DISCRETE POWER DEVICES

6th EDITION

DISCRETE POWER DEVICES

SGS

Technology and Service

DISCRETE POWER DEVICES
6th EDITION
ISSUED OCTOBER 1984

INTRODUCTION

This databook contains data sheets on the SGS-ATES range of discrete power devices for professional, industrial and consumer applications.
Selection guides are provided in the following pages to facilitate rapid identification of the most suitable device for the intended use.
The information on each product has been specially presented in order that the performance of the product can be readily evaluated within any required equipment design.

SGS-ATES GROUP OF COMPANIES

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TABLE OF CONTENTS

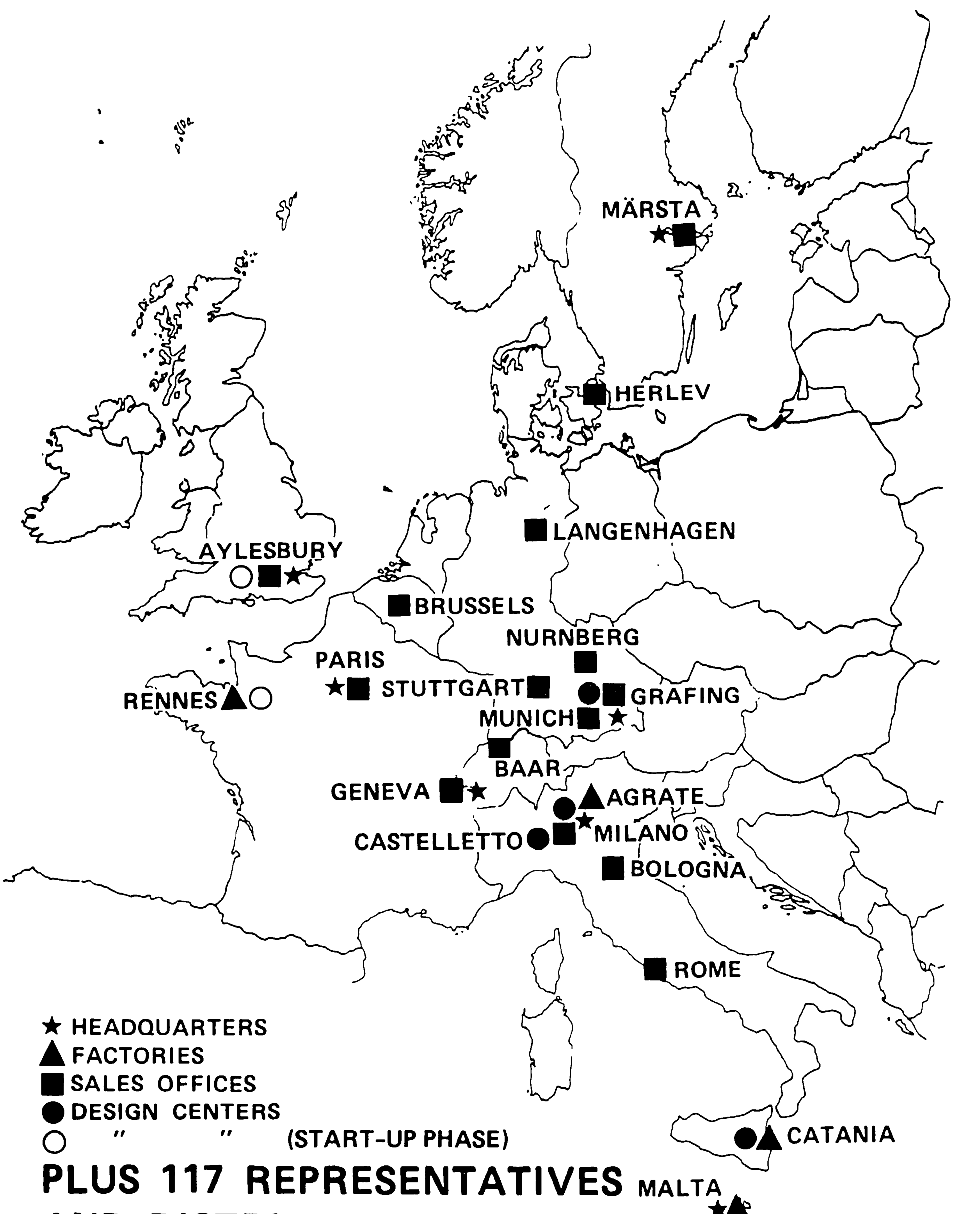
IDENTITY

Late in 1957, SGS was founded around a team of researchers who were already carrying out pioneer work in the field of semiconductors. From that small nucleus, the company has evolved into a Group of Companies, operating on a worldwide basis as a broad range semiconductor producer, with billings well over a quarter billion dollars and employing about 7500 people.

The SGS Group of Companies has now reached a total of 11 subsidiaries, located in Brazil, France, Germany, Italy, Malta, Malaysia, Singapore, Sweden, Switzerland, United Kingdom and the USA.

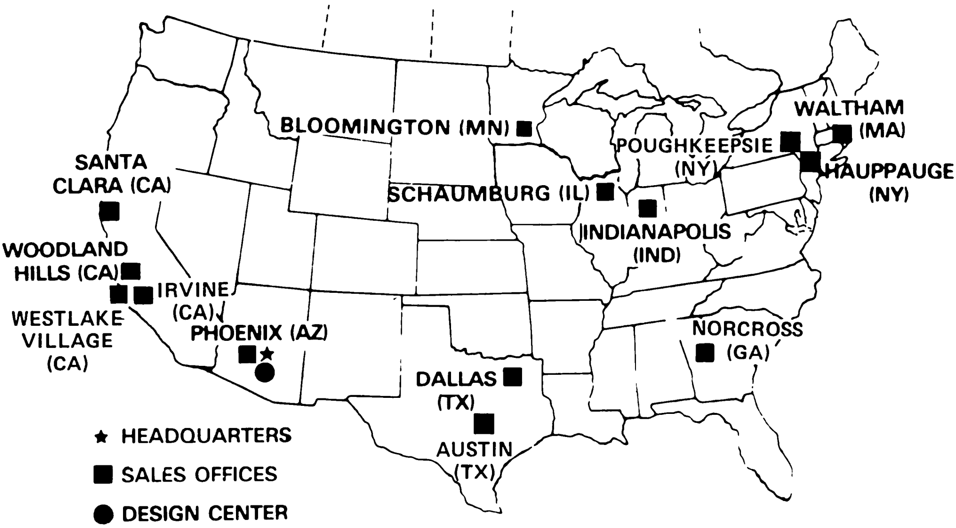
To go with its logo, the company takes the motto "Technology and Service", underlining the accent given to the development of state-of-the-art technologies and the corporate commitment to offer customers the best quality and service in the industry.

SGS-ATES LOCATIONS - EUROPE



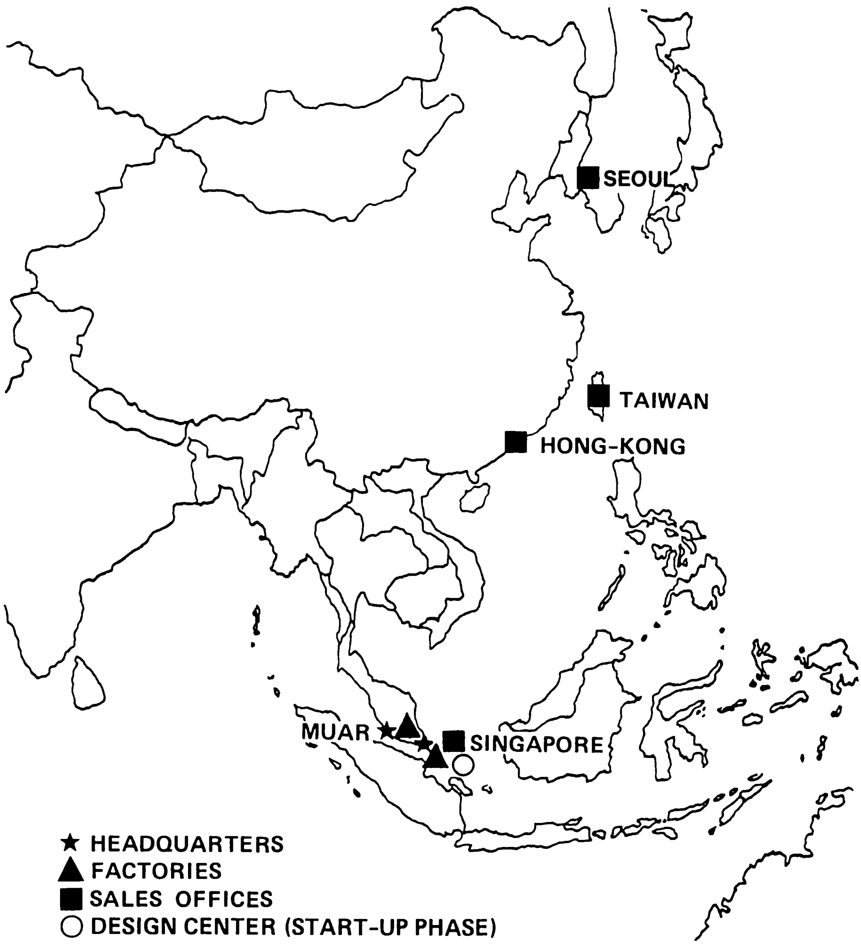
PLUS 117 REPRESENTATIVES AND DISTRIBUTORS

SGS-ATES LOCATIONS
NORTH AMERICA



PLUS 136 REPRESENTATIVES AND DISTRIBUTORS

SGS-ATES LOCATIONS - ASIA/PACIFIC



★ HEADQUARTERS
▲ FACTORIES
■ SALES OFFICES
○ DESIGN CENTER (START-UP PHASE)

PLUS 25 REPRESENTATIVES AND DISTRIBUTORS

ALPHANUMERICAL INDEX

ALPHANUMERICAL INDEX

ALPHANUMERICAL INDEX

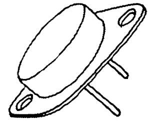
ALPHANUMERICAL INDEX

ALPHANUMERICAL INDEX

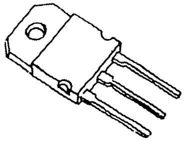
SELECTION GUIDE

SELECTION GUIDE

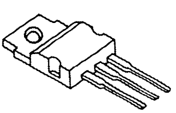
SGS power transistors cover a wide range of technologies optimized for almost every application.
These include epitaxial base (medium voltage, high ruggedness, general purpose) epitaxial planar (high speed with good voltage capability) multiepitaxial planar (high current switching) and multiepitaxial mesa (high voltage-high power switching) and NOW N-channel POWER MOS.
A wide choice of packages are available.
In order to be easy to use following power transistor selector guides cover only a part of the complete range. Other voltage ratings and gain selections shown on the full data sheets are equally available.
Many older devices which are less popular for new designs are also in production. Your nearest SGS sales office or distributor has full details available on request.



TO-3
TO-204



SOT-93
TO-218



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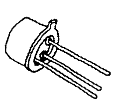

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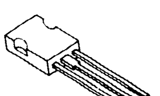

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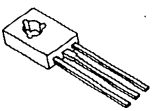


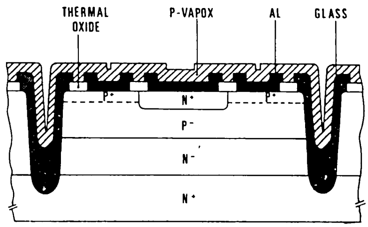
TO-126
SOT-32

SELECTION GUIDE

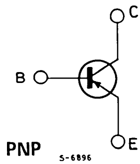
GENERAL PURPOSE

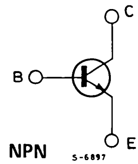
EPITAXIAL BASE - I_{CM} 1 to 3A; V_{CEO} 22 to 100V

NPN and PNP types
(perfect complementary pairs)
Medium V_{CEO} range (22 to 100V)
Medium switching speed
Medium f_T (2 to 20 MHz)
High ruggedness



INTERNAL SCHEMATIC DIAGRAMS





EPITAXIAL BASE

I_C (A)	V_{CBO} (V)	V_{CEO} (V)	P_{tot} (W)	Package	TYPE NPN	TYPE PNP	@ h_{FE} min	I_C (A)	V_{CE} (V)	@ V_{CEsat} max(V)	I_C (A)	I_B (mA)
1	40	40	30	SOT-32	2N4921	2N4918	30	0.5	1	0.6	1	100
1	40	40	30	TO-220	TIP29	TIP30	15	1	4	0.7	1	125
1	60	60	30	SOT-32	2N4922	2N4919	30	0.5	1	0.6	1	100
1	60	60	30	TO-220	TIP29A	TIP30A	15	1	4	0.7	1	125
1	80	80	30	SOT-32	2N4923	2N4920	30	0.5	1	0.6	1	100
1	80	80	30	TO-220	TIP29B	TIP30B	15	1	4	0.7	1	125
1	100	100	30	TO-220	TIP29C	TIP30C	15	1	4	0.7	1	125
2	45	45	25	SOT-32	BD233	BD234	25	1	2	0.6	1	100
2	55	45	30	TO-220	BD239	BD240	15	1	4	0.7	1	200
2	60	60	25	SOT-32	BD235	BD236	25	1	2	0.6	1	100
2	70	60	30	TO-220	BD239A	BD240A	15	1	4	0.7	1	200
2	90	80	30	TO-220	BD239B	BD240B	15	1	4	0.7	1	200
2	100	80	25	SOT-32	BD237	BD238	25	1	2	0.6	1	100
2	115	100	30	TO-220	BD239C	BD240C	15	1	4	0.7	1	200
3	30	30	25	SOT-32	MJE520	MJE370	25	1	1	–	–	–
3	30	30	25	SOT-82	SGS520		25	1	1	–	–	–
3	40	40	40	TO-220	TIP31	TIP32	25	1	4	1.2	3	375
3	45	45	30	SOT-32	BD175	BD176	40	0.15	2	0.8	1	100
3	45	45	30	SOT-32	BD175-10	BD176-10	63	0.15	2	0.8	1	100
3	45	45	30	SOT-32	BD175-16	BD176-16	100	0.15	2	0.8	1	100

SELECTION GUIDE

EPITAXIAL BASE (continued)

I_C (A)	V_{CBO} (V)	V_{CEO} (V)	P_{tot} (W)	Package	TYPE NPN	TYPE PNP	@ h_{FE} min	I_C (A)	V_{CE} (V)	@ V_{CEsat} max(V)	I_C (A)	I_B (mA)
3	45	45	30	SOT-32	BD175-6	BD176-6	40	0.15	2	0.8	1	100
3	55	45	40	TO-220	BD241	BD242	25	1	4	1.2	3	600
3	60	60	30	SOT-32	BD177	BD178	40	0.15	2	0.8	1	100
3	60	60	30	SOT-32	BD177-10	BD178-10	63	0.15	2	0.8	1	100
3	60	60	30	SOT-32	BD177-6	BD178-6	40	0.15	2	0.8	1	100
3	60	60	40	TO-220	TIP31A	TIP32A	25	1	4	1.2	3	375
3	70	60	40	TO-220	BD241A	BD242A	25	1	4	1.2	3	600
3	80	80	30	SOT-32	BD179	BD180	40	0.15	2	0.8	1	100
3	80	80	30	SOT-32	BD179-10	BD180-10	63	0.15	2	0.8	1	100
3	80	80	30	SOT-32	BD179-6	BD180-6	40	0.15	2	0.8	1	100
3	80	80	40	TO-220	TIP31B	TIP32B	25	1	4	1.2	3	375
3	90	80	40	TO-220	BD241B	BD242B	25	1	4	1.2	3	600
3	100	100	40	TO-220	TIP31C	TIP32C	25	1	4	1.2	3	375
3	115	100	40	TO-220	BD241C	BD242C	25	1	4	1.2	3	600
4	22	22	36	SOT-32	BD433	BD434	50	2	1	0.5	2	200
4	32	32	36	SOT-32	BD435	BD436	50	2	1	0.5	2	200
4	40	40	40	SOT-32	MJE521	MJE371	40	1	1	–	–	–
4	40	40	40	SOT-32	2N5190	2N5193	25	1.5	2	0.6	1.5	150
4	45	45	36	SOT-32	BD437	BD438	40	2	1	0.6	2	200
4	45	45	40	TO-220	2N6121	2N6124	25	1	2	0.6	1.5	150
4	60	60	36	SOT-32	BD439	BD440	25	2	1	0.8	2	200
4	60	60	40	SOT-32	2N5191	2N5194	25	1.5	2	0.6	1.5	150
4	60	60	40	TO-220	2N6122	2N6125	25	1.5	2	0.6	1.5	150
4	80	80	36	SOT-32	BD441	BD442	15	2	1	0.8	2	200
4	80	80	40	SOT-32	2N5192	2N5195	20	1.5	2	0.6	1.5	150
4	80	80	40	TO-220	2N6123	2N6126	20	1.5	2	0.6	1.5	150
5	40	25	15	SOT-32	MJE200	MJE210	70	0.5	1	0.3	0.5	50
6	40	40	65	TO-220	TIP41	TIP42	15	3	4	1.5	6	600
6	45	45	65	TO-220	BD243	BD244	15	3	4	1.5	6	1000
6	60	60	65	TO-220	BD243A	BD244A	15	3	4	1.5	6	1000
6	60	60	65	TO-220	TIP41A	TIP42A	15	3	4	1.5	6	600
6	80	80	65	TO-220	BD243B	BD244B	15	3	4	1.5	6	1000
6	80	80	65	TO-220	TIP41B	TIP42B	15	3	4	1.5	6	600
6	100	100	65	TO-220	BD243C	BD244C	15	3	4	1.5	6	1000
6	100	100	65	TO-220	TIP41C	TIP42C	15	3	4	1.5	6	600
7	40	30	40	TO-220	2N6288	2N6111	30	4	3	1	3	300
7	60	50	40	TO-220	2N6290	2N6109	30	4	2.5	1	2.5	250
7	80	70	40	TO-220	2N6292	2N6107	30	4	2	1	2	200
8	45	45	50	TO-220	BD533	BD534	25	2	2	0.8	2	200
8	60	60	50	TO-220	BD535	BD536	25	2	2	0.8	2	200
8	80	80	50	TO-220	BD537	BD538	15	2	2	0.8	2	200

SELECTION GUIDE

EPITAXIAL BASE (continued)

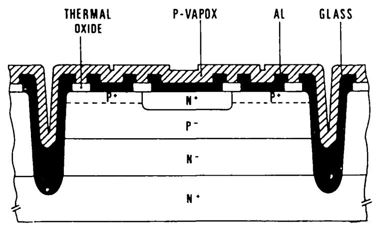
I_C (A)	V_{CBO} (V)	V_{CEO} (V)	P_{tot} (W)	Package	TYPE NPN	TYPE PNP	h_{FE} min	@ I_C (A)	V_{CE} (V)	V_{CEsat} max (V)	@ I_C (A)	I_B (mA)
10	60	60	150	TO-3	2N5877	2N5875	20	4	4	1	5	500
10	70	60	75	TO-220	MJE3055T	MJE2955T	20	4	4	1.1	4	400
10	80	60	150	TO-3	2N3715	2N3791	30	3	2	0.8	5	500
10	80	80	150	TO-3	2N5878	2N5876	20	4	4	1	5	500
10	100	80	150	TO-3	2N3716	2N3792	30	3	2	0.8	5	500
12	45	45	75	TO-220	BD705	BD706	20	4	4	1	4	400
12	60	60	75	TO-220	BD707	BD708	15	4	4	1	4	400
12	80	80	75	TO-220	BD709	BD710	15	4	4	1	4	400
12	100	100	75	TO-220	BD711	BD712	15	4	4	1	4	400
15	50	40	150	TO-3	2N3771		15	15	4	1.4	10	1000
15	45	45	90	TO-220	BD905	BD906	15	5	4	1	5	500
15	45	45	125	TO-3	BDW51	BDW52	20	5	4	1	5	500
15	50	50	75	TO-220	2N6486	2N6489	20	5	4	1.3	5	500
15	60	60	100	TO-220	BD907	BD908	15	5	4	1	5	500
15	60	60	125	TO-3	BDW51A	BDW52A	20	5	4	1	5	500
15	70	60	90	SOT-93	TIP3055	TIP2955	20	4	4	1.1	4	400
15	100	60	115	TO-3	2N3055	MJ2955	20	4	4	1.1	4	400
15	100	60	150	TO-3	2N3772		15	10	4	2	15	1500
15	100	60	150	TO-3	SGS3055		20	4	4	1	5	500
15	70	70	75	TO-220	2N6487	2N6490	20	5	4	1.3	5	500
15	80	80	90	TO-220	BD909	BD910	15	5	4	1	5	500
15	80	80	125	TO-3	BDW51B	BDW52B	20	5	4	1	5	500
15	90	90	75	TO-220	2N6488	2N6491	20	5	4	1.3	5	500
15	100	100	90	TO-220	BD911	BD912	15	5	4	1	5	500
15	100	100	125	TO-3	BDW51C	BDW52C	20	5	4	1	5	500
16	100	100	200	TO-3	2N5629	2N6029	25	8	2	1	10	1000
20	80	80	200	TO-3	2N5303	2N5745	40	1	2	1	10	1000
25	60	60	125	SOT-93	TIP35A	TIP36A	25	1.5	4	1.8	15	1500
25	60	60	200	TO-3	2N5885	2N5883	35	3	4	1	15	1500
25	80	80	125	SOT-93	TIP35B	TIP36B	25	1.5	4	1.8	15	1500
25	80	80	130	SOT-93	SGSD110	SGSD210	15	5	4	1.5	16	2000
25	80	80	200	TO-3	2N5886	2N5884	35	3	4	1	15	1500
25	100	100	125	SOT-93	TIP35C	TIP36C	25	1.5	4	1.8	15	1500
30	40	40	200	TO-3	2N5301	2N4398	40	1	2	0.75	10	1000
30	60	60	200	TO-3	2N5302	2N4399	40	1	2	0.75	10	1000
30	100	90	200	TO-3	MJ802	MJ4502	25	7.5	2	0.8	7.5	750

SELECTION GUIDE

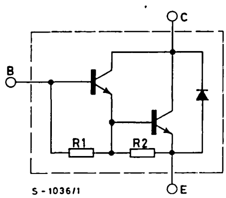
HIGH GAIN GENERAL PURPOSE

EPITAXIAL BASE - I_{CM} 2 to 30A; V_{CE} 45 to 180V

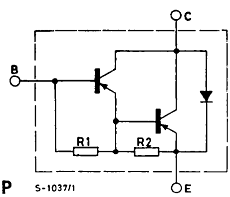
NPN and PNP types
Medium V_{CEO} range (45 to 180V)
Medium Switching speed
Medium f_T (2 to 20 MHz)
High ruggedness
Monolithic Darlingtons



INTERNAL SCHEMATIC DIAGRAMS



NPN



PNP

EPITAXIAL BASE

I_C (A)	V_{CBO} (V)	V_{CEO} (V)	P_{tot} (W)	Package	TYPE NPN	TYPE PNP	h_{FE} min	@ I_C (A)	@ V_{CE} (V)	V_{CEsat} max (V)	@ I_C (A)	@ I_B (mA)
2	45	45	40	SOT-32	BD675	BD676	750	1.5	3	2.5	1.5	30
2	60	60	50	SOT-82	SGS110	SGS115	1000	1	4	2.5	2	8
2	60	60	50	TO-220	TIP110	TIP115	1000	1	4	2.5	2	8
2	80	80	50	SOT-82	SGS111	SGS116	1000	1	4	2.5	2	8
2	80	80	50	TO-220	TIP111	TIP116	1000	1	4	2.5	2	8
2	100	100	50	SOT-82	SGS112	SGS117	1000	1	4	2.5	2	8
2	100	100	50	TO-220	TIP112	TIP117	1000	1	4	2.5	2	8
4	40	40	40	SOT-32	2N6037	2N6034	500	0.5	3	2	2	8
4	45	45	40	SOT-32	BD675A	DB676A	750	2	3	2.8	2	40
4	60	60	40	SOT-32	2N6038	2N6035	500	0.5	3	2	2	8
4	60	60	40	SOT-32	BD677	BD678	750	1.5	3	2.5	1.5	30
4	60	60	40	SOT-32	BD677A	BD678A	750	2	3	2.8	2	40
4	60	60	40	SOT-32	MJE800	MJE700	100	4	3	3	4	40
4	60	60	40	SOT-32	MJE801	MJE701	100	4	3	3	4	40
4	80	80	40	SPT-32	2N6039	2N6036	500	0.5	3	2	2	8

SELECTION GUIDE

EPITAXIAL BASE (continued)

I_C (A)	V_{CBO} (V)	V_{CEO} (V)	P_{tot} (W)	Package	TYPE NPN	TYPE PNP	h_{FE} min	@ I_C (A)	@ V_{CE} (V)	V_{CEsat} max (V)	@ I_C (A)	I_B (mA)
4	80	80	40	SOT-32	BD679	BD680	750	1.5	3	2.5	1.5	30
4	80	80	40	SOT-32	BD679A	BD680A	750	2	3	2.8	2	40
4	80	80	40	SOT-32	MJE802	MJE702	100	4	3	3	4	40
4	80	80	40	SOT-32	MJE803	MJE703	100	4	3	3	4	40
4	100	100	40	SOT-32	BD681	BD682	750	1.5	3	2.5	1.5	30
4	180	180	10	TO-39	BDW91	BDW92	1000	2	5	2	2	4
5	60	60	65	SOT-82	SGS120	SGS125	1000	3	3	2	3	12
5	60	60	65	TO-220	TIP120	TIP125	1000	3	3	2	3	12
5	80	80	65	SOT-82	SGS121	SGS126	1000	3	3	2	3	12
5	80	80	65	TO-220	TIP121	TIP126	1000	3	3	2	3	12
5	100	100	65	SOT-82	SGS122	SGS127	1000	3	3	2	3	12
5	100	100	65	TO-220	TIP122	TIP127	1000	3	3	2	3	12
6	45	45	50	TO-220	BDW23	BDW24	750	2	3	2	2	8
6	60	60	50	TO-220	BDW23A	BDW24A	750	2	3	2	2	8
6	60	60	60	SOT-82	BD331	BD332	750	3	3	2	3	12
6	80	80	50	TO-220	BDW23B	BDW24B	750	2	3	2	2	8
6	80	80	60	SOT-82	BD333	BD334	750	3	3	2	3	12
6	100	100	50	TO-220	BDW23C	BDW24C	750	2	3	2	2	8
6	100	100	60	SOT-82	BD335	BD336	750	3	3	2	3	12
6	140	140	60	TO-220	BDX53E	BDX54E	500	2	5	2	2	10
6	150	150	15	TO-39	BDX53S	BDX54S	500	2	5	2	2	8
6	160	160	60	TO-220	BDX53F	BDX54F	500	2	5	2	2	10
8	40	40	65	TO-220	2N6386		1000	3	3	2	3	6
8	40	40	65	SOT-82	SGS6386		1000	3	3	2	3	6
8	45	45	60	TO-220	BDX53	BDX54	750	3	3	2	3	12
8	60	60	60	TO-220	BDX53A	BDX54A	750	3	3	2	3	12
8	60	60	65	SOT-82	SGS130	SGS135	1000	4	4	2	4	16
8	60	60	70	TO-220	TIP130	TIP135	1000	4	4	2	4	16
8	60	60	75	TO-220	2N6043	2N6040	1000	4	4	2	4	16
8	60	60	80	TO-220	TIP100	TIP105	1000	3	4	2	3	6
8	60	60	90	TO-3	MJ1000	MJ900	1000	3	3	2	3	12
8	80	80	60	TO-220	BDX53B	BDX54B	750	3	3	2	3	12
8	80	80	65	SOT-82	SGS131	SGS136	1000	4	4	2	4	16
8	80	80	70	TO-220	TIP131	TIP136	1000	4	4	2	4	16
8	80	80	75	TO-220	2N6044	2N6041	1000	4	4	2	4	16
8	80	80	80	TO-220	TIP101	TIP106	1000	3	4	2	3	6
8	80	80	90	TO-3	MJ1001	MJ901	1000	3	3	2	3	12
8	100	100	60	TO-220	BDX53C	BDX54C	750	3	3	2	3	12
8	100	100	65	SOT-82	SGS132	SGS137	1000	4	4	2	4	16
8	100	100	70	TO-220	TIP132	TIP137	1000	4	4	2	4	16
8	100	100	75	TO-220	2N6045	2N6042	1000	3	4	2	3	12
8	100	100	80	TO-220	TIP102	TIP107	1000	3	4	2	3	6

SELECTION GUIDE

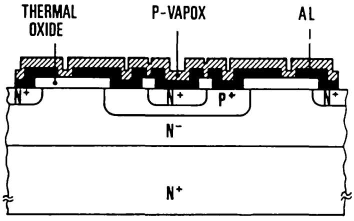
EPITAXIAL BASE (continued)

I_C (A)	V_{CBO} (V)	V_{CEO} (V)	P_{tot} (W)	Package	TYPE NPN	TYPE PNP	h_{FE} min	@ I_C (A)	V_{CE} (V)	V_{CEsat} max (V)	@ I_C (A)	I_B (mA)
10	45	45	70	TO-220	BDX33	BDX34	750	4	3	2.5	4	8
10	45	45	100	TO-3	BDX85	BDX86	1000	3	3	2	4	16
10	60	60	65	TO-220	2N6387		1000	5	3	2	5	10
10	60	60	65	SOT-82	SGS6387		1000	5	3	2	5	10
10	60	60	70	TO-220	BDX33A	BDX34A	750	4	3	2.5	4	8
10	60	60	100	TO-3	BDX85A	BDX86A	1000	3	3	2	4	16
10	60	60	125	SOT-93	TIP140	TIP145	1000	5	4	3	10	40
10	60	60	150	TO-3	MJ3000	MJ2500	1000	5	3	2	5	20
10	80	80	100	TO-3	BDX85B	BDX86B	1000	3	3	2	4	16
10	80	80	65	TO-220	2N6388		1000	5	3	2	5	10
10	80	80	65	SOT-82	SGS6388		1000	5	3	2	5	10
10	80	80	70	TO-220	BDX33B	BDX34B	750	3	3	2.5	3	6
10	80	80	125	SOT-93	TIP141	TIP146	1000	5	4	3	10	40
10	80	80	150	TO-3	MJ3001	MJ2501	1000	5	3	2	5	20
10	100	100	70	TO-220	BDX33C	BDX34C	750	3	3	2.5	3	6
10	100	100	100	TO-3	BDX85C	BDX86C	1000	3	3	2	4	16
10	100	100	125	SOT-93	TIP142	TIP147	1000	5	4	3	10	40
12	45	45	80	TO-220	BDW93	BDW94	750	5	3	2	5	20
12	45	45	120	TO-3	BDX87	BDX88	1000	5	3	2	6	24
12	60	60	80	TO-220	BDW93A	BDW94A	750	5	3	2	5	20
12	60	60	120	TO-3	BDX87A	BDX88A	1000	5	3	2	6	24
12	60	60	125	SOT-93	BDV65	BDV64	1000	5	4	2	5	20
12	80	80	80	TO-220	BDW93B	BDW94B	750	5	3	2	5	20
12	80	80	120	TO-3	BDX87B	BDX88B	1000	5	3	2	6	24
12	80	80	125	SOT-93	BDV65A	BDV64A	1000	5	4	2	5	20
12	100	100	80	TO-220	BDW93C	BDW94C	750	5	3	2	5	20
12	100	100	120	TO-3	BDX87C	BDX88C	1000	5	3	2	6	24
12	100	100	125	SOT-93	BDV65B	BDV64B	1000	5	4	2	5	20
16	60	60	150	TO-3	MJ4033	MJ4030	1000	10	3	4	16	80
16	80	80	150	TO-3	MJ4034	MJ4031	1000	10	3	4	16	80
16	100	100	150	TO-3	MJ4035	MJ4032	1000	10	3	4	16	80
20	60	60	160	TO-3	2N6282	2N6285	750	10	3	3	20	200
20	80	80	160	TO-3	2N6283	2N6286	750	10	3	3	20	200
20	100	100	160	TO-3	2N6284	2N6287	750	10	3	3	20	200
25	80	80	130	SOT-93	SGSD100	SGSD200	300	20	3	1.75	10	40
30	60	60	200	TO-3	MJ11012	MJ11011	1000	20	5	4	30	300
30	90	90	200	TO-3	MJ11014	MJ11013	1000	20	5	4	30	300
30	120	120	200	TO-3	MJ11016	MJ11015	1000	20	5	4	30	300

SELECTION GUIDE

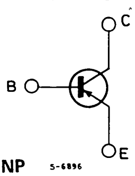
LOW POWER FAST SWITCHING

EPITAXIAL PLANAR - I_{CM} 0.3 to 10A; V_{CEO} 40 to 350V

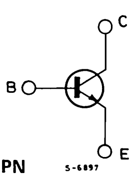


NPN and PNP types
Good voltage capability (V_{CES} up to 450V)
Low saturation voltage
Low leakage
Very high f_T (up to 100 MHz)
Very high speed
Moderate ruggedness
Total base-collector passivation

INTERNAL SCHEMATIC DIAGRAMS



PNP S-6896



NPN S-6897

EPITAXIAL PLANAR

I_C (A)	V_{CBO} (V)	V_{CEO} (V)	P_{tot} (W)	Package	TYPE NPN	TYPE PNP	@ h_{FE} min	@ I_C (A)	@ V_{CE} (V)	@ V_{CEsat} max (V)	@ I_C (A)	@ I_B (mA)
0.3	350	250	15	SOT-32	MJE3440		30	0.002	10	0.5	0.05	4
0.3	350	250	15	SOT-82	SGS3440		30	0.002	10	0.5	0.05	4
0.3	450	350	15	SOT-32	MJE3439		30	0.002	10	0.5	0.05	4
0.3	450	350	15	SOT-82	SGS3439		30	0.002	10	0.5	0.05	4
0.5	275	250	20	SOT-32	2N5655		25	0.05	10	1	0.1	10
0.5	275	250	20	SOT-32	BD157		30	0.05	10	–	–	–
0.5	275	250	20	SOT-82	SGS157		30	0.05	10	–	–	–
0.5	300	300	20	SOT-32	MJE340	MJE350	30	0.05	10	–	–	–
0.5	300	300	20	SOT-82	SGS340	SGS350	30	0.05	10	–	–	–
0.5	325	300	20	SOT-32	2N5656		25	0.05	10	1	0.1	10
0.5	325	300	20	SOT-32	BD158		30	0.05	10	–	–	–
0.5	325	300	20	SOT-82	SGS158		30	0.05	10	–	–	–
0.5	375	350	20	SOT-32	2N5657		25	0.05	10	1	0.1	10
0.5	375	350	20	SOT-32	BD159		30	0.05	10	–	–	–
0.5	375	350	20	SOT-82	SGS159		30	0.05	10	–	–	–

SELECTION GUIDE

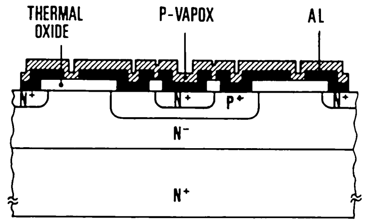
EPITAXIAL PLANAR (continued)

I_C (A)	V_{CBO} (V)	V_{CEO} (V)	P_{tot} (W)	Package	TYPE		@			@		
					NPN	PNP	h_{FE} min	I_C (A)	V_{CE} (V)	V_{CEsat} max (V)	I_C (A)	I_B (mA)
1	45	45	12	SOT-32	BD135	BD136	40	0.15	2	0.5	0.5	50
1	45	45	12	SOT-32	BD135-10	BD136-10	63	0.15	2	0.5	0.5	50
1	45	45	12	SOT-32	BD135-16	BD136-16	100	0.15	2	0.5	0.5	50
1	45	45	12	SOT-32	BD135-6	BD136-6	40	0.15	2	0.5	0.5	50
1	60	60	12	SOT-32	BD137	BD138	40	0.15	2	0.5	0.5	50
1	60	60	12	SOT-32	BD137-10	BD138-10	63	0.15	2	0.5	0.5	50
1	60	60	12	SOT-32	BD137-6	BD138-6	40	0.15	2	0.5	0.5	50
1	80	80	12	SOT-32	BD139	BD140	40	0.15	2	0.5	0.5	50
1	80	80	12	SOT-32	BD139-10	BD140-10	63	0.15	2	0.5	0.5	50
1	80	80	12	SOT-32	BD139-6	BD140-6	40	0.15	2	0.5	0.5	50
1	120	120	10	TO-39	2N5682	2N5680	40	0.25	2	1	0.5	50
1	200	200	10	TO-39		2N5415	30	0.05	10	2.5	0.05	5
1	300	250	10	TO-39	2N3440		40	0.02	10	0.5	0.05	4
1	350	300	10	TO-39		2N5416	30	0.05	10	2.5	0.05	5
1	450	350	10	TO-39	2N3439		40	0.02	10	0.5	0.05	4
1.5	120	120	5	TO-39	BSW67		15	1	5	1	1	150
1.5	150	150	5	TO-39	BSW68		15	1	5	1	1	150
2	50	45	25	SOT-32	BD375	BD376	40	0.15	2	1	1	100
2	75	60	25	SOT-32	BD377	BD378	40	0.15	2	1	1	100
2	100	80	25	SOT-32	BD379	BD380	40	0.15	2	1	1	100
3	40	40	6	TO-39		2N4234	30	0.25	1	0.6	1	125
3	60	40	12	SOT-32	MJE180	MJE170	30	0.5	1	0.3	0.5	50
3	80	60	12	SOT-32	MJE181	MJE171	50	0.1	1	0.3	0.5	50
3	100	80	12	SOT-32	MJE182	MJE172	50	0.1	1	0.3	0.5	50
3	250	150	10	TO-39	BU125S		30	0.25	3	1.5	0.5	50
3	250	200	10	TO-39	BUY49S		40	0.5	5	0.2	0.5	50
5	65	60	5	TO-39		BSS44	40	2	2	1	5	500
5	100	60	5	TO-39	BFX34		40	2	2	1	5	500
5	100	80	12	TO-39	2N5154	2N5153	70	2.5	5	0.7	2.5	250
5	150	80	7	TO-39	2N4897		40	2	2	1	5	500
5	100	100	6	TO-39	2N5338		20	5	2	1.2	5	500
5	100	100	6	TO-39	2N5339		40	5	2	1.2	5	500
7	100	60	10	TO-39	BUY68		40	1	1	1	5	500
7	130	60	10	TO-39	BU125		15	5	2	1	5	500
7	150	120	10	TO-39	BUY47		15	5	5	1	5	500
7	200	170	10	TO-39	BUY48		15	5	5	1	5	500
10	80	60	60	TO-3	BDY92		20	10	5	0.5	5	500
10	100	80	60	TO-3	BDY91		20	10	5	0.5	5	500
10	120	120	60	TO-3	BDY90		20	10	5	0.5	5	500

SELECTION GUIDE

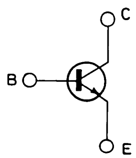
DEFLECTION CIRCUITS

EPITAXIAL PLANAR - I_{CM} 7 to 8A; V_{CEO} 150 to 200V

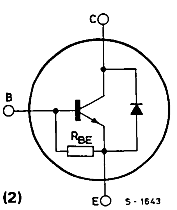


NPN types
Good voltage capability (V_{CES} up to 400V)
Low saturation voltage
Low leakage
Very high f_T (up to 100 MHz)
Very high speed
Moderate ruggedness
Total base-collector passivation

INTERNAL SCHEMATIC DIAGRAMS

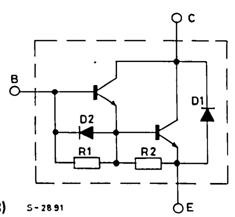


(1) S-6897



(2) S-1643

NPN TRANSISTOR



(3) S-2891

NPN DARLINGTON

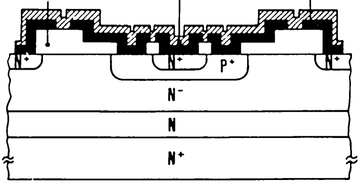
EPITAXIAL PLANAR (NPN)

I_C (A)	V_{CBO} (V)	V_{CEO} (V)	P_{tot} (W)	Package	TYPE	h_{FE} (min) @	I_C (A)	V_{CE} (V)	V_{CEsat} max (V) @	I_C (A)	I_B (mA)
7	330	150	60	TO-220	**BU407** (1)	10	5	1	1	5	500
7	400	200	60	TO-220	**BU406** (1)	10	5	1	1	5	500
7	400	200	60	TO-220	**BU408** (1)	5	5	1	1	6	1200
7	330	150	60	TO-220	**BU407D** (2)	8	5	1	1	5	650
7	400	200	60	TO-220	**BU406D** (2)	8	5	1	1	5	650
7	400	200	60	TO-220	**BU408D** (2)	5	5	1	1	6	1200
8	330	150	60	TO-220	**BU807** (3)	100	5	2	1.5	5	50
8	400	200	60	TO-220	**BU806** (3)	100	5	2	1.5	5	50

SELECTION GUIDE

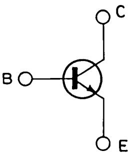
HIGH POWER FAST SWITCHING

MULTIEPITAXIAL PLANAR - I_{CM} 1 to 70A; V_{CEO} 30 to 400V



NPN types
I_C range up to 70A
Good h_{FE} linearity
Very low leakage
High switching speed
High $E_{s/b}$ capability
Total base-collector passivation

INTERNAL SCHEMATIC DIAGRAM



S-6897

MULTIPEPITAXIAL PLANAR (NPN)

I_C (A)	V_{CBO} (V)	V_{CEO} (V)	P_{tot} (W)	Package	TYPE	h_{FE} (min)	@ I_C (A)	V_{CE} (V)	V_{CEsat} max (V)	@ I_C (A)	I_B (mA)
1	350	250	40	TO-220	**TIP47**	10	1	10	1	1	200
1	400	300	40	TO-220	**TIP48**	10	1	10	1	1	200
1	450	350	40	TO-220	**TIP49**	10	1	10	1	1	200
1	500	400	40	TO-220	**TIP50**	10	1	10	1	1	200
3	200	200	25	SOT-32	**BU325**	30	0.5	5	1.5	0.5	50
3	250	200	15	SOT-32	**BUY49P**	40	0.5	5	0.2	0.5	50
4	40	30	30	TO-220	**D44C1**	25	0.2	1	0.5	1	100
4	40	30	30	TO-220	**D44C2**	100	0.2	1	0.5	1	50
4	40	30	30	TO-220	**D44C3**	40	0.2	1	0.5	1	50
4	55	45	30	TO-220	**D44C4**	25	0.2	1	0.5	1	100
4	55	45	30	TO-220	**D44C5**	100	0.2	1	0.5	1	50
4	55	45	30	TO-220	**D44C6**	40	0.2	1	0.5	1	50
4	70	60	30	TO-220	**D44C7**	25	0.2	1	0.5	1	100
4	70	60	30	TO-220	**D44C8**	100	0.2	1	0.5	1	50
4	70	60	30	TO-220	**D44C9**	40	0.2	1	0.5	1	50
4	90	80	30	TO-220	**D44C10**	25	0.2	1	0.5	1	100
4	90	80	30	TO-220	**D44C11**	100	0.2	1	0.5	1	50
4	90	80	30	TO-220	**D44C12**	40	0.2	1	0.5	1	50
4	200	125	31	TO-220	**D44Q1**	30	0.2	10	1	2	200
4	250	175	31	TO-220	**D44Q3**	30	0.2	10	1	2	200
4	300	225	31	TO-220	**D44Q5**	30	0.2	10	1	2	200

SELECTION GUIDE

MULTIEPITAXIAL PLANAR (continued)

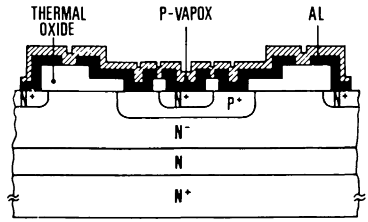
I_C (A)	V_{CBO} (V)	V_{CEO} (V)	P_{tot} (W)	Package	TYPE	h_{FE} (min)	@ I_C (A)	V_{CE} (V)	V_{CEsat} max (V)	@ I_C (A)	I_B (mA)
7	140	90	50	TO-220	2N6702	20	5	2	0.8	5	500
10	30	30	50	TO-220	D44H1	35	2	1	1	8	800
10	30	30	50	TO-220	D44H2	60	2	1	1	8	400
10	45	45	50	TO-220	D44H4	35	2	1	1	8	800
10	45	45	50	TO-220	D44H5	60	2	1	1	8	400
10	60	60	50	TO-220	D44H7	35	2	1	1	8	800
10	60	60	50	TO-220	D44H8	60	2	1	1	8	400
10	80	80	50	TO-220	D44H10	35	2	1	1	8	800
10	80	80	50	TO-220	D44H11	60	2	1	1	8	400
12	300	250	120	TO-3	BUX42	8	6	4	1.2	4	400
15	250	200	120	TO-3	BUX41	8	8	4	1.2	4	400
18	220	160	120	TO-3	BUX41N	8	12	4	1.2	8	800
20	120	75	140	TO-3	2N5039	20	10	5	1	10	1000
20	160	90	140	TO-3	2N5038	20	12	5	1	12	1200
20	160	125	120	TO-3	BUX40	8	15	4	1.2	10	1000
20	220	160	150	TO-3	BUX11N	10	15	4	0.6	8	800
20	250	200	150	TO-3	BUX11	10	12	4	0.6	6	600
20	300	250	150	TO-3	BUX12	10	10	4	1	5	500
25	120	80	175	TO-3	BDY57	20	10	4	1.4	10	1000
25	160	125	106	SOT-93	BUX10P	10	20	4	0.6	10	1000
25	160	125	150	TO-3	BUX10	10	20	4	0.6	10	1000
25	160	125	175	TO-3	BDY58	20	10	4	1.4	10	1000
25	160	140	106	SOT-93	BU999	12	25	2	0.8	10	1000
30	120	90	140	TO-3	2N5671	20	15	2	0.75	15	1200
30	150	120	140	TO-3	2N5672	20	15	2	0.75	15	1200
40	150	120	140	TO-3	2N6033	10	40	2	1	40	4000
40	250	200	250	TO-3	BUV21	10	25	4	0.6	12	1200
40	300	200	250	TO-3	BUR21	10	25	4	0.6	12	1200
40	300	250	250	TO-3	BUV22	10	20	4	1	10	1000
40	300	250	350	TO-3	BUX22	10	20	4	1	10	1000
40	350	250	250	TO-3	BUR22	10	20	4	1	10	1000
50	120	90	140	TO-3	2N6032	10	50	2.6	1.3	50	5000
50	160	125	250	TO-3	BUV20	10	50	4	0.6	25	2500
50	200	125	250	TO-3	BUR20	10	50	4	1	25	2000
60	300	200	350	TO-3	BUR51	15	50	4	1	30	2000
60	350	250	350	TO-3	BUR52	15	40	4	1.8	25	2000
70	200	125	350	TO-3	BUR50	15	50	4	1	35	2000
70	200	125	350	TO-3	BUR50S	15	50	4	1	35	2000

SELECTION GUIDE

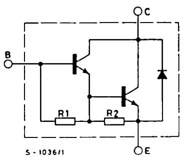
AUTOMOTIVE IGNITION

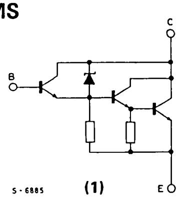
MULTIEPITAXIAL PLANAR - I_{CM} 6 to 15A; V_{CEO} 350 to 450V

NPN types
I_C range up to 15A
Good h_{FE} linearity
Very low leakage
High switching speed
High $E_{s/b}$ capability
Total base collector passivation



INTERNAL SCHEMATIC DIAGRAMS





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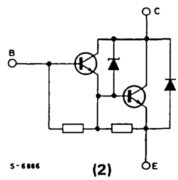


(2)

MULTIEPITAXIAL PLANAR (NPN)

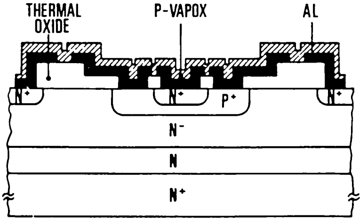
I_C (A)	V_{CBO} (V)	V_{CEO} (V)	P_{tot} (W)	Package	TYPE	h_{FE} (min)	@ I_C (A)	V_{CE} (V)	V_{CEsat} max (V)	@ I_C (A)	I_B (mA)
6	400	350	60	TO-220	BU910	20	4	1.8	1.8	2.5	50
6	400	350	60	SOT-82	SGS910	20	4	1.8	1.8	2.5	50
6	450	400	60	TO-220	BU911	20	4	1.8	1.8	2.5	50
6	450	400	60	SOT-82	SGS911	20	4	1.8	1.8	2.5	50
6	500	450	60	TO-220	BU912	20	4	1.8	1.8	2	50
6	500	450	60	SOT-82	SGS912	20	4	1.8	1.8	2	50
8	650	400	70	TO-220	SGSD00020 (1)	7000	1	5	4	3	3
10	400	350	105	SOT-93	BU920P	50	7	1.8	1.8	5	50
10	450	400	105	SOT-93	BU921P	50	7	1.8	1.8	5	50
10	500	450	105	SOT-93	BU922P	50	7	1.8	1.8	5	50
10	400	350	125	TO-3	BU920	50	7	1.8	1.8	5	50
10	450	400	125	TO-3	BU921	50	7	1.8	1.8	5	50
10	500	450	125	TO-3	BU922	50	7	1.8	1.8	5	50
15	350	350	150	SOT-93	BU930ZP (2)	80	8	1.8	2	10	150
15	350	350	175	TO-3	BU930Z (2)	80	8	1.8	2	10	150
15	400	350	105	SOT-93	BU930P	40	10	1.8	1.8	8	100
15	450	400	105	SOT-93	BU931P	40	10	1.8	1.8	8	100
15	450	400	125	SOT-93	BU931RP	40	10	1.8	1.6	7	70
15	500	450	105	SOT-93	BU932P	53	8	1.8	1.8	8	150
15	400	350	150	TO-3	BU930	40	10	1.8	1.8	8	100
15	450	400	150	TO-3	BU931	40	10	1.8	1.8	8	100
15	450	400	150	TO-3	BU931R	40	10	1.8	1.6	7	70
15	500	450	150	TO-3	BU932	53	8	1.8	1.8	8	150

SELECTION GUIDE

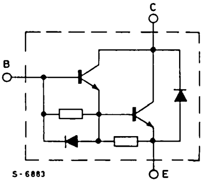
HIGH VOLTAGE FAST SWITCHING

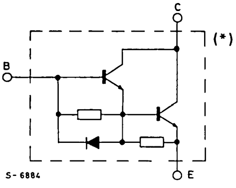
MULTIEPITAXIAL PLANAR - I_{CM} 2 to 28A; V_{CEO} 350 to 400V

NPN types
I_C range up to 28A
Monolithic speed-up diode
Very low leakage
High switching speed
High $E_{s/b}$ capability
Total base-collector passivation



INTERNAL SCHEMATIC DIAGRAMS





MULTIEPITAXIAL PLANAR (NPN)

I_C (A)	V_{CBO} (V)	V_{CEO} (V)	P_{tot} (W)	Package	TYPE	h_{FE} (min)	@ I_C (A)	V_{CE} (V)	V_{CEsat} max (V)	@ I_C (A)	I_B (mA)
3	600	400	35	SOT-32	BU801	100	1	3	2.2	1	15
7	600	400	75	TO-220	BU810	100	2	2	2.5	4	200
16	450	350	125	SOT-93	SGS10004P	40	8	5	1.8	8	400
16	450	350	175	TO-3	SGS10004	40	8	5	1.8	8	400
16	500	400	125	SOT-93	SGS10005P	40	8	5	1.8	8	400
16	500	400	175	TO-3	SGS10005	40	8	5	1.8	8	400
20	400	350	150	SOT-93	MJ10004P	50	5	5	1.9	10	400
20	400	350	175	TO-3	MJ10004	50	5	5	1.9	10	400
20	450	400	150	SOT-93	MJ10005P	50	5	5	1.9	10	400
20	450	400	175	TO-3	MJ10005	50	5	5	1.9	10	400
28	650	400	150	SOT-93	SGSD00030 *	120	12	2.5	2.5	12	100
28	650	400	150	TO-3	SGSD00031 *	120	12	2.5	2.5	12	100
28	600	400	150	SOT-93	SGSD311 *	30	10	5	2.5	18	1800
28	600	400	150	TO-3	SGSD310 *	30	10	5	2.5	18	1800

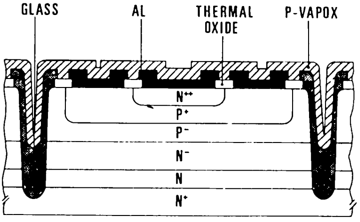
*Without parasitic CE diode

SELECTION GUIDE

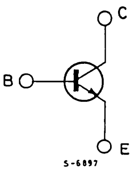
HIGH VOLTAGE FAST SWITCHING

MULTIEPITAXIAL MESA - I_{CM} 1.5 to 30A; V_{CEO} 300 to 700V

NPN types
High voltage (V_{CBO} up to 1200V)
High power
Very good $I_{s/b}$ and $E_{s/b}$ performance
High switching speed
High f_T (20MHz)
Good stability



INTERNAL SCHEMATIC DIAGRAM



MULTIEPITAXIAL MESA (NPN)

I_C (A)	V_{CBO} (V)	V_{CEO} (V)	P_{tot} (W)	Package	TYPE	h_{FE} (min)	@ I_C (A)	V_{CE} (V)	V_{CEsat} max (V)	@ I_C (A)	I_B (mA)
1.5	600	300	50	SOT-82	SGS13002	5	1	2	1	1	250
1.5	600	300	50	TO-220	SGS13002T	5	1	2	1	1	250
1.5	700	400	50	SOT-82	SGS13003	5	1	2	1	1	250
1.5	700	400	50	TO-220	SGS13003T	5	1	2	1	1	250
2	800	400	40	TO-220	BUX84	5	1	3	1.5	0.3	30
2	800	400	40	TO-220	BUX84A	5	1	1	0.8	0.3	30
2	1000	450	40	TO-220	BUX85	5	1	1	1	1	200
4	600	300	75	TO-220	MJE13004	10	1	5	0.6	2	500
4	700	400	75	TO-220	MJE13005	10	1	5	0.6	2	500
5	350	250	80	TO-220	2N6497	10	2.5	10	1	2.5	500
5	350	250	100	SOT-93	TIP51	10	3	10	1.5	3	600
5	400	300	80	TO-220	2N6498	10	2	10	1.25	2.5	500
5	400	300	100	SOT-93	TIP52	10	3	10	1.5	3	600
5	450	350	80	TO-220	2N6499	10	2.5	10	1.5	2.5	500
5	450	350	100	SOT-93	TIP53	10	3	10	1.5	3	600
5	500	400	100	SOT-93	TIP54	10	3	10	1.5	3	600
5	850	400	85	TO-220	BUV46	5	3.5	5	1.5	2.5	500
5	850	400	100	TO-220	BUT11	5	3	1.5	1.5	3	600
5	850	400	100	SOT-93	BUW11	5	3	1.5	1.5	3	600
5	1000	450	100	TO-220	BUT11A	5	2.5	1.5	1.5	2.5	500
5	1000	450	100	SOT-93	BUW11A	5	2.5	1.5	1.5	2.5	500

SELECTION GUIDE

MULTIEPITAXIAL MESA (continued)

I_C (A)	V_{CBO} (V)	V_{CEO} (V)	P_{tot} (W)	Package	TYPE	h_{FE} (min)	@ I_C (A)	V_{CE} (V)	V_{CEsat} max (V)	@ I_C (A)	I_B (mA)
6	800	375	75	TO-3	BU326 *	25	1	5	1.5	2.5	500
6	800	375	113	SOT-93	BU426 *	25	1	5	1.5	2.5	500
6	800	400	60	TO-3	BU326S	3.5	4	5	1.5	2.5	500
6	900	400	75	TO-3	BU326A *	25	1	5	1.5	2.5	500
6	900	400	113	SOT-93	BU426A *	25	0.6	5	1.5	2.5	500
8	600	300	80	TO-220	MJE13006	8	2	5	1.5	5	1000
8	450	400	120	TO-3	BUX44	8	4	4	1.5	4	800
8	700	400	80	TO-220	MJE13007	8	2	5	1.5	5	1000
8	850	400	80	TO-220	MJE13007A	8	2	5	1.5	5	1000
8	850	400	125	SOT-93	BUW12	5	6	1.5	1.5	6	1200
8	850	400	125	TO-3	2N6545	4	8	5	1.5	5	1000
8	1000	450	125	SOT-93	BUW12A	5	5	1.5	1.5	5	1000
9	850	400	120	SOT-93	BUV47	3.2	8	3	1.5	5	1000
9	850	400	125	TO-3	BUX47	3	9	3	1.5	6	1200
9	1000	450	120	SOT-93	BUV47A	3.2	8	3	1.5	5	1000
9	1000	450	120	TO-3	BUX47A	3	9	3	1.5	6	1200
10	800	325	100	TO-3	BUY69B	15	2.5	10	3.3	8	2500
10	325	400	120	TO-3	BUX43	8	5	4	2	5	1000
10	450	400	150	TO-3	BUX14	8	6	4	1.6	6	1200
10	500	400	125	TO-3	BUW34	15	1	5	1.5	5	1000
10	800	400	100	TO-3	BUX80	5	5	1.5	1.5	5	1000
10	800	400	125	TO-3	BUW35	15	1	5	1.5	5	1000
10	1000	400	100	TO-3	BUY69A	15	2.5	10	3.3	8	2500
10	900	450	125	TO-3	BUW36	15	1	5	1.5	5	1000
12	600	300	100	TO-220	MJE13008	8	5	5	1.5	8	1600
12	700	400	100	TO-220	MJE13009	8	5	5	1.5	8	1600
15	400	325	160	TO-3	BUX13	8	8	4	1.5	8	1600
15	500	400	175	TO-3	BUW44	6	6	1.5	3	10	2000
15	800	400	175	TO-3	BUW45	7	7	1.5	1.5	10	2000
15	850	400	150	SOT-93	BUW13	5	10	1.5	1.5	10	2000
15	850	400	150	SOT-93	BUV48	5	15	5	1.5	10	2000
15	850	400	175	TO-3	2N6547	5	15	5	1.5	10	2000
15	850	400	175	TO-3	BUX48	5	15	3	1.5	10	2000
15	900	450	175	TO-3	BUW46	7	7	1.5	1.5	10	2000
15	1000	450	150	SOT-93	BUV48A	5	12	5	1.5	8	1600
15	1000	450	150	SOT-93	BUW13A	5	8	1.5	1.5	8	1600
15	1000	450	175	TO-3	BUX48A	5	12	3	1.5	8	1600
15	500	500	250	TO-3	BUV25	15	4	4	1	8	1600
15	1200	600	150	SOT-93	BUV48B	15	1	10	2	8	2500
15	1200	600	175	TO-3	BUX48B	15	1	10	2	8	2500
15	1200	700	150	SOT-93	BUV48C	2.5	10	3	1.5	6	1500
15	1200	700	175	TO-3	BUX48C	2.5	10	3	1.5	6	1500
20	450	400	250	TO-3	BUV24	15	6	4	1	12	2400
30	400	325	250	TO-3	BUV23	15	8	4	1	16	3200
30	850	400	250	TO-3	BUX98	5	20	1.5	1.5	20	4000
30	1000	450	250	TO-3	BUX98A	5	16	1.5	1.5	16	3200
30	500	500	350	TO-3	BUX25	8	8	4	1	8	1600
30	1000	600	250	TO-3	BUX98B	4	12	1.5	1.5	12	3000
30	1200	700	250	TO-3	BUX98C	4	12	1.5	1.5	12	3000

* h_{FE} is typical

CROSS REFERENCE GUIDE

CROSS REFERENCE GUIDE

TYPE	SGS-ATES NEAREST	PAGE	TYPE	SGS-ATES NEAREST	PAGE	TYPE	SGS-ATES NEAREST	PAGE
BD135	BD135	*	BD195	BD533	106	BD244C	BD244C	89
BD135-6	BD135-6	*	BD196	BD534	106	BD245	BD705	115
BD135-10	BD135-10	*	BD197	BD535	106	BD245A	BD707	115
BD135-16	BD135-16	*	BD198	BD536	106	BD245B	BD709	115
BD136	BD136	*	BD199	BD537	106	BD245C	BD711	115
BD136-6	BD136-6	*	BD200	BD538	106	BD246	BD706	115
BD136-10	BD136-10	*	BD201	BD705	115	BD246A	BD708	115
BD136-15	BD136-16	*	BD202	BD706	115	BD246B	BD710	115
BD137	BD137	*	BD203	BD707	115	BD246C	BD712	115
BD137-6	BD137-6	*	BD204	BD708	115	BD253	BUW24	*
BD137-10	BD137-10	*	BD205	BD905	121	BD253A	BUW25	*
BD138	BD138	*	BD206	BD906	121	BD253B	BU136	*
BD138-6	BD138-6	*	BD207	BD907	121	BD253C	BU326A	220
BD138-10	BD138-10	*	BD208	BD908	121	BD262	BD678	110
BD139	BD139	*	BD220	BD537	106	BD262A	BD680	110
BD139-6	BD139-6	*	BD221	BD533	106	BD262B	BD682	110
BD139-10	BD139-10	*	BD222	BD535	106	BD263	BD677	110
BD140	BD140	*	BD223	BD538	106	BD263A	BD679	110
BD140-6	BD140-6	*	BD224	BD534	106	BD263B	BD681	110
BD140-10	BD140-10	*	BD225	BD536	106	BD264	BDW24A	*
BD157	BD157	70	BD226	BD375	*	BD264A	BDW24B	*
BD158	BD158	70	BD227	BD376	*	BD265	BDW23A	*
BD159	BD159	70	BD228	BD377	*	BD265A	BDW23B	*
BD165	BD437	97	BD229	BD378	*	BD266	BDX54A	155
BD166	BD438	97	BD230	BD379	*	BD266A	BDX54B	155
BD167	BD439	103	BD231	BD380	*	BD266B	BDX54C	155
BD168	BD440	103	BD233	BD233	78	BD267	BDX53A	155
BD169	BD441	103	BD234	BD234	78	BD267A	BDX53B	155
BD170	BD442	103	BD235	BD235	78	BD267B	BDX53C	155
BD175	BD175	72	BD236	BD236	78	BD268	BDW94A	145
BD175-6	BD175-6	72	BD237	BD237	78	BD268A	BDW94B	145
BD175-10	BD175-10	72	BD238	BD238	78	BD269	BDW93A	145
BD175-16	BD175-16	72	BD239	BD239	84	BD269A	BDW93B	145
BD176	BD176	72	BD239A	BD239A	84	BD271	BD533	106
BD176-6	BD176-6	72	BD239B	BD239B	84	BD272	BD534	106
BD176-10	BD176-10	72	BD239C	BD239C	84	BD273	BD535	106
BD176-16	BD176-16	72	BD240	BD240	84	BD274	BD536	106
BD177	BD177	72	BD240A	BD240A	84	BD275	BD537	106
BD177-6	BD177-6	72	BD240B	BD240B	84	BD276	BD538	106
BD177-10	BD177-10	72	BD240C	BD240C	84	BD277	BD664	*
BD178	BD178	72	BD241	BD241	87	BD278	BD663	*
BD178-6	BD178-6	72	BD241A	BD241A	87	BD301	BD533	106
BD178-10	BD178-10	72	BD241B	BD241B	87	BD302	BD534	106
BD179	BD179	72	BD241C	BD241C	87	BD303	BD535	106
BD179-6	BD179-6	72	BD242	BD242	87	BD304	BD536	106
BD179-10	BD179-10	72	BD242A	BD242A	87	BD311	BDW51A	132
BD180	BD180	72	BD242B	BD242B	87	BD312	BDW52A	132
BD180-6	BD180-6	72	BD242C	BD242C	87	BD313	BDW51B	132
BD180-10	BD180-10	72	BD243	BD243	89	BD314	BDW52B	132
BD185	BD435	97	BD243A	BD243A	89	BD331	BD331	91
BD186	BD436	97	BD243B	BD243B	89	BD332	BD332	91
BD187	BD437	97	BD243C	BD243C	89	BD333	BD333	91
BD188	BD438	97	BD244	BD244	89	BD334	BD334	91
BD189	BD439	103	BD244A	BD244A	89	BD335	BD335	91
BD190	BD440	103	BD244B	BD244B	89	BD336	BD336	91

* Data sheet available on request.

CROSS REFERENCE GUIDE

TYPE	SGS-ATES NEAREST	PAGE
BD361	BD433	97
BD361A	BD433	97
BD362	BD434	97
BD362A	BD434	97
BD375	BD375	*
BD376	BD376	*
BD377	BD377	*
BD378	BD378	*
BD379	BD379	*
BD380	BD380	*
BD433	BD433	97
BD434	BD434	97
BD435	BD435	97
BD436	BD436	97
BD437	BD437	97
BD438	BD438	97
BD439	BD439	103
BD440	BD440	103
BD441	BD441	103
BD442	BD442	103
BD533	BD533	106
BD534	BD534	106
BD535	BD535	106
BD536	BD536	106
BD537	BD537	106
BD538	BD538	106
BD539	BD241	87
BD539A	BD241A	87
BD539B	BD241B	87
BD539C	BD241C	87
BD540	BD242	87
BD540A	BD242A	87
BD540B	BD242B	87
BD540C	BD242C	87
BD543	BD905	121
BD543A	BD907	121
BD543B	BD909	121
BD544	BD906	121
BD544A	BD908	121
BD544B	BD910	121
BD561	BD437	97
BD562	BD438	97
BD575	BD533	106
BD576	BD534	106
BD577	BD535	106
BD578	BD536	106
BD579	BD537	106
BD580	BD538	106
BD585	BD533	106
BD586	BD534	106
BD587	BD535	106
BD588	BD536	106
BD589	BD537	106
BD590	BD538	106
BD595	BD705	115

TYPE	SGS-ATES NEAREST	PAGE
BD596	BD706	115
BD597	BD707	115
BD598	BD708	115
BD599	BD709	115
BD600	BD710	115
BD601	BD711	115
BD602	BD712	115
BD605	BD905	121
BD606	BD906	121
BD607	BD907	121
BD608	BD908	121
BD609	BD909	121
BD610	BD910	121
BD633	BD533	106
BD634	BD534	106
BD635	BD535	106
BD636	BD536	106
BD637	BD537	106
BD638	BD538	106
BD643	BDX53	155
BD644	BDX54	155
BD645	BDX53A	155
BD646	BDX54A	155
BD647	BDX53B	155
BD648	BDX54B	155
BD649	BDX53C	155
BD650	BDX54C	155
BD663	BD663	*
BD664	BD664	*
BD675	BD675	110
BD675A	BD675A	110
BD676	BD676	110
BD676A	BD676A	110
BD677	BD677	110
BD677A	BD677A	110
BD678	BD678	110
BD678A	BD678A	110
BD679	BD679	110
BD679A	BD679A	110
BD680	BD680	110
BD680A	BD680A	110
BD681	BD681	110
BD682	BD682	110
BD695A	BDX53	155
BD696A	BDX54	155
BD697	BDX53A	155
BD697A	BDX53A	155
BD698	BDX54A	155
BD698A	BDX54A	155
BD699	BDX53B	155
BD699A	BDX53B	155
BD700	BDX54B	155
BD700A	BDX54B	155
BD701	BDX53C	155
BD702	BDX54C	155

TYPE	SGS-ATES NEAREST	PAGE
BD705	BD705	115
BD706	BD706	115
BD707	BD707	115
BD708	BD708	115
BD709	BD709	115
BD710	BD710	115
BD711	BD711	115
BD712	BD712	115
BD733	BD533	106
BD734	BD534	106
BD735	BD533	106
BD736	BD534	106
BD737	BD533	106
BD738	BD534	106
BD795	BD705	115
BD796	BD706	115
BD797	BD707	115
BD798	BD708	115
BD799	BD709	115
BD800	BD710	115
BD801	BD711	115
BD802	BD712	115
BD805	BD905	121
BD806	BD906	121
BD807	BD907	121
BD808	BD908	121
BD809	BD909	121
BD810	BD910	121
BD895	BDW93	145
BD896	BDW94	145
BD897	BDW93A	145
BD898	BDW94A	145
BD899	BDW93B	145
BD900	BDW94B	145
BD901	BDW93C	145
BD902	BDW94C	145
BD905	BD905	121
BD906	BD906	121
BD907	BD907	121
BD908	BD908	121
BD909	BD909	121
BD910	BD910	121
BD911	BD911	121
BD912	BD912	121
BD933	BD239	84
BD934	BD240	84
BD935	BD239A	84
BD936	BD240A	84
BD937	BD239B	84
BD938	BD240B	84
BD939	BD239C	84
BD940	BD240C	84
BD943	BD533	106
BD944	BD534	106
BD945	BD535	106

* Data sheet available on request.

CROSS REFERENCE GUIDE

TYPE	SGS-ATES NEAREST	PAGE
BD946	BD534	106
BD947	BD533	106
BD948	BD534	106
BD949	BD241A	87
BD950	BD242A	87
BD951	BD241B	87
BD952	BD242B	87
BD953	BD241C	87
BD954	BD242C	87
BDT62	BDW94A	145
BDT62A	BDW94B	145
BDT62B	BDW94C	145
BDT63	BDW93A	145
BDT63A	BDW93B	145
BDT63B	BDW93C	145
BDT91	BD907	121
BDT92	BD908	121
BDT93	BD909	121
BDT94	BD910	121
BDT95	BD911	121
BDT96	BD912	121
DBV64	BDV64	127
BDV64A	BDV64A	127
BDV64B	BDV64B	127
BDV65	BDV65	127
BDV65A	BDV65A	127
BDV65B	BDV65B	127
BDW21	BDW21	*
BDW21A	BDW21A	*
BDW21B	BDW21B	*
BDW21C	BDW21C	*
BDW22	BDW22	*
BDW22A	BDW22A	*
BDW22B	BDW22B	*
BDW22C	BDW22C	*
BDW23	BDW23	*
BDW23A	BDW23A	*
BDW23B	BDW23B	*
BDW23C	BDW23C	*
BDW24	BDW24	*
BDW24A	BDW24A	*
BDW24B	BDW24B	*
BDW24C	BDW24C	*
BDW51	BDW51	132
BDW51A	BDW51A	132
BDW51B	BDW51B	132
BDW51C	BDW51C	132
BDW52	BDW52	132
BDW52A	BDW52A	132
BDW52B	BDW52B	132
BDW52C	BDW52C	132
BDW53	BDW23	*
BDW53A	BDW23A	*
BDW53B	BDW23B	*
BDW53C	BDW23C	*
BDW54	BDW24	*
BDW54A	BDW24A	*
BDW54B	BDW24B	*
BDW54C	BDW24C	*
BDW63	BDX53	155
BDW63A	BDX53A	155
BDW63B	BDX53B	155
BDW63C	BDX53C	155
BDW64	BDX54	155
BDW64A	BDX54A	155
BDW64B	BDX54B	155
BDW64C	BDX54C	155
BDW73	BDW93	145
BDW73A	BDW93A	145
BDW73B	BDW93B	145
BDW73C	BDW93C	145
BDW74	BDW94	145
BDW74A	BDW94A	145
BDW74B	BDW94B	145
BDW74C	BDW94C	145
BDW91	BDW91	139
BDW92	BDW92	139
BDW93	BDW93	145
BDW93A	BDW93A	145
BDW93B	BDW93B	145
BDW93C	BDW93C	145
BDW94	BDW94	145
BDW94A	BDW94A	145
BDW94B	BDW94B	145
BDW94C	BDW94C	145
BDX33	BDX33	148
BDX33A	BDX33A	148
BDX33B	BDX33B	148
BDX33C	BDX33C	148
BDX34	BDX34	148
BDX34A	BDX34A	148
BDX34B	BDX34B	148
BDX34C	BDX34C	148
BDX53	BDX53	155
BDX53A	BDX53A	155
BDX53B	BDX53B	155
BDX53C	BDX53C	155
BDX53E	BDX53E	158
BDX53F	BDX53F	158
BDX53S	BDX53S	164
BDX54	BDX54	155
BDX54A	BDX54A	155
BDX54B	BDX54B	155
BDX54C	BDX54C	155
BDX54E	BDX54E	158
BDX54F	BDX54F	158
BDX54S	BDX54S	164
BDX62	BDX86A	170
BDX62A	BDX86B	170
BDX62B	BDX86C	170
BDX63	BDX85A	170
BDX63A	BDX85B	170
BDX63B	BDX85C	170
BDX64	BDX88A	177
BDX64A	BDX88B	177
BDX64B	BDX88C	177
BDX65	BDX87A	177
BDX65A	BDX87B	177
BDX65B	BDX87C	177
BDX77	BD709	115
BDX78	BD710	115
BDX83	BDX87	177
BDX83A	BDX87A	177
BDX83B	BDX87B	177
BDX83C	BDX87C	177
BDX84	BDX88	177
BDX84A	BDX88A	177
BDX84B	BDX88B	177
BDX84C	BDX88C	177
BDX85	BDX85	170
BDX85A	BD85A	170
BDX85B	BDX85B	170
BDX85C	BDC85C	170
BDX86	BDX86	170
BDX86A	BDX86A	170
BDX86B	BDX86B	170
BDX86C	BDX86C	170
BDX87	BDX87	177
BDX87A	BDX87A	177
BDX87B	BDX87B	177
BDX87C	BDX87C	177
BDX88	BDX88	177
BDX88A	BDX88A	177
BDX88B	BDX88B	177
BDX88C	BDX88C	177
BDX91	BDW21A	*
BDX92	BDW22A	*
BDX93	BDW21B	*
BDX94	BDW22B	*
BDX95	BDW21C	*
BDX96	BDW22C	*
BDY57	BDY57	184
BDY58	BDY58	184
BDY90	BDY90	187
BDY91	BDY91	187
BDY92	BDY92	187
BFX34	BFX34	189
BSS44	BSS44	193
BSW67	BSW67	197
BSW68	BSW68	197
BU104	BU606	*
BU104D	BU606D	*
BU104DP	BU406D	235
BU106	BU607	*
BU107	BU607	*

* Data sheet available on request.

CROSS REFERENCE GUIDE

TYPE	SGS-ATES NEAREST	PAGE
BU109	BU607	*
BU109D	BU607D	*
BU110	BU607	*
BU111	BUW24	*
BU125	BU125	201
BU125S	BU125S	205
BU126	BU126	*
BU129	BU606	*
BU133	BU126	*
BU134	BUW25	*
BU137	BUY69A	507
BU208	BU208	209
BU208A	BU208A	209
BU208D	BU208D	209
BU310	BU607	*
BU311	BU607	*
BU312	BU607	*
BU322	BU920	*
BU322A	BU922	*
BU323	BU931R	287
BU323	BU930	*
BU323A	BU932	*
BU323A	BU932R	287
BU325	BU325	215
BU326	BU326	220
BU326A	BU326A	220
BU326S	BU326S	225
BU361	BUW35	381
BU406	BU406	229
BU406D	BU406D	235
BU406H	BU406H	229
BU407	BU407	241
BU407D	BU407D	235
BU407H	BU407H	241
BU408	BU408	229
BU408D	BU408D	235
BU411	BU607D	8
BU412	BU607D	*
BU426	BU426	247
BU426A	BU426A	247
BU508	BU508	250
BU508A	BU508A	250
BU508D	BU508D	250
BU606	BU606	*
BU606D	BU606D	*
BU607	BU607	*
BU607D	BU607D	*
BU608	BU608	*
BU608D	BU608D	*
BU801	BU801	256
BU806	BU806	261
BU807	BU807	261
BU810	BU810	267
BU910	BU910	600
BU911	BU911	600

TYPE	SGS-ATES NEAREST	PAGE
BU912	BU912	600
BU920	BU920	271
BU920P	BU920P	277
BU920T	BU920T	277
BU921	BU921	271
BU921P	BU921P	277
BU921T	BU921T	277
BU922	BU922	271
BU922P	BU922P	277
BU922T	BU922T	277
BU930	BU930	*
BU930P	BU930P	*
BU930Z	BU930Z	282
BU930ZP	BU940ZP	282
BU931	BU931	*
BU931P	BU931P	*
BU931R	BU931R	287
BU931RP	BU931RP	287
BU932	BU932	*
BU932P	BU932P	*
BU932R	BU932R	287
BU932RP	BU932RP	287
BU999	BU999	293
BUR20	BUR20	*
BUR21	BUR21	*
BUR22	BUR22	*
BUR23	BUV23	328
BUR24	BUV24	328
BUR50	BUR50	295
BUR50S	BUR50S	295
BUR51	BUR51	301
BUR52	BUR52	307
BUS12	BUW35	381
BUS13	BUX48	342
BUS13A	BUW46	395
BUT11	BUT11	313
BUT11A	BUT11A	313
BUT13	BUT13	318
BUT13P	BUT13P	318
BUV20	BUV20	325
BUV21	BUV21	325
BUV22	BUV22	325
BUV23	BUV23	328
BUV24	BUV24	328
BUV25	BUV25	328
BUV46	BUV46	331
BUV47	BUV47	333
BUV47A	BUV47A	333
BUV48	BUV48	342
BUV48A	BUV48A	342
BUW11	BUW11	358
BUW11A	BUW11A	358
BUW12	BUW12	364
BUW12A	BUW12A	364
BUW13	BUW13	*

TYPE	SGS-ATES NEAREST	PAGE
BUW13A	BUW13A	*
BUW22	BUW22	367
BUW22A	BUW22A	367
BUW22AP	BUW22AP	367
BUW22P	BUW22P	367
BUW24	BUW24	*
BUW25	BUW25	*
BUW26	BUW26	*
BUW32	BUW32	374
BUW32A	BUW32A	374
BUW32AP	BUW32AP	374
BUW32P	BUW32P	374
BUW34	BUW34	381
BUW35	BUW35	381
BUW36	BUW36	381
BUW42	BUW42	390
BUW42A	BUW42A	390
BUW42AP	BUW42AP	390
BUW42P	BUW42P	390
BUW44	BUW44	395
BUW45	BUW45	395
BUW46	BUW46	395
BUW57	BUX10	400
BUW58	BUX11N	415
BUW66	BUW66	*
BUW67	BUW67	*
BUW73	BUX11	409
BUX10	BUX10	400
BUX10P	BUX10P	406
BUX10S	BUX10	400
BUX11	BUX11	409
BUX11N	BUX11N	415
BUX11S	BUX11	409
BUX12	BUX12	421
BUX13	BUX13	427
BUX14	BUX14	429
BUX15	BUW44	475
BUX16	BUW24	*
BUX16A	BUW24	*
BUX16B	BUW24	*
BUX16C	BUW24	*
BUX17	BUX41N	461
BUX17A	BUX42	467
BUX17B	BUW44	395
BUX17C	BUW44	395
BUX18	BUX41	455
BUX18A	BUX42	467
BUX18B	BUW35	381
BUX18C	BUW35	381
BUX20	BUX20	431
BUX20S	BUX20S	*
BUX22	BUX22	443
BUX23	BUV23	328
BUX24	BUV24	328
BUX25	BUX25	*

* Data sheet available on request.

CROSS REFERENCE GUIDE

TYPE	SGS-ATES NEAREST	PAGE	TYPE	SGS-ATES NEAREST	PAGE	TYPE	SGS-ATES NEAREST	PAGE
BUX28	BU920	271	D44C12	D44C12	510	MJ13015	BUW34	381
BUX29	BU921	271	D44H1	D44H1	512	MJ13330	BUX41	455
BUX37	BU931	*	D44H2	D44H2	512	MJ13331	BUX42	467
BUX37	BU931R	287	D44H4	D44H4	512	MJ13332	BUV23	328
BUX40	BUX40	449	D44H5	D44H5	512	MJ13333	BUV24	328
BUX41	BUX41	455	D44H7	D44H7	512	MJ13334	BUV24	328
BUX41N	BUX41N	461	D44H8	D44H8	512	MJE170	MJE170	539
BUX41S	BUX41	455	D44H10	D44H10	512	MJE171	MJE171	539
BUX42	BUX42	467	D44H11	D44H11	512	MJE172	MJE172	539
BUX43	BUX43	473	D44Q1	D44Q1	514	MJE180	MJE180	539
BUX44	BUX44	475	D44Q3	D44Q3	514	MJE181	MJE181	539
BUX45	BUW34	381	D44Q5	D44Q5	514	MJE182	MJE182	539
BUX46	BUX46	477	MJ424	BUW35	381	MJE200	MJE200	543
BUX47	BUX47	333	MJ425	BUW35	381	MJE210	MJE210	543
BUX47A	BUX47A	333	MJ802	MJ802	516	MJE340	MJE340	549
BUX48	BUX48	342	MJ900	MJ900	522	MJE350	MJE350	549
BUX48A	BUX48A	342	MJ901	MJ901	522	MJE371	MJE371	559
BUX48B	BUX48B	352	MJ1000	MJ1000	522	MJE520	MJE520	553
BUX48C	BUX48C	352	MJ1001	MJ1001	522	MJE521	MJE521	559
BUX77	BUX77	*	MJ2500	MJ2500	524	MJE700	MJE700	565
BUX78	BUX78	*	MJ2501	MJ2501	524	MJE701	MJE701	565
BUX80	BUX80	479	MJ2955	MJ2955	526	MJE702	MJE702	565
BUX82	BUX82	*	MJ3000	MJ3000	524	MJE703	MJE703	565
BUX84	BUX84	484	MJ3001	MJ3001	524	MJE800	MJE800	565
BUX84A	BUX84A	484	MJ3029	BUW24	*	MJE801	MJE801	565
BUX85	BUX85	*	MJ3030	BUW25	*	MJE802	MJE802	565
BUX97	BUX97	*	MJ3040	BU920	271	MJE803	MJE803	565
BUX97A	BUX97A	*	MJ3041	BU920	271	MJE2955T	MJE2955T	570
BUX97B	BUX97B	*	MJ3042	BU922	271	MJE3055T	MJE3055T	570
BUX98	BUX98	486	MJ4030	MJ4030	528	MJE3439	MJE3439	573
BUX98A	BUX98A	486	MJ4031	MJ4031	528	MJE3440	MJE3440	573
BUX98B	BUX98B	*	MJ4032	MJ4032	528	MJE13002	SGS13002	616
BUX98C	BUX98C	488	MJ4033	MJ4033	528	MJE13003	SGS13003	616
BUY18S	BUY18S	*	MJ4034	MJ4034	528	MJE13004	MJE13004	577
BUY47	BUY47	492	MJ4035	MJ4035	528	MJE13005	MJE13005	577
BUY48	BUY48	492	MJ4502	MJ4502	516	MJE13006	MJE13006	582
BUY49P	BUY49P	497	MJ10000	BU931R	287	MJE13007	MJE13007	582
BUY49S	BUY49S	499	MJ10000	MJ10004	530	MJE13007A	MJE13007A	582
BUY57	BUX40	449	MJ10001	BU931R	287	MJE13008	MJE13008	591
BUY58	BUX41N	461	MJ10001	MJ10005	530	MJE13009	MJE13009	591
BUY68	BUY68	503	MJ10002	BU920P	277	SE9300	BDW93A	145
BUY69A	BUY69A	507	MJ10003	BU921P	277	SE9301	BDW93B	145
BUY69B	BUY69B	507	MJ10004	MJ10004	530	SE9302	BDW93C	145
BUY69C	BUY69C	507	MJ10004P	MJ10004P	530	SE9303	BDX87A	177
D44C1	D44C1	510	MJ10005	MJ10005	530	SE9304	BDX87B	177
D44C2	D44C2	510	MJ10005P	MJ10005P	530	SE9305	BDX87C	177
D44C3	D44C3	510	MJ10012	BU931	*	SE9400	BDW94A	145
D44C4	D44C4	510	MJ10012	BU931R	287	SE9401	BDW94B	145
D44C5	D44C5	510	MJ11011	MJ11011	533	SE9402	BDW94C	145
D44C6	D44C6	510	MJ11012	MJ11012	533	SE9403	BDX88A	177
D44C7	D44C7	510	MJ11013	MJ11013	533	SE9404	BDX88B	177
D44C8	D44C8	510	MJ11014	MJ11014	533	SE9405	BDX88C	177
D44C9	D44C9	510	MJ11015	MJ11015	533	SGS110	SGS110	661
D44C10	D44C10	510	MJ11016	MJ11016	533	SGS111	SGS111	661
D44C11	D44C11	510	MJ13014	BUW34	381	SGS112	SGS112	661

* Data sheet available on request.

CROSS REFERENCE GUIDE

TYPE	SGS-ATES NEAREST	PAGE	TYPE	SGS-ATES NEAREST	PAGE	TYPE	SGS-ATES NEAREST	PAGE
SGS115	SGS115	661	TIP31	TIP31	637	TIP127	TIP127	668
SGS116	SGS116	661	TIP31A	TIP31A	637	TIP130	TIP130	674
SGS117	SGS117	661	TIP31B	TIP31B	637	TIP131	TIP131	674
SGS120	SGS120	597	TIP31C	TIP31C	637	TIP132	TIP132	674
SGS121	SGS121	597	TIP32	TIP32	637	TIP135	TIP135	674
SGS122	SGS122	597	TIP32A	TIP32A	637	TIP136	TIP136	674
SGS125	SGS125	597	TIP32B	TIP32B	637	TIP137	TIP137	674
SGS126	SGS126	597	TIP32C	TIP32C	637	TIP140	TIP140	677
SGS127	SGS127	597	TIP35A	TIP35A	642	TIP141	TIP141	677
SGS130	SGS130	674	TIP35B	TIP35B	642	TIP142	TIP142	677
SGS131	SGS131	674	TIP35C	TIP35C	642	TIP145	TIP145	677
SGS132	SGS132	674	TIP36A	TIP36A	642	TIP146	TIP146	677
SGS135	SGS135	674	TIP36B	TIP36B	642	TIP147	TIP147	677
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SGS157	SGS157	*	TIP41A	TIP41A	644	TIP152	BU911	600
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SGS6387	SGS6387	610	TIP53	TIP53	652	2N3445	BDW51A	132
SGS6388	SGS6388	610	TIP54	TIP54	652	2N3446	BDW51B	132
SGS10004	SGS10004	613	TIP73	BD905	121	2N3553	BUY68	503
SGS10004P	SGS10004P	613	TIP73A	BD907	121	2N3554	BUY68	503
SGS10005	SGS10005	613	TIP73B	BD909	121	2N3713	2N3713	690
SGS10005P	SGS10005P	613	TIP73C	BD911	121	2N3714	2N3714	690
SGS13002	SGS13002	616	TIP74	BD906	121	2N3715	2N3715	690
SGS13002T	SGS13002T	616	TIP74A	BD908	121	2N3716	2N3716	690
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SGS13003T	SGS13003T	616	TIP74C	BD912	121	2N3720	BSS44	193
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TIP30A	TIP30A	634	TIP122	TIP122	668	2N4895	2N4895	704
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* Data sheet available on request.

CROSS REFERENCE GUIDE

TYPE	SGS-ATES NEAREST	PAGE
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2N6667	BDX54A	155

* Data sheet available on request.

CROSS REFERENCE GUIDE

TYPE	SGS-ATES NEAREST	PAGE
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* Data sheet available on request.

CROSS REFERENCE GUIDE

TYPE	SGS-ATES NEAREST	PAGE
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* Data sheet available on request.

CROSS REFERENCE GUIDE

TYPE	SGS-ATES NEAREST	PAGE
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2SD480	2N6038	786
2SD481	2N6039	786
2SD482	2N5655	756
2SD483	2N5656	756

* Data sheet available on request.

CROSS REFERENCE GUIDE

TYPE	SGS-ATES NEAREST	PAGE
2SD484	2N5657	756
2SD485	2N5190	726
2SD486	2N5191	726
2SD487	2N5192	726
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2SD1134	D44H11	512
2SD1163	BU406	229
2SD1163A	BU406	229
2SD1201	BU932R	287
2SD1203	BU930Z	282

* Data sheet available on request.

ALPHABETICAL LIST OF SYMBOLS

ALPHABETICAL LIST OF SYMBOLS

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 cutoff current with emitter open
I_{CEO}	Collector cutoff current with base open
I_{CER}	Collector cutoff current with specified resistance between emitter and base
I_{CES}	Collector cutoff current with emitter short-circuited to base
I_{CEV}	Collector cutoff current with specified reverse voltage between emitter and base
I_{CEX}	Collector cutoff 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 cutoff current with collector open
I_F	Continuous DC forward current
I_{FM}	Peak forward current
I_R	Continuous DC reverse current

ALPHABETICAL LIST OF SYMBOLS

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	Time
T_{amb}	Ambient temperature
T_{case}	Case temperature
t_c	Crossover time
t_d	Delay time
t_f	Fall time
T_j	Junction temperature
t_{off}	Turn-off time
t_{on}	Turn-on time
t_p	Pulse width
t_r	Rise time
t_{rr}	Reverse recovery time of a diode
t_s	Storage time
T_{stg}	Storage temperature
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 speficied resistance
$V_{(BR)\ CES}$	Collector-emitter breakdown voltage with emitter short-circuited to base

ALPHABETICAL LIST OF SYMBOLS

$V_{(BR)CEV}$	Collector-emitter breakdown voltage with specified reverse voltage between emitter and base
$V_{(BR)CEX}$	Collector-emitter breakdown 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
$V_{CEX\,(sus)}$	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

RATING SYSTEMS FOR ELECTRONIC DEVICES

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 determinated 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 characteristics 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 variations in characteristics of the device under consideration and of all other electronic devices in the equipment.

RATING SYSTEMS FOR ELECTRONIC DEVICES

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 responsibility 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.

QUALITY (SURE3)

- 100% ELECTRICAL TESTING
- MARKING
- GROUP A ACCEPTANCE
- PACKING
- PACKING AND DOCUMENTATION ACCEPTANCE
- SHIPPING

GROUP A ACCEPTANCE

Sub-group	Parameters	Temp. °C	Insp. Level	Acceptablee quality level (AQL) Hermetic and molded packages
A1	Visual and Mechanical Inspection, Major Minor		I	0.25 1
*A2	Inoperative failure (electrical and mechanical)	25°C	II	0.15
A3	DC parameters	25°C	II	0.65
	h_{FE} ranges □			1
A4	AC parameters at 25°C and DC parameters at high temperature		S4	2.5

□ Applicable when h_{FE} is guaranteed as min and max

* Definition of electrical inoperative:

- open or short circuit
- $<$ 80% of guaranteed spec value for: BV_{CBO}, BV_{CEO}, BV_{CER}, BV_{CES}, BV_{CEV}, BV_{EBO}
- $>$ 200% of guaranteed spec value for: $V_{CE(sat)}$
- $>$ 200% of guaranteed spec value for: I_{CBO}; I_{CES}, I_{CEO}, I_{CEV} at 50% guaranteed BV value
- $>$ 150% of guaranteed max spec values for h_{FE}
- $<$ 50% of guaranteed min spec values for h_{FE}

For further information Quality and Reliability see the SGS SURE 3 programme.

HANDLING OF POWER PLASTIC TRANSISTORS

HANDLING OF POWER PLASTIC TRANSISTORS

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

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.

Fig. 1 - Bending the leads

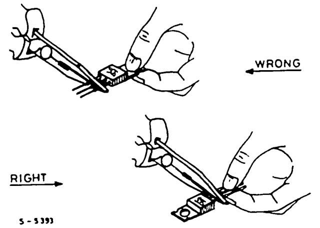


Fig. 2 - Lead forming or cutting mechanism

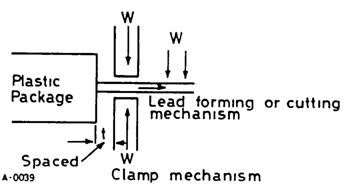
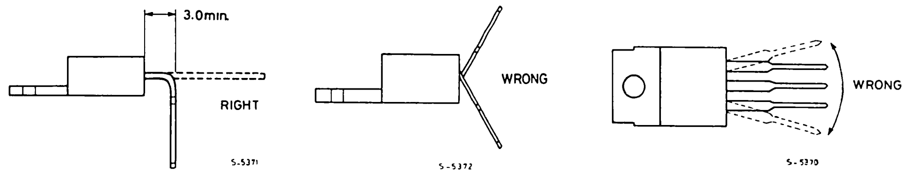


Fig. 3 - Angles for lead wire bending



a b c

HANDLING OF POWER PLASTIC TRANSISTORS

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.

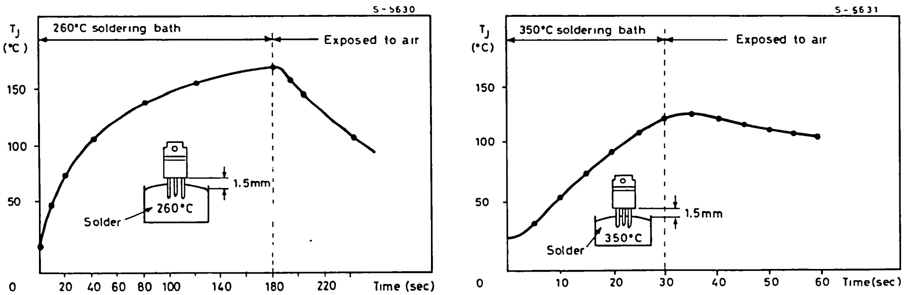
3. Soldering

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°C 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.

Fig. 4 – Junction temperatures during soldering

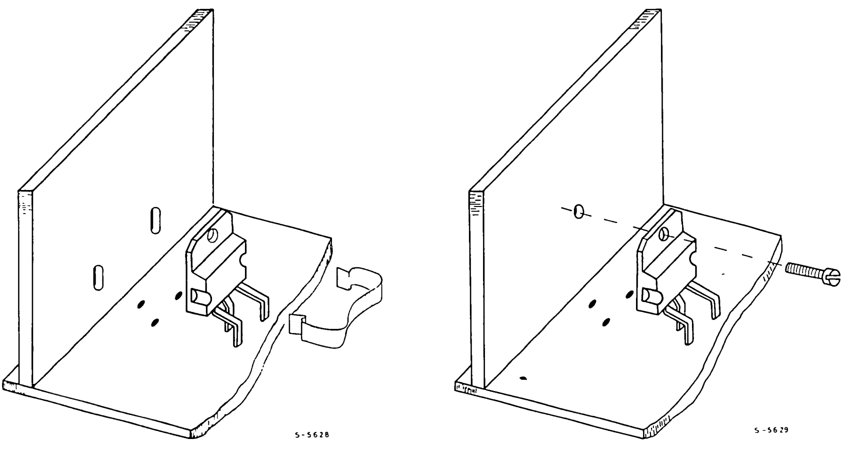


HANDLING OF POWER PLASTIC TRANSISTORS

4. **Mounting at heatsink**
   To exploit best the performance of power transistors 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 for its power transistors (SOT-32, SOT-82, SOT-93, Versawatt) 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).

Fig. 5 – SOT-93 mounting examples

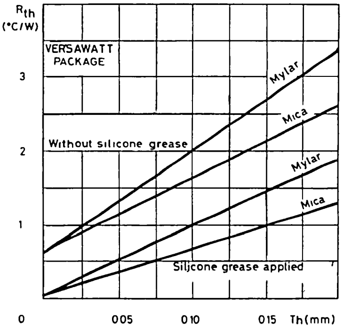


The screw should be properly tightened to ensure good contact between the back of the package and the heatsink but should not be too tight to avoid deformation of the copper part (tab) of the package causing breaking of the die or separation of the resin from the tab.

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}.

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.

Fig. 6 – Contact thermal resistance vs. insulator thickness.

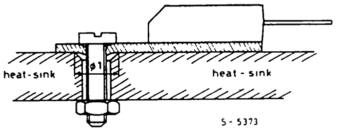


HANDLING OF POWER PLASTIC TRANSISTORS

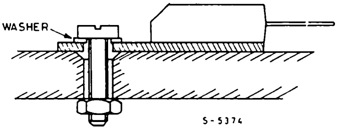
5.1. The planarity of the contact surface between device and heatsink must be $< 25\ \mu m$ for TO-220, SOT-93, TO-126 (SOT-32), SOT-82.

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 ϕ 1 (fig. 7) must be large enough to avoid distortion of the

Fig. 7 - Device mounting



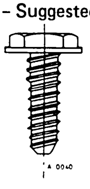
WRONG



RIGHT

tab during tightening. For this purpose it may be useful to insert a washer or use screws 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.

Fig. 8 - Suggested screw

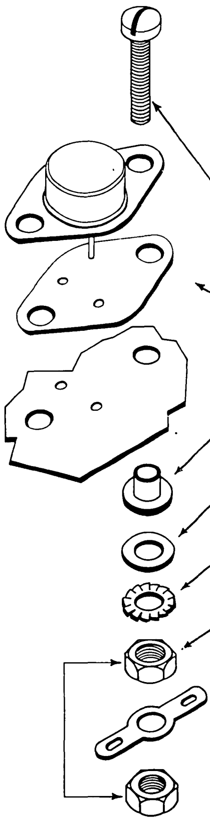


5.3. A very serious problem is that of the rigidity between heatsink, device and printed circuit board. Once the device and the heatsink are mechanically connected, and the heatsink is fixed to the apparatus frame, the device and the PCB are bound together by the leads of the devices. A solution of this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

ACCESSORIES AND MOUNTING INSTRUCTIONS

ACCESSORIES AND MOUNTING INSTRUCTIONS

TO-3



ACCESSORY TYPE	Q ty	ASSEMBLY NUMBER	MATERIAL	MECH. DATA Page
CHEESE HEAD SCREWS SLOTTED	2	NOT AVAILABLE FROM SGS	—	
MICA WASHER	1	* CDA 3126 A	MICA	64
INSULATING BUSHES	2	CDA 3155 A	NYLON	65
WASHERS	2	NOT AVAILABLE FROM SGS		
LOCK WASHERS	2	NOT AVAILABLE FROM SGS		
HEXAGON NUTS	4	NOT AVAILABLE FROM SGS		
SOLDER LUG	1	NOT AVAILABLE FROM SGS		

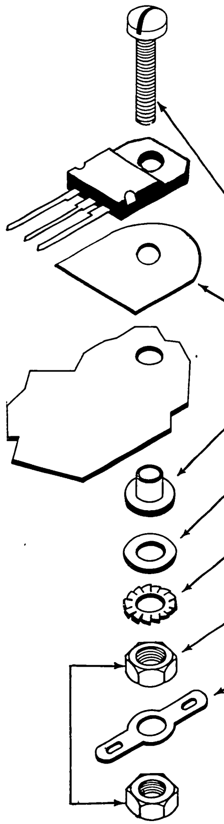
S-0375/3

* CDA 3126B FOR MODIFIED TO-3 (see 2N6032 and 2N6033)

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

ACCESSORIES AND MOUNTING INSTRUCTIONS

SOT-93



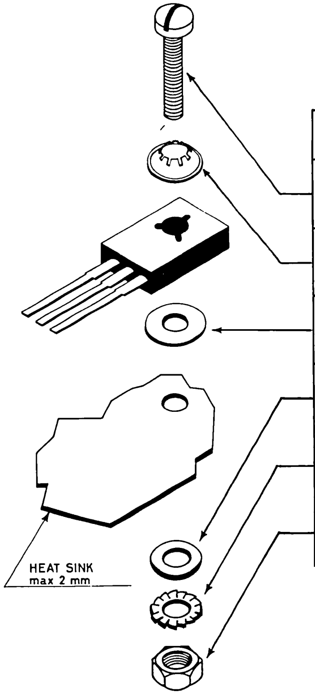
ACCESSORY TYPE	Q ty	ASSEMBLY NUMBER	MATERIAL	MECH DATA Page
CHEESE HEAD SCREWS SLOTTED	1	NOT AVAILABLE FROM SGS		
MICA WASHER	1	CDA 3154	MICA	65
INSULATING BUSHES	1	CDA 3155 C	NYLON	65
WASHERS	1	NOT AVAILABLE FROM SGS		
LOCK WASHERS	1	NOT AVAILABLE FROM SGS		
HEXAGON NUTS	2	NOT AVAILABLE FROM SGS		
SOLDER LUG	1	NOT AVAILABLE FROM SGS		

S-5668

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

ACCESSORIES AND MOUNTING INSTRUCTIONS

TO-126 (SOT-32)



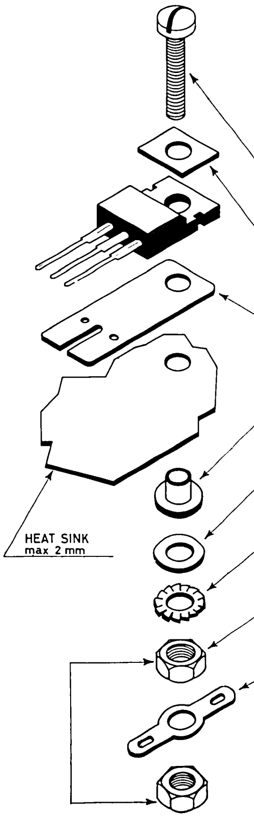
ACCESSORY TYPE	Q ty	ASSEMBLY NUMBER	MATERIAL	MECH. DATA Page
CHEESE HEAD SCREW SLOTTED	1	NOT AVAILABLE FROM SGS		
LOCK WASHER	1	CDA 3164	STEEL C72 UNI 3545	67
MICA WASHER	1	CDA 3162	MICA	66
WASHER	1	NOT AVAILABLE FROM SGS		
LOCK WASHER	1	NOT AVAILABLE FROM SGS		
HEXAGON NUT	1	NOT AVAILABLE FROM SGS		

S-0340/3

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

ACCESSORIES AND MOUNTING INSTRUCTIONS

TO-220



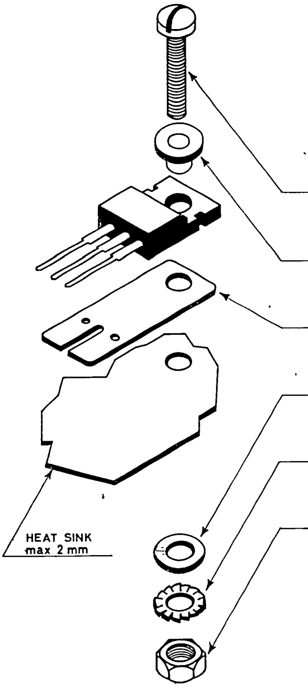
ACCESSORY TYPE	Q ty	ASSEMBLY NUMBER	MATERIAL	MECH. DATA Page
CHEESE HEAD SCREW SLOTTED	1	NOT AVAILABLE FROM SGS		
RECTANGULAR WASHER	1	CDA 3163		67
MICA WASHER	1	CDA 3159	MICA	66
INSULATING BUSHE	1	CDA 3155 B	NYLON	65
WASHER	1	NOT AVAILABLE FROM SGS		
LOCK WASHER	1	NOT AVAILABLE FROM SGS		
HEXAGON NUTS	2	NOT AVAILABLE FROM SGS		
SOLDER LUG	1	NOT AVAILABLE FROM SGS		

S-0388/3

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

ACCESSORIES AND MOUNTING INSTRUCTIONS

TO-220



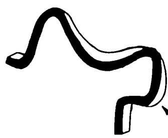
ACCESSORY TYPE	Q.ty	ASSEMBLY NUMBER	MATERIAL	MECH. DATA Page
CHEESE HEAD SCREWS SLOTTED	1	NOT AVAILABLE FROM SGS		
INSULATING BUSHING	1	CDA 3155B	NYLON	65
MICA INSULATOR	1	CDA 3159	MICA	66
METAL WASHER	1	NOT AVAILABLE FROM SGS		
LOCK WASHER	1	NOT AVAILABLE FROM SGS		
HEXAGON NUTS	2	NOT AVAILABLE FROM SGS		

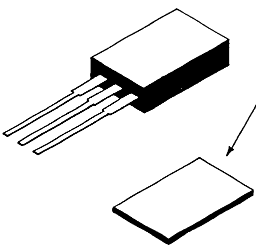
S-0389/3

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

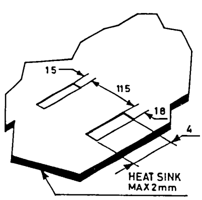
ACCESSORIES AND MOUNTING INSTRUCTIONS

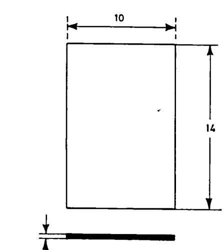
SOT-82 and TO-126



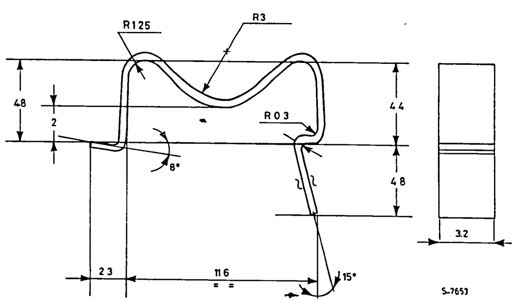


ACESSORY TYPE	Q.TA'	ASSEMBLY NUMBER	MATERIAL	MECH. DATA
SPRING CLIP	1	AVAILABLE ONLY ON REQUEST	STEEL C 100 UNI 3545	4-C 3004
MICA WASHER	1	AVAILABLE ONLY ON REQUEST	MICA	4-C 3003





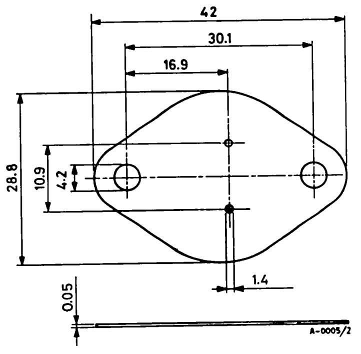
4-C-3003



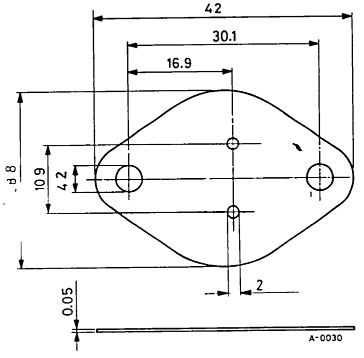
4-C-3004

ACCESSORIES AND MOUNTING INSTRUCTIONS

CDA 3126A

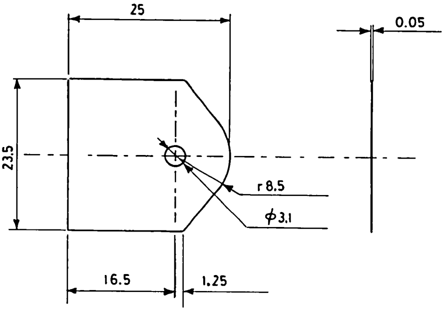


CDA 3126B



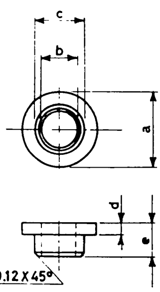
ACCESSORIES AND MOUNTING INSTRUCTIONS

CDA 3154



A-0042

CDA 3155



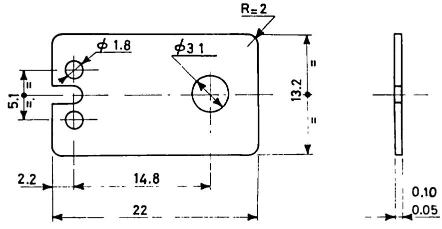
A - 0024/2

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.

ACCESSORIES AND MOUNTING INSTRUCTIONS

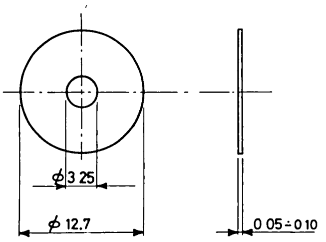
CDA 3159



A-0026/3

TYPE	MATERIAL	NOTE
CDA 3159	MICA	

CDA 3162

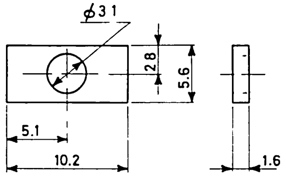


A-0025/3

TYPE	MATERIAL	NOTE
CDA 3162	MICA	

ACCESSORIES AND MOUNTING INSTRUCTIONS

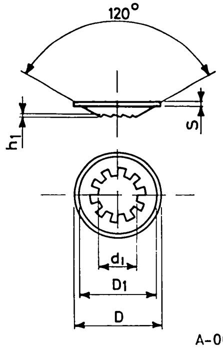
CDA 3163



A-0023/3

TYPE	MATERIAL	NOTE
CDA 3163	Steel nickel plated	

CDA 3164



A-0022/1

TYPE	d_i max	d_i min	D max	D min	D_1	S	h_1	NOTE
CDA3164	3.3	3.1	7.1	6.8	5.2	0.4	0.8	

MATERIAL: Steel nickel plated

DATASHEETS

BD157
BD158
BD159

EPITAXIAL PLANAR NPN

ADVANCE DATA

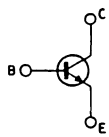
LOW POWER FAST SWITCHING

The BD157, BD158 and BD159 are silicon epitaxial planar NPN transistors in TO-126 plastic package, intended for applications in output stages for television, radio, phonograf and other consumer product.

ABSOLUTE MAXIMUM RATINGS

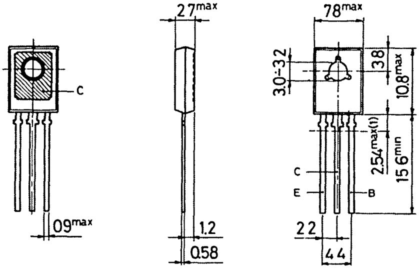
		BD157	BD158	BD159
V_{CBO}	Collector-base voltage ($I_E = 0$)	275V	325V	375V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	250V	300V	350V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		5V	
I_C	Collector current		0.5A	
I_{CM}	Collector peak current		1A	
I_B	Base current		0.25A	
P_{tot}	Total power dissipation at $T_{case} < 25°C$		20W	
T_{stg}	Storage temperautre		-65 to 150°C	
T_j	Junction temperature		150°C	

INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm



(1) Within this region the cross-section of the leads is uncontrolled

TO-126 (SOT-32)

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)

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 ($I_C = 0$)	$V_{BE} = 5V$			100	μA
V_{CEO}*	Collecor-emitter voltage	$I_C = 1mA$ for **BD157** for **BD158** for **BD159**	 250 300 350			 V V V
h_{FE}*	DC current gain	$I_C = 50mA$ $V_{CE} = 10V$	30		240	–

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

BD175 BD176
BD177 BD178
BD179 BD180

EPITAXIAL-BASE NPN/PNP

MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

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.

ABSOLUTE MAXIMUM RATINGS

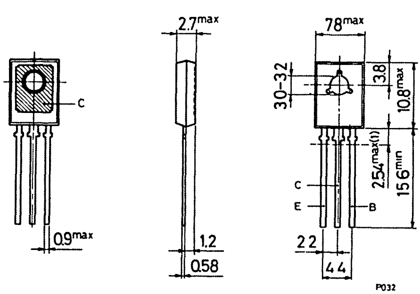
	NPN PNP*	BD175 BD176	BD177 BD178	BD179 BD180
V_{CBO}	Collector-base voltage ($I_E = 0$)	45V	60V	80V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	45V	60V	80V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		5V	
I_C	Collector current		3A	
I_{CM}	Collector peak current		7A	
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$		30V	
T_{stg}	Storage temperature		-65 to 150°C	
T_j	Junction temperature		150°C	

* **For PNP types voltage and current are negative**

INTERNAL SCHEMATIC DIAGRAMS

MECHANICAL DATA

Dimensions in mm



(1) Within this region the cross-section of the leads is uncontrolled

TO-126 (SOT-32)

THERMAL DATA

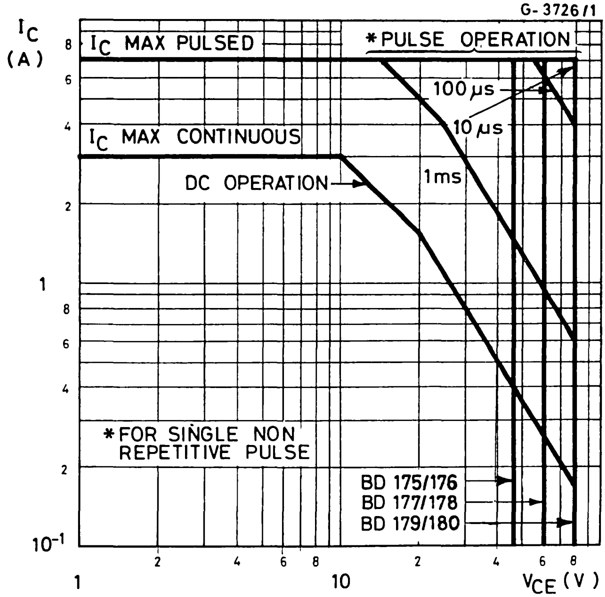
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	4.16 °C/W

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

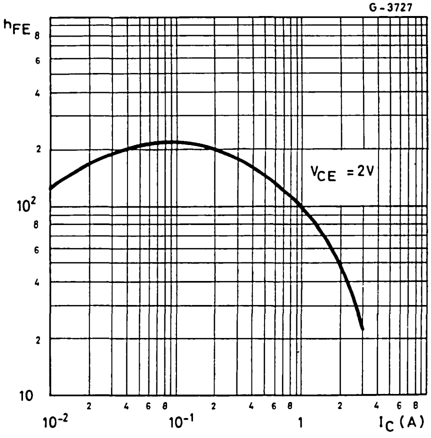
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current (I_E = 0)	for **BD175/76** V_{CB} = 45V for **BD177/78** V_{CB} = 60V for **BD179/80** V_{CB} = 80V			100 100 100	μA μA μA
I_{EBO}	Emitter cutoff current (I_C = 0)	V_{EB} = 5V			1	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage	I_C = 100mA for **BD175/76** for **BD177/78** for **BD179/80**	 45 60 80			 V V V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	I_C = 1A I_B = 0.1A			0.8	V
V_{BE}*	Base-emitter volt.	I_C = 1A V_{CE} = 2V			1.3	V
h_{FE}*	DC current gain	I_C = 150mA V_{CE} = 2V I_C = 1A V_{CE} = 2V	40 15			– –
h_{FE}	groups** 6 10 (only BD175/6) 16	I_C = 150mA V_{CE} = 2V	40 63 100		100 160 250	– – –
f_T	Transition freq.	I_C = 250mA V_{CE} = 10V	3		MHz	

* Pulsed: pulse duration = 300μs, duty cycle ⩽ 1.5%
** Only on request

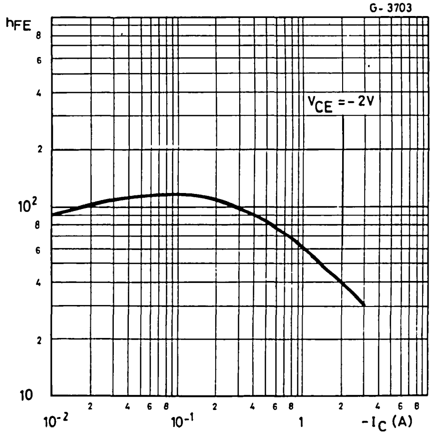
Safe operating areas



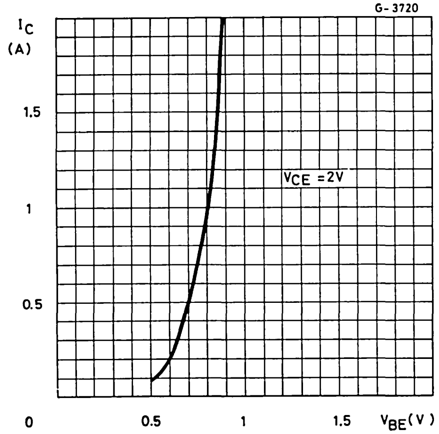
DC current gain (NPN types)



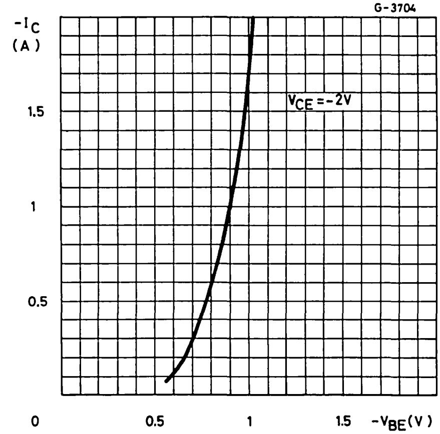
DC current gain (PNP types)



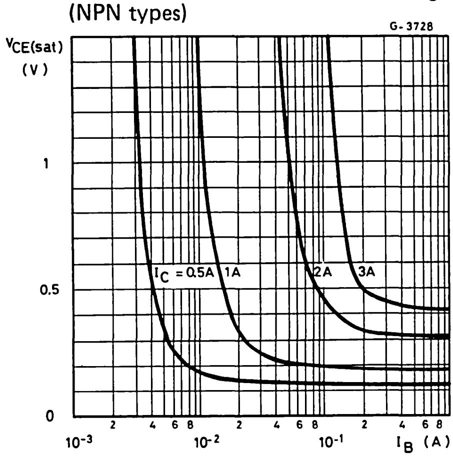
DC transconductance (NPN types)



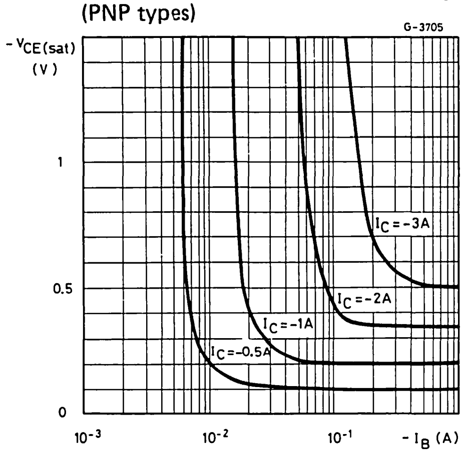
DC transconductance (PNP types)



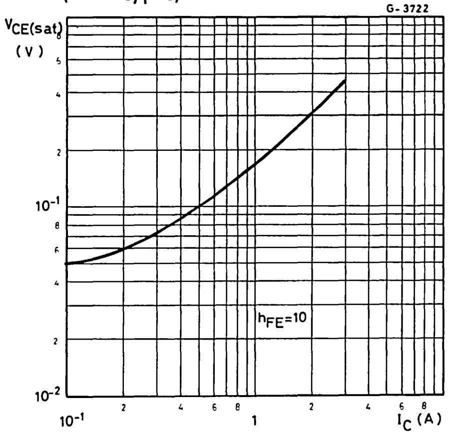
Collector-emitter saturation voltage (NPN types)



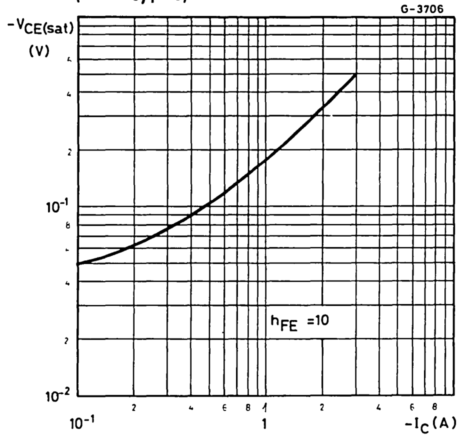
Collector-emitter saturation voltage (PNP types)



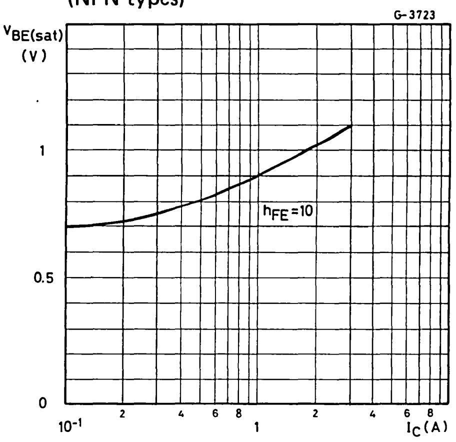
Collector-emitter saturation voltage
(NPN types)



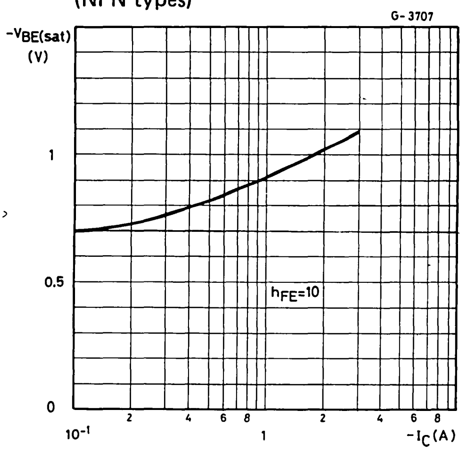
Collector-emitter saturation voltage
(PNP types)



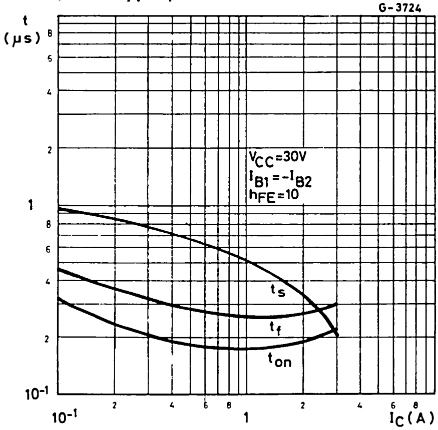
Base-emitter saturation voltage
(NPN types)



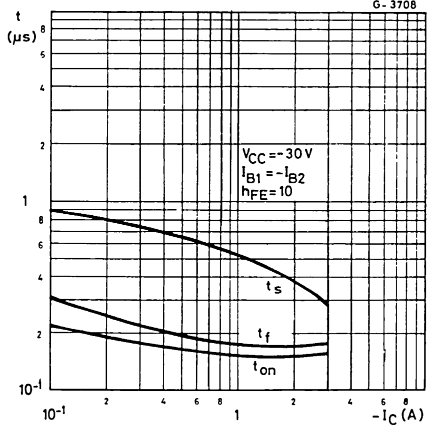
Base-emitter saturation voltage
(NPN types)



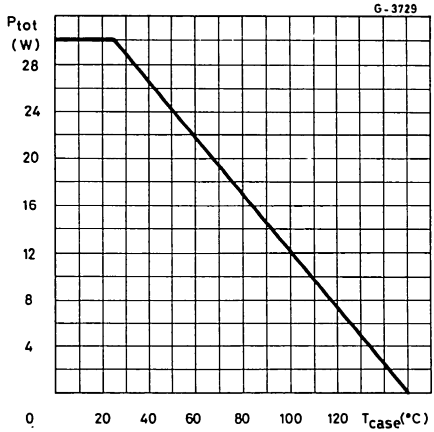
Saturated switching characteristics (NPN types)



Saturated switching characteristics (NPN types)



Power derating chart



BD233 BD234
BD235 BD236
BD237 BD238

EPITAXIAL-BASE NPN/PNP

MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

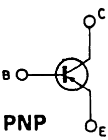
The BD 233, BD 235 and BD 237 are silicon epitaxial-base NPN power transistors in Jedec TO-126 plastic package intended for use in medium power linear and switching applications.
The complementary PNP types are the BD 234, BD 236 and BD 238 respectively.

ABSOLUTE MAXIMUM RATINGS

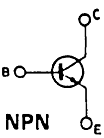
		NPN PNP*	BD233 BD234	BD235 BD236	BD237 BD238
V_{CBO}	Collector-base voltage ($I_E = 0$)		45V	60V	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)		45V	60V	80V
V_{CER}	Collector-emitter voltage ($R_{BE} = 1K\Omega$)		45V	60V	100V
V_{EBO}	Emitter-base voltage ($I_C = 0$)			5V	
I_C	Collector current			2A	
I_{CM}	Collector peak current			6A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$			25W	
T_{stg}	Storage temperature			-65 to 150°C	
T_j	Junction temperature			150°C	

*** For PNP types voltage and current values are negative**

INTERNAL SCHEMATIC DIAGRAMS



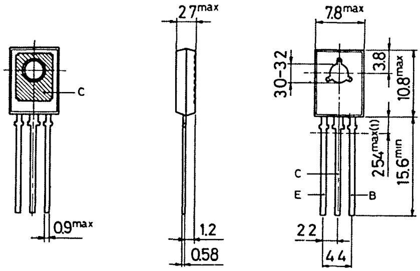
PNP



NPN

MECHANICAL DATA

Dimensions in mm



(1) Within this region the cross-section of the leads is uncontrolled

TO-126 (SOT-32)

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	5	°C/W

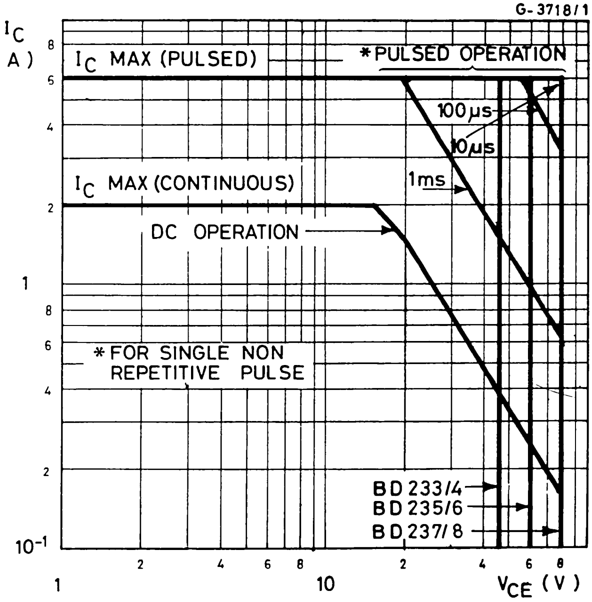
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	for **BD233/34** V_{CB}=45V for **BD235/36** V_{CB}=60V for **BD326/38** V_{CB}=100V T_{case} = 150°C for **BD233/34** V_{CB}=45V for **BD235/36** V_{CB}=60V for **BD237/38** V_{CB}=100V			100 100 100 2 2 2	µA µA µA 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 =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 =1A I_B =0.1A			0.6	V
V_{BE}*	Base-emitter voltage	I_C =1A V_{CE}=2V			1.3	V
h_{FE}*	DC current gain	I_C =150mA V_{CE}=2V I_C =1A V_{CE}=2V	40 25			– –
f_T	Transition frequency	I_C =250mA V_{CE}=10V	3			MHz
h_{FE1}/h_{FE2}*	Matched pairs BD233/BD234 BD235/BD236 BD237/BD238	I_C =150mA V_{CE}=2V		1.6		–

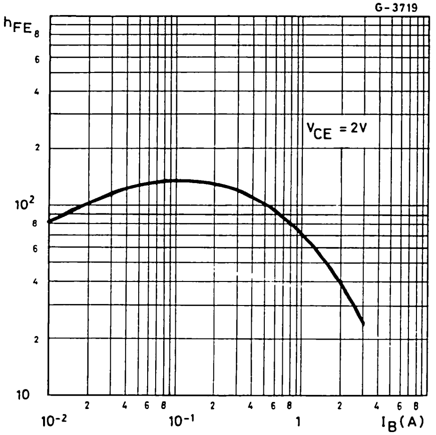
* Pulsed: pulse duration = 300 µs, duty cycle ≤ 1.5%

For PNP types voltage and current values are negative

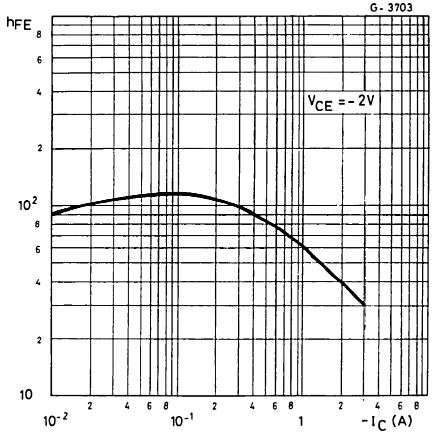
Safe operating areas



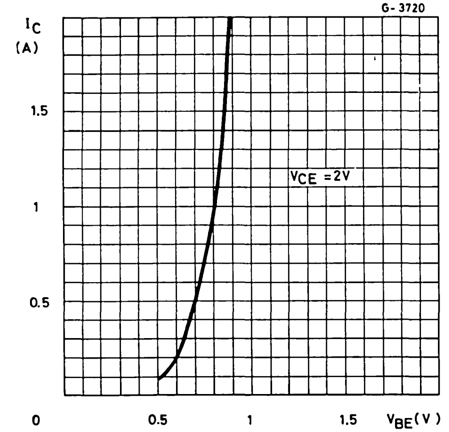
DC current gain (NPN types)



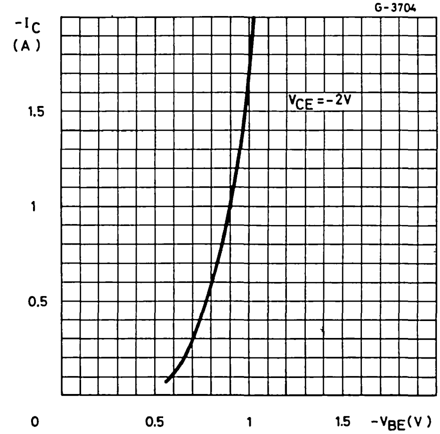
DC current gain (PNP types)



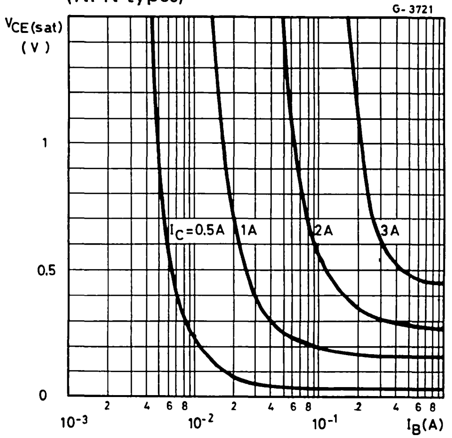
DC transconductance (NPN types)



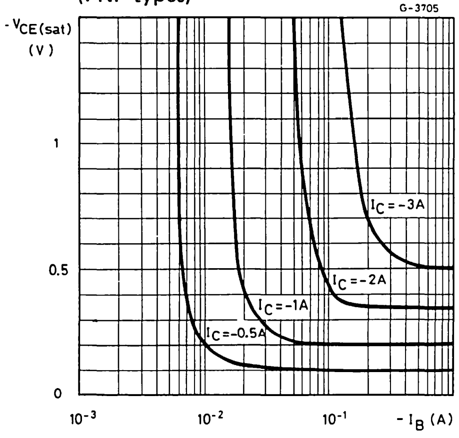
DC transconductance (PNP types)



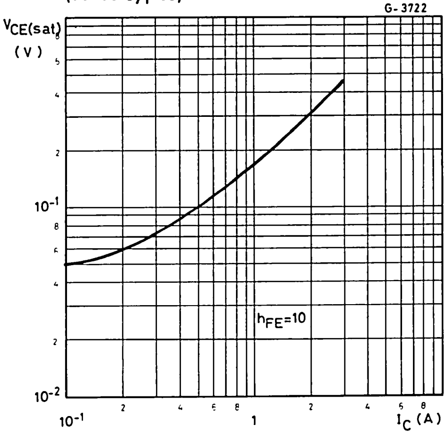
Collector-emitter saturation voltage (NPN types)



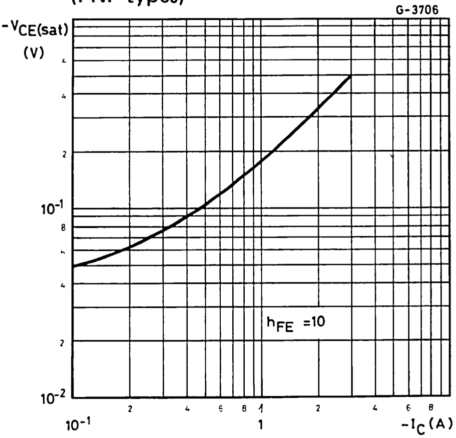
Collector-emitter saturation voltage (PNP types)



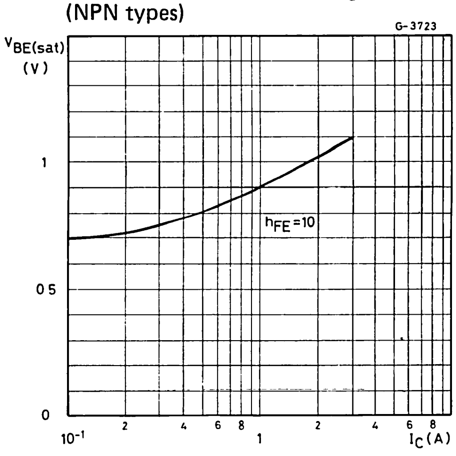
Collector-emitter saturation voltage (NPN types)



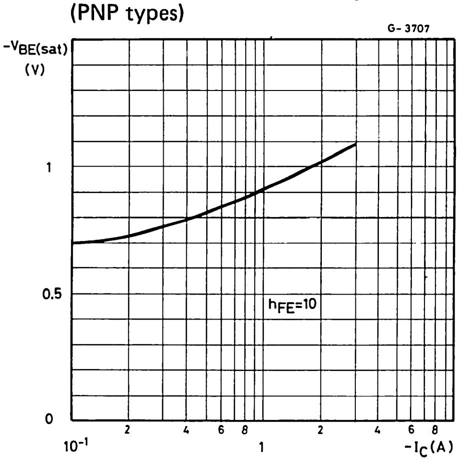
Collector-emitter saturation voltage (PNP types)



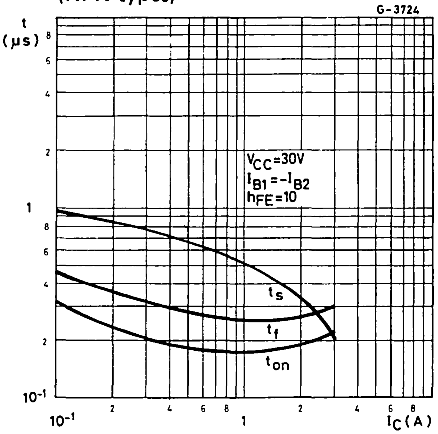
Base-emitter saturation voltage (NPN types)



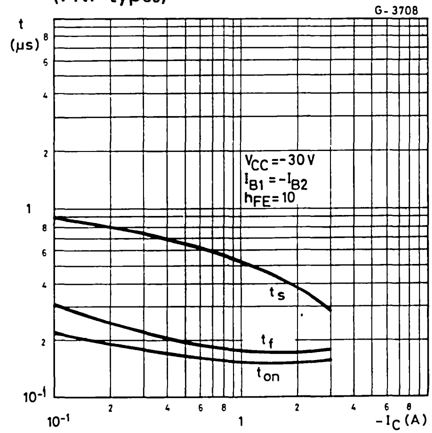
Base-emitter saturation voltage (PNP types)



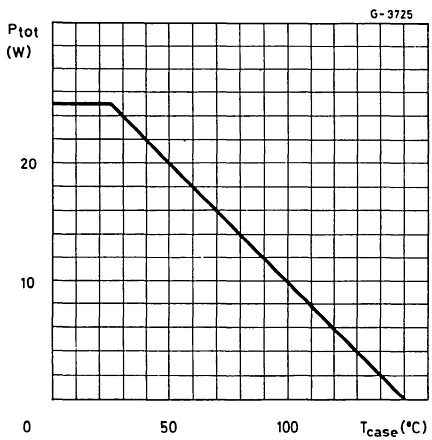
Saturated switching characteristics (NPN types)



Saturated switching characteristics (PNP types)



Power derating chart



BD239 BD240
BD239A BD240A
BD239B BD240B
BD239C BD240C

EPITAXIAL-BASE NPN/PNP

MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

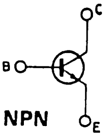
The BD239, BD239A, BD239B and BD239C are silicon epitaxial-base NPN power transistors in Jedec TO-220 plastic package, intended for use in medium power linear and switching applications. The complementary PNP types are BD240, BD240A, BD240B and BD240C respectively.

ABSOLUTE MAXIMUM RATINGS

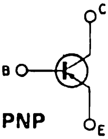
	NPN / PNP*	BD239 / BD240	BD239A / BD240A	BD239B / BD240B	BD239C / BD240C
V_{CER}	Collector-emitter voltage ($R_{BE} = 100\Omega$)	55V	70V	90V	115V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	45V	60V	80V	100V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5V			
I_C	Collector current	2A			
I_{CM}	Collector peak current	4A			
I_B	Base current	0.6A			
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$	30W			
	$T_{amb} \leq 25°C$	2W			
T_{stg}	Storage temperature	-65 to 150°C			
T_j	Junction temperature	150°C			

*** For PNP types voltage and current values are negative**

INTERNAL SCHEMATIC DIAGRAMS



NPN

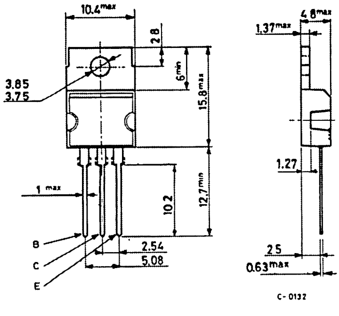


PNP

MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

THERMAL DATA

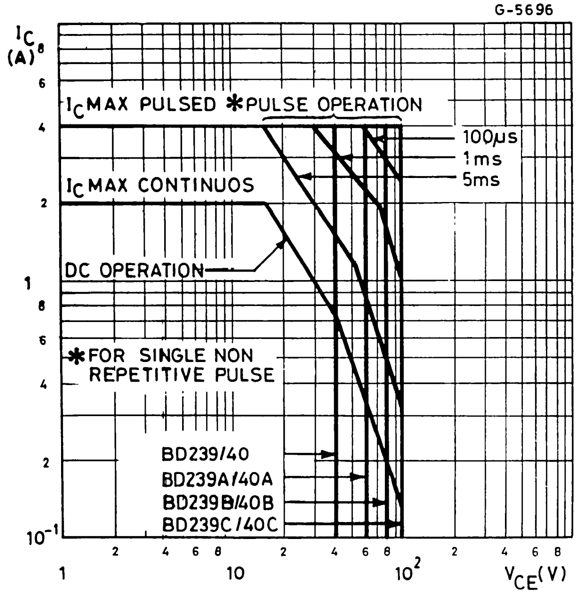
$R_{th\,j\text{-}case}$	Thermal resistance junction-case	max	4.17	°C/W
$R_{th\,j\text{-}amb}$	Thermal resistance junction-ambient	max	62.5	°C/W

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

Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B = 0$)	for **BD239/40/39A/40A** $V_{CE} = 30V$				0.3	mA
		for **BD239B/40B/39C/40C** $V_{CE} = 60V$				0.3	mA
I_{CES}	Collector cutoff current ($V_{BE} = 0$)	for **BD239/40**	$V_{CE} = 45V$			0.2	mA
		for **BD239A/40A**	$V_{CE} = 60V$			0.2	mA
		for **BD239B/40B**	$V_{CE} = 80V$			0.2	mA
		for **BD239C/40C**	$V_{CE} = 100V$			0.2	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$				1	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 30mA$					
		for **BD239/40**		45			V
		for **BD239A/40A**		60			V
		for **BD239B/40B**		80			V
		for **BD239C/40C**		100			V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C = 1A$	$I_B = 0.2A$			0.7	V
$V_{BE(on)}$*	Base-emitter voltage	$I_C = 1A$	$V_{CE} = 4V$			1.3	V
h_{FE}*	DC current gain	$I_C = 0.2A$	$V_{CE} = 4V$	40			–
		$I_C = 1A$	$V_{CE} = 4V$	15			–
h_{fe}	Small signal current gain	$I_C = 0.2A$ f = 1KHz	$V_{CE} = 10V$	20			–
		$I_C = 0.2A$ f = 1MHz	$V_{CE} = 10V$	3			–

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

Safe operating areas



For the others characteristics curves see TIP31/TIP32 series.

EPITAXIAL-BASE NPN/PNP

BD241 BD242
BD241A BD242A
BD241B BD242B
BD241C BD242C

MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

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,

ABSOLUTE MAXIMUM RATINGS

	NPN PNP*	BD241 BD242	BD241A BD242A	BD241B BD242B	BD241C BD242C
V_{CER}	Collector-emitter voltage ($R_{BE}=100\Omega$)	55V	70V	90V	115V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	45V	60V	80V	100V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5V			
I_C	Collector current	3A			
I_{CM}	Collector peak current	5A			
I_B	Base-current	1A			
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$	40W			
	$T_{amb} \leq 25°C$	2W			
T_{stg}	Storage temperature	-65 to 150°C			
T_j	Junction temperature	150°C			

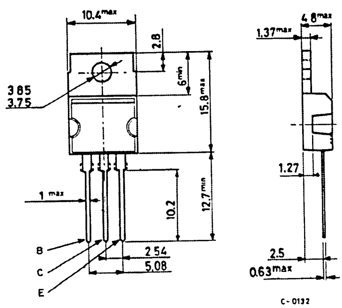
*** For PNP types voltage and current values are negative**

INTERNAL SCHEMATIC DIAGRAM

MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

10/84

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)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B = 0$)	for **BD241/42/41A/42A** $V_{CE} = 30V$			0.3	mA
		for **BD241B/42B/41C/42C** $V_{CE} = 60V$			0.3	mA
I_{CES}	Collector cutoff current ($V_{BE} = 0$)	for **BD241/42** $V_{CE} = 45V$			0.2	mA
		for **BD241A/42A** $V_{CE} = 60V$			0.2	mA
		for **BD241B/42B** $V_{CE} = 80V$			0.2	mA
		for **BD241C/42C** $V_{CE} = 100V$			0.2	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$			1	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 30mA$				
		for **BD241/42**	45			V
		for **BD241A/42A**	60			V
		for **BD241B/42B**	80			V
		for **BD241C/42C**	100			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	$I_C = 3A$ $I_B = 0.6A$			1.2	V
$V_{BE\ (on)}$*	Base-emitter voltage	$I_C = 3A$ $V_{CE} = 4V$			1.8	V
h_{FE}*	DC current gain	$I_C = 1A$ $V_{CE} = 4V$	25			—
		$I_C = 3A$ $V_{CE} = 4V$	10			—
h_{fe}	Small signal current gain	$I_C = 0.5A$ $V_{CE} = 10V$ f = 1KHz	20			—
		$I_C = 0.5A$ $V_{CE} = 10V$ f = 1MHz	3			—

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

For PNP types voltage and current values are negative

For the characteristics curves see TIP31/TIP32 series

BD243 BD244
BD243A BD244A
BD243B BD244B
BD243C BD244C

EPITAXIAL-BASE NPN/PNP

POWER LINEAR AND SWITCHING APPLICATIONS

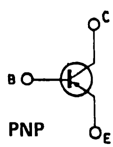
The BD243, BD243A, BD243B and BD243C are silicon epitaxial-base NPN power transistors in Jedec TO-220 plastic package, intended for use in medium power linear and switching applications. The complementary PNP types are the BD244, BD244A, BD244B and 244C respectively.

ABSOLUTE MAXIMUM RATINGS

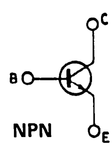
	NPN PNP*	BD243 BD244	BD243A BD244A	BD243B BD244B	BD243C BD244C
V_{CBO}	Collector-base voltage ($I_E = 0$)	45V	60V	80V	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	45V	60V	80V	100V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5V			
I_C	Collector current	6A			
I_{CM}	Collector peak current	10A			
I_B	Base current	2A			
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	65W			
T_{stg}	Storage temeprature	-65 to 150°C			
T_j	Junction temperature	150°C			

* **For PNP types voltage and current values are negative.**

INTERNAL SCHEMATIC DIAGRAMS



PNP

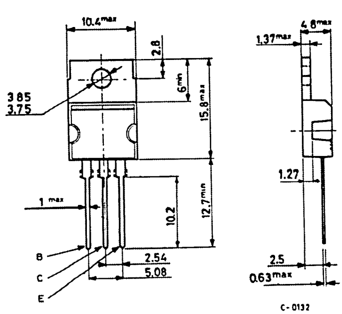


NPN

MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

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)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B = 0$)	for **BD243/44/43A/44A** $V_{CE} = 30V$			0.7	mA
		for **BD243B/44B/43C/44C** $V_{CE} = 60V$			0.7	mA
I_{CES}	Collector cutoff current ($V_{BE} = 0$)	for **BD243/44** $V_{CE} = 45V$			0.4	mA
		for **BD243A/44A** $V_{CE} = 60V$			0.4	mA
		for **BD243B/44B** $V_{CE} = 80V$			0.4	mA
		for **BD243C/44C** $V_{CE} = 100V$			0.4	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$			1	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 30mA$				
		for **BD243/44**	45			V
		for **BD243A/44A**	60			V
		for **BD243B/44B**	80			V
		for **BD243C/44C**	100			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	$I_C = 6A$ $I_B = 1A$			1.5	V
V_{BE}*	Base-emitter voltage	$I_C = 6A$ $V_{CE} = 4V$			2	V
h_{FE}*	DC current gain	$I_C = 0.3A$ $V_{CE} = 4V$	30			—
		$I_C = 3A$ $V_{CE} = 4V$	15			—
h_{fe}	Small signal current gain	$I_C = 0.5A$ $V_{CE} = 10V$ f = 1KHz	20			—
		$I_C = 0.50$ $V_{CE} = 10V$ f = 1MHz	3			—

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

For PNP types voltage and current values are negative

EPITAXIAL-BASE NPN/PNP

BD331 BD332
BD333 BD334
BD335 BD336

COMPLEMENTARY POWER DARLINGTONS

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.

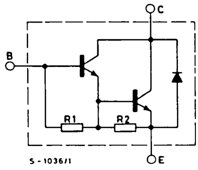
ABSOLUTE MAXIMUM RATINGS

	NPN	BD331	BD333	BD335
	PNP	BD332	BD334	BD336
V_{CBO}	Collector-base voltage ($I_E = 0$)	60V	80V	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	60V	80V	100V
V_{EBO}	Base-emitter voltage ($I_C = 0$)		5V	
I_C	Collector current		6A	
I_{CM}	Collector peak current ($t_p < 10$ ms)		10A	
I_B	Base current		0.15A	
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$		60W	
T_{stg}	Storage temperature		−65 to 150°C	
T_j	Junction temperature		150°C	

For PNP types voltage and current values are negative

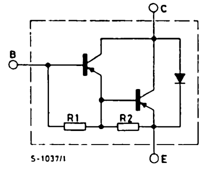
INTERNAL SCHEMATIC DIAGRAMS

NPN



R1 ≅ 10KΩ
R2 ≅ 150Ω

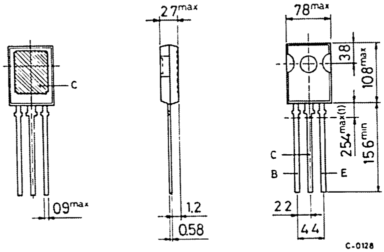
PNP



R1 ≅ 10KΩ
R2 ≅ 150Ω

MECHANICAL DATA

Dimensions in mm



(1) Within this region the cross-section of the leads is uncontrolled

SOT-82

THERMAL DATA

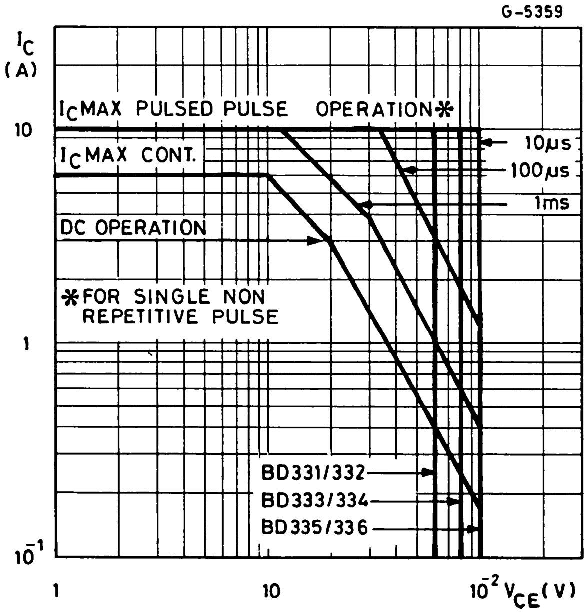
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	2.08	°C/W

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

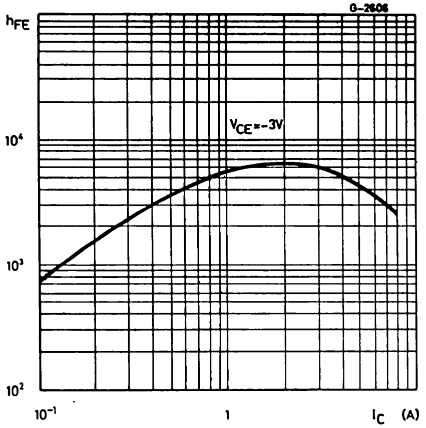
	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E=0$)	V_{CB} = rated V_{CBO} $T_{case}=150°C$			0.2 2	mA mA
I_{CEO}	Collector cutoff current ($I_B=0$)	$V_{CE}=1/2\ V_{CEO}$ max			0.5	mA
I_{EBO}	Emitter cutoff current ($I_C=0$)	$V_{EB}=5V$			5	mA
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C=3A$ $I_B=12mA$			2	V
V_{BE}*	Base-emitter voltage	$I_C=3A$ $V_{CE}=3V$			2.5	V
h_{FE}*	DC current gain	$I_C=0.5A$ $V_{CE}3V$ for **BD331, BD333, BD335** for **BD332, BD334, BD336** $I_C=3A$ $V_{CE}=3V$ for **BD331, BD333, BD335** for **BD332, BD334, BD336** $I_C=6A$ $V_{CE}=3V$ for **BD331, BD333, BD335** for **BD332, BD334, BD336**	 750 750	 1900 2700 3000 400		 — — — — — —
V_F*	Parallel diode forward voltage	$I_F=3A$		1.8		V
h_{fe}	Small signal current gain	$I_C=3A$ $V_{CE}=3V$ $f=1MHz$ for **BD331, BD333, BD335** for **BD332, BD334, BD336**		 50 150		 — —
t_{on}	Turn-on time	$I_C=3A$ $V_{CC}=30V$		1	2	μs
t_{off}	Turn-off time	$I_{B1}=-I_{B2}=12mA$		5	10	μs

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

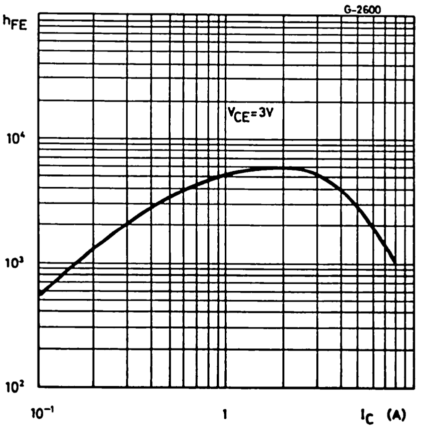
Safe operating areas



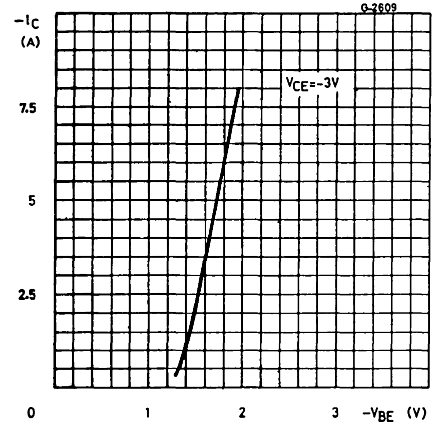
DC current gain (NPN types)



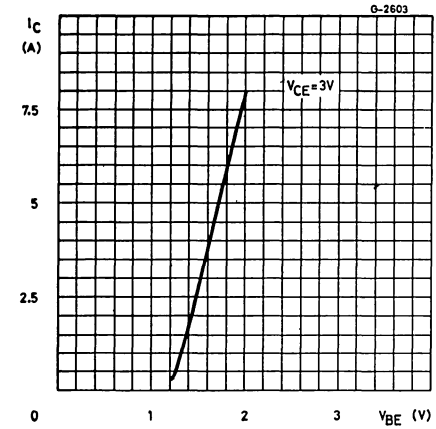
DC current gain (PNP types)



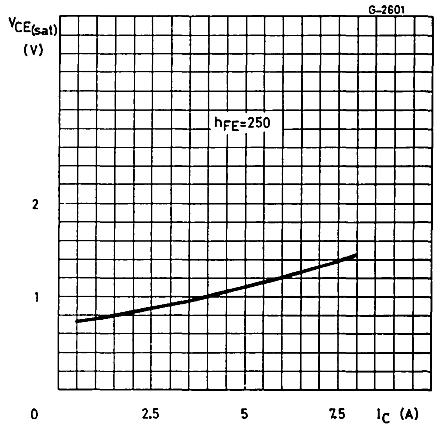
DC transconductance (NPN types)



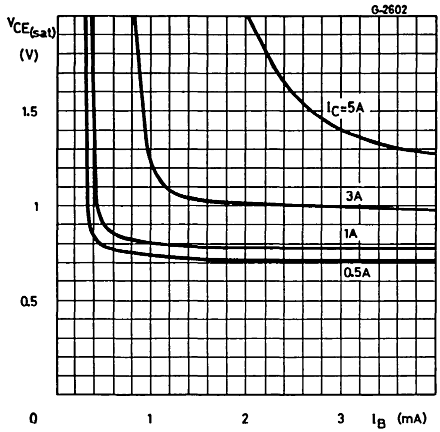
DC transconductance (PNP types)



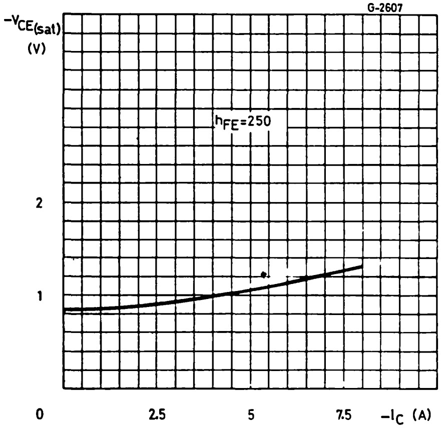
Collector-emitter saturation voltage (NPN types)



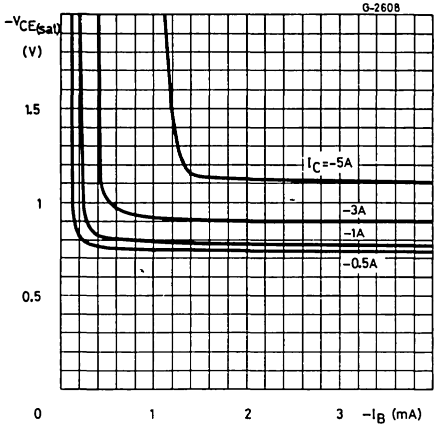
Collector-emitter saturation voltage (NPN types)



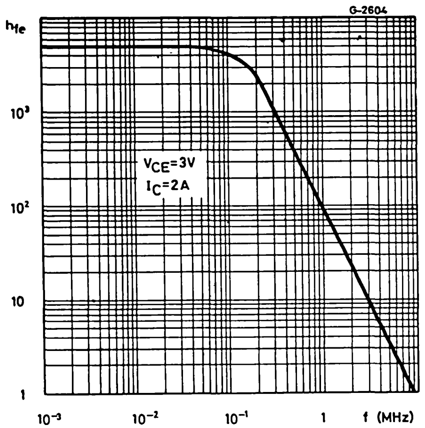
Collector-emitter saturation voltage (PNP types)



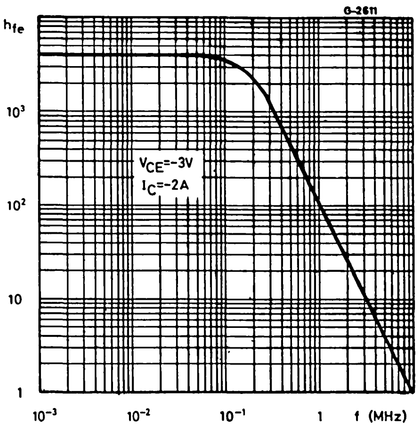
Collector-emitter saturation voltage (PNP types)



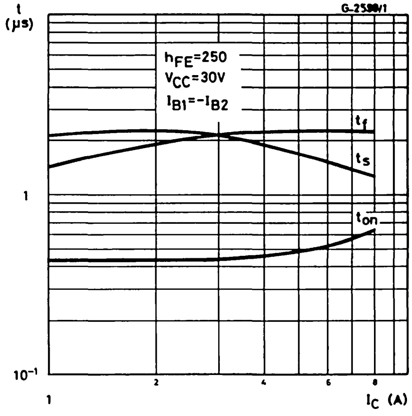
Small signal current gain (NPN types)



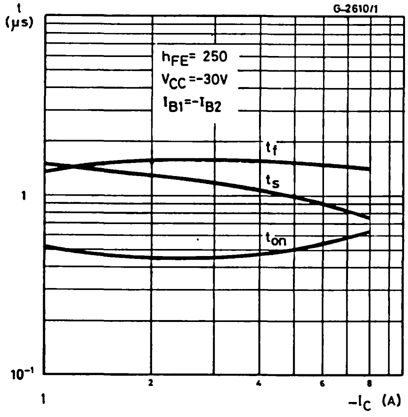
Small signal current gain (PNP types)



Saturated switching characteristics
(NPN types)



Saturated switching characteristics
(PNP types)



EPITAXIAL-BASE NPN/PNP

BD433 BD434
BD435 BD436
BD437 BD438

MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

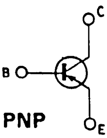
The BD 433, BD 435 and BD 437 are silicon epitaxial-base NPN power transistors in Jedec TO-126 plastic package, intended for use in medium power linear and switching applications.
The BD 433 is especially suitable for use in car-radio output stages.
The complementary PNP types are the BD 434, BD 436 and BD 438 respectively.

ABSOLUTE MAXIMUM RATINGS

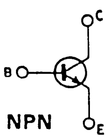
	NPN / PNP*	BD433 / BD434	BD435 / BD436	BD437 / BS438
V_{CBO}	Collector-base voltage ($I_E = 0$)	22V	32V	45V
V_{CES}	Collector-emitter voltage ($V_{BE} = 0$)	22V	32V	45V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	22V	32V	45V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		5V	
I_C	Collector current		4A	
I_{CM}	Collector peak current ($t \leq 10ms$)		7A	
I_B	Base current		1A	
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$		36W	
T_{stg}	Storage temperature		-65 to 150°C	
T_j	Junction temperature		150°C	

* **For PNP types voltage and current values are negative**

INTERNAL SCHEMATIC DIAGRAMS



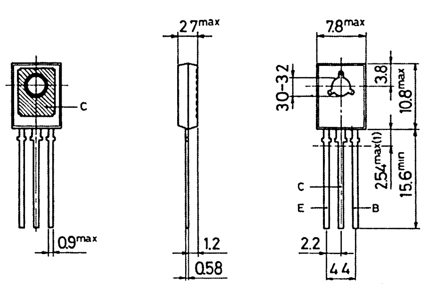
PNP



NPN

MECHANICAL DATA

Dimensions in mm



(1) Within this region the cross-section of the leads is uncontrolled

TO-126 (SOT-32)

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

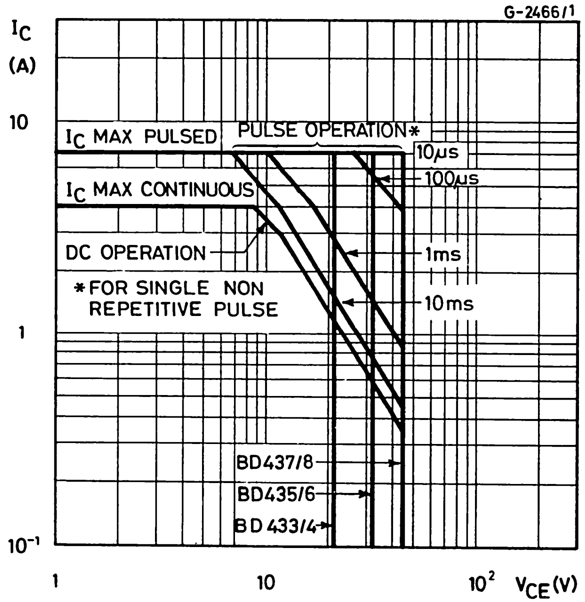
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current (I_E = 0)	for **BD433/34** V_{CB} = 22V			100	µA
		for **BD435/36** V_{CB} = 32V			100	µA
		for **BD437/38** V_{CB} = 45V			100	µA
I_{CES}	Collector cutoff current (V_{BE} = 0)	for **BD433/34** V_{CE} = 22V			100	µA
		for **BD435/36** V_{CE} = 32V			100	µA
		for **BD437/38** V_{CE} = 45V			100	µA
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 = 100mA				
		for **BD433/34**	22			V
		for **BD435/36**	32			V
		for **BD437/38**	45			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	I_C = 2A I_B = 0.2A				
		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} = 5V		0.58		V
		I_C = 2 A V_{CE} = 1V				
		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} = 5V				
		for **BD433/34**	40	130		—
		for **BD435/36**	40	130		—
		for **BD437/38**	30	130		—
		I_C = 500mA V_{CE} = 1V	85	140		—
		I_C = 2 A V_{CE} = 1V				
		for **BD433/34**	50			—
		for **BD435/36**	50			—
		for **BD437/38**	40			—
h_{FE_1}/h_{FE_2}*	Matched pair	I_C = 500mA V_{CE} = 1V			1.4	—
f_T	Transition frequency	I_C = 250mA V_{CE} = 1V	3			MHz

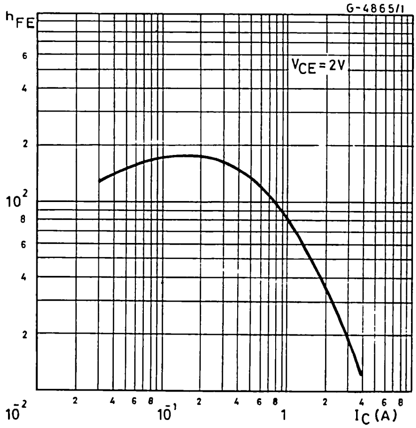
* Pulsed: pulse duration = 300 µs, duty cycle = 1.5%

For PNP types voltage and current values are negative

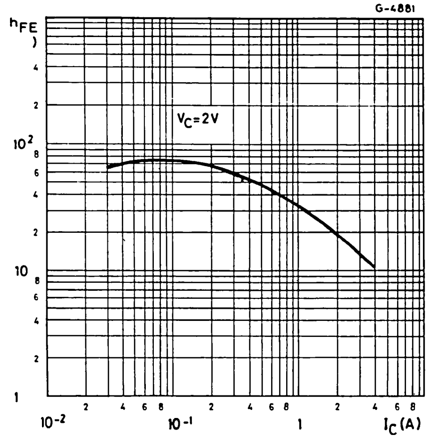
Safe operating areas



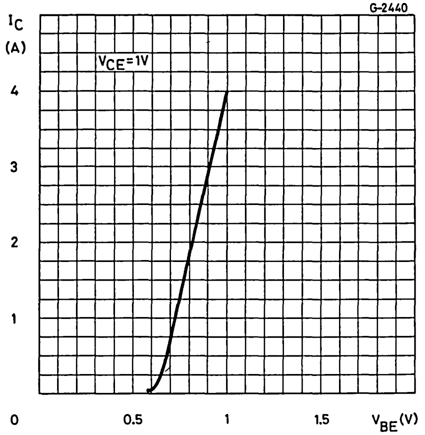
DC current gain (NPN types)



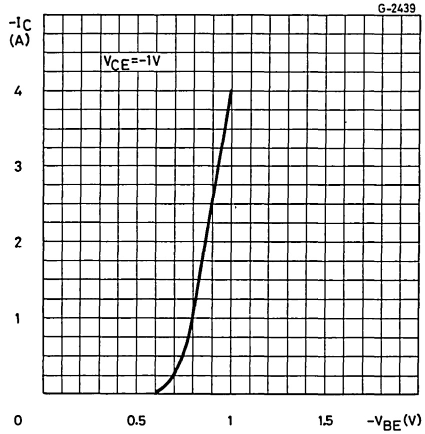
DC current gain (PNP types)



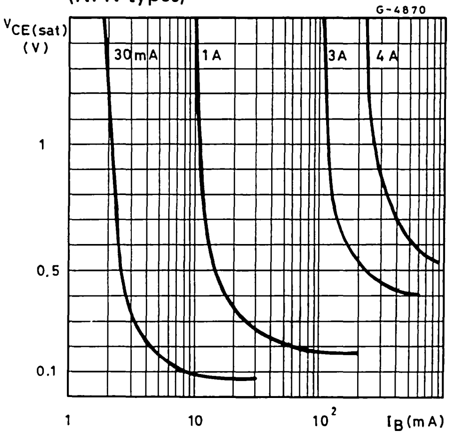
DC transconductance (NPN types)



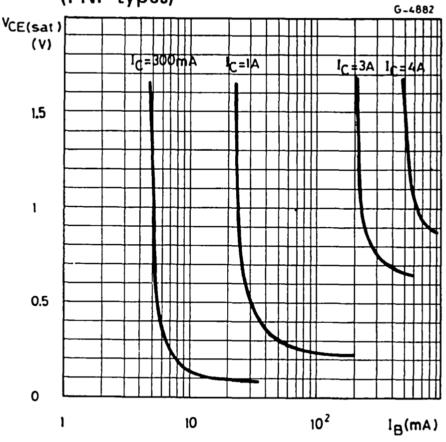
DC transconductance (PNP types)



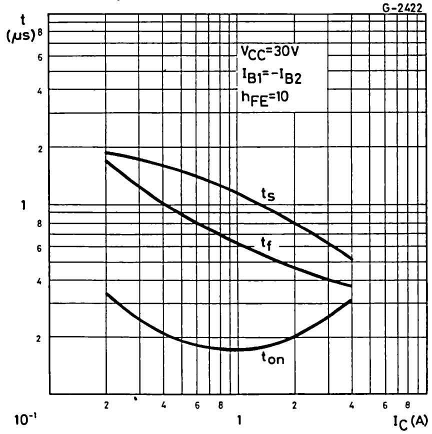
Collector-emitter saturation voltage (NPN types)



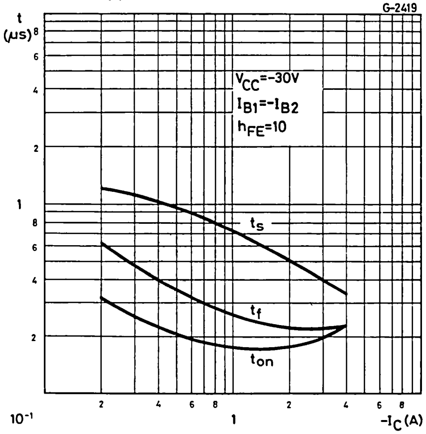
Collector-emitter saturation voltage (PNP types)



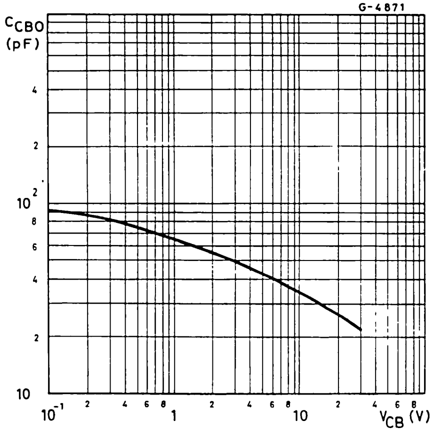
Saturated switching characteristics (NPN types)



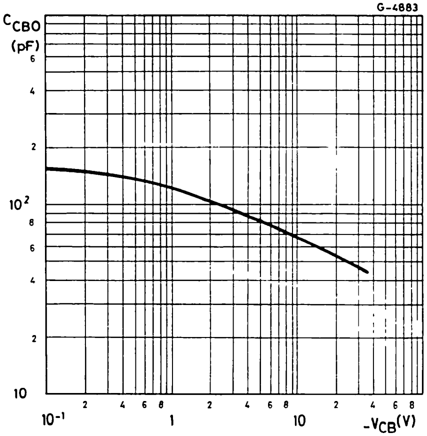
Saturated switching characteristics (PNP types)



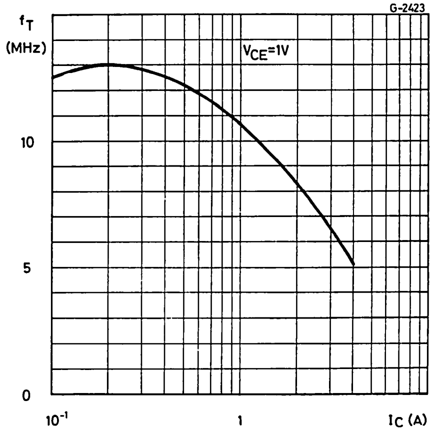
Collector-base capacitance (NPN types)



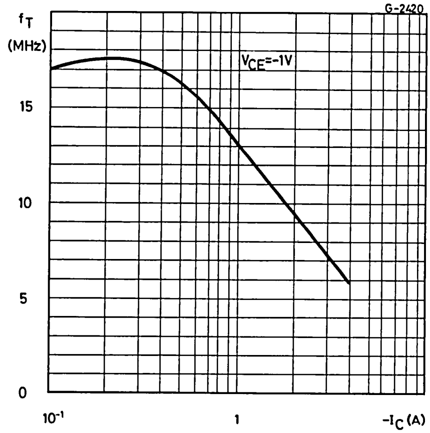
Collector-base capacitance (PNP types)



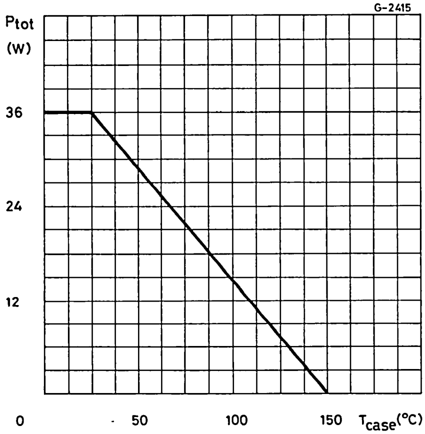
Transition frequency (NPN types)



Transition frequency (PNP types)



Power rating chart



EPITAXIAL-BASE NPN/PNP

BD439 BD440
BD441 BD442

MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

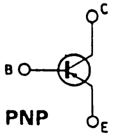
The BD 439 and BD 441 are silicon epitaxial-base NPN power transistors in Jedec TO-126 plastic package, intended for use in power linear and switching applications.
The complementary PNP types are the BD 440 and BD 442 respectively.

ABSOLUTE MAXIMUM RATINGS

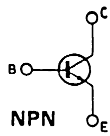
		NPN / PNP*	BD439 / BD440	BD441 / BD442
V_{CBO}	Collector-base voltage ($I_E = 0$)		60V	80V
V_{CES}	Collector-emitter voltage ($V_{BE} = 0$)		60V	80V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)		60V	80V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		5V	
I_C	Collector current		4A	
I_{CM}	Collector peak current ($t \leqslant 10ms$)		7A	
I_B	Base current		1A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$		36W	
T_{stg}	Storage temperature		-65 to 150°C	
T_j	Junction temperature		150°C	

* **For PNP types voltage and current values are negative**

INTERNAL SCHEMATIC DIAGRAMS



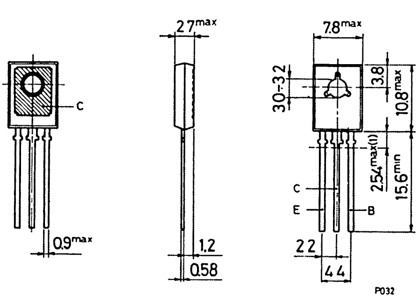
PNP



NPN

MECHANICAL DATA

Dimensions in mm



(1) Within this region the cross-section of the leads is uncontrolled

TO-126 (SOT-32)

BD439 BD440
BD441 BD442

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

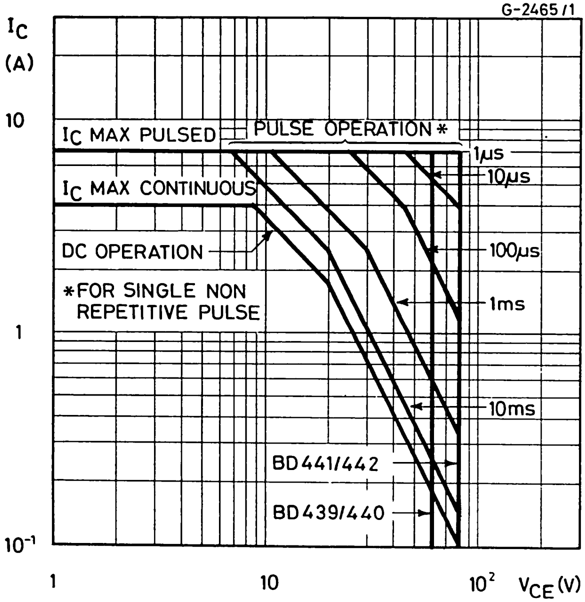
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current (I_E = 0)	for **BD439/40**	V_{CB} = 60V			100	µA
		for **BD441/42**	V_{CB} = 80V			100	µA
I_{CES}	Collector cutoff current (V_{BE} = 0)	for **BD439/40**	V_{CE} = 60V			100	µA
		for **BD441/42**	V_{CE} = 80V			100	µA
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 = 100mA	for **BD439/40**	60			V
			for **BD441/42**	80			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	I_C = 2A	I_B = 0.2A			0.8	V
V_{BE}*	Base-emitter voltage	I_C = 10 mA	V_{CE} = 5V		0.58		V
		I_C = 2 A	V_{CE} = 1V			1.5	V
h_{FE}*	DC current gain	I_C = 10 mA	V_{CE} = 5V				
			for **BD439/40**	20	130		—
			for **BD441/42**	15	130		—
		I_C = 500mA	V_{CE} = 1V				
			for **BD439/40**	40	140		—
			for **BD441/42**	40	140		—
		I_C = 2 A	V_{CE} = 1V				
			for **BD439/40**	25			—
			for **BD441/42**	15			—
h_{FE_1}/h_{FE_2}*	Matched pair	I_C = 500mA	V_{CE} = 1V			1.4	—
f_T	Transition frequency	I_C = 250mA	V_{CE} = 1V	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 characteristic curve see the BD433/BD434 series

BD533 BD534
BD535 BD536
BD537 BD538

EPITAXIAL-BASE NPN/PNP

MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

The BD 533, BD 535 and BD 537 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 BD 534, BD 536 and BD 538 respectively.

ABSOLUTE MAXIMUM RATINGS

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

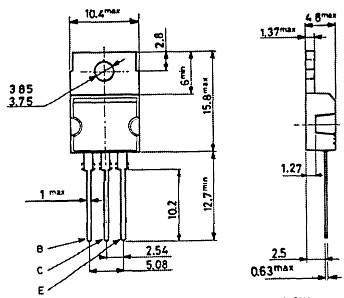
* **For PNP types voltage and current values are negative**

INTERNAL SCHEMATIC DIAGRAMS

MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

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

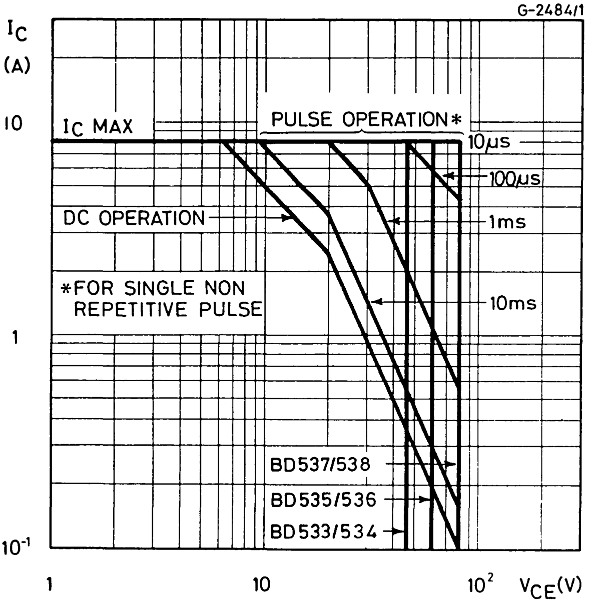
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current (I_E = 0)	for **BD533/34** V_{CB} = 45V			100	μA
		for **BD535/36** V_{CB} = 60V			100	μA
		for **BD537/38** V_{CB} = 80V			100	μA
I_{CES}	Collector cutoff current (V_{BE} = 0)	for **BD533/34** V_{CE} = 45V			100	μA
		for **BD535/36** V_{CE} = 60V			100	μA
		for **BD537/38** V_{CE} = 80V			100	μA
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 = 100mA for **BD533/34**	45			V
		for **BD535/36**	60			V
		for **BD537/38**	80			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	I_C = 2A I_B = 0.2A			0.8	V
		I_C = 6A I_B = 0.6A		0.8		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} = 5V				
		for **BD533/34**	20			—
		for **BD535/36**	20			—
		for **BD537/38**	15			—
		I_C = 500mA V_{CE} = 2V	40			—
		I_C = 2 A V_{CE} = 2V				
		for **BD533/34**	25			—
		for **BD535/36**	25			—
		for **BD537/38**	15			—
f_T	Transition frequency	I_C = 500mA V_{CE} = 1V	3	12		MHz
h_{FE} groups**:	J	I_C = 2A V_{CE} = 2 V	30		75	—
		I_C = 3A V_{CE} = 2 V	15			—
	K	I_C = 2A V_{CE} = 2 V	40		100	—
		I_C = 3A V_{CE} = 2 V	20			—

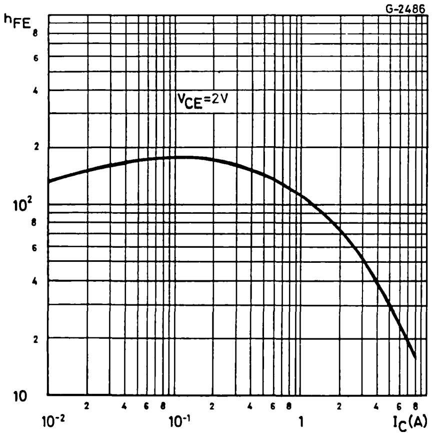
* Pulsed: pulse duration = 300 μs, duty cycle = 1 5% ** Only on request

For PNP types voltage and current values are negative

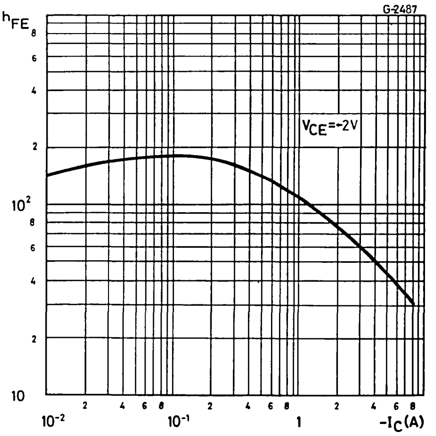
Safe operating areas



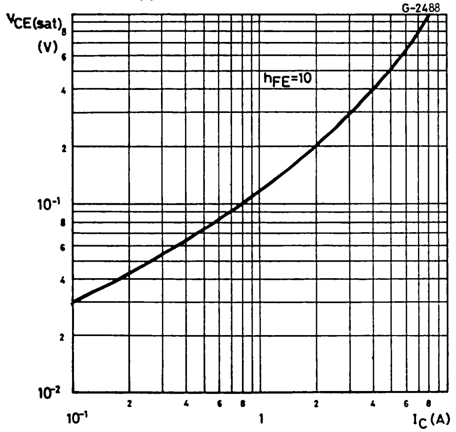
DC current gain (NPN types)



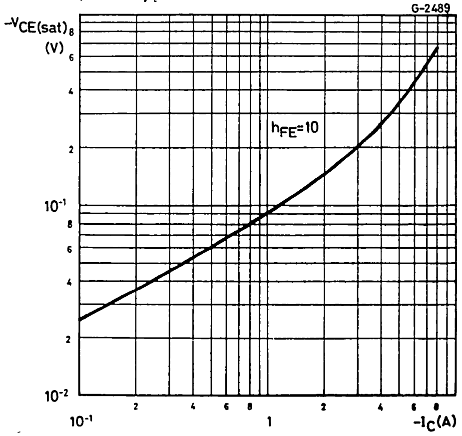
DC current gain (PNP types)



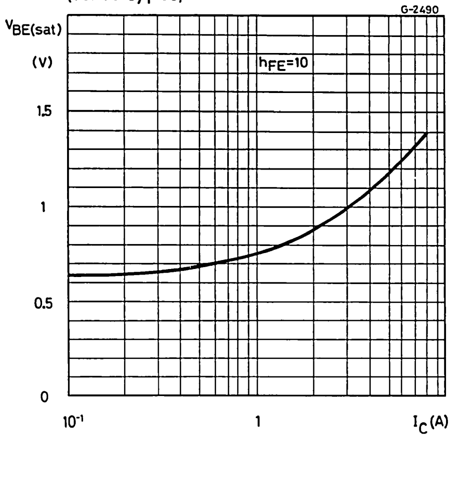
Collector-emitter saturation voltage (NPN types)



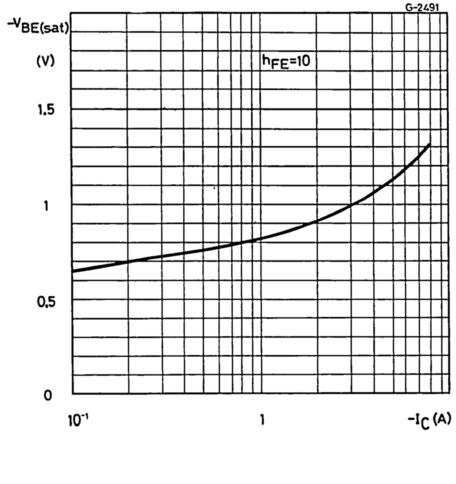
Collector-emitter saturation voltage (PNP types)



Base-emitter saturation voltage (NPN types)



Base-emitter saturation voltage (PNP types)



BD675A BD676A
BD677A BD678A
BD679A BD680A
BD681 BD682

EPITAXIAL-BASE NPN/PNP

MEDIUM POWER DARLINGTONS

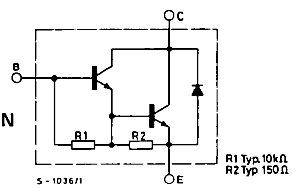
The BD675, BD675A, BD677, BD677A, BD679, BD679A and BD681 are silicon epitaxial-base NPN power transistors in monolithic Darlington configuration and are mounted in Jedec TO-126 plastic package. They are intended for use in medium power linear and switching applications.

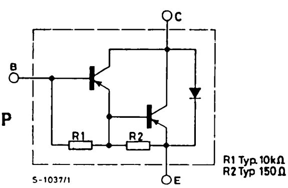
The complementary PNP types (the BD676, BD676A, BD678, BD678A, BD680, BD680A and BD682 respectively) have same characteristics of NPN types but voltage and current values are negative.

