD AREAS

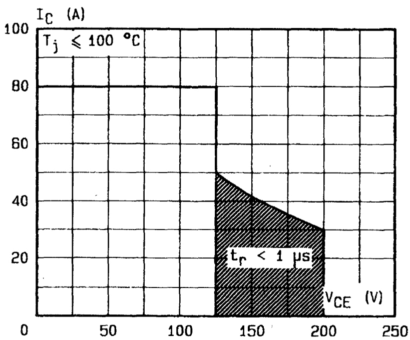


Transistor Forward Biased
- During the turn-on
- During the turn-off without negative base-emitter voltage and $1.5\Omega \leq R_{BE} \leq 50\Omega$

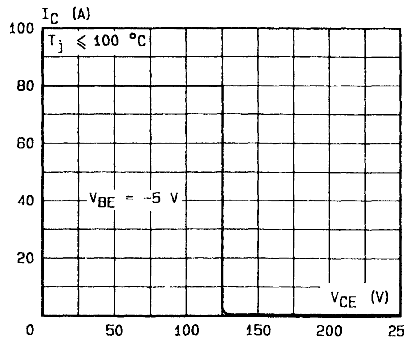


Transistor Reverse Biased
- During the turn-off with negative base emitter voltage

Forward Biased Safe Operating Area (FBSOA).

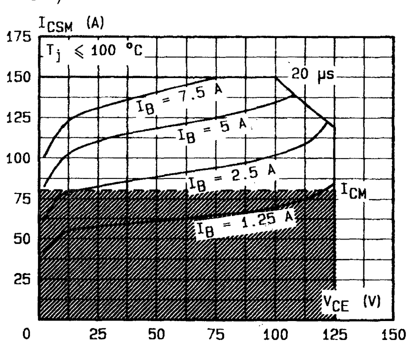


Reverse Biased Safe Operating Area (RBSOA).

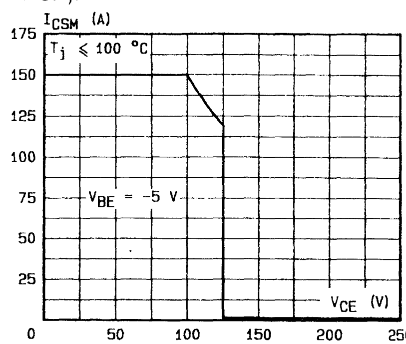


The hatched zone can only be used for turn-on.

Forward Biased Accidental Overload Area (FBAOA).



Reverse Biased Accidental Overload Area (RBAOA).



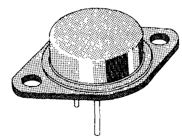
The Kellog network (heavy point) allows the calculation of the maximum value of the short-circuit for a given base current I_B (90 % confidence).

After the accidental overload current the RBAOA has to be used for the turn-off.

High accidental surge currents (I I_{CM}) are allowed if they are non repetitive and applied less than 3000 times during the component life.

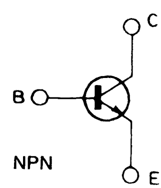
FAST SWITCHING POWER TRANSISTOR

- FAST SWITCHING TIMES
- LOW SWITCHING LOSSES
- VERY LOW SATURATION VOLTAGE AND HIGH GAIN FOR REDUCED LOAD OPERATION



TO–3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	300	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	200	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	50	A
I_{CM}	Collector Peak Current	75	A
I_B	Base Current	8	A
I_{BM}	Base Peak Current	15	A
P_{base}	Reverse Bias Base Dissipation (B.E. junction in avalanche)	2	W
P_{tot}	Total Dissipation at T_C < 25°C	250	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

$R_{th\ j-case}$	Thermal Resistance Junction-case	Max	0.7	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_C = 100°C			1 5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = - 1.5V $V_{CE} = V_{CEV}$ V_{BE} = - 1.5V T_C = 100°C			1 4	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	200			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 12.5A I_B = 0.625A I_C = 25A I_B = 2.5A I_C = 40 A I_B = 5A I_C = 12.5A I_B = 0.625A T_j = 100°C I_C = 25A I_B = 2.5A T_j = 100°C I_C = 40A I_B = 5A T_j = 100°C		0.65 0.4 0.6 0.5 0.5 0.75	0.9 0.9 1.2 1.2 1.5 1.9	V V V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 25A I_B = 2.5A I_C = 40A I_B = 5A I_C = 25A I_B = 2.5A T_j = 100°C I_C = 40A I_B = 5A T_j = 100°C		1.05 1.35 1.1 1.35	1.4 1.8 1.7 1.8	V V V V
di_C/dt	Rated of Rise of on-state Collector Current	V_{CC} = 160V R_C = 0 I_{B1} = 3.75A T_j = 25°C See fig. 2 T_j = 100°C	70 60	130 110		A/μs A/μS
$V_{CE(2\mu s)}$	Collector Emitter Dynamic Voltage	V_{CC} = 160V I_{B1} = 2.5A R_C = 6.4Ω T_j = 25°C See fig. 2 T_j = 100°C		1.3 1.8	3 5	V V
$V_{CE(4\mu s)}$	Collector Emitter Dynamic Voltage	V_{CC} = 160V I_{B1} = 2.5A R_C = 6.4Ω T_j = 25°C See fig. 2 T_j = 100°C		0.95 1.1	2 3	V V

RESISTIVE LOAD

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_r t_s t_f	Rise Time Storage Time Fall Time	V_{CC} = 160V I_C = 40A V_{BB} = − 5V I_{B1} = 5A R_{B2} = 0.5Ω t_p = 30μs See fig. 1		0.55 0.6 0.07	0.7 1.2 0.3	μs μs μs

ELECTRICAL CHARACTERISTICS (continued)

INDUCTIVE LOAD

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
t_s t_f t_t t_c	Storage Time Fall time Tail Time in Turn-on Crossover Time	V_{CC} = 160V I_C = 25A V_{BB} = – 5V L_C = 0.32mH	V_{clamp} = 200V I_B = 2.5A R_{B2} = 1Ω See fig. 3		0.85 0.06 0.01 0.11	1.9 0.15 0.07 0.3	µs µs µs µs
t_s t_f t_t t_c	Storage Time Fall time Tail Time in Turn-on Crossover Time	V_{CC} = 160V I_C = 25A V_{BB} = – 5V L_C = 0.32mH See fig. 3	V_{clamp} = 200V I_B = 2.5A R_{B2} = 1Ω T_j = 100°C		1.1 0.08 0.02 0.15	2.4 0.25 0.15 0.5	µs µs µs µs
t_s t_f t_t	Storage Time Fall time Tail Time in Turn-on	V_{CC} = 160V I_C = 25A V_{BB} = 0 L_C = 0.32mH	V_{clamp} = 200V I_B = 2.5A R_{B2} = 2.7Ω See fig. 3		1.6 0.7 0.2		µs µs µs
t_s t_f t_t	Storage Time Fall time Tail Time in Turn-on	V_{CC} = 160V I_C = 25A V_{BB} = 0 L_C = 0.32mH See fig. 3	V_{clamp} = 200V I_B = 2.5A R_{B2} = 2.7Ω T_j = 100°C		2.7 1 0.3		µs µs µs

* Pulsed : Pulse duration = 300µs, duty cycle = 2%.

Figure 1 : Switching Times Test Circuit (resistive load).

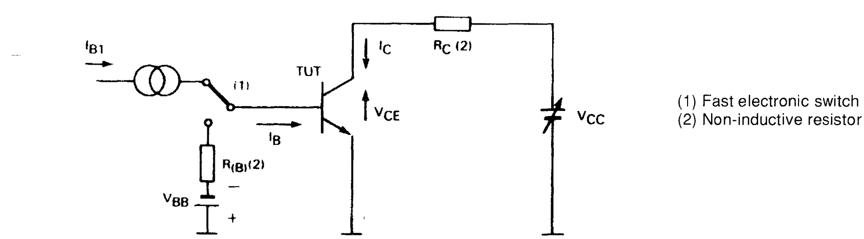


Figure 2 : Turn-on Switching Waveforms.

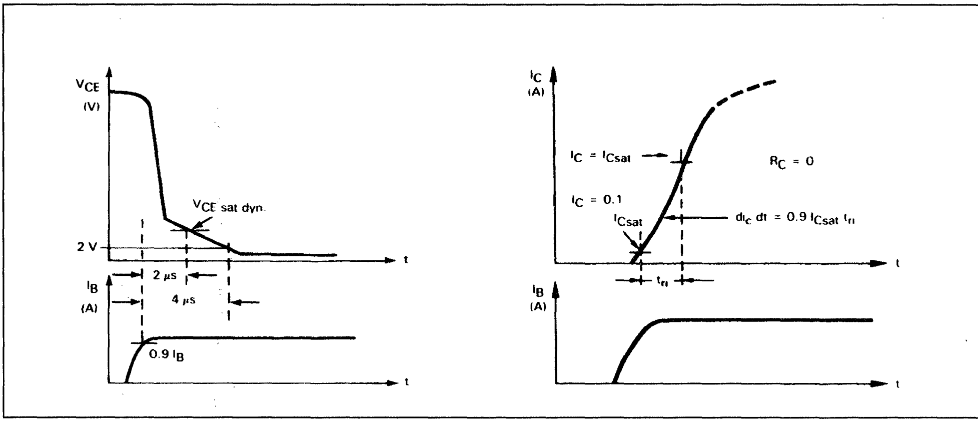


Figure 3a : Turn-off Switching Test Circuits.

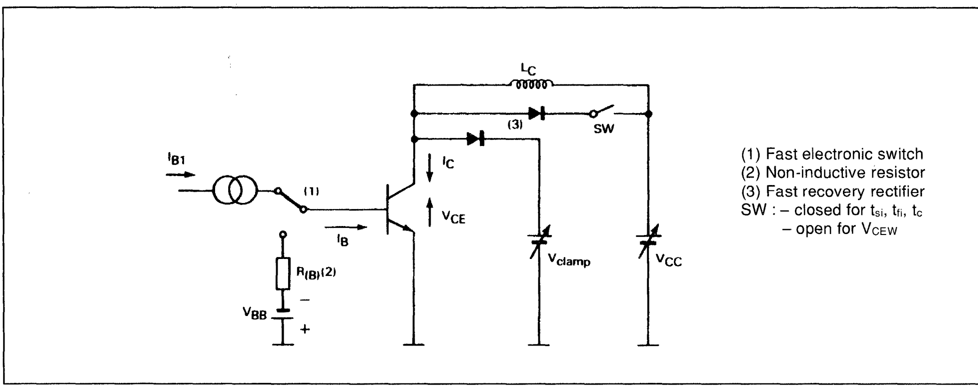
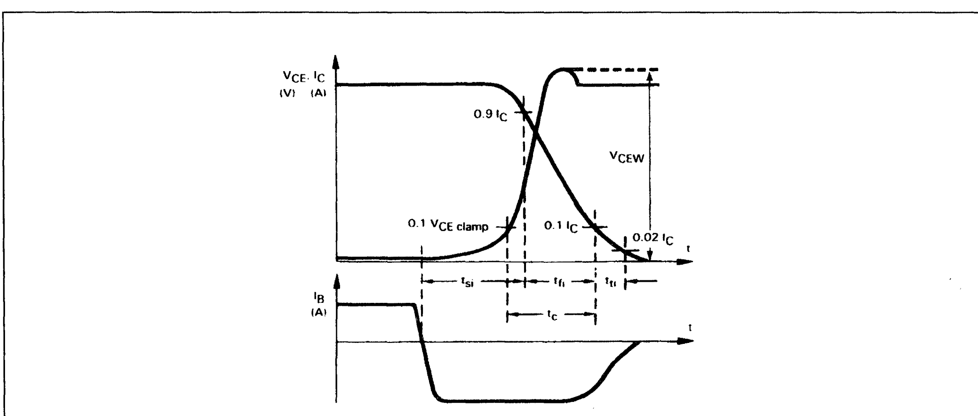
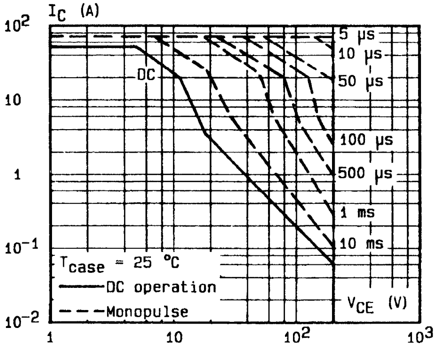


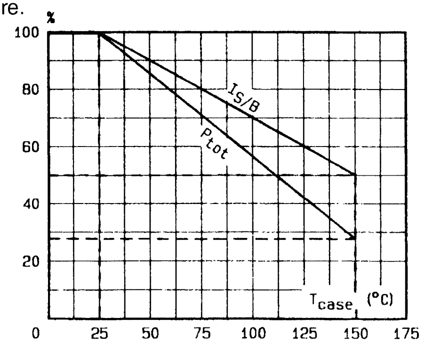
Figure 3b : Turn-off Switching Waveforms (inductive load).



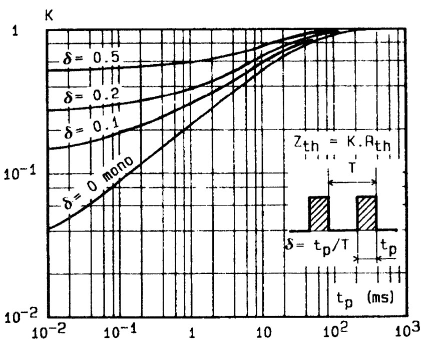
DC and AC Pulse Area.



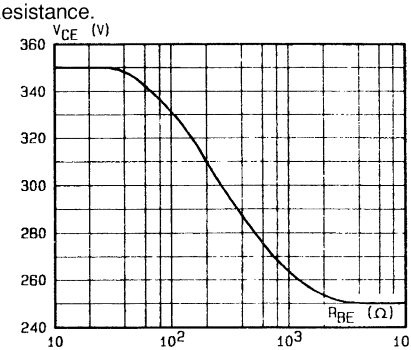
Power and $I_{S/B}$ Derating versus Case Temperature.



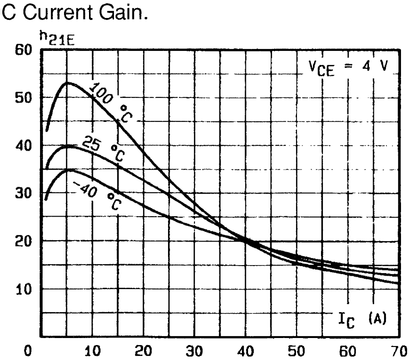
Transient Thermal Response.



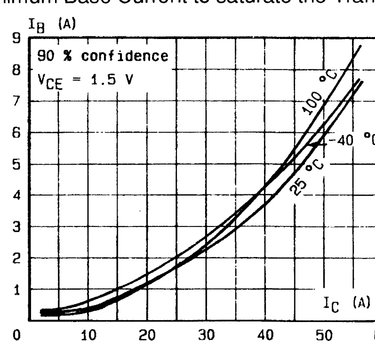
Collector-emitter Voltage versus Base-emitter Resistance.



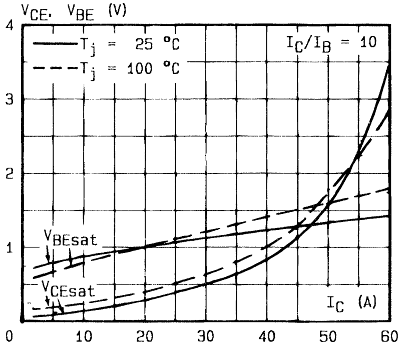
DC Current Gain.



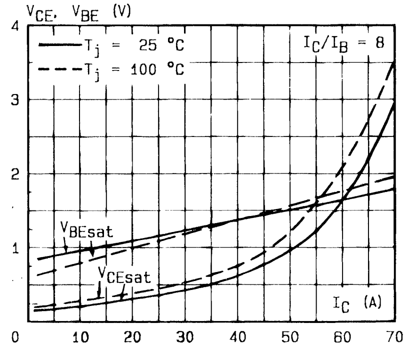
Minimum Base Current to saturate the Transistor.



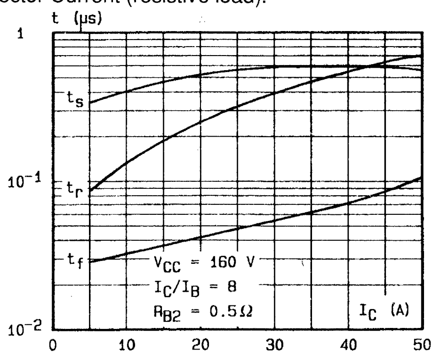
Saturation Voltage.



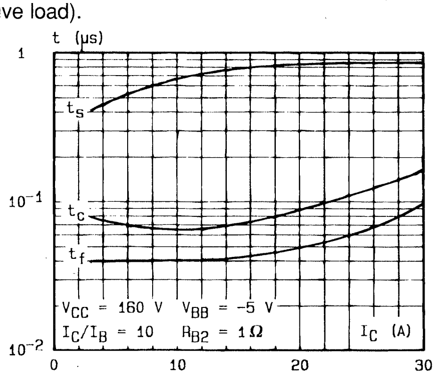
Saturation Voltage.



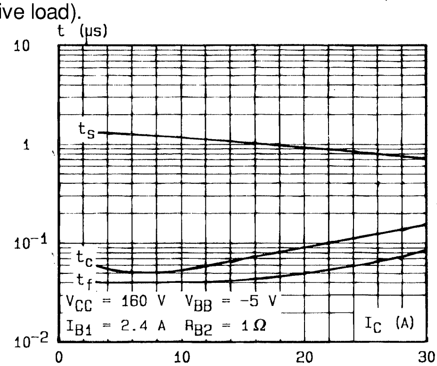
Switching Times versus Collector Current (resistive load).



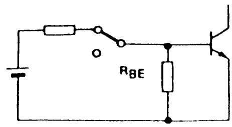
Switching Times versus Collector Current (inductive load).



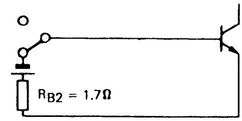
Switching Times versus Collector Current (inductive load).



SWITCHING OPERATING AND OVERLOAD AREAS

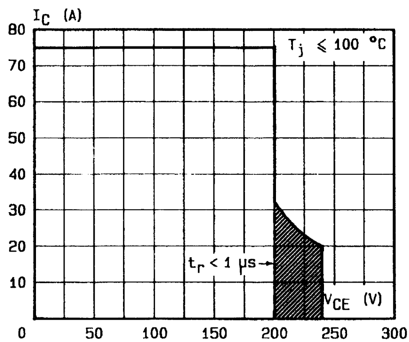


Transistor Forward Biased
- During the turn-on
- During the turn-off without negative base-emitter voltage and $2.7\Omega \leq R_{BE} \leq 50\ \Omega$



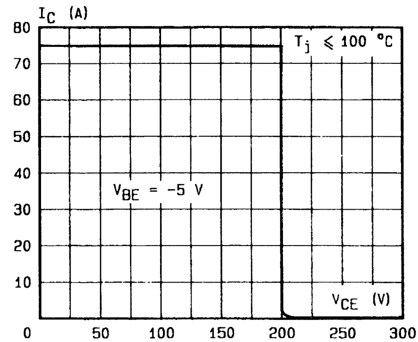
Transistor Reverse Biased
- During the turn-off with negative base emitter voltage

Forward Biased Safe Operating Area (FBSOA).

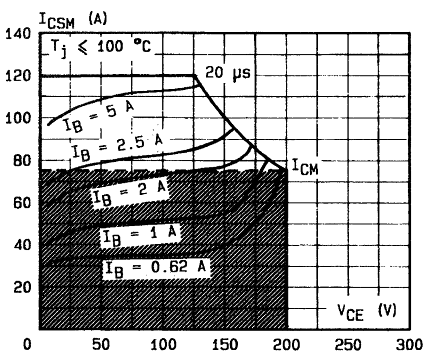


The hatched zone can only be used for turn-on.

Reverse Biased Safe Operating Area (RBSOA).

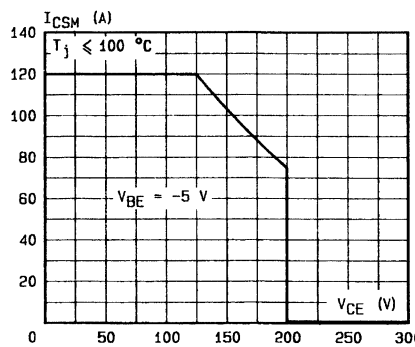


Forward Biased Accidental Overload Area (FBAOA).



The Kellog network (heavy point) allows the calculation of the maximum value of the short-circuit for a given base current I_B (90 % confidence).

Reverse Biased Accidental Overload Area (RBAOA).

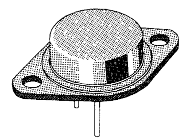


After the accidental overload current the RBAOA has to be used for the turn-off.

High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

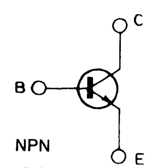
FAST SWITCHING POWER TRANSISTOR

- FAST SWITCHING TIMES
- LOW SWITCHING LOSSES
- VERY LOW SATURATION VOLTAGE AND HIGH GAIN FOR REDUCED LOAD OPERATION



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	350	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	250	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	40	A
I_{CM}	Collector Peak Current	60	A
I_B	Base Current	7	A
I_{BM}	Base Peak Current	12	A
P_{base}	Reverse Bias Base Dissipation (B.E. junction in avalanche)	2	W
P_{tot}	Total Dissipation at T_c < 25°C	250	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case Max	0.7	°C/W

ELECTRICAL CHARACTERISITCS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			1 5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = − 1.5V $V_{CE} = V_{CEV}$ V_{BE} = − 1.5V T_c = 100°C			1 4	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)*}$	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25 mH	250			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 8A I_B = 0.53A I_C = 16A I_B = 1.6A I_C = 24A I_B = 3A I_C = 8A I_B = 0.53A T_j = 100°C I_C = 16A I_B = 1.6A T_j = 100°C I_C = 24A I_B = 3A T_j = 100°C		0.35 0.45 0.6 0.35 0.6 0.9	0.9 0.9 1.2 1.2 1.5 1.9	V V V V V V
$V_{BE(sat)*}$	Base-emitter Saturation Voltage	I_C = 16A I_B = 1.6A I_C = 24A I_B = 3A I_C = 16A I_B = 1.6A T_j = 100°C I_C = 24A I_B = 3A T_j = 100°C		0.9 1.2 1 1.2	1.3 1.5 1.3 1.5	V V V V
di_c/dt	Rated of Rise of On-state Collector Current	V_{CC} = 200V R_C = 0 I_{B1} = 2.4A T_j = 25°C See fig. 2 T_j = 100°C	 50 45	 130 120		 A/μs A/μs
$V_{CE(2μs)}$	Collector Emitter Dynamic Voltage	V_{CC} = 200V I_{B1} = 1.6A R_C = 13Ω T_j = 25°C See fig. 2 T_j = 100°C		 1.8 2/8	 3 6	 V V
$V_{CE(4μs)}$	Collector Emitter Dynamic Voltage	V_{CC} = 200V I_{B1} = 1.6A R_C = 13Ω T_j = 25°C See fig. 2 T_j = 100°C		 1.1 1.5	 1.7 2.5	 V V

* Pulsed : Pulse duration = 300μs, duty cycle = 2 %.

ELECTRICAL CHARACTERISTICS (continued)

RESISTIVE LOAD

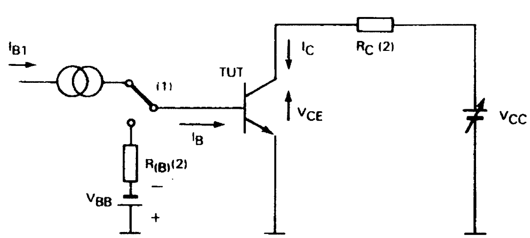
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_r	Rise Time	V_{CC} = 200V I_C = 24A V_{BB} = – 5V I_{B1} = 3A R_{B2} = 0.83Ω t_p = 30μs See fig. 1		0.3	0.6	μs
t_s	Storage Time			1.2	1.8	μs
t_f	Fall Time			0.15	0.35	μs

INDUCTIVE LOAD

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	V_{CC} = 200V V_{clamp} = 250V I_C = 16A I_B = 1.6A V_{BB} = – 5V R_{B2} = 1.6Ω L_C = 0.63mH See fig. 3		1.2	2	μs
t_f	Fall Time			0.08	0.2	μs
t_t	Tail Time in Turn-on			0.03	0.12	μs
t_c	Crossover Time			0.15	0.35	μs
t_s	Storage Time	V_{CC} = 200V V_{clamp} = 250V I_C = 16A I_B = 1.6A V_{BB} = – 5V R_{B2} = 3.3Ω L_C = 0.63mH T_j = 100°C See fig. 3		1.8	2.5	μs
t_f	Fall Time			0.2	0.4	μs
t_t	Tail Time in Turn-on			0.08	0.2	μs
t_c	Crossover Time			0.3	0.7	μs
t_s	Storage Time	V_{CC} = 200V V_{clamp} = 250V I_C = 16A I_B = 1.6A V_{BB} = 0 R_{B2} = 3.3Ω L_C = 0.63mH See fig. 3		3		μs
t_f	Fall Time			0.6		μs
t_t	Tail Time in Turn-on			0.2		μs
t_s	Storage Time	V_{CC} = 200V V_{clamp} = 250V I_C = 16A I_B = 1.6A V_{BB} = 0 R_{B2} = 3.3Ω L_C = 0.63mH T_j = 100°C See fig. 3		5		μs
t_f	Fall Time			1		μs
t_t	Tail Time in Turn-on			0.45		μs

* Pulsed : Pulse duration = 300μs, duty cycle = 2 %.

Figure 1 : Switching Times Test Circuit (resistive load).



(1) Fast switching
(2) Non-inductive resistor

Figure 2 : Turn-on Switching Waveforms.

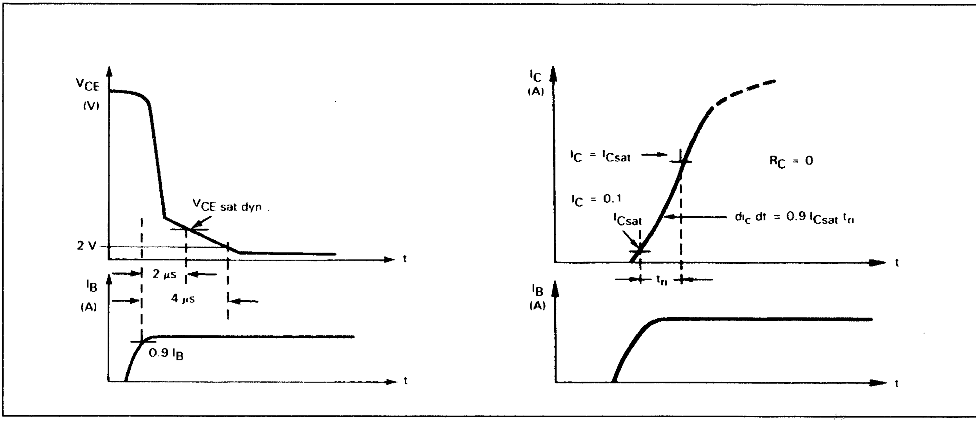


Figure 3a : Turn-on Switching Test Circuit.

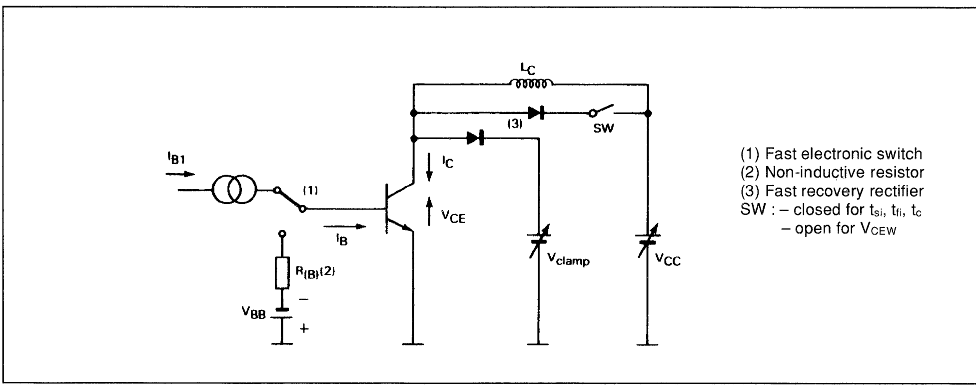
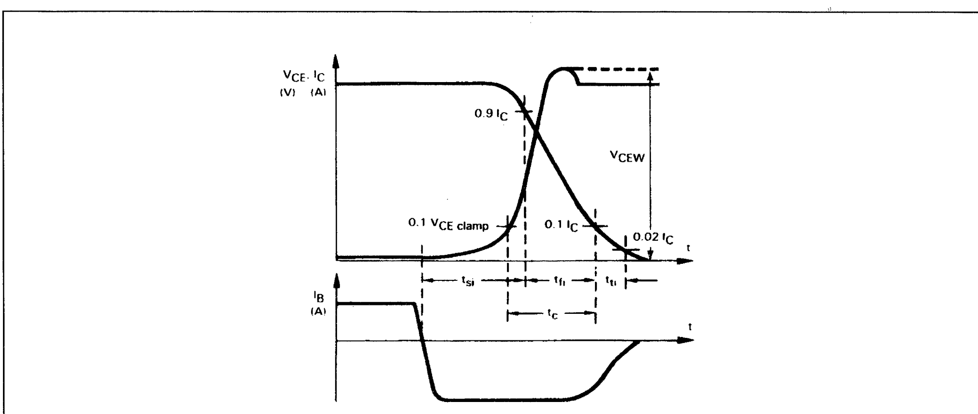
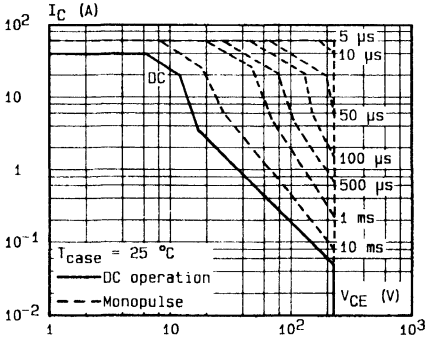


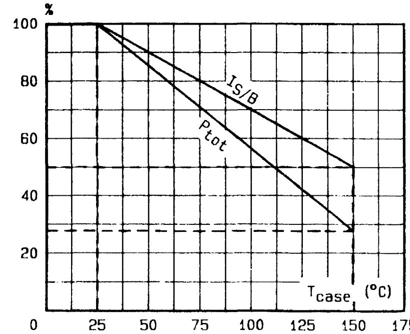
Figure 3b : Turn-off Switching Waveforms (inductive load).



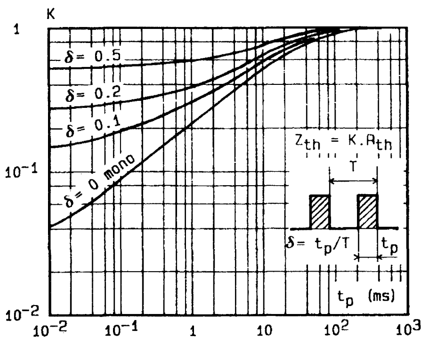
DC and AC Pulse Area.



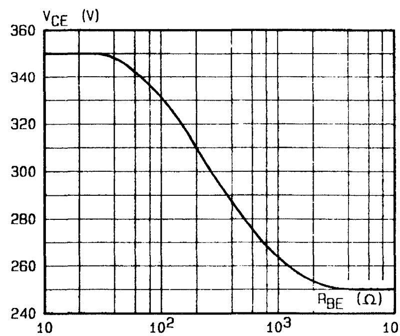
Power and $I_{S/B}$ Derating versus Case Temperature.



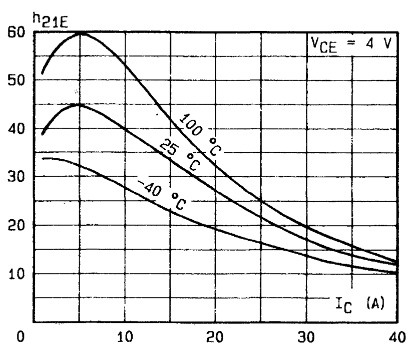
Transient Thermal Response.



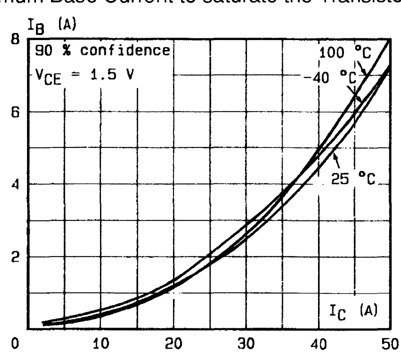
Collector-emitter Voltage versus Base-emitter Resistance.



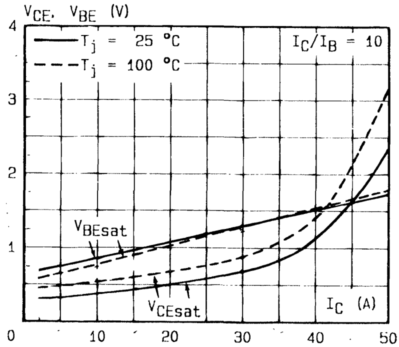
DC Current Gain.



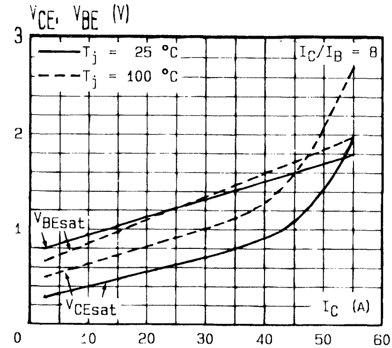
Minimum Base Current to saturate the Transistor.



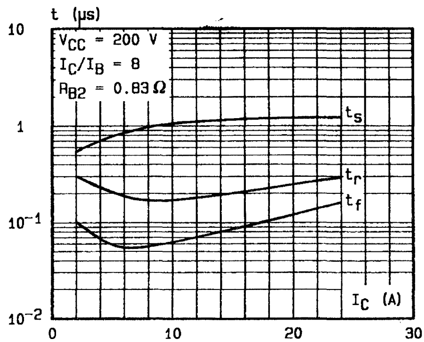
Saturation Voltage.



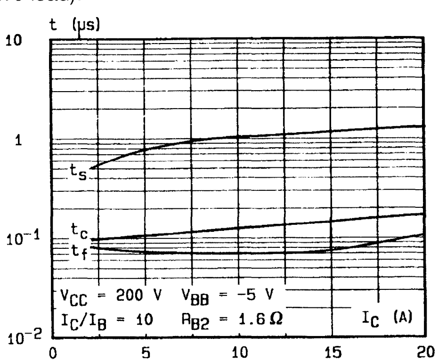
Saturation Voltage.



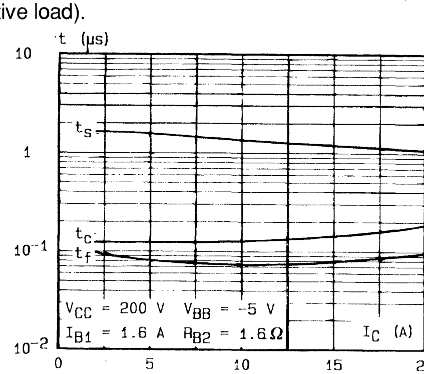
Switching Times versus Collector Current (resistive load).



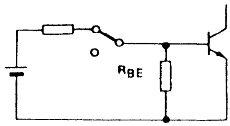
Switching Times versus Collector Current (inductive load).



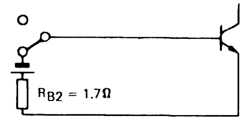
Switching Times versus Collector Current (inductive load).



SWITCHING OPERATING AND OVERLOAD AREAS

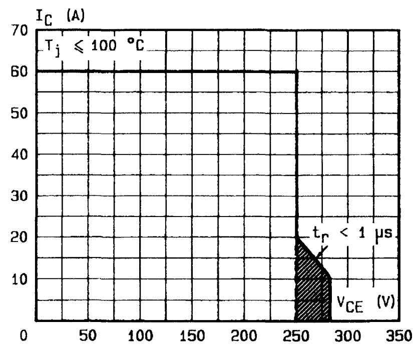


Transistor Forward Biased
- During the turn on
- During the turn off without negative base-emitter voltage and $3.3\Omega \leq R_{BE} \leq 50\ \Omega$



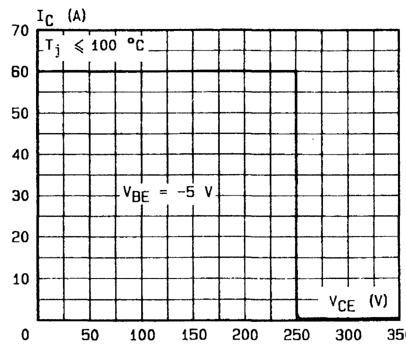
Transistor Reverse Biased
- During the turn off with negative base emitter voltage

Forward Biased Safe Operating Area (FBSOA).

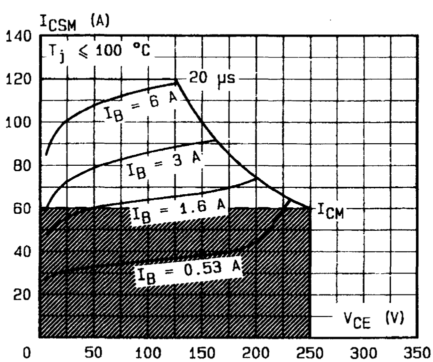


The hatched zone can only be used for turn-on

Reverse Biased Safe Operating Area (RBSOA).

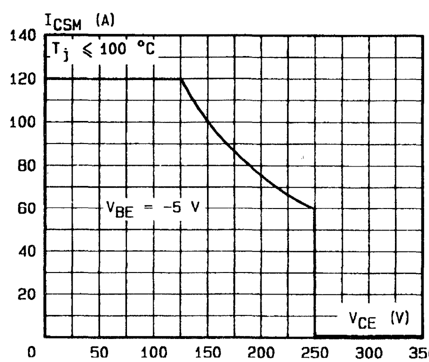


Forward Biased Accidental Overload Area (FBAOA).



The Kellog network (heavy point) allows the calculation of the maximum value of the short-circuit for a given base current I_B (90 % confidence).

Reverse Biased Accidental Overload Area (RBAOA).

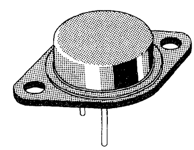


After the accidental overload current the RBAOA has to be used for the turn-off.

High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

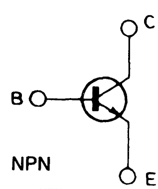
FAST SWITCHING POWER TRANSISTOR

- FAST SWITCHING TIMES
- LOW SWITCHING LOSSES
- LOW BASE CURRENT REQUIREMENTS
- VERY LOW SATURATION VOLTAGE AND HIGH GAIN



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	400	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	300	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	40	A
I_{CM}	Collector Peak Current	60	A
I_B	Base Current	8	A
I_{BM}	Base Peak Current	12	A
P_{tot}	Total Dissipation at T_c < 25°C	250	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case Max	0.7	°C/W

ELECTRICAL CHARACTERISITCS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			1 5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = – 1.5V $V_{CE} = V_{CEV}$ V_{BE} = – 1.5V T_c = 100°C			1 4	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	300			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 15A I_B = 1.5A I_C = 15A I_B = 1.5A T_j = 100°C			0.9 1.9	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 15A I_B = 1.5A I_C = 15A I_B = 1.5A T_j = 100°C			1.3 1.3	V V
di_c/dt	Rated of Rise of On-state Collector Current	V_{CC} = 250V R_C = 0 I_{B1} = 2.25A t_p = 3µs T_j = 100°C See fig. 1	65			A/µs

INDUCTIVE LOAD

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	V_{CC} = 250V V_{clamp} = 300V I_C = 15A I_B = 1.5A V_{BB} = – 5V R_{BB} = 1.6Ω L_C = 0.83mH T_j = 100°C See fig. 2			3	µs
t_f	Fall Time				0.4	µs
t_c	Crossover Time				0.7	µs
V_{CEW}	Maximum Collector Emitter Voltage without Snubber	V_{CC} = 50V I_{CWoff} = 22A V_{BB} = – 5V I_{B1} = 1.5A L_C = 0.11mH R_{BB} = 1.6Ω T_j = 125°C See fig. 2	300			V

Figure 1 : Turn-on Switching Characteristics of the Transistor.

(1) Fast electronic switch
(2) Non-inductive resistor

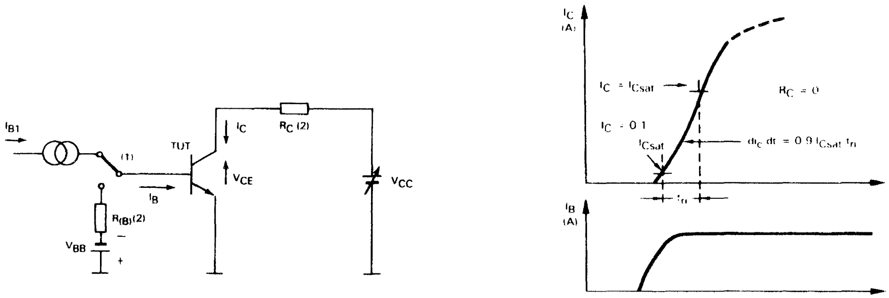
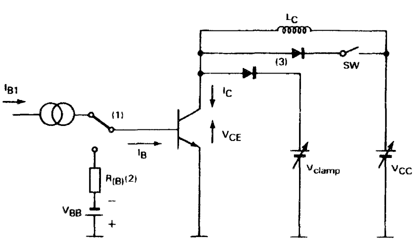
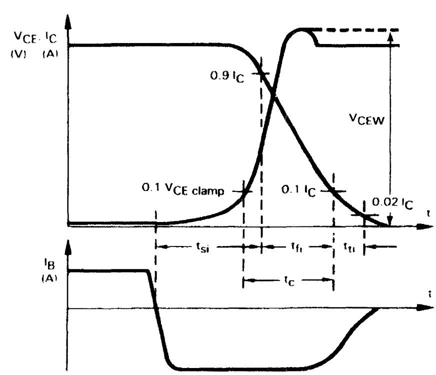


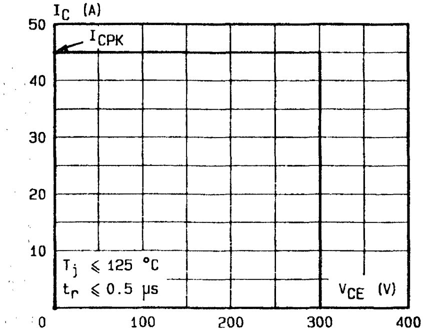
Figure 2 : Turn-off Switching Characteristics of the Transistor.

(1) Fast electronic switch
(2) Non-inductive resistor
(3) Fast recovery rectifier
SW : – closed for t_{si}, t_{fi}, t_c
– open for V_{CEW}

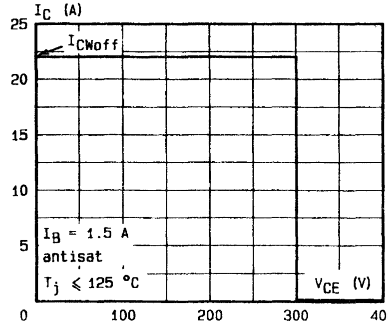




Forward Biased Safe Operating Area (FBSOA).

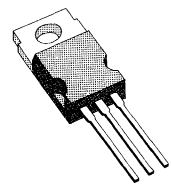


Reverse Biased Safe Operating Area (RBSOA).



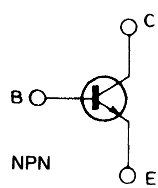
FAST SWITCHING POWER TRANSISTOR

- SUITABLE FOR SWITCHMODE POWER SUPPLY, UPS, DC AND AC MOTOR CONTROL



TO-220

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

High voltage, high speed transistor suited for use on the 220 and 380V mains.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	850	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	450	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	15	A
I_{CM}	Collector Peak Current	22	A
I_B	Base Current	5	A
I_{BM}	Base Peak Current	7.5	A
P_{tot}	Total Dissipation at T_c < 25°C	100	W
T_{stg}	Storage Temperature	– 65 to 150	°C
T_j	Max. Operating Junction Temperature	150	°C

THERMAL DATA

$R_{thj-case}$	Thermal Resistance Junction-case Max	1.25	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			0.2 1.5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = − 1.5V $V_{CE} = V_{CEV}$ V_{BE} = − 1.5V T_c = 100°C			0.2 1.5	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	450			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 8A I_B = 1.6A I_C = 8A I_B = 1.6A T_j = 100°C			1.2 2	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 8A I_B = 1.6A I_C = 8A I_B = 1.6A T_j = 100°C			1.3 1.3	V V
di_c/dt	Rate of Rise of On-state Collector Current	V_{CC} = 300V R_C = 0 I_{B1} = 2.4A t_p = 3μs T_j = 100°C See fig. 1	45			A/μs

INDUCTIVE LOAD

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	V_{CC} = 400V V_{clamp} = 450V I_C = 8A I_B = 1.6A V_{BB} = − 5V R_{BB} = 1.6Ω L_C = 2.5mH T_j = 100°C see fig. 2			3	μs
t_f	Fall Time				0.4	μs
t_c	Crossover Time				0.7	μs
V_{CEW}	Maximum Collector Emitter Voltage without Snubber	V_{CC} = 50V I_{CWoff} = 12A V_{BB} = − 5V I_{B1} = 1.6A L_C = 0.21mH R_{BB} = 1.6Ω T_j = 125°C See fig. 2	450			V

Figure 1 : Turn-on Switching Characteristics of the Transistor.

(1) Fast electronic switch
(2) Non-inductive resistor

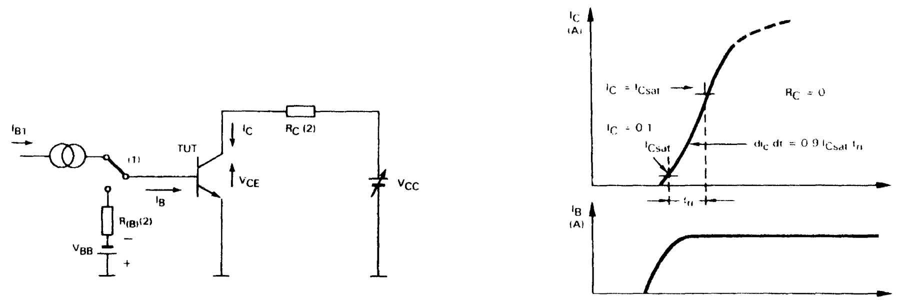
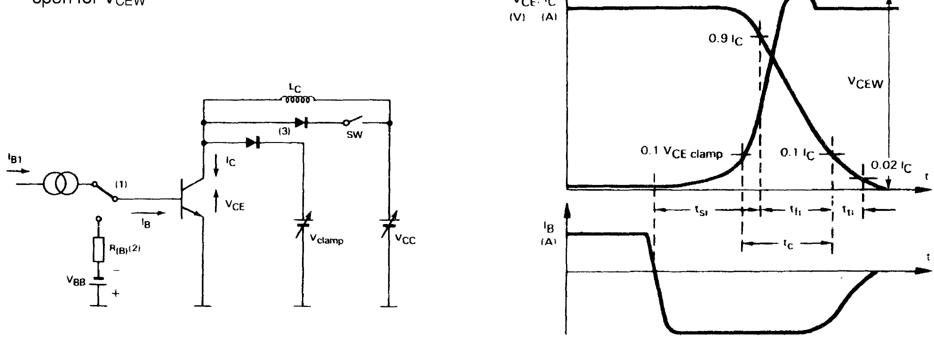
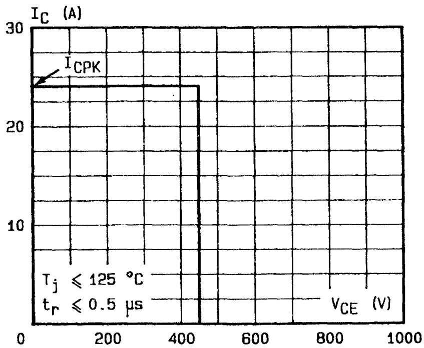


Figure 2 : Turn-off Switching Characteristics of the Transistor.

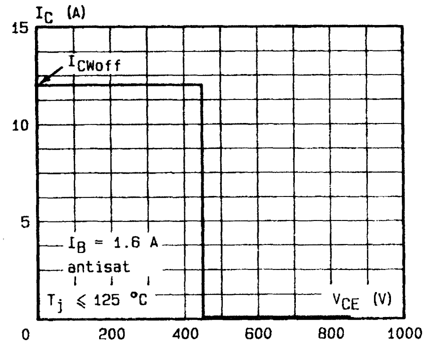
(1) Fast electronic switch
(2) Non-inductive resistor
(3) Fast recovery rectifier
SW : – closed for t_{si}, t_{fi}, t_c
– open for V_{CEW}



Forward Biased Safe Operating Area (FBSOA).



Reverse Biased Safe Operating Area (RBSOA).



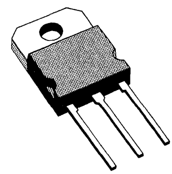
SGS-THOMSON
MICROELECTRONICS

BUW12
BUW12A

HIGH VOLTAGE POWER SWITCH

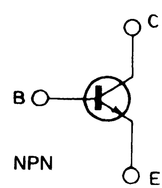
DESCRIPTION

The BUW12 and BUW12A are silicon multiepitaxial mesa NPN transistors in SOT-93 plastic package, particulary intended for high voltage, fast switching industrial applications.



TO-218

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BUW12	BUW12A	
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	850	1000	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	400	450	V
I_C	Collector Current	8		A
I_{CM}	Collector Peak Current ($t_p \leq 2$ ms)	20		A
I_B	Base Current	4		A
I_{BM}	Base Peak Current ($t_p \leq 2$ ms)	6		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	100		W
T_{stg}	Storage Temperature	– 65 to 150		°C
T_j	Junction Temperature	150		°C

THERMAL DATA

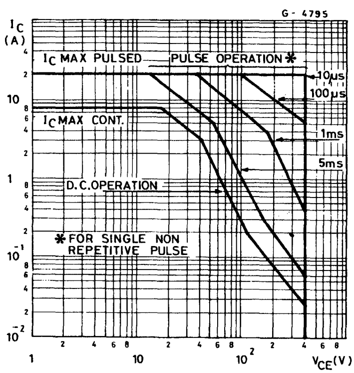
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	max	1.25	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	$V_{CE} = V_{CES}$ $V_{CE} = V_{CES}$ T_j = 125 °C			1 3	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 9 V			10	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 100 mA L = 25 mH	400			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 6 A I_B = 1.2 A			1.5	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 6 A I_B = 1.2 A			1.5	V
t_{on}	Turn-on Time	I_C = 6 A I_{B1} = 1.2 A I_{B2} = 1.2 A			1	ns
t_s	Storage Time				4	µs
t_f	Fall Time				0.8	µs

* Pulsed : pulse duration = 300 µs, duty cycle = 1.5 %.

Safe Operating Areas.



SGS-THOMSON
MICROELECTRONICS

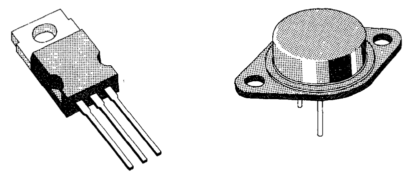
BUW22/22P
BUW22A/22AP

HIGH VOLTAGE POWER SWITCH

DESCRIPTION

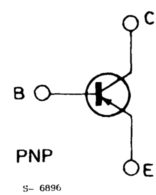
The BUW22, BUW22A are silicon multiepitaxial mesa PNP transistor in Jedec TO-3 metal case, particulary intended for switching applications.

The BUW22P, BUW22AP are mounted in TO-220 plastic package.



TO-220 TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BUW22/P	BUW22A/AP	
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	– 400	– 450	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 350	– 400	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 5	– 7	V
I_C	Collector Current	– 6		A
I_{CM}	Collector Peak Current ($t_p \leq$ 10 ms)	– 8		A
I_B	Base Current	– 2		A
I_{BM}	Base Peak Current ($t_p \leq$ 10 ms)	– 4		A
		TO-3	TO-220	
P_{tot}	Total Power Dissipation at $T_{case} \leq$ 25 °C	75	60	W
T_{stg}	Storage Temperature	– 65 to 175	– 65 to 150	°C
T_j	Junction Temperature	175	150	°C

THERMAL DATA

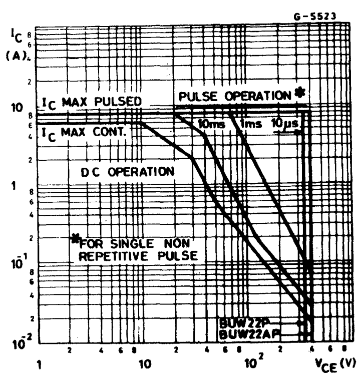
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	max	2	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

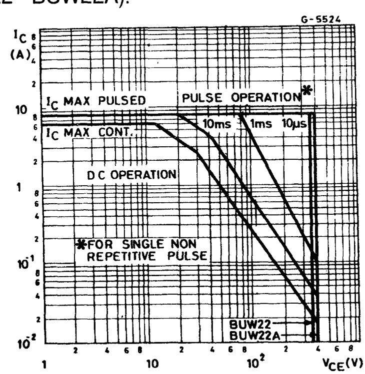
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = Rated V_{CES} T_{case} = 125 °C V_{CE} = Rated V_{CES}			– 1 – 5	mA mA
I_{EBO}	Collector Cutoff Current (I_C = 0)	V_{EB} = Rated V_{EBO}			– 1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = – 100 mA for **BUW22/P** for **BUW22A/AP**	 – 350 – 400			 V V
$V_{CE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 2.5 A I_B = – 1 A			– 1.5	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 2.5 A I_B = – 1 A			– 1.6	V
h_{FE}*	DC Current Gain	I_C = – 0.5 A V_{CE} = – 5 V	12			
$I_{s/b}$	Second Breakdown Collector Current	V_{CE} = – 30 V for **BUW22/A** for **BUW22P/AP**	 – 2.5 – 2			 A A
t_{on}	Turn-on Time	Resistive Load		0.4	0.8	µs
t_s	Storage Time	V_{CC} = – 250 V I_C = – 2.5 A		0.6	1.5	µs
t_f	Fall Time	I_{B1} = – I_{B2} = – 0.5 A		0.3	0.7	µs

* Pulsed : pulse duration = 300 µs, duty cycle = 1.5 %.

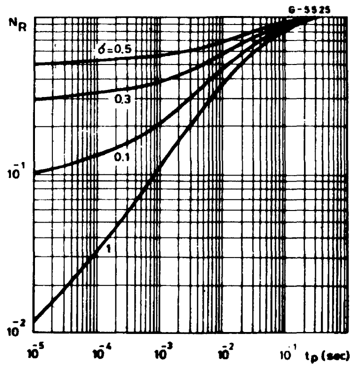
Safe Operating Areas.
(BUW22AP - BUW22P).



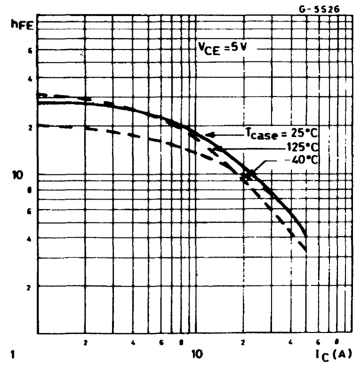
Safe Operating Areas.
(BUW22 - BUW22A).



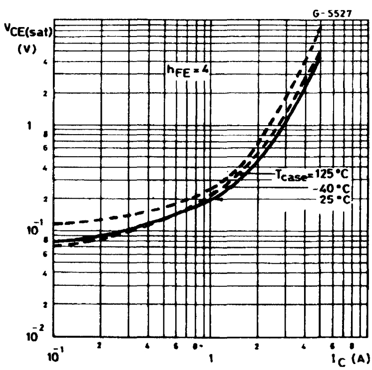
Transient Thermal Response.



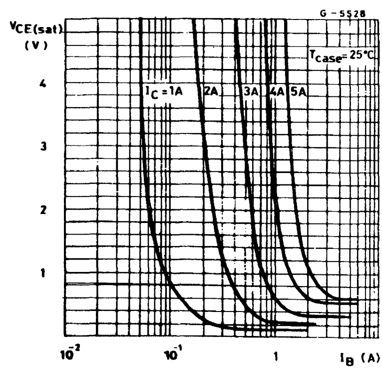
DC Current Gain.



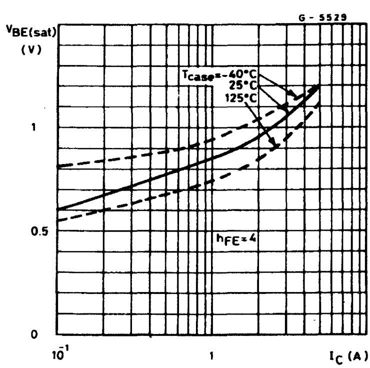
Collector-emitter Saturation Voltage.



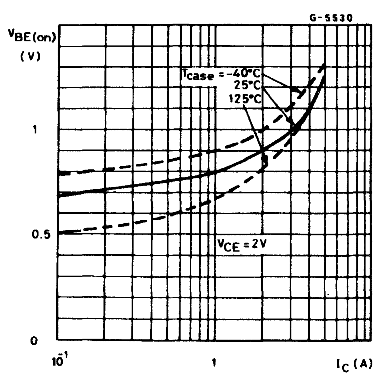
Collector-emitter Saturation Voltage.



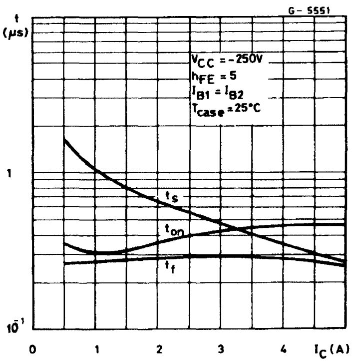
Base-emitter Saturation Voltage.



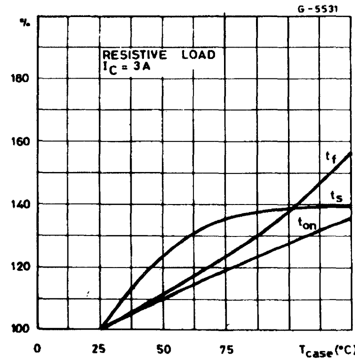
Base-emitter On Voltage.



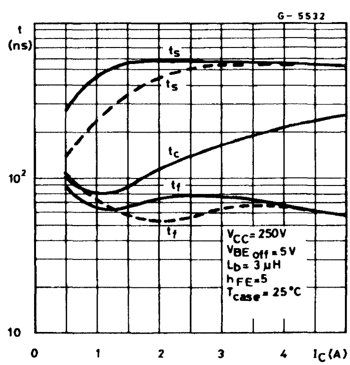
Switching Times Resistive Load (test circuit fig. 1).



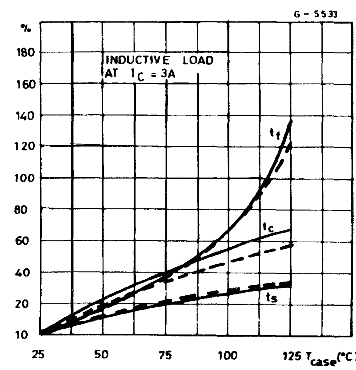
Switching Time Percentage Variation vs. T_{case}.



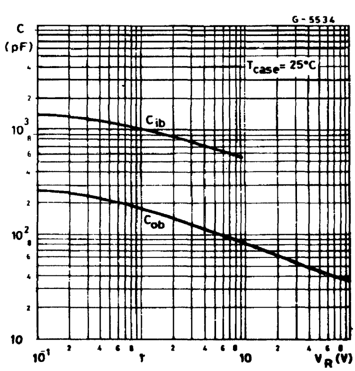
Turn-off Switching Times Inductive Load (test circuit fig. 2).



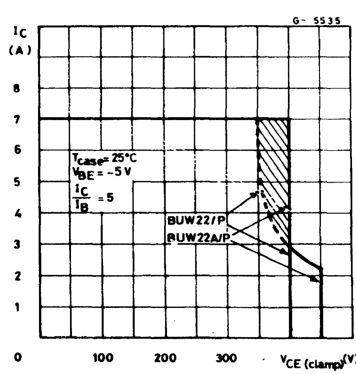
Switching Times Percentage Variation vs. T_{case}.



Capacitance.



Reserve Biased Safe Operating Area.



TEST CIRCUITS.

Figure 1.

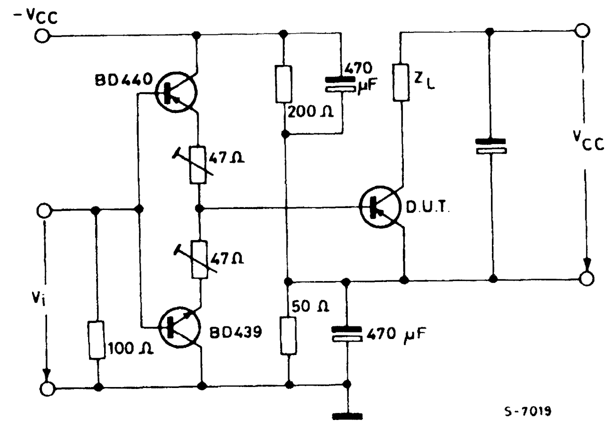
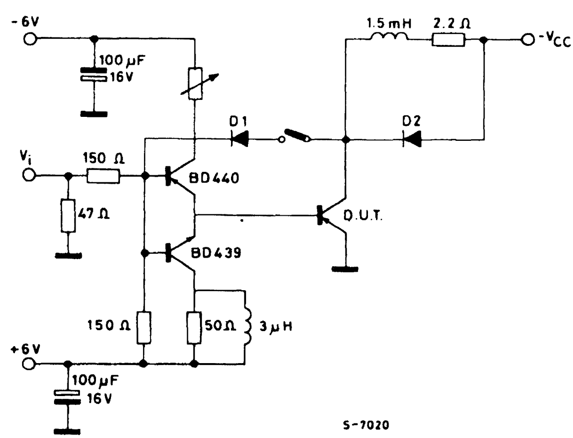


Figure 2.

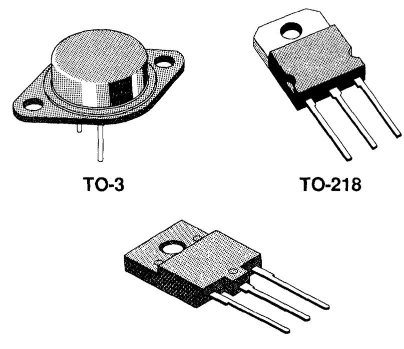


BUW32/32P/32PFI
BUW32A/32AP/32APFI

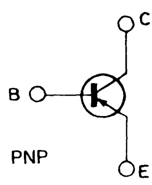
HIGH VOLTAGE POWER SWITCH

DESCRIPTION

The BUW32/A, BUW32P/AP and BUW32PFI/APFI are silicon multiepitaxial mesa PNP transistors mounted respectively in TO-3 metal case, TO-218 plastic package and ISOWATT218 fully isolated package. They are intended for high voltage, fast switching and industrial applications.



INTERNAL SHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	BUW 32/P/PFI		BUW 32A/AP/APFI	Unit
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	– 400		– 450	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 350		– 400	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 5		– 7	V
I_C	Collector Current	– 10			A
I_B	Base Current	– 5			A
		TO-3	TO-218	ISOWATT218	
P_{tot}	Total Power Dissipation at T_c < 25 °C	125	105	55	W
T_{stg}	Storage Temperature	– 65 to 175	– 65 to 150	– 65 to 150	°C
T_j	Max. Operating Junction Temperature	175	150	150	°C

THERMAL DATA

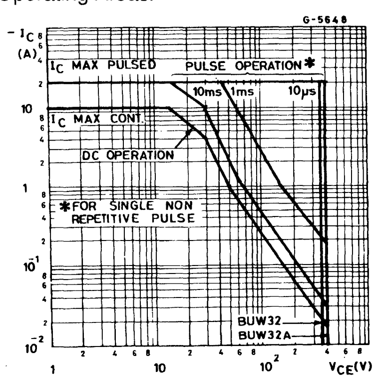
		TO-3	TO-218	ISOWATT218	
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case max	1.19	1.19	2.27	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

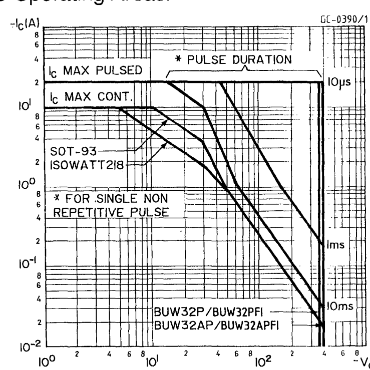
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = Rated V_{CES} V_{CE} = Rated V_{CES} T_{case} = 125 °C			– 1 – 5	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = Rated V_{EBO}			– 1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = – 100 mA for **BUW32/P/PFI** for **BUW32A/AP/APFI**	 – 350 – 400			 V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 5 A I_B = – 1.5 A			– 1.5	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 5 A I_B = – 1.5 A			– 1.6	V
h_{FE}*	DC Current Gain	I_C = – 1 A V_{CE} = – 5 V	12			
$I_{s/b}$	Second Breakdown Collector Current	V_{CE} = – 30 V for **BUW32/A** for **BUW32P/AP** for **BUW32PFI/APFI**	 – 4.2 – 3.5 – 1.7			 A A A
t_{on}	Turn-on Time	Resistive Load		0.3	0.6	µs
t_s	Storage Time	V_{CC} = – 250 V		0.7	1.5	µs
t_f	Fall Time	I_C = – 5 A I_{B1} = – I_{B2} = – 1 A		0.25	0.6	µs

* Pulsed : pulse duration = 300 µs, duty cycle = 1.5 %.

Safe Operating Areas.

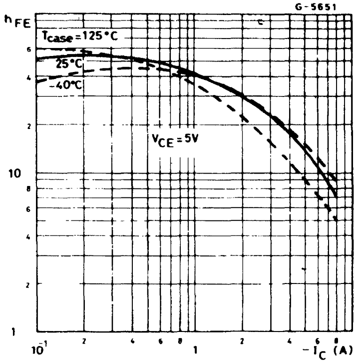


Safe Operating Areas.

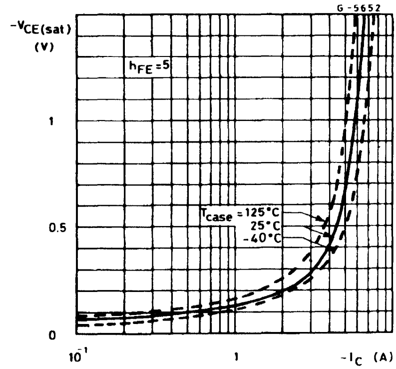


SGS-THOMSON MICROELECTRONICS

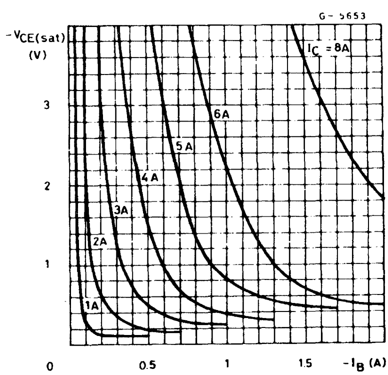
DC Current Gain.



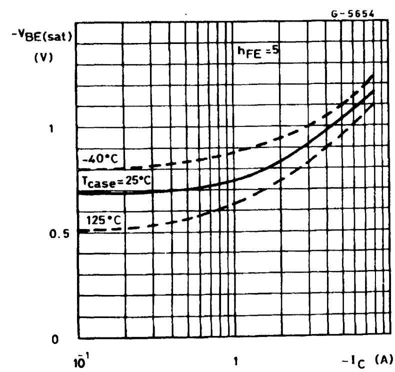
Collector-emitter Saturation Voltage.



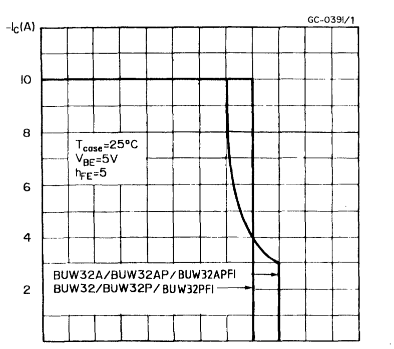
Collector-emitter Saturation Voltage.



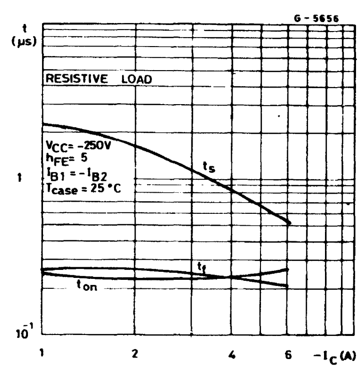
Base-emitter Saturation Voltage.



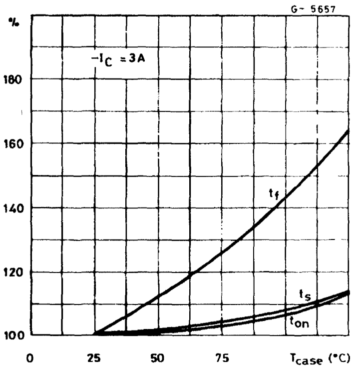
Clamped Reverse Bias Safe Operating Areas.



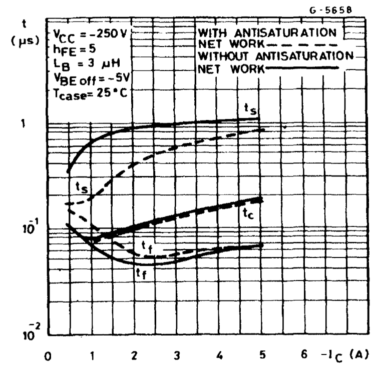
Saturated Switching Characteristics (test circuit fig. 1).



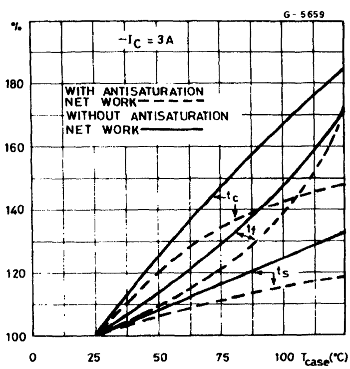
Switching Times Percentage Variation vs. T_{case} Resistive Load.



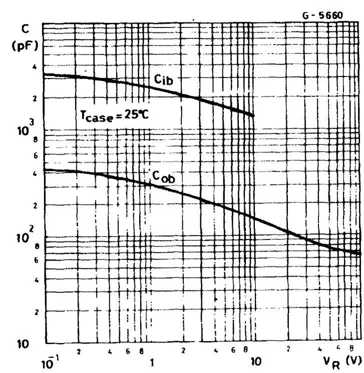
Switching Times Resistive Load (test circuit fig. 2).



Switching Time Percentage Variation vs. T_{case}. Resistive Load.



Capacitance.



TEST CIRCUITS.

Figure 1.

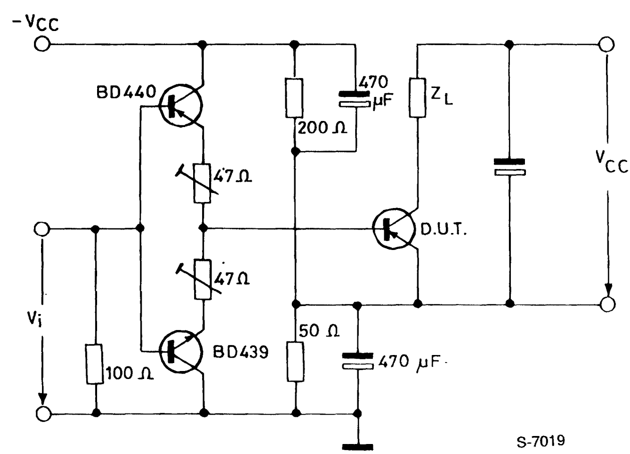
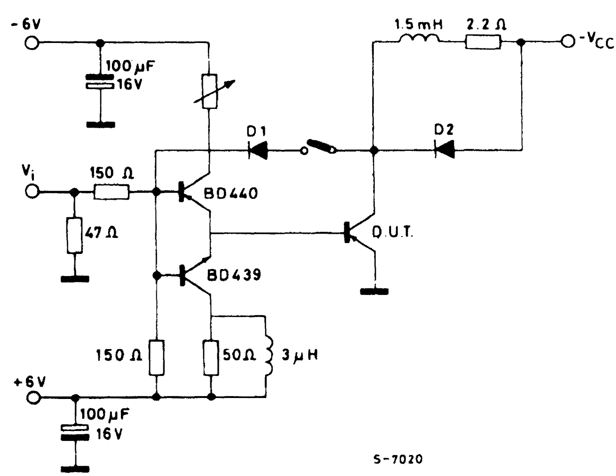


Figure 2.



ISOWATT218 PACKAGE CHARACTERISTICS AND APPLICATION.

ISOWATT218 is fully isolated to 4000V dc. Its thermal impedance, given in the data sheet, is optimised to give efficient thermal conduction together with excellent electrical isolation. The structure of the case ensures optimum distances between the pins and heatsink. These distances are in agreement with VDE and UL creepage and clearance standards. ISOWATT218 package eliminates the need for external isolation so reducing fixing hardware.

The package is supplied with leads longer than the standard TO-218 to allow easy mounting on pcbs.

Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

ISOWATT218 thermal performance is equivalent to that of the standard part, mounted with a 0.1mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for ISOWATT218 packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT218 PACKAGE

Fig. 3 illustrates the elements contributing to the thermal resistance of a transistor heatsink assembly, using ISOWATT218 package.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements. The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1 - For a short duration power pulse of less than 1ms :

$$Z_{th} < R_{thJ\text{-}C}$$

2 - For an intermediate power pulse of 5ms to 50ms seconds :

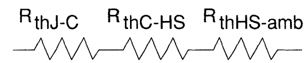
$$Z_{th} = R_{thJ\text{-}C}$$

3 - For long power pulses of the order of 500ms seconds or greater :

$$Z_{th} = R_{thJ\text{-}C} + R_{thC\text{-}HS} + R_{thHS\text{-}amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

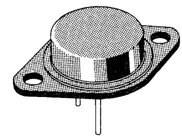
Figure 3.



HIGH VOLTAGE POWER SWITCH

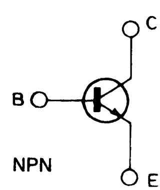
DESCRIPTION

The BUW34, BUW35 and BUW36 are silicon multiepitaxial mesa NPN transistors in Jedec TO-3 metal case. They are intended for high voltage, fast switching applications.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		BUW34	BUW35	BUW36	
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	500	800	900	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	400	400	450	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7			V
I_C	Collector Current	10			A
I_{CM}	Collector Peak Current	15			A
I_B	Base Current	5			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	125			W
T_{stg}	Storage Temperature	– 65 to 200			°C
T_j	Junction Temperature	200			°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case max	1.4	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	for **BUW34** V_{CE} = 500 V for **BUW35** V_{CE} = 800 V for **BUW36** V_{CE} = 900 V T_{case} = 125 °C for **BUW34** V_{CE} = 500 V for **BUW35** V_{CE} = 800 V for **BUW36** V_{CE} = 900 V			500 500 500 3 3 3	µA µA µA mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA for **BUW34** for **BUW35** for **BUW36**	 400 400 450			 V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	All Types I_C = 5 A I_B = 1 A for **BUW35** I_C = 8 A I_B = 2.5 A for **BUW36** I_C = 8 A I_B = 2.5 A			1.5 1.5 3	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	All Types I_C = 5 A I_B = 1 A for **BUW35** I_C = 8 A I_B = 2.5 A for **BUW36** I_C = 8 A I_B = 2.5 A			1.5 1.8 1.8	V V V

RESISTIVE SWITCHING TIMES (see fig. 1)

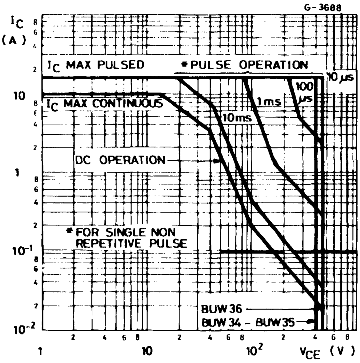
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	I_C = 5 A, I_{B1} = 1 A, V_{CC} = 250 V			0.70	µs
ts	Storage Time	I_C = 5 A, I_{B1} = 1 A, I_{B2} = − 1 A, V_{CC} = 250 V			3	µs
t_f	Fall Time				0.8	µs

INDUCTIVE SWITCHING TIMES (see fig. 2)

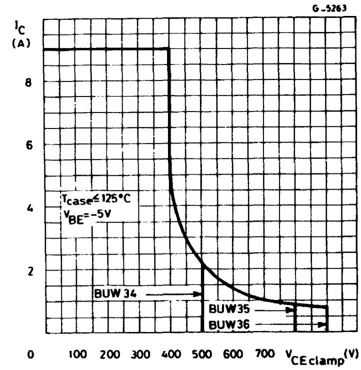
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_f	Fall Time	I_C = 5 A I_{B1} = 1 A V_{BE} = − 5 V V_{CC} = 300 V T_{case} = 100 °C I_C = 5 A I_{B1} = 1 A V_{BE} = − 5 V V_{CC} = 300 V			 0.3 0.6	 µs µs

* Pulsed : pulse duration ≤ 300 µs, duty cycle ≤ 1.5 %.

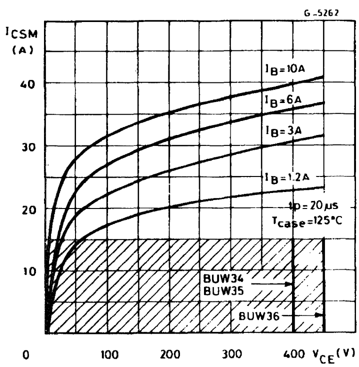
Safe Operating Areas.



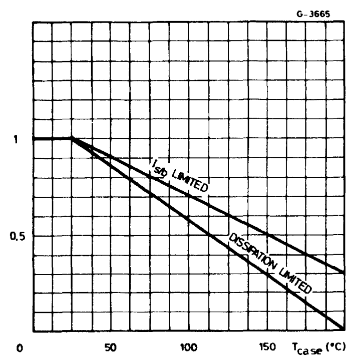
Clamped Reverse Bias Safe Operating Areas.



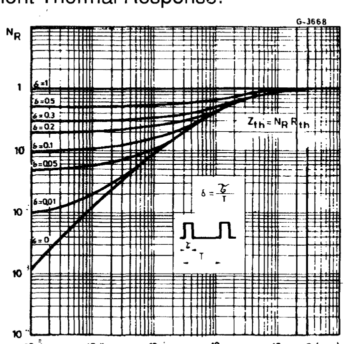
Forward Biased Accidental Overload Area (see fig. 3).



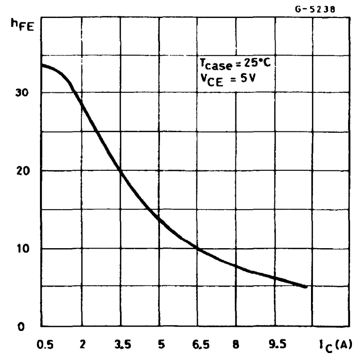
Derating Curves.



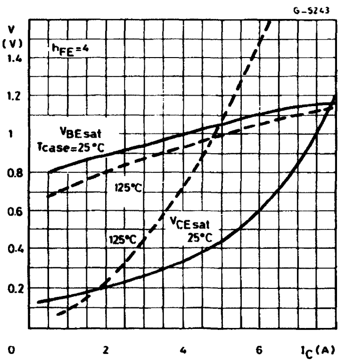
Transient Thermal Response.



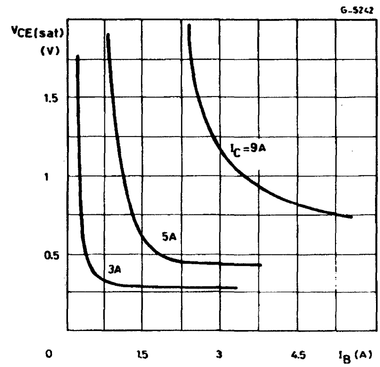
DC Current Gain.



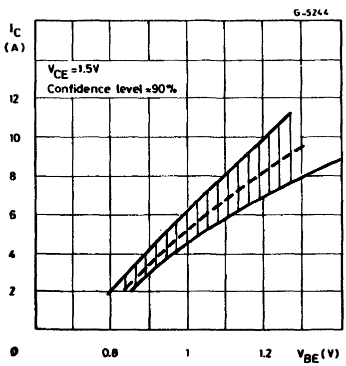
Saturation Voltages.



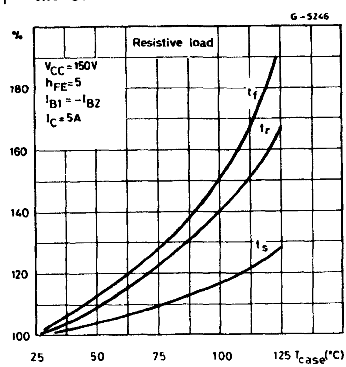
Collector-emitter Saturation Voltage.



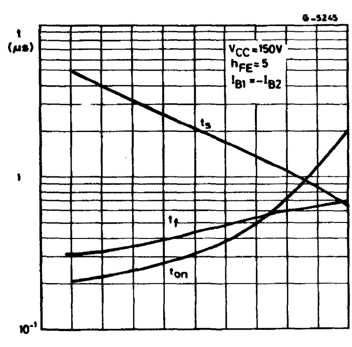
Collector Current Spread vs. Base Emitter Voltage.



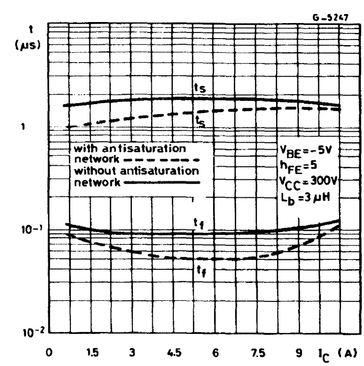
Switching Time Percentage Variation vs. case Temperature.



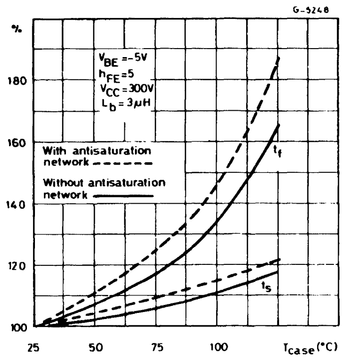
Switching Times Resistive Load (see fig. 1).



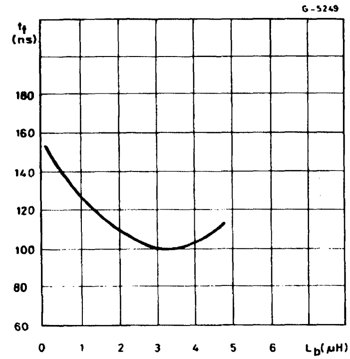
Switching Time Inductive Load (see fig. 2).



Switching Time Inductive Load vs. Case Temperature.



Fall Times vs. LB (see fig. 2).



Dynamic Collector-emitter Saturation Voltage (see fig. 4).

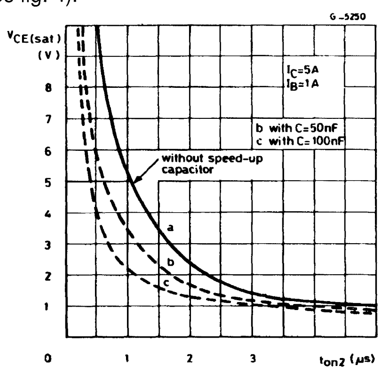


Figure 1 : Switching Times Test Circuit on resistive Load.

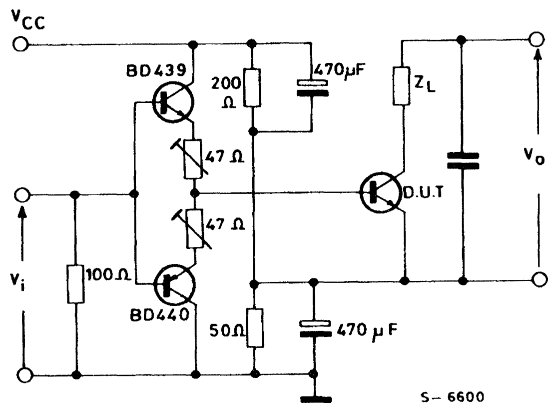
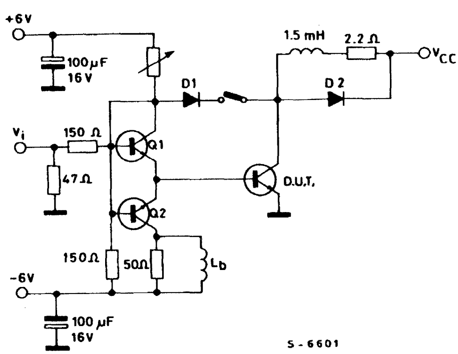


Figure 2 : Switching Times Test Circuit on Inductive Load with Ad without Antisaturation Network.



D1, D2 - Fast recovery diodes
Q1, Q2 - Transistors SGS: 2N5191, 2N5195.

Figure 3 : Forward Biased Accidental Over Load Area Test Circuit.

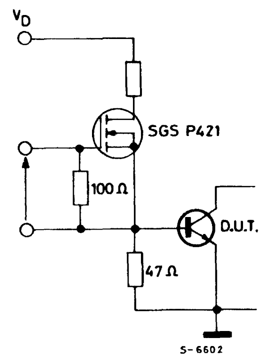


Figure 4 : $V_{CE\ (sat)}$ Dyn. Test Circuit.

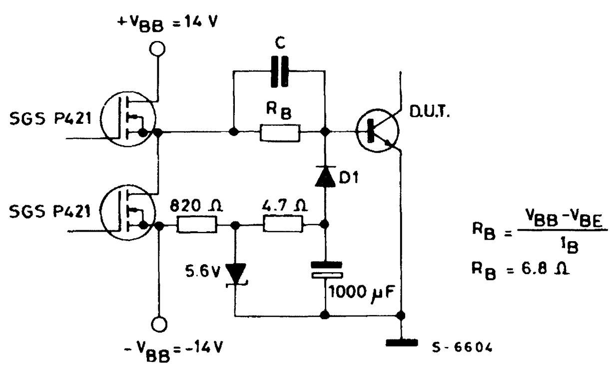
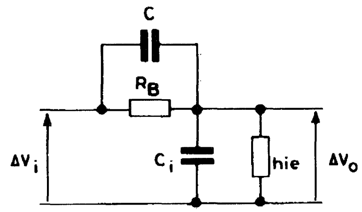


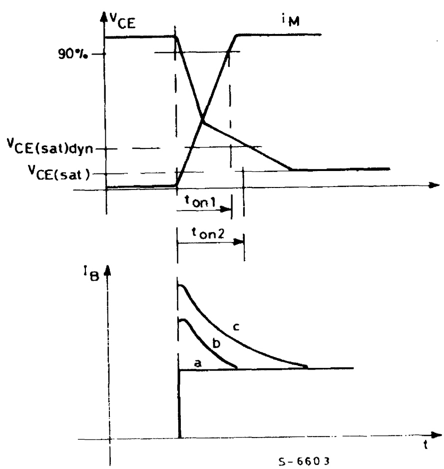
Figure 5 : Equivalent Input Schematic at Turn-on.



$$\Delta V_O = \Delta V_i \frac{C}{C_i + C}$$

if $C \gg C_i$ $\Delta V_O = \Delta V_i$

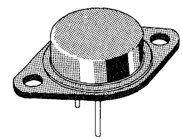
Figure 6 : Remarks to $V_{CE\ (sat)}$ Dyn. Test Circuit (fig. 4).



The speed-up capacitor decreases the $V_{CE\ (sat)}$ dyn. as shown in diagram (figure 6). The 50 nF capacitor modifies the shape of base current with a overshoot.

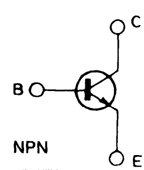
NPN HIGH CURRENT SWITCHING POWER TRANSISTORS

- HIGH CURRENT CAPABILITY
- VERY LOW SATURATION VOLTAGE AT $I_C = 20$ A
- FAST TURN-OFF AND TURN-ON
- HIGH FREQUENCY AND EFFICIENCY CONVERTERS
- SWITCHING REGULATORS
- MOTOR CONTROLS



TO-3

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

High current, high speed transistors suited for low voltage applications.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BUW38	BUW39	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	120	160	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	60	80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	7	V
I_C	Collector Current	30	30	A
I_{CM}	Collector Peak Current ($t_p < 5$ms)	45	40	A
I_B	Base Current	8	6	A
I_{BM}	Base Peak Current ($t_p < 5$ms)	20	15	A
P_{tot}	Total Dissipation at $T_c < 25$°C	150		W
T_{stg}	Storage Temperature	– 65 to 200		°C
T_j	Max. Operating Junction Temperature	200		°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	max	1.17	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

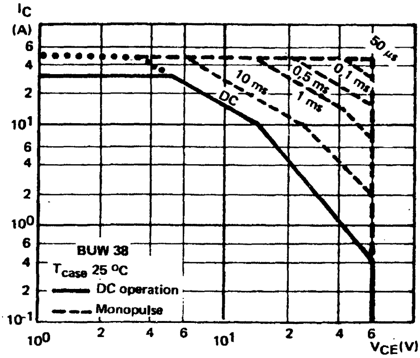
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEX}	Collector Cutoff Current	$V_{CE} = V_{CEX}$ $V_{BE} = -1.5V$ $V_{CE} = V_{CEX}$ $V_{BE} = -1.5V$ $T_c = 100°C$			1 3	mA mA
I_{EBO}	Emitter Cutoff Current ($I_C = 0$)	$V_{EB} = 5V$			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	$I_C = 0.2A$ L = 25mH for **BUW38** for **BUW39**	60 80			V V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	$I_E = 50mA$	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	$I_C = 20A$ $I_B = 2A$ for **BUW38** $I_C = 40A$ $I_B = 4A$ for **BUW38** $I_C = 15A$ $I_B = 1.5A$ for **BUW39** $I_C = 30A$ $I_B = 3A$ for **BUW39**			0.6 1.4 0.5 1.2	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	$I_C = 40A$ $I_B = 4A$ for **BUW38** $I_C = 30A$ $I_B = 3A$ for **BUW39**			2.1 2	V V
f_T	Transtion Frequency	f = 10MHz $V_{CE} = 15A$ $I_C = 1A$	8			MHz

RESISTIVE LOAD

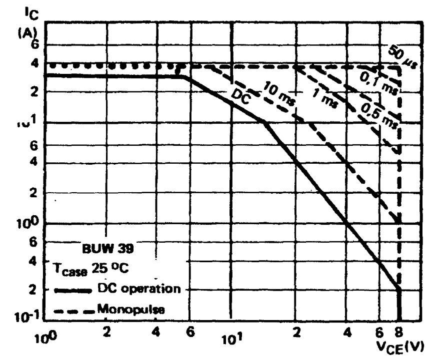
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on} t_s t_f	Turn-on Time Storage Time Fall Time	for **BUW38** $V_{CC} = 60V$ $I_C = 40A$ $I_{B1} = -I_{B2} = 4A$		1.2 0.6 0.17	1.5 1.1 0.25	µs µs µs
t_s t_f	Storage Time Fall Time	for **BUW38** $V_{CC} = 60V$ $I_C = 40A$ $I_{B1} = -I_{B2} = 4A$ $T_c = 125°C$			1.65 0.5	µs µs
t_{on} t_s t_f	Turn-on Time Storage Time Fall Time	for **BUW39** $V_{CC} = 80V$ $I_C = 30A$ $I_{B1} = -I_{B2} = 3A$		0.8 0.6 0.15	1.2 1.1 0.25	µs µs µs
t_s t_f	Storage Time Fall Time	for **BUW39** $V_{CC} = 80V$ $I_C = 30A$ $I_{B1} = -I_{B2} = 3A$ $T_c = 125°C$			1.65 0.5	µs µs

* Pulsed : Pulse duration = 300 µs, duty cycle = 2 %.

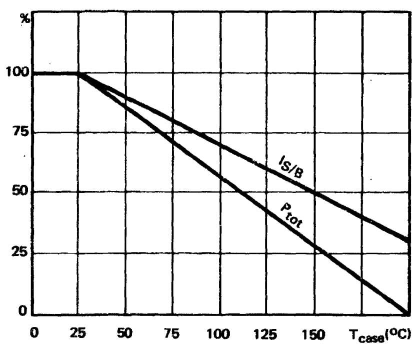
DC and AC Pulse Area.



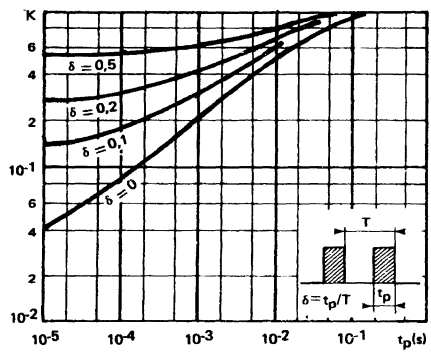
DC and AC Pulse Area.



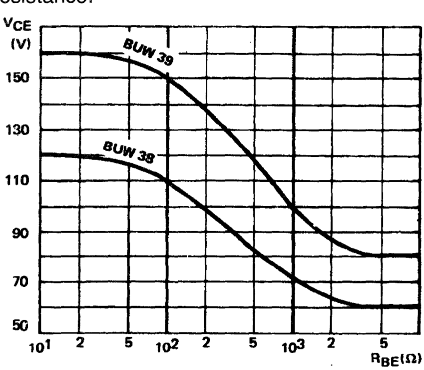
Power and $I_{S/B}$ Derating vs. Case Temperature.



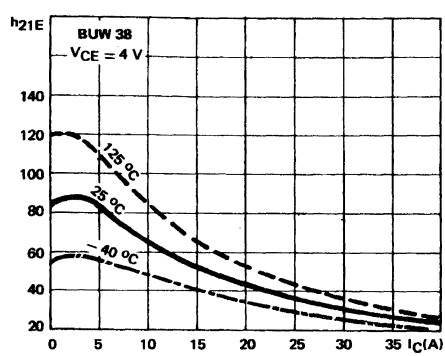
Transient Thermal Response.



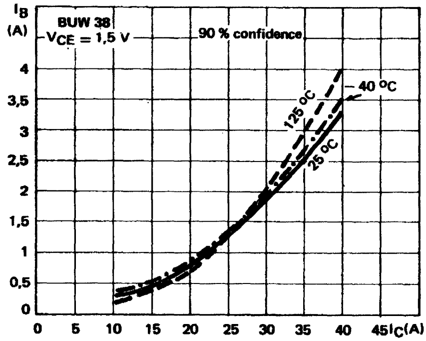
Collector-emitter Voltage vs. Base- emitter Resistance.



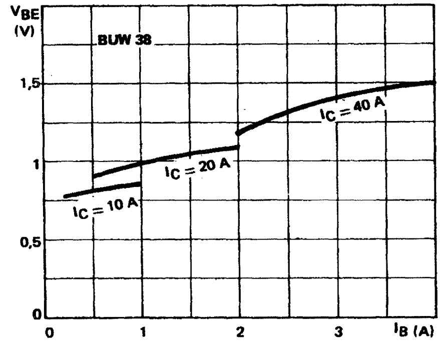
DC Current Gain.



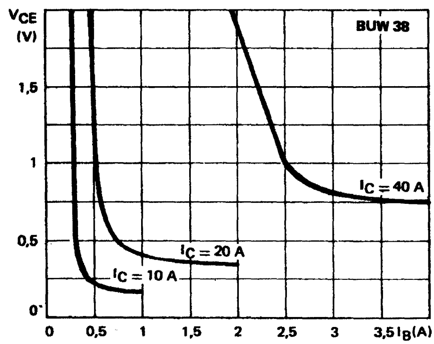
Minimum Base Current to Saturate the Transistor.



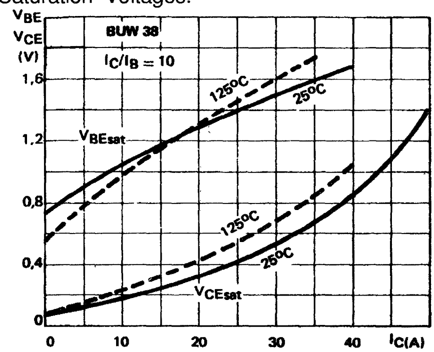
Base Characteristics.



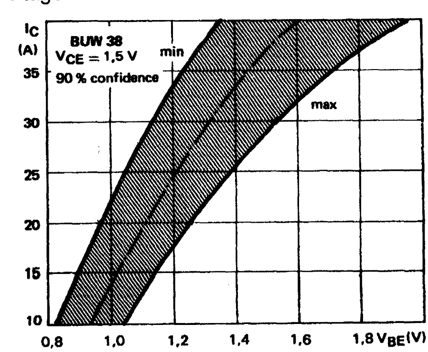
Colle ctor Saturation Region.



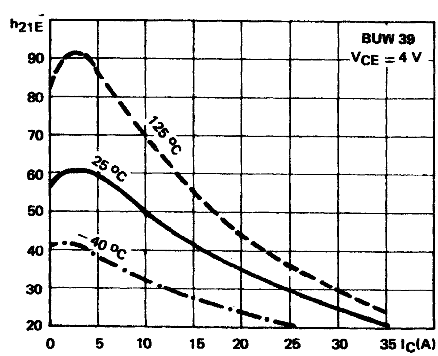
Saturation Voltages.



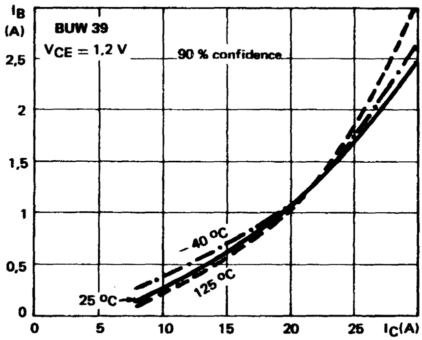
Collector Current Spread vs. Base Emitter Voltage.



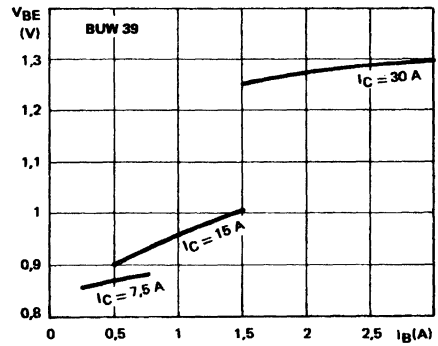
DC Current Gain.



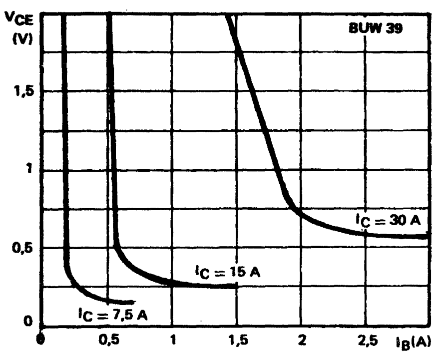
Minimum Base Current to saturate the Transistor.



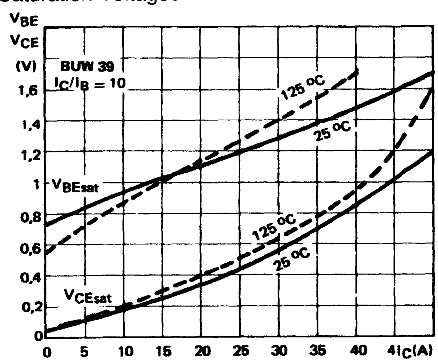
Base Characteristics.



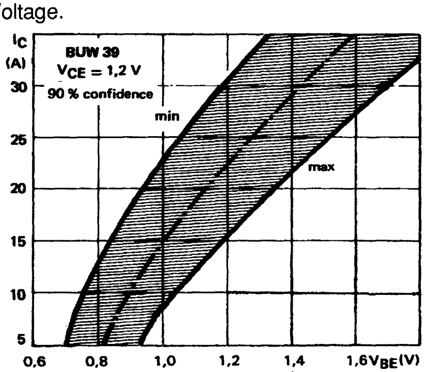
Collector Saturation Region.



Saturation Voltages.



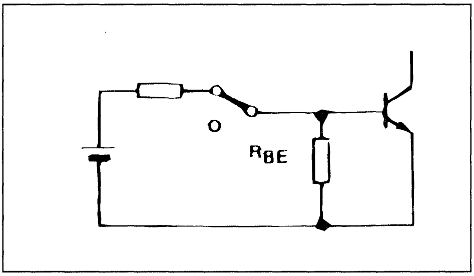
Collector Current Spread vs. Base Emitter Voltage.



SWITCHING OPERATING AND OVERLOAD AREAS

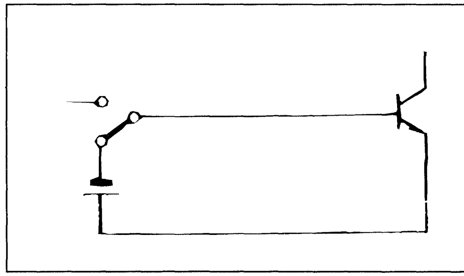
TRANSISTOR FORWARD BIASED

- During the turn on
- During the turn off without negative base-emitter voltge and $R_{BE} \geq 5\Omega$

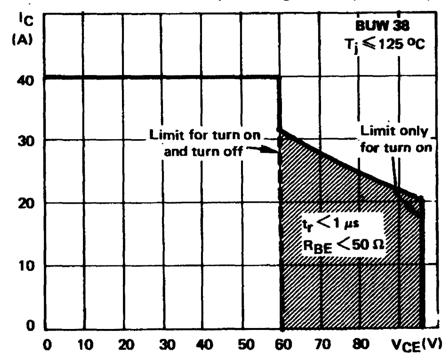


TRANSISTOR REVERSE BIASED

- During the turn off without negative base-emitter voltge

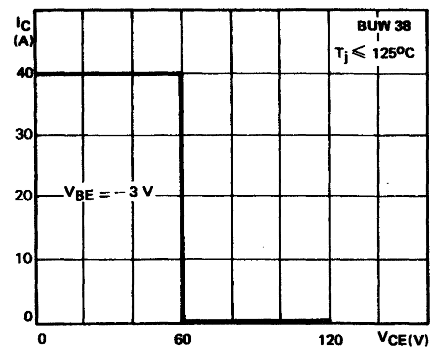


Forward Biased Safe Operating Area (FBSOA).

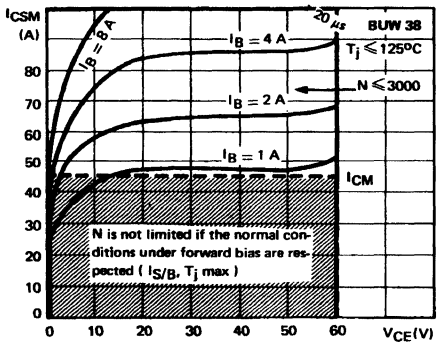


The hatched zone can only be used for turn-on.

Reverse Biased Safe Operating Area (RBSOA).

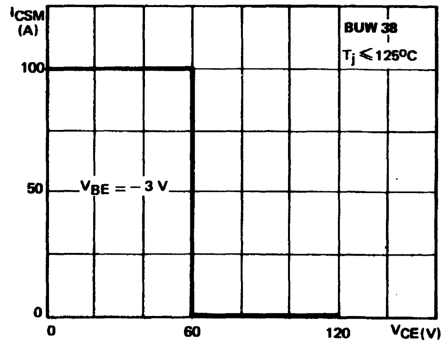


Forward Biased Accidental Overload Area (FBAOA).



The Kellog network (heavy print) allows the calculation of the maximum value of the short circuit current for a given base current IB (90% confidence).

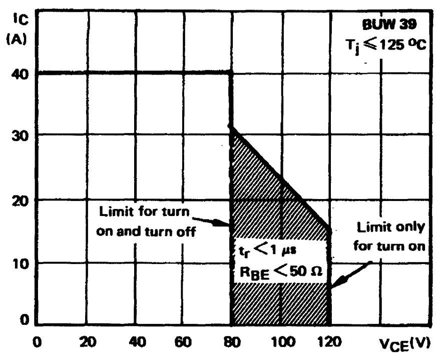
Reverse Biased Accidental Overload Area (RBAOA).



After the acidental overload current, the RBAOA has to be used for the turn off.

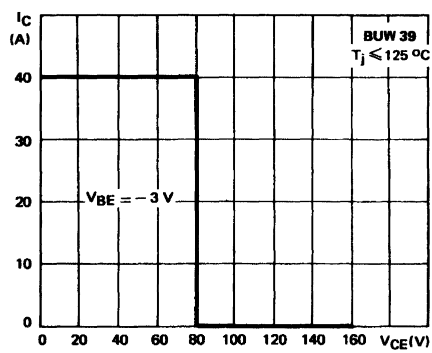
High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

Forward Biased Safe Operating Area (FBSOA).

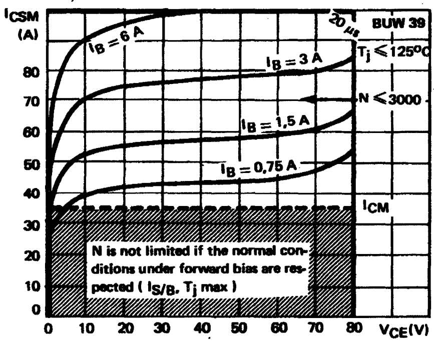


The hatched zone can only be used for turn-on.

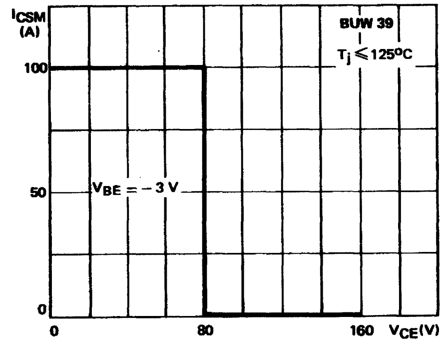
Reverse Biased Safe Operating Area (RBSOA).



Forward Biased Accidental Overload Area (FBAOA).



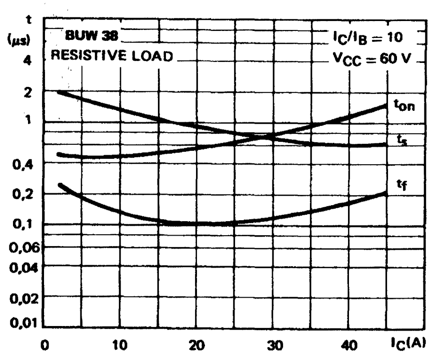
Reverse Biased Accidental Overload Area (RBAOA).



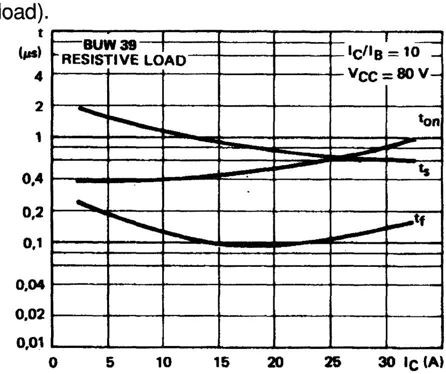
The Kellog network (heavy print) allows the calculation of the maximum value of the short-circuit current for a given base current I_B (90% confidence).

High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

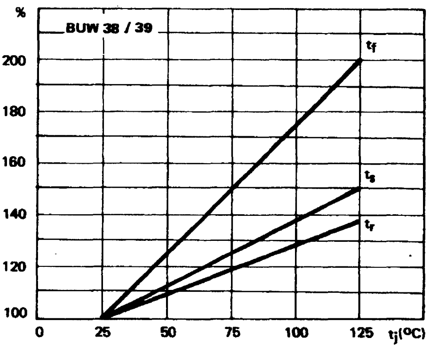
Switching Times vs. Collector Current (resistive load).



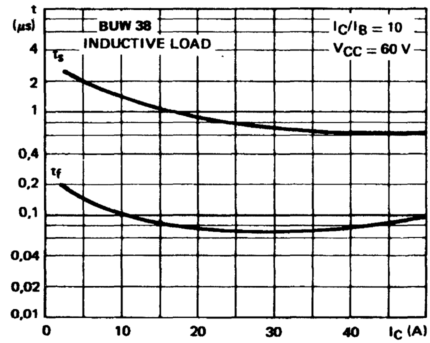
Switching Times vs. Collector Current (resistive load).



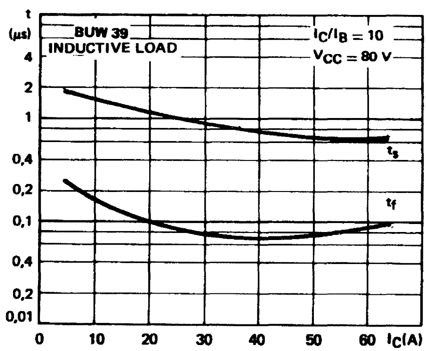
Switching Times vs. Junction Temperature.



Switching Times vs. Collector Current (inductive load).



Switching Times vs. Collector Current (inductive load).



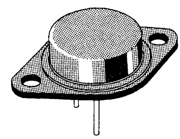
BUW42/42P/42PFI
BUW42A/42AP/42APFI

HIGH VOLTAGE POWER SWITCH

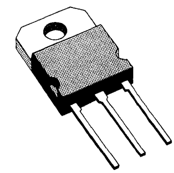
DESCRIPTION

The BUW42/A, BUW42P/42AP and BUW42PFI/APFI are silicon multiepitaxial mesa PNP transistors mounted respectively in TO-3 metal case, TO-218 plastic package and ISOWATT218 fully isolated package.

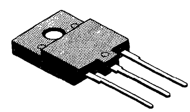
They are intended in fast switching applications for high output power.



TO-3

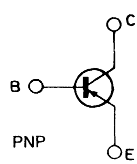


TO-218



ISOWATT218

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	BUW			Unit
		42/P/PFI		42A/AP/APFI	
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	– 400		– 450	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 350		– 400	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 7			V
I_C	Collector Current	– 15			A
I_{CM}	Collector Peak Current	– 30			A
I_B	Base Current	– 10			A
		TO-3	TO-218	ISOWATT218	
P_{tot}	Total Dissipation at T_c < 25°C	150	105	65	W
T_{stg}	Storage Temperature	– 65 to 175	– 65 to 150	– 65 to 150	°C
T_j	Max. Operating Junction Temperature	175	150	150	°C

THERMAL DATA

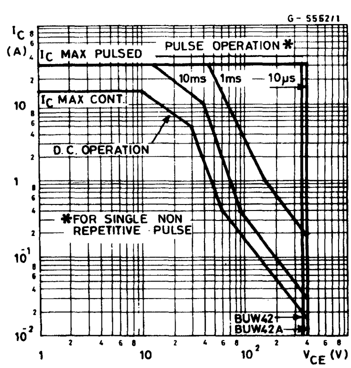
		TO-3	SOT-93	ISOWATT218	Unit
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case Max	1.2	1.2	1.92	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

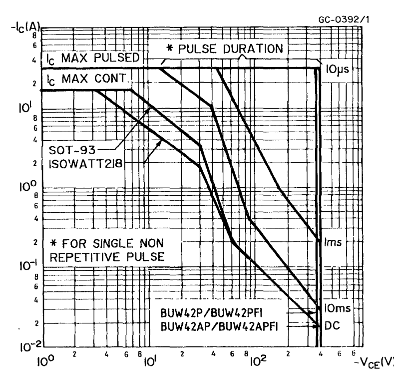
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = – 400V for **BUW42/P/PFI** V_{CE} = – 450V for **BUW42A/AP/APFI**			– 1 – 1	mA mA
I_{EBO}	Emitter Cutoff Current	V_{EB} = – 5V for **BUW42/P/PFI** V_{EB} = – 7V for **BUW42A/AP/APFI**			– 1 – 1	mA mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = – 100mA for **BUW42/P/PFI** for **BUW42A/AP/APFI**	 – 350 – 400			 V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 10A I_B = – 3A			– 1.5	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 10A I_B = – 3A			– 2	V
h_{FE}*	DC Current Gain	I_C = – 3A V_{CE} = – 5V	12		80	
 t_{on} t_s t_f	RESISTIVE LOAD Turn-on Time Storage Time Fall Time	 V_{CC} = – 250V I_C = – 10A I_{B1} = – I_{B2} = – 3.3A		 0.3 0.5 0.3	 0.6 1.5 0.6	 µs µs µs

* Pulsed : pulse duration = 300 µs, duty cycle = 1.5 %.

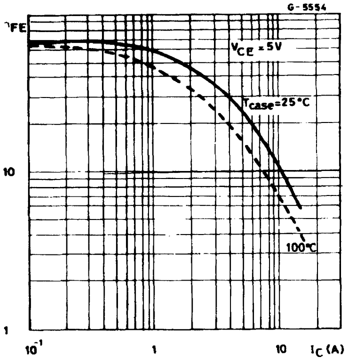
Safe Operating Areas.
(TO-3).



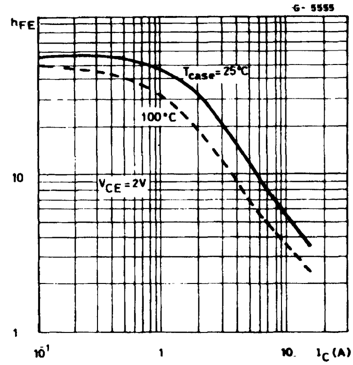
Safe Operating Areas.
(TO-218, ISOWATT218).



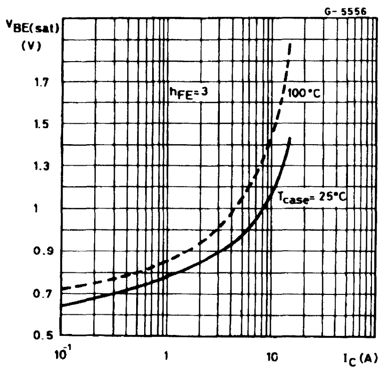
DC Current Gain.



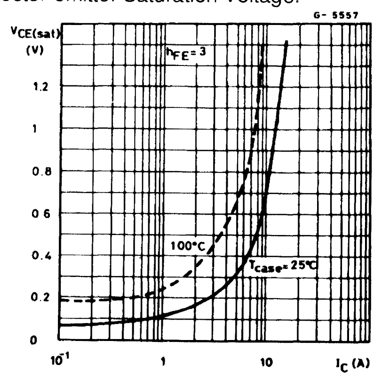
DC Current Gain.



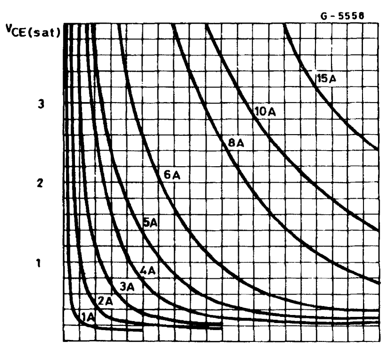
Base-emitter Saturation Voltage.



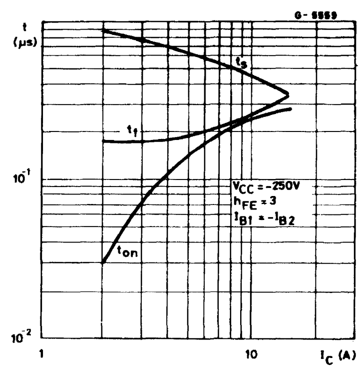
Collector-emitter Saturation Voltage.



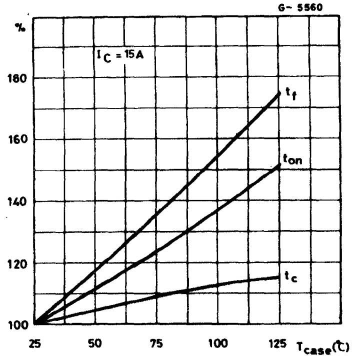
Collector-emitter Saturation Voltage.



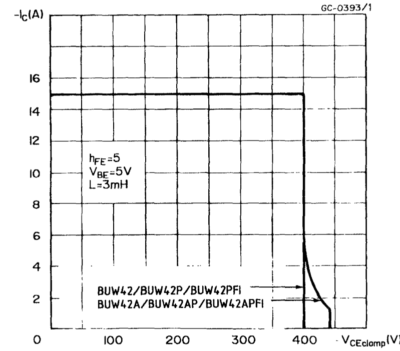
Saturated Switching-times Resistive Load.



Switching Times Percentage Variation vs. T_{case} Resistive Load.



Clamped Reverse Bias Safe Operating Areas.



ISOWATT218 PACKAGE CHARACTERISTICS AND APPLICATION.

ISOWATT218 is fully isolated to 4000V dc. Its thermal impedance, given in the data sheet, is optimised to give efficient thermal conduction together with excellent electrical isolation. The structure of the case ensures optimum distances between the pins and heatsink. These distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 package eliminates the need for external isolation so reducing fixing hardware.

The package is supplied with leads longer than the standard TO-218 to allow easy mounting on pcbs. Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

ISOWATT218 thermal performance is equivalent to that of the standard part, mounted with a 0.1mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for ISOWATT218 packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT218 PACKAGE

Figure 3 illustrates the elements contributing to the thermmal resistance of a transistor heatsink assembly, using ISOWATT218 package.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements. The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1-For a short duration power pulse of less than 1 ms :

$$Z_{th} < R_{thJ\text{-}C}$$

2 - For an intermediate power pulse of 5ms to 50ms seconds :

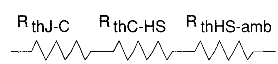
$$Z_{th} = R_{thJ\text{-}C}$$

3 - For long power pulses of the order of 500ms seconds or greater :

$$Z_{th} = R_{thJ\text{-}C} + R_{thC\text{-}HS} + R_{thHS\text{-}amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 3.



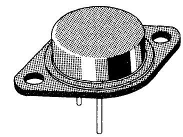
SGS-THOMSON
MICROELECTRONICS

BUW44/BUW45
BUW46

HIGH VOLTAGE, HIGH CURRENT POWER SWITCH

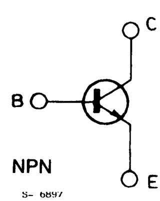
DESCRIPTION

The BUW44, BUW45 and BUW46 are multiepitaxial mesa NPN transistors in Jedec TO-3 metal case intended in fast switching applications for high output powers.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		BUW44	BUW45	BUW46	
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	500	800	900	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	400	400	450	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7			V
I_C	Collector Current	15			A
I_{CM}	Collector Peak Current	30			A
I_B	Base Current	10			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	175			W
T_{stg}	Storage Temperature	– 65 to 200			°C
T_j	Junction Temperature	200			°C

THERMAL DATA

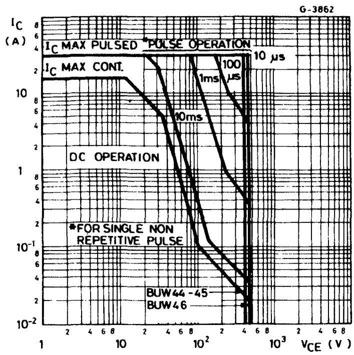
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case max	1	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

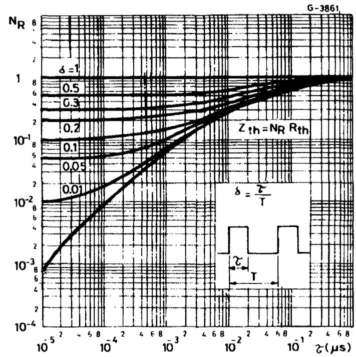
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	for **BUW44** V_{CE} = 500V for **BUW45** V_{CE} = 800V for **BUW46** V_{CE} = 900V T_{case} = 125°C for **BUW44** V_{CE} = 500V for **BUW45** V_{CE} = 800V for **BUW46** V_{CE} = 900V			500 500 500 3 3 3	µA µA µA mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 100mA for **BUW44** for **BUW45** for **BUW46**	400 400 450			V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	for **BUW44** I_C = 10A I_B = 2A I_C = 6A I_B = 1A for **BUW45** and **BUW46** I_C = 10A I_B = 2A I_C = 7A I_B = 1A			 3 1.5 1.5 1.5	 V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	for **BUW44** I_C = 10A I_B = 2A I_C = 6A I_B = 1A for **BUW45** and **BUW46** I_C = 10A I_B = 2A I_C = 7A I_B = 1A			 1.8 1.4 1.8 1.4	 V V V V
t_{on}	Turn-on Time	I_C = 10A I_{B1} = 2A V_{CC} = 250V			0.75	µs
t_s	Storage Time	I_C = 10A I_{B1} = 2A I_{B2} = – 2A V_{CC} = 250V			3	µs
t_f	Fall Time				0.8	µs

* Pulsed : pulse duration = 300 µs, duty cycle = 1.5 %.

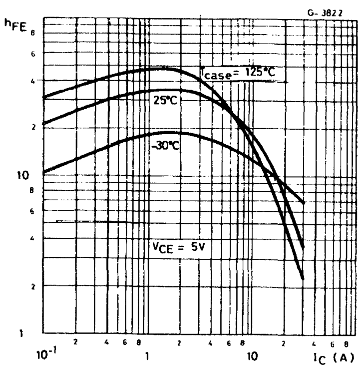
Safe Operating Areas.



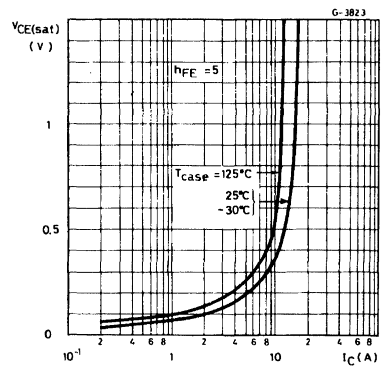
Thermal Transient Response.



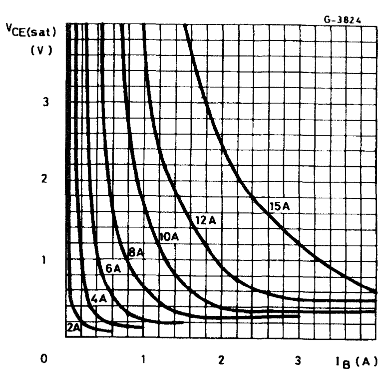
DC Current Gain.



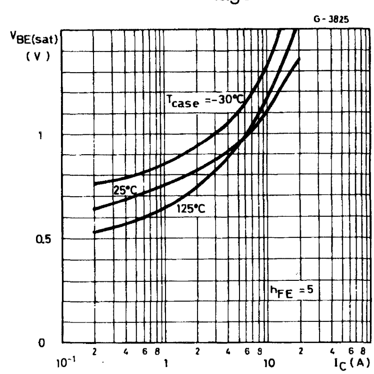
Collector-emitter Saturation Voltage.



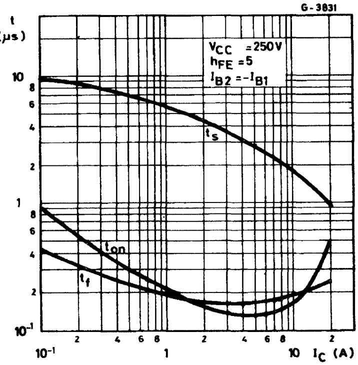
Collector-emitter Saturation Voltage.



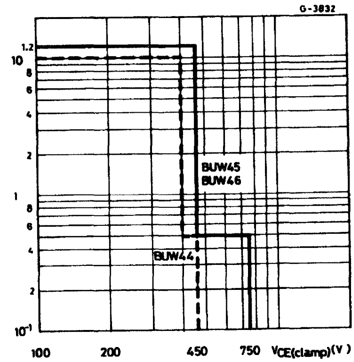
Base-emitter Saturation Voltage.



Saturated Switching Characteristics.

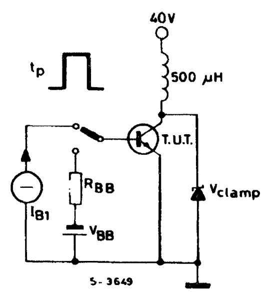


Clamped Reverse Bias Safe Operating Areas.



Clamped $E_{s/b}$ Test Circuit.

Test conditions :
5 V ≥ | $-V_{BB}$ | ≥ 2 V
I_C / I_B = 5
$2I_{B1}$ > | $-I_{B2}$ | > I_{B1}
t_p = adjusted for nominal I_C
R_{BB} = adjusted for I_{B2}

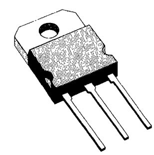


NPN HIGH CURRENT SWITCHING TRANSISTORS

- HIGH CURRENT CAPABILITY
- VERY LOW SATURATION VOLTAGE AT I_C = 20A
- FAST TURN-ON AND TURN-OFF

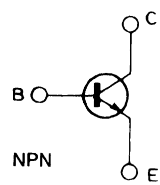
APPLICATIONS

- HIGH FREQUENCY AND EFFICENCY CONVERTERS
- SWITCHING REGULATORS
- MOTOR CONTROLS



TO-218

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BUW48	BUW49	
V_{CBO}	Collector-base Voltage (I_E = 0)	120	160	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	60	80	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	7	V
I_C	Collector Current	30	30	A
I_{CM}	Collector Peak Current (t_p < 10ms)	45	40	A
I_B	Base Current	8	6	A
I_{BM}	Base Peak Current (t_p < 10ms)	12	10	A
P_{tot}	Total Dissipation at T_c < 25°C	150		W
T_{stg}	Storage Temperature	– 65 to 175		°C
T_j	Max. Operating Junction Temperature	175		°C

THERMAL DATA

$R_{thj-case}$	Thermal Resistance Junction-case	Max	1	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

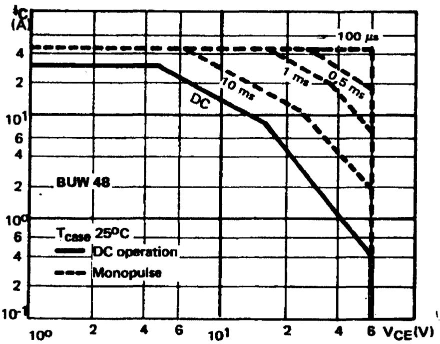
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEX}	Collector Cutoff Current	$V_{CE} = V_{CEX}$ $V_{BE} = -1.5V$ $V_{CE} = V_{CEX}$ $V_{BE} = -1.5V$ $T_c = 125°C$			1 3	mA mA
I_{EBO}	Emitter Cutoff Current ($I_C = 0$)	$V_{EB} = 5V$			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	$I_C = 0.2A$ L = 25mH for **BUW48** for **BUW49**	60 80			V V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	$I_E = 50mA$	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	$I_C = 20A$ $I_B = 2A$ for **BUW48** $I_C = 40A$ $I_B = 4A$ for **BUW48** $I_C = 15A$ $I_B = 1.5A$ for **BUW49** $I_C = 30A$ $I_B = 3A$ for **BUW49**			0.6 1.4 0.5 1.2	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	$I_C = 40A$ $I_B = 4A$ for **BUW48** $I_C = 30A$ $I_B = 3A$ for **BUW49**			2.1 2	V V
f_T	Transition Frequency	$I_C = 1A$ $V_{CE} = 15V$ f = 1MHz		8		MHz

RESISTIVE LOAD

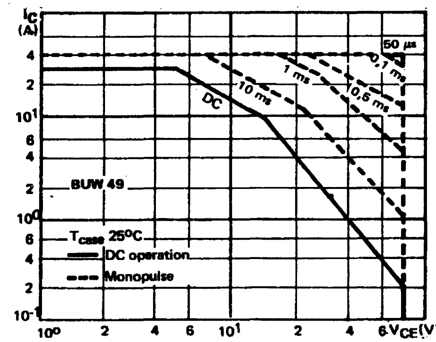
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on} t_s t_f	Turn-on Time Storage Time Fall Time	for **BUW48** $V_{CC} = 60V$ $I_C = 40A$ $I_{B1} = -I_{B2} = 4A$		1.2 0.6 0.17	1.5 1.1 0.25	µs µs µs
t_s t_f	Storage Time Fall Time	for **BUW48** $V_{CC} = 60V$ $I_C = 40A$ $I_{B1} = -I_{B2} = 4A$			1.65 0.5	µs µs
t_{on} t_s t_f	Turn-on Time Storage Time Fall Time	for **BUW49** $V_{CC} = 80V$ $I_C = 30A$ $I_{B1} = -I_{B2} = 3A$		0.8 0.6 0.15	1.2 1.1 0.25	µs µs µs
t_s t_f	Storage Time Fall Time	for **BUW49** $V_{CC} = 80V$ $I_C = 30A$ $I_{B1} = -I_{B2} = 3A$			1.65 0.5	µs µs

* Pulsed : Pulse duration = 300µs, duty cycle = 1.5%.

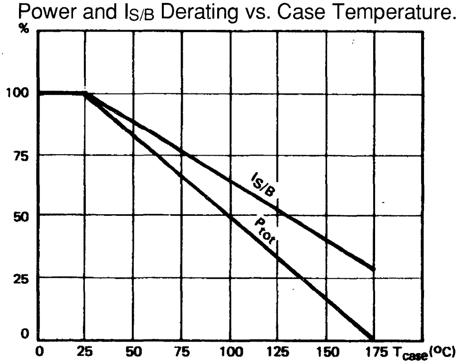
DC and Pulse Area.



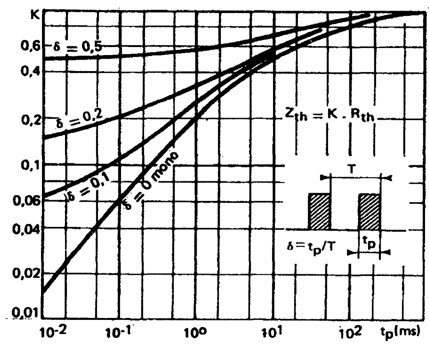
DC and Pulse Area.



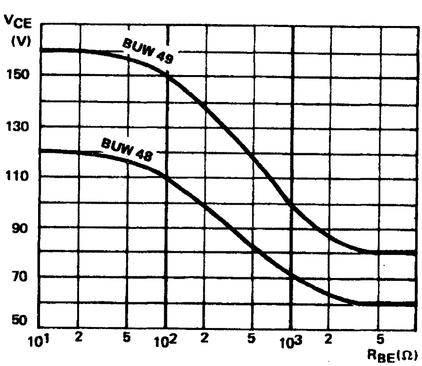
Power and $I_{S/B}$ Derating vs. Case Temperature.



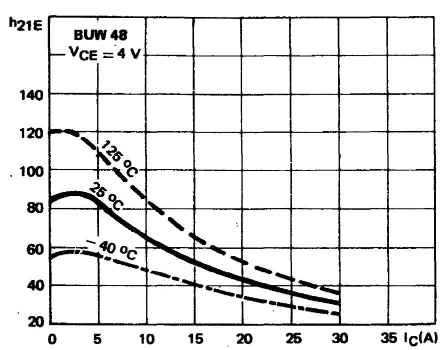
Transient Thermal Response.



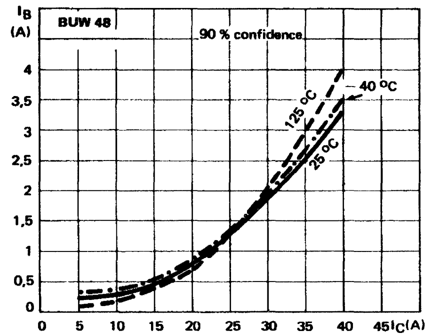
Collector-emitter Voltage vs. Base-emitter Resistance.



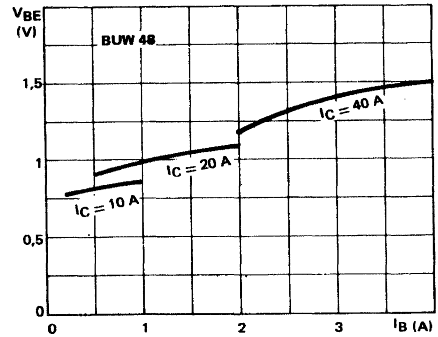
DC Current Gain.



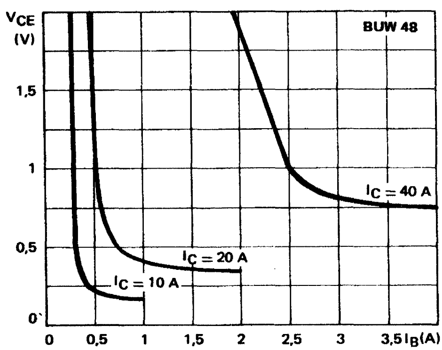
Minimum Base Current to Saturate theTransistor.



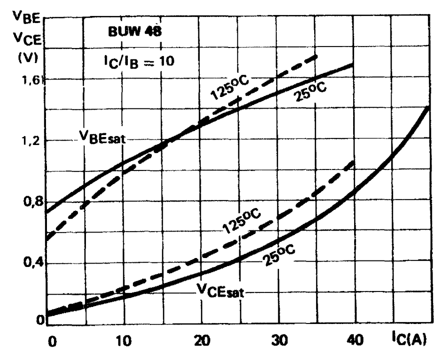
Base Characteristics.



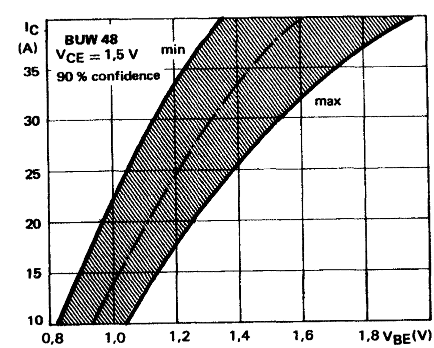
Collector Saturation Region.



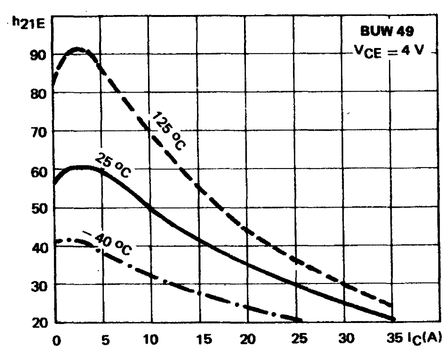
Saturation Voltage.



Collector Current Spread vs. Base Emitter Voltage.

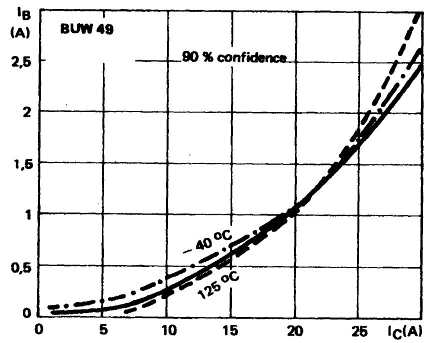


DC Current Gain.

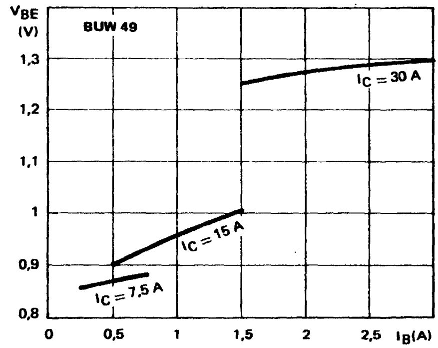


SGS-THOMSON MICROELECTRONICS

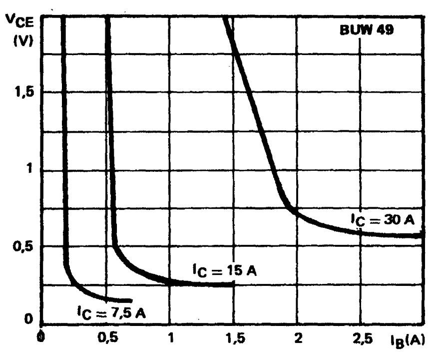
Minimum Base Current to saturate the Transistor.



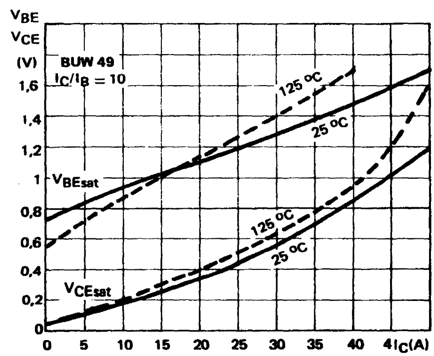
Base Characteristics.



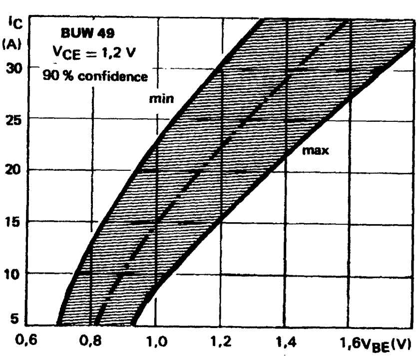
Collector Saturation Region.



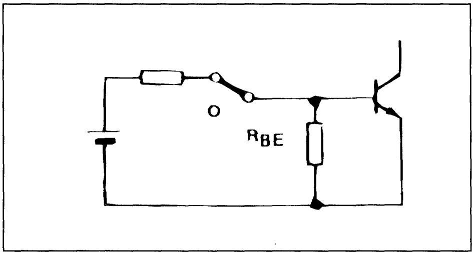
Saturation Voltage.



Collector Current Spread vs. Base Emitter Voltage.



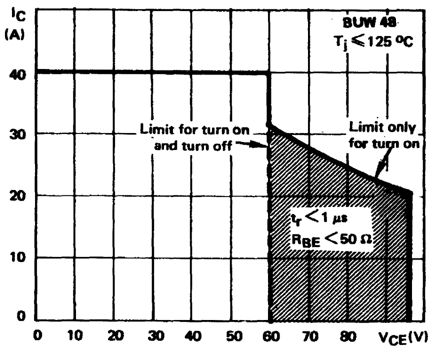
SWITCHING OPERATING AND OVERLOAD AREAS



TRANSISTOR FORWARD BIASED

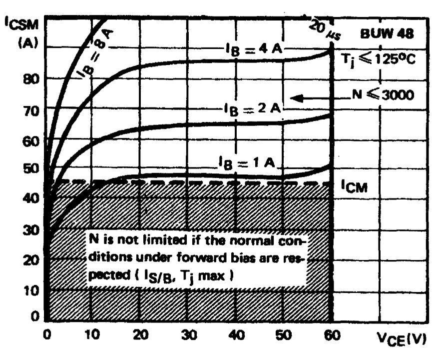
- During the turn on
- During the turn off without negative base-emitter voltage and $R_{BE} \geq 5\Omega$

Forward Biased Safe Operating Area (FBSOA).

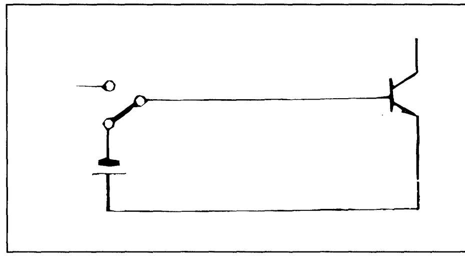


The hatched zone can only be used for turn on.

Forward Biased Accidental Overload Area (FBAOA).



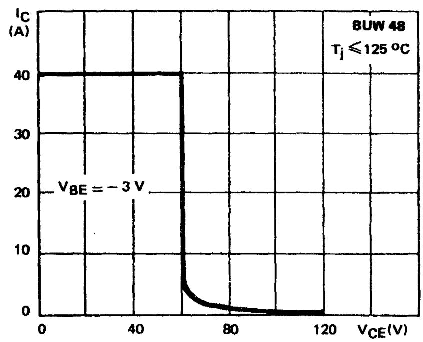
The Kellog network (heavy print) allows the calculation of the maximum value of the short-circuit current for a given base current I_B (90% confidence).



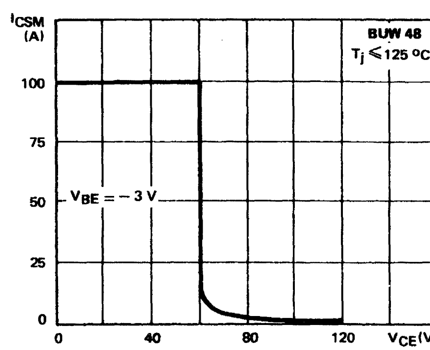
TRANSISTOR REVERSE BIASED

- During the turn off without negative base-emitter voltge

Reverse Biased Safe Operating Area (RBSOA).



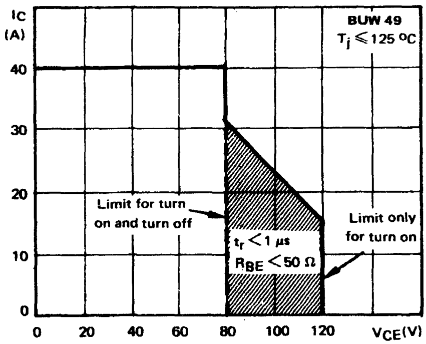
Reverse Biased Accidental Overload Area (RBAOA).



After the accidental overload current, the RBAOA has to be used for the turn off.

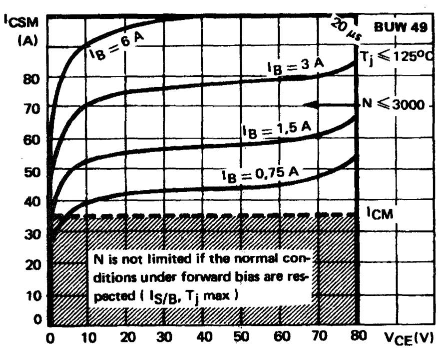
High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

Forward Biased Safe Operating Area (FBSOA).



The hatched zone can only be used for turn on.

Figure 25 : Forward Biased Accidental Overload Area (FBAOA).



The Kellog network (heavy print) allows the calculation of the maximum value of the short-circuit current for a given base current I_B (90% confidence).

Reverse Biased Safe Operating Area (RBSOA).

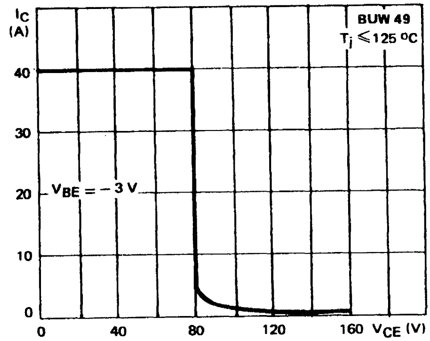
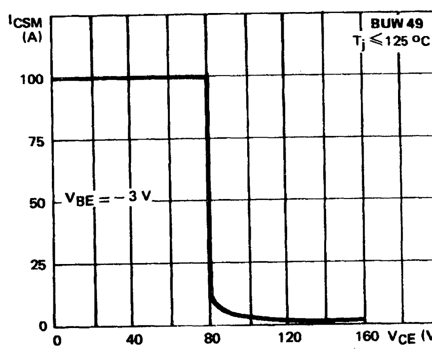


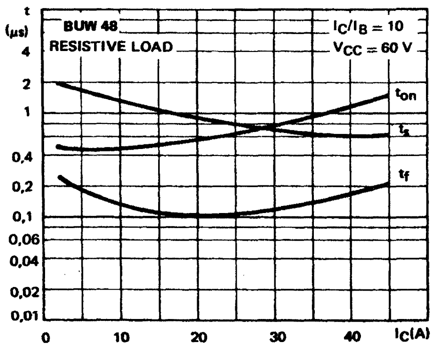
Figure 26 : Reverse Biased Accidental Overload Area (RBAOA).



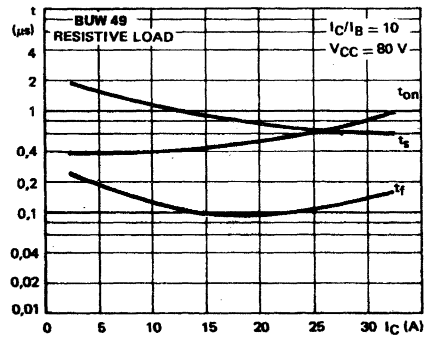
After the accidental overload current, the RBAOA has to be used for the turn off.

High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

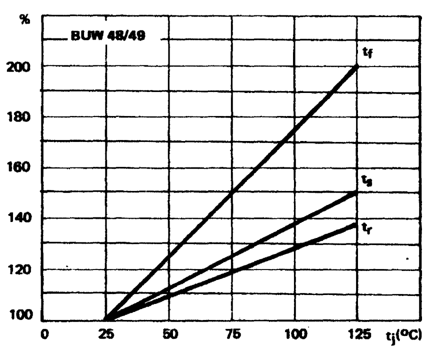
Switching Times vs. Collector Current (resistive load).



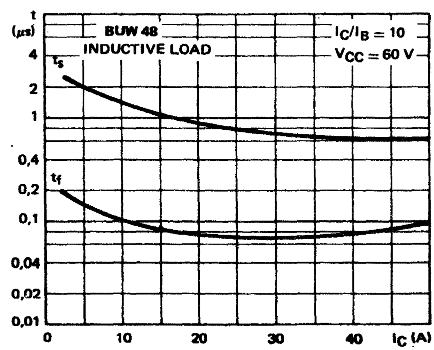
Switching Times vs. Collector Current (resistive load).



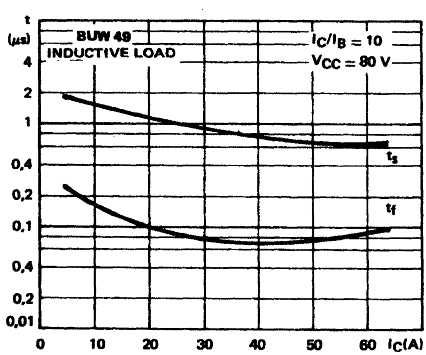
Switching Times vs. Junction Temperature.



Switching Times vs. Collector Current (inductive load).



Switching Times vs. Collector Current (inductive load).

