TOSHIBA

DATA BOOK

HIGH-FREQUENCY DEVICE

1994

TOSHIBA HIGH-FREQUENCY DEVICE DATA BOOK '94

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FOREWORD

Thank you for your continuing use of Toshiba semiconductor products. We are pleased to send you the semiconductor data book "High-Frequency Device ('94 Edition)".

ICs now come in a large variety of forms — LSIs, VLSIs, digital products and ASICs. Highly advanced systems are now configured on a single chip. However, where high-frequency, low-noise, and high-output amplification is required, ICs are still one step behind discrete semiconductors.

This data book is edited for users whose electrical and mechanical designs require transistors and diodes. The data book presents the electrical characteristics of transistors and diodes, and examples of application circuits and board mounting. We recommend the use of other Toshiba semiconductor data books and manuals for system design.

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1SS269	BG	115	1SV228	V4	185
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1SS295	BH	119	1SV230	T7	190
1SS312	BF	121	1SV231	TA	192
1SS313	BG	123	1SV232	T9	194
1SS314	TY	125	1SV237	BB	196
1SS315	S2	127	1SV238	TB	198
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1SS371	TY	131	1SV242	V5	202
1SV99	V99	133	1SV245	T3	204
1SV101	V101	135	1SV252	BE	206
1SV102	V102	138	1SV254	T1	208
1SV103	V103	141	1SV255	T2	210
1SV128	BB	143	1SV256	T4	212
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1SV172	BE	159	1SV269	TE	226
1SV186	T3	161	1SV270	TF	228
1SV204	T4	163	1SV271	TG	230
1SV211	T6	165	1SV273	TF	232
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1SV214	T1	169	1SV275	TE	235
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HN1V02H	1V02H	241	2SC3136	C3136	377
HN2V02H	2H02H	242	2SC3268	C3268	381
S3275	S3275	243	2SC3429	ME	385
2SA1161	A1161	245	2SC3547A	HI	388
2SA1245	MD	248	2SC3547B	HM	391
2SC380TM	C380TM	251	2SC3605	C3605	394
2SC941TM	C941TM	257	2SC3606	MH	399
2SC1815	C1815	261	2SC3607	MH	404
2SC1923	C1923	264	2SC3609	MH	409
2SC2216	C2216	270	2SC3745	MI	414
2SC2347	C2347	273	2SC3862	HL	417
2SC2348	C2348	276	2SC4214	HN	420
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2SC2458	C2458	283	2SC4244	HN	427
2SC2498	C2498	286	2SC4245	HB	431
2SC2499	C2499	290	2SC4246	HC	435
2SC2644	C2644	294	2SC4247	HI	438
2SC2668	C2668	297	2SC4248	HM	441
2SC2669	C2669	303	2SC4249	HD	444
2SC2670	C2670	309	2SC4250	HE	447
2SC2712	L□ (□…O, Y, G, L)	313	2SC4251	HF	451
2SC2714	Q□ (□…R, O, Y)	316	2SC4252	HO	454
2SC2715	R□ (□…R, O, Y)	322	2SC4253	HH	457
2SC2716	F□ (□…R, O, Y)	329	2SC4255	HO	460
2SC2717	C2717	270	2SC4315	MK	463
2SC2753	C2753	333	2SC4316	C4316	468
2SC2995	C2995	336	2SC4317	MN	473
2SC2996	G□ (□…R, O, Y)	342	2SC4318	MN	478
2SC3011	MA	348	2SC4320	MN	483
2SC3098	MB	351	2SC4321	MN	488
2SC3099	MC	354	2SC4322	MO	493
2SC3120	HB	357	2SC4324	MO	498
2SC3121	HC	361	2SC4325	MO	503
2SC3122	HD	364	2SC4392	MA	508
2SC3123	HE	367	2SC4393	ME	511
2SC3124	HF	371	2SC4394	MH	514

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2SC4470	MP	519	2SK211	K□ (□···O, Y, G)	664
2SC4527	HP	524	2SK241	K241	669
2SC4839	MH	527	2SK302	T□ (□···O, Y, G)	674
2SC4840	MN	532	2SK709	K709	680
2SC4841	MO	537	2SK710	K710	683
2SC4842	MK	542	2SK711	RB□ (□···G, L, V)	686
2SC4843	MN	547	2SK881	K□ (□···O, Y, G)	689
2SC4844	MO	552	2SK882	T□ (□···Y, G)	693
2SC4915	Q□ (□···R, O, Y)	557	2SK1771	UB	697
2SC5064	MA□ (□···O, Y)	561	2SK1875	RB□ (□···G, L, V)	700
2SC5065	MA□ (□···O, Y)	566	2SK2331	F	703
2SC5066	M1 / M2 (···O / Y)	571	2SK2332	G	708
2SC5084	MC□ (□···O, Y)	576	3SK126	UC	713
2SC5085	MC□ (□···O, Y)	581	3SK127	UD	717
2SC5086	M5 / M6 (···O / Y)	586	3SK146	UE	722
2SC5087	MC□ (□···O, Y)	591	3SK151	UH	726
2SC5088	MC□ (□···O, Y)	592	3SK153	UI	730
2SC5089	MD□ (□···R, O)	593	3SK160	UL	734
2SC5090	MD□ (□···R, O)	598	3SK195	UJ	738
2SC5091	M7 / M8 (···R / O)	603	3SK199	UM	742
2SC5092	MD□ (□···R, O)	608	3SK207	UR	747
2SC5093	MD□ (□···R, O)	609	3SK225	UT	752
2SC5094	ME□ (□···R, O)	610	3SK226	UU	756
2SC5095	ME□ (□···R, O)	615	3SK232	UO	760
2SC5096	M9 / MA (···R / O)	620	3SK240	UN	763
2SC5097	ME□ (□···R, O)	625	3SK249	UO	768
2SC5098	ME□ (□···R, O)	626	3SK256	UR	773
2SC5106	MF□ (□···O, Y)	627	3SK257	UT	778
2SC5107	MF□ (□···O, Y)	631	3SK258	UU	782
2SC5108	MB / MC (···O / Y)	635	3SK259	UI	786
2SC5109	MG□ (□···O, Y)	639	3SK260	UH	790
2SC5110	MG□ (□···O, Y)	643	3SK274	UN	794
2SC5111	MD / ME (···O / Y)	647	3SK283	U1	799
2SK161	K161	651	3SK284	U1	804
2SK192A	K192A	655	HN3C01F	WA	809
2SK210	Y□ (□···Y, G, B)	659	HN3C02F	WB	810

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HN3C06F	WE	812
HN3C07F	WF	813
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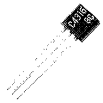
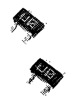
HN3G01J	Z□ (□···G, L, V)	815
TA4000F	<u>UA</u>	819
TA4001F	U9	822
TA4002F	U8	825
TA4003F	U2	828
TA4004F	U1	832
TA4006F	UB	836
TA4007F	UC	840
TA4100F	<u>UB</u>	844
TA4101F	4101F	847
TG2000F	UD	850

[I] PRODUCT OUTLINE & EXPLANATION

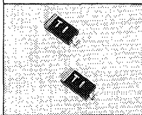
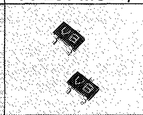
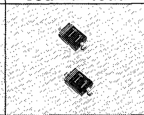
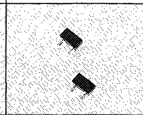
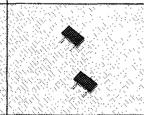
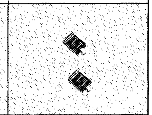
1. SELECTION GUIDE (PACKAGE TYPES & APPLICATION)

1.1 TRANSISTORS FOR TV TUNER

APPLICATION			Package Style				
			TO-92	Super-Mini (SOT-23 MOD./ TO-236 MOD.)	Super-Mini Quad (SOT-143 MOD.)	Ultra Super-Mini	USQ
							
UHF	RF	GaAs MES			3SK240 ∗3SK283		3SK274 ∗3SK284
UHF	RF	MOS			3SK127 3SK146 3SK153 3SK199 3SK207 3SK232		∗3SK249 ∗3SK256
UHF	RF	Bipolar			2SC3828 2SC4214	2SC4244	
UHF	MIX	Bipolar		2SC3120 2SC3862		2SC4245	
UHF	OSC	Bipolar	2SC2347	2SC3120 2SC3121 2SC3547A 2SC3547B		2SC4245 2SC4246 2SC4247 2SC4248 2SC4527	
VHF	RF	MOS			3SK126 3SK160 3SK153 3SK195 3SK225 3SK226		∗3SK257 ∗3SK258 ∗3SK259
VHF	RF	Bipolar	2SC2348	2SC3122		2SC4249	
VHF	MIX	Bipolar	2SC3136	2SC3123		2SC4250	
VHF	MIX	MOS			3SK151		∗3SK260
VHF	OSC	Bipolar	2SC2349	2SC3124 2SC4255		2SC4251 2SC4255	

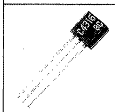
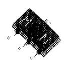
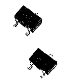
∗NEW

1.2 DIODES FOR TV TUNER

APPLICATION		Package Style					
		Super-Mini coaxial lead	Super-Mini (SOT-23 MOD./ TO-236 MOD.)	Ultra Super-Mini coaxial lead	Ultra Super-Mini	SSM	SSC
							
UHF	Tuning	1SV153 1SV153A		1SV214			*1SV254
	AFC	1SV204		1SV216			*1SV256
	Mixer	1SS242	1SS295	1SS315			
VHF	Tuning	1SV153 1SV153A 1SV161 1SV211 1SV226 1SV227	1SV242	1SV214 1SV215 1SV217 1SV231 1SV232 1SV238 *1SV262 *1SV269			*1SV254 *1SV255 *1SV259 *1SV274 *1SV275
	Band Switch	1SS241	1SS268 1SS269	1SS314	1SS312 1SS313	1SS364	*1SS371
	AFC	1SV204		1SV216			*1SV256

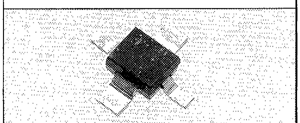
*NEW

1.3 TRANSISTORS FOR VHF~UHF EQUIPMENT

APPLICATION		Packege Style						
		TO-92	Super-Mini (SOT-23 MOD. TO-236 MOD.)	Power-Mini (SOT-89)	Super-Mini Quad. (SOT-143 MOD.)	Ultra Super-Mini	SSM	USQ
								
VHF~UHF Low Noise Amp	PNP·TR	2SA1161	2SA1245					
	NPN·TR	2SC2498 2SC2499 2SC2644 2SC2753 2SC3605 2SC4316	2SC3098 2SC3099 2SC3011 *2SC5064 2SC3429 *2SC5084 2SC4470 *2SC5089 *2SC5094	2SC3268 2SC3607 2SC4318	2SC3745 *2SC5087 *2SC5092 *2SC5097	2SC4392 *2SC5065 2SC4393 *2SC5085 *2SC5090 *2SC5095	*2SC5066 *2SC5086 *2SC5091 *2SC5096	*2SC5088 *2SC5093 *2SC5098
VHF~UHF OSC	NPN·TR		2SC3547A 2SC3547B *2SC5106 *2SC5109			2SC4247 2SC4248 *2SC5107 *2SC5110	*2SC5108 *2SC5111	

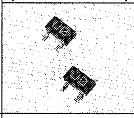
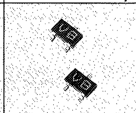
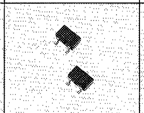
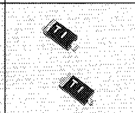
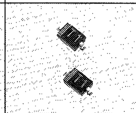
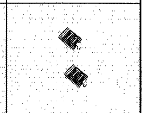
*NEW

1.4 GaAs MODFETS FOR SHF

APPLICATION	Package Style
	μ-X
	
SHF Low Noise Amp.	*2SK2331 *2SK2332

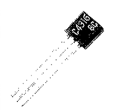
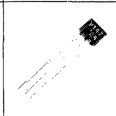
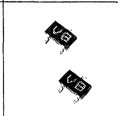
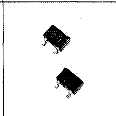
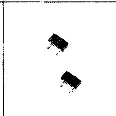
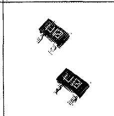
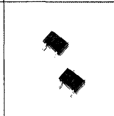
*NEW

1.5 DIODES FOR VHF~UHF EQUIPMENT

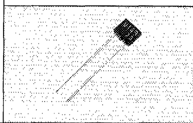
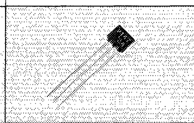
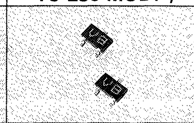
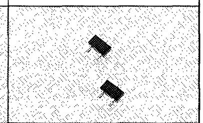
APPLICATION		Paxkage Style					
		Super-Mini Quad (SOR-143 MOD.)	Super-Mini (SOT-23 MOD./ TO-236 MOD.)	USM	Super-Mini coaxial-liad	Ultra Super-Mini coaxial lead	SSC
							
Attinuater, Switch PIN	Single		1SV128			* 1SV271	
	Twin	1SV237	1SV172	* 1SV252			
Mixer SBD	Single		1SS154		1SS239		
	Twin		1SS271 1SS295				
Tuning					1SV186 1SV212 1SV224	1SV229 1SV230 1SV239 1SV245 * 1SV270 * 1SV276	* 1SV257 * 1SV258 * 1SV260 * 1SV261 * 1SV273

* NEW

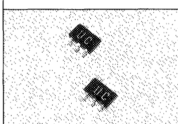
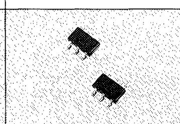
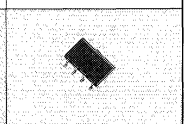
1.6 TRANSISTORS FOR FM AND AM TUNER

APPLICATION			Package Style						
			TO-92	Mini	Super-Mini (SOT-23 MOD./ TO-236 MOD.)	Ultra Super-Mini	SSM	Super-Mini Quad. (SOT-143 MOD.)	USQ
									
FM	RF	Dual Gate MOS						3SK126 3SK160 3SK195 3SK225 3SK226	*3SK257 *3SK258
		Single Gate MOS						2SK1771	
		Cascode MOS		2SK241	2SK302	2SK882			
		Cascode J-FET		2SK161	2SK211	2SK881			
		Single Gate K-FET		2SK192A	2SK210				
		Bipolar	2SC1923	2SC2668	2SC2714	2SC4215	*2SC4915		
	MIX	Dual Gage MOS						3SK126 3SK151	*3SK260
		Bipolar	2SC1923	2SC2668	2SC2714	2SC4215	*2SC4915		
	OSC	Single Gate J-FET		2SK192A	2SK210				
		Bipolar	2SC1923	2SC2668 2SC2995	2SC2714 2SC2996	2SC4215	*2SC4915		
	IF	Bipolar	2SC380TM	2SC2669 2SC2995	2SC2715 2SC2996				
AM	RF	Single Gate J-FET	2SK709	2SK710	2SK711	2SK1875			
		Bipolar	2SC941TM	2SC2670	2SC2716				
	CONV	Bipolar	2SC380TM 2SC941TM 2SC1815	2SC2669 2SC2670 2SC2458	2SC2715 2SC2716 2SC2712	2SC4116			
	IF	Bipolar	2SC380TM 2SC1815	2SC2669 2SC2458	2SC2715 2SC2712	2SC4116			

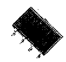
1.7 DIODES FOR FM AND AM TUNER

APPLICATION		Package Style			
		MINI MOD	MINI	Super-Mini (SOT-23 MOD./ TO-236 MOD.)	Ultra Super-Mini
					
FM Tuning	High VT		1SV103	1SV225	
	Low VT	1SV101	1SV147	1SV228	
AM Tuning	High VT	1SV102			
	Low VT	1SV149			
AFC				1SV160	
Attenuater, SW(PIN)	Single			1SV128	
	Twin			1SV172	1SV252

1.8 HYBRID DEVICES

APPLICATION	Package Style		
	SMV	SM6	FM8
			
AM RF (with AGC)	HN3G01J		
TV VHF		HN3C01F	
TV UHF		HN3C02F HN3C03F	
VHF～UHF Low Noise Amp.		HN3C06F HN3C07F HN3C08F	
AM Tuning			HN1V01H HN1V02H HN2V02H

1.9 CELL PACKS

APPLICATION	Package Style				
	SMQ	SMV	SM6	FM8	SM8
					
Diff. Wide Band Amp.			TA4000F		
CATV CONV DBM				S3275	
VHF～UHF **Wide Band Amp.**	TA4001F TA4002F	TA4003F TA4004F			
VHF Wide RF Amp.		TA4006F			
VHF RF Amp.		TA4007F			
UHF RF Amp.		#TG2000F			
VHF～UHF Amp. MIX			TA4100F		
VHF～UHF DBM					TA4101F

GaAs

2. CHARACTERISTICS CHART

2.1 TRANSISTORS FOR TV TUNER

APPLICATION	Type No.	MAX. RATINGS			ELECTRICAL CHARACTERISTICS													OUT LINE
		V_{CEO}	I_C	P_C	h_{FE}			f_T(TYP.)			Gp(Gc·)/NF(TYP.)					Cre	Cob	
						V_{CE}	I_C		V_{CE}	I_C		V_{CC}	I_C	V_{AGC}	f	(Crb▲)		
		(V)	(mA)	(mW)		(V)	(mA)	(MHz)	(V)	(mA)	(dB/dB)	(V)	(mA)	(V)	(MHz)	(pF)	(pF)	
PIF AMP	2SC382TM	40	50	250	30MIN.	10	4	400MIN.	10	4	Gp32~40	12	4	—	45	1.2MAX.	—	TO-92
PIF AMP	2SC383TM	45	50	300	20~100	12.5	12.5	300MIN.	12.5	12.5	Gp29~36	12.5	12.5	—	45	—	0.8~2.0	TO-92
PIF AMP	2SC388ATM	25	50	300	20~200	12.5	12.5	300MIN.	12.5	12.5	Gp28~36	12.5	12.5	—	45	—	0.8~2.0	TO-92
PIF AMP	2SC2216	45	50	300	40~140	12.5	12.5	300MIN.	12.5	12.5	Gp29~36	12.5	12.5	—	45	—	0.8~2.0	TO-92
UHF OSC	2SC2347	15	50	250	20MIN.	3	8	650MIN.	10	8	—	—	—	—	—	—	1.2	TO-92
VHF RF	2SC2348	30	20	250	20~200	10	2	650	10	2	24/2.3	12	—	1.4	200	0.3	—	TO-92
VHF OSC	2SC2349	15	50	250	20MIN.	3	8	600MIN.	10	8	—	—	—	—	—	—	1.2	TO-92
PIF AMP	2SC2717	25	50	300	40~240	12.5	2	300MIN.	12.5	12.5	Gp28~36	12.5	12.5	—	45	—	0.8~2.0	TO-92
UHF MIX/OSC	2SC3120	15	50	150	40~200	10	5	2400	10	2	17·/8	10	2	—	800	0.6	—	S-MINI
UHF OSC	2SC3121	15	50	150	60~320	3	8	1500	10	8	—	—	—	—	—	—	0.9	S-MINI
VHF RF	2SC3122	30	20	150	60~300	10	2	650	10	2	24/2	12	—	1.4	200	0.3	—	S-MINI
VHF MIX	2SC3123	20	50	150	40~300	10	5	1400	10	5	23·/3.8	12	3	—	200	0.4	—	S-MINI
VHF OSC	2SC3124	15	50	150	40~200	3	8	1100	10	8	—	—	—	—	—	—	0.9	S-MINI
PIF AMP	2SC3125	25	50	150	20~200	10	10	600	10	10	—	—	—	—	—	—	1.1	S-MINI
VHF MIX	2SC3136	20	50	250	40~300	10	5	1400	10	5	23·/3.8	12	—	—	200	0.4	—	TO-92
UHF OSC	2SC3547A	12	30	150	35~130	10	5	4000	10	10	—	—	—	—	—	—	1.05	S-MINI
UHF OSC	2SC3547B	12	30	150	70~300	10	5	4000	10	10	—	—	—	—	—	—	1.05	S-MINI
UHF RF	2SC3828	20	20	150	40MIN.	10	2	1100	10	2	18/5MAX	12	—	3	800	0.2▲	—	SMQ
UHF MIX	2SC3862	15	50	150	40~200	10	5	2400	10	2	—	—	—	—	—	0.6	—	S-MINI E.B.Rev
UHF RF	2SC4214	20	20	150	40MIN.	3	1	850	3	1	15/2.8	4.5	—	2	800	0.3▲	—	SMQ
UHF RF	2SC4244	20	20	100	40MIN.	3	1	850	3	1	17/4	4.5	—	2	800	0.4▲	—	USM
UHF MIX/OSC	2SC4245	15	50	100	40~200	10	5	2400	10	2	17·/8	10	2	—	800	0.6	—	USM
UHF OSC	2SC4246	15	50	100	60~320	3	8	1500	10	8	—	—	—	—	—	—	0.9	USM
UHF OSC	2SC4247	12	30	100	35~130	10	5	4000	10	10	—	—	—	—	—	—	1.05	USM
UHF OSC	2SC4248	12	30	100	70~300	10	5	4000	10	10	—	—	—	—	—	—	1.05	USM
VHF RF	2SC4249	30	20	100	60~300	10	2	650	10	2	24/2	12	—	1.4	200	0.35	—	USM
VHF MIX	2SC4250	20	50	100	40~300	10	5	1400	10	5	25·/4.3	12	3	—	200	0.45	—	USM
VHF OSC	2SC4251	15	50	100	40~200	3	8	1100	10	8	—	—	—	—	—	—	0.9	USM
VHF OSC	2SC4252	12	30	100	40~250	10	5	2000	10	5	—	—	—	—	—	—	1.05	USM
PIF AMP	2SC4253	25	50	100	20~200	10	10	600	10	10	—	—	—	—	—	—	1.1	USM
VHF OSC	2SC4255	12	30	150	40~250	10	5	2000	10	5	—	—	—	—	—	—	1.05	S-MINI
UHF OSC	2SC4527	15	50	100	60~320	3	8	1500	10	8	—	—	—	—	—	—	0.9	USM E.B.Rev

2.2 FETS FOR TV TUNER

APPLICATION	Type No.	MAX. RATINGS			ELECTRICAL CHARACTERISTICS												OUT LINE
		V_{DS} (V_{GDO})	I_D	P_D	I_{DSS}			|Yfs| @1 kHz(TYP.)				G_{PS}(G_{CS}°)/NF(NF_{CS}°) (TYP.)					
						V_{DS}	V_{G1S}/V_{G2S}		V_{DS}	I_D	V_{G2S}		V_{DS}	I_D	V_{G2S}	f	
		(V)	(mA)	(mW)	(mA)	(V)	(V)	(mS)	(V)	(mA)	(V)	(dB/dB)	(V)	(mA)	(V)	(MHz)	
VHF RF/MIX	3SK126	15	30	150	0~6	6	0/3	20	6	10	3	25/1.4	6	10	3	200	SMQ
	3SK151	15	30	150	3~14	6	0/3	27	6	10	3	24.5°/3.3°	6	—	—	200	SMQ
	3SK160	13.5	30	150	0~2	6	0/3	18	6	10	3	18/2.1	6	10	3	500	SMQ
	3SK195	13.5	30	150	0~0.1	6	0/4	13	6	10	4	27/1.1	6	10	4	200	SMQ
	3SK225	13.5	30	150	0~0.1	6	0/4.5	21	6	10	4.5	22/2.0	6	10	4.5	500	SMQ
	3SK226	13.5	30	150	0~0.1	6	0/4.5	13	6	10	4.5	27/1.1	6	10	4.5	200	SMQ
	3SK257	13.5	30	100	0~0.1	6	0/4.5	21	6	10	4.5	22/2.0	6	10	4.5	500	USQ
	3SK258	13.5	30	100	0~0.1	6	0/4.5	13	6	10	4.5	27/1.1	6	10	4.5	200	USQ
	3SK260	15	30	100	3~14	6	0/3	27	6	10	3	24.5°/3.3°	6	—	—	200	USQ
UHF RF/MIX	3SK127	15	30	150	0~6	6	0/3	17	6	10	3	16/3.2	6	10	3	800	SMQ
	3SK146	13.5	30	150	0~2	6	0/3	16	6	10	3	18/2.6	6	10	3	800	SMQ
	3SK153	13.5	30	150	0~2	6	0/3	21	6	10	3	18.5/2.6	6	10	3	800	SMQ
	3SK199	13.5	30	150	0~0.1	6	0/4	21.5	6	10	4	19.5/1.9	6	10	4	800	SMQ
	3SK207	13.5	30	150	0~0.1	6	0/4.5	21.5	6	10	4.5	19.5/1.9	6	10	4.5	800	SMQ
	3SK232	12.5	30	150	0~0.1	6	0/4.5	21	6	10	4.5	20/1.5	6	10	4.5	800	SMQ
	*3SK240	(−9)	25	150	6~20	3	0/0	19	3	5	1	20.5/1.0	3	5	1	800	SMQ
	3SK249	12.5	30	100	0~0.1	6	0/4.5	21	6	10	4.5	20/1.5	6	10	4.5	800	USQ
	3SK256	13.5	30	100	0~0.1	6	0/4.5	21.5	6	10	4.5	19.5/1.9	6	10	4.5	800	USQ
	3SK259	15	30	100	0~0.1	6	0/3	18.5	6	10	3	19/2.6	6	10	3	800	USQ
	*3SK274	(−9)	25	100	6~20	3	0/0	19	3	5	1	20.5/1.0	3	5	1	800	USQ
	*3SK283	(−6)	20	150	4~16	2	0/0	12	2	2	0.5	18.5/1.3	2	2	0.5	800	SMQ
	*3SK284	(−6)	20	100	4~16	2	0/0	12	2	2	0.5	18.5/1.3	2	2	0.5	800	USQ

* GaAs

2.3 TRANSISTORS FOR VHF~UHF EQUIPMENT

APPLICATION	Type No.	MAX. RATINGS			ELECTRICAL CHARACTERISTICS													OUT LINE
		V_{CEO}	I_C	P_C	Cob	Cre	f_T(TYP.)			S_{21e}^2(TYP.)				NF (TYP.)				
		(V)	(mA)	(mW)	(pF)	(pF)	(GHz)	V_{CE} (V)	I_C (mA)	(dB)	V_{CE} (V)	I_C (mA)	f (GHz)	(dB)	V_{CE} (V)	I_C (mA)	f (GHz)	
VHF~UHF AMP	2SA1161	−8	−30	200	0.95	0.75	3.5	−5	−10	8.0	−5	−10	1	3.5	−5	−3	1	TO-92
	2SA1245	−8	−30	150	0.75	0.6	4	−5	−10	9.5	−5	−10	1	3	−5	−3	1	S-MINI
	2SC2498	20	50	300	1.15	0.75	3.5	10	10	14.5	10	10	0.5	2.5	10	5	0.5	TO-92
	2SC2499	20	30	300	0.9	0.6	4	10	10	15.0	10	10	0.5	1.7	10	3	0.5	TO-92
	2SC2644	12	120	500	1.6	1.1	4	10	30	14.0	10	30	0.5	2.3	10	10	0.5	TO-92
	2SC2753	12	70	300	1.1	0.65	5	10	20	10.5	10	20	1	1.7	10	5	1	TO-92
	2SC3011	7	30	150	0.7	0.5	6.5	5	10	12	5	10	1	2.3	5	5	1	S-MINI
	2SC3098	20	50	150	1.15	0.75	3.5	10	10	14.5	10	10	0.5	2.5	10	5	0.5	S-MINI
	2SC3099	20	30	150	0.9	0.6	4	10	10	15.0	10	10	0.5	1.7	10	3	0.5	S-MINI
	2SC3268	12	70	*800	1.05	0.7	5	10	20	9.5	10	20	1	2	10	5	1	P-MINI
	2SC3429	12	70	150	0.85	0.57	5	10	20	10.5	10	20	1	1.7	10	5	1	S-MINI
	2SC3605	12	80	600	1.2	0.75	6.5	10	20	10	10	20	1	1.1	10	5	1	TO-92
	2SC3607	12	80	*800	1.15	0.8	6.5	10	20	9.5	10	20	1	1.1	10	5	1	P-MINI
	2SC3745	7	30	150	0.8	0.5	6.5	5	10	12	5	10	1	2.0	5	5	1	SMQ
	2SC4316	10	40	400	0.85	0.5	9	8	20	6	8	20	2	1.7	8	5	2	TO-92
	2SC4318	10	40	*800	0.75	0.55	9	8	20	5.5	8	20	2	1.7	8	5	2	P-MINI
	2SC4392	7	30	100	0.7	0.5	6.5	5	10	12	5	10	1	2.3	5	5	1	USM
	2SC4393	12	70	100	0.85	0.57	5	10	20	10.5	10	20	1	1.7	10	5	1	USM
	2SC4470	12	80	150	1.0	0.7	7	10	20	11	10	20	1	1.1	10	5	1	S-MINI
	2SC5064	12	30	150	0.7	0.45	7	5	10	12	5	10	1	1.1	5	3	1	S-MINI
	2SC5065	12	30	100	0.7	0.45	7	5	10	12	5	10	1	1.1	5	3	1	USM
	2SC5066	12	30	100	0.7	0.45	7	5	10	12	5	10	1	1.1	5	3	1	SSM
	2SC5084	12	80	150	1.0	0.65	7	10	20	11	10	20	1	1.1	10	5	1	SM
	2SC5085	12	80	100	1.0	0.65	7	10	20	11	10	20	1	1.1	10	5	1	USM
	2SC5086	12	80	100	1.0	0.65	7	10	20	11	10	20	1	1.1	10	5	1	SSM
	★2SC5087	12	80	150	1.0	0.65	7	10	20	13	10	20	1	1.1	10	5	1	SMQ
	★2SC5088	12	80	100	1.0	0.65	7	10	20	13	10	20	1	1.1	10	5	1	USQ
	2SC5089	10	40	150	0.7	0.5	10	8	20	7	8	20	2	1.7	8	5	2	P-MINI
	2SC5090	10	40	100	0.7	0.5	10	8	20	7	8	20	2	1.7	8	5	2	USM
	2SC5091	10	40	100	0.7	0.5	10	8	20	7	8	20	2	1.7	8	5	2	SSM
	★2SC5092	10	40	150	0.7	0.5	10	8	20	9	8	20	2	1.7	8	5	2	SMQ
	★2SC5093	10	40	100	0.7	0.5	10	8	20	9	8	20	2	1.7	8	5	2	USQ
	2SC5094	10	15	150	0.5	0.4	10	6	7	7.5	6	7	2	1.8	6	3	2	S-MINI
	2SC5095	10	15	100	0.5	0.4	10	6	7	7.5	6	7	2	1.8	6	3	2	USM
	2SC5096	10	15	100	0.5	0.4	10	6	7	7.5	6	7	2	1.8	6	3	2	SSM
	★2SC5097	10	15	150	0.5	0.4	10	6	7	9.5	6	7	2	1.8	6	3	2	SMQ
	★2SC5098	10	15	100	0.5	0.4	10	6	7	9.5	6	7	2	1.8	6	3	2	USQ
VHF~UHF OSC	2SC5106	10	30	150	0.7	0.5	6	5	5	11	5	5	1	—	—	—	—	S-MINI
	2SC5107	10	30	100	0.7	0.5	6	5	5	11	5	5	1	—	—	—	—	USM
	2SC5108	10	30	100	0.7	0.5	6	5	5	11	5	5	1	—	—	—	—	SSM
	2SC5109	10	60	150	0.9	0.7	5	5	5	10	5	5	1	—	—	—	—	S-MINI
	2SC5110	10	60	100	0.9	0.7	5	5	5	10	5	5	1	—	—	—	—	USM
	2SC5111	10	60	100	0.9	0.7	5	5	5	10	5	5	1	—	—	—	—	SSM
	2SC3547A	12	30	150	1.05	—	4	10	10	—	—	—	—	—	—	—	—	S-MINI
	2SC3547B	12	30	150	1.05	—	4	10	10	—	—	—	—	—	—	—	—	S-MINI
	2SC4247	12	30	100	1.05	—	4	10	10	—	—	—	—	—	—	—	—	USM
	2SC4248	12	30	100	1.05	—	4	10	10	—	—	—	—	—	—	—	—	USM

★ TENTATIVE

* Assembled on Al_2O_3 substrate (250mm^2×0.8mmt)

2.4 GaAs MODFETS FOR SHF BAND

APPLICATION	Type No.	MAX. RAITINGS			ELECTRICAL CHARACTERISTICS										OUT LINE
		V_{GDO}	I_D	P_D	I_{DSS}			|Yfs| 1kHz(TYP.)			NF/Ga(TYP.)				
						V_{DS}	V_{GS}		V_{DS}	I_D		V_{DS}	I_D	f	
		(V)	(mA)	(mW)	(mA)	(V)	(V)	(mS)	(V)	(mA)	(dB/dB)	(V)	(mA)	(GHz)	
SHF AMP	2SK2331	−3	120	150	25~120	1	0	100	1	20	0.45/11	1	20	12	MMX
	2SK2332	−3	120	150	25~120	1	0	100	1	20	0.65/11	1	20	12	MMX

2.5 TRANSISTORS FOR FM/AM TUNERS

APPLICATION	Type No.	MAX. RATINGS			ERECTRICAL CHARACTERISTICS							OUT LINE
		V_{CEO}	I_C	P_C	h_{FE}			f_T TYP.(MIN.)			Cre	
						V_{CE}	I_C		V_{CE}	I_C	(Cob)	
		(V)	(mA)	(mW)		(V)	(mA)	(MHz)	(V)	(mA)	(pF)	
FM RF, MIX/OSC	2SC1923	30	20	100	40~200	6	1	550	6	1	0.7	TO-92
	2SC2668	30	20	100	40~200	6	1	550	6	1	0.7	MINI
	2SC2714	30	20	100	40~200	6	1	550	6	1	0.7	S-MINI
	2SC4215	30	20	100	40~200	6	1	550	6	1	0.7	USM
	2SC4915	30	20	100	40~200	6	1	550	6	1	0.7	SSM
FM OSC	2SC2995	30	50	200	40~240	6	1	350	6	1	0.9	MINI
	2SC2996	30	50	150	40~240	6	1	350	6	1	0.9	S-MINI
FM IF/AM CONV, IF	2SC380TM	30	50	300	40~240	12	2	(100)	10	1	(2.0)	TO-92
	2SC2669	30	50	200	40~240	12	2	(100)	10	1	(2.0)	MINI
	2SC2715	30	50	150	40~240	12	2	(100)	10	1	(2.0)	S-MINI
AM RF, CONV	2SC941TM	30	100	400	40~240	12	2	(80)	10	2	2.2	TO-92
	2SC2670	30	100	200	40~240	12	2	(80)	10	2	2.2	MINI
	2SC2716	30	100	150	40~240	12	2	(80)	10	2	2.2	S-MINI
AM CONV, IF	2SC1815	50	150	400	70~700	6	2	(80)	10	1	(2.0)	TO-92
	2SC2458	50	150	200	70~700	6	2	(80)	10	1	(2.0)	MINI
	2SC2712	50	150	150	70~700	6	2	(80)	10	1	(2.0)	S-MINI
	2SC4116	50	150	100	70~700	6	2	(80)	10	1	(2.0)	USM

2.6 FETS FOR FM/AM TUNER

APPLICATION	Type No.	MAX. RATINGS			ELECTRICAL CHARACTERISTICS												OUT LINE
		V_{DS}	I_D	P_D	I_{DSS}			Yfs @1 kHz(TYP.)				$G_{rs}(G_{CS'})$/NF($NF_{CS'}$) (TYP.)					
		*V_{GDS} (V_{GDO}) (V)	(I_C) (mA)	(mW)	(mA)	V_{DS} (V)	V_{G1S}/ V_{G2S} (V)	(mS)	V_{DS} (V)	I_D (mA)	V_{G2S} V_{GS} (V)	(dB/dB)	V_{DS} (V)	I_D (mA)	V_{G2S} (V_{GS}) (V)	f (MHz)	
FM RF, MIX	3SK126	15	30	150	0~6	6	0/3	20	6	10	3	25/1.4	6	10	3	200	SMQ
	3SK151	15	30	150	3~14	6	0/3	27	6	10	3	24.5/3.3	V_{DD}10	10	—	200	SMQ
	3SK160	13.5	30	150	0~2	6	0/3	18	6	10	3	18/2.1	6	10	3	500	SMQ
	3SK195	13.5	30	150	0~0.1	6	0/4	13	6	10	4	27/1.1	6	—	4	200	SMQ
	3SK225	13.5	30	150	0~0.1	6	0/4.5	21	6	10	4.5	22/2.0	6	10	4.5	500	SMQ
	3SK226	13.5	30	150	0~0.1	6	0/4.5	13	6	10	4.5	27/1.1	6	10	4.5	200	SMQ
	3SK257	13.5	30	100	0~0.1	6	0/4.5	21	6	10	4.5	22/2.0	6	10	4.5	500	USQ
	3SK258	13.5	30	100	0~0.1	6	0/4.5	13	6	10	4.5	27/1.1	6	10	4.5	200	USQ
FM RF	2SK241	20	30	200	1.5~14	10	0	10	10	—	(0)	28/1.7	10	—	(0)	100	MINI
	2SK302	20	30	150	1.5~14	10	0	10	10	—	(0)	28/1.7	10	—	(0)	100	S-MINI
	2SK882	20	30	100	3~14	10	0	10	10	—	(0)	28/1.7	10	—	(0)	100	USM
	2SK161	(−18)	(10)	200	1~10	10	0	9	10	—	(0)	18/2.5	10	—	(0)	100	MINI
	2SK211	(−18)	(10)	150	1~10	10	0	9	10	—	(0)	18/2.5	10	—	(0)	100	S-MINI
	2SK881	(−18)	(10)	100	1~10	10	0	9	10	—	(0)	18/2.5	10	—	(0)	100	USM
	2SK1771	12.5	30	150	0~0.1	8	0	15	8	10	—	23/1.0	8	16	—	100	SMQ
FM RF, OSC	2SK192A	(−18)	(10)	200	3~24	10	0	7	10	—	(0)	24/1.8	10	—	(0)	100	MINI
	2SK210	(−18)	(10)	100	3~24	10	0	7	10	—	(0)	24/1.8	10	—	(0)	100	S-MINI
AM RF	2SK709	*−20	(10)	300	6~32	5	0	25	5	—	(0)	−/0.5	5	1	Rg 1kΩ	1kHz	TO-92
	2SK710	*−20	(10)	200	6~32	5	0	25	5	—	(0)	−/0.5	5	1	Rg 1kΩ	1kHz	MINI
	2SK711	*−20	(10)	150	6~32	5	0	25	5	—	(0)	—	—	—	—	—	S-MINI
	2SK1875	*−20	(10)	100	6~32	5	0	25	5	—	(0)	—	—	—	—	—	USM

2.7 TUNING DIODES FOR TV TUNER AND VHF~UHF EQUIPMENT

APPLICATION	Type No.	V_R	I_R		$C_T(1)$		$C_T(2)$		$C_T(1)/C_T(2)$	r_s(TYP.)			OUT LINE
				V_R		V_R		V_R			V_R(V)	f	
		(V)	(nA)	(V)	(pF)	(V)	(pF)	(V)		(Ω)	*C(pF)	(MHz)	
V, UHF Tuning	1SV153	30	10	28	14.16~16.25	2	2.11~2.43	25	5.9~7.15	0.45	*9	470	SMC
V, UHF Tuning	1SV153A	30	10	28	14.16~16.25	2	2.11~2.43	25	5.9~7.15	0.4	5	470	SMC
VHF Tuning (CATV)	1SV161	30	10	28	26~32	2	2.5~3.2	25	9.5MIN.	0.6	5	470	SMC
UHF Tuning (DBS 2ND C/V)	1SV186	30	10	28	3.31~4.55	2	0.66~0.82	25	45MIN.	1.2	1	470	SMC
AFC	1SV204	30	10	28	10.5~16	2	3.3~5.7	10	2.5~3.4	0.55	5	470	SMC
VHF Tuning (CATV)	1SV211	30	10	28	33~39	2	2.6~3.2	25	11.5MIN.	0.83	5	470	SMC
UHF VCO	1SV212	15	3	15	14~16	2	5.5~6.5	10	2.0MIN.	0.2	5	470	SMC
V, UHF Tuning	1SV214	30	10	28	14.16~16.25	2	2.11~2.43	25	5.9~7.15	0.4	5	470	USC
VHF Tuning (CATV)	1SV215	30	10	28	26~32	2	2.5~3.2	25	9.5MIN.	0.6	5	470	USC
AFC	1SV216	30	10	28	10.5~16	2	3.3~5.7	10	2.5~3.4	0.55	5	470	USC
VHF Tuning (CATV)	1SV217	30	10	28	33~39	2	2.6~3.2	25	11MIN.	0.83	5	470	USC
CATV CONV OSC	1SV224	30	10	28	13.9~16.1	2	1.7~2.1	20	7.1MIN.	0.73	5	470	SMC
VHF Tuning (CATV)	1SV226	30	10	28	41~49.5	2	2.7~3.4	25	14MIN.	1.05	5	470	SMC
VHF Tuning (CATV)	1SV227	30	10	28	28~32	2	2.75~3.1	25	10MIN.	0.55	5	470	SMC
UHF VCO	1SV229	15	3	15	14~16	2	5.5~6.5	10	2.0MIN.	0.2	5	470	USC
CATV CONV OSC	1SV230	30	10	28	13.9~16.1	2	1.7~2.1	20	7.1MIN.	0.73	5	470	USC
VHF Tuning (CATV)	1SV231	30	10	28	41~49.5	2	2.7~3.4	25	14MIN.	1.05	5	470	USC
VHF Tuning (CATV)	1SV232	30	10	28	28~32	2	2.75~3.1	25	10MIN.	0.55	5	470	USC
VHF Tuning (CATV)	1SV238	30	10	28	31~38	2	2.75~3.25	25	10.7MIN.	0.7	5	470	USC
UHF VCO	1SV239	15	3	15	3.8~4.7	2	1.5~2.0	10	2.0MIN.	0.45	1	470	USC
VHF Tuning (CATV)	1SV242	30	10	28	36~42	1	2.43~3.0	28	13.4MIN.	0.65	5	470	SM
UHF Tuning	1SV245	30	10	28	3.31~4.55	2	0.61~0.77	25	5.0MIN.	1.2	1	470	USC
V, UHF Tuning	1SV254	30	10	28	14.16~16.25	2	2.11~2.43	25	5.9~7.15	0.4	5	470	SSC
VHF Tuning (CATV)	1SV255	30	10	28	26~32	2	2.5~3.2	25	9.5MIN.	0.6	5	470	SSC
AFC	1SV256	30	10	28	10.5~16	2	3.3~5.7	10	2.5~3.4	0.55	5	470	SSC
UHF VCO	1SV257	15	3	15	14~16	2	5.5~6.5	10	2.0MIN.	0.2	5	470	SSC
CATV CONV OSC	1SV258	30	10	28	13.9~16.1	2	1.7~2.1	20	7.1MIN.	0.73	5	470	SSC
VHF Tuning (CATV)	1SV259	30	10	28	28~32	2	2.75~3.1	25	10MIN.	0.55	5	470	SSC
UHF VCO	1SV260	15	3	15	3.8~4.7	2	1.5~2.0	10	2.0MIN.	0.45	1	470	SSC
UHF Tuning	1SV261	30	10	28	3.31~4.55	2	0.61~0.77	25	5.0MIN.	1.2	1	470	SSC
VHF Tuning (CATV)	1SV262	34	10	32	33~38	2	2.6~3.0	25	12MIN.	0.6	5	470	USC
VHF Tuning (CATV)	1SV269	34	10	32	29~34	2	2.5~2.9	25	10.8MIN.	0.55	5	470	USC
UHF VCO	1SV270	10	3	10	15~17	1	7.3~8.7	4	1.8MIN.	0.28	1	470	USC
UHF VCO	1SV273	10	3	10	15~17	1	7.3~8.7	4	1.8MIN.	0.28	1	470	SSC
VHF Tuning (CATV)	1SV274	34	10	32	33~38	2	2.6~3.0	25	12MIN.	0.6	5	470	SSC
VHF Tuning (CATV)	1SV275	34	10	32	29~34	2	2.5~2.9	25	10.8MIN.	0.55	5	470	SSC
UHF VCO	1SV276	10	3	10	15~17	1	7.0~8.5	4	1.8MIN.	0.22	1	470	USC

2.8 TUNING DIODES FOR FM/AM TUNER

APPLICATION	Type No.	V_R (V)	I_R (nA)	V_R (V)	$C_T(1)$ (pF)	V_R (V)	$C_T(2)$ (pF)	V_R (V)	$Q(rs(\Omega)TYP.)$ (−)	V_R (V)	f (MHz)	OUT LINE
AM Tuning	1SV102	30	50	30	360~460	2	15~21	25	200	2	1	MINI
	1SV149	15	50	15	435~540	1	19.9~30	8	200	1	1	
FM Tuning	1SV101	15	10	15	28~32	3	12~14	9	(0.3)	C=30pF	50	
FM Tuning (TWIN)	1SV103	32	50	30	37~42	3	13.2~16.2	30	*(0.35)	C=20pF	50	
	1SV228	15	10	15	*28.5~32.5	3	*11.7~13.7	8	*(0.3)	3	100	S-MINI
	1SV147	15	50	15	*28.5~32.5	3	*11.7~13.7	8	*(0.3)	C=30pF	50	MINI
	1SV225	32	50	30	*18.5~21	3	* 6.6~7.7	30	*(0.35)	3	100	S-MINI
AFC	1SV160	15	100	4	7~14	4	—	—	(0.7)	4	50	S-MINI

*Twin Characteristics

2.9 TUNING HYBRID DIODES FOR AM TUNER

APPLICATION	Type No.	V_R (V)	I_R(MAX) (nA)	V_R (V)	$C_T(1)$ (pF)	V_R (V)	$C_T(2)$ (pF)	V_R (V)	Q MIN (−)	V_R (V)	f (MHz)	CONTENTS	OUT LINE
AM Tuning	HN1V01H	16	20	16	435~540	1	19.9~26.7	8	200	1	1	1SV149×4	FM8
	HN1V02H	16	20	16	435~540	1	19.9~26.7	8	200	1	1	1SV149×2	FM8
	HN2V02H	16	20	16	435~540	1	19.9~26.7	8	200	1	1	1SV149×3	FM8
	*HN9V01H	16	20	16	435~540	1	19.9~26.7	8	200	1	1	1SV149×3	FM8

*UNDER DEVELOPMENT

2.10 PIN DIODES FOR TV BAND SW AND ATT.

APPLICATION		Type No.	V_R (V)	I_R(MAX) (μA)	V_R (V)	V_F(MAX) (V)	I_F (mA)	C_T(MAX) (pF)	V_R (V)	rs(TYP.) (Ω)	I_F (mA)	f (MHz)	OUT LINE
TV Band Switch	Single	1SS241	30	0.1	15	0.85	2	1.2	6	0.6	2	100	SMC
		1SS314	30	0.1	15	0.85	2	1.2	6	0.5	2	100	USC
		1SS371	30	0.1	15	0.85	2	1.2	6	0.5	2	100	SSC
	Twin	1SS268	30	0.1	15	0.85	2	1.2	6	0.6	2	100	S-MINI
		1SS269	30	0.1	15	0.85	2	1.2	6	0.6	2	100	S-MINI
		1SS312	30	0.1	15	0.85	2	1.2	6	0.6	2	100	USM
		1SS313	30	0.1	15	0.85	2	1.2	6	0.6	2	100	USM
		1SS364	30	0.1	15	0.85	2	1.2	6	0.6	2	100	SSM

2.11 PIN DIODES FOR AM/FM~UHF ATT.

APPLICATION		Type No.	V_R (V)	I_R(MAX) (μA)	V_R (V)	V_F(MAX) (V)	I_R (mA)	C_T(MAX) (pF)	V_R (V)	rs(TYP.) (Ω)	I_F (mA)	f (MHz)	OUT LINE
SW, ATT	Single	1SV99	50	0.1	50	0.95	50	0.3	30	7	10	100	TO-92
		1SV128	50	0.1	50	0.95	50	0.25	50	7	10	100	S-MINI
		1SV271	50	0.1	50	0.95	50	0.25	50	4	10	100	USC
	Twin	1SV172	50	0.1	50	0.95	50	0.25	50	7	10	100	S-MINI
		1SV237	50	0.1	50	0.95	50	0.25	50	4	10	100	SMQ
		1SV252	50	0.1	50	0.95	50	0.25	50	7	10	100	USM

2.12 SCHOTTKY BARRIER DIODES FOR VHF~UHF MIXER

APPLICATION	Type No.	V_R $*V_{RM}$ (V)	I_F (mA)	V_F(TYP.) (V)	I_F (mA)	C_T(TYP.) (pF)	V_R (V)	OUT LINE
VHS~S Band MIX	1SS154	6	30	0.5	10	0.8	0	S-MINI (Single)
	1SS239	6	30	0.5	10	0.8	0	SMC
	1SS271	6	30	0.55	10	0.9	0	S-MINI (Twin)
UHF MIX	1SS242	*5	30	0.25	2	0.6	0.2	SMC
	1SS295	4	30	0.25	2	0.8	0.2	S-MINI (Twin)
	1SS315	*5	30	0.25	2	0.6	0.2	USC

2.13 HYBRID TRANSISTORS FOR AM TUNERS

APPLICATION	Type No.	V_{GDS} (V)	I_G (mA)	V_{CEO} (V)	I_C (mA)	P_T (mW)	I_{DSS} (mA)	V_{DS} (V)	V_{GS} (V)	|Yfs| TYP. (ms)	V_{DS} (V)	V_{GS} (V)	h_{FE}	V_{CE} (V)	I_C (mA)	CONTENTS	OUT LINE
AM RF	HN3G01J	−20	10	50	150	200	6~32	5	0	25	5	0	120~400	6	2	2SK711+2SC2712	SMV

2.14 HYBRID TRANSISTORS FOR VHF~UHF BAND

APPLICATION	Type No.	V_{CEO} (V)	I_C (mA)	P_C* (mW)	h_{FE}	V_{CE} (V)	I_C (mA)	f_T TYP. (GHz)	V_{CE} (V)	I_C (mA)	NF TYP. (dB)	V_{CE} (V)	I_C (mA)	f (GHz)	CONTENTS	OUT LINE
VHF MIX. OSC	HN3C01F	20	50	300	40~300	10	5	1.4	10	5	—	—	—	—	2SC3123×2	SM6
UHF MIX. OSC	HN3C02F	15	50	300	40~200	10	5	2.4	10	2	—	—	—	—	2SC3120×2	SM6
UHF MIX. OSC	HN3C03F	12	30	300	35~130	10	5	4	10	10	—	—	—	—	2SC3547A×2	SM6
VHF/UHF Low Noise Amp.	HN3C06F	12	80	300	30~250	10	20	7	10	20	1.1	10	5	1	2SC3606×2	SM6
VHF/UHF Low Noise Amp.	HN3C07F	10	40	300	50~250	8	20	10	8	20	1.7	8	5	2	2SC4317×2	SM6
VHF/UHF Low Noise Amp.	HN3C08F	10	15	300	50~250	6	7	10	6	7	1.8	6	3	2	2SC4322×2	SM6

*Total Pc

2.15 CELL PACKS FOR VHF~UHF

APPLICATION	Type No.	I_{CC} (mA)	V_{CC} (V)	$\|S_{21}\|^2$TYP. (dB)	V_{CC} (V)	f (MHz)	NF TYP. (dB)	V_{CC} (V)	f (MHz)	BW TYP. (GHz)	V_{CC} (V)	P_o TYP. (dBmW)	V_{CC} (V)	f (MHz)	Pi (dBmW)	OUT LINE
Diff Wide Band Amp.	TA4000F	9~15	5	15	5	400	4	5	400	1.3	5	−2	5	400	−10	SM6
VHF~UHF Wide Band Amp.	TA4001F	14~24	5	12.5	5	500	5.2	5	500	2.4	5	2	5	500	0	SMQ
VHF~UHF Wide Band Amp.	TA4002F	10~20	5	23	5	500	4.7	5	500	1.3	5	5	5	500	0	SMQ
VHF~UHF Wide Band Amp.	TA4003F	2.5~4.5	2	11	2	500	5.2	2	500	1.5	2	0	2	500	0	SMV
VHF~UHF Wide Band Amp.	TA4004F	2.5~4	2	10.5	2	500	4.2	2	500	1.2	2	0	2	500	0	SMV

APPLICATION	Type No.	I_{DD} (mA)	V_{DD} (V)	V_{G2} (V)	Gps/NF TYP. (dB/dB)	V_{DD} (V)	V_{G2} (V)	f (MHz)	OUT LINE
VHF Wide RF Amp.	TA4006F	6~14	9	7	24/2.0	9	7	500	SMV
VHF RF Amp.	TA4007F	6~14	9	7	28/1.3	9	7	200	SMV
UHF RF Amp.	TG2000F	11 TYP.	4.5	2.5	19/1.5	4.5	2.5	800	SMV

APPLICATION	Type No.	I_C (mA)	P_D (mW)	h_{FE} (−)	V_C (V)	I_C (mA)	f_T (GHz)	V_C (V)	I_C (mA)	OUT LINE
VHF-UHF RF/MIX	TA4100F	6~14	15*(1) 30*(2)	50~150*(1) 70~250*(2)	6	5*(1) 10*(2)	3.5~7	6*(1) 4*(2)	5*(1) 10*(2)	SM6

*(1) Q1, Q2 *(2) Q3

APPLICATION	Type No.	I_{CC} (mA)	P_D (mW)	G_{MIX}/NF_{MIX} (dB/dB)	V_{CC} (V)	f_{RF} (MHz)	f_{LO} (MHz)	f_{IF} (MHz)	OUT LINE
VHF~UHF DBM	TA4101F	5.7	*300	−3.5/9.0	5	800	860	60	SM8

2.16 CELL PACKS FOR CATV CONV

APPLICATION	Type No.	V_R (V)	I_F (mA)	V_F TYP. (V)	I_F (mA)	C_T TYP. (pF)	V_R (V)	ΔV_F MAX. (mV)	I_F (mA)	ΔC_T MAX. (pF)	V_R (V)	OUT LINE
CATV CONV, DBM	S3275	6	15	0.53	10	0.65	0	20	10	0.15	0	FM8

2.17 RF TRANSISTOR f_T 7GHz SERIES

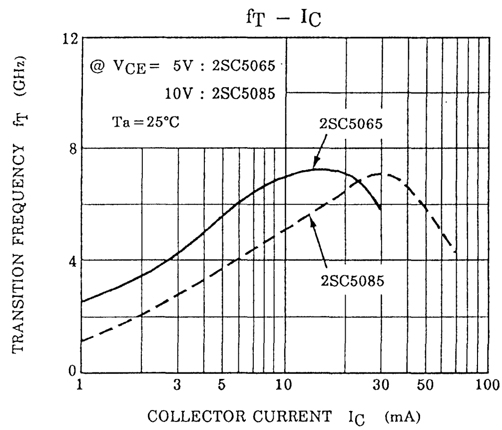
- Low noise figure and high gain
- High current application: 2SC5065 (2SC5064 series)
- Low current application: 2SC5085 (2SC5084 series)
- 5 different pack (Surface mount type)
- Application circuit: AMP, MIX, OSC stage for UHF Band

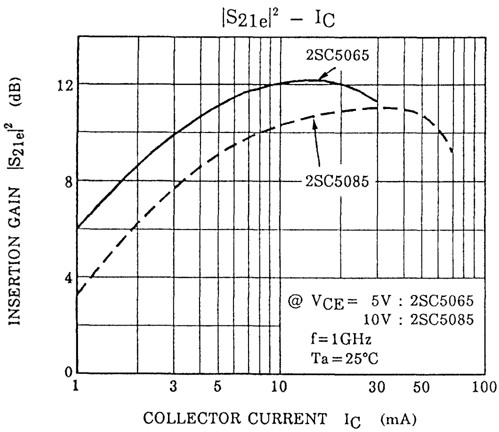
RF CHARACTERISTICS (TYP.)

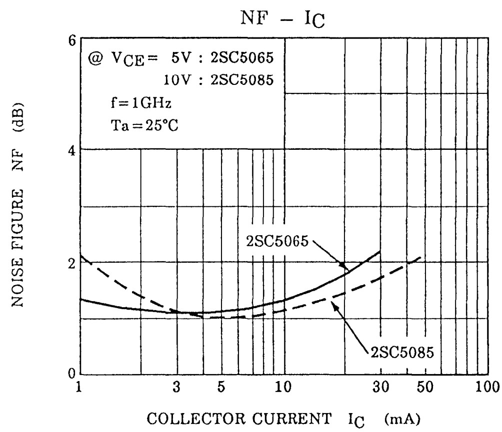
Type \ Symbol	NF (dB)		$\|S_{21e}\|^2$ (dB)	
	500MHz	1GHz	500MHz	1GHz
2SC5064	1.0	1.1	17	12
2SC5084	1.0	1.1	16.5	11

LINE UP

Type	Package
High Current	
2SC5084	S-Mini
2SC5085	USM
2SC5086	SSM
2SC5087	SMQ
2SC5088	USQ
Low Current	
2SC5064	S-Mini
2SC5065	USM
2SC5066	SSM







2.18 RF TRANSISTORS NEW f_T 10GHz SERIES

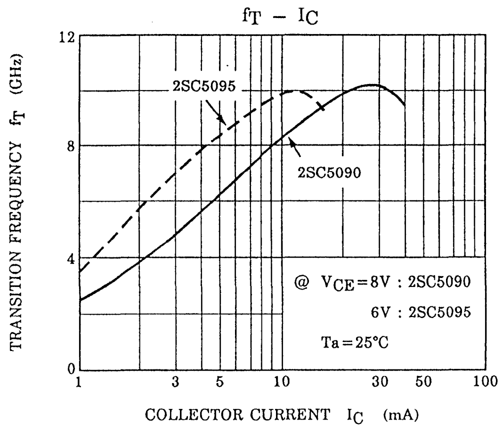
- 1M-bit and 4M-bit DRAM stepper technologies
  Emitter width=0.6μm
- Low noise figure and high gain
- High current application: 2SC5090 (2SC5089 series)
- Low current application: 2SC5095 (2SC5094 series)
- 5 different pack (Surface mount type)
- Application circuit: AMP, MIX, OSC stage for UHF Band

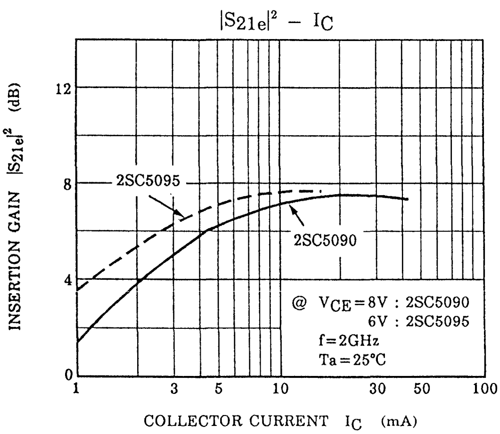
RF CHARACTERISTICS (TYP.)

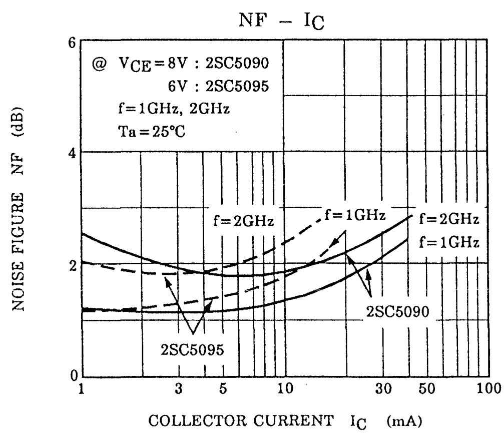
Symbol / Type No.	NF (dB)		$\lvert S_{21e}\rvert^2$ (dB)	
	1GHz	2GHz	1GHz	2GHz
2SC5089	1.1	1.7	13	7
2SC5094	1.4	1.8	13	7.5

LINE UP

Type No.	Package
High Current application	
2SC5089	S-Mini
2SC5090	USM
2SC5091	SSM
2SC5092	SMQ
2SC5093	USQ
Low Current application	
2SC5094	S-Mini
2SC5095	USM
2SC5096	SSM
2SC5097	SMQ
2SC5098	USQ







2.19 RF TRANSISTORS FOR PAGER 2SC5064, 2SC5094, 2SC5106 SERIES

- SUPERIOR LOW VOLTAGE/LOW CURRENT OPERATION CHARACTERISTICS, SUIT FOR PAGER AND HAND HELD PHONE.

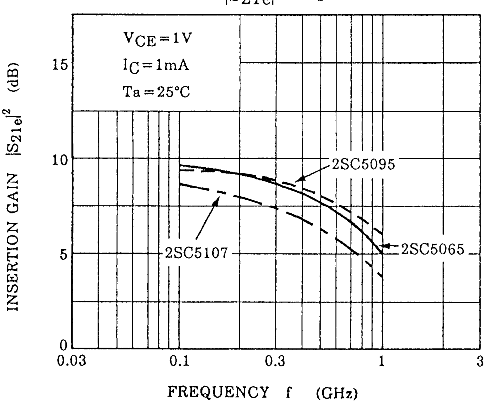
RF CHARACTERISTICS (@VCE=1V/Ic=1mA)

PRT \ Symbol / f (MHz)	$\lvert S_{21e}\rvert^2$ (dB) 150	280	450	900	fT (GHz)
2SC5065	10	9	8	6	2
2SC5095	9	9	8	7	3
2SC5107	8	8	7	4	2

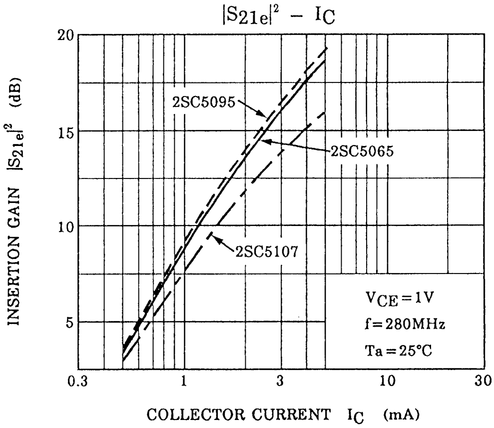
BLOCK \ PACKAGE	TRANSISTOR SM	USM	SSM
RF Amp.	2SC5064	2SC5065	2SC5066
MIX	2SC5094	2SC5095	2SC5096
OSC	2SC5106	2SC5107	2SC5108

- 2SC5095 IS SUITSBLE FOR US PAGER (450MHz, 900MHz)
- 3 DIFFERENT PACKAGES: SM, USM, SSM

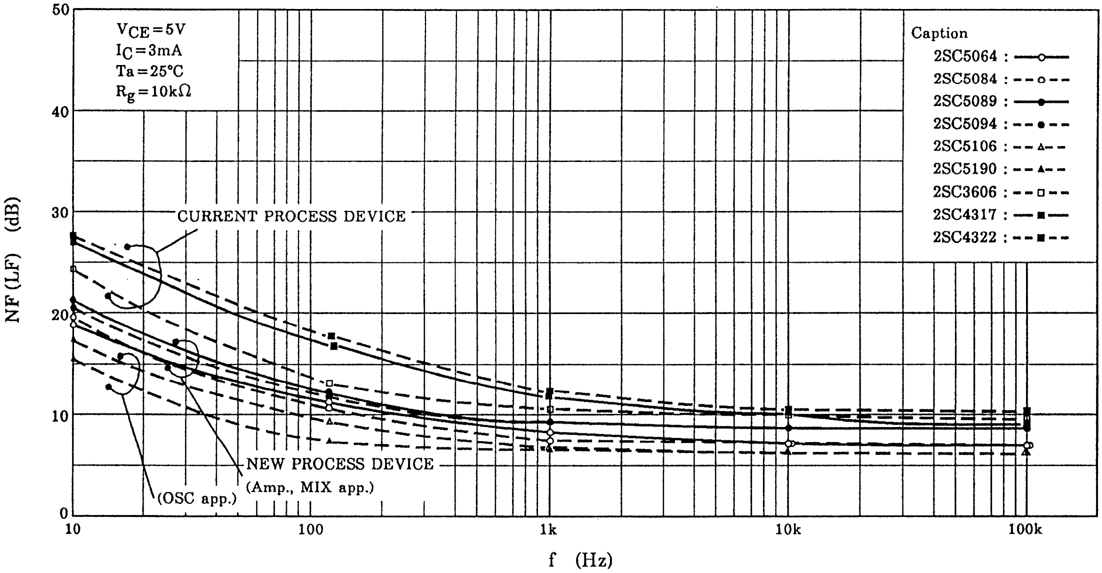
$\lvert S_{21e}\rvert^2 - f$



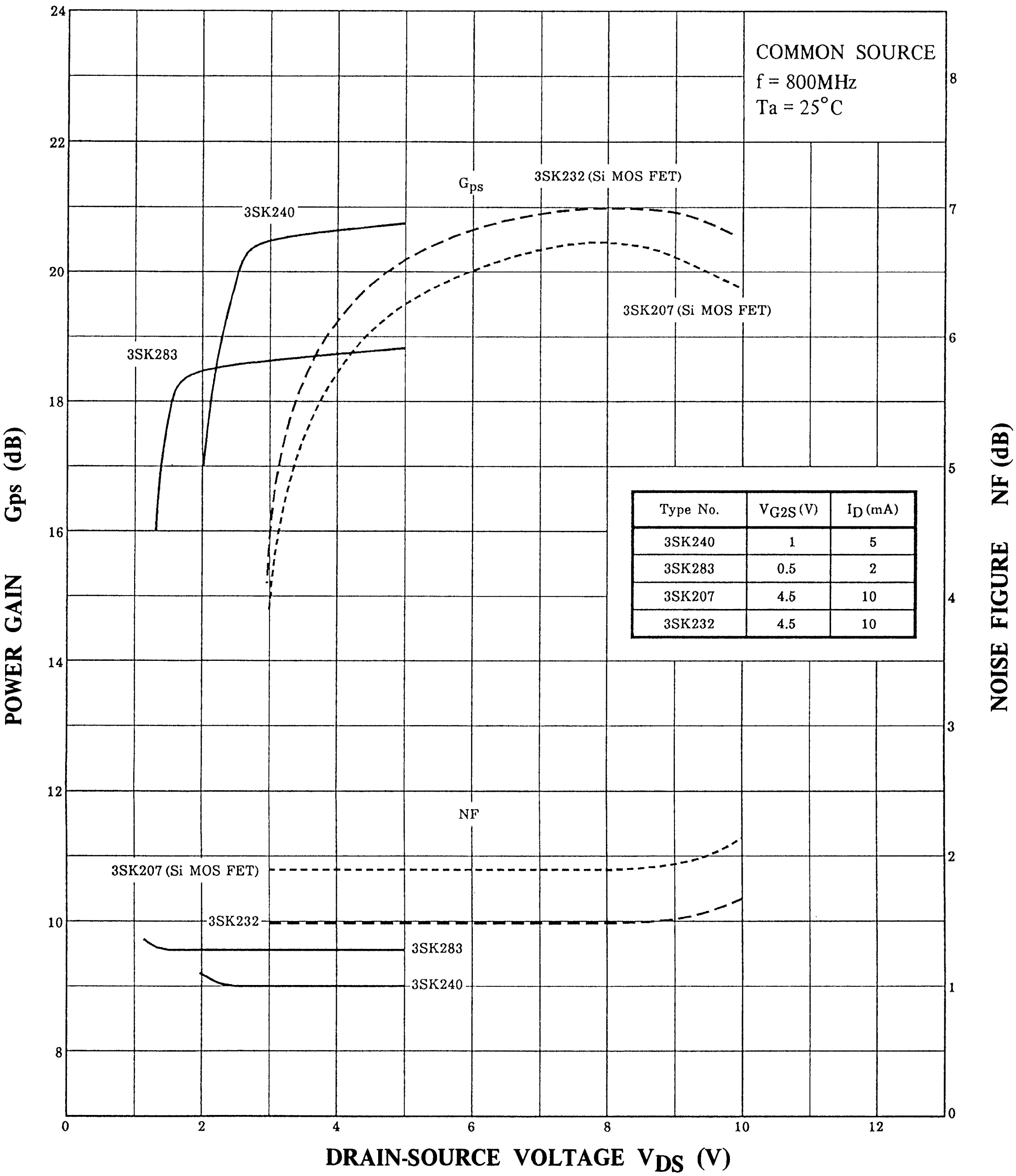
$\lvert S_{21e}\rvert^2 - I_C$



2.20 COMPARISON DATA OF LOW FREQUENCY NF

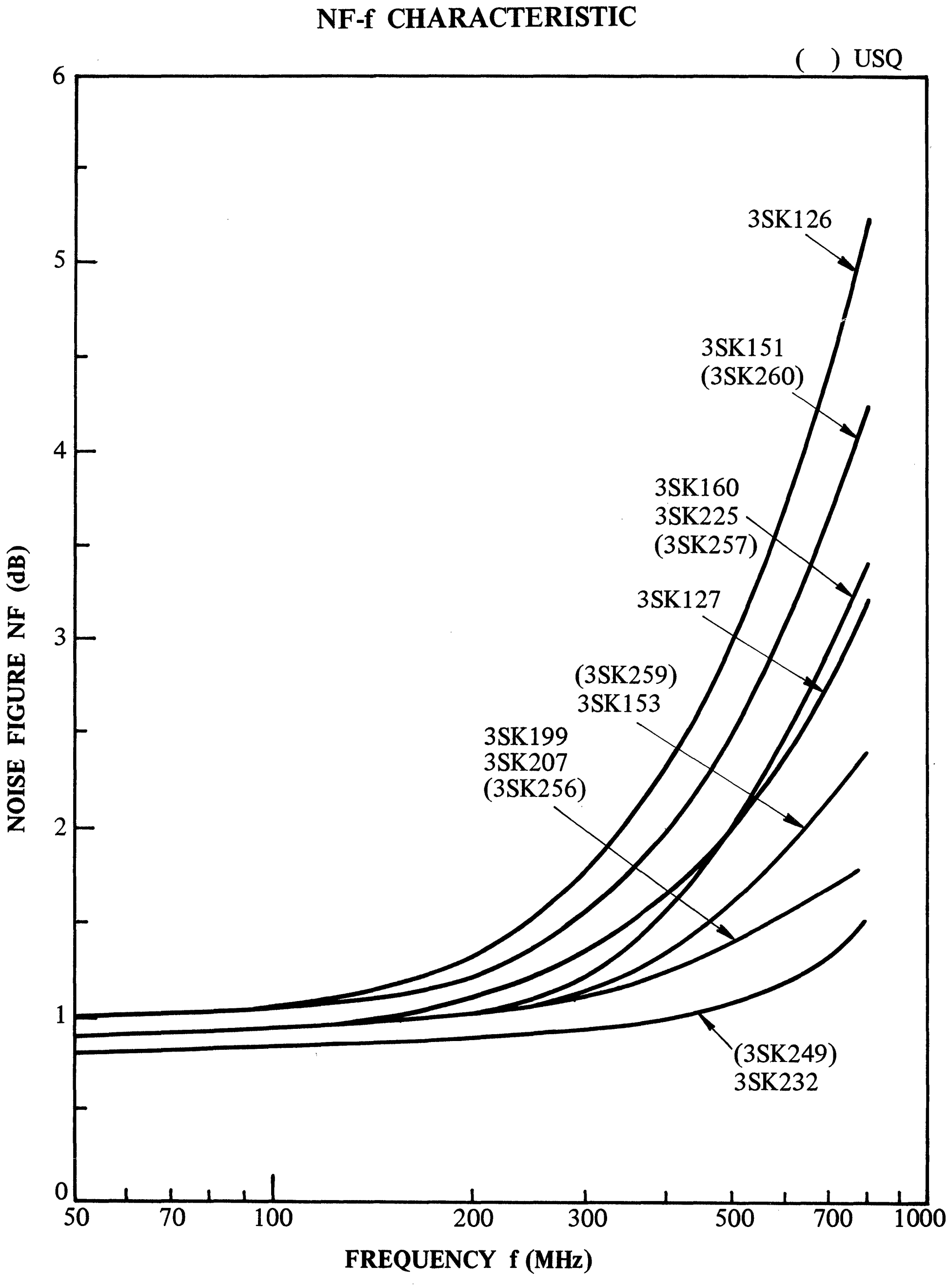


2.21 Gps, NF-V_{DS} CHARACTERISTIC

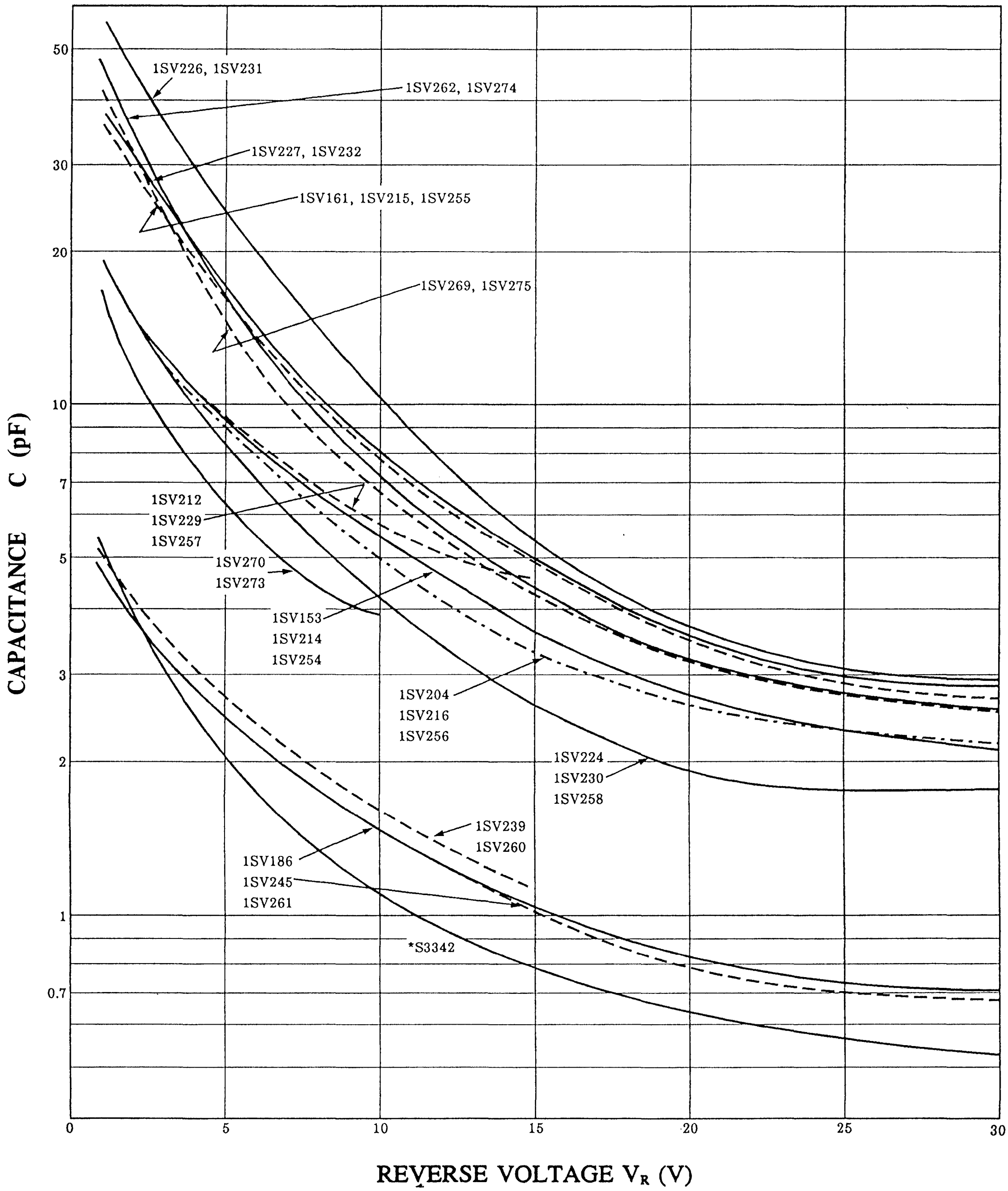


Type No.	V_{G2S} (V)	I_D (mA)
3SK240	1	5
3SK283	0.5	2
3SK207	4.5	10
3SK232	4.5	10

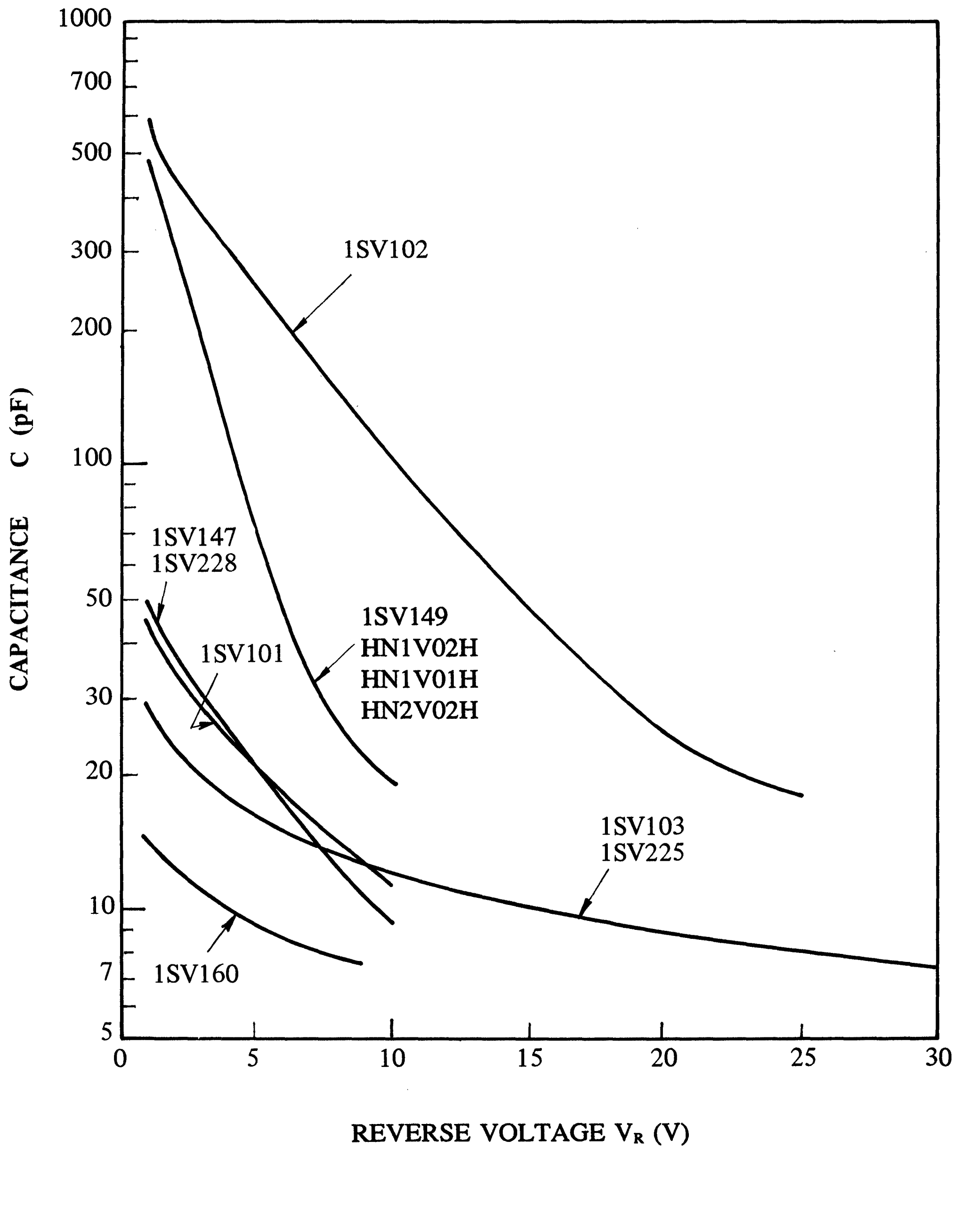
2.22 DUAL GATE FET



2.23 VARICAP C-V CHARACTERISTICS IN TV TUNERS, BS TUNERS AND TELECOMMUNICATION USE



2.24 VARICAP C-V CHARACTERISTICS IN AUDIO TUNERS



3. BLOCK DIAGRAM OF RECOMMENDED PRODUCTS

3.1 RF DISCRETE DEVICES FOR AM TUNER

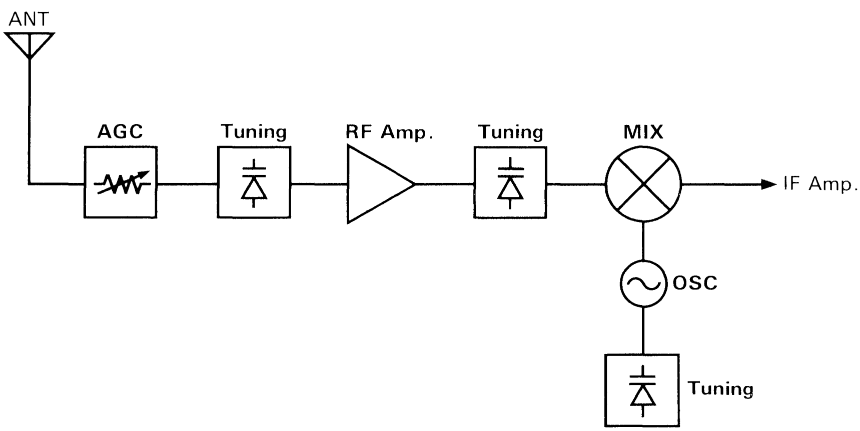
AGC

PIN Diode					
Single			Double		
TO-92	SM	USC	SM	SMQ	USM
1SV99	1SV128	*1SV271	1SV172	1SV237	*1SV252

*NEW

MIX

Bi-Transistor		
TO-92	MINI	SM
2SC380TM	2SC2669	2SC2715
2SC941TM	2SC2670	2SC2716



RF Amp.

AGC		RF Amp.			
Bi-Tr		J-FET			
MINI	SM	TO-92	MINI	SM	USM
2SC2458	2SC2712	2SK709	2SK710	2SK711	2SK1875
AGC+RF Amp.					
SMV					
HN3G01J					

Tuning

Tuning Varicap
MINI
1SV102 1SV149
FM8
HN1V01H HN1V02H HN2V02H ◈ HN9V01H

◈ Under development

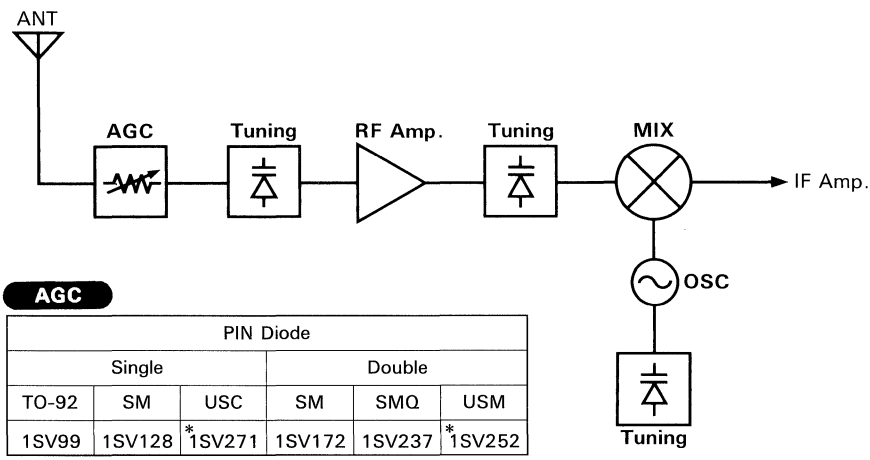
3.2 RF DISCRETE DEVICES FOR FM TUNER

RF Amp.

Dusl Gate MOS FET			Single Gate MOS FET		
SMQ		USQ	MINI	SM	USM
3SK126 3SK160 3SK195	3SK225 3SK226	3SK257 3SK258	2SK241	2SK302 SMQ 2SK1771	2SK882
Bi-Transisitor			J-FET		
MINI	SM	USM	MINI	SM	USM
2SC2668	2SC2714	2SC4215	2SK161 2SK192A	2SK211 2SK210	2SK881
Cell Pack					
SMV					
TA4007F					

MIX

Dual Gate MOS FET			
SMQ		USQ	
3SK126 3SK151		3SK260	
Bi-Transistor			
MINI	SM	USM	SSM
2SC2668	2SC2714	2SC4215	2SC4915



AGC

PIN Diode					
Single			Double		
TO-92	SM	USC	SM	SMQ	USM
1SV99	1SV128	*1SV271	1SV172	1SV237	*1SV252

* NEW

Tuning

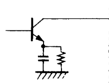
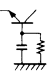
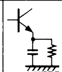
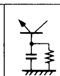
Tuning Varicap Diode		
Single Type	Twin Type	
MINI	MINI	SM
1SV101	1SV103 1SV147	1SV225 1SV228
AFC Varicap Diode		
SM		
1SV160		

OSC

J-EFT			
MINI		SM	
2SK192A		2SK210	
Bi-Transistor			
MINI	SM	USM	SSM
2SC2668 2SC2995	2SC2714 2SC2996	2SC4215	2SC4915

3.3 RF DISCRETE DEVICES FOR TV/VCR TUNER

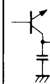
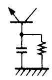
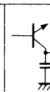
MIX

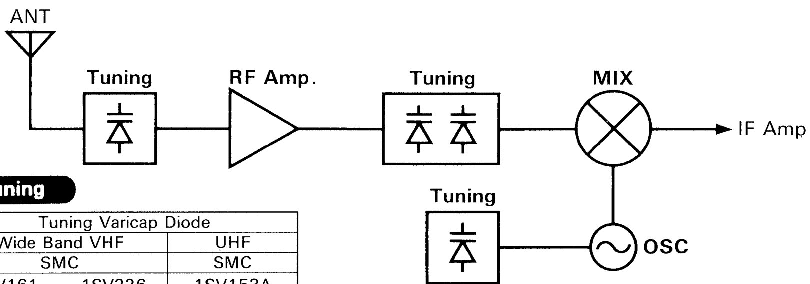
Bi-Transistor					
VHF				UHF	
				 EMITTER COMMON	 BASE COMMON
USM	SM	USM	SM	SM	SM
2SC4250	2SC3123	2SC4253	2SC3125	2SC3120	2SC3547A
2SC4245	2SC3120	2SC4251	2SC3124	2SC3862	2SC3547B
		2SC4246	2SC3121	USM	USM
(Wide Band)	(Wide Band)	(Wide Band)	(Wide Band)	2SC4245	2SC4247 2SC4248

Dual Gate FET		Schottky Diode	
VHF and Wide Band VHF		UHF	
SMQ	USQ	SMC	USC
3SK151	*3SK260	1SS242	1SS315
3SK153	*3SK259		

*NEW

OSC

Bi-Transistor					
VHF		UHF			
 COLLECTOR COMMON		 BASE COMMON		 COLLECTOR COMMON	
USM	SM	USM	SM	USM	SM
2SC4251	2SC3124				
2SC4246	2SC3121				
2SC4252	2SC4255	2SC4246	2SC3121	2SC4247	2SC3547A
				2SC4248	2SC3547B
(Wide Band)	(Wide Band)				

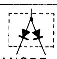


Tuning

Tuning Varicap Diode	
Wide Band VHF	UHF
SMC	SMC
1SV161 1SV226 1SV211 1SV227	1SV153A 1SV153
USC	USC
1SV215 1SV231 1SV217 1SV232 *1SV262 *1SV269	1SV214
SSC	SSC
*1SV255 — — *1SV259 *1SV274 *1SV275	*1SV254

SM(Twin Type)
1SV242

AFC Diode		
VHF~UHF		
SMC	USC	SSC
1SV204	1SV216	*1SV256

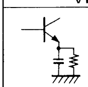
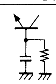
Band SW		
VHF and Wide Band VHF		
Single	Twin	
	 ANODE COMMON	 CATHODE COMMON
SMC	SM	
1SS242	1SS269	1SS268
USC	USM	
1SS314	1SS313	1SS312
SSC	SSM	
*1SS371		*1SS364

*NEW

RF Amp.

Dual Gate FET			
VHF		UHF	
SMQ	USQ	SMQ	USQ
3SK126		#3SK240	#3SK274
3SK160		#3SK283	#3SK284
3SK153	*3SK259	3SK146	
3SK195		3SK199	
3SK225	*3SK257	3SK207	*3SK256
3SK226	*3SK258	3SK232	*3SK249

Cell Pack	
SMV	SMV
*TA4006F *TA4007F	#TG2000F

Bi-Transistor			
VHF		UHF	
 EMITTER COMMON		 BASE COMMON	
USM	SM	USM	SMQ
2SC4249	2SC3122	2SC4244	2SC3828 2SC4214

NOTE *NEW
#GaAs

3.4 RF DISCRETE DEVICES FOR CATV CONVERTER

RF Amp.

Bi-Transistor	
TO-92	PW-Mini
2SC3605	2SC3607

ATT

Pin Diode			
Single		Twin	
USC		SMQ	
*1SV271		1SV237	
TO-92	SM	SM	USM
1SV99	1SV128	1SV172	*1SV252

*NEW

2'nd OSC

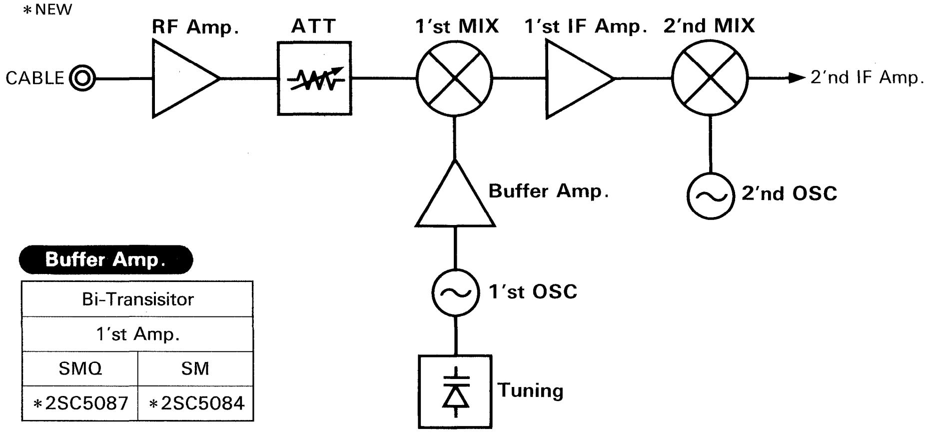
Bi-Transistor	
Base Common	
USM	SM
2SC4246	2SC3121
Si Dual Gate MOS FET	
SMQ	USQ
3SK199 3SK232	*3SK249

*NEW

2'nd MIX

Schottky Diode	
SMQ	SM
1SS239	1SS154
Si Dual Gate MOS FET	
SMQ	USQ
3SK199 3SK232	*3SK249

*NEW



Buffer Amp.

Bi-Transisitor	
1'st Amp.	
SMQ	SM
*2SC5087	*2SC5084

Tuning

Tuning Varicap
SMC
1SV153A 1SV224
USC
1SV214 1SV230
SSC
*1SV254 *1SV258

*NEW

1'st MIX

Schottky Diode
SMC
1SS239
FM8
S3275

1'st OSC

Bi-Transistor
Base Common
SM
2SC4255
USM
2SC4252

1'st IF Amp.

Bi-Transistor	
SM	SMQ
*2SC5084	*2SC5087
GaAs Dual Gate FET	
SMQ	USQ
3SK240	3SK274
Si Dual Gate MOS FET	
SMQ	USQ
3SK199 3SK232	*3SK249

*NEW

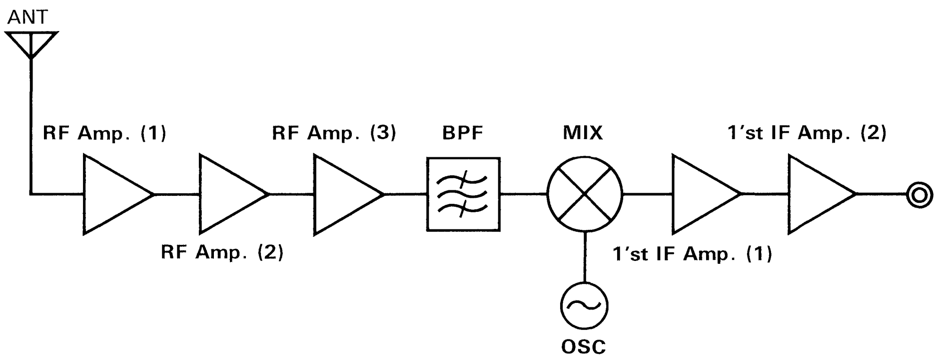
3.5 RF DISCRETE DEVICES FOR SHF LNB DOWN CONVERTER

RF Amp. (1)
MODFET
MMX
*2SK2331 *2SK2332

RF Amp. (2)
MODFET
MMX
*2SK2332 ◈S1B66

RF Amp. (3)
MODFET
MMX
◈S1B66

MIX
MODFET
MMX
◈S1B66



1'st IF Amp. (1)
Bi-Transistor
SMQ
*2SC5087 *2SC5092

1'st IF Amp. (2)
Bi-Transistor
SMQ
*2SC5087 *2SC5092
Cell Pack
*TA4001F

* NEW
◈ Under Development

3.6 RF DISCRETE DEVICES FOR SHF 2'nd CONVERTER

1'st IF Amp.

Bi-Transistor
SMQ
*2SC5092 *2SC5087

*NEW

MIX

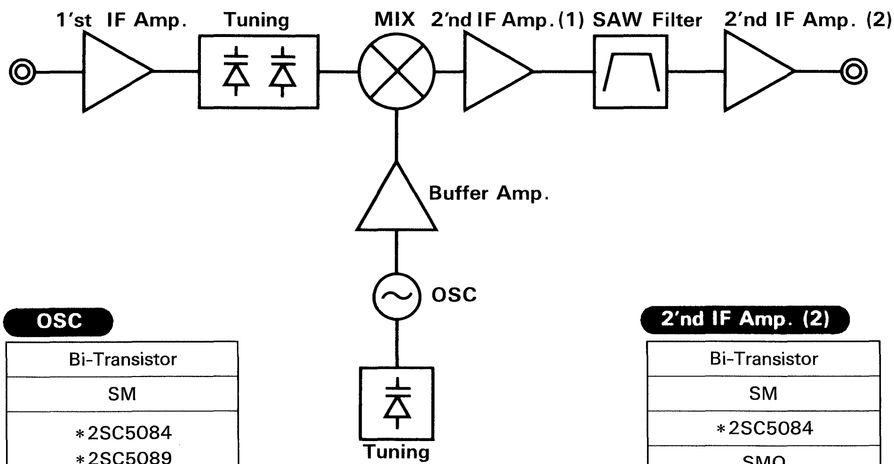
Bi-Transistor
SMQ
*2SC5087 *2SC5092
Schottky Diode
SMC
1SS239

*NEW

2'nd IF Amp. (1)

Bi-Transistor
SMQ
*2SC5087 *2SC5092
SM
*2SC5084 *2SC5089
Cell Pack
TA4002F TA4003F

*NEW



OSC

Bi-Transistor
SM
*2SC5084 *2SC5089

*NEW

Tuning

Preselector and Tuning Varicap Diode
SMC
1SV186
USC
1SV245, 1SV239 ◈S3342
SSC
*1SV261, *1SV260

*NEW
◈Under Development

Buffer Amp.

Bi-Transistor
SMQ
*2SC5087 *2SC5092
Cell Pack
TA4001F

*NEW

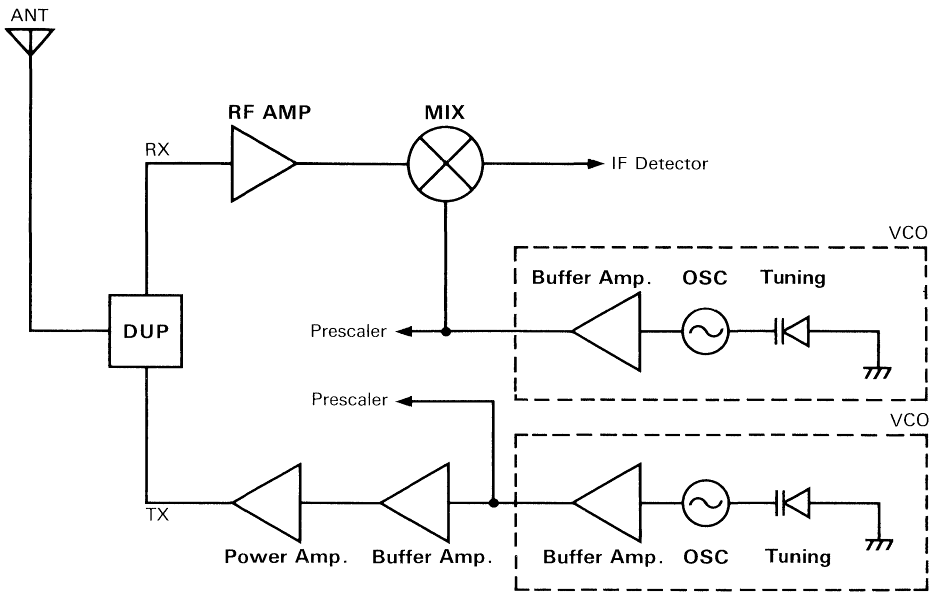
2'nd IF Amp. (2)

Bi-Transistor
SM
*2SC5084
SMQ
*2SC5087
Cell Pack
TA4000F

SAW Filter (Balanced Output)
SBU4027D SBU4827BD

*NEW

3.7 RF DISCRETE DEVICES FOR 900 MHz CORDLESS TELEPHONE



RF/Buffer/ Power Amp., MIX

Bi-Transisitor		
Type No.		Package
*2SC5084	*2SC5064	SM
*2SC5085	*2SC5065	USM
*2SC5086	*2SC5066	SSM
*2SC5087	—	SMQ
*2SC5088	—	USQ
HN3C06F	—	SM6

*NEW

OSC

Bi-Transistor		
Type No.		Package
*2SC5106	*2SC5109	SM
*2SC5107	*2SC5110	USM
*2SC5108	*2SC5111	SSM

Buffer Amp

Cell Pack	
Type No.	Package
TA4002F	SMQ
TA4003F	SMV
TA4004F	SMV

Tuning

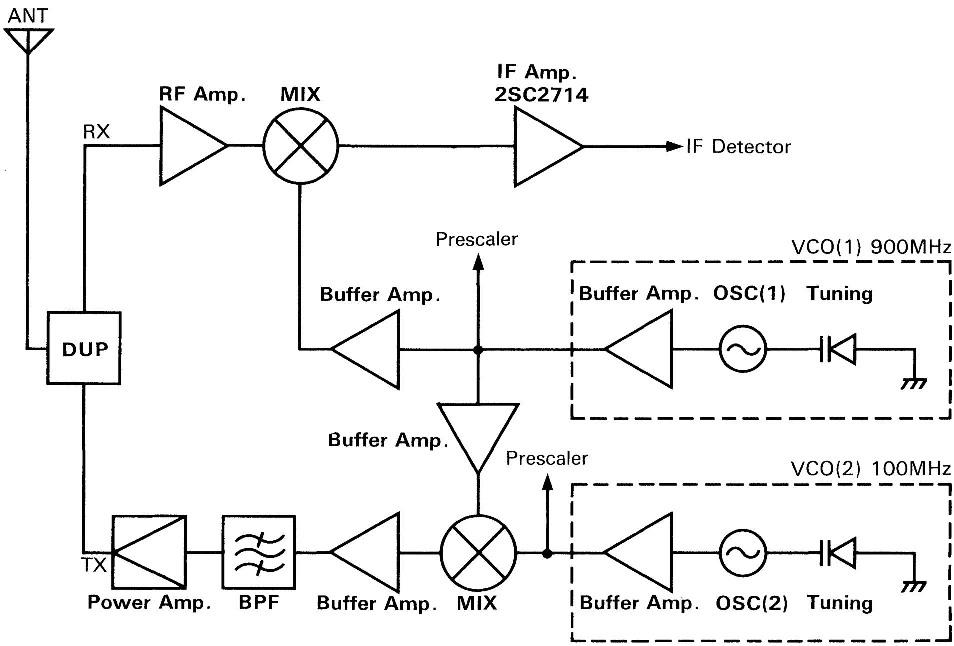
Varicap Diode	
Type No.	Package
1SV229	USC
*1SV270	USC
*1SV257	SSC
*1SV276	USC

MIX

Cell Pack	
Type No.	Package
TA4100F	SM6
*TA4101F	SM8

*NEW

3.8 RF DISCRETE DEVICES FOR CELLULAR RADIO

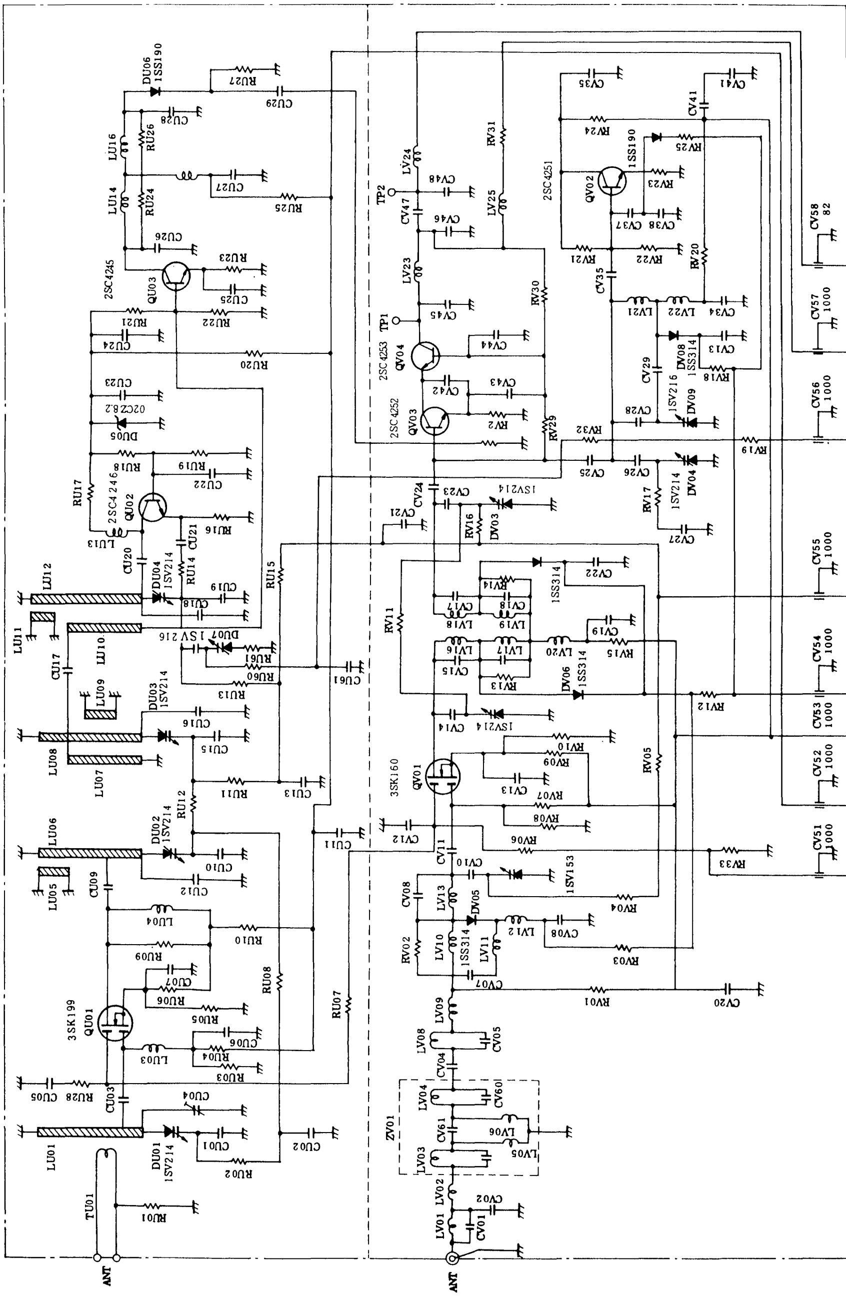


Device / Package / Stage	Transistor, FET, Diode							Cell Pack
	SM	USM	SSM	SMQ	USQ	USC	SSC	
RF Amp. Buffer Amp.	*2SC5064 *2SC5084 *2SC5089 *2SC5094	*2SC5065 *2SC5085 *2SC5090 *2SC5095	*2SC5066 *2SC5086 *2SC5091 *2SC5096	— *2SC5087 *2SC5092 *2SC5097	— *2SC5088 *2SC5093 *2SC5098	—	—	TA4001F TA4003F (Buffer Amp.)
MIX	*2SC5064 *2SC5084	*2SC5065 *2SC5085	*2SC5066 *2SC5086	— *2SC5087 3SK240 (GaAs)	— *2SC5088 3SK274 (GaAs)	—	—	TA4100F (SBM)
OSC	*2SC5064 *2SC5084 *2SC5106 *2SC5109	*2SC5065 *2SC5085 *2SC5107 *2SC5110	*2SC5066 *2SC5086 *2SC5108 *2SC5111	—	—	—	—	—
Tuning	—	—	—	—	—	1SV229	*1SV257	—
	—	—	—	—	—	*1SV270	*1SV273	—
	—	—	—	—	—	*1SV276	—	—

*NEW

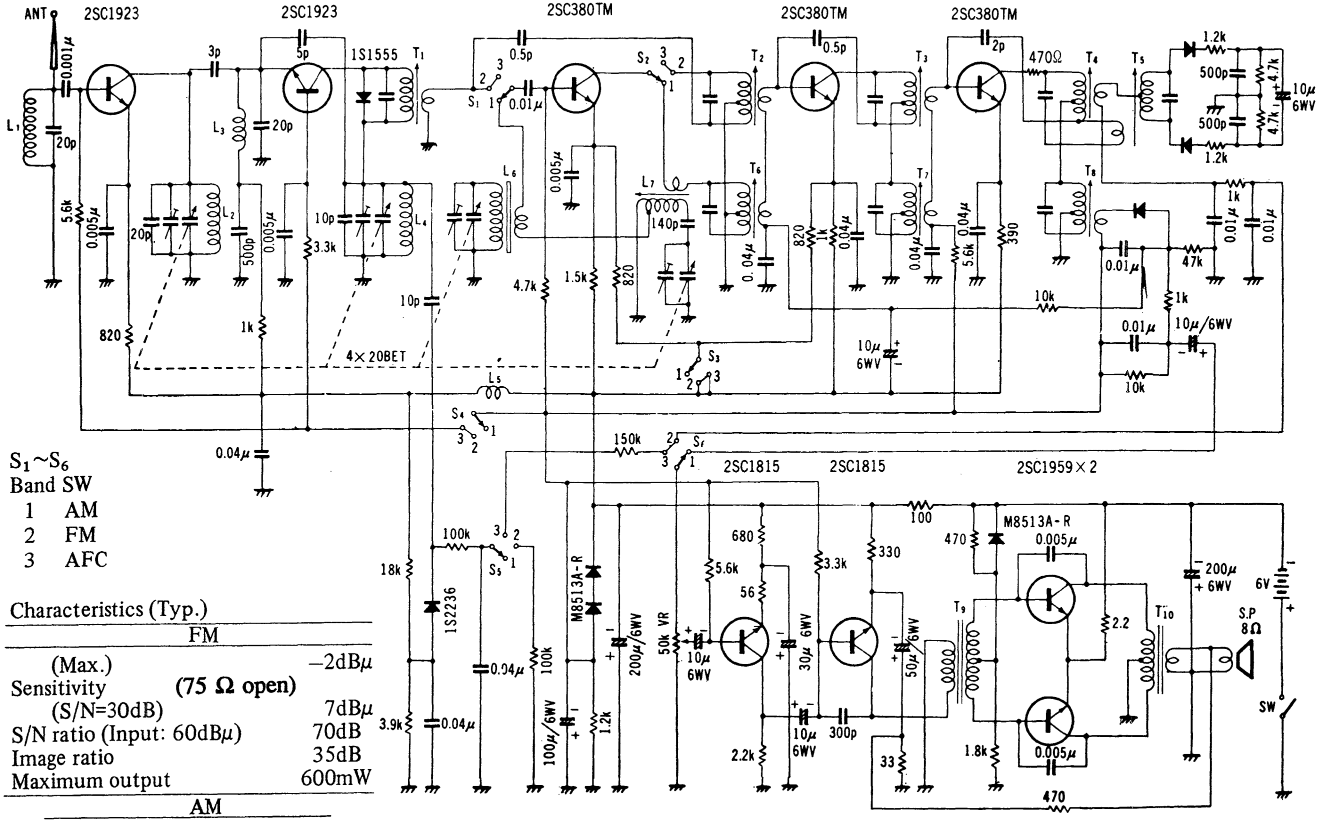
4. APPLICATION CIRCUIT EXAMPLES

4.1 TV TUNERS



4.2 AM/FM RADIO TUNER

4.2.1 9-TRANSISTOR FM/AM RADIO CIRCUIT



$S_1 \sim S_6$
Band SW
1 AM
2 FM
3 AFC

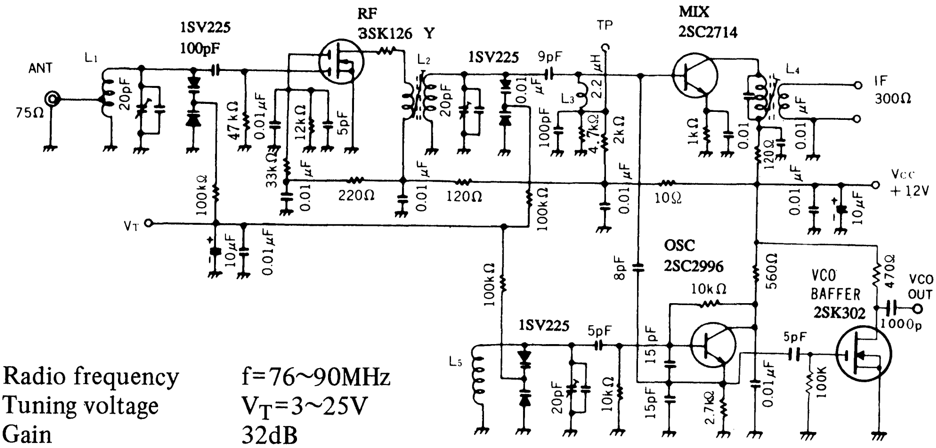
Characteristics (Typ.)

FM		
Sensitivity	(Max.)	−2dBμ
	(75 Ω open)	
	(S/N=30dB)	7dBμ
S/N ratio (Input: 60dBμ)		70dB
Image ratio		35dB
Maximum output		600mW

AM	
Sensitivity (Max.)	33dBμ
S/N ratio (60dBμ)	35dB
Selectivity ±10kHz	24dB
Maximum output	600mW

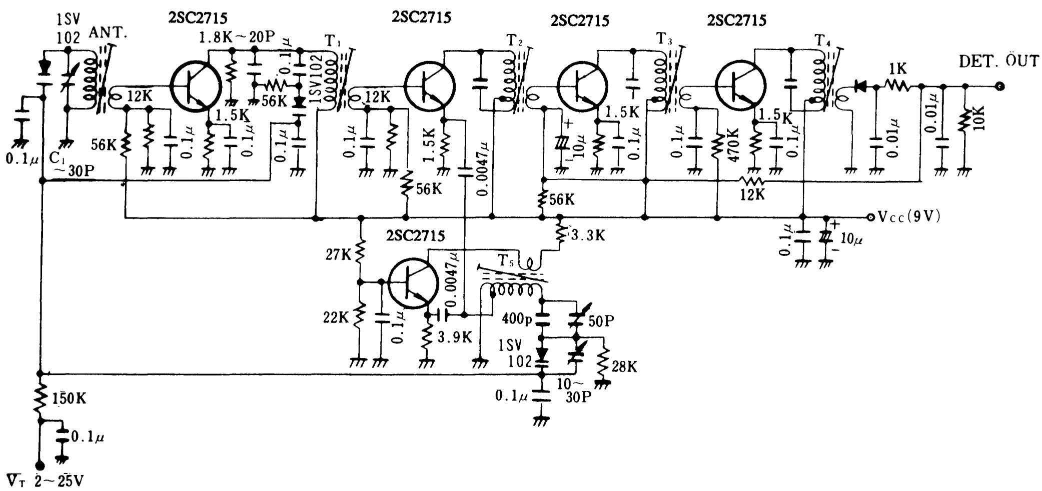
Unless otherwise spesified, Unit ; R : (Ω), C : (F), L : (H)

4.2.2 ELECTRONIC FM TUNER



Radio frequency	f=76~90MHz
Tuning voltage	V_T=3~25V
Gain	32dB
Image ratio	62dB
S/N ratio	74dB

4.2.3 ELECTRONIC AM TUNER (Hi-Fi)



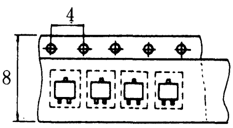
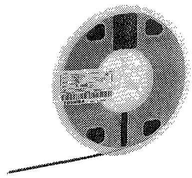
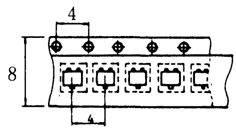
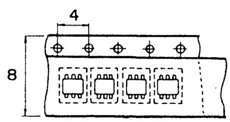
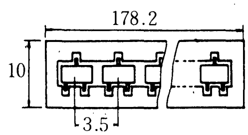
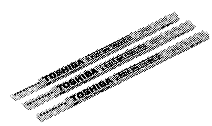
Radio frequency	f=535~1605kHz
Tuning voltage	V_T=2~25V
Maximum sensitivity	33dBμ
S/N ratio	48dB

5. PACKAGE FORMS

5.1 PACKAGE FORM SELECTION TABLE

5.1.1 SUPER-MINI DEVICES (S-MINI (SC-59), SMQ (SC-61), SMV, SM6)

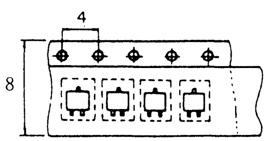
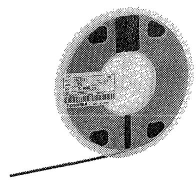
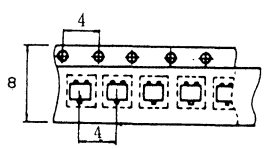
Unit: mm

PACKAGING FORM		SPECIFICATION	PACKAGE OUTLINE	PACKAGE EXTERIOR	PACKAGE UNIT
Taping	Pack	TE85L			3000 pcs/ Reel
		TE85R			
		TE85N (Available only in SM6 package)			
*Magazine	Horizontal	—			50 pcs/ Magazine

*: SMV and SM6 are not available in magazine packages.