ABSOLUTE MAXIMUM RATINGS

		BD675 BD675A	BD677 BD677A	BD679 BD679A	BD681
V_{CBO}	Collector-base voltage ($I_E = 0$)	45V	60V	80V	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	45V	60V	80V	100V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5V			
I_C	Collector current	4A			
I_{CM}	Collector peak current (repetitive)	6A			
I_B	Base current	100mA			
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$	40W			
T_{stg}	Storage temperature	-65 to 150°C			
T_j	Junction temperature	150°C			

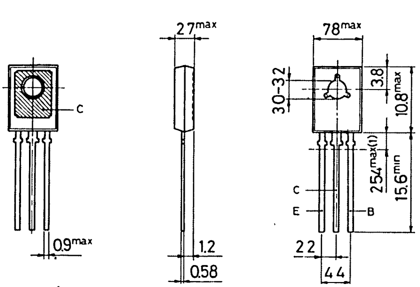
INTERNAL SCHEMATIC DIAGRAMS





MECHANICAL DATA

Dimensions in mm



(1) Within this region the cross-section of the leads is uncontrolled

TO-126 (SOT-32)

THERMAL DATA

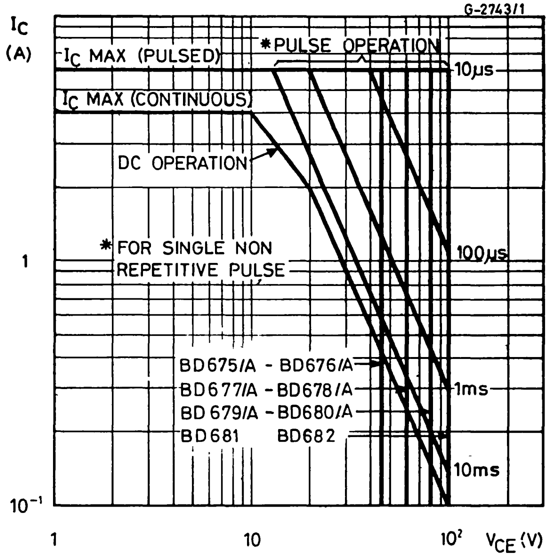
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max.	3.12	°C/W
$R_{th\ j\text{-}amb}$	Thermal resistance junction-ambient	max.	100	°C/W

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

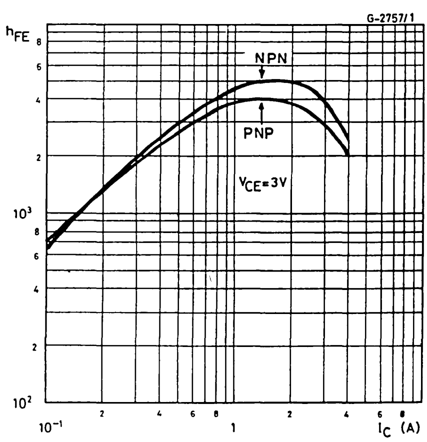
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	V_{CB} = rated V_{CBO}			200	μA
		V_{CB} = rated V_{CBO} T_{case} = 100°C			2	mA
I_{CEO}	Collector cutoff current ($I_B = 0$)	V_{CE} = half rated V_{CEO}			500	μA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	V_{EB} = 5V			2	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	I_C = 50mA				
		for **BD675/675A**	45			V
		for **BD677/677A**	60			V
		for **BD679/679A**	80			V
		for **BD681**	100			V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	for **BD675/677/679/681** I_C = 1.5A I_B = 30mA			2.5	V
		for **BD675A/677A/679A** I_C = 2A I_B = 40mA			2.8	V
V_{BE}*	Base-emitter voltage	for **BD675/677/679/681** I_C = 1.5A V_{CE} = 3V			2.5	V
		for **BD675A/677A/679A** I_C = 2A V_{CE} = 3V			2.5	V
h_{FE}*	DC current gain	for **BD675/677/679/681** I_C = 1.5A V_{CE} = 3V	750			–
		for **BD675A/677A/679A** I_C = 2A V_{CE} = 3V	750			–
h_{fe}	Small signal current gain	I_C = 1.5A V_{CE} = 3V f = 1MHz	1			–

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

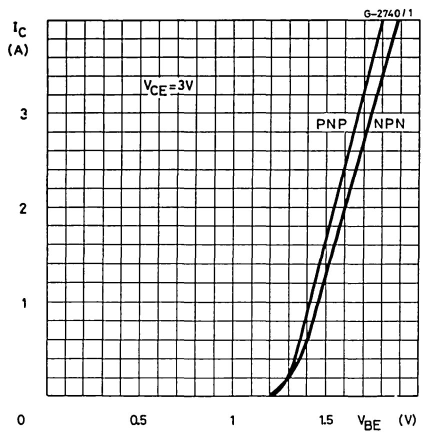
Safe operating areas



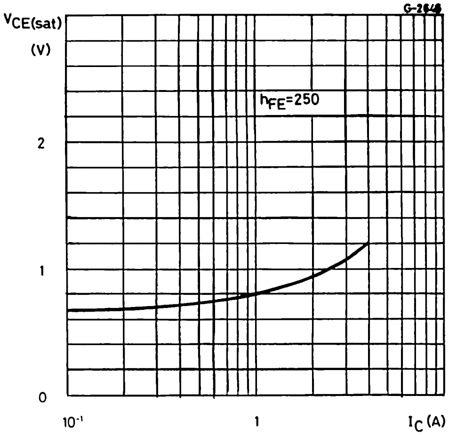
DC current gain



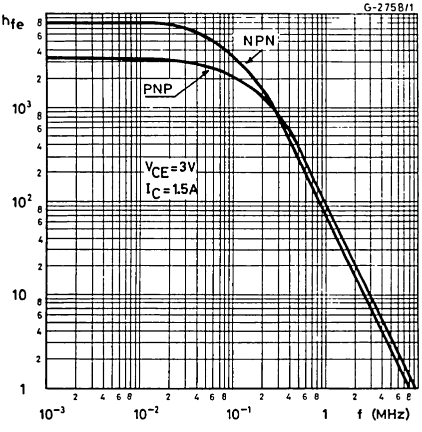
DC transconductance



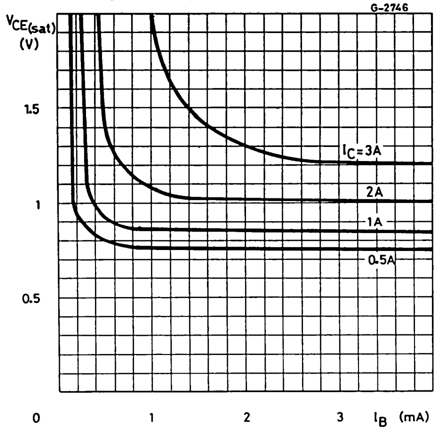
Collector–emitter saturation voltage



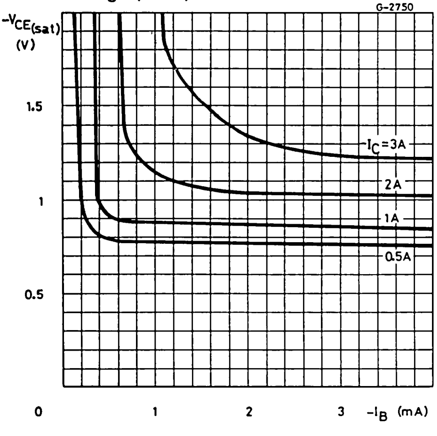
Small signal current gain



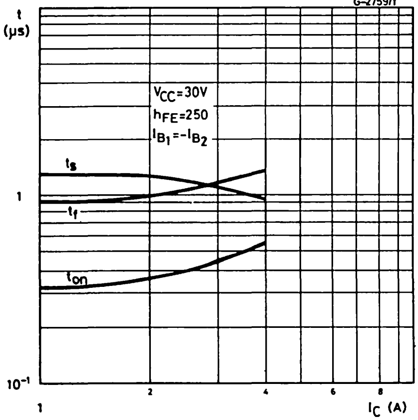
Collector–emitter saturation voltage (NPN)



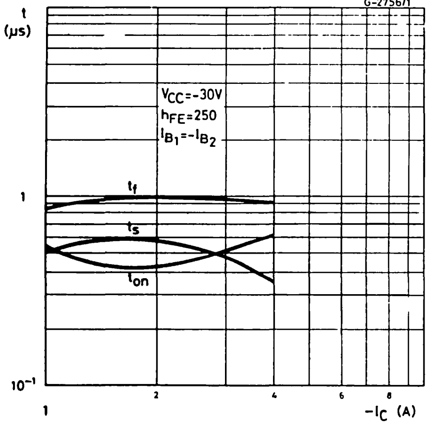
Collector–emitter saturation voltage (PNP)



Saturated switching characteristics (NPN)



Saturated switching characteristics (PNP)



EPITAXIAL-BASE NPN/PNP

BD705 BD706
BD707 BD708
BD709 BD710
BD711 BD712

POWER LINEAR AND SWITCHING APPLICATIONS

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.

ABSOLUTE MAXIMUM RATINGS

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

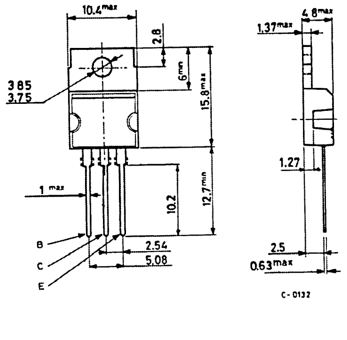
* For PNP types voltage and current values are negative

INTERNAL SCHEMATIC DIAGRAMS

MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

10/84

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)

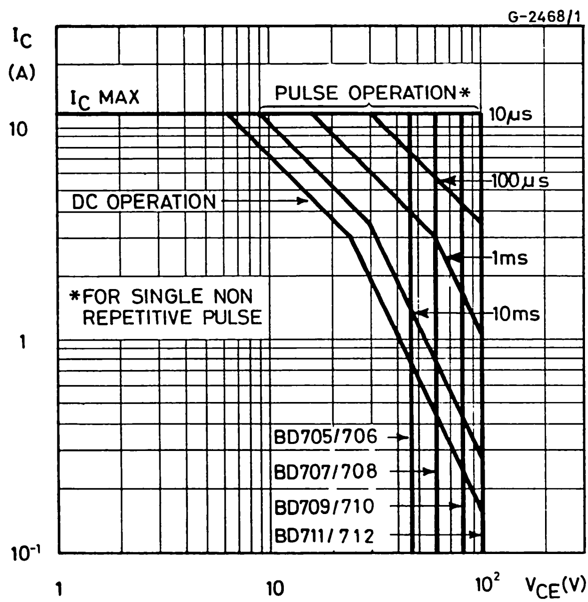
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current (I_E = 0)	for **BD705/706** V_{CB} = 45 V			100	μA
		for **BD707/708** V_{CB} = 60 V			100	μA
		for **BD709/710** V_{CB} = 80 V			100	μA
		for **BD711/712** V_{CB} = 100 V			100	μA
		T_{case} = 150°C				
		for **BD705/706** 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 = 3A I_B = **		0.4		V
V_{BE}*	Base-emitter voltage	I_C = 4A V_{CE} = 4V			1.5	V

ELECTRICAL CHARACTERISTICS (continued)

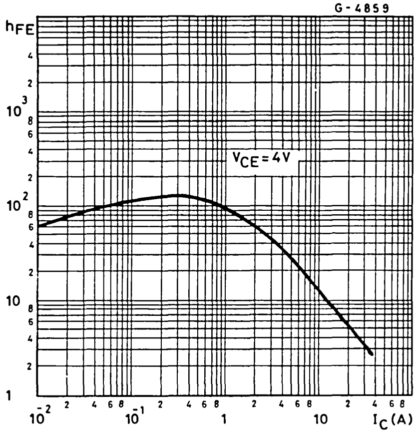
Parameter		Test conditions		Min.	Typ.	Max.	Unit
h_{FE}*	DC current gain	I_C = 0.5A	V_{CE} = 2V	40	120	400	—
		I_C = 2A	V_{CE} = 2V				
			for **BD705/706**	30			—
			for **BD707/708**	30			—
			for **BD709/710**	30			—
		I_C = 4A	V_{CE} = 4V				
			for **BD705/706**	20	30	150	—
			for **BD707/708**	15		150	—
			for **BD709/710**	15		150	—
			for **BD711/712**	15		150	—
		I_C = 10A	V_{CE} = 4V				
			for **BD705/706**	5	10		—
			for **BD707/708**	5	10		—
			for **BD709/710**		8		—
			for **BD711/712**		8		—
f_T	Transition frequency	I_C = 300mA	V_{CE} = 3V	3			MHz

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

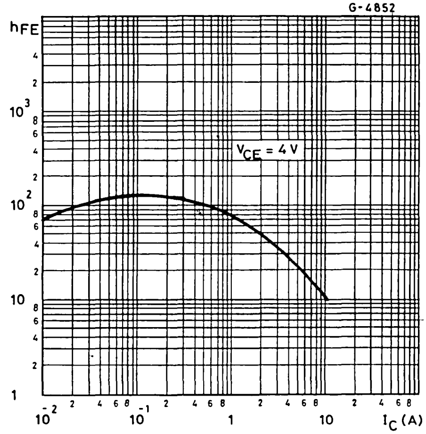
Safe operating areas



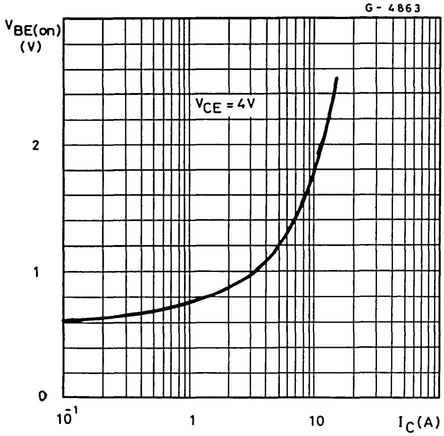
DC current gain (NPN types)



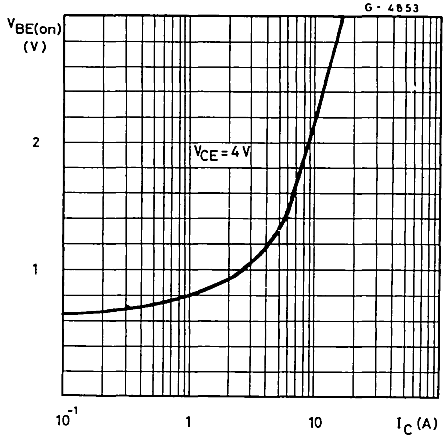
DC current gain (PNP types)



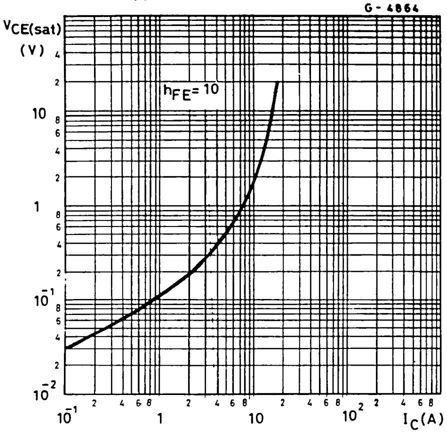
DC transconductance (NPN types)



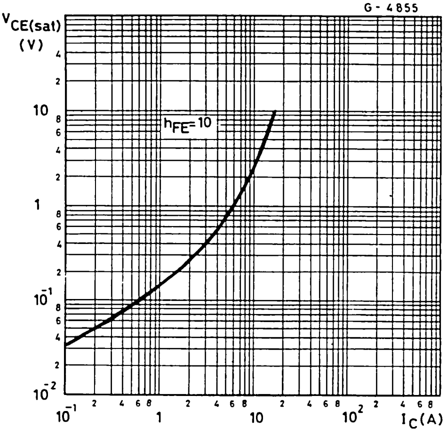
DC transconductance (PNP types)



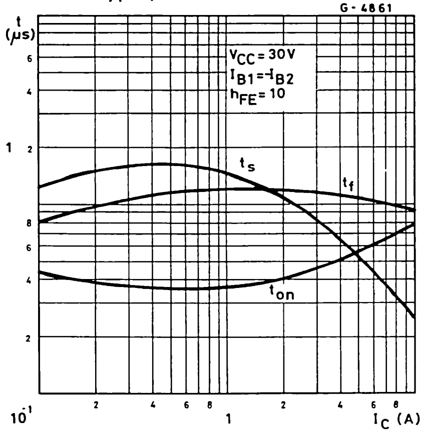
Collector-emitter saturation voltage (NPN types)



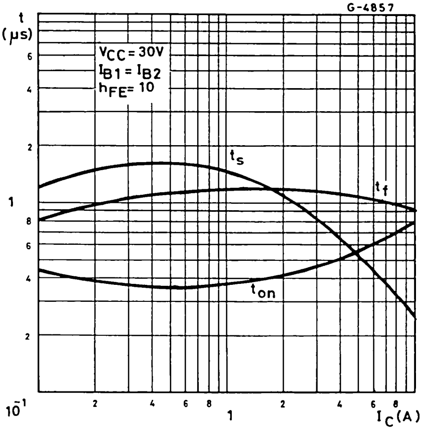
Collector-emitter saturation voltage (PNP types)



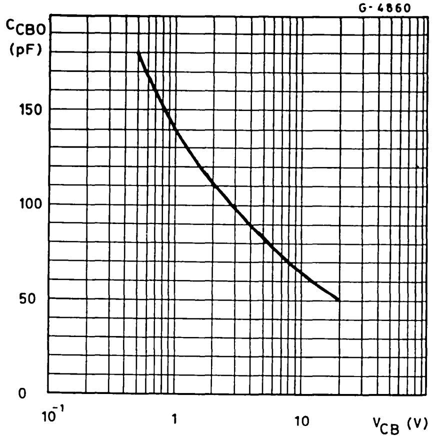
Saturated switching characteristics (NPN types)



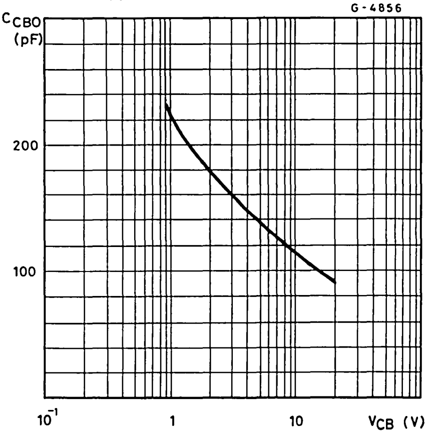
Saturated switching characteristics (PNP types)



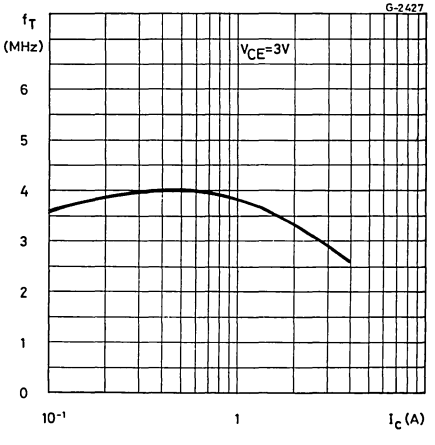
Collector-base capacitance (NPN types)



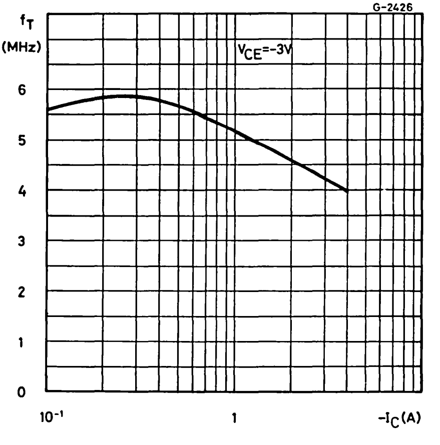
Collector-base capacitance (PNP types)



Transition frequency (NPN types)



Transition frequency (PNP types)



BD905 BD906
BD907 BD908
BD909 BD910
BD911 BD912

EPITAXIAL-BASE NPN/PNP

POWER LINEAR AND SWITCHING APPLICATIONS

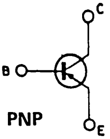
The BD 905, BD 907, BD 909, BD 911 are silicon epitaxial-base NPN power transistors in Jedec TO-220 plastic package. They are intended for use in power linear and switching applications.
The complementary PNP types are the BD 906, BD 908, BD 910 and BD 912 respectively.

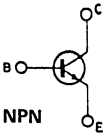
ABSOLUTE MAXIMUM RATINGS

		NPN PNP*	BD905 BD906	BD907 BD908	BD909 BD910	BD911 BD912
V_{CBO}	Collector-base voltage ($I_E = 0$)		45V	60V	80V	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)		45V	60V	80V	100V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		5V			
I_E, I_C	Emitter and collector current		15A			
I_B	Base current		5A			
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$		90W			
T_{stg}	Storage temperature		-65 to 150°C			
T_j	Junction temperature		150°C			

* **For PNP types voltage and current values are negative**

INTERNAL SCHEMATIC DIAGRAMS

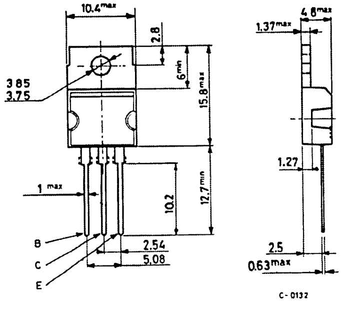




MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1.4	°C/W

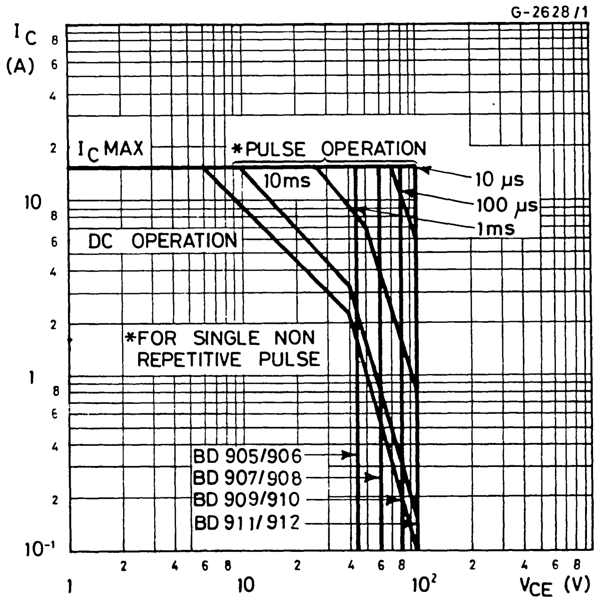
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	for **BD905/906**	V_{CB} = 45V			500	µA
		for **BD907/908**	V_{CB} = 60V			500	µA
		for **BD909/910**	V_{CB} = 80V			500	µA
		for **BD911/912**	V_{CB} = 100V			500	µA
		T_{case} = 150°C					
		for **BD905/906**	V_{CB} = 45V			5	mA
		for **BD907/908**	V_{CB} = 60V			5	mA
		for **BD909/910**	V_{CB} = 80V			5	mA
		for **BD911/912**	V_{CB} = 100V			5	mA
I_{CEO}	Collector cutoff current ($I_B = 0$)	for **BD905/906**	V_{CE} = 30V			1	mA
		for **BD907/908**	V_{CE} = 30V			1	mA
		for **BD909/910**	V_{CE} = 40V			1	mA
		for **BD911/912**	V_{CE} = 50V			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 = 100mA					
			for **BD905/906**	45			V
			for **BD907/908**	60			V
			for **BD909/910**	80			V
			for **BD911/912**	100			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	I_C = 5A	I_B = 0.5A			1	V
		I_C = 10A	I_B = 2.5A			3	V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	I_C = 10A	I_B = 2.5A			2.5	V
V_{BE}*	Base-emitter voltage	I_C = 5A	V_{CE} = 4V			1.5	V
h_{FE}*	DC current gain	I_C = 0.5A	V_{CE} = 4V	40		250	—
		I_C = 5A	V_{CE} = 4V	15		150	—
		I_C = 10A	V_{CE} = 4V	5			—
f_T	Transition frequency	I_C = 0.5A	V_{CE} = 4V	3			MHz

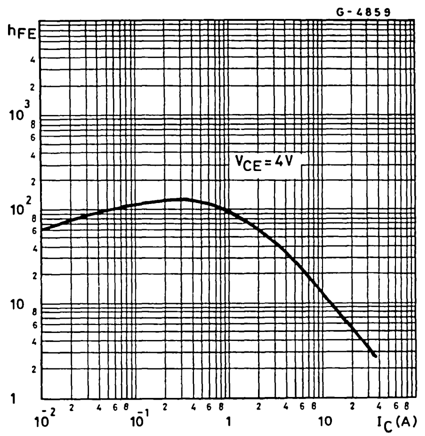
* Pulsed: pulse duration = 300 µs, duty cycle = 1.5%

For PNP types voltage and current values are negative

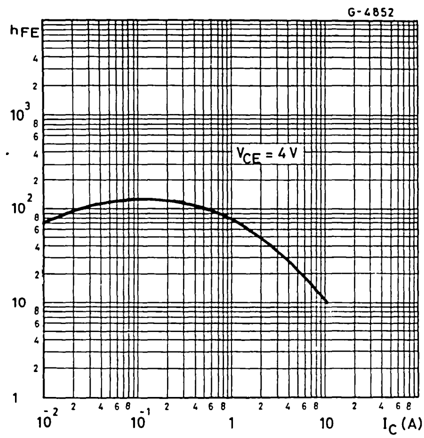
Safe operating areas



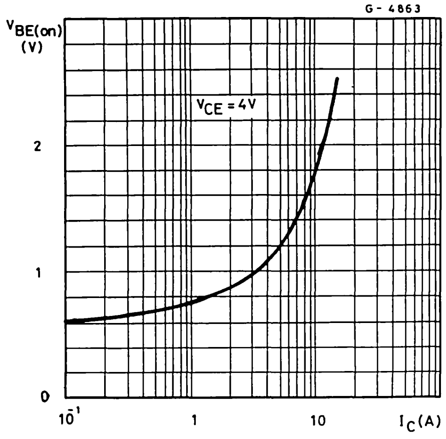
DC current gain (NPN types)



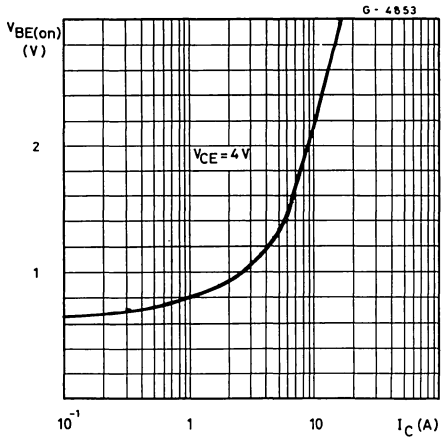
DC current gain (PNP types)



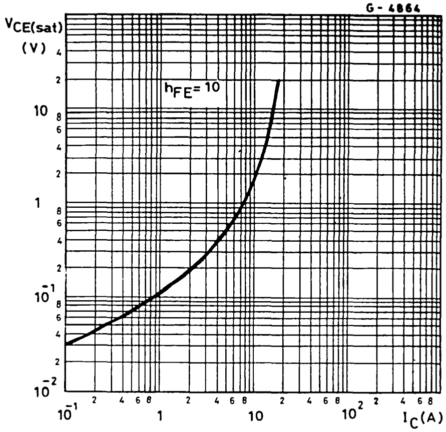
DC transconductance (NPN types)



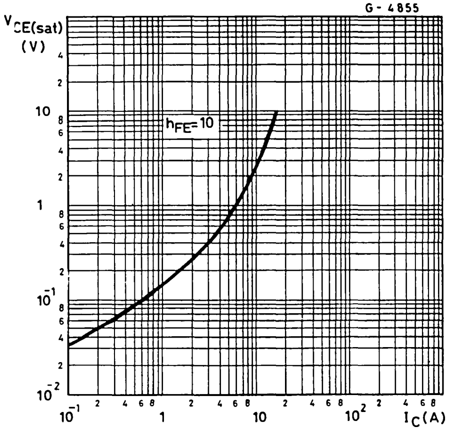
DC transconductance (PNP types)



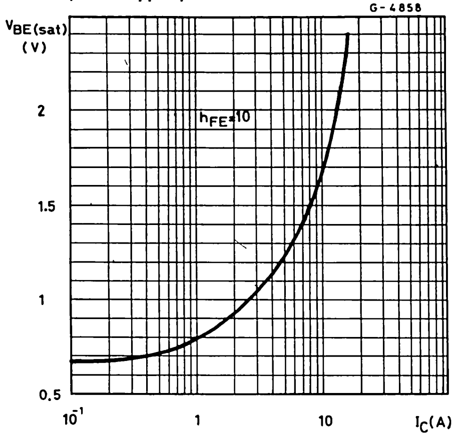
Collector-emitter saturation voltage (NPN types)



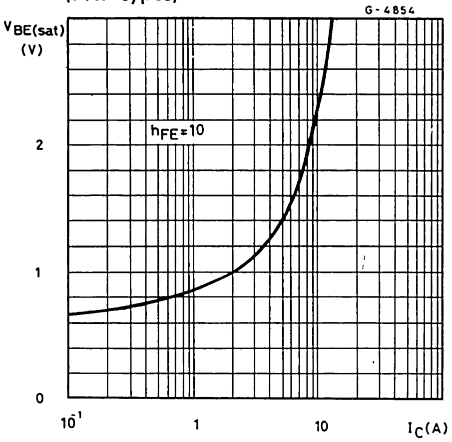
Collector-emitter saturation voltage (PNP types)



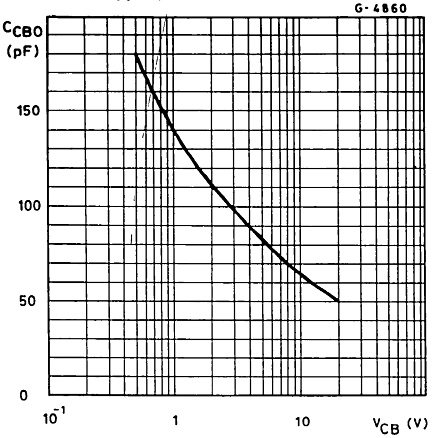
Base-emitter saturation voltage
(NPN types)



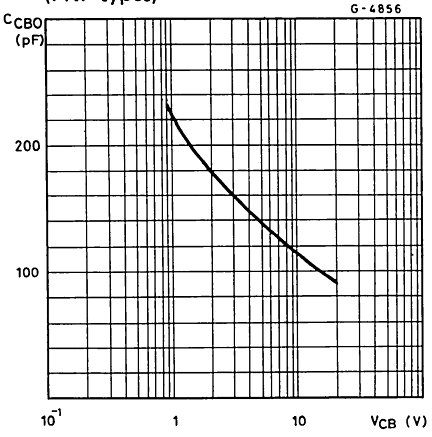
Base-emitter saturation voltage
(PNP types)



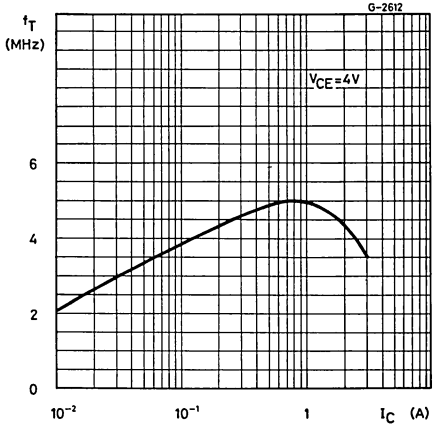
Collector-base capacitance
(NPN types)



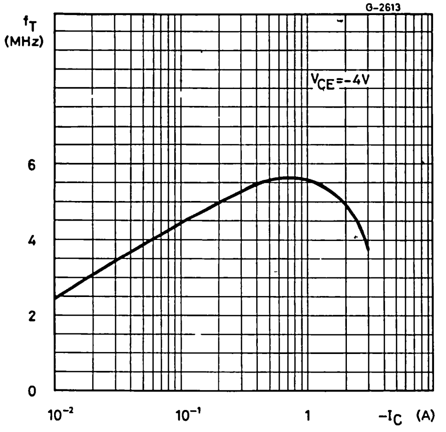
Collector-base capacitance
(PNP types)



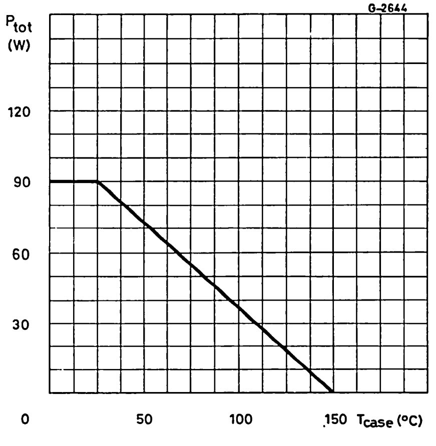
Transition frequency (NPN types)



Transition frequency (PNP types)



Power rating chart



EPITAXIAL-BASE NPN/PNP

BDV64 BDV65
BDV64A BDV65A
BDV64B BDV65B

POWER DARLINGTONS

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.

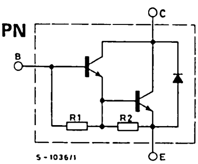
ABSOLUTE MAXIMUM RATINGS

	* PNP NPN	BDV64 BDV65	BDV64A BDV65A	BDV64B BDV65B
V_{CBO}	Collector-base voltage ($I_E = 0$)	60V	80V	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	60V	80V	100V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		5V	
I_C	Collector current		12A	
I_{CM}	Collector peak current (repetitive)		20A	
I_B	Base current		0.5A	
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$		125W	
T_{stg}	Storage temperature		-65 to 150°C	
T_j	Junction temperature		150°C	

* For PNP types voltage and current values are negative

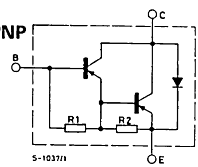
INTERNAL SCHEMATIC DIAGRAMS

NPN



R1 ≅ 5KΩ
R2 ≅ 150Ω

PNP

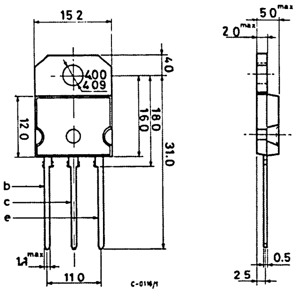


R1 ≅ 5KΩ
R2 ≅ 150Ω

MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



(sim. to **TO-218**) **SOT-93**

BDV64 BDV65
BDV64A BDV65A
BDV64B BDV65B

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction–case	max. 1 °C/W

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

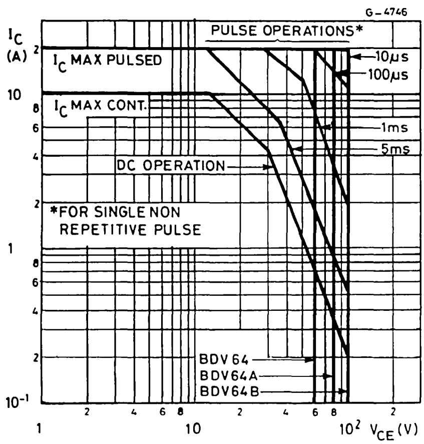
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	for **BDV64/5** V_{CB} = 60V for **BDV64A/5A** V_{CB} = 80V for **BDV64B/5B** V_{CB} = 100V T_{case} = 150°C for **BDV64/65** V_{CB} = 30V for **BDV64A/5A** V_{CB} = 40V for **BDV64B/5B** V_{CB} = 50V			400 400 400 2 2 2	μA μA μA mA mA mA
I_{CEO}	Collector cutoff current ($I_B = 0$)	for **BDV64/65** V_{CE} = 30V for **BDV64A/5A** V_{CE} = 40V for **BDV64B/5B** V_{CE} = 50V			1 1 1	mA mA mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	V_{EBO} = 5V			5	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	I_C = 30mA for **BDV64/65** for **BDV64A/5A** for **BDV64B/5B**	 60 80 100			 V V V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	I_C = 5A I_B = 20mA			2	V
V_{BE} *	Base-emitter voltage	I_C = 5A V_{CE} = 4V			2.5	V
h_{FE} *	DC current gain	I_C = 1A V_{CE} = 4V I_C = 5A V_{CE} = 4V I_C = 10A V_{CE} = 4V	 1000 	2500 500		– – –
V_F	Parallel diode forward voltage	I_F = 5A		1.2		V

ELECTRICAL CHARACTERISTICS (continued)

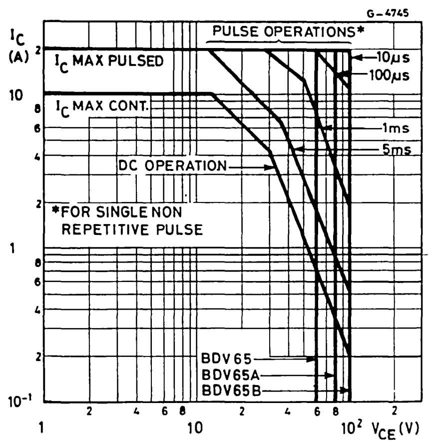
Parameter		Test conditions		Min.	Typ.	Max.	Unit
h_{fe}	Small signal current gain	$I_C = 5A$ $f = 1$ MHz	$V_{CE} = 4V$		60		–
C_{CBO}	Collector-base capacitance	$V_{CB} = 10V$ $f = 1$ MHz	$I_E = 0$		100		pF
t_{on}	Turn-on time	$I_C = 5A$ $I_{B2} = 20A$	$I_{B1} = 20mA$ $V_{CC} = 16V$		0.5		μs
t_s	Storage time				1.1 1.3	**	μs μs
t_f	Fall time				2.5 1.0	**	μs μs

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

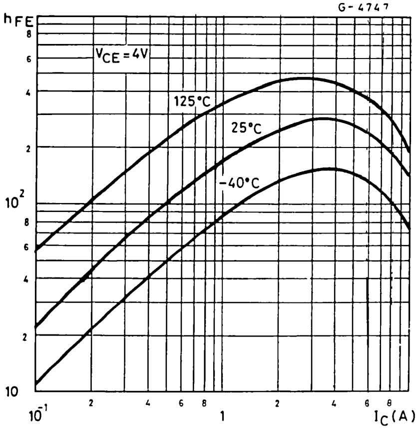
Safe operating areas



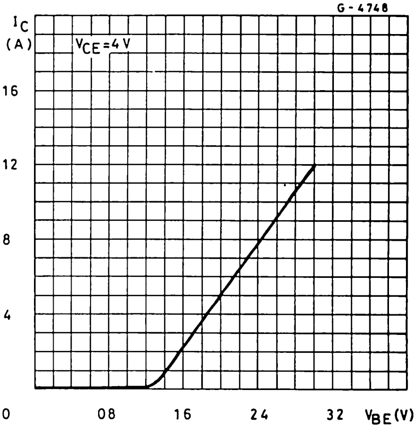
Safe operating areas



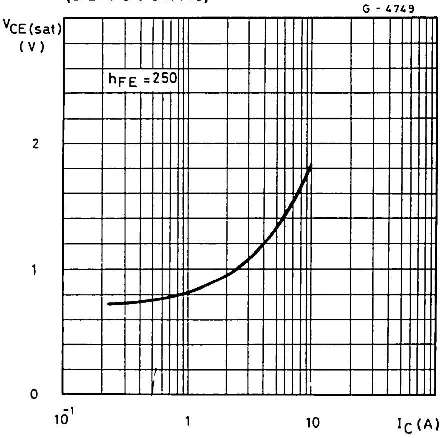
DC current gain (BDV64 series)



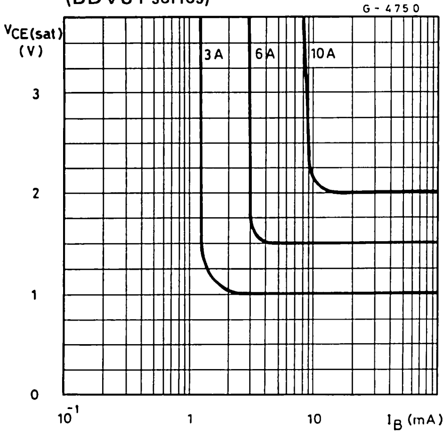
DC transconductance (BDV64 series)



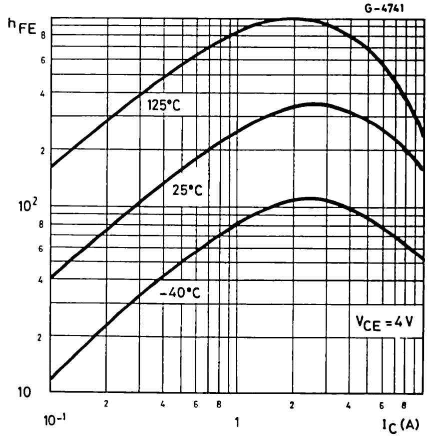
Collector-emitter saturation voltage (BDV64 series)



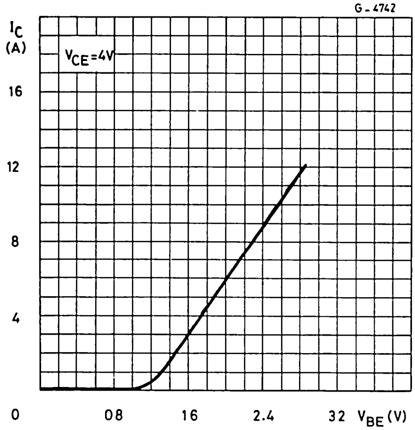
Collector-emitter saturation voltage (BDV64 series)



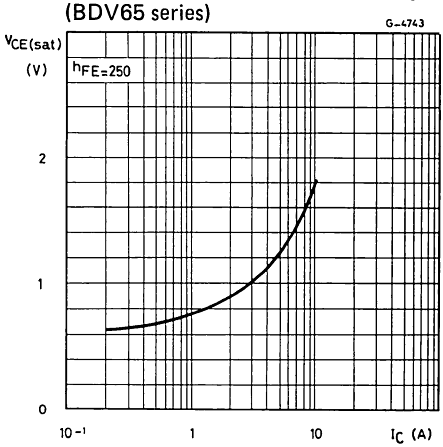
DC current gain (BDV65 series)



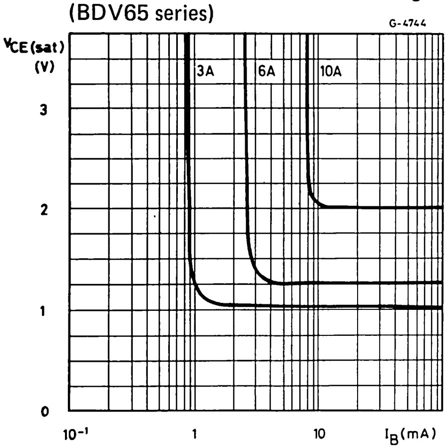
DC transconductance (BDV65 series)



Collector-emitter saturation voltage (BDV65 series)



Collector-emitter saturation voltage (BDV65 series)



BDW51 BDW52
BDW51A BDW52A
BDW51B BDW52B
BDW51C BDW52C

EPITAXIAL-BASE NPN/PNP

POWER LINEAR AND SWITCHING APPLICATIONS

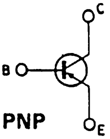
The BDW 51, BDW 51A, BDW 51B and BDW 51C are silicon epitaxial-base NPN power transistors in Jedec TO-3 metal case. They are intended for use in power linear and switching applications.
The complementary PNP types are the BDW 52, BDW 52A, BDW 52B and BDW 52C respectively.

ABSOLUTE MAXIMUM RATINGS

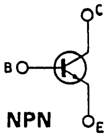
	NPN / PNP*	BDW51 / BDW52	BDW51A / BDW52A	BDW51B / BDW52B	BDW51C / BDW52C
V_{CBO}	Collector-base voltage ($I_E = 0$)	45V	60V	80V	100V
V_{CES}	Collector-emitter voltage ($V_{BE} = 0$)	45V	60V	80V	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	45V	60V	80V	100V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5V			
I_C	Collector current	15A			
I_{CM}	Collector peak current (repetitive)	20A			
I_B	Base current	7A			
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$	125W			
T_{stg}	Storage temperature	-65 to 200°C			
T_j	Junction temperature	200°C			

* For PNP types voltage and current values are negative

INTERNAL SCHEMATIC DIAGRAMS



PNP

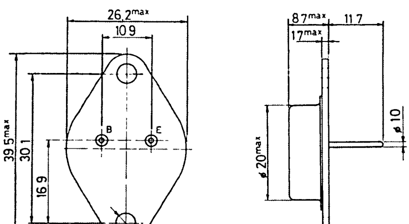


NPN

MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1.4	°C/W

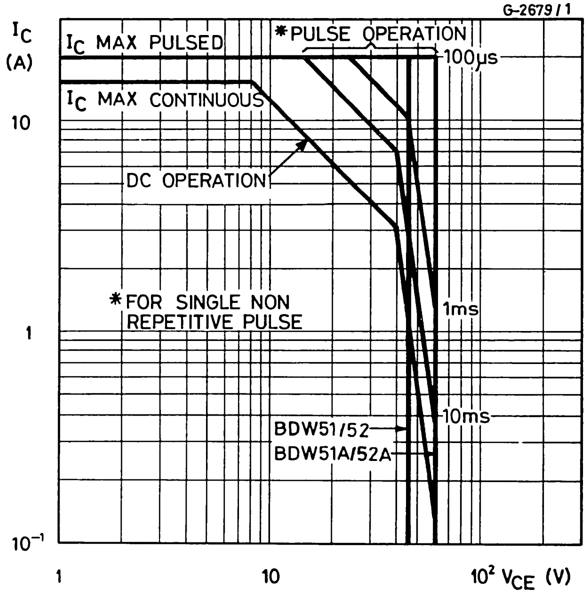
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current (I_E = 0)	for **BDW51/52** V_{CB} = 45V for **BDW51A/52A** V_{CB} = 60V for **BDW51B/52B** V_{CB} = 80V for **BDW51C/52C** V_{CB} = 100V T_{case} = 150°C for **BDW51/52** V_{CB} = 45V for **BDW51A/52A** V_{CB} = 60V for **BDW51B/52B** V_{CB} = 80V for **BDW51C/52C** V_{CB} = 100V			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} = 22V for **BDW51A/52A** V_{CE} = 30V for **BDW51B/52B** V_{CE} = 40V for **BDW51C/52C** V_{CE} = 50V			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 = 5A I_B = 0.5A I_C = 10A I_B = 2.5A			1 3	V V
$V_{BE(sat)}$*	Base-emitter saturation voltage	I_C = 10A I_B = 2.5A			2.5	V
V_{BE}*	Base-emitter voltage	I_C = 5A V_{CE} = 4V			1.5	V
h_{FE}*	DC current gain	I_C = 5A V_{CE} = 4V I_C = 10A V_{CE} = 4V	20 5		150	— —
f_T	Transition frequency	I_C = 0.5A V_{CE} = 4V	3			MHz

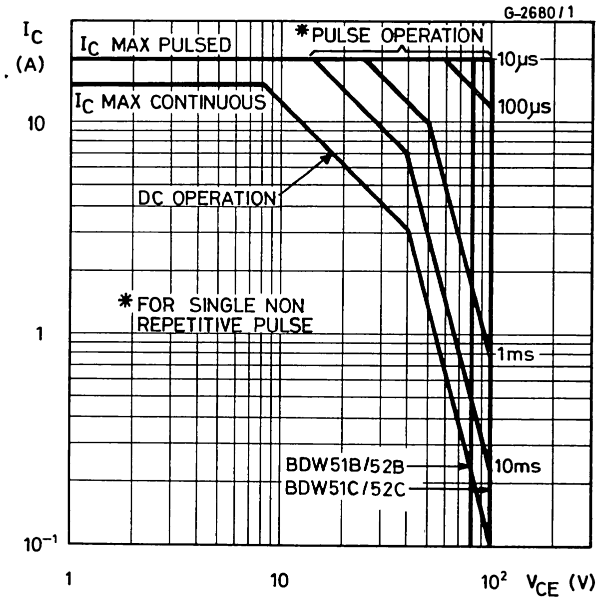
* Pulsed: pulse duration = 300 µs, duty cycle = 1.5%

For PNP types voltage and current values are negative.

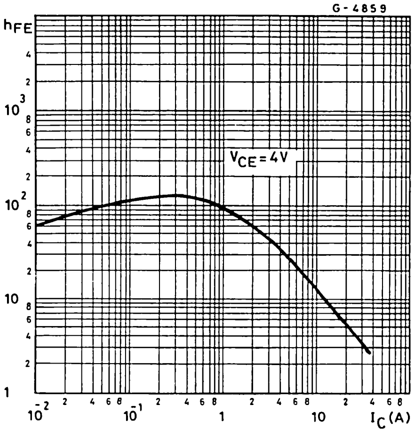
Safe operating areas (for **BDW51, BDW51A, BDW52, BDW52A**).



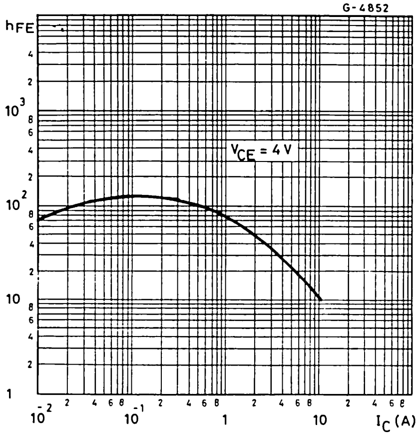
Safe operating areas (for **BDW51B, BDW51C, BDW52B, BDW52C**).



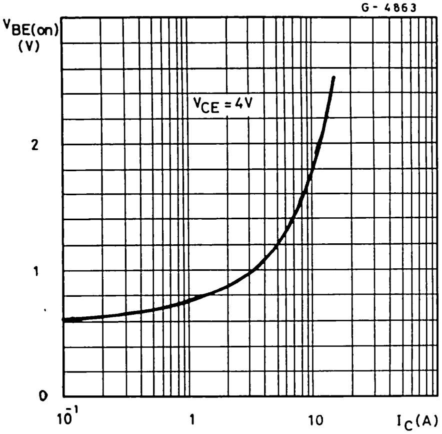
DC current gain (NPN types)



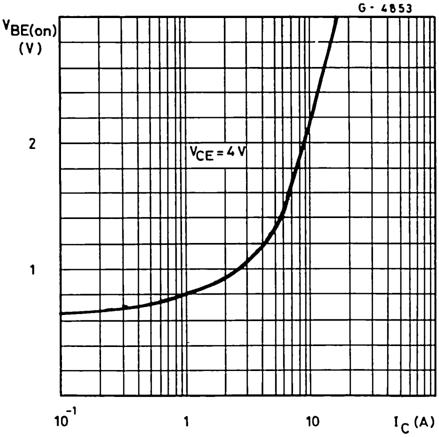
DC current gain (PNP types)



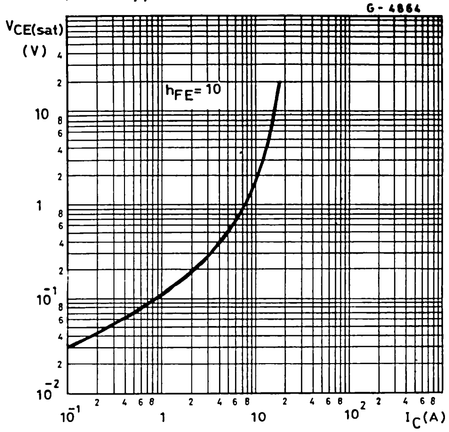
DC transconductance (NPN types)



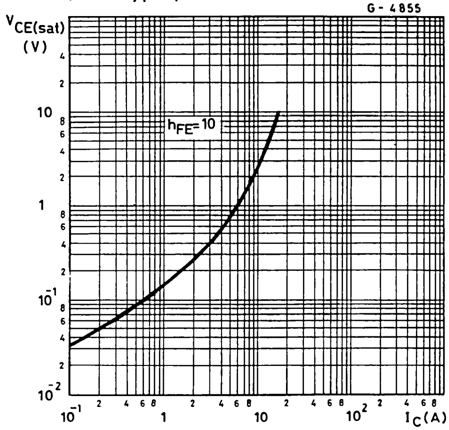
DC transconductance (PNP types)



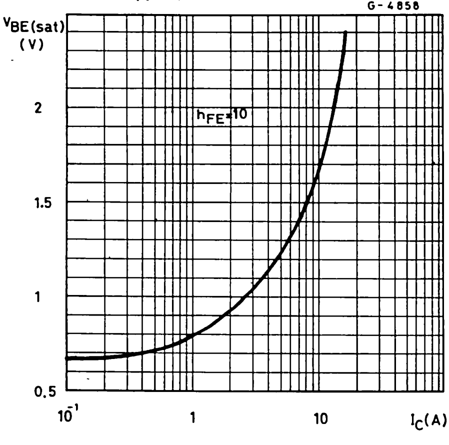
Collector-emitter saturation voltage (NPN types)



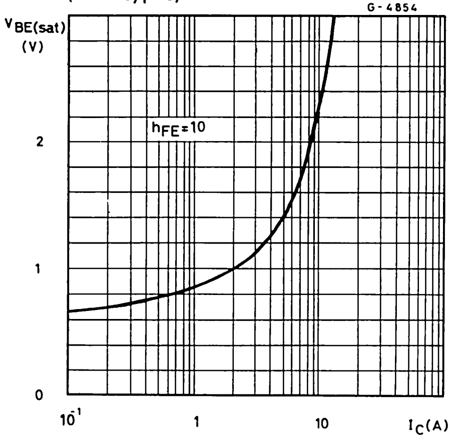
Collector-emitter saturation voltage (PNP types)



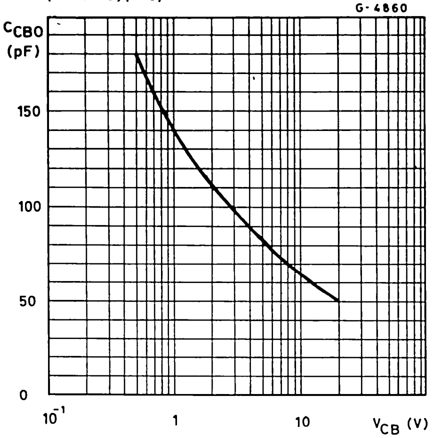
Base-emitter saturation voltage (NPN types)



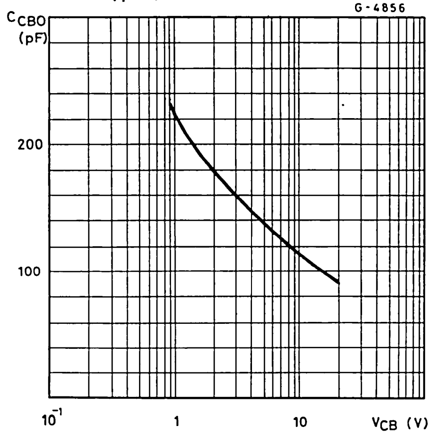
Base-emitter saturation voltage (PNP types)



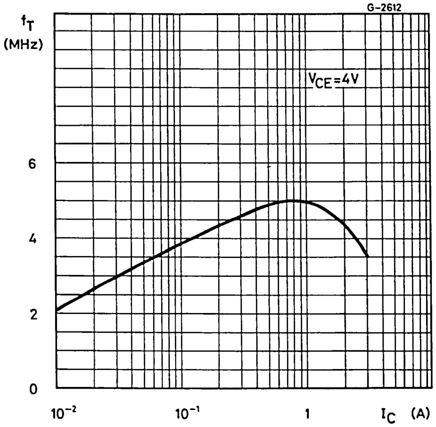
Collector-base capacitance
(NPN types)



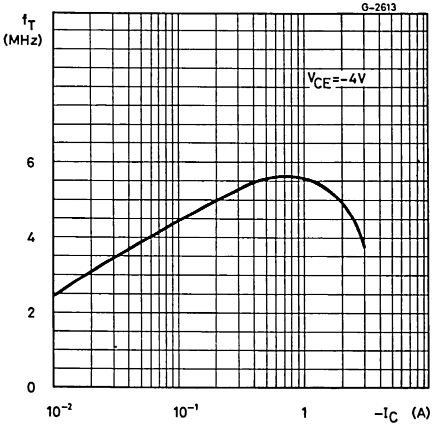
Collector-base capacitance
(PNP types)



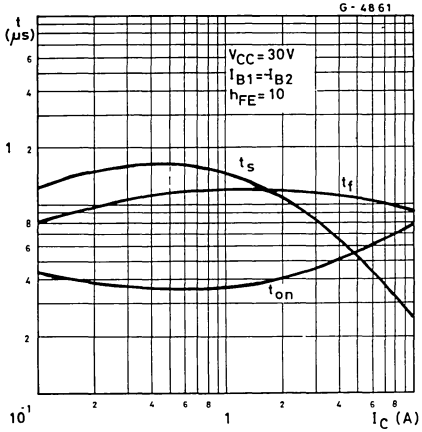
Transition frequency (NPN types)



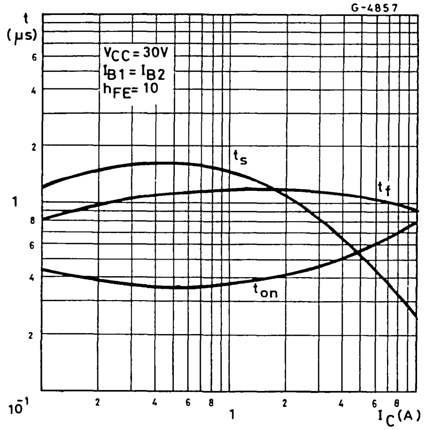
Transition frequency (PNP types)



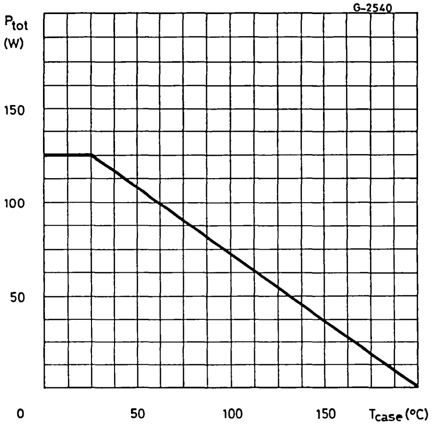
Saturated switching characteristics (NPN types)



Saturated switching characteristics (PNP types)



Power rating chart



EPITAXIAL-BASE NPN/PNP

BDW91
BDW92

MEDIUM POWER DARLINGTON

The BDW 91 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.

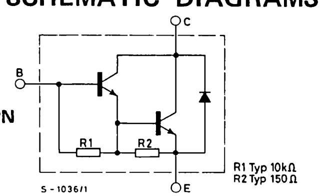
ABSOLUTE MAXIMUM RATINGS

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 $T_{case} \leq 25°C$	10	W
	$T_{amb} \leq 25°C$	1	W
T_{stg}	Storage temperature	-65 to 200	°C
T_j	Junction temperature	200	°C

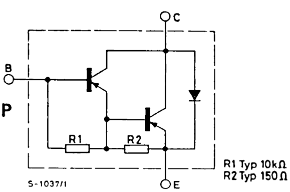
For PNP type voltage and current values are negative.

INTERNAL SCHEMATIC DIAGRAMS

NPN



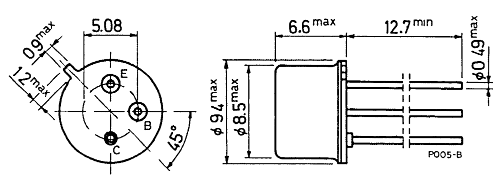
PNP



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-39

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

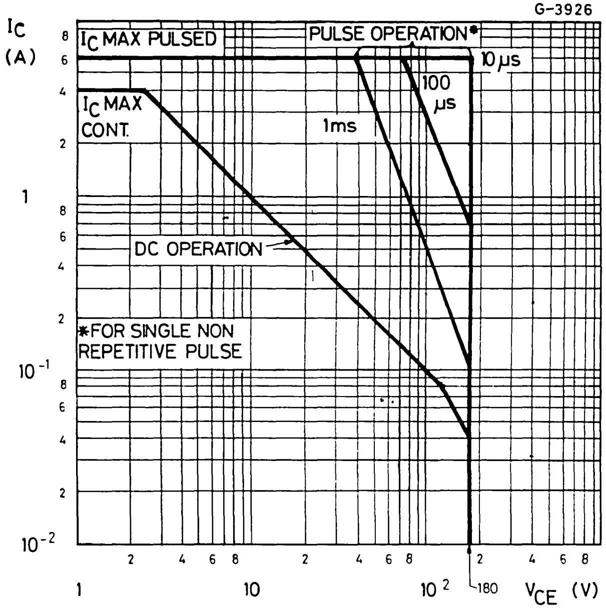
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	$V_{CB} = 180V$			50	μA
I_{CEO}	Collector cutoff current ($I_B = 0$)	$V_{CE} = 90V$			50	μA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{BE} = 6V$	0.4		2	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage	$I_C = 50\ mA$	180			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	$I_C = 2A$ $I_B = 4mA$			2	V
V_{BE}*	Base-emitter voltage	$I_C = 2A$ $V_{CE} = 2V$			2.5	V
h_{FE}*	DC current gain	$I_C = 2A$ $V_{CE} = 5V$ $I_C = 50mA$ $V_{CE} = 5V$	1000 150	3000 300		— —
V_F*	Parallel diode forward voltage	$I_F = 2A$			2.5	V
h_{fe}	Small signal currente gain	$I_C = 0.5A$ $V_{CE} = 2V$ $f = 1MHz$		20		—

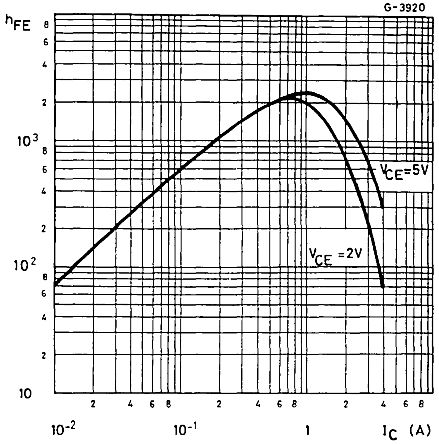
* Pulsed: pulse duration = 300 μsec, duty cycle = 1%

For PNP type voltage and current values are negative

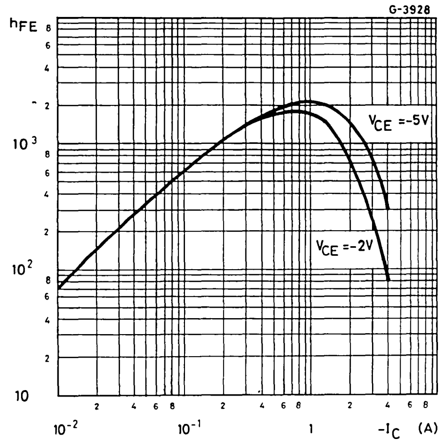
Safe operating areas



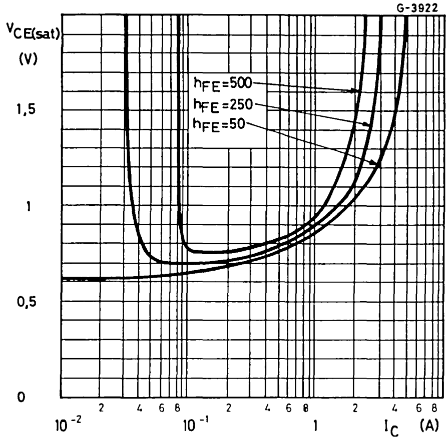
DC current gain (BDW91)



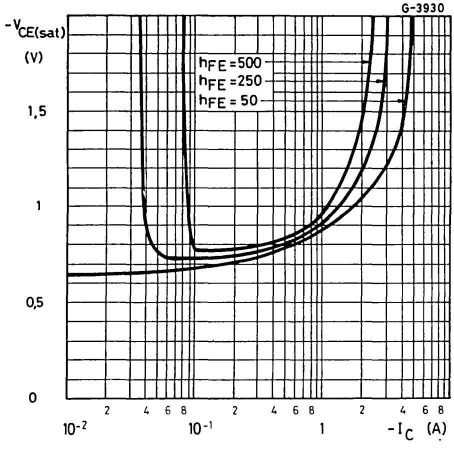
DC current gain (BDW92)



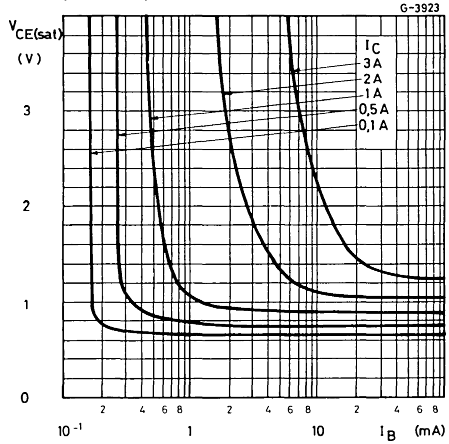
Collector-emitter saturation voltage (BDW91)



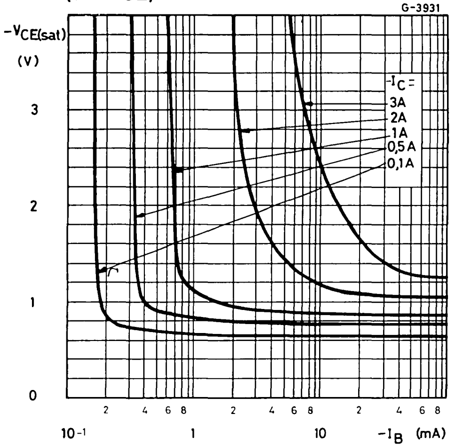
Collector-emitter saturation voltage (BDW92)



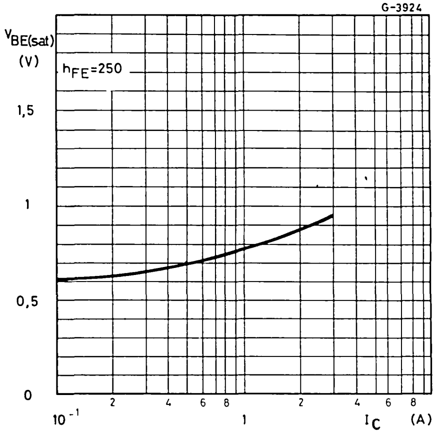
Collector-emitter saturation voltage (BDW91)



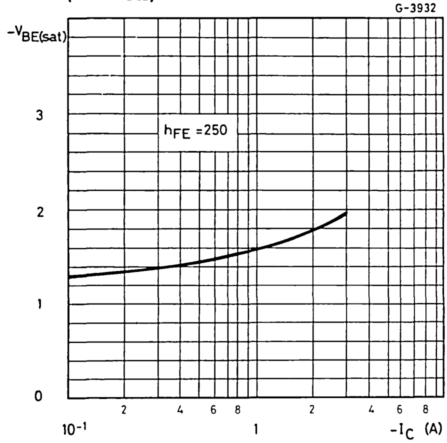
Collector-emitter saturation voltage (BDW92)



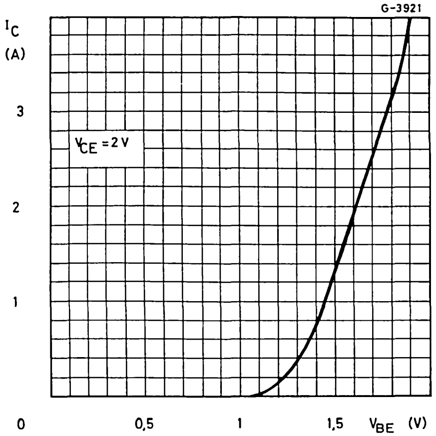
Base-emitter saturation voltage (BDW91)



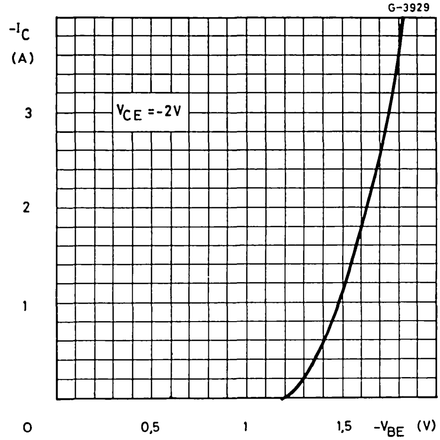
Base-emitter saturation voltage (BDW92)



DC transconductance (BDW91)

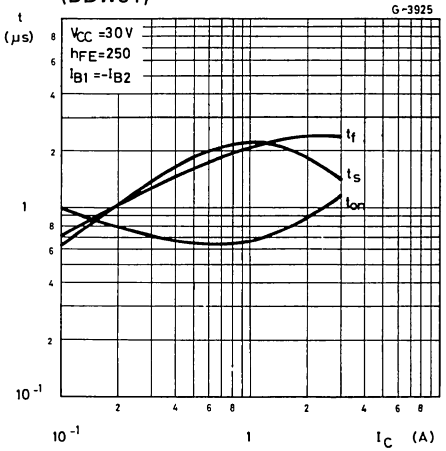


DC transconductance (BDW92)

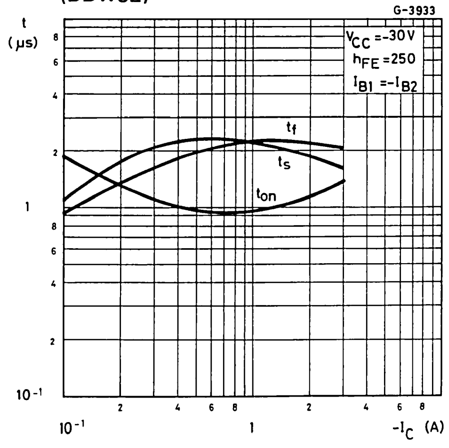


BDW91
BDW92

Saturated switching characteristics (BDW91)



Saturated switching characteristics (BDW92)



EPITAXIAL-BASE NPN/PNP

BDW93 BDW94
BDW93A BDW94A
BDW93B BDW94B
BDW93C BDW94C

POWER DARLINGTONS

The BDW 93, BDW 93A, BDW 93B and BQW 93C 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 BDW 94, BDW 94A, BDW 94B and BDW 94C respectively.

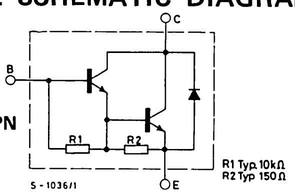
ABSOLUTE MAXIMUM RATINGS

	NPN PNP*	BDW93 BDW94	BDW93A BDW94A	BDW93B BDW94B	BDW93C BDW94C
V_{CBO}	Collector-base voltage ($I_E = 0$)	45V	60V	80V	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	45V	60V	80V	100V
I_C	Collector current	12A			
I_{CM}	Collector peak current	15A			
I_B	Base current	0.2A			
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$	80W			
T_{stg}	Storage temperature	-65 to 150°C			
T_j	Junction temperature	150°C			

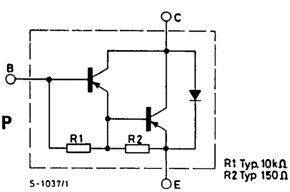
* **For PNP types voltage and current values are negative**

INTERNAL SCHEMATIC DIAGRAMS

NPN



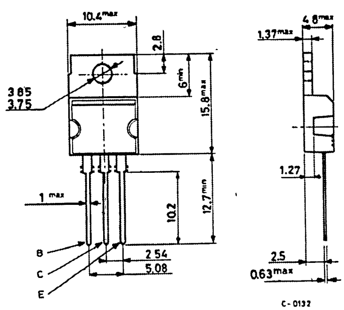
PNP



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

BDW93 BDW94
BDW93A BDW94A
BDW93B BDW94B
BDW93C BDW94C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1.56	°C/W

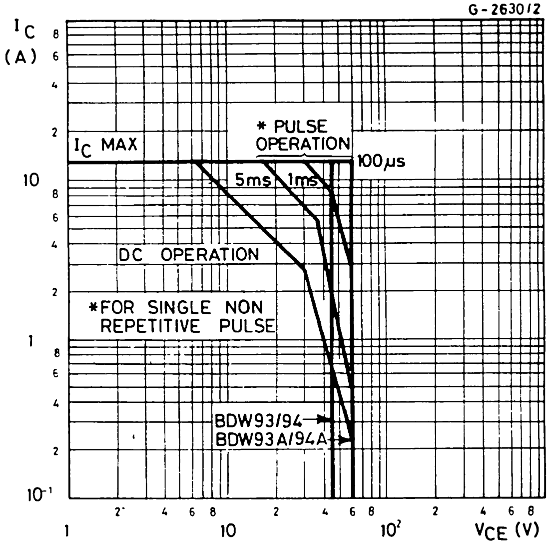
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Parameter		Test conditions	Min.	Typ.	Max.	Unit.
I_{CBO}	Collector cutoff current ($I_E = 0$)	for **BDW93/94** V_{CB} = 45V for **BDW93A/94A** V_{CB} = 60V for **BDW93B/94B** V_{CB} = 80V for **BDW93C/94C** V_{CB} = 100V T_{case} = 150°C for **BDW93/94** V_{CB} = 45V for **BDW93A/94A** V_{CB} = 60V for **BDW93B/94B** V_{CB} = 80V for **BDW93C/94C** V_{CB} = 100V			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} = 40V for **BDW93A/94A** V_{CE} = 60V for **BDW93B/94B** V_{CE} = 80V for **BDW93C/94C** V_{CE} = 80V			1 1 1 1	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 **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 = 5A I_B = 20mA I_C = 10A I_B = 100mA			2 3	V V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	I_C = 5A I_B = 20mA I_C = 10A I_B = 100mA			2.5 4	V V
h_{FE}*	DC current gain	I_C = 3A V_{CE} = 3V I_C = 5A V_{CE} = 3V I_C = 10A V_{CE} = 3V	1000 750 100		 20000 	— — —
V_F*	Parallel-diode forward voltage	I_F = 5A I_F = 10A		1.3 1.8	2 4	V V
h_{fe}	Small signal current gain	I_C = 1A V_{CE} = 10V f = 1 MHz	20			—

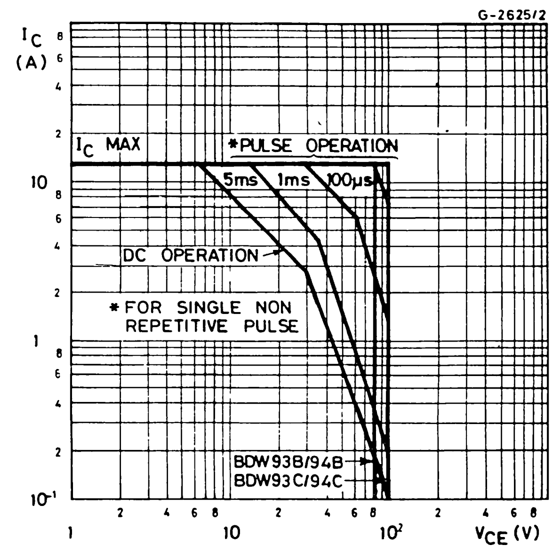
* Pulsed: pulse duration = 300 μs, duty cycle = 1.5%

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**)



For the others characteristics see BDX33/BDX34 series

BDX33 BDX34
BDX33A BDX34A
BDX33B BDX34B
BDX33C BDX34C

EPITAXIAL-BASE NPN/PNP

HIGH GAIN GENERAL PURPOSE

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.

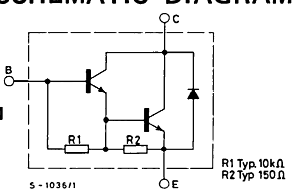
ABSOLUTE MAXIMUM RATINGS

		NPN / *PNP	BDX33 / BDX34	BDX33A / BDX34A	BDX33B / BDX34B	BDX33C / BDX34C
V_{CBO}	Collector-base voltage (I_E=0)		45	60	80	100
V_{CEO}	Collector-emitter voltage (I_B=0)		45	60	80	100
I_C	Collector current		10A			
I_{CM}	Collector peak current		15A			
I_B	Base current		0.25A			
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$		70W			
T_{stg}	Storage Temperature		-65 to 150°C			
T_j	Junction temperature		150°C			

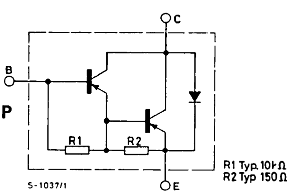
* **For PNP types voltage and current values are negative.**

INTERNAL SCHEMATIC DIAGRAMS

NPN



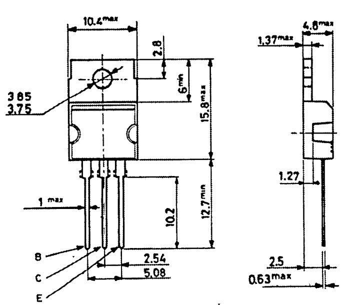
PNP



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

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)

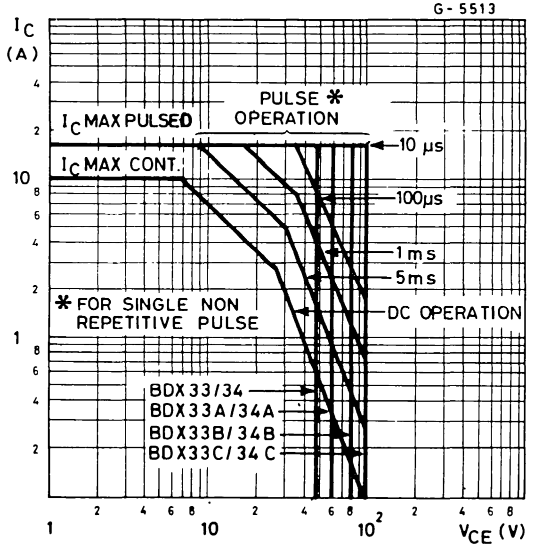
Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current (I_E=0)	for **BDX33/34**	V_{CB} = 45V			0.2	mA
		for **BDX33A/34A**	V_{CB} = 60V			0.2	mA
		for **BDX33B/34B**	V_{CB} = 80V			0.2	mA
		for **BDX33C/34C**	V_{CB} = 100V			0.2	mA
		T_{case} = 100°C					
		for **BDX33/34**	V_{CB} = 45V			5	mA
		for **BDX33A/34A**	V_{CB} = 60V			5	mA
		for **BDX33B/34B**	V_{CB} = 80V			5	mA
		for **BDX33C/34C**	V_{CB} = 100V			5	mA
I_{CEO}	Collector cutoff current (I_B = 0)	for **BDX33/34**	V_{CE} = 22V			0.5	mA
		for **BDX33A/34A**	V_{CE} = 30V			0.5	mA
		for **BDX33B/34B**	V_{CE} = 40V			0.5	mA
		for **BDX33C/34C**	V_{CE} = 50V			0.5	mA
		T_{case} = 100°C					
		for **BDX33/34**	V_{CE} = 22V			10	mA
		for **BDX33A/34A**	V_{CE} = 30V			10	mA
		for **BDX33B/34B**	V_{CE} = 40V			10	mA
		for **BDX33C/34C**	V_{CE} = 50V			10	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 **BDX33/34**		45			V
		for **BDX33A/34A**		60			V
		for **BDX33B/34B**		80			V
		for **BDX33C/34C**		100			V
$V_{CER\ (sus)}$*	Collector-emitter sustaining voltage (I_B=0 R_{BE}=100Ω)	I_C = 100mA					
		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}=-1.5V)	I_C = 100mA					
		for **BDX33/34**		45			V
		for **BDX33A/34A**		60			V
		for **BDX33B/34B**		80			V
		for **BDX33C/34C**		100			V

ELECTRICAL CHARACTERISTICS (continued)

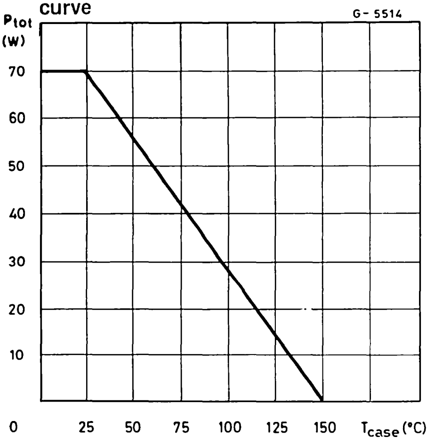
Parameter		Test conditions	Min.	Typ.	Max.	Unit
$V_{CE\,(sat)}$*	Collector-emitter saturation voltage	for **BDX33/33A/34/34A** $I_C = 4A$ $I_B = 8mA$ for **BDX33B/33C/34B/34C** $I_C = 3A$ $I_B = 6mA$			2.5 2.5	V V
V_{BE}*	Base-emitter voltage	for **BDX33/33A/34/34A** $I_C = 4A$ $V_{CE} = 3V$ for **BDX33B/33C/34B/34C** $I_C = 3A$ $V_{CE} = 3V$			2.5 2.5	V V
h_{FE}*	DC current gain	for **BDX33/33A/34/34A** $I_C = 4A$ $V_{CE} = 3V$ for **BDX33B/33C/34B/34C** $I_C = 3A$ $V_{CE} = 3V$	750 750			– –
V_F*	Parallel-diode forward voltage	$I_F = 8A$			4	V
h_{fe}	Small signal current gain	$I_C = 1A$ $V_{CE} = 5V$ f= 1KHz	1000			–

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

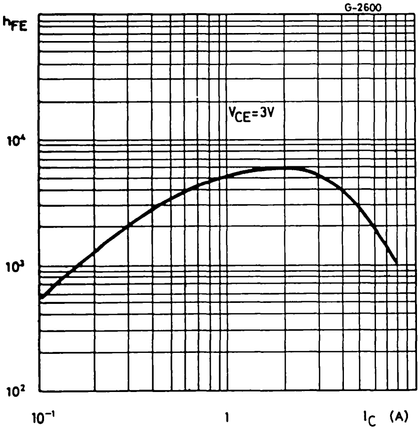
Safe operating areas



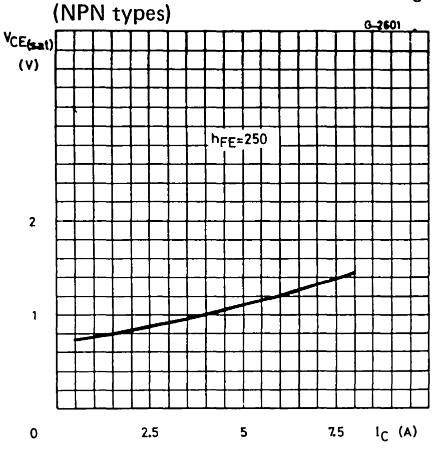
Case temperature dissipation derating curve



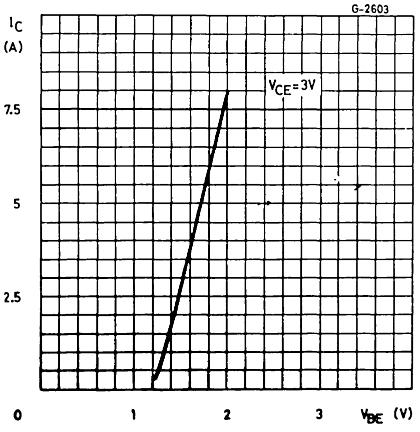
DC current gain (NPN types)



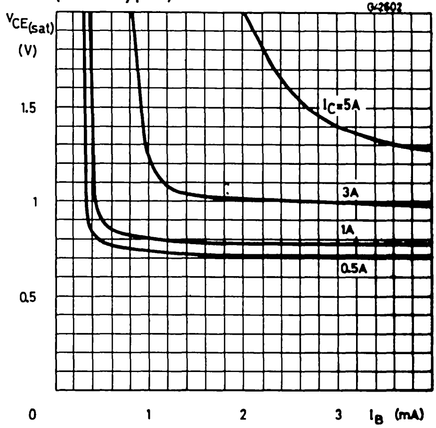
Collector-emitter saturation voltage (NPN types)



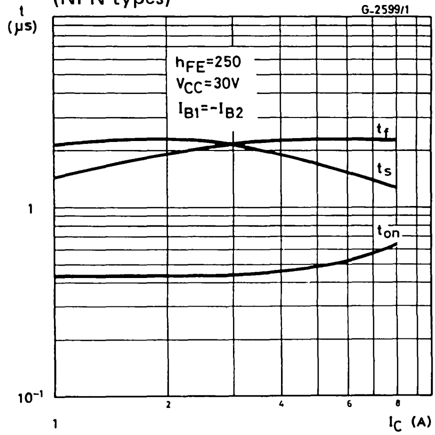
DC transconductance (NPN types)



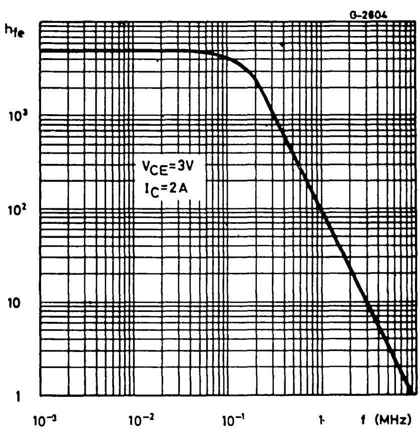
Collector-emitter saturation voltage (NPN types)



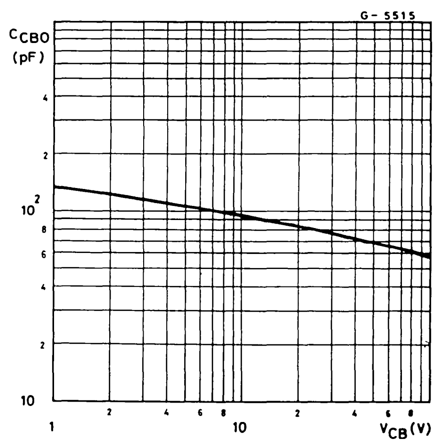
Saturated switching characteristics (NPN types)



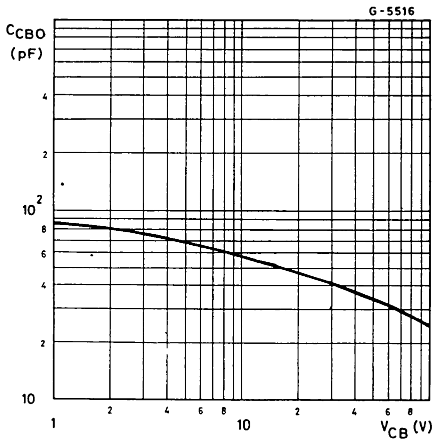
Small signal current gain (NPN types)



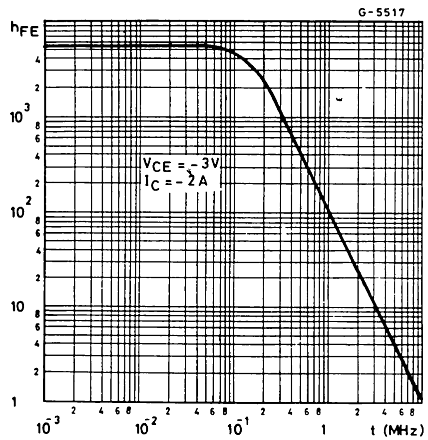
Collector-base capacitance (PNP types)



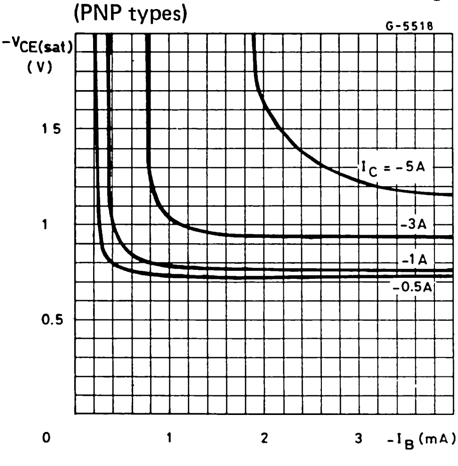
Collector-base capacitance (NPN types)



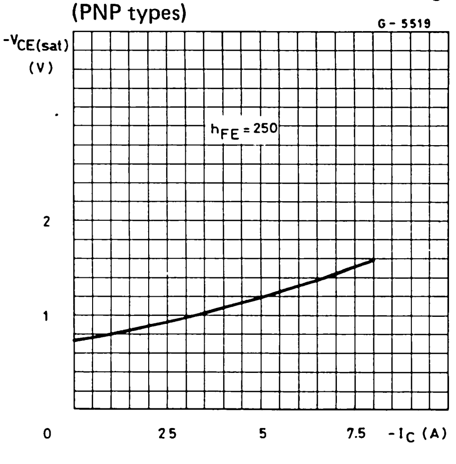
Small signal current gain (PNP types)



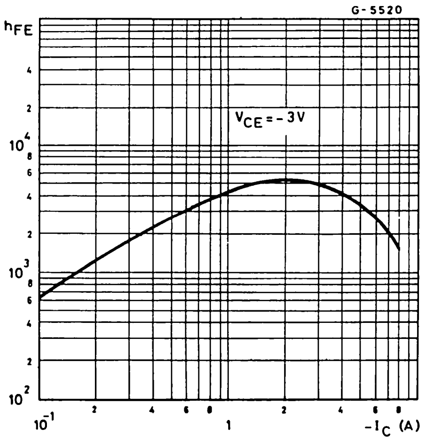
Collector-emitter saturation voltage (PNP types)



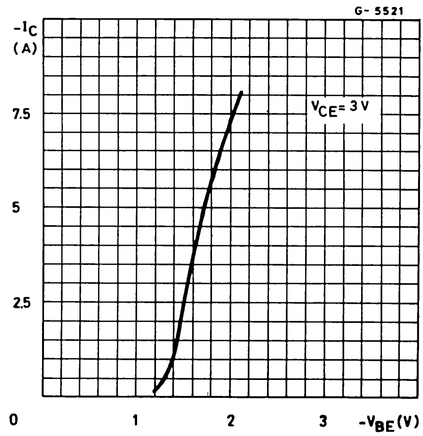
Collector-emitter saturation voltage (PNP types)



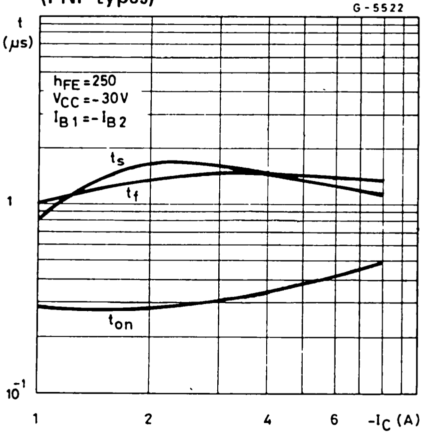
DC current gain (PNP types)



DC transconductance (PNP types)



Saturated switching characteristics (PNP types)



EPITAXIAL-BASE NPN/PNP

BDX53 BDX54
BDX53A BDX54A
BDX53B BDX54B
BDX53C BDX54C

POWER DARLINGTONS

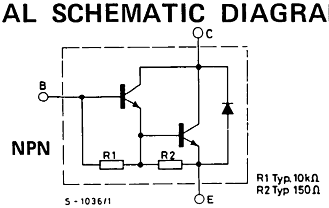
The BDX 53, BDX 53A, BDX 53B and BDX 53C are silicon epitaxial-base NPN transistors in monolithic Darlington configuration and are mounted in Jedec TO-220 plastic package, intended for use in hammer drivers, audio amplifiers and other medium power linear and switching applications.
The complementary PNP types are the BDX 54, BDX 54A, BDX 54B and BDX 54C respectively.

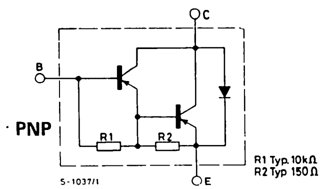
ABSOLUTE MAXIMUM RATINGS

	NPN / PNP*	BDX53 / BDX54	BDX53A / BDX54A	BDX53B / BDX54B	BDX53C / BDX54C
V_{CBO}	Collector-base voltage ($I_E = 0$)	45V	60V	80V	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	45V	60V	80V	100V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5V			
I_C	Collector current	8A			
I_{CM}	Collector peak current (repetitive)	12A			
I_B	Base current	0.2A			
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$	60W			
T_{stg}	Storage temperature	-65 to 150°C			
T_j	Junction temperature	150°C			

* **For PNP types voltage and current values are negative**

INTERNAL SCHEMATIC DIAGRAMS

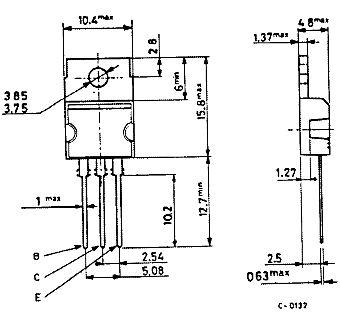




MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

10/84

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

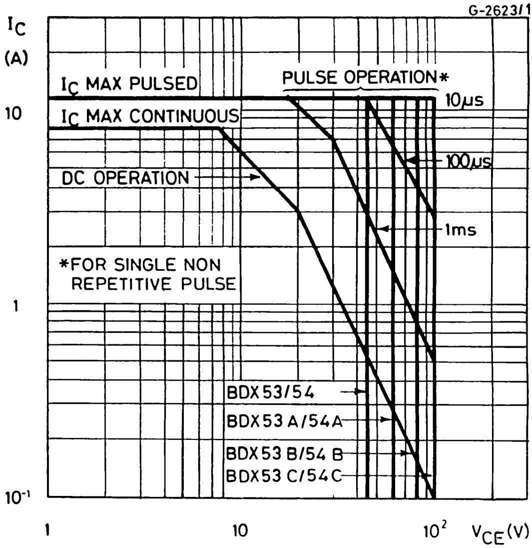
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current (I_E = 0)	for **BDX53/54** V_{CB} = 45V for **BDX53A/54A** V_{CB} = 60V for **BDX53B/54B** V_{CB} = 80V for **BDX53C/54C** V_{CB} = 100V			200 200 200 200	μA μA μA μA
I_{CEO}	Collector cutoff current (I_B = 0)	for **BDX53/54** V_{CE} = 22V for **BDX53A/54A** V_{CE} = 30V for **BDX53B/54B** V_{CE} = 40V for **BDX53C/54C** V_{CE} = 50V			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 = 3A I_B = 12mA			2	V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	I_C = 3A I_B = 12mA			2.5	V
h_{FE}*	DC current gain	I_C = 3A V_{CE} = 3V	750			—
V_F	Parallel-diode forward voltage	I_F = 3A I_F = 8A		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



For the other characteristics curves see TIP120/TIP125 series.

BDX53E BDX54E
BDX53F BDX54F

EPITAXIAL-BASE NPN/PNP

POWER DARLINGTONS

The BDX 53E, BDX 53F 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 BDX 54E and BDX 54F respectively.

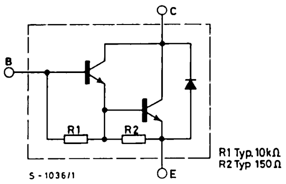
ABSOLUTE MAXIMUM RATINGS

		NPN / PNP*	BDX53E / BDX54E	BDX53F / BDX54F
V_{CBO}	Collector-base voltage ($I_E = 0$)		140V	160V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)		140V	160V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		5V	
I_C	Collector current		8A	
I_{CM}	Collector peak current		12A	
I_B	Base current		0.2A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$		60W	
T_{stg}	Storage temperature		-65 to 150°C	
T_j	Junction temperature		150°C	

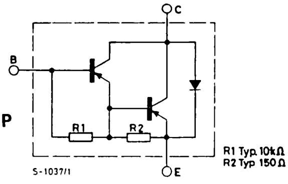
* For PNP types voltage and current values are negative

INTERNAL SCHEMATIC DIAGRAMS

NPN



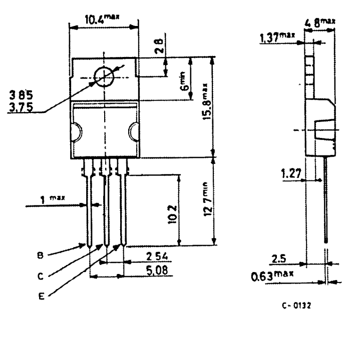
PNP



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

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

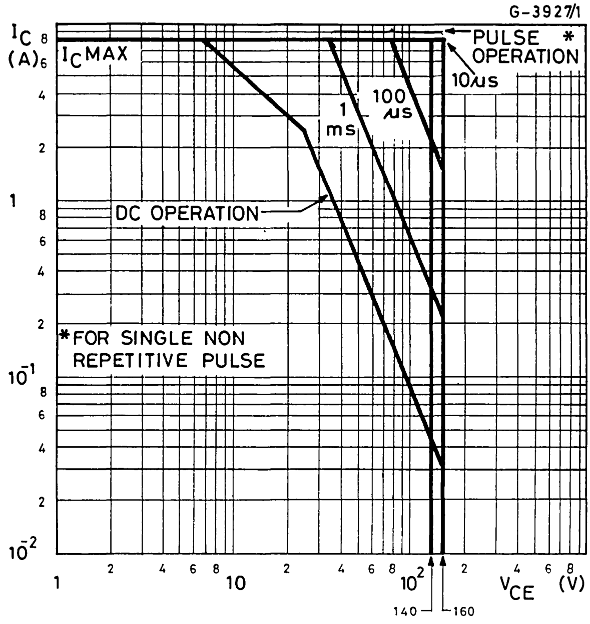
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current (I_B = 0)	for **BDX53E/4E** V_{CE} = 70V for **BDX53F/4F** V_{CE} = 80V			0.5 0.5	mA mA
I_{CBO}	Collector cutoff current (I_E = 0)	for **BDX53E/4E** V_{CB} = 140V for **BDX53F/4F** V_{CB} = 160V			0.2 0.2	mA mA
I_{EBO}	Emitter cutoff current (I_E = 0)	V_{EB} = 5V			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 = 2A I_B = 10mA			2	V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	I_C = 2A I_B = 10mA			2.5	V
h_{FE}*	DC current gain	I_C = 2A V_{CE} = 5V I_C = 3A V_{CE} = 5V	500 150			– –
V_F*	Parallel diode forward voltage	I_F = 2A			2.5	V
h_{fe}	Small signal currente gain	I_C = 0.5A V_{CE} = 2V f = 1MHz		20		–

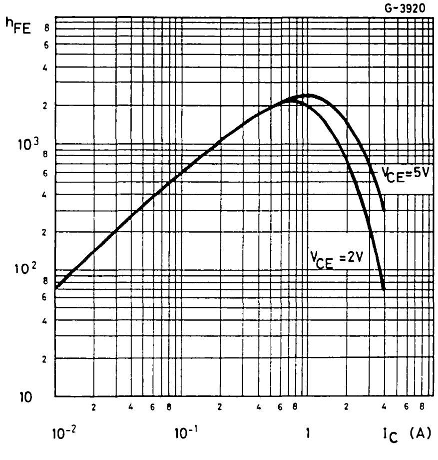
* Pulsed: pulse duration = 300 µs, duty cycle = 1%

For PNP types voltage and current values are negative

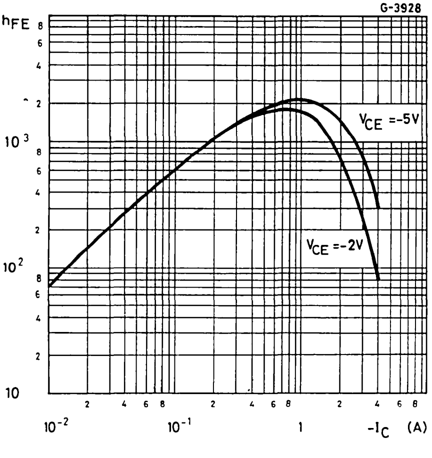
Safe operating areas



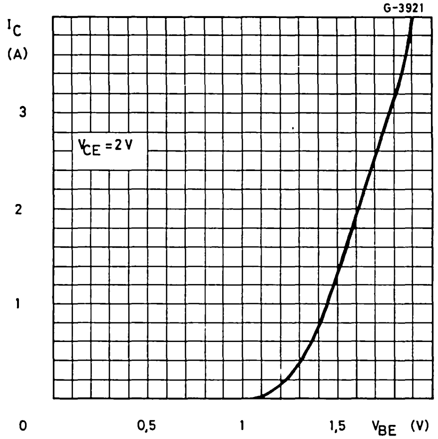
DC current gain (NPN types)



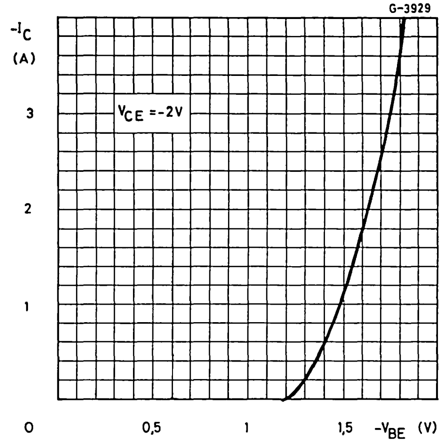
DC current gain (PNP types)



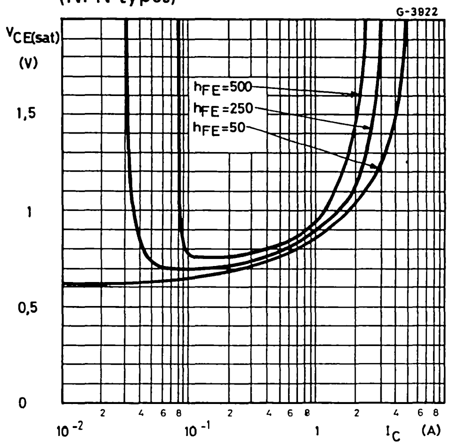
DC transconductance (NPN types)



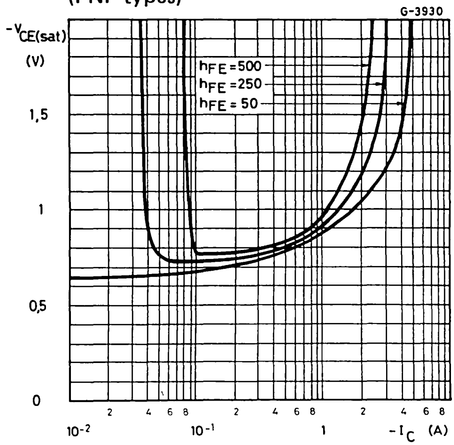
DC transconductance (PNP types)



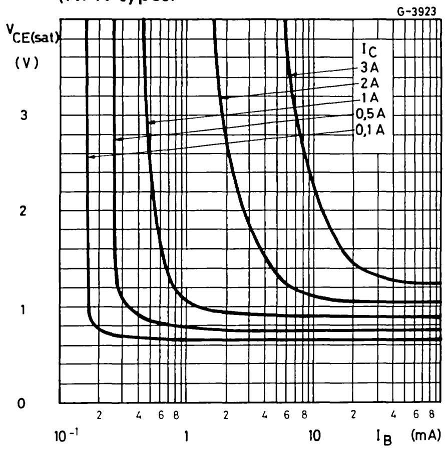
Collector-emitter saturation voltage (NPN types)



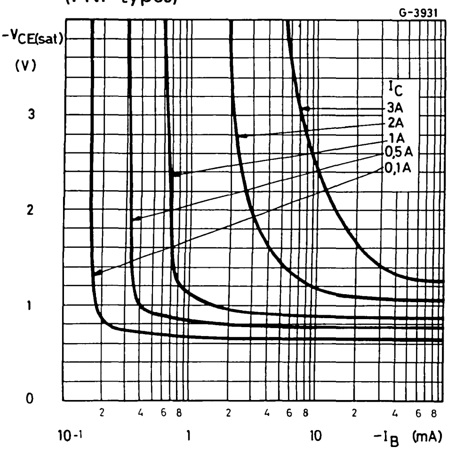
Collector-emitter saturation voltage (PNP types)



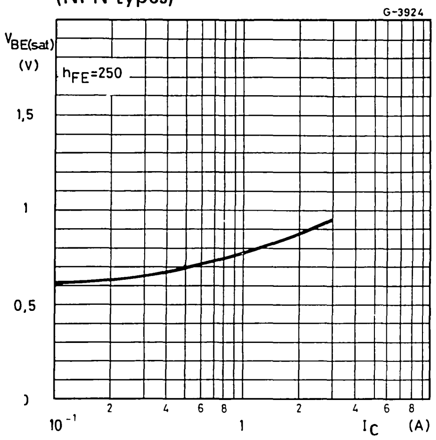
Collector-emitter saturation voltage (NPN types)



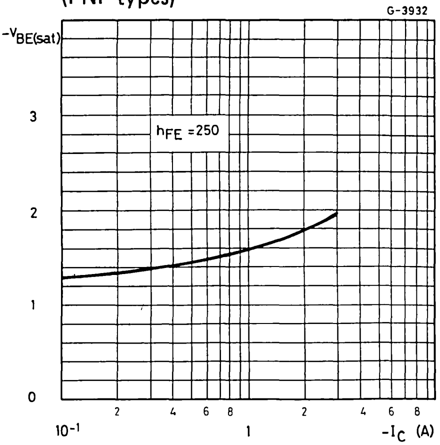
Collector-emitter saturation voltage (PNP types)



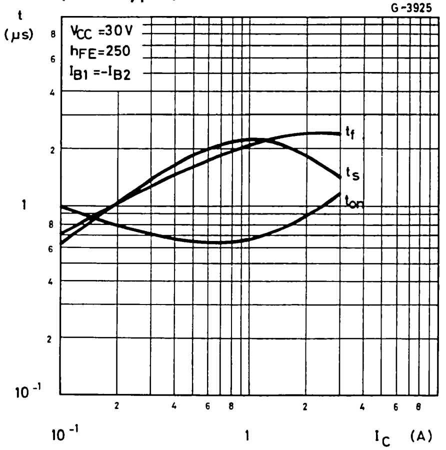
Base-emitter saturation voltage (NPN types)



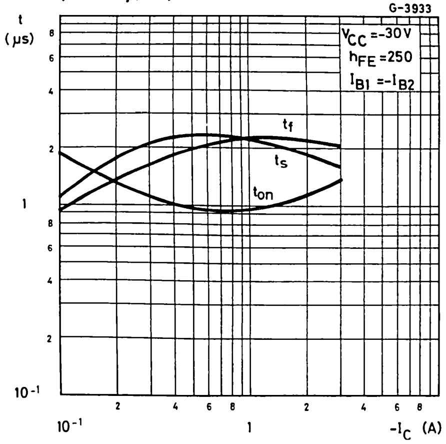
Base-emitter saturation voltage (PNP types)



Saturated switching characteristics
(NPN types)



Saturated switching characteristics
(PNP types)



BDX53S
BDX54S

EPITAXIAL-BASE NPN / PNP

MEDIUM POWER DARLINGTON

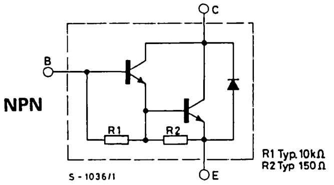
The BDX53S is a silicon epitaxial-base NPN transistor in monolithic Darlington configuration and is mounted in Jedec TO-39 metal case.
It is intended for use in medium in power linear and switching applications.
The complementary PNP type is the BDX54S

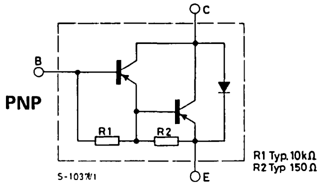
ABSOLUTE MAXIMUM RATINGS

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 $T_{case} \leq 25°C$	15	W
	$T_{amb} \leq 25°C$	1	W
T_{stg}	Storage temperature	-65 to 200	°C
T_j	Junction temperature	200	°C

For PNP type voltage and current values are negative

INTERNAL SCHEMATIC DIAGRAMS

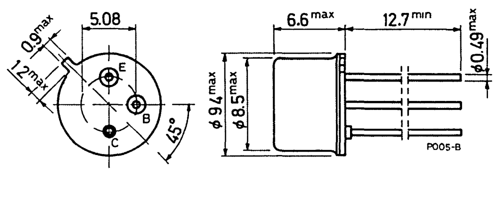




MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-39

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

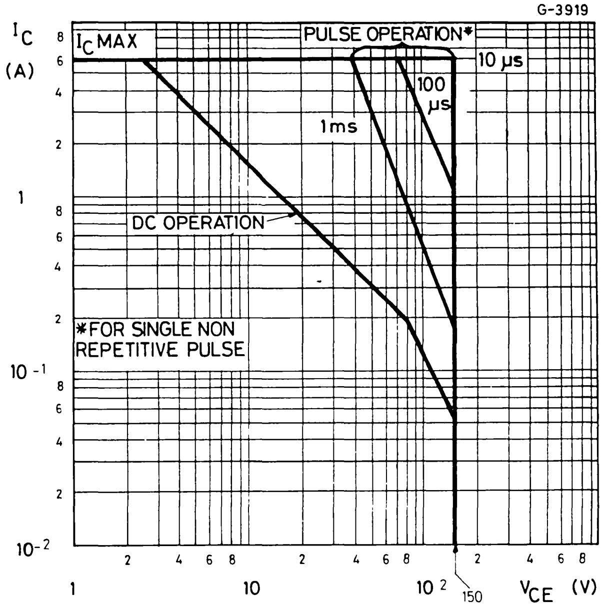
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

	Parameter	Test conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	$V_{CB} = 150V$				0.2	mA
		$T_{case} = 125°C$ $V_{CB} = 150V$				2	mA
I_{CEO}	Collector cutoff current ($I_B = 0$)	$V_{CE} = 75V$				0.2	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$				5	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 50\ mA$		150			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	$I_C = 2A$	$I_B = 8mA$			2	V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	$I_C = 2A$	$I_B = 8mA$			2.5	V
h_{FE}*	DC current gain	$I_C = 100mA$	$V_{CE} = 5V$	100			—
		$I_C = 2A$	$V_{CE} = 5V$	500			—
V_F*	Parallel diode forward voltage	$I_F = 2A$				2.5	V
h_{fe}	Small signal currente gain	$I_C = 0.5A$ $f = 1MHz$	$V_{CE} = 2V$		20		—

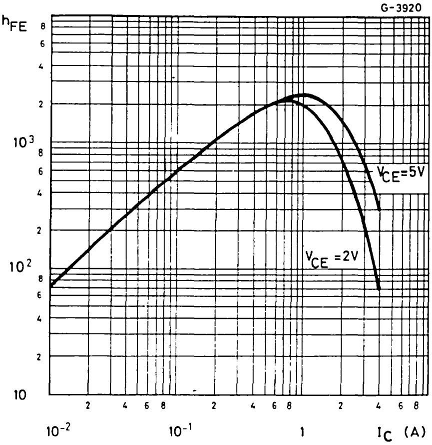
* Pulsed: pulse duration = 300 μs, duty cycle = 1%

For PNP type voltage and current values are negative.

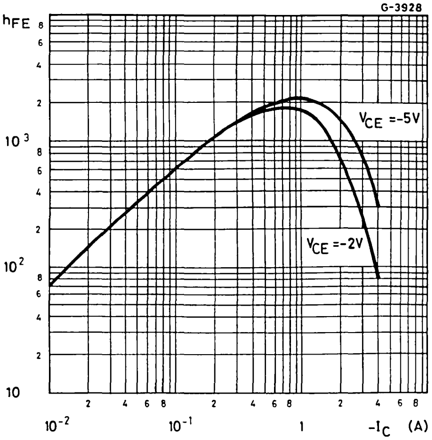
Safe operating area



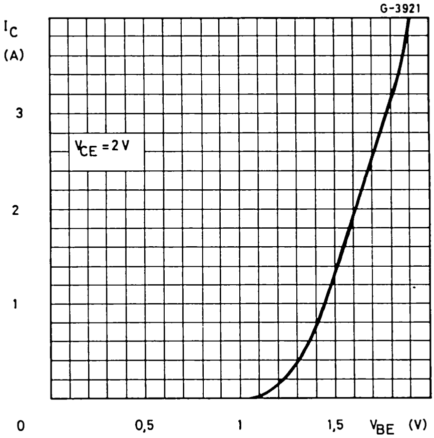
DC current gain (BDX53S)



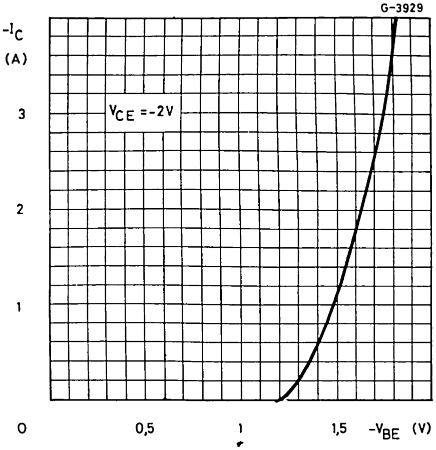
DC current gain (BDX54S)



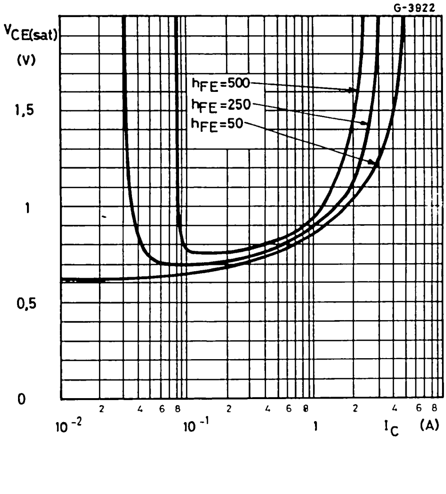
DC transconductance (BDX53S)



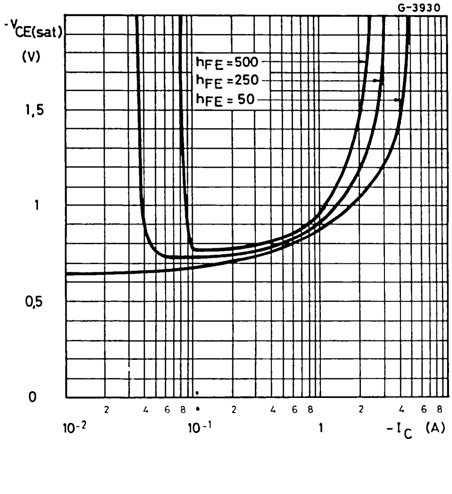
DC transconductance (BDX54S)



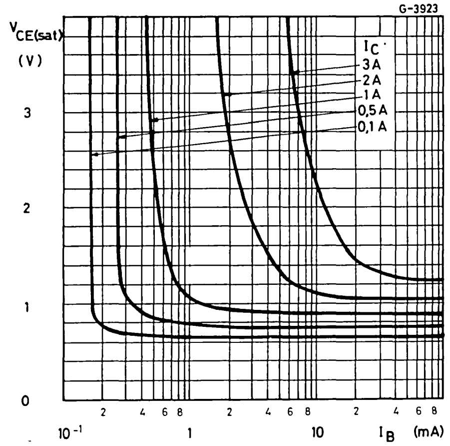
Collector-emitter saturation voltage (BDX53S)



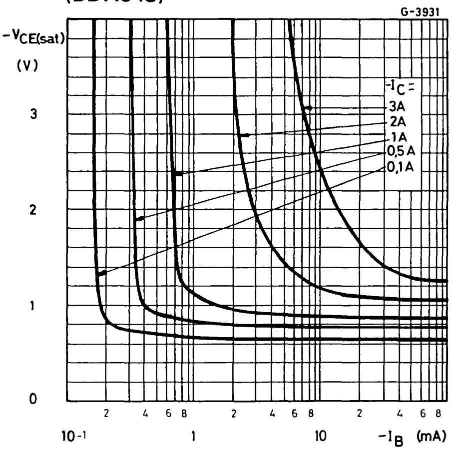
Collector-emitter saturation voltage (BDX54S)



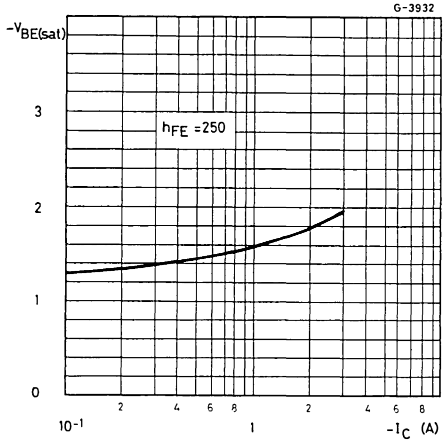
Collector-emitter saturation voltage (BDX53S)



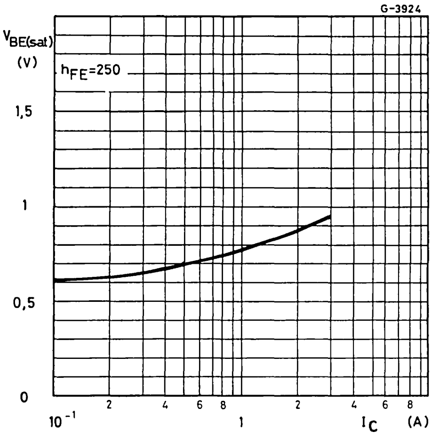
Collector-emitter saturation voltage (BDX54S)



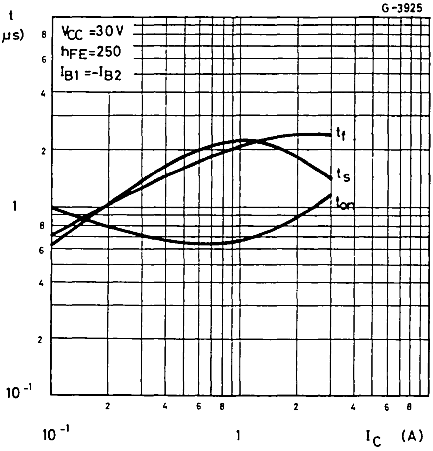
Base-emitter saturation voltage (BDX53S)



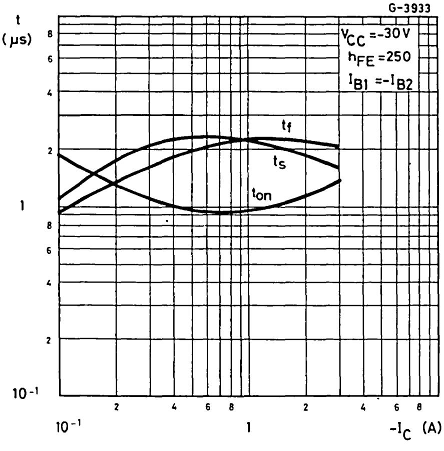
Base-emitter saturation voltage (BDX54S)



Saturated switching characteristics
(BDX53S)



Saturated switching characteristics
(BDX54S)



BDX85 BDX86
BDX85A BDX86A
BDX85B BDX86B
BDX85C BDX86C

EPITAXIAL-BASE NPN/PNP

POWER DARLINGTONS

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.

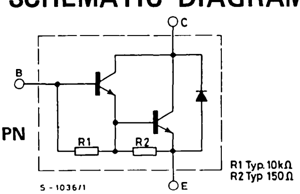
ABSOLUTE MAXIMUM RATINGS

	NPN / PNP*	BDX85 / BDX86	BDX85A / BDX86A	BDX85B / BDX86B	BDX85C / BDX86C
V_{CBO}	Collector-base voltage ($I_E = 0$)	45V	60V	80V	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	45V	60V	80V	100V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5V			
I_C	Collector current	10A			
I_{CM}	Collector peak current (repetitive)	15A			
I_B	Base current	0.1A			
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$	100W			
T_{stg}	Storage temperature	-65 to 200°C			
T_j	Junction temperature	200°C			

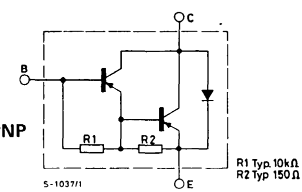
* **For PNP types voltage and current values are negative**

INTERNAL SCHEMATIC DIAGRAMS

NPN



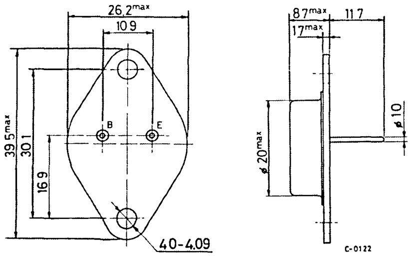
PNP



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

THERMAL DATA

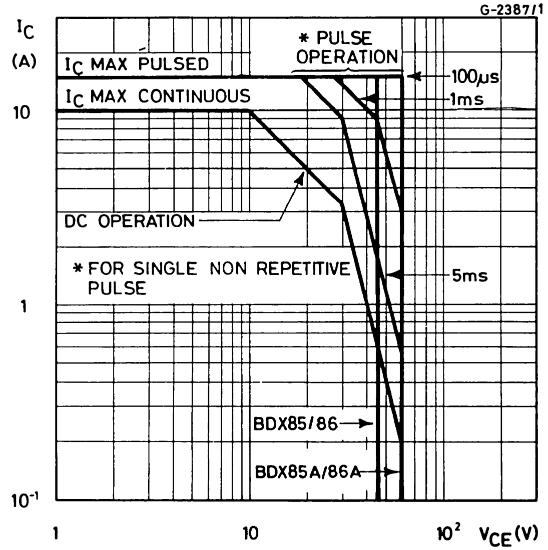
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1.75	°C/W

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

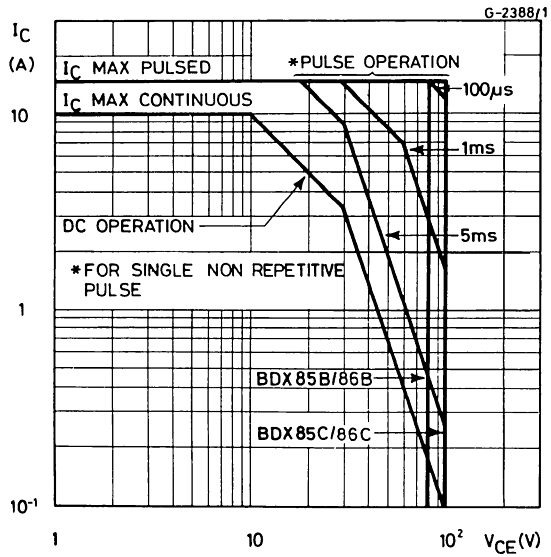
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current (I_E = 0)	for **BDX85/86** V_{CB} = 45 V for **BDX85A/86A** V_{CB} = 60 V for **BDX85B/86B** V_{CB} = 80 V for **BDX85C/86C** V_{CB} = 100 V T_{case} = 150°C for **BDX85/86** V_{CB} = 45 V for **BDX85A/86A** V_{CB} = 60 V 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 = 4A I_B = 16 mA I_C = 8A I_B = 40 mA			2 4	V V
$V_{BE(sat)}$*	Base-emitter saturation voltage	I_C = 8A I_B = 80 mA			4	V
V_{BE}*	Base-emitter voltage	I_C = 4A V_{CE} = 3V			2.8	V
h_{FE}*	DC current gain	I_C = 3A V_{CE} = 3V I_C = 4A V_{CE} = 3V I_C = 8A V_{CE} = 4V	1000 750 200		 18000 	— — —
V_F	Parallel-diode forward voltage	I_F = 3A I_F = 8A		 2.5	1.8 	V V
h_{fe}	Small signal current gain	I_C = 3A V_{CE} = 3V f = 1 MHz		10		—

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

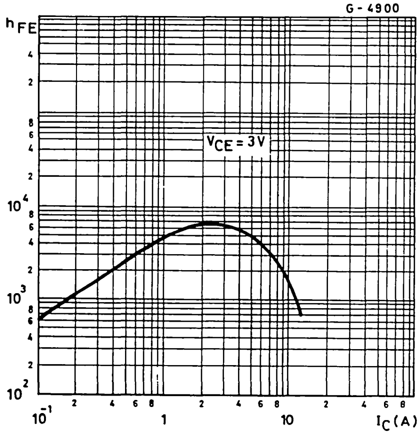
Safe operating areas
(for **BDX85, BDX85A**
BDX86, BDX86A).



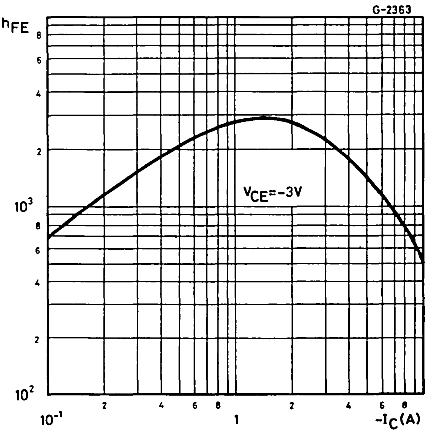
Safe operating areas
(for **BDX85B, BDX85C,**
BDX86B, BDX86C).



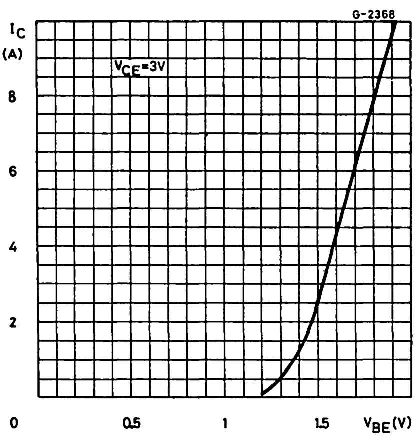
DC current gain (NPN types)



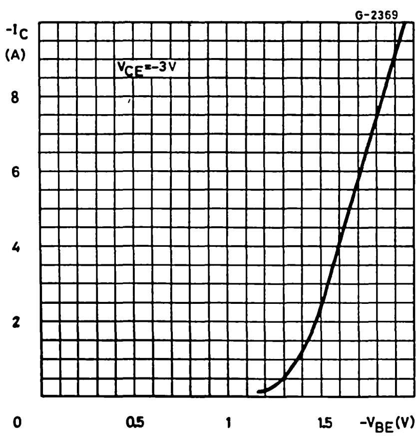
DC current gain (PNP types)



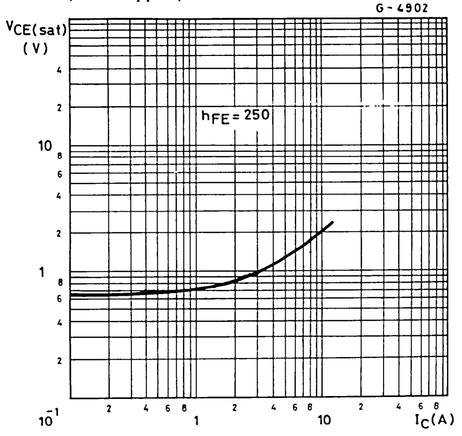
DC transconductance (NPN types)



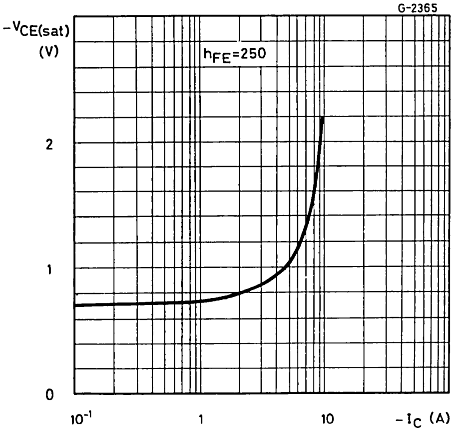
DC transconductance (PNP types)



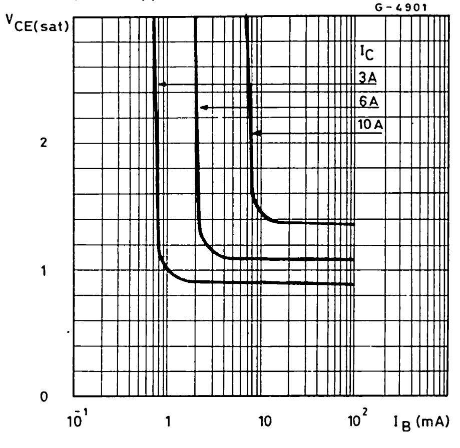
Collector-emitter saturation voltage (NPN types)



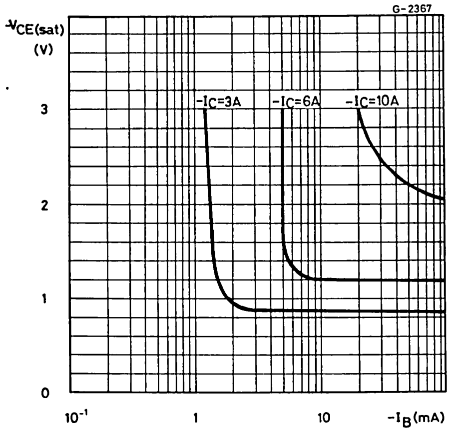
Collector-emitter saturation voltage (PNP types)



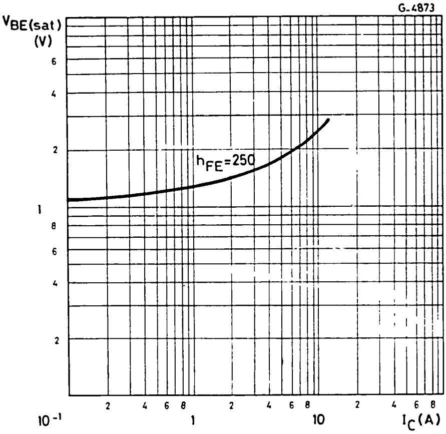
Collector-emitter saturation voltage (NPN types)



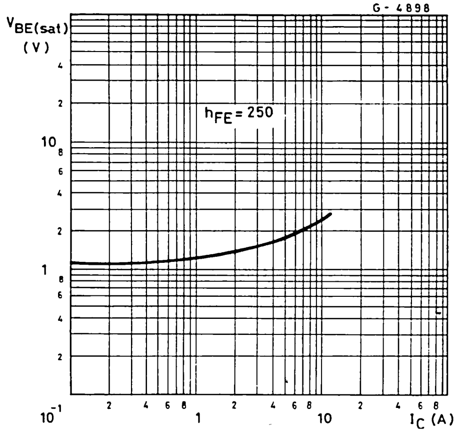
Collector-emitter saturation voltage (PNP types)



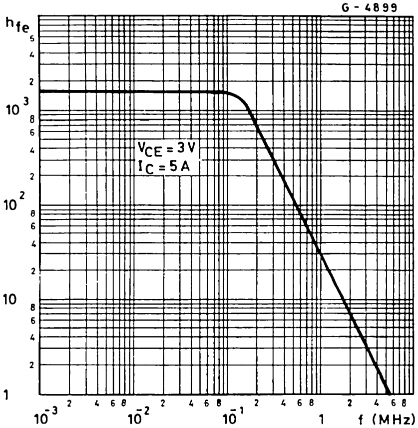
Base-emitter saturation voltage
(NPN types)



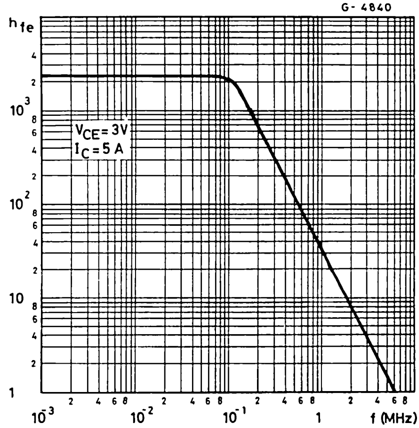
Base-emitter saturation voltage
(PNP types)



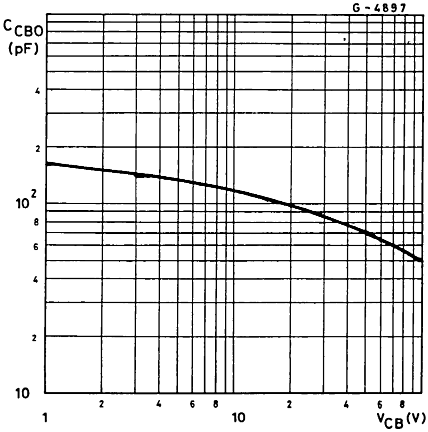
Small signal current gain (NPN types)



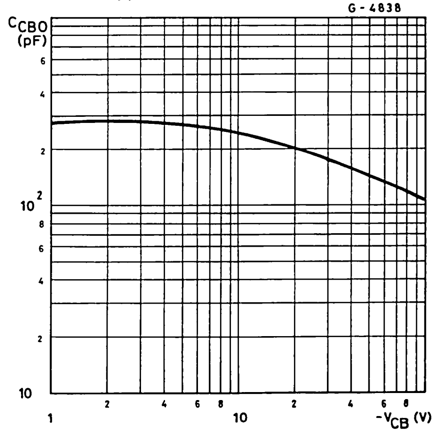
Small signal current gain (PNP types)



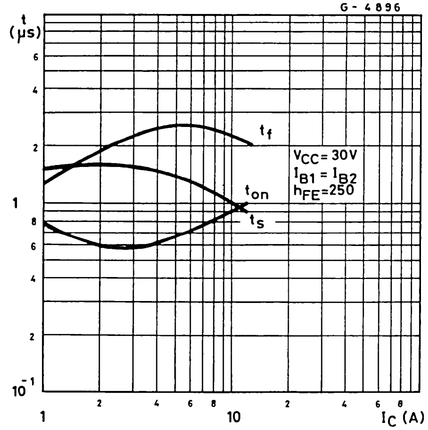
Collector-base capacitance
(NPN types)



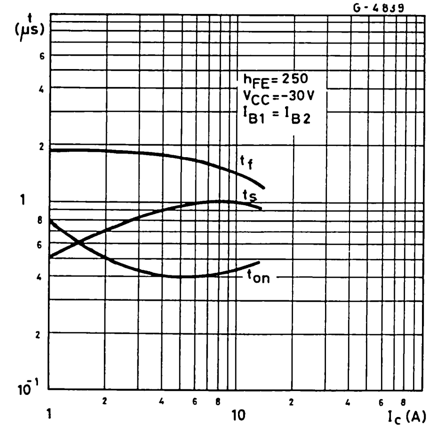
Collector-base capacitance
(PNP types)



Saturated switching characteristics
(NPN types)



Saturated switching characteristics
(PNP types)



EPITAXIAL-BASE NPN/PNP

BDX87 BDX88
BDX87A BDX88A
BDX87B BDX88B
BDX87C BDX88C

POWER DARLINGTONS

The BDX 87, BDX 87A, BDX 87B and BDX 87C 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 88, BDX 88A, BDX 88B and BDX 88C respectively.

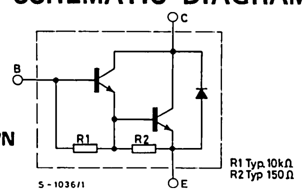
ABSOLUTE MAXIMUM RATINGS

	NPN PNP*	BDX87 BDX88	BDX87A BDX88A	BDX87B BDX88B	BDX87C BDX88C
V_{CBO}	Collector-base voltage ($I_E = 0$)	45V	60V	80V	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	45V	60V	80V	100V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5V			
I_C	Collector current	12A			
I_{CM}	Collector peak current (repetitive)	18A			
I_B	Base current	0.2A			
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$	120W			
T_{stg}	Storage temperature	-65 to 200°C			
T_j	Junction temperature	200°C			

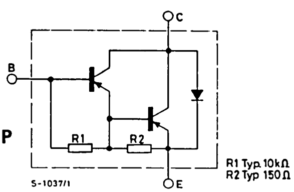
*** For PNP types voltage and current values are negative**

INTERNAL SCHEMATIC DIAGRAMS

NPN



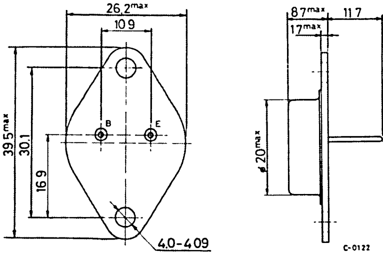
PNP



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1.45	°C/W

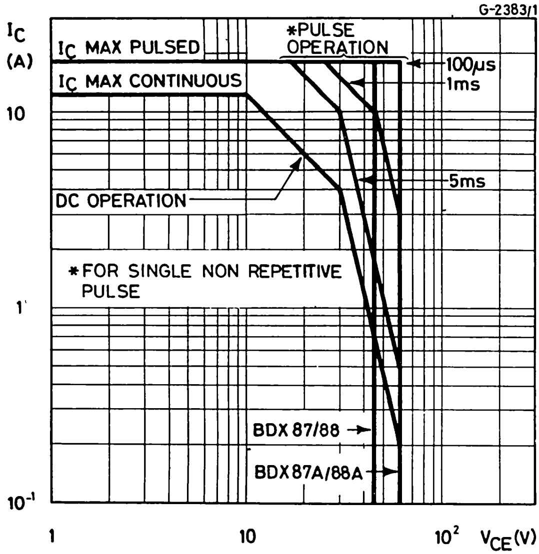
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

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 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			2	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 = 6A I_B = 24 mA I_C = 12A I_B = 120 mA			2 3	V V
$V_{BE(sat)}$*	Base-emitter saturation voltage	I_C = 12A I_B = 120 mA			4	V
V_{BE}*	Base-emitter voltage	I_C = 6A V_{CE} = 3V			2.8	V
h_{FE}*	DC current gain	I_C = 5A V_{CE} = 3V I_C = 6A V_{CE} = 3V I_C = 12A V_{CE} = 3V	1000 750 100		 18000 	— — —
V_F	Parallel-diode forward voltage	I_F = 3A I_F = 8A		 2.5	1.8 	V V
h_{fe}	Small signal current gain	I_C = 5A V_{CE} = 3V f = 1 MHz		 25		—

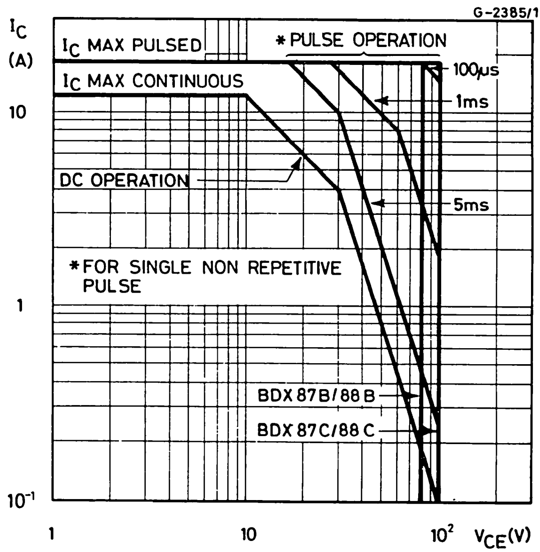
* Pulsed: pulse duration = 300 μs, duty cycle = 1.5%

For PNP types voltage and current values are negative

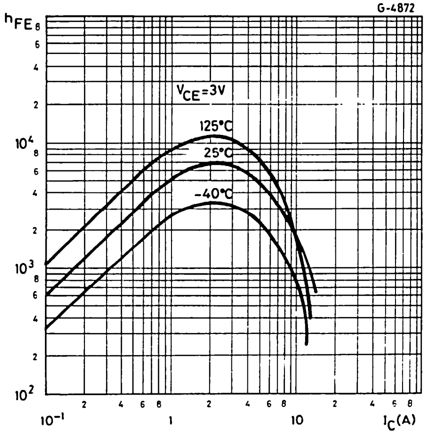
Safe operating areas
(for **BDX87, BDX87A**
BDX88, BDX88A).



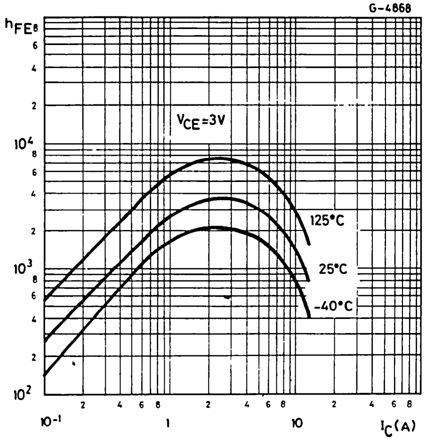
Safe operating areas
(for **BDX87A, BDX87C**
BDX88B, BDX88C).



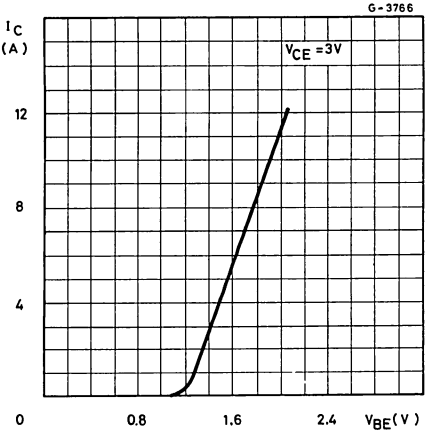
DC current gain (NPN types)



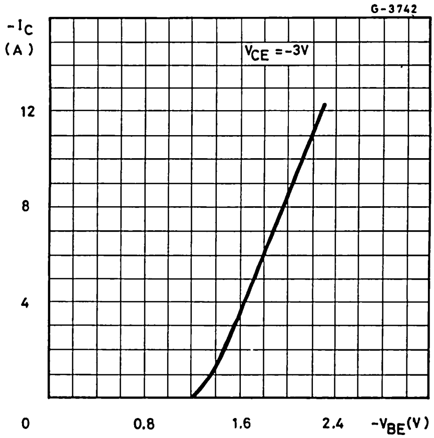
DC current gain (PNP types)



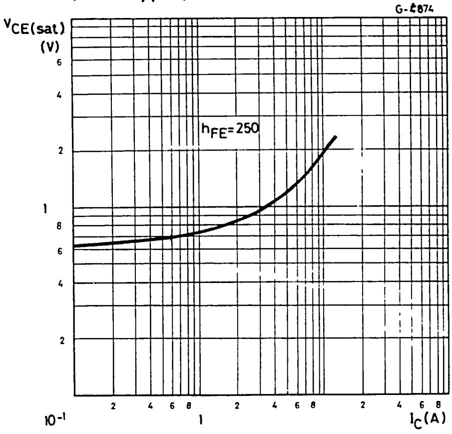
DC transconductance (NPN types)



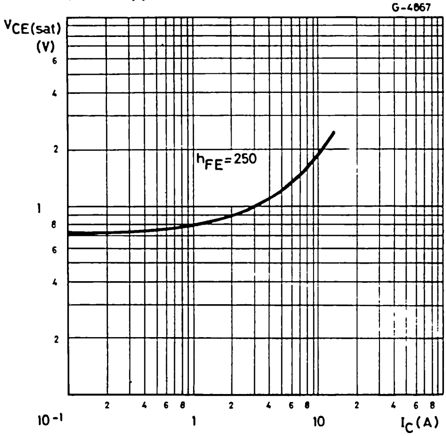
DC transconductance (PNP types)



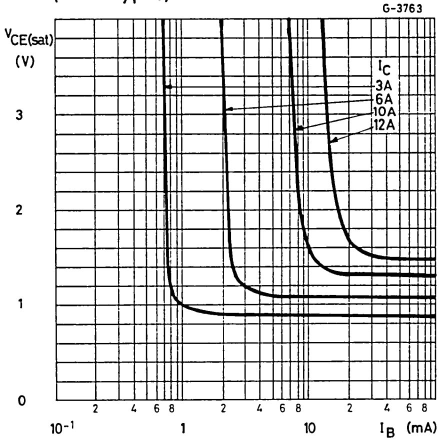
Collector-emitter saturation voltage (NPN types)



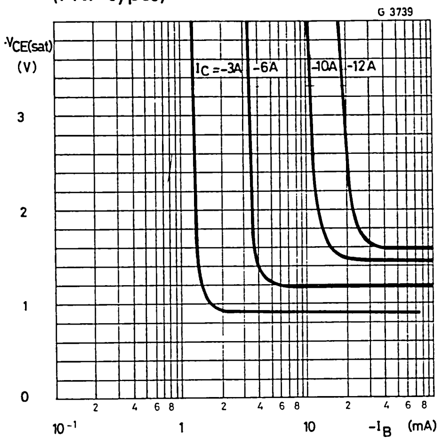
Collector-emitter saturation voltage (PNP types)



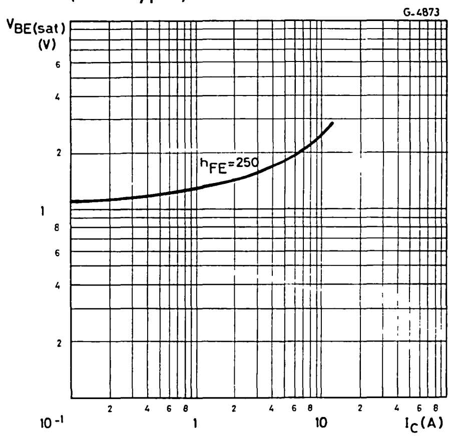
Collector-emitter saturation voltage (NPN types)



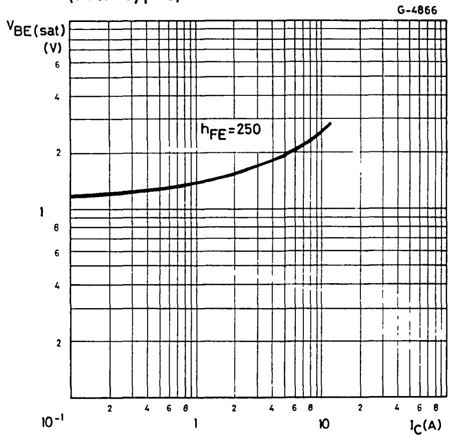
Collector-emitter saturation voltage (PNP types)



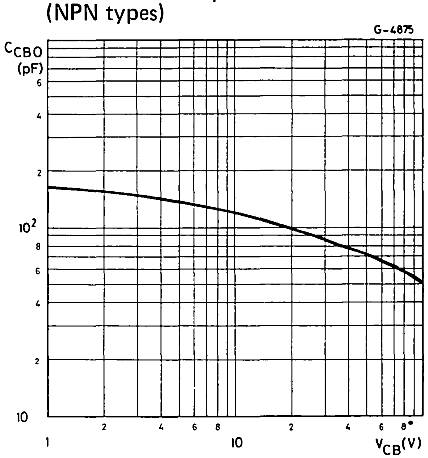
Base-emitter saturation voltage
(NPN types)



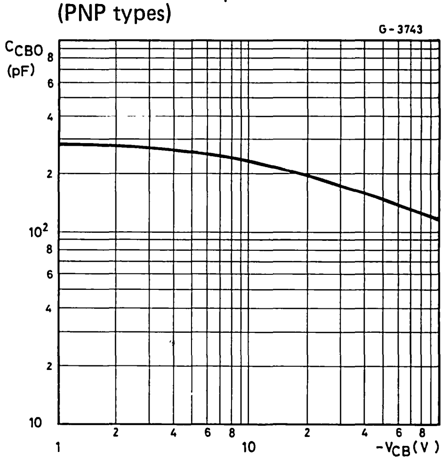
Base-emitter saturation voltage
(PNP types)



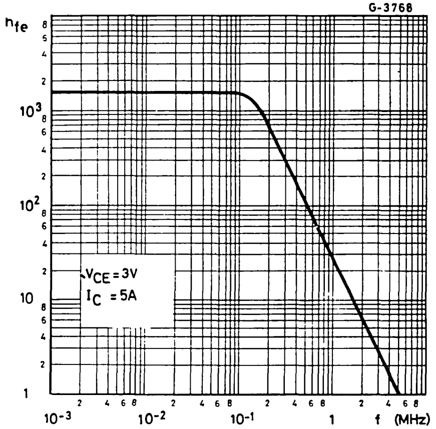
Collector-base capacitance
(NPN types)



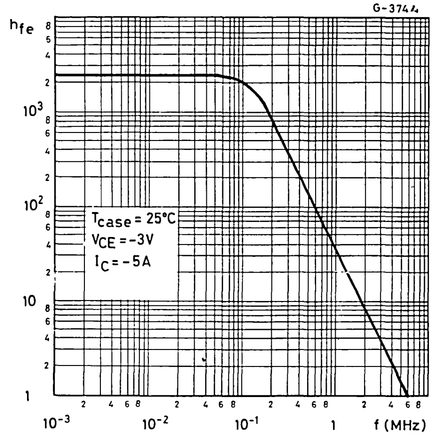
Collector-base capacitance
(PNP types)



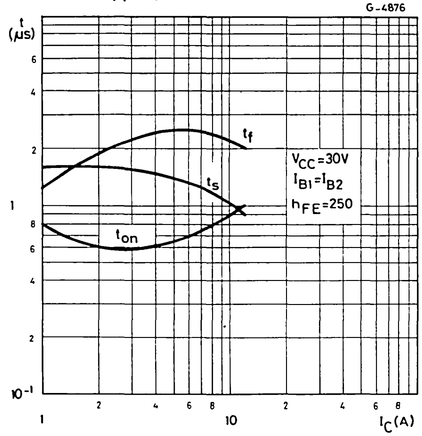
Small signal current gain (NPN types)



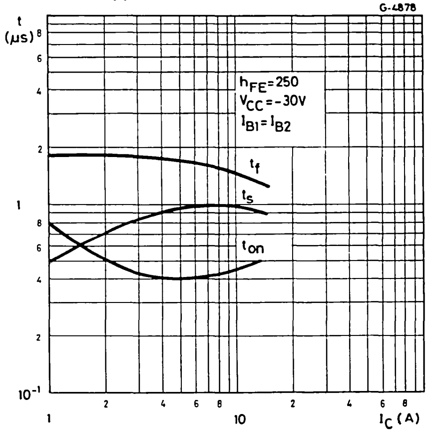
Small signal current gain (PNP types)



Saturated switching characteristics (NPN types)



Saturated switching characteristics (PNP types)



BDY57
BDY58

MULTIEPITAXIAL PLANAR NPN

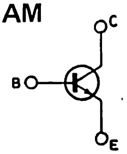
HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTORS

The BDY 57 and BDY 58 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.

ABSOLUTE MAXIMUM RATINGS

		BDY 57	BDY 58
V_{CBO}	Collector-base voltage ($I_E = 0$)	120V	160V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	80V	125V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	10V	
I_C	Collector current	25A	
I_B	Base current	6A	
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$	175W	
T_{stg}	Storage temperature	–65 to 200°C	
T_j	Junction temperature	200°C	

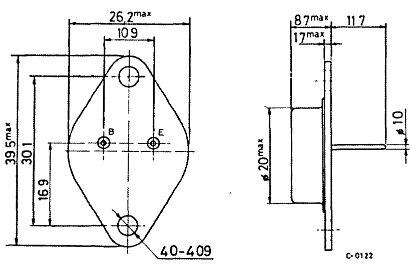
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1	°C/W

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

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	$V_{CB} = 120V$			1	mA
I_{CER}	Collector cutoff current	$V_{CE} = 80V$ $R_{BE} = 10\Omega$ $T_{case} = 100°C$			10	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 10V$			0.5	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage	$I_C = 100mA$ for **BDY 57** for **BDY 58**	 80 125			 V V
$V_{(BR)\ CBO}$*	Collector-base breakdown voltage	$I_C = 5mA$ for **BDY 57** for **BDY 58**	 120 160			 V V
$V_{(BR)\ EBO}$*	Emitter-base breakdown voltage ($I_C = 0$)	$I_E = 5mA$	10			V
$V_{CE\ sat}$*	Collector-emitter saturation voltage	$I_C = 10A$ $I_B = 1A$		0.5	1.4	V
$V_{BE\ sat}$*	Base-emitter saturation voltage	$I_C = 10A$ $I_B = 1A$		1.4	2	V

ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
h_{FE}*	DC current gain	$I_C = 10A$ $V_{CE} = 4V$	20		60	—
		$I_C = 20A$ $V_{CE} = 4V$		15		—
		$T_{case} = -30°C$ $I_C = 10A$ $V_{CE} = 4V$	10			—
f_T	Transition frequency	$I_C = 1A$ $V_{CE} = 15V$ $f = 10MHz$	7			MHz
t_{on}	Turn-on time	$I_C = 15A$ $I_{B1} = 1.5A$			1	μs
t_{off}	Turn-off time	$I_C = 15A$ $I_{B1} = -I_{B2} = 1.5A$			2	μs
	Clamped $E_{s/b}$ Collector current	$V_{(clamp)} = 125V$ $L = 500\mu H$	15			A

* Pulsed: pulse duration = $300\mu s$, duty cycle $\leqslant 2\%$.

MULTIEPITAXIAL PLANAR NPN

BDY90
BDY91
BDY92

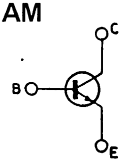
HIGH CURRENT, HIGH SPEED TRANSISTORS

The BDY 90, BDY 91, BDY 92 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.

ABSOLUTE MAXIMUM RATINGS

		BDY 90	BDY 91	BDY 92
V_{CBO}	Collector-base voltage ($I_E = 0$)	120V	100V	80V
V_{CEV}	Collector-emitter voltage ($V_{BE} = -1,5V$)	120V	100V	80V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	100V	80V	60V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		6V	
I_C	Collector current		10A	
I_{CM}	Collector peak current		15A	
I_B	Base current		2A	
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$		60W	
T_{stg}	Storage temperature		–65 to 175°C	
T_j	Junction temperature		175°C	

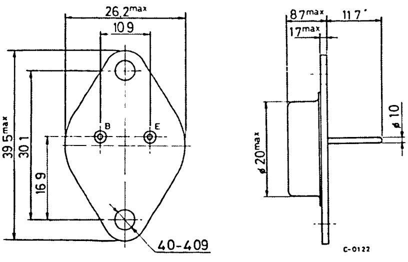
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

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)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	$V_{CB} = V_{CBO}$ max			1	mA
I_{CEV}	Collector cutoff current ($V_{BE} = -1.5V$)	$V_{CE} = V_{CEV}$ max			1	mA
		$T_{case} = 150°C$ $V_{CE} = V_{CEV}$ max			3	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 6V$			1	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 100mA$				
		for **BDY 90**	120			V
		for **BDY 91**	100			V
		for **BDY 92**	80			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	$I_C = 5A$ $I_B = 0.5A$			0.5	V
		$I_C = 10A$ $I_B = 1A$				
		for **BDY 90, BDY 91**			1.5	V
		for **BDY 92**			1	V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	$I_C = 5A$ $I_B = 0.5A$			1.2	V
		$I_C = 10A$ $I_B = 1A$			1.5	V
h_{FE}*	DC current gain	$I_C = 1A$ $V_{CE} = 2V$	35			—
		$I_C = 5A$ $V_{CE} = 5V$	30		120	—
		$I_C = 10A$ $V_{CE} = 5V$	20			—
f_t	Transition frequency	$I_C = 0.5A$ $V_{CE} = 5V$ f = 5MHz		70		MHz
t_{on}	Turn-on time	$I_C = 5A$ $I_{B1} = 0.5A$ $V_{CC} = 30V$			0.35	μs
t_s	Storage time	$I_C = 5A$ $I_{B1} = -I_{B2} = 0.5A$ $V_{CC} = 30V$			1.3	μs
t_f	Fall time				0.2	μs

* Pulsed: pulse duration = 300μs, duty cycle $\leqslant$2%.

BFX34

EPITAXIAL PLANAR NPN

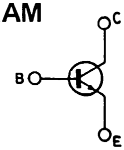
HIGH CURRENT, GENERAL PURPOSE TRANSISTOR

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 relay drivers, inverters.

ABSOLUTE MAXIMUM RATINGS

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 $T_{amb} \leqslant 25°C$	0.87	W
	$T_{case} \leqslant 25°C$	5	W
T_{stg}	Storage temperature	-65 to 200	°C
T_j	Junction temperature	200	°C

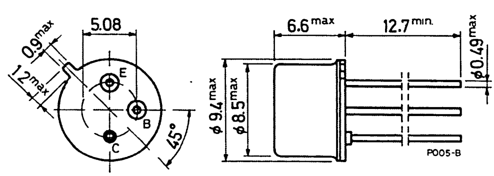
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-39

BFX34

THERMAL DATA

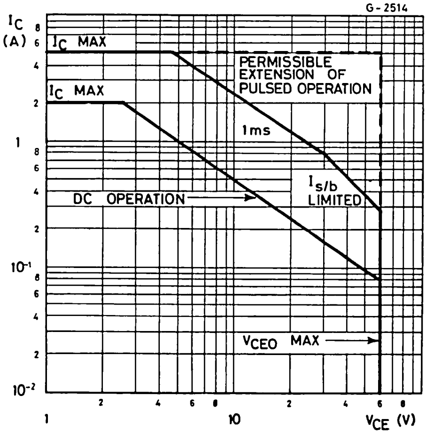
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	35	°C/W
$R_{th\ j\text{-}amb}$	Thermal resistance junction-ambient	max	200	°C/W

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

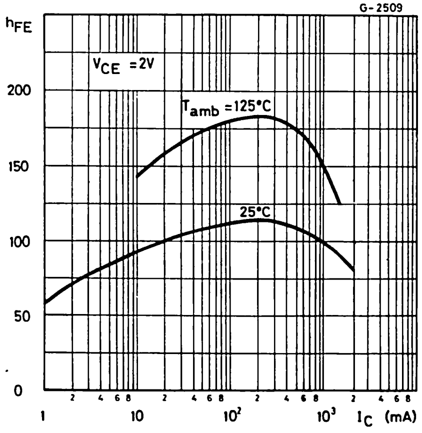
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current (V_{BE} = 0)	V_{CE} = 60V		0.02	10	μA
I_{EBO}	Emitter cutoff current (I_C = 0)	V_{EB} = 4V		0.05	10	μA
$V_{(BR)\,CBO}$*	Collector-base breakdown voltage (I_E = 0)	I_C = 5mA	120			V
$V_{CEO\,(sus)}$*	Collector-emitter sustaining voltage (I_B = 0)	I_C = 100mA	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 = 5A I_B = 0.5A		0.4	1	V
$V_{BE\,(sat)}$*	Base-emitter saturation voltage	I_C = 5A I_B = 0.5A		1.3	1.6	V
h_{FE}*	DC current gain	I_C = 1A V_{CE} = 2V I_C = 1.5A V_{CE} = 0.6V I_C = 2A V_{CE} = 2V	 40	100 75 80	 150	— — —
f_T	Transition frequency	I_C = 0.5 A V_{CE} = 5 V f = 20 MHz	70	100		MHz
C_{EBO}	Emitter-base capacitance	I_C = 0 V_{EB} = 0.5V f = 1 MHz		300	500	pF
C_{CBO}	Collector-base capacitance	I_E = 0 V_{CB} = 10V f = 1 MHz		40	100	pF
t_{on}	Turn-on time	I_C = 5 A V_{CC} = 20 V I_{B1} = $-I_{B2}$ = 0.5 A		0.25	0.6	μs
t_{off}	Turn-off time			0.6	1.2	μs

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

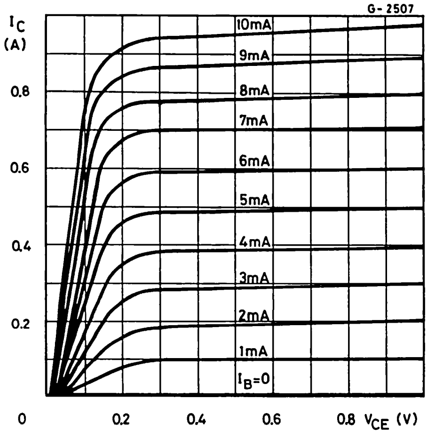
Safe operating areas



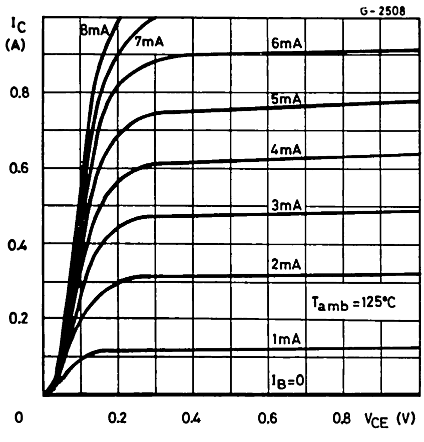
DC current gain



Output characteristics

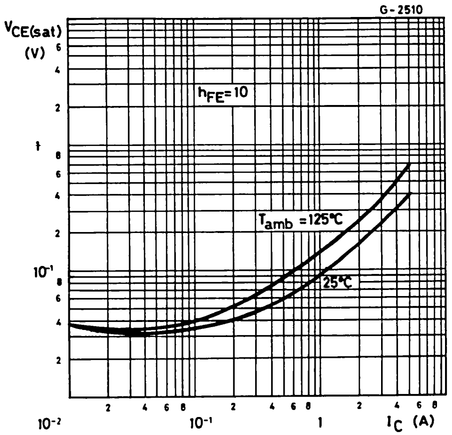


Output characteristics

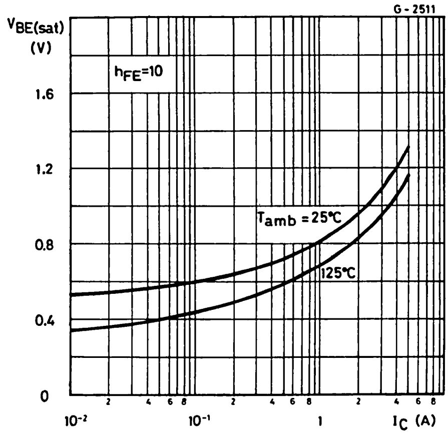


BFX34

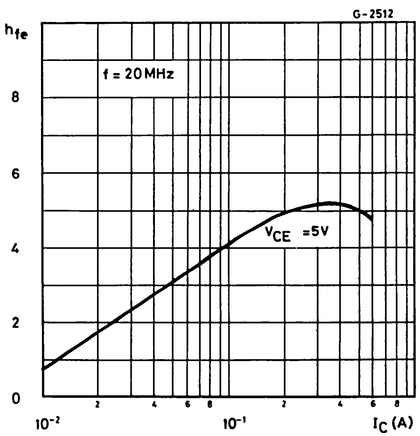
Collector-emitter saturation voltage



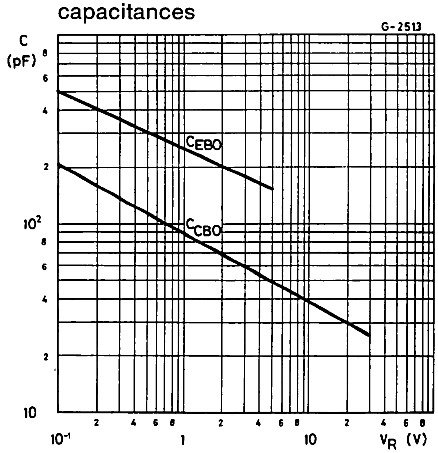
Base-emitter saturation voltage



Small signal current gain



Emitter-base and collector-base capacitances



EPITAXIAL PLANAR PNP

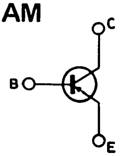
HIGH CURRENT, GENERAL PURPOSE TRANSISTOR

The BSS 44 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.

ABSOLUTE MAXIMUM RATINGS

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 $T_{amb} \leq 25°C$	0.87	W
	$T_{case} \leq 25°C$	5	W
T_{stg}	Storage temperature	-65 to 200	°C
T_j	Junction temperature	200	°C

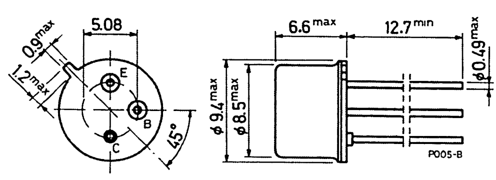
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-39

BSS44

THERMAL DATA

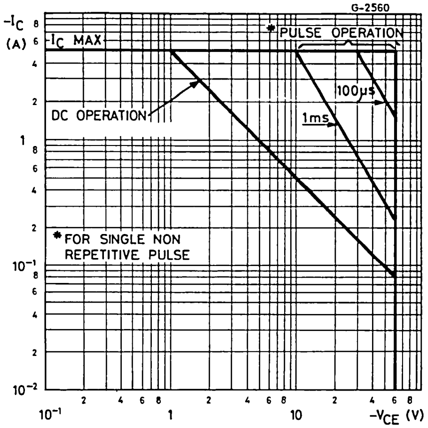
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	35	°C/W
$R_{th\ j\text{-}amb}$	Thermal resistance junction-ambient	max	200	°C/W

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

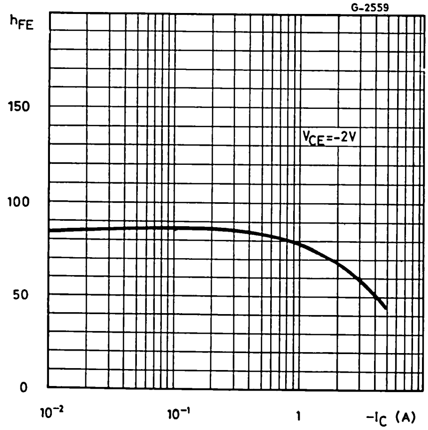
	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current (V_{BE} = 0)	V_{CE} = -60V			-0.5	μA
$V_{(BR)\ CBO}$	Collector-base breakdown voltage (I_E = 0)	I_C = -1 mA	-65			V
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage (I_B = 0)	I_C = -50 mA	-60			V
V_{EBO}*	**Emitter-base voltage** **(I_C =0)**	I_E = -1 mA	-6			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	I_C = -0.5A I_B = -50mA I_C = -5A I_B = -0.5A		-0.1 -0.4	 -1	V V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	I_C = -0.5A I_B = -50mA I_C = -5A I_B = -0.5A		-0.8 -1.1	 -1.6	V V
h_{FE}*	DC current gain	I_C = -0.5A V_{CE} = -2V I_C = -2A V_{CE} = -2V I_C = -5A V_{CE} = -2V	30 40 	 70 45		— — —
f_T	Transition frequency	I_C = -0.5A V_{CE} = -5V		80		MHz
C_{CBO}	Collector-base capacitance	I_E = 0 V_{CB} = -10 V f = 1 MHz			100	pF
t_{on}	Turn-on time	I_C = -0.5A V_{CC} = -20V I_{B1} = $-I_{B2}$ = -50mA		0.065		μs
t_{off}	Turn-off time			0.45		μs

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

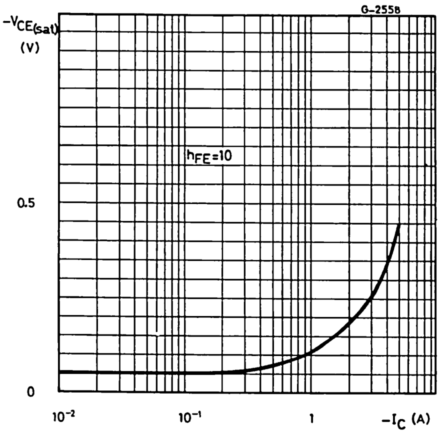
Safe operating areas



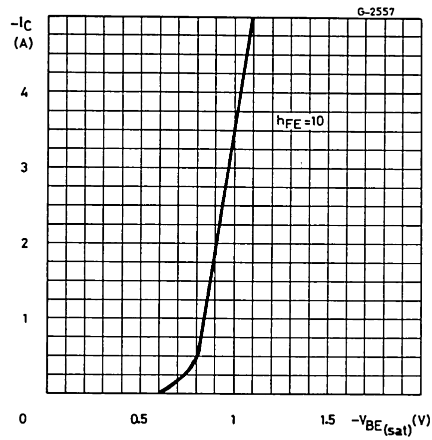
DC current gain



Collector-emitter saturation voltage

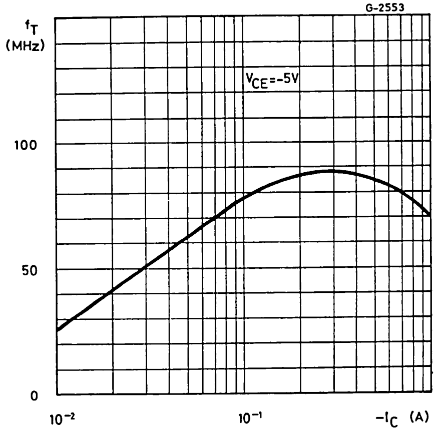


Base-emitter saturation voltage

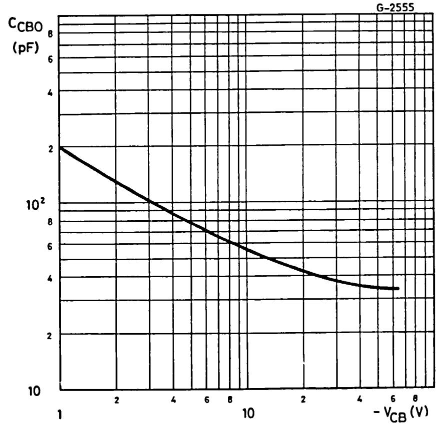


BSS44

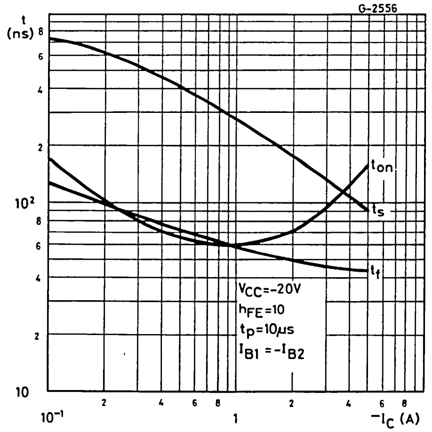
Transition frequency



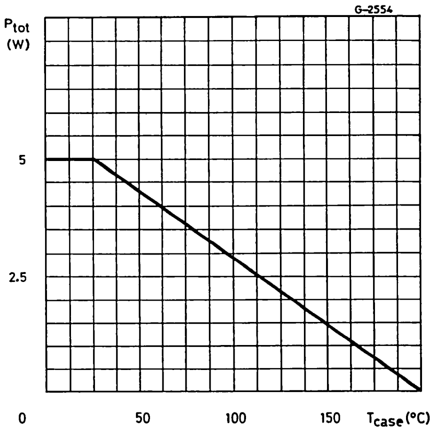
Collector-base capacitance



Saturated switching characteristics



Power rating chart



EPITAXIAL PLANAR NPN

BSW67
BSW68

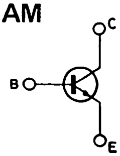
HIGH VOLTAGE SWITCH

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.

ABSOLUTE MAXIMUM RATINGS

		BSW 67	BSW 68
V_{CBO}	Collector-base voltage ($I_E = 0$)	120V	150V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	120V	150V
I_C	Collector current	1.5A	
I_{CM}	Collector peak current	2A	
P_{tot}	Total power dissipation at $T_{amb} \leqslant 45°C$	0.7W	
	$T_{case} \leqslant 25°C$	5W	
	$T_{case} \leqslant 100°C$	2.85W	
T_{stg}	Storage temperature	-65 to 200 °C	
T_j	Junction temperature	200 °C	

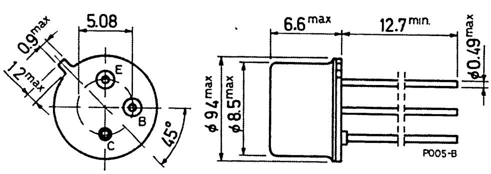
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-39

BSW67
BSW68

THERMAL DATA

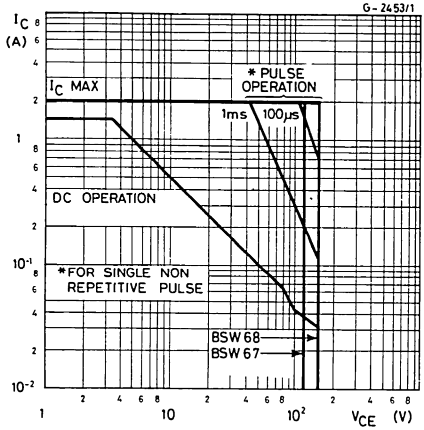
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	35	°C/W
$R_{th\ j\text{-}amb}$	Thermal resistance junction-ambient	max	220	°C/W

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

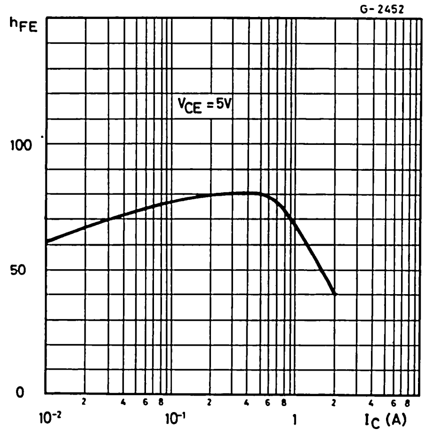
	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current (I_E = 0)	for **BSW 67**				
		V_{CB} = 60 V			100	nA
		V_{CB} = 60 V T_{case} = 150°C			50	μA
		for **BSW 68**				
		V_{CB} = 75 V			100	nA
		V_{CB} = 75 V T_{case} = 150°C			50	μA
$V_{(BR)\ CBO}$	Collector-base breakdown voltage (I_E = 0)	I_C = 100 μA				
		for **BSW 67**	120			V
		for **BSW 68**	150			V
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage (I_B = 0)	I_C = 100 mA				
		for **BSW 67**	120			V
		for **BSW 68**	150			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			0.15	V
		I_C = 0.5 A I_B = 0.05 A			0.5	V
		I_C = 1 A I_B = 0.15 A			1	V
$V_{BE\ (sat)}$*	Base-emitter voltage	I_C = 0.1 A I_B = 0.01 A			0.9	V
		I_C = 0.5 A I_B = 0.05 A			1.1	V
		I_C = 1 A I_B = 0.15 A			1.2	V
h_{FE}*	DC current gain	I_C = 0.1 A V_{CE} = 5 V	40			—
		I_C = 0.5 A V_{CE} = 5 V	30			—
		I_C = 1 A V_{CE} = 5 V	15			—
f_T	Transition frequency	I_C = 100mA 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 = 300 μs, duty cycle = 1.5%

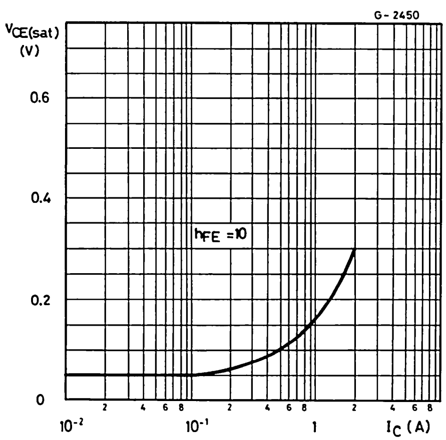
Safe operating areas



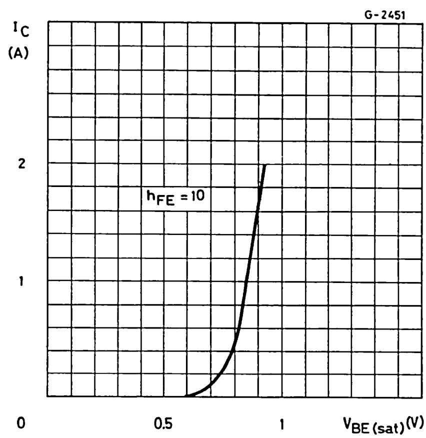
DC current gain



Collector-emitter saturation voltage

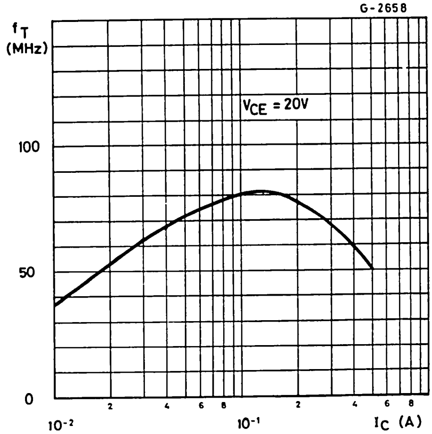


Base-emitter saturation voltage

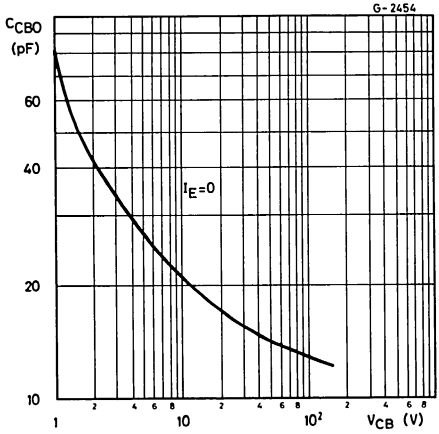


BSW67
BSW68

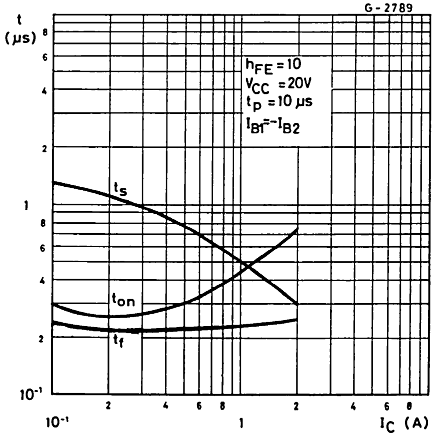
Transition frequency



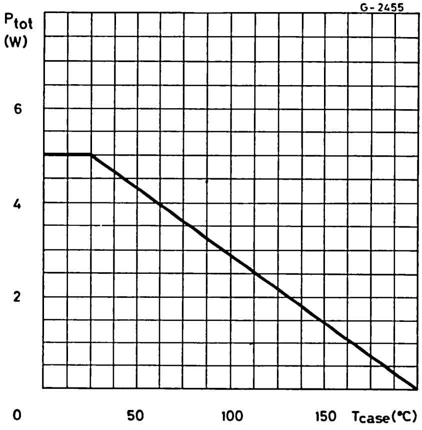
Collector-base capacitance



Saturated switching characteristics



Power rating chart



BU125

EPITAXIAL PLANAR NPN

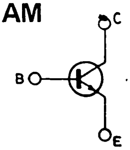
HIGH CURRENT,GENERAL PURPOSE TRANSISTOR

The BU 125 is a silicon epitaxial planar NPN transistor in Jedec TO-39 metal case. It is used in TV horizontal output and general purpose applications.

ABSOLUTE MAXIMUM RATINGS

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 $T_{amb} \leq 25°C$	1	W
	$T_{case} \leq 50°C$	10	W
T_{stg}	Storage temperature	-65 to 200	°C
T_j	Junction temperature	200	°C

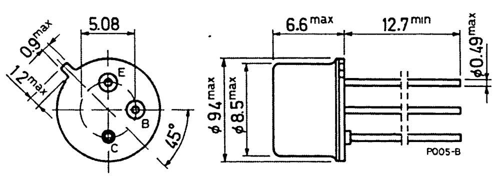
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-39

BU125

THERMAL DATA

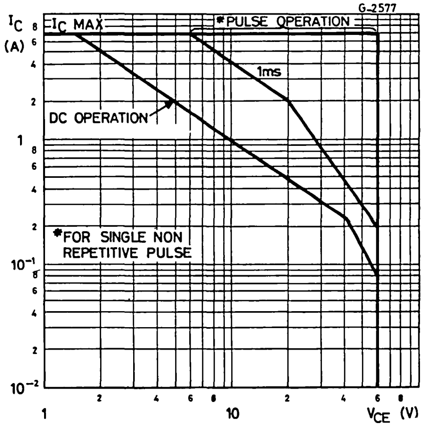
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	15	°C/W
$R_{th\ j\text{-}amb}$	Thermal resistance junction-ambient	max	175	°C/W

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

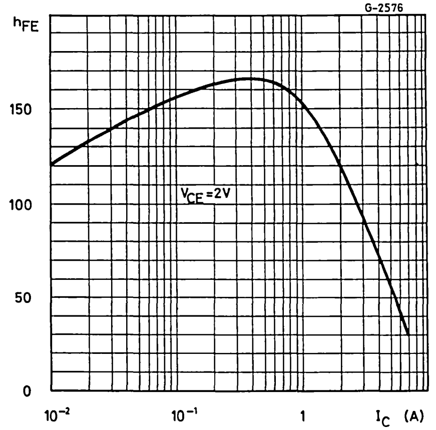
Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	$V_{CB} = 100$ V			0.02	10	μA
$V_{(BR)\ CBO}$*	Collector-base breakdown voltage ($I_E = 0$)	$I_C = 1$ mA		130			V
$V_{(BR)\ CES}$*	Collector-emitter breakdown voltage ($V_{BE} = 0$)	$I_C = 1$ mA		130			V
$V_{CEO\ (sus)}$*	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%

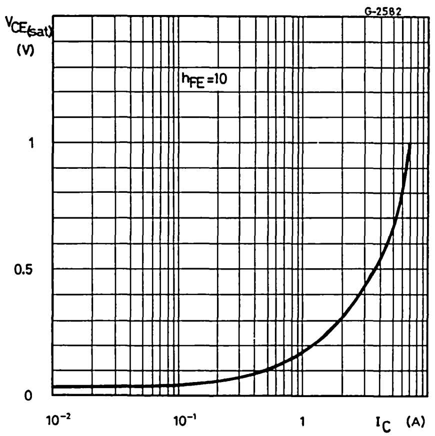
Safe operating areas



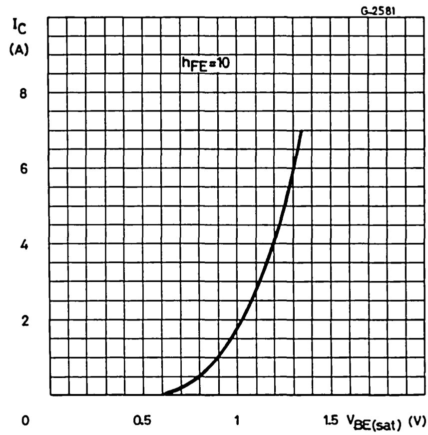
DC current gain



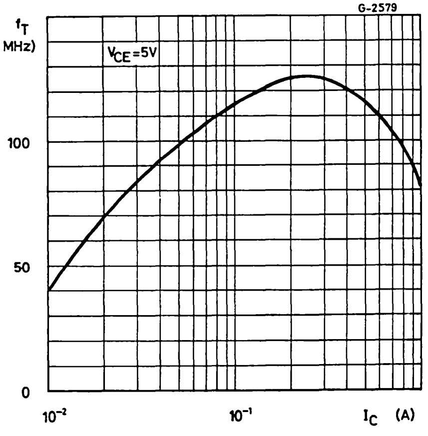
Collector-emitter saturation voltage



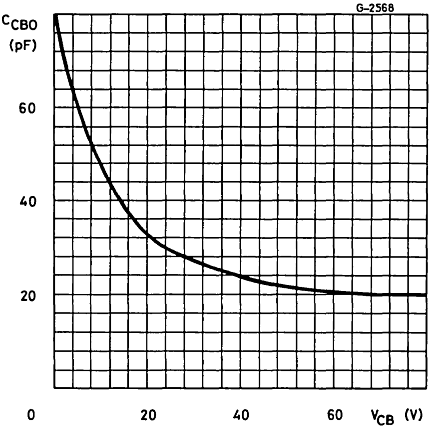
Base-emitter saturation voltage



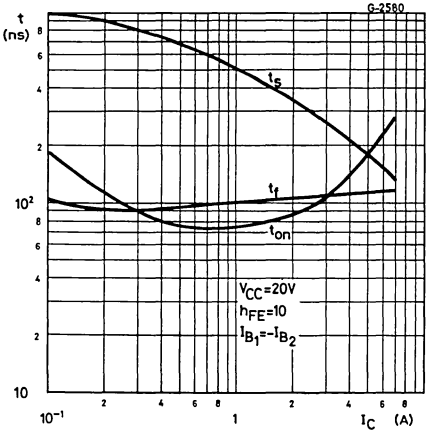
Transition frequency



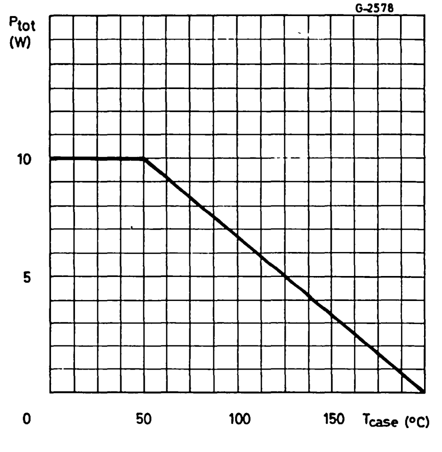
Collector-base capacitance



Saturated switching characteristics



Power rating chart



EPITAXIAL PLANAR NPN

BU125S

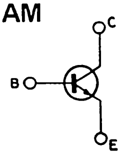
HIGH VOLTAGE POWER AMPLIFIER

The BU 125S is a silicon epitaxial planar NPN transistor in Jedec TO-39 metal case. It is intended for general purpose, linear and switching applications.

ABSOLUTE MAXIMUM RATINGS

V_{CBO}	Collector-base voltage ($I_E = 0$)	250	V
V_{CEV}	Collector-emitter voltage ($V_{BE} = -1.5V$)	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 $T_{amb} \leq 25°C$	1	W
	$T_{case} \leq 50°C$	10	W
T_{stg}	Storage temperature	-65 to 200	°C
T_j	Junction temperature	200	°C

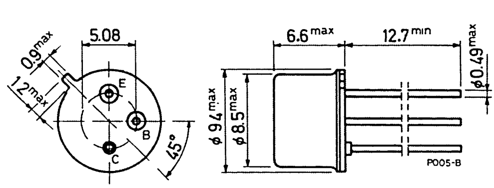
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-39

BU125S

THERMAL DATA

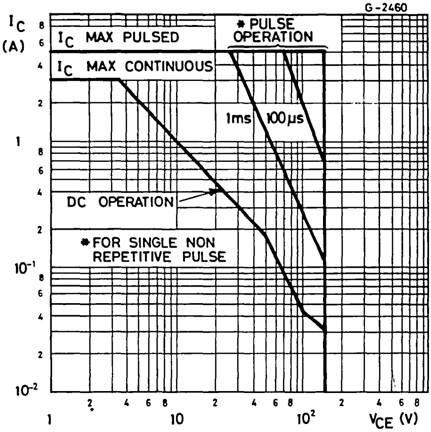
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	15	°C/W
$R_{th\ j\text{-}amb}$	Thermal resistance junction-ambient	max	175	°C/W

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

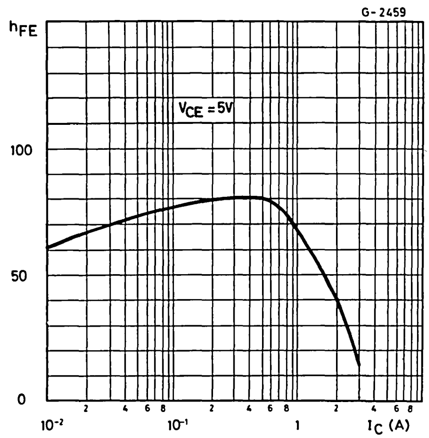
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current (I_E = 0)	V_{CB} = 200 V			10	μA
I_{EBO}	Emitter cutoff current (I_C = 0)	V_{EB} = 6 V			1	mA
V_{CBO}	Collector-base voltage (I_E = 0)	I_C = 1mA	250			V
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage (I_B = 0)	I_C = 20 mA	150			V
$V_{CE\ (sat)}$	Collector-emitter saturation voltage	I_C = 500mA I_B = 50mA			1.5	V
h_{FE}	DC current gain	I_C = 5 mA V_{CE} = 10V I_C = 250mA V_{CE} = 3V	30 30			— —
f_T	Transition frequency	I_C = 100mA V_{CE} = 10V	15			MHz
C_{CBO}	Collector-base capacitance	I_E = 0 V_{CB} = 20 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 = 300 μs, duty cycle = 1.5%

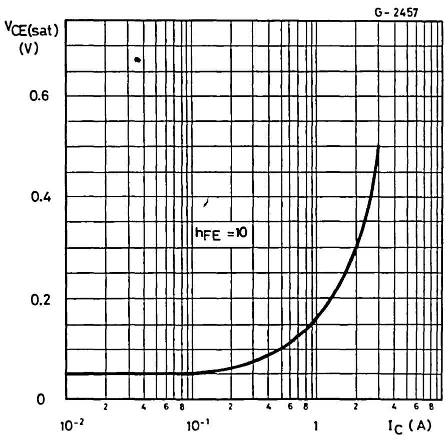
Safe operating areas



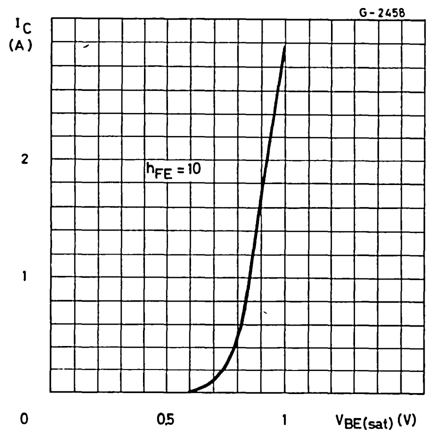
DC current gain



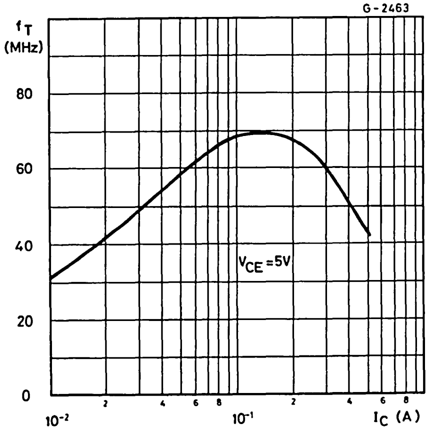
Collector-emitter saturation voltage



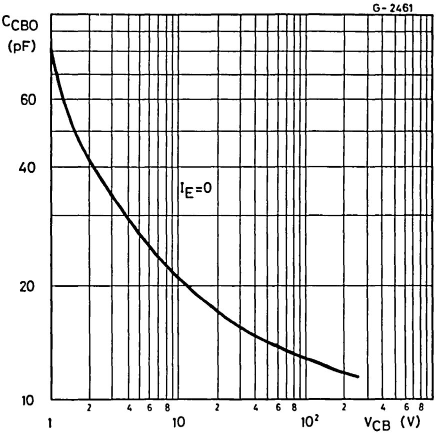
Base-emitter saturation voltage



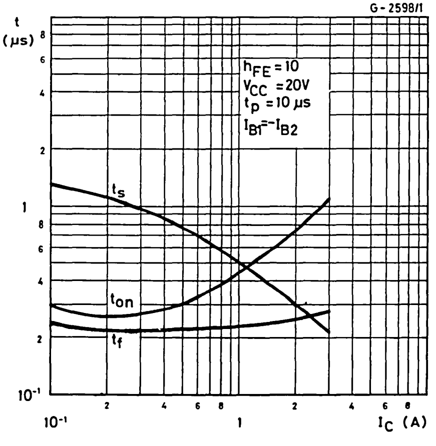
Transition frequency



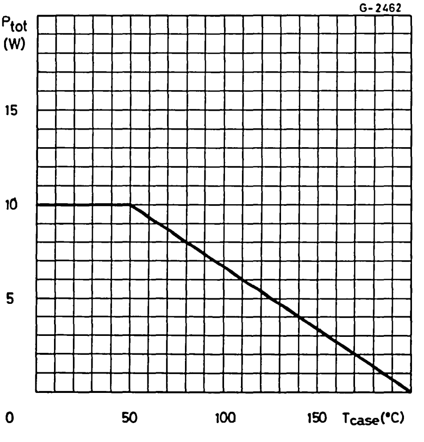
Collector-base capacitance



Saturated switching characteristics



Power rating chart



MULTIEPITAXIAL MESA NPN

BU208
BU208A
BU208D

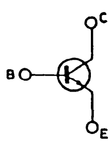
HORIZONTAL TVC DEFLECTION

The BU208, BU208A and the BU208D (the same as BU208A with integrated damper diode) are silicon multiepitaxial mesa NPN transistors in Jedec TO-3 metal case. They are fast switching, high voltage devices for use in horizontal deflection circuits of colour television receivers.