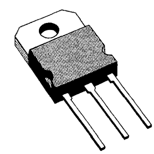


SGS-THOMSON MICROELECTRONICS

BUW50

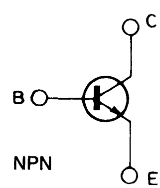
NPN FAST SWITCHING POWER TRANSISTOR

- VERY LOW SATURATION VOLTAGE AND HIGH GAIN FOR REDUCED LOAD OPERATION
- TURN-ON AND TURN-OFF TAIL SPECIFICATIONS
- TURN-ON di_C/dt FOR BETTER RECTIFIER CHOICE
- SWITCHING TIMES SPECIFIED WITH AND WITHOUT NEGATIVE BASE DRIVE
- FAST SWITCHING TIMES
- LOW SWITCHING LOSSES
- LOW ON-STATE VOLTAGE DROP
- BASE CURRENT REQUIREMENTS



TO-218

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage ($V_{BE} = -1.5V$)	250	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	125	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	25	A
I_{CM}	Collector Peak Current	50	A
I_B	Base Current	6	A
I_{BM}	Base Peak Current	12	A
P_{base}	Reverse Bias Base Power Dissipation (B.E. junction in avalance)	2	W
P_{tot}	Total Dissipation at $T_c < 25°C$	150	W
T_{stg}	Storage Temperature	– 65 to + 175	°C
TJ	Max. Operating Junction Temperature	175	°C

THERMAL DATA

$R_{thj-case}$	Thermal Resistance Junction-case	max	1	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			1 5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = − 1.5V $V_{CE} = V_{CEV}$ V_{BE} = − 1.5V T_c = 100°C			1 5	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	125			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 5A	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10A I_B = 0.5A I_C = 20A I_B = 2A I_C = 10A I_B = 0.5A T_j = 100°C I_C = 20A I_B = 2A T_j = 100°C		0.4 0.6 0.5 0.75	0.8 0.9 0.9 1.5	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 20A I_B = 2A I_C = 20A I_B = 2A T_j = 100°C		1.25 1.25	1.6 1.7	V V
di_c/dt	Rate of Rise of on State Collector Current	V_{CC} = 100V R_C = 0 I_{B1} = 3A T_j = 25°C T_j = 100°C See fig. 2	 50 45	 100 85		 A/µs A/µs
$V_{CE(2\mu s)}$	Collector-emitter Dynamic Voltage	V_{CC} = 100V R_C = 5Ω I_{B1} = 2A T_j = 25°C T_j = 100°C See fig. 2		 1.4 2.1	 3 4	 V V
$V_{CE(4\mu s)}$	Collector-emitter Dynamic Voltage	V_{CC} = 100V R_C = 5Ω I_{B1} = 2A T_j = 25°C T_j = 100°C See fig. 2		 1.1 1.5	 2 2.5	 V V

ELECTRICAL CHARACTERISTICS (continued)

RESISTIVE LOAD

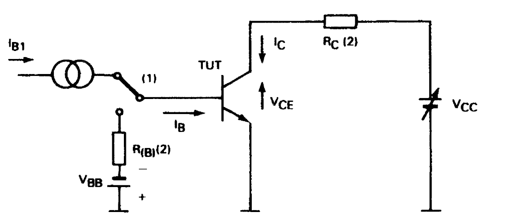
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
t_r	Rise Time	V_{CC} = 100V	I_C = 24A		0.33	0.6	µs
t_s	Storage Time	V_{BB} = − 5V	I_{B1} = 3A		0.75	1.2	µs
t_f	Fall Time	R_B = 0.83Ω	t_p = 30µs		0.15	0.3	µs

INDUCTIVE LOAD

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	V_{CC} = 100V I_C = 20A I_B = 2A		0.85	1.4	µs
t_f	Fall Time	V_{BB} = − 5V V_{clamp} = 125V		0.09	0.2	µs
t_t	Tail Time in Turn-on	L_C = 0.25mH R_B = 1.3Ω		0.04	0.05	µs
t_c	Crossover Time	see fig. 3		0.16	0.3	µs
t_s	Storage Time	V_{CC} = 100V I_C = 20A I_B = 2A		1.2	1.7	µs
t_f	Fall Time	V_{BB} = − 5V V_{clamp} = 125V		0.17	0.3	µs
t_t	Tail Time in Turn-on	L_C = 0.25mH R_B = 1.3Ω		0.07	0.1	µs
t_c	Crossover Time	see fig. 3 T_j = 100°C		0.3	0.5	µs
t_s	Storage Time	V_{CC} = 100V I_C = 20A I_B = 2A		2.1		µs
t_f	Fall Time	V_{BB} = 0 V_{clamp} = 125V		0.7		µs
t_t	Tail Time in Turn-on	L_C = 0.25mH R_B = 4.7Ω		0.28		µs
		see fig. 3				
t_s	Storage Time	V_{CC} = 100V I_C = 20A I_B = 2A		3.2		µs
t_f	Fall Time	V_{BB} = 0 V_{clamp} = 125V		1.2		µs
t_t	Tail Time in Turn-on	L_C = 0.25mH R_B = 4.7Ω		0.55		µs
		see fig. 3 T_j = 100°C				

* Pulsed : Pulse duration = 300µs, duty cycle = 2%.

Figure 1 : Switching Times Test Circuit (resistive load).



(1) Fast electronic switch
(2) Non-inductive resistor

Figure 2 : Turn-on Switching Waveforms.

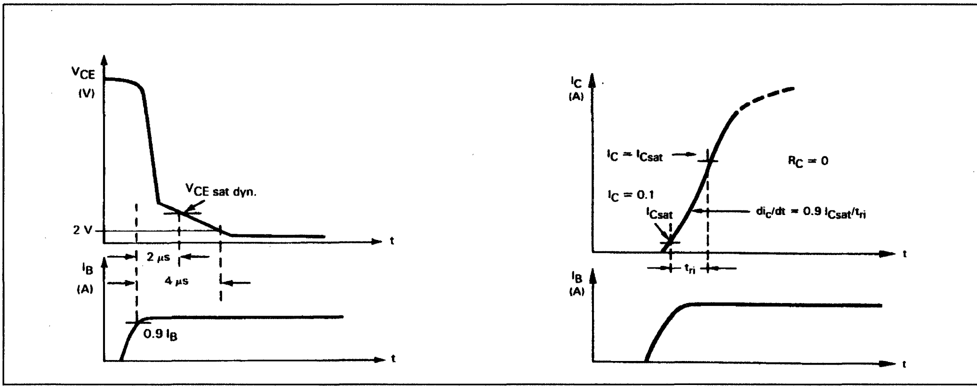


Figure 3a : Turn-off Switching Test Circuit.

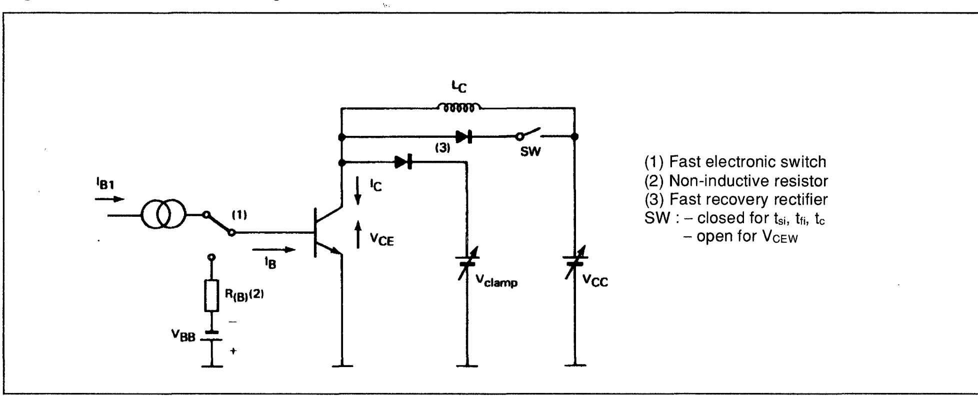
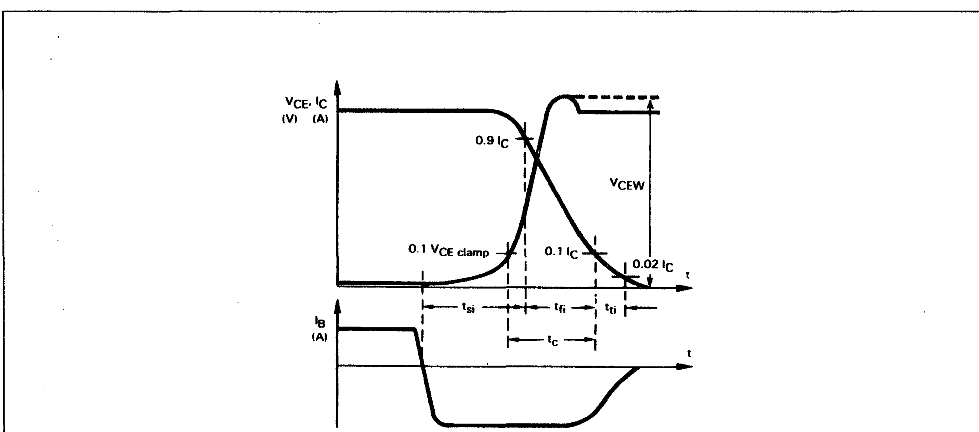
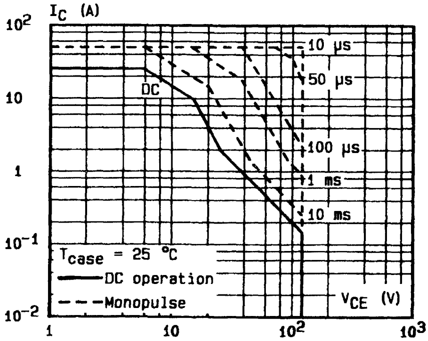


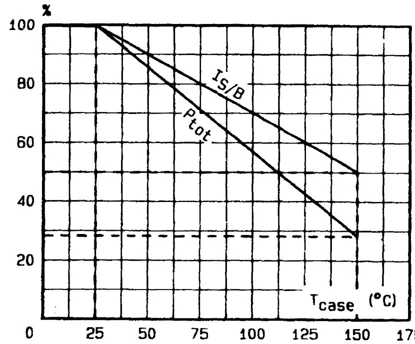
Figure 3b : Turn-off Switching Waveforms (inductive load).



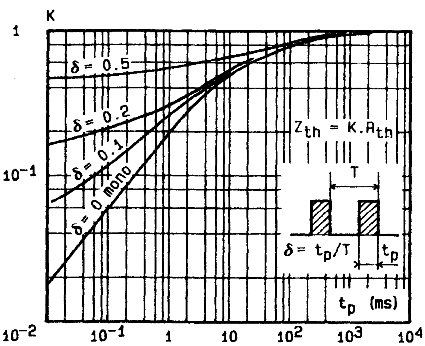
DC and AC Pulse Area.



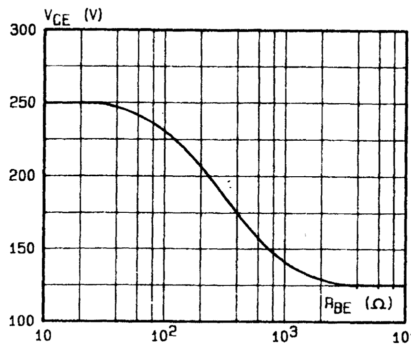
Power and $I_{S/B}$ Derating versus Case Temperature.



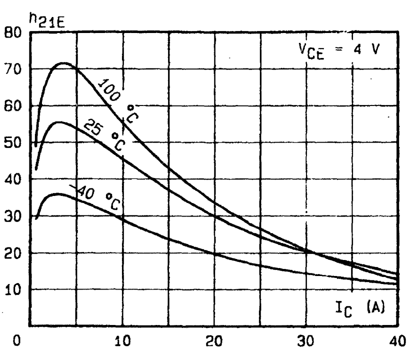
Transient Thermal Response.



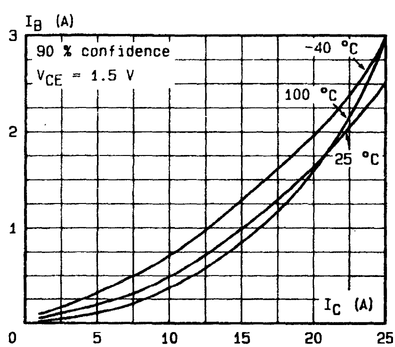
Collector-emitter Voltage versus Base-emitter Resistance.



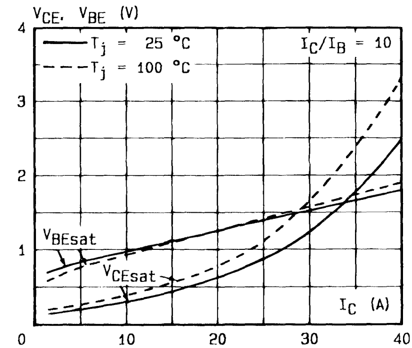
DC Current Gain.



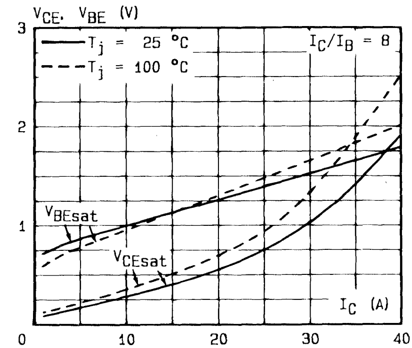
Minimum Base Current to Saturate the Transistor.



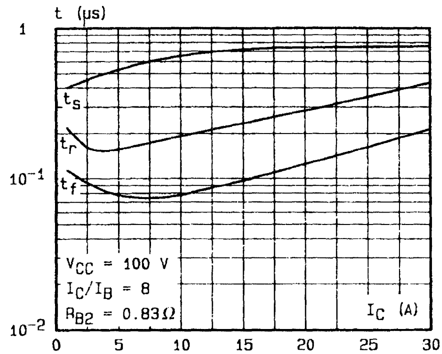
Saturation Voltage.



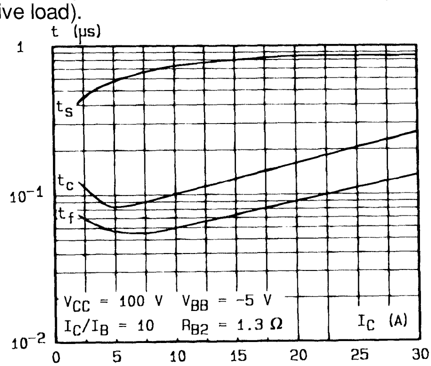
Saturation Voltage.



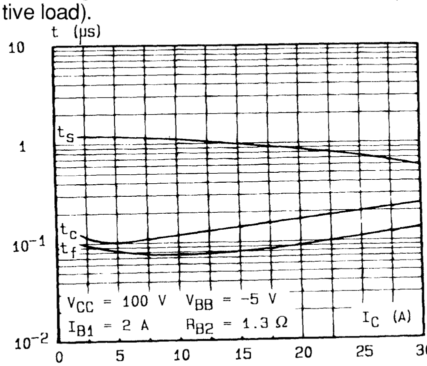
Switching Times versus Collector.



Switching Times versus Collector Current (inductive load).

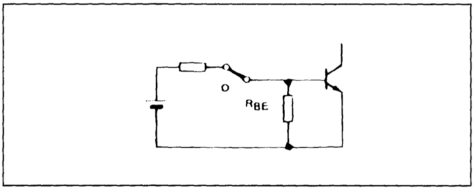


Switching Times versus Collector Current (inductive load).

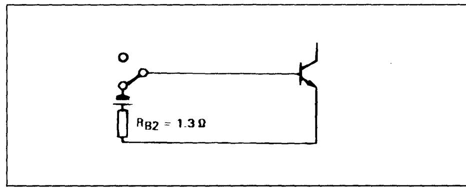


SWITCHING OPERATING AND OVERLOAD AREAS

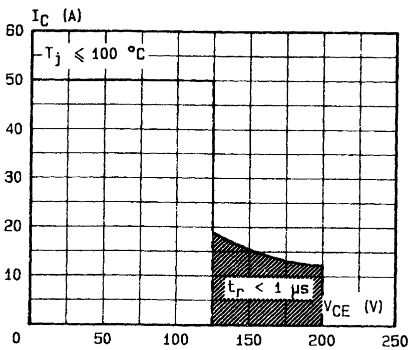
TRANSISTOR FORWARD BIASED
- During the turn-on
- During the turn-off without negative base-emitter voltage and 4.7 Ω ≤ R_{BE} ≤ 50 Ω.



TRANSISTOR REVERSE BIASED
- During the turn-off with negative base-emitter voltage.

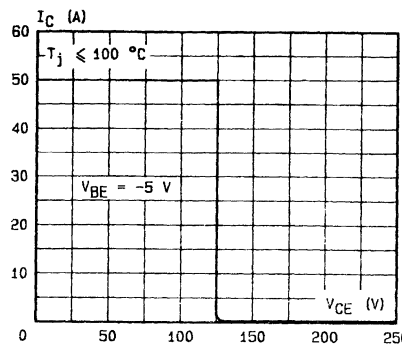


Forward Biased Safe Operating Area (FBSOA).

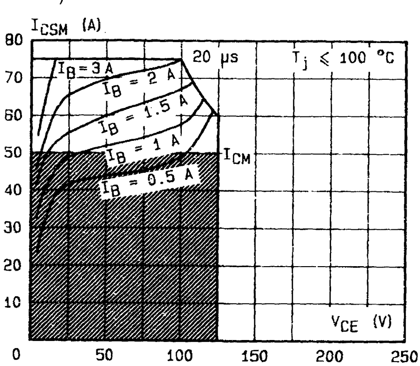


The hatched zone can only be used for turn-on.

Reverse Biased Safe Operating Area (RBSOA).

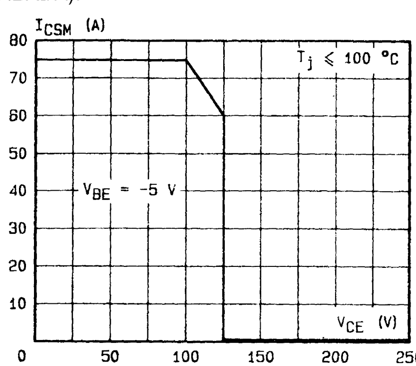


Forward Biased Accidental Overload Area (FBADA).



The Kellog network (heavy point) allows the calculation of the maximum value of the short-circuit for a given base current I_B (90 % confidence).

Reverse Biased Accidental Overload Area (RBADA).

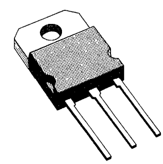


After the accidental overload current the RBAOA has to be used for the turn-off.

High accidental surge currents (I > I_{CM}) are allowed if they are non repetitive and applied less than 3000 times during the component life.

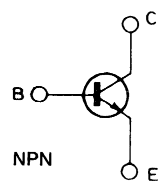
FAST SWITCHING POWER TRANSISTOR

- FAST SWITCHING TIMES
- LOW SWITCHING LOSSES
- VERY LOW SATURATION VOLTAGE AND HIGH GAIN



TO-218

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5 V)	300	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	200	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	20	A
I_{CM}	Collector Peak Current	28	A
I_B	Base Current	4	A
I_{BM}	Base Peak Current	7	A
P_{base}	Reverse Bias Base Power Dissipation (B.E. junction in avalanche)	1	W
P_{tot}	Total Dissipation at T_c < 25°C	150	W
T_{stg}	Storage Temperature	– 65 to 175	°C
T_j	Max. Operating Junction Temperature	175	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case max	1	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			0.5 2.5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = – 1.5V $V_{CE} = V_{CEV}$ V_{BE} = – 1.5V T_c = 100°C			0.5 2	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	200			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5A I_B = 0.25A I_C = 10A I_B = 1A I_C = 5A I_B = 0.25A T_j = 100°C I_C = 10A I_B = 1A T_j = 100°C		0.4 0.45 0.4 0.6	0.8 0.9 0.9 1.5	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 10A I_B = 1A I_C = 10A I_B = 1A T_j = 100°C		1.1 1	1.4 1.4	V V
di_C/dt	Rated of Rise of on-state Collector Current	V_{CC} = 160V R_C = 0 I_{B1} = 1.5A T_j = 25°C See fig. 2 T_j = 100°C	 35 30	 75 65		 A/µs A/µs
$V_{CE(2\mu s)}$	Collector Emitter Dynamic Voltage	V_{CC} = 160V R_C = 16Ω I_{B1} = 1A T_j = 25°C See fig. 2 T_j = 100°C		 1.8 3	 3 5	 V V
$V_{CE(4\mu s)}$	Collector Emitter Dynamic Voltage	V_{CC} = 160V R_C = 16Ω I_{B1} = 1A T_j = 25°C See fig. 2 T_j = 100°C		 1.1 1.4	 1.7 2.5	 V V

RESISTIVE LOAD

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_r t_s t_f	Rise Time Storage Time Fall Time	V_{CC} = 160V I_C = 14A V_{BB} = – 5V I_{B1} = 1.7A R_{B2} = 1.4Ω t_p = 30µs See fig. 1		0.3 0.6 0.12	0.6 1.4 0.3	µs µs µs

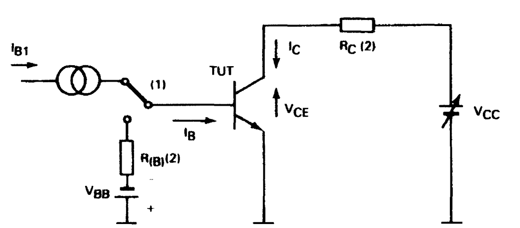
ELECTRICAL CHARACTERISTICS (continued)

INDUCTIVE LOAD

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
t_s t_f t_t t_c	Storage Time Fall Time Tail Time in Turn-on Crossover Time	V_{CC} = 160V I_C = 10A V_{BB} = – 5V L_C = 0.8mH	V_{clamp} = 200V I_B = 1A R_{B2} = 2.5Ω See fig. 3		0.7 0.06 0.01 0.13	1.5 0.2 0.07 0.3	μs μs μs μs
t_s t_f t_t t_c	Storage Time Fall Time Tail Time in Turn-on Crossover Time	V_{CC} = 160V I_C = 10A V_{BB} = – 5V L_C = 0.8mH See fig. 3	V_{clamp} = 200V I_B = 1A R_{B2} = 2.5Ω T_j = 100°C		1.1 0.12 0.03 0.24	2 0.3 0.15 0.5	μs μs μs μs
t_s t_f t_t	Storage Time Fall Time Tail Time in Turn-on	V_{CC} = 160V I_C = 10A V_{BB} = 0 L_C = 0.8mH	V_{clamp} = 200V I_B = 1A R_{B2} = 4.7Ω See fig. 3		1.5 0.5 0.12		μs μs μs
t_s t_f t_t	Storage Time Fall Time Tail Time in Turn-on	V_{CC} = 160V I_C = 10A V_{BB} = 0 L_C = 0.8mH See fig. 3	V_{clamp} = 200V I_B = 1A R_{B2} = 4.7Ω T_j = 100°C		2.7 0.85 0.25		μs μs μs

* Pulsed : Pulse duration = 300 μs, duty cycle = 2 %.

Figure 1 : Switching Times Test Circuit (resistive load).



(1) Fast electronic switch
(2) Non-inductive resistor

Figure 2 : Turn-on Switching Waveforms.

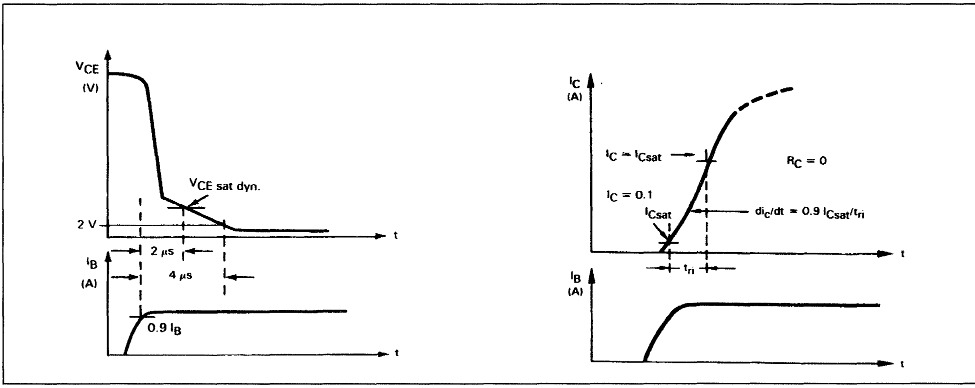


Figure 3a : Turn-off Switching Test Circuit.

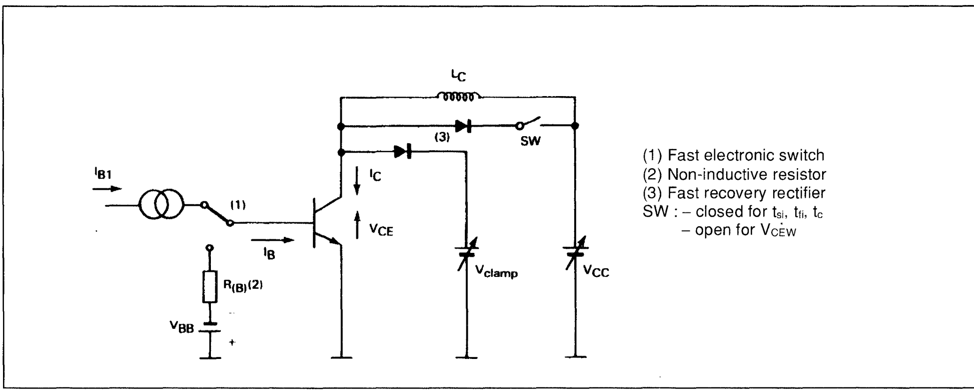
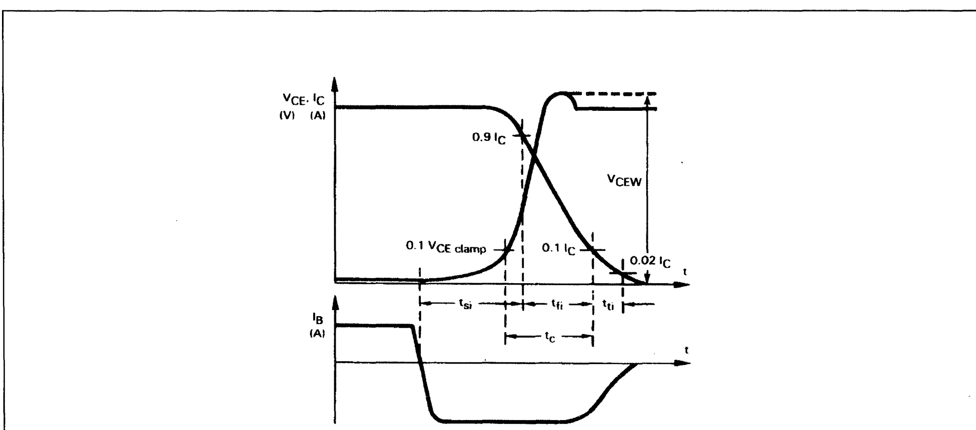
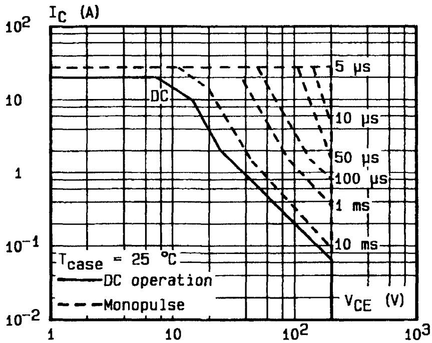


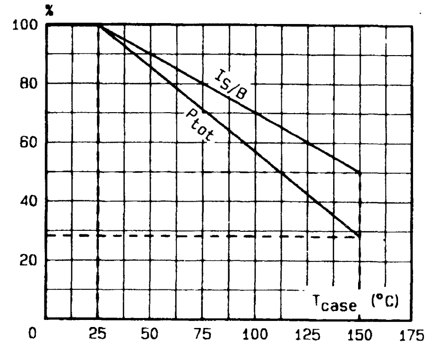
Figure 3b : Turn-off Switching Waveforms (inductive load).



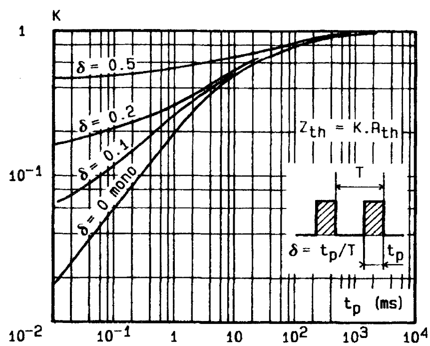
DC and AC Pulse Area.



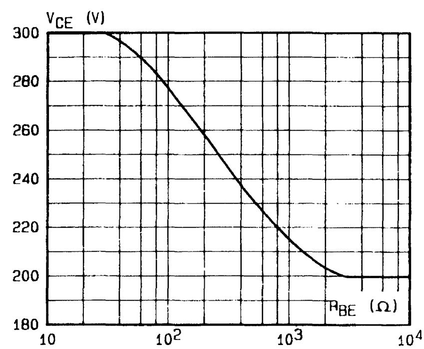
Power and $I_{S/B}$ Derating versus Case Temperature.



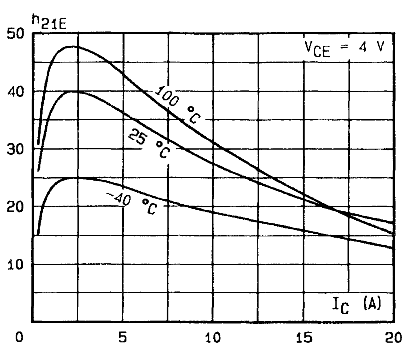
Transient Thermal Response.



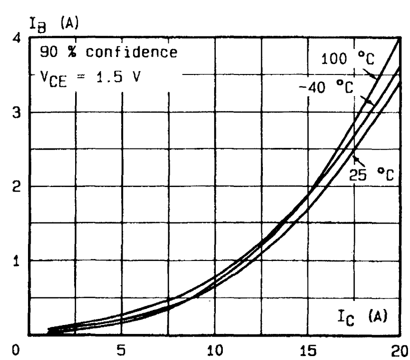
Collector-emitter Voltage versus Base-emitter Resistance.



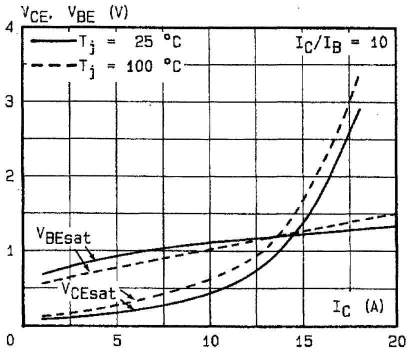
DC Current Gain.



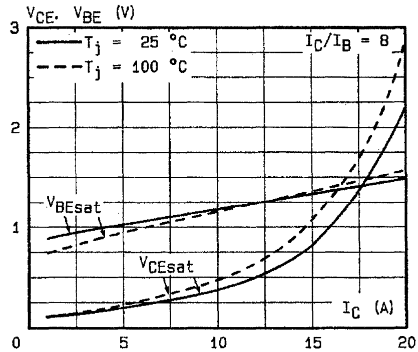
Minimum Base Current to Saturate the Transistor.



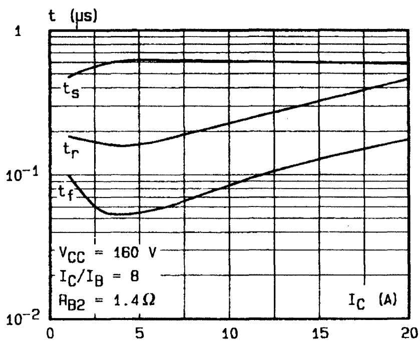
Saturation Voltage.



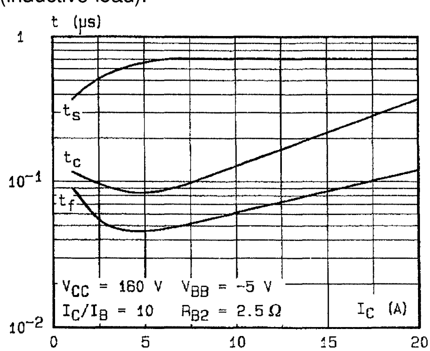
Saturation Voltage.



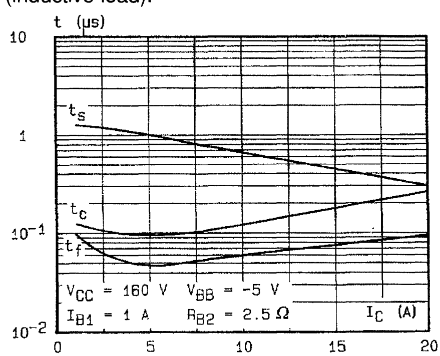
Switching Times versus Collector.



Switching Times versus Collector Current (inductive load).



Switching Times versus Collector Current (inductive load).

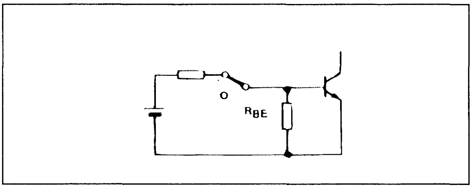


SGS-THOMSON MICROELECTRONICS

SWITCHING OPERATING AND OVERLOAD AREAS

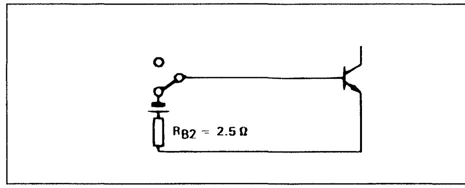
TRANSISTOR FORWARD BIASED

- During the turn-on
- During the turn-off without negative base-emitter voltage and 4.7 Ω ≤ R_{BE} ≤ 50 Ω.

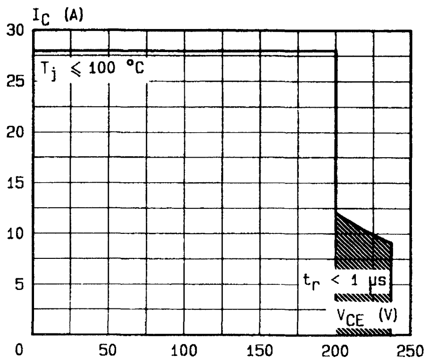


TRANSISTOR REVERSE BIASED

- During the turn-off with negative base-emitter voltage.

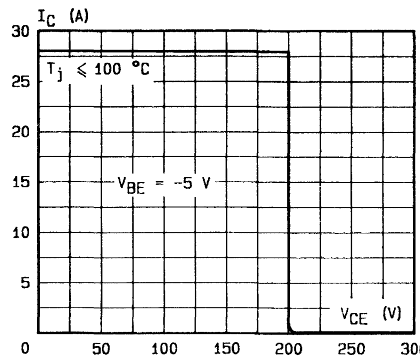


Forward Biased Safe Operating Area (FBSOA).

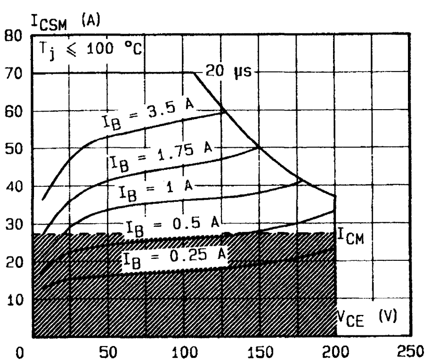


The hatched zone can only be used for turn-on.

Reverse Biased Safe Operating Area (RBSOA).

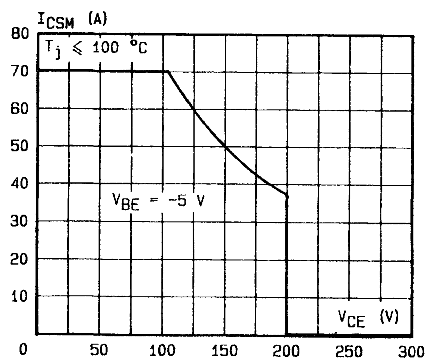


Forward Biased Accidental Overload Area (FBAOA).



The Kellog network (heavy point) allows the calculation of the maximum value of the short-circuit for a given base current I_B (90 % confidence).

Reverse Biased Accidental Overload Area (RBAOA).



After the accidental overload current the RBAOA has to be used for the turn-off.

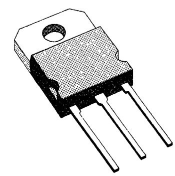
High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

SGS-THOMSON
MICROELECTRONICS

BUW52

FAST SWITCHING POWER TRANSISTOR

- FAST SWITCHING TIMES
- LOW SWITCHING LOSSES
- VERY LOW SATURATION VOLTAGE AND HIGH GAIN



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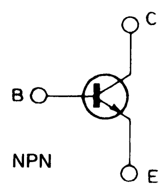
INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5 V)	350	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	250	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	20	A
I_{CM}	Collector Peak Current	30	A
I_B	Base Current	4	A
I_{BM}	Base Peak Current	6	A
P_{base}	Reverse Bias Base Power Dissipation (B.E. junction in avalanche)	1	W
P_{tot}	Total Dissipation at T_c < 25°C	150	W
T_{stg}	Storage Temperature	– 65 to 175	°C
T_j	Max. Operating Junction Temperature	175	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	max	1	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			0.5 2.5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = − 1.5V $V_{CE} = V_{CEV}$ V_{BE} = − 1.5V T_c = 100°C			0.5 2	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	250			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 4A I_B = 0.26A I_C = 8A I_B = 0.8A I_C = 4A I_B = 0.26A T_j = 100°C I_C = 8A I_B = 0.8A T_j = 100°C		0.35 0.45 0.35 0.6	0.8 0.9 0.9 1.5	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 8A I_B = 0.8A I_C = 8A I_B = 0.8A T_j = 100°C		1 0.9	1.3 1.3	V V
di_C/dt	Rated of Rise of on-state Collector Current	V_{CC} = 200V R_C = 0 I_{B1} = 1.2A T_j = 25°C See fig. 2 T_j = 100°C	 30 25	 70 60		 A/µs A/µs
$V_{CE(2\mu s)}$	Collector Emitter Dynamic Voltage	V_{CC} = 200V R_C = 25Ω I_{B1} = 0.8A See fig. 2 T_j = 25°C T_j = 100°C		 1.8 2.8	 3 5	 V V
$V_{CE(4\mu s)}$	Collector Emitter Dynamic Voltage	V_{CC} = 200V R_C = 25Ω I_{B1} = 0.8A See fig. 2 T_j = 25°C T_j = 100°C		 1.1 1.5	 1.7 2.5	 V V

ELECTRICAL CHARACTERISTICS (continued)

RESISTIVE LOAD

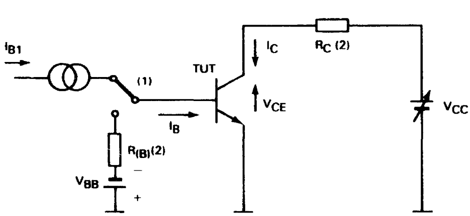
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
t_r t_s t_f	Rise Time Storage Time Fall Time	V_{CC} = 200V V_{BB} = – 5V R_{B2} = 1.7Ω See fig. 1	I_C = 12A I_{B1} = 1.5A t_p = 30µs		0.3 1 0.15	0.6 1.6 0.3	µs µs µs

INDUCTIVE LOAD

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
t_s t_f t_t t_c	Storage Time Fall Time Tail Time in Turn-on Crossover Time	V_{CC} = 200V I_C = 8A V_{BB} = – 5V L_C = 1.3mH	V_{clamp} = 250V I_B = 0.8A R_{B2} = 3.1Ω See fig. 3		1.2 0.08 0.03 0.15	1.8 0.2 0.12 0.35	µs µs µs µs
t_s t_f t_t t_c	Storage Time Fall Time Tail Time in Turn-on Crossover Time	V_{CC} = 200V I_C = 8A V_{BB} = – 5V L_C = 1.3mH See fig. 3	V_{clamp} = 250V I_B = 0.8A R_{B2} = 3.1Ω T_j = 100°C		1.8 0.2 0.08 0.35	2.4 0.4 0.2 0.7	µs µs µs µs
t_s t_f t_t	Storage Time Fall Time Tail Time in Turn-on	V_{CC} = 200V I_C = 8A V_{BB} = 0 L_C = 1.3mH	V_{clamp} = 250V I_B = 0.8A R_{B2} = 5.6Ω See fig. 3		2.8 0.5 0.15		µs µs µs
t_s t_f t_t	Storage Time Fall Time Tail Time in Turn-on	V_{CC} = 200V I_C = 8A V_{BB} = 0 L_C = 1.3mH See fig. 3	V_{clamp} = 250V I_B = 0.8A R_{B2} = 5.6Ω T_j = 100°C		4.5 0.8 0.4		µs µs µs

* Pulsed : Pulse duration = 300 ms, duty cycle = 2 %.

Figure 1 : Switching Times Test Circuit (resistive load).



(1) Fast electronic switch
(2) Non-inductive resistor

Figure 2 : Turn-on Switching Waveforms.

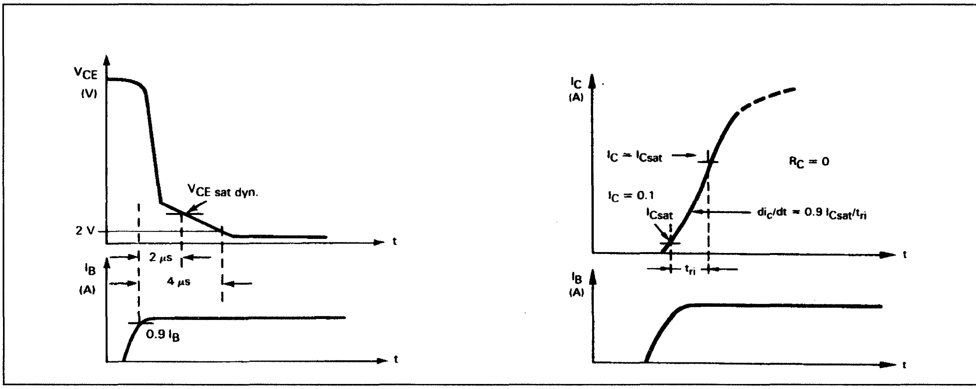


Figure 3a : Turn-off Switching Test Circuit.

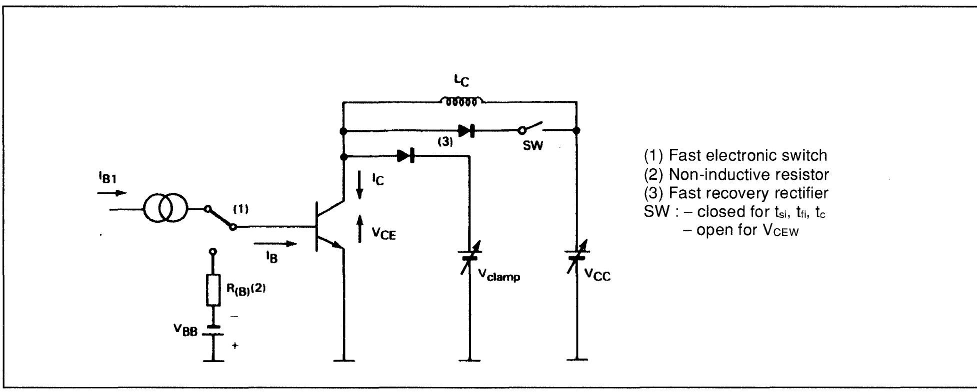
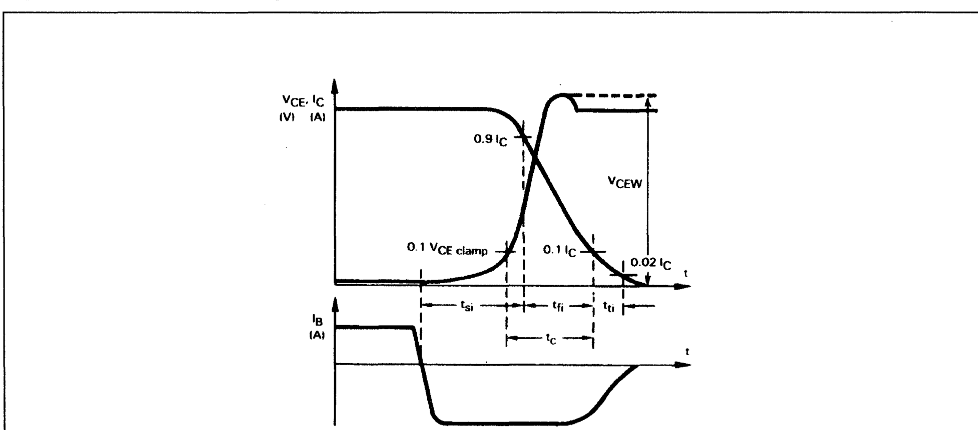
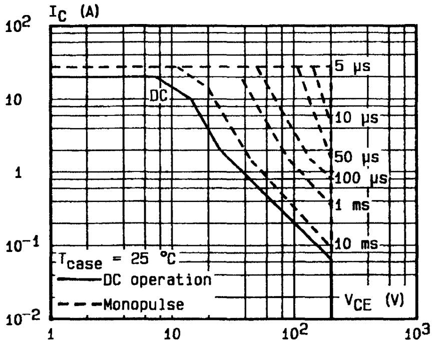


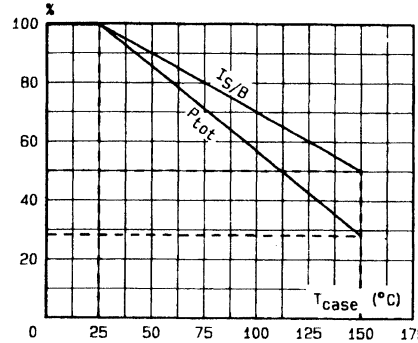
Figure 3b : Turn-off Switching Waveforms (inductive load).



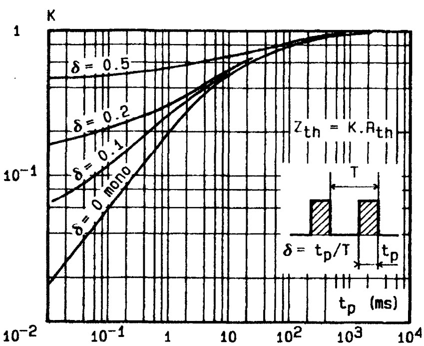
DC and AC Pulse Area.



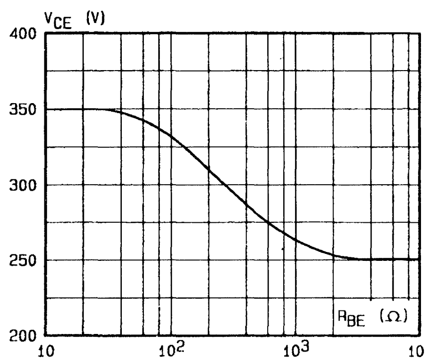
Power and $I_{S/B}$ Derating versus Case Temperature.



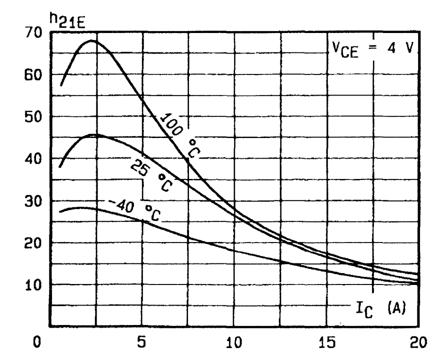
Transient Thermal Response.



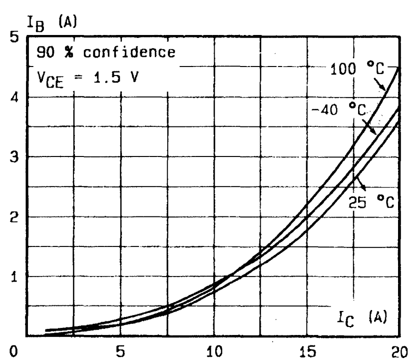
Collector-emitter Voltage versus Base-emitter Resistance.



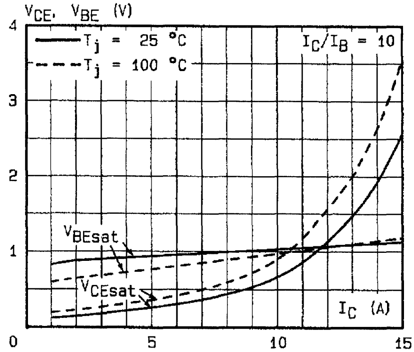
DC Current Gain.



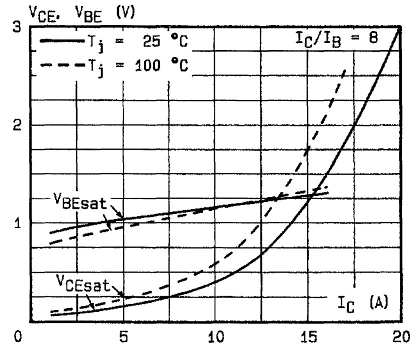
Minimum Base Current to Saturate the Transistor.



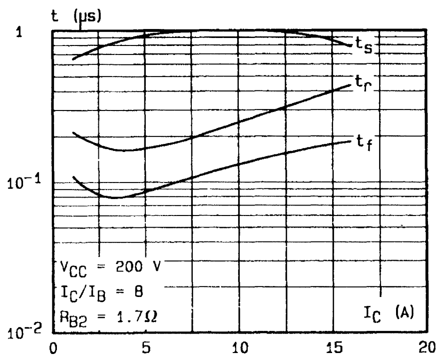
Saturation Voltage.



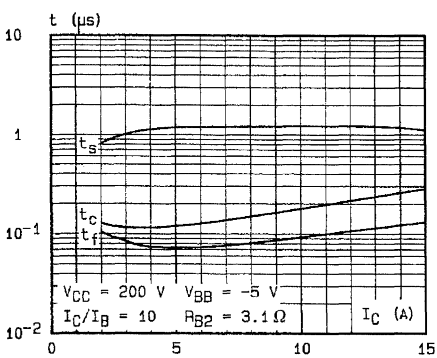
Saturation Voltage.



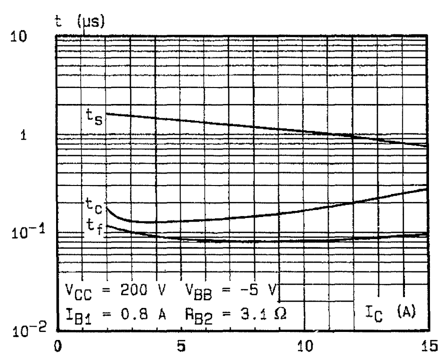
Switching Times versus Collector.



Switching Times versus Collector Current (inductive load).



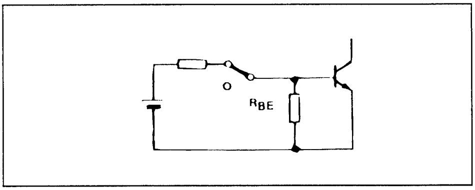
Switching Times versus Collector Current (inductive load).



SWITCHING OPERATING AND OVERLOAD AREAS

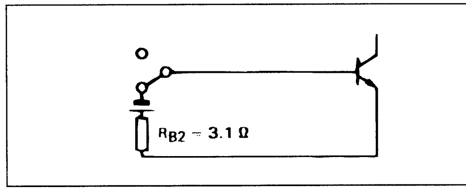
TRANSISTOR FORWARD BIASED

- During the turn-on
- During the turn-off without negative base-emitter voltage and 5.6 Ω ≤ R_{BE} ≤ 50 Ω.

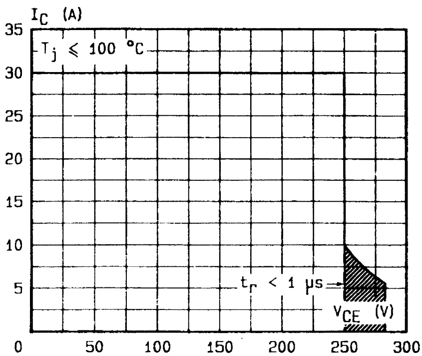


TRANSISTOR REVERSE BIASED

- During the turn-off with negative base-emitter voltage.

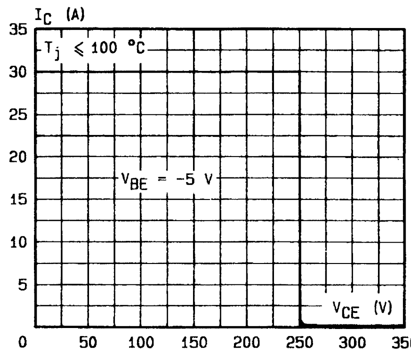


Forward Biased Safe Operating Area (FBSOA).

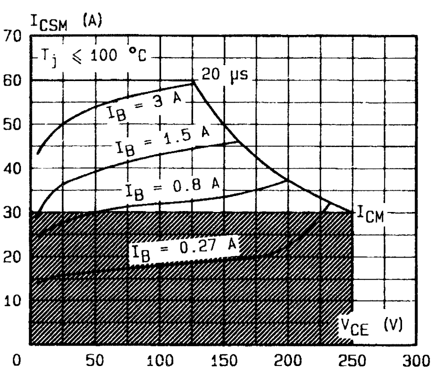


The hatched zone can only be used for turn-on.

Reverse Biased Safe Operating Area (RBSOA).

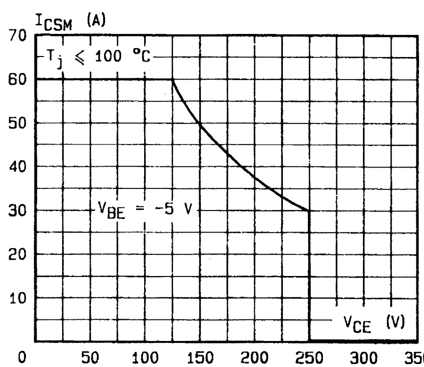


Forward Biased Accidental Overload Area (FBADA).



The Kellog network (heavy point) allows the calculation of the maximum value of the short-circuit for a given base current I_B (90 % confidence).

Reverse Biased Accidental Overload Area (RBADA).



After the accidental overload current the RBAOA has to be used for the turn-off.

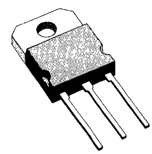
High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

SGS-THOMSON MICROELECTRONICS

BUW89

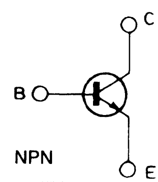
FAST SWITCHING POWER TRANSISTOR

- FAST SWITCHING TIMES
- LOW SWITCHING LOSSES
- VERY LOW SATURATION VOLTAGE AND HIGH GAIN



TO-218

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	160	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	90	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	25	A
I_{CM}	Collector Peak Current	45	A
I_B	Base Current	6	A
I_{BM}	Base Peak Current	9	A
P_{base}	Reverse Bias Base Power Dissipation (B.E. junction in avalanche)	1	W
P_{tot}	Total Dissipation at T_c < 25°C	125	W
T_{stg}	Storage Temperature	– 65 to 175	°C
T_j	Max. Operating Junction Temperature	175	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	max	1	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			1 5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = – 1.5V $V_{CE} = V_{CEV}$ V_{BE} = – 1.5V T_c = 100°C			1 5	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	90			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 7.5A I_B = 0.375A I_C = 15A I_B = 1.5A I_C = 7.5A I_B = 0.375A T_j = 100°C I_C = 15A I_B = 1.5A T_j = 100°C		0.5 0.65 0.5 0.8	0.8 0.9 0.9 1.5	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 15A I_B = 1.5A I_C = 15A I_B = 1.5A T_j = 100°C		1.4 1.45	1.7 1.8	V V
di_C/dt	Rated of Rise of on-state Collector Current	V_{CC} = 72V R_C = 0 I_{B1} = 2.25A T_j = 25°C See fig. 2 T_j = 100°C	 35 30	 50 45		 A/µs A/µs
$V_{CE(2\mu s)}$	Collector Emitter Dynamic Voltage	V_{CC} = 72V R_C = 4.8Ω I_{B1} = 1.5A T_j = 25°C See fig. 2 T_j = 100°C		 1.7 2	 2.5 4	 V V
$V_{CE(4\mu s)}$	Collector Emitter Dynamic Voltage	V_{CC} = 72V R_C = 4.8Ω I_{B1} = 1.5A T_j = 25°C See fig. 2 T_j = 100°C		 1 1.5	 2 3	 V V

RESISTIVE LOAD

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_r t_s t_f	Rise Time Storage Time Fall Time	V_{CC} = 72V I_C = 20A V_{BB} = – 5V I_{B1} = 2.5A R_{B2} = 1Ω t_p = 30µs See fig. 1		0.55 0.55 0.12	1.1 1 0.25	µs µs µs

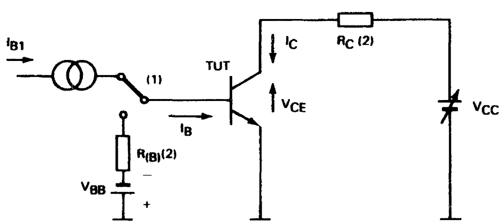
ELECTRICAL CHARACTERISTICS (continued)

INDUCTIVE LOAD

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
t_s t_f t_t t_c	Storage Time Fall Time Tail Time in Turn-on Crossover Time	V_{CC} = 72V I_C = 15A V_{BB} = – 5V L_C = 0.25mH	V_{clamp} = 90V I_B = 1.5A R_{B2} = 1.7Ω See fig. 3		0.75 0.09 0.03 0.14	1.2 0.2 0.05 0.3	µs µs µs µs
t_s t_f t_t t_c	Storage Time Fall Time Tail Time in Turn-on Crossover Time	V_{CC} = 72V I_C = 15A V_{BB} = – 5V L_C = 0.25mH See fig. 3	V_{clamp} = 90V I_B = 1.5A R_{B2} = 1.7Ω T_j = 100°C		0.95 0.15 0.06 0.3	1.7 0.3 0.1 0.5	µs µs µs µs
t_s t_f t_t	Storage Time Fall Time Tail Time in Turn-on	V_{CC} = 72V I_C = 15A V_{BB} = 0 L_C = 0.25mH	V_{clamp} = 90V I_B = 1.5A R_{B2} = 3.9Ω See fig. 3		1.4 0.7 0.22		µs µs µs
t_s t_f t_t	Storage Time Fall Time Tail Time in Turn-on	V_{CC} = 72V I_C = 15A V_{BB} = 0 L_C = 0.25mH See fig. 3	V_{clamp} = 90V I_B = 1.5A R_{B2} = 3.9Ω T_j = 100°C		1.85 1 0.44		µs µs µs

* Pulsed test t_p < 300 µs δ < 2 %.

Figure 1 : Switching Times Test Circuit (resistive load).



(1) Fast electronic switch
(2) Non-inductive resistor

Figure 2 : Turn-on Switching Waveforms.

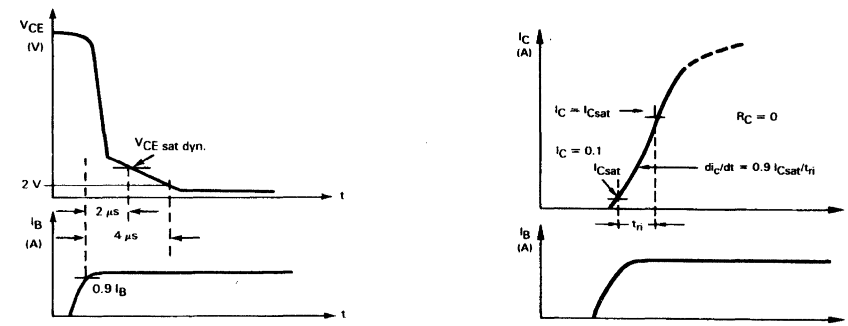
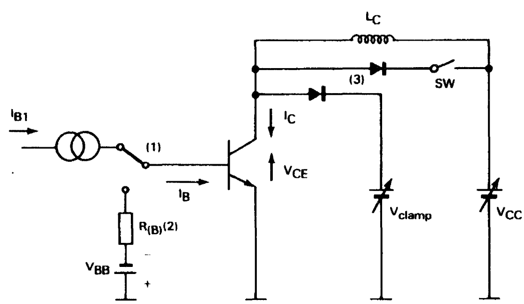
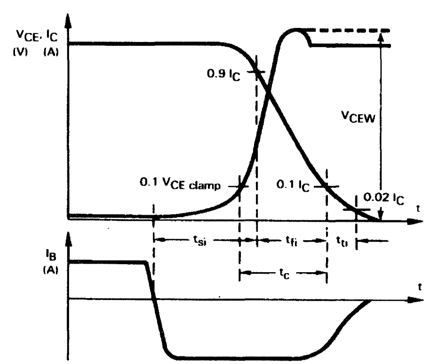


Figure 3a : Turn-off Switching Test Circuit.

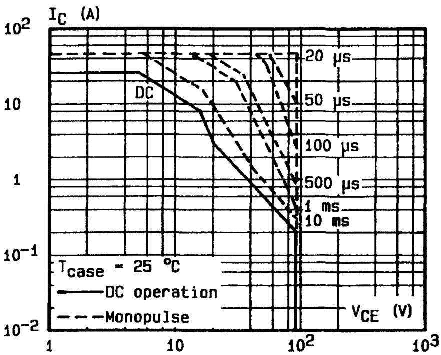


(1) Fast electronic switch
(2) Non-inductive resistor
(3) Fast recovery rectifier
SW : closed for t_{si}, t_{fi}, t_c
open for V_{CEW}

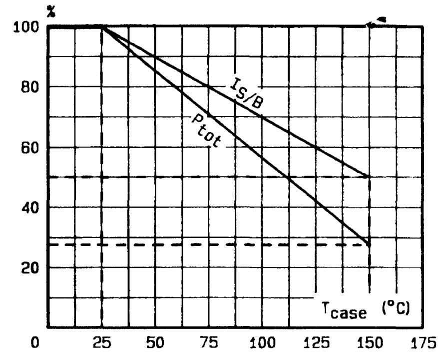
Figure 3b : Turn-off Switching Waveforms (inductive load).



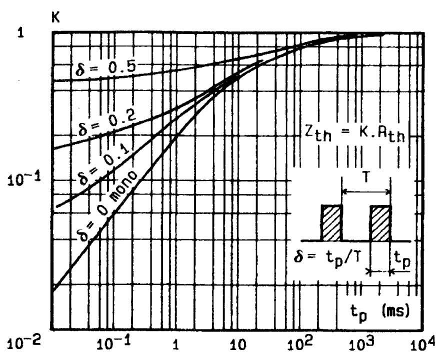
DC and AC Pulse Area.



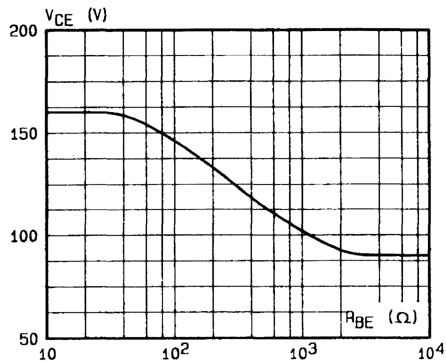
Power and $I_{S/B}$ Derating versus Case Temperature.



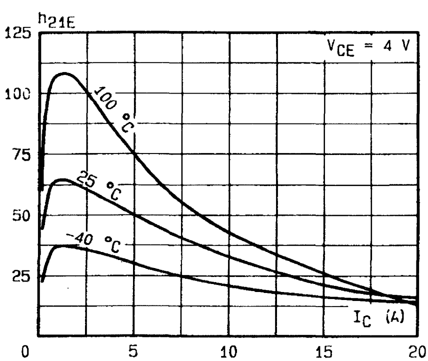
Transient Thermal Response.



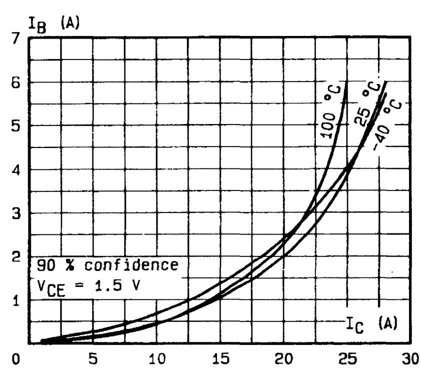
Collector-emitter Voltage versus Base-emitter Resistance.



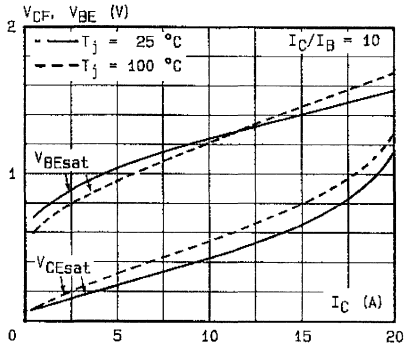
DC Current Gain.



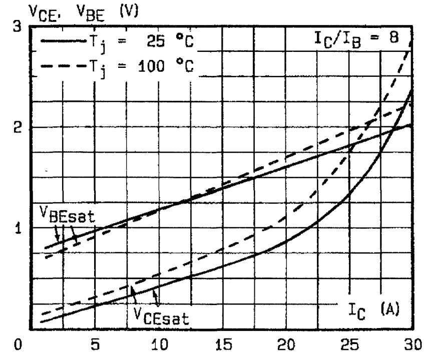
Minimum Base Current to Saturate the Transistor.



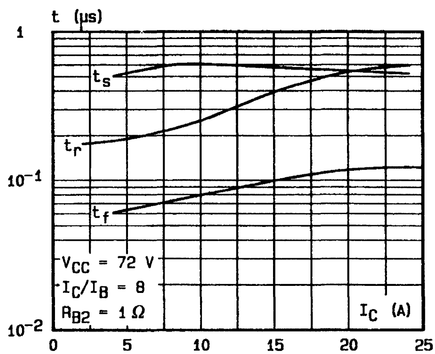
Saturation Voltage.



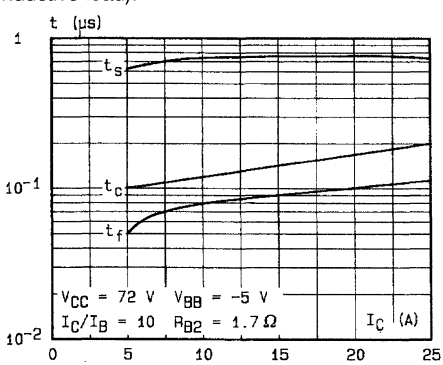
Saturation Voltage.



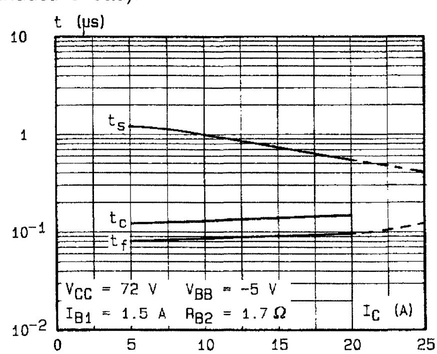
Switching Times Versus Collector



Switching Times versus Collector Current (inductive load).



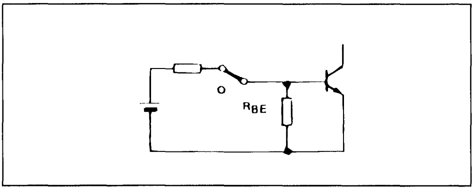
Switching Times versus Collector Current (inductive load).



SWITCHING OPERATING AND OVERLOAD AREAS

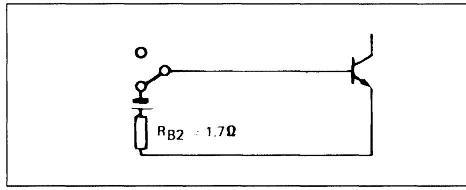
TRANSISTOR FORWARD BIASED

- During the turn-on
- During the turn-off without negative base-emitter voltage and 3.9 Ω ≤ R_{BE} ≤ 50 Ω.

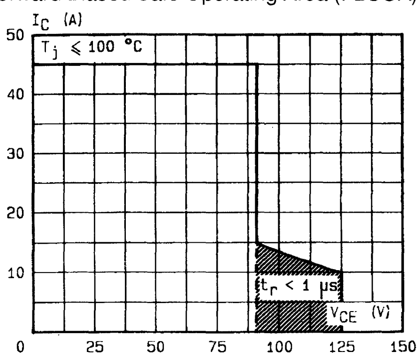


TRANSISTOR REVERSE BIASED

- During the turn-off with negative base-emitter voltage.

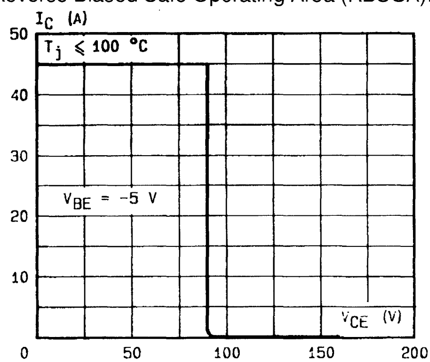


Forward Biased Safe Operating Area (FBSOA).

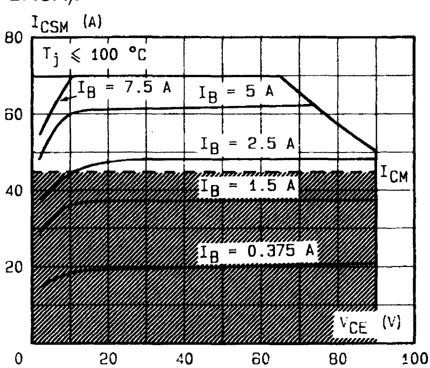


The hatched zone can only be used for turn-on.

Reverse Biased Safe Operating Area (RBSOA).

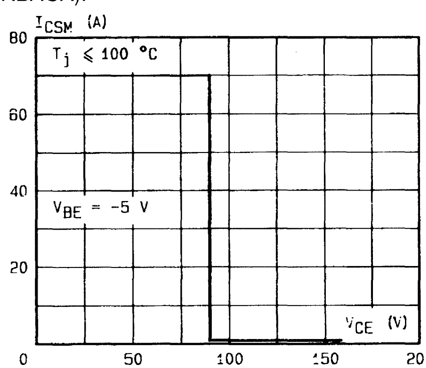


Forward Biased Accidental Overload Area (FBAOA).



The Kellog network (heavy point) allows the calculation of the maximum value of the short-circuit for a given base current I_B (90 % confidence).

Reverse Biased Accidental Overload Area (RBAOA).



After the accidental overload current the RBAOA has to be used for the turn-off.

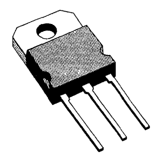
High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

SGS-THOMSON
MICROELECTRONICS

BUW90

NPN FAST SWITCHING POWER TRANSISTOR

- VERY LOW SATURATION VOLTAGE AND HIGH GAIN FOR REDUCED LOAD OPERATION
- TURN-ON AND TURN-OFF TAIL SPECIFICATIONS
- TURN-ON di_C/dt FOR BETTER RECTIFIER CHOICE
- SWITCHING TIMES SPECIFIED WITH AND WITHOUT NEGATIVE BASE DRIVE
- FAST SWITCHING TIMES
- LOW SWITCHING LOSSES
- LOW ON-STATE VOLTAGE DROP
- BASE CURRENT REQUIREMENTS



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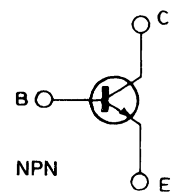
INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5 V)	250	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	125	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	20	A
I_{CM}	Collector Peak Current	30	A
I_B	Base Current	4	A
I_{BM}	Base Peak Current	6	A
P_{base}	Reverse Bias Base Power Dissipation (B.E. junction in avalance)	1	W
P_{tot}	Total Dissipation at T_c < 25 °C	125	W
T_{stg}	Storage Temperature	– 65 to 175	°C
T_j	Max. Operating Junction Temperature	175	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case Max	1.2	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

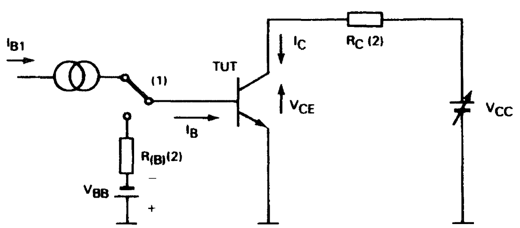
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10 Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100 °C			1 5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = − 1.5 V $V_{CE} = V_{CEV}$ V_{BE} = − 1.5 V T_c = 100 °C			1 5	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2 A L = 25 mH	125			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50 mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5.5 A I_B = 0.35 A I_C = 11 A I_B = 1.1 A I_C = 5.5 A I_B = 0.35 A T_j = 100 °C I_C = 11 A I_B = 1.1 A T_j = 100 °C		0.5 0.65 0.5 0.8	0.8 0.9 0.9 1.2	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 11 A I_B = 1.1 A I_C = 11 A I_B = 1.1 A T_j = 100 °C		1.3 1.35	1.6 1.7	V V
di_c/dt	Rate of Rise of on State Collector Current	V_{CC} = 100 V R_C = 0 I_{B1} = 1.65 A T_j = 25 °C T_j = 100 °C See fig. 2	 35 30	 45 40		 A/µs A/µs
$V_{CE(2\mu s)}$	Collector-emitter Dynamic Voltage	V_{CC} = 100 V R_C = 9 Ω I_{B1} = 1.1 A T_j = 25 °C T_j = 100 °C See fig. 2		 2 2.6	 2.5 4	 V V
$V_{CE(4\mu s)}$	Collector-emitter Dynamic Voltage	V_{CC} = 100 V R_C = 9 Ω I_{B1} = 1.1 A T_j = 25 °C T_j = 100 °C See fig. 2		 1.1 1.6	 2 2.5	 V V

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
	RESISTIVE LOAD					µs
t_r	Rise Time	V_{CC} = 100 V I_C = 15 A		0.4	1	µs
t_s	Storage Time	V_{BB} = – 5 V I_{B1} = 1.8 A		0.6	1	µs
t_f	Fall Time	R_B = 1.3 Ω t_p = 30 µs		0.14	0.3	
	INDUCTIVE LOAD					µs
t_s	Storage Time	V_{CC} = 100 V I_C = 11 A I_B = 1.1 A		0.75	1.4	µs
t_f	Fall Time	V_{BB} = – 5 V V_{clamp} = 125 V		0.08	0.2	µs
t_t	Tail Time in Turn-on	L_C = 0.25 mH R_B = 2.3 Ω		0.02	0.05	µs
t_c	Crossover Time	see fig. 3		0.15	0.3	
t_s	Storage Time	V_{CC} = 100 V I_C = 11 A I_B = 1.1 A		0.95	1.7	µs
t_f	Fall Time	V_{BB} = – 5 V V_{clamp} = 125 V		0.14	0.3	µs
t_t	Tail Time in Turn-on	L_C = 0.25 mH R_B = 2.3 Ω		0.04	0.1	µs
t_c	Crossover Time	see fig. 3 T_j = 100 °C		0.3	0.5	µs
t_s	Storage Time	V_{CC} = 100 V I_C = 11 A I_B = 1.1 A		1.8		µs
t_f	Fall Time	V_{BB} = 0 V_{clamp} = 125 V		0.7		µs
t_t	Tail Time in Turn-on	L_C = 0.25 mH R_B = 4.7 Ω		0.2		µs
		see fig. 3				
t_s	Storage Time	V_{CC} = 100 V I_C = 11 A I_B = 1.1 A		2.5		µs
t_f	Fall Time	V_{BB} = 0 V_{clamp} = 125 V		1		µs
t_t	Tail Time in Turn-on	L_C = 0.25 mH R_B = 4.7 Ω		0.4		µs
		see fig. 3 T_j = 100 °C				

* Pulsed : Pulse duration = 300 µs, duty cycle = 2 %.

Figure 1 : Switching Times Test Circuit (resistive load).



(1) Fast electronic switch
(2) Non-inductive resistor

Figure 2 : Turn-on Switching Waveforms.

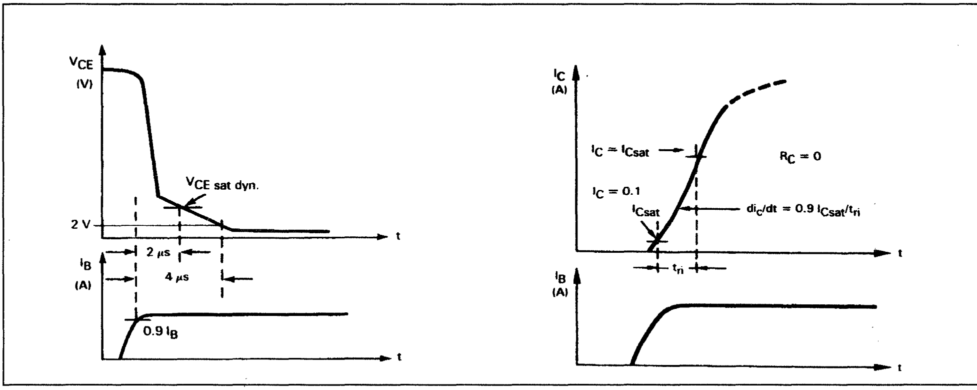
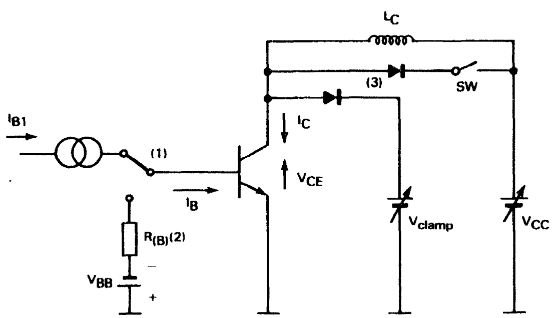
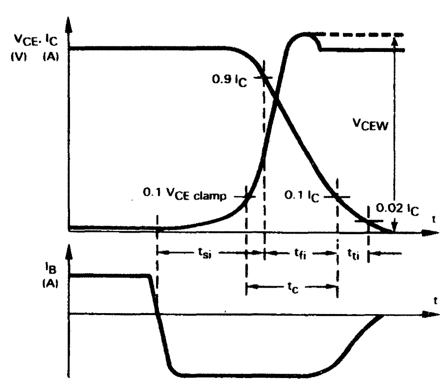


Figure 3a : Turn-off Switching Test Circuit.

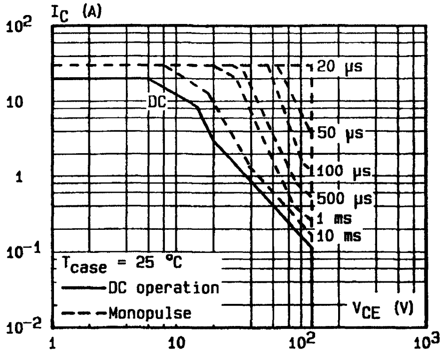


(1) Fast electronic switch
(2) Non-inductive resistor
(3) Fast recovery rectifier
SW : – closed for t_{si}, t_{fi}, t_c
– open for V_{CEW}

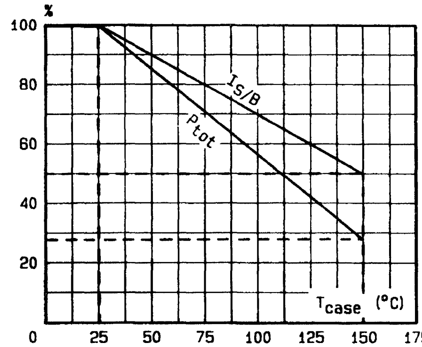
Figure 3b : Turn-off Switching Waveforms (inductive load).



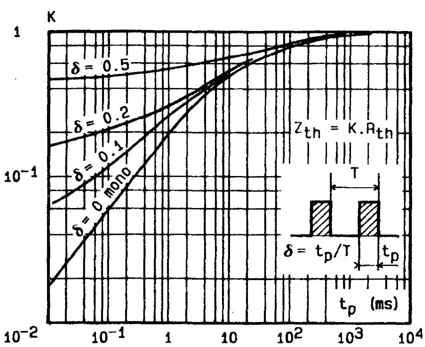
DC and AC Pulse Area.



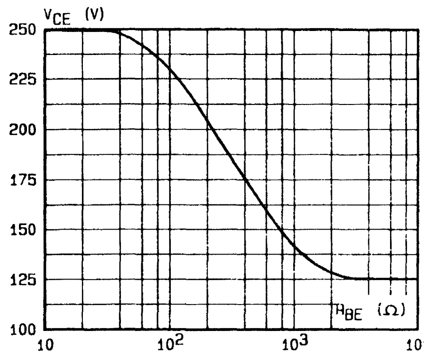
Power and $I_{S/B}$ Derating versus Case Temperature.



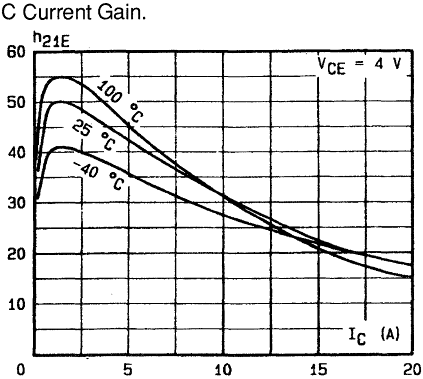
Transient Thermal Response.



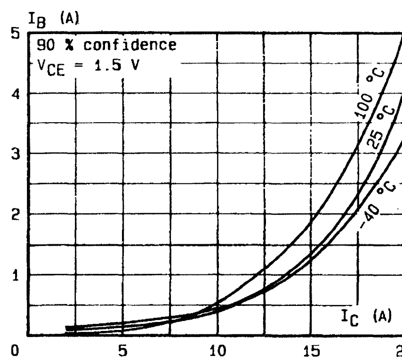
Collector-emitter Voltage versus Base-emitter Resistance.



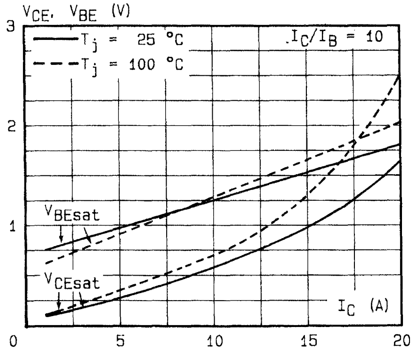
DC Current Gain.



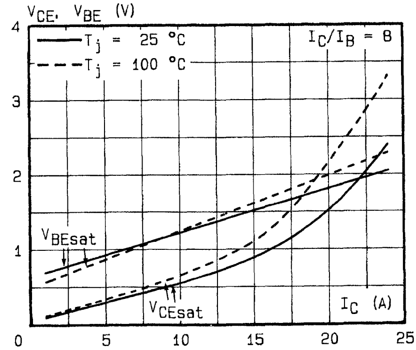
Minimum Base Current to Saturate the Transistor.



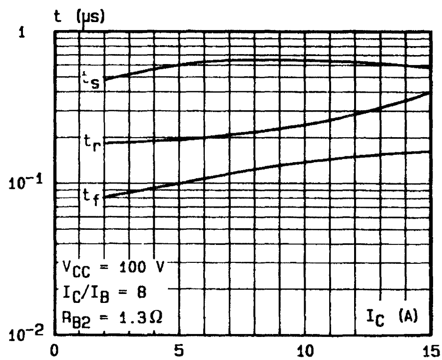
Saturation Voltage.



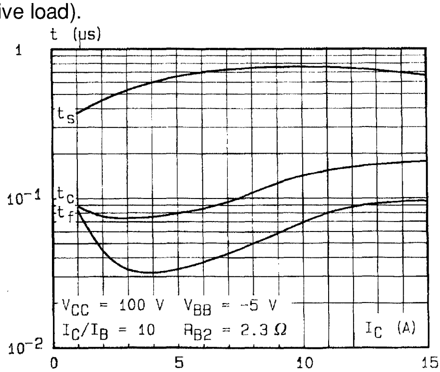
Saturation Voltage.



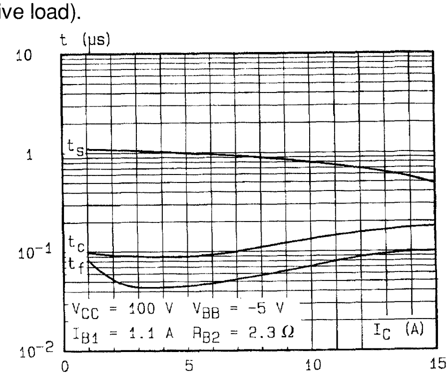
Switching Times versus Collector



Switching Times versus Collector Current (inductive load).



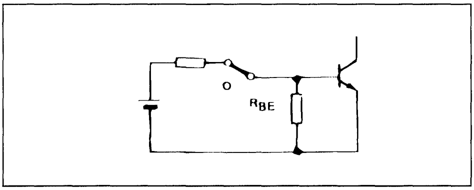
Switching Times versus Collector Current (inductive load).



SWITCHING OPERATING AND OVERLOAD AREAS

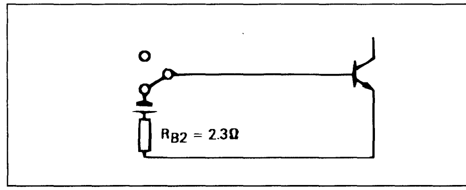
TRANSISTOR FORWARD BIASED

- During the turn-on
- During the turn-off without negative base-emitter voltage and 4.7 $\Omega \leq R_{BE} \leq 50\ \Omega$.

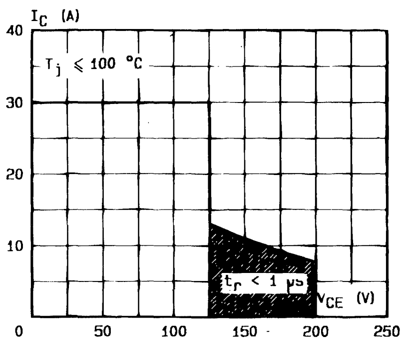


TRANSISTOR REVERSE BIASED

- During the turn-off with negative base-emitter voltage.

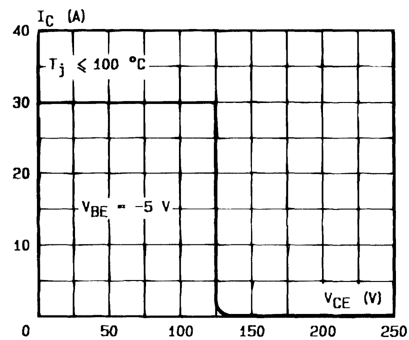


Forward Biased Safe Operating Area (FBSOA).

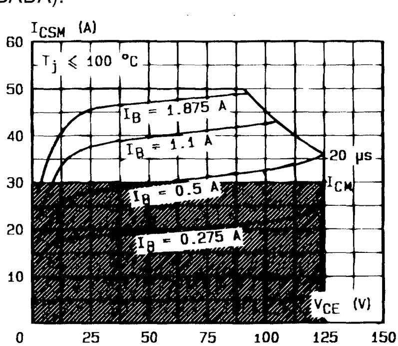


The hatched zone can only be used for turn-on.

Reverse Biaesd Safe Operating Area (RBSOA).

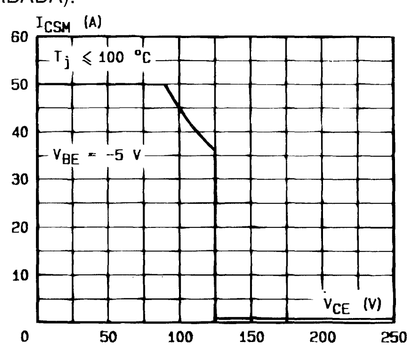


Forward Biased Accidental Overload Area (FBADA).



The Kellog network (heavy point) allows the calculation of the maximum value of the short-circuit for a given base current I_B.
(90 % confidence).

Reverse Biased Accidental Overload Area (RBADA).



After the accidental overload current the RBAOA has to be used for the turn-off.

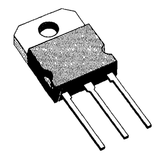
High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

SGS-THOMSON MICROELECTRONICS

BUW91

NPN FAST SWITCHING POWER TRANSISTOR

- VERY LOW SATURATION VOLTAGE AND HIGH GAIN FOR REDUCED LOAD OPERATION
- TURN-ON AND TURN-OFF TAIL SPECIFICATIONS
- TURN-ON di_C/dt FOR BETTER RECTIFIER CHOICE
- SWITCHING TIMES SPECIFIED WITH AND WITHOUT NEGATIVE BASE DRIVE
- FAST SWITCHING TIMES
- LOW SWITCHING LOSSES
- LOW ON-STATE VOLTAGE DROP
- BASE CURRENT REQUIREMENTS



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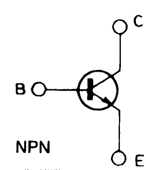
INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	300	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	200	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	15	A
I_{CM}	Collector Peak Current	20	A
I_B	Base Current	3	A
I_{BM}	Base Peak Current	5	A
P_{base}	Reverse bias Base Power Dissipation (B.E. junction in avalance)	1	W
P_{tot}	Total Dissipation at T_c < 25°C	125	W
T_{stg}	Storage Temperature	– 65 to 175	°C
T_j	Max. Operating Junction Temperature	175	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case Max	1.2	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			0.5 2.5	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = – 1.5V $V_{CE} = V_{CEV}$ V_{BE} = – 1.5V T_c = 100°C			0.5 2	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector emitter Sustaining Voltage	I_C = 0.2A L = 25 mH	200			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 5A	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 3A I_B = 0.15A I_C = 6A I_B = 0.6A I_C = 3A I_B = 0.15A T_j = 100°C I_C = 6A I_B = 0.6A T_j = 100°C		0.3 0.45 0.3 0.55	0.8 0.9 0.9 1.2	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 6A I_B = 0.6A I_C = 6A I_B = 0.6A T_j = 100°C		1.15 1.15	1.6 1.6	V V
di_c/dt	Rate of Rise of on State Collector Current	V_{CC} = 160V R_C = 0 I_{B1} = 0.9A T_j = 25°C T_j = 100°C See fig. 2	 30 25	 33 28		 A/µs A/µs
$V_{CE(2\mu s)}$	Collector-emitter Dynamic Voltage	V_{CC} = 160V R_C = 27Ω I_{B1} = 0.6A T_j = 25°C T_j = 100 °C See fig. 2		 1.05 1.53	 2.5 4	 V V
$V_{CE(4\mu s)}$	Collector-emitter Dynamic Voltage	V_{CC} = 160V R_C = 27Ω I_{B1} = 0.6A T_j = 25°C T_j = 100°C See fig. 2		 0.75 0.95	 1.7 2	 V V

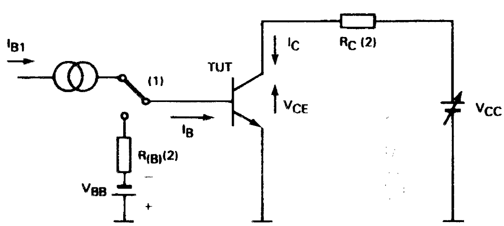
* Pulsed : Pulse duration = 300 µs, duty cycle = 2 %.

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
	RESISTIVE LOAD					
t_r	Rise Time	V_{CC} = 160V I_C = 8A		0.3	0.5	µs
t_s	Storage Time	V_{BB} = – 5V I_{B1} = 1A		0.6	1.2	µs
t_f	Fall Time	R_B = 2.5Ω t_p = 30µs		0.12	0.3	µs
	INDUCTIVE LOAD					
t_s	Storage Time	V_{CC} = 160V I_C = 6 A I_B = 0.6A		0.75	1.5	µs
t_f	Fall Time	V_{BB} = – 5V V_{clamp} = 200V		0.08	0.2	µs
t_t	Tail Time in Turn-on	L_C = 1.3mH R_B = 4.2Ω		0.01	0.07	µs
t_c	Crossover Time	see fig. 3		0.12	0.3	µs
t_s	Storage Time	V_{CC} = 160V I_C = 6 A I_B = 0.6A		1.2	2	µs
t_f	Fall Time	V_{BB} = – 5V V_{clamp} = 200V		0.12	0.3	µs
t_t	Tail Time in Turn-on	L_C = 1.3mH R_B = 4.2Ω		0.03	0.15	µs
t_c	Crossover Time	see fig. 3 T_j = 100°C		0.22	0.5	µs
t_s	Storage Time	V_{CC} = 160V I_C = 6 A I_B = 0.6A		1.8		µs
t_f	Fall Time	V_{BB} = 0 V_{clamp} = 200V		0.45		µs
t_t	Tail Time in Turn-on	L_C = 1.3mH R_B = 6.8Ω		0.15		µs
		see fig. 3				
t_s	Storage Time	V_{CC} = 160V I_C = 6 A I_B = 0.6A		3.3		µs
t_f	Fall Time	V_{BB} = 0 V_{clamp} = 200V		0.8		µs
t_t	Tail Time in Turn-on	L_C = 1.3mH R_B = 6.8Ω		0.44		µs
		see fig. 3 T_j = 100°C				

* Pulsed : Pulse duration = 300 µs. duty cycle = 2 %.

Figure 1 : Switching Times Test Circuit (resistive load).



(1) Fast electronic switch
(2) Non-inductive resistor

Figure 2 : Turn-on Switching Waveforms.

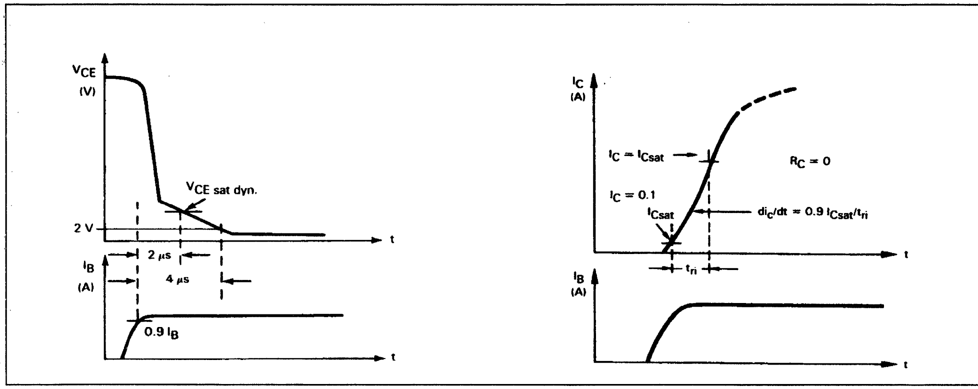


Figure 3a : Turn-off Switching Test Circuit.

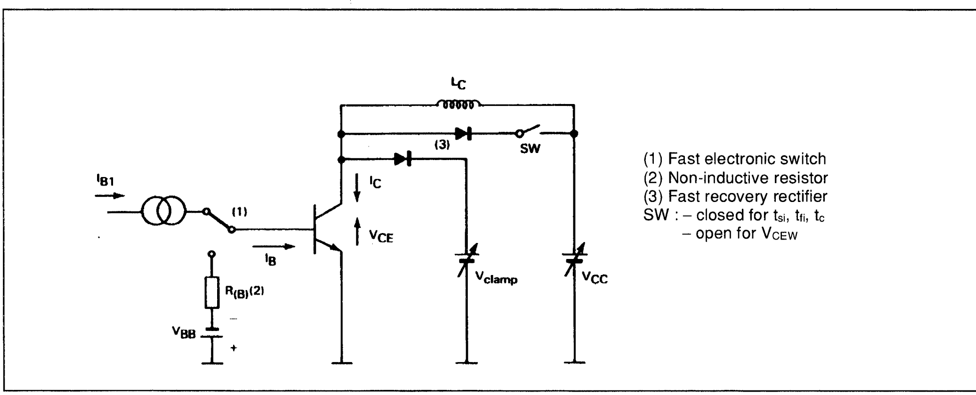
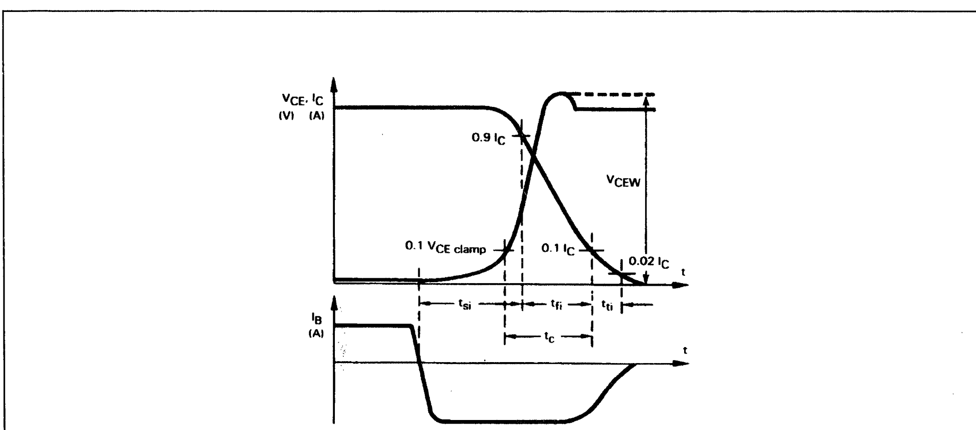
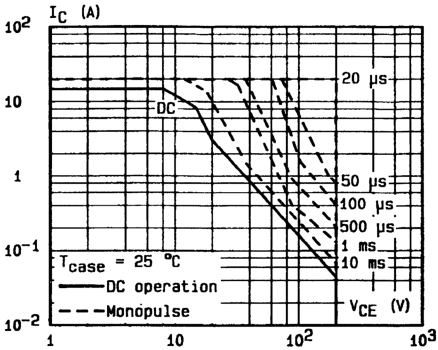


Figure 3b : Turn-off Switching Waveforms (inductive load).

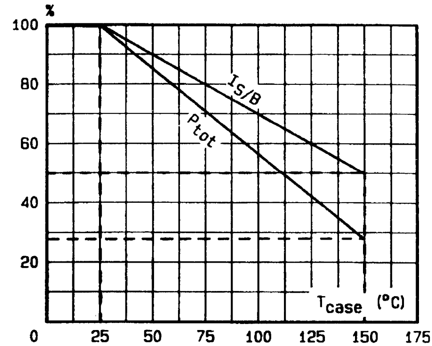


SGS-THOMSON MICROELECTRONICS

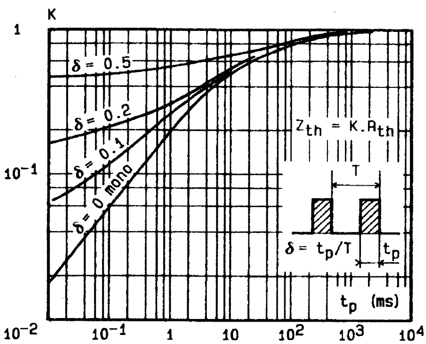
DC and AC Pulse Area.



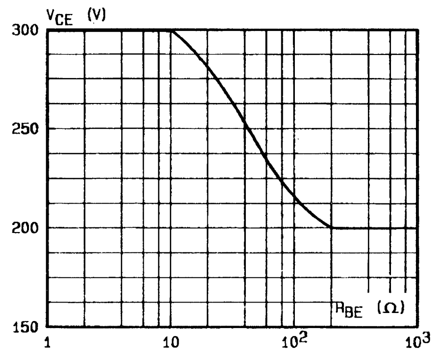
Power and $I_{S/B}$ Derating versus Case Temperature.



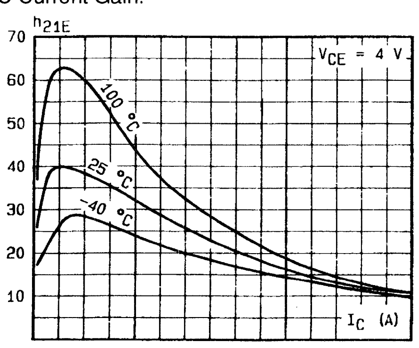
Transient Thermal Response.



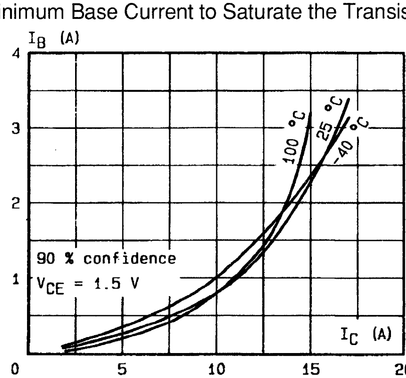
Collector-emitter Voltage versus Base-emitter Resistance.



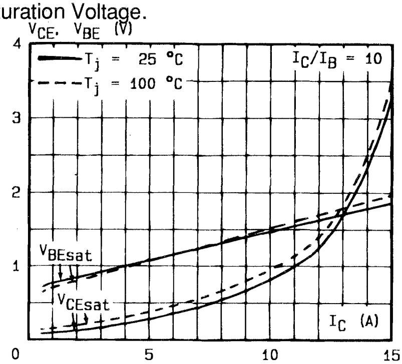
DC Current Gain.



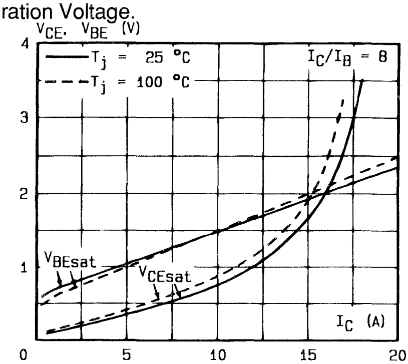
Minimum Base Current to Saturate the Transistor.



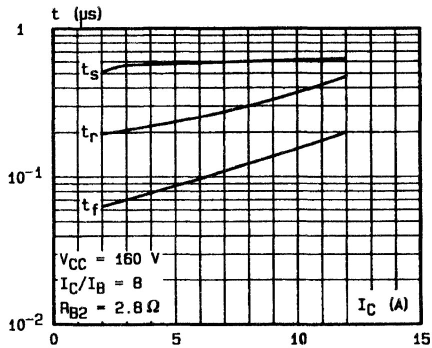
Saturation Voltage.



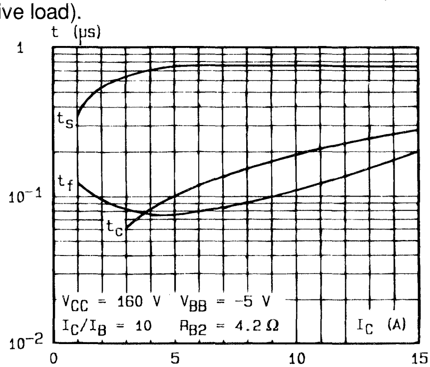
Saturation Voltage.



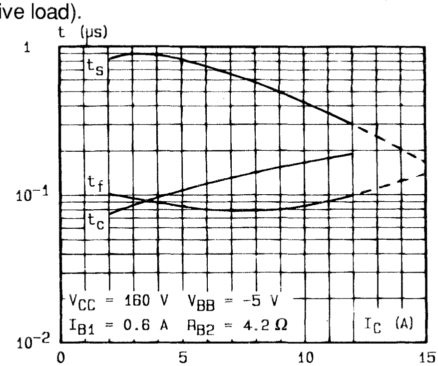
Switching Times versus Collector.



Switching Times versus Collector Current (inductive load).



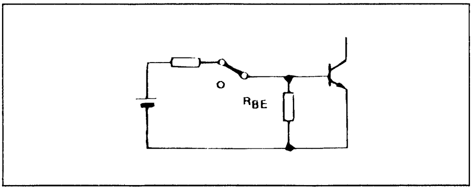
Switching Times versus Collector Current (inductive load).



SWITCHING OPERATING AND OVERLOAD AREAS

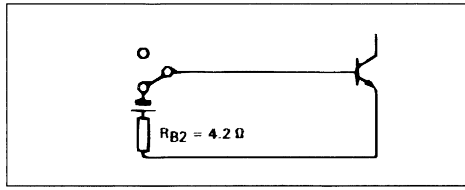
TRANSISTOR FORWARD BIASED

- During the turn-on
- During the turn-off without negative base-emitter voltage and 6.8 $\Omega \leq R_{BE} \leq 50\ \Omega$.

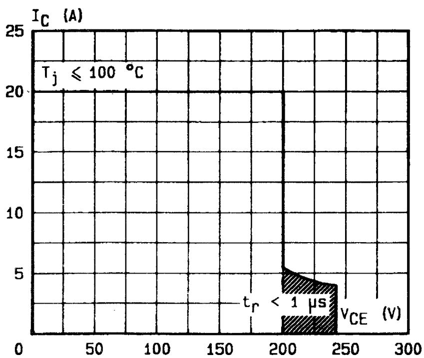


TRANSISTOR REVERSE BIASED

- During the turn-off with negative base-emitter voltage.

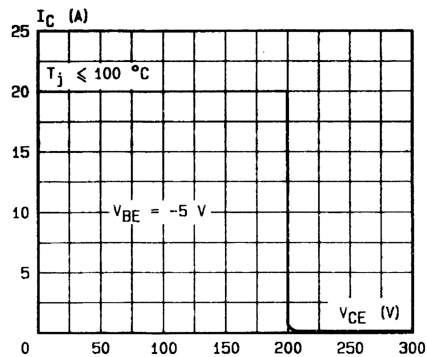


Forward Biased Safe Operating Area(FBSOA).

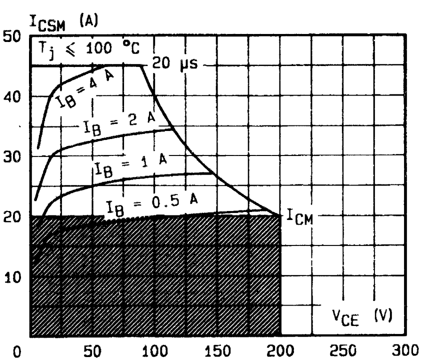


The hatched zone can only be used for turn-on

Reverse Biased Safe Operating Area (RBSOA).

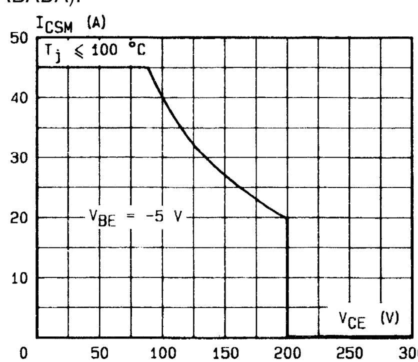


Forward Biased Accidental Overload Area (FBADA).



The Kellog network (heavy point) allows the calculation of the maximum value of the short-circuit for a given base current I_B.
(90 % confidence).

Reverse Biased Accidental Overload Area (RBADA).



After the accidental overload current the RBAOA has to be used for the turn-off.

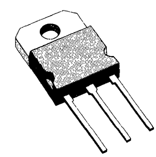
High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

SGS-THOMSON MICROELECTRONICS

BUW92

FAST SWITCHING POWER TRANSISTOR

- FAST SWITCHING TIMES
- LOW SWITCHING LOSSES
- VERY LOW SATURATION VOLTAGE AND HIGH GAIN



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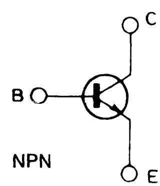
INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5 V)	350	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	250	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	12	A
I_{CM}	Collector Peak Current	18	A
I_B	Base Current	2.5	A
I_{BM}	Base Peak Current	4	A
P_{base}	Reverse Bias Base Power Dissipation (B.E. junction in avalanche)	1	W
P_{tot}	Total Dissipation at T_c < 25°C	125	W
T_{stg}	Storage Temperature	– 65 to 175	°C
T_j	Max. Operating Junction Temperature	175	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	max	1.2	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10Ω)	V_{CE} = V_{CEV} V_{CE} = V_{CEV} T_c = 100°C			0.5 2.5	mA mA
I_{CEV}	Collector Cutoff Current	V_{CE} = V_{CEV} V_{BE} = – 1.5V V_{CE} = V_{CEV} V_{BE} = – 1.5V T_c = 100°C			0.5 2	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	250			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 2A I_B = 0.13A I_C = 5A I_B = 0.5A I_C = 2A I_B = 0.13A T_j = 100°C I_C = 5A I_B = 0.5A T_j = 100°C		0.25 0.4 0.25 0.45	0.8 0.9 0.9 1.2	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 4A I_B = 0.4A I_C = 4A I_B = 0.4A T_j = 100°C		1 0.9	1.3 1.3	V V
di_C/dt	Rated of Rise of on-state Collector Current	V_{CC} = 200V R_C = 0 I_{B1} = 0.6A T_j = 25°C See fig. 2 T_j = 100°C	 25 20	 40 35		 A/µs A/µs
$V_{CE(2µs)}$	Collector Emitter Dynamic Voltage	V_{CC} = 200V R_C = 50Ω I_{B1} = 0.4A See fig. 2 T_j = 25°C T_j = 100°C		 1.7 2.5	 2.5 4	 V V
$V_{CE(4µs)}$	Collector Emitter Dynamic Voltage	V_{CC} = 200V R_C = 50Ω I_{B1} = 0.4A See fig. 2 T_j = 25°C T_j = 100°C		 0.9 1.1	 1.7 2	 V V

ELECTRICAL CHARATERISTICS (continued)

RESISTIVE LOAD

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_r	Rise Time	V_{CC} = 200V I_C = 6A V_{BB} = – 5V I_{B1} = 0.75A R_{B2} = 3.3Ω t_p = 30μs See fig. 1		0.3	0.4	μs
t_s	Storage Time			1	1.6	μs
t_f	Fall Time			0.15	0.3	μs

INDUCTIVE LOAD

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	V_{CC} = 200V V_{clamp} = 250V I_C = 4A I_B = 0.4A V_{BB} = – 5V R_{B2} = 6.3Ω L_C = 2.5mH See fig. 3		1.2	1.8	μs
t_f	Fall Time			0.08	0.2	μs
t_t	Tail Time in Turn-on			0.03	0.12	μs
t_c	Crossover Time			0.15	0.35	μs
t_s	Storage Time	V_{CC} = 200V V_{clamp} = 250V I_C = 4A I_B = 0.4A V_{BB} = – 5V R_{B2} = 6.3Ω L_C = 2.5mH T_j = 100°C See fig. 3		1.8	2.4	μs
t_f	Fall Time			0.2	0.4	μs
t_t	Tail Time in Turn-on			0.08	0.2	μs
t_c	Crossover Time			0.4	0.7	μs
t_s	Storage Time	V_{CC} = 200V V_{clamp} = 250V I_C = 4A I_B = 0.4A V_{BB} = 0 R_{B2} = 7.5Ω L_C = 2.5mH See fig. 3		2.5		μs
t_f	Fall Time			0.4		μs
t_t	Tail Time in Turn-on			0.15		μs
t_s	Storage Time	V_{CC} = 200V V_{clamp} = 250V I_C = 4A I_B = 0.4A V_{BB} = 0 R_{B2} = 7.5Ω L_C = 2.5mH T_j = 100°C See fig. 3		4.8		μs
t_f	Fall Time			0.7		μs
t_t	Tail Time in Turn-on			0.4		μs

* Pulsed : Pulse duration = 300 μs, duty cycle = 2 %.

Figure 1 : Switching Times Test Circuit (resistive load).

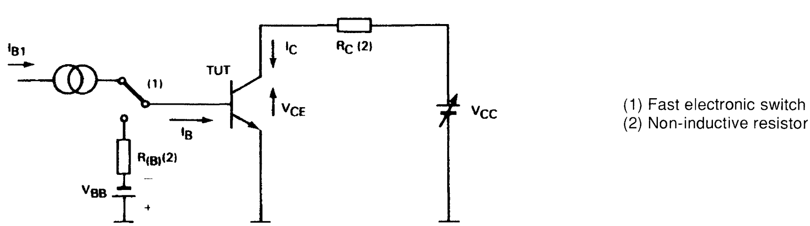


Figure 2 : Turn-on Switching Waveforms.

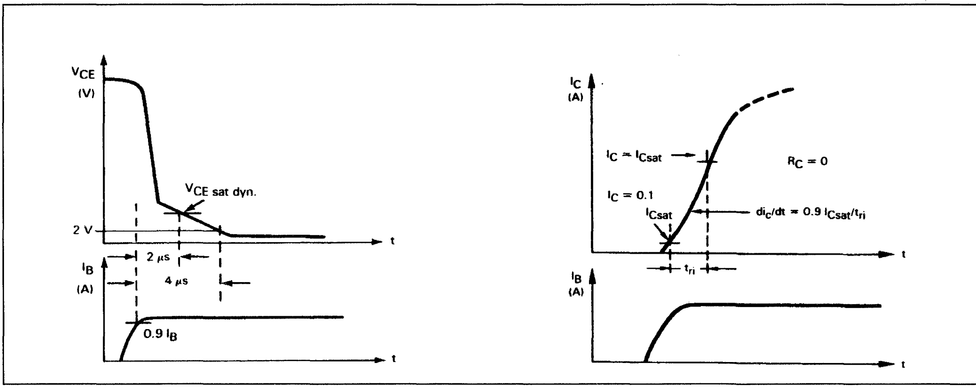


Figure 3a : Turn-off Switching Test Circuit.

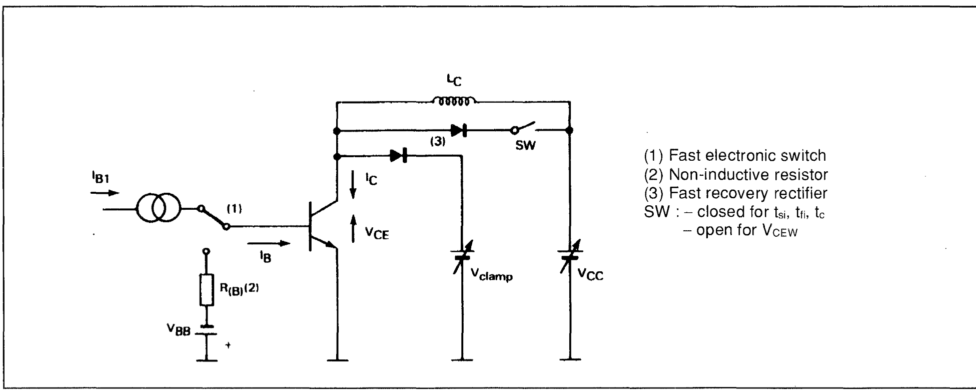
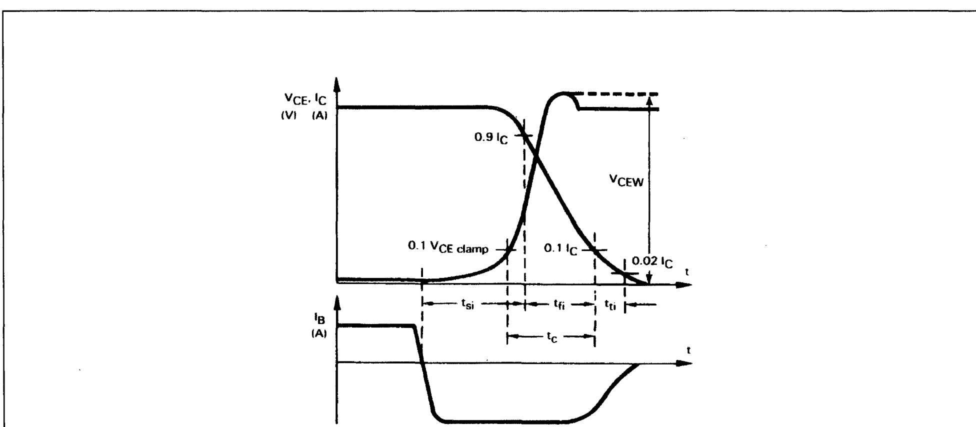
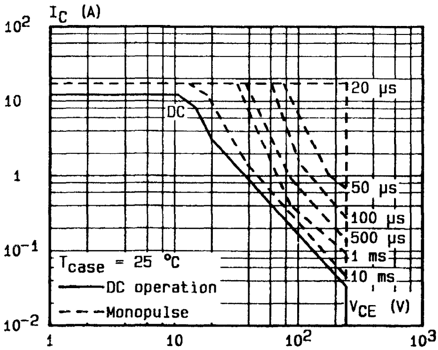


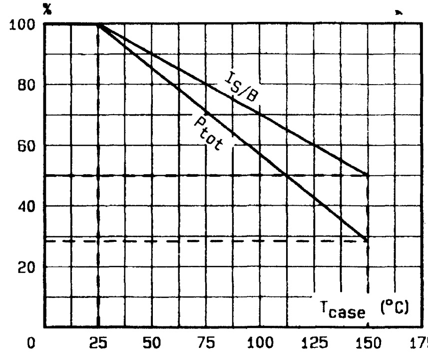
Figure 3b : Turn-off Switching Waveforms (inductive load).



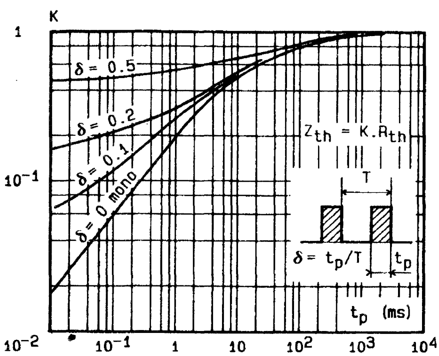
DC and AC Pulse Area.



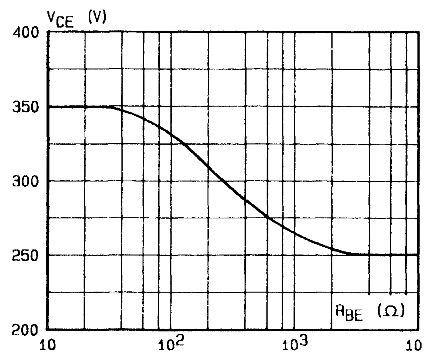
Power and $I_{S/B}$ Derating versus Case Temperature.



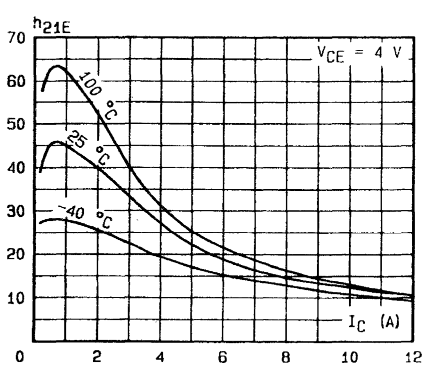
Transient Thermal Response.



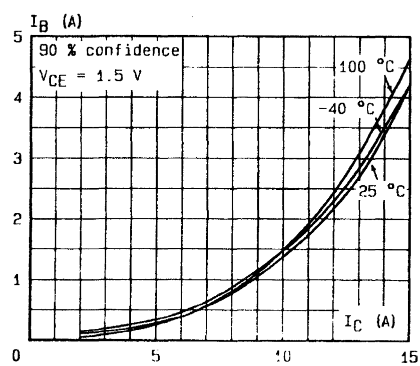
Collector-emitter Voltage versus Base-emitter Resistance.



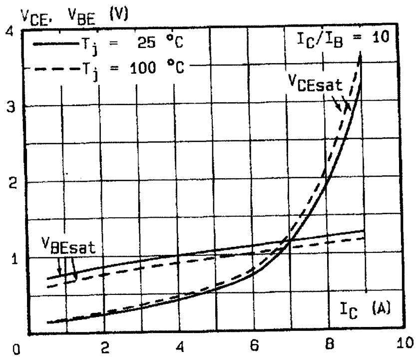
DC Current Gain.



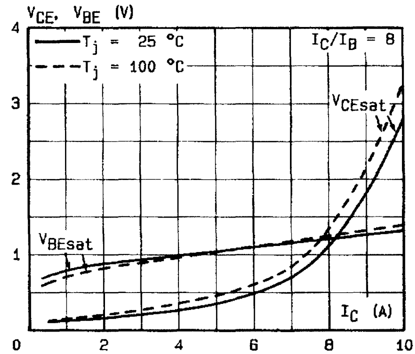
Minimum Base Current to Saturate the Transistor.



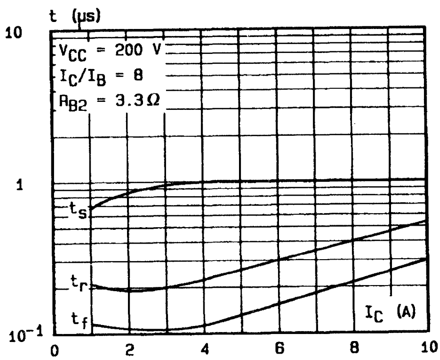
Saturation Voltage.



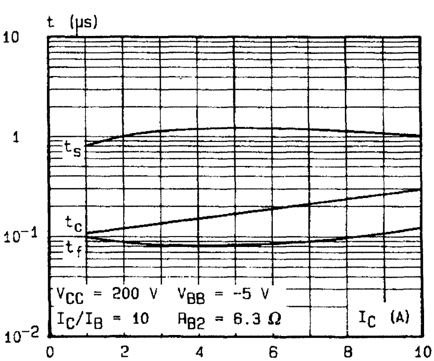
Saturation Voltage.



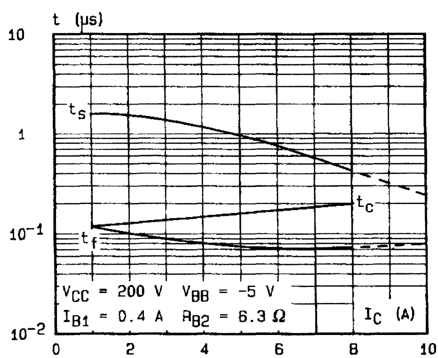
Switching Times versus Collector.



Switching Times versus Collector Current (inductive load).

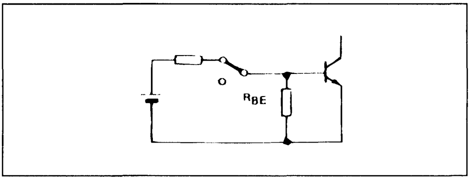


Switching Times versus Collector Current (inductive load).

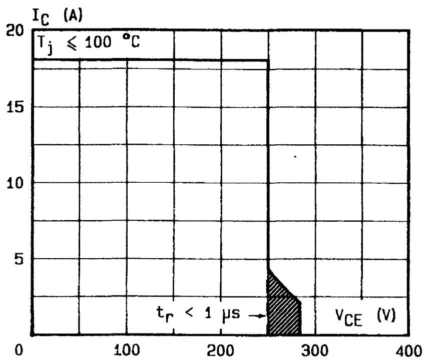


SWITCHING OPERATING AND OVERLOAD AREAS

TRANSISTOR FORWARD BIASED
- During the turn-on
- During the turn-off without negative base-emitter voltage and $7.5\ \Omega \leq R_{BE} \leq 50\ \Omega$.

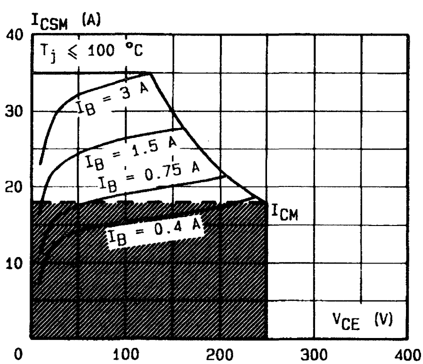


Forward Biased Safe Operating Area (FBSOA).



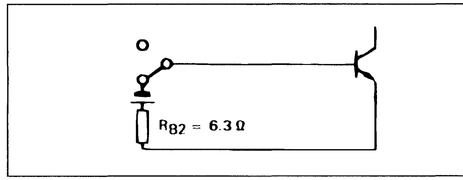
The hatched zone can only be used for turn-on.

Forward Biased Accidental Overload Area (FBAOA).

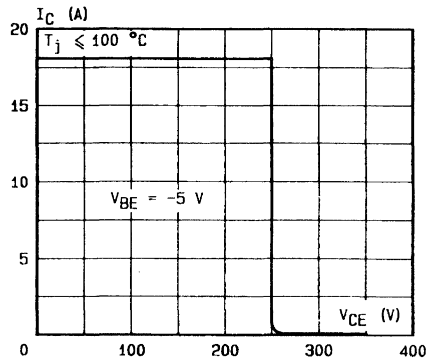


The Kellog network (heavy point) allows the calculation of the maximum value of the short-circuit for a given base current I_B.
(90 % confidence).

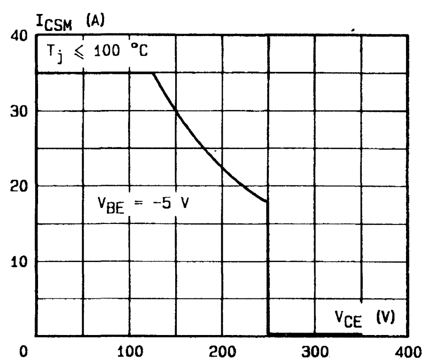
TRANSISTOR REVERSE BIASED
- During the turn-off with negative base-emitter voltage.



Reverse Biased Safe Operating Area (RBSOA).



Reverse Biased Accidental Overload Area (RBAOA).



After the acidental overload current the RBAOA has to be used for the turn-off.

High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

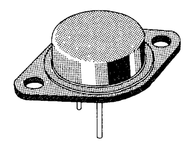
SGS-THOMSON MICROELECTRONICS

BUX10

HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

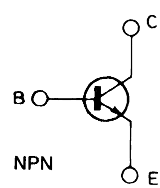
DESCRIPTION

The BUX10 is a silicon multiepitaxial planar NPN transistor in Jedec TO-3 metal case, intended for use in switching and linear applications in military and industrial equipment.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	160	V
V_{CEX}	Collector-emitter Voltage ($V_{BE} = -1.5$ V)	160	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	125	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	25	A
I_{CM}	Collector Peak Current ($t_p = 10$ ms)	30	A
I_B	Base Current	5	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	150	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

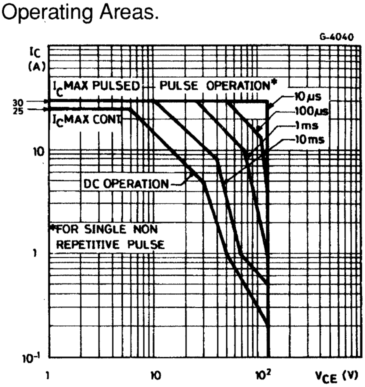
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.17	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

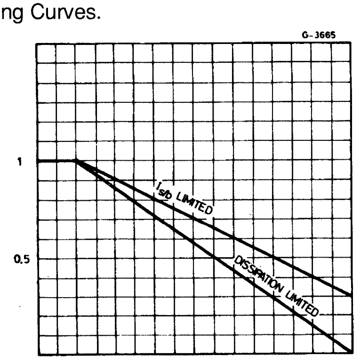
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 100 V			1.5	mA
I_{CEX}	Collector Cutoff Current	V_{CE} = 160 V V_{BE} = − 1.5 V T_{case} = 125 °C V_{CE} = 160 V V_{BE} = − 1.5 V			1.5 6	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 200 mA	125			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50 mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10 A I_B = 1 A I_C = 20 A I_B = 2 A		0.3 0.7	0.6 1.2	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 20 A I_B = 2 A		1.6	2	V
h_{FE}*	DC Current Gain	I_C = 10 A V_{CE} = 2 V I_C = 20 A V_{CE} = 4 V	20 10		60	
$I_{s/b}$	Second Breakdown Collector Current	V_{CE} = 30 V t = 1 s V_{CE} = 48 V t = 1 s	5 1			A A
f_T	Transition Frequency	I_C = 1 A V_{CE} = 15 V f = 10 MHz	8			MHz
t_{on}	Turn-on Time (fig. 2)	I_C = 20 A I_{B1} = 2 A V_{CC} = 30 V		0.5	1.5	µs
t_s	Storage Time (fig. 2)	I_C = 20 A I_{B1} = − I_{B2} = 2 A V_{CC} = 30 V		0.6	1.2	µs
t_f	Fall Time (fig. 2)			0.15	0.3	µs
	Clamped $E_{s/b}$ Collector Current (fig. 1)	V_{clamp} = 125 V L = 500 µH	20			A

* Pulsed : pulse duration = 300 µs, duty cycle ≤ 2 %.

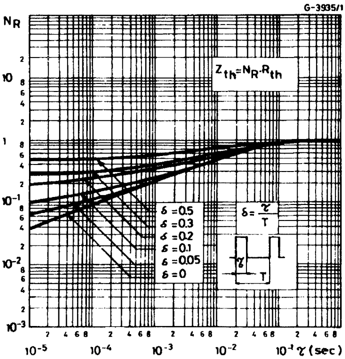
Safe Operating Areas.



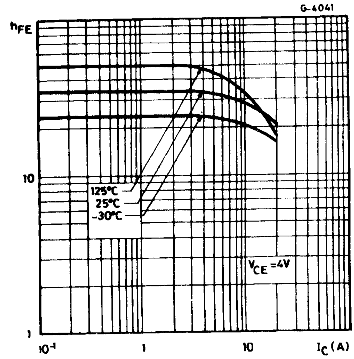
Derating Curves.



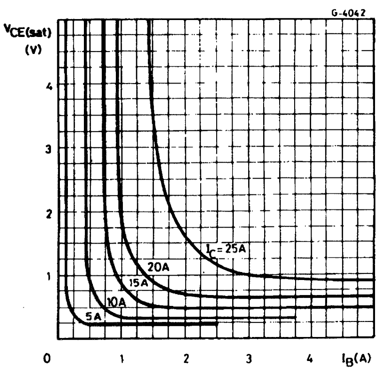
Thermal Transient Response.



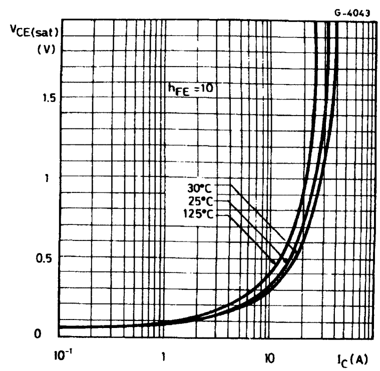
DC Current Gain.



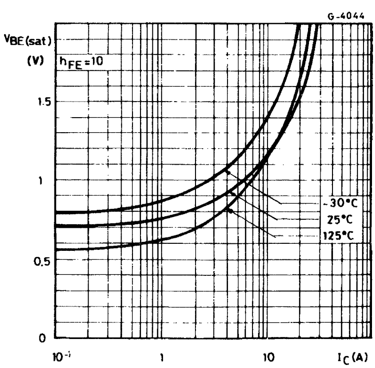
Collector-emitter Saturation Voltage.



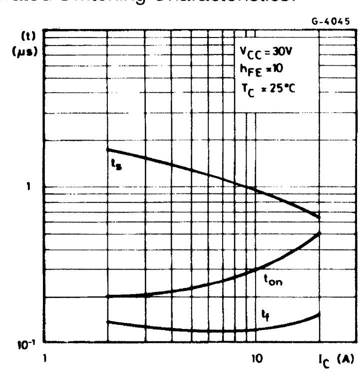
Collector-emitter Saturation Voltage.



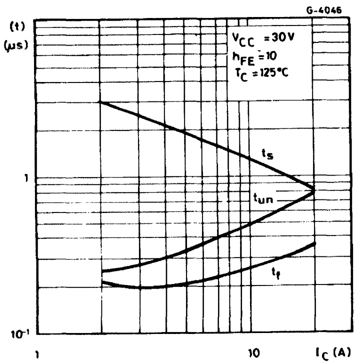
Base-emitter Saturation Voltage.



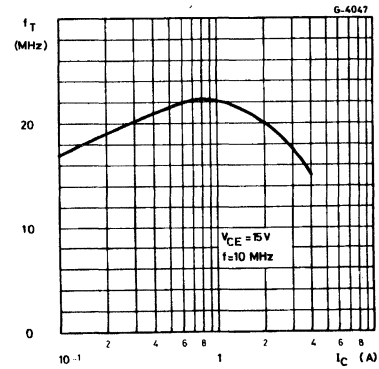
Saturated Switching Characteristics.



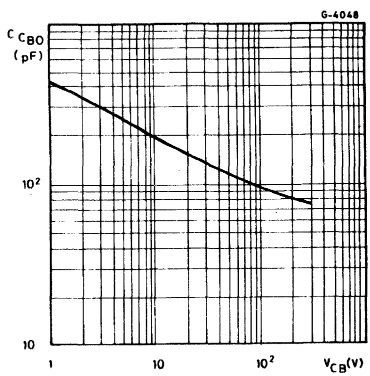
Saturated Switching Characteristics.



Transition Frequency.



Collector-base Capacitance.



Clamped Reverse Bias Safe Operating Area.

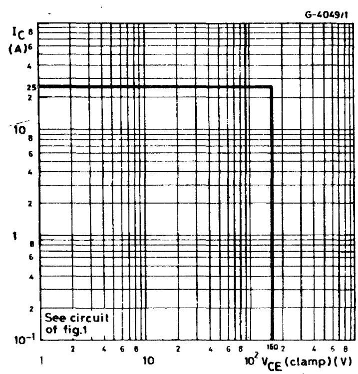


Figure 1 : Clamped $E_{s/b}$ Test Circuit.

TEST CONDITIONS :
7 V ≥ |- V_{BB}| ≥ 2 V
I_C / I_B = 10

t_P = adjusted for
nominalm 1_C
R_{BB} ≥ 1 Ω

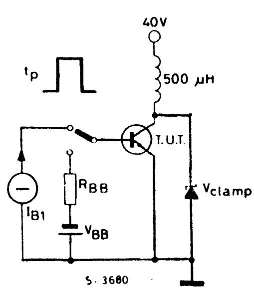
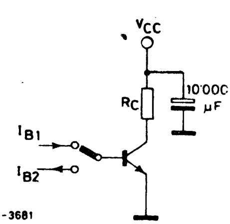


Figure 2 : Switching Times Test Circuit (resitive load).

TEST CONDITIONS :
V_{CC} = 30 V
$R_C = \frac{V_{CC} - V_{CE(sat)}}{I_C}$
INPUT PULSE
pulse width = 10 µs
t_r, t_f ≤ 50 ns
duty cycle = 1 %



SGS-THOMSON MICROELECTRONICS

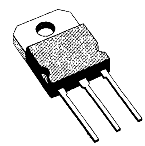
BUX10P

HIGH CURRENT, HIGH SPEED, POWER TRANSISTOR

ADVANCE DATA

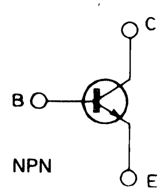
DESCRIPTION

The BUX10P is a silicon multiepitaxial planar NPN transistor in SOT-93 case, intended for use in switching and linear applications in military and industrial equipment.



SOT-93

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	160	V
V_{CEX}	Collector-emitter Voltage ($V_{BE} = 1.5$ V)	160	V
V_{CEO}	Collector-emitter ($I_B = 0$)	125	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	25	A
I_{CM}	Collector Peak Current ($t_p = 10$ ms)	30	A
I_B	Base Current	5	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	106	W
T_{stg}	Storage Temperature	– 65 to 150	°C
T_j	Junction Temperature	150	°C

This is advanced information on a new product now in development or undergoing evaluation. Details are subject to change without notice.

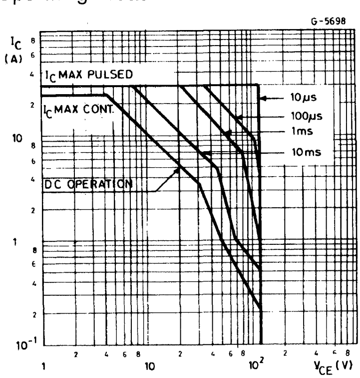
THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.17	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 100 V			1.5	mA
I_{CEX}	Collector Cutoff Current	V_{CE} = 160 V V_{BE} = – 1.5 V T_{case} = 125 °C V_{CE} = 160 V V_{BE} = – 1.5 V			1.5 6	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$	Collector-emitter Sustaining Voltage	I_C = 200 mA	125			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50 mA	7			V
$V_{CE(sat)}$	Collector-emitter Saturation Voltage	I_C = 10 A I_B = 1 A I_C = 20 A I_B = 2 A		0.3 0.7	0.6 1.2	V V
$V_{BE(sat)}$	Base-emitter Saturation Voltage	I_C = 20 A I_B = 2 A		1.6	2	V
h_{FE}	DC Current Gain	I_C = 10 A V_{CE} = 2 V I_C = 20 A V_{CE} = 4 V	20 10		60	
$I_{s/b}$	Second Breakdown Collector Current	V_{CE} = 30 V t = 1 s V_{CE} = 48 V t = 1 s	3.53 1			A A
f_T	Transition Frequency	I_C = 1 A V_{CE} = 15 V f = 10 MHz	8			MHz
t_{on}	Turn-on Time	I_C = 20 A I_{B1} = 2 A V_{CC} = 30 V		0.5	1.5	µs
t_s	Storage Time	I_C = 20 A I_{B1} = I_{B2} = 2 A V_{CC} = 30 V		0.6	1.2	µs
t_f	Fall Time			0.15	0.3	µs
	Clamped $E_{s/b}$ Collector Current	V_{clamp} = 125 V L = 500 µH	20			A

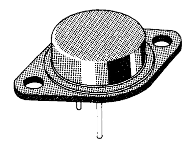
Safe Operating Areas.



HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

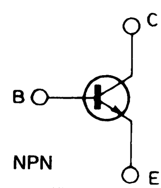
DESCRIPTION

The BUX11 is a silicon multiepitaxial NPN transistor in Jedec TO-3 metal case, intended for use in switching and linear applications in military and industrial equipment.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	250	V
V_{CEX}	Collector-emitter Voltage ($V_{BE} = -1.5$ V)	250	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	200	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	20	A
I_{CM}	Collector Peak Current ($t_p = 10$ ms)	25	A
I_B	Base Current	4	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	150	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

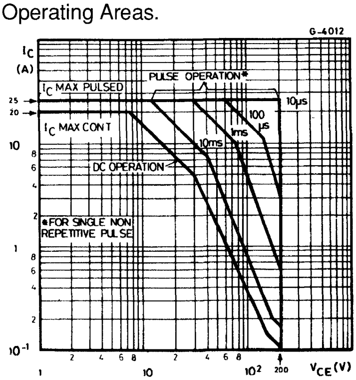
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case Max	1.17	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

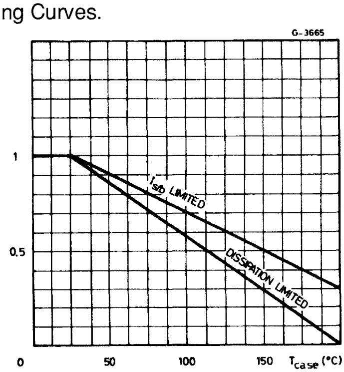
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 160 V			1.5	mA
I_{CEX}	Collector Cutoff Current	V_{CE} = 250 V V_{BE} = – 1.5 V V_{CE} = 250 V V_{BE} = – 1.5 V T_{case} = 125 °C			1.5 6	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 200 mA	200			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50 mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 6 A I_B = 0.6 A I_C = 12 A I_B = 1.5 A		0.3 0.6	0.6 1.5	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 12 A I_B = 1.5 A		1.3	1.5	V
h_{FE}*	DC Current Gain	I_C = 6 A V_{CE} = 2 V I_C = 12 A V_{CE} = 4 V	20 10		60	
$I_{s/b}$	Second Breakdown Collector Current	V_{CE} = 30 V t = 1 s V_{CE} = 140 V t = 1 s	5 0.15			A A
f_T	Transition Frequency	I_C = 1 A V_{CE} = 15 V f = 10 MHz	8			MHz
t_{on}	Turn-on Time (fig. 2)	I_C = 12 A I_{B1} = 1.5 A V_{CC} = 150 V		0.3	1	µs
t_s	Storage Time (fig. 2)	I_C = 12 A I_{B1} = 1.5 A I_{B2} = – 1.5 A V_{CC} = 150 V		1.2	1.8	µs
t_f	Fall Time (fig. 2)			0.24	0.4	µs
	Clamped $E_{s/b}$ Collector Current (fig. 1)	V_{clamp} = 200 V L = 500 µH	12			A

* Pulsed : pulse duration = 300 µs, duty cycle ≤ 2 %.

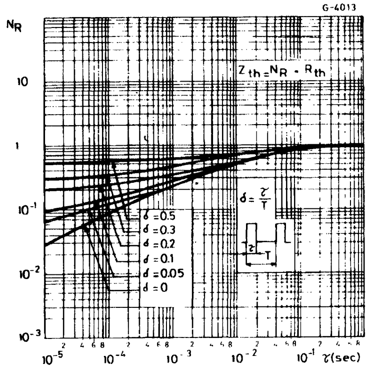
Safe Operating Areas.



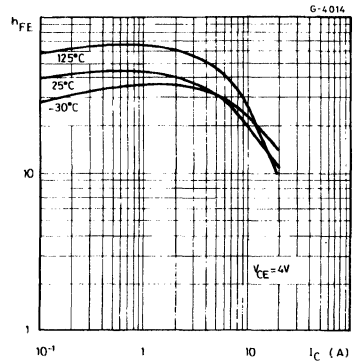
Derating Curves.



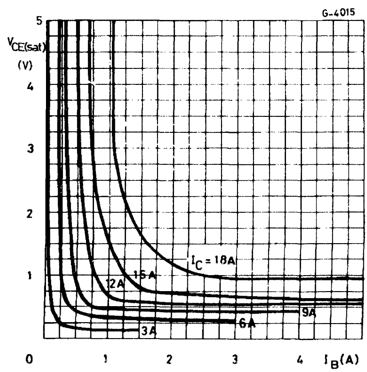
Thermal Transient Response.



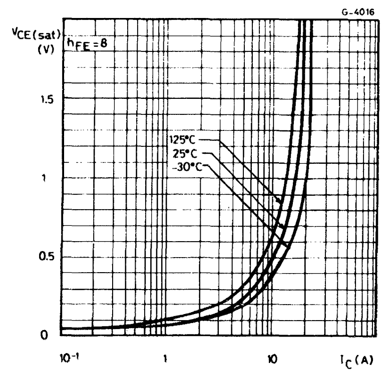
DC Current Gain.



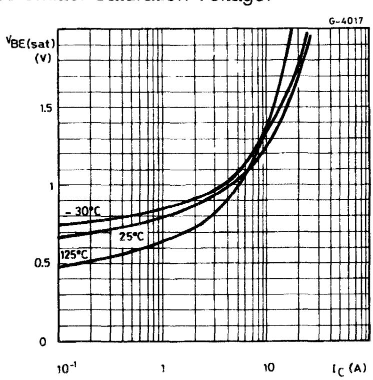
Collector-emitter Saturation Voltage.



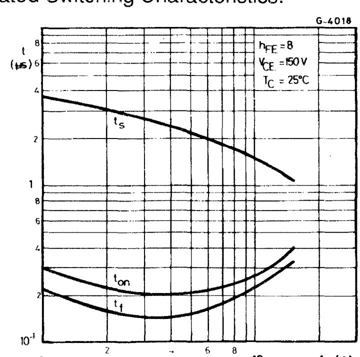
Collector-emitter Saturation Voltage.



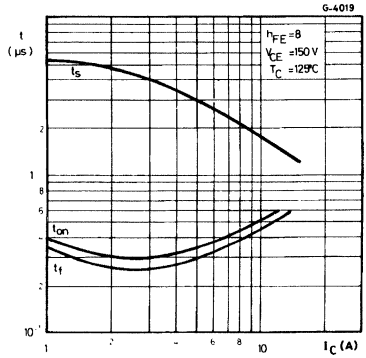
Base-emitter Saturation Voltage.



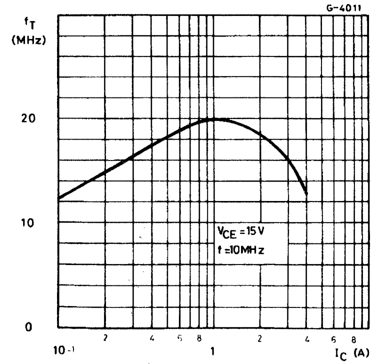
Saturated Switching Characteristics.



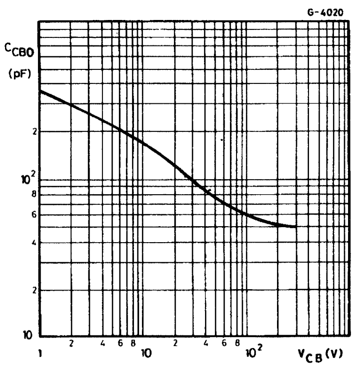
Saturated Switching Characteristics.



Transition Frequency.



Collector-base Capacitance.



Clamped Reverse Bias Safe Operating Area.

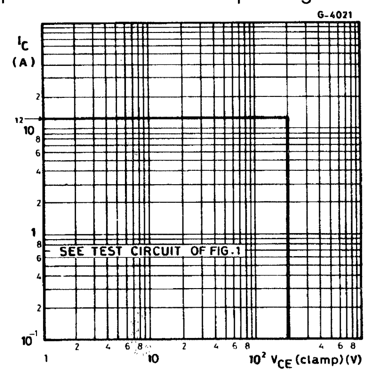


Figure 1 : Clamped $E_{s/b}$ Test Circuit.

TEST CONDITIONS :
$7\ V \geq |-V_{BB}| \geq 2\ V$
$I_C / I_B = 8$

t_P = adjusted for nominal I_C
$R_{BB} \geq 1\ \Omega$

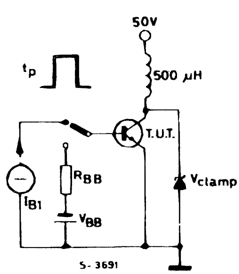
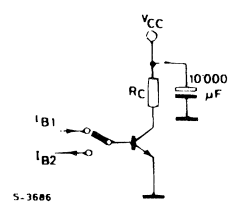


Figure 2 : Switching Times Test Circuit (resitive load).

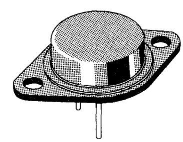
TEST CONDITIONS :
V_{CC} = 150 V
$R_C = \dfrac{V_{CC} - V_{CE(sat)}}{I_C}$
INPUT PULSE
pulse width = 10 µs
t_r, $t_f \leq 50$ ns
duty cycle = 1 %



HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

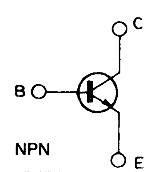
DESCRIPTION

The BUX11 is a silicon multiepitaxial NPN transistor in Jedec TO-3 metal case, intended for use in switching and linear applications in military and industrial equipment.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	220	V
V_{CEX}	Collector-emitter Voltage ($V_{BE} = -1.5$ V)	220	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	160	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	20	A
I_{CM}	Collector Peak Current ($t_p = 10$ ms)	25	A
I_B	Base Current	5	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	150	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

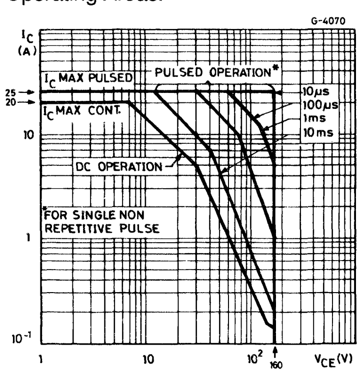
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.17	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

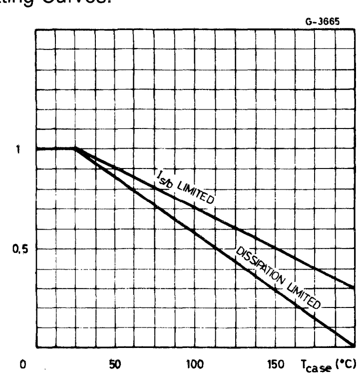
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 130 V			1.5	mA
I_{CEX}	Collector Cutoff Current	V_{CE} = 220 V V_{BE} = − 1.5 V V_{CE} = 220 V V_{BE} = − 1.5 V T_{case} = 125 °C			1.5 6	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 200 mA L = 25 mH	160			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50 mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 8 A I_B = 0.8 A I_C = 15 A I_B = 1.88 A		0.3 0.6	0.6 1.5	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 15 A I_B = 1.88 A		1.4	1.8	V
h_{FE}*	DC Current Gain	I_C = 8 A V_{CE} = 2 V I_C = 15 A V_{CE} = 4 V	20 10		60	
$I_{s/b}$	Second Breakdown Collector Current	V_{CE} = 30 V t = 1 s V_{CE} = 140 V t = 1 s	5 0.15			A A
f_T	Transition Frequency	V_{CE} = 15 V I_C = 1 A f = 10 MHz	8			MHz
t_{on}	Turn-on Time (fig. 2)	I_C = 15 A I_{B1} = 1.88 A V_{CC} = 30 V		0.4	1.5	μs
t_s	Storage Time (fig. 2)	I_C = 15 A I_{B1} = − I_{B2} = 1.88A V_{CC} = 30 V		0.75	1.5	μs
t_f	Fall Time (fig. 2)			0.14	0.5	μs
	Clamped $E_{s/b}$ Collector Current (fig. 1)	V_{clamp} = 160 V L = 500 μH	15			A

* Pulsed : pulse duration = 300μs, duty cycle ≤ 2%.

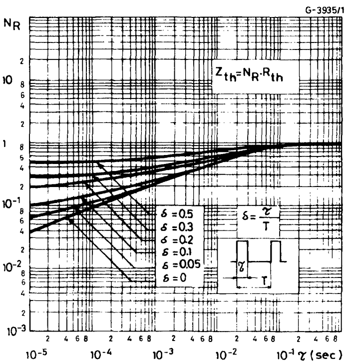
Safe Operating Areas.



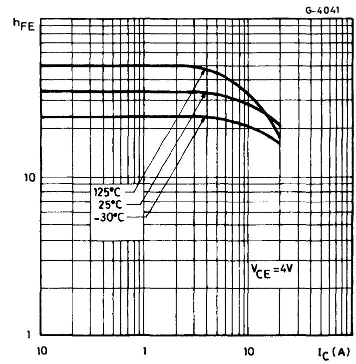
Derating Curves.



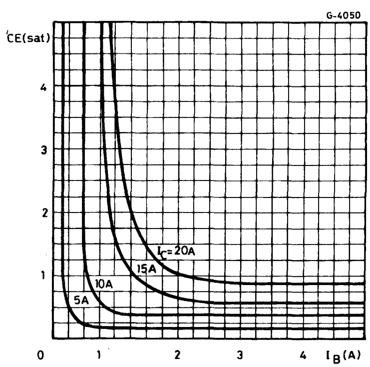
Thermal transient Response.



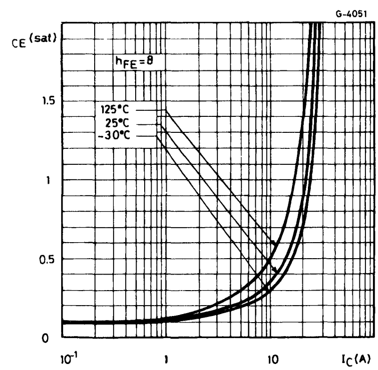
DC Current Gain.