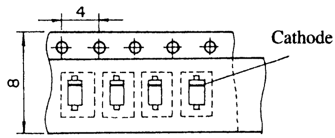
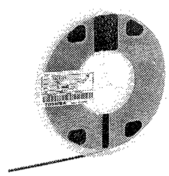
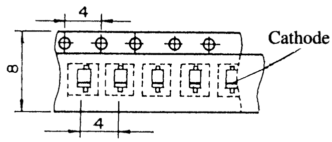
5.1.2 ULTRA-SUPER-MINI DEVICES (USM (SC-70), SSM) SMALL SUPER-MINI DEVICES

Unit: mm

PACKAGING FORM		SPECIFICATION	PACKAGE OUTLINE	PACKAGE EXTERIOR	PACKAGE UNIT
Taping	Pack	TE85L			3000 pcs/ Reel
		TE85R			

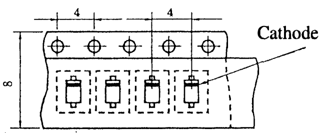
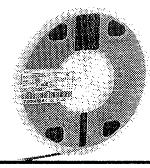
5.1.3 SUPER-MINI COAXIAL DIODE (SMC)
ULTRA-SUPER-MINI COAXIAL DIODE (USC)

Unit: mm

PACKAGING FORM		SPECIFI-CATION	PACKAGE OUTLINE	PACKAGE EXTERIOR	PAIR	PACKAGE UNIT
Taping	Pack	TPH2			○	2400~3000 pcs/Reel
		TPH3			×	3000 pcs/Reel
		TPH4			○	2400~3000 pcs/Reel
		TPHR2			○	2400~3000 pcs/Reel
		TPHR3			×	3000 pcs/Reel
		TPHR4			○	2400~3000 pcs/Reel

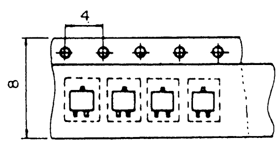
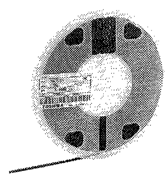
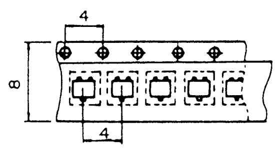
5.1.4 SMALL SUPER-MINI COAXIAL DIODE (SSC)

Unit: mm

PACKAGING FORM	SPECIFI-CATION	PACKAGE OUTLINE	PACKAGE EXTERIOR	PAIR	PACKAGE UNIT
Taping	TPH2			○	2400~3000 pcs/Reel
	TPH3			×	3000 pcs/Reel
	TPH4			○	2400~3000 pcs/Reel

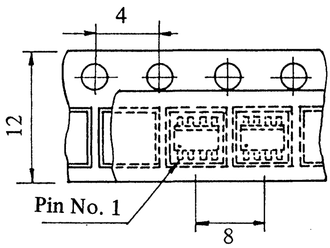
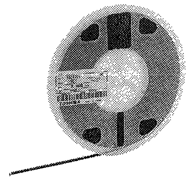
5.1.5 SUPER-MINI VARIABLE CAPACITANCE DIODE

Unit: mm

PACKAGING FORM		SPECIFI-CATION	PACKAGE OUTLINE	PACKAGE EXTERIOR	PAIR	PACKAGE UNIT
Taping	Pack	TPH2			○	3000 pcs/Reel
		TPH3			×	
		TPH4			○	
		TPH6			○	600~3000 pcs/Reel
		TPH7			○	3000 pcs/Reel
		TPHR2			○	3000 pcs/Reel
		TPHR3			×	
		TPHR4			○	
		TPHR6			○	600~3000 pcs/Reel
		TPHR7			○	3000 pcs/Reel

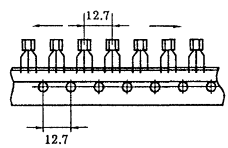
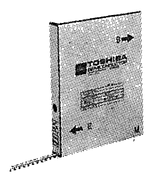
5.1.6 FLAT MINI 8-LEAD TYPE (FM8)

Unit: mm

PACKAGING FORM		SPECIFI-CATION	PACKAGE		PACKAGE UNIT
			OUTLINE	EXTERIOR	
Taping	Pack	TE12L			1000 pcs/ Reel

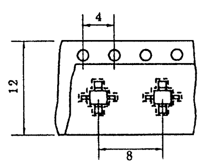
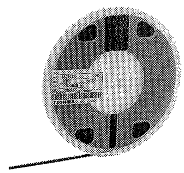
5.1.7 MINI TYPE (MINI)

Unit: mm

PACKAGING FORM	SPECIFI-CATION	PACKAGE		PACKAGE UNIT
		OUTLINE	EXTERIOR	
AMMO PACK	TPE4			5000pcs Carton

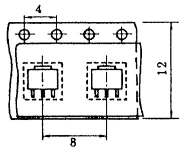
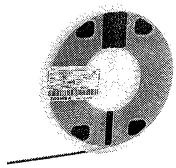
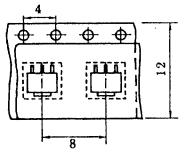
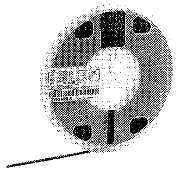
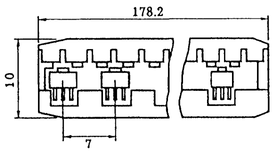
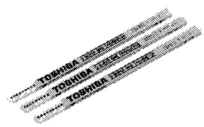
5.1.8 MOULD MICRO-X TYPE (MMX)

Unit: mm

PACKAGING FORM	SPECIFI-CATION	PACKAGE		PACKAGE UNIT
		OUTLINE	EXTERIOR	
Taping	TE12L			1000pcs Reel

5.1.9 POWER MINI TYPE (PW-MINI)

Unit: mm

PACKAGING FORM	SPECIFI-CATION	PACKAGE OUTLINE	PACKAGE EXTERIOR	PACKAGE UNIT
Taping	TE12L			1000pcs Real
	TE12R			
Magazine	—			Magazine

5.1.10 TO-92/MINI

PACKAGING FORM	SPECIFI-CATION	PACKAGE	EXTERIOR	PACKAGE INIT
AMMO PACK	TPE2	TO-92 (2-5F)		3000pcs
AMMO PACK	TPE4	MINI (2-4E)		5000pcs

5.2 LEAD FORMING TYPES

5.2.1 TO-92 MINI PACKAGE FORMING DIMENSION

(Unit: mm)

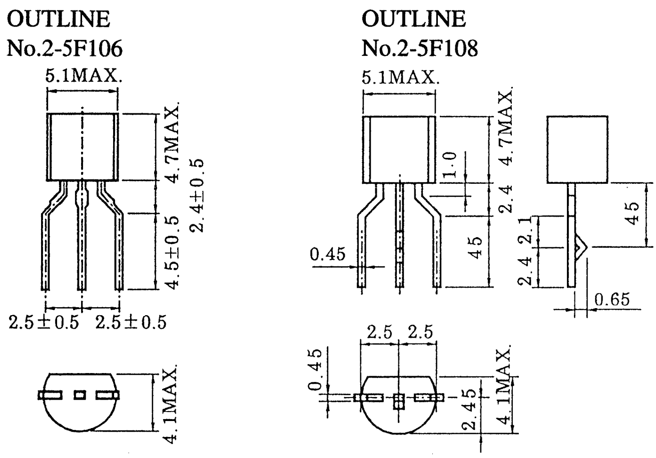


Fig. (a) TO-92 PACKAGE FORMING DIMENSION

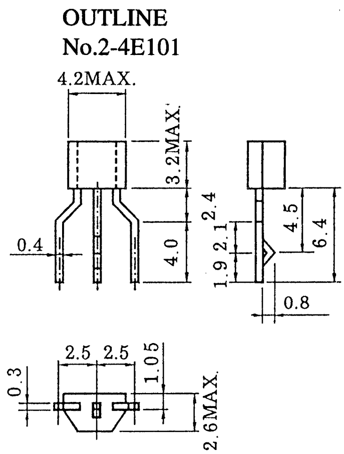
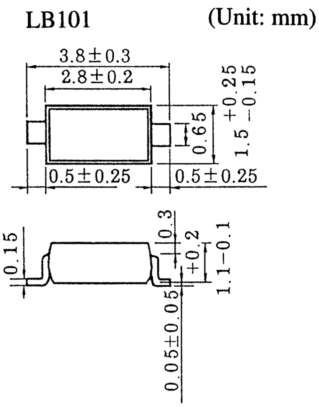


Fig. (b) MINI PACKAGE FORMING DIMENSION

5.2.2 SMC FORMING DIMENSION

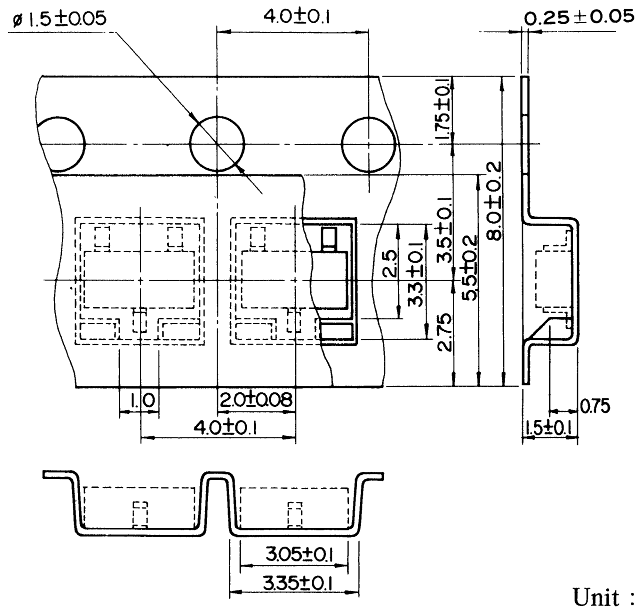


5.3 TAPING DIMENSIONS

5.3.1 SUPER-MINI TYPE TAPING DIMENSIONS (3-LEAD TYPE)

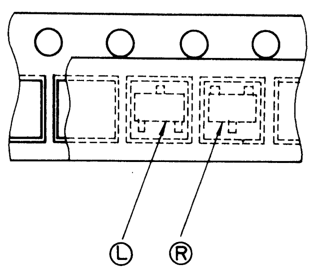
A taping specification of 3-lead Super-Mini Transistor FET/Diode. The diagram below shows the TE85R method.

NEW TAPING DIMENSIONS OF SUPER-MINI TYPE Example: TE85R

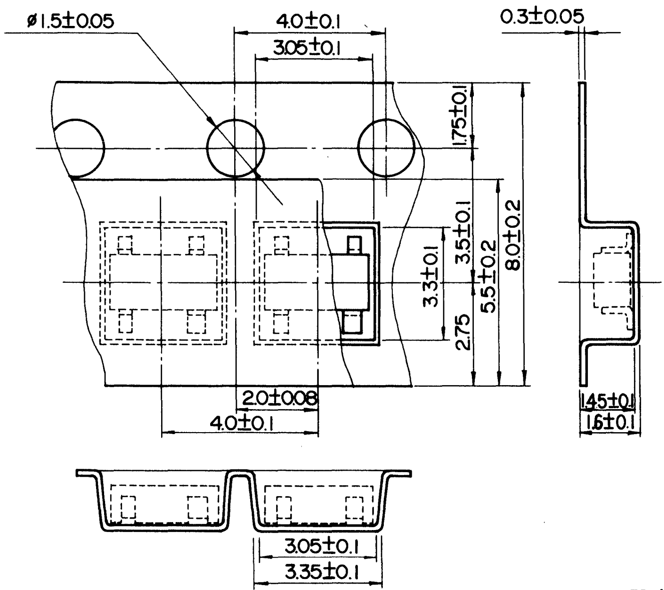


Unit : mm

Device direction
L : TE85L
R : TE85R

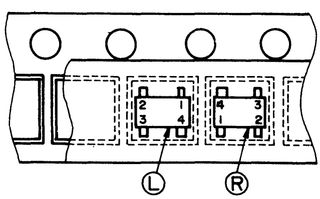


5.3.2 SUPER-MINI TAPING (4-LEAD TYPE) ...... SMQ

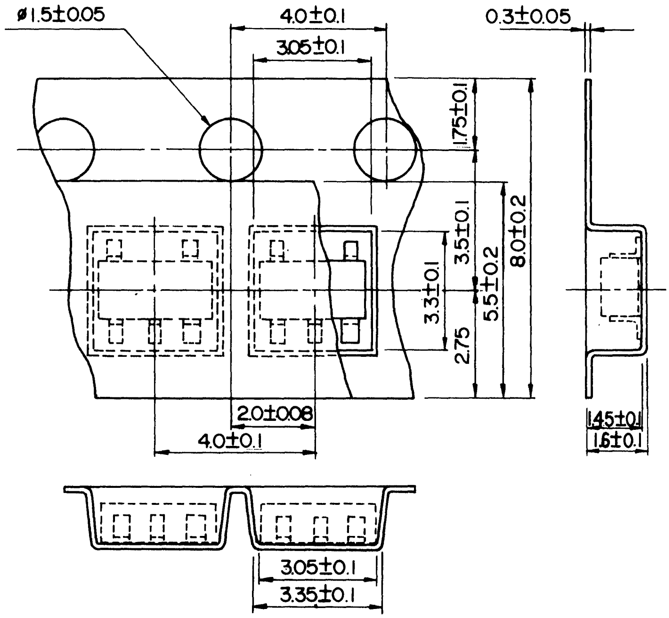


Unit : mm

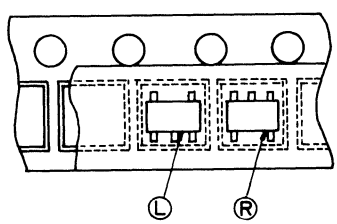
Divice direction
L : TE85L
R : TE85R



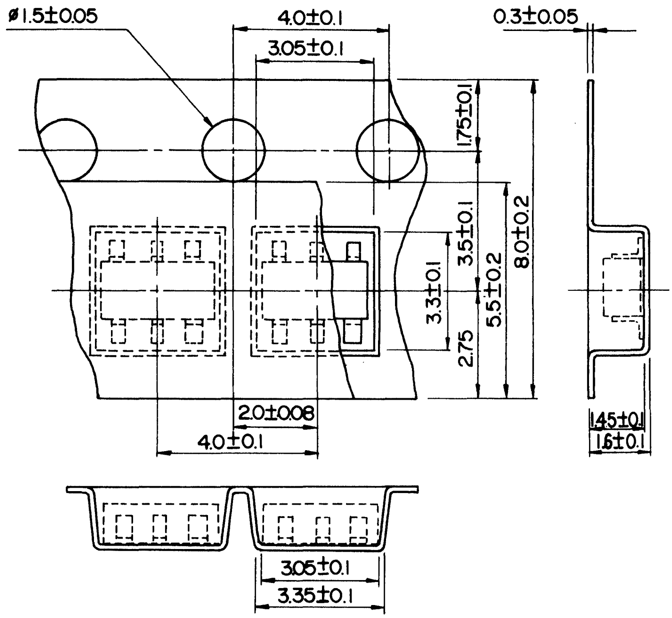
5.3.3 SUPER-MINI TAPING (5-LEAD TYPE) ...... SMV

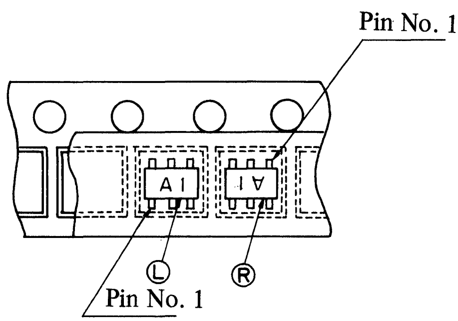


Device Direction
L : TE85L
R : TE85R

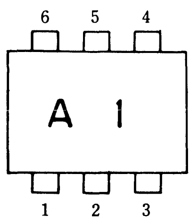


5.3.4 SUPER-MINI TAPING (6-LEAD TYPE) SM6





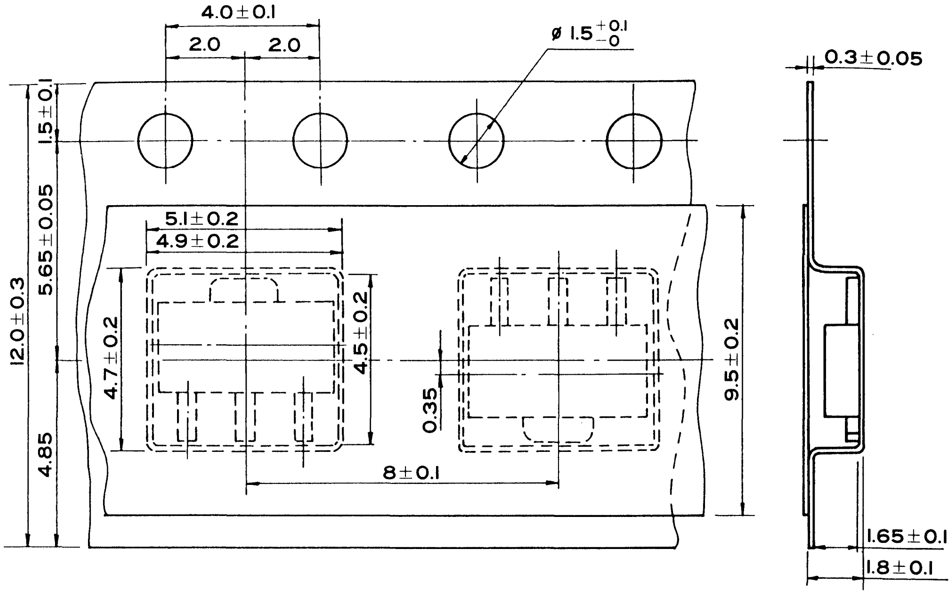
Pin No. 1 is on lower left of the marking.
(Example) : Top View



Device direction
L : TE85L
R : TE85R
N : TE85N when there is no direction (Note).

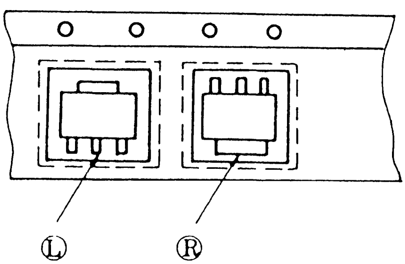
(Note) TE85N is Taping of the products organized with same chips and laid out point symmetry.

5.3.5 POWER-MINI TAPING ...... PW-Mini



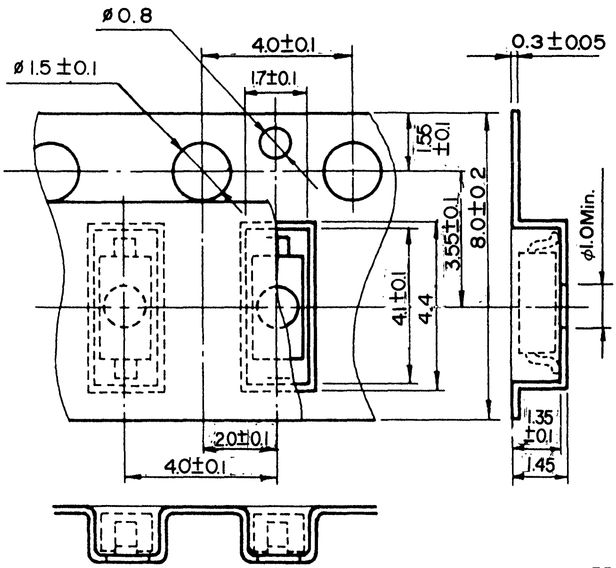
Unit : mm

Transistor direction



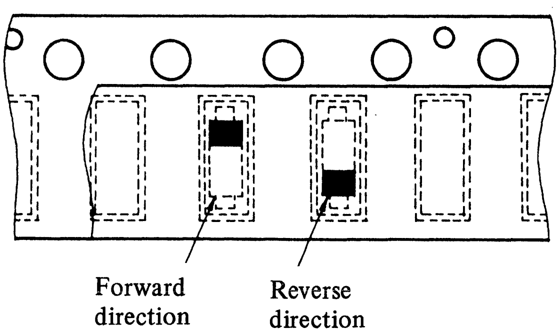
L : TE12L
R : TE12R

5.3.6 SUPER-MINI COAXIAL TAPING .... SMC

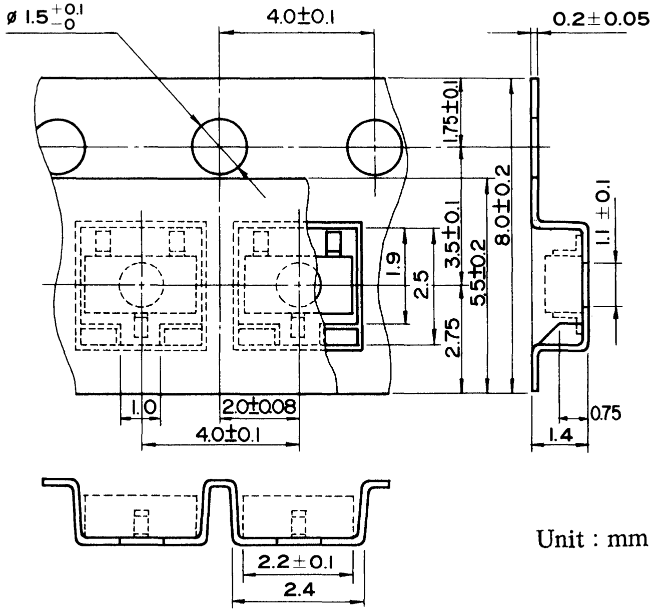


Unit : mm

Forward direction : TPH2, TPH3, TPH4
Reverse direction : TPHR2, TPHR3, TPHR4

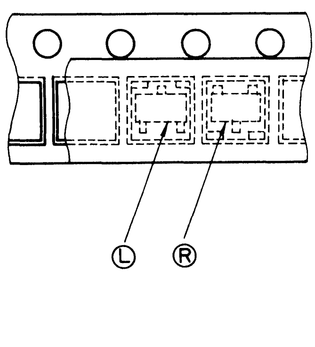


5.3.7 ULTRA-SUPER-MINI TAPING ...... USM

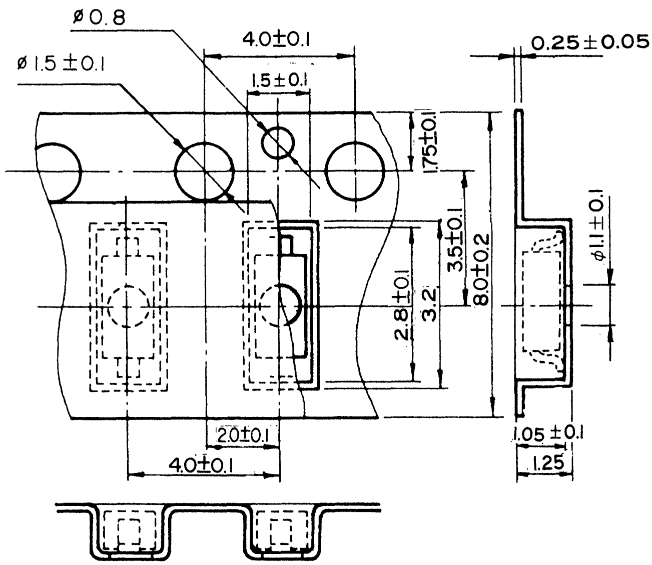


Unit : mm

Device direction
L : TE85L
R : TE85R

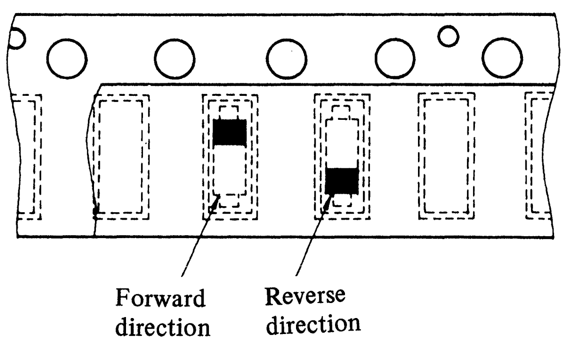


5.3.8 ULTRA-SUPER-MINI COAXIAL TAPING ...... USC



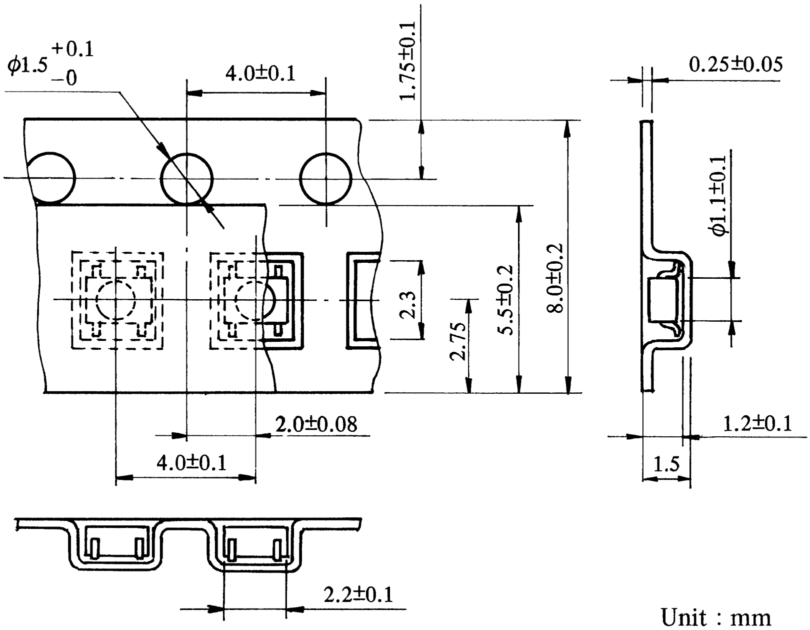
Unit : mm

Forward direction : TPH2, TPH3, TPH4
Reverse direction : TPHR2, TPHR3, TPHR4

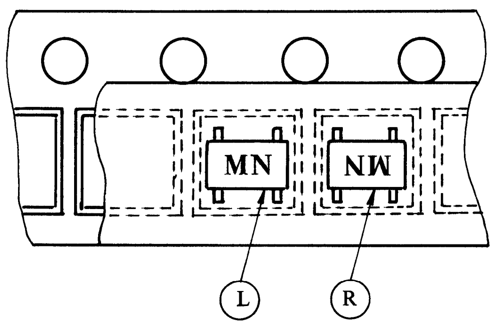


5.3.9 ULTRA-SUPER-MINI TAPING (4 LEAD TYPE) ...... USQ

- Taping dimensions and product direction



Unit : mm

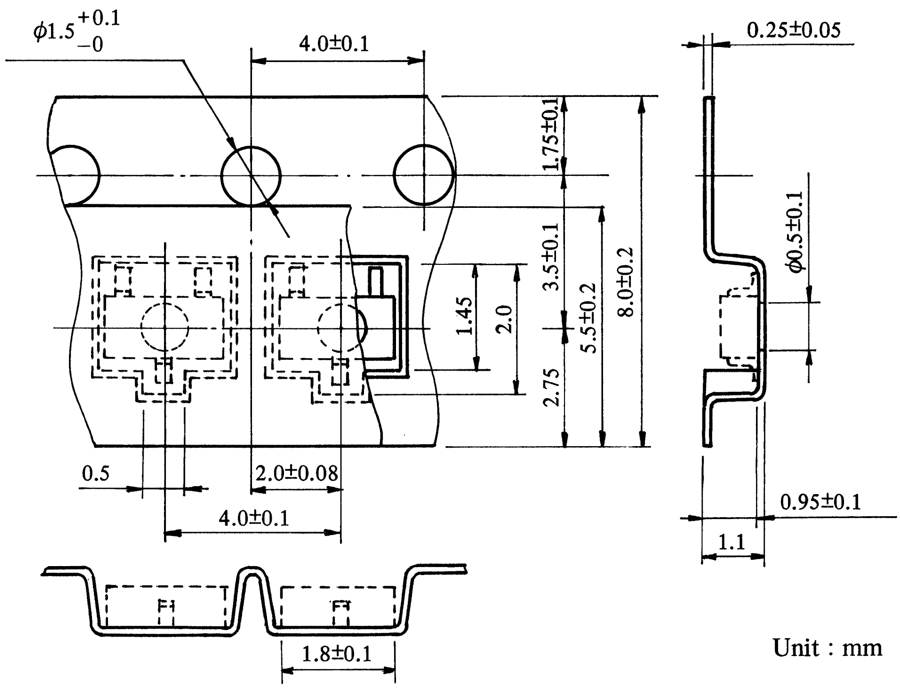


L : TE85L
R : TE85R

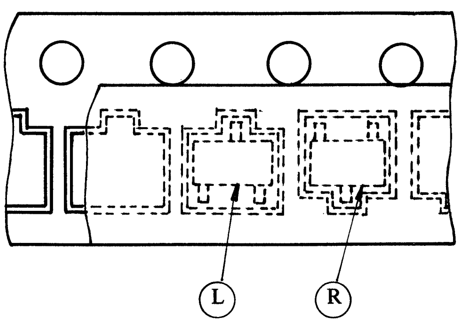
Package Qty : 3000 pcs/Reel

5.3.10 SMALL SUPER-MINI TAPING ...... SSM

• Taping dimensions and product direction



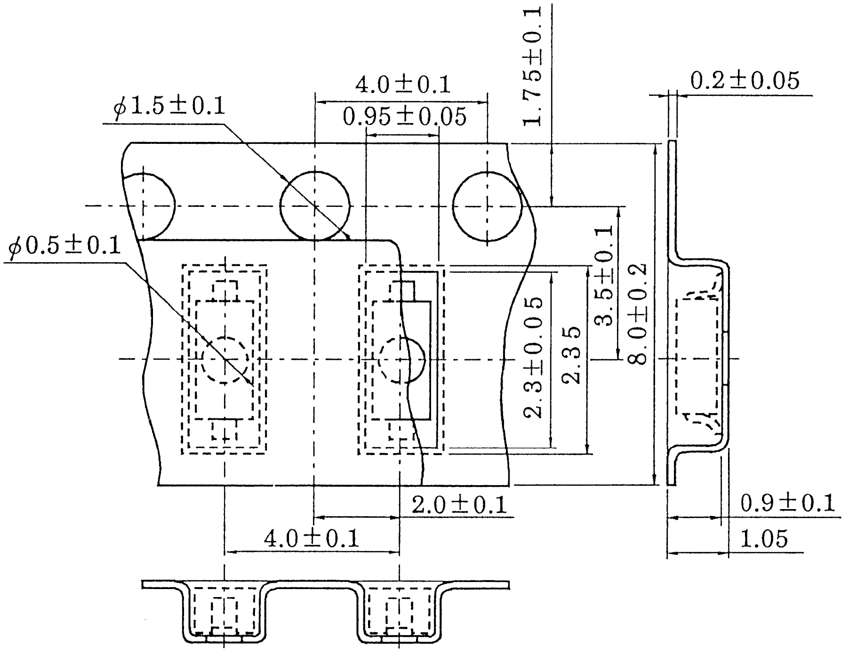
Unit : mm



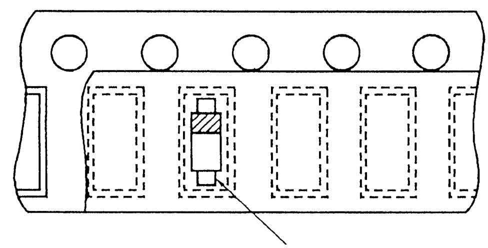
L : TE85L
R : TE85R

Package Qty : 3000 psc/Reel

5.3.11 SMALL SUPER-MINI COAXIAL TAPING...... SSC

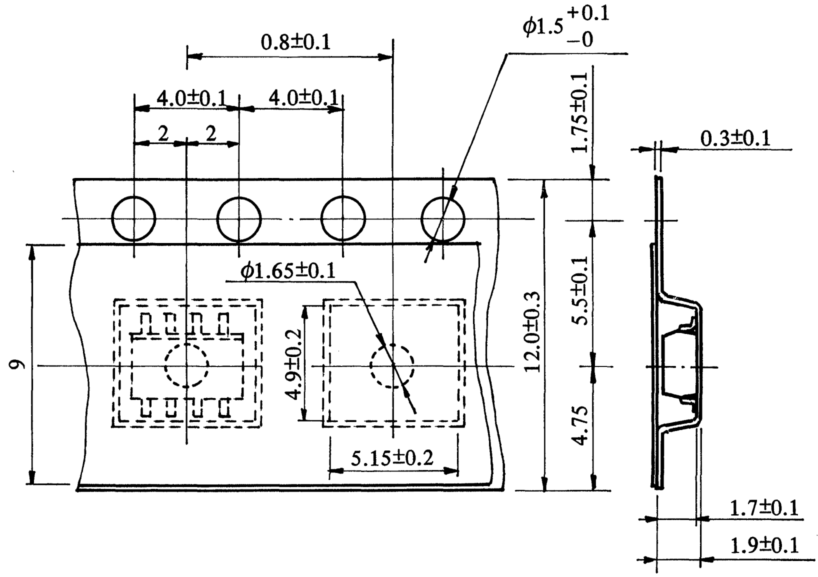


Unit: mm

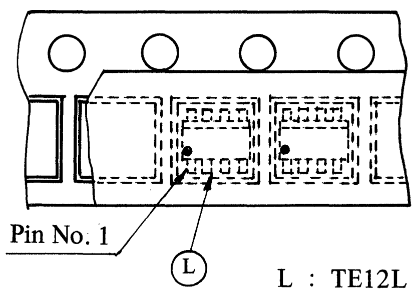


5.3.12 8-LEAD FM FLAT PACK MINI TAPING (8 LEAD TYPE) FM8

• Taping dimensions and product direction

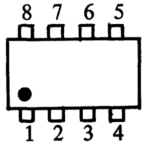


Unit : mm

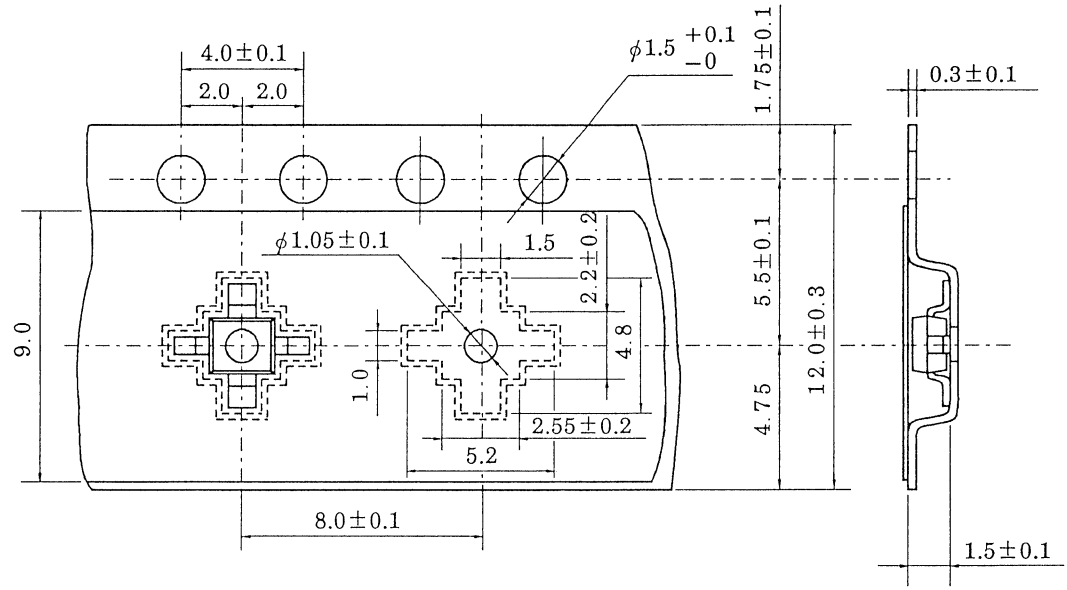


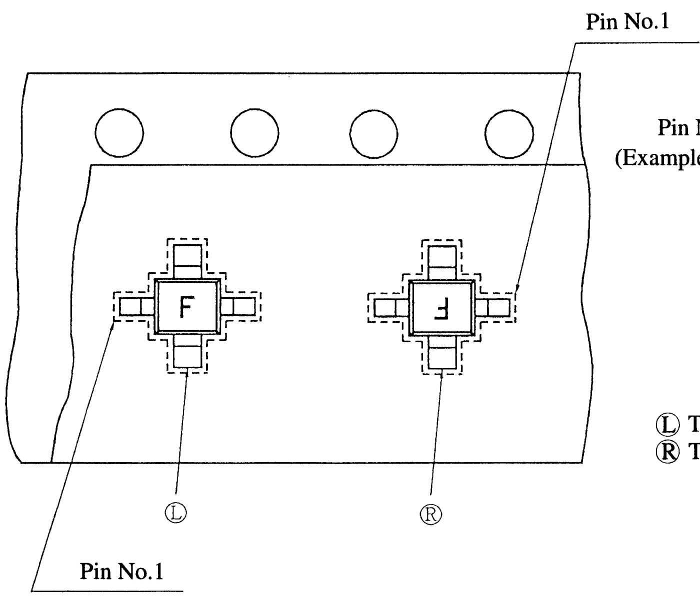
Pin No. 1 is on lower left of the marking.

(Example) : Top view



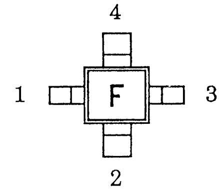
5.3.13 MOULD MICRO-X TAPING...... MMX





Pin No.1 is on lower left of the marking

(Example) Top View



Ⓛ TE12L

Ⓡ TE12R

5.3.14 TO-92/MINI RADIAL TAPING

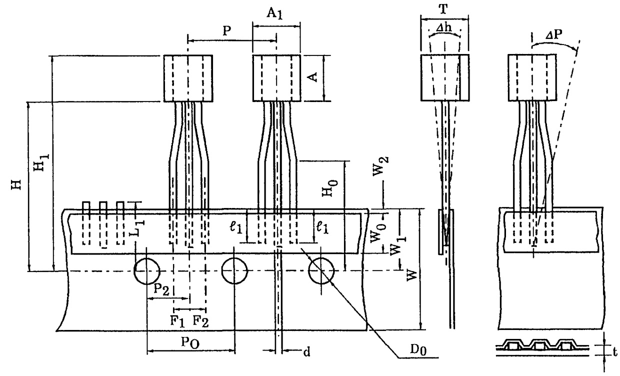


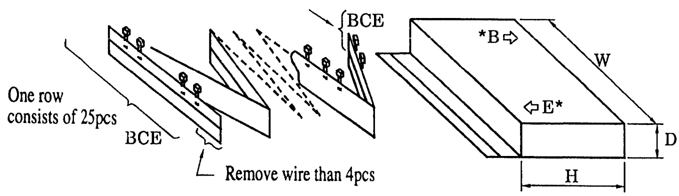
Table 3 Tape Dimensions (Common to Forward & Reverse Directions)

Unit in mm

Item	Symbol	Dimention				Note
		TO-92 (SC-43)	MINI	TO-92 MOD	MSTM	
Body width	A_1	6.0 MAX.	4.5 MAX.	5.1 MAX.	7.1 MAX.	
Body height	A	9.0 MAX.	3.5 MAX.	8.2 MAX.	4.7 MAX.	
Body thickness	T	6.0 MAX.	2.6 MAX.	4.1 MAX.	2.7 MAX.	
Lead wire diameter	d	0.45□ TYP.	0.4□ TYP.	0.67□ MAX.	0.45□ TYP.	
Lead wire (tape portion)	ℓ_1	2.5 MIN.		3.5 MIN.	2.6 MIN.	
Pitch of component	P	12.7±1.0			12.7±0.5	
Feed hole pitch	P_0	12.7±0.3			12.7±0.2	1
Hole center to component center	P_2	6.35±0.4				
Lead to lead distance	F_1/F_2	$2.5^{+0.6}_{-0.3}$			$2.54^{+0.3}_{-0.2}$	
Component alignment (1)	Δh	0±2.0			0±1.0	
Tape width	W	$18.0^{+1.0}_{-0.5}$				
Hold-down tape width	W_0	6.0±0.3				
Hole position	W_1	$9.0^{+0.75}_{-0.5}$		9.0±0.5		
Hold-down tape position	W_2	0.5 MAX.				
Height of component from tape center	H	20 MAX.	$20^{+0.75}_{-0.5}$	20 MAX.	19±0.5	
Lead wire clinch height	H_0	16.0±0.5			—	
Component height	H_1	32.25 MAX.			25.0 MAX.	
Feed hole diameter	D_0	4.0±0.2				
Total tape thickness	t	0.6±0.2				2
Length of snipped lead	L_1	11.0 MAX.				
Component alignment (2)	ΔP	0±1.0				

Note 1. Accumulated pitch tolerance is ±1mm/20 pitch.
2. Board is 0.4±0.1mm in thickness.

AMMO Pack Packing Form



Unit: mm

OUTLINE	W	H	D
TO-92 (SC-43)	336±3	250±3	47±3
MINI	336±3	260±3	47±3
TO-92 MOD	336±3	190±3	47±3
MSTM	336±3	230±3	47±3

Shows a first-out electrode of a lead

E: Emitter first-out
B: Base first-out

5.4 PRECAUTIONS FOR HYBRID DEVICE

(1) GENERAL CAUTIONS

(1.1) The resin portion of an SMD exterior package is small in size compared to the equivalent product package; and the ratio after a humidity critical test may be slightly different from that of conventional packages.

Therefore, for use under high-temperature, high-humidity conditions the device surface and surroundings must be coated with resin material.

(1.2) Flux elimination after soldering

When a hybrid device is soldered to a circuit board, or after pre-flux treatment, the flux should be removed by cleaning, since any flux remaining on a device may stain the leads. Avoid the use of inorganic fluxes, because they are difficult to remove.

(1.3) Handling precaution: lead-forming parts

When a stress is applied to the leads of a device, especially to the leads of super-mini transistor among the hybrid application devices, it may deform the leads since the device is very compact. Therefore, please be careful for the following..

- When mounting on the PC board, use vacuum tweezer or a tool equivalent to it. Do not mount a device by your hands. This prevents contamination on lead-soldering surface (mainly oil), thus making the soldering easy.
- When cleaning the PC board, do not apply a stress of more than 500g or above onto resin and lead parts. When an excessive stress is applied these parts, it may cause lead disconnection, deforming, and soldering defects.
- Ultrasonic wave cleaning

Avoid ultrasonic wave cleaning. When this method is necessary for device cleaning, device should be cleaned in a short period of time in a small-power ultrasonic wave tub.

(2) Soldering

The most commonly used soldering methods used for hybrid devices are reflow soldering and flow (dip) soldering. These methods, their application and precautions are described below.

(2.1) Soldering methods

(a) Reflow soldering

Available heating methods include infrared (halogen lamp) heating, laser heating, hot air heating, hot plate heating, heating furnace and pulse heater heating. The heat source is used to indirectly heat either the entire device or the leads and thus melt and adhere the solder. Vapor phase soldering (VPS) in which the soldering is perfomed in an atmosphere created by heating and vaporizing a solution with a high boiling point.

The method most frequently used for reflow soldering is infrared heating. While there is no sudden temperature fluctuation (thermal shock stress) as with the flow soldering method described later, the entire device is heated to above the rated temperature for long time so damage can accumulate. Also, temperature variations can easily occur due to the condition of the plastic resin surface, reflections from leads and pad areas of the PC board, and differences in absorption coefficients, so it is extremely difficult to set uniform prescribed temperature conditions. Local temperature increases are also invited due to absorption by the plastic resin, especially with near infrared heating. The adhesion of the plastic resin can also be weakened by temperature differences between the resin and leads. This also adversely affects heat and humidity resistance, so caution must be exercised.

(b) Flow soldering

The solder is melted beforehand in the atomizing soldering bath or the static soldering bath. Soldering is then performed by placing the molten solder, device and pads of the PC board in contact. Temperature fluctuations and temperature differences within the device itself, which cannot be avoided with the reflow soldering method using infrared heating, can be entirely ignored with this method, and prescribed temperature conditions can be accurately set.
However, molten solder with a large thermal capacity can cause excessive thermal shock stress when it comes into direct contact with a device, which can either weaken the device or cause a fatal failure.

Temporarily fastening the device to the PC board beforehand using adhesion is possible but the flow of solder can cause loosening and the formation of solder bridges.

(2.2) Mounting precautions

The melting temperature of solder is higher than the rated temperature of the device and the entire device is heated to a high temperature; therefore, failure to complete soldering within a short-time at a low temperature can adversely affect the characteristics, heat resistance and humidity resistance and can even result in failure. Consequently, the following items should always be observed to reduce as much as possible the thermal stress to which the devices are subjected.

(a) Always preheat, whether using the reflow or flow method of soldering.

(b) The difference between the preheating and soldering temperature should be 100°C or less. Soldering a device without preheating can cause excessive thermal shock stress which can result in damage.

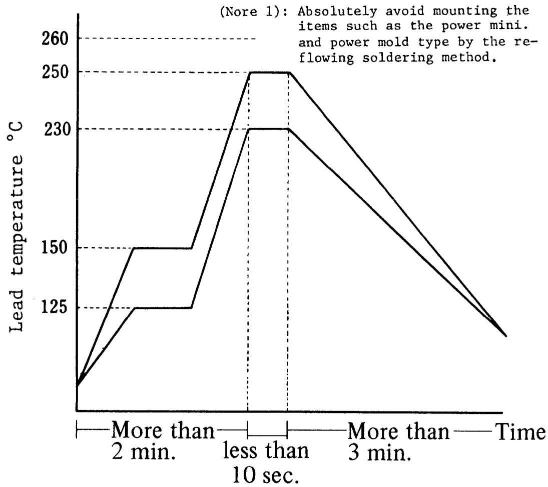
(c) When preheating and soldering, the temperatures of the leads and plastic resin surface shall not exceed the temperature ratings. When infrared heating is used with the reflow soldering method, the difference in the temperatures of the resin and leads shall be ΔT=10°C or less.

(d) The soldering temperature and time shall be 260°C for 10 sec. or less. When shifting from preheating to soldering, the maximum temperature gradient shall be 5°C/sec. ro less.

(e) After soldering is completed, the device shall be allowed to cool naturally for 3 minutes or more. Forced cooling will increase the temperature gradient and result in latent mechanical stress; therefore, use gradual cooling.

(f) Do not apply mechanical stress or shock during natural cooling.

(2.3) Recommended temperature profiles for mounting using reflow soldering and flow soldering. (Note1)



(Note1) Do not use the flow soldering method for power-mini, power-mold, NPM and TO-220 SM types.

(2.4) Others

When using the VPS (vapor phase soldering) method of reflow soldering for mounting, please be careful for the following.

(a) Always preheat. Temperature and time are in accordance with the recommended profile for mounting using reflow soldering.

(b) The temperature of the vapor varies depending on the solution used. Solder in a 215±3°C atmosphere for 30 sec. or less, or in a ±5°C atmosphere for 15 sec. or less.

(c) Use natural cooling after soldering in the vapor atmosphere. Do not use forced cooling.

(3) Circuit board cleaning

After soldering, use a flux solvent to clean the circuit board, using caution concerning the following items.

(3.1) Handling

Solvents with a high cleaning effect also affect the marking ink and plastic resin; therefore, do not rub indicator marks with hands or brush while cleaning or while a device is in the cleaning solution since this can cause the marks to become faint or be erased.

(3.2) Cleaning

The available cleaning methods include immersion cleaning and shower cleaning with which the entire circuit board is immersed in the solvent (agitation is used in some cases), vapor cleaning with which a solvent is heated to create vapor, and ultrasonic wave cleaning with which ultrasonic vibrations are applied while the circuit board is immersed in the solvent.

Multiple bath automatic cleaning devices which combine several of these cleaning methods are also in general use. The following precautions apply to these cleaning methods.

(a) Immersion cleaning, shower cleaning, vapor cleaning
Immersion, shower and steam cleaning depend on the chemical action of a solution and affect devices little as long as no mistake is made in selecting the solution. These methods are suitable for cleaning semiconductor products and are recommended. However, immersion time in the solution or vapor should be no longer than 1 minute at a temperature of 50°C or less.

(b) Ultrasonic wave cleaning
In ultrasonic wave cleaning, the device is immersed in a solvent and mechanical vibration or shock is applied. This method is widely used because thorough cleaning is possible within a short time. However, while thorough cleaning can be expected, the device is affected considerably and prolonged ultrasonic wave cleaning can affect the bond between the plastic resin and metal leads. This makes it easier for the solvent to enter the device; therefore, the cleaning time should be as short as possible.
Ultrasonic cleaning should not be used for hermetic sealed devices with metal and ceramic packages. Resonance may or may not occur, depending on how the device is mounted on the circuit board, the cleaning bath size, ultrasonic frequency and ultrasonic output, etc.; however, due to their construction, such packages are subjected to considerable shock which can shorten the service life extremely or even cause fetal failure.

(c) Recommended cleaning conditions
Immersion cleaning:
Solvent temperature 50°C or less for 1 minute or less
Vapor cleaning:
Vapor atmosphere for 1 minute or less
Ultrasonic cleaning:
Frequency: 27 to 29 kHz
Ultrasonic wave output: 0.25 W/cm^2 or less
(See note)
Solvent temperature: normal (room temperature)
Cleaning time: 30 sec. or less

PCBs and devices should be floating or suspended in the solvent to prevent direct contact with the ultrasonic vibrator.

(Note) Indicates the ultrasonic wave output per unit surface area of the bottom of the ultrasonic wave cleaning bath.

(4) Storage

(a) The temperature and humidity of the storage place should be normal (5°C to 35°C, 45% to 75% RH)
(b) Do not store in places where there is hamful (corrosive, etc.) gas or excessive dust.
(c) Avoid places where there are sudden temperature fluctuations since this causes condensation which can rust the leads and adversely affect the soldering.
(d) Use storage cases treated to prevent static electricity and do not apply loads on the devices.
(e) Do not store after processing the leads, etc.
(f) Do not stack the packing cases upside down or on their sides.

(5) Transport

(a) Handle carefully (do not throw or drop).
(b) Do not allow rubbing or chafing between plastic package devices and high molecular compounds.
(c) Deep water away (use special care when raining or snowing).
(d) During transport, use boxes treated to prevent static electricity.
(e) Avoid mechanical vibration and shock.

(6) Overcoating (secondary mold)

Please observe the precautions given below when using overcoating on the following package devices from the SMD lineup.

(a) The power-mini/power-mold types
The power-mini/power-mold typesare large and have a construction that can withstand the stress generated by hardening of the plastic resin of the overcoat. When overcoating is used, the quality and hardening conditions of the plastic resin should be carefully investigated before starting

mass production. The quality and hardening conditions of the plastic resin differ depending on the manufacturer, therefore, it is necessary to consult various manufacturers and select an appropriate plastic resin.

(7) Others

(a) All floors, work benches, conveyers, floor mats, etc., must be well grounded to prevent the accumulation of static electricity. Use special caution concerning the grounding of work benches with which devices come into direct contact and conductive floor mats.

(b) Always ground all measuring instruments, jigs, etc.

(c) All workers must wear clothing treated to prevent static electricity and conductive shoes, and ground their bodies using ground rings or ground bands. (Ground rings and bands are grounded through a resistance of 0.5 to 1 MΩ to protect the person.)

(d) Use only containers treated to prevent static electricity.

(e) Handle carefully.

(8) Cautions about power dissipation (Constant state)

Transistor by itself differ from board-mounted transistor in power dissipation. Changes in power dissipation for representative package types are described below.

Each representative package type and the power dissipation change is explained below. For details, please refer to the pamphlet 'Hybrid Devices'.

(8.1) Super-mini transistors

Allowable power dissipation of a super-mini transistor is 100 to 150mW as a single unit. However, when mounted on a ceramic board, the value increases depending on board size. This is shown in Figure 5.4.1 (transistors used: 2SA1162/2SC2712).

(8.2) Power-mini transistors

Since power-mini transistors are of compact size, P_{Cmax} is only 500 mW; however, when they are mounted on a circuit board, thermal diffusion from a drain fin to the board will be high. The drain power dissipation will then range from 1.0W to 2.0W, and a circuit design capability equivalent to that of TO-92MOD (800 ~ 900 mW) TO-126 (1.0~1.2W) is possible. Figure 5.2 shows the drain power dissipation for a typical case of circuit-board mounting of 2SC2873, 2SA1213.

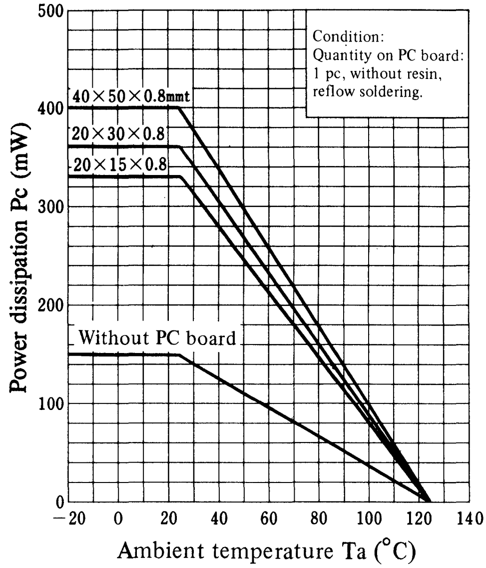


Fig. 5.1 **Pc(max) when alumina & ceramic boards mounted**
Ta characteristic (2SA1162, 2SC2712)

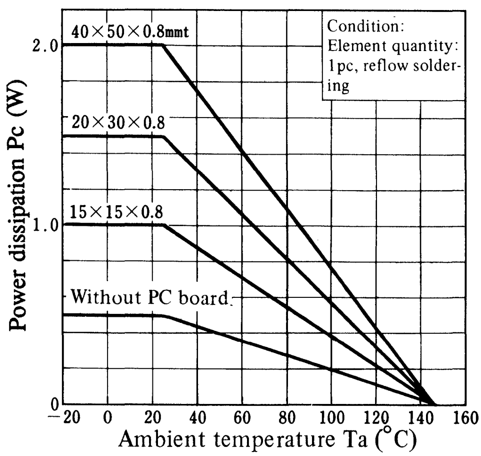


Fig. 5.2 **Pc (max) when alumina & ceramic board mounted.**
Ta characteristic (2SC2873, 2SA1213)

(8.3) Power-mold transistors

For straight-type transistors, the power dissipation (P_C) = 1W. However, LB-type transistors with the drain-fin, the installed power dissipation increases significantly. When a power-mold transistor is soldered to an alumina-ceramic board, P_C (1) (1000 mm^2) = 2W, P_C (2) (2500 mm^2) = 3W. Figure 5.3 shows the relationship of drain power dissipation P_C and ambient temperature Ta for the transistor 2SC3074, 2SA1244.

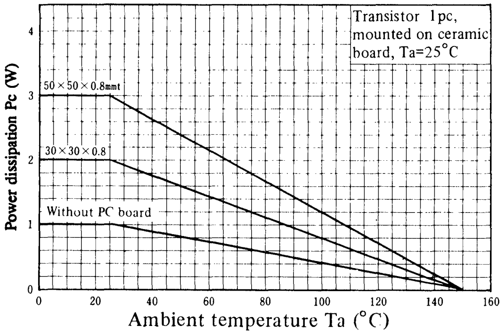


Fig. 5.3 Power dissipation Pc and ambient temperature Ta when mounted alumina and ceramic boards (2SC3074, 2SA1244).

(9) Cautions for power dissipation (transient state)

For designing strobe and motor drive circuits in cases other than P_C in saturated condition, power dissipation that can be applied in a very short time is needed. Toshiba supplies several types of power-mini transistors and power-mold transistors that meet such conditions. Figure 5.4 shows the relationship of P_C and pulse width in transient state for representative package types.

(9.1) Power-mini transistors

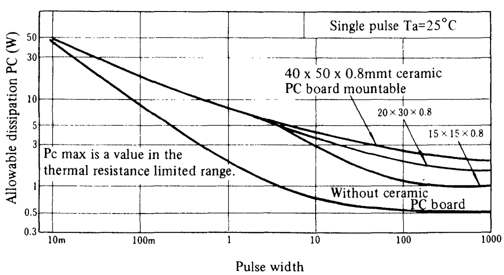


Fig. 5.4 Power dissipation in transient state. (2SC3074, 2SA1244).

(9.2) Power-mold transistors

For power-mold transistors, power dissipation in transient state can be taken at much greater values than in saturated state. This is shown in Figure 5.5

Note in Fig. 5.5 that:

- The display curve is a single pulse.
- The drain P_C value is within the thermal resistance limitation range.

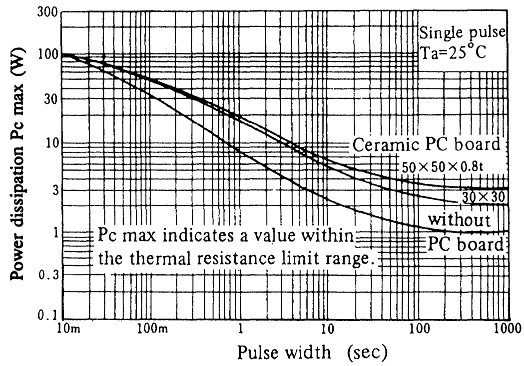


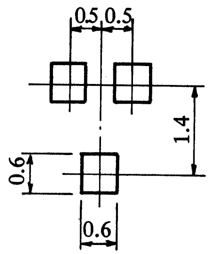
Fig. 5.5 Power dissipation and Pulse width (2SC3074, 2SA1244).

(10) Minimum pad dimensions

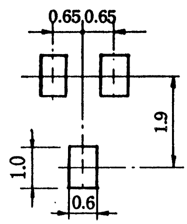
Power dissipation is greatly affected by the size of collector-connection pad area; the largest possible size pad should be used if effective heat radiation is a major consideration.

Figure. 5.6 Pad Dimensions when Mounted on a Board Reference Pad

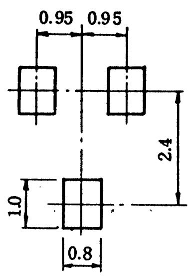
(1) SMALL SUPER-MINI (SSM)



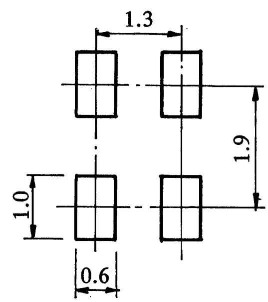
(2) ULTRA-SUPER-MINI (USM)
(EIAJ : SC-70)



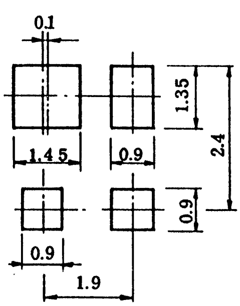
(3) SUPER-MINI (3-LEAD) (SM)
(EIAJ : SC-59)



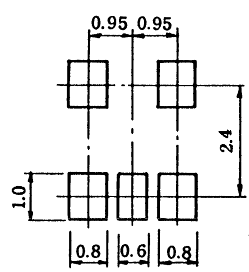
(4) 4-PIN ULTRA-SUPER-MINI TYPE (USQ)



(5) SUPER-MINI (4-LEAD) (SMQ)
(EIAJ : SC-61B)

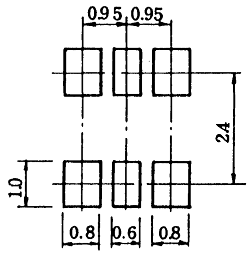


(6) SUPER-MINI (5 LEAD) (SMV)

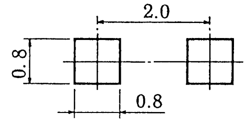


Unit: mm

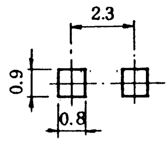
(7) SUPER-MINI (6 LEAD) (SM6)



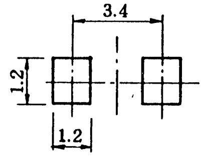
(8) SMALL SUPER-MINI (2-LEAD) (SSC)



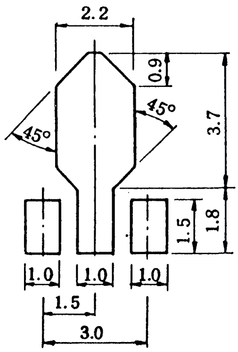
(9) ULTRA-SUPER-MINI (2-LEAD) (USC)



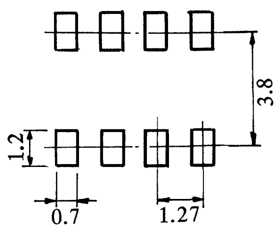
(10) SUPER-MINI (2-LEAD) (SMC)



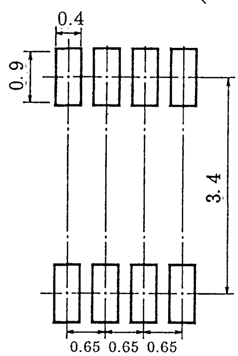
(11) POWER-MINI TRANSISTOR (EIAJ: SC-62)



(12) FLAT-MINI 8 TYPE (FM8)



(13) SMALL FLAT-MINI (8-LEAD)



5.5 MOUNTING PRECAUTION

(1) LEAD CUTTING AND FORMING

Leads are often cut or formed in preparation for circuitboard mounting. Such pre-processing, however, can result in the exertion of excessive stress on the device interior, leading to serious mechanical damage or decrease in reliability. When stress is applied to points between the lead and the semiconductor itself, breaking interior wiring, bonding, or case seals. Please take the following precautions to make sure that any stress applied during these procedures are limited only to the leads.

Proper care is needed for forming leads on mass production line automatic lead forming machines or automatic mounting machines. For example, when a machine bends a lead as in Figures 5.7 and 5.8, the lead must be clamped securely at point between the package body and the bending point, ensuring that no mechanical stress is transmitted to the device package itself. Furthermore, as demonstrated in Figure 5.9, no problem should arise as long as the leads are bent at the correct angles, and directions (i.e., bend only in the vertical direction; never sideways).

Note, however, that copper leads are used in some models. Copper leads are more vulnerable to the application of repeated bending stress. The total bending angle for copper leads must thus not exceed 180 degrees.

The precautions explained here are primarily those concerning bending angle stress. Precautions are necessary as well in regards to the application of linear pulling and pushing stresses, as shown also in Figure 5.9.

Also, besides angular bending as shown in the examples here, leads can also be formed in curved bending. The appropriate curve radius is determined from the lead dimensions (for example, a 0.5mm radius curve). Such carefully designed curved bending are preferable as they do not leave tool scars on the finished leads.

(2) PCB Mounting

When soldering the device onto a printed circuitboard, make sure there is no stress remaining on the mounted leads. Stress will remain on the leads when the leads are force bent to fit unmatching PCB dimensions, when there is space open between the device and the PCB surfaces (see Figure 5,10), when the device is force mounted onto the PCB without sufficient lead forming, or when there is excess tool stress remaining after installation. Any stress remaining on the leads can cause stress corrosions or whiskering, which can eventually result in problems such as line breakages and short-circuiting. To prevent such problems, circuits should ideally be designed to properly match device lead layouts.

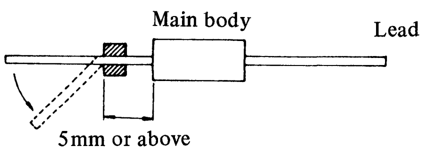
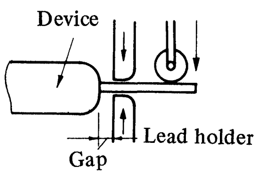


Figure 5.7 How to Bend a Lead



A distance of a gap must be maintained so that the main body does not touch the lead holder even when pulled by metal mold.

Figure 5.8 How to Bend a Lead Using a Metal Mold

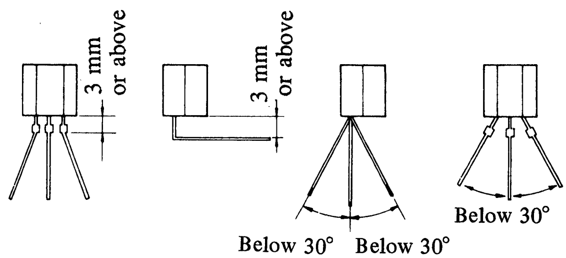


Figure 5.9 How to Bend a Lead Wire

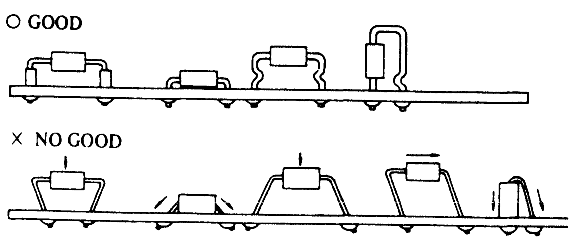


Figure 5.10 Mounting Example

[II] EXPLANATION OF HIGH-FREQUENCY CHARACTERISTICS

1. HIGH-FREQUENCY TRANSISTOR PARAMETER

Equivalent parameters of a transistor include the device parameters which closely respond to the internal operating mechanism of a transistor and the circuit parameters which are indicated as a matrix obtained from regarding a transistor as a terminal circuit network.

These parameters are also divided into small-signal equivalent circuits (analog circuits) and large-signal equivalent circuits (digital circuits), in accordance with the extent of signals (amplitude) to be handled.

Equivalent circuits have been developed very much. It is necessary for circuit designers to select an optimal one by paying attention to the application ranges and operating limits of respective equivalent circuits. Table 1.1 lists equivalent circuits presently employed.

Among others, small-signal eqivalent circuits are hereafter described, since they are generally used.

Table 1.1 List of transistor equivalent circuits

- Transistor equivalent circuits
  - Small-signal equivalent circuits (general linear circuits such as amplification, oscillation, modulation, and demodulation)
    - Device parameters
      - Early's T-type equivalent circuits (common base circuit)
      - Giacoletto's π-type equivalent circuit (emitter and collector common circuit)
    - Circuits parameters
      - Matrices showing the relation among the input and the output by voltage and current
        - a,b matrices;
        - g,h matrices (low frequency);
        - y,z matrices (high frequency)
      - Matrix showing the relation among the input and the output by power
        - s matrices (superhigh frequency) (transmittance coefficient, reflection coefficient indication)
  - Large-signal equivalent circuit—device parameter (nonlinear circuit such as pulse, digital, and switching circuits)
    - Current control model by Evers-Moll;
    - Charge control model by Beaufoy-Sparkes;
    - Density control model by Linvill;
    - other nonlinear models

1.1 Device parameter

(1) Early's T-type equivalent circuit

(Bipolar transistor)

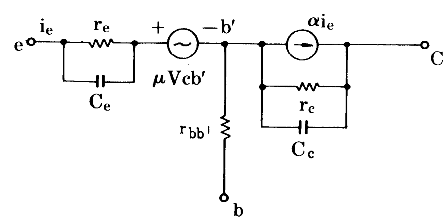


Fig. 1.1 Early's T-type equivalent circuit

Figure 1.1 shows Early's T-type equivalent circuit.

r_e: Emitter resistance,

This is represented by the following equation, since it is forward-biased resistance with emitter-to-base junction:

$$r_e = \frac{kT}{qI_E} (\Omega) \cdots\cdots (1)$$

where,

k: Boltzman's constant ($1.38 \times 10^{-23} J/°K$)

T: Absolute temperature (°K)

q: Electric charge of electron ($1.60 \times 10^{-19} C$)

I_E: Emitter current (A)

Equation (1) is changed as follows at normal temperature (300°K) if the emitter current is represented by mA:

$$r_e \doteq \frac{26}{I_E(mA)} (\Omega) \cdots\cdots (2)$$

C_e: Emitter capacitance ($C_{Te}+C_{De}$)

This is represented as a sum of the depletion layer capacitance and the diffusion capacitance. Normally since the depletion layer capacitance in an emitter-to-base junction is far smaller than the diffusion capacitance, it can be ignored.

The depletion layer capacitance C_{Te} and the diffusion capacitance C_{De} are represented as—

$$C_{Te} = A_e \sqrt{\frac{\frac{1}{2} \varepsilon q n \, n_N}{\phi_0 - V_{b'e}}} (F) \cdots\cdots (3)$$

where,

Ae: Emitter junction area (m^2)

ε: permittivity

n_N: Majority carrier density (m^{-3}) on high specific resistance side (NPN in this case)

ϕ_0: Contact potential difference (potential fault when balanced) (V)

$V_{b'e}$: Potential applied to both ends of base to emitter junction (1)

$$C_{De} = \frac{qI_E W^2}{2kTD} (F) \cdots\cdots (4)$$

where,

W: Base width (m)

D: Diffusion coefficient of minority carrier in base area (m^2/sec)

μ: Voltage feedback ratio (Early constant)

This constant, known as the Early effect, is a base width modulation parameter,

$$\mu = \frac{kTd_c}{3qW(\phi_0 - V_{b'c})} \cdots\cdots (5)$$

where,

d_c: Width of collector depletion layer (m)

r_c: Collector resistance

This is a kind of base width modulation parameter, represented as follows:

$$r_c = \frac{1}{I_E\left(\frac{\partial \alpha}{\partial V_{b'c}}\right)} (\Omega) \cdots\cdots (6)$$

The value of r_c is usually 1— 2 MΩ or so.

C_c: Collector capacitance

Similarly to emitter capacitance, this is shown as the sum of depletion layer capacitance and diffusion capacitance of the collector-to-base junction. However, since the diffusion capacitance of the collector-to-base junction is far smaller than the depletion layer capacitance, it can be ignored. The depletion layer capacitance is represented as

$$C_{TC} = A_C \sqrt[3]{\frac{\frac{\varepsilon 2 q a}{12}}{\phi_0 - V_{b'c}}} (F) \cdots\cdots (7)$$

where,

A_C: Collector junction area (m^2)

a: Impurity concentration gradient (m^{-4})

$V_{b'c}$: Potential applied to both ends of base to collector junction (V)

Usually the value of Cc is 1—10pF.

α: DC forward current transfer ratio

This is the only parameter among Early's T-type parameters that depends on frequency, represented by the equation

$$\alpha = \frac{\alpha_0}{1 + j\omega C_e r_e} \qquad f_\alpha = \frac{1}{2\pi C_e r_e}$$

therefore,

$$\alpha = \frac{\alpha_0}{1 + j\frac{f}{f_\alpha}} \cdots\cdots (8)$$

where,

α_0: Value of α at low frequency

f_α: α-interrupting frequency (frequency at which α is reduced by 3db less than α_0)

Fig. 1.2 shows the frequency locus of α. When actually measuring α, the difference between theoretical and measured values is increased as the frequency approaches $f\alpha$. This is because Early's equivalent circuit is based on the primary approximation of physical phenomena.

To correct it, Thomas-Moll introduced excess phase m and offered the equation

$$\alpha = \frac{\alpha_0}{1 + j\dfrac{f}{f_\alpha}} \exp\left(-jm\frac{f}{f_\alpha}\right) \cdots\cdots\cdots (9)$$

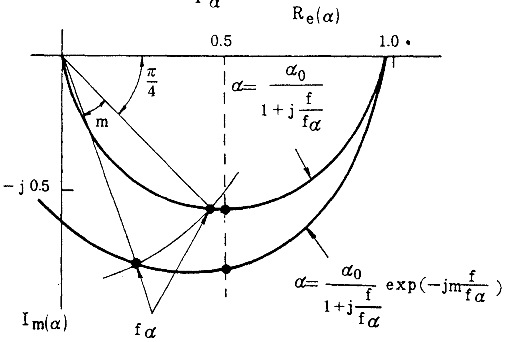


Fig. 1.2 Frequency locus of α

The above equation agrees well with measured values in frequencies less than f_α.

$r_{bb'}$: Base diffusion resistance

This is resistance from the center of base area to the external base terminal which actually contributes to transistor action and is determined according to shape and dimensions of the transistor and base specific resistance.

$$r_{bb'} \fallingdotseq \frac{q_B}{8\pi W}(\Omega) \cdots\cdots\cdots\cdots\cdots\cdots\cdots (10)$$

where,

q_B: Specific resistance of base area (Ω·m)

DC Current gain (β) at common emitter is represented as follows:

$$\beta = \frac{\alpha_0}{1-\alpha_0} \; \frac{1}{1 + j\omega C_{b'e}\, r_{b'e}}$$

$$= \frac{\beta_0}{1 + j\omega C_{b'e}\, r_{b'e}}$$

The β-interrupting frequency f_β is defined as the frequency at which the absolute value of β becomes $\beta o/\sqrt{2}$, similarly to $f\alpha$, f_β is represented as—

$$f_\beta = \frac{1}{2\pi C_{b'e}\, r_{b'e}}$$

therefore,

$$\beta = \frac{\beta_0}{1 + j\dfrac{f}{f_\beta}} \cdots\cdots\cdots\cdots\cdots\cdots\cdots (11)$$

(2) Giacoletto's π-type equivalent circuit (bipolar transistor)

Fig. 1.3 shows the π-type equivalent circuit. This equivalent circuit is in itself the same as Early's T-type equivalent circuit mentioned above. The only difference from Early's T-type eqivalent circuit is that each parameter has—in principle— no frequency response.

Since the physical meaning of each parameter is easy to understand, this circuit is popularly employed. When actually employed for circuit calculation, it will prove convenient if the basic style shown in Fig. 1.3 is slightly simplified by considering frequency range.

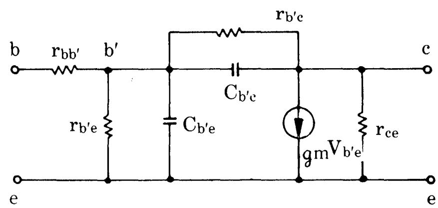


Fig. 1.3 π-type equivalent circuit

Paramaters of the T-type equivalent circuit and those of the π-type have the correlation shown in Table 1.2 .

Table 1.2 Relationship between paramaters of T-type and π-type equivalent circuits

π-type equivalent circuit paramaters	T-type equivalent circuit paramaters
$C_{b'e}$	C_e
$r_{be'}$	$\dfrac{r_e}{1-\alpha_0}$
$C_{b'c}$	C_c
$\dfrac{1}{r_{b'c}}$	$\dfrac{1}{r_c}-\dfrac{\mu(1-\alpha_0)}{r_e}$
r_{ce}	$\dfrac{r_e}{\mu}$
g_m	$\dfrac{\alpha_0}{r_e}$
$r_{bb'}$	$r_{bb'}$

(3) Types and structures of FETs

FETs can be classified into the following two types according to the gate:

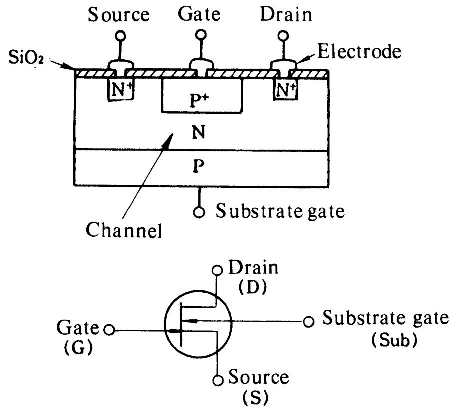
$$\text{FET}\begin{cases}\text{Junction FET (junction gate)}\\ \text{MOS FET (insulated gate)}\end{cases}$$

Fig. 1.4 shows the structures of both types.

A junction FET is one whose gate-to-channel portion is composed of a PN junction; an FET whose gate-to-channel portion is composed of **M**etal, **O**xide, and a **S**emiconductor is termed a MOS FET. FETs are also classified into P-channel and N-channel types according to the type (P or N) of the semiconductor layer through which drain current flows.

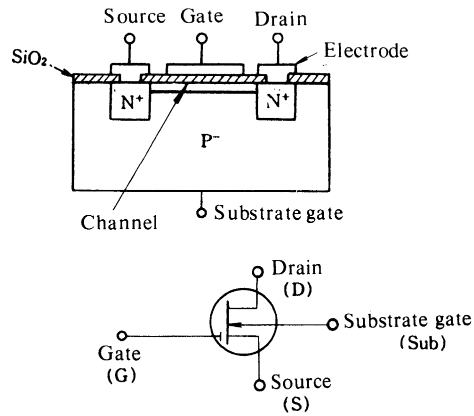
The structural drawings shown in Fig. 1.4 are all N-channel type.

Both junction and MOS types have their merits and disadvangtages. Since a MOS FET is insulated through the gate from its own structural features, it is much more easily broken by static electricity. Unless suitable protective measures are taken, extreme care must be exercised when handling a MOS FET.



* Substrate gate is usually connected to the source.

(a) Junction FET



* Substrate gate is usually connected to the source.

(b) MOS FET

Fig. 1.4 Structure and symbols for FET

However, almost all MOS FETs incorporate a protective diode at the gate to prevent such breakage, and it is very rare that they are broken when handled in a normal manner.

On the contrary, junction FETs are not damaged if they are handled normally, thus permitting them to be handled in the same manner as bipolar transistors without producing inconvenience.

Almost all MOS FETs are used for high-frequency circuits and chopper circuits. This is because, compared with the junction type, the MOS type is superior in cross modulation and inter modulation characteristics, and that when used in a chopper circuit, there is less spike and switching speed is higher.

When using FETs for a high-frequency circuit, it is necessary to reduce the internal feedback capacitance as low as possible so that stable gain is obtainable. Once FETs were employed by adopting a cascode connection for this purpose.

In recent years, this problem was solved by producing a cascode FET which two FETs are cascode-connected in the interior as well as dual-gate MOS FETs.

Fig. 1.5 illustrates the structure and a drawing of an equivalent connection of a cascode FET.

A cascode FET has two junction gates — the one near the drain coñnected to the substarate gate; thereby two FETs — namely a common source FET and a common gate FET — are produced.

This structure causes feedback from the drain to be grounded as alternate current, producing an FET with small reverse transfer capacitance.

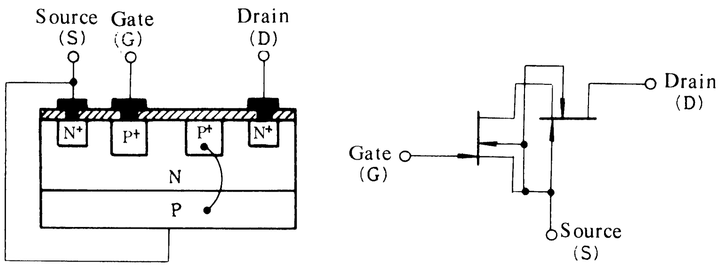


Fig. 1.5 Structure and equivalent connection drawing of cascode FET

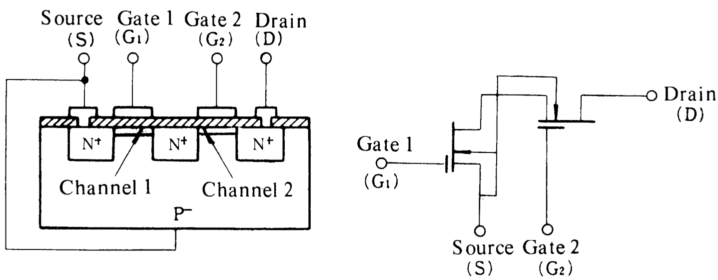


Fig. 1.6 Structure and equivalent connection drawing of dual-gate MOS FET

Fig. 1.6 shows the structure and equivalent connection drawing of a dual-gate MOS FET. As far as the operating principle is concerned, this FET is identical with a cascode FET. In the dual-gate MOS FET, gete 2 is lead out to be grounded for AC and to be supplied with positive bias voltage for DC, when the FET is used for an high-frequency amplifier circuit.

It is possible to use gate 2 as an injection terminal when using for mixing circuit.

The symbols used for junction cascode FET and dual-gate MOS FET are shown in Fig. 1.7. In addition to above, a power FET and a GaAs FET are avilable as other versions of FETs.

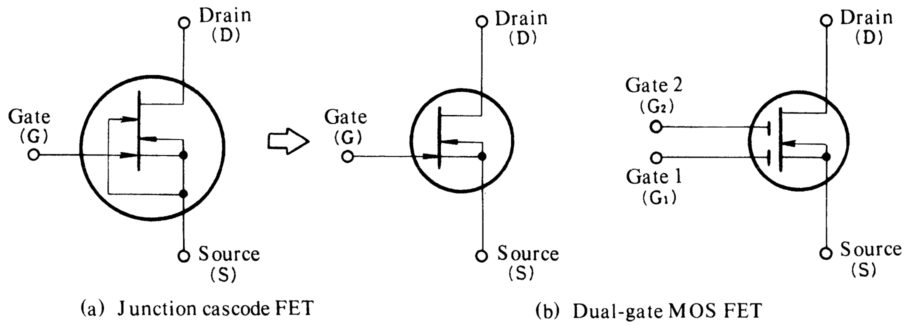


Fig. 1.7 Symbols used for junction cascode FET and dual-gate MOS FET

(4) FET equivalent circuit

Similarly to bipolar transistors, FET can be indicated by using an equivalent circuit. Fig. 1.8 is a schematic diagram of the equivalent circuit by relating to its structure.

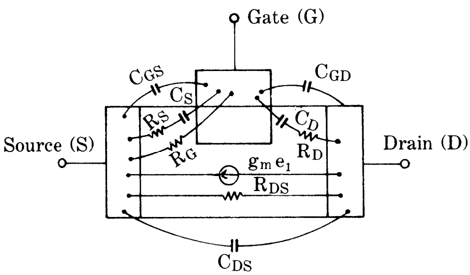


Fig. 1.8 Equivalent circuit in relation to structure of an FET

This diagram is rewritten into an equivalent circuit in Fig . 1.9(a), and further rewritten into a practical, simplified equivalent circuit in Fig. 1.9(b).

C_{GD}, C_{GS} and C_{DS} shown here are parasitic capacitances. Since their values are relatively small, it is possible to ignore them unless this circuit is used in VHF regions.

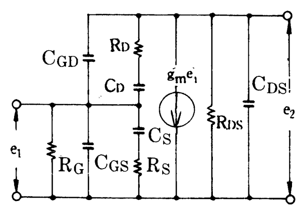
However, when using transistors whose capacitances between electrodes are large, such as a power FET and a high-gm FET in low-frequency regions, these capacitances must be considered fully.

For FET to be used in chopper circuits, it is necessary to keep the difference between C_{DG} and C_{GS} small to prevent spikes.

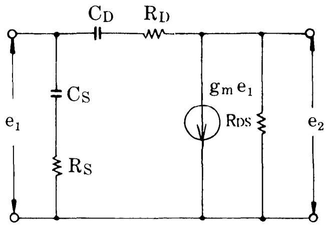
This equivalent circuit shows the characteristic of an FET very well, because it is related to the structure of an FET and it is shown by using basic parameters not depending on frequency.

As shown in the simplified equivalent circuit, for example, it is understood that DC input resistance (which is infinity) can be practically ignored and that C_D (internal feedback capacitance) is an unstable factor at high frequency.

At low frequency, it is possible to ignore capacitance; input resistance is infinity, while output resistance$=R_{DS}$. This is almost the equivalent circuit of a vacuum tube.



(a) Equivalent circuit



(b) Simplified equivalent circuit

Fig. 1.9 Equivalent circuit

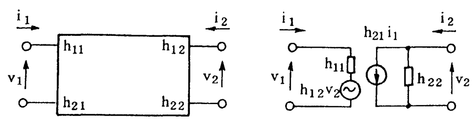
1.2 Circuit parameters

This is a method used to describe a transistor by regarding it as a four-terminal circuit network and by using the electrical characteristics of terminals irrespective of the physical characteristics of the transistor.

(1) Matrices showing the relation among the input and the output by voltage and current.

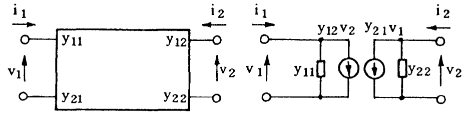
Those matrices have the six types shown in Table 1.1(a, b, g, h, y, and z matrices). Among others, both"h"and"y"matrices are used comparatively often.

Figs. 1.10 and 1.11 show the definitions of "h" and "y" matrices. Classification between the common emitter and the common base in shown by using suffixes e or b after i, r, f, or o.



$$\begin{pmatrix} v_i \\ i_2 \end{pmatrix} = \begin{pmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{pmatrix} \begin{pmatrix} i_1 \\ v_2 \end{pmatrix} = \begin{pmatrix} h_i & h_r \\ h_f & h_o \end{pmatrix} \begin{pmatrix} i_1 \\ v_2 \end{pmatrix}$$

Fig. 1.10 Circuit network by using "h" matrix



$$\begin{pmatrix} i_1 \\ i_2 \end{pmatrix} = \begin{pmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{pmatrix} \begin{pmatrix} v_1 \\ v_2 \end{pmatrix} = \begin{pmatrix} y_i & y_r \\ y_f & y_o \end{pmatrix} \begin{pmatrix} v_1 \\ v_2 \end{pmatrix}$$

Fig. 1.11 Circuit network by using "y" matrix

The physical meanings of each parameter in Figs. 1.10 and 1.11 are as follows:

h_i : input impedance
h_r : voltage feedback ratio
h_f : current gain
h_o : output admittance
y_i : input admittance
y_r : reverse transfer admittance
y_f : forward transfer admittance
y_o : output admittance

The h matrix are often used for the low-frequency regions, and y matrix for the high-frequency regions.

(2) Matrix showing the relation among the input and the output by power

Such phenomena as the reflection and transfer of waves in microwave circuits (such as waveguides and cavity resonators) are usually indicated by a "s" matrix (scattering matrix).

As the frequency limits for semiconductor products expand, the "s" matrix is occasionally used as a circuit paramater.

The definition of the "s" matrix is shown in Fig. 1.12; the physical meanings of each parameter are as follows:

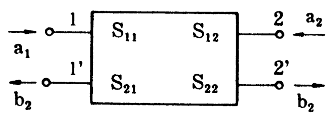
s_{11} : input reflection coefficient
s_{12} : reverse transfer coefficient

Table 1.3 Conversion of parameters

	[H]	[Y]	[S]
[H]	$\begin{matrix} h_i & h_r \\ h_f & h_o \end{matrix}$	$\begin{matrix} \frac{1}{y_i} & -\frac{y_r}{y_i} \\ \frac{y_f}{y_i} & \frac{y_i y_o - y_r y_f}{y_i} \end{matrix}$	$\begin{matrix} \frac{(1+s_o)(1+s_i)-s_r s_f}{(1-s_i)(1+s_o)+s_r s_f} & \frac{2s_r}{(1-s_i)(1+s_o)+s_r s_f} \\ \frac{-2s_f}{(1-s_i)(1+s_o)+s_r s_f} & \frac{(1-s_i)(1-s_o)-s_r s_f}{(1-s_i)(1+s_o)+s_r s_f} \end{matrix}$
[Y]	$\begin{matrix} \frac{1}{h_i} & -\frac{h_r}{h_i} \\ \frac{h_f}{h_i} & \frac{h_i h_o - h_r h_f}{h_i} \end{matrix}$	$\begin{matrix} y_i & y_r \\ y_f & y_o \end{matrix}$	$\begin{matrix} \frac{(1+s_o)(1-s_i)+s_r s_f}{(1+s_i)(1+s_o)-s_r s_f} & \frac{-2s_r}{(1+s_i)(1+s_o)-s_r s_f} \\ \frac{-2s_f}{(1+s_i)(1+s_o)-s_r s_f} & \frac{(1+s_i)(1-s_o)+s_r s_f}{(1+s_i)(1+s_o)-s_r s_f} \end{matrix}$
[S]	$\begin{matrix} \frac{(h_i-1)(h_o+1)-h_r h_f}{(h_i+1)(h_o+1)-h_r h_f} & \frac{2h_r}{(h_i+1)(h_o+1)-h_r h_f} \\ \frac{-2h_f}{(h_i+1)(h_o+1)-h_r h_f} & \frac{(1+h_i)(1-h_o)+h_r h_f}{(h_i+1)(h_o+1)-h_r h_f} \end{matrix}$	$\begin{matrix} \frac{(1-y_i)(1+y_o)+y_r y_f}{(1+y_i)(1+y_o)-y_r y_f} & \frac{-2y_r}{(1+y_i)(1+y_o)-y_r y_f} \\ \frac{-2y_f}{(1+y_i)(1+y_o)-y_r y_f} & \frac{(1+y_i)(1-y_o)+y_r y_f}{(1+y_i)(1+y_o)-y_r y_f} \end{matrix}$	$\begin{matrix} s_i & s_r \\ s_f & s_o \end{matrix}$

s_{21} : forward transfer coefficient
s_{22} : output reflection coefficient

Suffix b or e is used to indicate the common base or the common emitter in the same manner as y parameters and h parameters.



$$\begin{bmatrix} b_1 \\ b_2 \end{bmatrix} = \begin{bmatrix} s_{11} & s_{12} \\ s_{21} & s_{22} \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \end{bmatrix} = \begin{bmatrix} s_i & s_r \\ s_f & s_o \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \end{bmatrix}$$

Fig. 1.12 Circuit network by using "s" matrix

Table 1.4 Conversion formulas for "h" parameters

		Converted "h" parameters		
		Common base	Common emitter	Common collector
Known "h" parameters	Common base		$\begin{matrix} \frac{h_{ib}}{1+h_{fb}} & \frac{\Delta h_b - h_{rb}}{1+h_{fb}} \\ \frac{-h_{fb}}{1+h_{fb}} & \frac{h_{oh}}{1+h_{fb}} \end{matrix}$	$\begin{matrix} \frac{h_{ib}}{1+h_{fb}} & 1 \\ \frac{-1}{1+h_{fb}} & \frac{h_{ob}}{1+h_{fb}} \end{matrix}$
	Common emitter	$\begin{matrix} \frac{h_{ie}}{1+h_{fe}} & \frac{\Delta h_e - h_{re}}{1+h_{fe}} \\ \frac{-h_{fe}}{1+h_{fe}} & \frac{h_{oe}}{1+h_{fe}} \end{matrix}$		$\begin{matrix} h_{ie} & 1-h_{re} \\ -(1+h_{fe}) & h_{oe} \end{matrix}$
	Common collector	$\begin{matrix} \frac{-h_{ic}}{h_{fc}} & \frac{-\Delta h_c}{h_{fc}} - 1 \\ \frac{-(1+h_{fc})}{h_{fc}} & \frac{h_{oc}}{h_{fc}} \end{matrix}$	$\begin{matrix} h_{ic} & 1-h_{rc} \\ -(1+h_{fc}) & h_{oc} \end{matrix}$	

$\Delta h_e = h_{ie} \cdot h_{oe} - h_{re} \cdot h_{fe}$ $\quad \Delta h_b = h_{ib} \cdot h_{ob} - h_{rb} \cdot h_{fb}$ $\quad \Delta h_c = h_{ic} \cdot h_{oc} - h_{rc} \cdot h_{fc}$

Table 1.5 Conversion formulas for "y" parameters

		Converted "y" parameters		
		Common base	Common emitter	Common collector
Known "y" parameters	Common base		$\begin{matrix} \Sigma y_b & -(y_{rb}+y_{ob}) \\ -(y_{fb}+y_{ob}) & y_{ob} \end{matrix}$	$\begin{matrix} \Sigma y_b & -(y_{ib}+y_{ob}) \\ -(y_{ib}+y_{rb}) & y_{ib} \end{matrix}$
	Common emitter	$\begin{matrix} \Sigma y_e & -(y_{re}+y_{oe}) \\ -(y_{fe}+y_{oe}) & y_{oe} \end{matrix}$		$\begin{matrix} y_{ie} & -(y_{ie}+y_{re}) \\ -(y_{ie}+y_{fe}) & \Sigma y_e \end{matrix}$
	Common collector	$\begin{matrix} y_{oc} & -(y_{fc}+y_{oc}) \\ -(y_{rc}+y_{oc}) & \Sigma y_c \end{matrix}$	$\begin{matrix} y_{ic} & -(y_{ic}+y_{rc}) \\ -(y_{ic}+y_{fc}), & \Sigma y_c \end{matrix}$	

$\Sigma y_e = y_{ie} + y_{re} + y_{fe} + y_{oe}$
$\Sigma y_b = y_{ib} + y_{rb} + y_{fb} + y_{ob}$
$\Sigma y_c = y_{ic} + y_{rc} + y_{fc} + y_{oc}$

Table 1.6 "h" parameters converted by Early's T-type device parameters

	Common base		Common emitter
h_{ib}	$\dfrac{r_e + r_{bb'}\left((1-\alpha_0) + j\dfrac{f}{f\alpha}\right)}{1 + j(f/f\alpha)}$	h_{ie}	$r_{bb'} + \dfrac{r_e}{(1-\alpha_0)+j(f/f\alpha)}$
h_{rb}	$j2\pi fC_c r_{bb'}$	h_{re}	$2\pi f\alpha C_c r_e \dfrac{j\dfrac{f}{f\alpha}}{(1-\alpha_0)+j(f/f\alpha)}$
h_{fb}	$\dfrac{-\alpha_0}{1+j(f/f\alpha)}$	h_{fe}	$\dfrac{\alpha_0}{(1-\alpha_0)+j(f/f\alpha)}$
h_{ob}	$j2\pi fC_c$	h_{oe}	$2\pi f\alpha C_c \dfrac{j\dfrac{f}{f\alpha}(1+j\dfrac{f}{f\alpha})}{(1-\alpha_0)+j(f/f\alpha)}$

Table 1.7 "y" parameters converted by Early's T-type device parameters

	Common base		Common emitter
y_{ib}	$\dfrac{1+j\dfrac{f}{f\alpha}}{r_e + j r_{bb'}\dfrac{f}{f\alpha}}$	y_{ie}	$\dfrac{(1-\alpha_0)+j\dfrac{f}{f\alpha}}{r_e + j r_{bb'}\dfrac{f}{f\alpha}}$
y_{rb}	$-2\pi f\alpha C_c \dfrac{j\dfrac{f}{f\alpha}\left(1+j\dfrac{f}{f\alpha}\right)}{\dfrac{r_e}{r_{bb'}}+j\dfrac{f}{f\alpha}}$	y_{re}	$-2\pi f\alpha C_c \dfrac{r_e}{r_{bb'}} \dfrac{j\dfrac{f}{f\alpha}}{\dfrac{r_e}{r_{bb'}}+j\dfrac{f}{f\alpha}}$
y_{fb}	$-\dfrac{\alpha_0}{r_e + j r_{bb'}\dfrac{f}{f\alpha}}$	y_{fe}	$\dfrac{\alpha_0}{r_e + j r_{bb'}\dfrac{f}{f\alpha}}$
y_{ob}	$2\pi f\alpha C_c \dfrac{j\dfrac{f}{f\alpha}\left(1+\dfrac{r_e}{r_{bb'}}+j\dfrac{f}{f\alpha}\right)}{\dfrac{r_e}{r_{bb'}}+j\dfrac{f}{f\alpha}}$	y_{oe}	y_{ob}

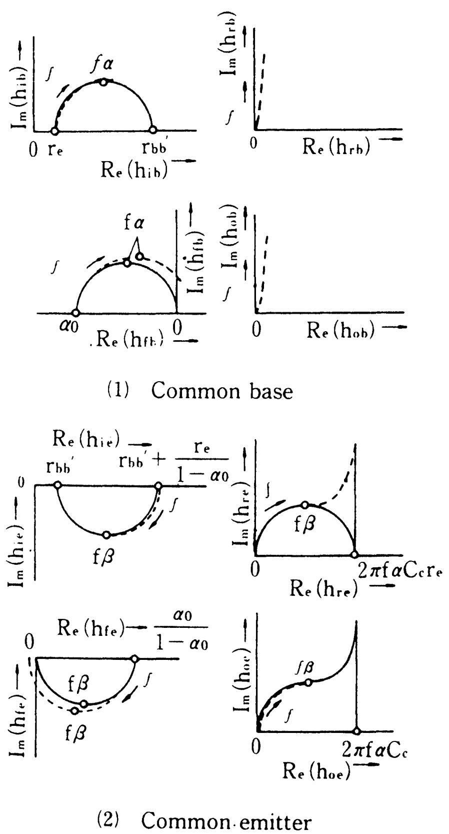


Fig. 1.13 Frequency locus of "h" parameters

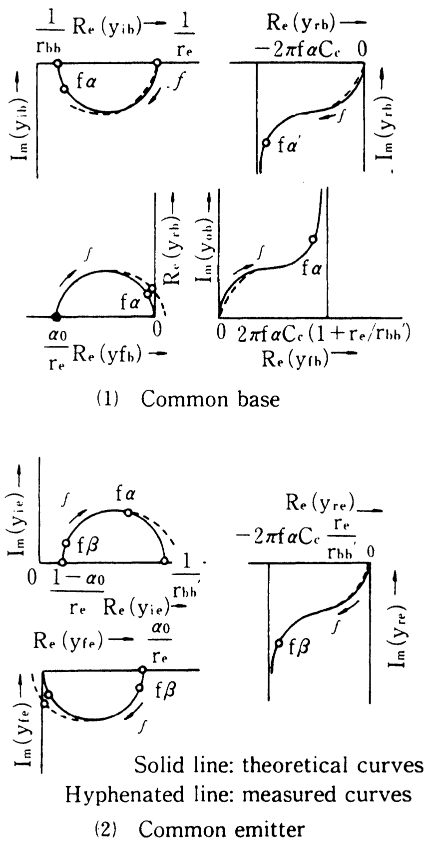


Fig. 1.14 Frequency locus of "y" parameters

Please refer to Tables 1.3, 1.4 and 1.5 for the correlation and conversion of common base and common emitter among circuit parameters.

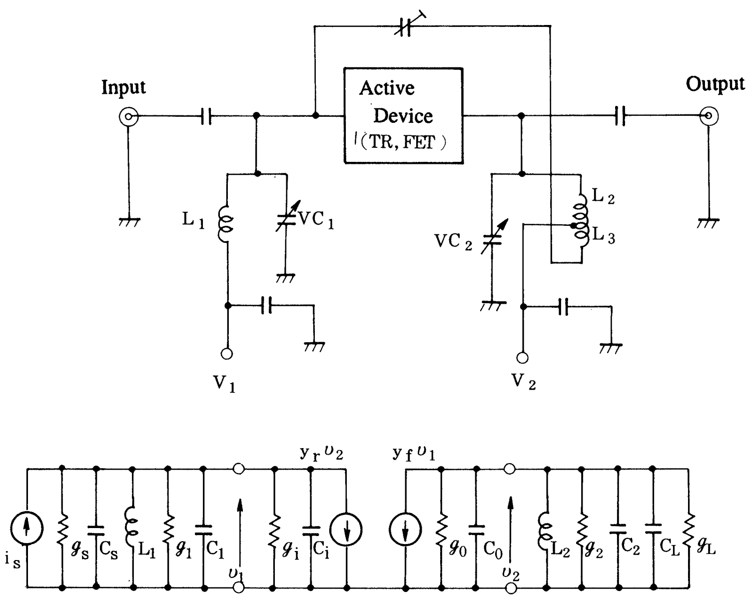
Figs. 1.13 and 1.14 shows the frequency locuses of "h" and "y" parameters obtained from Tables 1.6 and 1.7.

The above-mentioned parameters vary according to the operating points and temperature; thus, circuit designers should effect designing by comprehending the rough trends of such variations.

2. GAIN AND STABILITY

Figure 2.1 shows the basic high-frequency amplification circuit of a transistor/FET and its equivalent circuit. When this amplification circuit is tuned to the center frequency, the capacitance is removed and only the conductance remains as shown in the equivalent circuit in Figure 2.2.

In this circuit, if both the capacitance and the conductance are neutralized, or, for active devices with small reverse transfer capacitance, such as cascaded FETs, it can be assumed that $|y_r| = 0$. Also, when the unloaded Q in the I/O coil is large, and when loss conductance g_1 and g_2 are ignored, an equivalent circuit with simple configuration is structured as shown in Figure 2.3.



is:	signal constant current source
gs, Cs:	signal source conductance, capacitance
gi, Ci:	input conductance, capacitance
L_1, L_2:	I/O tuning inductance
g_0, C_0:	output conductance, capacitance
g_1, g_2:	power loss conductance of an I/O coil
g_L, C_L:	load conductance, capacitance
C_1, C_2:	additional capacitance in external I/O

Figure 2.1 Basic High-Frequency Amplifier Circuit and Its Equinalent Circuit

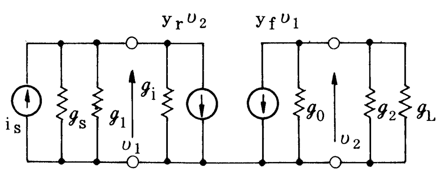


Figure 2.2 Equivalent Circuit (Tuned Frequency)

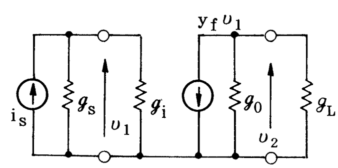


Figure 2.3 Unidirectional Equivalent Circuit

We now find the power gain of the equivalent circuit.

$$Gp = \frac{P_0}{Pi\ (Max)} = \frac{|\upsilon_2|^2 g_L}{|i_s|^2/4g_s} \quad \text{.......} \quad (1)$$

Combining with

$$\upsilon_2 = \frac{y_f\,\upsilon_1}{g_0 + g_L}, \quad i_s = -\upsilon_1\,(g_s + g_i)$$

we obtain

$$Gp = \frac{4\,|y_f|^2 g_s g_L}{(g_s + g_i)^2\,(g_0 + g_L)^2} \quad \text{.......} \quad (2)$$

When gs=gi and g_L=g_0, the power gain becomes maximum; namely, when the input and the output are matched.

$$Gp\ (Max) = \frac{|y_{fs}|^2}{4g_ig_0} \quad \text{.......} \quad (3)$$

Gp (Max) is MAG (maximum avalilable gain) that can be achieved when a device fully matches with the input and the output unidirectional.

Therefore, in practice, power gain (stability gain) must be considered stability.

The active device stability coefficient s is

$$s = \frac{2g_i \cdot g_0}{1 + \cos(\phi_r + \phi_f)\ |y_r| \cdot |y_f|} \quad \text{.......} \quad (4)$$

Where ø is the phase angle of the y parameter

$$\begin{cases} \phi_r = \tan^{-1}(b_r/g_r) \\ \phi_f = \tan^{-1}(b_f/g_f) \end{cases}$$

This means that it is inversely related to the gain, i.e., the better for the stability coefficient s large I/O admittance, and small forward transfer admittance are.

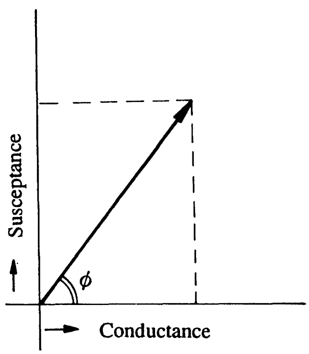


Figure 2.4 Phase Angle Diagram

The stability coefficient is calculated from the device y parameter, and, if $s>1$, it is stable without considering the I/O circuit; however, when $s \leqq 1$, there is a danger that the I/O circuit may cause oscillation.
In a high-frequency amplifier circuit, S is expressed by using Gi and Go.

$$S = \frac{2}{1+\cos(\phi_r+\phi_f)} \cdot \frac{G_i \cdot G_0}{|y_r|\,|y_f|} \quad \text{.......} (5)$$

Where $G_i = g_s + g_1 + g_i$
$G_0 = g_0 + g_2 + g_L$

The relationship between this S and the stability coefficient of a device (s) can be expressed as follows

$$S = \frac{G_i G_0}{g_i g_0} \cdot s$$

$$= \left(1 + \frac{g_s + g_1}{g_i}\right)\left(1 + \frac{g_L + g_2}{g_0}\right) \cdot s \quad \text{.......} (6)$$

$$S \geqq s$$

In other words, by selecting larger g_s, g_L or g_1, g_2 increase the circuit stability.
When the input and output are matched, even though the loss conductance of the coil is $(g_1, g_2) = 0$,

$$\begin{cases} G_i = g_s + g_i = 2g_i \\ G_0 = g_0 + g_L = 2g_0 \end{cases}$$

$$S = 4s$$

and stability can be achieved that is four times larger than that of a device.
After considering the power gain, S is expressed by

$$Gp = \frac{1}{S} \cdot \frac{2}{1+\cos(\phi_r+\phi_f)} \cdot \frac{|yf|}{|yr|} \quad \text{.......} (7)$$

This formula can be changed to

$$Gp = \frac{4}{S} \cdot \frac{2}{1+\cos(\phi_r+\phi_f)} \cdot \frac{g_i \cdot g_0}{|yr|\,|yf|} \cdot \frac{|yf|^2}{4gig_0} \quad \text{.......} (8)$$

$$= \frac{4s}{S} \cdot Gp\,(Max) \quad \text{.......} (9)$$

Select '4' or more for the value of S: $S \geqq 4$.

$$Gp \leqq s \cdot Gp\,(Max) \quad \text{.......} (10)$$

A stability gain of $s \leqq 1$ in the circuit can be achieved when device stability coefficient s is multiplied by MAG.

Table 2.1 shows the Gp of a high-frequency transistor/FET when MAG and S=4.

Table 2.1 Gain and Stability (Example)

f = 100 MHz

		MAG (dB)	s	Gps (dB)
TR	2SC1923	34.9	0.030	19.6
J-FET	2SK192A	26.9	0.023	10.5
	2SK161	26.4	0.265	20.7
MOS FET	2SK241	34.0	0.120	24.8
	3SK73	28.6	0.690	27.0

Several methods are available for achieving stable gain in high-frequency circuits. The most popular method using a circuit is to ignore the feedback by installing a neutralized circuit. Figure 2.5 shows an example.

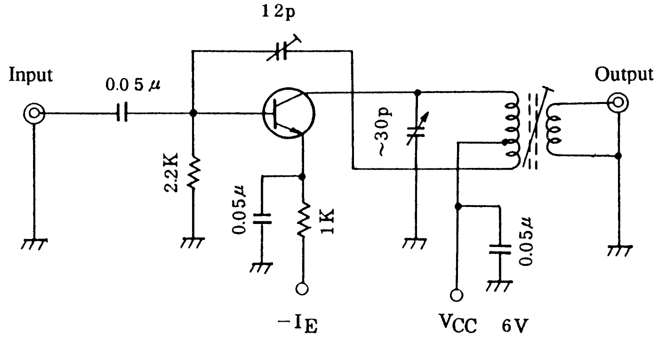


Figure 2.5 2SC380TM10.7MHz Amplifier Circuit

Another method is to lower the feedback capacitance by cascode connection. Figure 2.6 is a typical example of a cascode-connected circuit.

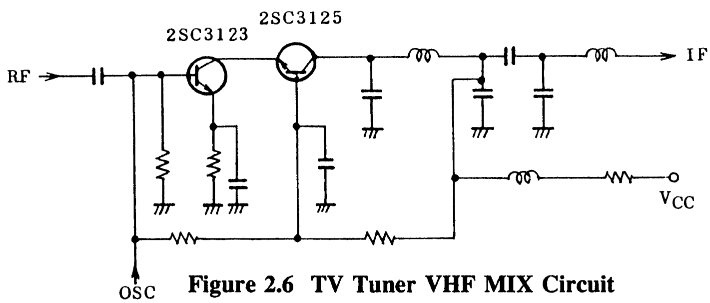


Figure 2.6 TV Tuner VHF MIX Circuit

For transistors, the Faraday shield (electrostatic screen) method is used to prevent interference from active devices.

For FETs, devices with cascode equally connected inside the device — such as cascode FETs and dual MOS FETs — are equivalent to the method mentioned above.

3. 3-TERMINAL MOS FET FOR USE AT HIGH-FREQUENCIES (2SK241, 2SK302)

This 3-terminal MOS FET is a new type of MOS FET that leads current electronics technology. The dual-gate MOS FET is the most popular type of conventional high-frequency MOS FET. In this type, Gate 2 achieves several advantages when compared to junction-type FETs or bipolar transistors. Generally, Gate 2 can be used as the local oscillation signal injector terminal for mixer circuits, and an AGC terminal. However, there is another method as shown in Figure 3.1. This shows a typical high-frequency amplifier in a Hi-Fi tuner. Gate 2 in the figure is used only as a DC fixed bias terminal in order to achieve power gain.

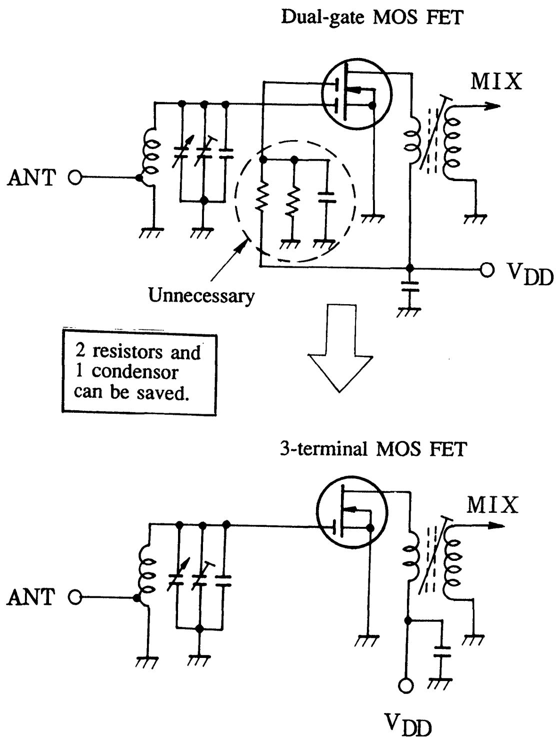


Figure 3.1

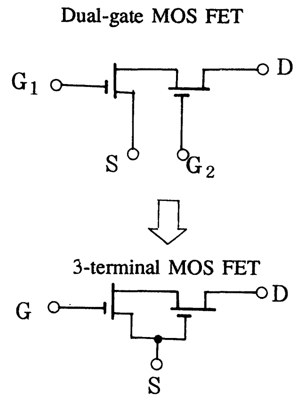


Figure 3.2

Assuming that a dual-gate MOS FET can achieve good performance when the Gate 2 bias voltage is zero, Gate 2 only needs to be grounded; however, in practice, Gate 2 has to be biased in a voltage range of 3 to 5V.

Passive components required for this purpose are at least two resistors and one capacitor. However, a 3-terminal MOS FET does not require such components to achieve the same characteristics as a dual-gate MOS FET.

The 3-terminal MOS FET is a cascode-connected device that connects Gate 2 of the dual-gate MOS FET to the source.

In addition, special consideration has been given to maintaining excellent performance even when Gate 2 is zero biased: this is achieved by the channel control from the Gate 2 side.

Moreover, our original manufacturing technique allows a decrease in the amount of bonding for reliability improvement.

Three types of packages are available to respond to trends in compact FM tuners: Mini Mold (2SK241), Super Mini (2SK302), and Ultra Super Mini (2SK882).

4. AGC OF DUAL-GATE MOS FET

4.1 Typical AGC Circuit in Dual-gate MOS FETs

Dual-gate MOS FET AGC (automatic gain control) is achieved by changing the bias of Gate 2. This type of control is used mainly for the RF stage in TVs (VHF/UHF) and FM tuners. Figure 4.1 shows a typical example of a bias circuit.

One point in the design of this circuit, shown in the figure, is the proper setting of V_{G1} and Vs. Briefly, the I_D-V_{G1S} operation point locus in Gate 2 V_{AGC} is determined by the setting of V_{G1} and Vs. This is because there is a close relationship between the I_D-V_{G1S} operation point locus and gain reduction — cross modulation characteristics. The I_D-V_{G1S} operation point and the cross modulation characteristics are described below.

4.2 Relationship Between V_{G1S} and Cross Modulation, |yfs|, I_D

Cross modulation (undesire signal level) – V_{G1S} characteristics against I_D, |yfs| – V_{G1S} characteristics are shown in Figure 4.2 as a representative example.

Three bad points (A, B, C) of the 1% cross modulation characteristic in |yfs| – V_{G1S} characteristics can be seen, and three good points (D, E, F) can also be seen. In short, the figure shows that in a region with a sharp |yfs| – V_{G1S} curve, the secondary |yfs| (tertiary I_D) order term is large, and therefore is bad; the region close to the straight line is good since secondary |yfs| is small. Explanation of each point is as follows.

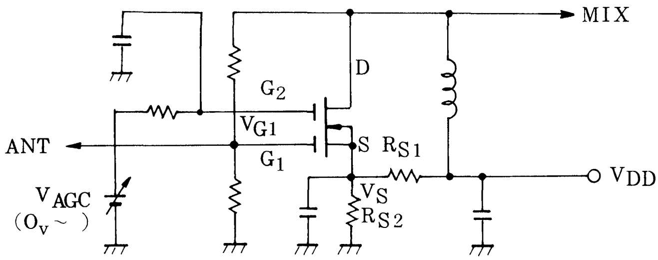


Figure 4.1 Typical AGC Circuit In a Dual-Gate MOS FET

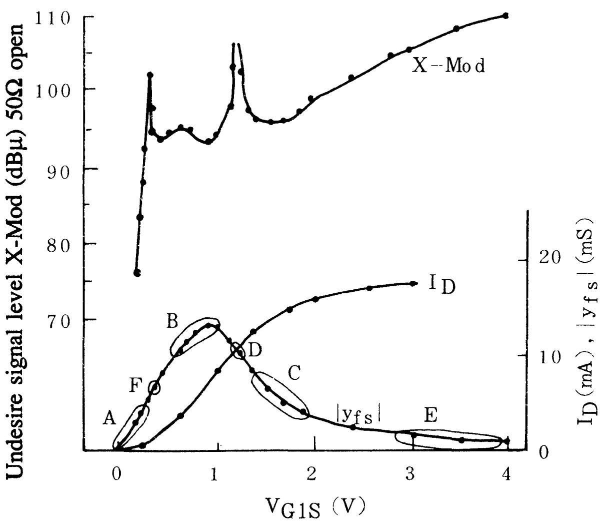


Figure 4.2 I_D, |yfs|, X-Mod-V_{G1S} Characteristics

(1) Point A

This point is that in the section close to the OFF state of the front-stage FET in a dual-gate MOS FET, similar to that of single-gate FET and bipolar transistor's reverse AGC, place where GR (gain reduction) is large has very poor cross-modulation characteristics. Therefore, in a dual-gate FET, it is not favorable when Gate 1's operation point with large GR is in A range in which AGC is applied at Gate 2. This should be avoided at all times.

(2) Point B

From the viewpoint of the $I_D - V_{G1S}$ (or $|yfs| - V_{G1S}$) characteristic, this is the point where the rear-stage FET starts to have an effect (the front-stage FET, however, is controlled by the A and F points). This is a point that exists at all times if the device is a dual-gate FET. The V_{G1S} at this point is characterized by V_{G2S} becoming smaller, it moves close to $V_{G1S\ (OFF)}$, and the cross modulation tends to be worse. However, this point is passed through when the actual-GR is small (V_{G2S} is large). Therefore, mounting on a tuner is not a problem since it is buried by the cross modulation (MIX) after RF.

(3) Point C

From point B which is affected by the rear-stage FET, this point moves to a section one step before being affected by the rear-stage FET increases. Like point B, this point exists at all times if a device is a dual-gate FET. The point's position on V_{G1S} shows similar movement against V_{G2S} as point B. Also, the cross-modulation characteristic tends to become similar to point B. However, a problem that is different from point B arises. If this point of device cross modulation is poor when passing through GR = 10 to 30 dB, that affects tuner characteristics.

(4) Points D, F

These two points exist because there are A, B, and B, C points with poor cross modulation on both sides against V_{G1S}. In other words, when I_D is Taylor's series by V_{G1S}, tertiary order term/primary order term codes move inversely, and inevitably, tertiary order term/primary order term equal to zero. Also, the V_{G1S} range of these points is very narrow, and since cross modulation on both sides is poor, it is very difficult to trace these points as an operation point against V_{G2S}. Therefore, in cross-modulation characteristics (undesire signal level vs GR), it may be considered that there are some good points in cross modulation.

(5) Point E

In $I_D - V_{G1S}$ (or $|yfs| - V_{G1S}$) characteristics, this is the point strongly affected by the rear-stage FET characteristics. The feature of this section is that GR is relatively large and cross modulation is good (most advantageous part of a dual-gate FET). The position on V_{G1S} is that as V_{G2S} becomes small and point C moves close to the $V_{G1S\ (OFF)}$, the V_{G1S} range becomes wider.

When applying AGC to V_{G2S}, the device must be designed to place a larger GR's V_{G1S} operation point at Point E in order to make best use of the advantages of a dual-gate FET.

4.3 AGC Circuit Design in Dual-Gate FET

AGC circuit design considering the dual-gate FET's cross-modulation characteristic, in short, requires the $I_D - V_{G1S}$ operation point locus to be set against V_{AGC} ($=V_{G2S}$). The relationship between the $I_D - V_{G1S}$ operation point locus and the cross modulation characteristic using the actual test data is given below. A dual-gate MOS FET for TV/VHF tuner RF, the 3SK126, is used.

Operation point locus ① in Figure 4.3 shows a poor example where it does not reach point E when V_{G2S} is small (GR is large); the 1% cross modulation characteristic in Figure 4.4 shows the poor result where GR is large. On the other hand, operation point loci ② and ③ reach Point E where V_{G2S} is small, and the 1% cross modulation characteristic is better where GR is large. Also, for Point B (near GR=4 dB in Fig. 4.4) and Point C (near GR=15 dB in Fig. 4.4), the operating point loci ② and ③ are better when compared to ①. This is because the operating point passes through Point B and C where V_{G2S} is large, in the order ③, ②, ①. Therefore, when designing a circuit by placing the operation point locus on Point E where GR is large and cross modulation is in good condition (for ② and ③), the cross modulation characteristic at Point GR will automatically be good.

Considering the above, we now find V_{G1}, V_S, R_{S1}, and R_{S2} in the 3SK126 using the circuit shown in Figure 4.1.