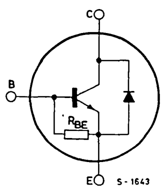
ABSOLUTE MAXIMUM RATINGS

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 ($I_C = 0$)	5	V
I_C	Collector current	8	A
I_{CM}	Collector peak current	15	A
P_{tot}	Total power dissipation at $T_{case} = 25°C$	150	W
T_{stg}	Storage temperature	-65 to 150	°C
T_j	Max operting junction temperature	175	°C

INTERNAL SCHEMATIC DIAGRAMS



BU208, BU208A



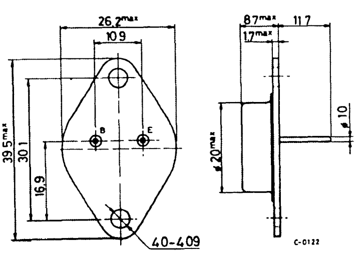
BU208D

R_{BE} Typ. 30Ω

MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

BU208
BU208A
BU208D

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1	°C/W

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

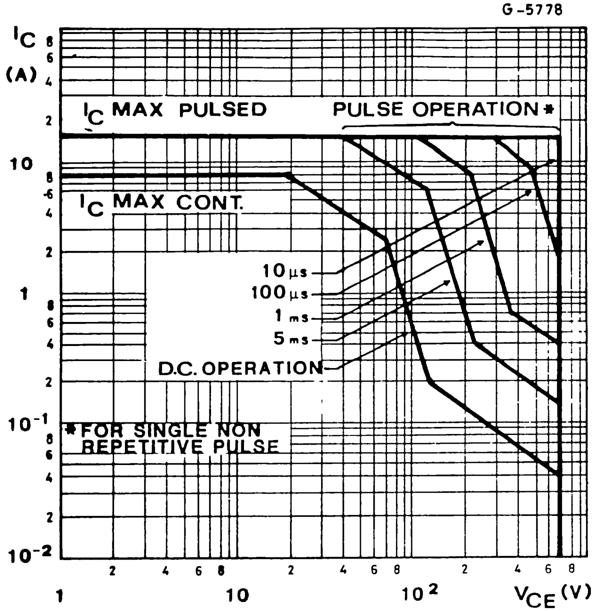
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current (V_{BE} = 0)	$V_{CE} = V_{CES}$			1	mA
$V_{CEO\,(sus)}$*	Collector-emitter sustaining voltage (I_B = 0)	I_C = 100mA	700			V
V_{EBO}	Emitter-base voltage (I_C = 0)	I_{EBO} = 10mA for **BU508** and **BU508A**	5			V
I_{EBO}	Emitter cutoff current (I_C = 0)	V_{EBO} = 5V for **BU508D**			300	mA
V_F	Diode forward voltage	I_F = 4A for **BU508D**			2	V
$V_{CE\,(sat)}$*	Collector-emitter saturation voltage	I_C = 4.5A I_B = 2A for **BU508A** and **BU508D** for **BU508**			 1 5	 V V
$V_{BE\,(sat)}$*	Base-emitter saturation voltage	I_C = 4.5A I_B = 2A			1.5	V

INDUCTIVE SWITCHING TIMES

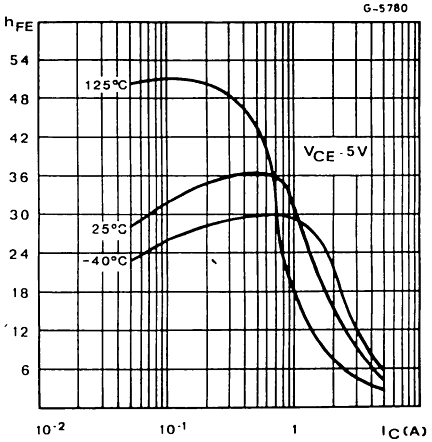
t_s t_f	Storage time Fall time	I_c = 4.5A, h_{FE} = 2.5, V_{CC} = 140V L_c = 0.9mH L_B = 3μH		7.0 0.5		μs μs

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

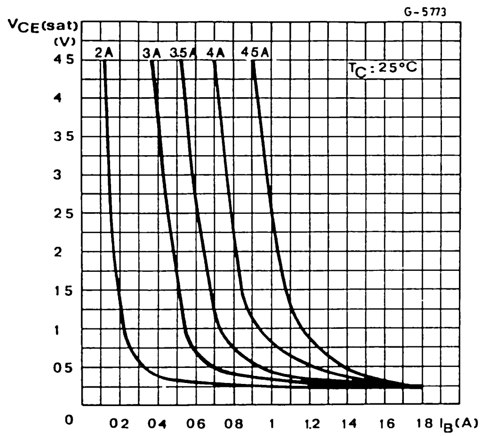
Safe operating area



DC current gain

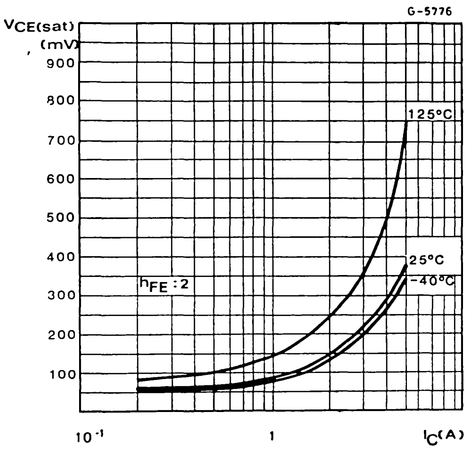


Collector saturation region

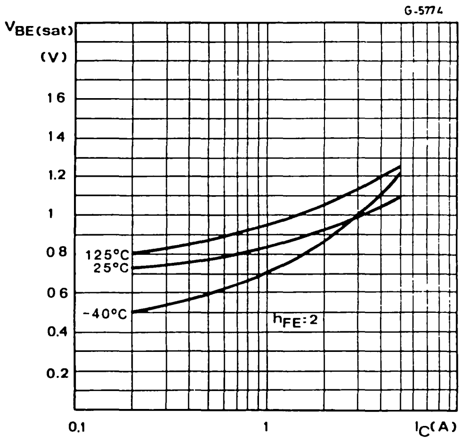


BU208
BU208A
BU208D

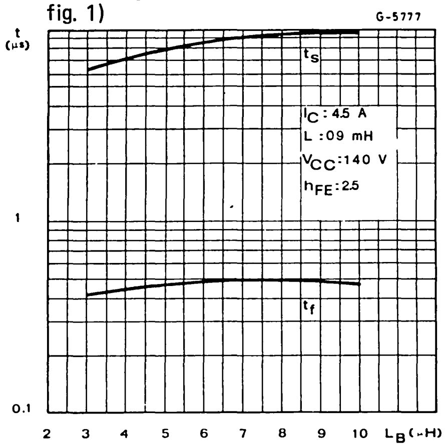
Collector-emitter saturation voltage



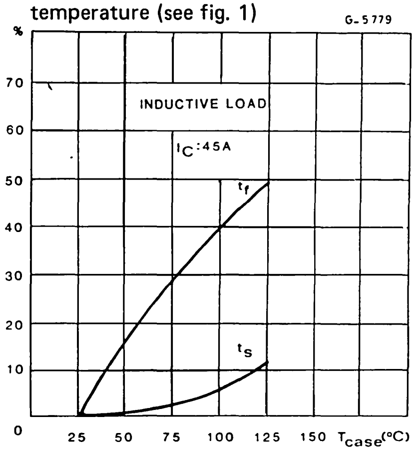
Base-emitter saturation voltage



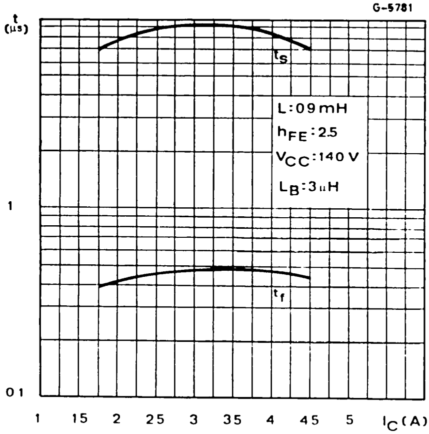
Switching times inductive load (see fig. 1)



Switching times percentage vs. case temperature (see fig. 1)



Switching times inductive load (fig. 1)



$V_{CE\,sat}$ dinamic (fig. 2)

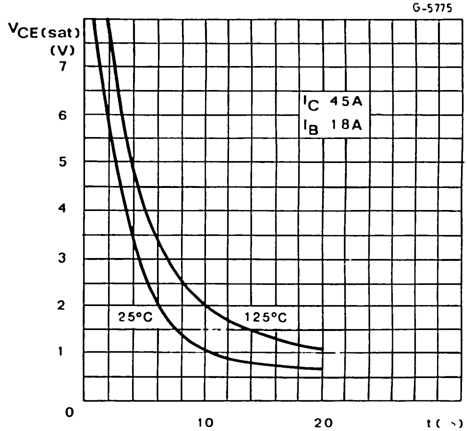
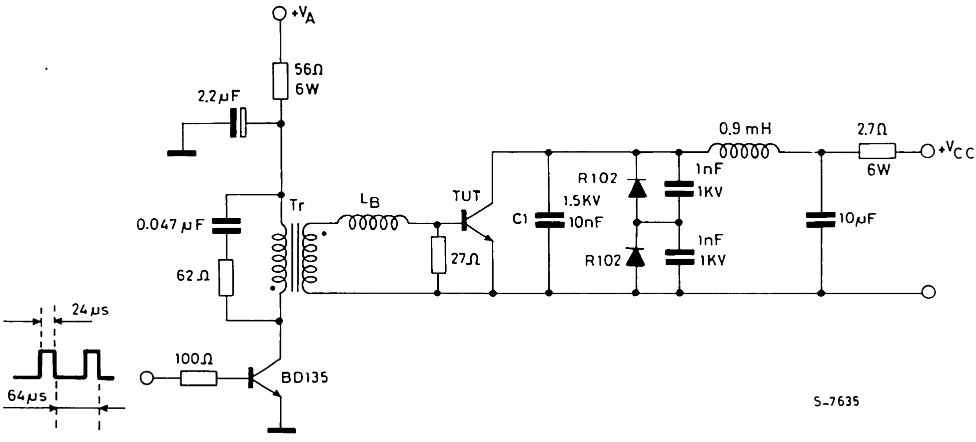


Fig. 1 – Switching times test circuit on inductive load



A TYPICAL SWITCH-OFF CYCLE (see fig. 1)

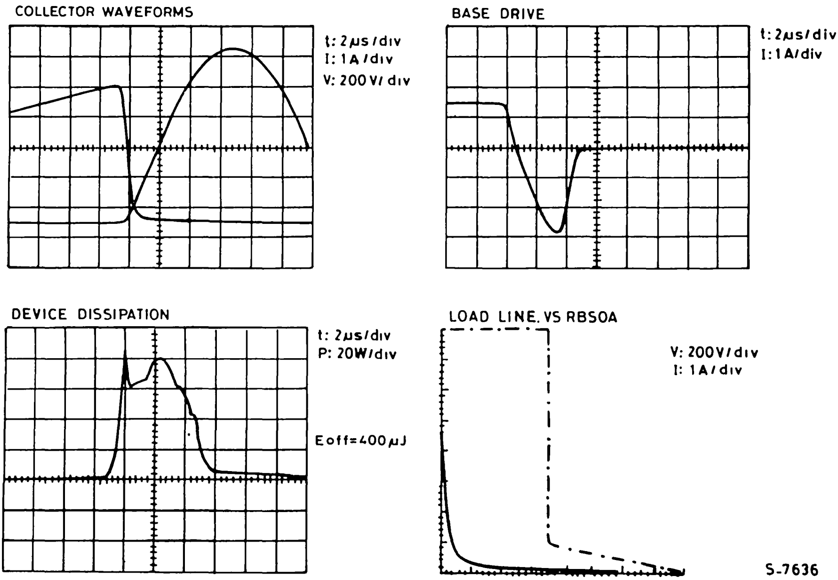
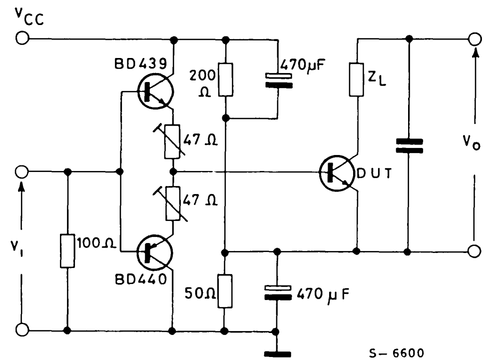


Fig. 2 — $V_{CE\,(sat)}$ dyn. test circuit



BU325

EPITAXIAL PLANAR NPN

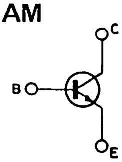
HIGH VOLTAGE SWITCH

The BU 325 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.

ABSOLUTE MAXIMUM RATINGS

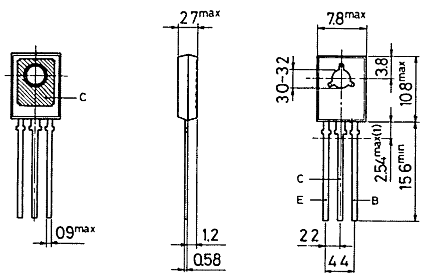
V_{CBO}	Collector-base voltage ($I_E=0$)	200	V
V_{CEO}	Collector-emitter voltage ($I_B=0$)	200	V
V_{EBO}	Emitter-base voltage ($I_C=0$)	5	V
I_C	Collector current	3	A
I_B	Base current	1	A
P_{tot}	Total power dissipation at $T_{amb} \leq 25\,°C$	1.25	W
	$T_{case} \leq 25\,°C$	25	W
T_{stg}	Storage temperature	-65 to 150	°C
T_j	Junction temperature	150	°C

INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm



(1) Within this region the cross-section of the leads is uncontrolled

TO-126 (SOT-32)

BU325

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	5	°C/W
$R_{th\ j\text{-}amb}$	Thermal resistance junction-amb.	max	100	°C/W

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

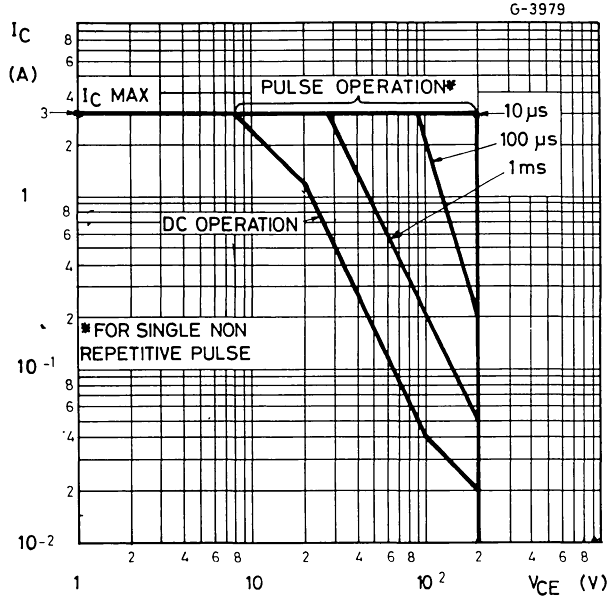
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current (I_E=0)	V_{CB}=200V			100	μA
V_{CBO}	Collector base breakdown voltage (I_E=0)	I_C =100μA	200			V
$V_{CEO\ (sus)}$ *	Collector-emitter sustaining voltage (I_B = 0)	I_C =10mA	200			V
V_{EBO}*	Emitter-base voltage (I_C=0)	I_E =1mA	5			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	I_C =150mA I_B =15mA I_C =500mA I_B =50mA		0.06 0.10	1.0 1.5	V V
$V_{BE(sat)}$*	Base-emitter saturation voltage	I_C =150mA I_B =15mA I_C =500mA I_B =50mA		0.73 0.80	1.0 1.2	V V
h_{FE}*	DC current gain	I_C =50mA V_{CE}=5V I_C =150mA V_{CE}=5V I_C =500mA V_{CE}=5V	30 30 30		200 200 200	— — —

ELECTRICAL CHARACTERISTICS (continued)

	Parameter	Test conditions	Min. Typ. Max.	Unit
f_T	Transition frequency	I_C =500mA V_{CE}=5V	40	MHz
C_{CBO}	Collector-base capacitance	I_E =0 V_{CB}=10V f =1MHz	50	pF
t_{on}	Turn-on time	I_C =0.5A I_{B1} =50mA V_{CC}=20V	0.3	µs
t_{off}	Turn-off time	I_C =0.5A I_{B1} =-I_{B2} =50mA V_{CC}=20V	1	µs

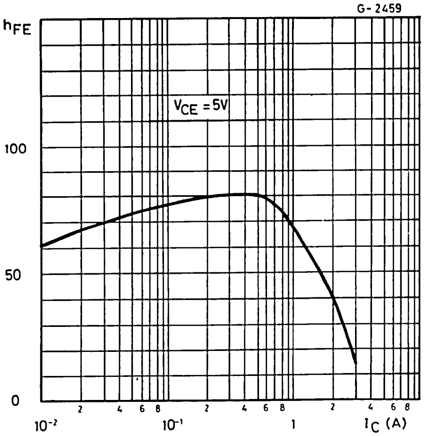
* Pulsed: pulse duration =300 µs, duty cycle =1.5%

Safe operating areas

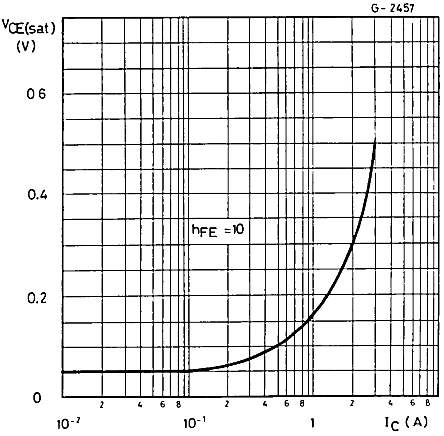


BU325

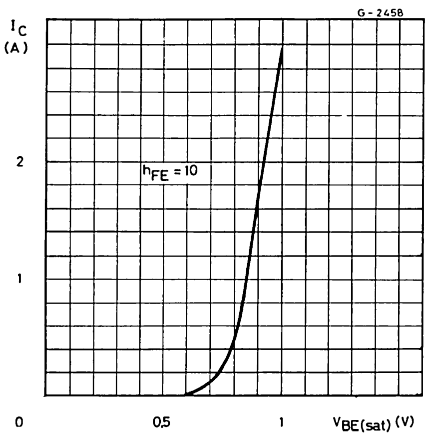
DC current gain



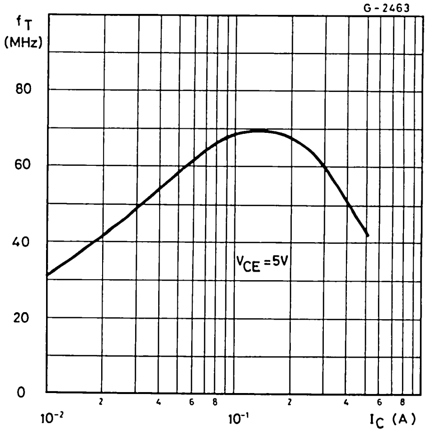
Collector-emitter saturation voltage



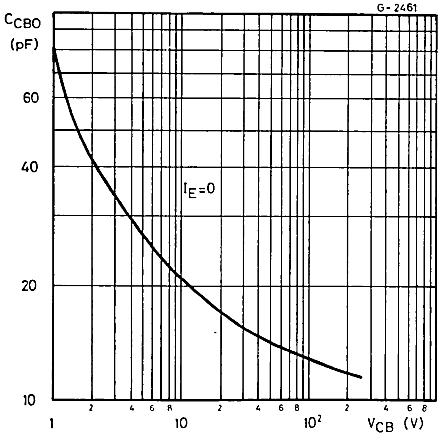
Base-emitter saturation voltage



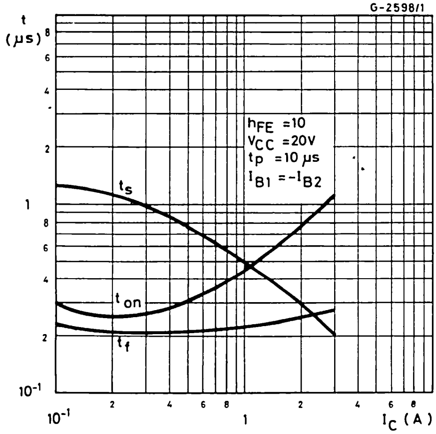
Transition frequency



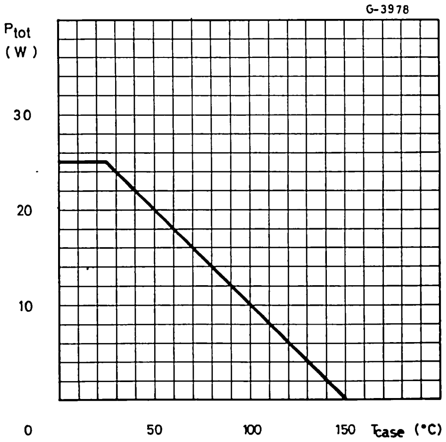
Collector-emitter saturation voltage



Saturated switching characteristics



Power rating chart



BU326
BU326A

MULTIEPITAXIAL MESA NPN

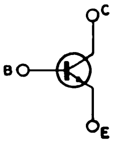
HIGH VOLTAGE POWER SWITCH

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

ABSOLUTE MAXIMUM RATINGS

<table>
<tr><th></th><th></th><th>BU326A</th><th>BU326</th></tr>
<tr><td>V_{CES}</td><td>Collector-emitter voltage ($V_{BE} = 0$)</td><td>900V</td><td>800V</td></tr>
<tr><td>V_{CEO}</td><td>Collector-emitter voltage ($I_B = 0$)</td><td>400V</td><td>325V</td></tr>
<tr><td>V_{EBO}</td><td>Base-emitter voltage ($I_C = 0$)</td><td colspan="2">10V</td></tr>
<tr><td>I_C</td><td>Collector current</td><td colspan="2">6A</td></tr>
<tr><td>I_{CM}</td><td>Collector peak current</td><td colspan="2">8A</td></tr>
<tr><td>I_B</td><td>Base current</td><td colspan="2">3A</td></tr>
<tr><td>P_{tot}</td><td>Total power dissipation at $T_{case} \leqslant 25^\circ C$</td><td colspan="2">75W</td></tr>
<tr><td>T_{stg}</td><td>Storage temperature</td><td colspan="2">-65 to 200°C</td></tr>
<tr><td>T_j</td><td>Junction temperature</td><td colspan="2">200°C</td></tr>
</table>

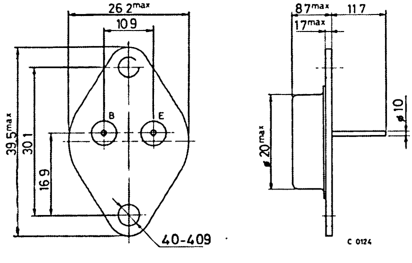
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	2.33	°C/W

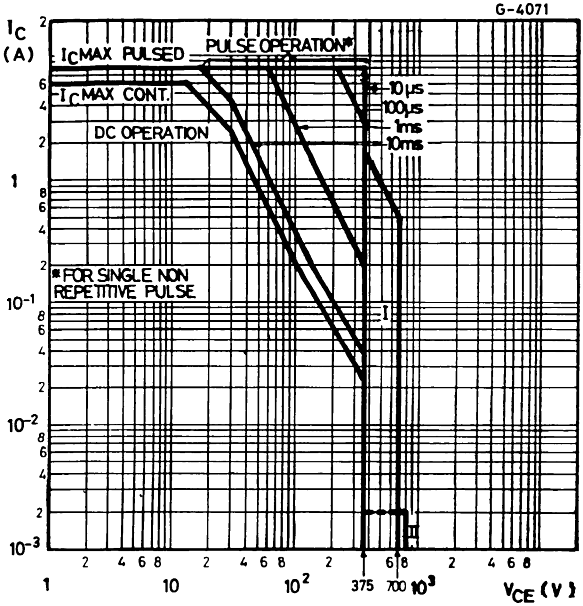
ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current (V_{BE}=0)	V_{CE} = 900V	for **BU326A**			1	mA
		V_{CE} = 800V	for **BU326**			1	mA
		V_{CE} = 800V T_{case} = 125°C	for **BU326**			2	mA
		V_{CE} = 900V T_{case} = 125°C	for **BU326A**			2	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**	325			V
			for **BU326A**	400			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	I_C =2.5A	I_B =0.5A			1.5	V
		I_C =4A	I_B =1.25A			3	V
$V_{BE(sat)}$*	Base-emitter saturation voltage	I_C =2.5A	I_B =0.5A			1.4	V
		I_C =4A	I_B =1.25A			1.6	V
h_{FE}*	DC current gain	I_C =1A	V_{CE}=5V		25		—
t_{on}	Turn-on time	I_C =2.5A V_{CC}=250V	I_{B1} =0.5A			0.5	μs
t_s	Storage time	I_C =2.5A I_{B2} =-1A	I_{B1} =0.5A V_{CC}=250V			3.5	μs
t_f	Fall time	I_C =2.5A I_{B2} =-1A	I_{B1} =0.5A V_{CC}=250V			0.5	μs

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

BU326
BU326A

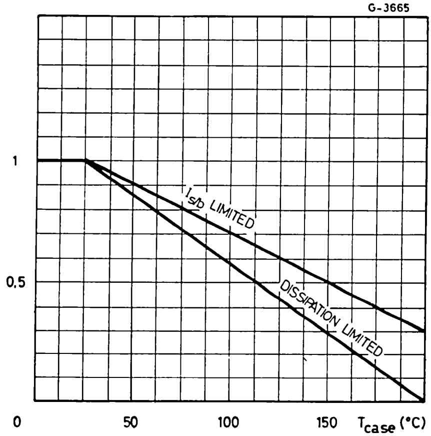
Safe operating areas



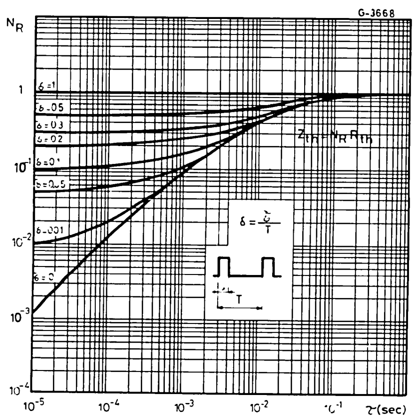
I — Area of permissible operation during turn-on provided $R_{BE} \leq 100\Omega$ and $t_p \leq 0.6$ µs

II— Area of permissible operation with $V_{BE} \leq 0$ and $t_p \leq 2$ µs

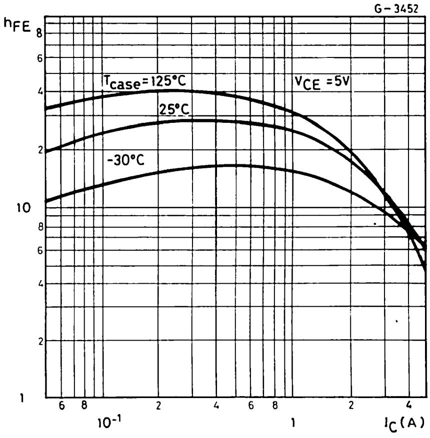
Derating curves



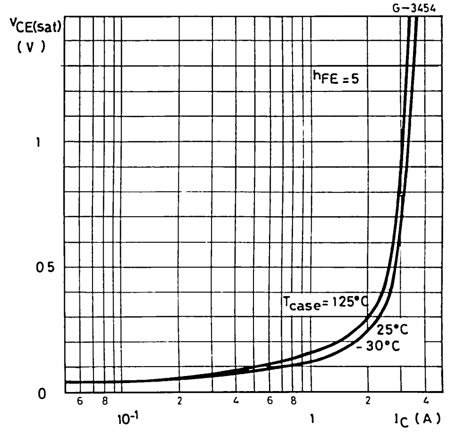
Thermal transient response



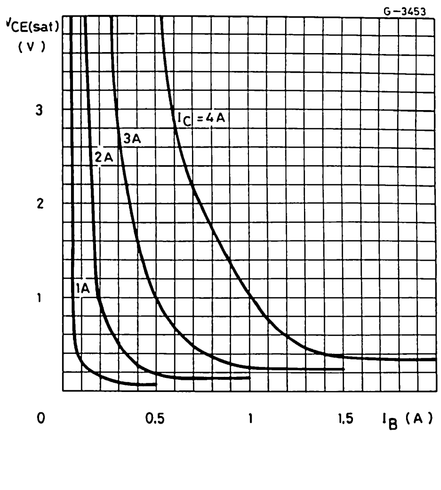
DC current gain



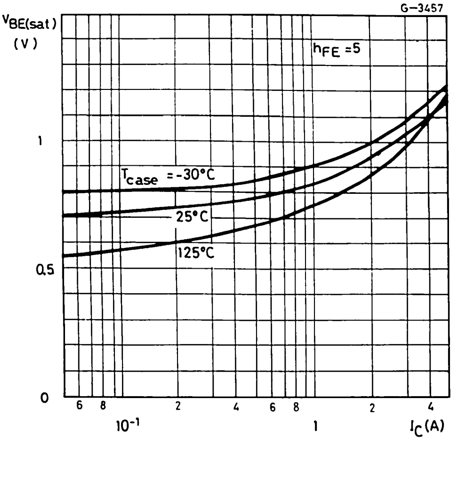
Collector-emitter saturation voltage



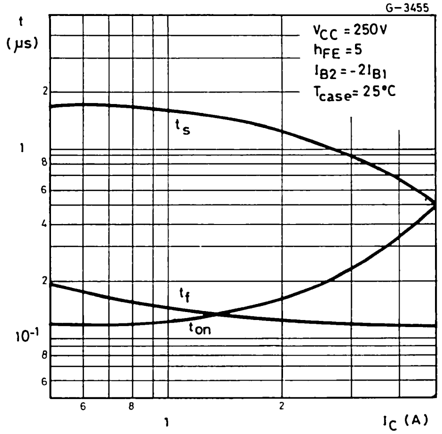
Collector-emitter saturation voltage



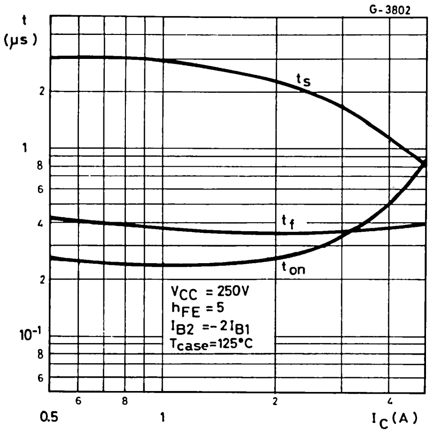
Base-emitter saturation voltage



Saturated switching characteristics



Saturated switching characteristics



BU326S

MULTIEPITAXIAL MESA NPN

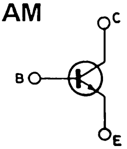
HIGH VOLTAGE POWER SWITCH

The BU 326S is a silicon multiepitaxial NPN transistor in Jedec TO-3 metal case, particularly intended for switch-mode CTV applications.

ABSOLUTE MAXIMUM RATINGS

V_{CES}	Collector-emitter voltage ($V_{BE} = 0$)	800	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	6	A
I_{CM}	Collector peak current	8	A
I_B	Base current	3	A
P_{tot}	Total power dissipation at $T_{case} \leq 75°C$	60	W
T_{stg}	Storage temperature	-65 to 175	°C
T_j	Junction temperature	175	°C

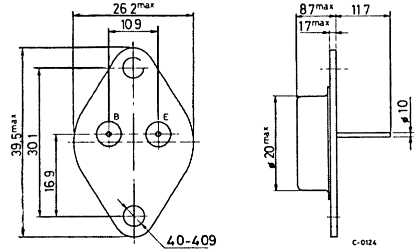
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

BU326S

THERMAL DATA

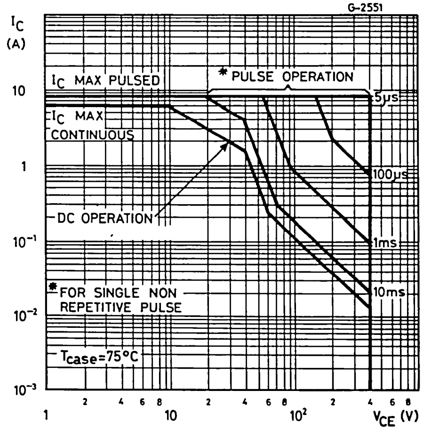
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1.67	°C/W

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

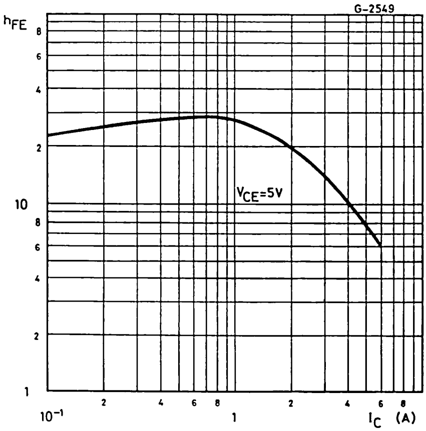
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current (V_{BE} = 0)	V_{CE} = 800 V V_{CE} = 800 V T_{case} = 150°C			1 3	mA mA
I_{EBO}	Emitter cutoff current (I_C = 0)	V_{EB} = 7 V			1	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage (I_B = 0)	I_C = 100mA	400			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 1.8	V V
h_{FE}*	DC current gain	I_C = 4 A V_{CE} = 5V	3.5		10	—
f_T	Transition frequency	I_C = 0.5A V_{CE} = 10V		20		MHz
t_{on}	Turn-on time	I_C = 2.5A V_{CC} = 250V I_{B1} = 0.5A		0.3		μs
t_s	Storage time	I_C = 2.5A V_{CC} = 250V I_{B1} = 0.5A I_{B2} = -1A		1.8		μs
t_f	Fall time			0.3		μs

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

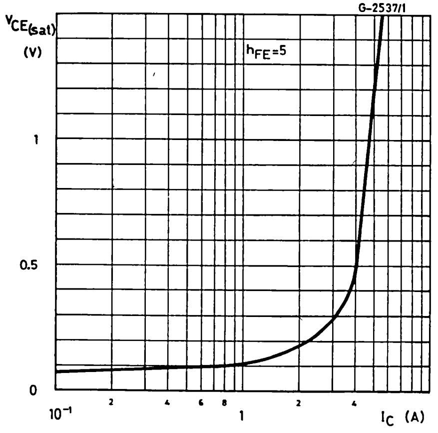
Safe operating areas



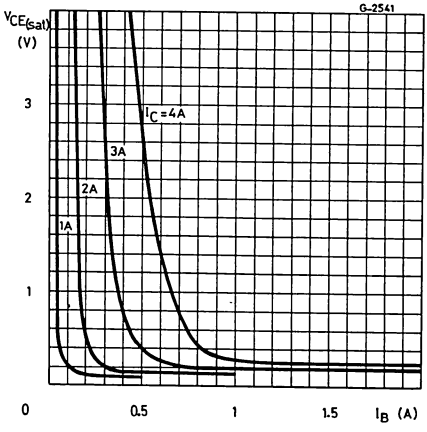
DC current gain



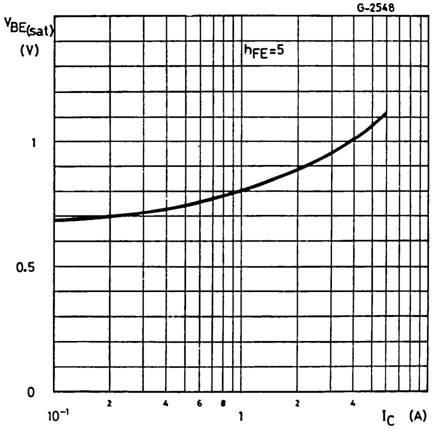
Collector-emitter saturation voltage



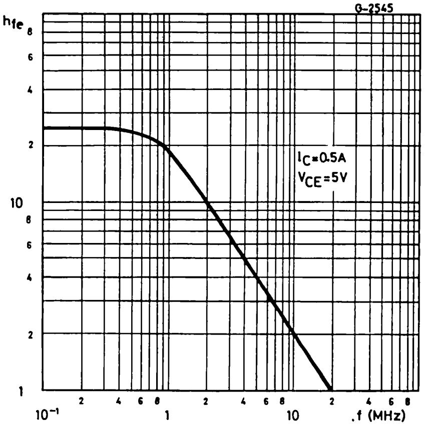
Collector-emitter saturation voltage



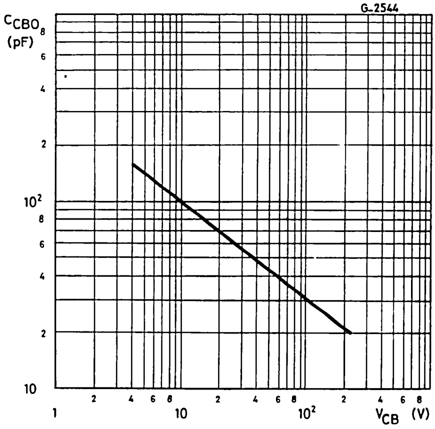
Base-emitter saturation voltage



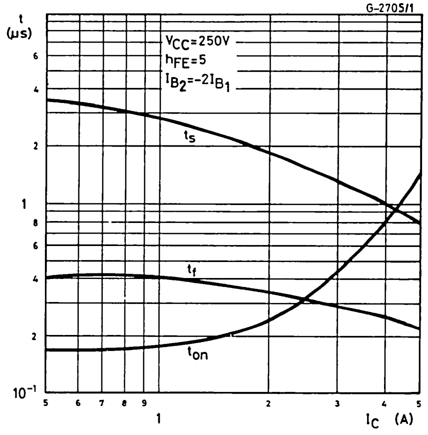
Small signal current gain



Collector-base capacitance



Saturated switching characteristics



EPITAXIAL PLANAR NPN

BU406
BU406H
BU408

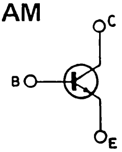
HORIZONTAL TV DEFLECTORS

The BU 406, BU 406H and BU 408 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.

ABSOLUTE MAXIMUM RATINGS

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 = 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

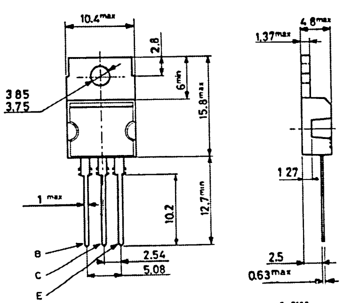
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

BU406
BU406H
BU408

THERMAL DATA

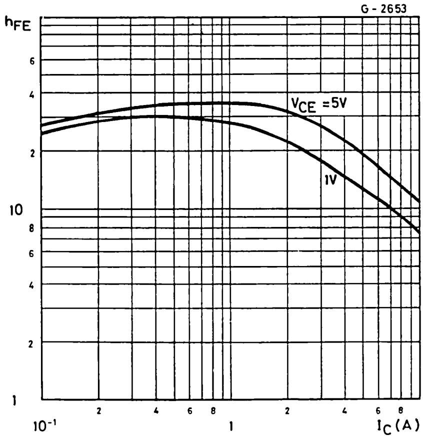
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	2.08	°C/W
$R_{th\ j\text{-}amb}$	Thermal resistance junction-ambient	max	70	°C/W

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

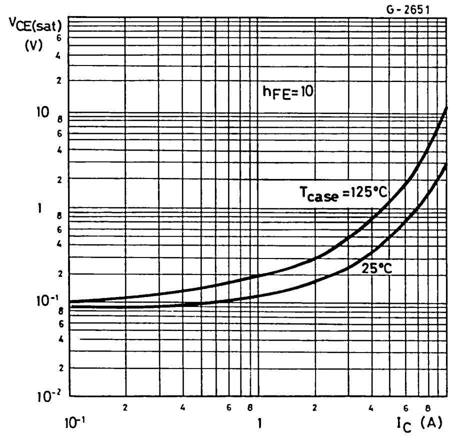
	Parameter	Test conditions		Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current ($V_{BE} = 0$)	V_{CE} = 400 V V_{CE} = 250 V V_{CE} = 250 V	 $T_{case} = 150°C$			5 100 1	mA μA mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	V_{EB} = 6 V				1	mA
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	for **BU406** I_C = 5 A for **BU406H** I_C = 5 A for **BU408** I_C = 6 A	 I_B = 0.5 A I_B = 0.8 A I_B = 1.2 A			 1 1 1	 V V V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	for **BU406** I_C = 5 A for **BU406H** I_C = 5 A for **BU408** I_C = 6 A	 I_B = 0.5 A I_B = 0.8 A I_B = 1.2 A			 1.2 1.2 1.5	 V V V
f_T	Transition frequency	I_C = 0.5 A	V_{CE} = 10 V	10			MHz
t_{off}**	Turn-off time	for **BU406** I_C = 5 A for **BU406H** I_C = 5 A for **BU408** I_C = 6 A	 $I_{B\ end}$ = 0.5A $I_{B\ end}$ = 0.8A $I_{B\ end}$ = 1.2A			 0.75 0.4 0.4	 μs μs μs
$I_{s/b}$	Second breakdown collector current	V_{CE} = 40 V	t = 10ms		4		A

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

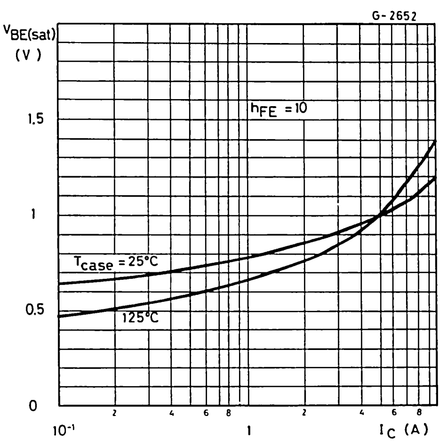
DC current gain



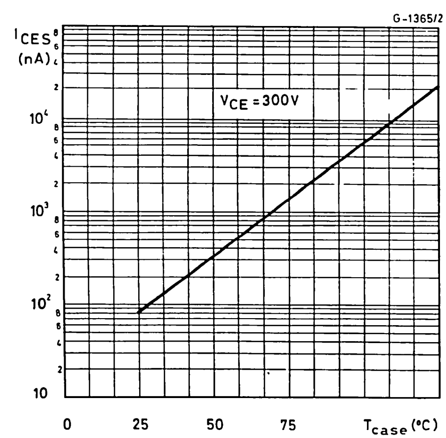
Collector-emitter saturation voltage



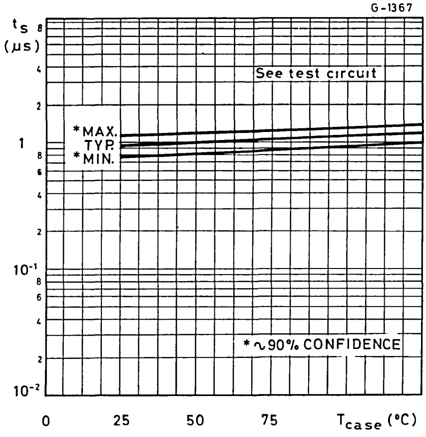
Base-emitter saturation voltage



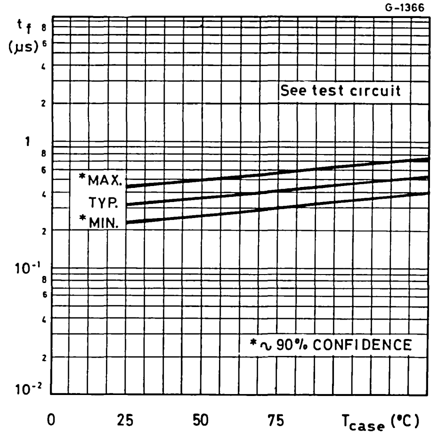
Collector cutoff current



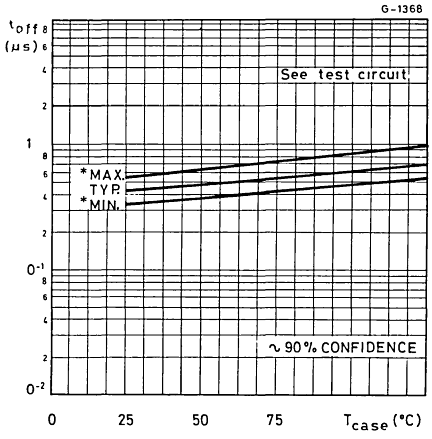
Storage time



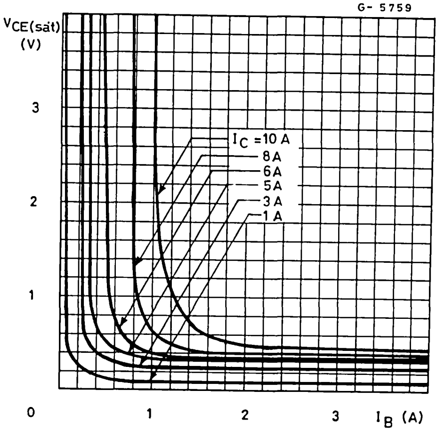
Fall time



Turn-off time

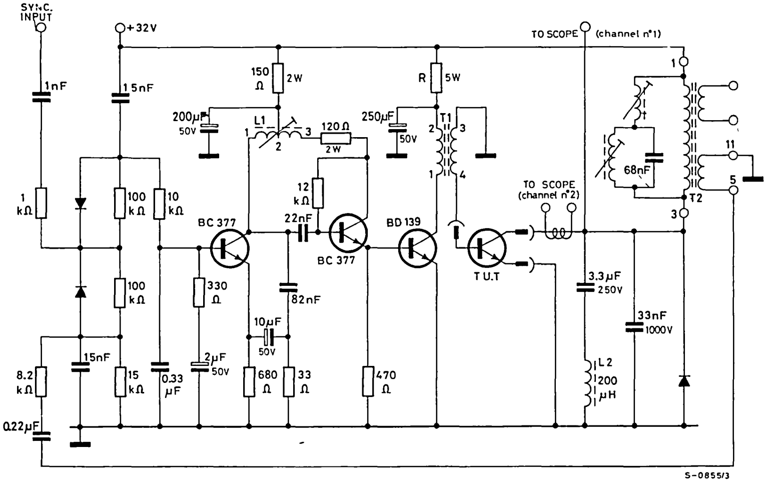


Collector-emitter saturation voltage



SWITCHING TIMES

Test circuit (fall, storage and turn-off time)



L1 Horizontal hold coil Pins 1-2=75 turns Ø 0.2mm; R=1.5Ω; L min = 0.62 mH
Pins 2-3=293 turns Ø 0.2mm; R=4.8Ω; L max = 4.1 mH Core=siferrit B62120 25x4x2

L2 Horizontal yoke=200 µH

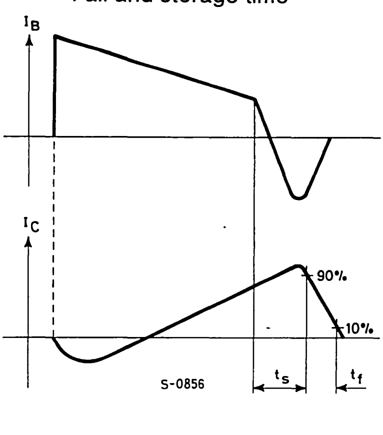
T1 Driver transformer: Pins 1-2=125 turns Ø 0.2 mm;
Pins 3-4=25 turns Ø 0.4 mm, Gap =0.12mm; Core=3E3 double E 19x15x5

T2 EHT transformer manufacturer ARCO type 249.065/035

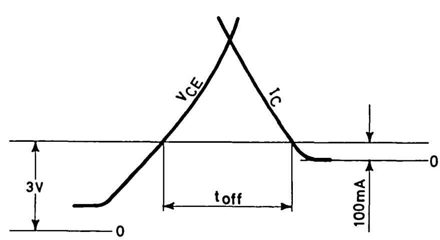
R = 330Ω for BU406
R = 220Ω for BU406H
R = 180Ω for BU408

Waveforms

Fall and storage time



Turn-off time

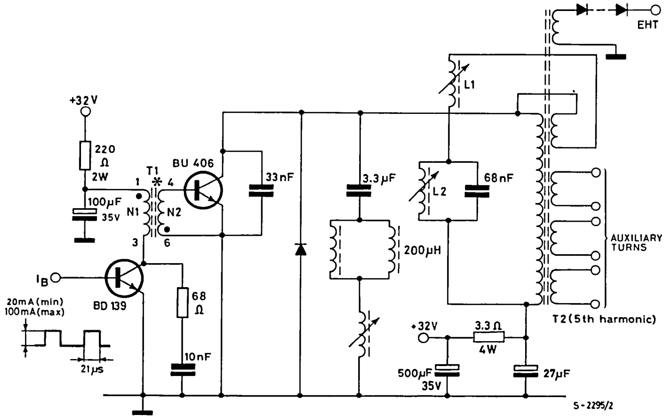


Turn-off time is the time for the collector current I_C to decrease to 100mA after the collector to emitter voltage V_{CE} has risen 3V into its flyback excursion

S-0857

APPLICATION INFORMATION

BU 406 - application circuit for 17" to 24" - 110° - 28 mm neck picture tubes



*N1=125 turns ∅ 0.3mm; N2=25 turns ∅ 0 6mm; GAP=0.12mm; CORE=DOUBLE E 19x5x8 mm; FERRITE 3E1 TYPE

EPITAXIAL PLANAR NPN

BU406D
BU407D
BU408D

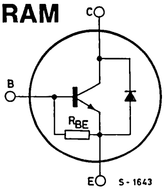
HORIZONTAL TV DEFLECTORS

The BU 406D, BU 407D and BU 408D 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 BU 406D and BU 408D are primarily intended for large screen, while the BU 407D is for medium and small screens.

ABSOLUTE MAXIMUM RATINGS

		BU406D	BU407D	BU408D
V_{CBO}	Collector-base voltage ($I_E = 0$)	400V	330V	400V
V_{CEV}	Collector-emitter voltage ($V_{BE} =$ -1.5V)	400V	330V	400V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		6V	
I_C	Collector current		7A	
I_{CM}	Collector peak current (repetitive)		10A	
I_{CM}	Collector peak current (t = 10 ms)		15A	
I_B	Base current		4A	
P_{tot}	Total power dissipation at $T_{case} \leq 25$ °C		60W	
T_{stg}	Storage temperature		-65 to 150 °C	
T_j	Junction temperature		150 °C	

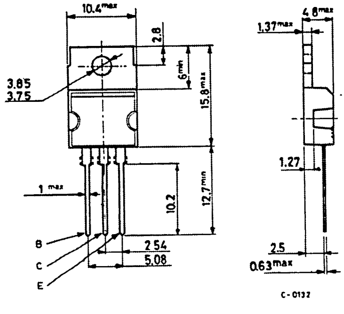
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

THERMAL DATA

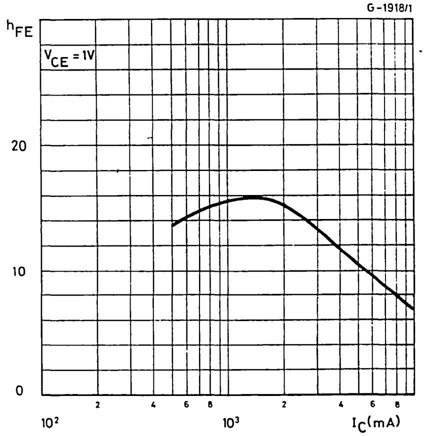
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	2.08	°C/W
$R_{th\ j\text{-}amb}$	Thermal resistance junction-ambient	max	70	°C/W

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

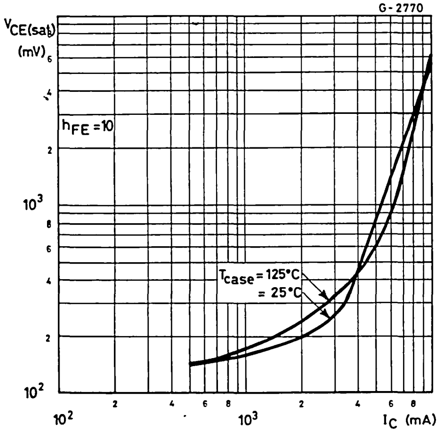
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector cutoff current ($V_{BE} = -1.5V$)	for **BU406D** and **BU408D** $V_{CE} = 400$ V for **BU407D** $V_{CE} = 330$ V			 15 15	 mA mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 6$ V			400	mA
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	for **BU406D** and **BU407D** $I_C = 5$ A $I_B = 0.65$ A for **BU408D** $I_C = 6$ A $I_B = 1.2$ A			 1 1	 V V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	for **BU406D** and **BU407D** $I_C = 5$ A $I_B = 0.65$ A for **BU408D** $I_C = 6$ A $I_B = 1.2$ A			 1.3 1.5	 V V
f_T	Transition frequency	$I_C = 0.5$ A $V_{CE} = 10$ V	10			MHz
t_{off}	Turn-off time	for **BU406D** and **BU407D** $I_C = 5$ A $I_{B\ end} = 0.65$ A for **BU408D** $I_C = 6$ A $I_{B\ end} = 1.2$ A			 0.75 0.5	 μs μs
$I_{s/b}$	Second breakdown collector current	$V_{CE} = 40$ V $t = 10$ ms		4		A
V_F	Diode forward voltage	$I_F = 5$ A			1.5	V

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

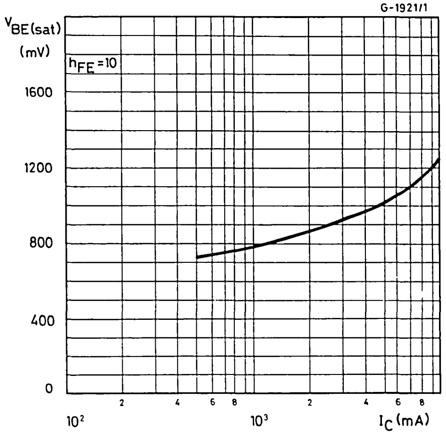
DC current gain



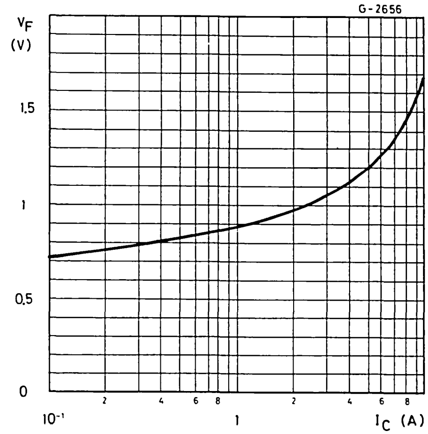
Collector-emitter saturation voltage



Base-emitter saturation voltage

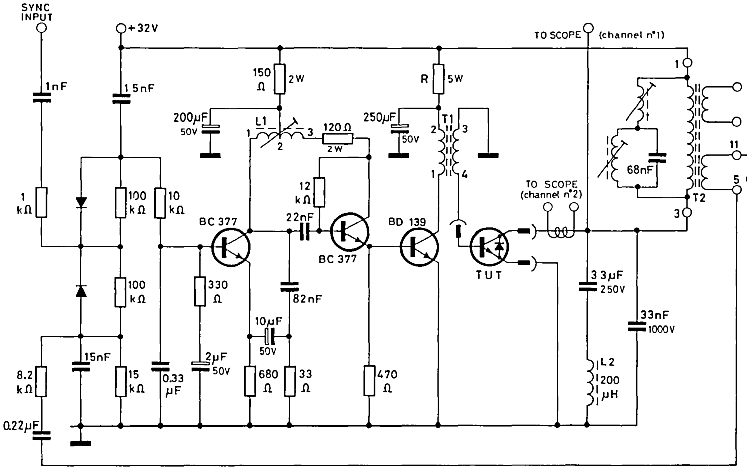


Forward voltage



SWITCHING TIMES

Test circuit (fall, storage and turn-off time)



S-2297/1

L1 Horizontal hold coil: Pins 1–2=75 turns Ø 0.2 mm; R=1.5 Ω; L min = 0.62 mH
Pins 2–3=293 turns Ø 0.2 mm; R=4.8 Ω; L max = 4.1 mH Core=siferrit B62120 25×4×2

L2 Horizontal yoke=200 µH

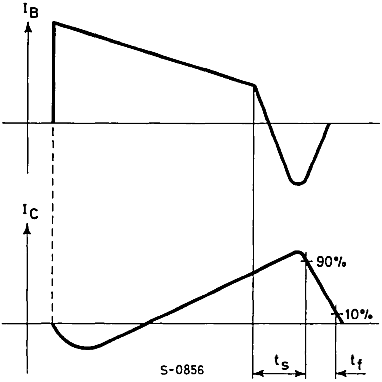
T1 Driver transformer: Pins 1–2=125 turns Ø 0.2 mm;
Pins 3–4=25 turns Ø 0.4 mm; Gap =0.12 mm; Core=3E3 double E 19×15×5

T2 EHT transformer manufacturer ARCO type 249.065/035

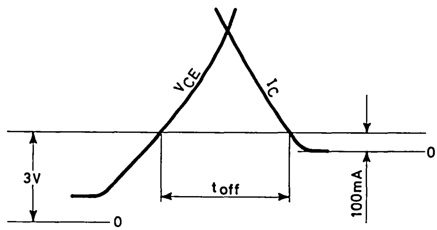
R = 270 Ω for BU406D and BU407D
R = 180 Ω for BU408D

Waveforms

Fall and storage time



Turn-off time



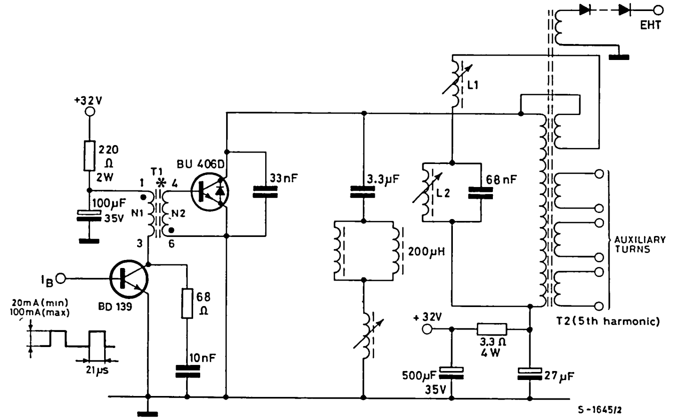
Turn-off time is the time for the collector current I_C to decrease to 100 mA after the collector to emitter voltage V_{CE} has risen 3V into its flyback excursion

S-0857

APPLICATION INFORMATION

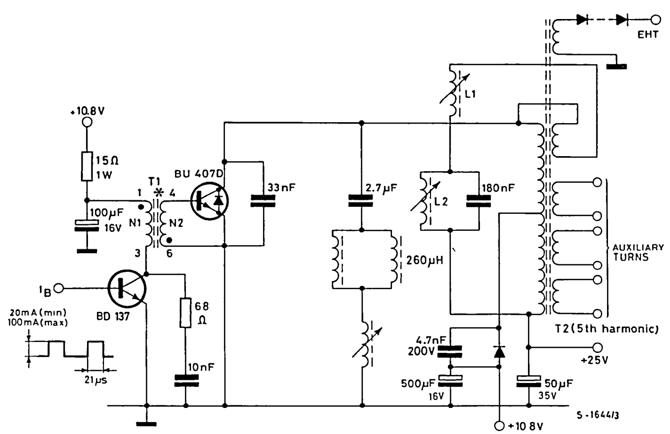
Two examples are given of the BU 406D and BU 407D in conventional MTV horizontal deflection circuits.

BU 406D - application circuit for 17'' to 24'' - 110° - 28 mm neck picture tubes



*N1=125 turns ∅ 0.3mm ; N2=25 turns ∅ 0.6mm ; GAP=0.12mm ; CORE=DOUBLE E 19x5x8 mm;FERRITE 3E1TYPE

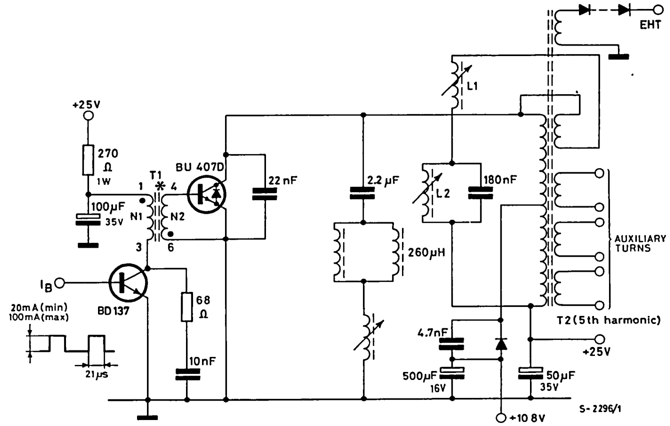
BU 407D - application circuit for 12'' to 17'' - 110° - 20 mm neck picture tubes
(driver supply voltage = 10.8 V)



*N1= 90 turns ∅ 0.3mm , N2=30 turns ∅ 0.6mm ; GAP=0.12mm , CORE=DOUBLE E 19x5x8 mm,FERRITE 3E1TYPE

APPLICATION INFORMATION (continued)

BU 407D - application circuit for 12" to 17" - 110° - 20 mm neck picture tubes
(driver supply voltage = 25 V)



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

EPITAXIAL PLANAR NPN

BU407
BU407H

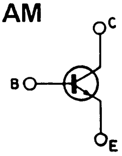
HORIZONTAL TV DEFLECTORS

The BU 407 and BU 407H 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.

ABSOLUTE MAXIMUM RATINGS

V_{CBO}	Collector-base voltage ($I_E = 0$)	330	V
V_{CEV}	Collector-emitter voltage ($V_{BE} =$ -1.5V)	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

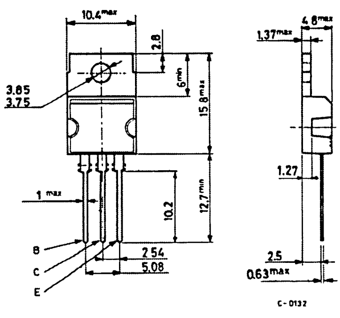
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

BU407
BU407H

THERMAL DATA

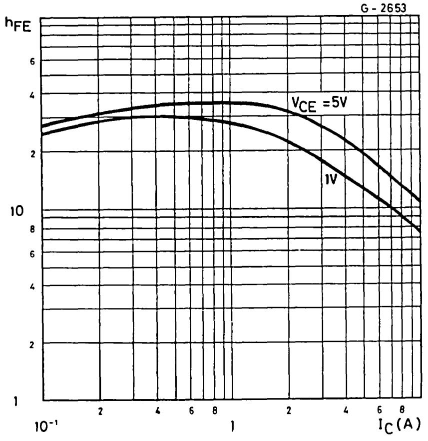
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	2.08	°C/W
$R_{th\ j\text{-}amb}$	Thermal resistance junction-ambient	max	70	°C/W

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

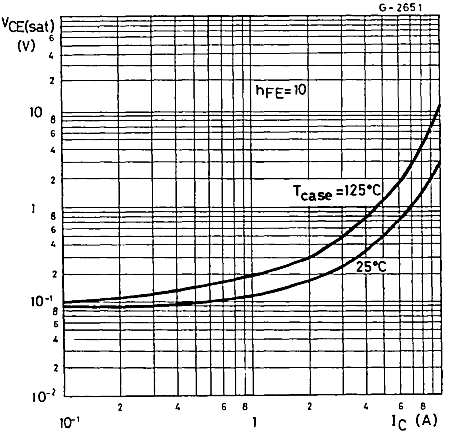
Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current ($V_{BE} = 0$)	$V_{CE} = 330V$ $V_{CE} = 200V$ $V_{CE} = 200V$	 $T_{case} = 150°C$			5 100 1	mA µA mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 6\ V$				1	mA
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	for **BU407** $I_C = 5\ A$ for **BU407H** $I_C = 5\ A$	 $I_B = 0.5A$ $I_B = 0.8A$			 1 1	 V V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	for **BU407** $I_C = 5\ A$ for **BU407H** $I_C = 5\ A$	 $I_B = 0.5A$ $I_B = 0.8A$			 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** $I_C = 5\ A$ for **BU407H** $I_C = 5\ A$	 $I_{B\ end} = 0.5A$ $I_{B\ end} = 0.8A$			 0.75 0.4	 µs µs
$I_{s/b}$	Second breakdown collector current	$V_{CE} = 40\ V$	$t = 10ms$		4		A

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

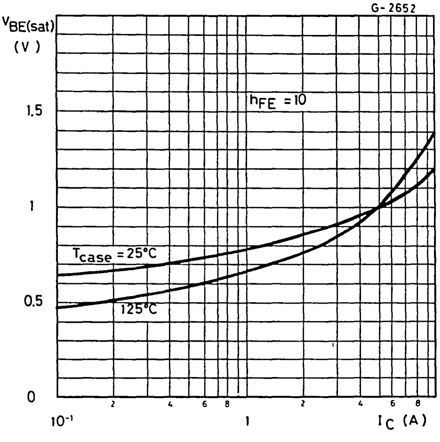
DC current gain



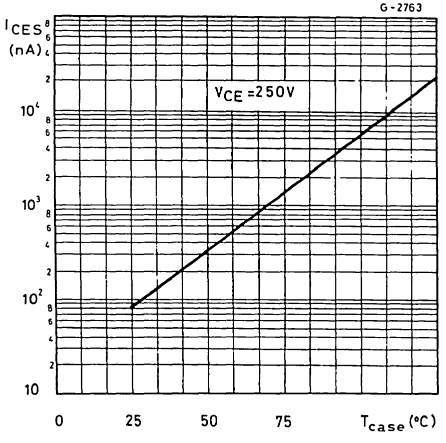
Collector-emitter saturation voltage



Base-emitter saturation voltage

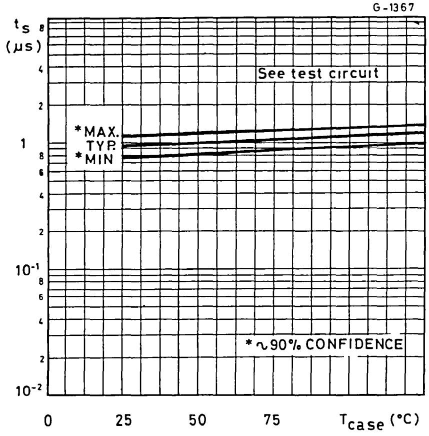


Collector cutoff current

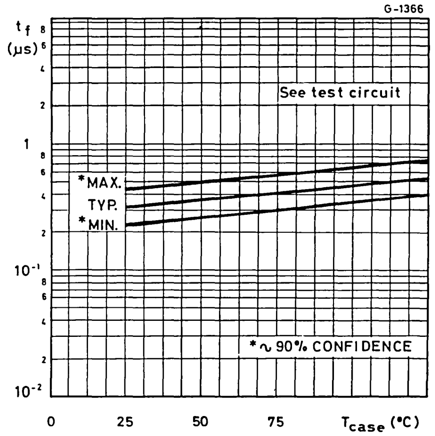


BU407
BU407H

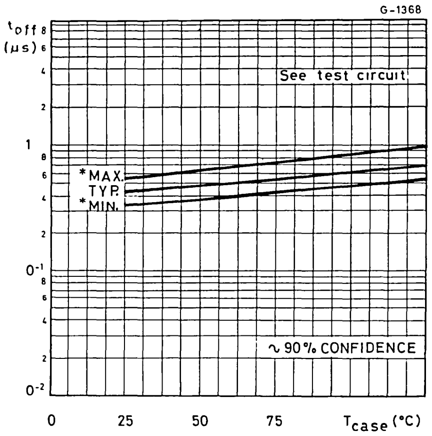
Storage time



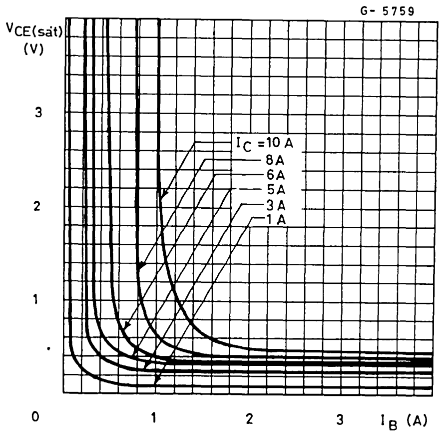
Fall time



Turn-off time



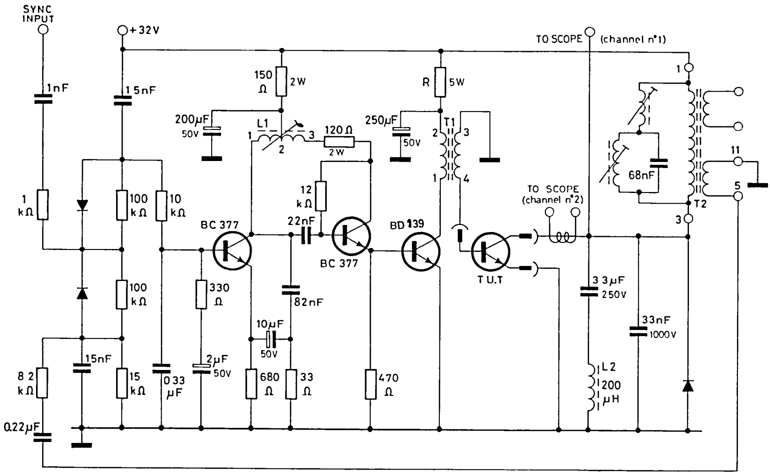
Collector-emitter saturation voltage



BU407
BU407H

SWITCHING TIMES

Test circuit (fall, storage and turn-off time)



S-2291/2

L1 Horizontal hold coil. Pins 1-2=75 turns Ø 0.2mm; R=1.5Ω; L min = 0.62 mH
Pins 2-3=293 turns Ø 0.2mm, R=4.8Ω; L max = 4.1 mH Core=siferrit B62120 25×4×2

L2 Horizontal yoke=200 µH

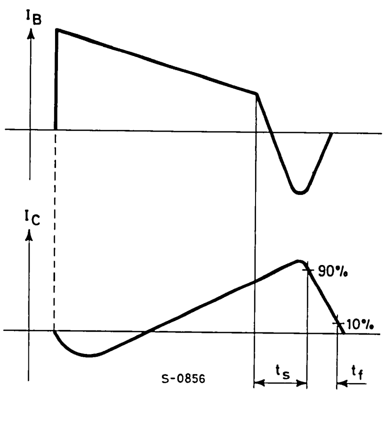
T1 Driver transformer: Pins 1-2=125 turns Ø 0.2 mm,
Pins 3-4=25 turns Ø 0.4 mm; Gap =0.12mm; Core=3E3 double E 19×15×5

T2 EHT transformer manufacturer ARCO type 249.065/035

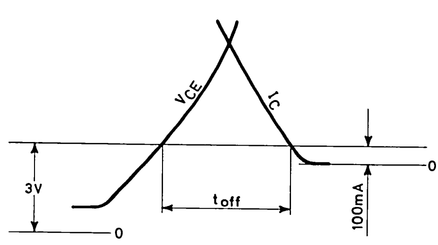
R = 330 Ω for BU407
R = 220 Ω for BU407H

Waveforms

Fall and storage time



Turn-off time



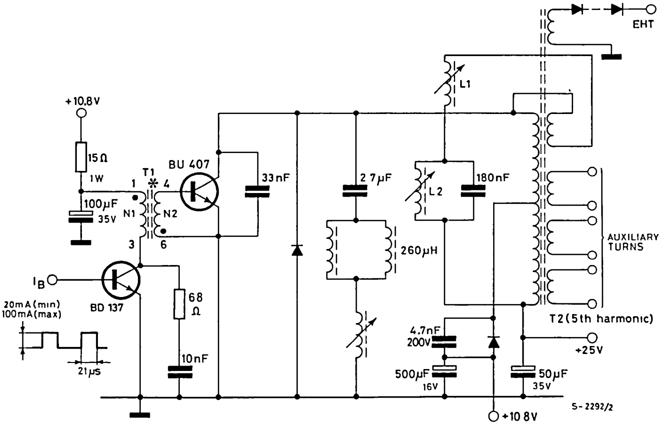
Turn-off time is the time for the collector current I_C to decrease to 100mA after the collector to emitter voltage V_{CE} has risen 3V into its flyback excursion

S-0857

APPLICATION INFORMATION

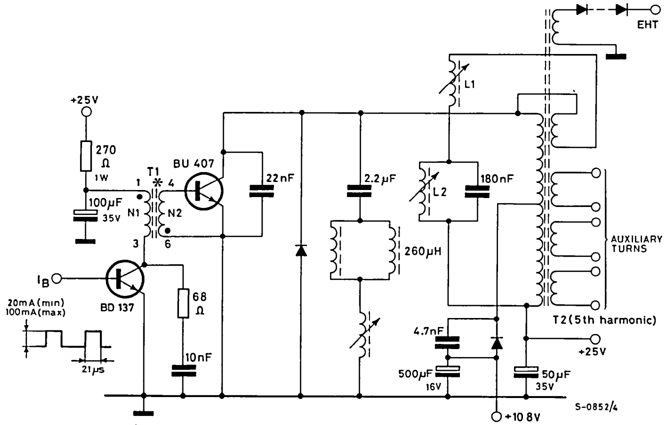
Two examples are given of the BU407 in conventional MTV horizontal deflection circuits

BU 407 - application circuit for 12" to 17" - 110° - 20 mm neck picture tubes
(driver supply voltage = 10.8V)



*N1=125 turns ∅ 0 3mm; N2=30 turns ∅ 0 6mm, GAP=0.12mm, CORE=DOUBLE E 19x5x8 mm;FERRITE 3E1TYPE

BU 407 - application circuit for 12" to 17" - 110° - 20 mm neck picture tubes
(driver supply voltage = 25 V)



*N1=125 turns ∅ 0.3mm; N2=25 turns ∅ 0 6mm, GAP=0.12mm; CORE=DOUBLE E 19x5x8 mm;FERRITE 3E1TYPE

BU426
BU426A

MULTIEPITAXIAL MESA NPN

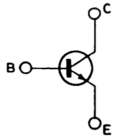
HIGH VOLTAGE POWER SWITCH

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

ABSOLUTE MAXIMUM RATINGS

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

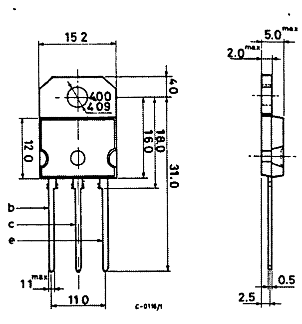
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



(sim. to **TO-218**) **SOT-93**

BU426
BU426A

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)

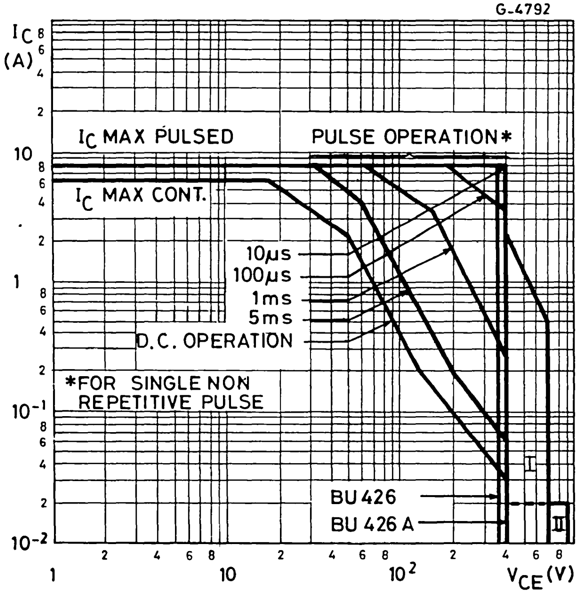
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current ($V_{BE} = 0$)	for **BU426** $V_{CE} = 800V$ for **BU426A** $V_{CE} = 900V$ $T_{case} = 125°C$ for **BU426** $V_{CE} = 800V$ for **BU426A** $V_{CE} = 900V$			1 1 2 2	mA mA mA mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 10V$			10	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	for **BU426** $I_C = 100mA$ for **BU426A** $I_C = 100mA$	375 400			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	$I_C = 0.6A$ $V_{CE} = 5V$	30		60	
t_{on}	Turn-on time	$I_C = 2.5A$ $I_{B1} = 0.5A$ $V_{CC} = 250V$		0.25	0.5	μs

ELECTRICAL CHARACTERISTIC (Continued)

	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t_s	Storage time	$I_C = 2.5A$ $I_{B1} = 0.5A$ $I_{B2} = -1A$ $V_{CC} = 250V$		2.5	3.5	μs
t_f	Fall time			0.2	0.5	μs
t_f	Fall time	$I_C = 2.5A$ $I_{B1} = 0.5A$ $I_{B2} = -1A$ $V_{CC} = 250V$ $T_{case} = 100°C$			0.75	μs

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

Safe operating areas



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

For the others characteristic curves see the BU326 type

BU508
BU508A
BU508D

MULTIEPITAXIAL MESA NPN

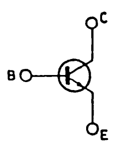
HORIZONTAL TVC DEFLECTION

The BU508, BU508A and the BU508D (the same as BU508A with integrated damper diode) are silicon multiepitaxial mesa NPN transistors in SOT-93 plastic package. They are fast switching, high voltage devices for use in horizontal deflection circuits of colour television receivers.

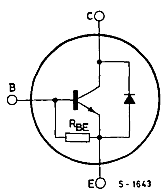
ABSOLUTE MAXIMUM RATINGS

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 ($I_C = 0$)	5	V
I_C	Collector current	8	A
I_{CM}	Collector peak current	15	A
P_{tot}	Total power dissipation at $T_{case} = 25°C$	125	W
T_{stg}	Storage temperature	-65 to 150	°C
T_j	Max operating junction temperature	150	°C

INTERNAL SCHEMATIC DIAGRAMS



BU508, BU508A



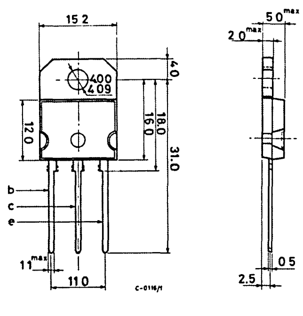
R_{BE} Typ. 30Ω

BU508D

MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



(sim. to **TO-218**) **SOT-93**

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1	°C/W

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

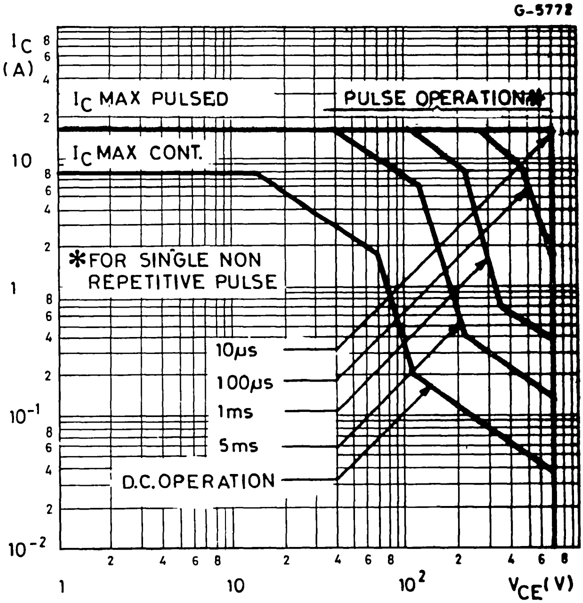
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current ($V_{BE} = 0$)	$V_{CE} = V_{CES}$			1	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 100mA$	700			V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	$I_{EBO} = 10mA$ for **BU208** and **BU208A**	5			V
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EBO} = 5V$ for **BU208D**			300	mA
V_F	Diode forward voltage	$I_F = 4A$ for **BU208D**			2	V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	$I_C = 4.5A$ $I_B = 2A$ for **BU208A** and **BU208D** for **BU208**			 1 5	 V V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	$I_C = 4.5A$ $I_B = 2A$			1.5	V

INDUCTIVE SWITCHING TIMES (see fig. 1)

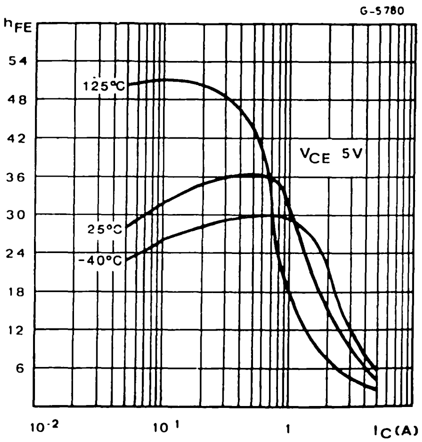
t_s t_f	Storage time Fall time	$I_c = 4.5A$, $h_{FE} = 2.5$, $V_{CC} = 140V$ $L_c = 0.9mH$ $L_B = 3\mu H$	7.0 0.5	μs μs

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

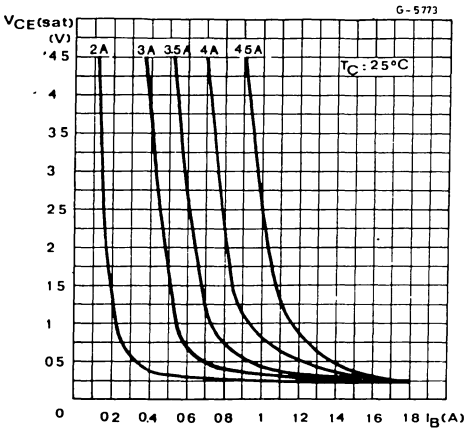
Safe operating area



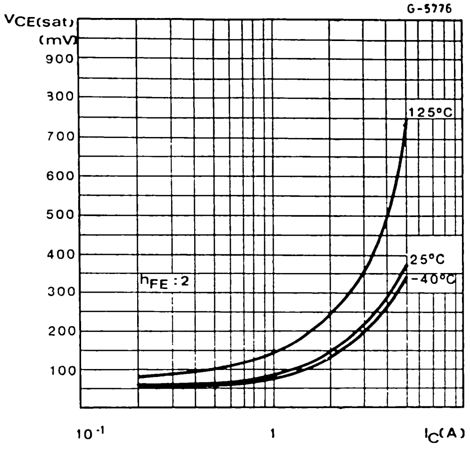
DC current gain



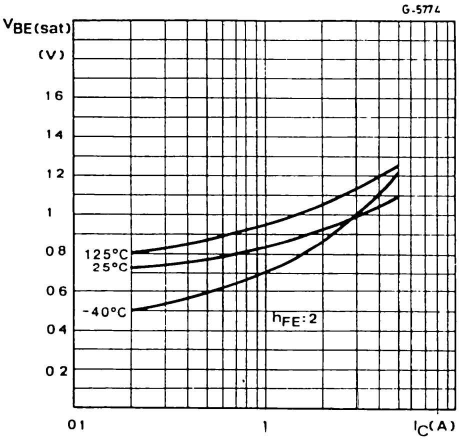
Collector saturation region



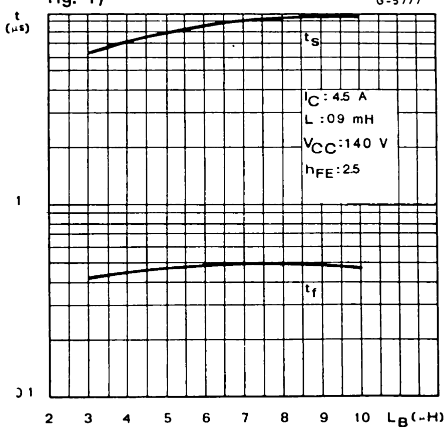
Collector-emitter saturation voltage



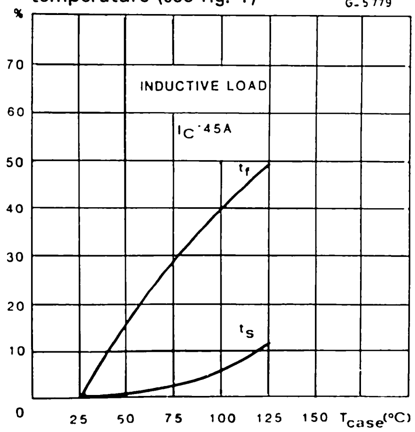
Base-emitter saturation voltage



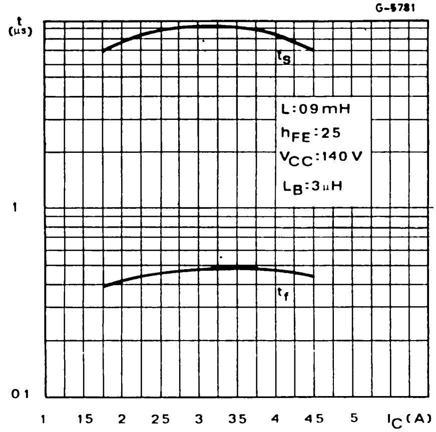
Switching times inductive load (see fig. 1)



Switching times percentage vs. case temperature (see fig. 1)



Switching times inductive load (fig. 1)



$V_{CE\,sat}$ dinamic (fig. 2)

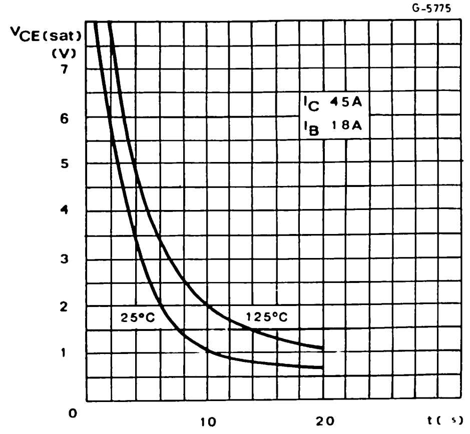
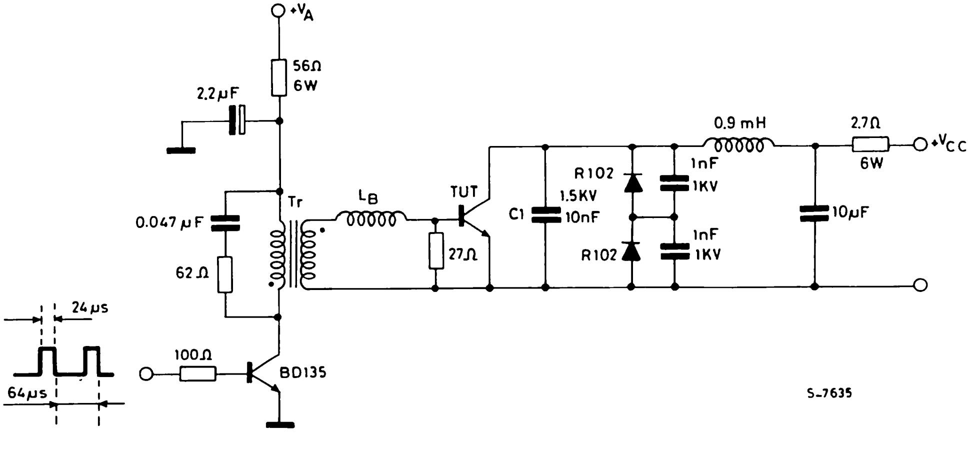


Fig. 1 — Switching times test circuit on inductive load



A TYPICAL SWITCH-OFF CYCLE (see fig. 1)

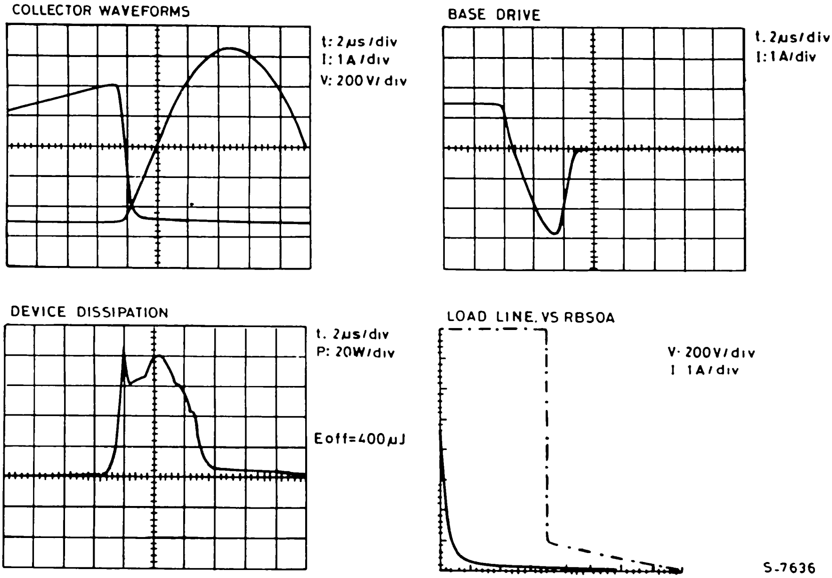
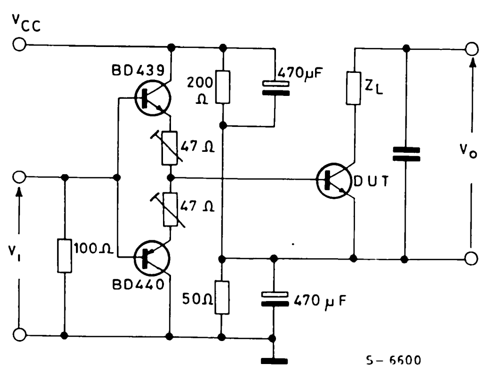


Fig. 2 – $V_{CE\,(sat)}$ dyn. test circuit



BU801

EPITAXIAL PLANAR NPN

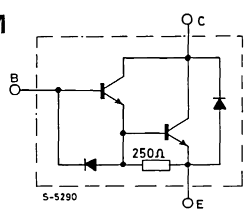
HIGH VOLTAGE FAST DARLINGTON

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.

ABSOLUTE MAXIMUM RATINGS

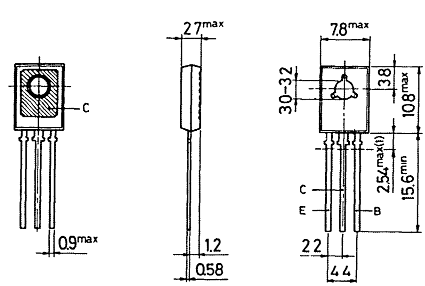
V_{CBO}	Collector-base voltage ($I_E = 0$)	600	V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	400	V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	7	V
I_C, I_E	Collector and emitter currents	3	A
I_B	Base current	1	A
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	40	W
T_{stg}	Storage temperature	-65 to 150	°C
T_j	Junction temperature	150	°C

INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm



(1) Within this region the cross-section of the leads is uncontrolled

TO-126 (SOT-32)

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)

Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CES}	Collector-cutoff current (V_{BE}= 0)	V_{CE}= 600V				200	μA
I_{CEO}	Collector-cutoff current (I_B= 0)	V_{CE}= 400V				1	mA
I_{EBO}*	Emitter cutoff current (I_C= 0)	V_{EB}= 7V				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 mA	I_B= 2 mA		1.0	1.5	V
		I_C= 1A	I_B= 20 mA		1.2	2.0	V
		I_C= 2A	I_B= 200 mA		1.8	3.0	V
$V_{BE(sat)}$*	Base-emitter saturation voltage	I_C= 200 mA	I_B= 2 mA			2	V
		I_C= 1A	I_B= 20 mA			2.5	V
		I_C= 2A	I_B= 200 mA			3	V
h_{FE}*	DC current gain	I_C= 200 mA	V_{CE}= 3V	100			–
V_F*	Diode forward voltage	I_F= 1A				4	V

RESISTIVE SWITCHING TIMES

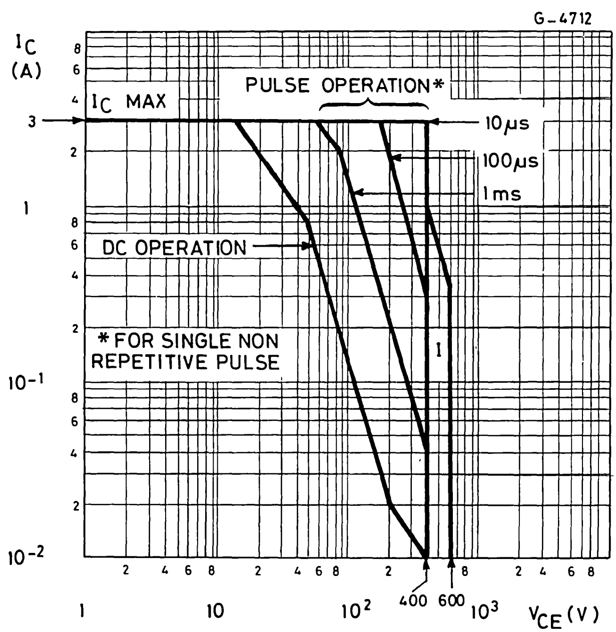
			Min.	Typ.	Max.	Unit
t_{on}	Turn-on time	V_{CC}= 250V I_C= 200 mA I_{B_1}= 2 mA V_{BEoff}= -5V		0.17	0.8	μs
t_s	Storage time			0.37	1	μs
t_f	Fall time			0.13	0.5	μs

ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on time	V_{CC} = 250V, I_C = 1A, I_{B1} = 20 mA, V_{BEoff} = -5V		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						
t_s	Storage time	V_{Clamp} = 250V, I_C = 200 mA, I_{B1} = 2 mA, V_{BEoff} = -5V		0.35	1	µs
t_f	Fall time			0.09	0.4	µs
t_s	Storage time	V_{Clamp} = 250V, I_C = 1A, I_{B1} = 20 mA, V_{BEoff} = -5V		0.5	1	µs
t_f	Fall time			0.06	0.4	µs

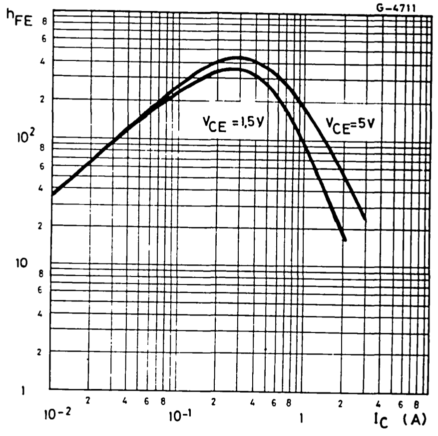
* Pulsed: Pulse duration = 300 µs, duty cycle = 1.5%

Safe operating areas

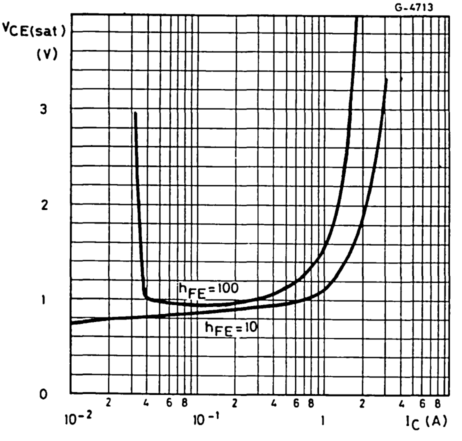


I = Area of permissible operation during turn-on with $t_p \leqslant 1$ µs.

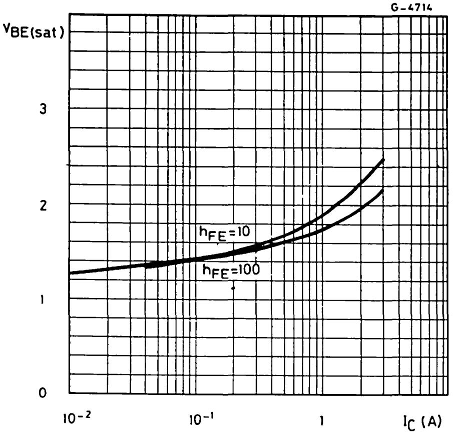
DC current gain



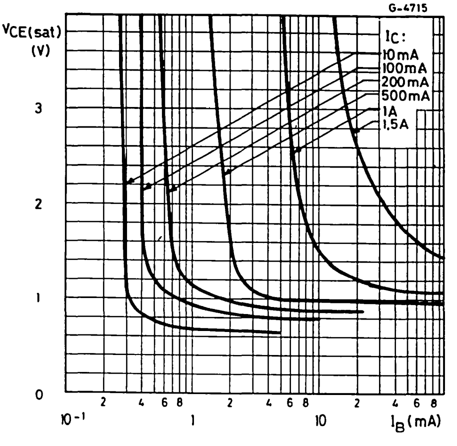
Collector-emitter saturation voltage



Base-emitter saturation voltage

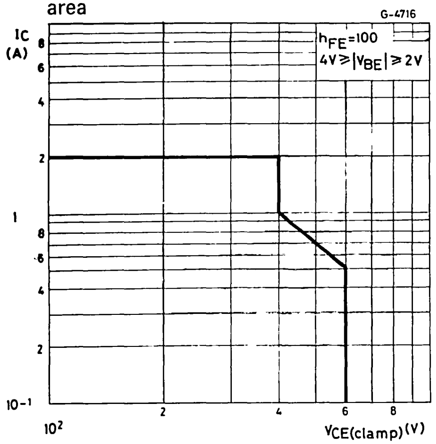


Collector-emitter saturation voltage

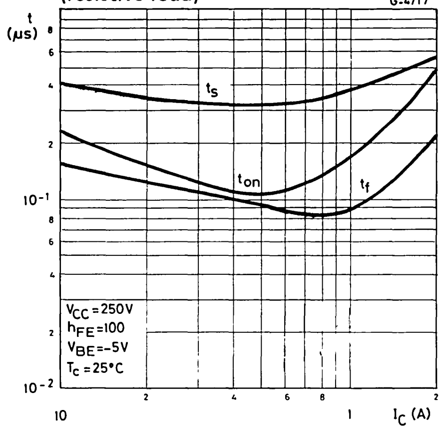


BU801

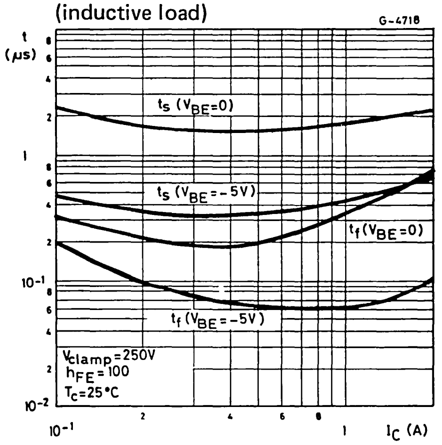
Clamped reverse bias safe operating area



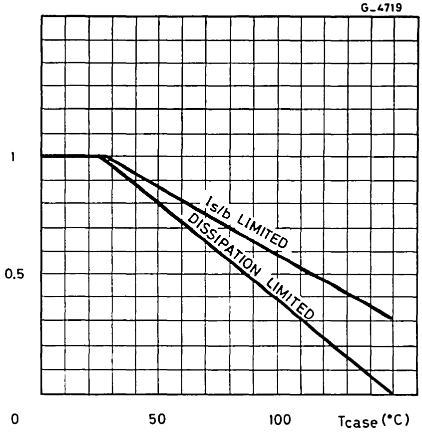
Saturated switching characteristics (resistive load)



Saturated switching characteristics (inductive load)



Derating curves



BU806
BU807

EPITAXIAL PLANAR NPN

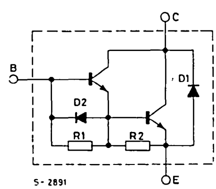
FAST SWITCHING DARLINGTON TRANSISTORS

The BU 806 and BU 807 are silicon epitaxial planar NPN power Darlington transistors with integrated base-emitter speed-up diode, mounted in Jedec TO-220 plastic 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 BU 806 is primarily intended for large screeen, while the BU 807 is for medium and small screens.

ABSOLUTE MAXIMUM RATINGS

		BU 806	BU 807
V_{CBO}	Collector-base voltage ($I_E = 0$)	400V	330V
V_{CEV}	Collector-emitter voltage ($V_{BE} = -6V$)	400V	330V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	200V	150V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	6V	
I_C	Collector current	8A	
I_{CM}	Collector peak current	15A	
I_{DM}	Damper diode peak forward current	10A	
I_B	Base current	2A	
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$	60W	
T_{stg}	Storage temperature	-65 to 150°C	
T_j	Junction temperature	150°C	

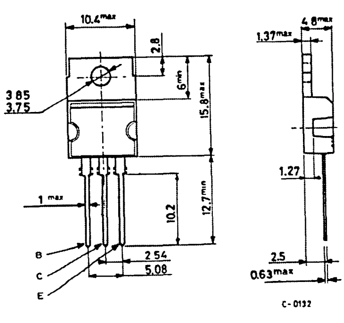
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

BU806
BU807

THERMAL DATA

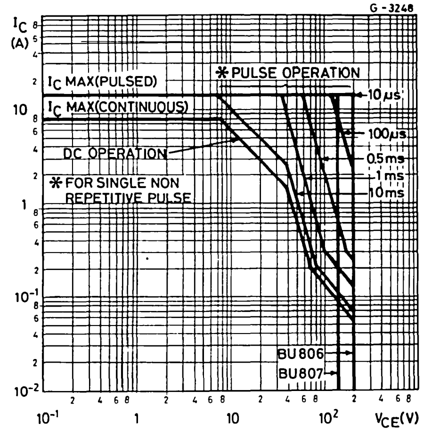
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	2.08	°C/W
$R_{th\ j\text{-}case}$	Thermal resistance junction-ambient	max	70	°C/W

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

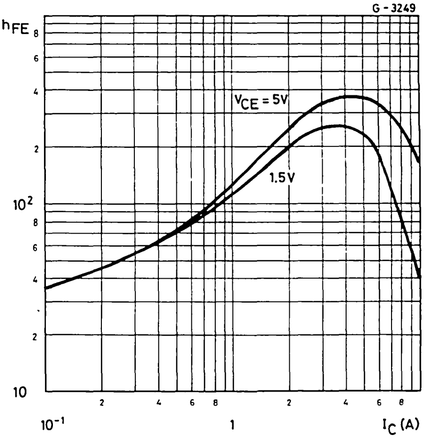
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current (V_{BE}=0)	for **BU807** V_{CE}=330V for **BU806** V_{CE}=400V			100 100	µA µA
I_{CEV}	Collector cutoff current (V_{BE}=-6V)	for **BU807** V_{CE}=330V for **BU806** V_{CE}=400V			100 100	µA µA
I_{EBO}	Emitter cutoff current (I_C=0)	V_{EB}=6V			3.5	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage (I_B=0)	I_C =100mA for **BU807** for **BU806**	 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 I_{B2} =-500mA V_{CC}=100V		0.55		µs
t_f	Fall time			0.2		µs

* Pulsed: pulse duration =300µs, duty cycle = 1,5%
** See test circuit

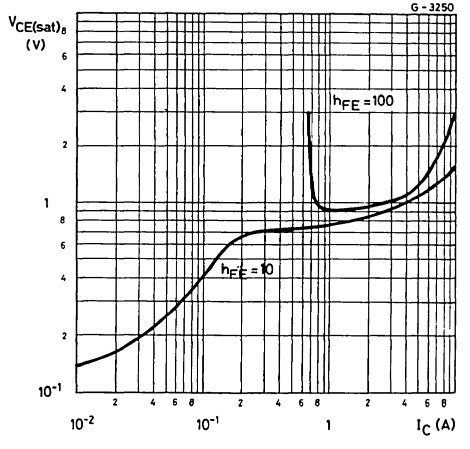
Safe operating areas



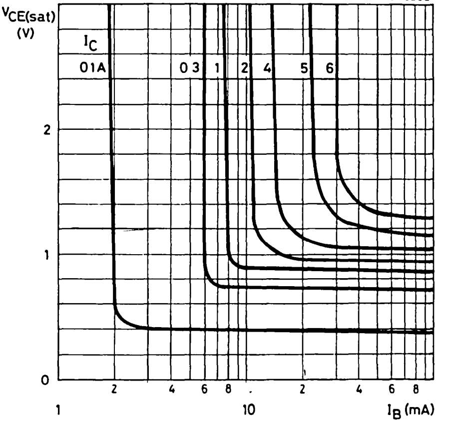
DC current gain



Collector-emitter saturation voltage

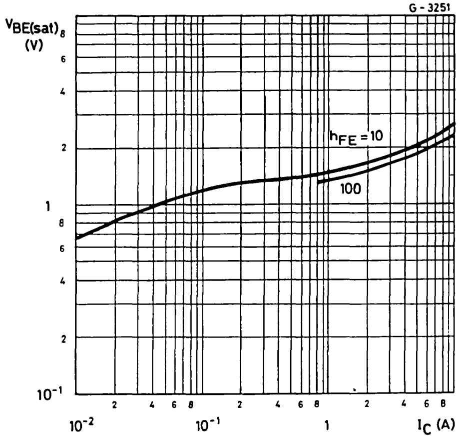


Collector-emitter saturation voltage

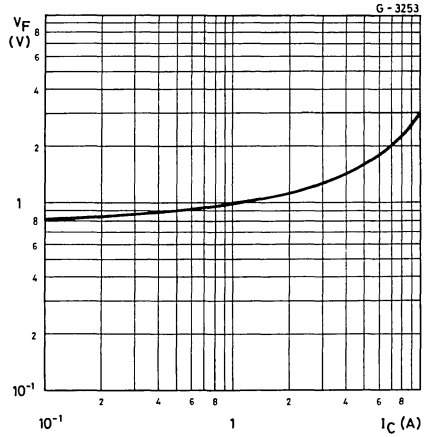


BU806
BU807

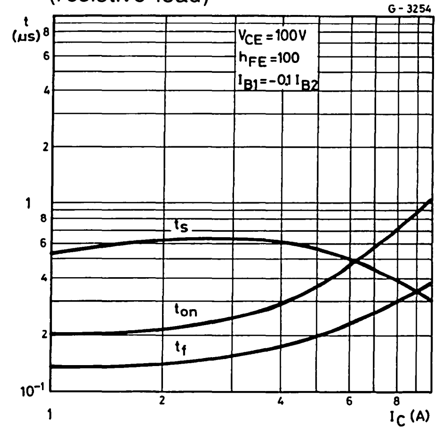
Base-emitter saturation voltage



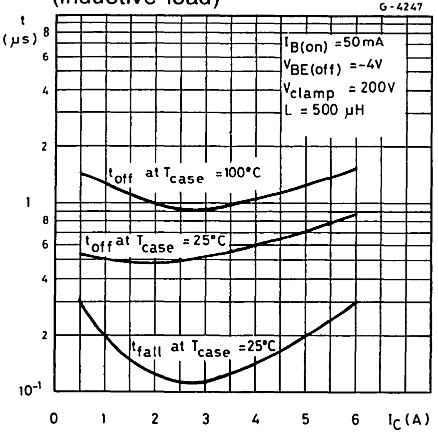
Damper diode



Saturated switching characteristics (resistive load)

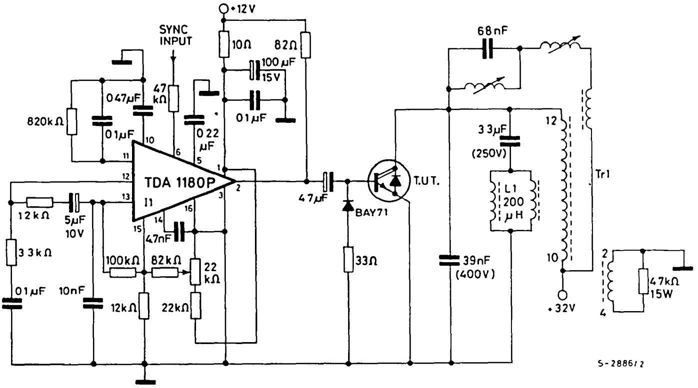


Saturated switching characteristics (inductive load)



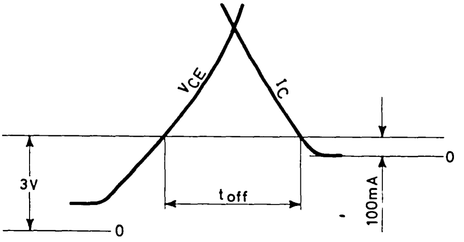
HORIZONTAL DEFLECTION TURN-OFF TIME

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

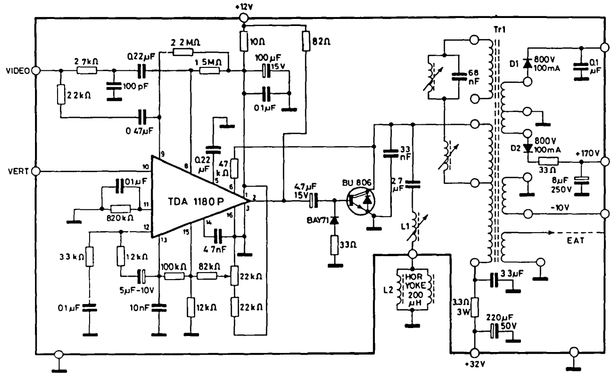


Turn-off time is the time for the collector current I_C to decrease to 100mA after the collector to emitter voltage V_{CE} has risen 3V into its flyback excursion

S-0857

APPLICATION INFORMATION

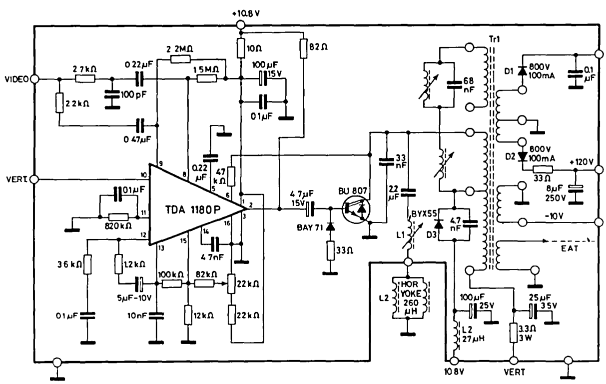
Horizontal deflection circuit using the darlington BU 806 directly driven by the TDA 1180 (B & W TV set: large screen solution)



L1 = Linearity inductance RL33 INELCO

L_l = Linearity inductance 19÷39µH

Horizontal deflection circuit using the darlington BU 807 directly driven by the TDA 1180 (B & W TV set: small screen solution)'.



L1 = Linearity inductance RL 46 INELCO

L_l = Linearity inductance 37÷67µH

EPITAXIAL PLANAR NPN

BU810

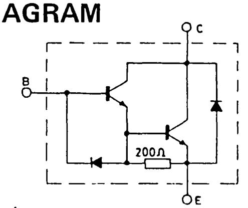
MEDIUM POWER FAST SWITCHING

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.

ABSOLUTE MAXIMUM RATINGS

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 $T_{case} \leqslant 25°C$	75	W
T_{stg}	Storage temperature	-65 to 150	°C
T_j	Junction temperature	150	°C

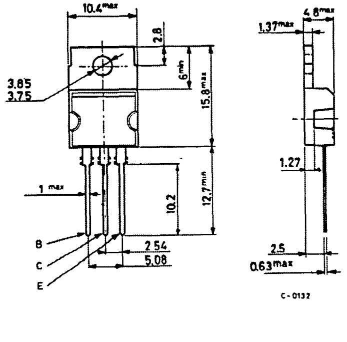
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

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)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current (V_{BE} = 0)	V_{CE} = 600V			200	μA
I_{CEO}	Collector cutoff current (I_B = 0)	V_{CE} = 400V			1	mA
I_{EBO} *	Emitter cutoff current (I_C = 0)	V_{EB} = 5V			150	mA
$V_{CEO(sus)}$ *	Collector-emitter sustaining voltage	I_C = 100mA	400			V
$V_{CE(sat)}$ *	Collector-emitter saturation voltage	I_C = 2A I_B = 20mA I_C = 4A I_B = 200mA I_C = 7A I_B = 0.7A			2 2.5 3	V V V
$V_{BE(sat)}$ *	Base-emitter saturation voltage	I_C = 2A I_B = 20mA I_C = 4A I_B = 200mA			2.2 3	V V
V_F *	Diode forward voltage	I_F = 7A			3	V

RESISTIVE SWITCHING TIMES

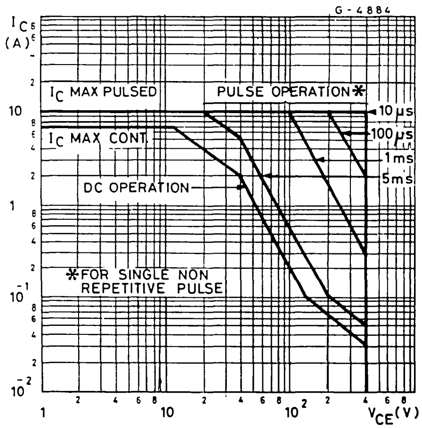
t_{on}	Turn-on time	V_{CC} = 250V I_C = 2A I_{B1} = 20mA $V_{BE(off)}$ = -5V			0.6	μs
t_s	Storage time				1.5	μs
t_f	Fall time				0.5	μs

INDUCTIVE SWITCHING TIMES

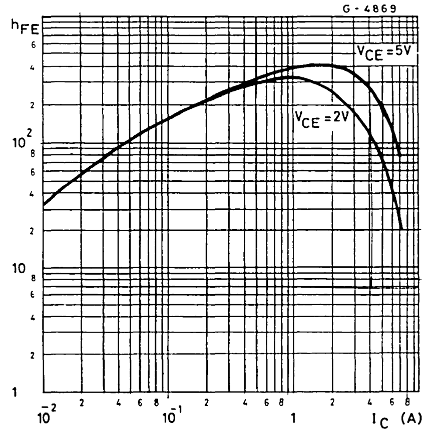
t_s	Storage time	V_{Clamp} = 250V I_C = 7A I_{B1} = 0.7A $V_{BE(off)}$ = -5V			1.5	μs
t_f	Fall time				0.4	μs
t_s	Storage time				1.5	μs
t_f	Fall time				0.7	μs

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

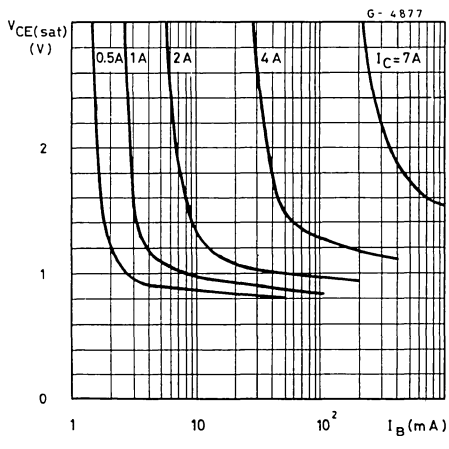
Safe operating areas



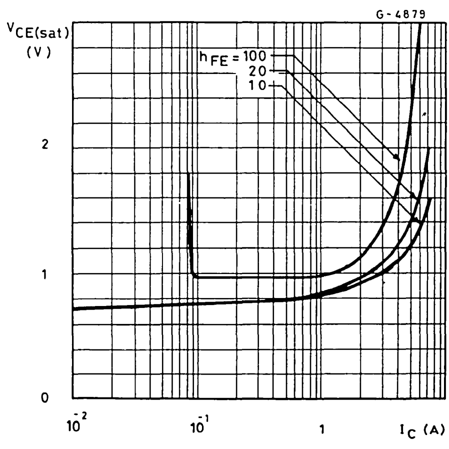
DC current gain



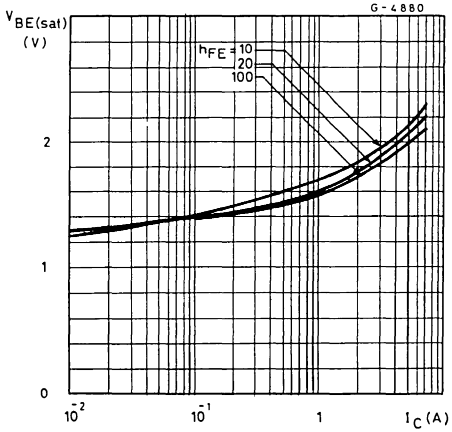
Collector-emitter saturation voltage



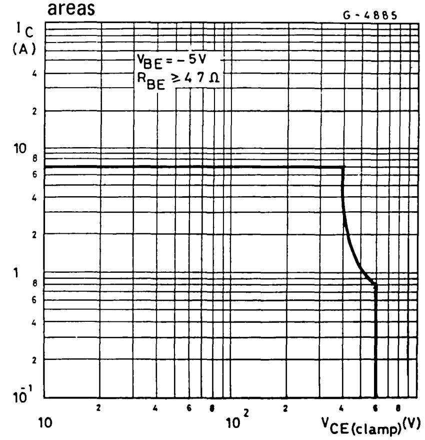
Collector-emitter saturation voltage



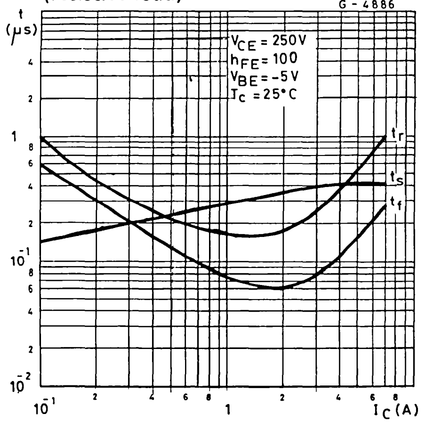
Base-emitter saturation voltage



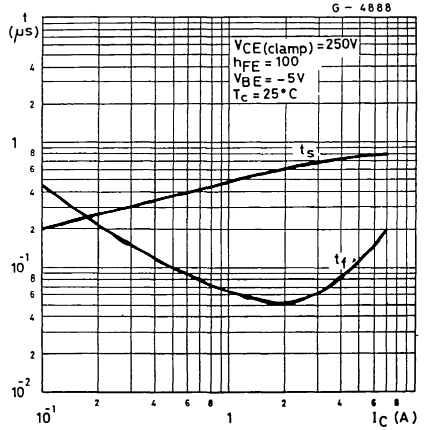
Clampled reverse bias safe operating areas



Saturated switching characteristics (resistive load)



Saturated switching characteristics



MULTIEPITAXIAL MESA NPN

BU920
BU921
BU922

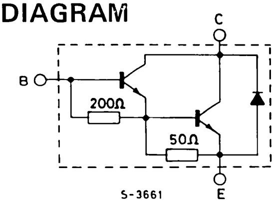
HIGH VOLTAGE POWER DISSIPATION

The BU920, BU921 and BU922 are high voltage, high current silicon NPN transistors in monolithic Darlington configuration in Jedec TO-3 metal case, specially intended for automotive ignition applications and inverter circuits for motor controls

ABSOLUTE MAXIMUM RATINGS

		BU920	BU921	BU922
V_{CES}	Collector-emitter voltage ($V_{BE} = 0$)	400V	450V	500V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	350V	400V	450V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		5V	
I_C	Collector current		10A	
I_{CM}	Collector peak current		15A	
I_B	Base current		5A	
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$		120W	
T_{stg}	Storage temperature		-65 to 175°C	
T_j	Junction temperature		175°C	

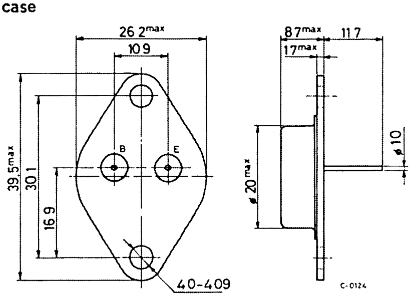
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

THERMAL DATA

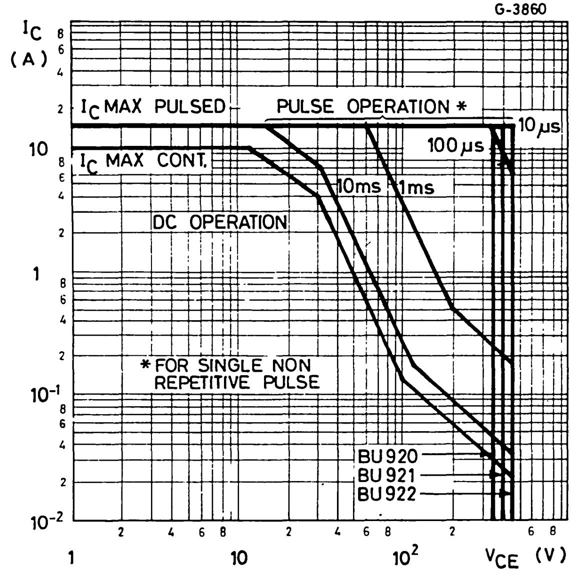
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1.25	°C/W

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

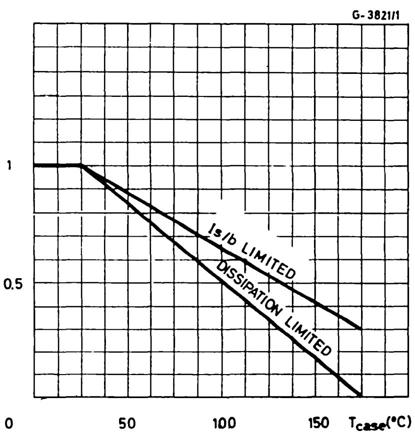
Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current ($V_{BE} = 0$)	for **BU920**	$V_{CE} = 400V$			1	mA
		for **BU921**	$V_{CE} = 450V$			1	mA
		for **BU922**	$V_{CE} = 500V$			1	mA
		$T_{case} = 150°C$					
		for **BU920**	$V_{CE} = 400V$			5	mA
		for **BU921**	$V_{CE} = 450V$			5	mA
		for **BU922**	$V_{CE} = 500V$			5	mA
I_{CEO}	Collector cutoff current ($I_C = 0$)	for **BU920**	$V_{CE} = 350V$			1	mA
		for **BU921**	$V_{CE} = 400V$			1	mA
		for **BU922**	$V_{CE} = 450V$			1	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$				50	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 100mA$					
		for **BU920**		350			V
		for **BU921**		400			V
		for **BU922**		450			V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C = 5A$	$I_B = 50mA$			1.8	V
		$I_C = 7A$	$I_B = 140mA$			1.8	V
$V_{BE(sat)}$*	Base-emitter saturation voltage	$I_C = 5A$	$I_B = 50mA$			2.2	V
		$I_C = 7A$	$I_B = 140mA$			2.5	V
V_F*	Diode forward voltage	$I_F = 7A$				2.5	V
	Functional test (see test circuit figg. 1 and 2)	for **BU920**					
		$V_{CE} = 350V$	$L = 7mH$	7			A
		for **BU921** and **BU922**					
		$V_{CE} = 400$	$L = 7mH$	7			A

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

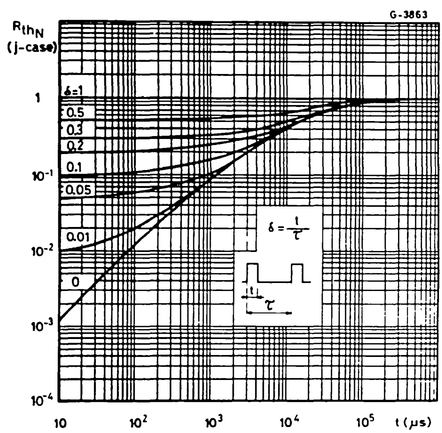
Safe operating areas



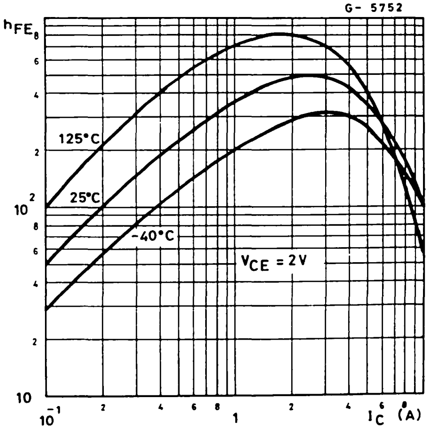
Derating curves



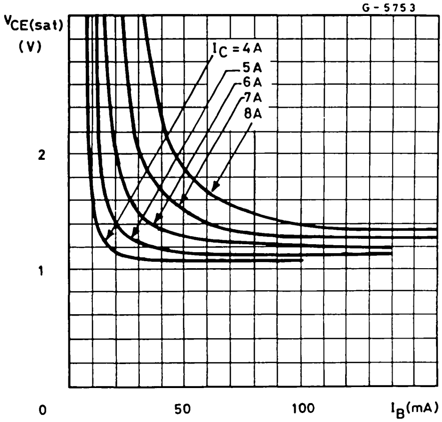
Thermal transient response



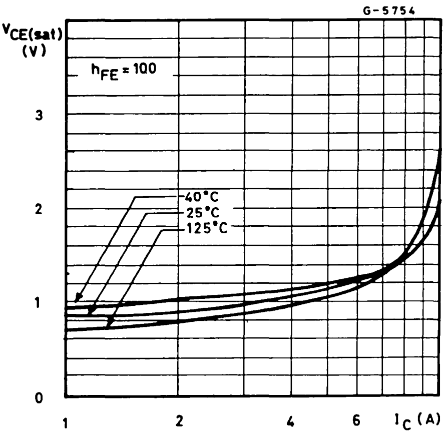
DC current gain



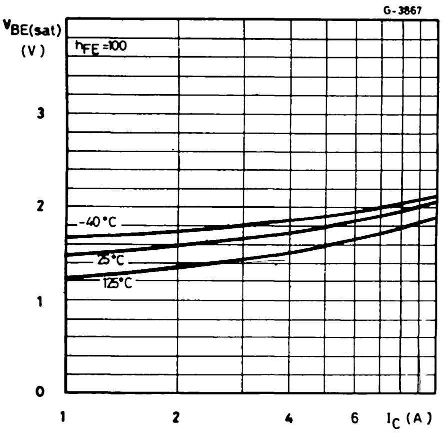
Collector-emitter saturation voltage



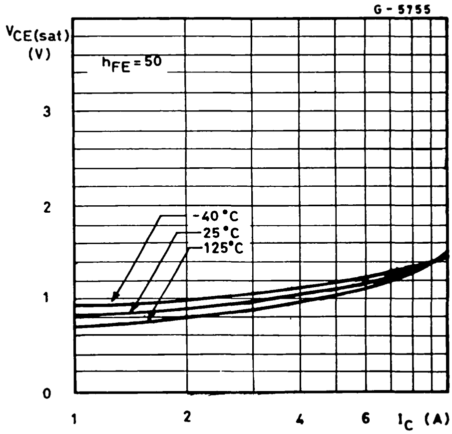
Collector-emitter saturation voltage



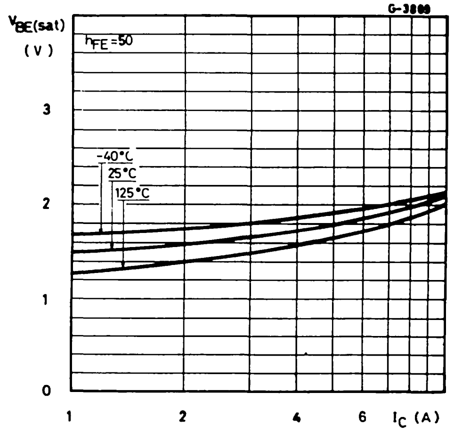
Base-emitter saturation voltage



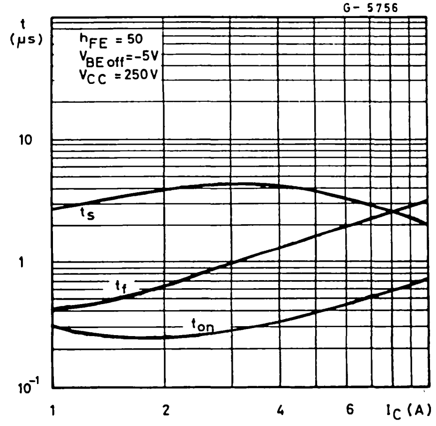
Collector-emitter saturation voltage



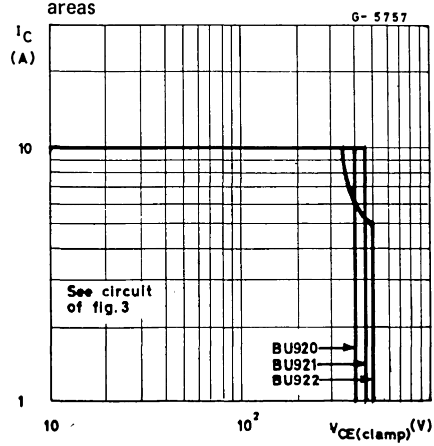
Base-emitter saturation voltage



Saturated switching characteristics



Clamped reverse bias safe operating areas



BU920
BU921
BU922

Fig. 1 — Functional test circuit

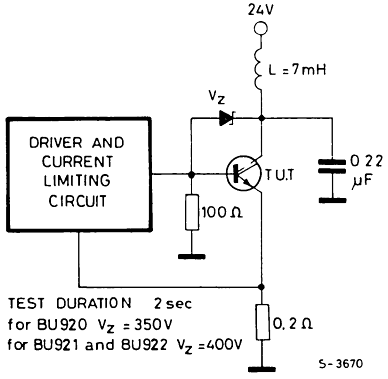


Fig. 2 — Functional test waveforms

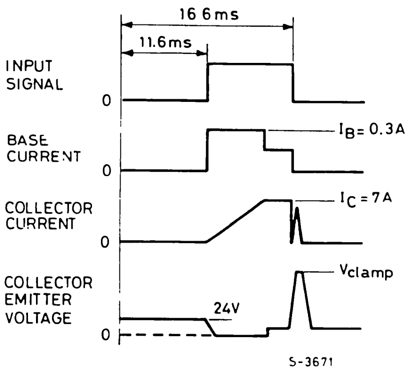
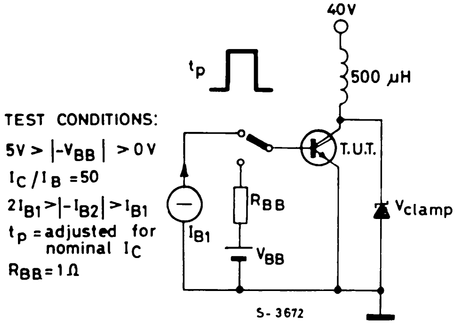


Fig. 3 — Clamped $E_{s/b}$ test circuit



MULTIEPITAXIAL PLANAR NPN

BU920P BU920T
BU921P BU921T
BU922P BU922T

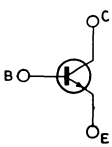
HIGH VOLTAGE POWER DARLINGTON

The BU920P, BU921P, BU922P (SOT-93 plastic package), and the BU920T, BU921T, BU922T (TO-220 plastic package) are high current silicon NPN transistors in monolithic Darlington configuration, specially intended for automotive ignition applications and invert circuits for motor controls.

ABSOLUTE MAXIMUM RATINGS

	TO-220 SOT-93	BU920T BU920P	BU921T BU921P	BU922T BU922P
V_{CES}	Collector-emitter voltage ($V_{BE} = 0$)	400V	450V	500V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	350V	400V	450V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		5V	
I_C	Collector current		10A	
I_{CM}	Collector peak current		15A	
I_B	Base current		5A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$		105W	
T_{stg}	Storage temperature		-65 to 150°C	
T_j	Junction temperature		150°C	

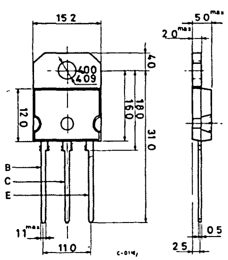
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

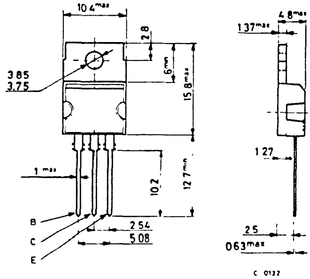
Dimensions in mm

Collector connected to tab



(sim. to **TO-218**) **SOT-93**

Collector connected to tab



TO-220

BU920P BU920T
BU921P BU921T
BU922P BU922T

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)

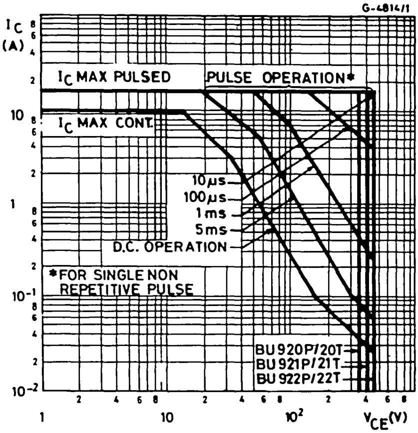
Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current ($V_{BE} = 0$)	for **BU920P/20T**	$V_{CE} = 400V$			1	mA
		for **BU921P/21T**	$V_{CE} = 450V$			1	mA
		for **BU922P/22T**	$V_{CE} = 500V$			1	mA
		$T_{case} = 150°C$					
		for **BU920P/20T**	$V_{CE} = 400V$			5	mA
		for **BU921P/21T**	$V_{CE} = 450V$			5	mA
		for **BU922P/22T**	$V_{CE} = 500V$			5	mA
I_{CEO}	Collector cutoff current ($I_C = 0$)	for **BU920P/20T**	$V_{CE} = 350V$			1	mA
		for **BU921P/21T**	$V_{CE} = 400V$			1	mA
		for **BU922P/22T**	$V_{CE} = 450V$			1	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$				50	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 100mA$	for **BU920P/20T**	350			V
			for **BU921P/21T**	400			V
			for **BU922P/22T**	450			V

ELECTRICAL CHARACTERISTICS (continued)

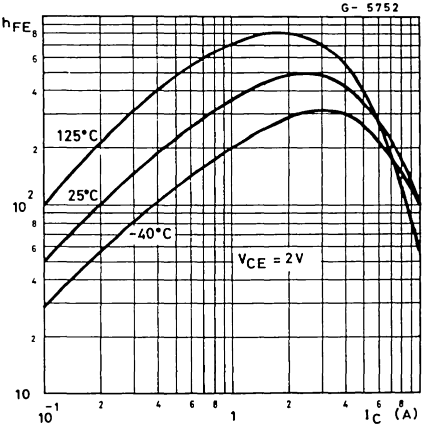
Parameter	Test conditions	Min. Typ. Max.	Unit
$V_{CE(sat)}$ * Collector-emitter saturation voltage	$I_C = 5A$ $I_B = 50mA$ $I_C = 7A$ $I_B = 140mA$	1.8 1.8	V V
$V_{BE(sat)}$ * Base-emitter saturation voltage	$I_C = 5A$ $I_B = 50mA$ $I_C = 7A$ $I_B = 140mA$	2.2 2.5	V V
V_F * Diode forward voltage	$I_F = 7A$	2.5	V

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

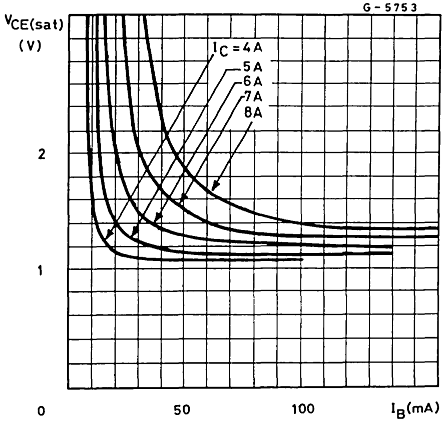
Safe operating areas



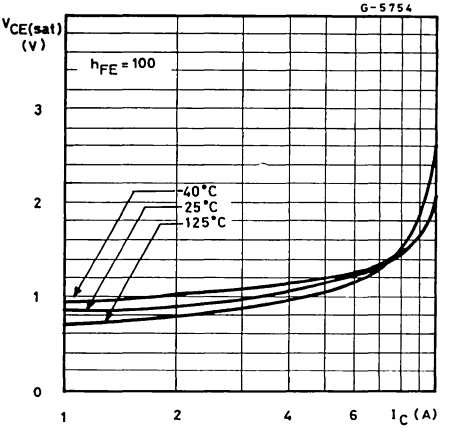
DC current gain



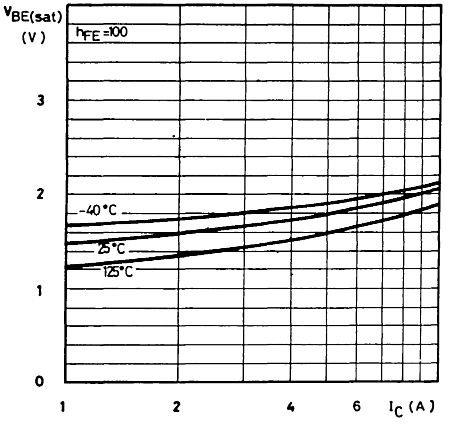
Collector-emitter saturation voltage



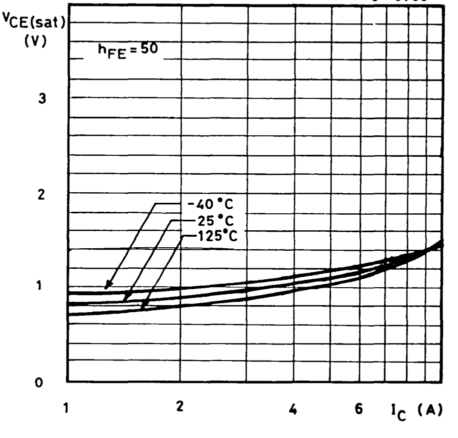
Collector-emitter saturation voltage



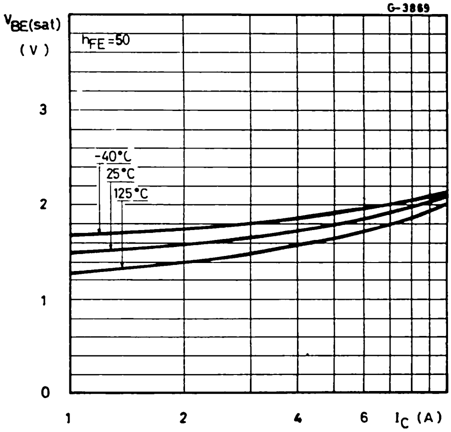
Base-emitter saturation voltage



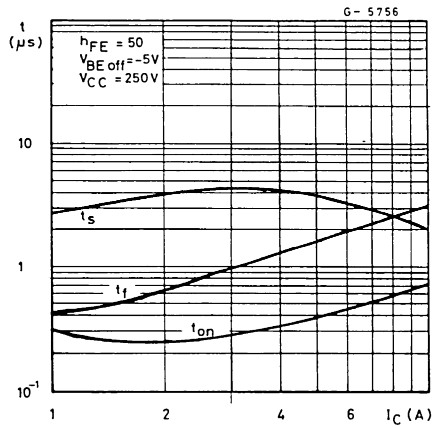
Collector-emitter saturation voltage



Base-emitter saturation voltage



Saturated switching characteristics



Clamped reverse bias safe operating areas

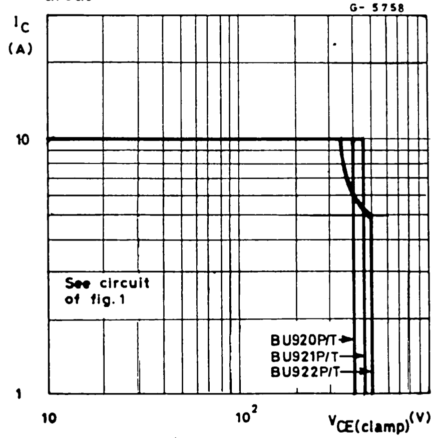
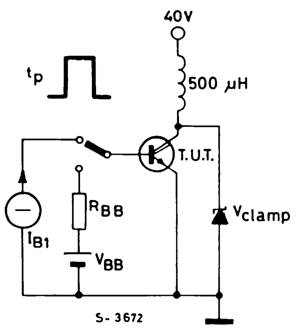


Fig. 1 — Clamped $E_{s/b}$ test circuit

TEST CONDITIONS:
$5V > |-V_{BB}| > 0V$
$I_C / I_B = 50$
$2I_{B1} > |-I_{B2}| > I_{B1}$
t_p = adjusted for nominal I_C
$R_{BB} = 1\Omega$



BU930Z
BU930ZP

MULTIEPITAXIAL BIPLANAR NPN

PRELIMINARY DATA

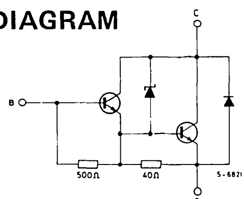
NPN POWER DARLINGTONS

The BU930Z and BU930ZP are silicon NPN multiepitaxial biplanar darlingtons respectively in TO-3 and SOT-93 package. They are designed for applications in high performance electronic car ignition.
They features very high ruggedness thanks to the integrated high voltage zener.

ABSOLUTE MAXIMUM RATINGS

		BU930Z	BU930ZP
V_{CBO}	Collector-base voltage ($I_E = 0$)	350V	
V_{CER}	Collector-emitter voltage ($R_{BE} = 100\Omega$)	350V	
V_{CES}	Collector-base voltage ($V_{BE} = 0$)	350V	
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	350V	
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5V	
I_C	Collector current	20A	
I_B	Base current	5A	
P_{tot}	Total power dissipation at $T_{amb} = 25°C$	175W	150W
T_{stg}	Storage temperature	-40 to +200°C	-40 to +175°C
T_j	Junction temperature	200°C	175°C

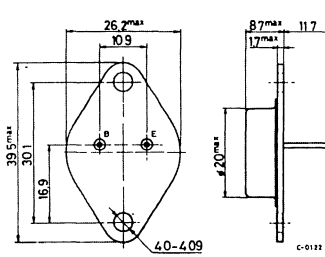
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

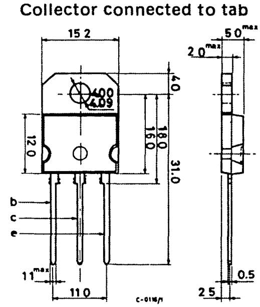
Dimension in mm

Collector connected to case



TO-3

Collector connected to tab



(sim. to TO-218) SOT-93

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max.	1	°C/W

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

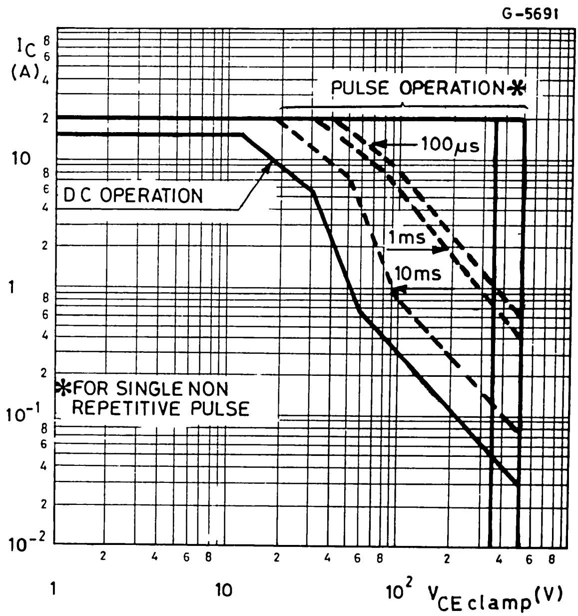
Parameter		Test Conditions	Min.	Typ.	Max.	Unit
I_{CL}	Clamping current	$V_{CE} = 350V$ either $I_B = 0$ or $V_{BE} = 0$			 1 1	 mA mA
$I_{CE(off)}$	Collector-emitter off state current $I_B = 0$	$V_{CC} = 16V$ $T_j = 125°C$ $V_{BE} = 400mV$			0.5	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$			50	mA
V_{CL}	Clamping voltage	either $I_B = 0$ or $V_B = 0$ and $I_C = 100mA$ same, $T_j = 125°C$	 350 350		 500 500	 V V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C = 7A$ $I_B = 70mA$ same, $T_j = 125°C$ $I_C = 8A$ $I_B = 100mA$ same, $T_j = 125°C$ $I_C = 10A$ $I_B = 150mA$ same, $T_j = 125°C$		1.25 1.30 1.45 1.65 1.65 1.85	1.6 1.8 1.8 2.1 2 2.4	V V V V V V
$V_{BE(sat)}$*	Base-emitter saturation voltage	$I_C = 8A$ $I_B = 100mA$ $I_C = 10A$ $I_B = 250mA$			2.2 2.5	V V
$V_{BE(on)}$*	Base-emitter voltage	$I_C = 5A$ $V_{CE} = 2V$ same, $T_j = -40°C$ same, $T_j = 125°C$ $I_C = 10A$ $V_{CE} = 2V$ same, $T_j = -40°C$ same, $T_j = 125°C$	 1.3 1.4	1.67 2 	 2.1 2.4 	V V V V V V
V_F*	Diode forward voltage	$I_F = 10A$			2.5	V

ELECTRICAL CHARACTERISTICS (continued

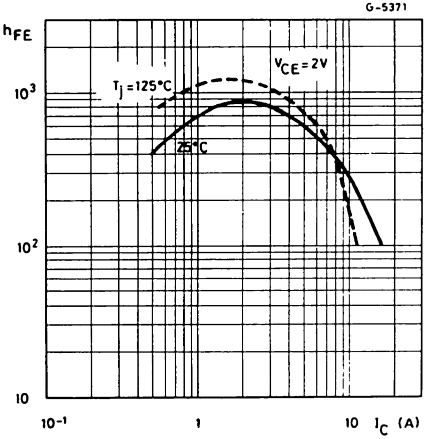
	Parameter	Test conditions		Min.	Typ.	Max.	Unit
$E_{s/b}$	Second breakdown energy unclamped (see fig. 1)	V_{CC} = 40V I_C = 14A V_{BE} = 0V	L = 12mH I_B = 350mA	700			mJ
 t_s t_f	**INDUCTIVE** Storage time Fall time (see fig. 1)	V_{CC} = 12V I_C = 7A V_{CL} = 350V	L = 6mH I_B = 70mA V_{BE} = 0V		 8.5 2.6		 µs µs
$I_{s/b}$	Second breakdown collector current	V_{CE} = 30V t = 500ms for **BU930Z** t = 250ms for **BU930P**		 6 6			 A A

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

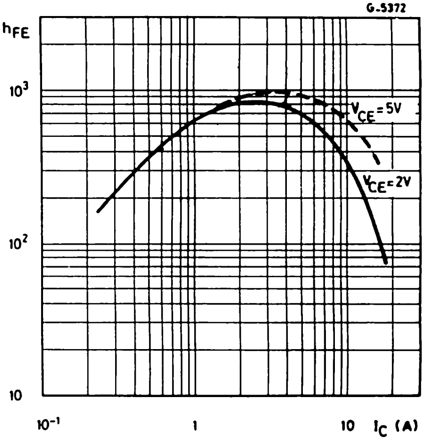
Safe operating areas



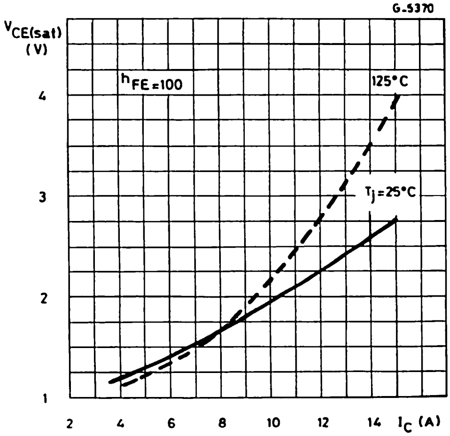
DC current gain



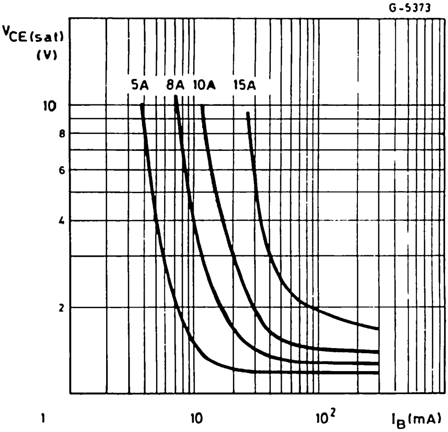
DC current gain



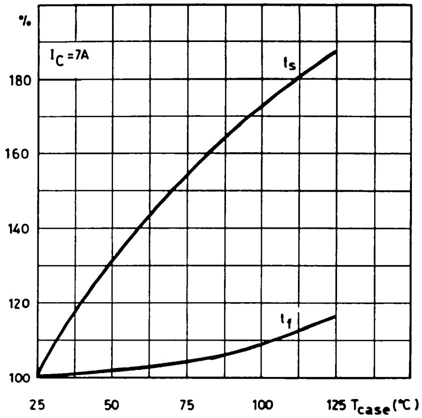
Collector-emitter saturation voltage



Collector-emitter saturation voltage



Switching times percentage variations vs. T_{case} (inductive load)



Base-emitter saturation voltage

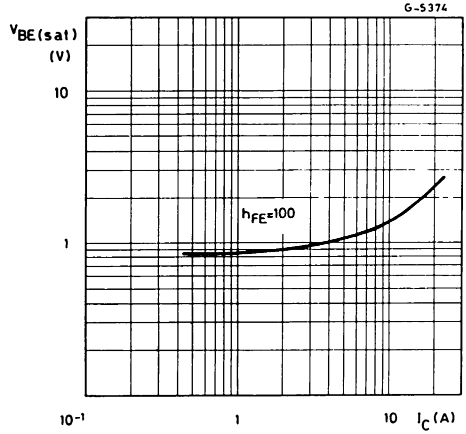
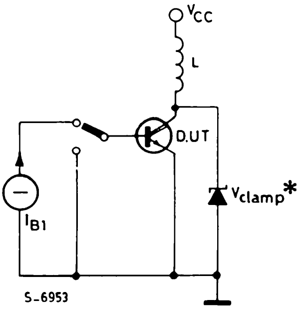


Fig. 1 - Switching times and $E_{s/b}$ test circuit.



* Only for switching times

MULTIEPITAXIAL BIPLANAR NPN

BU931R
BU931RP
BU932R
BU932RP

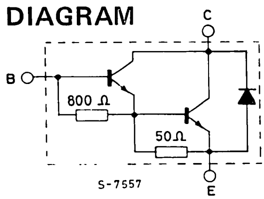
HIGH VOLTAGE FAST SWITCHING POWER DARLINGTONS

NPN transistors in monolithic darlington configurations specially intended for automotive ignition applications and inverter circuits for motor controls. Controlled performances in the linear region make them particularly suitable for car ignitions where current limiting is achieved desaturating the darlington.

ABSOLUTE MAXIMUM RATINGS

		TO-3 BU931R	SOT-93 BU931RP	TO-3 BU932R	SOT-93 BU932RP
V_{CES}	Collector-base voltage ($V_{BE} = 0$)	450V	450V	500V	500V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	400V	400V	450V	450V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5V			
I_C	Collector current	15A			
I_{CM}	Collector peak current ($tp < 10ms$)	30A			
I_B	Base current	1A			
I_{BM}	Base peak current ($tp < 10ms$)	5A			
P_{tot}	Total power dissipation at $T_{case} < 25°C$	175W	150W	175W	150W
T_{stg}	Storage temperature for TO-3	40 to 200°C			
	for SOT-93	40 to 175°C			
T_j	Junction temperature	200°C	175°C	200°C	175°C

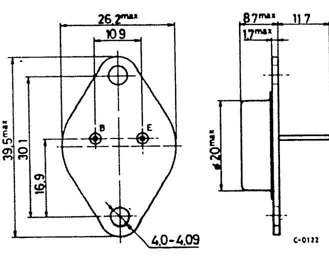
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

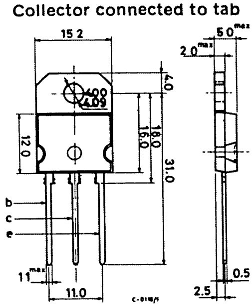
Dimension in mm

Collector connected to case



TO-3

Collector connected to tab



(sim. to TO-218) SOT-93

THERMAL DATA

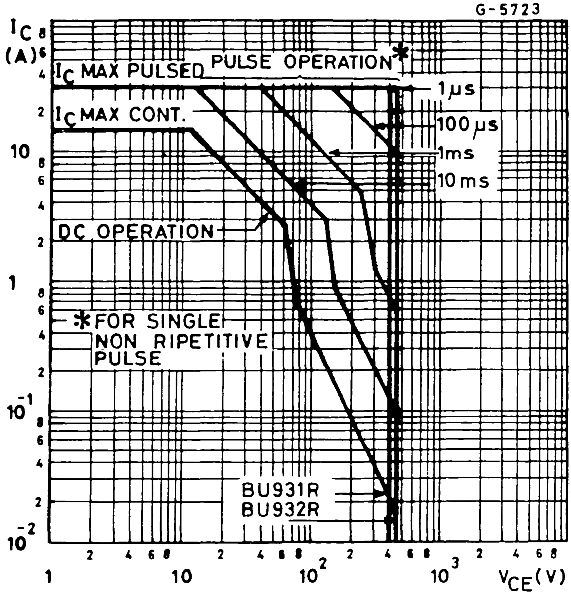
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1	°C/W

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

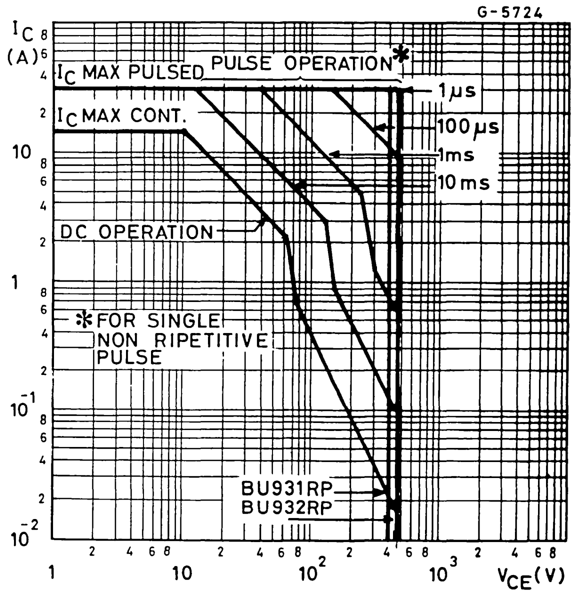
Symbol	Parameters	Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current ($V_{BE} = 0$)	$V_{CE} = 450V$ for **BU931R/P** $V_{CE} = 500V$ for **BU932R/P** $T_{case} = 125°C$ $V_{CE} = 450V$ for **BU931R/P** $V_{CE} = 500V$ for **BU932R/P**			1 1 5 5	mA mA mA mA
I_{CEO}	Collector cutoff current ($I_B = 0$)	$V_{CE} = 400V$ for **BU931R/P** $V_{CE} = 450V$ for **BU932R/P**			1 1	mA mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{BE} = -5V$			50	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage	$I_C = 100mA$ for **BU931R/P** for **BU932R/P**	400 450			V V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C = 7A$, $I_B = 70mA$, for **BU931R/P** $I_C = 8A$, $I_B = 100mA$, for **BU931R/P** $I_C = 10A$, $I_B = 250mA$, for **BU931R/P** $I_C = 8A$, $I_B = 150mA$, for **BU932R/P**		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	$I_C = 8A$, $I_B = 100mA$, for **BU931R/P** $I_C = 10A$, $I_B = 250mA$, for **BU931R/P** $I_C = 8A$, $I_B = 150mA$, for **BU932R/P**		1.75 1.92 1.77	2.2 2.5 2.2	V V V
h_{FE}*	DC current gain	$I_C = 5A$ $V_{CE} = 10V$	300			–
V_f*	Diode forward voltage	$-I_C = 10A$		1.43	2.8	V
	USE TEST (see fig. 3)	$V_{CC} = 24V$ $V_{Clamp} = 400V$ $L = 7mH$	8			A
  t_s t_f	INDUCTIVE LOAD (see fig. 1) Storage time Fall time	$V_{CC} = 12V$, $L = 7mH$, $V_{Cl} = 300V$ $I_C = 7A$ $I_B = 70mA$ $V_{BE} = 0$ $R_{BE} = 47\Omega$		 15 0.5		 µs µs

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

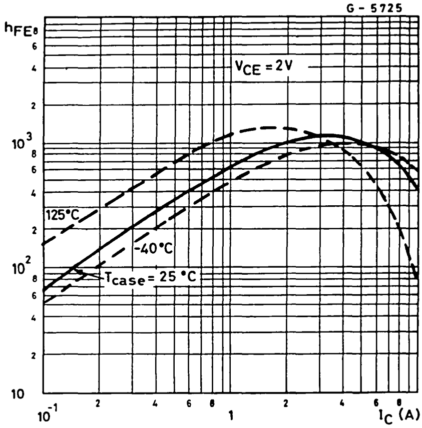
Safe operating areas
(BU931R, BU932R)



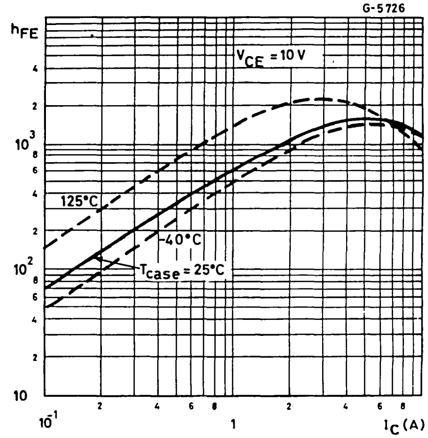
Safe operating areas
(BU931RP, BU932RP)



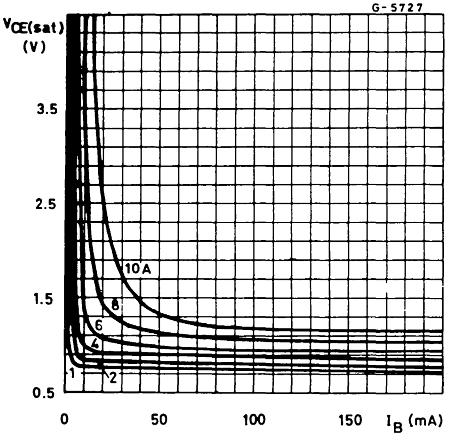
DC current gain



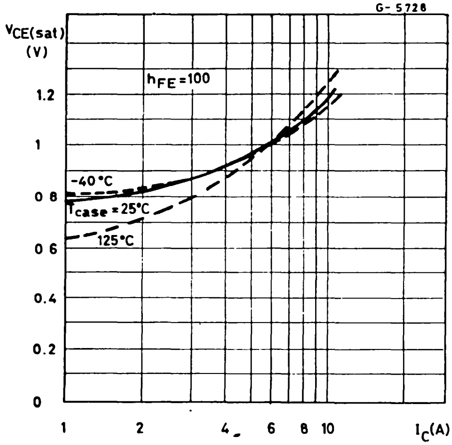
DC current gain



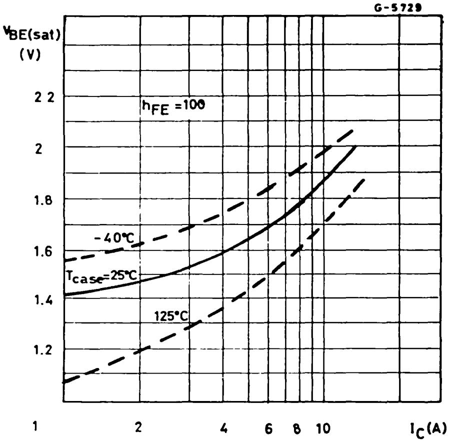
Collector-emitter saturation voltage



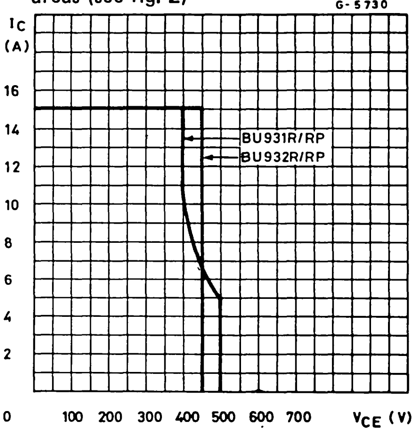
Collector-emitter saturation voltage



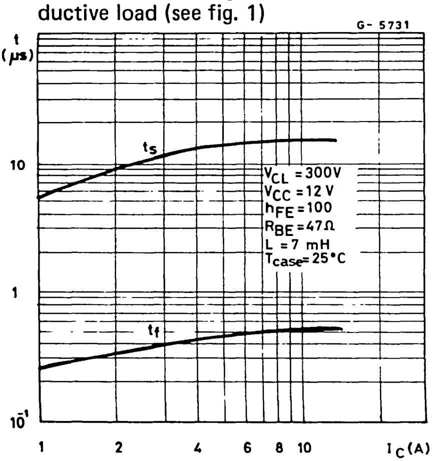
Base-emitter saturation voltage



Clamped reverse bias safe operating areas (see fig. 2)



Saturated switching characteristics inductive load (see fig. 1)



Switching times percentage variation vs. T_{case} inductive load

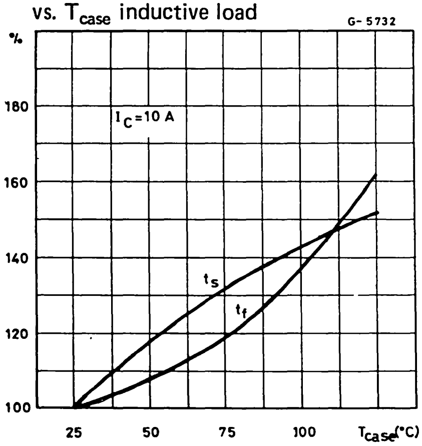


Fig. 1 — Switching times test circuit.

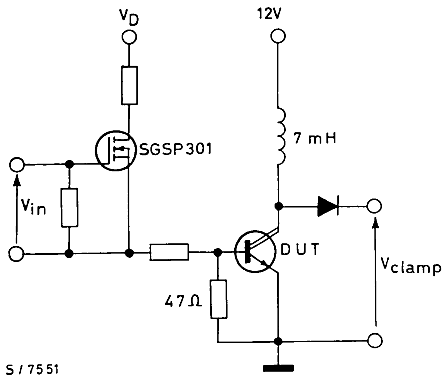


Fig. 2 — Clamped $E_{s/b}$ test circuit

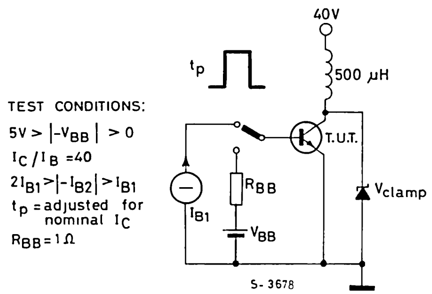


Fig. 3 — Functional test circuit

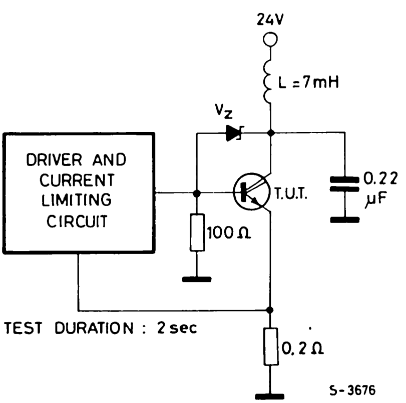
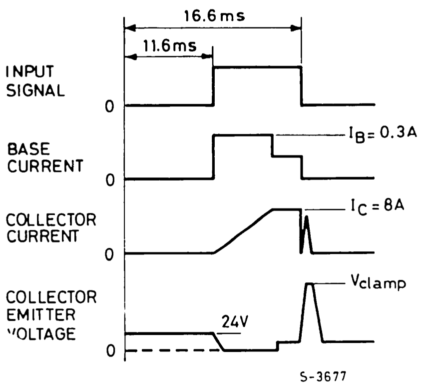


Fig. 4 — Functional test waveforms



MULTIEPITAXIAL PLANAR NPN

BU999

ADVANCE DATA

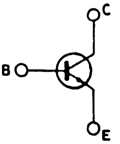
HIGH POWER FAST SWITCHING

The BU1999 type is a silicon multiepitaxial planar NPN transistors and is mounted in SOT-93 plastic package. It is intended for use in switching and linear applications, in military and industrial equipments.

ABSOLUTE MAXIMUM RATINGS

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 $T_{case} \leqslant 25°C$	106	W
T_{stg}	Storage temperature	-65 to 150	°C
T_j	Junction temperature	150	°C

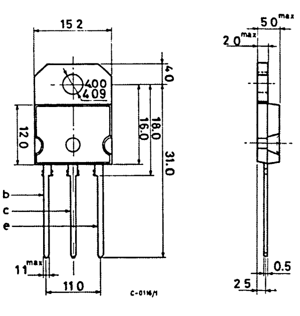
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



(sim. to **TO-218**) **SOT-93**

BU999

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)

Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current (I_E = 0)	V_{CB} = 160V				100	μA
I_{CEO}	Collector cutoff current (I_B = 0)	V_{CE} = 70V				50	μA
I_{CEX}	Collector cutoff current	V_{CE} = 140V V_{BE} = -1.5V				10	μA
I_{EBO}	Emitter cutoff current	V_{EB} = 6V I_C = 0				100	μA
$V_{CEO\ (sus)}$	Collector-emitter sustaining voltage	I_C = 50mA I_B = 0		140			V
$V_{CE\ (sat)}$	Collector-emitter saturation voltage	I_C = 10A I_C = 25A	I_B = 1A I_B = 2.5A			0.8 1.5	V V
$V_{BE\ (sat)}$	Base-emitter saturation voltage	I_C = 10A I_C = 25A	I_B = 1A I_B = 2.5A			1.8 2.5	V V
$V_{BE\ (on)}$	Base-emitter on voltage	I_C = 10A	V_{CE} = 2V			1.8	V
h_{FE}	DC current gain	I_C = 0.5A I_C = 10A I_C = 25A	V_{CE} = 2V V_{CE} = 2V V_{CE} = 2V	35 25 12		 100 	— — —
t_r	Rise time	V_{CC} = 80V I_C = 10A I_{B1} = I_{B2} = 1A				0.3	μs
t_s	Storage time					1.5	μs
t_f	Fall time					0.25	μs

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

MULTIEPITAXIAL PLANAR NPN

BUR50
BUR50S

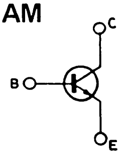
HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

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.

ABSOLUTE MAXIMUM RATINGS

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

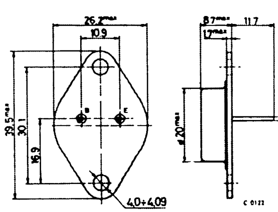
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

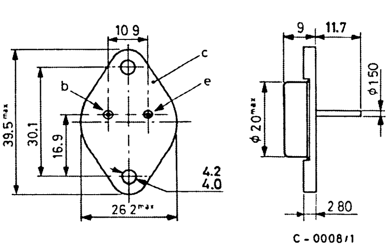
Dimensions in mm

Collector connected to case



BUR 50S

Collector connected to case



BUR50

BUR50
BUR50S

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)

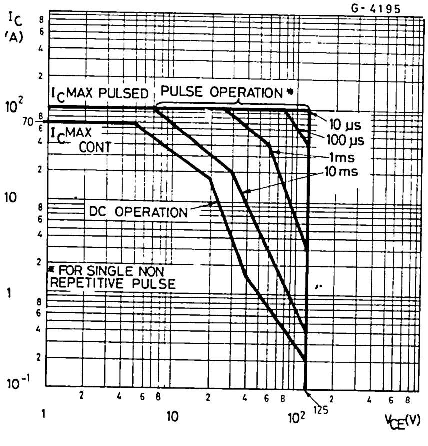
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	$V_{CB} = 200V$ $V_{CB} = 200V$ $T_{case} = 125\,°C$			0.2 2	mA mA
I_{CEO}	Collector cutoff current ($I_B = 0$)	$V_{CE} = 125V$			1	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 7V$			0.2	mA
$V_{CEO\,(sus)}$*	Collector-emitter sustaining voltage	$I_C = 200mA$	125			V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	$I_E = 10mA$	10			V
$V_{CE\,(sat)}$*	Collector-emitter saturation voltage	$I_C = 35A$ $I_B = 2A$ $I_C = 70A$ $I_B = 7A$		 0.8	1 1.5	V V
$V_{BE(sat)}$*	Base-emitter saturation voltage	$I_C = 35A$ $I_B = 2A$ $I_C = 70A$ $I_B = 7A$		 1.6	1.8 2	V V
h_{FE}*	DC current gain	$I_C = 5A$ $V_{CE} = 4V$ $I_C = 50A$ $V_{CE} = 4V$	20 15		100	– –
$I_{s/b}$	Second breakdown collector current	$V_{CE} = 20V$ $t = 1s$	17.5			A
f_T	Transition frequency	$I_C = 1A$ $V_{CE} = 5V$ $f = 1MHz$	10	16		MHz

ELECTRICAL CHARACTERISTICS (continued)

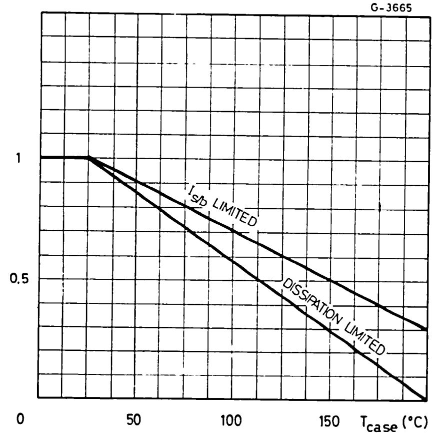
	Parameter	Test conditions	Min. Typ. Max.	Unit
t_{on}	Turn-on time (fig. 2)	I_C =70A I_{B1} =7A V_{CC}=60V	0.5 1.2	µs
t_s	Storage time (fig. 2)	I_C =70A I_{B1} =7A I_{B2} =-7A V_{CC}=60V	0.82 2	µs
t_f	Fall time (fig. 2)		0.1 0.5	µs
	Clamped $E_{s/b}$ Collector current (fig. 1)	V_{clamp}=125V L =500µH	70	A

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

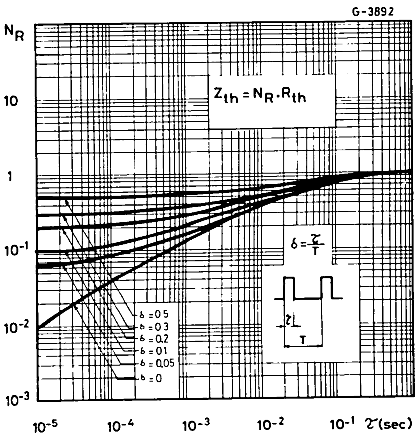
Safe operating areas



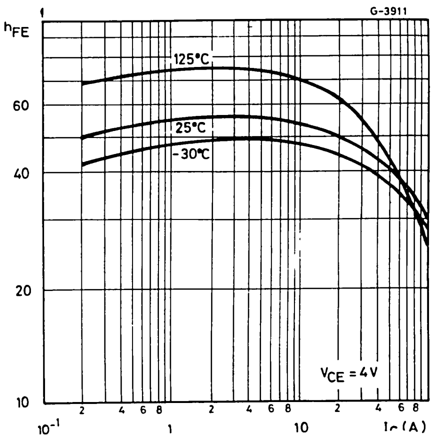
Derating curves



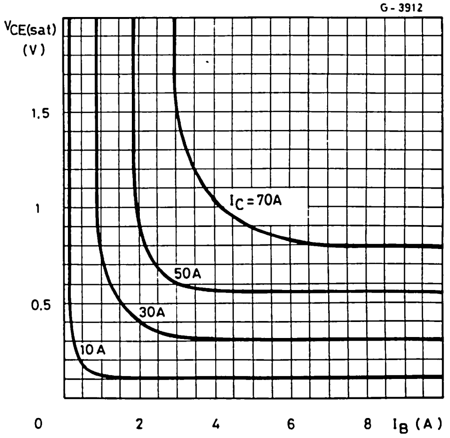
Thermal transient response



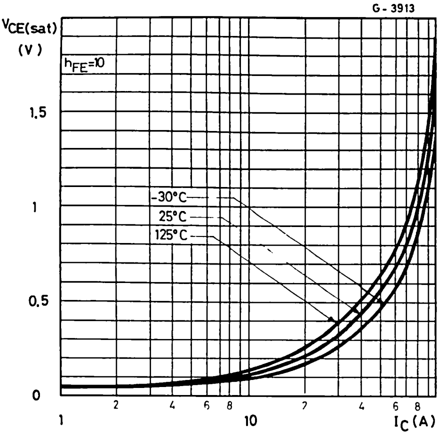
DC current gain



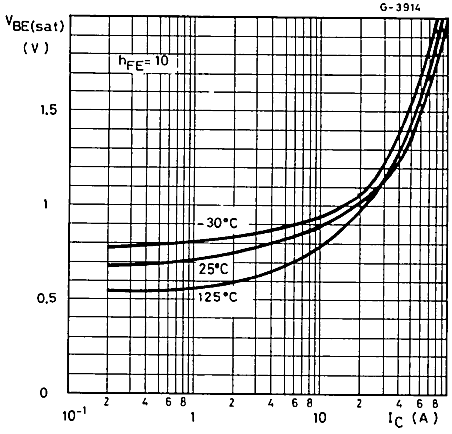
Collector-emitter saturation voltage



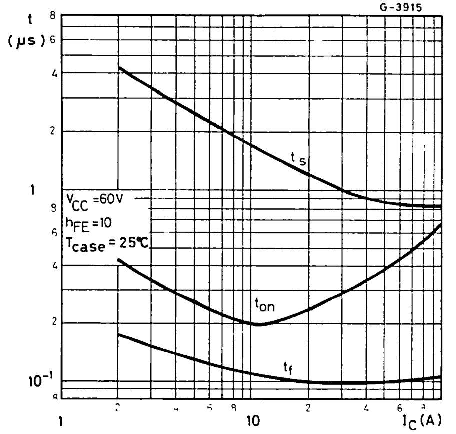
Collector-emitter saturation voltage



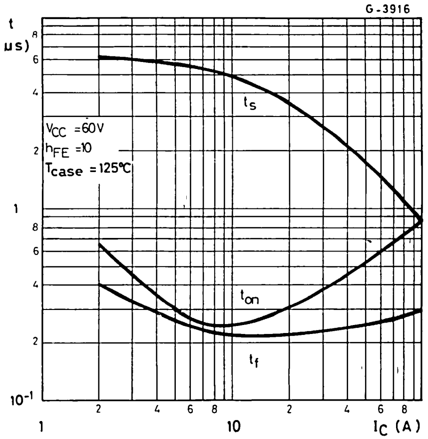
Base-emitter saturation voltage



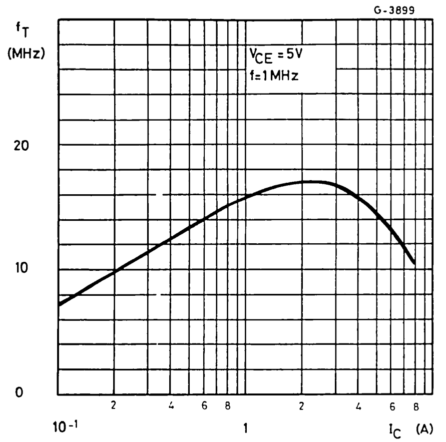
Saturated switching characteristics



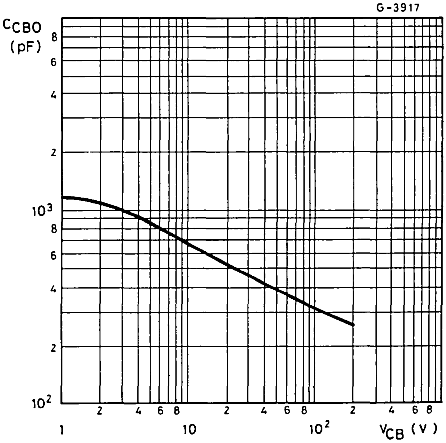
Saturated switching characteristics



Transition frequency



Collector-base capacitance



Clamped reverse bias safe operating areas

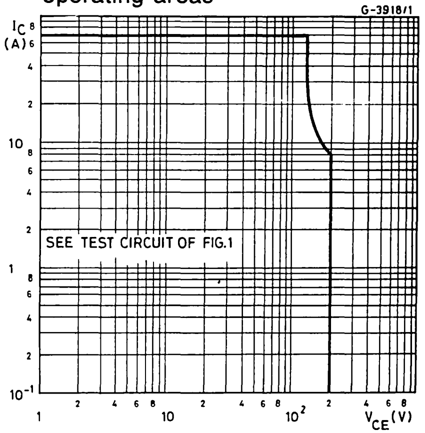


Fig. 1 — Clamped $E_{s/b}$ test circuit

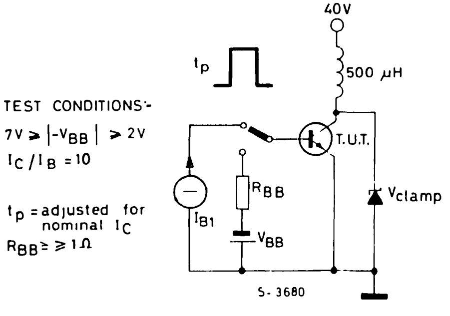
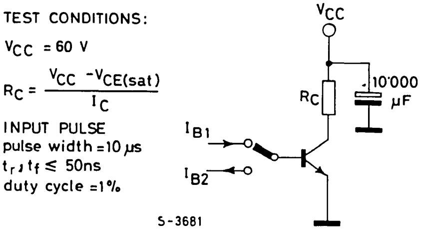


Fig. 2 — Switching times test circuit (resistive load)



BUR51

MULTIEPITAXIAL PLANAR NPN

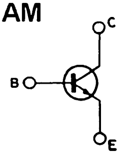
HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

The BUR 51 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.

ABSOLUTE MAXIMUM RATINGS

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

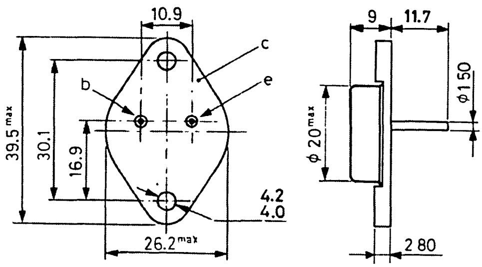
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



C - 0008/1

Modified TO-3

BUR51

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)

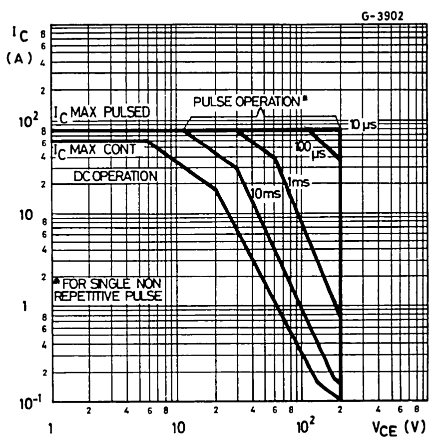
	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	$V_{CB} = 300V$ $V_{CB} = 300V$ $T_{case} = 125°C$			0.2 2	mA mA
I_{CEO}	Collector cutoff current ($I_B = 0$)	$V_{CE} = 200V$			1	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 7V$			0.2	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage	$I_C = 200mA$	200			V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	$I_E = 10mA$	10			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	$I_C = 30A$ $I_B = 2A$ $I_C = 50A$ $I_B = 5A$		 0.9	1 1.5	V V
$V_{BE(sat)}$*	Base-emitter saturation voltage	$I_C = 30A$ $I_B = 2A$ $I_C = 50A$ $I_B = 5A$		 1.55	1.8 2	V V
h_{FE}*	DC current gain	$I_C = 5A$ $V_{CE} = 4V$ $I_C = 50A$ $V_{CE} = 4V$	20 15		100	– –
$I_{s/b}$	Second breakdown collector current	$V_{CE} = 20V$ $t = 1s$	17.5			A
f_T	Transition frequency	$I_C = 1A$ $V_{CE} = 5V$ $f = 1MHz$	10	16		MHz

ELECTRICAL CHARACTERISTICS (continued)

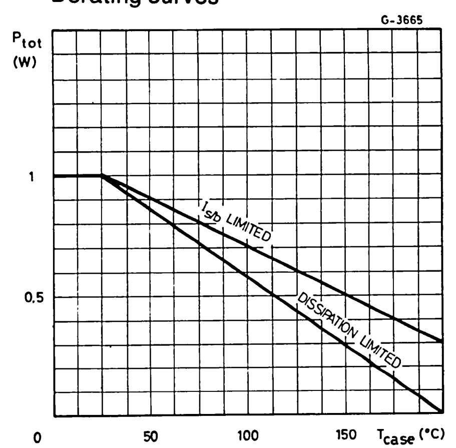
	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on time (fig. 2)	I_C =50A I_{B1} =5A V_{CC}=100V		0.35	1	µs
t_s	Storage time (fig. 2)	I_C =50A I_{B1} =5A I_{B2} =-5A V_{CC}=100V		0.9	2	µs
t_f	Fall time (fig. 2)			0.24	0.6	µs
	Clamped $E_{s/b}$ Collector current (fig. 1)	V_{clamp}=200V L =500µH	50			A

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

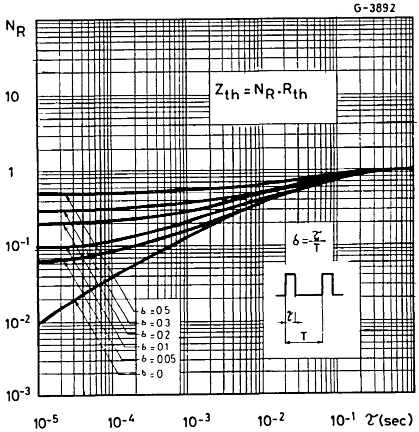
Safe operating areas



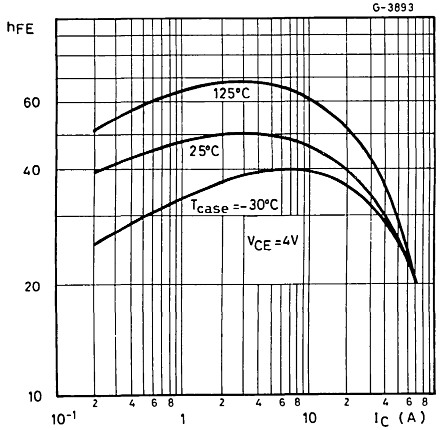
Derating curves



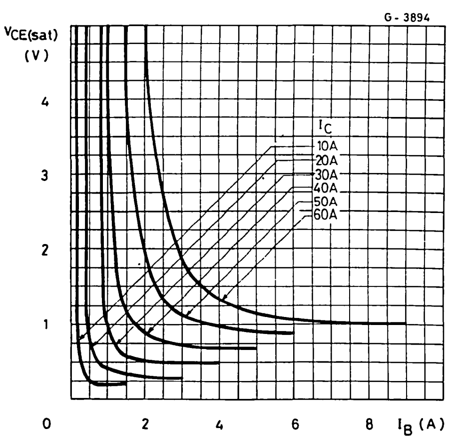
Thermal transient response



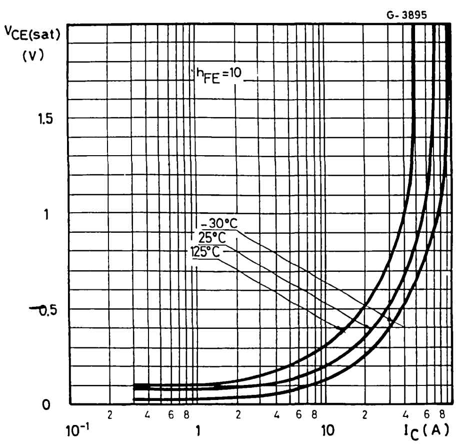
DC current gain



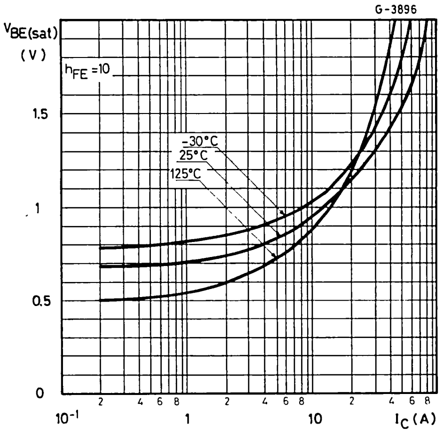
Collector-emitter saturation voltage



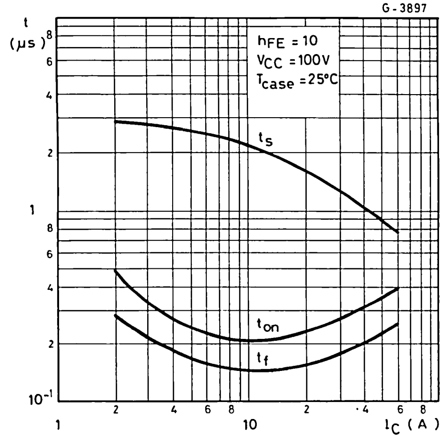
Collector-emitter saturation voltage



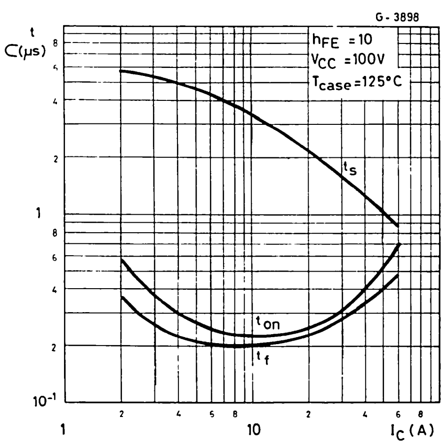
Base-emitter saturation voltage



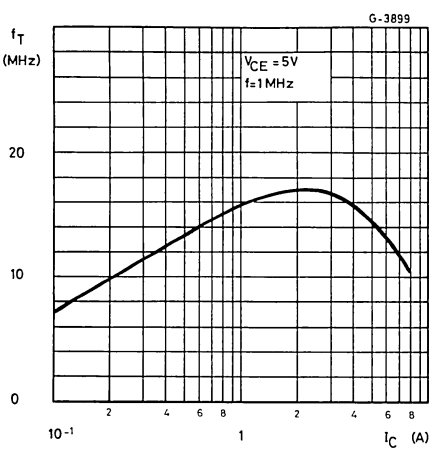
Saturated switching characteristics



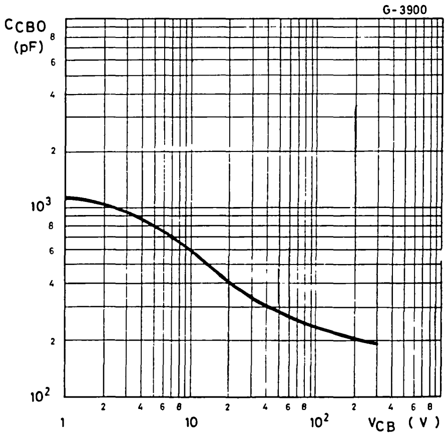
Saturated switching characteristics



Transition frequency



Collector-base capacitance



Clamped reverse bias
safe operating areas

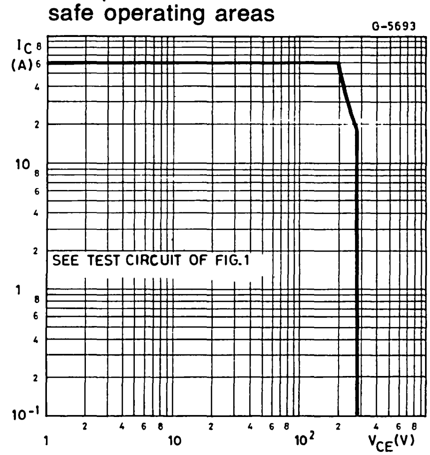


Fig. 1 — Clamped $E_{s/b}$ test circuit

TEST CONDITIONS

$7V \geq |-V_{BB}| \geq 2V$

$I_C / I_B = 10$

t_p = adjusted for nominal I_C

$R_{BB} \geq 1\Omega$

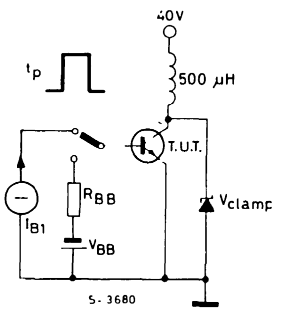


Fig. 2 — Switching times test circuit (resistive load)

TEST CONDITIONS:

$V_{CC} = 100V$

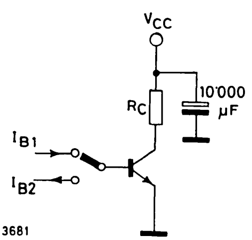
$$R_C = \frac{V_{CC} - V_{CE(sat)}}{I_C}$$

INPUT PULSE

pulse width = 10 μs

$t_r, t_f \leq 50ns$

duty cycle = 1%



MULTIEPITAXIAL PLANAR NPN

BUR52

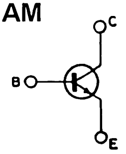
HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

The BUR 52 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.