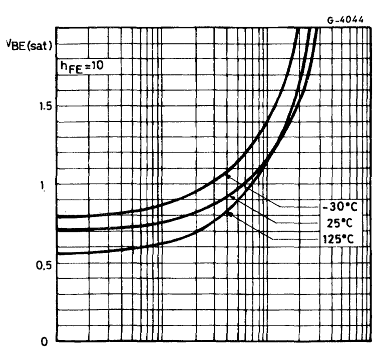
Collector-emitter Saturation Voltage.



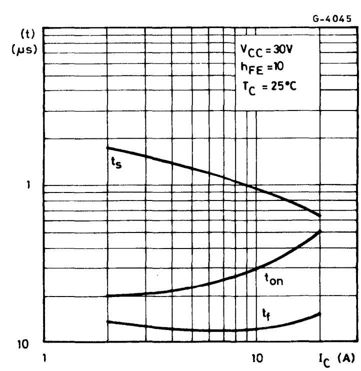
Collector-emitter Saturation Voltage.



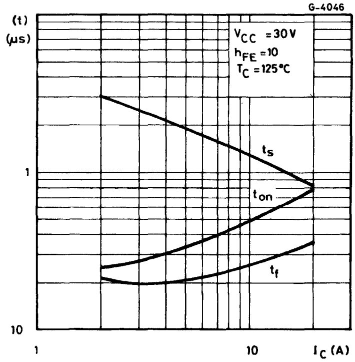
Base-emitter Saturation Voltage.



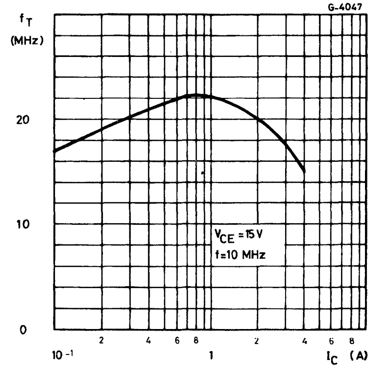
Saturated Switching Characteristics.



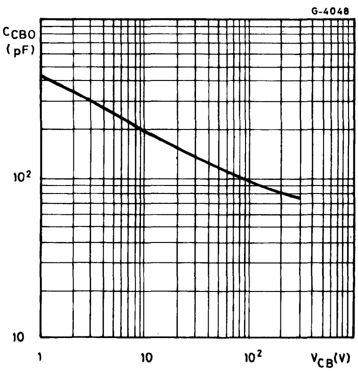
Saturated Switching Characteristics.



Transition Frequency.



Collector-base Capaciatnce.



Clamped Reverse Bias Safe

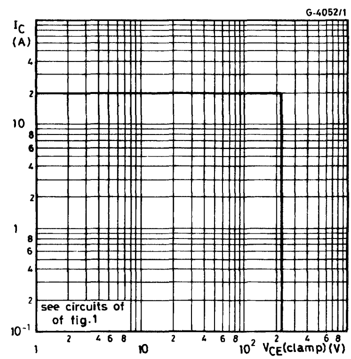


Figure 1 : Clamped $E_{s/b}$ Test Circuit.

TEST CONDITIONS :
7 V ≥ |- V_{BB}| ≥ 2 V
I_C/I_B = 8

t_P = adjusted for
nominal I_C
R_{BB} ≥ 1 Ω

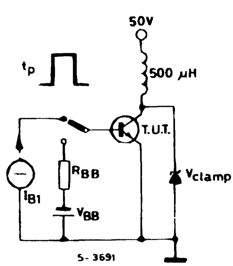
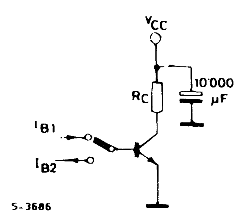


Figure 2 : Switching Times Test Circuit (resistive load).

TEST CONDITIONS :
V_{CC} = 30 V

$$R_C = \frac{V_{CC} - V_{CE(sat)}}{I_C}$$

INPUT PULSE
pulse width = 10 μs
t_r, t_f ≤ 50 ns
duty cycle = 1 %



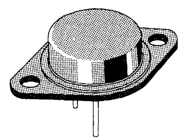
SGS-THOMSON
MICROELECTRONICS

BUX12

HIGH CURRENT, HIGH SPEED, HIGH POWER

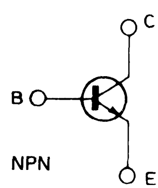
DESCRIPTION

The BUX12 is a silicon multiepitaxial planar NPN transistor in Jedec TO-3 metal case, intended for use in switching and linear applications in military and industrial equipment.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	300	V
V_{CEX}	Collector-emitter Voltage ($V_{BE} = -1.5$ V)	300	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	250	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	20	A
I_{CM}	Collector Peak Current ($t_p = 10$ ms)	25	A
I_B	Base Current	4	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	150	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

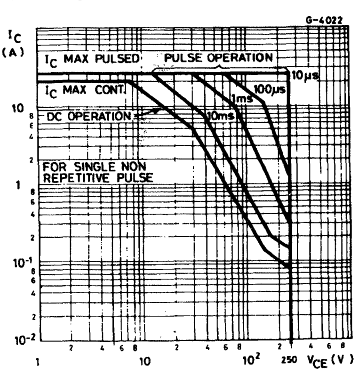
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.17	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

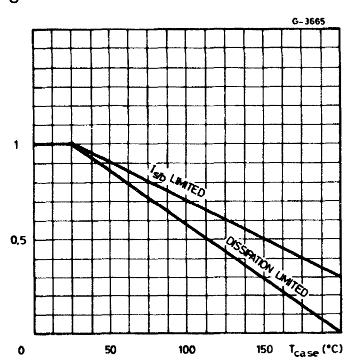
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 200 V			1.5	mA
I_{CEX}	Collector Cutoff Current	V_{CE} = 300 V V_{BE} = – 1.5 V T_{case} = 125 °C V_{CE} = 300 V V_{BE} = – 1.5 V			1.5 6	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 200 mA	250			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50 mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5 A I_B = 0.5 A I_C = 10 A I_B = 1.25 A		0.22 0.5	1 1.5	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 10 A I_B = 1.25 A		1.23	1.5	V
h_{FE}*	DC Current Gain	I_C = 5 A V_{CE} = 4 V I_C = 10 A V_{CE} = 4 V	20 10		60	
$I_{s/b}$	Second Breakdown Collector Current	V_{CE} = 30 V t = 1 s V_{CE} = 140 V t = 1 s	5 0.15			A A
f_T	Transition Frequency	I_C = 1 A V_{CE} = 15 V f = 10 MHz	8			MHz
t_{on}	Turn-on Time (fig. 2)	I_C = 10 A I_{B1} = 1.25 A V_{CC} = 150 V		0.28	1	µs
t_s	Storage Time (fig. 2)	I_C = 10 A I_{B1} = 1.25 A I_{B2} = – 1.25 A V_{CC} = 150 V		1.45	2	µs
t_f	Fall Time (fig. 2)			0.23	0.5	µs
	Clamped $E_{s/b}$ Collector Current (fig. 1)	V_{clamp} = 250 V L = 500 µH	10			A

* Pulsed : pulse duration = 300 µs, duty cycle ≤ 2 %.

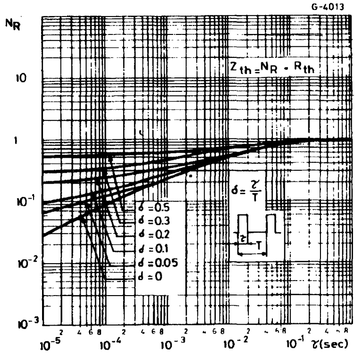
Safe Operating Areas.



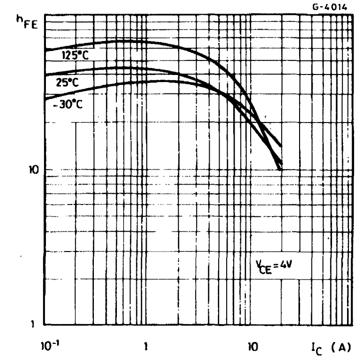
Derating Curves.



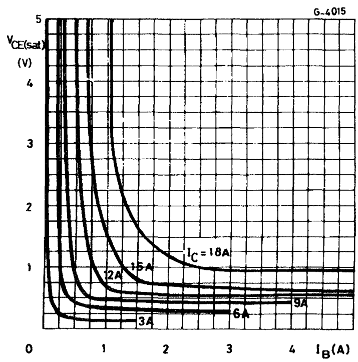
Thermal Transient Response.



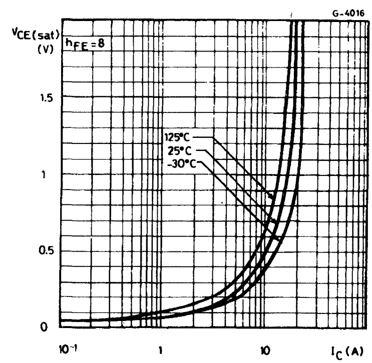
DC Current Gain.



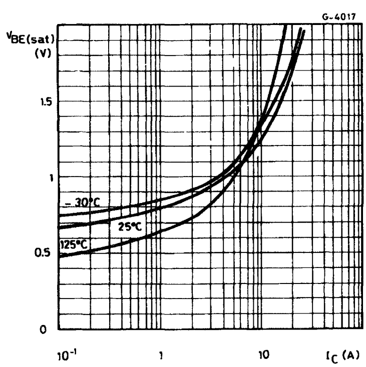
Collector-emitter Saturation Voltage.



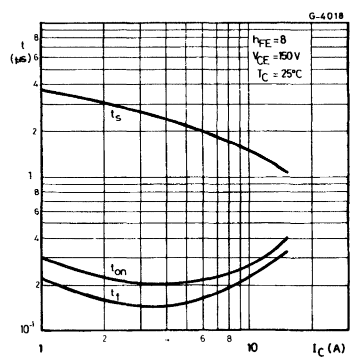
Collector-emitter Saturation Voltage.



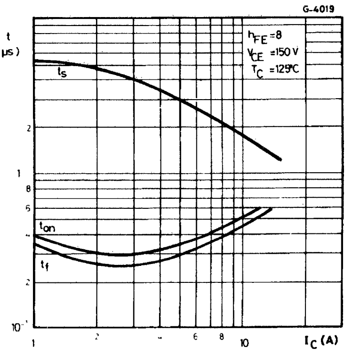
Base-emitter Saturation Voltage.



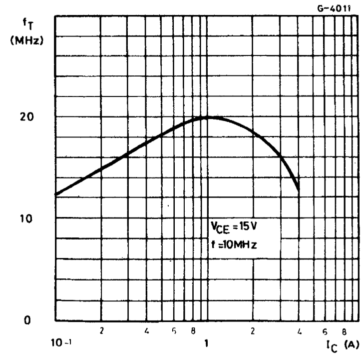
Saturated Switching Characteristics.



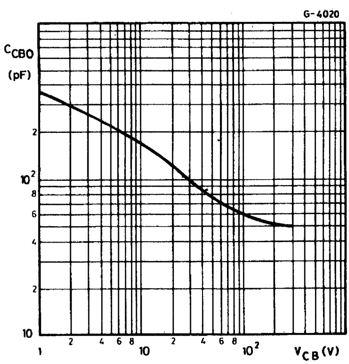
Saturated Switching Characteristics.



Transition Frequency.



Collector-base Capacitance.



Clamped Reverse Bias Safe Operating Area.

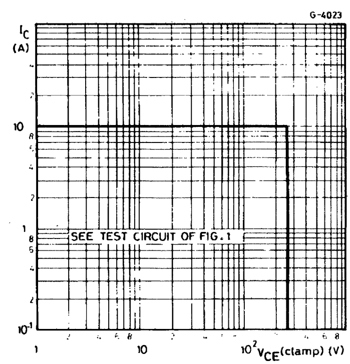


Figure 1 : Clamped $E_{s/b}$ Test Circuit.

TEST CONDITIONS :
7 V ≥ |- V_{BB}| ≥ 2 V
I_C / I_B = 8

t_P = adjusted for nominal I_C
R_{BB} ≥ 1 Ω

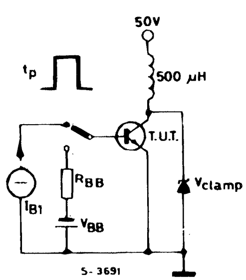
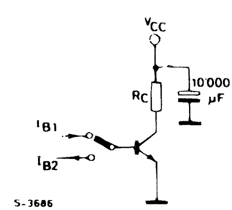


Figure 2 : Switching Times Test Circuit (resistive load).

TEST CONDITIONS :
V_{CC} = 150 V

$$R_C = \frac{V_{CC} - V_{CE(sat)}}{I_C}$$

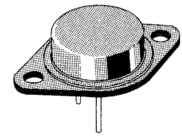
INPUT PULSE
pulse width = 10 μs
t_r, t_f ≤ 50 ns
duty cycle = 1 %



HIGH VOLTAGE POWER SWITCH

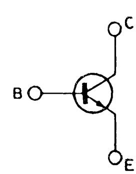
DESCRIPTION

The BUX13 is a silicon multiepitaxial mesa NPN transistor in Jedec TO-3 metal case, intended for high voltage, fast switching applications.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	400	V
V_{CER}	Collector-emitter Voltage ($R_{BE} \leq 100\ \Omega$)	390	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	325	V
V_{EBO}	Base-emitter Voltage (I_C = 0)	7	V
I_C	Collector Current	15	A
I_{CM}	Collector Peak Current ($t_p \leq 10$ ms)	20	A
I_B	Base Current	3	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	150	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.17	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 400 V V_{CE} = 400 V T_{case} = 125 °C			1.5 6	mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 260 V			1.5	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA	325			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 4 A I_B = 0.8 A I_C = 8 A I_B = 1.6 A			0.8 1.5	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 8 A I_B = 1.6 A			1.5	V
h_{FE}*	DC Current Gain	I_C = 4 A V_{CE} = 4 V I_C = 8 A V_{CE} = 4 V	15 8		60	
f_T	Transition Frequency	I_C = 1 A V_{CE} = 15 V f = 10 MHz	8			MHz
t_{on}	Turn-on Time	I_C = 8 A I_{B1} = 1.6 A V_{CC} = 150 V			1.2	μs
t_s	Storage Time	I_C = 8 A I_{B1} = − I_{B2} = 1.6 A V_{CC} = 150 V			2.5	μs
t_f	Fall Time				1	μs

* Pulsed : pulse duration = 300μs, duty cycle ≤ 2%.

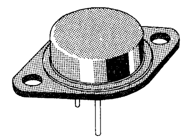
SGS-THOMSON MICROELECTRONICS

BUX14

HIGH VOLTAGE POWER SWITCH

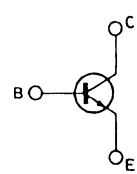
DESCRIPTION

The BUX14 is a silicon multiepitaxial mesa NPN transistor in Jedec TO-3 metal case, intended for high voltage, fast switching applications.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	450	V
V_{CER}	Collector-emitter Voltage ($R_{BE} \leq 100\ \Omega$)	440	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	400	V
V_{EBO}	Base-emitter Voltage (I_C = 0)	7	V
I_C	Collector Current	10	A
I_{CM}	Collector Peak Current ($t_p \leq 10$ ms)	15	A
I_B	Base Current	2	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	150	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.17	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

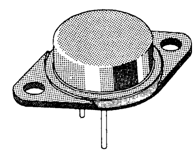
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 450 V V_{CE} = 450 V T_{case} = 125 °C			1.5 6	mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 320 V			1.5	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA	400			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 3 A I_B = 0.6 A I_C = 6 A I_B = 1.2 A			0.6 1.5	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 6 A I_B = 1.2 A			1.5	V
h_{FE}*	DC Current Gain	I_C = 3 A V_{CE} = 4 V I_C = 6 A V_{CE} = 4 V	15 8		60	
f_T	Transition Frequency	I_C = 1 A V_{CE} = 15 V f = 10 MHz	8			MHz
t_{on}	Turn-on Time	I_C = 6 A I_{B1} = 1.2 A V_{CC} = 150 V			1.4	µs
t_s	Storage Time	I_C = 6 A I_{B1} = − I_{B2} = 1.2 A V_{CC} = 150 V			3	µs
t_f	Fall Time				1.2	µs

* Pulsed : pulse duration = 300 µs, duty cycle ≤ 2 %.

HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

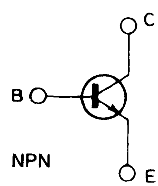
DESCRIPTION

The BUX20 is a silicon multiepitaxial planar NPN transistor in modified Jedec TO-3 metal case, intended for use in switching and linear applications in military and industrial equipment.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	160	V
V_{CEX}	Collector-emitter Voltage ($V_{BE} = -1.5$ V)	160	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	125	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	50	A
I_{CM}	Collector Peak Current ($t_p = 10$ ms)	60	A
I_B	Base Current	10	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	350	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

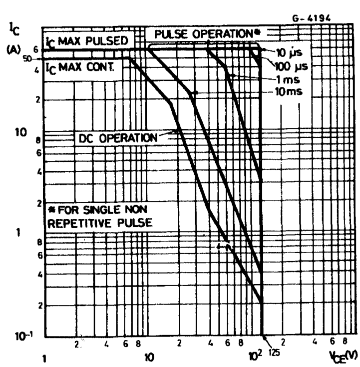
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	0.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

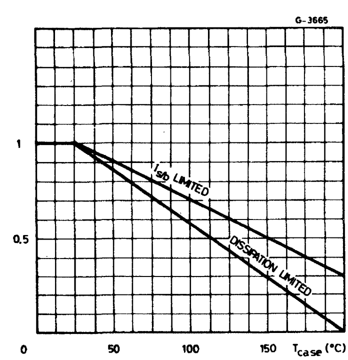
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 100 V			3	mA
I_{CEX}	Collector Cutoff Current	V_{CE} = 160 V V_{BE} = − 1.5 V T_{case} = 125 °C V_{BE} = − 1.5 V V_{CE} = 160 V			3 12	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 200 mA	125			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50 mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 25 A I_B = 2.5 A I_C = 50 A I_B = 5 A		0.3 0.55	0.6 1.2	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 50 A I_B = 5 A		1.35	2	V
h_{FE}*	DC Current Gain	I_C = 25 A V_{CE} = 2 V I_C = 50 A V_{CE} = 4 V	20 10		60	
$I_{s/b}$	Second Breakdown Collector Current	V_{CE} = 40 V t = 1 s V_{CE} = 20 V t = 1 s	1.5 17.5			A A
f_T	Transition Frequency	V_{CE} = 15 V I_C = 2 A f = 10 MHz	8			MHz
t_{on}	Turn-on Time (fig. 2)	I_C = 50 A I_{B1} = 5 A V_{CC} = 60 V		0.4	1.5	µs
t_s	Storage Time (fig. 2)	I_C = 50 A I_{B1} = 5 A I_{B2} = − 5 A V_{CC} = 60 V		0.85	1.2	µs
t_f	Fall Time (fig. 2)			0.1	0.3	µs
	Clamped $E_{s/b}$ Collector Current (fig. 1)	V_{clamp} = 125 V L = 500 µH	50			A

* Pulsed : pulse duration = 300µs, duty cycle ≤ 2%.

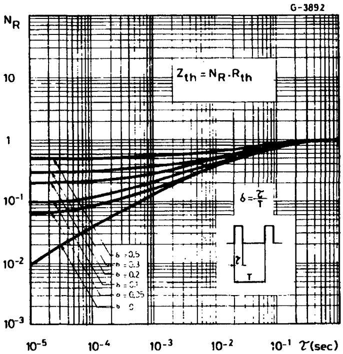
Safe Operating Areas.



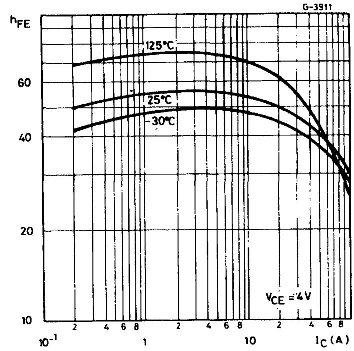
Derating Curves.



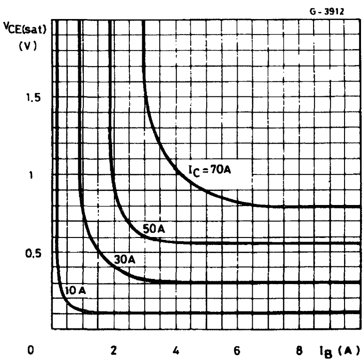
Thermal Transient Response.



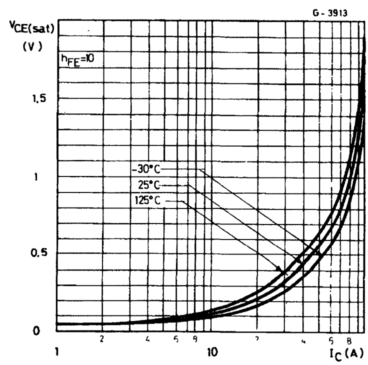
DC Current Gain.



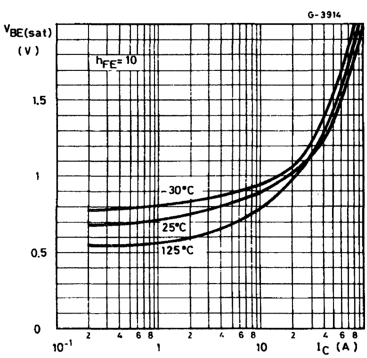
Collector-emitter Saturation Voltage.



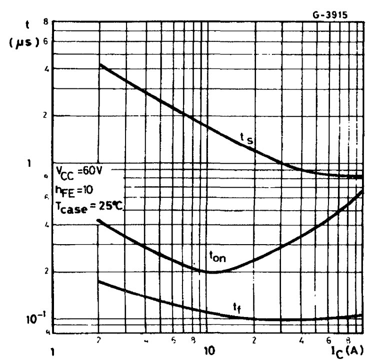
Collector-emitter Saturation Voltage.



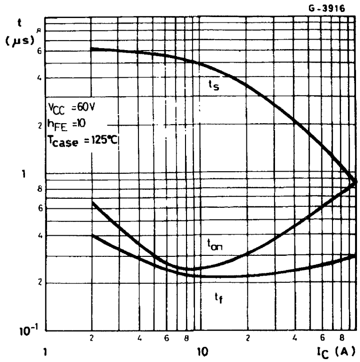
Base-emitter Saturation Voltage.



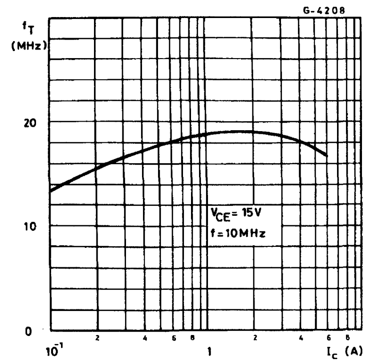
Saturated Switching Characteristics.



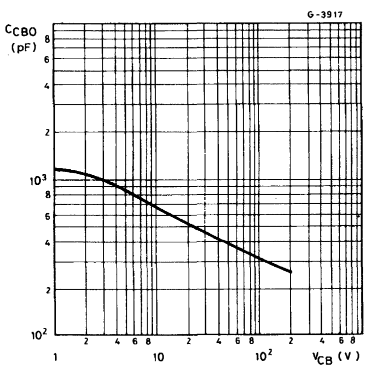
Saturated Switching Characteristics.



Transition Frequency.



Collector-base Capacitance.



Clamped Reverse Bias Safe Operating Area.

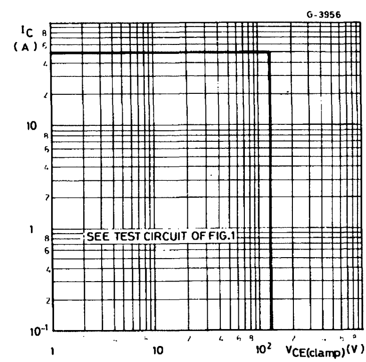


Figure 1 : Clamped $E_{s/b}$ Test Circuit.

TEST CONDITIONS :

$7V \geq |-V_{BB}| \geq 2V$

$I_C / I_B = 10$

t_P = adjusted for nominal I_C

$R_{BB} \geq 1\Omega$

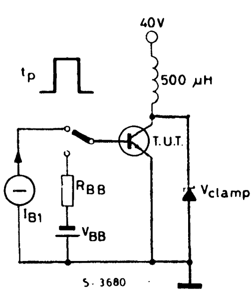


Figure 2 : Switching Times Test Circuit (resistive load).

TEST CONDITIONS :

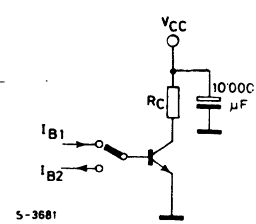
V_{CC} = 60V

$R_C = \dfrac{V_{CC} - V_{CE(sat)}}{I_C}$

INPUT PULSE

pulse width = 10μs

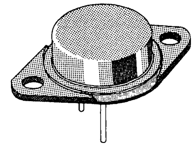
t_r, $t_f \leq$ 50ns



HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

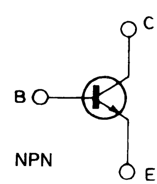
DESCRIPTION

The BUX21 is a silicon multiepitaxial planar NPN transistor in modified Jedec TO-3 metal case, intended for use in switching and linear applications in military and industrial equipment.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	250	V
V_{CEX}	Collector-emitter Voltage (V_{BE} = – 1.5 V)	250	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	200	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	40	A
I_{CM}	Collector Peak Current (t_p = 10 ms)	50	A
I_B	Base Current	8	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	350	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

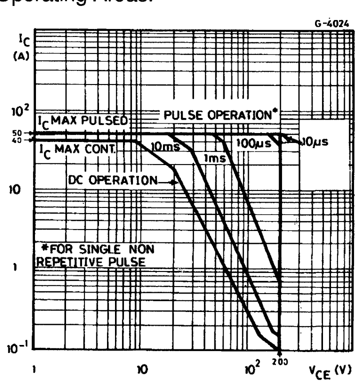
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	0.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

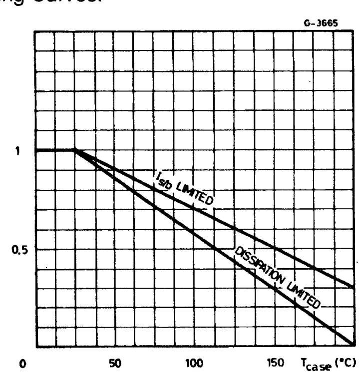
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 160 V			3	mA
I_{CEX}	Collector Cutoff Current	V_{CE} = 250 V V_{BE} = – 1.5 V T_{case} = 125 °C V_{CE} = 250 V V_{BE} = – 1.5 V			3 12	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 200 mA	200			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50 mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 12 A I_B = 1.2 A I_C = 25 A I_B = 3 A		0.22 0.4	0.6 1.5	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 25 A I_B = 3 A		1.2	1.5	V
h_{FE}*	DC Current Gain	I_C = 12 V_{CE} = 2 V I_C = 25 V_{CE} = 4 V	20 10		60	
$I_{s/b}$	Second Breakdown Collector Current	V_{CE} = 140 V t = 1 s V_{CE} = 20 V t = 1 s	0.15 17.5			A A
f_T	Transition Frequency	V_{CE} = 15 V I_C = 2 A f = 10 MHz	8			MHz
t_{on}	Turn-on Time (fig. 2)	I_C = 25 A I_{B1} = 3 A V_{CC} = 100 V		0.24	1.2	µs
t_s	Storage Time (fig. 2)	I_C = 25 A I_{B1} = 3 A I_{B2} = – 3 A V_{CC} = 100 V		1.3	1.8	µs
t_f	Fall Time (fig. 2)			0.18	0.4	µs
	Clamped $E_{s/b}$ Collector Current (fig. 1)	V_{clamp} = 200 V L = 500 µH	30			A

* Pulsed : pulse duration = 300µs, duty cycle ≤ 2%.

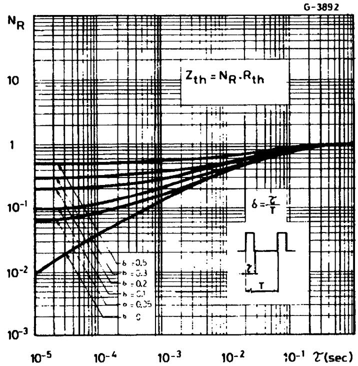
Safe Operating Areas.



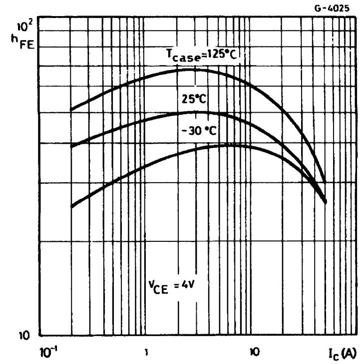
Derating Curves.



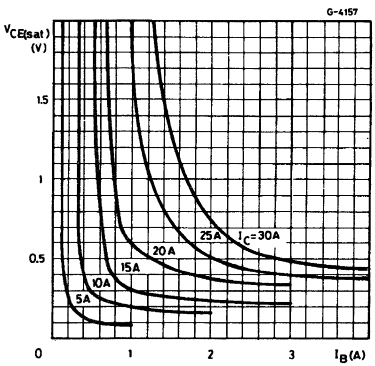
Thermal Transient Response.



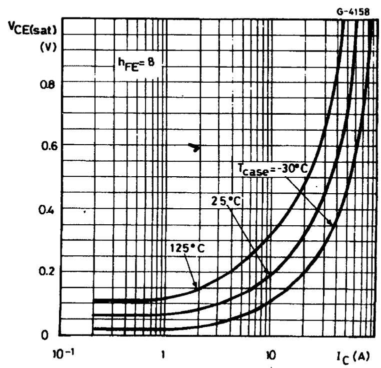
DC Current Gain.



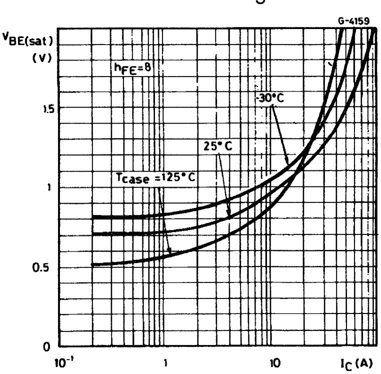
Collector-emitter Saturation Voltage.



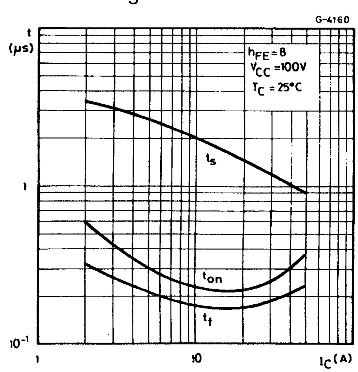
Collector-emitter Saturation Voltage.



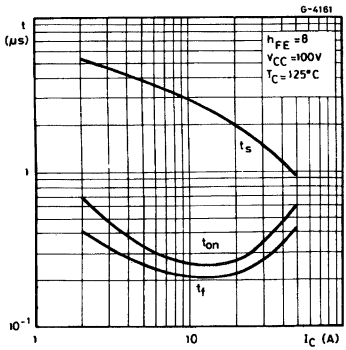
Base-emitter Saturation Voltage.



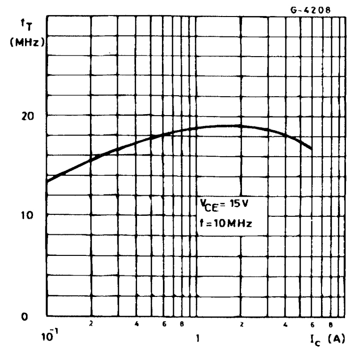
Saturated Switching Characteristics.



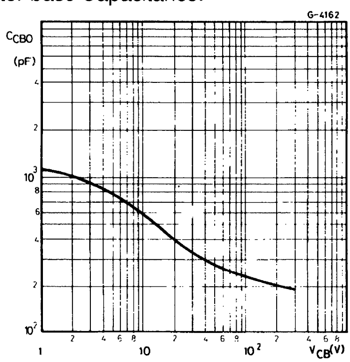
Saturated Switching Characteristics.



Transition Frequency.



Collector-base Capacitance.



Clamped Reverse Bias Safe Operating Area.

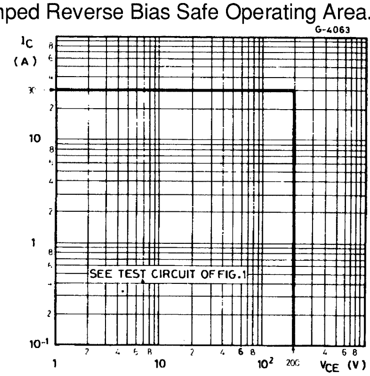


Figure 1 : Clamped $E_{s/b}$ Test Circuit.

TEST CONDITIONS :

$7V \geq |-V_{BB}| \geq 2V$

$I_C / I_B = 8$

t_P = adjusted for nominal I_C

$R_{BB} \geq 1\Omega$

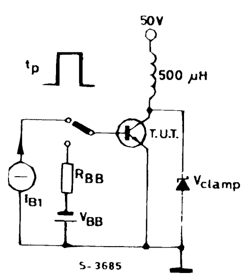


Figure 2 : Switching Times Test Circuit (resistive load).

TEST CONDITIONS :

V_{CC} = 100V

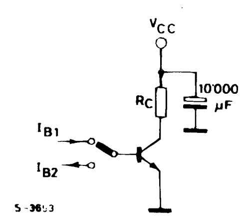
$R_C = \dfrac{V_{CC} - V_{CE(sat)}}{I_C}$

INPUT PULSE

pulse width = 5μs

t_r, $t_f \leq$ 50ns

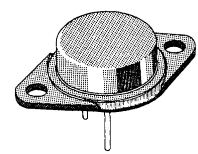
duty cycle = 1%



HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

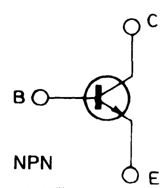
DESCRIPTION

The BUX22 is a silicon multiepitaxial planar NPN transistor in modified Jedec TO-3 metal case, intented for use in switching and linear applications in military and industrial equipment.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	300	V
V_{CEX}	Collector-emitter Voltage ($V_{BE} = -1.5$ V)	300	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	250	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	40	A
I_{CM}	Collector Peak Current ($t_p = 10$ ms)	50	A
I_B	Base Current	8	A
P_{tot}	Total Power Dissipation at $T_{case} \le 25$ °C	350	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

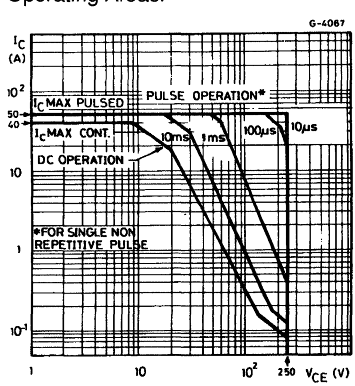
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	0.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

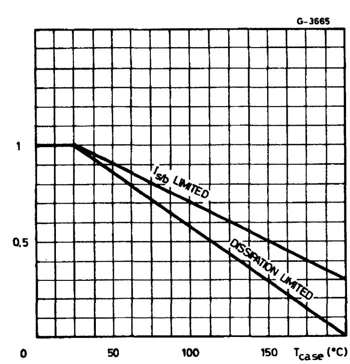
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 200 V			3	mA
I_{CEX}	Collector Cutoff Current	V_{CE} = 300 V V_{BE} = − 1.5 V T_{case} = 125 °C V_{CE} = 300 V V_{BE} = − 1.5 V			3 12	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 200 mA	250			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50 mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10 A I_B = 1 A I_C = 20 A I_B = 2.5 A		0.2 0.32	1 1.5	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 20 A I_B = 2.5 A		1.1	1.5	V
h_{FE}*	DC Current Gain	I_C = 10 A V_{CE} = 4 V I_C = 20 A V_{CE} = 4 V	20 10		60	
$I_{s/b}$	Second Breakdown Collector Current	V_{CE} = 140 V t = 1 s V_{CE} = 20 V t = 1 s	0.15 17.5			A A
f_T	Transition Frequency	I_C = 2 A V_{CE} = 15 V f = 10 MHz	10			MHz
t_{on}	Turn-on Time (fig. 2)	I_C = 20 A I_{B1} = 2.5 A V_{CC} = 100 V		0.22	1.3	μs
t_s	Storage Time (fig. 2)	I_C = 20 A I_{B1} = 2.5 A I_{B2} = − 2.5 A V_{CC} = 100 V		1.5	2	μs
t_f	Fall Time (fig. 2)			0.17	0.5	μs
	Clamped $E_{s/b}$ Collector Current (fig. 1)	V_{clamp} = 250 V L = 500 μH	25			A

* Pulsed : pulse duration = 300 μs, duty cycle ≤ 2 %.

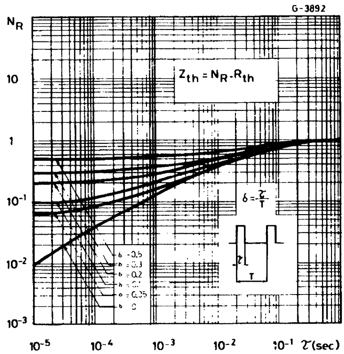
Safe Operating Areas.



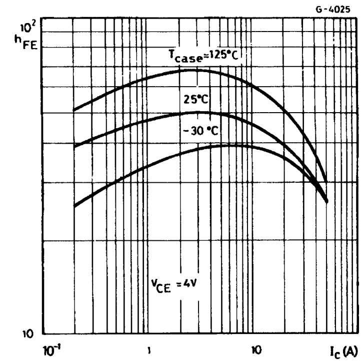
Derating Curves.



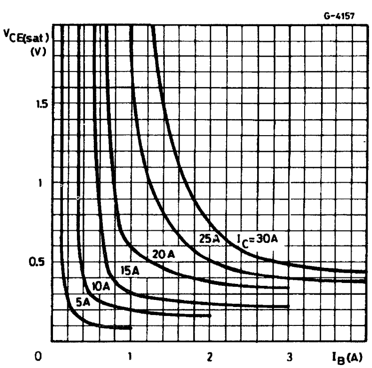
Thermal Transient Response.



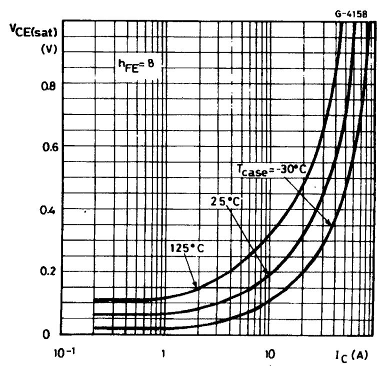
DC Current Gain.



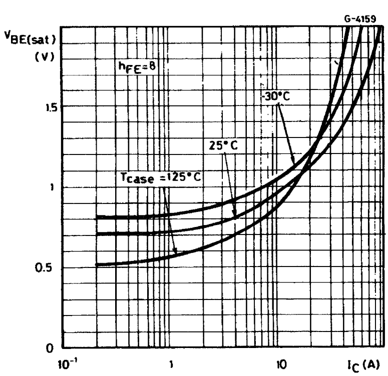
Collecteur-emitter Saturation Voltage.



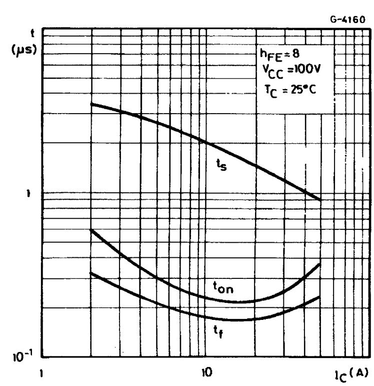
Collector-emitter Saturation Voltage.



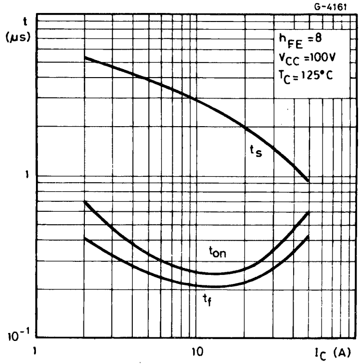
Base-emitter Saturation Voltage.



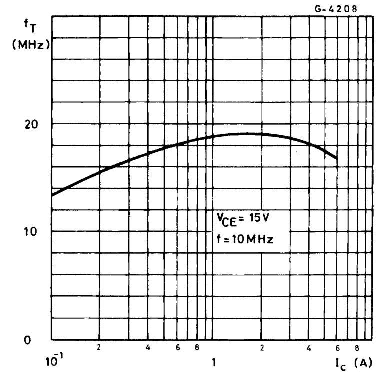
Saturated Switching Characteristics.



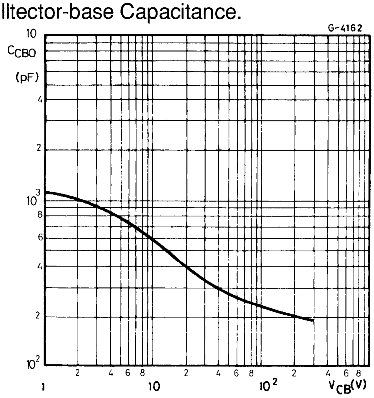
Saturated Switching Characteristics.



Transition Frequency.



Colltector-base Capacitance.



Clamped Reverse Bias Safe Operating Areas.

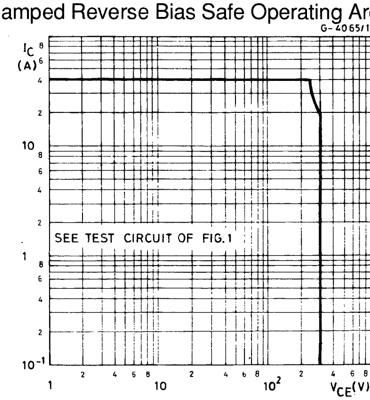
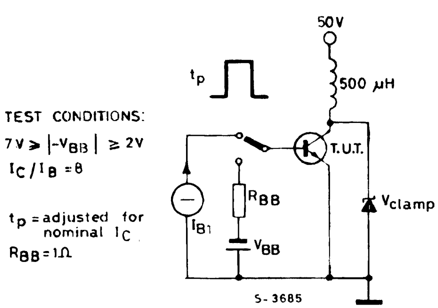
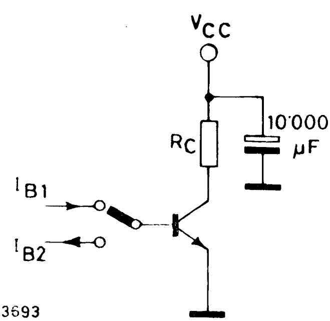


Figure 1 : Clamped $E_{s/b}$ Test Circuit.



TEST CONDITIONS :
7 V ≥ | – V_{BB} | ≥ 2 V
I_C / I_B = 8
t_p = adjusted for nominal I_C
R_{BB} ≥ 1 Ω

Figure 2 : Switching Times Test Circuit (resistive load).



TEST CONDITIONS :
V_{CC} = 100 V

$$R_C = \frac{V_{CC} - V_{CE(sat)}}{I_C}$$

INPUT PULSE
pulse width = 5 µs
t_r , t_f ≤ 50 ns
duty cycle = 1 %

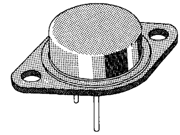
SGS-THOMSON
MICROELECTRONICS

BUX23

NPN SILICON TRANSISTOR

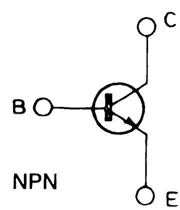
DESCRIPTION

High speed, high current, high power NPN transistor intended for use in switching and amplifier applications.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	400	V
V_{CER}	Collector-emitter Voltage	390	V
V_{CEX}	Collector-emitter Voltage	400	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	325	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	30	A
I_{CM}	Collector Peak Current ($t_p < 10ms$)	40	A
I_B	Base Current	6	A
P_{tot}	Total Dissipation at $T_c < 25°C$	350	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resitance Junction-case Max	0.5	°C/W

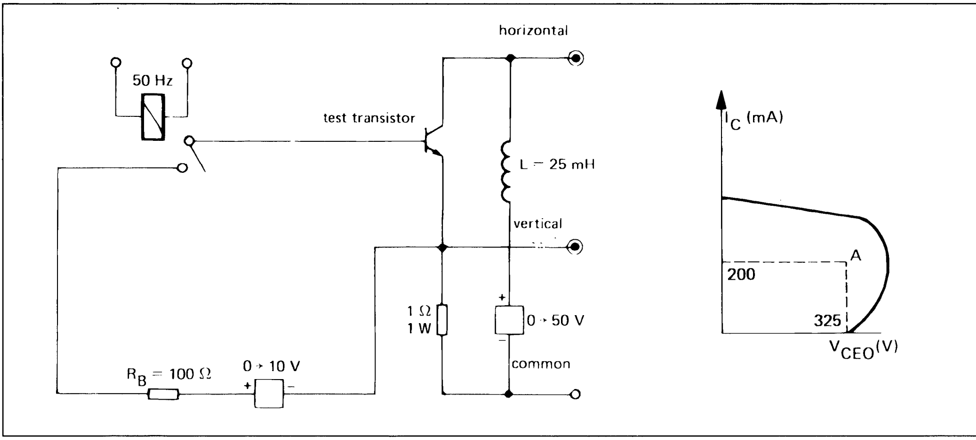
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEX}	Collector Cutoff Current	V_{CE} = 400V V_{BE} = – 1.5V V_{CE} = 400V V_{BE} = – 1.5V T_c = 125°C			3 12	mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 260V			3	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 200mA L = 25mH	325			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 8A I_B = 1.6A I_C = 16A I_B = 3.2A		0.2 0.35	0.8 1	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 16A I_B = 3.2A		1.15	1.5	V
h_{FE}*	DC Current Gain	I_C = 8A V_{CE} = 4V I_C = 16A V_{CE} = 4V	15 8		60	
$I_{S/B}$	Second Breakdown Collector Current	V_{CE} = 140V t = 1s V_{CE} = 16V t = 1s	0.15 22			A A
f_T	Transition Frequency	I_C = 2A V_{CE} = 15V f = 10MHz	8			MHz
t_{on}	Turn-on Time	I_C = 16A I_B = 3.2A		0.55	1.3	μs
t_s t_f	Storage Time Fall Time	I_C = 16A I_{B1} = - I_{B2} = 3.2A		1.7 0.26	2.5 1.2	μs μs

* Pulsed : Pulse duration = 300μs, duty cycle = 1.5%.

TEST CIRCUIT

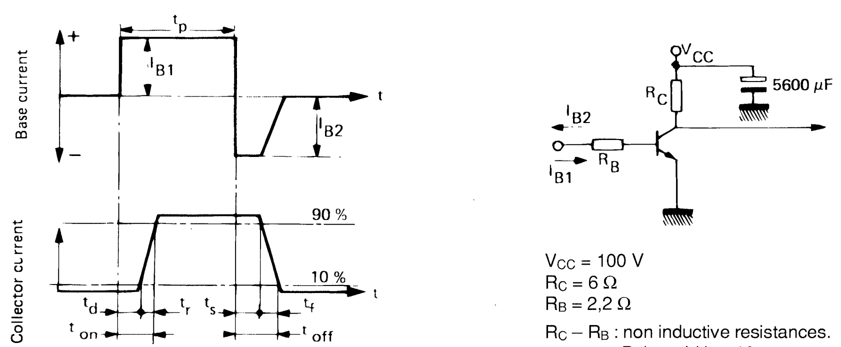
Figure 1: $V_{CEO\ (sus)}$.



Note : The sustaining voltage V_{CEO} is acceptable when the trace falls to the right and above point "A".

SWITCHING TIMES TEST CIRCUITS (and oscillograms)

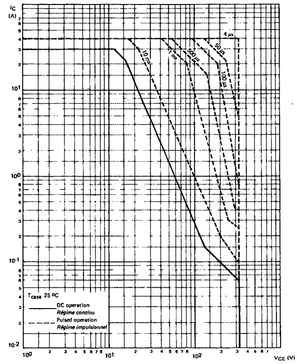
Figure 2.



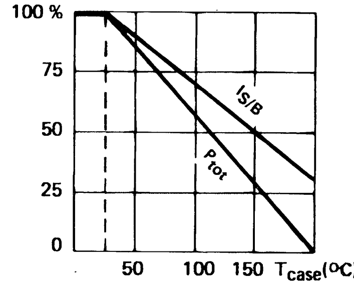
I_{B1} and I_{B2} mesured with Tektronix probe P6021 and Amplifier type 134.

V_{CC} = 100 V
R_C = 6 Ω
R_B = 2,2 Ω
R_C – R_B : non inductive resistances.
t_p : Pulse width = 10 µs.
Forme factor ≤ 1 %.
Rise and fall time ≤ 100 ns.

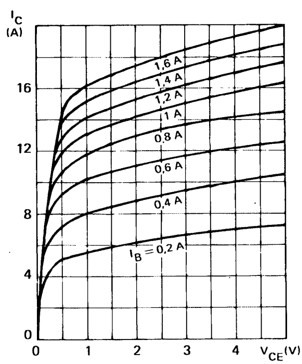
Safe Operating Area.



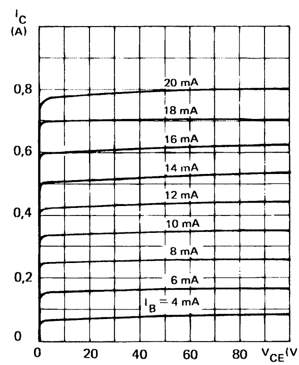
Derating and $I_{S/B}$ Derating.



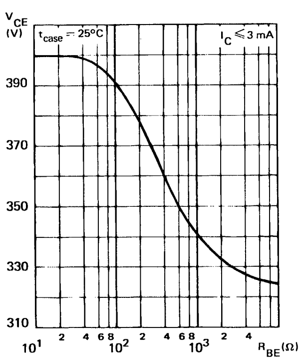
Collector Current versus Collector-emitter Voltage.



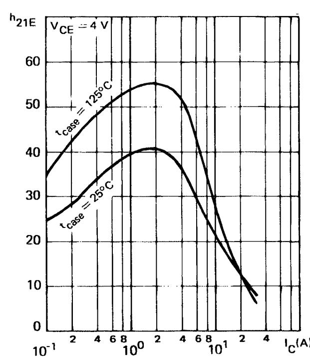
Collector Current versus Collector-emitter Voltage.



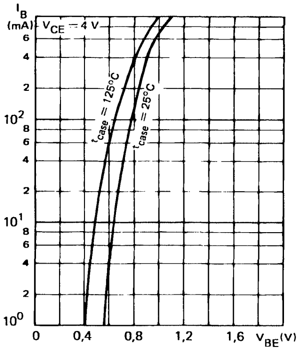
Collector Emitter Voltage versus Base-emitter Resistance (minimum value).



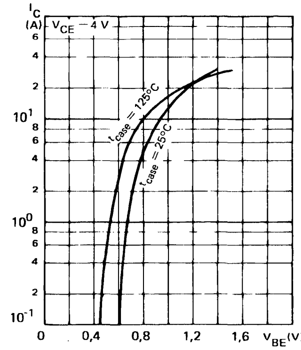
Static forward Current Transfer Ratio versus Collector Current.



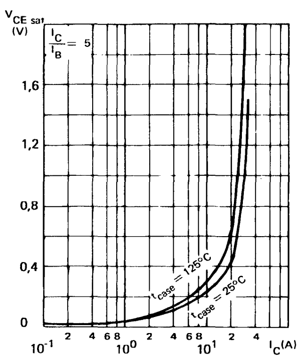
Base Current versus Base-emitter Voltage.



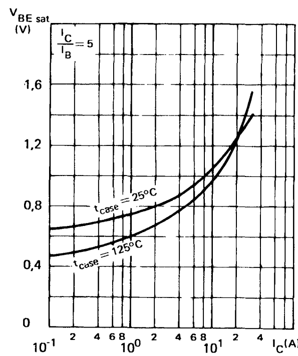
Collector Current versus Base-emitter Voltage.



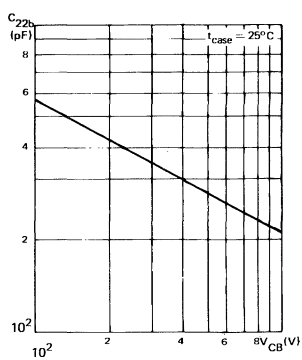
Collector-emitter Saturation Voltage versus Collector Current.



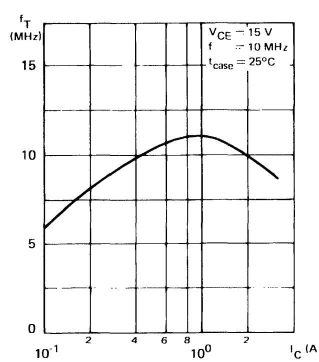
Base-emitter Saturation Voltage versus Collector Current.



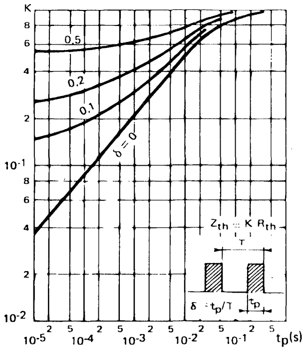
Output Capacitance versus Collector-base Voltage.



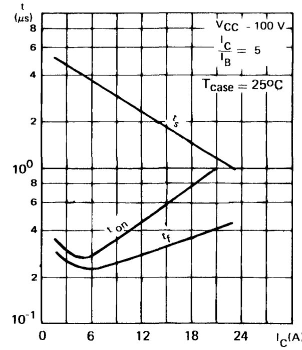
Transition Frequency versus Collector Current.



ransient Thermal Resistance Derating Factor under Pulses Conditions.



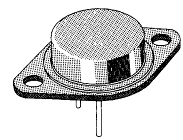
Switching Times versus Collector Current.



NPN SILICON TRANSISTOR

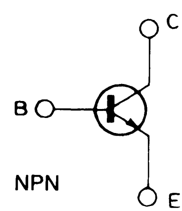
DESCRIPTION

High speed, high current, high power NPN transistor intended for use in switching and amplifier applications.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	450	V
V_{CER}	Collector-emitter Voltage	440	V
V_{CEX}	Collector-emitter Voltage	450	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	400	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	20	A
I_{CM}	Collector Peak Current (t_p < 10ms)	30	A
I_B	Base Current	4	A
P_{tot}	Total Dissipation at T_c < 25°C	350	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

$R_{thj-case}$	Thermal Resitance Junction-case	Max	0.5	°C/W

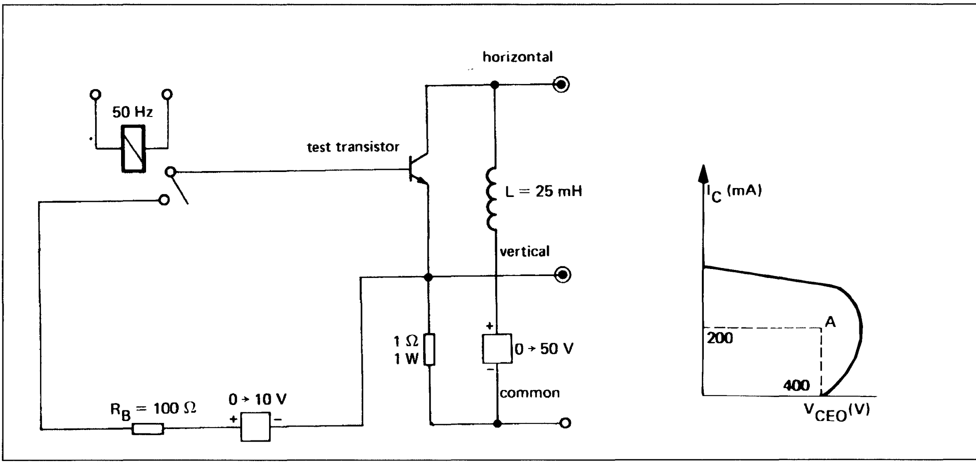
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEX}	Collector Cutoff Current	V_{CE} = 450V V_{BE} = − 1.5V V_{CE} = 450V V_{BE} = − 1.5V T_c = 125°C			3 12	mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 320V			3	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 200mA L = 25mH	400			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 6A I_B = 1.2A I_C = 12A I_B = 2.4A		0.15 0.3	0.6 1	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 12A I_B = 2.4A		1	1.5	V
h_{FE}*	DC Current Gain	I_C = 6A V_{CE} = 4V I_C = 12A V_{CE} = 4V	15 8		60	
$I_{S/B}$	Second Breakdown Collector Current	V_{CE} = 140V t = 1s V_{CE} = 19V t = 1s	0.15 18			A A
f_T	Transition Frequency	I_C = 2A V_{CE} = 15V f = 10MHz	8			MHz
t_{on}	Turn-on Time	I_C = 12A I_B = 3.2A		0.6	1.6	μs
t_s t_f	Storage Time Fall Time	I_C = 12A I_{B1} = - I_{B2} = 3.2A		1.5 0.6	3 1.4	μs μs

* Pulsed : Pulse duration = 300 μs, duty cycle = 1.5%.

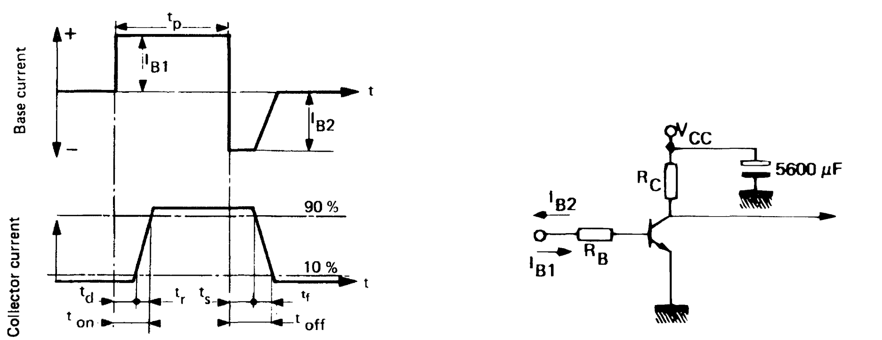
TEST CIRCUIT ($V_{CEO\,(sus)}$)

Figure 1.



Note : The sustaining voltage V_{CEO} is acceptable when the trace falls to the right and above point "A".

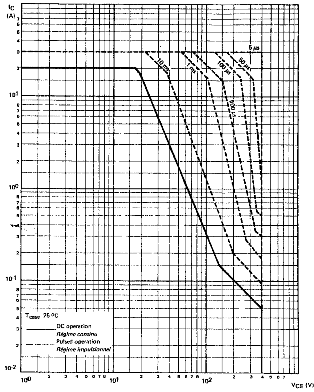
SWITCHING TIMES TEST CIRCUITS (and oscillograms)



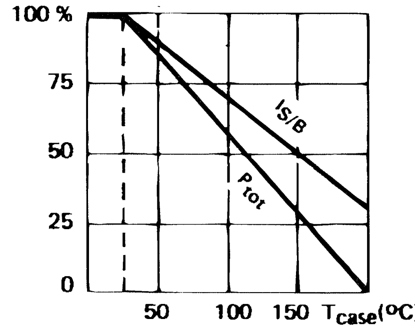
I_{B1} and I_{B2} mesured with Tektronix probe P 6021 and Amplifier type 134.

R_C – R_B : non inductive resistances
t_p : Pulse width = 10 μs
Forme factor ≤ 1 %
Rise and fall time ≤ 10 ns.

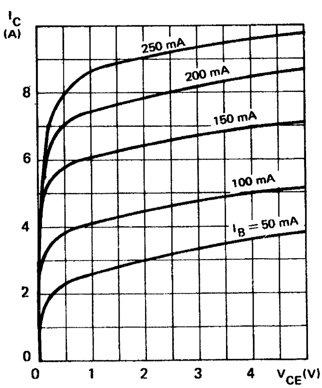
Safe Operating Area.



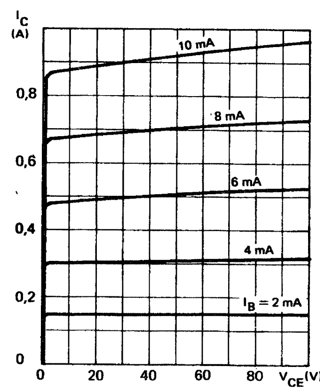
Dissipation and $I_{S/B}$ Derating.



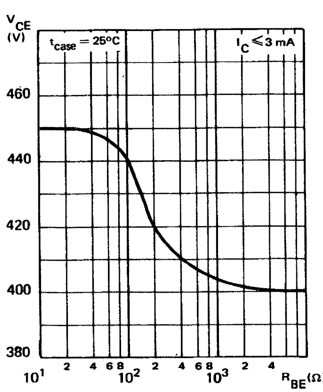
Collector Current versus Collector-emitter Voltage.



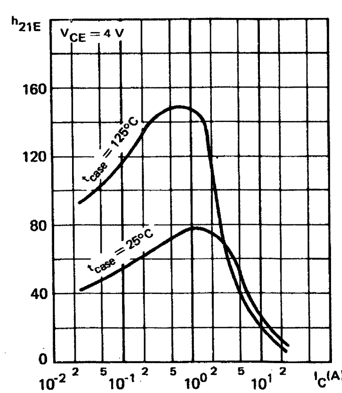
Collector Current versus Collector-emitter Voltage.



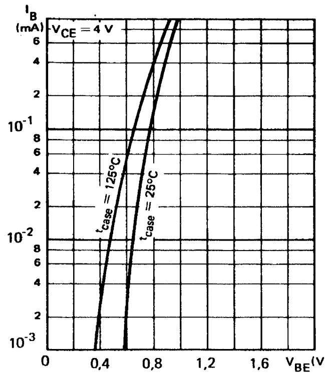
Collector Emitter Voltage versus Base-emitter Resistance (minimum value).



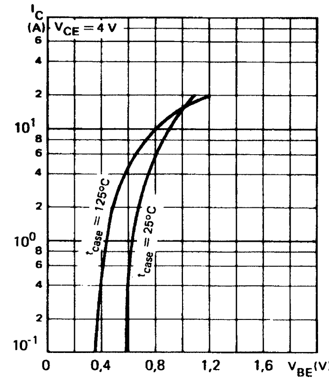
Static forward Current Transfer Ratio versus Collector Current



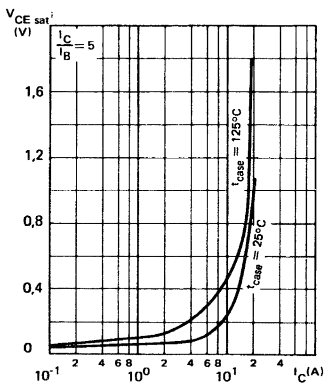
Base Current versus Base-emitter Voltage.



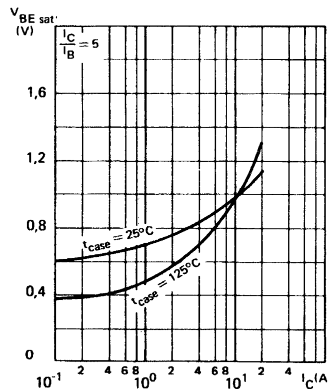
Collector Current versus Base-emitter Voltage.



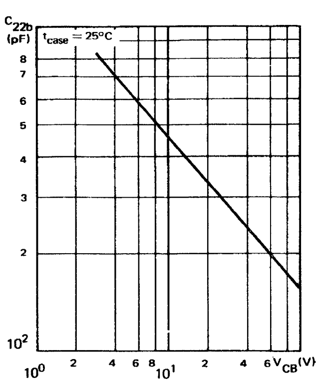
Collector-emitter Saturation Voltage versus Collector Current.



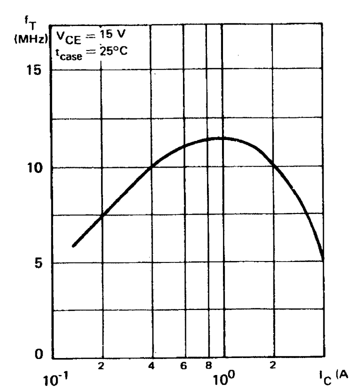
Base-emitter Saturation Voltage versus Collector Current.



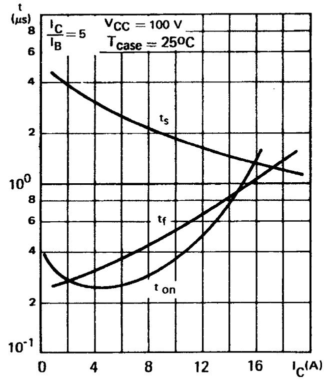
Output Capacitance versus Collector-base Voltage.



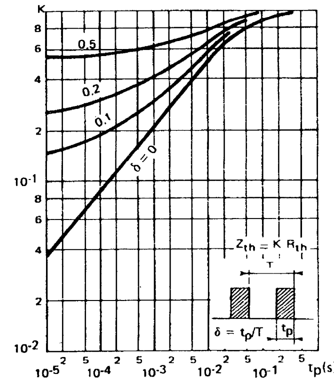
Transition Frequency versus Collector Current.



Switching Times versus Collector Current.



Transient Thermal Resistance Derating Factor under Pulses Conditions.

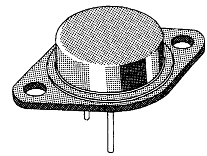


SGS-THOMSON
MICROELECTRONICS

BUX25

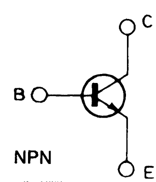
NPN SILICON TRANSISTOR

- HIGH SPEED, HIGH VOLTAGE, HIGH POWER TRANSISTOR
- SWITCHING AND AMPLIFIER TRANSISTOR



TO-3

INTERNAL SHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage	500	V
V_{CEO}	Collector-emitter Voltage	500	V
V_{CER}	Collector-emitter Voltage (R_{BE} = 100Ω)	500	V
V_{CEX}	Collector-emitter Voltage (V_{BE} = – 1.5V)	500	V
V_{EBO}	Emitter-base Voltage	7	V
I_C I_{CM}	Collector Current (t_p = 10ms)	15 20	A
I_B	Base Current	3	A
P_{tot}	Power Dissipation (T_{case} 25°C)	350	W
t_j T_{stg}	Storage and Junction Temperature (max)	200 – 65 to + 200	°C

THERMAL DATA

$R_{th(j-c)}$	Junction-case Thermal Resistance	Max	0.5	°C/W

STATIC CHARACTERISTICS (t_{case} = 25°C unless otherwise stated)

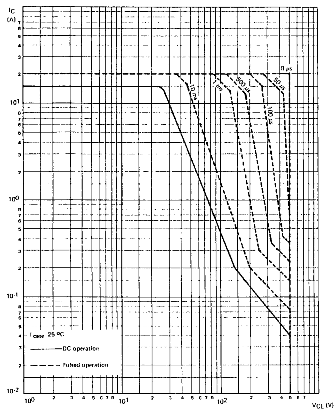
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector-emitter Cut-off Current	V_{CE} = 400V I_B = 0			3	mA
I_{CEX}	Collector-emitter Cut-off Current	V_{CE} = 500V V_{BE} = – 1.5V			3	mA
		V_{CE} = 500V t_{case} = 125°C V_{BE} = – 1.5V			12	mA
I_{EBO}	Emitter-base Cut-off Current	V_{EB} = 5V I_C = 0			1	mA
$V_{CEO(sus)}$	Collector-emitter Breakdown Voltage (fig. 1)	I_C = 200mA L = 25mH I_B = 0	500			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage	I_E = 50mA I_C = 0	7			V
h_{FE}*	DC Current Gain	V_{CE} = 4V I_C = 4A	15		60	
		V_{CE} = 4V I_C = 8A	8			
V_{CEsat}*	Collector-emitter Saturation Voltage	I_C = 4A I_B = 0.8A		0.2	0.6	V
		I_C = 8A I_B = 1.6A		0.6	1	V
V_{BEsat}*	Base-emitter Saturation Voltage	I_C = 8A I_B = 1.6A		1.2	1.5	V
$I_{S/B}$	Second Breakdown Collector Current	V_{CE} = 140V t = 1s	0.15			A
		V_{CE} = 25V t = 1s	14			A

* Pulsed t_p = 300 µs $\delta \leq 2$ %.

DYNAMIC CHARACTERISTICS (for small signals unless otherwise stated)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
f_T	Transition Frequency	V_{CE} = 15V f = 10MHz I_C = 2A	8			MHz
t_{on}	Turn-on Time (fig. 2)	I_C = 8A I_B = 1.6A		0.9	1.8	µs
t_f	Fall Time (fig. 2)	I_C = 8A I_{B2} = – 1.6A I_{B1} = 1.6A		0.9	1.6	µs
t_s	Carrier Storage Time (fig. 2)	I_C = 8A I_{B2} = – 1.6A I_{B1} = 1.6A		3.5	5	µs

Safe Operating Area.



Dissipation and $I_{S/B}$ derating.

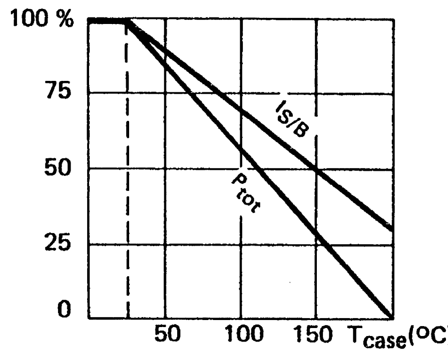
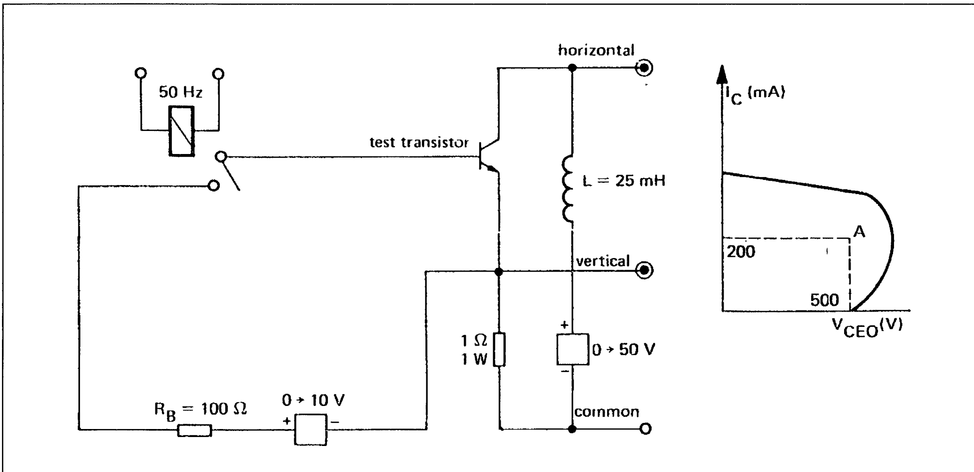
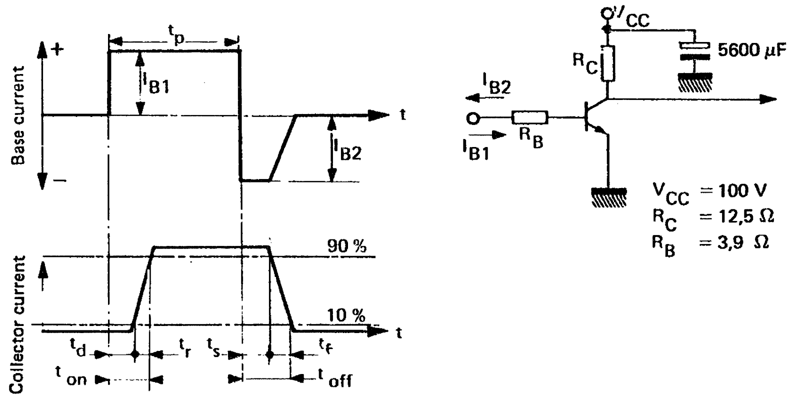


Figure 1 : Test Circuit $V_{CEO(sus)}$.



Note : The sustaining voltage V_{CEO} is acceptable when the trace falls to the right and above point "A".

Figure 2 : Switching Times Test Circuits (and oscillograms).



I_{B1} and I_{B2} mesured with Tektronix probe P 6021 and Amplifier type 134.

R_C - R_B : non-inductive resistances
t_p : Pulse width = 10μs
Forme factor ≤ 1%
Rise and fall time ≤ 100ns.

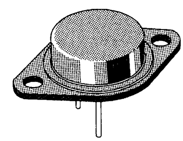
SGS-THOMSON MICROELECTRONICS

BUX40

HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

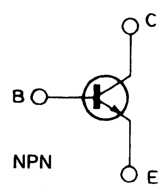
DESCRIPTION

The BUX40 is a silicon multiepitaxial planar NPN transistor in Jedec TO-3 metal case, intented for use in switching and linear applications in military e quipment.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	160	V
V_{CEX}	Collector-emitter Voltage (V_{BE} = – 1.5 V)	160	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	125	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	20	A
I_{CM}	Collector Peak Current (t_p = 10 ms)	28	A
I_B	Base Current	4	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	120	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

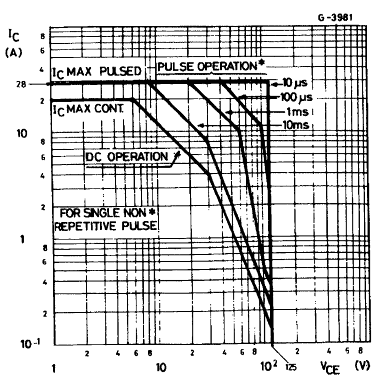
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.46	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

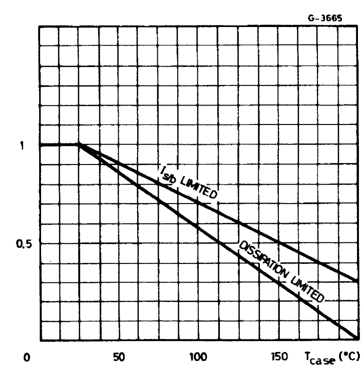
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 100 V			1	mA
I_{CEX}	Collector Cutoff Current	V_{CE} = 160 V V_{BE} = – 1.5 V T_{case} = 125 °C V_{CE} = 160 V V_{BE} = – 1.5 V			1 5	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 200 mA	125			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50 mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10 A I_B = 1 A I_C = 15 A I_B = 1.88 A		0.6 0.9	1.2 1.6	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 15 A I_B = 1.88 A		1.7	2	V
h_{FE}*	DC Current Gain	I_C = 10 A V_{CE} = 4 V I_C = 15 A V_{CE} = 4 V	15 8		45	
$I_{s/b}$	Second Breakdown Collector Current	V_{CE} = 30 V t = 1 s V_{CE} = 50 V t = 1 s	4 1			A A
f_T	Transition Frequency	I_C = 1 A V_{CE} = 15 V f = 10 MHz	8			MHz
t_{on}	Turn-on Time (see fig. 2)	I_C = 15 A I_{B1} = 1.88 A V_{CC} = 30 V		0.35	1.2	µs
t_s	Storage Time (see fig. 2)	I_C = 15 A I_{B1} = – I_{B2} = 1.88 A V_{CC} = 30 V		0.85	1	µs
t_f	Fall Time (see fig. 2)			0.14	0.4	µs
	Clamped $E_{s/b}$ Collector Current (see fig. 1)	V_{clamp} = 125 V L = 500 µH	15			A

* Pulsed : pulse duration = 300 µs, duty cycle ≤ 2 %.

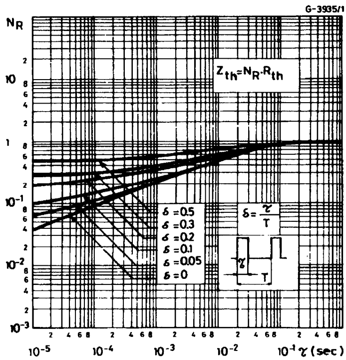
Safe Operating Areas.



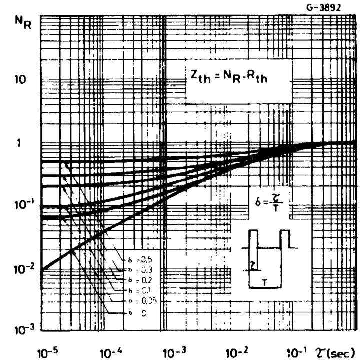
Derating Curves.



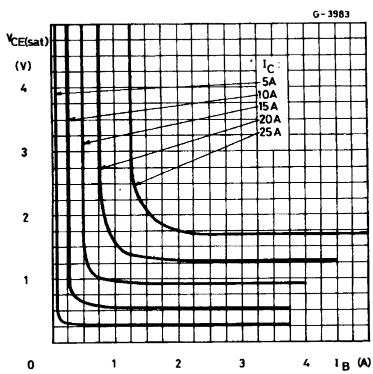
Thermal Transient Response.



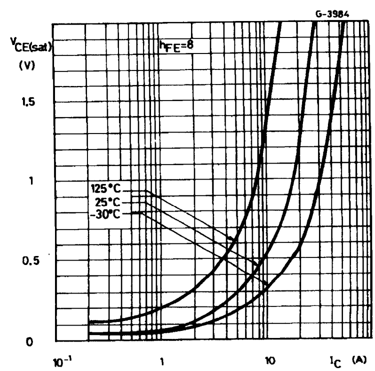
DC Current Gain.



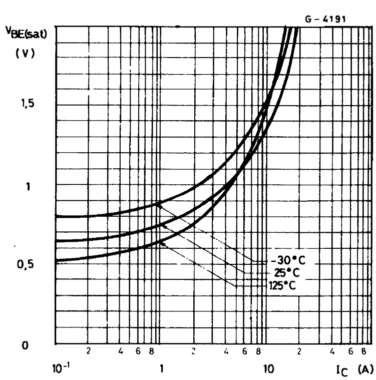
Collecteur-emitter Saturation Voltage.



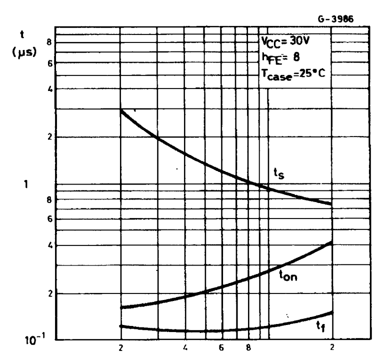
Collector-emitter Saturation Voltage.



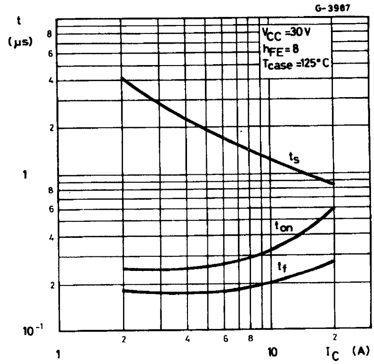
Base-emitter Saturation Voltage.



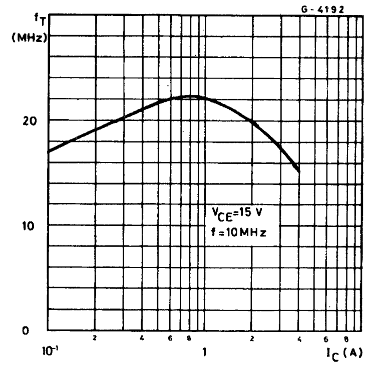
Saturated Switching Characteristics.



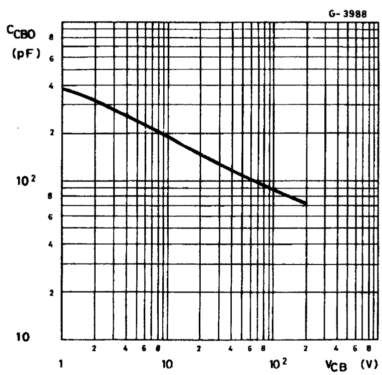
Saturated Switching Characteristics.



Transition Frequency.



Colltector-base Capacitance.



Clamped Reverse Bias Safe Operating Areas.

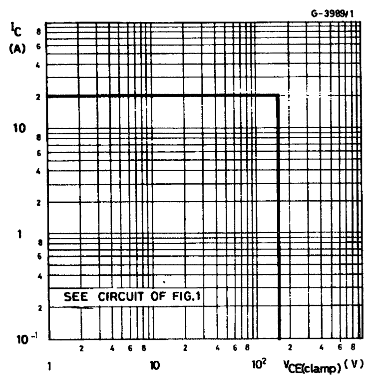
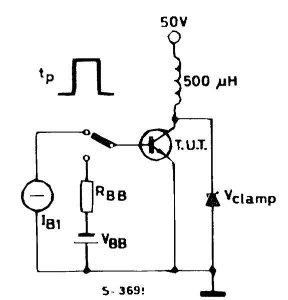
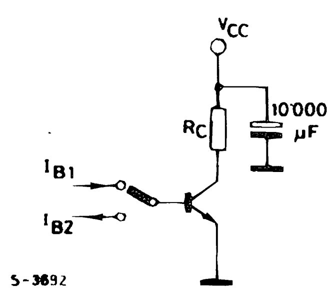


Figure 1 : Clamped $E_{s/b}$ Test Circuit.



TEST CONDITIONS :
$7\ V \geq | -V_{BB} | \geq 2\ V$
$I_C / I_B = 8$
t_p = adjusted for nominal I_C
$R_{BB} \geq 1\ \Omega$

Figure 2 : Switching Times Test Circuit (resistive load).



TEST CONDITIONS :
$V_{CC} = 30\ V$

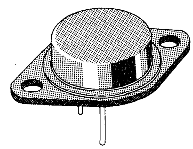
$$R_C = \frac{V_{CC} - V_{CE(sat)}}{I_C}$$

INPUT PULSE
pulse width = 10 μs
t_r , $t_f \leq 50$ ns
duty cycle = 1 %

HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

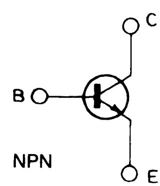
DESCRIPTION

The BUX41 is a silicon multiepitaxial planar NPN transistor in Jedec TO-3 metal case, intented for use in switching and linear applications in military and industrial equipment.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	250	V
V_{CEX}	Collector-emitter Voltage ($V_{BE} = -1.5$ V)	250	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	200	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	15	A
I_{CM}	Collector Peak Current ($t_p = 10$ ms)	20	A
I_B	Base Current	3	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	120	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

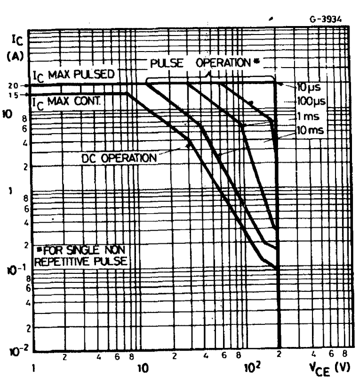
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.46	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

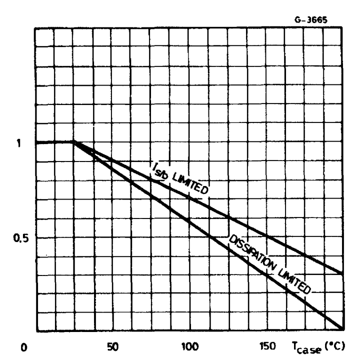
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 160 V			1	mA
I_{CEX}	Collector Cutoff Current	V_{CE} = 250 V V_{BE} = – 1.5 V T_{case} = 125 °C V_{CE} = 250 V V_{BE} = – 1.5 V			1 5	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 200 mA	200			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50 mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5 A I_B = 0.5 A I_C = 8 A I_B = 1 A		0.38 0.6	1.2 1.6	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 8 A I_B = 1 A		1.35	2	V
h_{FE}*	DC Current Gain	I_C = 5 A V_{CE} = 4 V I_C = 8 A V_{CE} = 4 V	15 8		45	
$I_{s/b}$	Second Breakdown Collector Current	V_{CE} = 30 V t = 1 s V_{CE} = 135 V t = 1 s	4 0.15			A A
f_T	Transition Frequency	I_C = 1 A V_{CE} = 15 V f = 10 MHz	8			MHz
t_{on}	Turn-on Time (fig. 2)	I_C = 8 A I_{B1} = 1 A V_{CC} = 150 V		0.28	1	µs
t_s	Storage Time (fig. 2)	I_C = 8 A I_{B1} = 1 A I_{B2} = – 1 A V_{CC} = 150 V		1.2	1.7	µs
t_f	Fall Time (fig. 2)			0.25	0.8	µs
	Clamped $E_{s/b}$ Collector Current (fig. 1)	V_{clamp} = 200 V L = 500 µH	8			A

* Pulsed : pulse duration = 300 µs, duty cycle ≤ 2 %.

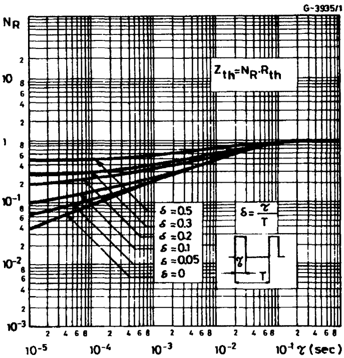
Safe Operating Areas.



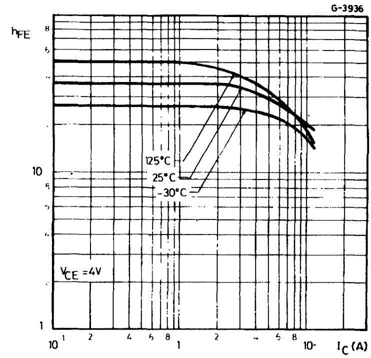
Derating Curves.



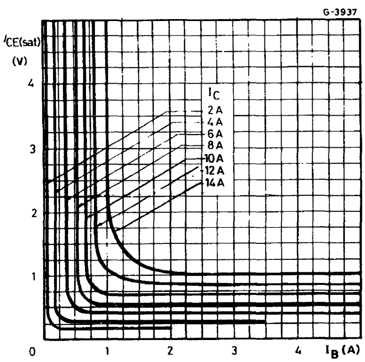
Thermal Transient Response.



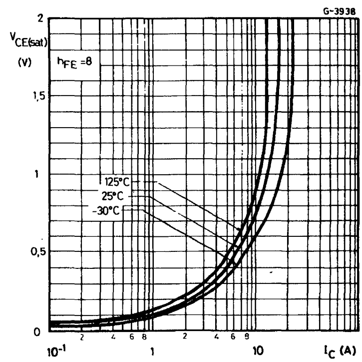
DC Current Gain.



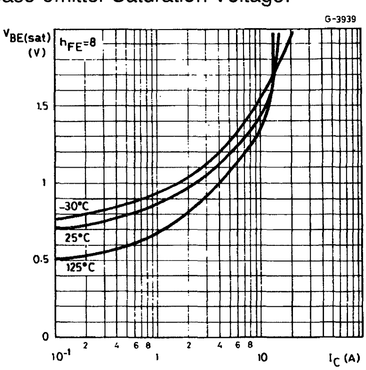
Collector-emitter Saturation Voltage.



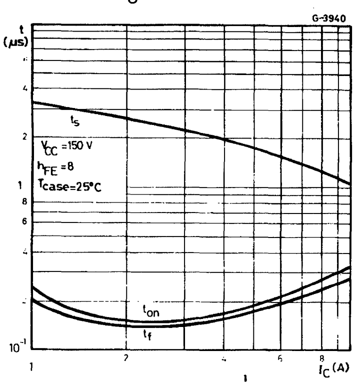
Collector-emitter Saturation Voltage.



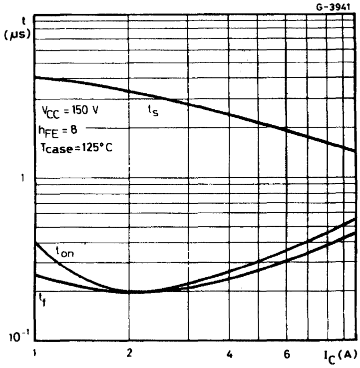
Base-emitter Saturation Voltage.



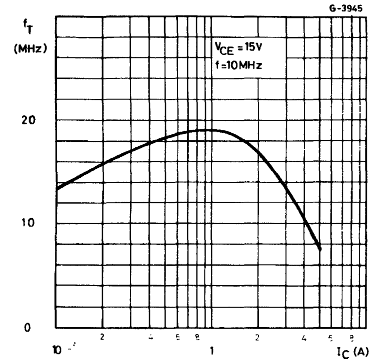
Saturated Switching Characteristics.



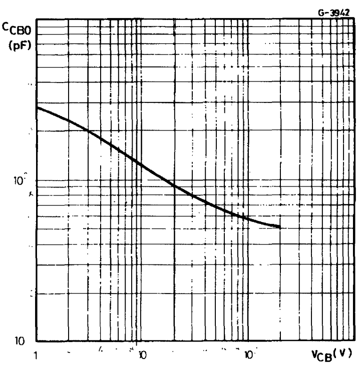
Saturated Switching Characteristics.



Transition Frequency.



Collector-base Capacitance.



Clamped Reverse Bias Safe Operating Area.

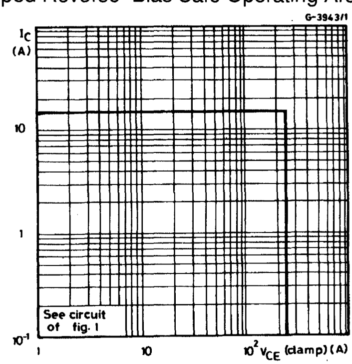
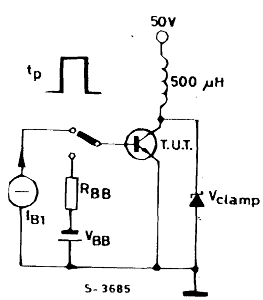
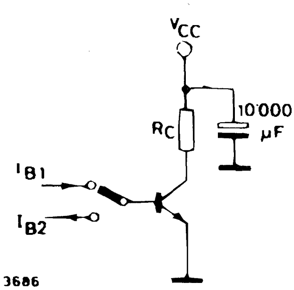


Figure 1 : Clamped $E_{s/b}$ Test Circuit.



TEST CONDITIONS :
7 V ≥ | – V_{BB} | ≥ 2 V
I_C / I_B = 8
t_p = adjusted for nominal I_C
R_{BB} ≥ 1 Ω

Figure 2 : Switching Times Test Circuit (resistive load).



TEST CONDITIONS :
V_{CC} = 150 V

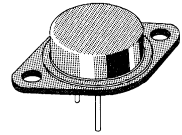
$$R_C = \frac{V_{CC} - V_{CE(sat)}}{I_C}$$

INPUT PULSE
pulse width = 10 µs
t_r , t_f ≤ 50 ns
duty cycle = 1 %

HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

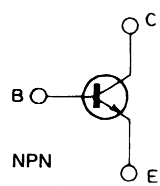
DESCRIPTION

The BUX41N is a silicon multiepitaxial planar NPN transistor in Jedec TO-3 metal case, intented for use in switching and linear applications in military and industrial equipment.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	220	V
V_{CEX}	Collector-emitter Voltage ($V_{BE} = -1.5$ V)	220	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	160	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	18	A
I_{CM}	Collector Peak Current ($t_p = 10$ ms)	25	A
I_B	Base Current	3.6	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	120	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

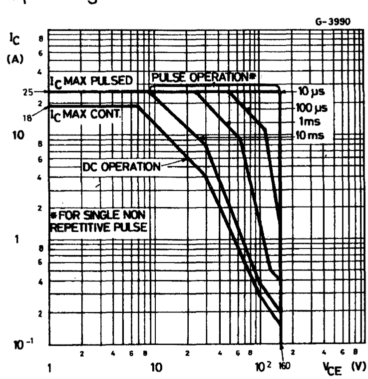
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.46	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

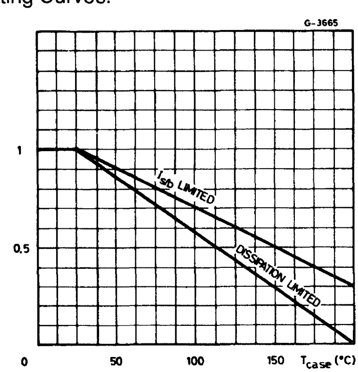
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 130 V			1	mA
I_{CEX}	Collector Cutoff Current	V_{CE} = 220 V V_{BE} = – 1.5 V T_{case} = 125 °C V_{CE} = 220 V V_{BE} = – 1.5 V			1 5	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 200 mA	160			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50 mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 8 A I_B = 0.8 A I_C = 12 A I_B = 1.5 A		0.5 0.75	1.2 1.6	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 12 A I_B = 1.5 A		1.5	2	V
h_{FE}*	DC Current Gain	I_C = 8 A V_{CE} = 4 V I_C = 12 A V_{CE} = 4 V	15 8		45	
$I_{s/b}$	Second Breakdown Collector Current	V_{CE} = 30 V t = 1 s V_{CE} = 100 V t = 1 s	4 0.27			A A
f_T	Transition Frequency	I_C = 1 A V_{CE} = 15 V f = 10 MHz	8			MHz
t_{on}	Turn-on Time (fig. 2)	I_C = 12 A I_{B1} = 1.5 A V_{CC} = 30 V		0.35	1.3	μs
t_s	Storage Time (fig. 2)	I_C = 12 A I_{B1} = – I_{B2} = 1.5 A V_{CC} = 30 V		0.85	1.5	μs
t_f	Fall Time (fig. 2)			0.14	0.8	μs
	Clamped $E_{s/b}$ Collector Current (fig. 1)	V_{clamp} = 160 V L = 500 μH	12			A

* Pulsed : pulse duration = 300 μs, duty cycle ≤ 2 %.

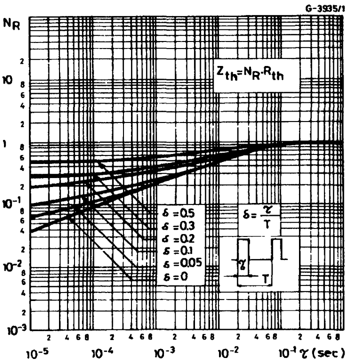
Safe Operating Areas.



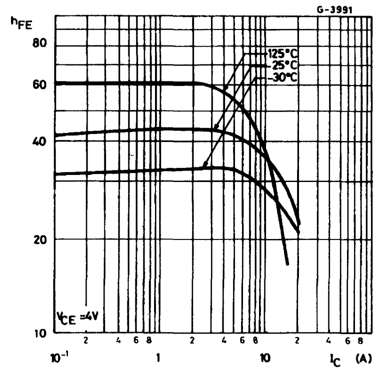
Derating Curves.



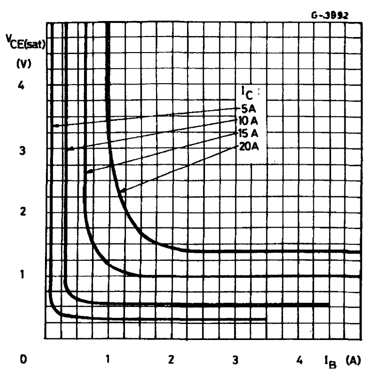
Thermal Transient Response.



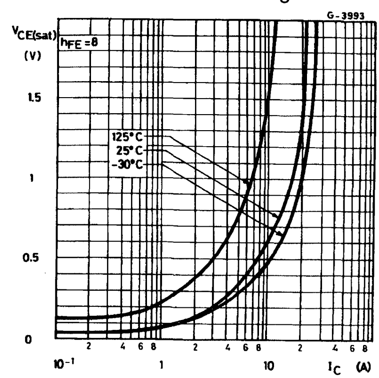
DC Current Gain.



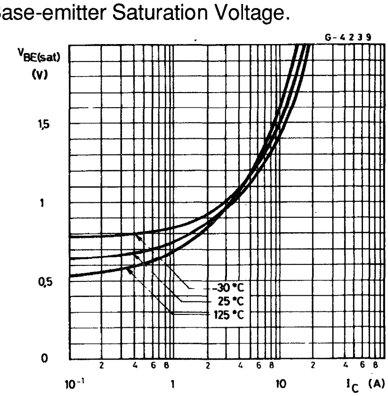
Collector-emitter Saturation Voltage.



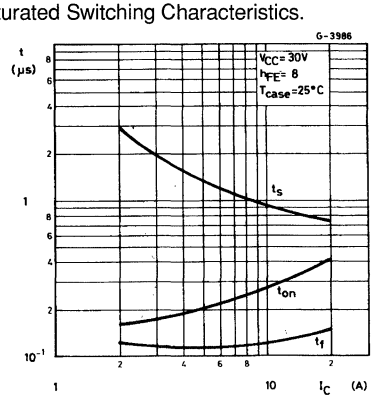
Collector-emitter Saturation Voltage.



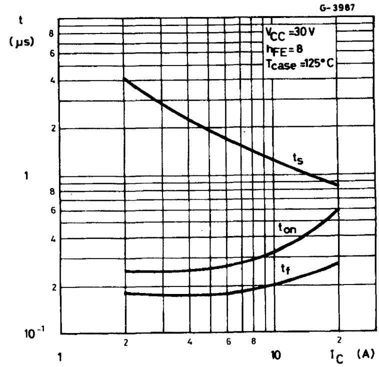
Base-emitter Saturation Voltage.



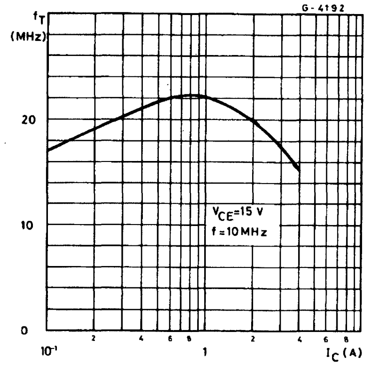
Saturated Switching Characteristics.



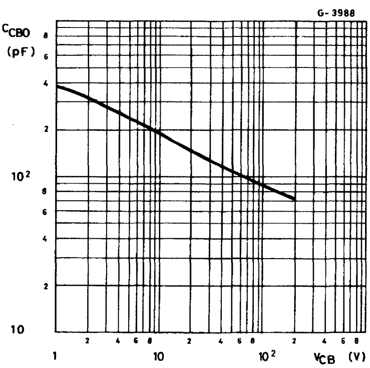
Saturated Switching Characteristics.



Transition Frequency.



Collector-base Capacitance.



Clamped Reverse Bias Safe Operating Areas.

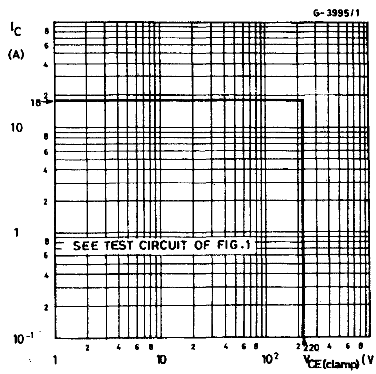
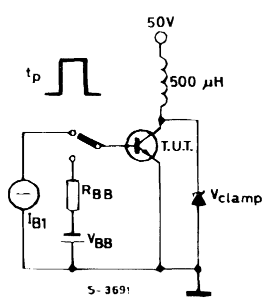
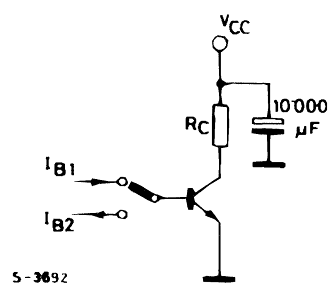


Figure 1 : Clamped $E_{s/b}$ Test Circuit.



TEST CONDITIONS :
$7\ V \geq |-V_{BB}| \geq 2\ V$
$I_C / I_B = 8$
t_p = adjusted for nominal I_C
$R_{BB} \geq$ V 1 Ω

Figure 2 : Switching Times Test Circuit (resistive load).



TEST CONDITIONS :
V_{CC} = 30 V

$$R_C = \frac{V_{CC} - V_{CE(sat)}}{I_C}$$

INPUT PULSE
pulse width = 10 µs
t_r , $t_f \leq$ 50 ns
duty cycle = 1 %

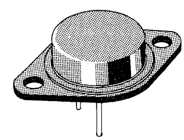
SGS-THOMSON
MICROELECTRONICS

BUX42

HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

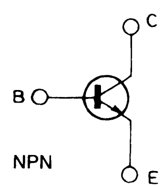
DESCRIPTION

The BUX42 is a silicon multiepitaxial planar NPN transistor in Jedec TO-3 metal case, intented for use in switching and linear applications in military and industrial equipment.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Pàrameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	300	V
V_{CEX}	Collector-emitter Voltage (V_{BE} = – 1.5 V)	300	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	250	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	12	A
I_{CM}	Collector Peak Current (t_p = 10 ms)	15	A
I_B	Base Current	2.4	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	120	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

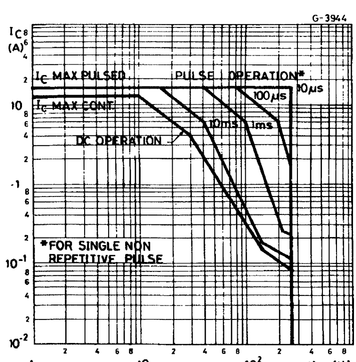
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.46	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

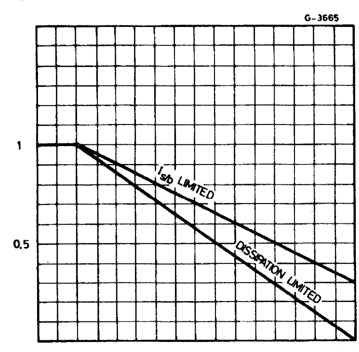
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 200 V			1	mA
I_{CEX}	Collector Cutoff Current	V_{CE} = 300 V V_{BE} = − 1.5 V T_{case} = 125 °C V_{CE} = 300 V V_{BE} = − 1.5 V			1 5	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 200 mA	250			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50 mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 4 A I_B = 0.4 A I_C = 6 A I_B = 0.75 A		0.33 0.45	1.2 1.6	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 6 A I_B = 0.75 A		1.23	2	V
h_{FE}*	DC Current Gain	I_C = 4 A V_{CE} = 4 V I_C = 6 A V_{CE} = 4 V	15 8		45	
$I_{s/b}$	Second Breakdown Collector Current	V_{CE} = 135 V t = 1 s V_{CE} = 30 V t = 1 s	0.15 4			A A
f_T	Transition Frequency	I_C = 1 A V_{CE} = 15 V f = 10 MHz	8			MHz
t_{on}	Turn-on Time (fig. 2)	I_C = 6 A I_{B1} = 0.75 A V_{CC} = 150 V		0.23	1	µs
t_s	Storage Time (fig. 2)	I_C = 6 A I_{B1} = 0.75 A I_{B2} = − 0.75 A V_{CC} = 150 V		1.5	2	µs
t_f	Fall Time (fig. 2)			0.2	1.2	µs
	Clamped $E_{s/b}$ Collector Current (fig. 1)	V_{clamp} = 250 V L = 500 µH	6			A

* Pulsed : pulse duration = 300 µs, duty cycle ≤ 2 %.

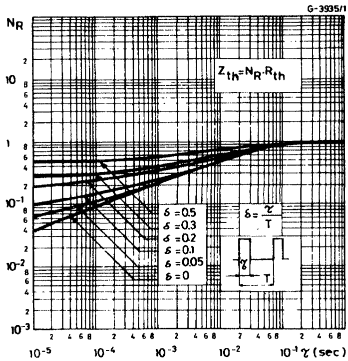
Safe Operating Areas.



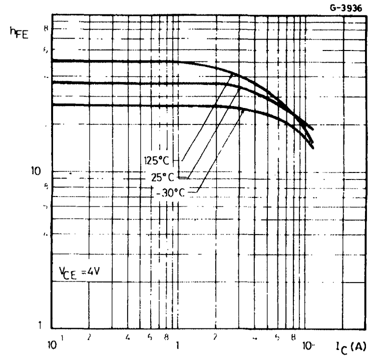
Derating Curves.



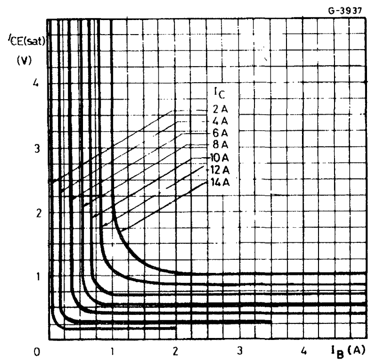
Thermal Transient Response.



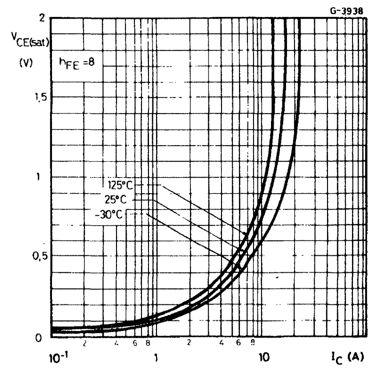
DC Current Gain.



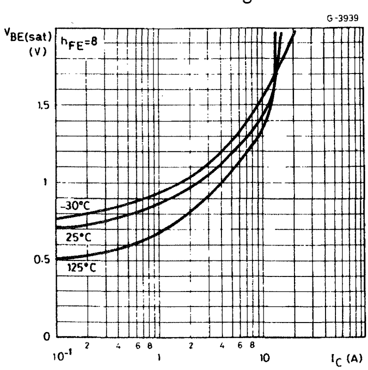
Collecteur-emitter Saturation Voltage.



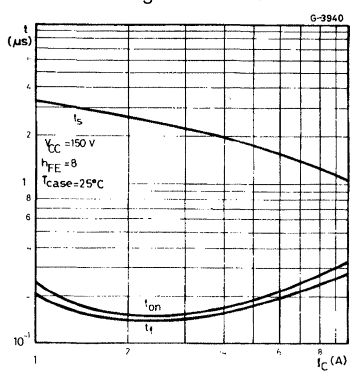
Collector-emitter Saturation Voltage.



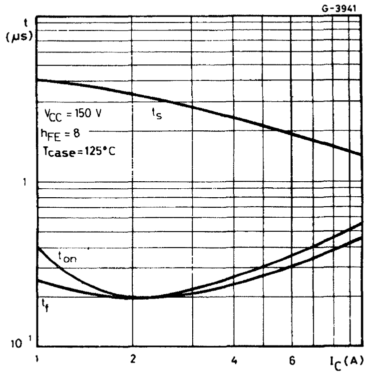
Base-emitter Saturation Voltage.



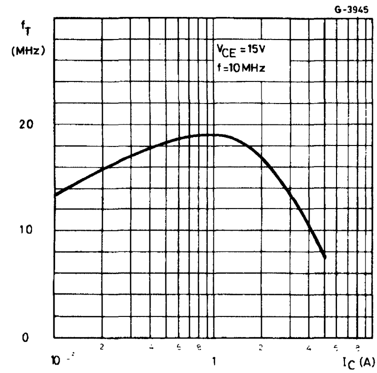
Saturated Switching Characteristics.



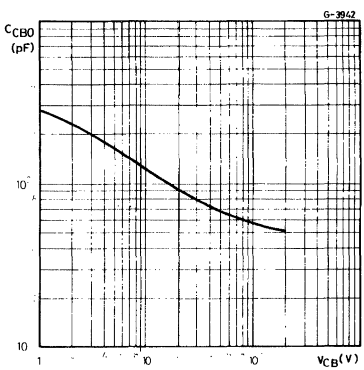
Saturated Switching Characteristics.



Transition Frequency.



Colltector-base Capacitance.



Clamped Reverse Bias Safe Operating Areas.

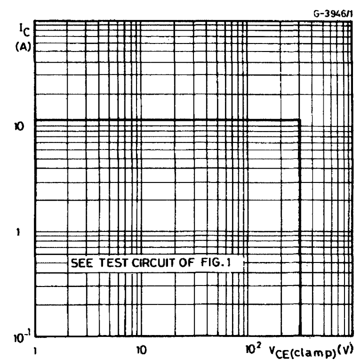
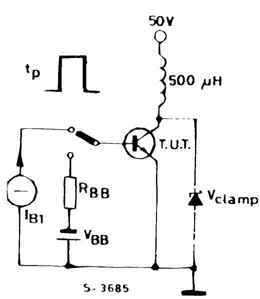
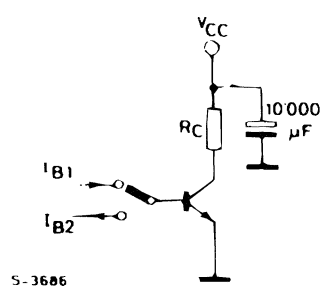


Figure 1 : Clamped $E_{s/b}$ Test Circuit.



TEST CONDITIONS :
7 V ≥ | – V_{BB} | ≥ 2 V
I_C / I_B = 8
t_p = adjusted for nominal I_C
R_{BB} ≥ V 1 Ω

Figure 2 : Switching Times Test Circuit (resistive load).



TEST CONDITIONS :
V_{CC} = 100 V

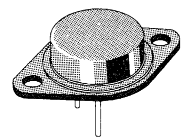
$$R_C = \frac{V_{CC} - V_{CE(sat)}}{I_C}$$

INPUT PULSE
pulse width = 5 µs
t_r, t_f ≤ 50 ns
duty cycle = 1 %

HIGH VOLTAGE POWER SWITCH

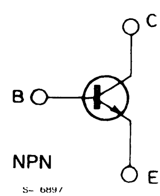
DESCRIPTION

The BUX43 is a silicon multiepitaxial mesa NPN transistor in Jedec TO-3 metal case, intented for high voltage, fast switching applications.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	400	V
V_{CER}	Collector-emitter Voltage ($R_{BE} \leq 100\ \Omega$)	360	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	325	V
V_{EBO}	Base-emitter Voltage (I_C = 0)	7	V
I_C	Collector Current	10	A
I_{CM}	Collector Peak Current ($t_p \leq 10$ ms)	12	A
I_B	Base Current	2	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	120	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.46	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

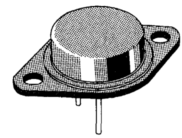
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 400 V V_{CE} = 400 V T_{case} = 125 °C			1 5	mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 260 V			1	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA	325			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 3 A I_B = 0.375 A I_C = 5 A I_B = 1 A			1 1.6	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 5 A I_B = 1 A			2	V
h_{FE}*	DC Current Gain	I_C = 3 A V_{CE} = 4 V I_C = 5 A V_{CE} = 4 V	15 8		60	
f_T	Transition Frequency	I_C = 1 A V_{CE} = 15 V f = 10 MHz	8			MHz
t_{on}	Turn-on Time	I_C = 5 A I_{B1} = 1 A V_{CC} = 150 V			1	μs
t_s	Storage Time	I_C = 5 A I_{B1} = – I_{B2} = 1 A V_{CC} = 150 V			2.2	μs
t_f	Fall Time				1.2	μs

* Pulsed : pulse duration = 300 μs, duty cycle ≤ 2 %.

HIGH VOLTAGE POWER SWITCH

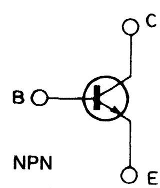
DESCRIPTION

The BUX44 is a silicon multiepitaxial mesa NPN transistor in Jedec TO-3 metal case, intented for high voltage, fast switching applications.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	450	V
V_{CER}	Collector-emitter Voltage ($R_{BE} \leq 100\ \Omega$)	440	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	400	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	8	A
I_{CM}	Collector Peak Current ($t_p \leq 10$ ms)	10	A
I_B	Base Current	1.6	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	120	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.46	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 450 V V_{CE} = 450 V T_{case} = 125 °C			1 5	mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 320 V			1	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA	400			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 2 A I_B = 0.25 A I_C = 4 A I_B = 0.8 A			1 2	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 4 A I_B = 0.8 A			2	V
h_{FE}*	DC Current Gain	I_C = 2 A V_{CE} = 4 V I_C = 4 A V_{CE} = 4 V	15 8		45	
f_T	Transition Frequency	I_C = 1 A V_{CE} = 15 V f = 10 MHz	8			MHz
t_{on}	Turn-on Time	I_C = 4 A I_B = 0.8 A V_{CC} = 150 V			1	μs
t_s	Storage Time	I_C = 4 A I_{B1} = − I_{B2} = 0.8 A V_{CC} = 150 V			2.5	μs
t_f	Fall Time				1.2	μs

* Pulsed : pulse duration = 300 μs, duty cycle ≤ 2 %.

SGS-THOMSON MICROELECTRONICS

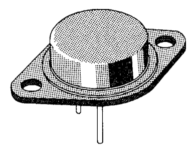
BUX47/V47/V47FI BUX47A/V47A/47AFI

HIGH VOLTAGE POWER SWITCH

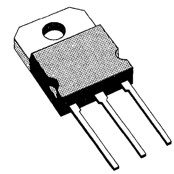
DESCRIPTION

The BUX47/A, BUV47/A, BUV47FI/AFI are silicon multiepitaxial mesa NPN transistors mounted respectively in TO-3 metal case, TO-218 plastic package and ISOWATT218 fully isolated package.

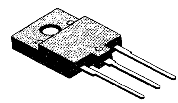
They are intended for high voltage, fast switching applications.



TO-3

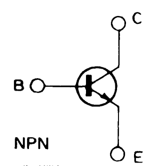


TO-218



ISOWATT 218

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		BUX47 BUV47 BUV47FI	BUX47A BUV47A BUV47AFI		
V_{CER}	Collector-emitter Voltage (R_{BE} = 10 Ω)	850	1000		V
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	850	900		V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	400	450		V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7			V
I_C	Collector Current	9			A
I_{CM}	Collector Peak Current (t_p < 5 ms)	15			A
I_B	Base Current	8			A
I_{BM}	Base Peak Current (t_p < 5 ms)	10			A
		TO-3	TO-218	ISOWATT218	
P_{tot}	Total Dissipation at T_c < 25 °C	125	100	55	W
T_{stg}	Storage Temperature	– 65 to 175	– 65 to 150	– 65 to 150	°C
T_j	Max. Operating Junction Temperature	175	150	150	°C

THERMAL DATA

		TO-3	TO-218	ISOWATT218	
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case max	1.2	1.25	2.27	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10 Ω)	V_{CE} = 850 V V_{CE} = 850 V T_{case} = 125 °C			0.4 3	mA mA
I_{CEV}	Collector Cutoff Current (V_{BE} = − 2.5 V)	V_{CE} = 850 V V_{CE} = 850 V T_{case} = 125 °C			0.15 1.5	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 0.2 A L = 25 mH for **BUX47/BUV47/BUV47FI** for **BUX47A/BUV47A/BUV47AFI**	 400 450			 V V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50 mA	7		30	V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	for **BUX47A/BUV47A/BUV47AFI** I_C = 5 A I_B = 1 A I_C = 8 A I_B = 2.5 A for **BUX47/BUV47/BUV47FI** I_C = 6 A I_B = 1.2 A I_C = 9 A I_B = 3 A			 1.5 3 1.5 3	 V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	for **BUX47A/BUV47A/BUV47AFI** I_C = 5 A I_B = 1 A for **BUX47/BUV47/BUV47FI** I_C = 6 A I_B = 1.2 A			 1.6 1.6	 V V

RESISTIVE SWITCHING TIMES (see fig. 1)

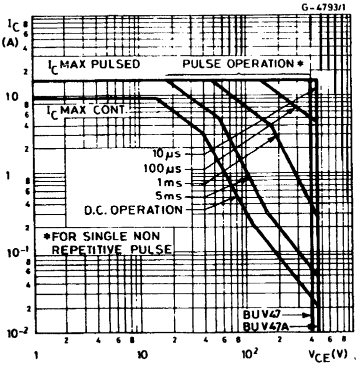
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	for **BUX47A/BUV47A/BUV47AFI**			0.7	µs
t_s	Storage Time	I_C = 5 A V_{CC} = 150 V			3	µs
t_f	Fall Time	I_{B1} = − I_{B2} = 1 A			0.8	µs
t_{on}	Turn-on Time	for **BUX47/BUV47/BUV47FI**			0.8	µs
t_s	Storage Time	I_C = 6 A V_{CC} = 150 V			2.5	µs
t_f	Fall Time	I_{B1} = − I_{B2} = 1.2 A			0.8	µs

INDUCTIVE SWITCHING TIMES (see fig. 2)

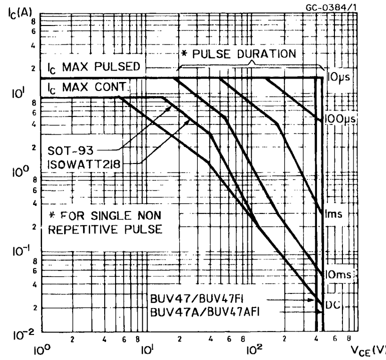
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_f	Fall Time	I_C = 5 A I_{B1} = 1 A V_{BE} = 5 V V_{CC} = 300 V L = 3 µH T_j = 100 °C			0.5	µs

* Pulsed : pulse duration ≤ 300 µs, duty cycle ≤ 1.5 %.

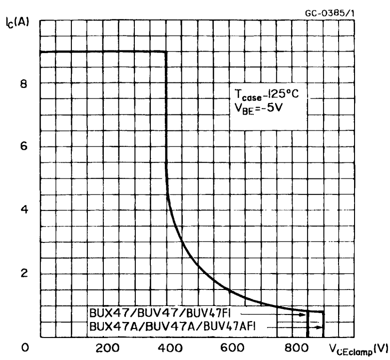
Safe Operating Areas (TO-3).



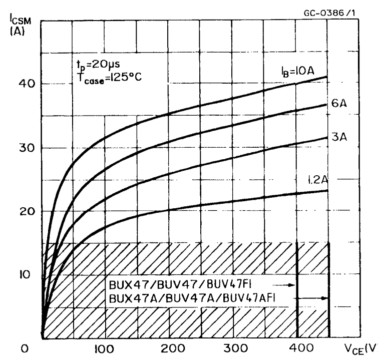
Safe Operating Areas (TO-218, ISOWATT218).



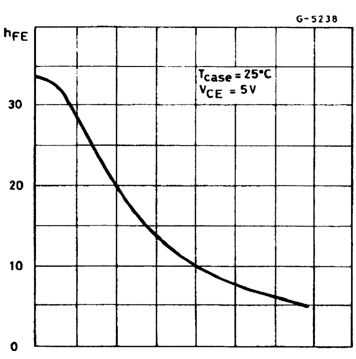
Clamped Reverse Bias Safe Operating Areas.



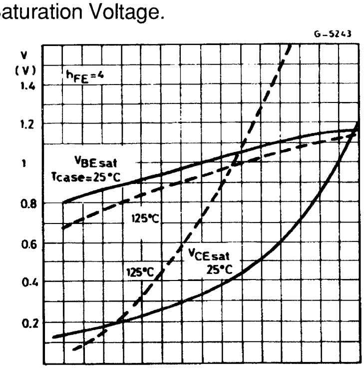
Forward Biased Accidental Overload Area (see fig. 3).



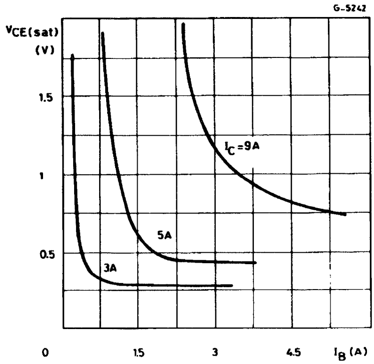
DC Current Gain.



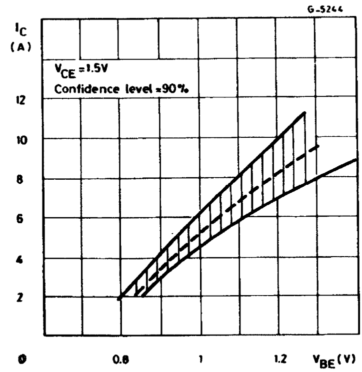
Saturation Voltage.



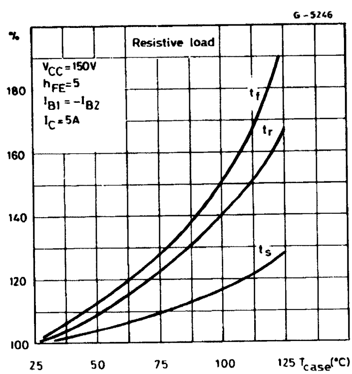
Collector-emitter Saturation Voltage.



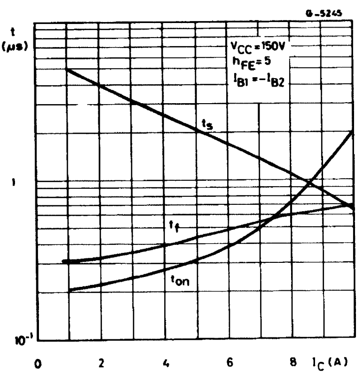
Collector Current Spread vs. Base Emitter Voltage.



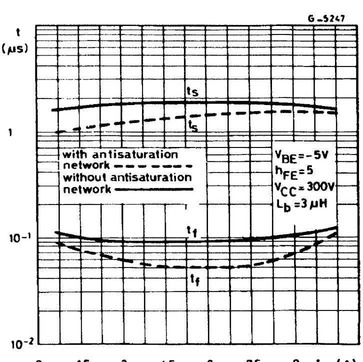
Switching Times Percentage Variation vs. Case Temperature.



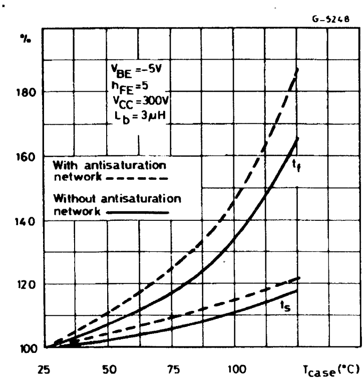
Switching Times Resistive Load (see fig. 1).



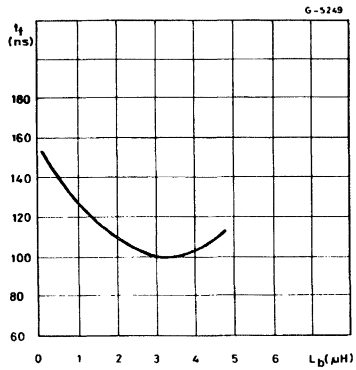
Switching Times Inductive Load (see fig. 2).



Switching Times Inductive Load vs. Case Temperature.



Fall Times vs. L_b (see fig. 2).



Dynamic Collector-emitter Saturation Voltage (see fig. 4).

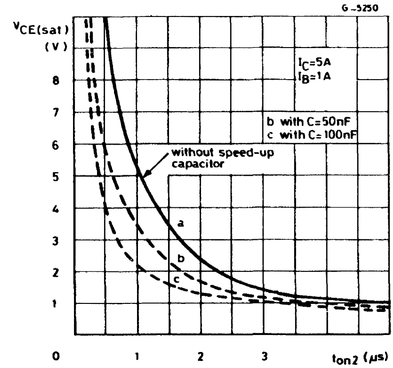


Figure 1 : Switching Times Test Circuit on Resistive Load.

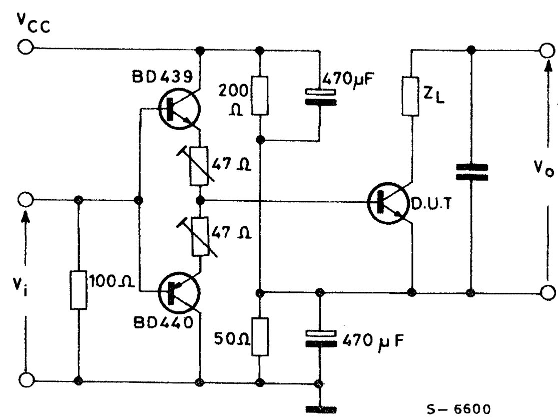
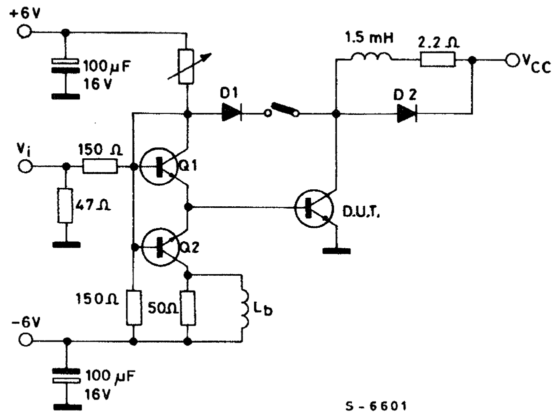


Figure 2 : Switching Times Test Circuit on Inductive Load. With and without Antisaturation Network.



D1, D2 : Fast recovery diodes
Q1, Q2 : Transistors SGS 2N5191, 2N5195.

Figure 3 : Forward Biased Accidental Overload Area Test Circuit.

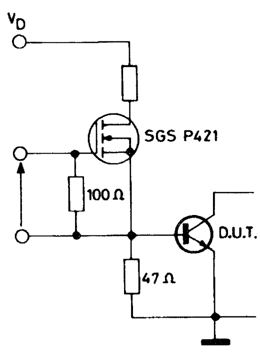


Figure 4 : $V_{CE\ (sat)}$ Dyn. Test Circuit.

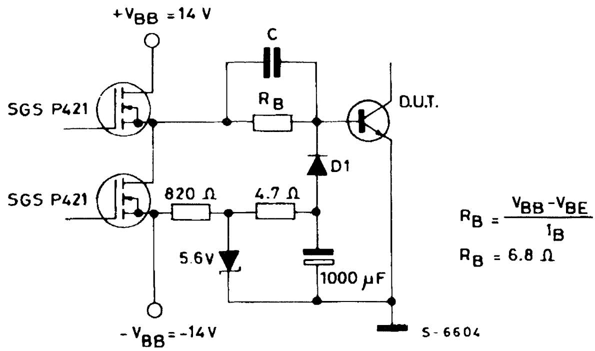
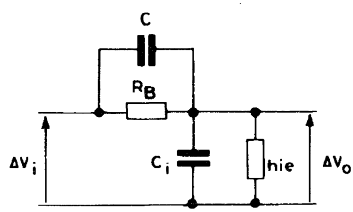


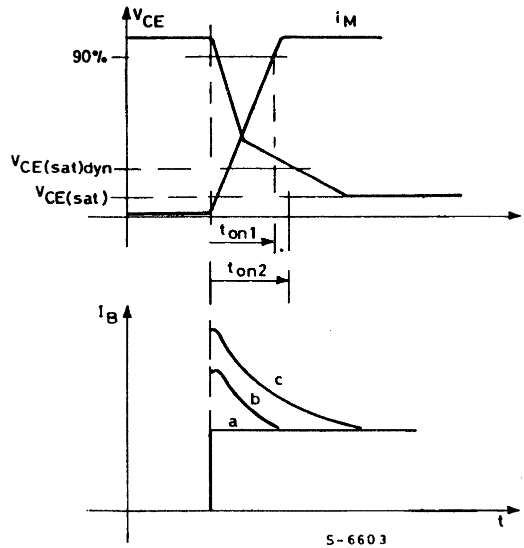
Figure 5 : Equivalent Input Schematic Circuit at Turn-on.



$$\Delta V_o = \Delta V_i \frac{C}{C_i + C}$$

if $C \gg C_i$ $\Delta V_o = \Delta V_i$

Figure 6 : Remarks to $V_{CE\ (sat)}$ Dyn. Test Circuit (fig. 4).



The speed-up capacitor decreases the $V_{CE\ (sat)}$ dyn. as shown in diagram (figure 6). The 50 nF capacitor modifies the shape of base current with a overshoot.

ISOWATT218 PACKAGE CHARACTERISTICS AND APPLICATION

ISOWATT218 is fully isolated to 4000V dc. Its thermal impedance, given in the data sheet, is optimised to give efficient thermal conduction together with excellent electrical isolation. The structure of the case ensures optimum distances between the pins and heatsink. These distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 package eliminates the need for external isolation so reducing fixing hardware.

The package is supplied with leads longer than the standard TO-218 to allow easy mounting on pcbs.

Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

ISOWATT218 thermal performance is equivalent to that of the standard part, mounted with a 0.1mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for ISOWATT218 packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT218 PACKAGE

Fig. 7 illustrates the elements contributing to the thermmal resistance of a transistor heatsink assembly, using ISOWATT218 package.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements. The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1 - For a short duration power pulse of less than 1ms :

$$Z_{th} < R_{thJ\text{-}C}$$

2 - For an intermediate power pulse of 5ms to 50ms seconds :

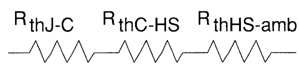
$$Z_{th} = R_{thJ\text{-}C}$$

3 - For long power pulses of the order of 500ms seconds or greater :

$$Z_{th} = R_{thJ\text{-}C} + R_{thC\text{-}HS} + R_{thHS\text{-}amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 7.



SGS-THOMSON
MICROELECTRONICS

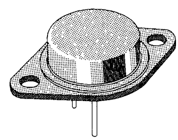
BUX48/V48/V48FI
BUX48A/V48A/V48AFI

HIGH VOLTAGE POWER SWITCH

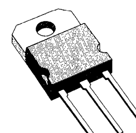
DESCRIPTION

The BUX48/A, BUV48/A, and BUV48FI/AFI are multiepitaxial mesa NPN transistors mounted respectively in TO-3 metal case, TO-218 plastic package and ISOWATT218 fully isolated package.

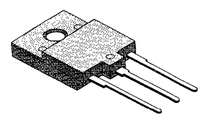
They are particulary intended for switching applications directly from the 220V and 380V mains.



TO-3

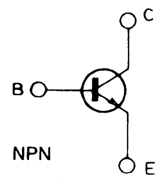


TO-218



ISOWATT218

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

<table>
<tr><th rowspan="3">Symbol</th><th rowspan="3">Parameter</th><th colspan="3">Value</th><th rowspan="3">Unit</th></tr>
<tr><th colspan="2">BUX48
BUV48
BUV48FI</th><th>BUX48A
BUV48A
BUV48AFI</th></tr>
<tr></tr>
<tr><td>V_{CER}</td><td>Collector-emitter Voltage (R_{BE} = 10 Ω)</td><td colspan="2">850</td><td>1000</td><td>V</td></tr>
<tr><td>V_{CES}</td><td>Collector-emitter Voltage (V_{BE} = 0)</td><td colspan="2">850</td><td>1000</td><td>V</td></tr>
<tr><td>V_{CEO}</td><td>Collector-emitter Voltage (I_B = 0)</td><td colspan="2">400</td><td>450</td><td>V</td></tr>
<tr><td>V_{EBO}</td><td>Emitter-base Voltage (I_C = 0)</td><td colspan="3">7</td><td>V</td></tr>
<tr><td>I_C</td><td>Collector Current</td><td colspan="3">15</td><td>A</td></tr>
<tr><td>I_{CM}</td><td>Collector Peak Current (t_p < 5 ms)</td><td colspan="3">30</td><td>A</td></tr>
<tr><td>I_{CP}</td><td>Collector Peak Current non Repetitive (t_p < 20 μs)</td><td colspan="3">55</td><td>A</td></tr>
<tr><td>I_B</td><td>Base Current</td><td colspan="3">4</td><td>A</td></tr>
<tr><td>I_{BM}</td><td>Base Peak Current</td><td colspan="3">20</td><td>A</td></tr>
<tr><td></td><td></td><td>TO-3</td><td>TO-218</td><td>ISOWATT218</td><td></td></tr>
<tr><td>P_{tot}</td><td>Total Dissipation at T_c < 25 °C</td><td>175</td><td>125</td><td>65</td><td>W</td></tr>
<tr><td>T_{stg}</td><td>Storage Temperature</td><td>– 65 to 200</td><td>– 65 to 150</td><td>– 65 to 150</td><td>°C</td></tr>
<tr><td>T_j</td><td>Max. Operating Junction Temperature</td><td>200</td><td>125</td><td>125</td><td>°C</td></tr>
</table>

THERMAL DATA

		TO-3	TO-218	ISOWATT218	
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case max	1	1	1.92	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = rated V_{CES} V_{CE} = rated V_{CES}, T_c = 125 °C			200 2	µA mA
I_{CER}	Collector Cutoff Current (R_{BE} = 10 Ω)	V_{CE} = rated V_{CER} V_{CE} = rated V_{CER}, T_c = 125 °C			500 4	µA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 200 mA L = 25 mH for **BUX48/BUV48/BUV48FI** for **BUX48A/BUV48A/BUV48AFI**	 400 450			 V V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50 mA	7		30	V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	for **BUX48/BUV48/BUV48FI** I_C = 10 A I_B = 2 A I_C = 15 A I_B = 4 A I_C = 15 A I_B = 3 A for **BUX48A/BUV48A/BUV48AFI** I_C = 8 A I_B = 1.6 A I_C = 12 A I_B = 2.4 A			 1.5 3.5 5 1.5 5	 V V V V V
$V_{BE(sat)}$	Base-emitter Saturation voltage	for **BUX48/BUV48/BUV48FI** I_C = 10 A I_B = 2 A for **BUX48A/BUV48A/BUV48AFI** I_C = 8 A I_B = 1.6 A			 1.6 1.6	 V V

* Pulsed : pulse duration = 300 µs, duty cycle ≤ 2 %.

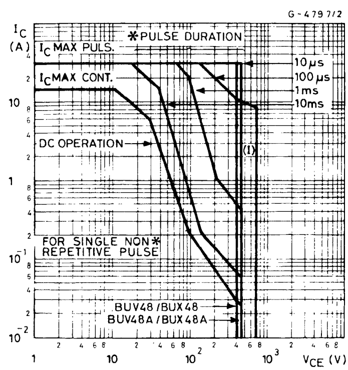
RESISTIVE SWITCHING TIMES (see fig. 2)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	for **BUX48/BUV48/BUV48FI** V_{CC} = 150 V I_C = 10 A I_{B1} = 2 A for **BUX48A/BUV48A/BUV48AFI** V_{CC} = 150 V I_C = 8 A I_{B1} = 1.6 A			 1 1	 µs µs
t_s	Storage Time	for **BUX48/BUV48/BUV48FI** V_{CC} = 150 V I_C = 10 A I_{B1} = – I_{B2} = 2 A for **BUX48A/BUV48A/BUV48AFI** V_{CC} = 150 V I_C = 8 A I_{B1} = – I_{B2} = 1.6 A			 3 3	 µs µs
t_f	Fall Time	for **BUX48/BUV48/BUV48FI** V_{CC} = 150 V I_C = 10 A I_{B1} = – I_{B2} = 2 A for **BUX48A/BUV48A/BUV48AFI** V_{CC} = 150 V I_C = 8 A I_{B1} = – I_{B2} = 1.6 A			 0.8 0.8	 µs µs

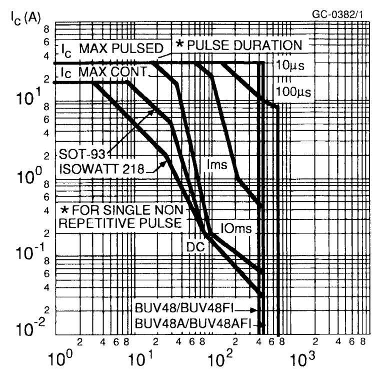
INDUCTIVE SWITCHING TIMES (see fig. 1)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	for **BUX48/BUV48/BUV48FI** V_{CC} = 300 V, I_C = 10 A, L_B = 3 µH V_{BE} = − 5 V, I_{B1} = 2 A same T_{case} = 125 °C for **BUX48A/BUV48A/BUV48AFI** V_{CC} = 300 V, I_C = 8 A, L_B = 3 µH V_{BE} = − 5 V, I_{B1} = 1.6 A same, T_{case} = 125 °C		 2.7 3 	 5 5	 µs µs µs µs
t_f	Fall Time	for **BUX48/BUV48/BUV48FI** V_{CC} = 300 V, I_C = 10 A, L_B = 3 µH V_{BE} = − 5 V, I_{B1} = 2 A same T_{case} = 125 °C for **BUX48A/BUV48A/BUV48AFI** V_{CC} = 300 V, I_C = 8 A, L_B = 3 µH V_{BE} = − 5 V, I_{B1} = 1.6 A same, T_{case} = 125 °C		 0.16 0.13 	 0.4 0.4	 µs µs µs µs

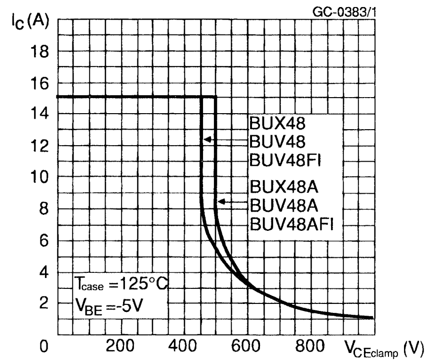
Safe Operating Area (TO-3).



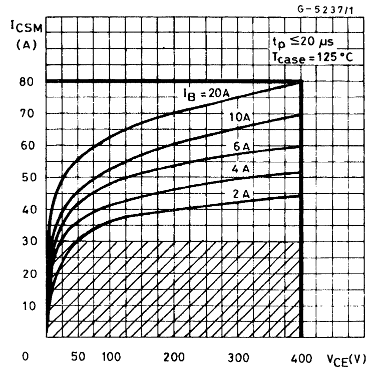
Safe Operating Area (TO-218, ISOWATT218).



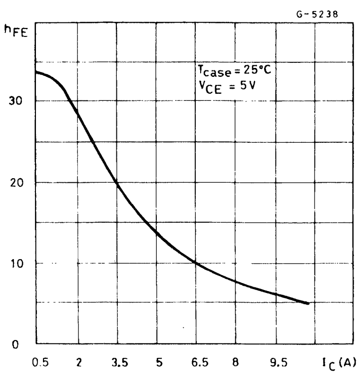
Clamped Reverse Bias Safe Operating Areas.



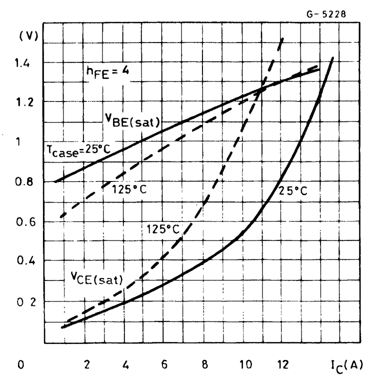
Forward Biased Accidental Overload Area. (see fig. 3).



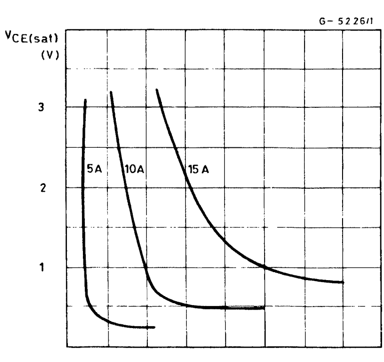
DC Current Gain..



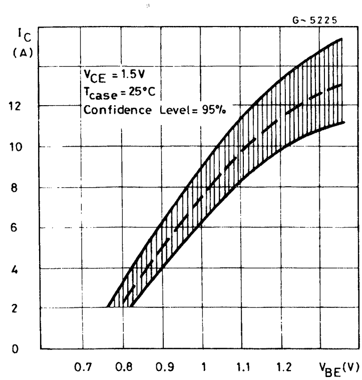
Saturation Voltage.



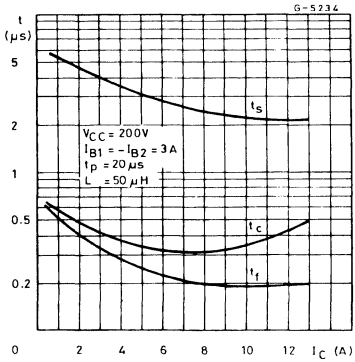
Collector-emitter Saturation Voltage.



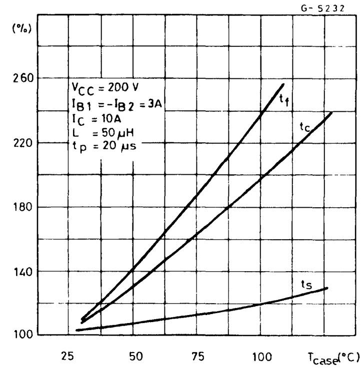
Collector Current Spread vs. Base Emitter Voltage.



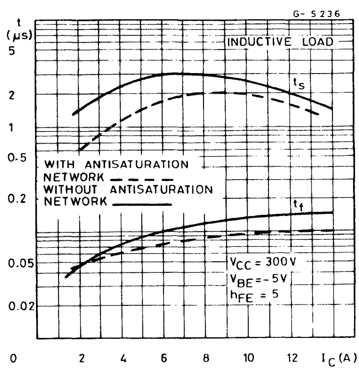
Switching Times vs. Collector Current with I_B Constant.



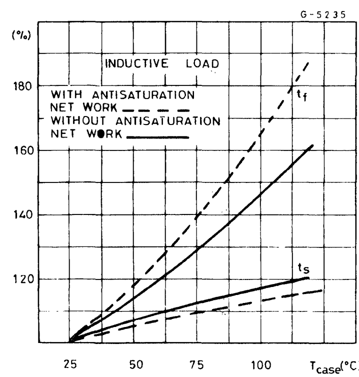
Switching Times Percentage Variation vs. Case Temperature.



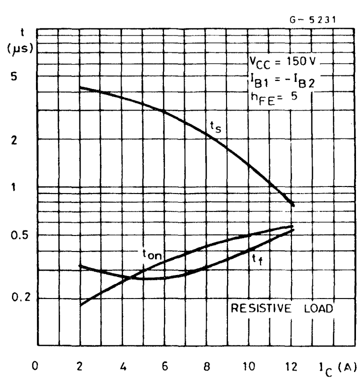
Switching Times with and without Antisaturation Network (see fig.1).



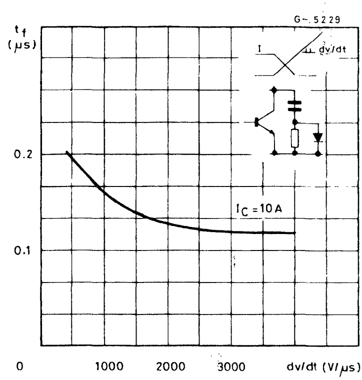
Switching Times Percentage vs. Case Temperature.



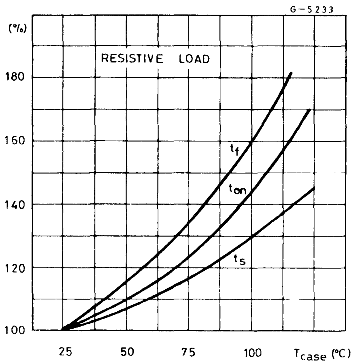
Switching Times vs. Collector Current (see fig.2).



Fall Times vs. Voltage Slope (see fig.2)..



Switching Times Percentage Variation vs. Case Temperature.



Dynamic Collector-emitter Saturation Voltage (see fig. 4).

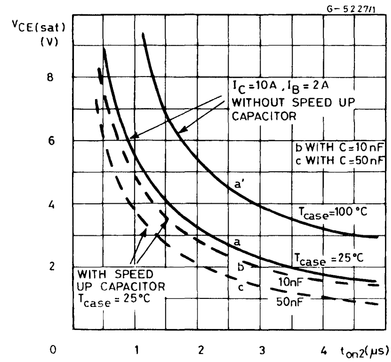
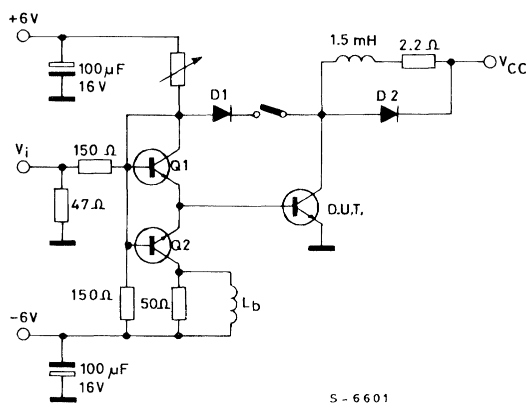


Figure 1 : Switching Times Test Circuit on Inductive Load, with and without Antisaturation Network.



D1, D2 : Fast recovery diodes
Q1, Q2 : Transistors SGS 2N5191, 2N5195.

Figure 2 : Switching Times Test Circuit on resistive Load.

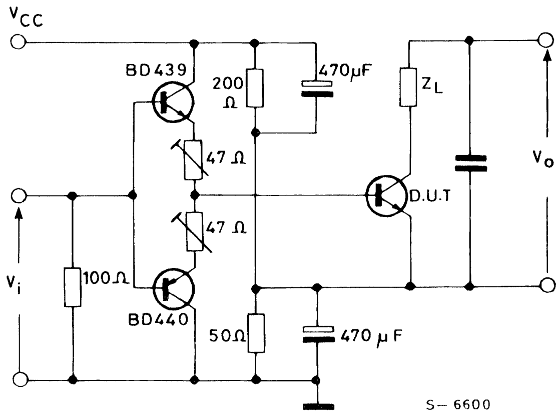


Figure 3 : Forward Biased Accidental Overload Area Test Circuit.

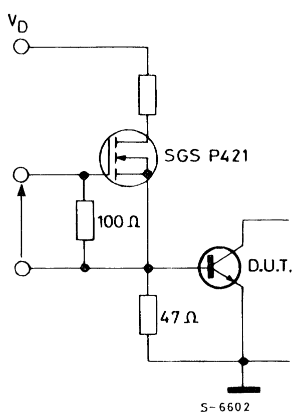


Figure 4 : $V_{CE(sat)}$ Dyn. Test Circuit.

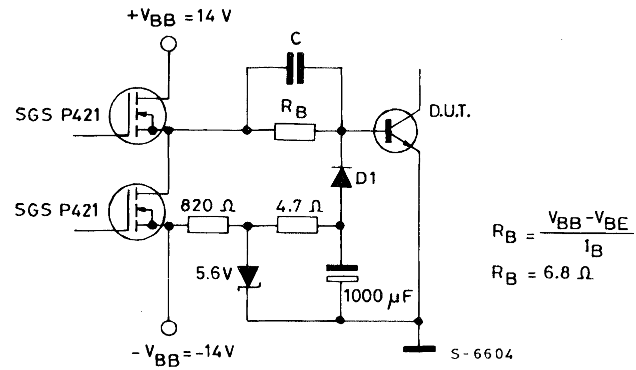
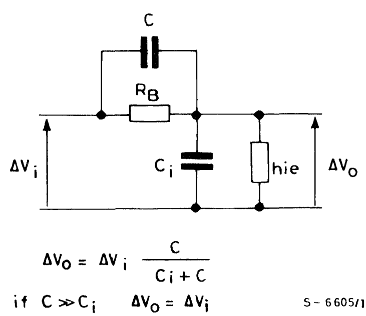
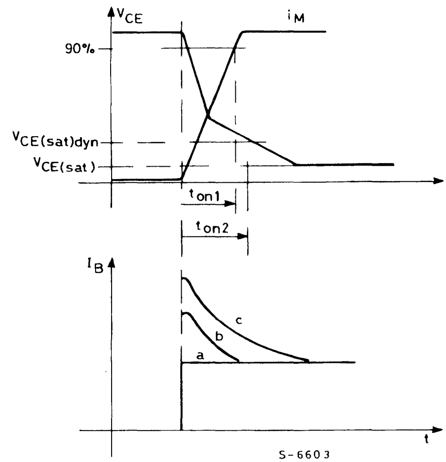


Figure 5 : Equivalent Input Schematic Circuit Circuit at Turn-on.



SGS-THOMSON MICROELECTRONICS

Figure 6 : Remarks to $V_{CE(sat)}$ Dyn. Test Circuit (fig.4).



The speed-up capacitor decreases the VCE (sat) dyn. as shown in diagram (figure 6). The 50 nF capacitor modifies the shape of base current with a overshoot.

ISOWATT218 PACKAGE CHARACTERISTICS AND APPLICATION

ISOWATT218 is fully isolated to 4000V dc. Its thermal impedance, given in the data sheet, is optimised to give efficient thermal conduction together with excellent electrical isolation. The structure of the case ensures optimum distances between the pins and heatsink. These distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 package eliminates the need for external isolation so reducing fixing hardware.

The package is supplied with leads longer than the standard TO-218 to allow easy mounting on pcbs.

Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

ISOWATT218 thermal performance is equivalent to that of the standard part, mounted with a 0.1mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for ISOWATT218 packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT218 PACKAGE

Figure 6 illustrates the elements contributing to the thermal resistance of a transistor heatsink assembly, using ISOWATT218 package.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements. The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1 - For a short duration power pulse of less than 1ms :

$$Z_{th} < R_{thJ\text{-}C}$$

2 - For an intermediate power pulse of 5ms to 50ms seconds :

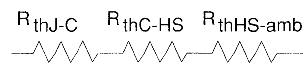
$$Z_{th} = R_{thJ\text{-}C}$$

3 - For long power pulses of the order of 500ms seconds or greater :

$$Z_{th} = R_{thJ\text{-}C} + R_{thC\text{-}HS} + R_{thHS\text{-}amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 6.



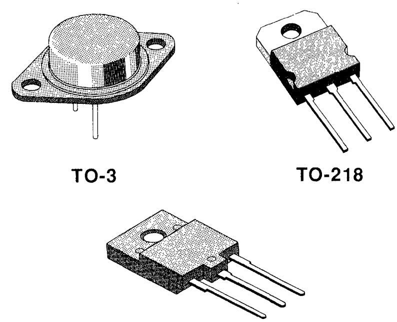
SGS-THOMSON MICROELECTRONICS

BUX48B/V48B/V48BFI BUX48C/V48C/V48CFI

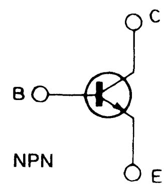
HIGH VOLTAGE POWER SWITCHING

DESCRIPTION

The BUX48B/C, BUV48B/C and BUV48BFI/CFI are silicon multiepitaxial mesa NPN transistors mounted respectively in TO-3 metal case, TO-218 plastic package and ISOWATT218 fully isolated package. They are particularly intended for switching and industrial applications from single and tree-phase mains.


TO-3 TO-218 ISOWATT218

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		BUX48B BUV48B BUV48BFI		BUX48C BUV48C BUV48CFI	
V_{CER}	Collector-emitter Voltage (R_{BE} = 10Ω)	1200		1200	V
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	1200		1200	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	600		700	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7			V
I_C	Collector Current	15			A
I_{CM}	Collector Peak Current (t_p < 5ms)	30			A
I_{CP}	Collector Peak Current non Repetitive (t_p < 20μs)	55			A
I_B	Base Current	4			A
I_{BM}	Base Peak Current (t_p < 5ms)	20			A
		TO-3	TO-218	ISOWATT218	
P_{tot}	Total Dissipation at T_c < 25°C	175	125	65	W
T_{stg}	Storage Temperature	– 65 to 200	– 65 to 150	– 65 to 150	°C
T_j	Max. Operating Junction Temperature	200	150	150	°C

THERMAL DATA

		TO-3	TO-218	ISOWATT218	
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case max	1	1	1.92	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10 Ω)	V_{CE} = 1200 V V_{CE} = 1200 V T_{case} = 125 °C			500 4	μA mA
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 1200 V V_{CE} = 1200 V T_{case} = 125 °C			500 3	μA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = V_{CEO}			1	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 6 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA for **BUX48B/BUV48B/BUV48BFI** for **BUX48C/BUV48C/BUV48CFI**	 600 700			V
$V_{CER(sus)}$*	Collector-emitter Sustaining Voltage (R_{BE} = 10 Ω)	I_C = 0.5 A V_{clamp} = 1200 V L = 2 mH	1200			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 6 A I_B = 1.5 A I_C = 10 A I_B = 4 A			1.5 3	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 6 A I_B = 1.5 A I_C = 10 A I_B = 4 A			1.5 2	V V

* Pulsed : pulse duration = 300 μs, duty cycle = 1.5 %.

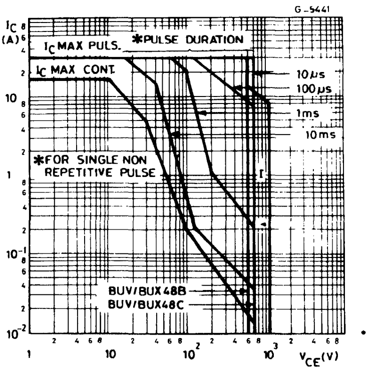
RESISTIVE SWITCHING TIMES

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	V_{CC} = 250 V I_C = 6 A I_{B1} = − I_{B2} = 1.5 A		0.5	1	μs
t_s	Storage Time			1.5	3	μs
t_f	Fall Time			0.2	0.7	μs

INDUCTIVE SWITCHING TIMES

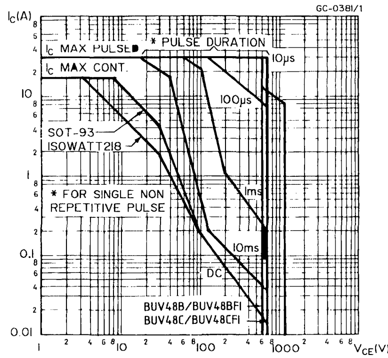
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	V_{CC} = 250 V I_C = 6 A I_{B1} = − I_{B2} = 1.5 A		2		μs
t_f	Fall Time			0.15		μs
t_s	Storage Time	V_{CC} = 250 V I_C = 6 A I_{B1} = − I_{B2} = 1.5 A T_C = 125 °C		3	6	μs
t_f	Fall Time			0.33	0.60	μs

Safe Operating Areas (TO-3).

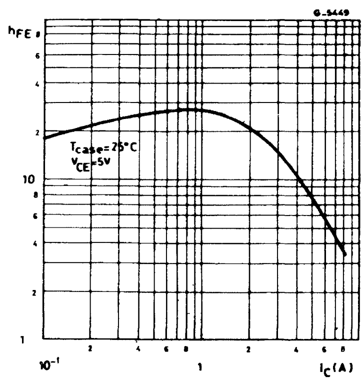


I - Area of permissible operation during turn-on provided $R_{BE} \leq 100\ \Omega$ and $t_p \leq$: 0.2 µs.

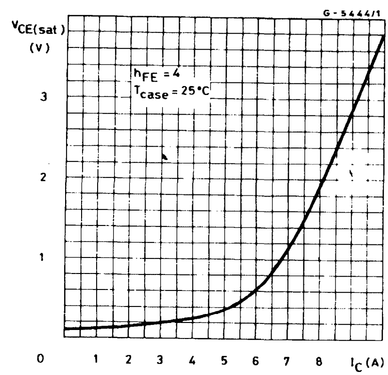
Safe Operating Areas (TO-218, ISOWATT218).



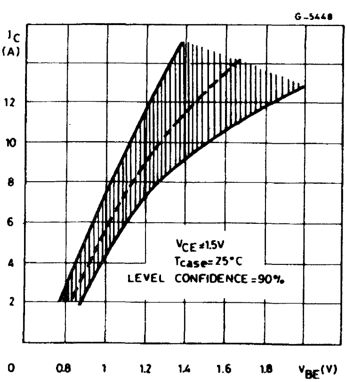
DC Current Gain.



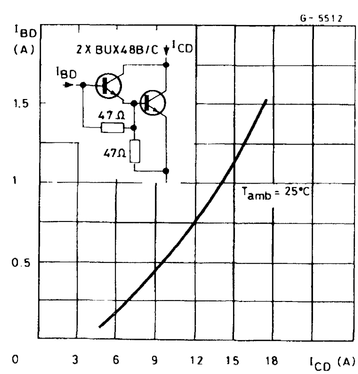
Collector-emitter Saturation Voltage.



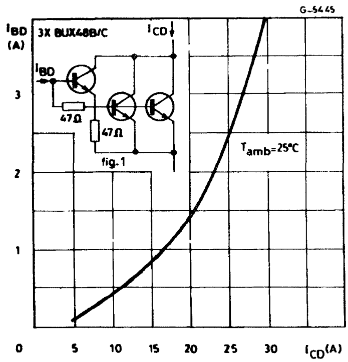
Collector Current Spread vs. Base Emitter Voltage.



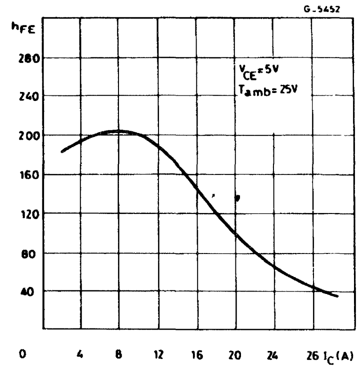
Minimum Bias Current I_{BD} to Saturate the Discrete darlington.



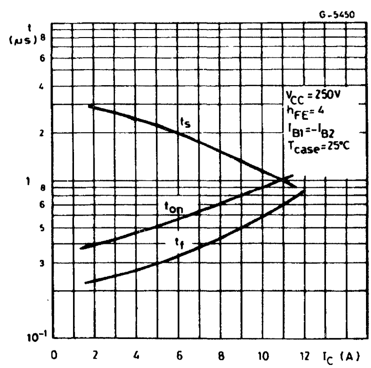
Minimum Base Current I_{BD} to Saturate the Discrete Darlington.



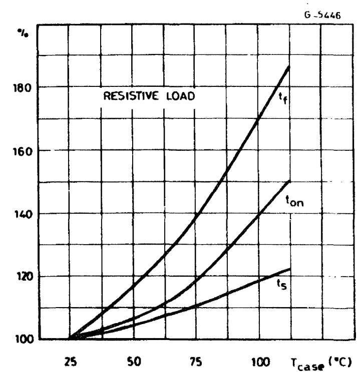
DC Current Gain for Darlington Configuration (see fig. 1).



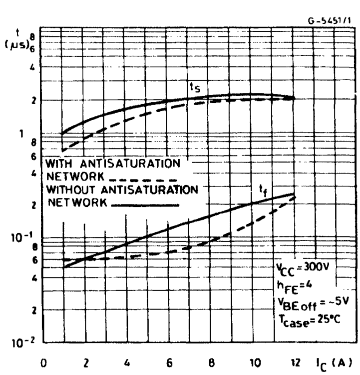
Switching Times Resistive Load.



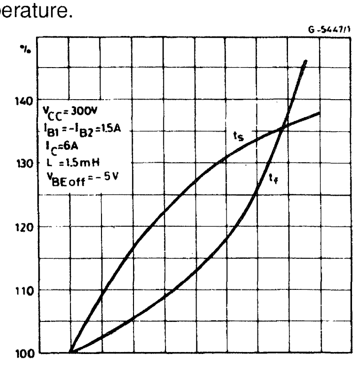
Switching Times Percentage Variation vs. Case Temperature.



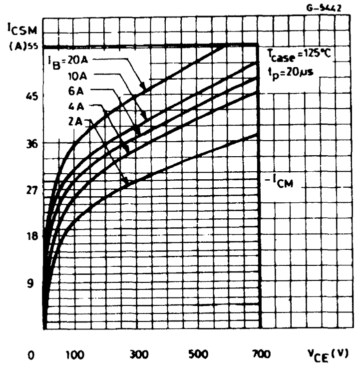
Switching Times Inductive Load.



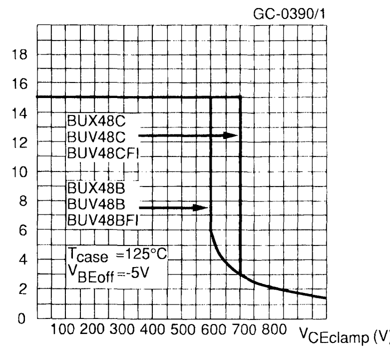
Switching Times Percentage Variation vs. Case Temperature.



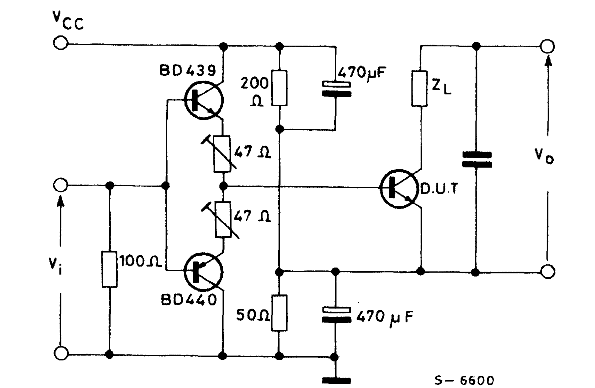
Forward Biased Accidental Overload Area.

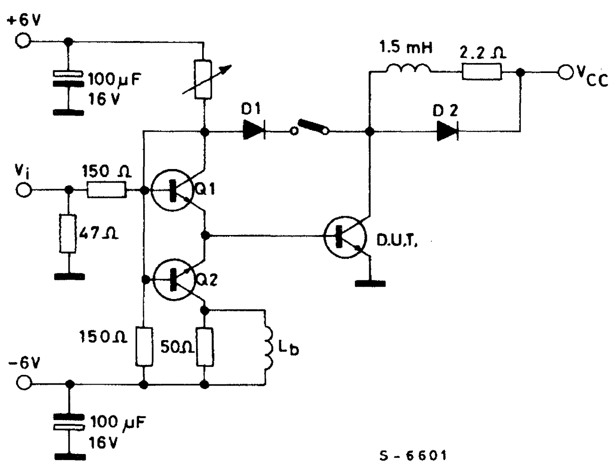


Clamped Reverse Biased Safe Operating.



TEST CIRCUITS





ISOWATT218 PACKAGE CHARACTERISTICS AND APPLICATION

ISOWATT218 is fully isolated to 4000V dc. Its thermal impedance, given in the data sheet, is optimised to give efficient thermal conduction together with excellent electrical isolation. The structure of the case ensures optimum distances between the pins and heatsink. These distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 package eliminates the need for external isolation so reducing fixing hardware.

The package is supplied with leads longer than the standard TO-218 to allow easy mounting on pcbs.

Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

ISOWATT218 thermal performance is equivalent to that of the standard part, mounted with a 0.1mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for ISOWATT218 packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT218 PACKAGE

Figure 1 illustrates the elements contributing to the thermmal resistance of a transistor heatsink assembly, using ISOWATT218 package.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements. The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1 - For a short duration power pulse of less than 1ms :

$$Z_{th} < R_{thJ-C}$$

2 - For an intermediate power pulse of 5ms to 50ms seconds :

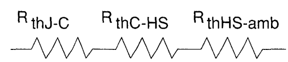
$$Z_{th} = R_{thJ-C}$$

3 - For long power pulses of the order of 500ms seconds or greater :

$$Z_{th} = R_{thJ-C} + R_{thC-HS} + R_{thHS-amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 1.



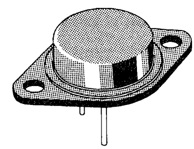
SGS-THOMSON
MICROELECTRONICS

BUX80

HIGH VOLTAGE POWER SWITCH

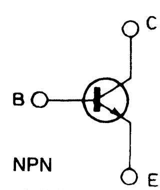
DESCRIPTION

The BUX80 is a silicon multiepitaxial mesa NPN transistor in Jedec TO-3 metal case, particularly intented for converters, inverters, switching regulators and motor control systems applications.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	800	V
V_{CER}	Collector-emitter Voltage (R_{BE} = 50 Ω)	500	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	400	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	10	V
I_C	Collector Current	10	A
I_{CM}	Collector Peak Current	15	A
I_B	Base Current	5	A
P_{tot}	Total Power Dissipation at T_{case} ≤ 40 °C	100	W
T_{stg}	Storage Temperature	– 65 to 150	°C
T_j	Junction Temperature	150	°C

THERMAL DATA

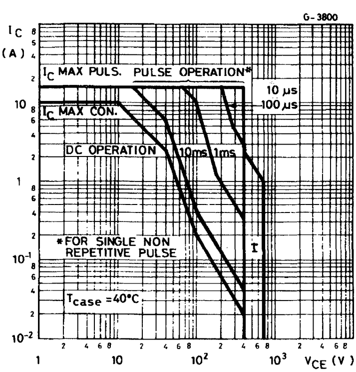
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.1	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

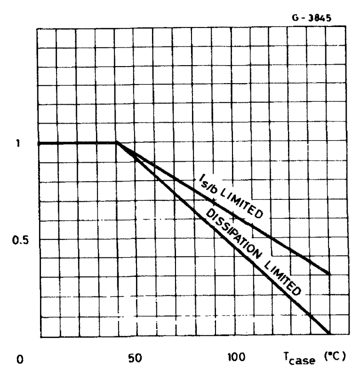
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 800 V V_{CE} = 800 V T_{case} = 125 °C			1 3	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 10 V			10	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA	400			V
$V_{CER(sus)}$*	Collector-emitter Sustaining Voltage (R_{BE} = 50 Ω)	I_C = 100 mA	500			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5 A I_B = 1 A I_C = 8 A I_B = 2.5 A			1.5 3	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 5 A I_B = 1 A I_C = 8 A I_B = 2.5 A			1.4 1.8	V V
h_{FE}*	DC Current Gain	I_C = 1.2 A V_{CE} = 5 V		30		
t_{on}	Turn-on Time	I_C = 5 A I_{B1} = 1 A V_{CC} = 250 V			0.5	µs
t_s	Storage Time	I_C = 5 A I_{B1} = 1 A I_{B2} = – 2 A V_{CC} = 250 V			3.5	µs
t_f	Fall Time	I_C = 5 A I_{B1} = 1 A I_{B2} = – 2 A V_{CC} = – 250 V			0.5	µs

* Pulsed : pulse duration = 300 µs, duty cycle = 1.5 %.

Safe Operating Areas.

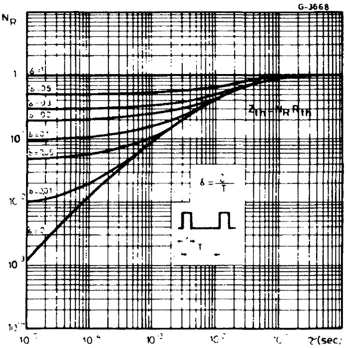


Derating Curves.

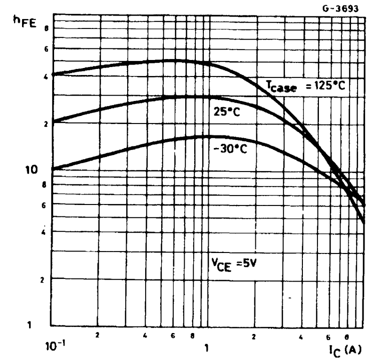


I - Area of permissible operation during Turn-on provided R_{BE} ≤ 100 Ω and t_p ≤ 0,6 µs.

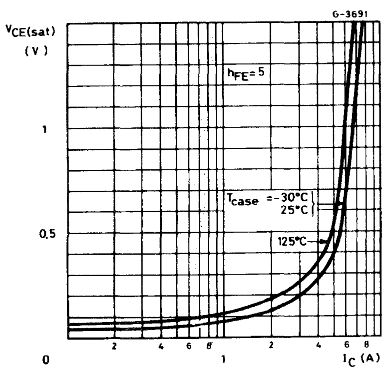
Transient Thermal Response.



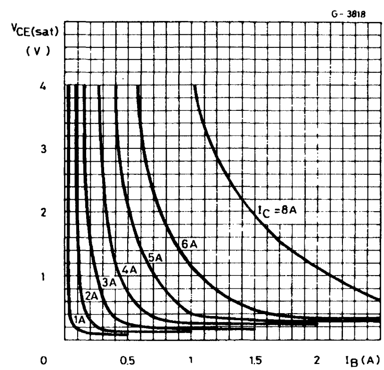
DC Current Gain.



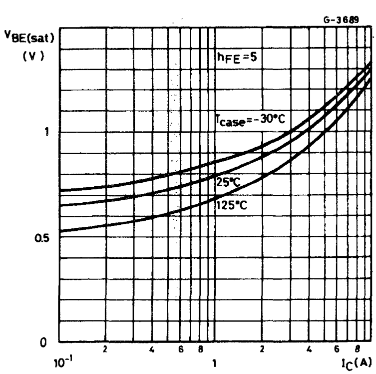
Collecteur-emitter Saturation Voltage.



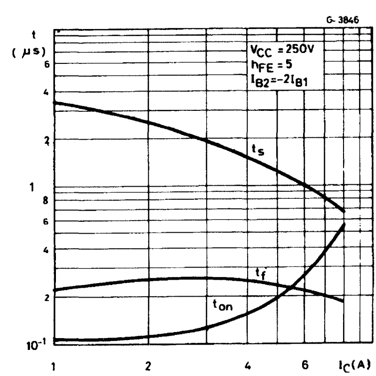
Collector-emitter Saturation Voltage.



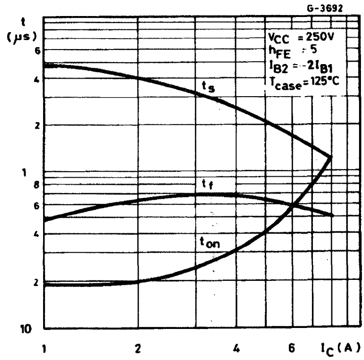
Base-emitter Saturation Voltage.



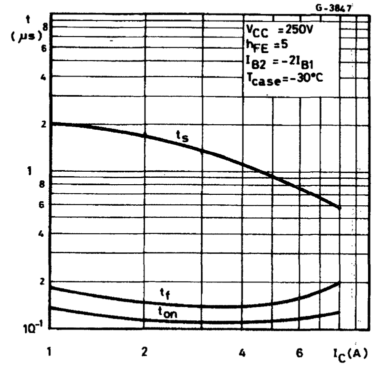
Saturated Switching Characteristics.



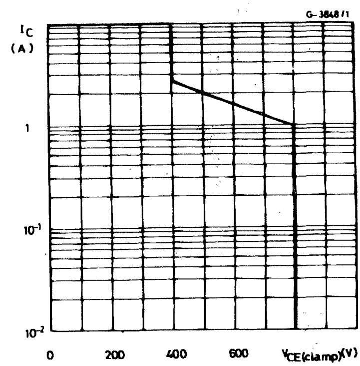
Saturated Switching Characteristics.



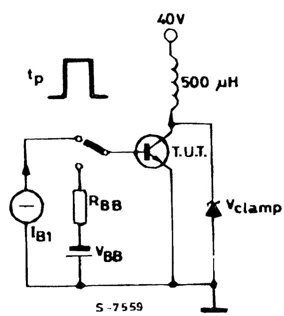
Saturated Switching Characteristics.



Clamped Reverse Bias Safe Operating Areas.



Clamped $E_{s/b}$ Test Circuit.



TEST CONDITIONS :
$V_{BE\ off} = -5$ V
$I_C / I_B = 5$
t_p = adjusted for nominal I_C
$R_{BB} = 1\ \Omega$

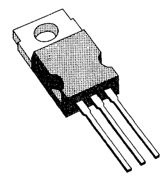
SGS-THOMSON MICROELECTRONICS

BUX84
BUX84A

HIGH VOLTAGE SWITCH

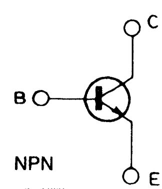
DESCRIPTION

The BUX84, and BUX84A are multiepitaxial mesa NPN transistors, intended for use in converters inverters, switching regulators, motor control system and switching applications. They are mounted in Jedec TO-220 plastic package.



TO-220

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	800	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	400	V
I_C	Collector Current	2	A
I_{CM}	Collector Peak Current	3	A
I_B	Base Current	0.75	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	40	W
T_{stg}	Storage Temperature	– 65 to 150	°C
T_j	Junction Temperature	150	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	3.125	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = rated V_{CES} at T_{case} = 125 °C			0.2 1.5	mA mA
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 0.3 A I_B = 30 mA for **BUX84** for **BUX84A** I_C = 1 A I_B = 0.2 A for **BUX84** for **BUX84A**			 1.5 0.8 3 1	 V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 1 A I_B = 0.2 A			1.1	V
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 100 mA L = 25 mH	400			V
f_T	Transition Frequency (f = 1 MHz)	I_C = 0.2 A V_{CE} = 10 V		20		MHz
t_{on}	Turn-on Time	I_C = 1 A V_{CC} = 250 V I_B = 0.2 A $-I_B$ = 0.4 A			0.5	μs
t_s	Storage Time				3.5	μs
t_f	Fall Time				1.4	μs

* Pulsed : pulse duration = 300 μs, duty cycle ≤ 2 %.

SGS-THOMSON MICROELECTRONICS

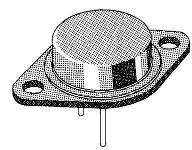
BUX98
BUX98A

HIGH VOLTAGE FAST SWITCHING

ADVANCE DATA

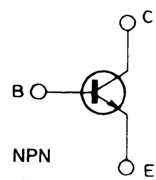
DESCRIPTION

The BUX98 and BUX98A are silicon multiepitaxial mesa NPN transistors in Jedec TO-3 metal-case intended and industrial applications from single and three-phase mains operation.



TO-3

INTERNAL SCHEMATIC DIAGRAMS



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BUX98	BUX98A	
V_{CER}	Collector-emitter Voltage ($R_{BE} \leq 10\ \Omega$)	850	1000	V
V_{CES}	Collector-base Voltage ($V_{BE} = 0$)	850	1000	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	400	450	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7		V
I_C	Collector Current	30		A
I_{CM}	Collector Peak Current ($t_p < 5$ ms)	60		A
I_{CP}	Collector Peak Current non Rep. ($t_p < 20\ \mu s$)	80		A
I_B	Base Current	8		A
I_{BM}	Base Peak Current ($t_p < 5$ ms)	30		A
P_{tot}	Total Power Dissipation at $T_{case} < 25$ °C	250		W
T_{stg}	Storage Temperature	– 65 to 200		°C
T_j	Junction Temperature	200		°C

This is advanced information on a new product now in development or undergoing evaluation. Details are subject to change without notice.

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	0.7	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10 Ω)	$V_{CE} = V_{CES}$ $V_{CE} = V_{CES}$ T_{case} = 125 °C			1 8	μA mA
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	$V_{CE} = V_{CES}$ $V_{CE} = V_{CES}$ T_{case} = 125 °C			400 4	μA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	$V_{CE} = V_{CEO}$			2	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			2	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 200 mA for **BUX98** for **BUX98A**	 400 450			 V V
$V_{CER(sus)}$*	Collector-emitter Sustaining Voltage	L = 2 mH I_C = 1 A for **BUX98** for **BUX98A**	 850 1000			 V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	for **BUX98** I_C = 20 A I_B = 4 A for **BUX98A** I_C = 16 A I_B = 3.2 A I_C = 24 A I_B = 5 A			 1.5 1.5 5	 V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	for **BUX98** I_C = 20 A I_B = 4 A for **BUX98A** I_C = 16 A I_B = 3.2 A			 1.6 1.6	 V V
t_{on}	Turn-on Time	for **BUX98** V_{CC} = 150 V I_C = 20 A, $I_{B1} = I_{B2}$ = 4 A			1	μs
t_s	Storage Time				3	μs
t_f	Fall Time				0.8	μs
t_{on}	Turn-on Time	for **BUX98A** V_{CC} = 150 V I_C = 16 A ;$I_{B1} = I_{B2}$ = 3.2 A			1	μs
t_s	Storage Time				3	μs
t_f	Fall Time				0.8	μs

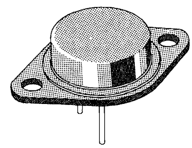
* Pulsed : pulse duration = 300 μs, duty cycle = 1.5 %.

BUX98B
BUX98C

HIGH VOLTAGE SWITCH

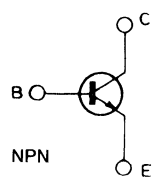
DESCRIPTION

The BUX98B and BUX98C are silicon multiepitaxial mesa NPN transistors in Jedec TO-3 metal case intended for use in switching and industrial applications from single and three-phase mains operations.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BUX98B	BUX98C	
V_{CER}	Collector-emitter Voltage	1200	1200	V
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	1200	1200	V
V_{CEX}	Collector-emitter Voltage	600	700	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7		V
I_C	Collector Current	30		A
I_{CM}	Collector Peak Current	60		A
I_{CP}	Collector Peak Current non Repetitive	80		A
I_B	Base Current	8		A
I_{BM}	Base Peak Current	30		A
P_{tot}	Total Dissipation at T_c < 25 °C	250		W
T_{stg}	Storage Temperature	– 65 to 200		°C
T_j	Max. Operating Junction Temperature	200		°C

THERMAL DATA

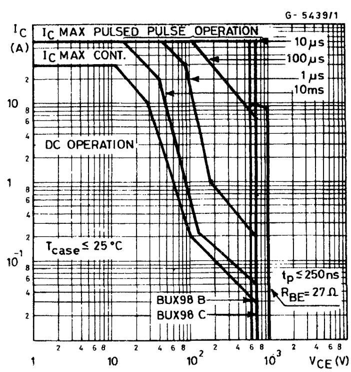
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	0.7	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

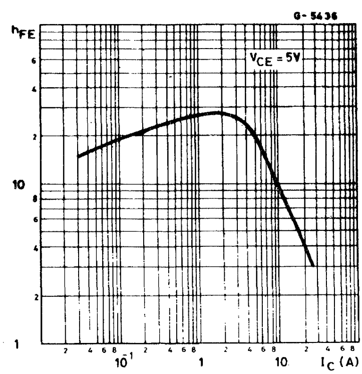
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10 Ω)	$V_{CE} = V_{CES}$ $V_{CE} = V_{CES}$ T_{case} = 125 °C			1 8	mA mA
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	$V_{CE} = V_{CES}$ $V_{CE} = V_{CES}$ T_{case} = 125 °C			1 6	mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	$V_{CE} = V_{CEO}$			2	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			2	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 100 mA	700			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 12 A I_B = 3 A I_C = 16 A I_B = 5 A I_C = 20 A I_B = 8 A			1.5 2 3	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 12 A I_B = 3 A I_C = 20 A I_B = 8 A			1.6 2	V V
t_{on}	Turn-on Time	RESISTIVE LOAD		0.5	1	µs
t_s	Storage Time	V_{CC} = 250 V I_C = 12 A		1.5	3	µs
t_f	Fall Time	$I_{B1} = -I_{B2}$ = 3 A		0.2	0.8	µs

* Pulsed : pulse duration = 300 µs duty cycle = 1.5 %.

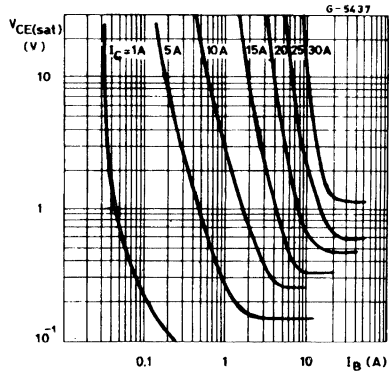
Safe Operating Areas.



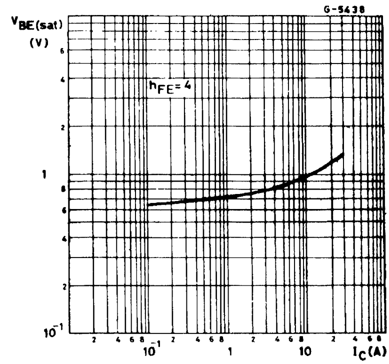
DC Current Gain.



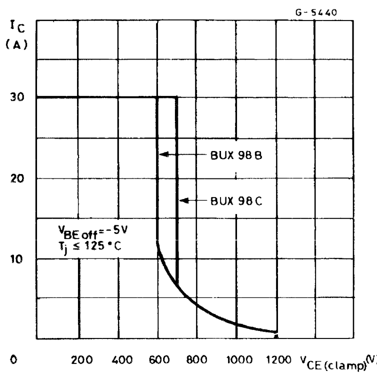
Collector-emitter Saturation Voltage.



Base-emitter Saturation Voltage.



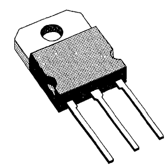
Reverse Biased Operating Area.



BUX98P

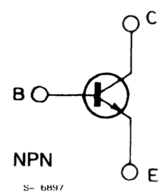
FAST SWITCHING POWER TRANSISTOR

- HIGH VOLTAGE HIGH SPEED TRANSISTOR SUITED FOR USE ON THE 220 AND 380V MAINS
- SUITABLE FOR SWITCH MODE POWER SUPPLY UPS, DC AND AC MOTOR CONTROL



TO-218

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = − 1.5V)	850	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	450	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_E	Emitter Current	30	A
I_{EM}	Emitter Peak Current	45	A
I_B	Base Current	6	A
I_{BM}	Base Peak Current	10	A
P_{tot}	Total Dissipation at T_c < 25°C	200	W
T_{stg}	Storage Temperature	− 65 to 150	°C
T_j	Max. Operating Junction Temperature	150	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	0.63	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 5Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			0.2 1	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = – 1.5V $V_{CE} = V_{CEV}$ V_{BE} = – 1.5V T_c = 100°C			0.2 1	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	450			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 100mA		7		V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 20A I_B = 4A I_C = 20A I_B = 4A T_j = 100°C		0.35 0.7	0.9 2	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 20A I_B = 4A I_C = 20A I_B = 4A T_j = 100°C		1.05 1	1.5 1.5	V V
di_C/dt	Rated of Rise of On-state Collector Current	V_{CC} = 300V R_C = 0 I_{B1} = 6A t_p = 3μs T_j = 100°C See fig. 1	120	160		A/μs
$V_{CE(3\mu s)}$	Collector Emitter Dynamic Voltage	V_{CC} = 300V I_{B1} = 6A R_C = 15Ω T_j = 100°C See fig. 1		4.5	8	V
$V_{CE(5\mu s)}$	Collector Emitter Dynamic Voltage	V_{CC} = 300V I_{B1} = 6A R_C = 15Ω T_j = 100°C See fig. 1		2.5	4	V

INDUCTIVE LOAD

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s t_f t_c	Storage Time Fall Time Crossover Time	V_{CC} = 50V V_{clamp} = 450V I_C = 20A I_B = 4A V_{BB} = – 5V R_{BB} = 0.62Ω L_C = 0.12mH T_j = 100°C See fig. 2		3 0.25 0.5	4.5 0.4 0.7	μs μs μs
V_{CEW}	Maximum Collector Emitter Voltage without Snubber	V_{CC} = 50V I_{CWoff} = 30A V_{BB} = – 5V I_{B1} = 4A L_C = 0.08mH R_{BB} = 0.62Ω T_j = 125°C See fig. 2	450			V

Figure 1 : Switching Times Test Circuit (resistive load).

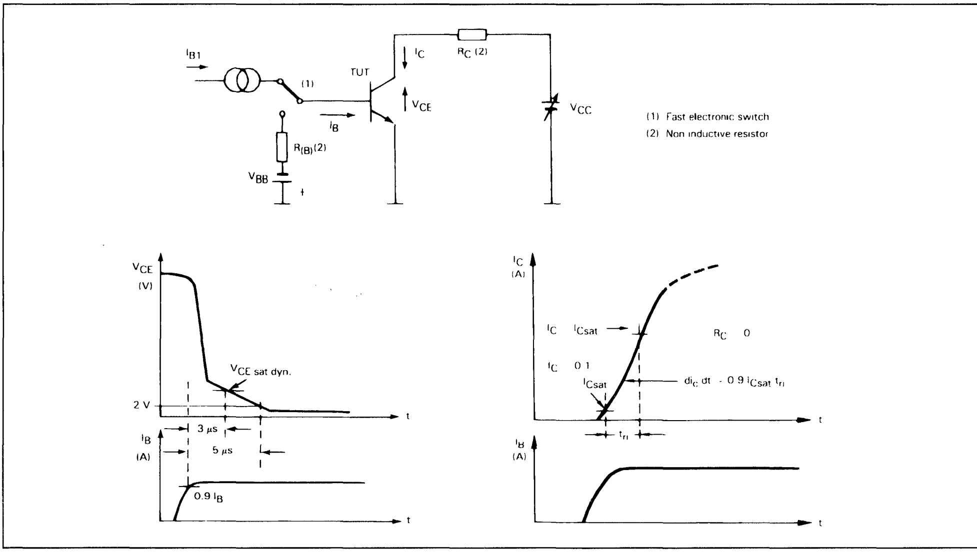


Figure 2a : Turn-off Switching Test Circuit.

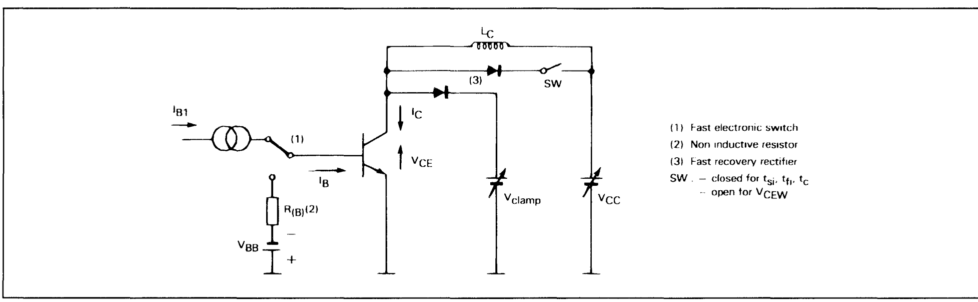
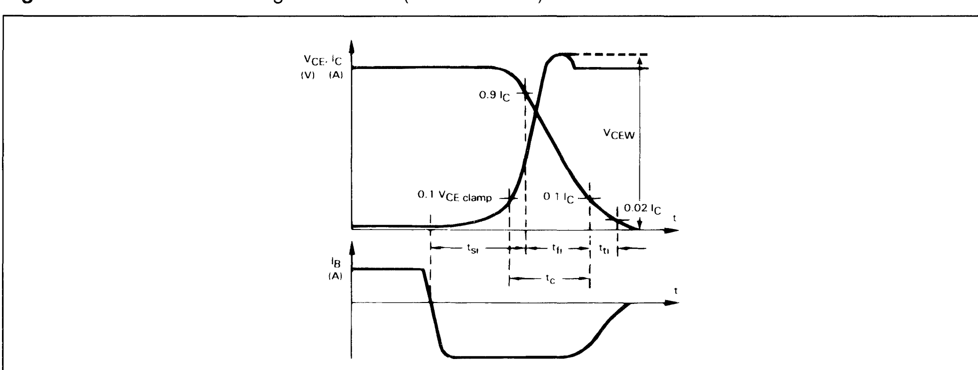
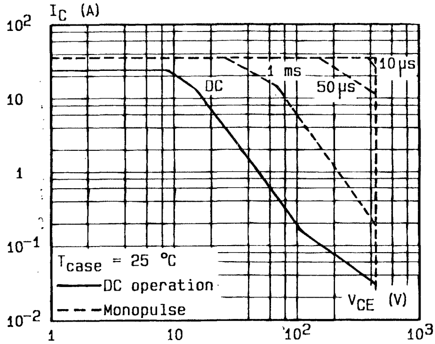


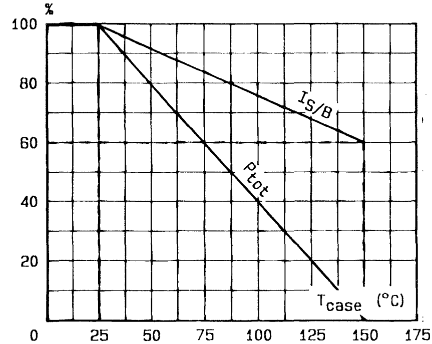
Figure 2b : Turn-off Switching Waveforms (inductive load).



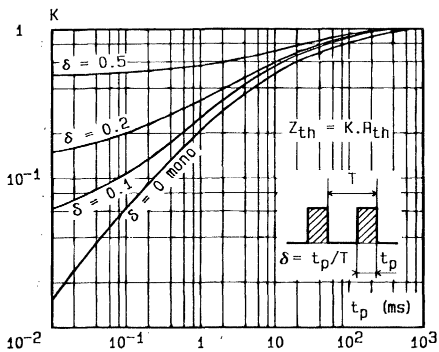
DC and AC Pulse Area.



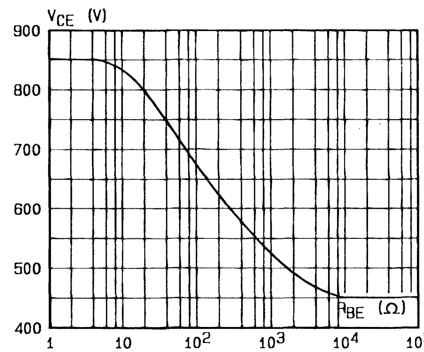
Power and $I_{S/B}$ Derating versus Case Temperature.



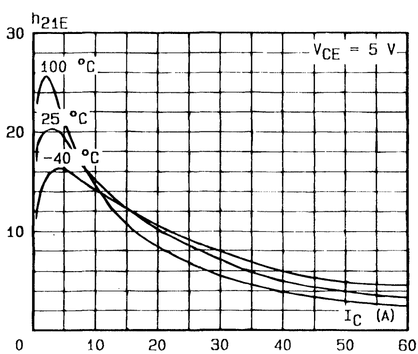
Transient Thermal Response.



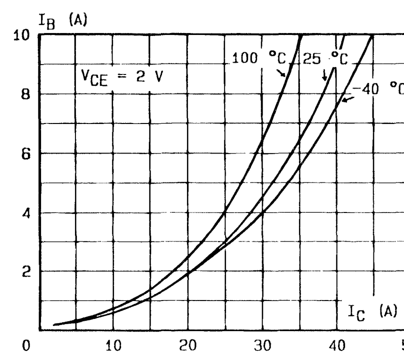
Collector-emitter Voltage versus Base-emitter Resistance.



DC Current Gain.

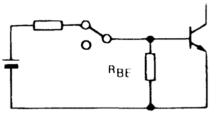


Minimum Base Current to saturate the Transistor.

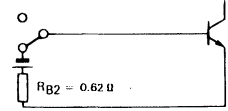


SWITCHING OPERATING AND OVERLOAD AREAS

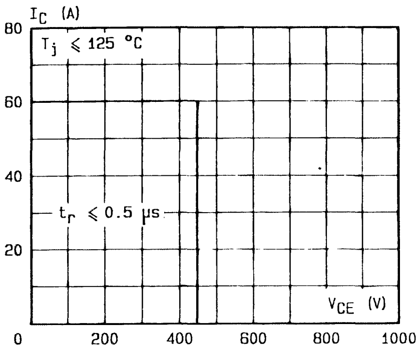
TRANSISTOR FORWARD BIASED
- During the turn-on
- During the turn-off without negative base-emitter voltage.



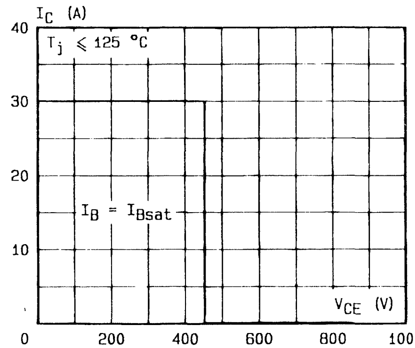
TRANSISTOR REVERSE BIASED
- During the turn-off with negative base-emitter voltage.



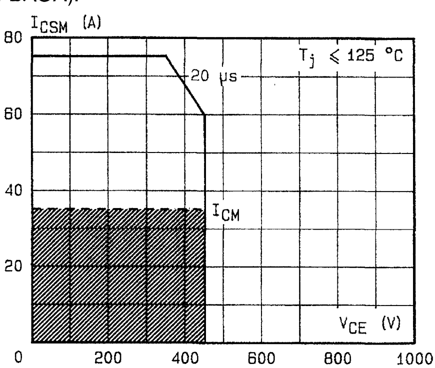
Forward Biased Safe Operating Area (FBSOA).



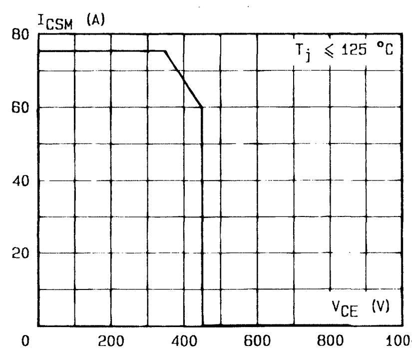
Reverse Biased Safe Operating Area (RBSOA).



Forward Biased Accidental Overload Area (FBAOA).

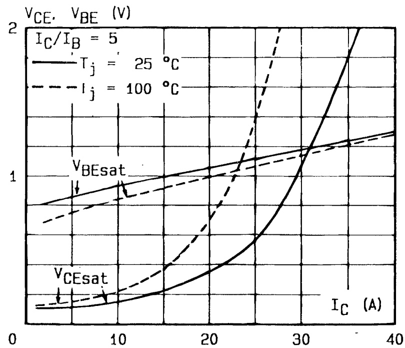


Reverse Biased Accidental Overload Area (RBAOA).

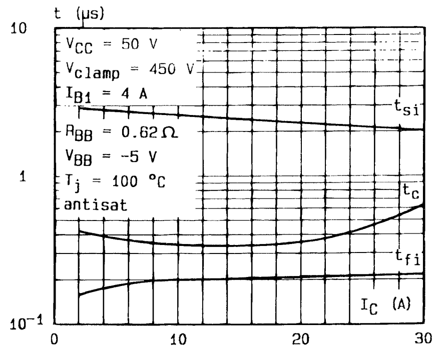


High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

Saturation Voltage.



Switching Times versus Collector Current.



SGS-THOMSON MICROELECTRONICS

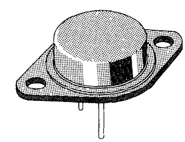
BUX348

FAST SWITCHING POWER TRANSISTOR

- HIGH VOLTAGE
- FAST SWITCHING
- OFF-LINE APPLICATIONS TO 380V

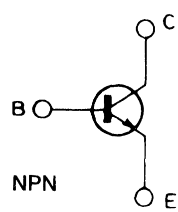
INDUSTRIAL APPLICATIONS :

- SWITCH MODE POWER SUPPLY
- UNINTERRUPTABLE POWER SUPPLY
- DC AND AC MOTOR CONTROL



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	850	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	450	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	45	A
I_{CM}	Collector Peak Current	60	A
I_B	Base Current	9	A
I_{BM}	Base Peak Current	15	A
P_{tot}	Total Dissipation at $T_c < 25°C$	300	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	0.58	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 5Ω)	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ T_c = 100°C			0.4 2	mA mA
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ V_{BE} = – 1.5V $V_{CE} = V_{CEV}$ V_{BE} = – 1.5V T_c = 100°C			0.4 2	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			2	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A L = 25mH	450			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 100mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 30A I_B = 6A I_C = 30A I_B = 6A T_j = 100°C		0.7 1.35	0.9 2	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 30A I_B = 6A I_C = 30A I_B = 6A T_j = 100°C		1.12 1.1	1.5 1.5	V V
di_C/dt	Rated of Rise of on-state Collector Current	V_{CC} = 300V R_C = 0 I_{B1} = 9A t_p = 3µs T_j = 100°C See fig.1	150	250		A/µs
$V_{CE(3\mu s)}$	Collector-emitter Dynamic Voltage Current	V_{CC} = 300V I_{B1} = 9A R_C = 10Ω T_j = 100°C See fig.1		4.4	8	V
$V_{CE(5\mu s)}$	Collector-emitter Dynamic Voltage Current	V_{CC} = 300V I_{B1} = 9A R_C = 10Ω T_j = 100°C See fig.1		2.3	4	V

INDUCTIVE LOAD

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s t_f t_c	Storage Time Fall Time Crossover Time	V_{CC} = 50V V_{clamp} = 450V I_C = 30A I_B = 6A V_{BB} = - 5V R_{BB} = 0.4Ω L_C = 80µH T_j = 100°C See fig.2		2.75 0.12 0.44	4.5 0.4 0.7	µs µs µs
V_{CEW}	Maximum Collector Emitter Voltage without Snubber	V_{CC} = 50V I_{CWoff} = 45A V_{BB} = - 5V I_{B1} = 6A L_C = 55µH R_{BB} = 0.4Ω T_j = 125°C See fig.2	450			V

Figure 1 : Turn-on Switching Characteristics.

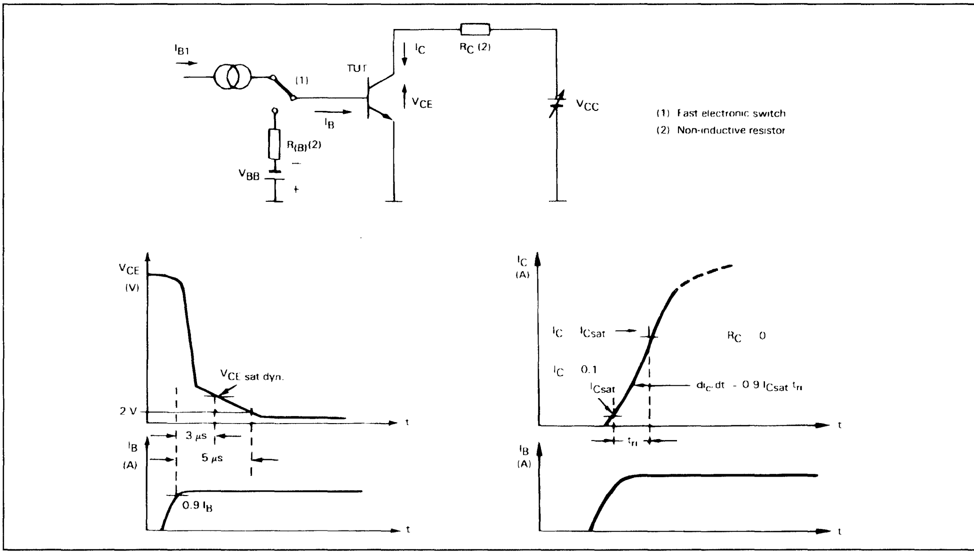


Figure 2a : Turn-off Switching Test Circuit.

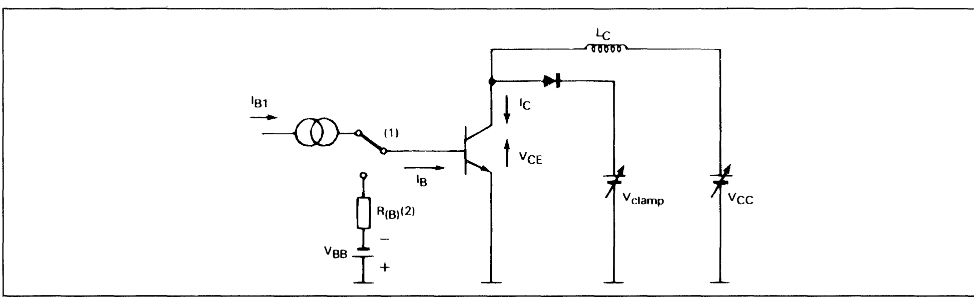
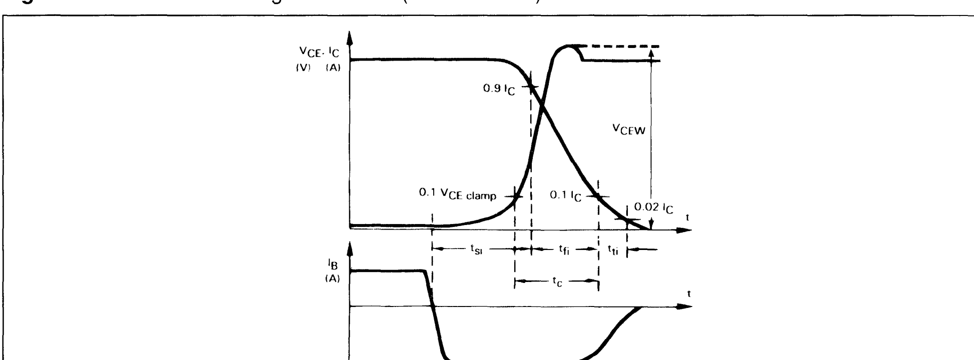
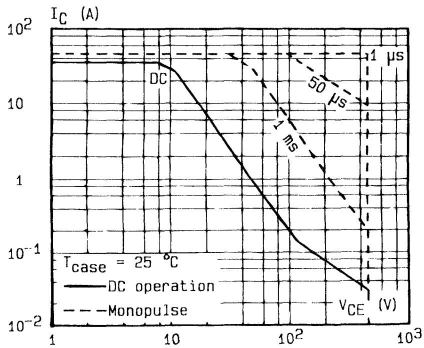


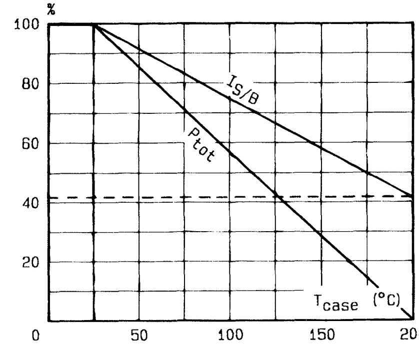
Figure 2b : Turn-off Switching Waveforms (inductive load).



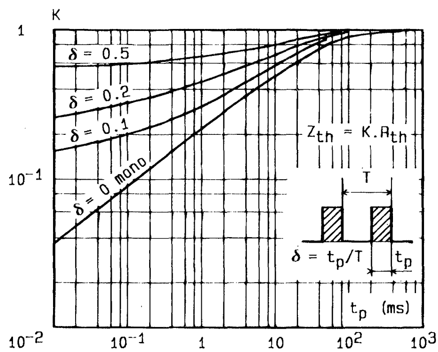
DC and AC Pulse Area.



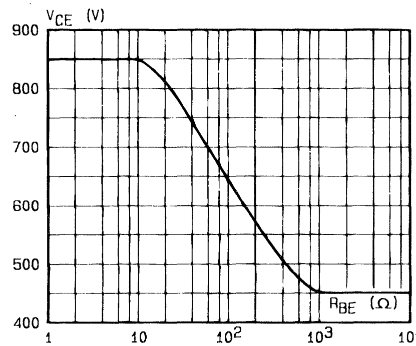
Power and $I_{S/B}$ Derating versus Case Temperature.



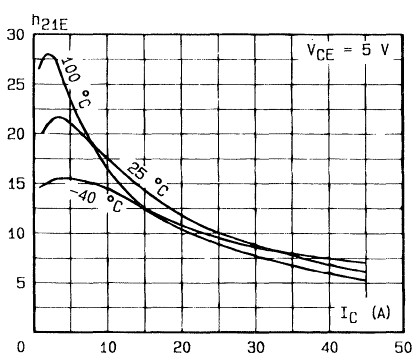
Transient Thermal Response.



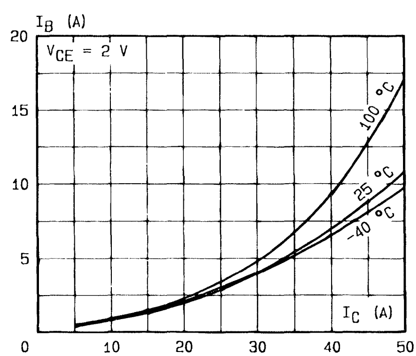
Collector-emitter Voltage versus Base-emitter Resistance.



DC Current Gain.

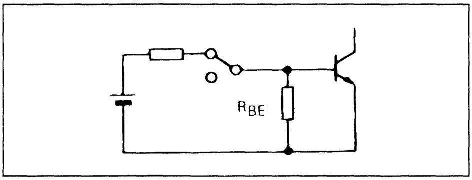


Minimum Base Current to Saturate the Transistor.

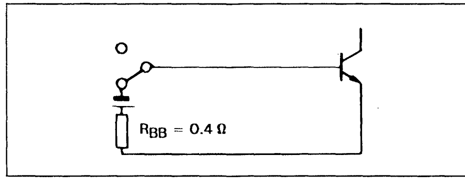


SWITCHING OPERATING AND OVERLOAD AREAS

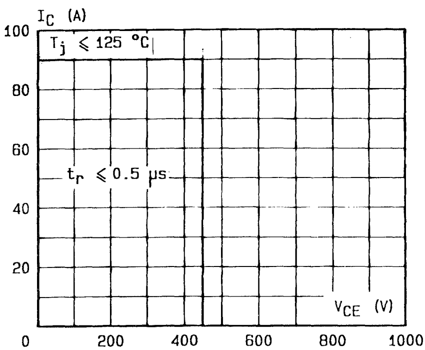
TRANSISTOR FORWARD BIASED
- During the turn-on
- During the turn-off without negative base-emitter voltage.



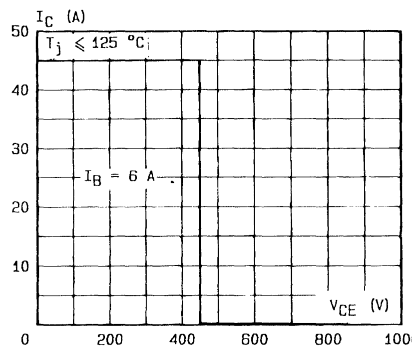
TRANSISTOR REVERSE BIASED
- During the turn-off with negative base-emitter voltage.



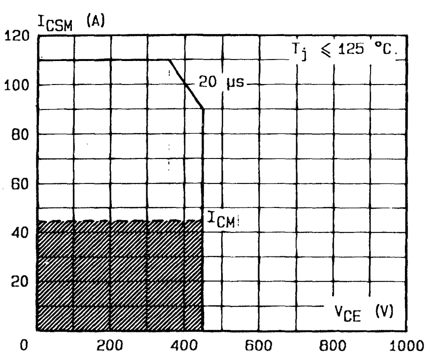
Forward Biased Safe Operationg Area (FBSOA).



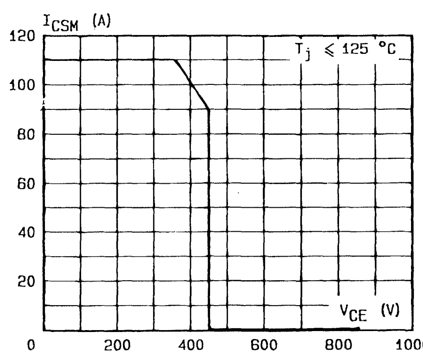
Reverse Biased Safe Operating Area (RBSOA).



Forward Biased Accidental Overload Area (FBAOA).

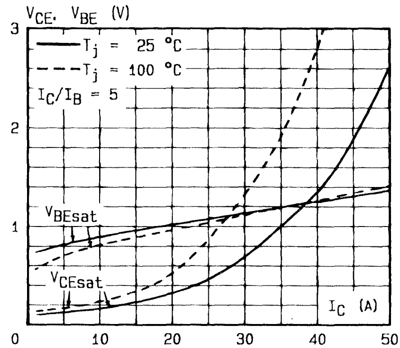


Reverse Biased Accidental Overload Area (RBAOA).

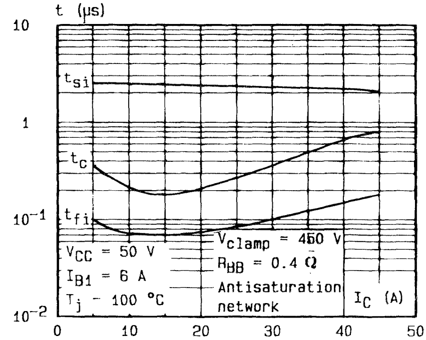


High accidental surge currents ($I > I_{CM}$) are allowed if they are non repetitive and applied less than 3000 times during the component life.

Saturation Voltage.



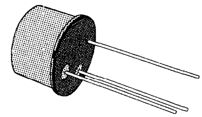
Switching Times versus Collector Current.



HIGH VOLTAGE, HIGH CURRENT SWITCH

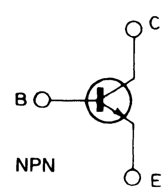
DESCRIPTION

The BUY47 and BUY48 are silicon epitaxial planar NPN transistors in Jedec TO-39 metal case. They are used in high-voltage, high-current switching applications up to 7 A.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BUY 47	BUY 48	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	150	200	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	120	170	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	6		V
I_C	Collector Current	7		A
I_{CM}	Collector Peak Current (repetitive)	10		A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C $T_{case} \leq 50$ °C	1 10		W W
T_{stg}	Storage Temperature	– 65 to 200		°C
T_j	Junction Temperature	200		°C

THERMAL DATA

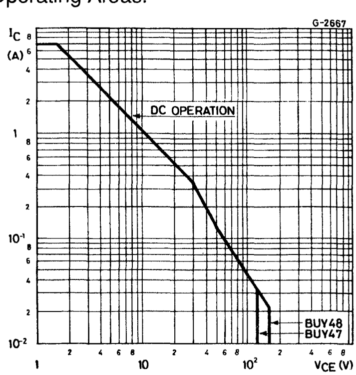
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	15	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

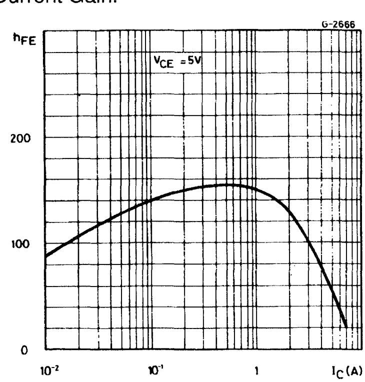
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **BUY 47** V_{CB} = 80 V V_{CB} = 80 V T_{case} = 125 °C for **BUY 48** V_{CB} = 100 V V_{CB} = 100 V T_{case} = 125 °C			10 1 10 1	μA mA μA mA
$V_{(BR)CBO}$*	Collector-base Breakdown Voltage (I_E = 0)	I_C = 1 mA for **BUY 47** for **BUY 48**	150 200			V V
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 20 mA for **BUY 47** for **BUY 48**	120 170			V V
V_{EBO}*	Emitter-base Voltage (I_C = 0)	I_E = 1 mA	6			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 0.5 A I_B = 50 mA I_C = 2 A I_B = 0.2 A I_C = 5 A I_B = 0.5 A		0.05	0.45 1	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 0.5 A I_B = 50 mA I_C = 2 A I_B = 0.2 A I_C = 5 A I_B = 0.5 A		0.8	1.1 1.5	V V V
h_{FE}*	DC Current Gain	I_C = 50 mA V_{CE} = 5 V I_C = 0.5 A V_{CE} = 5 V I_C = 2 A V_{CE} = 5 V I_C = 5 A V_{CE} = 5 V	 40 40 15	130 150 130 45		
f_T	Transition Frequency	I_C = 100 mA V_{CE} = 10 V		90		MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 50 V f = 1 MHz		45	80	pF
t_{on}	Turn-on Time	I_C = 5 A V_{CC} = 40 V I_{B1} = − I_{B2} = 0.5 A			1	μs
t_{off}	Turn-off Time				2	μs

* Pulsed : pulse duration = 300 μs, duty cycle = 1.5 %.

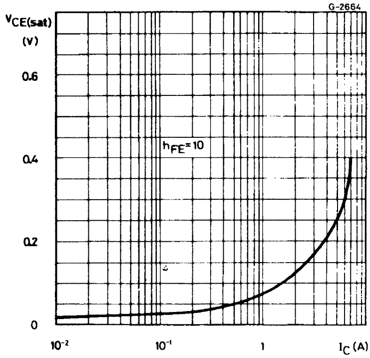
Safe Operating Areas.



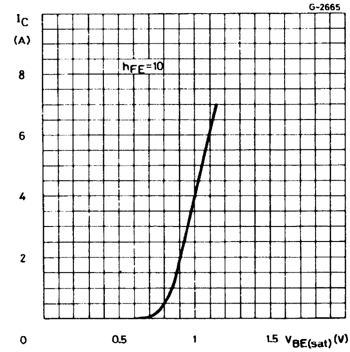
DC Current Gain.



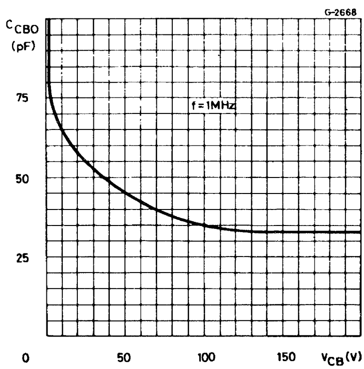
Collector-emitter Saturation Voltage.



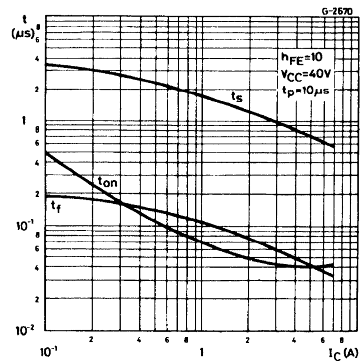
Base-emitter Saturation Voltage.



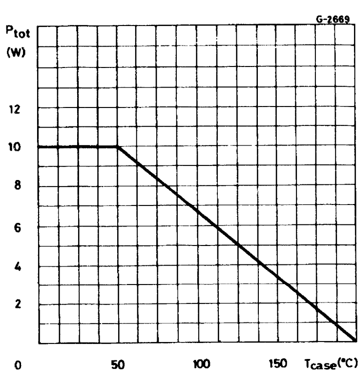
Collector-base Capacitance.



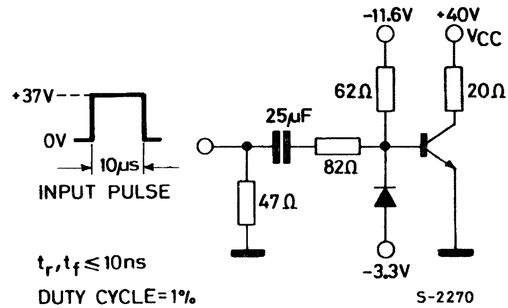
Saturated Switching Characteristics.



Power Rating Chart.



Switching Time Test Circuit.



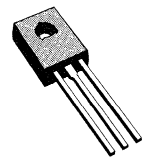
SGS-THOMSON MICROELECTRONICS

BUY49P

HIGH VOLTAGE, MEDIUM CURRENT SWITCH

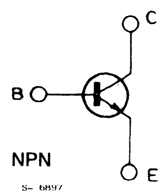
DESCRIPTION

The BUY49P is a silicon epitaxial planar NPN transistor in Jedec TO-126 plastic package. It is used in high-current switching applications up to 3A.



TO-126

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	250	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	200	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	6	V
I_C	Collector Current	3	A
I_{CM}	Collector Peak Current	5	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C	15	W
T_{stg}	Storage Temperature	– 65 to 150	°C
T_j	Junction Temperature	150	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	8.33	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

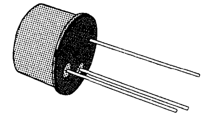
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 200 V			0.1	μA
V_{CBO}*	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 μA	250			V
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 20 mA	200			V
V_{EBO}*	Emitter-base Voltage (I_C = 0)	I_E = 1 mA	6			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 0.5 A I_B = 50 mA			0.2	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 0.5 A I_B = 50 mA			1.1	V
h_{FE}*	DC Current Gain	I_C = 20 mA V_{CE} = 2 V I_C = 20 mA V_{CE} = 5 V I_C = 0.5 mA V_{CE} = 5 V I_C = 20 mA V_{CE} = 2 V T_{case} = – 55 °C	30 40 40 16		 120	
f_T	Transition Frequency	I_C = 100 mA V_{CE} = 10 V	30			MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz			50	pF
t_{on}	Turn-on Time	I_C = 0.5 A V_{CC} = 20 V I_{B1} = – I_{B2} = 50 mA			0.8	μs
t_{off}	Turn-off Time				2.5	μs

* Pulsed : pulse duration = 300 μs, duty cycle = 1.5 %.

HIGH VOLTAGE, MEDIUM CURRENT SWITCH

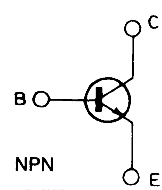
DESCRIPTION

The BUY49S is a silicon epitaxial planar NPN transistor in Jedec TO-39 metal case. It is used in high-voltage, high-current switching applications up to 3A.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	250	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	200	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	6	V
I_C	Collector Current	3	A
I_{CM}	Collector Peak Current	5	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C $T_{case} \leq 50$ °C	1 10	W W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

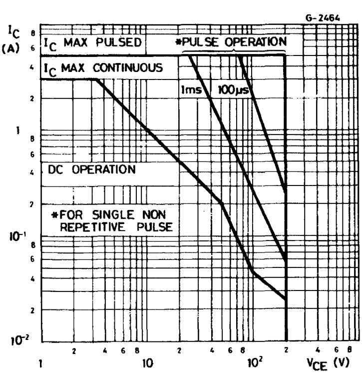
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	15	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

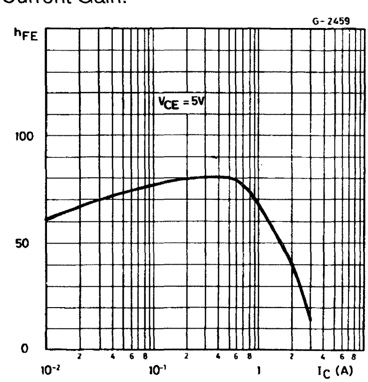
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 200 V V_{CB} = 200 V T_{case} = 150 °C			0.1 50	μA μA
$V_{(BR)CBO}$*	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 μA	250			V
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 20 mA	200			V
V_{EBO}*	Emitter-base Voltage (I_C = 0)	I_E = 1 mA	6			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 0.5 A I_B = 50 mA			0.2	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 0.5 A I_B = 50 mA			1.1	V
h_{FE}*	DC Current Gain	I_C = 20 mA V_{CE} = 5 V I_C = 0.5 A V_{CE} = 5 V I_C = 20 mA V_{CE} = 2 V T_{case} = − 55 °C	40 40 16	 80		
f_T	Transition Frequency	I_C = 100 mA V_{CE} = 10 V	50			MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz			30	pF
t_{on}	Turn-on Time	I_C = 0.5 A V_{CC} = 20 V I_{B1} = − I_{B2} = 50 mA			0.3	μs
t_{off}	Turn-off Time				1	μs
$I_{s/b}$**	Second Breakdown Collector Current	V_{CE} = 50 V	0.2			A

* Pulsed : pulse duration = 300 μs, duty cycle = 1.5 %.
** Pulsed : 1 s, non repetitive pulse.

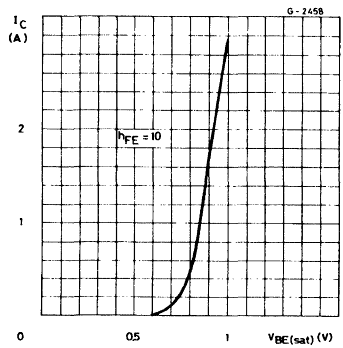
Safe Operating Areas.



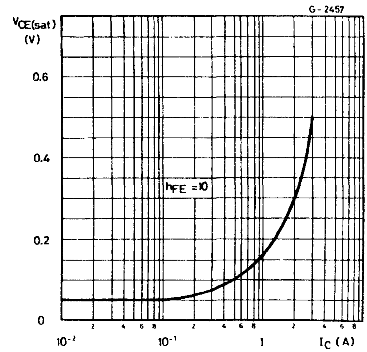
DC Current Gain.



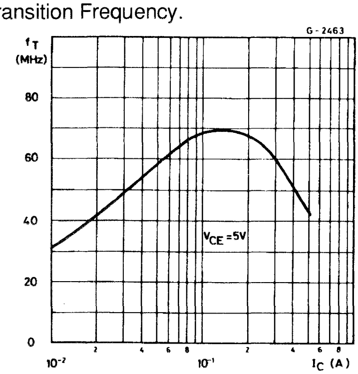
DC Transconductance.



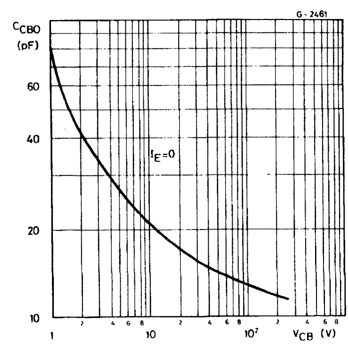
Collector-emitter Saturation Voltage.



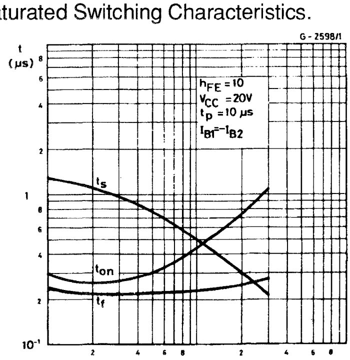
Transition Frequency.



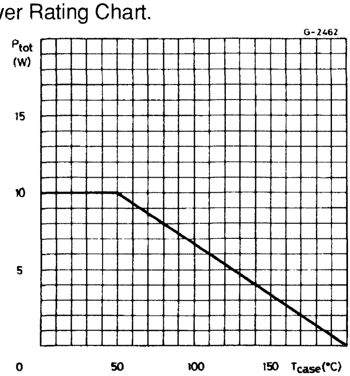
Collector-base Capacitance.



Saturated Switching Characteristics.



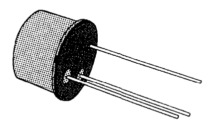
Power Rating Chart.



EPITAXIAL PLANAR NPN

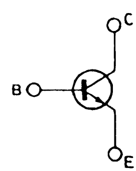
DESCRIPTION

The BUY68 is a silicon epitaxial planar NPN transistor in Jedec TO-39 metal case. It is used for high-current switching applications and in power amplifiers. The BUY68 is available in 3 h_{FE} gain bands



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	100	V
V_{CER}	Collector-emitter Voltage ($R_{BE} \leq 10\ \Omega$)	80	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	60	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	6	V
I_C	Collector Current	7	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C $T_{case} \leq 50$ °C	1 10	W W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

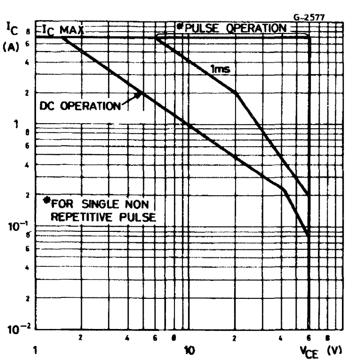
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	15	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

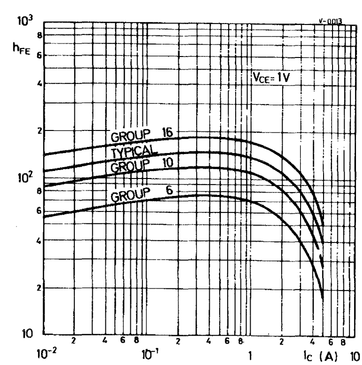
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 60 V				1	μA
$V_{(BR)CBO}$*	Collector-base Breakdown Voltage (I_E = 0)	I_C = 1 mA		100			V
$V_{CER(sus)}$*	Collector-emitter Sustaining Voltage (R_{BE} = 10 Ω)	I_C = 50 mA		80			V
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 50 mA		60			V
V_{EBO}*	Emitter-base Voltage (I_C = 0)	I_E = 1 mA		6			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 2 A I_C = 5 A	I_B = 0.2 A I_B = 0.5 A			0.6 1	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 2 A I_C = 5 A	I_B = 0.2 A I_B = 0.5 A		1 1.2	1.3 1.6	V V
h_{FE}*	DC Current Gain	I_C = 0.1 A	V_{CE} = 1 V Group 6 Group 10 Group 16	40 40 63 100	130 70 110 170		
		I_C = 1 A	V_{CE} = 1 V Group 6 Group 10 Group 16	40 40 63 100	130 70 110 170	250 100 160 250	
f_T	Transition Frequency	I_C = 0.5 A	V_{CE} = 5 V	50			MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 f = 1 MHz	V_{CB} = 10 V			80	pF
t_{on}	Turn-on Time	I_C = 5 A I_{B1} = − I_{B2} = 0.5 A	V_{CC} = 20 V			0.35	μs
t_{off}	Turn-off Time					0.75	μs

* Pulsed : pulse duration = 300 μs, duty cycle = 1.5 %.

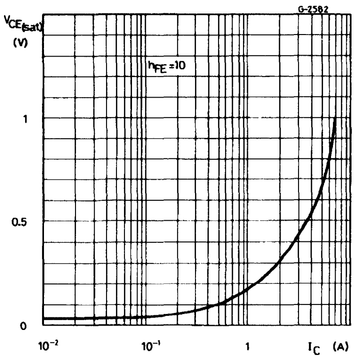
Safe Operating Areas.



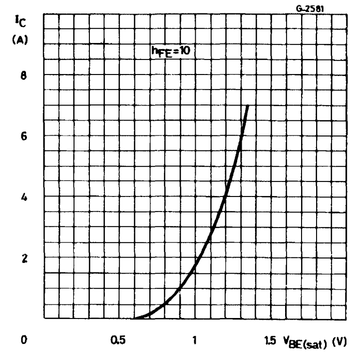
DC Current Gain.



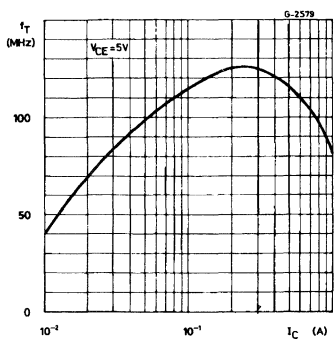
Collector-emitter Saturation Voltage.



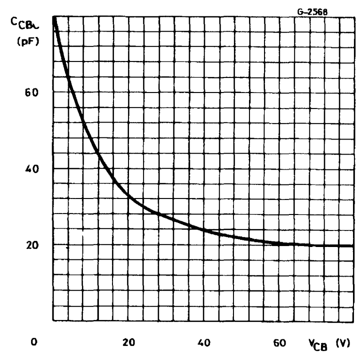
Base-emitter Saturation Voltage.



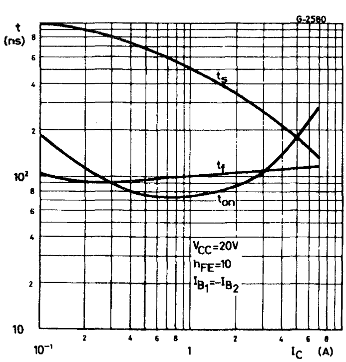
Transition Frequency.



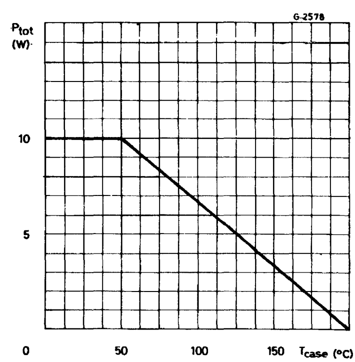
Collector-base Capacitance.



Saturated Switching Characteristics.



Power Rating Chart.

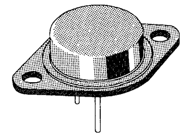


SGS-THOMSON MICROELECTRONICS

MULTIEPITAXIAL MESA NPN

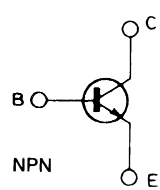
DESCRIPTION

The BUY69A, BUY69B, and BUY69C are silicon multiepitaxial mesa NPN transistors in Jedec TO-3 metal case. They are intended for horizontal deflection output stage of CTV receivers and high voltage, fast switching and industrial applications.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		BUY69A	BUY69B	BUY69C	
V_{CES}	Collector-emitter Voltage ($V_{BE} = 0$)	1000	800	500	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	400	325	200	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	8			V
I_C	Collector Current	10			A
I_{CM}	Collector Peak Current ($t_p \leq 10$ ms)	15			A
I_B	Base Current	3			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	100			W
T_{stg}	Storage Temperature	– 65 to 200			°C
T_j	Junction Temperature	200			°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.75	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	for **BUY69A** V_{CE} = 1000 V for **BUY69B** V_{CE} = 800 V for **BUY69C** V_{CE} = 500 V			1 1 1	mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 8 V			1	mA
V_{CBO}	Collector-base Voltage (I_E = 0)	for **BUY69A** I_C = 1 mA for **BUY69B** I_C = 1 mA for **BUY69C** I_C = 1 mA	1000 800 500			V V V
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA for **BUY69A** for **BUY69B** for **BUY69C**	 400 325 200			 V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 8 A I_B = 2.5 A			3.3	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 8 A I_B = 2.5 A			2.2	V
h_{FE}*	DC Current Gain	I_C = 2.5 A V_{CE} = 10 V	15			
f_T	Transition Frequency	I_C = 0.5 A V_{CE} = 10 V		10		MHz
$I_{s/b}$**	Second Breakdown Collector Current	V_{CE} = 25 V	4			A
t_{on}	Turn-on Time	I_C = 5 A V_{CE} = 250 V I_{B1} = 1 A		0.2		μs
t_s	Storage Time	I_C = 5 A V_{CE} = 250 V I_{B1} = − I_{B2} = 1 A		1.7		μs
t_f	Fall Time			0.3		μs
t_f	Fall Time	I_C = 8 A V_{CE} = 40 V I_{B1} = − I_{B2} = 2.5 A			1	μs

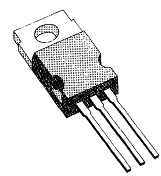
* Pulsed : pulse duration = 300 μs, duty cycle = 1.5 %.
** Pulsed : 1 s, non repetitive pulse.
For characteristics curves see the BUW 34/5/6 series.

D44C1/2/3/4/5/6
D44C7/8/9/10/11/12

LINEAR AND SWITCHING APPLICATIONS

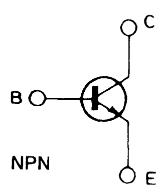
DESCRIPTION

The D44C1 to D44C12 are silicon multiepitaxial planar transistors in TO-220 plastic package intended for linear and switching applications.



TO-220

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value D44C 1/2/3	Value D44C 4/5/6	Value D44C 7/8/9	Value D44C 10/11/12	Unit
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	40	55	70	90	V
V_{CEO}	Collector -emitter Voltage (I_B = 0)	30	45	60	80	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5	5	5	5	V
I_C	Collector Current	4				A
I_{CM}	Collector Peak Current (t_p = 10 ms)	6				A
P_{tot}	Total Power Disssipation $T_{case} \leq 25$ °C $T_{amb} \leq 25$ °C	30 1.67				W W
T_{stg}	Storage Temperature	– 55 to 150				°C
T_j	Junction Temperature	150				°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	4.2	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	75	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = Rated V_{CES}			10	μA
I_{EBO}*	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			100	μA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 100 mA for **D44C1-2-3** for **D44C4-5-6** for **D44C7-8-9** for **D44C10-11-12**	 30 45 60 80			 V V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 1 A I_B = 50 mA for **D44C2-3-5-6-8-9-11-12** I_C = 1 A I_B = 0.1 A for **D44C1-4-7-10**			 0.5 0.5	 V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 1 A I_B = 100 mA			1.3	V
h_{FE}*	DC Current Gain	I_C = 0.2 A V_{CE} = 1 V I_C = 2 A V_{CE} = 1 V for **D44C3-6-9-12** I_C = 0.2 A V_{CE} = 1 V I_C = 1 A V_{CE} = 1 V for **D44C2-5-8-11** I_C = 0.2 A V_{CE} = 1 V I_C = 1 A V_{CE} = 1 V for **D44C1-4-7-10**	40 20 100 20 25 10		120 220	

* Pulsed : pulse duration = 300μs, duty cycle = 2%.

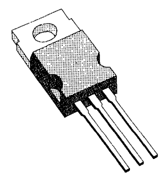
D44H1/2/4/5
D44H7/8/10/11

SWITCHING APPLICATIONS GENERAL PURPOSE

DESCRIPTION

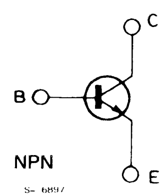
The D44H series are silicon multiepitaxial planar transistors and are mounted in Jedec TO-220 plastic package.

They are intended for various switching and general purpose applications.



TO-220

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value				Unit
		D44H 1/2	D44H 4/5	D44H 7/8	D44H 10/11	
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	30	45	60	80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5				V
I_C	Collector Current	10				A
I_{CM}	Collector Peak Current	20				A
P_{tot}	Total Power Disssipation $T_{case} \leq 25$ °C	50				W
T_{stg}	Storage Temperature	– 55 to 150				°C
T_j	Junction Temperature	150				°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	2.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

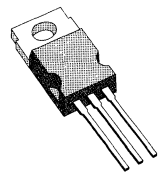
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = Rated V_{CEO}			10	μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = Rated V_{EBO}			100	μA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 100 mA for **D44H1/2** for **D44H4/5** for **D44H7/8** for **D44H10/11**	30 45 60 80			V V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 8 A I_B = 0.4 A for **D44H2/5/8/11** I_C = 8 A I_B = 0.8 A for **D44H1/4/7/10**			 1 1	 V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 8 A I_B = 0.8 A			1.5	V
h_{FE}*	DC Current Gain	V_{CE} = 1 V I_C = 2 A for **D44H1/4/7/10** for **D44H2/5/8/11** V_{CE} = 1 V I_C = 4 A for **D44H1/4/7/10** for **D44H2/5/8/11**	 35 60 20 40			

* Pulsed : pulse duration = 300μs, duty cycle = 1,5%.

MULTIEPITAXIAL PLANAR NPN

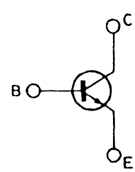
DESCRIPTION

The D44Q1, D44Q3, D44Q5 are silicon multiepitaxial planar transistors in TO-220 plastic package intended for linear and switching applications.



TO-220

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		D44Q1	D44Q3	D44Q5	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	200	250	300	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	125	175	225	V
V_{EBO}	Emitter-base Voltage ($I_B = 0$)	7	7	7	V
I_C	Collector Current	4			A
P_{tot}	Total Power Dissipation $T_{case} \leq 25$ °C $T_{amb} \leq 25$ °C	31.25 1.67			W W
T_{stg}	Storage Temperature	– 55 to 150			°C
T_j	Junction Temperature	150			°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	4	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	75	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

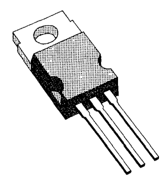
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	Rated V_{CEO}			10	μA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 10 mA for **D44Q1** for **D44Q3** for **D44Q5**	125 175 225			V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 2 A I_B = 0.2 A			1	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 2 A I_B = 0.2 A			1.3	V
h_{FE}*	DC Current Gain	I_C = 0.2 A V_{CE} = 10 V I_C = 2 A V_{CE} = 10 V	30 20			
f_T	Transition Frequency	I_C = 100 mA V_{CE} = 10 V		20		MHz
C_{CBO}	Collector Base Capacitance	V_{CB} = 10 V f = 1 MHz		32		pF
t_{on}	Turn-in Time	V_{CC} = 50 V I_C = 1 A I_{B1} = − I_{B2} = 0.1 A			0.4	μs
t_s	Storage Time				2	μs
t_f	Fall Time				1.7	μs

* Pulsed : pulse duration = 300 μs, duty cycle = 2 %.

PNP LOW VOLTAGE TRANSISTOR

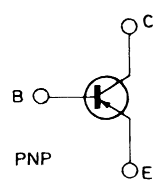
PRELIMINARY DATA

- LOW COLLECTOR SATURATION VOLTAGE
- EXCELLENT LINEARITY



TO-220

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

The D45H1, D45H2, D45H4, D45H5, D45H7, D45H8 and D45H10 are silicon multiepitaxial planar PNP transistors in TO-220 plastic package, intended for switching and general purpose applications.

The complementary NPN types are the D44H1, D44H2, D44H4, D44H5, D44H7, D44H8 and D44H10 respectively.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value				Unit
		D45H1 D45H2	D45H4 D45H5	D45H7 D45H8	D45H10	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	– 30	– 45	– 60	– 80	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	– 30	– 45	– 60	– 80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	– 5				V
I_C	Collector Current	– 10				A
I_{CM}	Collector Peak Current	– 20				A
I_B	Base Current	– 5				mA
P_{tot}	Total Dissipation at $T_c < 25°C$	50				W
T_{stg}	Storage Temperature	– 55 to 150				°C
T_j	Max. Operating Junction Temperature	150				°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	max	2.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = − 30V for **D45H1/2** V_{CB} = − 45V for **D45H4/5** V_{CB} = − 60V for **D45H7/8** V_{CB} = − 80V for **D45H10**			− 10 − 10 − 10 − 10	μA μA μA μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = − 5V			− 0.1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = − 0.1A for **D45H1/2** for **D45H4/5** for **D45H7/8** for **D45H10**	− 30 − 45 − 60 − 80			V V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = − 8A I_B = − 0.4A for **D45H2/5/8** I_C = − 8A I_B = − 0.8A for **D45H1/4/7/10**			 − 1 − 1	 V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = − 8A I_B = − 0.8A			− 1.5	V
h_{FE}*	DC Current Gain	I_C = − 2A V_{CE} = − 1V for **D45H2/5/8** for **D45H1/4/7/10** I_C = − 4A V_{CE} = − 1V for **D45H2/5/8** for **D45H1/4/7/10**	 60 35 40 20	 120 60 70 50		

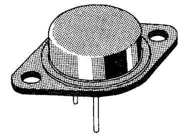
* Pulsed : Pulse duration = 300μs, duty cycle = 1.5%.

MJ802
MJ4502

COMPLEMENTARY HIGH POWER TRANSISTORS

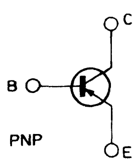
DESCRIPTION

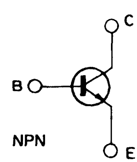
The MJ802 (NPN) and MJ4502 (PNP) are silicon epitaxial-base complementary power transistors in Jedec TO-3 metal case, intended for general purpose power amplifier and switching applications.



TO-3

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	90	V
V_{CBO}	Collector-base Voltage ($I_E = 0$)	100	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	4	V
I_C	Collector Current	30	A
I_B	Base Current	7.5	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$	200	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

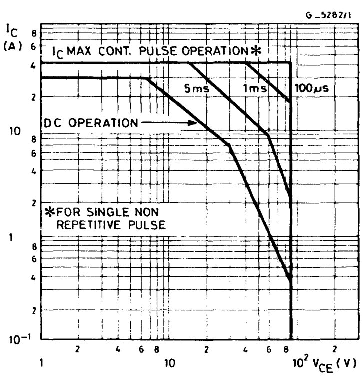
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	0.875	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

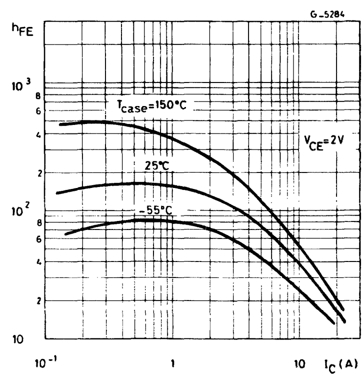
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
$V_{CEO\ (sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 200 mA		90			V
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 100V T_{case} = 150°C				1 5	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 4V				1	mA
$V_{CER\ (sus)}$*	Collector-emitter Sustaining Voltage (R_{BE} = 100Ω)	I_C = 200mA		100			V
h_{FE}*	DC Current Gain	I_C = 7.5A	V_{CE} = 2V	25		100	
$V_{CE\ (sat)}$*	Collector-emitter Saturation Voltage	I_C = 7.5A	I_B = 0.75A			0.8	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 7.5A	I_B = 0.75A			1.3	V
V_{BE}*	Base-emitter Voltage	I_C = 7.5A	V_{CE} = 2V			1.3	V
f_T	Transition Frequency	I_C = 1A f = 1MHz	V_{CE} = 10V	2			MHz

* Pulsed : pulse duration = 300 μs, duty cycle ≤ 2 %.
For PNP type voltage and current values are negative.

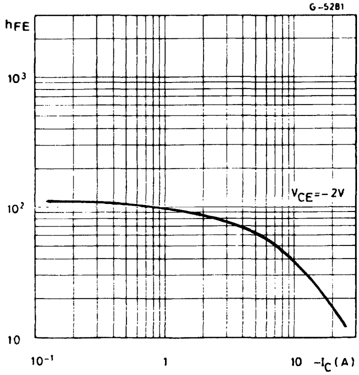
Safe Operating Areas.



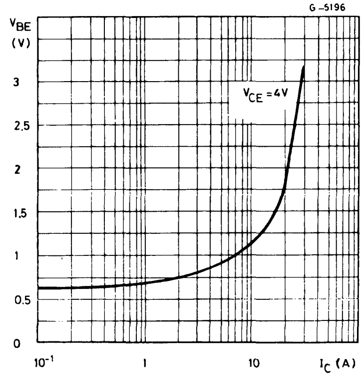
DC Current Gain (NPN type).



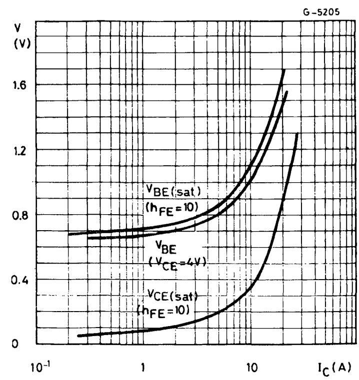
DC Current Gain (PNP type).



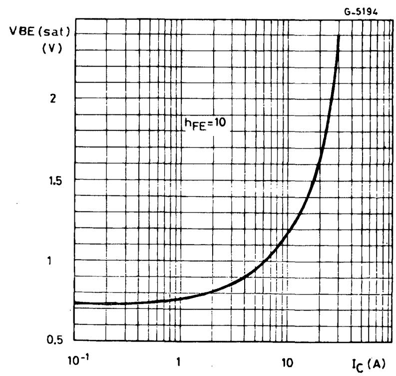
Base-emitter Voltage (PNP type).



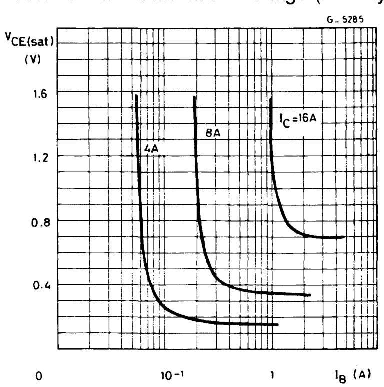
Saturation Voltage (NPN type).



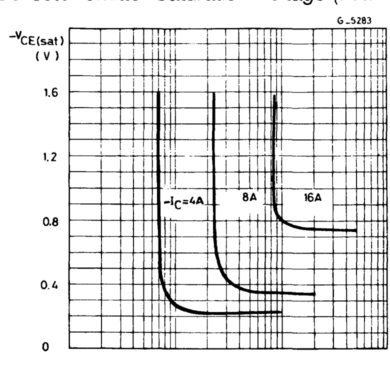
Base-emitter Saturation Voltage (PNP type).



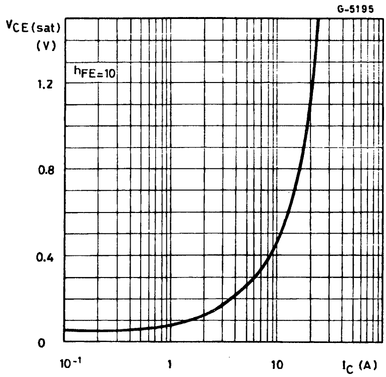
Collector-emitter Saturation Voltage (NPN type).



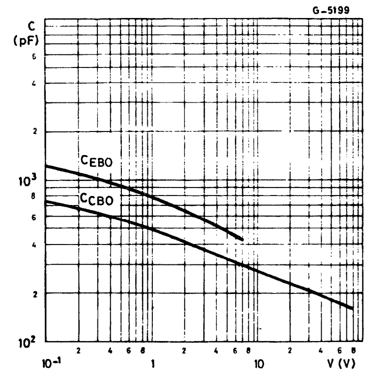
Collector-emitter Saturation Voltage (PNP type).



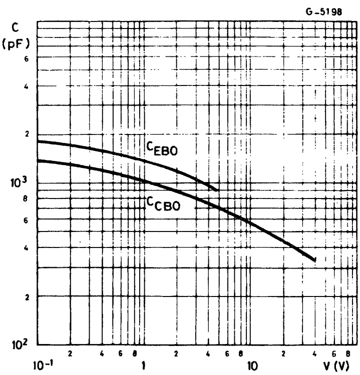
Collector-emitter Saturation Voltage (PNP type).



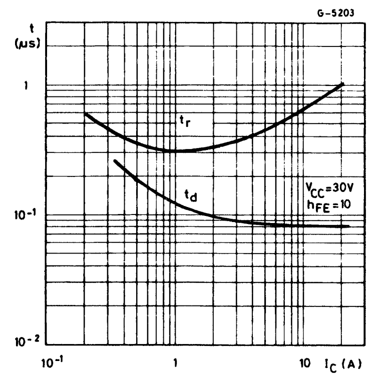
Capacitances (NPN type)



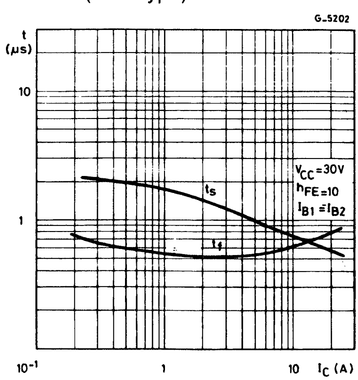
Capacitances (PNP type).



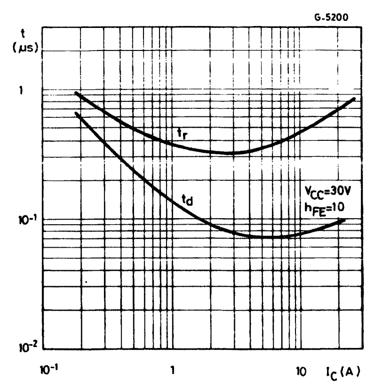
Turn-on Time (NPN type).



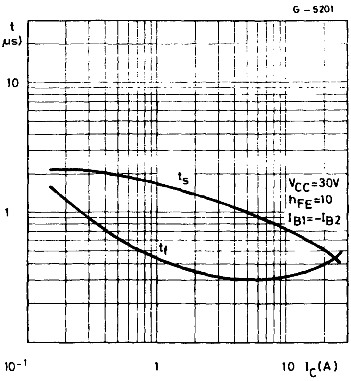
Turn-off Time (NPN type).



Turn-on Time (PNP type).



Turn-off Time (PNP type).



SGS-THOMSON MICROELECTRONICS

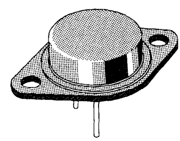
MJ900/901
MJ1000/1001

COMPLEMENTARY POWER DARLINGTONS

DESCRIPTION

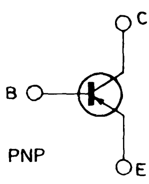
The MJ900, MJ901, MJ1000 and MJ1001 are silicon epitaxial-base transistors in monolithic Darlington configuration, and are mounted in Jedec TO-3 metal case. They are intended for use in power linear and switching applications.

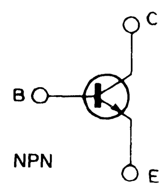
The PNP types are the MJ900 and MJ901 and their complementary NPN types are the MJ1000 and MJ1001 respectively.



TO-3

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	PNP° / NPN	Value		Unit
			MJ900 / MJ1000	MJ901 / MJ1001	
V_{CBO}	Collector-base Voltage ($I_E = 0$)		60	80	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)		60	80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)		5		V
I_C	Collector Current		8		A
I_B	Base Current		0.1		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$		90		W
T_{stg}	Storage Temperature		– 65 to 200		°C
T_j	Junction Temperature		200		°C

°For PNP types voltage and current values are negative.

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.94	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 1KΩ)	for **MJ900** and **MJ1000** V_{CE} = 60V			1	mA
		for **MJ901** and **MJ1001** V_{CE} = 80V			1	mA
		T_{case} = 150°C for **MJ900** and **MJ1000** V_{CE} = 60V			5	mA
		for **MJ901** and **MJ1001** V_{CE} = 80V			5	mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **MJ900** and **MJ1000** V_{CE} = 30V			0.5	mA
		for **MJ901** and **MJ1001** V_{CE} = 40V			0.5	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			2	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100mA for **MJ900** and **MJ1000**	60			V
		for **MJ901** and **MJ1001**	80			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 3A I_B = 12mA			2	V
		I_C = 8A I_B = 40mA			4	V
V_{BE}*	Base-emitter Voltage	I_C = 3A V_{CE} = 3V			2.5	V
h_{FE}*	DC Current Gain	I_C = 3A V_{CE} = 3V	1000			
		I_C = 4A V_{CE} = 3V	750			

* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.
For PNP types current and voltage values are negative.
For characteristic curves see the 2N6053/55 series.

SGS-THOMSON MICROELECTRONICS

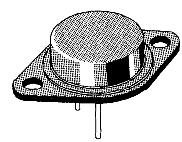
MJ2500/2501 MJ3000/3001

COMPLEMENTARY POWER DARLINGTONS

DESCRIPTION

The MJ2500, MJ2501, MJ3000 and MJ3001 are silicon epitaxial-base transistors in monolithic Darlington configuration and are mounted in Jedec TO-3 metal case. They are intended for use in power linear and switching applications.

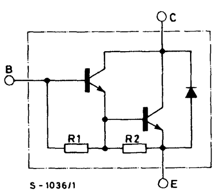
The PNP types are the MJ2500 and MJ2501 and their complementary NPN types are the MJ3000 and MJ3001 respectively.



TO-3

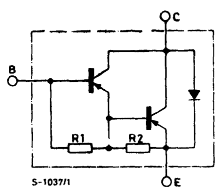
INTERNAL SCHEMATIC DIAGRAMS

PNP



R1 Typ. 10kΩ
R2 Typ. 150Ω

NPN



R1 Typ. 10kΩ
R2 Typ. 150Ω

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
	PNP / NPN	MJ2500 / MJ3000	MJ2501 / MJ3001	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	60	80	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	60	80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5		V
I_C	Collector Current	10		A
I_B	Base Current	0.2		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$	150		W
T_{stg}	Storage Temperature	– 65 to 200		°C
T_j	Junction Temperature	200		°C

For PNP types voltage and current values are negative.

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.17	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

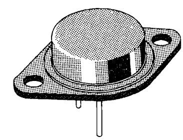
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 1KΩ)	for **MJ2500** and **MJ3000** V_{CE} = 60 V for **MJ2501** and **MJ3001** V_{CE} = 80 V T_{case} = 150 °C for **MJ2500** and **MJ3000** V_{CE} = 60 V for **MJ2501** and **MJ3001** V_{CE} = 80 V			1 1 5 5	mA mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **MJ2500** and **MJ3000** V_{CE} = 30 V for **MJ2501** and **MJ3001** V_{CE} = 40 V			1 1	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			2	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100mA for **MJ2500** and **MJ3000** for **MJ2501** and **MJ3001**	60 80			V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5A I_B = 20mA I_C = 10A I_B = 50mA			2 4	V V
V_{BE}*	Base-emitter Voltage	I_C = 5A V_{CE} = 3V			3	V
h_{FE}*	DC Current Gain	I_C = 5A V_{CE} = 3V	1000			

* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.
For PNP types current and voltage values are negative.

POWER LINEAR AND SWITCHING APPLICATIONS

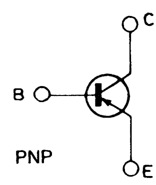
DESCRIPTION

The MJ2955 is a silicon epitaxial-base PNP power transistor in Jedec TO-3 metal case. It is intended for power switching circuits, series and shunt regulators, output stages and hi-fi amplifiers.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	– 100	V
V_{CER}	Collector-emitter Voltage ($R_{BE} \leq 100\Omega$)	– 70	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 60	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 7	V
I_C	Collector Current	– 15	A
I_B	Base Current	– 7	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	150	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.17	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEX}	Collector Cutoff Current (V_{BE} = 1.5V)	V_{CE} = – 100V V_{CE} = – 100V T_{case} = 150°C			– 1 – 5	mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = – 30V			– 0.7	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = – 7V			–5	mA
$V_{CER(sus)}$*	Collector-emitter Sustaining Voltage (R_{BE} = 100Ω)	I_C = – 200mA	– 70			V
$V_{CEO\ (sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = – 200mA	– 60			V
$V_{CE\ (sat)}$*	Collector-emitter Saturation Voltage	I_C = – 4A I_B = – 0.4A I_C = – 10A I_B = – 3.3A			– 1.1 – 3	V V
V_{BE}*	Base-emitter Voltage	I_C = – 4A V_{CE} = – 4V			– 1.8	V
h_{FE}*	DC Current Gain	I_C = – 4A V_{CE} = – 4V I_C = – 10A V_{CE} = – 4V	20 5		70	
f_T	Transition Frequency	I_C = – 0.5A V_{CE} = – 10V	4			MHz

* Pulsed : pulse duration = 300 µs, duty cycle = 1.5 %.

SGS-THOMSON
MICROELECTRONICS

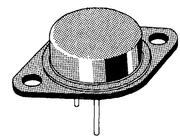
MJ4030/1/2
MJ4033/4/5

GENERAL PURPOSE

DESCRIPTION

The MJ4030/31/32/33/34/35 are medium-power silicon NPN Darlington in Jedec TO-3 metal case, intended for use in general purpose and amplifier applications.

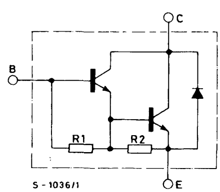
The complementary PNP types are the MJ4033/34/35 respectively.



TO-3

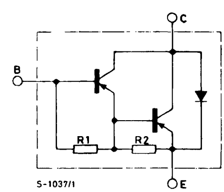
INTERNAL SCHEMATIC DIAGRAMS

NPN



R1 ≅ 5 KΩ
R2 ≅ 50 Ω

PNP



R1 ≅ 5 KΩ
R2 ≅ 50 Ω

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter		Value			Unit
		PNP* / NPN	MJ4030 / MJ4033	MJ4031 / MJ4034	MJ4032 / MJ4035	
V_{CBO}	Collector-base Voltage (I_E = 0)		60	80	100	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)		60	80	100	V
V_{EBO}	Emitter-base Voltage (I_C = 0)		5			V
I_C	Collector Current		16			A
I_B	Base Current		0.5			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$		150			W
T_{stg}	Storage Temperature		– 65 to 200			°C
T_j	Junction Temperature		200			°C

* For PNP types voltage and current values are negative.

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.17	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 30V I_B = 0 **MJ4030/33** V_{CE} = 40V I_B = 0 **MJ4031/34** V_{CE} = 50V I_B = 0 **MJ4032/35**			3 3 3	mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V I_C = 0			5	mA
I_{CER}	Collector Cutoff Current (R_{BE} = 1KΩ)	for **MJ4030/33** V_{CB} = 60V for **MJ4031/34** V_{CB} = 80V for **MJ4032/35** V_{CB} = 100V T_{case} = 150°C for **MJ4030/33** V_{CB} = 60V for **MJ4031/34** V_{CB} = 80V for **MJ4032/35** V_{CB} = 100V			1 1 1 5 5 5	mA mA mA mA mA mA
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage	I_C = 100mA I_B = 0 for **MJ4030/33** for **MJ4031/34** for **MJ4032/35**	 60 80 100			 V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10A I_B = 40mA I_C = 16A I_B = 80mA			2.5 4	V V
V_{BE}*	Base-emitter Voltage	I_C = 10A V_{CE} = 3V			3	V
h_{FE}*	DC Current Gain	I_C = 10A V_{CE} = 3V	1000			

* Pulsed : pulse duration = 300μs, duty cycles ≤ 2%.
For PNP types voltage and current values are negative.

MJ10004/4P/4PFI
MJ10005/5P/5PFI

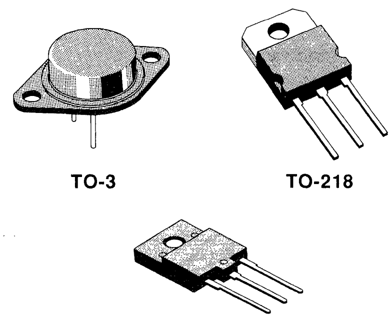
EPITAXIAL PLANAR NPN

DESCRIPTION

The MJ10004/5, MJ10004P/5P and MJ10004PFI/5PFI are silicon epitaxial planar NPN transistors in monolithic Darlington configuration with integrated speed-up diode.

They are mounted respectively in TO-3 metal case, TO-218 plastic package and ISOWATT218 fully isolated package.

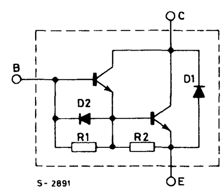
They are designed for high power, fast switching applications.



TO-3 TO-218

ISOWATT218

INTERNAL SCHEMATIC DIAGRAM



R1 Typ. 250 Ω
R2 Typ. 500 Ω

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	MJ10004/4P/4PFI		MJ10005/5P/5PFI	Unit
V_{CEX}	Collector-emitter Voltage (V_{BE} = – 5V)	350		400	V
V_{CEV}	Collector-emitter Voltage (V_{BE} = 1.5V)	400		450	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	450		500	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	8			V
I_C	Collector Current	20			A
I_{CM}	Collector Peak Current	30			A
I_B	Base Current	2.5			A
I_{BM}	Base Peak Current	5			A
		TO-3	TO-218	ISOWATT218	
P_{tot}	Total Power Dissipation at $T_c \leq 25°C$	175	125	60	W
T_{stg}	Storage Temperature	– 65 to 200	– 65 to 150	– 65 to 150	°C
T_j	Max. Operating Junction Temperature	200	150	150	°C

THERMAL DATA

		TO-3	TO-218	ISOWATT218	
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case Max	1	1	2.08	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 50Ω)	V_{CE} = Rated V_{CEV} T_{case} = 100°C			5	mA
I_{CEV}	Collector Cutoff Current (V_{BE} = 1.5V)	V_{CEV} = Rated Value V_{CEV} = Rated Value T_{case} = 150°C			0.25 5	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 2V			175	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 250mA V_{clamp} = Rated V_{CEO} for **MJ10004/4P/4PFI** for **MJ10005/5P/4PFI**	 350 400			 V V
$V_{CEX(sus)}$*	Collector-emitter Sustaining Voltage (V_{BE} = – 5V)	I_C = 2A V_{clamp} = Rated V_{CEX} T_{case} = 100°C for **MJ10004/4P/4PFI** for **MJ10005/5P/5PFI** I_C = 10A T_{case} = 100°C V_{clamp} = Rated V_{CEX} for **MJ10004/4P/4PFI** for **MJ10005/5P/5PFI**	 400 450 275 325			 V V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10A I_B = 400mA I_C = 20A I_B = 2A I_C = 10A I_B = 400mA T_{case} = 100°C			1.9 3 2.5	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 10A I_B = 400mA I_C = 10A I_B = 400mA T_{case} = 100°C			2.5 2.5	V V
h_{FE}*	DC Current Gain	I_C = 5A V_{CE} = 5V I_C = 10A V_{CE} = 5V	50 40		600 400	
V_F*	Diode Forward Voltage	I_F = 10A		1.8	5	V
h_{fe}	Small-signal Current Gain	I_C = 1A V_{CE} = 10V f = 1MHz	10			
C_{ob}	Output Capacitance	V_{CB} = 10V I_E = 0 f = 100MHz	100		325	pF
t_{on}	Turn-on Time	V_{CC} = 250V I_C = 10A I_{B1} = – I_{B2} = 400mA $V_{BE(off)}$ = 5V t_p = 50µs Duty Cycle – 2%		0.5	0.8	µs
t_s	Storage Time			1	1.5	µs
t_f	Fall Time			0.3	0.5	µs

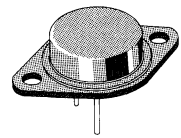
SGS-THOMSON MICROELECTRONICS

MJ11011/13/15 MJ11012/14/16

COMPLEMENTARY POWER DARLINGTONS

DESCRIPTION

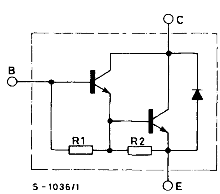
The MJ11011/12/13/14/15/16 are epitaxial-base silicon transistors in monolithic Darlington configuration in Jedec TO-3 metal case. They are intended for general purpose and amplifier applications.



TO-3

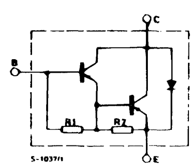
INTERNAL SCHEMATIC DIAGRAMS

NPN



R1 ≅ 8 KΩ
R2 ≅ 60 Ω

NPN



R1 ≅ 8 KΩ
R2 ≅ 60 Ω

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
	PNP / NPN	MJ11011 / MJ11012	MJ11013 / MJ11014	MJ11015 / MJ11016	
V_{CEO}	Collector-emitter Voltage (I_B = 0)	60	90	120	V
V_{CBO}	Collector-base Voltage (I_E = 0)	60	90	120	V
V_{EBO}	Base-emitter Voltage (I_C = 0)	5			V
I_C	Collector Current	30			A
I_B	Base Current	1			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$	200			W
T_{stg}	Storage Temperature	– 65 to 200			°C
T_j	Junction Temperature	200			°C

For PNP types voltage and current values are negative.

December 1988

THERMAL DATA

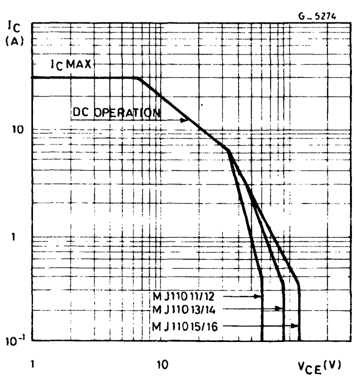
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	0.87	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

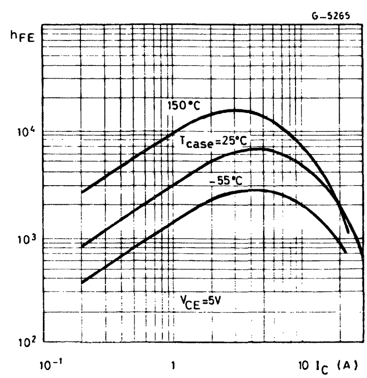
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 50V			1	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			5	mA
I_{CER}	Collector Cutoff Current (R_{BE} = 1KΩ)	V_{CE} = Rated V_{CEO} T_{case} = 150°C V_{CE} = Rated V_{CEO}			1 5	mA mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100mA **MJ11011, MJ11012** **MJ11013, MJ11014** **MJ11015, MJ11016**	 60 90 120			 V V V
h_{FE}*	DC Current Gain	I_C = 20A V_{CE} = 5V I_C = 30A V_{CE} = 5V	1000 200			
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 20A I_B = 200mA I_C = 30A I_B = 300mA			3 4	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 20A I_B = 200mA I_C = 30A I_B = 300mA			3.5 5	V V
h_{fe}	Small Signal Current Gain	I_C = 10A V_{CE} = 3V f = 1MHz	4			

* Pulsed : pulse duration = 300 µs, duty cycles ≤ 1.5 %.
For PNP types voltage and current values are negative.

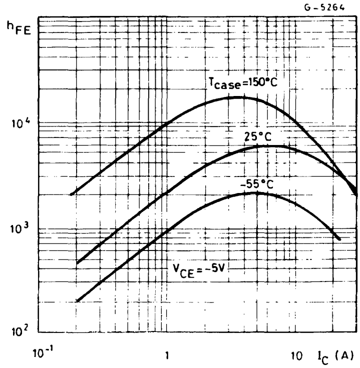
Safe Operating Areas.



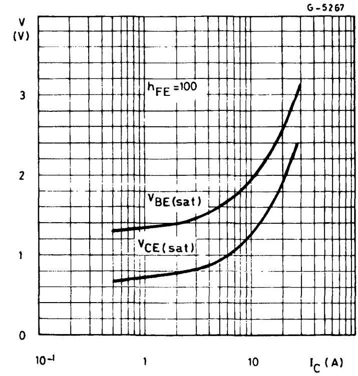
DC Current Gain (NPN types).



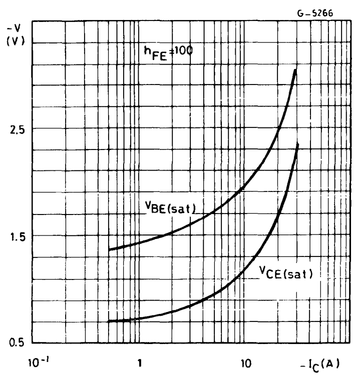
DC Current Gain (PNP types).



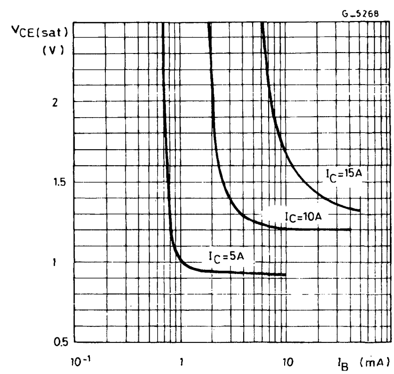
Saturation Voltages (NPN types).



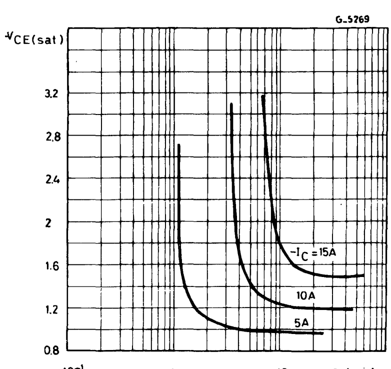
Saturation Voltages (PNP types.)



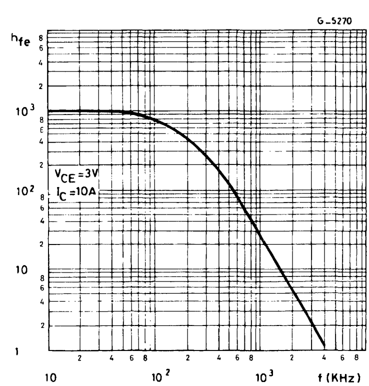
Collector-emitter Saturation Voltage (NPN types).



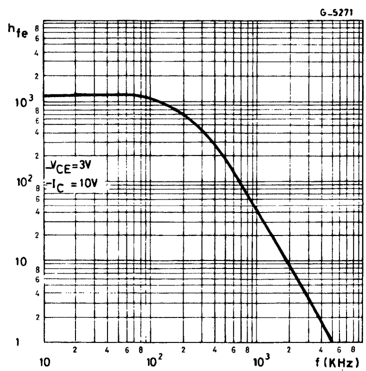
Collector-emitter Saturation Voltage (PNP types).



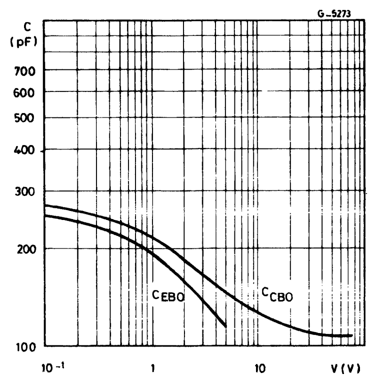
Small Signal Current Gain (NPN types).



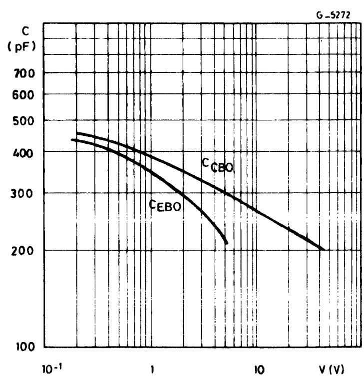
Small Signal Current Gain (PNP types).



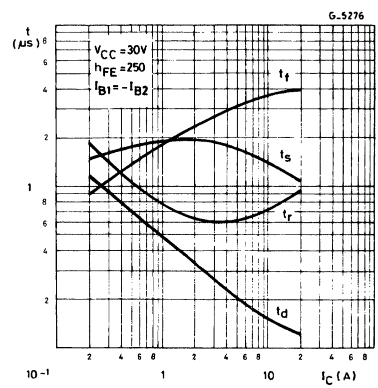
Capacitances (NPN types).



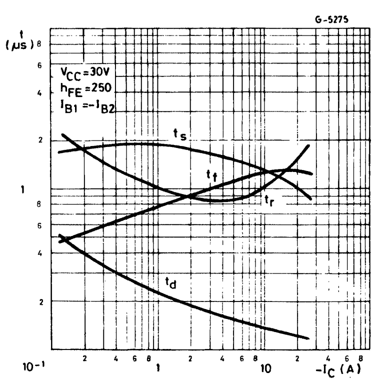
Capacitances (PNP types).



Saturated Switching Times (NPN types).



Saturated Switching Times (PNP types).



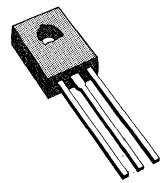
SGS-THOMSON MICROELECTRONICS

MJE170/171/172
MJE180/181/182

COMPLEMENTARY POWER TRANSISTORS

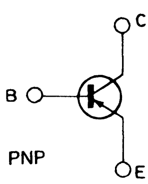
DESCRIPTION

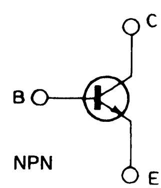
The MJE 170, MJE171, MJE172 (PNP types) and MJE180, MJE181, MJE182 (NPN types) are silicon epitaxial planar, complementary transistors in Jedec TO-126 plastic package, they are designed for low power audio amplifier and low current, high speed switching applications.



SOT-32 (TO-126)

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	PNP / NPN	Value			Unit
		PNP	MJE170	MJE171	MJE172	
		NPN	MJE180	MJE181	MJE182	
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)		40	60	80	V
V_{CBO}	Collector-base Voltage ($I_E = 0$)		60	80	100	V
V_{EBO}	Base-emitter Voltage ($I_C = 0$)		7			V
I_C	Collector Current		3			A
I_{CM}	Collector Peak Current		6			A
I_B	Base Current		1			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$		12.5			W
T_{stg}	Storage Temperature		– 65 to 150			°C
T_j	Junction Temperature		150			°C

For PNP types voltage and current values are negative.

THERMAL DATA

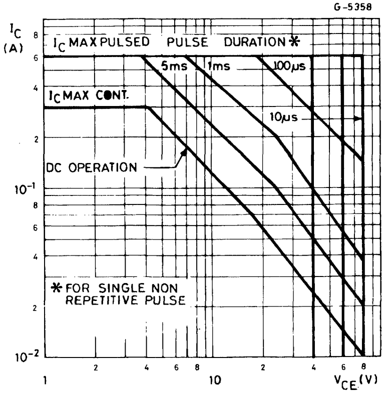
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	83.4	°C/W
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	10	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

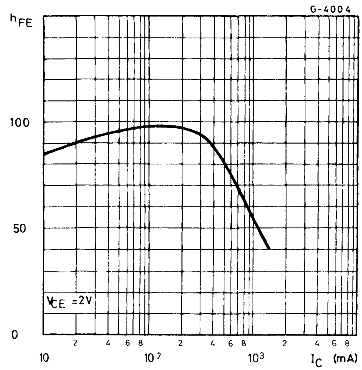
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = rated V_{CBO} T_{case} = 150°C			0.1 0.1	µA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7 V			0.1	µA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 10 mA for **MJE170, MJE180** for **MJE171, MJE181** for **MJE172, MJE182**	 40 60 80			 V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 0.5A I_B = 50mA I_C = 1.5A I_B = 0.15A I_C = 3A I_B = 0.6A			0.3 0.9 1.7	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 1.5A I_B = 0.15A I_C = 3A I_B = 0.6A			1.5 2	V V
V_{BE}*	Base-emitter Voltage	I_C = 0.5A V_{CE} = 1V			1.2	V
h_{FE}*	DC Current Gain	I_C = 0.1A V_{CE} = 1V I_C = 0.5A V_{CE} = 1V I_C = 1.5A V_{CE} = 1V	50 30 12		250	
f_T	Transition Frequency	I_C = 0.1A V_{CE} = 10V f = 10MHz	50			MHz
C_{CBO}	Collector-base Capacitance	V_{CB} = 10V ; I_E = 0 ; f = 0.1MHz for **MJE170, MJE172** for **MJE180, MJE182**			 60 40	 pF pF

* Pulsed : pulse duration = 300 µs, duty cycle ≤ 1.5 %.
For PNP types voltage and current values are negative.

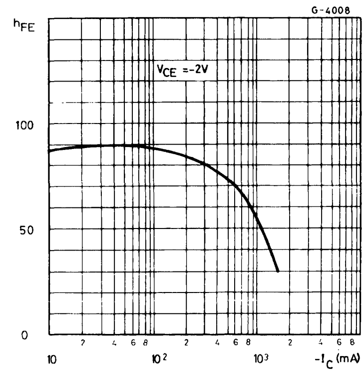
Safe Operating Areas.



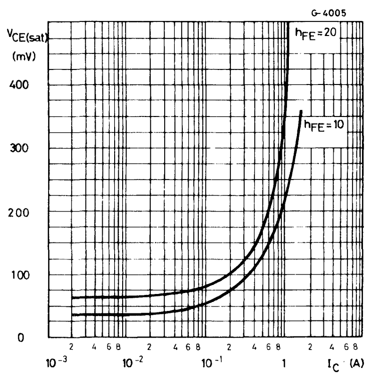
DC Current Gain (NPN types)



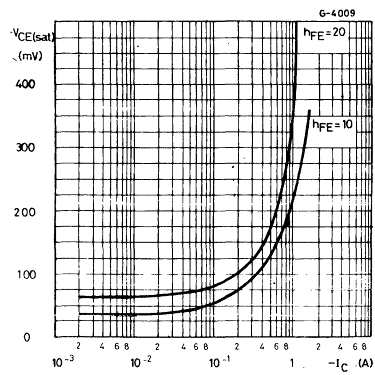
DC Current Gain (PNP types)



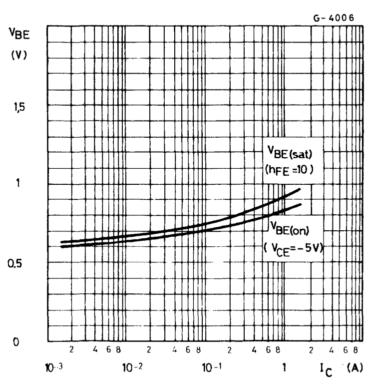
Collector-emitter saturation voltage (NPN types).



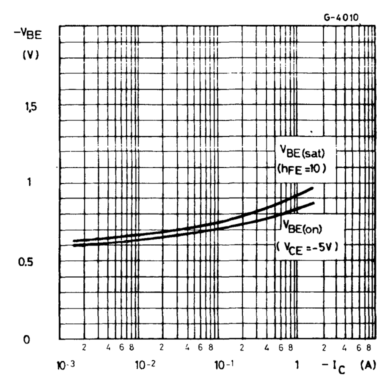
Collector-emitter Saturation Voltage (PNP types).



Base-emitter Voltage (NPN types).



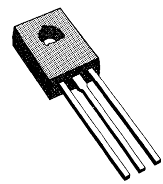
Base-emitter Voltage (PNP types).



COMPLEMENTARY POWER TRANSISTORS

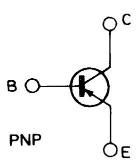
DESCRIPTION

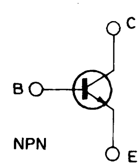
The MJE200 (NPN type) and MJE210 (PNP type) are silicon epitaxial-base transistors in Jedec TO-126 plastic package, designed for low voltage, low power, high gain audio amplifier applications.



SOT-32 (TO-126)

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	40	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	25	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	8	V
I_C	Collector Current	5	A
I_{CM}	Collector Peak Current	10	A
I_B	Base Current	1	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$ at $T_{amb} \leq 25°C$	15 1.5	W W
T_{stg}	Storage Temperature	– 65 to 150	°C
T_j	Junction Temperature	150	°C

For PNP type voltage and current values are negative.

THERMAL DATA

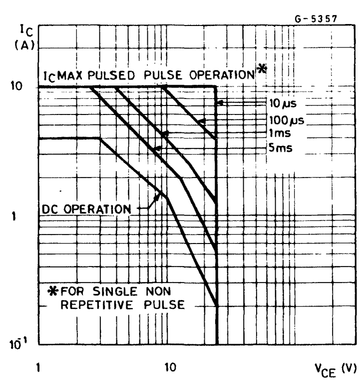
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	83.4	°C/W
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	8.34	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

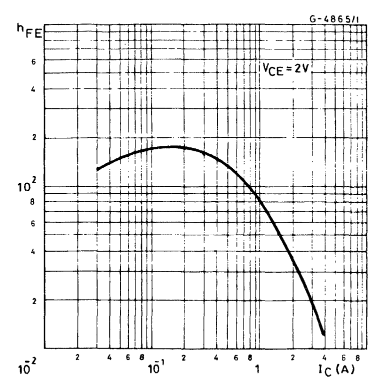
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 40V V_{CB} = 40V T_{case} = 125°C			100 100	nA μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 8V			100	nA
$V_{CEO\ (sus)}$*	Collector-emitter Sustaining Voltage	I_C = 10mA	25			V
$V_{CE\ (sat)}$*	Collector-emitter Saturation Voltage	I_C = 0.5A I_B = 50mA I_C = 2A I_B = 0.2A I_C = 5A I_B = 1A			0.3 0.75 1.8	V V V
$V_{BE\ (sat)}$*	Base-emitter Saturation Voltage	I_C = 5A I_B = 1A			2.5	V
V_{BE}*	Base-emitter Voltage	I_C = 2A V_{CE} = 1V			1.6	V
h_{FE}*	DC Current Gain	I_C = 0.5A V_{CE} = 1V I_C = 2A V_{CE} = 1V I_C = 5A V_{CE} = 2V	70 45 10		 180 	
f_T	Transition Frequency	I_C = 0.1A V_{CE} = 10V f = 10MHz	65			MHz
C_{CBO}	Collector-base Capacitance	V_{CB} = 10V ; I_E = 0 ; f = 0.1MHz for **MJE200** for **MJE201**			 80 120	 pF pF

* Pulsed : pulse duration = 300μs, duty cycle ≤ 1.5%.
For PNP type voltage and current values are negative.

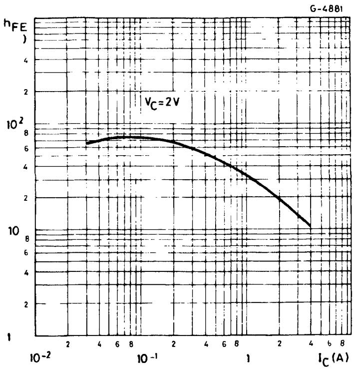
Safe Operating Areas.



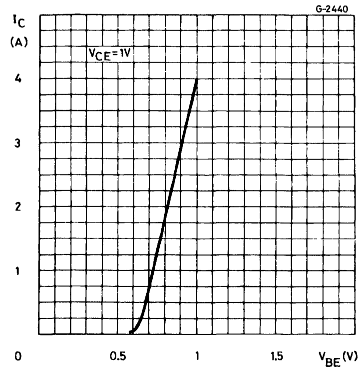
DC Current Gain (NPN type).



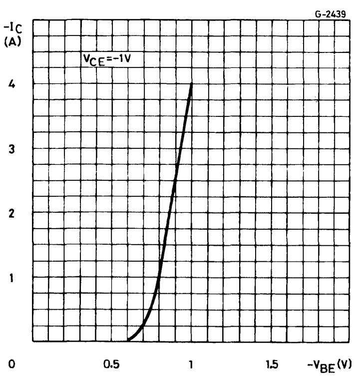
DC Current Gain (PNP type).



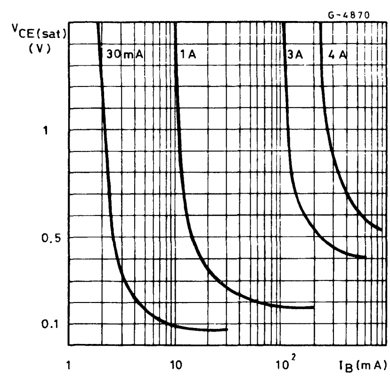
DC Transconductance (NPN type).



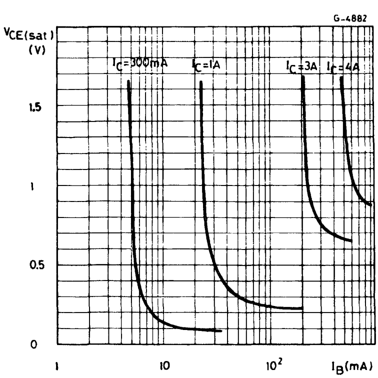
DC Transconductance (PNP type).



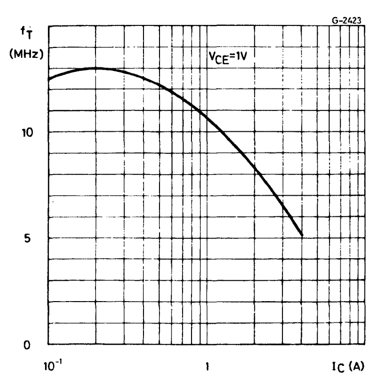
Collector-emitter Saturation Voltage (NPN type).



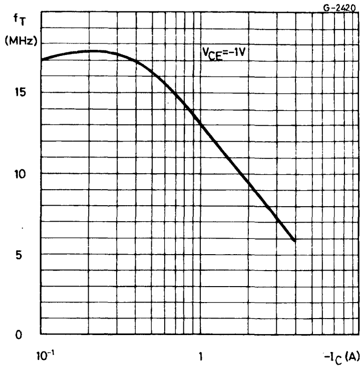
Collector-emitter Saturation Voltage (PNP type).



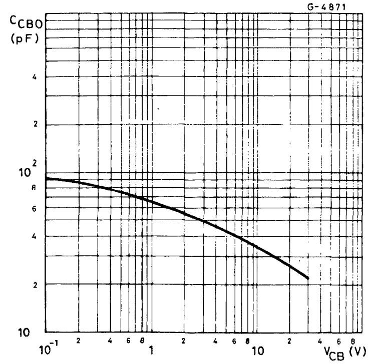
Transition Frequency (NPN type).



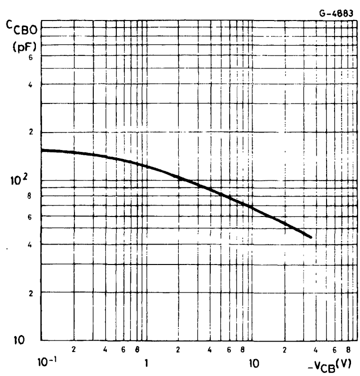
Transition Frequency (PNP type).



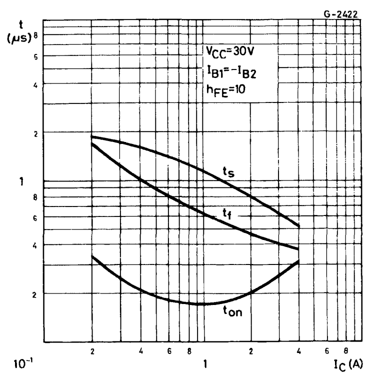
Collector-base Capacitance (NPN type).



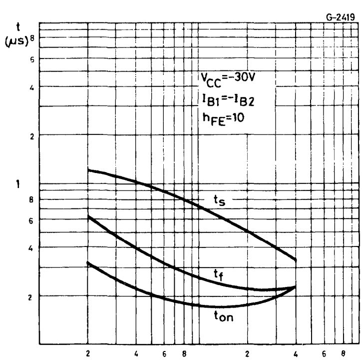
Collector-base Capacitance (PNP type).



Saturated Switching Characteristics (NPN type).



Saturated Switching Characteristics (PNP type).



SGS-THOMSON
MICROELECTRONICS

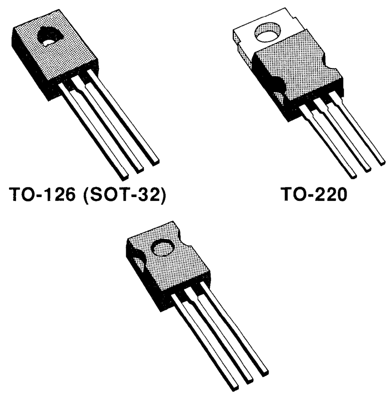
MJE340/T/SGS340
MJE350/T/SGS350

HIGH VOLTAGE POWER TRANSISTORS

DESCRIPTION

The MJE340, MJE340T, SGS340 are silicon epitaxial planar NPN transistors intended for use in medium power linear and switching applications. They are respectively mounted in TO-125, TO-220 and SOT-82 package.

The complementary PNP types are respectively the MJE350, MJE350T, SGS350.



INTERNAL SCHEMATIC DIAGRAMS

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	300	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	3	V
I_C	Collector Current	0.5	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$	20.8	W
T_{stg}	Storage Temperature	– 65 to 150	°C
T_j	Junction Temperature	150	°C

THERMAL DATA

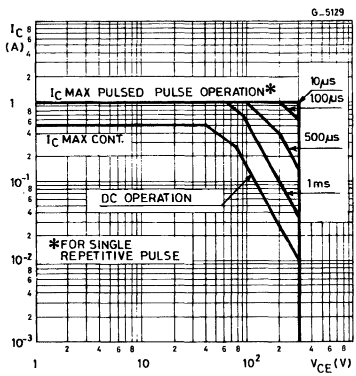
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	6.0	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

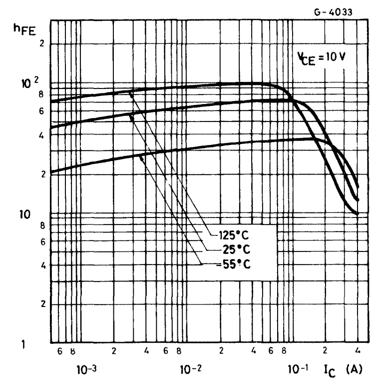
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 300V			100	μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 3V			100	μA
$V_{CEO(sus)}$*	Collector-Emitter Sustaining Voltage (I_B = 0)	I_C = 1mA	300			V
h_{FE}	DC Current Gain	I_C = 50mA V_{CE} = 10V	30		240	

* Pulsed : pulse duration = 300μs, duty cycle ≤ 2%.

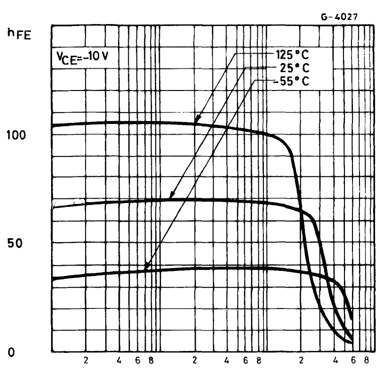
Safe Operating Areas.



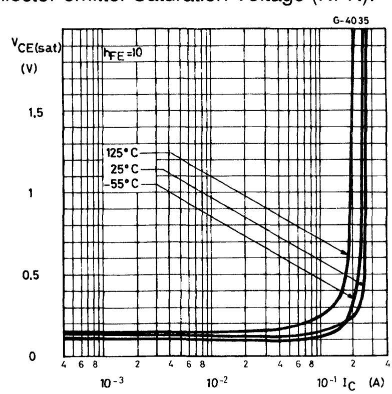
DC Current Gain (NPN).



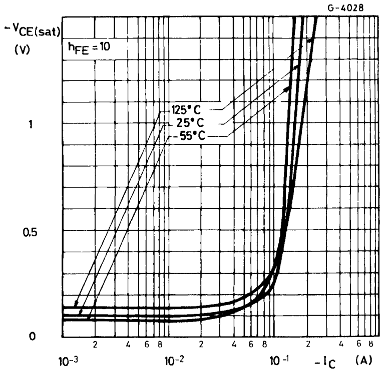
DC Current Gain (PNP).



Collector-emitter Saturation Voltage (NPN).



Collector-emitter Saturation Voltage (PNP).

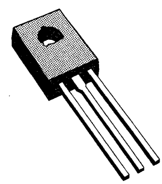


MJE370
MJE520

COMPLEMENTARY MEDIUM POWER TRANSISTORS

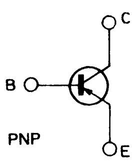
DESCRIPTION

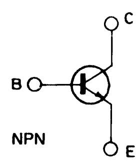
The MJE370 (PNP type) and the MJE520 (NPN type) are silicon epitaxial-base transistors in Jedec TO-126 plastic package, designed for use in general purpose amplifier and switching circuits.



SOT-32 (TO-126)

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	30	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	30	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	4	V
I_C	Collector Current	3	A
I_{CM}	Collector Peak Current	7	A
I_B	Base Current	2	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	25	W
T_{stg}	Storage Temperature	– 65 to 150	°C
T_j	Junction Temperature	150	°C

For PNP types voltage and current values are negative.

THERMAL DATA

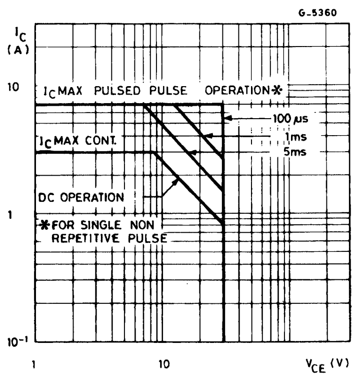
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

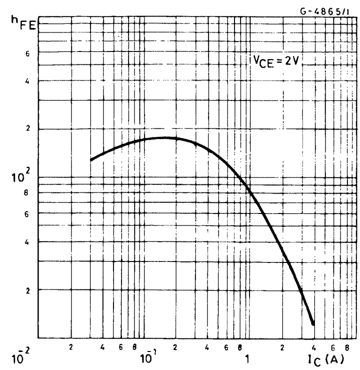
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 30V			100	μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 4V			100	μA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 100mA	30			V
h_{FE}*	DC Current Gain	I_C = 1A V_{CE} = 1V	25			

* Pulsed : pulse duration = 300μs, duty cycle ≤ 1.5%.
For PNP types voltage and current values are negative.

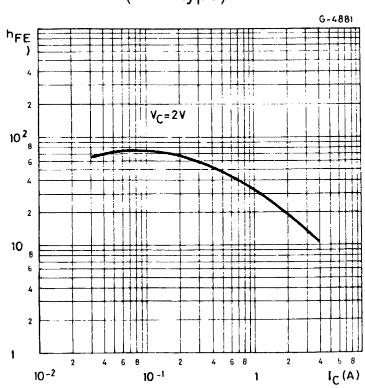
Safe Operating Areas.



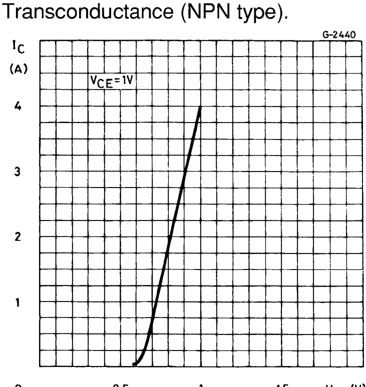
DC Current Gain (NPN type).



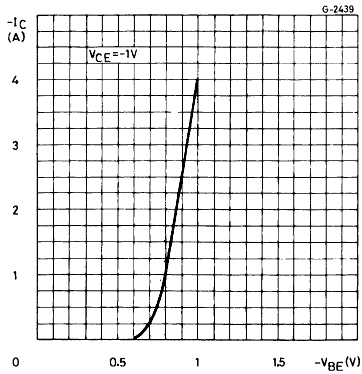
DC Current Gain (PNP type).



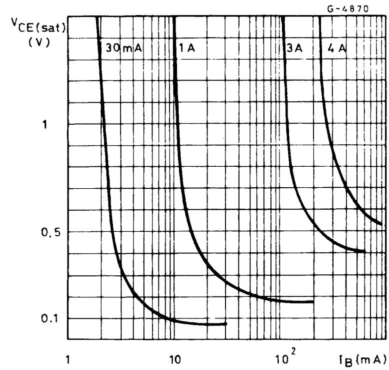
DC Transconductance (NPN type).



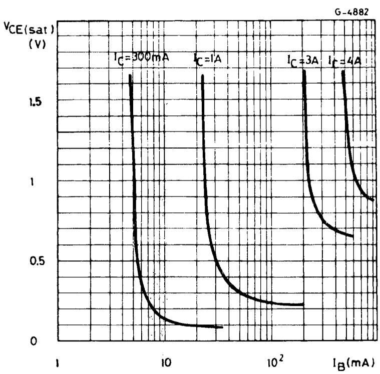
DC Transconductance(PNP type).



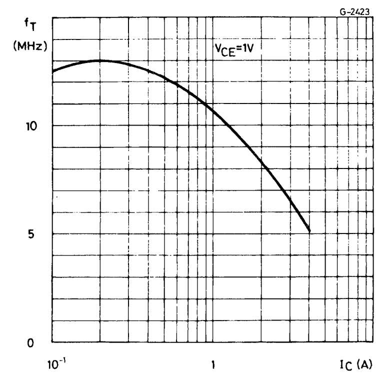
Collector-emitter Saturation Voltage (NPN type).



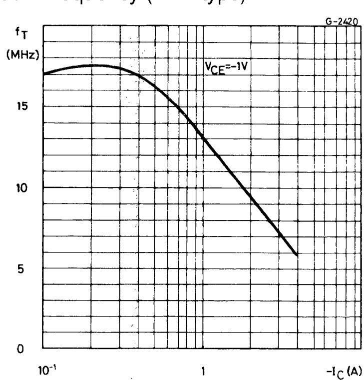
Collector-emitter saturation voltage (PNP type).



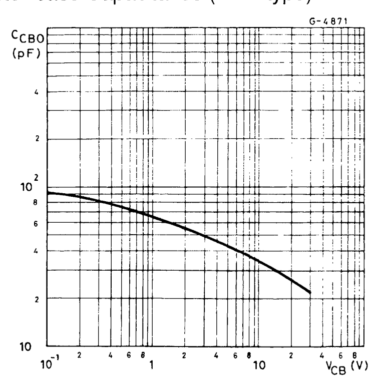
Transition Frequency (NPN type).



Transition Frequency (PNP type).

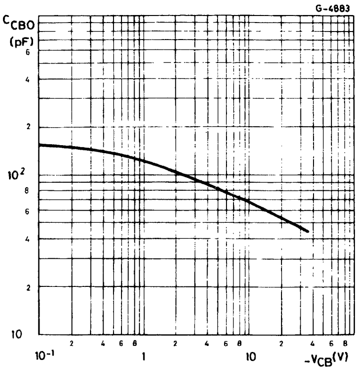


Collector-base Capacitance (NPN type).

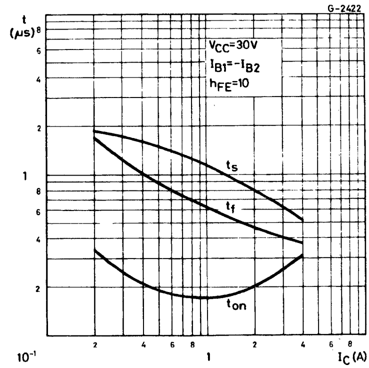


SGS-THOMSON MICROELECTRONICS

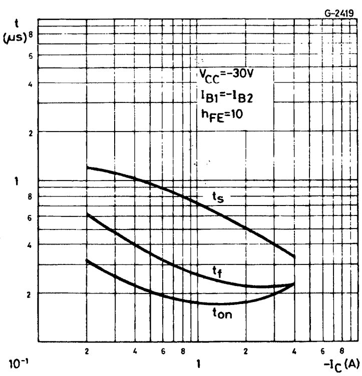
Collector-base Capacitance (PNP type).



Saturated Switching Characteristics (NPN type).



Saturated switching characteristics (PNP types).



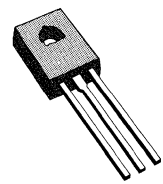
SGS-THOMSON
MICROELECTRONICS

MJE371
MJE521

COMPLEMENTARY POWER TRANSISTORS

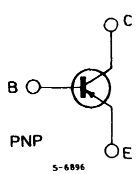
DESCRIPTION

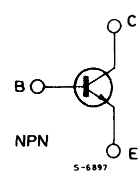
The MJE521 is a silicon epitaxial-base NPN transistor in Jedec TO-126 plastic package, intended for use in 5 to 20W audio amplifiers, general purpose amplifier and switching circuits. The complementary PNP type is the MJE371.



SOT-32 (TO-126)

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	40	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	40	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	4	V
I_C	Collector Current	4	A
I_{CM}	Collector Peak Current	8	A
I_B	Base Current	2	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	40	W
T_{stg}	Storage Temperature	– 65 to 150	°C
T_j	Junction Temperature	150	°C

For PNP types voltage and current values are negative.

THERMAL DATA

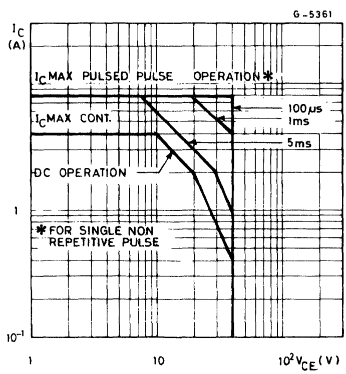
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	3.12	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

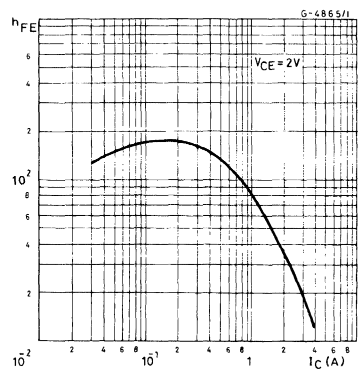
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 40V			100	μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 4V			100	μA
$V_{CEO(sus)}$*	Collector-Emitter Sustaining Voltage	I_C = 0.1A	40			V
h_{FE}*	DC Current Gain	I_C = 1A V_{CE} = 1V	40			

* Pulsed : pulse duration = 300 μs, duty cycle ≤ 1.5 %.
For PNP types voltage and current values are negative.