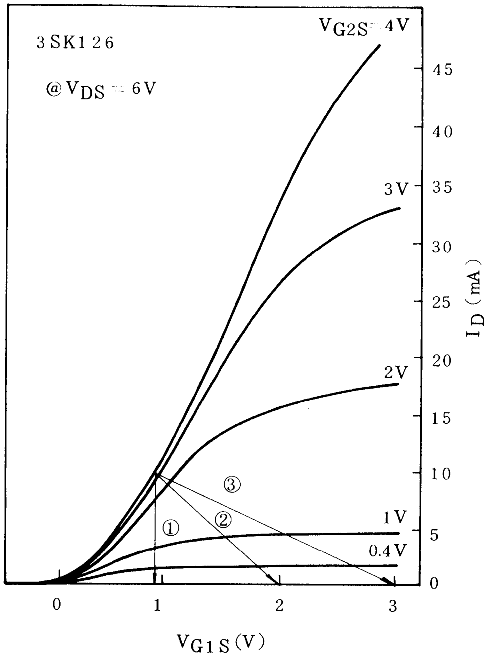


Figure 4.3 I_D – V_{G1S} Operation Point Locus

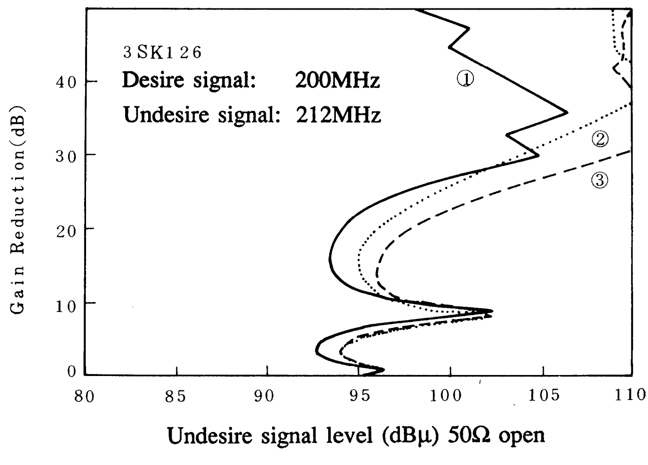


Figure 4.4 1% Cross Modulation Characteristics

First, the FET must be completely in the OFF state in V_{AGC} = Ov condition; $V_S|_{ID=0}$ must have some margins for its determination.

$$V_s|_{ID=0} = 1 - V_{G2S\,(OFF)}\ (V) \quad \text{.......} (1)$$

Next, for the V_{G1}, V_{G1S} ($=V_{G1}-V_S|_{ID=0}$) is required to be at Point E under the condition of V_{AGC}=0 and $V_S|_{ID=0}$ = $1-V_{G2S\,(OFF)}$. When operation locus (3) in Figure 4.3 is used, V_{G1} becomes

$$V_{G1S} = V_{G1S\,(OFF)} + 3v \quad \text{.......} (2)$$

Therefore,

$$V_{G1} = V_{G1S\,(OFF)} + V_s|_{ID=0} + 3v \quad \text{.......} (3)$$

When (1) is substituted in equation (3),

$$V_{G1} = 4 + V_{G1S\,(OFF)}\ (V) \quad \text{.......} (4)$$

Also when GR = 0 dB, V_{G2S} = 3V, and I_D = 10 mA, V_{AGC} max, R_{S1}, and R_{S2} are determined as follows.

$$R_S = R_{S1}\,R_{S2}/\,(R_{S1}+R_{S2}) \quad \text{.......} (5)$$

$$V_{G1S}|_{VG2S=3V,\,ID=10mA} = V_{G1} - (V_S|_{ID=0} + R_S \times 10\text{ mA}) \quad \text{.......} (6)$$

$$V_{G2S} = V_{AGC\,max} - (V_S|_{ID=0} + Rs \times 10mA) = 3\ (V) \quad \text{.......} (7)$$

and the design is completed after

$$R_S = \{V_{G1} - V_S|_{ID=0} - V_{G1S}|_{VG2S=3V,\,I_D=10mA}\}/10mA\ (\Omega) \quad \text{.......} (8)$$

$$V_{AGC\,max} = 3 + V_S|_{ID=0} + R_S \times 10\text{ mA}\ (V) \quad \text{.......} (9)$$

Using Figure 4.3 as a reference, when $V_{G1S\,(OFF)}$=0V, $V_{G2S\,(OFF)}$=0V, $V_{G1S}|_{VG2S=3V,\,ID=10mA}$ =0.92V, the $V_S|_{ID=0}$, V_{G1}, R_S, V_{AGC} range becomes

$V_S|_{I_D=0} = 1V$
$V_{G1} = 4V$
$R_S = 208\Omega$
$V_{AGC} = 0V\sim6.08V$

Also, when V_{DS} is under 6V GR=0 dB (V_{G2S}=3V, I_D=10 mA), V_{DD} become as follows.

$$\begin{aligned} V_{DD} &= V_S|_{ID=0} + R_S \times 10mA + V_{DS}|_{VGS=3V,\,ID=10mA} \\ &= 1V + 2.08V + 6V \\ &= 9.08V \end{aligned}$$

Finally, R_{S1} and R_{S2} must be found.

$$R_S = R_{S1}R_{S2}/\,(R_{S1} + R_{S2}) = 208\Omega \quad \text{.......} (10)$$

$$V_S|_{ID=0} = V_{DD}R_{S2}/\,(R_{S1}+R_{S2}) = 9.08 \times R_{S2}/\,(R_{S1}+R_{S2}) = 1V \quad \text{.......} (11)$$

When equation (10) is divided by equation (11),

$$R_{S1}/9.08 = 208$$
$$\therefore R_{S1} = 208 \times 9.08 = 1.89K\Omega$$

Therefore, $R_{S2} = 234\Omega$

The AGC circuit design in dual-gate FET, considering the cross modulation characteristics is now completed.

5. INTERMODULATION AND CROSS MODULATION

In general, for semiconductor amplifiers (bipolar transistors, FETs), output current and input voltage are related as follows.

$$I_C = a_0 + a_1V_{be} + a_2V_{be}^2 + a_3V_{be}^3 + a_4V_{be}^4 + a_5V_{be}^5 + \cdots\cdots \quad (1)$$

(For FETs, $Ic \Rightarrow I_d$, $V_{be} \Rightarrow V_{gs}$)

Here, when two signals of angular frequency ω_1 and ω_2 are inputted, the output frequency component will contain different types of components such as V_{be}^2, V_{be}^3, etc.
The input signal is calculated as follows.

$$V_{be} = V_1\sin\omega_1 t + V_2\sin\omega_2 t \quad \cdots\cdots \quad (2)$$

Here, equation (1) is substituted in equation (2). But to simplify this formula, V_{be}^3 should also be considered.

$$\begin{aligned} I_C &= a_0 + a_1 (V_1\sin\omega_1 t + V_2\sin\omega_2 t) \\ &+ \frac{1}{2} a_2 (V_1^2 + V_2^2) - \frac{1}{2} a_2(V_1^2\cos2\omega_1 t + V_2^2\cos2\omega_2 t) \pm a_2V_1V_2\cos(\omega_1 \mp \omega_2)t \\ &+ \frac{3}{4} a_3 (V_1^3\sin\omega_1 t + V_2^3\sin\omega_2 t) - \frac{1}{4} a_3 (V_1^3\sin3\omega_1 t + V_2^3\sin3\omega_2 t) \\ &+ \frac{3}{4} a_3\{V_1^2V_2\sin(\mp 2\omega_1 - \omega_2)t + V_1V_2^2\sin(\mp 2\omega_2 - \omega_1)t \\ &\boxed{+\frac{3}{2} a_3\{V_1^2V_2\sin\omega_2 t + V_1V_2^2\sin\omega_1 t\}} \quad \cdots\cdots \quad (3) \end{aligned}$$

In equation (3), represents the inter modulation term and represents the cross modulation. Figure 5.1 shows equation (3) in spectrum figure.

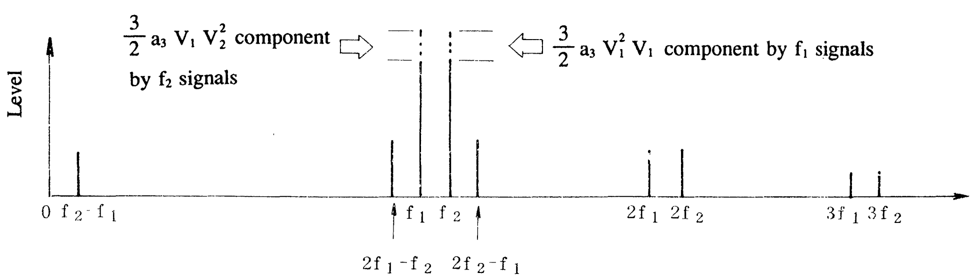


Figure 5.1

5.1 Intermodulation

(a) On both sides of two neighboring signals (f_1, f_2), the frequency components ($2f_1$-f_2, $2f_2$-f_1) appear in a region that shows the difference of the two signals. This is generally called IMD 3'rd distortion.

(b) In transmitters, inter modulation problems occur mainly because in SSB and FM-modulation transmitters, signals may interfere with neighboring channels when inter modulation is large.

(c) In tuners, inter modulation problem occur because, if there are three broadcasting stations (f_1, f_2, f_3), and if a tuner is tuned to f_1, f_1 signals are affected by f_2 and f_3 signals and the relation is f_1=$2f_2$-f_3 or f_1=$2f_3$-f_2.

(d) Measurement and expression of inter modulation are as follows.

(1) Input signals f_1 and f_2 are inputted with the same levels.

(2) IMD 3'rd distortion is expressed by the difference (dB) between f_1 (or f_2) output level and $2f_1$-f_2 (or $2f_2$-f_1) output level. As the dependence of IMD 3'rd distortion on input level (or output level) increases, the value gets worse.

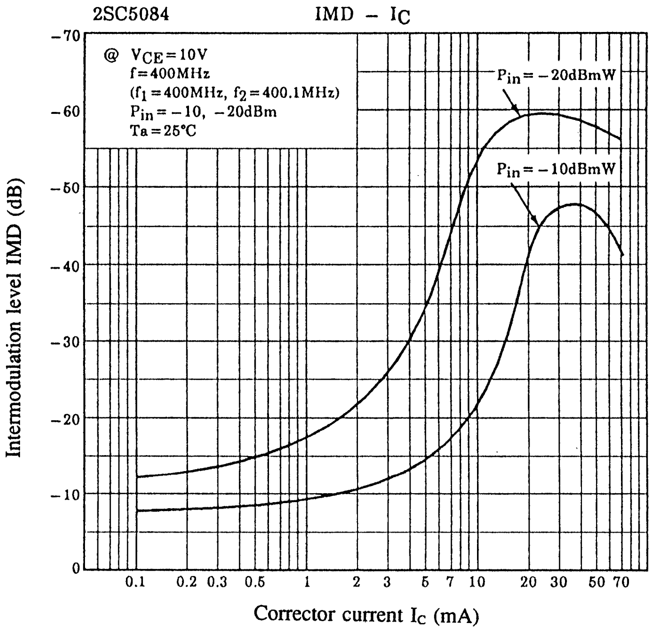


Figure 5.2 Intermodulation Characteristics

5.2 Cross Modulation

(a) When there are two neighboring signals (f_1, f_2), the f_2 (or f_1) signal affects f_1 (or f_2). For example, when tuned by a non-modulated signal f_1, the modulated f_2 signal affects the f_1 signal and creates f_2 modulated signals in wave-detection output.

(b) This problem arises in TV tuners when there are neighboring broadcasting stations (f_1, f_2). When tuned to station f_1, the video and audio signals are affected by the powerful station f_2 video and audio signals.

(c) Measurement and expression of cross modulation are as follows.

(1) When the desire signal is f_1 and the undesire signal is f_2, the f_1 signal is the non-modulation state and the f_2 signal is 30% AM modulation at 1kHz.

$$e_1 = E_1 \sin\omega_1 t$$
$$e_2 = E_2 (1 + m_2 \cos \omega_{m2} t) \sin \omega_2 t$$

(Notes) m_2: undesire signal modulation ratio (0.3)
ωm_2: modulation angular frequency (fm_2 = 1 kHz)

(2) By inputting e_1 and e_2, output is formed as the f_1 component by equation 3.

$$I_C \approx a_1E_1\{1+3 \cdot \frac{a_3}{a_1} \cdot m_2E_2^2 \cos \omega_{m2}t) \sin \omega_1 t$$

As shown by the above equation, the required f_1 signal (originally non-modulated) is modulated by undesire signal f_2 according to the following equation.

$$m_K = 3 \cdot \frac{a_3}{a_1} \cdot m_2 \cdot E_2^2$$

The modulated signal is expressed by

$$I_C = a_1E_1\{1+m_1 \cos \omega_{m1}\} \sin \omega_1 t$$

m_1: desire signal modulation ratio (0.3)
ωm_1: modulation angular frequency (fm1 = 1kHz)

Therefore, the cross modulation exponent is

$$K_C=\frac{m_K}{m_1}=\frac{3a_3m_2E_2^2}{a_1m_1}$$

In general, cross modulation is expressed by the level of the undesire signal E_2 where Kc=0.01. Therefore, when m_1=0.3, m_2=0.3,

$$E_2 = \sqrt{\frac{1}{300} \cdot \frac{a_1}{a_3}}$$

This shows that E_2 becomes larger if the distortion component is smaller (smaller a_3), thus making interference difficult.

6. DIODES FOR USE AT HIGHFREQUENCIES

6.1 Variable Capacitance Diode

Variable capacitance diodes are generally called varicap diodes. Rectifiers and switching diodes use the rectification property of the PN junction, and the constant-voltage diode uses the zener drop and avalanche drop. Varicap diodes, however, use the the change in PN junction capacitance caused by the reverse-bias voltage. These diodes are used in AFTs and AFCs in TV and FM tuners, or as FM modulators.

Due to progress in semiconductor technology, ICs that integrate automatic tuning control functions by means of varicap diodes are now widely used in TV and FM/AM tuners. These tuners are thin, compact and lightweight when compared to conventional mechanical tuners. Varicap diodes are currently widely used in various electronic fields including commercial equipment such as TVs and radios, and telecommunications.

(1) Basic Operating Principle

When the PN junction diode is reverse-biased, the depletion layer is affected by the reverse-bias voltage V_R. The PN junction capacitance depends on the width of the depletion layer.

If the depletion layer is wide, the capacitance is small, and conversely, if the range is narrow, the capacitance is large. Therefore the junction capacitance is controlled by the reverse-bias voltage V_R.

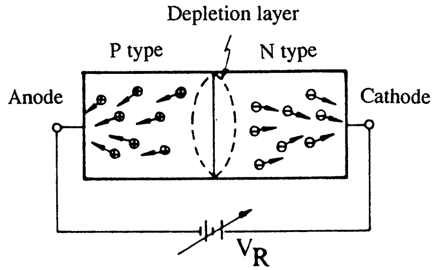


Figure 6.1 Operation Diagram

(2) Equivalent Circuit

Figure 6.2 shows a varicap diode expressed by its equivalent circuit.

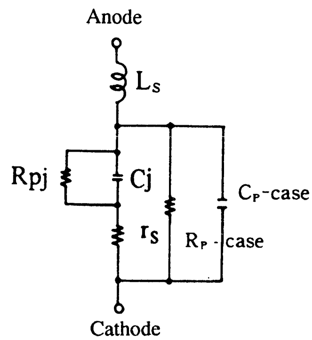


Figure 6.2 Equivalent Circuit of a Variable Capacitance Diode

C_j: Junction capacitance
r_s: series resistance
R_{pj}: junction power loss resistance
$R_{p\text{-}case}$: case power loss resistance (dependin on tan δ of the resincase used)
$C_{p\text{-}case}$: case capacitance
L_s:lead inductance

When the frequency is low, lead inductance Ls can be ignored; when junction capacitance Cj is large, the case capacitance Cp-case can be ignored.

(3) Varicap Diode Types and Features

Varicap diodes can be classified into three types depending on the inpurity density distribution: graded junction type, abrupt juntion type, and hyperabrupt junction type.

These types are shown in Table 6.1.

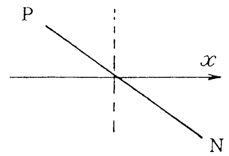
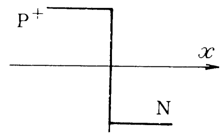
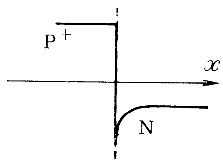
Here, n is related to the equation mentioned below in determining the coefficient capacitance (C) — reverse voltage (V_R) characteristic grade.

$$C = K (V_R + \phi)^{-n} \quad \text{..........................} \quad (11)$$

K: determined by inpurity density distribution, dielectric constant, junction area

ϕ: diffusion potential

Table 6.1 Variable Capacitance Diode: Types and Features

Classification	Inpurity Density Distribution	n	Application	Features
Graded Junction Type		1/3	General-Purpose Switching	Narrow variable range of capacitance; not used as a varicap diode.
Abrupt Junction Type		1/2	AFC Tuning Modulation	Stability in C-V curve is high; pairing is unnecessary when used for tuning. Capacitance change rate is small and high control voltage is required.
Hyperabrupt Junction Type		above 1/2	Tuning	Capacitance change rate can be large even when the working voltage range is narrow; on the other hand, a large number of diffusion processes are required, and C-V curve has low stability.

(4) Basic Parameter of a Varicap Diode

V_R: reverse voltage

Applied allowable voltage in a reversed-bias state varicap diode.

C_T: capacitance between terminals

Figure 7.2 shows the total capacitance between anode and cathode in the equivalent circuit.

C_{3V}: capacitance between terminals with V_R=3V (same for C_{9V} and C_{25V})

C_{3V}/C_{9V}: capacitance ratio between terminals with V_R=3V, 9V
(used in varicap diodes for tuning purposes)

K: capacitance ratio

$$K = \frac{\text{(capacitance between terminals in each voltage)} - \text{(capacitance between terminals in reference voltage)}}{\text{capacitance between terminals in reference voltage}}$$

Q: performance characteristic

In a circuit or a material, stored energy rate against energy consumed by a resistance component.

In the equivalent circuit shown in Figure 6.2, when lead inductance L_S, case capacitance $C_{p\text{-}case}$ are ignored, it can be expressed as

$$Q = \frac{1}{\omega C j r_s + \left(\frac{1}{R_{pj}} + \frac{1}{R_{p-case}} \right) / \omega C j} \qquad \text{.................................. (2)}$$

Generally, it is expressed as

$$Q = \frac{1}{\omega C_j r_S} \quad \cdots\cdots (3)$$

r_s: series resistor

One of the parameters that describes the performance characteristic Q can be expressed by

$$r_s = \frac{1}{S_j}\int \frac{d\chi}{q\mu n N(\chi)} + \frac{1}{S_j}\int \frac{d\chi}{q\mu P(\chi)} + Rc \quad \cdots\cdots (4)$$

S_j: junction area; μn: electron mobility; μp: electron-hole mobility;
$N(\chi)$: inpurity density distribution on side N; $P(\chi)$: inpurity density distribution on side P;
R_C: contact resistance

Matching:

For tuning varicap diodes, characteristics for all diodes must be equal when they are used in same tuner. This is required to guarantee the tracking of a tuner. Generally, pairing deflection of capacitance between terminals for each reverse voltage V_R is 3% or below.

(5) Voltage Dependency In a Capacitance

Depending on the inpurity density distribution rate, varicap diodes can be classified into three types: graded junction type, abrupt junction type, and hyperabrupt junction type.

When N-type inpurity distribution is given by function, it can be expressed as

$$E = \int \frac{qN(\chi)}{\varepsilon_r \varepsilon_0} d\chi \quad \cdots\cdots (5)$$

$$V = -\int E(\chi) d\chi \quad \cdots\cdots (6)$$

$$C_j = \frac{\varepsilon_r \varepsilon_0 S_j}{\chi} \quad \cdots\cdots (7)$$

ε_0: dielectric constant in a vacuum
ε_r: specific dielectric constant

Also, relationship of a capacitance and reverse voltage is expressed by $C=K(V_R+\phi)^{-n}$. For graded junction type, n=1/3; for abrupt junction type, n=1/2; and for hyperabrupt junction type, n= above 1/2. Figure 6.3 shows a typical capacitance — reverse-voltage characteristic diagram.

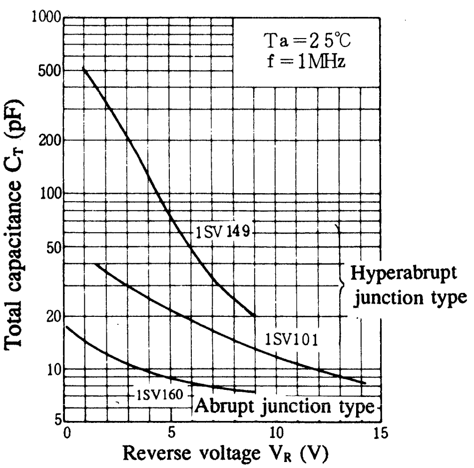


Figure 6.3 Capacitance — Reverse Voltage Characteristics: Varicap Diode

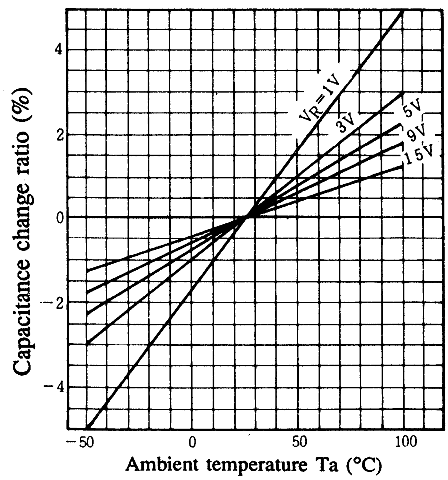


Figure 6.4 Capacitance Change Ratio— Ambient Temperature Characteristics: Varicap Diode (1SV101)

(6) Temperature Dependency of a Capacitance

Varicap diode's capacitance temperature change is caused by the following: (1) temperature change in diffusion potential, and (2) temperature change in dielectric constant. This can be expressed by the following equation.

$$\frac{1}{C_j} \cdot \frac{\partial C_j}{\partial T} = \frac{1}{K} \cdot \frac{dK}{dT} - \frac{n}{V_R+\phi} \cdot \frac{d\phi}{dT} \quad \cdots\cdots\cdots\cdots \quad (8)$$

Temperature change in dielectric constant in the first term is 35 ppm/°C (silicon). In the second term, temperature change in diffusion potential is approximately –2mV/°C.

It is impossible to completely eliminate tempeature dependency in a certain level of capacitance in a capacitance where there is a voltage dependency. However, when obtaining same capacitance ratio, the temperature dependency can be decreased to a certain extent, depending on what to choose for 'n' in reverse voltage V_R.

Figure 7.4 shows the temperature dependency in a capacitance in 1SV101.

(7) Average Capacitance Fluctuation In AC Signal Voltage

Varicap diode changes the depletion layers by changing the value of reverse-bias voltage during PN junction. This change in the depletion layers is used for the change in junction capacitance. Therefore, as shown in Figure 6.5, in a state where AC signals are on DC bias voltage, the AC signals affect the depletion layers.

Due to the facts mentioned above, average values of capacitance differs depending on whether AC signals are applied or not.

This is because the relationship between the capacitance and the reverse voltage expressed in equation (1) in general, does not become a linear function.

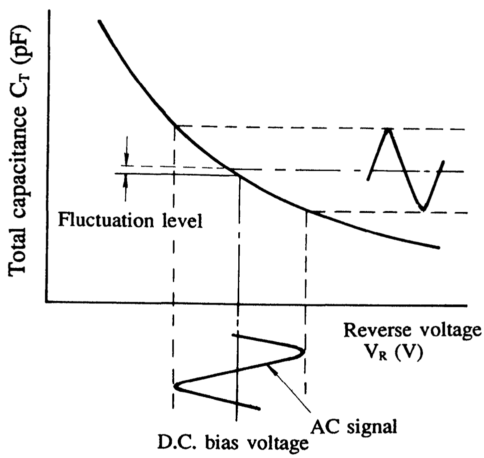


Figure 6.5 Capacitance Fluctuation In Capacitance — Reverse Voltage Relationship

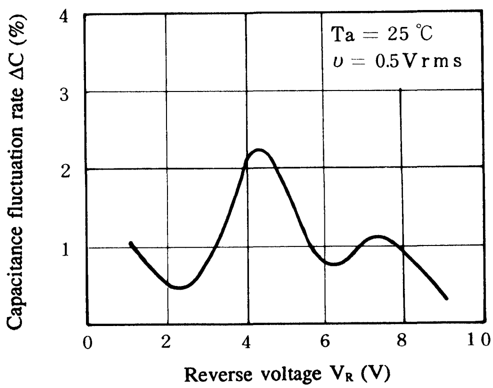


Figure 6.6 Typical Capacitance Fluctuation Rate — Reverse Voltage Characteristics (1SV149)

Average capacitance fluctuation is expressed by the equation below.

$$\frac{Cjac}{Cjdc} = \frac{1}{2\pi}\int_0^{2\pi} \{1+\frac{\upsilon \sin\omega t}{V_R+\phi}\}^{-n} d(\omega t) \quad \cdots\cdots\cdots\cdots \quad (9)$$

Cjac: capacitance when AC signals are applied

Cjdc: capacitance when DC bias voltage is applied

$\upsilon \sin\omega t$: AC signal level

Capacitance fluctuation rate ΔC is expressed as follows.

$$\Delta C = \frac{Cjac - Cj_{DC}}{Cj_{DC}} \times 100\ (\%) \quad \cdots\cdots\cdots\cdots \quad (10)$$

$$Cjac = \frac{1}{2\pi}\int_0^{2\pi} K(V_R + \phi + \upsilon \sin\omega t)^{-n}\, d(\omega t) \quad \cdots\cdots\cdots\cdots \quad (11)$$

Equations (9) to (11) are formed only in a section where 'n' is close to the constant value. In a hyperabrupt junction type diode, it must be careful when 'n' changes by the reverse voltage.

Same as that of temperature dependency characteristic in a capacitance, it is impossible to remove varicap diode's average capacitance fluctuation entirely by AC signal voltage.

However, when same capacitance fluctuation ratio has been chosen, the fluctuation can be decreased to some extent by the method in choosing the 'n' in a certain reverse voltage V_R.

Figure 6.6 shows the capacitance fluctuation ratio — reverse voltage characteristics diagram in 1SV149.

(8) Voltage and Frequency Dependency in Q

Performance characteristic 'Q' changes by the reverse voltage because junction capacitance Cj and series resistance r_s also change. However, when compared to the r_s change, change that occur in Cj is extremely large; therefore, Cj's voltage dependency greatly affects Q's voltage dependency.

Figure 6.7 shows voltage dependency characteristics in Q.

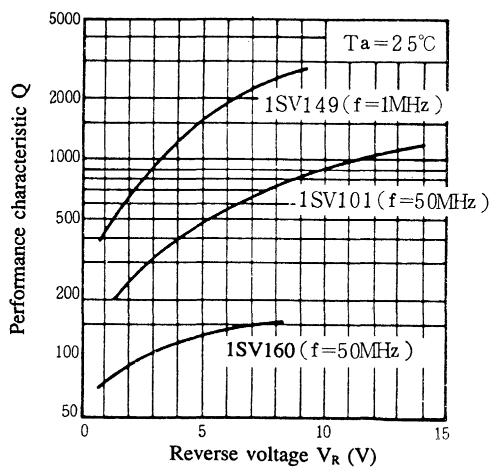


Figure 6.7 Voltage Dependency Characteristics in Q

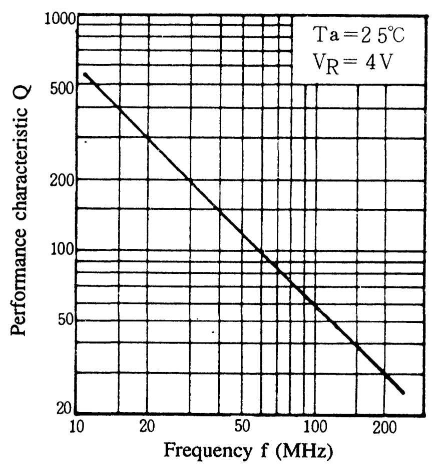


Figure 6.8 Frequency Dependency Characteristics in Q

By equation (3), Q's frequency characteristic is inversely proportional to the frequency when serial resistance rs is constant.

However, when the frequency is high, Q is affected by lead inductance L_S or by case-loss resistance R_P.case, and may lower its value.

7.2 PIN Diode

PIN diode provides I layer (intrinsic semiconductor) in an ordinary PN-junction diode, and formed by PIN junction.

By controlling the forward current in PIN junction, PIN diode acts as a high-frequency variable resistor and it can change the high-frequency series resistor r_s. PIN diodes are now used various fields including line switching of a microwave, band swithing in TV/radio, and AGC.

Currently, to prevent intermodulation and cross modulation in commercial car audio equipment, they are widely used as PIN AGCs. In the future, PIN diodes are expected to expand their use in commercial-application fields.

(1) Operation Principle and Configuration Diagram of a PIN Diode

As shown in Figure 6.9, when forward bias voltage is applied to the diode, electrons and electron holes are injected into I layer.

Injected electrons and electron holes are reconnected. Some of them serve as forward current and others are stored in I layer.

Electrons and electron holes stored in I layer increase their dielectric constant, decrease series resistance r_s in high-frequency range, and operate as a high-frequency variable resistors.

Figure 6.10 shows the structure diagram of a PIN diode.

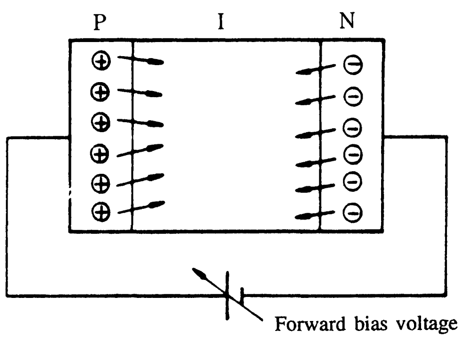


Figure 6.9 Operation Diagram

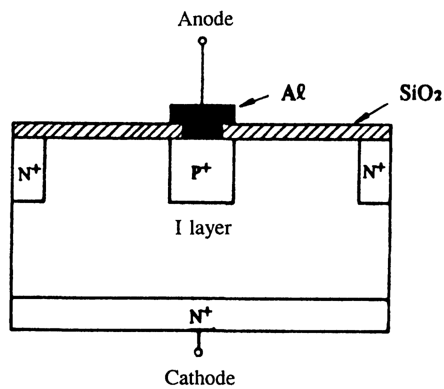


Figure 6.10 Structure Diagram

(2) Basic Parameter of a PIN Diode

r_S: series resistance

PIN diode series resistance r_S in forward bias can be expressed as

$$r_S = r_i + r_C \quad \text{.......} \quad (1)$$

r_i: I-layer resitance

r_C: semiconductor contact resistance

$$ri = \frac{l^2}{I_F \tau (\mu_e + \mu_h)} \quad \text{.......} \quad (2)$$

l: I-layer thickness

I_F: DC current

μ_e: drifting mobility of an electron

μ_h: drifting mobility of an electron hole

τ: carrier lifetime in an I layer

$$rc = \frac{\rho n^+ \, l n^+ \, \rho p^+ \, l p^+}{A} + \frac{\rho cn^+}{A} + \frac{\rho cp^+}{A}$$

$$= \frac{\overline{\rho} c}{A} \quad \text{.......} \quad (3)$$

ρn^+, ρp^+,:	specific resistance between n+ and p+ layers
$l n^+$, lp^+:	thickness of n+ and p+ layers
ρcn^+:	specific contact resistance of a metal and n+ layer
$\overline{\rho} cp^+$:	specific contact resistance of a metal and p+ layer
ρc:	total equivalent specific contact resistance
A:	diode area

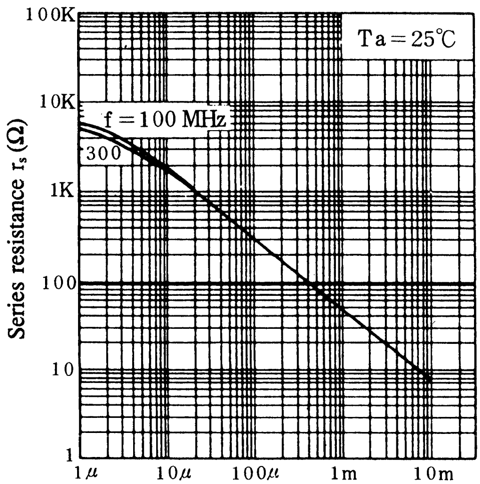


Figure 6.11 Typical rs - IF Characteristics (1SV99)

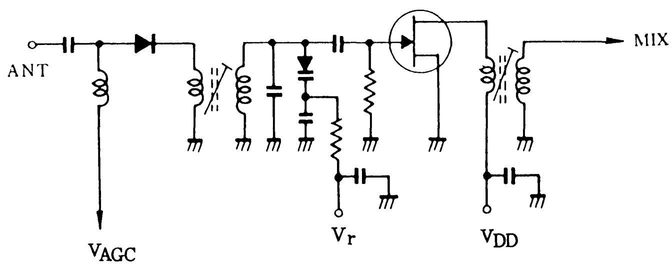
From the equation (2) and (3),

$$rs = \frac{l^2}{I_F\tau(\mu e+\mu h)} + \frac{\overline{\rho}_c}{A} \qquad \text{.............. Formula (4)}$$

C_T: Total capacitance

Junction capacitance and case capacitance are dominating in anode-cathode total capacitance.

(3) Typical Application Circuit
Figure 6.12 shows the typical AGC circuit in FM front-end.



Figurie 6.12 FM Front-End

Figures 6.13 and 6.14 show the examples of π-type ATT circuit and high-frequency switch circuit, respectively.

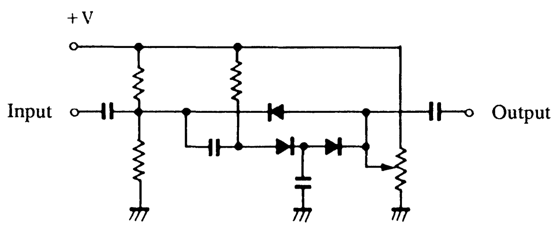


Figure 6.13 π-Type ATT

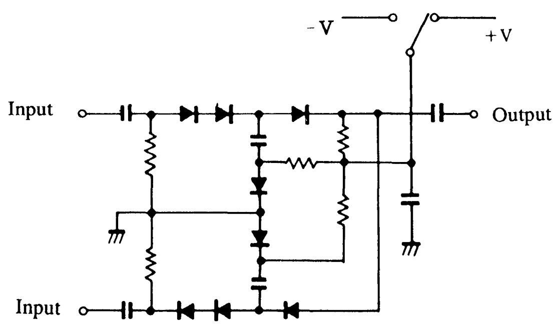


Figure 6.14 High-Frequency Switch

6.3 Schottky Barrier Diode

The schottky barrier diode uses the rectification of metal and semiconductor contacts. One of its characteristics is that it creates a schottky barrier between the evaporated metal and an N-type epitaxial layer. Typical metals used for schottky barriers are Molybdenum (Mo) and Titanium (Ti). As with the Ge diode, forward-bias voltage in the schottky barrier diode is low. Unlike the point-contact diode, it does not have complex requirements such as stylus force; therefore handling is easy in the manufacturing processes.

This type of diode is mainly used in mixer circuits and wave-detector circuits in bands above UHF. Its advantages are that noise characteristics are 2 dB lower than for point-contact diodes, and it is mechanically and electrically reliable.

Figure 6.15 shows a configuration diagram of a schottky barrier diode.

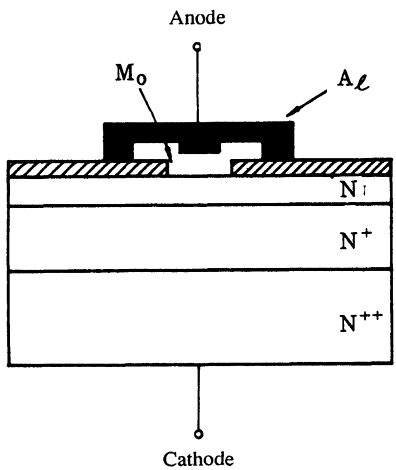


Figure 6.15 Structure Diagram

[III] TECHNICAL DATA SHEETS

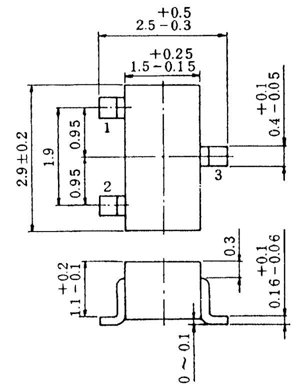
SILICON EPITAXIAL SCHOTTKY BARRIER TYPE DIODE

1SS154

UHF~S BAND MIXER / DETECTOR APPLICATIONS.

Unit in mm

- Small Package.



1. N.C.
2. ANODE
3. CATHODE

JEDEC	—
EIAJ	SC-59
TOSHIBA	1-3G1A

Weight : 0.012g

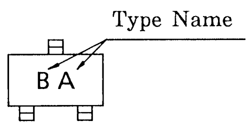
MAXIMUM RATINGS (Ta = 25°C)

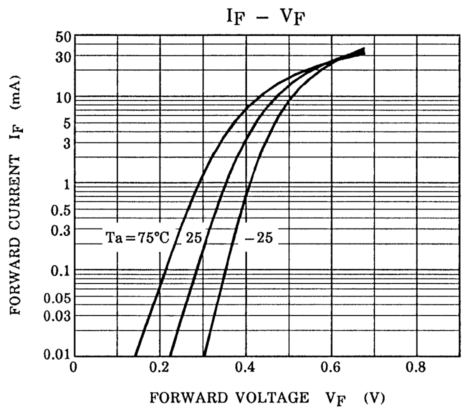
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	6	V
Forward Current	I_F	30	mA
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−30~125	°C

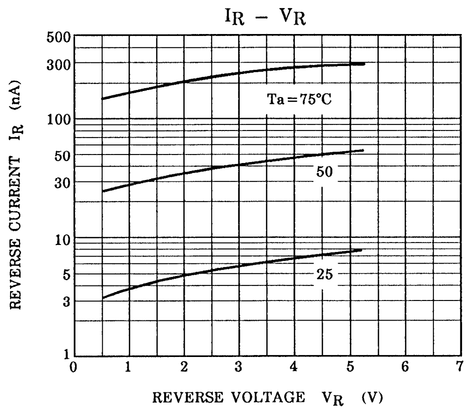
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

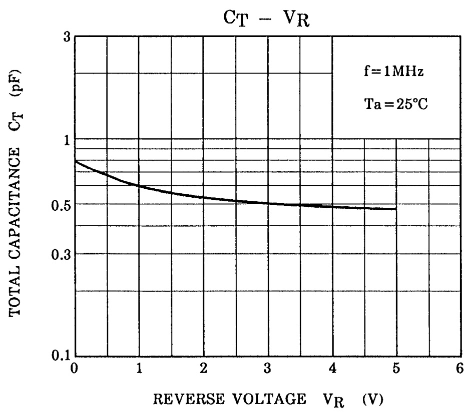
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 10\mu A$	6	—	—	V
Reverse Current	I_R	$V_R = 5V$	—	—	0.5	μA
Forward Voltage	$V_{F(1)}$	$I_F = 0.1mA$	—	—	0.35	V
Forward Voltage	$V_{F(2)}$	$I_F = 10mA$	—	0.5	—	V
Total Capacitance	C_T	$V_R = 0$, f = 1MHz	—	0.8	—	pF

Marking




I_F – V_F
FORWARD CURRENT I_F (mA)
50
30
10
5
3
1
0.5
0.3
0.1
0.05
0.03
0.01
Ta=75°C
25
−25
0
0.2
0.4
0.6
0.8
FORWARD VOLTAGE V_F (V)


I_R – V_R
REVERSE CURRENT I_R (nA)
500
300
100
50
30
10
5
3
1
Ta=75°C
50
25
0
1
2
3
4
5
6
7
REVERSE VOLTAGE V_R (V)

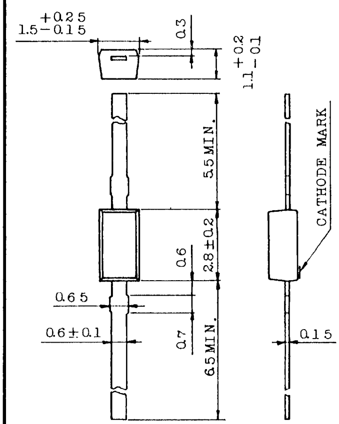

C_T – V_R
TOTAL CAPACITANCE C_T (pF)
3
1
0.5
0.3
0.1
f=1MHz
Ta=25°C
0
1
2
3
4
5
6
REVERSE VOLTAGE V_R (V)

SILICON EPITAXIAL SCHOTTKY BARRIER TYPE DIODE

1SS239

CATV / UHF / VHF MIXER APPLICATIONS.

Unit in mm



1. CATHODE
2. ANODE

JEDEC	—
EIAJ	—
TOSHIBA	1-2J1A

Weight : 0.02g

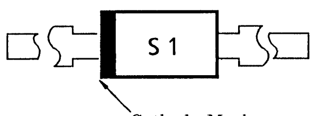
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	6	V
Forward Current	I_F	30	mA
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−30~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 10\mu A$	6	—	—	V
Reverse Current	I_R	$V_R = 5V$	—	—	0.5	μA
Forward Voltage	$V_{F(1)}$	$I_F = 0.1mA$	—	0.3	—	V
Forward Current	$V_{F(2)}$	$I_F = 10mA$	0.42	0.47	0.52	V
Total Capacitance	C_T	$V_R = 0$, f = 1MHz	—	0.8	—	pF
Delta Forward Voltage (Note 1)	ΔV_F	$I_F = 10mA$	—	—	10	mV
Delta Total Capacitance (Note 2)	ΔC_T	$V_R = 0$, f = 1MHz	—	—	0.2	pF

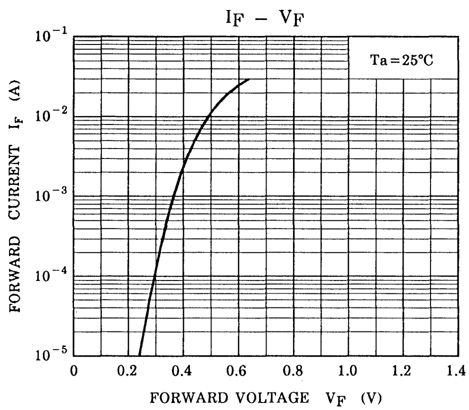
Marking

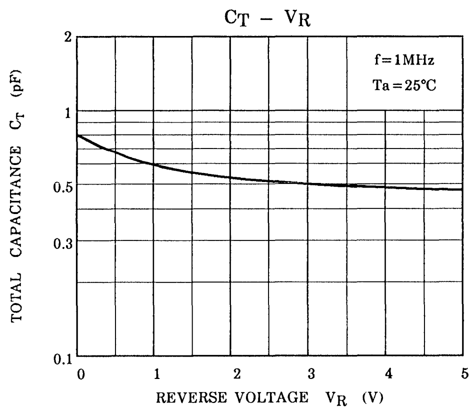


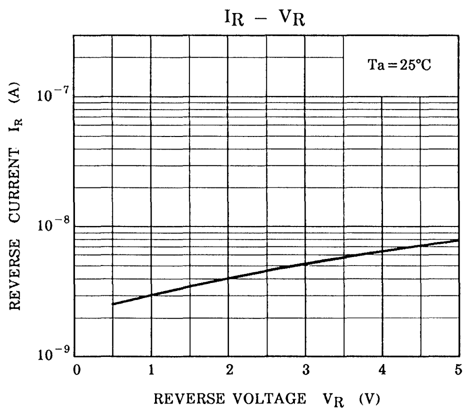
Cathode Mark

Note 1 : V_F (2) classification is available by 10mV step.

Note 2 : Maximum Total Capacitance difference in the classification of V_F (2).


IF – VF
Ta = 25°C
FORWARD CURRENT IF (A)
10−1
10−2
10−3
10−4
10−5
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
FORWARD VOLTAGE VF (V)


CT – VR
f = 1MHz
Ta = 25°C
TOTAL CAPACITANCE CT (pF)
2
1
0.5
0.3
0.1
0
1
2
3
4
5
REVERSE VOLTAGE VR (V)

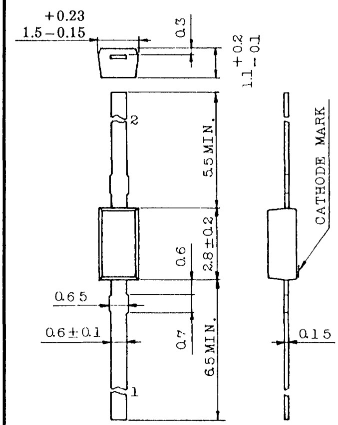

IR – VR
Ta = 25°C
REVERSE CURRENT IR (A)
10−7
10−8
10−9
0
1
2
3
4
5
REVERSE VOLTAGE VR (V)

SILICON EPITAXIAL PLANAR TYPE DIODE

1SS241

VHF TUNER BAND SWITCH APPLICATIONS.

Unit in mm



1. CATHODE
2. ANODE

JEDEC	—
EIAJ	—
TOSHIBA	1-2J1A

Weight : 0.02g

FEATURES :

- Small Package
- Small Total Capacitance : C_T=1.2pF (Max.)
- Low Series Resistance : r_s=0.6Ω (Typ.)

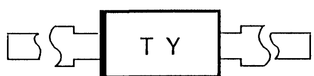
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Forward Current	I_F	100	mA
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

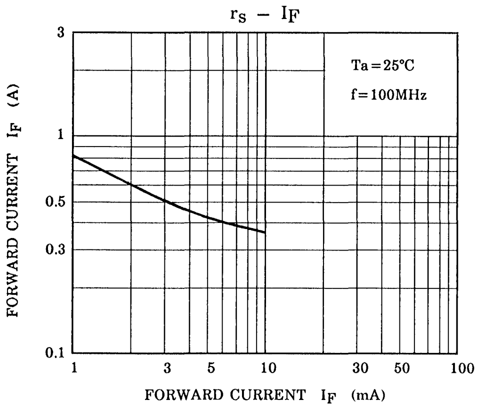
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

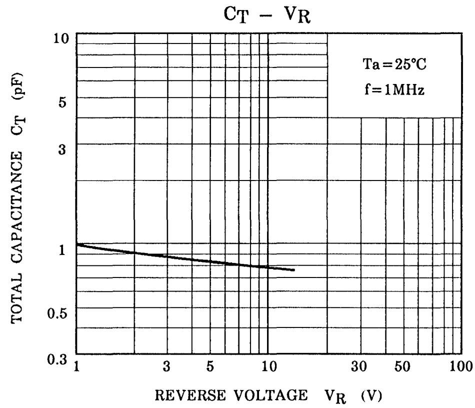
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=2mA	—	—	0.85	V
Reverse Current	I_R	V_R=15V	—	—	0.1	μA
Reverse Voltage	V_R	V_R=1μA	30	—	—	V
Total Capacitance	C_T	V_R=6V, f=1MHz	—	0.8	1.2	pF
Series Resistance	r_s	I_F=2mA, f=100MHz	—	0.6	0.9	Ω

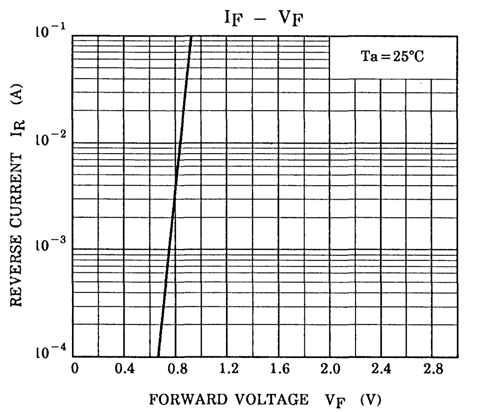
Marking



Cathode Mark


rS – IF
Ta=25°C
f=100MHz
FORWARD CURRENT IF (A)
3
1
0.5
0.3
0.1
1
3
5
10
30
50
100
FORWARD CURRENT IF (mA)

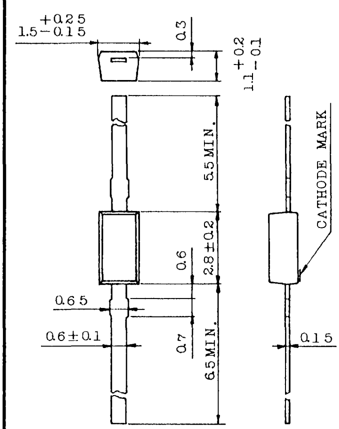

CT – VR
Ta=25°C
f=1MHz
TOTAL CAPACITANCE CT (pF)
10
5
3
1
0.5
0.3
1
3
5
10
30
50
100
REVERSE VOLTAGE VR (V)


IF – VF
Ta=25°C
REVERSE CURRENT IR (A)
10⁻¹
10⁻²
10⁻³
10⁻⁴
0
0.4
0.8
1.2
1.6
2.0
2.4
2.8
FORWARD VOLTAGE VF (V)

SILICON EPITAXIAL SCHOTTKY BARRIER TYPE DIODE **1SS242**

UHF BAND MIXER APPLICATIONS.

Unit in mm



1. CATHODE
2. ANODE

JEDEC	—
EIAJ	—
TOSHIBA	1-2J1A

Weight : 0.02g

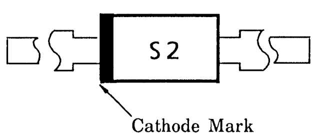
MAXIMUM RATINGS (Ta = 25°C)

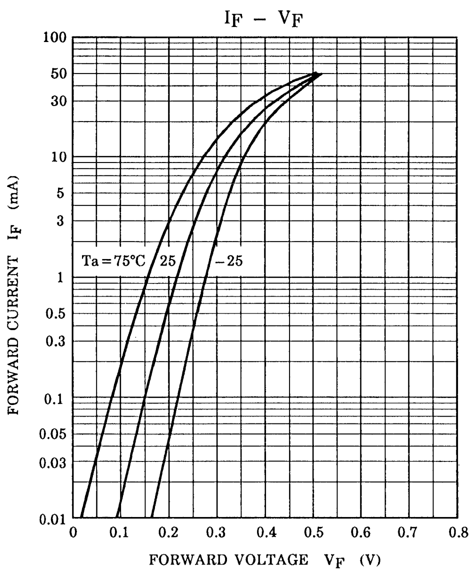
CHARACTERISTIC	SYMBOL	RATING	UNIT
Maximum (Peak) Reverse Voltage	V_{RM}	5	V
Forward Current	I_F	30	mA
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

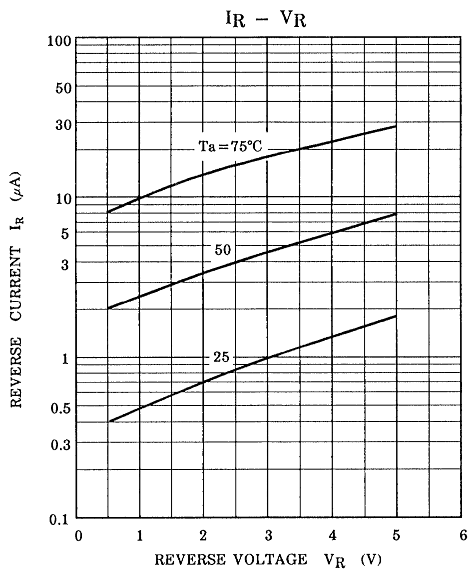
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

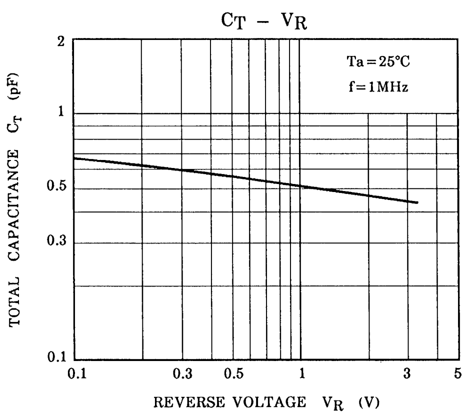
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	$I_F = 2mA$	—	0.25	—	V
Forward Current	I_F	$V_F = 0.5V$	30	—	—	mA
Reverse Current	I_R	$V_R = 0.5V$	—	—	25	μA
Total Capacitance	C_T	$V_R = 0.2V$, f = 1MHz	—	0.6	—	pF

Marking




IF – VF
100
50
30
10
5
3
1
0.5
0.3
0.1
0.05
0.03
0.01
Ta=75°C
25
–25
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
FORWARD CURRENT IF (mA)
FORWARD VOLTAGE VF (V)

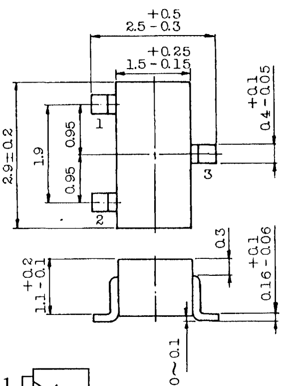

IR – VR
100
50
30
10
5
3
1
0.5
0.3
0.1
Ta=75°C
50
25
0
1
2
3
4
5
6
REVERSE CURRENT IR (μA)
REVERSE VOLTAGE VR (V)

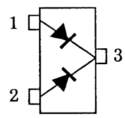

CT – VR
2
1
0.5
0.3
0.1
Ta=25°C
f=1MHz
0.1
0.3
0.5
1
3
5
TOTAL CAPACITANCE CT (pF)
REVERSE VOLTAGE VR (V)

SILICON EPITAXIAL PLANAR TYPE DIODE 1SS268

VHF TUNER BAND SWITCH APPLICATIONS

Unit in mm





1. ANODE
2. ANODE
3. CATHODE

JEDEC	—
EIAJ	SC-59
TOSHIBA	1-3G1F

Weight : 0.013g

FEATURES :

- Small Package.
- Small Total Capacitance : $C_T = 1.2pF$ (Max.)
- Low Series Resistance : $r_s = 0.6\Omega$ (Typ.)

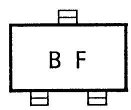
MAXIMUM RATINGS (Ta = 25°C)

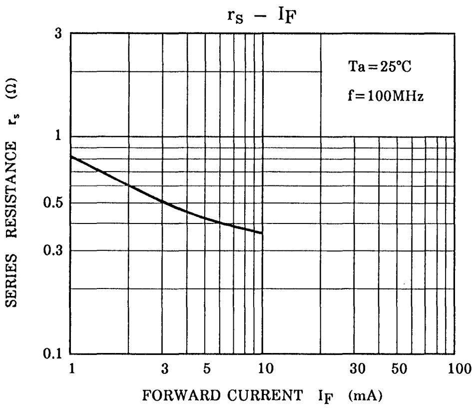
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Forward Current	IF	50	mA
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

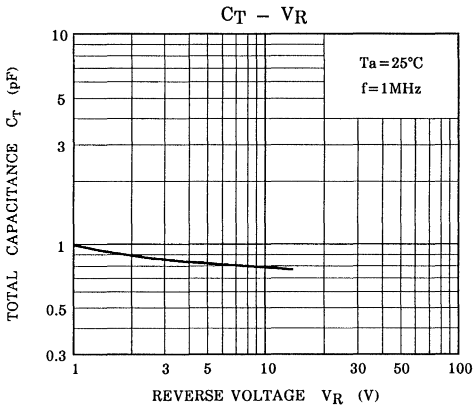
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

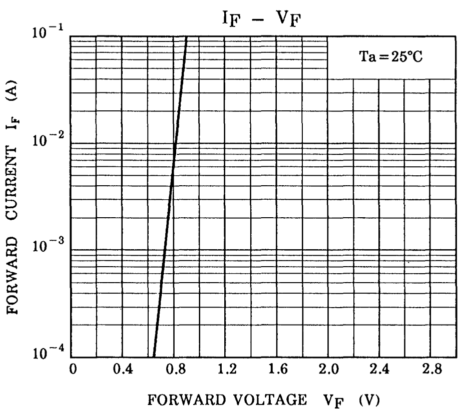
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	$I_F = 2mA$	—	—	0.85	V
Reverse Current	I_R	$V_R = 15V$	—	—	0.1	μA
Reverse Voltage	V_R	$I_R = 1\mu A$	30	—	—	V
Total Capacitance	C_T	$V_R = 6V$, f = 1MHz	—	0.8	1.2	pF
Series Resistance	r_s	$I_F = 2mA$, f = 100MHz	—	0.6	0.9	Ω

Marking




r_S – I_F
Ta=25°C
f=100MHz
SERIES RESISTANCE r_s (Ω)
3
1
0.5
0.3
0.1
1
3
5
10
30
50
100
FORWARD CURRENT I_F (mA)

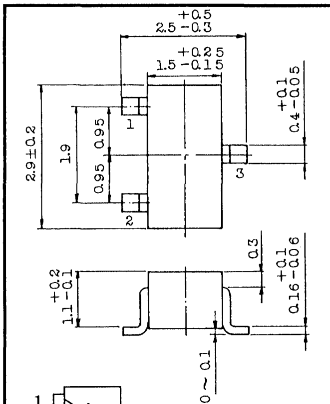

C_T – V_R
Ta=25°C
f=1MHz
TOTAL CAPACITANCE C_T (pF)
10
5
3
1
0.5
0.3
1
3
5
10
30
50
100
REVERSE VOLTAGE V_R (V)

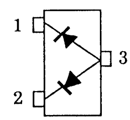

I_F – V_F
Ta=25°C
FORWARD CURRENT I_F (A)
10^{-1}
10^{-2}
10^{-3}
10^{-4}
0
0.4
0.8
1.2
1.6
2.0
2.4
2.8
FORWARD VOLTAGE V_F (V)

1SS269

VHF TUNER BAND SWITCH APPLICATIONS

Unit in mm





1. CATHODE
2. CATHODE
3. ANODE

JEDEC	—
EIAJ	SC-59
TOSHIBA	1-3G1E

Weight : 0.013g

FEATURES :

- Small Package.
- Small Total Capacitance : C_T = 1.2pF (Max.)
- Low Series Resistance : r_s = 0.6Ω (Typ.)

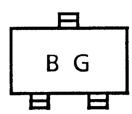
MAXIMUM RATINGS (Ta = 25°C)

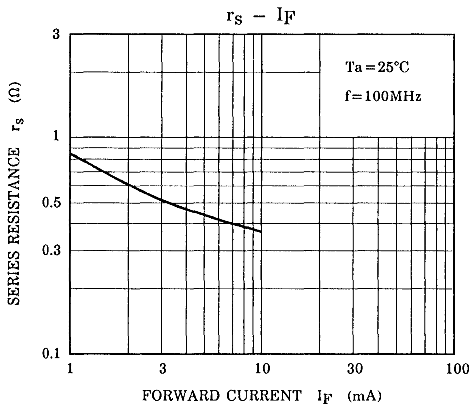
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Forward Current	I_F	50	mA
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

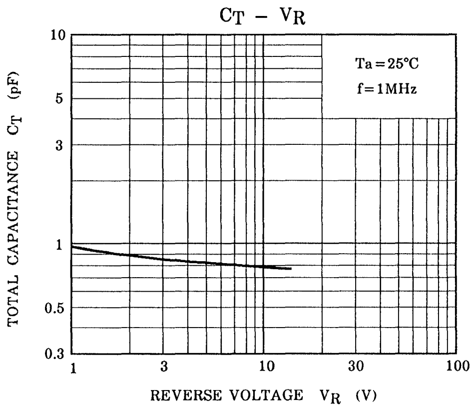
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_R	I_F = 2mA	—	—	0.85	V
Reverse Current	I_R	V_R = 15V	—	—	0.1	μA
Reverse Voltage	V_R	I_R = 1μA	30	—	—	V
Total Capacitance	C_T	V_R = 6V, f = 1MHz	—	0.8	1.2	pF
Series Resistance	r_s	I_F = 2mA, f = 100MHz	—	0.6	0.9	Ω

Marking

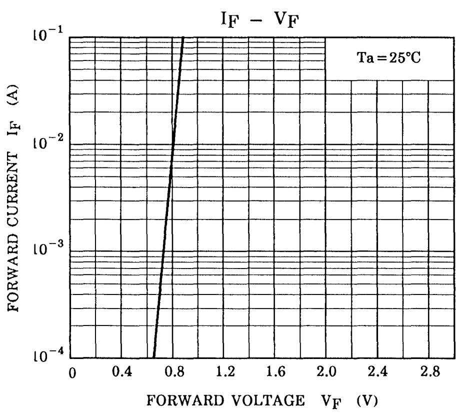




r_S – I_F
Ta=25°C
f=100MHz
SERIES RESISTANCE r_S (Ω)
3
1
0.5
0.3
0.1
1
3
10
30
100
FORWARD CURRENT I_F (mA)



C_T – V_R
Ta=25°C
f=1MHz
TOTAL CAPACITANCE C_T (pF)
10
5
3
1
0.5
0.3
1
3
10
30
100
REVERSE VOLTAGE V_R (V)

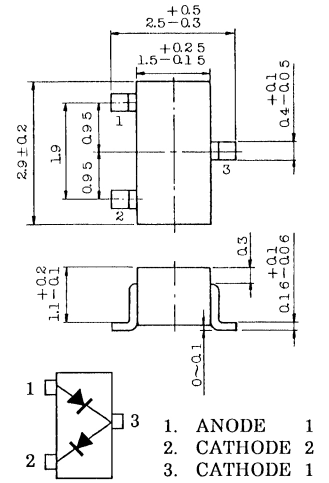


I_F – V_F
Ta=25°C
FORWARD CURRENT I_F (A)
10^{-1}
10^{-2}
10^{-3}
10^{-4}
0
0.4
0.8
1.2
1.6
2.0
2.4
2.8
FORWARD VOLTAGE V_F (V)

SILICON EPITAXIAL SCHOTTKY BARRIER TYPE DIODE 1SS271

VHF~UHF MIXER APPLICATION

Unit in mm



1. ANODE 1
2. CATHODE 2
3. CATHODE 1 /ANODE 2

JEDEC	—
EIAJ	SC-59
TOSHIBA	1-3G1G

Weight : 0.013g

- Small Package
- Small Delta Forward Voltage : $\Delta V_F = 10mV$ (Max.)
- Small Delta Total Capacitance : $\Delta C_T = 0.1pF$ (Max.)

MAXIMUM RATINGS (Ta = 25°C)

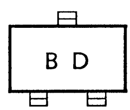
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	6	V
Forward Current	I_F	30	mA
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

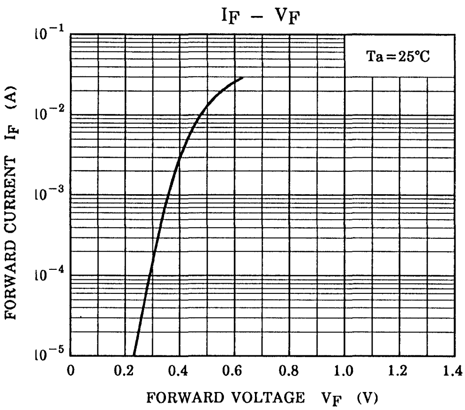
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

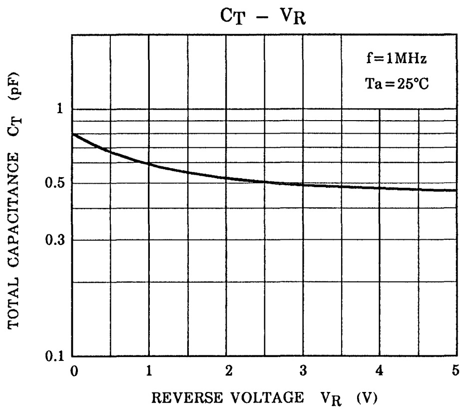
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 10\mu A$	6	—	—	V
Reverse Current	I_R	$V_R = 5V$	—	—	0.5	μA
Forward Voltage	V_F (1)	$I_F = 0.1mA$	—	0.3	—	V
Forward Voltage	V_F (2)	$I_F = 10mA$	0.42	0.5	0.55	V
Total Capacitance	C_T	$V_R = 0V$, f = 1MHz	—	0.8	1.0	pF
Delta Forward Voltage	ΔV_F	$I_F = 10mA$ (Note)	—	—	10	mV
Delta Total Capacitance	ΔC_T	$V_R = 0V$, f = 1MHz (Note)	—	—	0.1	pF

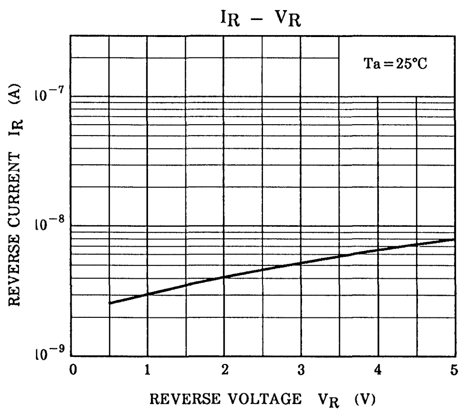
(Note) : Difference between 2 Devices in 1 Package.

Marking




I_F – V_F
Ta=25°C
FORWARD CURRENT I_F (A)
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
FORWARD VOLTAGE V_F (V)


C_T – V_R
f=1MHz
Ta=25°C
TOTAL CAPACITANCE C_T (pF)
1
0.5
0.3
0.1
0
1
2
3
4
5
REVERSE VOLTAGE V_R (V)

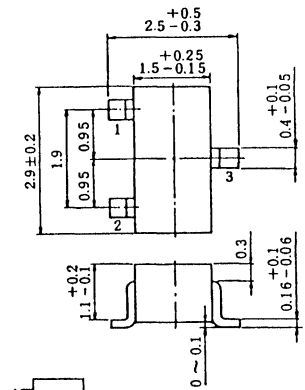

I_R – V_R
Ta=25°C
REVERSE CURRENT I_R (A)
10^{-7}
10^{-8}
10^{-9}
0
1
2
3
4
5
REVERSE VOLTAGE V_R (V)

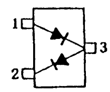
SILICON EPITAXIAL SCHOTTKY BARRIER TYPE DIODE

1SS295

UHF BAND MIXER APPLICATIONS.

Unit in mm





1. ANODE 1
2. CATHODE 2
3. CATHODE 1 /ANODE 2

JEDEC	—
EIAJ	SC-59
TOSHIBA	1-3G1G

Weight : 0.013g

- Small Package
- Small Delta Forward Voltage : $\Delta V_F = 10mV$ (Max.)
- Small Delta Total Capacitance : $\Delta C_T = 0.1pF$ (Max.)

MAXIMUM RATINGS (Ta = 25°C)

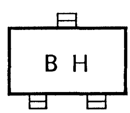
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	4	V
Forward Current	I_F	30	mA
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

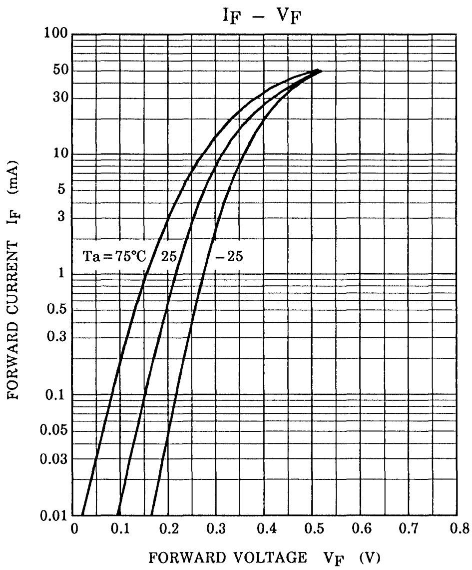
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	$I_F = 2mA$	—	0.25	0.32	V
Forward Current	I_F	$V_F = 0.5V$	30	—	—	mA
Reverse Current	I_R	$V_R = 0.5V$	—	—	25	μA
Total Capacitance	C_T	$V_R = 0.2V$, f = 1MHz	—	0.6	0.9	pF
Delta Forward Voltage	ΔV_F	$I_F = 2mA$ (Note)	—	—	10	mV
Delta Total Capacitance	ΔC_T	$V_R = 0.2V$, f = 100MHz (Note)	—	—	0.1	pF

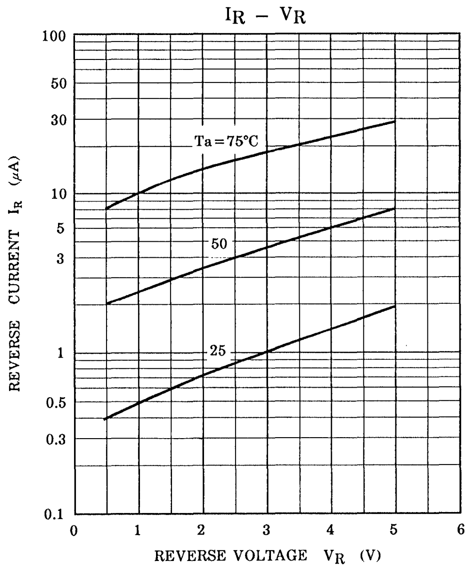
(Note) : Difference between 2 Devices 2 Devices in 1 package.

Marking

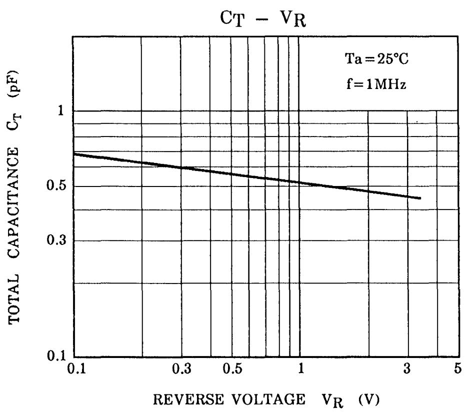




I_F – V_F
FORWARD CURRENT I_F (mA)
100
50
30
10
5
3
1
0.5
0.3
0.1
0.05
0.03
0.01
Ta=75°C
25
–25
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
FORWARD VOLTAGE V_F (V)



I_R – V_R
REVERSE CURRENT I_R (μA)
100
50
30
10
5
3
1
0.5
0.3
0.1
Ta=75°C
50
25
0
1
2
3
4
5
6
REVERSE VOLTAGE V_R (V)



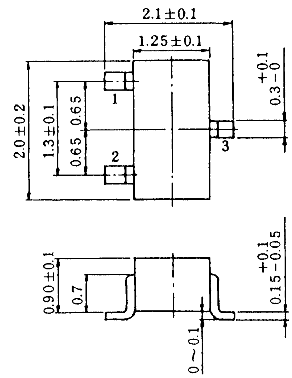
C_T – V_R
TOTAL CAPACITANCE C_T (pF)
Ta=25°C
f=1MHz
1
0.5
0.3
0.1
0.1
0.3
0.5
1
3
5
REVERSE VOLTAGE V_R (V)

SILICON EPITAXIAL PLANAR TYPE DIODE 1SS312

VHF TUNER BAND SWITCH APPLICATIONS.

- Small Package.
- Small Total Capacitance : $C_T = 1.2pF$ (Max.)
- Low Series Resistance : $r_s = 0.6\Omega$ (Typ.)

Unit in mm



1. ANODE
2. ANODE
3. CATHODE

JEDEC	—
EIAJ	SC-70
TOSHIBA	1-2P1A

Weight : 0.006g

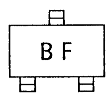
MAXIMUM RATINGS (Ta = 25°C)

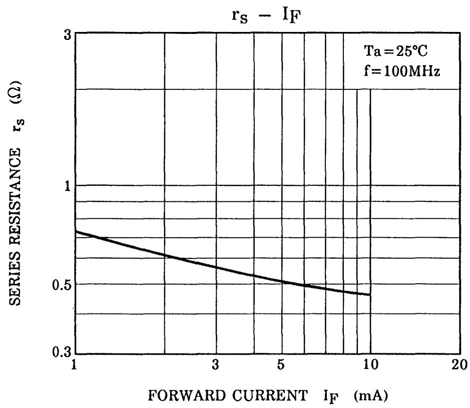
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Forward Current	I_F	50	mA
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55～125	°C

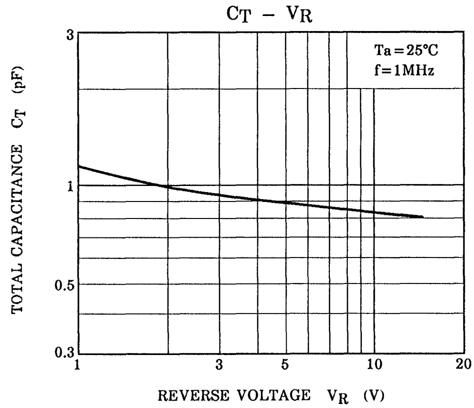
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

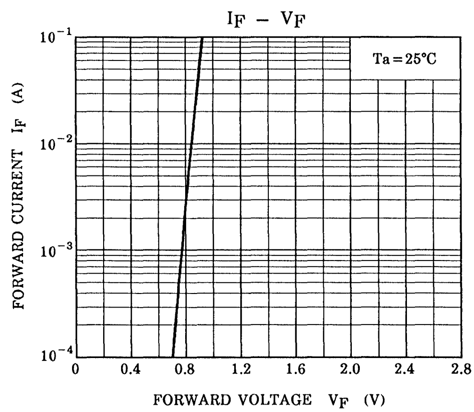
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	$I_F = 2mA$	—	—	0.85	V
Reverse Current	I_R	$V_R = 15V$	—	—	0.1	μA
Reverse Voltage	V_R	$I_R = 1\mu A$	30	—	—	V
Total Capacitance	C_T	$V_R = 6V$, f = 1MHz	—	0.8	1.2	pF
Series Resistance	r_s	$I_F = 2mA$, f = 100MHz	—	0.6	0.9	Ω

Marking




rS – IF
Ta=25°C
f=100MHz
SERIES RESISTANCE rS (Ω)
3
1
0.5
0.3
1
3
5
10
20
FORWARD CURRENT IF (mA)


CT – VR
Ta=25°C
f=1MHz
TOTAL CAPACITANCE CT (pF)
3
1
0.5
0.3
1
3
5
10
20
REVERSE VOLTAGE VR (V)

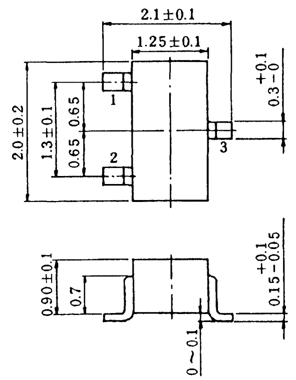

IF – VF
Ta=25°C
FORWARD CURRENT IF (A)
10^-1
10^-2
10^-3
10^-4
0
0.4
0.8
1.2
1.6
2.0
2.4
2.8
FORWARD VOLTAGE VF (V)

SILICON EPITAXIAL PLANAR TYPE DIODE

1SS313

VHF TUNER BAND SWITCH APPLICATIONS.

Unit in mm



1. CATHODE
2. CATHODE
3. ANODE

JEDEC	—
EIAJ	SC-70
TOSHIBA	1-2P1A

Weight : 0.006g

- Small Package.
- Small Total Capacitance : C_T=1.2pF (Max.)
- Low Series Resistance : r_S=0.6Ω (Typ.)

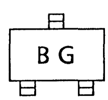
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Forward Current	I_F	50	mA
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

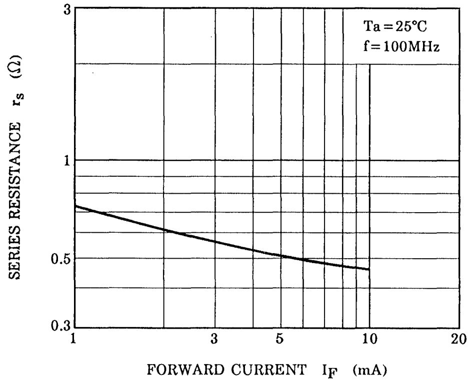
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=2mA	—	—	0.85	V
Reverse Current	I_R	V_R=15V	—	—	0.1	μA
Reverse Voltage	V_R	I_R=1μA	30	—	—	V
Total Capacitance	C_T	V_R=6V, f=1MHz	—	0.8	1.2	pF
Series Resistance	r_s	I_F=2mA, f=100MHz	—	0.6	0.9	Ω

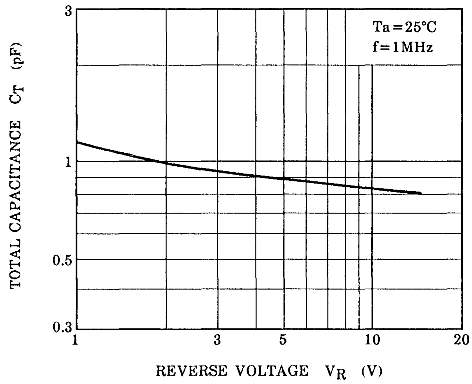
Marking



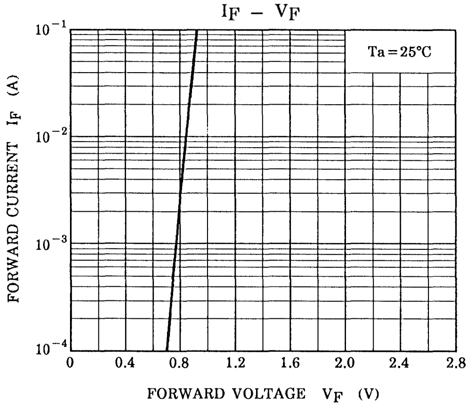
r_S – I_F



C_T – V_R



I_F – V_F

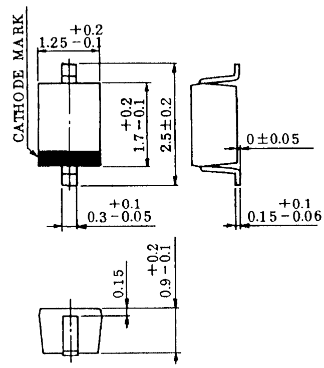


SILICON EPITAXIAL PLANAR TYPE DIODE

1SS314

VHF TUNER BAND SWITCH APPLICATIONS.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1E1A

Weight : 0.004g

- Small Package.
- Small Total Capacitance : C_T=1.2pF (Max.)
- Low Series Resistance : r_s=0.5Ω (Typ.)

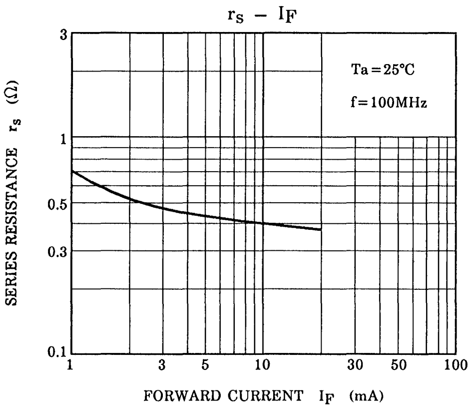
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Forward Current	I_F	100	mA
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

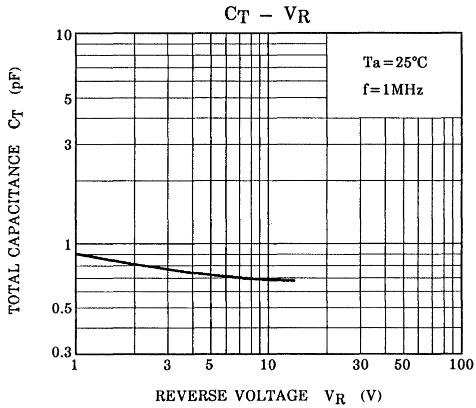
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=2mA	—	—	0.85	V
Reverse Current	I_R	V_R=15V	—	—	0.1	μA
Reverse Voltage	V_R	I_R=1μA	30	—	—	V
Total Capacitance	C_T	V_R=6V, f=1MHz	—	0.7	1.2	pF
Series Resistance	r_s	I_F=2mA, f=100MHz	—	0.5	0.9	Ω

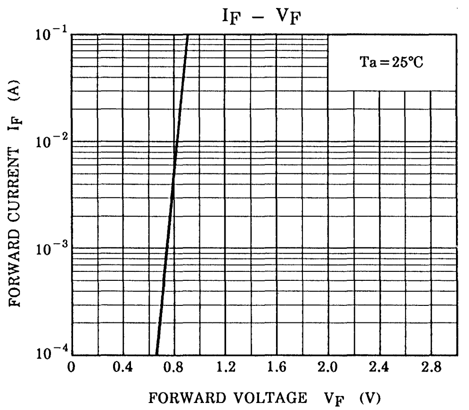
Marking



r_S – I_F
Ta = 25°C
f = 100MHz
SERIES RESISTANCE r_s (Ω)
3
1
0.5
0.3
0.1
1
3
5
10
30
50
100
FORWARD CURRENT I_F (mA)



C_T – V_R
Ta = 25°C
f = 1MHz
TOTAL CAPACITANCE C_T (pF)
10
5
3
1
0.5
0.3
1
3
5
10
30
50
100
REVERSE VOLTAGE V_R (V)



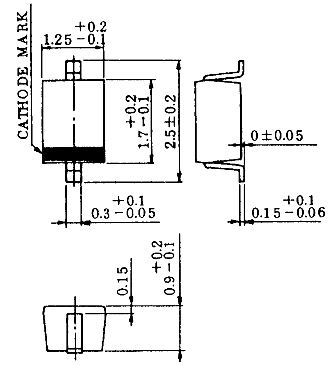
I_F – V_F
Ta = 25°C
FORWARD CURRENT I_F (A)
10^{-1}
10^{-2}
10^{-3}
10^{-4}
0
0.4
0.8
1.2
1.6
2.0
2.4
2.8
FORWARD VOLTAGE V_F (V)

SILICON EPITAXIAL SCHOTTKY BARRIER TYPE DIODE

1SS315

UHF BAND MIXER APPLICATIONS.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1E1A

Weight : 0.004g

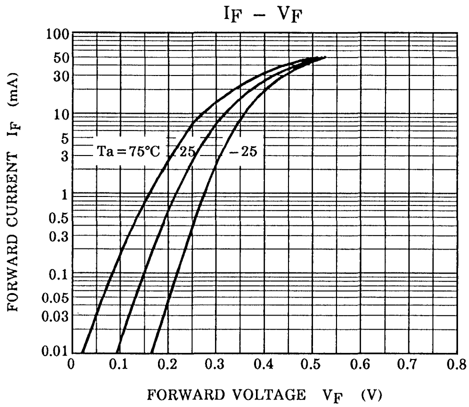
MAXIMUM RATINGS (Ta = 25°C)

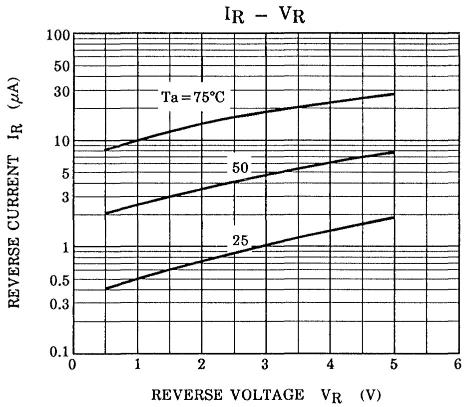
CHARACTERISTIC	SYMBOL	RATING	UNIT
Maximum (Peak) Reverse Voltage	V_{RM}	5	V
Forward Current	I_F	30	mA
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

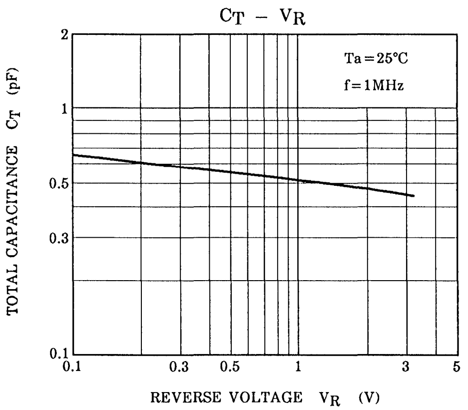
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=2mA	—	0.25	—	V
Forward Current	I_F	V_F=0.5V	30	—	—	mA
Reverse Current	I_R	V_R=0.5V	—	—	25	μA
Total Capacitance	C_T	V_R=0.2V, f=1MHz	—	0.6	—	pF

Marking


IF – VF
FORWARD CURRENT IF (mA)
100
50
30
10
5
3
1
0.5
0.3
0.1
0.05
0.03
0.01
Ta=75°C
25
−25
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
FORWARD VOLTAGE VF (V)


IR – VR
REVERSE CURRENT IR (μA)
100
50
30
10
5
3
1
0.5
0.3
0.1
Ta=75°C
50
25
0
1
2
3
4
5
6
REVERSE VOLTAGE VR (V)

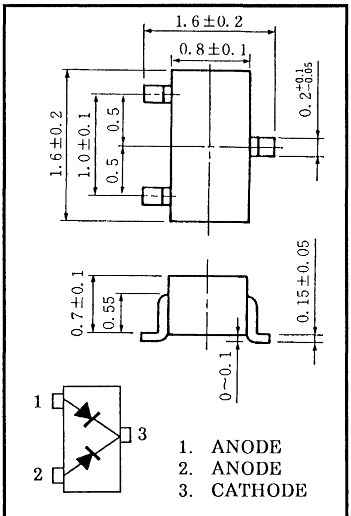

CT – VR
TOTAL CAPACITANCE CT (pF)
2
1
0.5
0.3
0.1
Ta=25°C
f=1MHz
0.1
0.3
0.5
1
3
5
REVERSE VOLTAGE VR (V)

SILICON EPITAXIAL PLANAR TYPE DIODE

1SS364

VHF TUNER BAND SWITCH APPLICATIONS

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-2S1B

- Small Package.
- Small Total Capacitance : $C_T = 1.2pF$ (Max.)
- Low Series Resistance : $r_s = 0.6\Omega$ (Typ.)

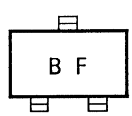
MAXIMUM RATINGS (Ta = 25°C)

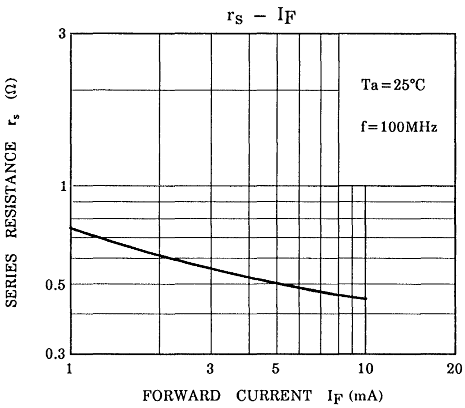
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Forward Current	I_F	50	mA
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

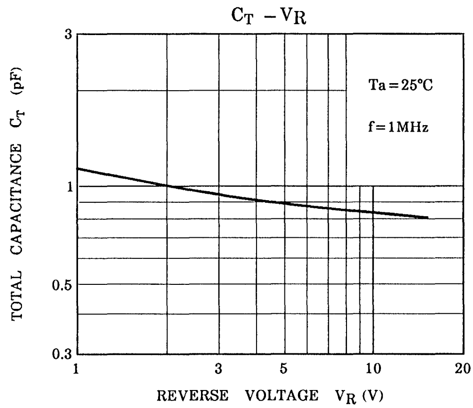
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

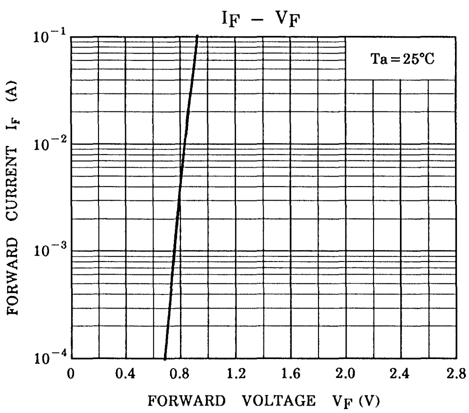
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	$I_F = 2mA$	—	—	0.85	V
Reverse Current	I_R	$V_R = 15V$	—	—	0.1	μA
Reverse Voltage	V_R	$I_R = 1\mu A$	30	—	—	V
Total Capacitance	C_T	$V_R = 6V$, f = 1MHz	—	0.85	1.2	pF
Series Resistance	r_s	$I_F = 2mA$, f = 100MHz	—	0.6	0.9	Ω

Marking




r_S – I_F
Ta=25°C
f=100MHz
SERIES RESISTANCE r_s (Ω)
3
1
0.5
0.3
1
3
5
10
20
FORWARD CURRENT I_F (mA)


C_T – V_R
Ta=25°C
f=1MHz
TOTAL CAPACITANCE C_T (pF)
3
1
0.5
0.3
1
3
5
10
20
REVERSE VOLTAGE V_R (V)

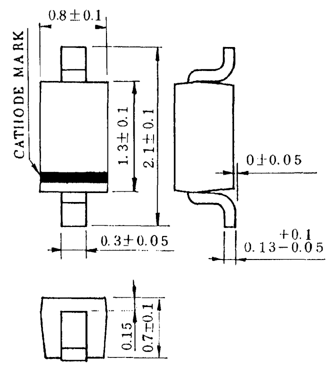

I_F – V_F
Ta=25°C
FORWARD CURRENT I_F (A)
10^{-1}
10^{-2}
10^{-3}
10^{-4}
0
0.4
0.8
1.2
1.6
2.0
2.4
2.8
FORWARD VOLTAGE V_F (V)

SILICON EPITAXIAL PLANAR TYPE DIODE

1SS371

VHF TUNER BAND SWITCH APPLICATIONS.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1F1A

Weight : 1.9mg

- Small Package
- Small Total Capacitance : $C_T = 1.0pF$ (Max.)
- Low Series Resistance : $r_S = 0.6\Omega$ (Typ.)

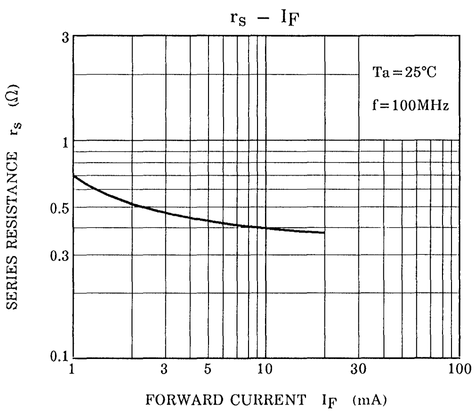
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Forward Current	I_F	100	mA
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

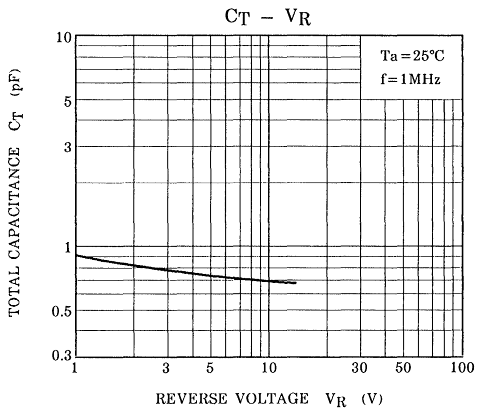
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	$I_F = 2mA$	—	—	0.82	V
Reverse Current	I_R	$V_R = 15V$	—	—	50	nA
Reverse Voltage	V_R	$I_R = 1\mu A$	30	—	—	V
Total Capacitance	C_T	$V_R = 6V$, $f = 1MHz$	—	0.7	1.0	pF
Series Resistance	r_S	$I_F = 2mA$, $f = 100MHz$	—	0.6	0.9	Ω

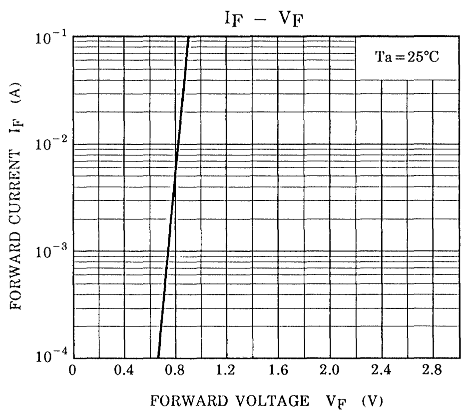
MARKING



r_S – I_F
Ta = 25°C
f = 100MHz
SERIES RESISTANCE r_S (Ω)
3
1
0.5
0.3
0.1
1
3
5
10
30
100
FORWARD CURRENT I_F (mA)



C_T – V_R
Ta = 25°C
f = 1MHz
TOTAL CAPACITANCE C_T (pF)
10
5
3
1
0.5
0.3
1
3
5
10
30
50
100
REVERSE VOLTAGE V_R (V)



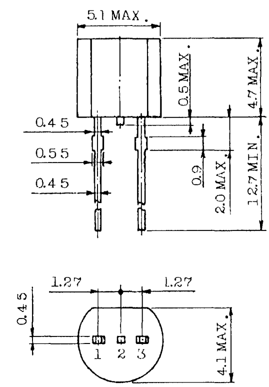
I_F – V_F
Ta = 25°C
FORWARD CURRENT I_F (A)
10^{-1}
10^{-2}
10^{-3}
10^{-4}
0
0.4
0.8
1.2
1.6
2.0
2.4
2.8
FORWARD VOLTAGE V_F (V)

SILICON EPITAXIAL PLANAR TYPE PIN DIODE

1SV99

RF ATTENUATOR APPLICATIONS.
RF BAND SWITCH APPLICATIONS.

Unit in mm



1. ANODE
2. N. C.
3. CATHODE

JEDEC	TO-92MOD
EIAJ	—
TOSHIBA	1-5H1A

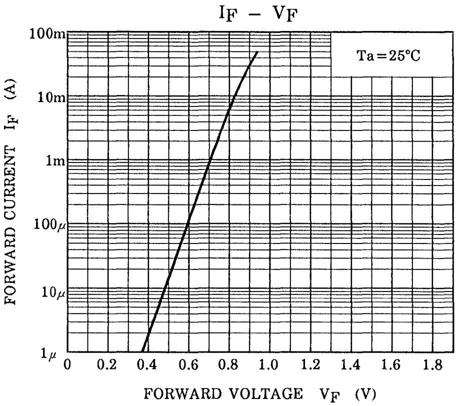
Weight : 0.2g

MAXIMUM RATINGS (Ta = 25°C)

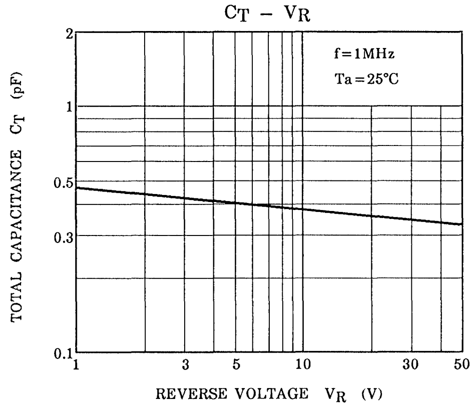
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	50	V
Forward Current	I_F	50	mA
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

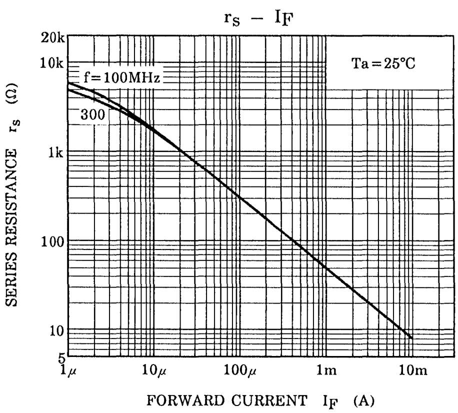
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_F	$I_F=50mA$	—	0.9	—	V
Reverse Current	I_R	$V_R=50V$	—	—	0.1	μA
Total Capacitance	C_T	$V_R=30V$, f=1MHz	—	0.3	0.5	pF
Series Resistance	r_s	$I_F=10mA$, f=100MHz	—	7	10	Ω



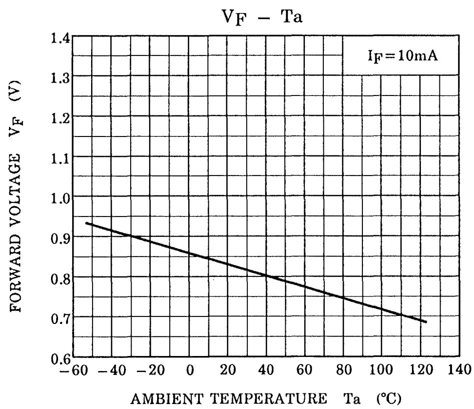
IF – VF
Ta=25°C
100m
10m
1m
100μ
10μ
1μ
0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8
FORWARD VOLTAGE VF (V)
FORWARD CURRENT IF (A)



CT – VR
f=1MHz
Ta=25°C
2
1
0.5
0.3
0.1
1 3 5 10 30 50
REVERSE VOLTAGE VR (V)
TOTAL CAPACITANCE CT (pF)



rs – IF
Ta=25°C
f=100MHz
300
20k
10k
1k
100
10
5
1μ 10μ 100μ 1m 10m
FORWARD CURRENT IF (A)
SERIES RESISTANCE rs (Ω)



VF – Ta
IF=10mA
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
−60 −40 −20 0 20 40 60 80 100 120 140
AMBIENT TEMPERATURE Ta (°C)
FORWARD VOLTAGE VF (V)

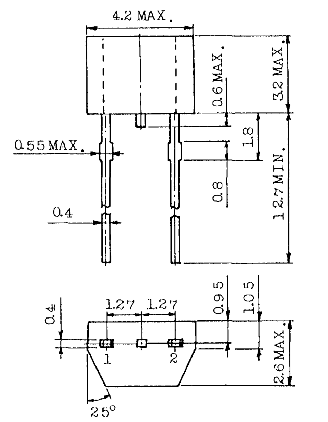
SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

1SV101

FM TUNER APPLICATIONS.

Unit in mm

- High Capacitance Ratio : $C_{3V}/C_{9V}=2.0\sim2.7$
- Low Series Resistance : $r_s=0.3\Omega$ (Typ.)
- Small Package.
- Low Tuning Voltage Range : 3V-9V



1. ANODE
2. CATHODE

JEDEC	—
EIAJ	—
TOSHIBA	1-4E1A

Weight : 0.9g

MAXIMUM RATINGS ($Ta = 25°C$)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	15	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	$-55\sim125$	°C

ELECTRICAL CHARACTERISTICS ($Ta = 25°C$)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R=10\mu A$	15	—	—	V
Reverse Current	I_R	$V_R=15V$	—	—	10	nA
Capacitance	C_{3V}	$V_R=3V$, f=1MHz	28	—	32	pF
Capacitance	C_{9V}	$V_R=9V$, f=1MHz	12	—	14	pF
Capacitance Ratio	C_{3V}/C_{9V}	—	2.0	—	2.7	
Series Resistance	r_s	C=30pF, f=50MHz	—	0.3	0.5	Ω

Note: Units are compounded in one package and are matched to 3%.

$$\frac{C(\text{Max.})-C(\text{Min.})}{C(\text{Min.})} \leqq 0.03 \quad (V_R=3V\text{-}9V)$$

and capacitance is classified as Table 1.

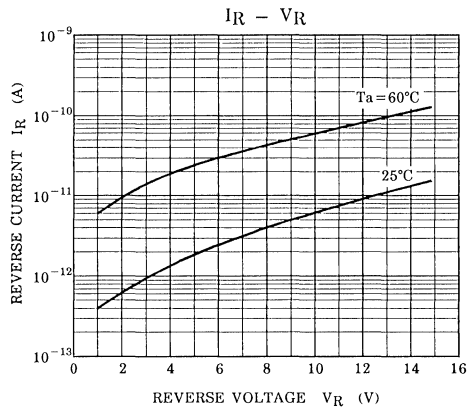
Table 1 : Address classification of capacitance
TEST CONDITION : f = 1MHz, Ta = 25°C

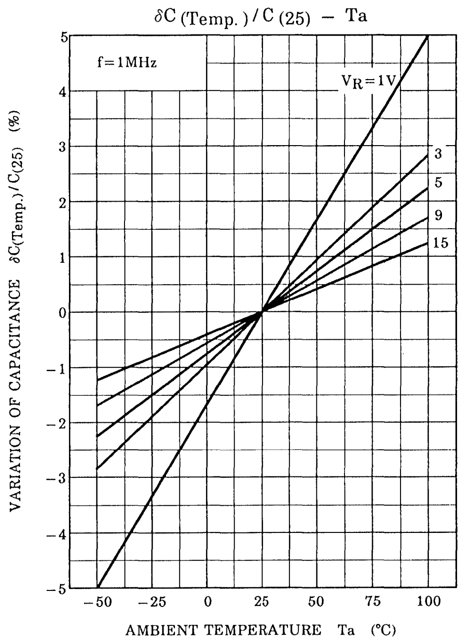
Unit : pF

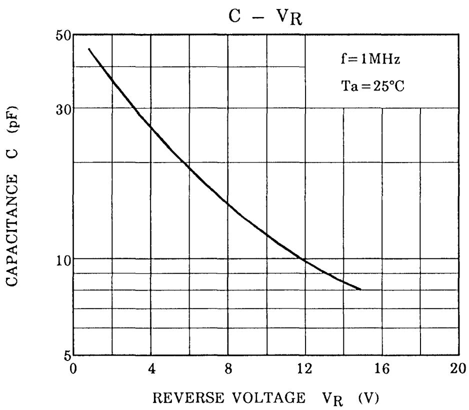
No.	C_{3V}	C_{5V}	C_{7V}	C_{9V}
1	28.20~29.04	20.50~21.11	15.65~16.11	12.066~12.427
2	28.85~29.71	20.97~21.59	16.01~16.49	12.343~12.713
3	29.51~30.39	21.44~22.08	16.38~16.87	12.627~13.005
4	30.19~31.09	21.94~22.59	16.76~17.26	12.917~13.304
5	30.89~31.81	22.45~23.12	17.15~17.66	13.214~13.610
6		22.97~23.65	17.54~18.06	13.518~13.923
7		23.49~24.19	17.94~18.47	

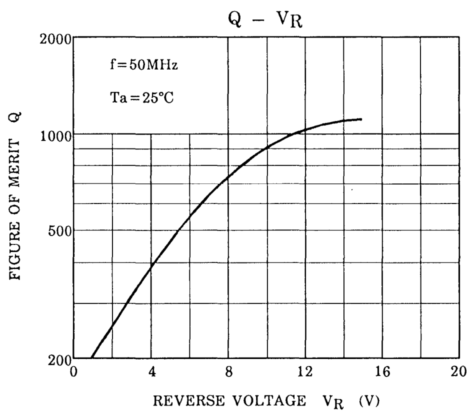
(1) The capacitance value of address classification is shown with confidence to at least ±0.5% accuracy.
(2) The address is specified in the compounded package (or label).

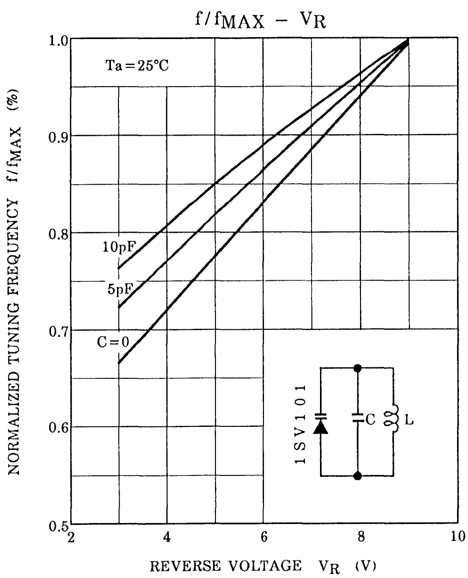
Example
4 – 3 – 2 – 1
(C_{3V}) (C_{5V}) (C_{7V}) (C_{9V})


IR – VR
Ta=60°C
25°C
REVERSE CURRENT IR (A)
REVERSE VOLTAGE VR (V)


δC (Temp.) / C (25) – Ta
f=1MHz
VR=1V
3
5
9
15
VARIATION OF CAPACITANCE δC(Temp.)/C(25) (%)
AMBIENT TEMPERATURE Ta (°C)


C – VR
f=1MHz
Ta=25°C
CAPACITANCE C (pF)
REVERSE VOLTAGE VR (V)


Q – VR
f=50MHz
Ta=25°C
FIGURE OF MERIT Q
REVERSE VOLTAGE VR (V)


f / fMAX – VR
Ta=25°C
10pF
5pF
C=0
1SV101
C
L
NORMALIZED TUNING FREQUENCY f/fMAX (%)
REVERSE VOLTAGE VR (V)

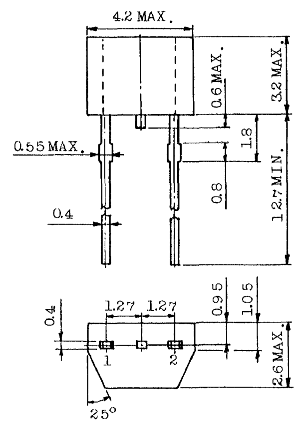
1SV102

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

AM RADIO BAND TUNING APPLICATIONS.

- High Capacitance Ratio : $C_{2V} / C_{25V} = 23$ (Typ.)
- High Q : $Q = 400$ (Typ.)
- Small Package.

Unit in mm



1. ANODE
2. CATHODE

JEDEC	—
EIAJ	—
TOSHIBA	1-4E1A

Weight : 0.09g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 10\mu A$	30	—	—	V
Reverse Current	I_R	$V_R = 30V$	—	—	50	nA
Capacitance	C_{2V}	$V_R = 2V$, f = 1MHz	360	—	460	pF
Capacitance	C_{25V}	$V_R = 25V$, f = 1MHz	15	—	21	pF
Capacitance Ratio	C_{2V} / C_{25V}	—	20	23	—	
Figure of Merit	Q	$V_R = 2V$, f = 1MHz	200	400	—	

Note: Available in matched group for capacitance to 3.0%.

$$\frac{C(Max.) - C(Min.)}{C(Min.)} \leqq 0.03 \quad (V_R = 2V\text{-}25V)$$

and capacitance is classified as Table 1.

Table 1 : Capacitance Data
TEST CONDITION : f = 1MHz, Ta = 25°C

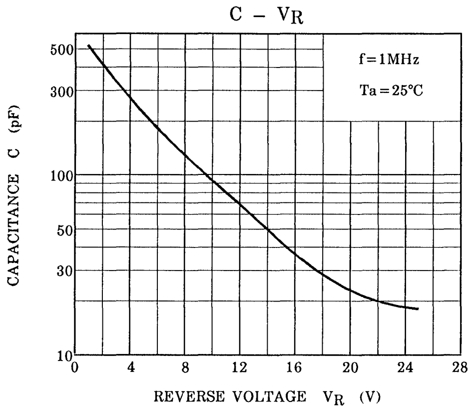
Unit : pF

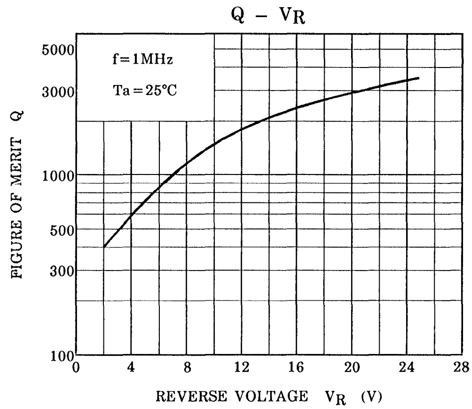
No.	C_{2V}	C_{10V}	C_{20V}	C_{25V}
1	363.9~374.8	75.67~77.93	17.41~17.93	15.34~15.80
2	372.9~384.0	77.53~79.85	17.83~18.36	15.72~16.19
3	382.0~393.4	79.45~81.83	18.26~18.80	16.10~16.58
4	391.4~403.1	81.42~83.86	18.70~19.26	16.48~16.97
5	401.1~413.1	83.44~85.94	19.16~19.73	16.87~17.37
6	411.0~423.3	85.50~88.06	19.63~20.21	17.27~17.78
7	421.1~433.7	87.61~90.23	20.10~20.70	17.68~18.21
8	431.5~444.4	89.77~92.46	20.58~21.19	18.11~18.65
9	442.0~455.2	91.98~94.73	21.07~21.70	18.55~19.10
10		94.25~97.07	21.58~22.22	19.00~19.57
11		96.57~99.46	22.10~22.76	19.47~20.05
12		98.96~101.92	22.64~23.31	19.95~20.54
13		101.40~104.44	23.19~23.88	
14		103.92~107.03	23.76~24.47	
15		106.49~109.68	24.33~25.05	
16		109.12~112.39	24.91~25.65	
17		111.82~115.17	25.51~26.27	
18		114.59~118.02	26.13~26.91	
19			26.77~27.57	

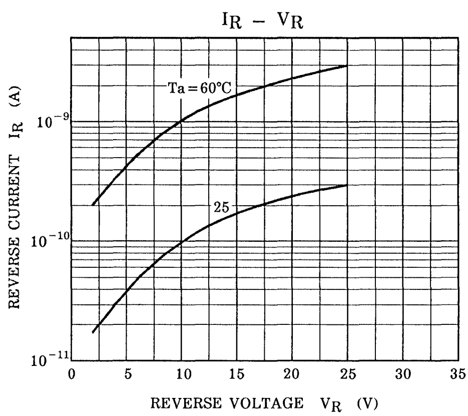
(1) This table is not selection guide, which means only to show the data.
(2) The number on the vinyl package (on the label in the vinyl package) is to show the capacitance data at each voltage in a matched group.

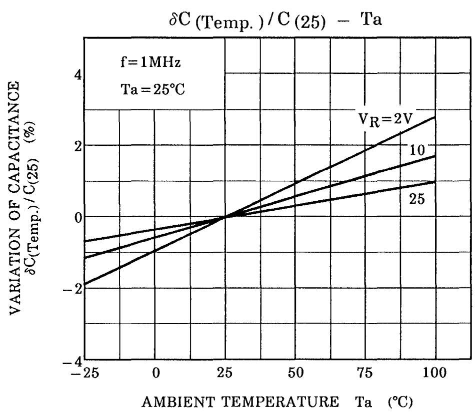
EXAMPLE : 4 – 3 – 2 – 1
(C_{2V}) (C_{10V}) (C_{20V}) (C_{25V})

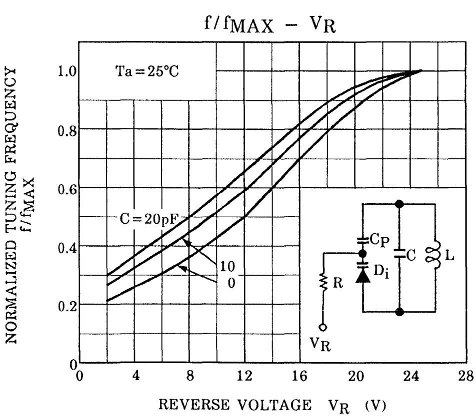
(3) The absolute capacitance value is in ±0.5%


C – VR
f=1MHz
Ta=25°C
CAPACITANCE C (pF)
500
300
100
50
30
10
0 4 8 12 16 20 24 28
REVERSE VOLTAGE VR (V)


Q – VR
f=1MHz
Ta=25°C
FIGURE OF MERIT Q
5000
3000
1000
500
300
100
0 4 8 12 16 20 24 28
REVERSE VOLTAGE VR (V)


IR – VR
Ta=60°C
25
REVERSE CURRENT IR (A)
10⁻⁹
10⁻¹⁰
10⁻¹¹
0 5 10 15 20 25 30 35
REVERSE VOLTAGE VR (V)


δC (Temp.) / C (25) – Ta
f=1MHz
Ta=25°C
VR=2V
10
25
VARIATION OF CAPACITANCE
δC(Temp.)/C(25) (%)
4
2
0
−2
−4
−25 0 25 50 75 100
AMBIENT TEMPERATURE Ta (°C)


f/fMAX – VR
Ta=25°C
C=20pF
10
0
CP
C
L
Di
R
VR
NORMALIZED TUNING FREQUENCY
f/fMAX
1.0
0.8
0.6
0.4
0.2
0
0 4 8 12 16 20 24 28
REVERSE VOLTAGE VR (V)

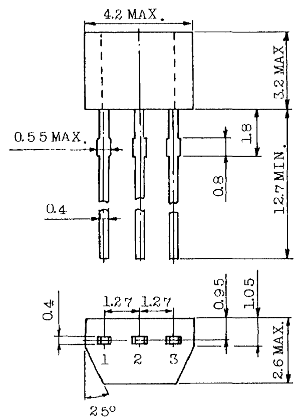
SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

1SV103

FM RADIO BAND TUNING APPLICATIONS.

- Low Series Resistance : $r_S = 0.35\Omega$ (Typ.)
- Small Package.

Unit in mm



1. ANODE 1
2. CATHODE
3. ANODE 2

JEDEC	—
EIAJ	—
TOSHIBA	1-4E2A

Weight : 0.13g

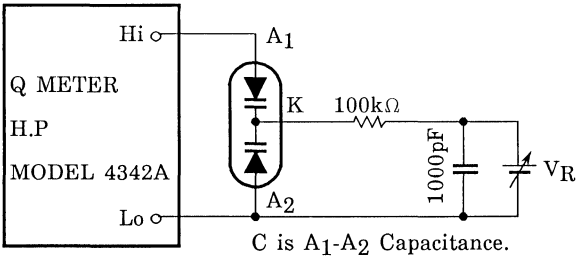
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	32	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

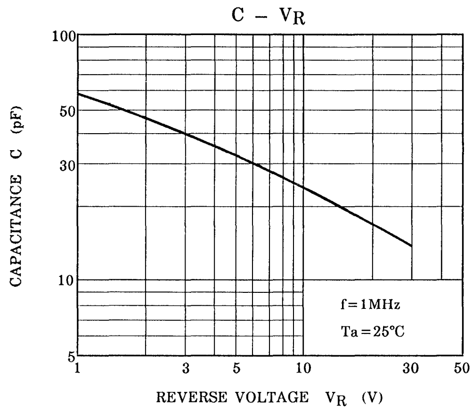
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

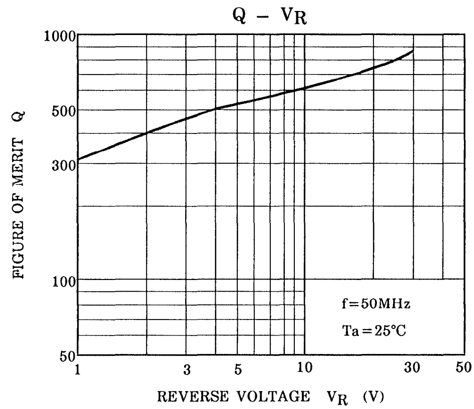
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 10\mu A$	32	—	—	V
Reverse Current	I_R	$V_R = 30V$	—	—	50	nA
Capacitance	C_{3V}	$V_R = 3V$, f = 1MHz	37	—	42	pF
Capacitance	C_{30V}	$V_R = 30V$, f = 1MHz	13.2	—	16.2	pF
Capacitance Ratio	C_{3V}/C_{30V}	—	2.6	—	2.9	
Series Resistance	r_s	C = 20pF, f = 50MHz (Note)	—	0.35	0.60	Ω

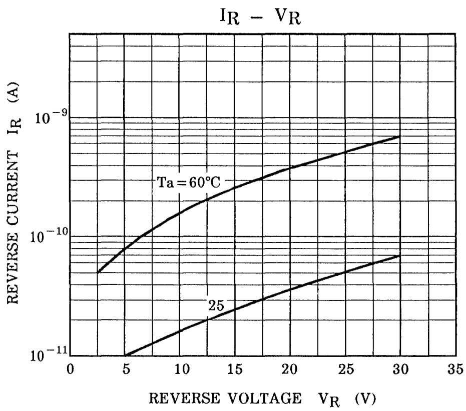
Note : r_S Test circuit

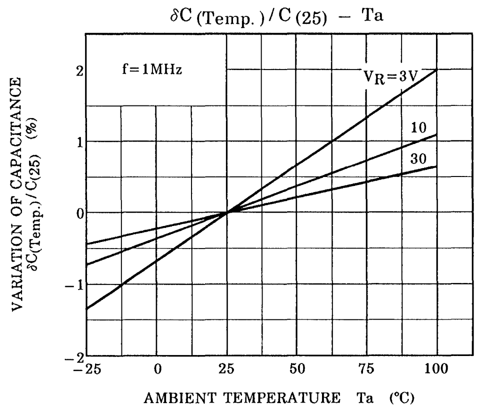


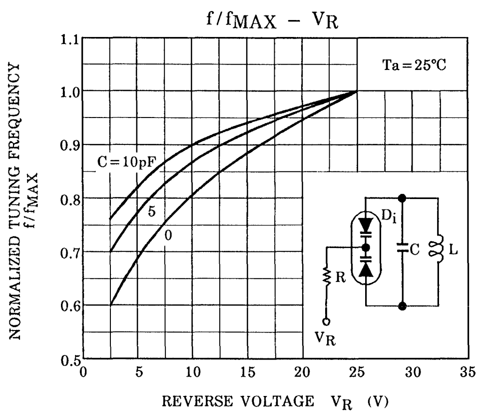
C is A_1-A_2 Capacitance.


C – V_R
100
50
30
10
5
CAPACITANCE C (pF)
1
3
5
10
30
50
REVERSE VOLTAGE V_R (V)
f=1MHz
Ta=25°C


Q – V_R
1000
500
300
100
50
FIGURE OF MERIT Q
1
3
5
10
30
50
REVERSE VOLTAGE V_R (V)
f=50MHz
Ta=25°C


I_R – V_R
10^{-9}
10^{-10}
10^{-11}
REVERSE CURRENT I_R (A)
Ta=60°C
25
0
5
10
15
20
25
30
35
REVERSE VOLTAGE V_R (V)


δC (Temp.) / C (25) – Ta
VARIATION OF CAPACITANCE
δC(Temp.) / C(25) (%)
2
1
0
−1
−2
f=1MHz
V_R=3V
10
30
−25
0
25
50
75
100
AMBIENT TEMPERATURE Ta (°C)


f / f_{MAX} – V_R
1.1
1.0
0.9
0.8
0.7
0.6
0.5
NORMALIZED TUNING FREQUENCY
f / f_{MAX}
Ta=25°C
C=10pF
5
0
D_i
C
L
R
V_R
0
5
10
15
20
25
30
35
REVERSE VOLTAGE V_R (V)

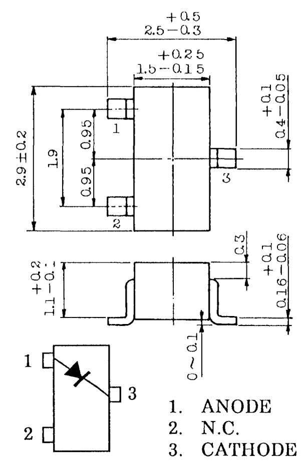
SILICON EPITAXIAL PIN TYPE DIODE

1SV128

VHF~UHF BAND RF ATTENUATOR APPLICATIONS.