ABSOLUTE MAXIMUM RATINGS

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

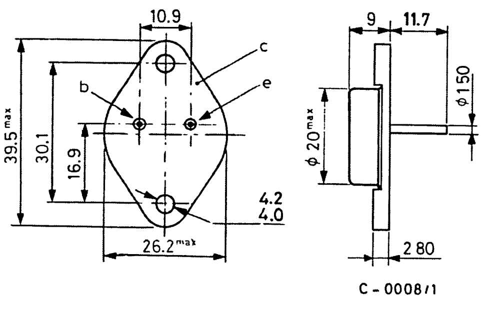
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



Modified TO-3

BUR52

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)

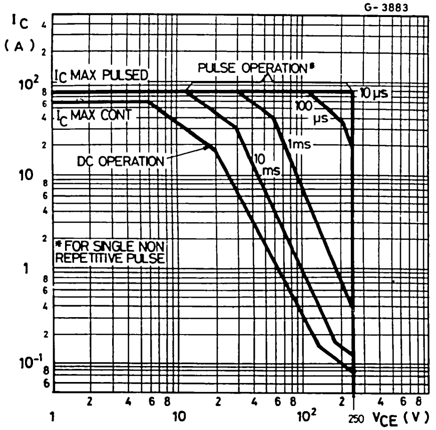
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E=0$)	$V_{CB}=350V$ $V_{CB}=350V$ $T_{case}=125\,°C$			0.2 2	mA mA
I_{CEO}	Collector cutoff current ($I_B=0$)	$V_{CE}=250V$			1	mA
I_{EBO}	Emitter cutoff current ($I_C=0$)	$V_{EB}=7V$			0.2	mA
$V_{CEO\,(sus)}$*	Collector-emitter sustaining voltage	$I_C=200mA$	250			V
V_{EBO}	Emitter-base voltage ($I_C=0$)	$I_E=10mA$	10			V
$V_{CE\,(sat)}$*	Collector-emitter saturation voltage	$I_C=25A$ $I_B=2A$ $I_C=40A$ $I_B=4A$		 0.70	1 1.5	V V
$V_{BE(sat)}$*	Base-emitter saturation voltage	$I_C=25A$ $I_B=2A$ $I_C=40A$ $I_B=4A$		 1.5	1.8 2	V V
h_{FE}*	DC current gain	$I_C=5A$ $V_{CE}=4V$ $I_C=40A$ $V_{CE}=4V$	20 15		100	— —
$I_{s/b}$	Second breakdown collector current	$V_{CE}=20V$ $t=1s$	17.5			A
f_T	Transition frequency	$I_C=1A$ $V_{CE}=5V$ $f=1MHz$	10	16		MHz
t_{on}	Turn-on time (fig. 2)	$I_C=40A$ $I_{B1}=4A$ $V_{CC}=100V$		0.3	1	µs

ELECTRICAL CHARACTERISTICS (continued)

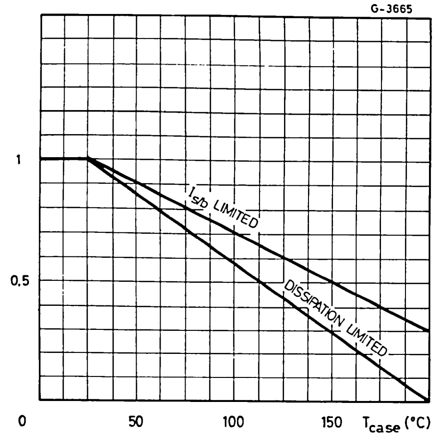
	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t_s	Storage time (fig. 2)	I_C =40A I_{B1} =4A I_{B2} =−4A V_{CC}=100V		1.2	2	µs
t_f	Fall time (fig. 2)			0.20	0.6	µs
	Clamped $E_{s/b}$ Collector current (fig. 1)	V_{clamp}=250V L=500µH	40			A

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

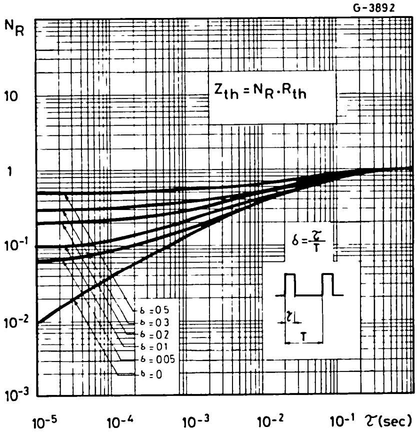
Safe operating areas



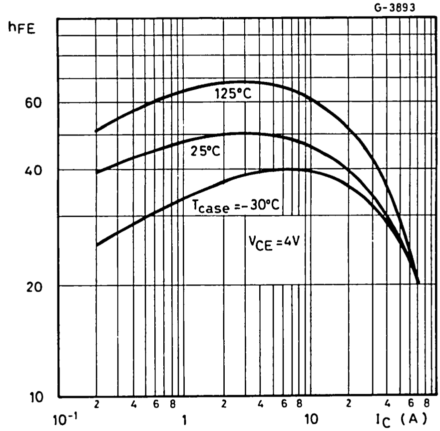
Derating curves



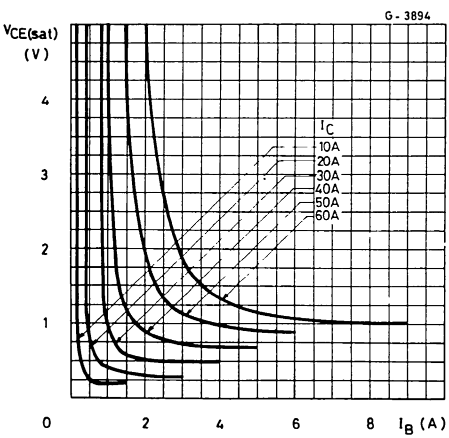
Thermal transient response



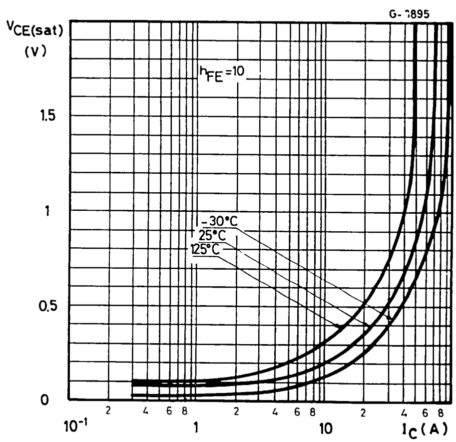
DC current gain



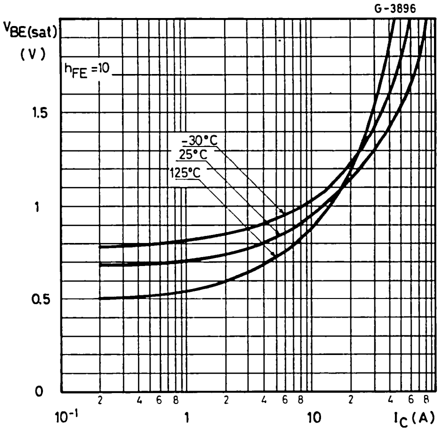
Collector-emitter saturation voltage



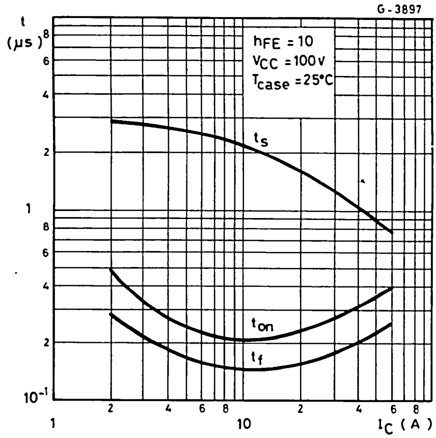
Collector-emitter saturation voltage



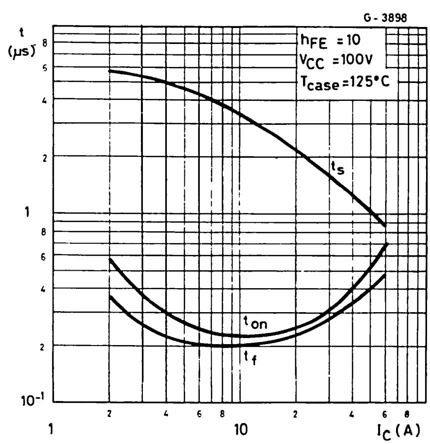
Base-emitter saturation voltage



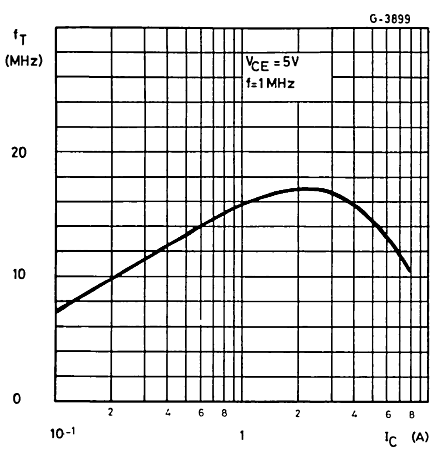
Saturated switching characteristics



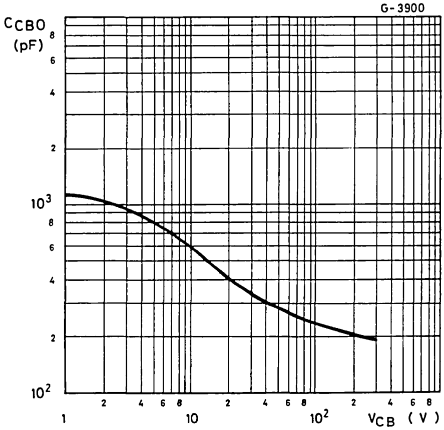
Saturated switching characteristics



Transition frequency



Collector-base capacitance



Clamped reverse bias safe operating areas

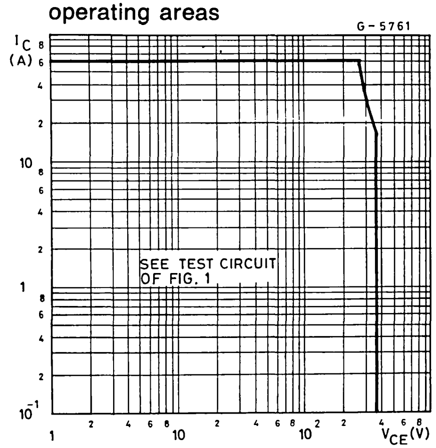


Fig. 1 — Clamped $E_{s/b}$ test circuit

TEST CONDITIONS

$7V \geq |-V_{BB}| \geq 2V$

$I_C / I_B = 10$

t_p = adjusted for nominal I_C

$R_{BB} \geq 1\Omega$

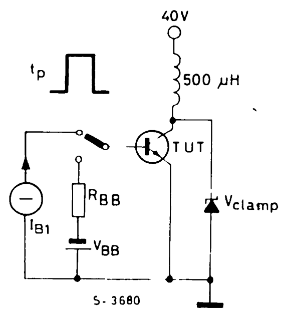


Fig. 2 — Switching times test circuit (resistive load)

TEST CONDITIONS:

$V_{CC} = 100V$

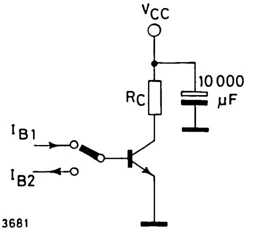
$$R_C = \frac{V_{CC} - V_{CE(sat)}}{I_C}$$

INPUT PULSE

pulse width = 10 µs

$t_r, t_f \leq 50ns$

duty cycle = 1%



MULTIEPITAXIAL MESA NPN

BUT11
BUT11A

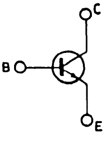
HIGH VOLTAGE SWITCH

The BUT11 and BUT11A are silicon multiepitaxial mesa NPN transistor in Jedec TO-220 plastic package particularly intended for switch application.

ABSOLUTE MAXIMUM RATINGS

		BUT11	BUT11A
V_{CES}	Collector-emitter voltage ($V_{BE} = 0$)	850V	1000V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	400V	450V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	9V	
I_C	Collector current	5A	
I_{CM}	Collector peak current	10A	
I_B	Base current	2A	
I_{BM}	Base peak current	4A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	100W	
T_{stg}	Storage temperature	-65 to 175°C	
T_j	Junction temperature	175°C	

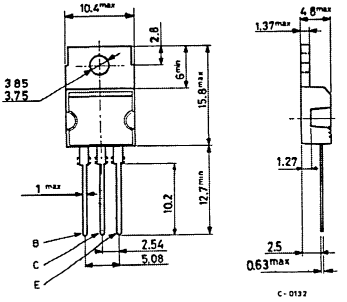
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

BUT11
BUT11A

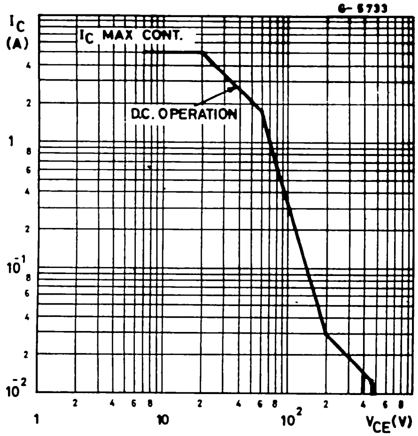
THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction case	max	1.5	°C/W

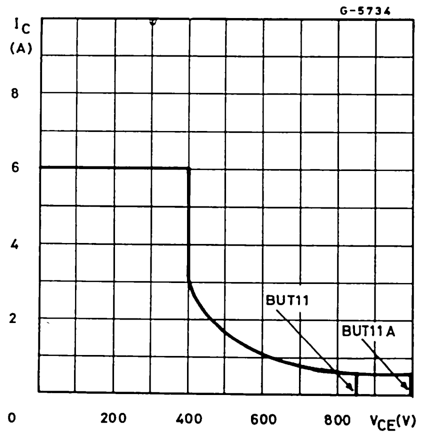
ELECTRICAL CHARACTERISTICS (T_{case} =25°C unless otherwise specified)

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 cutoff	$I_C = 0$ $V_{EB} = 9V$			10	mA
V_{CEO}	Collector-emitter sustaining voltage	$I_{B\ (off)} = 0$ $I_C = 100mA$ for **BUT11** for **BUT11A**	 400 450			V V
$V_{CE\ (sat)}$	Collector-emitter saturation voltage	$I_C = 3A$ $I_B = 0.6A$ for **BUT11** $I_C = 2.5A$ $I_B = 0.5A$ for **BUT11A**			1.5 1.5	V V
$V_{BE\ (sat)}$	Base-emitter saturation voltage	$I_C = 3A$ $I_B = 0.6A$ for **BUT11** $I_C = 2.5A$ $I_B = 0.6A$ for **BUT11A**			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

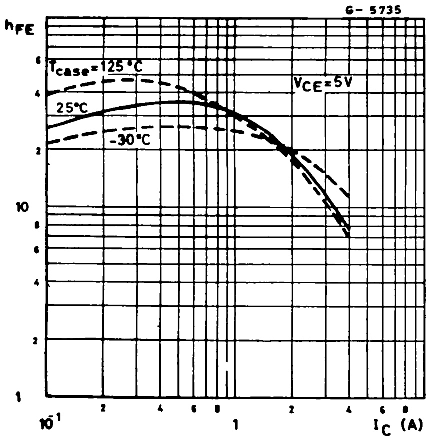
Safe operating area



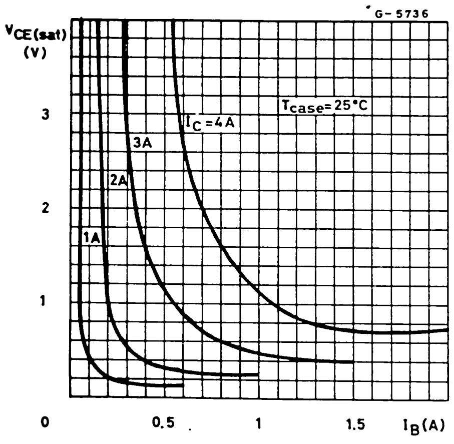
Reverse biased safe operating area



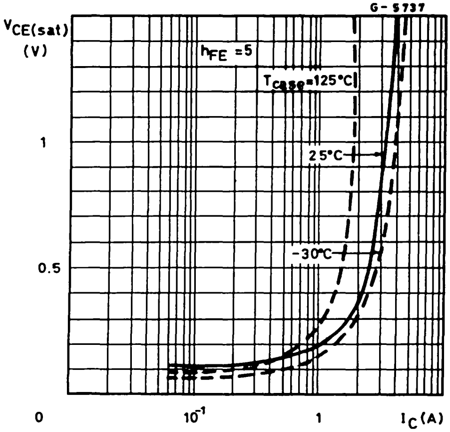
DC current gain



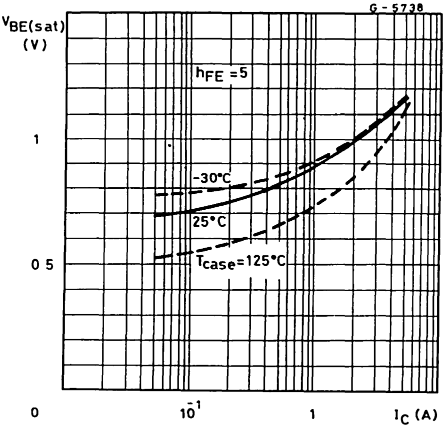
Collector-emitter saturation voltage



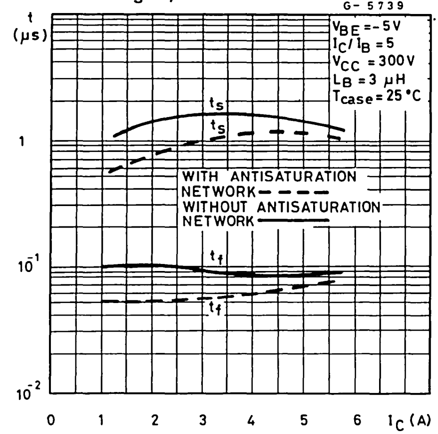
Collector-emitter saturation voltage



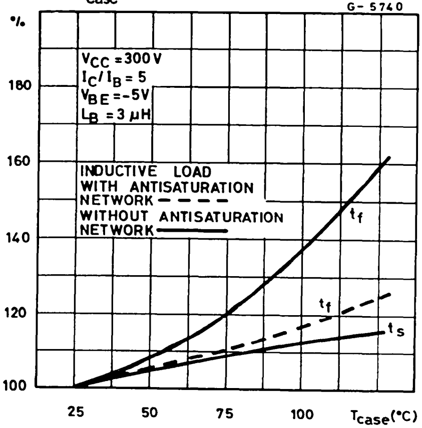
Base-emitter saturation voltage



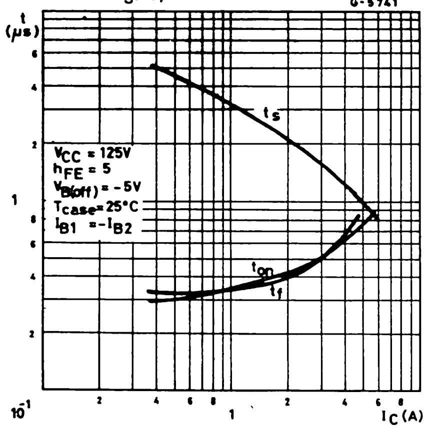
Switching times inductive load (test circuit fig. 2)



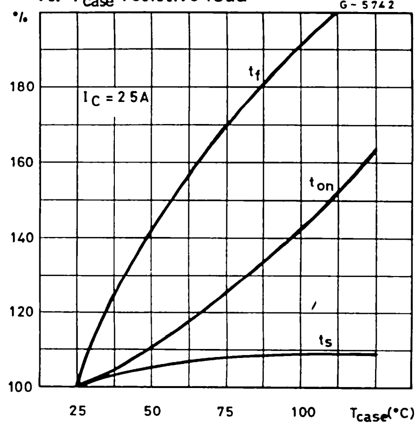
Switching times percentage variation vs. T_{case}



Saturated switching characteristics (test circuit fig. 1)



Switching time percentage variation vs. T_{case} resistive load



TEST CIRCUITS

Fig. 1

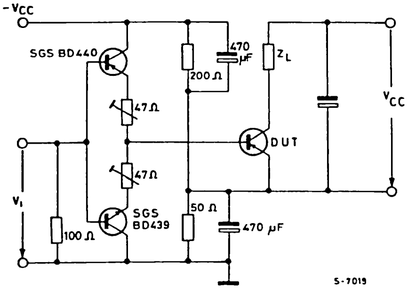
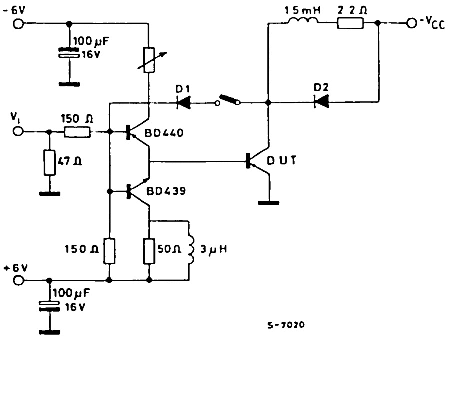


Fig. 2



BUT13
BUT13P

EPITAXIAL PLANAR NPN

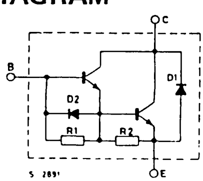
HIGH VOLTAGE, HIGH POWER, FAST SWITCHING

The BUT13 and BUT13P are a silicon epitaxial planar NPN Darlington transistors with i tegrated base-emitter speed-up diode, the BUT13 is mounted in Jedec TO-3 metal cas the BUT13P is mounted in SOT-93 plastic package (similar to TO-218). They are particularl suited for output stages in high power, fast switching applications.

ABSOLUTE MAXIMUM RATINGS

		BUT13	BUT13P
V_{CBO}	Collector-base voltage ($I_E = 0$)	600V	600V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	400V	400V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	10V	10V
I_C	Collector current	28A	28A
I_{CM}	Collector peak current ($t_p \leqslant 10ms$)	35A	35A
I_B	Base current	6A	6A
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	175W	150W
T_{stg}	Storage temperature	-65 to 200°C	-65 to 175°C
T_j	Junction temperature	200°C	175°C

INTERNAL SCHEMATIC DIAGRAM

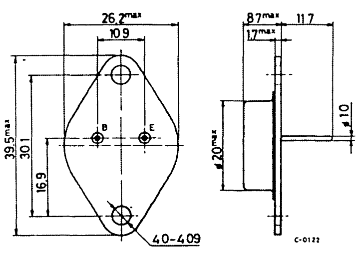


R1 = 250Ω
R2 = 500Ω

MECHANICAL DATA

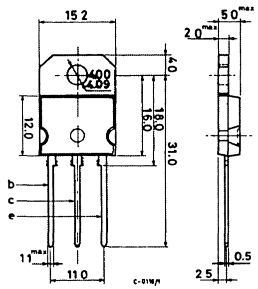
Dimension in mm

Collector connected to case



TO-3

Collector connected to tab



(sim. to TO-218) SOT-93

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max.	1	°C/W

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

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector cutoff current	V_{CE} = 600V V_{CE} = 600V T_{case} = 100°C			100 2	µA mA
I_{CEO}	Collector cutoff current (I_B = 0)	V_{CE} = 400V			1	mA
I_{EBO}	Emitter cutoff current (I_C = 0)	V_{BE} = 2V			20	mA
$V_{CEO(sus)}$	Collector cutoff sustaining voltage	I_C = 100mA	400			V
$V_{CE(sat)}$ *	Collector-emitter saturation voltage	I_C = 10A I_B = 0.5A I_C = 18A I_B = 1.8A I_C = 22A I_B = 2.2A I_C = 28A I_B = 5.6A		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 = 10A I_B = 0.5A I_C = 18A I_B = 1.8A I_C = 22A I_B = 2.2A		 2.5 	2.5 3 3.3	V V V
h_{FE}	DC current gain	I_C = 10A V_{CE} = 5V I_C = 18A V_{CE} = 5V	30 30	300 90		V V
V_F	Diode forward voltage	I_F = 22A		2.2	4	V

RESISTIVE SWITCHING TIMES

t_{on}	Turn-on time	V_{CC} = 250V I_C = 10A I_{B1} = 0.5A $V_{BE(off)}$ = -5V		0.5	0.6	µs
t_s	Storage time			1.1	1.5	µs
t_f	Fall time			0.3	0.6	µs

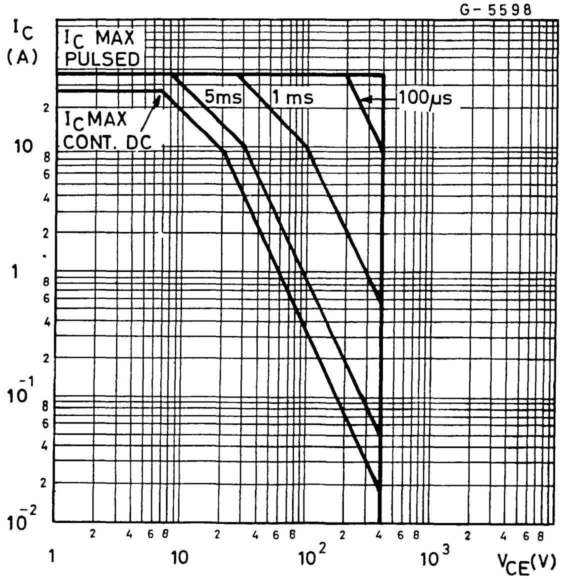
BUT13
BUT13P

ELECTRICAL CHARACTERISTICS (continued)

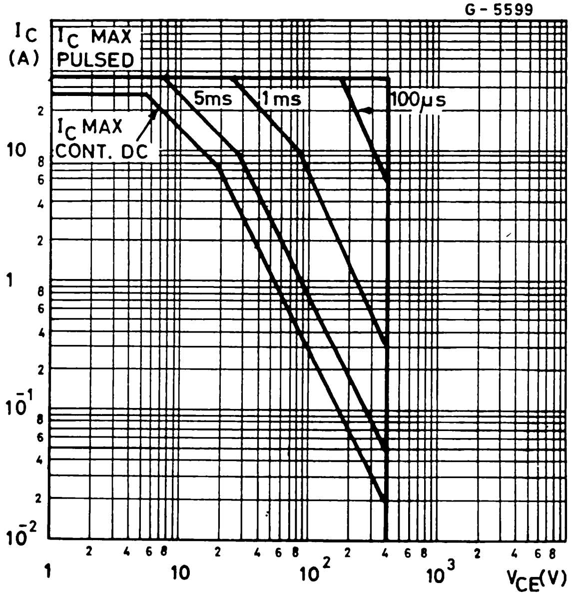
Parameter		Test conditions	Min.	Typ.	Max.	Unit
INDUCTIVE SWITCHING TIMES						
t_s	Storage time	$V_{Clamp} = 250V$ $I_C = 10A$ $I_{B1} = 0.2A$; $V_{BE\ (off)} = -5V$		1.3	2	μs
t_f	Fall time			0.11	0.5	μs
t_c	Crossover time			0.4	0.8	μs
t_s	Storage time	$V_{Clamp} = 250V$ $I_C = 20A$ $I_{B1} = 0.4A$; $V_{BE\ (off)} = -5V$		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 = 300μs, duty cycle = 1.5%

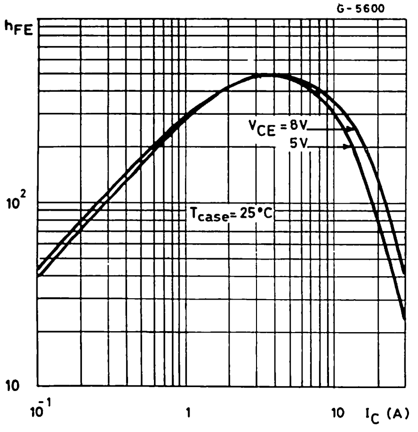
Safe operating areas (for BUT13)



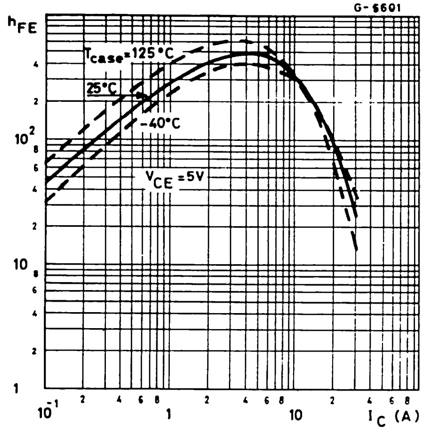
Safe operating areas
(for BUT13P)



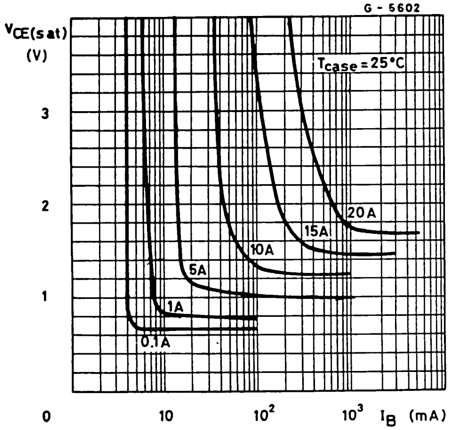
DC current gain



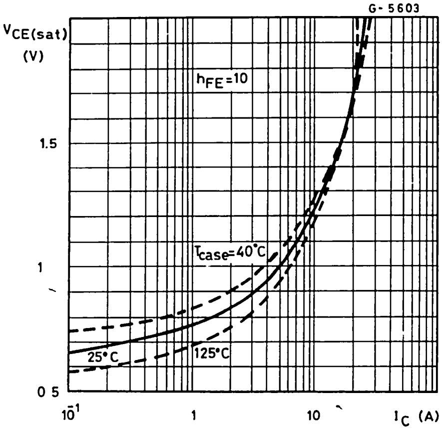
DC current gain



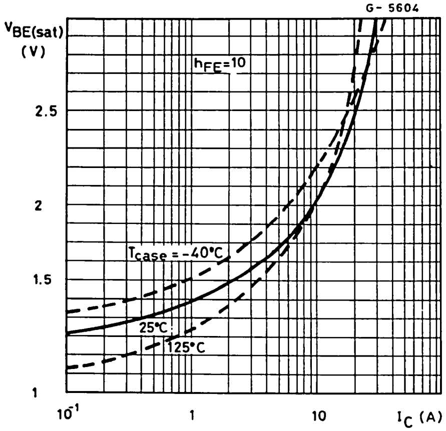
Collector-emitter saturation voltage



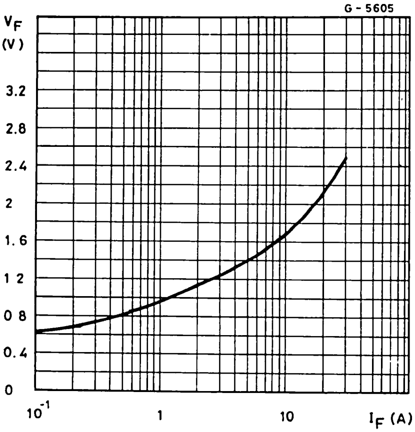
Collector-emitter saturation voltage



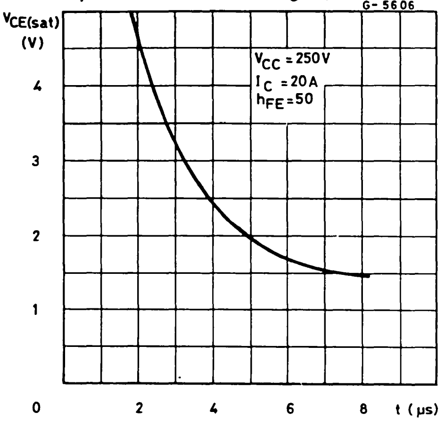
Base-emitter saturation voltage



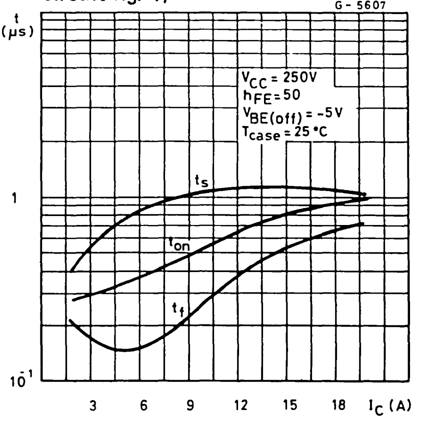
Freewheel diode forward voltage



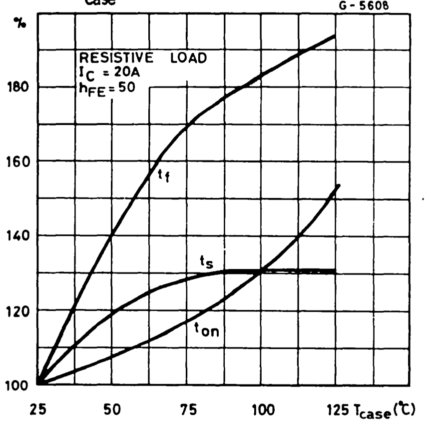
Collector-emitter saturation voltage dynamic (test circuit fig. 2)



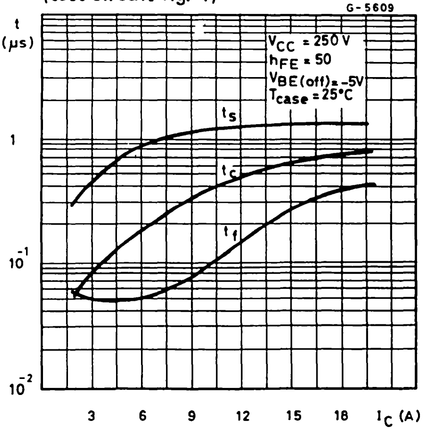
Switching times resistive load (test circuit fig. 1)



Switching times percentage variation vs. T_{case}

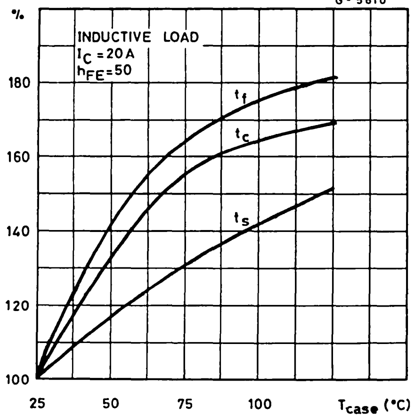


Switching times inductive load test (test circuit fig. 1)

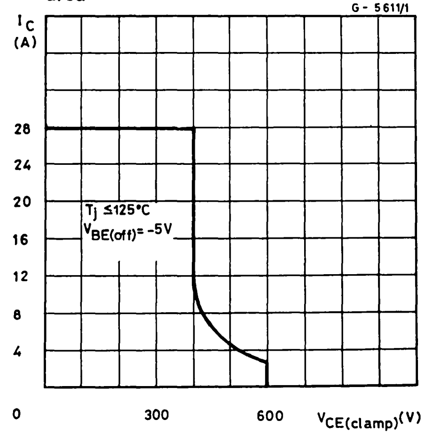


BUT13
BUT13P

Switching times percentage variation vs. T_{case}



Clamped reverse bias safe operating area



TEST CIRCUITS

Fig. 1

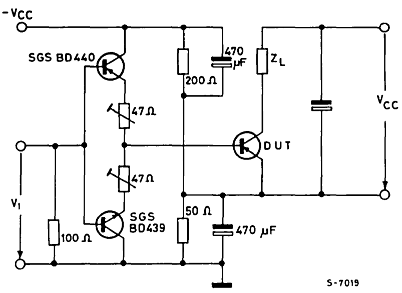
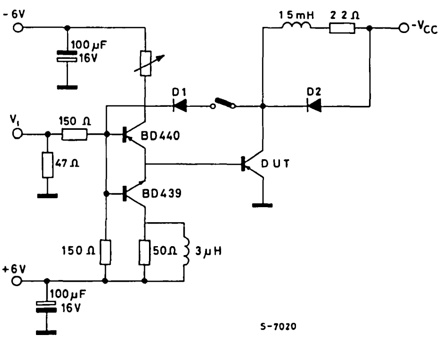


Fig. 2



MULTIEPITAXIAL PLANAR NPN

BUV20
BUV21
BUV22

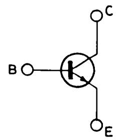
HIGH CURRENT POWER SWITCH

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.

ABSOLUTE MAXIMUM RATINGS

		BUV20	BUV21	BUV22
V_{CBO}	Collector-base voltage ($I_E = 0$)	160V	250V	300V
V_{CER}	Collector-emitter voltage ($R_{BE} = 100\Omega$)	150V	240V	290V
V_{CEX}	Collector-emitter voltage ($V_{BE} = -1.5V$)	160V	250V	300V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	125V	200V	250V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	7V	7V	7V
I_C	Collector current	50A	40A	40A
I_{CM}	Collector peak current	60A	50A	50A
I_B	Base current	10A	8A	8A
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$		250W	
T_{stg}	Storage temperature		-65 to 200°C	
T_j	Junction temperature		200°C	

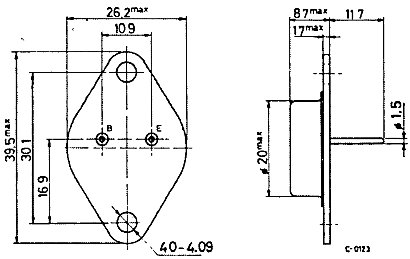
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

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)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B = 0$)	for **BUV20** $V_{CE} = 100V$ for **BUV21** $V_{CE} = 160V$ for **BUV22** $V_{CE} = 200V$			3 3 3	mA mA mA
I_{CEX}	Collector cutoff current ($V_{BE} = -1.5A$)	$V_{CE} = V_{CEX}$ 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 ($I_C = 0$)	$V_{EB} = 5V$			1	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 200mA$ $L = 25mH$ for **BUV20** for **BUV21** for **BUV22**	 125 200 250			 V V V
$V_{(BR)EBO}$*	Emitter-base breakdown voltage ($I_C = 0$)	$I_E = 50mA$	7			V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	for **BUV20** $I_C = 25A$ $I_B = 2.5A$ $I_C = 50A$ $I_B = 5A$ for **BUV21** $I_C = 12A$ $I_B = 1.2A$ $I_C = 25A$ $I_B = 3A$ for **BUV22** $I_C = 10A$ $I_B = 1A$ $I_C = 20A$ $I_B = 2.5A$		 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** $I_C = 50A$ $I_B = 5A$ for **BUV21** $I_C = 25A$ $I_B = 3A$ for **BUV22** $I_C = 40A$ $I_B = 4A$		 1.4 1.2 1.2	 2 1.5 1.5	 V V V

ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions		Min.	Typ.	Max.	Unit
h_{FE}*	DC current gain	for **BUV20**					
		$V_{CE} = 2V$	$I_C = 25A$	20		60	–
		$V_{CE} = 4V$	$I_C = 50A$	10			–
		for **BUV21**					
		$V_{CE} = 2V$	$I_C = 12A$	20		60	–
		$V_{CE} = 4V$	$I_B = 25A$	10			–
		for **BUV22**					
		$V_{CE} = 4V$	$I_C = 10A$	20		60	–
		$V_{CE} = 4V$	$I_C = 20A$	10			–
f_T	Transition frequency	$V_{CE} = 15V$ $f = 10MHz$	$I_C = 2A$	8			MHz
t_{on}	Turn-on time	for **BUV20**					
		$I_C = 50A$	$I_B = 5A$			1.5	μs
		for **BUV21**					
		$I_C = 25A$	$I_B = 3A$			1.2	μs
		for **BUV22**					
		$I_C = 20A$	$I_B = 2.5A$			1.3	μs
t_f	Fall time	for **BUV20**					
		$I_C = 50A$	$I_{B1} = -I_{B2} = 5A$			0.3	μs
		for **BUV21**					
		$I_C = 25A$	$I_{B1} = -I_{B2} = 3A$			0.4	μs
		for **BUV22**					
		$I_C = 20A$	$I_{B1} = -I_{B2} = 2.5A$			0.5	μs
t_s	Storage time	for **BUV20**					
		$I_C = 50A$	$I_{B1} = -I_{B2} = 5A$			1.2	μs
		for **BUV21**					
		$I_C = 25A$	$I_{B1} = -I_{B2} = 3A$			1.8	μs
		for **BUV22**					
		$I_C = 20A$	$I_{B1} = -I_{B2} = 2.5A$			2	μs

* Pulsed. pulse duration = 300 μs, duty cycle $\leqslant$ 2%.

BUV23
BUV24
BUV25

MULTIEPITAXIAL MESA NPN

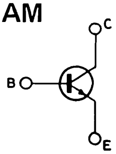
POWER SWITCH

The BUV23, BUV24 and BUV25 are silicon multiepitaxial mesa NPN transistors in Jedec TO-3 metal case, intended for use in power switching applications in military and industrial equipments.

ABSOLUTE MAXIMUM RATINGS

		BUV23	BUV24	BUV25
V_{CBO}	Collector-base voltate ($I_E = 0$)	400V	450V	500V
V_{CER}	Collector -emitter voltage ($R_{BE} = 100\Omega$)	390V	440V	500V
V_{CEX}	Collector-emitter voltage ($V_{BE} = -1.5V$)	400V	450V	500V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	325V	400V	500V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	7V	7V	7V
I_C	Collector current	30A	20A	15A
I_{CM}	Collector peak current ($t_p = 10ms.$)	40A	30A	20A
I_B	Base current	6A	4A	3A
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$		250W	
T_{stg}	Storage temperature		-65 to 200°C	
T_j	Junction temperature		200°C	

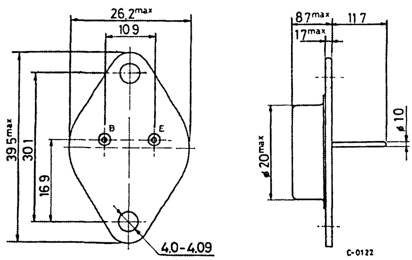
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

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)

Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B = 0$)	$V_{CE} = 260V$	for **BUV23**			3	mA
		$V_{CE} = 320V$	for **BUV24**			3	mA
		$V_{CE} = 400V$	for **BUV25**			3	mA
I_{CEX}	Collector cutoff current ($V_{BE} = -1.5V$)	$V_{CE} = V_{CEX}$				3	mA
		$T_{case} = 125°C$ $V_{CE} = V_{CEX}$				12	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$				1	mA
$V_{CE(sat)}$ *	Collector-emitter saturation voltage	for **BUV23**					
		$I_C = 8A$	$I_B = 1.6A$		0.2	0.8	V
		$I_C = 16A$	$I_B = 3.2A$		0.35	1	V
		for **BUV24**					
		$I_C = 6A$	$I_B = 1.2A$		0.15	0.6	V
		$I_C = 12A$	$I_B = 2.4A$		0.3	1	V
		for **BUV25**					
		$I_C = 4A$	$I_B = 0.8A$		0.2	0.6	V
		$I_C = 8A$	$I_B = 1.6A$		0.6	1	V
$V_{BE(sat)}$ *	Base-emitter saturation voltage	for **BUV23**					
		$I_C = 16A$	$I_B = 3.2A$		1.15	1.5	V
		for **BUV24**					
		$I_C = 12A$	$I_B = 2.4A$		1	1.15	V
		for **BUV25**					
		$I_C = 8A$	$I_B = 1.6A$		1.2	1.5	V
$V_{CEO(sus)}$ *	Collector-emitter sustaining voltage	$I_C = 200mA$	$L = 25mH$				
			for **BUV23**	325			V
			for **BUV24**	400			V
			for **BUV25**	500			V
$V_{(BR)EBO}$ *	Emitter-base breakdown voltage ($I_C = 0$)	$I_E = 50mA$		7			V
h_{FE} *	DC current gain	$V_{CE} = 4V$	for **BUV23**				
		$I_C = 8A$		15		60	—
		$I_C = 16A$		8			—
		$V_{CE} = 4V$	for **BUV24**				
		$I_C = 6A$		15		60	—
		$I_C = 12A$		8			—
		$V_{CE} = 4V$	for **BUV25**				
		$I_C = 4A$		15		60	—
		$I_C = 8A$		8			—

ELECTRICAL CHARACTERISTICS (continued)

	Parameter	Test conditions	Min.	Typ.	Max.	Unit
f_T	Transition frequency	$V_{CE} = 15V$ $I_C = 2A$ $f = 10MHz$	8			MHz
t_{on}	Turn-on time	for **BUV23** $I_C = 16A$ $I_B = 3.2A$		0.55	1.3	μs
		for **BUV24** $I_C = 12A$ $I_B = 2.4A$		0.6	1.6	μs
		for **BUV25** $I_C = 8A$ $I_B = 1.6A$		0.9	1.8	μs
t_f	Fall time	for **BUV23** $I_C = 16A; I_{B1} = -I_{B2} = 3.2A$		0.26	1.2	μs
		for **BUV24** $I_C = 12A; I_{B1} = -I_{B2} = 2.4A$		0.6	1.4	μs
		for **BUV25** $I_C = 8A; I_{B1} = -I_{B2} = 1.6A$		0.9	1.6	μs
t_s	Storage time	for **BUV23** $I_C = 16A; I_{B1} = -I_{B2} = 3.2A$		1.7	2.5	μs
		for **BUV24** $I_C = 12A; I_{B1} = -I_{B2} = 2.4A$		1.5	3	μs
		for **BUV25** $I_C = 8A; I_{B1} = -I_{B2} = 1.6A$		3.5	5	μs

* Pulsed: pulse duration = 300 μs, duty cycle $\leq$ 2%.

MULTIEPITAXIAL MESA NPN

BUV46

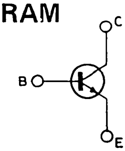
HIGH VOLTAGE POWER SWITCH

The BUV46 is a silicon multiepitaxial mesa NPN transistor in Jedec TO-220 plastic package, intended for high voltage, fast switching applications.

ABSOLUTE MAXIMUM RATINGS

V_{CES}	Collector-emitter voltage ($V_{BE} = 0$)	850	V
V_{CEX}	Collector-emitter voltage ($V_{BE} = -2.5V$)	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_B	Base current	3	A
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	85	W
T_{stg}	Storage temperature	-65 to 175	°C
T_j	Junction temperature	175	°C

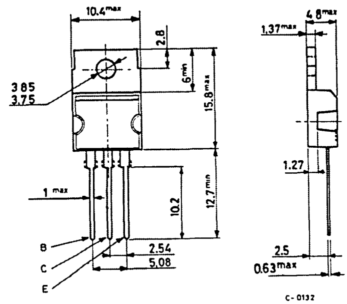
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

BUV46

THERMAL DATA

$R_{th\ j-case}$	Thermal resistance junction-case	max.	1.76	°C/W

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

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current ($V_{BE} = 0$)	$V_{CE} = 850V$ $V_{CE} = 850V$ $T_{case} = 125°C$			100 1	μA mA
I_{CER}	Collector cutoff current ($R_{BE} = 10\Omega$)	$V_{CE} = 850V$ $V_{CE} = 850V$ $T_{case} = 125°C$			300 2	μA mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 7V$			1	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage	$I_C = 100mA$	400			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	$I_C = 2.5A$ $I_B = 0.5A$ $I_C = 3.5A$ $I_B = 0.7A$			1.5 5	V V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	$I_C = 2.5A$ $I_B = 0.5A$			1.3	V
t_{on}	Turn-time	$I_C = 2.5A$ $V_{CC} = 150V$ $I_{B1} = -I_{B2} = 0.5\ A$			1	μs
t_s	Storage time				3	μs
t_f	Fall time				0.8	μs

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

MULTIEPITAXIAL MESA NPN

BUV47 BUV47A
BUX47 BUX47A

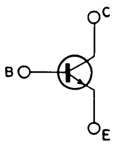
HIGH VOLTAGE POWER SWITCH

The BUV47, BUV47A, BUX47, and BUX47A are silicon multiepitaxial mesa NPN transistors respectively in SOT-93 and TO-3 package.
They are intended for high voltage, fast switching applications.

ABSOLUTE MAXIMUM RATINGS

	SOT-93 TO-3	BUV47 BUX47	BUV47A BUX47A
V_{CBO}	Collector base voltage ($I_E=0$)	850V	1000V
V_{CEO}	Collector-emitter voltage ($I_B=0$)	400V	450V
V_{CES}	Collector-emitter voltage ($V_{BE}=0$)	850V	900V
V_{EBO}	Emitter-base voltage ($I_C=0$)	7V	
I_C	Collector current	9A	
I_{CM}	Collector peak current ($t_p \leqslant 5ms$)	15A	
I_B	Base current	8A	
I_{BM}	Base peak current ($t_p \leqslant 5ms$)	10A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	120W (SOT-93) 125W (TO-3)	
T_{stg}	Storage temperature	-65 to 175°C	
T_j	Junction temperature	175°C	

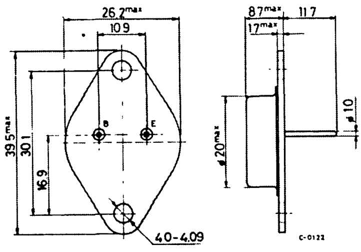
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

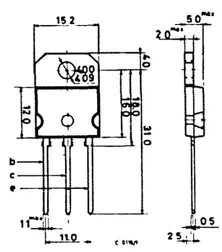
Dimensions in mm

Collector connected to case



TO-3

Collector connected tab.



(sim. to TO-218) SOT-93

THERMAL DATA

			SOT-93	TO-3
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1.25	1.20

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

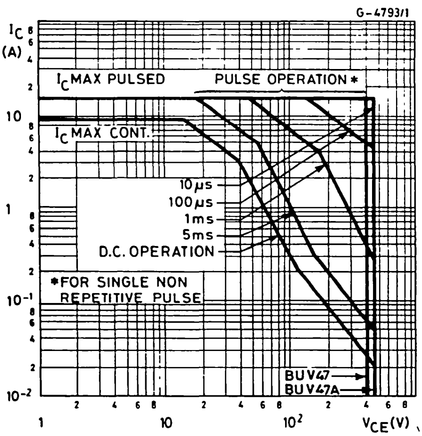
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector cutoff current ($R_{BE}=10\Omega$)	$V_{CE}=850V$ $V_{CE}=850V$ $T_{case}=125°C$			0.4 3	mA mA
I_{CEV}	Collector cutoff current ($V_{BE}=-2.5V$)	for **BUV47, BUV47A** $V_{CE}=850V$ $V_{CE}=850V$ $T_{case}=125°C$			 0.15 1.5	 mA mA
I_{CES}	Collector cutoff current ($V_{BE}=0$)	for **BUX47, BUX47A** $V_{CE}=850V$ $V_{CE}=850V$ $T_{case}=125°C$			 0.15 1.5	 mA mA
I_{EBO}	Emitter cutoff current ($I_C=0$)	$V_{EB}=5V$ for **BUV47, BUV47A** $V_{EB}=7V$ for **BUX47, BUX47A**			1 1	mA mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B=0$)	$I_C=0.2A$ $L=25mH$ for **BUV47, BUX47** for **BUV47A, BUX47A**	 400 450			 V V
V_{EBO}	Emitter-base voltage ($I_C=0$)	$I_E=50mA$ for **BUV47, BUV47A**	 7		 30	 V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	for **BUX47A, BUV47A** $I_C=5A$ $I_B=1A$ $I_C=8A$ $I_B=2.5A$ for **BUX47, BUV47** $I_C=6A$ $I_B=1.2A$ $I_C=9A$ $I_B=3A$			 1.5 3 1.5 3	 V V V V
$V_{BE(sat)}$*	Base-emmitter saturation voltage	for **BUX47A, BUV47A** $I_C=5A$ $I_B=1A$ for **BUX47, BUV47** $I_C=6A$ $I_B=1.2A$			 1.6 1.6	 V V

ELECTRICAL CHARACTERISTICS (Continued)

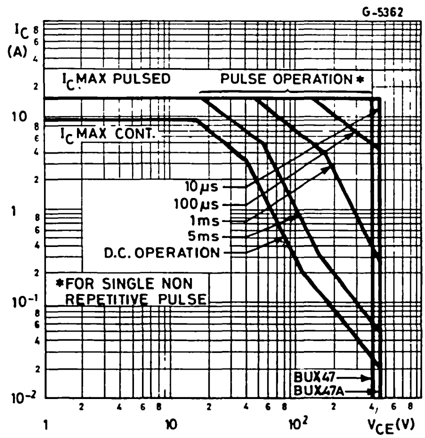
Parameter		Test conditions	Min. Typ. Max.	Unit
RESISTIVE SWITCHING TIMES (See fig. 1)				
t_{on}	Turn-on time	for **BUX47A, BUV47A** $I_C = 5A$ $V_{CC} = 150V$ $I_{B1} = -I_{B2} = 1A$	0.7	μs
t_s	Storage time		3	μs
t_f	Fall time		0.8	μs
t_{on}	Turn-on time	for **BUX47, BUV47** $I_C = 6A$ $V_{CC} = 150V$ $I_{B1} = -I_{B2} = 1.2A$	0.8	μs
t_s	Storage time		2.5	μs
t_f	Fall time		0.8	μs
INDUCTIVE SWITCHING TIMES (See fig. 2)				
t_f	Fall time	$I_C = 5A$ $I_{B1} = 1A$ $V_{BE} = 5V$ $V_{CC} = 300V$ $L = 3\mu H$ $T_j = 100°C$	0.5	μs

* Pulsed: pulse duration $\leqslant 300\mu s$, duty cycle $\leqslant 1.5\%$.

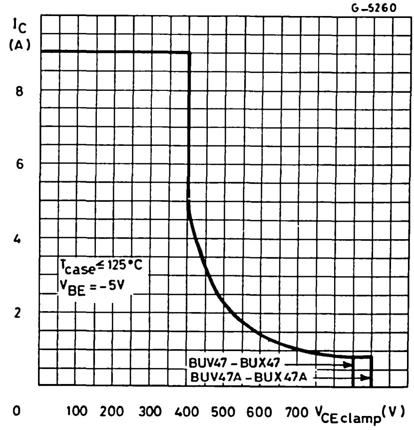
Safe operating areas



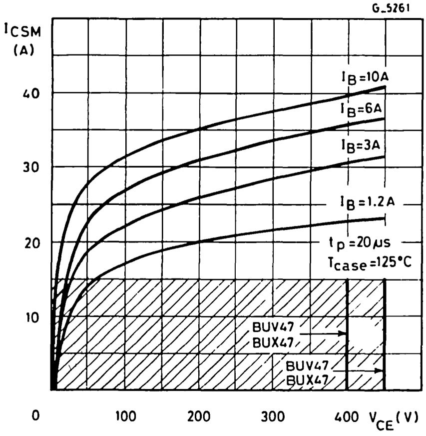
Safe operating areas



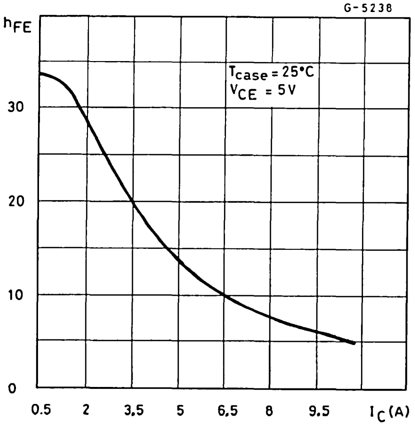
Clamped reverse bias safe operating areas



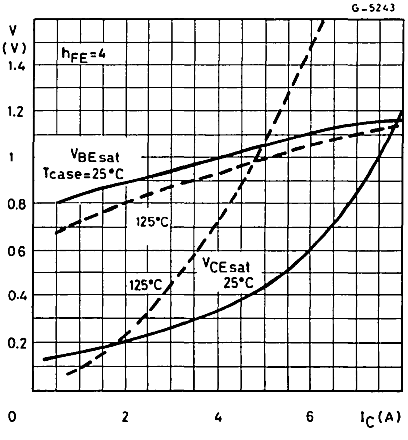
Forward biased accidental overload area (See fig. 3)



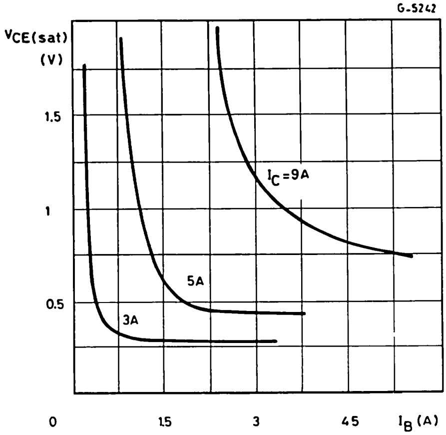
DC current gain



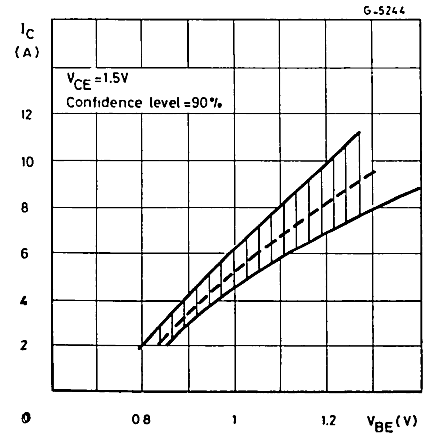
Saturation voltage



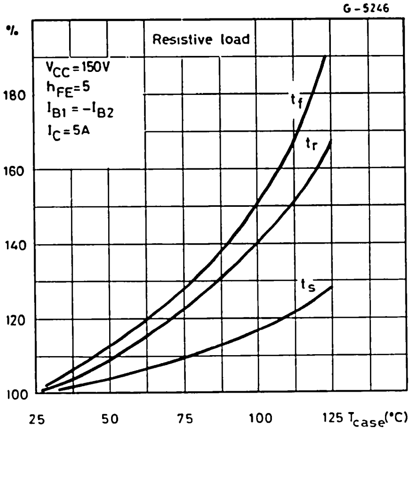
Collector—emitter saturation voltage



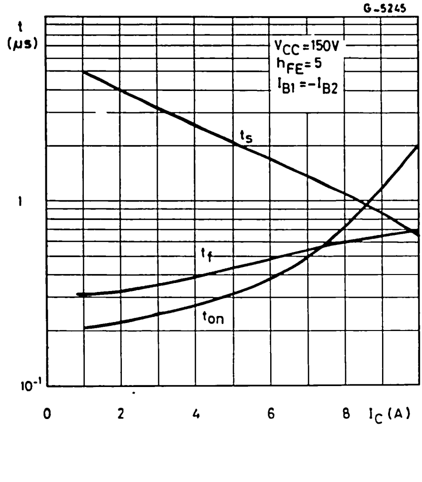
Collector current spread vs. base emitter voltage



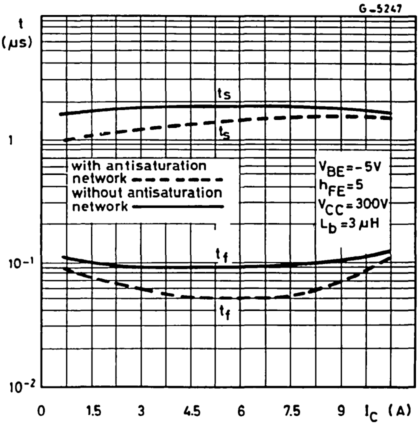
Switching times percentage variation vs. case temperature



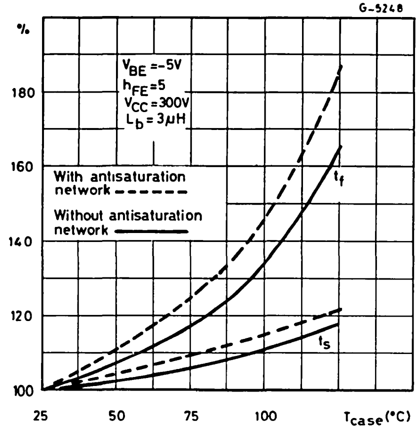
Switching times inductive load (See fig. 1)



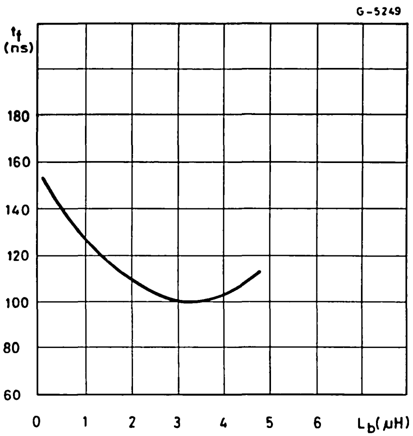
Switching times inductive load (See fig. 2)



Switching times inductive load vs. case temperature



Fall times vs. L_b (See fig. 2)



Dynamic collector-emitter saturation voltage (See fig. 4)

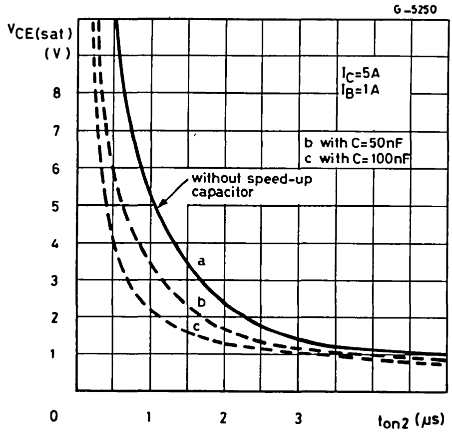


Fig. 1 - Switching times test circuit on resistive load

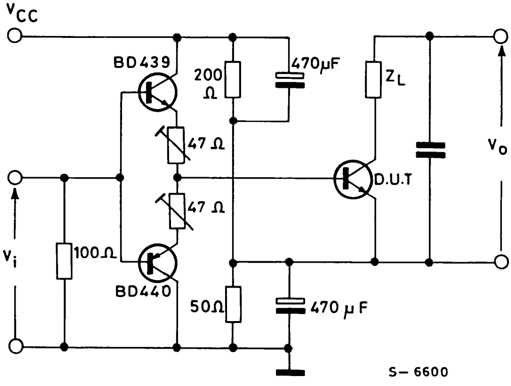
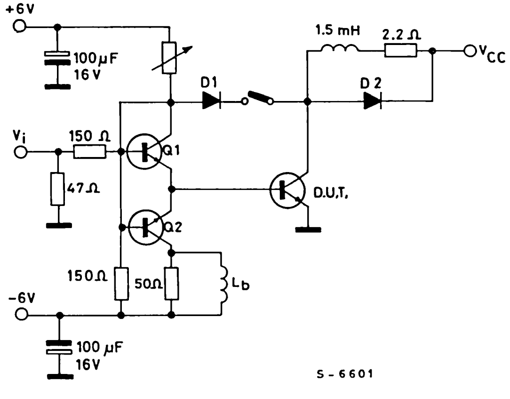


Fig. 2 - Switching times test circuit on inductive load.
With and without antisaturation network.



D1,D2: Fast recovery diodes
Q1,Q2: Transistors SGS 2N5191, 2N5195

Fig. 3 - Forward biased accidental overload area test circuit.

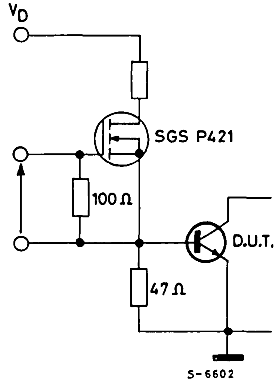


Fig. 4 - $V_{CE(sat)}$ dyn. test circuit.

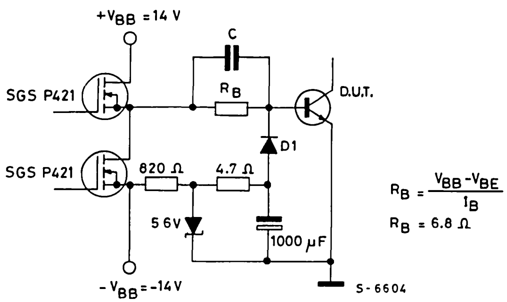


Fig. 5 - Equivalent input schematic circuit at turn-on.

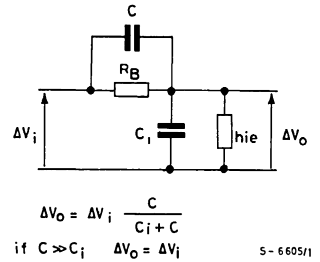
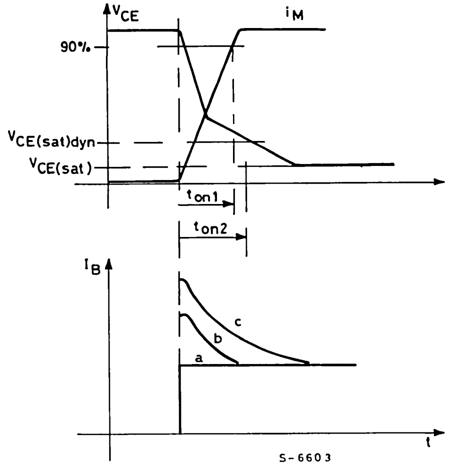


Fig. 6 - Remarks to $V_{CE(sat)}$ dyn. test circuit (fig. 4)



The speed-up capacitor decreases the $V_{CE\ (sat)}$ dyn. as shown in diagram (figure 6).
The 50nF capacitor modifies the shape of base current with a overshoot.

BUV48 BUV48A
BUX48 BUX48A

MULTIEPITAXIAL MESA NPN

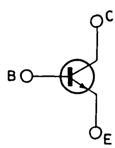
HIGH VOLTAGE POWER SWITCH

The BUX48, BUX48A, BUV48 and BUV48A are multiepitaxial mesa NPN in TO-3 and SOT-93 (TO-218) case, particularly intended for switching applications directly from mains.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	BUX48	BUX48A	BUV48	BUV48A
V_{CES}	Collector-emitter voltage ($V_{BE}=0$)	850V	1000V	850V	1000V
V_{CER}	Collector-emitter voltage ($R_{BE}=10\Omega$)	850V	1000V	850V	1000V
V_{CEO}	Collector-emitter voltage ($I_B=0$)	400V	450V	400V	450V
V_{EBO}	Emitter-base voltage ($I_C=0$)	7V			
I_C	Collector current	15A			
I_{CM}	Collector peak current ($t_p \leqslant 5ms$)	30A			
I_{CP}	Collector peak current non rep. ($t_p \leqslant 20\mu s$)	55A			
I_B	Base current	4A			
I_{BM}	Base peak current ($t_p \leqslant 5ms$)	20A			
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	175W		150W	
T_{stg}	Storage temperature	-65 to 200°C		-65 to 175°C	
T_j	Junction temperature	200°C		175°C	

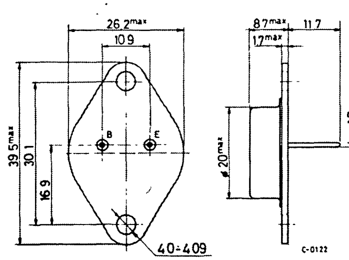
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

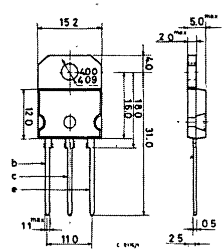
Dimensions in mm

Collector connected to case



TO-3

Collector connected tab.



(sim. to TO-218) SOT-93

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1	°C/W

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

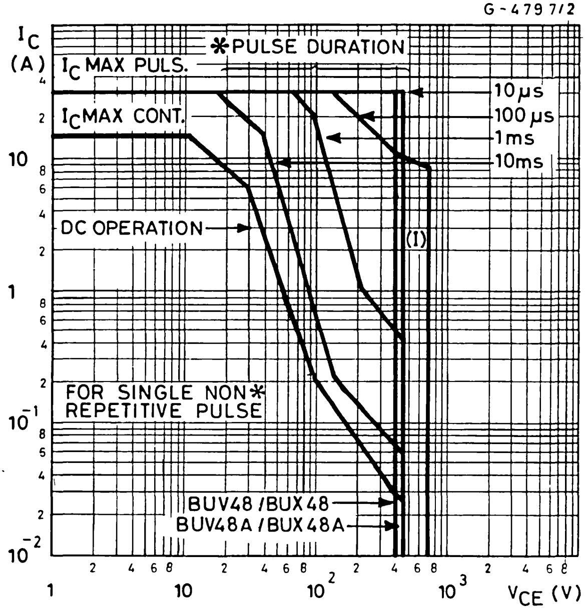
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current ($V_{BE} = 0$)	V_{CE} = rated V_{CES} same, $T_{case} = 125°C$			200 2	μA mA
I_{CER}	Collector cutoff current ($R_{BE} = 10\Omega$)	V_{CE} = rated V_{CER} same, $T_{case} = 125°C$			500 4	μA mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$			1	mA
$V_{CEO(sus)}$	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 200mA$ $L = 25mH$ for **BUX48, BUV48** for **BUX48A, BUV48A**	 400 450			 V V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	$I_E = 50mA$	7		30	V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	for **BUX48, BUV48** $I_C = 10A$ $I_B = 2A$ $I_C = 15A$ $I_B = 4A$ $I_C = 15A$ $I_B = 3A$ for **BUX48A, BUV48A** $I_C = 8A$ $I_B = 1.6A$ $I_C = 12A$ $I_B = 2.4A$			 1.5 3.5 5 1.5 5	 V V V V V
$V_{BE(sat)}$	Base-emitter saturation voltage	for **BUX48, BUV48** $I_C = 10A$ $I_B = 2A$ for **BUX48A,BUV48A** $I_C = 8A$ $I_B = 1.6A$			 1.6 1.6	 V V

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

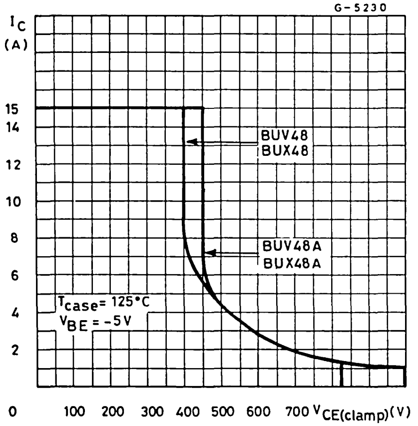
ELECTRICAL CHARACTERISTICS (Continued)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
RESISTIVE SWITCHING TIMES (See fig. 2)						
t_{on}	Turn-on time	for **BUX48, BUV48**				
		$V_{CC}=150V$ $I_C=10A$				
		$I_{B1}=2A$			1	μs
		for **BUX48A, BUV48A**				
		$V_{CC}=150V$ $I_C=8A$				
		$I_{B1}=1.6A$			1	μs
t_s	Storage time	for **BUX48, BUV48**				
		$V_{CC}=150V$ $I_C=10A$				
		$I_{B1}=-I_{B2}=2A$			3	μs
		for **BUX48A, BUV48A**				
		$V_{CC}=150V$ $I_C=8A$				
		$I_{B1}=-I_{B2}=1.6A$			3	μs
t_f	fall time	for **BUX48, BUV48**				
		$V_{CC}=150V$ $I_C=10A$				
		$I_{B1}=-I_{B2}=2A$			0.8	μs
		for **BUX48A, BUV48A**				
		$V_{CC}=150V$ $I_C=8A$				
		$I_{B1}=-I_{B2}=1.6A$			0.8	μs
INDUCTIVE SWITCHING TIMES (See fig. 1)						
t_s	Storage time	for **BUX48, BUV48**				
		$V_{CC}=300V$, $I_C=10A$, $L_B=3\mu H$				
		$V_{BE}=-5V$, $I_{B1}=2A$		2.7		μs
		same $T_{case}=100°C$			5	μs
		for **BUX48A, BUV48A**				
		$V_{CC}=300V$, $I_C=8A$, $L_B=3\mu H$				
		$V_{BE}=-5V$, $I_{B1}=1.6A$		3		μs
		same, $T_{case}=100°C$			5	μs
t_f	Fall time	for **BUX48, BUV48**				
		$V_{CC}=300V$, $I_C=10A$, $L_B=3\mu H$				
		$V_{BE}=-5V$, $I_{B1}=2A$		0.16		μs
		same, $T_{case}=100°C$			0.4	μs
		for **BUX48A, BUV48A**				
		$V_{CC}=300V$, $I_C=8A$, $L_B=3\mu H$				
		$V_{BE}=-5V$, $I_{B1}=1.6A$		0.13		μs
		same, $T_{case}=100°C$			0.4	μs

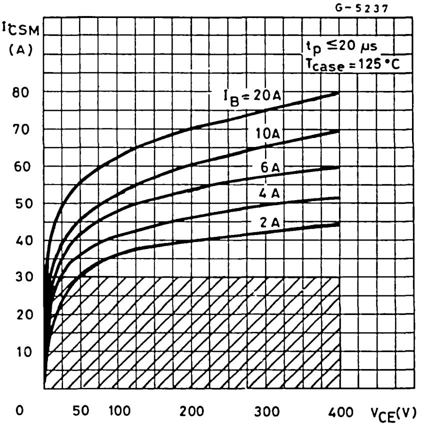
Safe operating areas



Clamped reverse bias safe operating areas

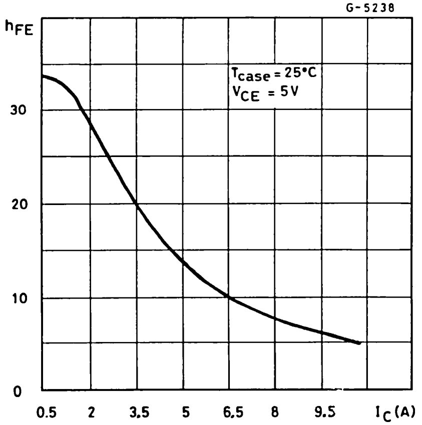


Forward biased accidental overload area (See fig. 3)

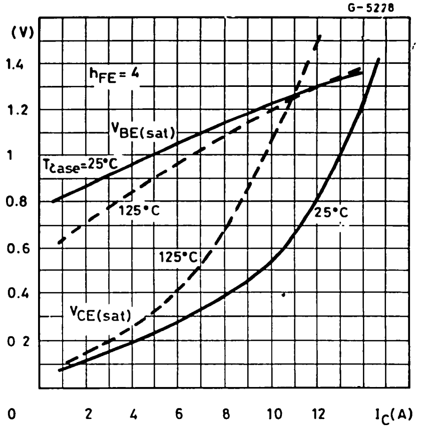


BUV48 BUV48A
BUX48 BUX48A

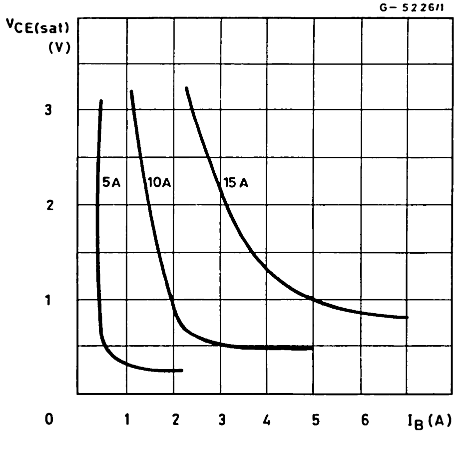
DC current gain



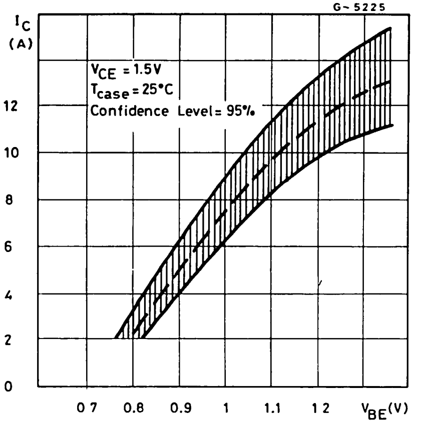
Saturation voltages



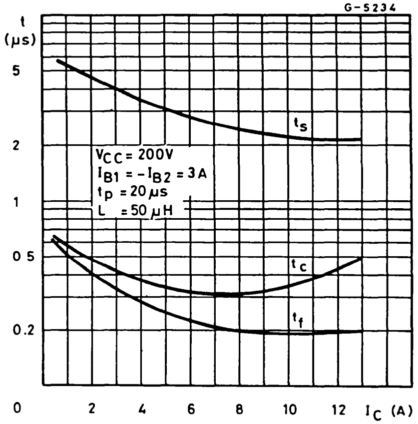
Collector-emitter saturation voltage



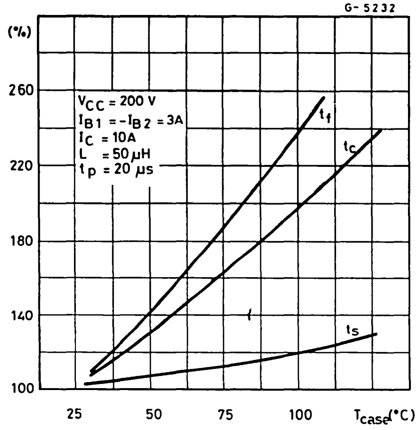
Collector current spread vs. base emitter voltage



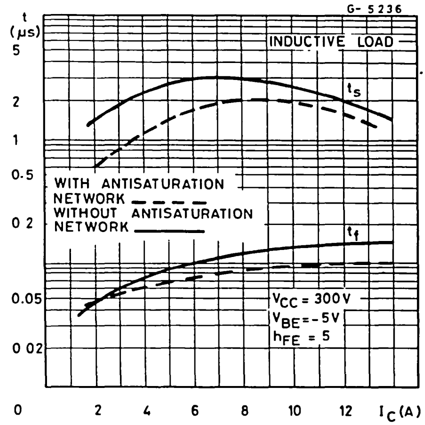
Switching times vs. collector current with I_B constant



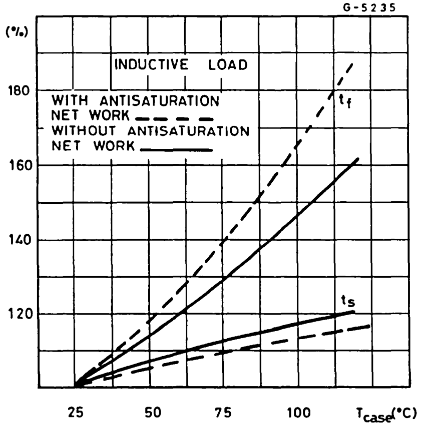
Switching times percentage variation vs. case temperature



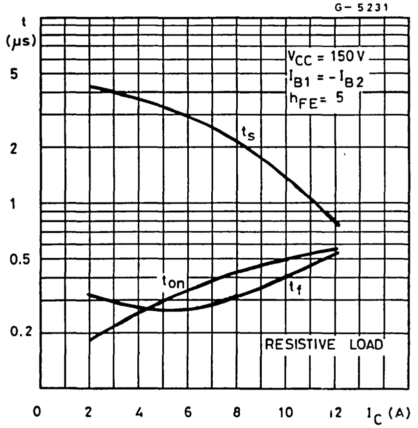
Switching times with and withour antisaturation network (See fig. 1)



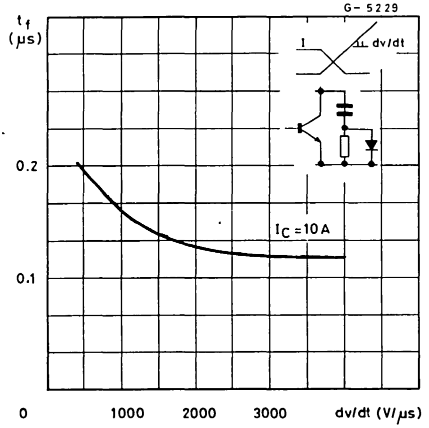
Switching times percentage vs. case temperature



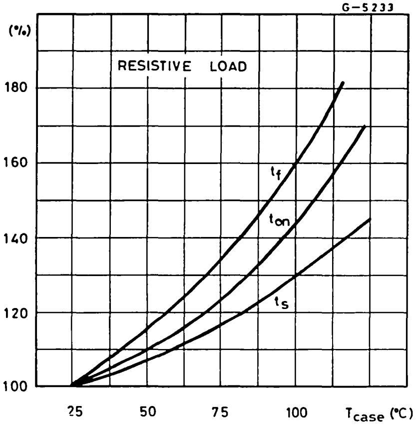
Switching times vs. collector current (See fig. 2)



Fall time vs. voltage slope (See fig. 2)



Switching times percentage variation vs. case temperature



Dynamic collector-emitter saturation voltage (See fig. 4)

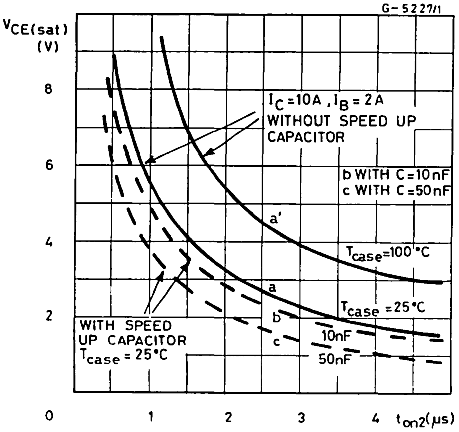
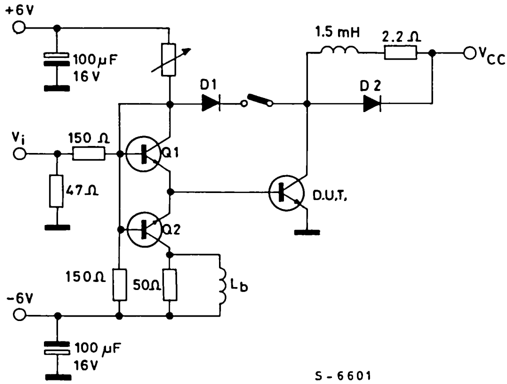


Fig. 1 - Switching times test circuit on inductive load, with and without antisaturation network



D1, D2 - Fast recovery diodes
Q1, Q2 - Transistors SGS: 2N5191, 2N5195

Fig. 2 - Switching times test circuit on resistive load.

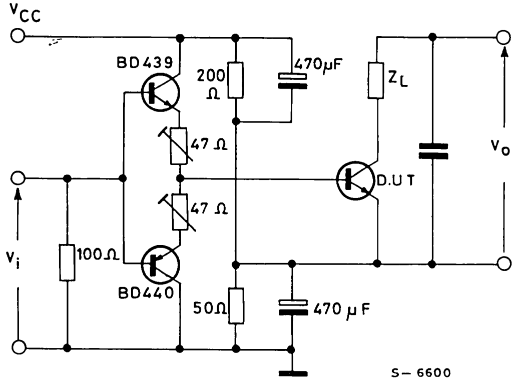


Fig. 3 - Forward biased accidental overload area test circuit.

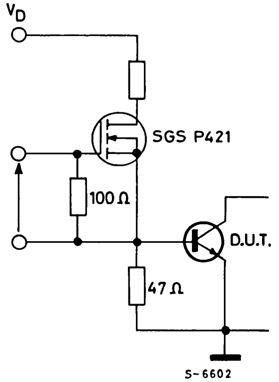


Fig. 4 - $V_{CE(sat)}$ dyn. test circuit.

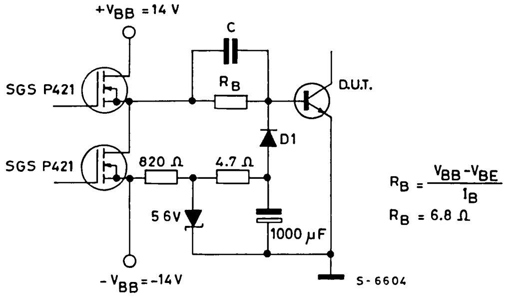


Fig. 5 - Equivalent input schematic circuit at turn-on.

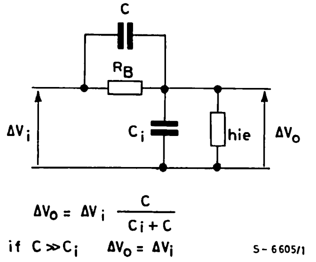
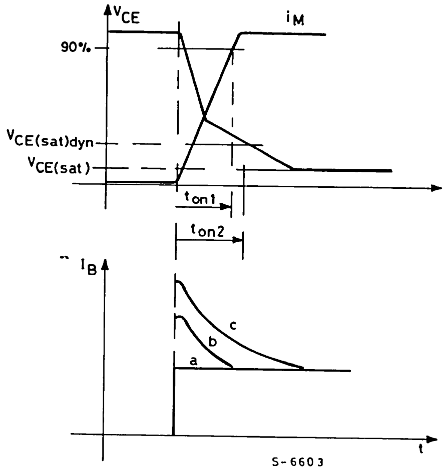


Fig. 6 - Remarks to $V_{CE(sat)}$ dyn. test circuit (fig. 4)



The speed-up capacitor decreases the $V_{CE\ (sat)}$ dyn. as shown in diagram (figure 6). The 50nF capacitor modifies the shape of base current with a overshoot.

BUV48B BUX48B
BUV48C BUX48C

MULTIEPITAXIAL MESA NPN

PRELIMINARY DATA

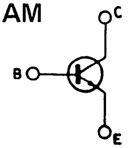
HIGH VOLTAGE POWER SWITCHING

The BUV48B, BUV48C, BUX48B and BUX48C are multiepitaxial mesa NPN in SOT-93 (TO-218) or TO-3 case, particulary intended for switching and industrial applications from single and three-phase mains.

ABSOLUTE MAXIMUM RATINGS

	SOT-93 TO-3	BUV48B BUX48B	BUV48C BUX48C
V_{CBO}	Collector-base voltage ($I_E = 0$)	1200V	1200V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	600V	700V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	7V	
I_C	Collector current	15A	
I_{CM}	Collector peak current ($t_p < 5ms$)	30A	
I_{CP}	Collector peak current non repet. ($t_p \leqslant 25\mu s$)	55A	
I_B	Base current	4A	
I_{BM}	Base peak current ($t_p < 5ms$)	20A	
P_{tot}	Total power dissipation at $T_{amb} = 25°C$	150W	175W
T_{stg}	Storage temperature	-65 to 175°C	-65 to 200°C
T_j	Junction temperature	175°C	200°C

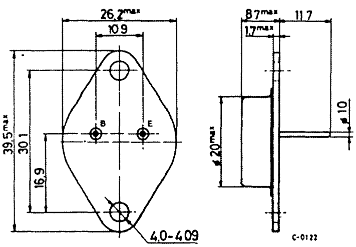
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

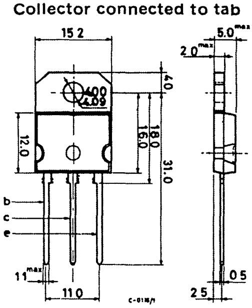
Dimension in mm

Collector connected to case



TO-3

Collector connected to tab



(sim. to **TO-218**) **SOT-93**

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max.	1	°C/W

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

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector cutoff current ($R_{BE}=10\Omega$)	$V_{CE}=1200V$ $V_{CE}=1200V$ $T_{case}=125°C$			500 4	μA mA
I_{CES}	Collector cutoff current ($V_{BE}=0$)	$V_{CE}=1200V$ $V_{CE}=1200V$ $T_{case}=125°C$			500 3	μA mA
I_{CEO}	Collector cutoff current ($I_B=0$)	$V_{CE}=V_{CEO}$			1	mA
I_{EBO}	Emitter cutoff current ($I_C=0$)	$V_{EB}=6V$			1	mA
$V_{CEO\,(sus)}$*	Collector-emitter sustaining voltage ($I_B=0$)	$I_C=100mA$ for **BUV48B/BUX48B** for **BUV48C/BUX48C**	 600 700			V
$V_{CER(sus)}$*	Collector-emitter sustaining voltage ($R_{BE}=10\Omega$)	$I_C=0.5A$ $V_{clamp}=1200V$ $L=2mH$	1200			V
$V_{CE\,(sat)}$*	Collector-emitter saturation voltage	$I_C=6A$ $I_B=1.5A$ $I_C=10A$ $I_B=4A$			1.5 3	V V
$V_{BE\,(sat)}$*	Base-emitter saturation voltage	$I_C=6A$ $I_B=1.5A$ $I_C=10A$ $I_B=4A$			1.5 2	V V

ELECTRICAL CHARACTERISTICS (continued)

RESISTIVE SWITCHING TIMES

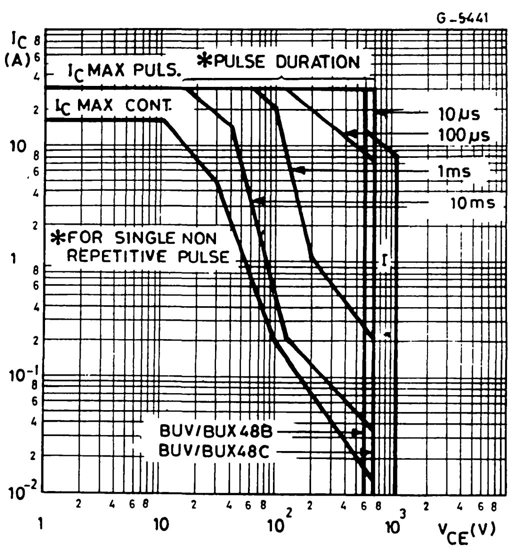
Parameter		Test conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on time	$V_{CC}=250V$ $I_C=6A$ $I_{B1}=-I_{B2}=1.5A$		0.5	1	μs
t_s	Storage time			1.5	3	μs
t_f	Fall time			0.2	0.7	μs

INDUCTIVE SWITCHING TIMES

Parameter		Test conditions	Min.	Typ.	Max.	Unit
t_s	Storage time	$V_{CC}=250V$ $I_C=6A$ $I_{B1}=-I_{B2}=1.5A$		2		μs
t_f	Fall time			0.15		μs
t_s	Storage time	Same conditions $T_{case}=125°C$		3	6	μs
t_f	Fall time			0.33	0.60	μs

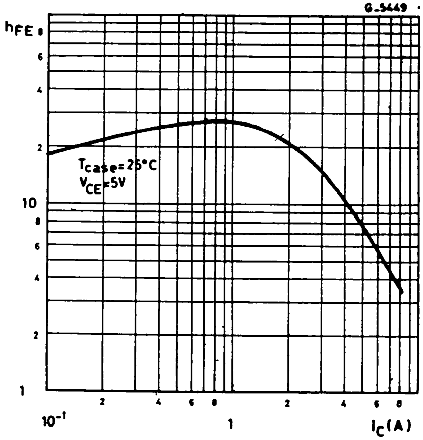
* Pulsed: Pulse duration = 300μs, duty cycle = 1.5%

Safe operating areas

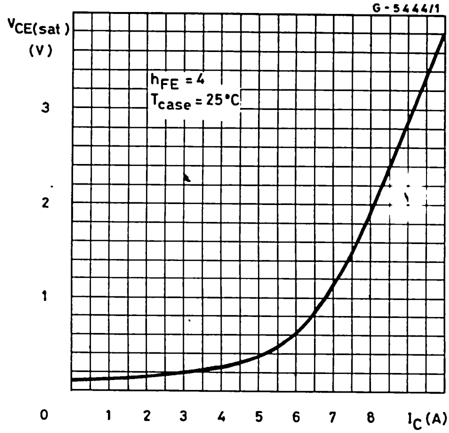


I - Area of permissible operation during turn-on provided $R_{BE} \leqslant 100\Omega$ and tp $\leqslant$: 0.25μs

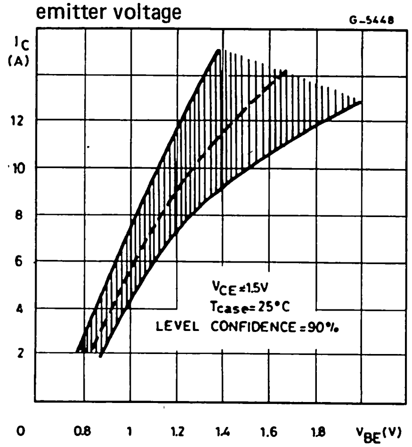
DC current gain



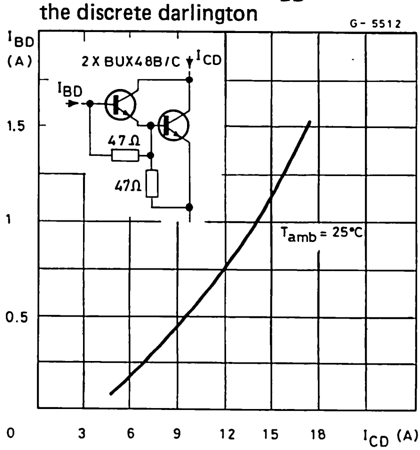
Collector-emitter saturation voltage



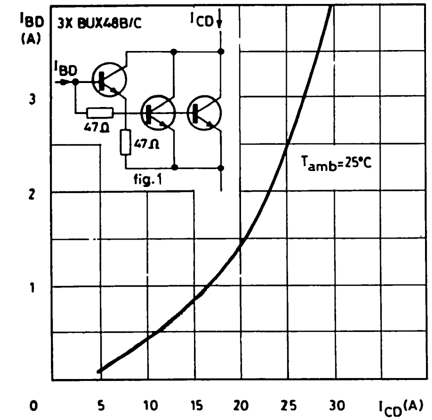
Collector current spread vs. base emitter voltage



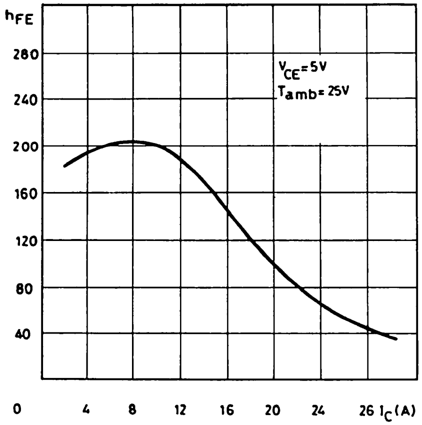
Minimum base current I_{BD} to saturate the discrete darlington



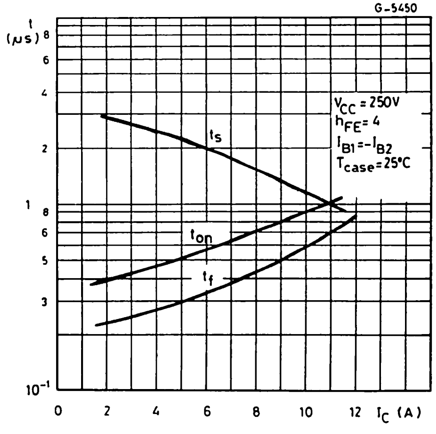
Minimum base current I_{BD} to saturate the discrete darlington



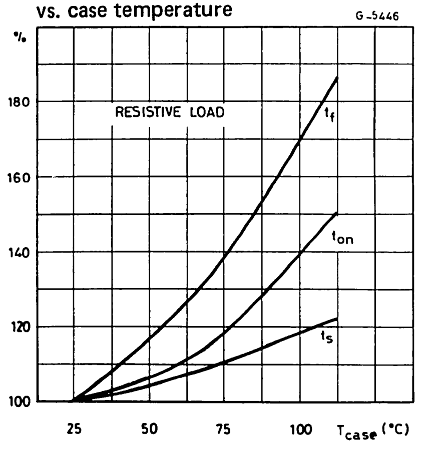
DC current gain for darlington configuration (see fig. 1)



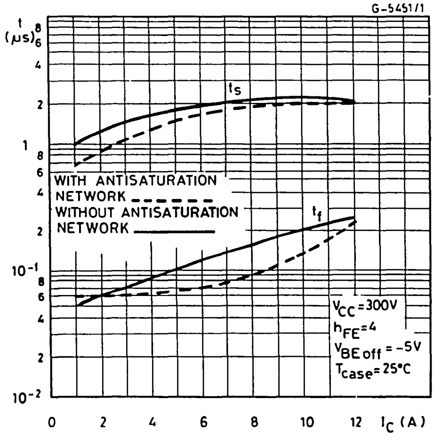
Switching times resistive load



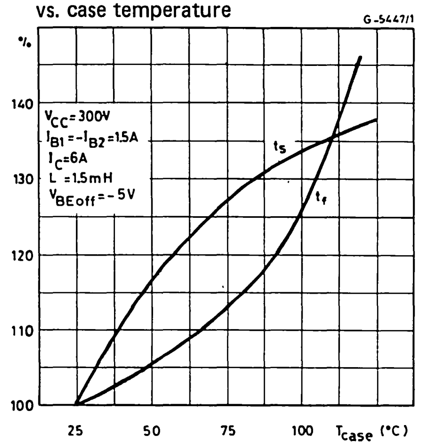
Switching times percentage variation vs. case temperature



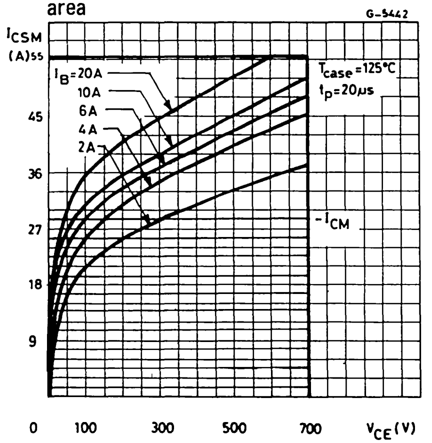
Switching times inductive load



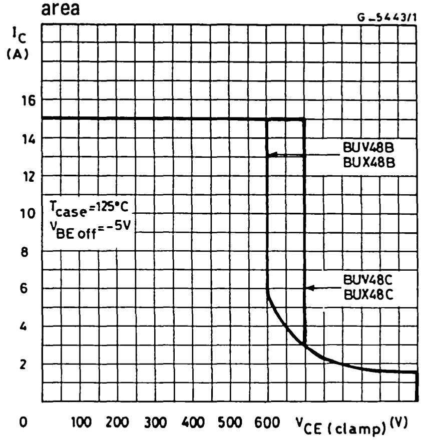
Switching times percentage variation vs. case temperature



Forward biased accidental overload area



Clamped reverse biased safe operating area



BUW11
BUW11A

MULTIEPITAXIAL MESA NPN

ADVANCE DATA

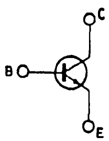
HIGH VOLTAGE POWER SWITCH

The BUW11 and BUW11A are silicon multiepitaxial mesa NPN transistor in SOT-93 plastic package, particularly intended for switching applications

ABSOLUTE MAXIMUM RATINGS

<table>
<tr><th></th><th></th><th>BUW11</th><th>BUW11A</th></tr>
<tr><td>V_{CES}</td><td>Collector-emitter voltage ($V_{BE} = 0$)</td><td>850V</td><td>1000V</td></tr>
<tr><td>V_{CEO}</td><td>Collector-emitter voltage ($I_B = 0$)</td><td>400V</td><td>450V</td></tr>
<tr><td>V_{EBO}</td><td>Emitter-base voltage ($I_C = 0$)</td><td colspan="2">9A</td></tr>
<tr><td>I_C</td><td>Collector current</td><td colspan="2">5A</td></tr>
<tr><td>I_{CM}</td><td>Collector peak current (tp $\leqslant$ 5ms)</td><td colspan="2">10A</td></tr>
<tr><td>I_B</td><td>Base current</td><td colspan="2">2A</td></tr>
<tr><td>I_{BM}</td><td>Base peak current (tp $\leqslant$ 5ms)</td><td colspan="2">4A</td></tr>
<tr><td>P_{tot}</td><td>Total power dissipation at $T_{case} = 25°C$</td><td colspan="2">113W</td></tr>
<tr><td>T_{stg}</td><td>Storage temperature</td><td colspan="2">-65 to 175°C</td></tr>
<tr><td>T_j</td><td>Junction temperature</td><td colspan="2">175°C</td></tr>
</table>

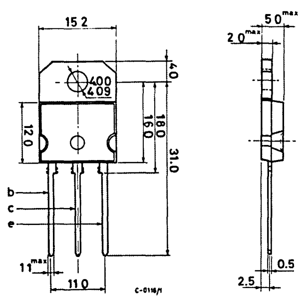
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



(sim. to **TO-218**) **SOT-93**

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)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current ($V_{BE} = 0$)	V_{CE} = rated V_{CES} $T_{case} = 125°C$			1 2	mA mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{BE} = 9V$			10	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage	$I_{B\ off} = 0$ $I_C = 100mA$ for **BUW11** for **BUW11A**	 400 450			 V V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	$I_C = 3A$ $I_B = 0.6A$ for **BUW11** $I_C = 2.5A$ $I_B = 0.5A$ for **BUW11A**			 1.5 1.5	 V V V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	$I_C = 3A$ $I_B = 0.6A$ for **BUW11** $I_C = 2.5A$ $I_B = 0.5A$ for **BUW11A**			 1.3 1.3	 V V
t_{on}	Turn-on time	$I_C = 2.5A$ $V_{CC} = 250V$			1	ns
t_s	Storage time	$I_{B1} = -I_{B2} = 0.5A$			4	μs
t_f	Fall time				0.8	μs

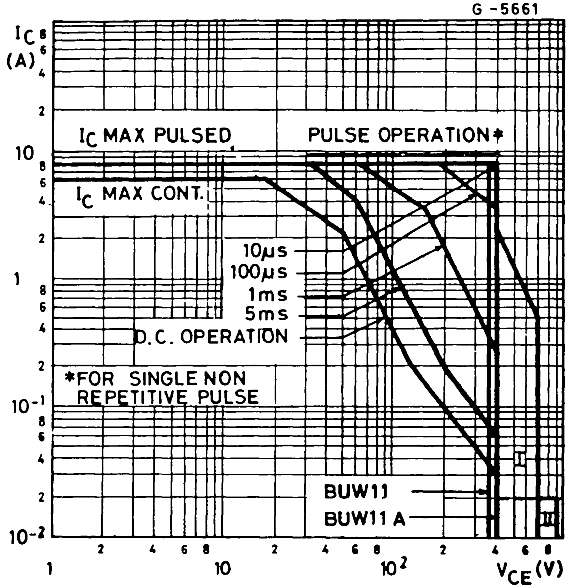
* Pulsed: pulse duration = 300μs, duty cycle = 1.5%

BUW11
BUW11A

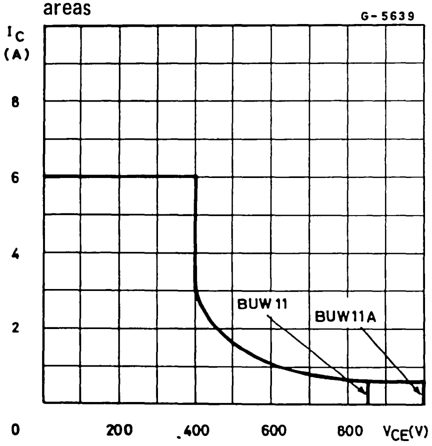
Safe operating areas

I = Area of permissible operation driving turn-on provided $R_{BE} = 100\Omega$ and $t_p \leqslant 0.6\mu s$.

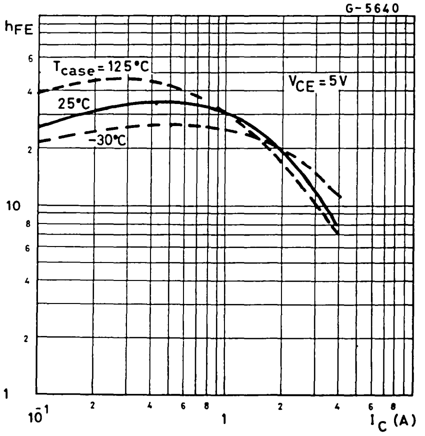
II = Area of permissible operation with $V_{BE} \leqslant 0$; $t_p \leqslant 2\mu s$.



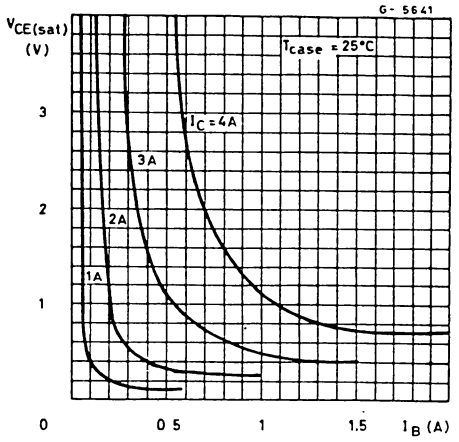
Clamped reverse bias safe operating areas



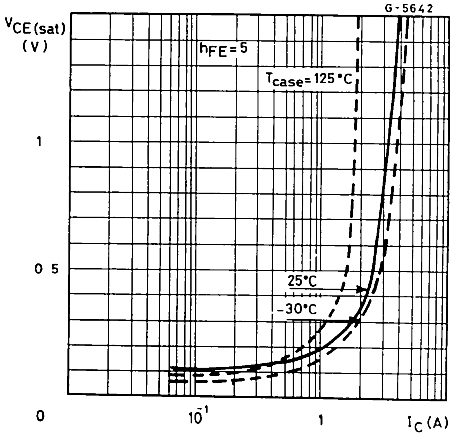
DC current gain



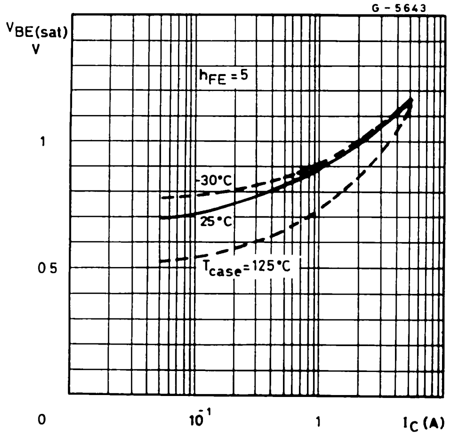
Collector-emitter saturation voltage



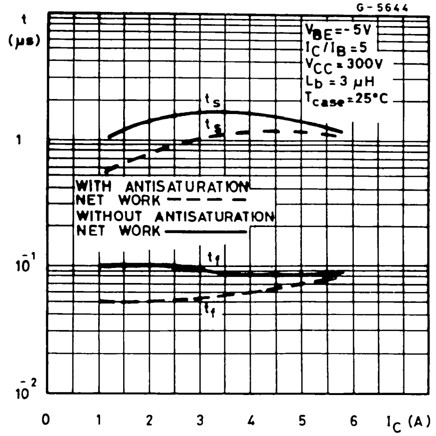
Collector-emitter saturation voltage



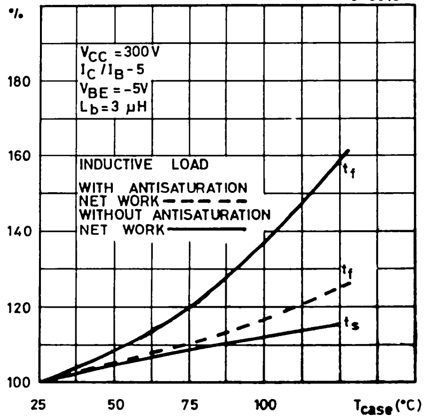
Base-emitter saturation voltage



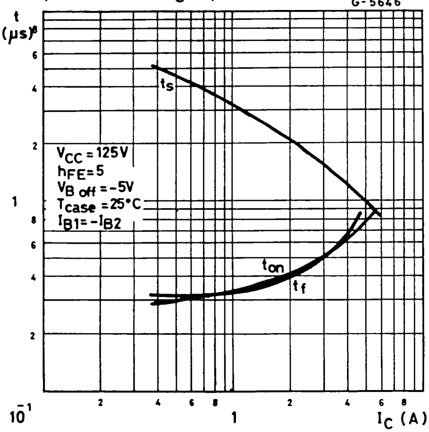
Switching times inductive load



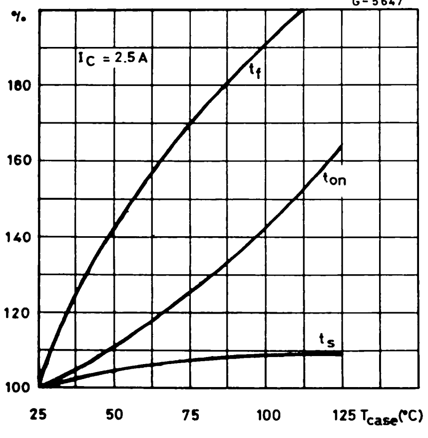
Switching times percentage variation vs. T_{case} temperature



Saturated switching characteristics (test circuit fig. 1)



Switching times variation vs. T_{case} resistive load



TEST CIRCUITS

Fig. 1

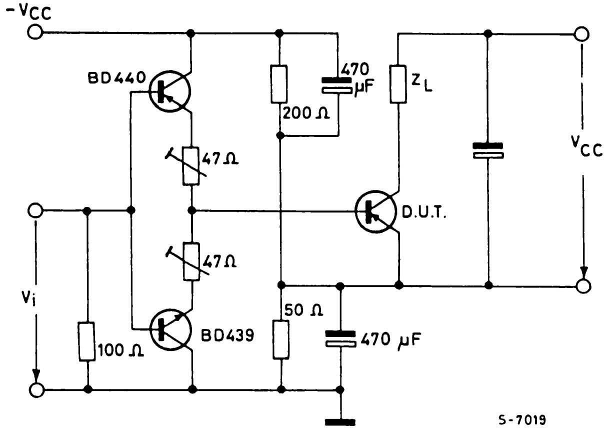
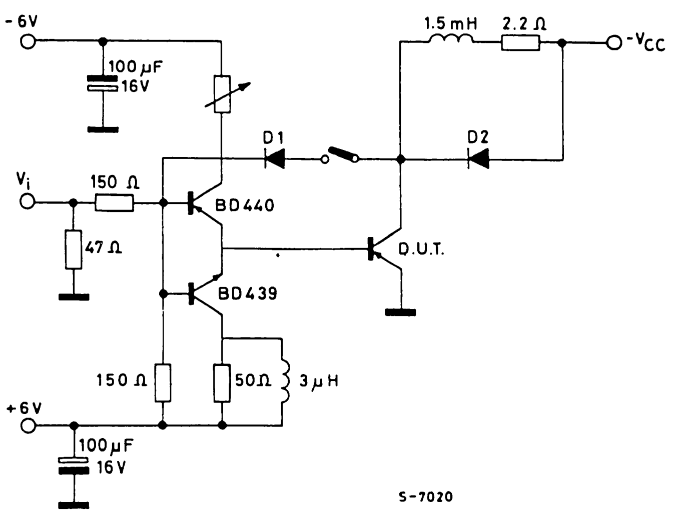


Fig. 2



BUW12
BUW12A

MULTIEPITAXIAL MESA NPN

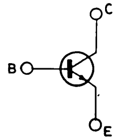
HIGH VOLTAGE POWER SWITCH

The BUW12 and BUW12A are silicon multiepitaxial mesa NPN transistors in SOT-93 plastic package, particularly intended for high voltage, fast switching industrial applications.

ABSOLUTE MAXIMUM RATING

		BUW12	BUW12A
V_{CES}	Collector-emitter voltage ($V_{BE}=0$)	850V	1000V
V_{CEO}	Collector-emitter voltage ($I_B=0$)	400V	450V
I_C	Collector current	8A	
I_{CM}	Collector peak current ($t_p \leqslant 2ms$)	20A	
I_B	Base current	4A	
I_{BM}	Base peak current ($t_p \leqslant 2ms$)	6A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	125W	
T_{stg}	Storage temperature	-65 to 175°C	
T_j	Junction temperature	175°C	

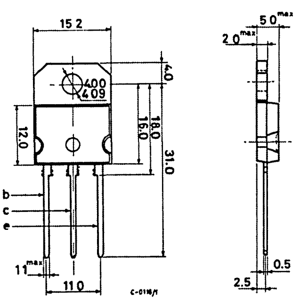
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



(sim. to **TO-218**) **SOT-93**

THERMAL DATA

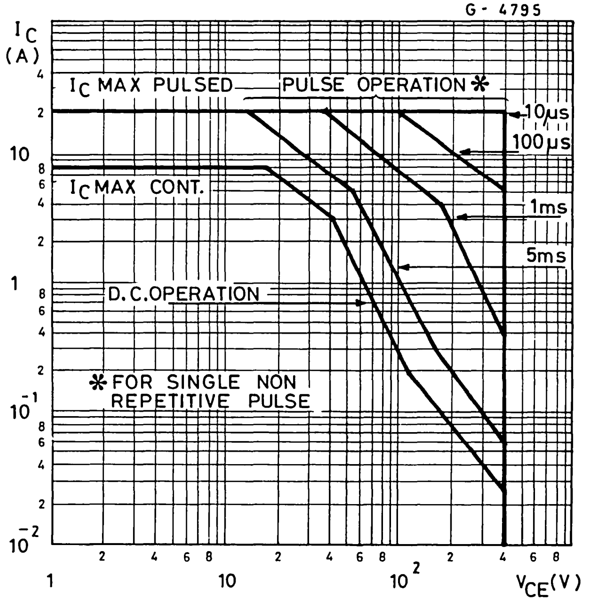
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max.	1.2	°C/W

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

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} = 9V			10	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage	I_C = 100mA L = 25mH	400			V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	I_C = 6A I_B = 1.2A			1.5	V
$V_{BE(sat)}$*	Base emitter saturation voltage	I_C = 6A I_B = 1.2A			1.5	V
t_{on}	Turn-on time	I_C = 6A I_{B1} = 1.2A I_{B2} = 1.2A			1	μs
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



MULTIEPITAXIAL MESA PNP

BUW22
BUW22A
BUW22AP
BUW22P

ADVANCE DATA

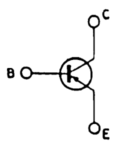
HIGH VOLTAGE POWER SWITCH

The BUW22, BUW22A are silicon miltiepitaxial mesa PNP transistor, in Jedec TO-3, metal case, particularly intended for high voltage, fast switching applications.
The BUW22P, BUW22AP are mounted in TO-220 plastic package.

ABSOLUTE MAXIMUM RATINGS

		BUW22/P	BUW22A/P
V_{CES}	Collector-emitter voltage ($V_{BE} = o$)	-400V	-450V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	-350V	-400V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	-5V	-7V
I_C	Collector current	-6A	
I_{CM}	Collector peak current ($t_p \leqslant 10ms$)	-8A	
I_B	Base current	-2A	
I_{BM}	Base peak current ($t_p \leqslant 10ms$)	-4A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	(TO-3) 75W	(TO-220) 60W
T_{stg}	Storage temperature	-65 to 175°C	-65 to 150°C
T_j	Junction temperature	175°C	150°C

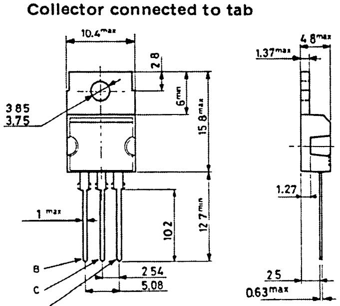
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

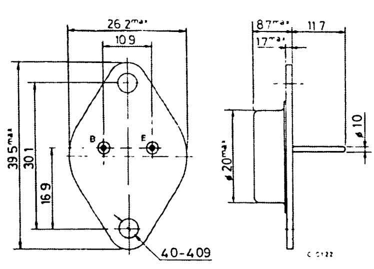
Dimensions in mm

Collector connected to tab



TO-220

Collector connected to tab



TO-3

THERMAL DATA

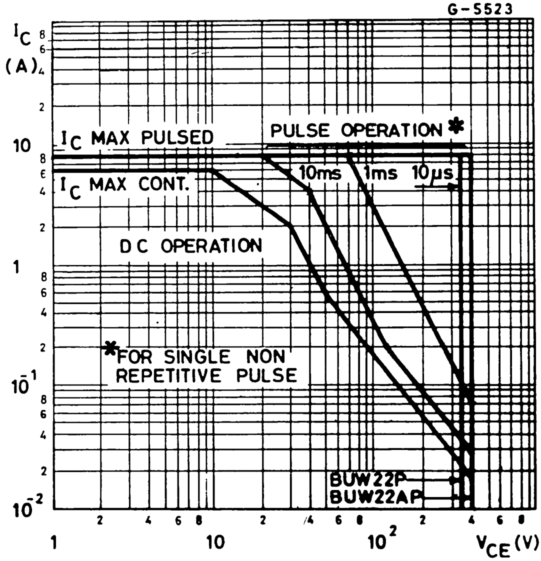
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	2	°C/W

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

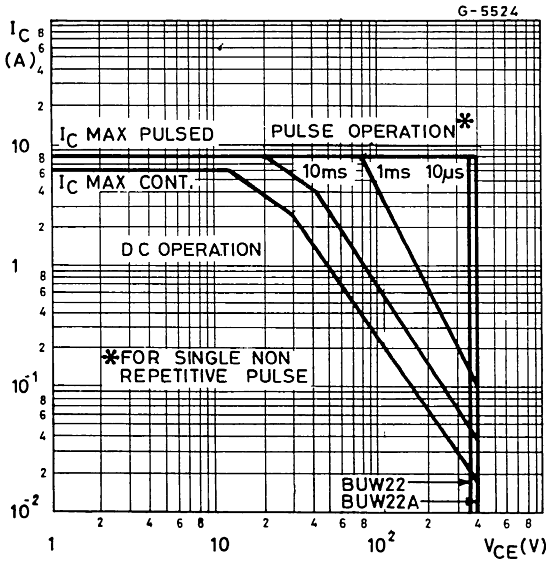
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current ($V_{BE} = 0$)	V_{CE} = Rated V_{CES}			-1	mA
		$T_{case} = 125°C$ V_{CE} = Rated V_{CES}			-5	mA
I_{EBO}	Collector cutoff Current ($I_C = 0$)	V_{EB} = Rated V_{EBO}			-1	mA
$V_{CEO(sus)}$ *	Collector-emitter sustaining voltage ($I_B = 0$)	I_C = -100mA for **BUW22/P** for **BUW22A/P**	 -350 -400			 V V
$V_{CE(sat)}$ *	Base-emitter saturation voltage	I_C = -2.5A I_B = -1A			-1.5	V
$V_{BE(sat)}$ *	Base-emitter saturation voltage	I_C = -2.5A I_B = -1A			-1.6	V
h_{FE} *	DC current gain	I_C = 0.5A V_{CE} = -5V	12			–
$I_{s/b}$	Second breakdown collector current	V_{CE} = -30V for **BUW22/A** for **BUW22P/AP**	 -2.5 -2			 A A
t_{on}	Turn-on time	Resistive load V_{CC} = -250V I_C = -2.5A $I_{B1} = -I_{B2}$ = -0.5A		0.4	0.8	μs
t_s	Storage time			0.6	1.5	μs
t_f	Fall time			0.3	0.7	μs

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

Safe operating areas
(BUW22AP - BUW22P)

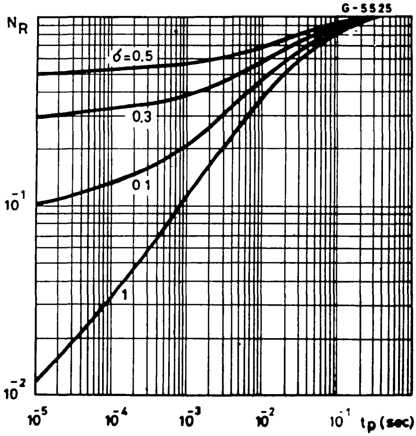


Safe operating areas
(BUW22 - BUW22A)

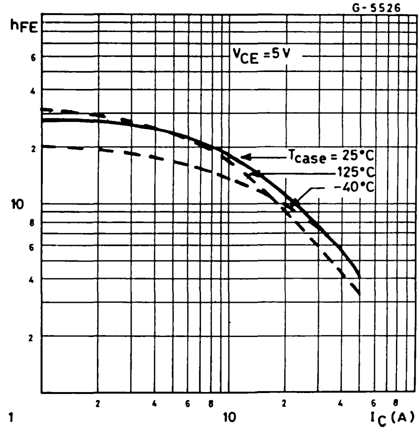


BUW22
BUW22A
BUW22AP
BUW22P

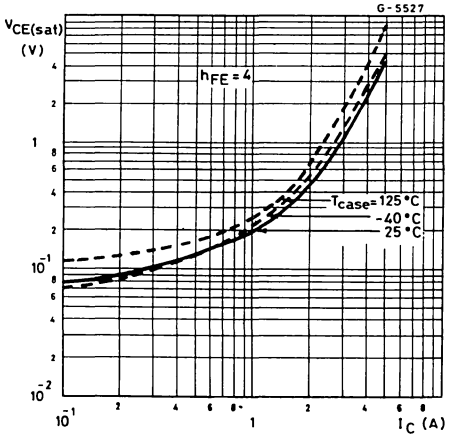
Transient thermal response



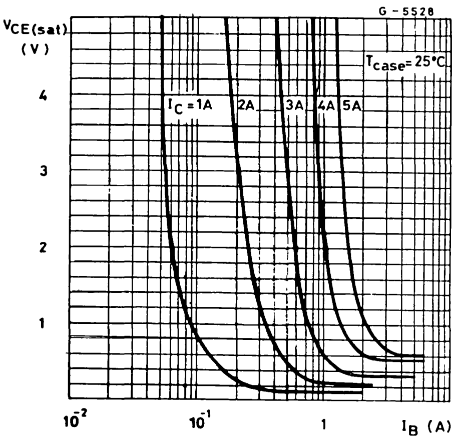
DC current gain



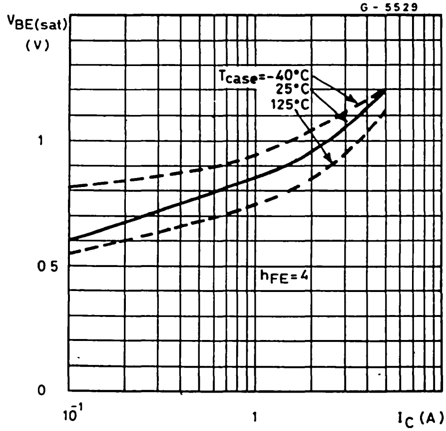
Collector-emitter saturation voltage



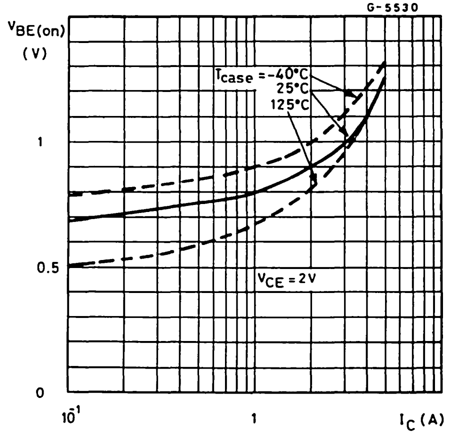
Collector-emitter saturation voltage



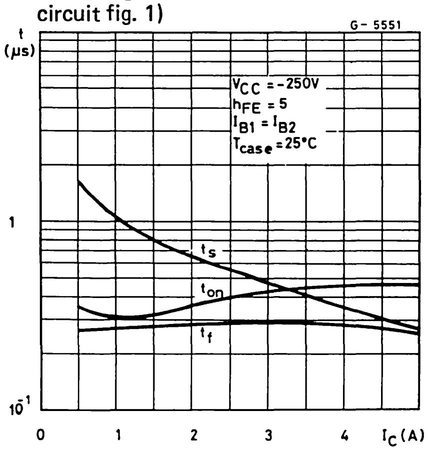
Base-emitter saturation voltage



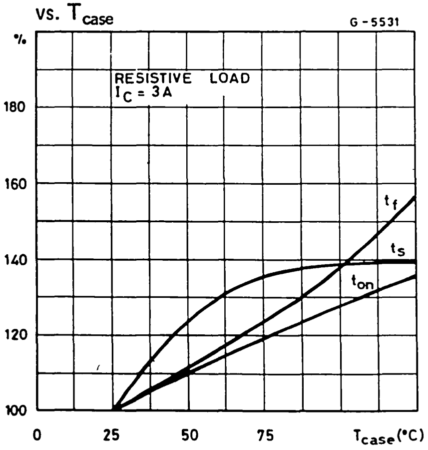
Base-emitter on voltage



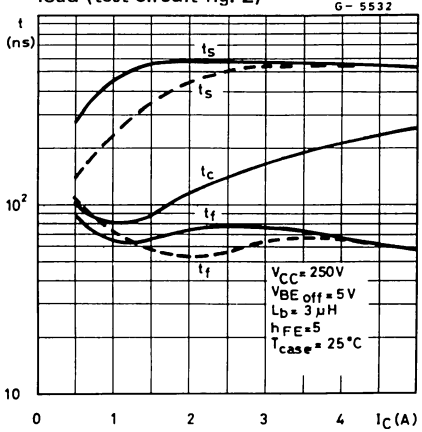
Switching times resistive load (test circuit fig. 1)



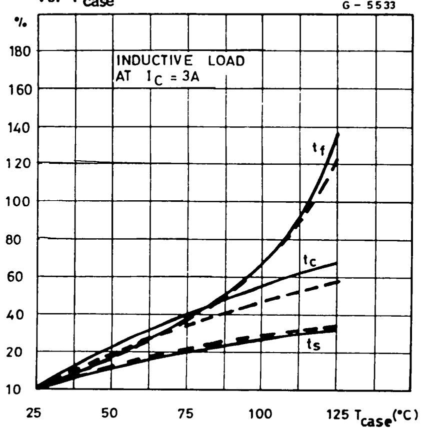
Switching times percentage variation vs. T_{case}



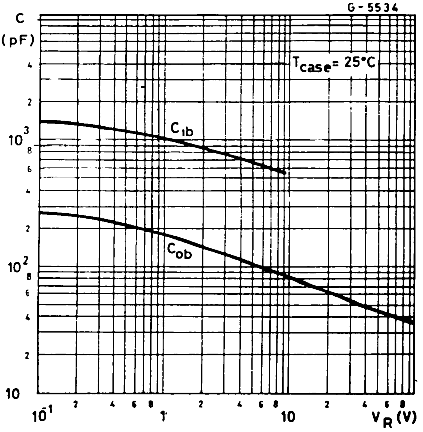
Turn off switching times inductive load (test circuit fig. 2)



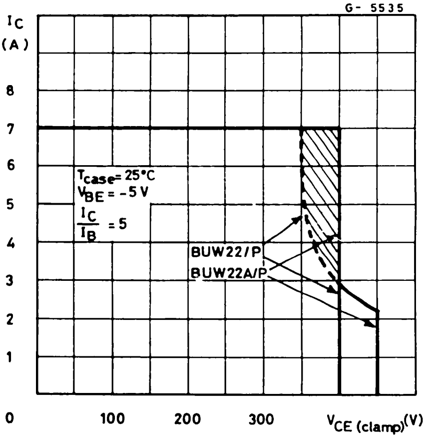
Switching times percentage variation vs. T_{case}



Capacitance



Reserve biased safe operating area



TEST CIRCUITS

Fig. 1

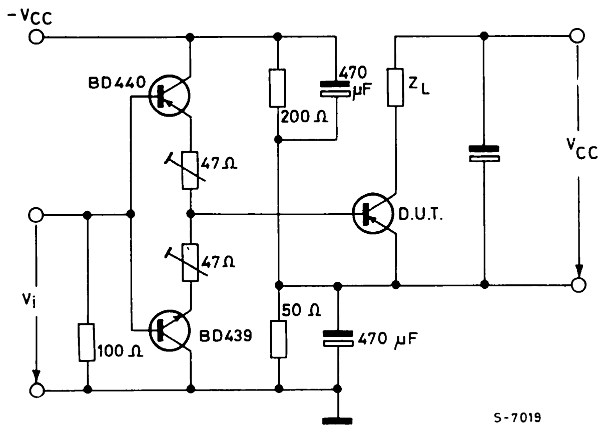
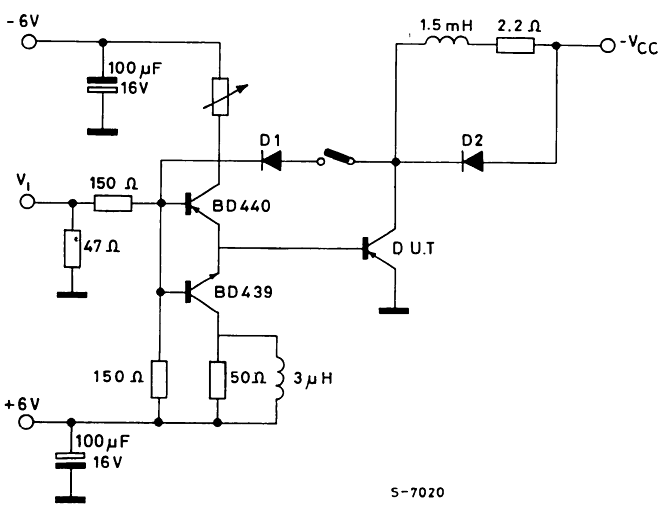


Fig. 2



BUW32
BUW32A
BUW32AP
BUW32P

MULTIEPITAXIAL MESA PNP

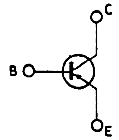
ADVANCE DATA

HIGH VOLTAGE POWER SWITCH

The BUW32/A are silicon multiepitaxial mesa PNP transistors in TO-3 metal case. It is intended for high voltage, fast switching and industrial applications. The BUW32P/32AP are mounted in SOT-93 case similar to TO-218.

ABSOLUTE MAXIMUM RATINGS		BUW32/P	BUW32A/AP
V_{CES}	Collector-emitter voltage ($V_{BE} = 0$)	-400V	-450V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	-350V	-400V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	-5V	-7V
I_C	Collector current	-10A	
I_B	Base current	-5A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	(TO-3) 125W	(SOT-93) 105W
T_{stg}	Storage temperature	-65 to 175°C	-65 to 150°C
T_j	Junction temperature	175°C	150°C

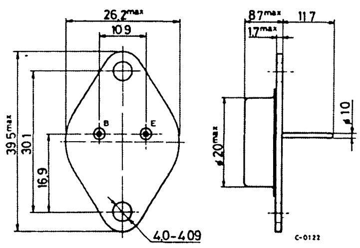
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

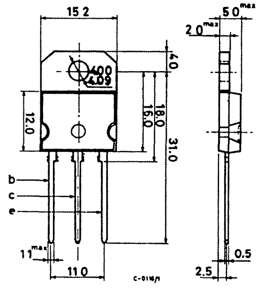
Dimension in mm

Collector connected to case



TO-3

Collector connected to tab



(sim. to TO-218) SOT-93

THERMAL DATA

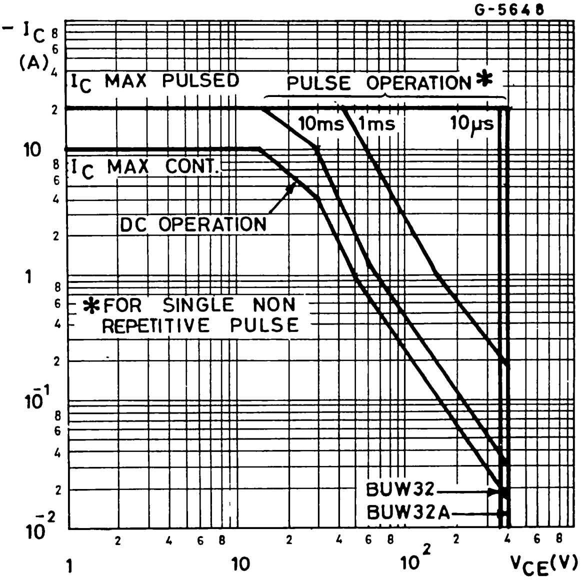
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1.19	°C/W

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

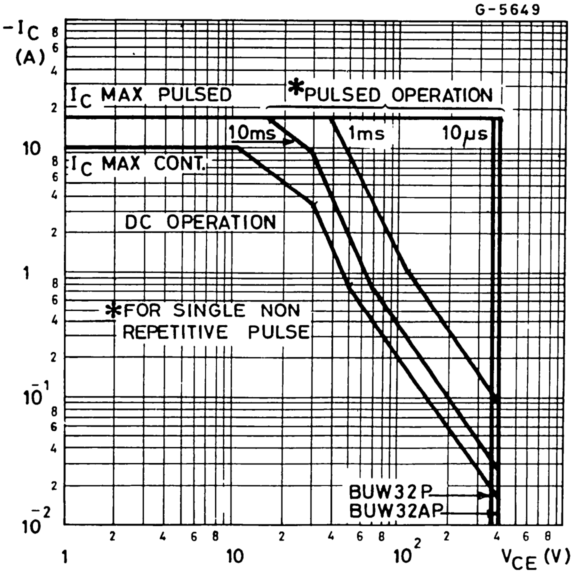
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current ($V_{BE} = 0$)	V_{CE} = Rated V_{CES} V_{CE} = Rated V_{CES} $T_{case} = 125°C$			-1 -5	mA mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	V_{EB} = Rated V_{EBO}			-1	mA
$V_{CEO\,(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	I_C = -100mA for **BUW32/P** for **BUW32A/AP**	 -350 -400			 V V
$V_{CE\,(sat)}$*	Collector-emitter saturation voltage	I_C = -5A I_B = 1.5A			-1.5	V
$V_{BE\,(sat)}$*	Base-emitter saturation voltage	I_C = -5A I_B = 1.5A			-1.6	V
h_{FE}*	DC current gain	I_C = 1A V_{CE} = -5V	12			–
$I_{s/b}$	Second breakdown collector current	V_{CE} = 30V for **BUW32/A** for **BUW32P/AP**	 -4.2 -3.5			 A A
t_{on}	Turn-on time	Resistive load V_{CC} = -250V I_C = -5A $I_{B1} = -I_{B2}$ = -1A		0.3	0.6	μs
t_s	Storage time			0.7	1.5	μs
t_f	Fall time			0.25	0.6	μs

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

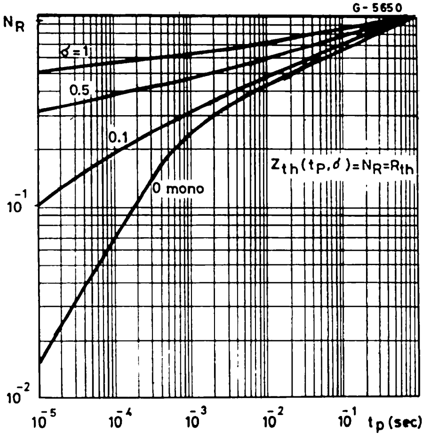
Safe operating areas
(BUW32, BUW32A)



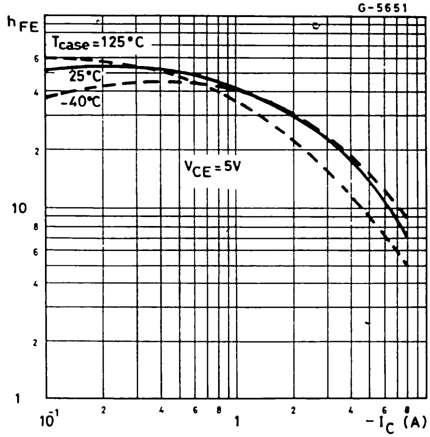
Safe operating areas
(BUW32P, BUW32AP)



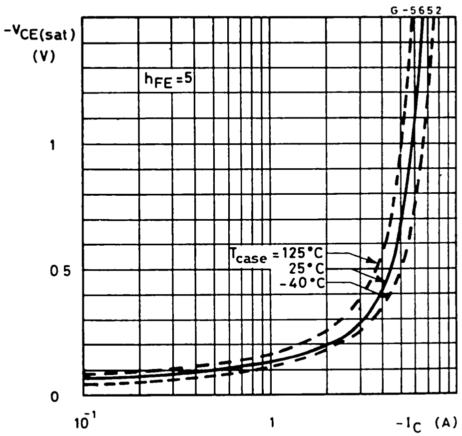
Transient thermal response



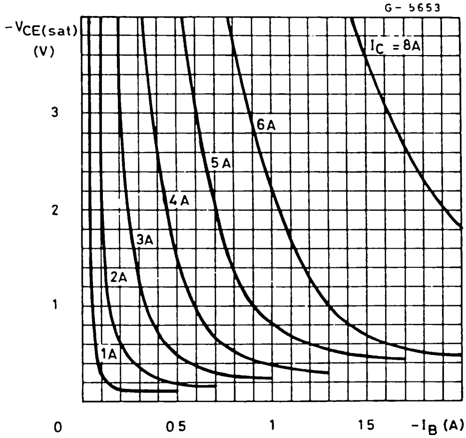
DC current gain



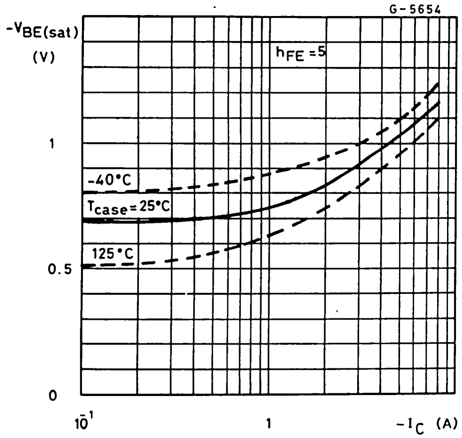
Collector-emitter saturation voltage



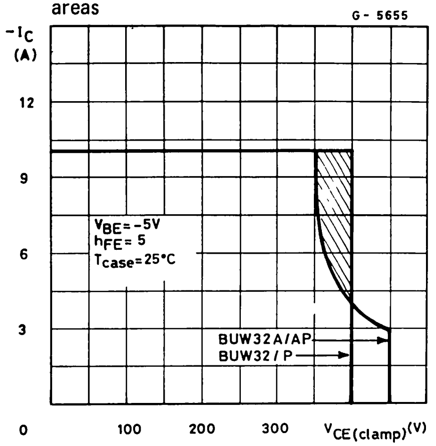
Collector-emitter saturation voltage



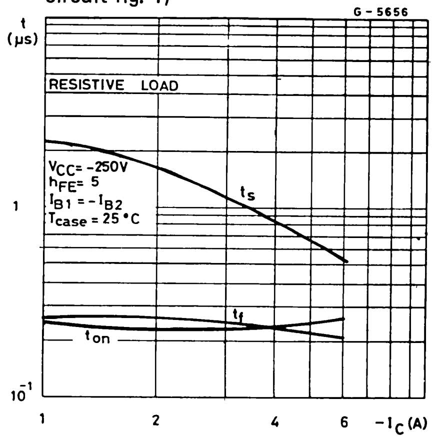
Base-emitter saturation voltage



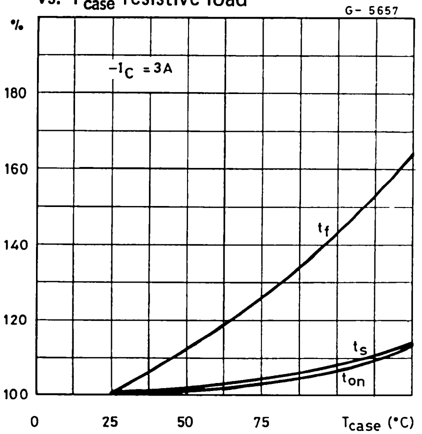
Clamped reverse bias safe operating areas



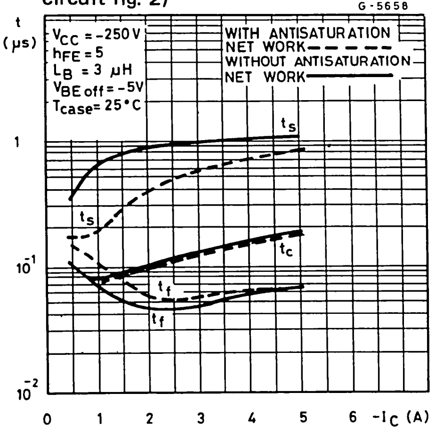
Saturated switching characteristics (test circuit fig. 1)



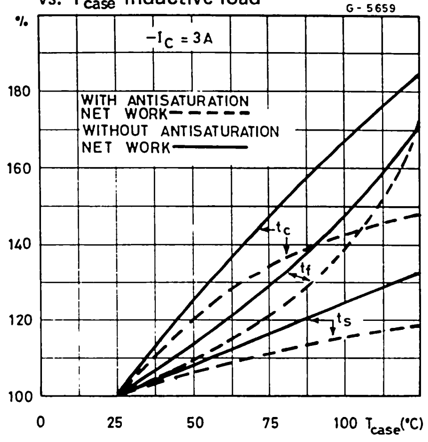
Switching times percentage variation vs. T_{case} resistive load



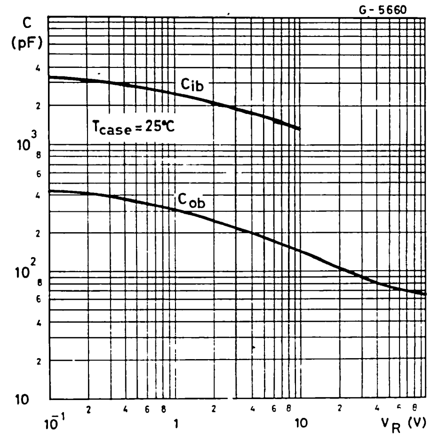
Switching times inductive load (test circuit fig. 2)



Switching times percentage variation vs. T_{case} inductive load



Capacitance



TEST CIRCUITS

Fig. 1

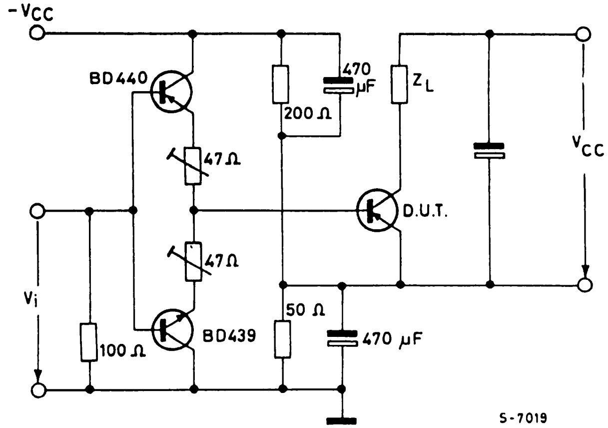
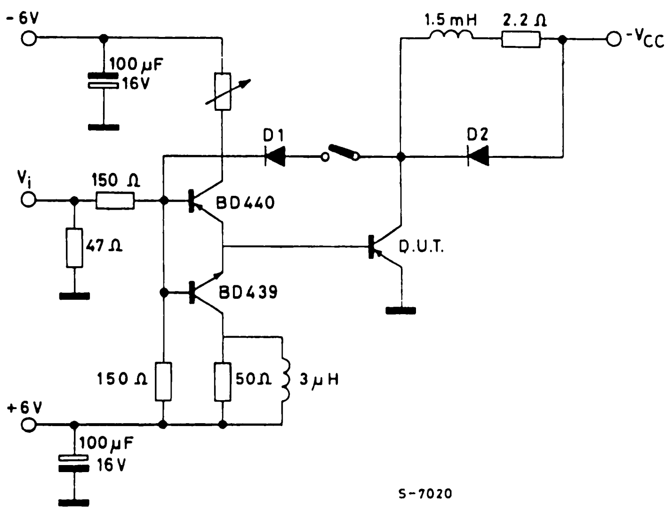


Fig. 2



MULTIEPITAXIAL MESA NPN

BUW34
BUW35
BUW36

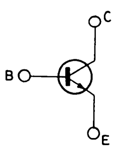
HIGH VOLTAGE POWER SWITCH

The BUW 34, BUW 35 and BUW 36 are silicon multiepitaxial mesa NPN transistors in Jedec TO-3 metal case. They are intended for high voltage, fast switching applications.

ABSOLUTE MAXIMUM RATINGS

		BUW34	BUW35	BUW36
V_{CES}	Collector-emitter voltage ($V_{BE}=0$)	500V	800V	900V
V_{CEO}	Collector-emitter voltage ($I_B=0$)	400V	400V	450V
V_{EBO}	Emitter-base voltage ($I_C=0$)		7V	
I_C	Collector current		10A	
I_{CM}	Collector peak current		15A	
I_B	Base current		5A	
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$		125W	
T_{stg}	Storage temperature		-65 to 200°C	
T_j	Junction temperature		200°C	

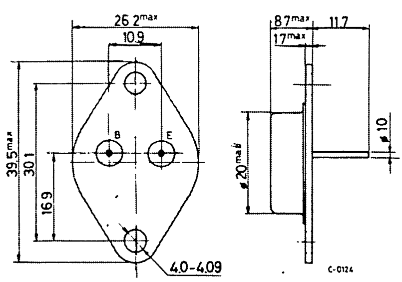
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

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)

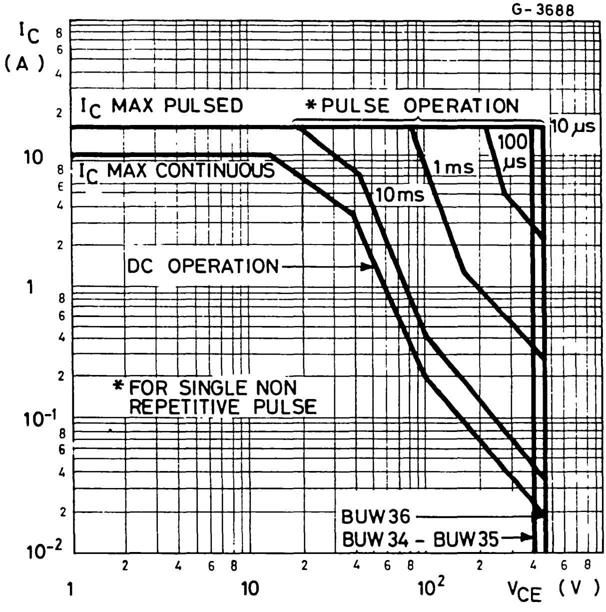
Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current ($V_{BE} = 0$)	for **BUW34**	$V_{CE} = 500V$			500	μA
		for **BUW35**	$V_{CE} = 800V$			500	μA
		for **BUW36**	$V_{CE} = 900V$			500	μA
		$T_{case} = 125°C$					
		for **BUW34**	$V_{CE} = 500V$			3	mA
		for **BUW35**	$V_{CE} = 800V$			3	mA
		for **BUW36**	$V_{CE} = 900V$			3	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 7V$				1	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 100mA$					
		for **BUW34**		400			V
		for **BUW35**		400			V
		for **BUW36**		450			V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	All types	$I_C = 5A$ $I_B = 1A$			1.5	V
		for **BUW35**	$I_C = 8A$ $I_B = 2.5A$			1.5	V
		for **BUW36**	$I_C = 8A$ $I_B = 2.5A$			3	V
$V_{BE(sat)}$*	Base-emitter saturation voltage	All types	$I_C = 5A$ $I_B = 1A$			1.5	V
		for **BUW35**	$I_C = 8A$ $I_B = 2.5A$			1.8	V
		for **BUW36**	$I_C = 8A$ $I_B = 2.5A$			1.8	V

ELECTRICAL CHARACTERISTICS (Continued)

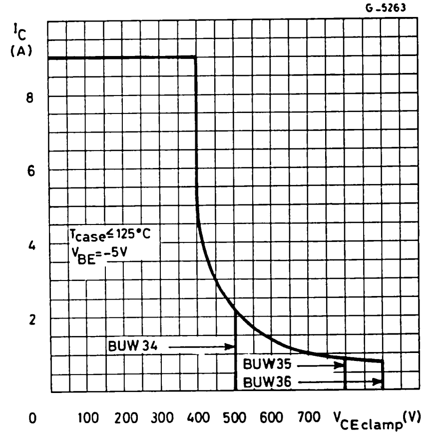
Parameter		Test conditions	Min.	Typ.	Max.	Unit
RESISTIVE SWITCHING TIMES (See fig. 1)						
t_{on}	Turn-on time	$I_C = 5A$, $I_{B1} = 1A$, $V_{CC} = 250V$			0.70	μs
t_s	Storage time	$I_C = 5A$, $I_{B1} = 1A$, $V_{CC} = 250V$			3	μs
t_f	Fall time	$I_{B2} = -1A$			0.8	μs
INDUCTIVE SWITCHING TIMES (See fig. 2)						
t_f	Fall time	$I_C = 5A$ $I_{B1} = 1A$ $V_{BE} = -5V$ $V_{CC} = 300V$			0.3	μs
		$T_{case} = 100°C$ $I_C = 5A$ $I_{B1} = 1A$ $V_{BE} = -5V$ $V_{CC} = 300V$			0.6	μs

* Pulsed: pulse duration $\leqslant 300\mu s$ duty cycle $\leqslant 1.5\%$

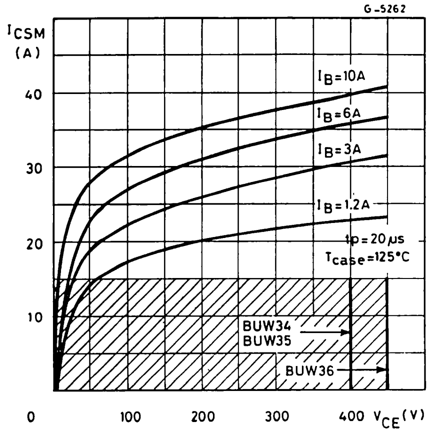
Safe operating areas



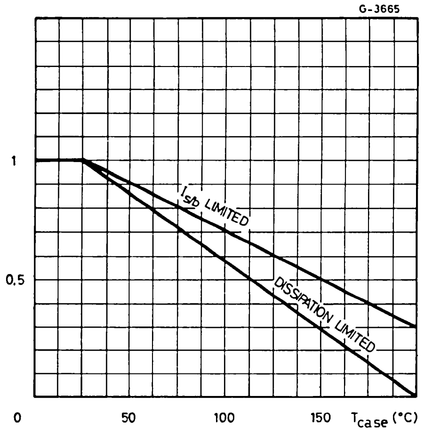
Clamped reverse bias safe operating areas



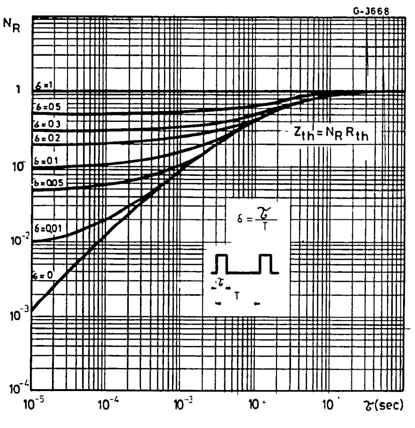
Forward biased accidental overload area (See fig. 3)



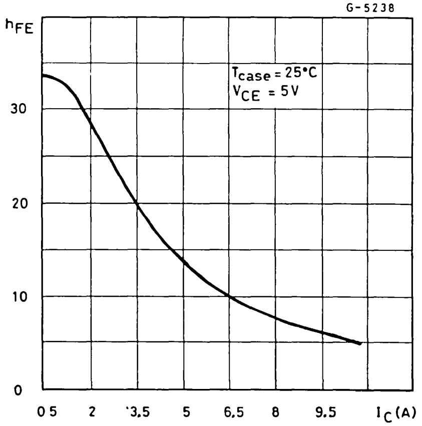
Derating curves



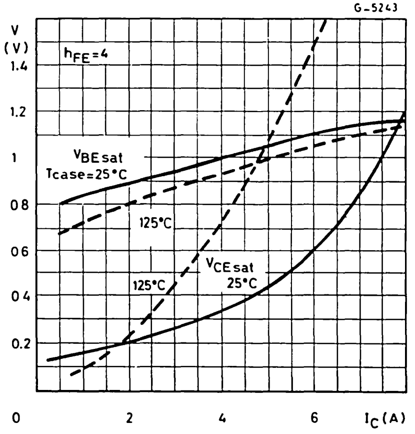
Transient thermal response



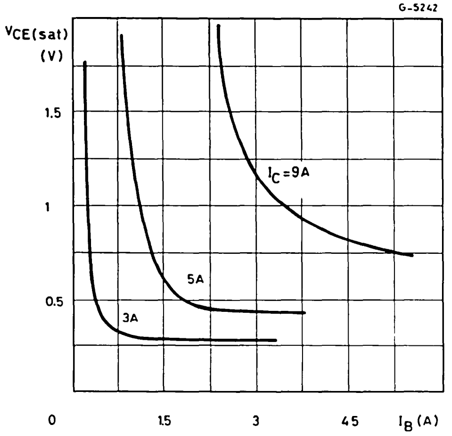
DC current gain



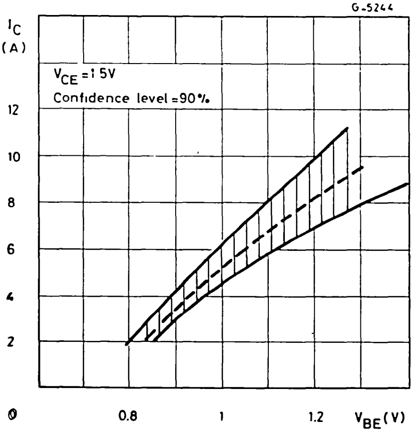
Saturation voltages



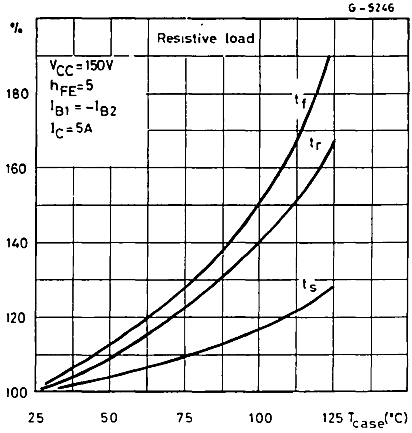
Collector-emitter saturation voltage



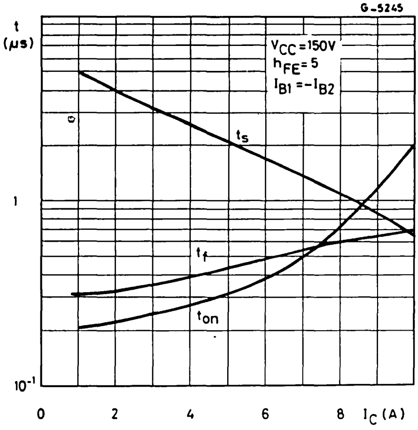
Collector current spread vs. base emitter voltage



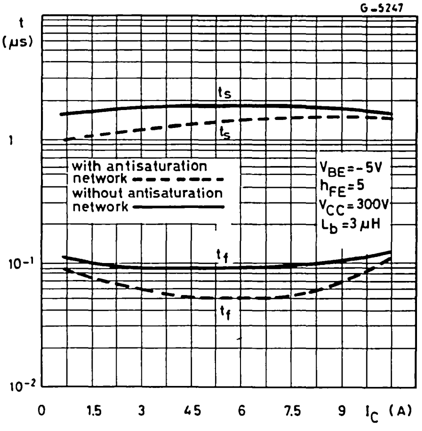
Switching times percentage variation vs. case temperature



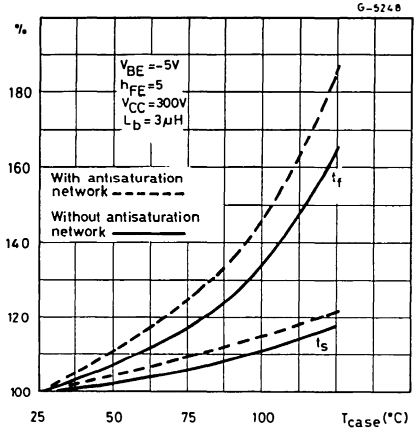
Switching times resistive load (See fig. 1)



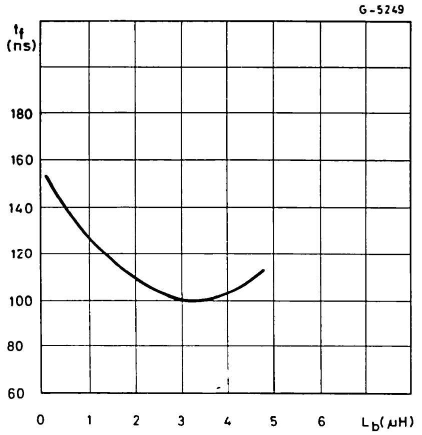
Switching times inductive load (See fig. 2)



Switching times inductive load vs. case temperature



Fall times vs. L_B (See fig. 2)



Dynamic collector-emitter saturation voltage (See fig. 4)

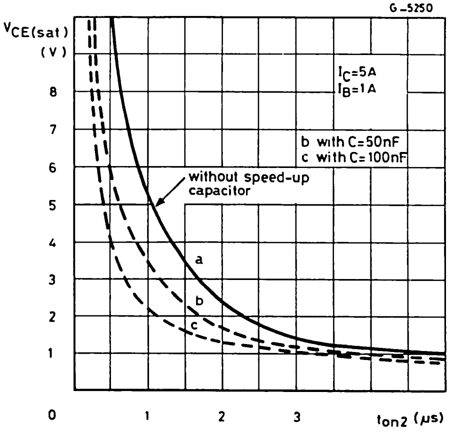


Fig. 1 - Switching times test circuit on resistive load

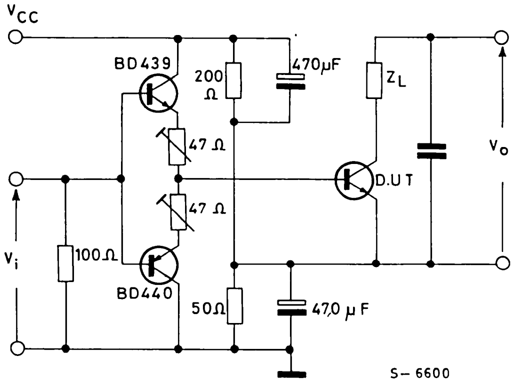
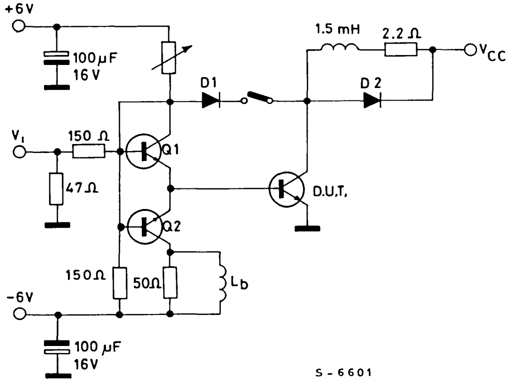


Fig. 2 - Switching times test circuit on inductive load with ad without antisaturation network



D1,D2 - Fast recovery diodes
Q1,Q2 - Transistors SGS: 2N5191, 2N5195

Fig. 3 - Forward biased accidental over load area test circuit

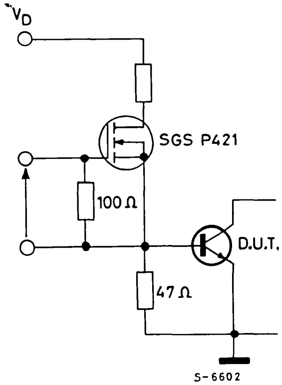
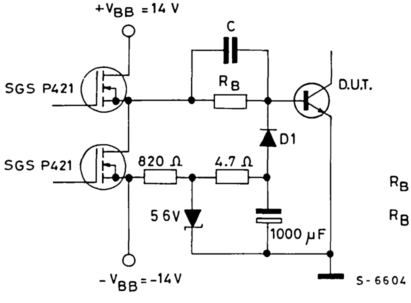


Fig. 4 - $V_{CE(sat)}$ dyn. test circuit



$$R_B = \frac{V_{BB} - V_{BE}}{I_B}$$

$$R_B = 6.8\ \Omega$$

Fig. 5 - Equivalent input schematic at turn-on

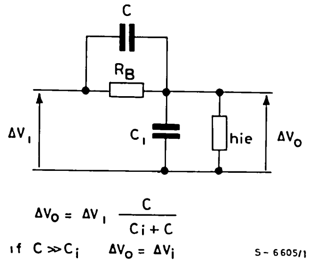
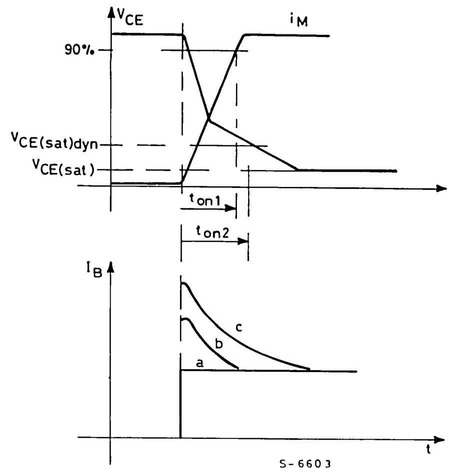


Fig. 6 - Remarks to $V_{CE(sat)}$ dyn. test circuit (fig. 4)



The speed-up capacitor decreases the $V_{CE\ (sat)}$ dyn. as shown in diagram (figure 6).
The 50nF capacitor modifies the shape of base current with a overshoot.

BUW42
BUW42A
BUW42AP
BUW42P

MULTIEPITAXIAL MESA PNP

ADVANCE DATA

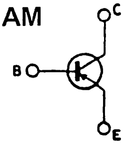
HIGH VOLTAGE POWER SWITCH

The BUW42/A and the BUW42P/AP are silicon multiepitaxial PNP transistors (respectively, in Jedec TO-3 metal case and in SOT-93) intended in fast switching applications for high output power.

ABSOLUTE MAXIMUM RATINGS

		BUW42/P	BUW42A/AP
V_{CES}	Collector-emitter voltage ($V_{BE} = 0$)	400V	450V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	350V	400V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	-7V	
I_C	Collector current	-15A	
I_{CM}	Collector peak current	-30A	
I_B	Base current	-10A	
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$: **TO-3**	150W	
	SOT-93	105W	
T_{stg}	Storage temperature: **TO-3**	-65 to 175°C	
	SOT-93	-65 to 150°C	
T_j	Junction temperature: **TO-3**	175°C	
	SOT-93	150°C	

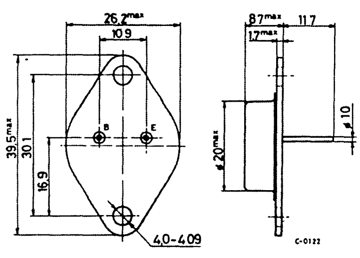
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

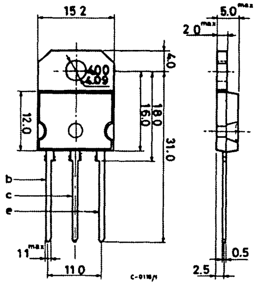
Dimension in mm

Collector connected to case



TO-3

Collector connected to tab



(sim. to TO-218) SOT-93

THERMAL DATA

			SOT-93	TO-3
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max.	1.2°C/W	1°C/W

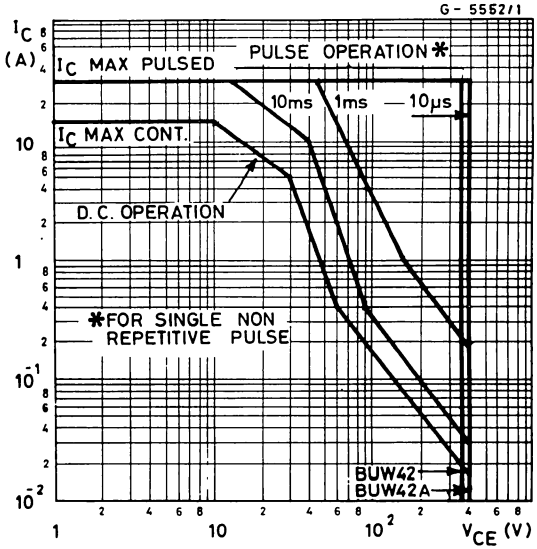
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current (V_{BE} = 0)	V_{CE} = -400V for **BUW42/P**			-1	mA
		V_{CE} = -450V for **BUW42A/AP**			-1	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage (I_B = 0)	I_C = -100mA for **BUW42/P**	350			V
		for **BUW42A/AP**	400			V
I_{EBO}	Emitter cutoff current	V_{EB} = -5V for **BUW42/P**			-1	mA
		V_{EB} = -7V for **BUW42A/AP**			-1	mA
$V_{CE\ (sat)}$*	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}	Turn-on time	Resistive load V_{CC} = -250V I_C = -10A I_{B1} = I_{B2} = -3.3A		0.3	0.6	μs
t_s	Storage time			0.5	1.5	μs
t_f	Fall time			0.3	0.6	μs

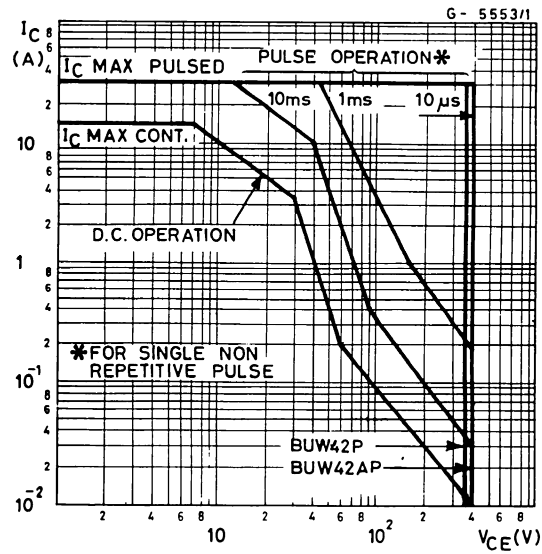
* Pulsed: pulse duration = 300μs, duty cycle = 1.5%.

BUW42
BUW42A
BUW42AP
BUW42P

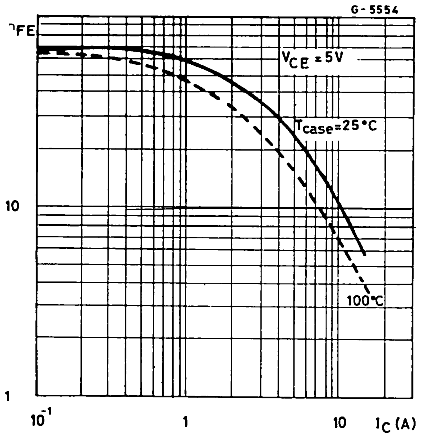
Safe operating area
(for BUW42/A)



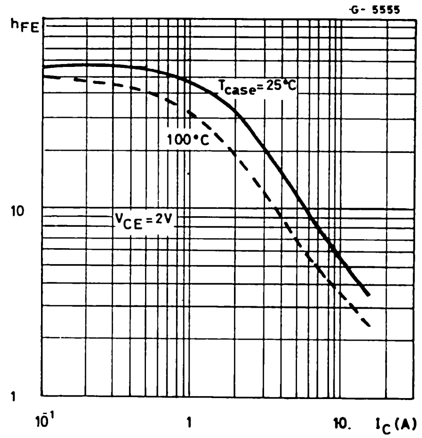
Safe operating area
(for BUW42P/AP)



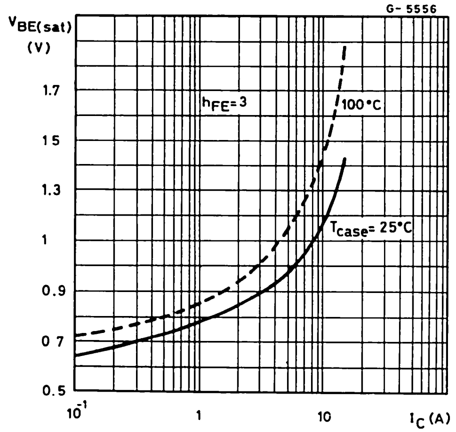
DC current gain



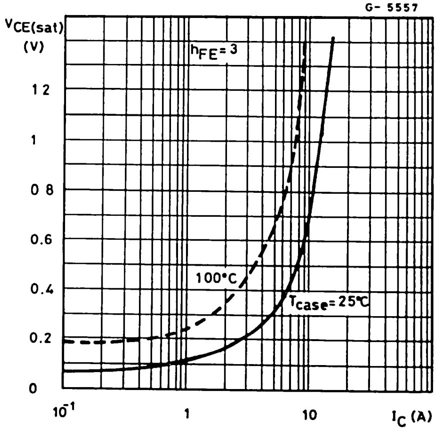
DC current gain



Base-emitter saturation voltage

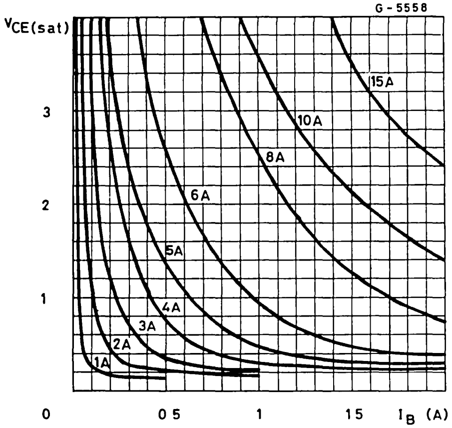


Collector-emitter saturation voltage

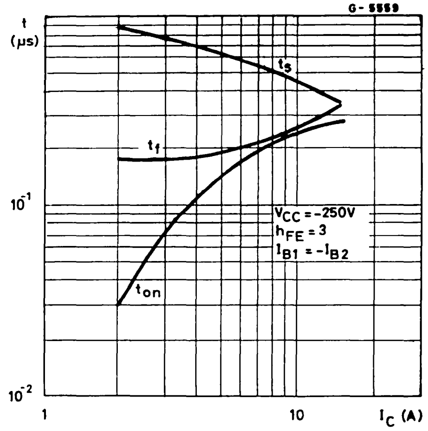


BUW42
BUW42A
BUW42AP
BUW42P

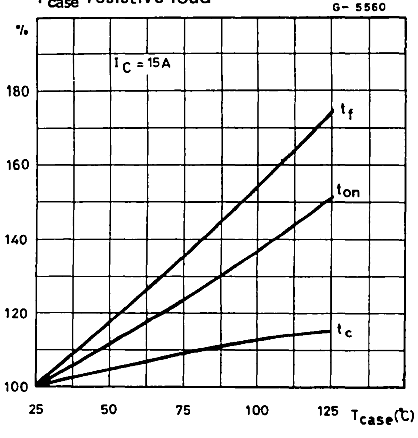
Collector-emitter saturation voltage



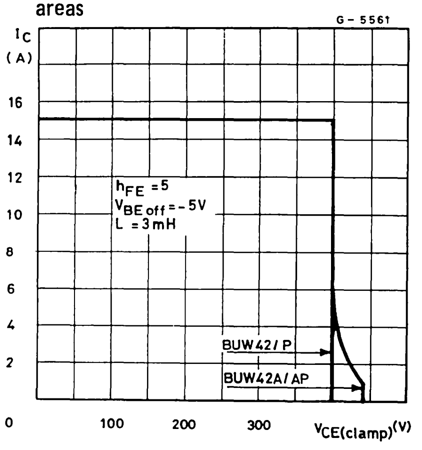
Saturated switching-times resistive load



Switching times percentage variation vs. T_{case} resistive load



Clamped reverse bias safe operating areas



MULTIEPITAXIAL MESA NPN

BUW44
BUW45
BUW46

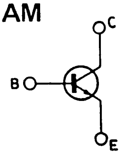
HIGH VOLTAGE, HIGH CURRENT POWER SWITCH

The BUW 44, BUW 45 and BUW 46 are multiepitaxial mesa NPN transistors in Jedec TO-3 metal case, intended in fast switching applications for high output powers.

ABSOLUTE MAXIMUM RATINGS

		BUW44	BUW45	BUW46
V_{CES}	Collector-emitter voltage ($V_{BE}=0$)	500V	800V	900V
V_{CEO}	Collector-emitter voltage ($I_B=0$)	400V	400V	450V
V_{EBO}	Emitter-base voltage ($I_C=0$)	7V		
I_C	Collector current	15A		
I_{CM}	Collector peak current	30A		
I_B	Base current	10A		
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$	175W		
T_{stg}	Storage temperature	-65 to 200°C		
T_j	Junction temperature	200°C		

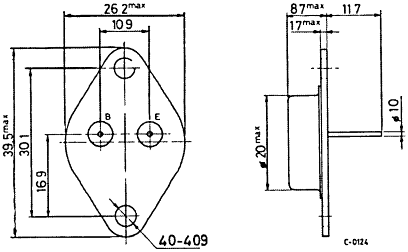
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

5/80

BUW44
BUW45
BUW46

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1	°C/W

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

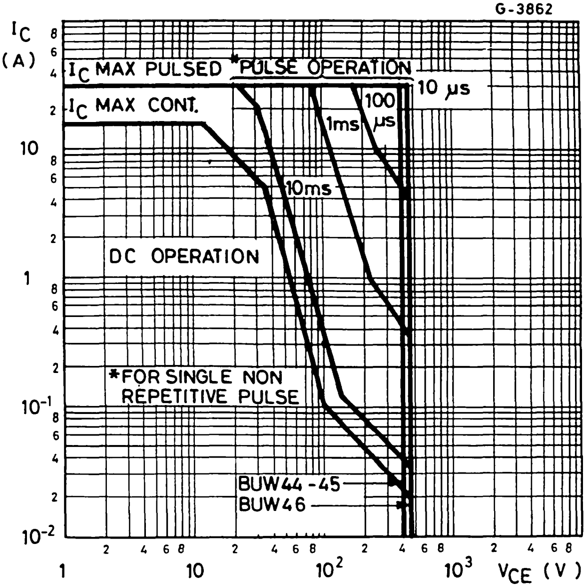
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current ($V_{BE}=0$)	for **BUW44** $V_{CE}=500V$			500	µA
		for **BUW45** $V_{CE}=800V$			500	µA
		for **BUW46** $V_{CE}=900V$			500	µA
		$T_{case}=125°C$				
		for **BUW44** $V_{CE}=500V$			3	mA
		for **BUW45** $V_{CE}=800V$			3	mA
		for **BUW46** $V_{CE}=900V$			3	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**	400			V
		for **BUW45**	400			V
		for **BUW46**	450			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	for **BUW44**				
		I_C = 10A I_B = 2A			3	V
		I_C = 6A I_B = 1A			1.5	V
		for **BUW45** and **BUW46**				
		I_C = 10A I_B = 2A			1.5	V
		I_C = 7A I_B = 1A			1.5	V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	for **BUW44**				
		I_C = 10A I_B = 2A			1.8	V
		I_C = 6A I_B = 1A			1.4	V
		for **BUW45** and **BUW46**				
		I_C = 10A I_B = 2A			1.8	V
		I_C = 7A I_B = 1A			1.4	V

ELECTRICAL CHARACTERISTICS (continued)

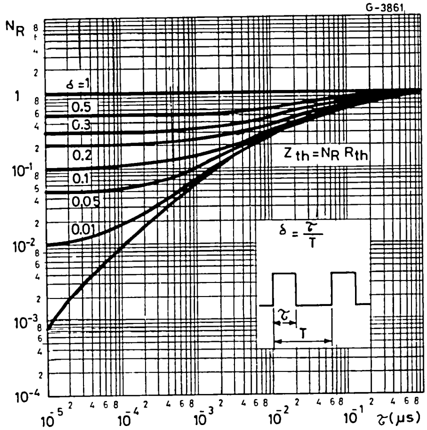
Parameter		Test conditions	Min. Typ. Max.	Unit
t_{on}	Turn-on time	I_C = 10A I_{B1} = 2A V_{CC} = 250V	0.75	µs
t_s	Storage time	I_C = 10A I_{B1} = 2A I_{B2} = -2A V_{CC} = 250V	3	µs
t_f	Fall time		0.8	µs

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

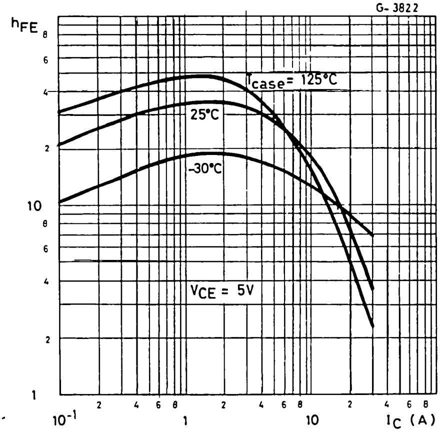
Safe operating areas



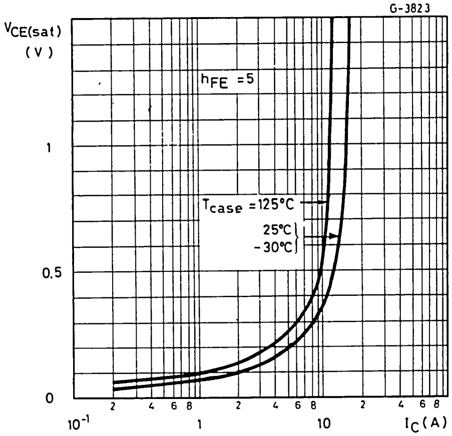
Thermal transient response



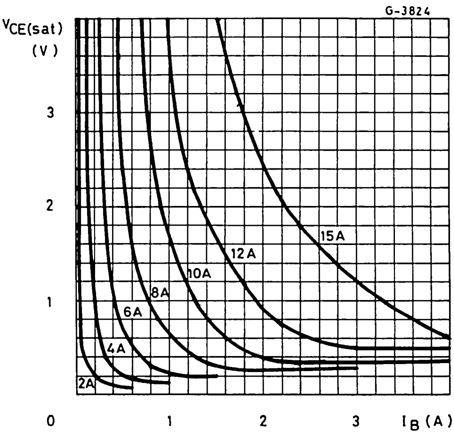
DC current gain



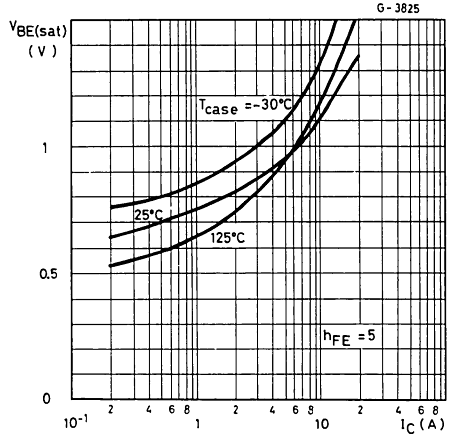
Collector-emitter saturation voltage



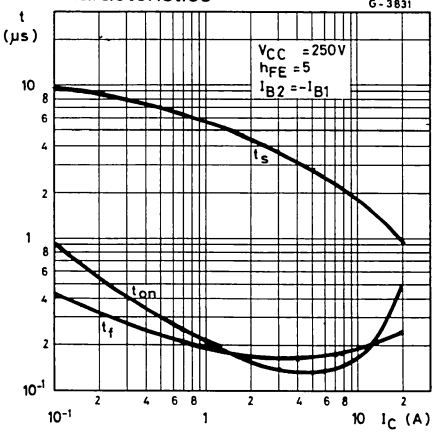
Collector-emitter saturation voltage



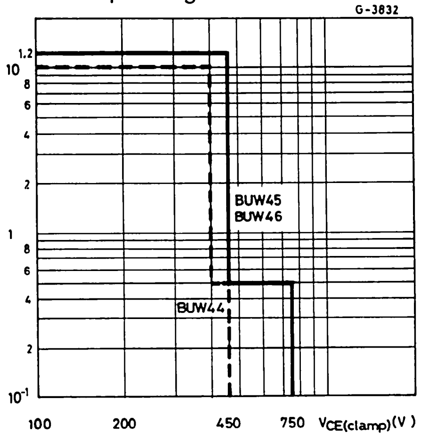
Base-emitter saturation voltage



Saturated switching characteristics



Clamped reverse bias safe operating areas



Clamped $E_{s/b}$ test circuit

TEST CONDITIONS

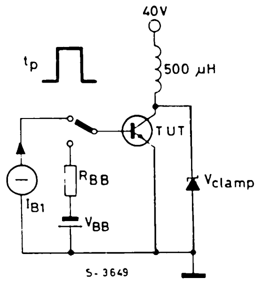
$5V > |-V_{BB}| > 2V$

$I_C / I_B = 5$

$2I_{B1} > |-I_{B2}| > I_{B1}$

t_p = adjusted for nominal I_C

R_{BB} = adjusted for I_{B2}



BUX10

MULTIEPITAXIAL PLANAR NPN

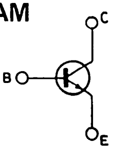
HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

The BUX 10 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.