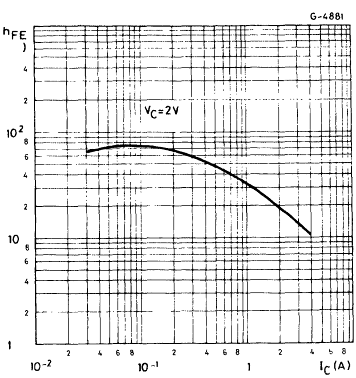
Safe Operating Areas.



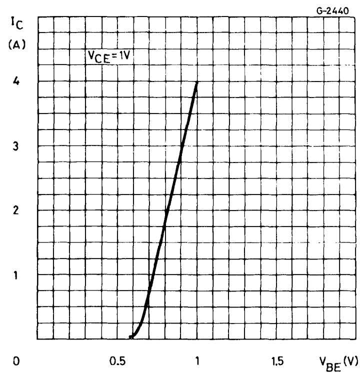
DC Current Gain (NPN type).



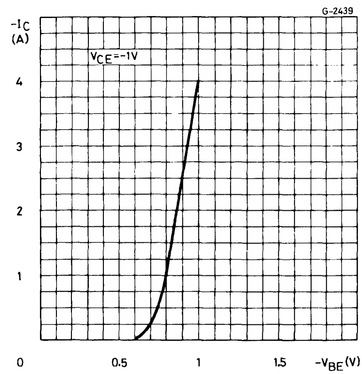
DC Current Gain (PNP type).



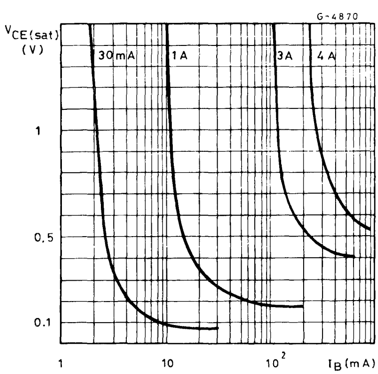
DCTransconductance (NPN type).



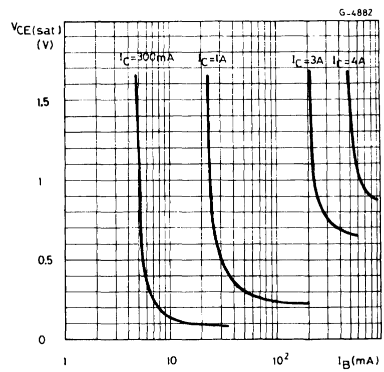
DC Transconductance (PNP type).



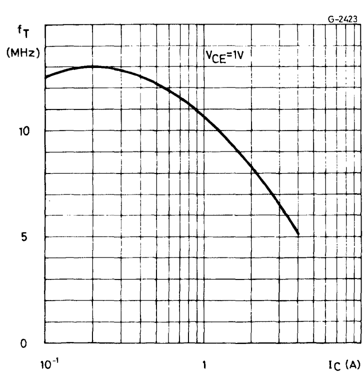
Collector-emitter Saturation Voltage (NPN type).



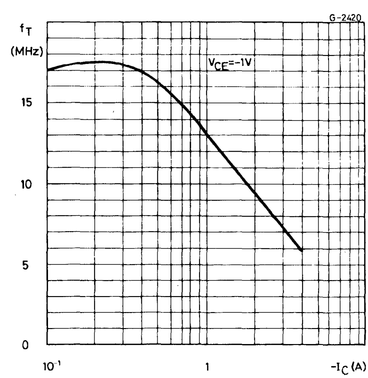
Collector-emitter Saturation Voltage (PNP type).



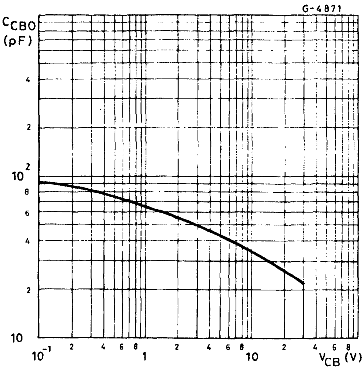
Transition Frequency (NPN type).



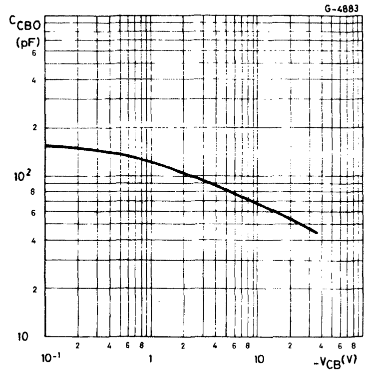
Transition Frequency (PNP type).



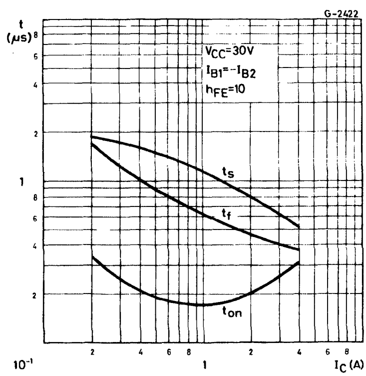
Collector-base Capacitance (NPN type).



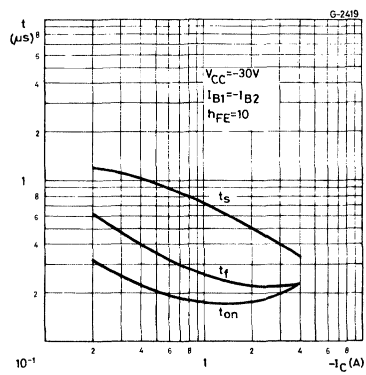
Collector-base Capacitance(PNP type).



Saturated Switching Characteristics (NPN type).



Saturated Switching Characteristics (PNP type).



SGS-THOMSON MICROELECTRONICS

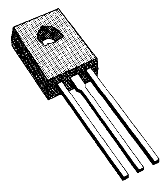
MJE800/1/2/3
MJE700/1/2/3

MEDIUM POWER DARLINGTONS

DESCRIPTION

The MJE800, MJE801, MJE802 and MJE803 are silicon epitaxial-base NPN power transistors in monolithic Darlington configuration and are mounted in Jedec TO-126 plastic package. They are intended for use in medium power linear and switching applications.

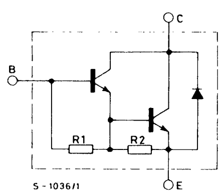
The complementary PNP types are the MJE700, MJE701, MJE702 and MJE703 respectively.



TO-126 (SOT-32)

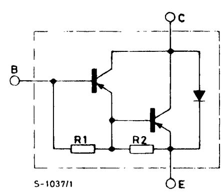
INTERNAL SCHEMATIC DIAGRAMS

NPN



R1 typ. 10kΩ
R2 typ. 150kΩ

PNP



R1 typ. 10kΩ
R2 typ. 150kΩ

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		MJE800/1 MJE700/1	MJE802/3 MJE702/3	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	60	80	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	60	80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5		V
I_C	Collector Current	4		A
I_B	Base Current	0.1		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$	40		W
T_{stg}	Storage Temperature	– 65 to 150		°C
T_j	Junction Temperature	150		°C

For PNP types voltage and current values are negative.

THERMAL DATA

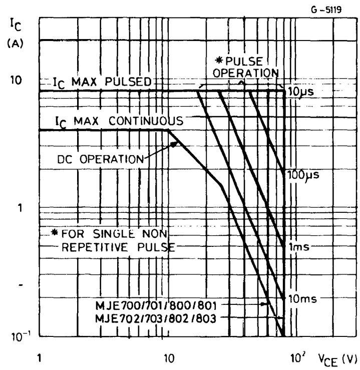
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	3.13	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

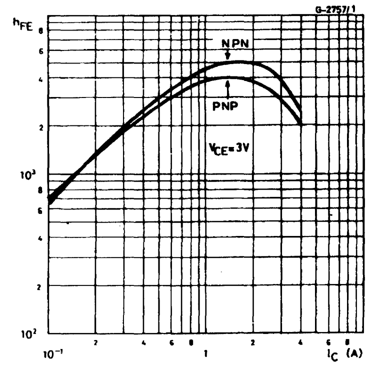
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = rated V_{CBO} V_{CB} = rated V_{CBO} T_{case} = 100°C			100 500	μA μA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = rated V_{CEO}			100	μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			2	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 50mA for **MJE800/1, MJE700/1** for **MJE802/3, MJE702/3**	 60 80			 V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 4A I_B = 40mA for **MJE800/2, MJE700/2** I_C = 1.5A I_B = 30mA for **MJE801/3, MJE701/3** I_C = 2A I_B = 40mA			3 2.5 2.8	V V V
V_{BE}*	Base-emitter Voltage	I_C = 4A V_{CE} = 3V for **MJE800/1, MJE700/1** I_C = 1.5A V_{CE} = 3V for **MJE801/3, MJE701/3** I_C = 2A V_{CE} = 3V			3 2.5 2.5	V V V
h_{FE}*	DC Current Gain	I_C = 4A V_{CE} = 3V for **MJE800/2, MJE700/2** I_C = 1.5A V_{CE} = 3V for **MJE801/3, MJE701/3** I_C = 2A V_{CE} = 3V	100 750 750			
h_{fe}	Small Signal Current Gain	I_C = 1.5A V_{CE} = 3V f = 1MHz	1			

* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.

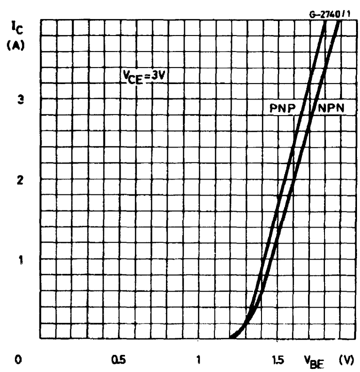
Safe Operating Areas.



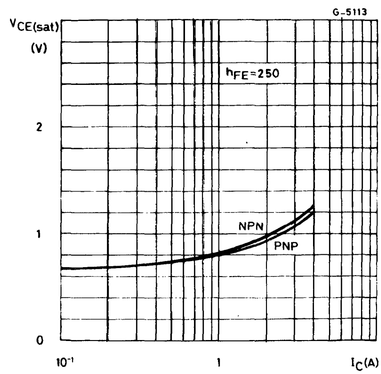
DCCurrent Gain.



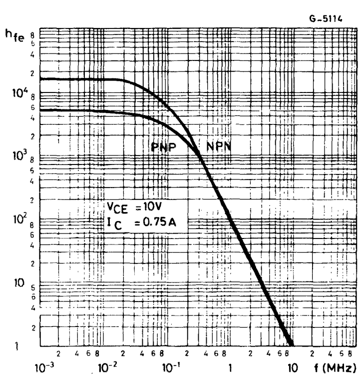
DC Transconductance.



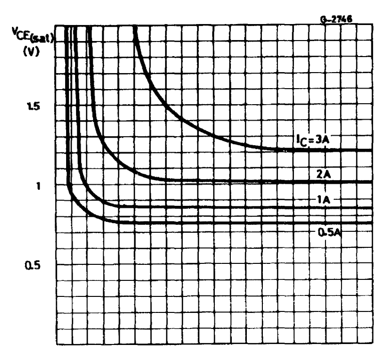
Collector-emitter Saturation Voltage.



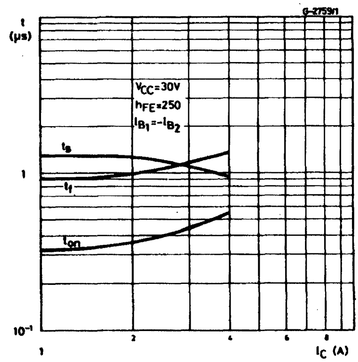
Small Signal Current Gain.



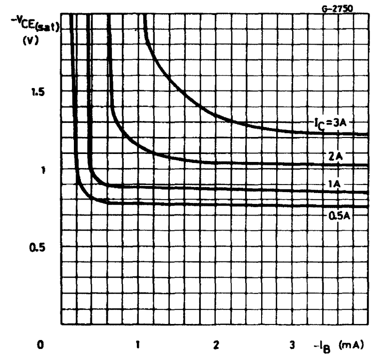
Collector-emitter Saturation Voltage (NPN).



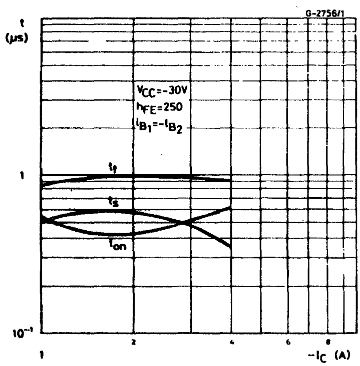
Saturated Switching Characteristics (NPN).



Collector-emitter Saturation Voltage (PNP).



Collector-emitter Saturation Voltage (PNP).



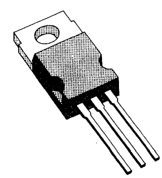
SGS-THOMSON
MICROELECTRONICS

MJE2955T
MJE3055T

MEDIUM POWER AND SWITCHING APPLICATIONS

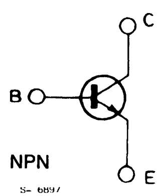
DESCRIPTION

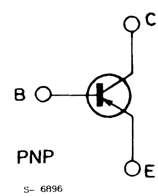
The MJE3055T is a silicon epitaxial-base NPN transistor in Jedec TO-220 package. It is intended for power switching circuits and general-purpose amplifiers. The complementary PNP type is MJE2955T.



TO-220

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	60	V
V_{CBO}	Collector-base Voltage ($I_E = 0$)	70	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5	V
I_C	Collector Current	10	A
I_B	Base Current	6	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	75	W
T_{stg}	Storage Temperature	– 55 to 150	°C
T_j	Junction Temperature	150	°C

For PNP types voltage and current values are negative.

THERMAL DATA

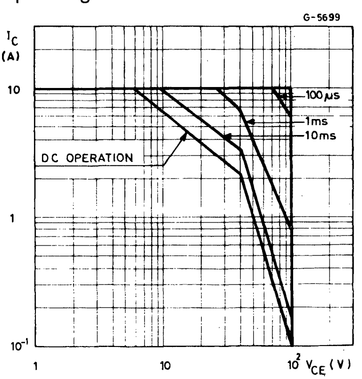
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.66	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 30V			700	μA
I_{CEX}	Collector Cutoff Current (V_{EB} = 1.5V)	V_{CE} = 70V T_{case} = 150°C			1 5	mA mA
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CBO} = 70V T_{case} = 150°C			1 10	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EBO} = 5V			5	mA
$V_{CEO(sus)}$*	Collector-Emitter Sustaining Voltage	I_C = 200mA	60			V
$V_{CE(sat)}$*	Collector-emitter Sustaining Voltage	I_C = 4A I_B = 0.4A I_C = 10A I_B = 3.3A			1.1 8	V V
$V_{BE(on)}$*	Base-emitter on Voltage	I_C = 4A V_{CE} = 4V			1.8	V
h_{FE}*	DC Current Gain	I_C = 4A V_{CE} = 4V I_C = 10A V_{CE} = 4V	20 5		70	
f_T	Transition Frequency	I_C = 500mA V_{CE} = 10V f = 500KHz	2			MHz

* Pulsed : pulse duration = 300μs, duty cycle ≤ 2 %.
For PNP type voltage and current values are negative.

Safe Operating Areas.



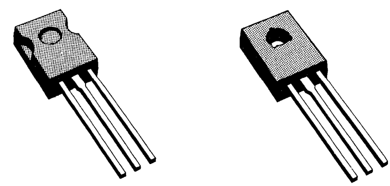
SGS-THOMSON MICROELECTRONICS

MJE3439-SGS3439
MJE3440-SGS3440

HIGH VOLTAGE TRANSISTOR

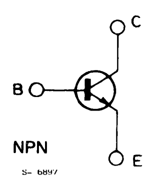
DESCRIPTION

The MJE3439, MJE3440, SGS3439 and SGS3440 are NPN silicon epitaxial planar transistors respectively in TO-126 and SOT-82 plastic package. They are designed for use in consumer and industrial line-operated applications.



SOT-82 TO-126 (SOT-32)

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		MJE3439 SGS3439	MJE3440 SGS3440	
V_{CBO}	Collector-base Voltage (I_E = 0)	450	350	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	350	250	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5		V
I_C	Collector Current	0.3		A
I_B	Base Current	0.15		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$	15		W
T_{stg}	Storage Temperature	– 65 to 150		°C
T_j	Junction Temperature	150		°C

THERMAL DATA

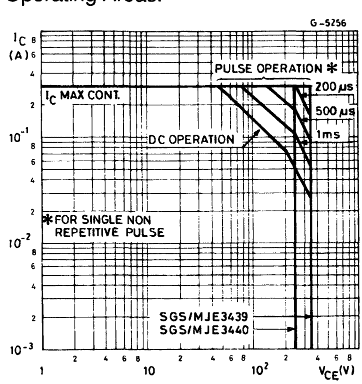
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	8.33	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

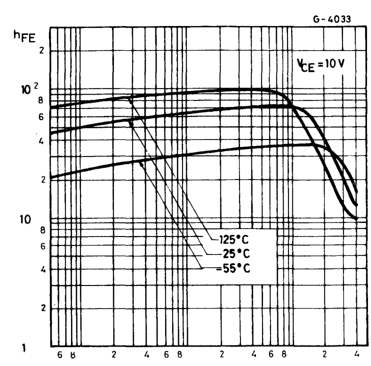
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **MJE3439, SGS3439** V_{CB} = 350V for **MJE3440, SGS3440** V_{CB} = 250V			20 20	µA µA
I_{CEV}	Collector Cutoff Current (V_{BE} = – 1.5V)	for **MJE3439, SGS3439** V_{CE} = 450V for **MJE3440, SGS3440** V_{CE} = 300V			500 500	µA µA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **MJE3439, SGS3439** V_{CE} = 300V for **MJE3440, SGS3440** V_{CE} = 200V			20 50	µA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			20	µA
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 50mA I_B = 4mA			0.5	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 50mA I_B = 4mA			0.3	V
V_{BE}*	Base-emitter Voltage	I_C = 50mA V_{CE} = 10V			0.8	V
h_{FE}*	DC Current Gain	I_C = 2mA V_{CE} = 10V I_C = 20mA V_{CE} = 10V	30 50		 200	
h_{fe}	Small Signal Current Gain	I_C = 5mA V_{CE} = 10V f = 1KHz	25			
f_T	Transition Frequency	I_C = 10mA V_{CE} = 10V f = 5MHz	15			MHz
C_{CBO}*	Collector-base Capacitance	V_{CB} = 10V I_E = 0 f = 1MHz			10	pF

* Pulsed : pulse duration = 300µs, duty cycle ≤ 1.5%.

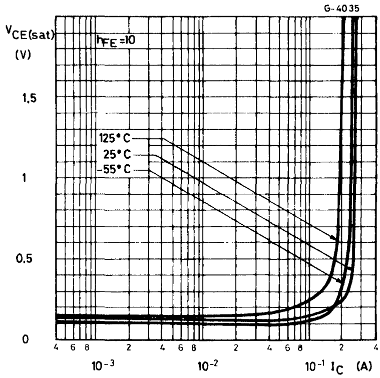
Safe Operating Areas.



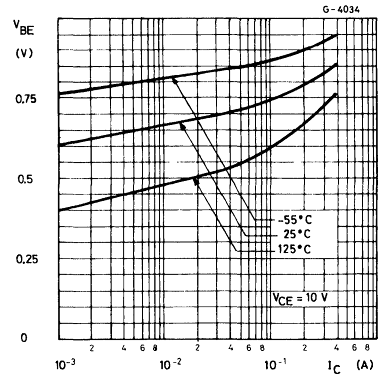
DC Current Gain.



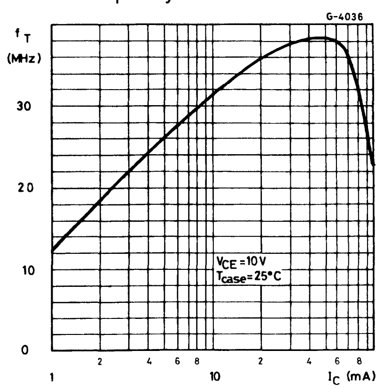
Collector-emitter Saturation Voltage.



Base-emitter Voltage.



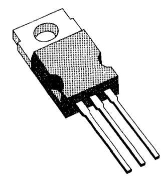
Transition Frequency.



MJE13004
MJE13005

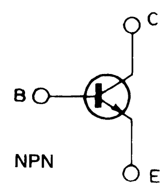
HIGH VOLTAGE POWER SWITCH

DESCRIPTION
The MJE13004/13005 are silicon multiepitaxial mesa NPN transistors in Jedec TO-220 plastic package particularly intended for switch-mode applications.



TO-220

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		MJE13004	MJE13005	
V_{CEV}	Collector-emitter Voltage	600	700	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	300	400	V
V_{EBO}	Emitter-base ($I_C = 0$)	9		V
I_C	Collector Current	4		A
I_{CM}	Collector Peak Current	8		A
I_B	Base Current	2		A
I_{BM}	Base Peak Current	4		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$	75		W
T_{stg}	Storage Temperature	– 65 to 150		°C
T_j	Junction Temperature	150		°C

THERMAL DATA

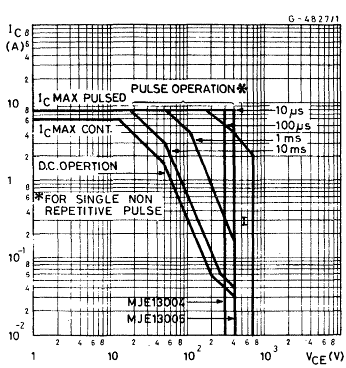
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	max	1.67	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector Cutoff Current (V_{BE} = – 1.5V)	for **MJE13004** V_{CE} = 600V V_{CE} = 600V T_{case} = 100°C for **MJE13005** V_{CE} = 700V V_{CE} = 700V T_{case} = 100°C			 1 5 1 5	 mA mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 9V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 10mA for **MJE13004** for **MJE13005**	300 400			V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 1A I_B = 0.2A I_C = 2A I_B = 0.5A I_C = 4A I_B = 1A			0.5 0.6 1	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 1A I_B = 0.2A I_C = 2A I_B = 0.5A			1.2 1.6	V V
h_{FE}	DC Current Gain	I_C = 1A V_{CE} = 5V I_C = 2A V_{CE} = 5V	10 8	30	60 40	
t_{on} t_s t_f	Turn-on Time Storage Time Fall Time	I_C = 2A I_{B1} = – I_{B2} = 0.4A V_{CC} = 250V			0.8 4 0.9	µs µs µs

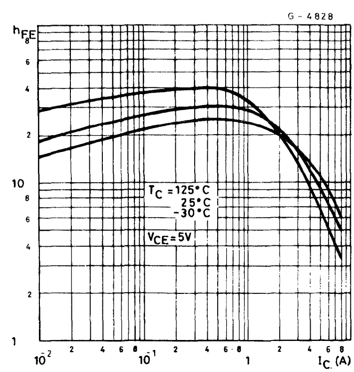
* Pulsed : pulse duration = 300µs, duty cycle = 1.5%.

Safe Operating Areas.

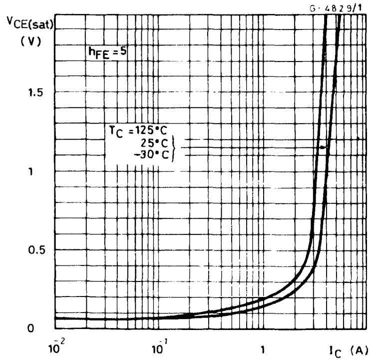


I - Area of permissible operation during turn-on provided $R_{BE} \leq 100\Omega$ and $t_p \leq 0.25\mu s$.

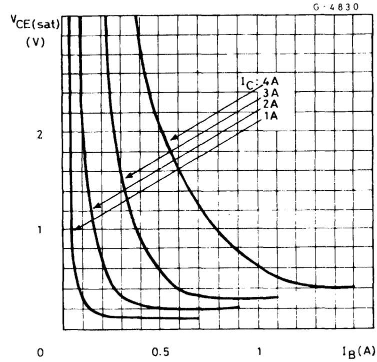
DC Current Gain.



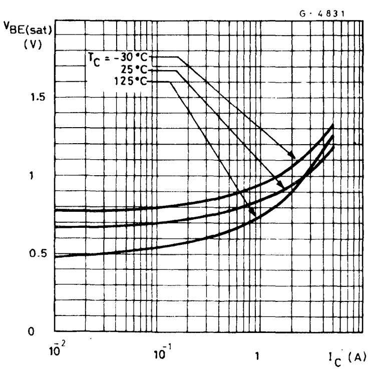
Collector-emitter Saturation Voltage.



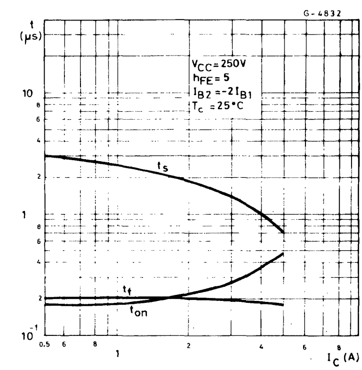
Collector-emitter Saturation Voltage.



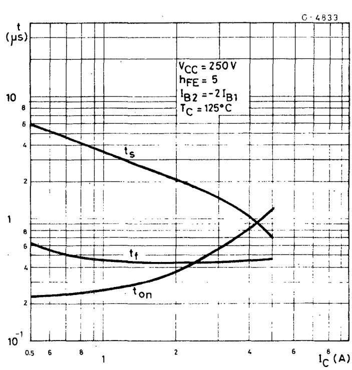
Base-emitter Saturation Voltage.



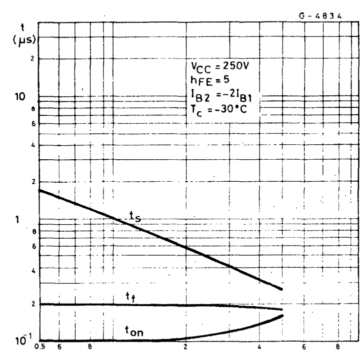
Saturated Switching Characteristics.



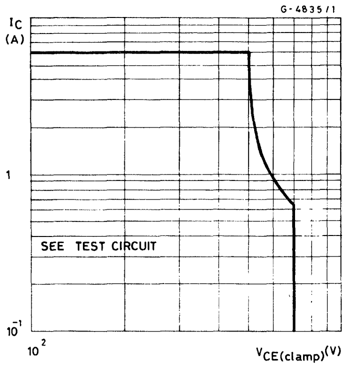
Saturated Switching Characteristics.



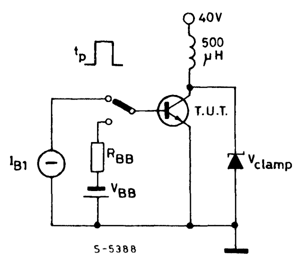
Saturated Switching Characteristics.



Clamped Reverse bias Safe Operating Areas.



Clamped $E_{s/b}$ Test Circuit.



TEST CONDITIONS :

$5V \geq |-V_{BB}| \geq 2V$
$I_C / I_B \geq 4$
$2I_{B1} \geq |-I_{B2}| \geq I_{B1}$
t_p = adjusted for normal I_C
R_{BB} = adjusted for I_{B2}

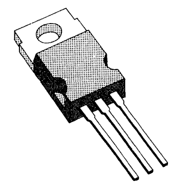
SGS-THOMSON MICROELECTRONICS

MJE13006
MJE13007/A

MOTOR CONTROL, SWITCH REGULATORS

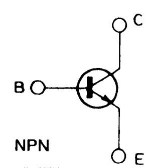
DESCRIPTION

The MJE13006, MJE13007 and MJE13007A are silicon multiepitaxial mesa NPN transistors. They are mounted in Jedec TO-220 plastic package, intended for use in motor controls, switching regulator's etc.



TO-220

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		MJE13006	MJE13007	MJE13007A	
V_{CEO}	Collector-emitter Voltage (V_B = 0)	300	400	400	V
V_{CEV}	Collector-emitter Voltage	600	700	850	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	9			V
I_C	Collector Current	8			A
I_{CM}	Collector Peak Current	16			A
I_B	Base Current	4			A
I_{BM}	Base Peak Current	8			A
I_E	Emitter Current	12			A
I_{EM}	Emitter Peak Current	24			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$	80			W
T_{stg}	Storage Temperature	– 65 to 150			°C
T_j	Junction Temperature	150			°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.56	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 9 V			1	mA
I_{CEV}	Collector Cutoff Current (V_{BE} = 1.5V)	V_{CEV} = rated value V_{CEV} = rated value T_{case} = 100°C			1 5	mA mA
$V_{CEO(sus)}$*	Collector-Emitter Sustaining Voltage (I_B = 0)	I_C = 10 mA for **MJE13006** for **MJE13007/13007A**	 300 400			 V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 2A I_B = 0.4A I_C = 5A I_B = 1A I_C = 8A I_B = 2A I_C = 5A I_B = 1A T_{case} = 100°C			1 1.5 3 2	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 2A I_B = 0.4A I_C = 5A I_B = 1A I_C = 5A I_B = 1A T_{case} = 100°C			1.2 1.6 1.5	V V V
h_{FE}*	DC Current Gain	I_C = 2A V_{CE} = 5V I_C = 5A V_{CE} = 5V	8 6		40 30	
f_T	Transition Frequency	I_C = 500mA V_{CE} = 10V f = 1MHz	4			MHz
C_{CBO}	Output Capacitance	V_{CB} = 10V I_E = 0 f = 0.1MHz		110		pF

RESISTIVE SWITCHING TIMES (fig. 2)

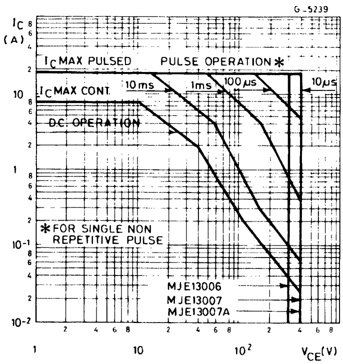
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	V_{CC} = 125V I_C = 5A I_{B1} = − I_{B2} = 1A t_p = 25µs Duty Cycle < 1%			0.7	µs
t_s	Storage Time				3	µs
t_f	Fall Time				0.7	µs

INDUCTIVE SWITCHING TIMES (fig. 1)

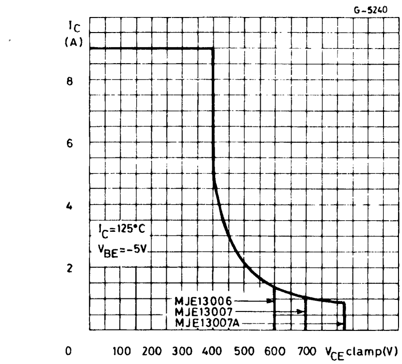
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_f	Fall Time	V_{CC} = 125V I_C = 5A I_{B1} = 1A t_p = 25µs Duty Cycle < 1% T_{case} = 100°C V_{CC} = 125V I_C = 5A I_{B1} = 1A t_p = 25µs Duty Cycle ≤ 1%			0.3 0.6	µs µs

* Pulsed : pulse duration ≤ 300 µs, duty cycle ≤ 1.5 %.

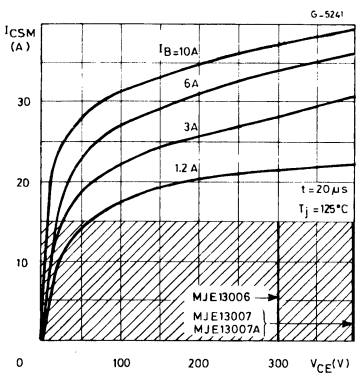
Safe Operating Areas.



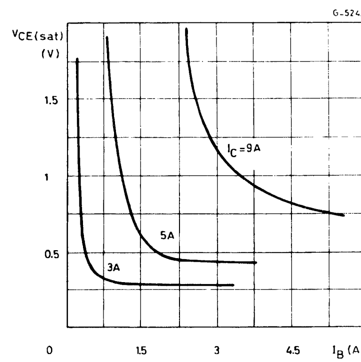
Clamped Reverse Bias operating Areas.



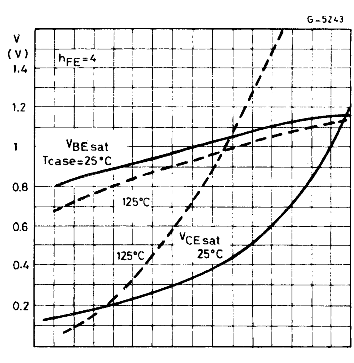
Forward Biased Accidental Overload Area (see fig. 3).



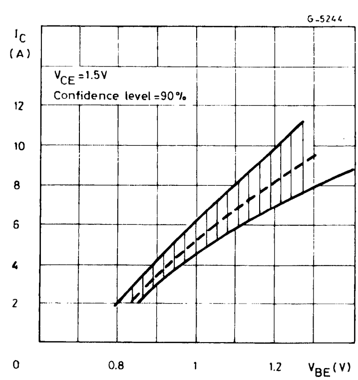
Collector Saturation Voltage.



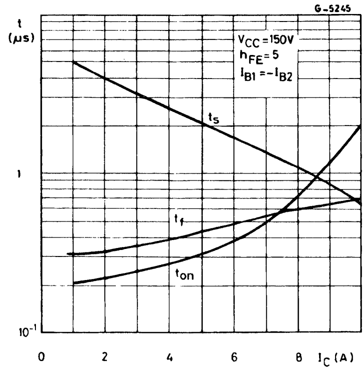
Saturation Voltages.



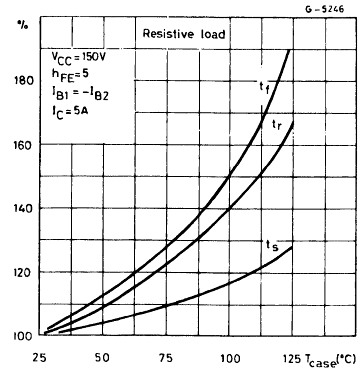
Collector Current Spread vs. Emitter Voltage.



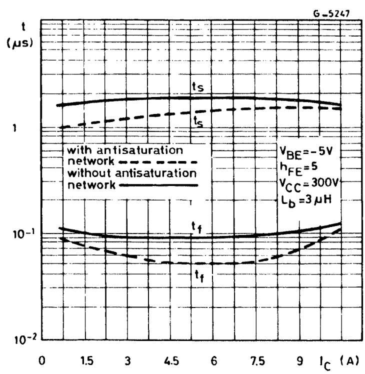
Switching Times Resistive Load (see fig. 2).



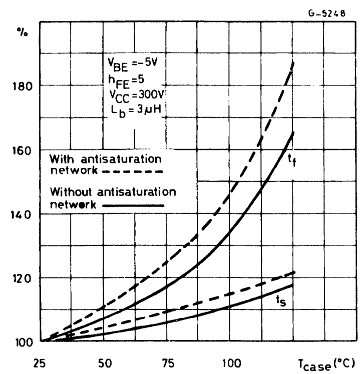
Switching Times Percentage Variation vs. Case Temperature.



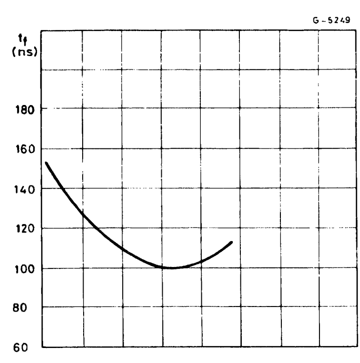
Switching Times Inductive Load (see fig. 1).



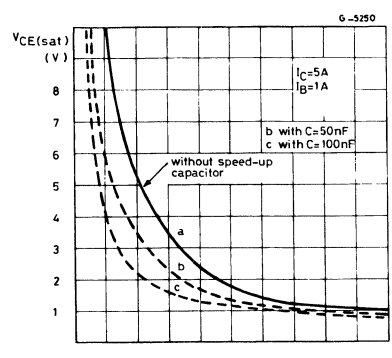
Switching Times Inductive Load vs. Case Temperature.



Fall Times vs. Lb (see fig. 1).



Dynamic Collector-emitter Saturation Voltage (see fig. 4).



DC Current Gain.

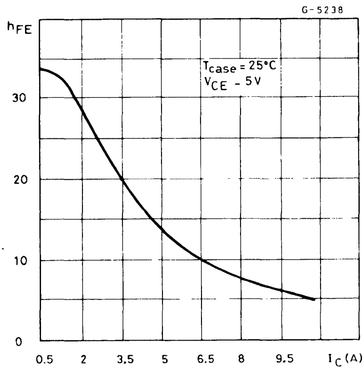
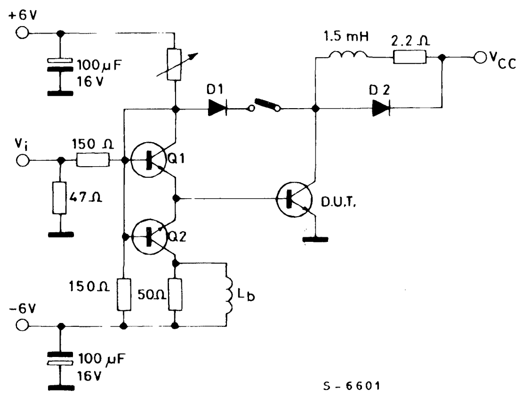


Figure 1 : Switching Times Test Circuit on Inductive Load, with and without Antisaturation Network.



D1, D2 - Fast recovery diodes
Q1, Q2 - Transistors SGS : 2N5191, 2N5195

Figure 2 : Switching Times Test Circuit on Resistive Load.

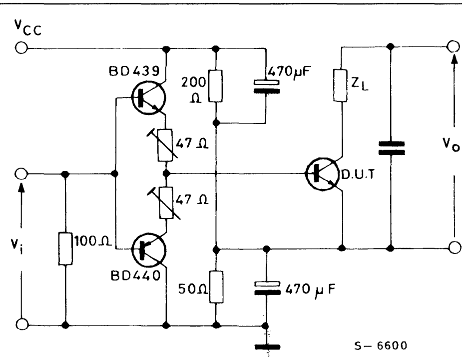


Figure 3 : Forward Biased Accidental Overload Area Test Circuit.

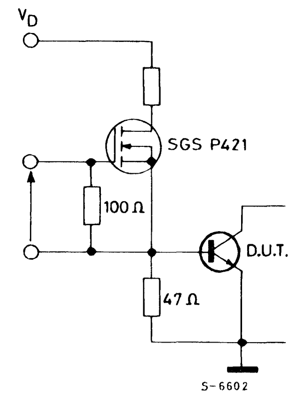


Figure 4 : $V_{CE(sat)}$ Dyn. Test Circuit.

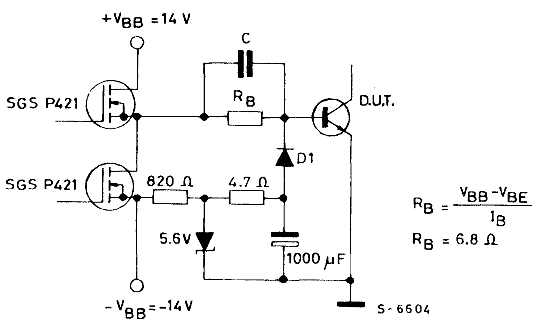


Figure 5 : Equivalent Input Schematic Circuit at Turn-on.

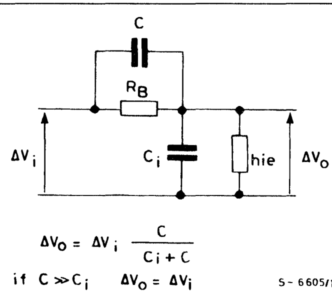
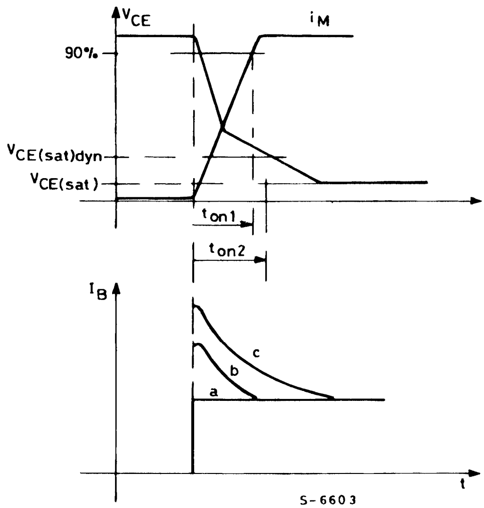


Figure 6 : Remarks to VCE(sat) Dyn. Test Circuit (fig. 4).



The speed-up capacitor decreases the V_{CE}(sat) dyn. as shown in diagram (figure 6).
The 50 nF capacitor modifies the shape of base current with a overshoot.

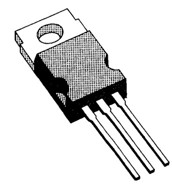
SGS-THOMSON
MICROELECTRONICS

MJE13008
MJE13009

HIGH VOLTAGE, HIGH SPEED, POWER SWITCHING

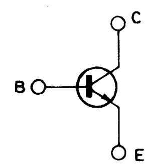
DESCRIPTION

The MJE13008 and MJE13009 are silicon multiepitaxial mesa NPN transistors. They are mounted in Jedec TO-220 plastic package, intended for use in motor controls, switching regulators deflection circuits, etc.



TO-220

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		MJE13008	MJE13009	
V_{CEO}	Collector-emitter Voltage (I_B = 0)	300	400	V
V_{CEV}	Collector-emitter Voltage	600	700	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	9		V
I_C	Collector Current	12		A
I_{CM}	Collector Peak Current ($t_p \leq$ 10ms)	24		A
I_B	Base Current	6		A
I_{BM}	Base Peak Current ($t_p \leq$ 10ms)	12		A
I_E	Emitter Current	18		A
I_{EM}	Emitter Peak Current	36		A
P_{tot}	Total Power Dissipation at $T_{case} \leq$ 25°C	100		W
T_{stg}	Storage Temperature	– 65 to 150		°C
T_j	Junction Temperature	150		°C

THERMAL DATA

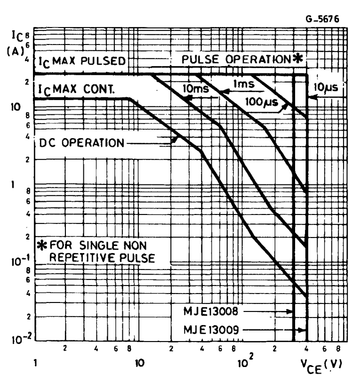
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.25	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

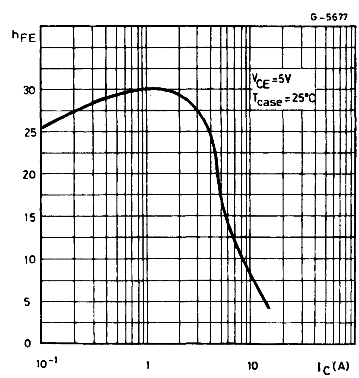
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 9 V			1	mA
I_{CEV}	Collector Cutoff Current	V_{CEV} = rated value $V_{BE(off)}$ = 1.5V V_{CEV} = rated value $V_{EB(off)}$ = 1.5V T_{case} = 100°C			1 5	mA mA
$V_{CEO(sus)}$*	Collector-Emitter Sustaining Voltage	I_C = 10 mA I_E = 0 for **MJE13008** for **MJE13009**	 300 400			 V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5A I_B = 1A I_C = 8A I_B = 1.6A I_C = 12A I_B = 3A I_C = 8A I_B = 1.6A T_{case} = 100°C			1 1.5 3 2	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 5A I_B = 1A I_C = 8A I_B = 1.6A I_C = 8A I_B = 1.6A T_{case} = 100°C			1.2 1.6 1.5	V V V
h_{FE}*	DC Current Gain	I_C = 5A V_{CE} = 5V I_C = 8A V_{CE} = 5V	8 6		40 30	
f_T	Transition Frequency	I_C = 500mA V_{CE} = 10V	4			MHz
C_{OB}	Output Capacitance	V_{CB} = 10V I_E = 0 f = 0.1MHz		180		pF
t_{on}	Turn-on Time	RESISTIVE LOAD			1.1	µs
t_s	Storage Time	V_{CC} = 125V I_C = 8A I_{B1} = I_{B2} = 1.6A t_p = 25µs			3	µs
t_f	Fall Time	Duty Cycle ≤ 1%			0.7	µs

* Pulsed : pulse duration = 300µs, duty cycle ≤ 2%.

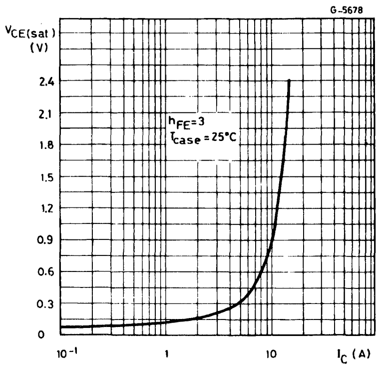
Safe Operating Areas.



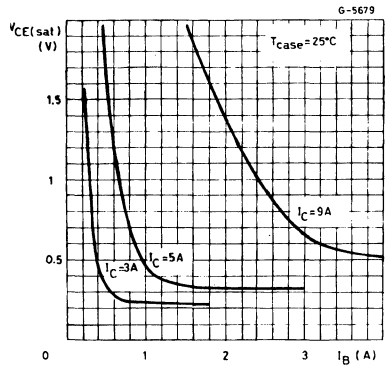
DC Current Gain.



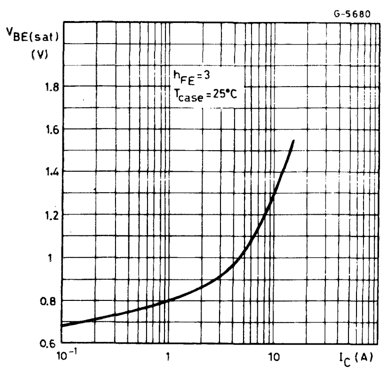
Collector-emitter Saturation Voltage.



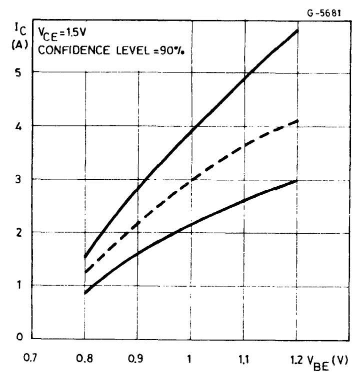
Collector-emitter Saturation Voltage.



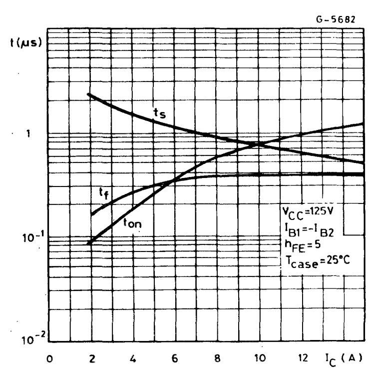
Base-emitter Saturation Voltage.



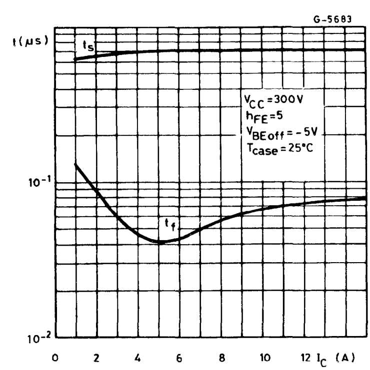
Collector Current Spread vs. Base-emitter Voltage.



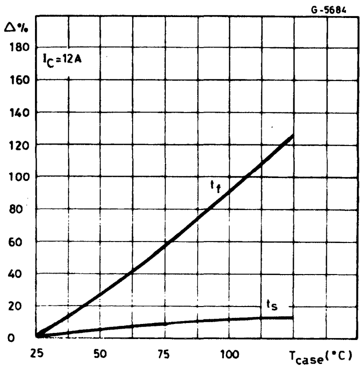
Switching Times Resistive Load (see fig. 2).



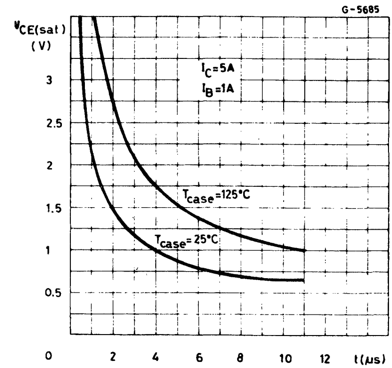
Switching Times Inductive Load (see fig. 1).



Switching Times vs. T_{case} Inductive Load.



Dynamic Collector-emitter Saturation Voltage (see fig. 2).



Clamped Reverse Bias Safe Operating Areas..

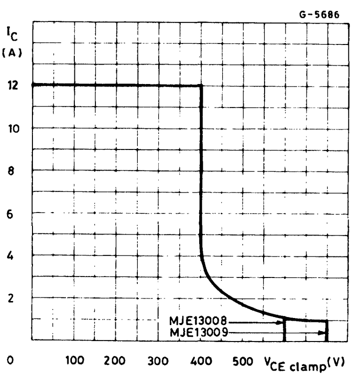
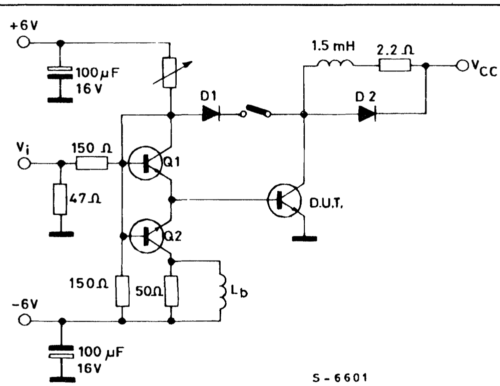
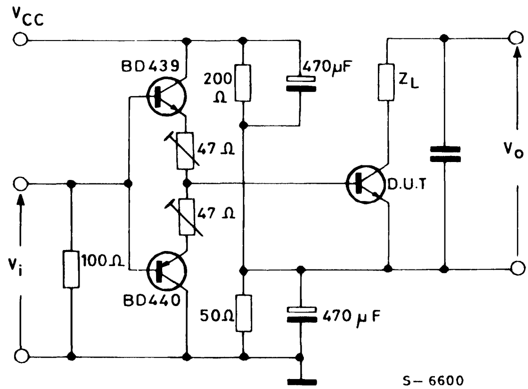


Figure 1 : Switching Times Test Circuit on Inductive Load.



D1, D2 - Fast recovery diodes
Q1, Q2 - Transistors SGS : 2N5191, 2N5195

Figure 2 : Switching Times Test Circuit on Resistive Load and $V_{CE(sat)}$ Dyn. Test Circuit.

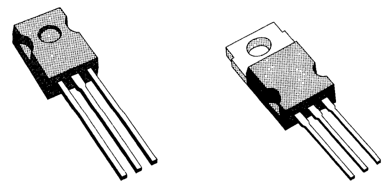


SGS13002/13003
SGS13002T/13003T

HIGH VOLTAGE SWITCHING APPLICATIONS

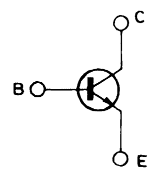
DESCRIPTION

The SGS13002, SGS13003 (SOT-82 plastic package) and the SGS13002T, SGS13003T (TO-220 plastic package) are silicon multiepitaxial-mesa NPN transistors, intended for high voltage applications. They are pin to pin replacement to MJE13002 & 13003 (TO-126, with reserved pin out).



SOT-82 TO-220

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		SGS13002 SGS13002T	SGS13003 SGS13003T	
V_{CEV}	Collector-emitter Voltage (V_{BE} = 1.5 V)	600	700	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	300	400	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	9		V
I_C	Collector Current	1.5		A
I_{CM}	Collector Peak Current (tp < 5 ms)	3		A
I_B	Base Current	0.75		A
I_{BM}	Base Peak Current (tp < 5 ms)	1.5		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C at $T_{amb} \leq 25$ °C	50 2		W W
T_{stg}	Storage Temperature	– 65 to 150		°C
T_j	Junction Temperature	150		°C

THERMAL DATA

$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	62.5	°C/W
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	2.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector Cutoff Current (V_{BE} = – 1.5 V)	for **SGS13002/ 13002T**				
		V_{CE} = 600 V			1	mA
		V_{CE} = 600 V T_{case} = 100 °C			5	mA
		for **SGS13003/ 13003T**				
		V_{CE} = 700 V			1	mA
		V_{CE} = 700 V T_{case} = 100 °C			5	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 9 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 10 mA				
		for **SGS13002/ 13002T**	300			V
		for **SGS13003/ 13003T**	400			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 0.5 A I_B = 0.1 A			0.5	V
		I_C = 1 A I_B = 0.25 A			1	V
		I_C = 1.5 A I_B = 0.5 A			3	V
		I_C = 1 A ; I_B = 0.25A ; T_{case} = 100 °C			1	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 0.5 A I_B = 0.1 A			1	V
		I_C = 1 A I_B = 0.25 A			1.2	V
		I_C = 1 A ; I_B = 0.25 A ; T_{case} = 100 °C			1.1	V
h_{FE}*	DC Current Gain	I_C = 0.5 A V_{CE} = 2 V	8		40	
		I_C = 1 A V_{CE} = 2 V	5		25	
f_T	Transition Frequency	I_C = 100 mA ; V_{CE} = 10 V, f = 1 MHz	5	10		MHz
C_{CBO}	Collector-base Capacitance	V_{CB} = 10 V f = 0.1 MHz		30		pF

RESISTIVE SWITCHING TIMES

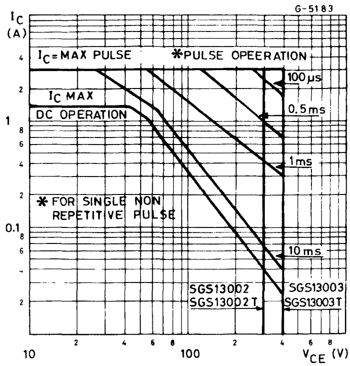
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit.
t_r	Rise Time	V_{CC} = 125 V I_C = 1 A $2I_{B1}$ = – I_{B2} = 0.2 A		0.3	0.8	μs
t_s	Storage Time			1.1	2.5	μs
t_f	Fall Time			0.12	0.5	μs

INDUCTIVE SWITCHING TIMES

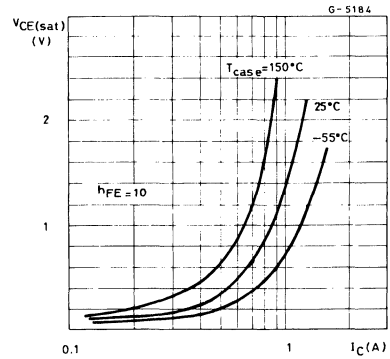
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit.
t_{sv}	Storage Time	I_C = 1 A I_{B1} = 0.2 A V_{BE} = – 5 V L = 50 mH V_{clamp} = 300 V		0.8	2.5	μs
t_C	Crossover Time			0.1	0.75	μs

* Pulsed : pulse duration = 300μs, duty cycle = 1.5 %.

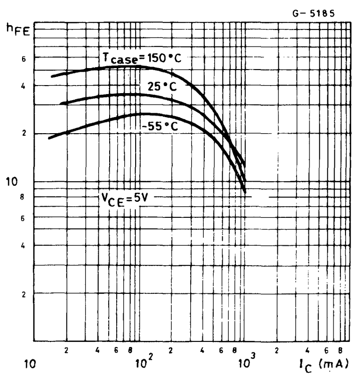
Safe Operating Areas.



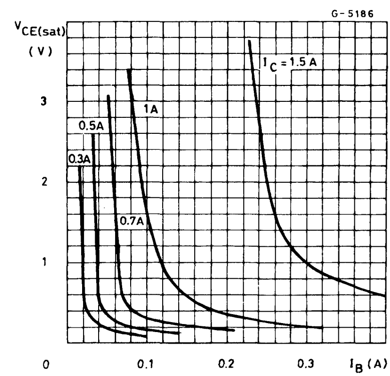
Collector-emitter Saturation Voltage.



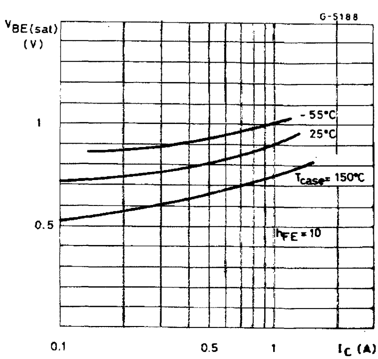
DC Current Gain.



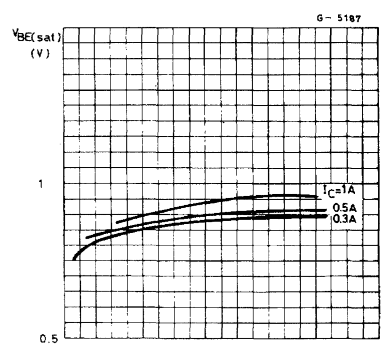
Collector-emitter Saturation Voltage.



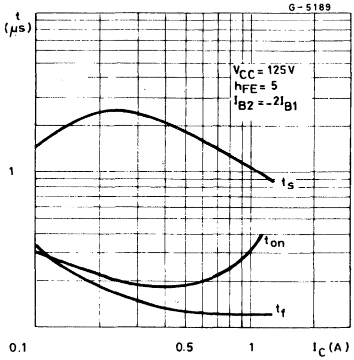
Base-emitter Saturation Voltage.



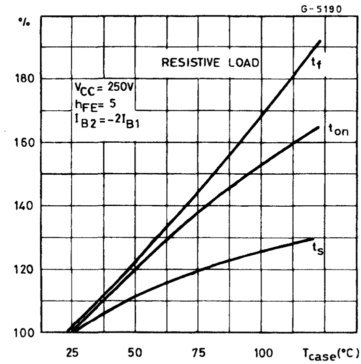
Base-emitter Saturation Voltage.



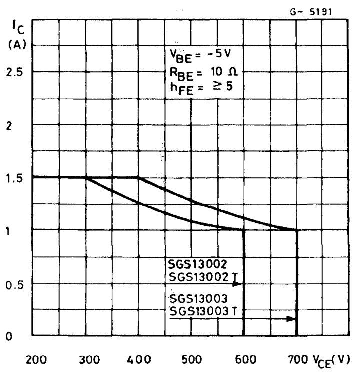
Resistive Load Switching Times.



Switching Times Percentage Variation vs. case Temperature.



Clamped Reverse Bias Safe Operating Areas.



SGS-THOMSON MICROELECTRONICS

SGSD93E
SGSD93F
SGSD93G

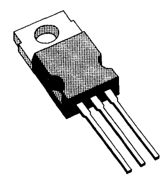
EPITAXIAL PLANAR NPN

ADVANCE DATA

- DAMPER DIODE

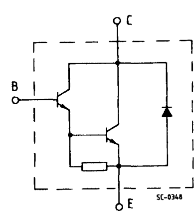
AUTOMOTIVE

- SWITCHING APPLICATION



TO-220

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

The SGSD93E/93F/93G are silicon epitaxial planar NPN transistors in Darlington configuration mounted in Jedec TO-220 plastic package.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		SGSD93E	SGSD93F	SGSD93G	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	160	180	200	V
V_{CES}	Collector-emitter Voltage ($V_{BE} = 0$)	140	160	180	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	140	160	180	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5			V
I_C	Collector Current	12			A
I_{CM}	Collector Peak Current	15			A
I_B	Base Current	0.2			A
P_{tot}	Total Dissipation at $T_c < 25$ °C	80			W
T_{stg}	Storage Temperature	– 65 to 150			°C
T_j	Max. Operating Junction Temperature	150			°C

This is advanced information on a new product now in development or undergoing evaluation. Details are subject to change without notice.

THERMAL DATA

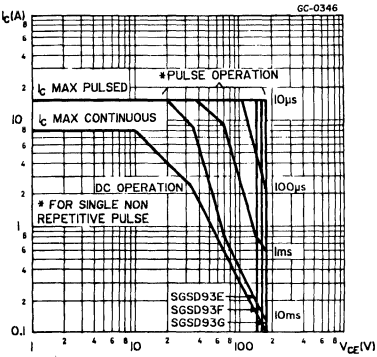
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.56	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

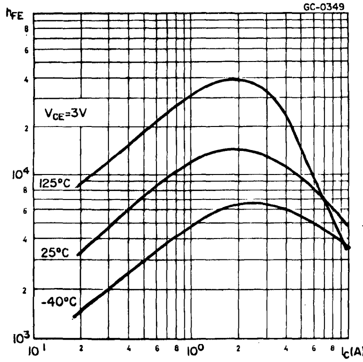
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 160 V for **SGSD93E** V_{CB} = 180 V for **SGSD93F** V_{CB} = 200 V for **SGSD93G**			50 50 50	µA µA µA
		V_{CB} = 160 V for **SGSD93E** V_{CB} = 180 V for **SGSD93F** V_{CB} = 200 V for **SGSD93G** T_c = 150 °C			2 2 2	mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 140 V for **SGSD93E** V_{CE} = 160 V for **SGSD93F** V_{CE} = 180 V for **SGSD93G**			0.5 0.5 0.5	mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{BE} = − 5 V			0.1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 0.1 A for **SGSD93E** for **SGSD93F** for **SGSD93G**	140 160 180			V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5 A I_B = 5 mA I_C = 10 A I_B = 20 mA I_C = 5 A I_B = 5 mA T_c = 150 °C I_C = 10 A I_B = 20 mA T_c = 150 °C I_C = 5 A I_B = 5 mA T_c = − 40 °C			1.4 2.0 1.4 2.2 1.6	V V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 5 A I_B = 5 mA I_C = 10 A I_B = 20 mA I_C = 5 A I_B = 5 mA T_c = 150 °C I_C = 5 A I_B = 5 mA T_c = − 40 °C			2.0 2.8 2.0 2.2	V V V V
h_{FE}*	DC Current Gain	I_C = 150 mA V_{CE} = 1 V I_C = 3 A V_{CE} = 3 V I_C = 5 A V_{CE} = 3 V I_C = 10 A V_{CE} = 3 V	500 1000 1000 750		 20000 	
V_F*	Diode Forward Voltage	I_F = 5 A I_F = 10 A			1.8 3.0	V V
h_{fe}	Small Signal Current Gain	I_C = 1 A V_{CE} = 5 V f = 5 MHz		25		
	RESISTIVE LOAD					
t_{on} t_s t_f	Turn-on Time Storage Time Fall Time	I_C = 6 A I_{B1} = − I_{B2} = 24 mA V_{CC} = 30 V	500 1.4 1.5	700 3.2 2.5	1100 5.0 4.5	ns µs µs

* Pulsed : pulsed duration = 300 µs, duty cycle = 1.5 %.

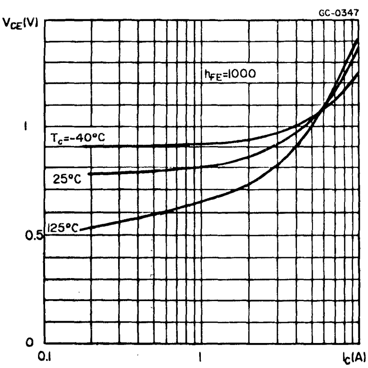
Safe Operating Areas.



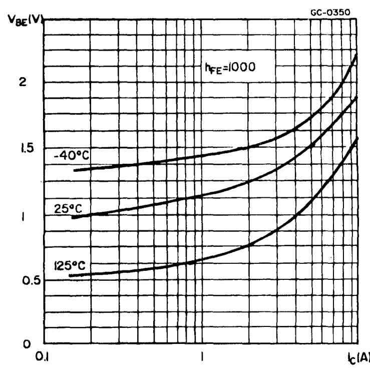
DC Current Gain.



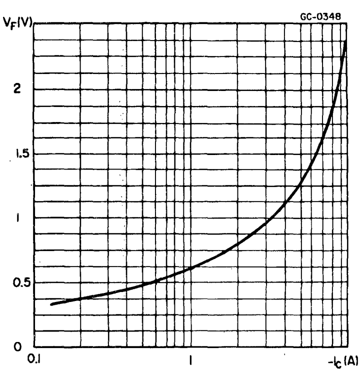
Collector-emitter Saturation Voltage.



Base-emitter Saturation Voltage.



Emitter-collector Voltage.

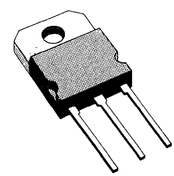


SGSD100
SGSD200

HIGH CURRENT DARLINGTONS

DESCRIPTION

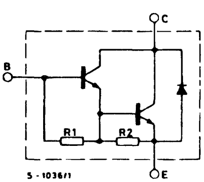
The SGSD100 is a silicon epitaxial-base NPN transistors in TO-218 plastic package, intended for use in general purpose high current amplifier applications. The complementary PNP type is the SGSD200.



TO-218

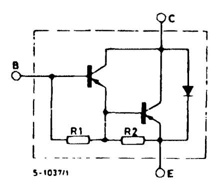
INTERNAL SCHEMATIC DIAGRAM

NPN



R1 ≡ 8KΩ
R2 ≡ 90Ω

PNP



R1 ≡ 5KΩ
R2 ≡ 50Ω

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEO}	Collector-emitter Voltage	80	V
V_{CBO}	Collector-base Voltage	80	V
I_C	Collector Current	25	A
I_{CM}	Collector Peak Current	40	A
I_B	Base Current	6	A
I_{BM}	Base Peak Current	10	A
V_{EBO}	Emitter Base-voltage	10	V
P_{tot}	Total Power Dissipation	130	W
T_j	Junction Temperature	150	°C

For PNP types voltage and current values are negative.

THERMAL DATA

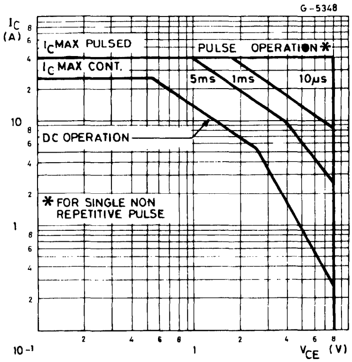
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	0.96	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

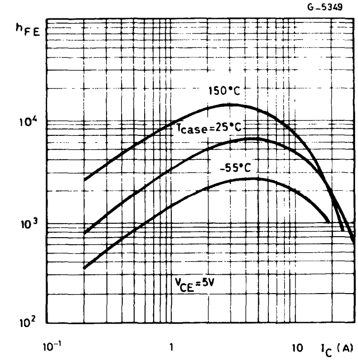
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 50mA	80			V
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 60V T_j = 100°C			500 1.5	μA mA
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CE} = 80V T_j = 100°C			500 1.5	μA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			2	mA
I_{CEV}	Collector Cutoff Current (V_{BE} = – 0.3V)	V_{CE} = 80V T_j = 100°C			100 2	μA mA
h_{FE}*	DC Current Gain	I_C = 5A V_{CE} = 3V T_j = 100°C I_C = 10A V_{CE} = 3V T_j = 100°C I_C = 20A V_{CE} = 3V T_j = 100°C	600 500 300	5K 8K 4K 8K 2K 2K	15K 10K 5K	
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5A I_B = 20mA T_j = 100°C I_C = 10A I_B = 40mA T_j = 100°C I_C = 20A I_B = 80mA T_j = 100°C		0.95 0.8 1.2 1.3 2 2.3	1.2 1.75 3.5	V V V V V V
V_{BE}*	Base-emitter Voltage	I_C = 10A V_{CE} = 3V T_j = 100°C	1	1.8 1.6	3	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 20A I_B = 80mA T_j = 100°C		2.6 2.5	3.3	V V
V_F	Diode Forward Voltage	I_F = 5A T_j = 100°C I_F = 10A T_j = 100°C I_F = 20A T_j = 100°C		1.2 0.85 1.6 1.4 2.3 1.3		V V V V V V
$E_{s/b}$	Second Breakdown Energy	L = 3mH V_{CC} = 30V T_j = 100°C	250 250			mJ mJ
$I_{s/b}$	Second Breakdown Collector Current	V_{CE} = 25V t = 500ms	6			A

* Pulsed : pulse duration = 300μs, duty cycle = 1.5 %
For PNP types voltage and current values are negative.

Safe Operating Areas.



DC Current Gain (NPN type).



DC Current Gain (PNP type).

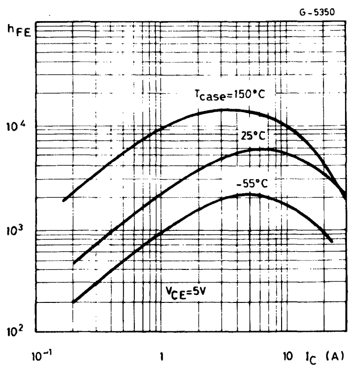
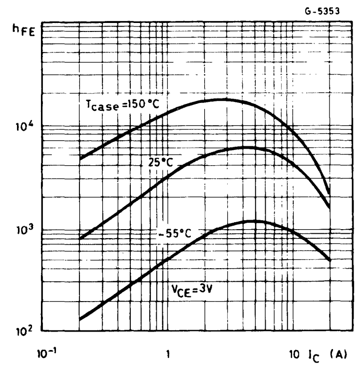
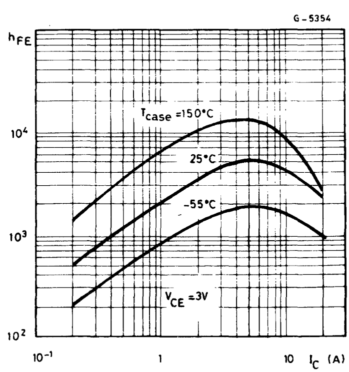


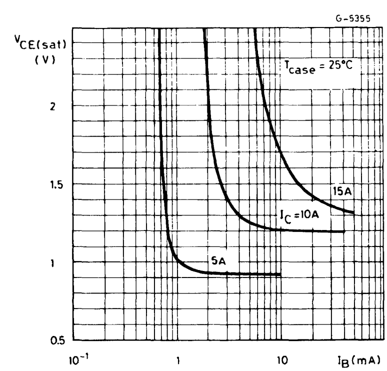
Figure 4 : DC Current Gain (NPN type).



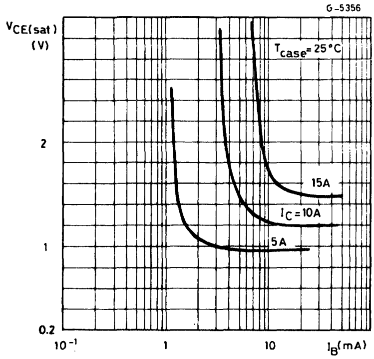
DC Current Gain (PNP type).



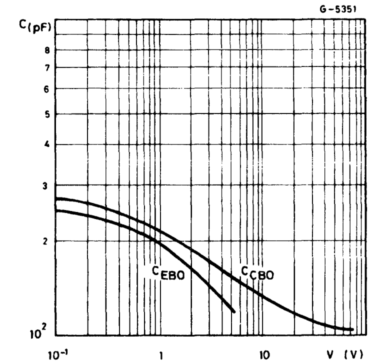
Collector-emitter Saturation Voltage (NPN type).



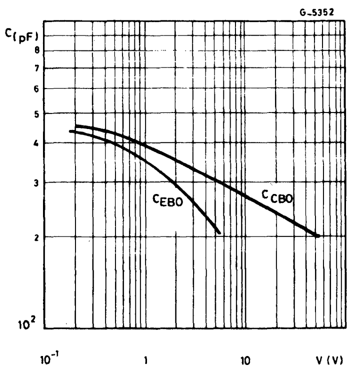
Collector-emitter Saturation Voltage (PNP type).



Capacitances (NPN type).



Capacitances (PNP type).



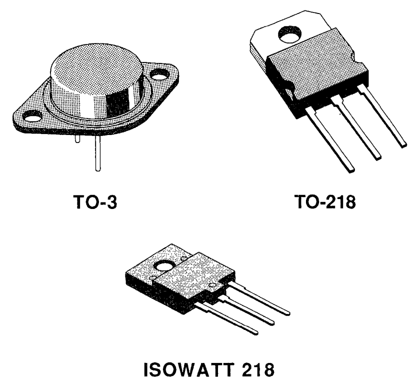
HIGH VOLTAGE, HIGH POWER, FAST SWITCHING

DESCRIPTION

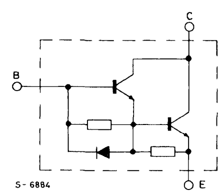
The SGSD310, SGSD311 and SGSD311FI are silicon multiepitaxial planar NPN transistors in monolithic Darlington configuration with integrated speed-up diode, mounted respectively in the TO-3 metal case, TO-218 plastic package and ISOWATT218 fully isolated package.

No parasitic collector-emitter diode, so that an external fast recovery free wheeling diode can be added.

They are particularly suitable as output stage in high power, fast switching applications.



INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
V_{CER}	Collector-emitter Voltage ($R_{BE} = 50\Omega$)	600			V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	400			V
I_C	Collector-current	28			A
I_{CM}	Collector Peak Current ($t_p < 10ms$)	40			A
I_B	Base Current	6			A
I_{BM}	Base Peak Current ($t_p < 10ms$)	12			A
		TO-3	TO-218	ISOWATT218	
P_{tot}	Total Power Dissipation at $T_c < 25°C$	150	125	60	W
T_{stg}	Storage Temperature	– 65 to 175	– 65 to 150	– 65 to 150	°C
T_j	Max. Operating Junction Temperature	175	150	150	°C

THERMAL DATA

		TO-3	TO-218	ISOWATT218	
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case Max	1	1	2.08	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector Cutoff Current (V_{BE} = – 1.5 V)	V_{CE} = 600 V V_{CE} = 600 V T_{case} = 100 °C			100 2	µA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 2 V			30	mA
$V_{CEO\ (sus)}$*	Collector-emitter Sustaining Voltage	I_C = 100 mA	400			V
$V_{CE\ (sat)}$*	Collector-emitter Saturation Voltage	I_C = 10 A I_B = 0.5 A I_C = 18 A I_B = 1.8 A I_C = 22 A I_B = 2.2 A I_C = 28 A I_B = 5.6 A			2 2.5 3 5	V V V V
$V_{BE\ (sat)}$*	Base-emitter Saturation Voltage	I_C = 10 A I_B = 0.5 A I_C = 18 A I_B = 1.8 A I_C = 22 A I_B = 2.2 A			2.5 3 3.3	V V V
h_{FE}*	DC Current Gain	I_C = 10 A V_{CE} = 5 V I_C = 18 A V_{CE} = 5 V	30 20			
I_{ol}	Output Current Overload	Accidental Overload Switch-off Current V_{clamp} = 400 V L = 100 µH t_{ol} = 10 µs T_j = 125 °C	28			A

RESISTIVE SWITCHING TIMES

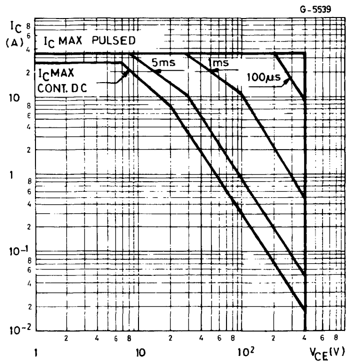
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit.
t_{on}	Turn-on Time	V_{CC} = 250 V I_C = 10 A I_{B1} = 0.5 A $V_{BE(off)}$ = – 5 V			0.6	µs
t_s	Storage Time				1.5	µs
t_f	Fall Time				0.6	µs

INDUCTIVE SWITCHING TIMES

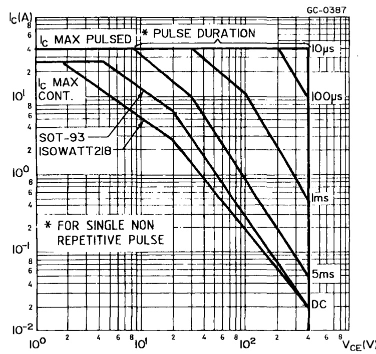
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit.
t_s	Storage Time	V_{clamp} = 250 V I_C = 10 A I_{B1} = 0.5 A $V_{BE(off)}$ = – 5 V L = 180 µH			1.5	µs
t_f	Fall Time				0.5	µs
t_s	Storage Time	V_{clamp} = 250 V I_C = 20 A I_{B1} = 2 A $V_{BE(off)}$ = – 5 V L = 180 µH			1.5	µs
t_f	Fall Time				0.7	µs

* Pulsed : pulse duration = 300µs, duty cycle = 1.5%.

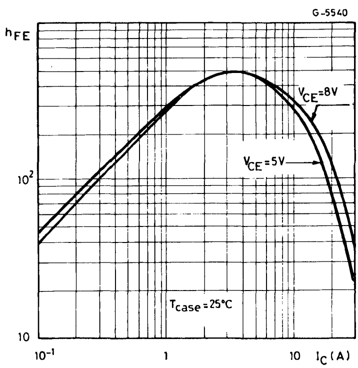
Safe Operating Areas (TO-3).



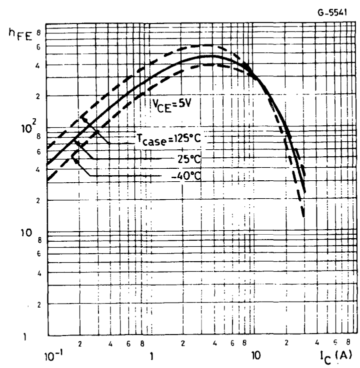
Safe Operating Areas (TO-218, ISOWATT218).



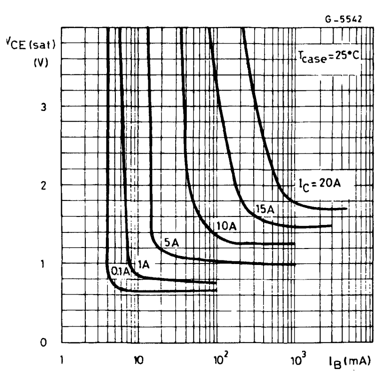
DC Current Gain.



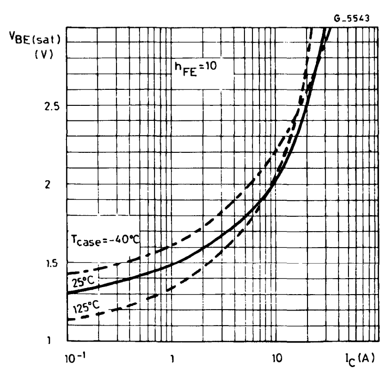
DC Current Gain.



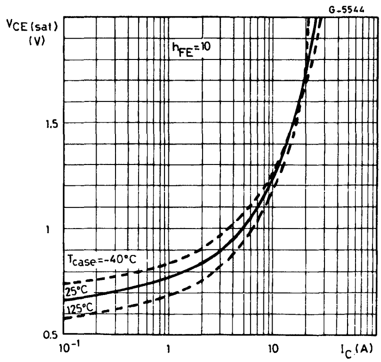
Collector-emitter Saturation Voltage.



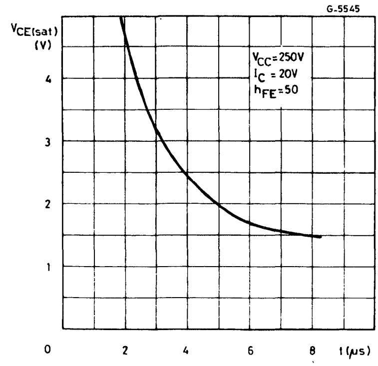
Base-emitter Saturation Voltage.



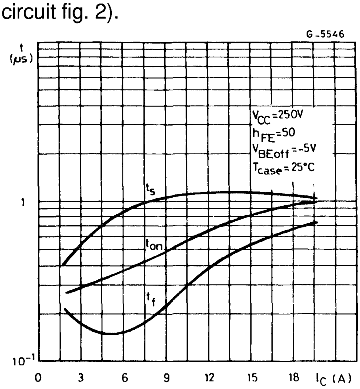
Collector-emitter Saturation Voltage.



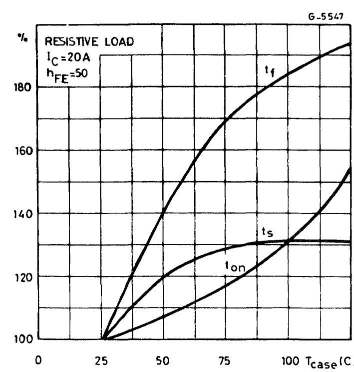
Collector-emitter Saturation Voltage Dynamic (test circuit fig. 2).



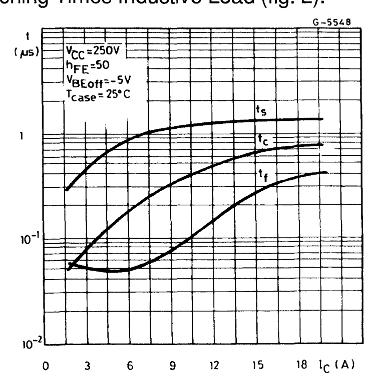
Switching Times Resistive Load (test circuit fig. 2).



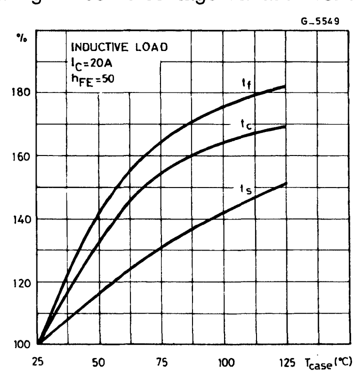
Switching Times Percentage Variation vs. T_{case}.



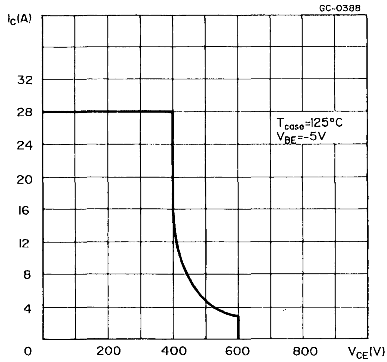
Switching Times Inductive Load (fig. 2).



Switching Times Percentage Variation vs. T_{case}.

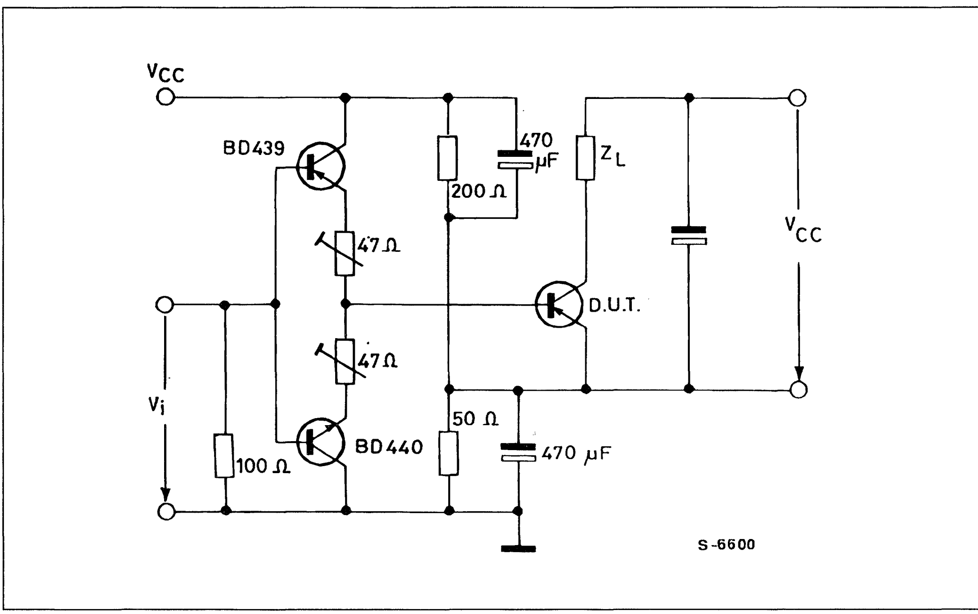


Clamped Reverse bias Safe Operating Area.



TEST CIRCUIT

Figure 2.



ISOWATT218 PACKAGE CHARACTERISTICS AND APPLICATION

ISOWATT218 is fully isolated to 4000V dc. Its thermal impedance, given in the data sheet, is optimised to give efficient thermal conduction together with excellent electrical isolation. The structure of the case ensures optimum distances between the pins and heatsink. These distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 package eliminates the need for external isolation so reducing fixing hardware.

The package is supplied with leads longer than the standard TO-218 to allow easy mounting on pcbs.

Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

ISOWATT218 thermal performance is equivalent to that of the standard part, mounted with a 0.1mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for ISOWATT218 packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT218 PACKAGE

Fig. 3 illustrates the elements contributing to the thermmal resistance of a transistor heatsink assembly, using ISOWATT218 package.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements. The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1 - For a short duration power pulse of less than 1ms :

$$Z_{th} \quad R_{thJ-C}$$

2 - For an intermediate power pulse of 5ms to 50ms seconds :

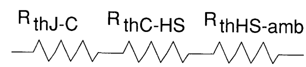
$$Z_{th} = R_{thJ-C}$$

3 - For long power pulses of the order of 500ms seconds or greater :

$$Z_{th} = R_{thJ-C} + R_{thC-HS} + R_{thHS-amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 3.



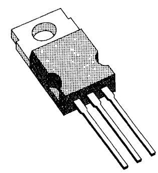
SGS-THOMSON MICROELECTRONICS

SGS-THOMSON MICROELECTRONICS

SGSD00020

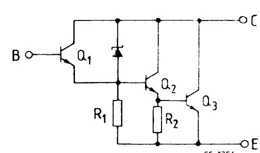
NPN HIGH VOLTAGE DARLINGTON

- VERY HIGH GAIN
- HIGH VOLTAGE
- HIGH RUGGEDNESS BY INTEGRATED HIGH VOLTAGE ZENER
- AUTOMOTIVE FUNCTIONAL TEST



TO-220

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

NPN multiepitaxial planar integrated trilinton in TO-220 plastic package, intended for use in high performance electronic ignition or inductive switching circuit.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEO}	Collector-emitter Voltage (I_B = 0)	400	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	8	V
I_C	Collector Current	5	A
I_{CM}	Collector Peak Current	8	A
I_B	Base Current	1	A
P_{tot}	Total Dissipation at T_c < 25°C	50	W
T_{stg}	Storage Temperature	– 55 to 150	°C
T_j	Max. Operating Junction Temperature	150	°C

THERMAL DATA

$R_{thj-case}$	Thermal Resistance Junction-case	max	2.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 8V				100	μA
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 400V				100	μA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 50mA		400			V
$V_{CE(sat)}$*	Collector-emitter saturation Voltage	I_C = 3A I_C = 2.5A	I_B = 3mA I_B = 1mA			4 4	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 3A	I_B = 3mA			3.5	V
h_{FE}*	DC Current Gain	I_C = 1A	V_{CE} = 5V	7000			
$E_{s/b}$	Second Breakdown Energy	I_C = 4A	L = 10mH	80			mJ

* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.

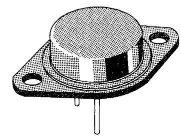
HIGH VOLTAGE, HIGH POWER, FAST SWITCHING

DESCRIPTION

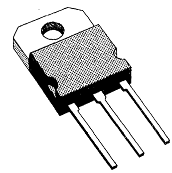
The SGSD00030,SGSD00031 and SGSD00031FI are silicon multiepitaxial planar NPN transistors in monolithic Darlington configuration with integrated speed-up diode, mounted respectively in the TO-3 metal case, TO-218 plastic package and ISO-WATT218 fully isolated package.

No parasitic collector-emitter diode, so that an external fast recovery free wheeling can be added.

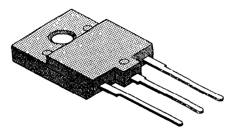
They are particularly suitable as output stage in high power, fast switching applications.



TO-3

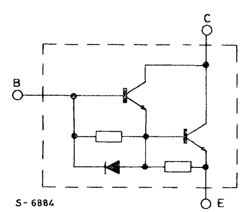


SOT-93



ISOWATT218

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
V_{CER}	Collector-emitter Voltage (R_{BE} = 50Ω)	650			V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	400			V
I_C	Collector-current	28			A
I_{CM}	Collector Peak Current (t_p < 10ms)	40			A
I_B	Base Current	6			A
I_{BM}	Base Peak Current (t_p < 10 ms)	12			A
		TO-3	**TO-218**	**ISOWATT218**	
P_{tot}	Total Power Dissipation at T_c < 25°C	150	125	60	W
T_{stg}	Storage Temperature	– 65 to 175	– 65 to 150	– 65 to 150	°C
T_j	Max. Operating Junction Temperature	175	150	150	°C

THERMAL DATA

		TO-3	TO-218	ISOWATT218	
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case Max	1	1	2.08	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector Cutoff Current (V_{BE} = – 15 V)	V_{CE} = 600 V V_{CE} = 600 V T_{case} = 100 °C			100 2	μA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 2 V			30	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 100 mA	400			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10 A I_B = 0.1 A I_C = 18 A I_B = 1.8 A			2.5 3.5	V V
h_{FE}*	DC Current Gain	I_C = 10 A V_{CE} = 5 V I_C = 18 A V_{CE} = 5 V	30 20			
I_{ol}	Output Current Overload	Accidental Overload Switch-off Current V_{clamp} = 400 V L = 100 μH t_{ol} = 10 μs T_j = 125 °C	28			A

RESISTIVE SWITCHING TIMES

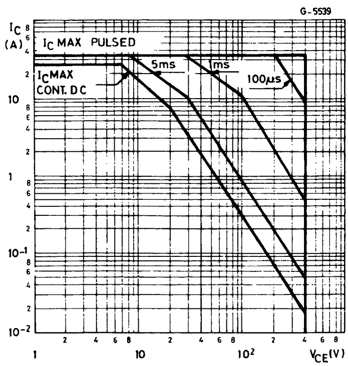
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit.
t_s	Turn-on Time	V_{CC} = 250 V I_C = 12 A I_{B1} = 0.1 A $V_{BE(off)}$ = – 5 V			0.6	μs
t_s	Storage Time				1.5	μs
t_f	Fall Time				0.6	μs

INDUCTIVE SWITCHING TIMES

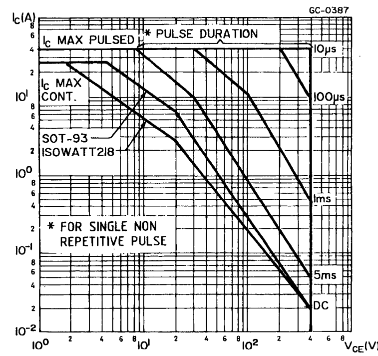
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit.
t_s	Storage Time	V_{clamp} = 250 V I_C = 12 A I_{B1} = 0.1 A $V_{BE(off)}$ = – 5 V L = 180 μH			1.5	μs
t_f	Fall Time				0.5	μs
t_s	Storage Time	V_{clamp} = 250 V I_C = 18 A I_{B1} = 1.8 A $V_{BE(off)}$ = – 5 V L = 180 μH			1.5	μs
t_f	Fall Time				0.7	μs

* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.

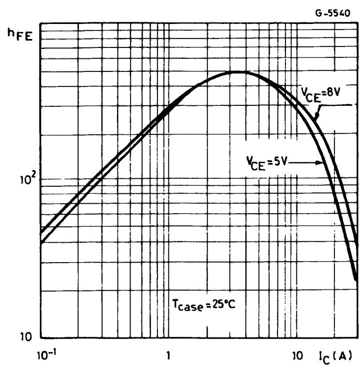
Safe Operating Areas (TO-3).



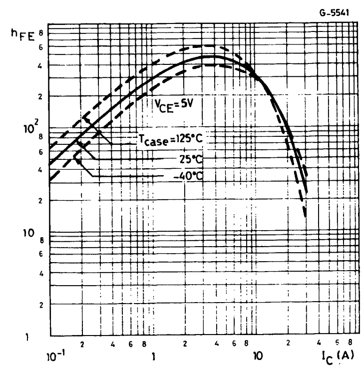
Safe Operating Areas (TO-218, ISOWATT218).



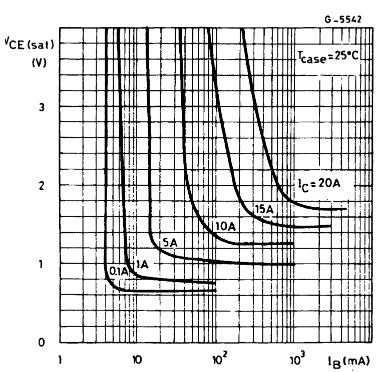
DC Current Gain.



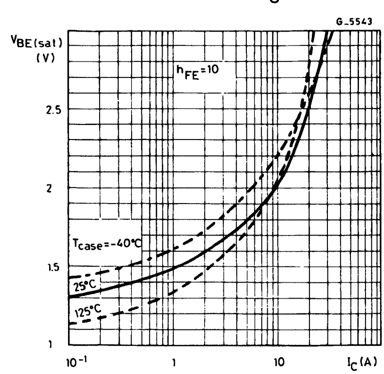
DC Current Gain.



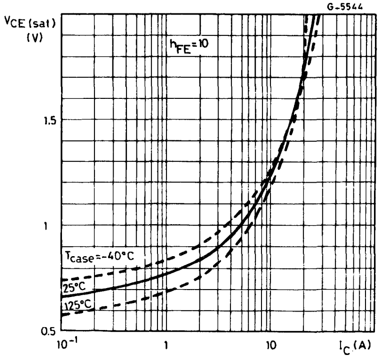
Collector-emitter Saturation Voltage.



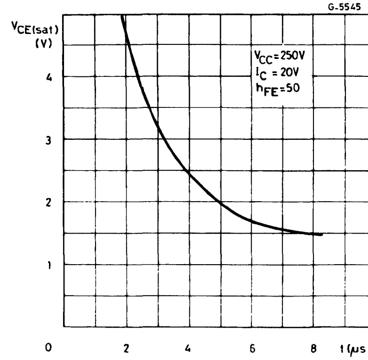
Base-emitter Saturation Voltage.



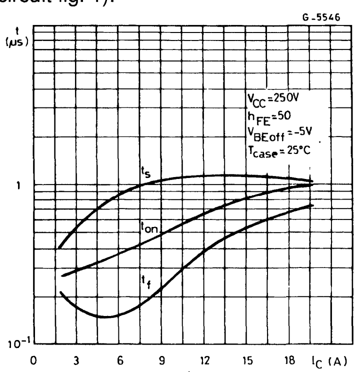
Collector-emitter Saturation Voltage.



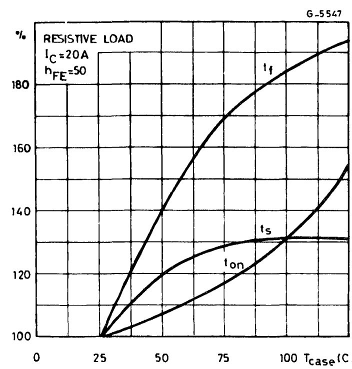
Collector-emitter Saturation Voltage Dynamic (test circuit fig. 2).



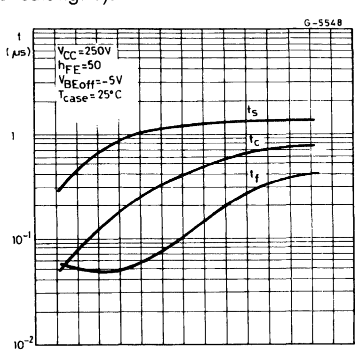
Switching Times Resistive Load (test circuit fig. 1).



Switching Times Percentage Variation vs. T_{case}.



Switching Times Inductive Load (test circuit fig. 1).



Switching Times Percentage Variation vs. T_{case}.

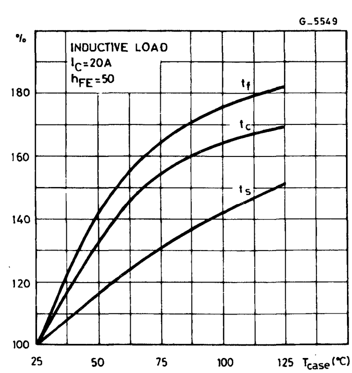
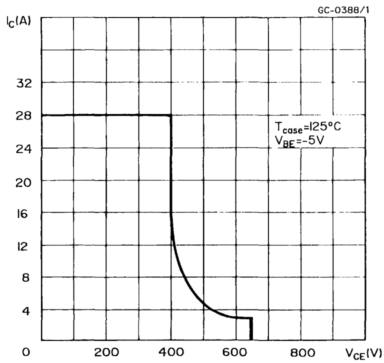
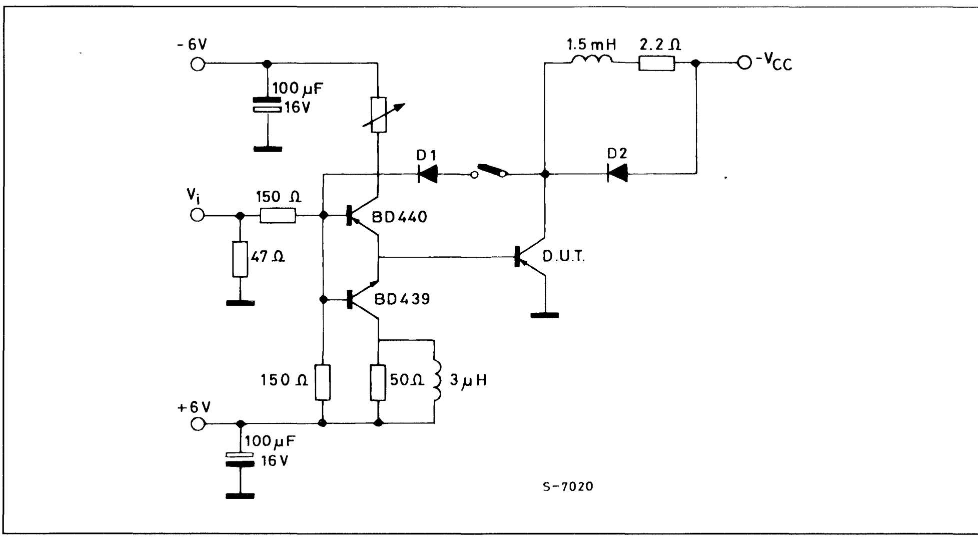


Figure 12 : Clamped Reverse Bias Safe Operating Area.



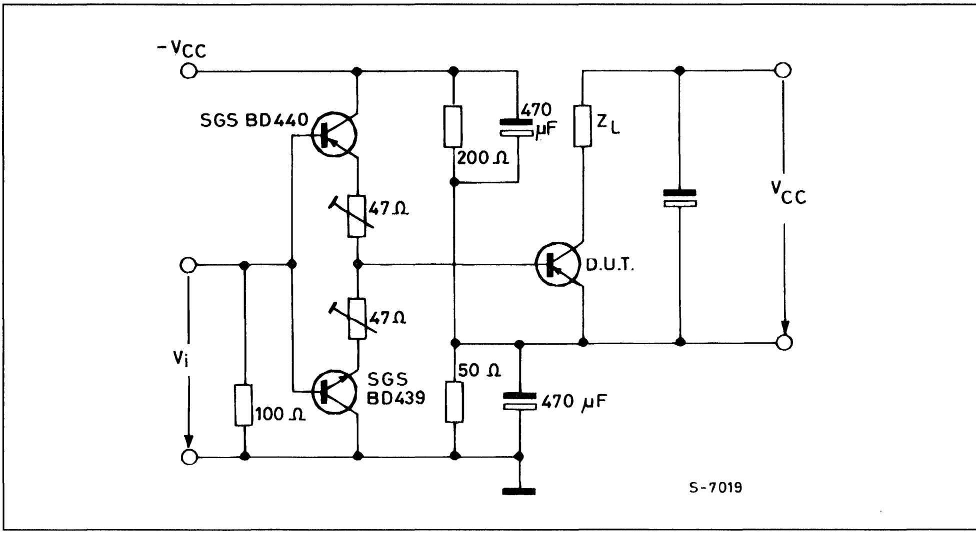
SWITCHING TIMES TEST CIRCUITS

Figure 1.



SWITCHING TIMES TEST CIRCUITS (continued)

Figure 2.



ISOWATT218 PACKAGE CHARACTERISTICS AND APPLICATION

ISOWATT218 is fully isolated to 4000V dc. Its thermal impedance, given in the data sheet, is optimised to give efficient thermal conduction together with excellent electrical isolation.

The structure of the case ensures optimum distances between the pins and heatsink. These distances are in agreement with VDE and UL creepage and clearance standarads. The ISOWATT218 package eliminates the need for external isolation so reducing fixing hardware.

The package is supplied with leads longer than the standard TO-218 to allow easy mounting on pcbs. Accurate moulding techniques used i, manufacture assures consistent heat spreader-to-heatsink capacitance.

ISOWATT218 thermal performance is equivalent to that of the standard part, mounted with a 0.1mm mica washer.

The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets.

Power derating for ISOWATT218 packages is determinated by :

$$P_D = \frac{T_J - T_C}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT218 PACKAGE

Figure 2 illustrates the elements contributing to the thermal resistance of a transistor heatsink assembly, using ISOWATT218 package.

The total thermal resistance Rth(tot) is the sum of each of these elements.

The transient thermal resistance impedance, Zth for different pulse durations can be stimated as follows :

1. For a short duration power pulse of less than 1ms :

$$Z_{th} < R_{thJ\text{-}C}$$

2. For an intermediate power pulse of 5ms to 50ms seconds :

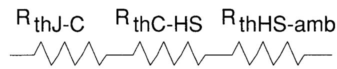
$$Z_{th} = R_{thJ\text{-}C}$$

3. For long power pulses of the order of 500ms seconds or greater :

$$Z_{th} = R_{thJ\text{-}C} + R_{thC\text{-}HS} + R_{thHS\text{-}amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

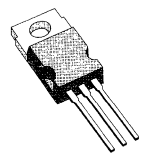
Figure 2.



HIGH VOLTAGE FAST SWITCHING NPN DARLINGTON

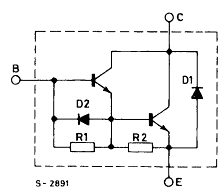
ADVANCE DATA

- HIGH VOLTAGE
- HIGH GAIN
- FAST SWITCHING
- GOOD RBSOA



TO-220

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

The SGSD00055 is a silicon multiepitaxial planar NPN transistor in monolithic Darlington configuration with integrated speed-up diode mounted in TO-220 plastic package. It is a fast switching high voltage device intended for off-line flyback SMPS and monochrome deflection.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	1000	V
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	1000	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	400	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	7	A
I_{CM}	Collector Peak Current (t_p < 1ms)	10	A
I_B	Base Current	3	A
P_{tot}	Total Dissipation at T_c < 25°C	75	W
T_{stg}	Storage Temperature	– 65 to 150	°C
T_j	Max. Operating Junction Temperature	150	°C

This is advanced information on a new product now in development or undergoing evaluation. Details are subject to change without notice.

THERMAL DATA

$R_{thj-case}$	Thermal Resistance Junction-case	max	1.67	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 1000V V_{CE} = 1000V T_c = 125°C			200 2	μA mA
I_{CEX}	Collector Cutoff Current	V_{CE} = 1000V V_{BE} = − 1.5V			200	μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			50	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A V_{CL} = 400V L = 25mH	400			V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50mA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 1.6A I_B = 25mA I_C = 3A I_B = 200mA			2 2.5	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 1.6A I_B = 25mA I_C = 3A I_B = 200mA			2.2 3	V V
t_s t_f	Storage Time Fall Time	V_{CC} = V_{CL} = 350V I_C = 3A V_{BB} = − 5V I_{B1} = 0.2A L_C = 0.9mH		0.8 0.15		μs μs
V_{CEW}	Maximum Collector Emitter Voltage without Snubber	V_{CC} = V_{CL} = 400V I_C = 8A V_{BB} = − 5V I_{B1} = 0.5A L_C = 0.9mH	400			V

* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.

SGSF321/IF321
SGSF421/IF421

FASTSWITCH HOLLOW–EMITTER NPN TRANSISTORS

- HIGH SWITCHING SPEED NPN POWER-TRANSISTORS
- HOLLOW EMITTER TECHNOLOGY
- HIGH VOLTAGE FOR OFF-LINE APPLICATIONS
- 70kHz SWITCHING SPEED
- LOW COST DRIVE CIRCUITS
- LOW DYNAMIC SATURATION

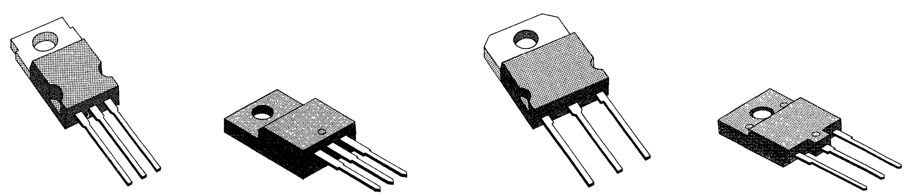
APPLICATIONS

- SMPS

DESCRIPTION

Hollow emitter FASTSWITCH NPN power transistors have been specifically designed for 220V (and 117V with input doubler) off-line switching power supply applications. Hollow emitter transistors can operate up to 70kHz with low cost drive circuits. These devices are suitable for flyback and forward low power converters, 140W to 250W, when normal high voltage peaks associated with single transistor design are limited by a transformer clamp winding or over voltage snubbing at 850V. When used in conjunction with a low voltage Power MOSFET in emitter switch configuration, they can operate at up to 100kHz.

Hollow emitter FASTSWITCH transistors are available in TO-220, TO-218, ISOWATT220 and ISOWATT218 packages. The ISOWATT218 conforms to the creepage distance and isolation requirements of VDE, IEC, and UL specifications.



TO-220 **ISOWATT220** **TO-218** **ISOWATT218**

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	SGS				Unit
		F321	IF321	F421	IF421	
V_{CES}	Collector - Emitter Voltage (V_{BE} = 0)	850				V
V_{CEO}	Collector - Emitter Voltage (I_B = 0)	400				V
V_{EBO}	Emitter - Base Voltage (I_C = 0)	7				V
I_C	Collector Current	5				A
I_{CM}	Collector Peak Current (t_p < 5ms)	10				A
I_B	Base Current	3				A
I_{BM}	Base Peak Current (t_p < 5ms)	6				A
P_{tot}	Total Dissipation at $T_c \leq 25°C$	70	35	80	45	W
T_{stg}	Storage Temperature – 65 to	150	150	150	150	°C
T_j	Junction Temperature	150	150	150	150	°C

THERMAL DATA

		SGS				
		F321	IF321	F421	IF521	
$R_{thj-case}$	Thermal Resistance Junction-case Max	1.78	3.57	1.56	2.78	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 850V			200	µA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 380V V_{CE} = 400V			200 2	µA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO\ (sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.1A	400			V
$V_{CE\ (sat)}$*	Collector Emitter Saturation Voltage	I_C = 3.5A I_B = 0.7A I_C = 2.5A I_B = 0.35A			1.5 1.5	V V
$V_{BE\ (sat)}$*	Base Emitter Saturation Voltage	I_C = 3.5A I_B = 0.7A I_C = 2.5A I_B = 0.35A			1.5 1.5	V V

RESISTIVE LOAD

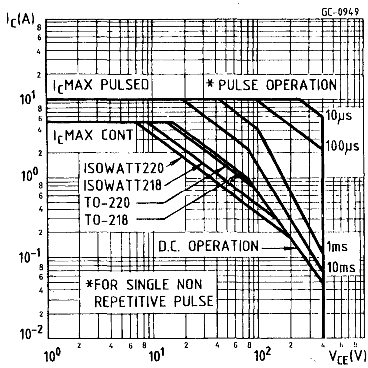
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	I_C = 3.5A V_{CC} = 250V I_{B1} = 0.7A I_{B2} = – 2I_{B1}		0.5	1	µs
t_s	Storage Time			1.5	2.5	µs
t_f	Fall Time			0.18	0.3	µs
t_{on}	Turn-on Time	I_C = 3.5A V_{CC} = 250V I_{B1} = 0.7A I_{B2} = – 2I_{B1} with Antisaturation Network		0.5		µs
t_s	Storage Time			1.1		µs
t_f	Fall Time			0.13		µs
t_{on}	Turn-on Time	I_C = 3.5A V_{CC} = 250V I_{B1} = 0.7A $V_{BE(off)}$ = – 5V		0.5		µs
t_s	Storage Time			1.1		µs
t_f	Fall Time			0.13		µs

INDUCTIVE LOAD

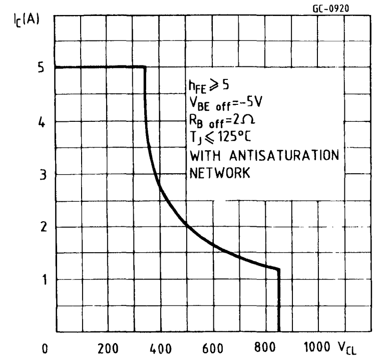
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	I_C = 3.5A h_{FE} = 5 V_{CL} = 350V $V_{BE(off)}$ = – 5V L = 300µH $R_{B(off)}$ = 2Ω		1	2	µs
t_f	Fall Time			0.1	0.2	µs
t_s	Storage Time	I_C = 3.5A h_{FE} = 5 V_{CL} = 350V $V_{BE(off)}$ = – 5V L = 300µH $R_{B(off)}$ = 2Ω T_c = 100°C			3	µs
t_f	Fall Time				0.3	µs

* Pulsed : Pulse duration = 300µs, duty cycle = 1.5%

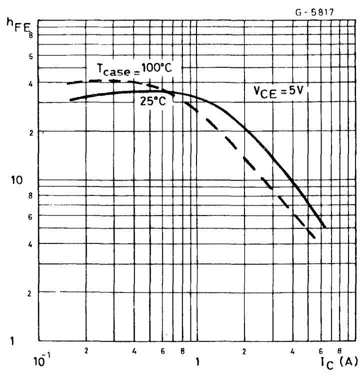
Safe Operating Areas



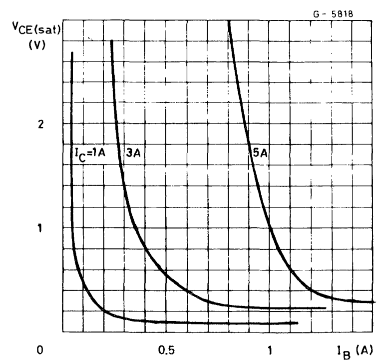
Reverse Biased Safe Operating Area



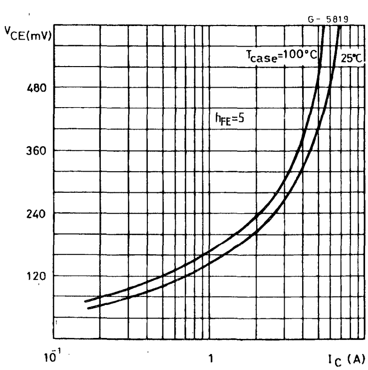
DC Current Gain



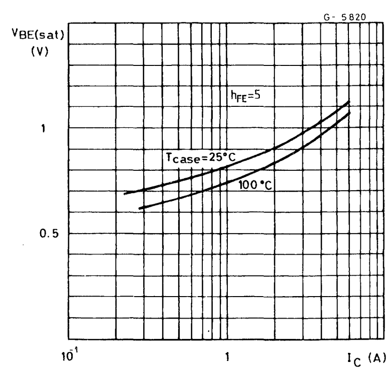
Collector-emitter Saturation Voltage



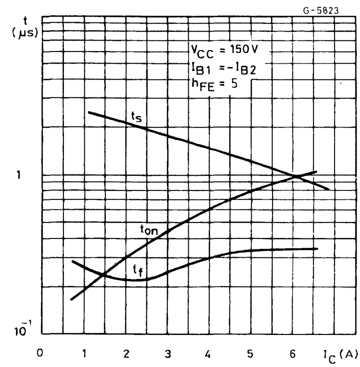
Collector-emitter Saturation Voltage



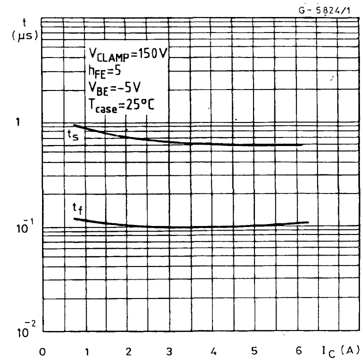
Base-emitter Saturation Voltage



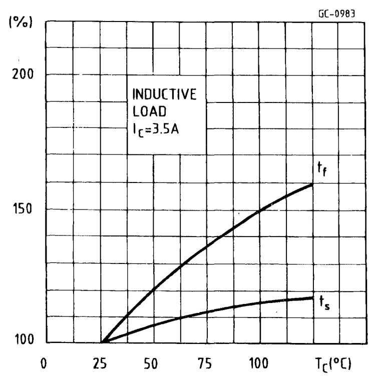
Resistive Load Switching Times



Inductive Load Switching Times



Switching Times Percentance Variation



ISOWATT PACKAGES CHARACTERISTICS AND APPLICATION

The ISOWATT220 and ISOWATT218 are fully isolated packages. The ISOWATT220 is isolated to 2000V dc and the ISOWATT218 to 4000V dc. Their thermal impedence, given in the datasheet, is optimised to give efficient thermal conduction together with excellent electrical isolation.

The structure of the case ensures optimum distances between the pins and heatsink. For the ISOWATT218 these distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 is supplied with longer leads than the standard TO-218 to allow easy mounting on PCB's. The ISOWATT220 and ISOWATT218 packages eliminate the need for external isolation so reducing fixing hardware. Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

The thermal performance of these packages is better than that of the standard part mounted with a 0.1mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for these ISOWATT packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT PACKAGES

Fig. 1 illustrates the elements contributing to the thermal resistance of a transistor heatsink assembly, using ISOWATT packages.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements. The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1 - For a short duration power pulse of less than 1ms :

$$Z_{th} < R_{thJ\text{-}C}$$

2 - For an intermediate power pulse of 5ms to 50ms seconds :

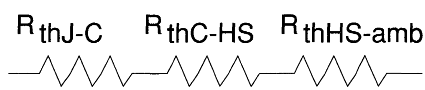
$$Z_{th} = R_{thJ\text{-}C}$$

3 - For long power pulses of the order of 500ms seconds or greater :

$$Z_{th} = R_{thJ\text{-}C} + R_{thC\text{-}HS} + R_{thHS\text{-}amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 1.



SGS-THOMSON MICROELECTRONICS

SGSF323/IF323 SGSF423/IF423

FASTSWITCH HOLLOW–EMITTER NPN TRANSISTORS

- HIGH SWITCHING SPEED NPN POWER TRANSISTORS
- HOLLOW EMITTER TECHNOLOGY
- FOR FAST SWITCHING
- HIGH VOLTAGE FOR OFF-LINE APPLICATIONS
- 70kHz SWITCHING SPEED
- LOW COST DRIVE CIRCUITS
- LOW DYNAMIC SATURATION

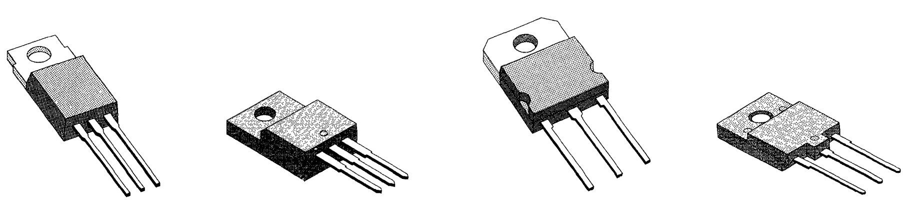
APPLICATIONS

- SMPS

DESCRIPTION

Hollow emitter FASTSWITCH NPN power transistors have been specifically designed for 220V (and 117V with input doubler) off-line switching power supply applications. Hollow emitter transistors can operate up to 70kHz with low cost drive circuits. These devices are suitable for flyback and forward low power converters (100W to 250W) where normal high voltage peaks, associated with single transistor design, are limited by a transformer clamp winding or over voltage snubbing at 1000V. When used in conjunction with a low voltage Power MOSFET in emitter switch configuration, they can operate at up to 100kHz.

Hollow emitter FASTSWITCH transistors are available in TO-220, TO-218, ISOWATT220 and ISOWATT218 packages. The ISOWATT218 conforms to the creepage distance and isolation requirements of VDE, IEC, and UL specifications.



TO-220 **ISOWATT220** **TO-218** **ISOWATT218**

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	SGS				Unit
		F323	IF323	F423	IF423	
V_{CES}	Collector - Emitter Voltage (V_{BE} = 0)	1000				V
V_{CEO}	Collector - Emitter Voltage (I_B = 0)	450				V
V_{EBO}	Emitter - Base Voltage (I_C = 0)	7				V
I_C	Collector Current	5				A
I_{CM}	Collector Peak Current (t_p < 5ms)	10				A
I_B	Base Current	3				A
I_{BM}	Base Peak Current (t_p < 5ms)	6				A
P_{tot}	Total Dissipation at $T_c \leq 25°C$	70	35	80	45	W
T_{stg}	Storage Temperature – 65 to	150	150	150	150	°C
T_j	Junction Temperature	150	150	150	150	°C

THERMAL DATA

		SGS				
		F323	IF323	F423	IF423	
$R_{thj-case}$	Thermal Resistance Junction-case Max	1.78	3.57	1.56	2.78	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 1000V			200	µA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 380V V_{CE} = 450V			200 2	µA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.1A	450			V
$V_{CE(sat)}$*	Collector Emitter Saturation Voltage	I_C = 2.5A I_B = 0.5A I_C = 1.75A I_B = 0.25A			1.5 1.5	V V
$V_{BE(sat)}$*	Base Emitter Saturation Voltage	I_C = 2.5A I_B = 0.5A I_C = 1.75A I_B = 0.25A			1.5 1.5	V V

RESISTIVE LOAD

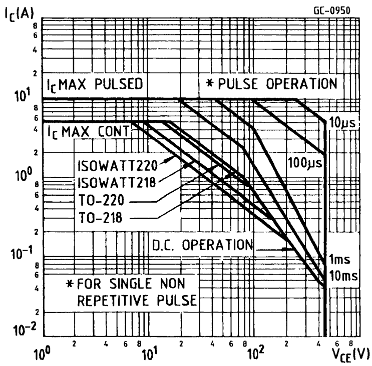
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	I_C = 2.5A V_{CC} = 250V I_{B1} = 0.5A I_{B2} = – $2I_{B1}$		0.5	1	µs
t_s	Storage Time			1.5	2.5	µs
t_f	Fall Time			0.18	0.3	µs
t_{on}	Turn-on Time	I_C = 2.5A V_{CC} = 250V I_{B1} = 0.5A I_{B2} = – $2I_{B1}$ With Antisaturation Network		0.5		µs
t_s	Storage Time			1.1		µs
t_f	Fall Time			0.13		µs
t_{on}	Turn-on Time	I_C = 2.5A V_{CC} = 250V I_{B1} = 0.5A $V_{BE(off)}$ = – 5V		0.5		µs
t_s	Storage Time			1.1		µs
t_f	Fall Time			0.13		µs

INDUCTIVE LOAD

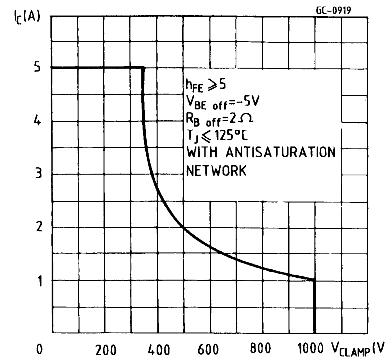
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	I_C = 2.5A h_{FE} = 5 V_{CL} = 350V $V_{BE(off)}$ = – 5V L = 300µH $R_{B(off)}$ = 2Ω		1	2	µs
t_f	Fall Time			0.1	0.2	µs
t_s	Storage Time	I_C = 2.5A V_{CL} = 350V L = 300µH T_c = 100°C h_{FE} = 5 $V_{BE(off)}$ = – 5V $R_{B(off)}$ = 2Ω			3	µs
t_f	Fall Time				0.3	µs

* Pulsed : Pulse duration = 300µs, duty cycle = 1.5%

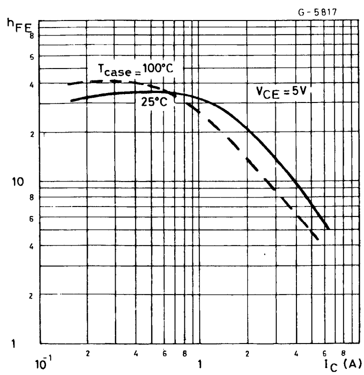
Safe Operating Areas



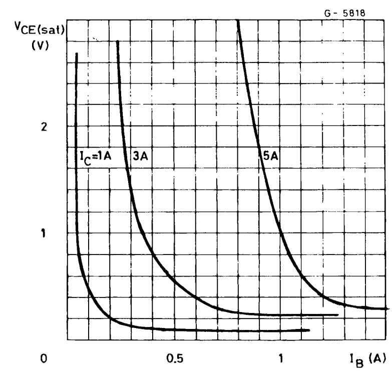
Reverse Biased Safe Operating Area



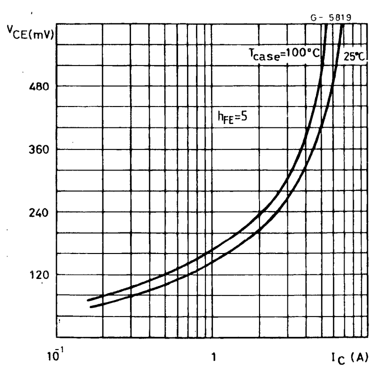
DC Current Gain



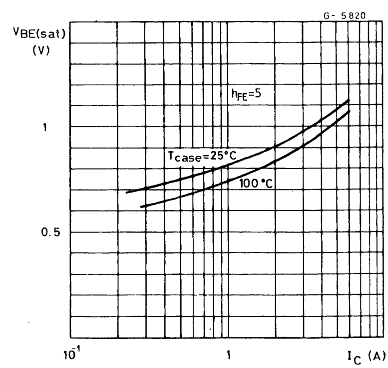
Collector-emitter Saturation Voltage



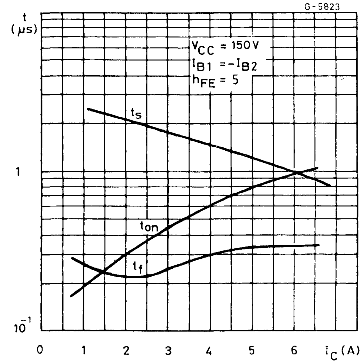
Collector-emitter Saturation Voltage



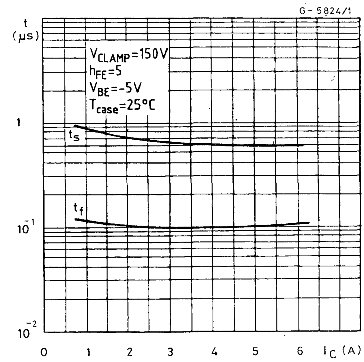
Base-emitter Saturation Voltage



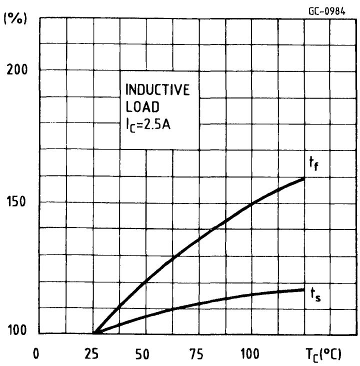
Resistive Load Switching Times



Inductive Load Switching Times



Switching Times Percentance Variation



ISOWATT PACKAGES CHARACTERISTICS AND APPLICATION

The ISOWATT220 and ISOWATT218 are fully isolated packages. The ISOWATT220 is isolated to 2000V dc and the ISOWATT218 to 4000V dc. Their thermal impedence, given in the datasheet, is optimised to give efficient thermal conduction together with excellent electrical isolation.

The structure of the case ensures optimum distances between the pins and heatsink. For the ISOWATT218 these distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 is supplied with longer leads than the standard TO-218 to allow easy mounting on PCB's. The ISOWATT220 and ISOWATT218 packages eliminate the need for external isolation so reducing fixing hardware. Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

The thermal performance of these packages is better than that of the standard part mounted with a 0.1mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for these ISOWATT packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT PACKAGES

Fig. 1 illustrates the elements contributing to the thermal resistance of a transistor heatsink assembly, using ISOWATT packages.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements. The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1 - For a short duration power pulse of less than 1ms :

$$Z_{th} < R_{thJ\text{-}C}$$

2 - For an intermediate power pulse of 5ms to 50ms seconds :

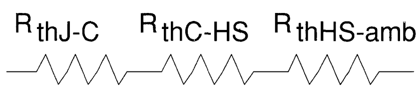
$$Z_{th} = R_{thJ\text{-}C}$$

3 - For long power pulses of the order of 500ms seconds or greater :

$$Z_{th} = R_{thJ\text{-}C} + R_{thC\text{-}HS} + R_{thHS\text{-}amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 1.



SGS-THOMSON MICROELECTRONICS

SGSF324/IF324 SGSF424/IF424

FASTSWITCH HOLLOW–EMITTER NPN TRANSISTORS

- HIGH SWITCHING SPEED NPN POWER TRANSISTORS
- HOLLOW EMITTER TECHNOLOGY
- HIGH VOLTAGE FOR OFF-LINE APPLICATIONS
- 50kHz SWITCHING SPEED
- LOW COST DRIVE CIRCUITS
- LOW DYNAMIC SATURATION

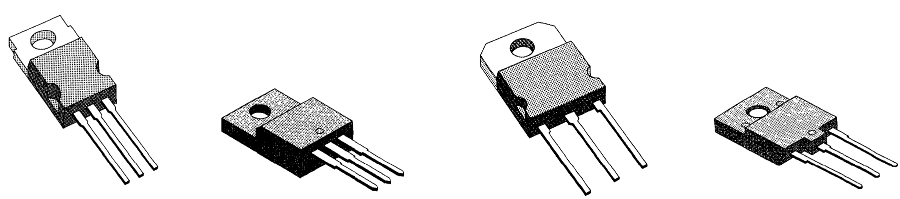
APPLICATIONS

- SMPS
- TV HORIZONTAL DEFLECTION

DESCRIPTION

Hollow emitter FASTSWITCH NPN power transistors have been especially designed for 220V (and 117V with input doubler) off-line switching power supply and colour CRT horizontal deflection applications. High voltage hollow emitter transistors can operate up to 50kHz with low cost drive circuits. These transistors can be used to advantage in off-line switching power supply applications where their high voltage rating is a benefit because a costly transformer clamp winding or over voltage snubbing can be omitted. These transistors are suitable for suitable for application in flyback and forward single transistor low power converters, 70W to 150W. When used in conjunction with a low voltage Power MOSFET in emitter switch configuration in flyback and forward converters, they can operate at up to 100kHz.

These hollow emitter FASTSWITCH transistors are available in TO-220, TO-218, ISOWATT220 and ISOWATT218 packages. The ISOWATT218 conforms to te creepage distance and isolation requirements of VDE, IEC, and UL specifications.



TO-220 **ISOWATT220** **TO-218** **ISOWATT218**

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	SGS F324	SGS IF324	SGS F424	SGS IF424	Unit
V_{CES}	Collector - Emitter Voltage ($V_{BE} = 0$)	1200				V
V_{CEO}	Collector - Emitter Voltage ($I_B = 0$)	600				V
V_{EBO}	Emitter - Base Voltage ($I_C = 0$)	7				V
I_C	Collector Current	4				A
I_{CM}	Collector Peak Current ($t_p < 5ms$)	8				A
I_B	Base Current	3				A
I_{BM}	Base Peak Current ($t_p < 5ms$)	6				A
P_{tot}	Total Dissipation at $T \leq 25°C$	70	35	80	45	W
T_{stg}	Storage Temperature – 65 to	150	150	150	150	°C
T_j	Junction Temperature	150	150	150	150	°C

THERMAL DATA

			SGS				
			F324	IF324	F424	IF424	
$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	1.78	3.57	1.56	2.78	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 1200V			200	μA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 380V V_{CE} = 600V			200 2	μA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.1A	600			V
$V_{CE(sat)}$*	Collector Emitter Saturation Voltage	I_C = 1.75A I_B = 0.35A I_C = 1.25A I_B = 0.18A			1.5 1.5	V V
$V_{BE(sat)}$*	Base Emitter Saturation Voltage	I_C = 1.75A I_B = 0.35A I_C = 1.25A I_B = 0.18A			1.5 1.5	V V

RESISTIVE LOAD

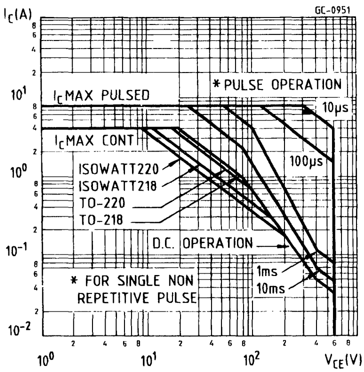
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	I_C = 1.75A V_{CC} = 250V I_{B1} = 0.35A I_{B2} = – 2I_{B1}		0.6	1	μs
t_s	Storage Time			3	4.5	μs
t_f	Fall Time			0.2	0.35	μs
t_{on}	Turn-on Time	I_C = 1.75A V_{CC} = 250V I_{B1} = 0.35A I_{B2} = – 2I_{B1} with Antisaturation Network		0.6		μs
t_s	Storage Time			2		μs
t_f	Fall Time			0.16		μs
t_{on}	Turn-on Time	I_C = 1.75A V_{CC} = 250V I_{B1} = 0.35A $V_{BE(off)}$ = – 5V		0.6		μs
t_s	Storage Time			1		μs
t_f	Fall Time			0.5		μs

INDUCTIVE LOAD

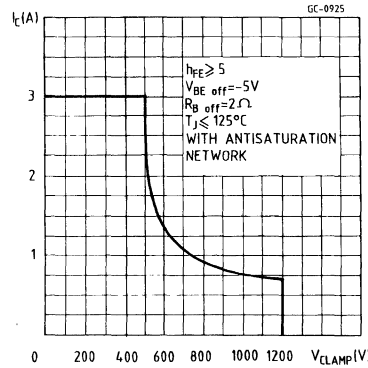
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	I_C = 1.75A h_{FE} = 5 V_{CL} = 450V $V_{BE(off)}$ = – 5V L = 300μH $R_{B(off)}$ = 2Ω		1.2	2.5	μs
t_f	Fall Time			0.1	0.2	μs
t_s	Storage Time	I_C = 1.75A h_{FE} = 5 V_{CL} = 450V $V_{BE(off)}$ = – 5V L = 300μH $R_{B(off)}$ = 2 Ω T_c = 100°C			3.7	μs
t_f	Fall Time				0.3	μs

* Pulsed : Pulse duration = 300μs, duty cycle = 1.5%

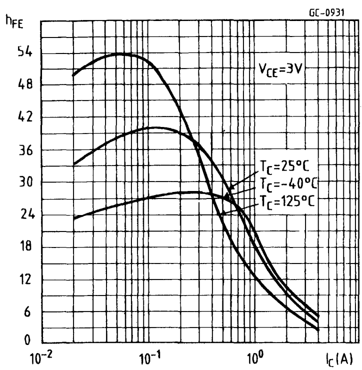
Safe Operating Areas



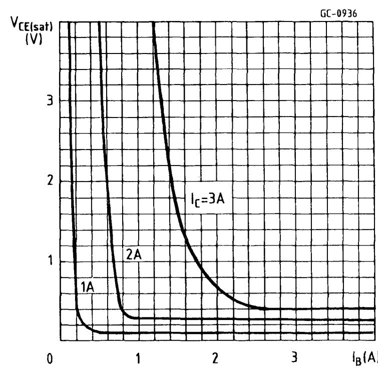
Reverse Biased Safe Operating Area



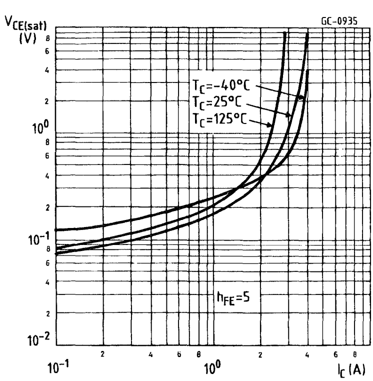
DC Current Gain



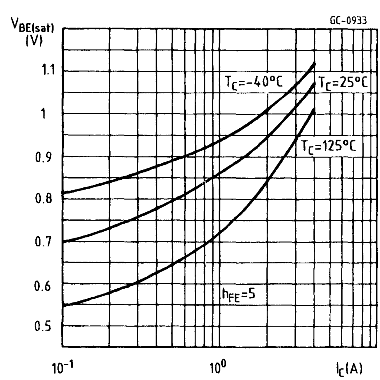
Collector-emitter Saturation Voltage



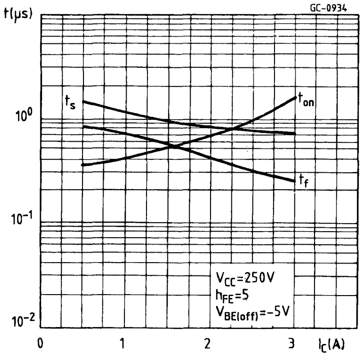
Collector-emitter Saturation Voltage



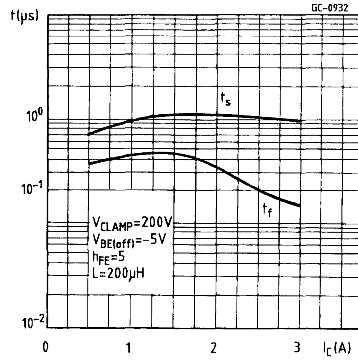
Base-emitter Saturation Voltage



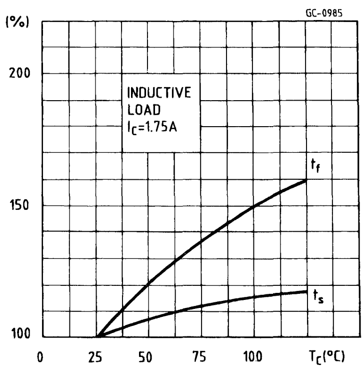
Resistive Load Switching Times



Inductive Load Switching Times



Switching Times Percentance Variation



ISOWATT PACKAGES CHARACTERISTICS AND APPLICATION

The ISOWATT220 and ISOWATT218 are fully isolated packages. The ISOWATT220 is isolated to 2000V dc and the ISOWATT218 to 4000V dc. Their thermal impedence, given in the datasheet, is optimised to give efficient thermal conduction together with excellent electrical isolation.

The structure of the case ensures optimum distances between the pins and heatsink. For the ISOWATT218 these distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 is supplied with longer leads than the standard TO-218 to allow easy mounting on PCB's. The ISOWATT220 and ISOWATT218 packages eliminate the need for external isolation so reducing fixing hardware. Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

The thermal performance of these packages is better than that of the standard part mounted with a 0.1mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for these ISOWATT packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT PACKAGES

Fig. 1 illustrates the elements contributing to the thermal resistance of a transistor heatsink assembly, using ISOWATT packages.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements. The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1 - For a short duration power pulse of less than 1ms :

$$Z_{th} < R_{thJ\text{-}C}$$

2 - For an intermediate power pulse of 5ms to 50ms seconds :

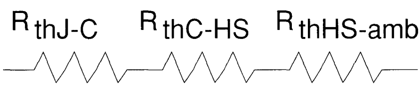
$$Z_{th} = R_{thJ\text{-}C}$$

3 - For long power pulses of the order of 500ms seconds or greater :

$$Z_{th} = R_{thJ\text{-}C} + R_{thC\text{-}HS} + R_{thHS\text{-}amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 1.



FASTSWITCH HOLLOW–EMITTER NPN TRANSISTORS

- HIGH SWITCHING SPEED NPN POWER TRANSISTORS
- HOLLOW EMITTER TECHNOLOGY
- HIGH VOLTAGE FOR OFF-LINE APPLICATIONS
- 50kHz SWITCHING SPEED
- LOW COST DRIVE CIRCUITS
- LOW DYNAMIC SATURATION

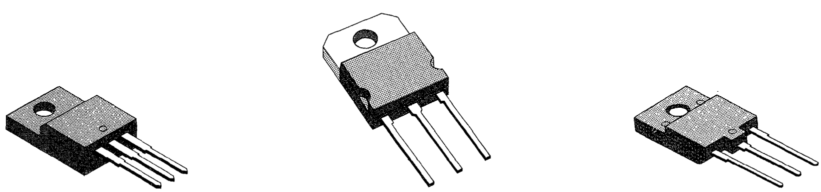
APPLICATIONS

- SMPS
- TV HORIZONTAL DEFLECTION

DESCRIPTION

Hollow emitter FASTSWITCH NPN power transistors are specially designed for 220V (and 117V with input doubler) off-line switching power supply and colour CRT deflection applications. High voltage hollow emitter transistors can operate up to 50kHz with low cost drive circuits. These transistors can be used to advantage in off-line switching power supply applications where their high voltage rating is a benefit because costly transformer clamp windings or over voltage snubbing can be omitted. These transistors are suitable for application in flyback and forward single transistor low power converters, 50W to 100W. When used in conjunction with a Power MOSFET in emitter switch configuration in flyback and forward converters, they can operate at over 100kHz.

These hollow emitter FASTSWITCH transistors are available in TO-218 and fully isolated ISOWATT220 and ISOWATT218 packages. The ISOWATT218 conforms to the creepage distance and isolation requirements of VDE, IEC, and UL specifications.



ISOWATT220 TO-218 ISOWATT218

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	SGS			Unit
		IF325	F425	IF425	
V_{CES}	Collector - Emitter Voltage (V_{BE} = 0)	1300			V
V_{CEO}	Collector - Emitter Voltage (I_B = 0)	600			V
V_{EBO}	Emitter - Base Voltage (I_C = 0)	7			V
I_C	Collector Current	4			A
I_{CM}	Collector Peak Current (t_p < 5ms)	8			A
I_B	Base Current	3			A
I_{BM}	Base Peak Current (t_p < 5ms)	6			A
P_{tot}	Total Dissipation at $T_c \leq 25°C$	35	80	45	W
T_{stg}	Storage Temperature – 65 to	150	150	150	°C
T_j	Junction Temperature	150	150	150	°C

THERMAL DATA

		SGS			
		IF325	F425	IF425	
$R_{thj-case}$	Thermal Resistance Junction-case Max	3.57	1.56	2.78	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 1300V			200	μA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 380V V_{CE} = 600V			200 2	μA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO\ (sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.1A	600			V
$V_{CE\ (sat)}$*	Collector Emitter Saturation Voltage	I_C = 1.25A I_B = 0.25A I_C = 1A I_B = 0.15A			1.5 1.5	V V
$V_{BE\ (sat)}$*	Base Emitter Saturation Voltage	I_C = 1.25A I_B = 0.25A I_C = 1A I_B = 0.15A			1.5 1.5	V V

RESISTIVE LOAD

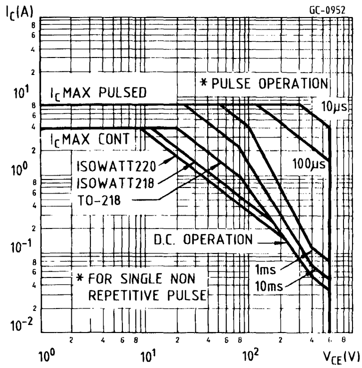
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	I_C = 1.25A V_{CC} = 250V I_{B1} = 0.25A I_{B2} = − 2I_{B1}		0.6	1	μs
t_s	Storage Time			3	4.5	μs
t_f	Fall Time			0.2	0.35	μs
t_{on}	Turn-on Time	I_C = 1.25A V_{CC} = 250V I_{B1} = 0.25A I_{B2} = − 2I_{B1} With Antisaturation Network		0.6		μs
t_s	Storage Time			2		μs
t_f	Fall Time			0.16		μs
t_{on}	Turn-on Time	I_C = 1.25A V_{CC} = 250V I_{B1} = 0.25A $V_{BE(off)}$ = − 5V		0.6		μs
t_s	Storage Time			1		μs
t_f	Fall Time			0.5		μs

INDUCTIVE LOAD

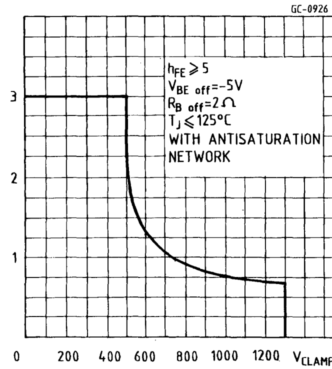
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	I_C = 1.25A h_{FE} = 5 V_{CL} = 450V $V_{BE(off)}$ = − 5V L = 300μH $R_{B(off)}$ = 2Ω		1.2	2.5	μs
t_f	Fall Time			0.1	0.2	μs
t_s	Storage Time	I_C = 1.25A h_{FE} = 5 V_{CL} = 450V $V_{BE(off)}$ = − 5V L = 300μH $R_{B(off)}$ = 2Ω T_c = 100°C			3.7	μs
t_f	Fall Time				0.3	μs

* Pulsed : Pulse duration = 300μs, duty cycle = 1.5%

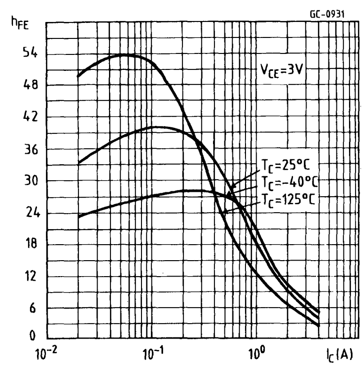
Safe Operating Areas



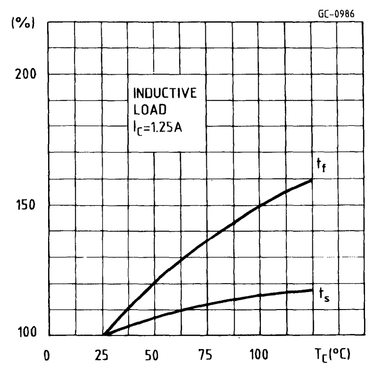
Reverse Biased Safe Operating Area



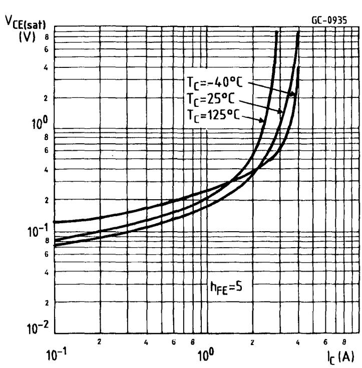
DC Current Gain



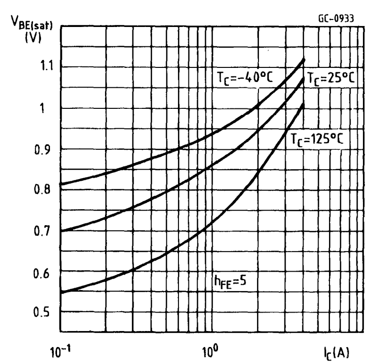
Collector-emitter Saturation Voltage



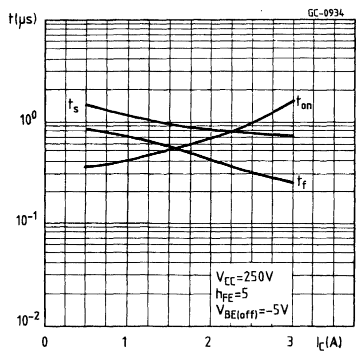
Collector-emitter Saturation Voltage



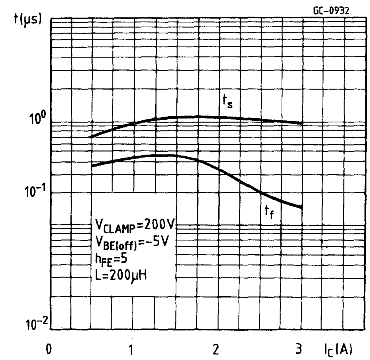
Base-emitter Saturation Voltage



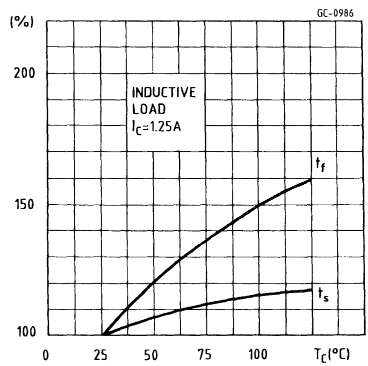
Resistive Load Switching Times



Inductive Load Switching Times



Switching Times Percentance Variation



ISOWATT PACKAGES CHARACTERISTICS AND APPLICATION

The ISOWATT220 and ISOWATT218 are fully isolated packages. The ISOWATT220 is isolated to 2000V dc and the ISOWATT218 to 4000V dc. Their thermal impedance, given in the datasheet, is optimized to give efficient thermal conduction together with excellent electrical isolation.

The structure of the case ensures optimum distances between the pins and heatsink. For the ISOWATT218 these distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 is supplied with longer leads than the standard TO-218 to allow easy mounting on PCB's. The ISOWATT220 and ISOWATT218 packages eliminate the need for external isolation so reducing fixing hardware. Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

The thermal performance of these packages is better than that of the standard part mounted with a 0.1mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for these ISOWATT packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT PACKAGES

Fig. 1 illustrates the elements contributing to the thermal resistance of a transistor heatsink assembly, using ISOWATT packages.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements. The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1 - For a short duration power pulse of less than 1ms :

$$Z_{th} < R_{thJ\text{-}C}$$

2 - For an intermediate power pulse of 5ms to 50ms seconds :

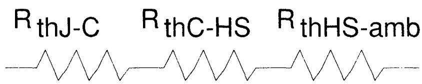
$$Z_{th} = R_{thJ\text{-}C}$$

3 - For long power pulses of the order of 500ms seconds or greater :

$$Z_{th} = R_{thJ\text{-}C} + R_{thC\text{-}HS} + R_{thHS\text{-}amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 1.



SGS-THOMSON MICROELECTRONICS

SGSF341/IF341 SGSF441/IF441/F541

FASTSWITCH HOLLOW–EMITTER NPN TRANSISTORS

- HIGH SWITCHING SPEED NPN POWER TRANSISTORS
- HOLLOW EMITTER FOR FAST SWITCHING
- HIGH VOLTAGE FOR OFF-LINE APPLICATIONS
- 70kHz SWITCHING SPEED
- LOW COST DRIVE CIRCUITS
- LOW DYNAMIC SATURATION

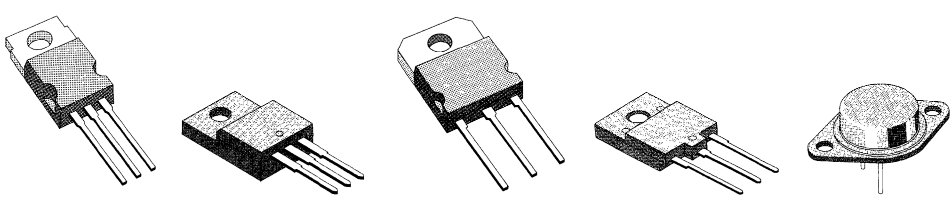
APPLICATIONS

- SMPS

DESCRIPTION

Hollow emitter FASTSWITCH NPN power transistors have been specifically designed for 220V (and 117V with input doubler) off-line switching power supply applications. Hollow emitter transistors can operate up to 70kHz with simple drive circuits which helps to simplify design and improve reliability. These transistors are suitable for applications in bridge and two transistor forward medium power converters, 450W to 900W. When used in conjunction with a low voltage Power MOSFET in emitter switch configuration in flyback and forward converters, they can operate at up to 100kHz.

These hollow emitter FASTSWITCH transistors are available in TO-220, TO-218, ISOWATT220 and ISOWATT218 packages. The ISOWATT218 conforms to the creepage distance and isolation requirements of VDE, IEC, and UL specifications. Additionally these FASTSWITCH transistors are available in metal TO-3 packages.