Unit in mm

- Small Package
- Small Total Capcitance : C_T=0.25pF (Typ.)



JEDEC	—
EIAJ	SC-59
TOSHIBA	1-3G1B

Weight : 0.012g

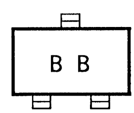
MAXIMUM RATINGS (Ta = 25°C)

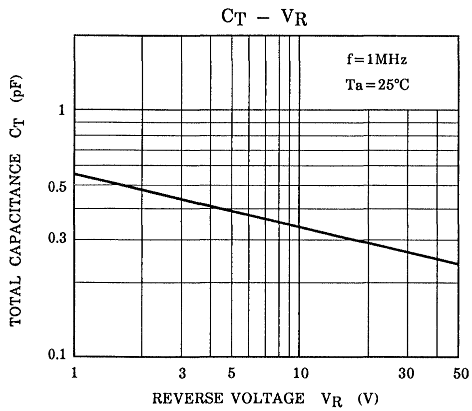
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	50	V
Forward Current	I_F	50	mA
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

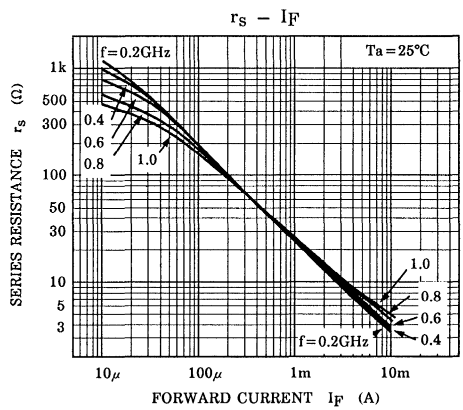
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	I_R=10μA	50	—	—	V
Reverse Current	I_R	V_R=50V	—	—	0.1	μA
Forward Voltage	V_F	I_F=50mA	—	0.95	—	V
Total Capacitance	C_T	V_R=50V, f=1MHz	—	0.25	—	pF
Series Resistance	r_s	I_F=10mA, f=100MHz	—	7	—	Ω
Minority Carrier Life Time	τ	I_F=10mA. I_R=6mA	—	400	—	ns

Marking




C_T – V_R
f=1MHz
Ta=25°C
TOTAL CAPACITANCE C_T (pF)
1
0.5
0.3
0.1
1
3
5
10
30
50
REVERSE VOLTAGE V_R (V)

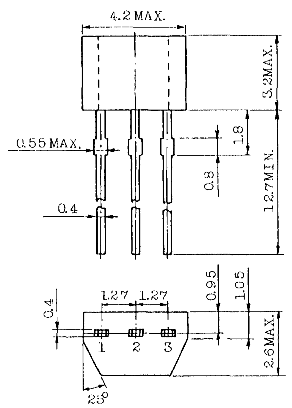

r_S – I_F
f=0.2GHz
Ta=25°C
SERIES RESISTANCE r_S (Ω)
1k
500
300
100
50
30
10
5
3
0.4
0.6
0.8
1.0
1.0
0.8
0.6
f=0.2GHz
0.4
10μ
100μ
1m
10m
FORWARD CURRENT I_F (A)

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

1SV147

FM RADIO BAND TUNING APPLICATIONS.

Unit in mm



1. ANODE 1
2. CATHODE 1, 2
3. ANODE 2

JEDEC	—
EIAJ	—
TOSHIBA	1-4E2A

Weight : 0.13g

- Low r_S : $r_S = 0.3\Omega$ (Typ.)
- Small Package

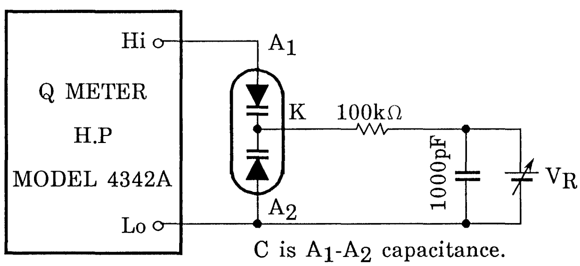
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	15	V
Junction Temperature	T_j	125	°C
Storage Temperature	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 10\mu A$	15	—	—	V
Reverse Current	I_R	$V_R = 15V$	—	—	50	nA
Capacitance	C_{3V}	$V_R = 3V$, f = 1MHz	28.5	—	32.5	pF
Capacitance	C_{8V}	$V_R = 8V$, f = 1MHz	11.7	—	13.7	pF
Capacitance Ratio	C_{3V}/C_{8V}	—	2.1	—	2.6	—
Series Resistance	r_s	C = 30pF, f = 50MHz (Note)	—	0.3	0.5	Ω

Note : r_S test circuit



C is A_1-A_2 capacitance.

Table 1: Capacitance Data

TEST CONDITION (f = 1MHz, Ta = 25°C)

No.	C_{2V}	C_{3V}	C_{6V}	C_{8V}
1	34.70 ~ 35.74	28.60 ~ 29.45	16.80 ~ 17.30	11.72 ~ 12.07
2	35.56 ~ 36.62	29.31 ~ 30.18	17.21 ~ 17.72	12.01 ~ 12.37
3	36.44 ~ 37.53	30.03 ~ 30.93	17.63 ~ 18.15	12.31 ~ 12.67
4	37.35 ~ 38.47	30.77 ~ 31.69	18.06 ~ 18.60	12.61 ~ 12.98
5	38.27 ~ 39.41	31.53 ~ 32.47	18.50 ~ 19.05	12.92 ~ 13.30
6			18.95 ~ 19.51	13.23 ~ 13.62

(1) Available in matched group for capacitance to 3.0%.

$$\frac{C_{(Max.)} - C_{(Min.)}}{C_{(Min.)}} \leqq 0.03\ (V_R = 2 \sim 8V)$$

and capacitance is classified as Table 1.

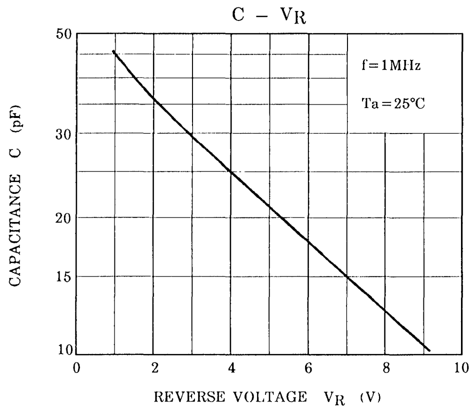
(2) C_{2V}, C_{3V}, C_{6V} and C_{8V} are A_1-A_2 capacitance.

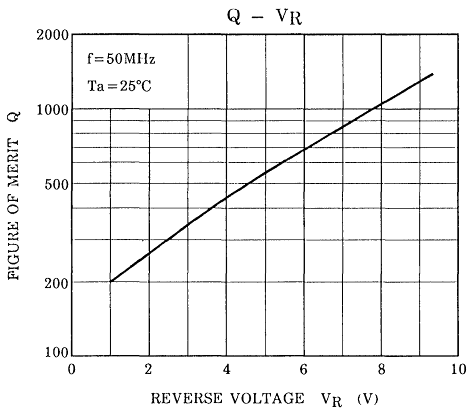
(3) This table is not selection guide, which means only to show the data.

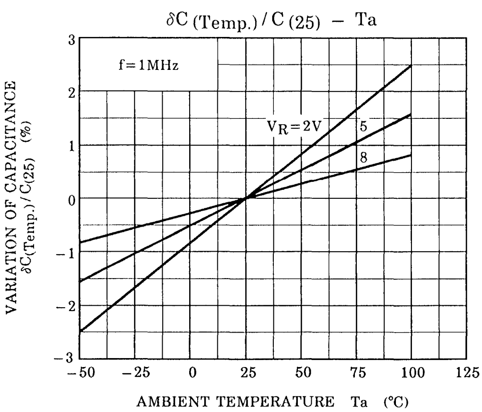
(4) The number on the vinyl package (on the lable in the vinyl package) is to show the capacitance data at each voltage in a matched group.

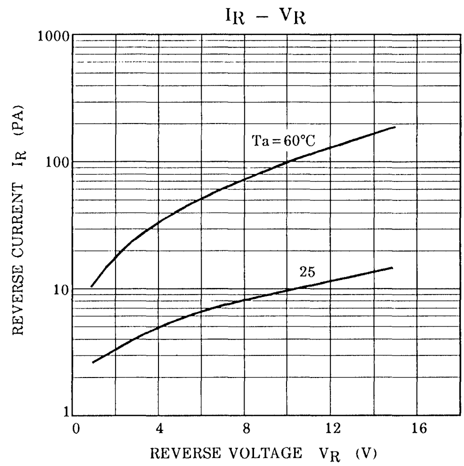
EXAMPLE: 5 – 4 – 3 – 2
(C_{2V}) (C_{3V}) (C_{6V}) (C_{8V})

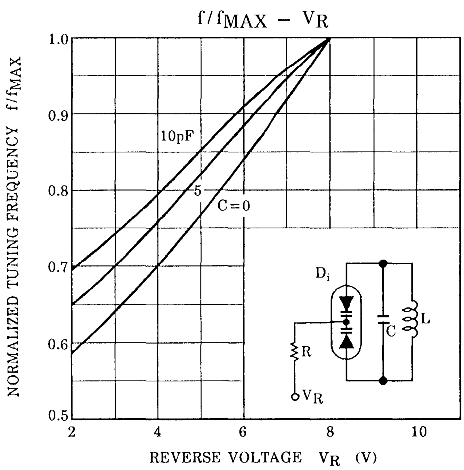
(5) The absolute capacitance value is in ±0.5%.


C – VR
f=1MHz
Ta=25°C
CAPACITANCE C (pF)
50
30
20
15
10
0 2 4 6 8 10
REVERSE VOLTAGE VR (V)


Q – VR
f=50MHz
Ta=25°C
FIGURE OF MERIT Q
2000
1000
500
200
100
0 2 4 6 8 10
REVERSE VOLTAGE VR (V)


δC (Temp.) / C (25) – Ta
f=1MHz
VR=2V
5
8
VARIATION OF CAPACITANCE
δC(Temp.)/C(25) (%)
3
2
1
0
−1
−2
−3
−50 −25 0 25 50 75 100 125
AMBIENT TEMPERATURE Ta (°C)


IR – VR
Ta=60°C
25
REVERSE CURRENT IR (PA)
1000
100
10
1
0 4 8 12 16
REVERSE VOLTAGE VR (V)


f / fMAX – VR
10pF
5
C=0
Di
R
C
L
VR
NORMALIZED TUNING FREQUENCY f/fMAX
1.0
0.9
0.8
0.7
0.6
0.5
2 4 6 8 10
REVERSE VOLTAGE VR (V)

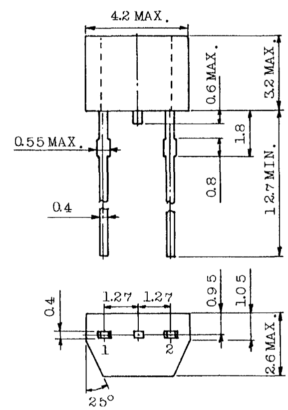
1SV149

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

AM RADIO BAND TUNING APPLICATIONS.

- High Capacitance Ratio : $C_{1V}/C_{8V}=15$ (Min.)
- High Q : $Q=200$ (Min.)
- Small Package
- Low Voltage Operation : 1V-8V

Unit in mm



1. ANODE
2. CATHODE

JEDEC	—
EIAJ	—
TOSHIBA	1-4E1A

Weight : 0.09g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	15	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R=10\mu A$	15	—	—	V
Reverse Current	I_R	$V_R=15V$	—	—	50	nA
Capacitance	C_{1V}	$V_R=1V$, f=1MHz	435	—	540	pF
Capacitance	C_{8V}	$V_R=8V$, f=1MHz	19.9	—	30.0	pF
Capacitance Ratio	C_{1V}/C_{8V}	—	15.0	19.5	—	—
Figure of Merit	Q	$V_R=1V$, f=1MHz	200	—	—	—

Note : Available in matched group for capacitance to 2.5%.

$$\frac{C_{(Max.)}-C_{(Min.)}}{C_{(Min.)}} \leqq 0.025\ (V_R=1V\sim8V)$$

and capacitance is classified as Table 1.

Table 1: Capacitance Data

TEST CONDITION (f = 1MHz, Ta = 25°C) Unit : pF

No.	C_{1V}	C_{3V}	C_{5V}	C_{8V}
1	438.0 ~ 448.9	140.00 ~ 143.51	55.00 ~ 56.37	20.00 ~ 20.50
2	446.7 ~ 457.9	142.81 ~ 146.38	56.09 ~ 57.49	20.40 ~ 20.91
3	455.7 ~ 467.0	145.66 ~ 149.31	57.21 ~ 58.64	20.81 ~ 21.33
4	464.8 ~ 476.3	148.57 ~ 152.29	58.36 ~ 59.81	21.23 ~ 21.76
5	474.1 ~ 485.9	151.55 ~ 155.34	59.53 ~ 61.01	21.66 ~ 22.19
6	483.5 ~ 495.6	154.58 ~ 158.45	60.71 ~ 62.23	22.09 ~ 22.63
7	493.2 ~ 505.5	157.67 ~ 161.6	61.93 ~ 63.47	22.53 ~ 23.08
8	503.1 ~ 515.6	160.8 ~ 164.8	63.17 ~ 64.75	22.98 ~ 23.54
9	513.2 ~ 526.0	164.0 ~ 168.1	64.43 ~ 66.04	23.44 ~ 24.01
10	523.4 ~ 536.5	167.3 ~ 171.5	65.72 ~ 67.36	23.91 ~ 24.50
11		170.7 ~ 174.9	67.04 ~ 68.71	24.38 ~ 24.99
12		174.1 ~ 178.4	68.37 ~ 70.08	24.87 ~ 25.49
13		177.6 ~ 182.0	69.74 ~ 71.48	25.37 ~ 26.00
14		181.2 ~ 185.6	71.14 ~ 72.92	25.88 ~ 26.52
15		184.8 ~ 189.3	72.56 ~ 74.37	26.40 ~ 27.05
16		188.5 ~ 193.1	74.01 ~ 75.85	26.93 ~ 27.59
17		192.3 ~ 197.0	75.49 ~ 77.37	27.47 ~ 28.15
18		196.2 ~ 201.0	76.99 ~ 78.91	28.01 ~ 28.71
19		200.0 ~ 205.0	78.53 ~ 80.49	28.57 ~ 29.28
20		204.0 ~ 209.1	80.09 ~ 82.10	29.14 ~ 29.86
21		208.1 ~ 213.3	81.70 ~ 83.74	
22		212.3 ~ 217.6	83.34 ~ 85.42	
23		216.6 ~ 221.9	85.00 ~ 87.12	
24		220.9 ~ 226.3	86.70 ~ 88.87	
25		225.3 ~ 230.8	88.43 ~ 90.64	
26		229.8 ~ 235.4	90.20 ~ 92.46	
27		234.4 ~ 240.1	92.00 ~ 94.30	
28		239.1 ~ 245.0	93.84 ~ 96.18	
29		243.8 ~ 249.9	95.72 ~ 98.11	
30			97.63 ~ 100.07	
31			99.59 ~ 102.08	
32			101.58 ~ 104.12	

(1) This table is not selection guide, which means only to show the data.

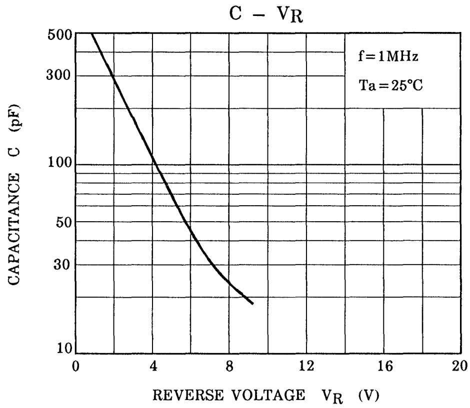
(2) The number on the vinyl package (on the label in the vinyl package) is to show the capacitance data at each voltage in a matched group.

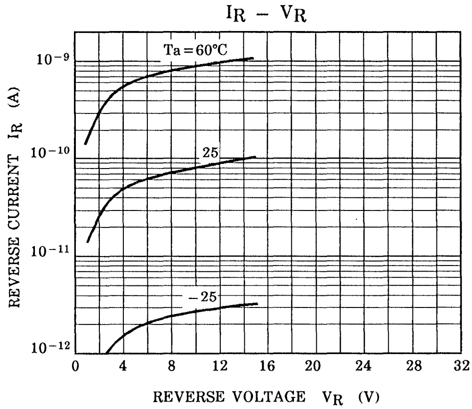
EXAMPLE: 4 – 3 – 2 – 1
(C_{1V}) (C_{3V}) (C_{5V}) (C_{8V})

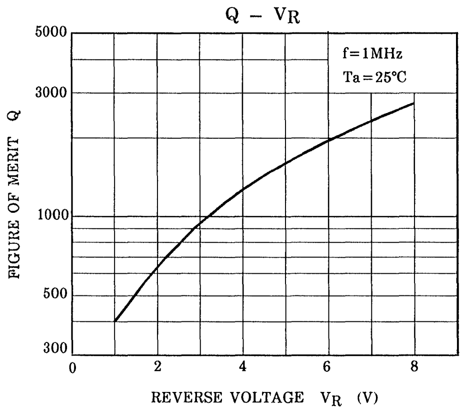
(3) The absolute capacitance value is in ±0.5%.

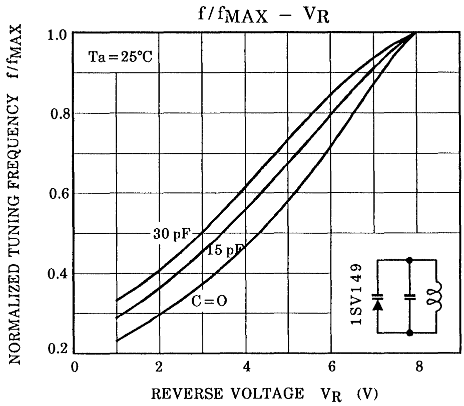
(4) C_{8V} Classification

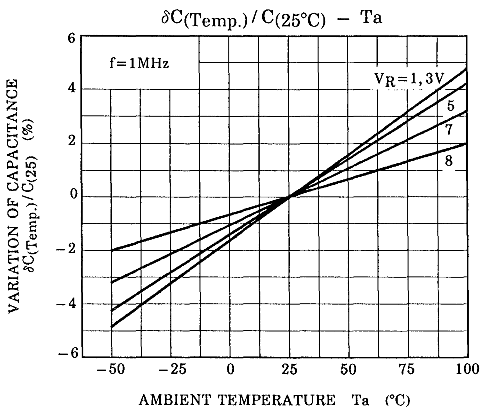
A : Address No.1~7
B : Address No.8~14
C : Address No.14~20


C – VR
f=1MHz
Ta=25°C
CAPACITANCE C (pF)
500
300
100
50
30
10
0 4 8 12 16 20
REVERSE VOLTAGE VR (V)


IR – VR
Ta=60°C
25
–25
REVERSE CURRENT IR (A)
10⁻⁹
10⁻¹⁰
10⁻¹¹
10⁻¹²
0 4 8 12 16 20 24 28 32
REVERSE VOLTAGE VR (V)


Q – VR
f=1MHz
Ta=25°C
FIGURE OF MERIT Q
5000
3000
1000
500
300
0 2 4 6 8
REVERSE VOLTAGE VR (V)


f/fMAX – VR
Ta=25°C
30 pF
15 pF
C=O
1SV149
NORMALIZED TUNING FREQUENCY f/fMAX
1.0
0.8
0.6
0.4
0.2
0 2 4 6 8
REVERSE VOLTAGE VR (V)


δC(Temp.)/C(25°C) – Ta
f=1MHz
VR=1,3V
5
7
8
VARIATION OF CAPACITANCE δC(Temp.)/C(25) (%)
6
4
2
0
–2
–4
–6
–50 –25 0 25 50 75 100
AMBIENT TEMPERATURE Ta (°C)

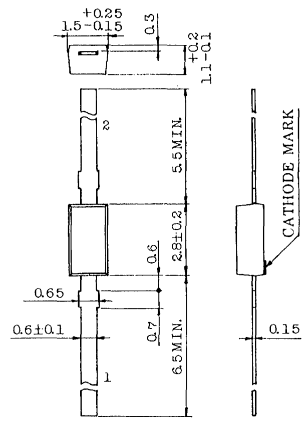
SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

1SV153

TV TUNING.

Unit in mm

- High Capacitance Ratio : $C_{2V}/C_{25V}=6.5$ (Typ.)
- Low Series Resistance : $r_s=0.45\Omega$ (Typ.)
- Excellent C-V Characteristics, and Small Tracking Error.
- Useful for Small Size Tuner.



1. CATHODE
2. ANODE

JEDEC	—
EIAJ	—
TOSHIBA	1-2J1A

Weight : 0.02g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 ($R_L=10k\Omega$)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R=1\mu A$	30	—	—	V
Reverse Current	I_R	$V_R=28V$	—	—	10	nA
Capacitance	C_{2V}	$V_R=2V$, f=1MHz	14.16	—	16.25	pF
Capacitance	C_{25V}	$V_R=25V$, f=1MHz	2.11	—	2.43	pF
Capacitance Ratio	C_{2V}/C_{25V}	—	5.90	6.50	7.15	—
Series Resistance	r_s	C=9pF, f=470MHz	—	0.45	0.6	Ω

Note 1 : Units are compounded in one package and are matched to 2.5%.

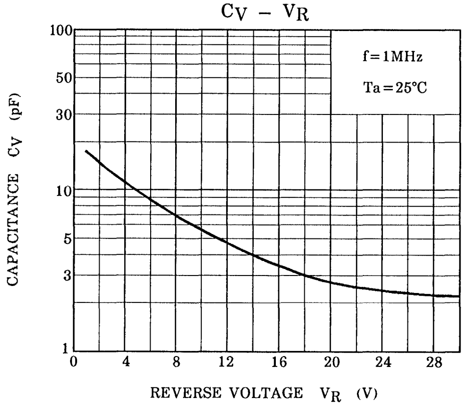
$$\frac{C\,(\text{Max.}) - C\,(\text{Min.})}{C\,(\text{Min.})} \leqq 0.025$$

($V_R=2\sim25V$)

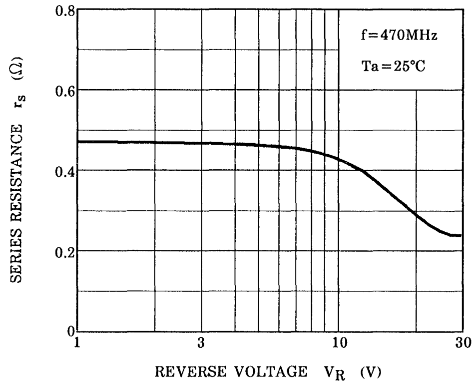
Note 2 : Quantity in a package must be 4×n pcs.
($n\geqq1$)

Marking

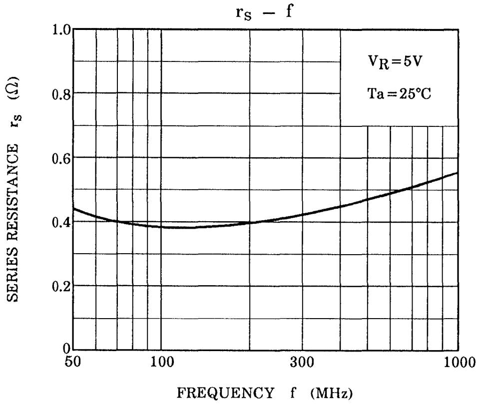
$C_V - V_R$



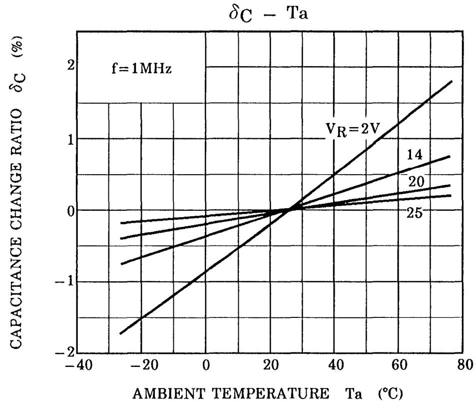
$r_s - V_R$



$r_s - f$



$\delta_C - Ta$



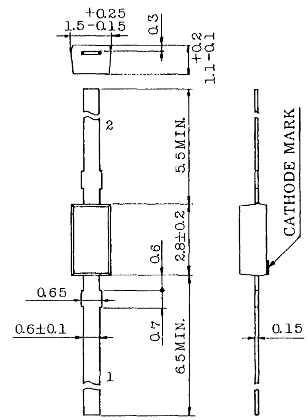
$$\text{NOTE : } \delta_C = \frac{C\,(Ta) - C\,(25)}{C\,(25)} \times 100$$

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

1SV153A

TV TUNING

Unit in mm



1. CATHODE
2. ANODE

JEDEC	—
EIAJ	—
TOSHIBA	1-2J1A

Weight : 0.02g

- High Capacitance Ratio : $C_{2V} / C_{25V} = 6.5$ (Typ.)
- Low Series Resistance : $r_s = 0.4\Omega$ (Typ.)
- Excellent C-V Characteristics, and Small Tracking Error.
- Useful for Small Size Tuner.

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 ($R_L = 10k\Omega$)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 1\mu A$	30	—	—	V
Reverse Current	I_R	$V_R = 28V$	—	—	10	nA
Capacitance	C_{2V}	$V_R = 2V$, f = 1MHz	14.16	—	16.25	pF
Capacitance	C_{25V}	$V_R = 25V$, f = 1MHz	2.11	—	2.43	pF
Capacitance Ratio	C_{2V} / C_{25V}	—	5.90	6.50	7.15	—
Series Resistance	r_s	$V_R = 5V$, f = 470MHz	—	0.4	0.55	Ω

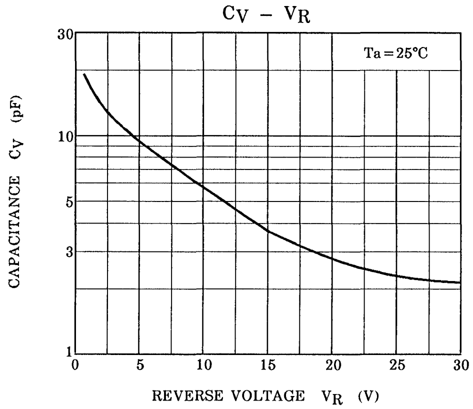
Note 1 : Units are compounded in one package and are matched to 2.5%.

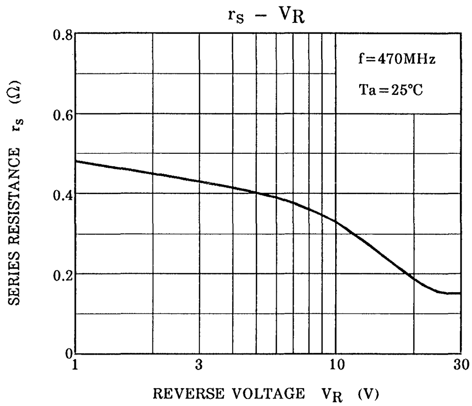
$$\frac{C\,(\mathrm{Max.}) - C\,(\mathrm{Min.})}{C\,(\mathrm{Min.})} \leqq 0.025\ (V_R = 2\sim25V)$$

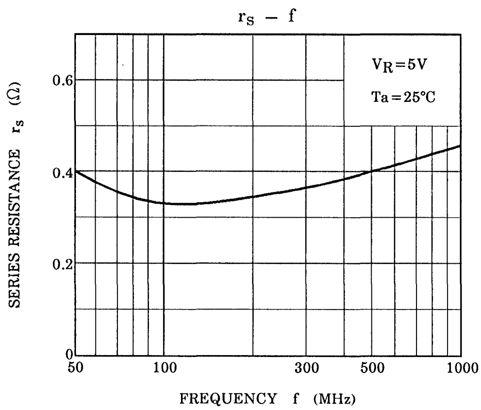
Note 2 : Quantity in a package must be 4×n pcs. ($n \geqq 1$)

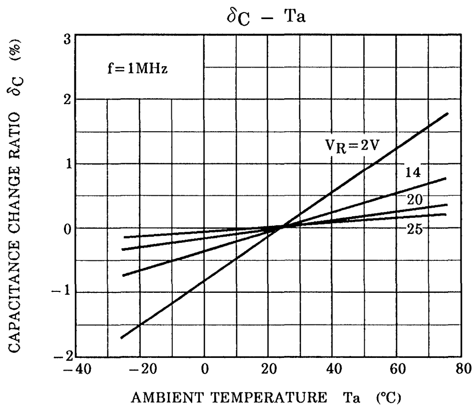
Marking

1SV153A









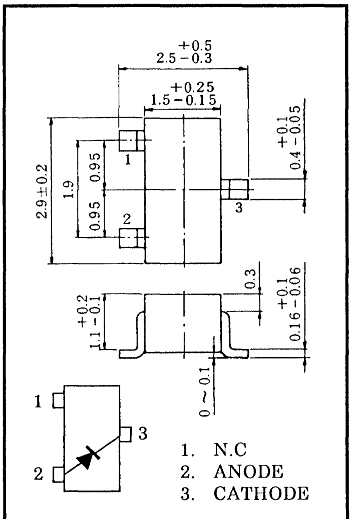
$$\text{NOTE : } \delta_C = \frac{C\,(Ta) - C\,(25)}{C\,(25)} \times 100$$

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

1SV160

AFC APPLICATION FOR FM RECEIVER

Unit in mm



JEDEC	—
EIAJ	SC-59
TOSHIBA	1-3G1A

Weight : 0.012g

- Small Package.
- Low Series Resistance : $r_S = 0.7\Omega$ (Typ.)

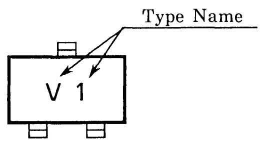
MAXIMUM RATINGS (Ta = 25°C)

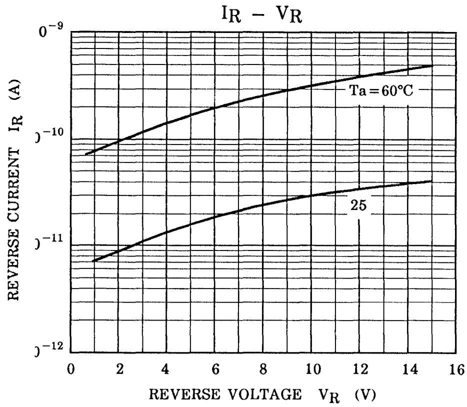
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	15	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

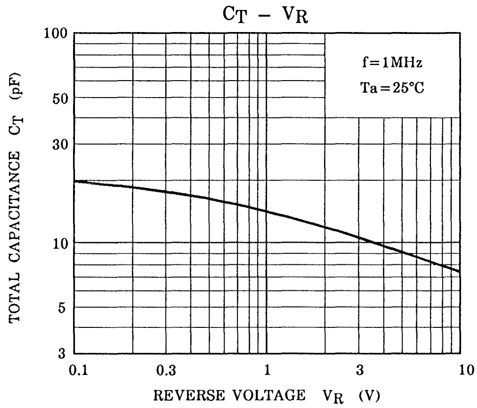
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

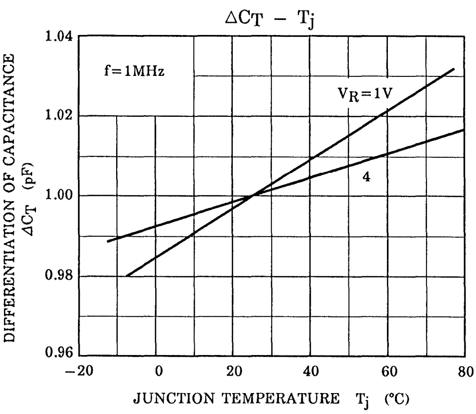
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Current	I_R	$V_R = 4V$	—	—	100	nA
Reverse Voltage	V_R	$I_R = 10\mu A$	15	—	—	V
Total Capacitance	C_T	$V_R = 4V$, f=1MHz	7	—	14	pF
Capacitance Ratio	C2V / C4V	—	1.2	—	1.5	—
Series Resistance	r_S	$V_R = 4V$, f=50MHz	—	0.7	1.2	Ω

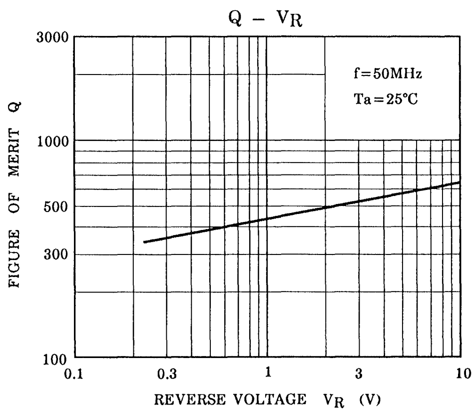
Marking




I_R – V_R
Ta=60°C
25
REVERSE CURRENT I_R (A)
REVERSE VOLTAGE V_R (V)
0 2 4 6 8 10 12 14 16


C_T – V_R
f=1MHz
Ta=25°C
TOTAL CAPACITANCE C_T (pF)
100 50 30 10 5 3
0.1 0.3 1 3 10
REVERSE VOLTAGE V_R (V)


ΔC_T – T_j
f=1MHz
V_R=1V
4
DIFFERENTIATION OF CAPACITANCE ΔC_T (pF)
1.04 1.02 1.00 0.98 0.96
−20 0 20 40 60 80
JUNCTION TEMPERATURE T_j (°C)


Q – V_R
f=50MHz
Ta=25°C
FIGURE OF MERIT Q
3000 1000 500 300 100
0.1 0.3 1 3 10
REVERSE VOLTAGE V_R (V)

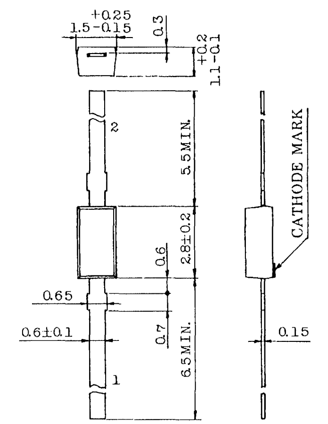
SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

1SV161

CATV TUNING.

- High Capacitance Ratio : $C_{2V}/C_{25V}=10.5$ (Typ.)
- Low Series Resistance : $r_s=0.6\Omega$ (Typ.)
- Excellent C-V Characteristics, and Small Tracking Error.
- Useful for Small Size Tuner.

Unit in mm



1. CATHODE
2. ANODE

JEDEC	—
EIAJ	—
TOSHIBA	1-2J1A

Weight : 0.02g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 ($R_L=10k\Omega$)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	$-55\sim125$	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R=1\mu A$	30	—	—	V
Reverse Current	I_R	$V_R=28V$	—	—	10	nA
Capacitance	C_{2V}	$V_R=2V$, f=1MHz	26	—	32	pF
Capacitance	C_{25V}	$V_R=25V$, f=1MHz	2.5	—	3.2	pF
Capacitance Ratio	C_{2V}/C_{25V}	—	9.5	10.5	—	—
Series Resistance	r_s	$V_R=5V$, f=470MHz	—	0.6	0.8	Ω

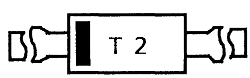
Note 1 : Available in matched group for capacitance to 2.5%.

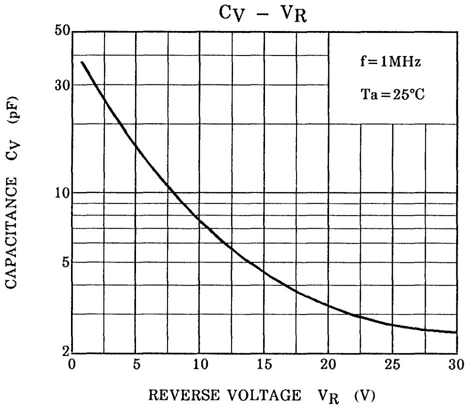
$$\frac{C\,(\text{Max.})-C\,(\text{Min.})}{C\,(\text{Min.})}\leqq 0.025$$

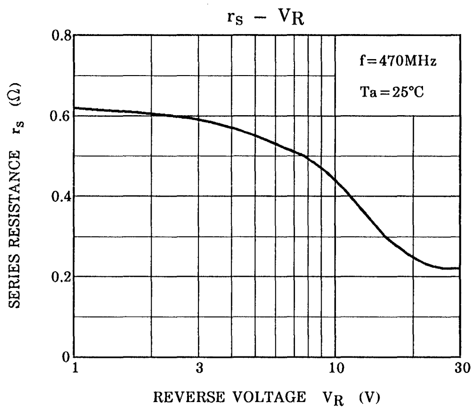
($V_R=2\sim25V$)

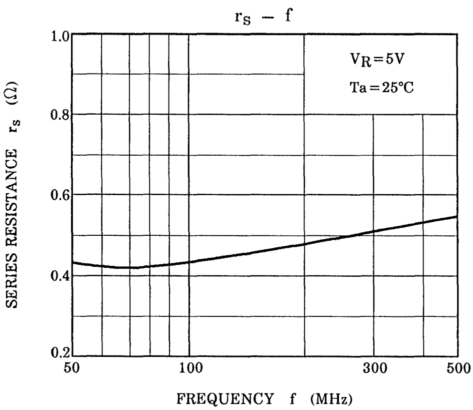
Note 2 : Quantity in a package must be 4×n pcs. (n≧1)

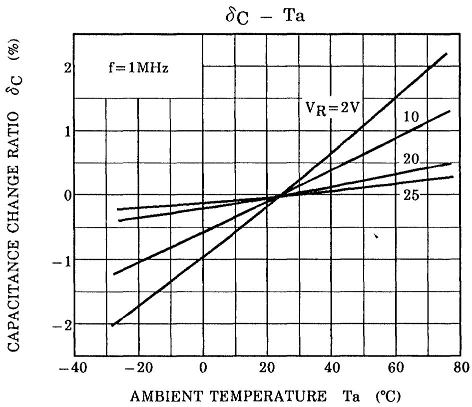
Marking











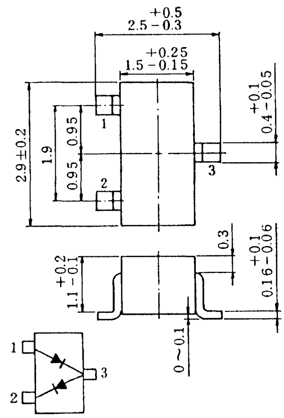
NOTE : $\delta_C = \frac{C(Ta) - C(25)}{C(25)} \times 100$

SILICON EPITAXIAL PIN TYPE DIODE

1SV172

VHF~UHF BAND RF ATTENUATOR APPLICATIONS.

Unit in mm



1. ANODE 1
2. CATHODE 2
3. CATHODE 1 / ANODE 2

JEDEC	—
EIAJ	SC-59
TOSHIBA	1-3G1G

Weight : 0.013g

MAXIMUM RATINGS (Ta = 25°C)

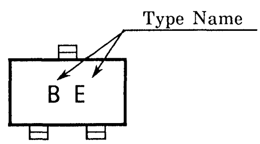
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	50	V
Forward Current	I_F	50	mA
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

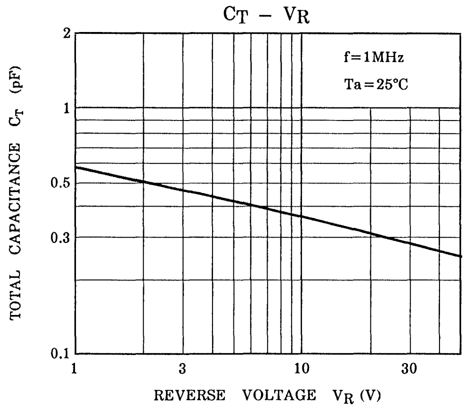
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

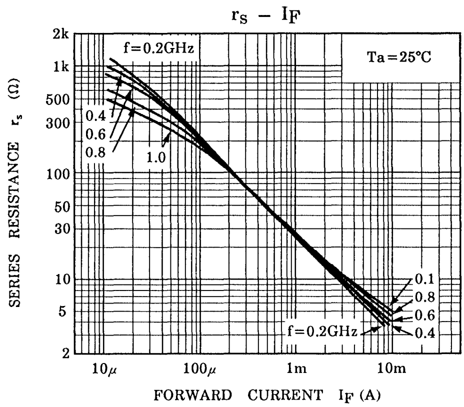
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 10\mu A$	50	—	—	V
Reverse Current	I_R	$V_R = 50V$	—	—	0.1	μA
Forward Voltage	V_F	$I_F = 50mA$	—	0.95	—	V
Total Capacitance (Note)	C_T	$V_R = 50V$, f = 1MHz	—	0.25	—	pF
Series Resistance	r_s	$I_F = 10mA$, f = 100MHz	—	7	—	Ω

Note: C_T is measured by 3 terminal method with capacitance bridge.

Marking




CT – VR
f=1MHz
Ta=25°C
TOTAL CAPACITANCE CT (pF)
2
1
0.5
0.3
0.1
1
3
10
30
REVERSE VOLTAGE VR (V)

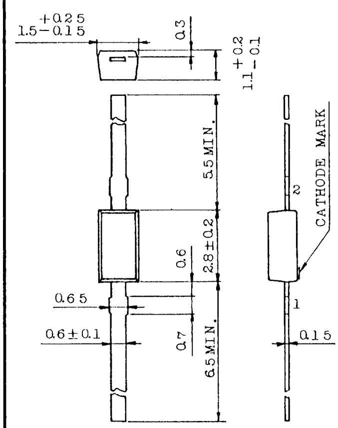

rs – IF
f=0.2GHz
Ta=25°C
0.4
0.6
0.8
1.0
0.1
0.8
0.6
0.4
f=0.2GHz
SERIES RESISTANCE rs (Ω)
2k
1k
500
300
100
50
30
10
5
2
10μ
100μ
1m
10m
FORWARD CURRENT IF (A)

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

1SV186

UHF SHF TUNING

Unit in mm



1. CATHODE
2. ANODE

JEDEC	—
EIAJ	—
TOSHIBA	1-2J1A

Weight : 0.02g

FEATURES:

- High Capacitance Ratio : C2V / C25V = 5.2 (Typ.)
- Low Series Resistance : r_s = 1.2Ω (Typ.)
- Excellent C - V Characteristics, and Small Tracking Error.

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 (R_L = 10kΩ)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	I_R = 1μA	30	—	—	V
Reverse Current	I_R	V_R = 28V	—	—	10	nA
Capacitance	C2V	V_R = 2V, f = 1MHz	3.31	—	4.55	pF
Capacitance	C25V	V_R = 25V, f = 1MHz	0.66	—	0.82	pF
Capacitance Ratio	C2V / C25V	—	4.5	5.2	6.0	—
Series Resistance	r_s	V_R = 1V, f = 470MHz	—	1.2	2.0	Ω

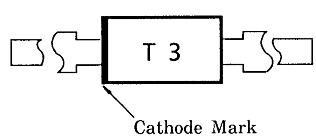
Note 1 : Units are compounded in one package and are matched to 6.0%

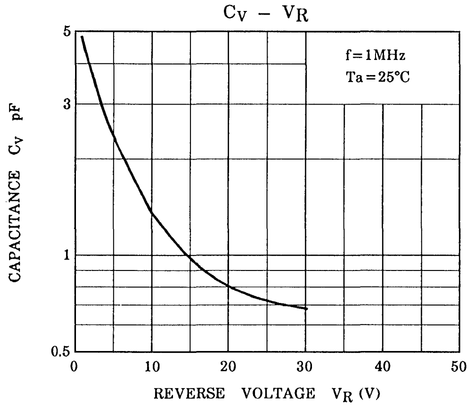
$$\frac{C\,(\mathrm{Max.}) - C\,(\mathrm{Min.})}{C\,(\mathrm{Min.})} \leqq 0.06$$

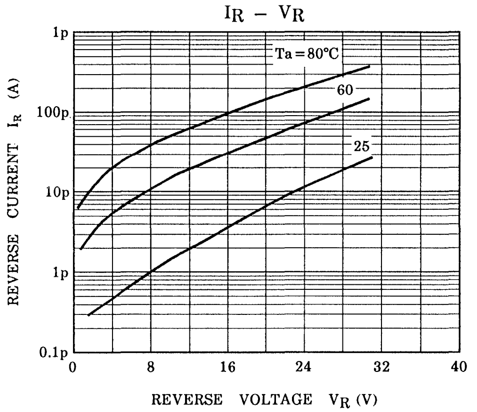
(V_R = 2~25V)

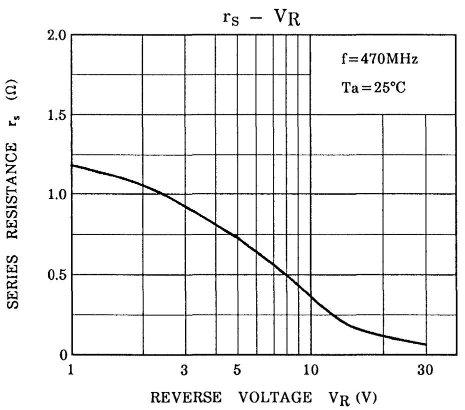
Note 2 : Quantity in a package must be 4 × n pcs. (n ≧ 1)

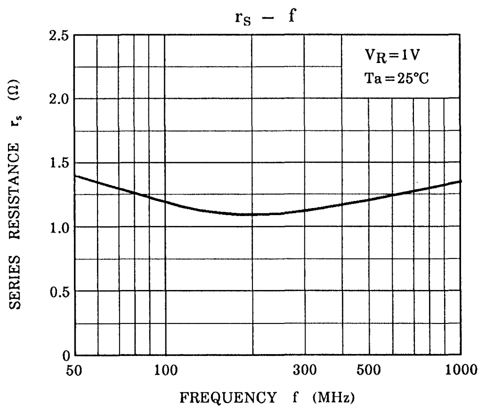
Marking

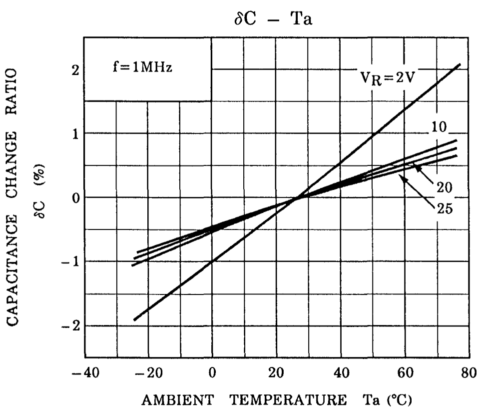












NOTE

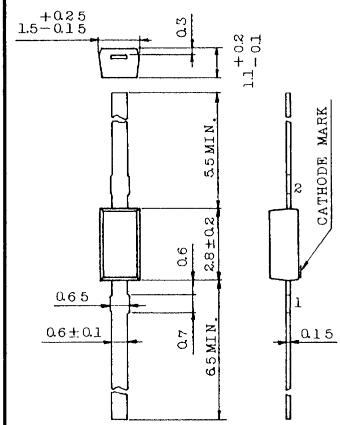
$$\delta C = \frac{C\,(Ta = T°C) - C\,(Ta = 25°C)}{C\,(Ta = 25°C)} \times 100$$

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

1SV204

TV VHF UHF TUNER AFC

Unit in mm



1. CATHODE
2. ANODE

JEDEC	—
EIAJ	—
TOSHIBA	1-2J1A

Weight : 0.02g

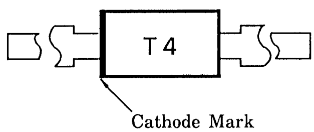
MAXIMUM RATINGS (Ta = 25°C)

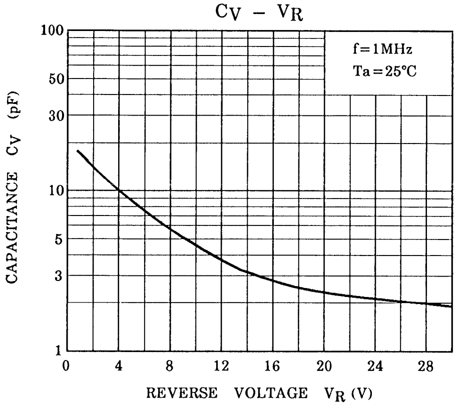
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 ($R_L = 10k\Omega$)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

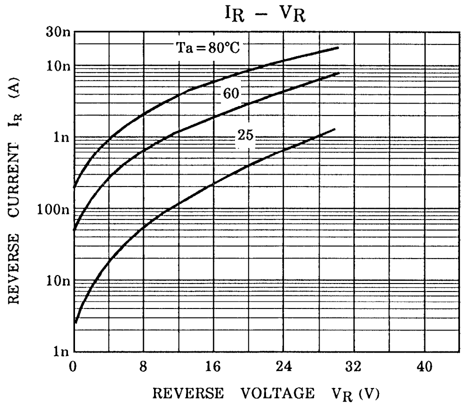
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

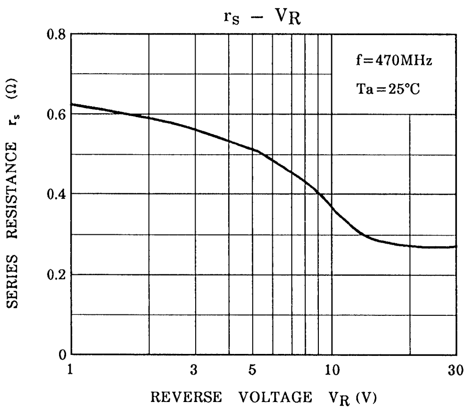
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 1\mu A$	30	—	—	V
Reverse Current	I_R	$V_R = 28V$	—	—	10	nA
Capacitance	C2V	$V_R = 2V$, f=1MHz	10.5	—	16	pF
Capacitance	C10V	$V_R = 10V$, f=1MHz	3.3	—	5.7	pF
Capacitance Ratio	C2V / C10V	—	2.5	—	3.4	—
Series Resistance	r_s	$V_R = 5V$, f=470MHz	—	—	1.2	Ω

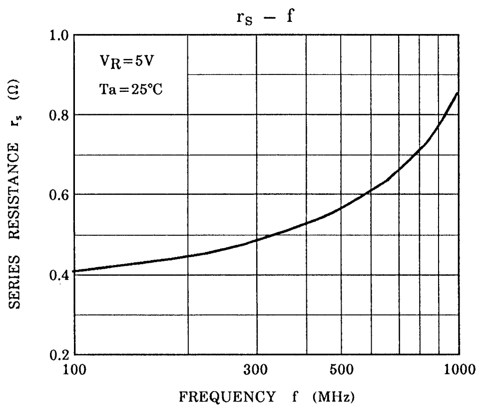
Marking

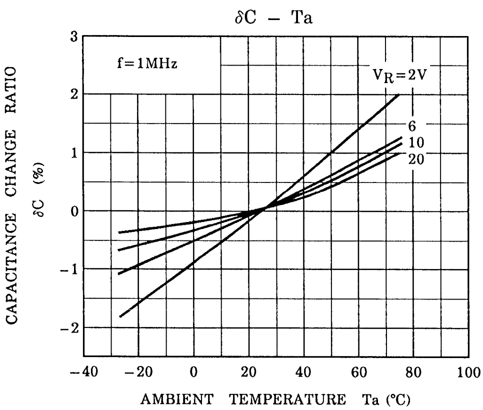












NOTE : $\delta C(\%) = \dfrac{C(Ta) - C(25)}{C(25)} \times 100$

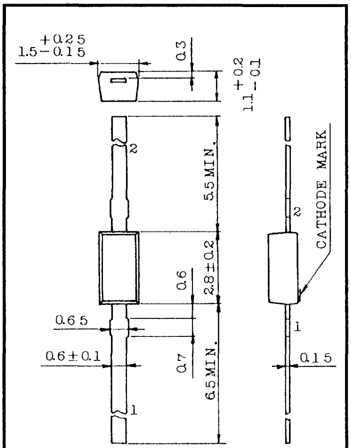
SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

1SV211

CATV TUNING.

- High Capacitance Ratio : C2V / C25V = 12.5 (Typ.)
- Excellent C - V Characteristics, and Small Tracking Error.
- Useful for Small Size Tuner.

Unit in mm



1. CATHODE
2. ANODE

JEDEC	—
EIAJ	—
TOSHIBA	1-2J1A

Weight : 0.02g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 ($R_L = 10k\Omega$)	°C
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 1\mu A$	30	—	—	V
Reverse Current	I_R	$V_R = 28V$	—	—	10	nA
Capacitance	C2V	$V_R = 2V$, f = 1MHz	33	36	39	pF
Capacitance	C25V	$V_R = 25V$, f = 1MHz	2.6	2.88	3.2	pF
Capacitance Ratio	C2V / C25V	—	11.5	12.5	—	—
Series Resistance	r_s	$V_R = 5V$, f = 470MHz	—	0.83	1.0	Ω

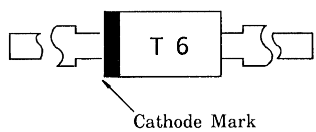
Note 1 : Available in matched group for capacitance to 2.5%.

$$\frac{C\,(\text{Max.}) - C\,(\text{Min.})}{C\,(\text{Min.})} \leqq 0.025$$

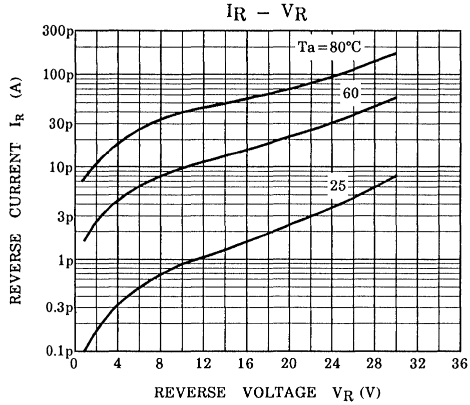
($V_R = 2$~$25V$)

Note 2 : Quantity in a package must be 4 × n pcs. (n≧1)

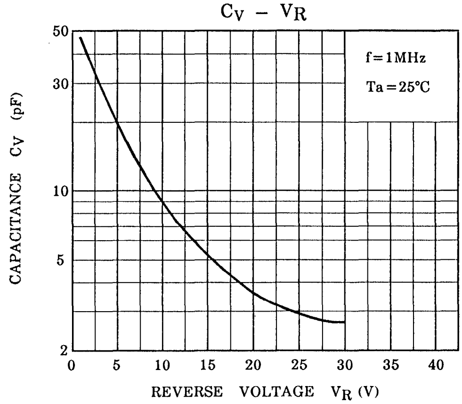
Marking



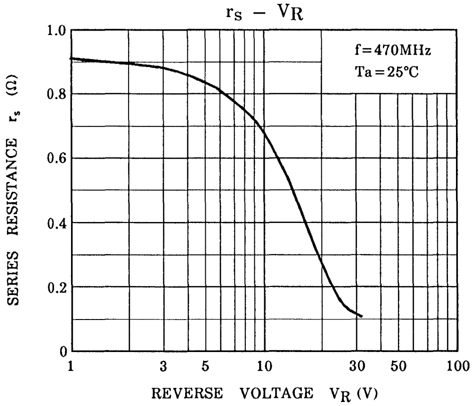
$I_R - V_R$



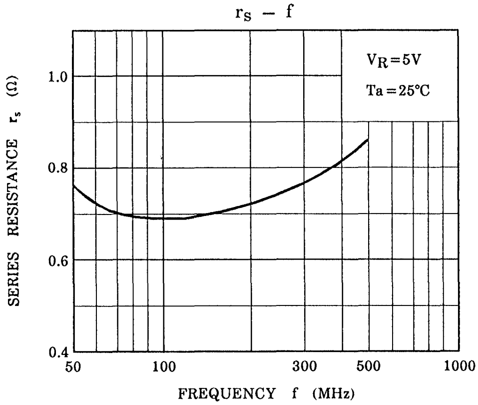
$C_V - V_R$



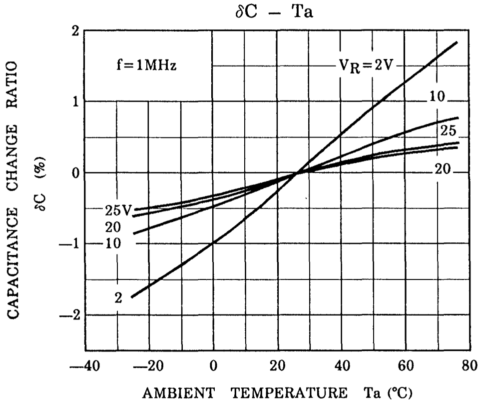
$r_S - V_R$



$r_S - f$



$\delta C - Ta$



NOTE : $\delta C\,(\%) = \dfrac{C\,(Ta) - C\,(25°C)}{C\,(25°C)} \times 100$

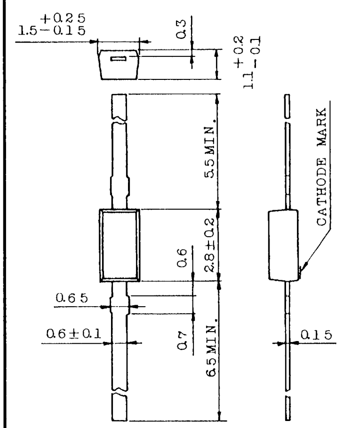
SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

1SV212

VCO FOR UHF BAND RADIO

- Ultra Low Series Resistance: $r_S = 0.2\Omega$ (Typ.)
- Useful for Small Size Set

Unit in mm



1. CATHODE
2. ANODE

JEDEC	—
EIAJ	—
TOSHIBA	1-2J1A

Weight : 0.02g

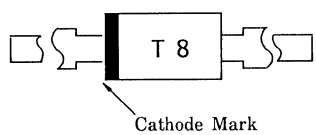
MAXIMUM RATINGS (Ta = 25°C)

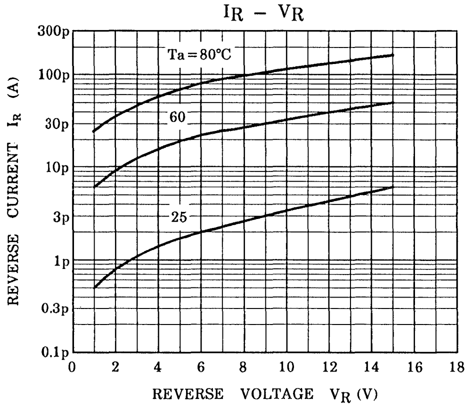
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	15	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

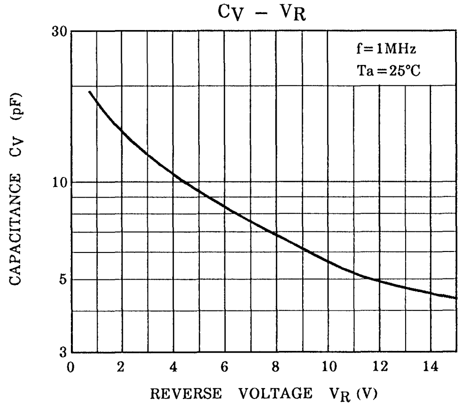
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

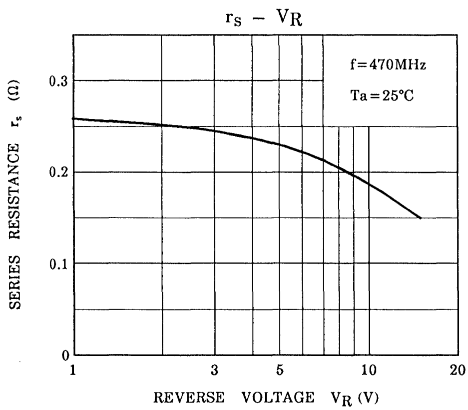
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 1\mu A$	15	—	—	V
Reverse Current	I_R	$V_R = 15V$	—	—	3	nA
Capacitance	C2V	$V_R = 2V$, f=1MHz	14	15	16	pF
Capacitance	C10V	$V_R = 10V$, f=1MHz	5.5	6	6.5	pF
Capacitance Ratio	C2V / C10V	—	2.0	2.5	—	—
Series Resistance	r_S	$V_R = 5V$, f=470MHz	—	0.2	0.4	Ω

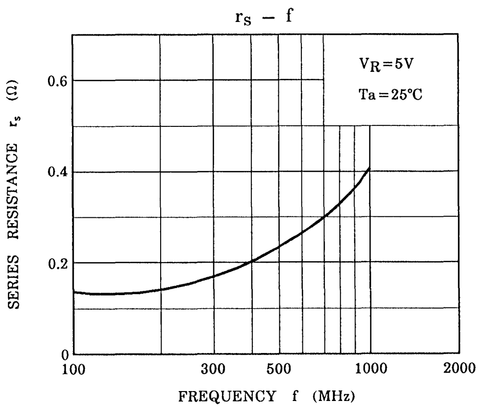
Marking

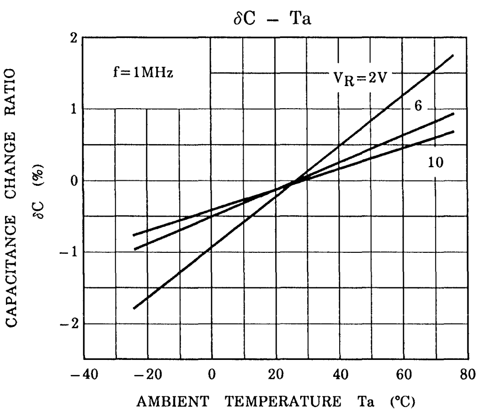












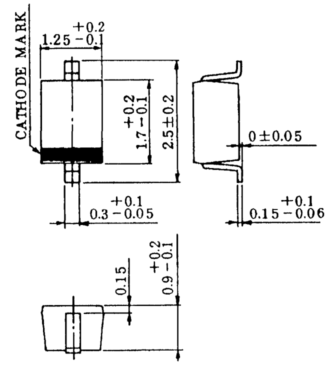
NOTE : $\delta C\,(\%) = \dfrac{C\,(Ta) - C\,(25°C)}{C\,(25°C)} \times 100$

1SV214

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

TV TUNING.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1E1A

Weight : 0.004g

- High Capacitance Ratio : C2V / C25V = 6.5 (Typ.)
- Low Series Resistance : $r_S = 0.4\Omega$ (Typ.)
- Excellent C-V Characteristics, and Small Tracking Error.
- Useful for Small Size Tuner.

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 ($R_L = 10k\Omega$)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

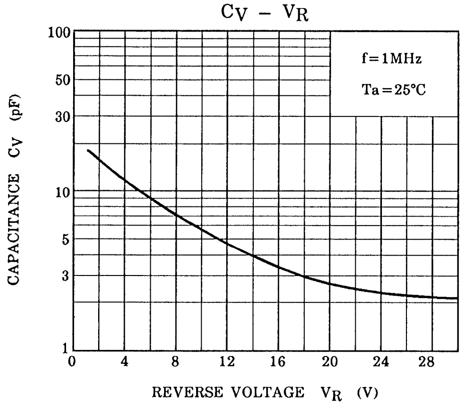
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 1\mu A$	30	—	—	V
Reverse Current	I_R	$V_R = 28V$	—	—	10	nA
Capacitance	C2V	$V_R = 2V$, f = 1MHz	14.16	—	16.25	pF
Capacitance	C25V	$V_R = 25V$, f = 1MHz	2.11	—	2.43	pF
Capacitance Ratio	C2V / C25V	—	5.90	6.50	7.15	—
Series Resistance	r_S	$V_R = 5V$, f = 470MHz	—	0.4	0.55	Ω

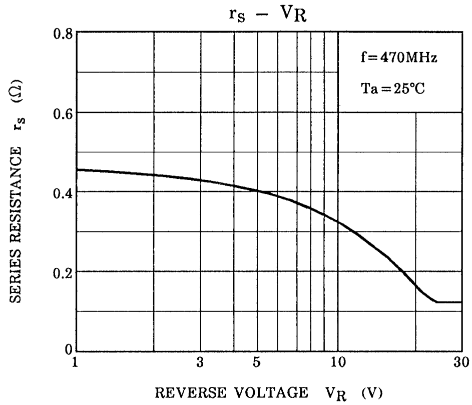
Note 1 : Units are compounded in one package and are matched to 2.5%.

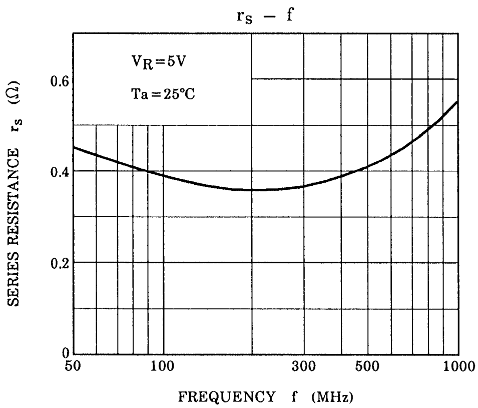
$$\frac{C(Max.) - C(Min.)}{C(Min.)} \leqq 0.025$$

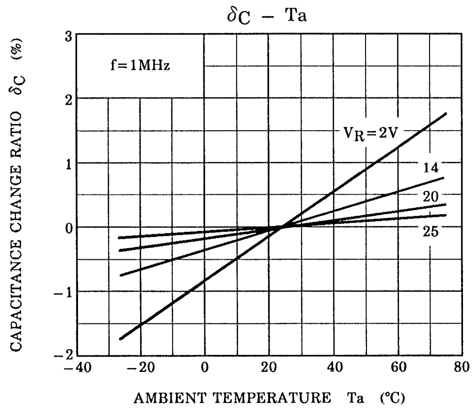
($V_R = 2\sim25V$)

Marking









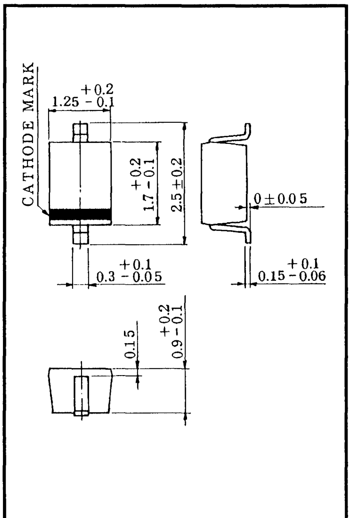
NOTE : $\delta_C = \frac{C(Ta) - C(25)}{C(25)} \times 100$

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

1SV215

CATV TUNING.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1E1A

Weight : 0.004g

- High Capacitance Ratio : $C_{2V}/C_{25V}=10.5$ (Typ.)
- Low Series Resistance : $r_s=0.6\Omega$ (Typ.)
- Excellent C-V Characteristics, and Small Tracking Error.
- Useful for Small Size Tuner.

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 ($R_L=10k\Omega$)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

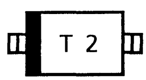
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R=1\mu A$	30	—	—	V
Reverse Current	I_R	$V_R=28V$	—	—	10	nA
Capacitance	C_{2V}	$V_R=2V$, f=1MHz	26	—	32	pF
Capacitance	C_{25V}	$V_R=25V$, f=1MHz	2.5	—	3.2	pF
Capacitance Ratio	C_{2V}/C_{25V}	—	9.5	10.5	—	—
Series Resistance	r_s	$V_R=5V$, f=470MHz	—	0.6	0.8	Ω

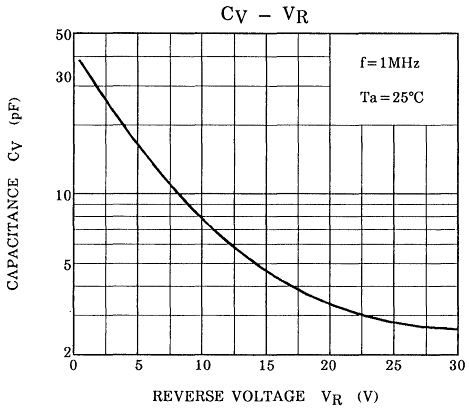
Note 1 : Available in matched group for capacitance to 2.5%.

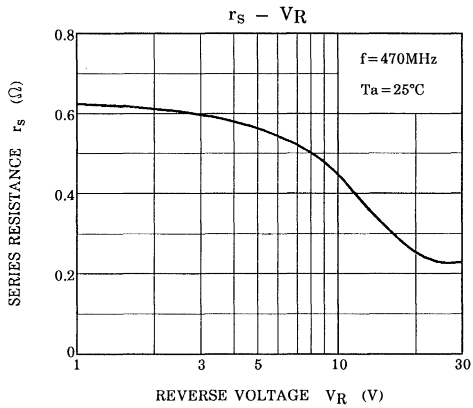
$$\frac{C\,(\text{Max.}) - C\,(\text{Min.})}{C\,(\text{Min.})} \leqq 0.025$$

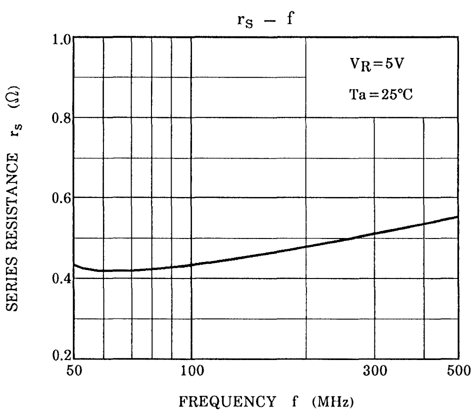
($V_R=2\sim25V$)

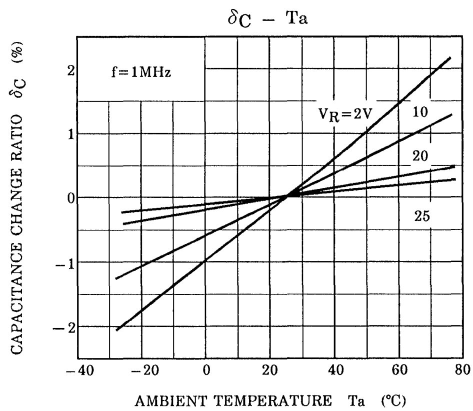
Marking











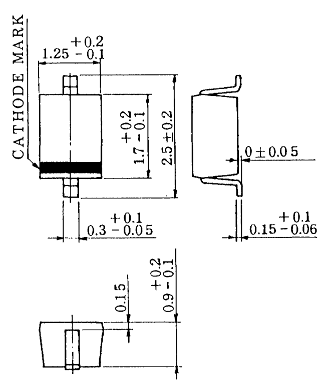
$$\text{NOTE : } \delta C\,(\%) = \frac{C\,(Ta) - C\,(25)}{C\,(25)} \times 100$$

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

1SV216

TV VHF UHF TUNER AFC

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1E1A

Weight : 0.004g

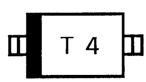
MAXIMUM RATINGS (Ta = 25°C)

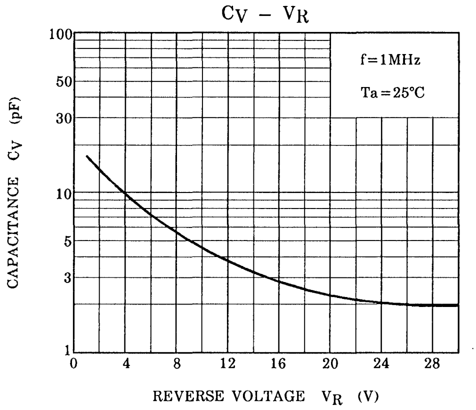
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 ($R_L = 10k\Omega$)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

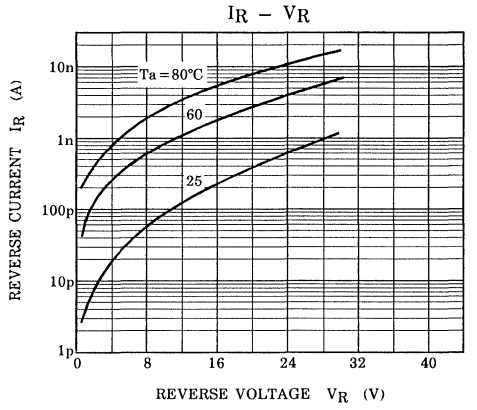
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

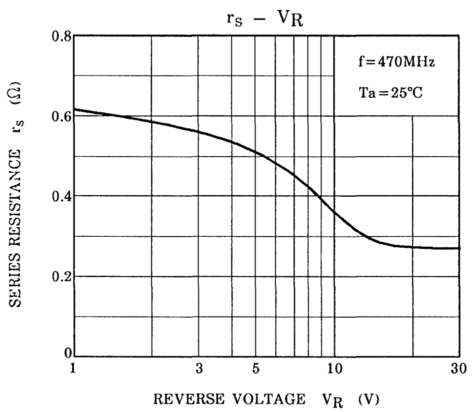
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 1\mu A$	30	—	—	V
Reverse Current	I_R	$V_R = 28V$	—	—	10	nA
Capacitance	C_{2V}	$V_R = 2V$, f=1MHz	10.5	—	16	pF
Capacitance	C_{10V}	$V_R = 10V$, f=1MHz	3.3	—	5.7	pF
Capacitance Ratio	C_{2V}/C_{10V}	—	2.5	—	3.4	—
Series Resistance	r_s	$V_R = 5V$, f=470MHz	—	0.55	1.2	Ω

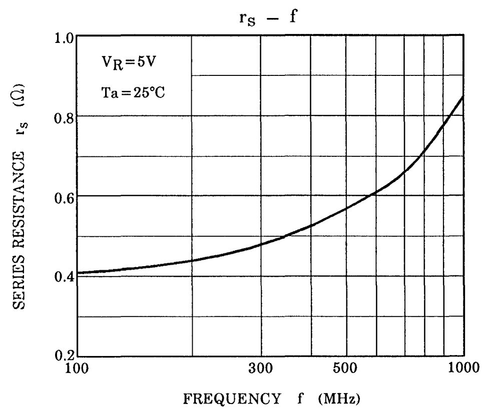
Marking

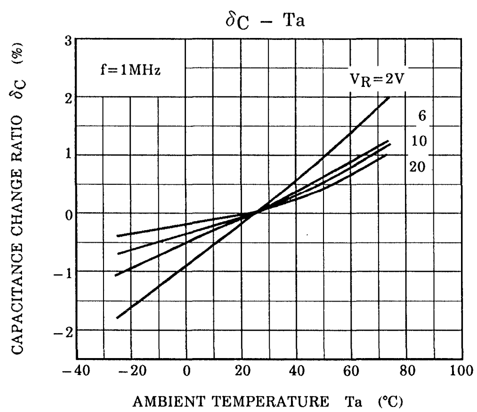












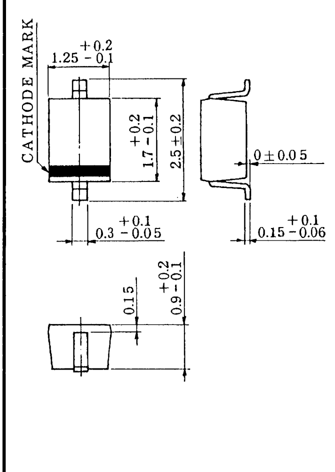
NOTE : $\delta_C(\%) = \dfrac{C(Ta) - C(25)}{C(25)} \times 100$

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

1SV217

CATV TUNING.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1E1A

Weight : 0.004g

- High Capacitance Ratio : $C_{2V}/C_{25V}=12.5$ (Typ.)
- Excellent C-V Characteristics, and Small Tracking Error.
- Useful for Small Size Tuner.

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 ($R_L=10k\Omega$)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

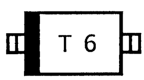
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R=1\mu A$	30	—	—	V
Reverse Current	I_R	$V_R=28V$	—	—	10	nA
Capacitance	C_{2V}	$V_R=2V$, f=1MHz	33	36	39	pF
Capacitance	C_{25V}	$V_R=25V$, f=1MHz	2.6	2.88	3.2	pF
Capacitance Ratio	C_{2V}/C_{25V}	—	11.5	12.5	—	—
Series Resistance	r_s	$V_R=5V$, f=470MHz	—	0.83	1.0	Ω

Note 1 : Available in matched group for capacitance to 2.5%.

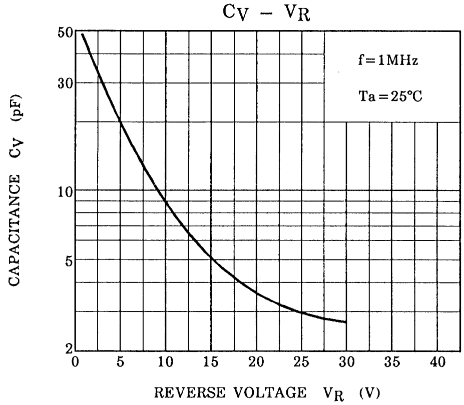
$$\frac{C\,(\text{Max.}) - C\,(\text{Min.})}{C\,(\text{Min.})} \leqq 0.025$$

$(V_R=2\sim25V)$

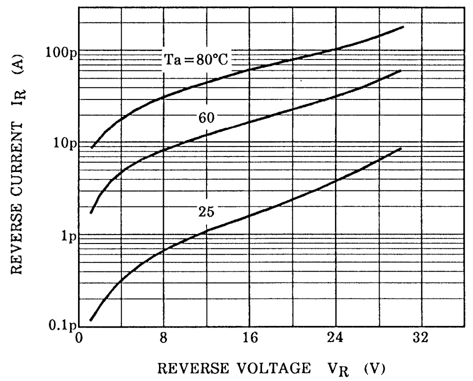
Marking



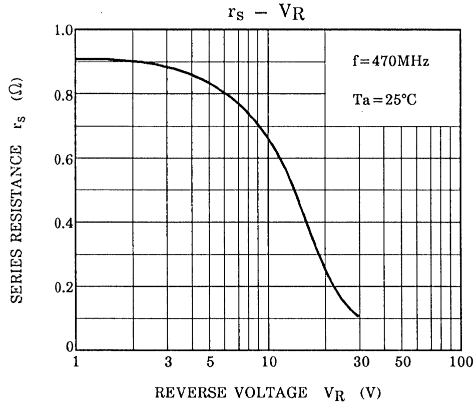
$C_V - V_R$



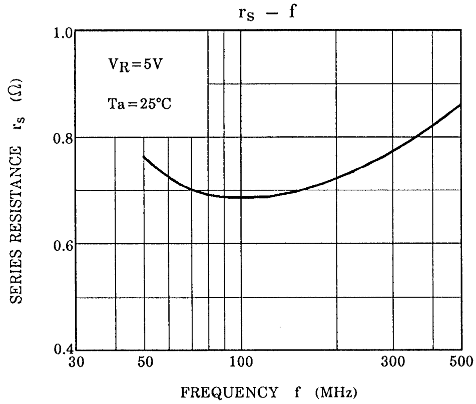
$I_R - V_R$



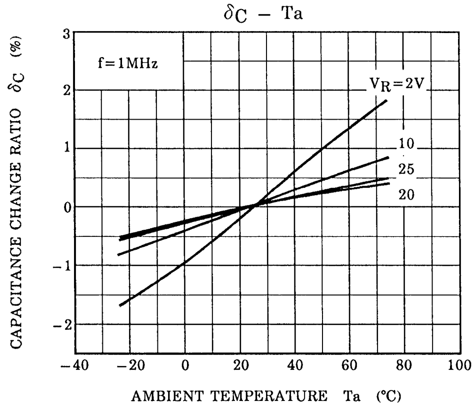
$r_s - V_R$



$r_s - f$



$\delta_C - Ta$



NOTE : $\delta_C\,(\%) = \dfrac{C\,(Ta) - C\,(25)}{C\,(25)} \times 100$

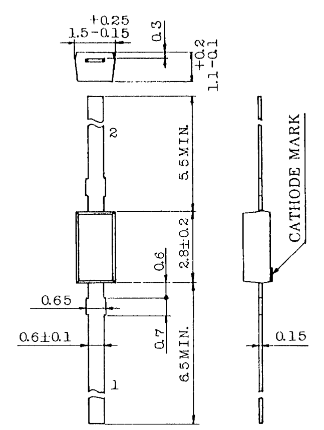
SILICON EPITAXIAL PLANAR TYPE VARIABLE CAPACITANCE DIODE

1SV224

CATV CONVERTER 1st OSC TUNING.

- High Capacitance Ratio : $C_{2V}/C_{20V}=8$ (Typ.)
- Low Series Resistance : $r_s=0.73\Omega$ (Typ.)
- Excellent C-V Characteristics, and Small Tracking Error.
- Useful for Small Size Tuner.

Unit in mm



1. CATHODE
2. ANODE

JEDEC	—
EIAJ	—
TOSHIBA	1-2J1A

Weight : 0.02g

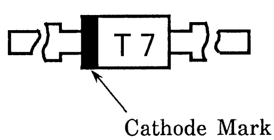
MAXIMUM RATINGS (Ta = 25°C)

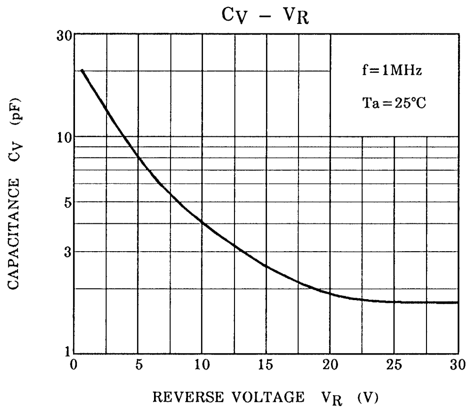
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 ($R_L=10k\Omega$)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

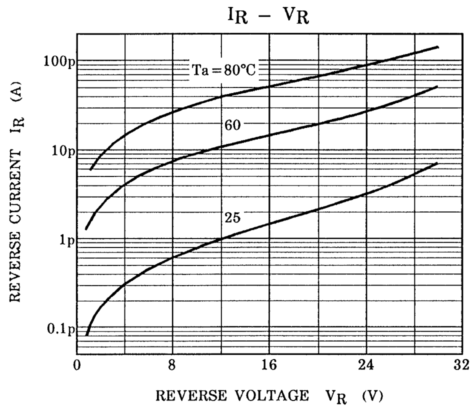
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

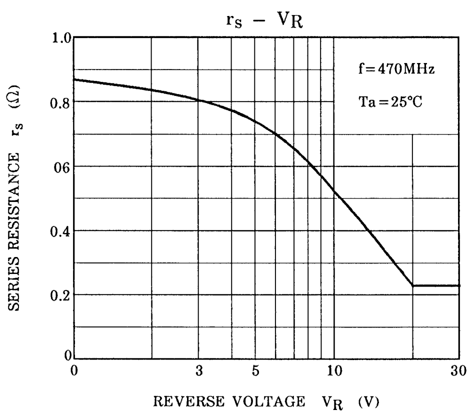
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R=1\mu A$	30	—	—	V
Reverse Current	I_R	$V_R=28V$	—	—	10	nA
Capacitance	C_{2V}	$V_R=2V$, f=1MHz	13.9	15	16.1	pF
Capacitance	C_{20V}	$V_R=20V$, f=1MHz	1.7	1.9	2.1	pF
Capacitance Ratio	C_{2V}/C_{20V}	—	7.1	8	—	—
Series Resistance	r_s	$V_R=5V$, f=470MHz	—	0.73	0.9	Ω

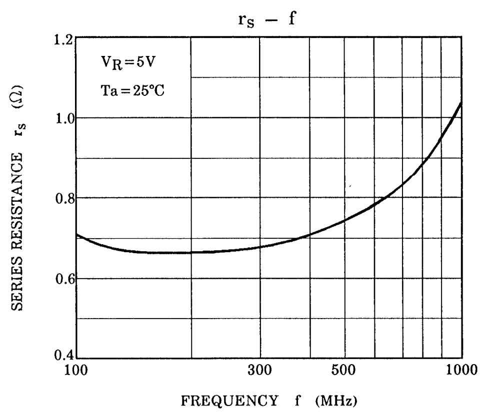
Marking

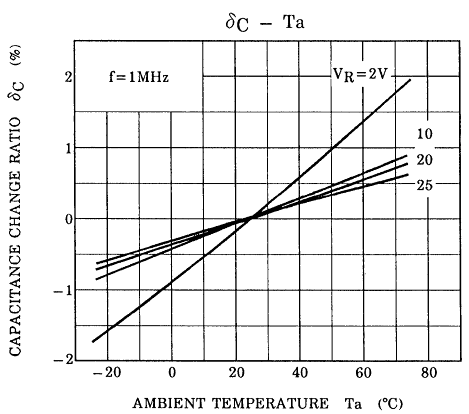












NOTE : $\delta_C = \frac{C(Ta) - C(25)}{C(25)} \times 100$

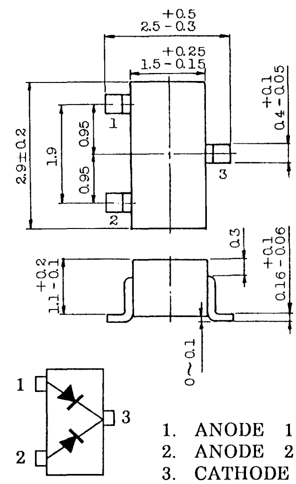
SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

1SV225

ELECTRONIC TUNING APPLICATIONS OF FM RECEIVERS.

- Low Series Resistance : $r_S = 0.35$ (Typ.)
- Small Package

Unit in mm



1. ANODE 1
2. ANODE 2
3. CATHODE

JEDEC	—
EIAJ	SC-59
TOSHIBA	1-3G1F

Weight : 0.013g

MAXIMUM RATINGS (Ta = 25°C)

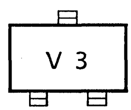
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	32	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

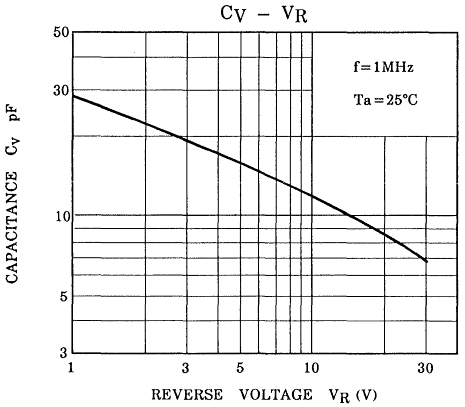
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

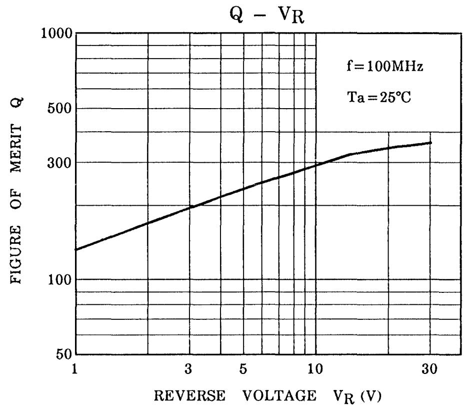
CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 10\mu A$		32	—	—	V
Reverse Current	I_R	$V_R = 30V$		—	—	50	nA
Capacitance	C_{3V}	$V_R = 3V$, f=1MHz	(Note)	18.5	19.7	21	pF
Capacitance	C_{30V}	$V_R = 30V$, f=1MHz	(Note)	6.6	7.2	7.7	pF
Capacitance Ratio	C_{3V}/C_{30V}	—	(Note)	2.6	—	2.9	—
Series Resistance	r_S	$V_R = 3V$, f=100MHz	(Note)	—	0.35	0.5	Ω

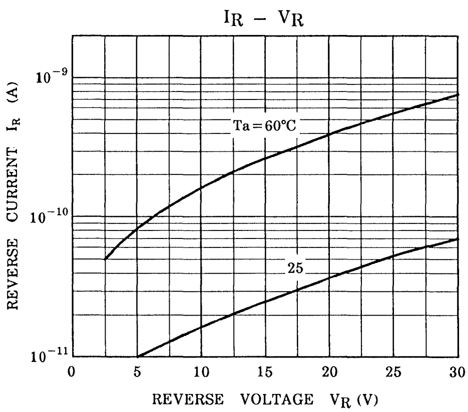
Note: Characteristic between Anode 1 and Anode 2

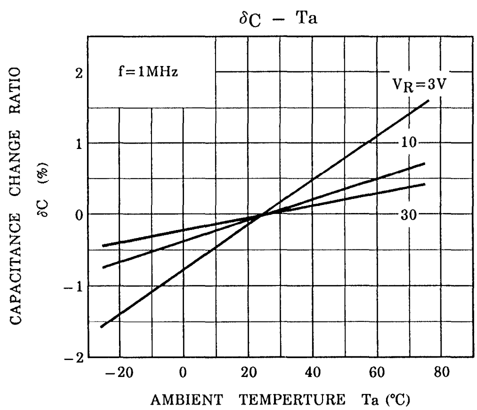
Marking











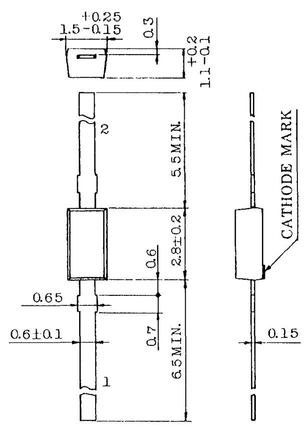
NOTE : $\delta C = \dfrac{C(Ta) - C(25)}{C(25)} \times 100$

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

1SV226

CATV TUNING.

Unit in mm



1. CATHODE
2. ANODE

JEDEC	—
EIAJ	—
TOSHIBA	1-2J1A

Weight : 0.02g

- High Capacitance Ratio : $C_{2V}/C_{25V}=15$ (Typ.)
- Excellent C-V Characteristics, and Small Tracking Error.
- Useful for Small Size Tuner.

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 ($R_L=10k\Omega$)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R=1\mu A$	30	—	—	V
Reverse Current	I_R	$V_R=28V$	—	—	10	nA
Capacitance	C_{2V}	$V_R=2V$, f=1MHz	41.0	45.0	49.5	pF
Capacitance	C_{25V}	$V_R=25V$, f=1MHz	2.7	3.0	3.4	pF
Capacitance Ratio	C_{2V}/C_{25V}	—	14	15	—	—
Series Resistance	r_s	$V_R=5V$, f=470MHz	—	1.05	1.25	Ω

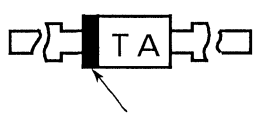
Note 1 : Available in matched group for capacitance to 2.5%.

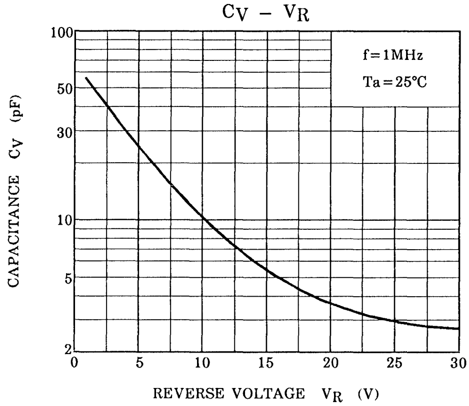
$$\frac{C\,(Max.)-C\,(Min.)}{C\,(Min.)}\leqq 0.025$$

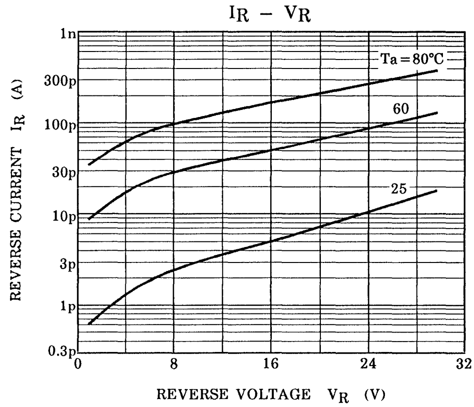
($V_R=2\sim25V$)

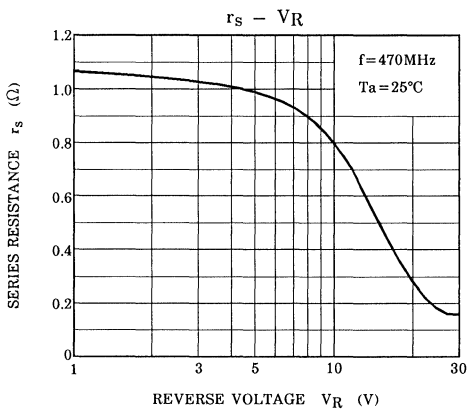
Note 2 : Quantity in a package must be 4×n pcs. (n≧1)

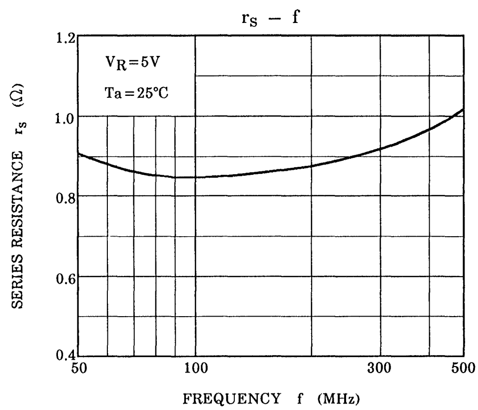
Marking

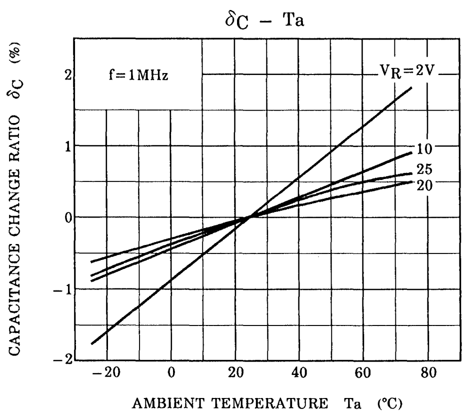












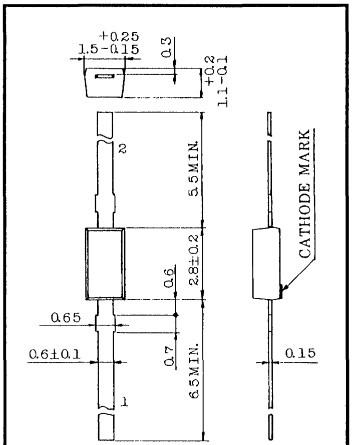
NOTE : $\delta_C(\%) = \dfrac{C(Ta) - C(25)}{C(25)} \times 100$

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

1SV227

CATV TUNING.

Unit in mm



1. CATHODE
2. ANODE

JEDEC	—
EIAJ	—
TOSHIBA	1-2J1A

Weight : 0.02g

- High Capacitance Ratio : $C_{2V} / C_{25V} = 10.5$ (Typ.)
- Excellent C-V Characteristics, and Small Tracking Error.
- Useful for Small Size Tuner.

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 ($R_L = 10k\Omega$)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 1\mu A$	30	—	—	V
Reverse Current	I_R	$V_R = 28V$	—	—	10	nA
Capacitance	C_{2V}	$V_R = 2V$, f = 1MHz	28	30.3	32	pF
Capacitance	C_{25V}	$V_R = 25V$, f = 1MHz	2.75	2.90	3.10	pF
Capacitance Ratio	C_{2V} / C_{25V}	—	10	10.5	—	—
Series Resistance	r_s	$V_R = 5V$, f = 470MHz	—	0.55	0.70	Ω

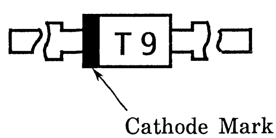
Note 1 : Available in matched group for capacitance to 2.0%.

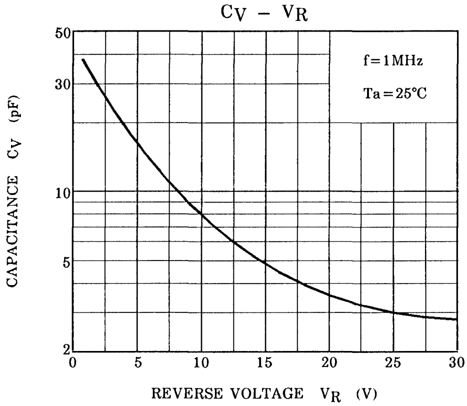
$$\frac{C\,(\text{Max.}) - C\,(\text{Min.})}{C\,(\text{Min.})} \leqq 0.02$$

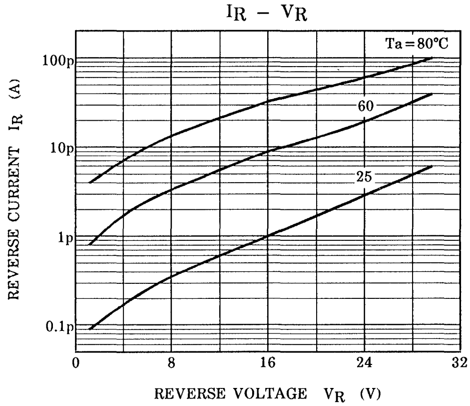
($V_R = 2\sim25V$)

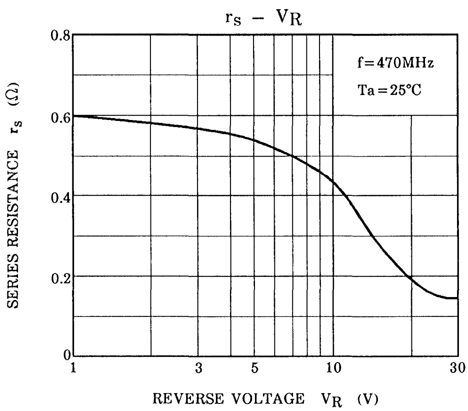
Note 2 : Quantity in a package must be 4×n pcs. (n≧1)

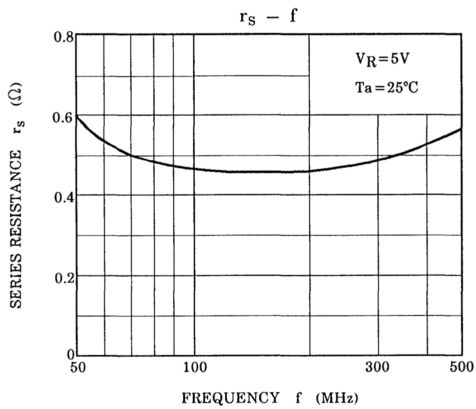
Marking

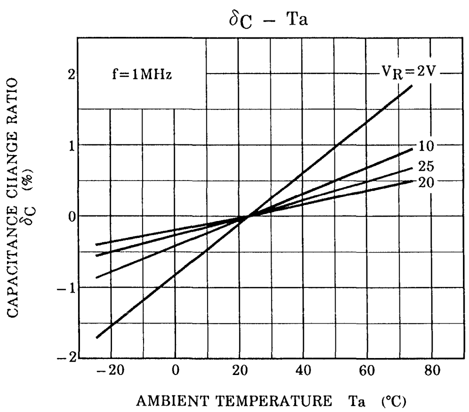












NOTE : $\delta_C(\%) = \dfrac{C(Ta) - C(25)}{C(25)} \times 100$

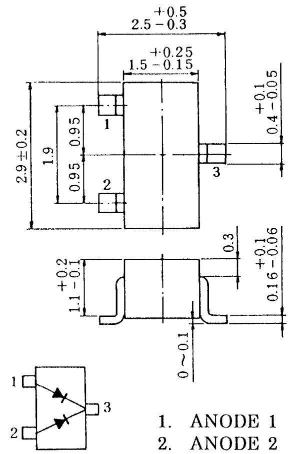
SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

1SV228

ELECTRONIC TUNING APPLICATIONS OF FM RECEIVERS.

- Low r_S : $r_S = 0.3\Omega$ (Typ.)
- Small Package

Unit in mm



1. ANODE 1
2. ANODE 2
3. CATHODE

JEDEC	—
EIAJ	SC-59
TOSHIBA	1-3G1F

Weight : 0.13g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	15	V
Junction Temperature	T_j	125	°C
Storage Temperature	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 10\mu A$	15	—	—	V
Reverse Current	I_R	$V_R = 15V$	—	—	10	nA
Capacitance	C_{3V}	$V_R = 3V$, f = 1MHz (Note)	28.5	30.5	32.5	pF
Capacitance	C_{8V}	$V_R = 8V$, f = 1MHz (Note)	11.7	12.7	13.7	pF
Capacitance Ratio	C_{3V}/C_{8V}	— (Note)	2.1	—	2.6	—
Series Resistance	r_S	$V_R = 3V$, f = 100MHz (Note)	—	0.3	0.5	Ω

(Note) : Characteristics between Anode 1 and Anode 2

Marking

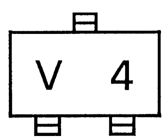


Table 1 : ADDRESS CLASSIFICATION OF CAPACITANCE
TEST CONDITION : f = 1MHz, Ta = 25°C

No.	C_{2V}	C_{3V}	C_{6V}	C_{8V}
1	34.70~35.74	28.60~29.45	16.80~17.30	11.72~12.07
2	35.56~36.62	29.31~30.18	17.21~17.72	12.01~12.37
3	36.44~37.53	30.03~30.93	17.63~18.15	12.31~12.67
4	37.35~38.47	30.77~31.69	18.06~18.60	12.61~12.98
5	38.27~39.41	31.53~32.47	18.50~19.05	12.92~13.30
6	—	—	18.95~19.51	13.23~13.62

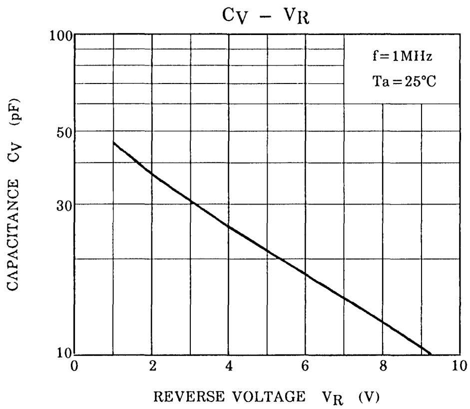
(1) Units are compounded in one package and are matched to 3%.

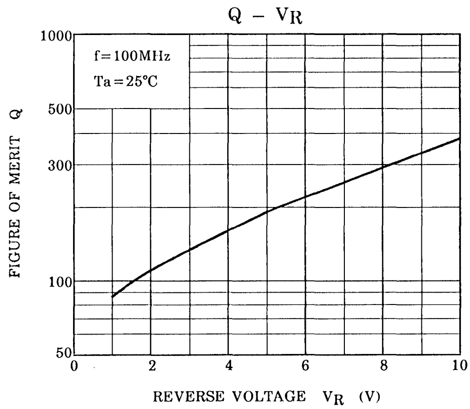
$$\frac{C\,(\text{Max.}) - C\,(\text{Min.})}{C\,(\text{Min.})} \leqq 0.03\ (V_R = 2 \sim 8\text{V})$$

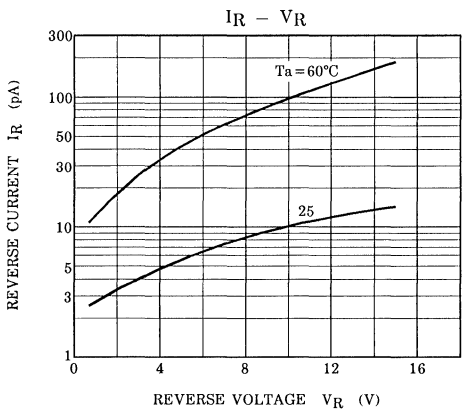
and capacitance is classified as Table 1.

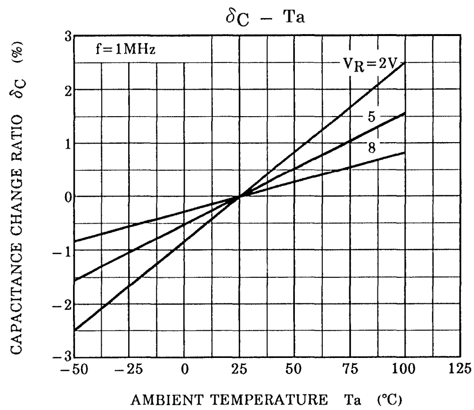
(2) C_{2V}, C_{3V}, C_{6V}, C_{8V} are A1-A2 capacitance.

(3) The tolerance of address is ±1 address.









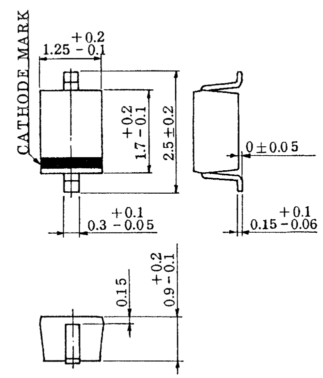
$$\text{NOTE : } \delta_C (\%) = \frac{C(Ta) - C(25)}{C(25)} \times 100$$

1SV229

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

VCO FOR UHF BAND RADIO

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1E1A

Weight : 0.004g

- Ultra Low Series Resistance : $r_S = 0.2\Omega$ (Typ.)
- Useful for Small Size Set

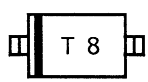
MAXIMUM RATINGS (Ta = 25°C)

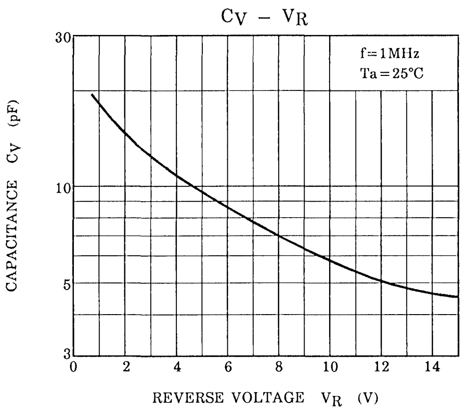
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	15	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

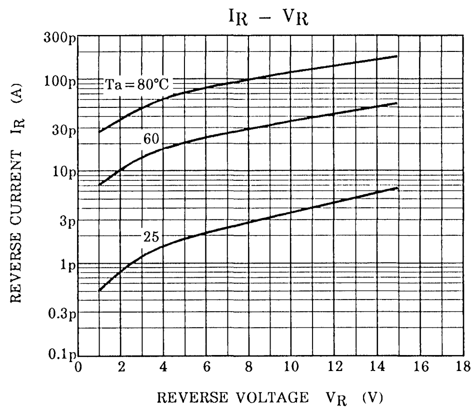
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

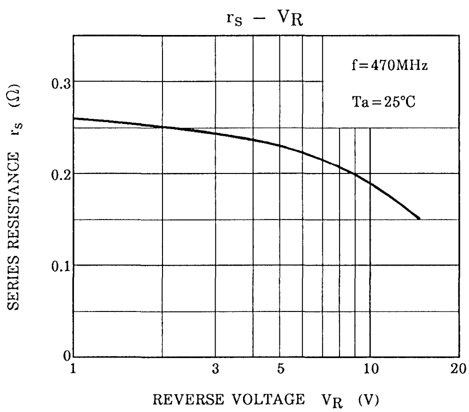
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 1\mu A$	15	—	—	V
Reverse Current	I_R	$V_R = 15V$	—	—	3	nA
Capacitance	C_{2V}	$V_R = 2V$, f = 1MHz	14	15	16	pF
Capacitance	C_{10V}	$V_R = 10V$, f = 1MHz	5.5	6	6.5	pF
Capacitance Ratio	C_{2V} / C_{10V}	—	2.0	2.5	—	—
Series Resistance	r_s	$V_R = 5V$, f = 470MHz	—	0.2	0.4	Ω

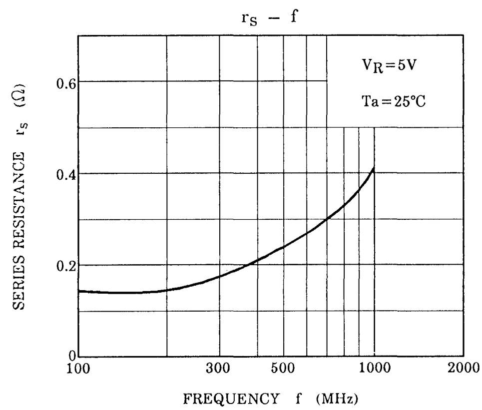
Marking

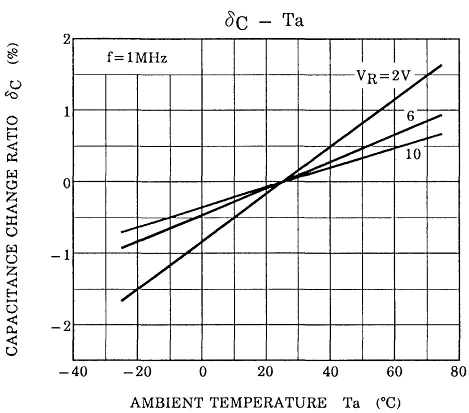












NOTE : $\delta_C(\%) = \dfrac{C(Ta) - C(25°C)}{C(25°C)} \times 100$

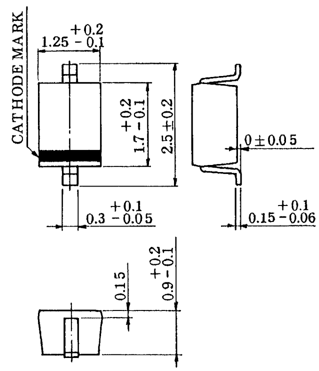
1SV230

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

CATV CONVERTER 1st OSC TUNING.

- High Capacitance Ratio : $C_{2V} / C_{20V} = 8$ (Typ.)
- Low Series Resistance : $r_s = 0.73\Omega$ (Typ.)
- Useful for Small Size Tuner.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1E1A

Weight : 0.004g

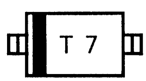
MAXIMUM RATINGS (Ta = 25°C)

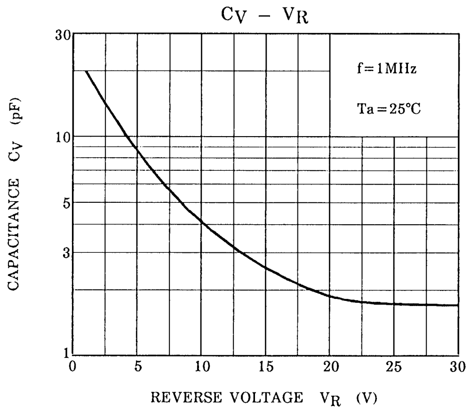
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 ($R_L = 10k\Omega$)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

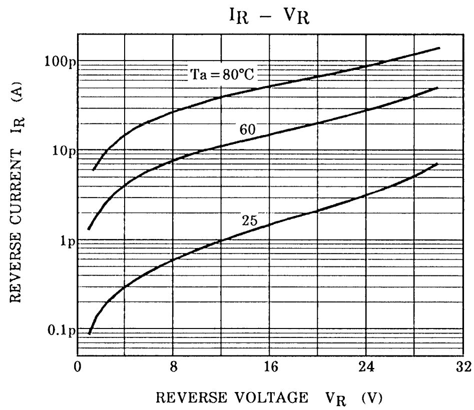
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

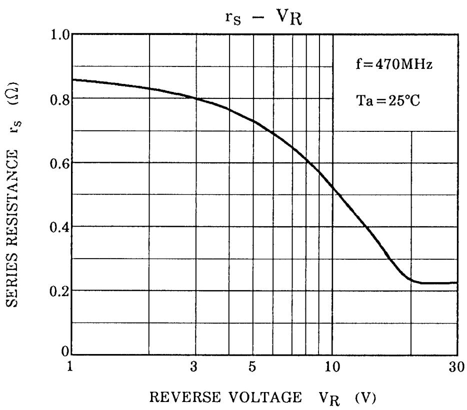
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 1\mu A$	30	—	—	V
Reverse Current	I_R	$V_R = 28V$	—	—	10	nA
Capacitance	C_{2V}	$V_R = 2V$, f = 1MHz	13.9	15	16.1	pF
Capacitance	C_{20V}	$V_R = 20V$, f = 1MHz	1.7	1.9	2.1	pF
Capacitance Ratio	C_{2V} / C_{20V}	—	7.1	8	—	—
Series Resistance	r_s	$V_R = 5V$, f = 470MHz	—	0.73	0.9	Ω

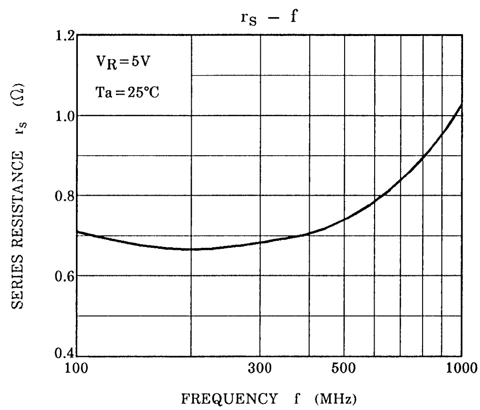
Marking

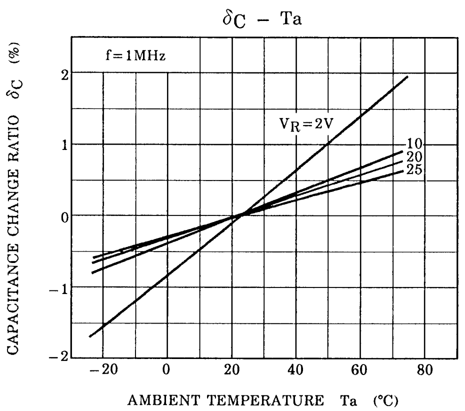












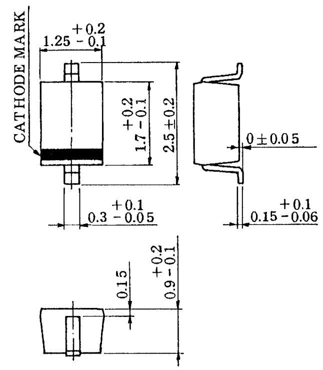
NOTE : $\delta_C\,(\%) = \dfrac{C\,(Ta) - C\,(25)}{C\,(25)} \times 100$

1SV231

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

CATV TUNING.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1E1A

Weight : 0.004g

- High Capacitance Ratio : $C_{2V} / C_{25V} = 15$ (Typ.)
- Excellent C-V Characteristics, and Small Tracking Error.
- Useful for Small Size Tuner.

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 ($R_L = 10k\Omega$)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

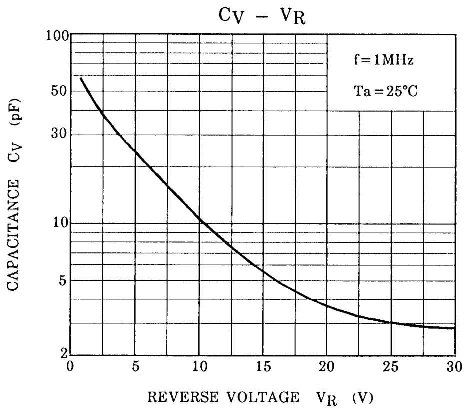
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 1\mu A$	30	—	—	V
Reverse Current	I_R	$V_R = 28V$	—	—	10	nA
Capacitance	C_{2V}	$V_R = 2V$, f = 1MHz	41.0	45.0	49.5	pF
Capacitance	C_{25V}	$V_R = 25V$, f = 1MHz	2.7	3.0	3.4	pF
Capacitance Ratio	C_{2V} / C_{25V}	—	14	15	—	—
Series Resistance	r_s	$V_R = 5V$, f = 470MHz	—	1.05	1.25	Ω

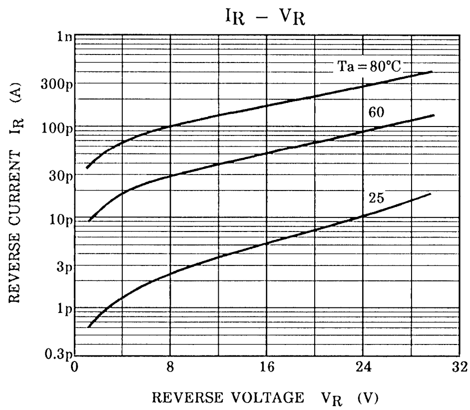
Note 1 : Available in matched group for capacitance to 2.5%.