ABSOLUTE MAXIMUM RATINGS

V_{CBO}	Collector-base voltage ($I_E=0$)	160	V
V_{CEX}	Collector-emitter voltage ($V_{BE}=-1.5V$)	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

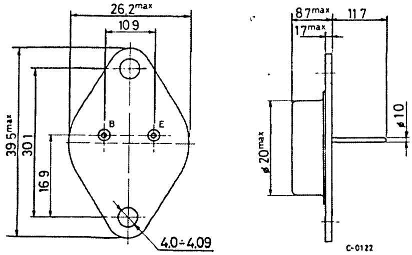
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

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)

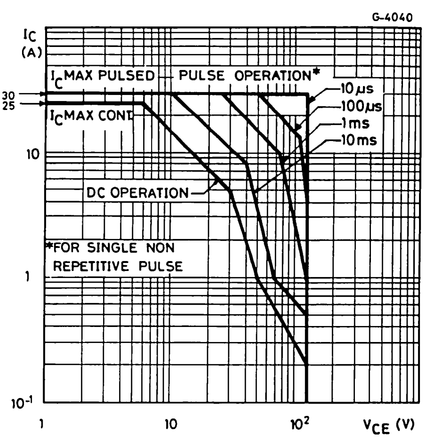
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B=0$)	$V_{CE}=100V$			1.5	mA
I_{CEX}	Collector cutoff current	$V_{CE}=160V$ $V_{BE}=-1.5V$ $T_{case}=125\,°C$ $V_{CE}=160V$ $V_{BE}=-1.5V$			1.5 6	mA mA
I_{EBO}	Emitter cutoff current ($I_C=0$)	$V_{EB}=5V$			1	mA
$V_{CEO\ (sus)}$	*Collector-emitter sustaining voltage	I_C =200mA	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 =1A I_C =20A I_B =2A		0.3 0.7	0.6 1.2	V V
$V_{BE(sat)}$*	Base-emitter saturation voltage	I_C =20A I_B =2A		1.6	2	V
h_{FE}*	DC current gain	I_C =10A $V_{CE}=2V$ I_C =20A $V_{CE}=4V$	20 10		60	– –
$I_{s/b}$	Second breakdown collector current	$V_{CE}=30V$ t =1s $V_{CE}=48V$ t =1s	5 1			A A
f_T	Transition frequency	I_C =1A $V_{CE}=15V$ f =10MHz	8			MHz

ELECTRICAL CHARACTERISTICS (continued)

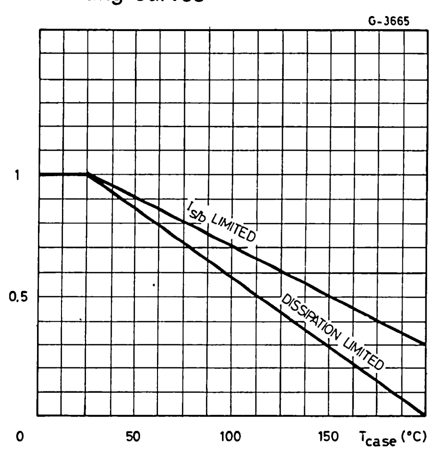
	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on time (fig. 2)	I_C =20A I_{B1} =2A V_{CC}=30V		0.5	1.5	µs
t_s	Storage time (fig. 2)	I_C =20A I_{B1}=-I_{B2}=2A V_{CC}=30V		0.6	1.2	µs
t_f	Fall time (fig. 2)			0.15	0.3	µs
	Clamped $E_{s/b}$ Collector current (fig. 1)	V_{clamp}=125V L =500µH	20			A

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

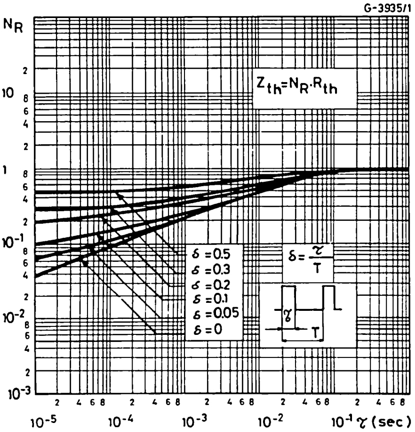
Safe operating areas



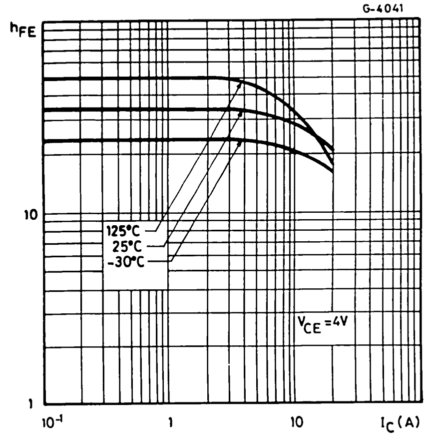
Derating curves



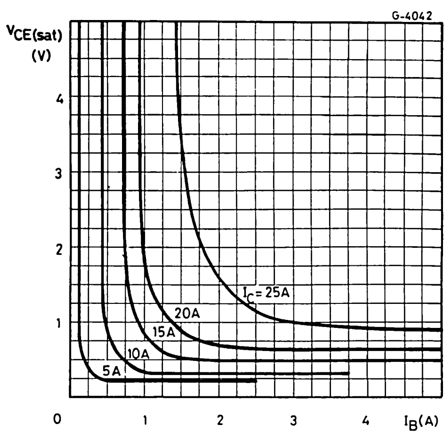
Thermal transient response



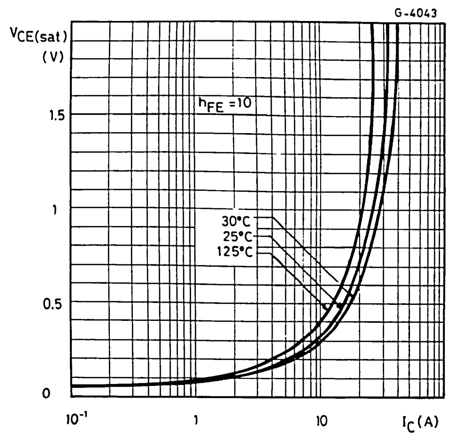
DC current gain



Collector-emitter saturation voltage

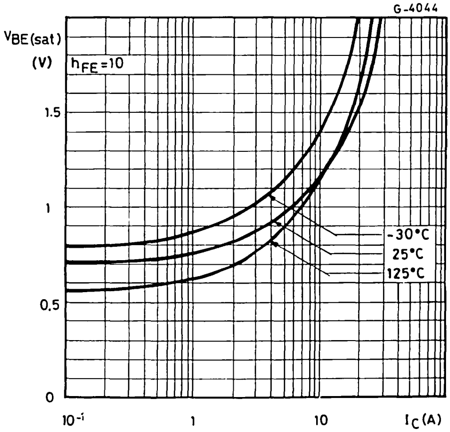


Collector-emitter saturation voltage

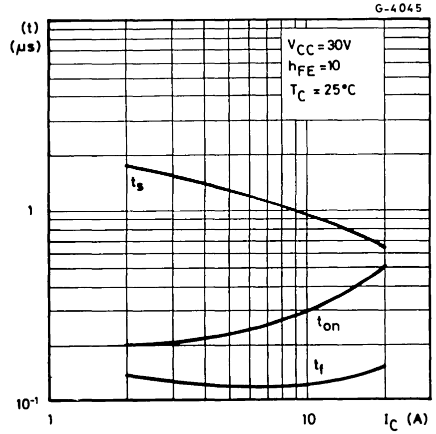


BUX10

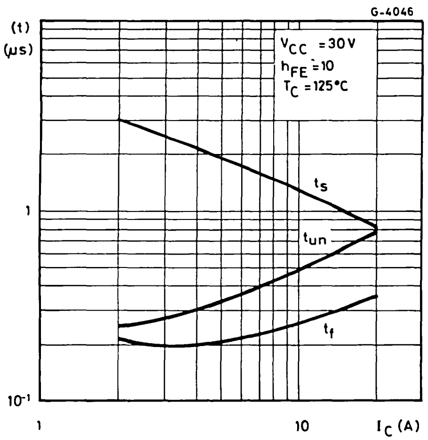
Base-emitter saturation voltage



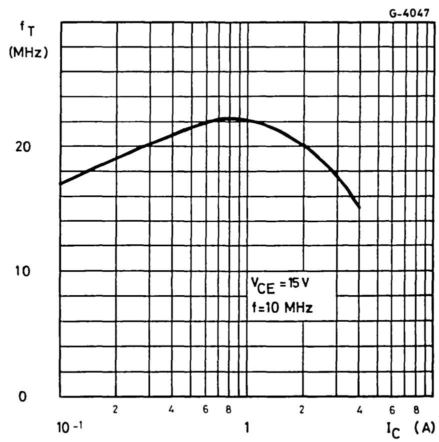
Saturated switching characteristics



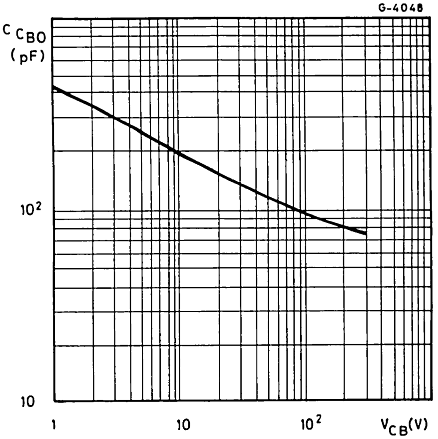
Saturated switching characteristics



Transition frequency



Collector-base capacitance



Clamped reverse bias safe operating area

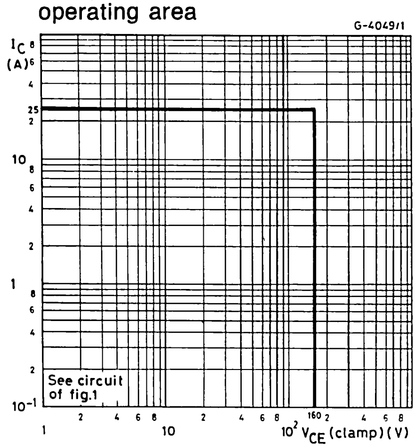


Fig. 1 — Clamped $E_{s/b}$ test circuit

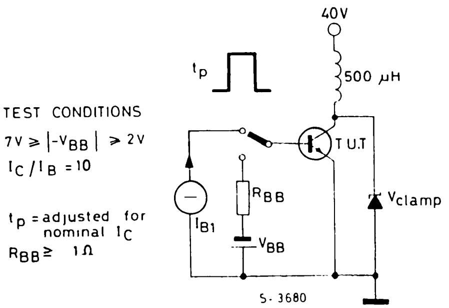
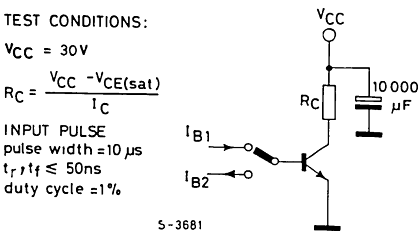


Fig. 2 — Switching times test circuit (resistive load)



BUX10P

MULTIEPITAXIAL PLANAR NPN

ADVANCE DATA

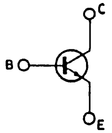
HIGH CURRENT, HIGH SPEED, POWER TRANSISTOR

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.

ABSOLUTE MAXIMUM RATINGS

V_{CBO}	Collector-base voltage ($I_E = 0$)	160	V
V_{CEX}	Collector-emitter voltage ($V_{BE} = 1.5V$)	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 ($t_p = 10ms$)	30	A
I_B	Base current	5	A
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	106	W
T_{stg}	Storage temperature	-65 to 150	°C
T_j	Junction temperature	150	°C

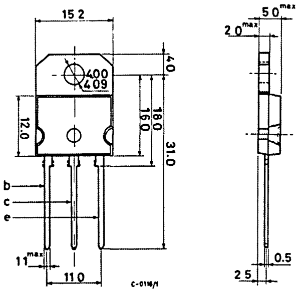
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



(sim. to **TO-218**) **SOT-93**

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max 1.17 °C/W

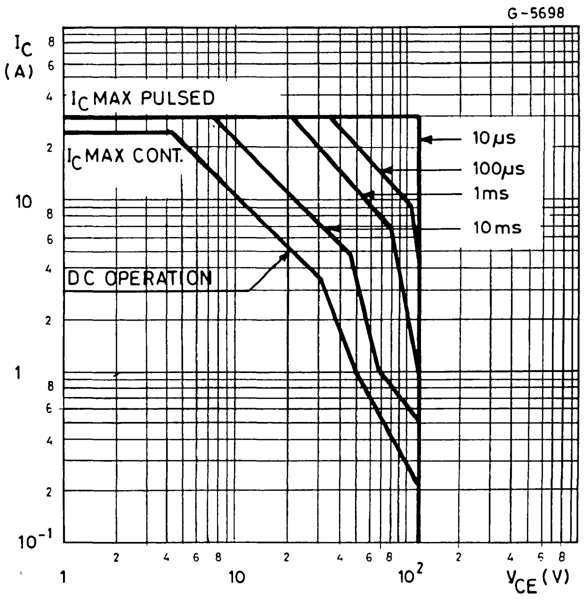
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Parameter		Test conditions	Min.	Typ.	Max	Unit
I_{CEO}	Collector cutoff current ($I_B = 0$)	$V_{CE} = 100V$			1.5	mA
I_{CEX}	Collector cutoff current	$V_{CE} = 160V$ $V_{BE} = -1.5V$			1.5	mA
		$T_{case} = 125°C$ $V_{CE} = 160V$ $V_{BE} = -1.5V$			6	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$			1	mA
$V_{CEO\,(sus)}$	Collector-emitter sustaining voltage	$I_C = 200mA$	125			V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	$I_E = 50mA$	7			V
$V_{CE\,(sat)}$	Collector-emitter saturation voltage	$I_C = 10A$ $I_B = 1A$		0.3	0.6	V
		$I_C = 20A$ $I_B = 2A$		0.7	1.2	V
$V_{BE\,(sat)}$	Base-emitter saturation voltage	$I_C = 20A$ $I_B = 2A$		1.6	2	V
h_{FE}	DC current gain	$I_C = 10A$ $V_{CE} = 2V$	20		60	–
		$I_C = 20A$ $V_{CE} = 4V$	10			–
$I_{s/b}$	Second breakdown collector current	$V_{CE} = 30V$ $t = 1s$	3.53			A
		$V_{CE} = 48V$ $t = 1s$	1			A
f_T	Transition frequency	$I_C = 1A$ $V_{CE} = 15V$ $f = 10$ MHz	8			MHz
t_{on}	Turn-on time	$I_C = 20A$ $I_{B1} = 2A$ $V_{CC} = 30V$		0.5	1.5	μs

ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditons	Min.	Typ.	Max.	Unit
t_s	Storage time	$I_C = 20A$ $V_{CC} = 30V$ $I_{B1} = I_{B2} = 2A$		0.6	1.2	μs
t_f	Fall time			0.15	0.3	μs
	Clamped $E_{s/b}$ Collector current	$V_{clamp} = 125V$ $L = 500\ \mu H$	20			A

Safe operating area



BUX11

MULTIEPITAXIAL PLANAR NPN

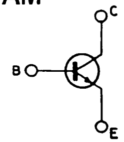
HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

The BUX 11 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.

ABSOLUTE MAXIMUM RATINGS

V_{CBO}	Collector-base voltage ($I_E=0$)	250	V
V_{CEX}	Collector-emitter voltage ($V_{BE}=-1.5V$)	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

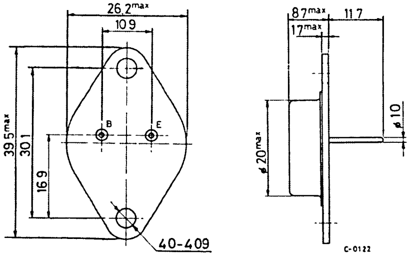
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

BUX11

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)

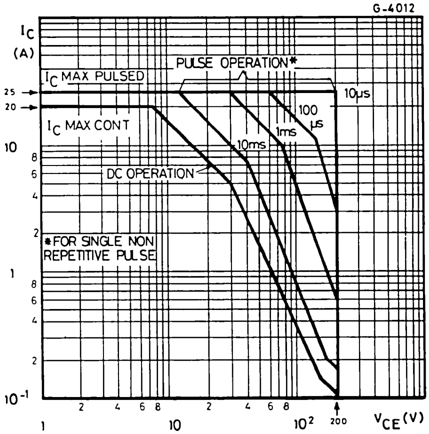
	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current (I_B=0)	V_{CE}=160V			1.5	mA
I_{CEX}	Collector cutoff current	V_{CE}=250V V_{BE}=-1.5V V_{CE}=250V V_{BE}=-1.5V T_{case}=125°C			1.5 6	mA mA
I_{EBO}	Emitter cutoff current (I_C=0)	V_{EB}=5V			1	mA
$V_{CEO\ (sus)}$	*Collector-emitter sustaining voltage	I_C =200mA	200			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 =0.6A I_C =12A I_B =1.5A		0.3 0.6	0.6 1.5	V V
$V_{BE(sat)}$*	Base-emitter saturation voltage	I_C =12A I_B =1.5A		1.3	1.5	V
h_{FE}*	DC current gain	I_C =6A V_{CE}=2V I_C =12A V_{CE}=4V	20 10		60	— —
$I_{s/b}$	Second breakdown collector current	V_{CE}=30V t = 1s V_{CE}=140V t = 1s	5 0.15			A A
f_T	Transition frequency	I_C =1A V_{CE}=15V f =10MHz	8			MHz

ELECTRICAL CHARACTERISTICS (continued)

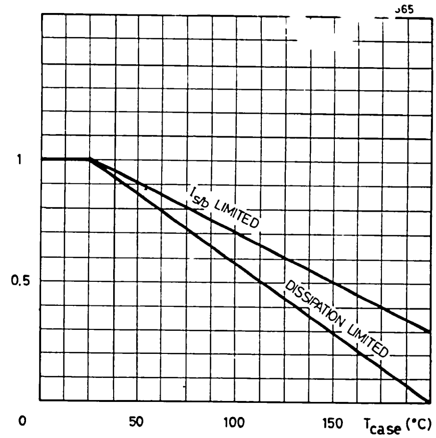
	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on time (fig. 2)	I_C =12A I_{B1} =1.5A V_{CC}=150V		0.3	1	µs
t_s	Storage time (fig. 2)	I_C =12A I_{B1} =1.5A I_{B2} =-1.5A V_{CC}=150V		1.2	1.8	µs
t_f	Fall time (fig. 2)	I_C =12A I_{B1} =1.5A I_{B2} =-1.5A V_{CC}=150V		0.24	0.4	µs
	Clamped $E_{s/b}$ Collector current (fig. 1)	V_{clamp}=200V L =500µH	12			A

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

Safe operating areas

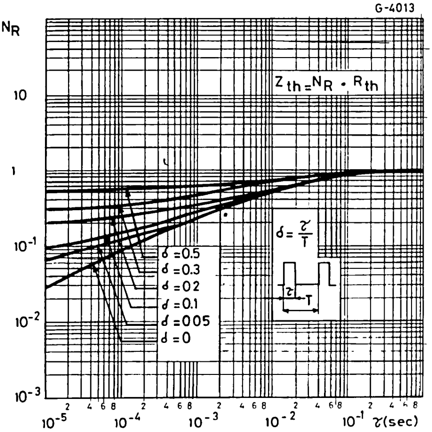


Derating curves

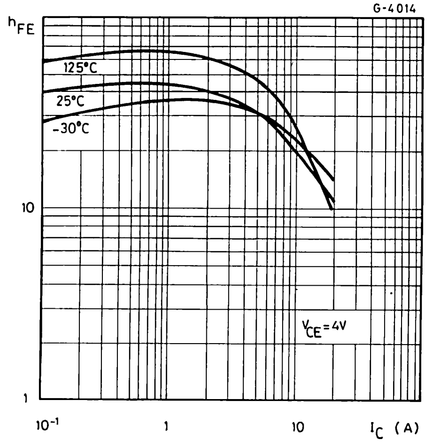


BUX11

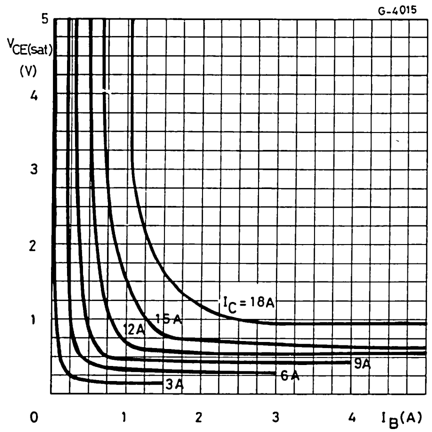
Thermal transient response



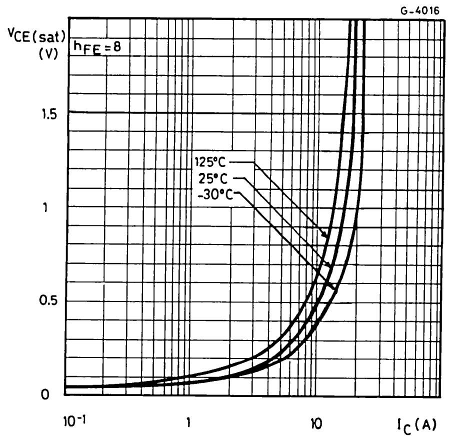
DC current gain



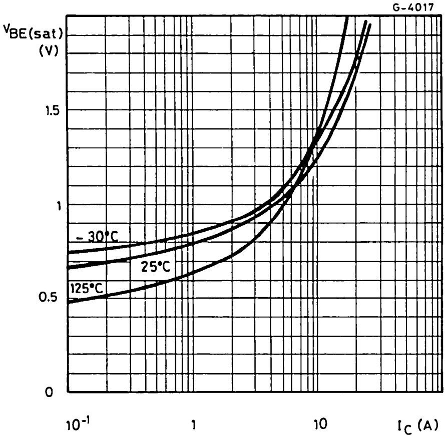
Collector-emitter saturation voltage



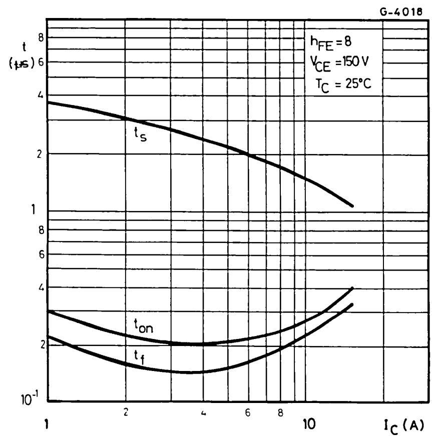
Collector-emitter saturation voltage



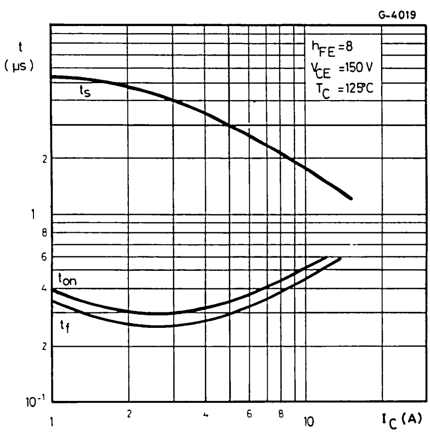
Base-emitter saturation voltage



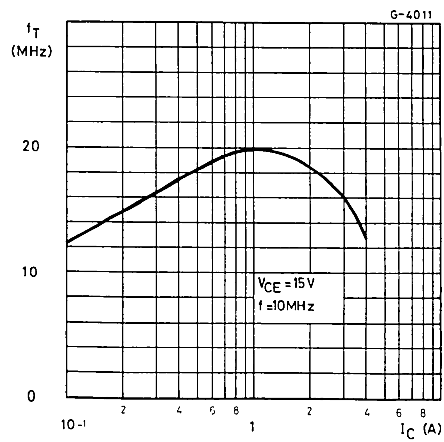
Saturated switching characteristics



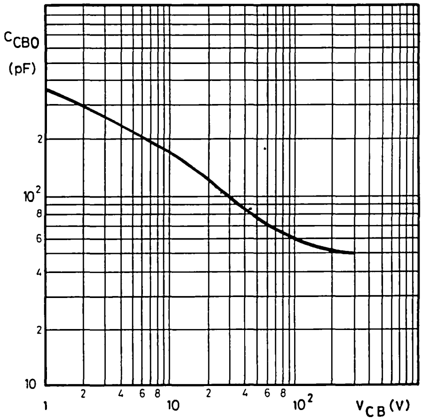
Saturated switching characteristics



Transition frequency



Collector-base capacitance



Clamped reverse bias safe operating area

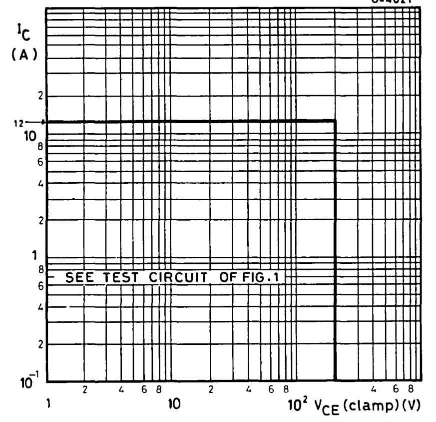


Fig. 1 — Clamped $E_{s/b}$ test circuit

TEST CONDITIONS:

$7V \geq |-V_{BB}| \geq 2V$

$I_C / I_B = 8$

t_p = adjusted for nominal I_C

$R_{BB} \geq 1\,\Omega$

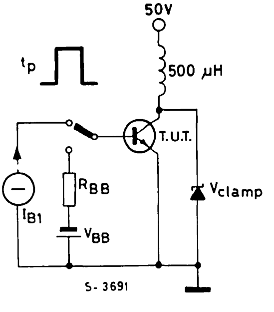


Fig. 2 — Switching times test circuit (resistive load)

TEST CONDITIONS:

V_{CC} = 150 V

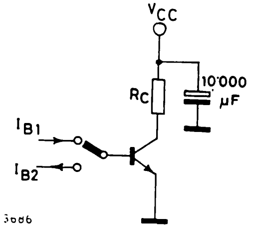
$$R_C = \frac{V_{CC} - V_{CE(sat)}}{I_C}$$

INPUT PULSE

pulse width = 10 μs

$t_r, t_f \leq 50$ns

duty cycle = 1 %



MULTIEPITAXIAL PLANAR NPN

BUX11N

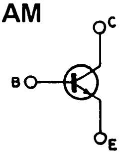
HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

The BUX 11N 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.

ABSOLUTE MAXIMUM RATINGS

V_{CBO}	Collector-base voltage ($I_E = 0$)	220	V
V_{CEX}	Collector-emitter voltage ($V_{BE} = -1.5V$)	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

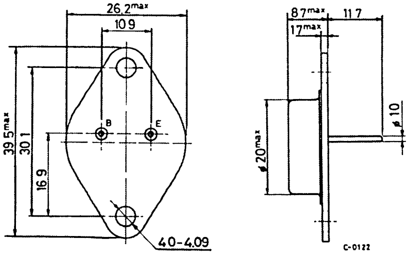
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

BUX11N

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)

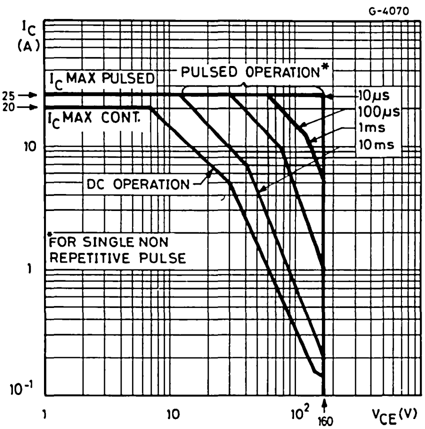
	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current (I_B=0)	V_{CE}= 130V			1.5	mA
I_{CEX}	Collector cutoff current	V_{CE}= 220V V_{BE}= -1.5V V_{CE}= 220V V_{BE}= -1.5V T_{case}= 125°C			1.5 6	mA mA
I_{EBO}	Emitter cutoff current (I_C= 0)	V_{EB}= 5V			1	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage	I_C = 200mA L = 25 mH	160			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 = 0.8A I_C = 15A I_B = 1.88A		0.3 0.6	0.6 1.5	V V
$V_{BE(sat)}$*	Base-emitter saturation voltage	I_C = 15A I_B = 1.88A		1.4	1.8	V
h_{FE}*	DC current gain	I_C = 8A V_{CE}= 2V I_C = 15A V_{CE}= 4V	20 10		60	– –
$I_{s/b}$	Second breakdown collector current	V_{CE}= 30V t = 1s V_{CE}= 140V t = 1s	5 0.15			A A
f_T	Transition frequency	V_{CE}= 15V I_C = 1A f = 10MHz	8			MHz

ELECTRICAL CHARACTERISTICS (continued)

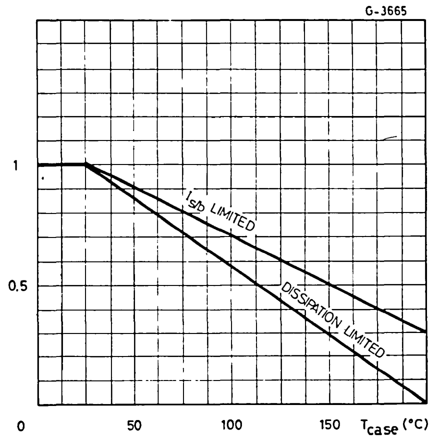
	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on time (fig. 2)	$I_C = 15A$ $I_{B1} = 1.88A$ $V_{CC} = 30V$		0.4	1.5	µs
t_s	Storage time (fig. 2)	$I_C = 15A$ $I_{B1} = -I_{B2} = 1.88A$ $V_{CC} = 30V$		0.75	1.5	µs
t_f	Fall time (fig. 2)			0.14	0.5	µs
	Clamped $E_{s/b}$ Collector current (fig. 1)	$V_{clamp} = 160V$ $L = 500µH$	15			A

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

Safe operating areas

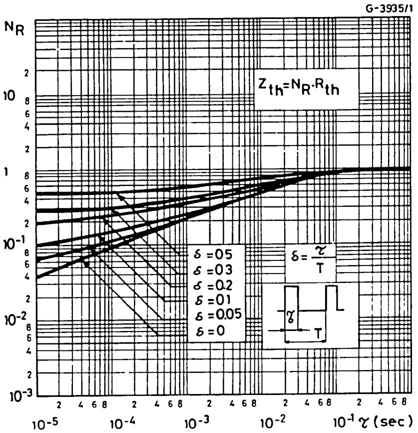


Derating curves

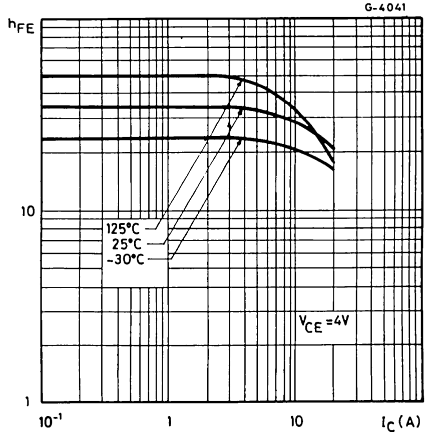


BUX11N

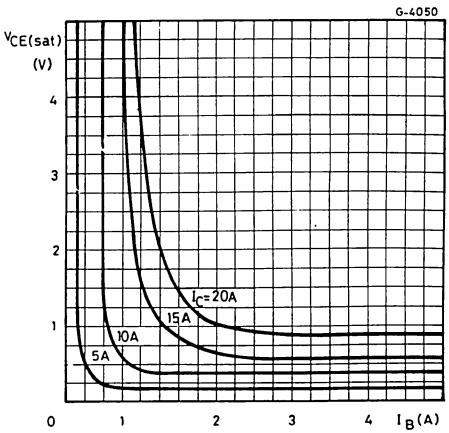
Thermal transient response



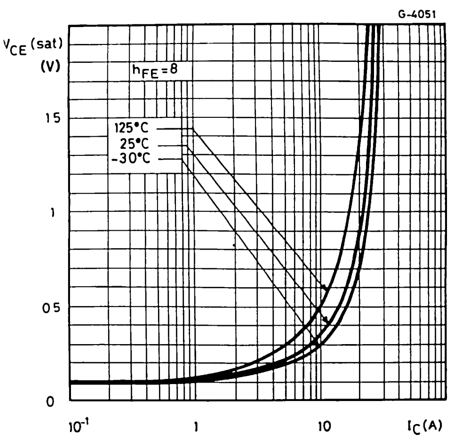
DC current gain



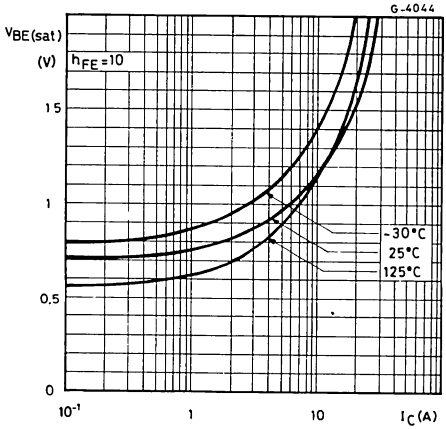
Collector-emitter saturation voltage



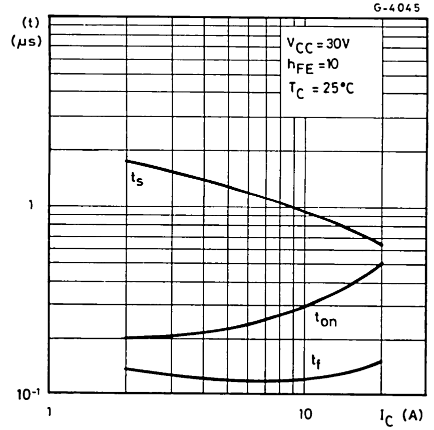
Collector-emitter saturation voltage



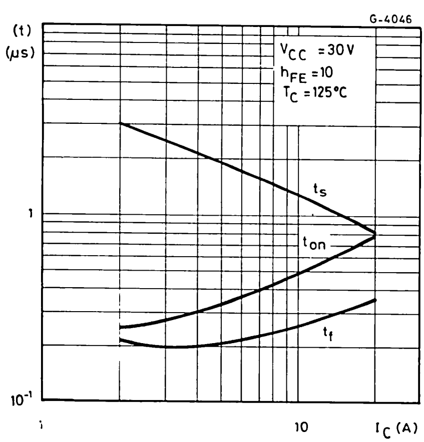
Base-emitter saturation voltage



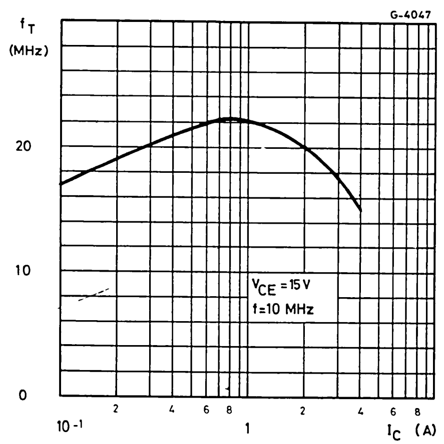
Saturated switching characteristics



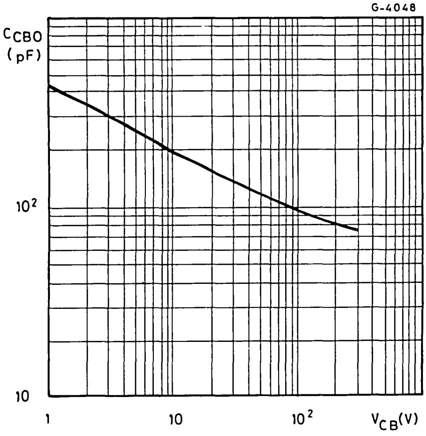
Saturated switching characteristics



Transition frequency



Collector base capacitance



Clamped reverse bias safe operating areas

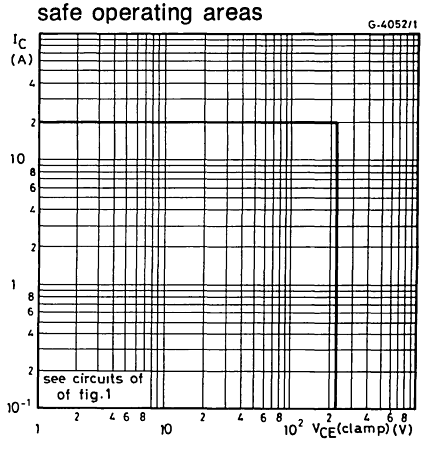


Fig. 1 – Clamped $E_{s/b}$ test circuit

TEST CONDITIONS

$7V \geq |-V_{BB}| \geq 2V$

$I_C / I_B = 8$

t_p = adjusted for nominal I_C

$R_{BB} \geq 1\,\Omega$

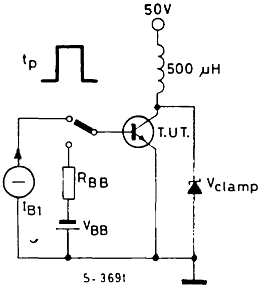


Fig. 2 – Switching times test circuit (Resistive load)

TEST CONDITIONS:

V_{CC} = 30V

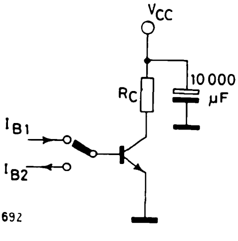
$$R_C = \frac{V_{CC} - V_{CE(sat)}}{I_C}$$

INPUT PULSE

pulse width = 10 μs

$t_r, t_f \leq$ 50ns

duty cycle = 1%



MULTIEPITAXIAL PLANAR NPN

BUX12

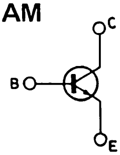
HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

The BUX 12 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.

ABSOLUTE MAXIMUM RATINGS

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 ($I_B=0$)	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

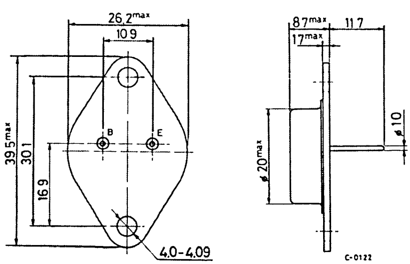
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

BUX12

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)

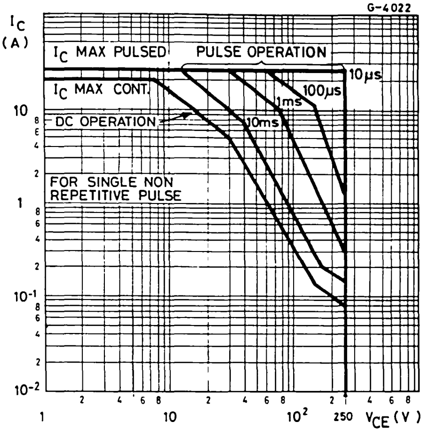
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B=0$)	$V_{CE}=200V$			1.5	mA
I_{CEX}	Collector cutoff current	$V_{CE}=300V$ $V_{BE}=-1.5V$ $T_{case}=125\,°C$ $V_{CE}=300V$ $V_{BE}=-1.5V$			1.5 6	mA mA
$V_{CEO\,(sus)}$*	Collector-emitter sustaining voltage	$I_C=200mA$	250			V
I_{EBO}	Emitter cutoff current ($I_C=0$)	$V_{EB}=5V$			1	mA
V_{EBO}	Emitter-base voltage ($I_C=0$)	$I_E=50mA$	7			V
$V_{CE\,(sat)}$*	Collector-emitter saturation voltage	$I_C=5A$ $I_B=0.5A$ $I_C=10A$ $I_B=1.25A$		0.22 0.5	1 1.5	V V
$V_{BE(sat)}$*	Base-emitter saturation voltage	$I_C=10A$ $I_B=1.25A$		1.23	1.5	V
h_{FE}*	DC current gain	$I_C=5A$ $V_{CE}=4V$ $I_C=10A$ $V_{CE}=4V$	20 10		60	— —
$I_{s/b}$	Second breakdown collector current	$V_{CE}=30V$ $t=1s$ $V_{CE}=140V$ $t=1s$	5 0.15			A A
f_T	Transition frequency	$I_C=1A$ $V_{CE}=15V$ $f=10MHz$	8			MHz

ELECTRICAL CHARACTERISTICS (continued)

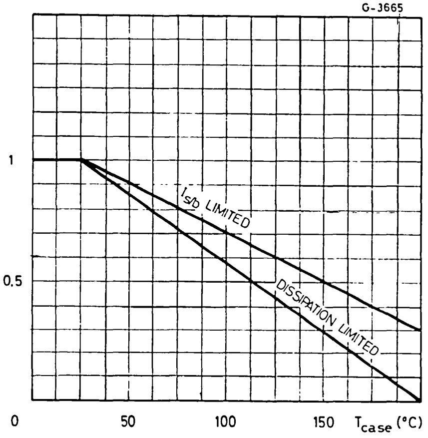
Parameter		Test conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on time (fig. 2)	I_C =10A I_{B1} =1.25A V_{CC}=150V		0.28	1	µs
t_s	Storage time (fig. 2)	I_C =10A I_{B1} =1.25A I_{B2} =-1.25A V_{CC}=150V		1.45	2	µs
t_f	Fall time (fig. 2)	I_C =10A I_{B1} =1.25A I_{B2} =-1.25A V_{CC}=150V		0.23	0.5	µs
	Clamped $E_{s/b}$ Collector current (fig. 1)	V_{clamp}=250V L = 500µH	10			A

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

Safe operating areas

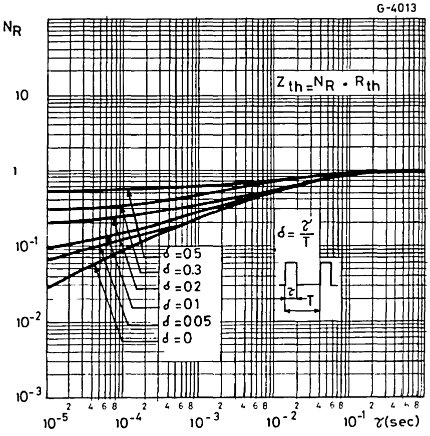


Derating curves

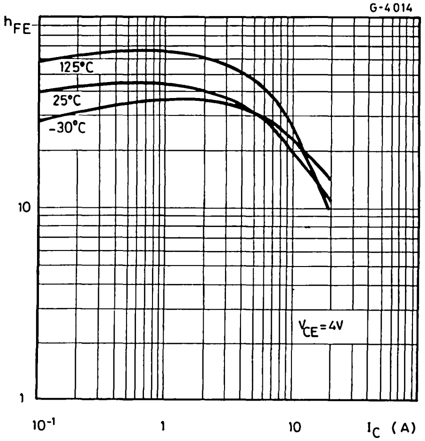


BUX12

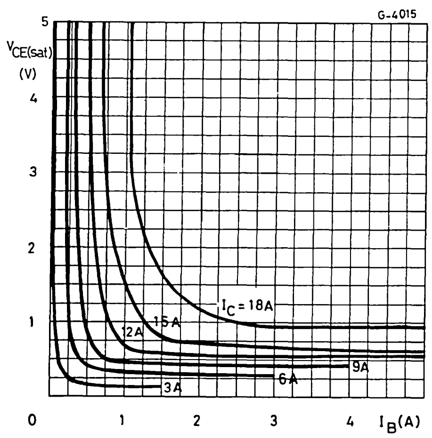
Thermal transient response



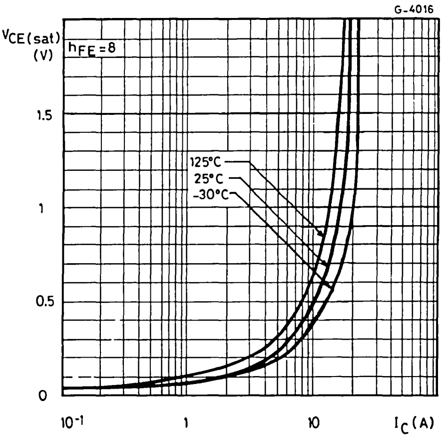
DC current gain



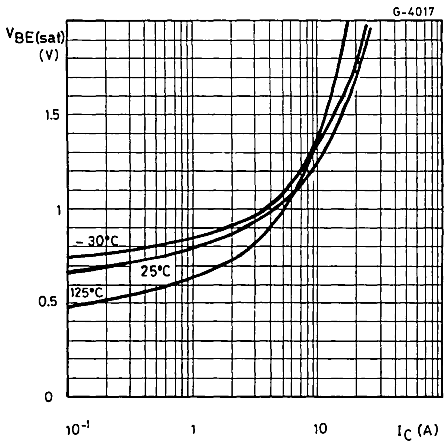
Collector-emitter saturation voltage



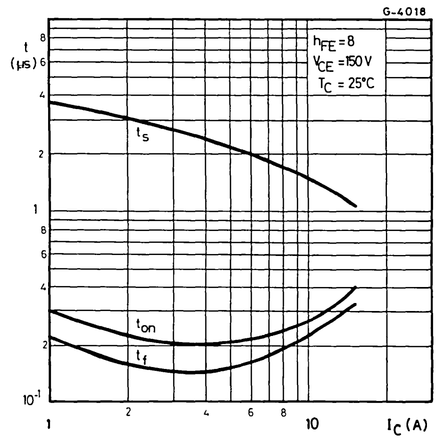
Collector-emitter saturation voltage



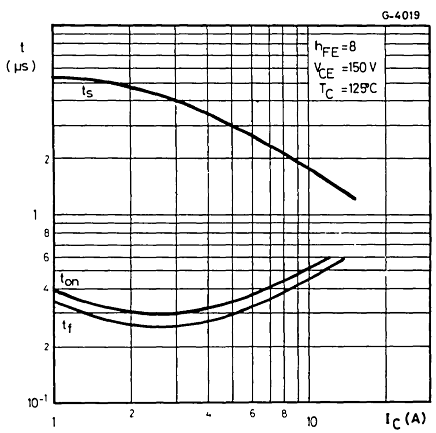
Base-emitter saturation voltage



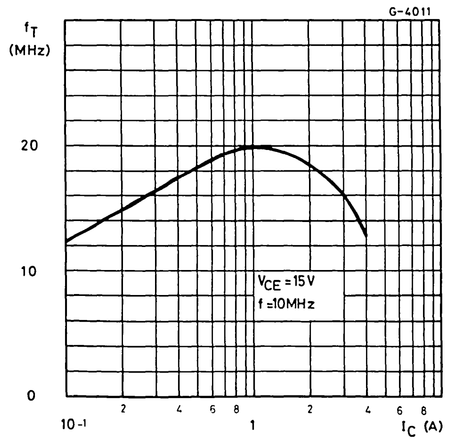
Saturated switching characteristics



Saturated switching characteristics

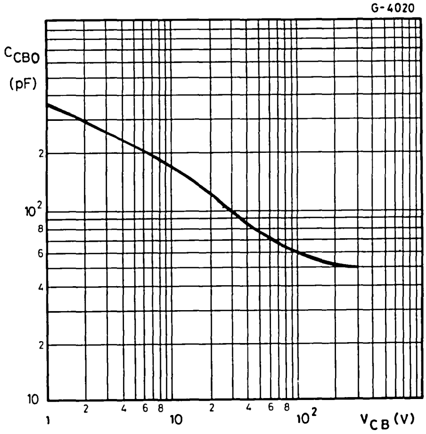


Transition frequency



BUX12

Collector-base capacitance



Clamped reverse bias safe operating areas

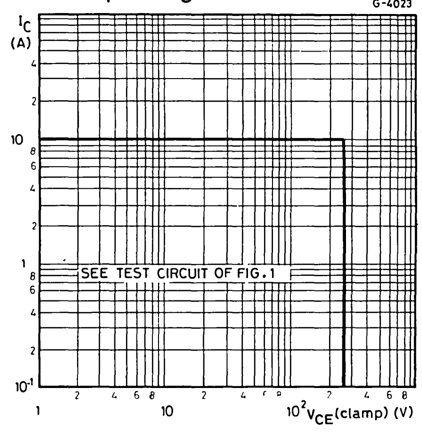


Fig. 1 — Clamped $E_{s/b}$ test circuit

TEST CONDITIONS

$7V \geq |-V_{BB}| \geq 2V$

$I_C / I_B = 8$

t_p = adjusted for nominal I_C

$R_{BB} \geq 1\,\Omega$

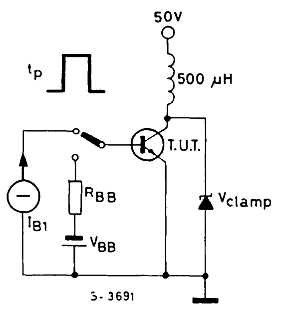


Fig. 2 — Switching times test circuit (resistive load)

TEST CONDITIONS.

V_{CC} = 150V

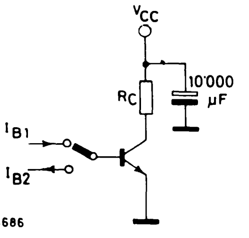
$R_C = \dfrac{V_{CC} - V_{CE(sat)}}{I_C}$

INPUT PULSE

pulse width = 10 µs

$t_r, t_f \leq$ 50ns

duty cycle = 1%



MULTIEPITAXIAL MESA NPN

BUX13

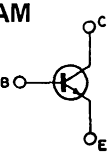
HIGH VOLTAGE POWER SWITCH

The BUX 13 is a silicon multiepitaxial mesa NPN transistor in Jedec TO-3 metal case, intended for high voltage, fast switching applications.

ABSOLUTE MAXIMUM RATINGS

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 ($t_p \leq 10ms$)	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

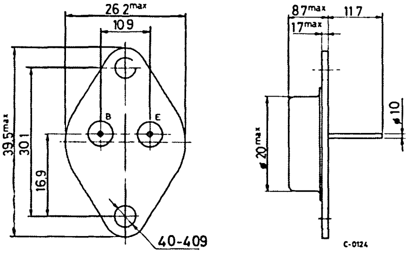
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

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)

Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current (V_{BE} = 0)	V_{CE} = 400V V_{CE} = 400V	 T_{case} = 125°C			1.5 6	mA mA
I_{CEO}	Collector cutoff current (I_B = 0)	V_{CE} = 260V				1.5	mA
I_{EBO}	Emitter cutoff current (I_C = 0)	V_{EB} = 7V				1	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage (I_B = 0)	I_C = 100mA		325			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	I_C = 4A I_C = 8A	I_B = 0.8A I_B = 1.6A			0.8 1.5	V V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	I_C = 8A	I_B = 1.6A			1.5	V
h_{FE}*	DC current gain	I_C = 4A I_C = 8A	V_{CE} = 4V V_{CE} = 4V	15 8		60	— —
f_T	Transition frequency	I_C = 1A f = 10MHz	V_{CE} = 15V	8			MHz
t_{on}	Turn-on time	I_C = 8A V_{CC} = 150V	I_{B1} = 1.6A			1.2	μs
t_s	Storage time	I_C = 8A I_{B1} = $-I_{B2}$ = 1.6A V_{CC} = 150V				2.5	μs
t_f	Fall time					1	μs

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

MULTIEPITAXIAL MESA NPN

BUX14

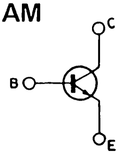
HIGH VOLTAGE POWER SWITCH

The BUX 14 is a silicon multiepitaxial mesa NPN transistor in Jedec TO-3 metal case, intended for high voltage, fast switching applications

ABSOLUTE MAXIMUM RATINGS

V_{CES}	Collector-emitter voltage ($V_{BE} = 0$)	450	V
V_{CER}	Collector-emitter voltage ($R_{BE} \leqslant 100\Omega$)	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 ($t_p \leqslant 10ms$)	15	A
I_B	Base current	2	A
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	150	W
T_{stg}	Storage temperature	–65 to 200	°C
T_j	Junction temperature	200	°C

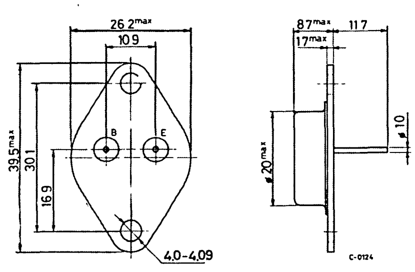
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

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)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current (V_{BE} = 0)	V_{CE} = 450V V_{CE} = 450V T_{case} = 125°C			1.5 6	mA mA
I_{CEO}	Collector cutoff current (I_B = 0)	V_{CE} = 320V			1.5	mA
I_{EBO}	Emitter cutoff current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage (I_B = 0)	I_C = 100mA	400			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	I_C = 3A I_B = 0.6A I_C = 6A I_B = 1.2A			0.6 1.5	V V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	I_C = 6A I_B = 1.2A			1.5	V
h_{FE}*	DC current gain	I_C = 3A V_{CE} = 4V I_C = 6A V_{CE} = 4V	15 8		60	— —
f_T	Transition frequency	I_C = 1A V_{CE} = 15V f = 10MHz	8			MHz
t_{on}	Turn-on time	I_C = 6A I_{B1} = 1.2A V_{CC} = 150V			1.4	μs
t_s	Storage time	I_C = 6A $I_{B1} = -I_{B2}$ = 1.2A V_{CC} = 150V			3	μs
t_f	Fall time				1.2	μs

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

BUX20

MULTIEPITAXIAL PLANAR NPN

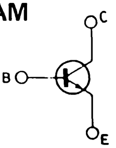
HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

The BUX 20 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.

ABSOLUTE MAXIMUM RATINGS

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

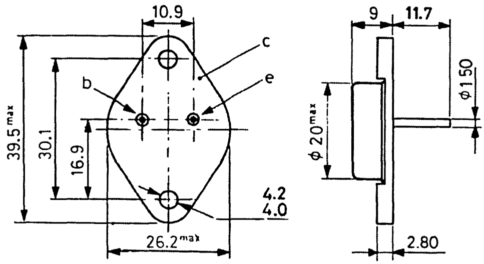
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



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Modified TO-3

BUX20

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)

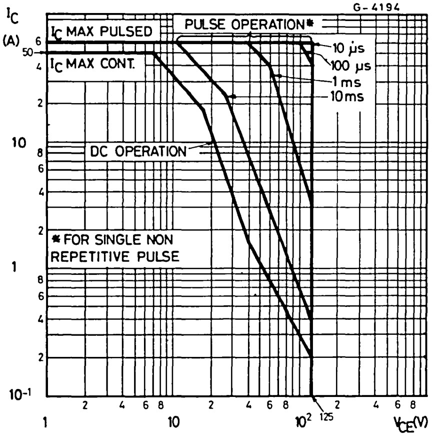
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current (I_B=0)	V_{CE}=100V			3	mA
I_{CEX}	Collector cutoff current	V_{CE}=160V V_{BE}=-1.5V T_{case}=125°C V_{CE}=160V V_{BE}=-1.5V			3 12	mA mA
I_{EBO}	Emitter cutoff current (I_C=0)	V_{EB}=5V			1	mA
$V_{CEO\ (sus)}$	*Collector-emitter sustaining voltage	I_C =200mA	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 =2.5A I_C =50A I_B =5A		0.3 0.55	0.6 1.2	V V
$V_{BE(sat)}$*	Base-emitter saturation voltage	I_C =50A I_B =5A		1.35	2	V
h_{FE}*	DC current gain	I_C =25A V_{CE}=2V I_C =50A V_{CE}=4V	20 10		60	– –
$I_{s/b}$	Second breakdown collector current	V_{CE}=40V t = 1s V_{CE}=20V t = 1s	1.5 17.5			A A
f_T	Transition frequency	V_{CE}=15V I_C =2A f =10MHz	8			MHz

ELECTRICAL CHARACTERISTICS (continued)

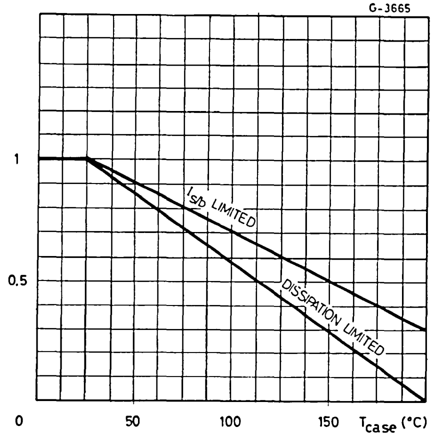
	Parameter	Test conditions	Min. Typ. Max.	Unit
t_{on}	Turn-on time (fig. 2)	I_C =50A I_{B1} =5A V_{CC}=60V	0.4 1.5	µs
t_s	Storage time (fig. 2)	I_C =50A I_{B1} =5A I_{B2} =-5A V_{CC}=60V	0.85 1.2	µs
t_f	Fall time (fig. 2)		0.1 0.3	µs
	Clamped $E_{s/b}$ Collector current (fig. 1)	V_{clamp}=125V L =500µH	50	A

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

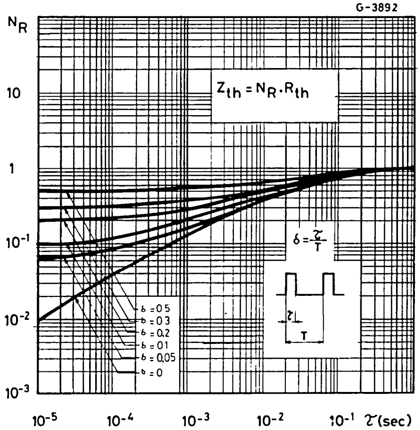
Safe operating areas



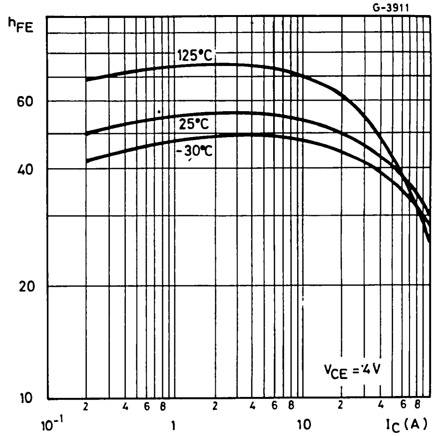
Derating curves



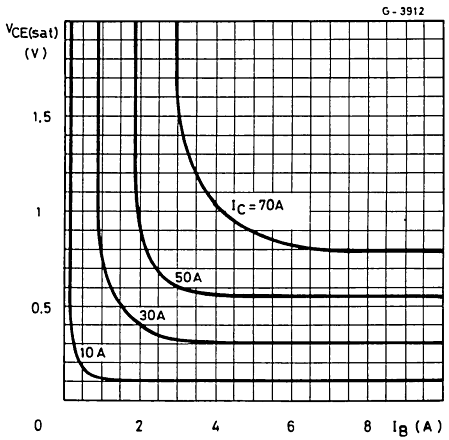
Thermal transient response



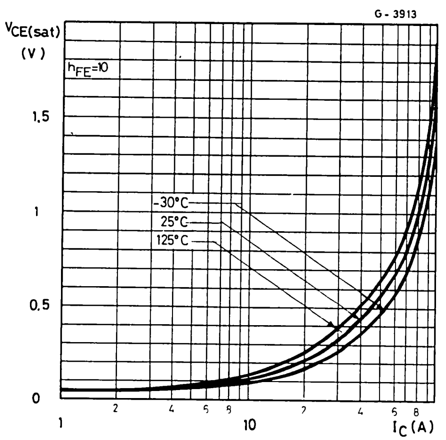
DC current gain



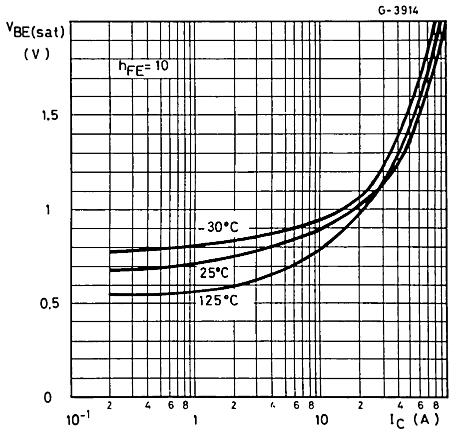
Collector-emitter saturation voltage



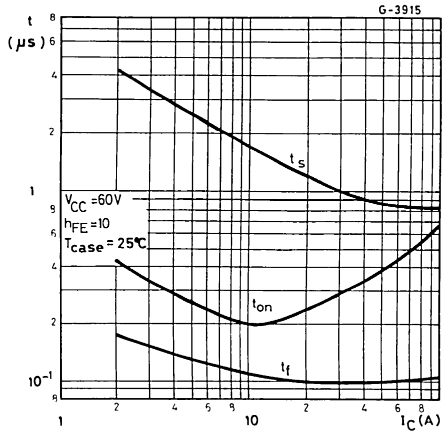
Collector-emitter saturation voltage



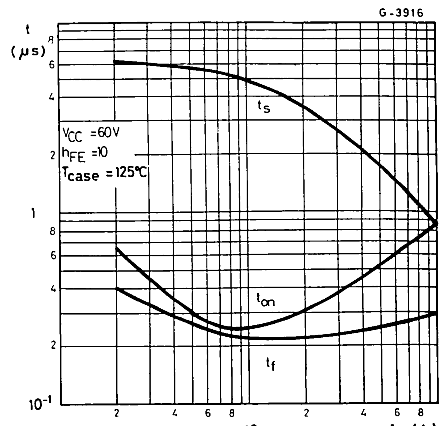
Base-emitter saturation voltage



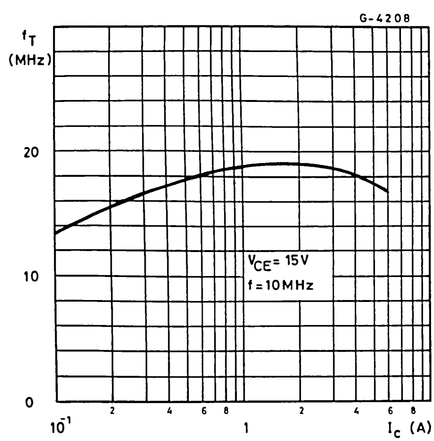
Saturated switching characteristics



Saturated switching characteristics

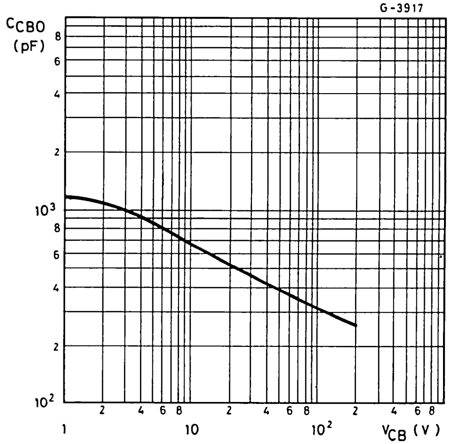


Transition frequency



BUX20

Collector-base capacitance



Clamped reverse bias safe operating areas

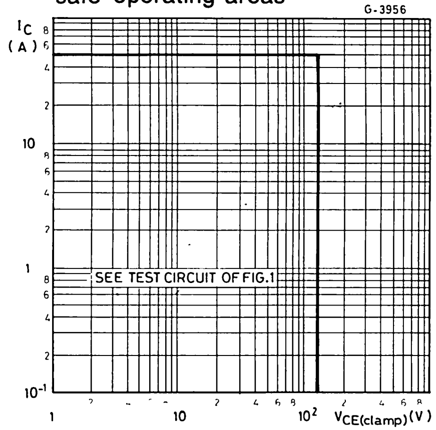


Fig. 1 — Clamped $E_{s/b}$ test circuit

TEST CONDITIONS

$7V \geq |-V_{BB}| \geq 2V$

$I_C / I_B = 10$

t_p = adjusted for nominal I_C

$R_{BB} \geq 1\Omega$

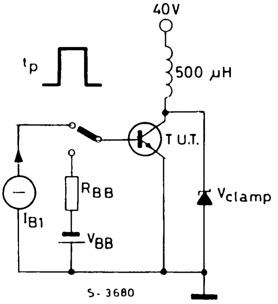


Fig. 2 — Switching times test circuit (resistive load)

TEST CONDITIONS:

V_{CC} = 60 V

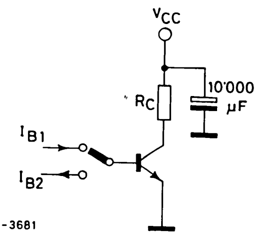
$$R_C = \frac{V_{CC} - V_{CE(sat)}}{I_C}$$

INPUT PULSE

pulse width = 10 µs

$t_r, t_f \leq$ 50ns

duty cycle = 1%



BUX21

MULTIEPITAXIAL PLANAR NPN

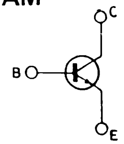
HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

The BUX 21 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.

ABSOLUTE MAXIMUM RATINGS

V_{CBO}	Collector-base voltage ($I_E=0$)	250	V
V_{CEX}	Collector-emitter voltage ($V_{EB}=-1.5V$)	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

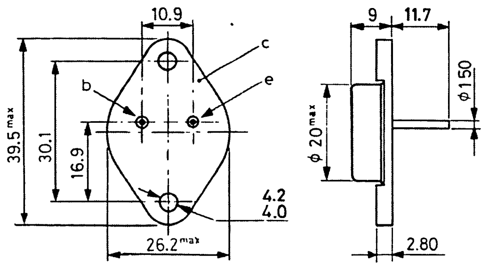
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



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Modified TO-3

BUX21

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)

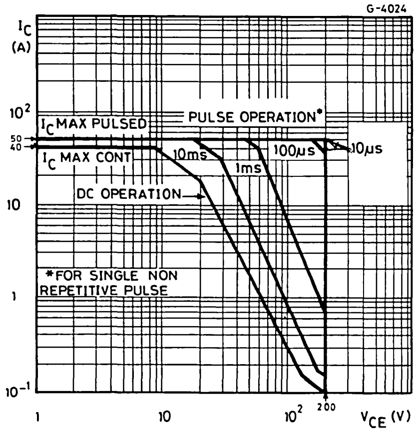
	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B = 0$)	$V_{CE} = 160V$			3	mA
I_{CEX}	Collector cutoff current	$V_{CE} = 250V$ $V_{BE} = -1.5V$			3	mA
		$T_{case} = 125°C$ $V_{CE} = 250V$ $V_{BE} = -1.5V$			12	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$			1	mA
$V_{CEO\,(sus)}$*	Collector-emitter sustaining voltage	$I_C = 200mA$	200			V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	$I_E = 50mA$	7			V
$V_{CE\,(sat)}$*	Collector-emitter saturation voltage	$I_C = 12A$ $I_B = 1.2A$		0.22	0.6	V
		$I_C = 25A$ $I_B = 3A$		0.4	1.5	V
$V_{BE(sat)}$*	Base-emitter saturation voltage	$I_C = 25A$ $I_B = 3A$		1.2	1.5	V
h_{FE}*	DC current gain	$I_C = 12$ $V_{CE} = 2V$	20		60	—
		$I_C = 25$ $V_{CE} = 4V$	10			—
$I_{s/b}$	Second breakdown collector current	$V_{CE} = 140V$ $t = 1s$	0.15			A
		$V_{CE} = 20V$ $t = 1s$	17.5			A
f_T	Transition frequency	$V_{CE} = 15V$ $I_C = 2$ $f = 10MHz$	8			MHz

ELECTRICAL CHARACTERISTICS (continued)

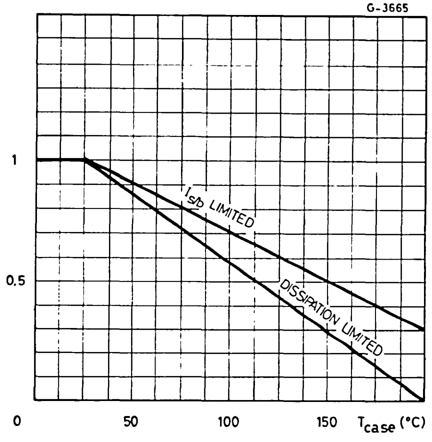
	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on time (fig. 2)	I_C =25A I_{B1} =3A V_{CC}=100V		0.24	1.2	µs
t_s	Storage time (fig. 2)	I_C =25A I_{B1} =3A I_{B2} =-3A V_{CC}=100V		1.3	1.8	µs
t_f	Fall time (fig. 2)			0.18	0.4	µs
	Clamped $E_{s/b}$ Collector current (fig. 1)	V_{clamp}=200V L =500µH	30			A

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

Safe operating areas

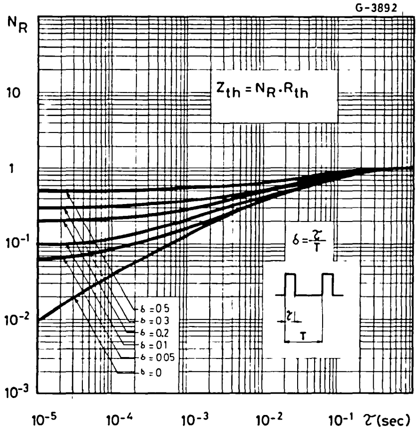


Derating curves

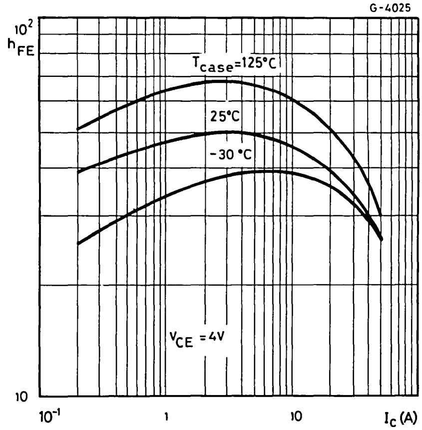


BUX21

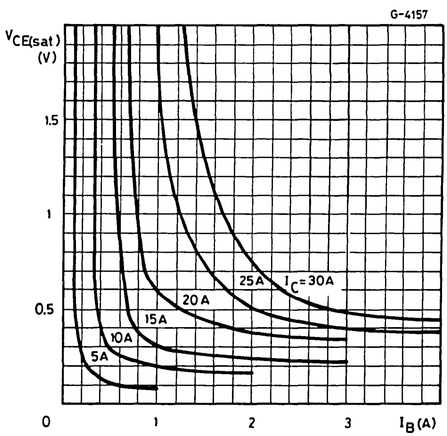
Thermal transient response



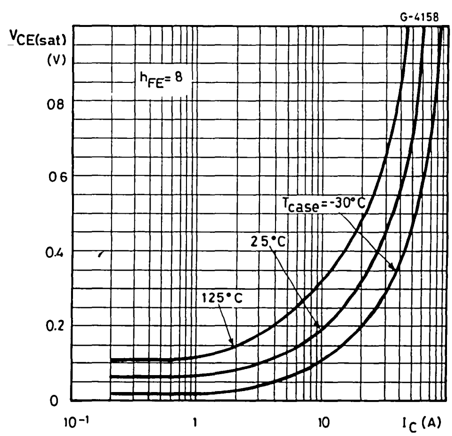
DC current gain



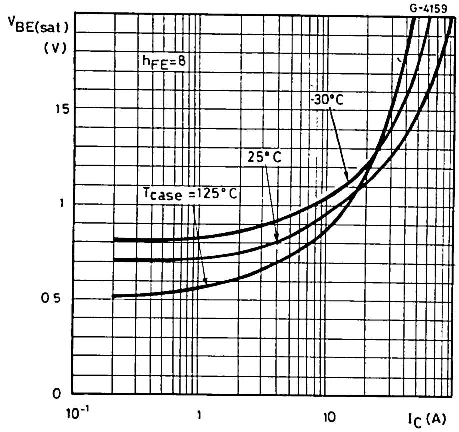
Collector-emitter saturation voltage



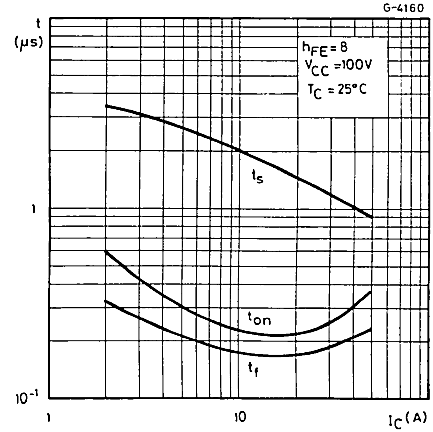
Collector-emitter saturation voltage



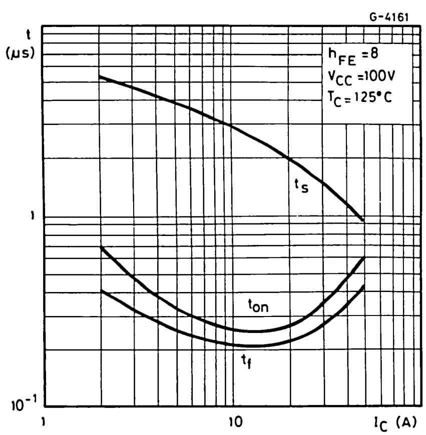
Base-emitter saturation voltage



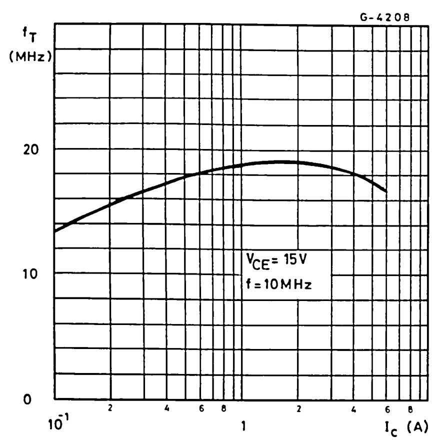
Saturated switching characteristics



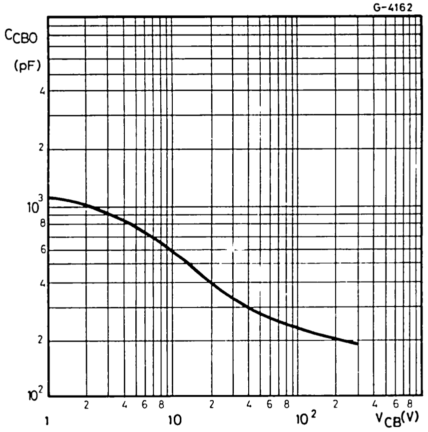
Saturated switching characteristics



Transition frequency



Collector-base capacitance



Clamped reverse bias safe operating areas

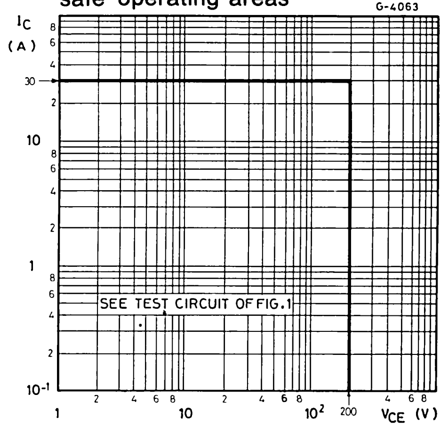


Fig. 1 — Clamped $E_{s/b}$ test circuit

TEST CONDITIONS:
$7V \geq |-V_{BB}| \geq 2V$
$I_C/I_B = 8$

t_p = adjusted for nominal I_C.
$R_{BB} = 1\Omega$

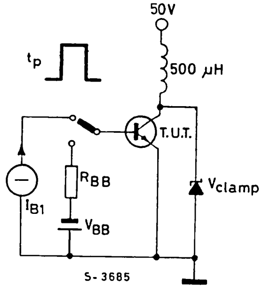
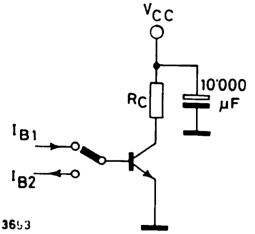


Fig. 2 — Switching times test circuit (resistive load)

TEST CONDITIONS:
$V_{CC} = 100V$

$R_C = \frac{V_{CC} - V_{CE(sat)}}{I_C}$

INPUT PULSE
pulse width = 5µs
$t_r, t_f \leq 50ns$
duty cycle = 1%



MULTIEPITAXIAL PLANAR NPN

BUX22

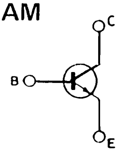
HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

The BUX 22 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.

ABSOLUTE MAXIMUM RATINGS

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 ($I_B=0$)	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 $T_{case} \leq 25\,°C$	350	W
T_{stg}	Storage temperature	-65 to 200	°C
T_j	Junction temperature	200	°C

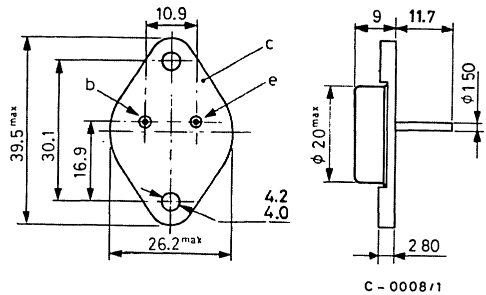
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



C - 0008/1

Modified TO-3

BUX22

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)

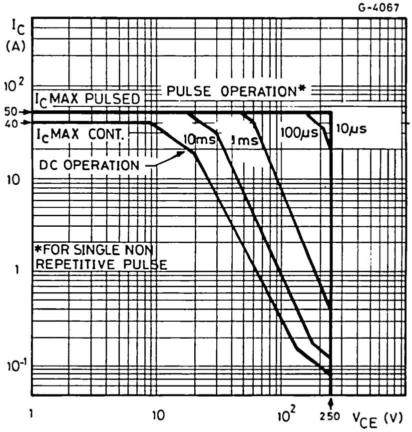
	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B = 0$)	$V_{CE} = 200V$			3	mA
I_{CEX}	Collector cutoff current	$V_{CE} = 300V$ $V_{BE} = -1.5V$			3	mA
		$T_{case} = 125\,°C$ $V_{CE} = 300V$ $V_{BE} = -1.5V$			12	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$			1	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage	$I_C = 200mA$	250			V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	$I_E = 50mA$	7			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	$I_C = 10A$ $I_B = 1A$		0.2	1	V
		$I_C = 20A$ $I_B = 2.5A$		0.32	1.5	V
$V_{BE(sat)}$*	Base-emitter saturation voltage	$I_C = 20A$ $I_B = 2.5A$		1.1	1.5	V
h_{FE}*	DC current gain	$I_C = 10A$ $V_{CE} = 4V$	20		60	—
		$I_C = 20A$ $V_{CE} = 4V$	10			—
$I_{s/b}$	Second breakdown collector current	$V_{CE} = 140V$ $t = 1s$	0.15			A
		$V_{CE} = 20V$ $t = 1s$	17.5			A
f_T	Transition frequency	$I_C = 2A$ $V_{CE} = 15V$ $f = 10MHz$	10			MHz

ELECTRICAL CHARACTERISTICS (continued)

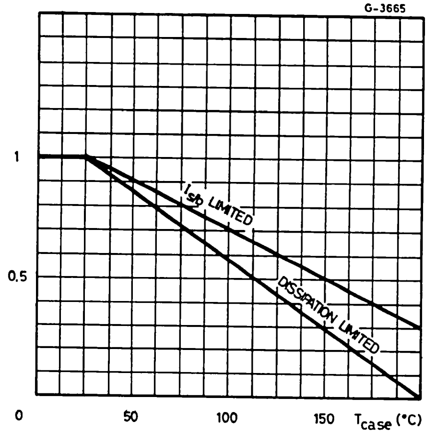
	Parameter	Test conditions	Min. Typ. Max.	Unit
t_{on}	Turn-on time (fig. 2)	I_C =20A I_{B1} =2.5A V_{CC}=100V	0.22 1.3	µs
t_s	Storage time (fig. 2)	I_C =20A I_{B1} =2.5A I_{B2} =-2.5A V_{CC}=100V	1.5 2	µs
t_f	Fall time (fig. 2)		0.17 0.5	µs
	Clamped $E_{s/b}$ Collector current (fig. 1)	V_{clamp}=250V L =500µH	25	A

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

Safe operating areas

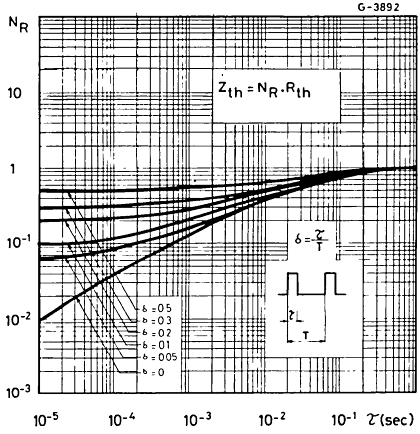


Derating curves

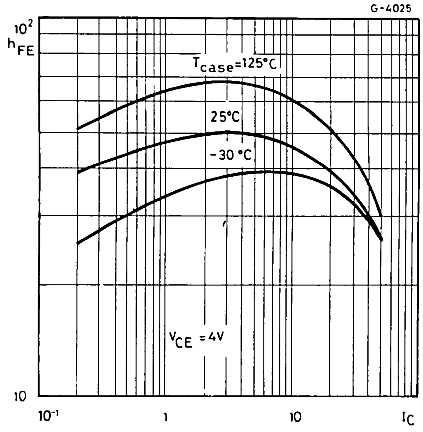


BUX22

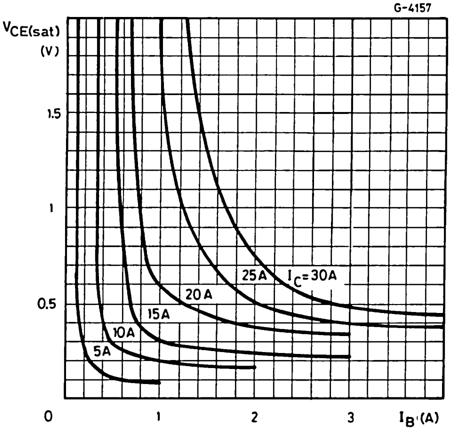
Thermal transient response



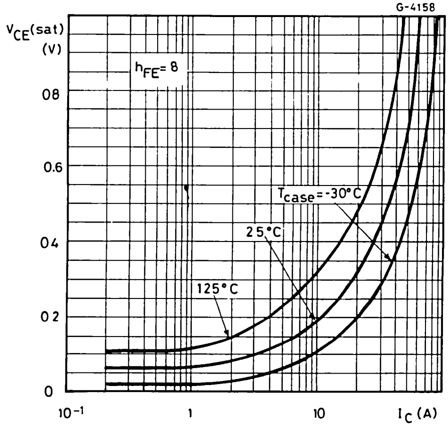
DC current gain



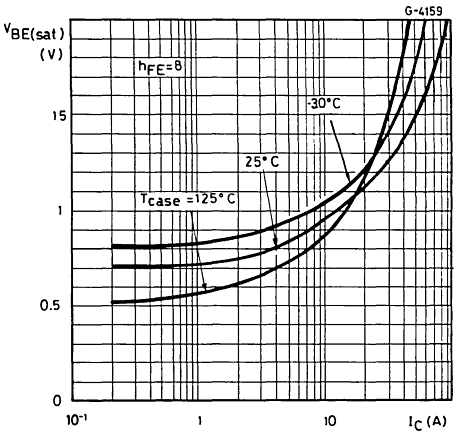
Collector-emitter saturation voltage



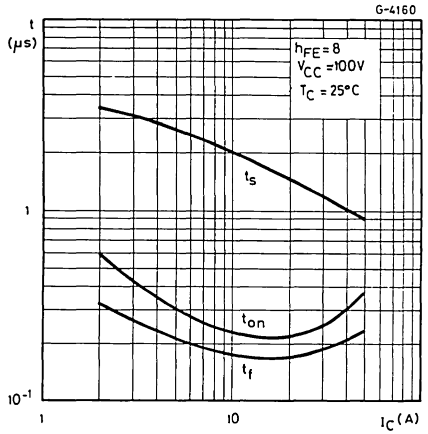
Collector-emitter saturation voltage



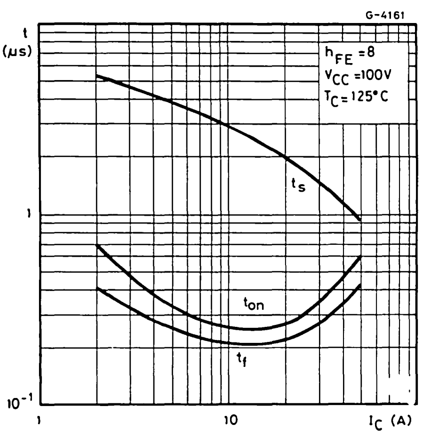
Base-emitter saturation voltage



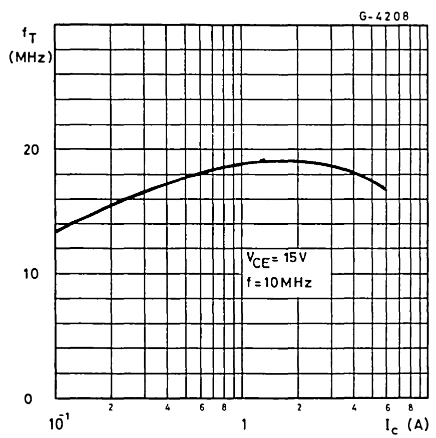
Saturated switching characteristics



Saturated switching characteristics

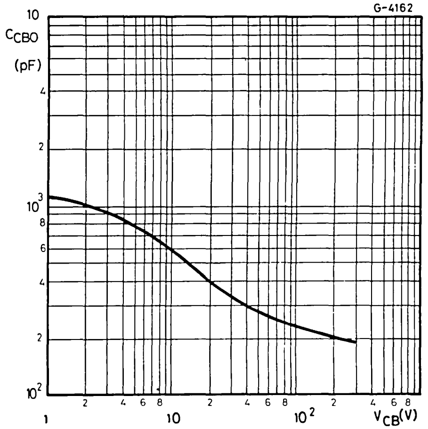


Transition frequency



BUX22

Collector-base capacitance



Clamped reverse bias safe operating areas

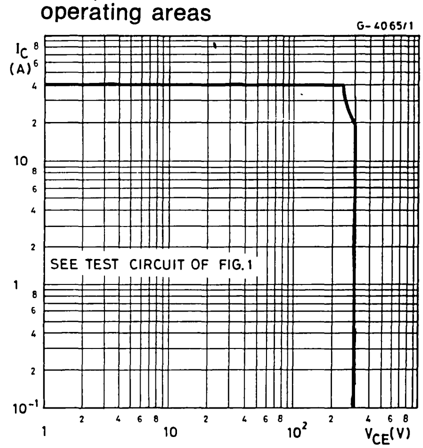


Fig. 1 — Clamped $E_{s/b}$ test circuit

TEST CONDITIONS

$7V \geq |-V_{BB}| \geq 2V$

$I_C / I_B = 8$

t_p = adjusted for nominal I_C

$R_{BB} \geq 1\Omega$

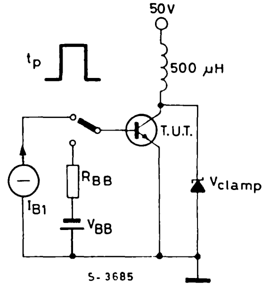


Fig. 2 — Switching times test circuit (resistive load)

TEST CONDITIONS:

$V_{CC} = 100V$

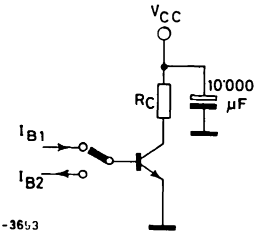
$R_C = \frac{V_{CC} - V_{CE(sat)}}{I_C}$

INPUT PULSE

pulse width = 5μs

$t_r, t_f \leq 50ns$

duty cycle = 1%



MULTIEPITAXIAL PLANAR NPN

BUX40

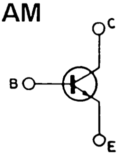
HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

The BUX 40 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.

ABSOLUTE MAXIMUM RATINGS

V_{CBO}	Collector-base voltage ($I_E = 0$)	160	V
V_{CEX}	Collector-emitter voltage ($V_{BE} = -1.5V$)	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 ($t_p = 10ms$)	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

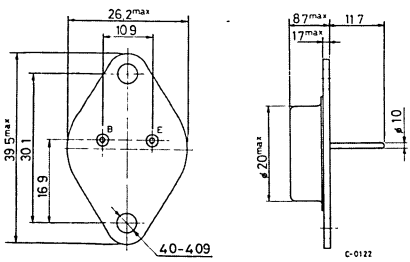
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

BUX40

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)

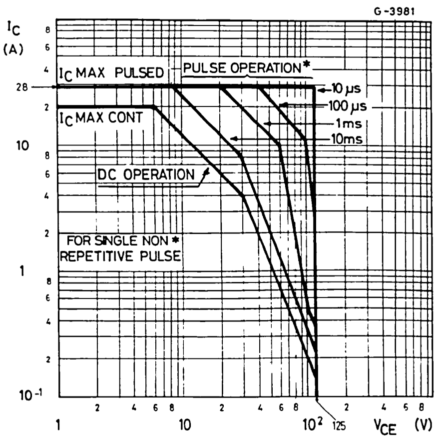
	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B = 0$)	$V_{CE} = 100V$			1	mA
I_{CEX}	Collector cutoff current	$V_{CE} = 160V$ $V_{BE} = -1.5V$ $T_{case} = 125°C$ $V_{CE} = 160V$ $V_{BE} = -1.5V$			1 5	mA mA
I_{EBO}	Emitter-cutoff current ($I_C = 0$)	$V_{EB} = 5V$			1	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage	$I_C = 200mA$	125			V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	$I_E = 50mA$	7			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	$I_C = 10A$ $I_B = 1A$ $I_C = 15A$ $I_B = 1.88\ A$		0.6 0.9	1.2 1.6	V V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	$I_C = 15A$ $I_B = 1.88A$		1.7	2	V
h_{FE}*	DC current gain	$I_C = 10A$ $V_{CE} = 4V$ $I_C = 15A$ $V_{CE} = 4V$	15 8		45	— —
$I_{s/b}$	Second breakdown collector current	$V_{CE} = 30V$ $t = 1\ s$ $V_{CE} = 50V$ $t = 1\ s$	4 1			A A
f_T	Transition frequency	$I_C = 1A$ $V_{CE} = 15V$ $f = 10MHz$	8			MHz

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

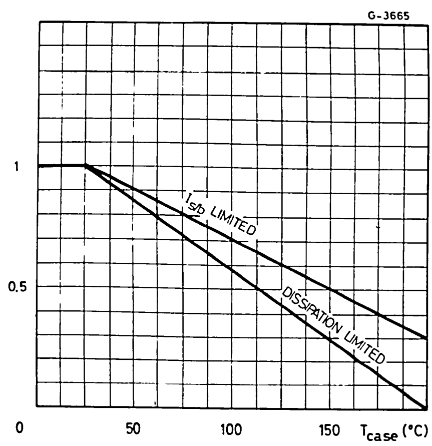
ELECTRICAL CHARACTERISTICS (continued)

	Parameter	Test conditions	Min. Typ. Max.	Unit
t_{on}	Turn-on time (see fig. 2)	I_C =15A I_{B1}=1.88A V_{CC}=30V	0.35 1.2	µs
t_s	Storage time (see fig. 2)	I_C =15A I_{B1}=-I_{B2}=1.88A V_{CC}=30V	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}=125V L=500µH	15	A

Safe operating areas

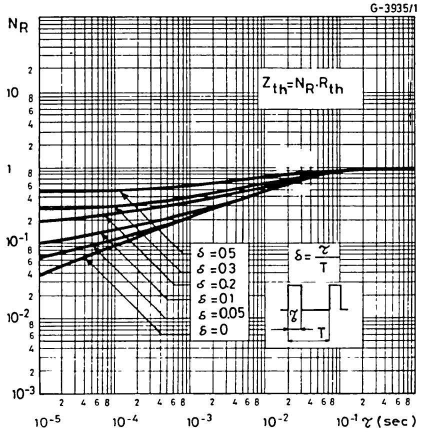


Derating curves

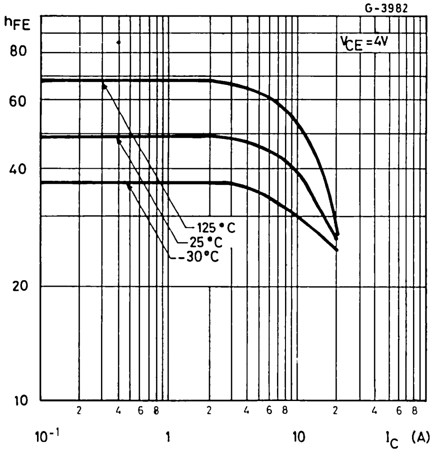


BUX40

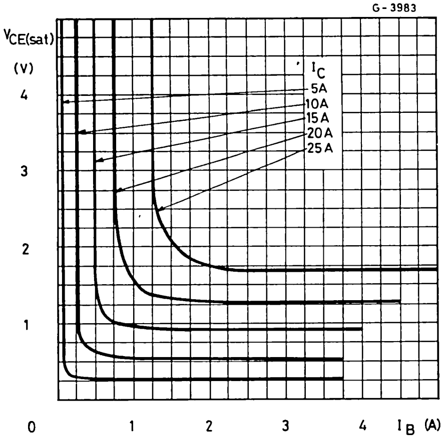
Thermal transient response



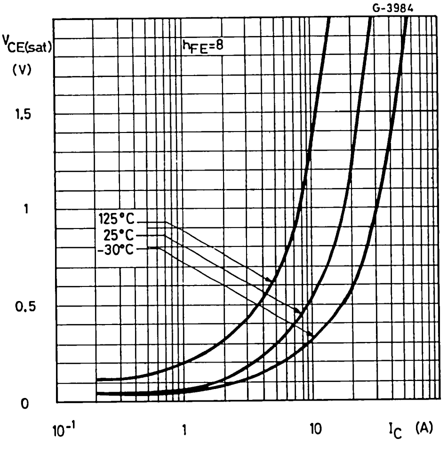
DC current gain



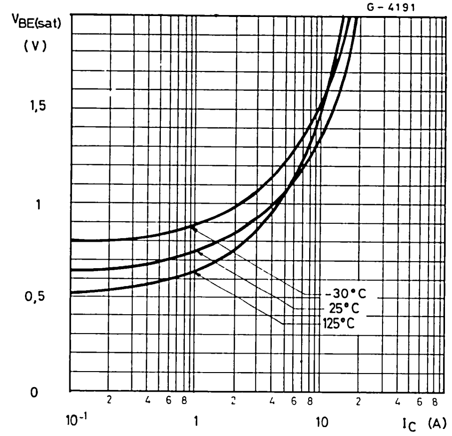
Collector-emitter saturation voltage



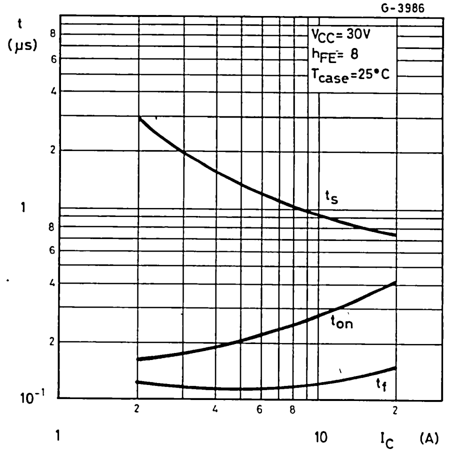
Collector-emitter saturation voltage



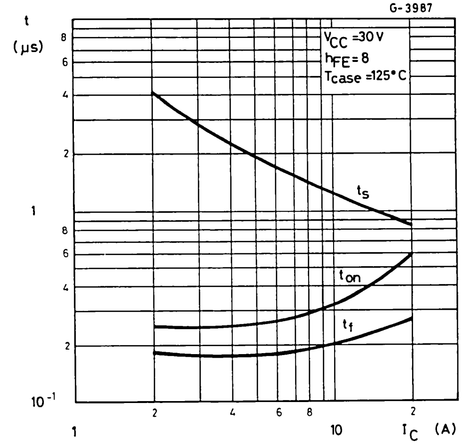
Base-emitter saturation voltage



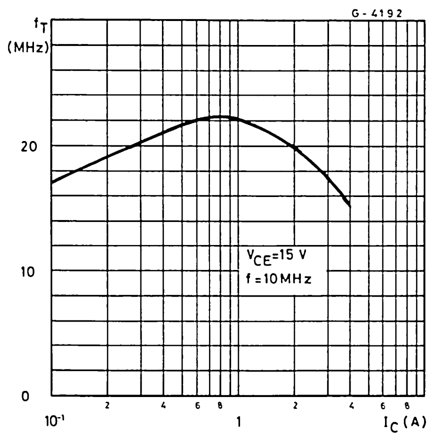
Saturated switching characteristics



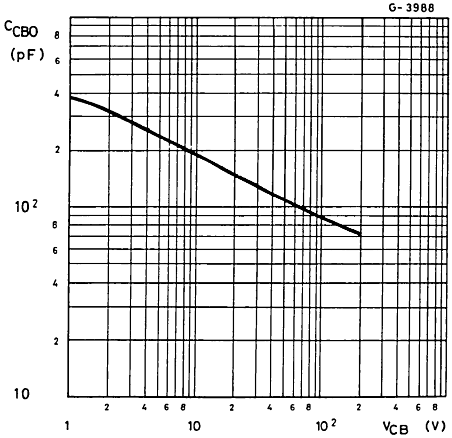
Saturated switching characteristics



Transition frequency



Collector-base capacitance



Clamped reverse bias safe operating areas

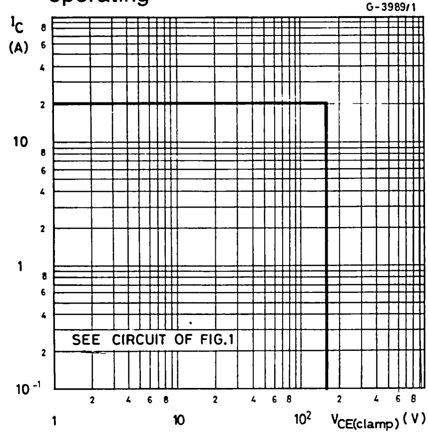


Fig. 1 — Clamped $E_{s/b}$ test circuit

TEST CONDITIONS:

$7V \geq |-V_{BB}| \geq 2V$

$I_C / I_B = 8$

t_p = adjusted for nominal I_C

$R_{BB} = 1\,\Omega$

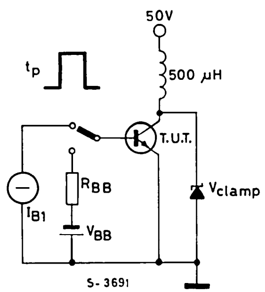


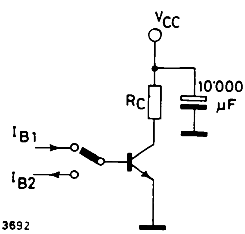
Fig. 2 — Switching times test circuit (resistive load)

TEST CONDITIONS:

$V_{CC} = 30V$

$R_C = \frac{V_{CC} - V_{CE(sat)}}{I_C}$

INPUT PULSE
pulse width = 10 µs
$t_r, t_f \leq 50ns$
duty cycle = 1%



MULTIEPITAXIAL PLANAR NPN

BUX41

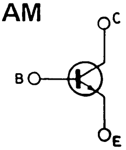
HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

The BUX 41 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.

ABSOLUTE MAXIMUM RATINGS

V_{CBO}	Collector-base voltage ($I_E=0$)	250	V
V_{CEX}	Collector-emitter voltage ($V_{BE}=-1.5V$)	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

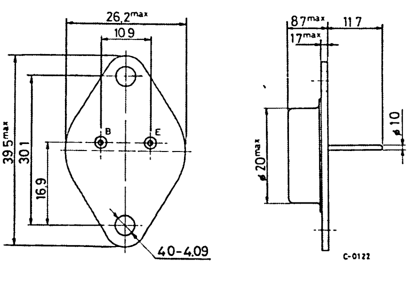
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

5/80

BUX41

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)

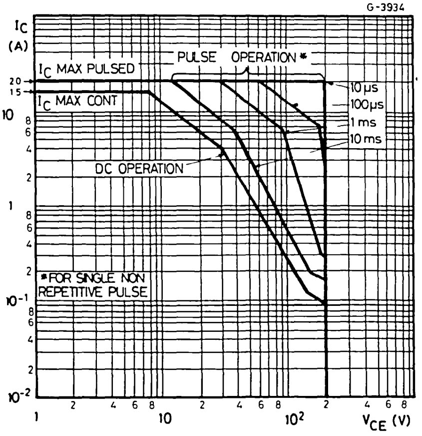
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B = 0$)	$V_{CE} = 160V$			1	mA
I_{CEX}	Collector cutoff current	$V_{CE} = 250V$ $V_{BE} = -1.5V$ $T_{case} = 125\,°C$ $V_{CE} = 250V$ $V_{BE} = -1.5V$			1 5	mA mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$			1	mA
$V_{CEO\,(sus)}$*	Collector-emitter sustaining voltage	$I_C = 200mA$	200			V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	$I_E = 50mA$	7			V
$V_{CE\,(sat)}$*	Collector-emitter saturation voltage	$I_C = 5A$ $I_B = 0.5A$ $I_C = 8A$ $I_B = 1A$		0.38 0.6	1.2 1.6	V V
$V_{BE(sat)}$*	Base-emitter saturation voltage	$I_C = 8A$ $I_B = 1A$		1.35	2	V
h_{FE}*	DC current gain	$I_C = 5A$ $V_{CE} = 4V$ $I_C = 8A$ $V_{CE} = 4V$	15 8		45	– –
$I_{s/b}$	Second breakdown collector current	$V_{CE} = 30V$ $t = 1s$ $V_{CE} = 135V$ $t = 1s$	4 0.15			A A
f_t	Transition frequency	$I_C = 1A$ $V_{CE} = 15V$ $f = 10MHz$	8			MHz

ELECTRICAL CHARACTERISTICS (continued)

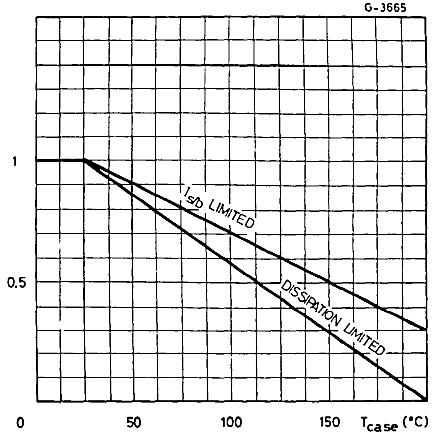
Parameter		Test conditions	Min. Typ. Max.	Unit
t_{on}	Turn-on time (fig. 2)	I_C *=8A I_{B1} =1A V_{CC}=150V	0.28 1	µs
t_s	Storage time (fig. 2)	I_C =8A I_{B1} =1A I_{B2} =-1A V_{CC}=150V	1.2 1.7	µs
t_f	Fall time (fig. 2)		0.25 0.8	µs
	Clamped $E_{s/b}$ Collector current (fig. 1)	V_{clamp}=200V L =500µH	8	A

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

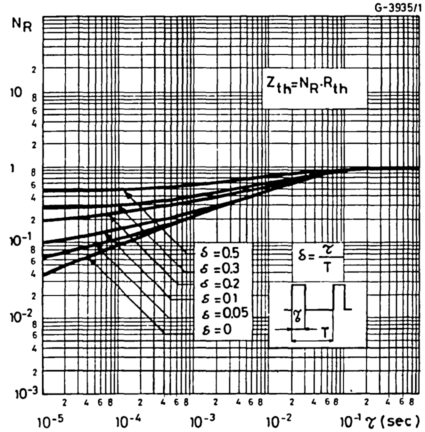
Safe operating areas



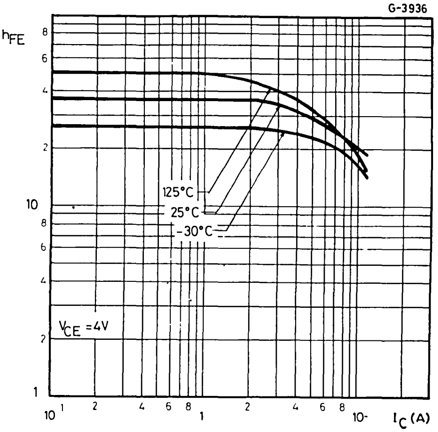
Derating curves



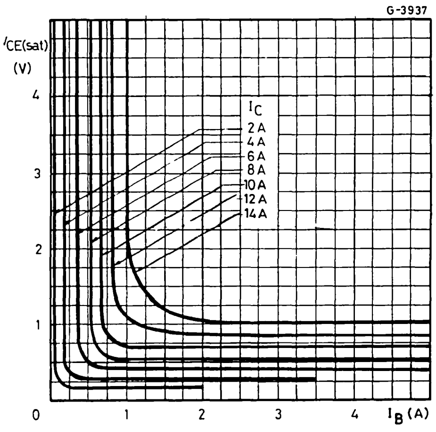
Thermal transient response



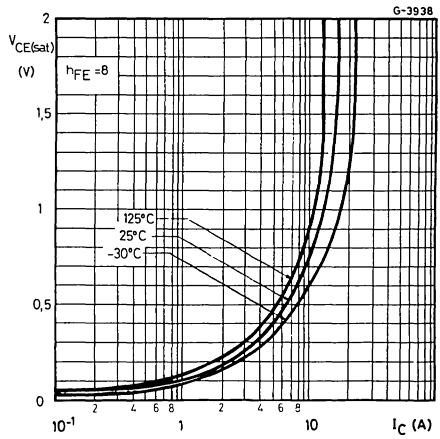
DC current gain



Collector-emitter saturation voltage

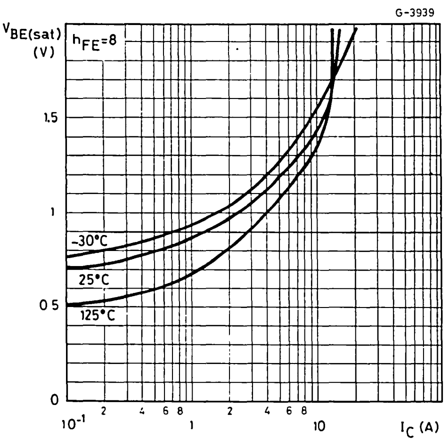


Collector-emitter saturation voltage

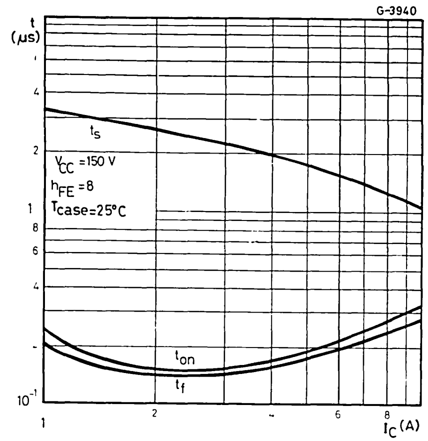


BUX41

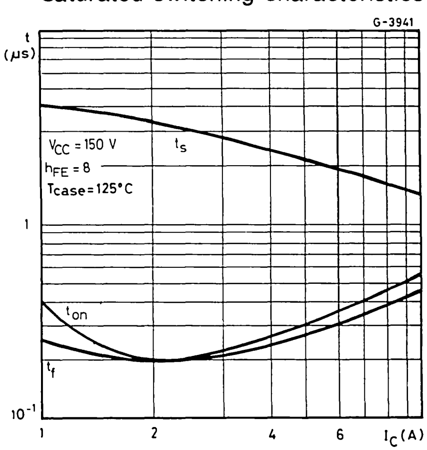
Base-emitter saturation voltage



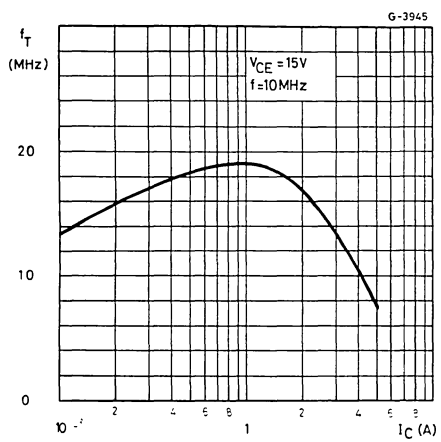
Saturated switching characteristics



Saturated switching characteristics

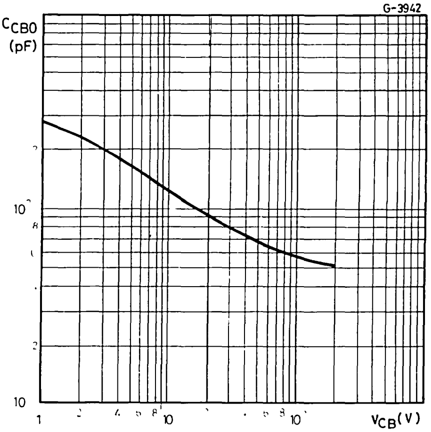


Transition frequency



BUX41

Collector-base capacitance



Clamped reverse bias safe operating area

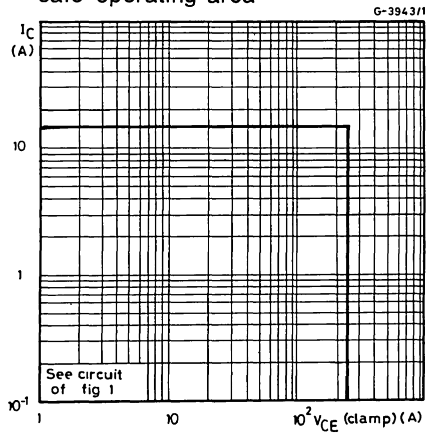


Fig. 1 — Clamped $E_{s/b}$ test circuit

TEST CONDITIONS

$7\,V \geq |-V_{BB}| \geq 2\,V$

$I_C / I_B = 8$

t_p = adjusted for nominal I_C

$R_{BB} \geq 1\Omega$

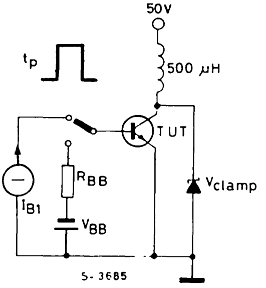


Fig. 2 — Switching times test circuit (resistive load)

TEST CONDITIONS:

V_{CC} = 150 V

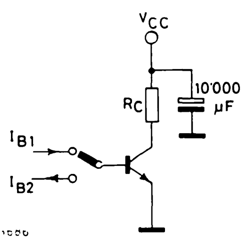
$R_C = \dfrac{V_{CC} - V_{CE(sat)}}{I_C}$

INPUT PULSE

pulse width = 10 µs

$t_r, t_f \leq$ 50ns

duty cycle = 1%



BUX41N

MULTIEPITAXIAL PLANAR NPN

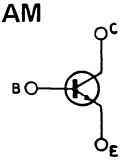
HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

The BUX 41 N 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.

ABSOLUTE MAXIMUM RATINGS

V_{CBO}	Collector-base voltage ($I_E = 0$)	220	V
V_{CEX}	Collector-emitter voltage ($V_{BE} = -1.5V$)	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

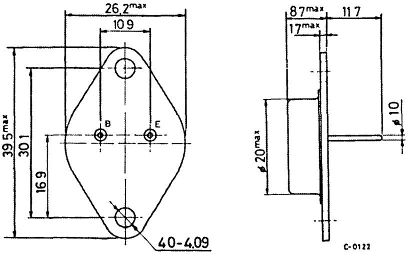
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

BUX41N

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)

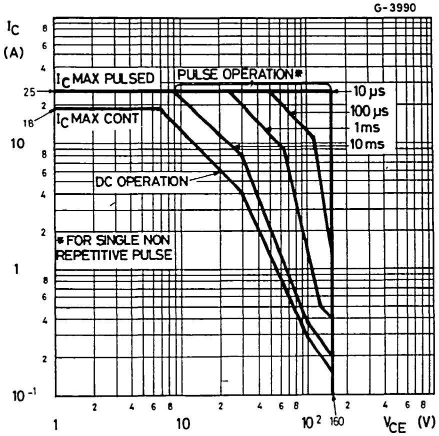
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B = 0$)	$V_{CE} = 130V$			1	mA
I_{CEX}	Collector cutoff current	$V_{CE} = 220V$ $V_{BE} = -1.5V$			1	mA
		$T_{case} = 125\,°C$ $V_{CE} = 220V$ $V_{BE} = -1.5V$			5	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$			1	mA
$V_{CEO\,(sus)}$*	Collector-emitter sustaining voltage	$I_C = 200mA$	160			V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	$I_E = 50mA$	7			V
$V_{CE\,(sat)}$*	Collector-emitter saturation voltage	$I_C = 8A$ $I_B = 0.8A$		0.5	1.2	V
		$I_C = 12A$ $I_B = 1.5A$		0.75	1.6	V
$V_{BE(sat)}$*	Base-emitter saturation voltage	$I_C = 12A$ $I_B = 1.5A$		1.5	2	V
h_{FE}*	DC current gain	$I_C = 8A$ $V_{CE} = 4V$	15		45	—
		$I_C = 12A$ $V_{CE} = 4V$	8			—
$I_{s/b}$	Second breakdown collector current	$V_{CE} = 30V$ $t = 1s$	4			A
		$V_{CE} = 100V$ $t = 1s$	0.27			A
f_T	Transition frequency	$I_C = 1A$ $V_{CE} = 15V$ $f = 10MHz$	8			MHz

ELECTRICAL CHARACTERISTICS (continued)

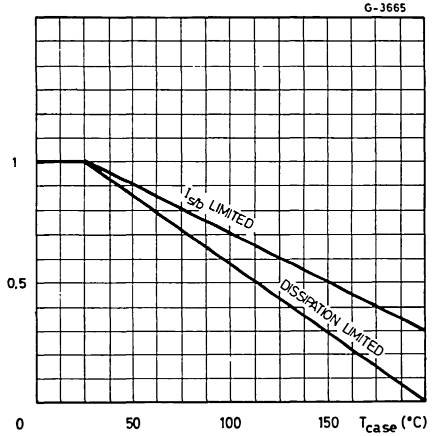
	Parameter	Test conditions	Min. Typ. Max.	Unit
t_{on}	Turn-on time (fig. 2)	I_C =12A I_{B1} =1.5A V_{CC}=30V	0.35 1.3	µs
t_s	Storage time (fig. 2)	I_C =12A I_{B1}=-I_{B2}=1.5 A V_{CC}=30V	0.85 1.5	µs
t_f	Fall time (fig. 2)		0.14 0.8	µs
	Clamped $E_{s/b}$ Collector current (fig. 1)	V_{CLAMP}=160V L =500µH	12	A

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

Safe operating areas

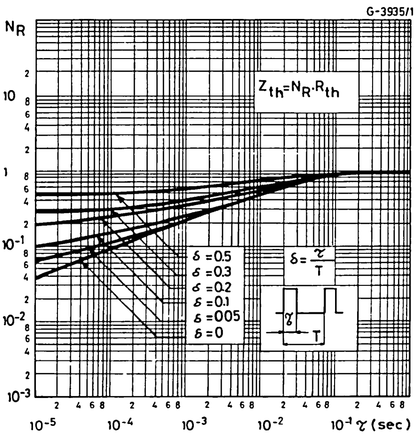


Derating curves

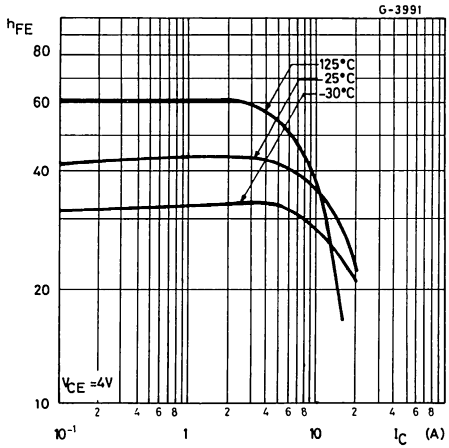


BUX41N

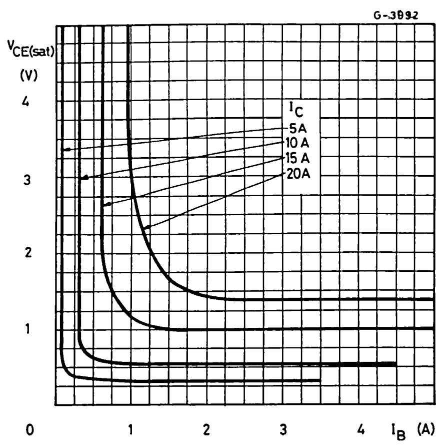
Thermal transient response



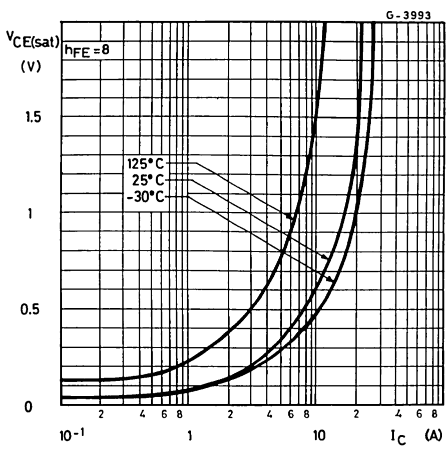
DC current gain



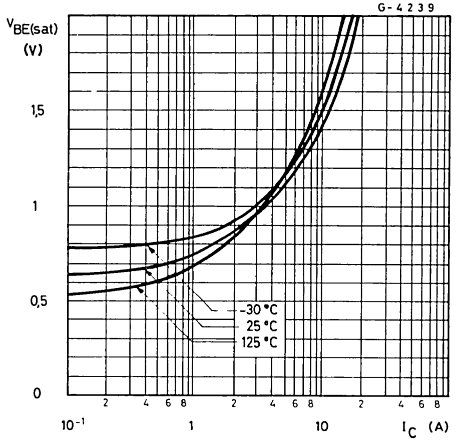
Collector-emitter saturation voltage



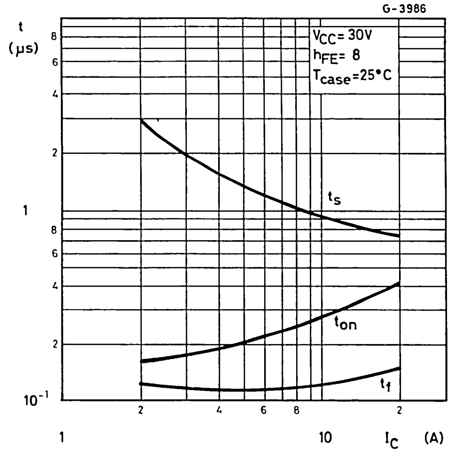
Collector-emitter saturation voltage



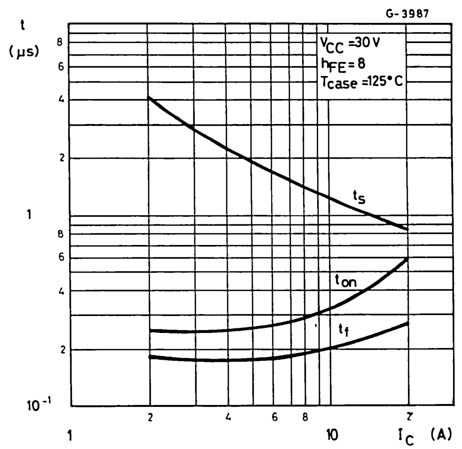
Base-emitter saturation voltage



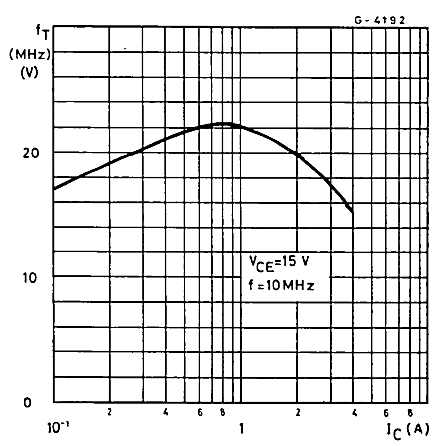
Saturated switching characteristics



Saturated switching characteristics

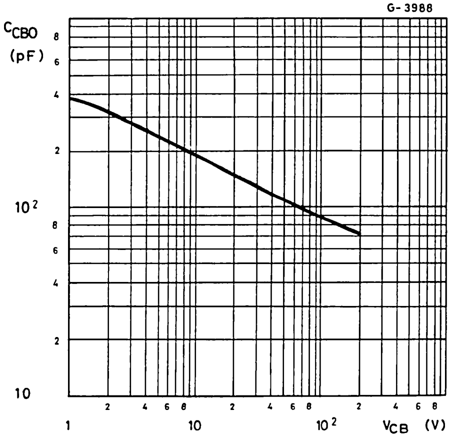


Transition frequency



BUX41N

Collector-base capacitance



Clamped reverse bias safe operating areas

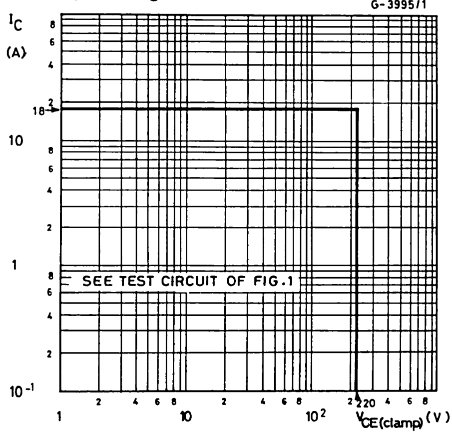


Fig. 1 — Clamped $E_{s/b}$ test circuit

TEST CONDITIONS:

$7V \geq |-V_{BB}| \geq 2V$

$I_C / I_B = 8$

t_p = adjusted for nominal I_C

$R_{BB} = 1\,\Omega$

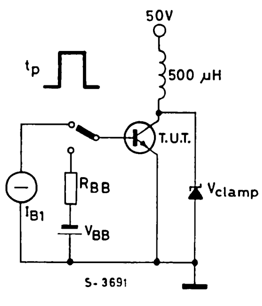


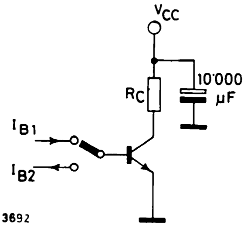
Fig. 2 — Switching times test circuit (resistive load)

TEST CONDITIONS:

V_{CC} = 30V

$R_C = \dfrac{V_{CC} - V_{CE(sat)}}{I_C}$

INPUT PULSE
pulse width = 10 μs
$t_r, t_f \leq$ 50ns
duty cycle = 1%



MULTIEPITAXIAL PLANAR NPN

BUX42

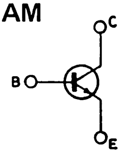
HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTOR

The BUX 42 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.

ABSOLUTE MAXIMUM RATINGS

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 ($I_B=0$)	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

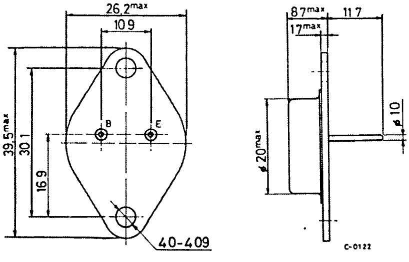
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

BUX42

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)

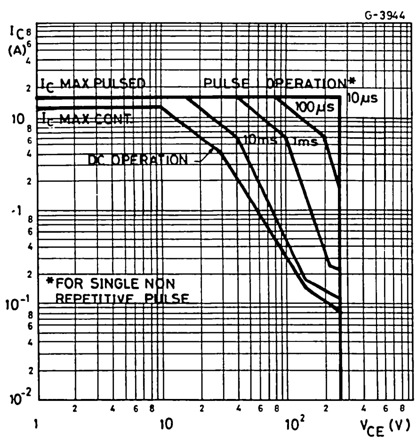
	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B = 0$)	$V_{CE} = 200V$			1	mA
I_{CEX}	Collector cutoff current	$V_{CE} = 300V$ $V_{BE} = -1.5V$ $T_{case} = 125°C$ $V_{CE} = 300V$ $V_{BE} = -1.5V$			1 5	mA mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$			1	mA
$V_{CEO\,(sus)}$*	Collector-emitter sustaining voltage	$I_C = 200mA$	250			V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	$I_E = 50mA$	7			V
$V_{CE\,(sat)}$*	Collector-emitter saturation voltage	$I_C = 4A$ $I_B = 0.4A$ $I_C = 6A$ $I_B = 0.75A$		0.33 0.45	1.2 1.6	V V
$V_{BE(sat)}$*	Base-emitter saturation voltage	$I_C = 6A$ $I_B = 0.75A$		1.23	2	V
h_{FE}*	DC current gain	$I_C = 4A$ $V_{CE} = 4V$ $I_C = 6A$ $V_{CE} = 4V$	15 8		45	— —
$I_{s/b}$	Second breakdown collector current	$V_{CE} = 135V$ $t = 1s$ $V_{CE} = 30V$ $t = 1s$	0.15 4			A A
f_T	Transition frequency	$I_C = 1A$ $V_{CE} = 15V$ $f = 10MHz$	8			MHz

ELECTRICAL CHARACTERISTICS (continued)

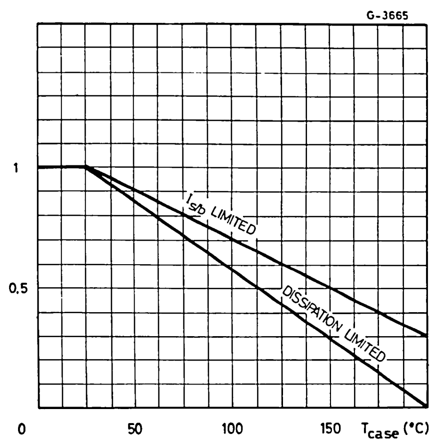
	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on time (fig. 2)	I_C =6A I_{B1} =0.75A V_{CC}=150V		0.23	1	µs
t_s	Storage time (fig. 2)	I_C =6A I_{B1} =0.75A I_{B2} =-0.75A V_{CC}=150V		1.5	2	µs
t_f	Fall time (fig. 2)			0.2	1.2	µs
	Clamped $E_{s/b}$ Collector current (fig. 1)	V_{clamp}=250V L =500µH	6			A

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

Safe operating areas

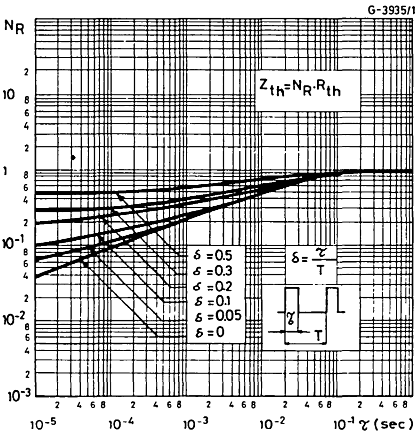


Derating curves

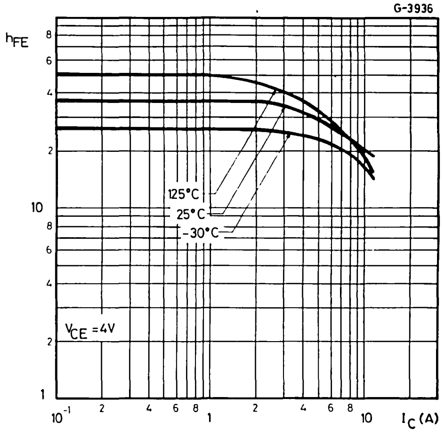


BUX42

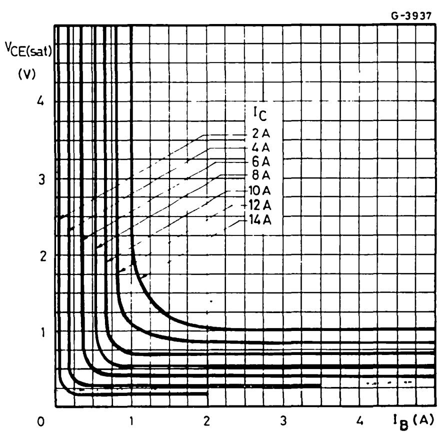
Thermal transient response



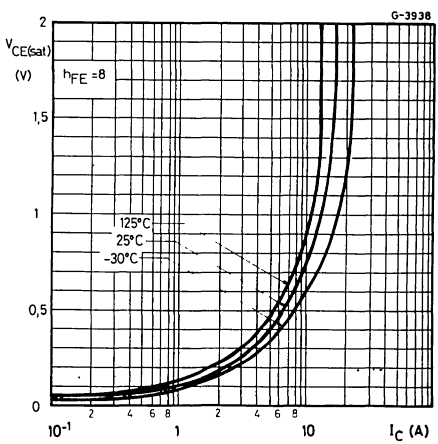
DC current gain



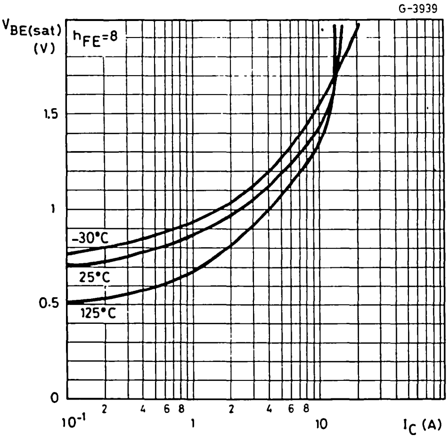
Collector-emitter saturation voltage



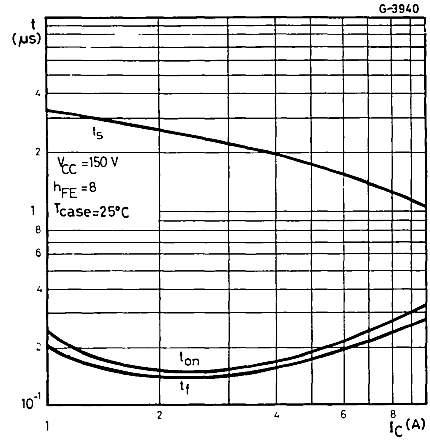
Collector-emitter saturation voltage



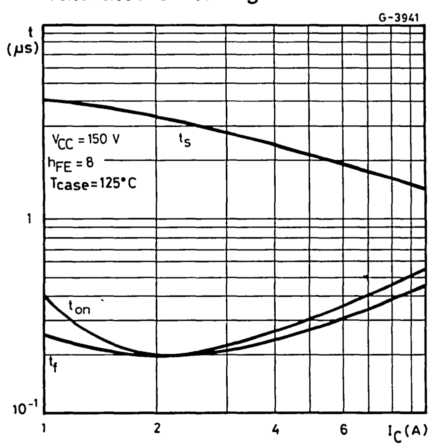
Base-emitter saturation voltage



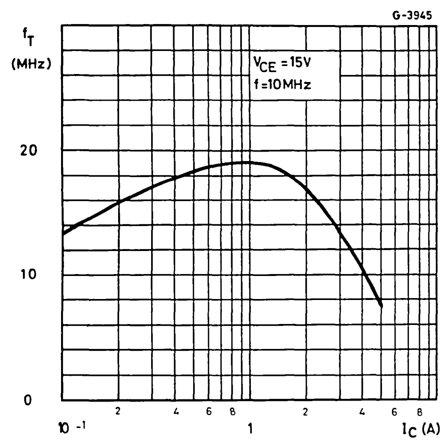
Saturated switching characteristics



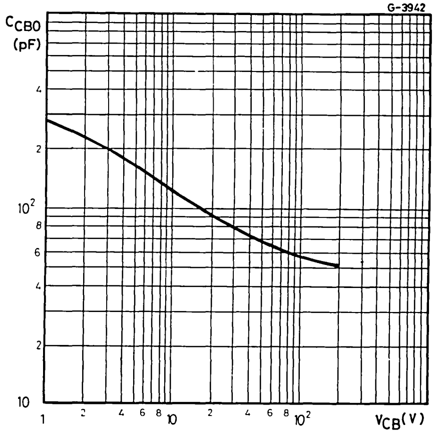
Saturated switching characteristics



Transition frequency



Collector-base capacitance



Clamped reverse bias safe operating areas

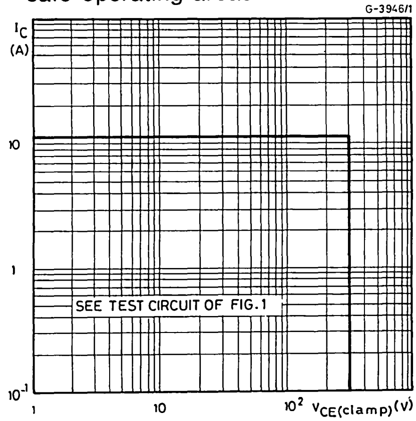


Fig. 1 — Clamped $E_{s/b}$ test circuit

TEST CONDITIONS

$7\,V \geq |-V_{BB}| \geq 2\,V$

$I_C / I_B = 8$

t_p = adjusted for nominal I_C

$R_{BB} \geq 1\Omega$

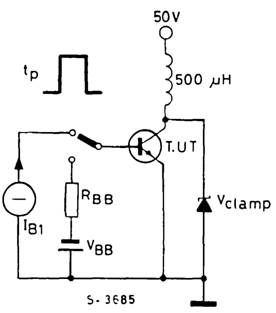


Fig. 2 — Switching times test circuit (resistive load)

TEST CONDITIONS:

V_{CC} = 150 V

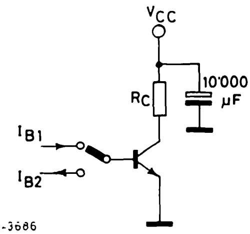
$R_C = \dfrac{V_{CC} - V_{CE(sat)}}{I_C}$

INPUT PULSE

pulse width = 10 µs

$t_r, t_f \leq$ 50ns

duty cycle = 1%



BUX43

MULTIEPITAXIAL MESA NPN

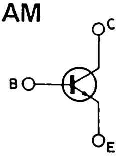
HIGH VOLTAGE POWER SWITCH

The BUX 43 is a silicon multiepitaxial mesa NPN transistor in Jedec TO-3 metal case, intended for high voltage, fast switching applications.

ABSOLUTE MAXIMUM RATINGS

V_{CES}	Collector-emitter voltage ($V_{BE} = 0$)	400	V
V_{CER}	Collector-emitter voltage ($R_{BE} \leqslant 100\Omega$)	360	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	10	A
I_{CM}	Collector peak current ($t_p \leqslant 10ms$)	12	A
I_B	Base current	2	A
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	120	W
T_{stg}	Storage temperature	–65 to 200	°C
T_j	Junction temperature	200	°C

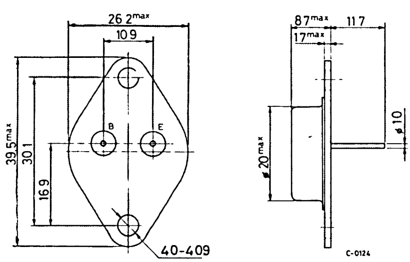
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

BUX43

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)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current (V_{BE} = 0)	V_{CE} = 400V V_{CE} = 400V T_{case} = 125°C			1 5	mA mA
I_{CEO}	Collector cutoff current (I_B = 0)	V_{CE} = 260V			1	mA
I_{EBO}	Emitter cutoff current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage (I_B = 0)	I_C = 100mA	325			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	I_C = 3A I_B = 0.375A I_C = 5A I_B = 1A			1 1.6	V V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	I_C = 5A I_B = 1A			2	V
h_{FE}*	DC current gain	I_C = 3A V_{CE} = 4V I_C = 5A V_{CE} = 4V	15 8		60	— —
f_T	Transition frequency	I_C = 1A V_{CE} = 15V f = 10MHz	8			MHz
t_{on}	Turn-on time	I_C = 5A I_{B1} = 1A V_{CC} = 150V			1	μs
t_s	Storage time	I_C = 5A I_{B1} = $-I_{B2}$ = 1A V_{CC} = 150V			2.2	μs
t_f	Fall time				1.2	μs

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

MULTIEPITAXIAL MESA NPN

BUX44

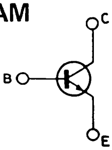
HIGH VOLTAGE POWER SWITCH

The BUX 44 is a silicon multiepitaxial mesa NPN transistor in Jedec TO-3 metal case, intended for high voltage, fast switching applications.

ABSOLUTE MAXIMUM RATINGS

V_{CES}	Collector-emitter voltage ($V_{BE} = 0$)	450	V
V_{CER}	Collector-emitter voltage ($R_{BE} \leqslant 100\Omega$)	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 ($t_p \leqslant 10ms$)	10	A
I_B	Base current	1.6	A
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	120	W
T_{stg}	Storage temperature	–65 to 200	°C
T_j	Junction temperature	200	°C

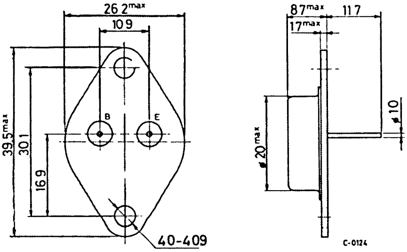
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

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)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current (V_{BE} = 0)	V_{CE} = 450V V_{CE} = 450V T_{case} = 125°C			1 5	mA mA
I_{CEO}	Collector cutoff current (I_B = 0)	V_{CE} = 320V			1	mA
I_{EBO}	Emitter cutoff current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage (I_B = 0)	I_C = 100mA	400			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	I_C = 2A I_B = 0.25A I_C = 4A I_B = 0.8A			1 2	V V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	I_C = 4A I_B = 0.8A			2	V
h_{FE}*	DC current gain	I_C = 2A V_{CE} = 4V I_C = 4A V_{CE} = 4V	15 8		45	— —
f_T	Transition frequency	I_C = 1A V_{CE} = 15V f = 10MHz	8			MHz
t_{on}	Turn-on time	I_C = 4A I_B = 0.8A V_{CC} = 150V			1	μs
t_s	Storage time	I_C = 4A I_{B1} = $-I_{B2}$ = 0.8A V_{CC} = 150V			2.5	μs
t_f	Fall time				1.2	μs

* Pulsed: pulse duration = 300μs, duty cycle $\leqslant$2%.

MULTIEPITAXIAL MESA NPN

BUX46

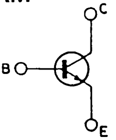
HIGH VOLTAGE POWER SWITCH

The BUX 46 is a silicon multiepitaxial mesa NPN transistor in Jedec TO-3 metal case, intended for high voltage, fast switching applications.

ABSOLUTE MAXIMUM RATINGS

V_{CES}	Collector-emitter voltage ($V_{BE} = 0$)	850	V
V_{CER}	Collector-emitter voltage ($R_{BE} \leqslant 10\Omega$)	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_B	Base current	3	A
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	85	W
T_{stg}	Storage temperature	–65 to 175	°C
T_j	Junction temperature	175	°C

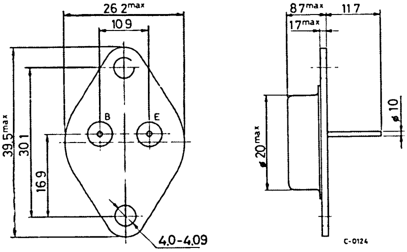
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

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)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current (V_{BE} = 0)	V_{CE} = 850V V_{CE} = 850V T_{case} = 125°C			100 1	μA mA
I_{CER}	Collector cutoff current ($R_{BE} \leq 10\Omega$)	V_{CE} = 850V V_{CE} = 850V T_{case} = 125°C			300 2	μA mA
I_{EBO}	Emitter cutoff current (I_C = 0)	V_{EB} = 7V			1	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage (I_B = 0)	I_C = 100mA	400			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	I_C = 2.5A I_B = 0.5A I_C = 3.5A I_B = 0.7A			1.5 5	V V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	I_C = 2.5A I_B = 0.5A			1.3	V
t_{on}	Turn-on time	I_C = 2.5A V_{CC} = 150V $I_{B1} = -I_{B2}$ = 0.5A			1	μs
t_s	Storage time				3	μs
t_f	Fall time				0.8	μs

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

MULTIEPITAXIAL MESA NPN

BUX80

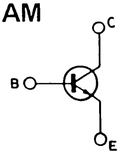
HIGH VOLTAGE POWER SWITCH

The BUX 80 is a silicon multiepitaxial mesa NPN transistor in Jedec TO-3 metal case, particularly intended for converters, inverters, switching regulators and motor control systems applications.

ABSOLUTE MAXIMUM RATINGS

V_{CES}	Collector-emitter voltage ($V_{BE}=0$)	800	V
V_{CER}	Collector-emitter voltage ($R_{BE}=50\Omega$)	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 $T_{case} \leq 40°C$	100	W
T_{stg}	Storage temperature	-65 to 150	°C
T_j	Junction temperature	150	°C

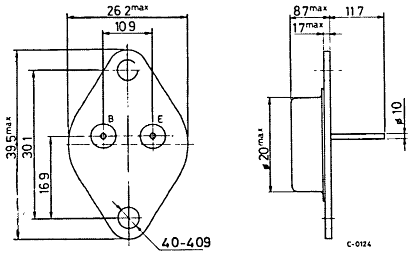
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

BUX80

THERMAL DATA

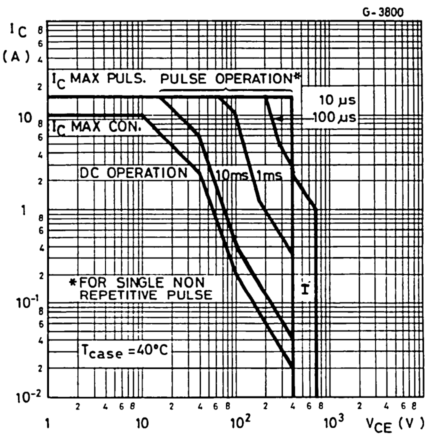
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1.1	°C/W

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

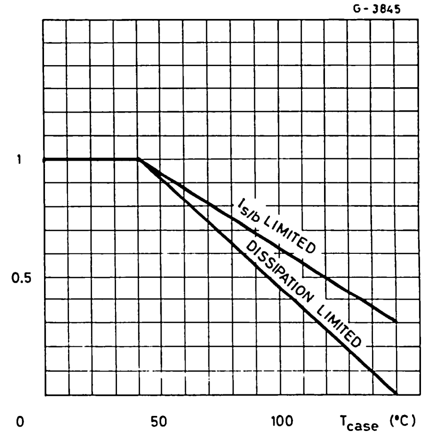
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current ($V_{BE}=0$)	$V_{CE}=800V$ $V_{CE}=800V$ $T_{case}=125°C$			1 3	mA mA
I_{EBO}	Emitter cutoff current ($I_C=0$)	$V_{EB}=10V$			10	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage ($I_B=0$)	I_C =100mA	400			V
$V_{CER(sus)}$*	Collector-emitter sustaining voltage ($R_{BE}=50\Omega$)	I_C =100mA	500			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	I_C =5A I_B =1A I_C =8A I_B =2.5A			1.5 3	V V
$V_{BE(sat)}$*	Base-emitter saturation voltage	I_C =5A I_B =1A I_C =8A I_B =2.5A			1.4 1.8	V V
h_{FE}*	DC current gain	I_C =1.2A V_{CE}=5V		30		—
t_{on}	Turn-on time	I_C =5A I_{B1} =1A V_{CC}=250V			0.5	µs
t_s	Storage time	I_C =5A I_{B1} =1A I_{B2} =-2A V_{CC}=250V			3.5	µs
t_f	Fall time	I_C =5A I_{B1} =1A I_{B2} =-2A V_{CC}=-250V			0.5	µs

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

Safe operating areas

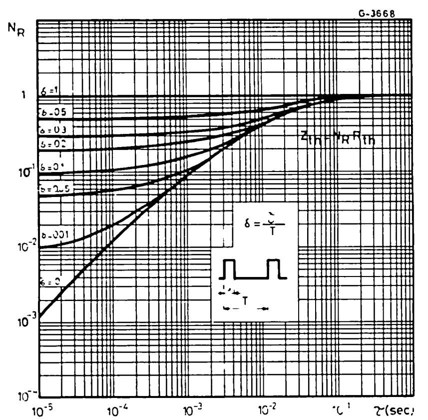


Derating curves

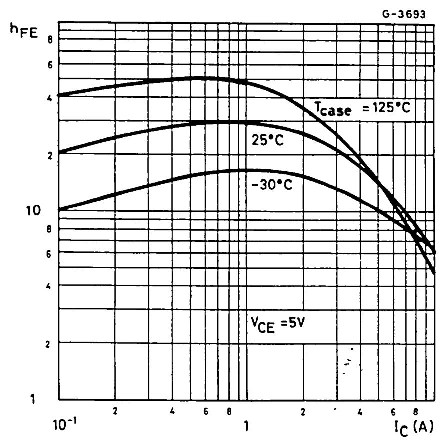


I — Area of permissible operation during Turn-on provided $R_{BE} \leq 100\Omega$ and $t_p \leq 0{,}6\mu s$

Transient thermal response

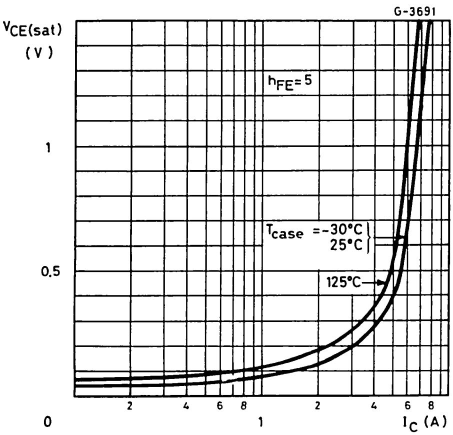


DC current gain

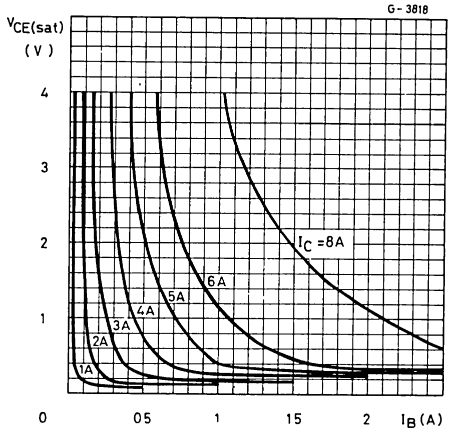


BUX80

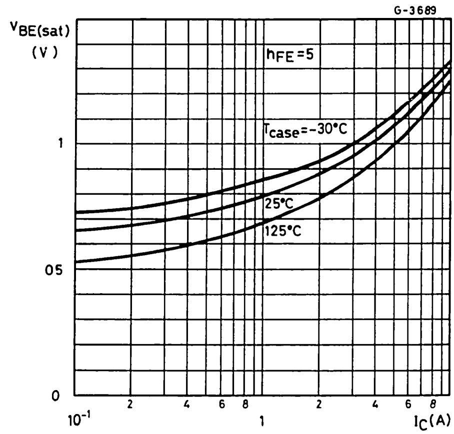
Collector-emitter saturation voltage



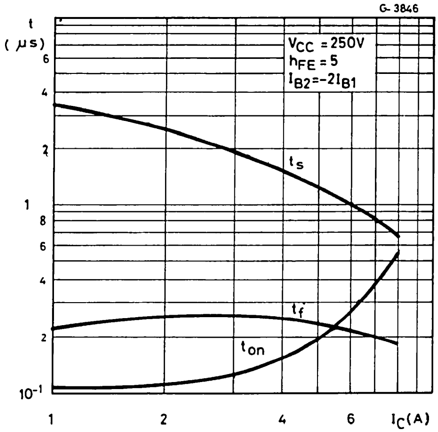
Collector-emitter saturation voltage



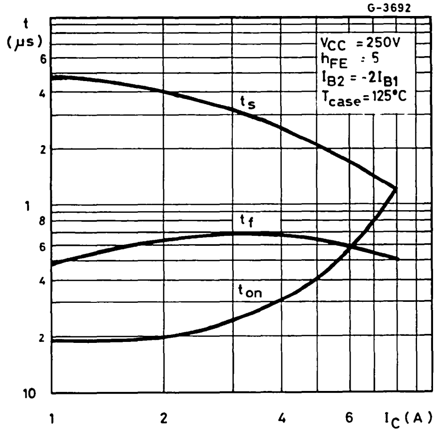
Base-emitter saturation voltage



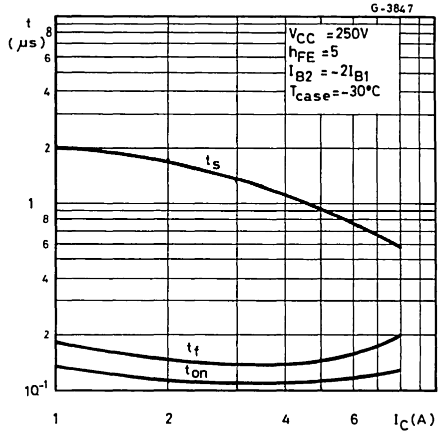
Saturated switching characteristics



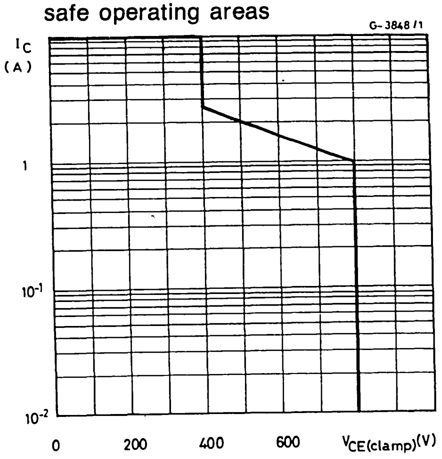
Saturated switching characteristics



Saturated switching characteristics



Clamped reverse bias safe operating areas



Clamped $E_{s/b}$ test circuit

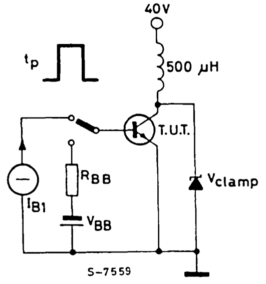
TEST CONDITIONS:

$V_{BE\ off} = -5V$

$I_C / I_B = 5$

t_p = adjusted for nominal I_C

$R_{BB} = 1\ \Omega$



BUX84
BUX84A

MULTIEPITAXIAL MESA NPN

ADVANCE DATA

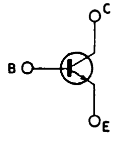
HIGH VOLTAGE SWITCH

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.

ABSOLUTE MAXIMUM RATINGS

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

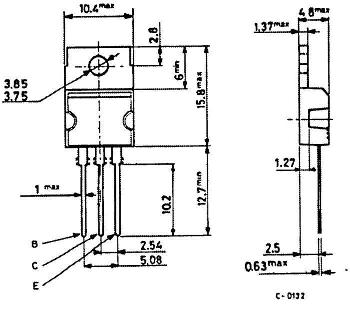
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

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)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{EBO}	Emitter cutoff current (I_C = 0)	V_{EB} = 5V			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 = 0.3A I_B = 30mA for **BUX84** for **BUX84A** I_C = 1A I_B = 0.2A for **BUX84** for **BUX84A**			 1.5 0.8 3 1	 V V V V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	I_C = 1A I_B = 0.2			1.1	V
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage	I_C = 100mA L = 25mH	400			V
f_T	Transition frequency (f = 1MHz)	I_C = 0.2A V_{CE} = 10V		20		MHz
t_{on}	Turn on time	I_C = 1A V_{CC} = 250V I_B = 0.2A $-I_B$ = 0.4A			0.5	μs
t_s	Storage time				3.5	μs
t_f	Fall time				1.4	μs

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

BUX98
BUX98A

MULTIEPITAXIAL MESA NPN

ADVANCE DATA

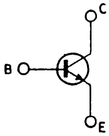
HIGH VOLTAGE FAST SWITCHING

The BUX98 and BUX98A 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 operation.

ABSOLUTE MAXIMUM RATINGS

		BUX98	BUX98A
V_{CER}	Collector-emitter voltage ($R_{BE} = 10\Omega$)	850V	1000V
V_{CES}	Collector-base voltage ($V_{BE} = 0$)	850V	1000V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	400V	450V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	7V	
I_C	Collector current	30A	
I_{CM}	Collector peak current ($t_p < 5ms$)	60A	
I_{CP}	Collector peak current non rep. ($t_p < 20\mu s$)	80A	
I_B	Base current	8A	
I_{BM}	Base peak current ($t_p < 5ms$)	30A	
P_{tot}	Total power dissipation at $T_{case} < 25°C$	250W	
T_{stg}	Storage temperature	-65 to 200°C	
T_j	Junction temperature	200°C	

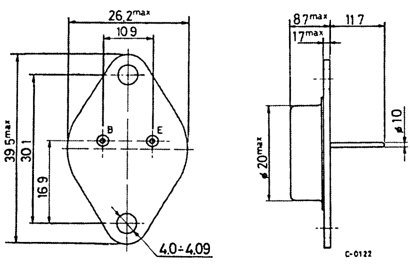
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

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)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector cutoff current (R_{BE}=10Ω)	$V_{CE} = V_{CES}$ $V_{CE} = V_{CES}$ 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_{BE}=5V			2	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage	I_C=200mA for **BUX98** for **BUX98A**	 400 450			 V V
$V_{CER\ (sus)}$*	Collector-emitter sustaining voltage	L = 2mH I_C = 1A for **BUX98** for **BUX98A**	 850 1000			 V V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	for **BUX98** I_C = 20A I_B = 4A for **BUX98A** I_C = 16A I_B = 3.2A I_C = 24A I_B = 5A			 1.5 1.5 5	 V V V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	for **BUX98** I_C = 20A I_B = 4A for **BUX98A** I_C = 16A I_B = 3.2A			 1.6 1.6	 V V
t_{on}	Turn-on time	for **BUX98** V_{CC} = 150V I_C = 20A, I_{B1} = I_{B2} = 4A			1	μs
t_s	Storage time				3	μs
t_f	Fall time				0.8	μs
t_{on}	Turn-on time	for **BUX98A** V_{CC} = 150V I_C = 16A; I_{B1} = I_{B2} = 3.2A			1	μs
t_s	Storage time				3	μs
t_f	Fall time				0.8	μs

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

BUX98C

MULTIEPITAXIAL MESA NPN

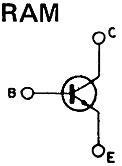
HIGH VOLTAGE SWITCH

The BUX98C, is a multiepitaxial mesa NPN transistors in Jedec TO-3 metal-case intended for use in switching and industrial applications from single and three-phase mains operation.

ABSOLUTE MAXIMUM RATINGS

V_{CER}	Collector-emitter voltage ($R_{BE} = 10\Omega$)	1200	V
V_{CES}	Collector-base voltage ($V_{BE} = 0$)	1200	V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	700	V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	7	V
I_C	Collector current	30	A
I_{CM}	Collector peak current ($t_p < 5ms$)	60	A
I_{CP}	Collector peak current non repetitive ($t_p < 20\mu s$)	80	A
I_B	Base current	8	A
I_{BM}	Base peak current ($t_p < 5ms$)	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

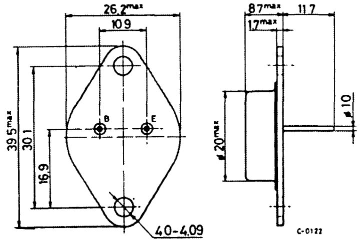
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

THERMAL DATA

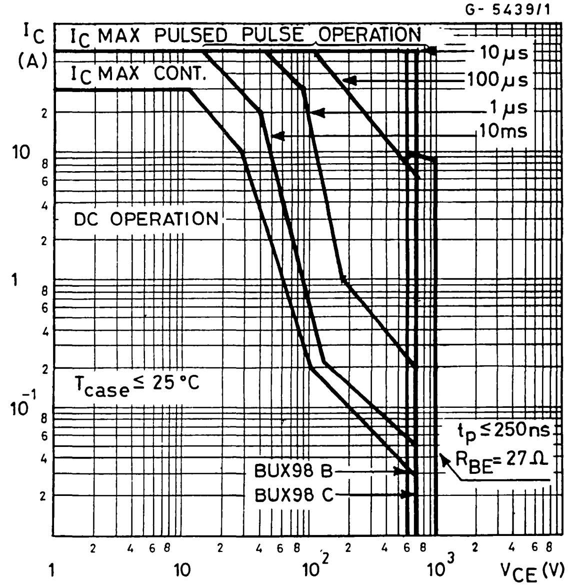
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max.	max.	0.7	°C/W

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

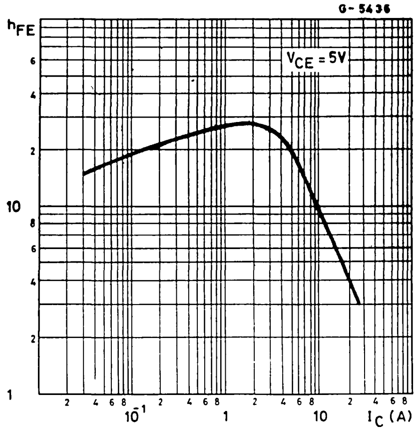
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector cutoff current (R_{BE} = 10Ω)	$V_{CE} = V_{CES}$ $V_{CE} = V_{CES}$ T_{case} = 125°C			1 8	mA mA
I_{CES}	Collector cutoff current (V_{BE} = 0)	$V_{CE} = V_{CES}$ $V_{CE} = V_{CES}$ T_{case} = 125°C			1 6	mA mA
I_{CEO}	Collector cutoff current (I_B = 0)	$V_{CE} = V_{CEO}$			2	mA
I_{EBO}	Emitter cutoff current (I_C = 0)	V_{BE} = 5V			2	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage	I_C = 100mA	700			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	I_C = 12A I_B = 3A I_C = 16A I_B = 5A I_C = 20A I_B = 8A			1.5 2 3	V V V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	I_C = 12A I_B = 3A I_C = 20A I_B = 8A			1.6 2	V V
t_{on}	Turn-on time	RESISTIVE LOAD		0.5	1	μs
t_s	Storage time	V_{CC} = 250V I_C = 12A $I_{B1} = -I_{B2}$ = 3A		1.5	3	μs
t_f	Fall time			0.2	0.8	μs

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

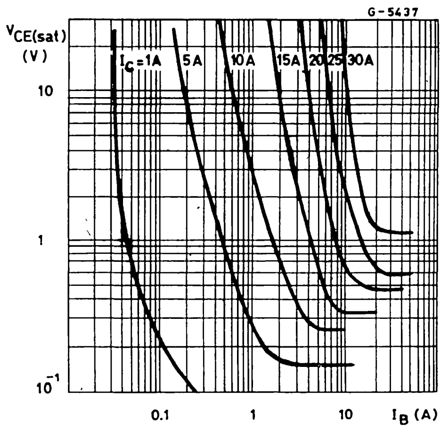
Safe operating areas



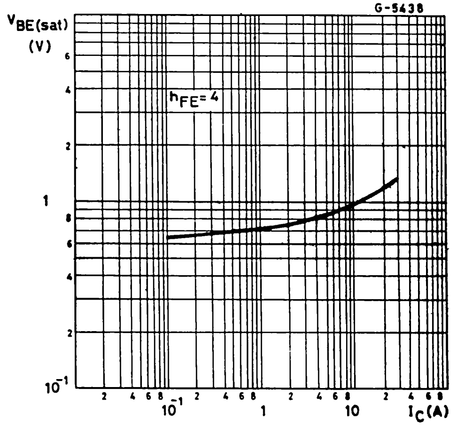
DC current gain



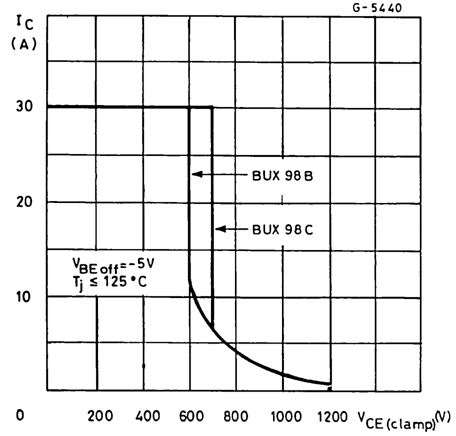
Collector-emitter saturation voltage



Base-emitter saturation voltage



Reverse biased operating area



BUY47
BUY48

EPITAXIAL PLANAR NPN

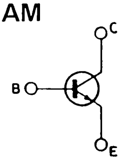
HIGH VOLTAGE, HIGH CURRENT SWITCH

The BUY 47 and BUY 48 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.

ABSOLUTE MAXIMUM RATINGS

		BUY 47	BUY 48
V_{CBO}	Collector-base voltage ($I_E = 0$)	150V	200V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	120V	170V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	6V	
I_C	Collector current	7A	
I_{CM}	Collector peak current (repetitive)	10A	
P_{tot}	Total power dissipation at $T_{amb} \leq 25°C$	1W	
	$T_{case} \leq 50°C$	10W	
T_{stg}	Storage temperature	-65 to 200 °C	
T_j	Junction temperature	200 °C	

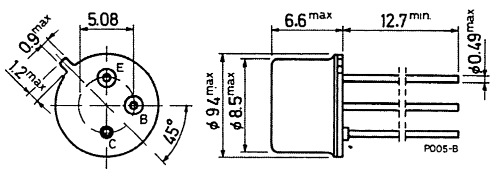
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-39

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)

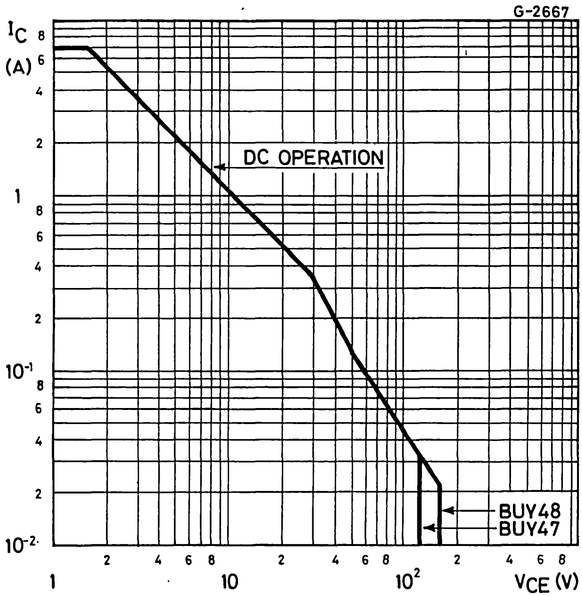
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	for **BUY 47** V_{CB} = 80 V V_{CB} = 80 V T_{case} = 125°C for **BUY 48** V_{CB} = 100 V V_{CB} = 100 V T_{case} = 125°C			 10 1 10 1	 µA mA µA mA
$V_{(BR)\ CBO}$*	Collector-base breakdown voltage ($I_E = 0$)	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

ELECTRICAL CHARACTERISTICS (continued)

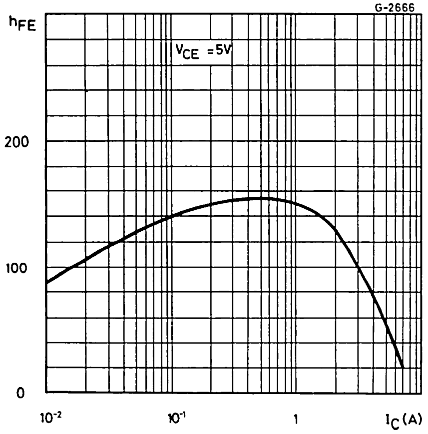
Parameter		Test conditions	Min.	Typ.	Max.	Unit
h_{FE}*	DC current gain	I_C = 50 mA V_{CE} = 5 V I_C = 0.5 A V_{CE} = 5 V I_C = 2 A V_{CE} = 5 V I_C = 5 A V_{CE} = 5 V	 40 40 15	130 150 130 45		— — — —
f_T	Transition frequency	I_C = 100mA V_{CE} = 10 V		90		MHz
C_{CBO}	Collector-base capacitance	I_E = 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%

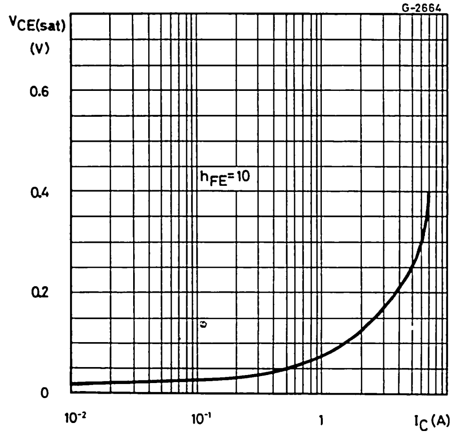
Safe operating areas



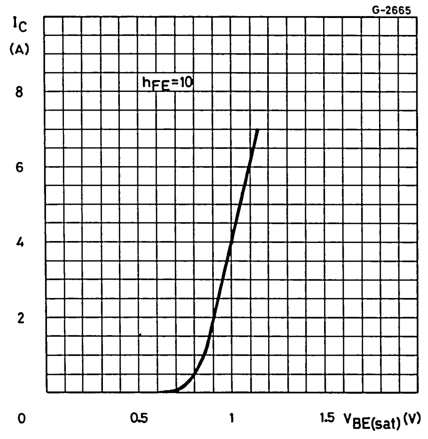
DC current gain



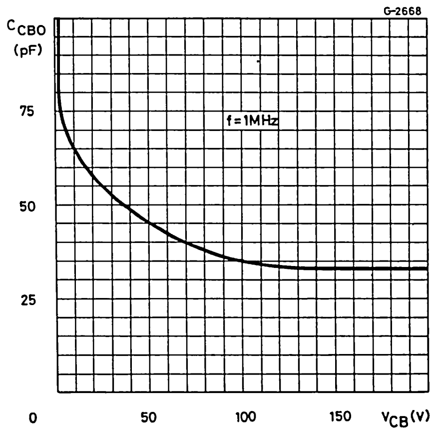
Collector-emitter saturation voltage



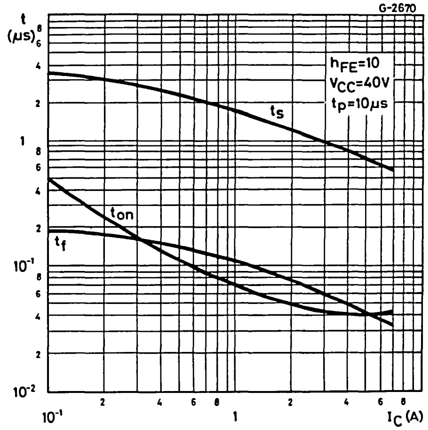
Base-emitter saturation voltage



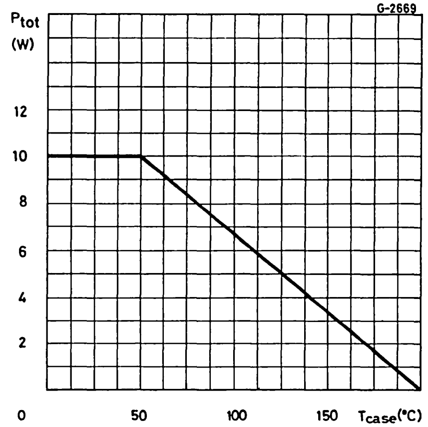
Collector-base capacitance



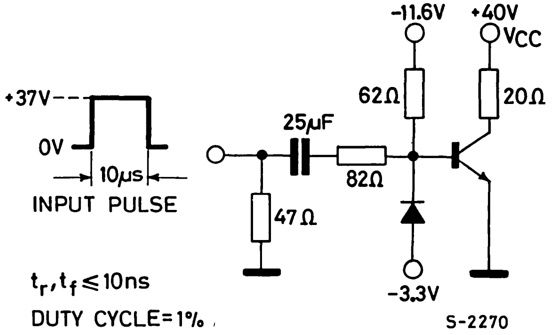
Saturated switching characteristics



Power rating chart



Switching time test circuit



EPITAXIAL PLANAR NPN

BUY49P

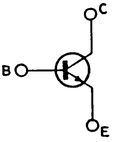
HIGH VOLTAGE, MEDIUM CURRENT SWITCH

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.

ABSOLUTE MAXIMUM RATINGS

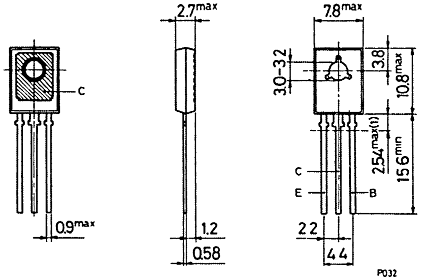
V_{CBO}	Collector-base voltage ($I_E = 0$)	250	V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	200	V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	6	V
I_C	Collector current	3	A
I_{CM}	Collector peak current	5	A
P_{tot}	Total power dissipation at $T_{amb} \leqslant 25°C$	15	W
T_{stg}	Storage temperature	-65 to 150	°C
T_j	Junction temperature	150	°C

INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm



(1) Within this region the cross-section of the leads is uncontrolled

TO-126 (SOT-32)

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)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	$V_{CB} = 200V$			0.1	μA
V_{CBO} *	Collector-base breakdown voltage ($I_E = 0$)	$I_C = 100\ \mu A$	250			V
$V_{CEO(sus)}$ *	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 20mA$	200			V
V_{EBO} *	Emitter-base voltage ($I_C = 0$)	$I_E = 1mA$	6			V
$V_{CE(sat)}$ *	Collector-emitter saturation voltage	$I_C = 0.5A$ $I_B = 50mA$			0.2	V
$V_{BE(sat)}$ *	Base-emitter saturation voltage	$I_C = 0.5A$ $I_B = 50mA$			1.1	V
h_{FE} *	DC current gain	$I_C = 20mA$ $V_{CE} = 2V$	30			–
		$I_C = 20mA$ $V_{CE} = 5V$	40		120	–
		$I_C = 0.5A$ $V_{CE} = 5V$	40			–
		$I_C = 20mA$ $V_{CE} = 2V$ $T_{case} = -55°C$	16			–
f_T	Transition frequency	$I_C = 100mA$ $V_{CE} = 10V$	30			MHz
C_{CBO}	Collector-base capacitance	$I_E = 0$ $V_{CB} = 10V$ f = 1MHz			50	pF
t_{on}	Turn-on time	$I_C = 0.5A$ $V_{CC} = 20V$			0.8	μs
t_{off}	Turn-off time	$I_{B1} = -I_{B2} = 50mA$			2.5	μs

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

EPITAXIAL PLANAR NPN

BUY49S

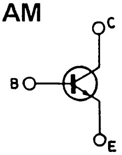
HIGH VOLTAGE, MEDIUM CURRENT SWITCH

The BUY 49S 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.

ABSOLUTE MAXIMUM RATINGS

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 $T_{amb} \leq 25°C$	1	W
	$T_{case} \leq 50°C$	10	W
T_{stg}	Storage temperature	-65 to 200	°C
T_j	Junction temperature	200	°C

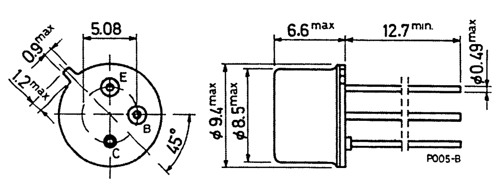
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-39

BUY49S

THERMAL DATA

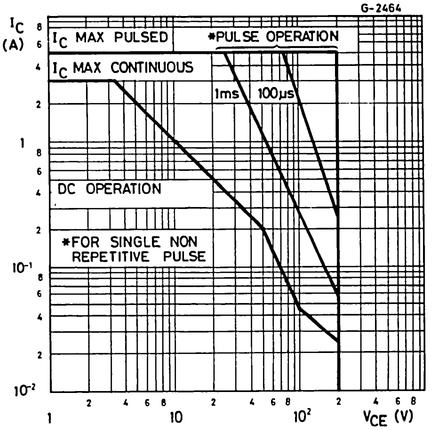
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	15	°C/W
$R_{th\ j\text{-}amb}$	Thermal resistance junction-ambient	max	175	°C/W

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

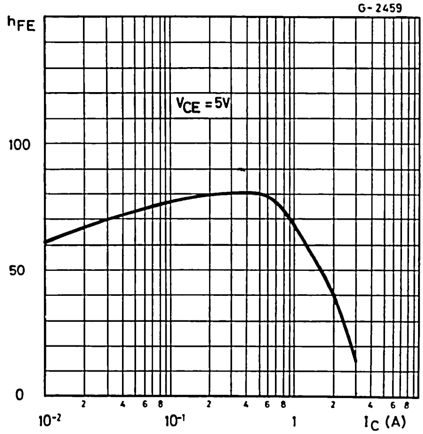
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current (I_E = 0)	V_{CB} = 200 V V_{CB} = 200 V T_{case} = 150°C			0.1 50	µA µA
$V_{(BR)\,CBO}$*	Collector-base breakdown voltage (I_E = 0)	I_C = 100 µA	250			V
$V_{CEO\,(sus)}$*	Collector-emitter sustaining voltage (I_B = 0)	I_C = 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 = 100mA 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: 1s, non repetitive pulse

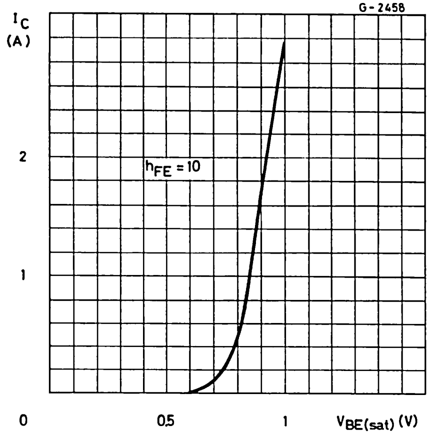
Safe operating areas



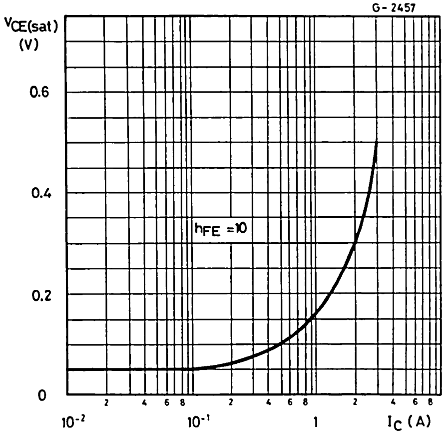
DC current gain



DC transconductance

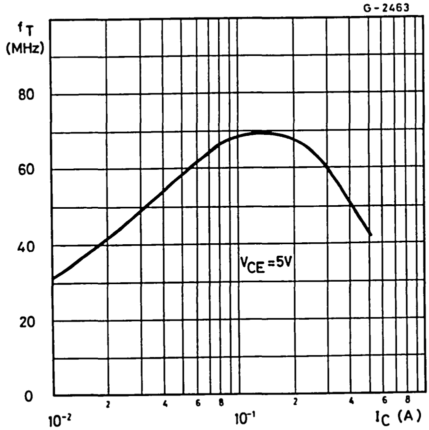


Collector-emitter saturation voltage

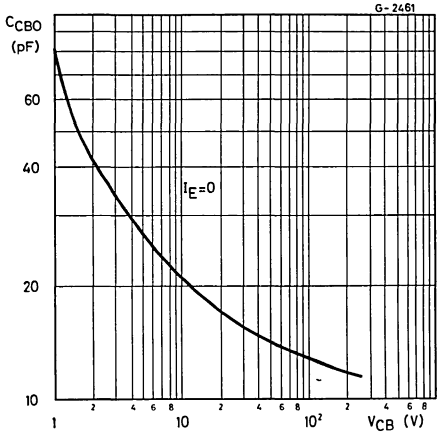


BUY49S

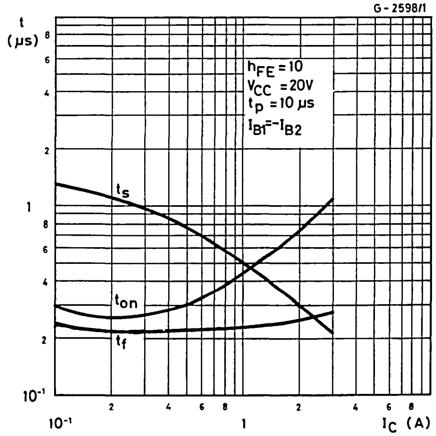
Transition frequency



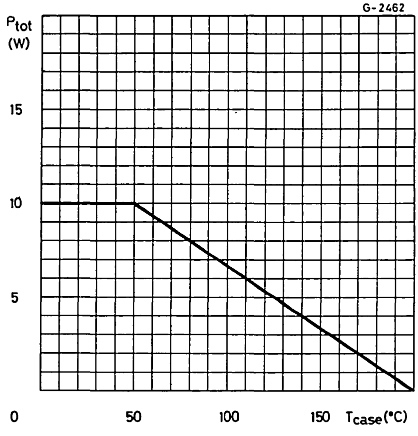
Collector-base capacitance



Saturated switching characteristics



Power rating chart



BUY68

EPITAXIAL PLANAR NPN

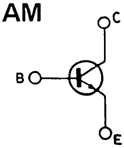
HIGH CURRENT, GENERAL PURPOSE TRANSISTOR

The BUY 68 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 BUY 68 is available in 3 h_{FE} gain bands.

ABSOLUTE MAXIMUM RATINGS

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 $T_{amb} \leqslant 25°C$	1	W
	$T_{case} \leqslant 50°C$	10	W
T_{stg}	Storage temperature	-65 to 200	°C
T_j	Junction temperature	200	°C

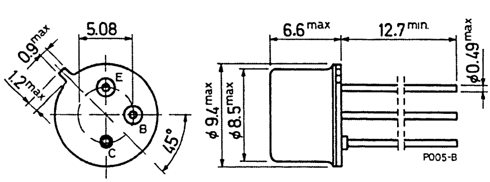
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-39

BUY68

THERMAL DATA

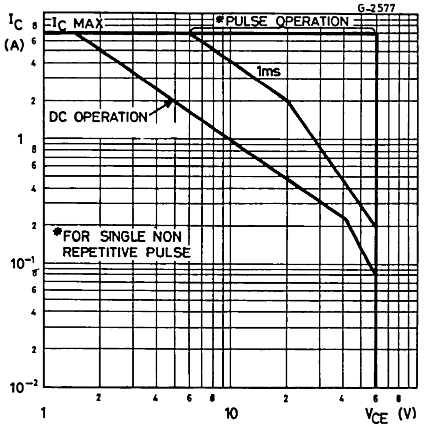
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	15	°C/W
$R_{th\ j\text{-}amb}$	Thermal resistance junction-ambient	max	175	°C/W

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

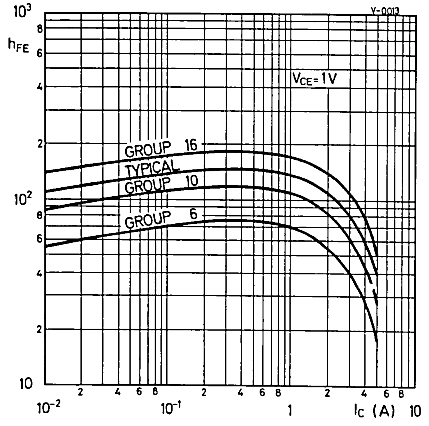
	Parameter	Test conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current (I_E = 0)	V_{CB} = 60 V				1	μA
$V_{(BR)\ CBO}$*	Collector-base breakdown voltage (I_E = 0)	I_C = 1 mA		100			V
$V_{CER\ (sus)}$*	Collector-emitter sustaining voltage (R_{BE} = 10 Ω)	I_C = 50 mA		80			V
$V_{CEO\ (sus)}$*	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_B = 0.2 A			0.6	V
		I_C = 5 A	I_B = 0.5 A			1	V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	I_C = 2 A	I_B = 0.2 A		1	1.3	V
		I_C = 5 A	I_B = 0.5 A		1.2	1.6	V
h_{FE}*	DC current gain	I_C = 0.1 A	V_{CE} = 1 V	40	130		—
			Group 6	40	70		—
			Group 10	63	110		—
			Group 16	100	170		—
		I_C = 1 A	V_{CE} = 1 V	40	130	250	—
			Group 6	40	70	100	—
			Group 10	63	110	160	—
			Group 16	100	170	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%

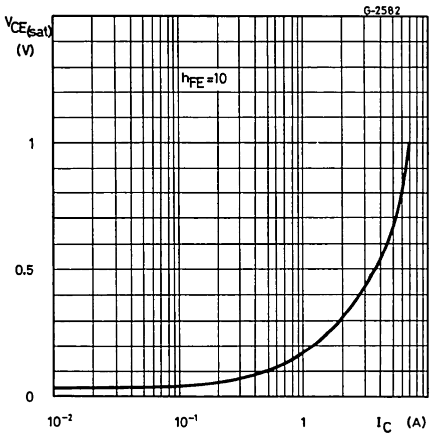
Safe operating areas



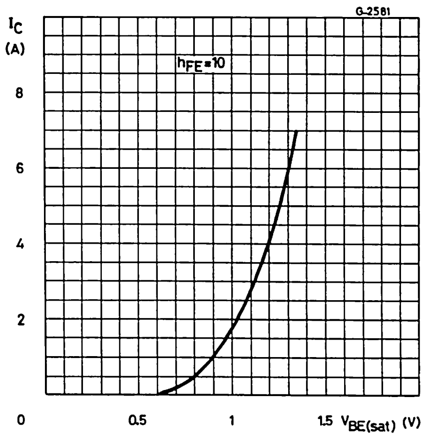
DC current gain



Collector-emitter saturation voltage

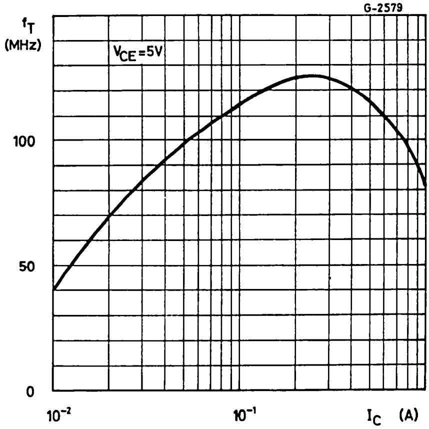


Base-emitter saturation voltage

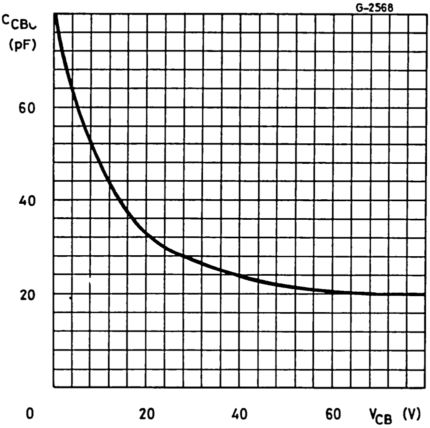


BUY68

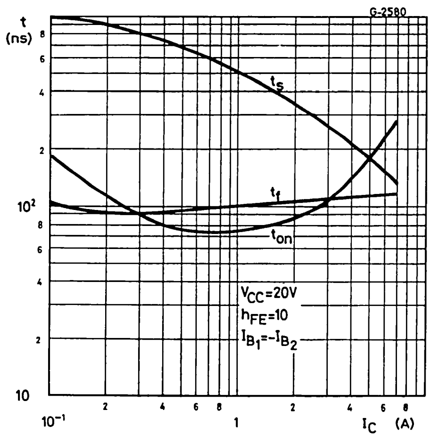
Transition frequency



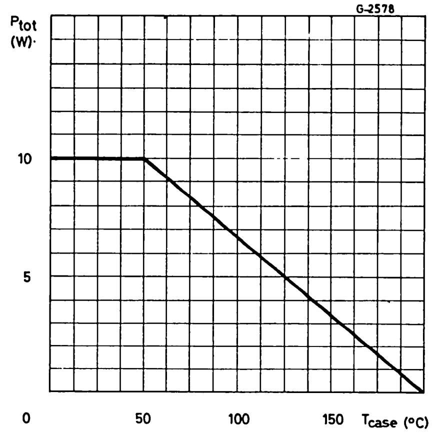
Collector-base capacitance



Saturated switching characteristics



Power rating chart



MULTIEPITAXIAL MESA NPN

BUY69A
BUY69B
BUY69C

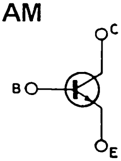
HIGH VOLTAGE POWER SWITCH

The BUY 69A, BUY 69B, and BUY 69C 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.

ABSOLUTE MAXIMUM RATINGS

		BUY 69A	BUY 69B	BUY 69C
V_{CES}	Collector-emitter voltage ($V_{BE} = 0$)	1000V	800V	500V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	400V	325V	200V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		8V	
I_C	Collector current		10A	
I_{CM}	Collector peak current ($t_p \leq 10ms$)		15A	
I_B	Base current		3A	
P_{tot}	Total power dissipation at $T_{case} \leq 25\,°C$		100W	
T_{stg}	Storage temperature		−65 to 200 °C	
T_j	Junction temperature		200 °C	

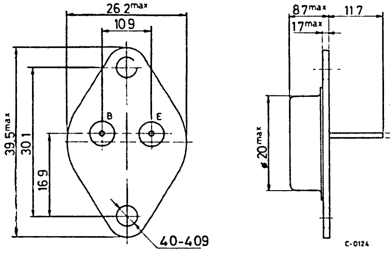
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

BUY69A
BUY69B
BUY69C

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)

Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current (V_{BE} = 0)	for **BUY69A** for **BUY69B** for **BUY69C**	V_{CE} = 1000V V_{CE} = 800V V_{CE} = 500V			1 1 1	mA mA mA
I_{EBO}	Emitter cutoff current (I_C = 0)	V_{EB} = 8V				1	mA
V_{CBO}	Collector-base voltage (I_E = 0)	for **BUY69A** for **BUY69B** for **BUY69C**	I_C = 1mA I_C = 1mA I_C = 1mA	1000 800 500			V V V
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage (I_B = 0)	I_C = 100mA for **BUY69A** for **BUY69B** for **BUY69C**		 400 325 200			 V V V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	I_C = 8A	I_B = 2.5A			3.3	V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	I_C = 8A	I_B = 2.5A			2.2	V
h_{FE}*	DC current gain	I_C = 2.5A	V_{CE} = 10V	15			—
f_T	Transition frequency	I_C = 0.5A	V_{CE} = 10V		10		MHz
$I_{S/b}$**	Second breakdown collector current	V_{CE} = 25V		4			A
t_{on}	Turn-on time	I_C = 5A I_{B1} = 1A	V_{CE} = 250V		0.2		μs

ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions	Min. Typ. Max.	Unit
t_s	Storage time	$I_C = 5A$ $V_{CE} = 250V$ $I_{B1} = -I_{B2} = 1A$	1.7	μs
t_f	Fall time		0.3	μs
t_f	Fall time	$I_C = 8A$ $V_{CE} = 40V$ $I_{B1} = -I_{B2} = 2.5A$	1	μs

* Pulsed: pulse duration = 300μs, duty cycle = 1.5%
** Pulsed: 1 s, non repetitive pulse

For characteristics curves see the BUW 34/5/6 series.

D44C1 / 2 / 3
D44C4 / 5 / 6
D44C7 / 8 / 9
D44C10 / 11 / 12

MULTIEPITAXIAL PLANAR NPN

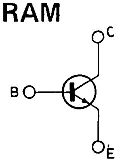
LINEAR AND SWITCHING APPLICATIONS

The D44C1 to D44C12 are silicon multiepitaxial planar transistors in TO-220 plastic package intended for linear and switching applications.