TO-220 ISOWATT220 TO-218 ISOWATT218 TO-3

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	SGS					Unit
		F341	IF341	F441	IF441	F541	
V_{CES}	Collector - Emitter Voltage (V_{BE} = 0)	850					V
V_{CEO}	Collector - Emitter Voltage (I_B = 0)	400					V
V_{EBO}	Emitter - Base Voltage (I_C = 0)	7					V
I_C	Collector Current	10					A
I_{CM}	Collector Peak Current (t_p < 5ms)	15					A
I_B	Base Current	6					A
I_{BM}	Base Peak Current (t_p < 5ms)	10					A
P_{tot}	Total Dissipation at $T_c \leq 25°C$	85	40	95	55	115	W
T_{stg}	Storage Temperature – 65 to	150	150	150	150	175	°C
T_j	Junction Temperature	150	150	150	150	175	°C

THERMAL DATA

		SGS					
		F341	IF341	F441	IF441	F541	
$R_{thj-case}$	Thermal Resistance Junction-case Max	1.47	3.12	1.31	2.27	1.3	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 850V			200	µA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 380V V_{CE} = 400V			200 2	µA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO\ (sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.1A	400			V
$V_{CE\ (sat)}$*	Collector Emitter Saturation Voltage	I_C = 6A I_B = 1.2A I_C = 4A I_B = 0.6A			1.5 1.5	V V
$V_{BE\ (sat)}$*	Base Emitter Saturation Voltage	I_C = 6A I_B = 1.2A I_C = 4A I_B = 0.6A			1.5 1.5	V V

RESISTIVE LOAD

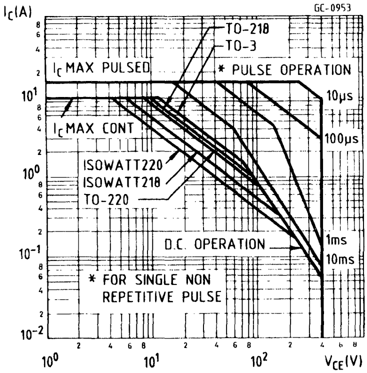
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	I_C = 6A V_{CC} = 250V I_{B1} = 1.2A I_{B2} = – 2I_{B1}		0.5	1	µs
t_s	Storage Time			1.6	2.5	µs
t_f	Fall Time			0.25	0.35	µs
t_{on}	Turn-on Time	I_C = 6A V_{CC} = 250V I_{B1} = 1.2A I_{B2} = – 2I_{B1} with Antisaturation Network		0.5		µs
t_s	Storage Time			1.1		µs
t_f	Fall Time			0.2		µs
t_{on}	Turn-on Time	I_C = 6A V_{CC} = 250V I_{B1} = 1.2A $V_{BE(off)}$ = – 5V		0.5		µs
t_s	Storage Time			1.4		µs
t_f	Fall Time			0.1		µs

INDUCTIVE LOAD

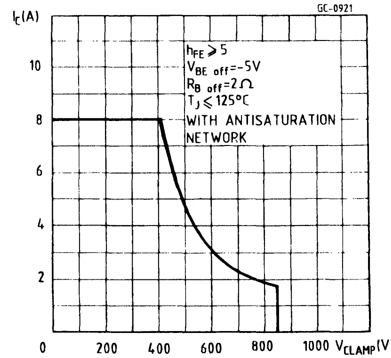
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	I_C = 6A h_{FE} = 5 V_{CL} = 350V $V_{BE(off)}$ = – 5V L = 300µH $R_{B(off)}$ = 1.2Ω		1.4	2.8	µs
t_f	Fall Time			0.1	0.2	µs
t_s	Storage Time	I_C = 6A h_{FE} = 5 V_{CL} = 350V $V_{BE(off)}$ = – 5V L = 300µH $R_{B(off)}$ = 1.2Ω T_c = 100°C			4	µs
t_f	Fall Time				0.3	µs

* Pulsed : Pulse duration = 300µs, duty cycle = 1.5%

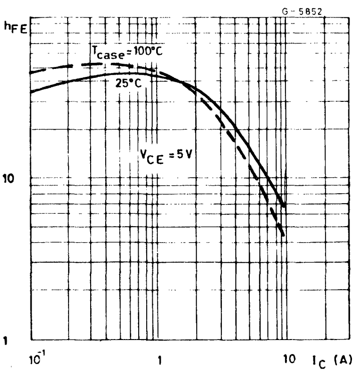
Safe Operating Areas



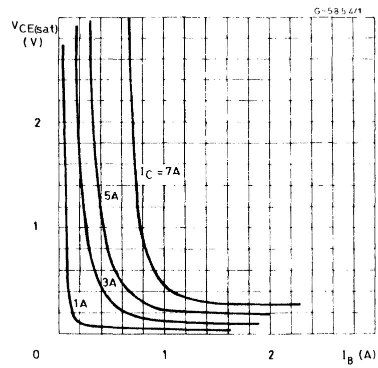
Reverse Biased Safe Operating Area



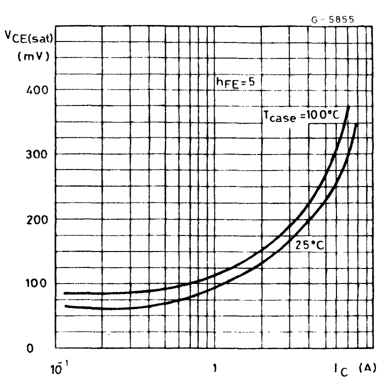
DC Current Gain



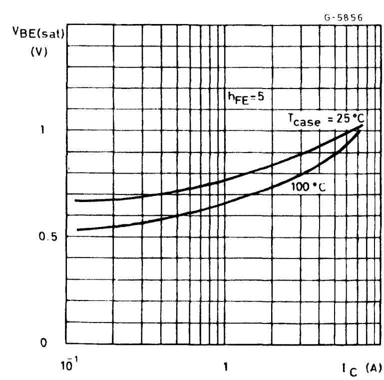
Collector-emitter Saturation Voltage



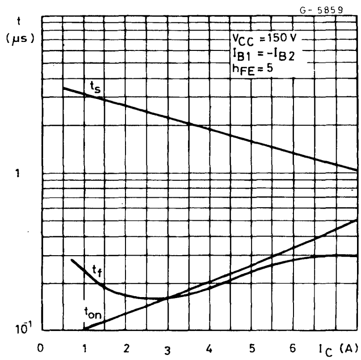
Collector-emitter Saturation Voltage



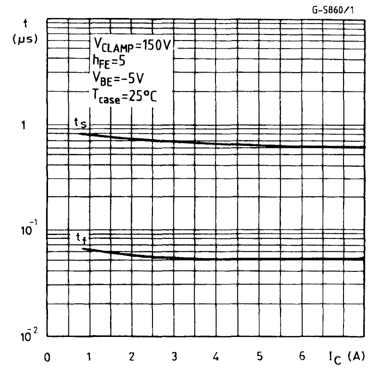
Base-emitter Saturation Voltage



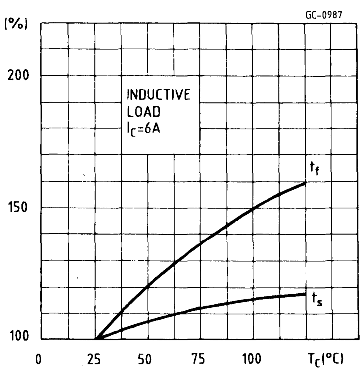
Resistive Load Switching Times



Inductive Load Switching Times



Switching Times Percentance Variation



ISOWATT PACKAGES CHARACTERISTICS AND APPLICATION

The ISOWATT220 and ISOWATT218 are fully isolated packages. The ISOWATT220 is isolated to 2000V dc and the ISOWATT218 to 4000V dc. Their thermal impedence, given in the datasheet, is optimised to give efficient thermal conduction together with excellent electrical isolation.

The structure of the case ensures optimum distances between the pins and heatsink. For the ISOWATT218 these distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 is supplied with longer leads than the standard TO-218 to allow easy mounting on PCB's. The ISOWATT220 and ISOWATT218 packages eliminate the need for external isolation so reducing fixing hardware. Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

The thermal performance of these packages is better than that of the standard part mounted with a 0.1mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for these ISOWATT packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT PACKAGES

Fig. 1 illustrates the elements contributing to the thermal resistance of a transistor heatsink assembly, using ISOWATT packages.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements. The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1 - For a short duration power pulse of less than 1ms :

$$Z_{th} < R_{thJ-C}$$

2 - For an intermediate power pulse of 5ms to 50ms seconds :

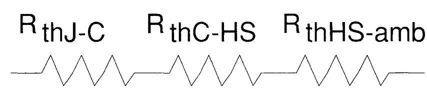
$$Z_{th} = R_{thJ-C}$$

3 - For long power pulses of the order of 500ms seconds or greater :

$$Z_{th} = R_{thJ-C} + R_{thC-HS} + R_{thHS-amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 1.



SGS-THOMSON
MICROELECTRONICS

SGSF343/IF343
SGSF443/IF443/F543

FASTSWITCH HOLLOW–EMITTER NPN TRANSISTORS

- HIGH SWITCHING SPEED NPN POWER TRANSISTORS
- HOLLOW EMITTER TECHNOLOGY
- HIGH VOLTAGE FOR OFF-LINE APPLICATIONS
- 70kHz SWITCHING SPEED
- LOW COST DRIVE CIRCUITS
- LOW DYNAMIC SATURATION

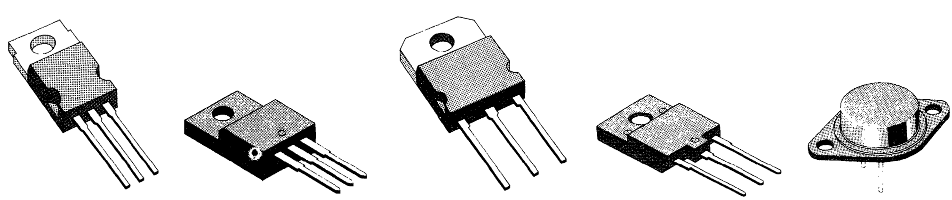
APPLICATIONS

- SMPS

DESCRIPTION

Hollow emitter FASTSWITCH NPN power transistors have been specifically designed for 220V (and 117V with input doubler) off-line switching power supply applications. Hollow emitter transistors can operate up to 70kHz with snubber drive circuits which helps to simplify designs and improve reliability. The high voltage rating of these transistors allows simplification of the over voltage snubbing network. These transistors are suitable for application in half bridge and full bridge medium power converters, 350W to 700W. When used in conjuction with a low voltage Power MOSFET in emitter switch configuration they can operate at up to 100kHz.

These hollow emitter FASTSWITCH transistors are available in TO-220, TO-218, ISOWATT220 and ISOWATT218 packages. The ISOWATT218 conforms to the creepage distance and isolation requirements of VDE, IEC, and UL specifications. Additionally these FASTSWITCH transistors are available in metal TO-3 packages.



TO-220 **ISOWATT220** **TO-218** **ISOWATT218** **TO-3**

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	SGS F343	SGS IF343	SGS F443	SGS IF443	SGS F543	Unit
V_{CES}	Collector - Emitter Voltage (V_{BE} = 0)	1000					V
V_{CEO}	Collector - Emitter Voltage (I_B = 0)	450					V
V_{EBO}	Emitter - Base Voltage (I_C = 0)	7					V
I_C	Collector Current	8					A
I_{CM}	Collector Peak Current (t_p < 5ms)	15					A
I_B	Base Current	5					A
I_{BM}	Base Peak Current (t_p < 5ms)	8					A
P_{tot}	Total Dissipation at $T_c \leq 25°C$	85	40	95	55	115	W
T_{stg}	Storage Temperature – 65 to	150	150	150	150	175	°C
T_j	Junction Temperature	150	150	150	150	175	°C

THERMAL DATA

		SGS					
		F343	IF343	F443	IF443	F453	
$R_{thj\text{-}case}$	Thermal Resistance Junction-case Max	1.47	3.12	1.31	2.27	1.3	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 1000V			200	μA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 380V V_{CE} = 450V			200 2	μA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO\,(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.1A	450			V
$V_{CE\,(sat)}$*	Collector Emitter Saturation Voltage	I_C = 4.5A I_B = 0.9A I_C = 3A I_B = 0.45A			1.5 1.5	V V
$V_{BE\,(sat)}$*	Base Emitter Saturation Voltage	I_C = 4.5A I_B = 0.9A I_C = 3A I_B = 0.45A			1.5 1.5	V V

RESISTIVE LOAD

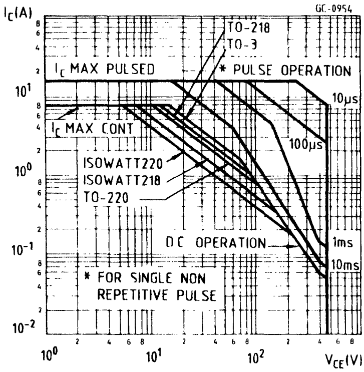
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	I_C = 4.5A V_{CC} = 250V I_{B1} = 0.9A I_{B2} = – 2 I_{B1}		0.5	1	μs
t_s	Storage Time			1.6	2.5	μs
t_f	Fall Time			0.25	0.35	μs
t_{on}	Turn-on Time	I_C = 4.5A V_{CC} = 250V I_{B1} = 0.9A I_{B2} = – 2 I_{B1} With Antisaturation Network		0.5		μs
t_s	Storage Time			1.1		μs
t_f	Fall Time			0.2		μs
t_{on}	Turn-on Time	I_C = 4.5A V_{CC} = 250V I_{B1} = 0.9A $V_{BE(off)}$ = – 5V		0.5		μs
t_s	Storage Time			1.4		μs
t_f	Fall Time			0.1		μs

INDUCTIVE LOAD

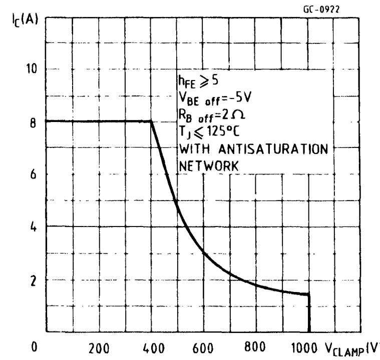
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	I_C = 4.5A h_{FE} = 5 V_{CL} = 350V $V_{BE(off)}$ = – 5V L = 300μH $R_{B(off)}$ = 1.2Ω		1.4	2.8	μs
t_f	Fall Time			0.1	0.2	μs
t_s	Storage Time	I_C = 4.5A h_{FE} = 5 V_{CL} = 350V $V_{BE(off)}$ = – 5V L = 300μH $R_{B(off)}$ = 1.2Ω T_C = 100°C			4	μs
t_f	Fall Time				0.3	μs

* Pulsed : Pulse duration = 300μs, duty cycle = 1.5%

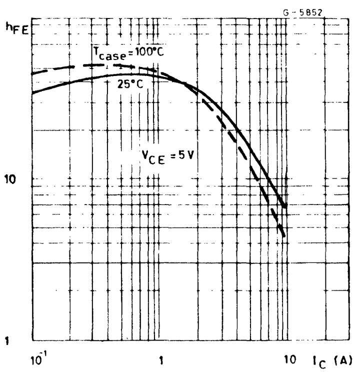
Safe Operating Areas



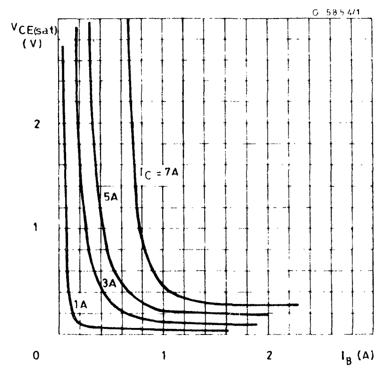
Reverse Biased Safe Operating Area



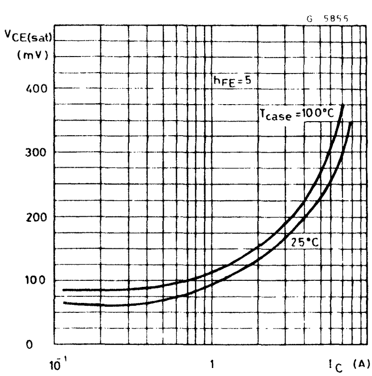
DC Current Gain



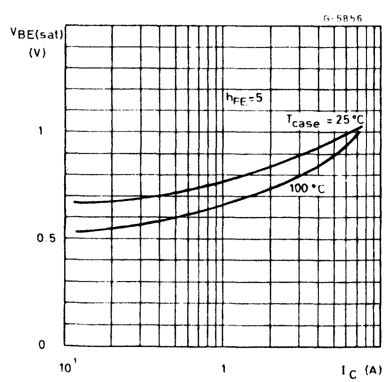
Collector-emitter Saturation Voltage



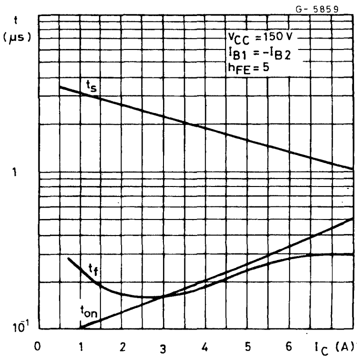
Collector-emitter Saturation Voltage



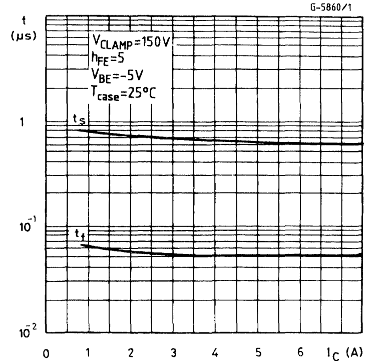
Base-emitter Saturation Voltage



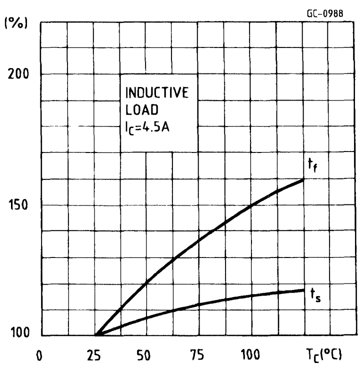
Resistive Load Switching Times



Inductive Load Switching Times



Switching Times Percentance Variation



ISOWATT PACKAGES CHARACTERISTICS AND APPLICATION

The ISOWATT220 and ISOWATT218 are fully isolated packages. The ISOWATT220 is isolated to 2000V dc and the ISOWATT218 to 4000V dc. Their thermal impedence, given in the datasheet, is optimised to give efficient thermal conduction together with excellent electrical isolation.

The structure of the case ensures optimum distances between the pins and heatsink. For the ISOWATT218 these distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 is supplied with longer leads than the standard TO-218 to allow easy mounting on PCB's. The ISOWATT220 and ISOWATT218 packages eliminate the need for external isolation so reducing fixing hardware. Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

The thermal performance of these packages is better than that of the standard part mounted with a 0.1mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for these ISOWATT packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT PACKAGES

Fig. 1 illustrates the elements contributing to the thermal resistance of a transistor heatsink assembly, using ISOWATT packages.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements. The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1 - For a short duration power pulse of less than 1ms :

$$Z_{th} < R_{thJ\text{-}C}$$

2 - For an intermediate power pulse of 5ms to 50ms seconds :

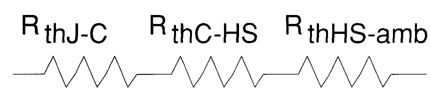
$$Z_{th} = R_{thJ\text{-}C}$$

3 - For long power pulses of the order of 500ms seconds or greater :

$$Z_{th} = R_{thJ\text{-}C} + R_{thC\text{-}HS} + R_{thHS\text{-}amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 1.



SGS-THOMSON
MICROELECTRONICS

SGSF344/IF344
SGSF444/IF444/F544

FASTSWITCH HOLLOW–EMITTER NPN TRANSISTORS

- HIGH SWITCHING SPEED NPN POWER TRANSISTORS
- HOLLOW EMITTER TECHNOLOGY
- HIGH VOLTAGE FOR OFF-LINE APPLICATIONS
- 50kHz SWITCHING SPEED
- LOW COST DRIVE CIRCUITS
- LOW DYNAMIC SATURATION

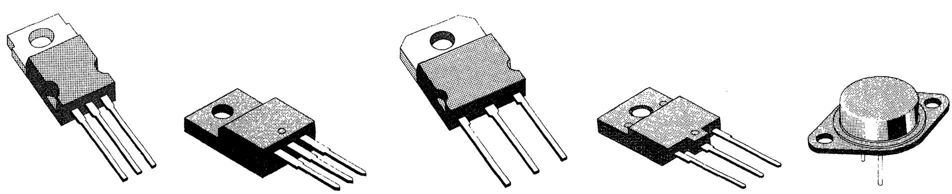
APPLICATIONS

- SMPS
- TV HORIZONTAL DEFLECTION

DESCRIPTION

Hollow emitter FASTSWITCH NPN power transistors are specially designed for 220V (and 117V with input doubler) off-line switching power supply and colour CRT deflection applications. Hollow emitter transistors can operate up to 50kHz with simple drive circuits which helps to simplify design and improve reliability. These transistors are suitable for application in flyback and forward low power converters, 140W to 250W. The high voltage rating of hollow emitter transistors can be used to advantage because a costly transformer clamp winding or over voltage snubbers can be omitted. When used in conjunction with a low voltage Power MOSFET in emitter switch configuration in flyback and forward converters, they can operate at up to 100kHz.

These hollow emitter FASTSWITCH transistors are available in TO-220, TO-218, ISOWATT220 and ISOWATT218 packages. The ISOWATT218 conforms to the creepage distance and isolation requirements of VDE, IEC, and UL specifications. Additionally these FASTSWITCH transistors are available in metal TO-3 packages.



TO-220 ISOWATT220 TO-218 ISOWATT218 TO-3

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	SGS					Unit
		F344	IF344	F444	IF444	F544	
V_{CES}	Collector - Emitter Voltage ($V_{BE} = 0$)	1200					V
V_{CEO}	Collector - Emitter Voltage ($I_B = 0$)	600					V
V_{EBO}	Emitter - Base Voltage ($I_C = 0$)	7					V
I_C	Collector Current	7					A
I_{CM}	Collector Peak Current ($t_p < 5ms$)	12					A
I_B	Base Current	5					A
I_{BM}	Base Peak Current ($t_p < 5ms$)	8					A
P_{tot}	Total Dissipation at $T_c \leq 25°C$	85	40	95	55	115	W
T_{stg}	Storage Temperature – 65 to	150	150	150	150	175	°C
T_j	Junction Temperature	150	150	150	150	175	°C

THERMAL DATA

		SGS					
		F344	IF344	F444	IF444	F544	
$R_{thj\text{-}case}$	Thermal Resistance Junction-case Max	1.47	3.12	1.31	2.27	1.3	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 1200V			200	μA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 380V V_{CE} = 600V			200 2	μA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO\,(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.1A	600			V
$V_{CE\,(sat)}$*	Collector Emitter Saturation Voltage	I_C = 3.5A I_B = 0.7A I_C = 2.5A I_B = 0.35A			1.5 1.5	V V
$V_{BE\,(sat)}$*	Base Emitter Saturation Voltage	I_C = 3.5A I_B = 0.7A I_C = 2.5A I_B = 0.35A			1.5 1.5	V V

RESISTIVE LOAD

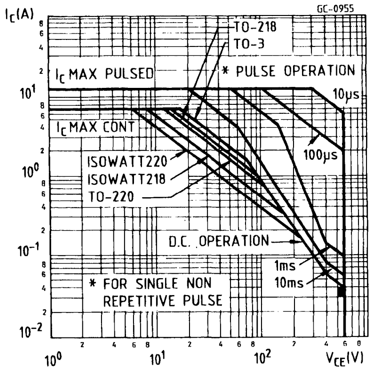
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	I_C = 3.5A V_{CC} = 250V I_{B1} = 0.7A I_{B2} = – 2I_{B1}		0.7	1.2	μs
t_s	Storage Time			2.2	3.5	μs
t_f	Fall Time			0.18	0.3	μs
t_{on}	Turn-on Time	I_C = 3.5A V_{CC} = 250V I_{B1} = 0.7A I_{B2} = – 2I_{B1} with Antisaturation Network		0.7		μs
t_s	Storage Time			1.5		μs
t_f	Fall Time			0.2		μs
t_{on}	Turn-on Time	I_C = 3.5A V_{CC} = 250V I_{B1} = 0.7A $V_{BE(off)}$ = – 5V		0.7		μs
t_s	Storage Time			1		μs
t_f	Fall Time			0.2		μs

INDUCTIVE LOAD

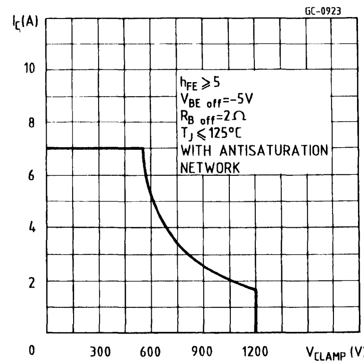
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	I_C = 3.5A h_{FE} = 5 V_{CL} = 450V $V_{BE(off)}$ = – 5V L = 300μH $R_{B(off)}$ = 1.2Ω		1.4	2.8	μs
t_f	Fall Time			0.1	0.2	μs
t_s	Storage Time	I_C = 3.5A h_{FE} = 5 V_{CL} = 450V $V_{BE(off)}$ = – 5V L = 300μH $R_{B(off)}$ = 1.2Ω T_c = 100°C			4	μs
t_f	Fall Time				0.3	μs

* Pulsed : Pulse duration = 300μs, duty cycle = 1.5%

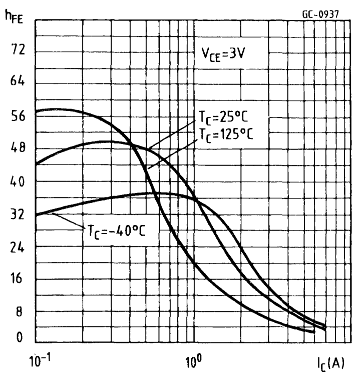
Safe Operating Areas



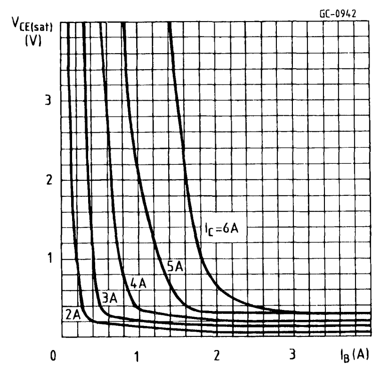
Reverse Biased Safe Operating Area



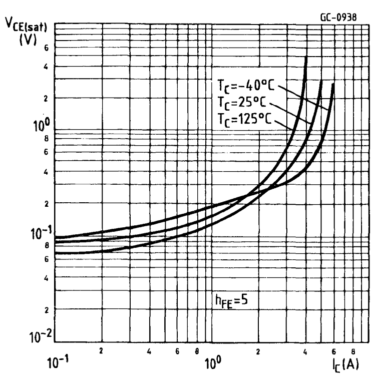
DC Current Gain



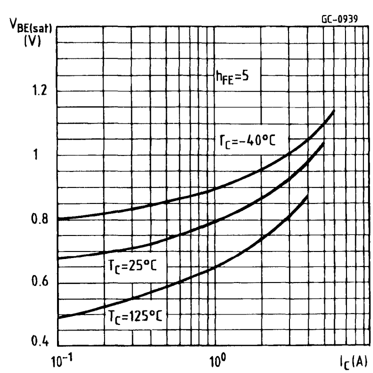
Collector-emitter Saturation Voltage



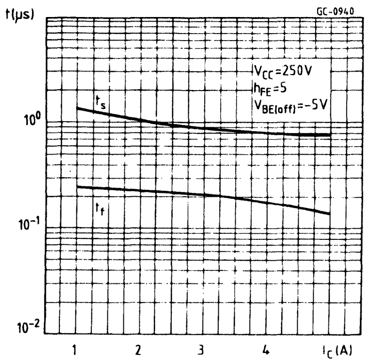
Collector-emitter Saturation Voltage



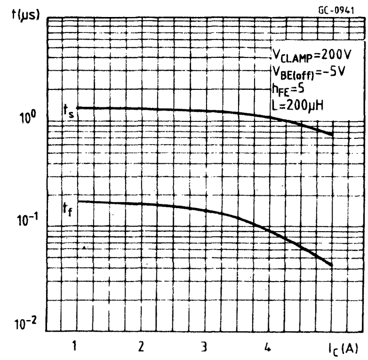
Base-emitter Saturation Voltage



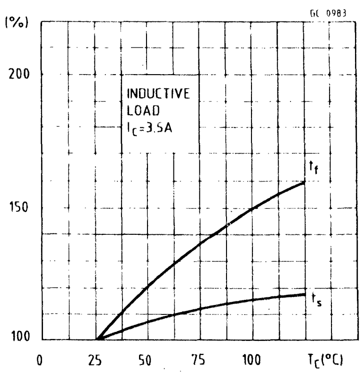
Resistive Load Switching Times



Inductive Load Switching Times



Switching Times Percentance Variation



ISOWATT PACKAGES CHARACTERISTICS AND APPLICATION

The ISOWATT220 and ISOWATT218 are fully isolated packages. The ISOWATT220 is isolated to 2000V dc and the ISOWATT218 to 4000V dc. Their thermal impedance, given in the datasheet, is optimised to give efficient thermal conduction together with excellent electrical isolation.

The structure of the case ensures optimum distances between the pins and heatsink. For the ISOWATT218 these distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 is supplied with longer leads than the standard TO-218 to allow easy mounting on PCB's. The ISOWATT220 and ISOWATT218 packages eliminate the need for external isolation so reducing fixing hardware. Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

The thermal performance of these packages is better than that of the standard part mounted with a 0.1mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for these ISOWATT packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT PACKAGES

Fig. 1 illustrates the elements contributing to the thermal resistance of a transistor heatsink assembly, using ISOWATT packages.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements. The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1 - For a short duration power pulse of less than 1ms :

$$Z_{th} < R_{thJ\text{-}C}$$

2 - For an intermediate power pulse of 5ms to 50ms seconds :

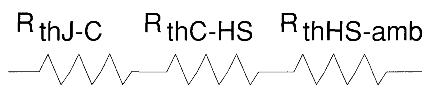
$$Z_{th} = R_{thJ\text{-}C}$$

3 - For long power pulses of the order of 500ms seconds or greater :

$$Z_{th} = R_{thJ\text{-}C} + R_{thC\text{-}HS} + R_{thHS\text{-}amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 1.



SGS-THOMSON MICROELECTRONICS

SGSIF345/F445
SGSIF445/F545

FASTSWITCH HOLLOW–EMITTER NPN TRANSISTORS

- HIGH SWITCHING SPEED NPN POWER TRANSISTORS
- HOLLOW EMITTER TECHNOLOGY
- HIGH VOLTAGE FOR OFF-LINE APPLICATIONS
- 50kHz SWITCHING SPEED
- LOW COST DRIVE CIRCUITS
- LOW DYNAMIC SATURATION

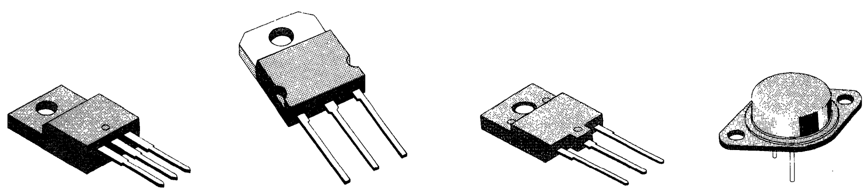
APPLICATIONS

- SMPS
- TV HORIZONTAL DEFLECTION

DESCRIPTION

Hollow emitter FASTSWITCH NPN power transistors are specially designed for 220V (and 117V with input doubler) off-line switching power supply and colour CRT deflection applications. High voltage hollow emitter transistors can operate up to 50kHz with simple drive circuits which helps to simplify design and improve reliability. These transistors are suitable for application in flyback and forward low power converters, 120W to 240W. Their high voltage rating can be used to advantage as it allows a costly transformer clamp winding or over voltage snubbers to be omitted. When used in conjuction with a low Power MOSFET in emitter switch configuration, they can operate at over 100kHz.

These hollow emitter FASTSWITCH transistors are available in TO-218, and fully isolated ISOWATT220 and ISOWATT218 packages. The ISOWATT218 conforms to the creepage distance and isolation requirements of VDE, IEC, and UL specifications. Additionally these FASTSWITCH transistors are available in metal TO-3 packages.



ISOWATT220 TO-218 ISOWATT218 TO-3

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	SGS IF345	SGS F445	SGS IF445	SGS F545	Unit
V_{CES}	Collector - Emitter Voltage (V_{BE} = 0)	1300				V
V_{CEO}	Collector - Emitter Voltage (I_B = 0)	600				V
V_{EBO}	Emitter - Base Voltage (I_C = 0)	7				V
I_C	Collector Current	7				A
I_{CM}	Collector Peak Current (t_p < 5ms)	12				A
I_B	Base Current	5				A
I_{BM}	Base Peak Current (t_p < 5ms)	8				A
P_{tot}	Total Dissipation at $T_c \leq 25°C$	40	95	55	115	W
T_{stg}	Storage Temperature – 65 to	150	150	150	175	°C
T_j	Junction Temperature	150	150	150	175	°C

THERMAL DATA

		SGS				
		IF345	F445	IF445	F545	
$R_{thj\text{-}case}$	Thermal Resistance Junction-case Max	3.12	1.31	2.27	1.3	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 1300V			200	μA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 380V V_{CE} = 600V			200 2	μA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO\,(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.1A	600			V
$V_{CE\,(sat)}$*	Collector Emitter Saturation Voltage	I_C = 3A I_B = 0.6A I_C = 2A I_B = 0.3A			1.5 1.5	V V
$V_{BE\,(sat)}$*	Base Emitter Saturation Voltage	I_C = 3A I_B = 0.6A I_C = 2A I_B = 0.3A			1.5 1.5	V V

RESISTIVE LOAD

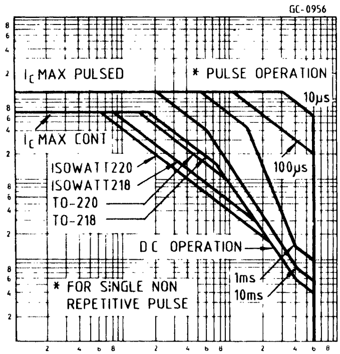
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	I_C = 3A V_{CC} = 250V I_{B1} = 0.6A I_{B2} = – 2I_{B1}		0.7	1.2	μs
t_s	Storage Time			2.2	3.5	μs
t_f	Fall Time			0.18	0.3	μs
t_{on}	Turn-on Time	I_C = 3A V_{CC} = 250V I_{B1} = 0.6A I_{B2} = – 2I_{B1} With Antisaturation Network		0.7		μs
t_s	Storage Time			1.5		μs
t_f	Fall Time			0.2		μs
t_{on}	Turn-on Time	I_C = 3A V_{CC} = 250V I_{B1} = 0.6A $V_{BE(off)}$ = – 5V		0.7		μs
t_s	Storage Time			1		μs
t_f	Fall Time			0.2		μs

INDUCTIVE LOAD

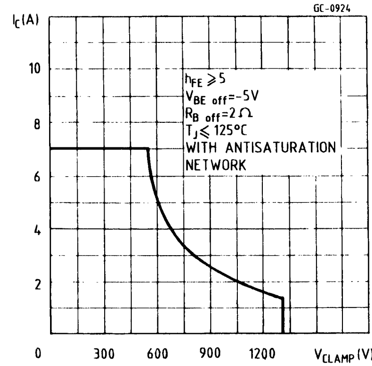
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	I_C = 3A h_{FE} = 5 V_{CL} = 450V $V_{BE(off)}$ = – 5V L = 300μH $R_{B(off)}$ = 1.2Ω		1.4	2.8	μs
t_f	Fall Time			0.1	0.2	μs
t_s	Storage Time	I_C = 3A h_{FE} = 5 V_{CL} = 450V $V_{BE(off)}$ = – 5V L = 300μH $R_{B(off)}$ = 1.2Ω T_c = 100°C			4	μs
t_f	Fall Time				0.3	μs

* Pulsed : Pulse duration = 300μs, duty cycle = 1.5%

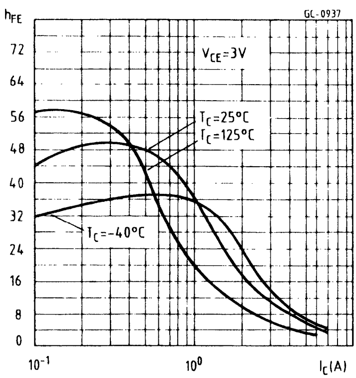
Safe Operating Areas



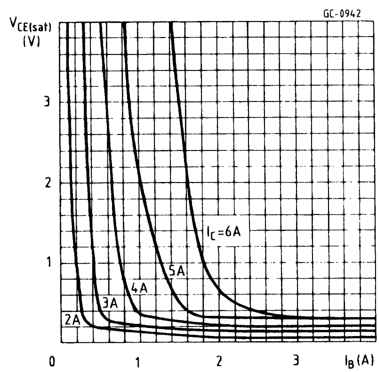
Reverse Biased Safe Operating Area



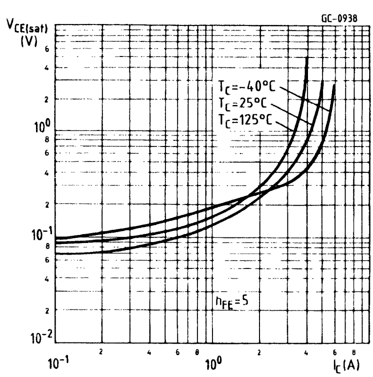
DC Current Gain



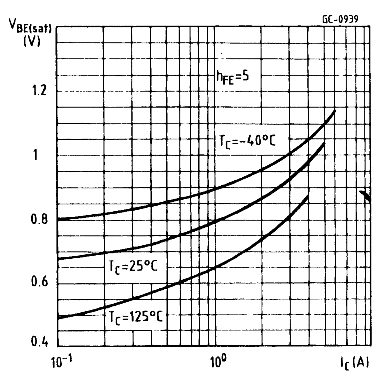
Collector-emitter Saturation Voltage



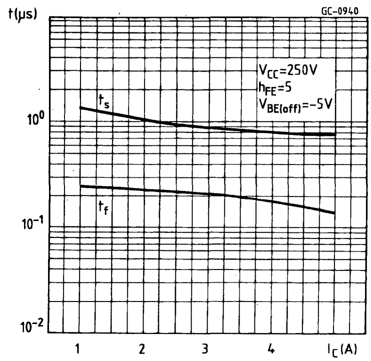
Collector-emitter Saturation Voltage



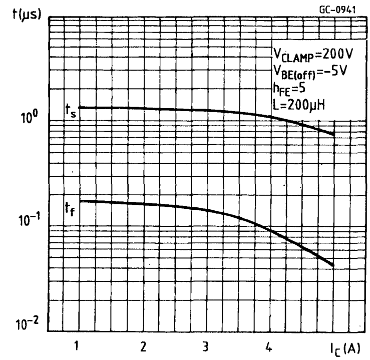
Base-emitter Saturation Voltage



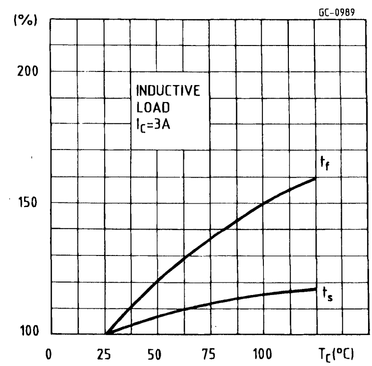
Resistive Load Switching Times



Inductive Load Switching Times



Switching Times Percentance Variation



ISOWATT PACKAGES CHARACTERISTICS AND APPLICATION

The ISOWATT220 and ISOWATT218 are fully isolated packages. The ISOWATT220 is isolated to 2000V dc and the ISOWATT218 to 4000V dc. Their thermal impedence, given in the datasheet, is optimised to give efficient thermal conduction together with excellent electrical isolation.

The structure of the case ensures optimum ditances between the pins and heatsink. For the ISOWATT218 these distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 is supplied with longer leads than the standard TO-218 to allow easy mounting on PCB's. The ISOWATT220 and ISOWATT218 packages eliminate the need for external isolation so reducing fixing hardware. Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

The thermal performance of these packages is better than that of the standard part mounted with a 0.1mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for these ISOWATT packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT PACKAGES

Fig. 1 illustrates the elements contributing to the thermal resistance of a transistor heatsink assembly, using ISOWATT packages.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements. The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1 - For a short duration power pulse of less than 1ms :

$$Z_{th} < R_{thJ\text{-}C}$$

2 - For an intermediate power pulse of 5ms to 50ms seconds :

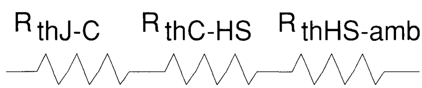
$$Z_{th} = R_{thJ\text{-}C}$$

3 - For long power pulses of the order of 500ms seconds or greater :

$$Z_{th} = R_{thJ\text{-}C} + R_{thC\text{-}HS} + R_{thHS\text{-}amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 1.



SGS-THOMSON
MICROELECTRONICS

SGSF461
SGSIF461/F561

FASTSWITCH HOLLOW–EMITTER NPN TRANSISTORS

- HIGH SWITCHING SPEED NPN POWER TRANSISTORS
- HOLLOW EMITTER TECHNOLOGY
- HIGH VOLTAGE FOR OFF-LINE APPLICATIONS
- 70kHz SWITCHING SPEED
- LOW COST DRIVE CIRCUITS
- LOW DYNAMIC SATURATION

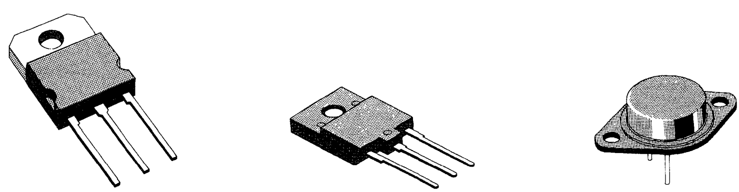
APPLICATIONS

- SMPS

DESCRIPTION

Hollow emitter FASTSWITCH NPN power transistors are specially designed for 220V (and 117V with input doubler) off-line switching power supply applications. Hollow emitter transistors can operate up to 70kHz with simple drive circuits which helps to simplify designs and improve reliability. The superior switching performance reduces dissipation and consequently lowers the equipment operating temperature. These transistors are suitable for application in half bridge, push-pull and full bridge medium power transistor converters, 750W to 1500W. When used in conjunction with a low voltage Power MOSFET in emitter switch configuration, they can operate at up to 100kHz.

These hollow emitter FASTSWITCH transistors are available in TO-218 and the fully isolated ISOWATT218 packages. The ISOWATT218 conforms to the creepage distance and isolation requirements of VDE, IEC, and UL specifications. Additionally these FASTSWITCH transistors are available in metal TO-3 packages.



TO-218 ISOWATT218 TO-3

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	SGS F461	SGS IF461	SGS F561	Unit
V_{CES}	Collector - Emitter Voltage (V_{BE} = 0)	850			V
V_{CEO}	Collector - Emitter Voltage (I_B = 0)	400			V
V_{EBO}	Emitter - Base Voltage (I_C = 0)	7			V
I_C	Collector Current	15			A
I_{CM}	Collector Peak Current (t_p < 5ms)	25			A
I_B	Base Current	8			A
I_{BM}	Base Peak Current (t_p < 5ms)	15			A
P_{tot}	Total Dissipation at $T_c \leq 25°C$	125	65	150	W
T_{stg}	Storage Temperature – 65 to	150	150	175	°C
T_j	Junction Temperature	150	150	175	°C

THERMAL DATA

		SGS			
		F461	IF461	F561	
$R_{thj-case}$	Thermal Resistance Junction-case Max	1	1.92	1	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 700V			200	µA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 380V V_{CE} = 400V			200 2	µA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.1A	400			V
$V_{CE(sat)}$*	Collector Emitter Saturation Voltage	I_C = 10A I_B = 2A I_C = 5.5A I_B = 0.8A			1.5 1.5	V V
$V_{BE(sat)}$*	Base Emitter Saturation Voltage	I_C = 10A I_B = 2A I_C = 5.5A I_B = 0.8A			1.5 1.5	V V

RESISTIVE LOAD

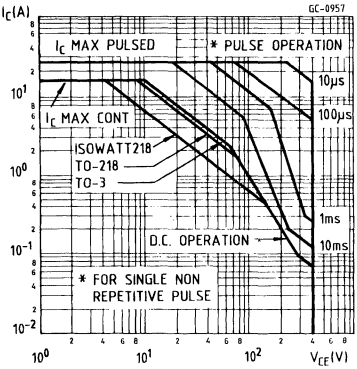
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	I_C = 10A V_{CC} = 250V I_{B1} = 2A I_{B2} = – 2I_{B1}		1	1.7	µs
t_s	Storage Time			1.4	2.3	µs
t_f	Fall Time			0.25	0.5	µs
t_{on}	Turn-on Time	I_C = 10A V_{CC} = 250V I_{B1} = 2A I_{B2} = – 2I_{B1} With Antisaturation Network		1		µs
t_s	Storage Time			1		µs
t_f	Fall Time			0.15		µs
t_{on}	Turn-on Time	I_C = 10A V_{CC} = 250V I_{B1} = 2A $V_{BE(off)}$ = – 5V		1		µs
t_s	Storage Time			1		µs
t_f	Fall Time			0.06		µs

INDUCTIVE LOAD

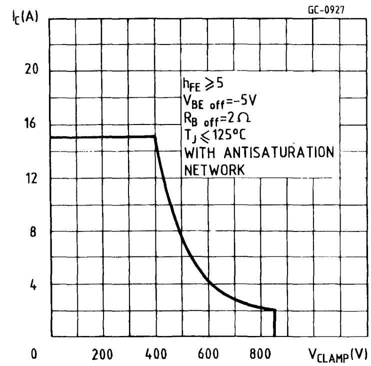
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	I_C = 10A h_{FE} = 5 V_{CL} = 350V $V_{BE(off)}$ = – 5V L = 300µH $R_{B(off)}$ = 1.2Ω		1.4	2.8	µs
t_f	Fall Time			0.1	0.2	µs
t_s	Storage Time	I_C = 10A h_{FE} = 5 V_{CL} = 350V $V_{BE(off)}$ = – 5V L = 300µH $R_{B(off)}$ = 1.2Ω T_c = 100°C			4	µs
t_f	Fall Time				0.3	µs

* Pulsed : Pulse duration = 300µs, duty cycle = 1.5%

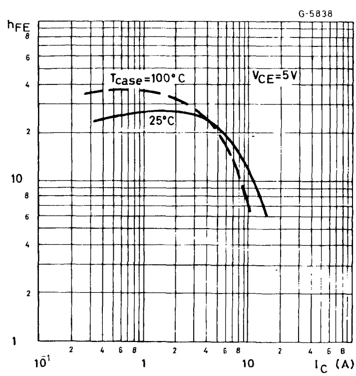
Safe Operating Areas



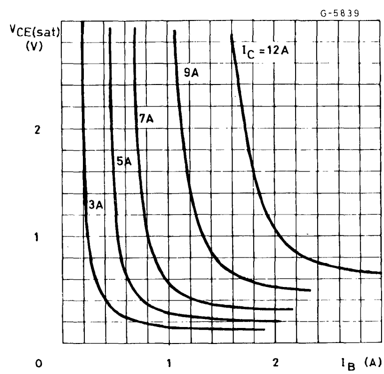
Reverse Biased Safe Operating Area



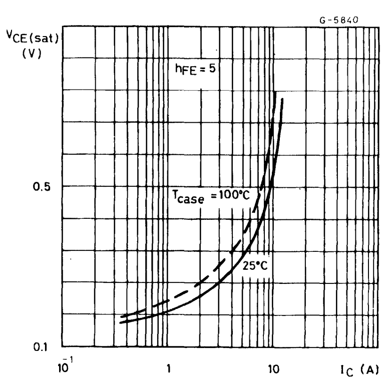
DC Current Gain



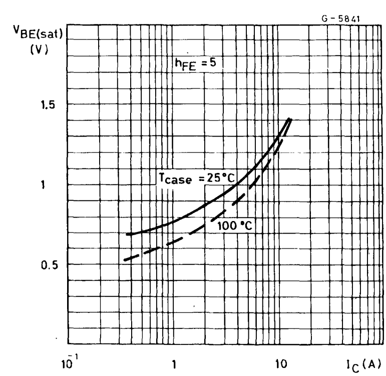
Collector-emitter Saturation Voltage



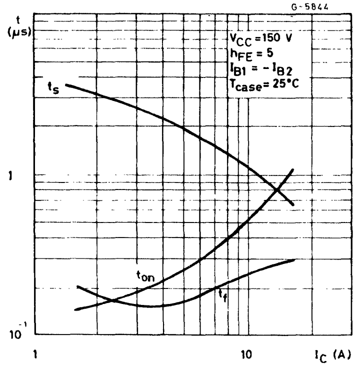
Collector-emitter Saturation Voltage



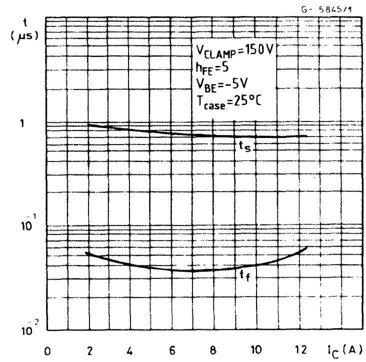
Base-emitter Saturation Voltage



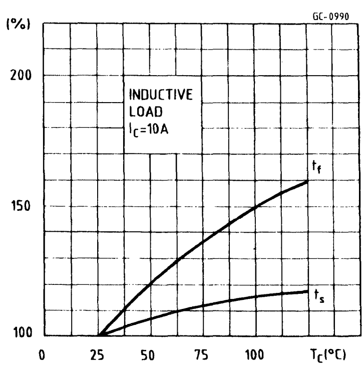
Resistive Load Switching Times



Inductive Load Switching Times



Switching Times Percentance Variation



ISOWATT218 PACKAGE CHARACTERISTICS AND APPLICATION

ISOWATT218 is fully isolated to 4000V dc. Its thermal impedance, given in the data sheet, is optimised to give efficient thermal conduction together with excellent electrical isolation. The structure of the case ensures optimum distances between the pins and heatsink. These distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 package eliminates the need for external isolation so reducing fixing hardware.

The package is supplied with leads longer than the standard TO-218 to allow easy mounting on pcbs. Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

ISOWATT218 thermal performance is equivalent to that of the standard part, mounted with a 0.1mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for ISOWATT218 packages is determined by :

$$P_D = \frac{T_j - T_C}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT218 PACKAGE

Fig. 1 illustrates the elements contributing to the thermal resistance of a transistor heatsink assembly, using ISOWATT218 package.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements. The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1 - For a short duration power pulse of less than 1ms :

$$Z_{th} < R_{thJ\text{-}C}$$

2 - For an intermediate power pulse of 5ms to 50ms seconds :

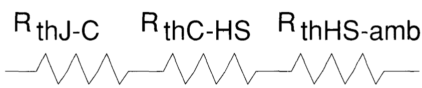
$$Z_{th} = R_{thJ\text{-}C}$$

3 - For long power pulses of the order of 500ms seconds or greater :

$$Z_{th} = R_{thJ\text{-}C} + R_{thC\text{-}HS} + R_{thHS\text{-}amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 1.



SGS-THOMSON MICROELECTRONICS

SGSF463 SGSIF463–SGSF563

FASTSWITCH HOLLOW–EMITTER NPN TRANSISTORS

- HIGH SWITCHING SPEED NPN POWER TRANSISTORS
- HOLLOW EMITTER TECHNOLOGY
- HIGH VOLTAGE FOR OFF-LINE APPLICATIONS
- 70kHz SWITCHING SPEED
- LOW COST DRIVE CIRCUITS
- LOW DYNAMIC SATURATION

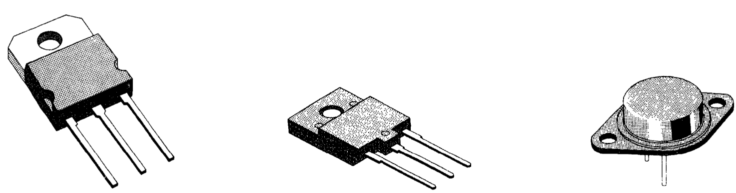
APPLICATIONS

- SMPS

DESCRIPTION

Hollow emitter FASTSWITCH NPN power transistors are specially designed for 240V (and 110V with input doubler) off-line switching power supply applications. Hollow emitter transistors can operate up to 70kHz with simple drive circuits which helps to simplify designs and improve reliability. The superior switching performance reduces dissipation and consequently lowers the equipment operating temperature. The high voltage rating of these transistors allows simplification of the over voltage snubbing network. These transistors are suitable for applications in half bridge, push-pull and full bridge medium power converters, 550W to 1100W. When used in conjunction with a low voltage Power MOSFET in emitter switch configuration, they can operate at up to 100kHz.

These hollow emitter FASTSWITCH transistors are available in TO-218 and the fully isolated ISOWATT218 packages. The ISOWATT218 conforms to the creepage distance and isolation requirements of VDE, IEC, and UL specifications. Additionally these FASTSWITCH transistors are available in metal TO-3 packages.



TO-218 **ISOWATT218** **TO-3**

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	SGS			Unit
		F463	IF463	F563	
V_{CES}	Collector - Emitter Voltage ($V_{BE} = 0$)	1000			V
V_{CEO}	Collector - Emitter Voltage ($I_B = 0$)	450			V
V_{EBO}	Emitter - Base Voltage ($I_C = 0$)	7			V
I_C	Collector Current	12			A
I_{CM}	Collector Peak Current ($t_p < 5ms$)	20			A
I_B	Base Current	7			A
I_{BM}	Base Peak Current ($t_p < 5ms$)	12			A
P_{tot}	Total Dissipation at $T_c \leq 25°C$	125	65	150	W
T_{stg}	Storage Temperature – 65 to	150	150	175	°C
T_j	Junction Temperature	150	150	175	°C

THERMAL DATA

		SGS			
		F463	IF463	F563	
$R_{thj-case}$	Thermal Resistance Junction-case Max	1	1.92	1	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 1000V			200	µA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 380V V_{CE} = 450V			200 2	µA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO\ (sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.1A	450			V
$V_{CE\ (sat)}$*	Collector Emitter Saturation Voltage	I_C = 7A I_B = 1.4A I_C = 4A I_B = 0.6A			1.5 1.5	V V
$V_{BE\ (sat)}$*	Base Emitter Saturation Voltage	I_C = 7A I_B = 1.4A I_C = 4A I_B = 0.6A			1.5 1.5	V V

RESISTIVE LOAD

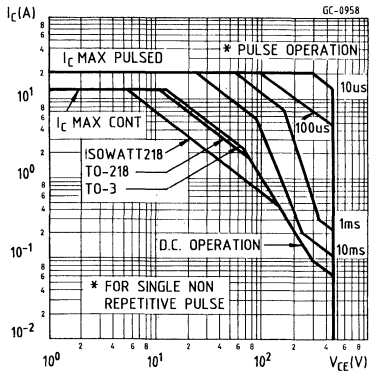
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	I_C = 7A V_{CC} = 250V I_{B1} = 1.4A I_{B2} = – 2I_{B1}		1	1.7	µs
t_s	Storage Time			1.4	2.3	µs
t_f	Fall Time			0.25	0.5	µs
t_{on}	Turn-on Time	I_C = 7A V_{CC} = 250V I_{B1} = 1.4A I_{B2} = – 2I_{B1} with Antisaturation Network		1		µs
t_s	Storage Time			1		µs
t_f	Fall Time			0.15		µs
t_{on}	Turn-on Time	I_C = 7A V_{CC} = 250V I_{B1} = 1.4A $V_{BE(off)}$ = – 5V		1		µs
t_s	Storage Time			1		µs
t_f	Fall Time			0.06		µs

INDUCTIVE LOAD

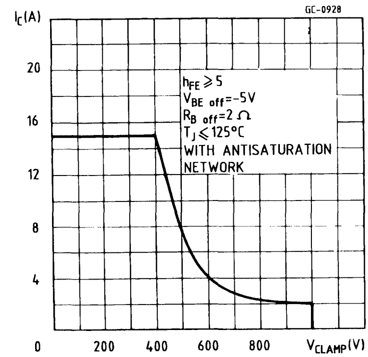
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	I_C = 7A h_{FE} = 5 V_{CL} = 350V $V_{BE(off)}$ = – 5V L = 300µH $R_{B(off)}$ = 1.2Ω		1.4	2.8	µs
t_f	Fall Time			0.1	0.2	µs
t_s	Storage Time	I_C = 7A h_{FE} – 5 V_{CL} = 350V $V_{BE(off)}$ = – 5V L = 300µH $R_{B(off)}$ = 1.2Ω T_c = 100°C			4	µs
t_f	Fall Time				0.3	µs

* Pulsed : Pulse duration = 300µs, duty cycle = 1.5%

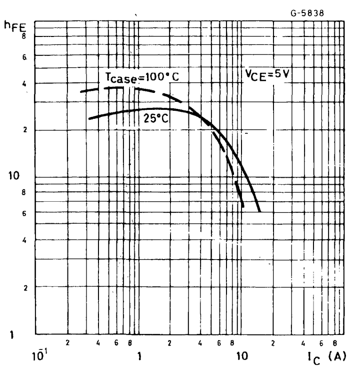
Safe Operating Areas



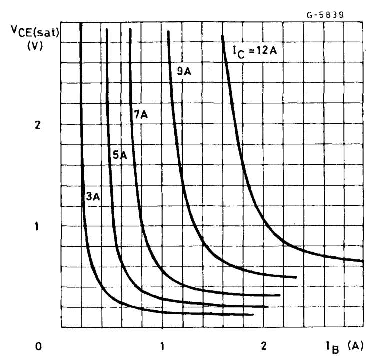
Reverse Biased Safe Operating Area



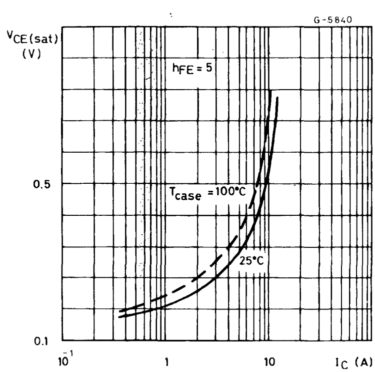
DC Current Gain



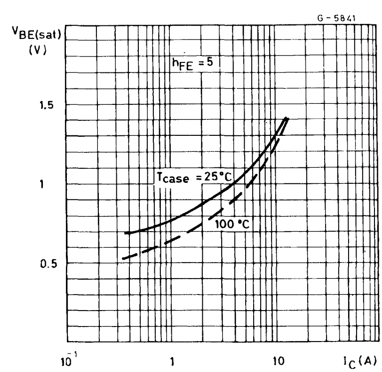
Collector-emitter Saturation Voltage



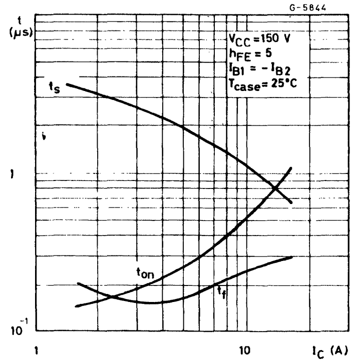
Collector-emitter Saturation Voltage



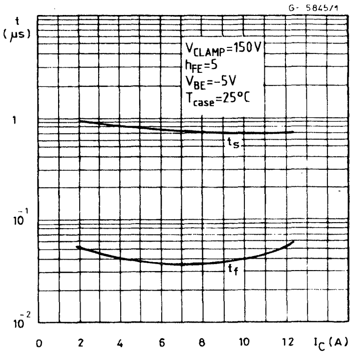
Base-emitter Saturation Voltage



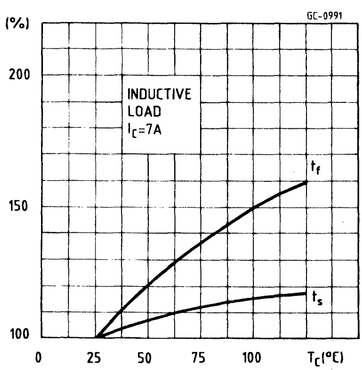
Resistive Load Switching Times



Inductive Load Switching Times



Switching Times Percentance Variation



ISOWATT218 PACKAGE CHARACTERISTICS AND APPLICATION

ISOWATT218 is fully isolated to 4000V dc. Its thermal impedance, given in the data sheet, is optimised to give efficient thermal conduction together with excellent electrical isolation. The structure of the case ensures optimum distances between the pins and heatsink. These distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 package eliminates the need for external isolation so reducing fixing hardware.

The package is supplied with leads longer than the standard TO-218 to allow easy mounting on pcbs. Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

ISOWATT218 thermal performance is equivalent to that of the standard part, mounted with a 0.1mm mica washer.

The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for ISOWATT218 packages is determined by :

$$P_D = \frac{T_j - T_C}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT218 PACKAGE

Fig. 1 illustrates the elements contributing to the thermal resistance of a transistor heatsink assembly, using ISOWATT218 package.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements.

The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1 - For a short duration power pulse of less than 1ms :

$$Z_{th} < R_{thJ\text{-}C}$$

2 - For an intermediate power pulse of 5ms to 50ms seconds :

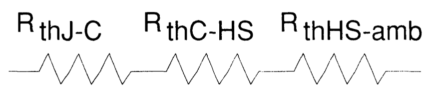
$$Z_{th} = R_{thJ\text{-}C}$$

3 - For long power pulses of the order of 500ms seconds or greater :

$$Z_{th} = R_{thJ\text{-}C} + R_{thC\text{-}HS} + R_{thHS\text{-}amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 1.



FASTSWITCH HOLLOW–EMITTER NPN TRANSISTORS

- HIGH SWITCHING SPEED NPN POWER TRANSISTORS
- HOLLOW EMITTER TECHNOLOGY
- HIGH VOLTAGE FOR OFF-LINE APPLICATIONS
- 50kHz SWITCHING SPEED
- LOW COST DRIVE CIRCUITS
- LOW DYNAMIC SATURATION

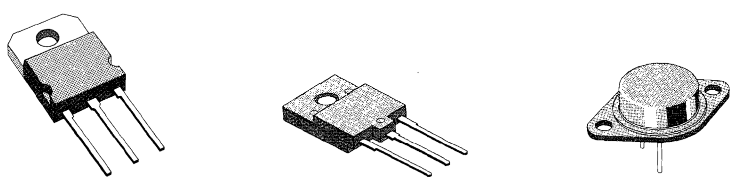
APPLICATIONS

- SMPS
- TV HORIZONTAL DEFLECTION

DESCRIPTION

These hollow emitter FASTSWITCH NPN power transistors are specially designed for 220V (and 117V with input doubler) off-line switching power supply and colour CRT deflection applications. Hollow emitter transistors can be used to advantage in off-line switching power supply applications where their high voltage rating is a benefit in forward and flyback converters because a costly transformer clamp winding or over voltage snubbers can be omitted. High voltage hollow emitter transistors can operate up to 50kHz with simple drive circuits which help to simplify design and improve reliability. These transistors can also be used in half bridge, push-pull and full bridge medium power converters, 450W to 950W. When used in conjunction with a low voltage Power MOSFET in emitter switch configuration in flyback and forward converters, they can operate at up to 100kHz.

These hollow emitter FASTSWITCH transistors are available in TO-218 and fully isolated TO-218 packages. The ISOWATT218 conforms to the creepage distance and isolation requirements of VDE, IEC, and UL specifications. Additionally these FASTSWITCH transistors are available in metal TO-3 packages.



TO-218 ISOWATT218 TO-3

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	SGS			Unit
		F464	IF464	F564	
V_{CES}	Collector - Emitter Voltage ($V_{BE} = 0$)	1200			V
V_{CEO}	Collector - Emitter Voltage ($I_B = 0$)	600			V
V_{EBO}	Emitter - Base Voltage ($I_C = 0$)	7			V
I_C	Collector Current	10			A
I_{CM}	Collector Peak Current ($t_p < 5ms$)	15			A
I_B	Base Current	7			A
I_{BM}	Base Peak Current ($t_p < 5ms$)	12			A
P_{tot}	Total Dissipation at $T_c \leq 25°C$	125	65	150	W
T_{stg}	Storage Temperature – 65 to	150	150	175	°C
T_j	Junction Temperature	150	150	175	°C

THERMAL DATA

		SGS			
		F464	IF464	F564	
$R_{thj-case}$	Thermal Resistance Junction-case Max	1	1.92	1	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 1200V			200	µA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 380V V_{CE} = 600V			200 2	µA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.1A	600			V
$V_{CE(sat)}$*	Collector Emitter Saturation Voltage	I_C = 6A I_B = 1.2A I_C = 3.5A I_B = 0.5A			1.5 1.5	V V
$V_{BE(sat)}$*	Base Emitter Saturation Voltage	I_C = 6A I_B = 1.2A I_C = 3.5A I_B = 0.5A			1.5 1.5	V V

RESISTIVE LOAD

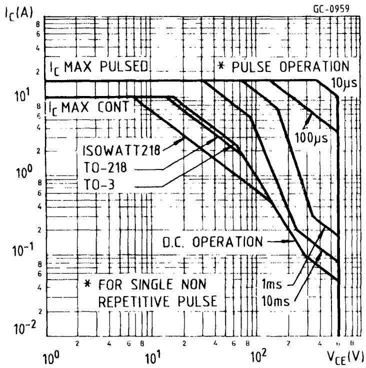
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	I_C = 6A V_{CC} = 250V I_{B1} = 1.2A I_{B2} = – 2I_{B1}		0.6	1.2	µs
t_s	Storage Time			2.45	3.5	µs
t_f	Fall Time			0.12	0.4	µs
t_{on}	Turn-on Time	I_C = 6A V_{CC} = 250V I_{B1} = 1.2A I_{B2} = – 2I_{B1} With Antisaturation Network		0.6		µs
t_s	Storage Time			1.7		µs
t_f	Fall Time			0.12		µs
t_{on}	Turn-on Time	I_C = 6A V_{CC} = 250V I_{B1} = 1.2A $V_{BE(off)}$ = – 5V		0.6		µs
t_s	Storage Time			1.3		µs
t_f	Fall Time			0.2		µs

INDUCTIVE LOAD

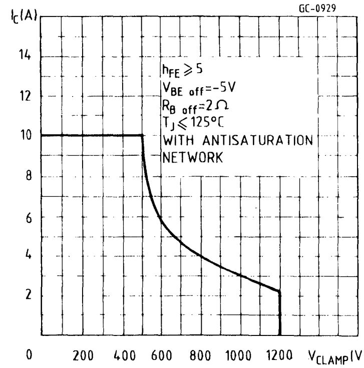
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	I_C = 6A h_{FE} = 5 V_{CL} = 450V $V_{BE(off)}$ = – 5V L = 300µH $R_{B(off)}$ = 0.8Ω		1.4	2.8	µs
t_f	Fall Time			0.1	0.2	µs
t_s	Storage Time	I_C = 6A h_{FE} = 5 V_{CL} = 450V $V_{BE(off)}$ = – 5V L = 300µH $R_{B(off)}$ = 0.8Ω T_c = 100°C			4	µs
t_f	Fall Time				0.3	µs

* Pulsed : Pulse duration = 300µs, duty cycle = 1.5%

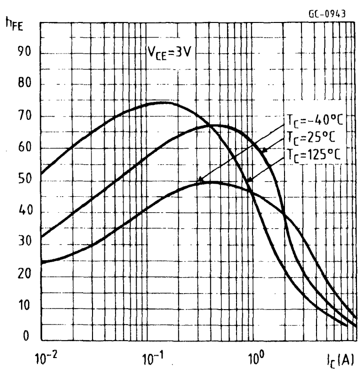
Safe Operating Areas



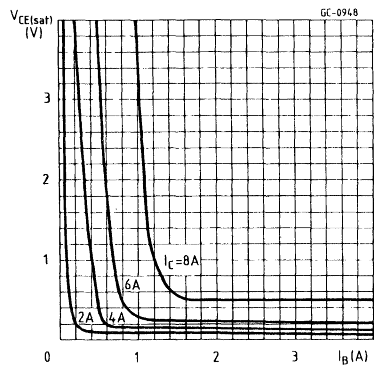
Reverse Biased Safe Operating Area



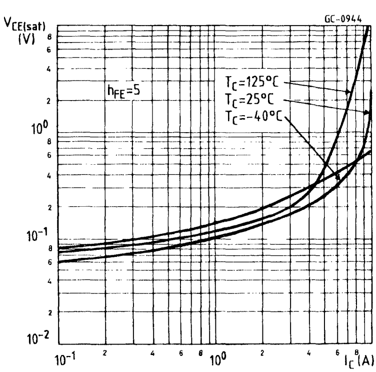
DC Current Gain



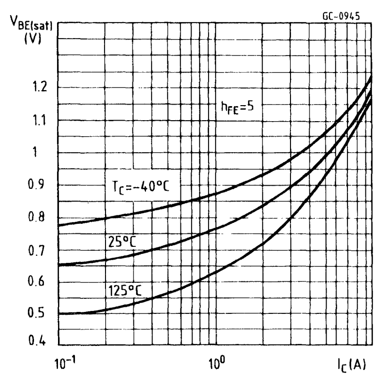
Collector-emitter Saturation Voltage



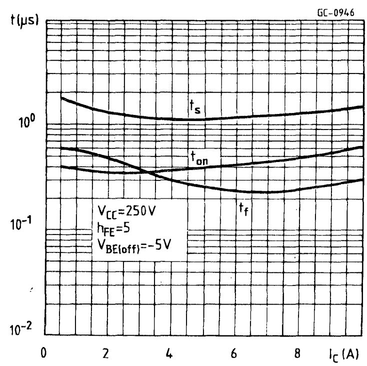
Collector-emitter Saturation Voltage



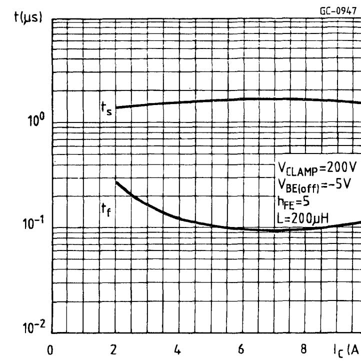
Base-emitter Saturation Voltage



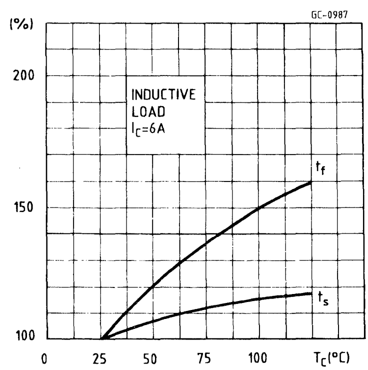
Resistive Load Switching Times



Inductive Load Switching Times



Switching Times Percentance Variation



ISOWATT218 PACKAGE CHARACTERISTICS AND APPLICATION

ISOWATT218 is fully isolated to 4000V dc. Its thermal impedance, given in the data sheet, is optimised to give efficient thermal conduction together with excellent electrical isolation. The structure of the case ensures optimum distances between the pins and heatsink. These distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 package eliminates the need for external isolation so reducing fixing hardware.

The package is supplied with leads longer than the standard TO-218 to allow easy mounting on pcbs. Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

ISOWATT218 thermal performance is equivalent to that of the standard part, mounted with a 0.1mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for ISOWATT218 packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT218 PACKAGE

Fig. 1 illustrates the elements contributing to the thermal resistance of a transistor heatsink assembly, using ISOWATT218 package.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements.

The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1 - For a short duration power pulse of less than 1ms :

$$Z_{th} < R_{thJ\text{-}C}$$

2 - For an intermediate power pulse of 5ms to 50ms seconds :

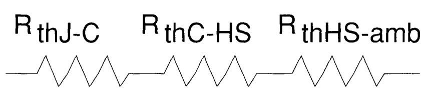
$$Z_{th} = R_{thJ\text{-}C}$$

3 - For long power pulses of the order of 500ms seconds or greater :

$$Z_{th} = R_{thJ\text{-}C} + R_{thC\text{-}HS} + R_{thHS\text{-}amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 1.



SGS-THOMSON
MICROELECTRONICS

SGSF465
SGSIF465/F565

FASTSWITCH HOLLOW–EMITTER NPN TRANSISTORS

- HIGH SWITCHING SPEED NPN POWER TRANSISTORS
- HOLLOW EMITTER FOR FAST SWITCHING
- HIGH VOLTAGE FOR OFF-LINE APPLICATIONS
- 50kHz SWITCHING SPEED WITH EASY DRIVE CIRCUITS
- LOW COST DRIVE CIRCUITS
- LOW DYNAMIC SATURATION

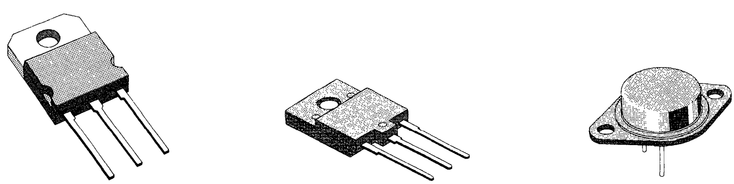
APPLICATIONS

- SMPS
- TV HORIZONTAL DEFLECTION

DESCRIPTION

These hollow emitter FASTSWITCH NPN power transistors are specially designed for 220V (and 117V with input doubler) off-line switching power supply and colour CRT deflection applications. Hollow emitter transistors can be used to advantage in off-line switching power supply applications where their high voltage rating is a benefit in forward and flyback medium power converters because a costly transformer clamp winding or over voltage snubbers can be omitted. High voltage hollow emitter transistors can operate up to 50kHz with simple drive circuits which help to simplify design and improve reliability. When used in conjunction with a low voltage Power MOSFET in emitter switch configuration in flyback and forward converters, they can operate at up to 100kHz.

These hollow emitter FASTSWITCH transistors are available in TO-218 and fully isolated TO-218 packages. The ISOWATT218 conforms to the creepage distance and isolation requirements of VDE, IEC, and UL specifications. Additionally these FASTSWITCH transistors are available in metal TO-3 packages.



TO-218 ISOWATT218 TO-3

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	SGS			Unit
		F465	IF465	F565	
V_{CES}	Collector - Emitter Voltage (V_{BE} = 0)	1300			V
V_{CEO}	Collector - Emitter Voltage (I_B = 0)	600			V
V_{EBO}	Emitter - Base Voltage (I_C = 0)	7			V
I_C	Collector Current	10			A
I_{CM}	Collector Peak Current (t_p < 5ms)	15			A
I_B	Base Current	7			A
I_{BM}	Base Peak Current (t_p < 5ms)	12			A
P_{tot}	Total Dissipation at $T \leq 25°C$	125	65	150	W
T_{stg}	Storage Temperature – 65 to	150	150	175	°C
T_j	Junction Temperature	150	150	175	°C

THERMAL DATA

			SGS			
			F465	IF465	F565	
$R_{thj-case}$	Thermal Resistance Junction-case	Max	1	1.92	1	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 1300V			200	μA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 380V V_{CE} = 600V			200 2	μA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.1A	600			V
$V_{CE(sat)}$*	Collector Emitter Saturation Voltage	I_C = 5A I_B = 1A I_C = 3A I_B = 0.4A			1.5 1.5	V V
$V_{BE(sat)}$*	Base Emitter Saturation Voltage	I_C = 5A I_B = 1A I_C = 3A I_B = 0.4A			1.5 1.5	V V

RESISTIVE LOAD

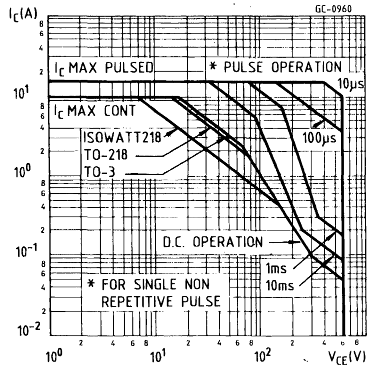
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	I_C = 5A V_{CC} = 250V I_{B1} = 1A I_{B2} = – 2I_{B1}		0.6	1.2	μs
t_s	Storage Time			2.45	3.5	μs
t_f	Fall Time			0.12	0.4	μs
t_{on}	Turn-on Time	I_C = 5A V_{CC} = 250V I_{B1} = 1A I_{B2} = – 2I_{B1} With Antisaturation Network		0.6		μs
t_s	Storage Time			1.7		μs
t_f	Fall Time			0.12		μs
t_{on}	Turn-on Time	I_C = 5A V_{CC} = 250V I_{B1} = 1A $V_{BE(off)}$ = – 5V		0.6		μs
t_s	Storage Time			1.3		μs
t_f	Fall Time			0.2		μs

INDUCTIVE LOAD

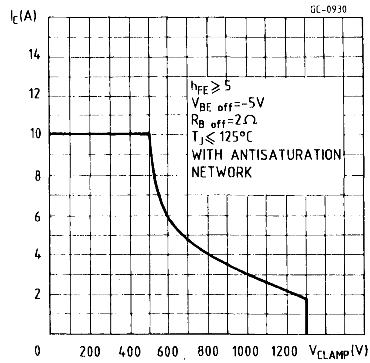
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	I_C = 5A h_{FE} = 5 V_{CL} = 450V $V_{BE(off)}$ = – 5V L = 300μH $R_{B(off)}$ = 0.8Ω		1.4	2.8	μs
t_f	Fall Time			0.1	0.2	μs
t_s	Storage Time	I_C = 5A h_{FE} = 5 V_{CL} = 450V $V_{BE(off)}$ = – 5V L = 300μH $R_{B(off)}$ = 0.8Ω T_C = 100°C			4	μs
t_f	Fall Time				0.3	μs

* Pulsed : Pulse duration = 300μs, duty cycle = 1.5%

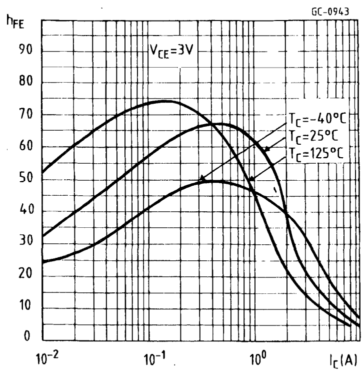
Safe Operating Areas



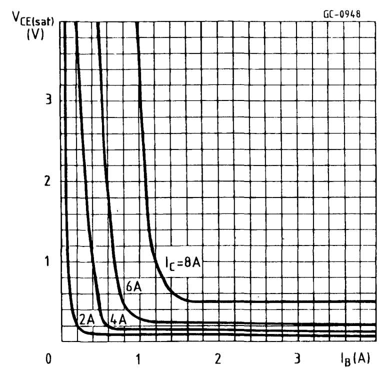
Reverse Biased Safe Operating Area



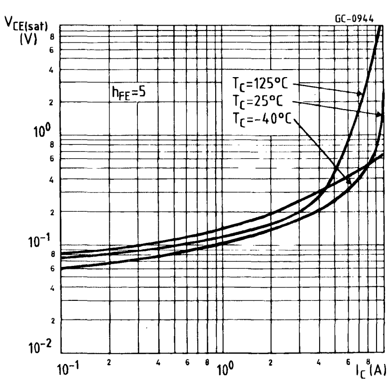
DC Current Gain



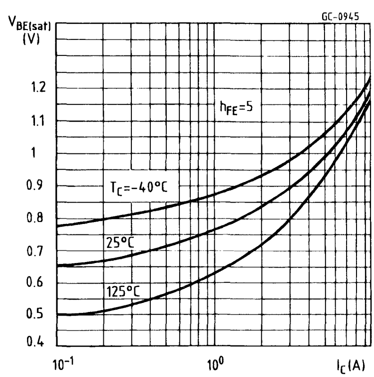
Collector-emitter Saturation Voltage



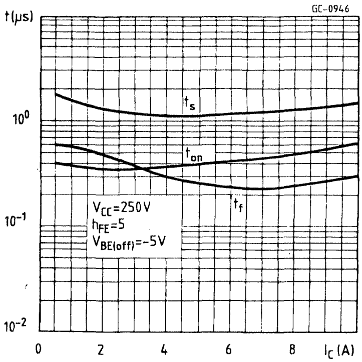
Collector-emitter Saturation Voltage



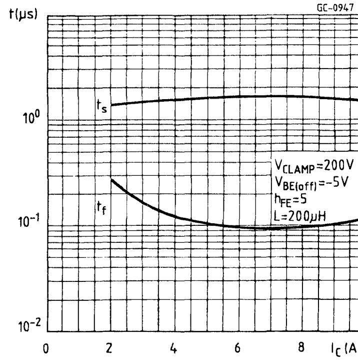
Base-emitter Saturation Voltage



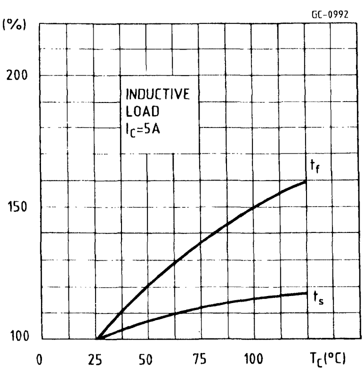
Resistive Load Switching Times



Inductive Load Switching Times



Switching Times Percentance Variation



ISOWATT218 PACKAGE CHARACTERISTICS AND APPLICATION

ISOWATT218 is fully isolated to 4000V dc. Its thermal impedance, given in the data sheet, is optimised to give efficient thermal conduction together with excellent electrical isolation. The structure of the case ensures optimum distances between the pins and heatsink. These distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 package eliminates the need for external isolation so reducing fixing hardware.

The package is supplied with leads longer than the standard TO-218 to allow easy mounting on pcbs. Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

ISOWATT218 thermal performance is equivalent to that of the standard part, mounted with a 0.1mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for ISOWATT218 packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT218 PACKAGE

Fig. 1 illustrates the elements contributing to the thermal resistance of a transistor heatsink assembly, using ISOWATT218 package.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements.

The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1 - For a short duration power pulse of less than 1ms :

$$Z_{th} < R_{thJ\text{-}C}$$

2 - For an intermediate power pulse of 5ms to 50ms seconds :

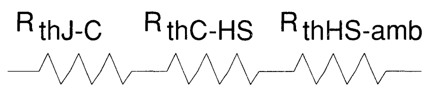
$$Z_{th} = R_{thJ\text{-}C}$$

3 - For long power pulses of the order of 500ms seconds or greater :

$$Z_{th} = R_{thJ\text{-}C} + R_{thC\text{-}HS} + R_{thHS\text{-}amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 1.



FASTSWITCH HOLLOW–EMITTER NPN TRANSISTOR

- HIGH SWITCHING SPEED NPN POWER TRANSISTOR
- HOLLOW EMITTER TECHNOLOGY
- HIGH VOLTAGE FOR OFF-LINE APPLICATIONS
- 70kHz SWITCHING SPEED
- LOW COST DRIVE CIRCUITS
- LOW DYNAMC SATURATION

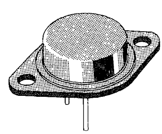
APPLICATIONS

- SMPS

DESCRIPTION

This hollow emitter FASTSWITCH NPN power transistor is specially designed for 220V (and 117V with input doubler) off-line switching power supply applications. It can also be used for 117V three phase mains off-line switching power supplies. Hollow emitter transistors can operate up to 70kHz with simple drive circuits which helps to simplify designs and improve reliability. The superior switching performance reduces dissipation and consequently lowers the equipment operating temperature. This transistor is suitable for application in half bridge and full bridge high power converters, 1500W to 3000W. When used in conjunction with a low vol-tage Power MOSFET in emitter switch configuration in flyback and forward converters, they can operate at up to 100kHz.

This hollow emitter FASTSWITCH transistor is available in the metal can TO-3 package.



TO-3

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	SGSF661	Unit
V_{CES}	Collector - Emitter Voltage (V_{BE} = 0)	850	V
V_{CEO}	Collector - Emitter Voltage (I_B = 0)	400	V
V_{EBO}	Emitter - Base Voltage (I_C = 0)	7	V
I_C	Collector Current	30	A
I_{CM}	Collector Peak Current (t_p < 5ms)	50	A
I_B	Base Current	16	A
I_{BM}	Base Peak Current (t_p < 5ms)	30	A
P_{tot}	Total Dissipation at $T_c \leq 25°C$	250	W
T_{stg}	Storage Temperature – 65 to	175	°C
T_j	Junction Temperature	175	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case Max	0.6	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 45°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 700V			400	μA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 380V V_{CE} = 400V			400 4	μA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			2	mA
$V_{CEO\,(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A	400			V
$V_{CE\,(sat)}$*	Collector Emitter Saturation Voltage	I_C = 20A I_B = 4A I_C = 11A I_B = 1.6A			1.5 1.5	V V
$V_{BE\,(sat)}$*	Base Emitter Saturation Voltage	I_C = 20A I_B = 4A I_C = 11A I_B = 1.6A			1.5 1.5	V V

RESISTIVE LOAD

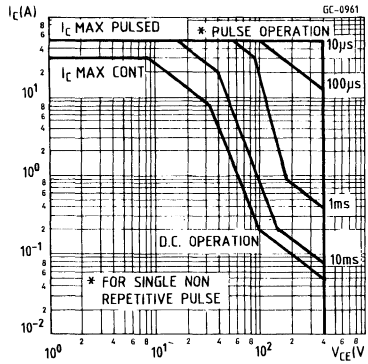
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	I_C = 20A V_{CC} = 250V I_{B1} = 4A I_{B2} = – 2 I_{B1}		1	1.7	μs
t_s	Storage Time			1.4	2.3	μs
t_f	Fall Time			0.25	0.5	μs
t_{on}	Turn-on Time	I_C = 20A V_{CC} = 250V I_{B1} = 4A I_{B2} = – 2 I_{B1} with Antisaturation Network		1		μs
t_s	Storage Time			1		μs
t_f	Fall Time			0.15		μs
t_{on}	Turn-on Time	I_C = 20A V_{CC} = 250V I_{B1} = 4A $V_{BE(off)}$ = – 5V		1		μs
t_s	Storage Time			1		μs
t_f	Fall Time			0.06		μs

INDUCTIVE LOAD

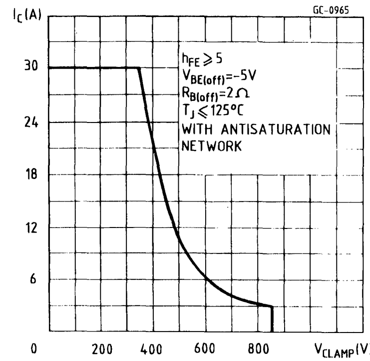
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	I_C = 20A h_{FE} = 5 V_{CL} = 350V $V_{BE(off)}$ = – 5V L = 300μH $R_{B(off)}$ = 1Ω		1.5	3.2	μs
t_f	Fall Time			0.12	0.25	μs
t_s	Storage Time	I_C = 20A h_{FE} = 5 V_{CL} = 350V $V_{BE(off)}$ = – 5V L = 300μH $R_{B(off)}$ = 1Ω T_C = 100°C			4.5	μs
t_f	Fall Time				0.35	μs

* Pulsed : Pulse duration = 300μs, duty cycle = 1.5%

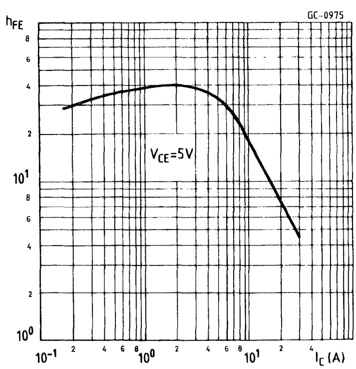
Safe Operating Areas



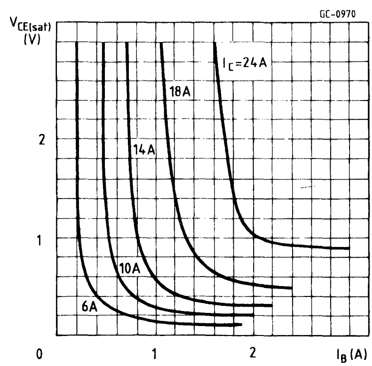
Reverse Biased Safe Operating Area



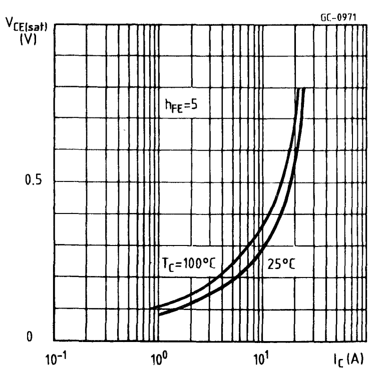
DC Current Gain



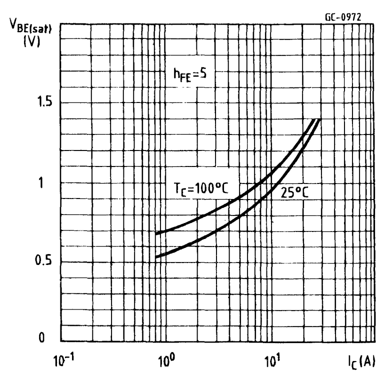
Collector-emitter Saturation Voltage



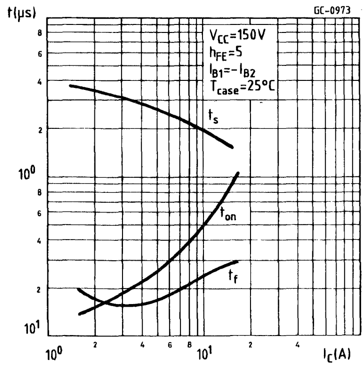
Collector-emitter Saturation Voltage



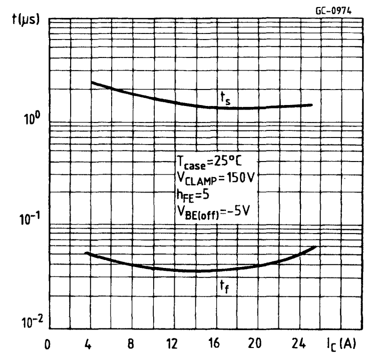
Base-emitter Saturation Voltage



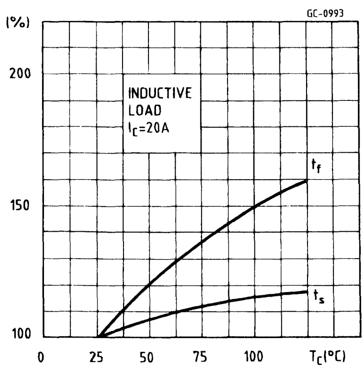
Resistive Load Switching Times



Inductive Load Switching Times



Switching Times Percentance Variation



SGS-THOMSON MICROELECTRONICS

FASTSWITCH HOLLOW–EMITTER NPN TRANSISTOR

- HIGH SWITCHING SPEED NPN POWER TRANSISTOR
- HOLLOW EMITTER TECHNOLOGY
- HIGH VOLTAGE FOR OFF-LINE APPLICATIONS
- 70kHz SWITCHING SPEED
- LOW COST DRIVE CIRCUITS
- LOW DYNAMIC SATURATION

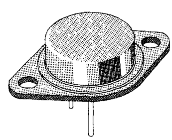
APPLICATIONS

- SMPS

DESCRIPTION

This hollow emitter FASTSWITCH NPN power transistor is specially designed for 220V (and 117V with input doubler) off-line switching power supply applications. It can also be used for 117V three phase mains off-line switching power supplies. Hollow emitter can operate up to 70kHz with simple drive circuits which helps to simplify design and improve reliability. The superior switching performance reduces dissipation and consequently lowers the equipment operating temperature. This transistor is suitable for applications in half bridge and full bridge high power converters, 1000W to 2000W. When used in conjunction with a low voltage Power MOSFET in emitter switch configuration, they can operate at up to 100kHz.

This hollow emitter FASTSWITCH transistor is available in the metal can TO-3 package.



TO-3

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	SGSF663	Unit
V_{CES}	Collector - Emitter Voltage (V_{BE} = 0)	1000	V
V_{CEO}	Collector - Emitter Voltage (I_B = 0)	450	V
V_{EBO}	Emitter - Base Voltage (I_C = 0)	7	V
I_C	Collector Current	24	A
I_{CM}	Collector Peak Current (t_p < 5ms)	40	A
I_B	Base Current	14	A
I_{BM}	Base Peak Current (t_p < 5ms)	24	A
P_{tot}	Total Dissipation at $T_c \leq 25°C$	250	W
T_{stg}	Storage Temperature – 65 to	175	°C
T_j	Junction Temperature	175	°C

THERMAL DATA

$R_{thj-case}$	Thermal Resistance Junction-case	Max	0.6	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 1000V			400	μA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 380V V_{CE} = 450V			400 4	μA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			2	mA
$V_{CEO (sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A	450			V
$V_{CE (sat)}$*	Collector Emitter Saturation Voltage	I_C = 14A I_B = 2.8A I_C = 8A I_B = 1.2A			1.5 1.5	V V
$V_{BE (sat)}$*	Base Emitter Saturation Voltage	I_C = 14A I_B = 2.8A I_C = 8A I_B = 1.2A			1.5 1.5	V V

RESISTIVE LOAD

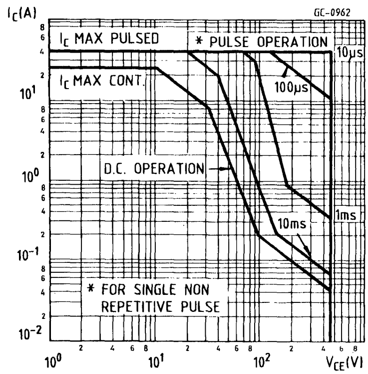
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	I_C = 14A V_{CC} = 250V I_{B1} = 2.8A I_{B2} = − 2I_{B1}		1	1.7	μs
t_s	Storage Time			1.4	2.3	μs
t_f	Fall Time			0.25	0.5	μs
t_{on}	Turn-on Time	I_C = 14A V_{CC} = 250V I_{B1} = 2.8A I_{B2} = − 2I_{B1} With Antisaturation Network		1		μs
t_s	Storage Time			1		μs
t_f	Fall Time			0.15		μs
t_{on}	Turn-on Time	I_C = 14A V_{CC} = 250V I_{B1} = 2.8A $V_{BE(off)}$ = − 5V		1		μs
t_s	Storage Time			1		μs
t_f	Fall Time			0.06		μs

INDUCTIVE LOAD

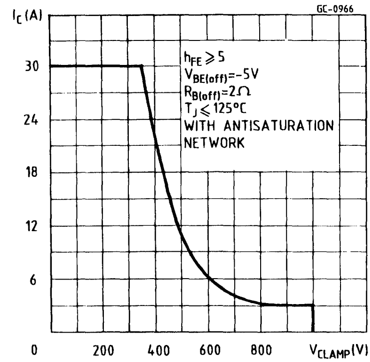
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	I_C = 14A h_{FE} = 5 V_{CL} = 350V $V_{BE(off)}$ = − 5V L = 300μH $R_{B(off)}$ = 1Ω		1.5	3.2	μs
t_f	Fall Time			0.12	0.25	μs
t_s	Storage Time	I_C = 14A h_{FE} = 5 V_{CL} = 350V $V_{BE(off)}$ = − 5V L = 300μH $R_{B(off)}$ = 1Ω T_C = 100°C			4.3	μs
t_f	Fall Time				0.35	μs

* Pulsed : Pulse duration = 300μs, duty cycle = 1.5%

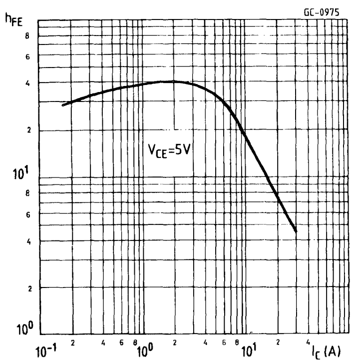
Safe Operating Areas



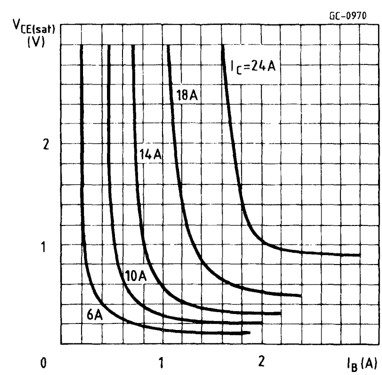
Reverse Biased Safe Operating Area



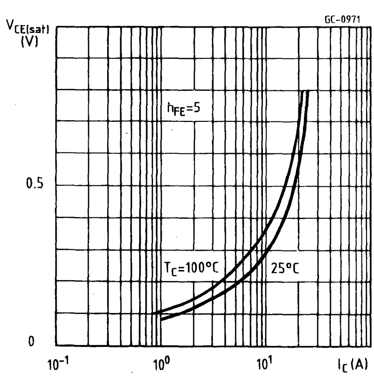
DC Current Gain



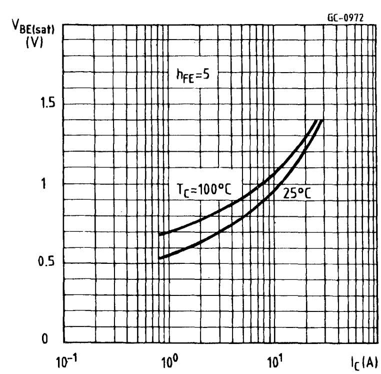
Collector-emitter Saturation Voltage



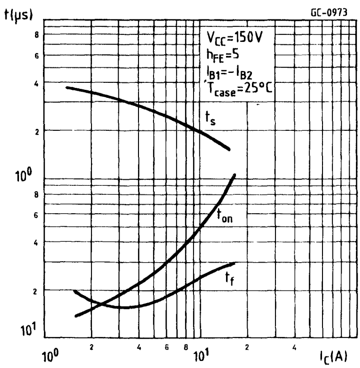
Collector-emitter Saturation Voltage



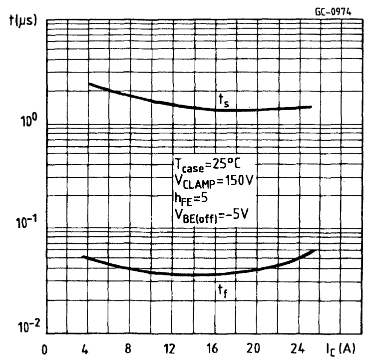
Base-emitter Saturation Voltage



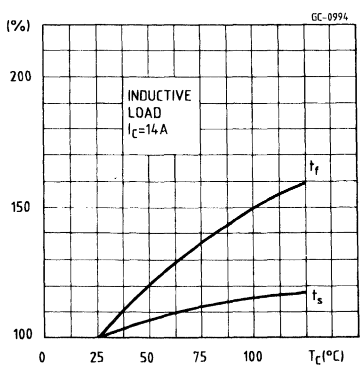
Resistive Load Switching Times



Inductive Load Switching Times



Switching Times Percentance Variation



FASTSWITCH HOLLOW–EMITTER NPN TRANSISTOR

- HIGH SWITCHING SPEED NPN POWER TRANSISTOR
- HOLLOW EMITTER TECHNOLOGY
- HIGH VOLTAGE FOR OFF-LINE APPLICATIONS
- 50kHz SWITCHING SPEED
- LOW COST DRIVE CIRCUITS
- LOW DYNAMIC SATURATION

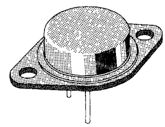
APPLICATIONS

- SMPS
- TV AND MONITOR DEFLECTION

DESCRIPTION

This hollow emitter FASTSWITCH NPN power transistor is specially designed for 220V (and 117V with input doubler) off-line switching power supply applications. It can also be used for 117V three phase mains off-line switching power supplies. Hollow emitter transistors can operate at up to 50kHz with simple drive circuits which helps to simplify design and improve reliability. The superior switching performance reduces dissipation and consequently lowers the equipment operating temperature. This transistor is suitable for applications in half bridge and full bridge high power converters, 900W to 1800W. The high switching speed of this transistor together with its high voltage and current rating, make it ideal for horizontal deflection circuits in large screen colour televisions and monitors. When used in conjunction with a low voltage Power MOSFET in emitter switch configuration, they can operate at up to 100kHz.

This hollow emitter FASTSWITCH transistor is available in the metal can TO-3 package.



TO-3

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	SGSF664	Unit
V_{CES}	Collector - Emitter Voltage (V_{BE} = 0)	1200	V
V_{CEO}	Collector - Emitter Voltage (I_B = 0)	600	V
V_{EBO}	Emitter - Base Voltage (I_C = 0)	7	V
I_C	Collector Current	20	A
I_{CM}	Collector Peak Current (t_p < 5ms)	30	A
I_B	Base Current	14	A
I_{BM}	Base Peak Current (t_p < 5ms)	24	A
P_{tot}	Total Dissipation at T ≤ 25°C	250	W
T_{stg}	Storage Temperature – 65 to	175	°C
T_j	Junction Temperature	175	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case Max	0.6	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 1200V			400	µA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 380V V_{CE} = 600V			400 4	µA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			2	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A	600			V
$V_{CE(sat)}$*	Collector Emitter Saturation Voltage	I_C = 12A I_B = 2.4A I_C = 7A I_B = 1A			1.5 1.5	V V
$V_{BE(sat)}$*	Base Emitter Saturation Voltage	I_C = 12A I_B = 2.4A I_C = 7A I_B = 1A			1.5 1.5	V V

RESISTIVE LOAD

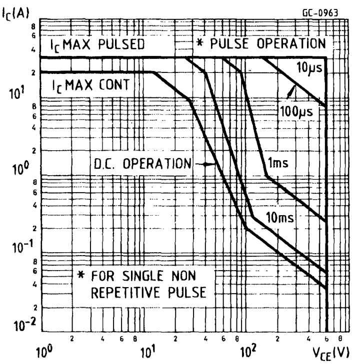
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	I_C = 12A V_{CC} = 250V I_{B1} = 2.4A I_{B2} = – 2I_{B1}		0.6	1.2	µs
t_s	Storage Time			2.45	3.5	µs
t_f	Fall Time			0.12	0.4	µs
t_{on}	Turn-on Time	I_C = 12A V_{CC} = 250V I_{B1} = 2.4A I_{B2} = – 2I_{B1} with Antisaturation Network		0.6		µs
t_s	Storage Time			1.7		µs
t_f	Fall Time			0.12		µs
t_{on}	Turn-on Time	I_C = 12A V_{CC} = 250V I_{B1} = 2.4A $V_{BE(off)}$ = – 5V		0.6		µs
t_s	Storage Time			1.3		µs
t_f	Fall Time			0.2		µs

INDUCTIVE LOAD

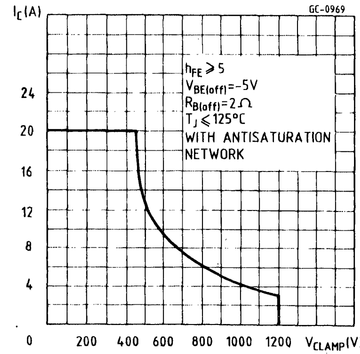
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	I_C = 12A h_{FE} = 5 V_{CL} = 450V $V_{BE(off)}$ = – 5V L = 300µH $R_{B(off)}$ = 0.5Ω		1.5	3	µs
t_f	Fall Time			0.12	0.25	µs
t_s	Storage Time	I_C = 12A h_{FE} = 5 V_{CL} = 450V $V_{BE(off)}$ = – 5V L = 300µH $R_{B(off)}$ = 0.5Ω T_c = 100°C			4.3	µs
t_f	Fall Time				0.35	µs

* Pulsed : Pulse duration = 300µs, duty cycle = 1.5%

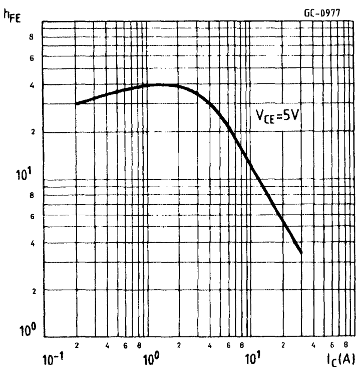
Safe Operating Areas



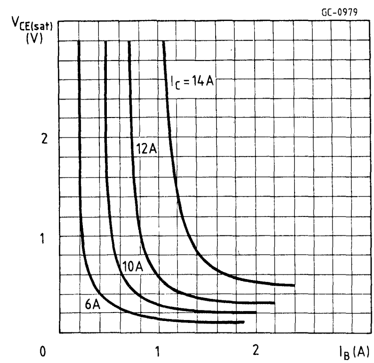
Reverse Biased Safe Operating Area



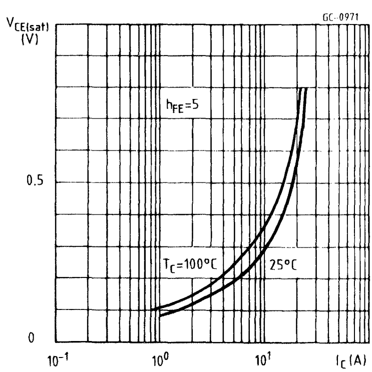
DC Current Gain



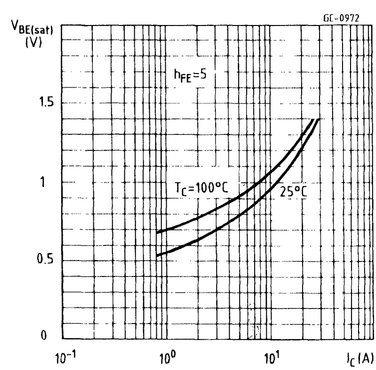
Collector-emitter Saturation Voltage



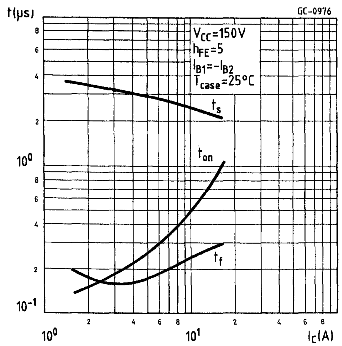
Collector-emitter Saturation Voltage



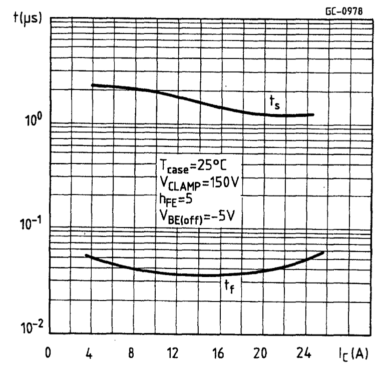
Base-emitter Saturation Voltage



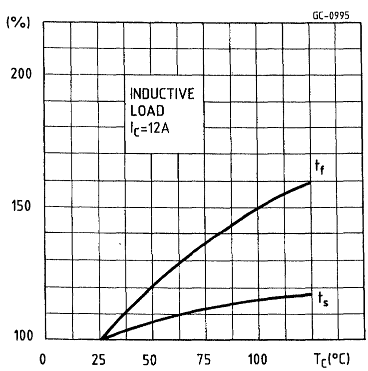
Resistive Load Switching Times



Inductive Load Switching Times



Switching Times Percentance Variation



SGS-THOMSON MICROELECTRONICS

SGSF665

FASTSWITCH HOLLOW–EMITTER NPN TRANSISTOR

- HIGH SWITCHING SPEED NPN POWER TRANSISTOR
- HOLLOW EMITTER TECHNOLOGY
- HIGH VOLTAGE FOR OFF-LINE APPLICATIONS
- 50kHz SWITCHING SPEED
- LOW COST DRIVE CIRCUITS
- LOW DYNAMIC SATURATION

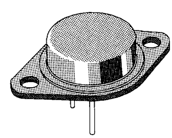
APPLICATIONS

- SMPS
- TV AND MONITOR DEFLECTION

DESCRIPTION

This hollow emitter FASTSWITCH NPN power transistor is specially designed for 220V (and 117V with input doubler) off-line switching power supply applications. It can also be used for 117V three phase mains off-line switching power supplies. The superior switching performance reduces dissipation and consequently lowers the equipment operating temperature. This transistor is suitable for applications in half bridge and full bridge high power converters, 700W to 1500W. The high switching speed of this transistor, together with its high voltage and current rating, make it ideal for horizontal deflection circuits in large screen colour televisions and monitors. When used in conjunction with a low voltage Power MOSFET in emitter switch configuration, they can operate at up to 100kHz.

This hollow emitter FASTSWITCH transistor is available in the metal can TO-3 package.



TO-3

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	SGSF665	Unit
V_{CES}	Collector - Emitter Voltage ($V_{BE} = 0$)	1300	V
V_{CEO}	Collector - Emitter Voltage ($I_B = 0$)	600	V
V_{EBO}	Emitter - Base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	20	A
I_{CM}	Collector Peak Current ($t_p < 5ms$)	30	A
I_B	Base Current	14	A
I_{BM}	Base Peak Current ($t_p < 5ms$)	24	A
P_{tot}	Total Dissipation at $T \leq 25°C$	250	W
T_{stg}	Storage Temperature – 65 to	175	°C
T_j	Junction Temperature	175	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case Max	0.6	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 1300V			400	µA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 380V V_{CE} = 600V			400 4	µA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			2	mA
$V_{CEO\ (sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.2A	600			V
$V_{CE\ (sat)}$*	Collector Emitter Saturation Voltage	I_C = 10A I_B = 2A I_C = 6A I_B = 0.9A			1.5 1.5	V V
$V_{BE\ (sat)}$*	Base Emitter Saturation Voltage	I_C = 10A I_B = 2A I_C = 6A I_B = 0.9A			1.5 1.5	V V

RESISTIVE LOAD

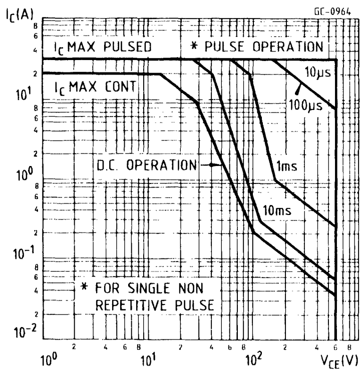
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	I_C = 10A V_{CC} = 250V I_{B1} = 2A I_{B2} = – 2 I_{B1}		0.6	1.2	µs
t_s	Storage Time			2.45	3.5	µs
t_f	Fall Time			0.12	0.4	µs
t_{on}	Turn-on Time	I_C = 10A V_{CC} = 250V I_{B1} = 2A I_{B2} = – 2 I_{B1} With Antisaturation Network		0.6		µs
t_s	Storage Time			1.7		µs
t_f	Fall Time			0.12		µs
t_{on}	Turn-on Time	I_C = 10A V_{CC} = 250V I_{B1} = 2A $V_{BE(off)}$ = – 5V		0.6		µs
t_s	Storage Time			1.3		µs
t_f	Fall Time			0.2		µs

INDUCTIVE LOAD

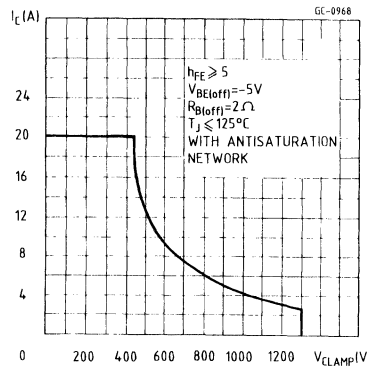
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s	Storage Time	I_C = 10A h_{FE} = 5 V_{CL} = 450V $V_{BE(off)}$ = – 5V L = 300µH $R_{B(off)}$ = 0.5Ω		1.5	3	µs
t_f	Fall Time			0.12	0.25	µs
t_s	Storage Time	I_C = 10A h_{FE} = 5 V_{CL} = 450V $V_{BE(off)}$ = – 5V L = 300µH $R_{B(off)}$ = 0.5Ω T_C = 100°C			4.3	µs
t_f	Fall Time				0.35	µs

* Pulsed : Pulse duration = 300µs, duty cycle = 1.5%

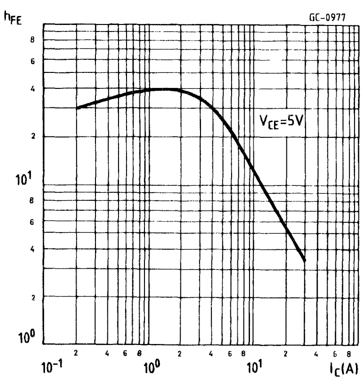
Safe Operating Areas



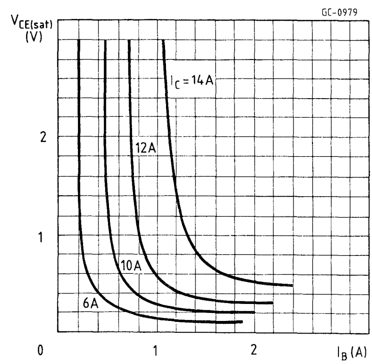
Reverse Biased Safe Operating Area



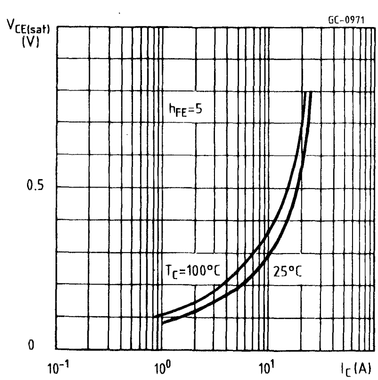
DC Current Gain



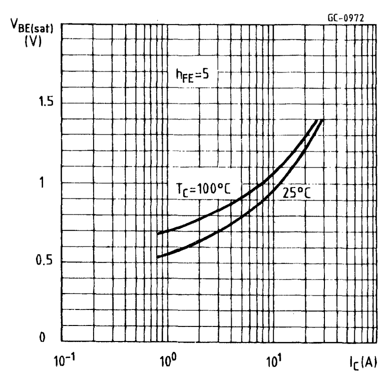
Collector-emitter Saturation Voltage



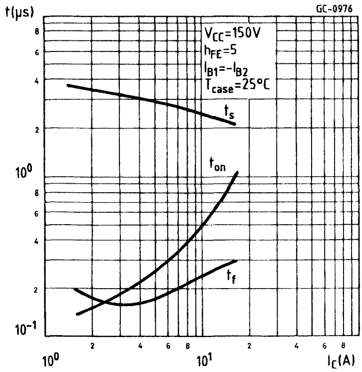
Collector-emitter Saturation Voltage



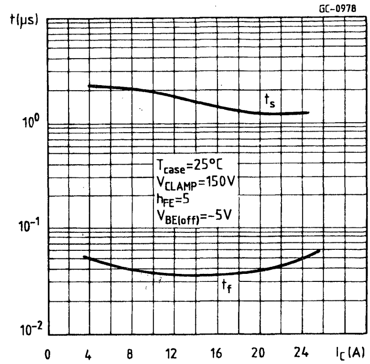
Base-emitter Saturation Voltage



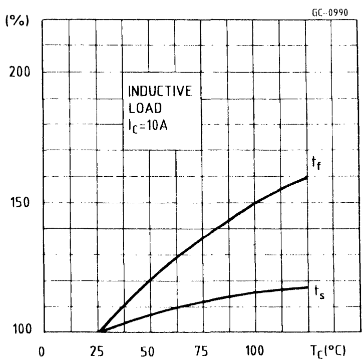
Resistive Load Switching Times



Inductive Load Switching Times



Switching Times Percentance Variation



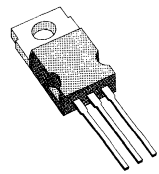
SGS-THOMSON
MICROELECTRONICS

TIP31/31A/31B/31C
TIP32/32A/32B/32C

MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

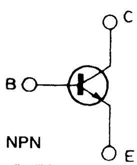
DESCRIPTION

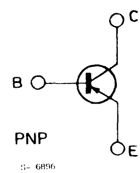
The TIP31, TIP31A, TIP31B and TIP31C are silicon epitaxial-base power NPN transistors in Jedec TO-220 plastic package, intended for use in medium power linear and switching applications. The complementary PNP types are the TIP32, TIP32A, TIP32B and TIP32C.



TO-220

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	NPN / PNP*	Value				Unit
		NPN	TIP31	TIP31A	TIP31B	TIP31C	
		PNP*	TIP32	TIP32A	TIP32B	TIP32C	
V_{CBO}	Collector-base Voltage ($I_E = 0$)		40	60	80	100	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)		40	60	80	100	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)		5				V
I_C	Collector Current		3				A
I_{CM}	Collector Peak Current		5				A
I_B	Base Current		1				A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C $T_{amb} \leq 25$°C		40 2				W W
T_{stg}	Storage Temperature		– 65 to 150				°C
T_j	Junction Temperature		150				°C

* For PNP types voltage and current values are negative.

THERMAL DATA

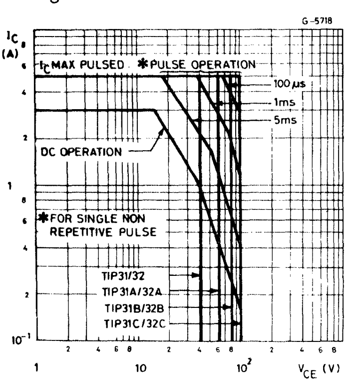
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	3.12	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	62.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

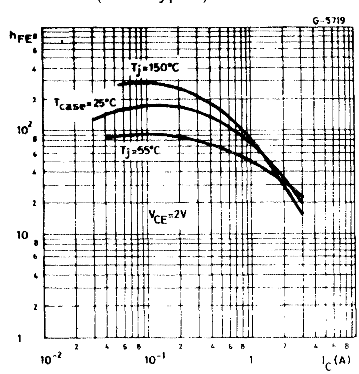
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **TIP31/31A/32/32A** V_{CE} = 30 V for **TIP31B/31C/32B/32C** V_{CE} = 60 V			0.3 0.3	mA mA
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	for **TIP31/32** V_{CE} = 40 V for **TIP31A/32A** V_{CE} = 60 V for **TIP31B/32B** V_{CE} = 80 V for **TIP31C/32C** V_{CE} = 100 V			0.2 0.2 0.2 0.2	mA mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 30 mA for **TIP31/32** for **TIP31A/32A** for **TIP31B/32B** for **TIP31C/32C**	40 60 80 100			V V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 3 A I_B = 375 mA			1.2	V
$V_{BE(on)}$*	Base-emitter Voltage	I_C = 3 A V_{CE} = 4 A			1.8	V
h_{FE}*	DC current Gain	I_C = 1 A V_{CE} = 4 V I_C = 3 A V_{CE} = 4 V	25 10		50	
h_{fe}	Small Signal Current Gain	I_C = 0.5 A V_{CE} = 10 V f = 1 KHz I_C = 0.5 A V_{CE} = 10 V f = 1 MHz	20 3			

* Pulsed : pulse duration = 300 µs, duty cycle ≤ 2 %.
For PNP types voltage and current values are negative.

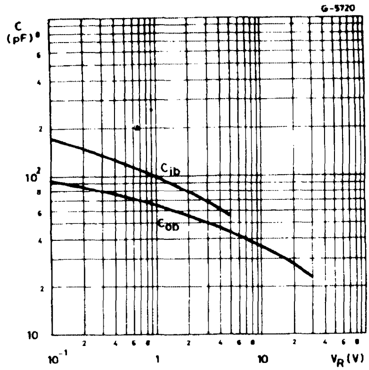
Safe Operating Areas.



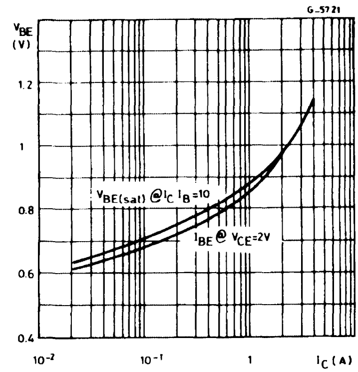
DC Current Gain (NPN types).



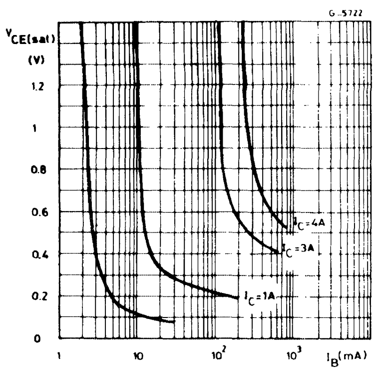
Input and Output Capacitance (NPN types).



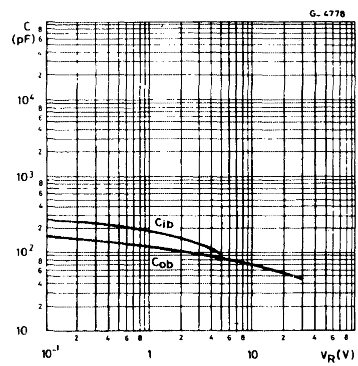
Base-emitter Voltage (NPN types).



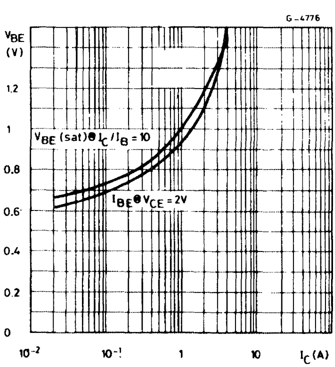
Collector-emitter Saturation Voltage (NPN types).



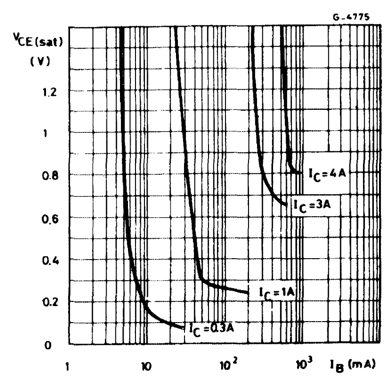
Input and Output Capacitance (PNP types).



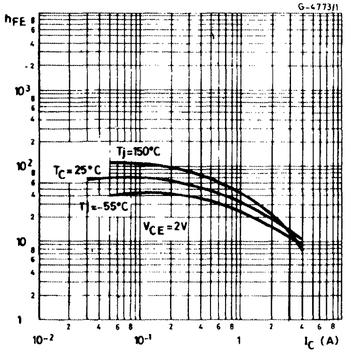
Base-emitter Voltage (PNP types).



Collector-emitter Saturation Voltage (PNP types).



DC Current Gain (PNP types).



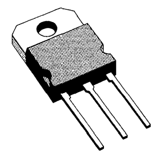
SGS-THOMSON MICROELECTRONICS

TIP33A/B/C
TIP34A/B/C

NPN MEDIUM POWER TRANSISTORS

ADVANCE DATA

- 10A RATED COLLECTOR CURRENT
- HIGH SPEED SWITCHING



TO-218

DESCRIPTION

The TIP33A, TIP33B and TIP33C are silicon epitaxial base NPN power transistors in TO-218 plastic package intended for use in linear and switching applications.

The complementary PNP types are TIP34A, TIP34B and TIP34C respectively.

INTERNAL SCHEMATIC DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	NPN / PNP	Value TIP33A / TIP34A	Value TIP33B / TIP34B	Value TIP33C / TIP34C	Unit
V_{CBO}	Collector-base Voltage	$I_E = 0$	100	120	140	V
V_{CES}	Collector-emitter Voltage	$V_{BE} = 0$	100	120	140	V
V_{CEO}	Collector-emitter Voltage	$I_B = 0$	60	80	100	V
V_{EBO}	Emitter-base Voltage	$I_C = 0$	7			V
I_C	Collector Current		10			A
I_{CM}	Collector Peak Current t_p < ?ms		12			A
I_B	Base Current		3			A
P_{tot}	Total Dissipation at $T_c < 25°C$		80			W
T_{stg}	Storage Temperature		– 65 to 150			°C
T_j	Max. Operating Junction Temperature		150			°C

For PNP types voltage and current values are negative.

This is advanced information on a new product now in development or undergoing evaluation. Details are subject to change without notice.

THERMAL DATA

$R_{thj-case}$	Thermal Resistance Junction-case	max	1.56	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 100V for **TIP33A/34A** V_{CE} = 120V for **TIP33B/34B** V_{CE} = 140V for **TIP33C/34C**			400 400 400	µA µA µA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 30V for **TIP33A/34A** V_{CE} = 60V for **TIP33B/34B** V_{CE} = 60V for **TIP33C/34C**			0.7 0.7 0.7	mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 30mA for **TIP33A/34A** for **TIP33B/34B** for **TIP33C/34C**	60 80 100			V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 3A I_B = 0.3A I_C = 10A I_B = 2.5A			1 4	V V
$V_{BE(on)}$*	Base-emitter Voltage	I_C = 3A V_{CE} = 4V I_C = 10A V_{CE} = 4V			1.6 3	V V
h_{FE}*	DC Current Gain	I_C = 1A V_{CE} = 4V I_C = 3A V_{CE} = 4V	40 20		 100	
h_{fe}	Small Signal Current Gain	I_C = 0.5A V_{CE} = 10V f = 1KHz	20			
f_T	Transition Frequency	I_C = 0.5A V_{CE} = 10V f = 1MHz	3			MHz
 t_{on} t_s t_f	RESISTIVE LOAD Turn-on Time Storage Time Fall Time	 V_{CC} = 30V I_C = 6A V_{BB} = − 6V I_{B1} = − I_{B2} = 0.6A t_p = 20µs		 0.6 0.4 1		 µs µs µs

* Pulsed : pulse duration = 300µs, duty cycle = 1.5%.
For PNP types voltage and current values are negative.

SGS-THOMSON MICROELECTRONICS

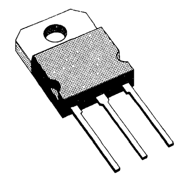
TIP35/35A/35B/35C
TIP36/36A/36B/36C

POWER AMPLIFIER AND SWITCHING APPLICATIONS

ADVANCE DATA

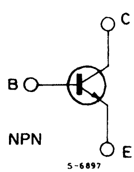
DESCRIPTION

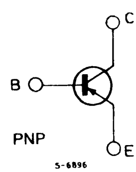
The TIP35/TIP35A/TIP35B/TIP35C are silicon epitaxial-base NPN transistors in SOT-93 plastic package. They are intended for power amplifier and switching applications. The complementary PNP types are the TIP36/TIP36A/TIP36B/TIP36C.



TO-218

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	PNP* NPN	Value				Unit
			TIP36 TIP35	TIP36A TIP35A	TIP36B TIP35B	TIP36C TIP35C	
V_{CEO}	Collector-emitter Voltage (I_B = 0)		40	60	80	100	V
V_{CBO}	Collector-base Voltage (I_E = 0)		40	60	80	100	V
V_{EBO}	Emitter-base Voltage (I_C = 0)		5				V
I_C	Collector Current		25				A
I_{CM}	Collector Peak Current		50				A
I_B	Base Current		5				A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C		125				W
T_{stg}	Storage Temperature		– 65 to 150				°C
T_j	Junction Temperature		150				°C

* For PNP types voltage and current values are negative.

This is advanced information on a new product now in development or undergoing evaluation. Details are subject to change without notice.

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **TIP35/35A/36/36A** V_{CE} = 30 V for **TIP35B/35C/36B/36C** V_{CE} = 60 V			1 1	mA mA
I_{EBO}	Emitter Cutoff Current (V_{BE} = 0)	V_{EB} = 5 V			1	mA
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = Rated V_{CEO}			0.7	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 30 mA for **TIP35/36** for **TIP35A/36A** for **TIP35B/36B** for **TIP35C/36C**	 40 60 80 100			 V V V V
h_{FE}*	DC current Gain	I_C = 1.5 A V_{CE} = 4 V I_C = 15 A V_{CE} = 4 V	25 10		50	
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C =15 A I_B = 1.5 A I_C = 25 A I_B = 5 A			1.8 4	V V
$V_{BE(on)}$*	Base-emitter on Voltage	I_C = 15 A V_{CE} = 4 V I_C = 25 A V_{CE} = 4 V			2 4	V V
f_T	Transition Frequency	I_C = 1 A V_{CE} = 10 V f = 1 MHz	3			MHz
h_{fe}	Small Signal Current Gain	I_C = 1 A V_{CE} = 10 V f = 1 KHz	25			

* Pulsed : pulse duration ≤ 300 μs, duty cycle ≤ 2 %.
For PNP types voltage and current values are negative.

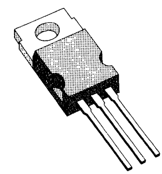
SGS-THOMSON MICROELECTRONICS

TIP41/41A/41B/41C
TIP42/42A/42B/42C

MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

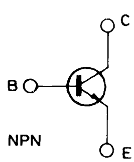
DESCRIPTION

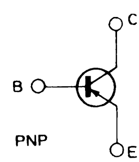
The TIP41, TIP41A, TIP41B and TIP41C are silicon epitaxial-base NPN power transistors in Jedec TO-220 plastic package intended for use in medium power linear and switching applications. The complementary PNP types are the TIP42, TIP42A, TIP42B and TIP42C respectively.



TO-220

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	NPN / PNP*	Value				Unit
			TIP41 / TIP42	TIP41A / TIP42A	TIP41B / TIP42B	TIP41C / TIP42C	
V_{CBO}	Collector-base Voltage ($I_E = 0$)		40	60	80	100	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)		40	60	80	100	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)		5				V
I_C	Collector Current		6				A
I_{CM}	Collector Peak Current		10				A
I_B	Base Current		3				A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C $T_{amb} \leq 25$°C		65 2				W W
T_{stg}	Storage Temperature		– 65 to 150				°C
T_j	Junction Temperature		150				°C

* For PNP types voltage and current values are negative.

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.92	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	62.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **TIP41/41A/42/42A** V_{CE} = 30 V for **TIP41B/41C/42B/42C** V_{CE} = 60 V			0.7 0.7	mA mA
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	for **TIP41/42** V_{CE} = 40 V for **TIP41A/42A** V_{CE} = 60 V for **TIP41B/42B** V_{CE} = 80 V for **TIP41C/42C** V_{CE} = 100 V			0.4 0.4 0.4 0.4	mA mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 30 mA for **TIP41/42** for **TIP41A/42A** for **TIP41B/42B** for **TIP41C/42C**	 40 60 80 100			 V V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 6 A I_B = 0.6 A			1.5	V
V_{BE}*	Base-emitter Voltage	I_C = 6 A V_{CE} = 4 V			2	V
h_{FE}*	DC current Gain	I_C = 0.3 A V_{CE} = 4 V I_C = 3 A V_{CE} = 4 V	30 15		75	
h_{fe}	Small Signal Current Gain	I_C = 0.5 A V_{CE} = 10 V f = 1 KHz f = 1 MHz	 20 3			

* Pulsed : pulse duration = 300 µs, duty cycle ≤ 2 %.
For PNP types voltage and current values are negative.

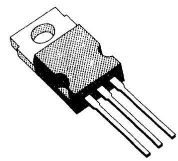
SGS-THOMSON MICROELECTRONICS

TIP47/TIP48
TIP49/TIP50

LINEAR AND SWITCHING APPLICATIONS

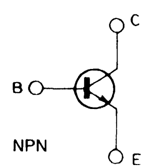
DESCRIPTION

The TIP47 to TIP50 are silicon multiepitaxial planar transistors in TO-220 plastic package intended for linear and switching applications.



TO-220

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value				Unit
		TIP47	TIP48	TIP49	TIP50	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	350	400	450	500	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	250	300	350	400	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5				V
I_C	Collector Current	1				A
I_{CM}	Collector Peak Current	2				A
I_B	Base Current	0.6				A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	40				W
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$°C	2				W
T_{stg}	Storage Temperature	– 65 to 150				°C
T_j	Junction Temperature	150				°C

THERMAL DATA

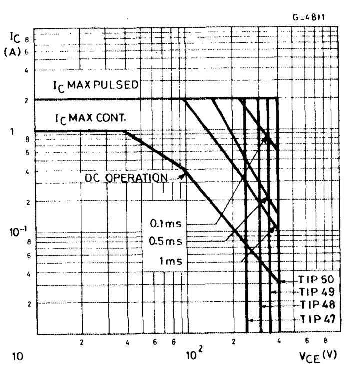
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	3.125	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	62.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

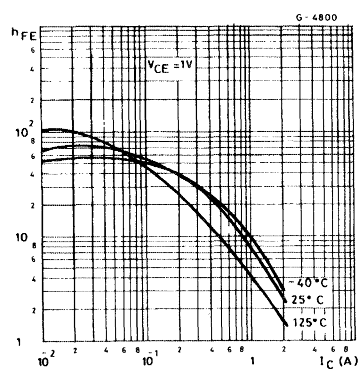
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	for **TIP47**	V_{CE} = 350 V			1	mA
		for **TIP48**	V_{CE} = 400 V			1	mA
		for **TIP49**	V_{CE} = 450 V			1	mA
		for **TIP50**	V_{CE} = 500 V			1	mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **TIP47**	V_{CE} = 150 V			1	mA
		for **TIP48**	V_{CE} = 200 V			1	mA
		for **TIP49**	V_{CE} = 250 V			1	mA
		for **TIP50**	V_{CE} = 300 V			1	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V				1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 30 mA	for **TIP47**	250			V
			for **TIP48**	300			V
			for **TIP49**	350			V
			for **TIP50**	400			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 1 A	I_B = 0.2 A			1	V
$V_{BE(on)}$*	Base-emitter on Voltage	I_C = 1 A	V_{CE} = 10 V			1.5	V
h_{FE}*	DC current Gain	I_C = 0.3 A	V_{CE} = 10 V	30		150	
		I_C = 1 A	V_{CE} = 10 V	10			
f_T	Transition Frequency	V_{CE} = 10 V, f = 2 MHz	I_C = 0.2 A	10			MHz
h_{fe}	Small Signal Current Gain	V_{CE} = 10 V, f = 1 KHz	I_C = 0.2 A	25			

* Pulsed : pulse duration = 300 µs, duty cycle ≤ 2 %.

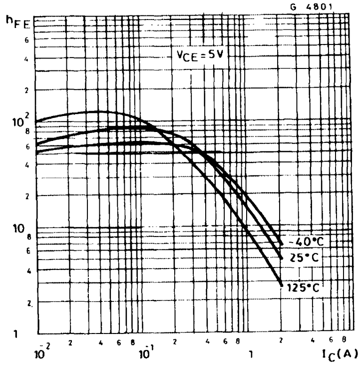
Safe Operating Areas.



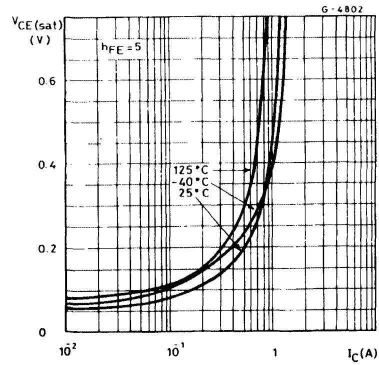
DC Current Gain.



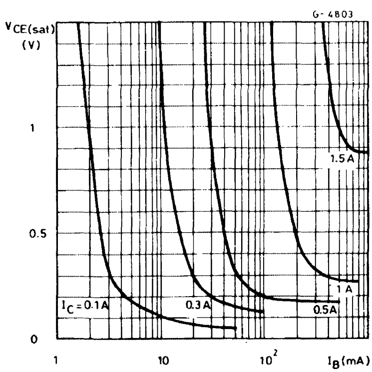
DC Current Gain.



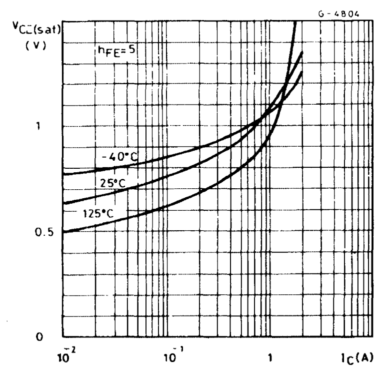
Collector-emitter Saturation Voltage.



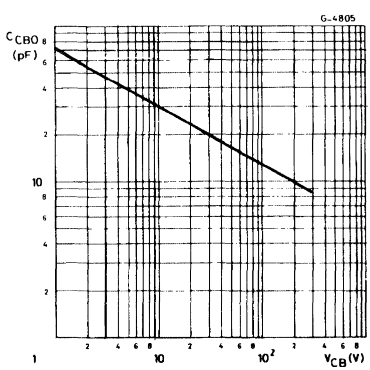
Collector-emitter Saturation Voltage.



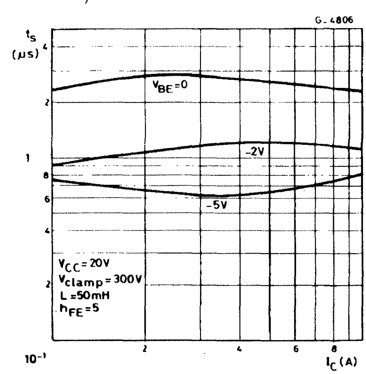
Base-emitter Saturation Voltage.



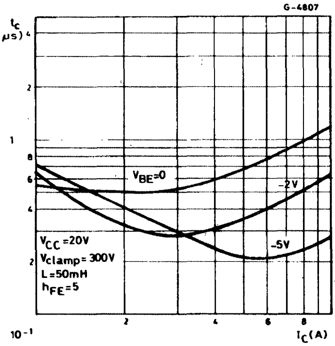
Collector-base capacitance.



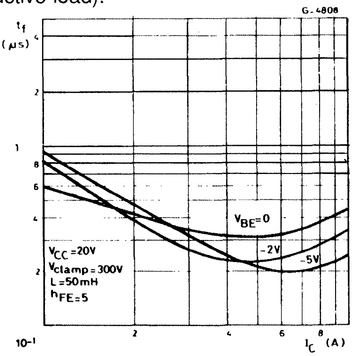
Saturated Swtiching Characteristics (inductive load).



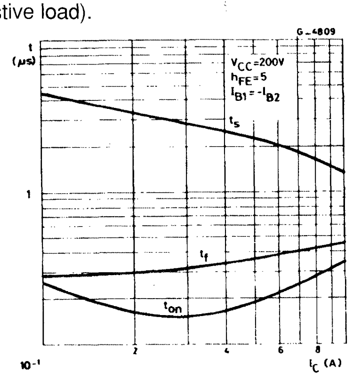
Saturated Swtiching Characteristics (inductive load).



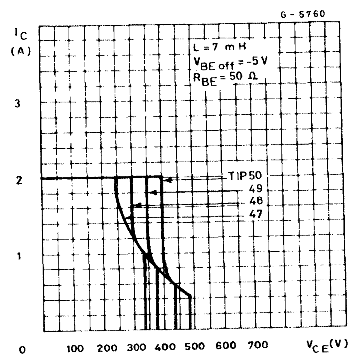
Saturated Swtiching Characteristics (inductive load).



Saturated Swtiching Characteristics (resistive load).



Campled Reverse Bias Safe Operating Areas.



SGS-THOMSON
MICROELECTRONICS

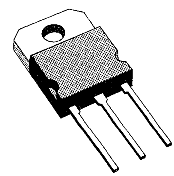
TIP51/TIP52
TIP53/TIP54

HIGH VOLTAGE POWER SWITCH

DESCRIPTION

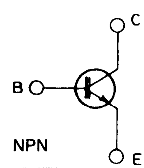
The TIP51, TIP52, TIP53 and TIP54 are silicon multiepitaxial mesa NPN transistors in SOT-93 plastic package.

They are intended for high voltage, fast switching industrial and consumer applications.



TO-218

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value				Unit
		TIP51	TIP52	TIP53	TIP54	
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	350	400	450	500	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	250	300	350	400	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5				V
I_C	Collector Current	3				A
I_{CM}	Collector Peak Current	5				A
I_B	Base Current	0.6				A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	100				W
T_{stg}	Storage Temperature	– 65 to 150				°C
T_j	Junction Temperature	150				°C

THERMAL DATA

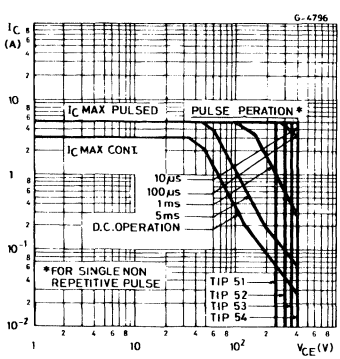
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.25	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	for **TIP51** V_{CE} = 350 V for **TIP52** V_{CE} = 400 V for **TIP53** V_{CE} = 450 V for **TIP54** V_{CE} = 500 V			1 1 1 1	mA mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **TIP51** V_{CE} = 150 V for **TIP52** V_{CE} = 200 V for **TIP53** V_{CE} = 250 V for **TIP54** V_{CE} = 300 V			1 1 1 1	mA mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 30 mA for **TIP51** for **TIP52** for **TIP53** for **TIP54**	250 300 350 400			V V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 3 A I_B = 0.6 A			1.5	V
V_{BE}*	Base-emitter	I_C = 3 A V_{CE} = 10 V			1.5	V
h_{FE}*	DC current Gain	I_C = 0.3 A V_{CE} = 10 V I_C = 3 A V_{CE} = 10 V	30 10		150	
h_{fe}	Small Signal Current Gain	I_C = 0.2 A ; V_{CE} = 10 V ; f = 1 KHz I_C = 0.2 A ; V_{CE} = 10 V ; f = 1 MHz	30 2.5			
$E_{s/b}$	Second Breakdown Unclamped Energy	V_{BE} = 20 V R_{BE} = 100 Ω L = 30 mH	100			mJ
t_{on}	Turn-on Time	I_C = 1 A I_{B1} = 100 mA V_{CC} = 200 V		0.2		µs
t_{off}	Turn-off Time	I_C = 1 A I_{B1} = − I_{B2} = 100 mA V_{CC} = 200 V		2		µs

* Pulsed : pulse duration = 300 µs, duty cycle = 1.5 %.

Safe Operating Areas.



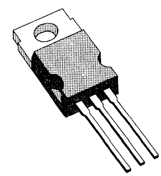
SGS-THOMSON
MICROELECTRONICS

TIP100/101/102
TIP105/106/107

POWER DARLINGTONS

DESCRIPTION

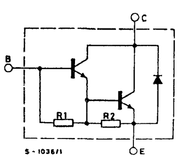
The TIP100, TIP101 and TIP102 are silicon epitaxial-base NPN transistors in monolithic Darlington configuration mounted in Jedec TO-220 plastic package, intended for use in power linear and switching applications. The complementary PNP types are the TIP105, TIP106 and TIP107 respectively.



TO-220

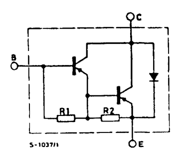
INTERNAL SCHEMATIC DIAGRAMS

NPN



R1 Typ. 5 KΩ
R2 Typ. 150 KΩ

PNP



R1 Typ. 5 KΩ
R2 Typ. 150 KΩ

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter NPN / PNP*	Value			Unit
		TIP100 TIP105	TIP101 TIP106	TIP101 TIP107	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	60	80	100	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	60	80	100	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5			V
I_C	Collector Current	8			A
I_{CM}	Collector Peak Current	15			A
I_B	Base Current	1			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C $T_{amb} \leq 25$ °C	80 2			W W
T_{stg}	Storage Temperature	– 65 to 150			°C
T_j	Junction Temperature	150			°C

* For PNP types voltage and current values are negative.

THERMAL DATA

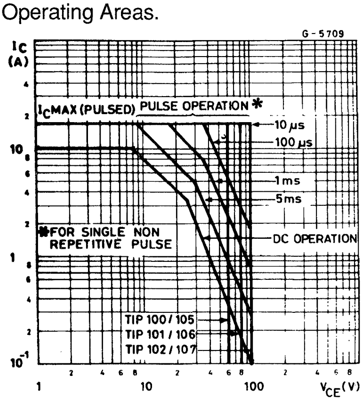
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.56	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	62.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

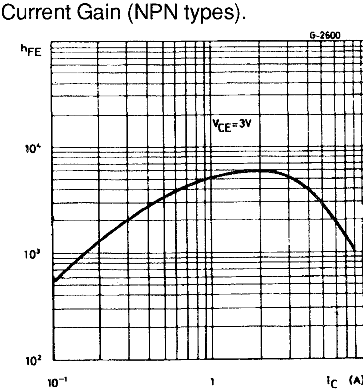
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **TIP100/105** V_{CE} = 30 V for **TIP101/106** V_{CE} = 40 V for **TIP102/107** V_{CE} = 50 V			50 50 50	µA µA µA
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **TIP100/105** V_{CB} = 60 V for **TIP101/106** V_{CB} = 80 V for **TIP102/107** V_{CB} = 100 V			50 50 50	µA µA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			8	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 30 mA for **TIP100/105** for **TIP101/106** for **TIP102/107**	 60 80 100			 V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 3 A I_B = 6 mA I_C = 8 A I_B = 80 mA			2 2.5	V V
V_{BE}*	Base-emitter Voltage	I_C = 8 A V_{CE} = 4 V			2.8	V
h_{FE}*	DC current Gain	I_C = 3 A V_{CE} = 4 V I_C = 8 A V_{CE} = 4 V	1000 200		20000	
V_F*	Forward Voltage of Commutation Diode (I_B = 0)	I_F = − I_C = 10 A			2.8	V

* Pulsed : pulse duration = 300 µs, duty cycle ≤ 2 %.
For PNP types voltage and current values are negative.

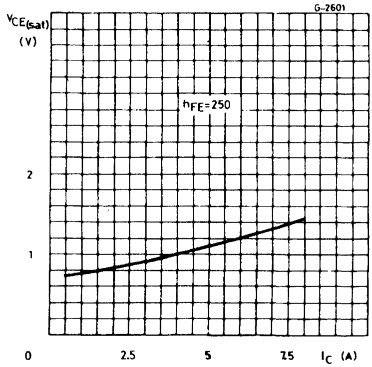
Safe Operating Areas.



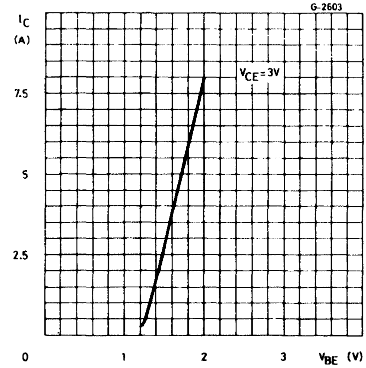
DC Current Gain (NPN types).



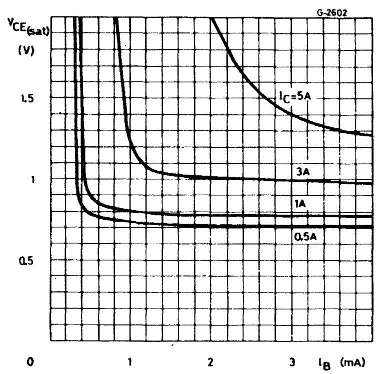
Collector-emitter Saturation Voltage (NPN types).



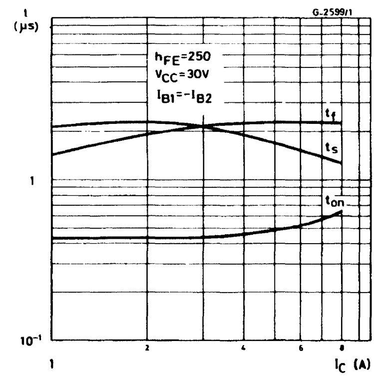
DC Transconductance (NPN types).



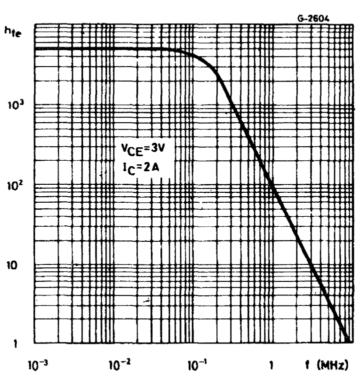
Collector-emitter Saturation Voltage (NPN types).



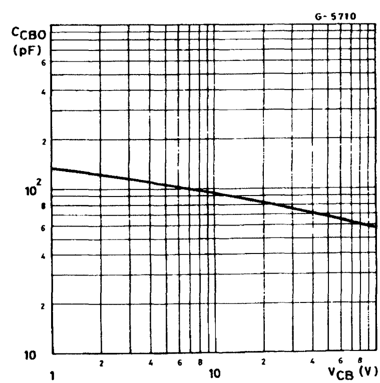
Saturated Switching Characteristics (NPN types).