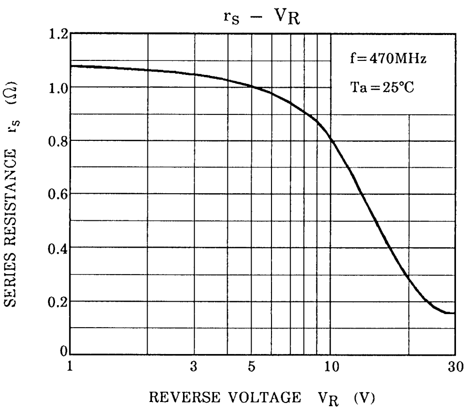
$$\frac{C\,(\text{Max.}) - C\,(\text{Min.})}{C\,(\text{Min.})} \leqq 0.025$$

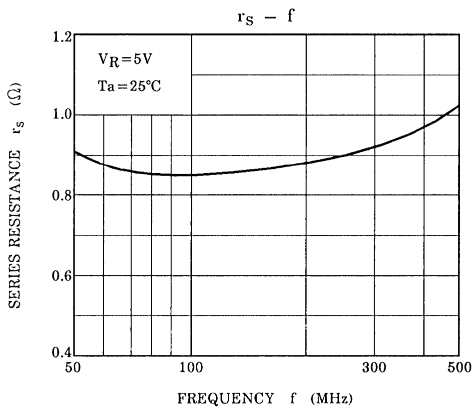
($V_R = 2 \sim 25V$)

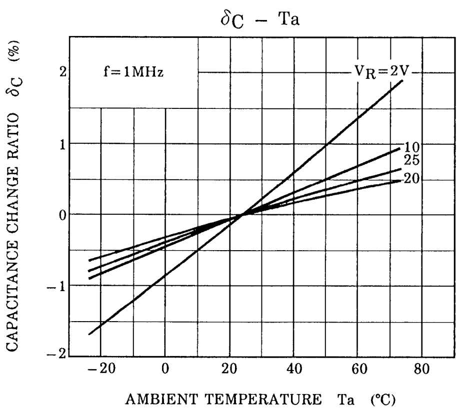
Marking











NOTE : $\delta_C(\%) = \dfrac{C(Ta) - C(25)}{C(25)} \times 100$

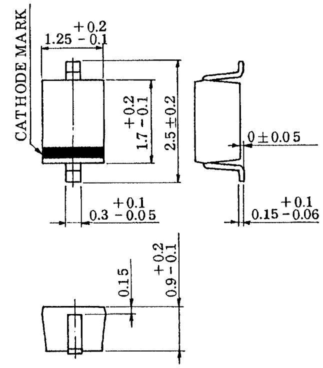
1SV232

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

CATV TUNING.

- High Capacitance Ratio : $C_{2V}/C_{25V}=10.5$ (Typ.)
- Excellent C-V Characteristics, and Small Tracking Error.
- Useful for Small Size Tuner.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1E1A

Weight : 0.004g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 ($R_L=10k\Omega$)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

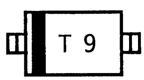
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R=1\mu A$	30	—	—	V
Reverse Current	I_R	$V_R=28V$	—	—	10	nA
Capacitance	C_{2V}	$V_R=2V$, f=1MHz	28	30.3	32	pF
Capacitance	C_{25V}	$V_R=25V$, f=1MHz	2.75	2.90	3.10	pF
Capacitance Ratio	C_{2V}/C_{25V}	—	10	10.5	—	—
Series Resistance	r_s	$V_R=5V$, f=470MHz	—	0.55	0.70	Ω

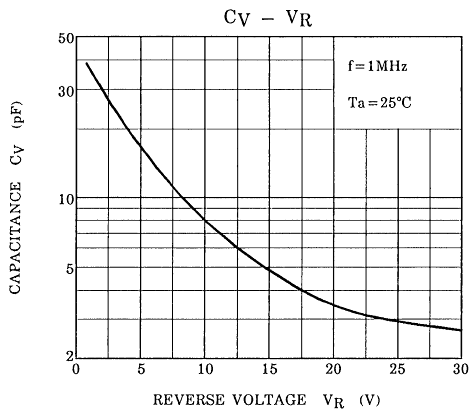
Note 1 : Available in matched group for capacitance to 2.0%.

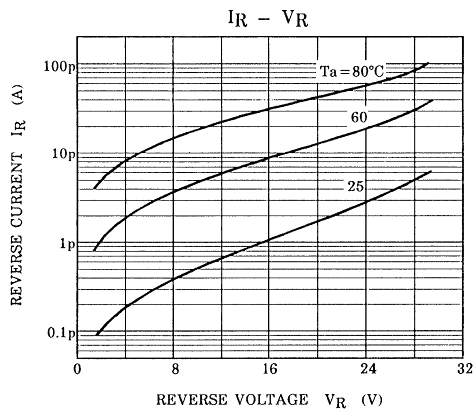
$$\frac{C\,(\text{Max.}) - C\,(\text{Min.})}{C\,(\text{Min.})} \leqq 0.02$$

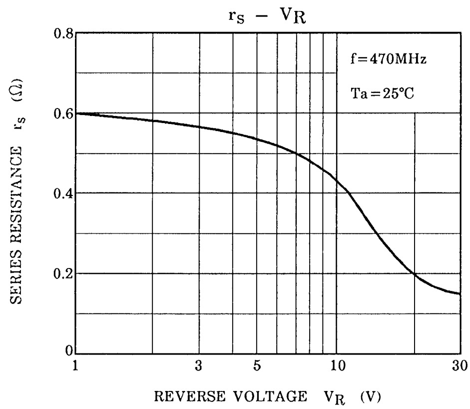
($V_R=2\sim25V$)

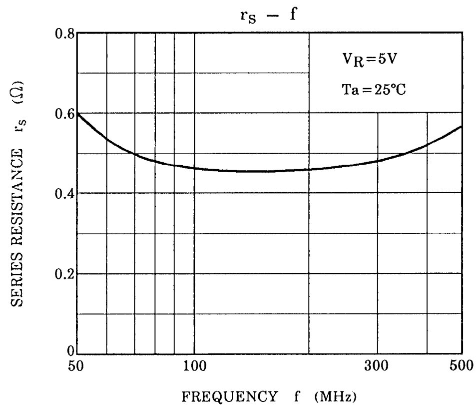
Marking

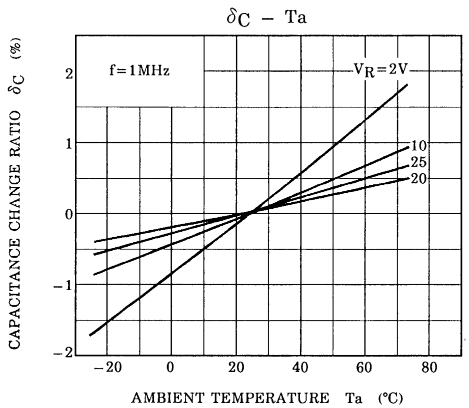












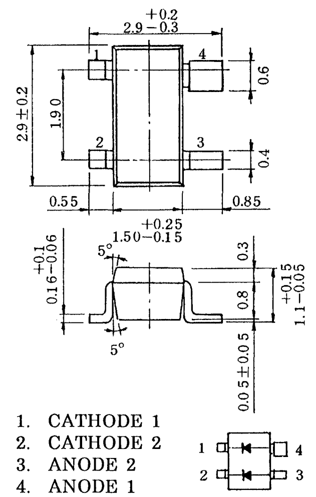
NOTE : $\delta_C\,(\%) = \dfrac{C\,(Ta) - C\,(25)}{C\,(25)} \times 100$

1SV237

SILICON EPITAXIAL PIN TYPE DIODE

VHF~UHF BAND RF ATTENUATOR APPLICATIONS.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-3J1A

Weight : 0.013g

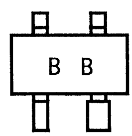
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	50	V
Forward Current	I_F	50	mA
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

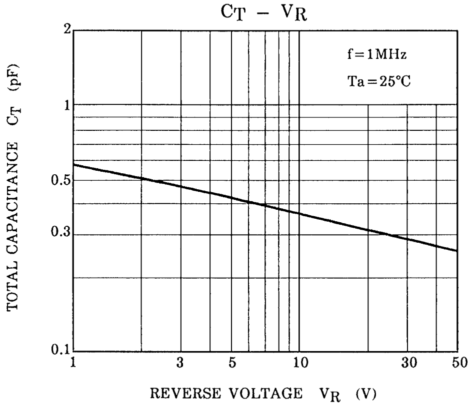
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 10\mu A$	50	—	—	V
Reverse Current	I_R	$V_R = 50V$	—	—	0.1	μA
Forward Voltage	V_F	$I_F = 50mA$	—	0.95	—	V
Total Capacitance	C_T	$V_R = 50V$, f = 1MHz	—	0.25	—	pF
Series Resistance	r_s	$I_F = 10mA$, f = 100MHz	—	3.5	—	Ω

Marking

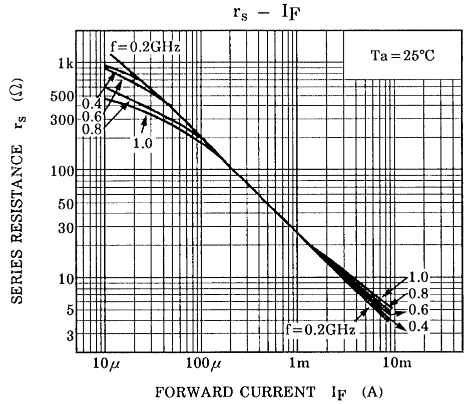


C_T – V_R



f=1MHz
Ta=25°C
TOTAL CAPACITANCE CT (pF)
2
1
0.5
0.3
0.1
1
3
5
10
30
50
REVERSE VOLTAGE VR (V)

r_s – I_F



Ta=25°C
f=0.2GHz
0.4
0.6
0.8
1.0
SERIES RESISTANCE rs (Ω)
1k
500
300
100
50
30
10
5
3
10μ
100μ
1m
10m
FORWARD CURRENT IF (A)

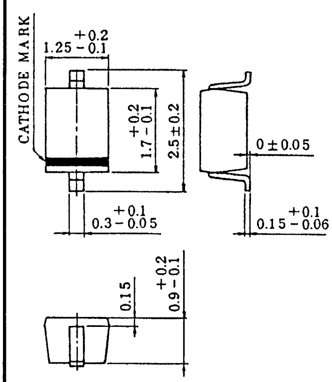
1SV238

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

CATV TUNING.

- High Capacitance Ratio: C2V / C25V = 11.5 (Typ.)
- Excellent C-V Characteristics, and Small Tracking Error.
- Usful for Small Size Tuner.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1E1A

Weight : 0.004g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 (RL = 10kΩ)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

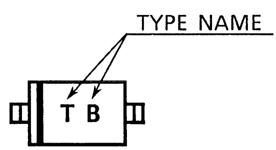
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 1\mu A$	30	—	—	V
Reverse Current	I_R	$V_R = 28V$	—	—	10	nA
Capacitance	C2V	$V_R = 2V$, f = 1MHz	31	35	38	pF
Capacitance	C25V	$V_R = 25V$, f = 1MHz	2.75	3.0	3.25	pF
Capacitance Ratio	C2V / C25V	—	10.7	11.5	—	—
Series Resistance	r_s	$V_R = 5V$, f = 470MHz	—	0.7	0.85	Ω

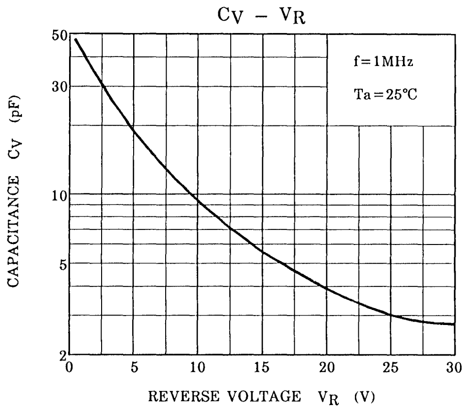
Note 1: Available in matched group for capacitance to 2.5%.

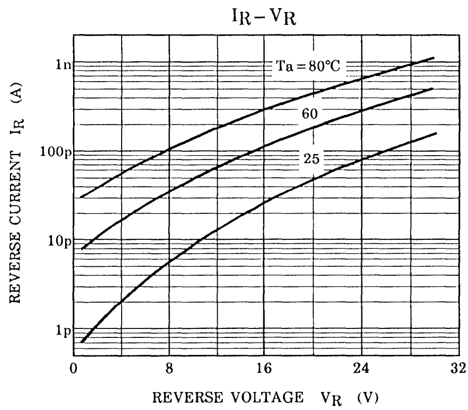
$$\frac{C\,(Max.) - C\,(Min.)}{C\,(Min.)} \leqq 0.025$$

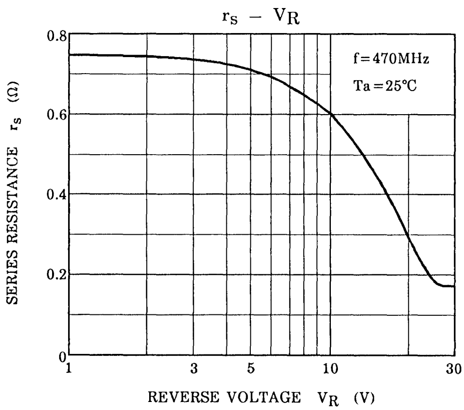
(VR = 2~25V)

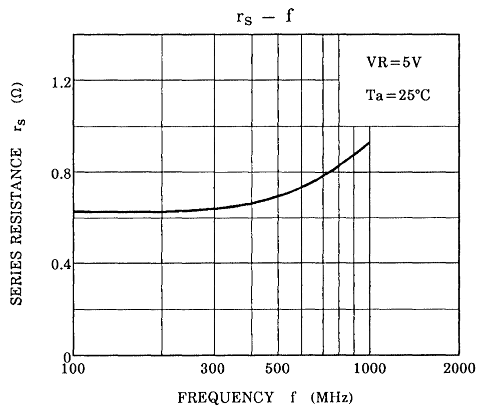
Marking

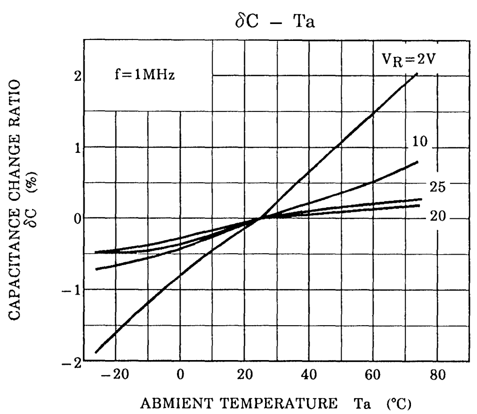












NOTE: $\delta C(\%) = \frac{C(Ta) - C(25)}{C(25)} \times 100$

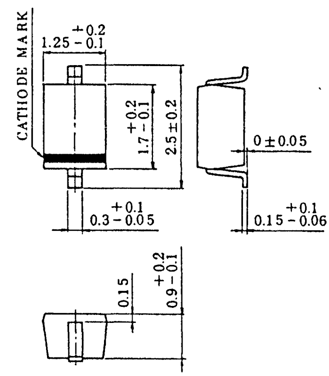
1SV239

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

VCO FOR UHF RADIO

- Ultra Low Series Resistance : $r_S = 0.44\Omega$ (Typ.)
- Useful for Small Size Set

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1E1A

Weight : 0.004g

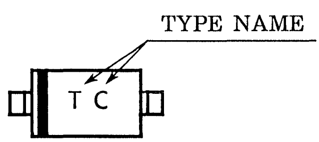
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	15	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

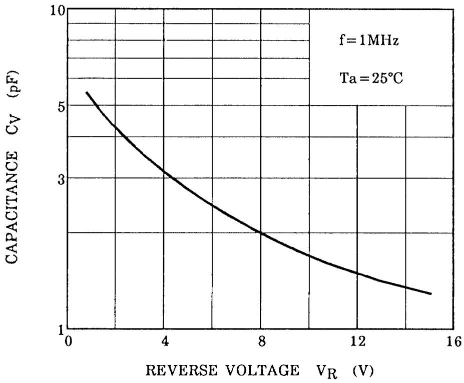
ELECTRICAL CHARACTERISTIC (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	VR	$I_R = 1\mu A$	15	—	—	V
Reverse Current	I_R	$V_R = 15V$	—	—	3	nA
Capacitance	C2V	$V_R = 2V$, f=1MHz	3.8	4.25	4.7	pF
Capacitance	C10V	$V_R = 10V$, f=1MHz	1.5	1.75	2.0	pF
Capacitance Ratio	C2V / C10V	—	2.0	2.4	—	
Series Resistance	r_S	$V_R = 1V$, f=470MHz	—	0.44	0.6	Ω

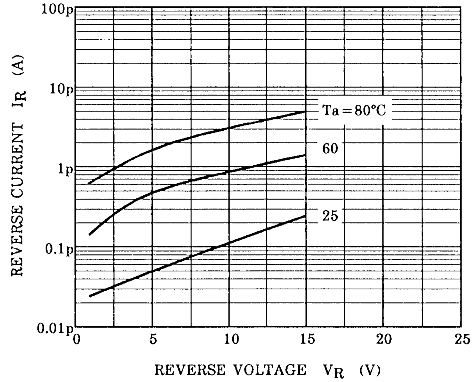
Marking



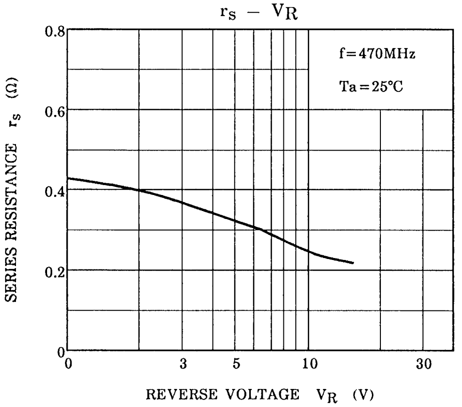
$C_V - V_R$



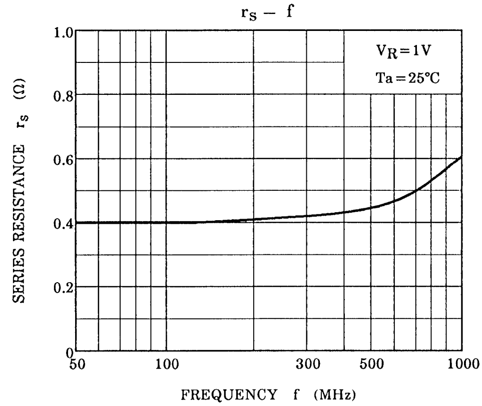
$I_R - V_R$



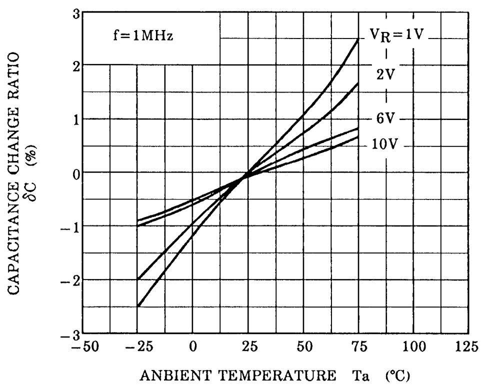
$r_s - V_R$



$r_s - f$



$\delta C - Ta$



NOTE : $\delta C\,(\%) = \dfrac{C\,(Ta) - C\,(25)}{C\,(25)} \times 100$

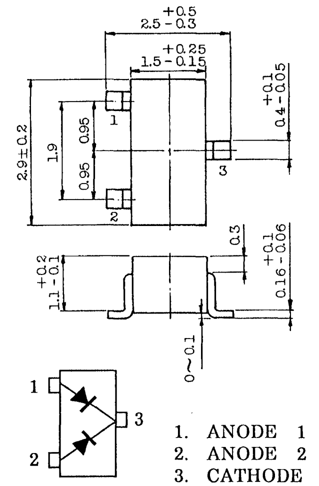
1SV242

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

TV VHF WIDE BAND TUNING

Unit in mm

- High Capacitance Ratio : C1V / C28V = 14.5 (Typ.)
- Low Series Resistance : $r_S = 0.65\Omega$ (Typ.)
- Excellent C - V Characteristics, and Small Tracking Error.
- Small Package



1. ANODE 1
2. ANODE 2
3. CATHODE

JEDEC	—
EIAJ	SC-59
TOSHIBA	1-3G1F

Weight : 0.013g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 ($R_L = 10k\Omega$)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

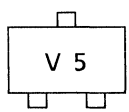
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 1\mu A$	30	—	—	V
Reverse Current	I_R	$V_R = 28V$	—	—	10	nA
Capacitance	C1V	$V_R = 1V$, f = 1MHz (Note 1)	36	39	42	pF
Capacitance	C28V	$V_R = 28V$, f = 1MHz (Note 1)	2.43	2.7	3.0	pF
Capacitance Ratio	C1V / C28V	— (Note 1)	13.4	14.5	—	—
Series Resistance	r_s	$V_R = 5V$, f = 470MHz (Note 1)	—	0.65	0.8	Ω

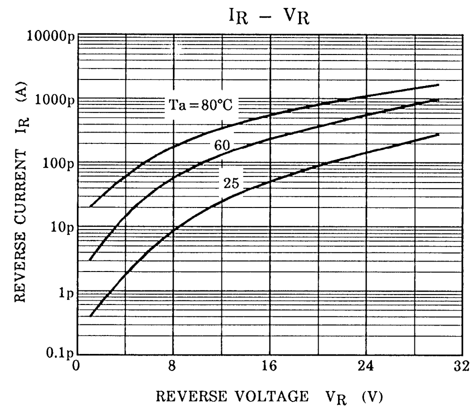
Note 1 : Characteristic between Anode 1 and Anode 2

Note 2 : Units are compounded in one package and are matched to 2.5%

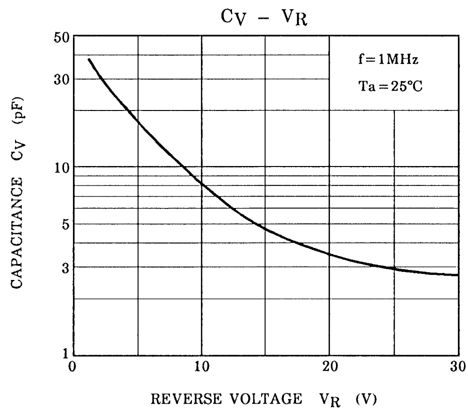
$$\frac{C\,(Max.) - C\,(Min.)}{C\,(Min.)} \leqq 0.025 \quad (VR = 1{\sim}28V)$$

Marking

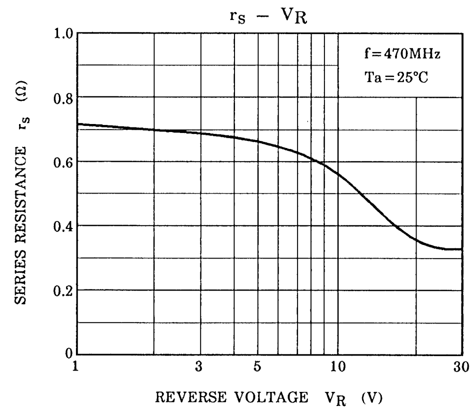




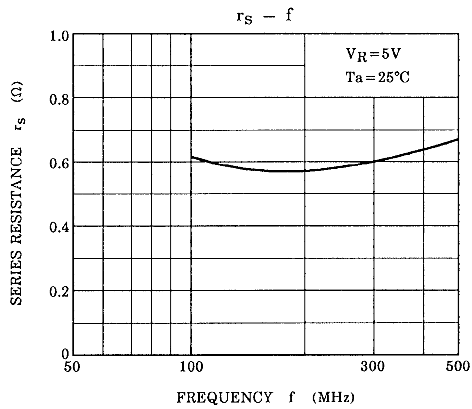
IR – VR
10000p
1000p
100p
10p
1p
0.1p
REVERSE CURRENT IR (A)
Ta = 80°C
60
25
0
8
16
24
32
REVERSE VOLTAGE VR (V)



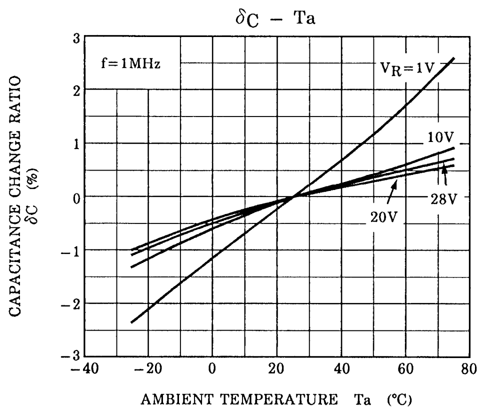
CV – VR
f = 1MHz
Ta = 25°C
50
30
10
5
3
1
CAPACITANCE CV (pF)
0
10
20
30
REVERSE VOLTAGE VR (V)



rs – VR
f = 470MHz
Ta = 25°C
1.0
0.8
0.6
0.4
0.2
0
SERIES RESISTANCE rs (Ω)
1
3
5
10
30
REVERSE VOLTAGE VR (V)



rs – f
VR = 5V
Ta = 25°C
1.0
0.8
0.6
0.4
0.2
0
SERIES RESISTANCE rs (Ω)
50
100
300
500
FREQUENCY f (MHz)



δC – Ta
f = 1MHz
VR = 1V
10V
20V
28V
3
2
1
0
−1
−2
−3
CAPACITANCE CHANGE RATIO
δC (%)
−40
−20
0
20
40
60
80
AMBIENT TEMPERATURE Ta (°C)

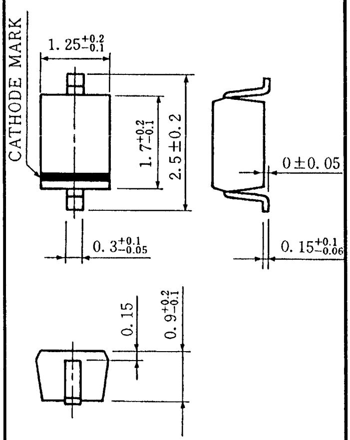
1SV245

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

UHF SHF TUNING

Unit in mm

- High Capacitance Ratio : C2V / C25V = 5.7 (Typ.)
- Low Series Resistance : rs = 1.2Ω (Typ.)
- Excellent C - V Characteristics, and Small Tracking Error.



JEDEC	—
EIAJ	—
TOSHIBA	1-1E1A

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 (R_L = 10kΩ)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

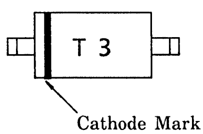
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	I_R = 1μA	30	—	—	V
Reverse Current	I_R	V_R = 28V	—	—	10	nA
Capacitance	C2V	V_R = 2V, f = 1MHz	3.31	—	4.55	pF
Capacitance	C25V	V_R = 25V, f = 1MHz	0.61	—	0.77	pF
Capacitance Ratio	C2V / C25V	—	5.0	5.7	6.5	—
Series Resistance	r_s	V_R = 1V, f = 470MHz	—	1.2	2.0	Ω

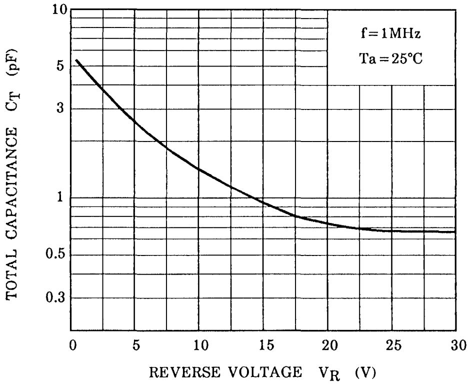
Note1 : Unites are compounded in one package and are matched to 6.0%.

$$\frac{C\,(Max.) - C\,(Min.)}{C\,(Min.)} \leqq 0.06\ (VR = 2\sim25V)$$

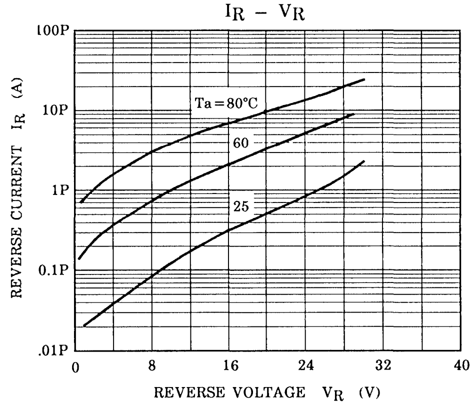
Marking



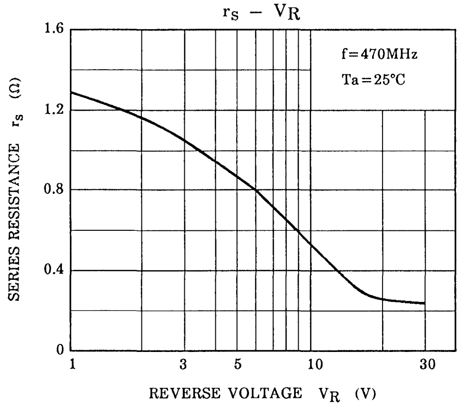
$C_V - C_R$



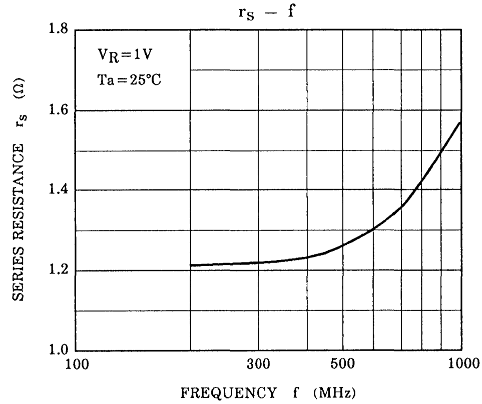
$I_R - V_R$



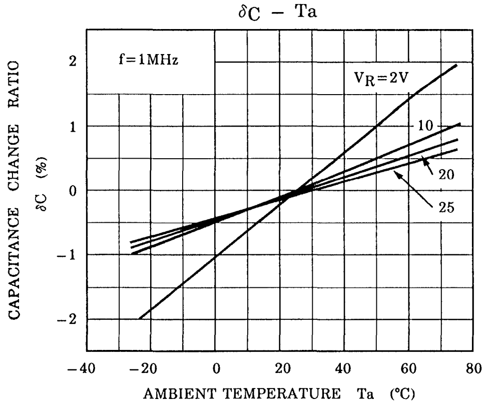
$r_s - V_R$



$r_s - f$



$\delta C - Ta$



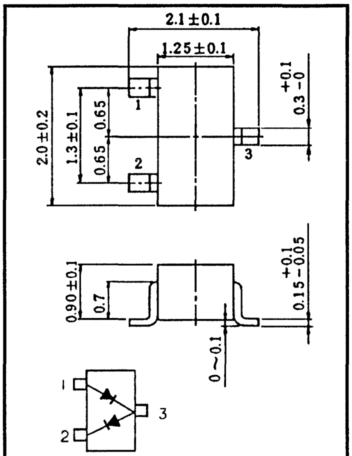
NOTE : $\delta_C(\%) = \dfrac{C(Ta) - C(25)}{C(25)} \times 100$

1SV252

SILICON EPITAXIAL PIN TYPE DIODE

VHF~UHF BAND RF ATTENUATOR APPLICATIONS.

Unit in mm



1. ANODE 2
2. CATHODE 1
3. ANODE 1/CATHODE 2

JEDEC	—
EIAJ	SC-70
TOSHIBA	1-2P1C

Weight : 0.006g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	50	V
Forward Current	I_F	50	mA
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

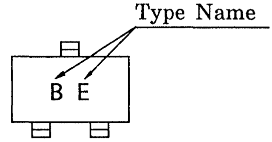
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

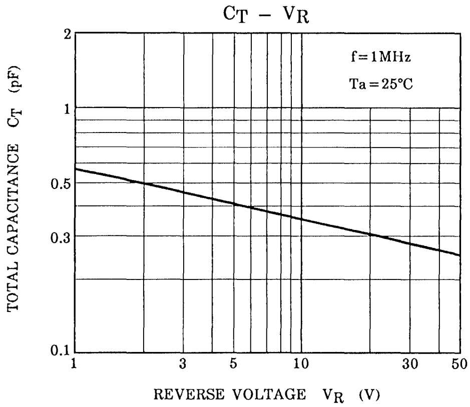
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 10\mu A$	50	—	—	V
Reverse Current	I_R	$V_R = 50V$	—	—	0.1	μA
Forward Voltage	V_F	$I_F = 50mA$	—	0.95	—	V
Total Capacitance (Note)	C_T	$V_R = 50V$, f=1MHz	—	0.25	—	pF
Series Resistance	r_s	$I_F = 10mA$, f=100MHz	—	7	—	Ω

Note : C_T is measured by 3 terminal method with capacitance bridge.

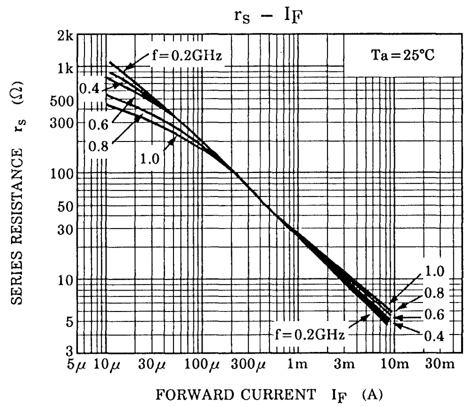
MARKING

Type Name





CT – VR
f=1MHz
Ta=25°C
TOTAL CAPACITANCE CT (pF)
2
1
0.5
0.3
0.1
1
3
5
10
30
50
REVERSE VOLTAGE VR (V)



rs – IF
Ta=25°C
f=0.2GHz
0.4
0.6
0.8
1.0
SERIES RESISTANCE rs (Ω)
2k
1k
500
300
100
50
30
10
5
3
5μ
10μ
30μ
100μ
300μ
1m
3m
10m
30m
FORWARD CURRENT IF (A)

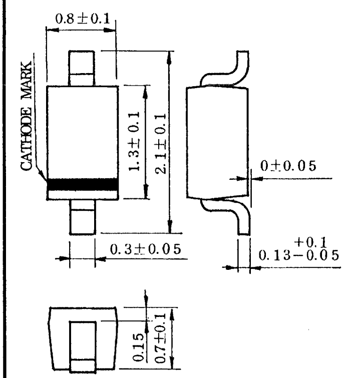
1SV254

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

TV TUNING.

- High Capacitance Ratio : C2V / C25V = 6.5 (Typ.)
- Low Series Resistance : $r_S = 0.4\Omega$ (Typ.)
- Excellent C-V Characteristics, and Small Tracking Error.
- Useful for Small Size Tuner.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1F1A

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 (RL = 10kΩ)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

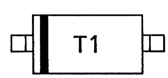
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 1\mu A$	30	—	—	V
Reverse Current	I_R	$V_R = 28V$	—	—	10	nA
Capacitance	C_{2V}	$V_R = 2V$, f = 1MHz	14.16	15.0	16.25	pF
Capacitance	C_{25V}	$V_R = 25V$, f = 1MHz	2.11	2.27	2.43	pF
Capacitance Ratio	C_{2V} / C_{25V}	—	5.90	6.50	7.15	
Series Resistance	r_s	$V_R = 5V$, f = 470MHz	—	0.4	0.55	Ω

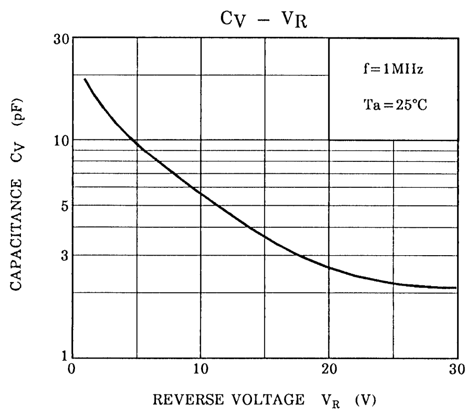
Note 1 : Units are compounded in one package and are matched to 2.5%.

$$\frac{C\,(\mathrm{Max.}) - C\,(\mathrm{Min.})}{C\,(\mathrm{Min.})} \leqq 0.025$$

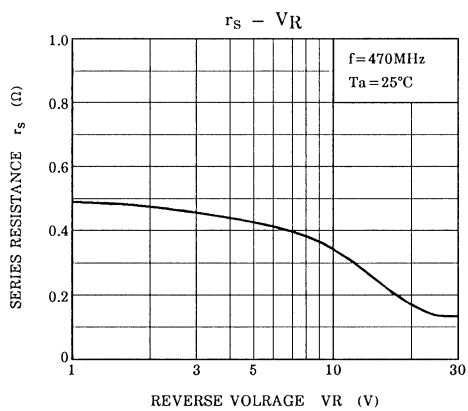
$(V_R = 2 \sim 25V)$

MARKING

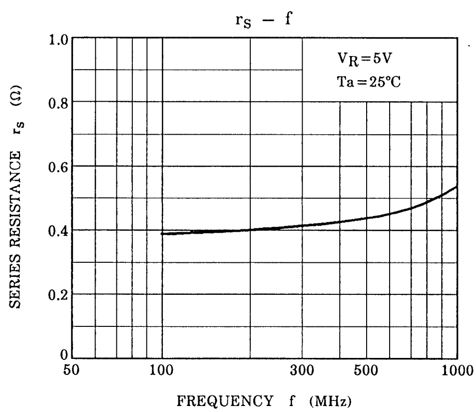




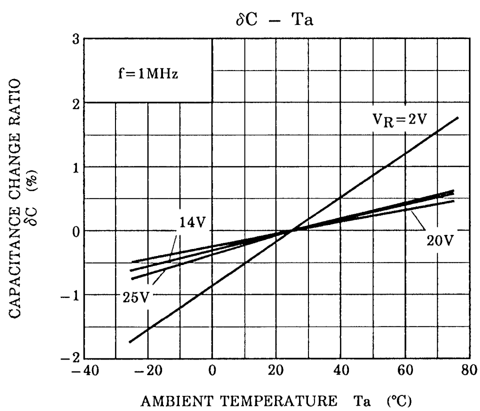
$C_V - V_R$
f=1MHz
Ta=25°C
CAPACITANCE CV (pF)
30
10
5
3
1
0
10
20
30
REVERSE VOLTAGE V_R (V)



$r_S - V_R$
f=470MHz
Ta=25°C
SERIES RESISTANCE r_s (Ω)
1.0
0.8
0.6
0.4
0.2
0
1
3
5
10
30
REVERSE VOLRAGE VR (V)



$r_S - f$
V_R=5V
Ta=25°C
SERIES RESISTANCE r_s (Ω)
1.0
0.8
0.6
0.4
0.2
0
50
100
300
500
1000
FREQUENCY f (MHz)



δC − Ta
f=1MHz
V_R=2V
14V
20V
25V
CAPACITANCE CHANGE RATIO δC (%)
3
2
1
0
−1
−2
−40
−20
0
20
40
60
80
AMBIENT TEMPERATURE Ta (°C)

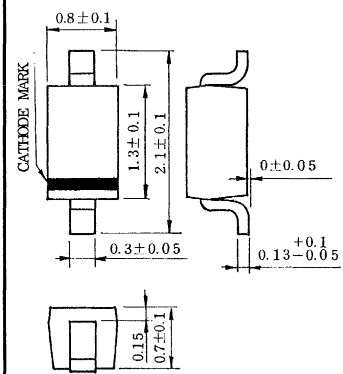
1SV255

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

CATV TUNING.

- High Capacitance Ratio : C2V / C25V = 10.5 (Typ.)
- Low Series Resistance : $r_S = 0.6\Omega$ (Typ.)
- Excellent C-V Characteristics, and Small Tracking Error.
- Useful for Small Size Tuner.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1F1A

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 ($R_L = 10k\Omega$)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

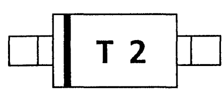
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 1\mu A$	30	—	—	V
Reverse Current	I_R	$V_R = 28V$	—	—	10	nA
Capacitance	C2V	$V_R = 2V$, f = 1MHz	26	29	32	pF
Capacitance	C25V	$V_R = 25V$, f = 1MHz	2.5	2.85	3.2	pF
Capacitance Ratio	C2V / C25V	—	9.5	10.2	—	—
Series Resistance	r_S	$V_R = 5V$, f = 470MHz	—	0.6	0.8	Ω

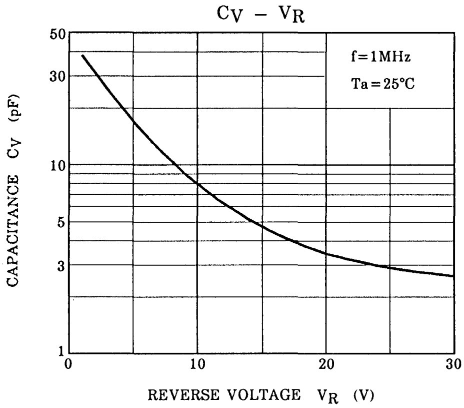
Note 1 : Available in matched group for capacitance to 2.5%.

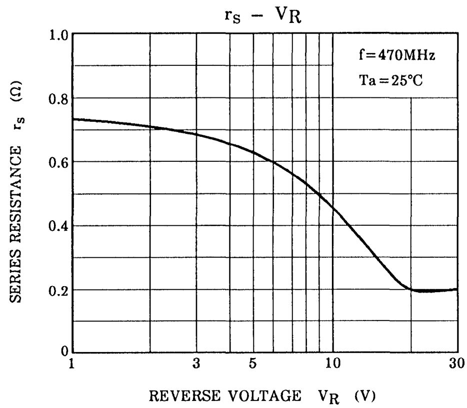
$$\frac{C\,(\mathrm{Max.}) - C\,(\mathrm{Min.})}{C\,(\mathrm{Min.})} \leqq 0.025$$

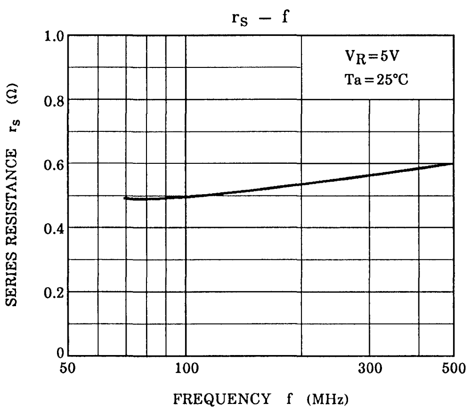
($V_R = 2 \sim 25V$)

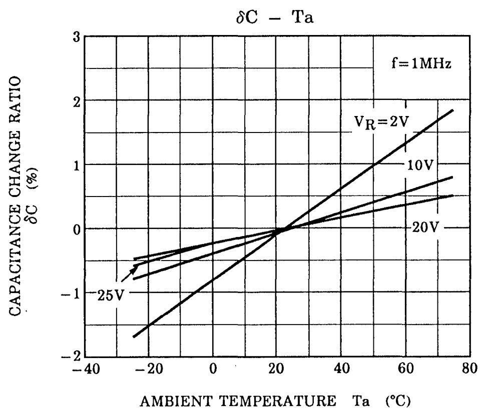
Marking











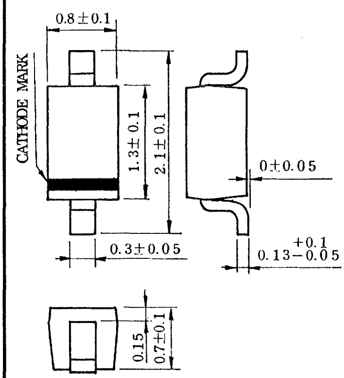
$$\text{NOTE}: \delta_C(\%) = \frac{C(Ta) - C(25)}{C(25)} \times 100$$

1SV256

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

TV VHF UHF TUNER AFC

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1F1A

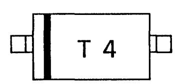
MAXIMUM RATINGS (Ta = 25°C)

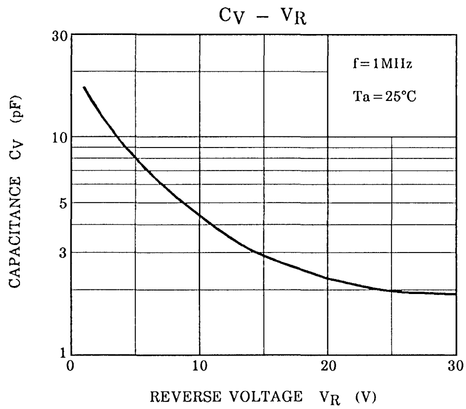
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 (R_L=10kΩ)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

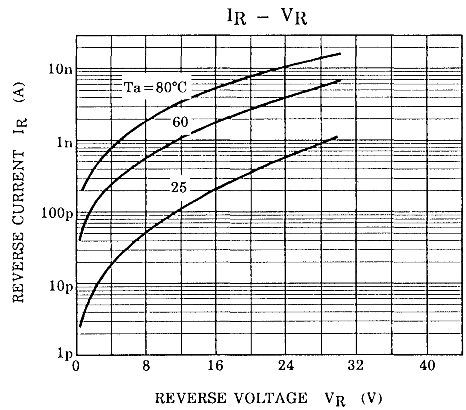
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

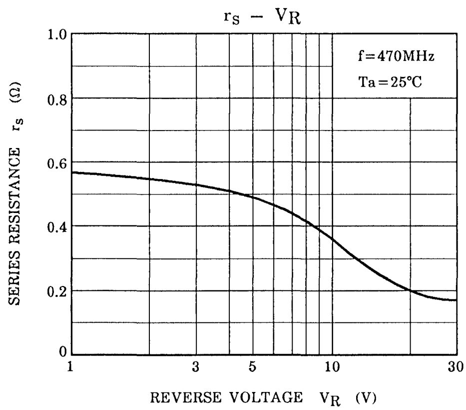
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	I_R=1μA	30	—	—	V
Reverse Current	I_R	V_R=28V	—	—	10	nA
Capacitance	C2V	V_R=2V, f=1MHz	10.5	14	16	pF
Capacitance	C10V	V_R=10V, f=1MHz	3.3	4.5	5.7	pF
Capacitance Ratio	C2V / C10V	—	2.5	3.1	3.4	—
Series Resistance	r_s	V_R=5V, f=470MHz	—	0.53	0.8	Ω

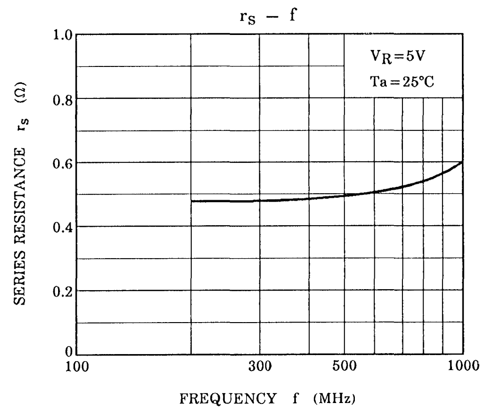
Marking

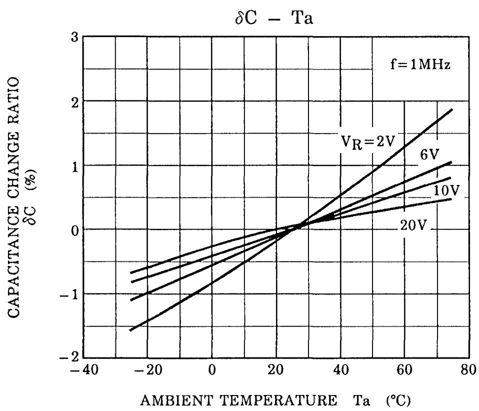












NOTE : $\delta_C(\%) = \frac{C(Ta) - C(25)}{C(25)} \times 100$

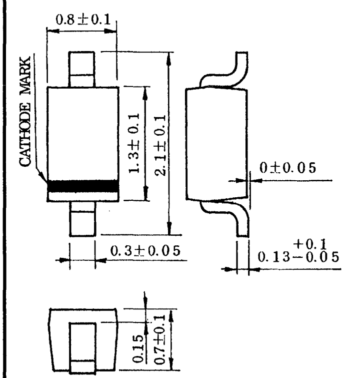
1SV257

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

VCO FOR UHF BAND RADIO

- Ultra Low Series Resistance : $r_S = 0.2\Omega$ (Typ.)
- Useful for Small Size Set

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1F1A

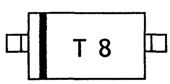
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	15	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

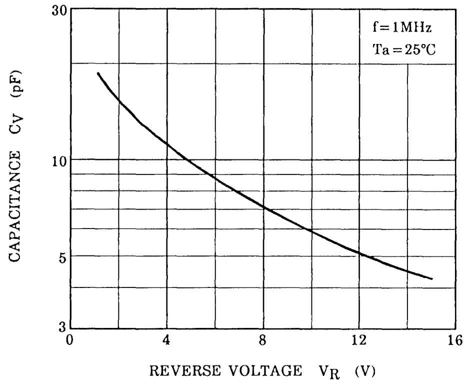
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 1\mu A$	15	—	—	V
Reverse Current	I_R	$V_R = 15V$	—	—	3	nA
Capacitance	C2V	$V_R = 2V$, f=1MHz	14	15	16	pF
Capacitance	C10V	$V_R = 10V$, f=1MHz	5.5	6	6.5	pF
Capacitance Ratio	C2V / C10V	—	2.0	2.5	—	—
Series Resistance	r_s	$V_R = 5V$, f=470MHz	—	0.2	0.4	Ω

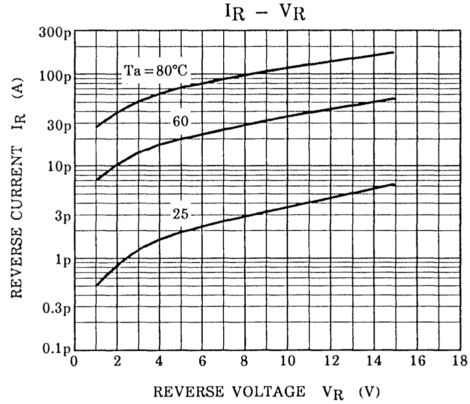
Marking



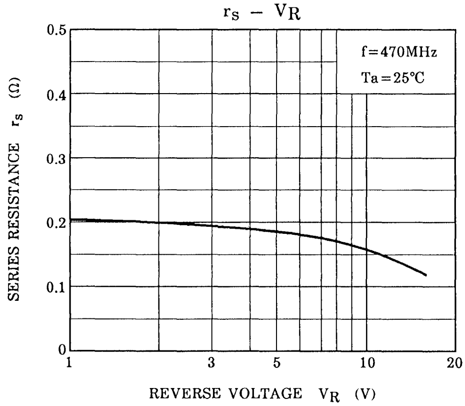
$C_V - V_R$



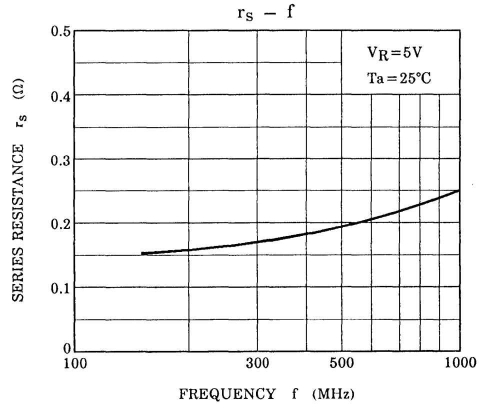
$I_R - V_R$



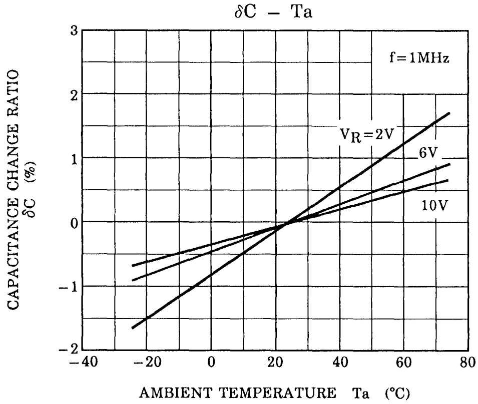
$r_S - V_R$



$r_S - f$



$\delta C - Ta$



NOTE : $\delta_C(\%) = \frac{C(Ta) - C(25)}{C(25)} \times 100$

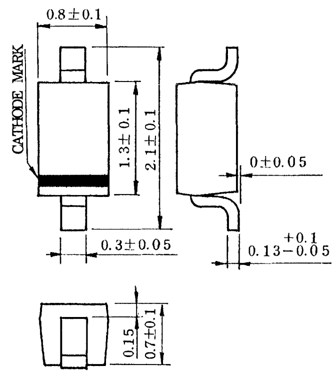
1SV258

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

CATV CONVERTER 1st OSC TUNING.

- High Capacitance Ratio : C2V / C20V = 8 (Typ.)
- Low Series Resistance : $r_S = 0.73\Omega$ (Typ.)
- Useful for Small Size Tuner.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1F1A

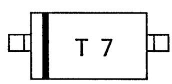
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 (R_L = 10kΩ)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

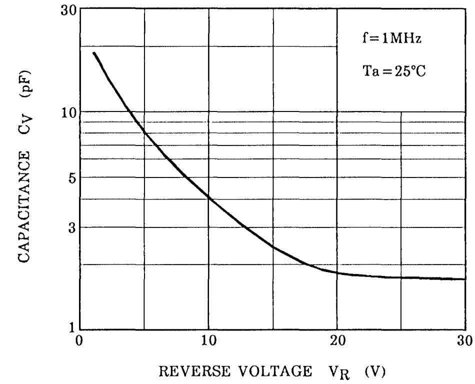
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 1\mu A$	30	—	—	V
Reverse Current	I_R	$V_R = 28V$	—	—	10	nA
Capacitance	C2V	$V_R = 2V$, f = 1MHz	13.9	—	16.1	pF
Capacitance	C20V	$V_R = 20V$, f = 1MHz	1.7	—	2.1	pF
Capacitance Ratio	C2V / C20V	—	7.3	—	8.4	—
Series Resistance	r_S	$V_R = 5V$, f = 470MHz	—	0.73	0.9	Ω

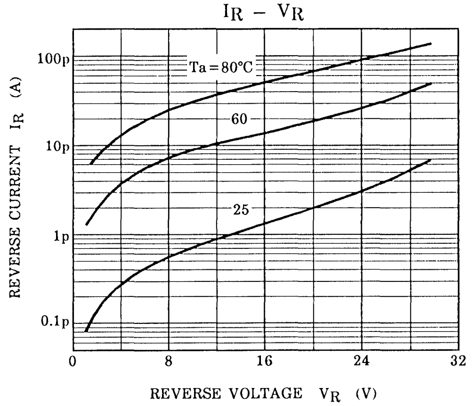
Marking



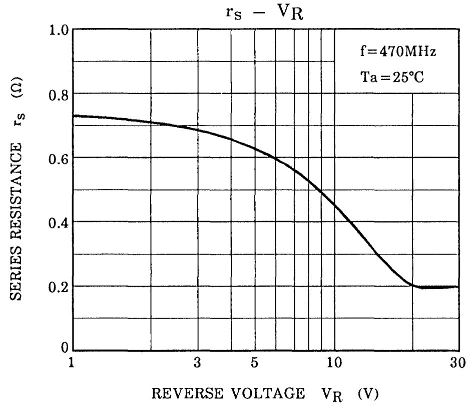
$C_V - V_R$



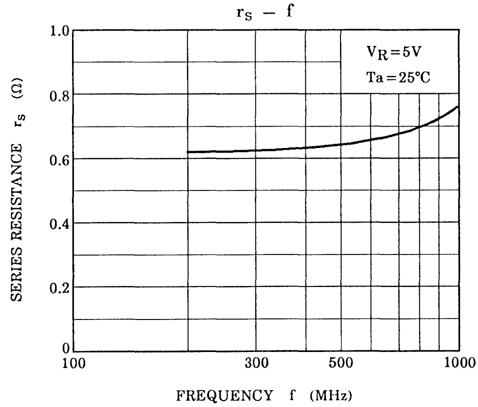
$I_R - V_R$



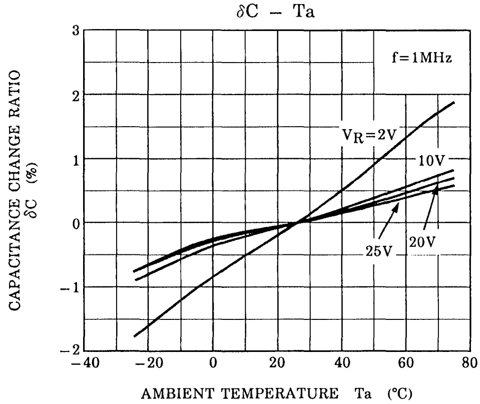
$r_s - V_R$



$r_s - f$



$\delta C - Ta$



NOTE : $\delta_C (\%) = \dfrac{C(Ta) - C(25)}{C(25)} \times 100$

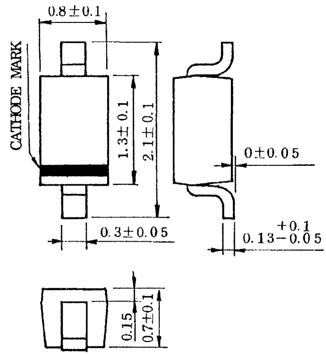
1SV259

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

CATV TUNING.

- High Capacitance Ratio : C2V / C25V = 10.5 (Typ.)
- Excellent C-V Characteristics, and Small Tracking Error.
- Useful for Small Size Tuner.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1F1A

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 (R_L = 10kΩ)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

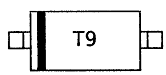
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	I_R = 1μA	30	—	—	V
Reverse Current	I_R	V_R = 28V	—	—	10	nA
Capacitance	C2V	V_R = 2V, f = 1MHz	28	30.3	32	pF
Capacitance	C25V	V_R = 25V, f = 1MHz	2.75	2.90	3.10	pF
Capacitance Ratio	C2V / C25V	—	10	10.5	—	—
Series Resistance	r_s	V_R = 5V, f = 470MHz	—	0.55	0.70	Ω

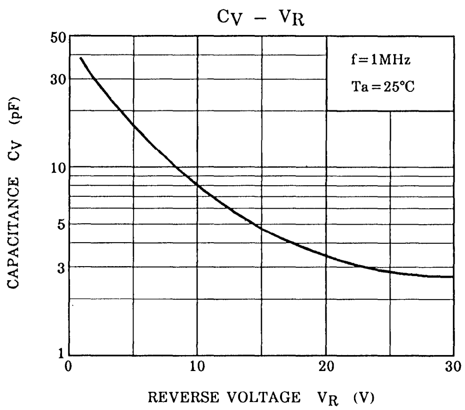
Note 1 : Available in matched group for capacitance to 2.0%.

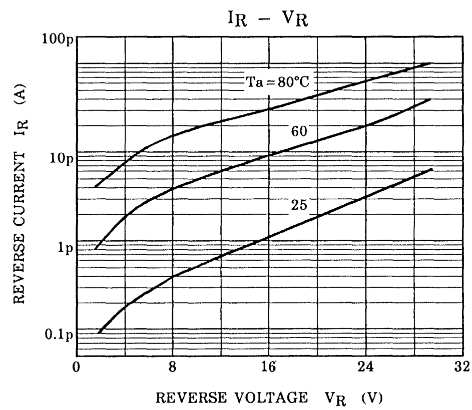
$$\frac{C\,(\text{Max.}) - C\,(\text{Min.})}{C\,(\text{Min.})} \leqq 0.02$$

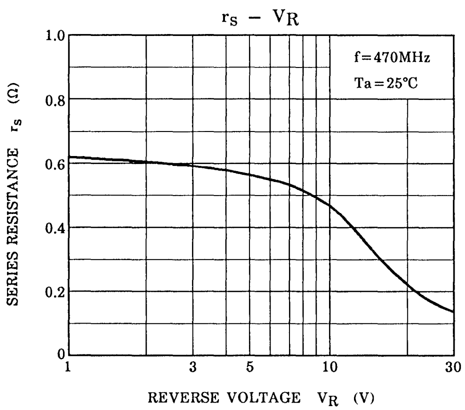
(V_R = 2~25V)

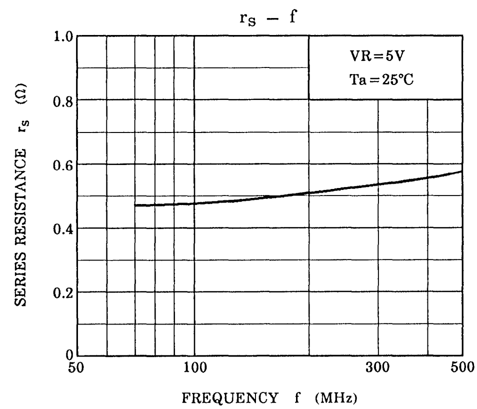
MARKING

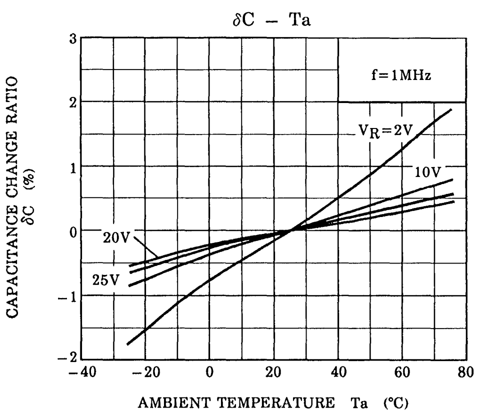












NOTE : $\delta_C(\%) = \dfrac{C(Ta) - C(25)}{C(25)} \times 100$

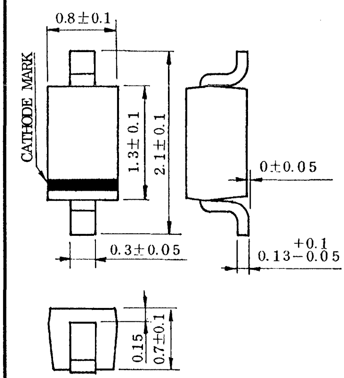
1SV260

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

VCO FOR UHF RADIO

- Ultra Low Series Resistance : $r_S = 0.44\Omega$ (Typ.)
- Useful for Small Size Set

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1F1A

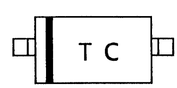
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	15	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

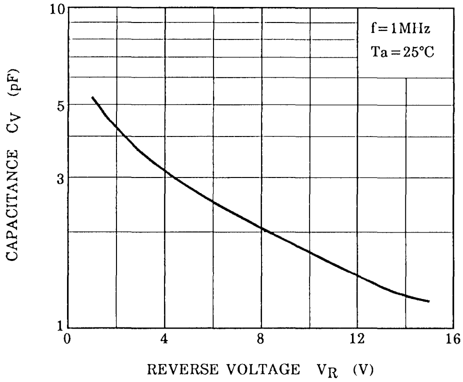
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 1\mu A$	15	—	—	V
Reverse Current	I_R	$V_R = 15V$	—	—	3	nA
Capacitance	C2V	$V_R = 2V$, f=1MHz	3.8	4.25	4.7	pF
Capacitance	C10V	$V_R = 10V$, f=1MHz	1.5	1.75	2.0	pF
Capacitance Ratio	C2V / C10V	—	2.0	2.4	—	—
Series Resistance	r_s	$V_R = 1V$, f=470MHz	—	0.44	0.6	Ω

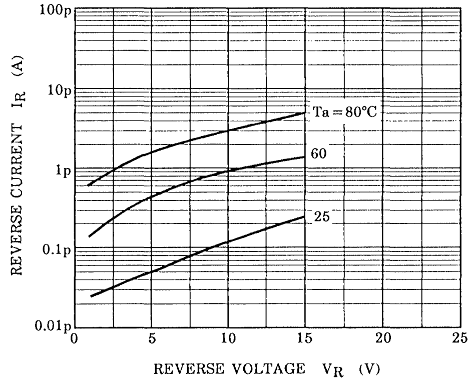
Marking



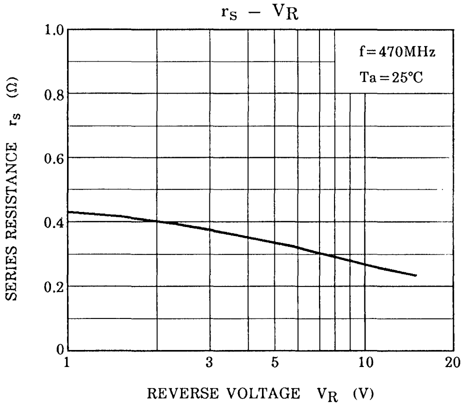
$C_V - V_R$



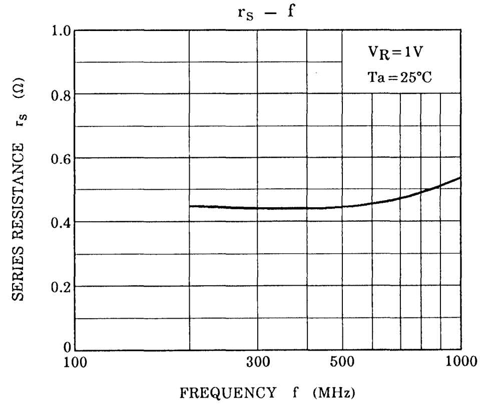
$I_R - V_R$



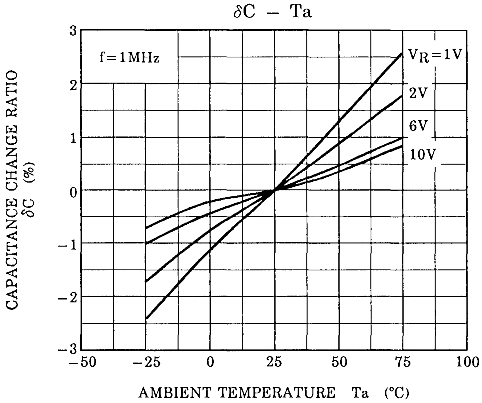
$r_S - V_R$



$r_S - f$



$\delta C - Ta$



NOTE : $\delta_C(\%) = \frac{C(Ta) - C(25)}{C(25)} \times 100$

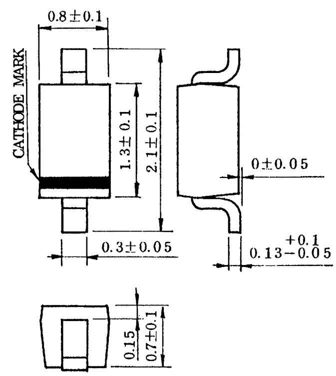
1SV261

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

UHF SHF TUNING

- High Capacitance Ratio : C2V / C25V = 5.7 (Typ.)
- Low Series Resistance : rs = 1.2Ω (Typ.)
- Excellent C-V Characteristics, and Small Tracking Error.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1F1A

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Peak Reverse Voltage	V_{RM}	35 (R_L = 10kΩ)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

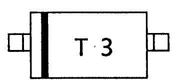
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

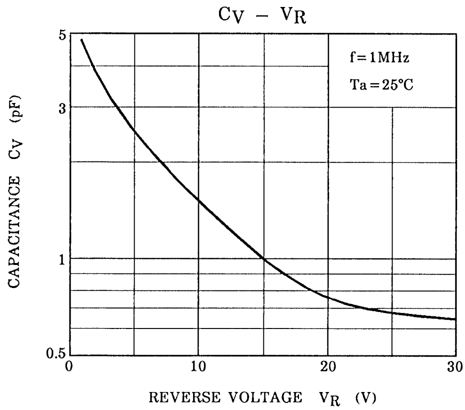
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	I_R = 1μA	30	—	—	V
Reverse Current	I_R	V_R = 28V	—	—	10	nA
Capacitance	C2V	V_R = 2V, f = 1MHz	3.31	—	4.55	pF
Capacitance	C25V	V_R = 25V, f = 1MHz	0.61	—	0.77	pF
Capacitance Ratio	C2V / C25V	—	5.0	5.7	6.5	—
Series Resistance	r_s	V_R = 1V, f = 470MHz	—	1.2	2.0	Ω

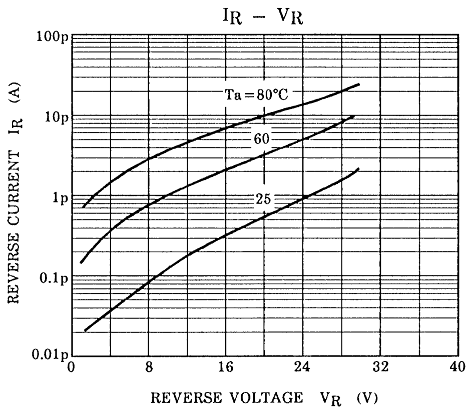
Note 1 : Unites are compounded in one package and are matched to 6.0%.

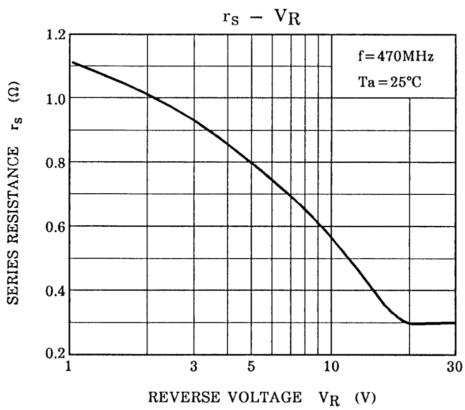
$$\frac{C\,(\text{Max.}) - C\,(\text{Min.})}{C\,(\text{Min.})} \leqq 0.06\ (VR = 2\sim25V)$$

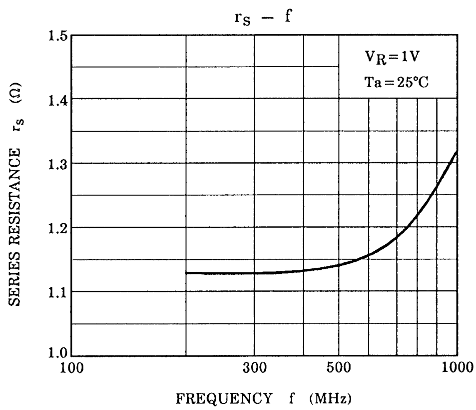
Marking

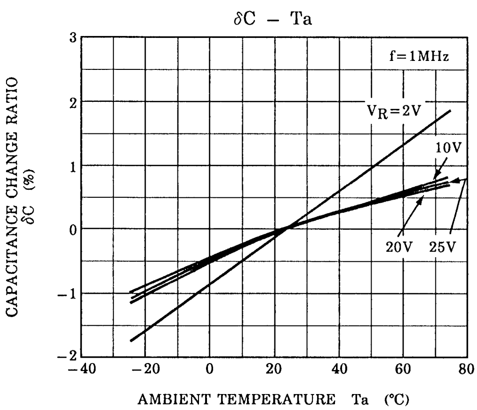












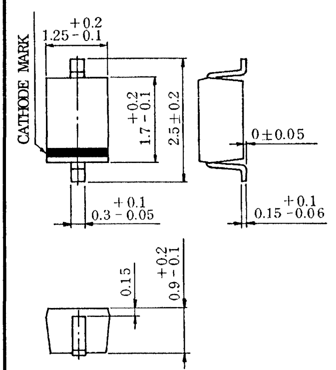
NOTE : $\delta_C\,(\%) = \dfrac{C\,(Ta)\ -\ C\,(25)}{C\,(25)} \times 100$

1SV262

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

CATV TUNING.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1E1A

- High Capacitance Ratio : C2V / C25V = 12.5 (Typ.)
- Low Series Resistance : rs = 0.6Ω (Typ.)
- Excellent C-V Characteristics, and Small Tracking Error.
- Small Package

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	34	V
Peak Reverse Voltage	V_{RM}	36 (R_L = 10kΩ)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

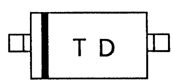
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

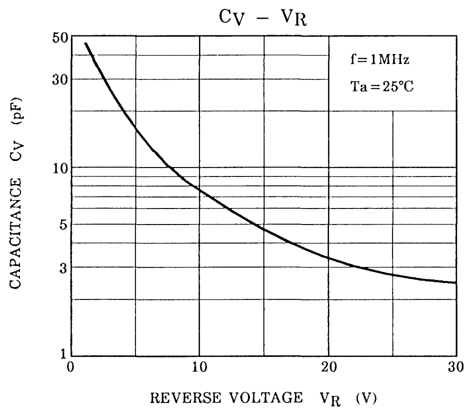
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	I_R = 1μA	34	—	—	V
Reverse Current	I_R	V_R = 32V	—	—	10	nA
Capacitance	C2V	V_R = 2V, f = 1MHz	33	35.5	38	pF
Capacitance	C25V	V_R = 25V, f = 1MHz	2.6	2.85	3.0	pF
Capacitance Ratio	C2V / C25V	—	12.0	12.5	—	—
Capacitance Ratio	C25V / C28V	—	1.03	—	—	—
Series Resistance	r_s	V_R = 5V, f = 470MHz	—	0.6	0.8	Ω

Note 1 : Available in matched group for capacitance to 2.0%.

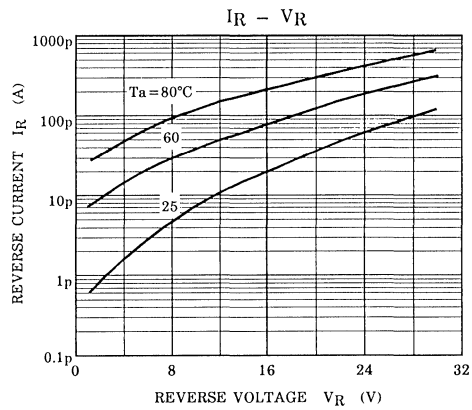
$$\frac{C\,(\text{Max.}) - C\,(\text{Min.})}{C\,(\text{Min.})} \leqq 0.02 \ (\text{VR} = 2\sim25\text{V})$$

Marking

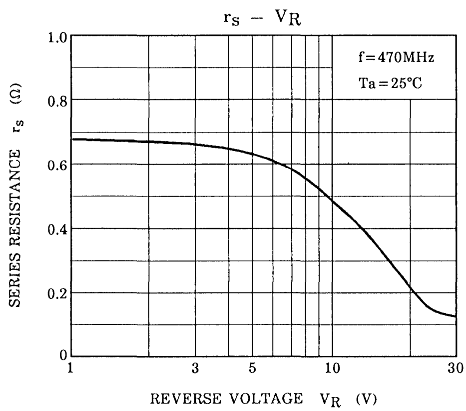




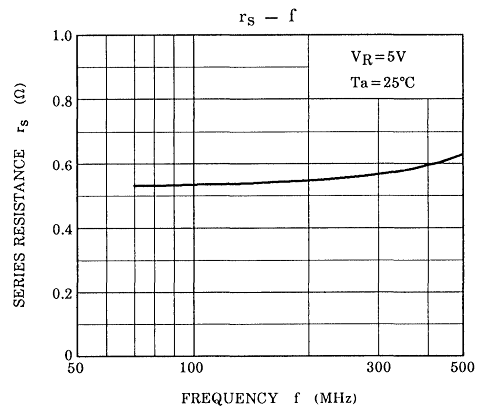
CV – VR
f=1MHz
Ta=25°C
CAPACITANCE CV (pF)
REVERSE VOLTAGE VR (V)



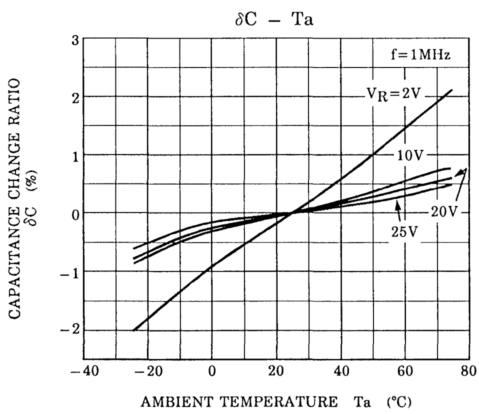
IR – VR
Ta=80°C
60
25
REVERSE CURRENT IR (A)
REVERSE VOLTAGE VR (V)



rs – VR
f=470MHz
Ta=25°C
SERIES RESISTANCE rs (Ω)
REVERSE VOLTAGE VR (V)



rs – f
VR=5V
Ta=25°C
SERIES RESISTANCE rs (Ω)
FREQUENCY f (MHz)



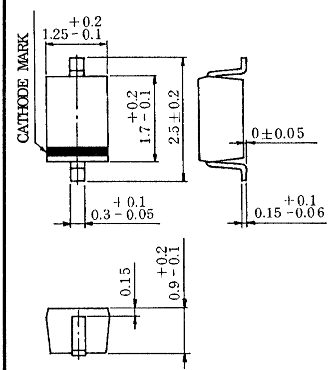
δC – Ta
f=1MHz
VR=2V
10V
20V
25V
CAPACITANCE CHANGE RATIO δC (%)
AMBIENT TEMPERATURE Ta (°C)

1SV269

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

CATV TUNING.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1E1A

- High Capacitance Ratio : C2V / C25V = 11.5 (Typ.)
- Low Series Resistance : rs = 0.55Ω (Typ.)
- Excellent C-V Characteristics, and Small Tracking Error.
- Small Package

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	34	V
Peak Reverse Voltage	V_{RM}	36 (R_L = 10kΩ)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

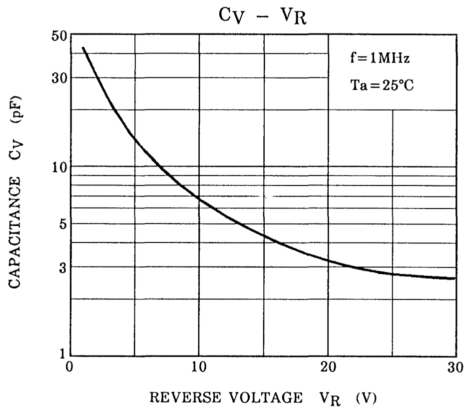
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

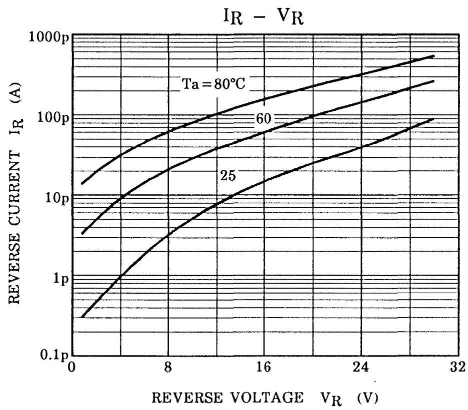
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	I_R = 1μA	34	—	—	V
Reverse Current	I_R	V_R = 32V	—	—	10	nA
Capacitance	C2V	V_R = 2V, f = 1MHz	29	31.5	34	pF
Capacitance	C25V	V_R = 25V, f = 1MHz	2.5	2.75	2.9	pF
Capacitance Ratio	C2V / C25V	—	11.0	11.5	—	—
Capacitance Ratio	C25V / C28V	—	1.03	1.05	—	—
Series Resistance	r_s	V_R = 5V, f = 470MHz	—	0.55	0.7	Ω

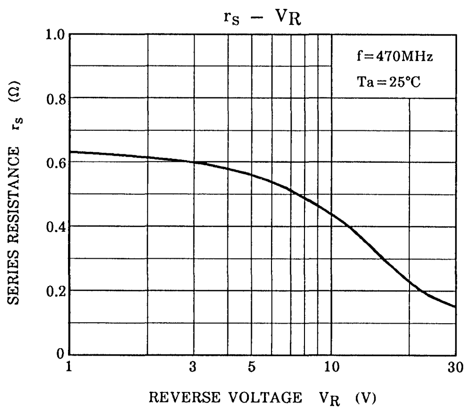
Note 1 : Available in matched group for capacitance to 2.0%.

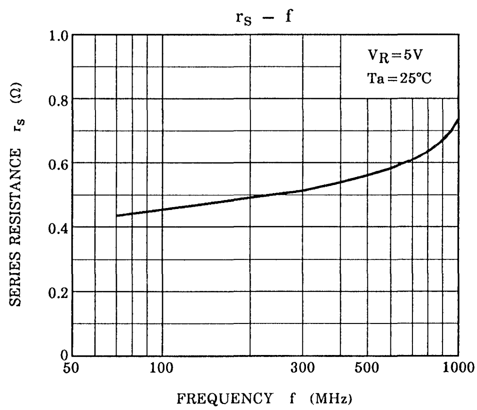
$$\frac{C\,(\mathrm{Max.}) - C\,(\mathrm{Min.})}{C\,(\mathrm{Min.})} \leqq 0.02 \quad (VR = 2\sim25V)$$

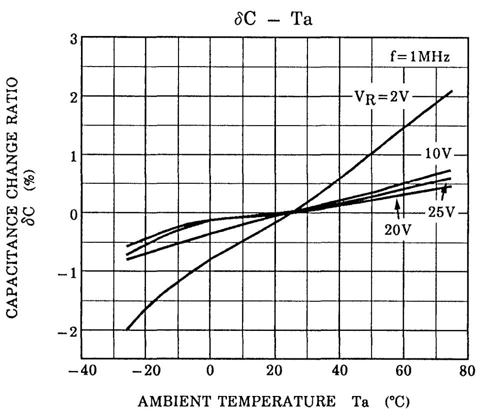
Marking


CV – VR
f=1MHz
Ta=25°C
CAPACITANCE CV (pF)
REVERSE VOLTAGE VR (V)
50
30
10
5
3
1
0
10
20
30


IR – VR
Ta=80°C
60
25
REVERSE CURRENT IR (A)
REVERSE VOLTAGE VR (V)
1000p
100p
10p
1p
0.1p
0
8
16
24
32


rs – VR
f=470MHz
Ta=25°C
SERIES RESISTANCE rs (Ω)
REVERSE VOLTAGE VR (V)
1.0
0.8
0.6
0.4
0.2
0
1
3
5
10
30


rs – f
VR=5V
Ta=25°C
SERIES RESISTANCE rs (Ω)
FREQUENCY f (MHz)
1.0
0.8
0.6
0.4
0.2
0
50
100
300
500
1000


δC – Ta
f=1MHz
VR=2V
10V
25V
20V
CAPACITANCE CHANGE RATIO δC (%)
AMBIENT TEMPERATURE Ta (°C)
3
2
1
0
−1
−2
−40
−20
0
20
40
60
80

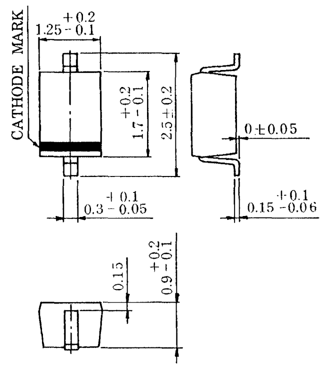
1SV270

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

VCO FOR UHF BAND RADIO

Unit in mm

- High Capacitance Ratio : C1V / C4V = 2.0 (Typ.)
- Low Series Resistance : rs = 0.28Ω (Typ.)
- Small Package



JEDEC	—
EIAJ	—
TOSHIBA	1-1E1A

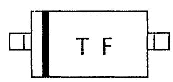
MAXIMUM RATINGS (Ta = 25°C)

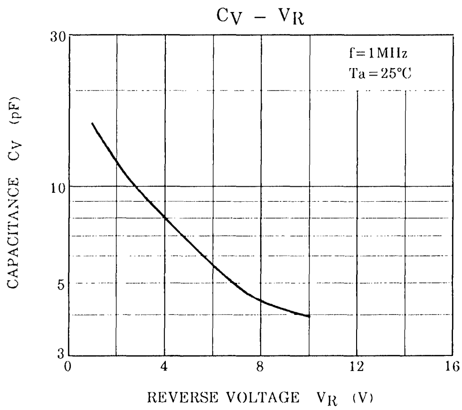
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	10	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

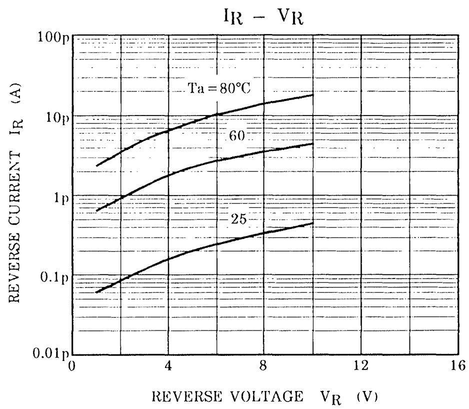
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

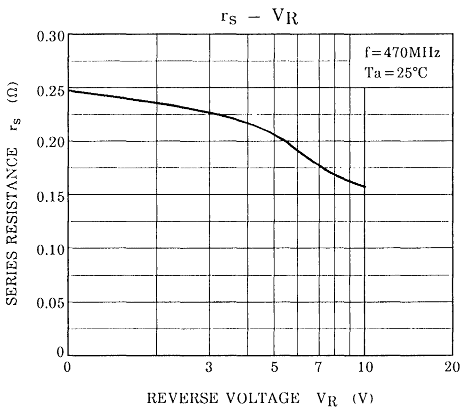
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 1\mu A$	10	—	—	V
Reverse Current	I_R	$V_R = 10V$	—	—	3	nA
Capacitance	C1V	$V_R = 1V$, f = 1MHz	15	16	17	pF
Capacitance	C4V	$V_R = 4V$, f = 1MHz	7.3	8.0	8.7	pF
Capacitance Ratio	C1V / C4V	—	1.8	2.0	—	—
Series Resistance	rs	$V_R = 1V$, f = 470MHz	—	0.28	0.5	Ω

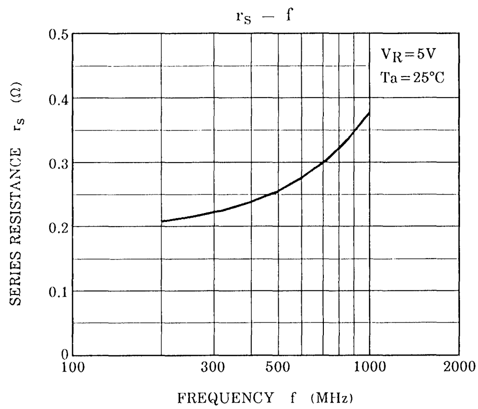
Marking

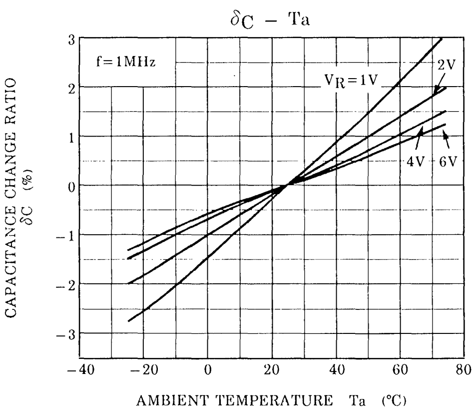



Cv – VR
f=1MHz
Ta=25°C
CAPACITANCE Cv (pF)
30
10
5
3
0
4
8
12
16
REVERSE VOLTAGE VR (V)


IR – VR
Ta=80°C
60
25
REVERSE CURRENT IR (A)
100p
10p
1p
0.1p
0.01p
0
4
8
12
16
REVERSE VOLTAGE VR (V)


rs – VR
f=470MHz
Ta=25°C
SERIES RESISTANCE rs (Ω)
0.30
0.25
0.20
0.15
0.10
0.05
0
0
3
5
7
10
20
REVERSE VOLTAGE VR (V)


rs – f
VR=5V
Ta=25°C
SERIES RESISTANCE rs (Ω)
0.5
0.4
0.3
0.2
0.1
0
100
300
500
1000
2000
FREQUENCY f (MHz)


δC – Ta
f=1MHz
VR=1V
2V
4V
6V
CAPACITANCE CHANGE RATIO δC (%)
3
2
1
0
−1
−2
−3
−40
−20
0
20
40
60
80
AMBIENT TEMPERATURE Ta (°C)

1SV271 SILICON EPITAXIAL PIN TYPE DIODE

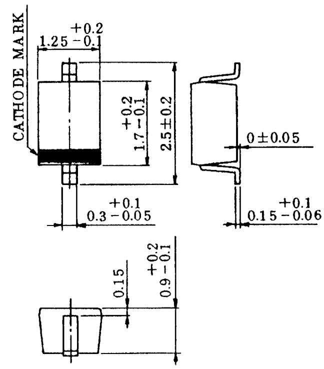
VHF~UHF BAND RF ATTENUATOR APPLICATIONS

- Useful for Small Size Tuner
- Small Total Capacitance : $C_T = 0.25pF$ (Typ.)
- Low Series Resistance : $r_s = 3\Omega$ (Typ.)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	50	V
Forward Current	I_F	50	mA
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Unit in mm

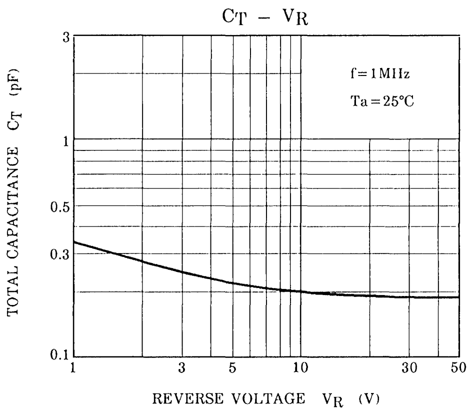


JEDEC	—
EIAJ	—
TOSHIBA	1-1E1A

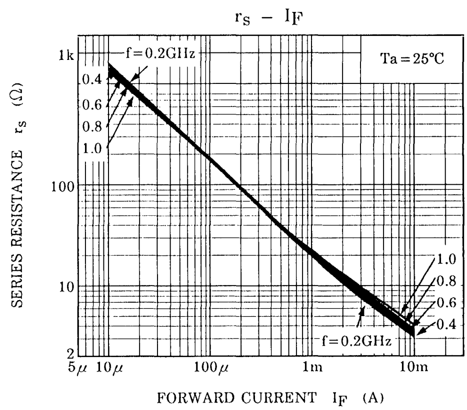
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 1\mu A$	50	—	—	V
Reverse Current	I_R	$V_R = 50V$	—	—	0.1	μA
Forward Voltage	V_F	$I_F = 50mA$	—	0.93	1.0	V
Total Capacitance	C_T	$V_R = 50V$, $f = 1MHz$	—	0.25	0.4	pF
Series Resistance	r_s	$I_F = 10mA$, $f = 100MHz$	—	3	4.5	Ω

MARKING



CT – VR
f=1MHz
Ta=25°C
TOTAL CAPACITANCE CT (pF)
3
1
0.5
0.3
0.1
1
3
5
10
30
50
REVERSE VOLTAGE VR (V)



rS – IF
Ta=25°C
f=0.2GHz
0.4
0.6
0.8
1.0
SERIES RESISTANCE rS (Ω)
1k
100
10
2
5μ
10μ
100μ
1m
10m
FORWARD CURRENT IF (A)

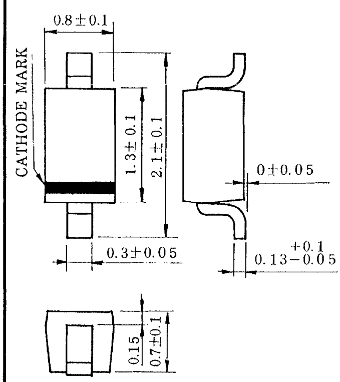
1SV273

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

VCO FOR UHF BAND RADIO

Unit in mm

- High Capacitance Ratio : $C_{1V}/C_{4V}=2.0$ (Typ.)
- Low Series Resistance : $r_S=0.28\Omega$ (Typ.)
- Small Package



JEDEC	—
EIAJ	—
TOSHIBA	1-1F1A

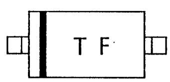
MAXIMUM RATINGS (Ta = 25°C)

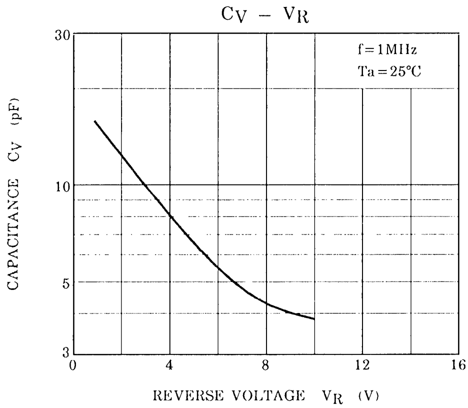
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	10	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

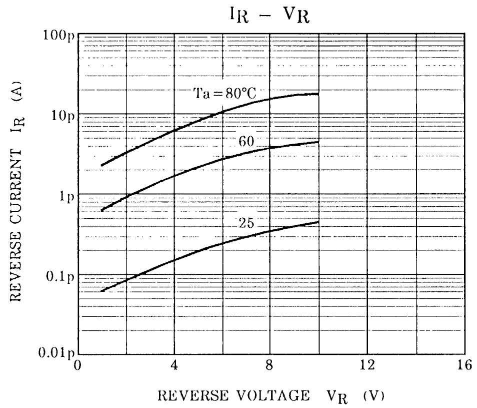
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

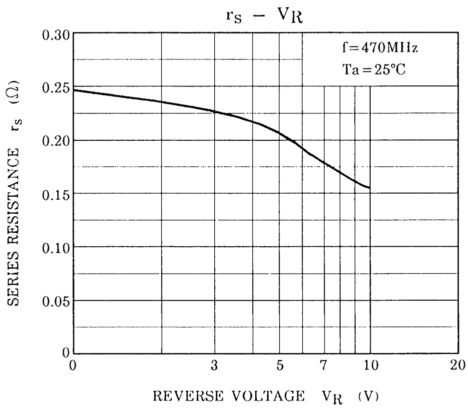
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R=1\mu A$	10	—	—	V
Reverse Current	I_R	$V_R=10V$	—	—	3	nA
Capacitance	C_{1V}	$V_R=1V$, f=1MHz	15	16	17	pF
Capacitance	C_{4V}	$V_R=4V$, f=1MHz	7.3	8.0	8.7	pF
Capacitance Ratio	C_{1V}/C_{4V}	—	1.8	2.0	—	—
Series Resistance	r_S	$V_R=1V$, f=470MHz	—	0.28	0.5	Ω

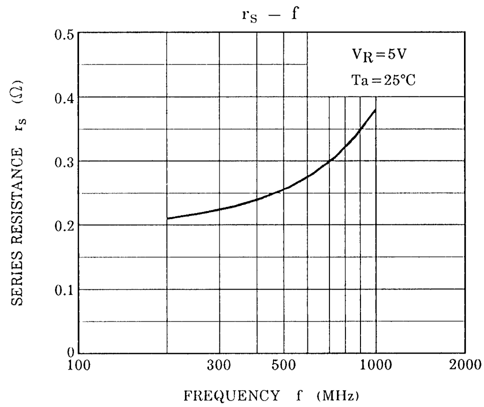
MARKING

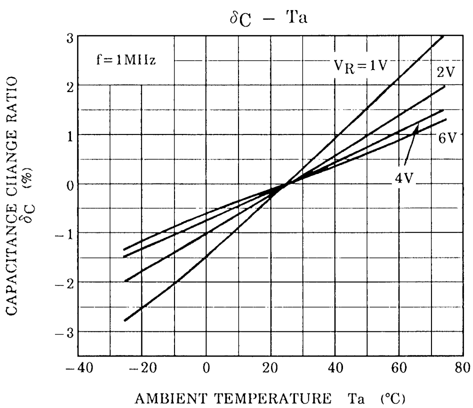



CV – VR
f = 1MHz
Ta = 25°C
CAPACITANCE CV (pF)
30
10
5
3
0
4
8
12
16
REVERSE VOLTAGE VR (V)


IR – VR
Ta = 80°C
60
25
REVERSE CURRENT IR (A)
100p
10p
1p
0.1p
0.01p
0
4
8
12
16
REVERSE VOLTAGE VR (V)


rS – VR
f = 470MHz
Ta = 25°C
SERIES RESISTANCE rS (Ω)
0.30
0.25
0.20
0.15
0.10
0.05
0
0
3
5
7
10
20
REVERSE VOLTAGE VR (V)


rS – f
VR = 5V
Ta = 25°C
SERIES RESISTANCE rS (Ω)
0.5
0.4
0.3
0.2
0.1
0
100
300
500
1000
2000
FREQUENCY f (MHz)


δC – Ta
f = 1MHz
VR = 1V
2V
6V
4V
CAPACITANCE CHANGE RATIO δC (%)
3
2
1
0
−1
−2
−3
−40
−20
0
20
40
60
80
AMBIENT TEMPERATURE Ta (°C)

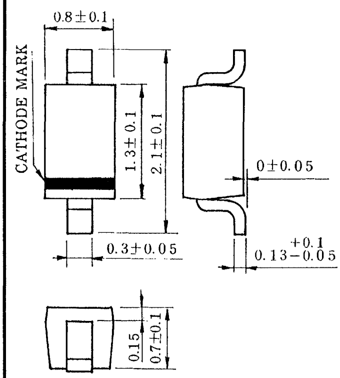
1SV274

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

CATV TUNING.

- High Capacitance Ratio : $C_{2V}/C_{25V}=12.5$ (Typ.)
- Low Series Resistance : $r_s=0.6\Omega$ (Typ.)
- Excellent C-V Characteristics, and Small Tracking Error.
- Small Package

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1F1A

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	34	V
Peak Reverse Voltage	V_{RM}	36 ($R_L=10k\Omega$)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R=1\mu A$	34	—	—	V
Reverse Current	I_R	$V_R=32V$	—	—	10	nA
Capacitance	C_{2V}	$V_R=2V$, f=1MHz	33	35.5	38	pF
Capacitance	C_{25V}	$V_R=25V$, f=1MHz	2.6	2.85	3.0	pF
Capacitance Ratio	C_{2V}/C_{25V}	—	12.0	12.5	—	—
Capacitance Ratio	C_{25V}/C_{28V}	—	1.03	—	—	—
Series Resistance	r_s	$V_R=5V$, f=470MHz	—	0.6	0.8	Ω

Note 1 : Available in matched group for capacitance to 2.0%.

$$\frac{C\ (\mathrm{Max.})-C\ (\mathrm{Min.})}{C\ (\mathrm{Min.})} \leqq 0.02\ (V_R=2\sim25V)$$

MARKING

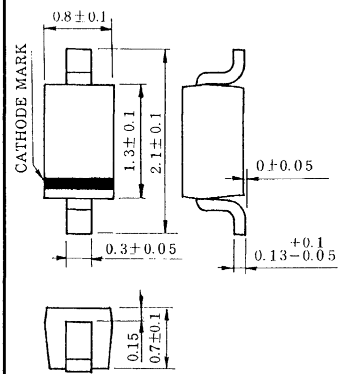
SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

1SV275

CATV TUNING.

Unit in mm

- High Capacitance Ratio : $C_{2V}/C_{25V}=11.5$ (Typ.)
- Low Series Resistance : $r_s=0.55\Omega$ (Typ.)
- Excellent C-V Characteristics, and Small Tracking Error.
- Small Package



JEDEC	—
EIAJ	—
TOSHIBA	1-1F1A

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	34	V
Peak Reverse Voltage	V_{RM}	36 ($R_L=10k\Omega$)	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R=1\mu A$	34	—	—	V
Reverse Current	I_R	$V_R=32V$	—	—	10	nA
Capacitance	C_{2V}	$V_R=2V$, f=1MHz	29	31.5	34	pF
Capacitance	C_{25V}	$V_R=25V$, f=1MHz	2.5	2.75	2.9	pF
Capacitance Ratio	C_{2V}/C_{25V}	—	11	11.5	—	—
Capacitance Ratio	C_{25V}/C_{28V}	—	1.03	1.05	—	—
Series Resistance	r_s	$V_R=5V$, f=470MHz	—	0.55	0.7	Ω

Note 1 : Available in matched group for capacitance to 2.0%.

$$\frac{C\,(\text{Max.})-C\,(\text{Min.})}{C\,(\text{Min.})} \leqq 0.02\ (V_R=2\sim25V)$$

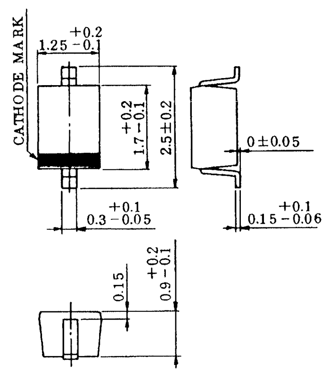
MARKING

1SV276

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

VCO FOR UHF BAND RADIO

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1E1A

- High Capacitance Ratio : $C_{1V}/C_{4V}=2.0$ (Typ.)
- Low Series Resistance : $r_s=0.22\Omega$ (Typ.)
- Small Package

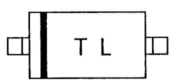
MAXIMUM RATINGS (Ta = 25°C)

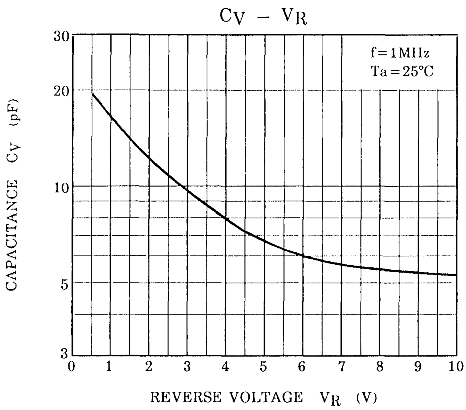
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	10	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

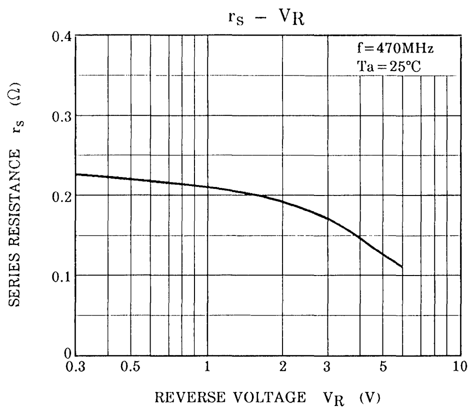
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R=1\mu A$	10	—	—	V
Reverse Current	I_R	$V_R=10V$	—	—	3	nA
Capacitance	C_{1V}	$V_R=1V$, f=1MHz	15	16	17	pF
Capacitance	C_{4V}	$V_R=4V$, f=1MHz	7.0	8.0	8.5	pF
Capacitance Ratio	C_{1V}/C_{4V}	—	1.8	2.0	—	—
Series Resistance	r_s	$V_R=1V$, f=470MHz	—	0.22	0.4	Ω

MARKING





$C_V - V_R$
f=1MHz
Ta=25°C
CAPACITANCE C_V (pF)
30
20
10
5
3
0 1 2 3 4 5 6 7 8 9 10
REVERSE VOLTAGE V_R (V)



$r_s - V_R$
f=470MHz
Ta=25°C
SERIES RESISTANCE r_s (Ω)
0.4
0.3
0.2
0.1
0
0.3 0.5 1 2 3 5 10
REVERSE VOLTAGE V_R (V)

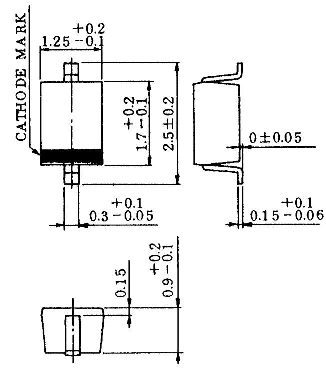
1SV277

SILICON EPITAXIAL PLANAR TYPE
VARIABLE CAPACITANCE DIODE

VCO FOR UHF BAND RADIO

- High Capacitance Ratio : $C_{1V} / C_{4V} = 2.3$ (Typ.)
- Low Series Resistance : $r_s = 0.42\Omega$ (Typ.)
- Small Package

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	1-1E1A

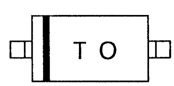
MAXIMUM RATINGS (Ta = 25°C)

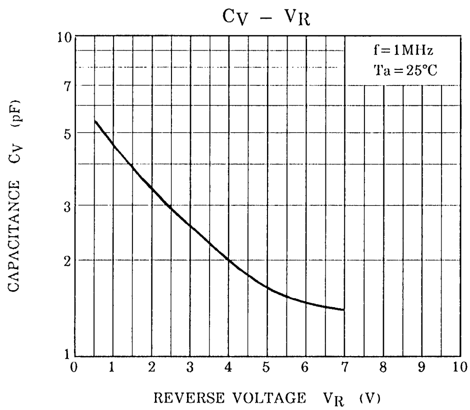
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	10	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

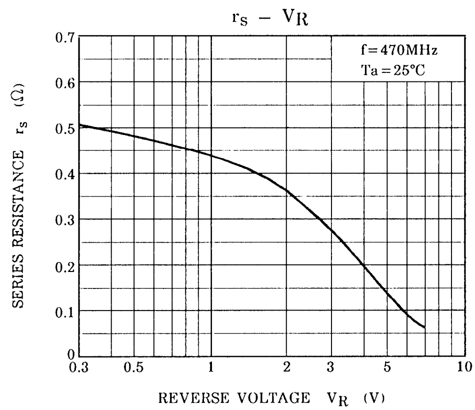
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 1\mu A$	10	—	—	V
Reverse Current	I_R	$V_R = 10V$	—	—	3	nA
Capacitance	C_{1V}	$V_R = 1V$, f = 1MHz	4.0	4.5	4.9	pF
Capacitance	C_{4V}	$V_R = 4V$, f = 1MHz	1.85	2.0	2.35	pF
Capacitance Ratio	C_{1V} / C_{4V}	—	2.0	2.3	—	—
Series Resistance	r_s	$V_R = 1V$, f = 470MHz	—	0.42	0.55	Ω

MARKING





C_V – V_R
f = 1MHz
Ta = 25°C
CAPACITANCE C_V (pF)
10
7
5
3
2
1
0
1
2
3
4
5
6
7
8
9
10
REVERSE VOLTAGE V_R (V)

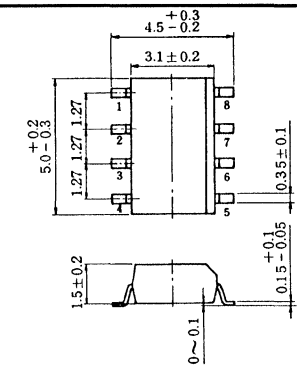


r_s – V_R
f = 470MHz
Ta = 25°C
SERIES RESISTANCE r_s (Ω)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.3
0.5
1
2
3
5
10
REVERSE VOLTAGE V_R (V)

HN1V01H SILICON EPITAXIAL PLANAR TYPE TRANSISTOR

AM RADIO BAND TUNING APPLICATIONS.

Unit in mm



- High Capacitance Ratio : C1V / C8V = 19.5 (Typ.)
- High Q : Q = 200 (Min.)
- Including Four Devices in FM8 Package (Flat Pack Mini 8Pin)
- Low Voltage Operation : V_R = 1~8V

1. ANODE 1
2, 7. CATHODE 1, 4
3, 6. CATHODE 2, 3
4. ANODE 2
5. ANODE 3
8. ANODE 4

JEDEC	—
EIAJ	—
TOSHIBA	1-5J1D

Weight : 0.05g

MAXIMUM RATINGS (Ta = 25°C) (D_1, D_2, D_3, D_4)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	16	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C) (D_1, D_2, D_3, D_4)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	I_R = 10μA	16	—	—	V
Reverse Current	I_R	V_R = 16V	—	—	20	nA
Capacitance	C1V	V_R = 1V, f = 1MHz	435	—	540	pF
Capacitance	C3V	V_R = 3V, f = 1MHz	140	—	250	pF
Capacitance	C5V	V_R = 5V, f = 1MHz	50.0	—	90.0	pF
Capacitance	C8V	V_R = 8V, f = 1MHz	19.9	—	26.7	pF
Capacitance	C1V / C8V	—	16.2	19.5	—	—
Figure of Merit	Q	V_R = 1V, f = 1MHz	200	—	—	—

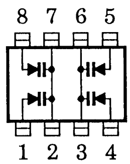
Note 1 : Four Devices in one Package are matched for capacitance to 2.5%.

$$\frac{C\,(\text{Max.}) - C\,(\text{Min.})}{C\,(\text{Min.})} \leqq 0.025\ (V_R = 1\sim 8V)$$

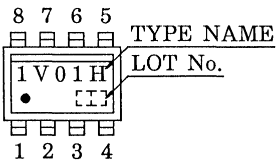
Note 2 : C8V is devided into two classifications as follows.

Classification	C8V (pF)
A	19.9~23.7
B	22.4~26.7

PIN ASSIGNMENT (TOP VIEW)



MARKING

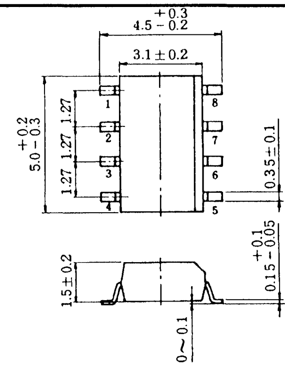


SILICON EPITAXIAL PLANAR TYPE TRANSISTOR

HN1V02H

AM RADIO BAND TUNING APPLICATIONS.

Unit in mm



1. ANODE 1
2, 7. CATHODE 1
3, 6. CATHODE 2
4. N.C.
5. ANODE 2
8. N.C.

JEDEC	—
EIAJ	—
TOSHIBA	1-5J1B

Weight : 0.05g

- High Capacitance Ratio : C1V / C8V = 19.5 (Typ.)
- High Q : Q = 200 (Min.)
- Including Two Devices in FM8 Package (Flat Pack Mini 8Pin)
- Low Voltage Operation : $V_R = 1 \sim 8V$

MAXIMUM RATINGS (Ta = 25°C) (D_1, D_2)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	16	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C) (D_1, D_2)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 10\mu A$	16	—	—	V
Reverse Current	I_R	$V_R = 16V$	—	—	20	nA
Capacitance	C1V	$V_R = 1V$, f = 1MHz	435	—	540	pF
Capacitance	C3V	$V_R = 3V$, f = 1MHz	140	—	250	pF
Capacitance	C5V	$V_R = 5V$, f = 1MHz	50.0	—	90.0	pF
Capacitance	C8V	$V_R = 8V$, f = 1MHz	19.9	—	26.7	pF
Capacitance Ratio	C1V / C8V	—	16.2	19.5	—	—
Figure of Merit	Q	$V_R = 1V$, f = 1MHz	200	—	—	—

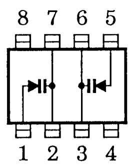
Note 1 : Two Devices in one Package are matched for capacitance to 2.5%.

$$\frac{C\,(Max.) - C\,(Min.)}{C\,(Min.)} \leqq 0.025\ (V_R = 1 \sim 8V)$$

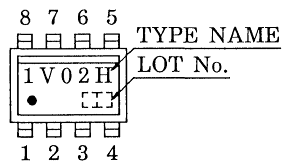
Note 2 : C8V is devided into two classifications as follows.

Classification	C8V (pF)
A	19.9~23.7
B	22.4~26.7

PIN ASSIGNMENT (TOP VIEW)



MARKING

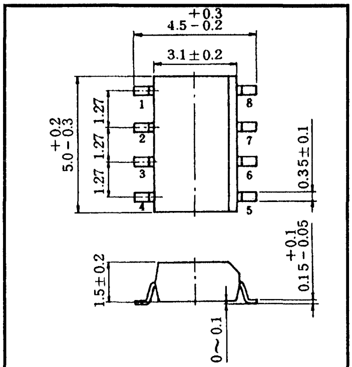


HN2V02H SILICON EPITAXIAL PLANAR TYPE TRANSISTOR

AM RADIO BAND TUNING APPLICATIONS.

- High Capacitance Ratio : C1V / C8V = 19.5 (Typ.)
- High Q : Q = 200 (Min.)
- Including Three Devices in FM8 Package (Flat Pack Mini 8Pin)
- Low Voltage Operation : $V_R = 1 \sim 8V$

Unit in mm



1. ANODE 1
2, 3. ANODE 2
4. ANODE 3
5. CATHODE 3
6, 7. CATHODE 2
8. CATHODE 1

JEDEC	—
EIAJ	—
TOSHIBA	1-5J1C

Weight : 0.05g

MAXIMUM RATINGS (Ta = 25°C) (D_1, D_2, D_3)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	16	V
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C) (D_1, D_2, D_3)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 10\mu A$	16	—	—	V
Reverse Current	I_R	$V_R = 16V$	—	—	20	nA
Capacitance	C1V	$V_R = 1V$, f = 1MHz	435	—	540	pF
Capacitance	C3V	$V_R = 3V$, f = 1MHz	140	—	250	pF
Capacitance	C5V	$V_R = 5V$, f = 1MHz	50.0	—	90.0	pF
Capacitance	C8V	$V_R = 8V$, f = 1MHz	19.9	—	26.7	pF
Capacitance Ratio	C1V / C8V	—	16.2	19.5	—	—
Figure of Merit	Q	$V_R = 1V$, f = 1MHz	200	—	—	—

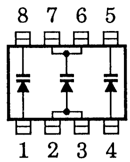
Note 1 : Three Devices in one Package are matched for capacitance to 2.5%.

$$\frac{C\,(Max.) - C\,(Min.)}{C\,(Min.)} \leqq 0.025 \; (V_R = 1 \sim 8V)$$

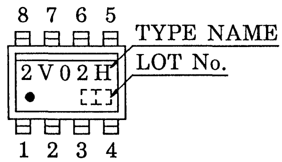
Note 2 : C8V is devided into two classifications as follows.

Classification	C8V (pF)
A	19.9~23.7
B	22.4~26.7

PIN ASSIGNMENT (TOP VIEW)



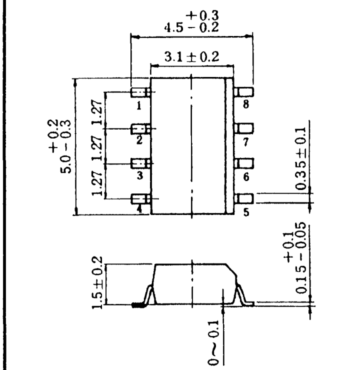
MARKING



SILICON EPITAXIAL SCHOTTKY BARRIER TYPE DIODE **S3275**

VHF~UHF MIXER APPLICATION.

Unit in mm



1. CATHODE 1
2. ANODE 3
3. ANODE 2
4. CATHODE 4
5. CATHODE 3, ANODE 4
6. N.C.
7. N.C.
8. ANODE 1, CATHODE 2

JEDEC	—
EIAJ	—
TOSHIBA	1-5J1A

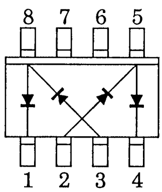
Weight : 0.05g

- Small Package.
- Small Delta Forward Voltage : $\Delta V_F = 20mV$
- Small Delta Total Capacitance : $\Delta C_T = 0.15pF$

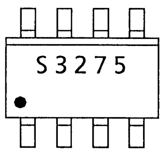
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	6	V
Forward Current	I_F	15	mA
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Pin Assigment



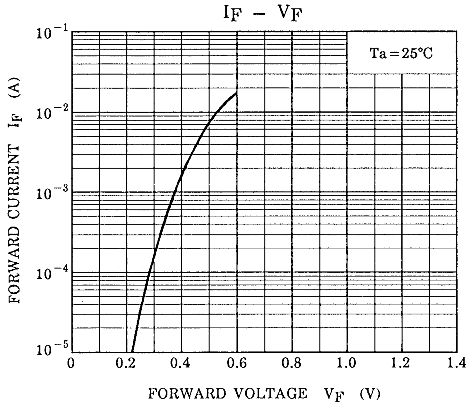
Marking

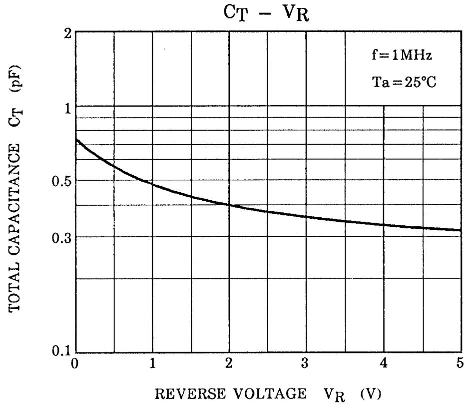


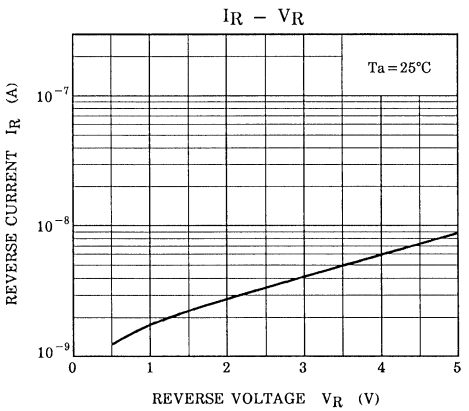
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	V_R	$I_R = 10\mu A$	6	—	—	V
Reverse Current	I_R	$V_R = 5V$	—	—	0.5	μA
Forward Voltage	$V_{F(1)}$	$I_F = 0.1mA$	—	0.32	—	V
Forward Voltage	$V_{F(2)}$	$I_F = 10mA$	0.45	0.53	0.60	V
Total Capacitance	C_T	$V_R = 0V$, f = 1MHz	—	0.65	0.9	pF
Delta Forward Voltage	ΔV_F	$I_F = 10mA$ (Note)	—	—	20	mV
Delta Total Capacitance	ΔC_T	$V_R = 0V$, f = 1MHz (Note)	—	—	0.15	pF

(Note) : Difference between 4 Device in 1 package.