ABSOLUTE MAXIMUM RATINGS

		D44C 1/2/3	D44C 4/5/6	D44C 7/8/9	D44C 10/11/12
V_{CES}	Collector-emitter voltage ($V_{BE} = 0$)	40V	55V	70V	90V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	30V	45V	60V	80V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5V	5V	5V	5V
I_C	Collector current	4A			
I_{CM}	Collector peak current ($t_p = 10ms$)	6A			
P_{tot}	Total power dissipation $T_{case} \leqslant 25°C$	30W			
	$T_{amb} \leqslant 25°C$	1,67W			
T_{stg}	Storage temperature	-55 to 150°C			
T_j	Junction temperature	150°C			

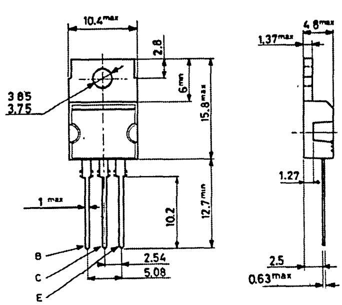
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

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)

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 ($I_C = 0$)	$V_{EB} = 5V$			100	μA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage	$I_C = 100mA$				
		for **D44C1-2-3**	30			V
		for **D44C4-5-6**	45			V
		for **D44C7-8-9**	60			V
		for **D44C10-11-12**	80			V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C = 1A$ $I_B = 50mA$ for **D44C2-3-5-6-8-9-11-12**			0.5	V
		$I_C = 1A$ $I_B = 0.1A$ for **D44C1-4-7-10**			0.5	V
$V_{BE(sat)}$*	Base-emitter saturation voltage	$I_C = 1A$ $I_B = 100mA$			1.3	V
h_{FE} *	DC current gain	$I_C = 0.2A$ $V_{CE} = 1V$	40		120	–
		$I_C = 2A$ $V_{CE} = 1V$	20			
		for **D44C3-6-9-12**				
		$I_C = 0.2A$ $V_{CE} = 1V$	100		220	–
		$I_C = 1A$ $V_{CE} = 1V$	20			
		for **D44C2-5-8-11**				
		$I_C = 0.2A$ $V_{CE} = 1V$	25			
		$I_C = 1A$ $V_{CE} = 1V$	10			
		for **D44C1-4-7-10**				

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

D44H1 D44H2
D44H4 D44H5
D44H7 D44H8
D44H10 D44H11

MULTIEPITAXIAL PLANAR NPN

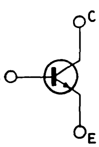
SWITCHING APPLICATIONS GENERAL PURPOSE

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.

ABSOLUTE MAXIMUM RATINGS

		D44H1/2	D44H4/5	D44H7/8	D44H10/11
V_{CEO}	Collector-emitter voltate ($I_B = 0$)	30V	45V	60V	80V
V_{EBO}	Emitter base voltage ($I_C = 0$)	5V			
I_C	Collector current	10A			
I_{CM}	Collector peak current	20A			
P_{tot}	Total power dissipation $T_{case} \leqslant 25°C$	50W			
T_{stg}	Storage temperature	-55 to 150°C			
T_j	Junction temperature	150°C			

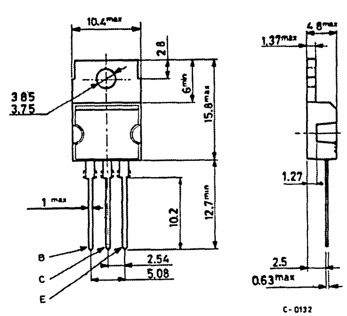
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

THERMAL DATA

$R_{th\ j-case}$	Thermal resistance junction-case	max.	2.5	°C/W

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

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 = 100mA for **D44H1/2**	30			V
		for **D44H4/5**	45			V
		for **D44H7/8**	60			V
		for **D44H10/11**	80			V
$V_{CE\,(sat)}$*	Collector-emitter saturation voltage	I_C = 8A I_B = 0.4A for **D44H2/5/8/11**			1	V
		I_C = 8A I_B = 0 8A for **D44H1/4/7/10**			1	V
$V_{BE\,(sat)}$*	Base-emitter saturation voltage	I_C = 8A I_B = 0 8A			1 5	V
h_{FE} *	DC current gain	V_{CE} = 1V I_C = 2A				
		for **D44H1/4/7/10**	35			—
		for **D44H2/5/8/11**	60			—
		V_{CE} = 1V I_C = 4A				
		for **D44H1/4/7/10**	20			—
		for **D44H2/5/8/11**	40			—

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

D44Q1
D44Q3
D44Q5

MULTIEPITAXIAL PLANAR NPN

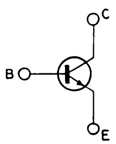
LINEAR AND SWITCHING APPLICATIONS

The D44Q1, D44Q3 and D44Q5 are silicon multiepitaxial planar transistors in TO-220 plastic package intended for linear and switching applications.

ABSOLUTE MAXIMUM RATINGS

		D44Q1	D44Q3	D44Q5
V_{CBO}	Collector-base voltage ($I_E = 0$)	200V	250V	300V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	125V	175V	225V
V_{EBO}	Emitter-base voltage ($I_B = 0$)	7V	7V	7V
I_C	Collector current		4A	
P_{tot}	Total power dissipation $T_{case} \leqslant 25°C$		31.25W	
	$T_{amb} \leqslant 25°C$		1.67W	
T_{stg}	Storage temperature		-55 to 150°C	
T_j	Junction temperature		150°C	

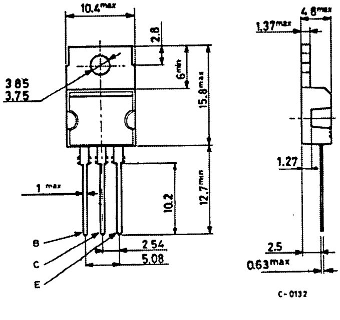
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

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)

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 = 10mA for **D44Q1** for **D44Q3** for **D44Q5**	 125 175 225			 V V V
$V_{CE(sat)}$*	Collector–emitter saturation voltage	I_C = 2A I_B = 0.2A			1	V
$V_{BE(sat)}$*	Base-emitter saturation voltage	I_C = 2A I_B = 0.2A			1.3	V
h_{FE}*	DC current gain	I_C = 0.2A V_{CE} = 10V I_C = 2A V_{CE} = 10V	30 20			– –
f_T	Transition frequency	I_C = 100mA V_{CE} = 10V		20		MHz
C_{CBO}	Collector base capacitance	V_{CB} = 10V f = 1MHz		32		pF
t_{on}	Turn-in time	V_{CC} = 50V I_C = 1A I_{B1} = $-I_{B2}$ = 0.1A			0.4	μs
t_s	Storage time				2	μs
t_f	Fall time				1.7	μs

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

MJ802
MJ4502

EPITAXIAL-BASE NPN/PNP

COMPLEMENTARY HIGH POWER TRANSISTORS

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.

ABSOLUTE MAXIMUM RATINGS

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 $T_{case} \leqslant 25°C$	200	W
T_{stg}	Storage temperature	−65 to 200	°C
T_j	Junction temperature	200	°C

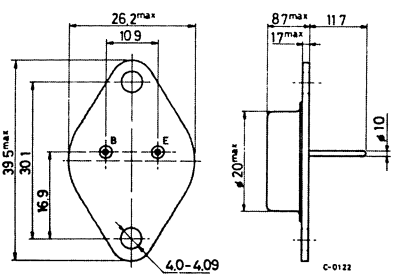
For PNP type voltage and current values are negative

INTERNAL SCHEMATIC DIAGRAMS

MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

THERMAL DATA

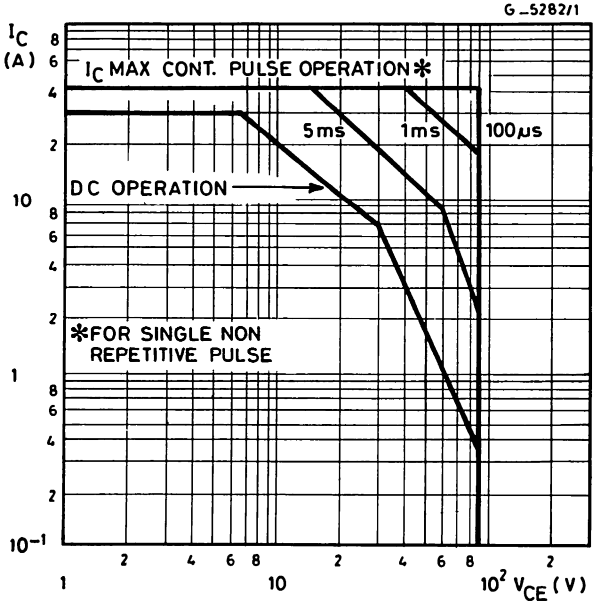
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	0.875	°C/W

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

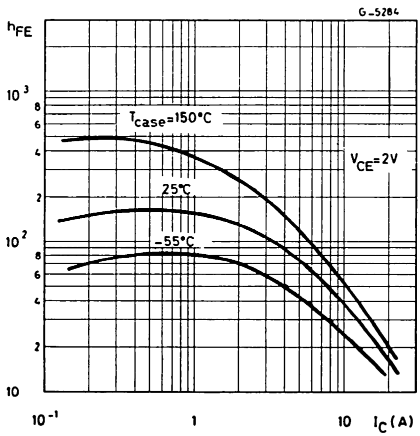
Parameter		Test conditions		Min.	Typ.	Max.	Unit
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B=0$)	$I_C=200mA$		90			V
I_{CBO}	Collector cutoff current ($I_E=0$)	$V_{CB}=100V$ $T_{case}=150°C$				1 5	mA mA
I_{EBO}	Emitter cutoff current ($I_C=0$)	$V_{EB}=4V$				1	mA
$V_{CER(sus)}$*	Collector-emitter sustaining voltage ($R_{BE}=100\Omega$)	$I_C=200mA$		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 = 300μs, duty cycle $\leqslant$2%
For PNP type voltage and current values are negative

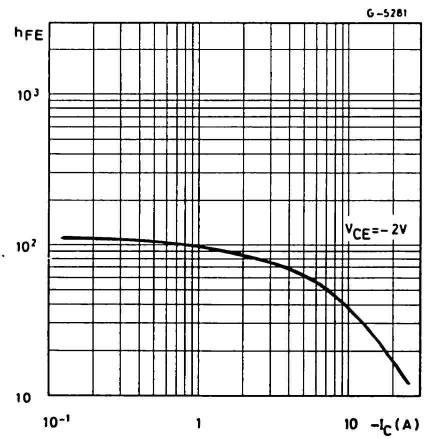
Safe operating areas



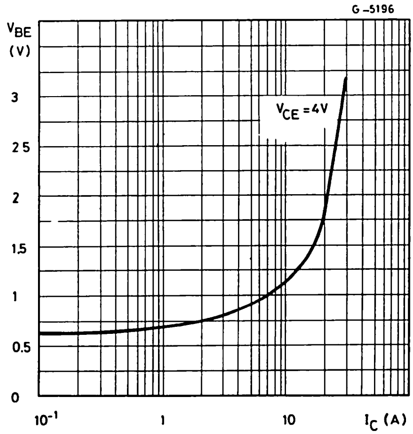
DC current gain (NPN type)



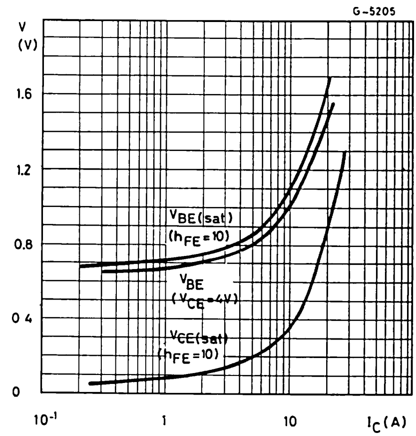
DC current gain (PNP type)



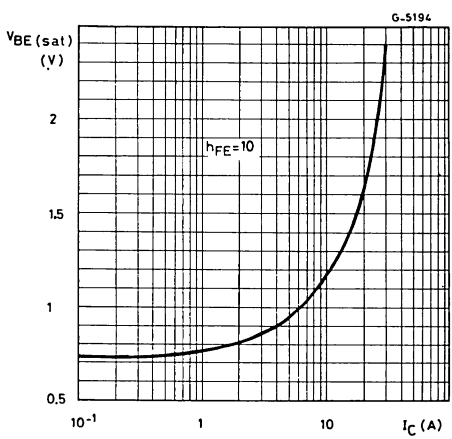
Base-emitter voltage (PNP type)



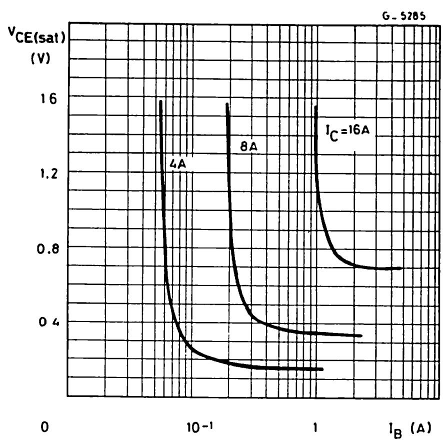
Saturation voltage (NPN type)



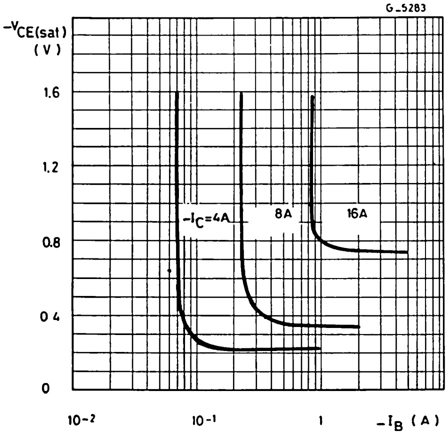
Base-emitter saturation voltage (PNP type)



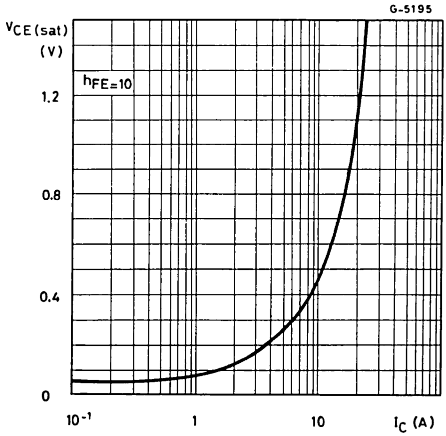
Collector-emitter saturation voltage (NPN type)



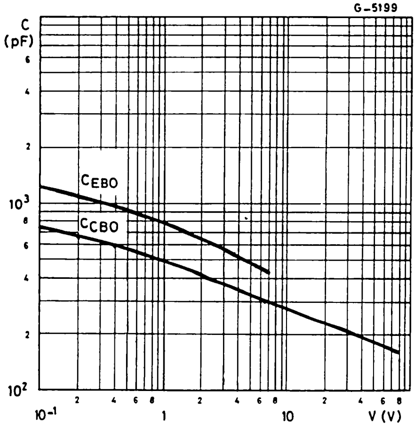
Collector-emitter saturation voltage
(PNP type)



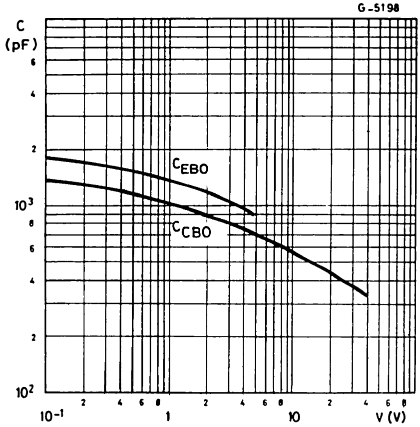
Collector-emitter saturation voltage
(PNP type)



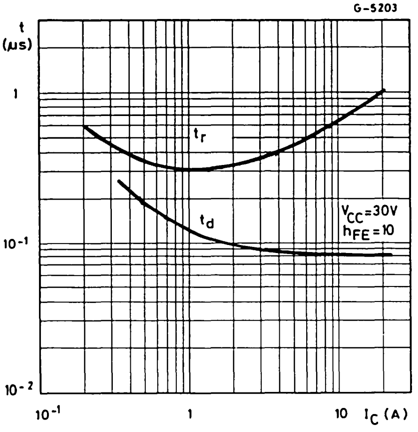
Capacitances (NPN type)



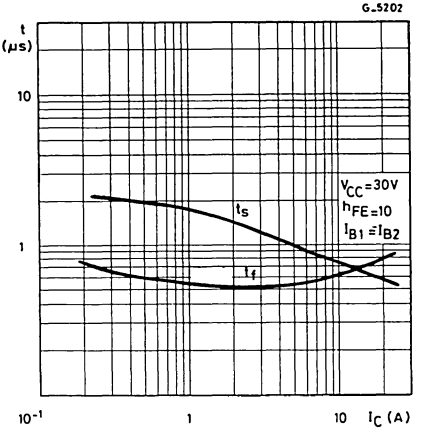
Capacitances (PNP type)



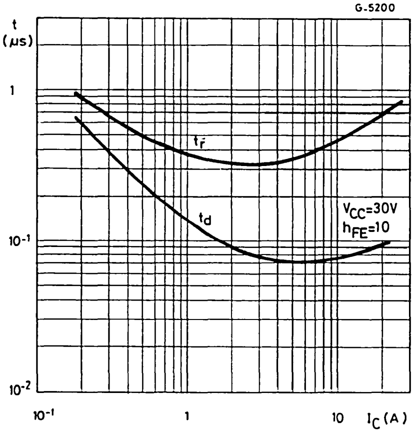
Turn-on time (NPN type)



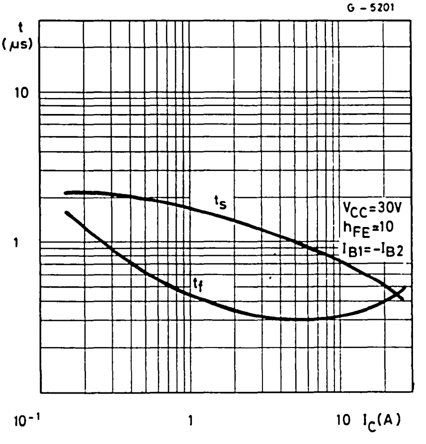
Turn-off time (NPN type)



Turn-on time (PNP type)



Turn-off time (PNP type)



MJ900
MJ901
MJ1000
MJ1001

EPITAXIAL-BASE NPN/PNP

COMPLEMENTARY POWER DARLINGTONS

The MJ 900, MJ 901, MJ 1000 and MJ 1001 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 MJ 900 and MJ 901 and their complementary NPN types are the MJ 1000 and MJ 1001 respectively.

ABSOLUTE MAXIMUM RATINGS

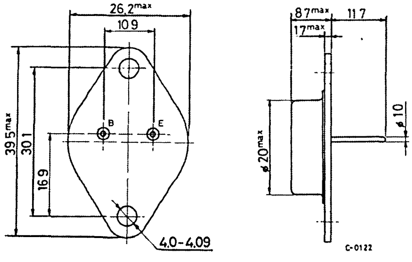
		PNP°	MJ 900	MJ 901
		NPN	MJ1000	MJ1001
V_{CBO}	Collector-base voltage ($I_E = 0$)		60V	80V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)		60V	80V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		5V	
I_C	Collector current		8A	
I_B	Base current		0.1A	
P_{tot}	Total power dissipation at $T_{case} \leq 25$ °C		90W	
T_{stg}	Storage temperature		-65 to 200 °C	
T_j	Junction temperature		200 °C	

° For PNP types voltage and current values are negative

MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

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)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector cutoff current (R_{BE} = 1kΩ)	for **MJ900** and **MJ1000** V_{CE} = 60 V for **MJ901** and **MJ1001** V_{CE} = 80 V T_{case} = 150°C for **MJ900** and **MJ1000** V_{CE} = 60 V for **MJ901** and **MJ1001** V_{CE} = 80 V			 1 1 5 5	 mA mA mA mA
I_{CEO}	Collector cutoff current (I_B = 0)	for **MJ900** and **MJ1000** V_{CE} = 30 V for **MJ901** and **MJ1001** V_{CE} = 40 V			 0.5 0.5	 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 = 100mA for **MJ900** and **MJ1000** for **MJ901** and **MJ1001**	 60 80			 V V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	I_C = 3 A I_B = 12mA I_C = 8 A I_B = 40mA			2 4	V V
V_{BE}*	Base-emitter voltage	I_C = 3 A V_{CE} = 3 V			2.5	V
h_{FE}*	DC current gain	I_C = 3 A V_{CE} = 3 V I_C = 4 A V_{CE} = 3 V	1000 750			— —

* Pulsed: pulse duration = 300 μs, duty cycle = 1.5%
° For PNP types current and voltage values are negative
For characteristic curves see the 2N 6053/55 series

MJ2500
MJ2501
MJ3000
MJ3001

EPITAXIAL-BASE NPN/PNP

COMPLEMENTARY POWER DARLINGTONS

The MJ 2500, MJ 2501, MJ 3000 and MJ 3001 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 MJ 2500 and MJ 2501 and the ir complementary NPN types are the MJ 3000 arld MJ 3001 respectively.

ABSOLUTE MAXIMUM RATINGS

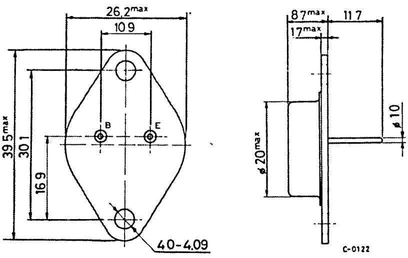
		PNP°	MJ2500	MJ2501
		NPN	MJ3000	MJ3001
V_{CBO}	Collector-base voltage ($I_E = 0$)		60V	80V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)		60V	80V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		5V	
I_C	Collector current		10A	
I_B	Base current		0.2A	
P_{tot}	Total power dissipation at $T_{case} \leq 25$ °C		150W	
T_{stg}	Storage temperature		-65 to 200 °C	
T_j	Junction temperature		200 °C	

° For PNP types voltage and current values are negative

MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

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)

	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector cutoff current ($R_{BE} = 1k\Omega$)	for **MJ2500** and **MJ3000** V_{CE} = 60 V			1	mA
		for **MJ2501** and **MJ3001** V_{CE} = 80 V			1	mA
		T_{case} = 150°C for **MJ2500** and **MJ3000** V_{CE} = 60 V			5	mA
		for **MJ2501** and **MJ3001** V_{CE} = 80 V			5	mA
I_{CEO}	Collector cutoff current ($I_B = 0$)	for **MJ2500** and **MJ3000** V_{CE} = 30 V			1	mA
		for **MJ2501** and **MJ3001** V_{CE} = 40 V			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 = 100mA				
		for **MJ2500** and **MJ3000**	60			V
		for **MJ2501** and **MJ3001**	80			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	I_C = 5 A I_B = 20mA			2	V
		I_C = 10 A I_B = 50mA			4	V
V_{BE}*	Base-emitter voltage	I_C = 5 A V_{CE} = 3 V			3	V
h_{FE}*	DC current gain	I_C = 5 A V_{CE} = 3 V	1000			—

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

For characteristic curves see the 2N6050 / 57 series

MJ2955

EPITAXIAL-BASE PNP

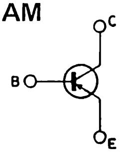
POWER LINEAR AND SWITCHING APPLICATIONS

The MJ 2955 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.

ABSOLUTE MAXIMUM RATINGS

V_{CBO}	Collector-base voltage ($I_E = 0$)	-100	V
V_{CER}	Collector-emitter voltage ($R_{BE} \leqslant 100\ \Omega$)	-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 $T_{case} \leqslant 25$ °C	150	W
T_{stg}	Storage temperature	-65 to 200	°C
T_j	Junction temperature	200	°C

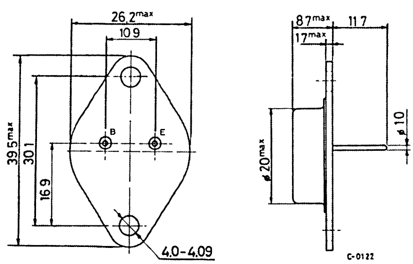
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

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)

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} = -30 V			-0.7	mA
I_{EBO}	Emitter cutoff current (I_C = 0)	V_{BE} = 7 V			-5	mA
$V_{CER\ (sus)}$*	Collector-emitter sustaining voltage (R_{BE} = 100 Ω)	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 = -4 A I_B = -0.4A I_C = -10 A I_B = -3.3A			-1.1 -3	V V
V_{BE}*	Base-emitter voltage	I_C = -4 A V_{CE} = -4 V			-1.8	V
h_{FE}*	DC current gain	I_C = -4 A V_{CE} = -4 V I_C = -10 A V_{CE} = -4 V	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%

For characteristic curves see the 2N 5875 series

MJ4030 MJ4033
MJ4031 MJ4034
MJ4032 MJ4035

EPITAXIAL-BASE NPN/PNP

GENERAL PURPOSE

The MJ4030/31/32/33/34/35 are medium-power silicon Darlington in Jedec TO-3 metal case, intended for use in general purpose and amplifier applications.

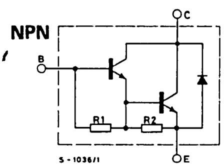
ABSOLUTE MAXIMUM RATINGS

		PNP*	MJ4030	MJ4031	MJ4032
		NPN	MJ4033	MJ4034	MJ4035
V_{CBO}	Collector-base voltage ($I_E = 0$)		60V	80V	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)		60V	80V	100V
V_{EBO}	Emitter-base voltage ($I_C = 0$)			5V	
I_C	Collector current			16A	
I_B	Base current			0.5A	
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$			150W	
T_{stg}	Storage temperature			-65 to 200°C	
T_j	Junction temperature			200°C	

* For PNP types voltage and current values are negative

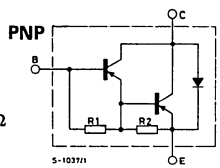
INTERNAL SCHEMATIC DIAGRAMS

NPN



R1 ≅ 5 KΩ
R2 ≅ 50Ω

PNP

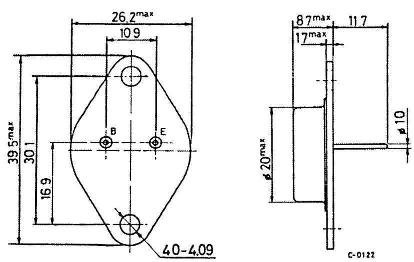


R1 ≅ 5 KΩ
R2 ≅ 50Ω

MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

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)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B = 0$)	$V_{CE} = 30V$ $I_B = 0$ **MJ4030/33**			3	mA
		$V_{CE} = 40V$ $I_B = 0$ **MJ4031/34**			3	mA
		$V_{CE} = 50V$ $I_B = 0$ **MJ4032/35**			3	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{BE} = 5V$ $I_C = 0$			5	mA
I_{CER}	Collector cutoff current ($R_{BE} = 1K\Omega$)	for **MJ4030/33** $V_{CB} = 60V$			1	mA
		for **MJ4031/34** $V_{CB} = 80V$			1	mA
		for **MJ4032/35** $V_{CB} = 100V$			1	mA
		$T_{case} = 150°C$				
		for **MJ4030/33** $V_{CB} = 60V$			5	mA
		for **MJ4031/34** $V_{CB} = 80V$			5	mA
		for **MJ4032/35** $V_{CB} = 100V$			5	mA
$V_{(BR)CEO}$*	Collector-emitter Breakdown voltage	$I_C = 100mA$ $I_B = 0$				
		for **MJ4030/33**	60			V
		for **MJ4031/33**	80			V
		for **MJ4032/35**	100			V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C = 10A$ $I_B = 40mA$			2.5	V
		$I_C = 16A$ $I_B = 80mA$			4	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 =300 μs, duty cycles $\leqslant 2\%$.
For PNP types voltage and current values are negative.

MJ10004
MJ10004P
MJ10005
MJ10005P

EPITAXIAL PLANAR NPN

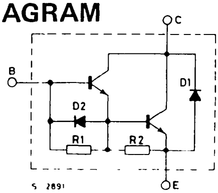
HIGH POWER FAST SWITCHING

The MJ10004/10005 are silicon darlington transistors with integrated base-emitter speed-up diode, mounted in Jedec TO-3 metal case designed for high-power, fast switching applications. The MJ10004P and MJ10005P are mounted in SOT-93 case similar to TO-218.

ABSOLUTE MAXIMUM RATINGS

		MJ10004/4P	MJ10005/5P
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	350V	400V
V_{CEX}	Collector-emitter voltage ($V_{BE} = -5V$)	400V	450V
V_{CEV}	Collector-emitter voltage ($V_{BE} = 1.5V$)	450V	500V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	8V	
I_C	Collector current	20A	
I_{CM}	Collector peak current	30A	
I_B	Base current	2.5A	
I_{BM}	Base peak current	5A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	TO-3 175W	SOT-93 150W
T_{stg}	Storage temperature	-65 to 200°C	-65 to 175°C
T_j	Junction temperature	200°C	175°C

INTERNAL SCHEMATIC DIAGRAM

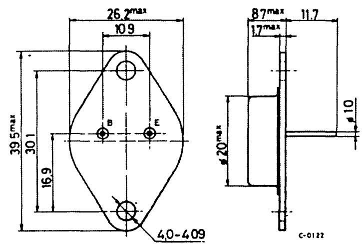


R1 Typ. 250Ω
R2 Typ. 500Ω

MECHANICAL DATA

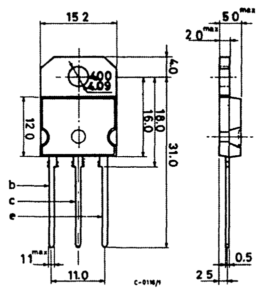
Dimension in mm

Collector connected to case



TO-3

Collector connected to tab



(sim. to TO-218) SOT-93

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max.	1	°C/W

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

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** for **MJ10005/5P**	 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** for **MJ10005/5P** I_C = 10A T_{case} = 100°C V_{Clamp} = Rated V_{CEX} for **MJ10004/4P** for **MJ10005/5P**	 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

(o) For MJ10004P/5P = 5V max.

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

	Parameter	Test conditions	Min.	Typ.	Max.	Unit
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	$I_C = 1A$ $V_{CE} = 10V$ $f_{test} = 1MHz$	10			—
C_{ob}	Output capacitance	$V_{CB} = 10V$ $I_E = 0$ $f_{test} = 100MHz$	100		325	pF
t_{on}	Turn-on time	$V_{CC} = 250V$ $I_C = 10A$ $I_{B1} = -I_{B2} = 400mA$ $V_{BE(off)} = 5V$ $t_p = 50\mu s$ 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

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

For characteristics curves see BUT13/P series.

EPITAXIAL-BASE NPN/PNP

MJ11011 MJ11012
MJ11013 MJ11014
MJ11015 MJ11016

COMPLEMENTARY POWER DARLINGTONS

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.

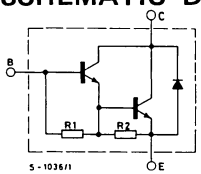
ABSOLUTE MAXIMUM RATINGS

	PNP	MJ11011	MJ11013	MJ11015
	NPN	MJ11012	MJ11014	MJ11016
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	60V	90V	120V
V_{CBO}	Collector-base voltage ($I_E = 0$)	60V	90V	120V
V_{EBO}	Base-emitter voltage ($I_C = 0$)	5V		
I_C	Collector current	30A		
I_B	Base current	1A		
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$	200W		
T_{stg}	Storage temperature	−65 to 200°C		
T_j	Junction temperature	200°C		

For PNP types voltage and current values are negative

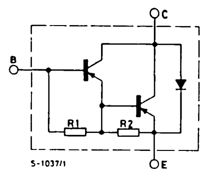
INTERNAL SCHEMATIC DIAGRAMS

NPN



R1 ≅ 8KΩ
R2 ≅ 60Ω

PNP

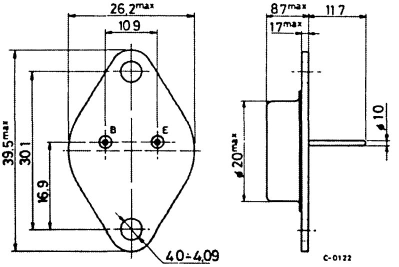


R1 ≅ 8KΩ
R2 ≅ 60Ω

MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

THERMAL DATA

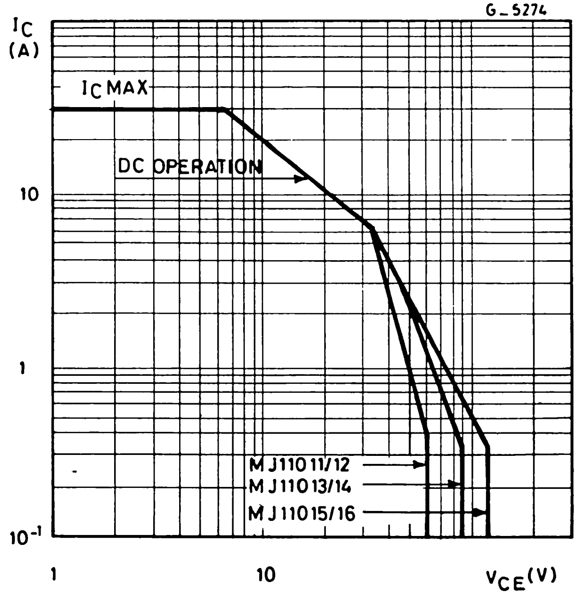
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	0.87	°C/W

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

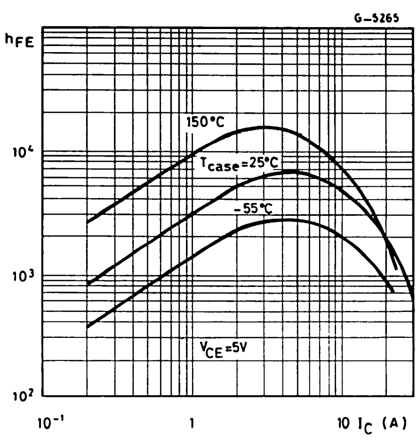
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B=0$)	$V_{CE}=50V$			1	mA
I_{EBO}	Emitter cutoff current ($I_C=0$	$V_{EB}=5V$			5	mA
I_{CER}	Collector cutoff current ($R_{BE}=1K\Omega$)	$V_{CE}=$ rated V_{CEO}			1	mA
		$T_{case}=150°C$ $V_{CE}=$ rated V_{CEO}			5	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B=0$)	$I_C=100mA$				
		MJ11011, MJ11012	60			V
		MJ11013, MJ11014	90			V
		MJ11015, MJ11016	120			V
h_{FE}*	DC current gain	$I_C=20A$ $V_{CE}=5V$	1000			—
		$I_C=30A$ $V_{CE}=5V$	200			—
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C=20A$ $I_B=200mA$			3	V
		$I_C=30A$ $I_B=300mA$			4	V
$V_{BE(sat)}$*	Base-emitter saturation voltage	$I_C=20A$ $I_B=200mA$			3.5	V
		$I_C=30A$ $I_B=300mA$			5	V
h_{fe}	Small signal current gain	$I_C=10A$ $V_{CE}=3V$ $f=1MHz$	4			—

* Pulsed: pulse duration = 300 μs, duty cycle $\leqslant$1.5%
For PNP devices voltage and current values are negative

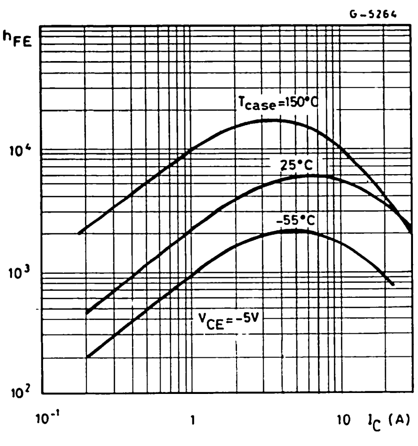
Safe operating areas



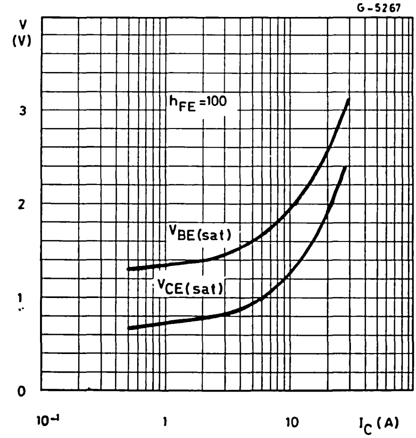
DC current gain (NPN types)



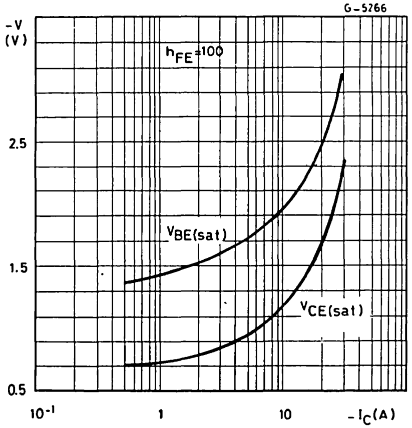
DC current gain (PNP types)



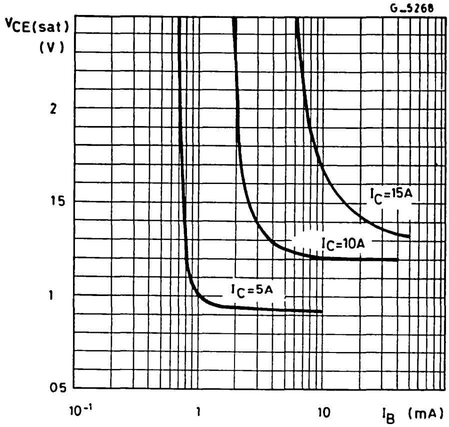
Saturation voltages (NPN types)



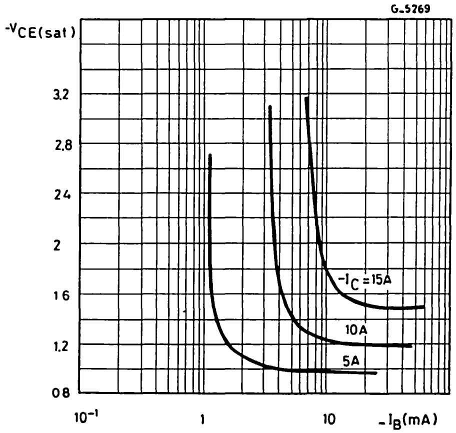
Saturation voltages (PNP types)



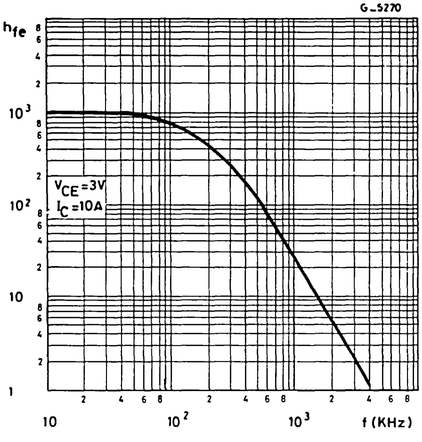
Collector-emitter saturation voltage (NPN types)



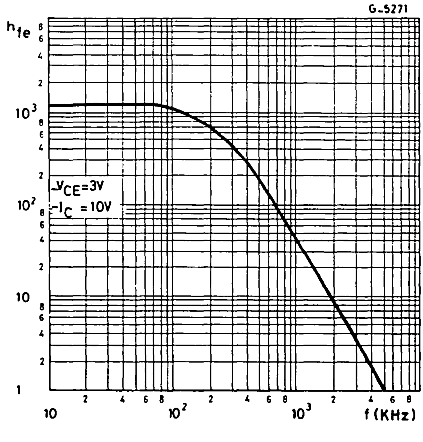
Collector-emitter saturation voltage (PNP types)



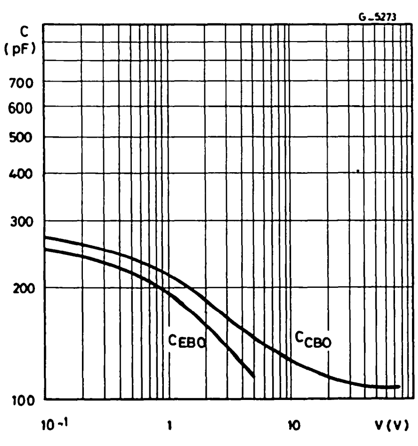
Small signal current gain (NPN types)



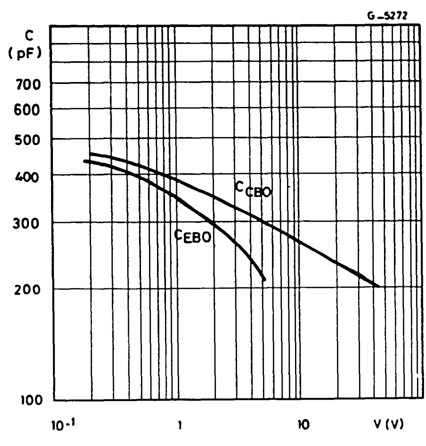
Small signal current gain (PNP types)



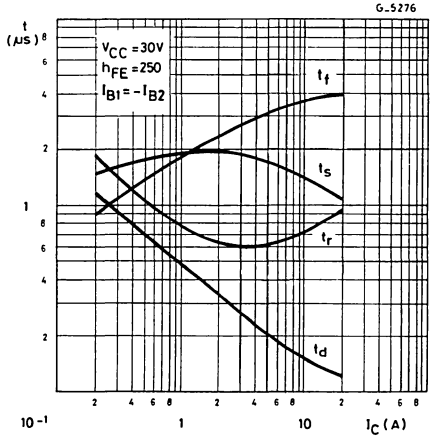
Capacitances (NPN types)



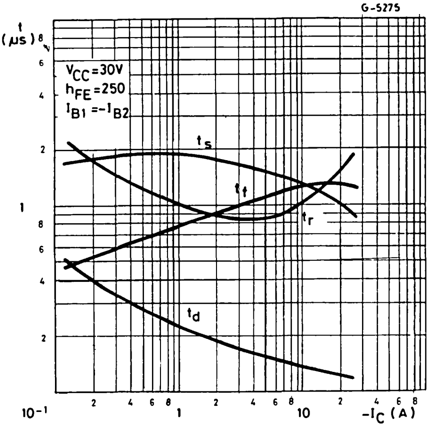
Capacitances (PNP types)



Saturated switching times (NPN types)



Saturated switching times (PNP types)



EPITAXIAL PLANAR NPN/PNP

MJE170 MJE180
MJE171 MJE181
MJE172 MJE182

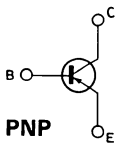
COMPLEMENTARY POWER TRANSISTORS

The MJE170, 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.

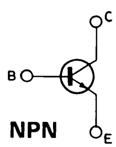
ABSOLUTE MAXIMUM RATINGS		PNP / NPN	MJE170 / MJE180	MJE171 / MJE181	MJE172 / MJE182
V_{CEO}	Collector-emitter voltage ($I_B=0$)		40V	60V	80V
V_{CBO}	Collector-base voltage ($I_E=0$)		60V	80V	100V
V_{EBO}	Base-emitter voltage ($I_C=0$)			7V	
I_C	Collector current			3A	
I_{CM}	Collector peack current			6A	
I_B	Base current			1A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$			12.5W	
T_{stg}	Storage temperature			−65 to 150°C	
T_j	Junction temperature			150°C	

For PNP types voltage and current values are negative

INTERNAL SCHEMATIC DIAGRAMS



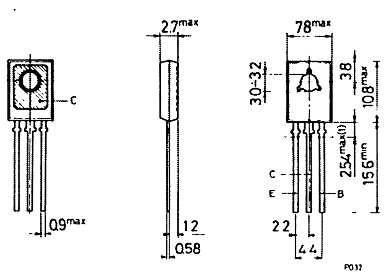
PNP



NPN

MECHANICAL DATA

Dimensions in mm



(1) Within this region the cross-section of the leads is uncontrolled

SOT-32 (TO-126)

THERMAL DATA

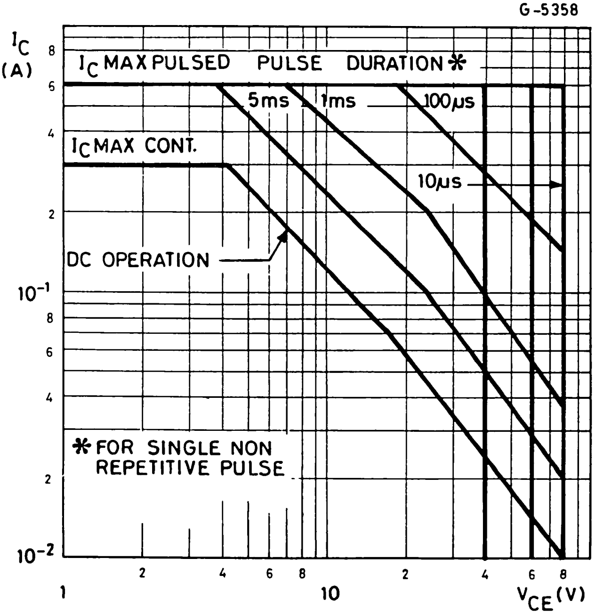
$R_{th\ j\text{-}amb}$	Thermal resistance junction-ambient	max	83.4	°C/W
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	10	°C/W

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

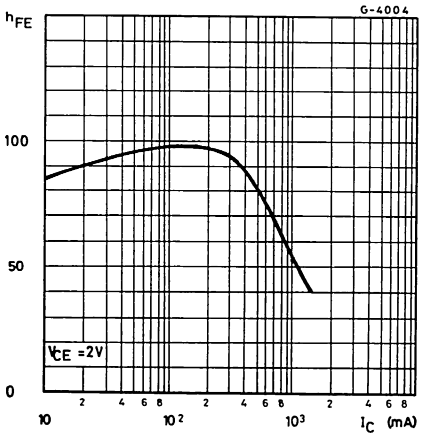
Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E=0$)	V_{CB} = rated V_{CBO} $T_{case}=150°C$				0.1 0.1	μA mA
I_{EBO}	Emitter cutoff current ($I_C=0$)	$V_{EB}=7V$				0.1	μA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage	$I_C=10mA$ for **MJE170, MJE180** for **MJE171, MJE181** for **MJE172, MJE182**		 40 60 80			 V V V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C=0.5A$ $I_C=1.5A$ $I_C=3A$	$I_B=50mA$ $I_B=0.15A$ $I_B=0.6A$			0.3 0.9 1.7	V V V
$V_{BE(sat)}$*	Base-emitter saturation voltage	$I_C=1.5A$ $I_C=3A$	$I_B=0.15A$ $I_B=0.6A$			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	$I_C=0.1A$ $I_C=0.5A$ $I_C=1.5A$	$V_{CE}=1V$ $V_{CE}=1V$ $V_{CE}=1V$	50 30 12		250	— — —
f_T	Transition frequency	$I_C=0.1A$ $f=10MHz$	$V_{CE}=10V$	 50			 MHz
C_{CBO}	Collector-base capacitance	$V_{CB}=10V$; $I_E=0$; $f=0.1MHz$ for **MJE170, MJE172** for **MJE180, MJE182I**				 60 40	 pF pF

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

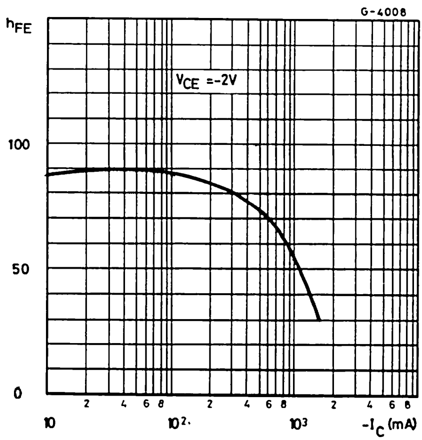
Safe operating areas



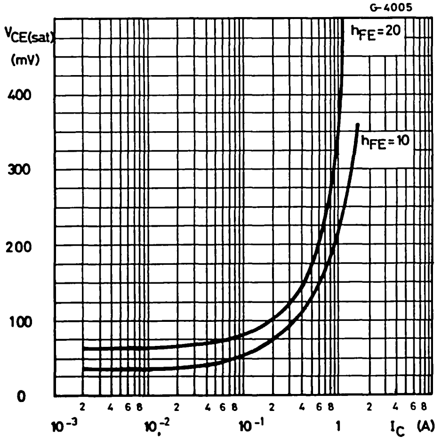
DC current gain (NPN types)



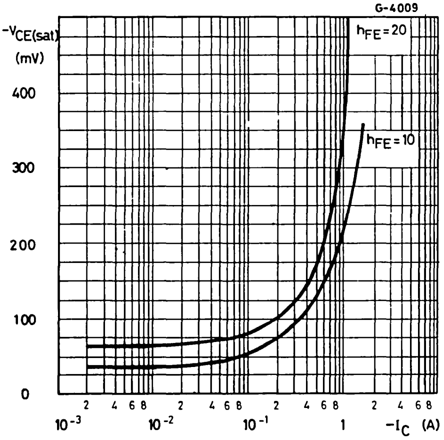
DC current gain (PNP types)



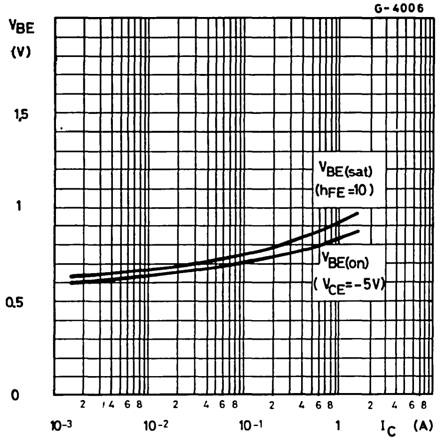
Collector-emitter saturation voltage (NPN types)



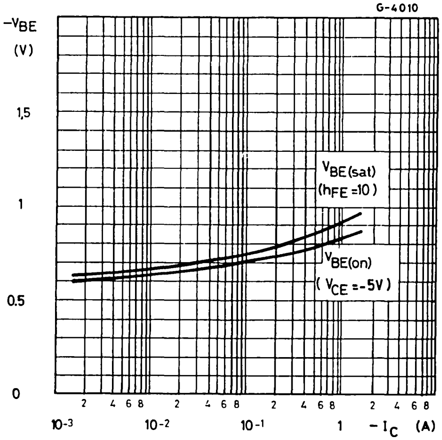
Collector-emitter saturation voltage (PNP types)



Base-emitter voltage (NPN types)



Base-emitter voltage (PNP types)



EPITAXIAL-BASE NPN/PNP

MJE200
MJE210

PRELIMINARY DATA

COMPLEMENTARY POWER TRANSISTORS

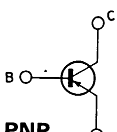
The MJE200 (NPN type) and MJE210 (PNP type) are silicon epitaxial-base transistors in Jedec TO-126 plastic package, designed for low voltage, low power, high gain audio amplifier applications.

ABSOLUTE MAXIMUM RATINGS

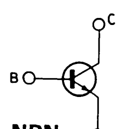
V_{CBO}	Collector-base voltage ($I_E = 0$)	40	V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	25	V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	8	V
I_C	Collector current	5	A
I_{CM}	Collector peak current	10	A
I_B	Base current	1	A
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$	15	W
	at $T_{amb} \leq 25°C$	1.5	W
T_{stg}	Storage temperature	−65 to 150	°C
T_j	Junction temperature	150	°C

For PNP type voltage and current values are negative

INTERNAL SCHEMATIC DIAGRAMS



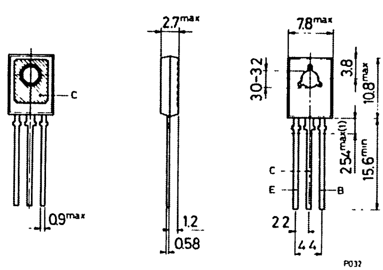
PNP



NPN

MECHANICAL DATA

Dimensions in mm



(1) Within this region the cross-section of the leads is uncontrolled

SOT-32 (TO-126)

THERMAL DATA

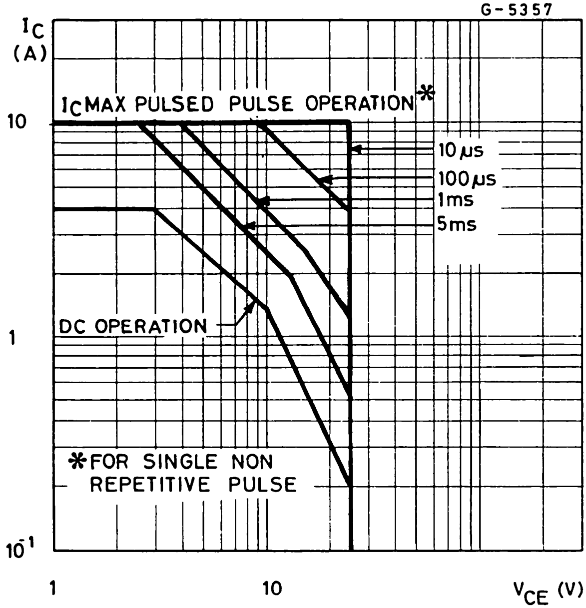
$R_{th\ j\text{-}amb}$	Thermal resistance junction-ambient	max	83.4	°C/W
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	8.34	°C/W

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

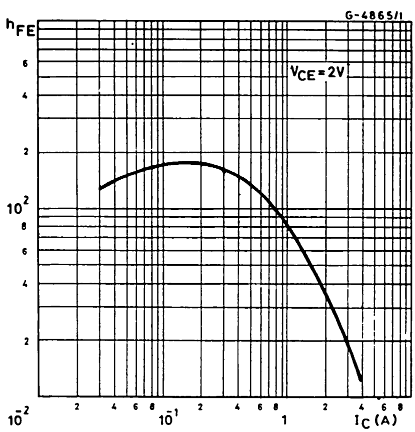
Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	$V_{CB} = 40V$ $V_{CB} = 40V$	 $T_{case} = 125°C$			100 100	nA μA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 8V$				100	nA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage	$I_C = 10mA$		25			V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C = 0.5A$ $I_C = 2A$ $I_C = 5A$	$I_B = 50mA$ $I_B = 0.2A$ $I_B = 1A$			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	$I_C = 0.5A$ $I_C = 2A$ $I_C = 5A$	$V_{CE} = 1V$ $V_{CE} = 1V$ $V_{CE} = 2V$	70 45 10		 180 	— — —
f_T	Transition frequency	$I_C = 0.1A$ $f = 10MHz$	$V_{CE} = 10V$	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 = 300 μs, duty cycle ≤1.5%
For PNP type voltage and current values are negative

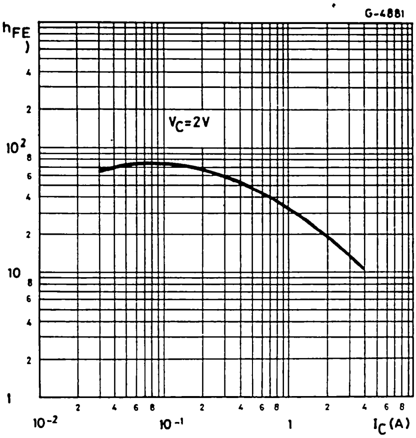
Safe operating areas



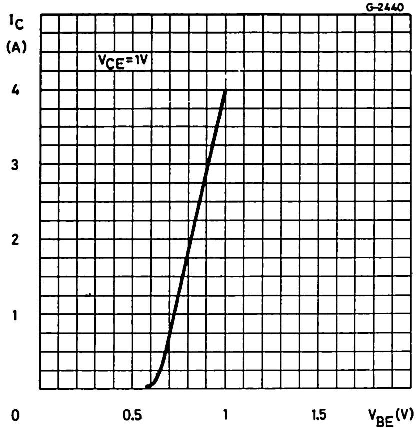
DC current gain (NPN type)



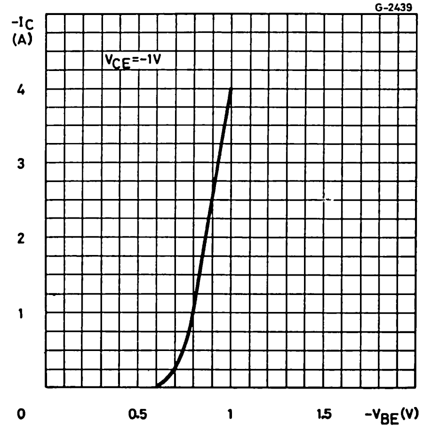
DC current gain (PNP type)



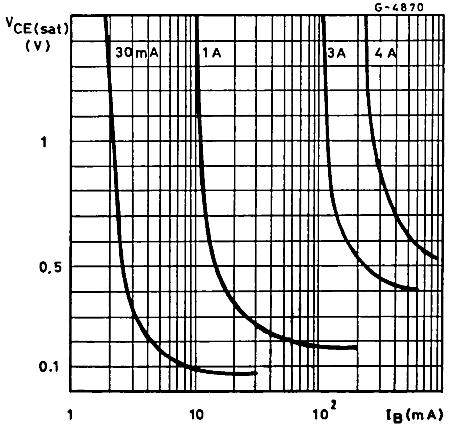
DC transconductance (NPN type)



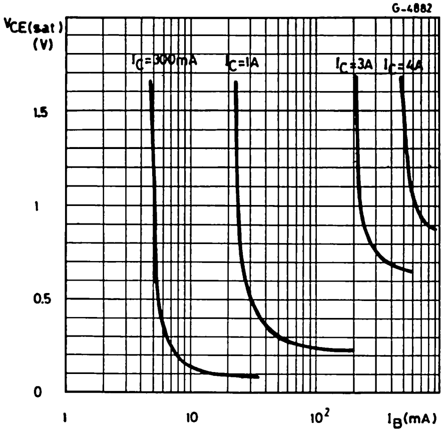
DC transconductance (PNP type)



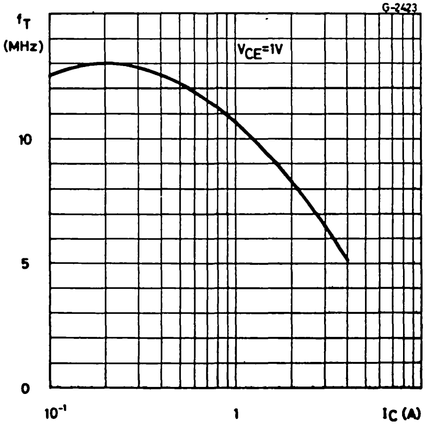
Collector-emitter saturation voltage (NPN type)



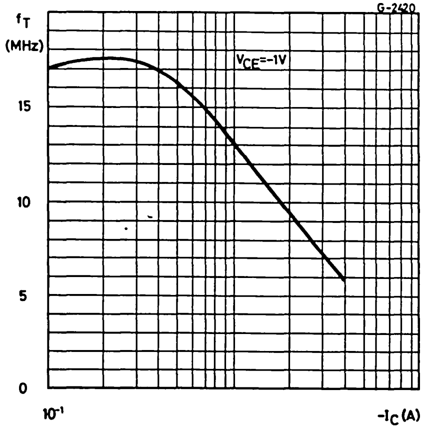
Collector-emitter saturation voltage (PNP type)



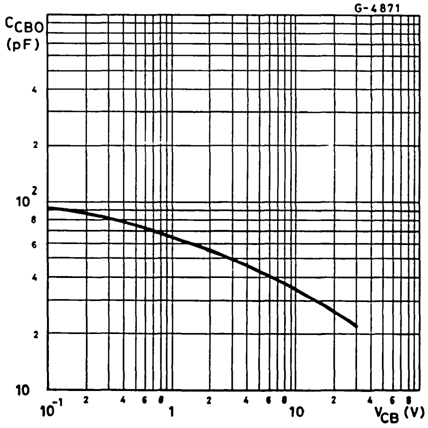
Transition frequency (NPN type)



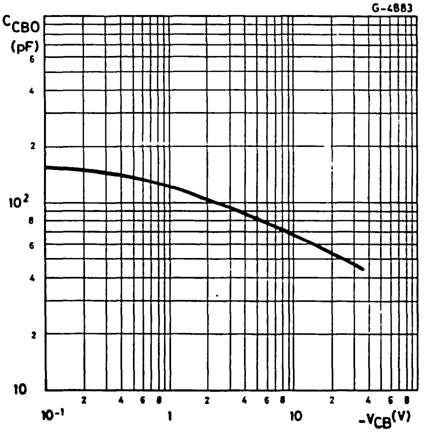
Transition frequency (PNP type)



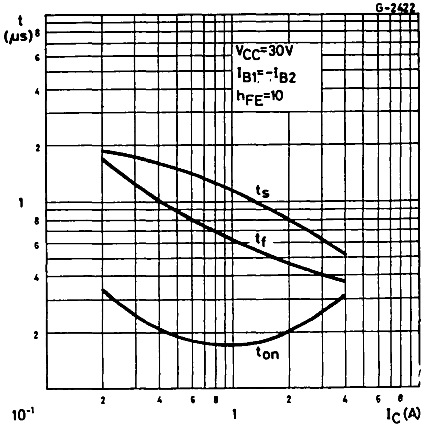
Collector-base capacitance (NPN type)



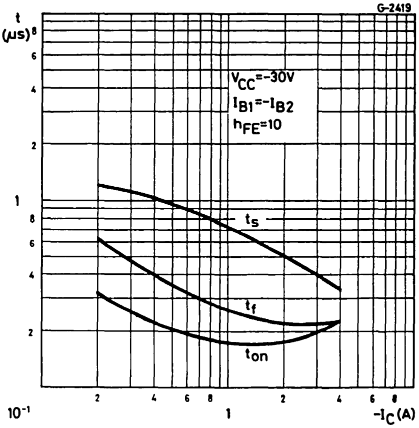
Collector-base capacitance (PNP type)



Saturated switching characteristics
(NPN type)



Saturated switching characteristics
(PNP type)



EPITAXIAL PLANAR NPN/PNP

MJE340 MJE350
MJE340T MJE350T
SGS340 SGS350

PRELIMINARY DATA

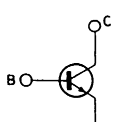
HIGH VOLTAGE POWER TRANSISTORS

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-126, TO-220 and SOT-82 package.
The complementary PNP types (the MJE350, MJE350T, SGS350) have same characteristics of NPN types but voltage and current values are negative.

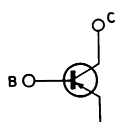
ABSOLUTE MAXIMUM RATINGS

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 $T_{case} \leqslant 25°C$	20.8	W
T_{stg}	Storage temperature	-65 to 150	°C
T_j	Junction temperature	150	°C

INTERNAL SCHEMATIC DIAGRAMS



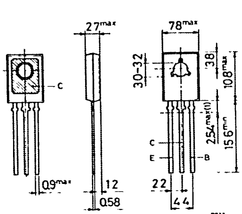
NPN



PNP

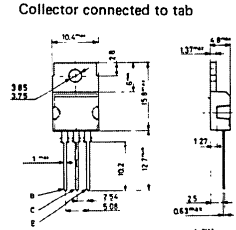
MECHANICAL DATA

Dimensions in mm

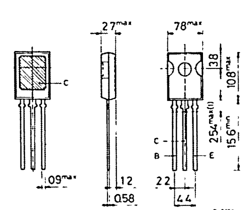


TO-126 (SOT-32)

Collector connected to tab



TO-220



SOT-82

(1) Within this region the cross-section of the leads is uncontrolled.

THERMAL DATA

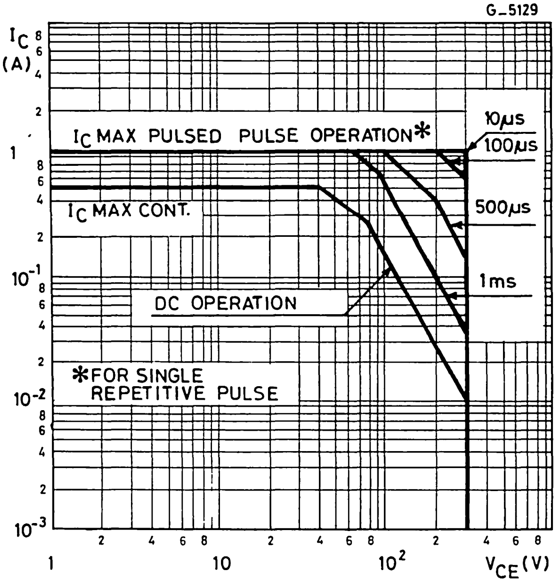
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max.	6.0	°C/W

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

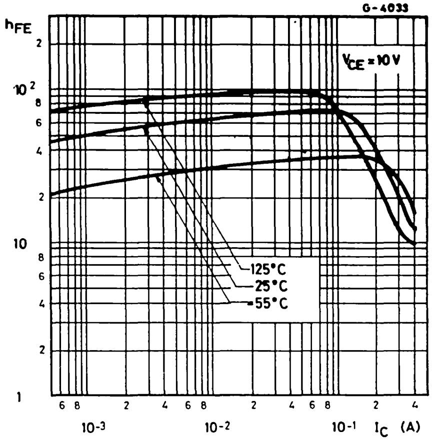
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	$V_{CB} = 300V$			100	μA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 3V$			100	μA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 1mA$	300			V
h_{FE}	DC current gain	$I_C = 50mA$ $V_{CE} = 10V$	30		240	–

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

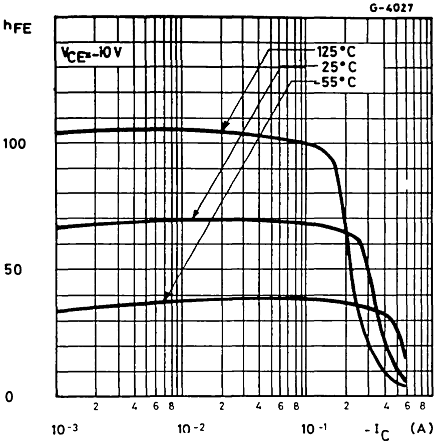
Safe operating areas



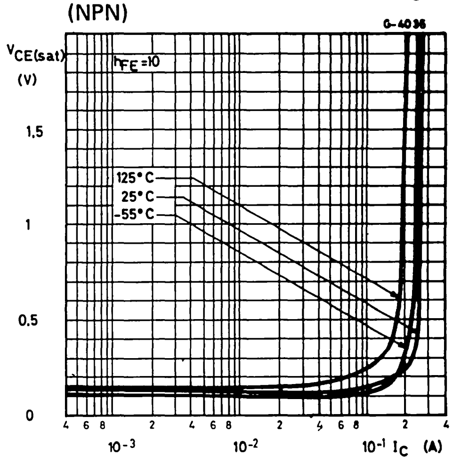
DC current gain (NPN)



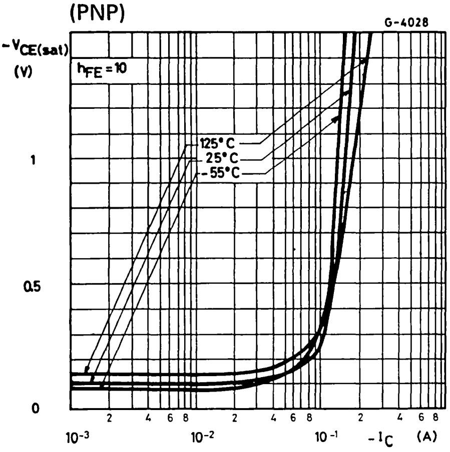
DC current gain (PNP)



Collector-emitter saturation voltage (NPN)



Collector-emitter saturation voltage (PNP)



EPITAXIAL-BASE NPN/PNP

MJE370
MJE520

PRELIMINARY DATA

COMPLEMENTARY MEDIUM POWER TRANSISTORS

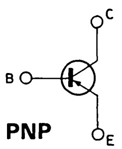
The MJE370 (PNP type) and the MJE520 (NPN type) are silicon epitaxial-base transistors in Jedec TO-126 plastic package, designed for use in general purpose amplifier and switching circuits.

ABSOLUTE MAXIMUM RATINGS

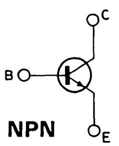
V_{CBO}	Collector-base voltage ($I_E=0$)	30	V
V_{CEO}	Collector-emitter voltage ($I_B=0$)	30	V
V_{EBO}	Emitter-base voltage ($I_C=0$)	4	V
I_C	Collector current	3	A
I_{CM}	Collector peak current	7	A
I_B	Base current	2	A
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	25	W
T_{stg}	Storage temperature	−65 to 150	°C
T_j	Junction temperature	150	°C

For PNP type voltage and current values are negative

INTERNAL SCHEMATIC DIAGRAMS



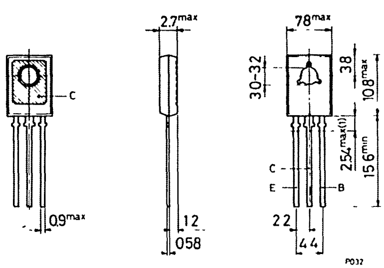
PNP



NPN

MECHANICAL DATA

Dimensions in mm



(1) Within this region the cross-section of the leads is uncontrolled

SOT-32 (TO-126)

MJE370
MJE520

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	5	°C/W

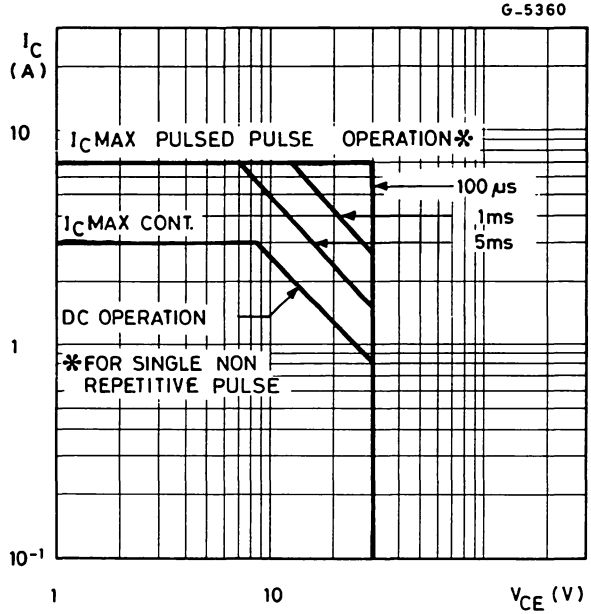
ELECTRICAL CHARACTERISTICS ($T_{case} = 25°C$ unless otherwise specified)

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			—

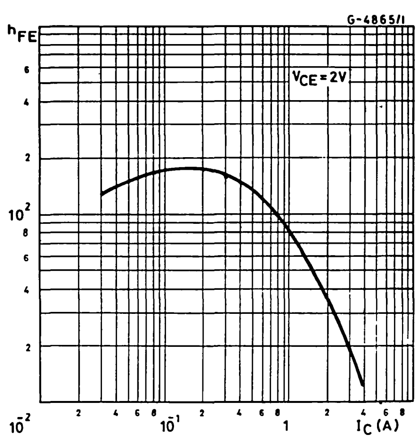
* Pulsed: pulse duration = 300 μs, duty cycle ⩽1.5%

For PNP types voltage and current values are negative

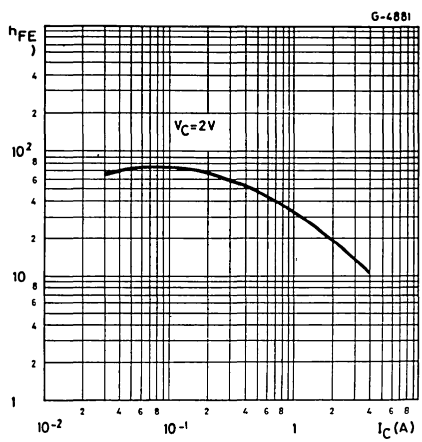
Safe operating areas



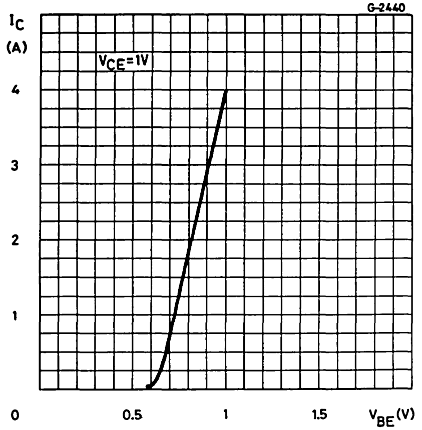
DC current gain (NPN type)



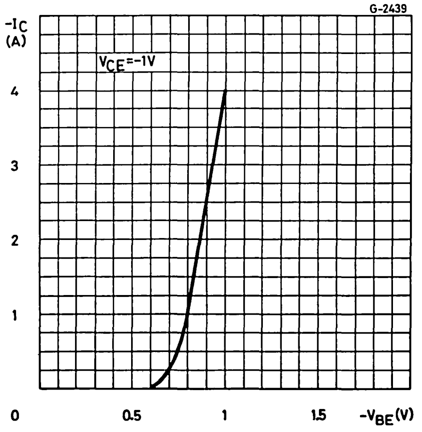
DC current gain (PNP type)



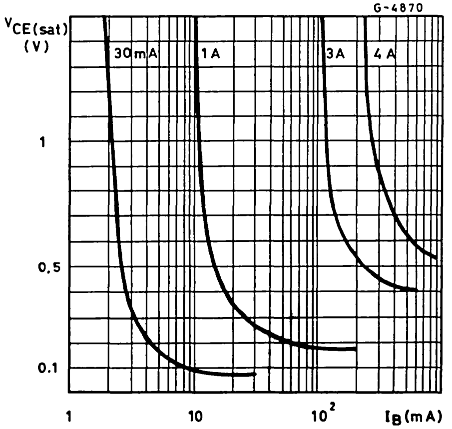
DC transconductance (NPN type)



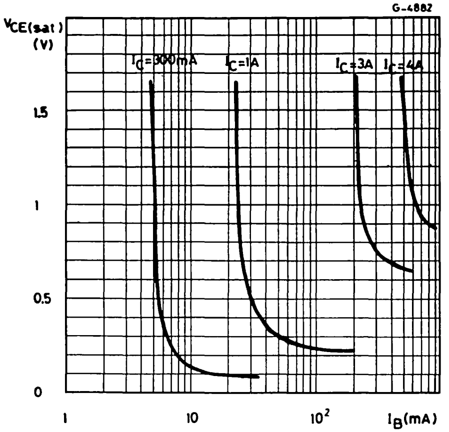
DC transconductance (PNP type)



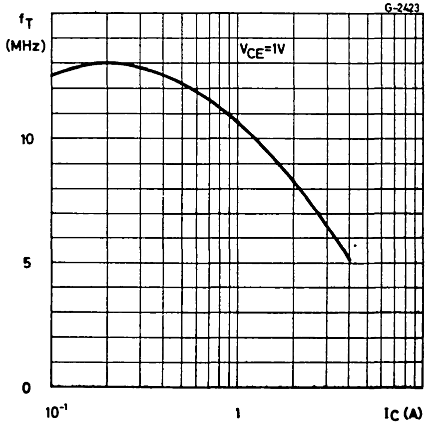
Collector-emitter saturation voltage (NPN type)



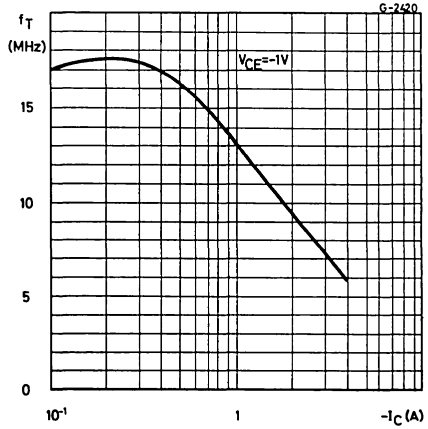
Collector-emitter saturation voltage (PNP type)



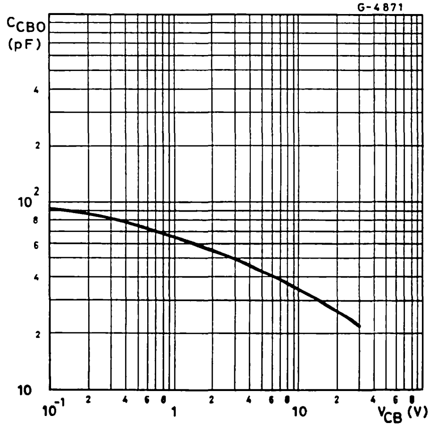
Transition frequency (NPN type)



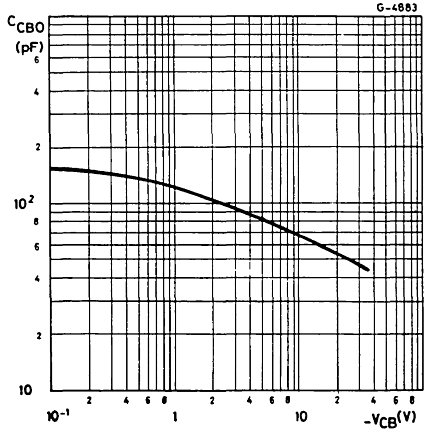
Transition frequency (PNP type)



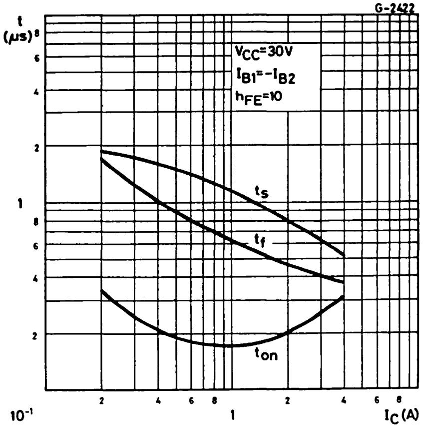
Collector-base capacitance (NPN type)



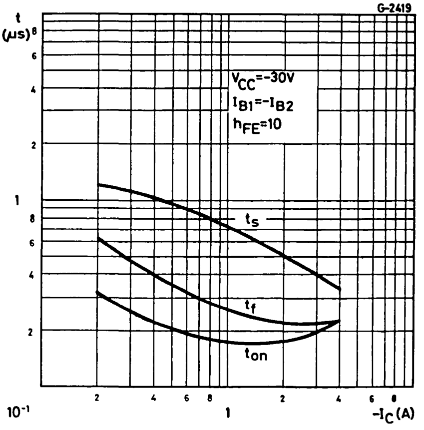
Collector-base capacitance (PNP type)



Saturated switching characteristics
(NPN type)



Saturated switching characteristics
(PNP type)



EPITAXIAL-BASE NPN/PNP

MJE371
MJE521

PRELIMINARY DATA

COMPLEMENTARY POWER TRANSISTORS

The MJE521 is a silicon epitaxial-base NPN transistors 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.

ABSOLUTE MAXIMUM RATINGS

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 $T_{case} \leqslant 25°C$	40	W
T_{stg}	Storage temperature	−65 to 150	°C
T_j	Junction temperature	150	°C

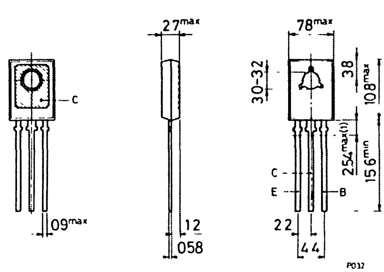
For PNP type voltage and current values are negative

INTERNAL SCHEMATIC DIAGRAMS

PNP NPN

MECHANICAL DATA

Dimensions in mm



(1) Within this region the cross-section of the leads is uncontrolled

SOT-32 (TO-126)

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	3.12	°C/W

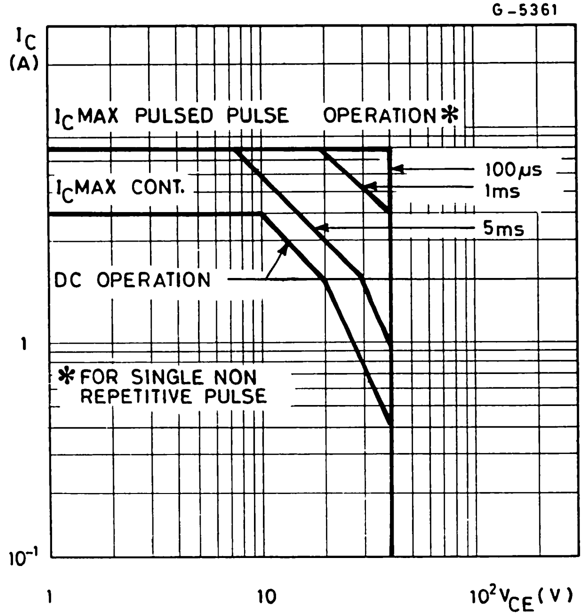
ELECTRICAL CHARACTERISTICS ($T_{case} = 25°C$ unless otherwise specified)

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			—

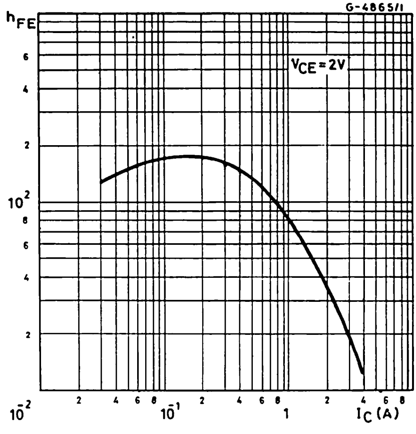
* Pulsed: pulse duration = 300 μs, duty cycle ≤1.5%

For PNP type voltage and current values are negative

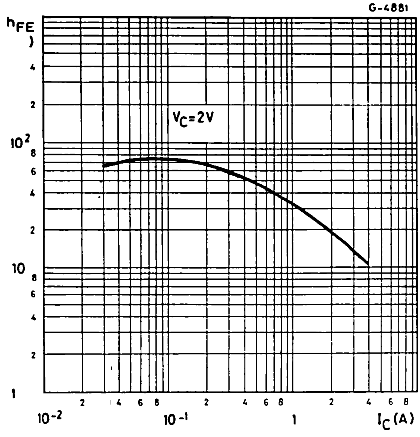
Safe operating areas



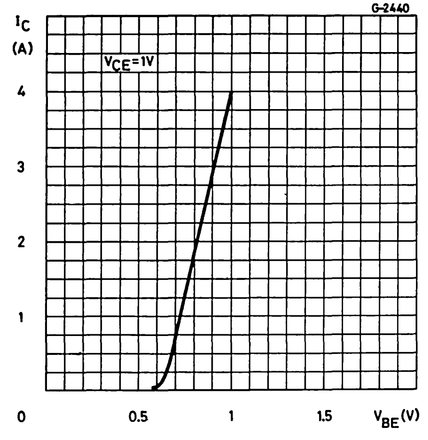
DC current gain (NPN type)



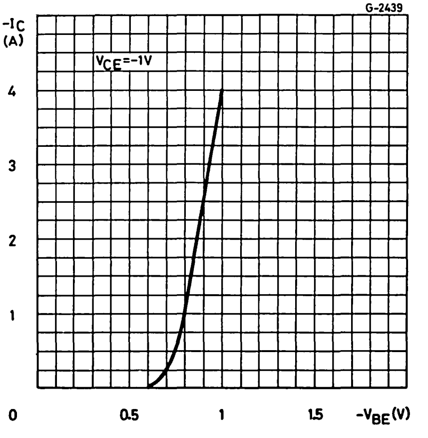
DC current gain (PNP type)



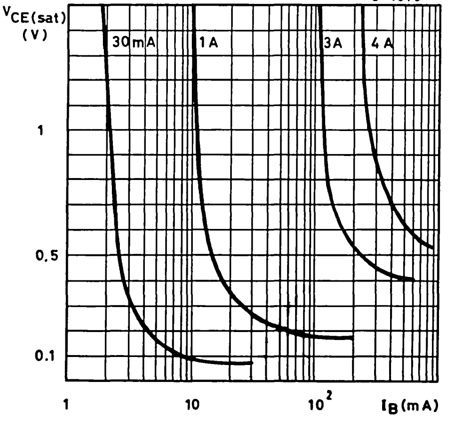
DC transconductance (NPN type)



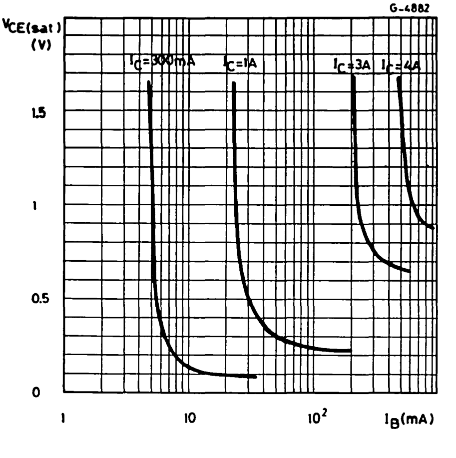
DC transconductance (PNP type)



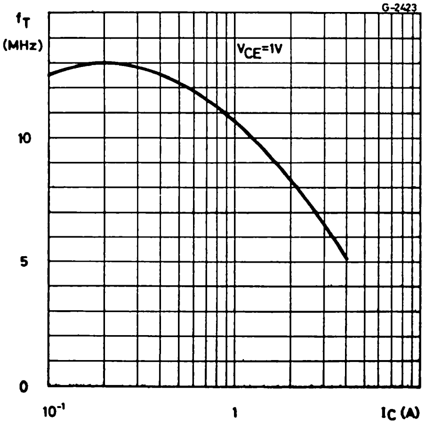
Collector-emitter saturation voltage (NPN type)



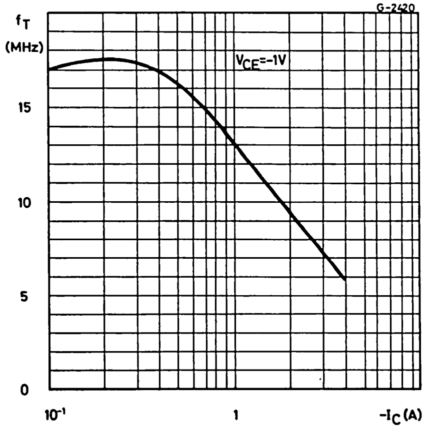
Collector-emitter saturation voltage (PNP type)



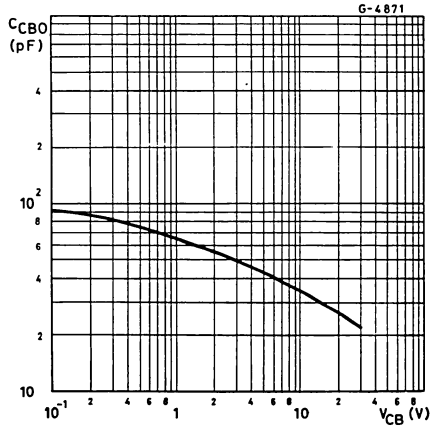
Transition frequency (NPN type)



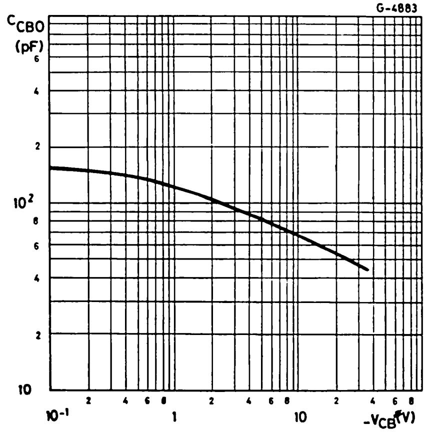
Transition frequency (PNP type)



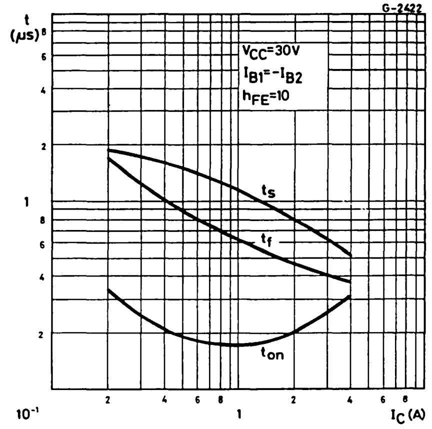
Collector-base capacitance (NPN type)



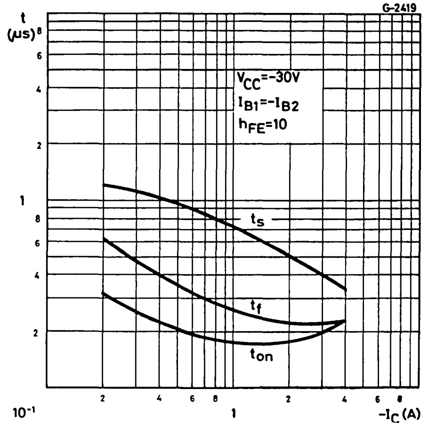
Collector-base capacitance (PNP type)



Saturated switching characteristics
(NPN type)



Saturated switching characteristics
(PNP type)



EPITAXIAL-BASE NPN/PNP

MJE800 MJE700
MJE801 MJE701
MJE802 MJE702
MJE803 MJE703

MEDIUM POWER DARLINGTONS

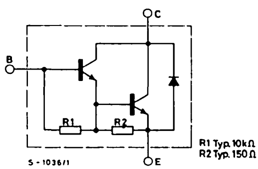
The MJE800, MJE801, MJE802 and MJE803 are silicon epitaxial-base NPN power transistors in monolithic Darlington configuration and are mounted in Jedec TO-126 plastic package. They are intended for use in medium power linear and switching applications.

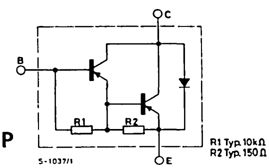
The complementary PNP types (the MJE700, MJE701, MJE702 and MJE703 respectively) have same characteristics of NPN types but voltage and current values are negative.

ABSOLUTE MAXIMUM RATINGS

		MJE800 MJE801	MJE802 MJE803
V_{CBO}	Collector-base voltage ($I_E = 0$)	60V	80V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	60V	80V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5V	
I_C	Collector current	4A	
I_B	Base current	0.1A	
P_{tot}	Total power dissipation at $T_{case} \leq 25$ °C	40W	
T_{stg}	Storage temperature	-60 to 150 °C	
T_j	Junction temperature	150 °C	

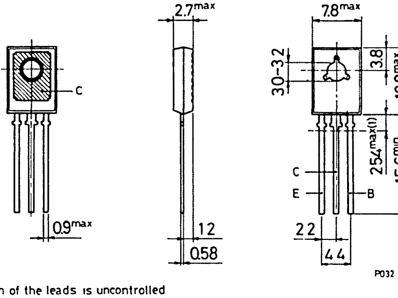
INTERNAL SCHEMATIC DIAGRAMS

NPN


PNP


MECHANICAL DATA

Dimensions in mm



(1) Within this region the cross-section of the leads is uncontrolled

TO-126 (SOT-32)

THERMAL DATA

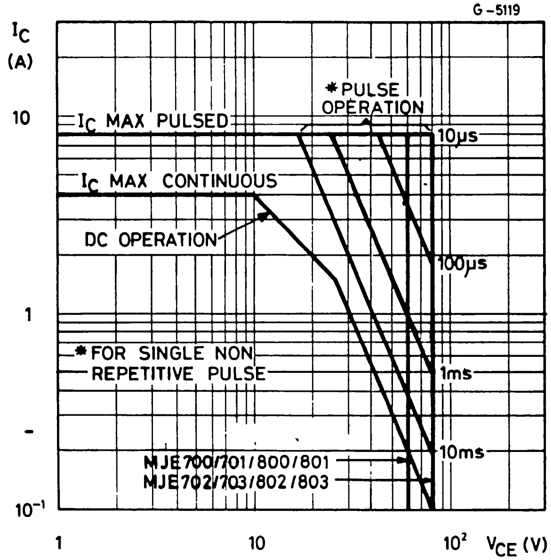
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	3.13	°C/W

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

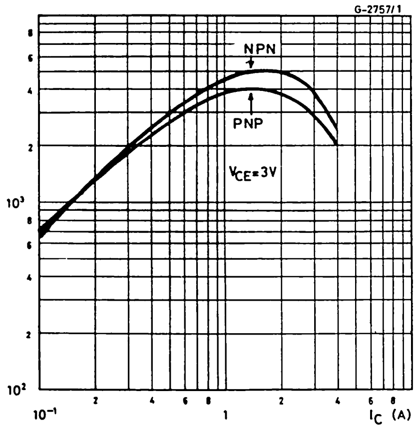
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	V_{CB} = rated V_{CBO}			100	μA
		V_{CB} = rated V_{CBO} T_{case} = 100 °C			500	μA
I_{CEO}	Collector cutoff current ($I_B = 0$)	V_{CE} = rated V_{CEO}			100	μA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	V_{EB} = 5V			2	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	I_C = 50mA				
		for **MJE800, MJE801**	60			V
		for **MJE802, MJE803**	80			V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	I_C = 4A I_B = 40mA for **MJE800, MJE802**			3	V
		I_C = 1.5A I_B = 30mA for **MJE801, MJE 803**			2.5	V
		I_C = 2A I_B = 40mA			2.8	V
V_{BE}*	Base-emitter voltage	I_C = 4A V_{CE} = 3V for **MJE800, MJE802**			3	V
		I_C = 1.5A V_{CE} = 3V for **MJE801, MJE803**			2.5	V
		I_C = 2A V_{CE} = 3V			2.5	V
h_{FE}*	DC current gain	I_C = 4A V_{CE} = 3V for **MJE800, MJE802**	100			–
		I_C = 1.5A V_{CE} = 3V for **MJE801, MJE803**	750			–
		I_C = 2A V_{CE} = 3V	750			–
h_{fe}	Small signal current gain	I_C = 1.5A V_{CE} = 3V f = 1 MHz	1			–

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

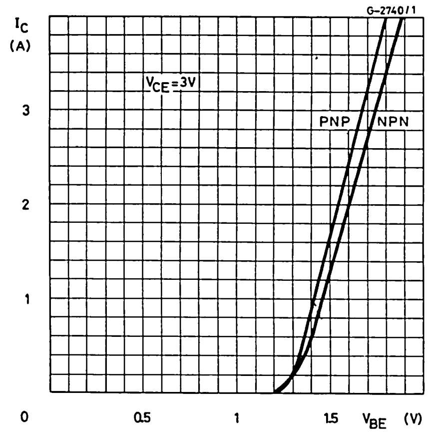
Safe operating areas



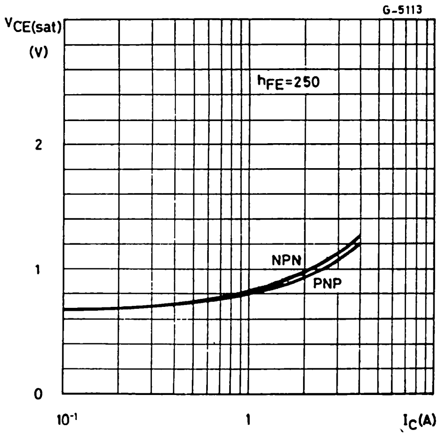
DC current gain



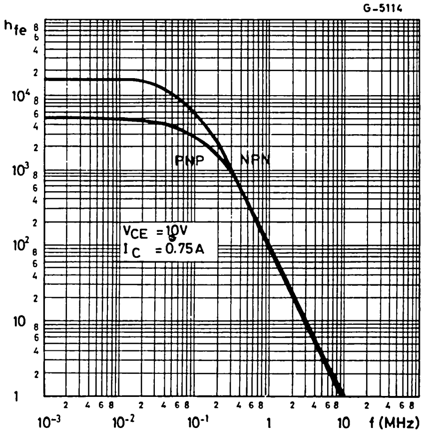
DC transconductance



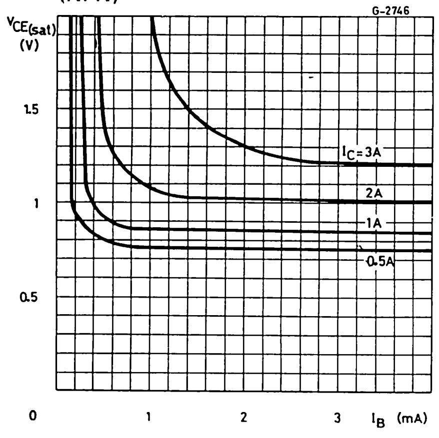
Collector-emitter saturation voltage



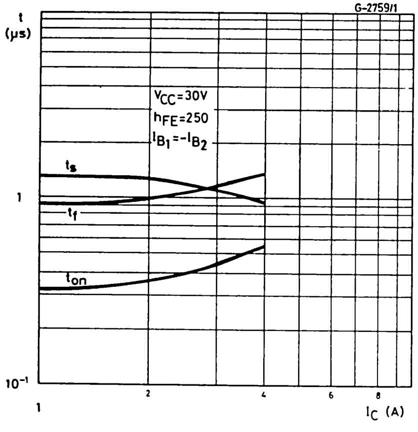
Small signal current gain



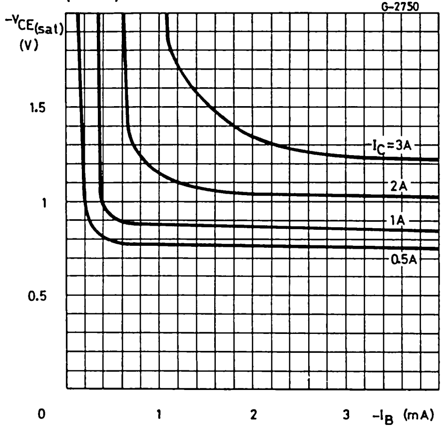
Collector-emitter saturation voltage (NPN)



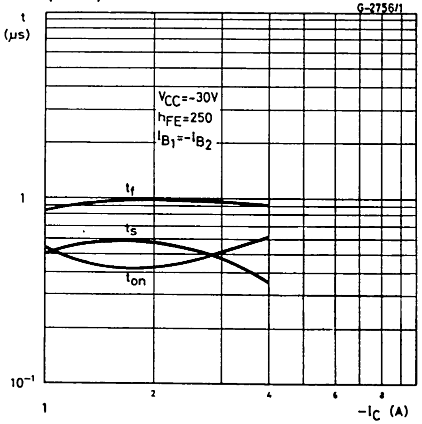
Saturated switching characteristics (NPN)



Collector-emitter saturation voltage (PNP)



Saturated switching characteristics (PNP)



MJE2955T
MJE3055T

EPITAXIAL-BASE NPN/PNP

ADVANCE DATA

MEDIUM POWER AND SWITCHING APPLICATIONS

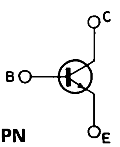
The MJE3055T is a silicon epitaxial-base NPN transistor in Jedec TO-220 package. It is intended for power switching circuits and general-purpose amplifiers. The complementary PNP type is MJE2955T.

ABSOLUTE MAXIMUM RATINGS

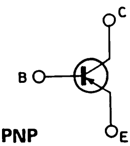
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	60	V
V_{CBO}	Collector-base voltage ($I_E = 0$)	70	V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5	V
I_C	Collector current	10	A
I_B	Base current	6	A
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	75	W
T_{stg}	Storage temperature	-55 to 150	°C
T_j	JUnction temperature	150	°C

For PNP type voltage and current values are negative

INTERNAL SCHEMATIC DIAGRAMS



NPN

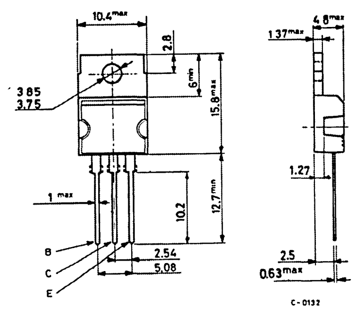


PNP

MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

THERMAL DATA

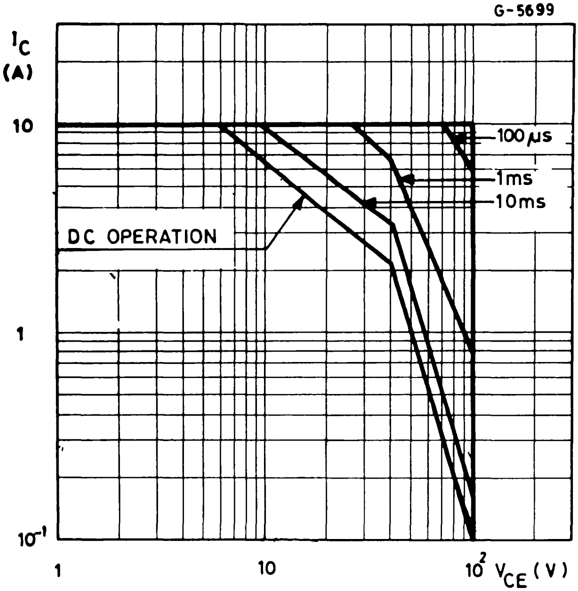
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1.66	°C/W

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

	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_{EBO}=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	$I_C = 4A$ $I_C = 10A$	$I_B = 0.4A$ $I_B = 3.3A$			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	$I_C = 4A$ $I_C = 10A$	$V_{CE} = 4V$ $V_{CE} = 4V$	20 5		70	– –
f_T	Transition frequency	$I_C = 500mA$ f = 500KHz	V_{CE}=10V	2			MHz

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

Safe operating area



MJE3439 SGS3439
MJE3440 SGS3440

EPITAXIAL PLANAR NPN

PRELIMINARY DATA

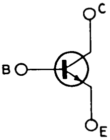
HIGH VOLTAGE TRANSISTORS

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.

ABSOLUTE MAXIMUM RATINGS

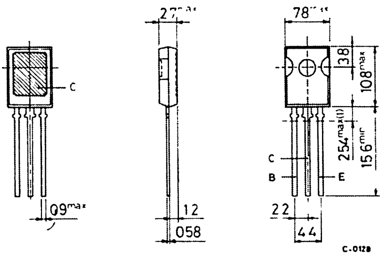
		MJE3439 SGS3439	MJE3440 SGS3440
V_{CBO}	Collector-base voltage ($I_E=0$)	450V	350V
V_{CEO}	Collector-emitter voltage ($I_B=0$)	350V	250V
V_{EBO}	Emitter-base voltage ($I_C=0$)	5V	
I_C	Collector current	0.3A	
I_B	Base current	0.15A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	15W	
T_{stg}	Storage temperature	-65 to 150°C	
T_j	Junction temperature	150°C	

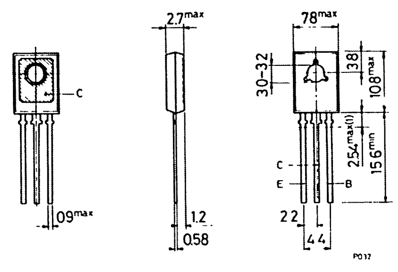
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm





(1) Within this region the cross-section of the leads is uncontrolled

SOT-82 **TO-126 (SOT-32)**

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)

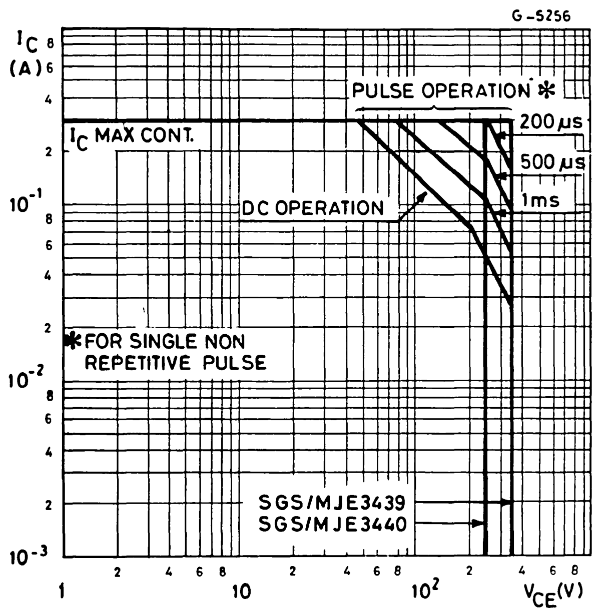
Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E=0$)	for **MJE3439, SGS3439** $V_{CB}=350V$				20	μA
		for **MJE3440, SGS3440** $V_{CB}=250V$				20	μA
I_{CEV}	Collector cutoff current ($V_{BE}=-1.5V$)	for **MJE3439, SGS3439** $V_{CE}=450V$				500	μA
		for **MJE3440, SGS3440** $V_{CE}=300V$				500	μA
I_{CEO}	Collector cutoff current ($I_B=0$)	for **MJE3439, SGS3439** $V_{CE}=300V$				20	μA
		for **MJE3440, SGS3440** $V_{CE}=200V$				50	μA
I_{EBO}	Emitter cutoff current ($I_C=0$)	$V_{EB}=5V$				20	μA
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C=50mA$	$I_B=4\ mA$			0.5	V
$V_{BE(sat)}$*	Base-emitter saturation voltage	$I_C=50mA$	$I_B=4\ mA$			0.3	V
V_{BE}*	Base-emitter voltage	$I_C=50mA$	$V_{CE}=10V$			0.8	V
h_{FE}*	DC current gain	$I_C=2mA$	$V_{CE}=10V$	30			—
		$I_C=20mA$	$V_{CE}=10V$	50		200	—

ELECTRICAL CHARACTERISTICS (Continued)

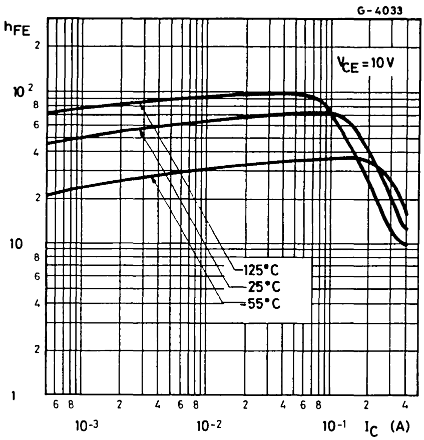
Parameter		Test conditions		Min.	Typ.	Max.	Unit
h_{fe}	Small signal current gain	$I_C = 5mA$ $f = 1KHz$	$V_{CE} = 10V$	25			—
f_T	Transition frequency	$I_C = 10mA$ $f = 5MHz$	$V_{CE} = 10V$	15			MHz
C_{CBO}*	Collector-base capacitance	$V_{CB} = 10V$ $f = 1MHz$	$I_E = 0$			10	pF

*Pulsed: pulse duration = 300μs duty cycle$\leqslant$1.5%

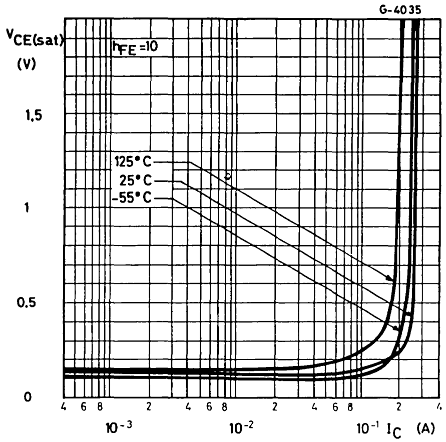
Safe operating areas



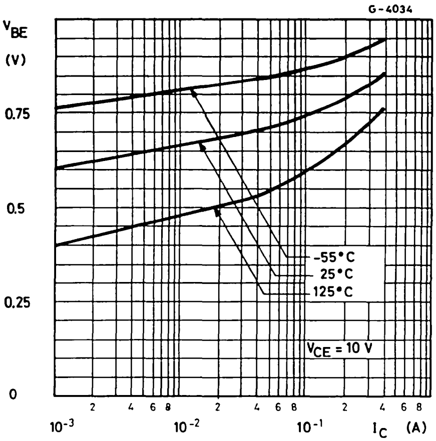
DC current gain



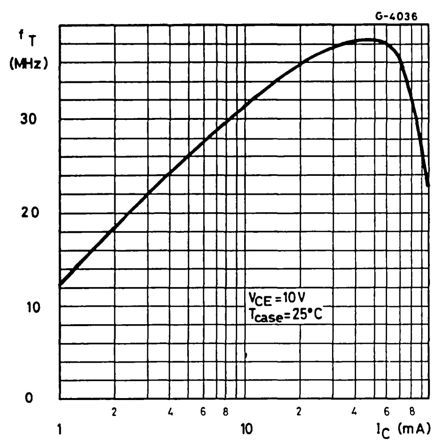
Collector-emitter saturation voltage



Base-emitter voltage



Transition frequency



MULTIEPITAXIAL MESA NPN

MJE13004
MJE13005

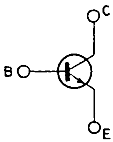
HIGH VOLTAGE POWER SWITCH

The MJE13004/13005 are silicon multiepitaxial mesa NPN transistors in Jedec TO-220 plastic package particularly intended for switch-mode applications.

ABSOLUTE MAXIMUM RATINGS

		MJE13004	MJE13005
V_{CEV}	Collector-emitter voltage	600V	700V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	300V	400V
V_{EBO}	Emitter-base ($I_C = 0$)	9V	
I_C	Collector current	4A	
I_{CM}	Collector peak current	8A	
I_B	Base current	2A	
I_{BM}	Base peak current	4A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	75W	
T_{stg}	Storage temperature	-65 to 150°C	
T_j	Junction temperature	150°C	

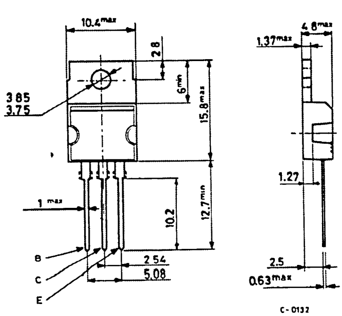
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

MJE13004
MJE13005

THERMAL DATA

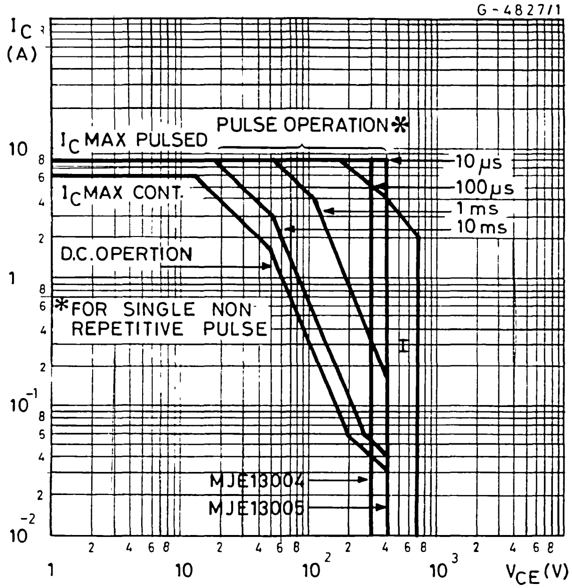
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max.	1.67	°C/W

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

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}	Turn-on time	I_C = 2A I_{B1} = $-I_{B2}$ = 0.4A V_{CC} = 250V			0.8	μs
t_s	Storage time				4	μs
t_f	Fall time				0.9	μs

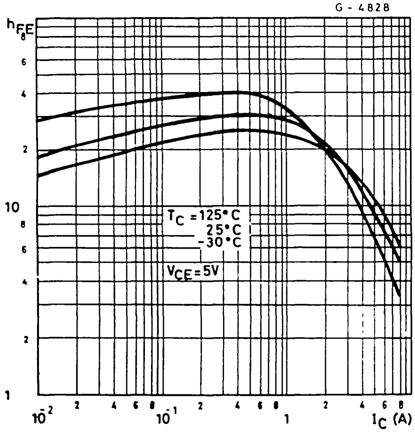
* Pulsed: pulse duration = 300 μs, duty cycle = 1.5%.

Safe operating areas

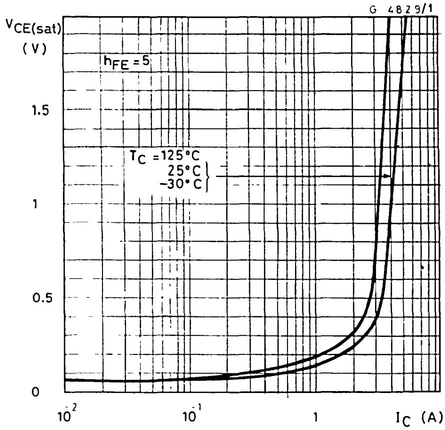


I — Area of permissible operation during turn-on provided $R_{BE} \leqslant 100\Omega$ and $t_p \leqslant 0.25\ \mu s$.

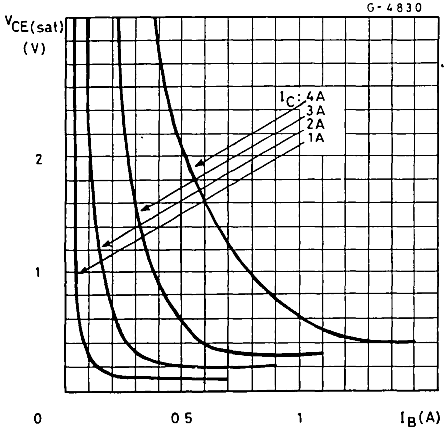
DC current gain



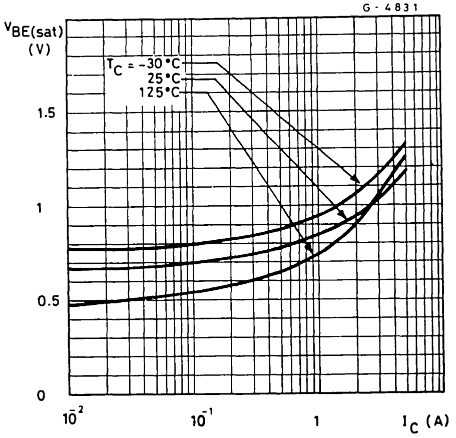
Collector-emitter saturation voltage



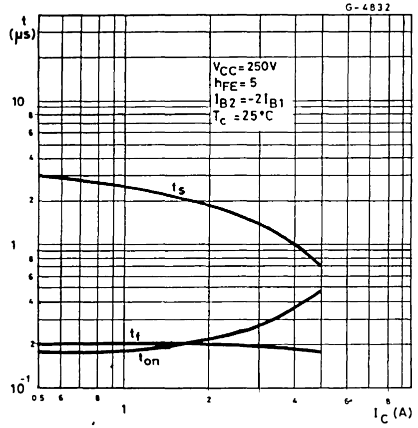
Collector-emitter saturation voltage



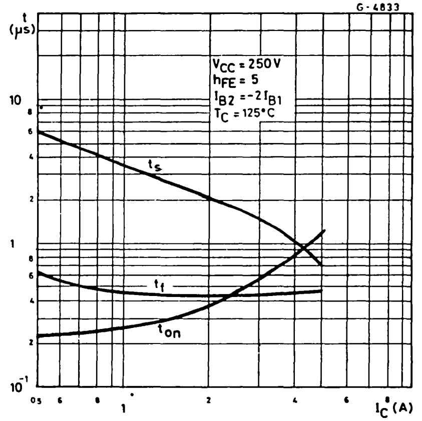
Base-emitter saturation voltage



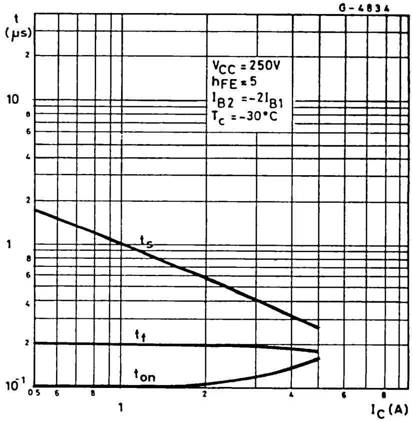
Saturated switching characteristics



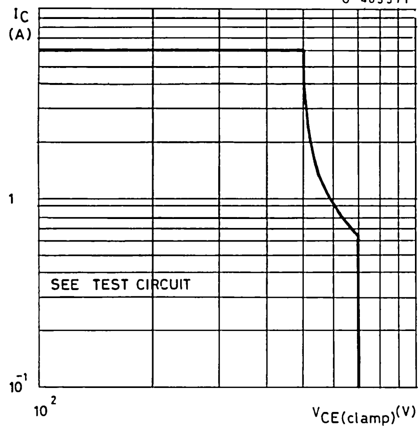
Saturated switching characteristics



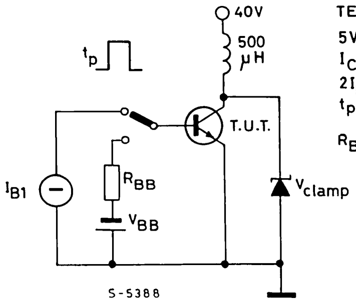
Saturated switching characteristics



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 nominal I_C

R_{BB}=adjusted for I_{B2}

MJE13006
MJE13007
MJE13007A

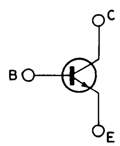
MULTIEPITAXIAL MESA NPN

MOTOR CONTROL, SWITCH REGULATORS

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.

ABSOLUTE MAXIMUM RATINGS		MJE13006	MJE13007	MJE13007A
V_{CEO}	Collector-emitter voltage ($V_B=0$)	300V	400V	400V
V_{CEV}	Collector-emitter voltage	600V	700V	850V
V_{EBO}	Emitter-base voltage ($I_C=0$)		9V	
I_C	Collector current		8A	
I_{CM}	Collector peak current		16A	
I_B	Base current		4A	
I_{BM}	Base peak current		8A	
I_E	Emitter current		12A	
I_{EM}	Emitter peak current		24A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$		80W	
T_{stg}	Storage temperature		-65 to 150°C	
T_j	Junction temperature		150°C	

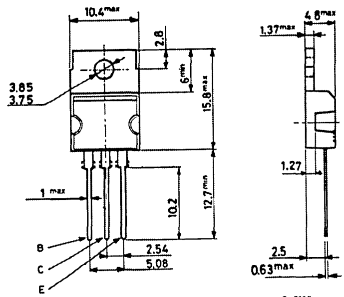
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

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)

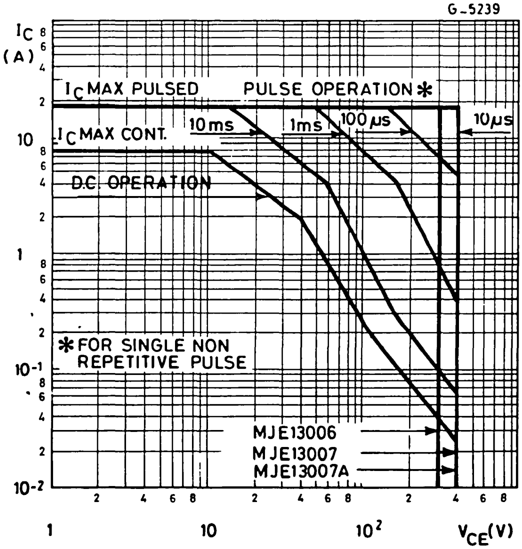
Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 9V$				1	mA
I_{CEV}	Collector cutoff current ($V_{BE} = 1.5V$)	V_{CEV} = Rated value V_{CEV} = Rated value $T_{case} = 100°C$		1		 5	mA mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 10mA$ for **MJE13006** for **MJE13007/13007A**		 300 400			 V V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C = 2A$ $I_C = 5A$ $I_C = 8A$ $I_C = 5A$ $T_{case} = 100°C$	$I_B = 0.4A$ $I_B = 1A$ $I_B = 2A$ $I_B = 1A$			1 1.5 3 2	V V V V
$V_{BE(sat)}$*	Base-emitter saturation voltage	$I_C = 2A$ $I_C = 5A$ $I_C = 5A$ $T_{case} = 100°C$	$I_B = 0.4A$ $I_B = 1A$ $I_B = 1A$			1.2 1.6 1.5	V V V
h_{FE}*	DC current gain	$I_C = 2A$ $I_C = 5A$	$V_{CE} = 5V$ $V_{CE} = 5V$	8 6		40 30	— —
f_T	Transition frequency	$I_C = 500mA$ $f = 1MHz$	$V_{CE} = 10V$	4			MHz
C_{CBO}	Output capacitance	$V_{CB} = 10V$ $f = 0.1MHz$	$I_E = 0$		110		pF

ELECTRICAL CHARACTERISTICS (Continued)

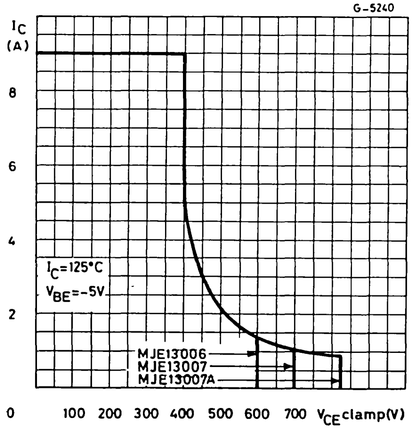
Parameter		Test conditions	Min. Typ. Max.	Unit
RESISTIVE SWITCHING TIMES (Fig. 2)				
t_{on}	Turn-on time	$V_{CC}=125V$ $I_C=5A$	0.7	μs
t_s	Storage time	$I_{B1}=-I_{B2}=1A$	3	μs
t_f	Fall time	$t_p=25\mu s$ Duty Cycle $<1\%$	0.7	μs
INDUCTIVE SWITCHING TIMES (Fig. 1)				
t_f	Fall time	$V_{CC}=125V$ $I_C=5A$ $I_{B1}=1A$ $t_p=25\mu s$ Duty cycle $<1\%$ $T_{case}=100°C$	0.3	μs
		$V_{CC}=125V$ $I_C=5A$ $I_{B1}=1A$ $t_p=25\mu s$ Duty cycle $\leqslant 1\%$	0.6	μs

* Pulsed: pulse duration $\leqslant 300\mu s$, duty cycle $\leqslant 1.5\%$

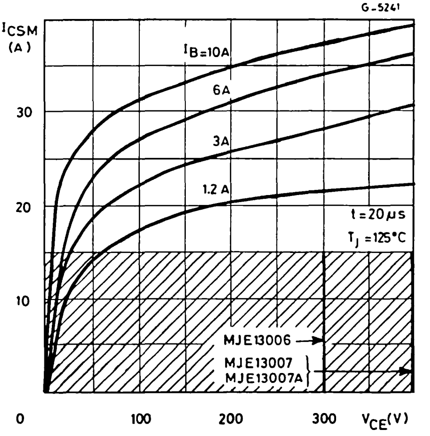
Safe operating areas



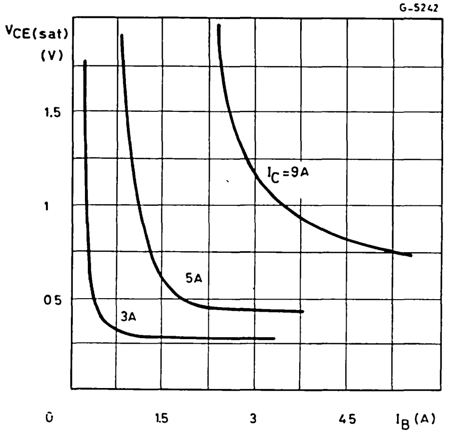
Clamped reverse bias safe operating areas



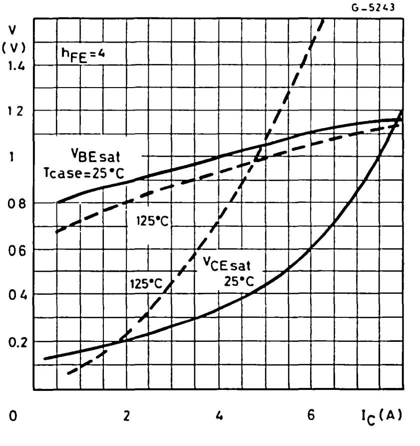
Forward biased accidental overload area (See fig. 3)



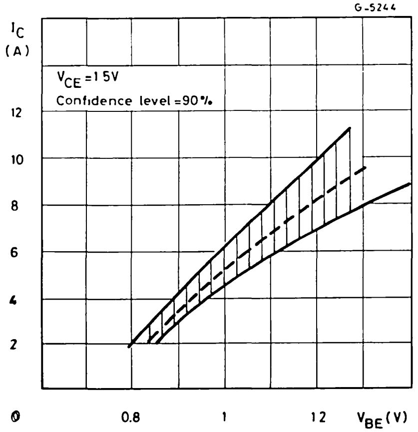
Collector saturation voltage



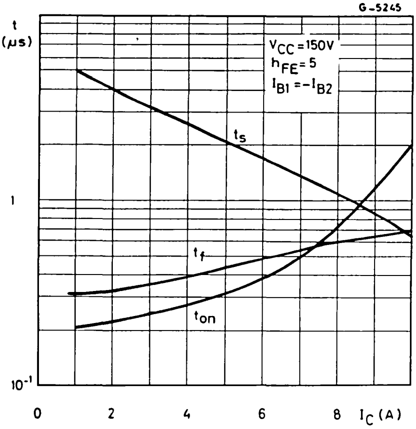
Saturation voltages



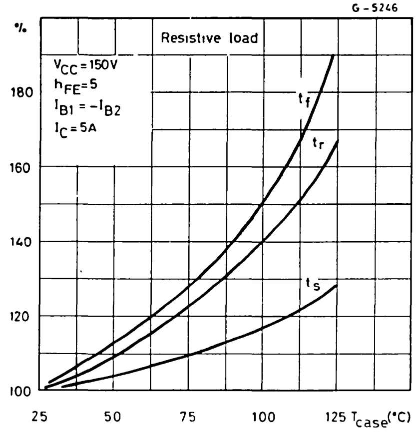
Collector current spread vs. base emitter voltage



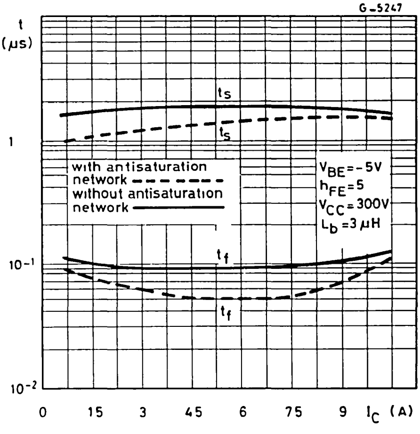
Switching times resistive load (See fig. 2)



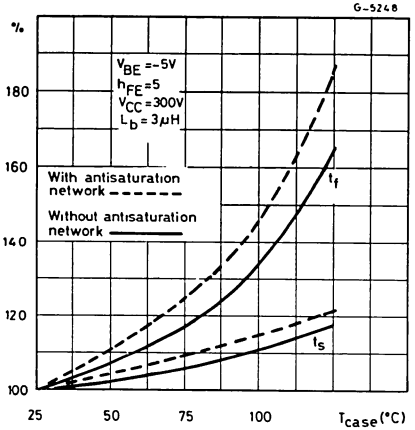
Switching times percentage variation vs. case temperature



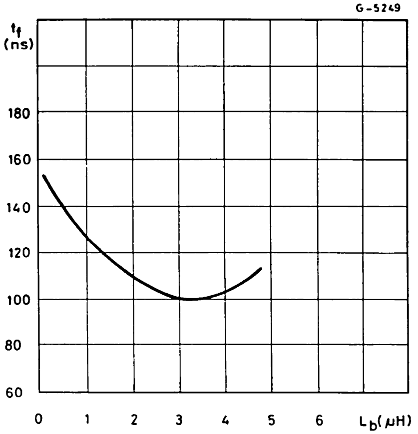
Switching times inductive load (See fig. 1)



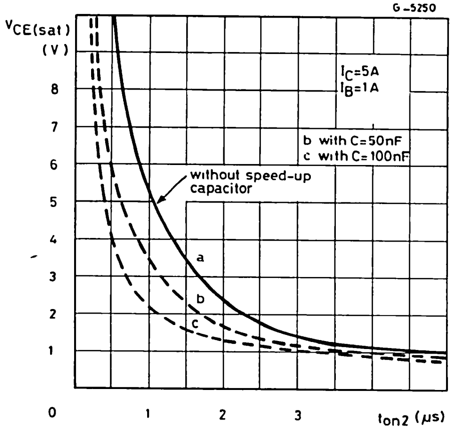
Switching times inductive load vs. case temperature



Fall times vs. L_b (See fig. 1)



Dynamic collector-emitter saturation voltage (See fig. 4)



DC current gain

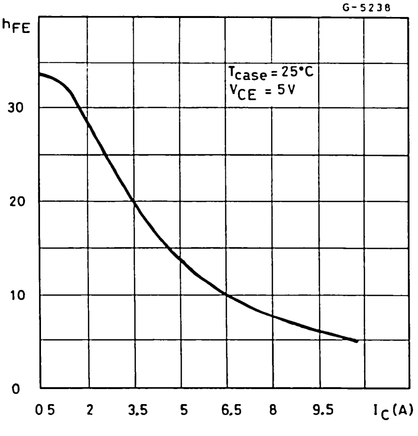
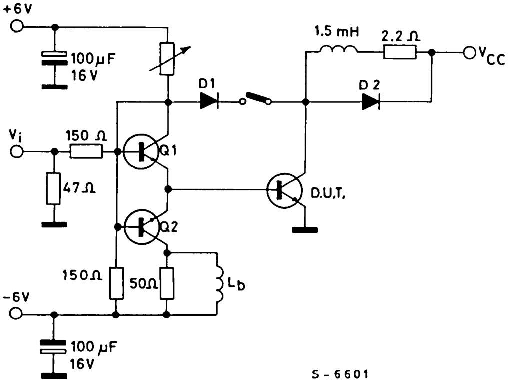


Fig. 1 - Switching times test circuit on inductive load, with and without antisaturation network



D1, D2 - Fast recovery diodes
Q1, Q2 - Transistors SGS: 2N5191, 2N5195

Fig. 2 - Switching times test circuit on resistive load.

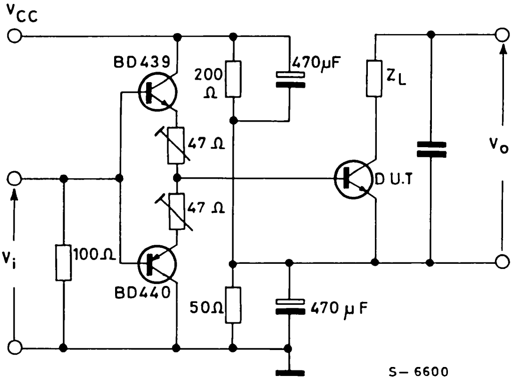


Fig. 3 - Forward biased accidental overload area test circuit.

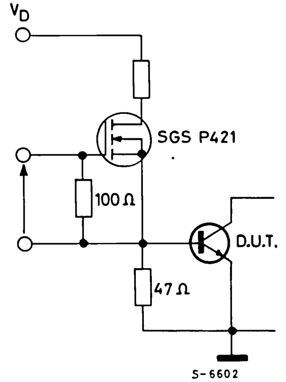


Fig. 4 - $V_{CE(sat)}$ dyn. test circuit.

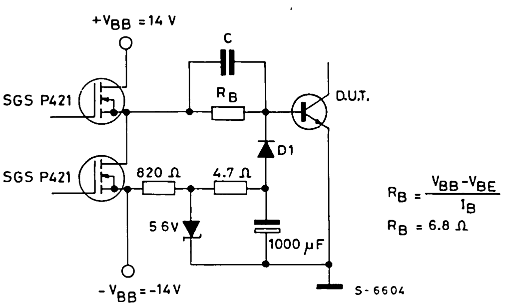
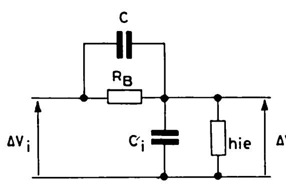


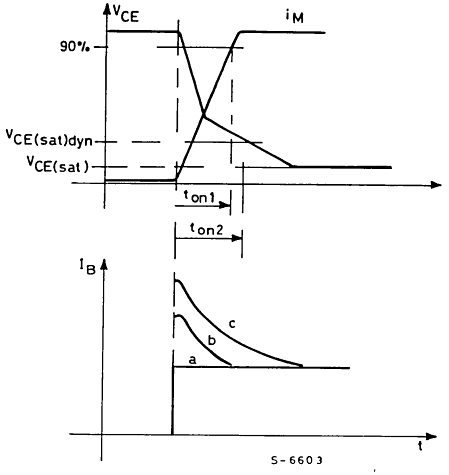
Fig. 5 - Equivalent input schematic circuit at turn-on.



$$\Delta V_o = \Delta V_i \frac{C}{C_i + C}$$

if $C \gg C_i$ $\quad \Delta V_o = \Delta V_i$

Fig. 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 50nF capacitor modifies the shape of base current with a overshoot.

MULTIEPITAXIAL MESA NPN

MJE13008
MJE13009

PRELIMINARY DATA

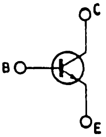
HIGH VOLTAGE, HIGH SPEED, POWER SWITCHING

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.

ABSOLUTE MAXIMUM RATINGS

		MJE13008	MJE13009
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	300V	400V
V_{CEV}	Collector-emitter voltage	600V	700V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	9V	
I_C	Collector current	12A	
I_{CM}	Collector peak current (tp $\leqslant$ 10ms)	24A	
I_B	Base current	6A	
I_{BM}	Base peak current (tp $\leqslant$ 10ms)	12A	
I_E	Emitter current	18A	
I_{EM}	Emitter peak current	36A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	100W	
T_{stg}	Storage temperature	-65 to 150°C	
T_j	Junction temperature	150°C	

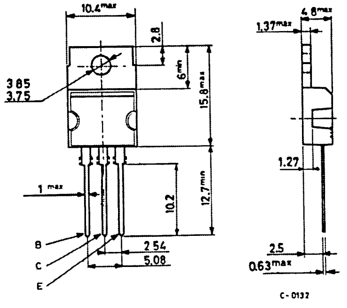
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

THERMAL DATA

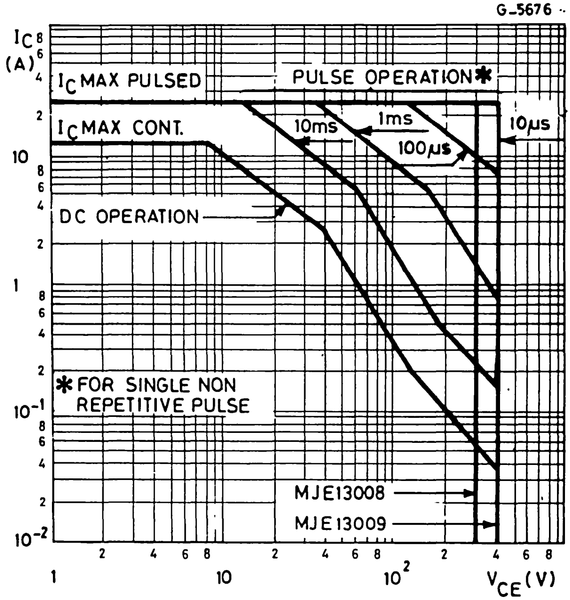
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1.25	°C/W

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

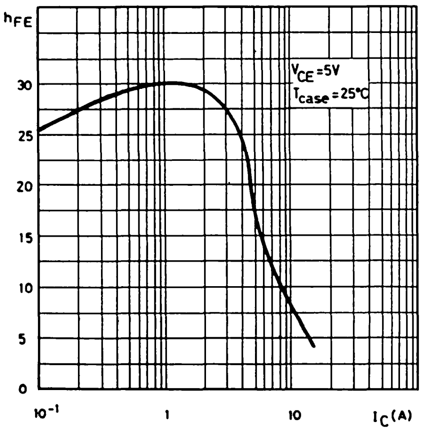
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 9V$			1	mA
I_{CEV}	Collector cutoff current	V_{CEV} = rated value $V_{BE(off)} = 1.5V$			1	mA
		V_{CEV} = rated value $V_{BE(off)} = 1.5V$ $T_{case} = 100°C$			5	mA
$V_{CEO(sus)}$ *	Collector-emitter sustaining voltage	$I_C = 10mA$ $I_E = 0$				
		for **MJE13008**	300			V
		for **MJE13009**	400			V
$V_{CE(sat)}$ *	Collector-emitter saturation voltage	$I_C = 5A$ $I_B = 1A$			1	V
		$I_C = 8A$ $I_B = 1.6A$			1.5	V
		$I_C = 12A$ $I_B = 3A$			3	V
		$I_C = 8A$ $I_B = 1.6A$ $T_{case} = 100°C$			2	V
$V_{BE(sat)}$ *	Base-emitter saturation voltage	$I_C = 5A$ $I_B = 1A$			1.2	V
		$I_C = 8A$ $I_B = 1.6A$			1.6	V
		$I_C = 8A$ $I_B = 1.6A$ $T_{case} = 100°C$			1.5	V
h_{FE} *	DC current gain	$I_C = 5A$ $V_{CE} = 5V$	8		40	–
		$I_C = 8A$ $V_{CE} = 5V$	6		30	–
f_T	Transition freq.	$I_C = 500mA$ $V_{CE} = 10V$	4			MHz
C_{OB}	Output capacitance	$V_{CB} = 10V$ $I_E = 0$ $f = 0.1$ MHz		180		pF
t_{on}	Turn-on time	RESISTIVE LOAD $V_{CC} = 125V$ $I_C = 8A$ $I_{B1} = I_{B2} = 1.6A$ $t_p = 25\ \mu s$ Duty cycle $\leqslant 1\%$			1.1	μs
t_s	Storage time				3	μs
t_f	Fall time				0.7	μs

* Pulsed: pulse duration = 300 μs, duty cycle $\leqslant 2\%$

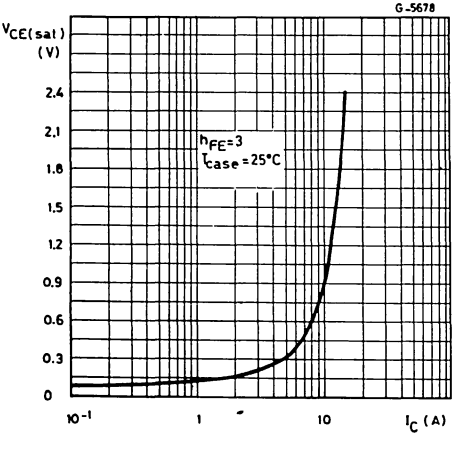
Safe operating areas



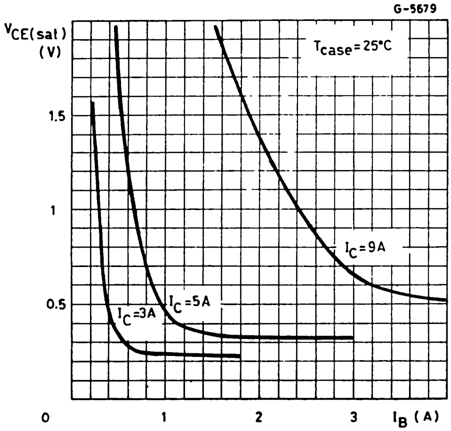
DC current gain



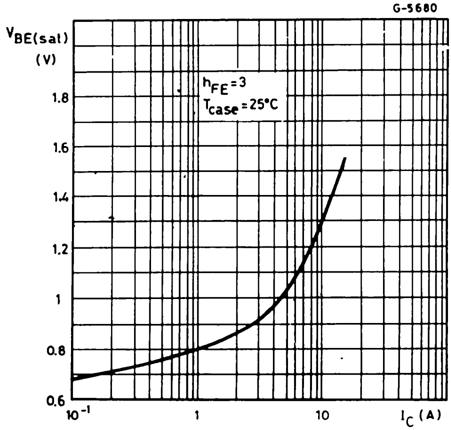
Collector-emitter saturation volage



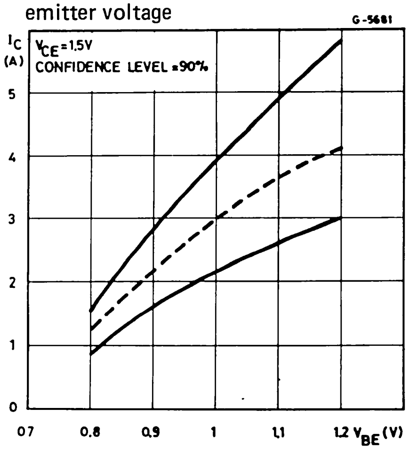
Collector-emitter saturation voltage



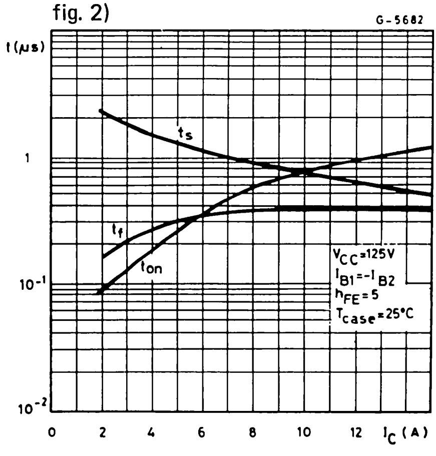
Base-emitter saturation voltage



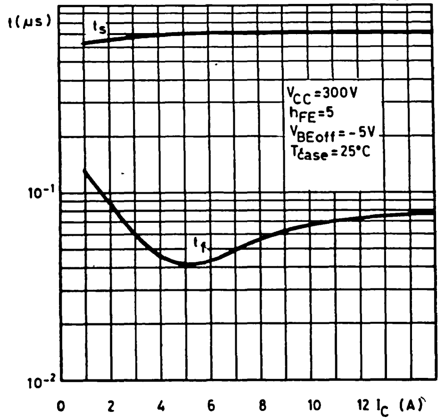
Collector current spread vs. base-emitter voltage



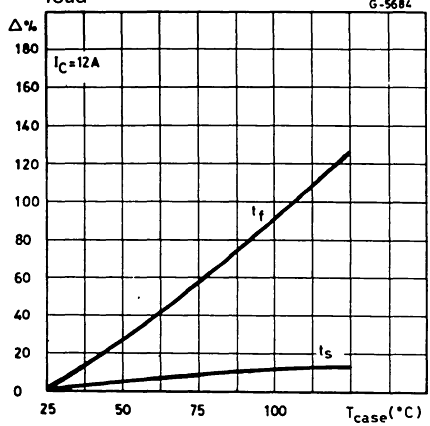
Switching times resistive load (see fig. 2)



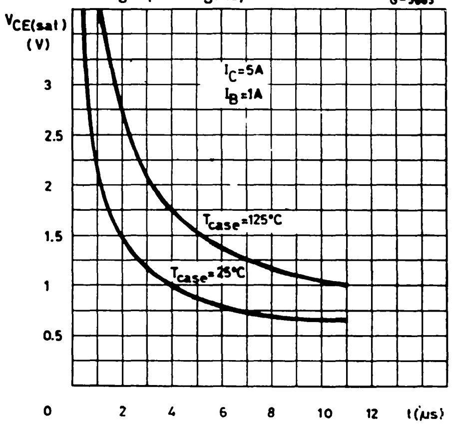
Switching times inductive load (see fig. 1)



Switching times vs. T_{case} inductive load



Dynamic collector-emitter saturation voltage (see fig. 2)



Clamped reverse bias safe operating areas

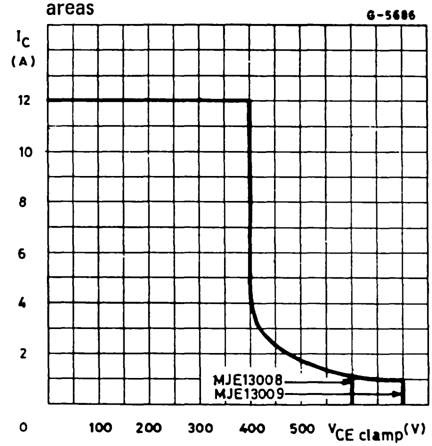
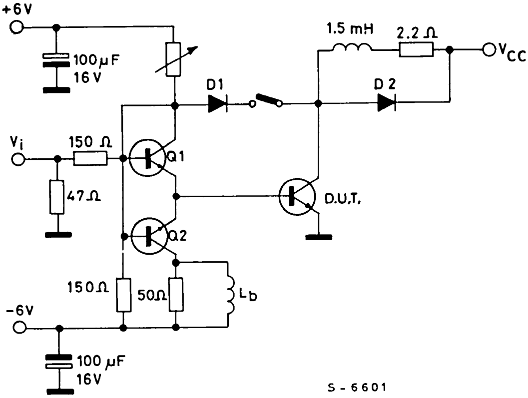
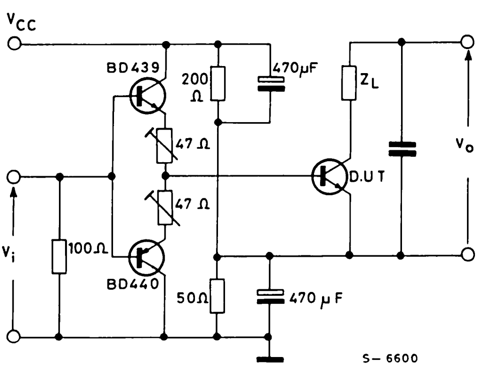


Fig. 1 — Switching times test circuit on inductive load



D1, D2 - Fast recovery diodes
Q1, Q2 - Transistors SGS: 2N5191, 2N5195

Fig. 2 — Switching times test circuit on resistive load and $V_{CE\,(sat)}$ dyn. test circuit



SGS120 SGS125
SGS121 SGS126
SGS122 SGS127

EPITAXIAL-BASE NPN / PNP

POWER DARLINGTONS

The SGS120, SGS121 and SGS122 are silicon epitaxial-base NPN transistors in monolithic Darlington configuration in SOT-82 plastic package intended for use in power linear and switching applications.
The complementary PNP type are the SGS125, SGS126 and SGS127 respectively.

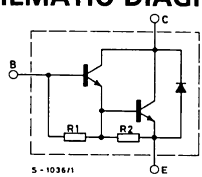
ABSOLUTE MAXIMUM RATINGS

		NPN / PNP	SGS120 / SGS125	SGS121 / SGS126	SGS122 / SGS127
V_{CBO}	Collector-base voltage ($I_E = 0$)		60V	80V	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)		60V	80V	100V
V_{EBO}	Emitter-base voltage ($I_C = 0$)			5V	
I_C	Collector current			5A	
I_{CM}	Collector peak current			8A	
I_B	Base current			0.1A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$			65W	
	$T_{amb} \leqslant 25°C$			2W	
T_{stg}	Storage temperature			-65 to 150°C	
T_j	Junction temperature			150°C	

For PNP types voltage and current values are negative.

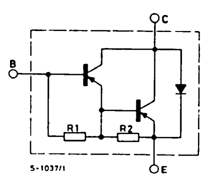
INTERNAL SCHEMATIC DIAGRAMS

NPN



R1 ≅ 5KΩ
R2 ≅ 150Ω

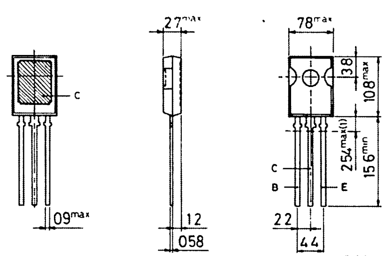
PNP



R1 ≅ 5KΩ
R2 ≅ 150Ω

MECHANICAL DATA

Dimensions in mm



SOT-82

(1) Within this region the cross-section of the leads is uncontrolled

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

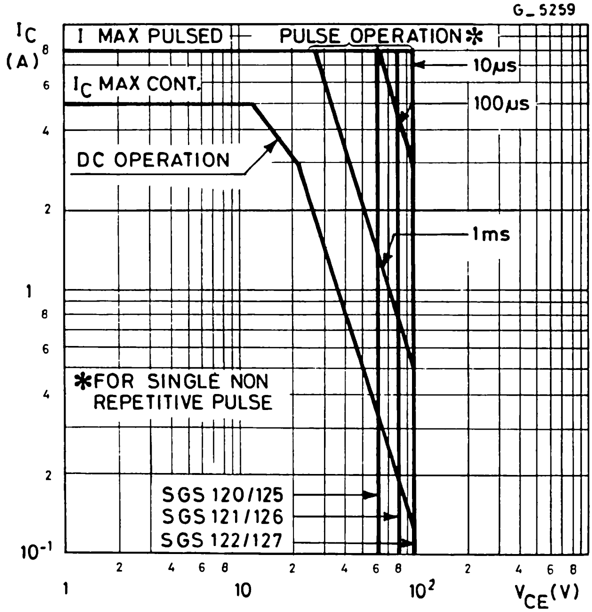
ELECTRICAL CHARACTERISTICS ($T_{case}=25°C$ unless otherwise specified)

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 ($I_C=0$)	$V_{EB}=5V$				2	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B=0$)	$I_C=30mA$ for **SGS 120/125** for **SGS 121/126** for **SGS 122/127**		 60 80 100			 V V V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C=3A$ $I_C=5A$	$I_B=12mA$ $I_B=20mA$			2 4	V V
V_{BE}*	Base-emitter voltage	$I_C=3A$	$V_{CE}=3V$			2.5	V
h_{FE}*	DC current gain	$I_C=0.5A$ $I_C=3A$	$V_{CE}=3V$ $V_{CE}=3V$	1000 1000			— —

* Pulsed: pulse duration = 300μs, duty cycle$\leqslant$2%.

For PNP types voltage and current values are negative

Safe operating areas



For the others characteristics curves see BDX33/BDX34 series

SGS910 BU910
SGS911 BU911
SGS912 BU912

MULTIEPITAXIAL PLANAR NPN

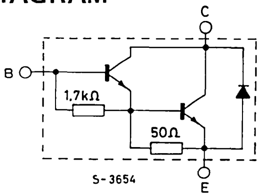
HIGH VOLTAGE POWER DARLINGTONS

The SGS910, SGS911, SGS912 and BU910, BU911, BU912 are silicon multiepitaxial planar NPN transistors in monolithic Darlington configuration respectively in Jedec SOT-82 and TO-220 plastic package. They are designed for applications such as electronic ignition, DC and AC motor controls, solenoid drivers, etc.

ABSOLUTE MAXIMUM RATINGS

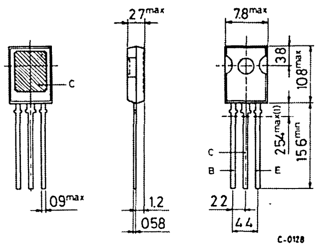
		SGS910 BU910	SGS911 BU911	SGS912 BU912
V_{CES}	Collector-emitter voltage ($V_{BE} = 0$)	400V	450V	500V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	350V	400V	450V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		5V	
I_C	Collector current		6A	
I_{CM}	Collector peak current		10A	
I_B	Base current		1A	
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$		60W	
T_{stg}	Storage temperature		-65 to 150 °C	
T_j	Junction temperature		150°C	

INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

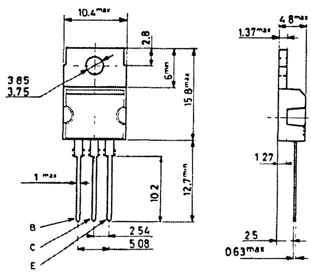
Dimensions in mm



(1) Within this region the cross-section of the leads is uncontrolled

SOT-82

Collector connected to tab



TO-220

THERMAL DATA

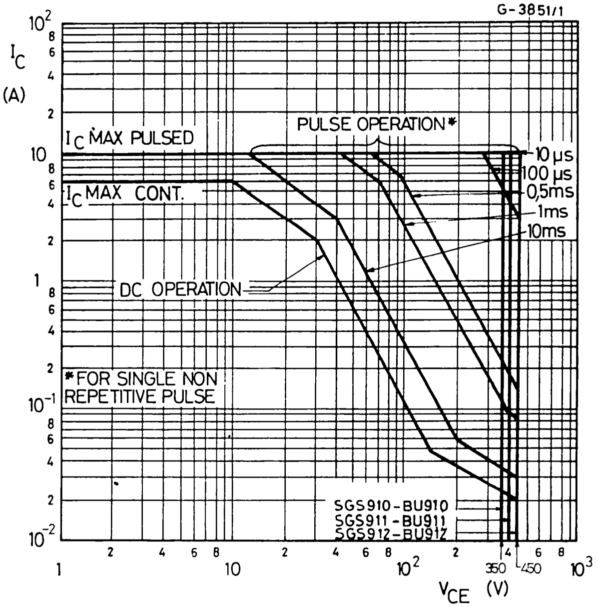
$R_{th\ j-case}$	Thermal resistance junction-case	max	2.08	°C/W

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

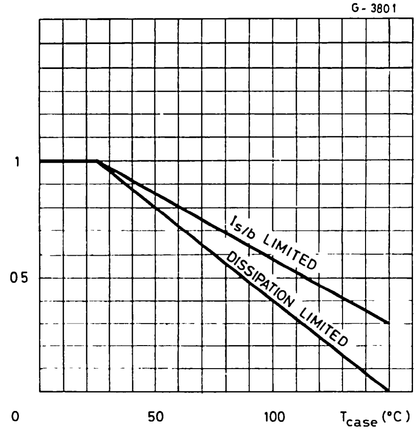
Parameter		Test conditions	Min.	Typ.	Max	Unit
I_{CES}	Collector cutoff current ($V_{BE} = 0$)	V_{CE} = rated V_{CES} $T_{case} = 125°C$			1 5	mA mA
I_{CEO}	Collector cutoff current ($I_B = 0$)	V_{CE} = rated V_{CEO}			1	mA
I_{EBO}	Emitter-cutoff current ($I_C = 0$)	$V_{EB} = 5V$			5	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	I_C = 100 mA for **SGS910/BU910** for **SGS911/BU911** for **SGS912/BU912**	 350 400 450			 V V V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	I_C = 2.5A I_B = 50 mA for **SGS910-911/BU910-911** I_C = 2A I_B = 50 mA for **SGS912/BU912** I_C = 4A I_B=0.2A(all types)			 1.8 1.8 1.8	 V V V
$V_{BE(sat)}$*	Base-emitter saturation voltage	I_C = 2.5A I_B = 50mA for **SGS910-911/BU910-911** I_C = 2A I_B = 50mA for **SGS912/BU912** I_C = 4A I_B=0.2A (all types)			 2.2 2.2 2.5	 V V V
V_F*	Diode forward voltage	I_F = 4A			2.5	V

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

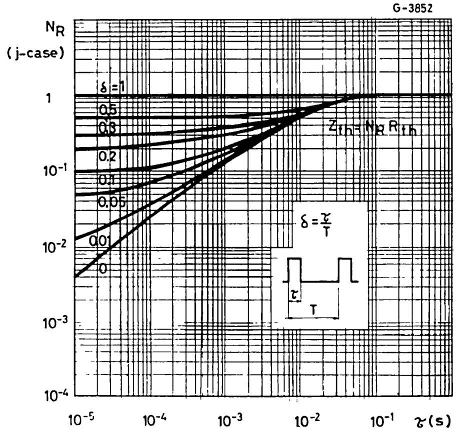
Safe operating areas



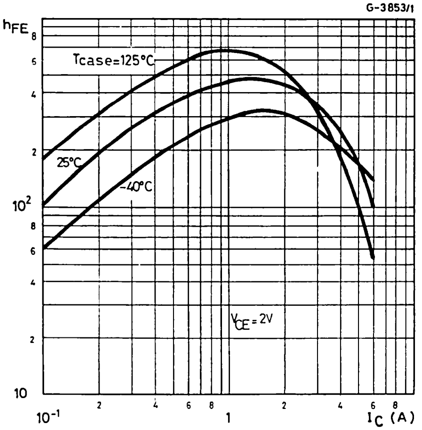
Derating curves



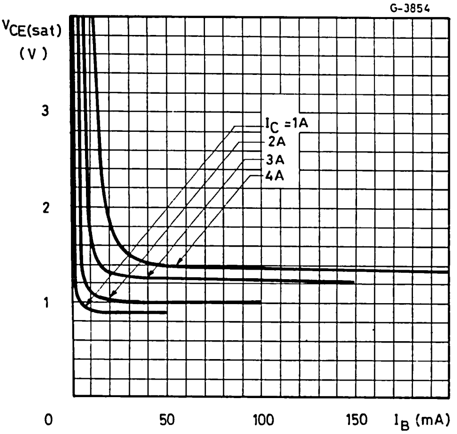
Thermal transient response



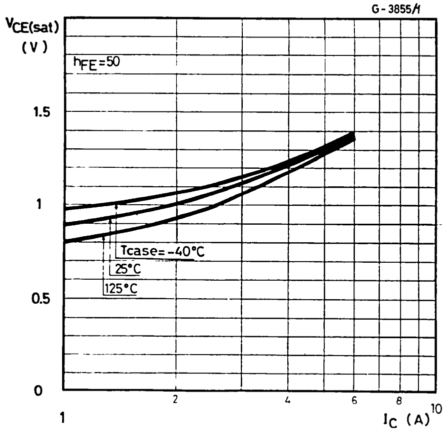
DC current gain



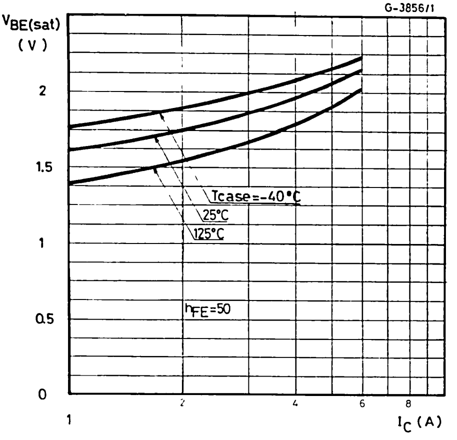
Collector-emitter saturation voltage



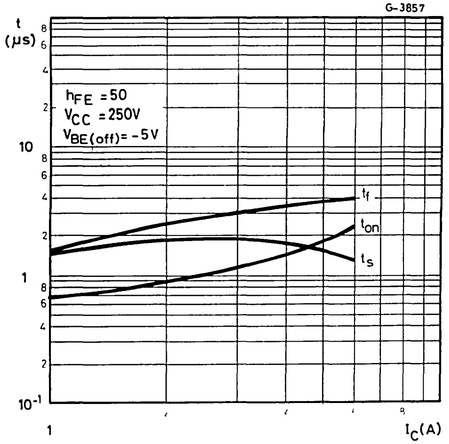
Collector-emitter saturation voltage



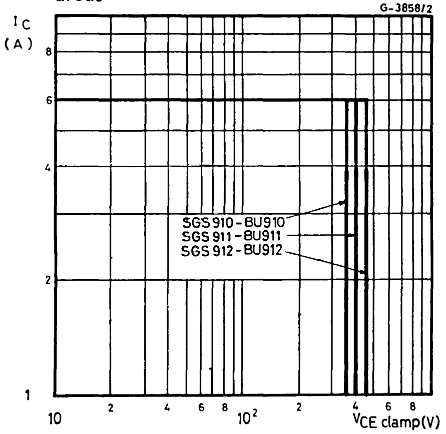
Base-emitter saturation voltage



Saturated switching characteristics



Clamped reverse bias safe operating areas



Clamped $E_{s/b}$ test circuit

TEST CONDITIONS:

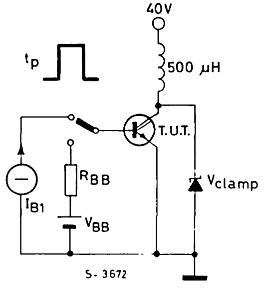
5V > $|-V_{BB}|$ > 0 V

I_C / I_B = 50

$2I_{B1} > |-I_{B2}| > I_{B1}$

t_p = adjusted for nominal I_C

R_{BB} = 1 Ω



EPITAXIAL-BASE NPN

SGS3055

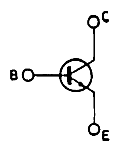
POWER LINEAR AND SWITCHING APPLICATIONS

The SGS3055 is a silicon epitaxial-base NPN transistors in Jedec TO-3 metal case. It is intended for power switching circuits, series and shunt regulators, output stages and high fidelity amplifiers.

ABSOLUTE MAXIMUM RATINGS

V_{CBO}	Collector-base voltage ($I_E = 0$)	100	V
V_{CER}	Collector-emitter ($R_{BE} = 100\Omega$)	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 $T_{case} \leqslant 25^\circ C$	150	W
T_{stg}	Storage temperature	-65 to 200	°C
T_j	Junction temperature	200	°C

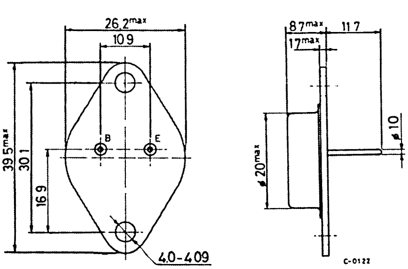
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

THERMAL DATA

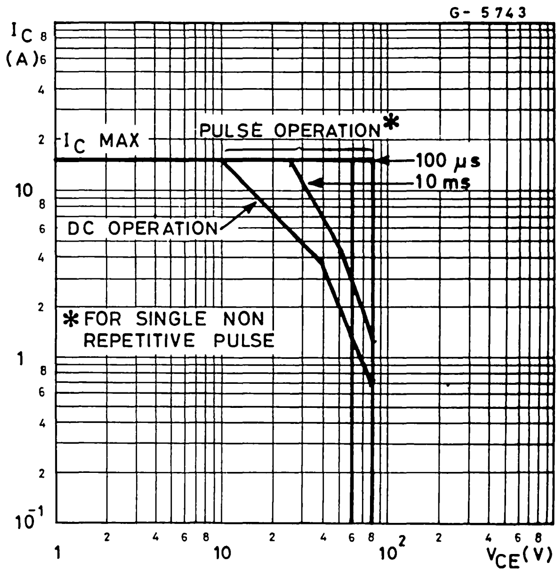
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1.17	°C/W

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

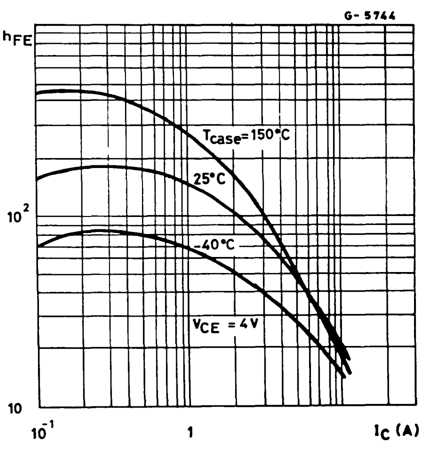
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector cutoff current ($V_{BE} = -1.5V$)	$V_{CE} = 100V$ $V_{CE} = 100V$ $T_{case} = 150°C$			1 5	mA mA
I_{CEO}	Collector cutoff current ($I_B = 30V$	$V_{CE} = 30V$			0.7	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 7V$			2	mA
$V_{CER\,(sus)}$*	Collector-emitter sustaining voltage ($R_{BE} = 100\Omega$)	$I_C = 200mA$	70			V
$V_{CEO\,(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 200mA$	60			V
$V_{CE\,(sat)}$*	Collector-emitter saturation voltage	$I_C = 5A$ $I_B = 0.5A$ $I_C = 10A$ $I_B = 3.3A$			1 3	V V
V_{BE}*	Base-emitter voltage	$I_C = 4A$ $V_{CE} = 4V$			1.5	V
h_{FE}*	DC current gain	$I_C = 4A$ $V_{CE} = 4V$ $I_C = 10A$ $V_{CE} = 4V$	20 5			– –
f_T	Transition frequency	$I_C = 1A$ $V_{CE} = 4V$	2.5			MHz
$I_{s/b}$**	Second breakdown collector current	$V_{CE} = 40V$	3.75			A

* Pulsed: pulse duration = 300μs, duty cycle = 1.5%
** Pulsed: 1s, non repetitive pulse

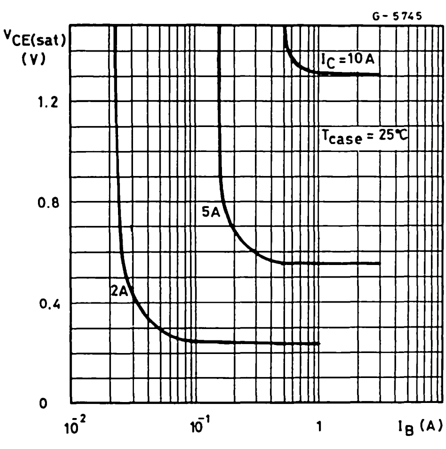
Safe operating area



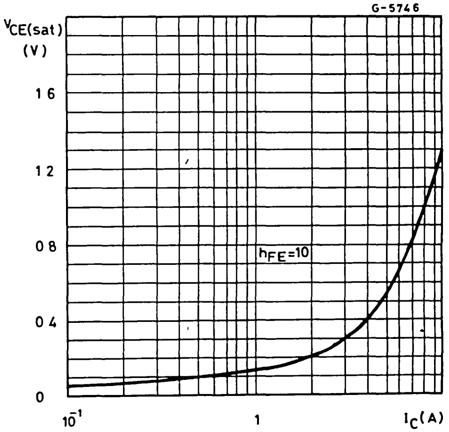
DC current gain



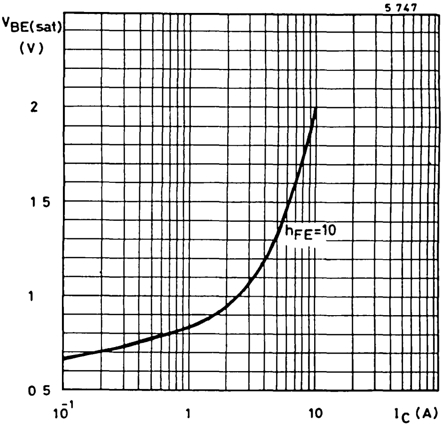
Collector-emitter satuaration voltage



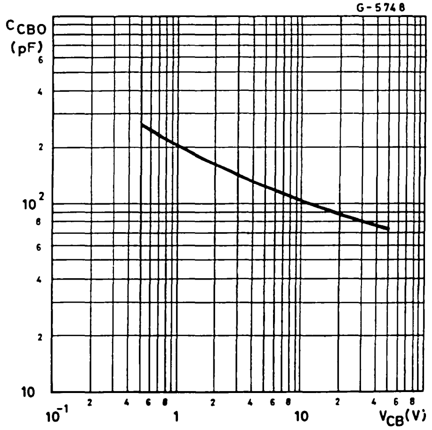
Collector-emitter saturation voltage



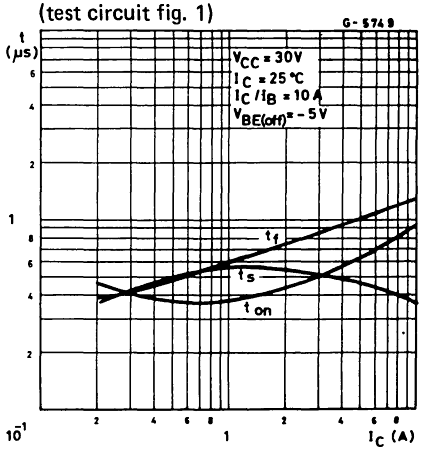
Base-emitter saturation voltage



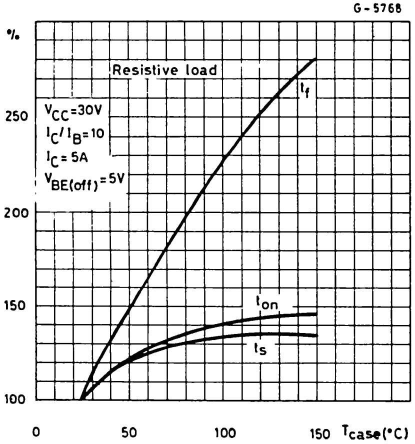
Collector base capacitance



Switching times vs collector current (test circuit fig. 1)



Switching times percentage vs T_{case}



Power rating chart

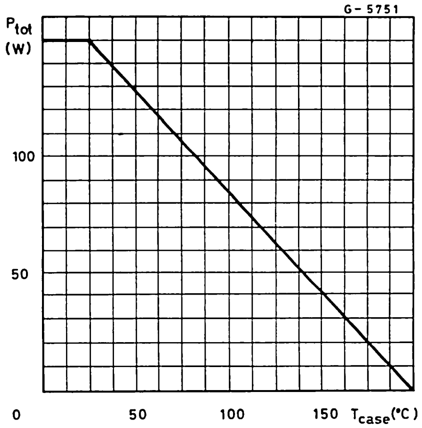
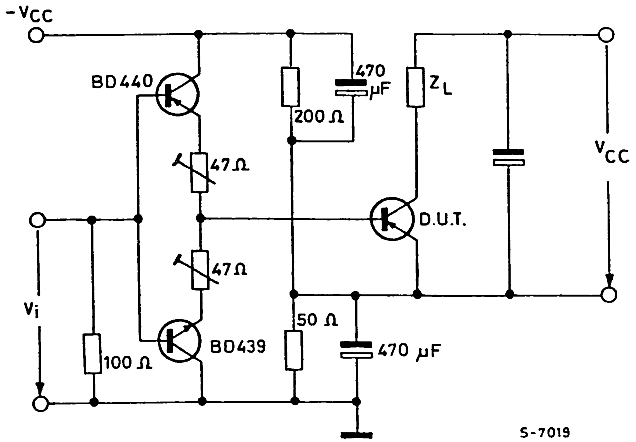


Fig. 1 — Test circuit



SGS6386
SGS6387
SGS6388

EPITAXIAL-BASE NPN

PRELIMINARY DATA

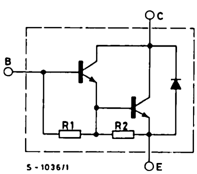
POWER DARLINGTONS

The SGS6386, SGS6387 and SGS6388 are silicon epitaxial-base NPN transistors in monolithic Darlington configuration and are mounted in SOT-82 plastic package.They are intended for use in low e medium frequency power applications.

ABSOLUTE MAXIMUM RATINGS

		SGS6386	SGS6387	SGS6388
V_{CBO}	Collector-base voltage ($I_E = 0$)	40V	60V	80V
V_{CER}	Collector-emitter voltage ($R_{BE} = 100\Omega$)	40V	60V	80V
V_{CEV}	Collector-emitter voltage ($V_{BE} = -1.5V$)	40V	60V	80V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	40V	60V	80V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5V	5V	5V
I_C	Collector current	8A	10A	10A
I_{CM}	Collector peak current		15A	
I_B	Base current		0.25A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$		65W	
T_{stg}	Storage temperature		-65 to 150°C	
T_j	Junction temperature		150°C	

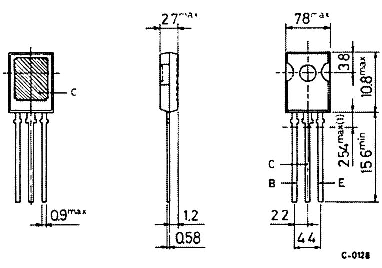
INTERNAL SCHEMATIC DIAGRAM



R1 ≅ 10KΩ
R2 ≅ 150Ω

MECHANICAL DATA

Dimensions in mm



SOT-82

(1) Within this region the cross-section of the leads is uncontrolled

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)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector cutoff current ($V_{BE} = -1.5V$)	V_{CE} = rated V_{CEO} V_{CE} = rated V_{CEO} $T_{case} = 125°C$			0.3 3	mA mA
I_{CEO}	Collector cutoff current ($I_B = 0$)	V_{CE} = rated V_{CEO}			1	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$			5	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage	$I_C = 0.2A$ for **SGS6386** for **SGS6387** for **SGS6388**	 40 60 80			 V V V
$V_{CER(sus)}$*	Collector-emitter sustaining voltage ($R_{BE} = 100\Omega$)	$I_C = 0.2A$ for **SGS6386** for **SGS6387** for **SGS6388**	 40 60 80			 V V V
$V_{CEV(sus)}$*	Collector-emitter sustaining voltage ($V_{BE} = -1.5V$)	$I_C = 0.2A$ for **SGS6386** for **SGS6387** for **SGS6388**	 40 60 80			 V V V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	for **SGS6386** $I_C = 3A$ $I_B = 6mA$ for **SGS6387, SGS6388** $I_C = 5A$ $I_B = 10mA$ for **SGS6386** $I_C = 6A$ $I_B = 60mA$ for **SGS6387,SGS6388** $I_C = 8A$ $I_B = 80mA$			 2 2 3 3	 V V V V

ELECTRICAL CHARACTERISTICS (Continued)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
V_{BE}*	Base-emitter voltage	for **SGS6386**				
		$I_C = 3A$ $V_{CE} = 3V$			2.8	V
		for **SGS6387, SGS6388**				
		$I_C = 5A$ $V_{CE} = 3V$			2.8	V
		for **SGS6386**				
		$I_C = 6A$ $V_{CE} = 3V$			4.5	V
		for **SGS6387,SGS6388**				
		$I_C = 8A$ $V_{CE} = 3V$			4.5	V
h_{FE}*	DC current gain	for **SGS6386**				
		$I_C = 3A$ $V_{CE} = 3V$	1000		20K	—
		for **SGS6387, SGS6388**				
		$I_C = 5A$ $V_{CE} = 3V$	1000		20K	—
		for **SGS6386**				
		$I_C = 6A$ $V_{CE} = 3V$	100			—
		for **SGS6387,SGS6388**				
		$I_C = 8A$ $V_{CE} = 3V$	100			—
V_F*	Parallel diode forward voltage	for **SGS6386** $-I_C = 6A$			4	V
		for **SGS6387/6388** $-I_C = 8A$			4	V
h_{fe}*	Small signal current gain	$I_C = 1A$ $V_{CE} = 10V$ $f = 1MHz$	20			—
		$I_C = 1A$ $V_{CE} = 10V$ $f = 1KHz$	1000			—
C_{CBO}	Collector-base capacitance	$V_{CB} = 10V$ $I_E = 0$ $f = 1MHz$			200	pF
$E_{s/b}$	Second breakdown energy	$L = 12mH$ $R_{BE} = 100\Omega$ $V_{BE} \leqslant -1.5V$ $I_C = 3.65A$	80			mJ

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

For characteristics curves see BDX33/BDX34 series

MULTIEPITAXIAL PLANAR NPN

SGS10004
SGS10004P
SGS10005
SGS10005P

ADVANCE DATA

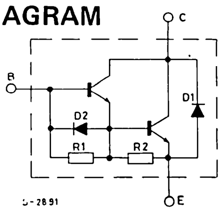
HIGH VOLTAGE FAST SWITCHING

The SGS10004/10005 are silicon power Darlington transistors with integrated base-emitter speed-up diode, mounted in Jedec TO-3 metal case designed for high-power, fast switching applications. The SGS10004P and SGS10005P are mounted in SOT-93 case similar to TO-218. This family is an economic alternative to MJ10004 or MJ10005 particularly suitable for applications at 8A operating currents.

ABSOLUTE MAXIMUM RATING

	SOT-93 TO-3	SGS10004P SGS10004	SGS10005P SGS10005
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	350V	400V
V_{CEX}	Collector-emitter voltage ($V_{BE} = -5V$)	400V	450V
V_{CEV}	Collector-emitter voltage ($V_{BE} = 1.5V$)	450V	500V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	8V	
I_C	Collector current	16A	
I_{CM}	Collector peak current	25A	
I_B	Base current	2.5A	
I_{BM}	Base peak current	5A	
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$	(TO-3) 175W	(SOT-93) 150W
T_{stg}	Storage temperature	-65 to 200°C	-65 to 175°C
T_j	Junction temperature	200°C	175°C

INTERNAL SCHEMATIC DIAGRAM

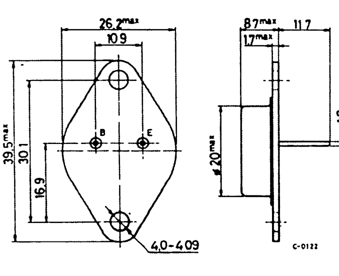


R1 Typ. 100Ω
R2 Typ. 350Ω

MECHANICAL DATA

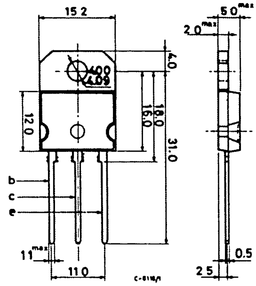
Dimension in mm

Collector connected to case



TO-3

Collector connected to tab



(sim. to TO-218) SOT-93

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1	°C/W

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

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{EBO}	Emitter cutoff current (I_C = 0)	V_{EB} = 2V			25	mA
I_{CER}	Collector cutoff current (R_{BE} = 50Ω)	V_{CE} = Rated V_{CEV} T_C = 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
h_{FE}*	DC Current gain	I_C = 5A V_{CE} = 5V I_C = 8A V_{CE} = 5V I_C = 16A V_{CE} = 5V	50 40 10			– – –
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage (I_B = 0)	I_C = 250mA V_{Clamp} = Rated V_{CEO} for **SGS10004** for **SGS10005**	 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 **SGS10004** for **SGS10005** I_C = 10A T_{case} = 100°C V_{Clamp} = Rated V_{CEX} for **SGS10004** for **SGS10005**	 400 450 275 325			 V V V V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	I_C = 8A I_B = 400mA I_C = 8A I_B = 400mA T_{case} = 100°C			1.8 2	V V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	I_C = 8A I_B = 400mA I_C = 8A I_B = 400mA T_{case} = 100°C			2.5 2.5	V V

ELECTRICAL CHARACTERISTICS (continued)

	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_f*	Diode forward voltage	$I_F = 10A$		3	5	V
h_{fe}	Small-signal current gain	$I_C = 1A$ $V_{CE} = 10V$ $f_{test} = 1MHz$	10			–
C_{OB}	Output capacitance	$V_{CB} = 10V$ $I_E = 0$ $f_{test} = 100MHz$	100		325	pF
t_{on}	Turn-on time	$V_{CC} = 250V$ $I_C = 8A$ $I_{B1} = -I_{B2} = 400mA$ $V_{BE\ (off)} = 5V$ $t_p = 50\mu s$ duty cycle $\leqslant 2\%$		0.22	0.8	μs
t_r	Rise Time			0.6	1.5	μs
t_f	Fall time			0.15	0.5	μs

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

SGS13002 -13003
SGS13002T-13003T

MULTIEPITAXIAL MESA NPN

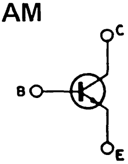
HIGH VOLTAGE SWITCHING APPLICATIONS

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).

ABSOLUTE MAXIMUM RATINGS

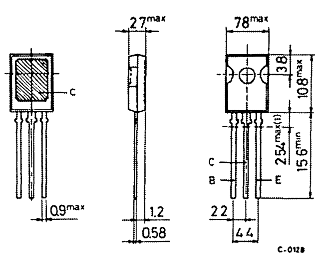
		SGS13002 SGS13002T	SGS13003 SGS13003T
V_{CEV}	Collector-emitter voltage ($V_{BE} = 1.5V$)	600V	700V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	300V	400V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	9V	
I_C	Collector current	1.5A	
I_{CM}	Collector peak current ($t_p < 5ms$)	3A	
I_B	Base current	0.75A	
I_{BM}	Base peak current ($t_p < 5ms$)	1.5A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25\,^\circ C$	50W	
	at $T_{amb} \leqslant 25\,^\circ C$	2W	
T_{stg}	Storage temperature	-65 to 150°C	
T_j	Junction temperature	150 °C	

INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

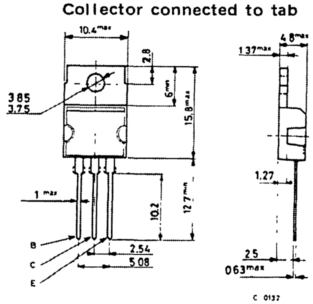
Dimensions in mm



(1) Within this region the cross-section of the leads is uncontrolled

SOT-82

Collector connected to tab



TO-220

THERMAL DATA

$R_{th\ j-amb}$	Thermal resistance junction-ambient	max	62.5	°C/W
$R_{th\ j-case}$	Thermal resistance junction case	max	2.5	°C/W

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

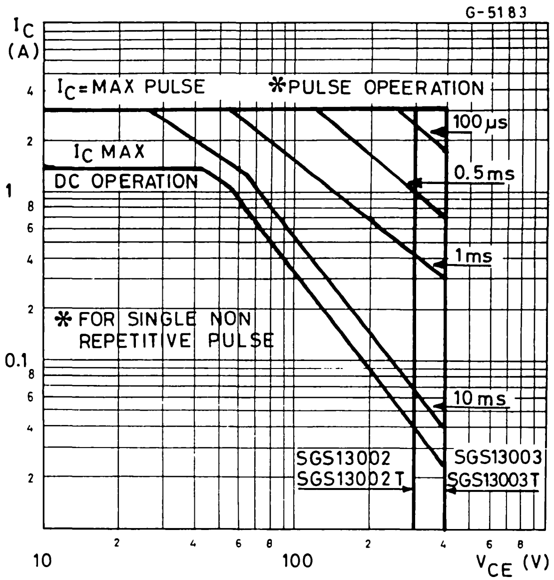
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector cutoff current (V_{BE} = -1.5V)	for **SGS13002/13002T**				
		V_{CE} = 600V			1	mA
		V_{CE} = 600V T_{case} = 100°C			5	mA
		for **SGS13003/13003T**				
		V_{CE} = 700V			1	mA
		V_{CE} = 700V T_{case} = 100°C			5	mA
I_{EBO}	Emitter cutoff current (I_C = 0)	V_{EB} = 9V			1	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage (I_B = 0)	I_C = 10mA				
		for **SGS13002/13002T**	300			V
		for **SGS13003/13003T**	400			V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	I_C = 0.5A I_B = 0.1A			0.5	V
		I_C = 1A I_B = 0.25A			1	V
		I_C = 1.5A I_B = 0.5A			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 = 0.5A I_B = 0.1A			1	V
		I_C = 1A I_B = 0.25A			1.2	V
		I_C = 1A; I_B = 0.25A; T_{case} = 100°C			1.1	V
h_{FE}*	DC current gain	I_C = 0.5A V_{CE} = 2V	8		40	–
		I_C = 1A V_{CE} = 2V	5		25	–

ELECTRICAL CHARACTERISTICS (continued)

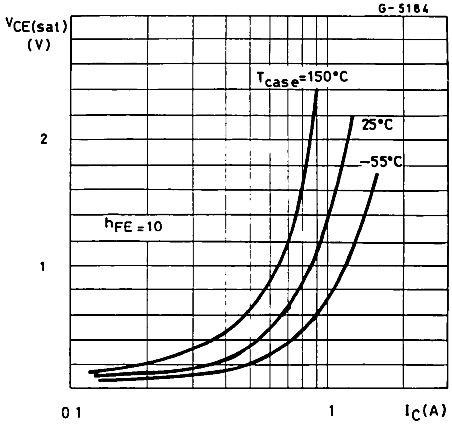
Parameter		Test conditions	Min.	Typ.	Max.	Unit
f_T	Transition frequency	I_C= 100mA; V_{CE}= 10V,f= 1MHz	5	10		MHz
C_{CBO}	Collector-base capacitance	V_{CB} = 10V f = 0.1 MHz		30		pF
RESISTIVE SWITCHING TIMES						
t_r	Rise time	V_{CC} = 125V I_C = 1A, $2I_{B1} = -I_{B2}$ = 0.2A		0.3	0.8	μs
t_s	Storage time			1.1	2.5	μs
t_f	Fall time			0.12	0.5	μs
INDUCTIVE SWITCHING TIMES						
t_{sv}	Storage time	I_C = 1A I_{B1} = 0.2A, V_{BE} =−5V, L = 50 mH, V_{clamp} = 300V		0.8	2.5	μs
t_C	Crossover time			0.1	0.75	μs

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

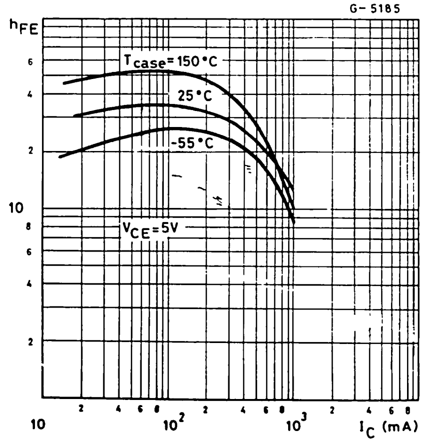
Safe operating areas



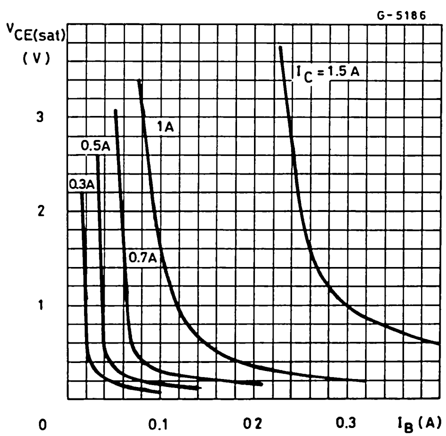
Collector-emitter saturation voltage



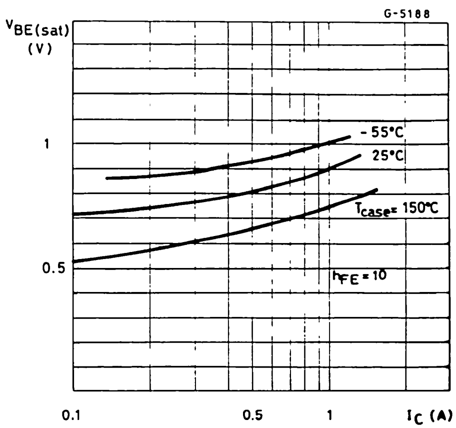
DC current gain



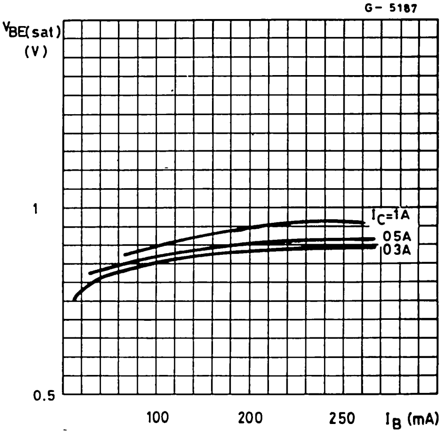
Collector-emitter saturation voltage



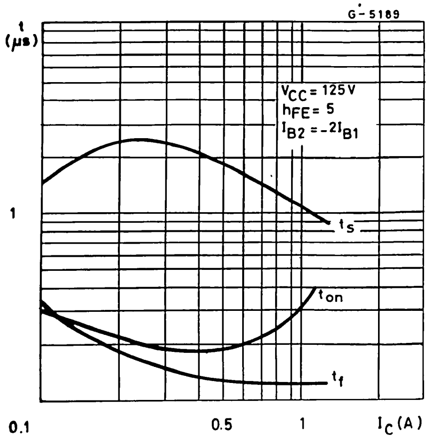
Base-emitter saturation voltage



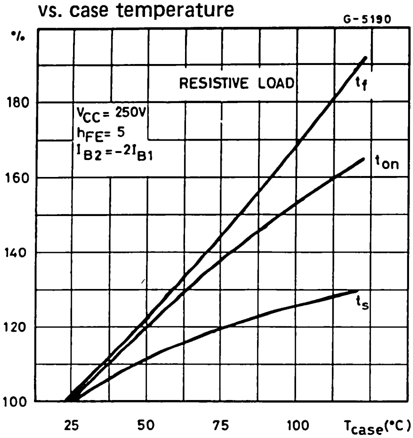
Base-emitter saturation voltage



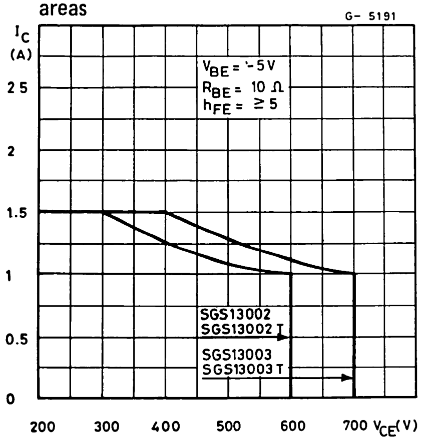
Resistive load switching times



Switching time percentage variation vs. case temperature



Clamped reverse bias safe operating areas



MULTIEPITAXIAL PLANAR NPN

SGSD00030
SGSD00031

PRELIMINARY DATA

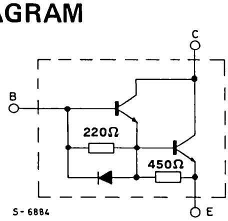
HIGH VOLTAGE, HIGH POWER, FAST SWITCHING

SGSD00031 and SGSD00030 are a silicon multiepitaxial planar NPN Darlington transistors with integrated base-emitter speed up diode, mounted in Jedec TO-3 and SOT-93, No parasitic C-E 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.