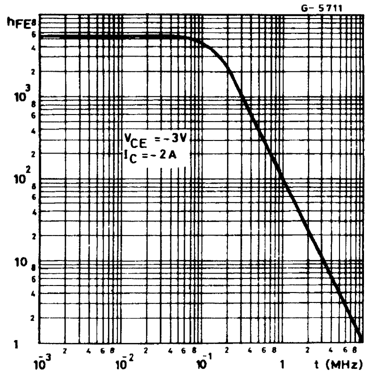
Small Signal Current Gain (NPN types).



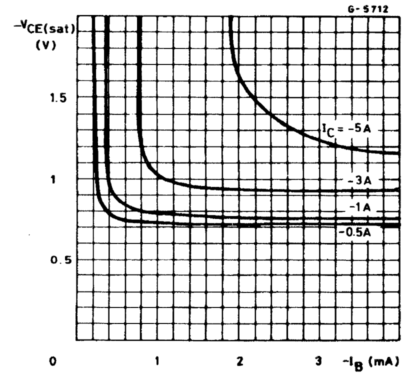
Collector-base Capacitance (PNP types).



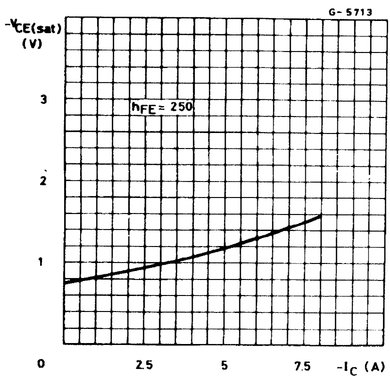
Small Signal Current Gain (PNP types).



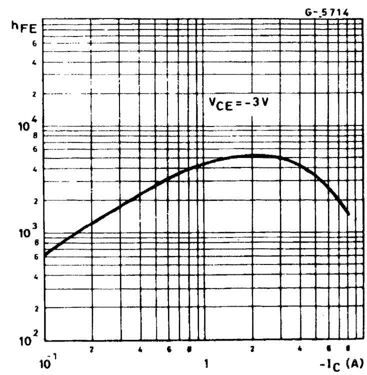
Collector-emitter Saturation Voltage (PNP types).



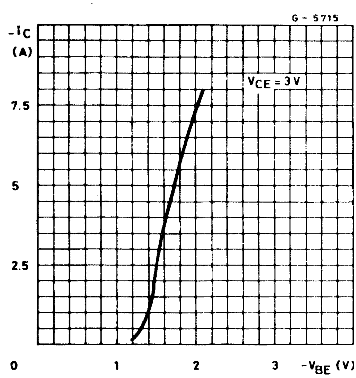
Collector-emitter Saturation Voltage (PNP types).



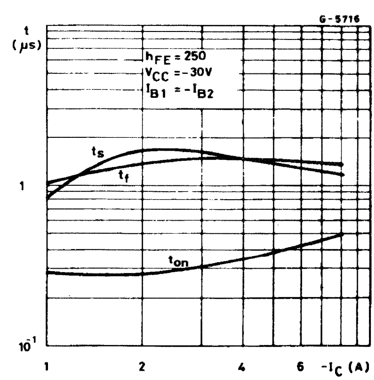
DC Current Gain (PNP types).



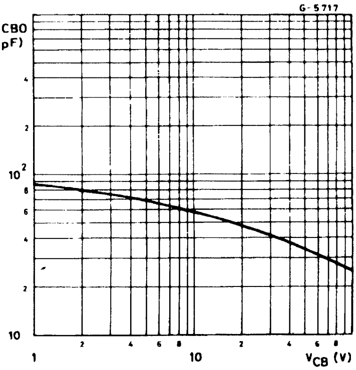
DC Transconductance (PNP types).



Saturated Switching Characteristics (PNP types).



Collector-base Capacitance (NPN types).



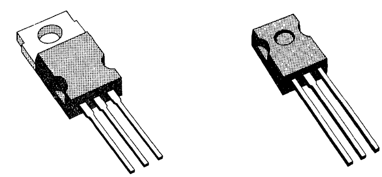
SGS-THOMSON
MICROELECTRONICS

TIP/SGS110-111-112
TIP/SGS115-116-117

POWER DARLINGTONS

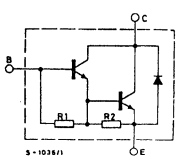
DESCRIPTION

The TIP110, TIP111, TIP112 and SGS110, SGS111, SGS112 are silicon epitaxial-base NPN transistors in monolithic Darlington configuration respectively in TO-220 and SOT-82 plastic package. They are intended for use in medium power linear and switching applications. The complementary PNP types are the TIP115, TIP116, TIP117 and SGS115, SGS116, SGS117 respectively.

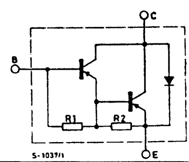


TO-220 SOT-82

INTERNAL SCHEMATIC DIAGRAMS



R1 ≅ 5 KΩ
R2 ≅ 150Ω



R1 ≅ 5 KΩ
R2 ≅ 150Ω

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter		Value			Unit
		NPN	TIP110	TIP111	TIP112	
		NPN	SGS110	SGS111	SGS112	
		PNP	TIP115	TIP116	TIP117	
		PNP	SGS115	SGS116	SGS117	
V_{CBO}	Collector-base Voltage ($I_E = 0$)		60	80	100	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)		60	80	100	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)		5			V
I_C	Collector Current		2			A
I_{CM}	Collector Peak Current		4			A
I_B	Base Current		50			mA
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C $T_{amb} \leq 25$°C		50 2			W W
T_{stg}	Storage Temperature		– 65 to 150			°C
T_j	Junction Temperature		150			°C

For PNP types voltage and current values are negative.

THERMAL DATA

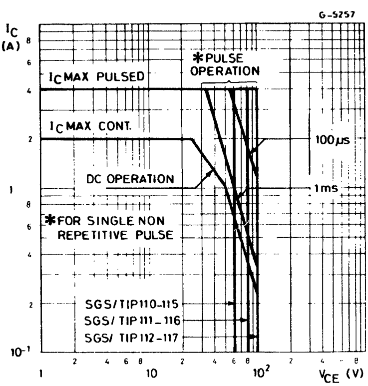
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	2.5	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	62.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

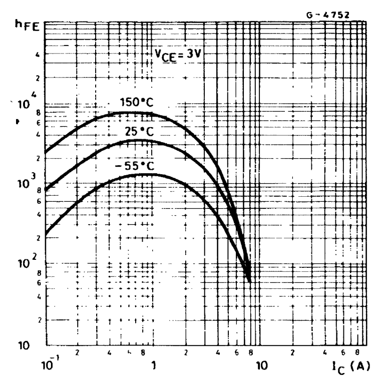
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = Half Rated V_{CEO}			2	mA
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = Rated V_{CBO}			1	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			2	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 30 mA for **TIP/SGS110** and **TIP/SGS115** for **TIP/SGS111** and **TIP/SGS116** for **TIP/SGS112** and **TIP/SGS117**	 60 80 100			 V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 2 A I_B = 8 mA			2.5	V
V_{BE}*	Base-emitter Voltage	I_C = 2 A V_{CE} = 4 V			2.8	V
h_{FE}*	DC current Gain	I_C = 1 A V_{CE} = 4 V I_C = 2 A V_{CE} = 4 V	1000 500			

* Pulsed : pulse duration = 300 µs, duty cycle ≤ 2 %.
For PNP types voltage and current values are negative.

Safe Operating Areas.

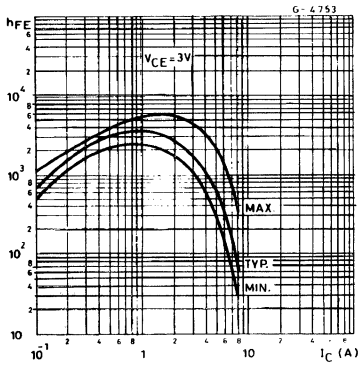


DC Current Gain (NPN types).

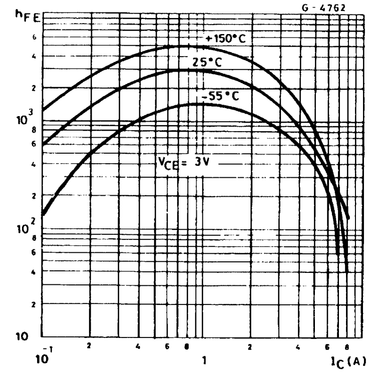


SGS-THOMSON MICROELECTRONICS

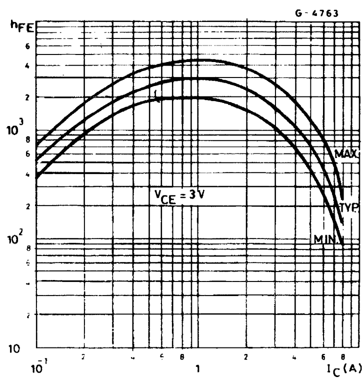
DC Current Gain (NPN types).



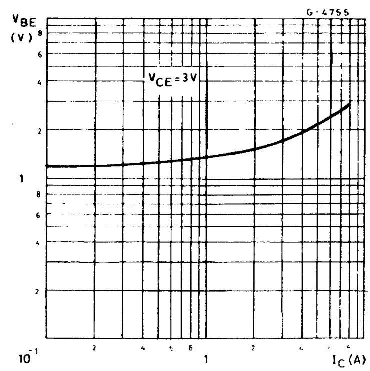
DC Current Gain (PNP types).



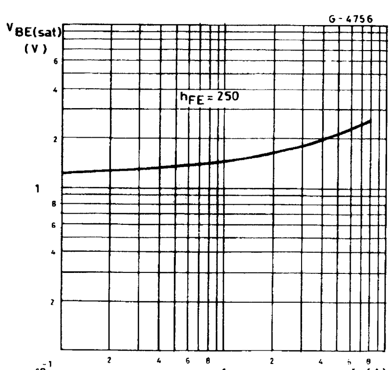
DC Current Gain (PNP types).



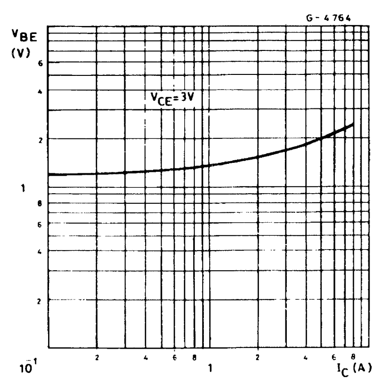
Base-emitter Voltage (NPN types).



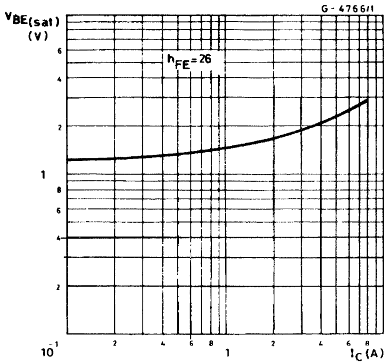
Base-emitter Saturation Voltage (NPN types).



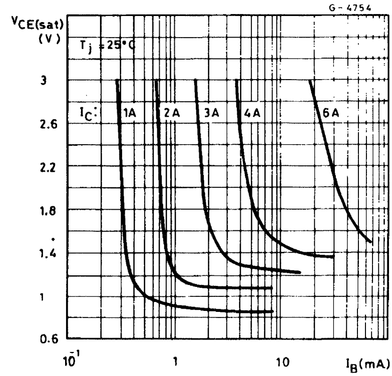
Base-emitter Voltage (PNP types).



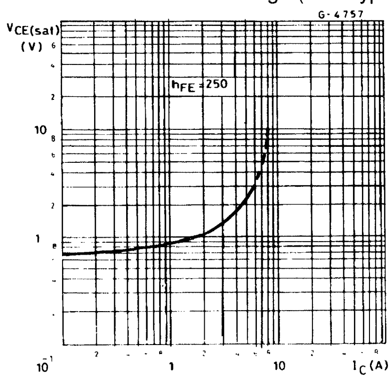
Base-emitter Saturation Voltage (PNP types).



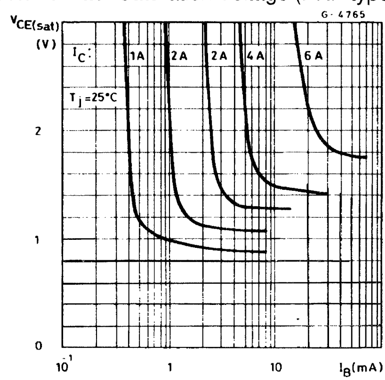
Collector-emitter Saturation Voltage (NPN types).



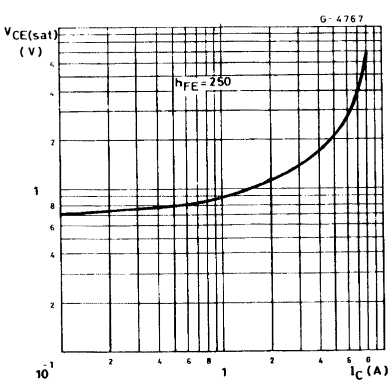
Collector-emitter Saturation Voltage (NPN types).



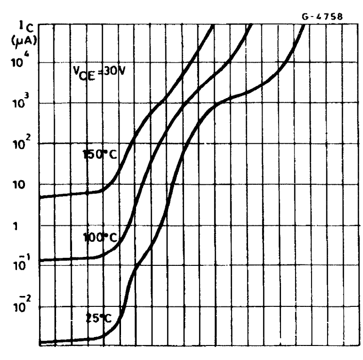
Collector-emitter Saturation Voltage (PNP types).



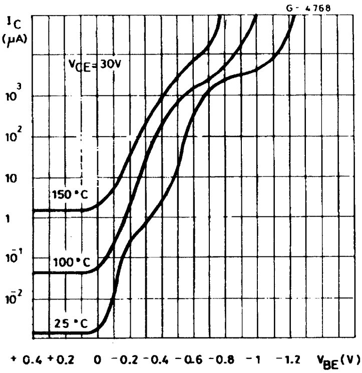
Collector-emitter Saturation Voltage (PNP types).



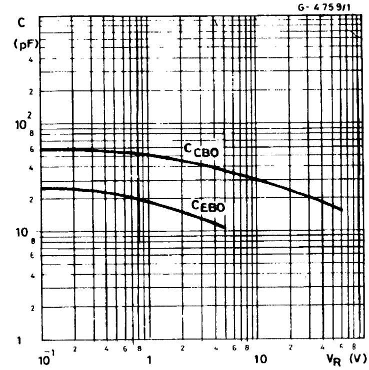
Collector Cutoff Current (NPN types).



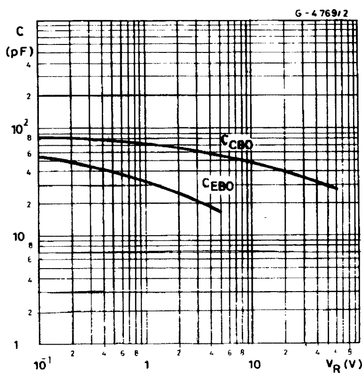
Collector Cutoff Current (NPN types).



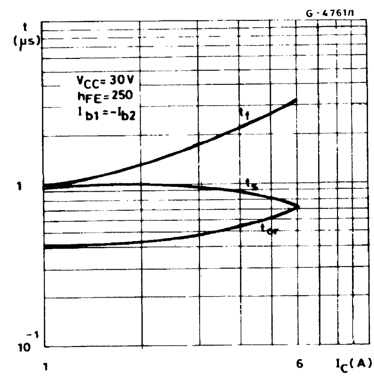
Capacitances (NPN types).



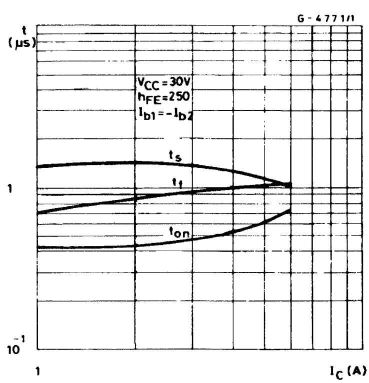
Capacitances (PNP types).



Saturated Switching Characteristics (NPN types).



Saturated Switching Characteristics (PNP types).

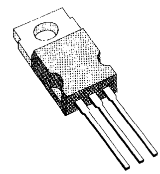


TIP120-121-122
TIP125-126-127

POWER DARLINGTONS

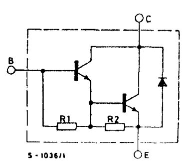
DESCRIPTION

The TIP120, TIP121 and TIP122 are silicon epitaxial-base NPN transistors in monolithic Darlington configuration in Jedec TO-220 plastic package, intended for use in power linear and switching applications. The complementary PNP types are the TIP125, TIP126 and TIP127 respectively.

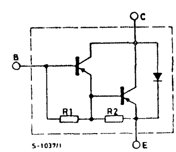


TO-220

INTERNAL SCHEMATIC DIAGRAMS



R1 Typ. 5 KΩ
R2 Typ. 150 KΩ



R1 Typ. 5 KΩ
R2 Typ. 150 KΩ

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter NPN / PNP*	Value			Unit
		TIP120 TIP125	TIP121 TIP126	TIP122 TIP127	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	60	80	100	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	60	80	100	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5			V
I_C	Collector Current	5			A
I_{CM}	Collector Peak Current	8			A
I_B	Base Current	0.1			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C $T_{amb} \leq 25$°C	65 2			W W
T_{stg}	Storage Temperature	– 65 to 150			°C
T_j	Junction Temperature	150			°C

* For PNP types voltage and current values are negative.

THERMAL DATA

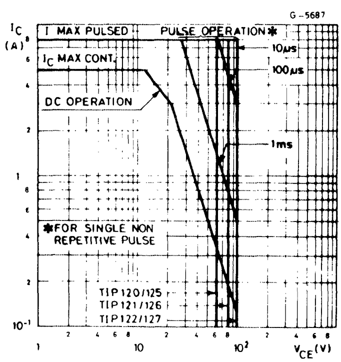
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.92	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	62.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

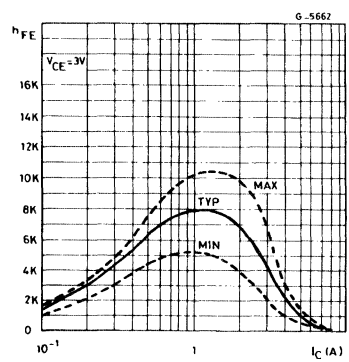
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **TIP120/5** V_{CE} = 30 V for **TIP121/6** V_{CE} = 40 V for **TIP122/7** V_{CE} = 50 V			0.5 0.5 0.5	mA mA mA
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **TIP120/5** V_{CB} = 60 V for **TIP121/6** V_{CB} = 80 V for **TIP122/7** V_{CB} = 100 V			0.2 0.2 0.2	mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			2	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 30 mA for **TIP120/5** for **TIP121/6** for **TIP122/7**	 60 80 100			 V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 3 A I_B = 12 mA I_C = 5 A I_B = 20 mA			2 4	V V
$V_{BE(on)}$*	Base-emitter Voltage	I_C = 3 A V_{CE} = 3 V			2.5	V
h_{FE}*	DC current Gain	I_C = 0.5 A V_{CE} = 3 V I_C = 3 A V_{CE} = 3 V	1000 1000			

* Pulsed : pulse duration = 300 µs, duty cycle ≤ 2 %.

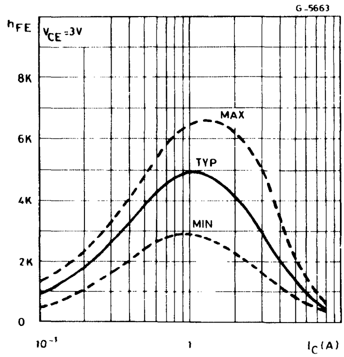
Safe Operating Areas.



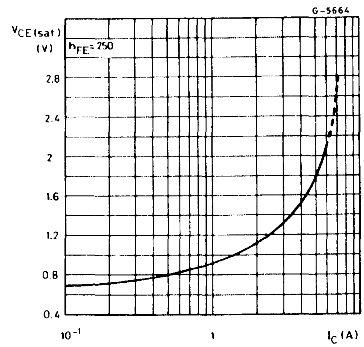
DC Current Gain (NPN types).



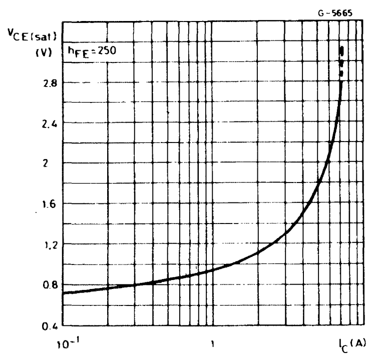
DC Current Gain (PNP types).



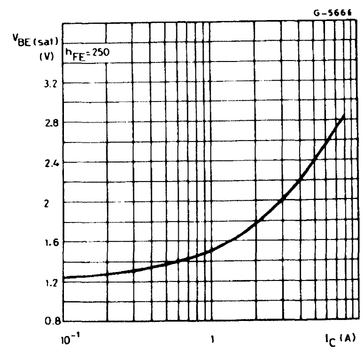
Collector-emitter Saturation Voltage (NPN types).



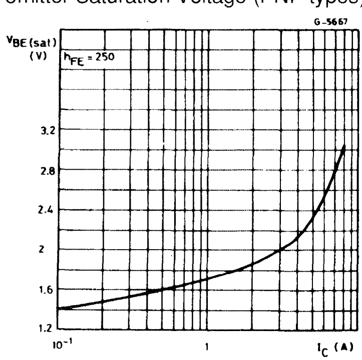
Collector-emitter Saturation Voltage (NPN types).



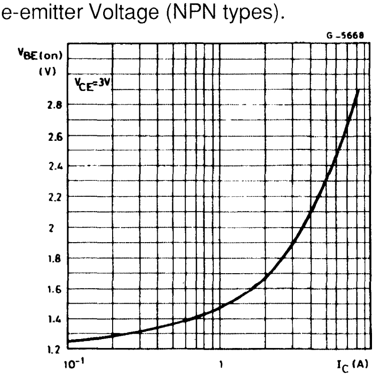
Base-emitter Saturation Voltage (NPN types).



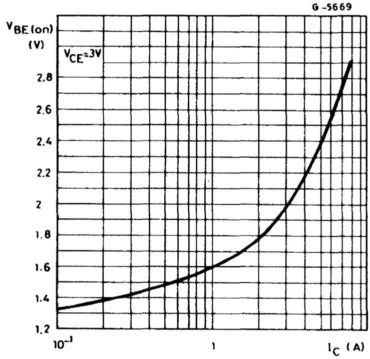
Base-emitter Saturation Voltage (PNP types).



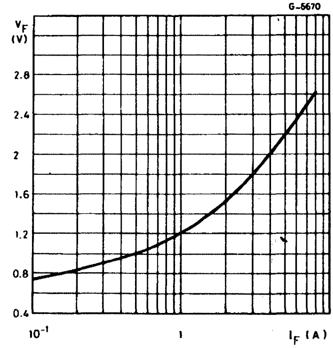
Base-emitter Voltage (NPN types).



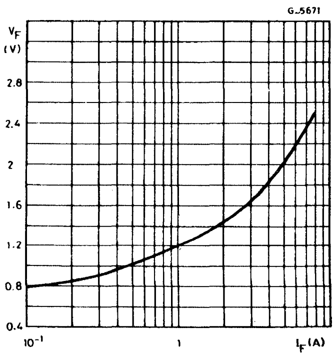
Base-emitter Voltage (PNP types).



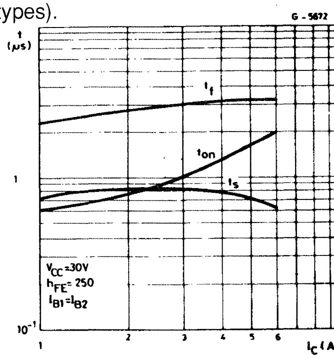
Freewheel Diode Forward Voltage (NPN types).



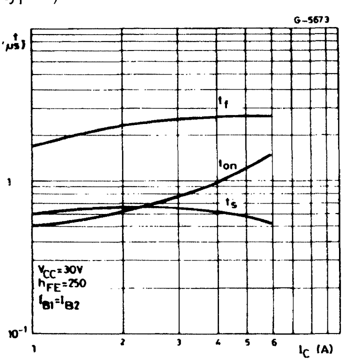
Freewheel Diode Forward Voltage (PNP types).



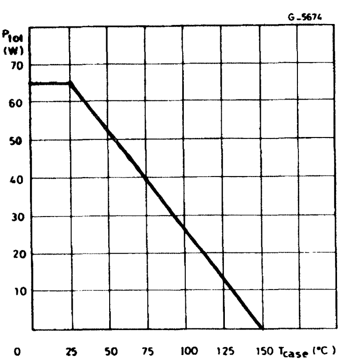
Switching Times vs. T_{case} Resistive Load (NPN types).



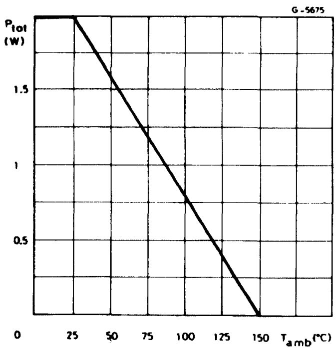
Switching Times vs. T_{case} Resistive Load (PNP types).



Derating Curve.



Free-air Temperature Derating Curve.



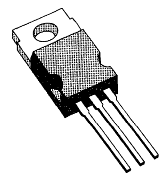
SGS-THOMSON MICROELECTRONICS

TIP/SGS130-131-132 TIP/SGS135-136-137

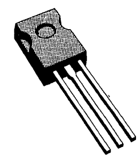
POWER DARLINGTONS

DESCRIPTION

The TIP130, TIP131, TIP132 and SGS130, SGS131, SGS132 are silicon epitaxial-base NPN transistors in monolithic Darlington configuration respectively in TO-220 and SOT-82 plastic package. They are intended for use in linear and switching applications. The complementary PNP types are the TIP135, TIP136 TIP137 and SGS135, SGS136, SGS137 respectively.

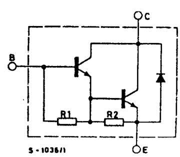


TO-220

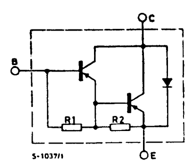


SOT-82

INTERNAL SCHEMATIC DIAGRAMS



R1 ≅ 5 KΩ
R2 ≅ 150 KΩ



R1 ≅ 5 KW
R2 ≅ 150 KW

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
	NPN	TIP130	TIP131	TIP132	
	NPN	SGS130	SGS131	SGS132	
	PNP	TIP135	TIP136	TIP137	
	PNP	SGS135	SGS136	SGS137	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	60	80	100	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	60	80	100	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5			V
I_C	Collector Current	8			A
I_{CM}	Collector Peak Current	12			A
I_B	Base Current	0.3			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	70			W
	$T_{amb} \leq 25$ °C	2			W
T_{stg}	Storage Temperature	– 65 to 150			°C
T_j	Junction Temperature	150			°C

For PNP types voltage and current values are negative.

THERMAL DATA

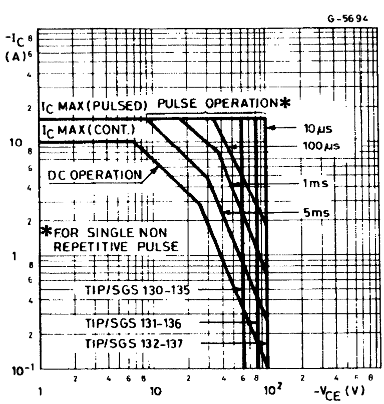
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.78	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	63.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

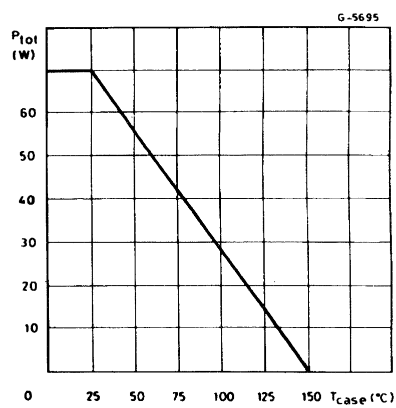
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = Half Rated V_{CEO}			0.5	mA
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = Rated V_{CBO}			0.2	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			5	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 30 mA for **TIP/SGS130** and **TIP/SGS135** for **TIP/SGS131** and **TIP/SGS136** for **TIP/SGS132** and **TIP/SGS137**	 60 80 100			 V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 4 A I_B = 16 mA I_C = 6 A I_B = 30 mA			2 3	V V
V_{BE}*	Base-emitter Voltage	I_C = 4 A V_{CE} = 4 V			2.5	V
h_{FE}*	DC current Gain	I_C = 1 A V_{CE} = 4 V I_C = 4 A V_{CE} = 4 V	500 1000		 15000	

* Pulsed : pulse duration = 300 μs, duty cycle ≤ 2 %.
For PNP types voltage and current values are negative.

Safe Operating Areas.



Power Derating Chart.



For the others characteristics see TIP100/105 series.

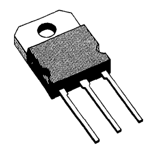
SGS-THOMSON MICROELECTRONICS

TIP140-141-142
TIP145-146-147

POWER DARLINGTONS

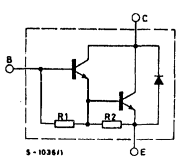
DESCRIPTION

The TIP140, TIP141, TIP142 are silicon epitaxial-base NPN transistors in monolithic Darlington configuration and are mounted in SOT-93 plastic package. They are intended for use in power linear and switching applications. The complementary PNP types are the TIP145, TIP146, TIP147 respectively.

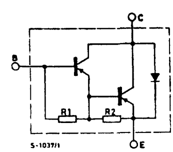


SOT-93

INTERNAL SCHEMATIC DIAGRAMS



R1 ≡ 5 KΩ
R2 ≡ 150 Ω



R1 ≡ 5 KΩ
R2 ≡ 150 Ω

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter NPN / *PNP	Value			Unit
		TIP140 TIP145	TIP141 TIP146	TIP142 TIP147	
V_{CBO}	Collector-base Voltage (I_E = 0)	60	80	100	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	60	80	100	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5			V
I_C	Collector Current	10			A
I_{CM}	Collector Peak Current (repetitive)	20			A
I_B	Base Current	0.5			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	125			W
T_{stg}	Storage Temperature	– 65 to 150			°C
T_j	Junction Temperature	150			°C

* For PNP types voltage and current values are negative.

THERMAL DATA

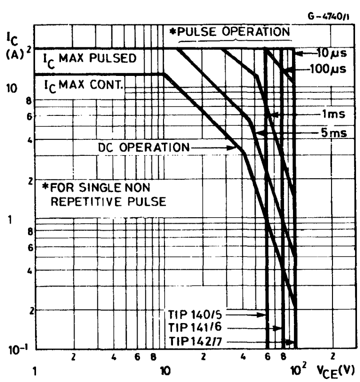
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

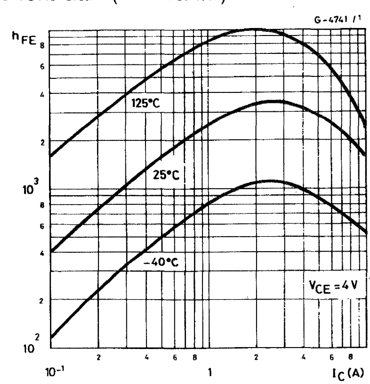
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **TIP140/5** V_{CB} = 60 V for **TIP141/6** V_{CB} = 80 V for **TIP142/7** V_{CB} = 100 V			1 1 1	mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **TIP140/5** V_{CB} = 30 V for **TIP141/6** V_{CE} = 40 V for **TIP142/7** V_{CE} = 50 V			2 2 2	mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EBO} = 5 V			2	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 30 mA for **TIP140/5** for **TIP141/6** for **TIP142/7**	60 80 100			V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5 A I_B = 10 mA I_C = 10 A I_B = 40 mA			2 3	V V
V_{BE}*	Base-emitter Voltage	I_C = 10 A V_{CE} = 4 V			3	V
h_{FE}*	DC current Gain	I_C = 5 A V_{CE} = 4 V I_C = 10 A V_{CE} = 4 V	1000 500			
t_{on}	Turn-on Time	I_C = 10 A I_{B1} = 40 mA I_{B2} = − 40 mA R_L = 3 Ω		0.9		µs
t_{off}	Turn-off Time			4		µs

* Pulsed : pulse duration = 200 µs, duty cycle = 1.5 %.
For PNP devices voltage and current values are negative.

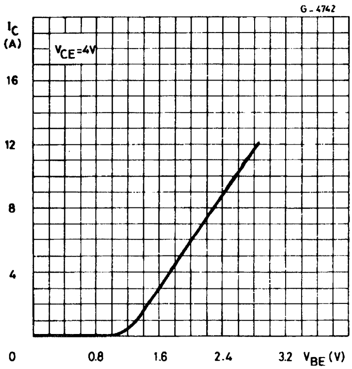
Safe Operating Areas.



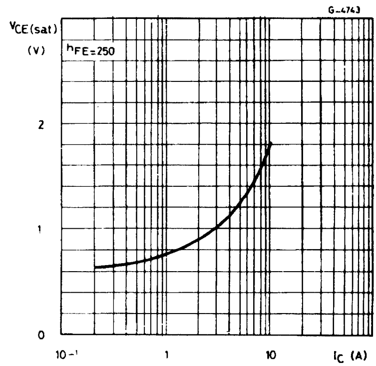
DC Current Gain (TIP140/1/2).



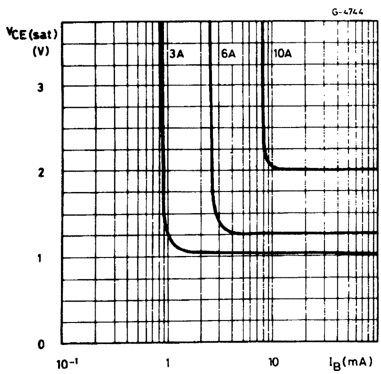
DC Transconductance (TIP140/1/2).



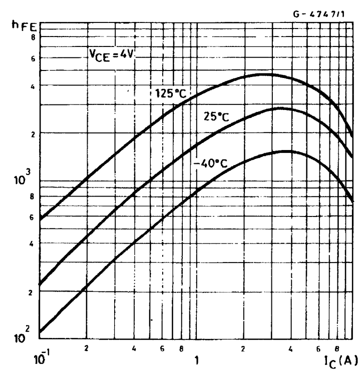
Collector-emitter Saturation Voltage (TIP140/1/2).



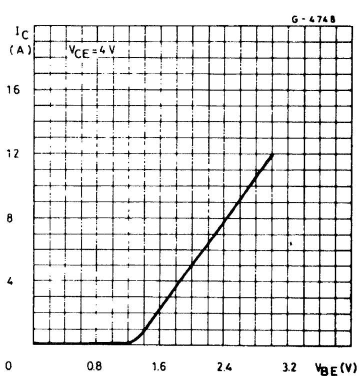
Collector-emitter Saturation Voltage (TIP140/1/2).



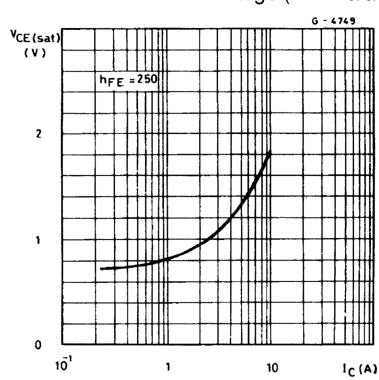
DC Current Gain (TIP145/6/7)



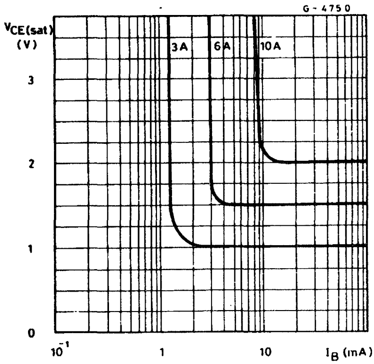
DC Transconductance (TIP145/6/7).



Collector-emitter Saturation Voltage (TIP145/6/7).



Collector-emitter Saturation Voltage (TIP145/6/7).

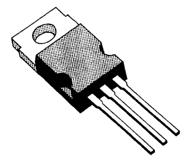


TIP140T/141T/142T TIP145T/146T/147T

LOW VOLTAGE HIGH CURRENT POWER DARLINGTON

ADVANCE DATA

- MONOLITHIC DARLINGTON CONFIGURATION
- LOW VOLTAGE
- HIGH CURRENT
- HIGH GAIN



TO-220

DESCRIPTION

The TIP140T, TIP141T and TIP142T are silicon multiepitaxial base NPN transistor in monolithic Darlington configuration mounted in TO-220 package.

They are intended for use in power linear and switching applications. The complementary PNP types are the TIP145T, TIP146T and TIP147T respectively.

INTERNAL SCHEMATIC DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value NPN			Unit
	NPN / PNP	TIP140T / TIP145T	TIP141T / TIP146T	TIP142T / TIP147T	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	60	80	100	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	60	80	100	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5			V
I_C	Collector Current	15			A
I_{CM}	Collector Peak Current (t_p < 5ms)	20			A
I_B	Base Current	0.5			A
P_{tot}	Total Dissipation at T_c < 25°C	125			W
T_{stg}	Storage Temperature	– 65 to 150			°C
T_j	Max. Operating Junction Temperature	150			°C

For PNP types voltage and current values are negative.

This is advanced information on a new product now in development or undergoing evaluation. Details are subject to change without notice.

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case max	1	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 60V for **TIP140T/145T** V_{CB} = 80V for **TIP141T/146T** V_{CB} = 100V for **TIP142T/147T**			1 1 1	mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 30V for **TIP140T/145T** V_{CE} = 40V for **TIP141T/146T** V_{CE} = 50V for **TIP142T/147T**			2 2 2	mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			2	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 30mA for **TIP140T/145T** for **TIP141T/146T** for **TIP142T/147T**	60 80 100			V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5A I_B = 10mA I_C = 10A I_B = 40mA			2 3	V V
$V_{BE(on)}$*	Base-emitter Voltage	I_C = 10A V_{CE} = 4V			3	V
h_{FE}*	DC Current Gain	I_C = 5A V_{CE} = 4V I_C = 10A V_{CE} = 4V	1000 500			
 t_{on} t_{off}	RESISTIVE LOAD Turn-on Time Turn-off Time	 I_C = 10A I_{B1} = 10mA I_{B2} = −40mA R_L = 3Ω		 0.9 4		 μs μs

* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.
For PNP types voltage and current value are negative.

SGS-THOMSON MICROELECTRONICS

TIP2955
TIP3055

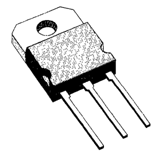
COMPLEMENTARY TRANSISTORS

PRELIMINARY DATA

DESCRIPTION

The TIP3055 is a silicon epitaxial base NPN transistor mounted in TO-218 plastic package and intended for power switching circuits, serie and shunt regulators, output stages and high fidelity amplifiers.

The complementary PNP type is the TIP2955.



TO-218

INTERNAL SCHEMATIC DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	100	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	60	V
I_C	Collector Current	15	A
I_B	Base Current	7	A
P_{tot}	Total Dissipation at $T_c < 25°C$	90	W
T_{stg}	Storage Temperature	– 65 to 150	°C
T_j	Max. Operating Junction Temperature	150	°C

For PNP type voltage and current values are negative.

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	max	1.4	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

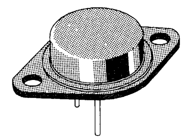
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEX}	Collector Cutoff Current	V_{CE} = 100V V_{BE} = – 1.5V			5	mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 30V			0.7	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			5	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 30mA	60			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 4A I_B = 0.4A I_C = 10A I_B = 3.3A			1.1 3	V V
$V_{BE(on)}$*	Base-emitter Voltage	I_C = 4A V_{CE} = 4V			1.8	V
h_{FE}*	DC Current Gain	I_C = 4A V_{CE} = 4V I_C = 10A V_{CE} = 4V	20 5			
h_{fe}	Small Signal Current Gain	I_C = 1A V_{CE} = 10V f = 1KHz	15			
f_T	Transition Frequency	I_C = 0.5A V_{CE} = 10V f = 1MHz	3			MHz
t_{on} t_{off}	RESISTIVE LOAD Turn-on Time Turn-off Time	I_C = 6A I_{B1} = 0.6A I_{B2} = – 0.6A V_{BEoff} = – 4V R_L = 5Ω		0.5 0.9		µs µs

* Pulsed : pulse duration = 300µs, duty cycle = 1.5%.
For PNP type voltage and current value are negative.

POWER LINEAR AND SWITCHING APPLICATIONS

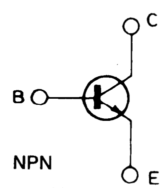
DESCRIPTION

The 2N3055 is a silicon epitaxial-base NPN transistor in Jedec TO-3 metal case.It is intended for power switching circuits, series and shunt regulators, output stages and high fidelity amplifiers.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	100	V
V_{CER}	Collector-emitter Voltage ($R_{BE} = 100\ \Omega$)	70	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	60	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	15	A
I_B	Base Current	7	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$	115	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

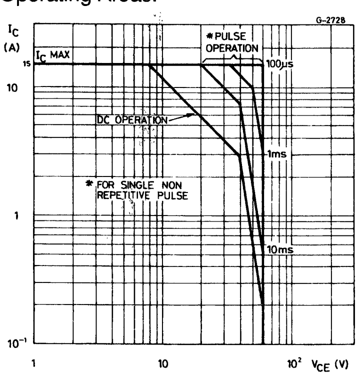
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case Max	1.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

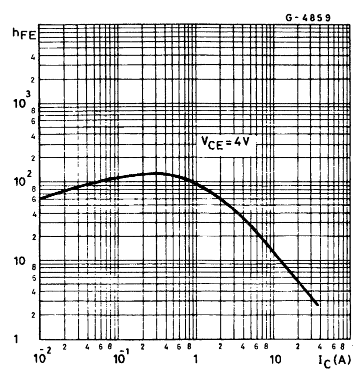
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector Cutoff Current (V_{BE} = − 1.5V)	V_{CE} = 100V V_{CE} = 100V T_{case} = 150°C			1 5	mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 30V			0.7	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			5	mA
$V_{CER(sus)}$*	Collector-emitter Sustaining Voltage (R_{BE} = 100Ω)	I_C = 200mA	70			V
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 200mA	60			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 4A I_B = 400mA I_C = 10A I_B = 3.3A			1 3	V V
V_{BE}*	Base-emitter Voltage	I_C = 4A V_{CE} = 4V			1.5	V
h_{FE}*	DC Current Gain Group 4 Group 5 Group 6 Group 7	 I_C = 0.5A V_{CE} = 4V I_C = 0.5A V_{CE} = 4V I_C = 0.5A V_{CE} = 4V I_C = 0.5A V_{CE} = 4V I_C = 4A V_{CE} = 4V I_C = 10A V_{CE} = 4V	 20 35 60 120 20 5		 50 75 145 250 70	
h_{FE1}/h_{FE2}*	Matched Pair	I_C = 0.5A V_{CE} = 4V			1.6	
f_T	Transistion Frequency	I_C = 1A V_{CE} = 4V	2.5			MHz
$I_{s/b}$*	Second Breakdown Collector Current	V_{CE} = 40V	2.87			A

* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.
** Pulsed : 1s, non repetitive pulse.

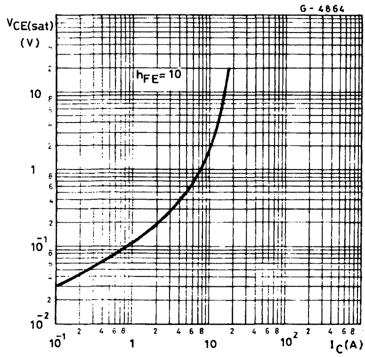
Safe Operating Areas.



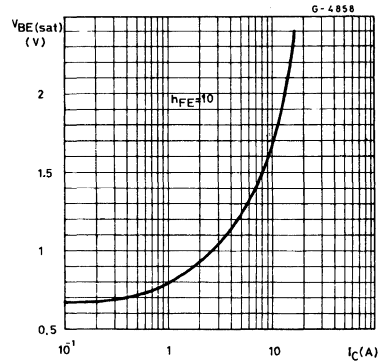
DC Current Gain.



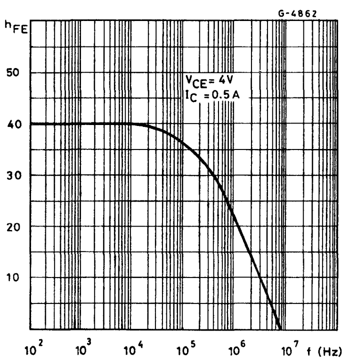
Collector-emitter Saturation Voltage.



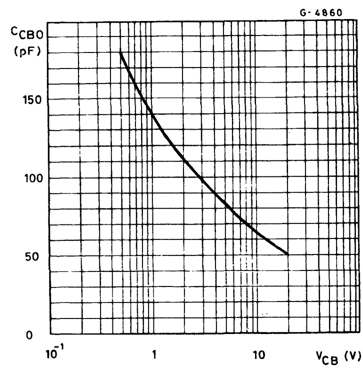
Base-emitter Saturation Voltage.



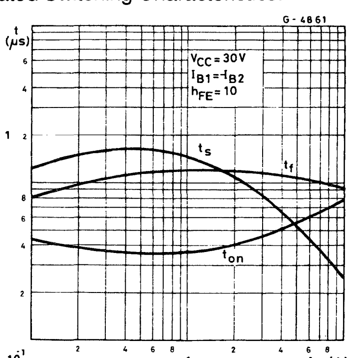
Small Signal Current Gain.



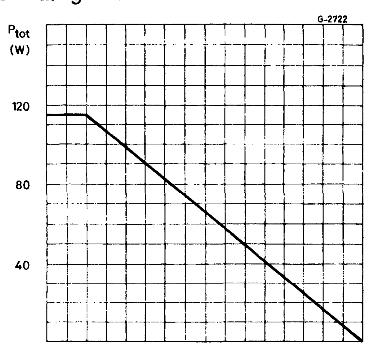
Collector-base Capacitance.



Saturated Switching Characteristics.



Power Rating Chart.

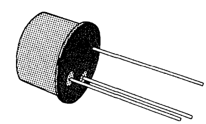


2N3439
2N3440

HIGH VOLTAGE TRANSISTORS

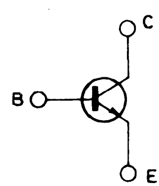
DESCRIPTION

The 2N3439, 2N3440 are high voltage silicon epitaxial planar transistors designed for use in consumer and industrial line-operated applications. These devices are particularly suited as drivers in high-voltage low current inverters, switching and series regulators.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	2N3439	2N3440	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	450	300	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	350	250	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7		V
I_C	Collector Current	1		A
I_B	Base Current	0.5		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$ $T_{amb} \leq 50°C$	10 1		W W
T_{stg}	Storage Temperature	– 65 to 200		°C
T_j	Junction Temperature	200		°C

THERMAL DATA

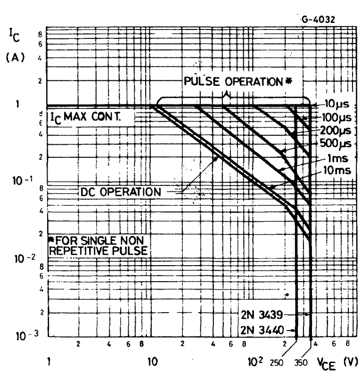
$R_{th\ j-case}$	Thermal Resistance Junction-case	Max	17.5	°C/W
$R_{th\ j-amb}$	Thermal Resistance Junction-ambient	Max	150	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

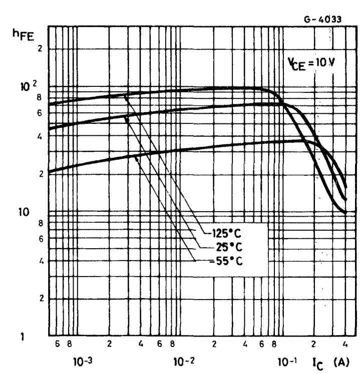
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **2N3439** V_{CB} = 360V for **2N3440** V_{CB} = 250V			20 20	µA µA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **2N3439** V_{CE} = 300V for **2N3440** V_{CE} = 200V			20 50	µA µA
I_{CEX}	Collector Cutoff Current (V_{BE} = – 1.5V)	for **2N3439** V_{CE} = 450V for **2N3440** V_{CE} = 300V			500 500	µA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 6V			20	µA
$V_{CEO\ (sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 50mA for **2N3439** for **2N3440**	 350 250			 V V
$V_{CE\ (sat)}$*	Collector-emitter Saturation Voltage	I_C = 50mA I_B = 4mA			0.5	V
$V_{BE\ (sat)}$*	Base-emitter Saturation Voltage	I_C = 50mA I_B = 4mA			1.3	V
C_{ob}	Output Capacitance	V_{CB} = 10V, f = 1MHz			10	pF
h_{FE}*	DC Current Gain	I_C = 20mA V_{CE} = 10V for **2N3439** I_C = 2mA V_{CE} = 10V	40 30		160	
h_{FE}	Small Signal Current Gain	I_C = 5mA V_{CE} = 10V f = 1KHz	25			
f_T	Transition Frequency	I_C = 10mA V_{CE} = 10V f = 5MHz	15			MHz

* Pulsed : pulse duration = 300µs, duty cycle ≤ 2%.

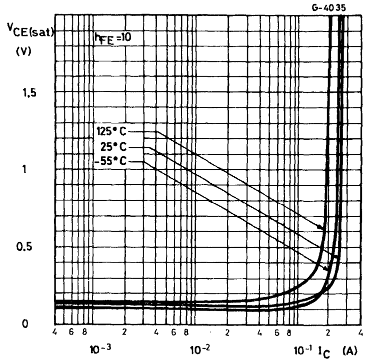
Safe Operating Areas.



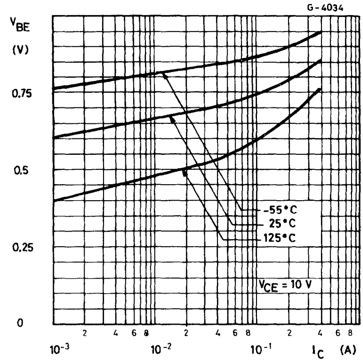
DC Current Gain.



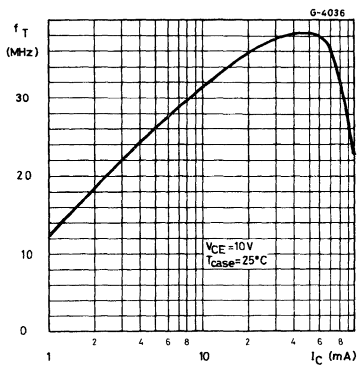
Collector-emitter Saturation Voltage.



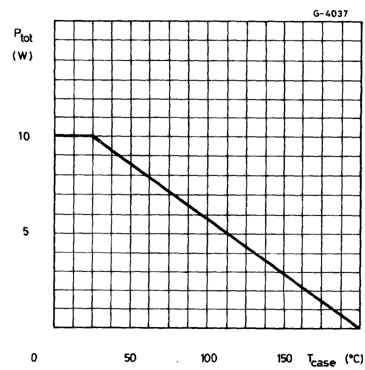
Base-emitter Voltage.



Transition Frequency.



.Power Rating Chart.



SGS-THOMSON MICROELECTRONICS

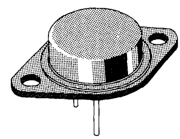
2N3713/14/15/16
2N3789/90/91/92

EPITAXIAL-BASE NPN/PNP

DESCRIPTION

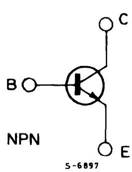
The 2N3713, 2N3714, 2N3715 and 2N3716 are silicon epitaxial-base NPN power transistors in Jedec TO-3 metal case. They are intended for use in power linear and switching applications.

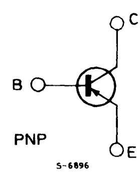
The complementary PNP types are the 2N3789, 2N3790, 2N3791 and 2N3792 respectively.



TO-3

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter			Unit
		PNP* 2N3789 PNP* 2N3791 NPN 2N3713 NPN 2N3715	2N3790 2N3792 2N3714 2N3716	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	80	100	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	60	80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7		V
I_C	Collector Current	10		A
I_B	Base Current	4		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	150		W
T_{stg}	Storage Temperature	– 65 to 200		°C
T_j	Junction Temperature	200		°C

* For PNP types voltage and current values are negative.

THERMAL DATA

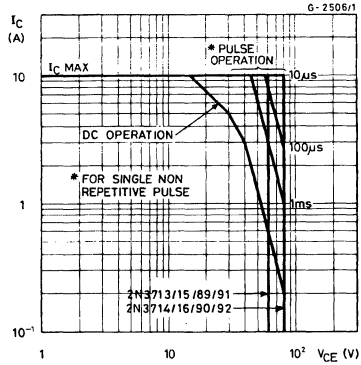
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.17	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

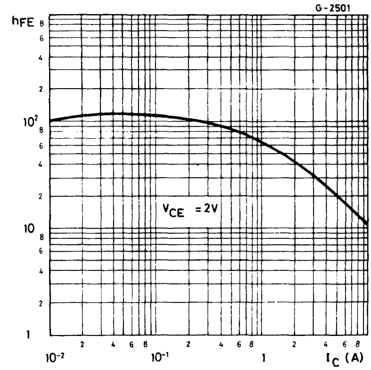
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEX}	Collector Cutoff Current (V_{BE} = − 1.5 V)	V_{CE} = 80 V for **2N3713/15/89/91** V_{CE} = 100 V for **2N3714/16/90/92** T_{case} = 150 °C V_{CE} = 60 V for **2N3713/15/89/91** V_{CE} = 80 V for **2N3713/14/90/92**			 1 1 10 10	 mA mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7 V			5	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 200 mA for **2N3713/15/89/91** for **2N3714/16/90/92**	 60 80			 V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5 A I_B = 0.5 A for **2N3713/14/91/92** for **2N3715/16** I_C = 4 A I_B = 0.5 A for **2N3789/90**			 1 0.8 1	 V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 5 A I_B = 0.5 A for **2N3713/14/89/90** for **2N3715/16/91/92**			 2 1.5	 V V
V_{BE}*	Base-emitter Voltage	I_C = 3 A V_{CE} = 2 V			1.5	V
h_{FE}*	DC Current Gain	I_C = 1 A V_{CE} = 2 V for **2N3713/14/89/90** for **2N3715/16** for **2N3791/92** I_C = 3 A V_{CE} = 2 V for **2N3713/14/89/90** for **2N3715/16/91/92** I_C = 10 A V_{CE} = 4 V	 25 50 50 15 30 5		 90 150 180	
f_T	Transition Frequency	I_C = 0.5 A V_{CE} = 10 V	4			MHz

* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.

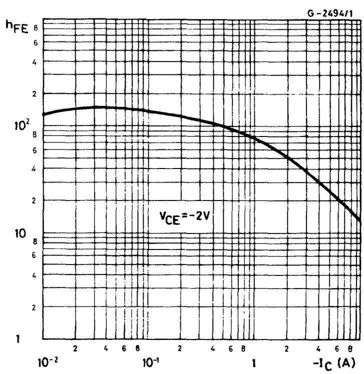
Safe Operating Areas.



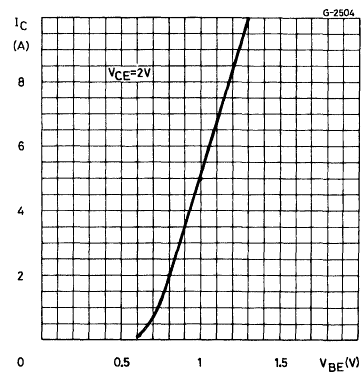
DC Current Gain (NPN types).



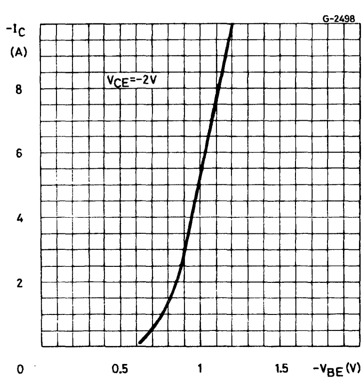
DC Current Gain (PNP types).



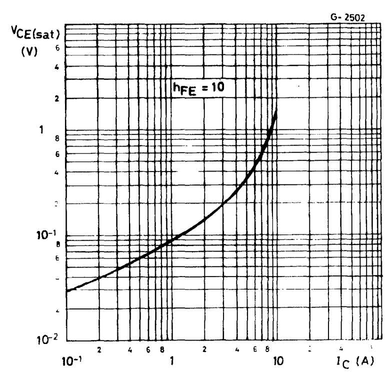
DC Transconductance (NPN types).



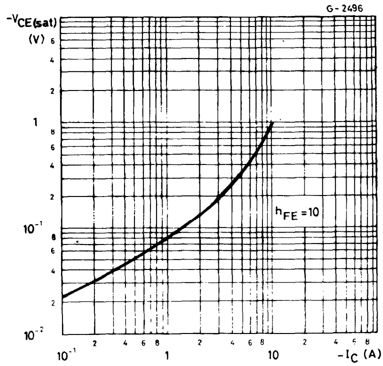
DC Transconductance (PNP types).



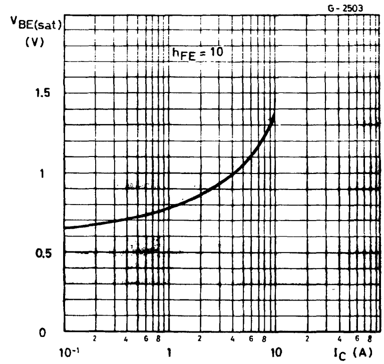
Collector-emitter Saturation Voltage (NPN types).



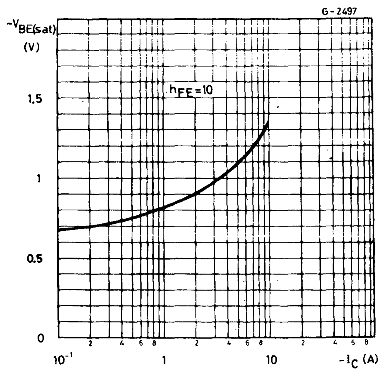
Collector-emitter Saturation Voltage (PNP types).



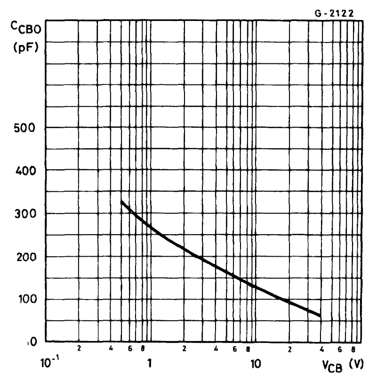
Base-emitter Saturation Voltage (NPN types).



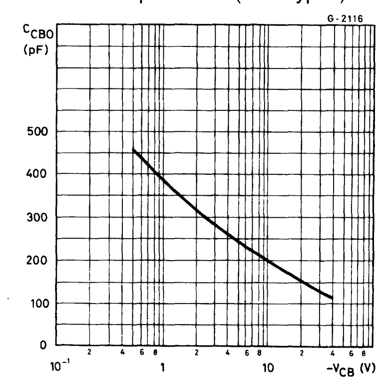
Base-emitter Saturation Voltage (PNP types).



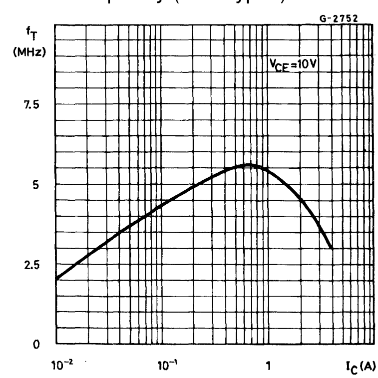
Collector-base Capacitance (NPN types).



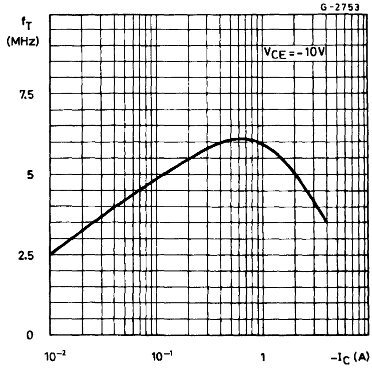
Collector-base Capacitance (PNP types).



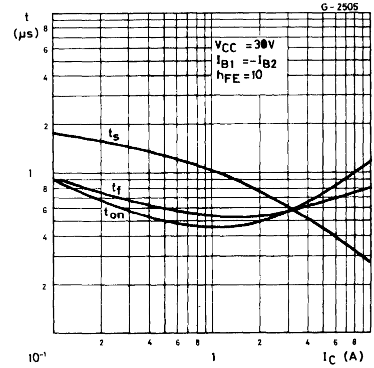
Transition Frequency (NPN types).



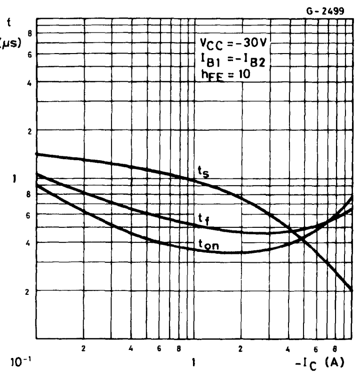
Transition Frequency (PNP types).



Saturated Switching Characteristics (NPN types).



Saturated Switching Characteristics (PNP types).



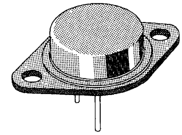
SGS-THOMSON MICROELECTRONICS

2N3771
2N3772

HIGH POWER TRANSISTORS

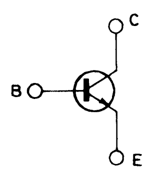
DESCRIPTION

The 2N3771, 2N3772 are silicon epitaxial-base NPN transistors mounted in Jedec TO-3 metal case. They are intended for linear amplifiers and inductive switching applications.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	2N3771	2N3772	Unit
V_{CEO}	Collector-emitter Voltage (I_B = 0)	40	60	V
V_{CEV}	Collector-emitter Voltage (V_{BE} = − 1.5V)	50	80	V
V_{CBO}	Collector-base Voltage (I_E = 0)	50	100	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5	7	V
I_C	Collector Current	15	10	A
I_{CM}	Collector Peak Current	30	30	A
I_B	Base Current	7.5	5	A
I_{BM}	Base Peak Current	15	15	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$	150		W
T_{stg}	Storage Temperature	− 65 to 200		°C
T_j	Junction Temperature	200		°C

THERMAL DATA

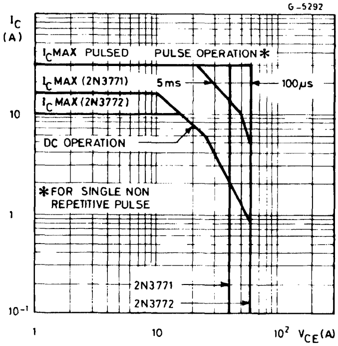
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.17	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

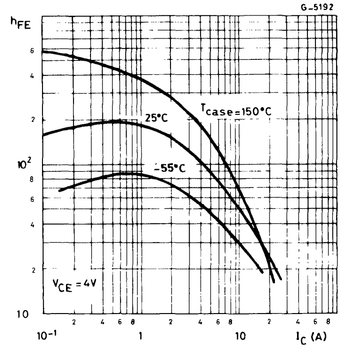
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **2N3771** V_{CE} = 30V for **2N3772** V_{CE} = 50V			10 10	mA mA
I_{CEV}	Collector Cutoff Current (V_{BE} = − 1.5V)	for **2N3771** V_{CE} = 50V for **2N3772** V_{CE} = 100V for all V_{CE} = 30V T_{case} = 150°C			2 5 10	mA mA mA
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **2N3771** V_{CB} = 50V for **2N3772** V_{CB} = 100V			4 5	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	for **2N3771** V_{EB} = 5V for **2N3772** V_{EB} = 7V			5 5	mA mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 0.2A for **2N3771** for **2N3772**	 40 60			 V V
$V_{CEV(sus)}$*	Collector-emitter Sustaining Voltage (V_{EB} = − 1.5V)	I_C = 0.2A R_{BE} = 100Ω for **2N3771** for **2N3772**	 50 80			 V V
$V_{CER(sus)}$*	Collector-emitter Sustaining Voltage (R_{BE} = 100Ω)	I_C = 0.2A for **2N3771** for **2N3772**	 45 70			 V V
h_{FE}*	DC Current Gain	for **2N3771** I_C = 15A V_{CE} = 4V I_C = 30A V_{CE} = 4V for **2N3772** I_C = 10A V_{CE} = 4V I_C = 20A V_{CE} = 4V	 15 5 15 5		 60 60 	
V_{BE}*	Base-emitter Voltage	for **2N3771** I_C = 15A V_{CE} = 4V for **2N3772** I_C = 10A V_{CE} = 4V			 2.7 2.7	 V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	for **2N3771** I_C = 15A I_B = 1.5A I_C = 30A I_B = 6A for **2N3772** I_C = 10A I_B = 1A I_C = 20A I_B = 4A			 2 4 1.4 4	 V V V V
f_T	Transistion Frequency	I_C = 1A V_{CE} = 4V ; f = 50KHz	0.2			MHz
h_{FE}	Small Signal Current Gain	I_C = 1A V_{CE} = 4V f = 1KHz	40			
$I_{s/b}$	Second Breakdown Collector Current	V_{CE} = 25V t = 1 s (non repetitive)	6			A

* Pulsed : pulse duration = 300μs, duty cycle ≤ 2%.

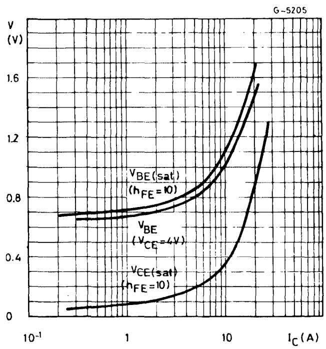
Safe Operating Areas



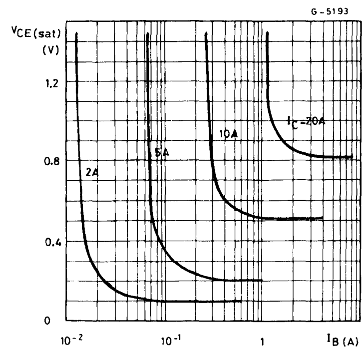
DC Current Gain.



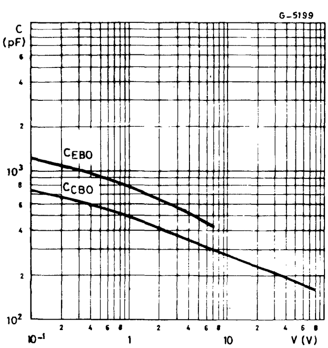
Saturation Voltage.



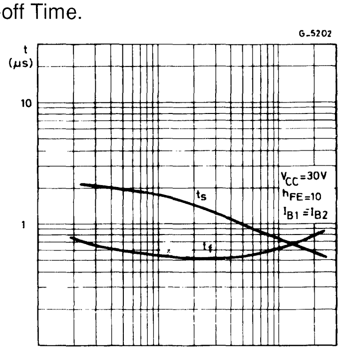
Collector-emitter Saturation Vol-



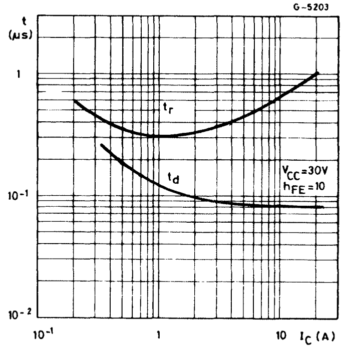
Capacitances.



Turn-off Time.



Turn-on Time.



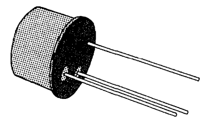
MEDIUM POWER GENERAL PURPOSE TRANSISTORS

DESCRIPTION

The 2N4234, 2N4235 and 2N4236 are silicon epitaxial planar PNP transistors mounted in Jedec TO-39 metal case.

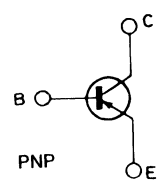
They are intended for use in switching and amplifier applications.

The complementary NPN types are the 2N4237, and 2N4238 and 2N4239 respectively.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	2N4234	2N4235	2N4236	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	– 40	– 60	– 80	V
V_{CEO}	Colletor-emitter Voltage ($I_B = 0$)	– 40	– 60	– 80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	– 7			V
I_C	Collector Current	– 3			A
I_B	Base Current	– 0.2			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$ $T_{amb} \leq 25°C$	6 1			W W
T_{stg}	Storage Temperature	– 65 to 200			°C
T_j	Junction Temperature	200			°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	29	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cuttoff Current (I_E = 0)	for **2N4234** V_{CE} = – 40V for **2N4235** V_{CE} = – 60V for **2N4236** V_{CE} = – 80V			– 0.1 – 0.1 – 0.1	mA mA mA
I_{CEV}	Collector Cutoff Current (V_{BE} = 1.5)	for **2N4234** V_{CE} = – 40V for **2N4235** V_{CE} = – 60V for **2N4236** V_{CE} = – 80V T_{case} = 150°C for **2N4234** V_{CE} = – 30V for **2N4235** V_{CE} = – 40V for **2N4236** V_{CE} = – 60V			– 0.1 – 0.1 – 0.1 – 1 – 1 – 1	mA mA mA mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **2N4234** V_{CE} = – 30V for **2N4235** V_{CE} = – 40V for **2N4236** V_{CE} = – 60V			– 1 – 1 – 1	mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			– 0.5	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = – 100mA for **2N4234** for **2N4235** for **2N4236**	 – 40 – 60 – 80			 V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 1A I_B = – 100mA			– 0.6	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 1A I_B = – 100mA			– 1.5	V
V_{BE}*	Base-emitter Voltage	I_C = – 0.25A V_{CE} = – 1V			– 1	V
h_{FE}*	DC Current Gain	I_C = – 100mA V_{CE} = – 1V I_C = – 250mA V_{CE} = – 1V I_C = – 500mA V_{CE} = – 1V I_C = – 1A V_{CE} = – 1V	40 30 20 10		 150	
f_T	Transistion Frequency	I_C = – 100mA V_{CE} = – 10V f = 1MHz	3			MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 10V f = 100KHz			100	pF
h_{fe}	Small Signal Current Gain	I_C = – 50mA V_{CE} = – 10V f = 1KHz	25			

* Pulsed : pulse duration = 300µs, duty cycle ≤ 2%.

SGS-THOMSON
MICROELECTRONICS

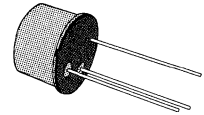
2N4895
2N4896/2N4897

HIGH CURRENT, FAST SWITCHING APPLICATIONS

DESCRIPTION

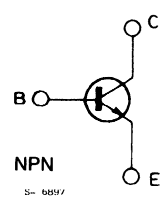
The 2N4895, 2N4896 and 2N4897 are silicon epitaxial planar NPN transistors in Jedec TO-3 metal case.

They are intended for high current, fast switching applicatliions and for power amplifiers.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	2N4895	2N4896	2N4897	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	120	120	150	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	60	60	80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	6			V
I_C	Collector Current	5			A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25°C$ $T_{case} \leq 25°C$ $T_{case} \leq 100°C$	1 7 4			W W W
T_{stg}	Storage Temperature	– 65 to 200			°C
T_j	Junction Temperature	200			°C

THERMAL DATA

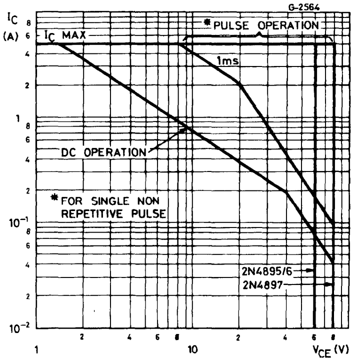
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	25	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

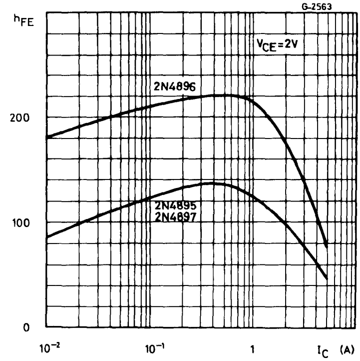
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	for **2N4895** and **2N4896** V_{CE} = 120V V_{CE} = 60V V_{CE} = 60V T_{case} = 150°C for **2N4897** V_{CE} = 150V V_{CE} = 100V V_{CE} = 100V T_{case} = 150°C			 1 1 100 1 1 100	 mA μA μA mA μA μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 6V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 50mA for **2N4895** and **2N4896** for **2N4897**	 60 80			 V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5A I_B = 0 .5A			1	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 5A I_B = 0.5A			1.6	V
h_{FE}*	DC Current Gain	I_C = 2A V_{CE} = 2V for **2N4895** and **2N4897** for **2N4896** I_C = 2A V_{CE} = 2V T_{case} = – 55°C for **2N4895** and **2N4897** for **2N4896**	 40 100 15 35		 120 300	
f_T	Transistion Frequency	I_C = 0.5A V_{CE} = 5V for **2N4895** and **2N4897** for **2N4896**	 50 80			 MHz MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10V f = 1 MHz			80	pF
t_{on}	Turn-on Time	I_C = 5A V_{CC} = 20V I_{B1} = 0.5A			0.35	μs
t_s	Storage Time	I_C = 5A V_{CC} = 20V I_{B1} = – I_{B2} = 0.5A			0.35	μs
t_f	Fall Time				0.3	μs

* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.

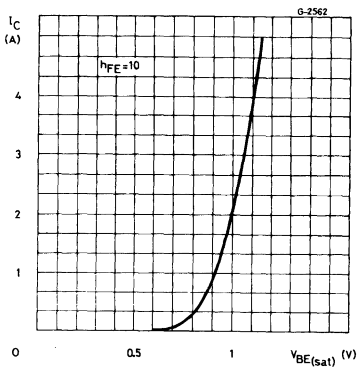
Safe Operating Areas



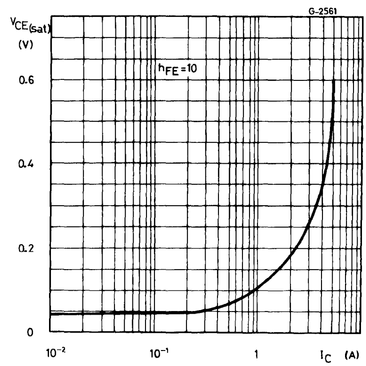
DC Current Gain.



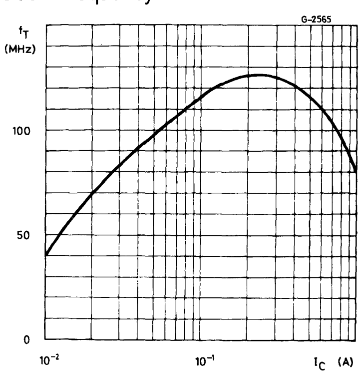
DC Transconductance.



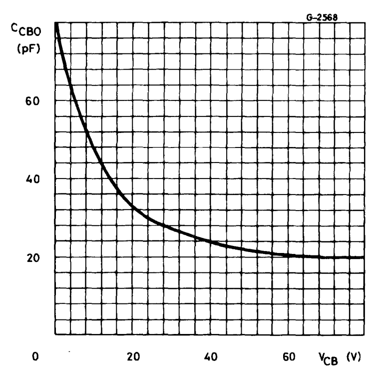
Collector-emitter Saturation Voltage.



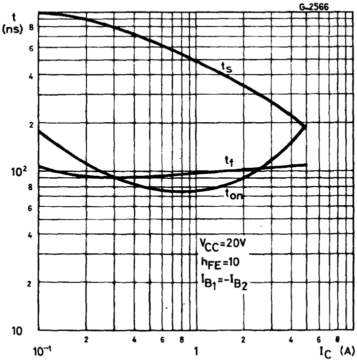
Transition Frequency.



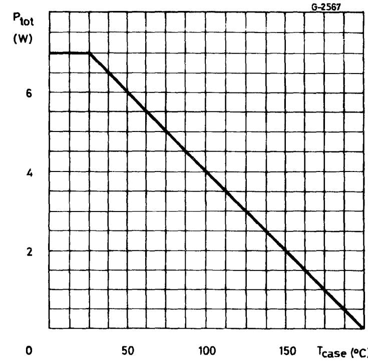
Collector-base Capacitance.



Saturated Switching Characteristics.



Power Rating Chart.



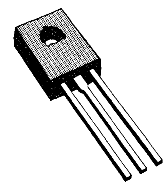
SGS-THOMSON
MICROELECTRONICS

2N4918/19/20
2N4921/22/23

MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

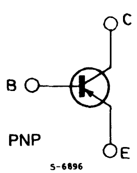
DESCRIPTION

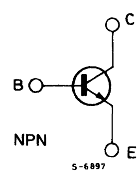
The 2N4921, 2N4922 and 2N4923 are silicon epitaxial planar NPN transistors in Jede TO-126 plastic package, they are intended for driver circuits, switching and amplifier applications. The complementary PNP types are the 2N4918, 2N4919 and 2N4920 respectively.



TO-126 (SOT-32)

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	PNP	2N4918	2N4919	2N4920	Unit
		NPN	2N4921	2N4922	2N4923	
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)		40	60	80	V
V_{CBO}	Collector-base Voltage ($I_E = 0$)		40	60	80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)			5		V
I_C	Collector Current			1		A
I_{CM}	Collector Peak Current			3		A
I_B	Base Current			1		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C			30		W
T_{stg}	Storage Temperature			– 65 to 150		°C
T_j	Junction Temperature			150		°C

* For PNP types voltage and current values are negative.

THERMAL DATA

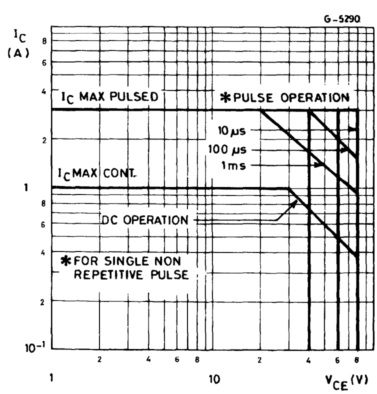
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	4.16	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

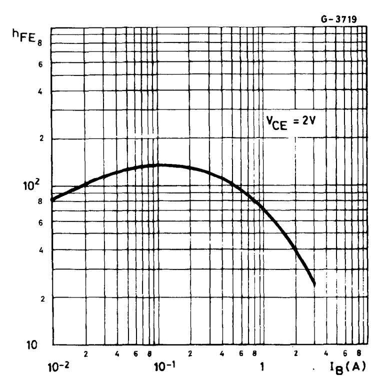
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_{BO} = 0)	V_{CE} = Half rated V_{CEO}			0.5	mA
I_{CEX}	Collector Cutoff Current (V_{BE} = – 1.5 V)	V_{CE} = rated V_{CEO} V_{CE} = rated V_{CEO} T_{case} = 125 °C			0.1 0.5	mA mA
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CE} = rated V_{CBO}			0.1	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 0.1 A for **2N4918, 2N4921** for **2N4919, 2N4922** for **2N4920, 2N4923**	 40 60 80			 V V V
h_{FE}*	DC Current Gain	I_C = 50 mA V_{CE} = 1 V I_C = 500 mA V_{CE} = 1 V I_C = 1 A V_{CE} = 1 V	40 30 10		 150 	
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 1 A I_B = 0.1 A			0.6	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 1 A I_B = 0.1 A			1.3	V
V_{BE}*	Base Emitter Voltage	I_C = 1 A V_{CE} = 1 V			1.3	V
f_T	Transistion Frequency	I_C = 250 mA V_{CE} = 10 V f = 1 MHz	3			MHz
C_{CBO}	Collector-base Capacitance	V_{CB} = 10 V I_E = 0 f = 100 KHz			100	pF
h_{FE}	Small Signal Current Gain	I_C = 250 mA V_{CE} = 10 V f = 1 KHz	25			

* Pulsed : pulse duration = 300μs duty cycle ≤ 2%.
For NPN types voltage and current values are negative.

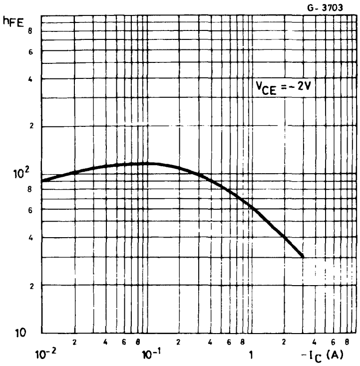
Safe Operating Areas.



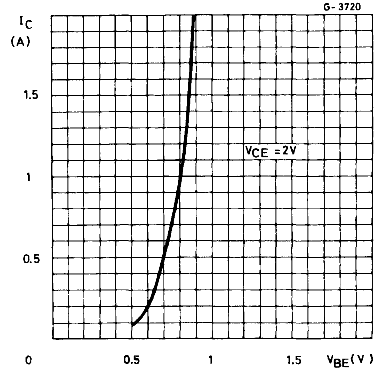
DC Current Gain (NPN types).



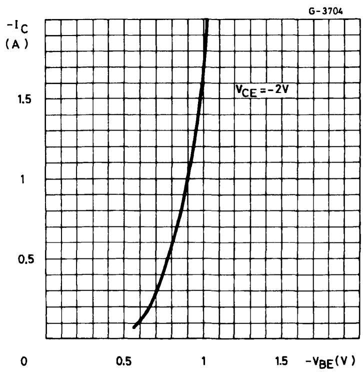
DC Current Gain (PNP types).



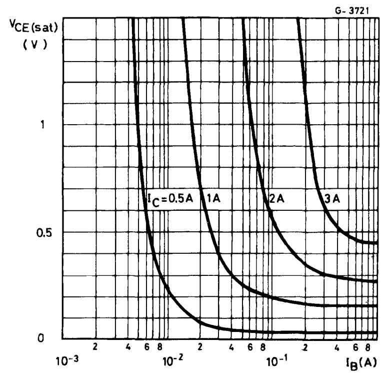
DC Transconductance (NPN types).



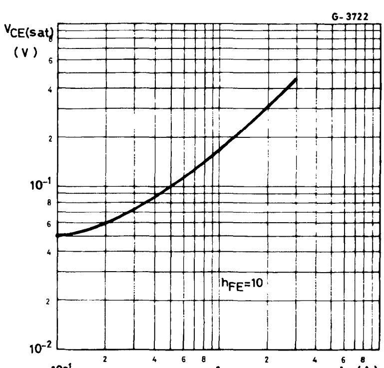
DC Transconductance (PNP types).



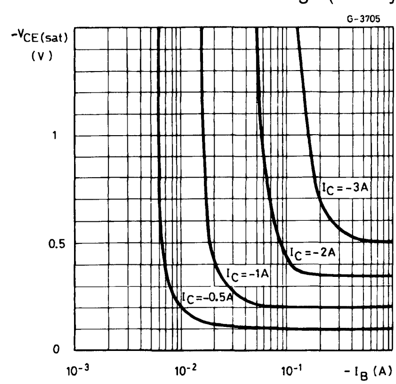
Collector-emitter Saturation Voltage (NPN types).



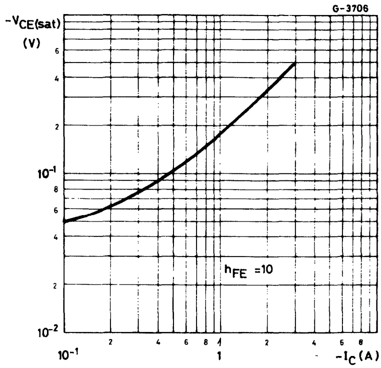
Collector-emitter Saturation Voltage (NPN types).



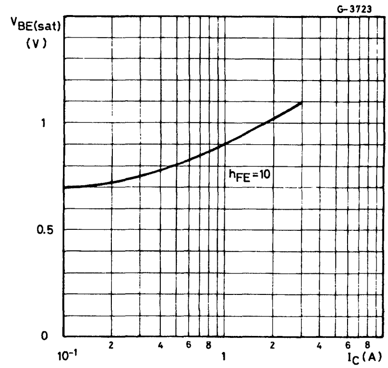
Collector-emitter Saturation Voltage (PNP types).



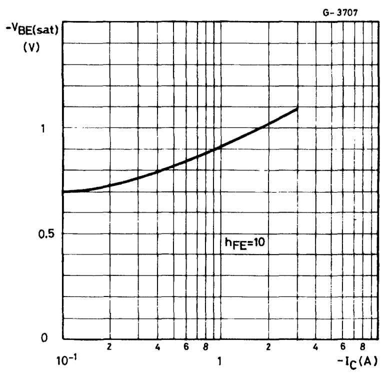
Collector-emitter Saturation Voltage (PNP types).



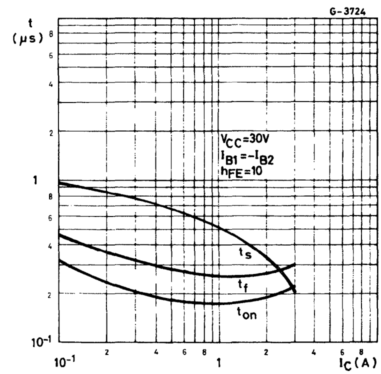
Base-emitter Saturation Voltage (NPN types).



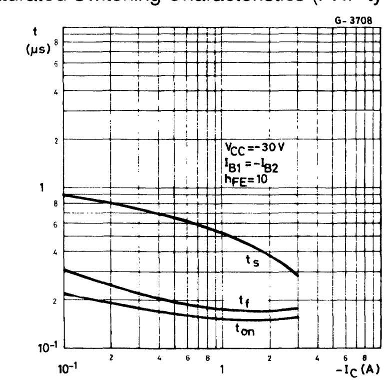
Base-emitter Saturation Voltage (PNP types).



Saturated Switching Characteristics (NPN types).



Saturated Switching Characteristics (PNP types).



SGS-THOMSON
MICROELECTRONICS

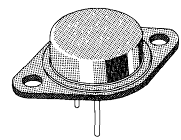
2N5038/39
2N6496

HIGH CURRENT POWER SWITCH

DESCRIPTION

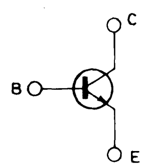
The 2N5038, 2N5039 and 2N6496 are silicon planar multiepitaxial NPN transistors in Jedec TO-3 metal case.

They are especially intended for high current and fast switching applications.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	2N5038	2N5039	2N6496	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	150	120	150	V
V_{CEX}	Collector-emitter Voltage ($V_{BE} = -1.5$ V, $R_{BE} = 100\ \Omega$)	150	120	150	V
V_{CER}	Collector-emitter Voltage ($R_{BE} \leq 50\ \Omega$)	110	95	130	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	90	75	110	V
V_{EBO}	Emitter-Base Voltage ($I_C = 0$)	7	7	7	V
I_C	Collector Current	20	20	15	V
I_{CM}	Collector Peak Current	30	30		V
I_B	Base Current	5			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	140			W
T_{stg}	Storage Temperature	– 65 to 200			°C
T_j	Junction Temperature	200			°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.25	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

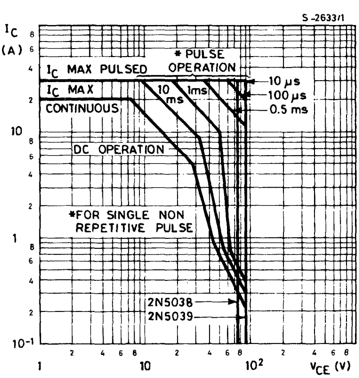
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector Cutoff Current (V_{BE} = – 1.5 V)	for **2N5038**				
		V_{CE} = 140 V			50	mA
		V_{CE} = 100 V T_{case} = 150 °C			10	mA
		for **2N5039**				
		V_{CE} = 110 V			50	mA
		V_{CE} = 85 V T_{case} = 150 °C			10	mA
		for **2N6496**				
		V_{CE} = 130 V			20	mA
		V_{CE} = 130 V T_{case} = 150 °C			25	mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **2N5038**				
		V_{CE} = 70 V			20	mA
		for **2N5039**				
		V_{CE} = 55 V			20	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7 V			50	mA
		V_{EB} = 5 V				
		for **2N5038**			5	mA
		for **2N5039**			15	mA
$V_{CEX(sus)}$*	Collector-emitter Sustaining Voltage (V_{BE} = – 1.5 V, R_{BE} = 100 Ω)	I_C = 200 mA				
		for **2N5038**	150			V
		for **2N5039**	120			V
		for **2N6496**	150			V
$V_{CER(sus)}$*	Collector-emitter Sustaining Voltage (R_{BE} = 50 Ω)	I_C = 200 mA				
		for **2N5038**	110			V
		for **2N5039**	95			V
		for **2N6496**	130			V
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 200 mA				
		for **2N5038**	90			V
		for **2N5039**	75			V
		for **2N6496**	110			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	for **2N5038**				
		I_C = 12 A I_B = 1.2 A			1	V
		I_C = 20 A I_B = 5 A			2.5	V
		for **2N5039**				
		I_C = 10 A I_B = 1 A			1	V
		I_C = 20 A I_B = 5 A			2.5	V
		for **2N6496**				
		I_C = 8 A I_B = 0.8 A			1	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	for **2N5038** and **2N5039**				
		I_C = 20 A I_B = 5 A			3.3	V
		for **2N6496**				
		I_C = 8 A I_B = 0.8 A			2	V
V_{BE}*	Base-emitter Voltage	for **2N5038**				
		I_C = 12 A V_{CE} = 5 V			1.8	V
		for **2N5039**				
		I_C = 10 A V_{CE} = 5 V			1.8	V
		for **2N6496**				
		I_C = 8 A V_{CE} = 2 V			1.6	V

ELECTRICAL CHARACTERISTICS (continued)

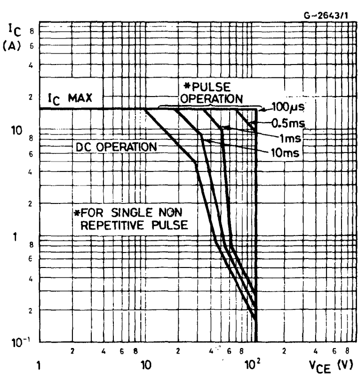
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
h_{FE}*	DC Current Gain	for **2N5038** $I_C = 2$ A $V_{CE} = 5$ V $I_C = 12$ A $V_{CE} = 5$ V for **2N5039** $I_C = 2$ A $V_{CE} = 5$ V $I_C = 10$ A $V_{CE} = 5$ V for **2N6496** $I_C = 8$ A $V_{CE} = 2$ V	 50 20 30 20 12		 250 100 250 100 100	
h_{fe}	Small Signal Current Gain	$I_C = 2$ A $V_{CE} = 10$ V f = 5 MHz	12			
C_{CBO}	Collector-base Capacitance	$I_E = 0$ $V_{CB} = 10$ V f = 1 MHz			300	pF
t_r	Rise Time	for **2N5038** $I_C = 12$ A $V_{CC} = 30$ V $I_{B1} = - I_{B2} = 1.2$ A			0.5	µs
t_s	Storage Time	for **2N5039** $I_C = 10$ A $V_{CC} = 30$ V $I_{B1} = - I_{B2} = 1$ A			1.5	µs
t_f	Fall Time	for **2N6496** $I_C = 8$ A $V_{CC} = 30$ V $I_{B1} = - I_{B2} = 0.8$ A			0.5	µs
$I_{s/b}$**	Second Breakdown Collector Current	$V_{CE} = 28$ V $V_{CE} = 45$ V	5 0.9			A A
$E_{s/b}$	Second Breakdown Energy	$V_{BE} = -4$ V $R_{BE} = 20\ \Omega$ L = 180 µH for **2N5038** for **2N5039** for **2N6496**	 13 13 5.7			 mJ mJ mJ

* Pulsed : pulse duration = 300µs duty cycle = 1.5%.
** Pulsed : 1 s non repetitive pulse.

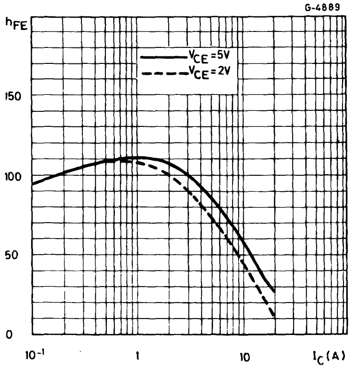
Safe Operating Areas (for **2N5038** and **2N5039**).



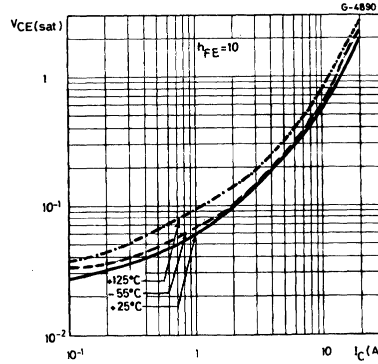
Safe Operating Areas (for **2N6496**).



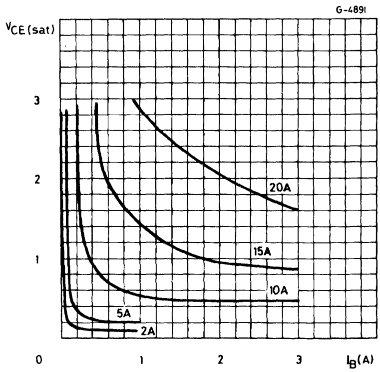
DC Current Gain.



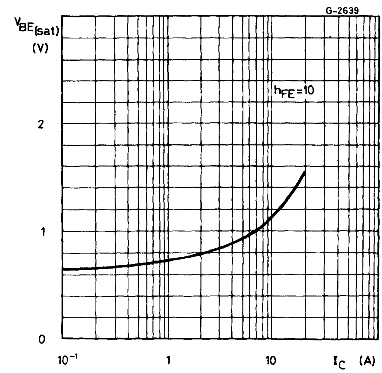
Collector-emitter Saturation Voltage.



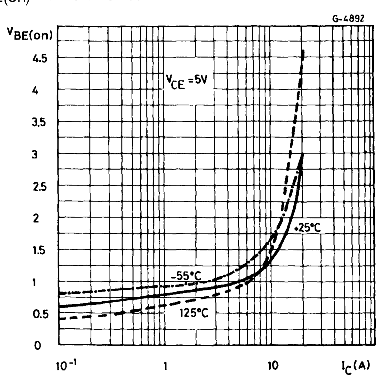
Collector-emitter Saturation Voltage.



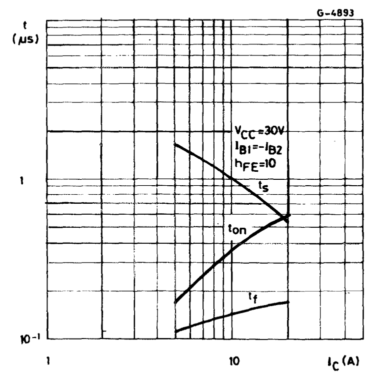
Base-emitter Saturation Voltage.



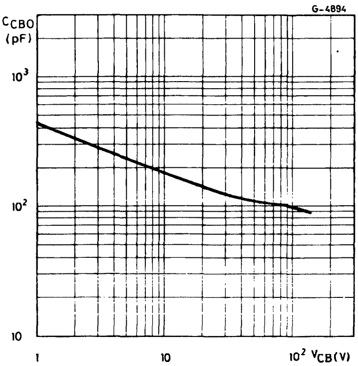
$V_{BE(on)}$ vs. Collector Current.



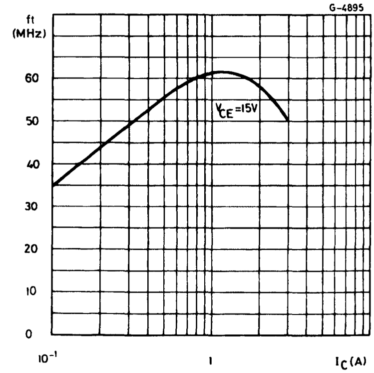
Saturated Switching Characteristics.



Collector-base Capacitance.



Transition Frequency.

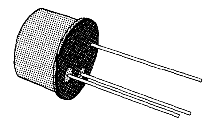


HIGH SPEED MEDIUM VOLTAGE SWITCHES

DESCRIPTION

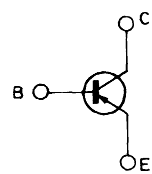
The 2N5151 and 2N5153 are silicon epitaxial planar PNP transistors in Jedec TO-39 metal case intended for use in switching applications.

The complementary NPN types are the 2N5152 and 2N5154 respectively.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		2N5151	2N5153	
V_{CBO}	Collector-base Voltage (I_E = 0)	– 100		V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 80		V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 5.5		V
I_C	Collector Current	– 5		A
I_{CM}	Collector Peak Current	– 10		A
I_B	Base Current	– 2.5		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 50$ °C $T_{case} \leq 100$ °C $T_{amb} \leq 25$ °C	10 6.7 1		W W W
T_{stg}	Storage Temperature	– 65 to 200		°C
T_j	Junction Temperature	200		°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	15	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = – 60 V V_{CE} = – 100 V			– 1 – 1	µA mA
I_{CEV}	Collector Cutoff Current (V_{BE} = 2 V)	V_{CE} = – 60 V T_{case} = 150 °C			– 500	µA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = – 40 V			– 50	µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = – 4 V V_{EB} = – 5.5 V			– 1 – 1	µA mA
$V_{CEO(sus)}$*	Collector-emiter Sustaining Voltage (I_B = 0)	I_C = – 100 mA	– 80			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 2.5 A I_B = – 250 mA I_C = – 5 A I_B = – 500 mA			– 0.75 – 1.5	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 2.5 A I_B = – 250 mA I_C = – 5 A I_B = – 500 mA			– 1.45 – 2.2	V V
V_{BE}*	Base-emitter Voltage	I_C = – 2.5 A V_{CE} = – 5 V			– 1.45	V
h_{FE}*	DC Current Gain	for **2N5151** I_C = – 50 mA V_{CE} = – 5 V I_C = – 2.5 A V_{CE} = – 5 V I_C = – 5 A V_{CE} = – 5 V T_{case} = – 55 °C I_C = 2.5 A V_{CE} = – 5 V for **2N5153** I_C = – 50 mA V_{CE} = – 5 V I_C = – 2.5 A V_{CE} = – 5 V I_C = – 5 mA V_{CE} = – 5 V T_{case} = – 55 °C I_C = 2.5 A V_{CE} = – 5 V	 20 30 20 15 50 70 40 35		 90 200	
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 10 V f = 1 MHz			250	pF
h_{fe}	Small Signal Current Gain	I_C = – 0.1 A V_{CE} = – 5 V f = 1 KHz for **2N5151** for **2N5153** I_C = – 0.5 A V_{CE} = – 5 V f = 20 MHz for **2N5151** for **2N5153**	 20 50 3 3.5			
t_{on}	Turn on Time	I_C = – 5 A I_{B1} = – 0.5 A V_{CC} = 30 V		0.5		µs
t_{off}	Turn off Time	I_C = – 5 A I_{B1} = – I_{B2} = 0.5 A V_{CC} = 30 V		1.3		µs

* Pulsed : pulse duration = 300 µs, duty cycle ≤ 2 %.

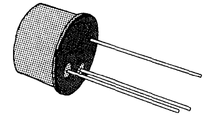
2N5152/2N5154

HIGH SPEED MEDIUM VOLTAGE SWITCHES

DESCRIPTION

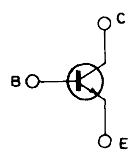
The 2N5152 and 2N5154 are silicon epitaxial planar NPN transistors in Jedec TO-39 metal case intended for use in switching applications.

The complementary PNP types are the 2N5151, and 2N5153 respectively.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	100	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	6	V
I_C	Collector Current	2	A
I_{CM}	Collector Peak Current	10	A
I_B	Base Current	1	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 50°C$ $T_{case} \leq 100°C$ $T_{amb} \leq 25°C$	10 6.7 1	W W W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	15	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 60V V_{CE} = 100V			1 1	μA mA
I_{CEV}	Collector Cutoff Current (V_{BE} = – 2V)	V_{CE} = 60V T_{case} = 150°C			500	μA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 40V			50	μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V V_{EB} = 6V			1 1	μA mA
$V_{CEO(sus)}$*	Collector-emiter Sustaining Voltage (I_B = 0)	I_C = 100mA	80			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 2.5A I_B = 250mA I_C = 5A I_B = 500mA			0.75 1.5	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 2.5A I_B = 250mA I_C = 5A I_B = 500mA			1.45 2.2	V V
V_{BE}*	Base-emitter Voltage	I_C = 2.5A V_{CE} = 5V			1.45	V
h_{FE}*	DC Current Gain	for **2N5152** I_C = 50mA V_{CE} = 5V I_C = 2.5A V_{CE} = 5V I_C = 5A V_{CE} = 5V T_{case} = – 55°C I_C = 2.5A V_{CE} = 5V for **2N5154** I_C = 50mA V_{CE} = 5V I_C = 2.5A V_{CE} = 5V I_C = 5A V_{CE} = 5V T_{case} = – 55°C I_C = 2.5A V_{CE} = 5V	 20 30 20 15 50 70 40 35		 90 200	
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10V f = 1MHz			250	pF
h_{fe}	Small Signal Current Gain	I_C = 0.1A V_{CE} = 5V f = 1KHz for **2N5152** for **2N5154** I_C = 0.5A V_{CE} = 5V f = 20MHz for **2N5152** for **2N5154**	 20 50 3 3.5			
t_{on}	Turn on Time	I_C = 5A I_{B1} = 0.5 A V_{CC} = 30V		0.5		μs
t_{off}	Turn off Time	I_C = 5A I_{B1} = – I_{B2} = 0.5A V_{CC} = 30V		1.3		μs

* Pulsed : pulse duration = 300μs, duty cycle ≤ 2%.

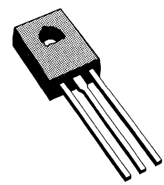
SGS-THOMSON MICROELECTRONICS

2N5190/91/92
2N5193/94/95

MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

DESCRIPTION

The 2N5190, 2N5191, 2N5192 are silicon epitaxial-base NPN power transistors in Jedec TO-126 plastic package, intended for use in medium power linear and switching applications. The complementary PNP types are the 2N5193, 2N5194 and 2N5195 respectively.



TO-126 (SOT-32)

INTERNAL SCHEMATIC DIAGRAMS

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	NPN PNP*	2N5190 2N5193	2N5191 2N5194	2N5192 2N5195	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)		40	60	80	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)		40	60	80	V
V_{EBO}	Emitter-base Voltage (I_C = 0)			5		V
I_C	Collector Current			4		A
I_{CM}	Collector Peak Current (t ≤ 10 ms)			7		A
I_B	Base Current			1		A
P_{tot}	Total Power Dissipation at T_{case} ≤ 25 °C			40		W
T_{stg}	Storage Temperature			– 65 to 150		°C
T_j	Junction Temperature			150		°C

* For PNP types voltage and current values are negative.

THERMAL DATA

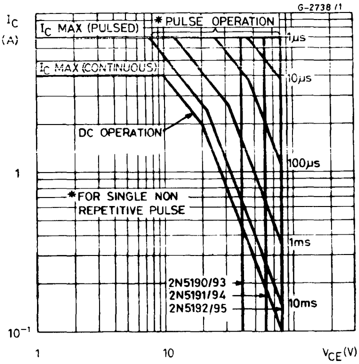
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	3.12	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	100	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

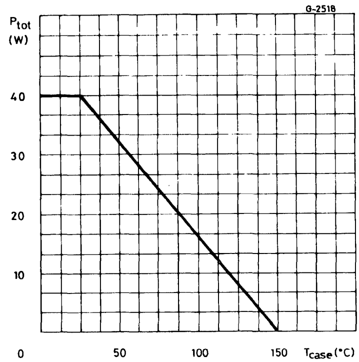
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **2N5190/93** V_{CB} = 40 V for **2N5191/94** V_{CB} = 60 V for **2N5192/95** V_{CB} = 80 V			100 100 100	µA µA µA
I_{CEX}	Collector Cutoff Current (V_{EB} = 1.5 V)	for **2N5190/93** V_{CE} = 40 V for **2N5191/94** V_{CE} = 60 V for **2N5192/95** V_{CE} = 80 V T_{case} = 125 °C for **2N5190/93** V_{CE} = 40 V for **2N5191/94** V_{CE} = 60 V for **2N5192/95** V_{CE} = 80 V			100 100 100 2 2 2	µA µA µA mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **2N5190/93** V_{CE} = 40 V for **2N5191/94** V_{CE} = 60 V for **2N5192/95** V_{CE} = 80 V			1 1 1	mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA for **2N5190/93** for **2N5191/94** for **2N5192/95**	40 60 80			V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 1.5 A I_B = 0.15 A I_C = 4 A I_B = 1 A for **2N5190/91/92** for **2N5193/94/95**			0.6 1.4 1.2	V V V
V_{BE}*	Base-emitter Voltage	I_C = 1.5 A V_{CE} = 2 V			1.2	V
h_{FE}*	DC Current Gain	I_C = 1.5 A V_{CE} = 2 V for **2N5190/93** for **2N5191/94** for **2N5192/95** I_C = 4 A V_{CE} = 2 V for **2N5190/93** for **2N5191/94** for **2N5192/95**	 25 25 20 10 10 7		 100 100 80	
f_T	Transistion Frequency	I_C = 1 A V_{CE} = 10 V	2			MHz

* Pulsed : pulse duration = 300µs duty cycle = 1.5%.
For NPN types voltage and current values are negative.

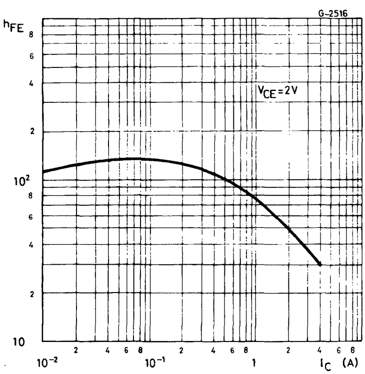
Safe Operating Areas.



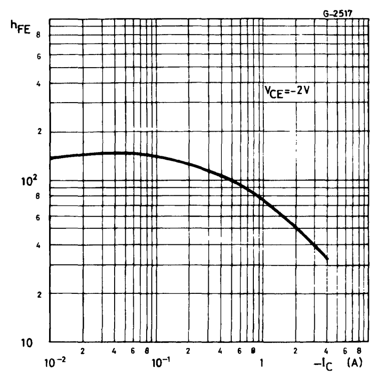
Power Rating Chart.



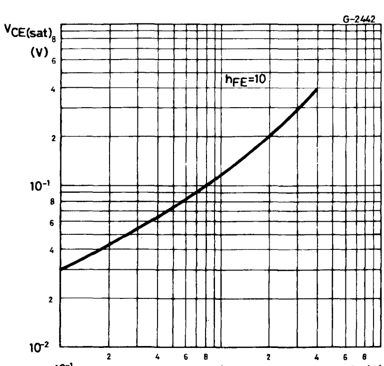
DC Current Gain (NPN types).



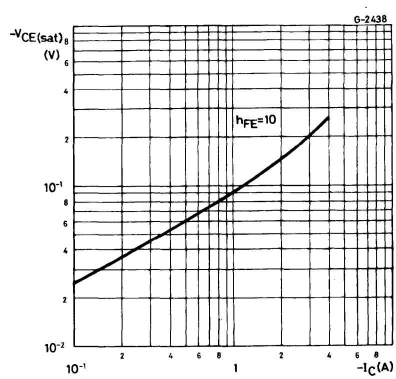
DC Current Gain (PNP types).



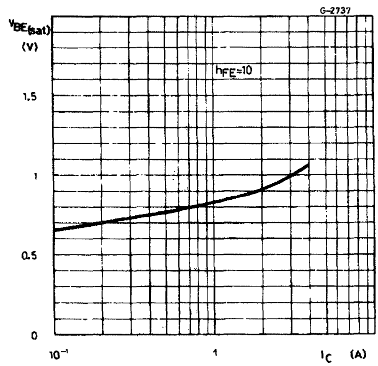
Collector-emitter Saturation Voltage (NPN types).



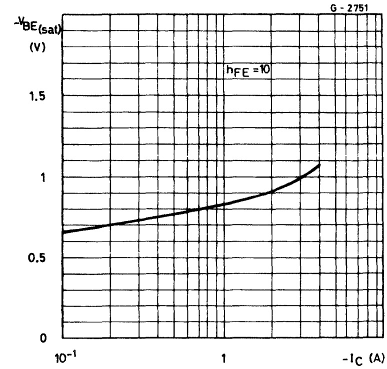
Collector-emitter Saturation Voltage (PNP types).



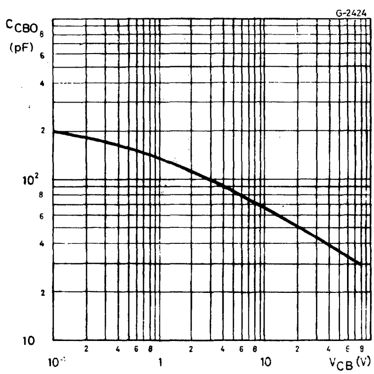
Base-emitter Saturation Voltage (NPN types).



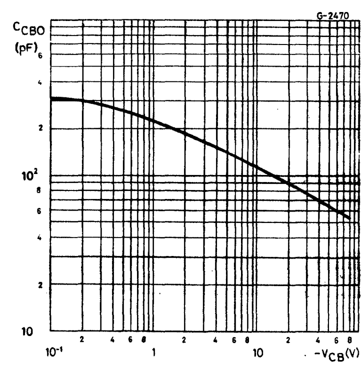
Base-emitter Saturation Voltage (PNP types).



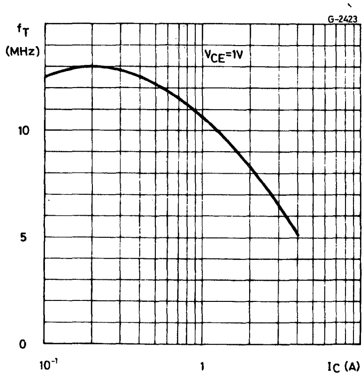
Collector-base Capacitance (NPN types).



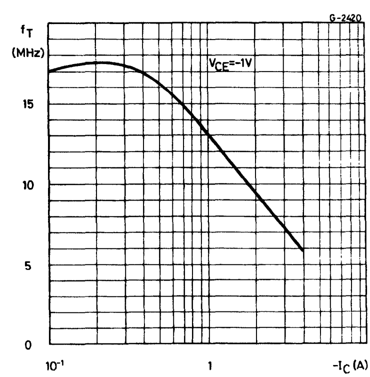
Collector-base Capacitance (PNP types).



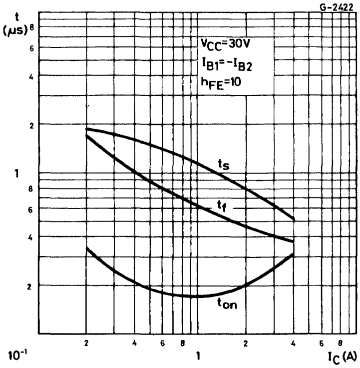
Transition Frequency (NPN types).



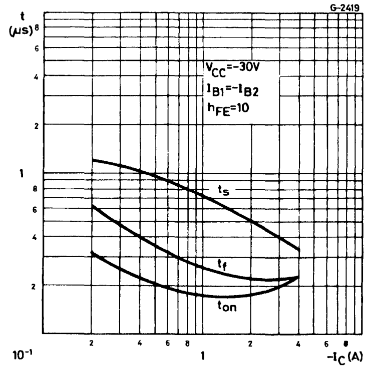
Transition Frequency (PNP types).



Saturated Switching Characteristics (NPN types).



Saturated Switching Characteristics (PNP types).



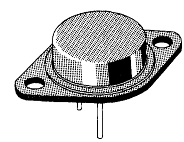
SGS-THOMSON
MICROELECTRONICS

2N5301/02/03
2N4398/99/5745

MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

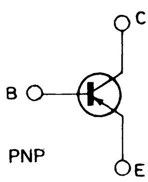
DESCRIPTION

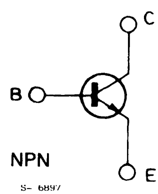
The 2N5301/2/3, are silicon epitaxial-base NPN transistors in Jedec TO-3 metal case. They are intended for power amplifier and switching circuits. The complementary PNP types are the 2N4398/99 and 2N5745 respectively.



TO-3

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	PNP	2N5301	2N5302	2N5303	Unit
		NPN	2N4398	2N4399	2N5745	
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)		40	60	80	V
V_{CBO}	Collector-base Voltage ($I_E = 0$)		40	60	80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)		5	5	5	V
I_C	Collector Current		30	30	20	A
I_{CM}	Collector Peak Current		50			A
I_B	Base Current		7.5			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C		200			W
T_{stg}	Storage Temperature		– 65 to 200			°C
T_j	Junction Temperature		200			°C

For PNP types voltage and current values are negative.

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	0.875	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified))

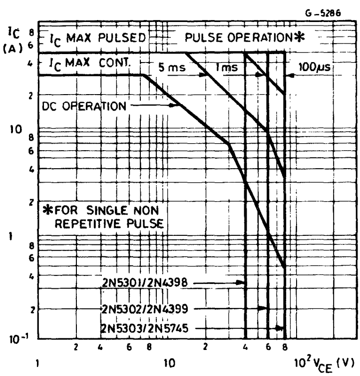
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			5	mA
I_{CBO}	Collector Current (I_E = 0)	V_{CB} = rated V_{CBO}			1	mA
I_{CEV}	Collector Cutoff Current (V_{BE} = – 1.5 V)	V_{CE} = rated V_{CEO} for **2N4398/99, 2N5745** for **2N5301/2/3** V_{CE} = 30 V T_{case} = 150 °C for **2N4398/99** V_{CE} = 80 V T_{case} = 150 °C for **2N5745** V_{CE} = rated V_{CEO} T_{case} = 150 °C for **2N5301/2/3**			 5 1 10 10 10	 mA mA mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = rated V_{CEO}			5	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 200 mA for **2N4398, 2N5301** for **2N4399, 2N5302** for **2N5745, 2N5303**	 40 60 80			 V V V
h_{FE}*	DC Current Gain	I_C = 1 A V_{CE} = 2 V for **2N5745, 2N5303** I_C = 10 A V_{CE} = 2 V I_C = 20 A V_{CE} = 2 V for **2N4398/99, 2N5301/2** I_C = 15 A V_{CE} = 2 V I_C = 30 A V_{CE} = 4 V	40 15 5 15 5		 60 60 	
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10 A I_B = 1 A for **2N4398/99, 2N5301/2** for **2N5745, 2N5303** I_C = 15 A I_B = 1.5 A for **2N4398/99, 2N5301/2** for **2N5745, 2N5303** I_C = 20 A I_B = 2 A for **2N4398/99, 2N5301/2** I_C = 20 A I_B = 4 A for **2N5745, 2N5303** I_C = 30 A I_B = 6 A for **2N4398/99, 2N5301/2**			 0.75 1 1 1.5 2 2 4	 V V V V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 10 A I_B = 1 A I_C = 15 A I_B = 1.5 A for **2N4398/99, 2N5301/2** for **2N5745, 2N5303** I_C = 20 A I_B = 2 A for **2N4398/99, 2N5301/2** I_C = 20 A I_C = 4 A for **2N5745, 2N5303**			1.7 1.8 2 2.5 2.5	V V V V V

ELECTRICAL CHARACTERISTICS (continued)

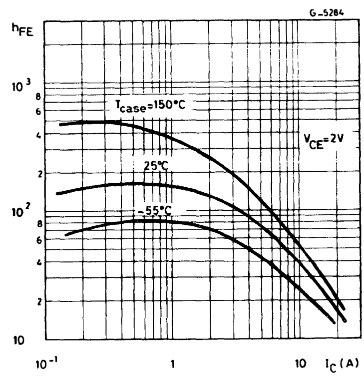
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{BE}*	Base-emitter Volage	I_C = 10 A V_{CE} = 2 V for **2N5745, 2N5303** I_C = 15 A V_{CE} = 2 V for **2N4398/99, 2N5301/2** I_C = 20 A V_{CE} = 4 V for **2N5745, 2N5303** I_C = 30 A V_{CE} = 4 V for **2N4398/99, 2N5301/3**			1.5 1.7 2.5 3	V V V V
f_T	Transition Frequency	I_C = 1 A V_{CE} = 10 V f = 1 MHz for **2N4398/99, 2N5301/2** for **2N5745, 2N5303**	4 2			MHz MHz
h_{fe}	Small Signal Current Gain	I_C = 1 A V_{CE} = 10 A f = 1KHz	40			
t_r	Rise Time	V_{CC} = 30 V I_C = 10 A I_{B1} = − I_{B2} = 1 A			1	µs
t_s	Storage Time				2	µs
t_f	Fall Time				1	µs

* Pulsed : pulse duration = 300µs, duty cycle ≤ 2%.
For PNP types voltage and current values are negative.

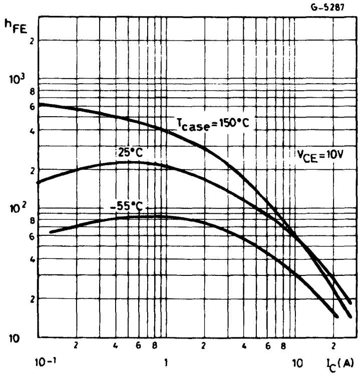
Safe Operating Areas.



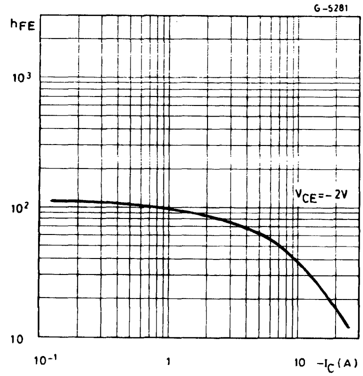
DC Current Gain (NPN types).



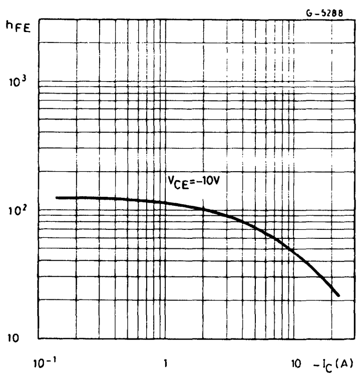
DC Current Gain (NPN types).



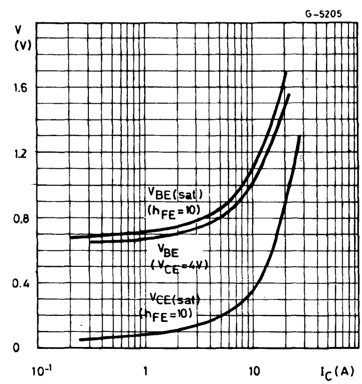
DC Current Gain (PNP types).



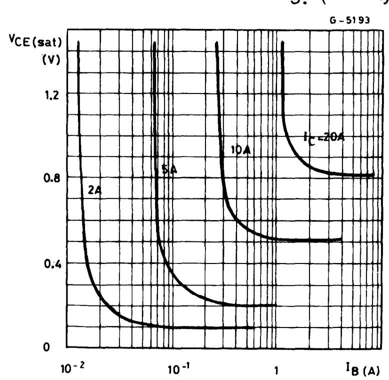
DC Current Gain (PNP types).



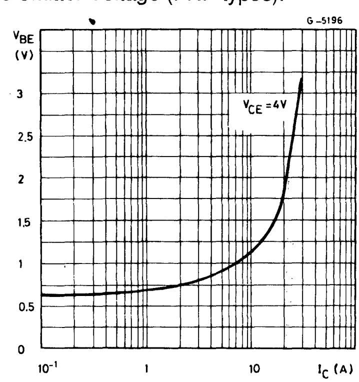
Saturation Voltage (NPN types).



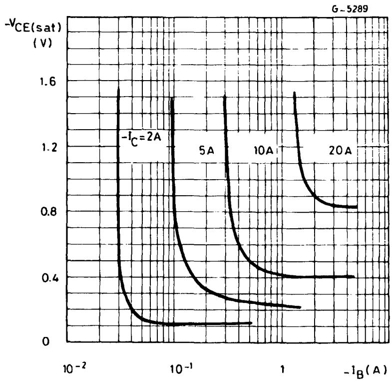
Collector-emitter Saturation Voltage (NPN types).



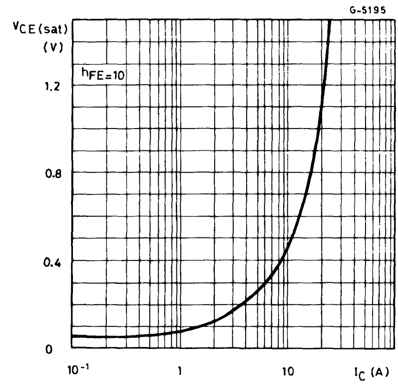
Base-emitter Voltage (PNP types).



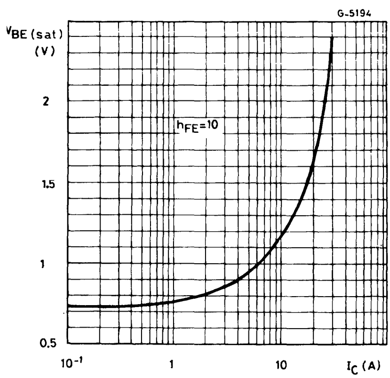
Collector-emitter Saturation Voltage (PNP types).



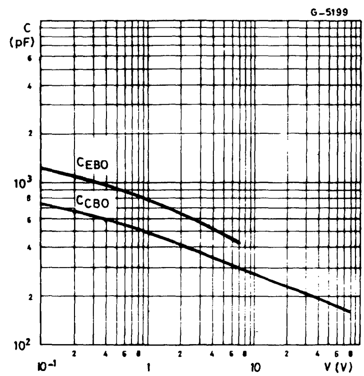
Collector-emitter Saturation Voltage (PNP types).



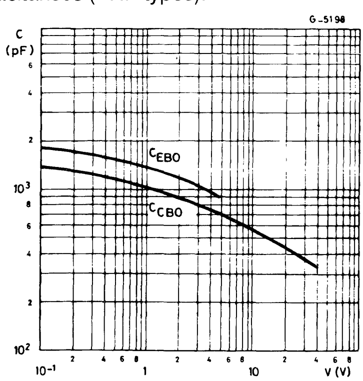
Base-emitter Saturation Voltage (PNP types).



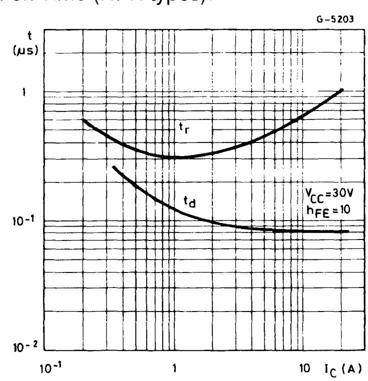
Capacitances (NPN types).



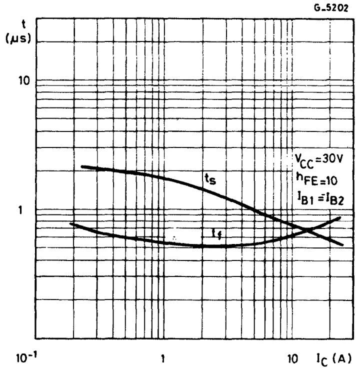
Capacitances (PNP types).



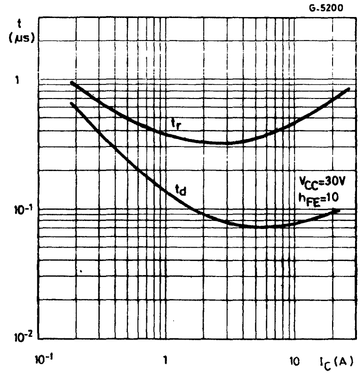
Turn-on Time (NPN types).



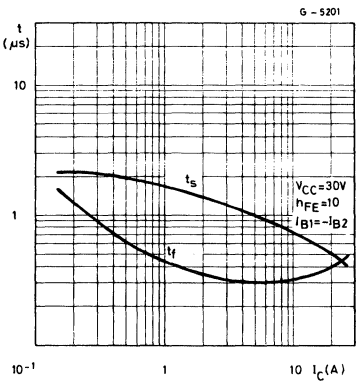
Turn-off Time (NPN types).



Turn-on Time (PNP types).



Turn-off Time (PNP types).

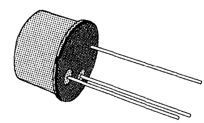


HIGH CURRENT FAST SWITCHING APPLICATION

DESCRIPTION

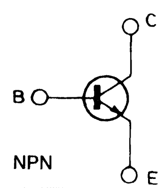
The 2N5336, 2N5337, 2N5338 and 2N5339 are silicon epitaxial planar NPN transistors in Jedec TO-39 metal case.

They are intended for high current switching applications up to 5A.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	2N5336 2N5337	2N5338 2N5339	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	80	100	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	80	100	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	6		V
I_C	Collector Current	5		A
I_{CM}	Collector Peak Current	7		A
I_B	Base Current	1		A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C $T_{case} \leq 25$ °C	1 6		W W
T_{stg}	Storage Temperature	– 65 to 200		°C
T_j	Junction Temperature	200		°C

THERMAL DATA

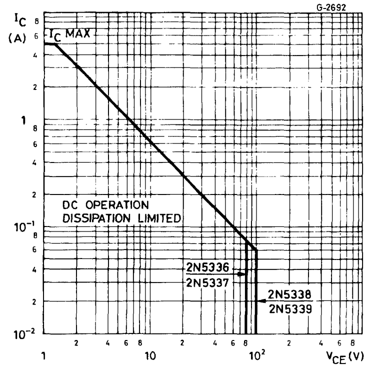
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	29.2	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

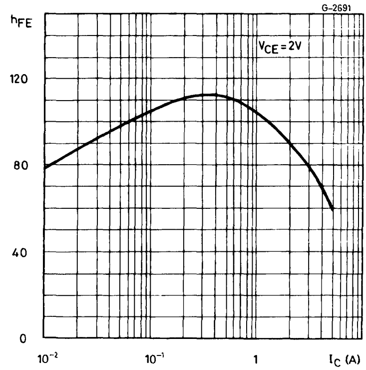
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **2N5336** and **2N5337** V_{CB} = 80 V for **2N5338** and **2N5339** V_{CB} = 100 V			 10 10	 µA µA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **2N5336** and **2N5337** V_{CE} = 75 V for **2N5338** and **2N5339** V_{CE} = 90 V			 100 100	 µA µA
I_{CEX}	Collector Cutoff Current (V_{BE} = – 1.5 V)	for **2N5336** and **2N5337** V_{CE} = 75 V V_{CE} = 75 V T_{case} = 150 °C for **2N5338** and **2N5339** V_{CE} = 90 V V_{CE} = 90 V T_{case} = 150 °C			 10 1 10 1	 µA mA µA mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 50 mA for **2N5336** and **2N5337** for **2N5338** and **2N5339**	 80 100			 V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 2 A I_B = 0.2 A I_C = 5 A I_B = 0.5 A			0.7 1.2	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 2 A I_B = 0.2 A I_C = 5 A I_B = 0.5 A			1.2 1.8	V V
h_{FE}*	DC Current Gain	I_C = 0.5 A V_{CE} = 2 V for **2N5336** and **2N5337** for **2N5338** and **2N5339** I_C = 2 A V_{CE} = 2 V for **2N5336** and **2N5337** for **2N5338** and **2N5339** I_C = 5 A V_{CE} = 2 V for **2N5336** and **2N5337** for **2N5338** and **2N5339**	 30 60 30 60 20 40		 120 240	
f_T	Transition Frequency	I_C = 0.5 A V_{CE} = 10 V	30			MHz
C_{CBO}	Collector-base Capacitance	V_{CB} = 10 V I_E = 0 f = 0.1 MHz			 250	 pF
t_{on}	Turn-on Time	I_C = 2 A V_{CC} = 40 V I_{B1} = 0.2 A			200	ns
t_s	Storage Time	I_C = 2 A V_{CC} = 40 V I_{B1} = – I_{B2} = 0.2 A			2	µs
t_f	Fall Time				200	ns

* Pulsed : pulse duration = 300µs, duty cycle = 1.5%.

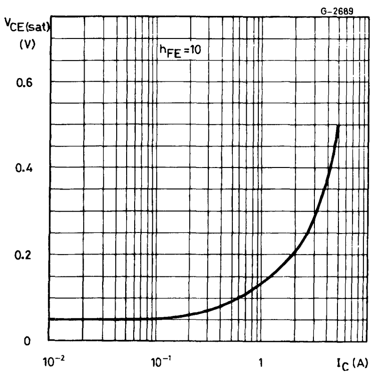
Safe Operating Areas.



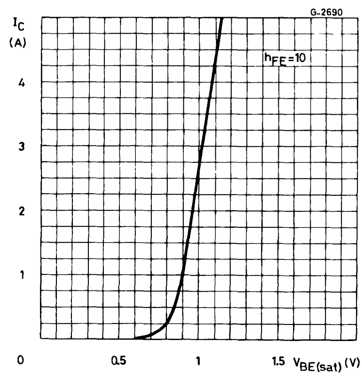
DC Current Gain.



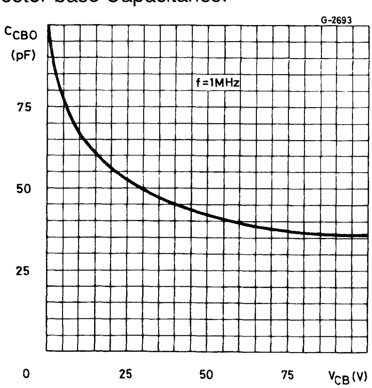
Collector-emitter Saturation Voltage.



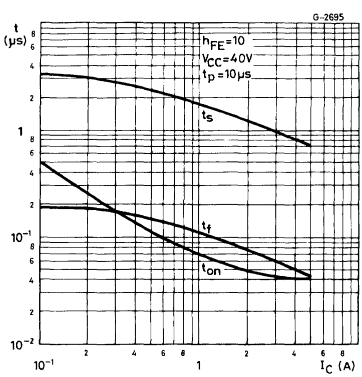
Base-emitter Saturation Voltage.



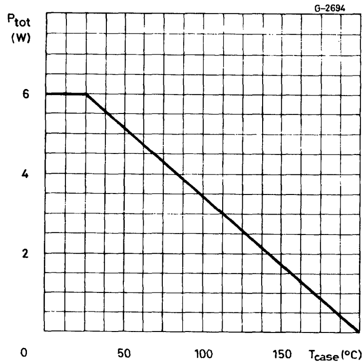
Collector-base Capacitance.



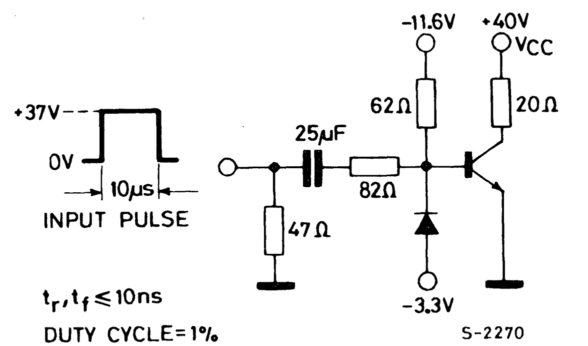
Saturated Switching Characteristics.



Power Rating Chart.



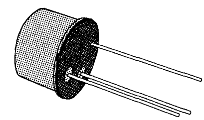
Switching Time Test Circuit.



HIGH VOLTAGE TRANSISTORS

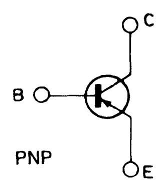
DESCRIPTION

The 2N5415, 2N5416 are high voltage silicon epitaxial planar transistors designed for use in consumer and industrial line-operated applications. These devices are particularly suited as drivers in high-voltage low current inverters, switching and series regulators.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	2N5415	2N5416	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	– 200	– 350	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	– 200	– 300	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	– 4	– 6	V
I_C	Collector Current	– 1		A
I_B	Base Current	– 0.5		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C $T_{amb} \leq 50$ °C	10 1		W W
T_{stg}	Storage Temperature	– 65 to 200		°C
T_j	Junction Temperature	200		°C

THERMAL DATA

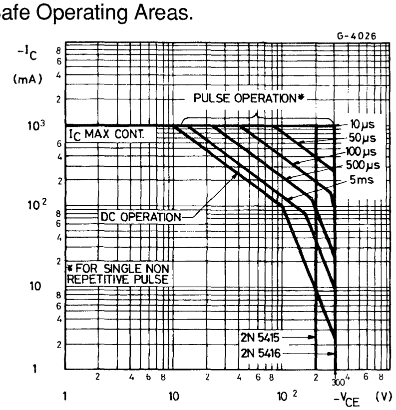
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	17.5	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	150	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

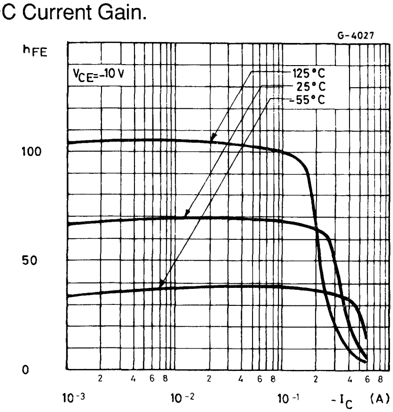
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **2N5415** V_{CB} = – 175 V for **2N5416** V_{CB} = – 280 V			– 50 – 50	µA µA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = – 150 V			– 50	µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	for **2N5415** V_{EB} = – 4 V for **2N5416** V_{EB} = – 6 V			– 20 – 20	µA µA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = – 10 mA for **2N5415** for **2N5416**	 – 200 – 300			 V V
V_{CER}*	Collector-emitter Sustaining Voltage (R_{BE} = 50 Ω)	I_C = – 50 mA for **2N5416**	– 350			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 50 mA I_B = – 5 mA			– 2.5	V
V_{BE}*	Base-emitter Voltage	I_C = – 50 mA V_{CE} = – 10 V			– 1.5	V
h_{FE}*	DC Current Gain	I_C = – 50 mA V_{CE} = – 10 V for **2N5415** for **2N5416**	 30 30		 150 120	
h_{fe}	Small Signal Current Gain	I_C = – 5 mA V_{CE} = – 10 V f = 1 KHz	25			
f_T	Transition Frequency	I_C = – 10 mA V_{CE} = – 10 V f = 5 MHz	15			MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 10 V f = 1 MHz			25	pF

* Pulsed : pulse duration = 300µs, duty cycle ≤ 2%.

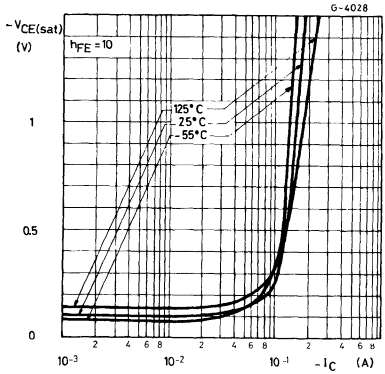
Safe Operating Areas.



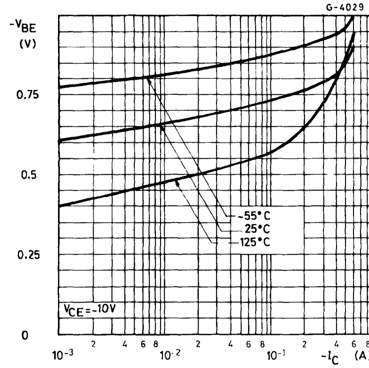
DC Current Gain.



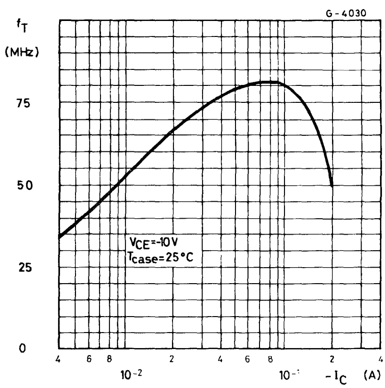
Collector-emitter Saturation Voltage.



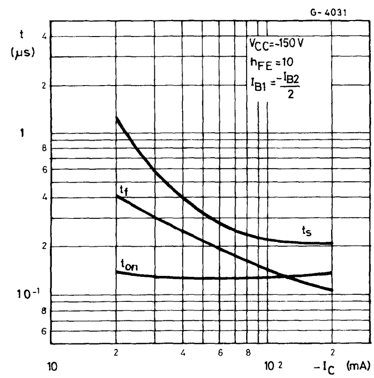
Base-emitter Voltage.



Transition Frequency.



Switching Times.



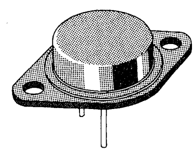
SGS-THOMSON MICROELECTRONICS

2N5629
2N6029

COMPLEMENTARY HIGH POWER TRANSISTORS

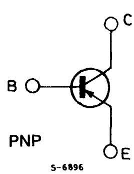
DESCRIPTION

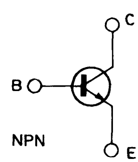
The 2N5629 (NPN) and 2N6029 (PNP) are complementary silicon epitaxial-base transistors in Jedec TO-3 metal case. They are intended for high power audio amplifier applications and switching regular circuits.



TO3

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	100	V
V_{CBO}	Collector-base Voltage ($I_E = 0$)	100	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	16	A
I_{CM}	Collector Peak Current	20	A
I_B	Base Current	5	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$	200	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temeprature	200	°C

For PNP type voltage and current values are negative.

THERMAL DATA

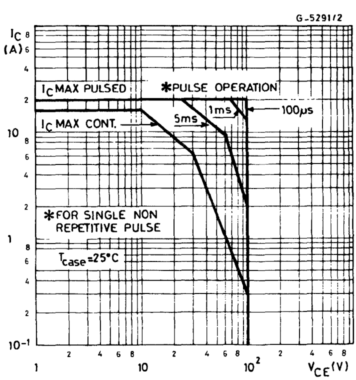
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	0.875	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

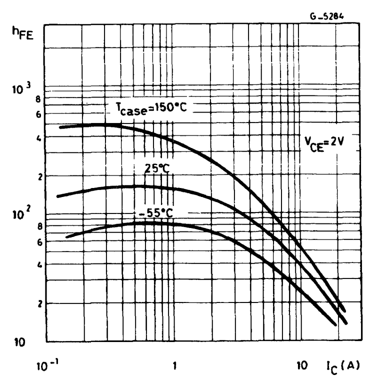
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 50V			1	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			1	mA
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 100V			1	mA
I_{CEV}	Collector-emitter Cutoff Current (V_{BE} = – 1.5V)	V_{CE} = 100V V_{CE} = 100V T_{case} = 150°C			1 5	mA mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 200mA	100			V
h_{FE}*	DC Current Gain	I_C = 8A V_{CE} = 2V I_C = 16A V_{CE} = 2V	25 4		100	
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10A I_B = 1A I_C = 16A I_B = 4A			1 2	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 10A I_B = 1A			1.8	V
V_{BE}*	Base-emitter Voltage	I_C = 8A V_{CE} = 2V			1.5	V
f_T	Transition Frequency	I_C = 1A V_{CE} = 20V f = 0.5MHz	1			MHz
C_{CBO}	Collector-base Capacitance	V_{CB} = 10V I_E = 0 f = 0.1MHz for **2N6029**			500 1000	pF pF
h_{fe}	Small Signal Current Gain	I_C = 4A V_{CE} = 10V f = 1KHz	15			

* Pulsed : pulse duration = 300 µs, duty cycle ≤ 2 %.
For PNP type voltage and current values are negative.

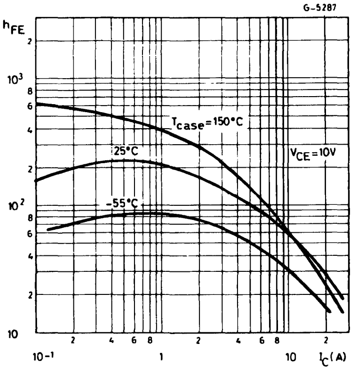
Safe Operating Areas.



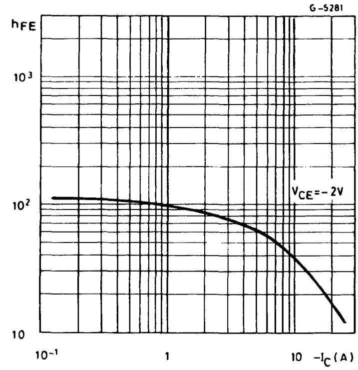
DC Current Gain (NPN type).



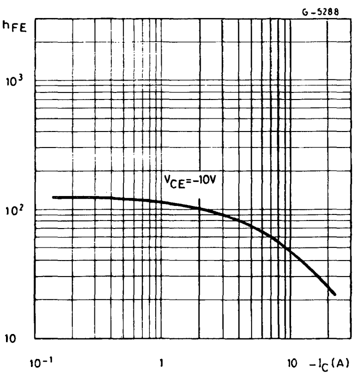
DC Current Gain (NPN type).



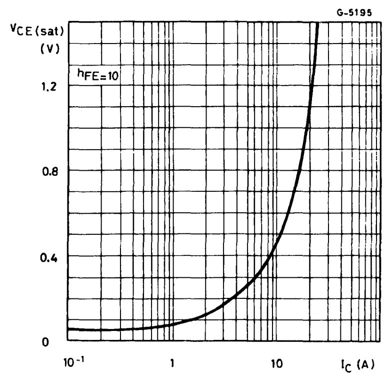
DC Current Gain (PNP type).



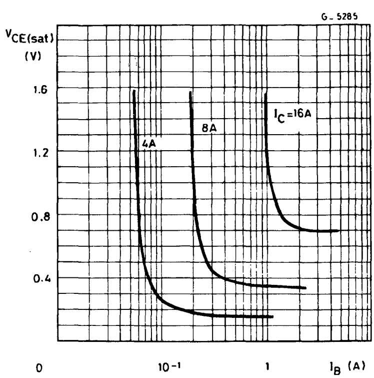
DC Current Gain (PNP type).



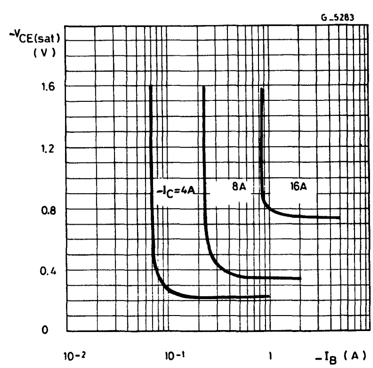
Collector-emitter Saturation Voltage (PNP type).



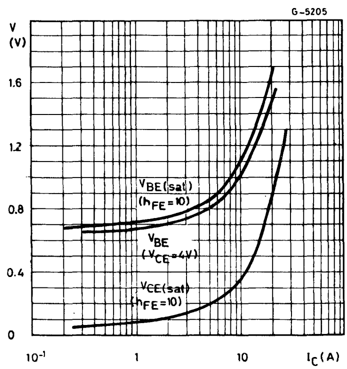
Collector-emitter Saturation Voltage (NPN type).



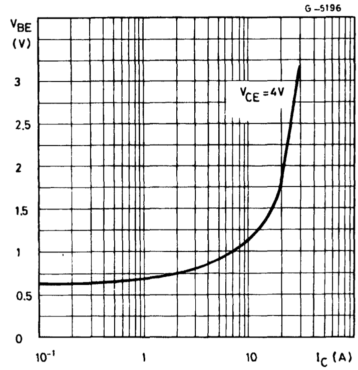
Collector-emitter Saturation Voltage (PNP type).



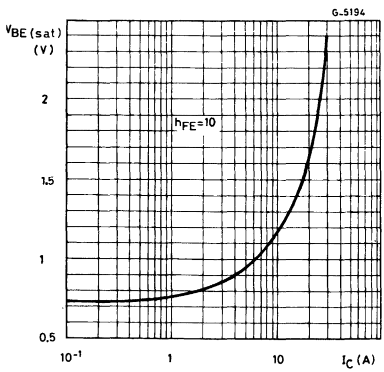
Saturation Voltage (PNP type).



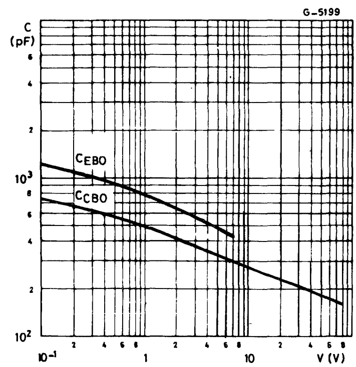
Base-emitter Voltage (PNP type).



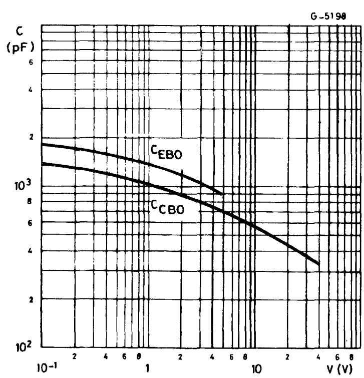
Base-emitter Saturation Voltage (PNP type).



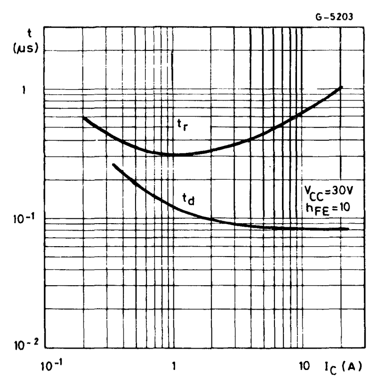
Capacitances (NPN type).



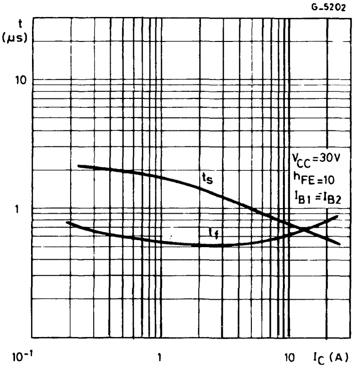
Capacitances (PNP type).



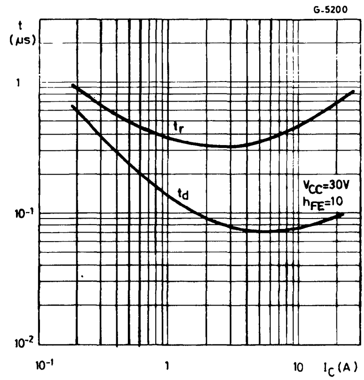
Turn-on Time (NPN type).



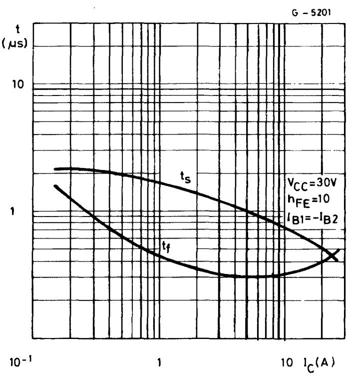
Turn-off Time (NPN type).



Turn-on Time (PNP type).



Turn-off Time (PNP type).

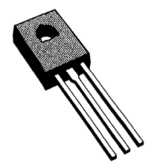


2N5655
2N5656-2N5657

HIGH VOLTAGE POWER TRANSISTORS

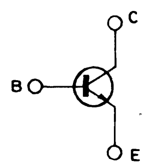
DESCRIPTION

The 2N5655, 2N5656 and 2N5657 are silicon epitaxial planar NPN transistors in Jedec TO-126 plastic package. They are intended for use audio output amplifiers, low current, high voltage converters and AC line relays.