I_F – V_F
Ta = 25°C
FORWARD CURRENT I_F (A)
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
0 0.2 0.4 0.6 0.8 1.0 1.2 1.4
FORWARD VOLTAGE V_F (V)

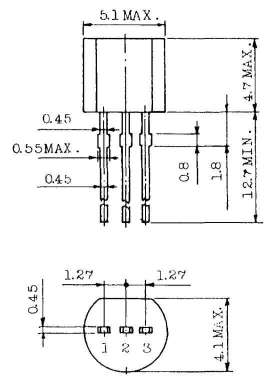

C_T – V_R
f = 1MHz
Ta = 25°C
TOTAL CAPACITANCE C_T (pF)
2
1
0.5
0.3
0.1
0 1 2 3 4 5
REVERSE VOLTAGE V_R (V)


I_R – V_R
Ta = 25°C
REVERSE CURRENT I_R (A)
10^{-7}
10^{-8}
10^{-9}
0 1 2 3 4 5
REVERSE VOLTAGE V_R (V)

SILICON PNP EPITAXIAL PLANAR TYPE TRANSISTOR **2SA1161**

HIGH SPEED SWITCHING APPLICATIONS.
VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	TO-92
EIAJ	SC-43
TOSHIBA	2-5F1E

Weight : 0.21g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	−15	V
Collector-Emitter Voltage	V_{CEO}	−8	V
Emitter-Base Voltage	V_{EBO}	−2	V
Collector Current	I_C	−30	mA
Base Current	I_E	30	mA
Collector Power Dissipation	P_C	200	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MICROWAVE CHARACTERISTICS (Ta = 25°C)

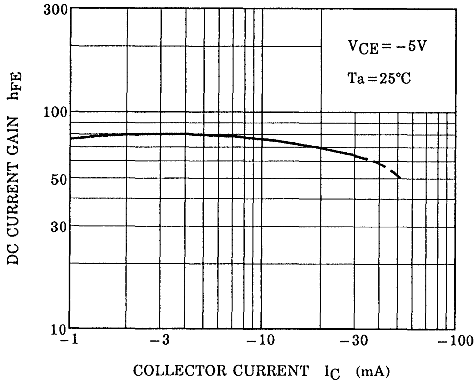
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	$V_{CE}=-5V$, $I_C=-10mA$	—	3.5	—	GHz
Insertion Gain	$\lvert S_{21e}\rvert^2$ (1)	$V_{CE}=-5V$, $I_C=-10mA$, $f=500MHz$	—	14	—	dB
	$\lvert S_{21e}\rvert^2$ (2)	$V_{CE}=-5V$, $I_C=-10mA$, $f=1GHz$	—	8.0	—	dB
Noise Figure	NF (1)	$V_{CE}=-5V$, $I_C=-3mA$, $f=500MHz$	—	2.5	—	dB
	NF (2)	$V_{CE}=-5V$, $I_C=-3mA$, $f=1GHz$	—	3.5	—	dB

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

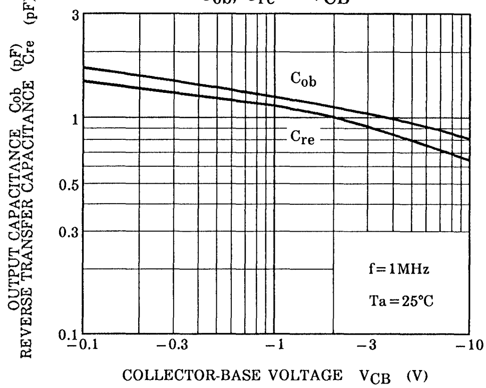
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CE}=-5V$, $I_E=0$	—	—	−0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=-1V$, $I_C=0$	—	—	−0.1	μA
DC Current Gain	h_{FE}	$V_{CE}=-5V$, $I_C=-10mA$	20	—	—	
Output Capacitance	C_{ob}	$V_{CB}=-5V$, $I_E=0$, $f=1MHz$	—	0.95	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.75	—	pF

Note : C_{re} is measured by 3 terminal method with Capacitance Bridge.

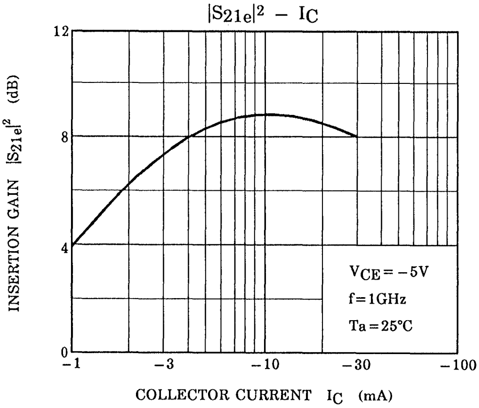
h_{FE} – I_C



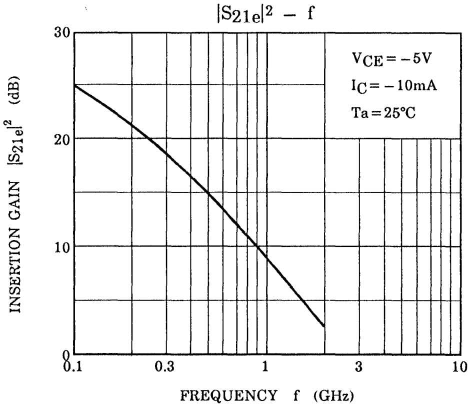
C_{ob}, C_{re} – V_{CB}



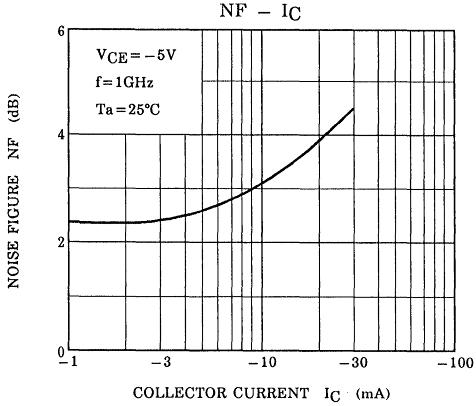
$|S_{21e}|^2$ – I_C



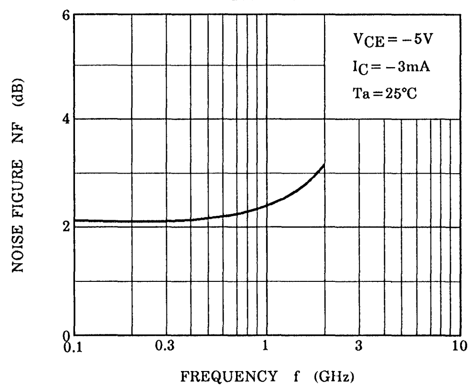
$|S_{21e}|^2$ – f



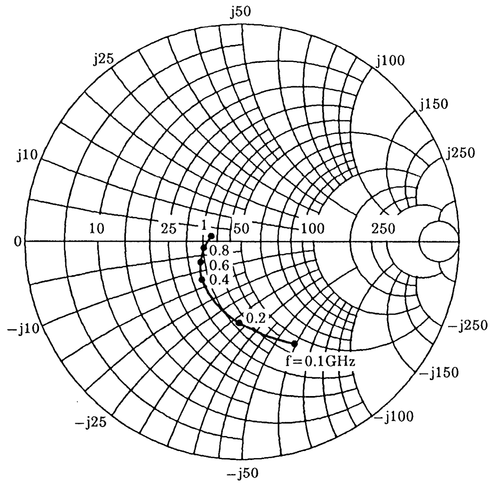
NF – I_C



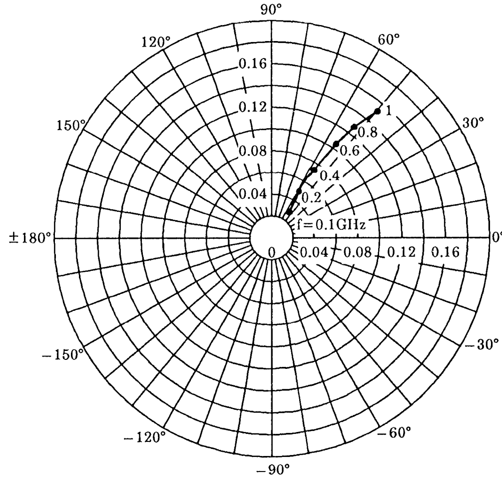
NF – f



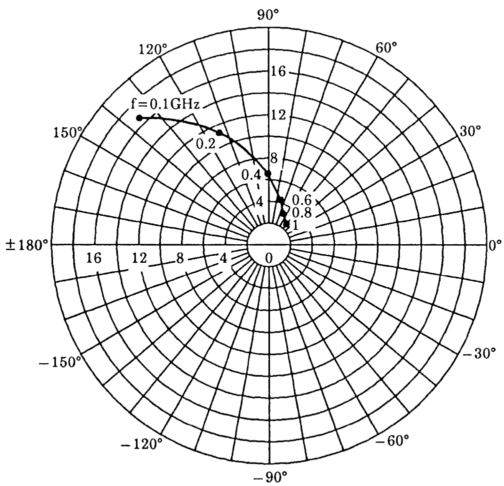
S_{11e}
$V_{CE} = -5V$
$I_C = -10mA$
$Ta = 25°C$
(UNIT : Ω)



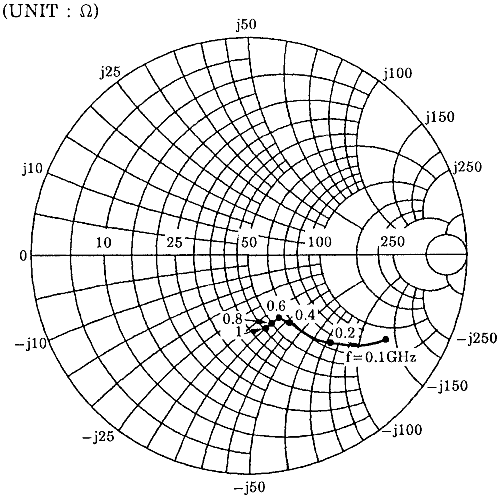
S_{12e}
$V_{CE} = -5V$
$I_C = -10mA$
$Ta = 25°C$



S_{21e}
$V_{CE} = -5V$
$I_C = -10mA$
$Ta = 25°C$



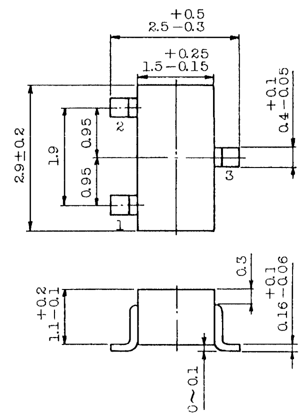
S_{22e}
$V_{CE} = -5V$
$I_C = -10mA$
$Ta = 25°C$
(UNIT : Ω)



2SA1245 SILICON PNP EPITAXIAL PLANAR TYPE TRANSISTOR

- HIGH FREQUENCY AMPLIFIER AND SWITCHING APPLICATIONS.
- VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

Unit in mm



1. EMITTER
2. BASE

S-MINI 3. COLLECTOR

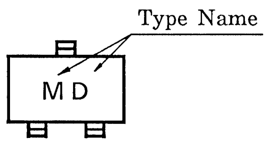
JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	−15	V
Collector-Emitter Voltage	V_{CEO}	−8	V
Emitter-Base Voltage	V_{EBO}	−2	V
Collector Current	I_C	−30	mA
Base Current	I_B	−15	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Marking



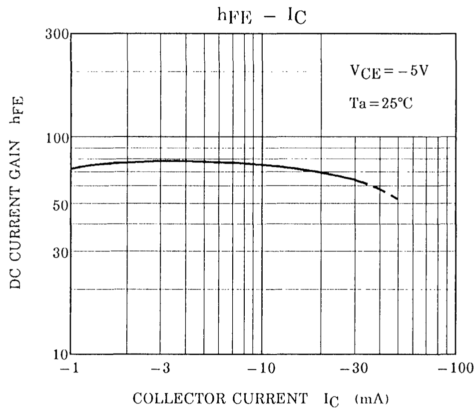
MICROWAVE CHARACTERISTICS (Ta = 25°C)

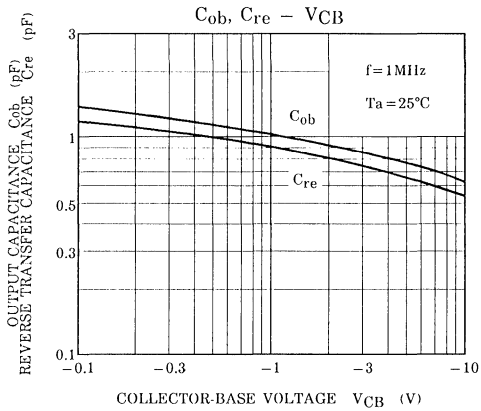
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	$V_{CE}=-5V$, $I_C=-10mA$	—	4	—	GHz
Insertion Gain	$\lvert S_{21e}\rvert^2$ (1)	$V_{CE}=-5V$, $I_C=-10mA$, f=500MHz	—	14	—	dB
	$\lvert S_{21e}\rvert^2$ (2)	$V_{CE}=-5V$, $I_C=-10mA$, f=1GHz	—	9.5	—	dB
Noise Figure	NF (1)	$V_{CE}=-5V$, $I_C=-3mA$, f=500MHz	—	2.5	—	dB
	NF (2)	$V_{CE}=-5V$, $I_C=-3mA$, f=1GHz	—	3.0	—	dB

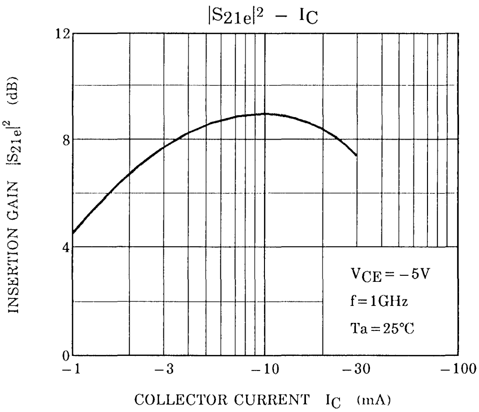
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

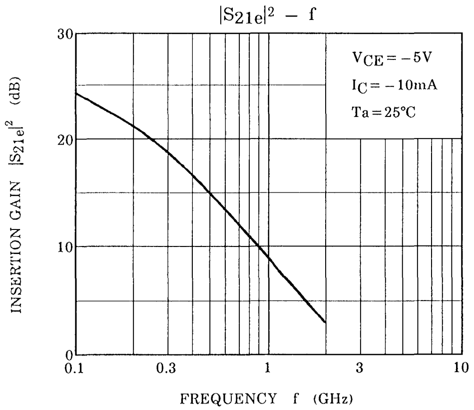
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=-5V$, $I_E=0$	—	—	−0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=-1V$, $I_C=0$	—	—	−0.1	μA
DC Current Gain	h_{FE}	$V_{CE}=-5V$, $I_C=-10mA$	20	—	—	—
Output Capacitance	C_{ob}	$V_{CB}=-5V$, $I_E=0$, f=1MHz (Note)	—	0.75	—	pF
Reserve Transfer Capacitance	C_{re}		—	0.60	—	pF

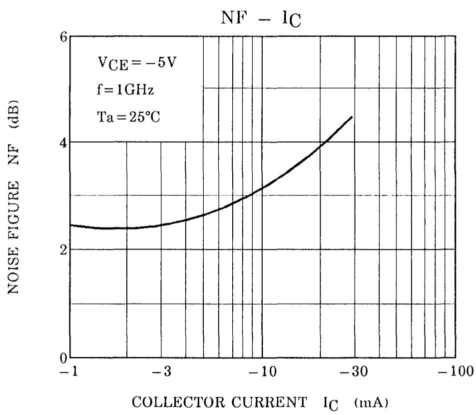
Note : C_{re} is measured by 3 terminal method with Capacitance Bridge.

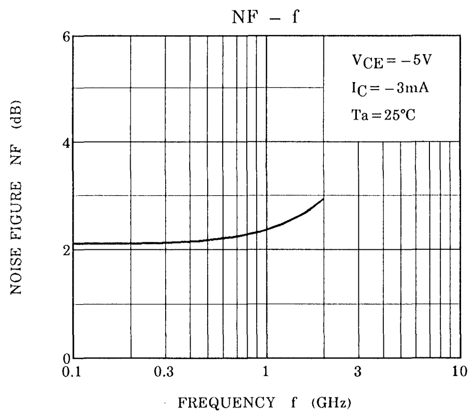

hFE – IC
DC CURRENT GAIN hFE
300
100
50
30
10
VCE = –5V
Ta = 25°C
–1
–3
–10
–30
–100
COLLECTOR CURRENT IC (mA)


Cob, Cre – VCB
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
3
1
0.5
0.3
0.1
f = 1MHz
Ta = 25°C
Cob
Cre
–0.1
–0.3
–1
–3
–10
COLLECTOR-BASE VOLTAGE VCB (V)

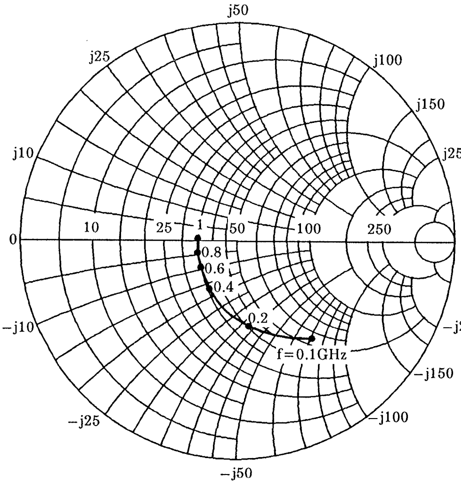

|S21e|2 – IC
INSERTION GAIN |S21e|2 (dB)
12
8
4
0
VCE = –5V
f = 1GHz
Ta = 25°C
–1
–3
–10
–30
–100
COLLECTOR CURRENT IC (mA)


|S21e|2 – f
INSERTION GAIN |S21e|2 (dB)
30
20
10
0
VCE = –5V
IC = –10mA
Ta = 25°C
0.1
0.3
1
3
10
FREQUENCY f (GHz)

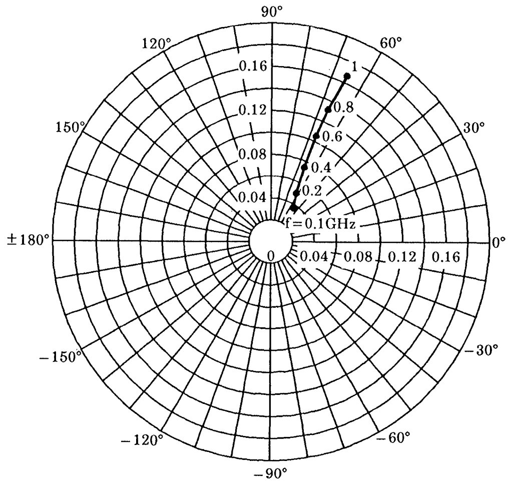

NF – IC
NOISE FIGURE NF (dB)
6
4
2
0
VCE = –5V
f = 1GHz
Ta = 25°C
–1
–3
–10
–30
–100
COLLECTOR CURRENT IC (mA)


NF – f
NOISE FIGURE NF (dB)
6
4
2
0
VCE = –5V
IC = –3mA
Ta = 25°C
0.1
0.3
1
3
10
FREQUENCY f (GHz)

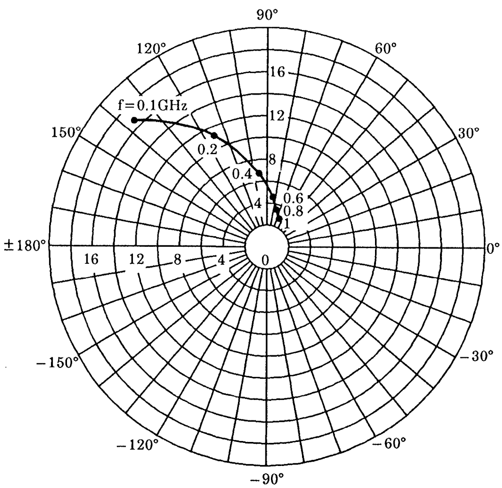
S_{11e}
$V_{CE} = -5V$
$I_C = -10mA$
$Ta = 25°C$
(UNIT : Ω)



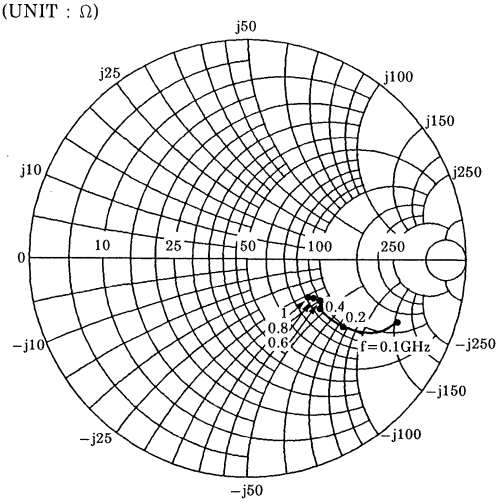
S_{12e}
$V_{CE} = -5V$
$I_C = -10mA$
$Ta = 25°C$



S_{21e}
$V_{CE} = -5V$
$I_C = -10mA$
$Ta = 25°C$



S_{22e}
$V_{CE} = -5V$
$I_C = -10mA$
$Ta = 25°C$
(UNIT : Ω)

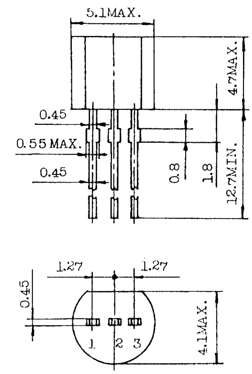


SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC380TM

HIGH FREQUENCY AMPLIFIER APPLICATIONS.

Unit in mm



1. EMITTER
2. COLLECTOR
3. BASE

JEDEC	TO-92
EIAJ	SC-43
TOSHIBA	2-5F1B

Weight : 0.21g

- High Power Gain : G_{pe}=29dB (Typ.) (f=10.7MHz)
- Recommended for FM IF, OSC Stage and AM CONV. IF Stage.

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	35	V
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Base Voltage	V_{EBO}	4	V
Collector Current	I_C	50	mA
Emitter Current	I_E	−50	mA
Collector Power Dissipation	P_C	300	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB}=35V, I_E=0	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB}=4V, I_C=0	—	—	0.1	μA
DC Current Gain	h_{FE} (Note)	V_{CE}=12V, I_C=2mA	40	—	240	—
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=10mA, I_B=1mA	—	—	0.4	V
Base-Emitter Voltage	V_{BE}	I_C=10mA, I_B=1mA	—	—	1.0	V
Transition Frequency	f_T	V_{CE}=10V, I_C=1mA	100	—	400	MHz
Collector Output Capacitance	C_{ob}	V_{CB}=10V, I_E=0, f=1MHz	1.4	2.0	3.2	pF
Collector-Base Time Constant	$C_c \cdot r_{bb'}$	V_{CE}=10V, I_E=−1mA, f=30MHz	10	—	50	ps
Power Gain	G_{pe}	V_{CC}=6V, I_E=−1mA, f=10.7MHz (Fig.)	27	29	33	dB

Note : h_{FE} classification R : 40~80, O : 70~140, Y : 120~240

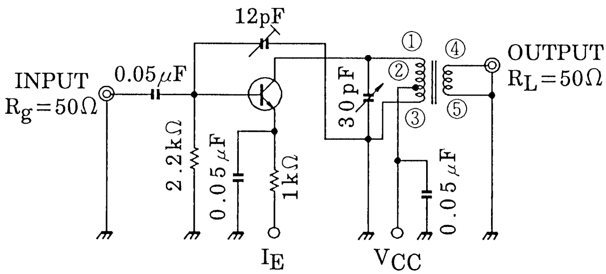
y PARAMETERS (Typ.)

(1) (COMMON EMITTER f = 455kHz, Ta = 25°C)

CHARACTERISTIC	SYMBOL	2SC380TM-R	2SC380TM-O	2SC380TM-Y	UNIT
Collector-Emitter Voltage	V_{CE}	6	6	6	V
Emitter Current	I_E	−1	−1	−1	mA
Input Conductance	g_{ie}	0.58	0.41	0.26	mS
Input Capacitance	C_{ie}	53	46	38	pF
Output Conductance	g_{oe}	1.9	2.7	4.8	μS
Output Capacitance	C_{oe}	2.6	2.8	3.6	pF
Forward Transfer Admittance	$\|y_{fe}\|$	38	38	38	mS
Phase Angle of Forward Transfer Admittance	θ_{fe}	−0.79	−0.83	−0.92	°
Reverse Transfer Admittance	$\|y_{re}\|$	5.7	5.7	6.2	μS
Phase Angle of Reverse Transfer Admittance	θ_{re}	−90	−90	−90	°

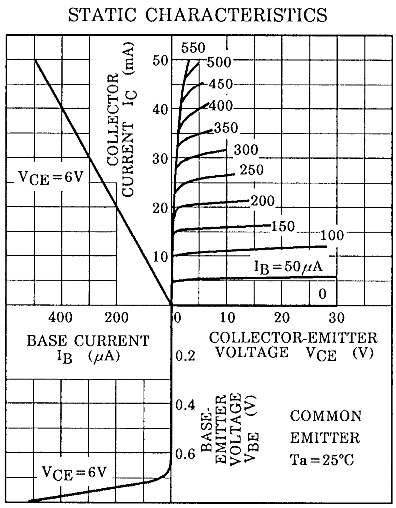
(2) (COMMON EMITTER f = 10.7MHz, Ta = 25°C)

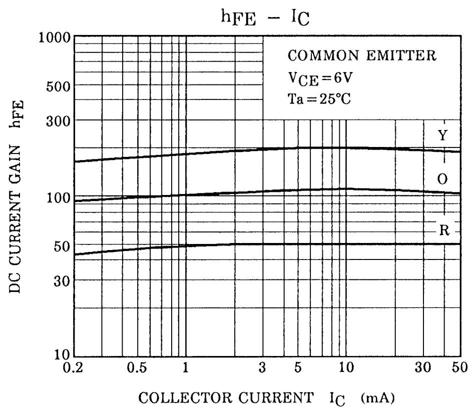
CHARACTERISTIC	SYMBOL	2SC380TM-R	2SC380TM-O	2SC380TM-Y	UNIT
Collector-Emitter Voltage	V_{CE}	6	6	6	V
Emitter Current	I_E	−1	−1	−1	mA
Input Conductance	g_{ie}	1.04	0.85	0.65	mS
Input Capacitance	C_{ie}	49	43	36	pF
Output Conductance	g_{oe}	10	15	28	μS
Output Capacitance	C_{oe}	2.7	2.9	3.6	pF
Forward Transfer Admittance	$\|y_{fe}\|$	37	37	37	mS
Phase Angle of Forward Transfer Admittance	θ_{fe}	−9.6	−10.4	−11.5	°
Reverse Transfer Admittance	$\|y_{re}\|$	120	120	140	μS
Phase Angle of Reverse Transfer Admittance	θ_{re}	−90	−90	−90	°



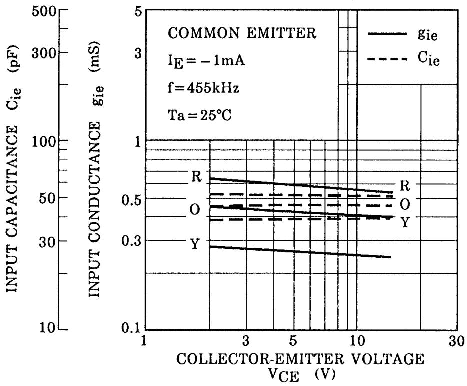
T : ①-② 0.1mmϕ UEW 20T
②-③ 0.1mmϕ UEW 8T
④-⑤ 0.1mmϕ UEW 2T

Fig.1 G_{pe} TEST CIRCUIT

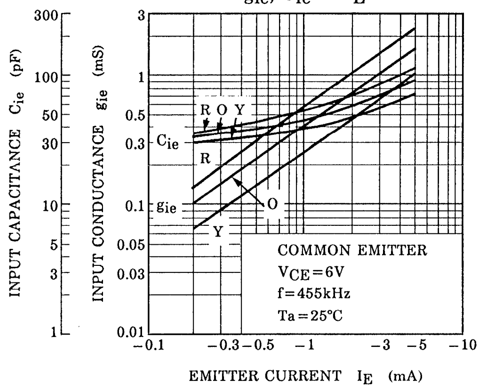




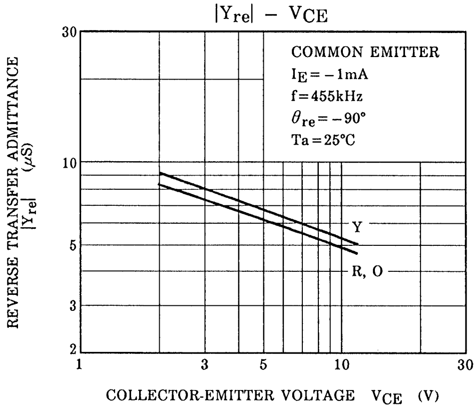
g_{ie}, C_{ie} – V_{CE}



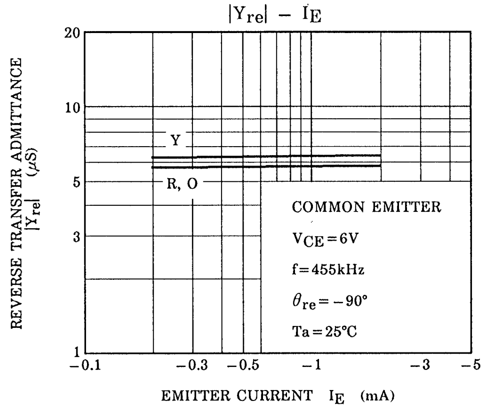
g_{ie}, C_{ie} – I_E



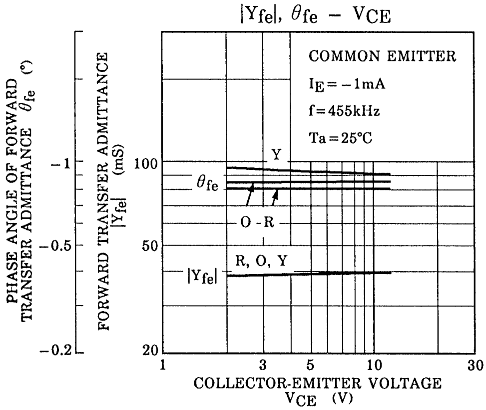
$|Y_{re}|$ – V_{CE}



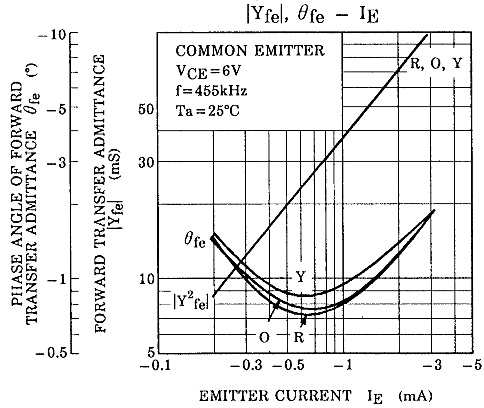
$|Y_{re}|$ – I_E

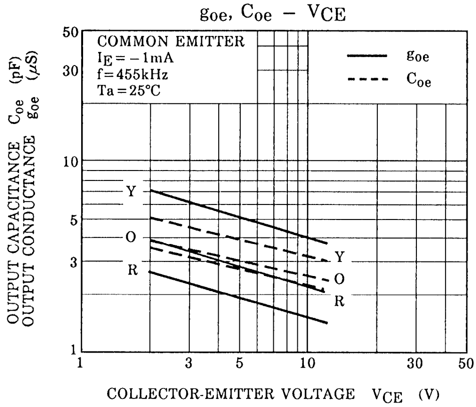


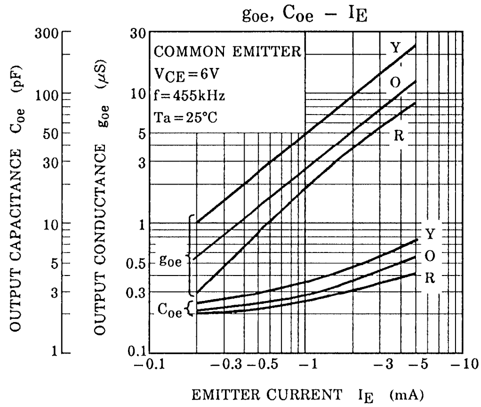
$|Y_{fe}|$, θ_{fe} – V_{CE}

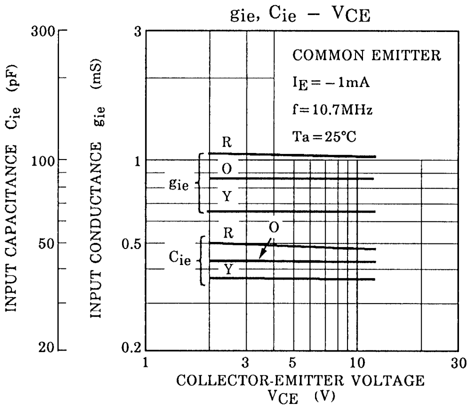


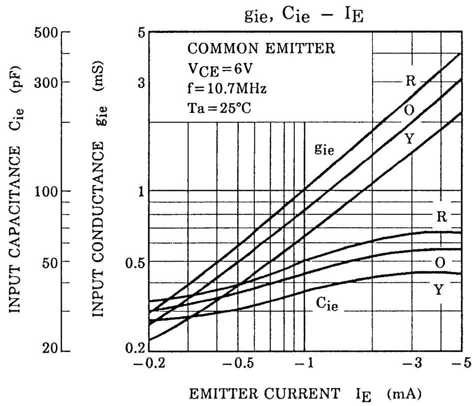
$|Y_{fe}|$, θ_{fe} – I_E

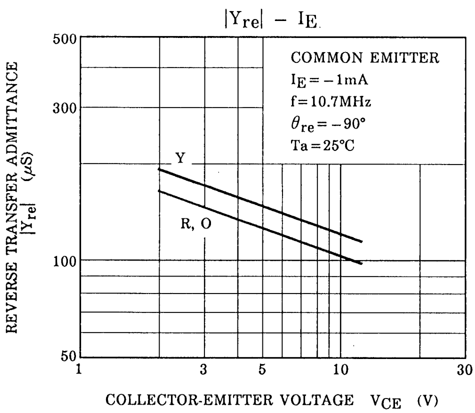


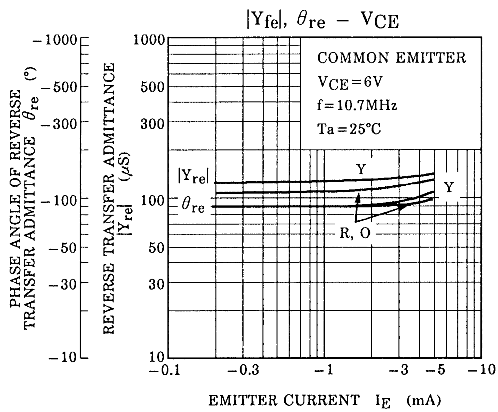

goe, Coe – VCE
COMMON EMITTER
IE = –1mA
f = 455kHz
Ta = 25°C
goe
Coe
OUTPUT CAPACITANCE Coe (pF)
OUTPUT CONDUCTANCE goe (μS)
COLLECTOR-EMITTER VOLTAGE VCE (V)
Y
O
R


goe, Coe – IE
COMMON EMITTER
VCE = 6V
f = 455kHz
Ta = 25°C
OUTPUT CAPACITANCE Coe (pF)
OUTPUT CONDUCTANCE goe (μS)
EMITTER CURRENT IE (mA)
goe
Coe
Y
O
R

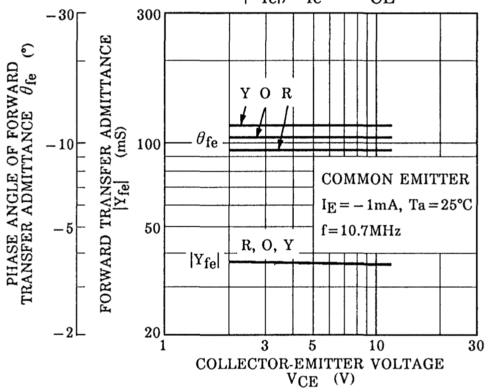

gie, Cie – VCE
COMMON EMITTER
IE = –1mA
f = 10.7MHz
Ta = 25°C
INPUT CAPACITANCE Cie (pF)
INPUT CONDUCTANCE gie (mS)
COLLECTOR-EMITTER VOLTAGE VCE (V)
gie
Cie
R
O
Y


gie, Cie – IE
COMMON EMITTER
VCE = 6V
f = 10.7MHz
Ta = 25°C
INPUT CAPACITANCE Cie (pF)
INPUT CONDUCTANCE gie (mS)
EMITTER CURRENT IE (mA)
gie
Cie
R
O
Y

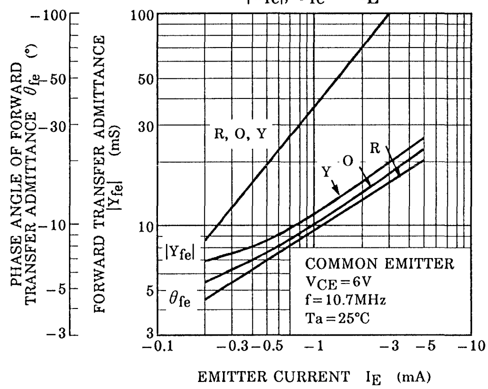

|Yre| – IE
COMMON EMITTER
IE = –1mA
f = 10.7MHz
θre = –90°
Ta = 25°C
REVERSE TRANSFER ADMITTANCE |Yre| (μS)
COLLECTOR-EMITTER VOLTAGE VCE (V)
Y
R, O


|Yfe|, θre – VCE
COMMON EMITTER
VCE = 6V
f = 10.7MHz
Ta = 25°C
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE θre (°)
REVERSE TRANSFER ADMITTANCE |Yre| (μS)
EMITTER CURRENT IE (mA)
|Yre|
θre
Y
R, O

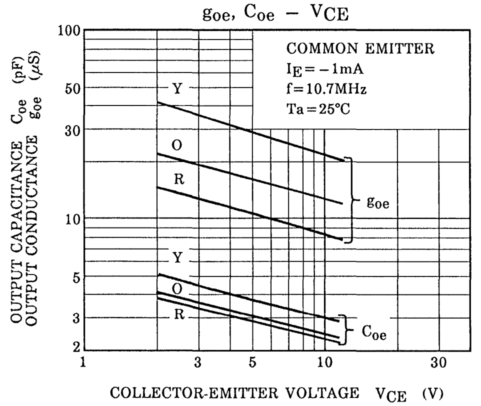
|Yfe|, θfe – VCE



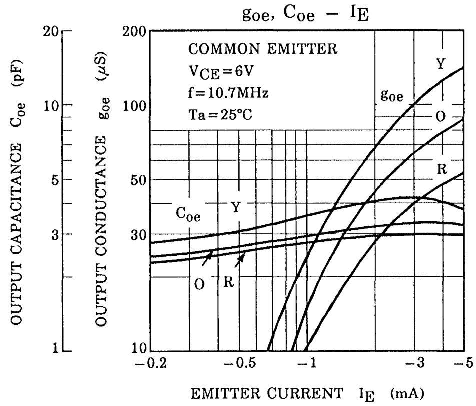
|Yfe|, θfe – IE



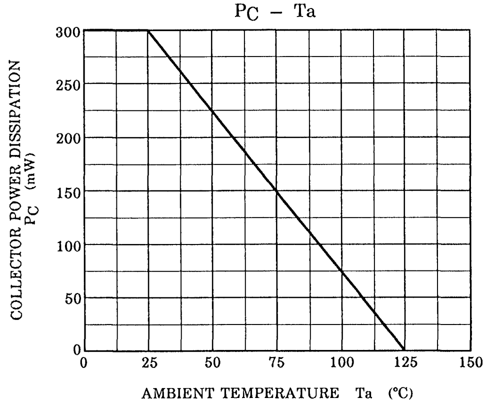
goe, Coe – VCE



goe, Coe – IE



PC – Ta



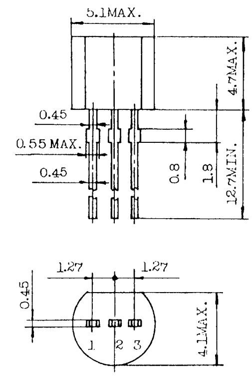
SILICON NPN EPITAXIAL TYPE TRANSISTOR

2SC941TM

HIGH FREQUENCY AMPLIFIER APPLICATIONS.
AM HIGH FREQUENCY AMPLIFIER APPLICATIONS.
AM FREQUENCY CONVERTER APPLICATIONS.

- Low Noise Figure : NF = 3.5dB (Max.) (f = 1MHz)

Unit in mm



1. EMITTER
2. COLLECTOR
3. BASE

JEDEC	TO-92
EIAJ	SC-43
TOSHIBA	2-5F1B

Weight : 0.21g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	35	V
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Base Voltage	V_{EBO}	4	V
Collector Current	I_C	100	mA
Base Current	I_B	20	mA
Collector Power Dissipation	P_C	400	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

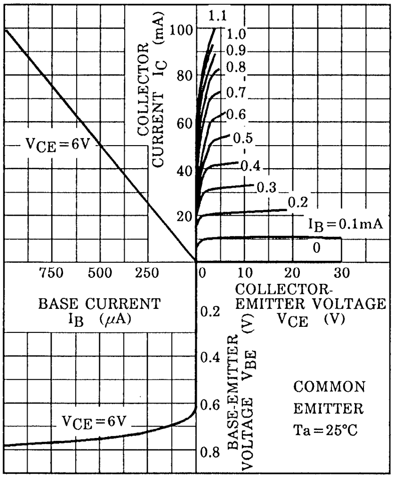
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=20V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=2V$, $I_C=0$	—	—	1.0	μA
DC Current Gain	h_{FE} (Note)	$V_{CE}=12V$, $I_C=2mA$	40	—	240	—
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=10mA$, $I_B=1mA$	—	—	0.4	V
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=10mA$, $I_B=1mA$	—	—	1.0	V
Transition Frequency	f_T	$V_{CE}=10V$, $I_C=2mA$	80	120	—	MHz
Reverse Transfer Capacitance	C_{re}	$V_{CB}=10V$, $I_E=0$, f=1MHz	—	2.2	3.0	pF
Collector-Base Time Constant	$C_c \cdot r_{bb'}$	$V_{CE}=10V$, $I_E=-1mA$, f=30MHz	—	30	50	ps
Noise Figure	NF	$V_{CE}=10V$, $I_E=-1mA$, f=1MHz, $R_g=50\Omega$	—	2.0	3.5	dB

Note : h_{FE} classification R : 40~80, O : 70~140, Y : 120~240

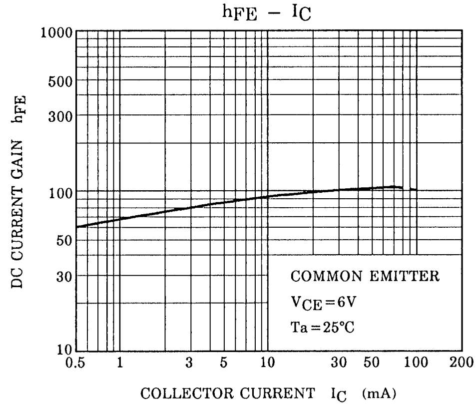
y PARAMETERS (Typ.) (COMMON EMITTER $V_{CE} = 6V$, $I_E = -1mA$, $f = 1MHz$)

CHARACTERISTIC	SYMBOL	2SC941-R	2SC941-O	2SC941-Y	UNIT
Input Conductance	g_{ie}	0.5	0.35	0.22	mS
Input Capacitance	C_{ie}	50	48	46	pF
Output Conductance	g_{oe}	4	5	6.5	μS
Output Capacitance	C_{oe}	3.7	3.4	3.2	pF
Forward Transfer Admittance	$\lvert y_{fe} \rvert$	36	36	36	mS
Phase Angle of Forward Transfer Admittance	θ_{fe}	−1.6	−1.6	−1.6	°
Reverse Transfer Admittance	$\lvert y_{re} \rvert$	14	14	14	μS
Phase Angle of Reverse Transfer Admittance	θ_{re}	−90	−90	−90	°

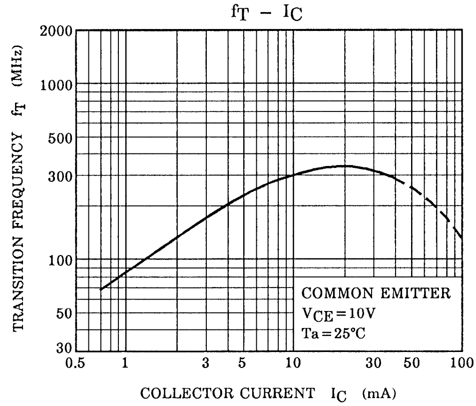
STATIC CHARACTERISTICS



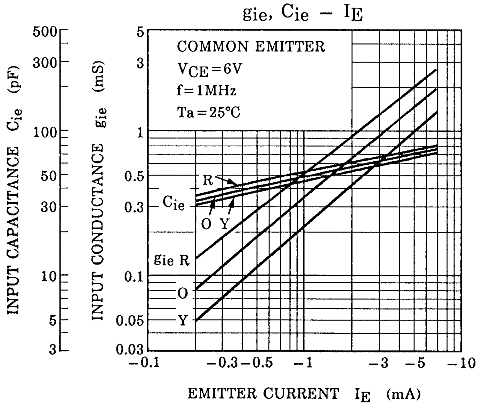
h_{FE} – I_C



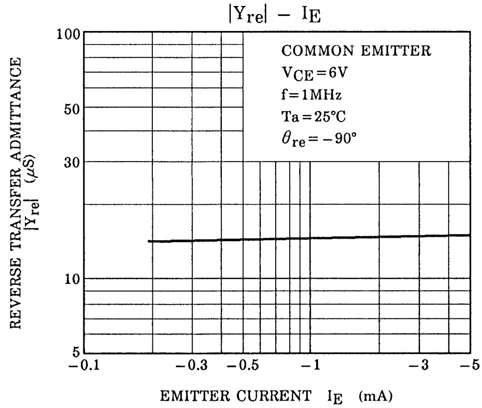
f_T – I_C



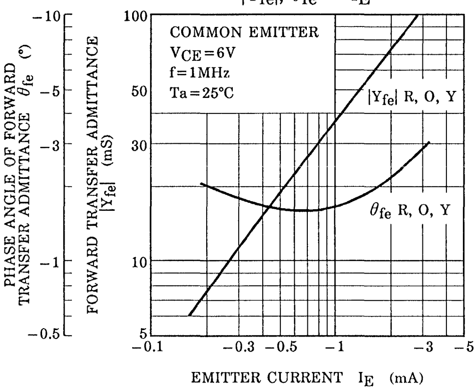
g_{ie}, C_{ie} – I_E



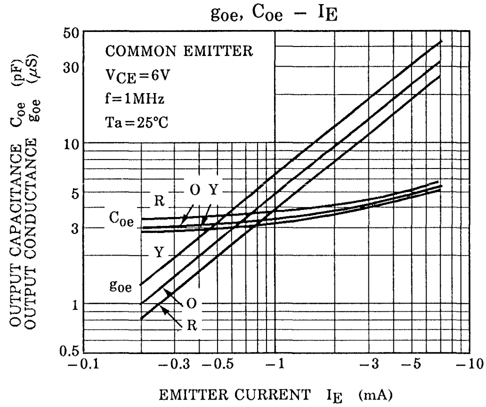
$|Y_{re}|$ – I_E



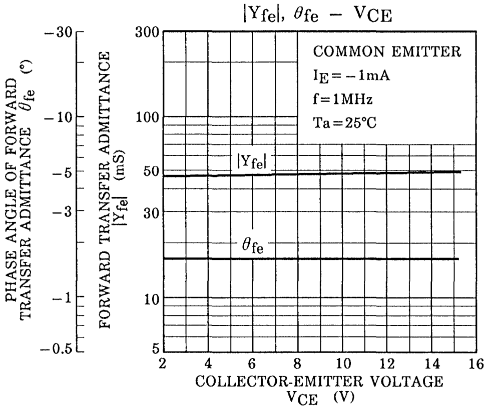
$|Y_{fe}|$, θ_{fe} – I_E



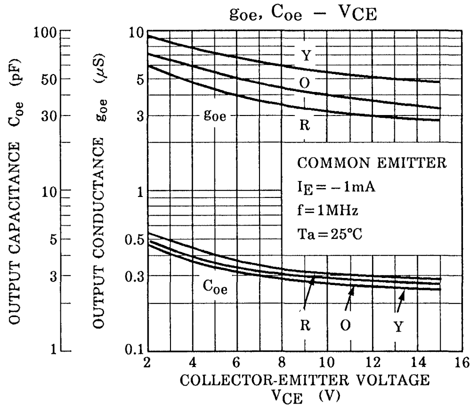
g_{oe}, C_{oe} – I_E



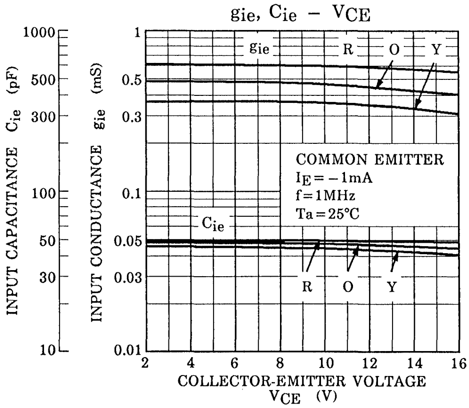
$|Y_{fe}|$, θ_{fe} – V_{CE}



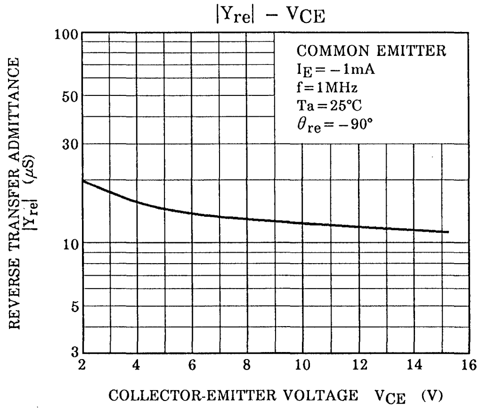
g_{oe}, C_{oe} – V_{CE}



g_{ie}, C_{ie} – V_{CE}



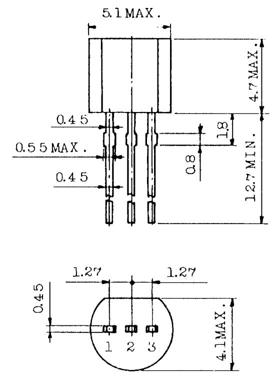
$|Y_{re}|$ – V_{CE}



2SC1815

AUDIO FREQUENCY GENERAL PURPOSE AMPLIFIER APPLICATIONS.
DRIVER STAGE AMPLIFIER APPLICATIONS.

Unit in mm



1. EMITTER
2. COLLECTOR
3. BASE

JEDEC	TO-92
EIAJ	SC-43
TOSHIBA	2-5F1B

Weight : 0.21g

- High Voltage and High Current
  : $V_{CEO}=50V$ (Min.), $I_C=150mA$ (Max.)
- Excellent h_{FE} Linearity
  : $h_{FE(2)}=100$ (Typ.) at $V_{CE}=6V$, $I_C=150mA$
  : h_{FE} ($I_C=0.1mA$) / h_{FE} ($I_C=2mA$) $=0.95$ (Typ.)
- Low Noise : NF=1dB (Typ.) at f=1kHz
- Complementary to 2SA1015 (O, Y, GR class)

MAXIMUM RATINGS (Ta = 25°C)

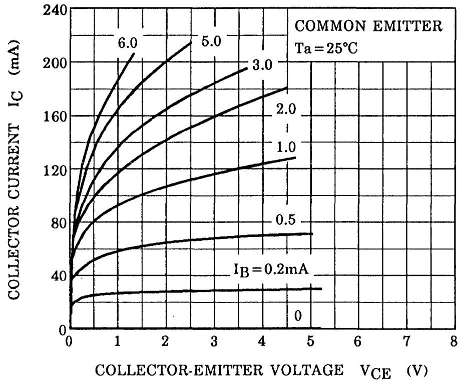
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	60	V
Collector-Emitter Voltage	V_{CEO}	50	V
Emitter-Base Voltage	V_{EBO}	5	V
Collector Current	I_C	150	mA
Base Current	I_B	50	mA
Collector Power Dissipation	P_C	400	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

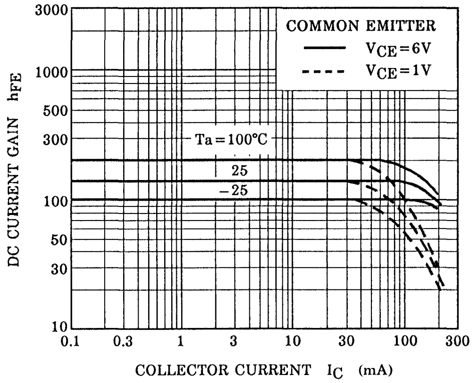
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=60V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=5V$, $I_C=0$	—	—	0.1	μA
DC Current Gain	$h_{FE(1)}$ (Note)	$V_{CE}=6V$, $I_C=2mA$	70	—	700	
	$h_{FE(2)}$	$V_{CE}=6V$, $I_C=150mA$	25	100	—	
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=100mA$, $I_B=10mA$	—	0.1	0.25	V
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=100mA$, $I_B=10mA$	—	—	1.0	V
Transition Frequency	f_T	$V_{CE}=10V$, $I_C=1mA$	80	—		MHz
Collector Ouput Capacitance	C_{ob}	$V_{CB}=10V$, $I_E=0$, $f=1MHz$	—	2.0	3.5	pF
Base Intrinsic Resistance	$r_{bb'}$	$V_{CE}=10V$, $I_E=-1mA$ f=30MHz	—	50	—	Ω
Noise Figure	NF	$V_{CE}=6V$, $I_C=0.1mA$ f=1kHz, $R_G=10k\Omega$	—	1.0	10	dB

Note : h_{FE} Classification O : 70~140 Y : 120~240 GR : 200~400 BL : 350~700

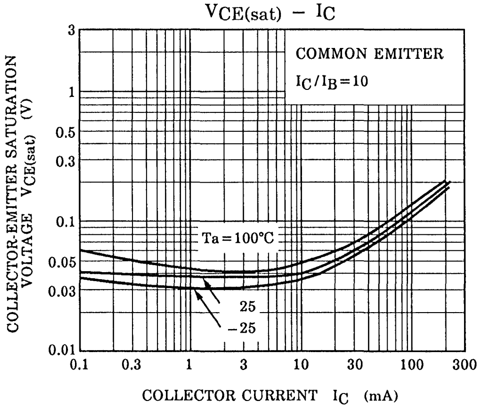
$I_C - V_{CE}$



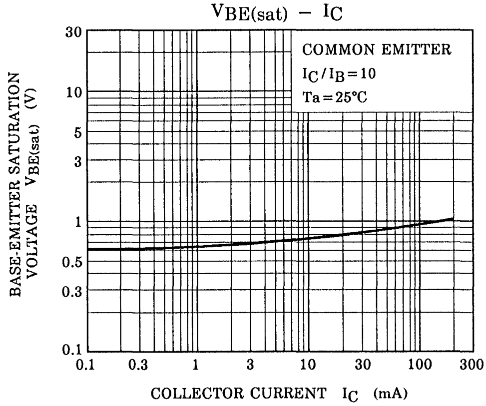
$h_{FE} - I_C$



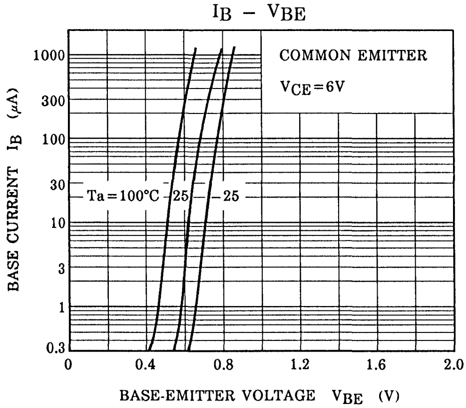
$V_{CE(sat)} - I_C$



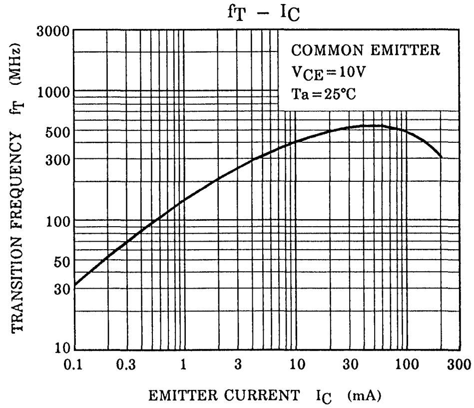
$V_{BE(sat)} - I_C$

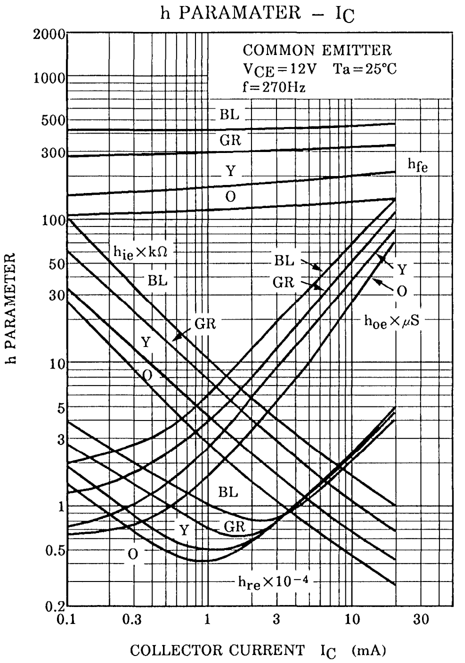


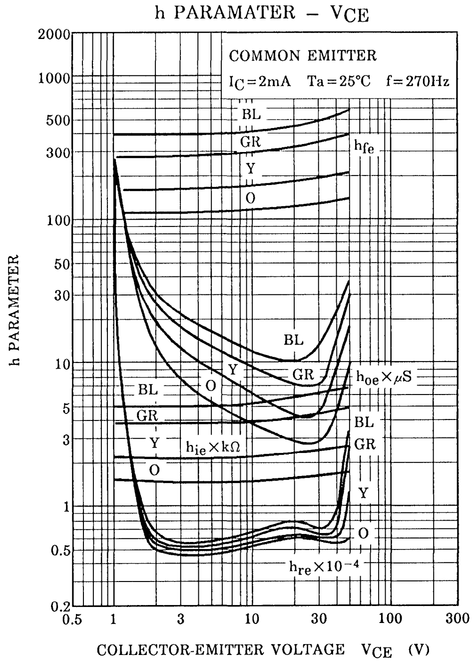
$I_B - V_{BE}$

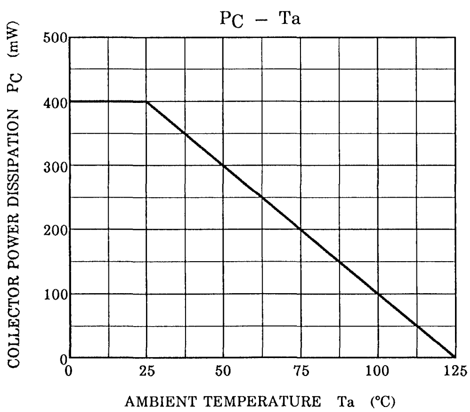


$f_T - I_C$




h PARAMATER – I_C
COMMON EMITTER
V_{CE}=12V Ta=25°C
f=270Hz
h PARAMETER
COLLECTOR CURRENT I_C (mA)
h_{fe}
h_{ie}×kΩ
h_{oe}×μS
h_{re}×10^-4
BL
GR
Y
O
2000
1000
500
300
100
50
30
10
5
3
1
0.5
0.2
0.1
0.3
1
3
10
30


h PARAMATER – V_{CE}
COMMON EMITTER
I_C=2mA Ta=25°C f=270Hz
h PARAMETER
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)
h_{fe}
h_{ie}×kΩ
h_{oe}×μS
h_{re}×10^-4
BL
GR
Y
O
2000
1000
500
300
100
50
30
10
5
3
1
0.5
0.2
0.5
1
3
10
30
100
300

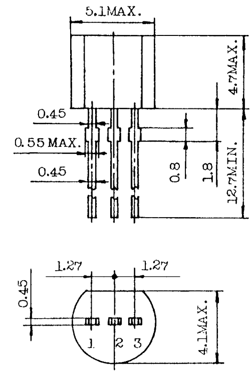

P_C – Ta
COLLECTOR POWER DISSIPATION P_C (mW)
AMBIENT TEMPERATURE Ta (°C)
500
400
300
200
100
0
0
25
50
75
100
125

2SC1923 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

HIGH FREQUENCY AMPLIFIER APPLICATIONS.
FM, RF, MIX, IF AMPLIFIER APPLICATIONS.

- Small Reverse Transfer Capacitance
  : C_{re} = 0.7pF (Typ.)
- Low Noise Figure
  : NF = 2.5dB (Typ.) (f = 100MHz)

Unit in mm



1. EMITTER
2. COLLECTOR
3. BASE

JEDEC	TO-92
EIAJ	SC-43
TOSHIBA	2-5F1B

Weight : 0.21g

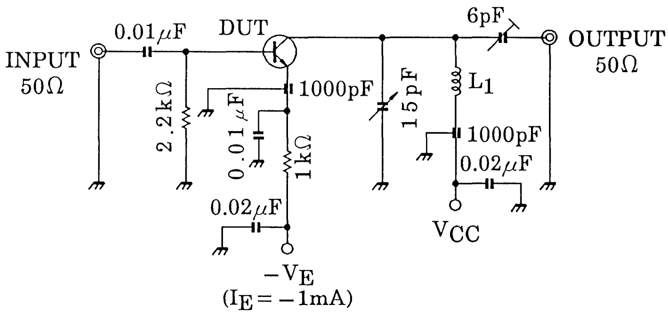
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	40	V
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Base Voltage	V_{EBO}	4	V
Collector Current	I_C	20	mA
Base Current	I_B	4	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 18V, I_E = 0	—	—	0.5	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 4V, I_C = 0	—	—	0.5	μA
DC Current Gain	h_{FE} (Note)	V_{CE} = 6V, I_C = 1mA	40	—	200	—
Reverse Transfer Capacitance	C_{re}	V_{CE} = 6V, f = 1MHz	—	0.70	—	pF
Transition Frequency	f_T	V_{CE} = 6V, I_C = 1mA	—	550	—	MHz
Collector-Base Time Constant	$C_c \cdot r_{bb'}$	V_{CE} = 6V, I_E = −1mA, f = 30MHz	—	—	30	ps
Noise Figure	NF	V_{CE} = 6V, I_E = −1mA, f = 100MHz, Fig.	—	2.5	4.0*	dB
Power Gain	G_{pe}		15	18	—	dB

Note : h_{FE} Classification R : 40~80, O : 70~140, Y : 100~200 (* NF = 5.0dB Max.)



L_1 : 0.8mmφ SILVER PLATED COPPER WIRE, 4T, 10ID, 8 LENGTH

Fig.1 NF, G_{pe} TEST CIRCUIT

y PARAMETER (Typ.)

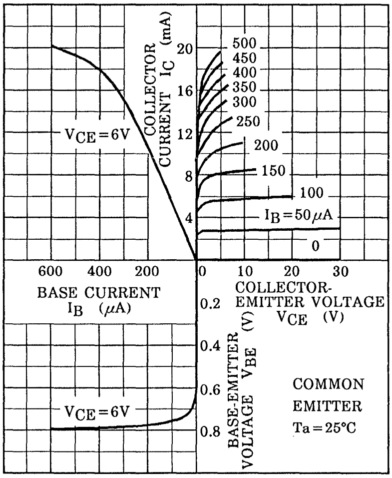
(1) COMMON EMITTER (V_{CE} = 6V, I_E = −1mA, f = 100MHz)

CHARACTERISTIC	SYMBOL	TYP.	UNIT
Input Conductance	g_{ie}	2.9	mS
Input Capacitance	C_{ie}	10.2	pF
Reverse Transfer Admittance	$\|y_{re}\|$	0.33	μS
Phase Angle of Reverse Transfer Admittance	θ_{re}	−90	°
Forward Transfer Admittance	$\|y_{fe}\|$	40	mS
Phase Angle of Forward Transfer Admittance	θ_{fe}	−20	°
Output Conductance	g_{oe}	45	μS
Output Capacitance	C_{oe}	1.1	pF

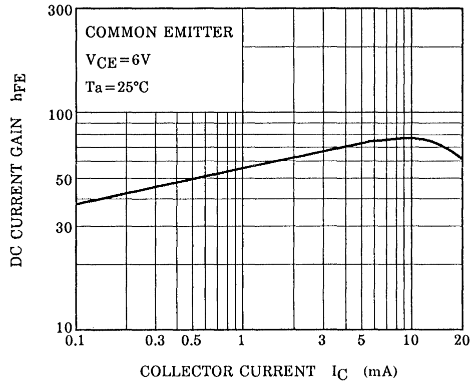
(2) COMMON BASE (V_{CE} = 6V, I_E = −1mA, f = 100MHz)

CHARACTERISTIC	SYMBOL	TYP.	UNIT
Input Conductance	g_{ib}	34	mS
Input Capacitance	C_{ib}	−10	pF
Reverse Transfer Admittance	$\|y_{rb}\|$	0.27	μS
Phase Angle of Reverse Transfer Admittance	θ_{rb}	−105	°
Forward Transfer Admittance	$\|y_{fb}\|$	34	mS
Phase Angle of Forward Transfer Admittance	θ_{fb}	165	°
Output Conductance	g_{ob}	45	μS
Output Capacitance	C_{ob}	1.1	pF

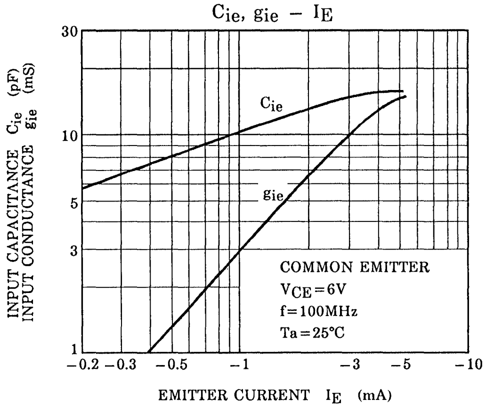
STATIC CHARACTERISTICS



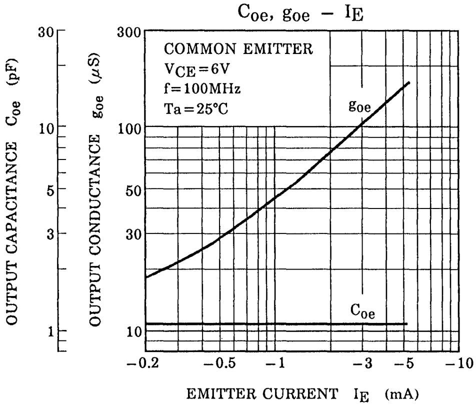
h_{FE} – I_C



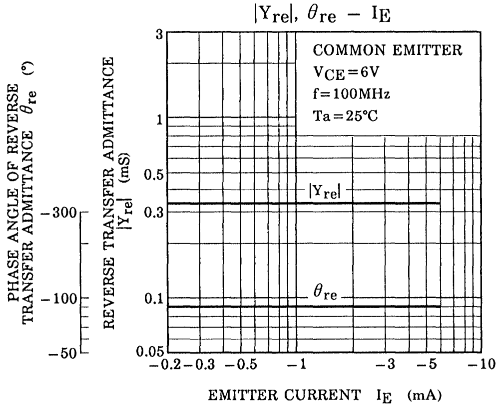
C_{ie}, g_{ie} – I_E

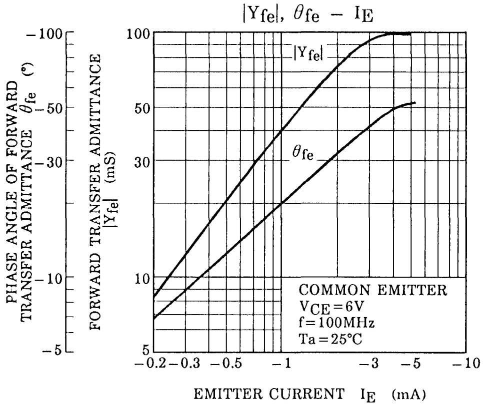


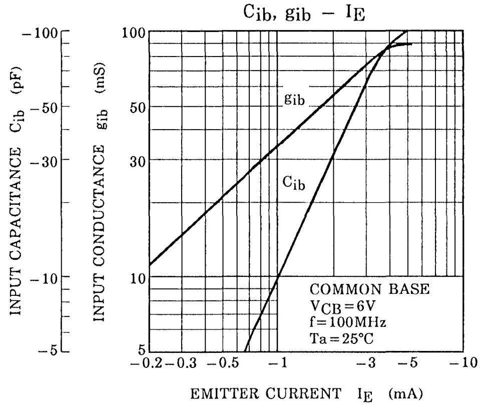
C_{oe}, g_{oe} – I_E

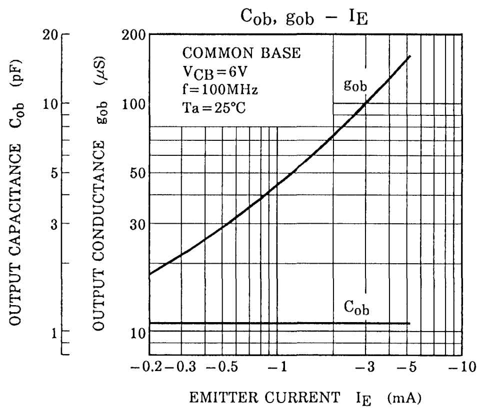


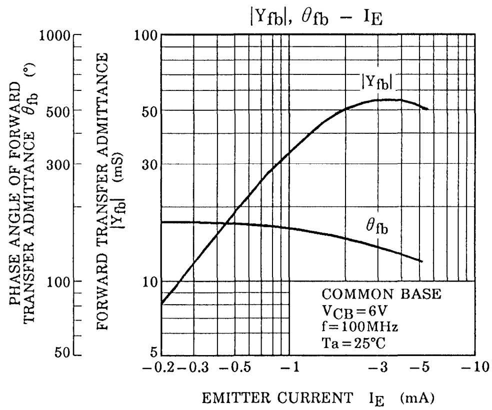
$|Y_{re}|$, θ_{re} – I_E

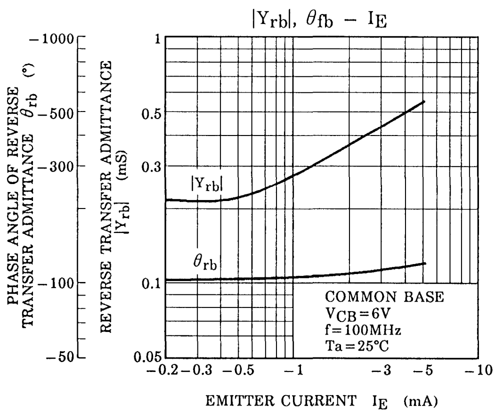


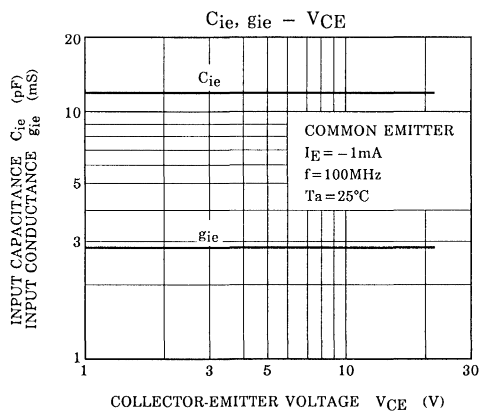

|Yfe|, θfe – IE
PHASE ANGLE OF FORWARD TRANSFER ADMITTANCE θfe (°)
FORWARD TRANSFER ADMITTANCE |Yfe| (mS)
|Yfe|
θfe
COMMON EMITTER
VCE=6V
f=100MHz
Ta=25°C
EMITTER CURRENT IE (mA)


Cib, gib – IE
INPUT CAPACITANCE Cib (pF)
INPUT CONDUCTANCE gib (mS)
gib
Cib
COMMON BASE
VCB=6V
f=100MHz
Ta=25°C
EMITTER CURRENT IE (mA)

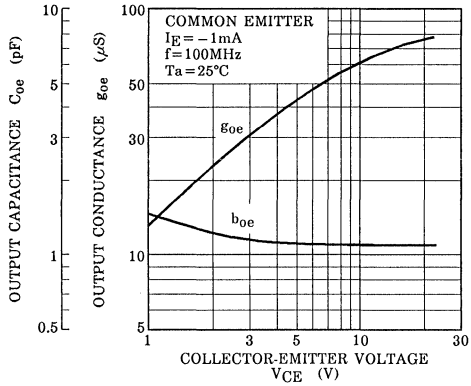

Cob, gob – IE
OUTPUT CAPACITANCE Cob (pF)
OUTPUT CONDUCTANCE gob (μS)
COMMON BASE
VCB=6V
f=100MHz
Ta=25°C
gob
Cob
EMITTER CURRENT IE (mA)


|Yfb|, θfb – IE
PHASE ANGLE OF FORWARD TRANSFER ADMITTANCE θfb (°)
FORWARD TRANSFER ADMITTANCE |Yfb| (mS)
|Yfb|
θfb
COMMON BASE
VCB=6V
f=100MHz
Ta=25°C
EMITTER CURRENT IE (mA)

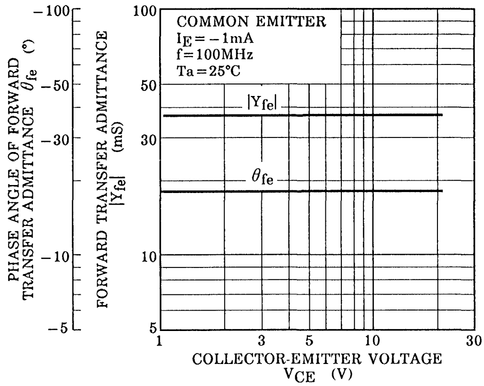

|Yrb|, θfb – IE
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE θrb (°)
REVERSE TRANSFER ADMITTANCE |Yrb| (mS)
|Yrb|
θrb
COMMON BASE
VCB=6V
f=100MHz
Ta=25°C
EMITTER CURRENT IE (mA)


Cie, gie – VCE
INPUT CAPACITANCE Cie (pF)
INPUT CONDUCTANCE gie (mS)
Cie
COMMON EMITTER
IE=–1mA
f=100MHz
Ta=25°C
gie
COLLECTOR-EMITTER VOLTAGE VCE (V)

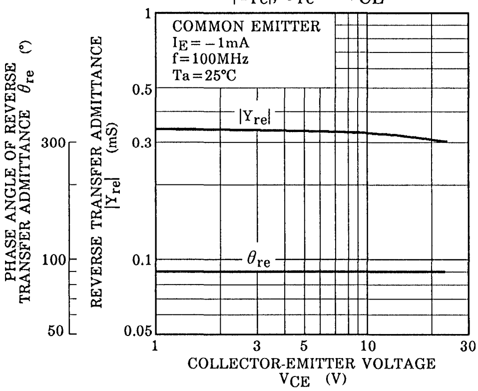
C_{oe}, g_{oe} – V_{CE}



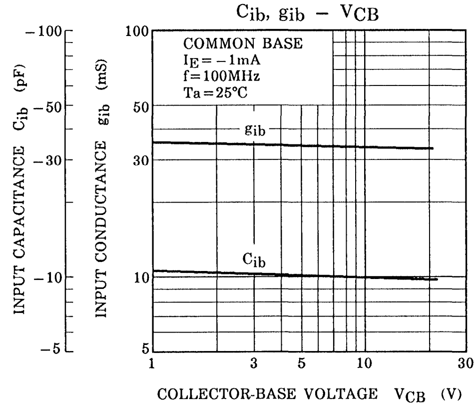
$|Y_{fe}|$, θ_{fe} – V_{CE}



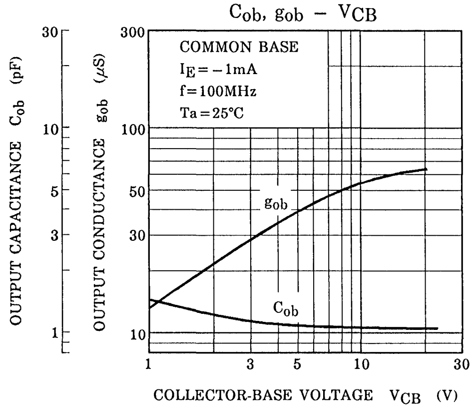
$|Y_{re}|$, θ_{re} – V_{CE}



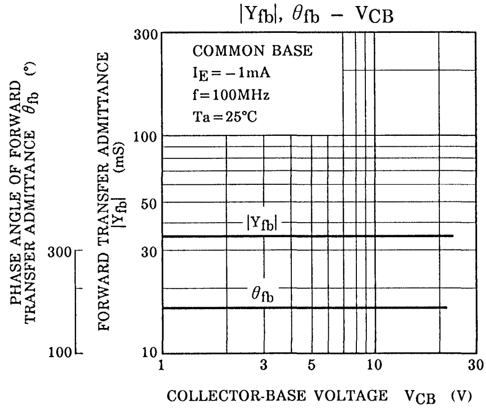
C_{ib}, g_{ib} – V_{CB}



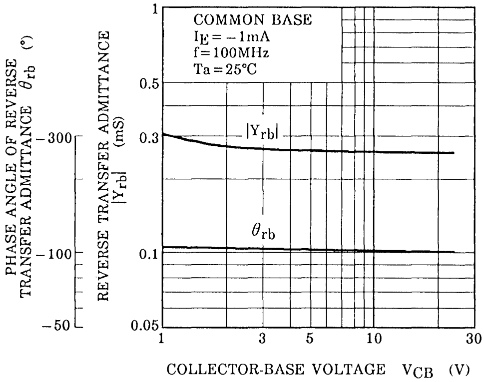
C_{ob}, g_{ob} – V_{CB}



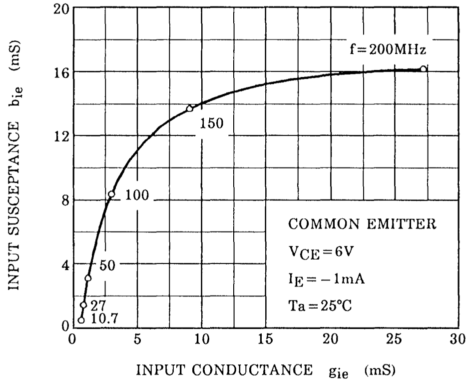
$|Y_{fb}|$, θ_{fb} – V_{CB}



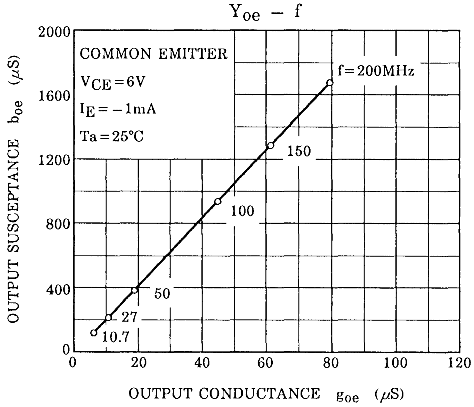
|Yrb|, θrb − VCB



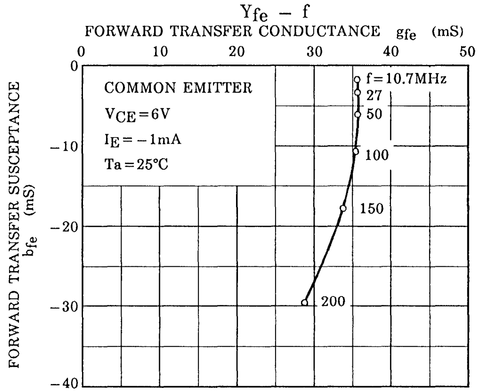
Yie − f



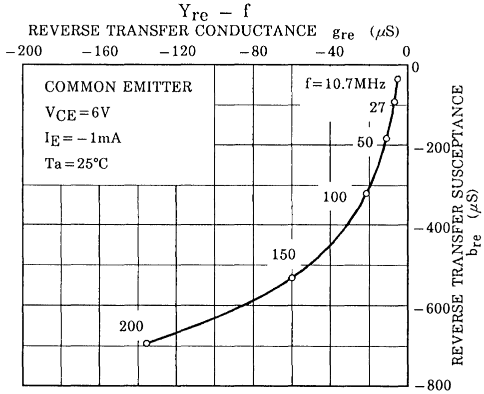
Yoe − f



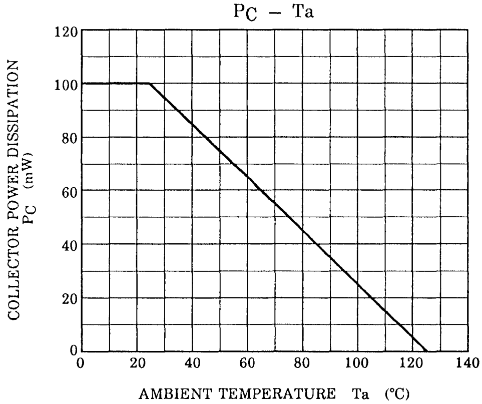
Yfe − f



Yre − f



PC − Ta



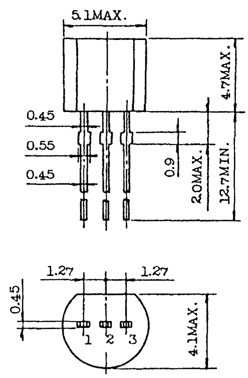
2SC2216/2717

SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

TV FINAL PICTURE IF AMPLIFIER APPLICATIONS.

- High Gain : G_{pe}=33dB (Typ.) (f=45MHz)
- Good Linearity of h_{FE}.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	TO-92
EIAJ	SC-43
TOSHIBA	2-5F1E

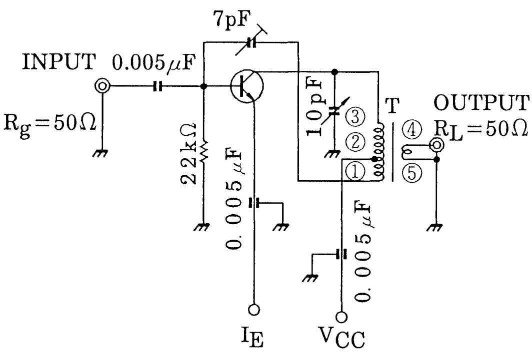
Weight : 0.21g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Collector-Base Voltage	2SC2216	V_{CBO}	50	V
	2SC2717		30	
Collector-Emitter Voltage	2SC2216	V_{CEO}	45	V
	2SC2717		25	
Emitter-Base Voltage		V_{EBO}	4	V
Collector Current		I_C	50	mA
Emitter Current		I_E	−50	mA
Collector Power Dissipation		P_C	300	mW
Junction Temperature		T_j	125	°C
Storage Temperature Range		T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

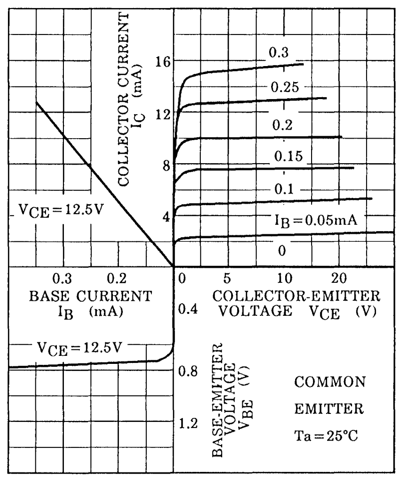
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	2SC2216	I_{CBO}	V_{CB}=50V, I_E=0	—	—	0.1	μA
	2SC2717		V_{CB}=30V, I_E=0				
Emitter Cut-off Current		I_{EBO}	V_{EB}=3V, I_C=0	—	—	0.1	μA
Collector-Emitter Breakdown Voltage	2SC2216	$V_{(BR)CEO}$	I_C=10mA, I_B=0	45	—	—	V
	2SC2717			25	—	—	
DC Current Gain	2SC2216	h_{FE}	V_{CE}=12.5V, I_C=12.5mA	40	—	140	—
	2SC2717			40	—	240	
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C=15mA, I_B=1.5mA	—	—	0.2	V
Base-Emitter Saturation Voltage		$V_{BE(sat)}$	I_C=15mA, I_B=1.5mA	—	—	1.5	V
Collector Output Capacitance		C_{ob}	V_{CB}=10V, I_E=0, f=30MHz	0.8	—	2.0	pF
Collector-Base Time Constant		$C_c \cdot r_{bb'}$	V_{CB}=10V, I_E=−1mA, f=30MHz	—	—	25	ps
Transition Frequency		f_T	V_{CE}=12.5V, I_C=12.5mA	300	—	—	MHz
Power Gain (Fig.)	2SC2216	G_{pe}	V_{CC}=12.5V, I_E=−12.5mA, f=45MHz	29	—	36	dB
	2SC2717			28	—	36	



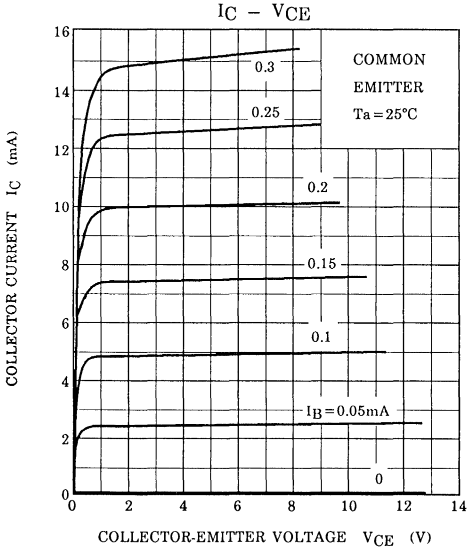
COIL DATA
0.20mmϕ Cu WIRE
L=1.2μH WITH M-5 CORE
T : ①-② 3.0T
②-③ 8.0T
④-⑤ 1.0T

Fig. 45MHz G_{pe} TEST CIRCUIT

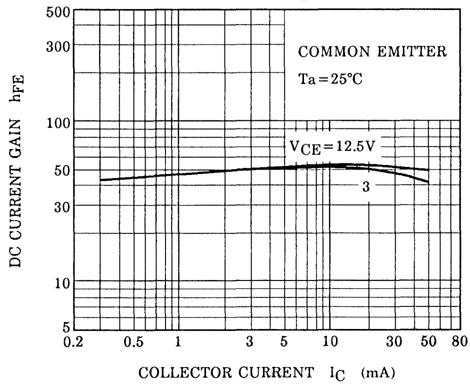
STATIC CHARACTERISTICS

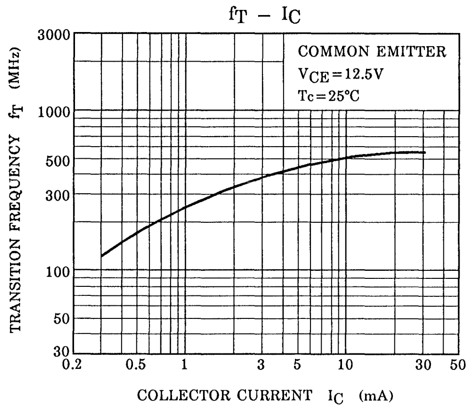


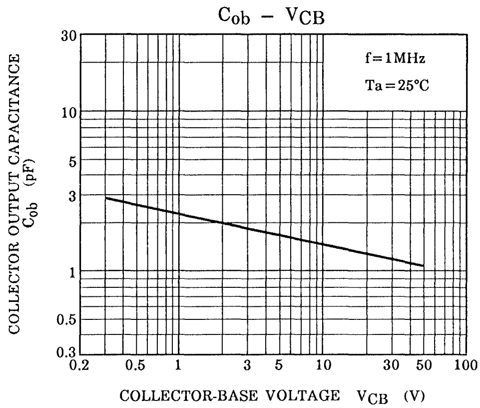
I_C – V_{CE}

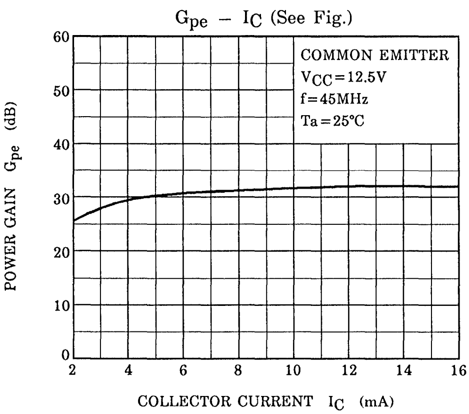


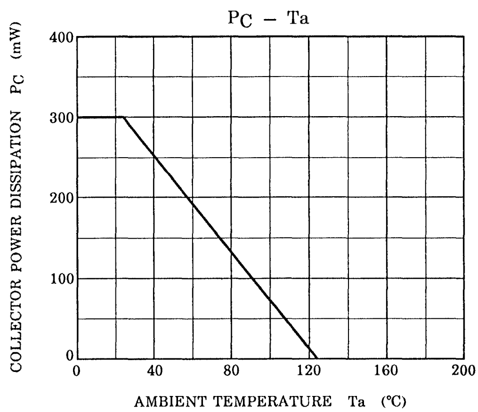
h_{FE} – I_C




f_T – I_C
COMMON EMITTER
V_{CE}=12.5V
Tc=25°C
TRANSITION FREQUENCY f_T (MHz)
3000
1000
500
300
100
50
30
0.2
0.5
1
3
5
10
30
50
COLLECTOR CURRENT I_C (mA)


C_{ob} – V_{CB}
f=1MHz
Ta=25°C
COLLECTOR OUTPUT CAPACITANCE C_{ob} (pF)
30
10
5
3
1
0.5
0.3
0.2
0.5
1
3
5
10
30
50
100
COLLECTOR-BASE VOLTAGE V_{CB} (V)


G_{pe} – I_C (See Fig.)
COMMON EMITTER
V_{CC}=12.5V
f=45MHz
Ta=25°C
POWER GAIN G_{pe} (dB)
60
50
40
30
20
10
0
2
4
6
8
10
12
14
16
COLLECTOR CURRENT I_C (mA)


P_C – Ta
COLLECTOR POWER DISSIPATION P_C (mW)
400
300
200
100
0
40
80
120
160
200
AMBIENT TEMPERATURE Ta (°C)

SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

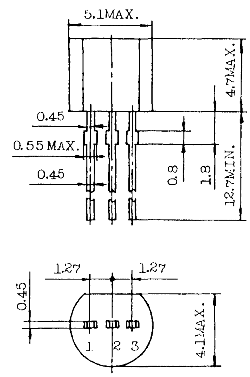
2SC2347

TV UHF OSCILLATOR APPLICATIONS.
TV VHF MIXER APPLICATIONS.

Unit in mm

MAXIMUM RATINGS ($Ta = 25°C$)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	15	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	50	mA
Emitter Current	I_E	−50	mA
Collector Power Dissipation	P_C	250	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C



1. EMITTER
2. COLLECTOR
3. BASE

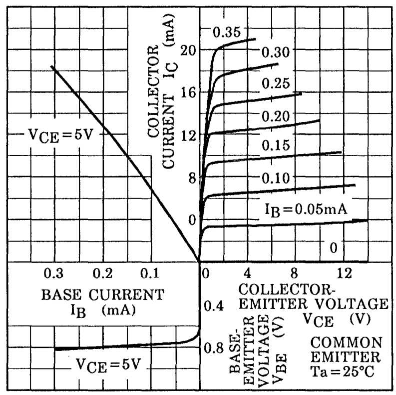
JEDEC	TO-92
EIAJ	SC-43
TOSHIBA	2-5F1B

Weight : 0.21g

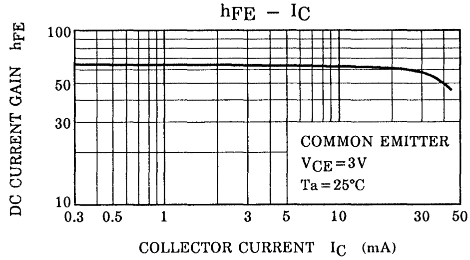
ELECTRICAL CHARACTERISTICS ($Ta = 25°C$)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=15V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=3V$, $I_C=0$	—	—	1.0	μA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA$, $I_B=0$	15	—	—	V
DC Current Gain	h_{FE}	$V_{CE}=3V$, $I_C=8mA$	20	—	—	—
Transition Frequency	f_T	$V_{CE}=10V$, $I_C=8mA$	650	—	—	MHz
Collector Output Capacitance	C_{ob}	$V_{CB}=10V$, $I_E=0$, f=MHz	—	1.2	1.5	pF
Collector-Base Time Constant	$C_c{\cdot}r_{bb'}$	$V_{CB}=10V$, $I_C=8mA$, f=30MHz	—	—	12	ps

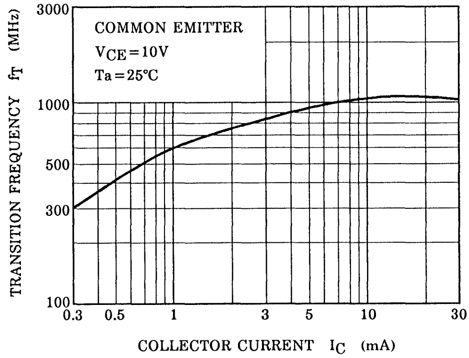
STATIC CHARACTERISTICS



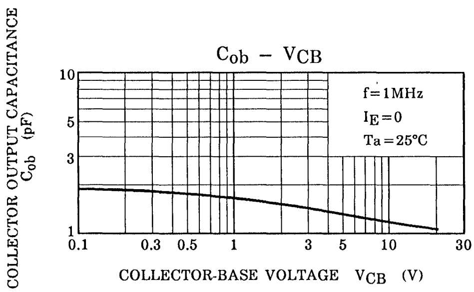
hFE – IC



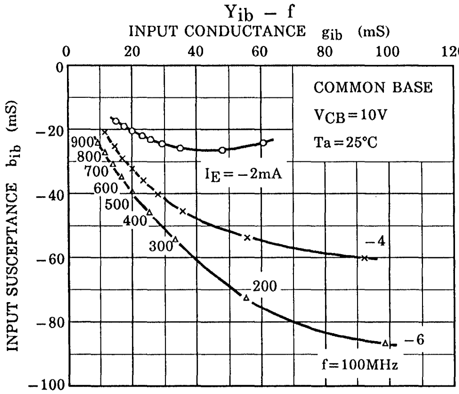
fT – IC



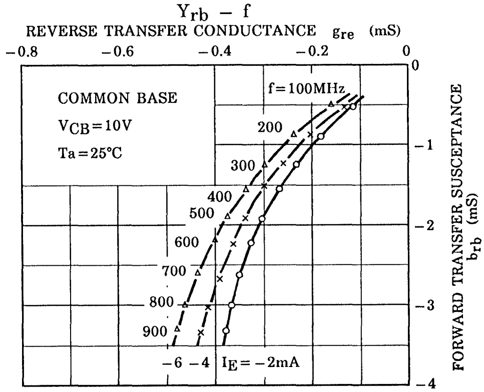
Cob – VCB



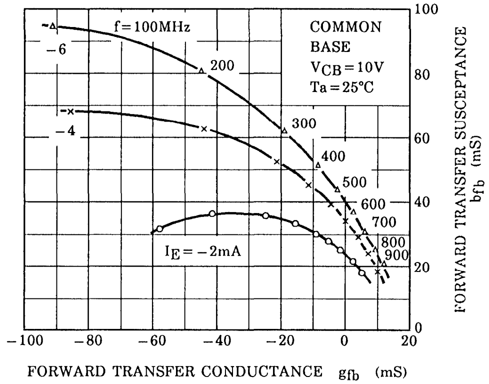
Yib – f



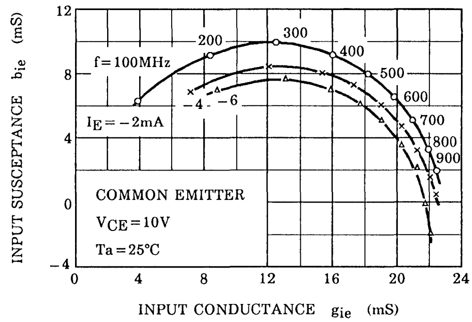
Yrb – f



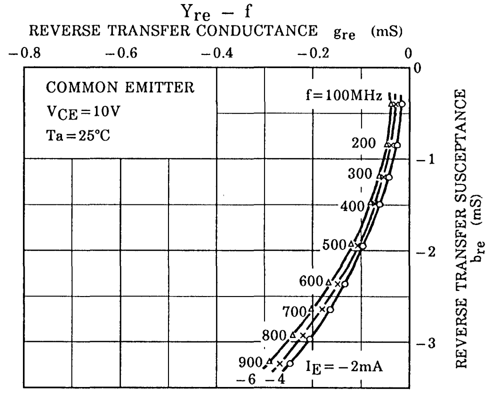
Yfb − f



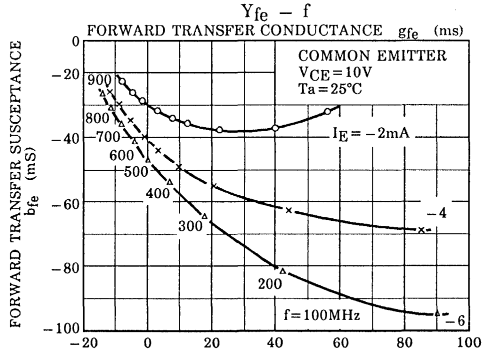
Yie − f



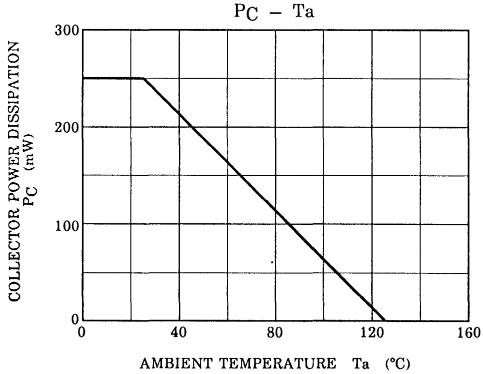
Yre − f



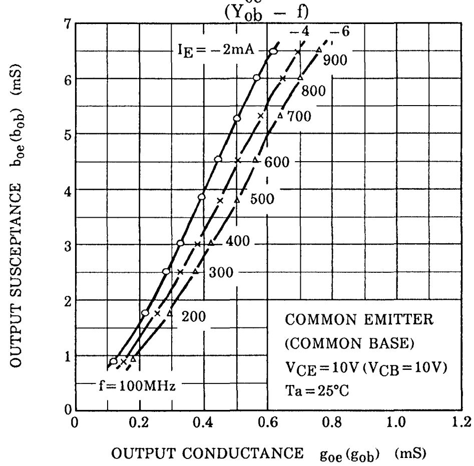
Yfe − f



P_C − Ta



Yoe − f
(Yob − f)

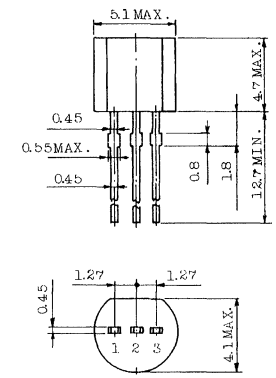


2SC2348 SILICON NPN PLANAR TYPE TRANSISTOR

TV VHF RF AMPLIFIER APPLICATIONS.

- High Gain : G_{pe} = 24dB (Typ.) (f = 200MHz)
- Low Noise : NF = 2.3dB (Typ.) (f = 200MHz)
- Excellent Forward AGC Characteristics.

Unit in mm



1. EMITTER
2. COLLECTOR
3. BASE

JEDEC	TO-92
EIAJ	SC-43
TOSHIBA	2-5F1E

Weight : 0.21g

MAXIMUM RATINGS (Ta = 25°C)

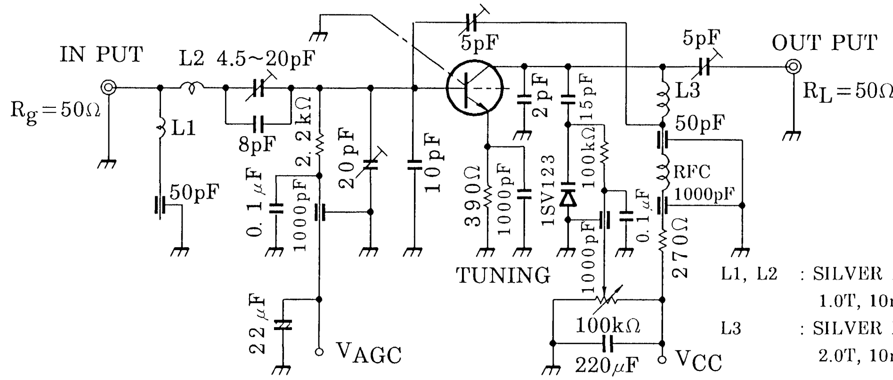
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Base Voltage	V_{EBO}	2	V
Collector Current	I_C	20	mA
Base Current	I_B	4	mA
Collector Power Dissipation	P_C	250	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 25V, I_E = 0	—	—	100	nA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 2V, I_C = 0	—	—	100	nA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C = 1mA, I_B = 0	30	—	—	V
DC Current Gain	h_{FE}	V_{CE} = 10V, I_C = 2mA	20	—	200	—
Reverse Transfer Capacitance	C_{re}	V_{CB} = 10V, I_E = 0, f = 1MHz	—	0.3	0.4	pF
Transition Frequency	f_T	V_{CE} = 10V, I_C = 2mA	400	650	—	MHz
Power Gain	G_{pe}	V_{CC} = 12V, V_{AGC} = 1.4V, f = 200MHz	20	24	28	dB
Noise Figure	NF		—	2.3	3.2	dB
AGC Voltage (Note)	V_{AGC}	V_{CC} = 12V, GR = 30dB, f = 200MHz	3.6	4.4	5.1	V

Note : V_{AGC} : V_{AGC} measured by test circuit shown in Fig. 1 when power gain is reduced to 30dB compared that of V_{AGC} at 1.4V.

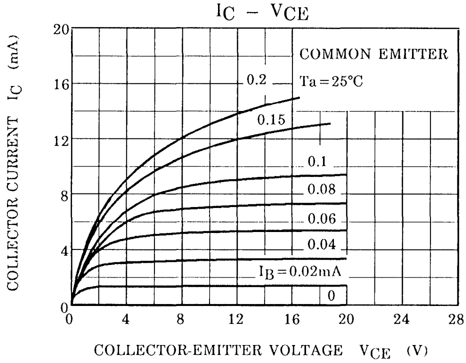
Fig.1 200MHz Gpe, NF & V_{AGC} TEST CIRCUIT



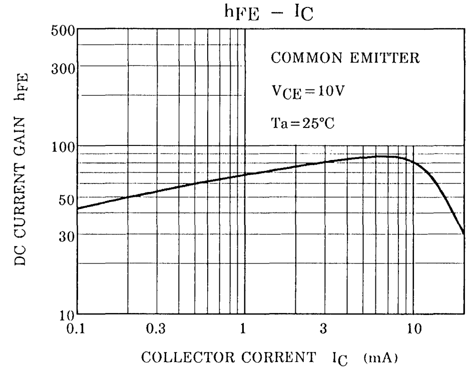
L1, L2 : SILVER PLATED COPPER WIRE, 1.0T, 10mm ID

L3 : SILVER PLATED COPPER WIRE, 2.0T, 10mm ID

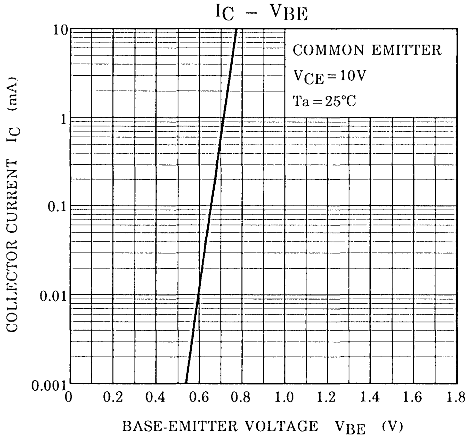
$I_C - V_{CE}$



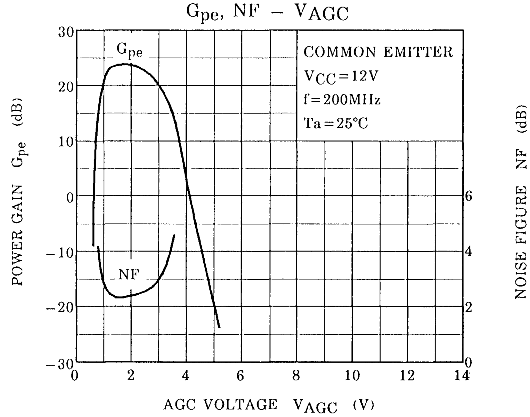
$h_{FE} - I_C$



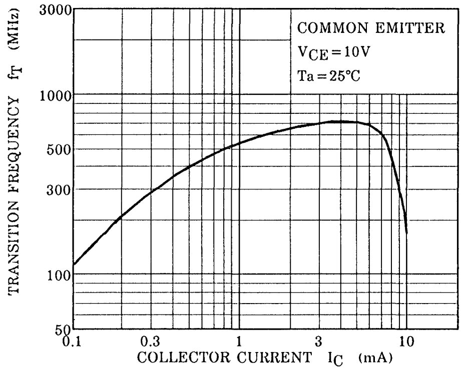
$I_C - V_{BE}$



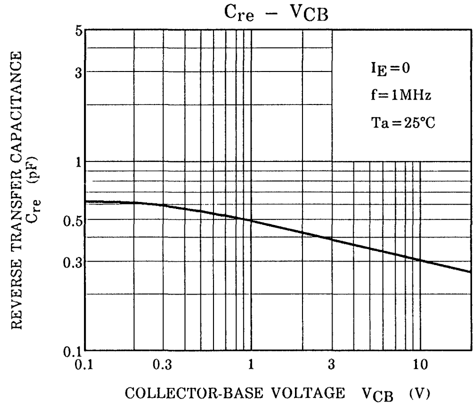
G_{pe}, NF $- V_{AGC}$



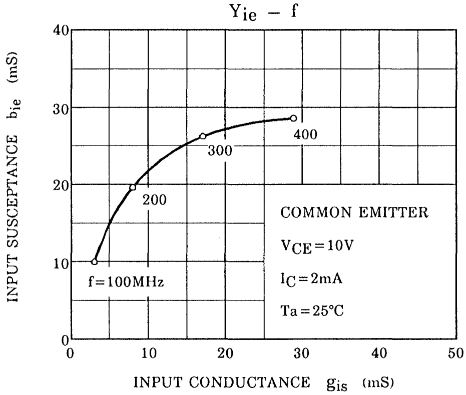
f_T – I_C



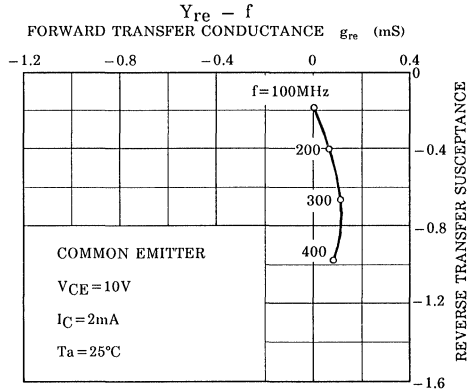
C_{re} – V_{CB}



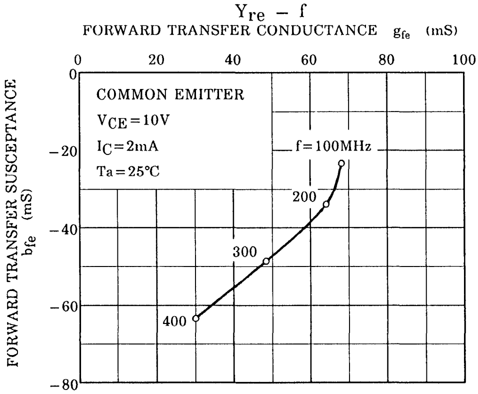
Y_{ie} – f



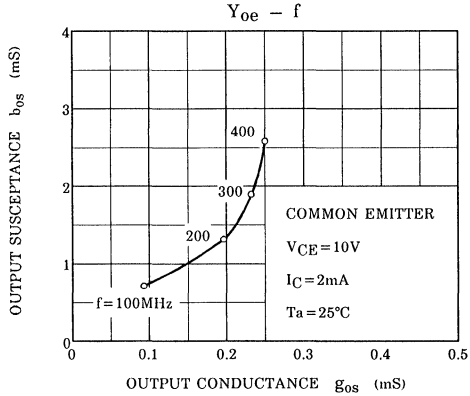
Y_{re} – f

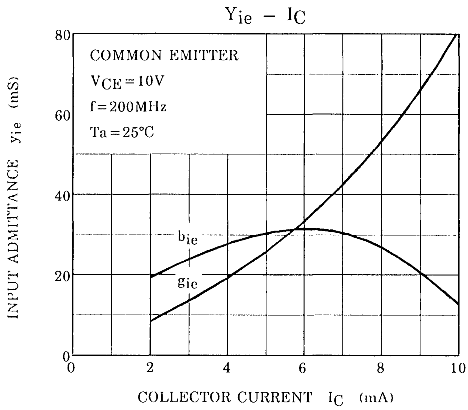


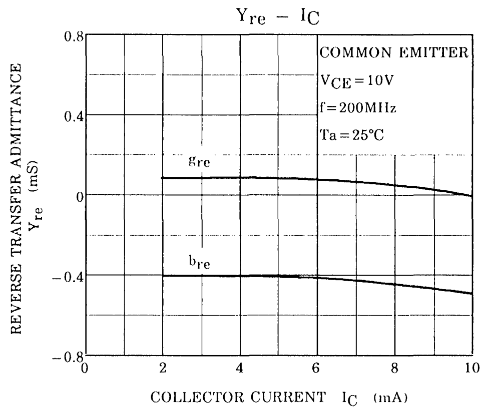
Y_{re} – f

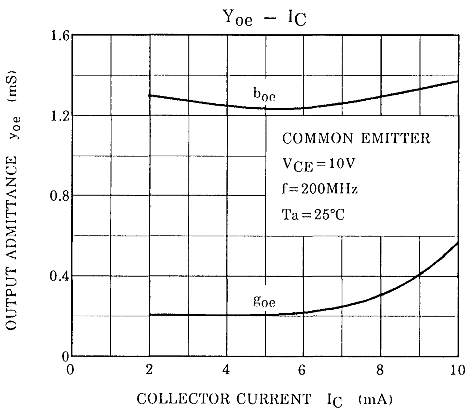


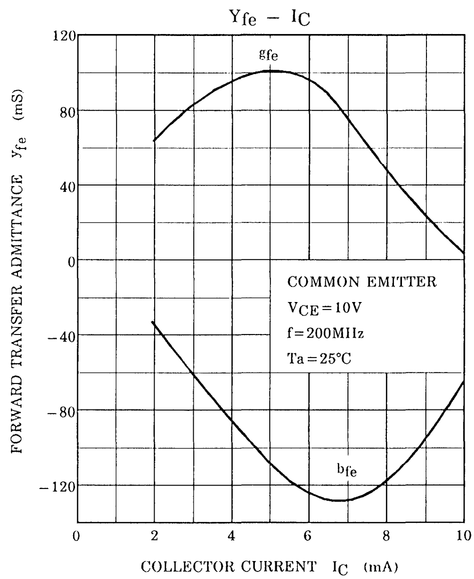
Y_{oe} – f

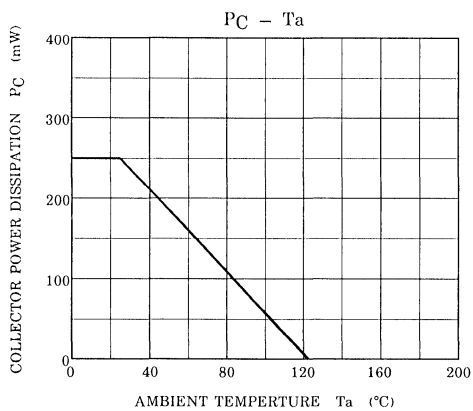



Yie – IC
COMMON EMITTER
VCE=10V
f=200MHz
Ta=25°C
bie
gie
INPUT ADMITTANCE yie (mS)
COLLECTOR CURRENT IC (mA)
0
20
40
60
80
0
2
4
6
8
10


Yre – IC
COMMON EMITTER
VCE=10V
f=200MHz
Ta=25°C
gre
bre
REVERSE TRANSFER ADMITTANCE Yre (mS)
COLLECTOR CURRENT IC (mA)
0.8
0.4
0
–0.4
–0.8
0
2
4
6
8
10


Yoe – IC
boe
COMMON EMITTER
VCE=10V
f=200MHz
Ta=25°C
goe
OUTPUT ADMITTANCE yoe (mS)
COLLECTOR CURRENT IC (mA)
1.6
1.2
0.8
0.4
0
0
2
4
6
8
10


Yfe – IC
gfe
COMMON EMITTER
VCE=10V
f=200MHz
Ta=25°C
bfe
FORWARD TRANSFER ADMITTANCE yfe (mS)
COLLECTOR CURRENT IC (mA)
120
80
40
0
–40
–80
–120
0
2
4
6
8
10


PC – Ta
COLLECTOR POWER DISSIPATION PC (mW)
AMBIENT TEMPERTURE Ta (°C)
400
300
200
100
0
0
40
80
120
160
200

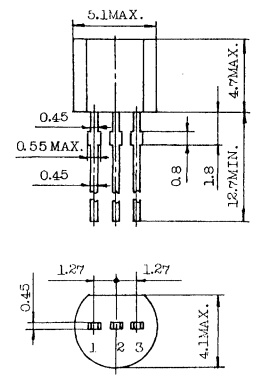
2SC2349 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

TV VHF OSCILLATOR APPLICATIONS.