ABSOLUTE MAXIMUM RATINGS

V_{CER}	Collector-emitter voltage ($R_{BE} = 50\Omega$)	650	V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	400	V
I_C	Collector-current	28	A
I_{CM}	Collector peak current (tp < 10ms)	40	A
I_B	Base current	6	A
I_{BM}	Base peak current (tp < 10ms)	12	A
P_{tot}	Total power dissipation at $T_{case} < 25°C$	150	W
T_{stg}	Storaga temperature	-65 to 175	°C
T_j	Junction temperature	175	°C

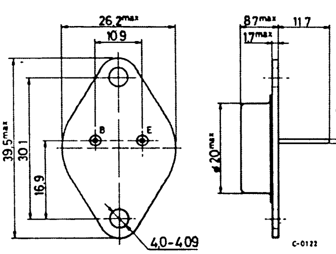
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

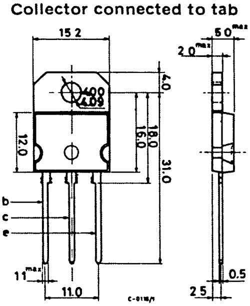
Dimension in mm

Collector connected to case



TO-3

Collector connected to tab



(sim. to TO-218) SOT-93

SGSD00030
SGSD00031

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction case	max	1	°C/W

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

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector cutoff current (V_{BE}=-15V)	V_{CE} = 600V same condition T_{case}=100°C			100 2	μA mA
I_{EBO}	Emitter cutoff current (I_C=0)	V_{BE} = 2V			30	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage	I_C = 100mA	400			V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	I_C = 10A I_B = 0.1A I_C = 18A I_B = 1.8A			2.5 3.5	V V
h_{FE}*	DC current gain	I_C = 10A V_{CE} = 5V I_C = 18A V_{CE} = 5V	30 20			– –
I_{ol}	Output current overload	accidental overload switch-off current V_{clamp} = 400V L= 100μH t_{ol} = 10μs T_j = 125°C	28			A

RESISTIVE SWITCHING TIMES

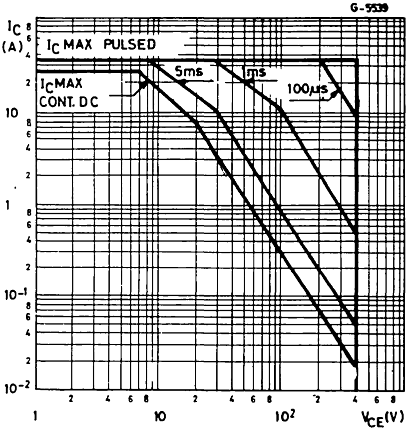
t_s	Turn-on time	V_{CC} = 250V I_C = 12A I_{B1} = 0.1A $V_{BE\,off}$ = -5V			0.6	μs
t_s	Storage time				1.5	μs
t_f	Fall time				0.6	μs

INDUCTIVE SWITCHING TIMES

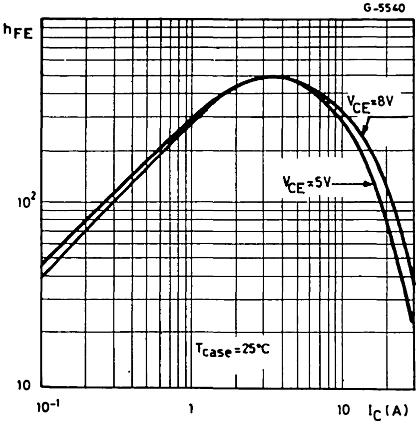
t_s	Storage time	V_{clamp} = 250V I_C = 12A I_{B1} = 0.1A $V_{BE\,off}$ = -5V L = 180μH			1.5	μs
t_f	Fall time				0.5	μs
t_s	Storage time	V_{clamp} = 250V I_C = 18A I_{B1} = 1.8A $V_{BE\,off}$ = -5V L = 180μH			1.5	μs
t_f	Fall time				0.7	μs

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

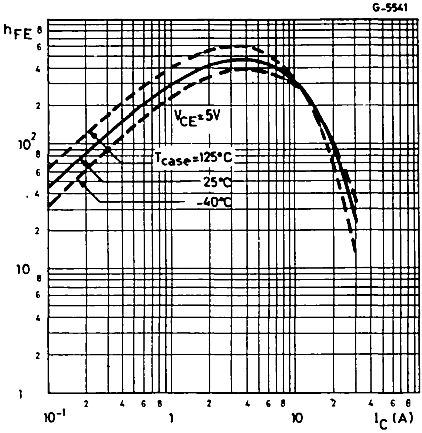
Safe operating area



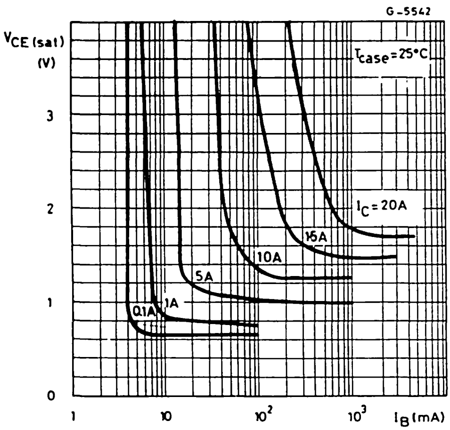
DC current gain



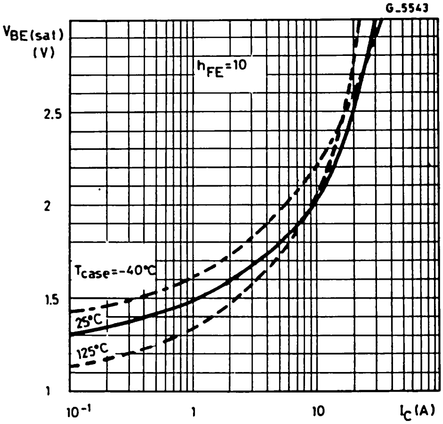
DC current gain



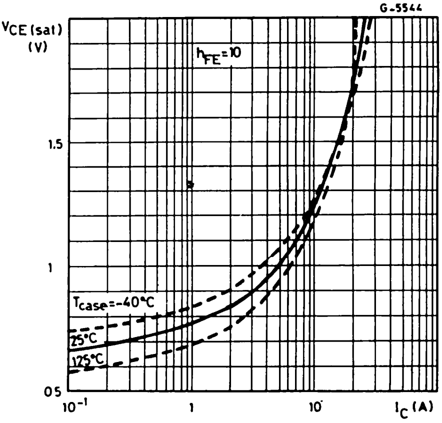
Collector-emitter saturation voltage



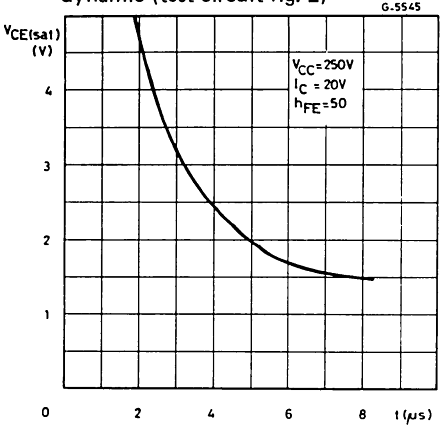
Base-emitter saturation voltage



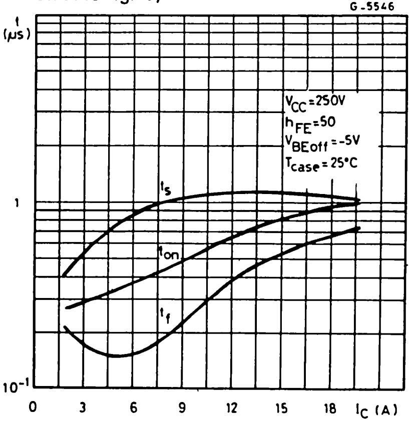
Collector-emitter saturation voltage



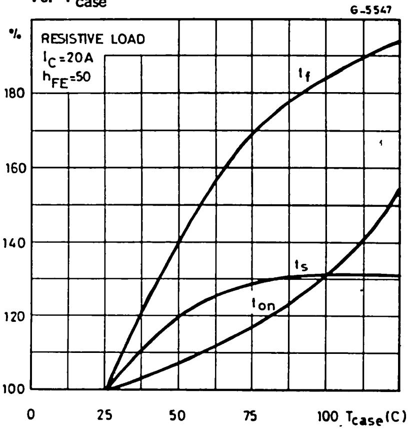
Collector-emitter saturation voltage dynamic (test circuit fig. 2)



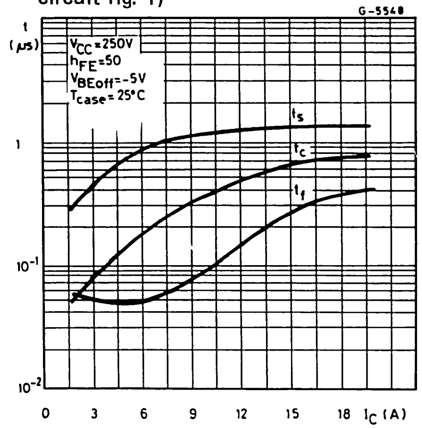
Switching times resistance load (test circuit fig. 1)



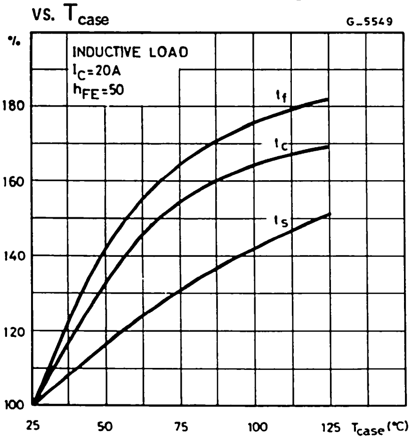
Switching times percentage variation vs. T_{case}



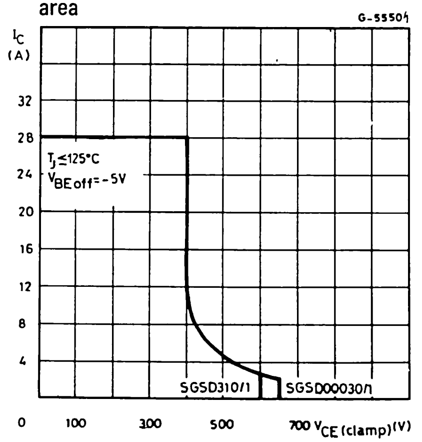
Switching times inductive load (test circuit fig. 1)



Switching times percentage variation vs. T_{case}



Clamped reverse bias safe operating area



SWITCHING TIMES TEST CIRCUITS

Fig. 1

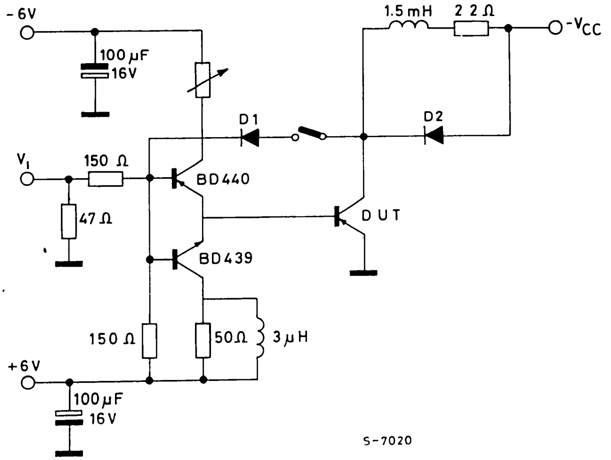
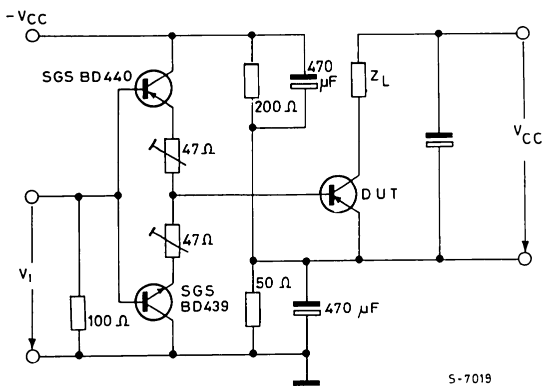


Fig. 2



EPITAXIAL-BASE NPN/PNP

SGSD100
SGSD200

HIGH CURRENT DARLINGTONS

The SGSD100 is a silicon epitaxial-base NPN transistors in SOT-93 plastic package, intended for use in general purpose high current amplifier application. The complementary PNP type is the SGSD200.

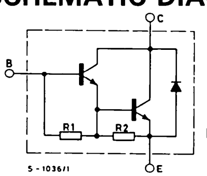
ABSOLUTE MAXIMUM RATINGS

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 type voltage and current values are negative

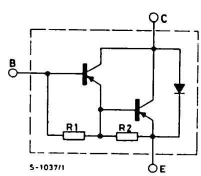
INTERNAL SCHEMATIC DIAGRAMS

NPN



R1 ≅ 8KΩ
R2 ≅ 90Ω

PNP

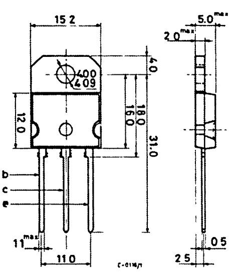


R1 ≅ 5KΩ
R2 ≅ 50Ω

MECHANICAL DATA

Dimensions in mm

Collector connected to tab



(Sim. to TO-218) SOT-93

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)

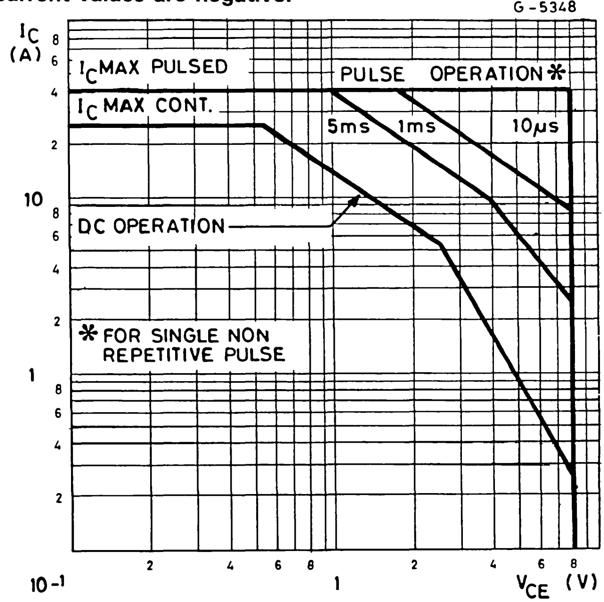
Parameter		Test conditions		Min.	Typ.	Max.	Unit
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 50mA$		80			V
I_{CEO}	Collector cutoff current ($I_B = 0$)	$V_{CE} = 60V$				500	μA
		$T_j = 100°C$				1.5	mA
I_{CBO}	Collector cutoff current ($I_E = 0$)	$V_{CE} = 80V$				500	μA
		$T_j = 100°C$				1.5	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$				2	mA
I_{CEV}	Collector cutoff current ($V_{BE} = -0.3V$)	$V_{CE} = 80V$				100	μA
		$T_j = 100°C$				2	mA
h_{FE}*	DC current gain	$I_C = 5A$	$V_{CE} = 3V$	600	5K	15K	—
		$T_j = 100°C$			8K		—
		$I_C = 10A$	$V_{CE} = 3V$	500	4K	10K	—
		$T_j = 100°C$			8K		—
		$I_C = 20A$	$V_{CE} = 3V$	300	2K	5K	—
		$T_j = 100°C$			2K		—
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C = 5A$	$I_B = 20mA$		0.95	1.2	V
		$T_j = 100°C$			0.8		V
		$I_C = 10A$	$I_B = 40mA$		1.2	1.75	V
		$T_j = 100°C$			1.3		V
		$I_C = 20A$	$I_B = 80mA$		2	3.5	V
		$T_j = 100°C$			2.3		V
V_{BE}*	Base-emitter voltage	$I_C = 10A$	$V_{CE} = 3V$	1	1.8	3	V
		$T_j = 100°C$			1.6		V

ELECTRICAL CHARACTERISTICS (Continued)

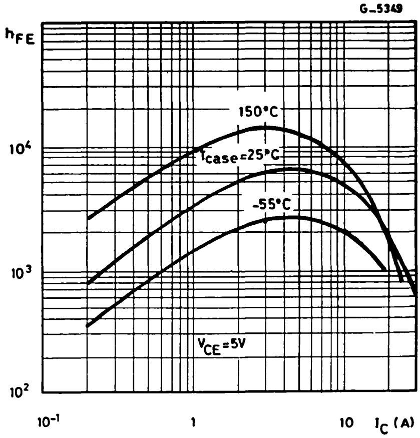
Parameter		Test conditions	Min.	Typ.	Max.	Unit
$V_{BE}(sat)$	Base-emitter saturation voltage	$I_C = 20A$ $I_B = 80mA$		2.6	3.3	V
		$T_j = 100°C$		2.5		V
V_F	Diode forward voltage	$I_F = 5A$		1.2		V
		$T_j = 100°C$		0.85		V
		$I_F = 10A$		1.6		V
		$T_j = 100°C$		1.4		V
		$I_F = 20A$		2.3		V
		$T_j = 100°C$		1.3		V
$E_{s/b}$	Second breakdown energy	$L = 3mH$ $V_{CC} = 30V$	250			mJ
		$T_j = 100°C$	250			mJ
$I_{s/b}$	Second breakdown collector current	$V_{CE} = 25V$ $t = 500$ ms	6			A

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

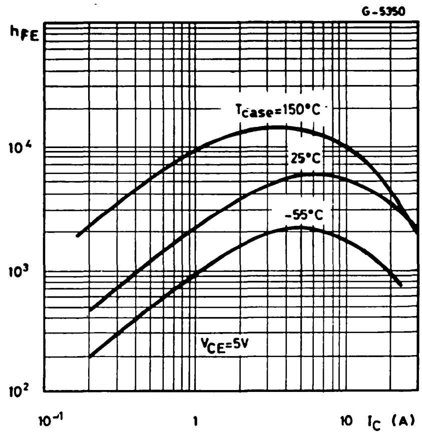
Safe operating areas



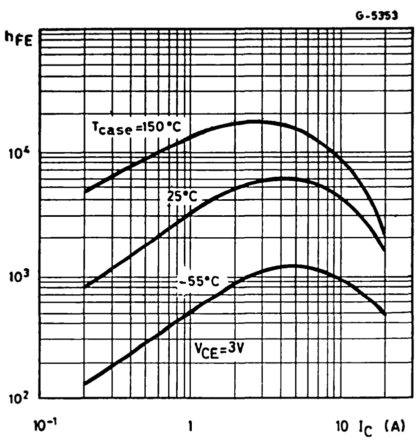
DC current gain (NPN type)



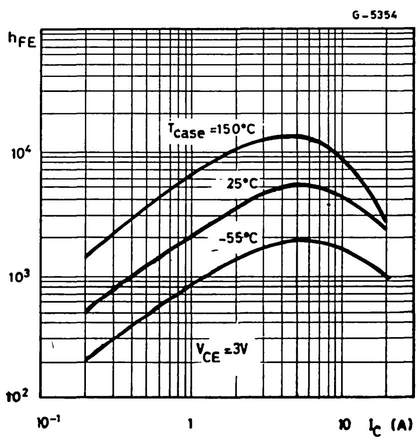
DC current gain (PNP type)



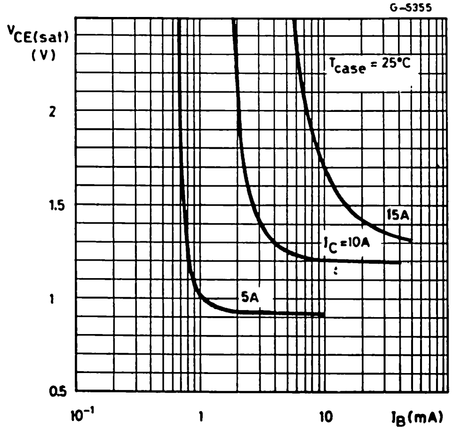
DC current gain (NPN type)



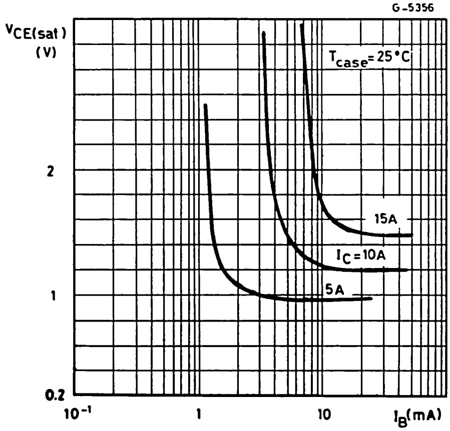
DC current gain (PNP type)



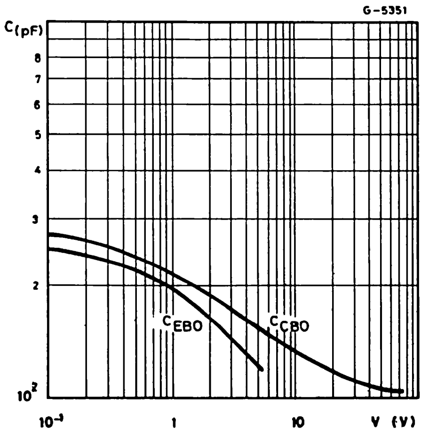
Collector-emitter saturation voltage (NPN type)



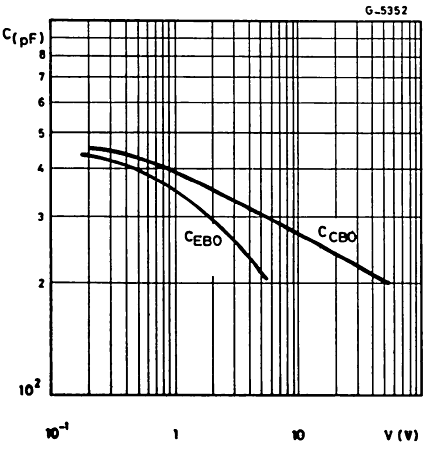
Collector-emitter saturation voltage (PNP type)



Capacitances (NPN type)



Capacitances (PNP type)



SGSD310
SGSD311

MULTIEPITAXIAL PLANAR NPN

PRELIMINARY DATA

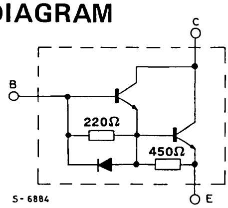
HIGH VOLTAGE, HIGH POWER, FAST SWITCHING

The SGSD310 and SGSD311 are silicon multiepitaxial planar NPN Darlington transistors with integrated base emitter speed up diode, mounted in Jedec TO-3 and SOT-93. No parasitic C-E diode, so that an external fast recovery free wheeling diode can be added. They are particulary suitable as output stage in high power, fast switching applications.

ABSOLUTE MAXIMUM RATINGS

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
P_{tot}	Total power dissipation at $T_{case} < 25°C$	150	W
T_{stg}	Storage temperature	-65 to 175	°C
T_j	Junction temperature	175	°C

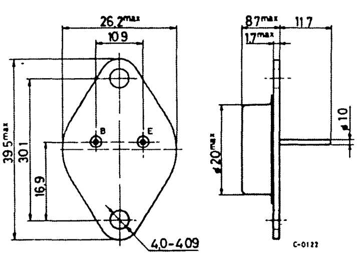
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

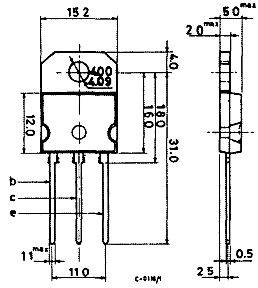
Dimension in mm

Collector connected to case



TO-3

Collector connected to tab



(sim. to TO-218) SOT-93

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction case	max	1	°C/W

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

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector cutoff current (V_{BE} =-1.5V)	V_{CE} = 600V same condition T_{case} = 100°C			100 2	μA mA
I_{EBO}	Emitter cutoff current (I_C = 0)	V_{BE} = 2V			30	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage	I_C = 100mA	400			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	I_C = 10A I_B = 0.5A I_C = 18A I_B = 1.8A I_C = 22A I_B = 2.2A I_C = 28A I_B = 5.6A			2 2.5 3 5	V V V V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	I_C = 10A I_B = 0.5A I_C = 18A I_B = 1.8A I_C = 22A I_B = 2.2A			2.5 3 3.3	V V V
h_{FE}*	DC current gain	I_C = 10A V_{CE} = 5V I_C = 18A V_{CE} = 5V	30 20			— —
I_{ol}	Output current overload	accidental overload switch-off current V_{clamp} = 400V L = 100μH t_{ol} = 10μs T_j = 125°C	28			A

RESISTIVE SWITCHING TIMES

t_{on}	Turn-on time	V_{CC} = 250V I_C = 10A I_{B1} = 0.5A $V_{BE\ off}$ = -5V			0.6	μs
t_s	Storage time				1.5	μs
t_f	Fall time				0.6	μs

INDUCTIVE SWITCHING TIMES

t_s	Storage time	V_{clamp} = 250V I_C = 10A I_{B1} = 0.5A $V_{BE\ off}$ = -5V L = 180μH			1.5	μs
t_f	Fall time				0.5	μs
t_s	Storage time	V_{clamp} = 250V I_C = 20A I_{B1} = 2A $V_{BE\ off}$ = -5V L = 180μH			1.5	μs
t_f	Fall time				0.7	μs

* Pulsed: pulse duration = 300μs, duty cycle = 1.5%
For characteristics curve see SGSD00030 series

TIP29 TIP30
TIP29A TIP30A
TIP29B TIP30B
TIP29C TIP30C

EPITAXIAL-BASE NPN/PNP

MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

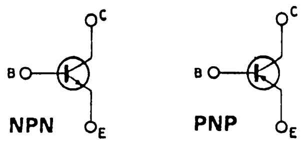
The TIP29, TIP29A, TIP29B and TIP29C are silicon epitaxial-base NPN power transistors in Jedec TO-220 plastic package, intended for use in medium power linear and switching applications. The complementary PNP types are the TIP30, TIP30A, TIP30B, TIP30C.

ABSOLUTE MAXIMUM RATINGS

	NPN PNP*	TIP29 TIP30	TIP29A TIP30A	TIP29B TIP30B	TIP29C TIP30C
V_{CBO}	Collector-base voltage ($I_E = 0$)	40V	60V	80V	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	40V	60V	80V	100V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5V			
I_C	Collector current	1A			
I_{CM}	Collector peak current	3A			
I_B	Base current	0.4A			
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	30W			
	$T_{amb} \leqslant 25°C$	2W			
T_{stg}	Storage temperature	-65 to 150°C			
T_j	Junction temperature	150°C			

*** For PNP types voltage and current values are negative**

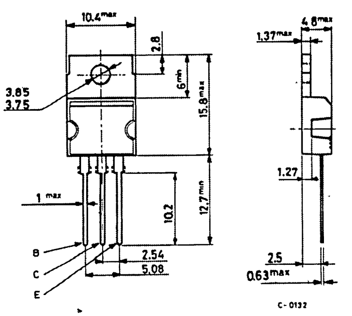
INTERNAL SCHEMATIC DIAGRAMS



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance jucntion-case	max	4.17	°C/W
$R_{th\ j\text{-}amb}$	Thermal resistance junciton-ambient	max	62.5	°C/W

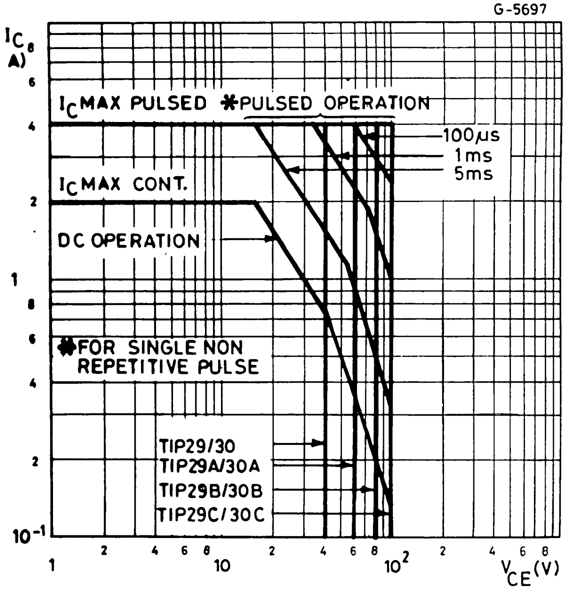
ELECTRICAL CHARACTERISTICS ($T_{case} = 25°C$ unless otherwise specified)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B = 0$)	for **TIP29/29A/30/30A** $V_{CE} = 30V$ for **TIP29B/29C/30B/30C** $V_{CE} = 60V$			0.3 0.3	mA mA
I_{CES}	Collector cutoff current ($V_{BE} = 0$)	for **TIP29/30** $V_{CE} = 40V$ for **TIP29A/30A** $V_{CE} = 60V$ for **TIP29B/30B** $V_{CE} = 80V$ for **TIP29C/30C** $V_{CE} = 100V$			0.2 0.2 0.2 0.2	mA mA mA mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$			1	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 30mA$ for **TIP29/30** for **TIP29A/30A** for **TIP29B/30B** for **TIP29C/30C**	40 60 80 100			V V V V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C = 1A$ $I_B = 125mA$			0.7	V
$V_{BE(on)}$*	Base-emitter voltage	$I_C = 1A$ $V_{CE} = 4A$			1.3	V
h_{FE}*	DC current gain	$I_C = 0.2A$ $V_{CE} = 4V$ $I_C = 1A$ $V_{CE} = 4V$	40 15			– –
h_{fe}	Small signal current gain	$I_C = 0.2A$ $V_{CE} = 10V$ $f = 1KHz$ $I_C = 0.2A$ $V_{CE} = 10V$ $f = 1MHz$	20 3			– –

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

For PNP types voltage and current values are negative

Safe operating areas



* **For the others characteristics see TIP31/TIP32 series**

TIP31 TIP32
TIP31A TIP32A
TIP31B TIP32B
TIP31C TIP32C

EPITAXIAL-BASE NPN/PNP

MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

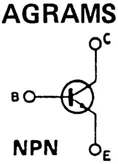
The TIP31, TIP31A, TIP31B and TIP31C are silicon epitaxial-base NPN power transistors in Jedec TO-220 plastic package, intended for use in medium power linear and switching applications. The complementary PNP types are the TIP32, TIP32A, TIP32B and TIP32C.

ABSOLUTE MAXIMUM RATINGS

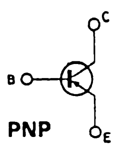
		NPN PNP*	TIP31 TIP32	TIP31A TIP32A	TIP31B TIP32B	TIP31C TIP32C
V_{CBO}	Collector-base voltage ($I_E = 0$)		40V	60V	80V	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)		40V	60V	80V	100V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		5V			
I_C	Collector current		3A			
I_{CM}	Collector peak current		5A			
I_B	Base-current		1A			
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$		40W			
	$T_{amb} \leqslant 25°C$		2W			
T_{stg}	Storage temperature		-65 to 150°C			
T_j	Junction temperature		150°C			

* **For PNP types voltage and current values are negative**

INTERNAL SHCEMATIC DIAGRAMS



NPN

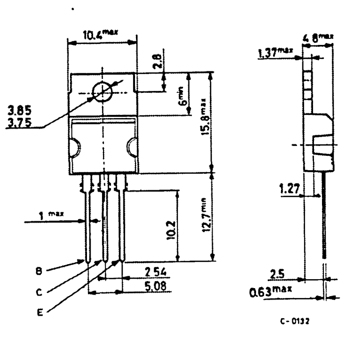


PNP

MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

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)

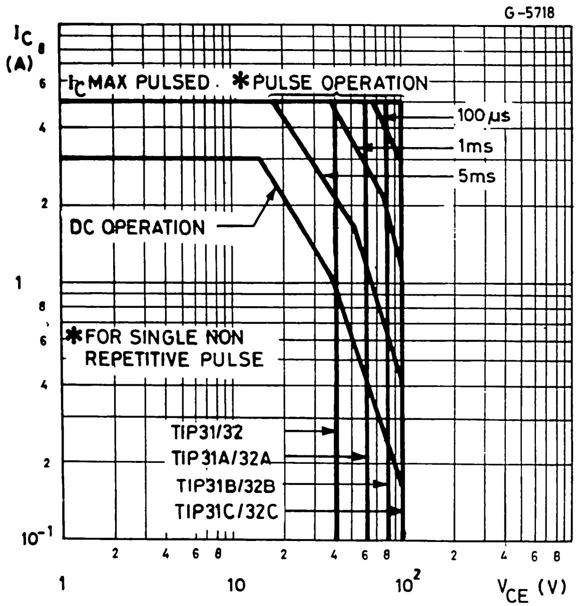
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B = 0$)	for **TIP31/31A/32/32A** $V_{CE} = 30V$			0.3	mA
		for **TIP31B/31C/32B/32C/** $V_{CE} = 60V$			0.3	mA
I_{CES}	Collector cutoff current ($V_{BE} = 0$)	for **TIP31/32** $V_{CE} = 40V$			0.2	mA
		for **TIP31A/32A** $V_{CE} = 60V$			0.2	mA
		for **TIP31B/32B** $V_{CE} = 80V$			0.2	mA
		for **TIP31C/32C** $V_{CE} = 100V$			0.2	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$			1	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 30mA$				
		for **TIP31/32**	40			V
		for **TIP31A/32A**	60			V
		for **TIP31B/32B**	80			V
		for **TIP31C/32C**	100			V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C = 3A$ $I_B = 375mA$			1.2	V

ELECTRICAL CHARACTERISTICS (continued)

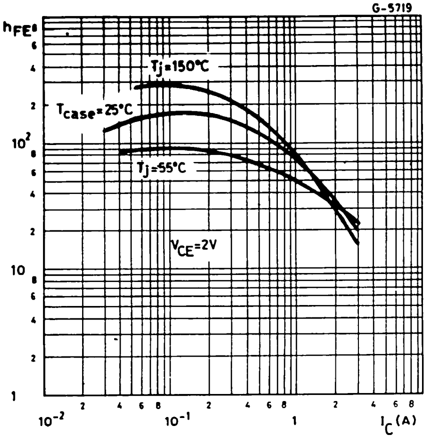
Parameter		Test conditions		Min.	Typ.	Max.	Unit
$V_{BE(on)}$*	Base-emitter voltage	$I_C = 3A$	$V_{CE} = 4V$			1.8	V
h_{FE}*	DC current gain	$I_C = 1A$ $I_C = 3A$	$V_{CE} = 4V$ $V_{CE} = 4V$	25 10		 50	– –
h_{fe}	Small signal current gain	$I_C = 0.5A$ $f = 1KHz$ $I_C = 0.5A$ $f = 1MHz$	$V_{CE} = 10V$ $V_{CE} = 10V$	20 3			– –

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

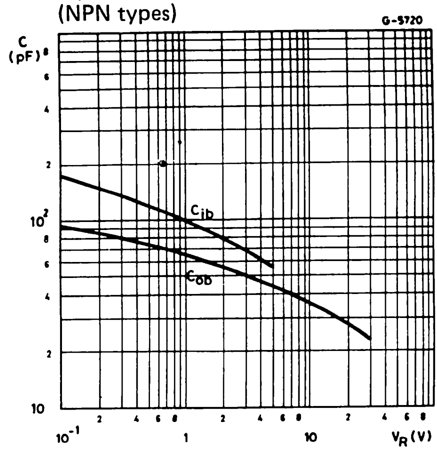
Safe operating areas



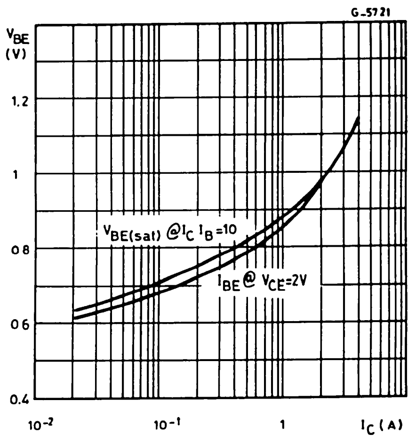
DC current gain (NPN types)



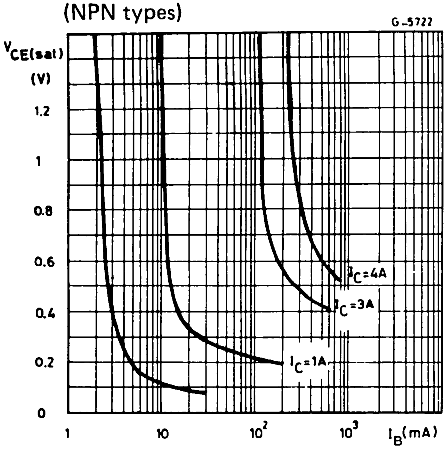
Input and output capacitance (NPN types)



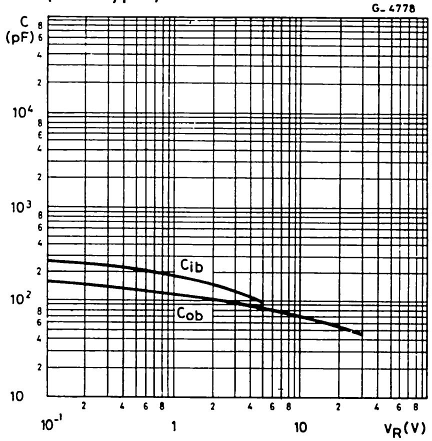
Base-emitter voltage (NPN types)



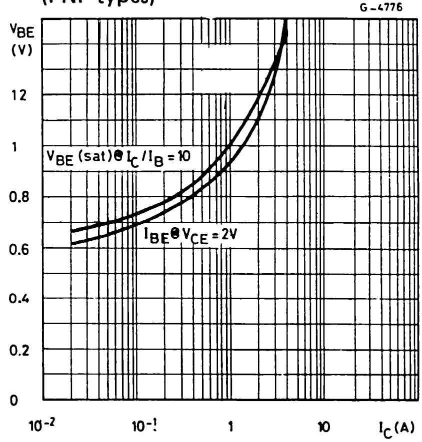
Collector-emitter saturation voltage (NPN types)



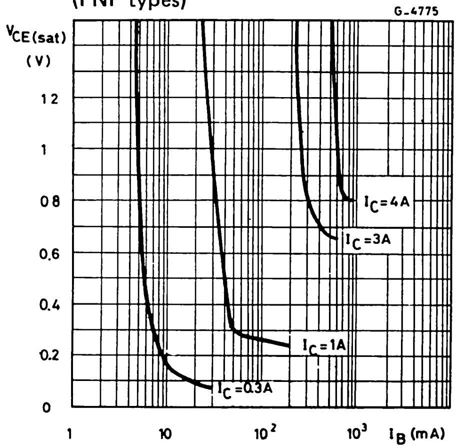
Input and output capacitance (PNP types)



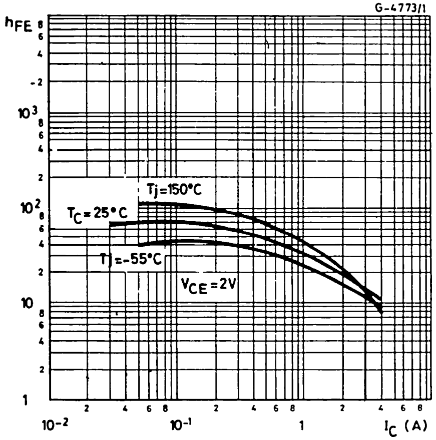
Base-emitter voltage (PNP types)



Collector-emitter saturation voltage (PNP types)



DC current gain (PNP types)



TIP35 TIP36
TIP35A TIP36A
TIP35B TIP36B
TIP35C TIP36C

EPITAXIAL-BASE NPN/PNP

ADVANCE DATA

POWER AMPLIFIER AND SWITCHING APPLICATIONS

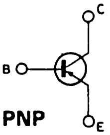
The TIP35/35A/35B/35C are silicon epitaxial base NPN transistors in SOT-93 plastic package. They are intended for power amplifier and switching applications. The complementary PNP types are TIP36/36A/36B/36C.

ABSOLUTE MAXIMUM RATINGS

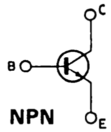
	PNP* / NPN	TIP36 / TIP35	TIP36A / TIP35A	TIP36B / TIP35B	TIP36C / TIP35C
V_{CEO}	Collector-emitter voltage (I_B=0)	40V	60V	80V	100V
V_{CBO}	Collector-base voltage (I_E=0)	40V	60V	80V	100V
V_{EBO}	Emitter-base voltage (I_C=0)	5V			
I_C	Collector current	25A			
I_{CM}	Collector peak current	50A			
I_B	Base current	5A			
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	125W			
T_{stg}	Storage temperature	-65 to 150°C			
T_j	Junction temperature	150°C			

*** For PNP types voltage and current values are negative**

INTERNAL SCHEMATIC DIAGRAMS



PNP

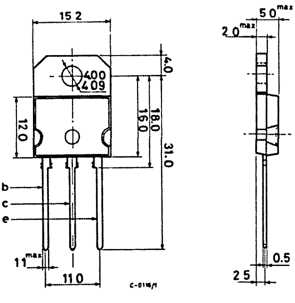


NPN

MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



(sim. to **TO-218) SOT-93**

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1	°C/W

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

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B = 0$)	for **TIP35/35A/36/36A** $V_{CE} = 30V$ for **TIP35B/35C/36B/36C** $V_{CE} = 60V$			 1 1	 mA mA
I_{EBO}	Emitter cutoff current ($V_{BE} = 0$)	$V_{BE} = 5V$			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	$I_C = 30mA$ for **TIP35/TIP36** for **TIP35A/TIP36A** for **TIP35B/TIP36B** for **TIP35C/TIP36C**	 40 60 80 100			 V V V V
h_{FE} *	DC Current gain	$I_C = 1.5A$ $V_{CE} = 4V$ $I_C = 15A$ $V_{CE} = 4V$	25 10		 50	– –
$V_{CE\ (sat)}$ *	Collector-emitter saturation voltage	$I_C = 15A$ $I_B = 1.5A$ $I_C = 25A$ $I_B = 5A$			1.8 4	V V
$V_{BE\ (on)}$ *	Base-emitter on voltage	$I_C = 15A$ $V_{CE} = 4V$ $I_C = 25A$ $V_{CE} = 4V$			2 4	V V
f_T	Transition frequency	$I_C = 1A$ $V_{CE} = 10V$ $f = 1MHz$	3			MHz
h_{fe}	Small signal current gain	$I_C = 1A$ $V_{CE} = 10V$ $f = 1KHz$	25			–

* Pulsed: pulse duration $\leqslant 300\mu s$, duty cycle $\leqslant 2\%$
For PNP types voltage and current values are negative

TIP41 TIP42
TIP41A TIP42A
TIP41B TIP42B
TIP41C TIP42C

EPITAXIAL-BASE NPN/PNP

MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

The TIP 41, TIP 41A, TIP 41B, and TIP 41C 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 TIP 42, TIP 42A, TIP 42B and TIP 42C respectively.

ABSOLUTE MAXIMUM RATINGS

	NPN / PNP*	TIP41 / TIP42	TIP41A / TIP42A	TIP41B / TIP42B	TIP41C / TIP42C
V_{CBO}	Collector-base voltage ($I_E = 0$)	40V	60V	80V	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	40V	60V	80V	100V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5V			
I_C	Collector current	6A			
I_{CM}	Collector peak current	10A			
I_B	Base current	3A			
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$	65W			
	$T_{amb} \leq 25°C$	2W			
T_{stg}	Storage temperature	-65 to 150°C			
T_j	Junction temperature	150°C			

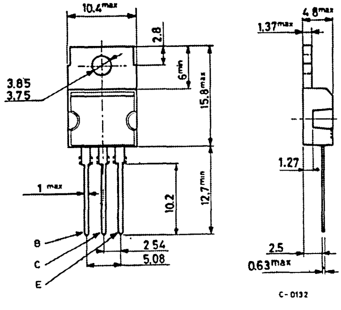
* **For PNP types voltage and current values are negative**

INTERNAL SCHEMATIC DIAGRAMS

MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

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)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B = 0$)	for **TIP41/41A/42/42A** $V_{CE} = 30V$			0.7	mA
		for **TIP41B/41C/42B/42C** $V_{CE} = 60V$			0.7	mA
I_{CES}	Collector cutoff current ($V_{BE} = 0$)	for **TIP41/42** $V_{CE} = 40V$			0.4	mA
		for **TIP41A/42A** $V_{CE} = 60V$			0.4	mA
		for **TIP41B/42B** $V_{CE} = 80V$			0.4	mA
		for **TIP41C/42C** $V_{CE} = 100V$			0.4	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$			1	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 30mA$ for **TIP41/42**	40			V
		for **TIP41A/42A**	60			V
		for **TIP41B/42B**	80			V
		for **TIP41C/42C**	100			V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C = 6A$ $I_B = 0.6A$			1.5	V
V_{BE}*	Base-emitter voltage	$I_C = 6A$ $V_{CE} = 4V$			2	V
h_{FE}*	DC current gain	$I_C = 0.3A$ $V_{CE} = 4V$	30			—
		$I_C = 3A$ $V_{CE} = 4V$	15		75	—
h_{fe}	Small signal current gain	$I_C = 0.5A$ $V_{CE} = 10V$ $f = 1KHz$	20			—
		$f = 1MHz$	3			—

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

For PNP types voltage and current values are negative

TIP47
TIP48
TIP49
TIP50

MULTIEPITAXIAL PLANAR NPN

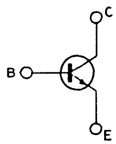
LINEAR AND SWITCHING APPLICATIONS

The TIP47 to TIP50 are silicon multiepitaxial planar transistors in TO-220 plastic package intended for linear and switching applications.

ABSOLUTE MAXIMUM RATINGS

		TIP47	TIP48	TIP49	TIP50
V_{CBO}	Collector base voltage ($I_E = 0$)	350V	400V	450V	500V
V_{CEO}	Collector emitter voltage ($I_B = 0$)	250V	300V	350V	400V
V_{EBO}	Emitter base voltage ($I_C = 0$)	5V			
I_C	Collector current	1A			
I_{CM}	Collector peak current	2A			
I_B	Base current	0.6A			
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	40W			
P_{tot}	Total power dissipation at $T_{amb} \leqslant 25°C$	2W			
T_{stg}	Storage temperature	-65 to 150°C			
T_j	Junction temperature	150°C			

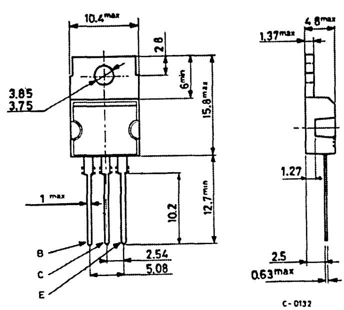
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

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)

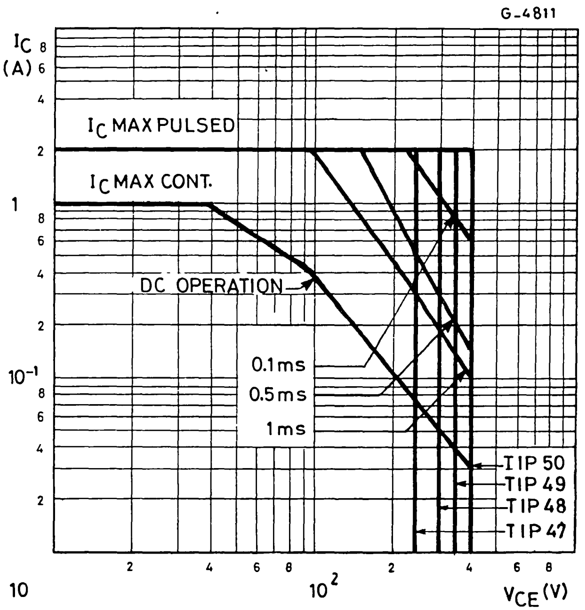
Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current (V_{BE} = 0)	for **TIP47**	V_{CE} = 350V			1	mA
		for **TIP48**	V_{CE} = 400V			1	mA
		for **TIP49**	V_{CE} = 450V			1	mA
		for **TIP50**	V_{CE} = 500V			1	mA
I_{CEO}	Collector cutoff current (I_B = 0)	for **TIP47**	V_{CE} = 150V			1	mA
		for **TIP48**	V_{CE} = 200V			1	mA
		for **TIP49**	V_{CE} = 250V			1	mA
		for **TIP50**	V_{CE} = 300V			1	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 **TIP47**	250			V
			for **TIP48**	300			V
			for **TIP49**	350			V
			for **TIP50**	400			V
$V_{CE(sat)}$*	Collector emitter saturation voltage	I_C = 1A	I_B = 0.2A			1	V
$V_{BE(on)}$*	Base emitter on voltage	I_C = 1A	V_{CE} = 10V			1.5	V

ELECTRICAL CHARACTERISTICS (continued)

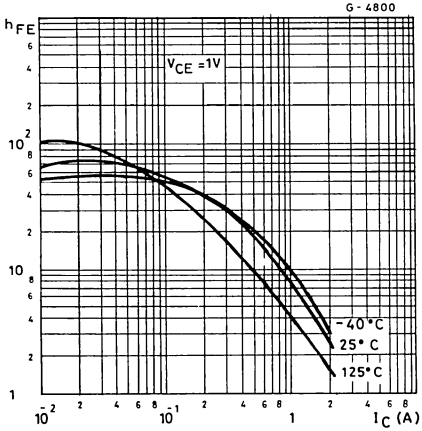
Parameter		Test conditions		Min.	Typ.	Max.	Unit
h_{FE}*	DC current gain	$I_C = 0.3A$ $I_C = 1A$	$V_{CE} = 10V$ $V_{CE} = 10V$	30 10		150	– –
f_T	Transition frequency	$V_{CE} = 10V$ $f = 2MHz$	$I_C = 0.2A$	10			MHz
h_{fe}	Small signal current gain	$V_{CE} = 10V$ $f = 1KHz$	$I_C = 0.2$	25			–

* Pulsed: pulse duration = 300 μs duty cycle $\leqslant$ 2%.

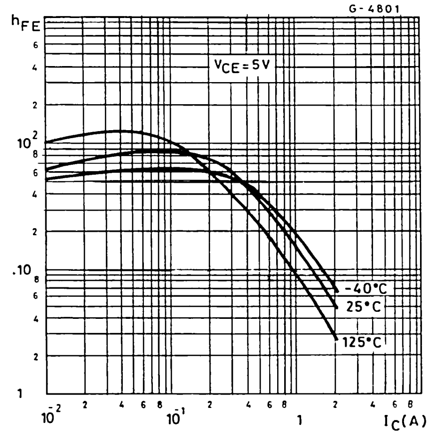
Safe operating areas



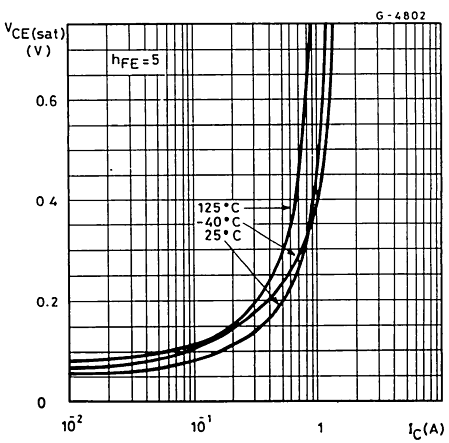
DC current gain



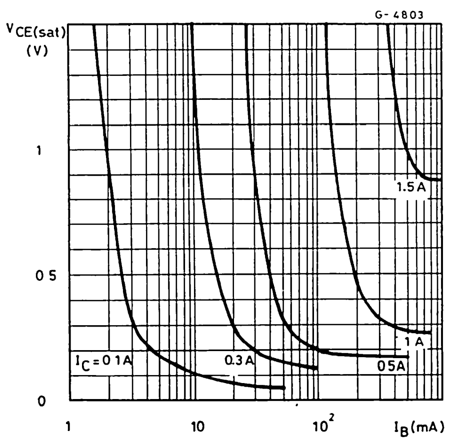
DC current gain



Collector-emitter saturation voltage

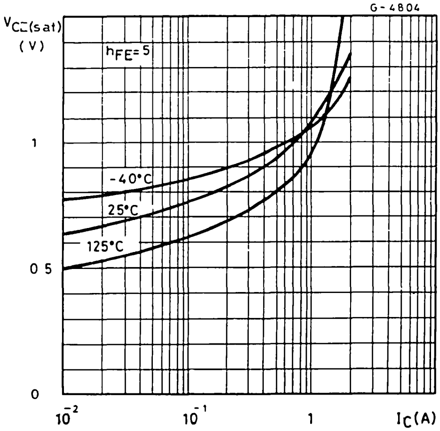


Collector-emitter saturation voltage

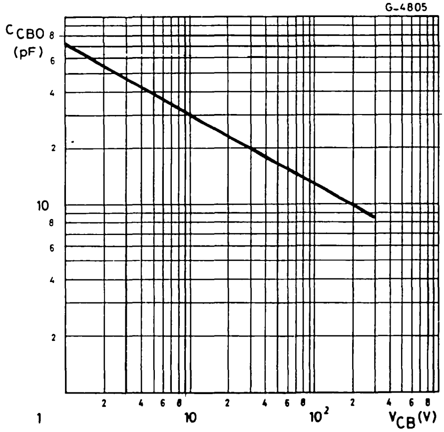


TIP47
TIP48
TIP49
TIP50

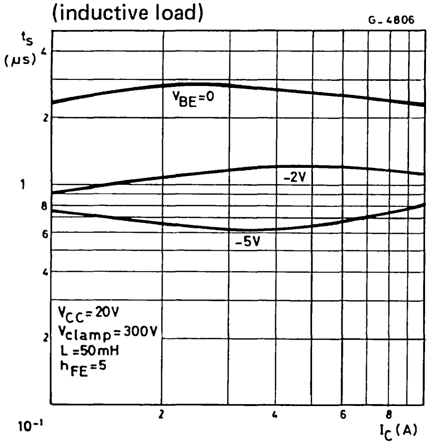
Base-emitter saturation voltage



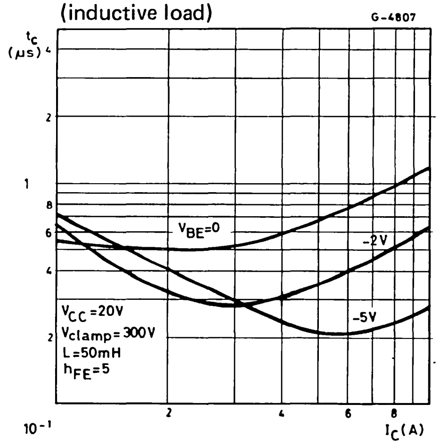
Collector-base capacitance



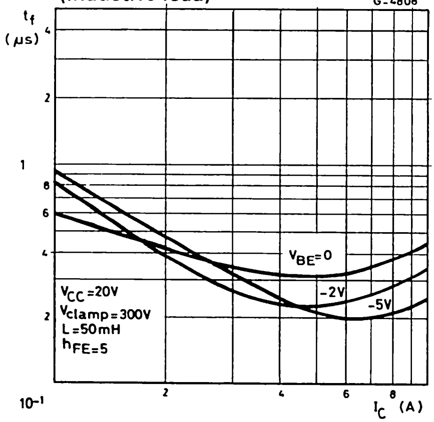
Saturated switching characteristics (inductive load)



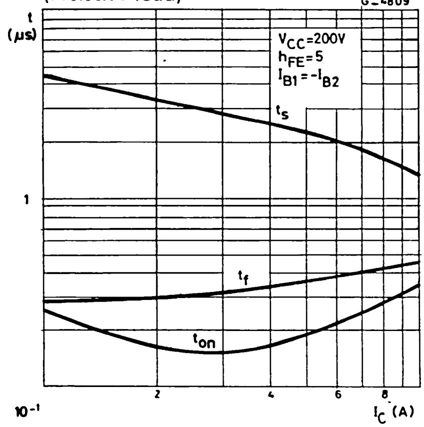
Saturated switching characteristics (inductive load)



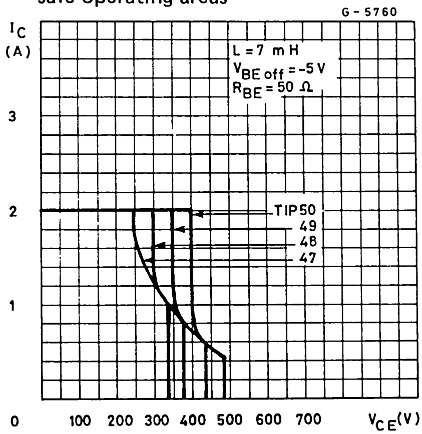
Saturated switching characteristics (inductive load)



Saturated switching characteristics (resistive load)



Clampled reverse bias safe operating areas



TIP51
TIP52
TIP53
TIP54

MULTIEPITAXIAL MESA NPN

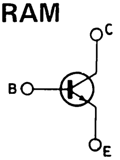
HIGH VOLTAGE POWER SWITCH

The TIP51, TIP52, TIP53, TIP54 are silicon multiepitaxial mesa NPN transistors in SOT-93 plastic package.
They are intended for high voltage, fast switching industrial and consumer applications.

ABSOLUTE MAXIMUM RATINGS

		TIP51	TIP52	TIP53	TIP54
V_{CES}	Collector-emitter voltage ($V_{BE} = 0$)	350V	400V	450V	500V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	250V	300V	350V	400V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5V			
I_C	Collector current	3V			
I_{CM}	Collector peak current	5A			
I_B	Base current	0.6A			
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	100W			
T_{stg}	Storage temperature	-65 to 150°C			
T_j	Junction temperature	150°C			

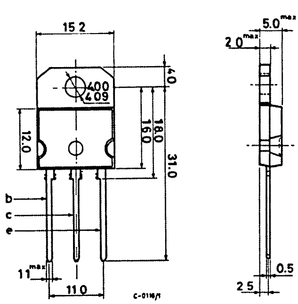
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



(sim. to **TO-218**) **SOT-93**

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)

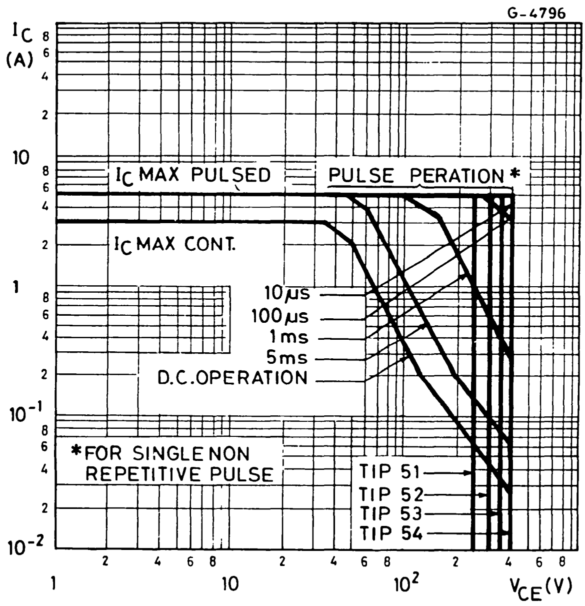
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector-cutoff current ($V_{BE} = 0$)	for **TIP51** $V_{CE} = 350V$ for **TIP52** $V_{CE} = 400V$ for **TIP53** $V_{CE} = 450V$ for **TIP54** $V_{CE} = 500V$			1 1 1 1	mA mA mA mA
I_{CEO}	Collector cutoff current ($I_B = 0$)	for **TIP51** $V_{CE} = 150V$ for **TIP52** $V_{CE} = 200V$ for **TIP53** $V_{CE} = 250V$ for **TIP54** $V_{CE} = 300V$			1 1 1 1	mA mA mA mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$			1	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 30mA$ for **TIP51** for **TIP52** for **TIP53** for **TIP54**	250 300 350 400			V V V V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C = 3A$ $I_B = 0.6A$			1.5	V
V_{BE}*	Base-emitter	$I_C = 3A$ $V_{CE} = 10V$			1.5	V
h_{FE}*	DC current gain	$I_C = 0.3A$ $V_{CE} = 10V$ $I_C = 3A$ $V_{CE} = 10V$	30 10		150	–
h_{fe}	Small signal current gain	$I_C=0.2A$; $V_{CE}=10V$; f=1KHz $I_C=0.2A$; $V_{CE}=10V$; f=1MHz	30 2.5			– –

ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
$E_{s/b}$	Second breakdown Un clamped energy	$V_{BE} = 20V$ $R_{BE} = 100\Omega$ $L = 30mH$	100			mJ
t_{on}	Turn-on time	$I_C = 1A$ $I_{B1} = 100mA$ $V_{CC} = 200V$		0.2		μs
t_{off}	Turn-off time	$I_C = 1A$ $I_{B1} = -I_{B2} = 100mA$ $V_{CC} = 200V$		2		μs

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

Safe operating areas



EPITAXIAL-BASE NPN/PNP

POWER DARLINGTONS

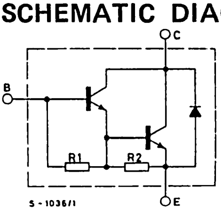
The TIP100, TIP101 and TIP102 are silicon epitaxial-base NPN transistors in monolithic Darlington configuration mounted in Jedec TO-220 plastic package, intended for use in power linear and switching applications. The complementary PNP types are the TIP105, TIP106 and TIP107 respectively.

ABSOLUTE MAXIMUM RATINGS

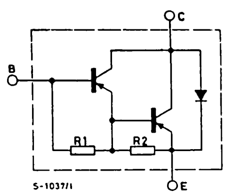
	NPN / PNP*	TIP100 / TIP105	TIP101 / TIP106	TIP101 / TIP107
V_{CBO}	Collector-base voltage ($I_E = 0$)	60V	80V	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	60V	80V	100V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		5V	
I_C	Collector current		8A	
I_{CM}	Collector peak current		15A	
I_B	Base current		1A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$		80W	
	$T_{amb} \leqslant 25°C$		2W	
T_{stg}	Storage temperature		-65 to 150°C	
T_j	Junction temperature		150°C	

* **For PNP types voltage and current values are negative**

INTERNAL SCHEMATIC DIAGRAMS



R1 Typ. 5KΩ
R2 Typ. 150Ω

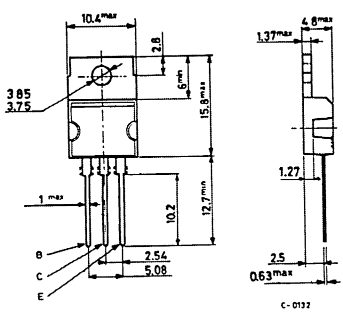


R1 Typ. 5KΩ
R2 Typ. 150Ω

MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

THERMAL DATA

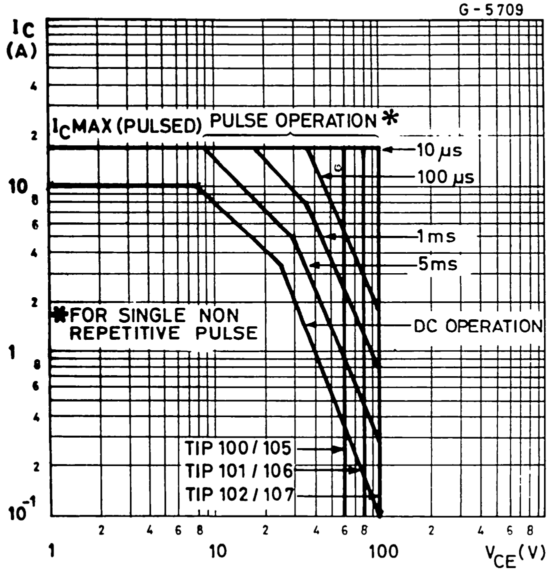
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1.56	°C/W
$R_{th\ j\text{-}amb}$	Thermal resistance junction-ambient	max	62.5	°C/W

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

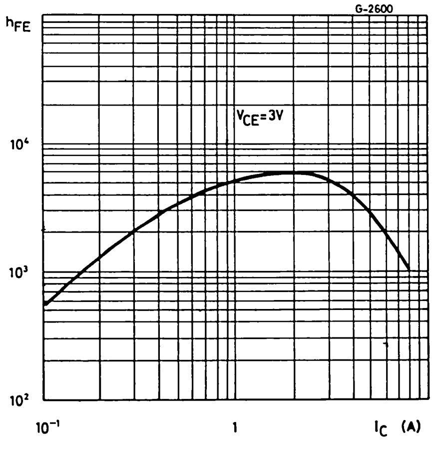
Parameter		Test conditions		Min	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B = 0$)	for **TIP100/105**	$V_{CE} = 30V$			50	μA
		for **TIP101/106**	$V_{CE} = 40V$			50	μA
		for **TIP102/107**	$V_{CE} = 50V$			50	μA
I_{CBO}	Collector cutoff current ($I_E = 0$)	for **TIP100/105**	$V_{CB} = 60V$			50	μA
		for **TIP101/106**	$V_{CB} = 80V$			50	μA
		for **TIP102/107**	$V_{CB} = 100V$			50	μA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$				8	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 30mA$					
		for **TIP100/105**		60			V
		for **TIP101/106**		80			V
		for **TIP102/107**		100			V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C = 3A$	$I_B = 6mA$			2	V
		$I_C = 8A$	$I_B = 80mA$			2.5	V
V_{BE}*	Base-emitter voltage	$I_C = 8A$	$V_{CE} = 4V$			2.8	V
h_{FE}*	DC current gain	$I_C = 3A$	$V_{CE} = 4V$	1000		20000	–
		$I_C = 8A$	$V_{CE} = 4V$	200			–
V_F*	Forward voltage of commutation diode ($I_B = 0$)	$I_F = -I_C = 10A$				2.8	V

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

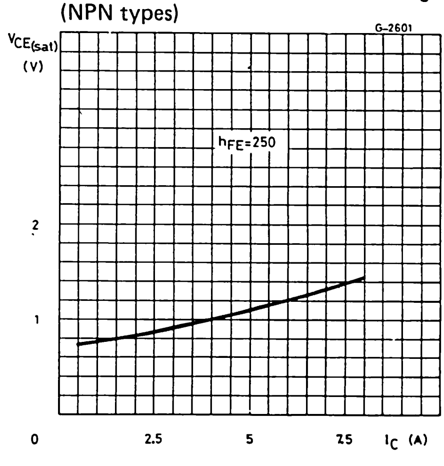
Safe operating areas



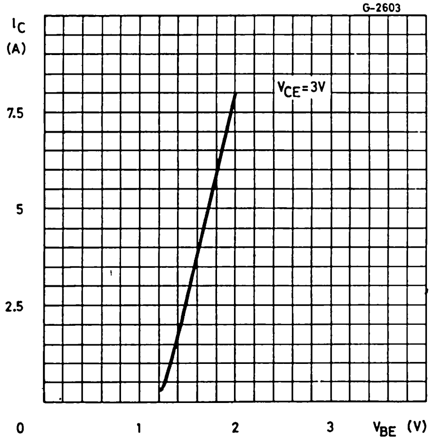
DC current gain (NPN types)



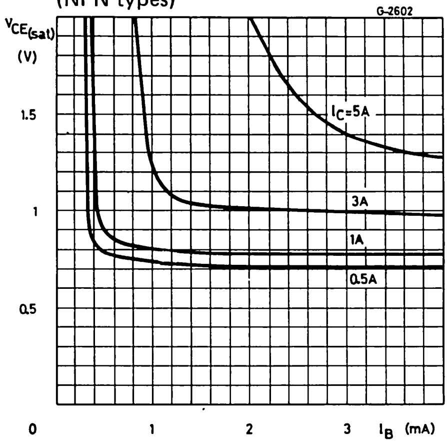
Collector-emitter saturation voltage (NPN types)



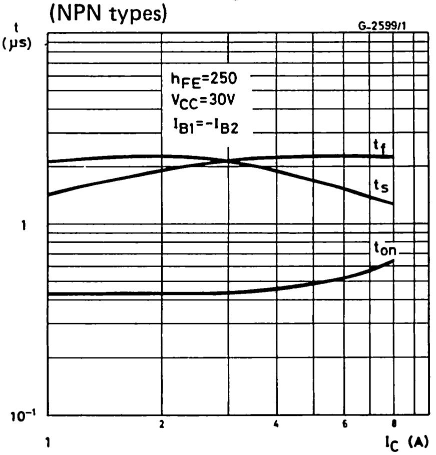
DC transconductance (NPN types)



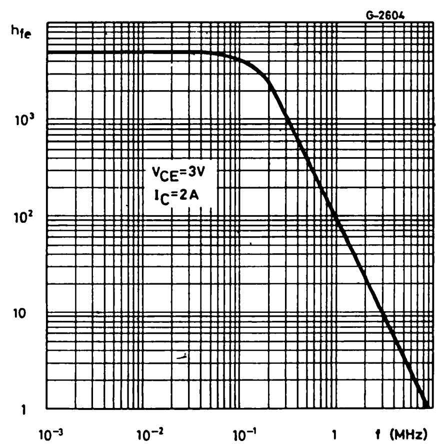
Collector-emitter saturation voltage (NPN types)



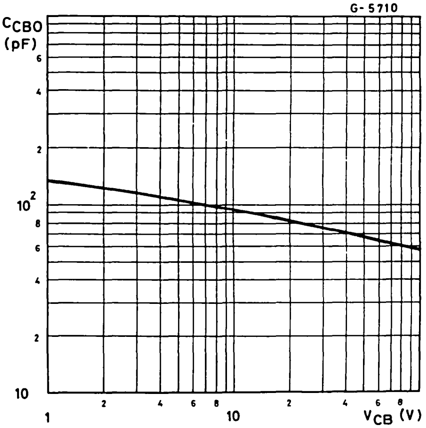
Saturated switching characteristics (NPN types)



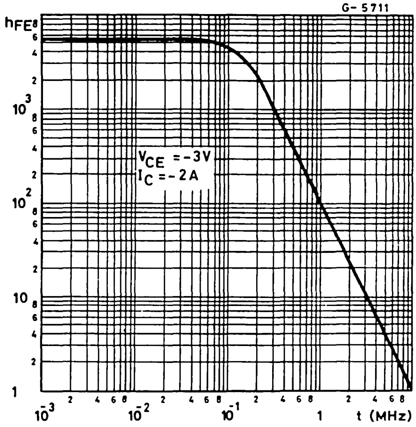
Small signal current gain (NPN types)



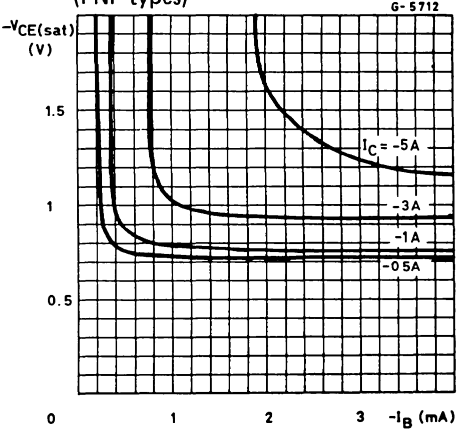
Collector-base capacitance (PNP types)



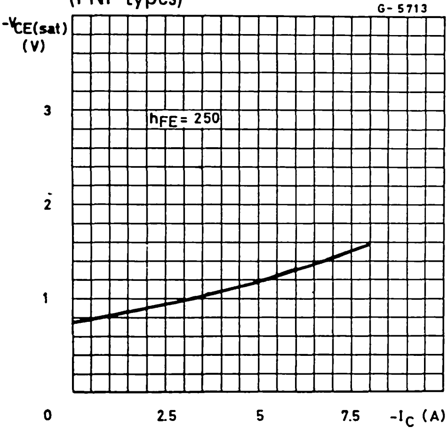
Small signal current gain (PNP types)



Collector-emitter saturation voltage (PNP types)

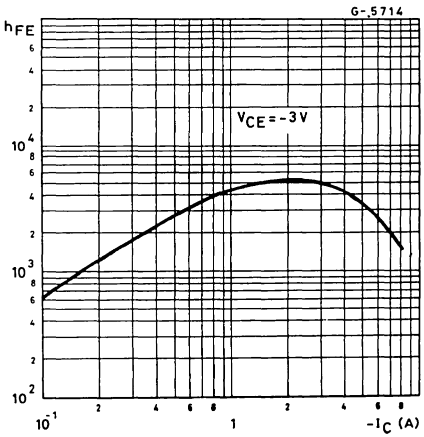


Collector-emitter saturation voltage (PNP types)

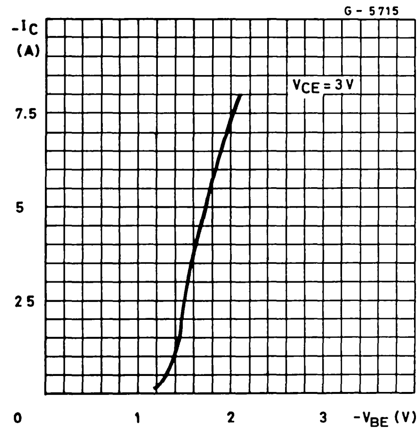


TIP100 TIP105
TIP101 TIP106
TIP102 TIP107

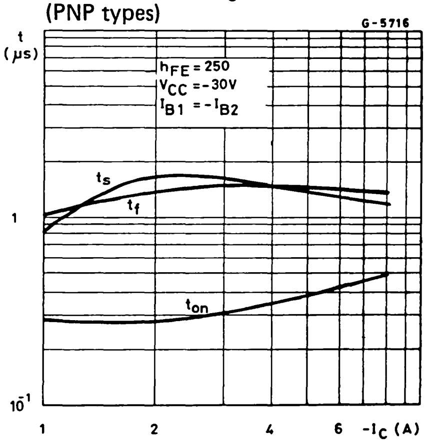
DC current gain (PNP types)



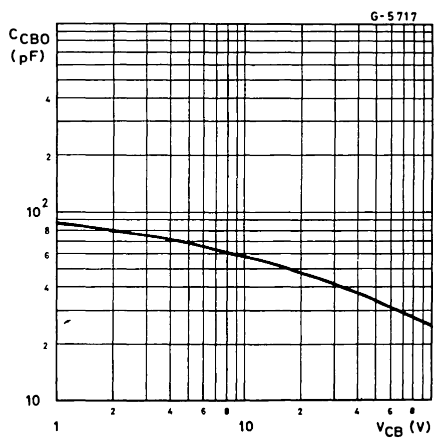
DC transconductance (PNP types)



Saturated switching characteristics (PNP types)



Collector-base capacitance (NPN types)



TIP/SGS110-115
TIP/SGS111-116
TIP/SGS112-117

EPITAXIAL-BASE NPN/PNP

POWER DARLINGTONS

The TIP110, TIP111, TIP112 and the 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 the SGS115, SGS116, SGS117 respectively.

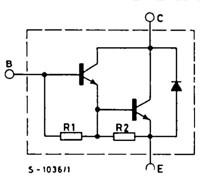
ABSOLUTE MAXIMUM RATINGS

		NPN	TIP110	TIP111	TIP112
		NPN	SGS110	SGS111	SGS112
		PNP	TIP115	TIP116	TIP117
		PNP	SGS115	SGS116	SGS117
V_{CBO}	Collector-base voltage ($I_E = 0$)		60V	80V	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)		60V	80V	100V
V_{EBO}	Emitter-base voltage ($I_C = 0$)			5V	
I_C	Collector current			2A	
I_{CM}	Collector peak current			4A	
I_B	Base current			50mA	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$			50W	
	$T_{amb} \leqslant 25°C$			2W	
T_{stg}	Storage temperature			-65 to 150°C	
T_j	Junction temperature			150°C	

For PNP types voltage and current values are negative.

INTERNAL SCHEMATIC DIAGRAMS

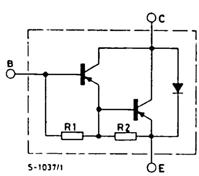
NPN



R1 ≅ 5KΩ
R2 ≅ 150Ω

S-1036/1

PNP

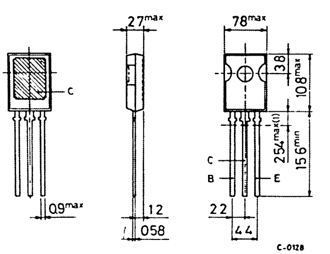


R1 ≅ 5KΩ
R2 ≅ 150Ω

S-1037/1

MECHANICAL DATA

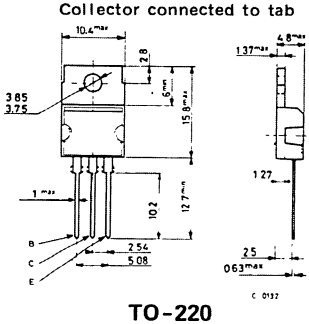
Dimensions in mm



(1) Within this region the cross-section of the leads is uncontrolled

SOT-82

Collector connected to tab



TO-220

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

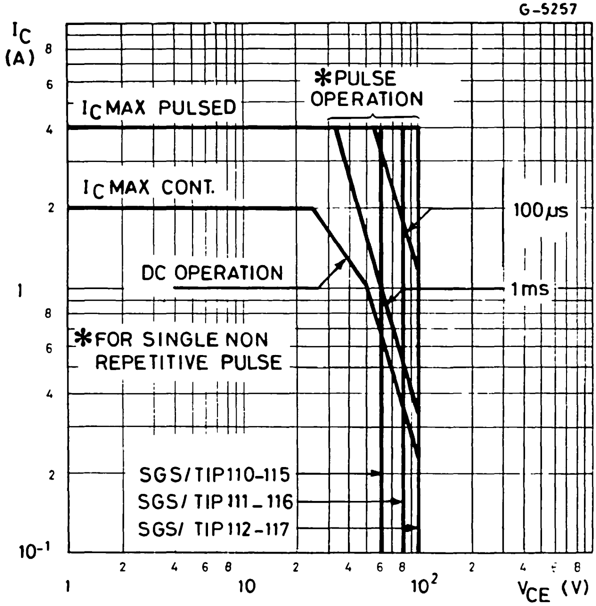
ELECTRICAL CHARACTERISTICS ($T_{case} = 25°C$ unless otherwise specified)

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 ($I_C = 0$)	$V_{EB} = 5V$			2	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 30mA$ 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	$I_C = 2A$ $I_B = 8mA$			2.5	V
V_{BE}*	Base-emitter voltage	$I_C = 2A$ $V_{CE} = 4V$			2.8	V
h_{FE}*	DC current gain	$I_C = 1A$ $V_{CE} = 4V$ $I_C = 2A$ $V_{CE} = 4V$	1000 500			— —

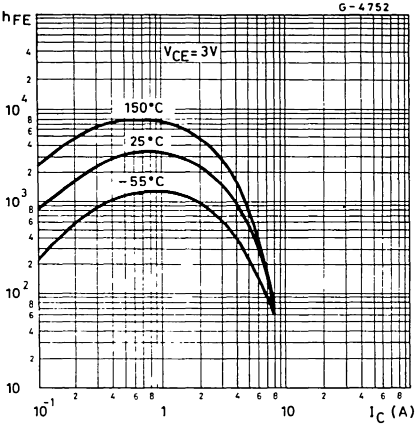
* Pulsed: pulse duration = 300μs, duty cycle ≤ 2%.

For PNP types voltage and current values are negative

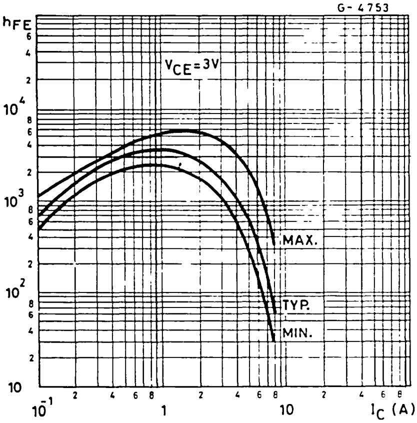
Safe operating areas



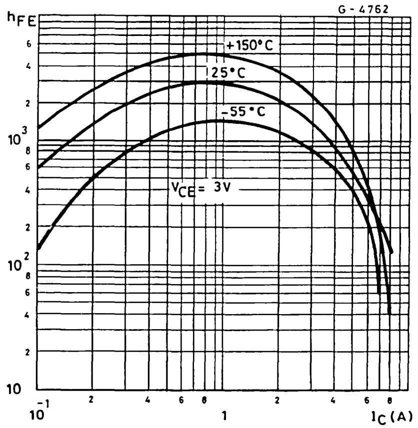
DC current gain (NPN types)



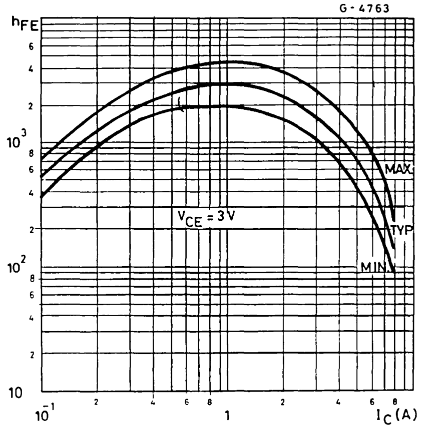
DC current gain (NPN types)



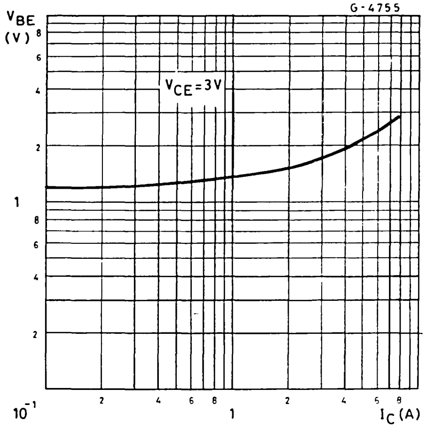
DC current gain (PNP types)



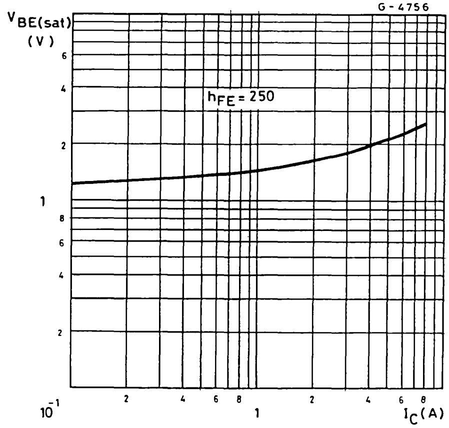
DC current gain (PNP types)



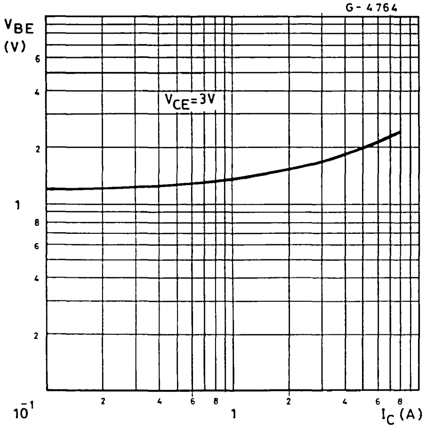
Base-emitter voltage (NPN types)



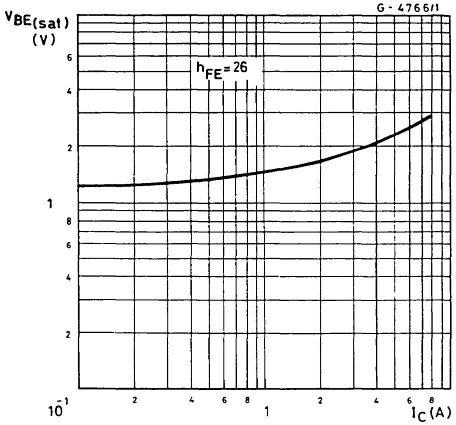
Base-emitter saturation voltage (NPN types)



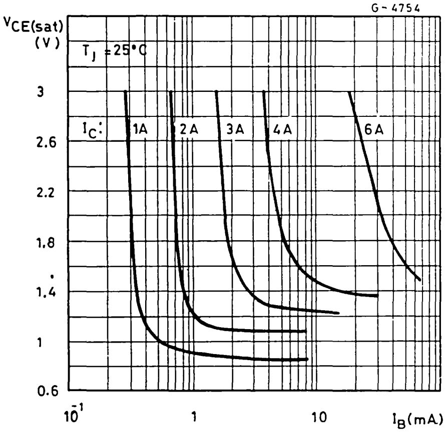
Base-emitter voltage (PNP types)



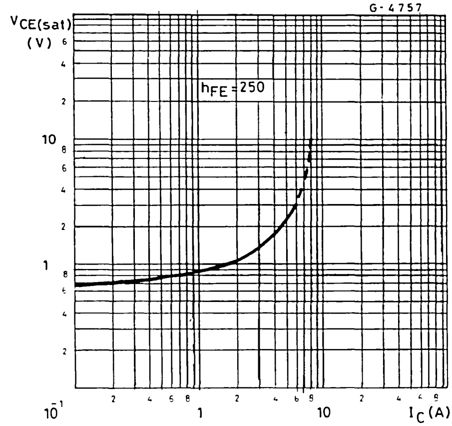
Base-emitter saturation voltage (PNP types)



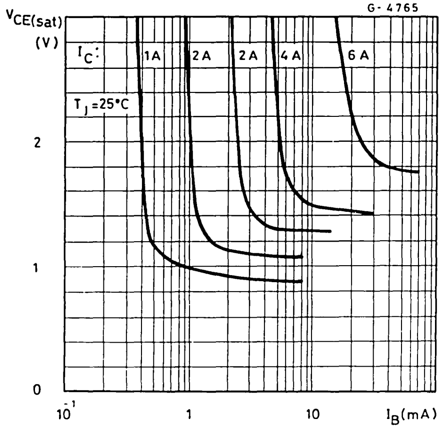
Collector-emitter saturation voltage (NPN types)



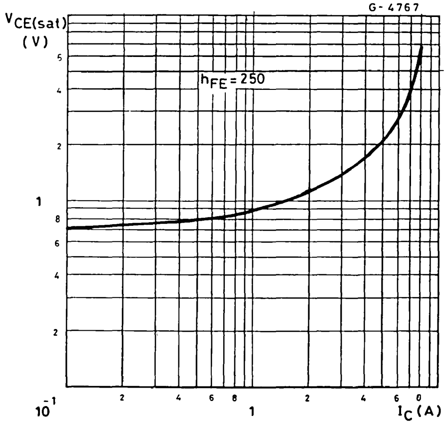
Collector-emitter saturation voltage (NPN types)



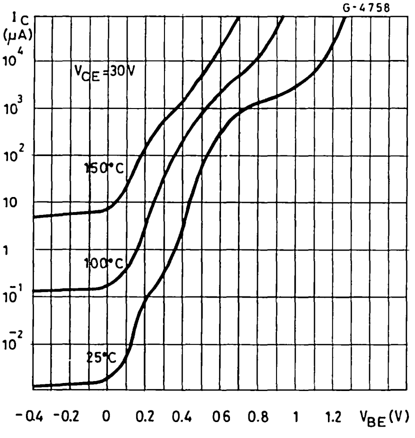
Collector-emitter saturation voltage (PNP types)



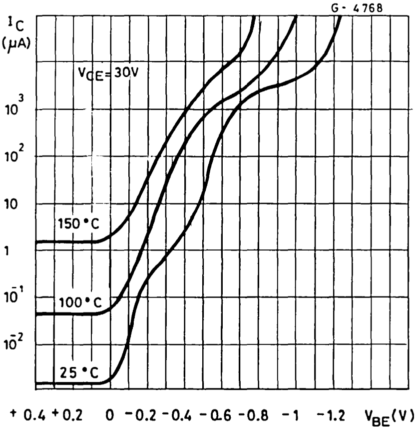
Collector-emitter saturation voltage (PNP types)



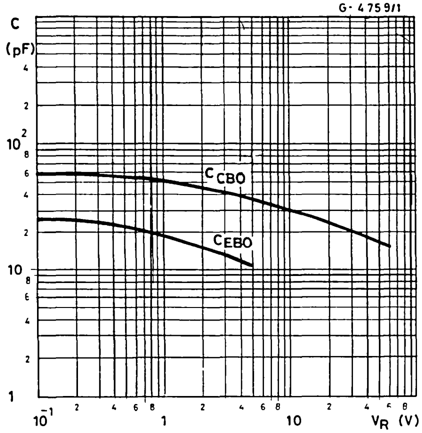
Collector cutoff current (NPN types)



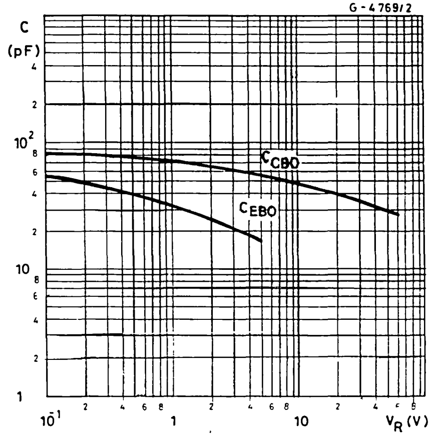
Collector cutoff current (PNP types)



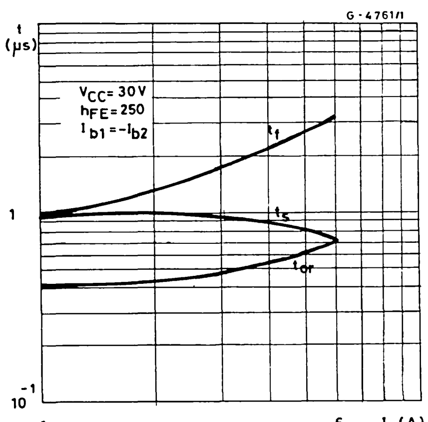
Capacitances (NPN types)



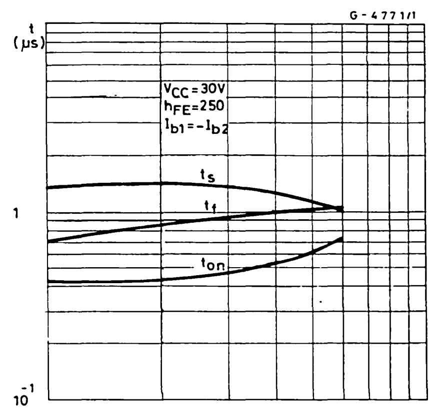
Capacitances (PNP types)



Saturated switching characteristics
(NPN types)



Saturated switching characteristics
(PNP types)



TIP120 TIP125
TIP121 TIP126
TIP122 TIP127

EPITAXIAL-BASE NPN/PNP

POWER DARLINGTONS

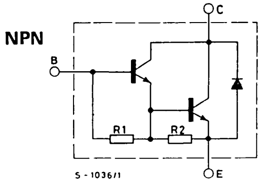
The TIP120, TIP121 and TIP122 are silicon epitáxial-base NPN transistors in monolithic Darlington configuration in Jedec TO-220 plastic package, intended for use in power linear and switching applications.
The complementary PNP types are the TIP125, TIP126 and TIP127 respectively.

ABSOLUTE MAXIMUM RATINGS

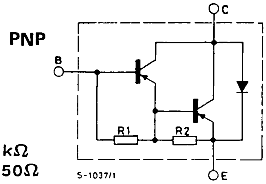
		NPN / PNP*	TIP120 / TIP125	TIP121 / TIP126	TIP122 / TIP127
V_{CBO}	Collector-base voltage ($I_E = 0$)		60V	80V	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)		60V	80V	100V
V_{EBO}	Emitter-base voltage ($I_C = 0$)			5V	
I_C	Collector current			5A	
I_{CM}	Collector peak current			8A	
I_B	Base current			0.1A	
P_{tot}	Total power dissipationa at $T_{case} \leqslant 25°C$			65W	
	$T_{amb} \leqslant 25°C$			2W	
T_{stg}	Storage temperature			-65 to 150°C	
T_j	Junction temperature			150°C	

*** For PNP types voltage and current values are negative.**

INTERNAL SCHEMATIC DIAGRAMS



R1 Typ. 5kΩ
R2 Typ. 150Ω

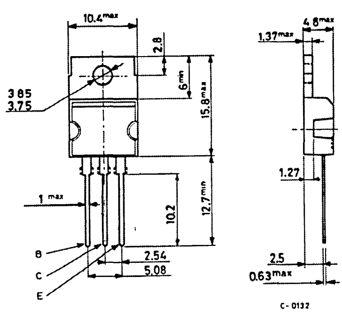


R1 Typ. 5kΩ
R2 Typ. 150Ω

MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

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

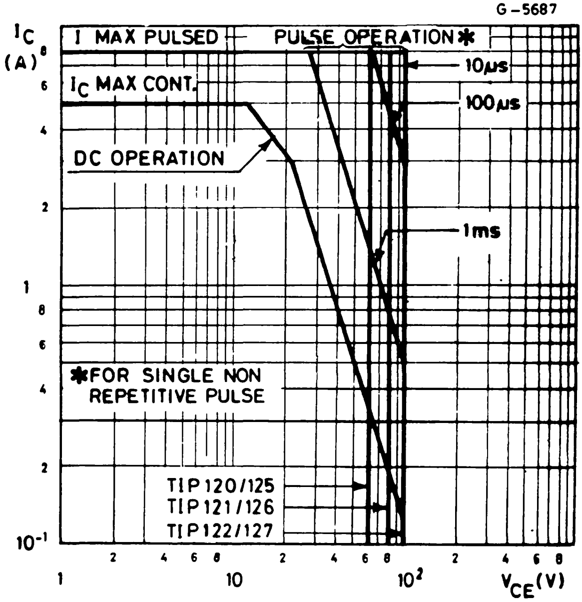
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B = 0$)	for **TIP120/5** $V_{CE} = 30V$ for **TIP121/6** $V_{CE} = 40V$ for **TIP122/7** $V_{CE} = 50V$			0.5 0.5 0.5	mA mA mA
I_{CBO}	Collector cutoff current ($I_E = 0$)	for **TIP120/5** $V_{CB} = 60V$ for **TIP121/6** $V_{CB} = 80V$ for **TIP122/7** $V_{CB} = 100V$			0.2 0.2 0.2	mA mA mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$			2	mA
$V_{CEO\,(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 30mA$ for **TIP120/5** for **TIP121/6** for **TIP122/7**	 60 80 100			 V V V
$V_{CE\,(sat)}$*	Collector-emitter saturation voltage	$I_C = 3A$ $I_B = 12mA$ $I_C = 5A$ $I_B = 20mA$			2 4	V V
$V_{BE\,(on)}$*	Base-emitter voltage	$I_C = 3A$ $V_{CE} = 3V$			2.5	V
h_{FE}*	DC current gain	$I_C = 0.5A$ $V_{CE} = 3V$ $I_C = 3A$ $V_{CE} = 3V$	1000 1000			– –

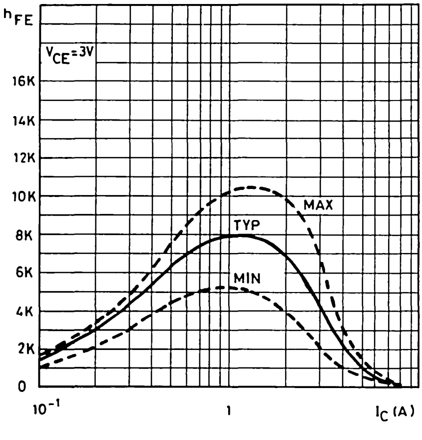
* Pulsed: pulse duration = 300μs, duty cycle ≤ 2%

SGS120 SGS125 SGS121 SGS126 SGS122 SGS127

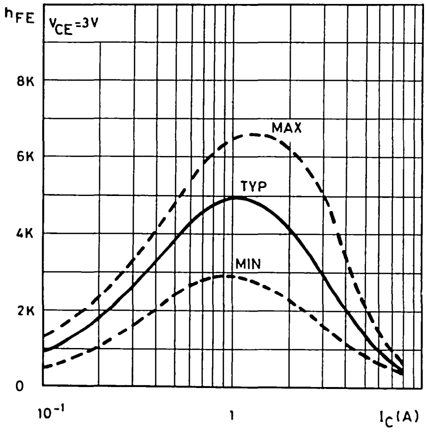
Safe operating areas



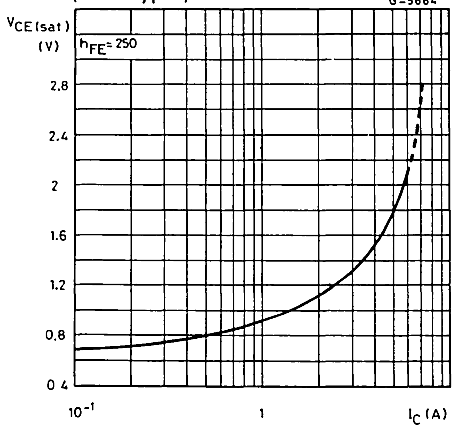
DC current gain (NPN types)



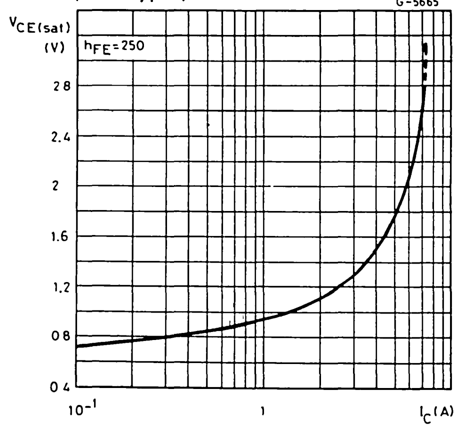
DC current gain (PNP types)



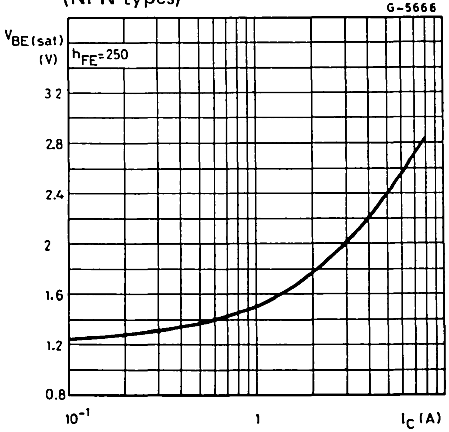
Collector-emitter saturation voltage
(NPN types)



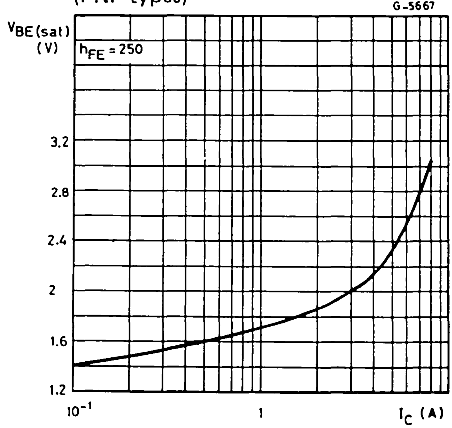
Collector-emitter saturation voltage
(PNP types)



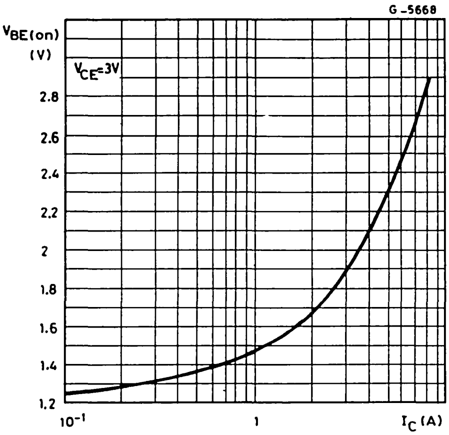
Base-emitter saturation voltage
(NPN types)



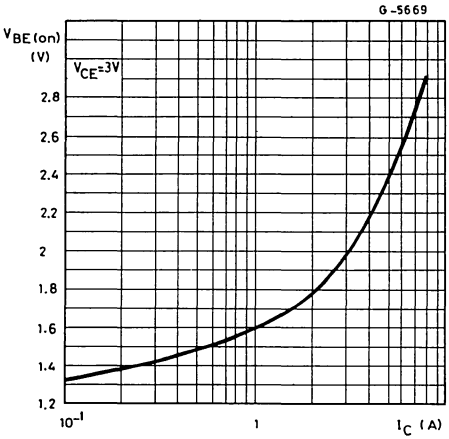
Base-emitter saturation voltage
(PNP types)



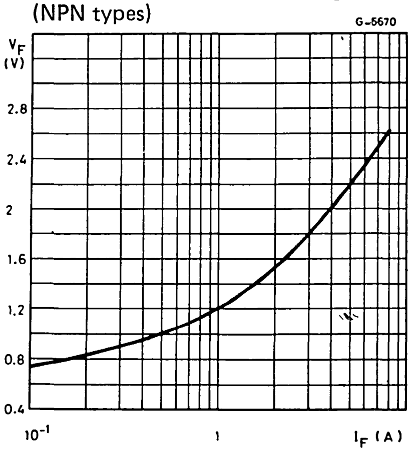
Base-emitter voltage (NPN types)



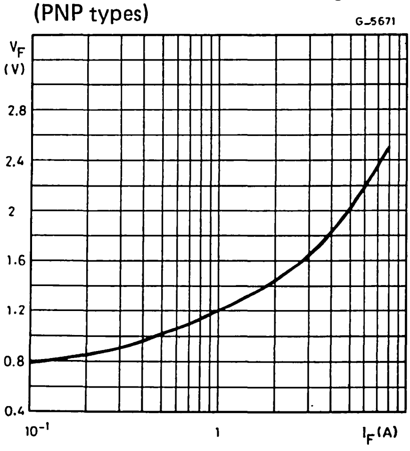
Base-emitter voltage (PNP types)



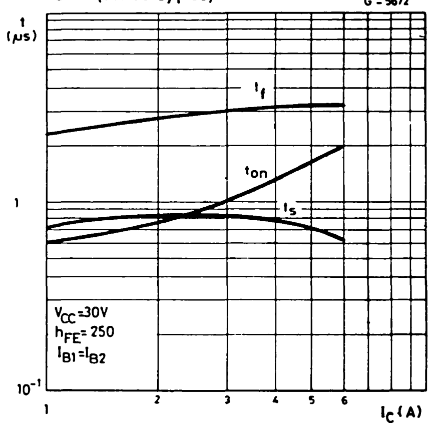
Freewheel diode forward voltage (NPN types)



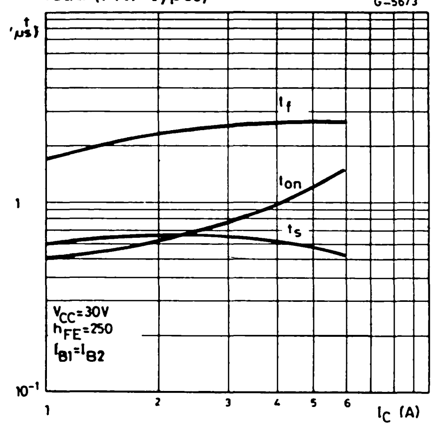
Freewheel diode forward voltage (PNP types)



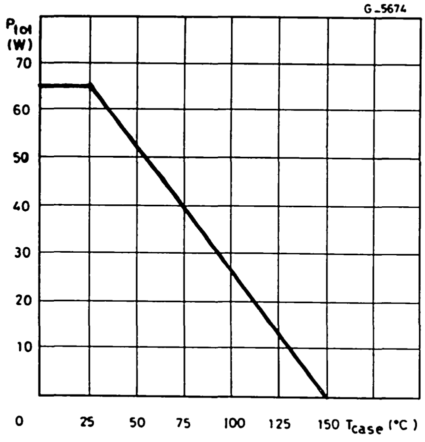
Switching times vs. T_{case} resistive load (NPN types)



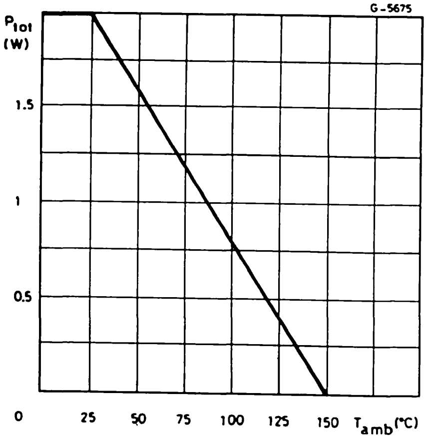
Switching times vs. T_{case} resistive load (PNP types)



Derating curve



Free-air temperature derating curve



TIP/SGS130-135
TIP/SGS131-136
TIP/SGS132-137

EPITAXIAL-BASE NPN/PNP

POWER DARLINGTONS

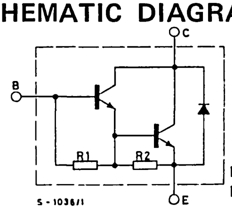
The TIP130, TIP131, TIP132 and the SGS130, SGS131, SGS132 are silicon epitaxial-base NPN transistors in monolithic Darlington configuration respectively in TO-220 and SOT-82 plastic package - They are intended for use in linear and switching applications. The complementary PNP types are the TIP135, TIP136, TIP137 and the SGS135, SGS136, SGS137 respectively.

ABSOLUTE MAXIMUM RATINGS

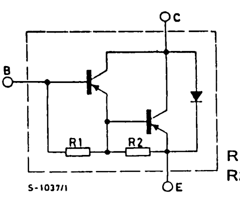
		NPN NPN PNP PNP	TIP130 SGS130 TIP135 SGS135	TIP131 SGS131 TIP136 SGS136	TIP132 SGS132 TIP137 SGS137
V_{CBO}	Collector-base voltage ($I_E = 0$)		60V	80V	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)		60V	80V	100V
V_{EBO}	Emitter-base voltage ($I_C = 0$)			5V	
I_C	Collector current			8A	
I_{CM}	Collector peak current			12A	
I_B	Base current			0.3A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$			70W	
	$T_{amb} \leqslant 25°C$			2W	
T_{stg}	Storage temperature			-65 to 150°C	
T_j	Junction temperature			150°C	

For PNP types voltage and current values are negative

INTERNAL SCHEMATIC DIAGRAMS



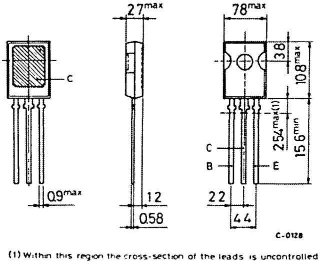
R1 ≅ 5KΩ
R2 ≅ 150Ω



R1 ≅ 5KΩ
R2 ≅ 150Ω

MECHANICAL DATA

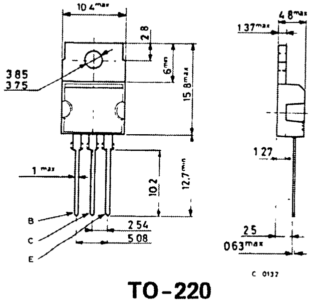
Dimensions in mm



(1) Within this region the cross-section of the leads is uncontrolled

SOT-82

Collector connected to tab



TO-220

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

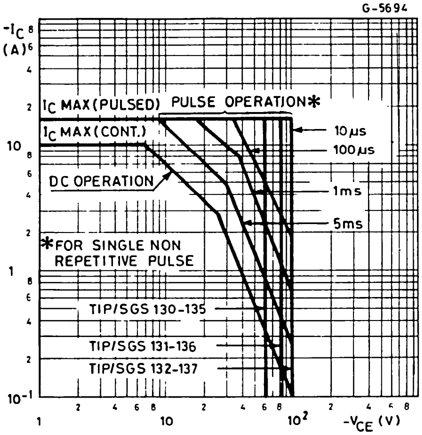
ELECTRICAL CHARACTERISTICS $T_{case} = 25°C$ unless otherwise specified)

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_{CBO} = rated V_{CBO}				0.2	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$				5	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 30mA$ 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	$I_C = 4A$ $I_C = 6A$	$I_B = 16mA$ $I_B = 30mA$			2 3	V V
V_{BE}*	Base-emitter voltage	$I_C = 4A$	$V_{CE} = 4V$			2.5	V
h_{FE}*	DC current gain	$I_C = 1A$ $I_C = 4A$	$V_{CE} = 4V$ $V_{CE} = 4V$	500 1000		 15000	– –

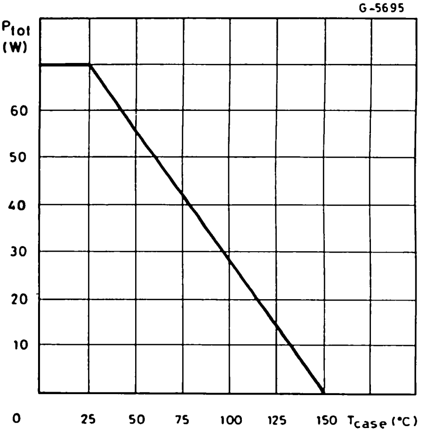
* Pulsed: pulse duration = 300μs, duty cycle $\leq$ 2%.
For PNP types voltage and current values are negative

TIP/SGS130-135
TIP/SGS131-136
TIP/SGS132-137

Safe operating areas



Power derating chart



For the others characteristics see TIP100/105 series

EPITAXIAL-BASE NPN/PNP

TIP140 TIP145
TIP141 TIP146
TIP142 TIP147

POWER DARLINGTONS

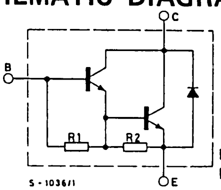
The TIP140, TIP141, TIP142 are silicon epitaxial base NPN transistors in monolithic Darlington configuration and are mounted in SOT-93 plastic package. They are intended for use in power linear and switching applications.
The complementary PNP types are TIP145, TIP146, TIP147 respectively.

ABSOLUTE MAXIMUM RATINGS

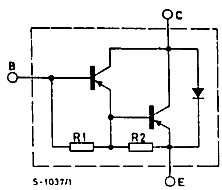
	NPN / *PNP	TIP140 / TIP145	TIP141 / TIP146	TIP142 / TIP147
V_{CBO}	Collector-base voltage ($I_E = 0$)	60V	80V	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	60V	80V	100V
V_{EBO}	Emitter base voltage ($I_C = 0$)		5V	
I_C	Collector current		10A	
I_{CM}	Collector peak current (repetitive)		20A	
I_B	Base current		0.5A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$		125W	
T_{stg}	Storage temperature		-65 to 150°C	
T_j	Junction temperature		150°C	

* For PNP types voltage and current values are negative.

INTERNAL SCHEMATIC DIAGRAMS



R1 ≅ 5KΩ
R2 ≅ 150Ω

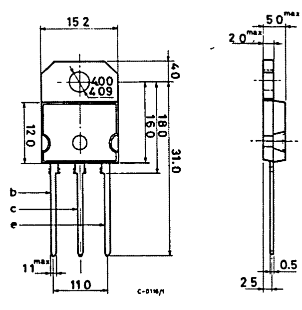


R1 ≅ 5KΩ
R2 ≅ 150Ω

MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



(sim. to **TO-218**) **SOT-93**

THERMAL DATA

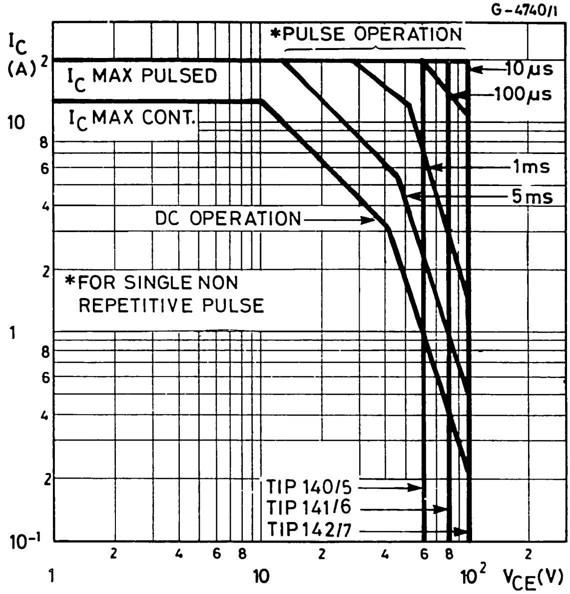
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1	°C/W

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

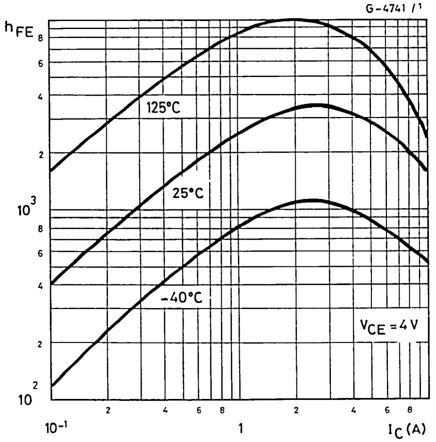
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	for **TIP140/5** V_{CB} = 60V for **TIP141/6** V_{CB} = 80V for **TIP142/7** V_{CB} = 100V			1 1 1	mA mA mA
I_{CEO}	Collector cutoff current ($I_B = 0$)	for **TIP140/5** V_{CB} = 30V for **TIP141/6** V_{CE} = 40V for **TIP142/7** V_{CE} = 50V			2 2 2	mA mA mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	V_{EBO} = 5V			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 = 5A I_B = 10 mA I_C = 10A I_B = 40 mA			2 3	V V
V_{BE} *	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}	Turn-on time	I_C = 10A I_{B1} = 40 mA I_{B2} = -40 mA R_L = 3Ω		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

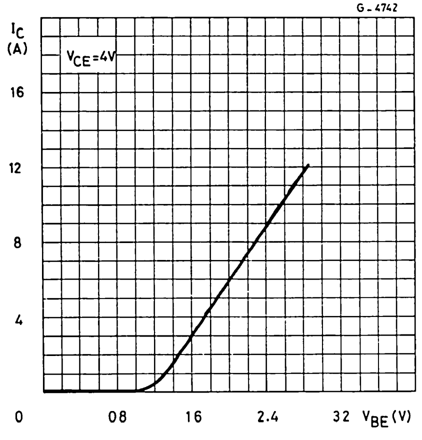
Safe operating areas



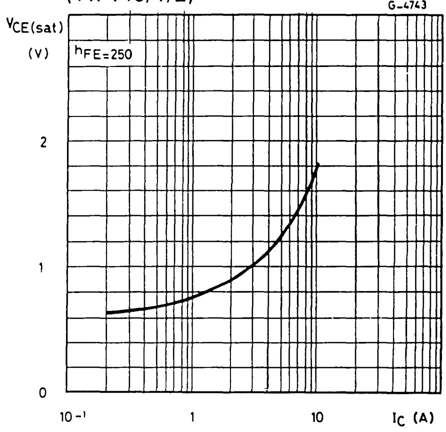
DC current gain (TIP140/1/2)



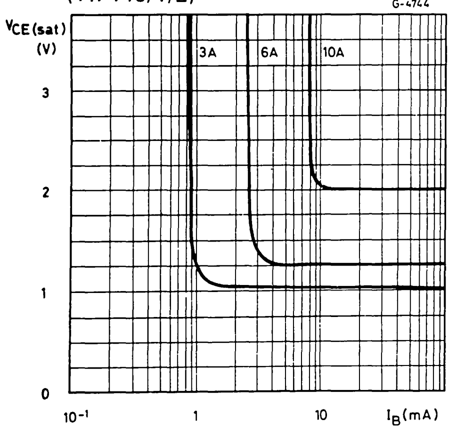
DC transconductance (TIP140/1/2)



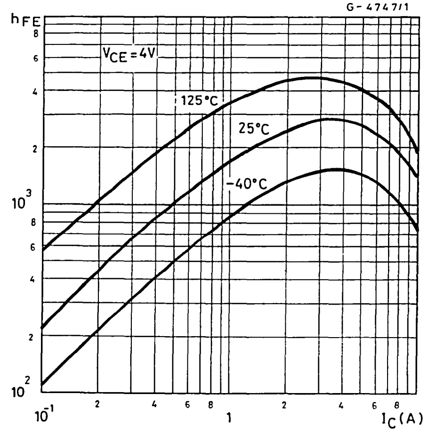
Collector-emitter saturation voltage (TIP140/1/2)



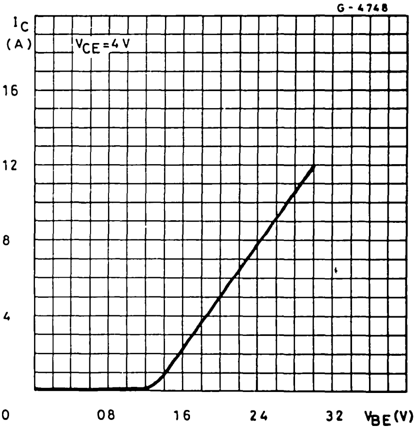
Collector-emitter saturation voltage (TIP140/1/2)



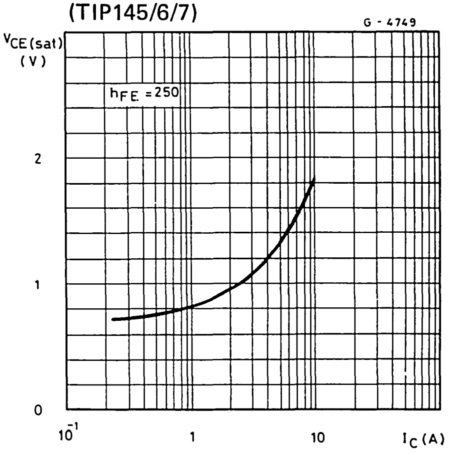
DC current gain (TIP145/6/7)



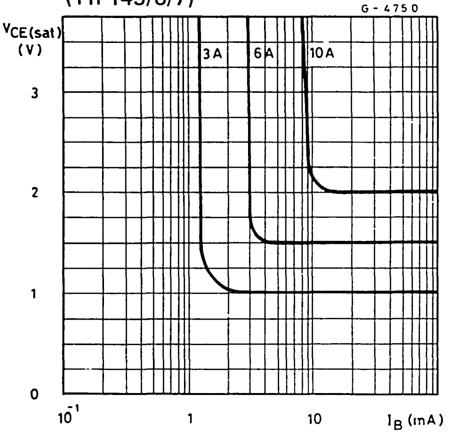
DC transconductance (TIP145/6/7)



Collector-emitter saturation voltage (TIP145/6/7)



Collector-emitter saturation voltage (TIP145/6/7)



2N3055

EPITAXIAL-BASE NPN

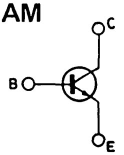
POWER LINEAR AND SWITCHING APPLICATIONS

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.

ABSOLUTE MAXIMUM RATINGS

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 $T_{case} \leqslant 25$ °C	115	W
T_{stg}	Storage temperature	-65 to 200	°C
T_j	Junction temperature	200	°C

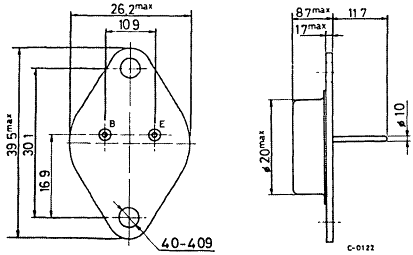
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

THERMAL DATA

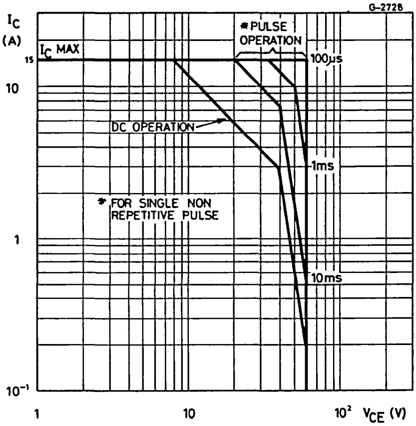
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1.5	°C/W

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

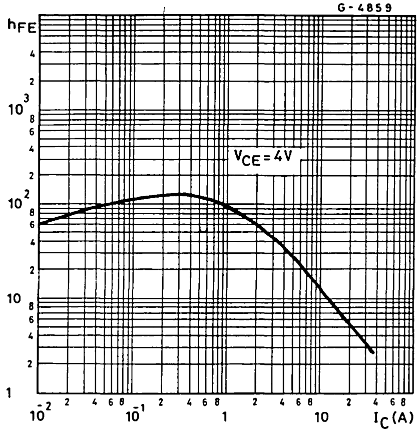
Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CEV}	Collector cutoff current (V_{BE} = -1.5V)	V_{CE} = 100 V V_{CE} = 100 V	 T_{case} = 150°C			1 5	mA mA
I_{CEO}	Collector cutoff current (I_B = 0)	V_{CE} = 30 V				0.7	mA
I_{EBO}	Emitter cutoff current (I_C = 0)	V_{EB} = 7 V				5	mA
$V_{CER\ (sus)}$*	Collector-emitter sust. voltage (R_{BE} = 100Ω)	I_C = 200 mA		70			V
$V_{CEO\ (sus)}$*	Collector-emitter sust. voltage (I_B = 0)	I_C = 200 mA		60			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	I_C = 4 A I_C = 10 A	I_B = 400mA I_B = 3.3A			1 3	V V
V_{BE}*	Base-emitter voltage	I_C = 4 A	V_{CE} = 4 V			1.5	V
h_{FE}*	DC current gain Group 4 Group 5 Group 6 Group 7	 I_C = 0.5 A I_C = 0.5 A I_C = 0.5 A I_C = 0.5 A I_C = 4 A I_C = 10 A	 V_{CE} = 4 V V_{CE} = 4 V V_{CE} = 4 V V_{CE} = 4 V V_{CE} = 4 V V_{CE} = 4 V	 20 35 60 120 20 5		 50 75 145 250 70	 — — — — — —
h_{FE1}/h_{FE2}*	Matched pair	I_C = 0.5 A	V_{CE} = 4 V			1.6	—
f_T	Transition frequency	I_C = 1 A	V_{CE} = 4 V	2.5			MHz
$I_{s/b}$**	Second breakdown collector current	V_{CE} = 40 V		2.87			A

* Pulsed: pulse duration = 300 μs, duty cycle = 1.5%
** Pulsed: 1s, non repetitive pulse

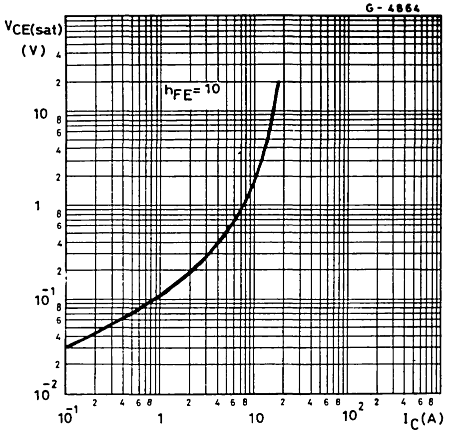
Safe operating areas



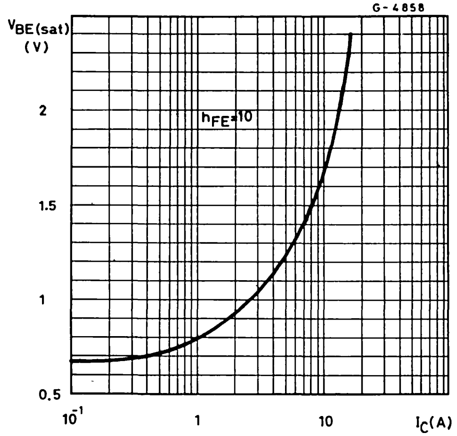
DC current gain



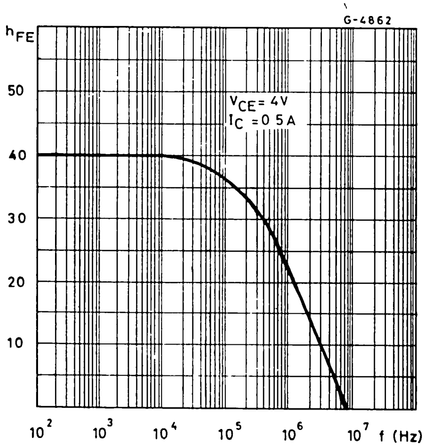
Collector-emitter saturation voltage



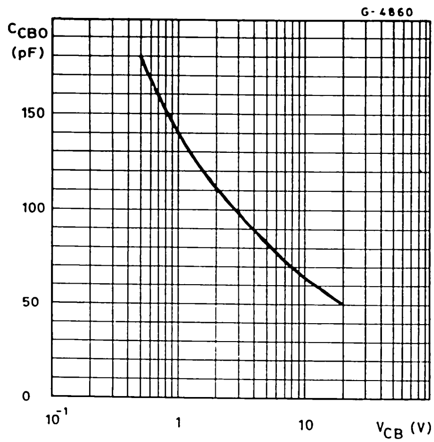
Base-emitter saturation voltage



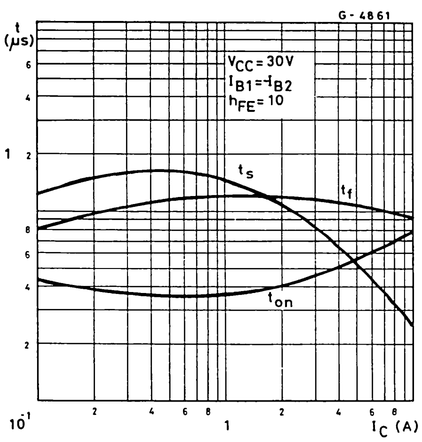
Small signal current gain



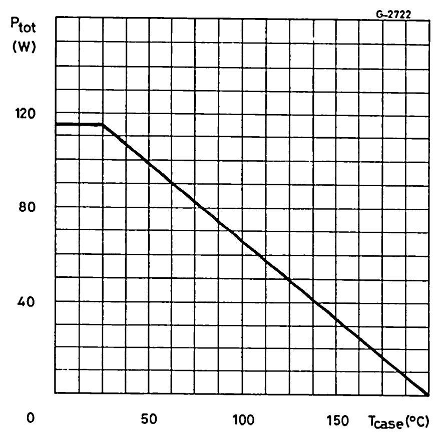
Collector-base capacitance



Saturated switching characteristics



Power rating chart



2N3439
2N3440

EPITAXIAL PLANAR NPN

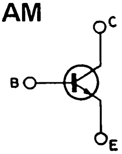
HIGH VOLTAGE TRANSISTORS

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.

ABSOLUTE MAXIMUM RATINGS

		2N3439	2N3440
V_{CBO}	Collector-base voltage ($I_E = 0$)	450V	300V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	350V	250V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	7V	
I_C	Collector current	1A	
I_B	Base current	0.5A	
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$	10W	
	$T_{amb} \leq 50°C$	1W	
T_{stg}	Storage temperature	-65 to 200°C	
T_j	Junction temperature	200°C	

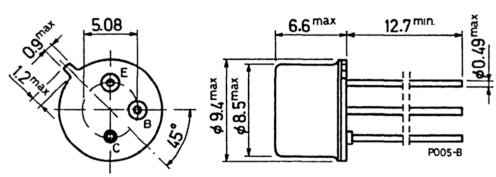
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-39

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

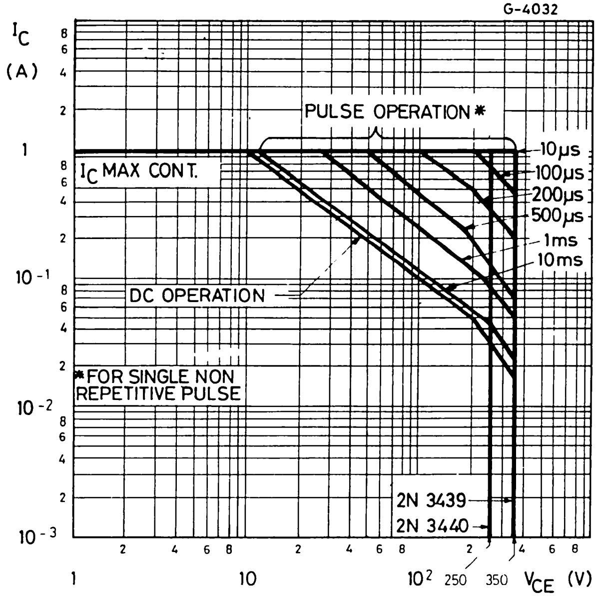
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

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

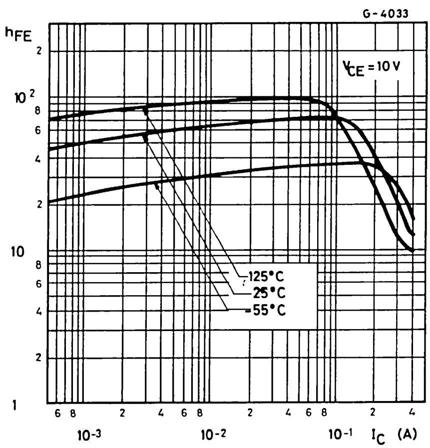
* Pulsed: pulse duration = 300 µs, duty cycle ≤ 2%

2N3439
2N3440

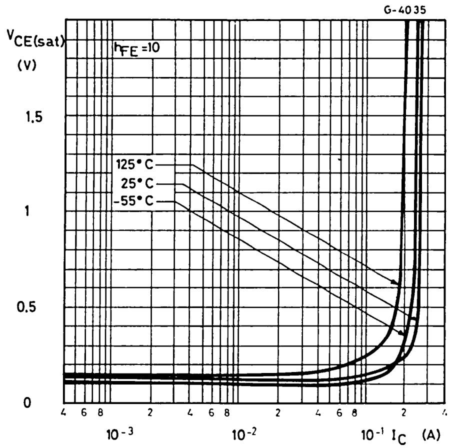
Safe operating areas



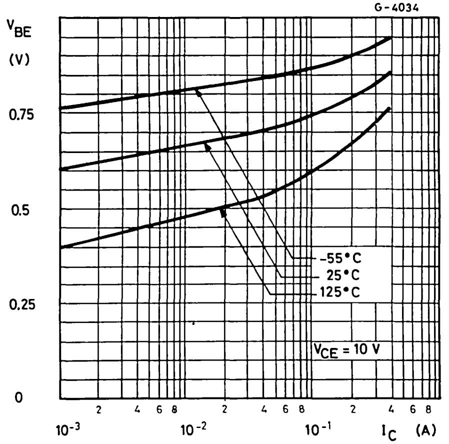
DC current gain



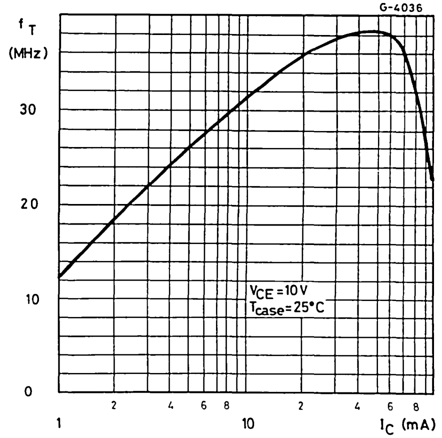
Collector-emitter saturation voltage



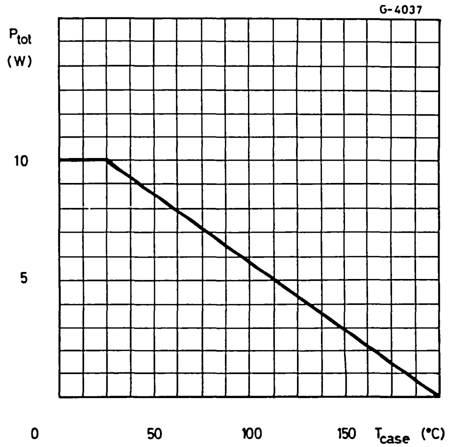
Base emitter voltage



Transition frequency



Power rating chart



2N3713 2N3789
2N3714 2N3790
2N3715 2N3791
2N3716 2N3792

EPITAXIAL-BASE NPN/PNP

POWER LINEAR AND SWITCHING APPLICATIONS

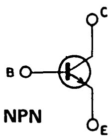
The 2N 3713, 2N 3714, 2N 3715 and 2N 3716 are silicon epitaxial-base NPN power transistors in Jedec TO-3 metal case. They are intended for use in power linear and switching applications.
The complementary PNP types are the 2N 3789, 2N 3790, 2N 3791 and 2N 3792 respectively.

ABSOLUTE MAXIMUM RATINGS

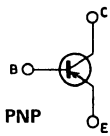
		PNP*	2N3789	2N3790
		PNP*	2N3791	2N3792
		NPN	2N3713	2N3714
		NPN	2N3715	2N3716
V_{CBO}	Collector-base voltage ($I_E = 0$)		80V	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)		60V	80V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		7V	
I_C	Collector current		10A	
I_B	Base current		4A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$		150W	
T_{stg}	Storage temperature		-65 to 200°C	
T_j	Junction temperature		200°C	

* For PNP types voltage and current values are negative

INTERNAL SCHEMATIC DIAGRAMS



NPN

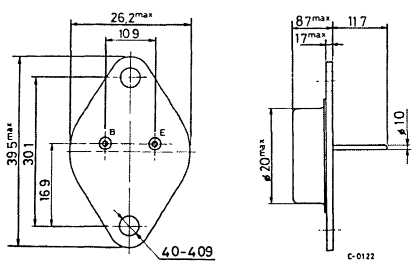


PNP

MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

THERMAL DATA

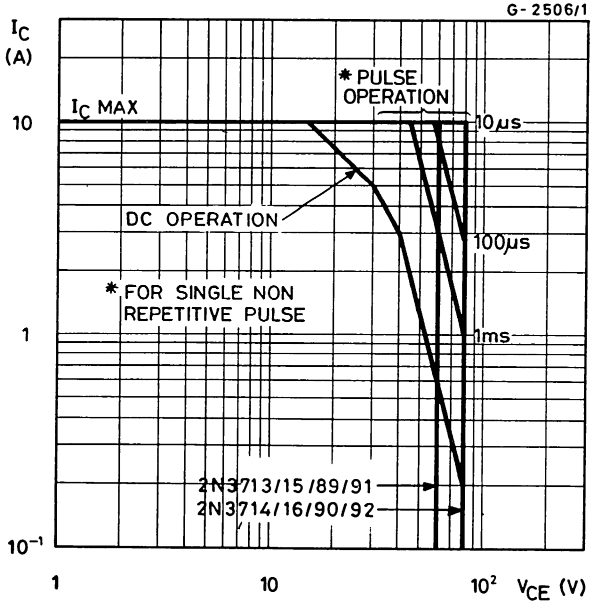
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1.17	°C/W

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

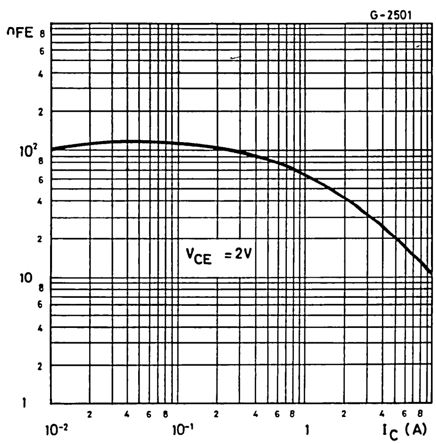
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEX}	Collector cutoff current ($V_{BE} = -1.5V$)	$V_{CE} = 80V$ for **2N3713/15/89/91**			1	mA
		$V_{CE} = 100V$ for **2N3714/16/90/92**			1	mA
		$T_{case} = 150°C$ $V_{CE} = 60V$ for **2N3713/15/89/91**			10	mA
		$V_{CE} = 80V$ for **2N3714/16/90/92**			10	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 7V$			5	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 200mA$ for **2N3713/15/89/91**	60			V
		for **2N3714/16/90/92**	80			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	$I_C = 5A$ $I_B = 0.5A$ for **2N3713/14/91/92**			1	V
		for **2N3715/16**			0.8	V
		$I_C = 4A$ $I_B = 0.5A$ for **2N3789/90**			1	V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	$I_C = 5A$ $I_B = 0.5A$ for **2N3713/14/89/90**			2	V
		for **2N3715/16/91/92**			1.5	V
V_{BE}*	Base-emitter volt.	$I_C = 3A$ $V_{CE} = 2V$			1.5	V
h_{FE}*	DC current gain	$I_C = 1A$ $V_{CE} = 3V$ for **2N3713/14/89/90**	25		90	–
		for **2N3715/16**	50		150	–
		for **2N3791/92**	50		180	–
		$I_C = 3A$ $V_{CE} = 2V$ for **2N3713/14/89/90**	15			–
		for **2N3715/16/91/92**	30			–
		$I_C = 10A$ $V_{CE} = 4V$	5			–
f_T	Transition freq.	$I_C = 0.5A$ $V_{CE} = 10V$	4			MHz

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

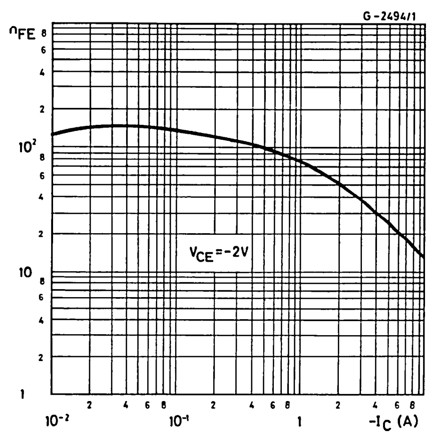
Safe operating areas



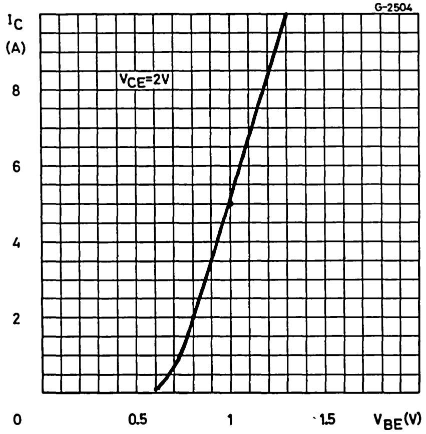
DC current gain (NPN types)



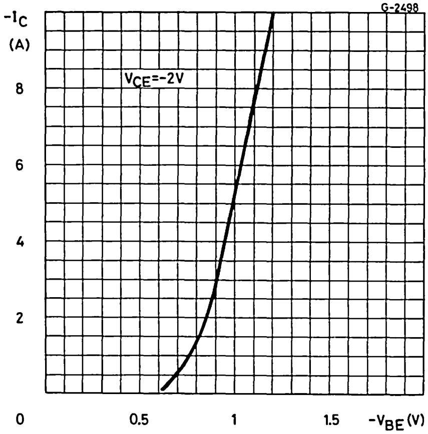
DC current gain (PNP types)



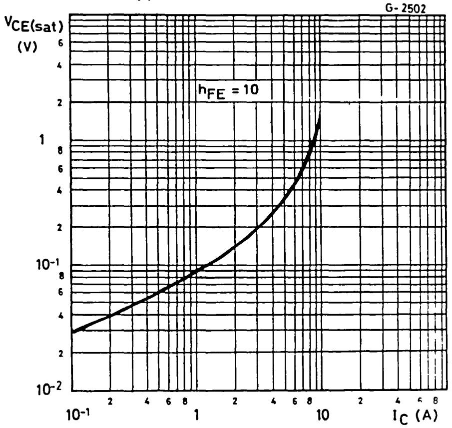
DC transconductance (NPN types)



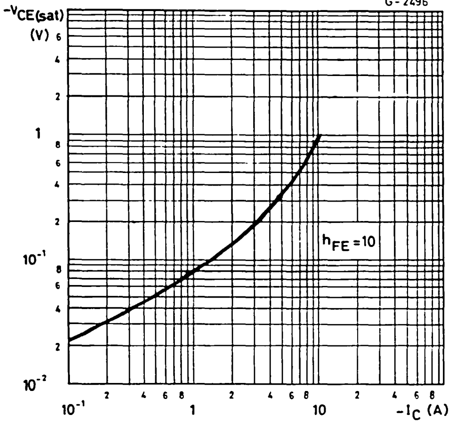
DC transconductance (PNP types)



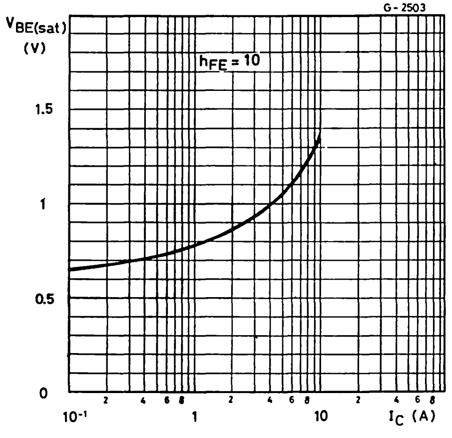
Collector-emitter saturation voltage (NPN types)



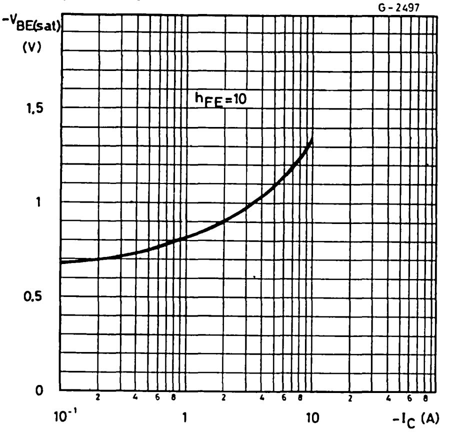
Collector-emitter saturation voltage (PNP types)



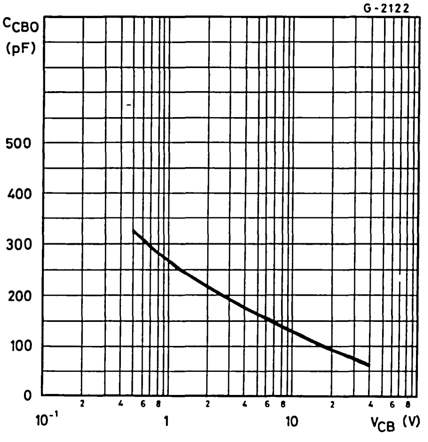
Base-emitter saturation voltage
(NPN types)



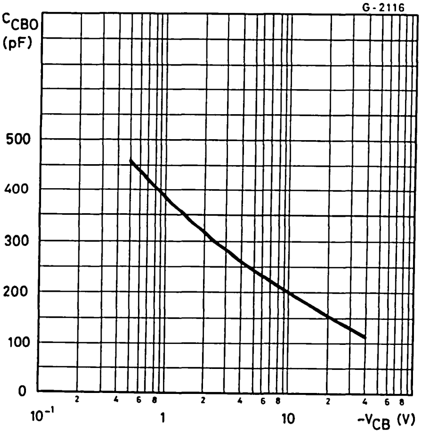
Base-emitter saturation voltage
(PNP types)



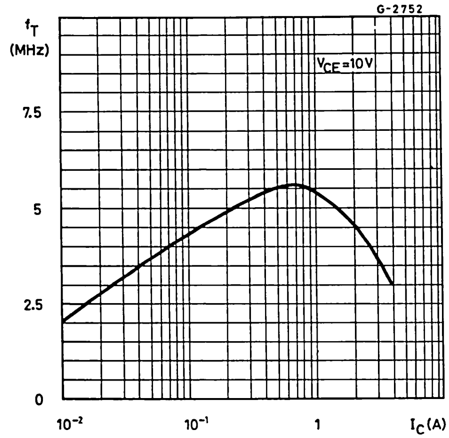
Collector-base capacitance (NPN types)



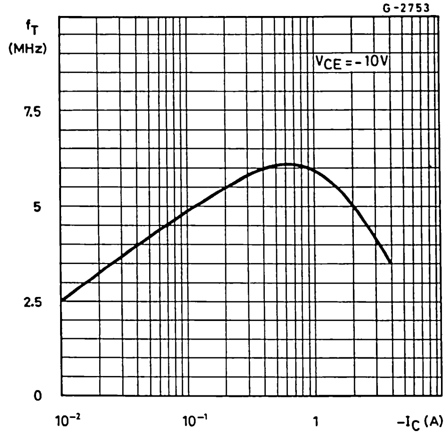
Collector-base capacitance (PNP types)



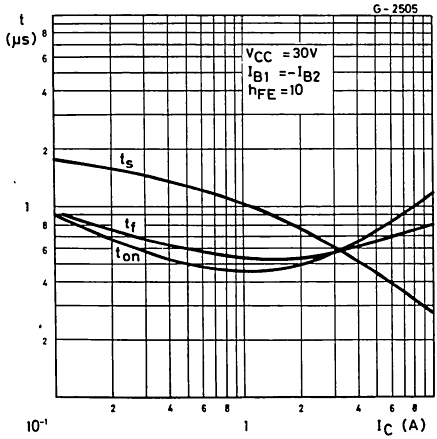
Transition frequency (NPN types)



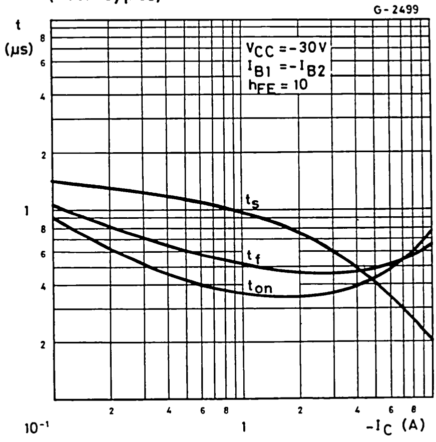
Transition frequency (PNP types)



Saturated switching characteristics (NPN types)



Saturated switching characteristics (PNP types)



2N3771
2N3772

EPITAXIAL-BASE NPN

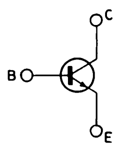
HIGH POWER TRANSISTORS

The 2N3771 and 2N3772 are silicon epitaxial-base transistors mounted in Jedec TO-3 metal case. They are intended for linear amplifiers and inductive switching applications.

ABSOLUTE MAXIMUM RATINGS

		2N3771	2N3772
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	40V	60V
V_{CEV}	Collector-emitter voltage ($V_{BE} = -1.5V$)	50V	80V
V_{CBO}	Collector-base voltage ($I_E = 0$)	50V	100V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5V	7V
I_C	Collector current	15A	10A
I_{CM}	Collector peak current	30A	30A
I_B	Base current	7.5A	5A
I_{BM}	Base peak current	15A	15A
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	150W	
T_{stg}	Storage temperature	−65 to 200°C	
T_j	Junction temperature	200°C	

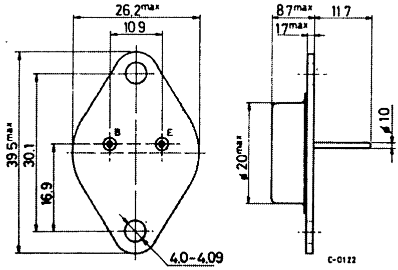
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

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)

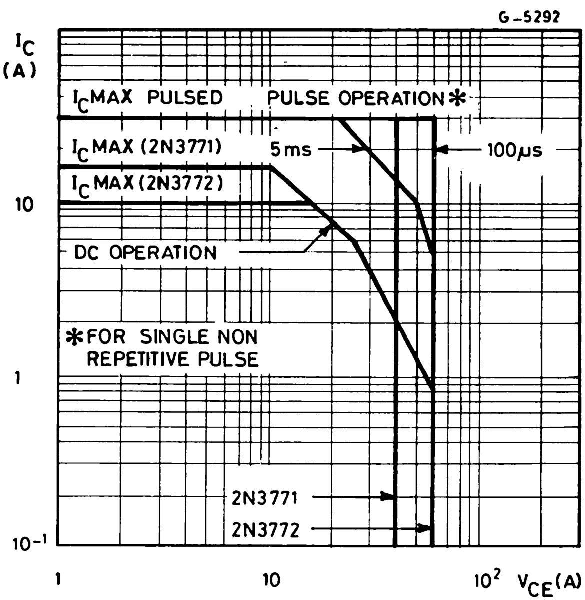
Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B = 0$)	for **2N3771** for **2N3772**	$V_{CE} = 30V$ $V_{CE} = 50V$			10 10	mA mA
I_{CEV}	Collector cutoff current ($V_{BE} = -1.5V$)	for **2N3771** for **2N3772** for All $T_{case} = 150°C$	$V_{CE} = 50V$ $V_{CE} = 100V$ $V_{CE} = 30V$			2 5 10	mA mA mA
I_{CBO}	Collector cutoff current ($I_E = 0$)	for **2N3771** for **2N3772**	$V_{CB} = 50V$ $V_{CB} = 100V$			4 5	mA mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	for **2N3771** for **2N3772**	$V_{EB} = 5V$ $V_{EB} = 7V$			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 ($V_{EB} = -1.5V$)	$I_C = 0.2A$ for **2N3771** for **2N3772**	$R_{BE} = 100\Omega$	 50 80			 V V
$V_{CER(sus)}$*	Collector-emitter sustaining voltage ($R_{BE} = 100\Omega$)	$I_C = 0.2A$ for **2N3771** for **2N3772**		 45 70			 V V
h_{FE}*	DC current gain	for **2N3771** $I_C = 15A$ $I_C = 30A$ for **2N3772** $I_C = 10A$ $I_C = 20A$	 $V_{CE} = 4V$ $V_{CE} = 4V$ $V_{CE} = 4V$ $V_{CE} = 4V$	 15 5 15 5		 60 60 	 — — — —
V_{BE}*	Base-emitter voltage	for **2N3771** $I_C = 15A$ for **2N3772** $I_C = 10A$	 $V_{CE} = 4V$ $V_{CE} = 4V$			 2.7 2.2	 V V

ELECTRICAL CHARACTERISTICS (Continued)

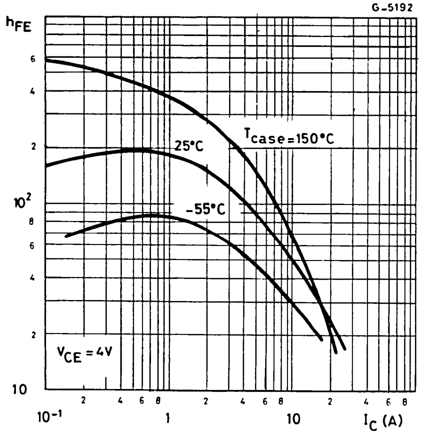
	Parameter	Test conditions	Min. Typ. Max.	Unit
$V_{CE(sat)}$*	Collector-emitter saturation voltage	for **2N3771** $I_C = 15A$ $I_B = 1.5A$ $I_C = 30A$ $I_B = 6A$ for **2N3772** $I_C = 10A$ $I_B = 1A$ $I_C = 20A$ $I_B = 4A$	 2 4 1.4 4	 V V V V
f_T	Transition frequency	$I_C = 1A$ $V_{CE} = 4V$; $f = 50KHz$	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	$V_{CE} = 25V$ $t = 1s$ (non ripetitive)	6	A

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

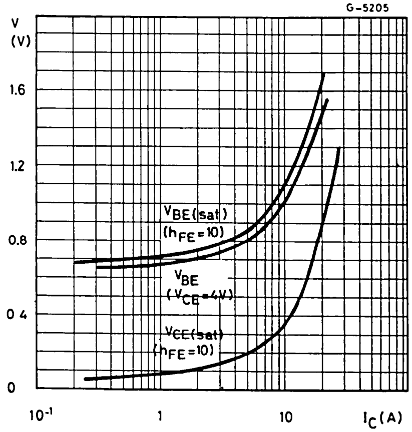
Safe operating areas



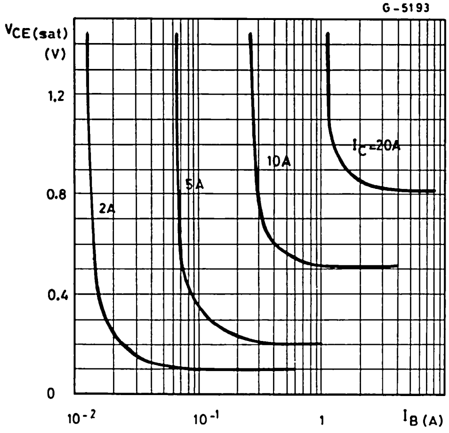
DC current gain



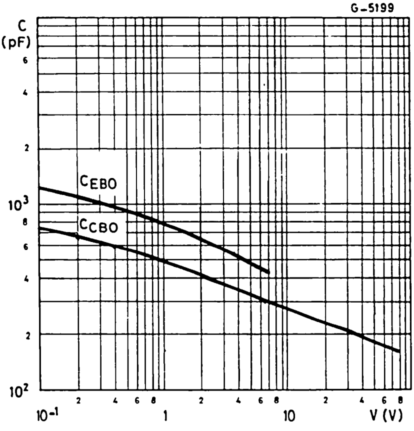
Saturation voltage



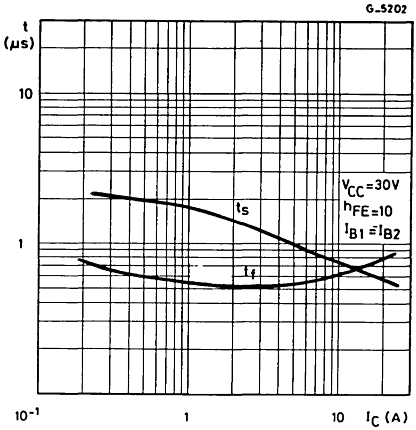
Collector-emitter saturation voltage



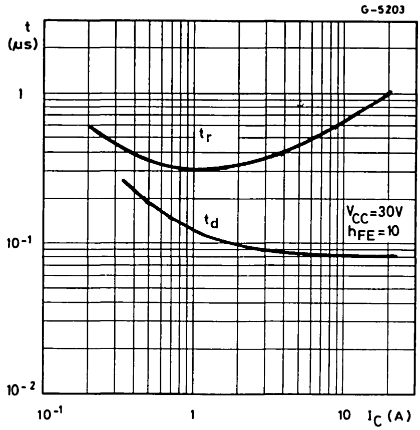
Capacitances



Turn-off time



Turn-on time



EPITAXIAL PLANAR PNP

2N4234
2N4235
2N4236

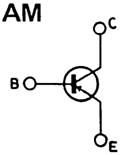
MEDIUM POWER GENERAL PURPOSE TRANSISTORS

The 2N4234, 2N4235 and 2N4236 are silicon epitaxial planar PNP transistors in Jedec TO-39 metal case.
They are intended for use in switching and amplifier applications.
The complementary NPN types are the 2N4237, 2N4238 and 2N4239 respectively.

ABSOLUTE MAXIMUM RATINGS

		2N4234	2N4235	2N4236
V_{CBO}	Collector-base voltage ($I_E = 0$)	−40V	−60V	−80V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	−40V	−60V	−80V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		−7V	
I_C	Collector current		−3A	
I_B	Base current		−0.2A	
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$		6W	
	$T_{amb} \leq 25°C$		1W	
T_{stg}	Storage temperature		−65 to 200°C	
T_j	Junction temperature		200°	

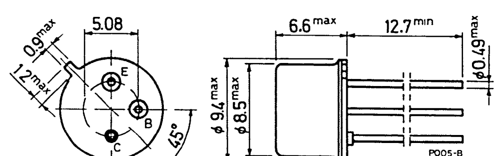
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-39

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)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	for **2N4234** $V_{CE} = -40V$			–0.1	mA
		for **2N4235** $V_{CE} = -60V$			–0.1	mA
		for **2N4236** $V_{CE} = -80V$			–0.1	mA
I_{CEV}	Collector cutoff current ($V_{BE} = 1.5$)	for **2N4234** $V_{CE} = -40V$			–0.1	mA
		for **2N4235** $V_{CE} = -60V$			–0.1	mA
		for **2N4236** $V_{CE} = -80V$			–0.1	mA
		$T_{case} = 150°C$				
		for **2N4234** $V_{CE} = -30V$			–1	mA
		for **2N4235** $V_{CE} = -40V$			–1	mA
		for **2N4236** $V_{CE} = -60V$			–1	mA
I_{CEO}	Collector cutoff current ($I_B = 0$)	for **2N4234** $V_{CE} = -30V$			–1	mA
		for **2N4235** $V_{CE} = -40V$			–1	mA
		for **2N4236** $V_{CE} = -60V$			–1	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{BE} = 7V$			–0.5	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = -100mA$				
		for **2N4234**	–40			V
		for **2N4235**	–60			V
		for **2N4236**	–80			V

ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions		Min.	Typ.	Max.	Unit
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	$I_C = -1A$	$I_B = -100\ mA$			−0.6	V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	$I_C = -1A$	$I_B = -100mA$			−1.5	V
V_{BE}*	Base-emitter voltage	$I_C = -0.25A$	$V_{CE} = -1V$			−1.0	V
h_{FE}*	DC current gain	$I_C = -100mA$	$V_{CE} = -1V$	40			—
		$I_C = -250mA$	$V_{CE} = -1V$	30		150	—
		$I_C = -500mA$	$V_{CE} = -1V$	20			—
		$I_C = -1A$	$V_{CE} = -1V$	10			—
f_T	Transition frequency	$I_C = -100mA$ $f = 1MHz$	$V_{CE} = -10V$	3			MHz
C_{CBO}	Collector-base capacitance	$I_E = 0$ $f = 100KHz$	$V_{CB} = -10V$			100	pF
h_{fe}	Small signal current gain	$I_C = -50mA$ $f = 1KHz$	$V_{CE} = -10V$	25			—

* Pulsed: pulse duration = 300μs, duty cycle $\leqslant$2%

2N4895
2N4896
2N4897

EPITAXIAL PLANAR NPN

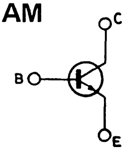
HIGH CURRENT, FAST SWITCHING APPLICATIONS

The 2N 4895, 2N 4896 and 2N 4897 are silicon expitaxial planar NPN transistors in Jedec TO-39 metal case.
They are intended for high current, fast switching applications and for power amplifiers.

ABSOLUTE MAXIMUM RATINGS

		2N4895	2N4896	2N4897
V_{CBO}	Collector-base voltage ($I_E = 0$)	120V	120V	150V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	60V	60V	80V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		6V	
I_C	Collector current		5A	
P_{tot}	Total power dissipation at $T_{amb} \leq 25°C$		1W	
	$T_{case} \leq 25°C$		7W	
	$T_{case} \leq 100°C$		4W	
T_{stg}	Storage temperature		-65 to 200 °C	
T_j	Junction temperature		200 °C	

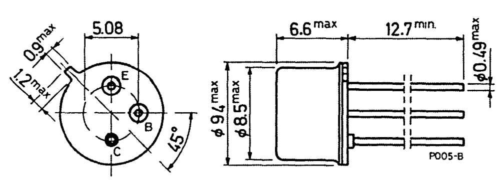
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-39

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

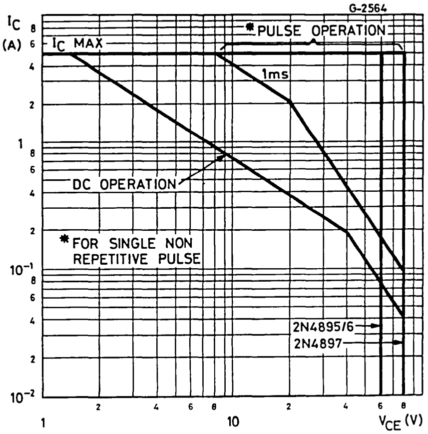
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current ($V_{BE}=0$)	for **2N4895** and **2N4896**				
		V_{CE} = 120V			1	mA
		V_{CE} = 60V			1	μA
		V_{CE} = 60V T_{case} = 150°C			100	μA
		for **2N4897**				
		V_{CE} = 150V			1	mA
		V_{CE} = 100V			1	μA
		V_{CE} = 100V T_{case} = 150°C			100	μA
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 = 50 mA				
		for **2N4895** and **2N4896**	60			V
		for **2N4897**	80			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	I_C = 5 A I_B = 0.5 A			1	V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	I_C = 5 A I_B = 0.5 A			1.6	V
h_{FE}*	DC current gain	I_C = 2 A V_{CE} = 2 V				
		for **2N4895** and **2N4897**	40		120	—
		for **2N4896**	100		300	—
		I_C = 2 A V_{CE} = 2 V T_{case} = -55°C				
		for **2N4895** and **2N4897**	15			—
		for **2N4896**	35			—
f_T	Transition frequency	I_C = 0.5A V_{CE} = 5 V				
		for **2N4895** and **2N4897**	50			MHz
		for **2N4896**	80			MHz
C_{CBO}	Collector-base capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz			80	pF
t_{on}	Turn-on time	I_C = 5 A V_{CC} = 20V I_{B1} = 0.5 A			0.35	μs
t_s	Storage time	I_C = 5 A V_{CC} = 20V I_{B1} = $-I_{B2}$ = 0.5A			0.35	μs
t_f	Fall time				0.3	μs

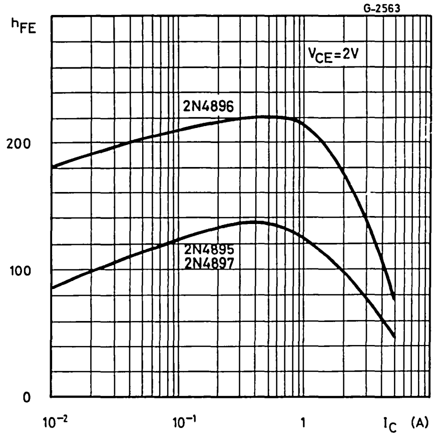
* Pulsed: pulse duration = 300 μs, duty cycle = 1.5%

2N4895
2N4896
2N4897

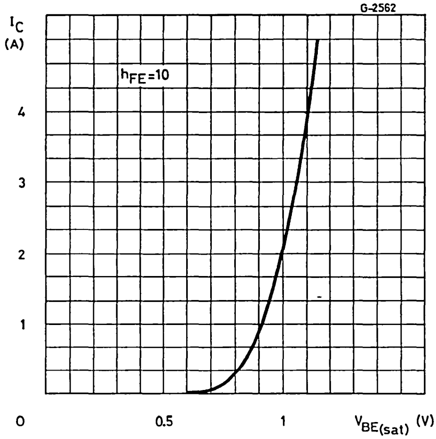
Safe operating areas



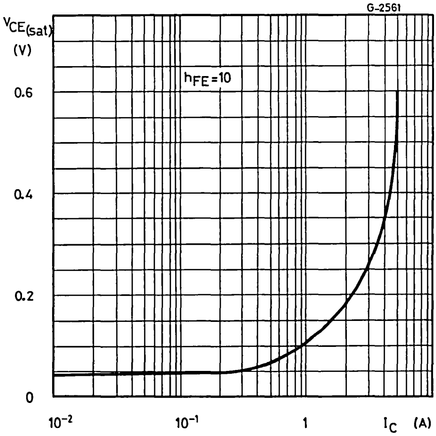
DC current gain



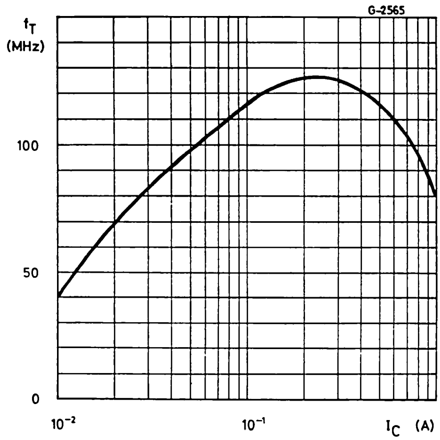
DC transconductance



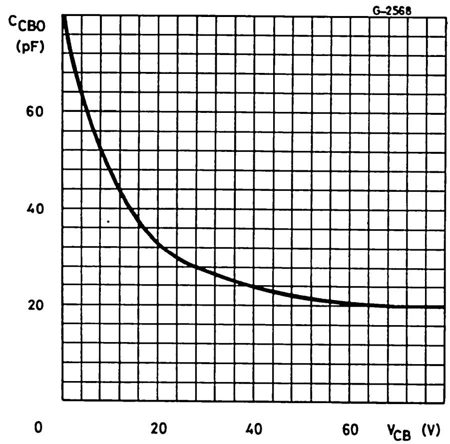
Collector-emitter saturation voltage



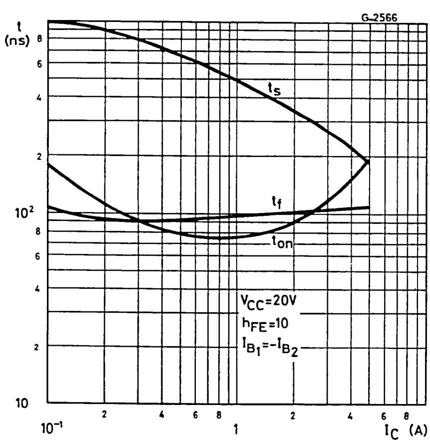
Transition frequency



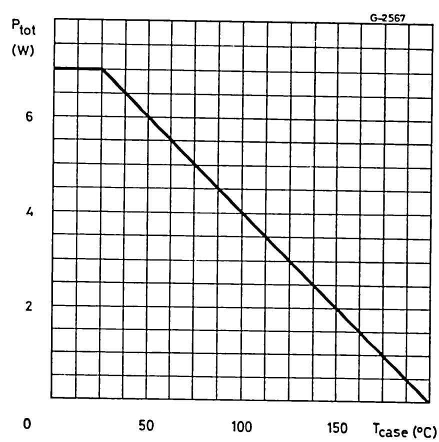
Collector-base capacitance



Saturated switching characteristics



Power rating chart



2N4918 2N4921
2N4919 2N4922
2N4920 2N4923

EPITAXIAL PLANAR NPN/PNP

PRELIMINARY DATA

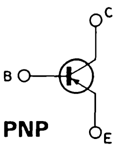
MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

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.

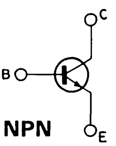
ABSOLUTE MAXIMUM RATINGS		PNP / NPN	2N4918 / 2N4921	2N4919 / 2N4922	2N4920 / 2N4923
V_{CEO}	Collector-emitter voltage ($I_B = 0$)		40V	60V	80V
V_{CBO}	Collector-base voltage ($I_E = 0$)		40V	60V	80V
V_{EBO}	Emitter-base voltage ($I_C = 0$)			5V	
I_C	Collector current			1A	
I_{CM}	Collector peak current			3A	
I_B	Base current			1A	
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$			30W	
T_{stg}	Storage temperature			−65 to 150°C	
T_j	Junction temperature			150°C	

For PNP types voltage and current values are negative

INTERNAL SCHEMATIC DIAGRAMS



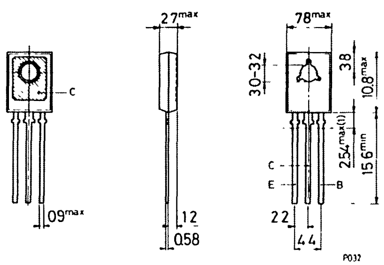
PNP



NPN

MECHANICAL DATA

Dimensions in mm



(1) Within this region the cross-section of the leads is uncontrolled

TO-126 (SOT-32)

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)

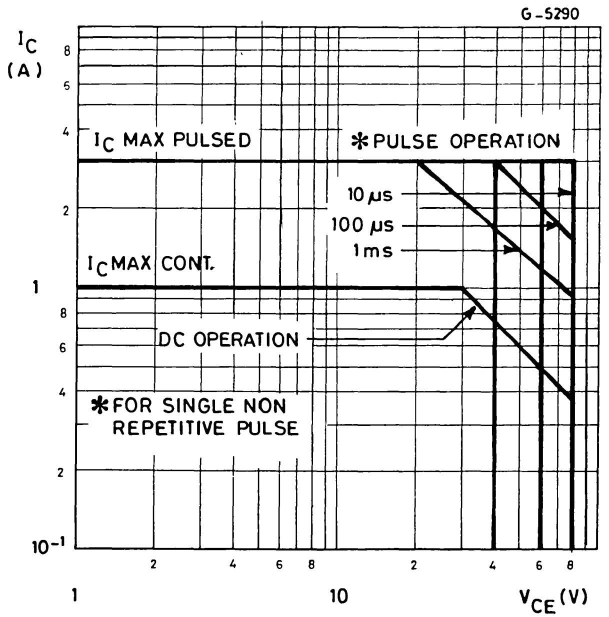
	Parameter	Test conditions		Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_{BO}=0$)	V_{CE}=half rated V_{CEO}				0.5	mA
I_{CEX}	Collector cutoff current ($V_{BE}=-1.5V$)	V_{CE}=rated V_{CEO}				0.1	mA
		V_{CE}=rated V_{CEO} $T_{case}=125°C$				0.5	mA
I_{CBO}	Collector cutoff current ($I_E=0$)	V_{CE}= rated V_{CBO}				0.1	mA
I_{EBO}	Emitter cutoff current ($I_C=0$)	$V_{EB}=5V$				1	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage	$I_C=0.1A$					
		for **2N4918, 2N4921**		40			V
		for **2N4919, 2N4922**		60			V
		for **2N4920, 2N4923**		80			V
h_{FE}*	DC current gain	$I_C=$ 50mA	$V_{CE}=1V$	40			—
		$I_C=500mA$	$V_{CE}=1V$	30		150	—
		$I_C=1A$	$V_{CE}=1V$	10			—
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C=1A$	$I_B=0.1A$			0.6	V

ELECTRICAL CHARACTERISTICS (Continued)

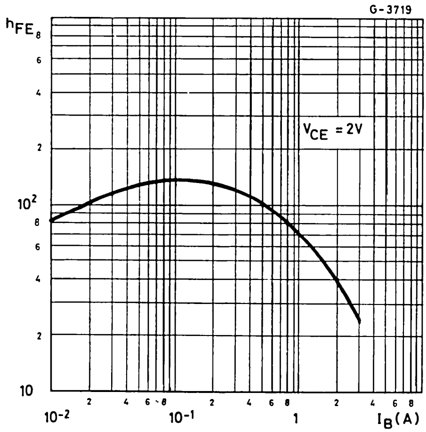
Parameter		Test conditions		Min.	Typ.	Max.	Unit
$V_{BE(sat)}$*	Base-emitter saturation voltage	$I_C = 1A$	$I_B = 0.1A$			1.3	V
V_{BE}*	Base emitter voltage	$I_C = 1A$	$V_{CE} = 1V$			1.3	V
f_T	Transition frequency	$I_C = 250mA$ $f = 1MHz$	$V_{CE} = 10V$	3			MHz
C_{CBO}	Collector-base capacitance	$V_{CB} = 10V$ $f = 100KHz$	$I_E = 0$			100	pF
h_{fe}	Small signal current gain	$I_C = 250mA$ $f = 1KHz$	$V_{CE} = 10V$	25			—

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

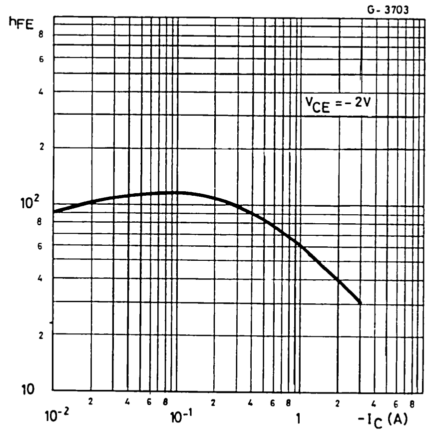
Safe operating areas



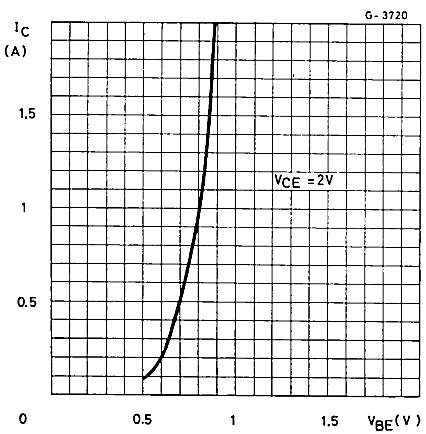
DC current gain (NPN types)



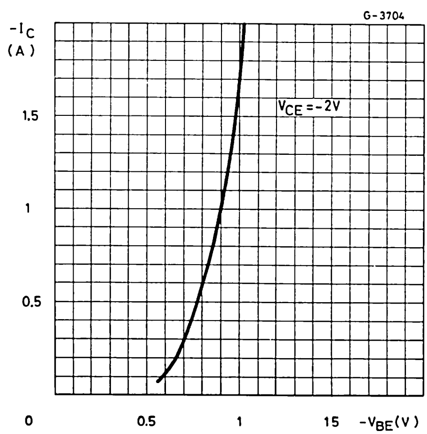
DC current gain (PNP types)



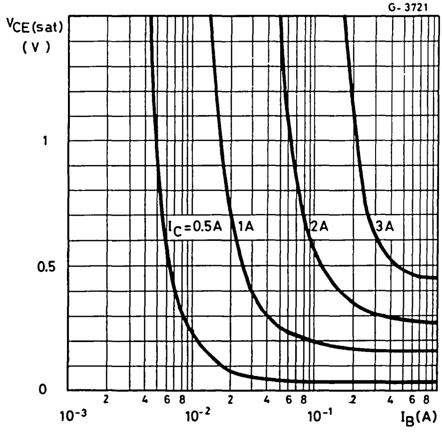
DC transconductance (NPN types)



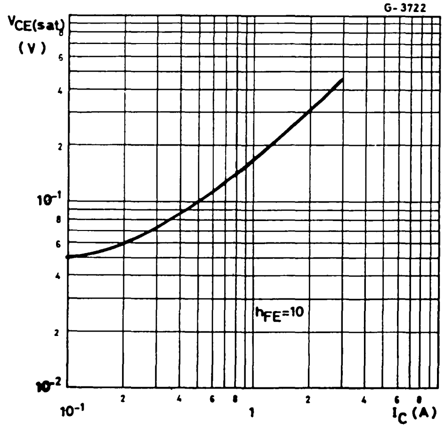
DC transconductance (PNP types)



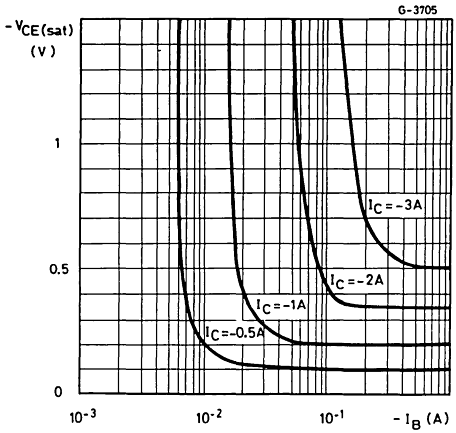
Collector-emitter saturation voltage (NPN types)



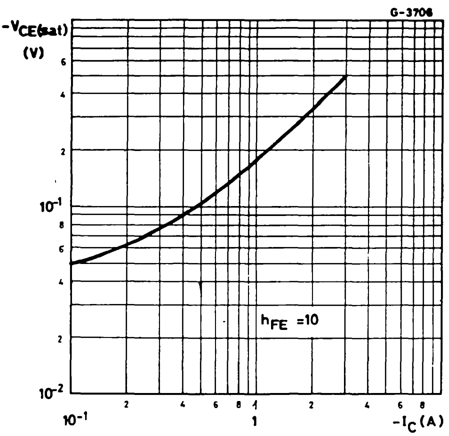
Collector-emitter saturation voltage (NPN types)



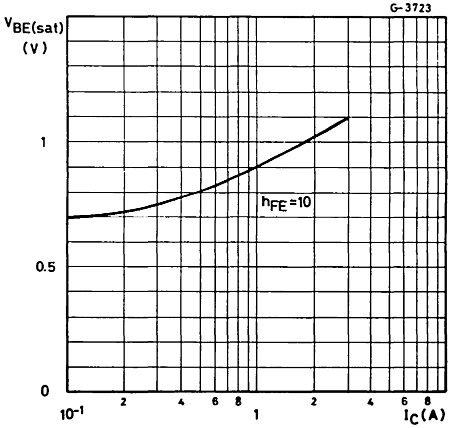
Collector-emitter saturation voltage (PNP types)



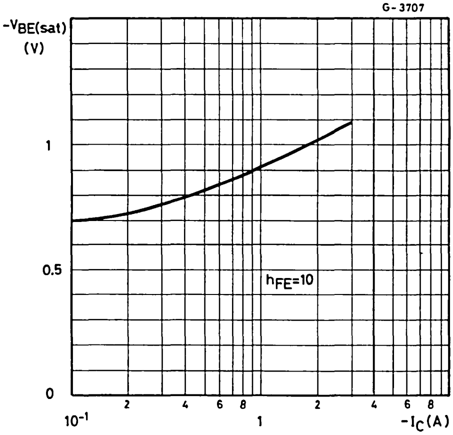
Collector-emitter saturation voltage (PNP types)



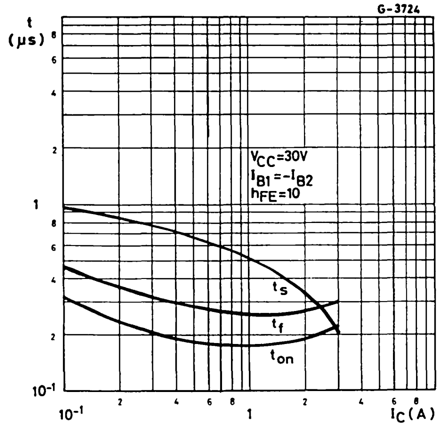
Base-emitter saturation voltage
(NPN types)



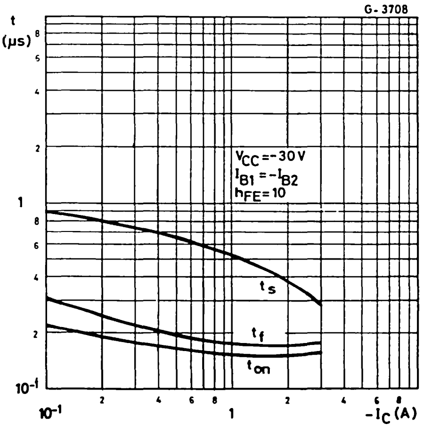
Base-emitter saturation voltage
(PNP types)



Saturated switching characteristics
(NPN types)



Saturated switching characteristics
(PNP types)



2N5038
2N5039
2N6496

MULTIEPITAXIAL PLANAR NPN

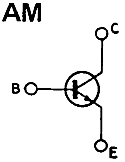
HIGH CURRENT POWER SWITCH

The 2N 5038, 2N 5039 and 2N 6496 are silicon planar multiepitaxial NPN transistors in Jedec TO-3 metal case.
They are especially intended for high current and fast switching applications.

ABSOLUTE MAXIMUM RATINGS

		2N5038	2N5039	2N6496
V_{CBO}	Collector-base voltage ($I_E = 0$)	150V	120V	150V
V_{CEX}	Collector-emitter voltage ($V_{BE} = -1.5V, R_{BE} = 100\Omega$)	150V	120V	150V
V_{CER}	Collector-emitter voltage ($R_{BE} \leq 50\ \Omega$)	110V	95V	130V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	90V	75V	110V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	7V	7V	7V
I_C	Collector current	20A	20A	15A
I_{CM}	Collector peak current	30A	30A	—
I_B	Base current		5A	
P_{tot}	Total power dissipation at $T_{case} \leq 25\ °C$		140W	
T_{stg}	Storage temperature		-65 to 200 °C	
T_j	Junction temperature		200 °C	

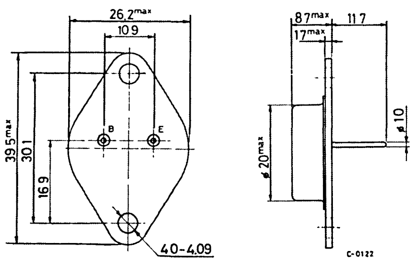
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

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} = 100V	T_{case} = 150°C			10	mA
		for **2N5039**					
		V_{CE} = 110V				50	mA
		V_{CE} = 85V	T_{case} = 150°C			10	mA
		for **2N6496**					
		V_{CE} = 130V				20	mA
		V_{CE} = 130V	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} = -1.5V, R_{BE} = 100Ω)	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 = 200mA					
			for **2N5038**	110			V
			for **2N5039**	95			V
			for **2N6496**	130			V
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage (I_B = 0)	I_C = 200mA					
			for **2N5038**	90			V
			for **2N5039**	75			V
			for **2N6496**	110			V

ELECTRICAL CHARACTERISTICS (continued)

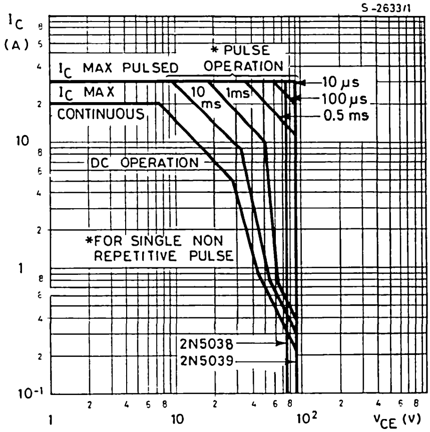
Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
$V_{CE\,(sat)}$*	Collector-emitter saturation voltage	for **2N5038**					
		I_C = 12 A	I_B = 1.2 A			1	V
		I_C = 20 A	I_B = 5 A			2.5	V
		for **2N5039**					
		I_C = 10 A	I_B = 1 A			1	V
		I_C = 20 A	I_B = 5 A			2.5	V
		for **2N6496**					
		I_C = 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
h_{FE}*	DC current gain	for **2N5038**					
		I_C = 2 A	V_{CE} = 5 V	50		250	—
		I_C = 12 A	V_{CE} = 5 V	20		100	—
		for **2N5039**					
		I_C = 2 A	V_{CE} = 5 V	30		250	—
		I_C = 10 A	V_{CE} = 5 V	20		100	—
		for **2N6496**					
		I_C = 8 A	V_{CE} = 2 V	12		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**				0.5	µs
		I_C = 12 A	V_{CC} = 30 V				
		I_{B1} = $-I_{B2}$ = 1.2 A					
t_s	Storage time	for **2N5039**					
		I_C = 10 A	V_{CC} = 30 V			1.5	µs
		I_{B1} = $-I_{B2}$ = 1 A					
t_f	Fall time	for **2N6496**					
		I_C = 8 A	V_{CC} = 30 V				
		I_{B1} = $-I_{B2}$ = 0.8 A				0.5	µs

ELECTRICAL CHARACTERISTICS (continued)

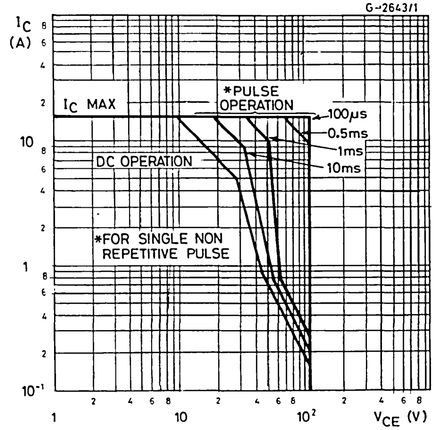
Parameter		Test conditions	Min. Typ. Max.	Unit
$I_{s/b}$**	Second breakdown collector current	V_{CE} = 28 V V_{CE} = 45 V	5 0.9	A A
$E_{s/b}$	Second breakdown energy	V_{BE} = -4 V R_{BE} = 20 Ω L = 180 μH for **2N5038** for **2N5039** for **2N6496**	 13 13 5.7	 mJ mJ mJ

* Pulsed: pulse duration = 300 μs, duty cycle = 1.5%
** Pulsed: 1 s non repetitive pulse

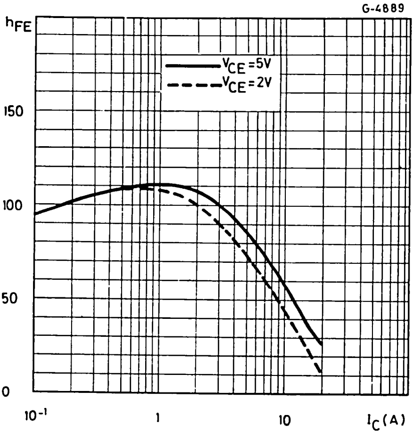
Safe operating areas
(for **2N5038** and **2N5039**)



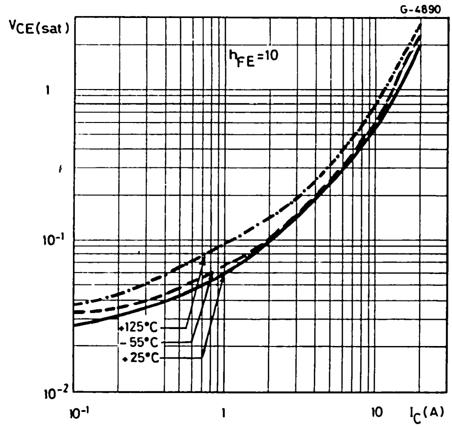
Safe operating areas
(for **2N6496**)



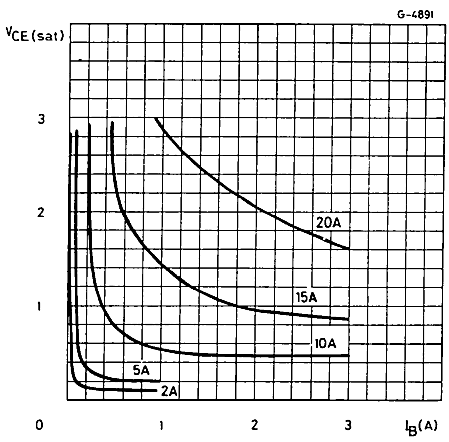
DC current gain



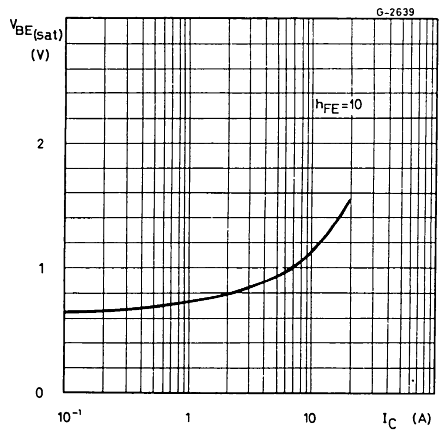
Collector-emitter saturation voltage



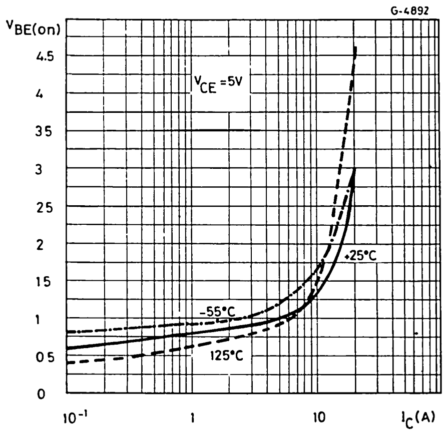
Collector-emitter saturation voltage



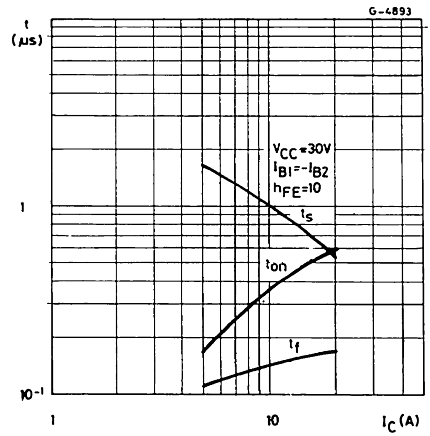
Base-emitter saturation voltage



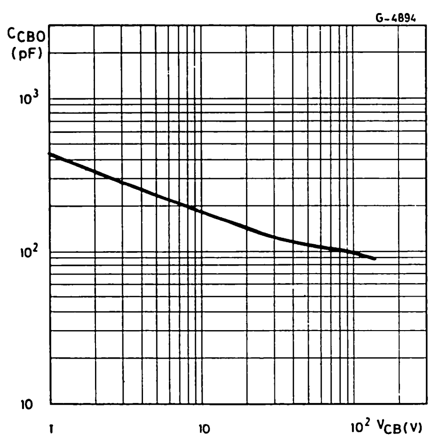
$V_{BE(on)}$ vs. collector current



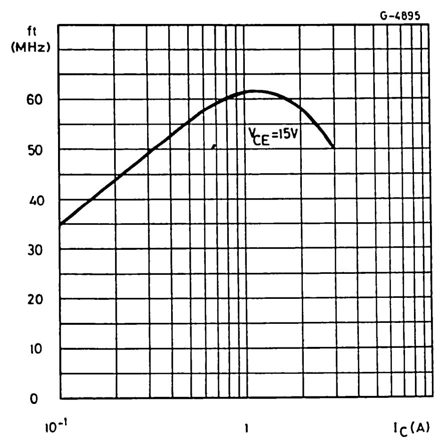
Saturated switching characteristics



Collector-base capacitance



Transition frequency



2N5151
2N5153

EPITAXIAL PLANAR PNP

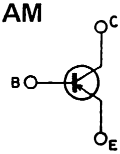
HIGH SPEED MEDIUM VOLTAGE SWITCHES

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.