TO-126

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	2N5655	2N5656	2N5657	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	275	325	375	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	250	300	350	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	6			V
I_C	Collector Current	0.5			A
I_{CM}	Collector Peak Current	1			A
I_B	Base Current	0.25			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$	20			W
T_{stg}	Storage Temperature	– 65 to 150			°C
T_j	Junction Temperature	150			°C

THERMAL DATA

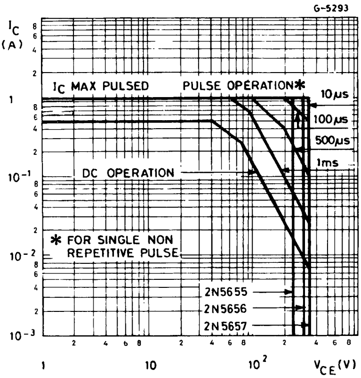
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	6.25	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

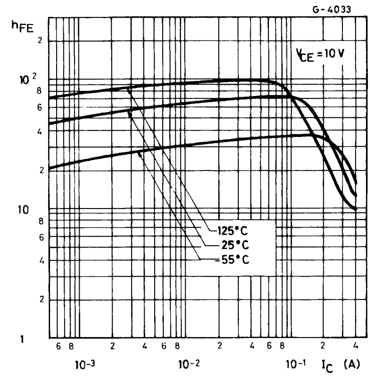
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = rated V_{CBO}			10	µA
I_{CEV}	Collector Cutoff Current (V_{BE} = − 1.5V)	V_{CE} = rated V_{CEO} T_{case} = 100°C for **2N5655** V_{CE} = 150V for **2N5656** V_{CE} = 200V for **2N5657** V_{CE} = 250V			0.1 1 1 1	mA mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **2N5655** V_{CE} = 150V for **2N5656** V_{CE} = 200V for **2N5657** V_{CE} = 250V			0.1 0.1 0.1	mA mA mA
I_{EBO}	Emitter-base Current (I_C = 0)	V_{EB} = 6V			10	µA
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 1mA for **2N5655** for **2N5656** for **2N5657**	250 300 350			V V V
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 100mA for **2N5655** L = 50mH for **2N5656** for **2N5657**	250 300 350			V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 0.1A I_B = 10mA I_C = 0.25A I_B = 25mA I_C = 0.5A I_B = 0.1A			1 2.5 10	V V V
V_{BE}*	Base-emitter Voltage	I_C = 0.1V V_{CE} = 10V			1	V
h_{FE}*	DC Current Gain	I_C = 50mA V_{CE} = 10V I_C = 0.1A V_{CE} = 10V I_C = 0.25A V_{CE} = 10V I_C = 0.5A V_{CE} = 10V	25 30 15 5		 250	
h_{fe}	Small Signal Current Gain	I_C = 0.1A V_{CE} = 10V f = 1KHz	20			
f_T	Transition Frequency	I_C = 50mA V_{CE} = 10V f = 10MHz	10			MHz
C_{CBO}	Collector-base Capacitance	V_{CB} = 10V f = 100KHz			25	pF

* Pulsed : pulse duration = 300µs, duty cycle ≤ 1.5 %.

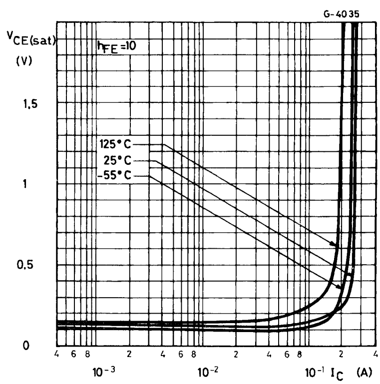
Safe Operating Areas.



DC Current Gain.



Collector-emitter Saturation Voltage.

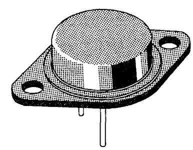


HIGH CURRENT FAST SWITCHING APPLICATIONS

DESCRIPTION

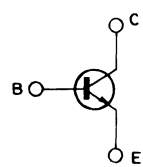
The 2N5671 and 2N5672 are silicon multiepitaxial planar NPN transistors in Jedec TO-3 metal case.

They are especially intended for high current, fast switching industrial applications.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	2N5671	2N5672	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	120	150	V
V_{CEX}	Collector-emitter Voltage (V_{BE} = – 1.5V, R_{BE} = 50Ω)	120	150	V
V_{CER}	Collector-emitter Voltage (R_{BE} ≤ 50Ω)	110	140	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	90	120	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7		V
I_C	Collector Current	30		A
I_B	Base Current	10		A
P_{tot}	Total Power Dissipation at T_{case} ≤ 25°C	140		W
T_{stg}	Storage Temperature	– 65 to 200		°C
T_j	Junction Temperature	200		°C

THERMAL DATA

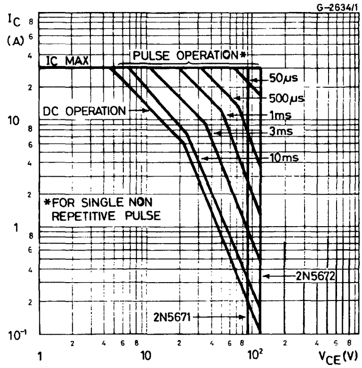
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case Max	1.25	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

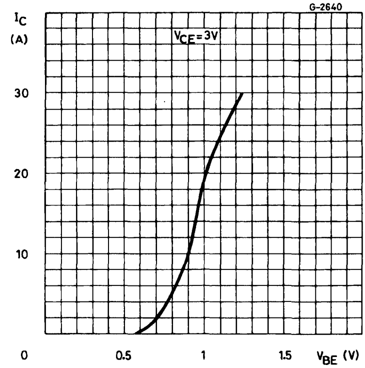
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector Cutoff Current (V_{BE} = – 1.5V)	for **2N5671** V_{CE} = 110V for **2N5672** V_{CE} = 135V V_{CE} = 100V T_{case} = 150°C for **2N5671** for **2N5672**			12 10 15 10	mA mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 80V			10	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			10	mA
$V_{CEX(sus)}$*	Collector-emitter Sustaining Voltage (V_{BE} = – 1.5V R_{BE} = 50Ω)	I_C = 200mA for **2N5671** for **2N5672**	120 150			V V
$V_{CER(sus)}$*	Collector-emitter Sustaining Voltage (R_{BE} = 50Ω)	I_C = 200mA for **2N5671** for **2N5672**	110 140			V V
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 200mA for **2N5671** for **2N5672**	90 120			V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 15A I_B = 1.2A			0.75	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 15A I_B = 1.2A			1.5	V
V_{BE}*	Base-emitter Voltage	I_C = 15A V_{CE} = 5V			1.6	V
h_{FE}*	DC Current Gain	I_C = 15A V_{CE} = 2V I_C = 20A V_{CE} = 5V	20 20		100	
f_T	Transistion Frequency	I_C = 2A V_{CE} = 10V	50			MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10V f = 1MHz			900	pF
t_{on}	Turn-on Time	I_C = 15A V_{CC} = 30A I_{B1} = – I_{B2} = 1.2A			0.5	µs
t_s	Storage Time				1.5	µs
t_f	Fall Time				0.5	µs
$I_{s/b}$**	Second Breakdown Collector Current	V_{CE} = 24V V_{CE} = 45V	5.8 0.9			A A
$E_{s/b}$	Second Breakdown Energy	V_{BE} = – 4V R_{BE} = 20Ω L = 180µH	20			mJ

* Pulsed : pulse duration = 300µs, duty cycle = 1.5 %.
** Pulsed : 1 s, non repetitive pulse.

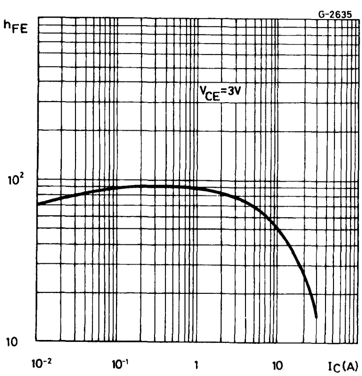
Safe Operating Areas.



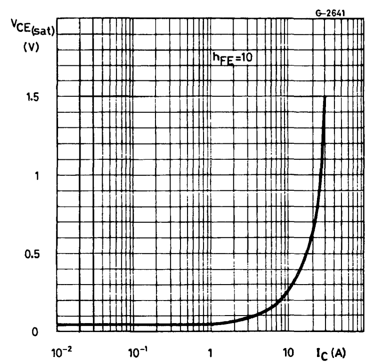
DC Transconductance.



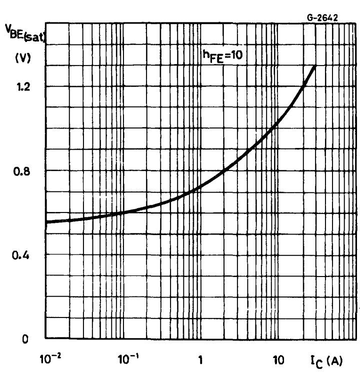
DC Current Gain.



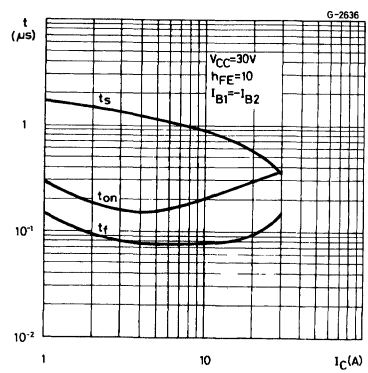
Collector-emitter Saturation Voltage.



Base-emitter Saturation Voltage.



Saturated Switching Characterisitcs.

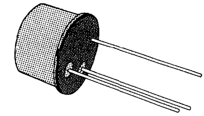


PNP SILICON TRANSISTORS

DESCRIPTION

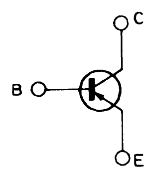
The 2N5679 and 2N5680 are silicon epitaxial planar PNP transistors in Jedec TO-39 metal case intended for use as drivers for high power transistors in general purpose, amplifier and switching circuit.

The complementary NPN types are the 2N5681 and 2N5682 respectively.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	2N5679	2N5680	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	– 100	– 120	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	– 100	– 120	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	– 4		V
I_C	Collector Current	– 1		A
I_B	Base Current	– 0.5		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$ $T_{amb} \leq 25°C$	10 1		W W
T_{stg}	Storage Temperature	– 65 to 200		°C
T_j	Junction Temperature	200		°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	17.5	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **2N5679** V_{CB} = – 100V for **2N5680** V_{CB} = – 120V			– 1 – 1	µA µA
I_{CEV}	Collector Cutoff Current (V_{BE} = 1.5)	for **2N5679** V_{CE} = – 100V for **2N5680** V_{CE} = – 120V T_{case} = 150°C for **2N5679** V_{CE} = – 100V for **2N5680** V_{CE} = – 120V			– 1 – 1 – 1 – 1	µA µA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **2N5679** V_{CE} = – 70V for **2N5680** V_{CE} = – 80V			– 10 – 10	µA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = – 4V			– 1	µA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = – 10mA for **2N5679** for **2N5680**	 – 100 – 120			 V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 250mA I_B = – 25mA I_C = – 500mA I_B = – 50mA I_C = – 1A I_B = – 200mA			– 0.6 – 1 – 2	V V V
V_{BE}*	Base-emitter Voltage	I_C = – 250mA V_{CE} = – 2V			– 1	V
h_{FE}*	DC Current Gain	I_C = – 250mA V_{CE} = – 2V I_C = – 1A V_{CE} = – 2V	40 5		150	
f_T	Transition Frequency	I_C = – 100mA V_{CE} = – 10V f = 10MHz	30			MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 20V f = 1MHz			50	pF
h_{fe}	Small Signal Current Gain	I_C = – 0.2A V_{CE} = – 1.5V f = 1KHz	40			

* Pulsed : pulse duration = 300µs, duty cycle ≤ 2 %.

SGS-THOMSON MICROELECTRONICS

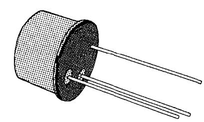
2N5681
2N5682

GENERAL PURPOSE TRANSISTORS

DESCRIPTION

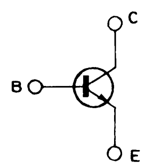
The 2N5681 and 2N5682 are silicon epitaxial planar NPN transistors in Jedec TO-39 metal case intended for use as drivers for high power transistors in general purpose amplifier and switching circuits.

The complementary PNP types are the 2N5679 and 2N5680 respectively.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	2N5681	2N5682	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	100	120	V
V_{CEO}	Collector-emiter Voltage (I_B = 0)	100	120	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	4		V
I_C	Collector Current	1		A
I_B	Base Current	0.5		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$ $T_{amb} \leq 25°C$	10 1		W W
T_{stg}	Storage Temperature	– 65 to 200		°C
T_j	Junction Temperature	200		°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	17.5	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

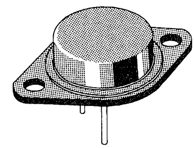
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current ($I_E = 0$)	for **2N5681** V_{CB} = 100V for **2N5682** V_{CB} = 120V			1 1	µA µA
I_{CEV}	Collector Cutoff Current ($V_{BE} = -1.5V$)	for **2N5681** V_{CE} = 100V for **2N5682** V_{CE} = 120V T_{case} = 150°C for **2N5681** V_{CE} = 100V for **2N5682** V_{CE} = 120V			1 1 1 1	µA µA mA mA
I_{CEO}	Collector Cutoff Current ($I_B = 0$)	for **2N5681** V_{CE} = 70V for **2N5682** V_{CE} = 80V			10 10	µA µA
I_{EBO}	Emitter Cutoff Current ($I_C = 0$)	V_{EB} = 4V			1	µA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage ($I_B = 0$)	I_C = 10mA for **2N5681** for **2N5682**	 100 120			 V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 250mA I_B = 25mA I_C = 500mA I_B = 50mA I_C = 1A I_B = 200mA			0.6 1 2	V V V
V_{BE}*	Base-emitter Voltage	I_C = 250mA V_{CE} = 2V			1	V
h_{FE}*	DC Current Gain	I_C = 250mA V_{CE} = 2V I_C = 1A V_{CE} = 2V	40 5		150	
f_T	Transistion Frequency	I_C = 100mA V_{CE} = 10V f = 10MHz	30			MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 20V f = 1MHz			50	pF
h_{fe}	Small Signal Curent Gain	I_C = 0.2A V_{CE} = 1.5V f = 1KHz	40			

* Pulsed : pulse duration = 300 µs, duty cycle ≤ 2 %.

SILICON HIGH POWER TRANSISTORS

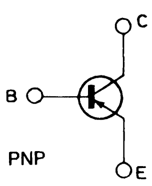
DESCRIPTION

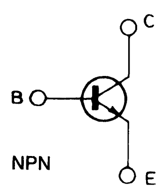
The 2N5877 and 2N5878 are silicon epitaxial-base NPN power transistors in Jedec TO-3 metal case. They are intended for use in power linear and switching applications. The complementary PNP types are the 2N5875 and 2N5876 respectively.



TO-3

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter			Unit
	NPN	2N5877	2N5878	
	PNP	2N5875	2N5876	
V_{CBO}	Collector-base Voltage (I_E = 0)	60	80	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	60	80	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5		V
I_C	Collector Current	10		A
I_{CM}	Collector Peak Current	20		A
I_B	Base Current	4		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$°C	150		W
T_{stg}	Storage Temperature	– 65 to 200		°C
T_j	Junction Temperature	200		°C

* For PNP types voltage and current values are negative.

THERMAL DATA

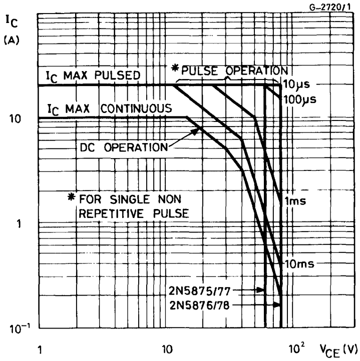
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.17	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

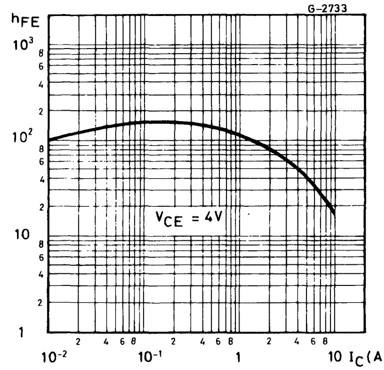
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **2N5877/75** V_{CB} = 60V for **2N5878/76** V_{CB} = 80V			0.5 0.5	mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **2N5877/75** V_{CE} = 30V for **2N5878/76** V_{CE} = 40V			1 1	mA mA
I_{CEX}	Collector Cutoff Current (V_{BE} = 1.5V)	for **2N5877/75** V_{CE} = 60V for **2N5878/76** V_{CE} = 80V Tcase = 150°C for **2N5877/75** V_{CE} = 60V for **2N5878/76** V_{CE} = 80V			0.5 0.5 5 5	mA mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 200mA for **2N5877/75** for **2N5878/76**	60 80			V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5A I_B = 0.5A I_C = 10A I_B = 2.5A			1 3	V V
$V_{BE(sat)}$*	Base-emitter Satuation Voltage	I_C = 10A I_C = 2.5A			2.5	V
V_{BE}*	Base-emitter Voltage	I_C = 4A V_{CE} = 4V			1.5	V
h_{FE}*	DC Current Gain	I_C = 4A V_{CE} = 4V I_C = 10A V_{CE} = 4V	20 4		100	
f_T	Transition Frequency	I_C = 0.5V V_{CE} = 10V	4			MHz
C_{CBO}	Collector-base Capacitance	V_{CB} = 10V f = 1MHz I_E = 0 for **2N5877/2N5878** for **2N5875/2N5876**			 300 500	 pF pF
t_r	Rise Time	I_C = 4A V_{CC} = 30V I_{B1} = 0.4A			0.7	µs
t_s	Storage Time	I_C = 4A V_{CC} = 30V I_{B1} = – I_{B2} = 0.4A			1	µs
t_f	Fall Time				0.8	µs

* Pulsed : pulse duration = 300µs, duty cycle = 1.5%.
For PNP types voltage and current values are negative.

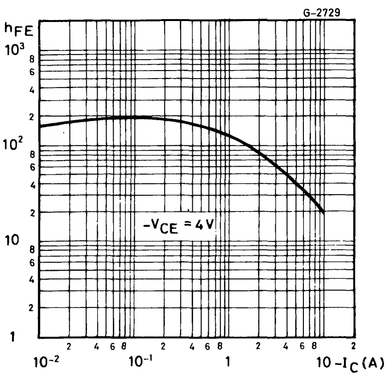
Safe Operating Areas.



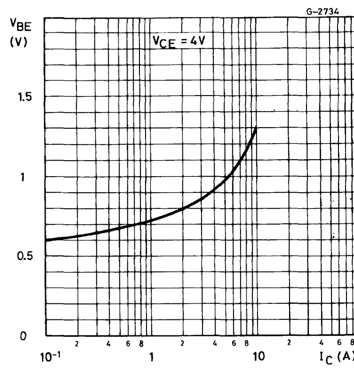
DC Current Gain (NPN types).



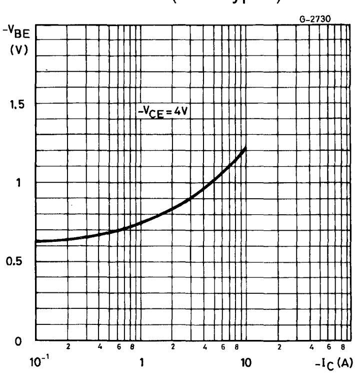
DC Current Gain (PNP types).



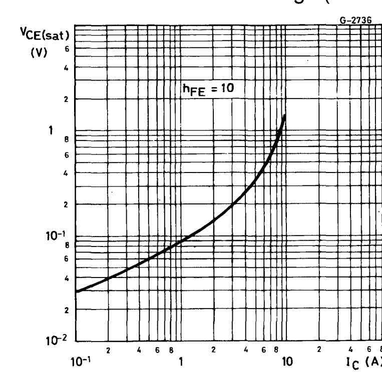
DC Transconductance (NPN types).



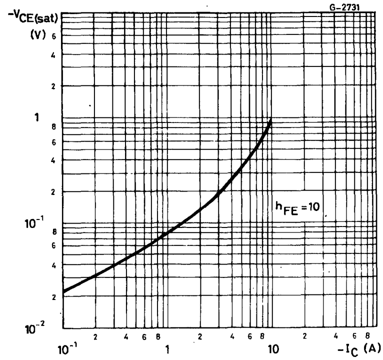
DC Transconductance (PNP types).



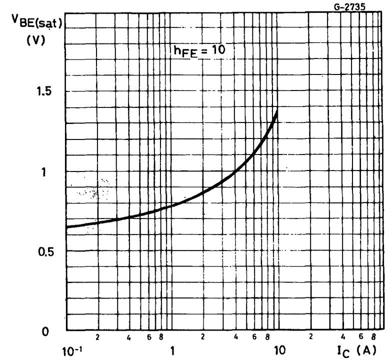
Collector-emitter Saturation Voltage (NPN types).



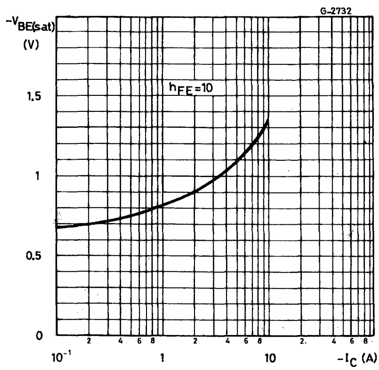
Collector-emitter Saturation Voltage (PNP types).



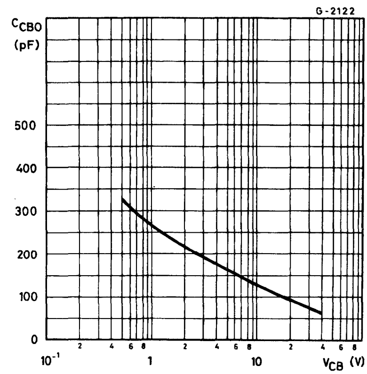
Base-emitter Saturation Voltage (NPN types).



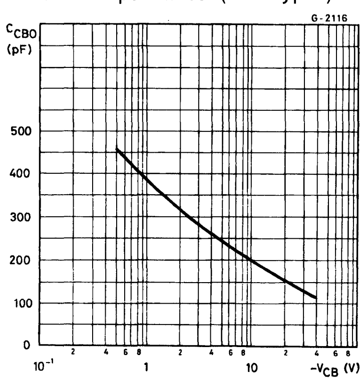
Base-emitter Saturation Voltage (PNP types).



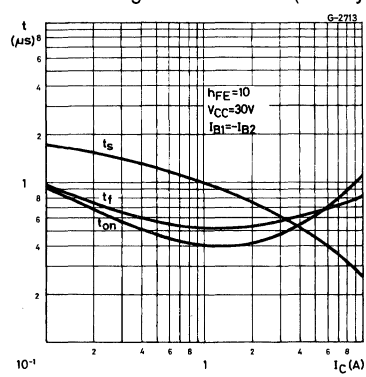
Collector-base Capacitance (NPN types).



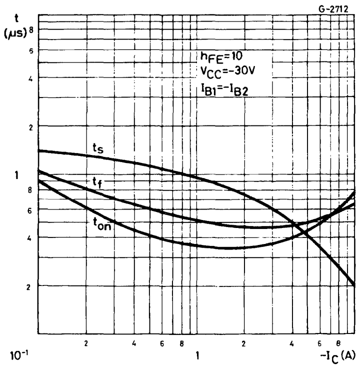
Collector-base Capacitance (NPN types).



Saturated Switching Characteristics (NPN types).



Saturated Switching Characteristics (PNP types).

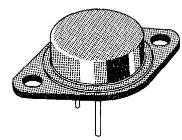


2N5883/2N5885
2N5884/2N5886

COMPLEMENTARY HIGH-POWER TRANSISTORS

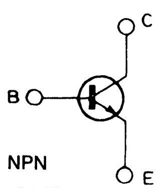
DESCRIPTION

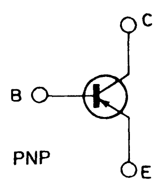
The 2N5885 and 2N5886 are silicon epitaxial-base NPN power transistors in Jedec TO-3 metal case, inted for power linear amplifiers and switching applications. The complementary PNP types are the 2N5883 and 2N5884.



TO-3

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	PNP	2N5883	2N5884	Unit
		NPN	2N5885	2N5886	
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)		60	80	V
V_{CBO}	Collector-base Voltage ($I_E = 0$)		60	80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)		5		V
I_C	Collector Current		25		A
I_{CM}	Collector Peak Current		50		A
I_B	Base Current		7.5		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$		200		W
T_{stg}	Storage Temperature		– 65 to 200		°C
T_j	Junction Temperature		200		°C

For PNP type voltage and current values are negative.

THERMAL DATA

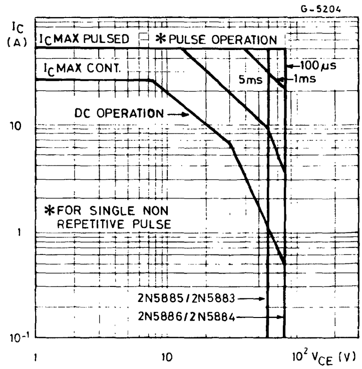
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case Max	0.875	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

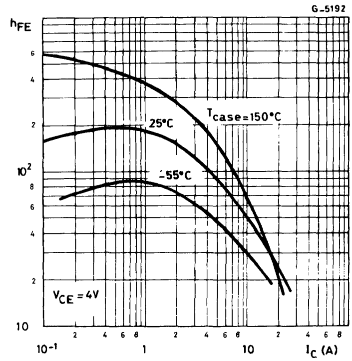
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **2N5883/5885** V_{CE} = 30V for **2N5884/5886** V_{CE} = 40V			2 2	mA mA
I_{CEV}	Collector Cutoff Current (V_{BE} = – 1.5V)	V_{CE} = rated V_{CEO} T_{case} = 150°C V_{CE} = rated V_{CEO}			1 10	mA mA
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = rated V_{CBO}			1	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 200mA for **2N5883/5885** for **2N5884/5886**	 60 80			 V V
h_{FE}*	DC Current Gain	I_C = 3A V_{CE} = 4V I_C = 10A V_{CE} = 4V I_C = 25A V_{CE} = 4V	35 20 4		 100 	
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 15A I_B = 1.5A I_C = 25A I_B = 6.25A			1 4	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 25A I_B = 6.25A			2.5	V
V_{BE}*	Base-emitter Voltage	I_C = 10A V_{CE} = 4V			1.5	V
f_T	Transistion Frequency	I_C = 1 A V_{CE} = 10 V f = 1MHz	4			MHz
C_{CBO}	Collector Base Capacitance	V_{CB} = 10V I_E = 0 f = 1MHz for PNP types			500 1000	pF pF
h_{fe}	Small-signal Current	I_C = 3 A V_{CE} = 4 V f = 1KHz	20			
t_r	Rise Time	V_{CC} = 30V I_C = 10A I_{B1} = – I_{B2} = 1A			0.7	µs
t_s	Storage Time				1	µs
t_f	Fall Time				0.8	µs

* Pulsed : pulse duration = 300µs, duty cycle ≤ 2 %.
For PNP type voltage and current values are negative.

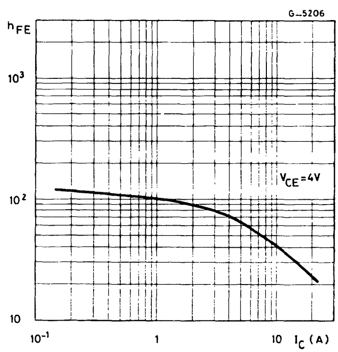
Safe Operating Areas.



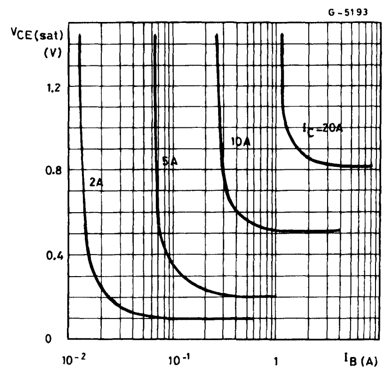
DC Current Gain (NPN types).



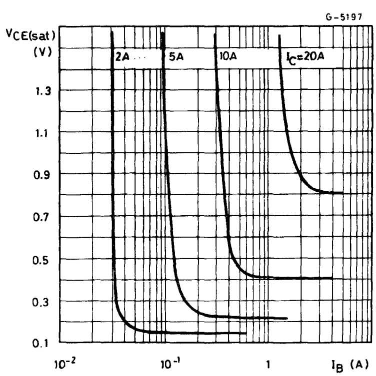
DC Current Gain (PNP type).



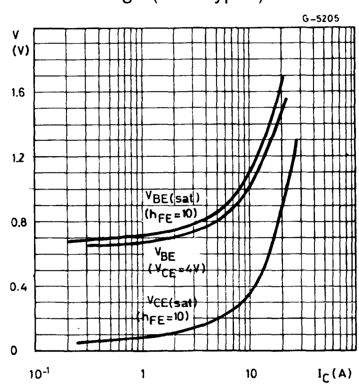
Collector-emitter Saturation Voltage (NPN type).



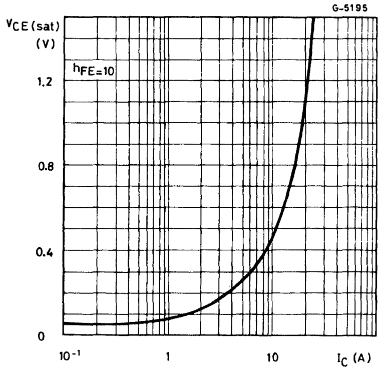
Collector-emitter Saturation Voltage (PNP type).



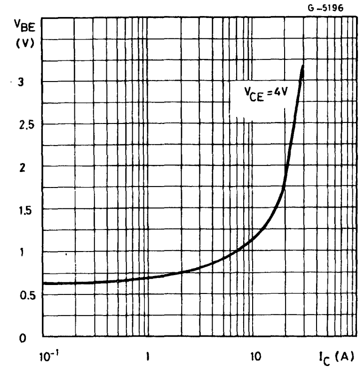
Saturation Voltage (NPN types).



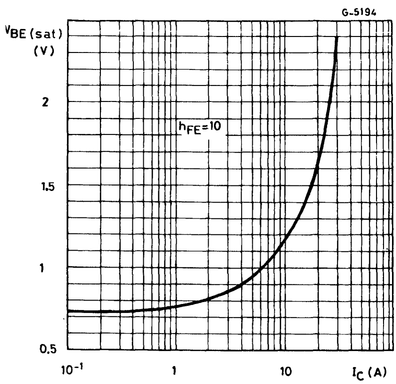
Collector-emitter Saturation Voltage (PNP types).



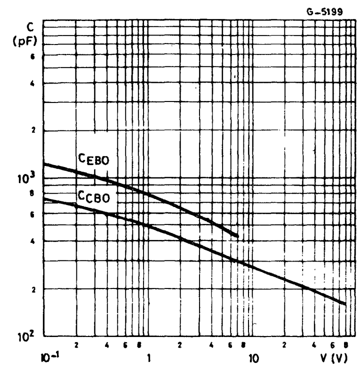
Base-emitter Voltage (PNP types).



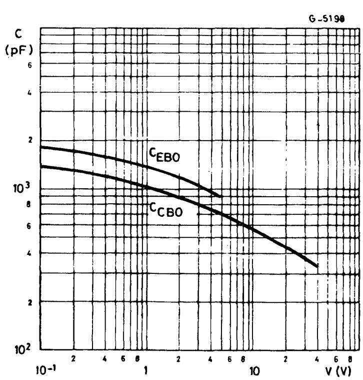
Base-emitter Saturation Voltage (PNP types).



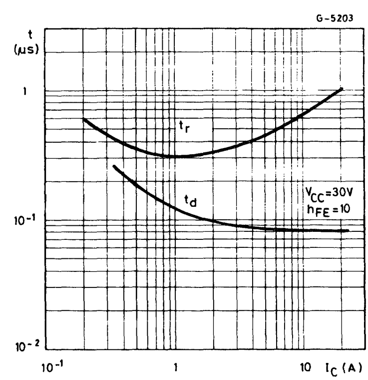
Capacitances (NPN types).



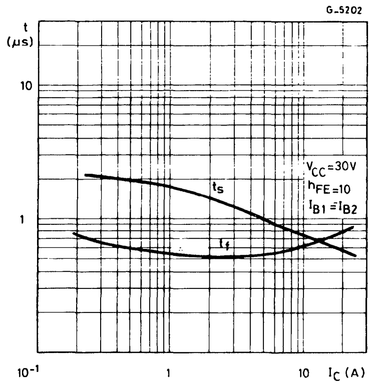
Capacitances (PNP types).



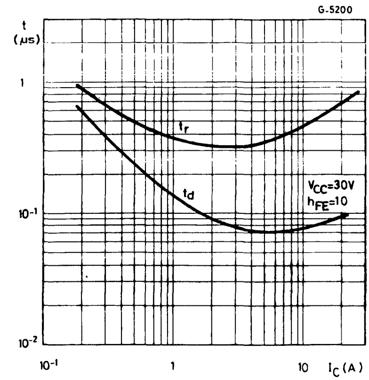
Turn-on Time (NPN types).



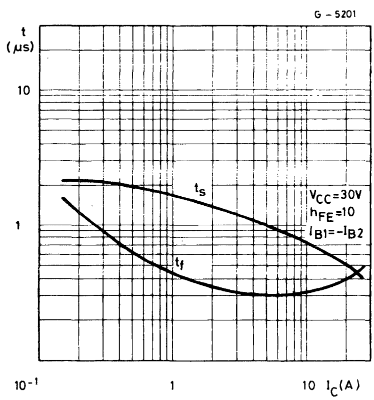
Turn-off Time (NPN types).



Turn-on Time (PNP types).



Turn-off Time (PNP types).



SGS-THOMSON
MICROELECTRONICS

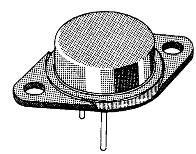
2N6032
2N6033

HIGH CURRENT HIGH SPEED HIGH POWER TRANSISTORS

DESCRIPTION

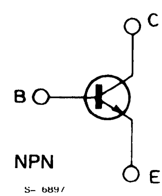
The 2N 6032 and 2N 6033 are silicon multiepitaxial planar NPN transistors in modified Jedec TO-3 metal case.

They have high current, high power handling capability, fast switching speed and are intended for use in switching and linear applications in military and industrial equipment.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	2N6032	2N6033	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	120	150	V
V_{CEX}	Collector-emitter Voltage (V_{BE} = – 1.5V, R_{BE} = 50Ω)	120	150	V
V_{CER}	Collector-emitter Voltage (R_{BE} = 50Ω)	110	140	V
V_{CEO}	Collector-emiter Voltage (I_B = 0)	90	120	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	7	V
I_C	Collector Current	50	40	A
I_B	Base Current	10		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$	140		W
T_{stg}	Storage Temperature	– 65 to 200		°C
T_j	Junction Temperature	200		°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.25	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

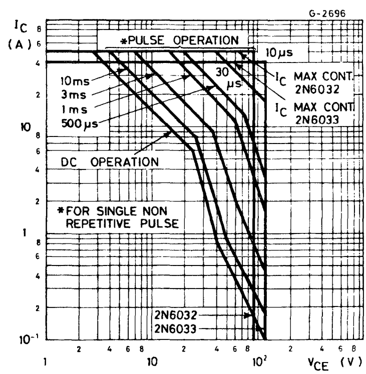
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector Cutoff Current (V_{BE} = – 1.5V)	for **2N6032** V_{CE} = 110V V_{CE} = 100V T_{case} = 150°C for **2N6033** V_{CE} = 135V V_{CE} = 100V T_{case} = 150°C			 12 15 10 10	 mA mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 80V			10	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			10	mA
$V_{CEX(sus)}$*	Collector-emitter Sustaining Voltage (V_{BE} = – 1.5V, R_{BE} = 50Ω, L = 2mH)	I_C = 200mA for **2N6032** for **2N6033**	 120 150			 V V
$V_{CER(sus)}$*	Collector-emitter Sustaining Voltage (R_{BE} = 50Ω, L = 15mH)	I_C = 200mA for **2N6032** for **2N6033**	 110 140			 V V
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 200mA for **2N6032** for **2N6033**	 90 120			 V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	for **2N6032** I_C = 50A I_B = 5A for **2N6033** I_C = 40A I_B = 4A			 1.3 1	 V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	for **2N6032** I_C = 50A I_B = 5A for **2N6033** I_C = 40A I_B = 4A			 2 2	 V V
V_{BE}*	Base-emitter Voltage	for **2N6032** I_C = 50A V_{CE} = 2V for **2N6033** I_C = 40A V_{CE} = 2V			 2 2	 V V
h_{FE}*	DC Current Gain	for **2N6032** I_C = 50A V_{CE} = 2.6V for **2N6033** I_C = 40A V_{CE} = 2V	 10 10		 50 50	 V V
h_{fe}	Small-signal Current Gain	I_C = 2A V_{CE} = 10V f = 5 MHz	10			
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10V f = 1 MHz			800	pF

ELECTRICAL CHARACTERISTICS (continued)

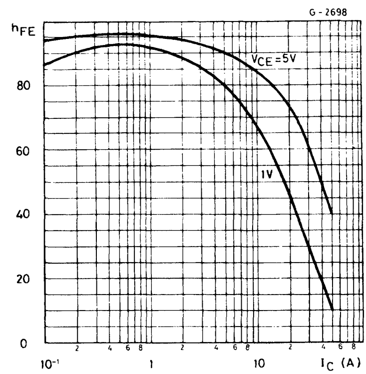
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_r	Rise Time	for **2N6032** $I_C = 50A$ $V_{CC} = 30V$ $I_{B1} = -I_{B2} = 5A$ for **2N6033** $I_C = 40A$ $V_{CC} = 30V$ $I_{B1} = -I_{B2} = 4A$			1	µs
t_s	Storage Time				1.5	µs
t_f	Fall Time				0.5	µs
$I_{s/b}$**	Second Breakdown Collector Current	$V_{CE} = 24V$ $V_{CE} = 40V$	5.8 0.9			A A
$E_{s/b}$	Second Breakdown Energy	$V_{BE} = -4V$ $R_{BE} = 5\Omega$ $L = 310\mu H$	62			mJ

* Pulsed : pulse duration = 300 µs, duty cycle = 1.5 %.
** Pulsed : 1 s non repetitive pulse.

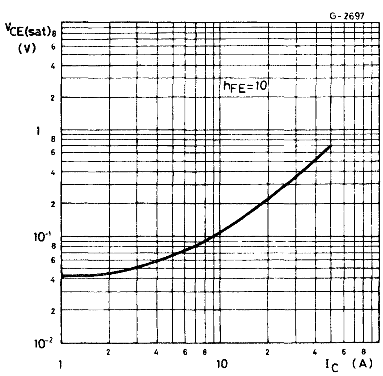
Safe Operating Areas.



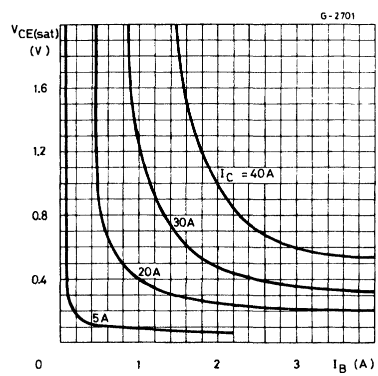
DC Current Gain.



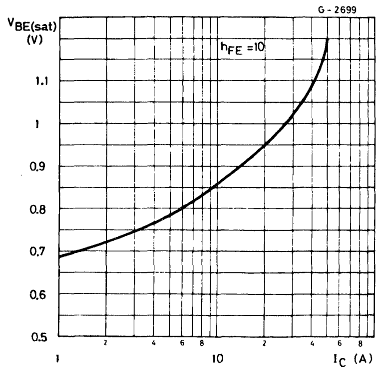
Collector-emitter Saturation Voltage.



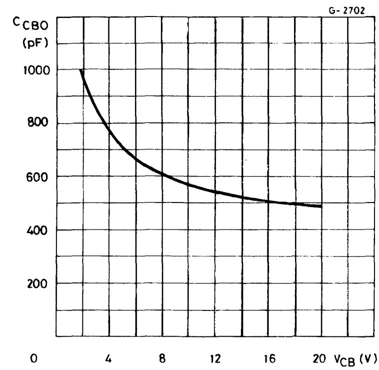
Collector-emitter Saturation Voltage.



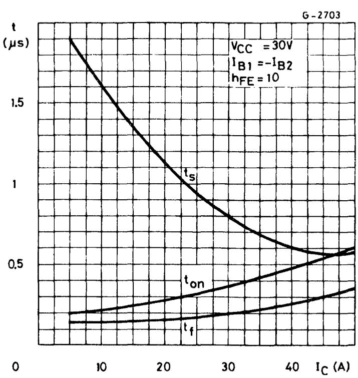
Base-emitter Saturation Voltage.



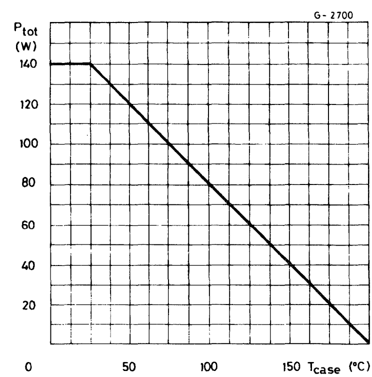
Collector-base Capacitance.



Saturated Switching Characteristics.



Power Rating Chart.

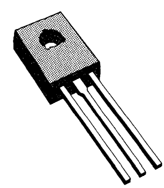


MEDIUM POWER DARLINGTONS

DESCRIPTION

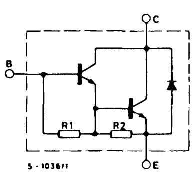
The 2N6037, 2N6038 and 2N6039 are silicon epitaxial-base NPN power transistors in monolithic Darlington configuration and are mounted in Jedec TO-126 plastic package.

The complementary PNP types are the 2N6034, 2N6035 and 2N6036 respectively.

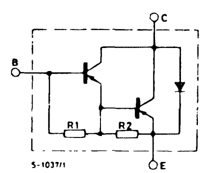


TO-126

INTERNAL SCHEMATIC DIAGRAMS



NPN



PNP

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	PNP NPN	2N6034 2N6037	2N6035 2N6038	2N6036 2N6039	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)		40	60	80	V
V_{CEO}	Colletor-emitter Voltage ($I_B = 0$)		40	60	80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)			5		V
I_C	Collector Current			4		A
I_{CM}	Collector Peak Current			8		A
I_B	Base Current			100		mA
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$			40		W
T_{stg}	Storage Temperature			– 65 to 150		°C
T_j	Junction Temperature			150		°C

THERMAL DATA

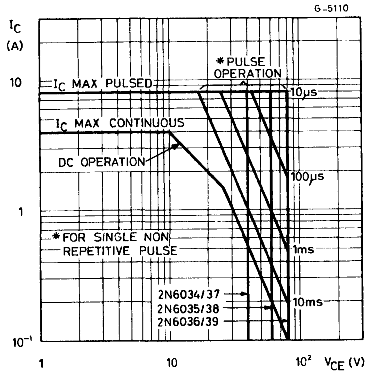
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	3.12	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	83.3	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

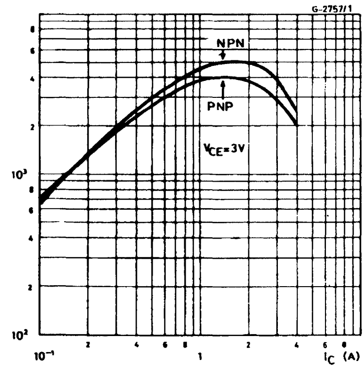
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cuttoff Current (I_E = 0)	for **2N6034/37** V_{CE} = 40V for **2N6035/38** V_{CE} = 60V for **2N6036/39** V_{CE} = 80V			100 100 100	µA µA µA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **2N6034/37** V_{CE} = 40V for **2N6035/38** V_{CE} = 60V for **2N6036/39** V_{CE} = 80V			100 100 100	µA µA µA
I_{CEX}	Collector Cutoff Current (V_{EB} = 1.5V)	for **2N6034/37** V_{CE} = 40V for **2N6035/38** V_{CE} = 60V for **2N6036/39** V_{CE} = 80V T_{case} = 125°C for **2N6034/37** V_{CE} = 40V for **2N6035/38** V_{CE} = 60V for **2N6036/39** V_{CE} = 80V			0.1 0.1 0.1 0.5 0.5 0.5	mA mA mA mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			2	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100mA for **2N6034/37** for **2N6035/38** for **2N6036/39**	40 60 80			V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 2A I_B = 8mA I_C = 4A I_B = 40mA			2 3	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 4A I_B = 40mA			4	V
V_{BE}*	Base-emitter Voltage	I_C = 2A V_{CE} = 3V			2.8	V
h_{FE}*	DC Current Gain	I_C = 0.5A V_{CE} = 3V I_C = 2A V_{CE} = 3V I_C = 4A V_{CE} = 3V	500 750 100		 15000 	
h_{fe}	Small Signal Current Gain	I_C = 0.75A V_{CE} = 10V f = 1MHz	25			
C_{CBO}	Collector-base Capacitance	V_{CB} = 10V I_E = 0 f = 1MHz			(•)100	

* Pulsed : pulse duration = 300µs, duty cycle ≤ 1.5%.
(•) for PNP types 200pF.

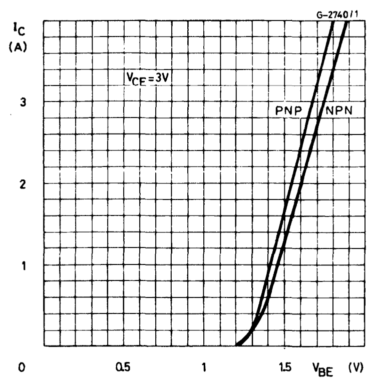
Safe Operating Areas.



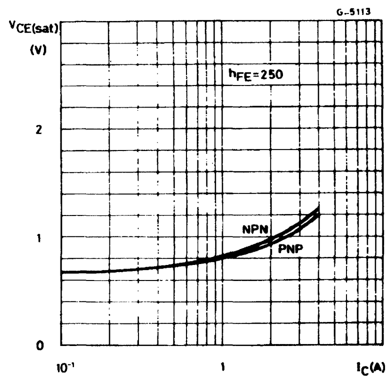
DC Current Gain.



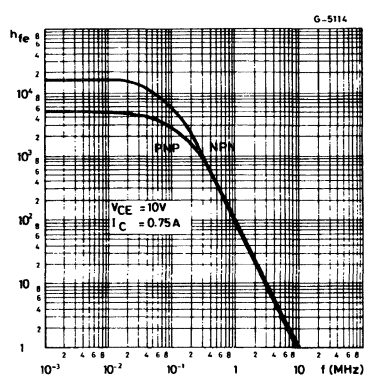
DC Transconductance



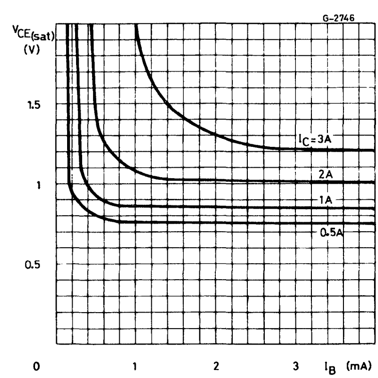
Collector-emitter Saturation Vol-



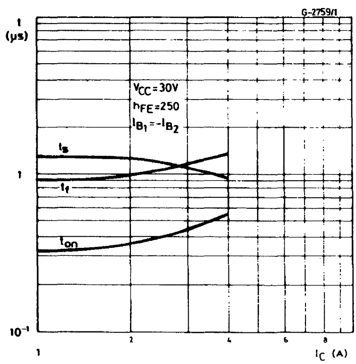
Small Signal Current Gain.



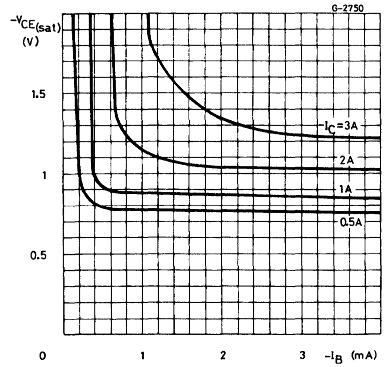
Collector-emitter Saturation Voltage (NPN).



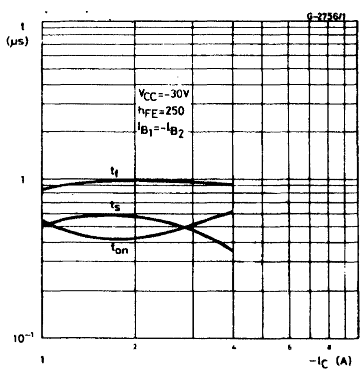
Saturated Switching Characteristics (NPN).



Collector-emitter Saturation Voltage (PNP).



Saturated Switching Characteristics (PNP).

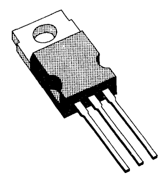


2N6042
2N6045

GENERAL PURPOSE

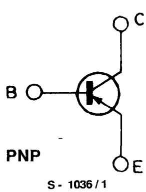
DESCRIPTION

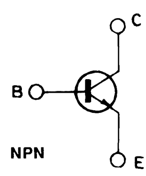
The 2N6045 is a silicon epitaxial-base NPN transistor in monolithic Darlington configuration and is mounted in Jedec TO-220 plastic package. It is intended for use in power linear and switching applications. The complementary PNP type is the 2N6042.



TO-220

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage	100	V
V_{CEO}	Collector-emitter Voltage	100	V
I_C	Collector Current	12	A
I_{CM}	Collector Peak Current	15	A
I_B	Base Current	0.2	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	80	W
T_{stg}	Storage Temperature	– 65 to 150	°C
T_j	Junction Temperature	150	°C

For PNP type voltage and current values are negative.

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.56	°C/W

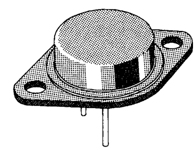
ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 6 V			2	mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 100 V			20	μA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 100 mA	100			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 3 A I_B = 12 mA I_C = 8 A I_B = 80 mA			2 4	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 8 A I_B = 80 mA			4.5	V
$V_{BE(on)}$*	Base-emitter Voltage	I_C = 4 A V_{CE} = 4 V			2.8	V
h_{FE}	DC Current Gain	I_C = 3 A V_{CE} = 4 V I_C = 8 A V_{CE} = 4 V	1000 100		20000	
h_{fe}	Small Signal Current Gain	I_C = 3 A V_{CE} = 4 V f = 1 MHz	4			
C_{CBO}	Collector-base Capacitance (I_E = 0)	V_{CB} = 10 V f = 0.1 MHz			300	pF

* Pulsed : pulse duration = 300μs, duty cycle = 1.5 %.
For PNP type voltage and current values are negative.

COMPLEMENTARY DARLINGTON

- HIGH GAIN
- HIGH CURRENT
- HIGH DISSIPATION



TO-3

DESCRIPTION

The 2N6050, 2N6051 and 2N6052 are silicon epitaxial base PNP transistors in monolithic Darlington configuration mounted in Jedec TO-3 metal case.

They are intended for use in power linear and low frequency switching applications.

The complementary NPN types are the 2N6057, 2N6058 and 2N6059 respectively.

INTERNAL SCHEMATIC DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
	PNP NPN	2N6050 2N6057	2N6051 2N6058	2N6052 2N6059	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	60	80	100	V
V_{CEX}	Collector-emitter Voltage ($V_{BE} = -1.5V$)	60	80	100	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	60	80	100	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5			V
I_C	Collector Current	12			A
I_{CM}	Collector Peak Current	20			A
I_B	Base Current	0.2			mA
P_{tot}	Total Dissipation at $T_c < 25°C$	150			W
T_{stg}	Storage Temperature	– 65 to 200			°C
T_j	Max. Operating Junction Temperature	200			°C

For PNP types voltage and current value are negative.

THERMAL DATA

$R_{thj-case}$	Thermal Resistance Junction-case	max	1.17	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEX}	Collector Cutoff Current	$V_{CE} = V_{CEX}$ $V_{BE} = -1.5V$ $V_{CE} = V_{CEX}$ $V_{BE} = -1.5V$ $T_c = 150°C$			500 5	μA mA
I_{CEO}	Collector Cutoff Current ($I_B = 0$)	$V_{CE} = 30V$ for **2N6050/57** $V_{CE} = 40V$ for **2N6051/58** $V_{CE} = 50V$ for **2N6052/59**			1 1 1	mA mA mA
I_{EBO}	Emitter Cutoff Current ($I_C = 0$)	$V_{EB} = 5V$			2	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	$I_C = 0.1A$ for **2N6050/57** for **2N6051/58** for **2N6052/59**	60 80 100			V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	$I_C = 6A$ $I_B = 24mA$ $I_C = 12A$ $I_B = 120mA$			2 3	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	$I_C = 12A$ $I_B = 120mA$			4	V
$V_{BE(on)}$*	Base-emitter Voltage	$I_C = 6A$ $V_{CE} = 3V$			2.8	V
h_{FE}*	DC Current Gain	$I_C = 6A$ $V_{CE} = 3V$ $I_C = 12A$ $V_{CE} = 3V$	750 100			
f_T	Transition Frequency	$I_C = 5A$ $V_{CE} = 3V$ f = 1MHz	4			MHz

* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.
For PNP types voltage and current values are negative.

SGS-THOMSON
MICROELECTRONICS

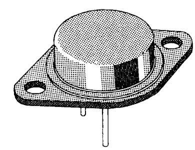
2N6053
2N6055

COMPLEMENTARY POWER DARLINGTON

DESCRIPTION

The 2N6053 is a silicon epitaxial base PNP transistor in monolithic Darlington configuration and are mounted in Jedec TO-3 metal case. They are intended for use in power linear and switching applications.

The complementary NPN type is the 2N6055.



TO-3

INTERNAL SCHEMATIC DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter		Value	Unit
		PNP NPN	2N6053 2N6055	
V_{CBO}	Collector-base Voltage (I_E = 0)		60	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)		60	V
V_{EBO}	Emitter-base Voltage (I_C = 0)		5	V
I_C	Collector Current		8	A
I_{CM}	Collector Peak Current		16	A
I_B	Base Current		120	mA
P_{tot}	Total Dissipation at T_c < 25°C		100	W
T_{stg}	Storage Temperature		– 65 to 200	°C
T_j	Max. Operating Junction Temperature		200	°C

For PNP type voltage and current values are negative.

THERMAL DATA

$R_{thj-case}$	Thermal Resistance Junction-case max	1.75	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEX}	Collector Cutoff Current	V_{CE} = 60V V_{BE} = – 1.5V V_{CE} = 60V V_{BE} = – 1.5V T_c = 150°C			500 5	μA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 30V			0.5	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			2	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 100mA	60			V
$V_{CE(sat)}$*	Collector-emitter saturation Voltage	I_C = 4A I_B = 16mA I_C = 8A I_B = 80mA			2 3	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 8A I_B = 80mA			4	V
$V_{BE(on)}$*	Base-emitter Voltage	I_C = 4A V_{CE} = 3V			2.8	V
h_{FE}*	DC Current Gain	I_C = 4A V_{CE} = 3V I_C = 8A V_{CE} = 3V	750 100		18K	
f_T	Transition Frequency	I_C = 3A V_{CE} = 3V f = 1MHz	4			MHz
C_{cbo}	Collector-base Capacitance	V_{CB} = 10V I_E = 0 f = 1MHz for NPN Type for PNP Type			 200 300	 pF pF

* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.
For PNP type voltage and current values are negative.

SGS-THOMSON MICROELECTRONICS

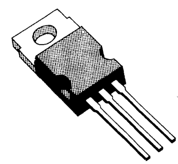
2N6107/09/11 2N6288/90/92

GENERAL PURPOSE COMPLEMENTARY PAIRS

DESCRIPTION

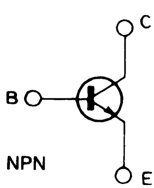
The 2N6107, 2N6109, 2N6111, 2N6288, 2N6290 and 2N6292 are epitaxial-base silicon transistors in Jedec TO-220 plastic package. They are intended for a wide variety of medium power switching and linear applications.

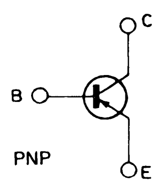
The PNP types are the 2N6107, 2N6109, 2N6111 and their complementary NPN types are the 2N6292, 2N6290 and 2N6288 respectively.



TO-220

INTERNAL SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter		PNP: 2N6107 / NPN: 2N6292	PNP: 2N6109 / NPN: 2N6290	PNP: 2N6111 / NPN: 2N6288	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)		80	60	40	V
V_{CEX}	Collector-emitter Voltage (R_{BE} = 100 Ω)		80	60	40	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)		70	50	30	V
V_{EBO}	Emitter-base Voltage (I_C = 0)		5			V
I_C	Collector Current		7			A
I_B	Base Current		3			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C		40			W
T_{stg}	Storage Temperature		– 65 to 150			°C
T_j	Junction Temperature		150			°C

For PNP devices voltage and current values are negative.

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	3.12	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	70	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEX}	Collector Cutoff Current (V_{BE} = – 1.5 V)	V_{CE} = 40V for **2N6111/2N6288** V_{CE} = 60V for **2N6109/2N6290** V_{CE} = 80V for **2N6107/2N6292** T_c = 150°C V_{CE} = 30V for **2N6111/2N6288** V_{CE} = 50V for **2N6109/2N6290** V_{CE} = 70V for **2N6107/2N6292**			0.1 0.1 0.1 2 2 2	mA mA mA mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 20V for **2N6111/2N6288** V_{CE} = 40V for **2N6109/2N6290** V_{CE} = 60V for **2N6107/2N6292**			1 1 1	mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = o)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.1 A for **2N6111/2N6288** for **2N6109/2N6290** for **2N6107/2N6292**	30 50 70			V V V
$V_{CER(sus)}$*	Collector Emitter Sustaining Voltage	I_C = 0.1 A R_{BE} = 100 ohm for **2N6111/2N6288** for **2N6109/2N6290** for **2N6107/2N6292**	 40 60 80			 V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 2 A I_B = 0.2 A for **2N6111/2N6288** I_C = 2.5 A I_B = 0.25 A for **2N6109/2N6290** I_C = 3 A I_B = 0.3 A for **2N6107/2N6292** I_C = 7 A I_B = 3 A			1 1 1 3.5	V V V V
$V_{BE(on)}$*	Base-emitter Voltage	I_C = 2 A V_{CE} = 4 A for **2N6111/2N6288** I_C = 2.5 A V_{CE} = 4 A for **2N6109/2N6290** I_C = 3 A V_{CE} = 4 A for **2N6107/2N6292** I_C = 7 A V_{CE} = 4 A			1.5 1.5 1.5 3	V V V V
h_{FE}*	DC Current Gain	I_C = 2 A V_{CE} = 4 A for **2N6111/2N6288** I_C = 2.5 A V_{CE} = 4 A for **2N6109/2N6290** I_C = 3 A V_{CE} = 4 A for **2N6107/2N6292** I_C = 7 A V_{CE} = 4 A	30 30 30 2.3		150 150 150	
h_{fe}	Small Signal Current Gain	I_C = 0.5 A V_{CE} = 4 V f = 50 KHz	20			
f_T	Transition Frequency	I_C = 0.5 A V_{CE} = 4 V for **NPN** Types I_C = 0.5 A V_{CE} = 4 V for **PNP** Types	10 4			MHz MHz
C_{cbo}	Collector-base Capacitance	V_{CB} = 10 V f = 1 MHz			250	pF

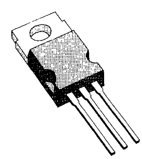
* Pulsed : pulse duration = 300µs, duty cycle = 1.5 %.
For PNP types voltage and current values are negative.
For characteristic curves see the BD533 (NPN) and BD534 (PNP) series.

MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

DESCRIPTION

The 2N6121, 2N6122 and 2N6123 are silicon epitaxial-base NPN power transistors in Jedec TO-220 plastic package, intended for use in medium power linear and switching applications.

The complementary PNP types are the 2N6124, 2N6125 and 6126 respectively.



TO-220

INTERNAL SCHEMATIC DIAGRAMS

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter (NPN / PNP*)	2N6121 / 2N6124	2N6122 / 2N6125	2N6123 / 2N6126	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	45	60	80	V
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	45	60	80	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	45	60	80	V
V_{EBO}	Emitter-base Voltage (I_C = 0)		5		V
I_C	Collector Current		4		A
I_{CM}	Collector Peak Current		7		A
I_B	Base Current		1		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C		40		W
T_{stg}	Storage Temperature		– 65 to 150		°C
T_j	Junction Temperature		150		°C

For PNP type voltage and current values are negative.

THERMAL DATA

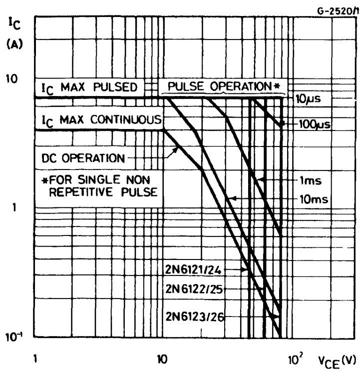
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	3.12	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	70	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

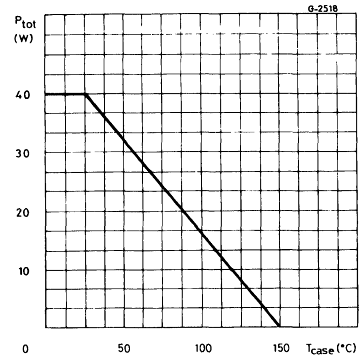
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff Current (I_E = 0)	for **2N6121/24** V_{CB} = 45 V for **2N6122/25** V_{CB} = 60 V for **2N6123/26** V_{CB} = 80 V			100 100 100	µA µA µA
I_{CEX}	Collector cutoff Current (V_{BE} = – 1.5 V)	for **2N6121/24** V_{CE} = 45 V for **2N6122/25** V_{CE} = 60 V for **2N6123/26** V_{CE} = 80 V T_{case} = 125 °C for **2N6121/24** V_{CE} = 45 V for **2N6122/25** V_{CE} = 60 V for **2N6123/26** V_{CE} = 80 V			100 100 100 2 2 2	µA µA µA µA µA µA
I_{CEO}	Collector cutoff Current (I_B = 0)	for **2N6121/24** V_{CE} = 45 V for **2N6122/25** V_{CE} = 60 V for **2N6123/26** V_{CE} = 80 V			1 1 1	mA mA mA
I_{EBO}	Emitter cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA for **2N6121/24** for **2N6122/25** for **2N6123/26**	45 60 80			V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 1.5 A I_B = 0.15 A I_C = 4 A I_B = 1 A			0.6 1.4	V V
V_{BE}*	Base-emitter Voltage	I_C = 1.5 A V_{CE} = 2 V			1.2	V
h_{FE}*	DC Current Gain	I_C = 1.5 A V_{CE} = 2 V for **2N6121/24** for **2N6122/25** for **2N6123/26** I_C = 4 A V_{CE} = 2 V for **2N6121/24** for **2N6122/25** for **2N6123/26**	 25 25 20 10 10 7		 100 100 80	
h_{fe}	Small Signal Current Gain	I_C = 1 A V_{CE} = 4 V f = 1 MHz	2.5			

* Pulsed : pulse duration = 300µs, duty cycle = 1.5 %..
For PNP types voltage and current values are negative.

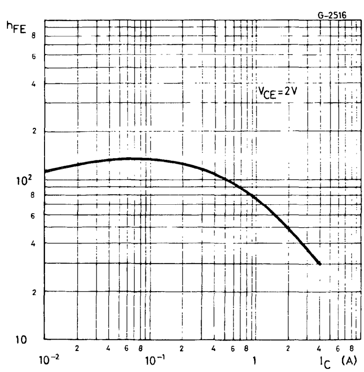
Safe Operating Areas.



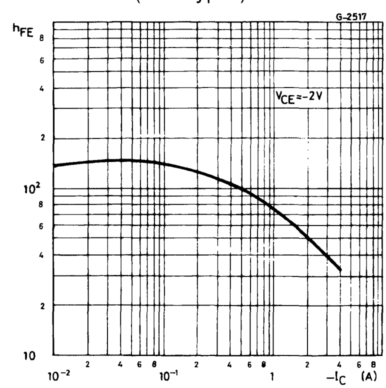
Power Rating Chart.



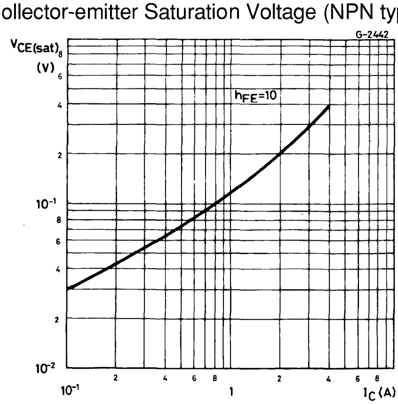
DC Current Gain (NPN types).



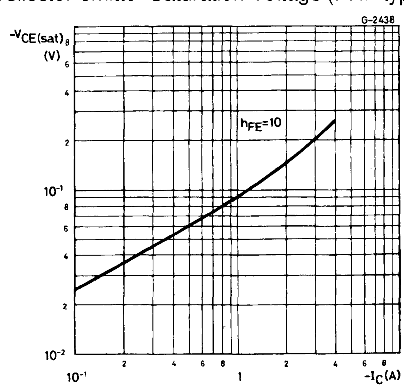
DC Current Gain (PNP types).



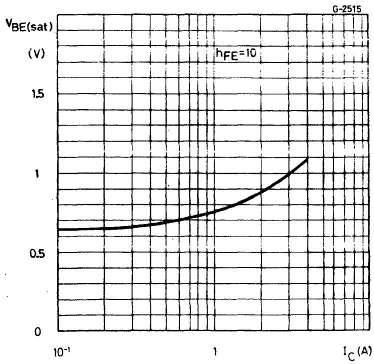
Collector-emitter Saturation Voltage (NPN types).



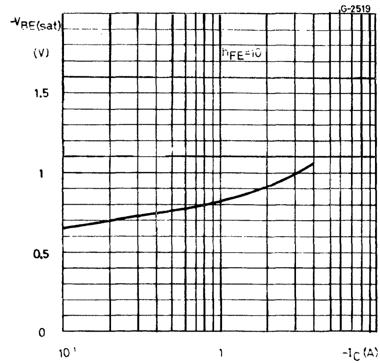
Collector-emitter Saturation Voltage (PNP types).



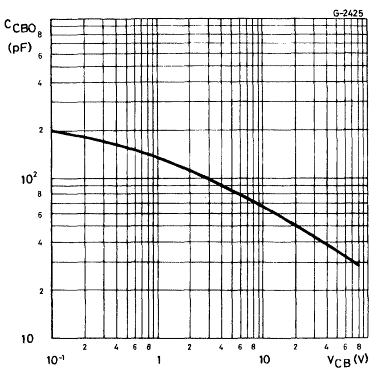
Base-emitter Saturation Voltage (NPN types).



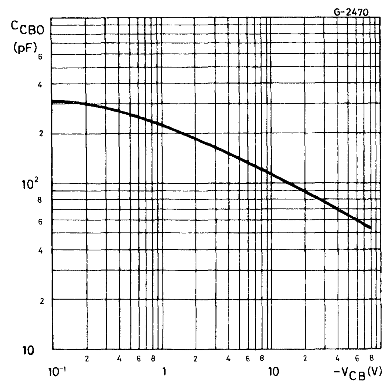
Base-emitter Saturation Voltage (PNP types).



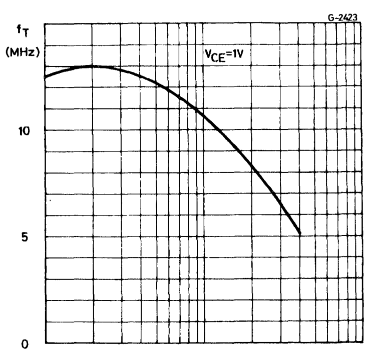
Collector-base Capacitance (NPN types).



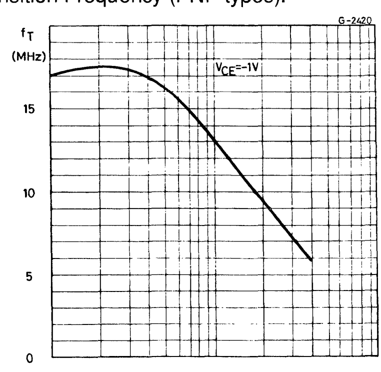
Collector-base Capacitance (PNP types).



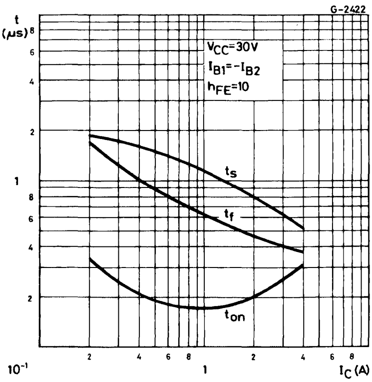
Transition Frequency (NPN types).



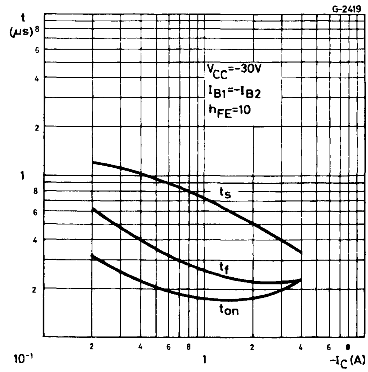
Transition Frequency (PNP types).



Saturated Switching Characteristics (NPN types).



Saturated Switching Characteristics (PNP types).



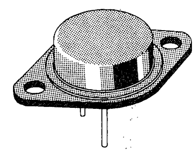
SGS-THOMSON
MICROELECTRONICS

2N6282/83/84
2N6285/86/87

COMPLEMENTARY POWER DARLINGTONS

DESCRIPTION

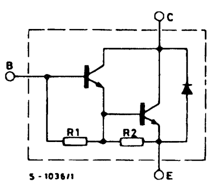
The 2N6282, 2N6283 and 2N6284 and the complementary PNP types 2N6285, 2N6286, 2N6287 are epitaxial-base silicon transistors in monolithic Darlington configuration in Jedec TO-3 metal Case. They are intended for general-purpose amplifier and low-frequency switching applications.



TO-3

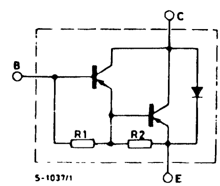
INTERNAL SCHEMATIC DIAGRAMS

NPN



R1 ≅ 8KΩ
R2 ≅ 60Ω

PNP



R1 ≅ 8KΩ
R2 ≅ 60Ω

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	2N6282 (PNP) / 2N6285 (NPN)	2N6283 (PNP) / 2N6286 (NPN)	2N6284 (PNP) / 2N6287 (NPN)	Unit
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	60	80	100	V
V_{CBO}	Collector-base Voltage ($I_E = 0$)	60	80	100	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5			V
I_C	Collector Current	20			A
I_{CM}	Collector Peak Current	40			A
I_B	Base Current	0.5			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$	160			W
T_{stg}	Storage Temperature	– 65 to 200			°C
T_j	Junction Temperature	200			°C

For PNP types voltage and current values are negative.

THERMAL DATA

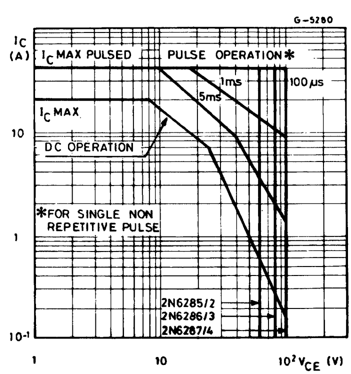
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.09	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

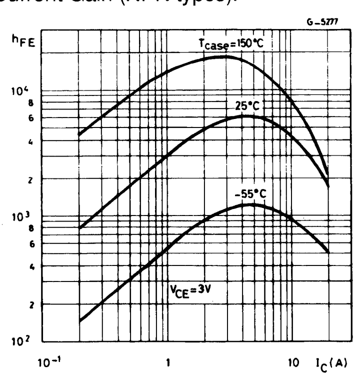
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **2N6282, 2N6285** V_{CE} = 30V for **2N6283, 2N6286** V_{CE} = 40V for **2N6284, 2N6287** V_{CE} = 50V			1 1 1	mA mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5V			2	mA
I_{CEV}	Collector Cutoff Current (V_{BE} = – 1.5V)	V_{CE} = rated V_{CBO} V_{CE} = rated V_{CBO} T_{case} = 150°C			0.5 5	mA mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 0.1A for **2N6282, 2N6285** for **2N6283, 2N6286** for **2N6284, 2N6287**	 60 80 100			 V V V
$V_{CE(sat)}$*	Base-emitter Saturation Voltage	I_C = 10A I_B = 40mA I_C = 20A I_B = 200mA			2 3	V V
$V_{BE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 20A I_B = 200mA			4	V
V_{BE}*	Base-emitter Voltage	I_C = 10A V_{CE} = 3V			2.8	V
h_{FE}*	DC Current Gain	I_C = 10A V_{CE} = 3V I_C = 20A V_{CE} = 3V	750 100		18000	
C_{CBO}	Collector-base Capacitance	V_{CB} = 10V I_E = 0 f = 0.1MHz for **2N6282, 2N6283, 2N6284** for **2N6285, 2N6286, 2N6287**			 400 600	 pF pF
h_{fe}	Small Signal Current Gain	I_C = 10A V_{CE} = 3V f = 1KHz	300			

* Pulsed : pulse duration = 300µs, duty cycle ≤ 2%.
For PNP types voltage and current values are negative.

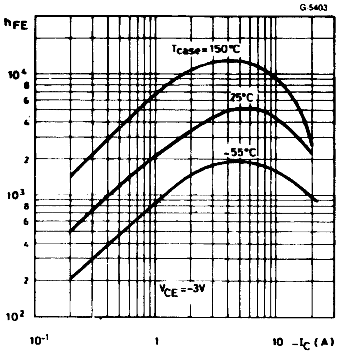
Safe Operating Areas.



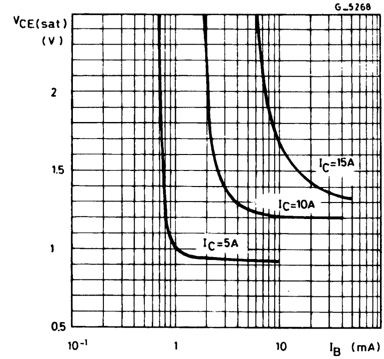
DC Current Gain (NPN types).



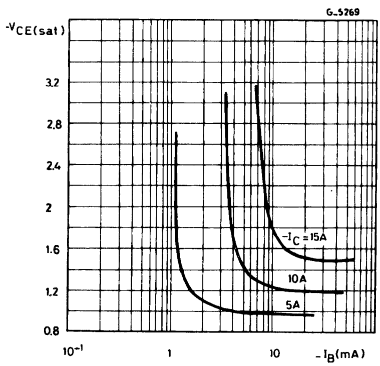
DC Current Gain (PNP types).



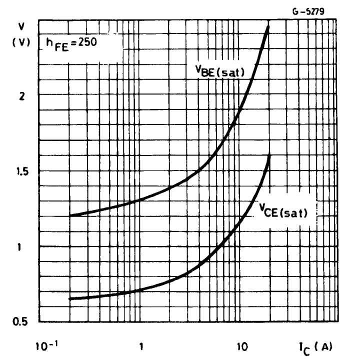
Collector-emitter Saturation Voltage (NPN types).



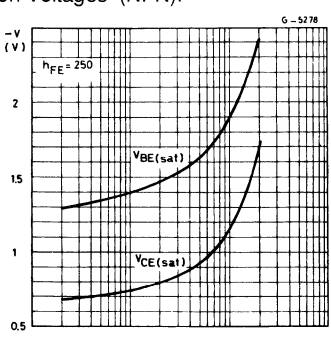
Collector-emitter saturation Voltage (PNP types).



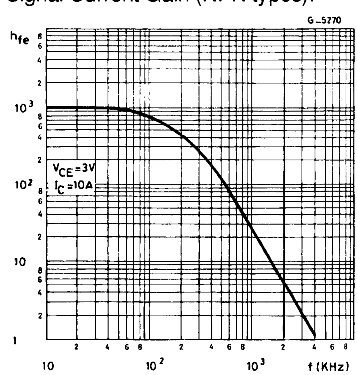
Saturation Voltages (NPN types).



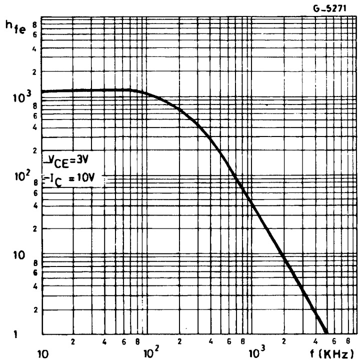
Saturation Voltages (NPN).



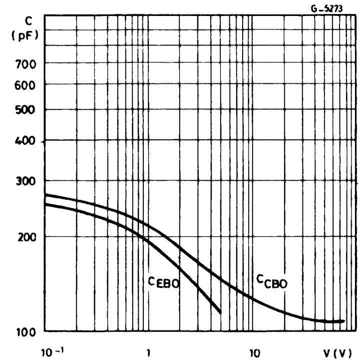
Small Signal Current Gain (NPN types).



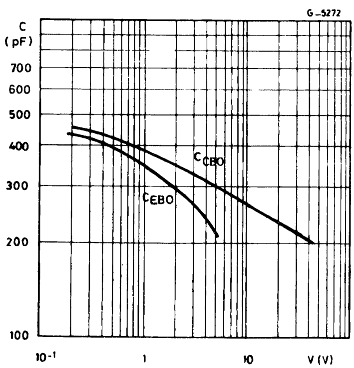
Small Signal Current Gain (PNP types).



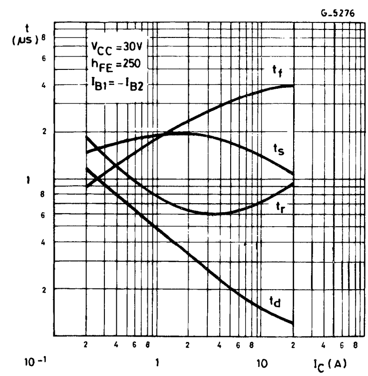
Capacitances (NPN types).



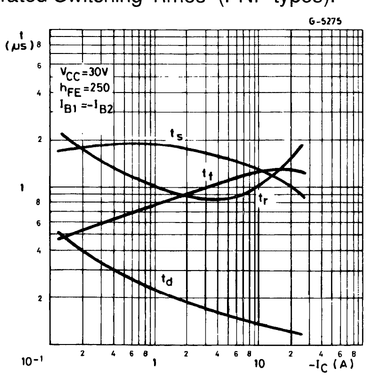
Capacitances (PNP types).



Saturated Switching Times (NPN types).



Saturated Switching Times (PNP types).



SGS-THOMSON
MICROELECTRONICS

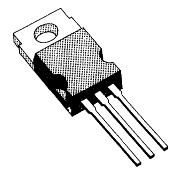
2N6386
2N6387/2N6388

POWER DARLINGTON TRANSISTORS

DESCRIPTION

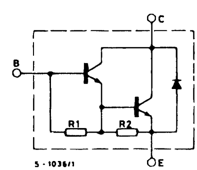
The 2N6386, 2N6387 and 2N6388 are silicon epitaxial-base NPN transistors in monolithic Darlington configuration and are mounted in Jedec TO-220 plastic package.

They are intended for use in low and medium frequency power applications.



TO-220

INTERNAL SCHEMATIC DIAGRAM



R1 Typ. 10kΩ
R2 Typ. 150Ω

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	2N6386	2N6387	2N6388	Unit
V_{CBO}	Collector-base Voltage ($I_B = 0$)	40	60	80	V
V_{CEV}	Collector-emitter Voltage ($V_{BE} = -1.5V$)	40	60	80	V
V_{CER}	Collector-emitter Voltage ($R_{BE} \leq 100\Omega$)	40	60	80	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	40	60	80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5	5	5	V
I_C	Collector Current	8	10	10	A
I_{CM}	Collector Peak Current		15		A
I_B	Base Current		250		mA
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$		65		W
T_{stg}	Storage Temperature		– 65 to 150		°C
T_j	Junction Temperature		150		°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.92	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector Cutoff Current V_{BE} = – 1.5V)	V_{CE} = 40V for **2N6386** V_{CE} = 60V for **2N6387** V_{CE} = 80V for **2N6388** T_{case} = 125°C V_{CE} = 40V for **2N6386** V_{CE} = 60V for **2N6387** V_{CE} = 80V for **2N6388**			0.3 0.3 0.3 3 3 3	mA mA mA mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 40V for **2N6386** V_{CE} = 60V for **2N6387** V_{CE} = 80V for **2N6388**			1 1 1	mA mA mA
I_{EBO}	Emitter-base Current (I_C = 0)	V_{EB} = 5V			5	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 200mA for **2N6386** for **2N6387** for **2N6388**	40 60 80			V V V
$V_{CER(sus)}$*	Collector-emitter Sustaining Voltage (R_{BE} = 100Ω)	I_C = 200mA for **2N6386** for **2N6387** for **2N6388**	40 60 80			V V V
$V_{CEV(sus)}$*	Collector-emitter Sustaining Voltage (V_{BE} = – 1.5V)	I_C = 200mA for **2N6386** for **2N6387** for **2N6388**	40 60 80			V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	for **2N6386** I_C = 3A I_B = 6mA for **2N6387** and **2N6388** I_C = 5A I_B = 10mA for **2N6386** I_C = 8A I_B = 80mA for **2N6387** and **2N6388** I_C = 10A I_B = 100mA			 2 2 3 3	 V V V V
V_{BE}*	Base-emitter Voltage	for **2N6386** I_C = 3A V_{CE} = 3V for **2N6387** and **2N6388** I_C = 5A V_{CE} = 3V for **2N6386** I_C = 8A V_{CE} = 3V for **2N6387** and **2N6388** I_C = 10A V_{CE} = 3V			 2.8 2.8 4.5 4.5	 V V V V
h_{FE}*	DC Current Gain	for **2N6386** I_C = 3A V_{CE} = 3V for **2N6387** and **2N6388** I_C = 5A V_{CE} = 3V for **2N6386** I_C = 8A V_{CE} = 3V for **2N6387** and **2N6388** I_C = 10A V_{CE} = 3V	 1000 1000 100 100		 20000 20000	

* Pulsed : pulse duration = 300µs, duty cycle = 1.5%.

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
h_{fe}	Small Signal Current Gain	I_C = 1A V_{CE} = 10V f = 1MHz V_{CE} = 10V f = 1KHz	 20 1000			
V_F*	Paralled-diode Forward Voltage	for **2N6386** I_F = 8A for **2N6387** and **2N6388** I_F = 10A			 4 4	 V V
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10V f = 1MHz			200	pF
$I_{s/b}$**	Second Breadkdown Collector Current	V_{CE} = 25V	2.6			A
$E_{s/b}$	Second Breakdown Energy	L = 12mH R_{BE} = 100Ω V_{BE} = − 1.5V I_C = 4.5A	120			mJ

* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.
** Pulsed : 1s non repetitive pulse.
For characteristic curves see BDX33/BDX34 series.

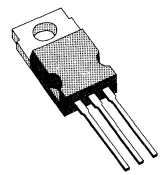
POWER LINEAR AND SWITCHING APPLICATIONS

DESCRIPTION

The 2N6486, 2N6487 and 2N6488 are silicon epitaxial-base NPN transistors mounted in Jedec TO-220 plastic package.

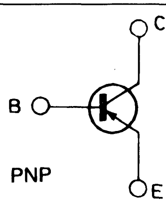
They are intended for use in power linear and switching applications.

The complementary PNP types are the 2N6489, 2N6490 and 2N6491 respectively.

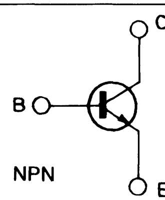


TO-220

INTERNAL SCHEMATIC DIAGRAMS



S-6896



S-6897

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter NPN / PNP*	2N6486 2N6489	2N6487 2N6490	2N6488 2N6491	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	50	70	90	V
V_{CEX}	Collector-base Voltage ($V_{BE} = 1.5V$; $R_{BE} = 100\Omega$)	50	70	90	V
V_{CEO}	Collector-base Voltage ($I_B = 0$)	40	60	80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)		5		V
I_C	Collector Current		15		A
I_B	Base-current		5		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$ $T_{case} \leq 25°C$		75 1.8		W W
T_{stg}	Storage Temperature		– 65 to 150		°C
T_j	Junction Temperature		150		°C

* For NPN types voltage and current values are negative.

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.67	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	70	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector-cutoff Current (I_B = 0)	for **2N6486/89** V_{CE} = 20V for **2N6487/90** V_{CE} = 30V for **2N6488/91** V_{CE} = 40V			1 1 1	mA mA mA
I_{CEX}	Collector-cutoff Current (V_{BE} = − 1.5V, R_{BE} = 100 Ω)	for **2N6486/89** V_{CE} = 45V for **2N6487/90** V_{CE} = 65V for **2N6488/91** V_{CE} = 85V T_{case} = 150°C for **2N6486/89** V_{CE} = 40V for **2N6487/90** V_{CE} = 60V for **2N6488/91** V_{CE} = 80V			0.5 0.5 0.5 5 5 5	mA mA mA mA mA mA
I_{CER}	Collector-cutoff Current (R_{BE} = 100Ω)	for **2N6486/89** V_{CE} = 35V for **2N6487/90** V_{CE} = 55V for **2N6488/91** V_{CE} = 75V			0.5 0.5 0.5	mA mA mA
I_{EBO}	Emitter-cutoff Current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 200mA for **2N6486/89** for **2N6487/90** for **2N6488/91**	 40 60 80			 V V V
$V_{CER(sus)}$*	Collector-emitter Sustaining Voltage (R_{BE} = 100Ω)	I_C = 200mA for **2N6486/89** for **2N6487/90** for **2N6488/91**	 45 65 85			 V V V
$V_{CEX(sus)}$*	Collector-emitter Sustaining Voltage (V_{BE} = − 1.5V, R_{BE} = 100Ω)	I_C = 200mA for **2N6486/89** for **2N6487/90** for **2N6488/91**	 50 70 90			 V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5A I_B = 0.5A I_C = 15A I_B = 5A			1.3 3.5	V V
V_{BE}*	Base-emitter Voltage	I_C = 5A V_{CE} = 4V I_C = 15A V_{CE} = 4V			1.3 3.5	V V
h_{FE}*	DC Current Gain	I_C = 5A V_{CE} = 4V I_C = 15A V_{CE} = 4V	20 5		150	
h_{fe}	Small Signal Current Gain	I_C = 1A V_{CE} = 4V f = 1MHz I_C = 1A V_{CE} = 4V f = 1KHz	 5 25			

* Pulsed : pulse duration = 300μs, duty cycle ≤ 2%.
For PNP types voltage and current values are negative.

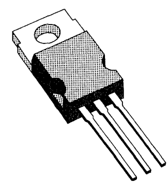
SGS-THOMSON
MICROELECTRONICS

2N6497
2N6498-2N6499

HIGH VOLTAGE POWER SWITCH

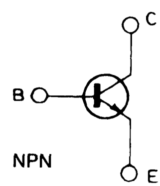
DESCRIPTION

The 2N6497/98/99 are silicon multiepitaxial mesa NPN transistors in Jedec TO-220 plastic package particularly intended for switch-mode applications.



TO-220

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	2N6497	2N6498	2N6499	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	350	400	450	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	250	300	350	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	6			V
I_C	Collector Current	5			A
I_{CM}	Collector Peak Current	10			A
I_B	Base Current	2			A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$	80			W
T_{stg}	Storage Temperature	– 65 to 150			°C
T_j	Junction Temperature	150			°C

THERMAL DATA

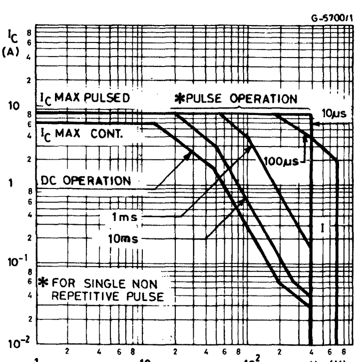
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.56	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector-cutoff Current (V_{BE} = − 1.5V)	for **2N6497**				
		V_{CE} = 350V			1	mA
		V_{CE} = 175V T_{case} = 100°C			10	mA
		for **2N6498**				
		V_{CE} = 400V			1	mA
		V_{CE} = 200V T_{case} = 100°C			10	mA
		for **2N6499**				
		V_{CE} = 450V			1	mA
		V_{CE} = 225V T_{case} = 100°C			10	mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 6V			1	mA
$V_{CEO(sus)}$	Collector-emitter Sustaining Volage (I_B = 0)	I_C = 25mA for **2N6497**	250			V
		I_C = 25mA for **2N6498**	300			V
		I_C = 25mA for **2N6499**	350			V
h_{FE}*	DC Current Gain	I_C = 2.5A V_{CE} = 10V	10		75	
		I_C = 5A V_{CE} = 10V	3			
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 2.5A I_B = 0.5A				
		for **2N6497**			1	V
		for **2N6498**			1.25	V
		for **2N6499**			1.5	V
		I_C = 5A I_B = 2A all types			5	V
t_{on}	Turn-on Time	I_C = 2.5A I_{B1} = 0.5A I_{B2} = − 1A V_{CC} = 125V			0.8	μs
t_s	Storage Time	I_C = 2.5A I_{B1} = 0.5A I_{B2} = − 1A V_{CC} = 125V			1.8	μs
t_f	Fall Time	I_C = 2.5A I_{B1} = 0.5A I_{B2} = − 1A V_{CC} = 125V			0.8	μs

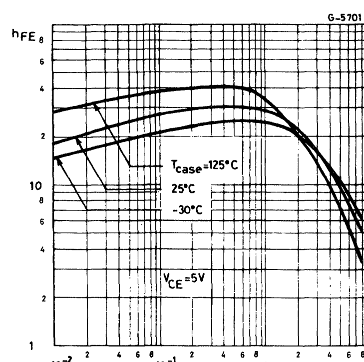
* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.

Safe Operating Areas.

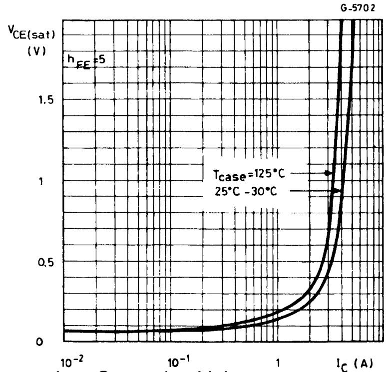


I-Area of permissible operation during turn-on provided R_{BE} ≤ 100Ω and t_p ≤ 0.25μs.

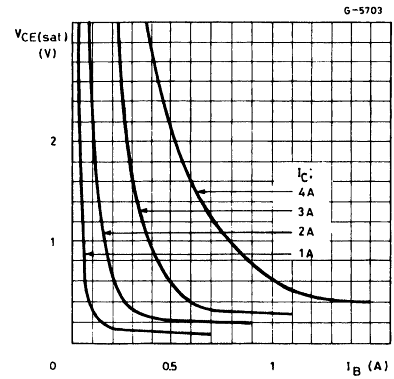
DC Current Gain.



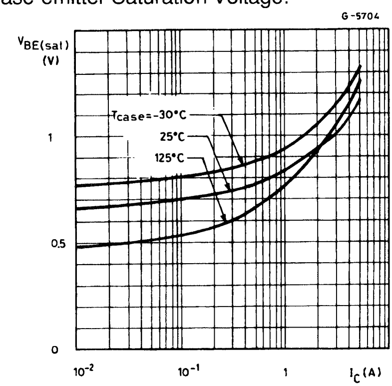
Collector-emitter Saturation Voltage



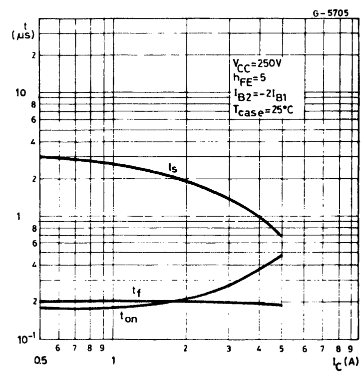
Collector-emitter Saturation Voltage.



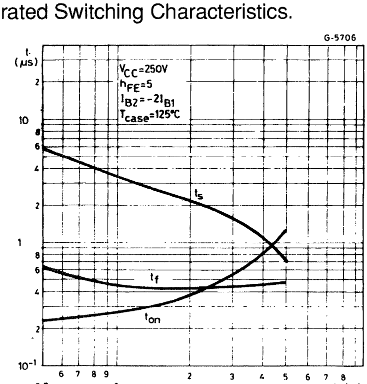
Base-emitter Saturation Voltage.



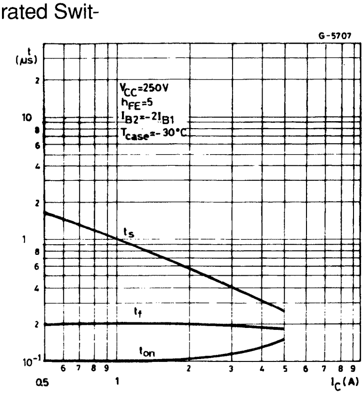
Saturated Switching Characteristics.



Saturated Switching Characteristics.



Saturated Swit-



Clamped Reverse bias Safe Operating Areas.

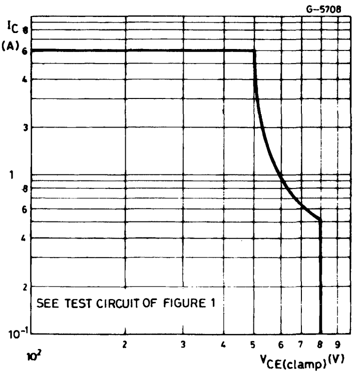
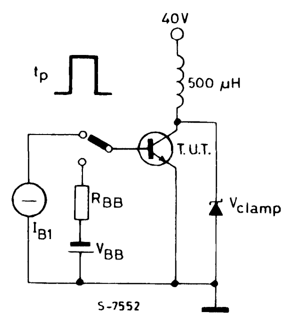


Figure 1 : Clamped Es/b Test Circuit.

TEST CONDITIONS :

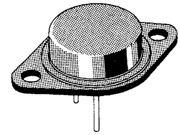
5V ≥ |-V_{BB}| ≥ 2V
I_C/I_B ≥ 4
$2I_{B1}$ ≥ |-I_{B2}| ≥ I_{B1}
t_p = adjusted for nominal I_C
R_{BB} = Adjusted for I_{B2}



HIGH VOLTAGE POWER SWITCH

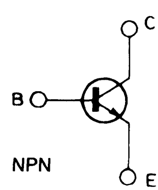
DESCRIPTION

The 2N6544 and 2N6545 are multiepitaxial mesa NPN transistors in Jedec TO-3 metal case. They are intended for high voltage, fast switching applications.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	2N6544	2N6545	Unit
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	650	850	V
V_{CEX}	(clamped) Collector-emitter Voltage (V_{BE} = – 5V)	350	450	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	300	400	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	9		V
I_C	Collector Current	8		A
I_{CM}	Collector Peak Current (t_p = 10ms)	16		A
I_B	Base Current	8		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25°C$	125		W
T_{stg}	Storage Temperature	– 65 to 200		°C
T_j	Junction Temperature	200		°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	1.4	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	for **2N6544** V_{CE} = 650V for **2N6545** V_{CE} = 850V T_{case} = 100°C for **2N6544** V_{CE} = 650V for **2N6545** V_{CE} = 850V			0.5 0.5 2.5 2.5	mA mA mA mA
I_{CER}	Collector Cutoff Current (R_{BE} = 50Ω)	T_{case} = 100°C for **2N6544** V_{CE} = 650V for **2N6545** V_{CE} = 850V			3 3	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 9V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100mA for **2N6544** for **2N6545**	 300 400			 V V
$V_{CEX(sus)}$	Collector-emitter Sustaining Voltage (clamped $E_{s/b}$)	I_C/I_B = 5 L = 180µH V_{BE} = − 5V T_{case} = 100°C V_{clamp} = rated $V_{CEX(sus)}$ I_C = 4.5A for **2N6544** for **2N6545** V_{clamp} = rated $V_{CEO(sus)}$ − 100V I_C = 8A for **2N6544** for **2N6545**	 350 450 200 300			 V V V V
$I_{s/b}$	Second Breakdown Collector Current	t = 1s (non repetitive) V_{CE} = 100V	0.2			A
$E_{s/b}$	Second Breakdown Energy	L = 40µH V_{BE} = − 4V R_{BE} = 50Ω	500			µJ
h_{FE}*	DC Current Gain	I_C = 2.5A V_{CE} = 3V I_C = 5A V_{CE} = 3V	12 7		60 35	
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5A I_B = 1A I_C = 8A I_B = 2A T_{case} = 100°C I_C = 5A I_B = 1A			1.5 5 2.5	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 5A I_B = 1A T_{case} = 100°C I_C = 5A I_B = 1A			1.6 1.6	V V
f_T	Transistion Frequency	I_C = 0.3A V_{CE} = 10V f = 1MHz	6		24	MHz
C_{CBO}	Collector-base Capacitance	V_{CB} = 10V I_E = 0 f = 1MHz			200	pF

ELECTRICAL CHARACTERISTICS (continued)

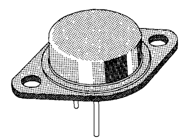
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	**RESISTIVE LOAD** I_C = 5A V_{CC} = 250V I_{B1} = – I_{B2} = 1A			1	μs
t_s	Storage Time				4	μs
t_f	Fall Time				1	μs
t_s	Storage Time	**INDUCTIVE LOAD** I_C = 5A(pk) I_{B1} = 1A V_{BE} = – 5V L = 180μH T_{case} = 100°C for **2N6544** V_{clamp} = 350V for **2N6545** V_{clamp} = 450V			4	μs
t_f	Fall Time				0.9	μs

* Pulsed : pulse duration = 300μs, duty cycle = 1.5%.
For characteristic curves see the BUX47 type.

2N6671/72/73

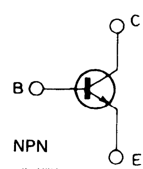
NPN HIGH VOLTAGE POWER TRANSISTORS

- SWITCHING REGULATORS
- INVERTERS
- SOLENOID AND RELAY DRIVERS
- MOTOR CONTROLS
- DEFLECTION CIRCUITS



TO-3

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

High voltage, high speed switching power transistors suited for use on the 220 and 380V mains.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	2N6671	2N6672	2N6673	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	450	550	650	V
V_{CEX}	Collector-emitter Voltage	350	400	450	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	300	350	400	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	8			V
I_C	Collector Current	8			A
I_{CM}	Collector Peak Current	10			A
I_B	Base Current	4			A
P_{tot}	Total Dissipation at T_c < 25°C	150			W
T_{stg}	Storage Temperature	– 65 to 200			°C
T_j	Max. Operating Junction Temperature	200			°C

THERMAL DATA

$R_{thj-case}$	Thermal Resistance Junction-case	Max	1.17	°C/W

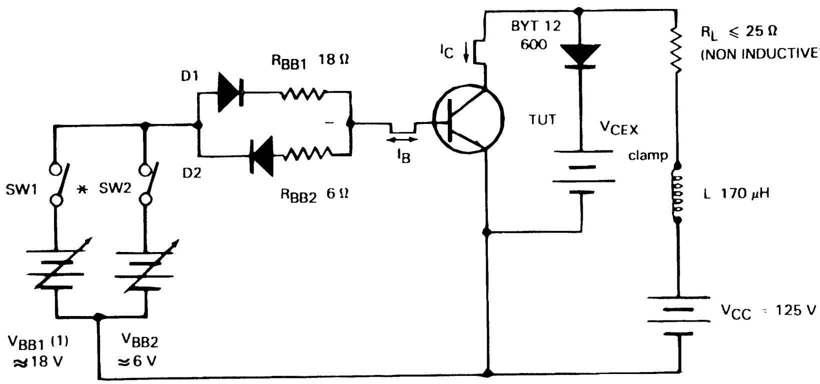
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ $V_{BE} = -1.5V$ $V_{CE} = V_{CEV}$ $V_{BE} = -1.5V$ $T_c = 125°C$			0.1 1	mA mA
I_{EBO}	Emitter Cutoff Current ($I_C = 0$)	$V_{EB} = 8V$			2	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	$I_C = 0.2A$ $L_C = 25mH$ for **2N6671** for **2N6672** for **2N6673**	 300 350 400			 V V V
$V_{CEX(clamp)}$	Collector Emitter Clamped Voltage	$V_{BB} = -5V$ $L_C = 170\mu H$ $R_{BB} = 5\Omega$ $I_C = 5A$ $I_{B1} = -I_{B2} = 1A$ for **2N6671** for **2N6672** for **2N6673** $I_C = 8A$ $I_{B1} = -I_{B2} = 3A$ for **2N6671** for **2N6672** for **2N6673**	 350 400 450 200 250 300			 V V V V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	$I_C = 5A$ $I_B = 1A$ $I_C = 5A$ $I_B = 1A$ $T_c = 100°C$ $I_C = 8A$ $I_B = 4A$			1 2 2	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	$I_C = 5A$ $I_B = 1A$			1.6	V
h_{FE}*	DC Current Gain	$I_C = 5A$ $V_{CE} = 3V$	10		40	
h_{fe}	Small Signal Current Gain	$I_C = 0.2A$ $V_{CE} = 10V$ $f = 1MHz$	3		12	

RESISTIVE LOAD

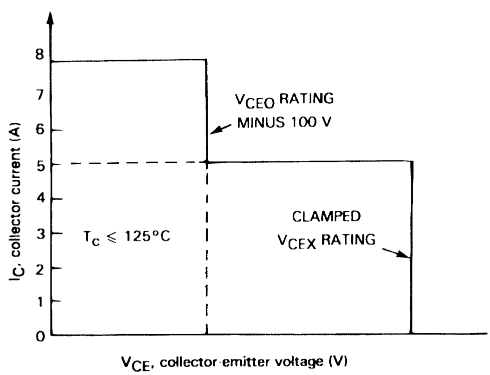
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_d t_r	Delay Time Rise Time	$V_{CC} = 125V$ $I_C = 5A$ $t_p = 20\mu s$ $V_{BB} = -6V$ $I_{B1} = 1A$			0.1 0.5	µs µs
t_r	Rise Time	$V_{CC} = 125V$ $I_C = 5A$ $t_p = 20\mu s$ $V_{BB} = -6V$ $I_{B1} = 1A$ $T_c = 125°C$			0.8	µs
t_s t_f	Storage Time Fall Time	$V_{CC} = 125V$ $I_C = 5A$ $t_p = 20\mu s$ $V_{BB} = -6V$ $I_{B1} = -I_{B2} = 1A$			2.5 0.4	µs µs
t_s t_f	Storage Time Fall Time	$V_{CC} = 125V$ $I_C = 5A$ $t_p = 20\mu s$ $V_{BB} = -6V$ $I_{B1} = -I_{B2} = 1A$ $T_c = 100°C$			4 0.8	µs µs

Figure 1 : Test Circuit RBSOA.



(1) Adjust for I_{B1} and $I_{B2} \pm 1A$.
* SW1 and SW2 : Electronic Switches.
D1-D2 = BYW100

Figure 2 : Maximum Operating Conditions for Switching between Saturation and Cut-off.



NPN HIGH VOLTAGE POWER TRANSISTORS

- SWITCHING REGULATORS
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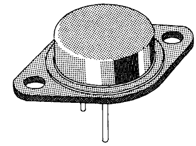
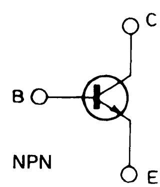
- DEFLECTION CIRCUITS



TO-3

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

High voltage, high speed switching power transistors suited for use on the 220 and 380V mains.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	2N6674	2N6675	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = –1.5V)	450	650	V
V_{CEX}	Collector-emitter Voltage	350	400	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	300	450	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7		V
I_C	Collector Current	15		A
I_{CM}	Collector Peak Current	20		A
I_B	Base Current	5		A
P_{tot}	Total Dissipation at T_c < 25°C	175		W
T_{stg}	Storage Temperature	– 65 to 200		°C
T_j	Max. Operating Junction Temperature	200		°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	1	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ $V_{BE} = -1.5V$ $V_{CE} = V_{CEV}$ $V_{BE} = -1.5V$ $T_c = 100°C$			0.1 1	mA mA
I_{EBO}	Emitter Cutoff Current ($I_C = 0$)	$V_{EB} = 7V$			2	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	$I_C = 0.2A$ $L_C = 25mH$ for **2N6674** for **2N6675**	300 400			V V
$V_{CEX(sus)}$*	Collector-emitter Sustaining Voltage	$I_C = 10A$ $L_C = 50\mu H$ $I_B = 2A$ $R_{BB} = 2\Omega$ $V_{BB} = -4V$ for **2N6674** for **2N6675**	350 450			V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	$I_C = 10A$ $I_B = 2A$ $I_C = 10A$ $I_B = 2A$ $T_c = 100°C$ $I_C = 15A$ $I_B = 5A$			1 2 5	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	$I_C = 10A$ $I_B = 2A$			1.5	V
h_{FE}*	DC Current Gain	$I_C = 10A$ $V_{CE} = 2V$	8			
h_{fe}	Small Signal Current Gain	$I_C = 1A$ $V_{CE} = 10V$ f = 5MHz	3		10	

RESISTIVE LOAD

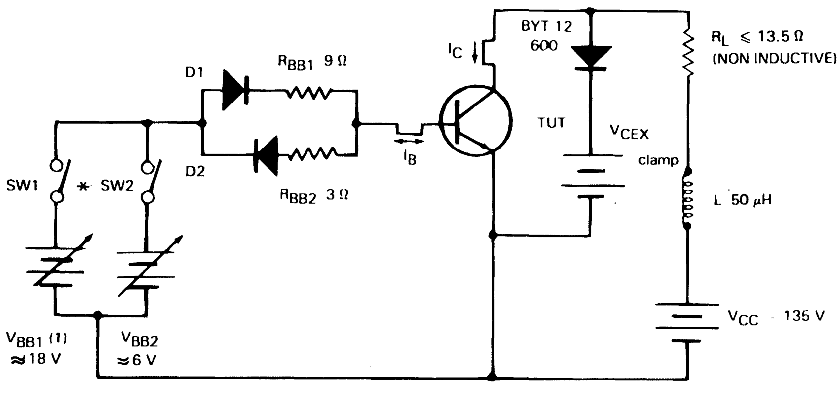
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_d	Delay Time	$V_{CC} = 135V$ $I_C = 10A$ $t_p = 20\mu s$ $V_{BB} = -6V$ I_t# p= 20µs			0.1	µs
t_r	Rise Time				0.6	µs
t_r	Rise Time	$V_{CC} = 135V$ $I_C = 10A$ $t_p = 20\mu s$ $V_{BB} = -6V$ $I_{B1} = 2A$ $T_c = 100°C$			1	µs
t_s	Storage Time	$V_{CC} = 135V$ $I_C = 10A$ $t_p = 20\mu s$ $V_{BB} = -6V$ $I_{B1} = -I_{B2} = 2A$			2.5	µs
t_f	Fall Time				0.5	µs
t_s	Storage Time	$V_{CC} = 135V$ $I_C = 10A$ $t_p = 20\mu s$ $V_{BB} = -6V$ $I_{B1} = -I_{B2} = 2A$ $T_c = 100°C$			4	µs
t_f	Fall Time				1	µs

INDUCTIVE LOAD

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_c	Crossover Time	$V_{CC} = 135V$ $I_C = 10A$ $I_C = 50\mu H$ $R_C = 13.5\Omega$ $I_{B1} = -I_{B2} = 2A$ $V_{clamp} = V_{CEX}$ $T_c = 25°C$ $T_c = 100°C$			0.5 0.8	µs µs

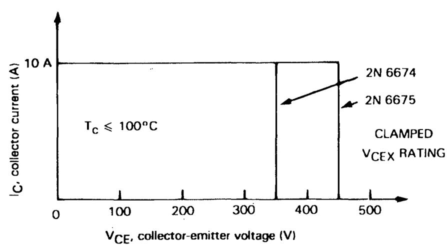
* Pulsed : Pulse duration = 300 µs, duty cycle = 2 %.

Figure 1 : Test Circuit RBSOA.



(1) Adjust for I_{B1} AND I_{B2} = ± 2 A
* SW1 AND SW2 Electronic Switches
D1 – D2 = BYW 100

Figure 2 : Maximum Operating Conditions for Switching between Saturation and Cut-off.



NPN HIGH VOLTAGE POWER TRANSISTORS

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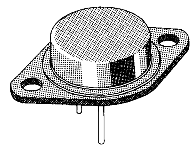
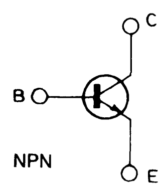


TO-3

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

High voltage, high speed switching power transistors suited for use on the 220 and 380 V mains.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	2N6676	2N6677	2N6678	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	450	550	650	V
V_{CEX}	Collector-emitter Voltage	350	400	450	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	300	350	400	V
V_{EBO}	Emitter-base Voltage (I_C = 0)		8		V
I_C	Collector Current		15		A
I_{CM}	Collector Peak Current		20		A
I_B	Base Current		5		A
P_{tot}	Total Dissipation at T_C < 25°C		175		W
T_{stg}	Storage Temperature		– 65 to 200		°C
T_j	Max. Operating Junction Temperature		200		°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	1	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ $V_{BE} = -1.5V$ $V_{CE} = V_{CEV}$ $V_{BE} = -1.5V$ $T_c = 100°C$			0.1 1	mA
I_{EBO}	Emitter Cutoff Current ($I_C = 0$)	$V_{EB} = 8V$			2	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	$I_C = 0.2A$ $L_C = 25mH$ for **2N6676** for **2N6677** for **2N6678**	 300 350 400			 V V V
$V_{CEX(sus)}$*	Collector Emitter Sustaining Voltage	$I_C = 15A$ $L_C = 50\mu H$ $I_B = 3A$ $R_{BB} = 2\Omega$ $V_{BB} = -6V$ for **2N6676** for **2N6677** for **2N6678**	 350 400 450			 V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	$I_C = 15A$ $I_B = 3A$ $I_C = 15A$ $I_B = 3A$ $T_c = 100°C$			1 2	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	$I_C = 15A$ $I_B = 3A$			1.5	V
h_{FE}*	DC Current Gain	$I_C = 15A$ $V_{CE} = 3V$	8			
h_{fe}	Small Signal Current Gain	$I_C = 1A$ $V_{CE} = 10V$ $f = 5MHz$	3		10	

RESISTIVE LOAD

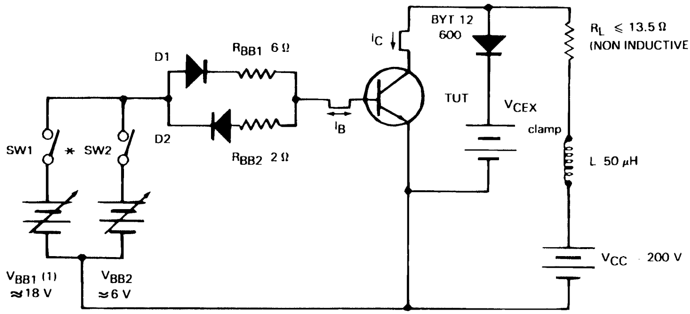
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_d t_r	Delay Time Rise Time	$V_{CC} = 200V$ $I_C = 15A$ $t_p = 20\mu s$ $V_{BB} = -6V$ $I_{B1} = 3A$			0.1 0.6	μs μs
t_r	Rise Time	$V_{CC} = 200V$ $I_C = 15A$ $t_p = 20\mu s$ $V_{BB} = -6V$ $I_{B1} = 3A$ $T_c = 100°C$			1	μs
t_s t_f	Storage Time Fall Time	$V_{CC} = 200V$ $I_C = 15A$ $t_p = 20\mu s$ $V_{BB} = -6V$ $I_{B1} = -I_{B2} = 3A$			2.5 0.5	μs μs
t_s t_f	Storage Time Fall Time	$V_{CC} = 200V$ $I_C = 15A$ $t_p = 20\mu s$ $V_{BB} = -6V$ $I_{B1} = -I_{B2} = 3A$ $T_c = 100°C$			4 1	μs μs

INDUCTIVE LOAD

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_c	Crossover Time	$V_{CC} = 200V$ $I_C = 15A$ $L_C = 50\mu H$ $R_C = 13.5\Omega$ $I_{B1} = -I_{B2} = 3A$ $V_{clamp} = V_{CEX}$ $T_c = 25°C$ $T_c = 100°C$			 0.5 0.8	 μs μs

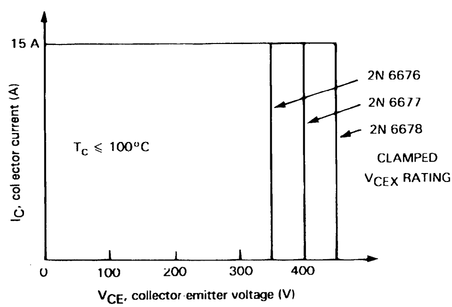
* Pulsed : pulse duration = 300μs, duty cycle = 2%.

Figure 1 : Test Circuit RBSOA.



(1) Adjust for IB1 and IB2 = ± 3 A
* SW1 and SW2 Electronic Switches.
D1 – D2 = BYW 100

Figure 2 : Maximum Operating Conditions for Switching between Saturation and Cut-off.



SGS-THOMSON MICROELECTRONICS

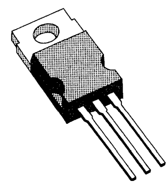
2N6702

SWITCHING AND GENERAL PURPOSE

DESCRIPTION

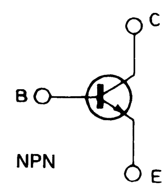
The 2N6702 is a silicon multiepitaxial planar NPN transistor and is mounted in Jedec TO-220 plastic package.

It is intended for various switching and general purpose applications.



TO-220

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CEV}	Collector-emitter Voltage (V_{BE} = – 1.5V)	140	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	90	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	7	A
I_{CM}	Collector Peak Current	10	A
I_B	Base Current	5	A
P_{tot}	Total Power Dissipation ($T_{case} \leq 25°C$)	50	W
T_{stg}	Storage Temperature	– 65 to 150	°C
T_j	Junction Temperature	150	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	2.5	°C/W

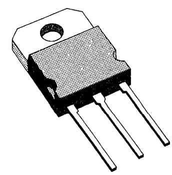
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector Cutoff Current (V_{BE} = – 1.5V)	V_{CE} = 140V V_{CE} = 140V at T_{case} = 125°C			100 1	µA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 7V			100	µA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 100mA	90			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 5A I_B = 0.5A I_C = 7A I_B = 0.7A			0.8 1.5	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 5A I_B= 0.5A			1.5	V
h_{FE}*	DC Current Gain	I_C = 0.2A V_{CE} = 2V I_C = 5A V_{CE} = 2V	30 20			
h_{fe}	Small Singal Current gain	I_C = 0.5A V_{CE} = 10V f = 5MHz	4		40	
f_T	Transistion Frequency	I_C = 0.5A V_C = 10V f = 5MHz	20		200	MHz
C_{CBO}	Collector Base Capacitance	I_E = 0 V_{CB} = 10V f = 100KHz	50		150	pF
$I_{s/b}$	Second Breakdown	V_{CE} = 20V t = 100ms	2.5			A
t_d	Delay Time	I_C = 5A I_{B1} = 0.5A V_{CC} = 70V			0.1	µs
t_r	Rise Time				0.25	µs
t_s	Storage Time	I_C = 5A I_{B1} = – I_{B2} = 0.5A V_{CC} = 70V			1	µs
t_r	Fall Time				0.5	µs

* Pulsed : pulse duration = 300µsec. ; duty cycle ≤ 2%.

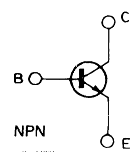
NPN HIGH VOLTAGE POWER TRANSISTORS

- OFF-LINE POWER SUPPLIES
- HIGH-VOLTAGE INVERTERS
- SWITCHING REGULATORS



TO–218

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

High-voltage, high-speed, switching power transistors suited for use on medium voltage supply.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter		2N6931	2N6932	Unit
V_{CEV}	Collector-emitter Voltage	$V_{BE} = -1.5V$	450	650	V
V_{CEX}	Collector-emitter Voltage		350	450	V
V_{CEO}	Collector-emitter Voltage	$I_B = 0$	300	400	V
V_{EBO}	Emitter-base Voltage	$I_C = 0$	8		V
I_C	Collector Current		10		A
I_{CM}	Collector Peak Current		15		A
I_B	Base Current		5		A
I_{BM}	Base Peak Current		7		A
I_E	Emitter Current		15		A
I_{EM}	Emitter Peak Current		22		A
P_{tot}	Total Dissipation at $T_c < 25°C$		150		W
T_{stg}	Storage Temperature		– 65 to 150		°C
T_j	Max. Operating Junction Temperature		150		°C

THERMAL DATA

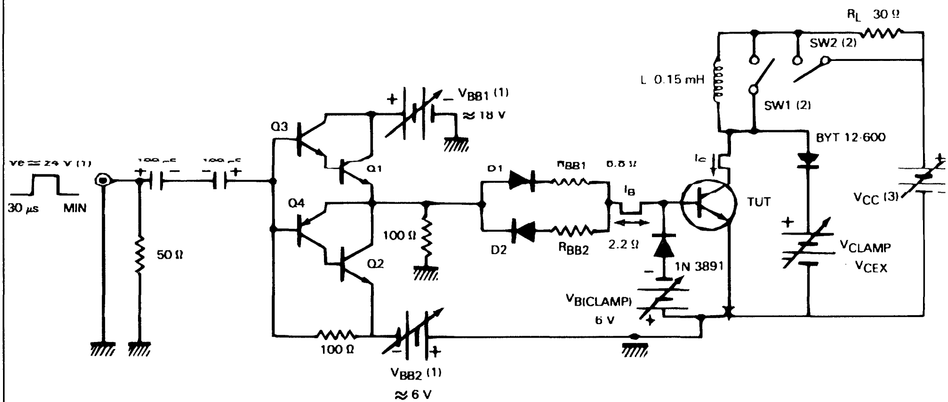
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	0.83	°C/W
T_L	Maximum Lead Temperature for Soldering Purpose		235	°C

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

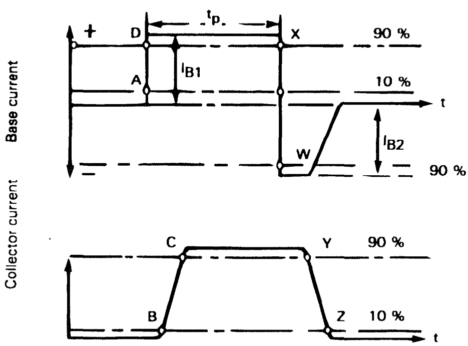
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ $V_{BE} = -1.5V$ $V_{CE} = V_{CEV}$ $V_{BE} = -1.5V$ $T_c = 100°C$			0.1 1	mA mA
I_{EBO}	Emitter Cutoff Current ($I_C = 0$)	$V_{EB} = 8V$			2	mA
$V_{CEO(sus)}$*	Collector Emitter Sustaining Voltage	$I_C = 0.2A$ L = 25mH for **2N6931** for **2N6932**	 300 400			 V V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	$I_E = 50mA$	8			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	$I_C = 10A$ $I_B = 2A$ $I_C = 10A$ $I_B = 2A$ $T_c = 100°C$			1 2	V V
$V_{BE(sat)}$*	Base-emitter saturation Voltage	$I_C = 10A$ $I_B = 2A$ $I_C = 10A$ $I_B = 2A$ $T_c = 100°C$			1.5 1.5	V V
h_{FE}*	DC Current Gain	$I_C = 10A$ $V_{CE} = 3V$	8		35	
h_{fe}	Small Signal Current Gain	$I_C = 1A$ $V_{CE} = 10V$ f = 5 MHz	2		6	
C_{cbo}	Collector-base Capacitance	$V_{CB} = 10V$ f = 1MHz	80		300	pF
 t_d t_r t_s t_f	RESISTIVE LOAD Delay Time Rise Time Storage Time Fall Time	 $V_{CC} = 300V$ $I_C = 10A$ $R_C = 30\Omega$ $I_{B1} = -I_{B2} = 2A$ $V_{BB} = -5V$ $t_p = 30\mu s$ See fig. 1			 0.1 0.7 2.5 0.5	 µs µs µs µs
 t_s t_f t_c	INDUCTIVE LOAD Storage Time Fall Time Crossover Time	 $V_{CC} = 50V$ $I_C = 10A$ $L_C = 150\mu H$ $I_{B1} = -I_{B2} = 2A$ $R_{BB} = 2.2\Omega$ $V_{clamp} = V_{CEX}$ $T_c = 100°C$ See fig. 1			 3.5 0.4 0.8	 µs µs µs
di_c/dt	Turn-on Current Slope	$V_{CC} = 300V$ $I_B = 3A$ $R_C = 0$ $t_p = 3\mu s$ See fig. 2	50			A/µs
V_{CEX}	Collector-emitter Sustaining Voltage	$V_{CC} = 50V$ $I_C = 10A$ $L_C = 150\mu H$ $I_{B1} = -I_{B2} = 2A$ $R_{BB} = 2.2\Omega$ $V_{clamp} = V_{CEX}$ $T_c = 100°C$ See fig. 3 for **2N6931** for **2N6932**	 350 450			 V V

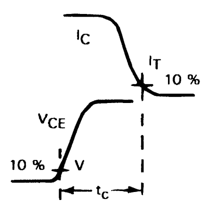
* Pulsed : Pulse duration = 300µs, duty cycle = 2%

Figure 1 : Switching Time Measurements.



(1)	Adjust for I_{B1} and $I_{B2} \pm$ 2A.	Q1, Q2	BUT60
(2)	SW1 Closed for t_d, t_r, t_s, t_f, SW1 Open for t_c	Q 3	BD243
	SW2 Closed for t_c, Open for t_d, t_r, t_s, t_f.	Q4	BD244
(3)	V_{CC} : 300V for t_d, t_r, t_s, t_f	D1, D2	BYW100
	V_{CC} : 50V for t_c.		





t_d A-B$t_{ransition}$ A-D : ≤0.3µs
t_r B-C$t_{ransition}$ X-W : ≤0.3µs
t_s X-Y
t_f Y-Z
t_c V-I

Figure 2 : Turn-on Switching Waveforms.

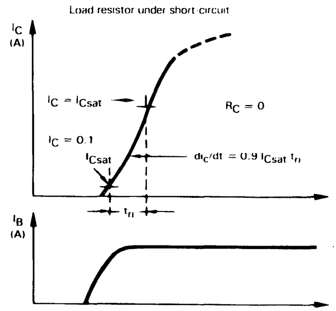
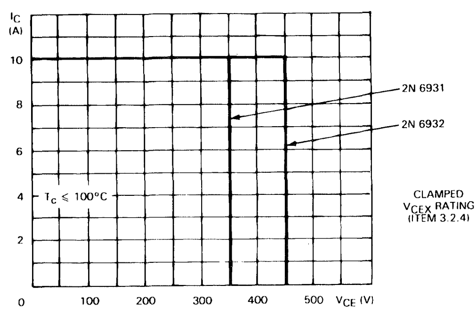
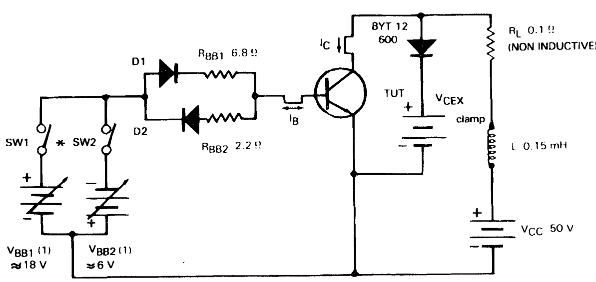


Figure 3 : Maximum Operating Conditions for Switching between Saturation and Cut off.

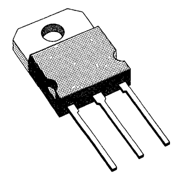




(1) Adjust for I_{B1} and I_{B2} ± 2A.
* SW1 and SW2 : Electronic Switches.
D1-D2 = BYW100

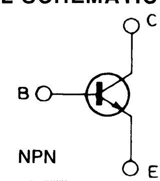
NPN HIGH VOLTAGE POWER TRANSISTORS

- OFF-LINE POWER SUPPLIES
- HIGH VOLTAGE INVERTERS
- SWITCHING REGULATORS



TO-218

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

High voltage, high speed, switching power transistors suited for use on medium voltage supply.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter		2N6933	2N6934	2N6935	Unit
V_{CEV}	Collector-emitter Voltage	(V_{BE} = − 1.5 V)	450	550	650	V
V_{CEX}	Collector-emitter Voltage		350	400	450	V
V_{CEO}	Collector-emitter Voltage	(I_B = 0)	300	350	400	V
V_{EBO}	Emitter-base Voltage	(I_C = 0)	8			V
I_C	Collector Current		15			A
I_{CM}	Collector Peak Current		23			A
I_B	Base Current		5			A
I_{BM}	Base Peak Current		7			A
I_C	Emitter Current		20			A
I_{CM}	Emitter Peak Current		30			A
P_{tot}	Total Dissipation at T_C < 25 °C		175			W
T_{stg}	Storage Temperature		− 65 to 150			°C
T_j	Max. Operating Junction Temperature		150			°C

THERMAL DATA

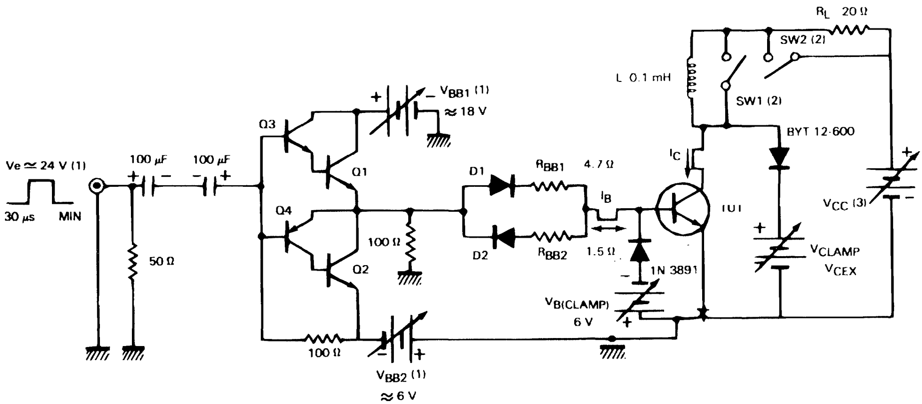
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max.	0.71	°C/W
T_L	Maximum Lead Temperature for Soldering Purpose		235	°C

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

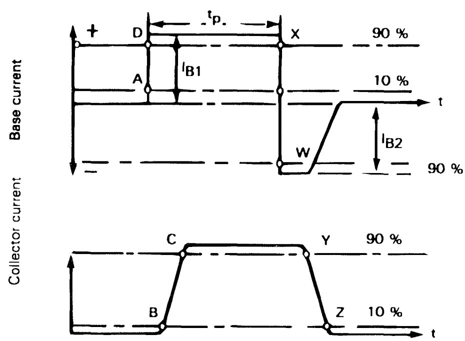
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector Cutoff Current	$V_{CE} = V_{CEV}$ $V_{BE} = -1.5$ V $V_{CE} = V_{CEV}$ $V_{BE} = -1.5$ V $T_c = 100$ °C			0.1 1	mA mA
I_{EBO}	Emitter Cutoff Current ($I_C = 0$)	$V_{EB} = 8$ V			2	mA
$V_{CEO(sus)}$*	Collector Emitter sustaining Voltage	$I_C = 0.2$ A L = 25 mH for **2N6933** for **2N6934** for **2N6935**	 300 350 400			 V V V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	$I_E = 50$ mA	8			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	$I_C = 15$ A $I_B = 3$ A $I_C = 15$ A $I_B = 3$ A $T_C = 100$ °C			1 2	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	$I_C = 15$ A $I_B = 3$ A $I_C = 15$ A $I_B = 3$ A $T_C = 100$ °C			1.5 1.5	V V
h_{FE}*	DC Current Gain	$I_C = 15$ A $V_{CE} = 3$ V	8		35	
h_{fe}	Small Signal Current Gain	$I_C = 1$ A $V_{CE} = 10$ V f = 5 MHz	2		6	
C_{cbo}	Collector-base Capacitance	$V_{CB} = 10$ V f = 1 MHz	150		400	pF
 t_d t_r t_s t_f	 Delay Time Rise Time Storage Time Fall time	**RESISTIVE LOAD** $V_{CC} = 300$ V $I_C = 15$ A $R_C = 20\ \Omega$ $I_{B1} = -I_{B2} = 3$ A $V_{BB} = -5$ V $t_p = 30$ µs see fig. 1			 0.1 0.7 2.5 0.5	 µs µs µs µs
 t_s t_f t_c	 Storage Time Fall Time Crossover Time	**INDUCTIVE LOAD** $V_{CC} = 50$ V $I_C = 15$ A $L_C = 100$ µH $I_{B1} = -I_{B2} = 3$ A $R_{BB} = 1.5\ \Omega$ $V_{clamp} = V_{CEX}$ $T_c = 100$ °C see fig. 1			 3.5 0.4 0.8	 µs µs µs
di_c/dt	Turn-on Current Slope	$V_{CC} = 300$ V $I_B = 4.5$ A $R_C = 0$ $t_p = 3$ µs see fig. 2	75			A/µs
V_{CEX}	Collector-emitter Sustaining Voltage	$V_{CC} = 50$ V $I_C = 15$ A $L_C = 100$ µH $I_{B1} = -I_{B2} = 3$ A $R_{BB} = 1.5\ \Omega$ $V_{clamp} = V_{CEX}$ $T_c = 100$ °C see fig. 3 for **2N6933** for **2N6934** for **2N6935**	 350 400 450			 V V V

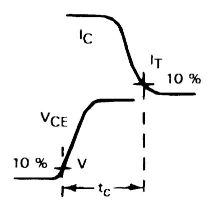
* Pulse duration = 300 µs, duty cycle 2 %.

Figure 1 : Switching Time Measurements.



(1)	Adjust for I_{B1} and I_{B2} ± 3A.	Q1, Q2	BUT60
(2)	SW1 Closed for t_d, t_r, t_s, t_f, SW1 Open for t_c.	Q3	BD243
	SW2 Closed for t_c, Open for t_d, t_r, t_s, t_f..	Q4	BD244
(3)	V_{CC} : 300V for t_d, t_r, t_s, t_f.	D1, D2	BYW100
	V_{CC} : 50V for t_c.		





t_d A-B$_{transition}$ A-D : σ ≤ 0.3µs
t_r B-C$_{transition}$ X-W : ≤ 0.3µs
t_s X-Y
t_f Y-Z
t_c V-I

Figure 2 : Turn-on Switching Waveforms.

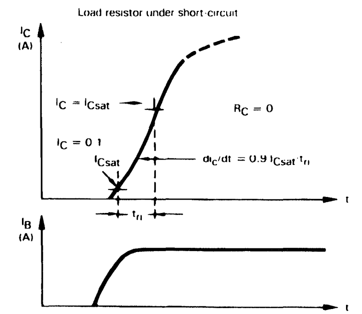
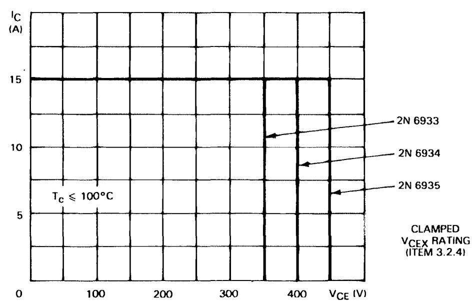
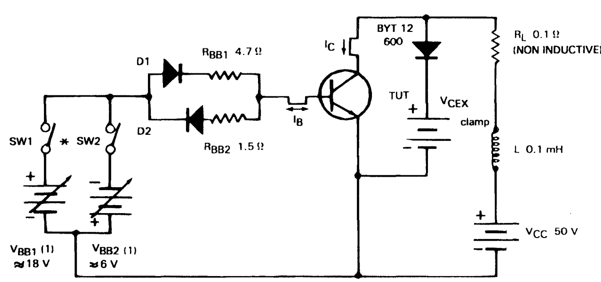


Figure 3 : Maximum Operating Conditions for Switching between Saturation and Cut off.

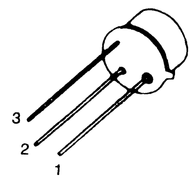




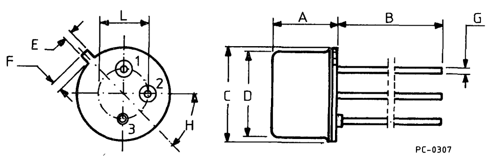
(1) Adjust for I_{B1} and $I_{B2} \pm 3A$.
* SW1 and SW2 : Electronic Switches.
D1-D2 = BYW100

PACKAGES

TO-39



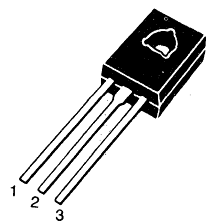
MECHANICAL DATA



	DIMENSIONS			
	mm		inches	
	min	max	min	max
A	—	6.6	—	0.260
B	12.7	—	0.500	—
C	—	9.4	—	0.370
D	—	8.5	—	0.334
E	—	0.9	—	0.035
F	—	1.2	—	0.047
G	—	0.49	—	0.019
H	45° typ		45° typ	
L	5.08 typ		0.200 typ	

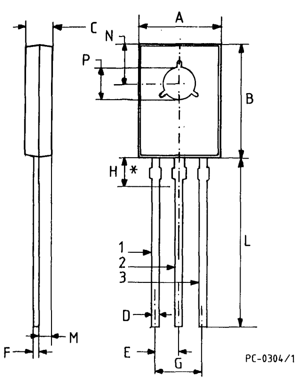
pin 1: Emitter - pin 2: Base - pin 3: Collector

SOT-32



MINIATURE PACKAGE WITH REVERSED TO-220 PINOUT

MECHANICAL DATA

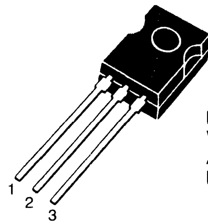


*: WITHIN THIS REGION THE CROSS-SECTION OF THE LEADS IS UNCONTROLLED

	DIMENSIONS			
	mm		inches	
	min	max	min	max
A	7.4	7.8	0.295	0.307
B	10.5	10.8	0.413	0.425
C	2.4	2.7	0.094	0.106
D	0.7	0.9	0.027	0.035
E	2.2 typ.		0.087 typ.	
F	0.49	0.75	0.019	0.029
G	4.4 typ.		0.173 typ.	
H	2.54 typ.		0.100 typ.	
L	15.7 typ.		0.618 typ.	
M	1.2 typ.		0.047 typ.	
N	3.8 typ.		0.149 typ.	
P	3.0	3.2	0.118	0.126

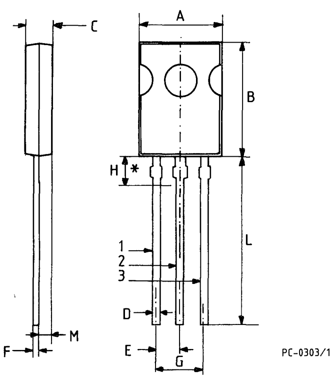
pin 1: Emitter - pin 2: Collector - pin 3: Base

SOT-82



MINIATURE PACKAGE WITH SAME PINOUT AS TO-220 IDEAL FOR MOUNTING WITH CLIPS

MECHANICAL DATA

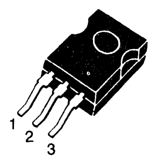


	DIMENSIONS			
	mm		inches	
	min	max	min	max
A	7.4	7.8	0.295	0.307
B	10.5	10.8	0.413	0.425
C	2.4	2.7	0.094	0.106
D	0.7	0.9	0.027	0.035
E	2.2 typ.		0.087 typ.	
F	0.49	0.75	0.019	0.029
G	4.4 typ.		0.173 typ.	
H	2.54 typ.		0.100 typ.	
L	15.7 typ.		0.618 typ.	
M	1.2 typ.		0.047 typ.	

pin 1: Base - pin 2: Collector - pin 3: Emitter

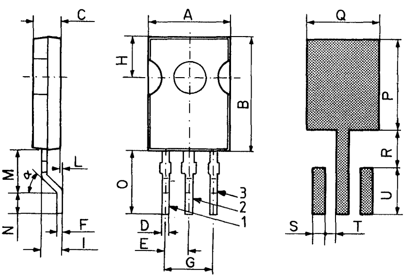
*: WITHIN THIS REGION THE CROSS-SECTION OF THE LEADS IS UNCONTROLLED

SOT-194



LEAD FORMED SOT-82 FOR SURFACE MOUNTING ASSEMBLY

MECHANICAL DATA

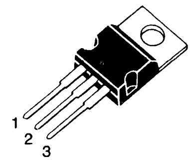


PC-0276/1

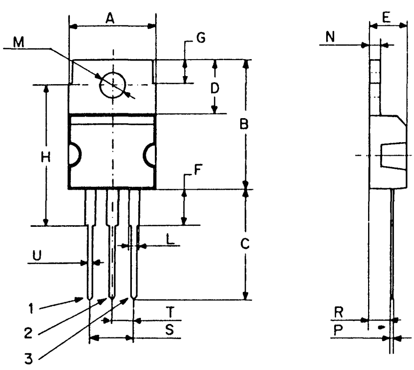
	DIMENSIONS			
	mm		inches	
	min	max	min	max
A	7.4	7.8	0.295	0.307
B	10.5	10.8	0.413	0.425
C	2.4	2.7	0.094	0.106
D	0.7	0.9	0.027	0.035
E	2.2 typ.		0.087 typ.	
F	0.45	0.65	0.017	0.026
G	4.4 typ.		0.173 typ.	
H	3.8 typ.		0.149 typ.	
I	1.8 typ.		0.070 typ.	
L	0.1 typ.		0.004 typ.	
M	3.8	4.2	0.149	0.165
N	2 typ.		0.078 typ.	
O	6 typ.		0.236 typ.	
α	45°		45°	
P	8.5 typ.		0.334 typ.	
Q	6.7 typ.		0.263 typ.	
R	3.5 typ.		0.137 typ.	
S	1.2 typ.		0.047 typ.	
T	1 typ.		0.039 typ.	
U	4.5 typ.		0.177 typ.	

pin 1: Base - pin 2: Collector - pin 3: Emitter

TO-220



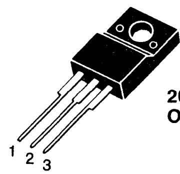
MECHANICAL DATA



	DIMENSIONS			
	mm		inches	
	min	max	min	max
A	10	10.4	0.393	0.409
B	15.2	15.9	0.598	0.626
C	12.7	13.7	0.500	0.539
D	6.2	6.6	0.244	0.260
E	4.4	4.6	0.173	0.181
F	3.5	5.5	0.137	0.216
G	2.65	2.95	0.104	0.116
H	17.6 typ.		0.692 typ.	
L	1.14	1.7	0.044	0.067
M	3.75	3.85	0.147	0.151
N	1.23	1.32	0.048	0.051
P	0.41	0.64	0.016	0.025
R	2.4	2.72	0.094	0.107
S	4.95	5.15	0.194	0.203
T	2.4	2.7	0.094	0.106
U	0.61	0.94	0.024	0.037

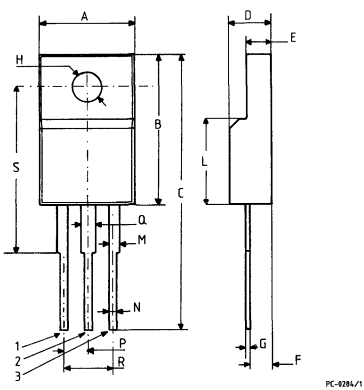
pin 1: Base - pin 2: Collector - pin 3: Emitter

ISOWATT220



2000V DC FULLY ISOLATED VERSIONE OF THE TO-220 PACKAGE

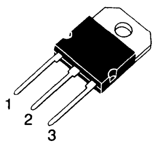
MECHANICAL DATA



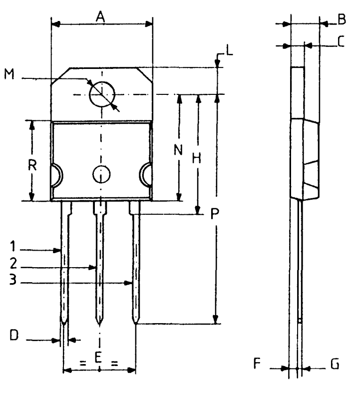
	DIMENSIONS			
	mm		inches	
	min	max	min	max
A	10	10.4	0.393	0.409
B	15.9	16.4	0.626	0.645
C	28.6	30.6	1.126	1.204
D	4.4	4.6	0.173	0.181
E	2.5	2.7	0.098	0.106
F	2.4	2.75	0.094	0.108
G	0.4	0.7	0.015	0.027
H	3	3.2	0.118	0.126
L	9	9.3	0.354	0.366
M	1.15	1.7	0.045	0.067
N	0.75	1	0.030	0.039
P	2.4	2.7	0.094	0.106
Q	1.15	1.7	0.045	0.067
R	4.95	5.2	0.195	0.204
S	16 typ		0.630 typ	

pin 1: Base - pin 2: Collector - pin 3: Emitter

TO-218 (SOT-93)



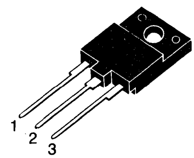
MECHANICAL DATA



	DIMENSIONS			
	mm		inches	
	min	max	min	max
A	14.7	15.2	0.578	0.598
B	4.7	4.9	0.185	0.193
C	1.9	2.1	0.075	0.082
D	1.1	1.3	0.043	0.051
E	10.8	11.1	0.425	0.437
F	2.5 typ		0.098 typ	
G	0.5	0.78	0.019	0.030
H	18 typ		0.708 typ	
L	3.95	4.15	0.155	0.163
M	4	4.1	0.157	0.161
N	—	16.2	—	0.637
P	31 typ		1.220 typ	
R	—	12.2	—	0.480

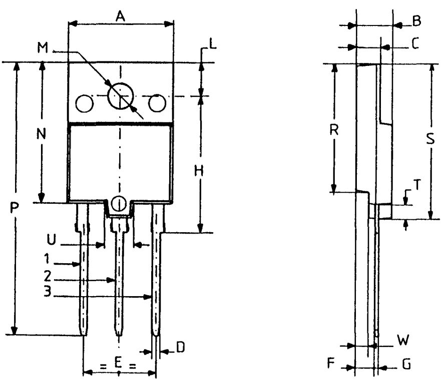
pin 1: Base - pin 2: Collector - pin 3: Emitter

ISOWATT218



4000V DC FULLY ISOLATED VERSION OF THE TO-218 PACKAGE CONFORMS TO UL AND VDE SAFETY STANDARDS

MECHANICAL DATA

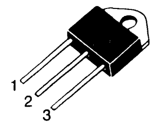


PC-0288

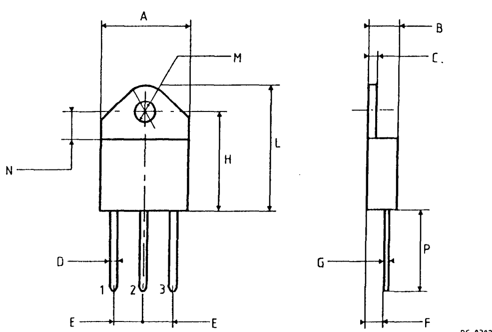
	DIMENSIONS			
	mm		inches	
	min	max	min	max
A	15.8	16.2	0.622	0.637
B	5.35	5.65	0.210	0.222
C	3.3	3.8	0.130	0.149
D	1.05	1.25	0.041	0.049
E	10.8	11.2	0.425	0.441
F	2.9	3.1	0.114	0.122
G	0.45	1	0.017	0.039
H	20.25	20.75	0.797	0.817
L	4.85	5.25	0.190	0.206
M	3.5	3.7	0.137	0.145
N	20.8	21.2	0.818	0.834
P	40.5	42.5	1.594	1.673
R	19.1	19.9	0.752	0.783
S	22.8	23.6	0.897	0.929
T	2.1	2.3	0.082	0.090
U	4.6 typ.		0.181 typ.	
W	1.88	2.08	0.074	0.081

pin 1: Base - pin 2: Collector - pin 3: Emitter

TOP-3I



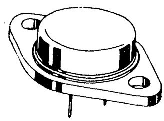
MECHANICAL DATA



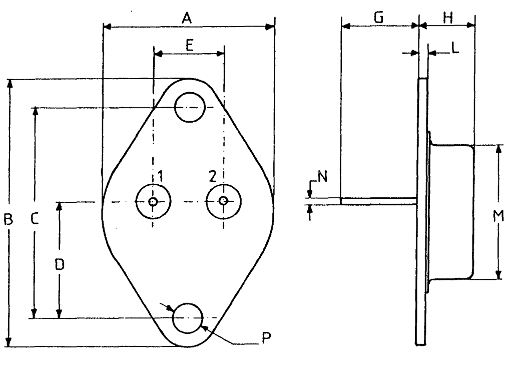
	DIMENSIONS			
	mm		inches	
	min	max	min	max
A	15.2	15.4	0.598	0.606
B	4.4	4.5	0.173	0.177
C	1.45	1.55	0.057	0.061
D	1.2	1.4	0.047	0.055
E	5.5 typ.		0.216 typ.	
G	0.5	—	0.019	—
H	16.1	16.5	0.633	0.649
L	20.7	21.1	0.815	0.830
M	4.1	4.2	0.161	0.165
N	3.4	—	0.133	—
P	15	15.6	0.590	0.614

pin 1: Base - pin 2: Collector - pin 3: Emitter

TO-3



MECHANICAL DATA



	DIMENSIONS			
	mm		inches	
	min	max	min	max
A	25	26	0.984	1.023
B	38.5	39.3	1.515	1.547
C	30	30.3	1.181	1.193
D	16.5	17.2	0.649	0.677
E	10.7	11.1	0.421	0.437
G	11	13.1	0.433	0.515
H	8.32	8.92	0.327	0.351
L	1.5	1.65	0.059	0.065
M	19	20	0.748	0.787
N	0.97	1.15	0.038	0.045
P	4	4.09	0.157	0.161

pin 1: Base - pin 2: Emitter - pin 3: Collector

NOTES

NOTES

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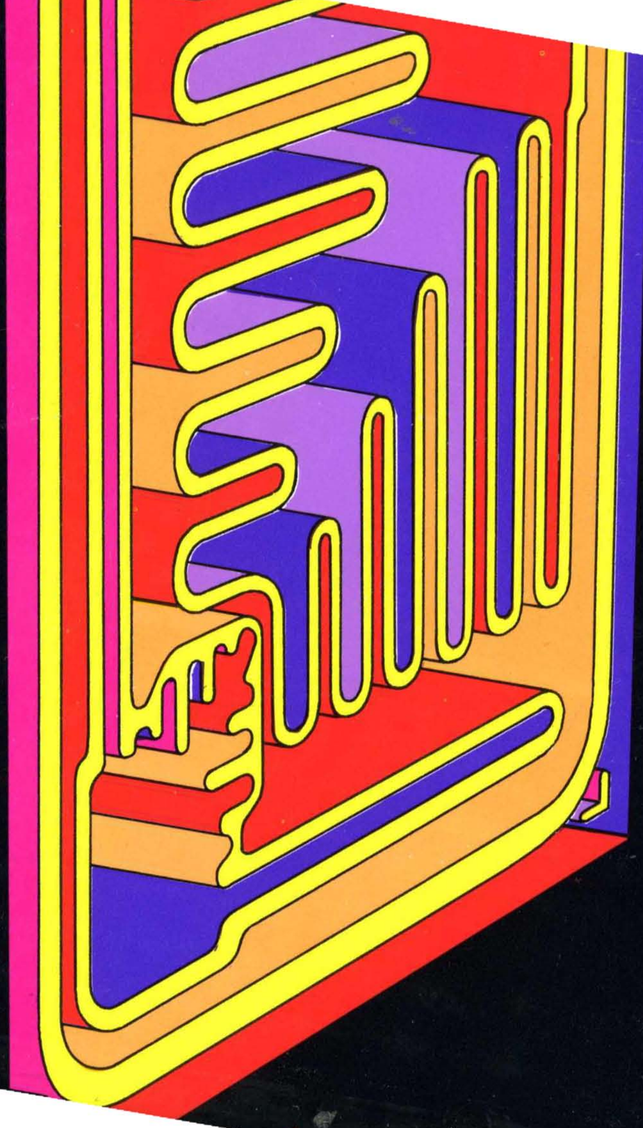

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