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	15	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	50	mA
Emitter Current	I_E	−50	mA
Collector Power Dissipation	P_C	250	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Unit in mm



1. EMITTER
2. COLLECTOR
3. BASE

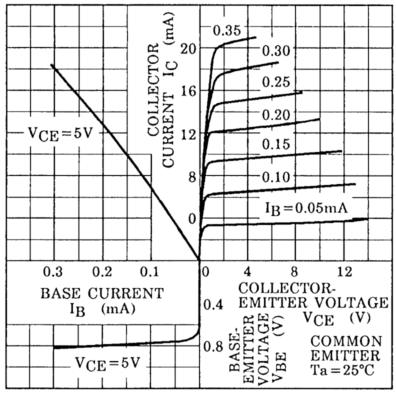
JEDEC	TO-92
EIAJ	SO-43
TOSHIBA	2-5F1B

Weight : 0.21g

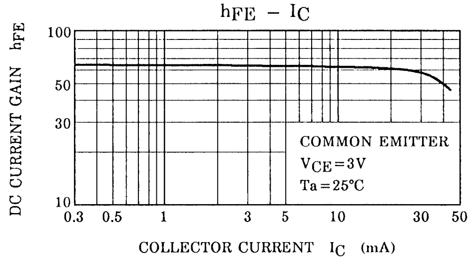
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=15V,\ I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=3V,\ I_C=0$	—	—	1.0	μA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA,\ I_B=0$	15	—	—	V
DC Current Gain	h_{FE}	$V_{CE}=3V,\ I_C=8mA$	20	—	—	—
Transition Frequency	f_T	$V_{CE}=10V,\ I_C=8mA$	650	—	—	MHz
Collector Output Capacitance	C_{ob}	$V_{CB}=10V,\ I_E=0,\ f=1MHz$	—	1.2	1.5	pF
Collector-Base Time Constant	$C_c \cdot r_{bb'}$	$V_{CB}=10V,\ I_C=8mA,\ f=30MHz$	—	—	20	ps

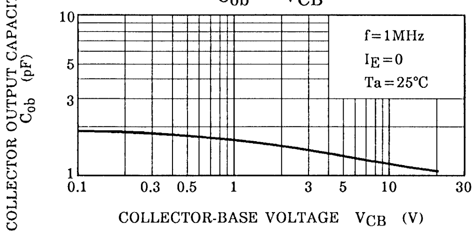
STATIC CHARACTERISTICS



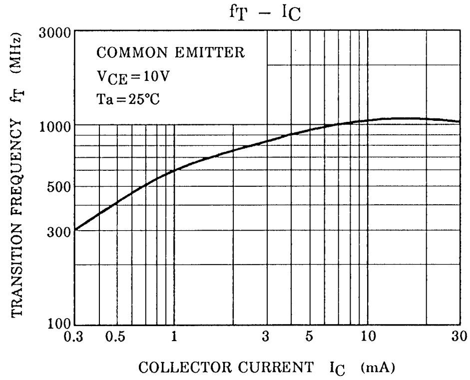
h_{FE} – I_C



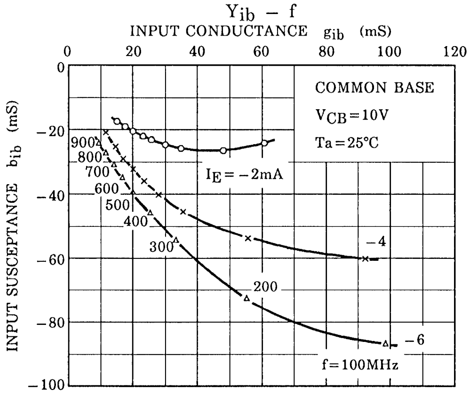
C_{ob} – V_{CB}



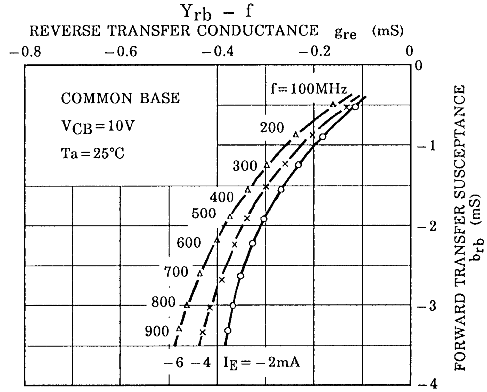
f_T – I_C

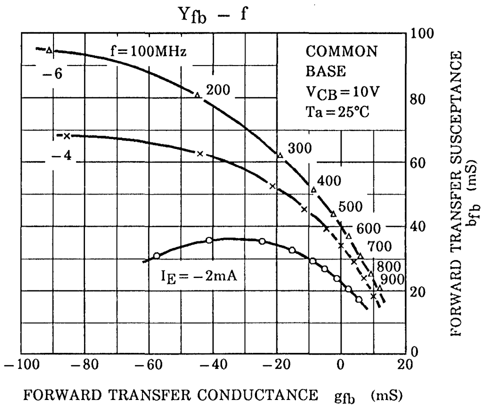


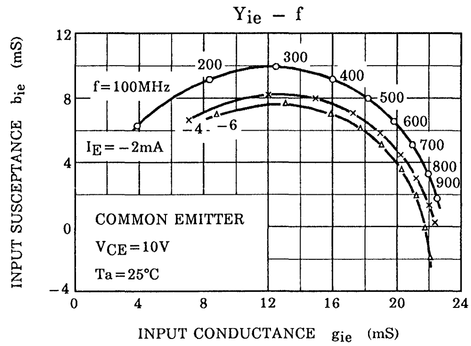
Y_{ib} – f

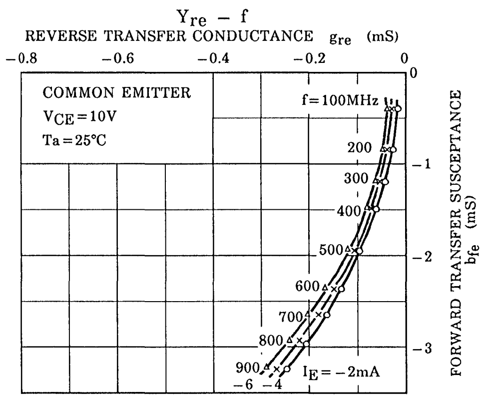


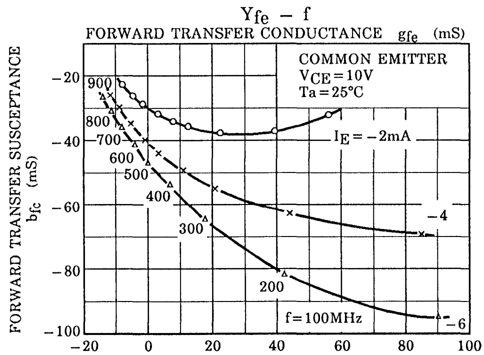
Y_{rb} – f

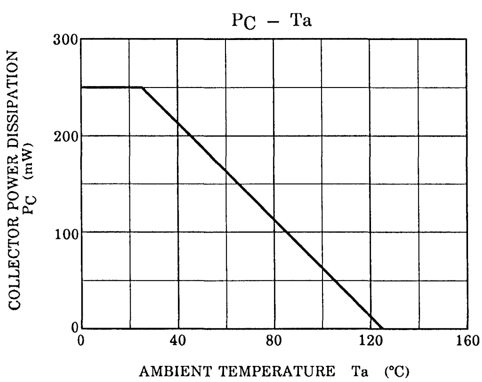


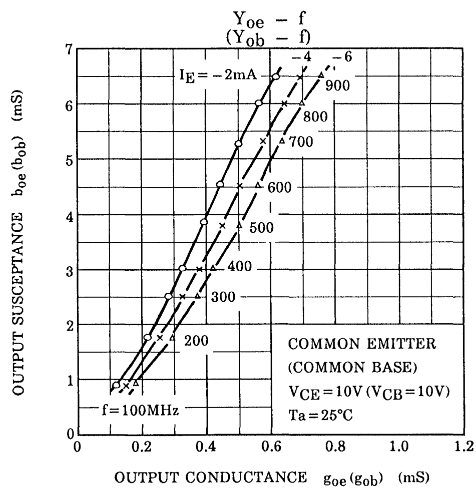

Yfb – f
COMMON BASE
VCB=10V
Ta=25°C
f=100MHz
IE=–2mA
–4
–6
FORWARD TRANSFER CONDUCTANCE gfb (mS)
FORWARD TRANSFER SUSCEPTANCE bfb (mS)


Yie – f
f=100MHz
IE=–2mA
COMMON EMITTER
VCE=10V
Ta=25°C
INPUT CONDUCTANCE gie (mS)
INPUT SUSCEPTANCE bie (mS)


Yre – f
REVERSE TRANSFER CONDUCTANCE gre (mS)
COMMON EMITTER
VCE=10V
Ta=25°C
f=100MHz
IE=–2mA
FORWARD TRANSFER SUSCEPTANCE bfe (mS)


Yfe – f
FORWARD TRANSFER CONDUCTANCE gfe (mS)
COMMON EMITTER
VCE=10V
Ta=25°C
IE=–2mA
f=100MHz
FORWARD TRANSFER SUSCEPTANCE bfe (mS)


PC – Ta
COLLECTOR POWER DISSIPATION PC (mW)
AMBIENT TEMPERATURE Ta (°C)


Yoe – f
(Yob – f)
IE=–2mA
COMMON EMITTER
(COMMON BASE)
VCE=10V (VCB=10V)
Ta=25°C
f=100MHz
OUTPUT CONDUCTANCE goe (gob) (mS)
OUTPUT SUSCEPTANCE boe (bob) (mS)

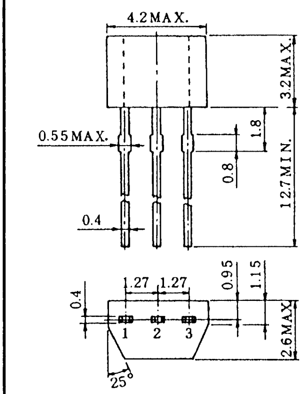
SILICON NPN EPITAXIAL TYPE TRANSISTOR

2SC2458

AUDIO AMPLIFIER APPLICATIONS.

- High Current Capability : $I_C = 150mA$ (Max.)
- High DC Current Gain : $h_{FE} = 70 \sim 700$
- Excellent h_{FE} Linearity
  : $h_{FE}(I_C = 0.1mA) / h_{FE}(I_C = 2mA) = 0.95$ (Typ.)
- Low Noise : NF (2) = 1dB (Typ.) , 10dB (Max.)
- Complementary to 2SA1048.
- Small Package.

Unit in mm



1. EMITTER
2. COLLECTOR
3. BASE

JEDEC	—
EIAJ	—
TOSHIBA	2-4E1A

Weight : 0.13g

MAXIMUM RATINGS (Ta = 25°C)

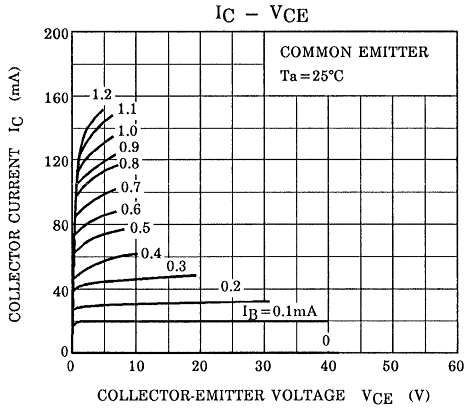
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	50	V
Collector-Emitter Voltage	V_{CEO}	50	V
Emitter-Base Voltage	V_{EBO}	5	V
Collector Current	I_C	150	mA
Base Current	I_B	50	mA
Collector Power Dissipation	P_C	200	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	$-55 \sim 125$	°C

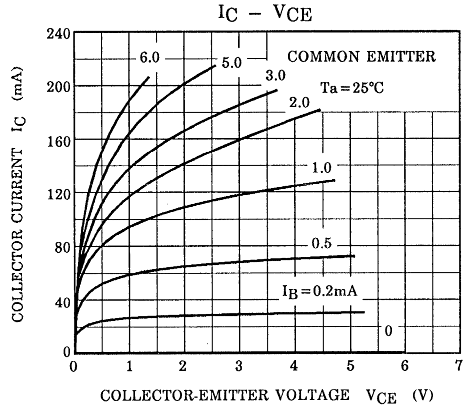
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

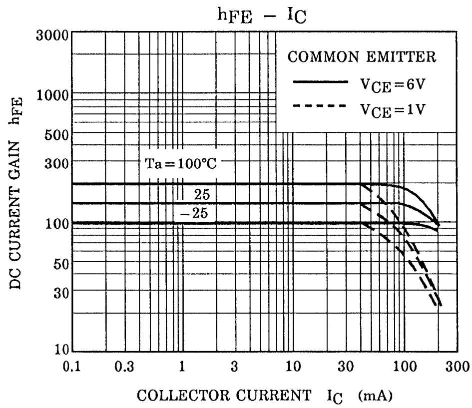
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB} = 50V$, $I_E = 0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB} = 5V$, $I_C = 0$	—	—	0.1	μA
DC Current Gain	h_{FE} (Note)	$V_{CE} = 6V$, $I_C = 2mA$	70	—	700	
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = 100mA$, $I_B = 10mA$	—	0.1	0.25	V
Transition Frequency	f_T	$V_{CE} = 10V$, $I_C = 1mA$	80	—	—	MHz
Collector Output Capacitance	C_{ob}	$V_{CB} = 10V$, $I_E = 0$, $f = 1MHz$	—	2.0	3.5	pF
Noise Figure	NF	$V_{CE} = 6V$, $I_C = 0.1mA$, $f = 1kHz$, $R_g = 10k\Omega$	—	1.0	10	dB

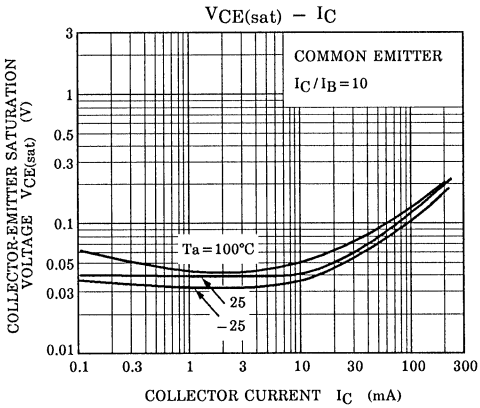
Note : h_{FE} Classification O : $70 \sim 140$, Y : $120 \sim 240$, GR : $200 \sim 400$, BL : $350 \sim 700$

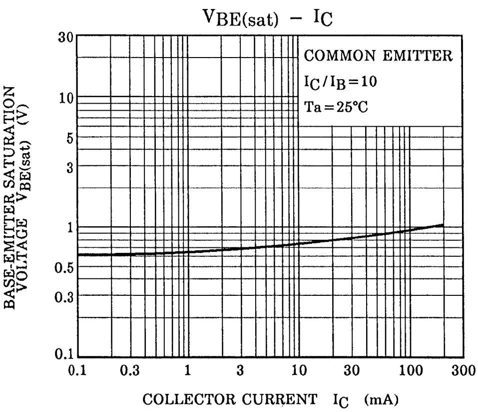
2SC2458

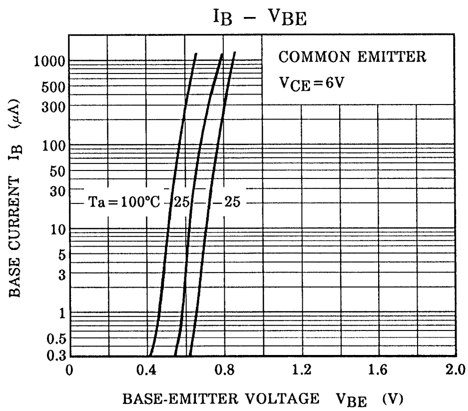

IC – VCE
COMMON EMITTER
Ta=25°C
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
IB=0.1mA
0
COLLECTOR CURRENT IC (mA)
COLLECTOR-EMITTER VOLTAGE VCE (V)

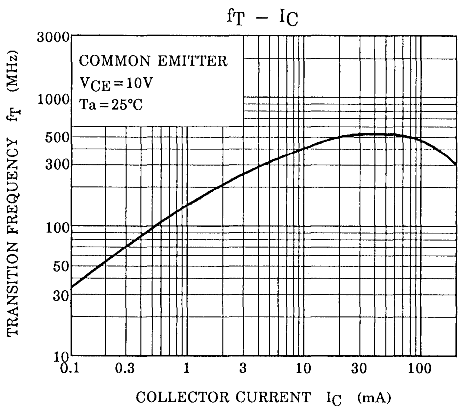

IC – VCE
COMMON EMITTER
Ta=25°C
6.0
5.0
3.0
2.0
1.0
0.5
IB=0.2mA
0
COLLECTOR CURRENT IC (mA)
COLLECTOR-EMITTER VOLTAGE VCE (V)

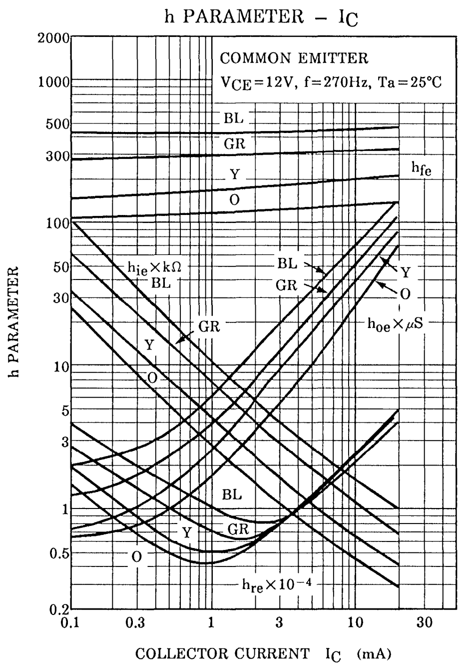

hFE – IC
COMMON EMITTER
VCE=6V
VCE=1V
Ta=100°C
25
−25
DC CURRENT GAIN hFE
COLLECTOR CURRENT IC (mA)

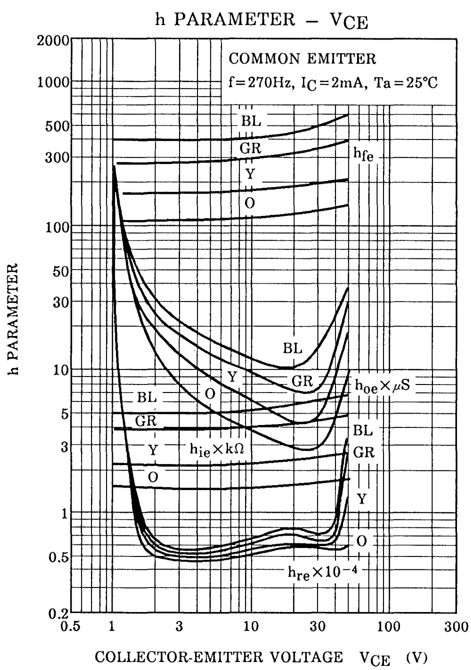

VCE(sat) – IC
COMMON EMITTER
IC/IB=10
Ta=100°C
25
−25
COLLECTOR-EMITTER SATURATION VOLTAGE VCE(sat) (V)
COLLECTOR CURRENT IC (mA)

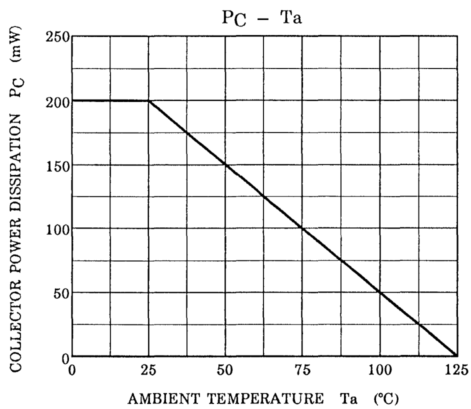

VBE(sat) – IC
COMMON EMITTER
IC/IB=10
Ta=25°C
BASE-EMITTER SATURATION VOLTAGE VBE(sat) (V)
COLLECTOR CURRENT IC (mA)


IB – VBE
COMMON EMITTER
VCE=6V
Ta=100°C
25
−25
BASE CURRENT IB (μA)
BASE-EMITTER VOLTAGE VBE (V)


fT – IC
COMMON EMITTER
VCE=10V
Ta=25°C
TRANSITION FREQUENCY fT (MHz)
COLLECTOR CURRENT IC (mA)


h PARAMETER – IC
COMMON EMITTER
VCE=12V, f=270Hz, Ta=25°C
BL
GR
Y
O
hfe
hie×kΩ
hoe×μS
hre×10⁻⁴
h PARAMETER
COLLECTOR CURRENT IC (mA)

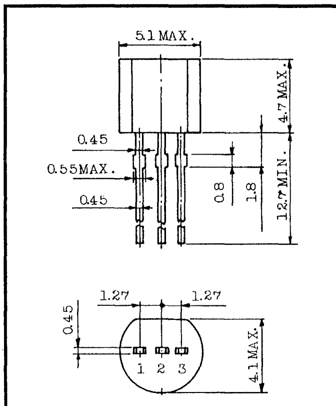

h PARAMETER – VCE
COMMON EMITTER
f=270Hz, IC=2mA, Ta=25°C
BL
GR
Y
O
hfe
hoe×μS
hie×kΩ
hre×10⁻⁴
h PARAMETER
COLLECTOR-EMITTER VOLTAGE VCE (V)


PC – Ta
COLLECTOR POWER DISSIPATION PC (mW)
AMBIENT TEMPERATURE Ta (°C)

2SC2498 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATION.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	TO-92
EIAJ	SC-43
TOSHIBA	2-5F1E

Weight : 0.21g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	20	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	50	mA
Base Current	I_B	25	mA
Collector Power Dissipation	P_C	300	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

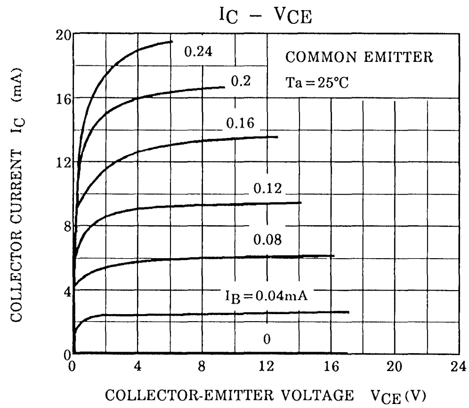
MICROWAVE CHARACTERISTICS (Ta = 25°C)

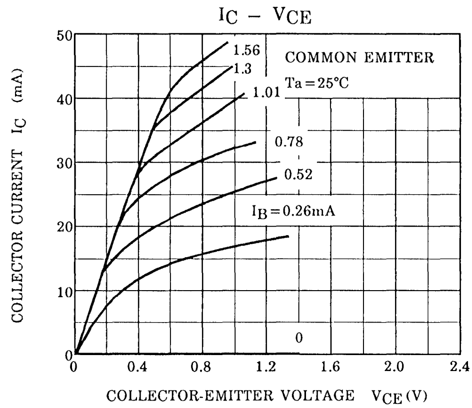
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	$V_{CE}=10V$, $I_C=10mA$	—	3.5	—	GHz
Insertion Gain	$\lvert S_{21e}\rvert^2(1)$	$V_{CE}=10V$, $I_C=10mA$, $f=500MHz$	—	14.5	—	dB
	$\lvert S_{21e}\rvert^2(2)$	$V_{CE}=10V$, $I_C=10mA$, $f=1GHz$	—	9	—	dB
Noise Figure	NF(1)	$V_{CE}=10V$, $I_C=5mA$, $f=500MHz$	—	2.5	—	dB
	NF(2)	$V_{CE}=10V$, $I_C=5mA$, $f=1GHz$	—	4	—	dB

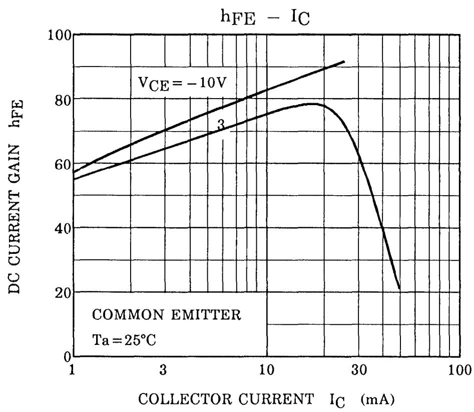
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

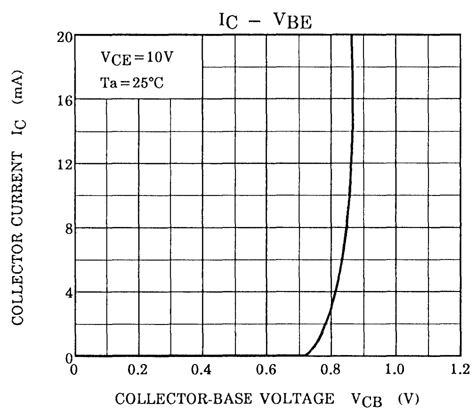
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=10V$, $I_E=0$	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=1V$, $I_C=0$	—	—	1	μA
DC Current Gain	h_{FE}	$V_{CE}=10V$, $I_C=10mA$	30	80	300	—
Collector Output Capacitance	C_{ob}	$V_{CB}=10V$, $I_E=0$, $f=1MHz$ (Note)	—	1.15	—	pF
Reverse Transfer Capacitance	C_{re}		—	0.75	—	pF

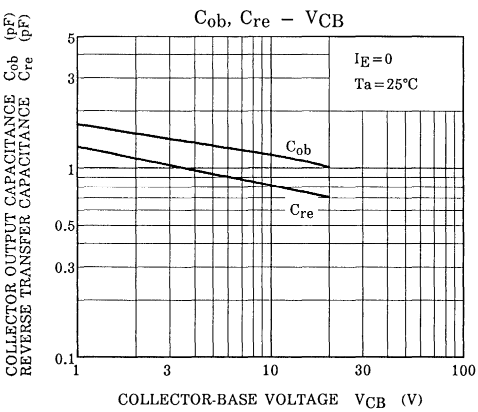
Note: Cre is measured by 3 terminal method with Capacitance Bridge.

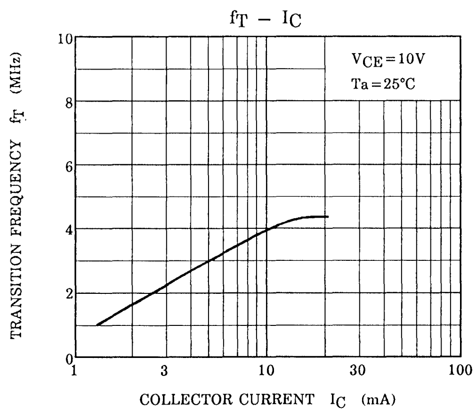

I_C – V_{CE}
COMMON EMITTER
Ta=25°C
0.24
0.2
0.16
0.12
0.08
I_B=0.04mA
0
COLLECTOR CURRENT I_C (mA)
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)
0 4 8 12 16 20 24

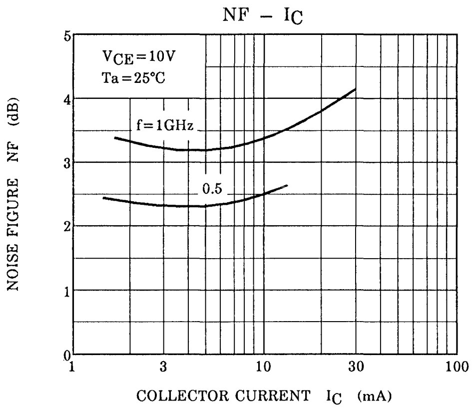

I_C – V_{CE}
COMMON EMITTER
Ta=25°C
1.56
1.3
1.01
0.78
0.52
I_B=0.26mA
0
COLLECTOR CURRENT I_C (mA)
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)
0 0.4 0.8 1.2 1.6 2.0 2.4

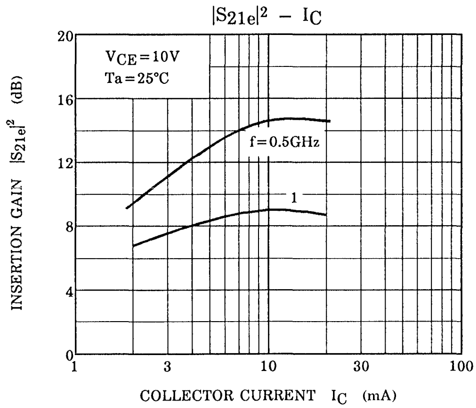

h_{FE} – I_C
V_{CE}=−10V
3
COMMON EMITTER
Ta=25°C
DC CURRENT GAIN h_{FE}
COLLECTOR CURRENT I_C (mA)
1 3 10 30 100

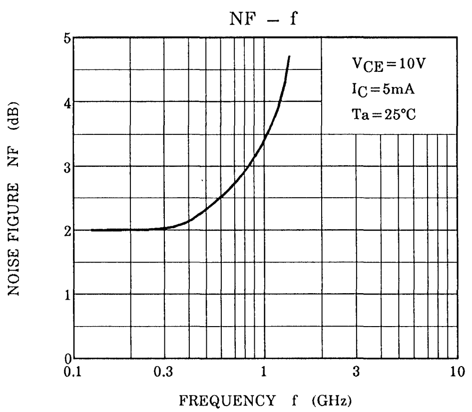

I_C – V_{BE}
V_{CE}=10V
Ta=25°C
COLLECTOR CURRENT I_C (mA)
COLLECTOR-BASE VOLTAGE V_{CB} (V)
0 0.2 0.4 0.6 0.8 1.0 1.2

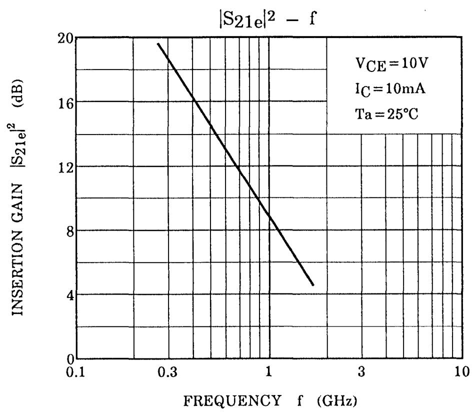

C_{ob}, C_{re} – V_{CB}
I_E=0
Ta=25°C
C_{ob}
C_{re}
COLLECTOR OUTPUT CAPACITANCE C_{ob} (pF)
REVERSE TRANSFER CAPACITANCE C_{re} (pF)
COLLECTOR-BASE VOLTAGE V_{CB} (V)
1 3 10 30 100


f_T – I_C
V_{CE}=10V
Ta=25°C
TRANSITION FREQUENCY f_T (MHz)
COLLECTOR CURRENT I_C (mA)
1 3 10 30 100


NF – IC
VCE=10V
Ta=25°C
f=1GHz
0.5
NOISE FIGURE NF (dB)
COLLECTOR CURRENT IC (mA)

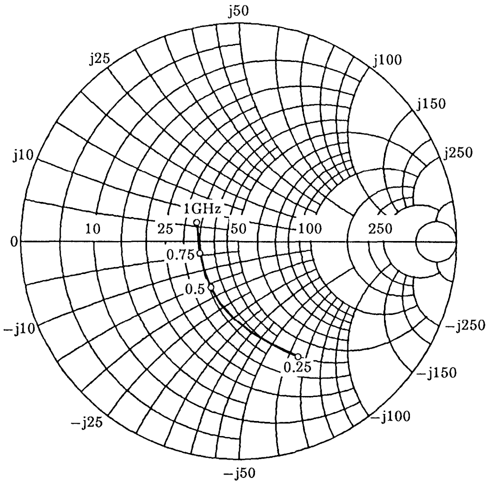

|S21e|2 – IC
VCE=10V
Ta=25°C
f=0.5GHz
1
INSERTION GAIN |S21e|2 (dB)
COLLECTOR CURRENT IC (mA)


NF – f
VCE=10V
IC=5mA
Ta=25°C
NOISE FIGURE NF (dB)
FREQUENCY f (GHz)

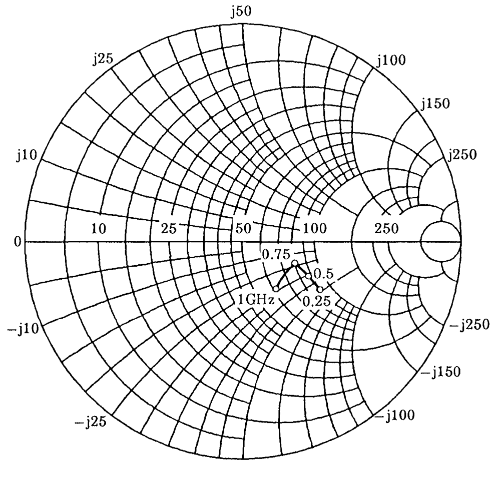

|S21e|2 – f
VCE=10V
IC=10mA
Ta=25°C
INSERTION GAIN |S21e|2 (dB)
FREQUENCY f (GHz)

COMMON EMITTER SMALL SIGNAL S-PARAMETERS OF 2SC2498.

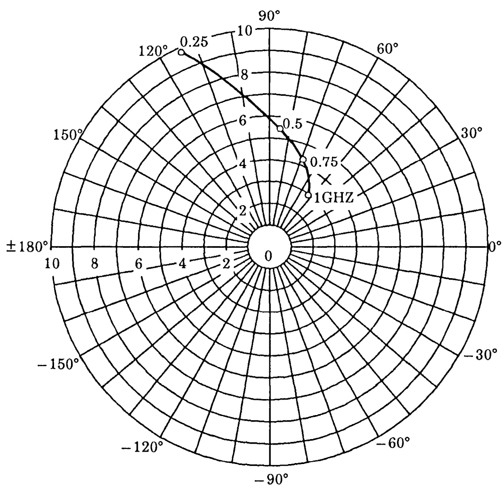
$V_{CE}=10V$, $I_C=10mA$



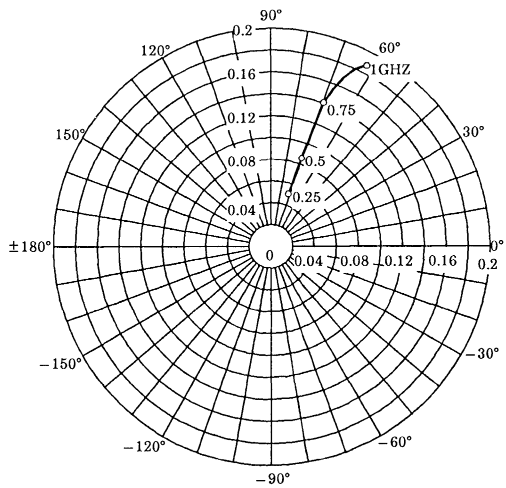
S_{11e} (UNIT : Ω)



S_{22e} (UNIT : Ω)



S_{21e}



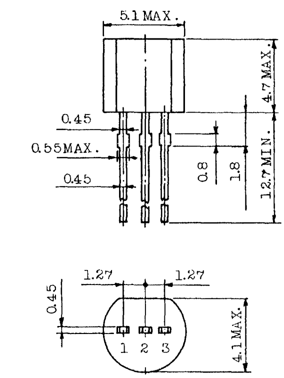
S_{12e}

2SC2499 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATION.

Unit in mm

- Low Noise Figure
- NF=1.7dB, $|S_{21e}|^2$=15dB (f=500MHz)
- NF=2.5dB, $|S_{21e}|^2$=9.5dB (f=1GHz)



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	TO-92
EIAJ	SC-43
TOSHIBA	2-5F1E

Weight : 0.21g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	20	V
Emitter-Base Voltage	V_{EBO}	3.0	V
Collector Current	I_C	30	mA
Base Current	I_B	15	mA
Collector Power Dissipation	P_C	300	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

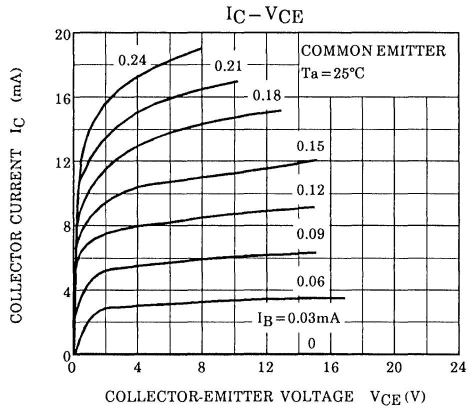
MICROWAVE CHARACTERISTICS (Ta = 25°C)

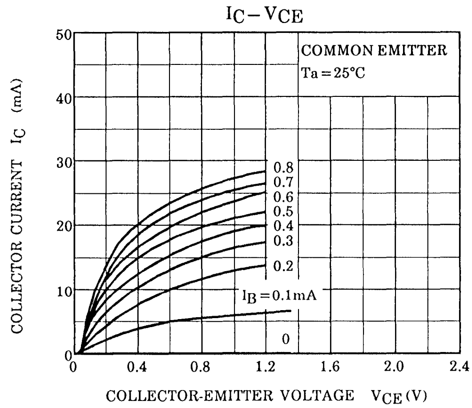
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE}=10V, I_C=10mA	—	4.0	—	GHz
Insertion Gain	$\|S_{21e}\|^2(1)$	V_{CE}=10V, I_C=10mA, f=500MHz	—	15.0	—	dB
	$\|S_{21e}\|^2(2)$	V_{CE}=10V, I_C=10mA, f=1GHz	—	9.5	—	dB
Noise Figure	NF(1)	V_{CE}=10V, I_C=3mA, f=500MHz	—	1.7	—	dB
	NF(2)	V_{CE}=10V, I_C=3mA, f=1GHz	—	2.5	—	dB

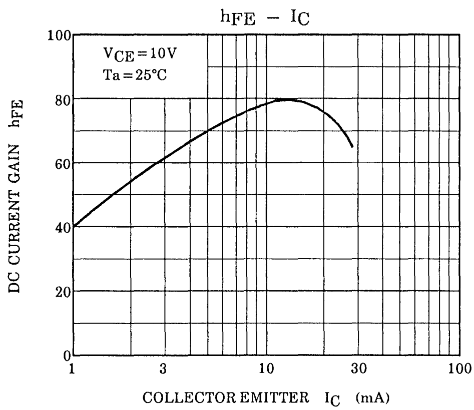
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

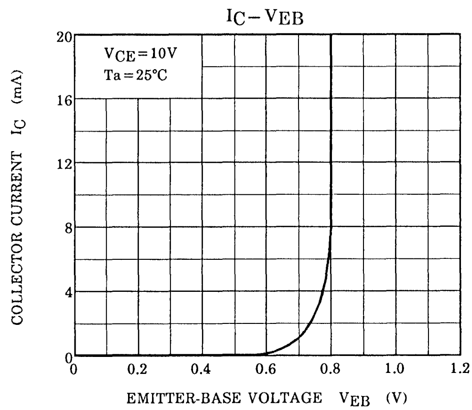
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB}=10V, I_E=0	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB}=1.0V, I_E=0	—	—	1.0	μA
DC Current Gain	h_{FE}	V_{CE}=10V, I_C=5mA	30	—	—	—
Collector Output Capacitance	C_{ob}	V_{CB}=10V, I_E=0, f=1MHz (Note)	—	0.9	—	pF
Reverse Transfer Capacitance	C_{re}		—	0.6	—	pF

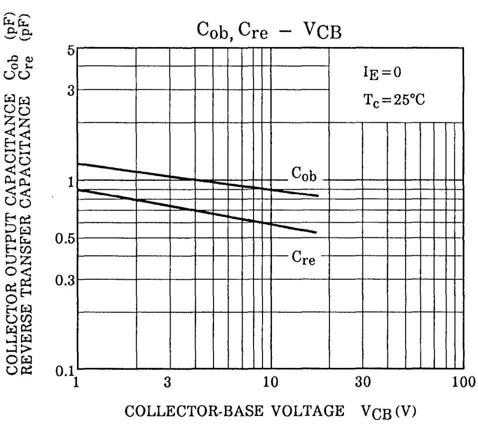
Note: Cre is measured by 3 terminal method with Capacitance Bridge.

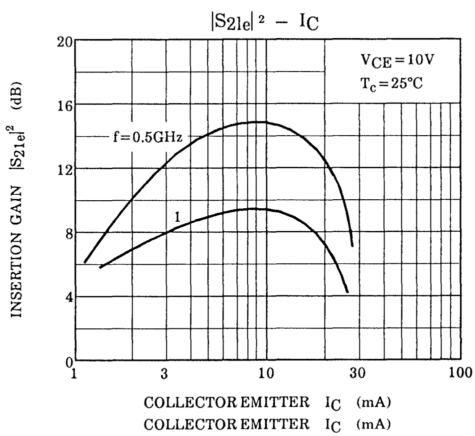

IC – VCE
COMMON EMITTER
Ta = 25°C
0.24
0.21
0.18
0.15
0.12
0.09
0.06
IB = 0.03mA
0
COLLECTOR CURRENT IC (mA)
COLLECTOR-EMITTER VOLTAGE VCE (V)
0
4
8
12
16
20
24

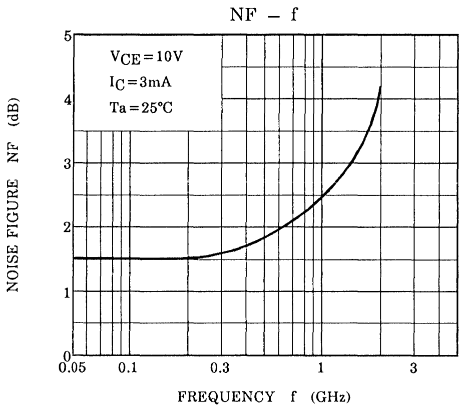

IC – VCE
COMMON EMITTER
Ta = 25°C
0.8
0.7
0.6
0.5
0.4
0.3
0.2
IB = 0.1mA
0
COLLECTOR CURRENT IC (mA)
COLLECTOR-EMITTER VOLTAGE VCE (V)
0
10
20
30
40
50
0.4
0.8
1.2
1.6
2.0
2.4

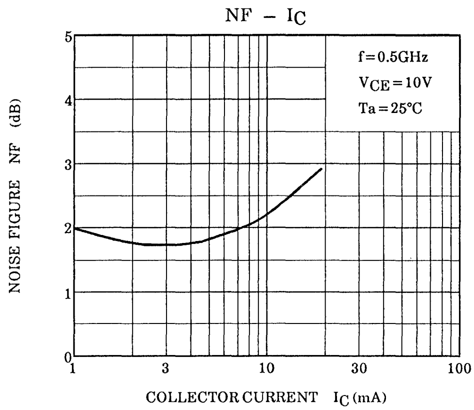

hFE – IC
VCE = 10V
Ta = 25°C
DC CURRENT GAIN hFE
COLLECTOR EMITTER IC (mA)
0
20
40
60
80
100
1
3
10
30
100

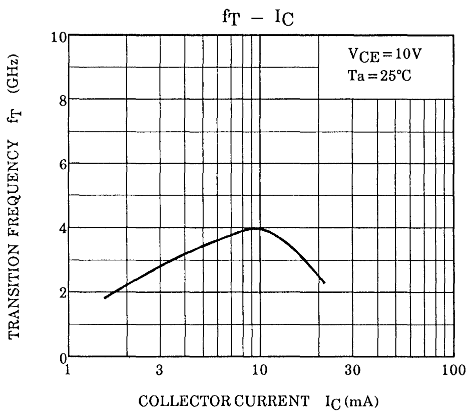

IC – VEB
VCE = 10V
Ta = 25°C
COLLECTOR CURRENT IC (mA)
EMITTER-BASE VOLTAGE VEB (V)
0
4
8
12
16
20
0.2
0.4
0.6
0.8
1.0
1.2


Cob, Cre – VCB
IE = 0
Tc = 25°C
Cob
Cre
COLLECTOR OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
COLLECTOR-BASE VOLTAGE VCB (V)
0.1
0.3
0.5
1
3
5
1
3
10
30
100


|S21e|² – IC
VCE = 10V
Tc = 25°C
f = 0.5GHz
1
INSERTION GAIN |S21e|² (dB)
COLLECTOR EMITTER IC (mA)
COLLECTOR EMITTER IC (mA)
0
4
8
12
16
20
1
3
10
30
100

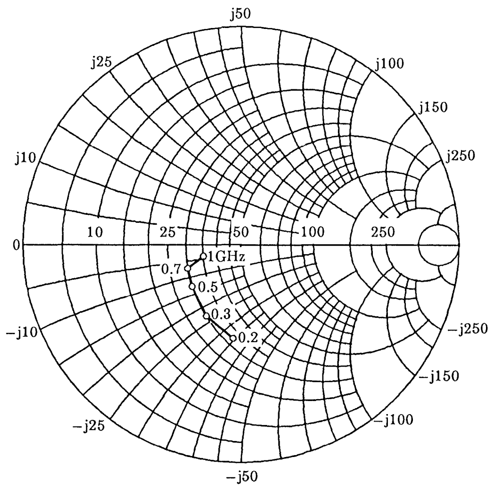

NF – f
VCE=10V
IC=3mA
Ta=25°C
NOISE FIGURE NF (dB)
5
4
3
2
1
0
0.05
0.1
0.3
1
3
FREQUENCY f (GHz)


NF – IC
f=0.5GHz
VCE=10V
Ta=25°C
NOISE FIGURE NF (dB)
5
4
3
2
1
0
1
3
10
30
100
COLLECTOR CURRENT IC (mA)

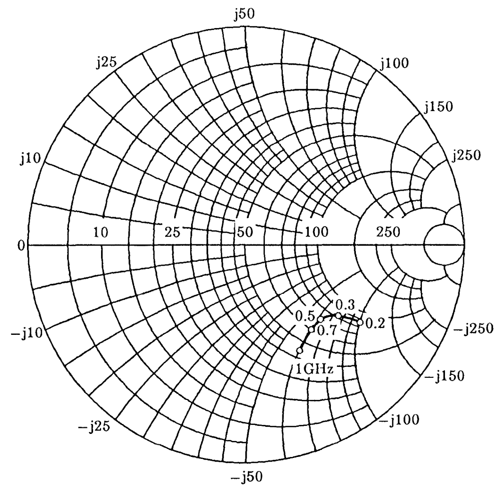

fT – IC
VCE=10V
Ta=25°C
TRANSITION FREQUENCY fT (GHz)
10
8
6
4
2
0
1
3
10
30
100
COLLECTOR CURRENT IC (mA)

COMMON EMITTER SMALL SIGNAL S−PARAMETERS OF 2SC2499

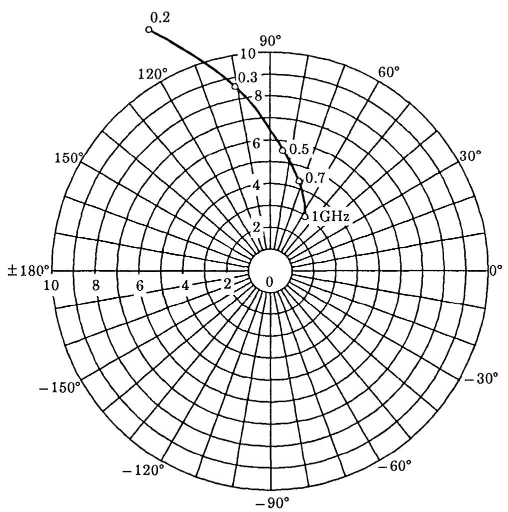
$V_{CE}=10V,\ I_C=10mA$



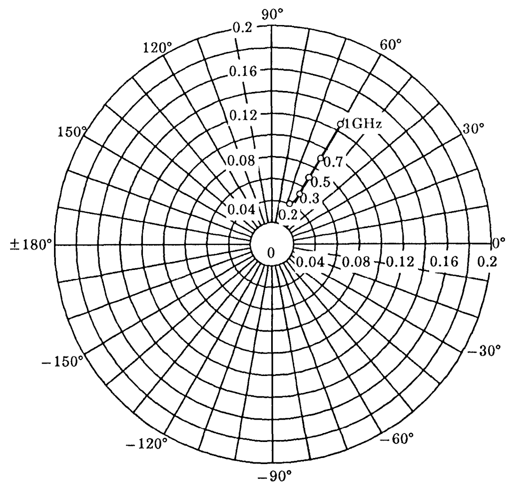
S_{11e} (UNIT : Ω)



S_{22e} (UNIT : Ω)



S_{21e}



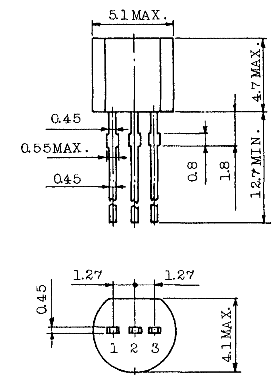
S_{12e}

2SC2644 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

VHF~UHF BAND WIDEBAND AMPLIFIER APPLICATIONS.

Unit in mm

- High Gain
- Low IMD
- $f_T = 4GHz$ (Typ.)



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	TO-92
EIAJ	SC-43
TOSHIBA	2-5F1E

Weight : 0.21g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	25	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3.0	V
Collector Current	I_C	120	mA
Emitter Current	I_B	40	mA
Collector Power Dissipation	P_C	0.5	W
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

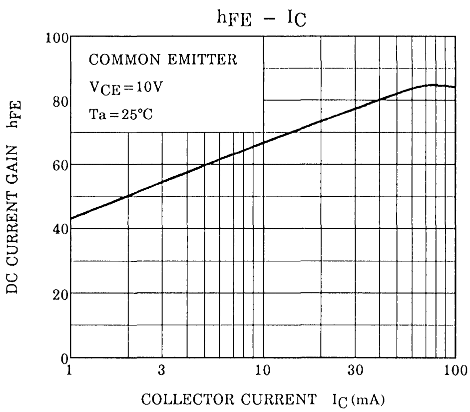
MICROWAVE CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	$V_{CE}=10V$, $I_C=30mA$	—	4.0	—	GHz
Insertion Gain	$\lvert S_{21e}\rvert^2(1)$	$V_{CE}=10V$, $I_C=30mA$, f=0.5GHz	—	14.0	—	dB
	$\lvert S_{21e}\rvert^2(2)$	VCE=10V, IC=30mA, f=1GHz	—	8.5	—	dB
Noise Figure	NF(1)	$V_{CE}=10V$, $I_C=10mA$, f=0.5GHz	—	2.3	—	dB
	NF(2)	$V_{CE}=10V$, $I_C=10mA$, f=1GHz	—	3.0	—	dB

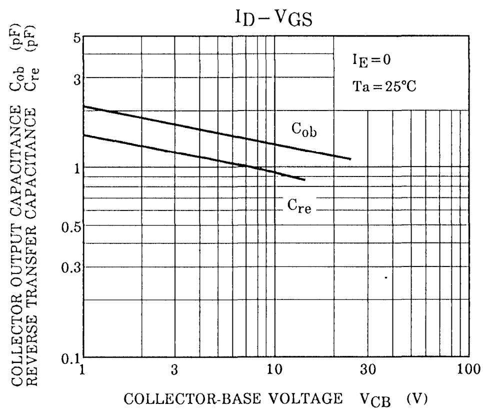
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDTION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=10V$, $I_E=0$	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=1.0V$, $I_C=0$	—	—	10	μA
DC Current Gain	h_{FE}	$V_{CE}=5V$, $I_C=50mA$	20	50	—	—
Collector Output Capacitance	C_{ob}	$V_{CB}=10V$, $I_E=0$, f=1MHz (Note)	—	1.6	—	pF
Reverse Transfer Capacitance	C_{re}		—	1.1	—	pF

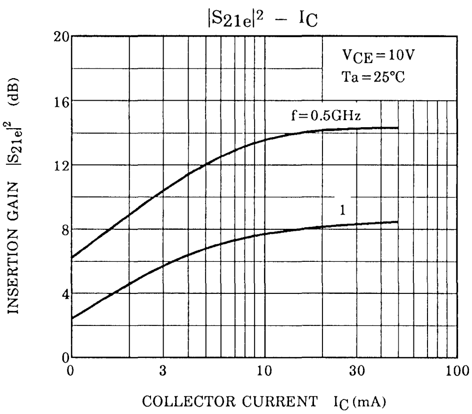
Note : C_{re} is measured by 3 terminal method with Capacitance Bridge.



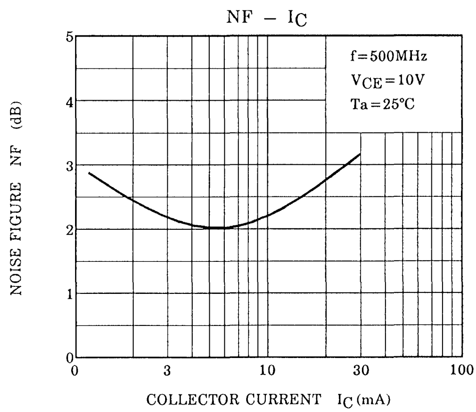
hFE − IC
COMMON EMITTER
VCE=10V
Ta=25°C
DC CURRENT GAIN hFE
COLLECTOR CURRENT IC (mA)



ID−VGS
IE=0
Ta=25°C
Cob
Cre
COLLECTOR OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
COLLECTOR-BASE VOLTAGE VCB (V)



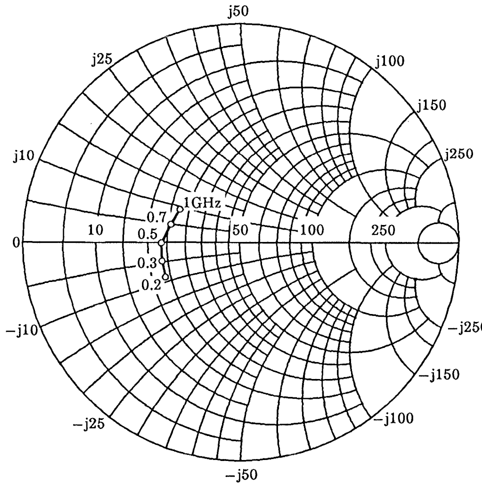
|S21e|2 − IC
VCE=10V
Ta=25°C
f=0.5GHz
1
INSERTION GAIN |S21e|2 (dB)
COLLECTOR CURRENT IC (mA)



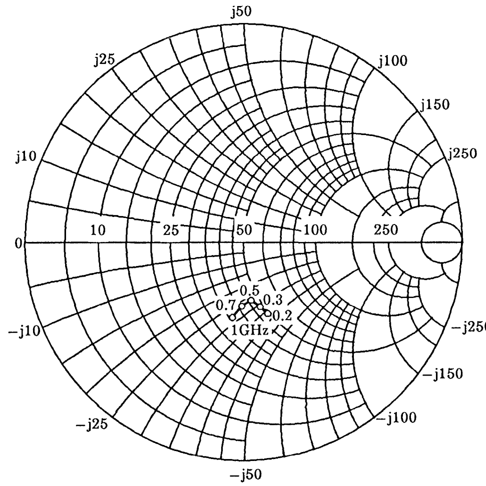
NF − IC
f=500MHz
VCE=10V
Ta=25°C
NOISE FIGURE NF (dB)
COLLECTOR CURRENT IC (mA)

COMMON EMITTER SMALL S−PARAMETERS OF 2SC2644

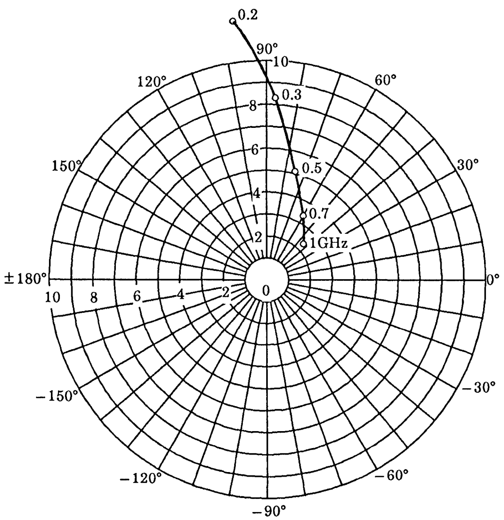
$V_{CE}=10V$, $I_C=30mA$



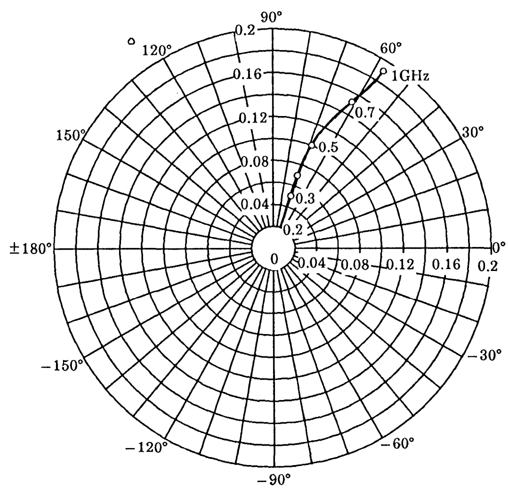
S_{11e} (UNIT : Ω)



S_{22e} (UNIT : Ω)



S_{21e}



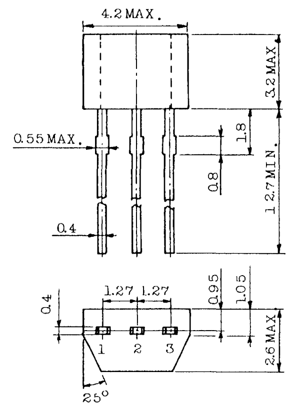
S_{12e}

SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC2668

HIGH FREQUENCY AMPLIFIER APPLICATIONS.
FM, RF, IF AMPLIFIER APLIFIER APPLICATIONS.

Unit in mm



1. EMITTER
2. COLLECTOR
3. BASE

JEDEC	—
EIAJ	—
TOSHIBA	2-4E1A

Weight : 0.13g

- Small Reverse Transfer Capacitance : $C_{re}=0.70pF$ (Typ.)
- Low Noise Figure : $NF=2.5dB$ (Typ.)

MAXIMUM RATINGS (Ta = 25°C)

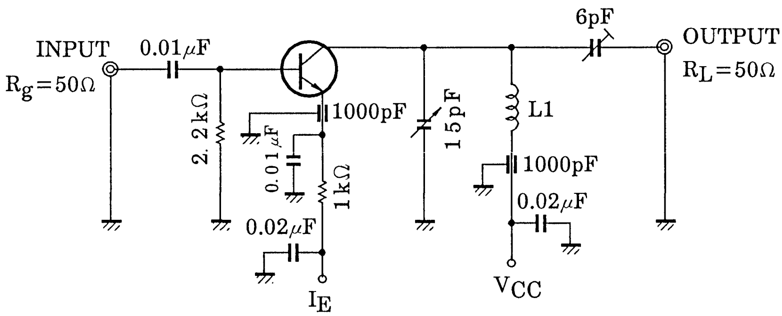
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	40	V
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Base Voltage	V_{EBO}	4	V
Collector Current	I_C	20	mA
Emitter Current	I_B	4	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature Range	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=40V,\ I_E=0$	—	—	0.5	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=4V,\ I_C=0$	—	—	0.5	μA
DC Current Gain	h_{FE} (Note)	$V_{CE}=6V,\ I_C=1mA$	40	—	200	—
Reverse Transfer Capacitance	C_{re}	$V_{CE}=6V,\ f=1MHz$	—	0.70	—	pF
Transistion Frequency	f_T	$V_{CE}=6V,\ I_C=1mA$	—	550	—	MHz
Collector-Base Time Constant	$C_c \cdot r_{bb'}$	$V_{CE}=6V,\ I_E=-1mA,$ $f=30MHz$	—	—	30	ps
Noise Figure	NF	$V_{CC}=6V,\ I_E=-1mA,$ $f=100MHz$ (Fig.1)	—	2.5	5.0	dB
Power Gain	G_{pe}		—	18	—	dB

Note : h_{FE} Classification R : 40~80, O : 70~140, Y : 100~200

Fig.1. NF, G_{pe} TEST CIRCUIT



L1 : 0.8mmϕ SILVER PLATED COPPER WIRE, 4Turns. 10mm ID, 8mm Lengh.

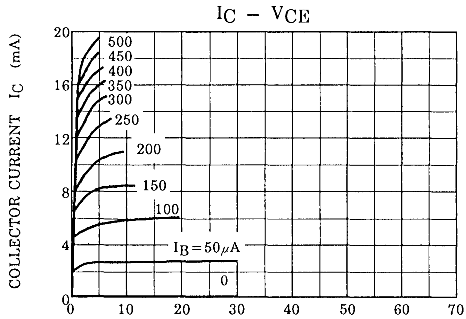
Y PARAMETER (Typ.)

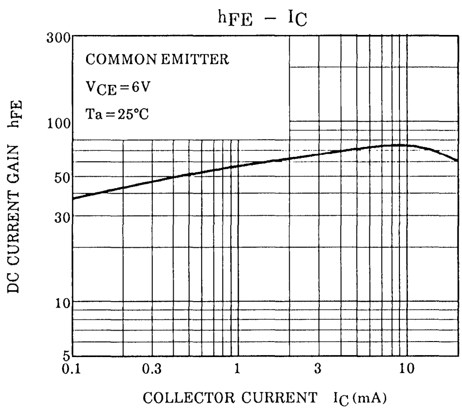
(1) COMMON EMITTER (V_{CE} = 6V, I_E = −1mA, f = 100MHz)

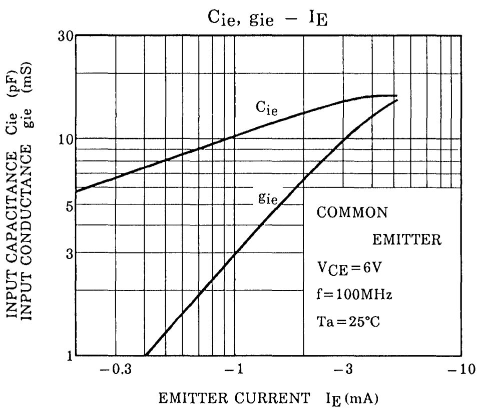
CHARACTERISTIC	SYMBOL	TYP.	UNIT
Input Conductance	g_{ie}	2.9	ms
Input Capacitance	C_{ie}	10.2	pF
Reverse Transfer Admittance	$\|Y_{re}\|$	0.33	ms
Phase Angle of Reverse Transfer Admittance	θ_{re}	−90	°
Forward transfer Admittance	$\|Y_{fe}\|$	40	ms
Phase Angle of Forward Transfer Admittance	θ_{fe}	−20	°
Output Conductance	g_{oe}	45	μs
Output Capacitance	C_{oe}	1.1	pF

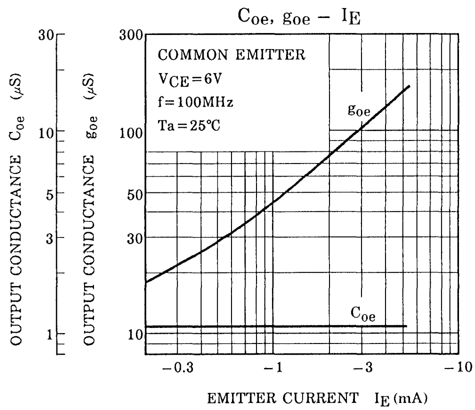
(2) COMMON BASE (V_{CB} = 6V, I_E = −1mA, f = 100MHz)

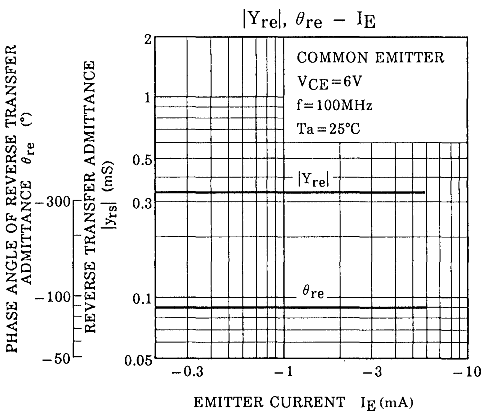
CHARACTERISTIC	SYMBOL	TYP.	UNIT
Input Conductance	g_{ib}	34	ms
Input Capacitance	C_{ib}	−10	pF
Reverse Transfer Admittance	$\|Y_{rb}\|$	0.27	ms
Phase Angle of Reverse Transfer Admittance	θ_{rb}	−105	°
Forward Transfer Admittance	$\|Y_{fb}\|$	34	ms
Phase Angle of Forward Transfer Admittance	θ_{fb}	165	°
Output Conductance	g_{ob}	45	μs
Output Capacitance	C_{ob}	1.1	pF

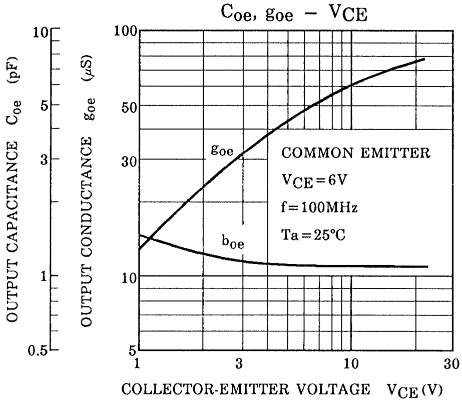

IC – VCE
COLLECTOR CURRENT IC (mA)
500
450
400
350
300
250
200
150
100
IB=50μA
0
0 10 20 30 40 50 60 70


hFE – IC
COMMON EMITTER
VCE=6V
Ta=25°C
DC CURRENT GAIN hFE
COLLECTOR CURRENT IC (mA)

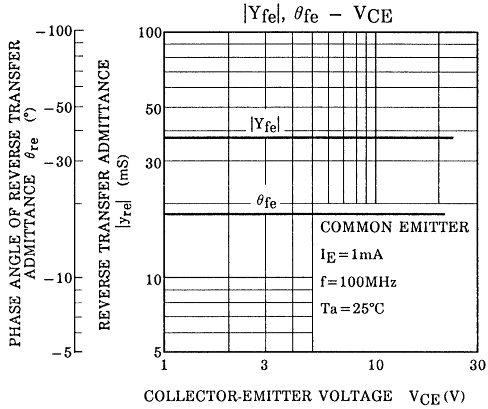

Cie, gie – IE
INPUT CAPACITANCE Cie (pF)
INPUT CONDUCTANCE gie (mS)
Cie
gie
COMMON EMITTER
VCE=6V
f=100MHz
Ta=25°C
EMITTER CURRENT IE (mA)


Coe, goe – IE
OUTPUT CONDUCTANCE Coe (μS)
OUTPUT CONDUCTANCE goe (μS)
COMMON EMITTER
VCE=6V
f=100MHz
Ta=25°C
goe
Coe
EMITTER CURRENT IE (mA)

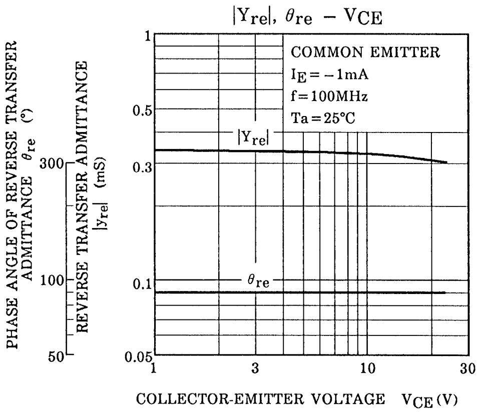

|Yre|, θre – IE
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE θre (°)
REVERSE TRANSFER ADMITTANCE |yrs| (mS)
COMMON EMITTER
VCE=6V
f=100MHz
Ta=25°C
|Yre|
θre
EMITTER CURRENT IE (mA)



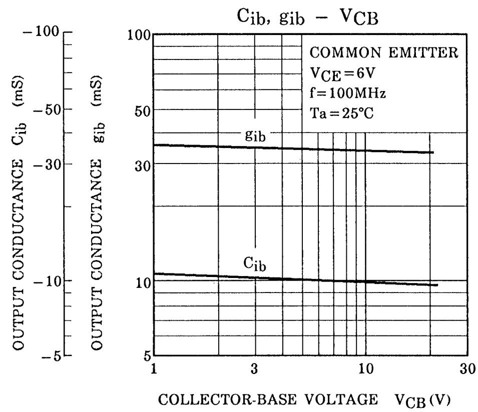
C_{oe}, g_{oe} – V_{CE}
OUTPUT CAPACITANCE C_{oe} (pF)
OUTPUT CONDUCTANCE g_{oe} (μS)
g_{oe}
b_{oe}
COMMON EMITTER
V_{CE}=6V
f=100MHz
Ta=25°C
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)



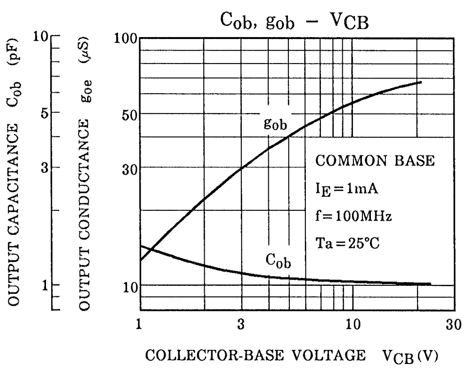
$|Y_{fe}|$, θ_{fe} – V_{CE}
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE θ_{re} (°)
REVERSE TRANSFER ADMITTANCE $|y_{rel}|$ (mS)
$|Y_{fe}|$
θ_{fe}
COMMON EMITTER
I_E=1mA
f=100MHz
Ta=25°C
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)



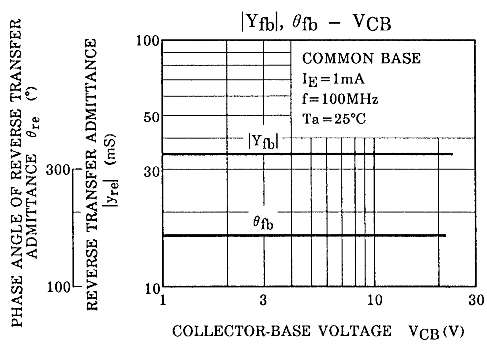
$|Y_{re}|$, θ_{re} – V_{CE}
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE θ_{re} (°)
REVERSE TRANSFER ADMITTANCE $|y_{rel}|$ (mS)
COMMON EMITTER
I_E=–1mA
f=100MHz
Ta=25°C
$|Y_{re}|$
θ_{re}
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)



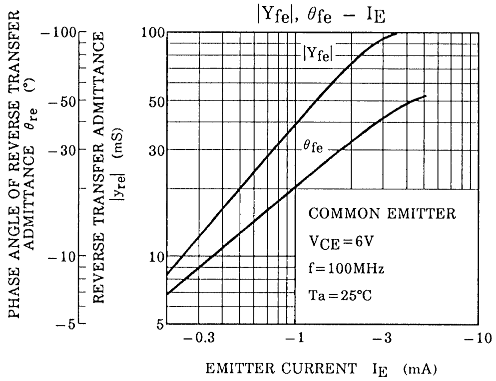
C_{ib}, g_{ib} – V_{CB}
OUTPUT CONDUCTANCE C_{ib} (mS)
OUTPUT CONDUCTANCE g_{ib} (mS)
COMMON EMITTER
V_{CE}=6V
f=100MHz
Ta=25°C
g_{ib}
C_{ib}
COLLECTOR-BASE VOLTAGE V_{CB} (V)

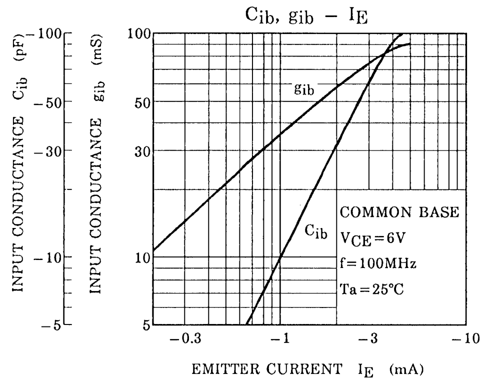


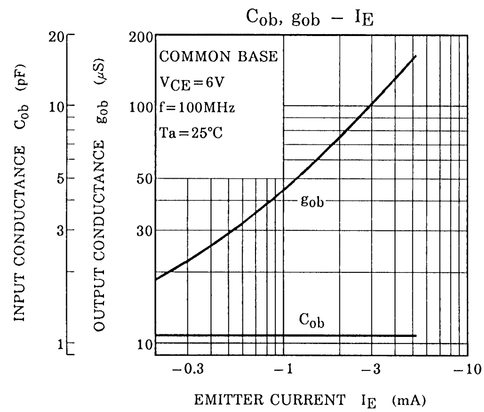
C_{ob}, g_{ob} – V_{CB}
OUTPUT CAPACITANCE C_{ob} (pF)
OUTPUT CONDUCTANCE g_{oe} (μS)
g_{ob}
C_{ob}
COMMON BASE
I_E=1mA
f=100MHz
Ta=25°C
COLLECTOR-BASE VOLTAGE V_{CB} (V)

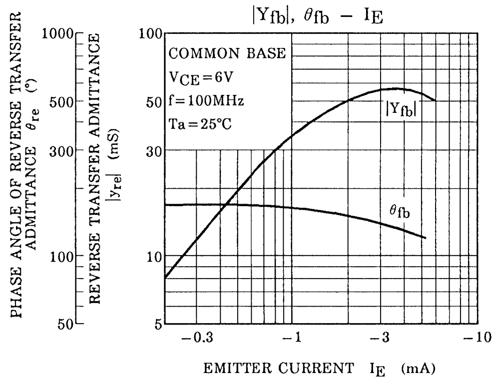


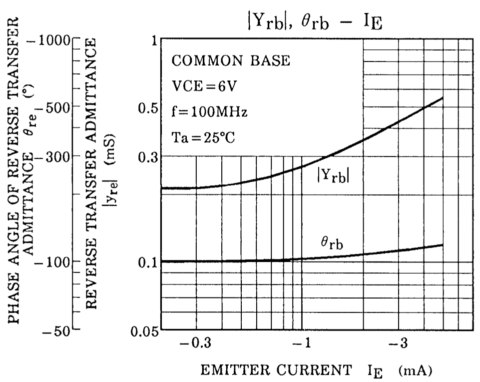
$|Y_{fb}|$, θ_{fb} – V_{CB}
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE θ_{re} (°)
REVERSE TRANSFER ADMITTANCE $|y_{rel}|$ (mS)
COMMON BASE
I_E=1mA
f=100MHz
Ta=25°C
$|Y_{fb}|$
θ_{fb}
COLLECTOR-BASE VOLTAGE V_{CB} (V)

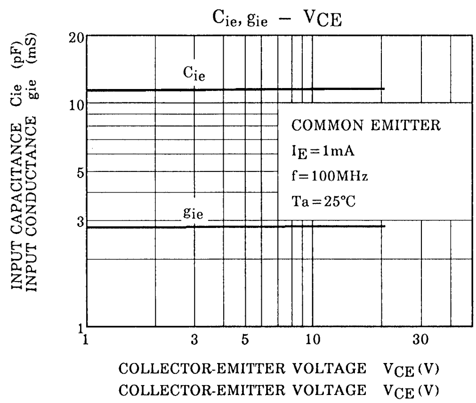

|Yfe|, θfe − IE
COMMON EMITTER
VCE=6V
f=100MHz
Ta=25°C
EMITTER CURRENT IE (mA)
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE θre (°)
REVERSE TRANSFER ADMITTANCE |yre| (mS)

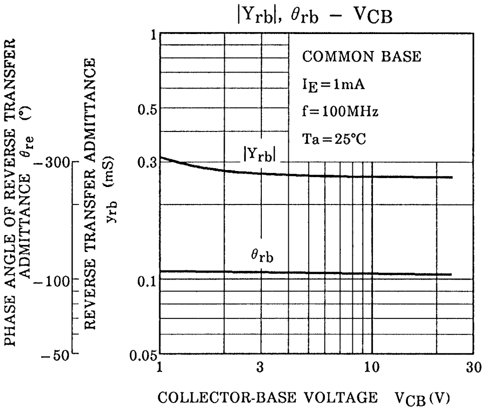

Cib, gib − IE
COMMON BASE
VCE=6V
f=100MHz
Ta=25°C
EMITTER CURRENT IE (mA)
INPUT CONDUCTANCE Cib (pF)
INPUT CONDUCTANCE gib (mS)

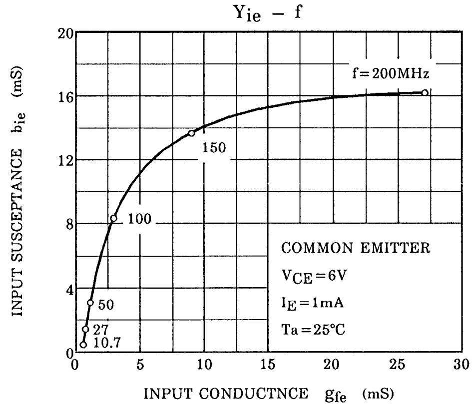

Cob, gob − IE
COMMON BASE
VCE=6V
f=100MHz
Ta=25°C
EMITTER CURRENT IE (mA)
INPUT CONDUCTANCE Cob (pF)
OUTPUT CONDUCTANCE gob (μS)

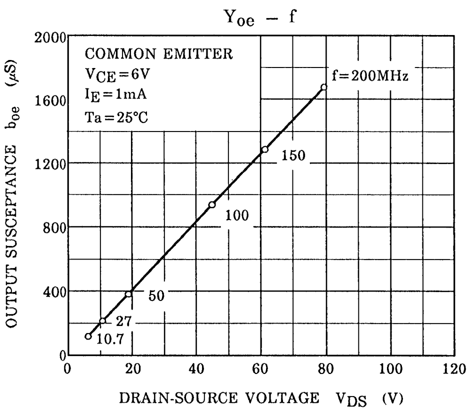

|Yfb|, θfb − IE
COMMON BASE
VCE=6V
f=100MHz
Ta=25°C
EMITTER CURRENT IE (mA)
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE θre (°)
REVERSE TRANSFER ADMITTANCE |yre| (mS)

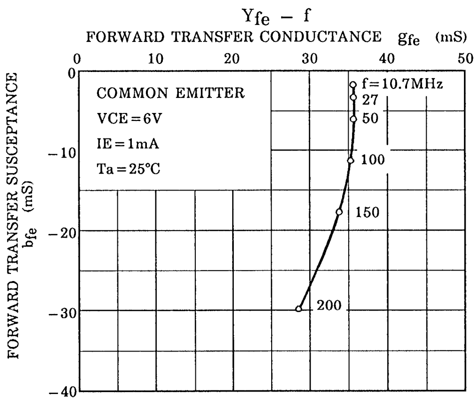

|Yrb|, θrb − IE
COMMON BASE
VCE=6V
f=100MHz
Ta=25°C
EMITTER CURRENT IE (mA)
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE θre (°)
REVERSE TRANSFER ADMITTANCE |yre| (mS)

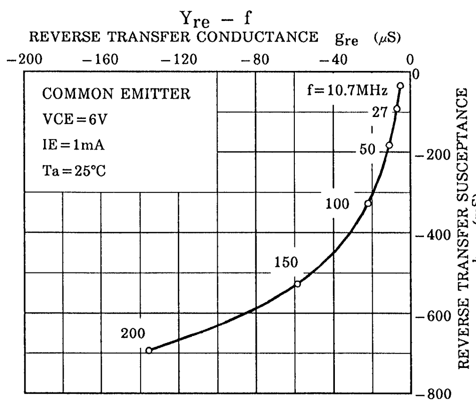

Cie, gie − VCE
COMMON EMITTER
IE=1mA
f=100MHz
Ta=25°C
COLLECTOR-EMITTER VOLTAGE VCE (V)
COLLECTOR-EMITTER VOLTAGE VCE (V)
INPUT CAPACITANCE Cie (pF)
INPUT CONDUCTANCE gie (mS)

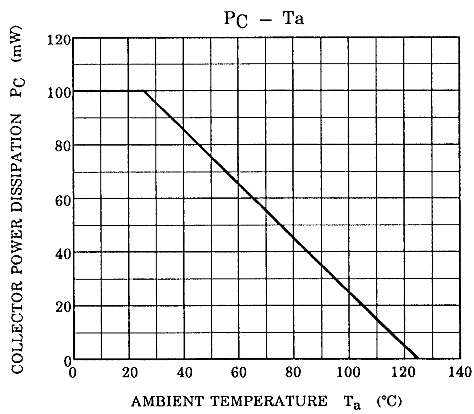

|Yrb|, θrb − VCB
COMMON BASE
IE=1mA
f=100MHz
Ta=25°C
|Yrb|
θrb
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE θre (°)
REVERSE TRANSFER ADMITTANCE yrb (mS)
COLLECTOR-BASE VOLTAGE VCB (V)


Yie − f
f=200MHz
150
100
50
27
10.7
COMMON EMITTER
VCE=6V
IE=1mA
Ta=25°C
INPUT SUSCEPTANCE bie (mS)
INPUT CONDUCTNCE gfe (mS)


Yoe − f
COMMON EMITTER
VCE=6V
IE=1mA
Ta=25°C
f=200MHz
150
100
50
27
10.7
OUTPUT SUSCEPTANCE boe (μS)
DRAIN-SOURCE VOLTAGE VDS (V)


Yfe − f
FORWARD TRANSFER CONDUCTANCE gfe (mS)
COMMON EMITTER
VCE=6V
IE=1mA
Ta=25°C
f=10.7MHz
27
50
100
150
200
FORWARD TRANSFER SUSCEPTANCE bfe (mS)


Yre − f
REVERSE TRANSFER CONDUCTANCE gre (μS)
COMMON EMITTER
VCE=6V
IE=1mA
Ta=25°C
f=10.7MHz
27
50
100
150
200
REVERSE TRANSFER SUSCEPTANCE bre (mS)


PC − Ta
COLLECTOR POWER DISSIPATION PC (mW)
AMBIENT TEMPERATURE Ta (°C)

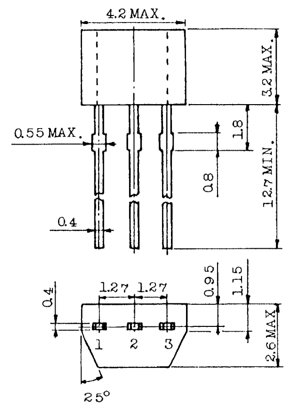
SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC2669

HIGH FREQUENCY AMPLIFIER APPLICATIONS.

Unit in mm

- High Power Gain : G_{pe}=30dB (Typ.) (f=10.7MHz)
- Recommended for FM IF, OSC Stage and AM CONV, IF Stage.



1. EMITTER
2. COLLECTOR
3. BASE

JEDEC	—
EIAJ	—
TOSHIBA	2-4E1A

Weight : 0.13g

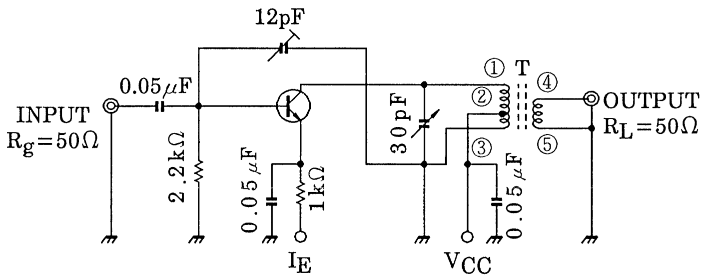
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	35	V
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Base Voltage	V_{EBO}	4	V
Collector Current	I_C	50	mA
Emitter Current	I_E	−50	mA
Collector Power Dissipation	P_C	200	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB}=35V, I_E=0	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB}=4V, I_C=0	—	—	1.0	μA
DC Current Gain	h_{FE} (Note)	V_{CE}=12V, I_C=2mA	40	—	240	—
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=10mA, I_B=1mA	—	—	0.4	V
Base-Emitter Voltage	V_{BE}	I_C=10mA, I_B=1mA	—	—	1.0	V
Transition Frequency	f_T	V_{CE}=10V, I_C=1mA	100	—	—	MHz
Collector Output Capacitance	C_{ob}	V_{CB}=10V, I_E=0, f=1MHz	—	2.0	3.2	pF
Collector-Base Time Constant	$C_c \cdot r_{bb'}$	V_{CE}=10V, I_E=−1mA, f=30MHz	—	—	50	ps
Power Gain	G_{pe}	V_{CC}=6V, I_E=−1mA, f=10.7MHz (Fig.)	27	30	33	dB

Note : h_{FE} Classification R : 40~80, O : 70~140, Y : 120~240



T : ①-② 0.1mmφ UEW 20T
②-③ 0.1mmφ UEW 8T
④-⑤ 0.1mmφ UEW 2T

Fig.1 G_{pe} TEST CIRCUIT

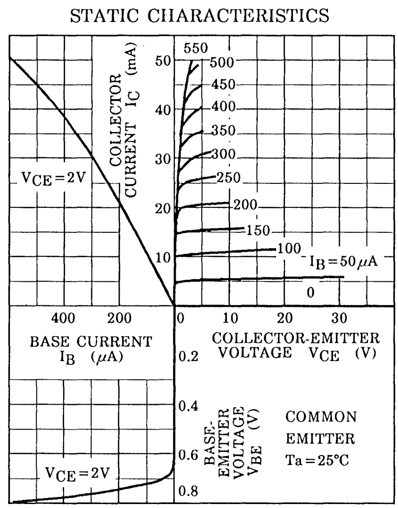
Y PARAMETERS (Typ.)

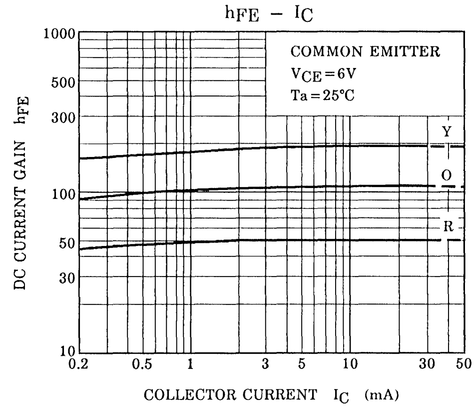
(1) (COMMON EMITTER f = 455kHz, Ta = 25°C)

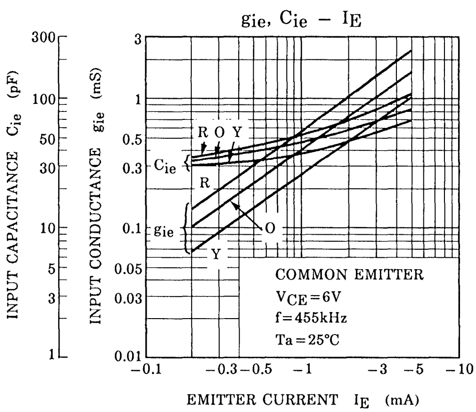
CHARACTERISTIC	SYMBOL	2SC2669-R	2SC2669-O	2SC2669-Y	UNIT
Collector-Emitter Voltage	V_{CE}	6	6	6	V
Emitter Current	I_E	−1	−1	−1	mA
Input Conductance	g_{ie}	0.58	0.41	0.26	mS
Input Capacitance	C_{ie}	53	46	38	pF
Output Conductance	g_{oe}	1.9	2.7	4.8	μS
Output Capacitance	C_{oe}	2.6	2.8	3.6	pF
Forward Transfer Admittance	$\|y_{fe}\|$	38	38	38	mS
Phase Angle of Forward Transfer Admittance	θ_{fe}	−0.79	−0.83	−0.92	°
Reverse Transfer Admittance	$\|y_{re}\|$	5.7	5.7	6.2	μS
Phase Angle of Reverse Transfer Admittance	θ_{re}	−90	−90	−90	°

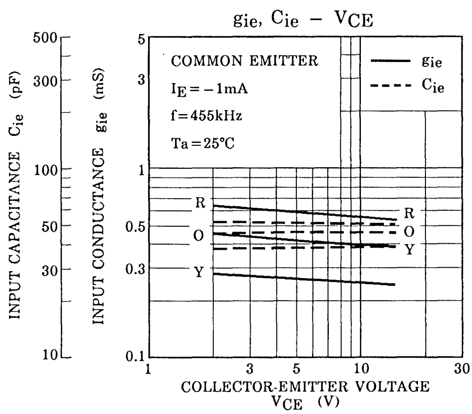
(2) (COMMON EMITTER f = 10.7MHz, Ta = 25°C)

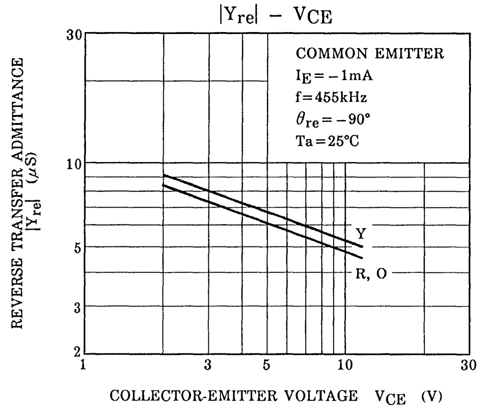
CHARACTERISTIC	SYMBOL	2SC2669-R	2SC2669-O	2SC2669-Y	UNIT
Collector-Emitter Voltage	V_{CE}	6	6	6	V
Emitter Current	I_E	−1	−1	−1	mA
Input Conductance	g_{ie}	1.04	0.85	0.65	mS
Input Capacitance	C_{ie}	49	43	36	pF
Output Conductance	g_{oe}	10	15	28	μS
Output Capacitance	C_{oe}	2.7	2.9	3.6	pF
Forward Transfer Admittance	$\|y_{fe}\|$	37	37	37	mS
Phase Angle of Forward Transfer Admittance	θ_{fe}	−9.6	−10.4	−11.5	°
Reverse Transfer Admittance	$\|y_{re}\|$	120	120	140	μS
Phase Angle of Reverse Transfer Admittance	θ_{re}	−90	−90	−90	°

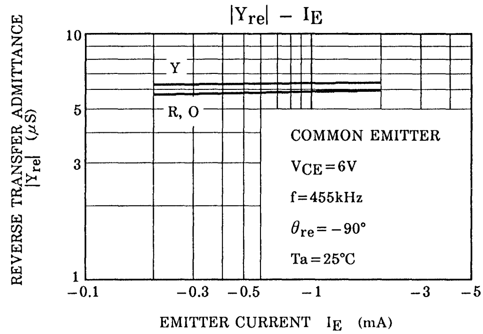

STATIC CHARACTERISTICS
COLLECTOR CURRENT IC (mA)
550
500
450
400
350
300
250
200
150
100
IB=50μA
0
VCE=2V
400 200
BASE CURRENT IB (μA)
0 10 20 30
COLLECTOR-EMITTER VOLTAGE VCE (V)
BASE-EMITTER VOLTAGE VBE (V)
COMMON EMITTER
Ta=25°C

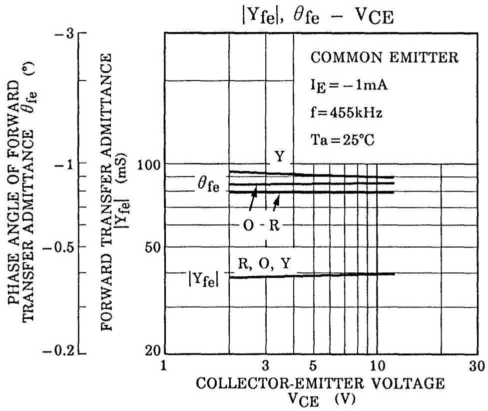

hFE – IC
DC CURRENT GAIN hFE
COMMON EMITTER
VCE=6V
Ta=25°C
Y
O
R
COLLECTOR CURRENT IC (mA)

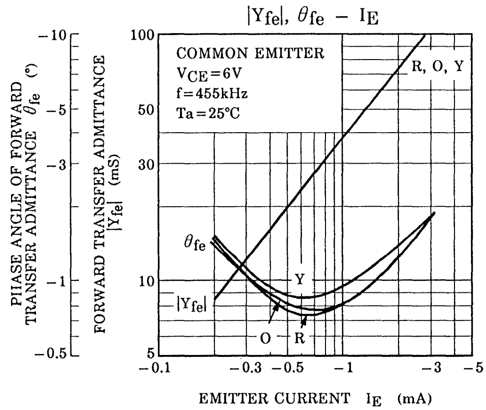

gie, Cie – IE
INPUT CAPACITANCE Cie (pF)
INPUT CONDUCTANCE gie (mS)
R O Y
Cie
gie
R
O
Y
COMMON EMITTER
VCE=6V
f=455kHz
Ta=25°C
EMITTER CURRENT IE (mA)

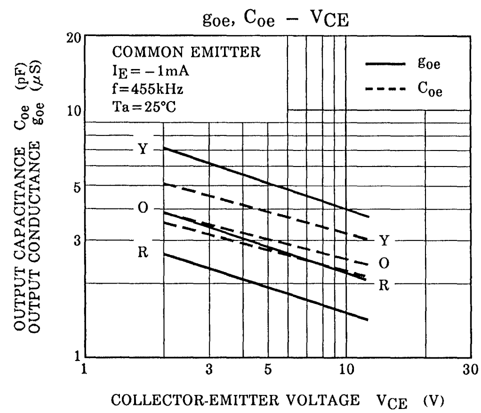

gie, Cie – VCE
INPUT CAPACITANCE Cie (pF)
INPUT CONDUCTANCE gie (mS)
COMMON EMITTER
IE=–1mA
f=455kHz
Ta=25°C
gie
Cie
R
O
Y
COLLECTOR-EMITTER VOLTAGE VCE (V)

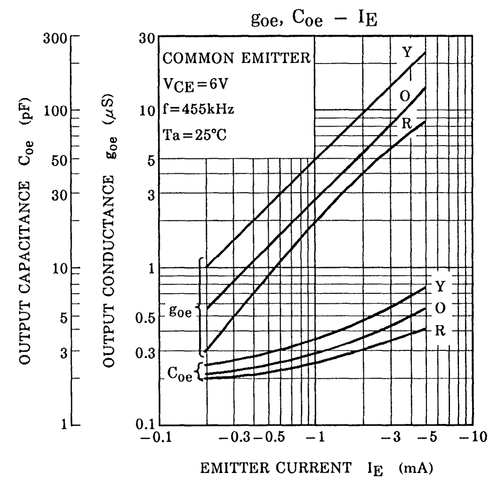

|Yre| – VCE
COMMON EMITTER
IE = –1mA
f = 455kHz
θre = –90°
Ta = 25°C
Y
R, O
REVERSE TRANSFER ADMITTANCE |Yre| (μS)
COLLECTOR-EMITTER VOLTAGE VCE (V)


|Yre| – IE
Y
R, O
COMMON EMITTER
VCE = 6V
f = 455kHz
θre = –90°
Ta = 25°C
REVERSE TRANSFER ADMITTANCE |Yre| (μS)
EMITTER CURRENT IE (mA)

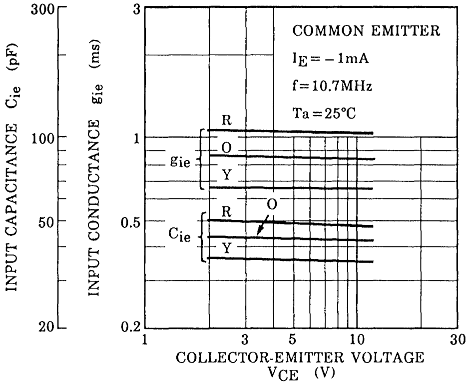

|Yfe|, θfe – VCE
COMMON EMITTER
IE = –1mA
f = 455kHz
Ta = 25°C
Y
θfe
O - R
R, O, Y
|Yfe|
PHASE ANGLE OF FORWARD TRANSFER ADMITTANCE θfe (°)
FORWARD TRANSFER ADMITTANCE |Yfe| (mS)
COLLECTOR-EMITTER VOLTAGE VCE (V)


|Yfe|, θfe – IE
COMMON EMITTER
VCE = 6V
f = 455kHz
Ta = 25°C
R, O, Y
θfe
Y
|Yfe|
O
R
PHASE ANGLE OF FORWARD TRANSFER ADMITTANCE θfe (°)
FORWARD TRANSFER ADMITTANCE |Yfe| (mS)
EMITTER CURRENT IE (mA)

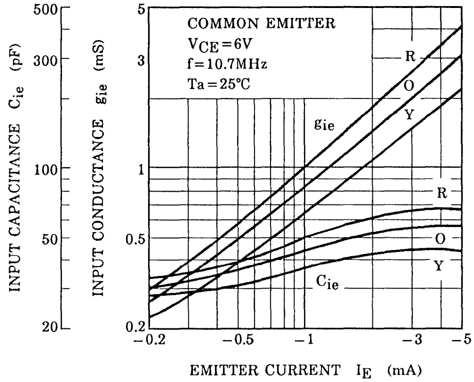

goe, Coe – VCE
COMMON EMITTER
IE = –1mA
f = 455kHz
Ta = 25°C
goe
Coe
Y
O
R
OUTPUT CAPACITANCE Coe (pF)
OUTPUT CONDUCTANCE goe (μS)
COLLECTOR-EMITTER VOLTAGE VCE (V)


goe, Coe – IE
COMMON EMITTER
VCE = 6V
f = 455kHz
Ta = 25°C
Y
O
R
goe
Coe
OUTPUT CAPACITANCE Coe (pF)
OUTPUT CONDUCTANCE goe (μS)
EMITTER CURRENT IE (mA)

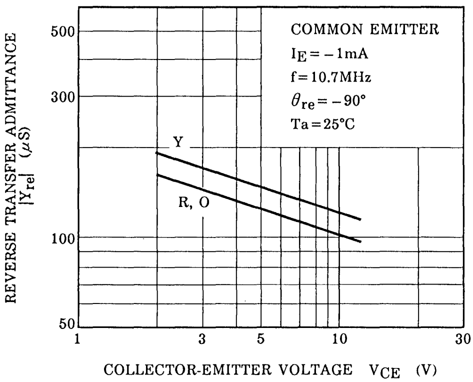
g_{ie}, C_{ie} – V_{CE}



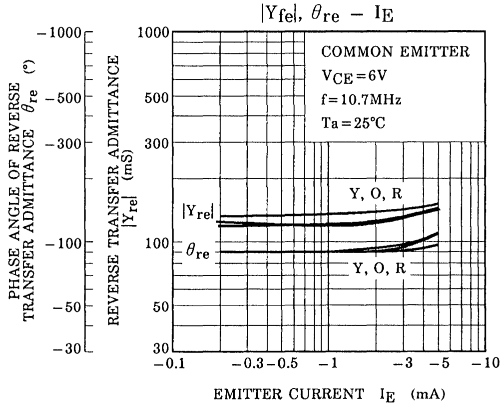
g_{ie}, C_{ie} – I_E



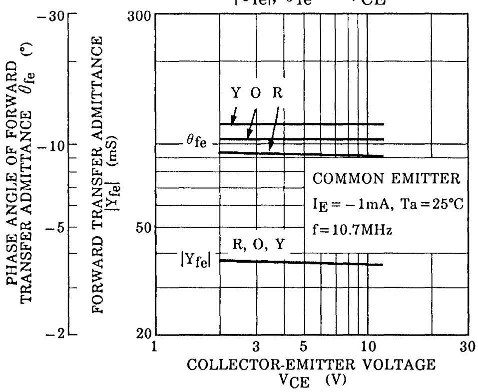
$|Y_{re}|$ – V_{CE}



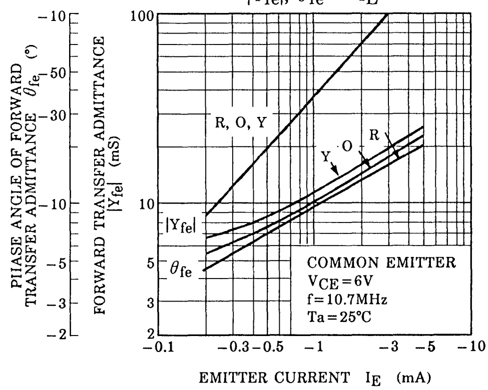
$|Y_{fe}|$, θ_{re} – I_E

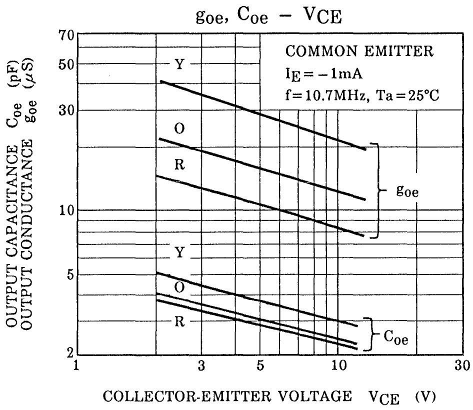


$|Y_{fe}|$, θ_{fe} – V_{CE}

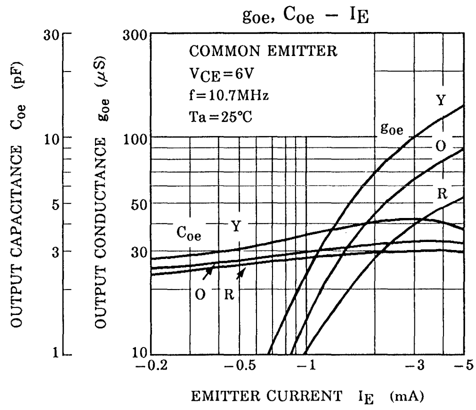


$|Y_{fe}|$, θ_{fe} – I_E

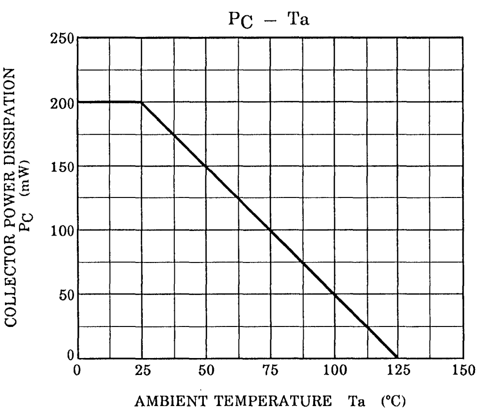




goe, Coe – VCE
COMMON EMITTER
IE = –1mA
f=10.7MHz, Ta=25°C
OUTPUT CAPACITANCE Coe (pF)
OUTPUT CONDUCTANCE goe (μS)
Y
O
R
goe
Y
O
R
Coe
70
50
30
10
5
2
1
3
5
10
30
COLLECTOR-EMITTER VOLTAGE VCE (V)



goe, Coe – IE
COMMON EMITTER
VCE=6V
f=10.7MHz
Ta=25°C
OUTPUT CAPACITANCE Coe (pF)
OUTPUT CONDUCTANCE goe (μS)
goe
Y
O
R
Coe
Y
O
R
30
10
5
3
1
300
100
50
30
10
–0.2
–0.5
–1
–3
–5
EMITTER CURRENT IE (mA)



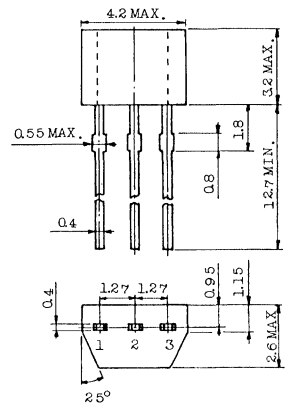
PC – Ta
COLLECTOR POWER DISSIPATION PC (mW)
250
200
150
100
50
0
0
25
50
75
100
125
150
AMBIENT TEMPERATURE Ta (°C)

SILICON NPN EPITAXIAL TYPE TRANSISTOR

2SC2670

HIGH FREQUENCY AMPLIFIER APPLICATIONS.
AM HIGH FREQUENCY AMPLIFIER APPLICATIONS.
AM FREQUENCY CONVERTER APPLICATIONS.

Unit in mm



1. EMITTER
2. COLLECTOR
3. BASE

JEDEC	—
EIAJ	—
TOSHIBA	2-4E1A

Weight : 0.13g

- Low Noise Figure : NF = 3.5dB (Max.) (f = 1MHz)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	35	V
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Base Voltage	V_{EBO}	4	V
Collector Current	I_C	100	mA
Base Current	I_B	20	mA
Collector Power Dissipation	P_C	200	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

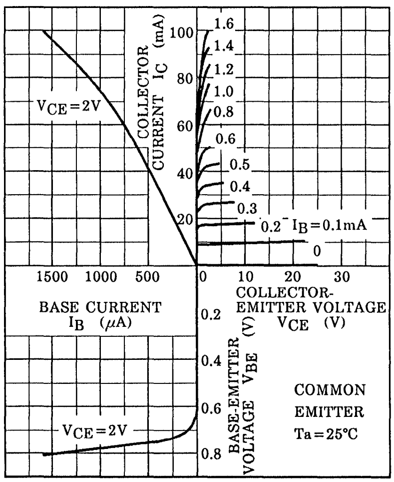
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 35V, I_E = 0	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 4V, I_C = 0	—	—	1.0	μA
DC Current Gain	h_{FE} (Note)	V_{CE} = 12V, I_C = 2mA	40	—	240	—
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C = 10mA, I_B = 1mA	—	—	0.4	V
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	I_C = 10mA, I_B = 1mA	—	—	1.0	V
Transition Frequency	f_T	V_{CE} = 10V, I_C = 2mA	80	—	—	MHz
Reverse Transfer Capacitance	C_{re}	V_{CE} = 10V, f = 1MHz	—	2.2	3.0	pF
Collector-Base Time Constant	$C_c \cdot r_{bb'}$	V_{CE} = 10V, I_E = −1mA, f = 30MHz	—	—	50	ps
Noise Figure	NF	V_{CE} = 10V, I_E = −1mA, f = 1MHz, R_g = 50Ω	—	2.0	3.5	dB

Note : h_{FE} Classification R : 40~80, O : 70~140, Y : 120~240

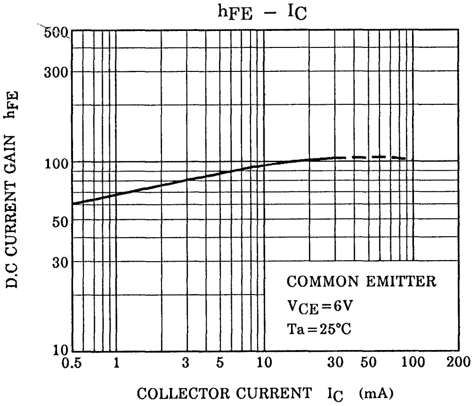
Y PARAMETERS (Typ.) (COMMON EMITTER $V_{CE}=6V$, $I_E=-1mA$, $f=1MHz$)

CHARACTERISTIC	SYMBOL	2SC2670-R	2SC2670-O	2SC2670-Y	UNIT
Input Conductance	g_{ie}	0.5	0.35	0.22	mS
Input Capacitance	C_{ie}	50	48	46	pF
Output Conductance	g_{oe}	4	5	6.5	μS
Output Capacitance	C_{oe}	3.7	3.4	3.2	pF
Forward Transfer Admittance	$\lvert y_{fe} \rvert$	36	36	36	mS
Phase Angle of Forward Transfer Admittance	θ_{fe}	−1.6	−1.6	−1.6	°
Reverse Transfer Admittance	$\lvert y_{re} \rvert$	14	14	14	μS
Phase Angle of Reverse Transfer Admittance	θ_{re}	−90	−90	−90	°

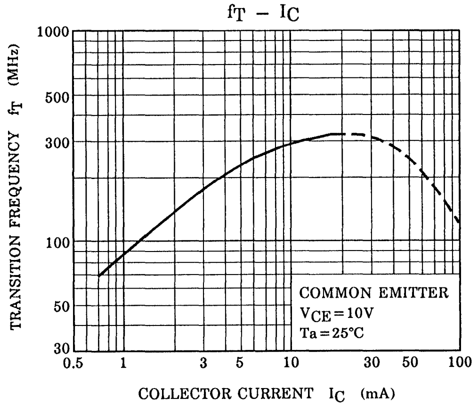
STATIC CHARACTERISTICS

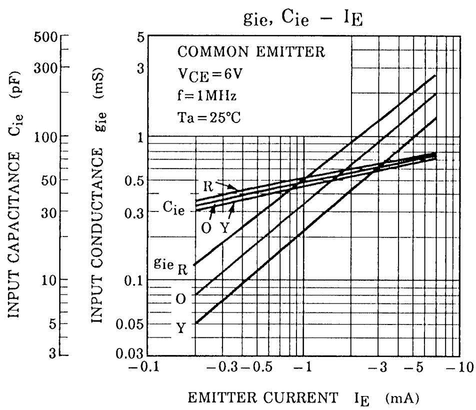


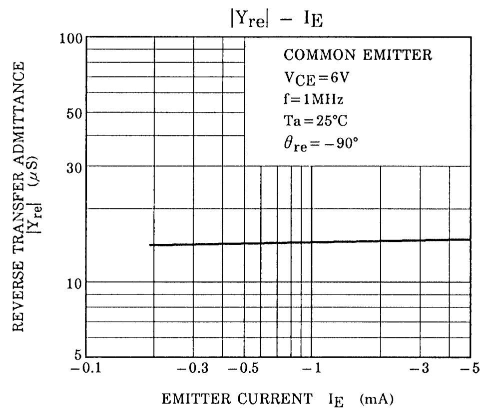
$h_{FE} - I_C$

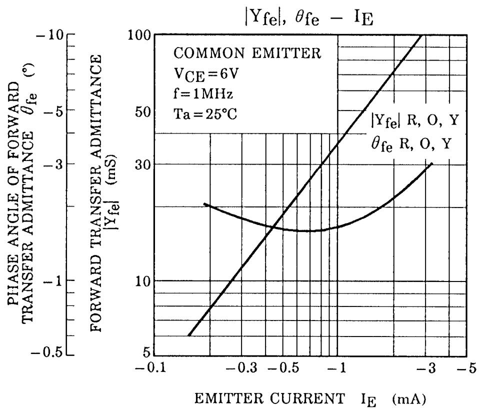


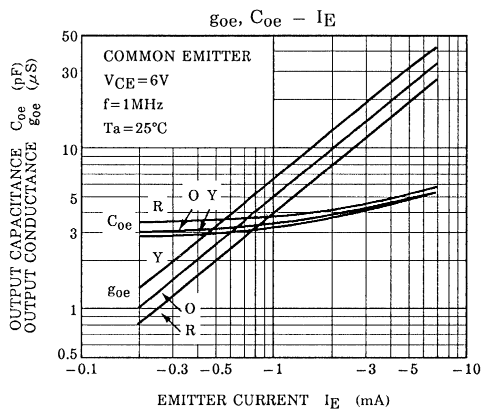
$f_T - I_C$

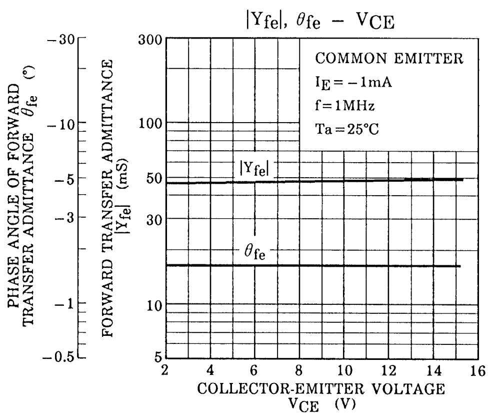


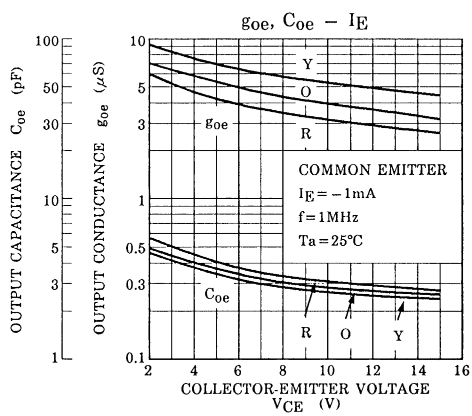

gie, Cie – IE
COMMON EMITTER
VCE=6V
f=1MHz
Ta=25°C
INPUT CAPACITANCE Cie (pF)
INPUT CONDUCTANCE gie (mS)
EMITTER CURRENT IE (mA)
R
O Y
Cie
gie R
O
Y

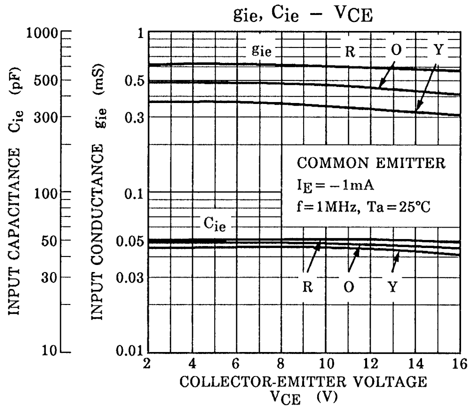

|Yre| – IE
COMMON EMITTER
VCE=6V
f=1MHz
Ta=25°C
θre=–90°
REVERSE TRANSFER ADMITTANCE |Yre| (μS)
EMITTER CURRENT IE (mA)

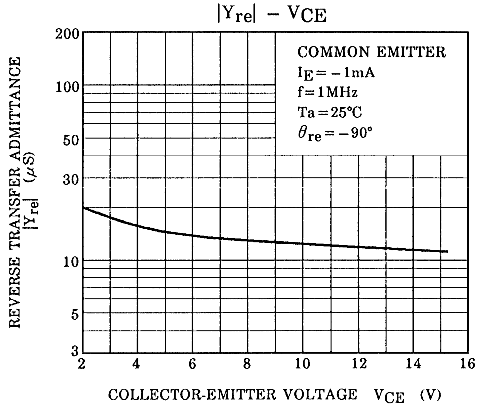

|Yfe|, θfe – IE
COMMON EMITTER
VCE=6V
f=1MHz
Ta=25°C
|Yfe| R, O, Y
θfe R, O, Y
PHASE ANGLE OF FORWARD TRANSFER ADMITTANCE θfe (°)
FORWARD TRANSFER ADMITTANCE |Yfe| (mS)
EMITTER CURRENT IE (mA)

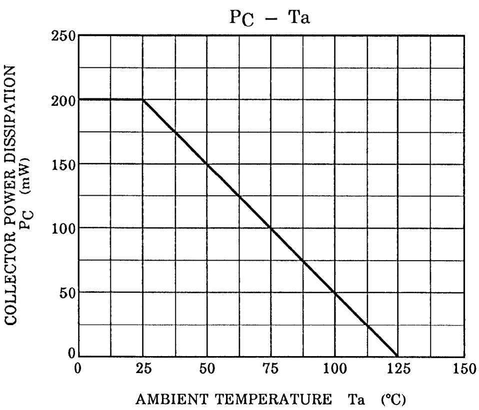

goe, Coe – IE
COMMON EMITTER
VCE=6V
f=1MHz
Ta=25°C
OUTPUT CAPACITANCE Coe (pF)
OUTPUT CONDUCTANCE goe (μS)
EMITTER CURRENT IE (mA)
R
O Y
Coe
Y
goe
O
R


|Yfe|, θfe – VCE
COMMON EMITTER
IE=–1mA
f=1MHz
Ta=25°C
|Yfe|
θfe
PHASE ANGLE OF FORWARD TRANSFER ADMITTANCE θfe (°)
FORWARD TRANSFER ADMITTANCE |Yfe| (mS)
COLLECTOR-EMITTER VOLTAGE VCE (V)


goe, Coe – IE
COMMON EMITTER
IE=–1mA
f=1MHz
Ta=25°C
Y
O
R
goe
Coe
R O Y
OUTPUT CAPACITANCE Coe (pF)
OUTPUT CONDUCTANCE goe (μS)
COLLECTOR-EMITTER VOLTAGE VCE (V)


gie, Cie – VCE
1000
500
300
100
50
30
10
1
0.5
0.3
0.1
0.05
0.03
0.01
INPUT CAPACITANCE Cie (pF)
INPUT CONDUCTANCE gie (mS)
gie
R
O
Y
Cie
COMMON EMITTER
IE = –1mA
f = 1MHz, Ta = 25°C
2 4 6 8 10 12 14 16
COLLECTOR-EMITTER VOLTAGE
VCE (V)

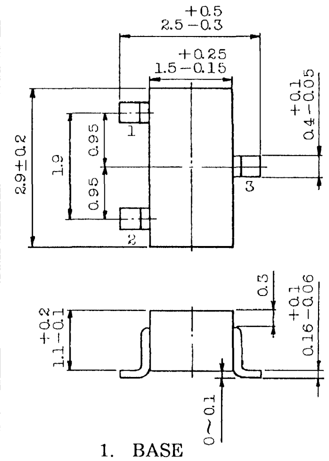

|Yre| – VCE
200
100
50
30
10
5
3
REVERSE TRANSFER ADMITTANCE
|Yre| (μS)
COMMON EMITTER
IE = –1mA
f = 1MHz
Ta = 25°C
θre = –90°
2 4 6 8 10 12 14 16
COLLECTOR-EMITTER VOLTAGE VCE (V)


PC – Ta
250
200
150
100
50
0
COLLECTOR POWER DISSIPATION
PC (mW)
0 25 50 75 100 125 150
AMBIENT TEMPERATURE Ta (°C)

SILICON NPN EPITAXIAL TYPE TRANSISTOR 2SC2712

AUDIO FREQUENCY GENERAL PURPOSE AMPLIFIER APPLICATIONS.