ABSOLUTE MAXIMUM RATINGS

		2N5151 | 2N5153
V_{CBO}	Collector-base voltage ($I_E = 0$)	−100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	−80V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	−5.5V
I_C	Collector current	−5A
I_{CM}	Collector peak current	−10A
I_B	Base current	−2.5A
P_{tot}	Total power dissipation at $T_{case} \leq 50°C$	10W
	$T_{case} \leq 100°C$	6.7W
	$T_{amb} \leq 25°C$	1W
T_{stg}	Storage temperature	−65 to 200°C
T_j	Junction temperature	200°C

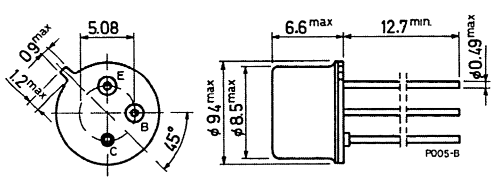
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-39

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)

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} = –4V V_{EB} = –5.5V			–1 –1	μA mA
$V_{CEO\ (sus)}$*	Collector-emitter 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 **2N5151**				
		I_C = –50mA V_{CE} = –5V	20			—
		I_C = –2.5A V_{CE} = –5V	30		90	—
		I_C = –5A V_{CE} = –5V	20			—
		T_{case} = –55°C I_C = –2.5A V_{CE} = –5V	15			—
		for **2N5153**				
		I_C = –50mA V_{CE} = –5V	50			—
		I_C = –2.5A V_{CE} = –5V	70		200	—
		I_C = –5A V_{CE} = –5V	40			—
		T_{case} = –55°C I_C = –2.5A V_{CE} = –5V	35			—

ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
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 **2N5151** for **2N5153** $I_C = -0.5A$ $V_{CE} = -5V$ $f = 20MHz$ for **2N5151** for **2N5153**	 20 50 3 3.5			 — — — —
t_{on}	Turn on time	$I_C = -5A$ $I_{B1} = -0.5A$ $V_{CC} = 30V$		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 $\leqslant$2%.

EPITAXIAL PLANAR NPN

2N5152
2N5154

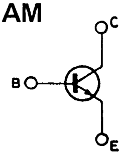
HIGH SPEED MEDIUM VOLTAGE SWITCHES

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.

ABSOLUTE MAXIMUM RATINGS

		2N5152 | 2N5154
V_{CBO}	Collector-base voltage ($I_E = 0$)	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	80V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	6V
I_C	Collector current	2A
I_{CM}	Collector peak current	10A
I_B	Base current	1A
P_{tot}	Total power dissipation at $T_{case} \leq 50°C$	10W
	$T_{case} \leq 100°C$	6.7W
	$T_{amb} \leq 25°C$	1W
T_{stg}	Storage temperature	–65 to 200°C
T_j	Junction temperature	200°C

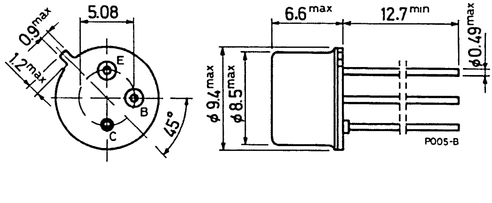
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-39

2N5152
2N5154

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)

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-emitter sustaining voltage (I_B = 0)	I_C = 100mA		80			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	I_C = 2.5A I_C = 5A	I_B = 250mA I_B = 500mA			0.75 1.5	V V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	I_C = 2.5A I_C = 5A	I_B = 250mA 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	20			—
		I_C = 2.5A	V_{CE} = 5V	30		90	—
		I_C = 5A	V_{CE} = 5V	20			—
		T_{case} = −55°C					
		I_C = 2.5A	V_{CE} = 5V	15			—
		for **2N5154**					
		I_C = 50mA	V_{CE} = 5V	50			—
		I_C = 2.5A	V_{CE} = 5V	70		200	—
		I_C = 5A	V_{CE} = 5V	40			—
		T_{case} = −55°C					
		I_C = 2.5A	V_{CE} = 5V	35			—

ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
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**	20			—
		for **2N5154**	50			—
		$I_C = 0.5A$ $V_{CE} = 5V$ $f = 20MHz$				
		for **2N5152**	3			—
		for **2N5154**	3.5			—
t_{on}	Turn on time	$I_C = 5A$ $I_{B1} = 0.5A$ $V_{CC} = 30V$		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 $\leqslant$2%.

2N5190 2N5193
2N5191 2N5194
2N5192 2N5195

EPITAXIAL-BASE NPN/PNP

MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

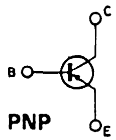
The 2N5190, 2N5191, 2N5192 are silicon epitaxial-base NPN power transistors in Jedec TO-126 plastic package, intended for use in medium power linear and switching applications. The complementary PNP types are the 2N5193, 2N5194 and 2N5195 respectively.

ABSOLUTE MAXIMUM RATINGS

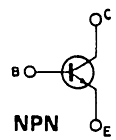
		NPN PNP*	2N5190 2N5193	2N5191 2N5194	2N5192 2N5195
V_{CBO}	Collector-base voltage ($I_E = 0$)		40V	60V	80V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)		40V	60V	80V
V_{EBO}	Emitter-base volage ($I_C = 0$)			5V	
I_C	Collector current			4A	
I_{CM}	Collector peak current ($t \leqslant 10ms$)			7A	
I_B	Base current			1A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$			40W	
T_{stg}	Storage temperature			-65 to 150°C	
T_j	Junction temperature			150°C	

*** For PNP types voltage and current values are negative**

INTERNAL SCHEMATIC DIAGRAMS



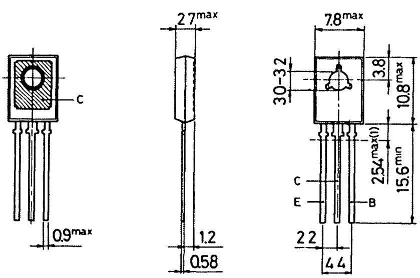
PNP



NPN

MECHANICAL DATA

Dimensions in mm



(1) Within this region the cross-section of the leads is uncontrolled

TO-126 (SOT-32)

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	3.12	°C/W
$R_{th\ j\text{-}case}$	Thermal resistance junction-ambient	max	100	°C/W

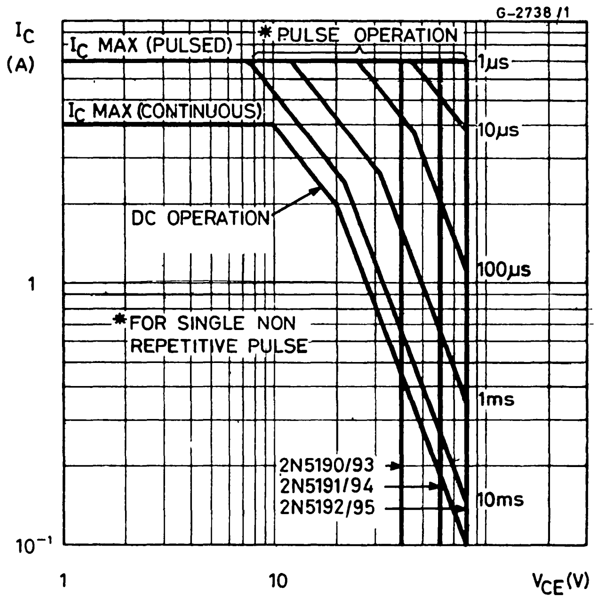
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	for **2N5190/93** $V_{CB} = 40V$			100	μA
		for **2N5191/94** $V_{CB} = 60V$			100	μA
		for **2N5192/95** $V_{CB} = 80V$			100	μA
I_{CEX}	Collector cutoff current ($V_{EB} = 1.5V$)	for **2N5190/93** $V_{CE} = 40V$			100	μA
		for **2N5191/94** $V_{CE} = 60V$			100	μA
		for **2N5192/95** $V_{CE} = 80V$			100	μA
		$T_{case} = 125°C$				
		for **2N5190/93** $V_{CE} = 40V$			2	mA
		for **2N5191/94** $V_{CE} = 60V$			2	mA
		for **2N5192/95** $V_{CE} = 80V$			2	mA
I_{CEO}	Collector cutoff current ($I_B = 0$)	for **2N5190/93** $V_{CE} = 40V$			1	mA
		for **2N5191/94** $V_{CE} = 60V$			1	mA
		for **2N5192/95** $V_{CE} = 80V$			1	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$			1	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 100mA$				
		for **2N5190/93**	40			V
		for **2N5191/94**	60			V
		for **2N5192/95**	80			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	$I_C = 1.5A$ $I_B = 0.15A$			0.6	V
		$I_C = 4A$ $I_B = 1A$				
		for **2N5190/91/92**			1.4	V
		for **2N5193/94/95**			1.2	V
V_{BE}*	Base-emitter volt.	$I_C = 1.5A$ $V_{CE} = 2V$			1.2	V
h_{FE}*	DC current gain	$I_C = 1.5A$ $V_{CE} = 2V$				
		for **2N5190/93**	25		100	–
		for **2N5191/94**	25		100	–
		for **2N5192/95**	20		80	–
		$I_C = 4A$ $V_{CE} = 2V$				
		for **2N5190/93**	10			–
		for **2N5191/94**	10			–
		for **2N5192/95**	7			–
f_T	Transition freq.	$I_C = 1A$ $V_{CE} = 10V$	2			MHz

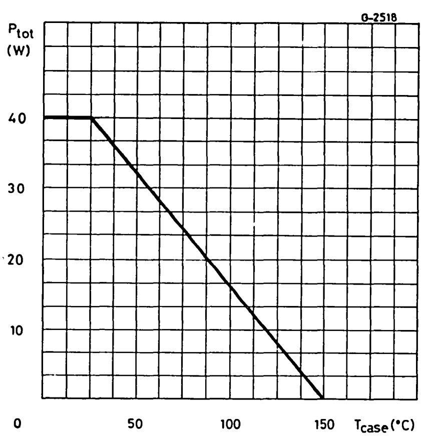
* Pulsed: pulse duration = 300μs duty cycle = 1.5%

For NPN types voltage and current values are negative

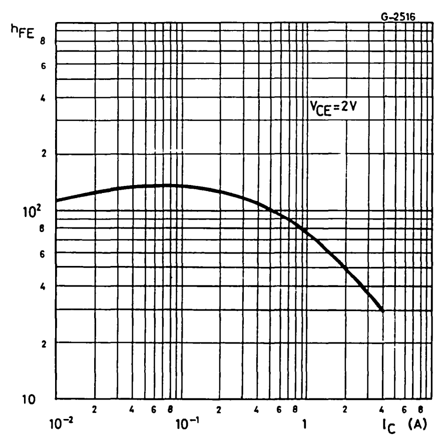
Safe operating areas



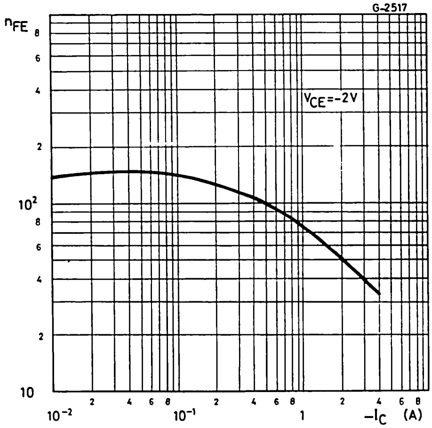
Power rating chart



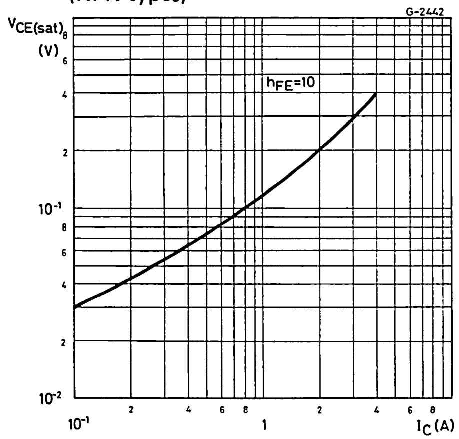
DC current gain (NPN types)



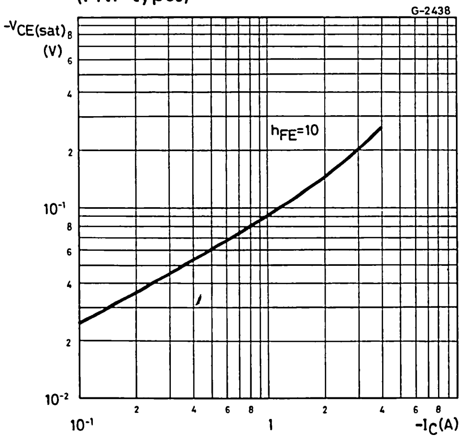
DC current gain (PNP types)



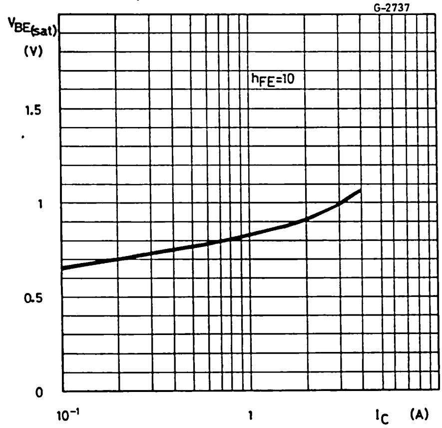
Collector-emitter saturation voltage (NPN types)



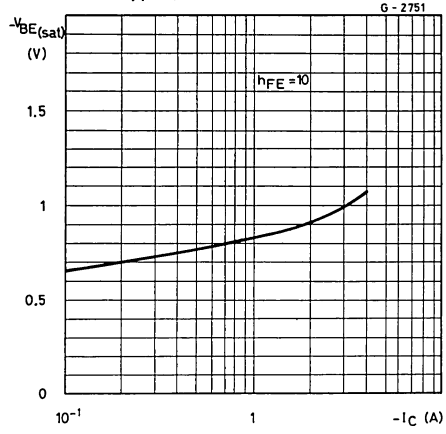
Collector-emitter saturation voltage (PNP types)



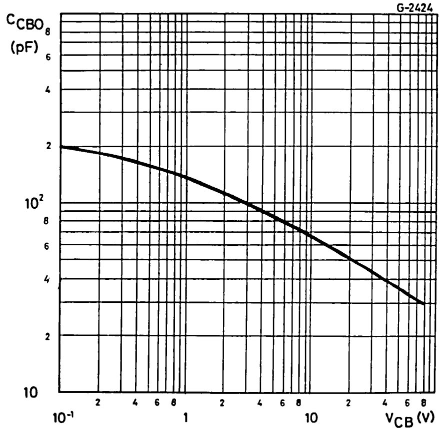
Base-emitter saturation voltage (NPN types)



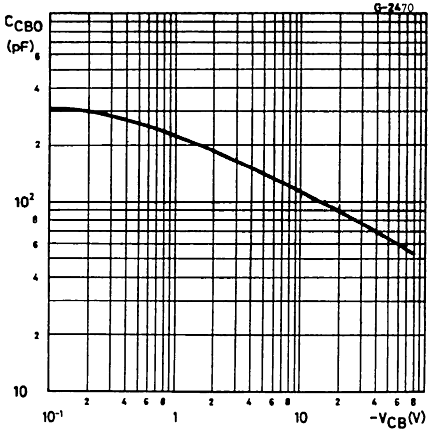
Base-emitter saturation voltage (PNP types)



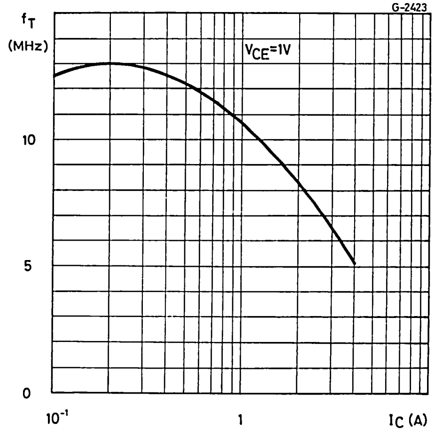
Collector-base capacitance (NPN types)



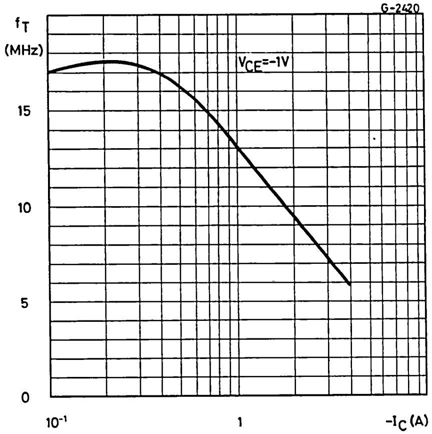
Collector-base capacitance (PNP types)



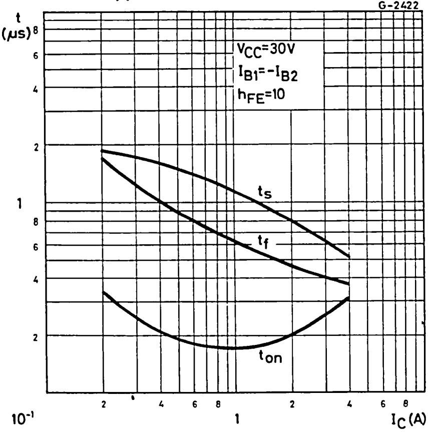
Transition frequency (NPN types)



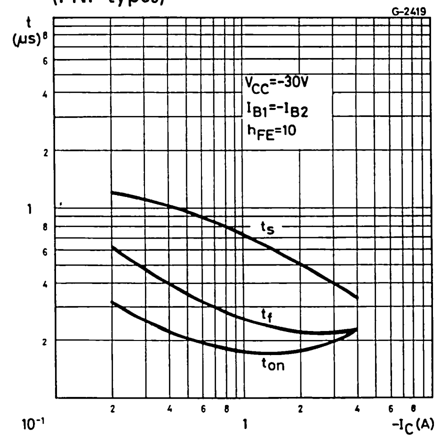
Transition frequency (PNP types)



Saturated switching characteristics (NPN types)



Saturated switching characteristics (PNP types)



2N5301/2/3
2N4398/99
2N5745

EPITAXIAL-BASE NPN/PNP

COMPLEMENTARY HIGH POWER TRANSISTORS

The 2N5301/2/3, 2N4398/99 and 2N5745 are silicon epitaxial-base transistors in Jedec TO-3 metal case. They are intended for power amplifier and switching circuits.

	ABSOLUTE MAXIMUM RATINGS	NPN / PNP	2N5301 / 2N4398	2N5302 / 2N4399	2N5303 / 2N5745
V_{CEO}	Collector-emitter voltage ($I_B = 0$)		40V	60V	80V
V_{CBO}	Collector-base voltage ($I_E = 0$)		40V	60V	80V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		5V	5V	5V
I_C	Collector current		30A	30A	20A
I_{CM}	Collector peak current			50A	
I_B	Base current			7.5A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$			200W	
T_{stg}	Storage temperature			−65 to 200°C	
T_j	Junction temperature			200°C	

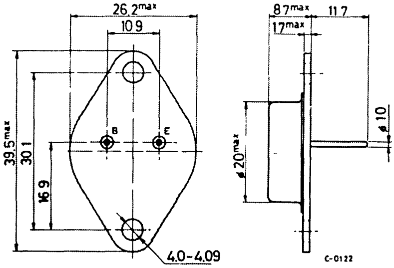
For PNP types voltage and current values are negative

INTERNAL SCHEMATIC DIAGRAMS

MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

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)

	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5V$			5	mA
I_{CBO}	Collector cutoff current ($I_E = 0$)	V_{CB} = rated V_{CBO}			1	mA
I_{CEV}	Collector cutoff current ($V_{BE} = -1.5V$)	V_{CE} = rated V_{CEO} for **2N4398/99, 2N5745** for **2N5301/2/3** $V_{CE} = 30V$ $T_{case} = 150°C$ for **2N4398/99** $V_{CE} = 80V$ $T_{case} = 150°C$ 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 ($I_B = 0$)	$I_C = 200mA$ for **2N4398, 2N5301** for **2N4399, 2N5302** for **2N5745, 2N5303**	 40 60 80			 V V V

ELECTRICAL CHARACTERISTICS (Continued)

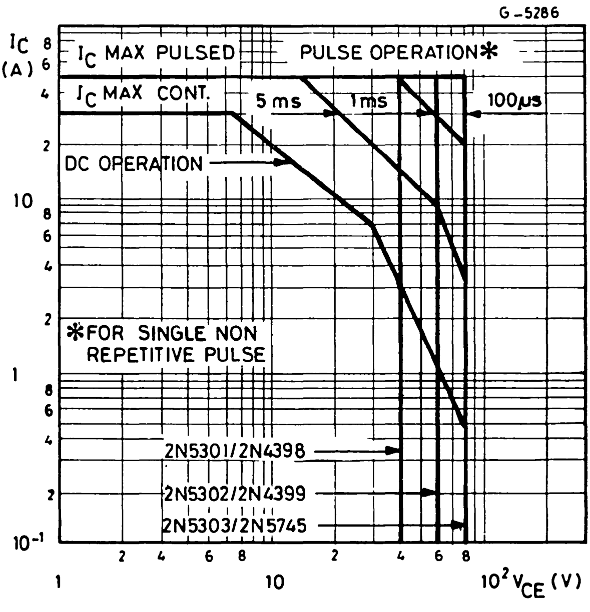
Parameter		Test conditions	Min.	Typ.	Max.	Unit
h_{FE}*	DC current gain	$I_C=1A$ $V_{CE}=2V$	40			—
		for **2N5745, 2N5303**				
		$I_C=10A$ $V_{CE}=2V$	15		60	—
		$I_C=20A$ $V_{CE}=2V$	5			—
		for **2N4398/99, 2N5301/2**				
		$I_C=15A$ $V_{CE}=2V$	15		60	—
		$I_C=30A$ $V_{CE}=4V$	5			—
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C=10A$ $I_B=1A$				
		for **2N4398/99, 2N5301/2**			0.75	V
		for **2N5745, 2N5303**			1	V
		$I_C=15A$ $I_B=1.5A$				
		for **2N4398/99, 2N5301/2**			1	V
		for **2N5745, 2N5303**			1.5	V
		$I_C=20A$ $I_B=2A$				
		for **2N4398/99, 2N5301/2**			2	V
		$I_C=20A$ $I_B=4A$				
		for **2N5745, 2N5303**			2	V
		$I_C=30A$ $I_B=6A$				
		for **2N4398/99, 2N5301/2**			4	V
$V_{BE(sat)}$*	Base-emitter saturation voltage	$I_C=10A$ $I_B=1A$			1.7	V
		$I_C=15A$ $I_B=1.5A$				
		for **2N4398/99, 2N5301/2**			1.8	V
		for **2N5745, 2N5303**			2	V
		$I_C=20A$ $I_B=2A$				
		for **2N4398/99, 2N5301/2**			2.5	V
		$I_C=20A$ $I_B=4A$				
		for **2N5745, 2N5303**			2.5	V
V_{BE}*	Base-emitter voltage	$I_C=10A$ $V_{CE}=2V$				
		for **2N5745, 2N5303**			1.5	V
		$I_C=15A$ $V_{CE}=2V$				
		for **2N4398/99, 2N5301/2**			1.7	V
		$I_C=20A$ $V_{CE}=4V$				
		for **2N5745, 2N5303**			2.5	V
		$I_C=30A$ $V_{CE}=4V$				
		for **2N4398/99, 2N5301/2**			3	V

ELECTRICAL CHARACTERISTICS (Continued)

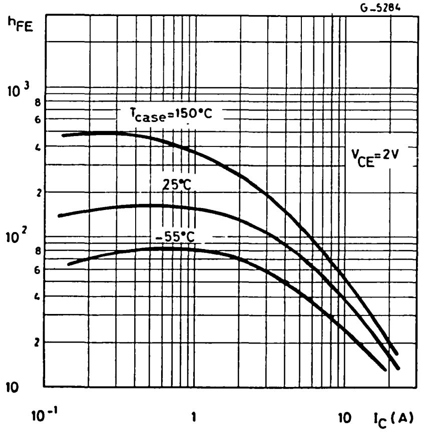
	Parameter	Test conditions	Min. Typ. Max.	Unit
f_T	Transition frequency	$I_C = 1A$ $V_{CE} = 10V$ $f = 1MHz$ for **2N4398/99, 2N5301/2** for **2N5745, 2N5303**	 4 2	 MHz MHz
h_{fe}	Small signal current gain	$I_C = 1A$ $V_{CE} = 10V$ $f = 1KHz$	40	—
t_r	Rise time	$V_{CC} = 30V$ $I_C = 10A$	1	μs
t_s	Storage time	$I_{B1} = -I_{B2} = 1A$	2	μs
t_f	Fall time		1	μs

* Pulsed: pulse duration = 300 μs, duty cycle $\leqslant 2\%$
For PNP types voltage and current are negative

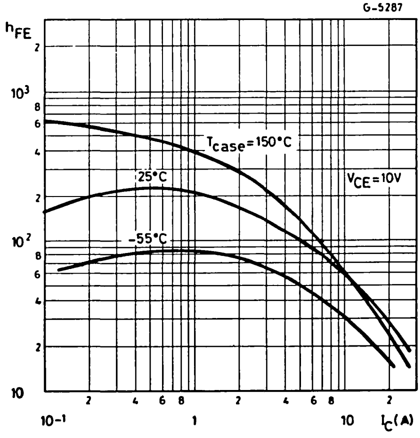
Safe operating areas



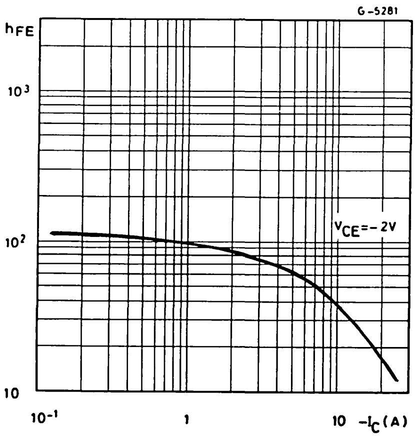
DC current gain (NPN types)



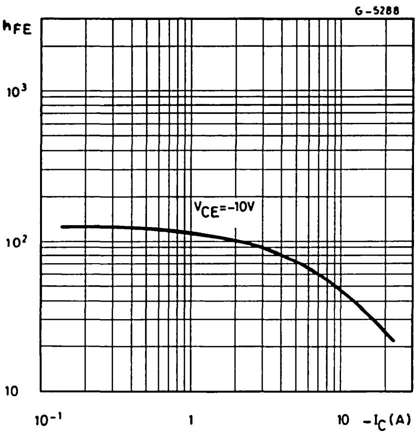
DC current gain (NPN types)



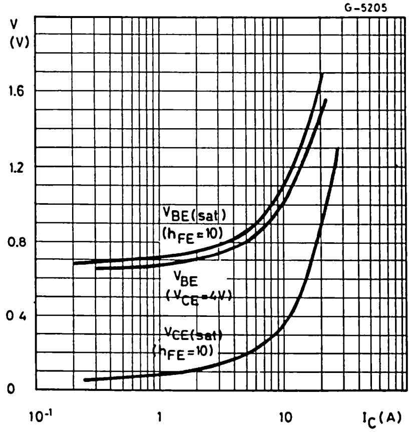
DC current gain (PNP types)



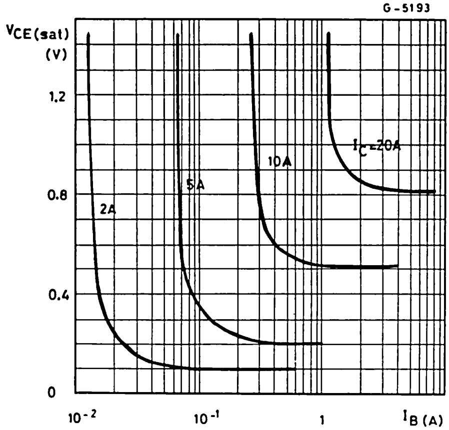
DC current gain (PNP types)



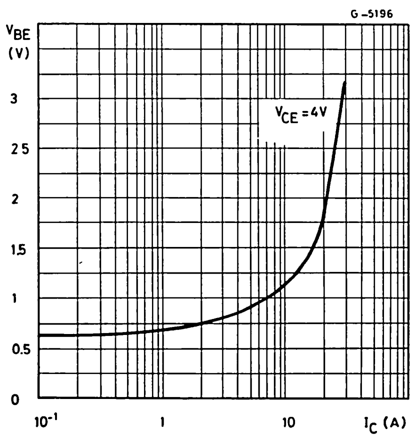
Saturation voltage (NPN types)



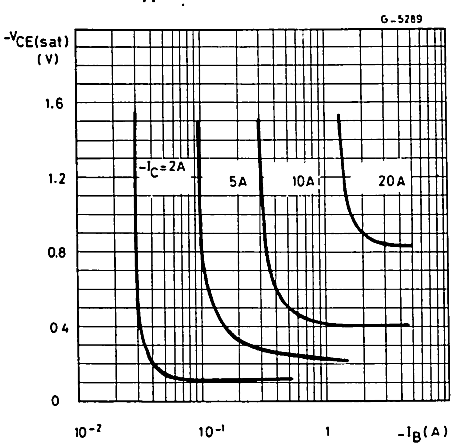
Collector-emitter saturation voltage (NPN types)



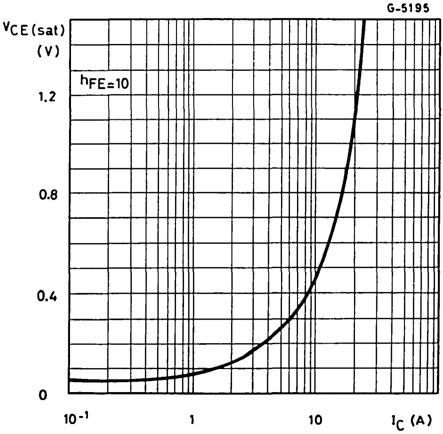
Base-emitter voltage (PNP types)



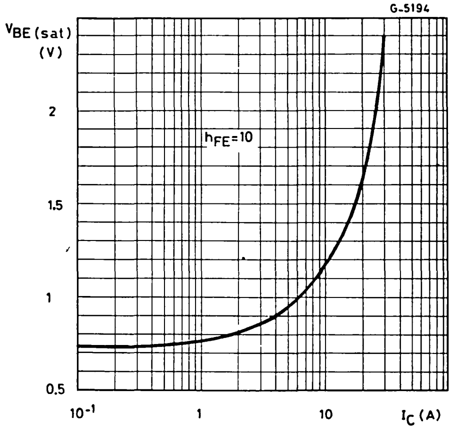
Collector-emitter saturation voltage (PNP types)



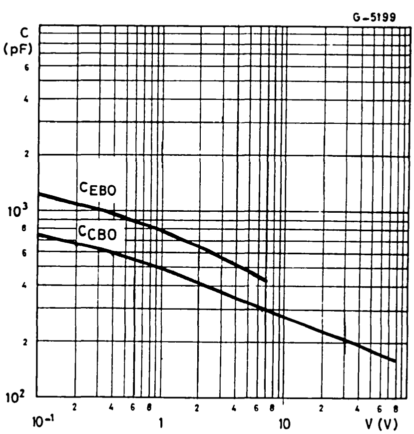
Collector-emitter saturation voltage (PNP types)



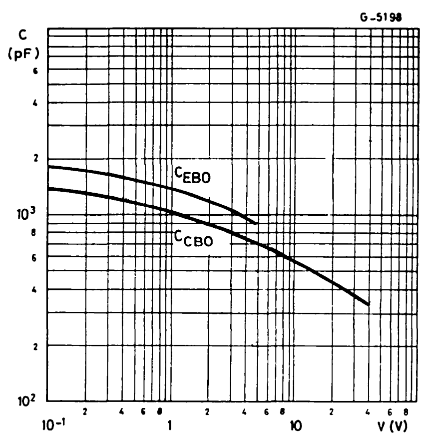
Base-emitter saturation voltage (PNP types)



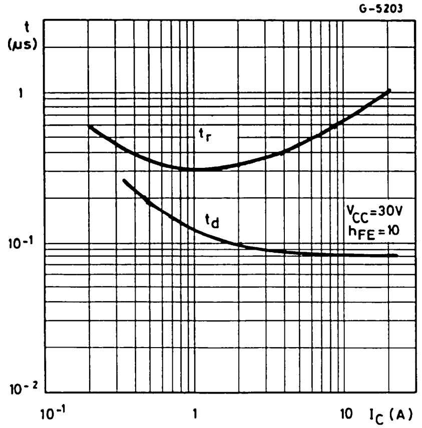
Capacitances (NPN types)



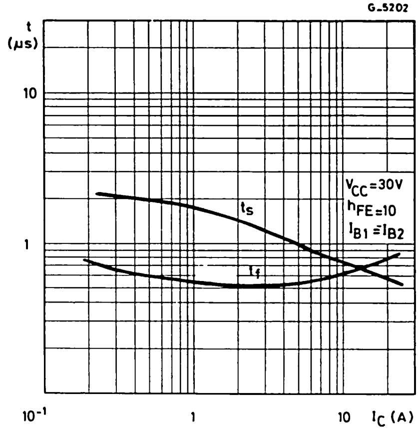
Capacitances (PNP types)



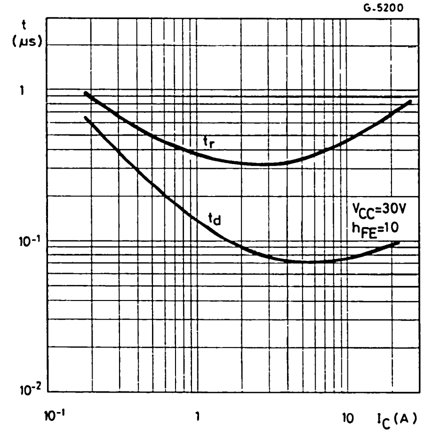
Turn-on time (NPN types)



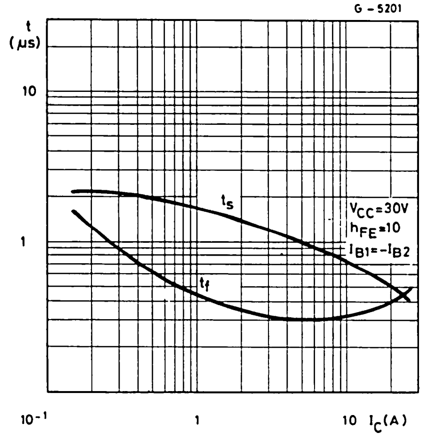
Turn-off time (NPN types)



Turn-on time (PNP types)



Turn-off time (PNP types)



2N5336
2N5337
2N5338
2N5339

EPITAXIAL PLANAR NPN

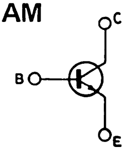
HIGH CURRENT FAST SWITCHING APPLICATIONS

The 2N 5336, 2N 5337, 2N 5338 and 2N 5339 are silicon epitaxial planar NPN transistors in Jedec TO-39 metal case.
They are intended for high current switching applications up to 5A.

ABSOLUTE MAXIMUM RATINGS

		2N5336 2N5337	2N5338 2N5339
V_{CBO}	Collector-base voltage ($I_E = 0$)	80V	100V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	80V	100V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	6V	
I_C	Collector current	5A	
I_{CM}	Collector peak current	7A	
I_B	Base current	1A	
P_{tot}	Total power dissipation at $T_{amb} \leq 25°C$	1W	
	$T_{case} \leq 25°C$	6W	
T_{stg}	Storage temperature	-65 to 200 °C	
T_j	Junction temperature	200 °C	

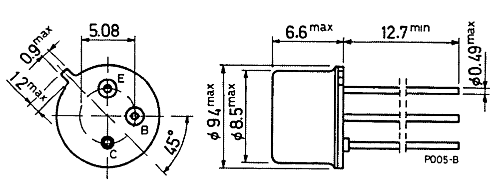
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-39

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)

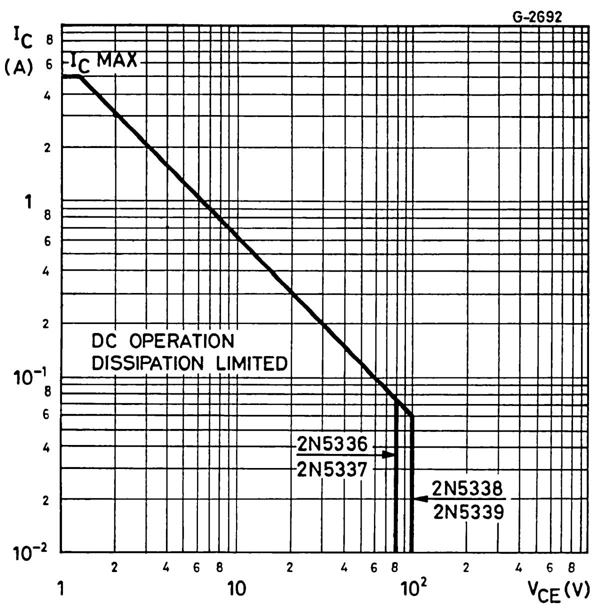
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	for **2N5336** and **2N5337**				
		V_{CB} = 80 V			10	μA
		for **2N5338** and **2N5339**				
		V_{CB} = 100 V			10	μA
I_{CEO}	Collector cutoff current ($I_B = 0$)	for **2N5336** and **2N5337**				
		V_{CE} = 75 V			100	μA
		for **2N5338** and **2N5339**				
		V_{CE} = 90 V			100	μA
I_{CEX}	Collector cutoff current (V_{BE} = -1.5 V)	for **2N5336** and **2N5337**				
		V_{CE} = 75 V			10	μA
		V_{CE} = 75 V T_{case} = 150°C			1	mA
		for **2N5338** and **2N5339**				
		V_{CE} = 90 V			10	μA
		V_{CE} = 90 V T_{case} = 150°C			1	mA
$V_{CEO\,(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	I_C = 50 mA				
		for **2N5336** and **2N5337**	80			V
		for **2N5338** and **2N5339**	100			V
$V_{CE\,(sat)}$*	Collector-emitter saturation voltage	I_C = 2 A I_B = 0.2 A			0.7	V
		I_C = 5 A I_B = 0.5 A			1.2	V
$V_{BE\,(sat)}$*	Base-emitter saturation voltage	I_C = 2 A I_B = 0.2 A			1.2	V
		I_C = 5 A I_B = 0.5 A			1.8	V
h_{FE}*	DC current gain	I_C = 0.5 A V_{CE} = 2 V				
		for **2N5336** and **2N5338**	30			—
		for **2N5337** and **2N5339**	60			—
		I_C = 2 A V_{CE} = 2 V				
		for **2N5336** and **2N5338**	30		120	—
		for **2N5337** and **2N5339**	60		240	—
		I_C = 5 A V_{CE} = 2 V				
		for **2N5336** and **2N5338**	20			—
		for **2N5337** and **2N5339**	40			—

ELECTRICAL CHARACTERISTICS (continued)

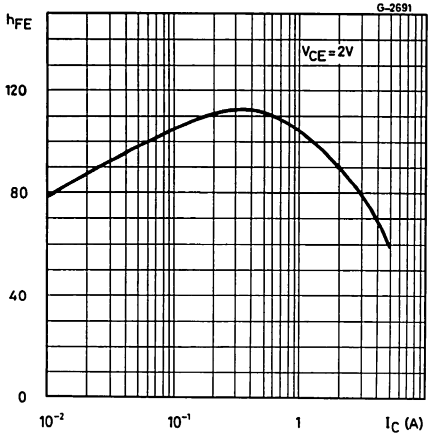
Parameter		Test conditions	Min. Typ. Max.	Unit
f_T	Transition frequency	I_C = 0.5A V_{CE} = 10 V	30	MHz
C_{CBO}	Collector-base capacitance	V_{CB} = 10V I_E = 0 f = 0.1 MHz	250	pF
t_{on}	Turn-on time	I_C = 2 A V_{CC} = 40V I_{B1} = 0.2 A	200	ns
t_s	Storage time	I_C = 2 A V_{CC} = 40V I_{B1} = $-I_{B2}$ = 0.2 A	2	μs
t_f	Fall time		200	ns

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

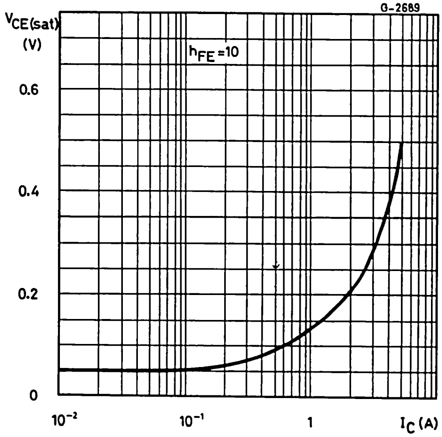
Safe operating areas



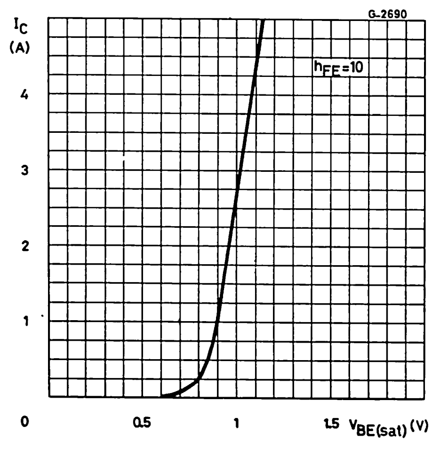
DC current gain



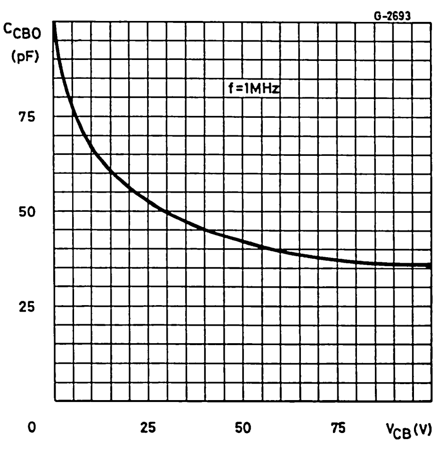
Collector-emitter saturation voltage



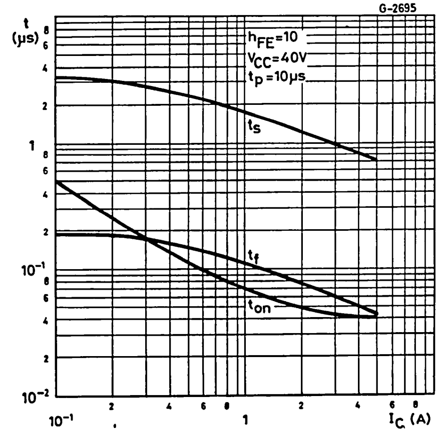
Base-emitter saturation voltage



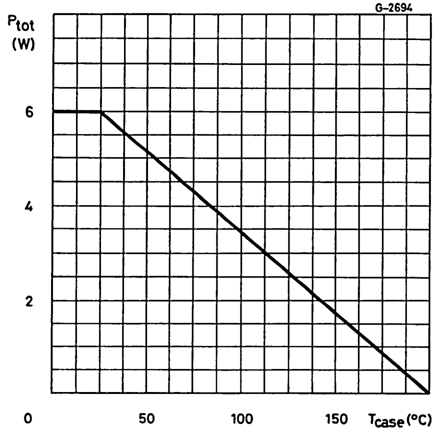
Collector-base capacitance



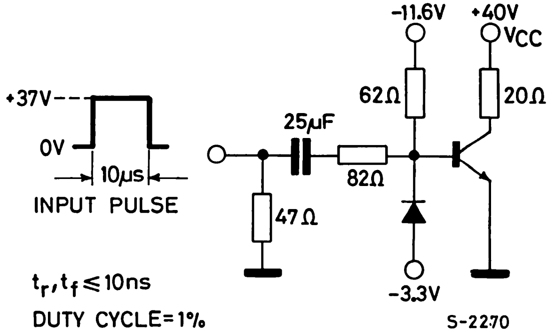
Saturated switching characteristics



Power rating chart



Switching time test circuit



EPITAXIAL PLANAR PNP

2N5415
2N5416

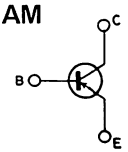
HIGH VOLTAGE TRANSISTORS

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.

ABSOLUTE MAXIMUM RATINGS

		2N5415	2N5416
V_{CBO}	Collector-base voltage ($I_E=0$)	-200V	-350V
V_{CEO}	Collector-emitter voltage ($I_B=0$)	-200V	-300V
V_{EBO}	Emitter-base voltage ($I_C=0$)	-4V	-6V
I_C	Collector current	-1A	
I_B	Base current	-0.5A	
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$	10W	
	$T_{amb} \leq 50°C$	1W	
T_{stg}	Storage temperature	-65 to 200°C	
T_j	Junction temperature	200°C	

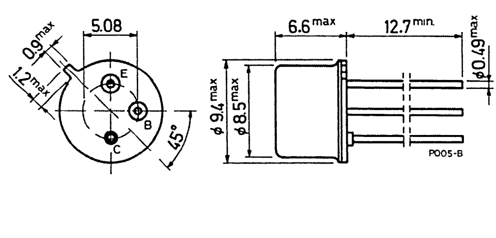
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-39

2N5415
2N5416

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)

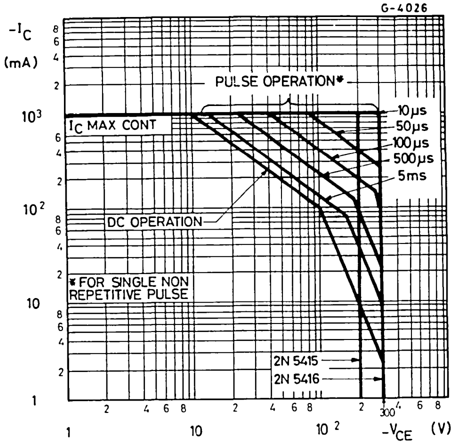
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	for **2N5415** $V_{CB} = -175V$ for **2N5416** $V_{CB} = -280V$			-50 -50	μA μA
I_{CEO}	Collector cutoff current ($I_B = 0$)	$V_{CE} = -150V$			-50	μA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	for **2N5415** $V_{EB} = -4V$ for **2N5416** $V_{EB} = -6V$			-20 -20	μA μA
$V_{CEO\,(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = -10mA$ for **2N5415** for **2N5416**	 -200 -300			 V V
V_{CER}*	Collector-emitter sustaining voltage ($R_{BE} = 50\Omega$)	$I_C = -50mA$ for **2N5416**	 -350			 V
$V_{CE\,(sat)}$*	Collector-emitter saturation voltage	$I_C = -50mA$ $I_B = -5mA$			-2.5	V
V_{BE}*	Base-emitter voltage	$I_C = -50mA$ $V_{CE} = -10V$			-1.5	V

ELECTRICAL CHARACTERISTICS (continued)

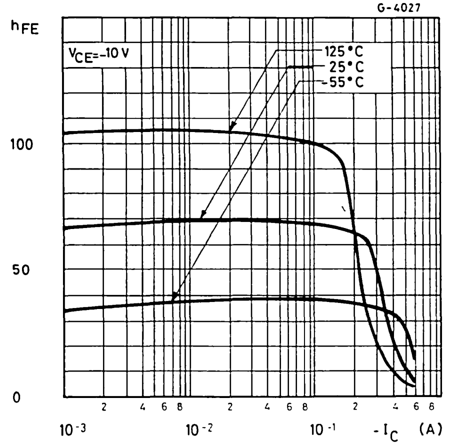
	Parameter	Test conditions	Min.	Typ.	Max.	Unit
h_{FE}*	DC current gain	I_C =-50mA V_{CE}=-10V for **2N5415** for **2N5416**	 30 30		 150 120	 – –
h_{fe}	Small signal current gain	I_C =-5mA V_{CE}=-10V f = 1KHz	25			–
f_T	Transition frequency	I_C =-10mA V_{CE}=-10V f = 5MHz	15			MHz
C_{CBO}	Collector-base capacitance	I_E =0 V_{CB}=-10V f = 1MHz			25	pF

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

Safe operating areas

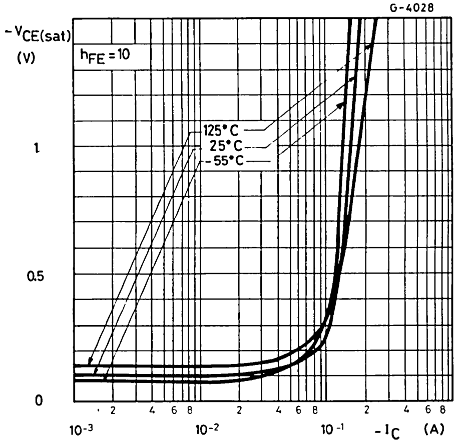


DC current gain

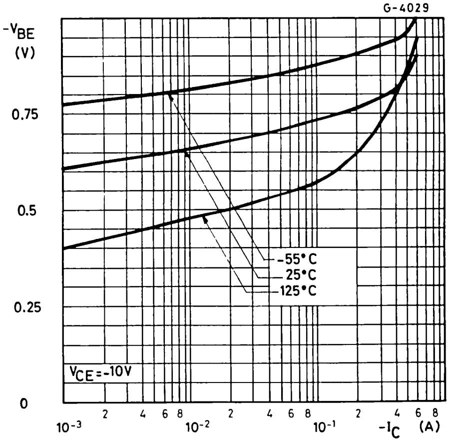


2N5415
2N5416

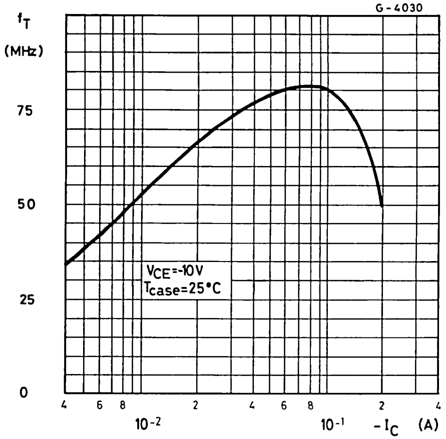
Collector-emitter saturation voltage



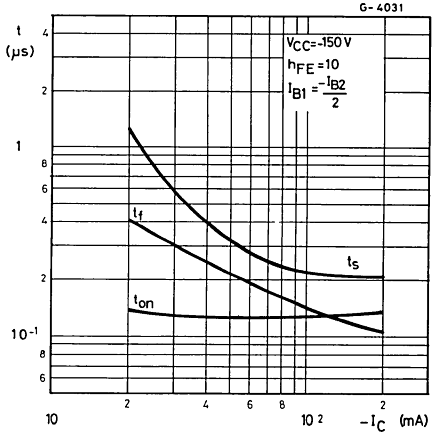
Base-emitter voltage



Transition frequency



Switching times



EPITAXIAL-BASE NPN/PNP

2N5629
2N6029

COMPLEMENTARY HIGH POWER TRANSISTORS

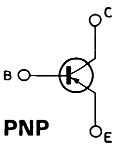
The 2N5629 (NPN) and 2N6029 (PNP) are complementary silicon epitaxial-base transistors in Jedec TO-3 metal case. They are intended for high power audio amplifier applications and switching regular circuits.

ABSOLUTE MAXIMUM RATINGS

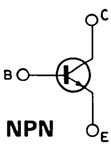
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	100	V
V_{CBO}	Collector-base voltage ($I_E = 0$)	100	V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	7	V
I_C	Collector current	16	A
I_{CM}	Collector peak current	20	A
I_B	Base current	5	A
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	200	W
T_{stg}	Storage temperature	−65 to 200	°C
T_j	Junction temperature	200	°C

For PNP type voltage and current values are negative

INTERNAL SCHEMATIC DIAGRAMS



PNP

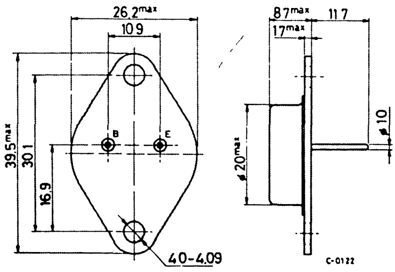


NPN

MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

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)

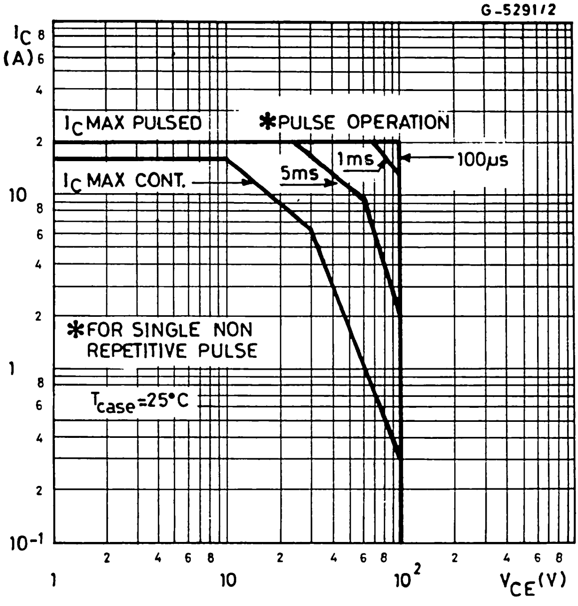
Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B = 0$)	$V_{CE} = 50V$				1	mA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 7V$				1	mA
I_{CBO}	Collector cutoff current ($I_E = 0$)	$V_{CB} = 100V$				1	mA
I_{CEV}	Collector-emitter cutoff current ($V_{BE} = -1.5V$)	$V_{CE} = 100V$ $V_{CE} = 100V$	 $T_{case} = 150°C$			1 5	mA mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 200mA$		100			V
h_{FE}*	DC current gain	$I_C = 8A$ $I_C = 16A$	$V_{CE} = 2V$ $V_{CE} = 2V$	25 4		100	– –
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C = 10A$ $I_C = 16A$	$I_B = 1A$ $I_B = 4A$			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	$I_C = 1A$ $f = 0.5MHz$	$V_{CE} = 20V$	1			MHz

ELECTRICAL CHARACTERISTICS (Continued)

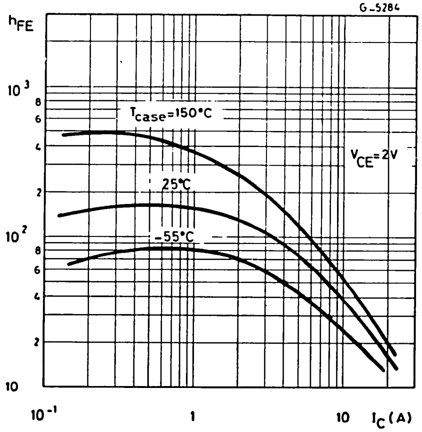
Parameter		Test conditions	Min. Typ. Max.	Unit
C_{CBO}	Collector-base capacitance	$V_{CB}=10V$ $I_E=0$ $f=0.1MHz$ for **2N6029**	500 1000	pF pF
h_{fe}	Small signal current gain	$I_C=4A$ $V_{CE}=10V$ $f=1KHz$	15	—

* Pulsed: pulse duration = 300 μs, duty cycle $\leqslant$2%
For PNP type voltage and current values are negative.

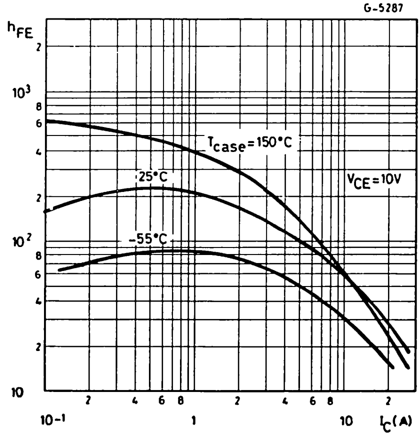
Safe operating areas



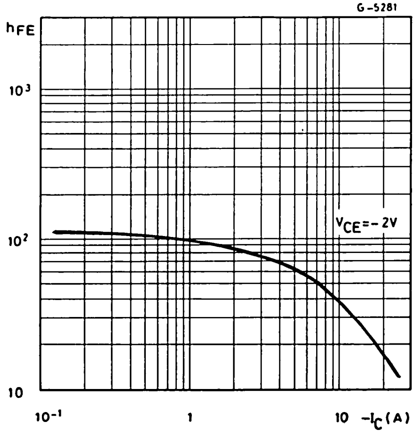
DC current gain (NPN type)



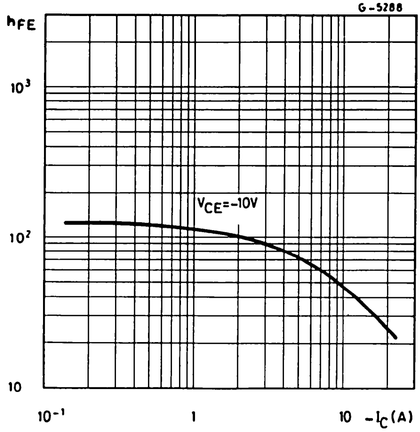
DC current gain (NPN type)



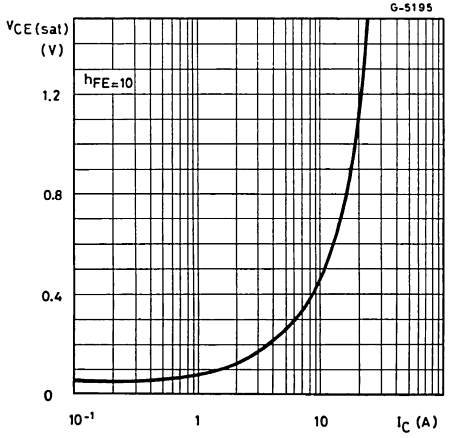
DC current gain (PNP type)



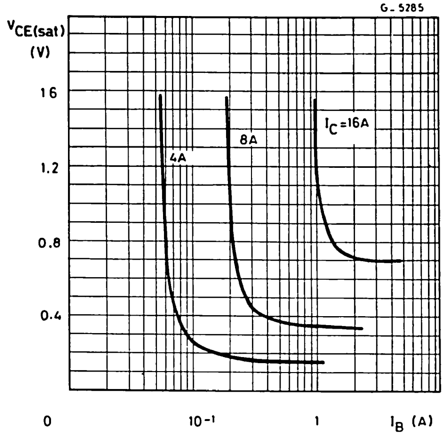
DC current gain (PNP type)



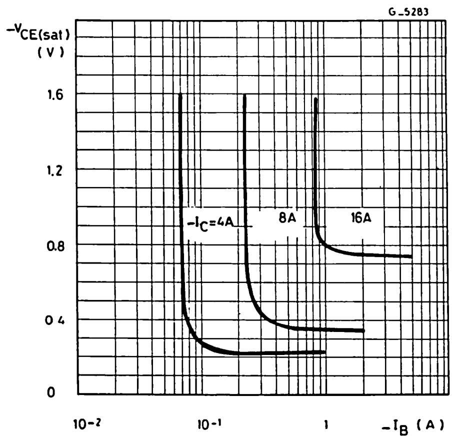
Collector-emitter saturation voltage (PNP type)



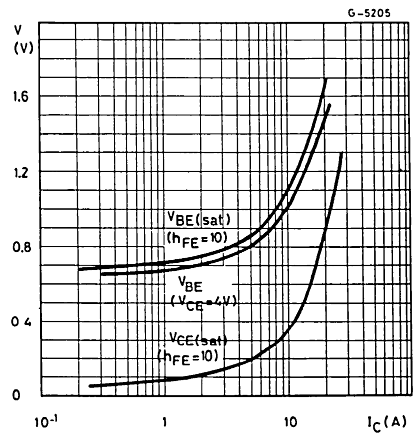
Collector-emitter saturation voltage (NPN type)



Collector-emitter saturation voltage (PNP type)

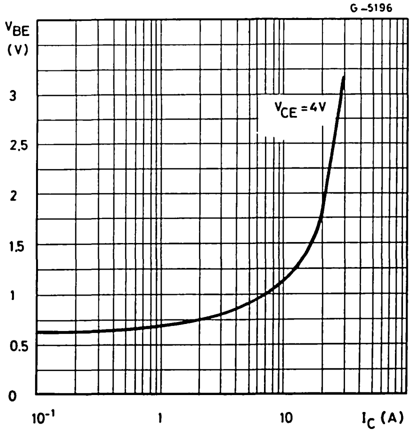


Saturation voltage (NPN type)

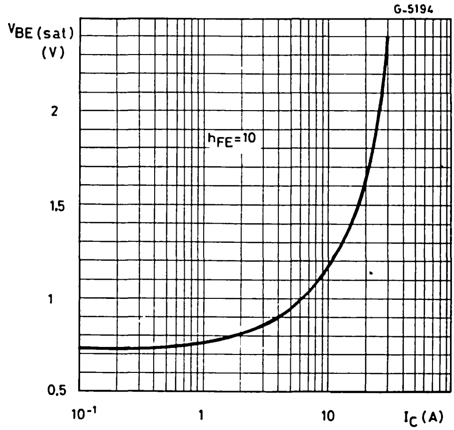


2N5629
2N6029

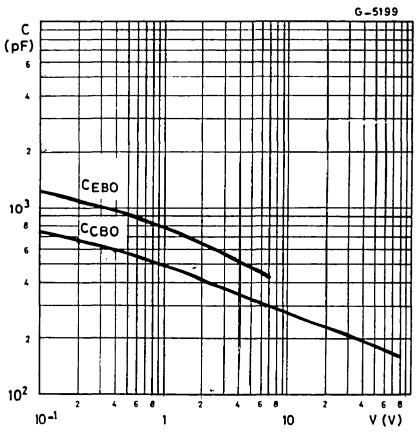
Base-emitter voltage (PNP type)



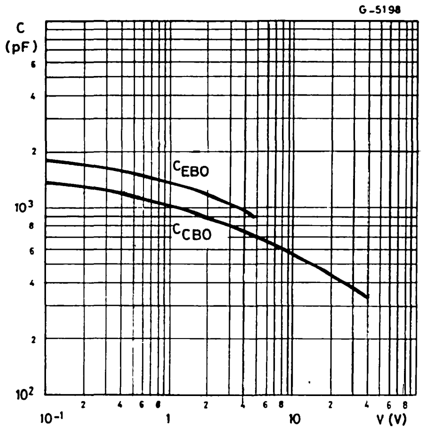
Base-emitter saturation voltage (PNP type)



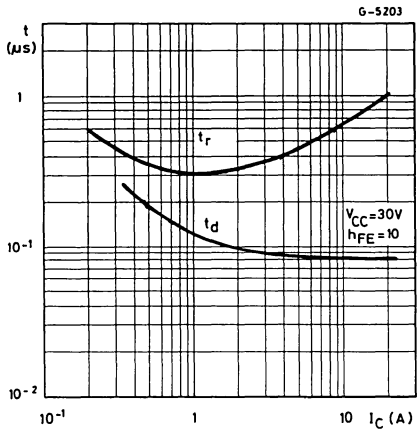
Capacitances (NPN type)



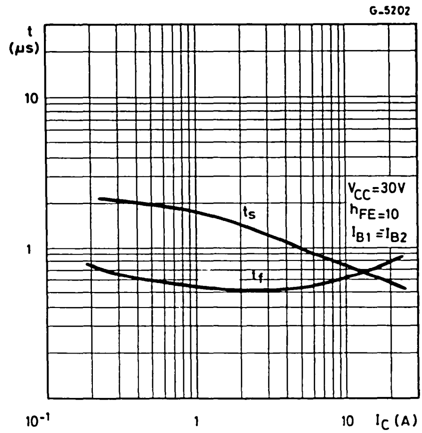
Capacitances (PNP type)



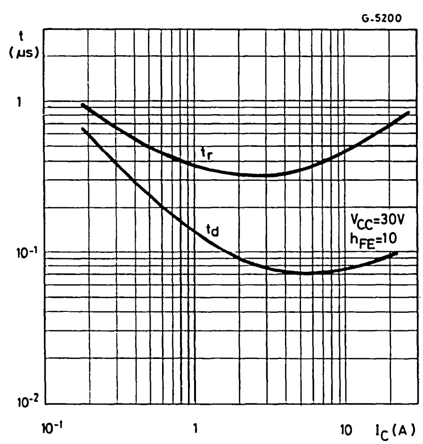
Turn-on time (NPN type)



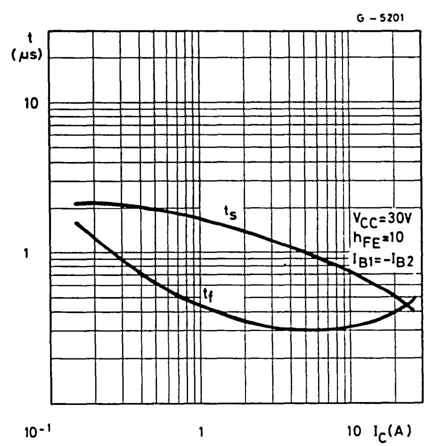
Turn-off time (NPN type)



Turn-on time (PNP type)



Turn-off time (PNP type)



2N5655
2N5656
2N5657

EPITAXIAL PLANAR NPN

PRELIMINARY DATA

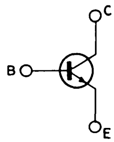
HIGH VOLTAGE POWER TRANSISTORS

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.

ABSOLUTE MAXIMUM RATINGS

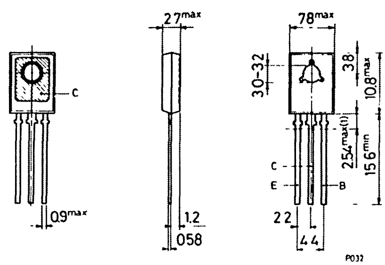
		2N5655	2N5656	2N5657
V_{CBO}	Collector-base voltage ($I_E = 0$)	275V	325V	375V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	250V	300V	350V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		6V	
I_C	Collector current		0.5A	
I_{CM}	Collector peak current		1A	
I_B	Base current		0.25A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$		20W	
T_{stg}	Storage temperature		−65 to 150°C	
T_j	Junction temperature		150°C	

INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm



(1) Within this region the cross-section of the leads is uncontrolled

TO-126 (SOT-32)

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)

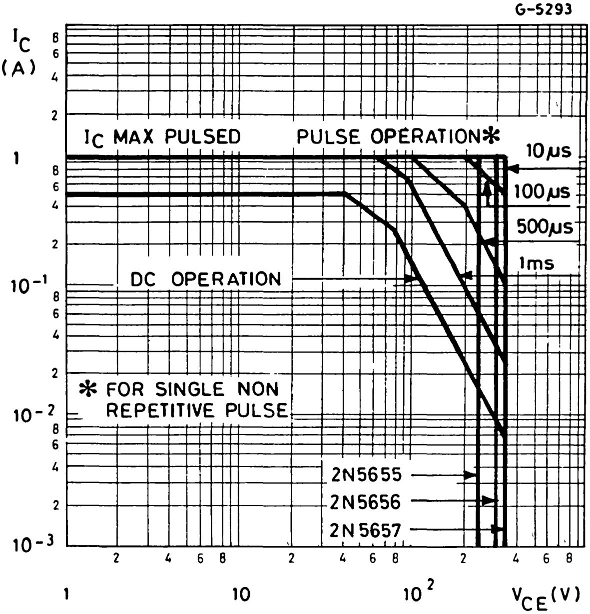
Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E=0$)	V_{CB} = rated V_{CBO}				10	μA
I_{CEV}	Collector cutoff current ($V_{BE}=-1.5V$)	V_{CE} = rated V_{CEO}				0.1	mA
		$T_{case}=100°C$					
		for **2N5655**	$V_{CE}=150V$			1	mA
		for **2N5656**	$V_{CE}=200V$			1	mA
		for **2N5657**	$V_{CE}=250V$			1	mA
I_{CEO}	Collector cutoff current ($I_B=0$)	for **2N5655**	$V_{CE}=150V$			0.1	mA
		for **2N5656**	$V_{CE}=200V$			0.1	mA
		for **2N5657**	$V_{CE}=250V$			0.1	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**	250			V
			for **2N5656**	300			V
			for **2N5757**	350			V
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage	$I_C=100mA$	for **2N5655**	250			V
		$L=50mH$	for **2N5656**	300			V
			for **2N5657**	350			V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C=0.1A$	$I_B=10mA$			1	V
		$I_C=0.25A$	$I_B=25mA$			2.5	V
		$I_C=0.5A$	$I_B=0.1A$			10	V

ELECTRICAL CHARACTERISTICS (Continued)

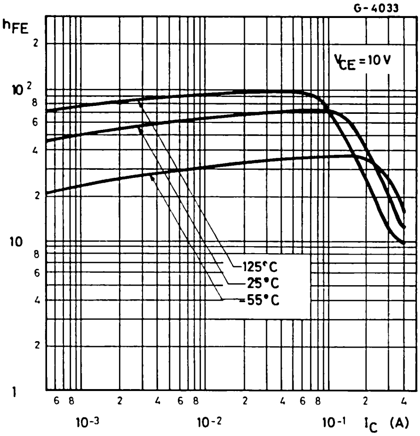
Parameter		Test conditions		Min.	Typ.	Max.	Unit
V_{BE}*	Base-emitter voltage	$I_C=0.1V$	$V_{CE}=10V$			1	V
h_{FE}*	DC current gain	$I_C=50mA$	$V_{CE}=10V$	25			—
		$I_C=0.1A$	$V_{CE}=10V$	30		250	—
		$I_C=0.25A$	$V_{CE}=10V$	15			—
		$I_C=0.5A$	$V_{CE}=10V$	5			—
h_{fe}	Small signal current gain	$I_C=0.1A$ $f=1KHz$	$V_{CE}=10V$	20			—
f_T	Transition frequency	$I_C=50mA$ $f=10MHz$	$V_{CE}=10V$	10			MHz
C_{CBO}	Collector-base capacitance	$V_{CB}=10V$	$f=100KHz$			25	pF

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

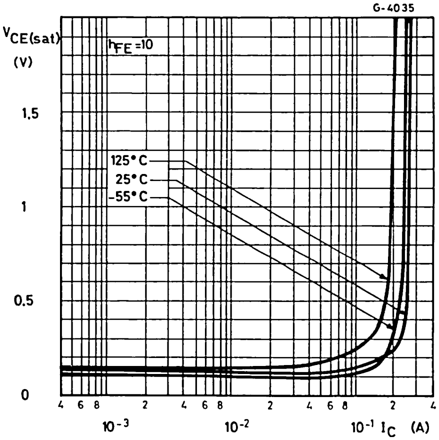
Safe operating areas



DC current gain



Collector-emitter saturation voltage



2N5671
2N5672

MULTIEPITAXIAL PLANAR NPN

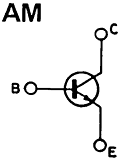
HIGH CURRENT FAST SWITCHING APPLICATIONS

The 2N 5671 and 2N 5672 are silicon multiepitaxial planar NPN transistors in Jedec TO-3 metal case.
They are especially intended for high current, fast switching industrial applications.

ABSOLUTE MAXIMUM RATINGS

		2N5671	2N5672
V_{CBO}	Collector-base voltage ($I_E = 0$)	120V	150V
V_{CEX}	Collector-emitter voltage ($V_{BE} =$ -1.5 V, $R_{BE} =$ 50 Ω)	120V	150V
V_{CER}	Collector-emitter voltage ($R_{BE} \leq$ 50 Ω)	110V	140V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	90V	120V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	7V	
I_C	Collector current	30A	
I_B	Base current	10A	
P_{tot}	Total power dissipation at $T_{case} \leqslant$ 25 °C	140W	
T_{stg}	Storage temperature	-65 to 200 °C	
T_j	Junction temperature	200 °C	

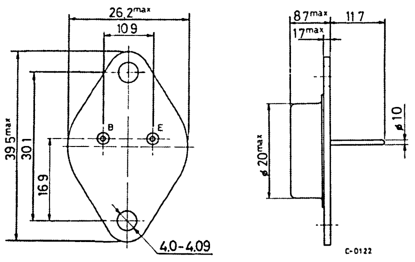
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

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)

Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CEV}	Collector cutoff current (V_{BE} = -1.5 V)	for **2N5671**	V_{CE} = 110 V			12	mA
		for **2N5672**	V_{CE} = 135 V			10	mA
		V_{CE} = 100V	T_{case} = 150°C				
			for **2N5671**			15	mA
			for **2N5672**			10	mA
I_{CEO}	Collector cutoff current (I_B = 0)	V_{CE} = 80 V				10	mA
I_{EBO}	Emitter cutoff current (I_C = 0)	V_{EB} = 7 V				10	mA
$V_{CEX\,(sus)}$*	Collector-emitter sustaining voltage (V_{BE} = -1.5V, R_{BE} = 50Ω)	I_C = 200 mA					
			for **2N5671**	120			V
			for **2N5672**	150			V
$V_{CER\,(sus)}$*	Collector-emitter sustaining voltage (R_{BE} = 50 Ω)	I_C = 200mA					
			for **2N5671**	110			V
			for **2N5672**	140			V
$V_{CEO\,(sus)}$*	Collector-emitter sustaining voltage (I_B = 0)	I_C = 200mA					
			for **2N5671**	90			V
			for **2N5672**	120			V
$V_{CE\,(sat)}$*	Collector-emitter saturation voltage	I_C = 15 A	I_B = 1.2 A			0.75	V
$V_{BE\,(sat)}$*	Base-emitter saturation voltage	I_C = 15 A	I_B = 1.2 A			1.5	V
V_{BE}*	Base-emitter voltage	I_C = 15 A	V_{CE} = 5 V			1.6	V
h_{FE}*	DC current gain	I_C = 15 A	V_{CE} = 2 V	20		100	—
		I_C = 20 A	V_{CE} = 5 V	20			—
f_T	Transition frequency	I_C = 2 A	V_{CE} = 10 V	50			MHz

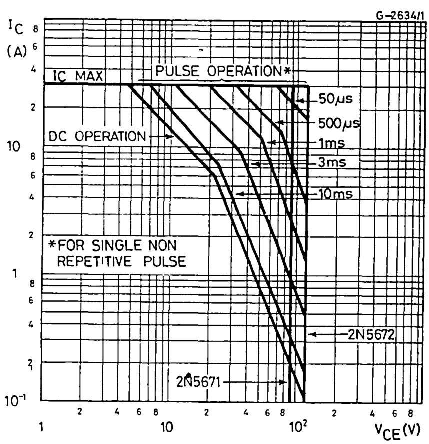
2N5671
2N5672

ELECTRICAL CHARACTERISTICS (continued)

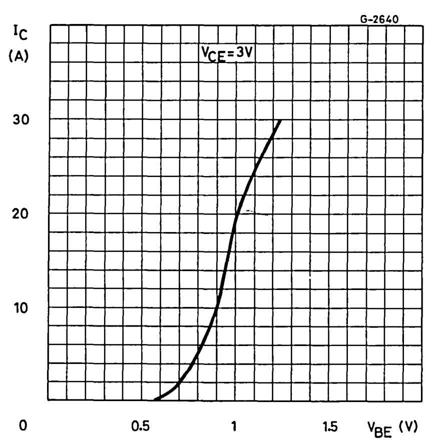
	Parameter	Test conditions	Min. Typ. Max.	Unit
C_{CBO}	Collector-base capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz	900	pF
t_{on}	Turn-on time	I_C = 15 A V_{CC} = 30 V I_{B1} = $-I_{B2}$ = 1.2A	0.5	μs
t_s	Storage time		1.5	μs
t_f	Fall time		0.5	μs
$I_{s/b}$**	Second breakdown collector current	V_{CE} = 24 V V_{CE} = 45 V	5.8 0.9	A A
$E_{s/b}$	Second breakdown energy	V_{BE} = -4 V, R_{BE} = 20 Ω L = 180 μH	20	mJ

* Pulsed: pulse duration = 300 μs, duty cycle = 1.5%
** Pulsed: 1 s, non repetitive pulse

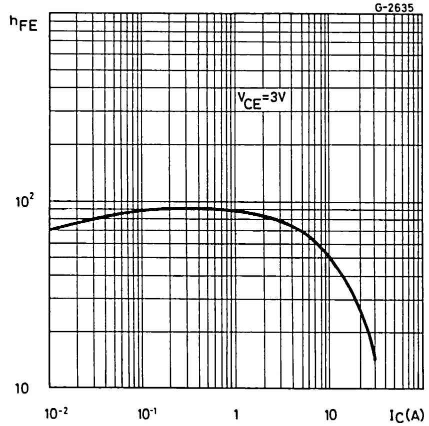
Safe operating areas



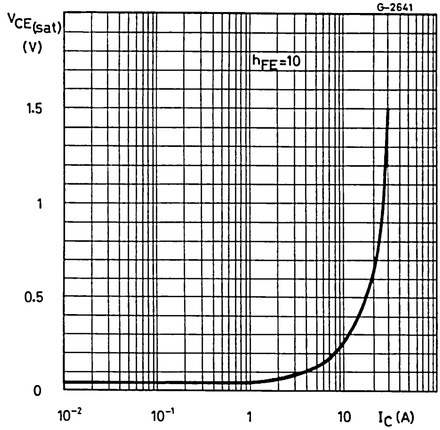
DC transconductance



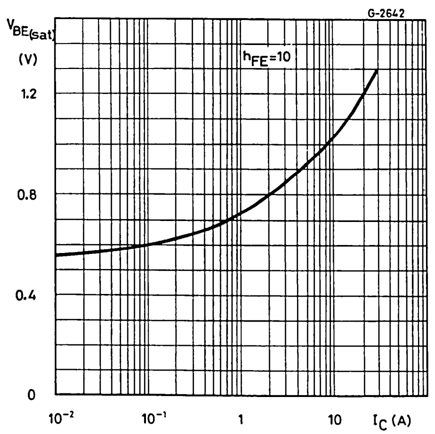
DC current gain



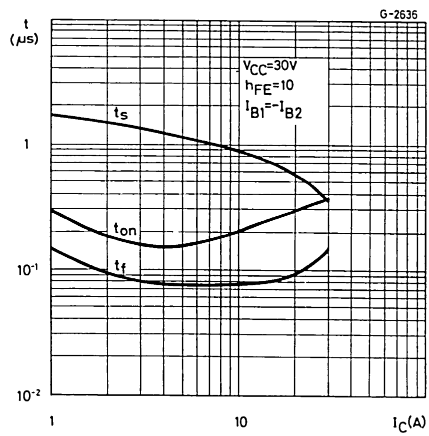
Collector-emitter saturation voltage



Base-emitter saturation voltage



Saturated switching characteristics



2N5679
2N5680

EPITAXIAL PLANAR PNP

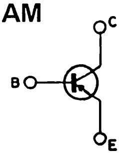
PNP SILICON TRANSISTORS

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.

ABSOLUTE MAXIMUM RATINGS

		2N5679	2N5680
V_{CBO}	Collector-base voltage ($I_E = 0$)	–100V	–120V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	–100V	–120V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	–4V	
I_C	Collector current	–1A	
I_B	Base current	–0.5A	
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$	10W	
	$T_{amb} \leq 25°C$	1W	
T_{stg}	Storage temperature	–65 to 200°C	
T_j	Junction temperature	200°C	

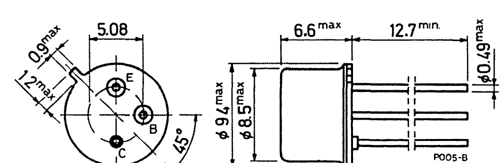
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-39

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)

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%.

2N5681
2N5682

EPITAXIAL PLANAR NPN

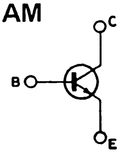
GENERAL PURPOSE TRANSISTORS

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.

ABSOLUTE MAXIMUM RATINGS

		2N5681	2N5682
V_{CBO}	Collector-base voltage ($I_E = 0$)	100V	120V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	100V	120V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	4V	
I_C	Collector current	1A	
I_B	Base current	0.5A	
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$	10W	
	$T_{amb} \leq 25°C$	1W	
T_{stg}	Storage temperature	−65 to 200°C	
T_j	Junction temperature	200°C	

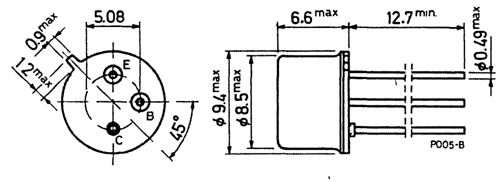
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-39

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)

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	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%.

2N5875
2N5876
2N5877
2N5878

EPITAXIAL-BASE NPN/PNP

SILICON HIGH POWER TRANSISTORS

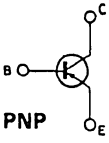
The 2N5877 and 2N5878 are silicon epitaxial-base NPN power transistors in Jedec TO-3 metal case. They are intended for use in power linear and switching applications. The complementary PNP types are the 2N5875 and 2N5876 respectively.

ABSOLUTE MAXIMUM RATINGS

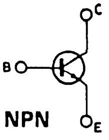
	NPN PNP*	2N5877 2N5875	2N5878 2N5876
V_{CBO}	Collector-base voltage ($I_E = 0$)	60V	80V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	60V	80V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5V	
I_C	Collector current	10A	
I_{CM}	Collector peak current	20A	
I_B	Base current	4A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	150W	
T_{stg}	Storage temperature	-65 to 200°C	
T_j	Junction temperature	200°C	

*** For PNP types voltage and current values are negative**

INTERNAL SCHEMATIC DIAGRAMS



PNP

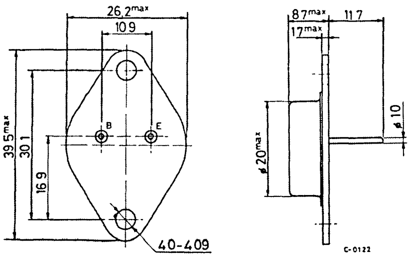


NPN

MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

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)

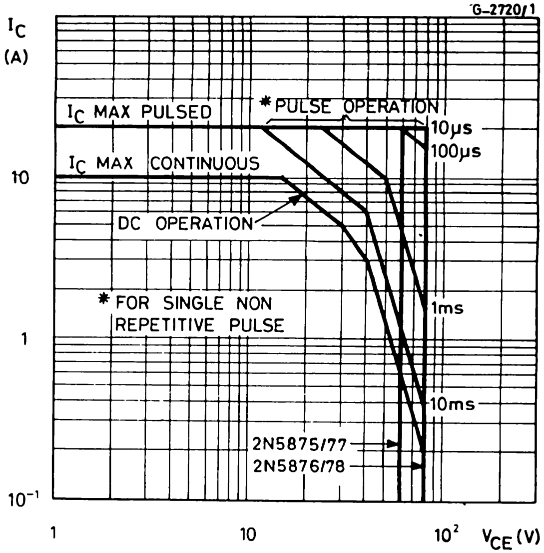
Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current (I_E = 0)	for **2N5877/75** V_{CB} = 60V for **2N5878/76** V_{CB} = 80V			0.5 0.5	mA mA
I_{CEO}	Collector cutoff current (I_B = 0)	for **2N5877/75** V_{CE} = 30V for **2N5878/76** V_{CE} = 40V			1 1	mA mA
I_{CEX}	Collector cutoff current (V_{BE} = 1.5V)	for **2N5877/75** V_{CE} = 60V for **2N5778/76** V_{CE} = 80V T_{case} = 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 saturation voltage	I_C = 10A I_C = 2.5A			2.5	V
V_{BE}*	Base-emitter volt.	I_C = 4A V_{CE} = 4V			1.5	V

ELECTRICAL CHARACTERISTICS (continued)

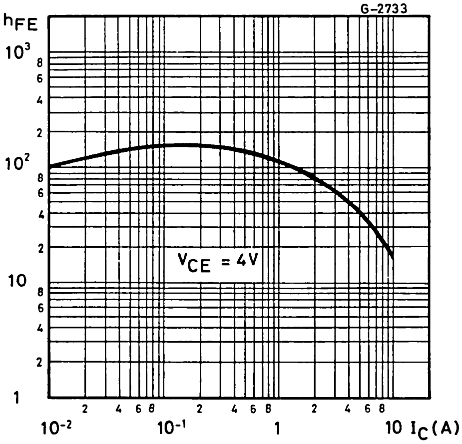
Parameter		Test conditions	Min.	Typ.	Max.	Unit
h_{FE}*	DC current gain	$I_C = 4A$ $V_{CE} = 4V$ $I_C = 10A$ $V_{CE} = 4V$	20 4		100	– –
f_T	Transition freq.	$I_C = 0.5A$ $V_{CE} = 10V$	4			MHz
C_{CBO}	Collector-base capacitance	$V_{CB} = 10V$ $f = 1MHz$ $I_E = 0$ for **2N5877/2N5878** for **2N5875/2N5876**			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

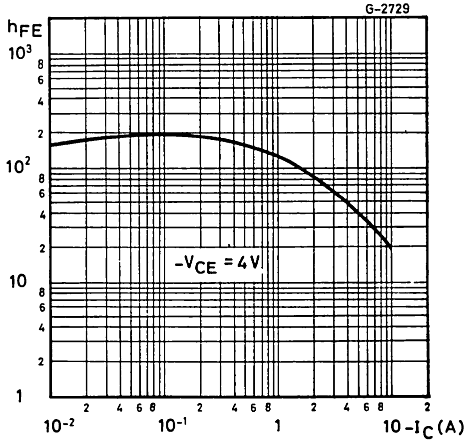
Safe operating areas



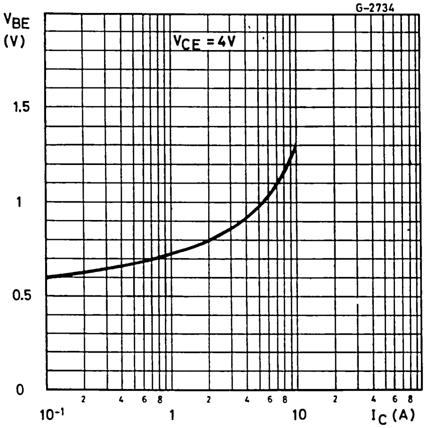
DC current gain (NPN types)



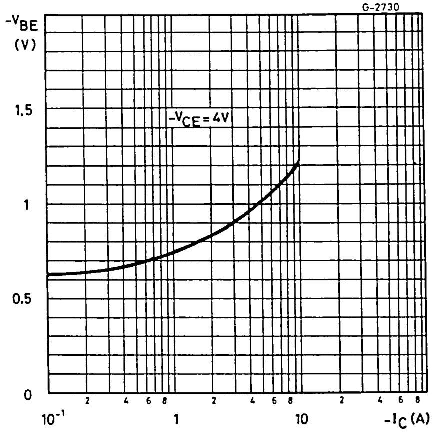
DC current gain (PNP types)



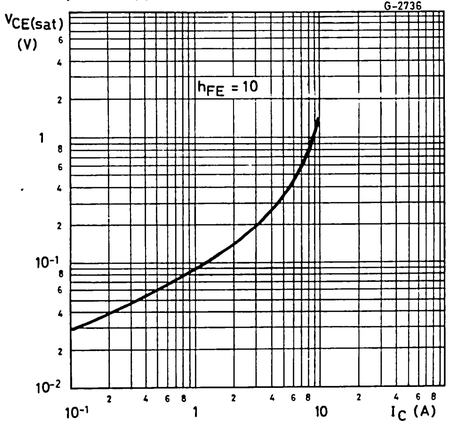
DC transconductance (NPN types)



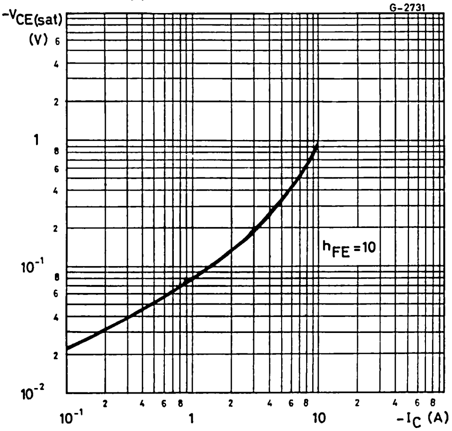
DC transconductance (PNP types)



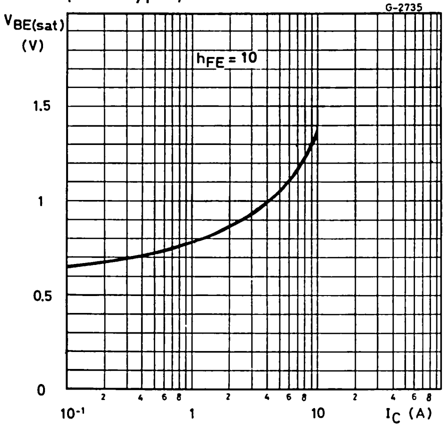
Collector-emitter saturation voltage (NPN types)



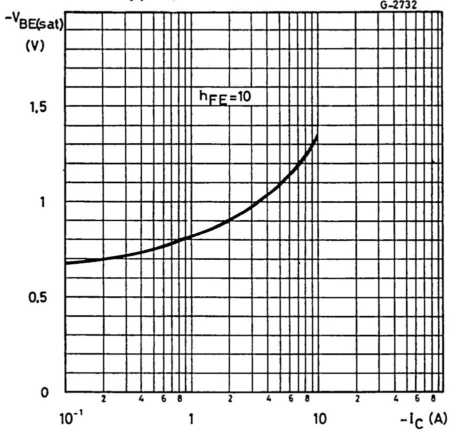
Collector-emitter saturation voltage (PNP types)



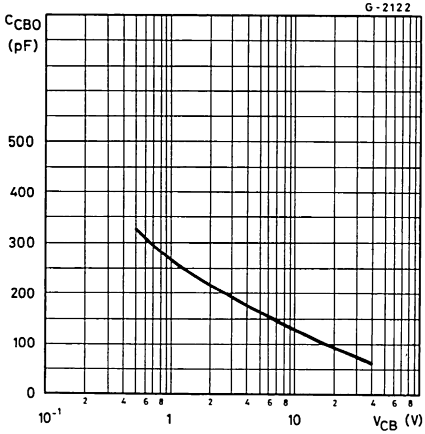
Base-emitter saturation voltage (NPN types)



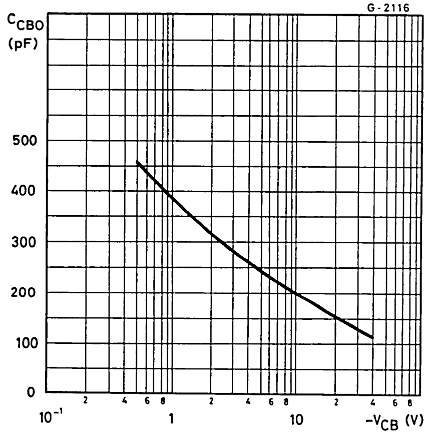
Base-emitter saturation voltage (PNP types)



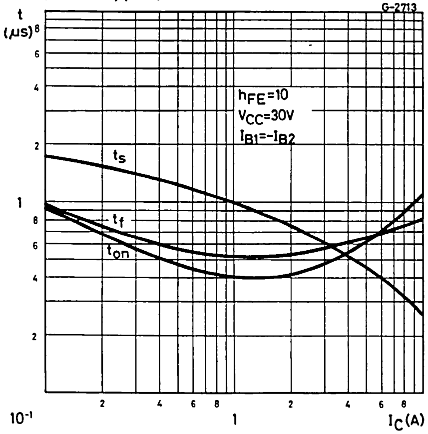
Collector-base capacitance (NPN types)



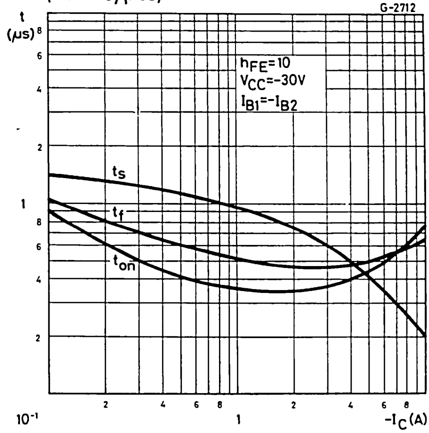
Collector-base capacitance (PNP types)



Saturated switching characteristics (NPN types)



Saturated switching characteristics (PNP types)



EPITAXIAL-BASE NPN/PNP

COMPLEMENTARY HIGH-POWER TRANSISTORS

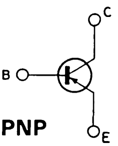
The 2N5885 and 2N5886 are silicon epitaxial-base NPN power transistors in Jedec T0-3 metal case, intend for power linear amplifiers and switching applications. The complementary PNP types are the 2N5883 and 2N5884.

ABSOLUTE MAXIMUM RATINGS

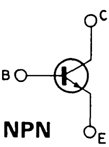
		PNP NPN	2N5883 2N5885	2N5884 2N5886
V_{CEO}	Collector-emitter voltage ($I_B = 0$)		60V	80V
V_{CBO}	Collector-base voltage ($I_E = 0$)		60V	80V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		5V	
I_C	Collector current		25A	
I_{CM}	Collector peak current		50A	
I_B	Base current		7.5A	
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$		200W	
T_{stg}	Storage temperature		-65 to 200°C	
T_j	Junction temperature		200°C	

For PNP types voltage and current values are negative.

INTERNAL SCHEMATIC DIAGRAM



PNP

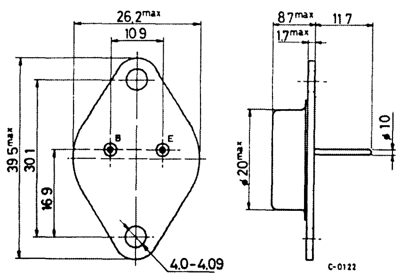


NPN

MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

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)

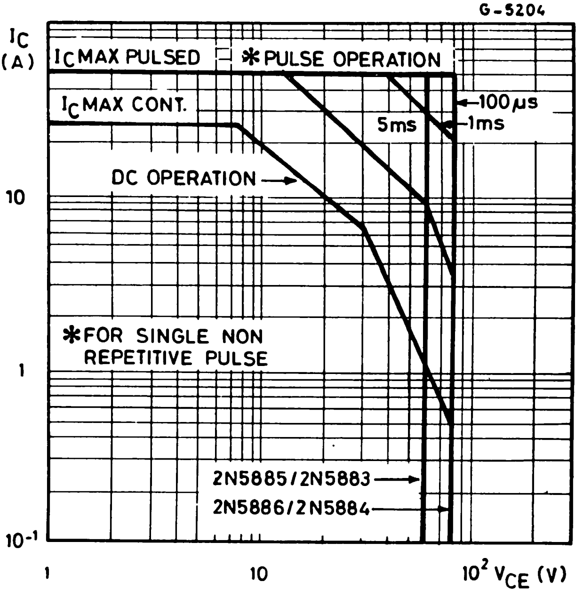
Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B = 0$)	for **2N5883/2N5885** $V_{CE} = 30V$ for **2N5884/2N5886** $V_{CE} = 40V$				2 2	mA mA
I_{CEV}	Collector cutoff current ($V_{BE} = -1.5V$)	V_{CE} = rated V_{CEO} $T_{case} = 150°C$ V_{CE} = rated V_{CEO}				1 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 **2N5883/2N5885** for **2N5884/2N5886**		60 80			V V
h_{FE}*	DC current gain	$I_C = 3A$ $I_C = 10A$ $I_C = 25A$	$V_{CE} = 4V$ $V_{CE} = 4V$ $V_{CE} = 4V$	35 20 4		 100	— — —
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C = 15A$ $I_C = 25A$	$I_B = 1.5A$ $I_B = 6.25A$			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

ELECTRICAL CHARACTERISTICS (Continued)

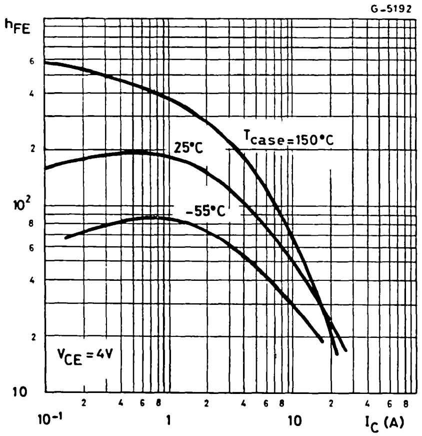
Parameter		Test conditions	Min. Typ. Max.	Unit
f_T	Transition frequency	$I_C = 1A$ $V_{CE} = 10V$ $f = 1MHz$	4	MHz
C_{CBO}	Collector base capacitance	$V_{CB} = 10V$ $I_E = 0$ $f = 1MHz$ for PNP types	500 1000	pF pF
h_{fe}	Small-signal current	$I_C = 3A$ $V_{CE} = 4V$ $f = 1KHz$	20	—
t_r	Rise time	$V_{CC} = 30V$ $I_C = 10A$	0.7	μs
t_s	Storage time	$I_{B1} = -I_{B2} = 1A$	1	μs
t_f	Fall time		0.8	μs

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

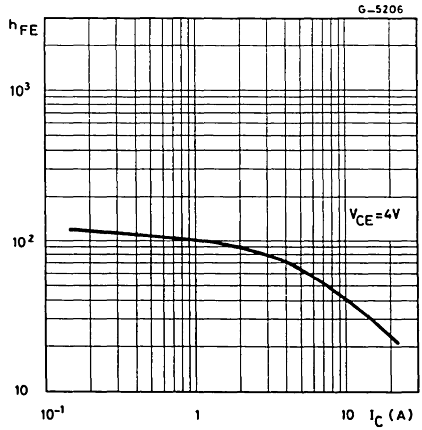
Safe operating areas



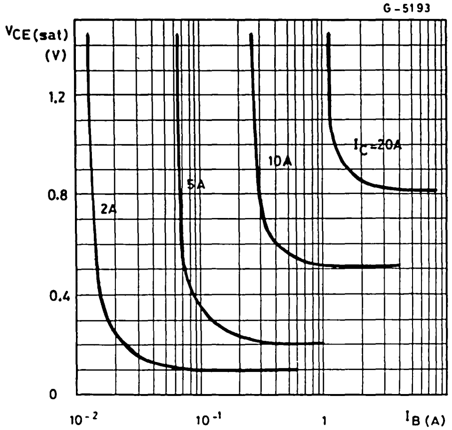
DC current gain (NPN types)



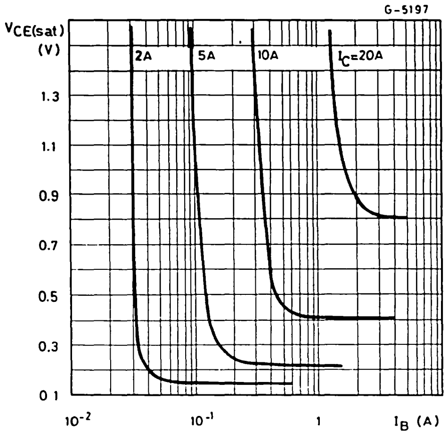
DC current gain (PNP types)



Collector-emitter saturation voltage (NPN types)

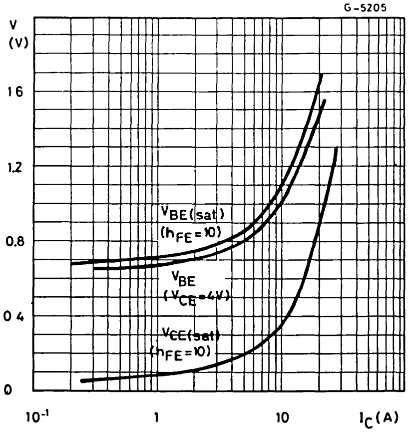


Collector-emitter saturation voltage (PNP types)

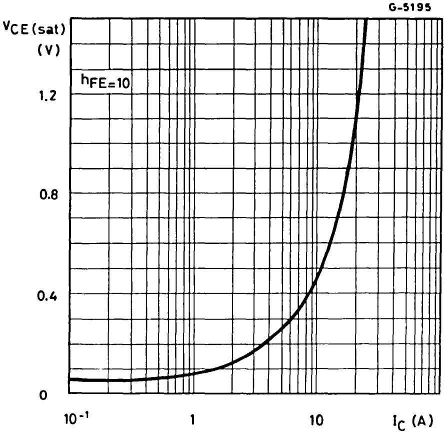


2N5883 2N5885
2N5884 2N5886

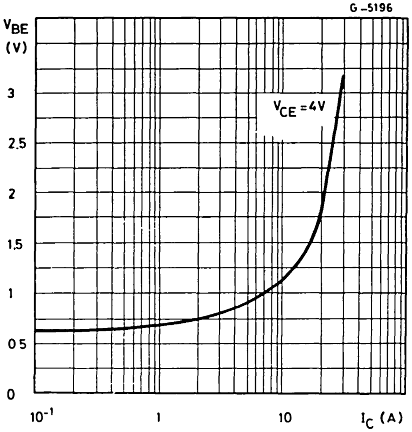
Saturation voltage (NPN types)



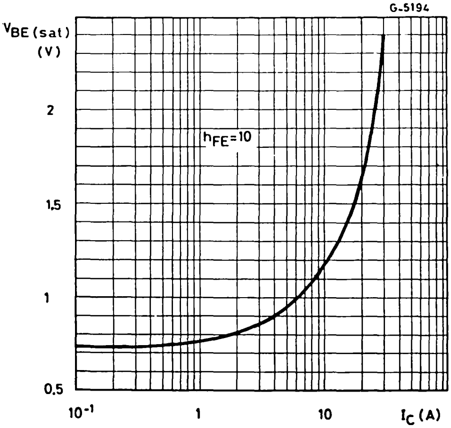
Collector-emitter saturation voltage (PNP types)



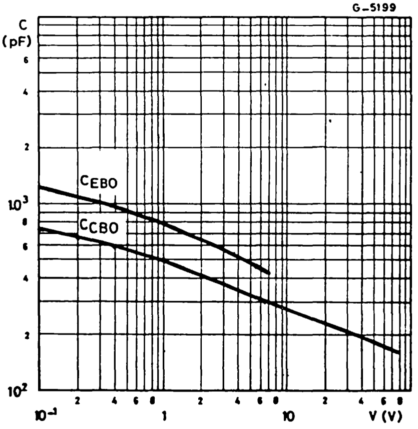
Base emitter voltage (PNP types)



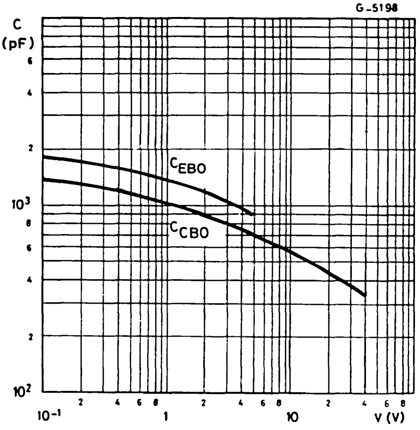
Base-emitter saturation voltage (PNP types)



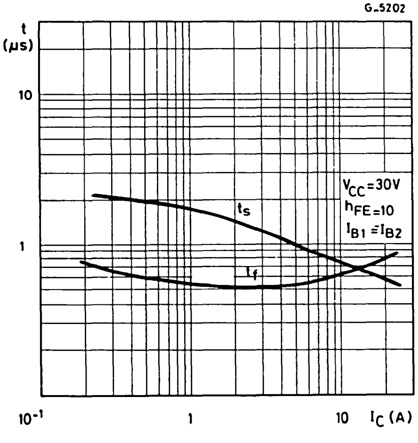
Capacitances (NPN types)



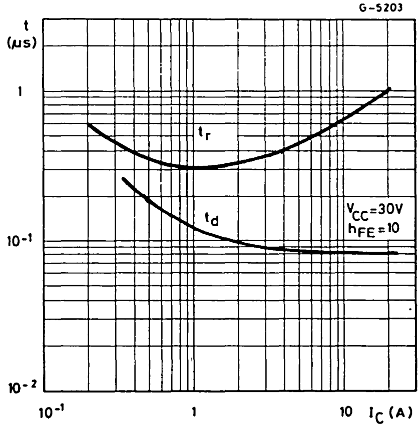
Capacitances (PNP types)



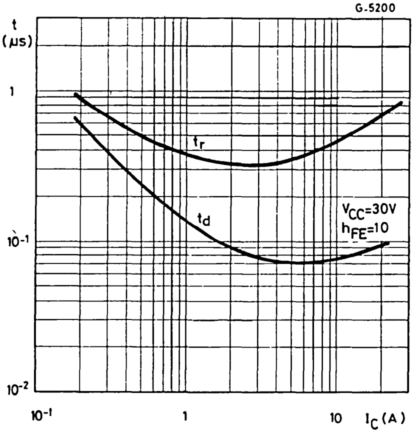
Turn-off time (NPN types)



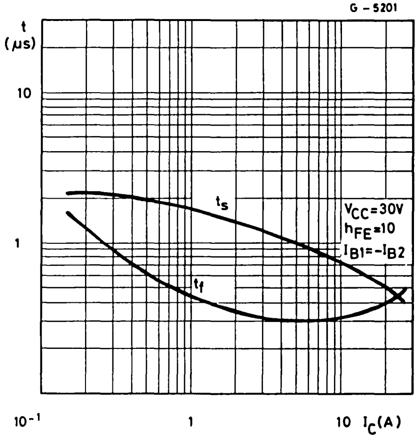
Turn-on time (NPN types)



Turn-on time (PNP types)



Turn-off time (PNP types)



MULTIEPITAXIAL PLANAR NPN

2N6032
2N6033

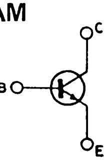
HIGH CURRENT, HIGH SPEED, HIGH POWER TRANSISTORS

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.

ABSOLUTE MAXIMUM RATINGS

		2N6032	2N6033
V_{CBO}	Collector-base voltage ($I_E = 0$)	120V	150V
V_{CEX}	Collector-emitter voltage ($V_{BE} = -1.5$ V, $R_{BE} = 50\ \Omega$)	120V	150V
V_{CER}	Collector-emitter voltage ($R_{BE} = 50\ \Omega$)	110V	140V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	90	120V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	7V	7V
I_C	Collector current	50A	40A
I_B	Base current	10A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25$ °C	140W	
T_{stg}	Storage temperature	-65 to 200 °C	
T_j	Junction temperature	200 °C	

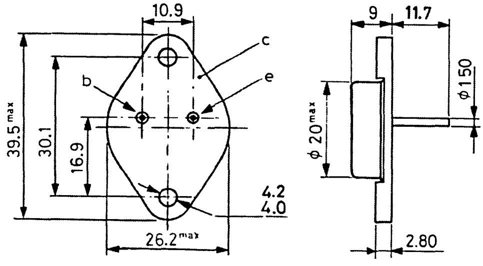
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



C - 0008/1

Modified TO-3

2N6032
2N6033

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)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector cutoff current (V_{BE} = -1.5 V)	for **2N6032**				
		V_{CE} = 110V			12	mA
		V_{CE} = 100V T_{case} = 150°C			15	mA
		for **2N6033**				
		V_{CE} = 135V			10	mA
		V_{CE} = 100V T_{case} = 150°C			10	mA
I_{CEO}	Collector cutoff current (I_B = 0)	V_{CE} = 80 V			10	mA
I_{EBO}	Emitter cutoff current (I_C = 0)	V_{EB} = 7 V			10	mA
$V_{CEX\ (sus)}$*	Collector-emitter sustaining voltage (V_{BE} = -1.5V, R_{BE} = 50Ω, L=2mH)	I_C = 200 mA				
		for **2N6032**	120			V
		for **2N6033**	150			V
$V_{CER\ (sus)}$*	Collector-emitter sustaining voltage (R_{BE}=50Ω, L=15mH)	I_C = 200mA				
		for **2N6032**	110			V
		for **2N6033**	140			V
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage (I_B = 0)	I_C = 200mA				
		for **2N6032**	90			V
		for **2N6033**	120			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	for **2N6032**				
		I_C = 50 A I_B = 5 A			1.3	V
		for **2N6033**				
		I_C = 40 A I_B = 4 A			1	V
$V_{BE\ (sat)}$*	Base-emitter saturation voltage	for **2N6032**				
		I_C = 50 A I_B = 5 A			2	V
		for **2N6033**				
		I_C = 40 A I_B = 4 A			2	V

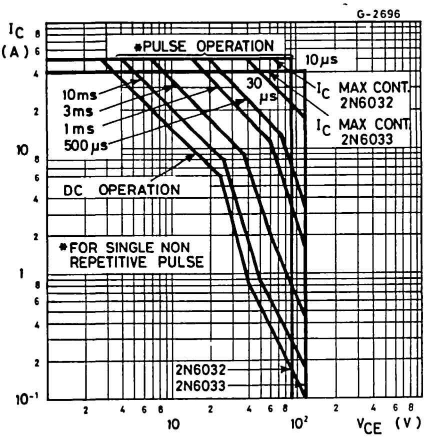
ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{BE}*	Base-emitter voltage	for **2N6032** I_C = 50 A V_{CE} = 2 V for **2N6033** I_C = 40 A V_{CE} = 2 V			 2 2	 V V
h_{FE}*	DC current gain	for **2N6032** I_C = 50 A V_{CE} = 2.6 V for **2N6033** I_C = 40 A V_{CE} = 2 V	 10 10		 50 50	 — —
h_{fe}	Small-signall current gain	I_C = 2 A V_{CE} = 10 V f = 5 MHz	10			—
C_{CBO}	Collector-base capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz			800	pF
t_r	Rise time	for **2N6032** I_C = 50 A V_{CC} = 30 V I_{B1} = $-I_{B2}$ = 5A for **2N6033** I_C = 40 A V_{CC} = 30 V 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} = 24 V V_{CE} = 40 V	5.8 0.9			A A
$E_{s/b}$	Second breakdown energy	V_{BE} = -4 V, R_{BE} = 5 Ω L = 310 µH	62			mJ

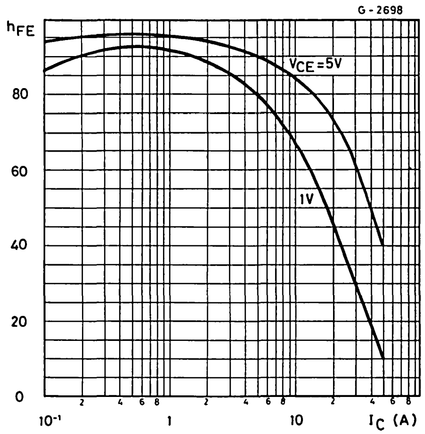
* Pulsed: pulse duration = 300 µs, duty cycle = 1.5%
** Pulsed: 1 s non repetitive pulse

2N6032
2N6033

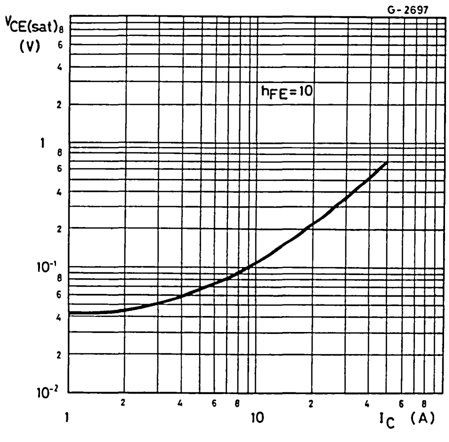
Safe operating areas



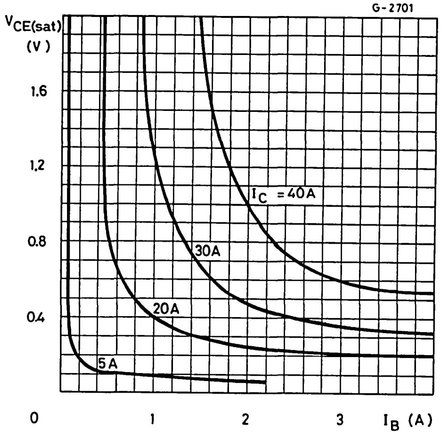
DC current gain



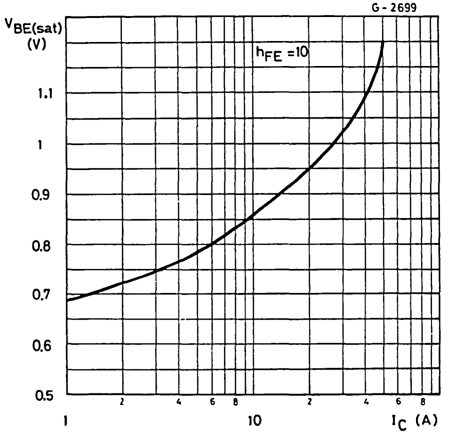
Collector-emitter saturation voltage



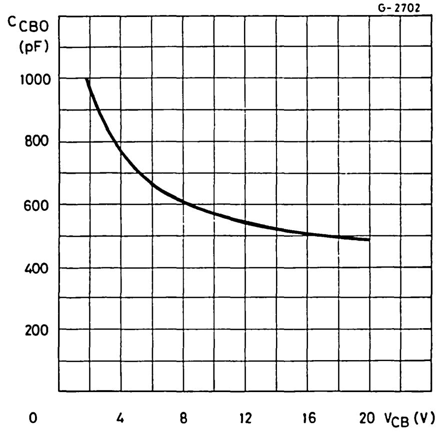
Collector-emitter saturation voltage



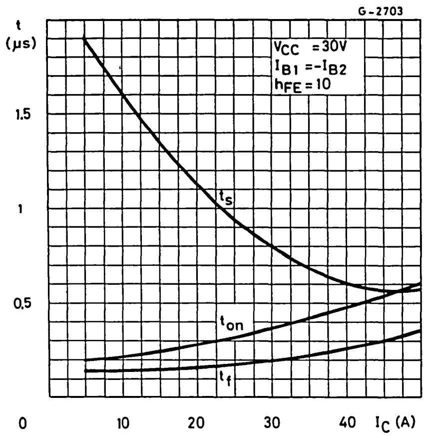
Base-emitter saturation voltage



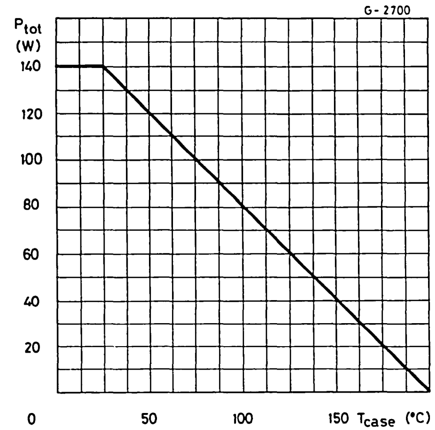
Collector-base capacitance



Saturated switching characteristics



Power rating chart



2N6037 2N6034
2N6038 2N6035
2N6039 2N6036

EPITAXIAL-BASE NPN / PNP

MEDIUM POWER DARLINGTONS

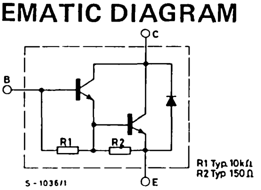
The 2N6037, 2N6038 and 2N6039 are silicon epitaxial-base NPN power transistors in monolithic Darlington configuration and are mounted in Jedec TO-126 plastic package.
They are intended for use in medium power linear and switching applications.

The complementary PNP types (the 2N6034, 2N6035 and 2N6036 respectively) have same characteristics of NPN types but voltage and current values are negative.

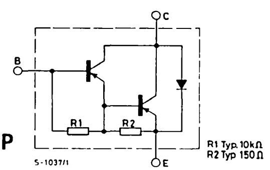
ABSOLUTE MAXIMUM RATINGS

		2N6037	2N6038	2N6039
V_{CBO}	Collector-base voltage ($I_E = 0$)	40V	60V	80V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	40V	60V	80V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5V		
I_C	Collector current	4A		
I_{CM}	Collector peak current	8A		
I_B	Base current	100mA		
P_{tot}	Total power dissipation at $T_{case} \leq 25\ ^\circ C$	40W		
T_{stg}	Storage temperature	-65 to 150 °C		
T_j	Junction tempetature	150 °C		

INTERNAL SCHEMATIC DIAGRAM



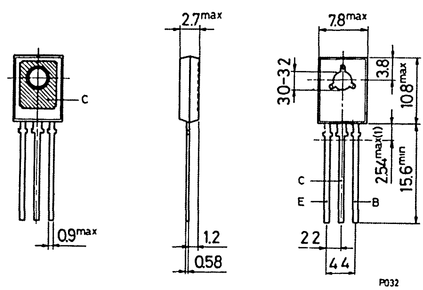
NPN



PNP

MECHANICAL DATA

Dimensions in mm



(1) Within this region the cross-section of the leads is uncontrolled

TO-126 (SOT-32)

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

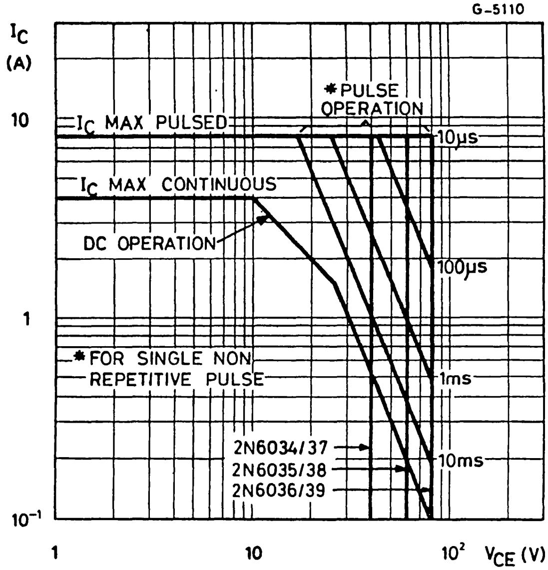
ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current (I_E = 0)	for **2N6037** V_{CB} = 40V for **2N6038** V_{CB} = 60V for **2N6039** V_{CB} = 80V			100 100 100	μA μA μA
I_{CEO}	Collector cutoff current (I_B = 0)	for **2N6037** V_{CE} = 40V for **2N6038** V_{CE} = 60V for **2N6039** V_{CE} = 80V			100 100 100	μA μA μA
I_{CEX}	Collector cutoff current (V_{EB} = 1.5V)	for **2N6037** V_{CE} = 40V for **2N6038** V_{CE} = 60V for **2N6039** V_{CE} = 80V T_{case} = 125 °C for **2N6037** V_{CE} = 40V for **2N6038** V_{CE} = 60V for **2N6039** 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 = 100 mA for **2N6037** for **2N6038** for **2N6039**	 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 = 1 MHz	25			– –
C_{CBO}	Collector-base capacitance	V_{CB} = 10V f = 1 MHz I_E = 0			(•) 100	pF

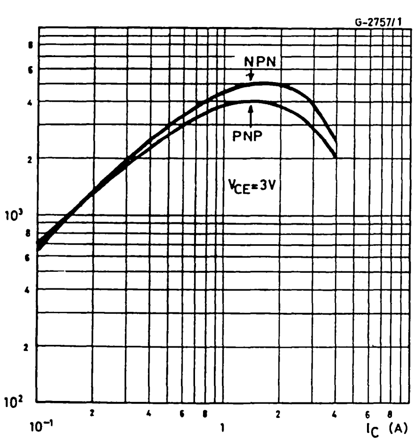
*Pulsed: pulse duration = 300 μs, duty cycle = 1.5%

(•) for PNP types 200 pF

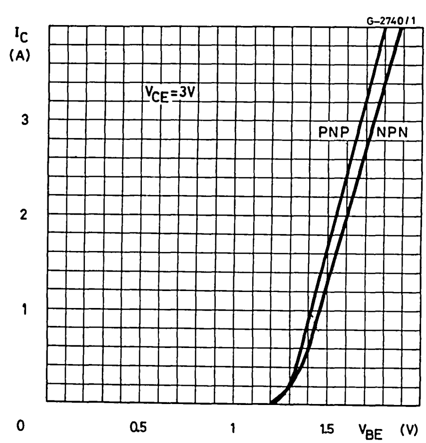
Safe operating areas



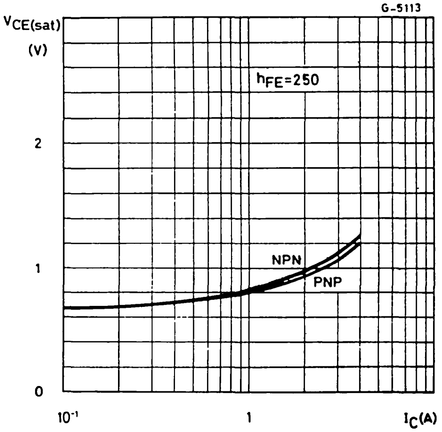
DC current gain



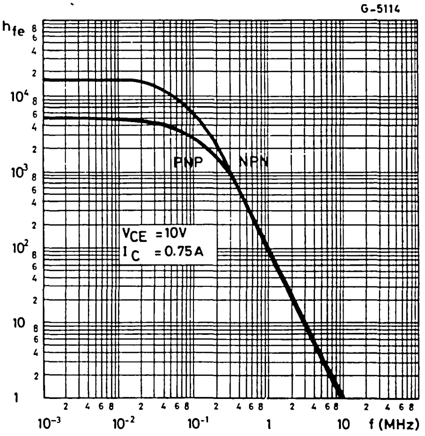
DC transconductance



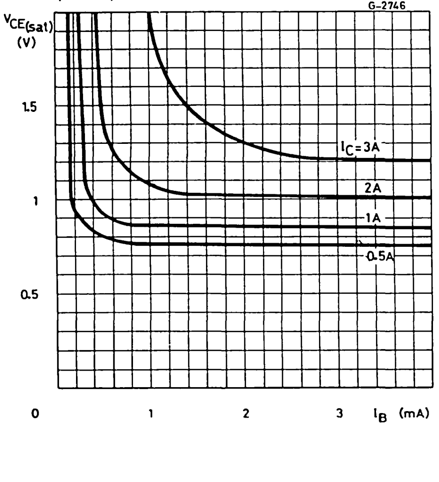
Collector-emitter saturation voltage



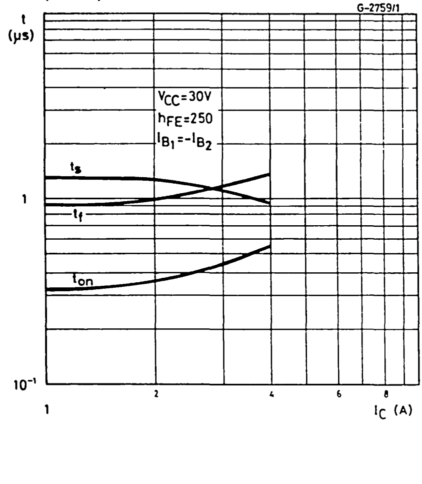
Small signal current gain



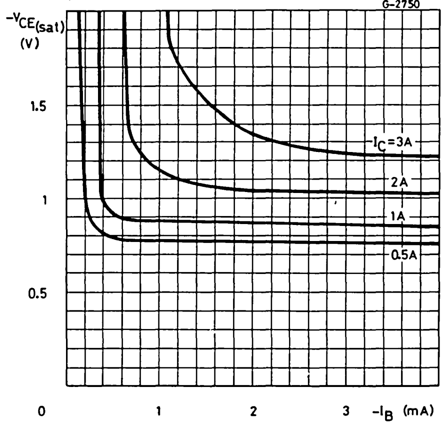
Collector-emitter saturation voltage (NPN)



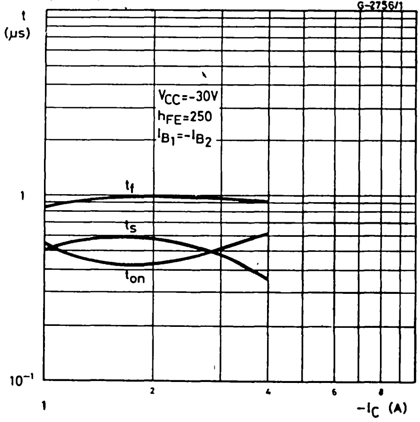
Saturated switching characteristics (NPN)



Collector-emitter saturation voltage (PNP)



Saturated switching characteristics (PNP)



EPITAXIAL-BASE NPN / PNP

2N6042
2N6045

ADVANCE DATA

GENERAL PURPOSE

The 2N6045 is a silicon epitaxial-base NPN transistor in monolitic Darlington configuration and is mounted in Jedec TO-200 plastic package. It is intended for use in power linear and switching applications. The complementary PNP type is the 2N6042.

ABSOLUTE MAXIMUM RATINGS

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

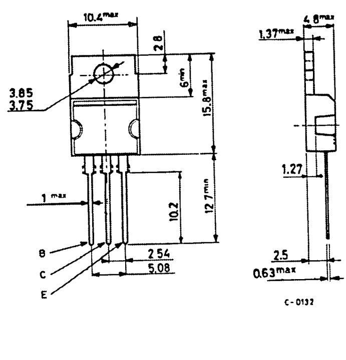
For PNP type voltage and current values are negative.

INTERNAL SCHEMATIC DIAGRAMS

MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

2N6042
2N6045

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)

Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 6V$				2	mA
I_{CEO}	Collector cutoff current ($I_B = 0$)	$V_{CE} = 100V$				20	μA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage	$I_C = 100mA$		100			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	$I_C = 3A$ $I_C = 8A$	$I_B = 12mA$ $I_B = 80mA$			2 4	V V
$V_{BE\ (sat)}$*	Basee-emitter saturation voltage	$I_C = 8A$	$I_B = 80mA$			4.5	V
$V_{BE\ (on)}$*	Base-emitter voltage	$I_C = 4A$	$V_{CE} = 4V$			2.8	V
h_{FE}	DC current gain	$I_C = 3A$ $I_C = 8A$	$V_{CE} = 4A$ $V_{CE} = 4V$	1000 100		10000	
h_{fe}	Small signal current gain	$I_C = 3A$ f = 1MHz	$V_{CE} = 4V$	4			
C_{CBO}	Collector-base capacitance (I_E=0)	$V_{CB} = 10V$	f = 1MHz			300	PF

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

2N6107 2N6292
2N6109 2N6290
2N6111 2N6288

EPITAXIAL-BASE NPN/PNP

GENERAL PURPOSE COMPLEMENTARY PAIRS

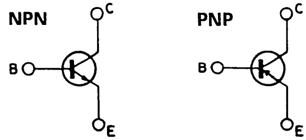
The 2N 6107, 2N 6109, 2N 6111, 2N 6288, 2N 6290 and 2N 6292 are epitaxial-base silicon transistors in Jedec TO-220 plastic package. They are intended for a wide variety of medium power switching and linear applications.
The PNP types are the 2N 6107, 2N 6109, 2N 6111 and their complementary NPN types are the 2N 6292, 2N 6290 and 2N 6288 respectively.

ABSOLUTE MAXIMUM RATINGS

		PNP°	2N6107	2N6109	2N6111
		NPN	2N6292	2N6290	2N6288
V_{CBO}	Collector-base voltage ($I_E = 0$)		80V	60V	40V
V_{CEX}	Collector-emitter voltage ($R_{BE} = 100\Omega$)		80V	60V	40V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)		70V	50V	30V
V_{EBO}	Emitter-base voltage ($I_C = 0$)			5V	
I_C	Collector current			7A	
I_B	Base current			3A	
P_{tot}	Total power dissipation at $T_{case} \leq 25$ °C			40W	
T_{stg}	Storage temperature			-65 to 150 °C	
T_j	Junction temperature			150 °C	

° For PNP devices voltage and current values are negative

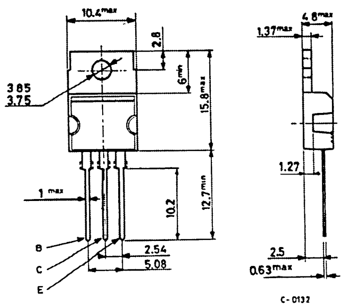
INTERNAL SCHEMATIC DIAGRAMS



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

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	70	°C/W

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

	Test conditions			2N6111		2N6109		2N6107		PNP
				2N6288		2N6290		2N6292		NPN
Parameter	V_{CE}(V)	I_C(A)	I_B(A)	Min.	Max.	Min.	Max.	Min.	Max.	Unit
I_{CEX} (V_{EB} = 1.5 V)	80								0.1	mA
	60						0.1			mA
	40				0.1					mA
T_{case} = 150 °C	70								2	mA
	50						2			mA
	30				2					mA
I_{CEO} ($I_B = 0$)	60								1	mA
	40						1			mA
	20				1					mA
I_{EBO} (V_{EB} = 5 V)		0			1		1		1	mA
$V_{CER\ (sus)}$* ($R_{BE} = 100\Omega$)		0.1		40		60		80		V
$V_{CEO\ (sus)}$*		0.1	0	30		50		70		V
$V_{CE\ (sat)}$*		2	0.2						1	V
		2.5	0.25				1			V
		3	0.3		1					V
		7	3		3.5		3.5		3.5	V
V_{BE}*	4	2							1.5	V
	4	2.5					1.5			V
	4	3			1.5					V
	4	7			3		3		3	V
h_{FE}*	4	2						30	150	—
	4	2.5				30	150			—
	4	3		30	150					—
	4	7		2.3		2.3		2.3		—
h_{fe} (f = 50 kHz)	4	0.5		20		20		20		—
f_T PNP types	4	0.5		10		10		10		MHz
f_T NPN types	4	0.5		4		4		4		MHz
C_{CBO} (f = 1MHz, V_{CB} = 10V)					250		250		250	pF

* Pulsed: pulse duration = 300 μs, duty cycle = 1.5%
° For PNP devices voltage and current values are negative
For characteristic curves see the BD 533 (NPN) and BD 534 (PNP) series

2N6121 2N6124
2N6122 2N6125
2N6123 2N6126

EPITAXIAL-BASE NPN / PNP

MEDIUM POWER LINEAR AND SWITCHING APPLICATIONS

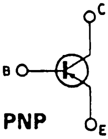
The 2N 6121, 2N 6122 and 2N 6123 are silicon epitaxial-base NPN power transistors in Jedec TO-220 plastic package, intended for use in medium power linear and switching applications.
The complementary PNP types are the 2N 6124, 2N 6125 and 6126 respectively.

ABSOLUTE MAXIMUM RATINGS

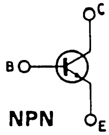
		NPN / PNP*	2N6121 / 2N6124	2N6122 / 2N6125	2N6123 / 2N6126
V_{CBO}	Collector-base voltage ($I_E = 0$)		45V	60V	80V
V_{CES}	Collector-emitter voltage ($V_{BE} = 0$)		45V	60V	80V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)		45V	60V	80V
V_{EBO}	Emitter-base voltage ($I_C = 0$)			5V	
I_C	Collector current			4A	
I_{CM}	Collector peak current			7A	
I_B	Base current			1A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$			40W	
T_{stg}	Storage temperature			-65 to 150°C	
T_j	Junction temperature			150°C	

*** For PNP types voltage and current values are negative**

INTERNAL SCHEMATIC DIAGRAMS



PNP

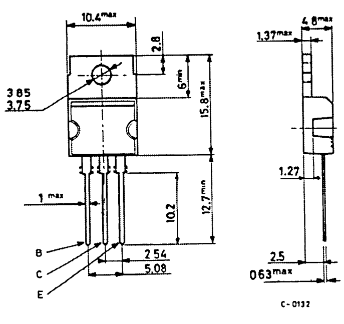


NPN

MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

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

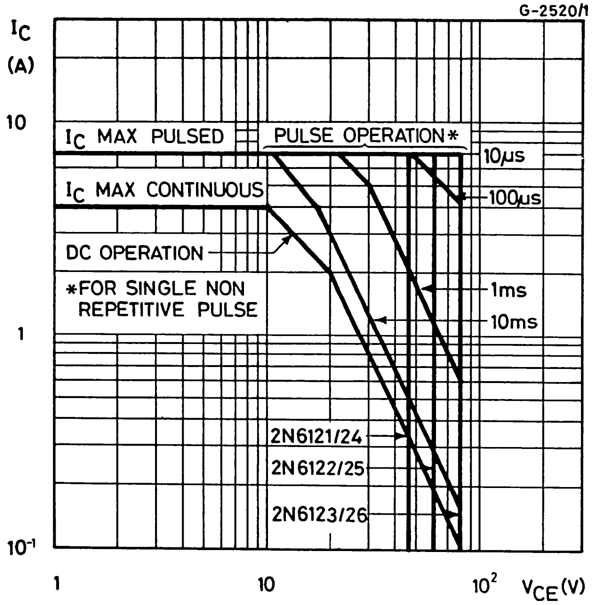
ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	for **2N6121/24** V_{CB} = 45 V			100	μA
		for **2N6122/25** V_{CB} = 60 V			100	μA
		for **2N6123/26** V_{CB} = 80 V			100	μA
I_{CEX}	Collector cutoff current (V_{BE} = -1.5V)	for **2N6121/24** V_{CE} = 45 V			100	μA
		for **2N6122/25** V_{CE} = 60 V			100	μA
		for **2N6123/26** V_{CE} = 80 V			100	μA
		T_{case} = 125 °C				
		for **2N6121/24** V_{CE} = 45 V			2	mA
		for **2N6122/25** V_{CE} = 60 V			2	mA
		for **2N6123/26** V_{CE} = 80 V			2	mA
I_{CEO}	Collector cutoff current ($I_B = 0$)	for **2N6121/24** V_{CE} = 45 V			1	mA
		for **2N6122/25** V_{CE} = 60 V			1	mA
		for **2N6123/26** V_{CE} = 80 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 **2N6121/24**	45			V
		for **2N6122/25**	60			V
		for **2N6123/26**	80			V
$V_{CE\,(sat)}$*	Collector-emitter saturation voltage	I_C = 1.5A I_B = 0.15A			0.6	V
		I_C = 4 A I_B = 1A			1 4	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**	25		100	—
		for **2N6122/25**	25		100	—
		for **2N6123/26**	20		80	—
		I_C = 4 A V_{CE} = 2 V				
		for **2N6121/24**	10			—
		for **2N6122/25**	10			—
		for **2N6123/26**	7			—
h_{fe}	Small signal current gain	I_C = 1 A V_{CE} = 4 V f = 1 MHz	2.5			—

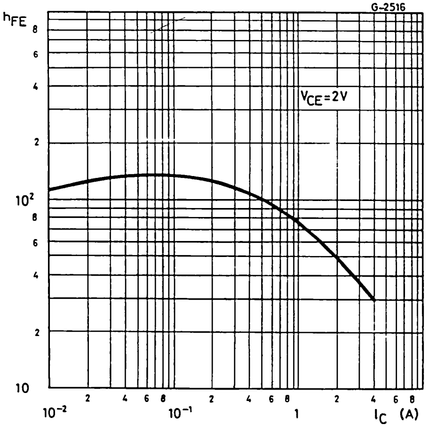
* Pulsed: pulse duration = 300 μs, duty cycle = 1.5%

For PNP types voltage and current values are negative

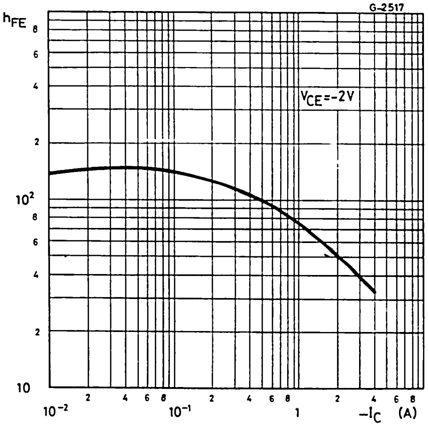
Safe operating areas



DC current gain (NPN types)

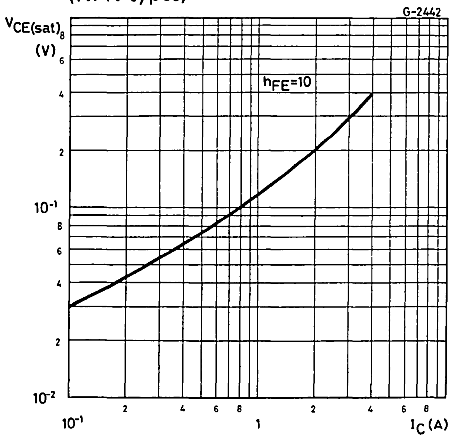


DC current gain (PNP types)

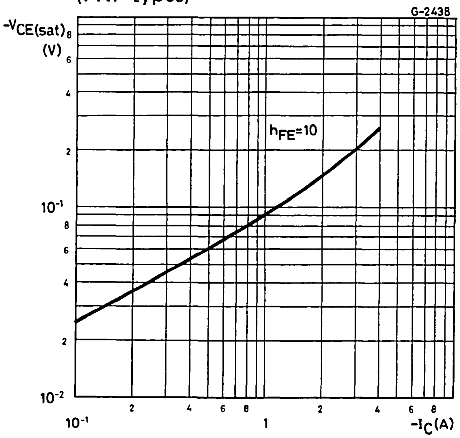


2N6121 2N6124
2N6122 2N6125
2N6123 2N6126

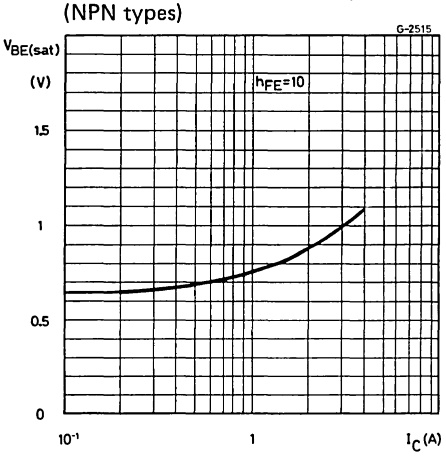
Collector-emitter saturation voltage (NPN types)



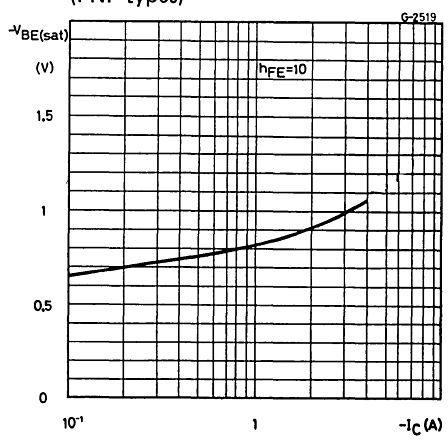
Collector-emitter saturation voltage (PNP types)



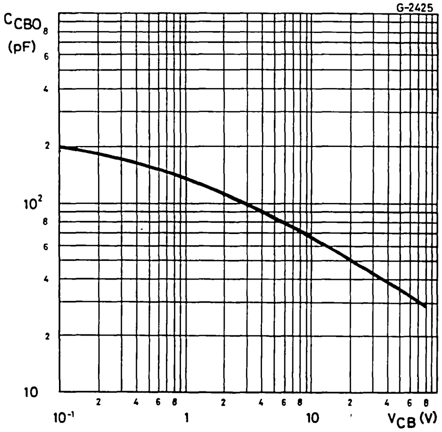
Base-emitter saturation voltage (NPN types)



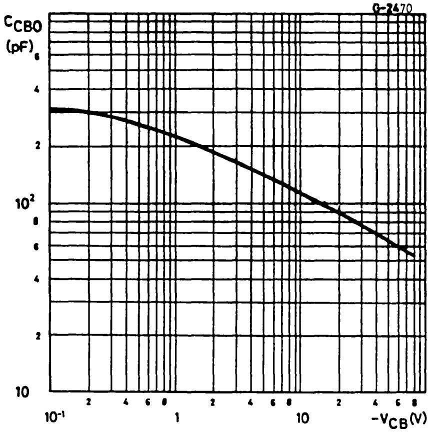
Base-emitter saturation voltage (PNP types)



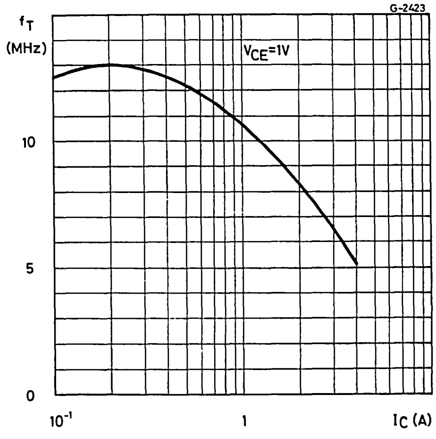
Collector-base capacitance (NPN types)



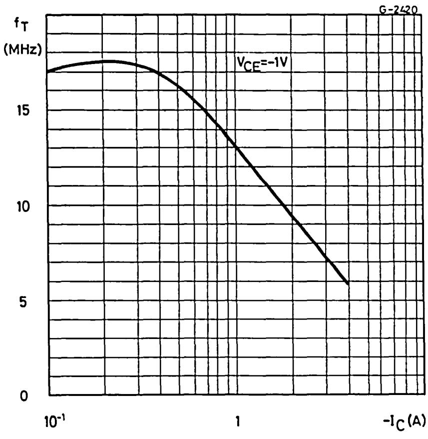
Collector-base capacitance (PNP types)



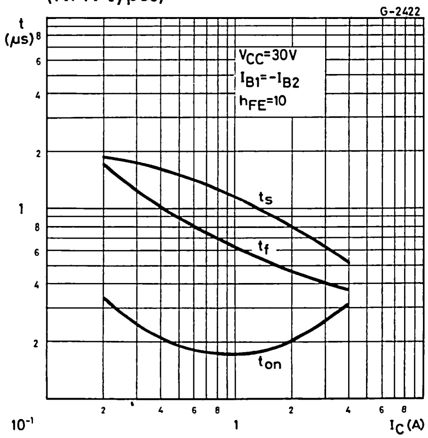
Transition frequency (NPN types)



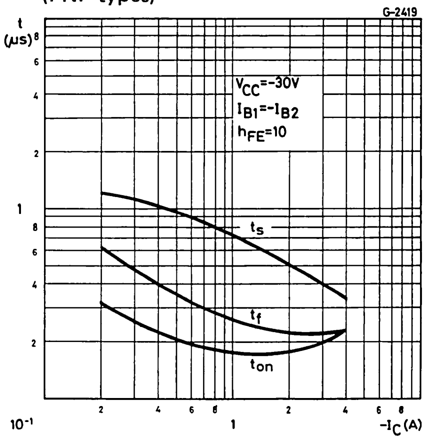
Transition frequency (PNP types)



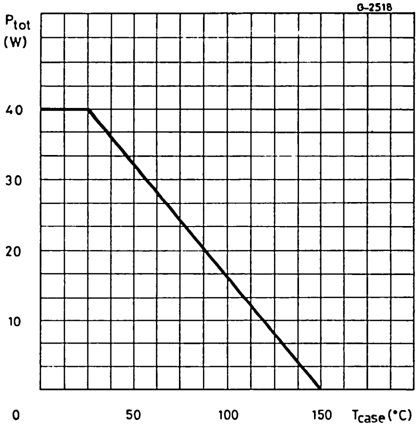
Saturated switching characteristics (NPN types)



Saturated switching characteristics (PNP types)



Power rating chart



EPITAXIAL-BASE NPN/PNP

2N6282 2N6285
2N6283 2N6286
2N6284 2N6287

COMPLEMENTARY POWER DARLINGTONS

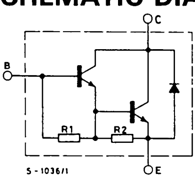
The 2N6282, 2N6283, 2N6284 and the complementary PNP types 2N6285, 2N6286, 2N6287 are epitaxial-base silicon transistors in monolithic Darlington configuration in Jedec TO-3 metal case. They are intended for general-purpose amplifier and low-frequency switching applications.

		NPN	2N6282	2N6283	2N6284
ABSOLUTE MAXIMUM RATINGS		PNP	2N6285	2N6286	2N6287
V_{CEO}	Collector-emitter voltage ($I_B = 0$)		60V	80V	100V
V_{CBO}	Collector-base voltage ($I_E = 0$)		60V	80V	100V
V_{EBO}	Emitter-base voltage ($I_C = 0$)			5V	
I_C	Collector current			20A	
I_{CM}	Collector peak current			40A	
I_B	Base current			0.5A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$			160W	
T_{stg}	Storage temperature			−65 to 200°C	
T_j	Junction temperature			200°C	

For PNP types voltage and current values are negative

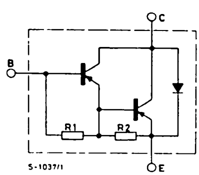
INTERNAL SCHEMATIC DIAGRAMS

NPN



R1 ≅ 8KΩ
R2 ≅ 60Ω

PNP

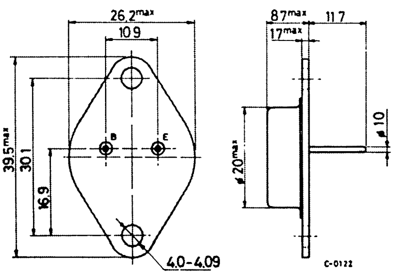


R1 ≅ 8KΩ
R2 ≅ 60Ω

MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

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)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector cutoff current ($I_B = 0$)	for **2N6282, 2N6285** $V_{CE} = 30V$			1	mA
		for **2N6283, 2N6286** $V_{CE} = 40V$			1	mA
		for **2N6284, 2N6287** $V_{CE} = 50V$			1	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}			0.5	mA
		$V_{CE} =$ rated V_{CBO} $T_{case} = 150°C$			5	mA
$V_{CEO(sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 0.1A$ for **2N6282, 2N6285**	60			V
		for **2N6283, 2N6286**	80			V
		for **2N6284, 2N6287**	100			V
$V_{CE(sat)}$*	Collector-emitter saturation voltage	$I_C = 10A$ $I_B = 40mA$			2	V
		$I_C = 20A$ $I_B = 200mA$			3	V
$V_{BE(sat)}$*	Base-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

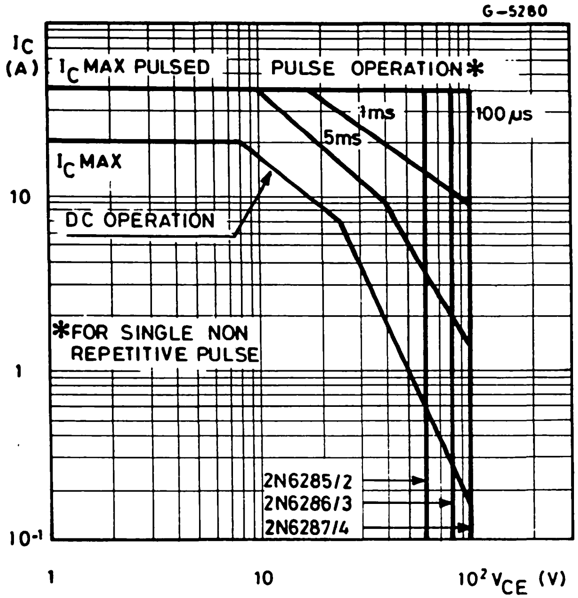
ELECTRICAL CHARACTERISTICS (Continued)

Parameter		Test conditions		Min.	Typ.	Max.	Unit
h_{FE}*	DC current gain	$I_C=10A$ $I_C=20A$	$V_{CE}=3V$ $V_{CE}=3V$	750 100		18000	— —
C_{CBO}	Collector-base capacitance	$V_{CB}=10V$ $f=0.1MHz$ for **2N6282, 2N6283, 2N6284** for **2N6285, 2N6286, 2N6287**	$I_E=0$			400 600	pF pF
h_{fe}	Small signal current gain	$I_C=10A$ $f=1KHz$	$V_{CE}=3V$	300			—

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

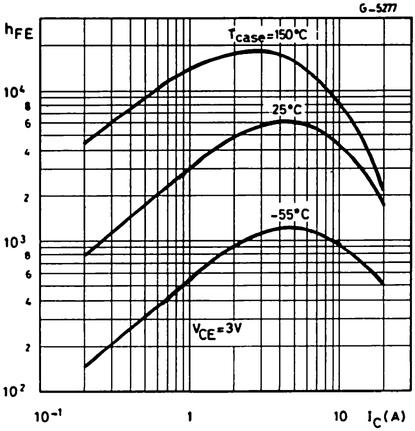
For PNP types voltage and current values are negative

Safe operating areas

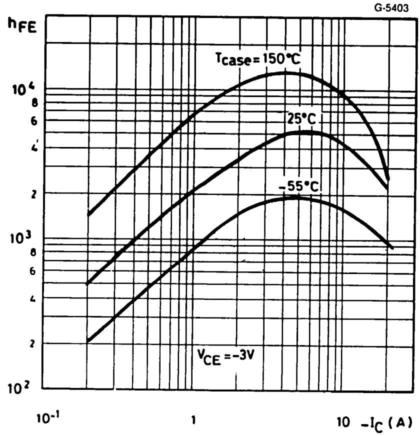


2N6282 2N6285
2N6283 2N6286
2N6284 2N6287

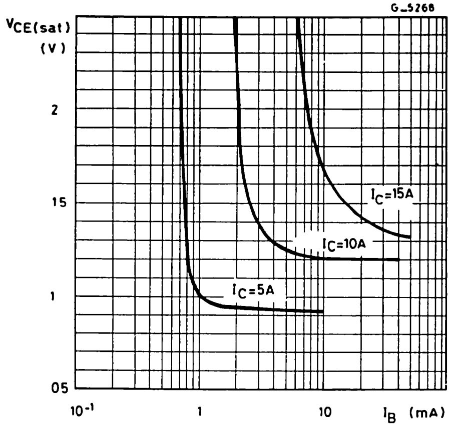
DC current gain (NPN types)



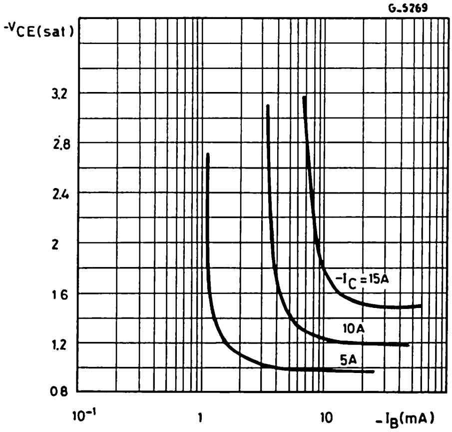
DC current gain (PNP types)



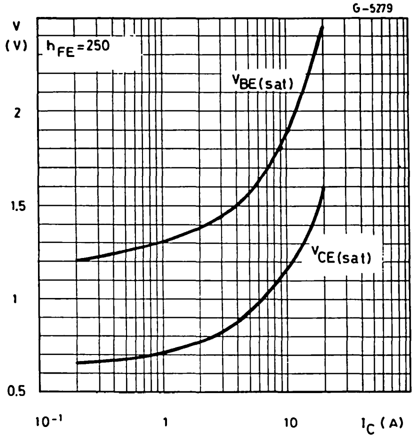
Collector-emitter saturation voltage
(NPN types)



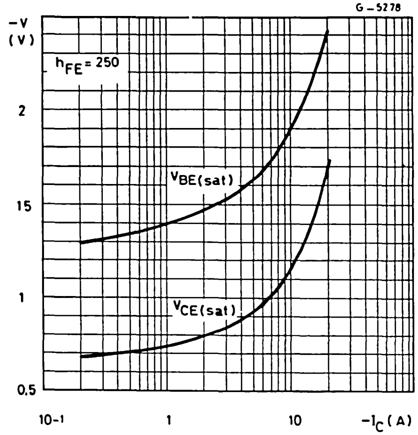
Collector-emitter saturation voltage
(PNP types)



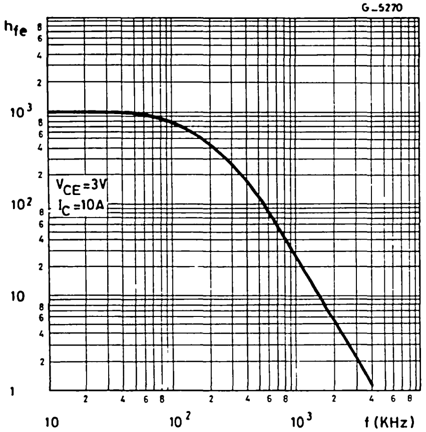
Saturation voltages (NPN types)



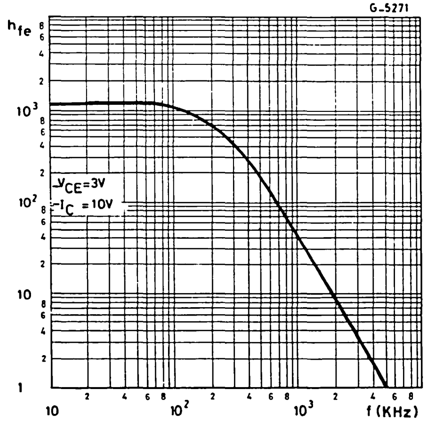
Saturation voltages (PNP types)



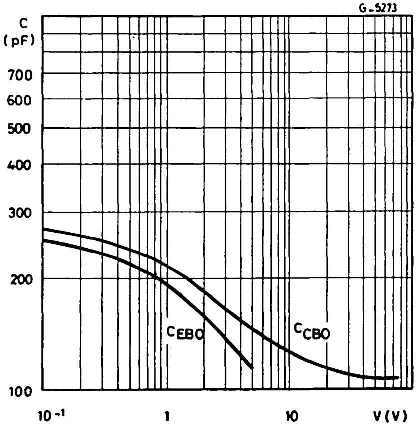
Small signal current gain (NPN types)



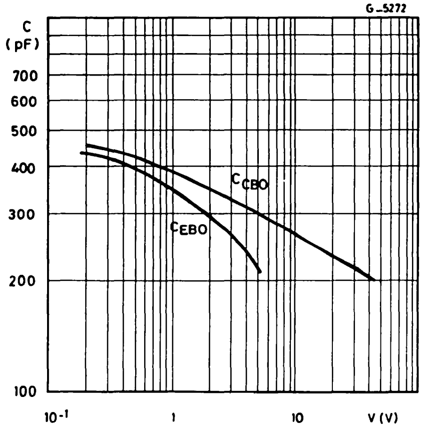
Small signal current gain (PNP types)



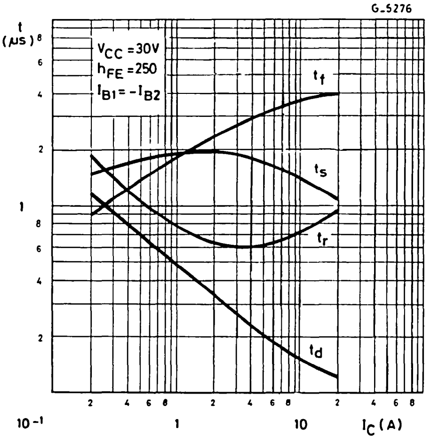
Capacitances (NPN types)



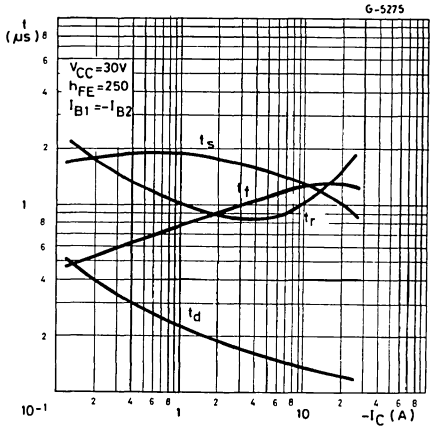
Capacitances (PNP types)



Saturated switching times (NPN types)



Saturated switching times (PNP types)



EPITAXIAL-BASE NPN

2N6386
2N6387
2N6388

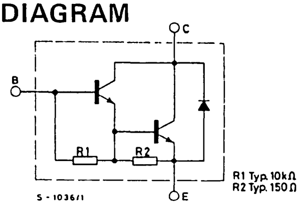
POWER DARLINGTON TRANSISTORS

The 2N 6386, 2N 6387 and 2N 6388 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.

ABSOLUTE MAXIMUM RATINGS

		2N6386	2N6387	2N6388
V_{CBO}	Collector-base voltage ($I_B = 0$)	40V	60V	80V
V_{CEV}	Collector-emitter voltage ($V_{BE} = -1.5$ V)	40V	60V	80V
V_{CER}	Collector-emitter voltage ($R_{BE} \leq 100\Omega$)	40V	60V	80V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	40V	60V	80V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5V	5V	5V
I_C	Collector current	8A	10A	10A
I_{CM}	Collector peak current		15A	
I_B	Base current		250mA	
P_{tot}	Total power dissipation at $T_{case} \leq 25$ °C		65W	
T_{stg}	Storage temperature		-65 to 150 °C	
T_j	Junction temperature		150 °C	

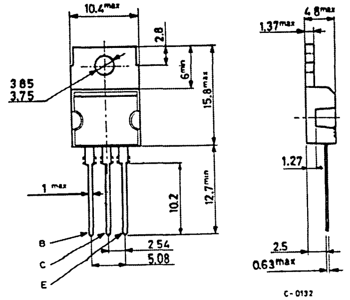
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

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)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector cutoff current (V_{BE} = -1.5 V)	V_{CE} = 40 V for **2N6386**			0.3	mA
		V_{CE} = 60V for **2N6387**			0.3	mA
		V_{CE} = 80 V for **2N6388**			0.3	mA
		T_{case} = 125°C				
		V_{CE} = 40 V for **2N6386**			3	mA
		V_{CE} = 60 V for **2N6387**			3	mA
		V_{CE} = 80 V for **2N6388**			3	mA
I_{CEO}	Collector cutoff current (I_B = 0)	V_{CE} = 40 V for **2N6386**			1	mA
		V_{CE} = 60 V for **2N6387**			1	mA
		V_{CE} = 80 V for **2N6388**			1	mA
I_{EBO}	Emitter-base current (I_C = 0)	V_{EB} = 5 V			5	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage (I_B = 0)	I_C = 200 mA				
		for **2N6386**	40			V
		for **2N6387**	60			V
		for **2N6388**	80			V
$V_{CER\ (sus)}$*	Collector-emitter sustaining voltage (R_{BE} = 100 Ω)	I_C = 200 mA				
		for **2N6386**	40			V
		for **2N6387**	60			V
		for **2N6388**	80			V
$V_{CEV\ (sus)}$*	Collector-emitter sustaining voltage (V_{BE} = -1.5 V)	I_C = 200 mA				
		for **2N6386**	40			V
		for **2N6387**	60			V
		for **2N6388**	80			V
$V_{CE\ (sat)}$*	Collector-emitter saturation voltage	for **2N6386**				
		I_C = 3 A I_B = 6 mA			2	V
		for **2N6387** and **2N6388**				
		I_C = 5 A I_B = 10mA			2	V
		for **2N6386**				
		I_C = 8 A I_B = 80mA			3	V
		for **2N6387** and **2N6388**				
		I_C = 10 A I_B = 100mA			3	V

2N6386
2N6387
2N6388

ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
V_{BE}*	Base-emitter voltage	for **2N6386**				
		I_C = 3 A V_{CE} = 3 V			2.8	V
		for **2N6387** and **2N6388**				
		I_C = 5 A V_{CE} = 3 V			2.8	V
		for **2N6386**				
		I_C = 8 A V_{CE} = 3 V			4.5	V
		for **2N6387** and **2N6388**				
		I_C = 10 A V_{CE} = 3 V			4.5	V
h_{FE}*	DC current gain	for **2N6386**				
		I_C = 3 A V_{CE} = 3 V	1000		20000	—
		for **2N6387** and **2N6388**				
		I_C = 5 A V_{CE} = 3 V	1000		20000	—
		for **2N6386**				
		I_C = 8 A V_{CE} = 3 V	100			—
		for **2N6387** and **2N6388**				
		I_C = 10 A V_{CE} = 3 V	100			—
h_{fe}	Small signal current gain	I_C = 1 A				
		V_{CE} = 10 V f = 1 MHz	20			—
		V_{CE} = 10 V f = 1 kHz	1000			—
V_F*	Paralled-diode forward voltage	for **2N6386**				
		I_F = 8 A			4	V
		for **2N6387** and **2N6388**				
		I_F = 10 A			4	V
C_{CBO}	Collector-base capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz			200	pF
$I_{s/b}$**	Second breakdown collector current	V_{CE} = 25 V	2.6			A
$E_{s/b}$	Second breakdown energy	L = 12 mH R_{BE} = 100Ω V_{BE} = -1.5 V I_C = 4.5 A	120			mJ

* Pulsed: pulse duration = 300 μs, duty cycle = 1.5%
** Pulsed: 1s non repetitive pulse

For characteristic curves see BDX33/BDX34 series

2N6486 2N6489
2N6487 2N6490
2N6488 2N6491

EPITAXIAL-BASE NPN/PNP

POWER LINEAR AND SWITCHING APPLICATIONS

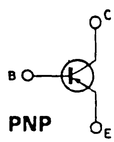
The 2N6486, 2N6487 and 2N6488 are silicon epitaxial-base NPN transistors mounted in Jedec TO-220 plastic package.
They are intended for use in power linear and switching applications.
The complementary PNP types are the 2N6489, 2N6490 and 2N6491 respectively.

ABSOLUTE MAXIMUM RATINGS

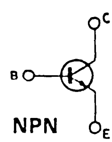
		NPN / PNP*	2N6486 / 2N6489	2N6487 / 2N6490	2N6488 / 2N6491
V_{CBO}	Collector-base voltage ($I_E = 0$)		50V	70V	90V
V_{CEX}	Collector-base voltage ($V_{BE} = 1.5V$; $R_{BE} = 100$)		50V	70V	90V
V_{CEO}	Collector-base voltage ($I_B = 0$)		40V	60V	80V
V_{EBO}	Emitter-base voltage ($I_C = 0$)			5V	
I_C	Collector-current			15A	
I_B	Base-current			5A	
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$			75W	
	$T_{case} \leq 25°C$			1.8W	
T_{stg}	Storage temperature			-65 to 150°C	
T_j	Junction temperature			150°C	

* **For PNP types voltage and current values are negative**

INTERNAL SCHEMATIC DIAGRAMS



PNP

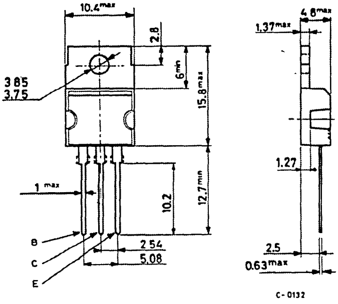


NPN

MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

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)

Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_{CEO}	Collector-cutoff current ($I_B = 0$)	for **2N6486/89**	V_{CE} = 20V			1	mA
		for **2N6487/90**	V_{CE} = 30V			1	mA
		for **2N6488/91**	V_{CE} = 40V			1	mA
I_{CEX}	Collector-cutoff current (V_{BE}=−1.5V R_{BE} = 100Ω)	for **2N6486/89**	V_{CE} = 45V			0 5	mA
		for **2N6487/90**	V_{CE} = 65V			0.5	mA
		for **2N6488/91**	V_{CE} = 85V			0.5	mA
		T_{case} = 150°C					
		for **2N6486/89**	V_{CE} = 40V			5	mA
		for **2N6487/90**	V_{CE} = 60V			5	mA
		for **2N6488/91**	V_{CE} = 80V			5	mA
I_{CER}	Collector-cutoff current (R_{BE}=100Ω)	for **2N6486/89**	V_{CE} = 35V			0.5	mA
		for **2N6487/90**	V_{CE} = 55V			0.5	mA
		for **2N6488/91**	V_{CE} = 75V			0.5	mA
I_{EBO}	Emitter-cutoff current ($I_C = 0$)	V_{BE} = 5V				1	mA
$V_{CEO\ (sus)}$*	Collector-emitter sustaining voltage ($I_B = 0$)	I_C = 200mA					
		for **2N6486/89**		40			V
		for **2N6487/90**		60			V
		for **2N6488/91**		80			V
$V_{CER\ (sus)}$*	Collector-emitter sustaining voltage (R_{BE} = 100Ω)	I_C = 200mA					
		for **2N6486/89**		45			V
		for **2N6487/90**		65			V
		for **2N6488/91**		85			V

ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions		Min.	Typ.	Max.	Unit
$V_{CEX\,(sus)}$*	Collector-emitter sustaining voltage ($V_{BE} = -1.5V$, $R_{BE} = 100\Omega$)	$I_C = 200mA$					
		for **2N6486/89**		50			V
		for **2N6487/90**		70			V
		for **2N6488/91**		90			V
$V_{CE\,(sat)}$*	Collector-emitter saturation voltage	$I_C = 5A$	$I_B = 0.5A$			1.3	V
		$I_C = 15A$	$I_B = 5A$			3.5	V
V_{BE}*	Base-emitter voltage	$I_C = 5A$	$V_{CE} = 4V$			1.3	V
		$I_C = 15A$	$V_{CE} = 4V$			3.5	V
h_{FE}*	DC current gain	$I_C = 5A$	$V_{CE} = 4V$	20		150	—
		$I_C = 15A$	$V_{CE} = 4V$	5			—
h_{fe}	Small signal current gain	$I_C = 1A$, $f = 1MHz$	$V_{CE} = 4V$	5			—
		$I_C = 1A$, $f = 1KHz$	$V_{CE} = 4V$	25			—

* Pulsed: pulse duration = 300μs, duty cycle $\leq$2%.

For PNP types voltage and current values are negative

MULTIEPITAXIAL MESA NPN

2N6497
2N6498
2N6499

ADVANCE DATA

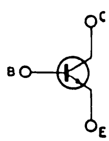
HIGH VOLTAGE POWER SWITCH

The 2N6497/98/99 are silicon multiepitaxial mesa NPN transistors in Jedec TO-220 plastic package particularly intended for switch-mode applications.

ABSOLUTE MAXIMUM RATINGS

		2N6497	2N6498	2N6499
V_{CBO}	Collector-base voltage ($I_E = 0$)	350V	400V	450V
V_{CEO}	Collector-emitter voltge ($I_B = 0$)	250V	300V	350V
V_{EBO}	Emitter-base voltage ($I_C = 0$)		6V	
I_C	Collector current		5A	
I_{CM}	Collector peak current		10A	
I_B	Base current		2A	
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$		80W	
T_{stg}	Storage temperature		-65 to 150°C	
T_J	Junction temperature		150°C	

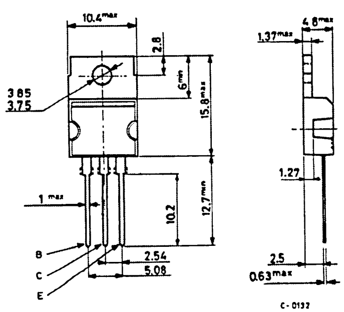
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

10/84

THERMAL DATA

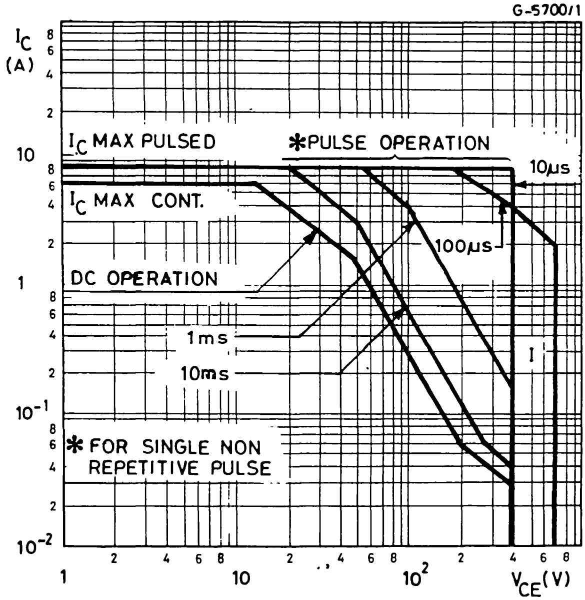
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	1.56	°C/W

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

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 voltage ($I_B = 0$)	$I_C = 25mA$	for **2N6497**	250			V
			for **2N6498**	300			V
			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	$I_C = 2.5A$ $I_{B2} = -1A$	$I_{B1} = 0.5A$ $V_{CC} = 125V$			0.8	μs
t_s	Storage time	$I_C = 2.5A$ $I_{B2} = -1A$	$I_{B1} = 0.5A$ $V_{CC} = 125V$			1.8	μs
t_f	Fall time	$I_C = 2.5A$ $I_{B2} = -1A$	$I_{B1} = 0.5A$ $V_{CC} = 125V$			0.8	μs

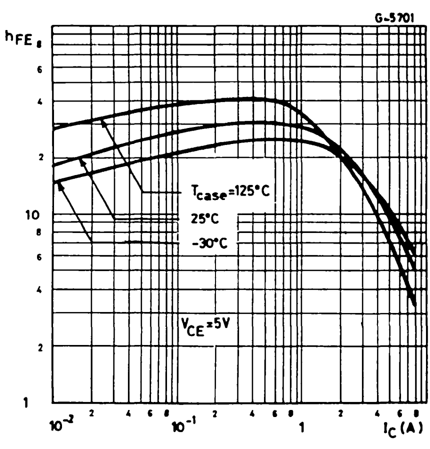
* Pulsed: pulse duration = 300μs, duty cycle = 1.5%

Safe operating areas

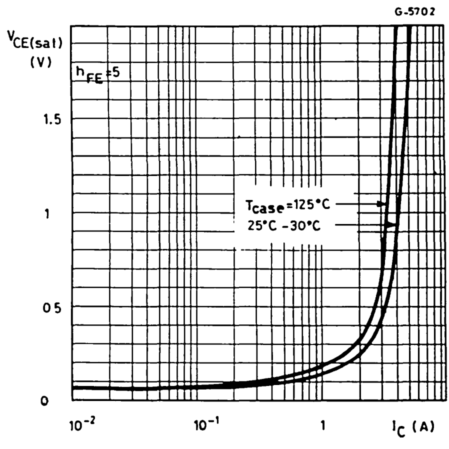


I — Area of permissible operation during turn-on provided $R_{BE} \leqslant 100\Omega$ and $t_p \leqslant 0.25\mu s$.

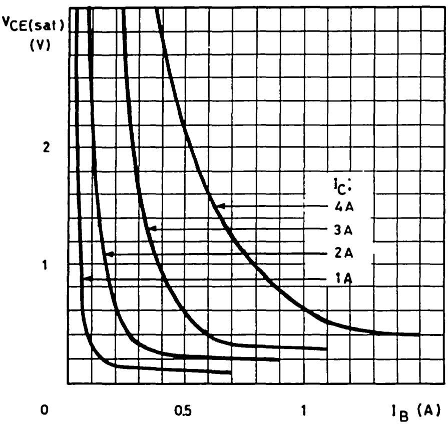
DC current gain



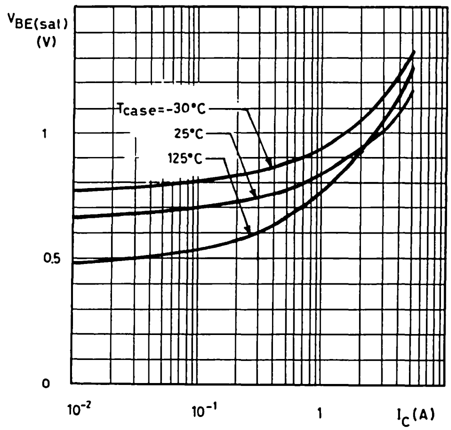
Collector-emitter saturation voltage



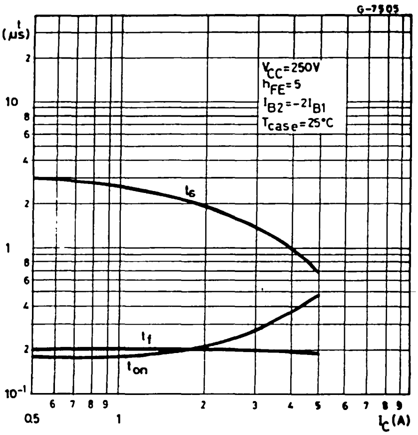
Collector-emitter saturation voltage



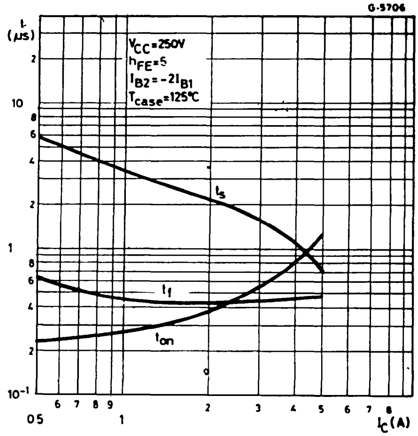
Base-emitter saturation voltage



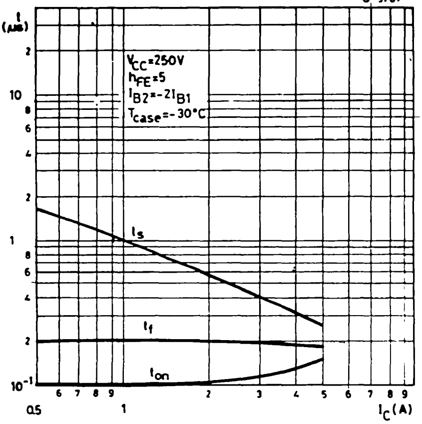
Saturated switching characteristics



Saturated switching characteristics



Saturated switching characteristics



Clamped reverse bias safe operating areas

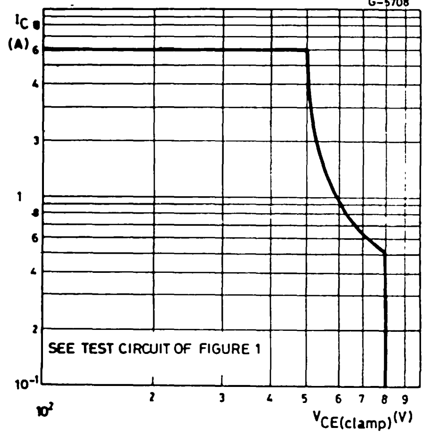


Fig. 1 – Clamped $E_{s/b}$ test circuit

TEST CONDITIONS:

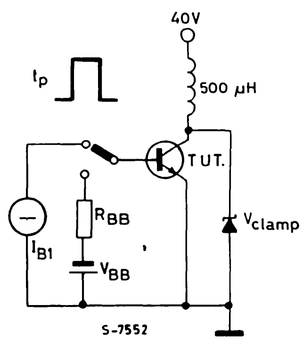
$5V \geq |-V_{BB}| \geq 2V$

$I_C / I_B \geq 4$

$2I_{B1} \geq |-I_{B2}| \geq I_{B1}$

t_p = adjusted for nominal I_C

R_{BB} = adjusted for I_{B2}



2N6544
2N6545

MULTIEPITAXIAL MESA NPN

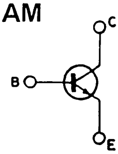
HIGH VOLTAGE POWER SWITCH

The 2N6544 and 2N6545 are multiepitaxial mesa NPN transistors in Jedec TO-3 metal case. They are intended for high voltage, fast switching applications.

ABSOLUTE MAXIMUM RATINGS

		2N6544	2N6545
V_{CES}	Collector-emitter voltage ($V_{BE} = 0$)	650V	850V
V_{CEX}	(Clamped) Collector-emitter voltage ($V_{BE} = -5V$)	350V	450V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	300V	400V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	9V	
I_C	Collector current	8A	
I_{CM}	Collector peak current ($t_p = 10ms$)	16A	
I_B	Base current	8A	
P_{tot}	Total power dissipation at $T_{case} \leqslant 25°C$	125W	
T_{stg}	Storage temperature	−65 to 200°C	
T_j	Junction temperature	200°C	

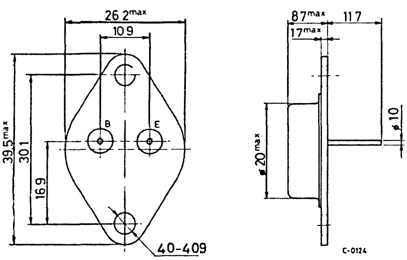
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

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)

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 = 1 s (non repetitive) V_{CE} = 100V	0.2			A
$E_{s/b}$	Second breakdown energy	L = 40μH V_{BE} = −4V R_{BE} = 50Ω	500			μJ

ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
h_{FE}*	DC current gain	$I_C = 2.5A$ $V_{CE} = 3V$	12		60	—
		$I_C = 5A$ $V_{CE} = 3V$	7		35	—
$V_{CE\,(sat)}$*	Collector-emitter saturation voltage	$I_C = 5A$ $I_B = 1A$			1.5	V
		$I_C = 8A$ $I_B = 2A$			5	V
		$T_{case} = 100°C$ $I_C = 5A$ $I_B = 1A$			2.5	V
$V_{BE\,(sat)}$*	Base-emitter saturation voltage	$I_C = 5A$ $I_B = 1A$			1.6	V
		$T_{case} = 100°C$ $I_C = 5A$ $I_B = 1A$			1.6	V
f_T	Transition 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
t_{on}	Turn-on time	**RESISTIVE LOAD** $I_C = 5A$ $V_C = 250V$ $I_{B1} = -I_{B2} = 1A$			1	μs
t_s	Storage time				4	μs
t_f	Fall time				1	μs
t_s	Storage time	**INDUCTIVE LOAD** $I_C = 5A$ (pk) $I_{B1} = 1A$ $V_{BE} = -5V$ $L = 180\mu H$ $T_{case} = 100°C$ 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 BUW 35 type.

MULTIEPITAXIAL MESA NPN

2N6546
2N6547

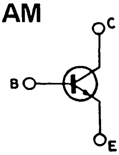
HIGH VOLTAGE, HIGH CURRENT POWER SWITCH

The 2N6546 and 2N6547 are multiepitaxial mesa NPN transistors in Jedec TO-3 metal case, intended in fast switching applications for high output power.

ABSOLUTE MAXIMUM RATINGS

		2N6546	2N6547
V_{CES}	Collector-emitter voltage ($V_{BE} = 0$)	650V	850V
V_{CEX}	(Clamped) Collector-emitter voltage ($V_{BE} = -5V$)	350V	450V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	300V	400V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	9V	
I_C	Collector current	15A	
I_{CM}	Collector peak current	30A	
I_B	Base current	10A	
P_{tot}	Total power dissipation at $T_{case} \leq 25°C$	175W	
T_{stg}	Storage temperature	−65 to 200°C	
T_j	Junction temperature	200°C	

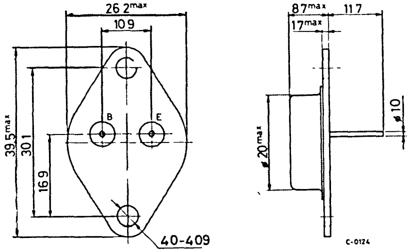
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-3

2N6546
2N6547

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max.	1	°C/W

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

Parameter		Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cutoff current ($V_{BE} = 0$)	for **2N6546** $V_{CE} = 650V$ for **2N6547** $V_{CE} = 850V$ $T_{case} = 100°C$ for **2N6546** $V_{CE} = 650V$ for **2N6547** $V_{CE} = 850V$			1 1 4 4	mA mA mA mA
I_{CER}	Collector cutoff current ($R_{BE} = 50\Omega$)	$T_{case} = 100°C$ for **2N6546** $V_{CE} = 650V$ for **2N6547** $V_{CE} = 850V$			 5 5	 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 **2N6546** for **2N6547**	 300 400			 V V
$V_{CEX\ (sus)}$*	Collector-emitter sustaining voltage (clamped $E_{S/B}$)	$I_C/I_B = 5$ $L = 180\mu H$ $V_{BE} = -5V$ $T_{case} = 100°C$ V_{clamp} = rated $V_{CEX\ (sus)}$ $I_C = 8A$ for **2N6546** for **2N6547** V_{clamp} = rated $V_{CEO\ (sus)}$–100V $I_C = 15A$ for **2N6546** for **2N6547**	 350 450 200 300			 V V V V
$I_{s/b}$	Second breakdown collector current	t = 1 s (non repetitive) $V_{CE} = 100V$	 0.2			 A
$E_{s/b}$	Second breakdown energy	$L = 40\mu H$ $V_{BE} = -4V$ $R_{BE} = 50\Omega$	2			mJ

ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
h_{FE}*	DC current gain	$I_C = 5A$ $V_{CE} = 2V$ $I_C = 10A$ $V_{CE} = 2V$	12 6		60 30	— —
$V_{CE\,(sat)}$*	Collector-emitter saturation voltage	$I_C = 10A$ $I_B = 2A$ $I_C = 15A$ $I_B = 3A$ $T_{case} = 100°C$ $I_C = 10A$ $I_B = 2A$			1.5 5 2.5	V V V
$V_{BE\,(sat)}$*	Base-emitter saturation voltage	$I_C = 10A$ $I_B = 2A$ $T_{case} = 100°C$ $I_C = 10A$ $I_B = 2A$			1.6 1.6	V V
f_T	Transition frequency	$I_C = 0.5A$ $V_{CE} = 10V$ $f = 1MHz$	6		24	MHz
C_{CBO}	Collector-base capacitance	$V_{CB} = 10V$ $I_E = 0$ $f = 1MHz$			360	pF
t_{on}	Turn-on time	**RESISTIVE LOAD**			1	μs
t_s	Storage time	$V_{CC} = 250V$ $I_C = 10A$ $I_{B1} = -I_{B2} = 2A$			4	μs
t_f	Fall time				0.7	μs
t_s	Storage time	**INDUCTIVE LOAD** $I_C = 10A$ (pk) $I_{B1} = 2A$ $V_{BE} = -5V$ $L = 180\mu H$			5	μs
t_f	Fall time	$T_{case} = 100°C$ for **2N6546** $V_{clamp} = 350V$ for **2N6547** $V_{clamp} = 450V$			1.5	μs

* Pulsed: pulse duration = $300\mu s$, duty cycle = 1.5%.

For characteristic curves see the BUW 45 type.

2N6702

MULTIEPITAXIAL PLANAR NPN

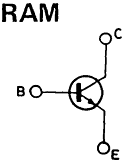
SWITCHING AND GENERAL PURPOSE

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.

ABSOLUTE MAXIMUM RATINGS

V_{CEV}	Collector-emitter voltage (V_{BE} = -1.5 V)	140	V
V_{CEO}	Collector-emitter voltage (I_B = 0)	90	V
V_{EBO}	Emitter-base voltate (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 ($T_{case} \leqslant 25°C$)	50	W
T_{stg}	Storage temperature	-65 to 150	°C
T_j	Junction temperature	150	°C

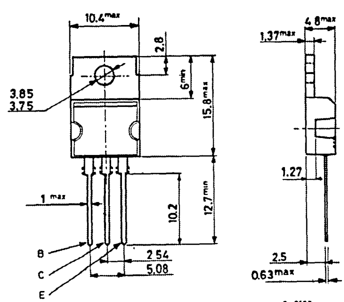
INTERNAL SCHEMATIC DIAGRAM



MECHANICAL DATA

Dimensions in mm

Collector connected to tab.



TO-220

THERMAL DATA

$R_{th\ j-case}$	Thermal resistance junction-case	max.	2.5	°C/W

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

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 signal current gain	I_C = 0.5A; V_{CE} = 10V f = 5MHz	4		40	–
f_T	Transition frequency	I_C = 0.5A; V_{CE} = 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 = 100 ms	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 = 300 μsec.; duty cycle ≤ 2%.

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