Unit in mm



S-MINI
1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	TO-236MOD
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

- High Voltage and High Current
  : V_{CEO}=50V, I_C=150mA (Max.)
- Excellent h_{FE} Linearity
  : h_{FE} (I_C=0.1mA) / h_{FE} (I_C=2mA) =0.95 (Typ.)
- High h_{FE} : h_{FE}=70~700
- Low Noise : NF=1dB (Typ.), 10dB (Max.)
- Complementary to 2SA1162
- Small Package

MAXIMUM RATINGS (Ta = 25°C)

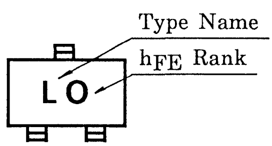
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	60	V
Collector-Emitter Voltage	V_{CEO}	50	V
Emitter-Base Voltage	V_{EBO}	5	V
Collector Current	I_C	150	mA
Base Current	I_B	30	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

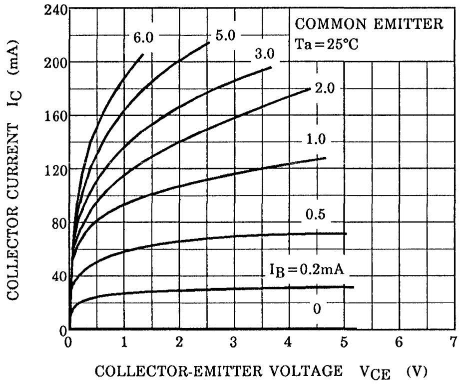
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB}=60V, I_E=0	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB}=5V, I_C=0	—	—	0.1	μA
DC Current Gain	h_{FE}(Note)	V_{CE}=6V, I_C=2mA	70	—	700	
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=100mA, I_B=10mA	—	0.1	0.25	V
Transtion Frequency	f_T	V_{CE}=10V, I_C=1mA	80	—	—	MHz
Collector Output Capacitance	C_{ob}	V_{CB}=10V, I_E=0, f=1MHz	—	2.0	3.5	pF
Noise Figure	NF	V_{CE}=6V, I_C=0.1mA, f=1kHz, R_g=10kΩ	—	1.0	10	dB

Note : h_{FE} Classification
O (O) : 70~140, Y (Y) : 120~240, GR (G) : 200~400,
BL (L) : 350~700
( ) Marking Symbol

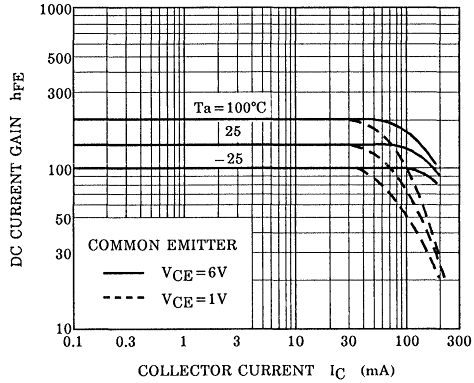
MARKING



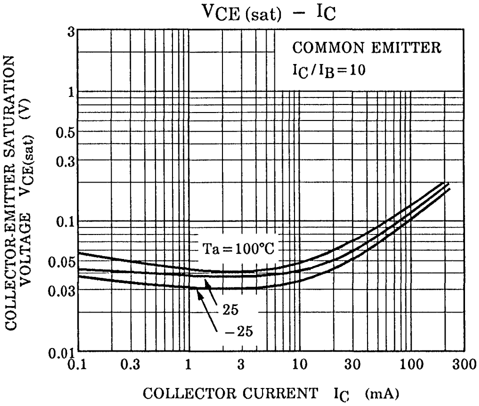
$I_C - V_{CE}$



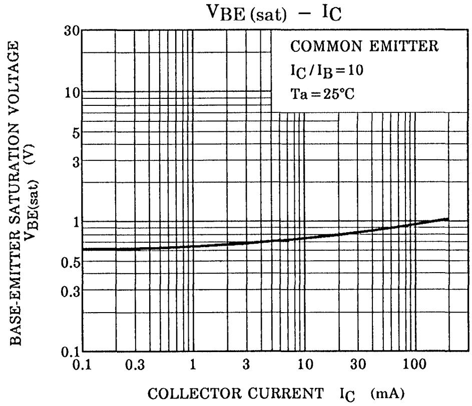
$h_{FE} - I_C$



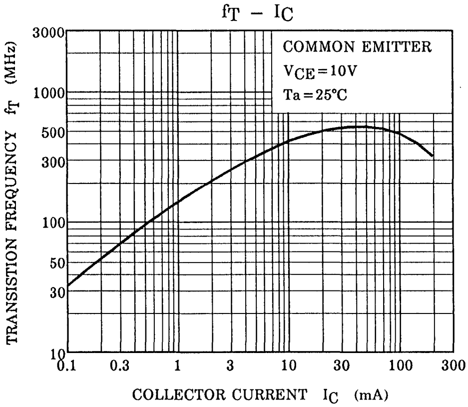
$V_{CE\,(sat)} - I_C$



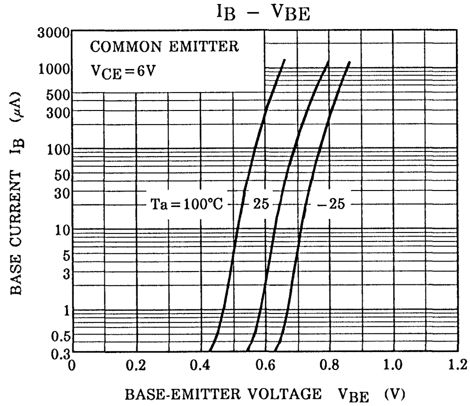
$V_{BE\,(sat)} - I_C$



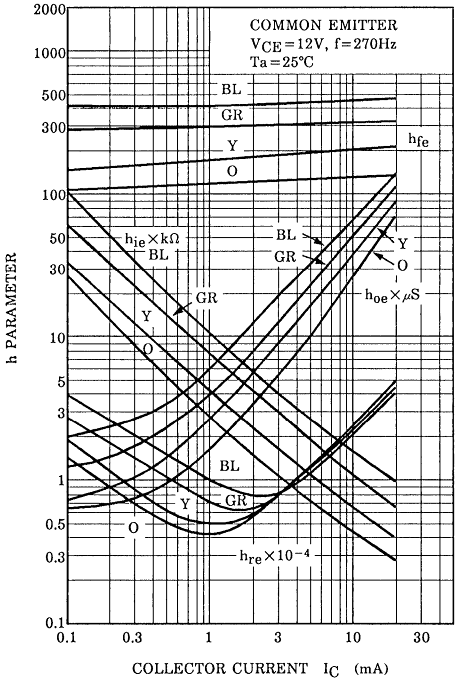
$f_T - I_C$



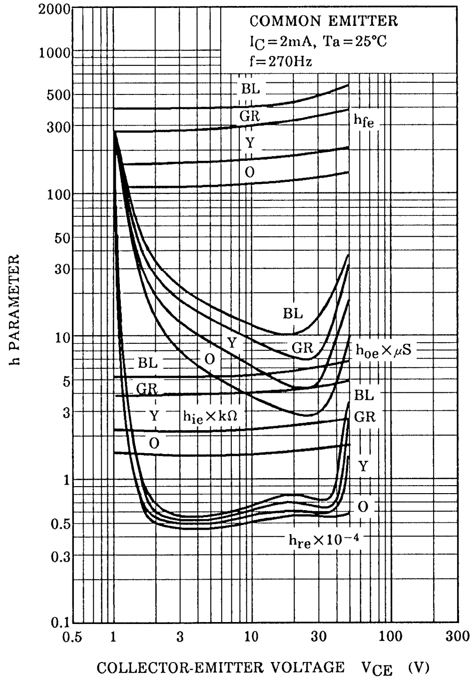
$I_B - V_{BE}$



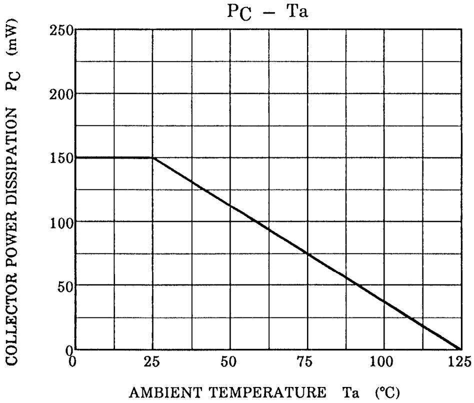
h PARAMETER – I_C



h PARAMETER – V_{CE}



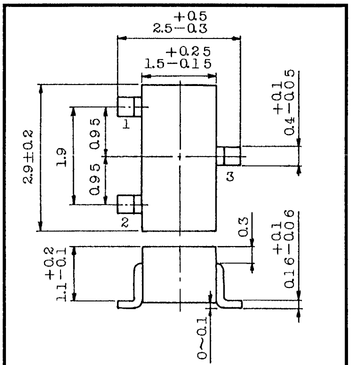
P_C – Ta



2SC2714 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

HIGH FREQUENCY AMPLIFIER APPLICATIONS.
FM, RF, MIX, IF AMPLIFIER APPLICATIONS.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

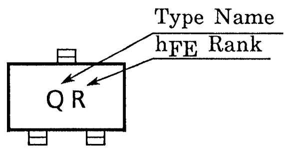
FEATURES :

- Small Reverse Transfer Capacitance: C_{re} = 0.7pF (Typ.)
- Low Noise Figure : NF = 2.5dB (Typ.) (f = 100MHz)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	40	V
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Base Voltage	V_{EBO}	4	V
Collector Current	I_C	20	mA
Emitter Current	I_E	−20	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Marking

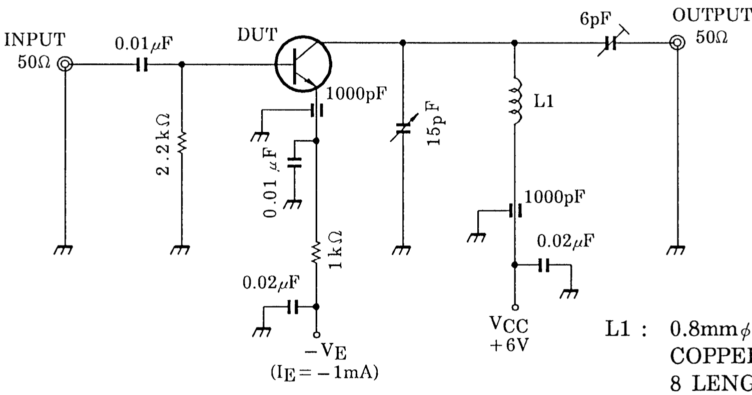


ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB}=18V, I_E=0	—	—	0.5	μA
Emitter Cut-off Current	I_{EBO}	V_{EB}=4V, I_C=0	—	—	0.5	μA
DC Current Gain	h_{FE} (Note)	V_{CE}=6V, I_C=1mA	40	—	200	
Reverse Transfer Capacitance	C_{re}	V_{CB}=6V, f=1MHz	—	0.7	—	pF
Transition Frequency	f_T	V_{CE}=6V, I_C=1mA	—	550	—	MHz
Collector-Base Time Constant	C_c . rbb'	V_{CB}=6V, I_E=−1mA, f=30MHz	—	—	30	ps
Noise Figure	NF	V_{CE}=6V, I_E=−1mA	—	2.5	5.0	dB
Power Gain	G_{pe}	f=100MHz, Fig.	17	23	—	dB

Note : h_{FE} Classification R : 40~80, O : 70~140, Y : 100~200

Fig. NF, G_{pe} TEST CIRCUIT



L1 : 0.8mmφ SILVER PLATED COPPER WIRE, 4T, 10ID, 8 LENGTH

y PARAMETER (Typ.)

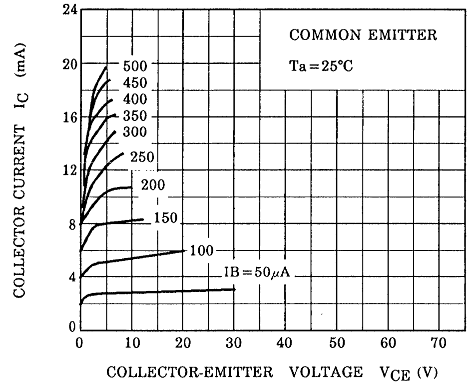
(1) COMMON EMITTER (V_{CE} = 6V, I_E = −1mA, f = 100MHz)

CHARACTERISTIC	SYMBOL	TYP.	UNIT
Input Conductance	g_{ie}	2.9	mS
Input Capacitance	C_{ie}	10.2	pF
Reverse Transfer Admittance	$\lvert y_{re}\rvert$	0.33	mS
Phase Angle of Reverse Transfer Adimttance	θ_{re}	−90	°
Forward Transfer Admittance	$\lvert y_{fe}\rvert$	40	mS
Phase Angle of Forward Transfer Admittance	θ_{fe}	−20	°
Output Conductance	g_{oe}	45	μS
Output Capacitance	C_{oe}	1.1	pF

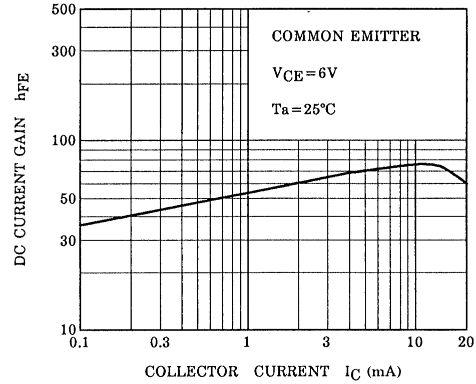
(2) COMMON BASE (V_{CE} = 6V, I_E = −1mA, f = 100MHz)

CHARACTERISTIC	SYMBOL	TYP.	UNIT
Input Conductance	g_{ib}	34	mS
Input Capacitance	C_{ib}	−10	pF
Reverse Transfer Admittance	$\lvert y_{rb}\rvert$	0.27	mS
Phase Angle of Reverse Transfer Adimttance	θ_{rb}	−105	°
Forward Transfer Admittance	$\lvert y_{fb}\rvert$	34	mS
Phase Angle of Forward Transfer Admittance	θ_{fb}	165	°
Output Conductance	g_{ob}	45	μS
Output Capacitance	C_{ob}	1.1	pF

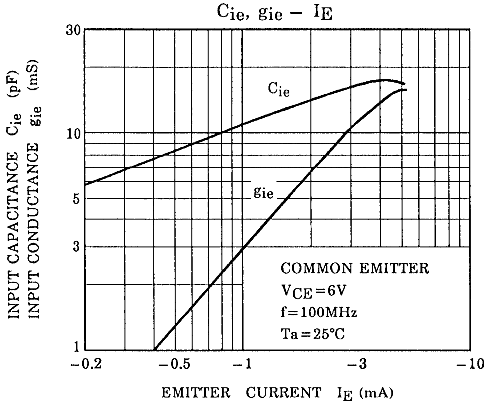
$I_C - V_{CE}$



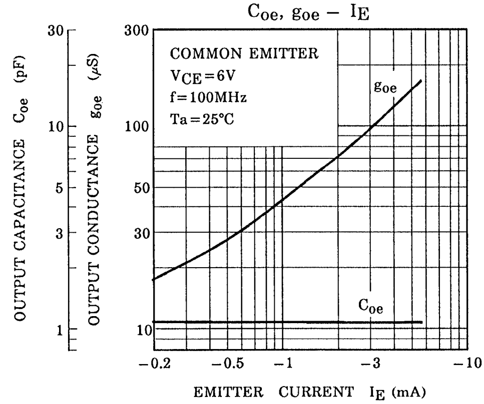
$h_{FE} - I_C$



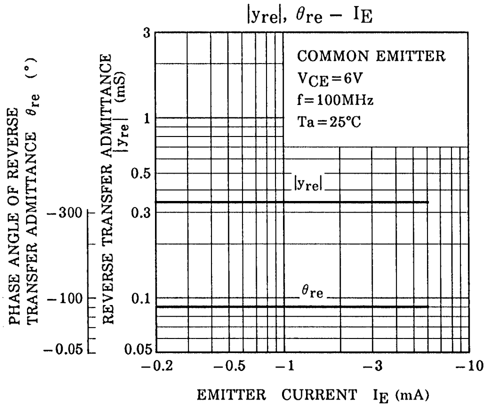
$C_{ie}, g_{ie} - I_E$



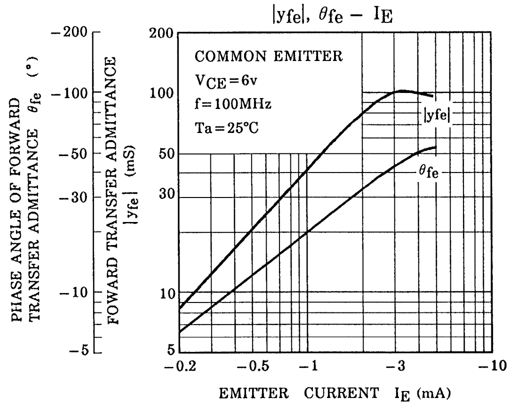
$C_{oe}, g_{oe} - I_E$



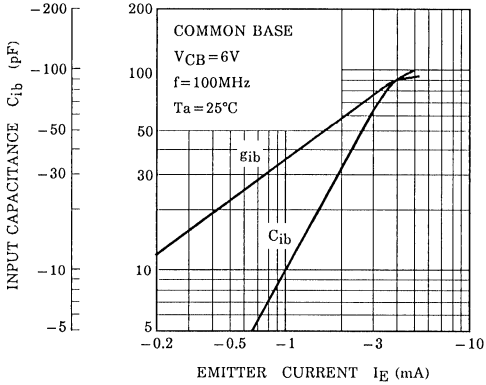
$|y_{re}|, \theta_{re} - I_E$



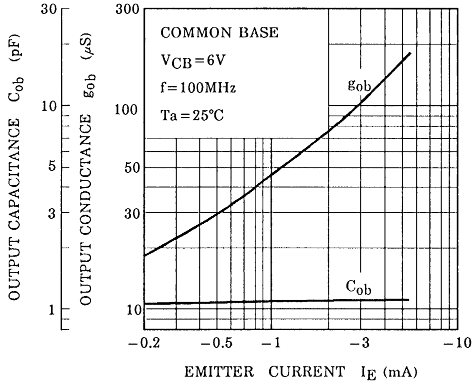
$|y_{fe}|, \theta_{fe} - I_E$



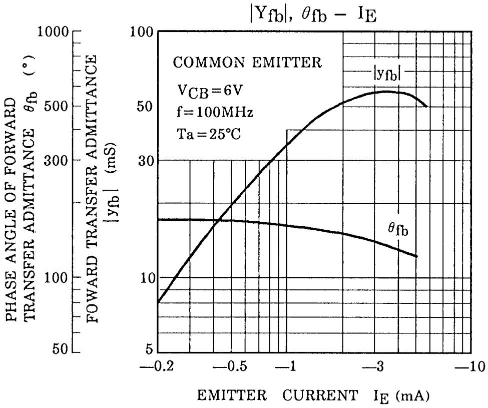
C_{ib}, g_{ib} – I_E



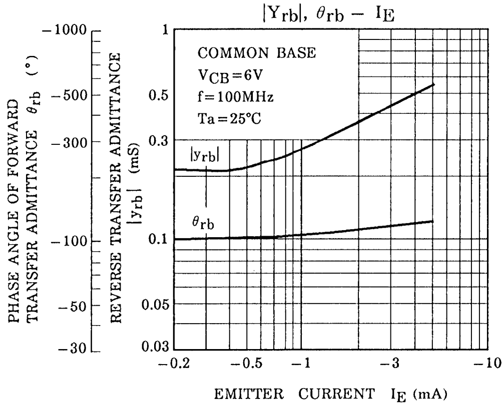
C_{ob}, g_{ob} – I_E



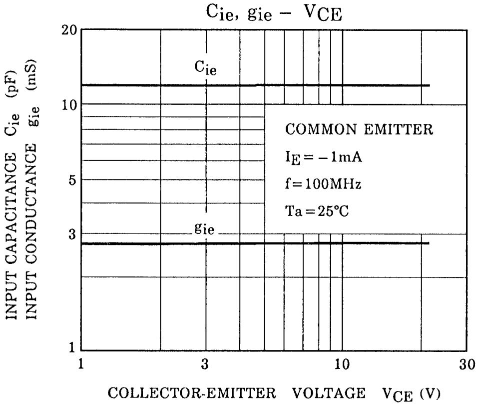
$|Y_{fb}|$, θ_{fb} – I_E



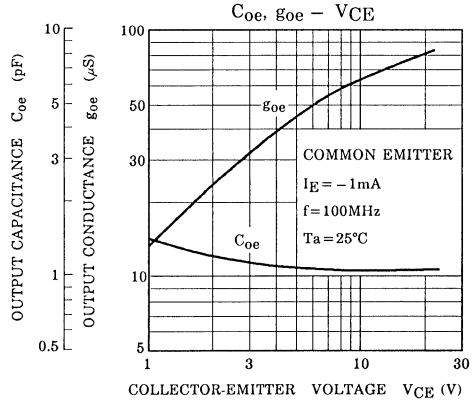
$|Y_{rb}|$, θ_{rb} – I_E

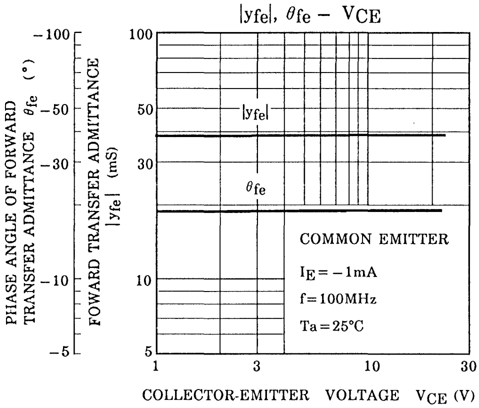


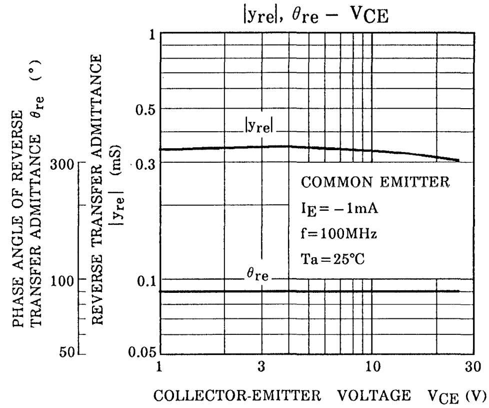
C_{ie}, g_{ie} – V_{CE}

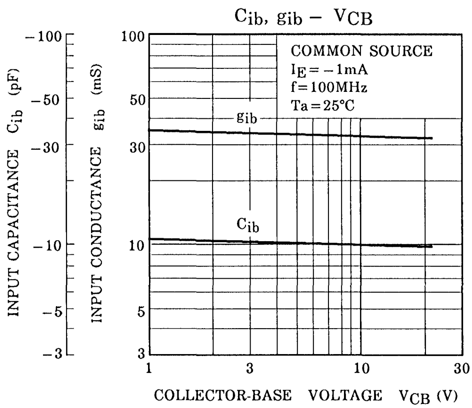


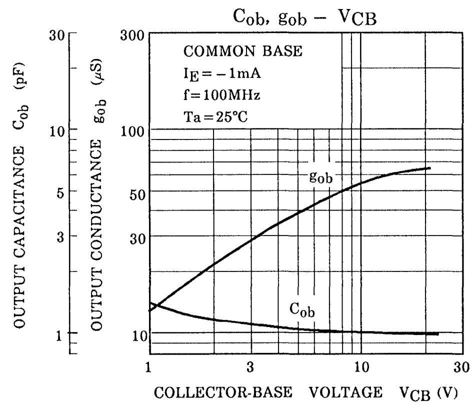
C_{oe}, g_{oe} – V_{CE}

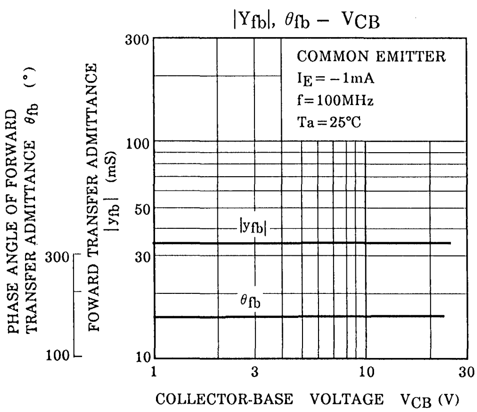


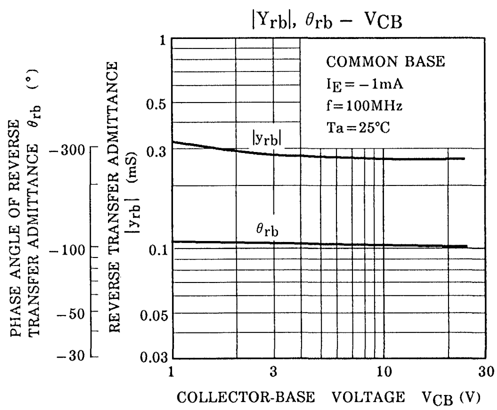

|yfe|, θfe – VCE
PHASE ANGLE OF FORWARD TRANSFER ADMITTANCE θfe (°)
FOWARD TRANSFER ADMITTANCE |yfe| (mS)
|yfe|
θfe
COMMON EMITTER
IE = –1mA
f = 100MHz
Ta = 25°C
COLLECTOR-EMITTER VOLTAGE VCE (V)


|yre|, θre – VCE
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE θre (°)
REVERSE TRANSFER ADMITTANCE |yre| (mS)
|yre|
θre
COMMON EMITTER
IE = –1mA
f = 100MHz
Ta = 25°C
COLLECTOR-EMITTER VOLTAGE VCE (V)

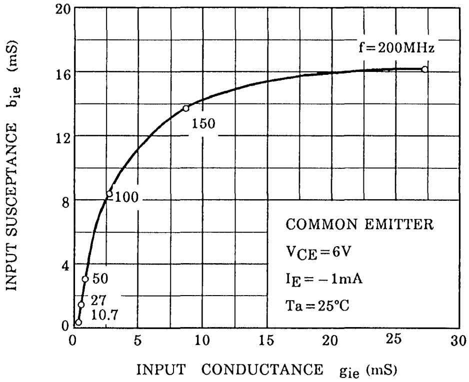

Cib, gib – VCB
INPUT CAPACITANCE Cib (pF)
INPUT CONDUCTANCE gib (mS)
COMMON SOURCE
IE = –1mA
f = 100MHz
Ta = 25°C
gib
Cib
COLLECTOR-BASE VOLTAGE VCB (V)


Cob, gob – VCB
OUTPUT CAPACITANCE Cob (pF)
OUTPUT CONDUCTANCE gob (μS)
COMMON BASE
IE = –1mA
f = 100MHz
Ta = 25°C
gob
Cob
COLLECTOR-BASE VOLTAGE VCB (V)

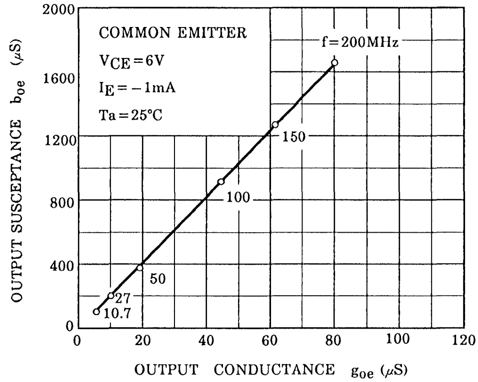

|Yfb|, θfb – VCB
PHASE ANGLE OF FORWARD TRANSFER ADMITTANCE θfb (°)
FOWARD TRANSFER ADMITTANCE |yfb| (mS)
COMMON EMITTER
IE = –1mA
f = 100MHz
Ta = 25°C
|yfb|
θfb
COLLECTOR-BASE VOLTAGE VCB (V)


|Yrb|, θrb – VCB
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE θrb (°)
REVERSE TRANSFER ADMITTANCE |yrb| (mS)
COMMON BASE
IE = –1mA
f = 100MHz
Ta = 25°C
|yrb|
θrb
COLLECTOR-BASE VOLTAGE VCB (V)

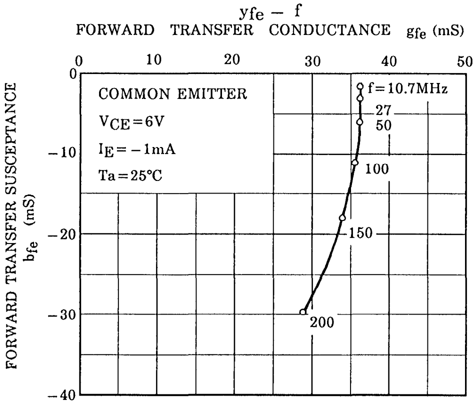
$y_{ie} - f$



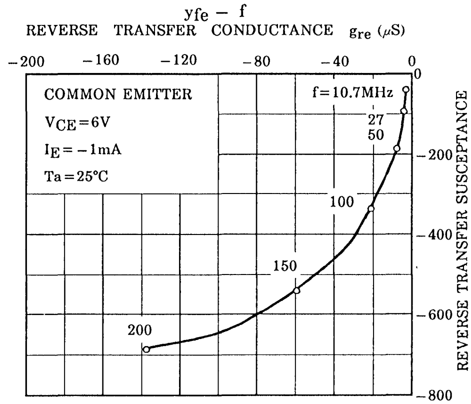
$y_{oe} - f$



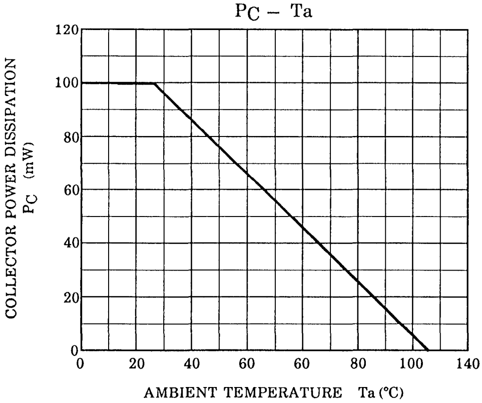
$y_{fe} - f$



$y_{fe} - f$



$P_C - Ta$



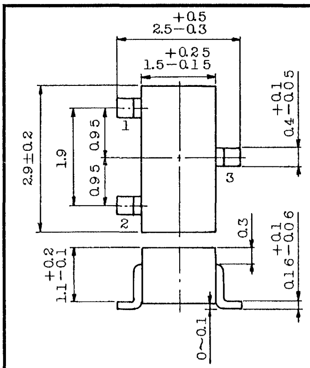
2SC2715 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

HIGH FREQUENCY AMPLIFIER APPLICATIONS.

FEATURES :

- High Power Gain : Gpe = 2dB (Typ.) (f = 10.7MHz)
- Recommended for FM IF, OSC Stage and AM CONV. IF Stage.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

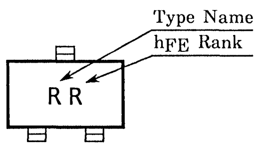
JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	35	V
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Base Voltage	V_{EBO}	4	V
Collector Current	I_C	50	mA
Base Current	I_B	10	mA
Collector Power Dissipation	P_C	150	wA
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Marking



ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=35V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=4V$, $I_C=0$	—	—	1.0	μA
DC Current Gain	h_{FE} (Note)	$V_{CE}=12V$, $I_C=2mA$	40	—	240	
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=10mA$, $I_B=1mA$	—	—	0.4	V
Base-Emitter Voltage	V_{BE}	$I_C=10mA$, $I_B=1mA$	—	—	1.0	V
Transition Frequency	f_T	$V_{CE}=10V$, $I_C=1mA$	100	—	400	MHz
Collector Output Capacitance	C_{ob}	$V_{CB}=10V$, $I_E=0$, $f=1MHz$	—	2.0	3.2	pF
Collector-Base Time Constant	$C_c \cdot r_{bb'}$	$V_{CE}=10V$, $I_E=-1mA$, $f=30MHz$	—	—	50	ps
Power Gain	G_{pe}	$V_{CC}=6V$, $I_E=-1mA$, $f=10.7MHz$ (Fig)	27	30	33	dB

Note : h_{FE} Classification R : 40~80, O : 70~140, Y : 120~240

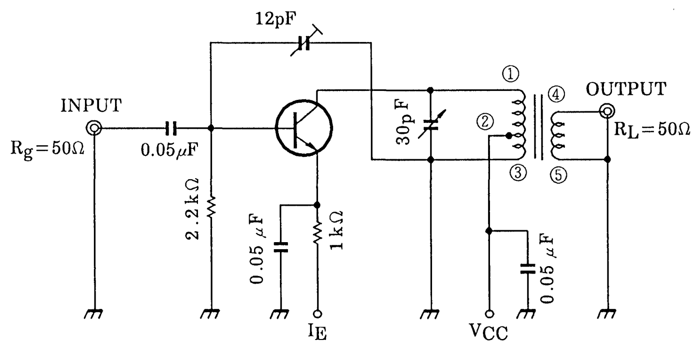
y PARAMETER (Typ.)
(1) (COMMON EMITTER f = 455MHz, Ta = 25°C)

CHARACTERISTIC	SYMBOL	2SC2715-R	2SC2715-O	2SC2715-Y	UNIT
Collector-Emitter Voltage	V_{CE}	6	6	6	V
Emitter Current	I_E	−1	−1	−1	mA
Input Conductance	g_{ie}	0.58	0.41	0.26	mS
Input Capacitance	C_{ie}	53	46	38	pF
Output Conductance	g_{oe}	1.9	2.7	4.8	μS
Output Capacitance	C_{oe}	2.6	2.8	3.6	pF
Forward Transfer Admittance	$\lvert y_{fe} \rvert$	38	38	38	mS
Phase Angle of Forward Transfer Admittance	θ_{fe}	−0.79	−0.83	−0.92	°
Reverse Transfer Admittance	$\lvert y_{re} \rvert$	5.7	5.7	6.2	μS
Phase Angle of Reverse Transfer Admittance	θ_{re}	−90	−90	−90	°

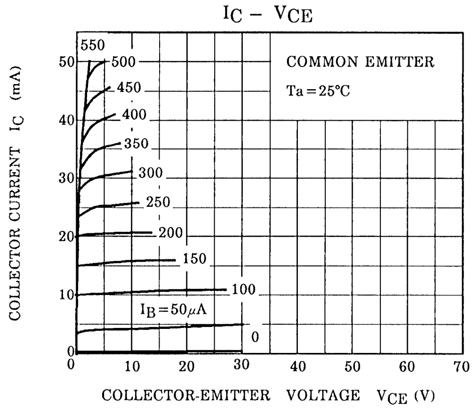
(2) (COMMON EMITTER f = 10.7MHz, Ta = 25°C)

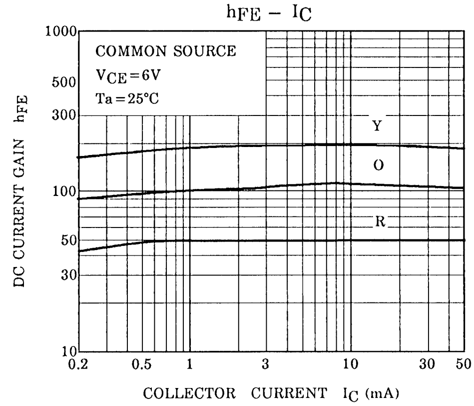
CHARACTERISTIC	SYMBOL	2SC2715 – R	2SC2715 – O	2SC2715 – Y	UNIT
Collector Emitter Voltage	V_{CE}	6	6	6	V
Emitter Current	I_E	–1	–1	–1	mA
Input Conductance	g_{ie}	1.04	0.85	0.65	mS
Input Capacitance	C_{ie}	49	43	36	pF
Output Conductance	g_{oe}	10	15	28	μS
Output Capacitance	C_{oe}	2.7	2.9	3.6	pF
Forward Transfer Admittance	$\|y_{fe}\|$	37	37	37	mS
Phase Angle of Forward Transfer Admittance	θ_{fe}	–9.6	–10.4	–11.5	°
Reverse Transfer Admittance	$\|y_{re}\|$	120	120	140	μS
Phase Angle of Reverse Transfer Admittance	θ_{re}	–90	–90	–90	°

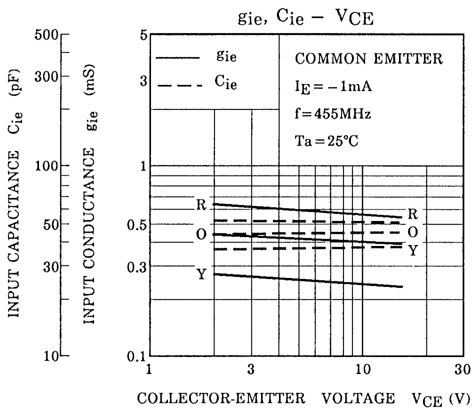
Fig. NF, Gpe TEST CIRCUIT

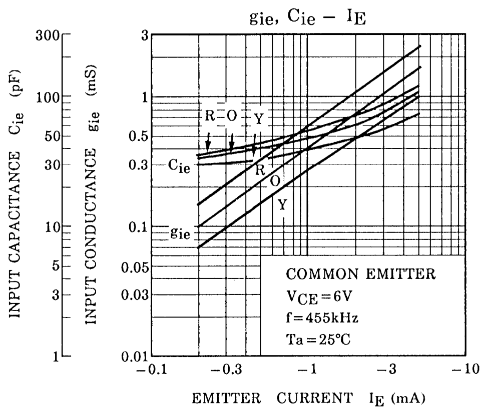


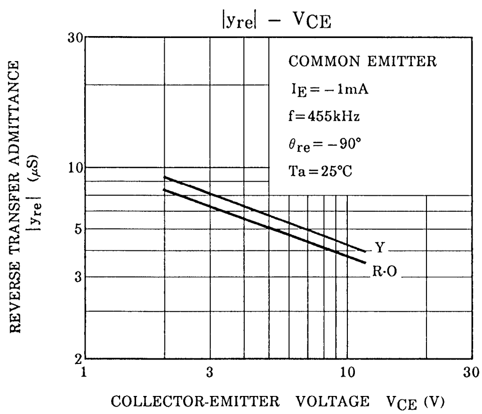
T : ① – ② 0.1mmφ UEW 20T
② – ③ 0.1mmφ UEW 8T
④ – ⑤ 0.1mmφ UEW 2T

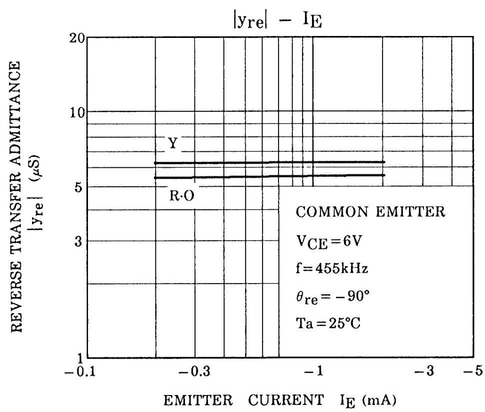

IC – VCE
COMMON EMITTER
Ta=25°C
550
500
450
400
350
300
250
200
150
100
IB=50μA
0
COLLECTOR CURRENT IC (mA)
COLLECTOR-EMITTER VOLTAGE VCE (V)

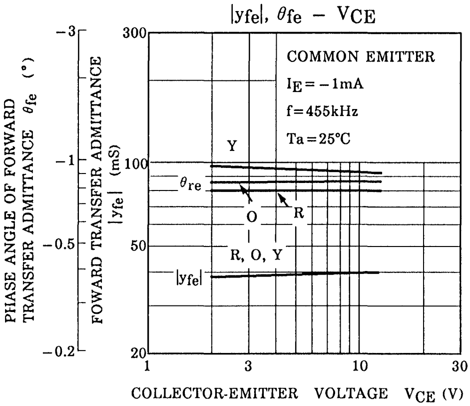

hFE – IC
COMMON SOURCE
VCE=6V
Ta=25°C
Y
O
R
DC CURRENT GAIN hFE
COLLECTOR CURRENT IC (mA)

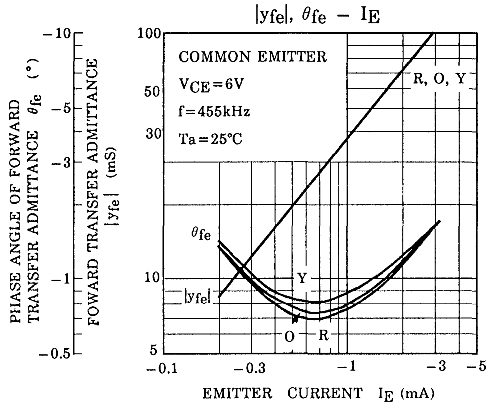

gie, Cie – VCE
gie
Cie
COMMON EMITTER
IE=–1mA
f=455MHz
Ta=25°C
R
O
Y
INPUT CAPACITANCE Cie (pF)
INPUT CONDUCTANCE gie (mS)
COLLECTOR-EMITTER VOLTAGE VCE (V)

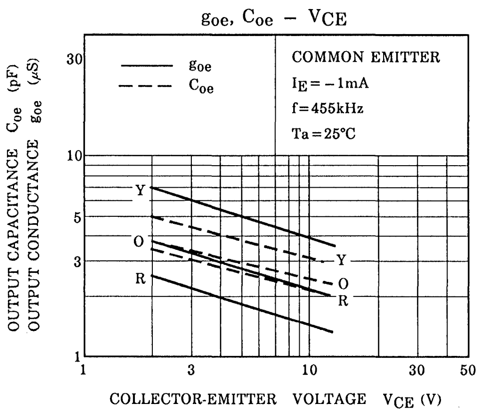

gie, Cie – IE
R O Y
Cie
gie
COMMON EMITTER
VCE=6V
f=455kHz
Ta=25°C
INPUT CAPACITANCE Cie (pF)
INPUT CONDUCTANCE gie (mS)
EMITTER CURRENT IE (mA)

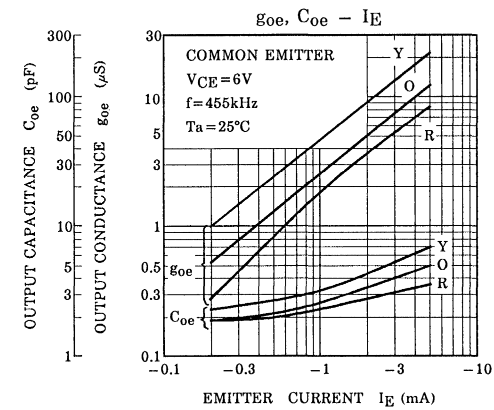

|yre| – VCE
COMMON EMITTER
IE=–1mA
f=455kHz
θre=–90°
Ta=25°C
Y
R·O
REVERSE TRANSFER ADMITTANCE |yre| (μS)
COLLECTOR-EMITTER VOLTAGE VCE (V)

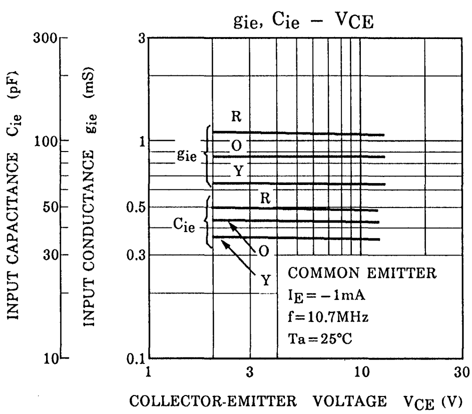

|yre| – IE
Y
R·O
COMMON EMITTER
VCE=6V
f=455kHz
θre=–90°
Ta=25°C
REVERSE TRANSFER ADMITTANCE |yre| (μS)
EMITTER CURRENT IE (mA)

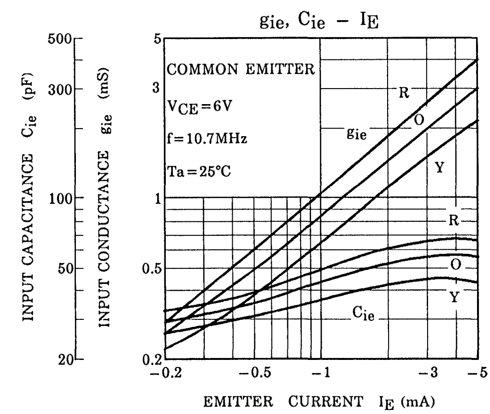

|yfe|, θfe – VCE
COMMON EMITTER
IE = –1mA
f = 455kHz
Ta = 25°C
PHASE ANGLE OF FORWARD TRANSFER ADMITTANCE θfe (°)
FOWARD TRANSFER ADMITTANCE |yfe| (mS)
COLLECTOR-EMITTER VOLTAGE VCE (V)

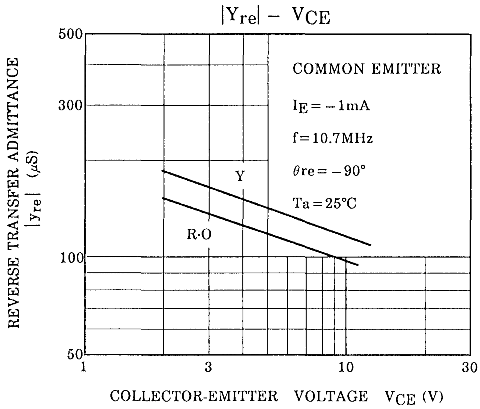

|yfe|, θfe – IE
COMMON EMITTER
VCE = 6V
f = 455kHz
Ta = 25°C
PHASE ANGLE OF FORWARD TRANSFER ADMITTANCE θfe (°)
FOWARD TRANSFER ADMITTANCE |yfe| (mS)
EMITTER CURRENT IE (mA)

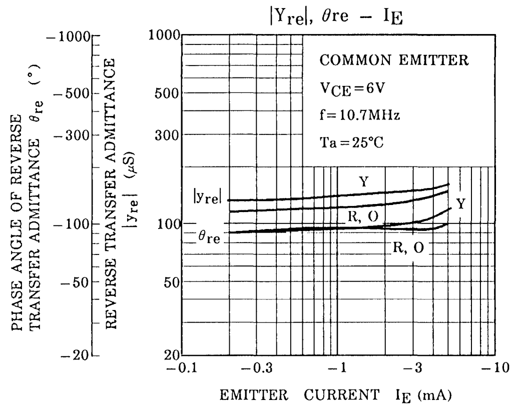

goe, Coe – VCE
COMMON EMITTER
IE = –1mA
f = 455kHz
Ta = 25°C
OUTPUT CAPACITANCE Coe (pF)
OUTPUT CONDUCTANCE goe (μS)
COLLECTOR-EMITTER VOLTAGE VCE (V)

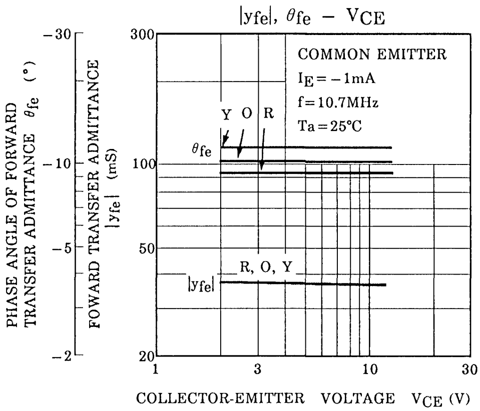

goe, Coe – IE
COMMON EMITTER
VCE = 6V
f = 455kHz
Ta = 25°C
OUTPUT CAPACITANCE Coe (pF)
OUTPUT CONDUCTANCE goe (μS)
EMITTER CURRENT IE (mA)

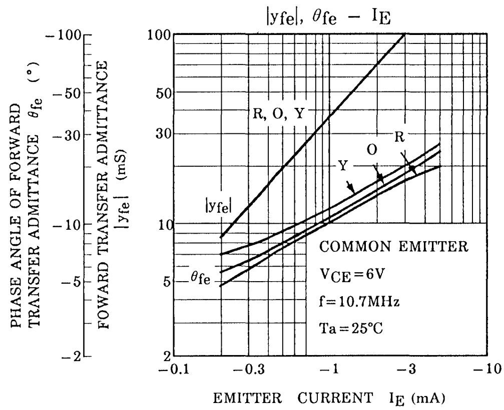

gie, Cie – VCE
COMMON EMITTER
IE = –1mA
f = 10.7MHz
Ta = 25°C
INPUT CAPACITANCE Cie (pF)
INPUT CONDUCTANCE gie (mS)
COLLECTOR-EMITTER VOLTAGE VCE (V)

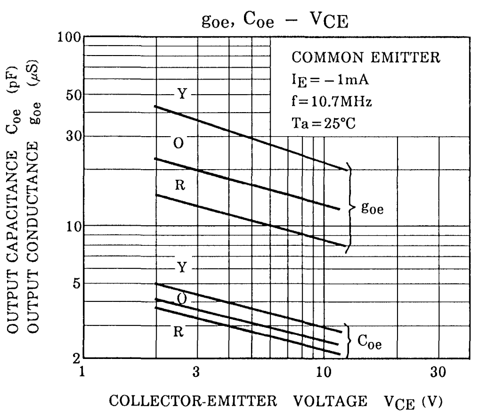

gie, Cie – IE
COMMON EMITTER
VCE = 6V
f = 10.7MHz
Ta = 25°C
INPUT CAPACITANCE Cie (pF)
INPUT CONDUCTANCE gie (mS)
EMITTER CURRENT IE (mA)

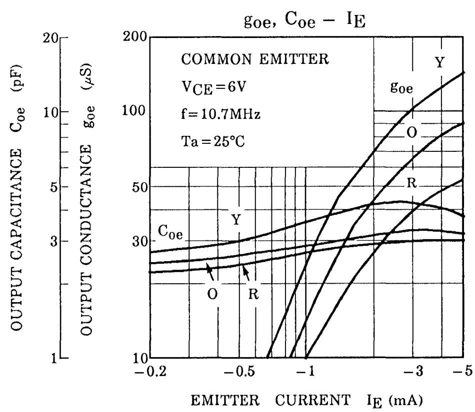

|Yre| – VCE
COMMON EMITTER
IE = –1mA
f = 10.7MHz
θre = –90°
Ta = 25°C
Y
R·O
REVERSE TRANSFER ADMITTANCE |yre| (μS)
500
300
100
50
1
3
10
30
COLLECTOR-EMITTER VOLTAGE VCE (V)

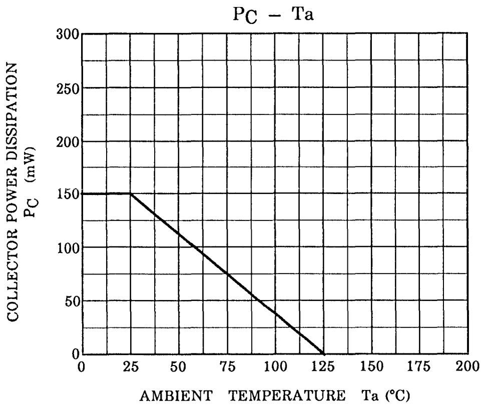

|Yre|, θre – IE
COMMON EMITTER
VCE = 6V
f = 10.7MHz
Ta = 25°C
|yre|
θre
Y
R, O
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE θre (°)
REVERSE TRANSFER ADMITTANCE |yre| (μS)
–1000
–500
–300
–100
–50
–20
1000
500
300
100
50
20
–0.1
–0.3
–1
–3
–10
EMITTER CURRENT IE (mA)


|yfe|, θfe – VCE
COMMON EMITTER
IE = –1mA
f = 10.7MHz
Ta = 25°C
Y O R
θfe
|yfe|
R, O, Y
PHASE ANGLE OF FORWARD TRANSFER ADMITTANCE θfe (°)
FOWARD TRANSFER ADMITTANCE |yfe| (mS)
–30
–10
–5
–2
300
100
50
20
1
3
10
30
COLLECTOR-EMITTER VOLTAGE VCE (V)


|yfe|, θfe – IE
COMMON EMITTER
VCE = 6V
f = 10.7MHz
Ta = 25°C
R, O, Y
|yfe|
θfe
R
O
Y
PHASE ANGLE OF FORWARD TRANSFER ADMITTANCE θfe (°)
FOWARD TRANSFER ADMITTANCE |yfe| (mS)
–100
–50
–30
–10
–5
–2
100
50
30
10
5
2
–0.1
–0.3
–1
–3
–10
EMITTER CURRENT IE (mA)


goe, Coe – VCE
COMMON EMITTER
IE = –1mA
f = 10.7MHz
Ta = 25°C
Y
O
R
goe
Coe
OUTPUT CAPACITANCE Coe (pF)
OUTPUT CONDUCTANCE goe (μS)
100
50
30
10
5
2
1
3
10
30
COLLECTOR-EMITTER VOLTAGE VCE (V)

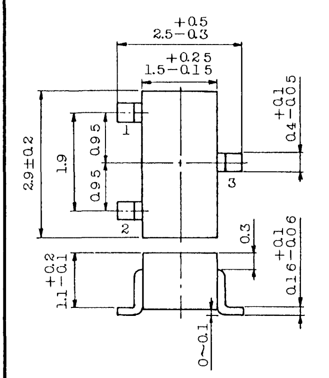

goe, Coe – IE
COMMON EMITTER
VCE = 6V
f = 10.7MHz
Ta = 25°C
goe
Y
O
R
Coe
OUTPUT CAPACITANCE Coe (pF)
OUTPUT CONDUCTANCE goe (μS)
20
10
5
3
1
200
100
50
30
10
–0.2
–0.5
–1
–3
–5
EMITTER CURRENT IE (mA)


PC – Ta
COLLECTOR POWER DISSIPATION PC (mW)
300
250
200
150
100
50
0
0 25 50 75 100 125 150 175 200
AMBIENT TEMPERATURE Ta (°C)

2SC2716

HIGH FREQUENCY AMPLIFIER APPLICATIONS.
AM HIGH FREQUENCY AMPLIFIER APPLICATIONS.
AM FREQUENCY CONVERTER APPLICATIOS.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

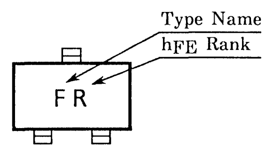
FEATURES :

- Low Noise Figure : NF = 3.5dB (Max.) (f = 1MHz)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	35	V
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Base Voltage	V_{EBO}	4	V
Collector Current	I_C	100	mA
Emitter Current	I_E	−100	mA
Collector Power Dissipation	P_C	150	wW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Marking



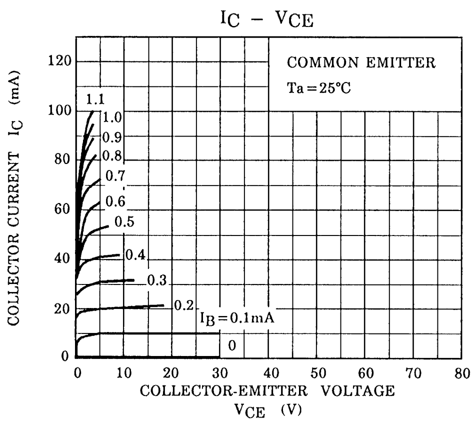
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

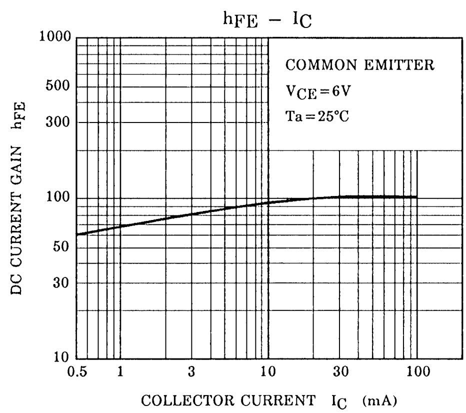
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=20V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=2V$, $I_C=0$	—	—	1.0	μA
DC Current Gain	h_{FE} (Note)	$V_{CE}=12V$, $I_C=2mA$	40	—	240	
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$	$I_C=10mA$, $I_B=1mA$	—	—	0.4	V
Base-Emitter Saturation Voltage	$V_{BE}(sat)$	$I_C=10mA$, $I_B=1mA$	—	—	1.0	V
Transition Frequency	f_T	$V_{CE}=10V$, $I_C=2mA$	80	120	—	MHz
Reverse Transfer Capacitance	C_{re}	$V_{CB}=10V$, $I_E=0$, $f=1MHz$	—	2.2	3.0	pF
Collector-Base Time Constant	$C_{c} \cdot r_{bb'}$	$V_{CE}=10V$, $I_E=-1mA$, $f=30MHz$	—	30	50	ps
Noise Figure	NF	$V_{CE}=10V$, $I_E=-1mA$, $f=1MHz$, $Rg=50\Omega$	—	2.0	3.5	dB

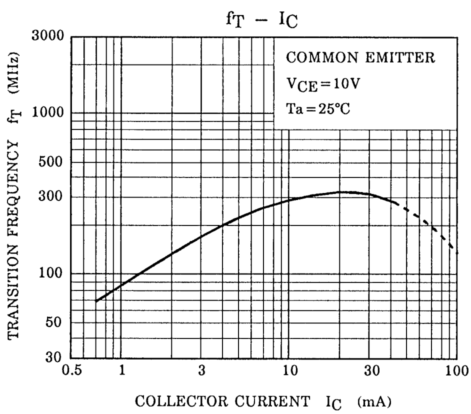
Note : h_{FE} Classification R : 40~80, O : 70~140, Y : 120~240

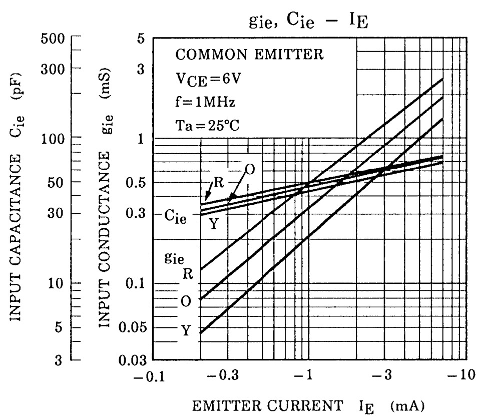
y PARAMETER (Typ.) (COMMON EMITTER VCE = 6V, IE = – 1mA, f = 1MHz)

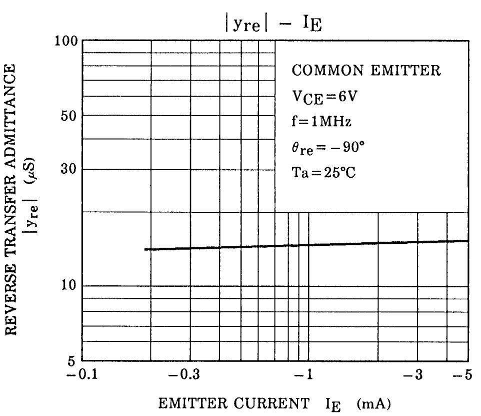
CHARACTERISTIC	SYMBOL	2SC2716–R	2SC2716–O	2SC2716–Y	UNIT
Input Conductance	g_{ie}	0.5	0.35	0.22	mS
Input Capacitance	C_{ie}	50	48	46	pF
Output Conductance	g_{oe}	4	5	6.5	μS
Output Capacitance	C_{oe}	3.7	3.4	3.2	pF
Forward Transfer Admittance	$\lvert y_{fe}\rvert$	36	36	36	mS
Phase Angle of Forward Transfer Admittance	θ_{fe}	−1.6	−1.6	−1.6	°
Reverse Transfer Admittance	$\lvert y_{re}\rvert$	14	14	14	μS
Phase Angle of Reverse Transfer Admittance	θ_{re}	−90	−90	−90	°

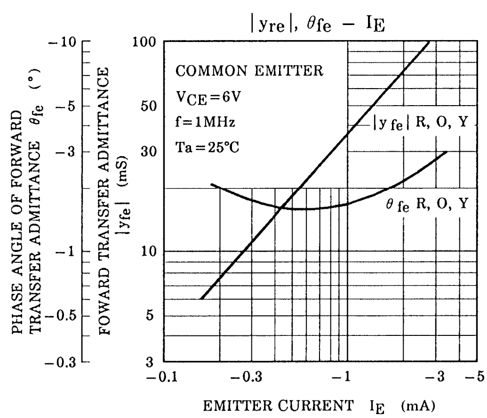

IC − VCE
COMMON EMITTER
Ta=25°C
COLLECTOR CURRENT IC (mA)
IB=0.1mA
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0
COLLECTOR-EMITTER VOLTAGE
VCE (V)

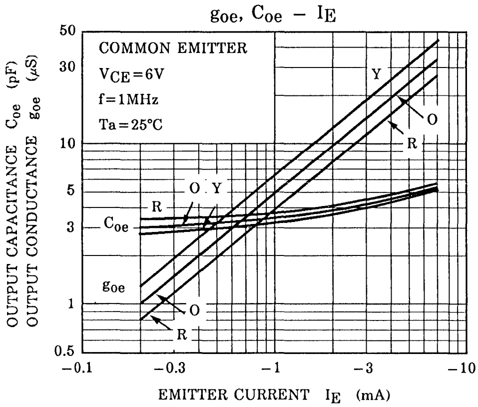

hFE − IC
COMMON EMITTER
VCE=6V
Ta=25°C
DC CURRENT GAIN hFE
COLLECTOR CURRENT IC (mA)

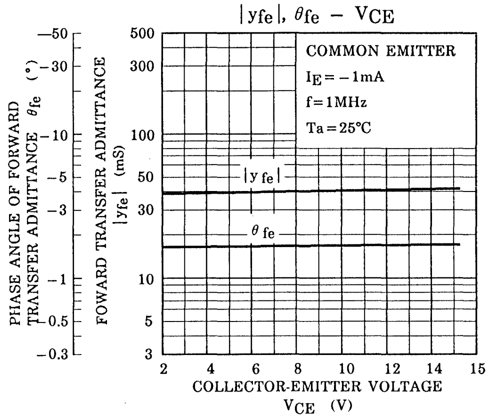

fT − IC
COMMON EMITTER
VCE=10V
Ta=25°C
TRANSITION FREQUENCY fT (MHz)
COLLECTOR CURRENT IC (mA)

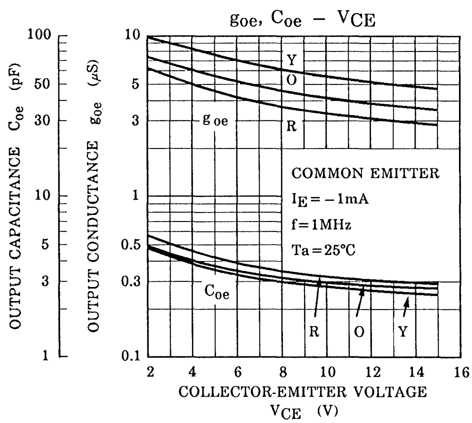

gie, Cie − IE
COMMON EMITTER
VCE=6V
f=1MHz
Ta=25°C
INPUT CAPACITANCE Cie (pF)
INPUT CONDUCTANCE gie (mS)
Cie
R
O
Y
gie
R
O
Y
EMITTER CURRENT IE (mA)

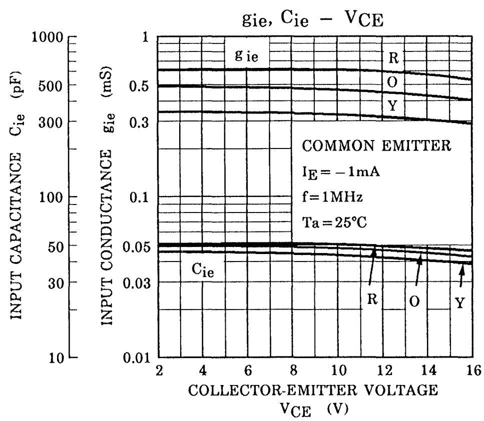

|yre| − IE
COMMON EMITTER
VCE=6V
f=1MHz
θre=−90°
Ta=25°C
REVERSE TRANSFER ADMITTANCE
|yre| (μS)
EMITTER CURRENT IE (mA)

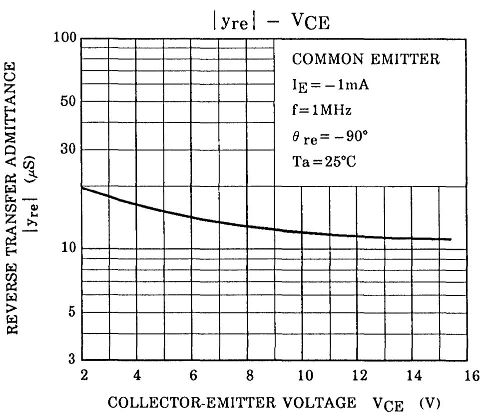

|yre|, θfe − IE
COMMON EMITTER
VCE=6V
f=1MHz
Ta=25°C
PHASE ANGLE OF FORWARD TRANSFER ADMITTANCE θfe (°)
FOWARD TRANSFER ADMITTANCE |yfe| (mS)
|y fe| R, O, Y
θ fe R, O, Y
EMITTER CURRENT IE (mA)


goe, Coe – IE
COMMON EMITTER
VCE=6V
f=1MHz
Ta=25°C
OUTPUT CAPACITANCE Coe (pF)
OUTPUT CONDUCTANCE goe (μS)
EMITTER CURRENT IE (mA)
Y
O
R
Coe
goe
50
30
10
5
3
1
0.5
−0.1
−0.3
−1
−3
−10


|yfe|, θfe – VCE
COMMON EMITTER
IE=−1mA
f=1MHz
Ta=25°C
PHASE ANGLE OF FORWARD TRANSFER ADMITTANCE θfe (°)
FOWARD TRANSFER ADMITTANCE |yfe| (mS)
COLLECTOR-EMITTER VOLTAGE VCE (V)
|yfe|
θfe
−50
−30
−10
−5
−3
−1
−0.5
−0.3
500
300
100
50
30
10
5
3
2
4
6
8
10
12
14
15


goe, Coe – VCE
COMMON EMITTER
IE=−1mA
f=1MHz
Ta=25°C
OUTPUT CAPACITANCE Coe (pF)
OUTPUT CONDUCTANCE goe (μS)
COLLECTOR-EMITTER VOLTAGE VCE (V)
Y
O
R
goe
Coe
100
50
30
10
5
3
1
0.5
0.3
0.1
2
4
6
8
10
12
14
16


gie, Cie – VCE
COMMON EMITTER
IE=−1mA
f=1MHz
Ta=25°C
INPUT CAPACITANCE Cie (pF)
INPUT CONDUCTANCE gie (mS)
COLLECTOR-EMITTER VOLTAGE VCE (V)
gie
Cie
R
O
Y
1000
500
300
100
50
30
10
1
0.5
0.3
0.1
0.05
0.03
0.01
2
4
6
8
10
12
14
16

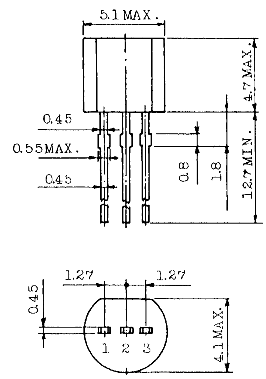

|yre| – VCE
COMMON EMITTER
IE=−1mA
f=1MHz
θre=−90°
Ta=25°C
REVERSE TRANSFER ADMITTANCE |yre| (μS)
COLLECTOR-EMITTER VOLTAGE VCE (V)
100
50
30
10
5
3
2
4
6
8
10
12
14
16

SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC2753

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATION.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	TO-92
EIAJ	SC-43
TOSHIBA	2-5F1E

Weight : 0.21g

- Low Noise Figure, High Gain
- NF = 1.5dB, $|S_{21e}|^2$ = 16dB (f = 500MHz)
- NF = 1.7dB, $|S_{21e}|^2$ = 10.5dB (f = 1GHz)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	17	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	70	mA
Base Current	I_B	30	mA
Collector Power Dissipation	P_C	300	mW
Junction Temperature	T_j	150	°C
Storage Temperature Range	T_{stg}	−55~125	°C

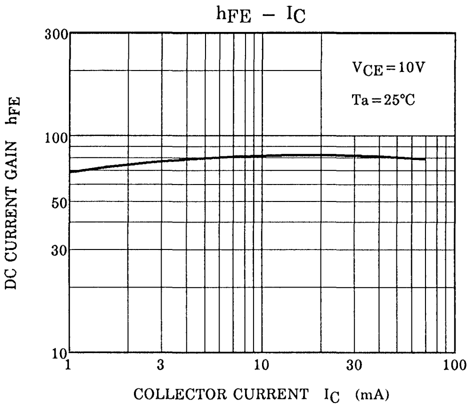
MICROWAVE CHARACTERISTICS (Ta = 25°C)

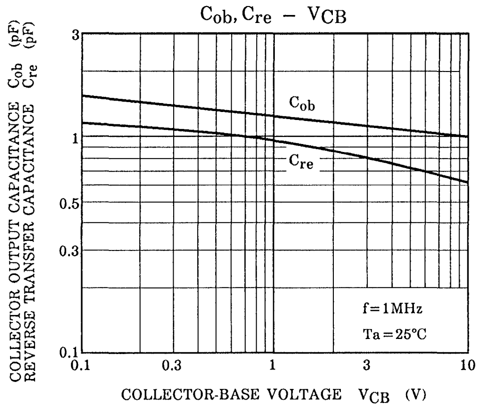
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 10V, I_C = 20mA	—	5	—	GHz
Insertion Gain	$\|S_{21e}\|^2(1)$	V_{CE} = 10V, I_C = 20mA, f = 500MHz	—	16	—	dB
	$\|S_{21e}\|^2(2)$	V_{CE} = 10V, I_C = 20mA, f = 1GHz	—	10.5	—	dB
Noise Figure	NF(1)	V_{CE} = 10V, I_C = 5mA, f = 500MHz	—	1.5	—	dB
	NF(2)	V_{CE} = 10V, I_C = 5mA, f = 1GHz	—	1.7	—	dB

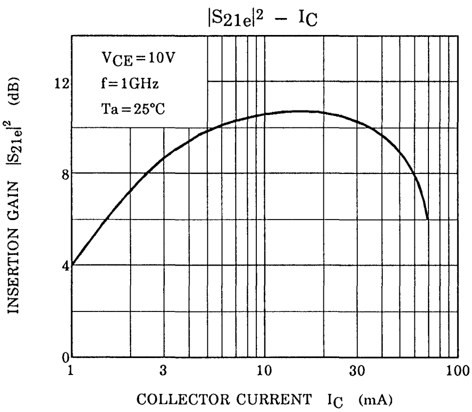
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

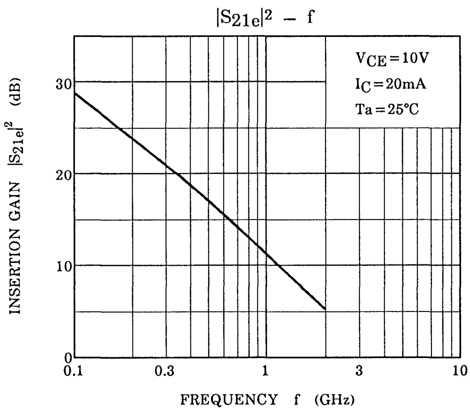
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_E = 0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE} = 10V, I_C = 20mA	30	—	180	—
Collector Output Capacitance	C_{ob}	V_{CB} = 10V, I_E = 0, f = 1MHz (Note)	—	1.1	—	pF
Reverse Transfer Capacitance	C_{re}		—	0.65	—	pF

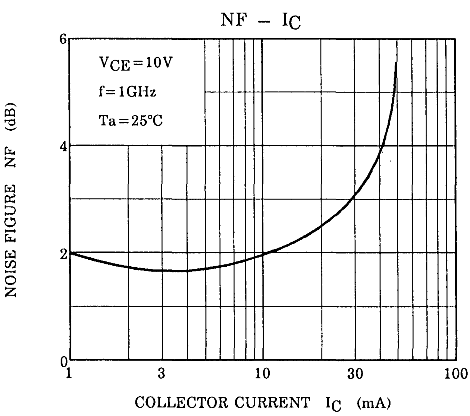
Note: Cre is measured by 3 terminal method with Capacitance Bridge.

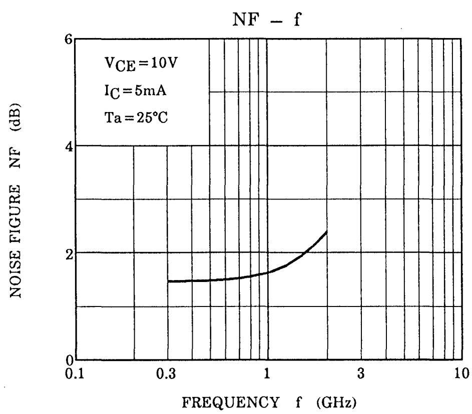

hFE – IC
VCE=10V
Ta=25°C
DC CURRENT GAIN hFE
300
100
50
30
10
1
3
10
30
100
COLLECTOR CURRENT IC (mA)


Cob, Cre – VCB
Cob
Cre
f=1MHz
Ta=25°C
COLLECTOR OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
3
1
0.5
0.3
0.1
0.1
0.3
1
3
10
COLLECTOR-BASE VOLTAGE VCB (V)

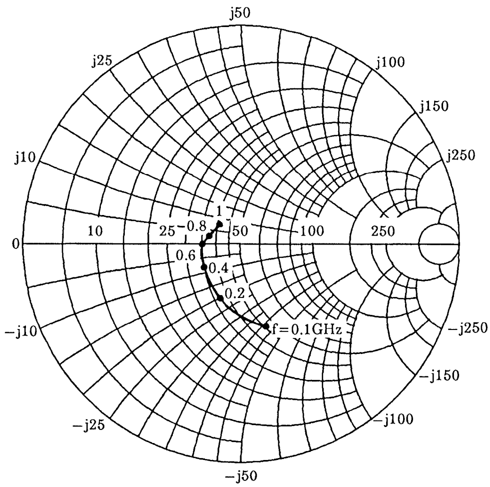

|S21e|2 – IC
VCE=10V
f=1GHz
Ta=25°C
INSERTION GAIN |S21e|2 (dB)
12
8
4
0
1
3
10
30
100
COLLECTOR CURRENT IC (mA)


|S21e|2 – f
VCE=10V
IC=20mA
Ta=25°C
INSERTION GAIN |S21e|2 (dB)
30
20
10
0
0.1
0.3
1
3
10
FREQUENCY f (GHz)

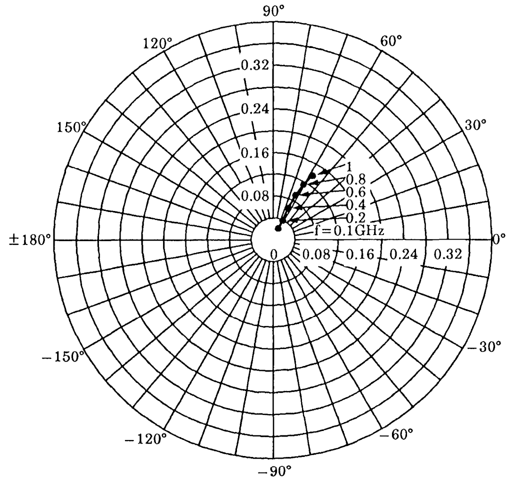

NF – IC
VCE=10V
f=1GHz
Ta=25°C
NOISE FIGURE NF (dB)
6
4
2
0
1
3
10
30
100
COLLECTOR CURRENT IC (mA)


NF – f
VCE=10V
IC=5mA
Ta=25°C
NOISE FIGURE NF (dB)
6
4
2
0
0.1
0.3
1
3
10
FREQUENCY f (GHz)

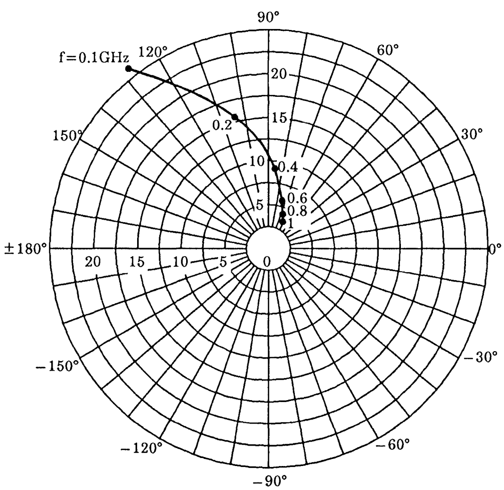
S_{11e}
$V_{CE}=10V$
$I_C=20mA$
Ta=25°C
(UNIT : Ω)



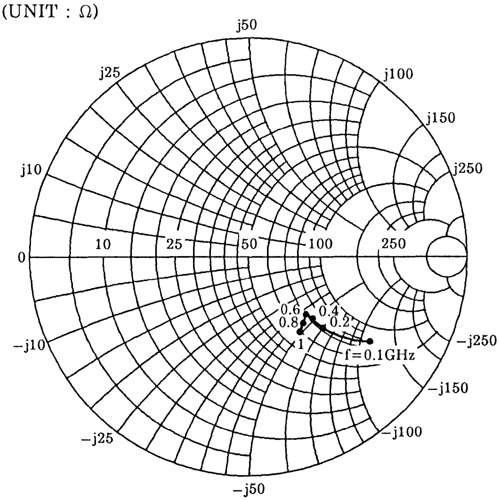
S_{12e}
$V_{CE}=10V$
$I_C=20mA$
Ta=25°C



S_{21e}
$V_{CE}=10V$
$I_C=20mA$
Ta=25°C



S_{22e}
$V_{CE}=10V$
$I_C=20mA$
Ta=25°C
(UNIT : Ω)

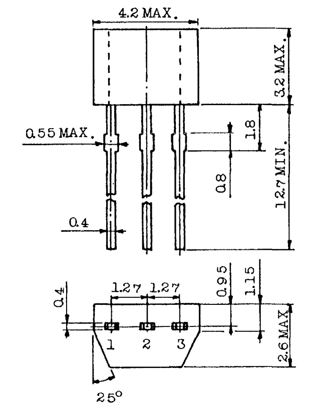


2SC2995 SILICON NPN EPITAXIAL TYPE TRANSISTOR

FM / AM RF, MIX, OSC, IF
HIGH FREQUENCY AMPLIFIER APPLICATIONS.

Unit in mm

- High stability Oscillation Voltage On FM Local Oscillator.
- Recommend FM / AM RF, MIX, OSC and IF.



1. EMITTER
2. COLLECTOR
3. BASE

JEDEC	—
EIAJ	—
TOSHIBA	2-4E1A

Weight : 0.13g

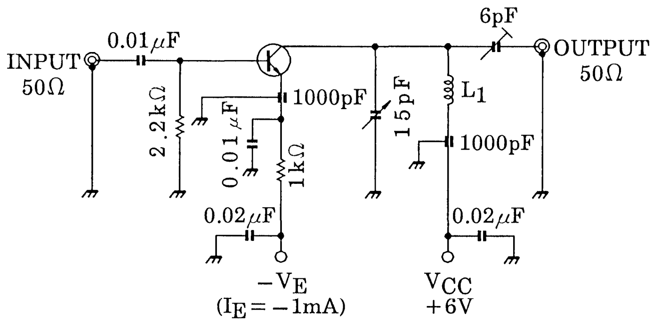
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	40	V
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Base Voltage	V_{EBO}	4	V
Collector Current	I_C	50	mA
Emitter Current	I_E	−50	mA
Collector Power Dissipation	P_C	200	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

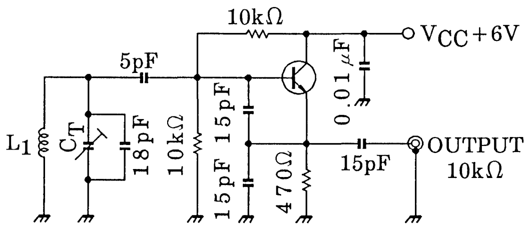
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=40V,\ I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=4V,\ I_C=0$	—	—	0.5	μA
DC Current Gain	h_{FE} (Note)	$V_{CE}=6V,\ I_C=1mA$	40	—	240	—
Reverse Transfer Capacitance	C_{re}	$V_{CE}=6V,\ f=1MHz$	—	0.9	1.3	pF
Transition Frequency	f_T	$V_{CE}=6V,\ I_E=-1mA$	150	350	—	MHz
Collector-Base Time Constant	$C_c \cdot r_{bb'}$	$V_{CE}=6V,\ I_E=-1mA,$ $f=30MHz$	—	15	30	ps
Noise Figure	NF	$V_{CC}=6V,\ I_E=-1mA,$ $f=100MHz$ (Fig.1)	—	4.0	—	dB
Power Gain	G_{pe}		—	15	—	
Oscillation Output Voltage	V_{OSC}	$V_{CC}=6V,\ f=100MHz$ (Fig.2)	—	150	—	mV

Note : h_{FE} Classification R : 40~80 O : 70~140 Y : 120~240



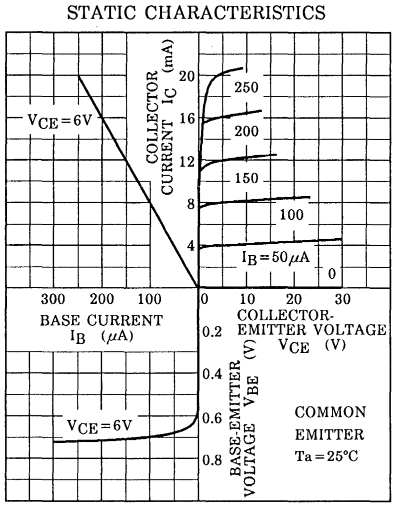
L_1 : 0.8mmϕ SILVER PLATED COPPER WIRE, 4T, 10ID, 8 LENGTH

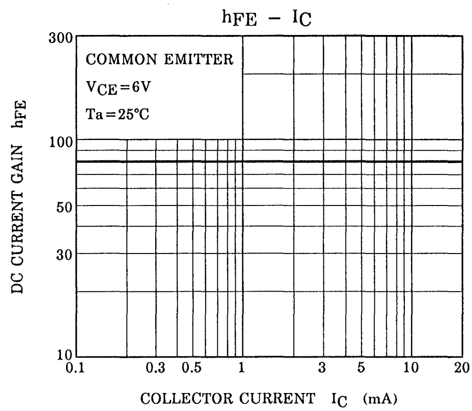
Fig.1 NF, G_{pe} TEST CIRCUIT

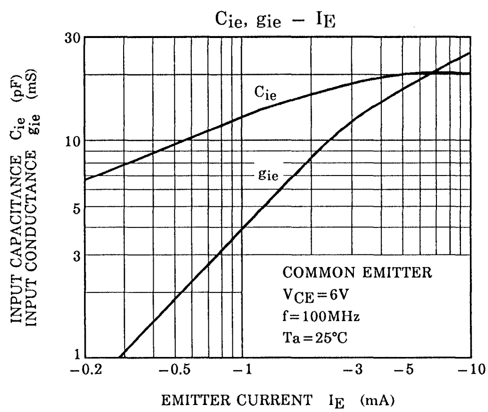


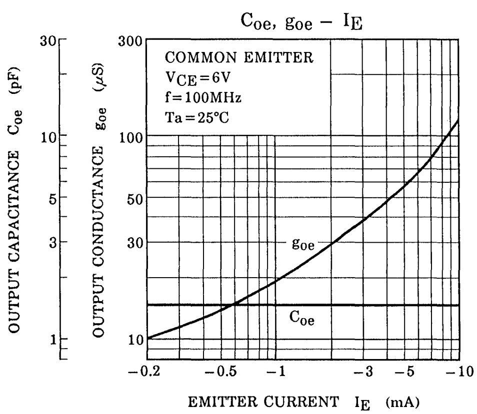
L_1 : 0.8mmϕ SILVER PLATED COPPER WIRE, 4T, 10ID, 8 LENGTH

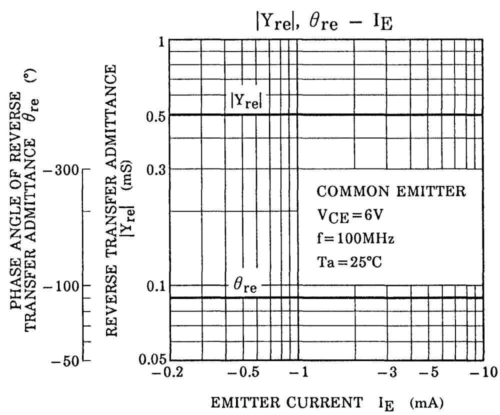
Fig.2 V_{OSC} TEST CIRCUIT


STATIC CHARACTERISTICS
COLLECTOR CURRENT IC (mA)
VCE=6V
250
200
150
100
IB=50μA
0
300 200 100
BASE CURRENT IB (μA)
0 10 20 30
COLLECTOR-EMITTER VOLTAGE VCE (V)
BASE-EMITTER VOLTAGE VBE (V)
COMMON EMITTER
Ta=25°C

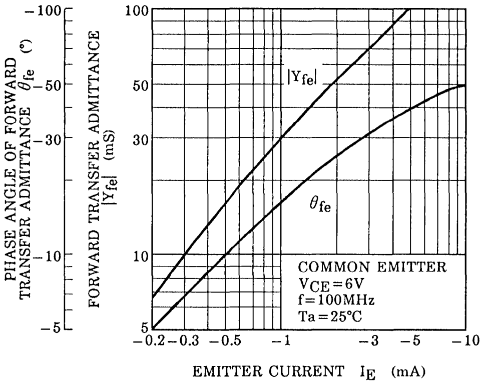

hFE – IC
COMMON EMITTER
VCE=6V
Ta=25°C
DC CURRENT GAIN hFE
COLLECTOR CURRENT IC (mA)


Cie, gie – IE
Cie
gie
COMMON EMITTER
VCE=6V
f=100MHz
Ta=25°C
INPUT CAPACITANCE Cie (pF)
INPUT CONDUCTANCE gie (mS)
EMITTER CURRENT IE (mA)

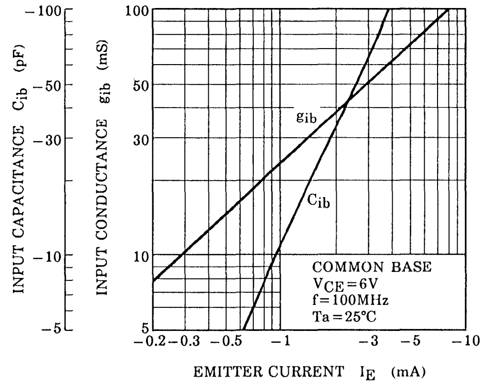

Coe, goe – IE
COMMON EMITTER
VCE=6V
f=100MHz
Ta=25°C
goe
Coe
OUTPUT CAPACITANCE Coe (pF)
OUTPUT CONDUCTANCE goe (μS)
EMITTER CURRENT IE (mA)


|Yre|, θre – IE
|Yre|
θre
COMMON EMITTER
VCE=6V
f=100MHz
Ta=25°C
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE θre (°)
REVERSE TRANSFER ADMITTANCE |Yre| (mS)
EMITTER CURRENT IE (mA)

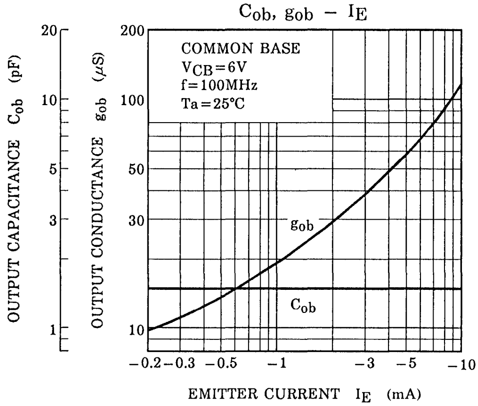
$|Y_{fe}|, \theta_{fe} - I_E$



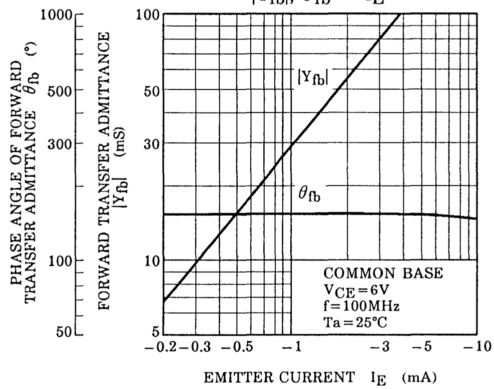
$C_{ib}, g_{ib} - I_E$



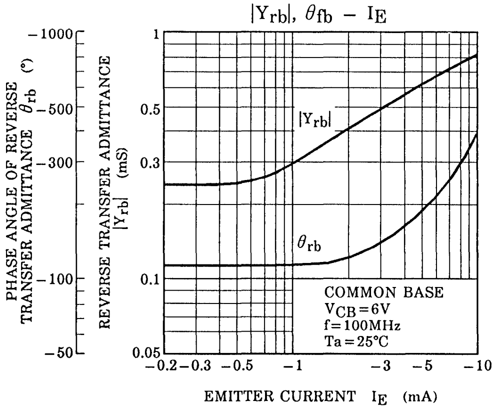
$C_{ob}, g_{ob} - I_E$



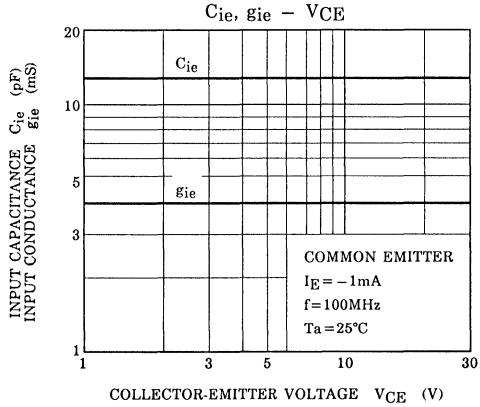
$|Y_{fb}|, \theta_{fb} - I_E$



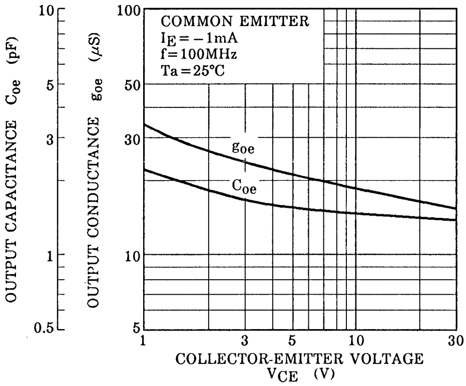
$|Y_{rb}|, \theta_{fb} - I_E$



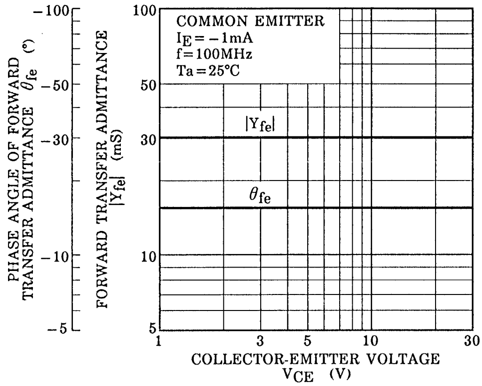
$C_{ie}, g_{ie} - V_{CE}$



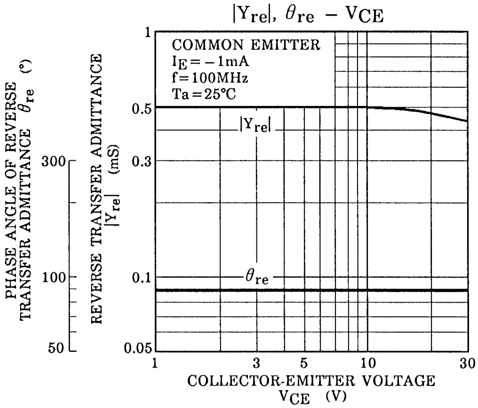
C_{oe}, g_{oe} – V_{CE}



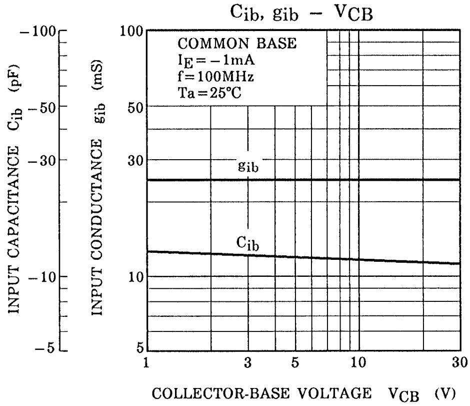
$|Y_{fe}|$, θ_{fe} – V_{CE}



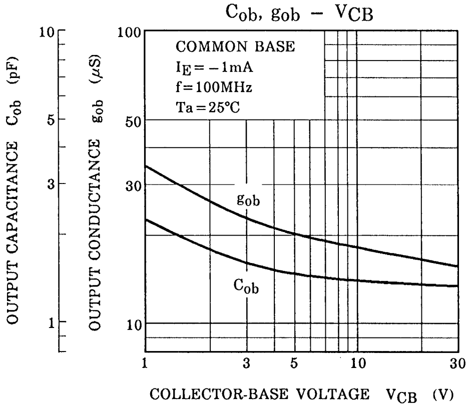
$|Y_{re}|$, θ_{re} – V_{CE}



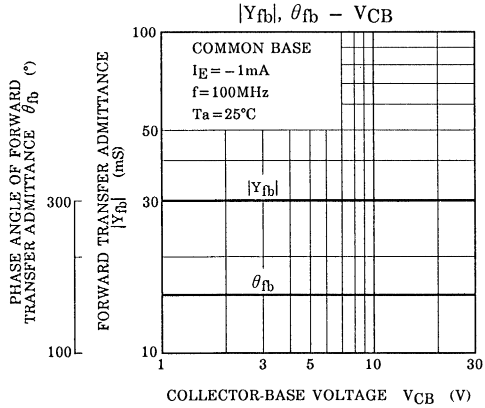
C_{ib}, g_{ib} – V_{CB}



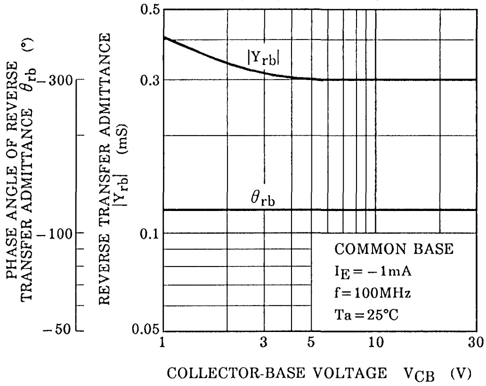
C_{ob}, g_{ob} – V_{CB}



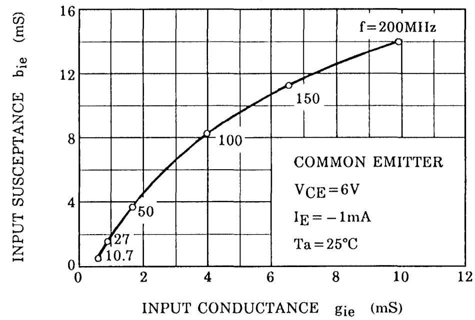
$|Y_{fb}|$, θ_{fb} – V_{CB}



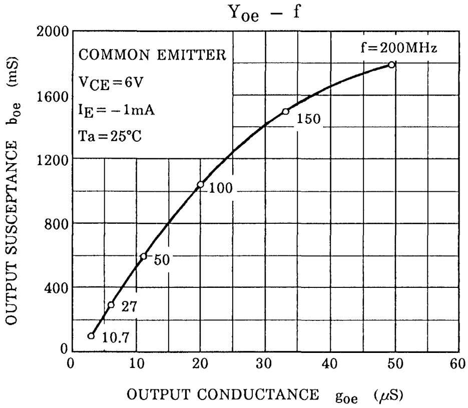
|Yrb|, θrb − VCB



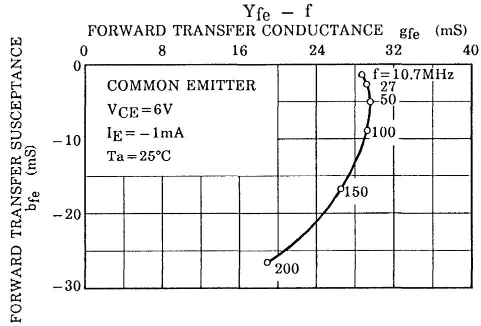
Yie − f



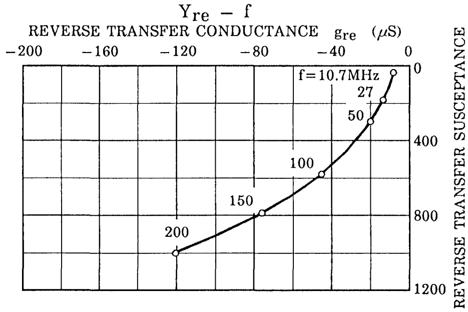
Yoe − f



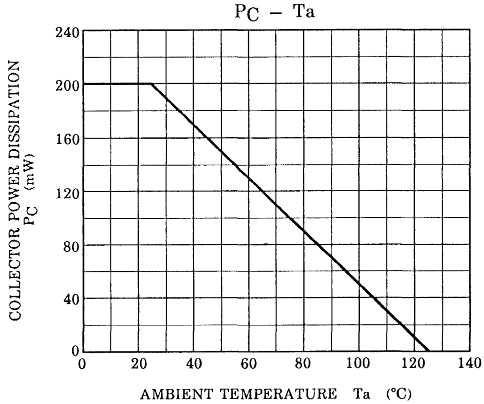
Yfe − f



Yre − f



PC − Ta

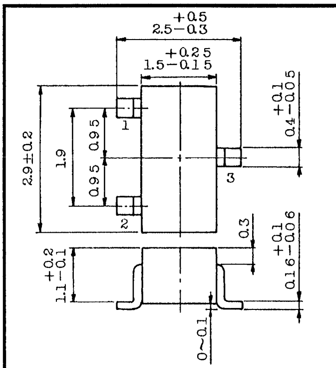


2SC2996

SILICON NPN EPITAXIAL TYPE TRANSISTOR

FM/AM, RF, MIX, LOCAL, IF
HIGH FREQUENCY AMPLIFIEP APPLICATIONS.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	TO—236
EIAJ	—
TOSHIBA	2-3F1A

Weight : 0.012g

FEATURES :

- High Stability Oscillation Voltage On FM Local Oscillator.
- Recommend FM/AM RF, MIX, Local and IF.

MAXIMUM RATINGS (Ta = 25°C)

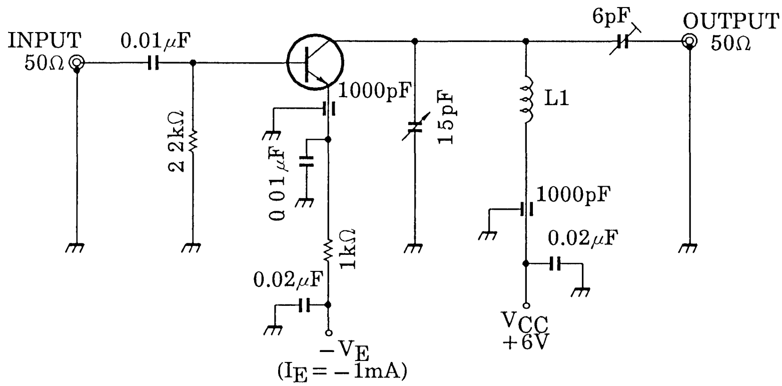
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	40	V
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Base Voltage	V_{EBO}	4	V
Collector Current	I_C	50	mA
Emitter Current	I_E	−50	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=40V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=4V$, $I_C=0$	—	—	0.5	μA
DC Current Gain	h_{FE} (Note)	$V_{CE}=6V$, $I_C=1mA$	40	—	240	
Reverse Transfer Capacitance	C_{re}	$V_{CE}=6V$, f=1MHz	—	0.9	1.3	pF
Transition Frequency	f_T	$V_{CE}=6V$, $I_E=-1mA$	150	350	—	MHz
C_c . rbb' Product	C_c . rbb'	$V_{CE}=6V$, $I_E=-1mA$, f=30MHz	—	15	30	ps
Noise Figure	NF	$V_{CE}=6V$, $I_E=-1mA$ f=100MHz (Fig.1)	—	4.0	—	dB
Power Gain	G_{pe}		—	15	—	
Oscillation Output Voltage	V_{OSC}	$V_{CE}=6V$, f=100MHz (Fig.2)	—	150	—	mV

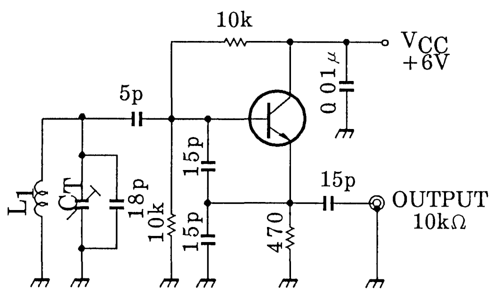
Note : h_{FE} Classification R : 40~80 O : 70~140 Y : 120~240

Fig. 1 NF, G_{pe} TEST CIRCUIT



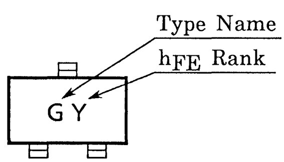
L_1 : 0.8mmφ SILVER PLATED COPPER WIRE, 4T, 10ID, 8 LENGTH

Fig. 2 V_{OSC} TEST CIRCUIT

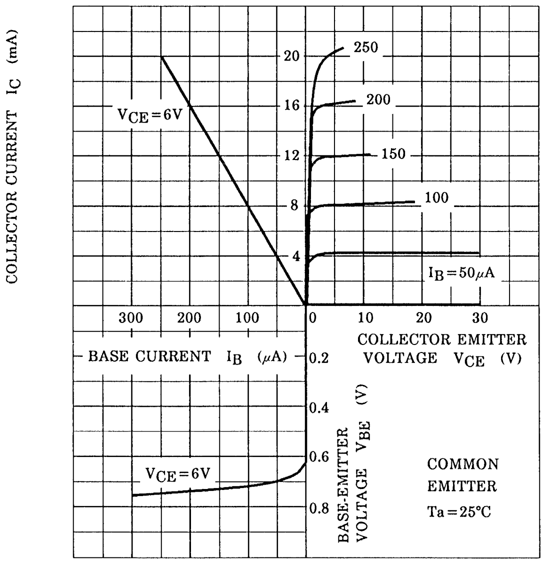


L_1 : 0.8mmφ SILVER PLATED COPPER WIRE, 4T, 10ID, 8 LENGTH

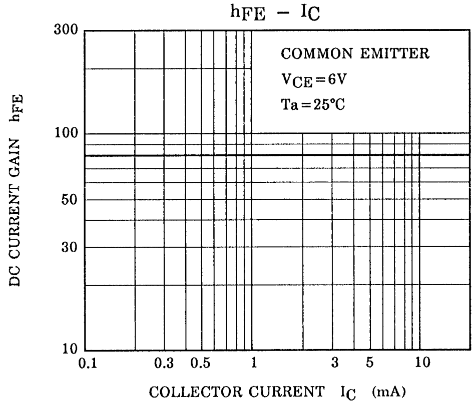
Marking



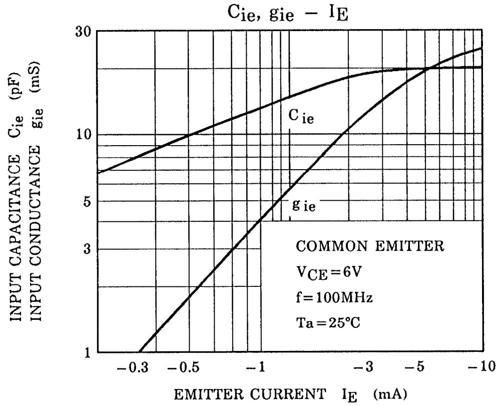
STATIC CHARACTERISTICS



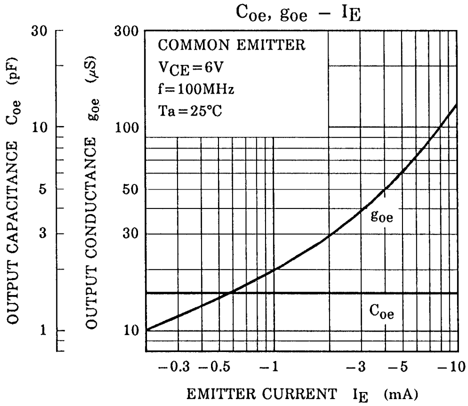
hFE − IC



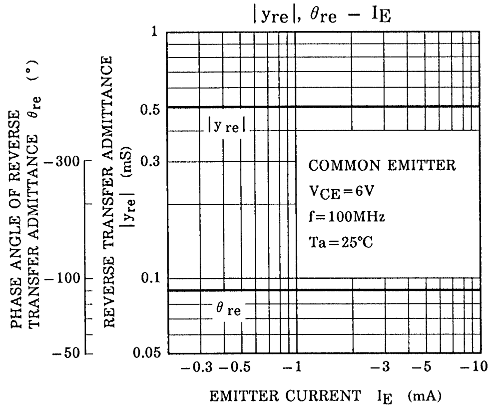
Cie, gie − IE

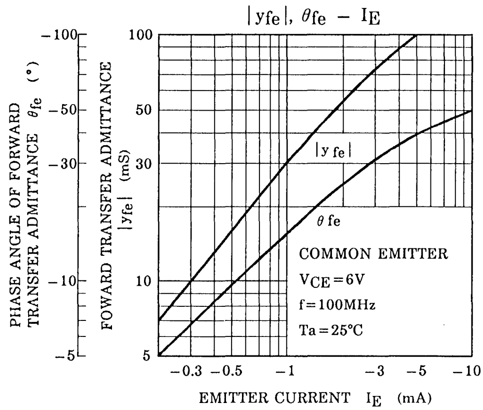


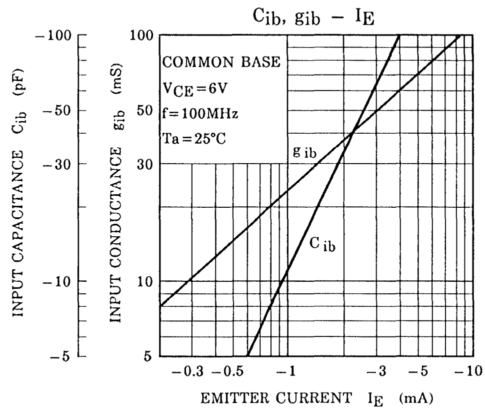
Coe, goe − IE

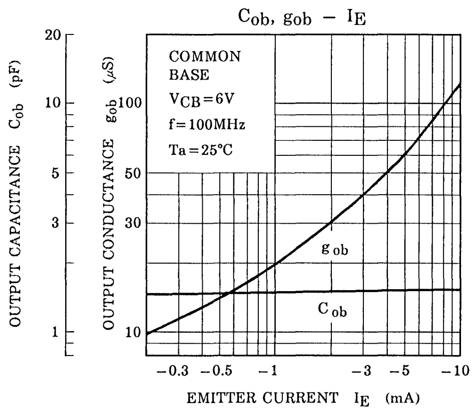


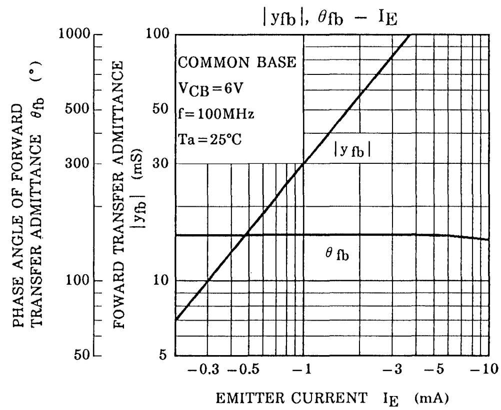
|yre|, θre − IE

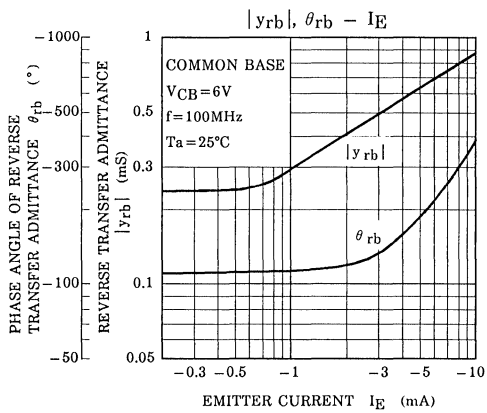


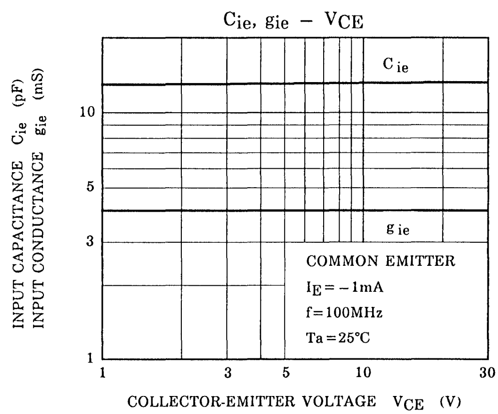

|yfe|, θfe − IE
PHASE ANGLE OF FORWARD TRANSFER ADMITTANCE θfe (°)
FOWARD TRANSFER ADMITTANCE |yfe| (mS)
|y fe|
θ fe
COMMON EMITTER
VCE=6V
f=100MHz
Ta=25°C
EMITTER CURRENT IE (mA)

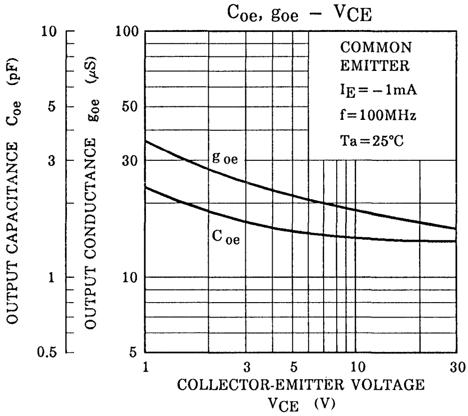

Cib, gib − IE
INPUT CAPACITANCE Cib (pF)
INPUT CONDUCTANCE gib (mS)
COMMON BASE
VCE=6V
f=100MHz
Ta=25°C
g ib
C ib
EMITTER CURRENT IE (mA)

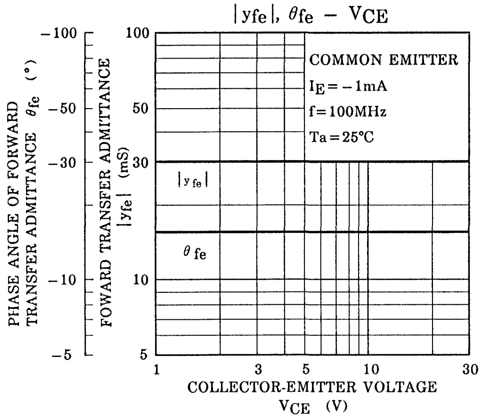

Cob, gob − IE
OUTPUT CAPACITANCE Cob (pF)
OUTPUT CONDUCTANCE gob (μS)
COMMON BASE
VCB=6V
f=100MHz
Ta=25°C
g ob
C ob
EMITTER CURRENT IE (mA)

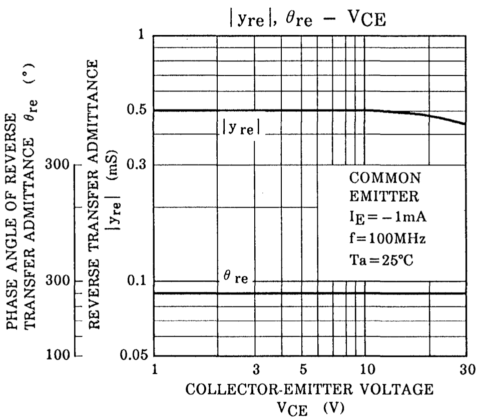

|yfb|, θfb − IE
PHASE ANGLE OF FORWARD TRANSFER ADMITTANCE θfb (°)
FOWARD TRANSFER ADMITTANCE |yfb| (mS)
COMMON BASE
VCB=6V
f=100MHz
Ta=25°C
|y fb|
θ fb
EMITTER CURRENT IE (mA)

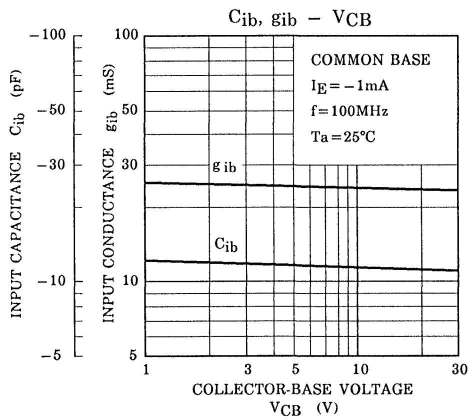

|yrb|, θrb − IE
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE θrb (°)
REVERSE TRANSFER ADMITTANCE |yrb| (mS)
COMMON BASE
VCB=6V
f=100MHz
Ta=25°C
|y rb|
θ rb
EMITTER CURRENT IE (mA)

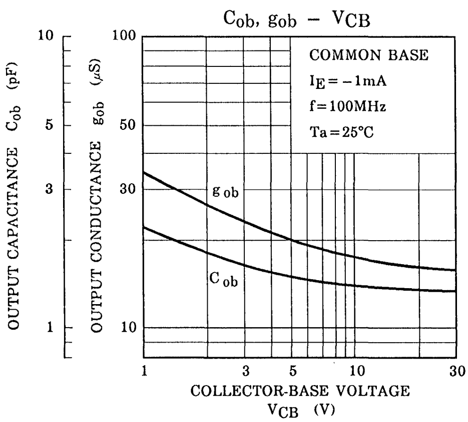

Cie, gie − VCE
INPUT CAPACITANCE Cie (pF)
INPUT CONDUCTANCE gie (mS)
C ie
g ie
COMMON EMITTER
IE=−1mA
f=100MHz
Ta=25°C
COLLECTOR-EMITTER VOLTAGE VCE (V)

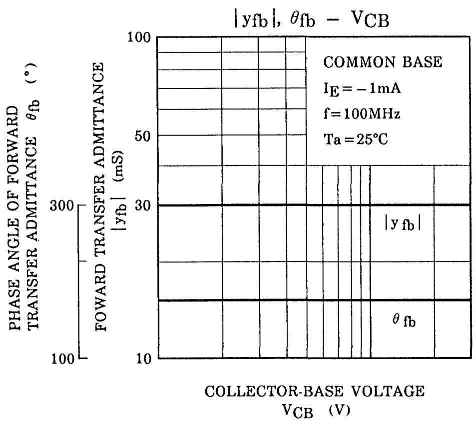

Coe, goe – VCE
COMMON EMITTER
IE = –1mA
f = 100MHz
Ta = 25°C
goe
Coe
OUTPUT CAPACITANCE Coe (pF)
OUTPUT CONDUCTANCE goe (μS)
10 5 3 1 0.5
100 50 30 10 5
1 3 5 10 30
COLLECTOR-EMITTER VOLTAGE
VCE (V)

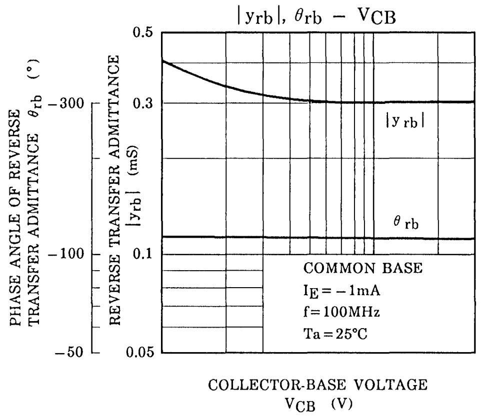

|yfe|, θfe – VCE
COMMON EMITTER
IE = –1mA
f = 100MHz
Ta = 25°C
|yfe|
θfe
PHASE ANGLE OF FORWARD TRANSFER ADMITTANCE θfe (°)
FOWARD TRANSFER ADMITTANCE |yfe| (mS)
–100 –50 –30 –10 –5
100 50 30 10 5
1 3 5 10 30
COLLECTOR-EMITTER VOLTAGE
VCE (V)

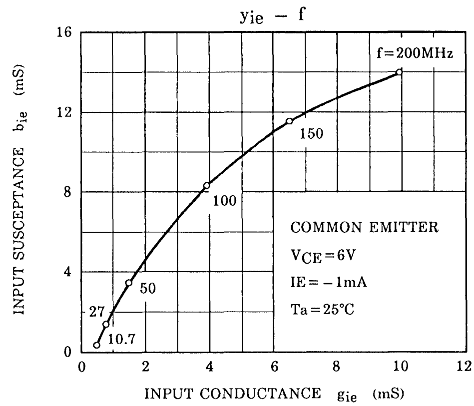

|yre|, θre – VCE
COMMON EMITTER
IE = –1mA
f = 100MHz
Ta = 25°C
|yre|
θre
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE θre (°)
REVERSE TRANSFER ADMITTANCE |yre| (mS)
300 300 100
1 0.5 0.3 0.1 0.05
1 3 5 10 30
COLLECTOR-EMITTER VOLTAGE
VCE (V)

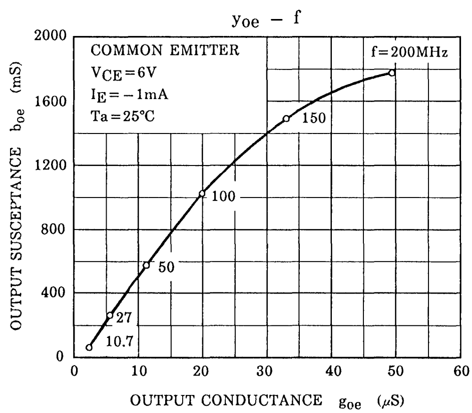

Cib, gib – VCB
COMMON BASE
IE = –1mA
f = 100MHz
Ta = 25°C
gib
Cib
INPUT CAPACITANCE Cib (pF)
INPUT CONDUCTANCE gib (mS)
–100 –50 –30 –10 –5
100 50 30 10 5
1 3 5 10 30
COLLECTOR-BASE VOLTAGE
VCB (V)

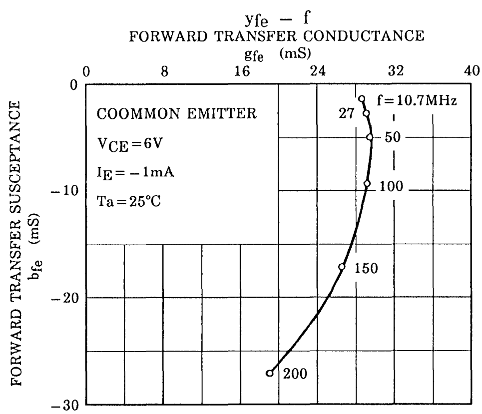

Cob, gob – VCB
COMMON BASE
IE = –1mA
f = 100MHz
Ta = 25°C
gob
Cob
OUTPUT CAPACITANCE Cob (pF)
OUTPUT CONDUCTANCE gob (μS)
10 5 3 1
100 50 30 10
1 3 5 10 30
COLLECTOR-BASE VOLTAGE
VCB (V)

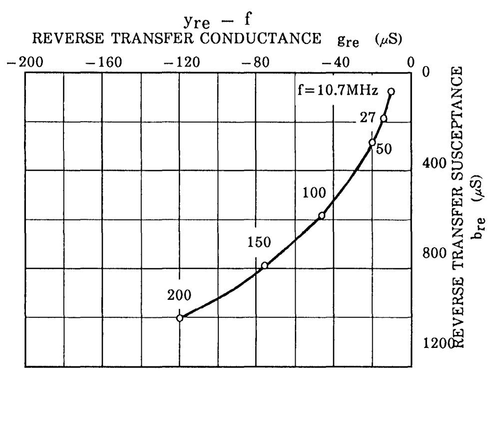

|yfb|, θfb – VCB
COMMON BASE
IE = –1mA
f = 100MHz
Ta = 25°C
|yfb|
θfb
PHASE ANGLE OF FORWARD TRANSFER ADMITTANCE θfb (°)
FOWARD TRANSFER ADMITTANCE |yfb| (mS)
300 100
100 50 30 10
COLLECTOR-BASE VOLTAGE
VCB (V)

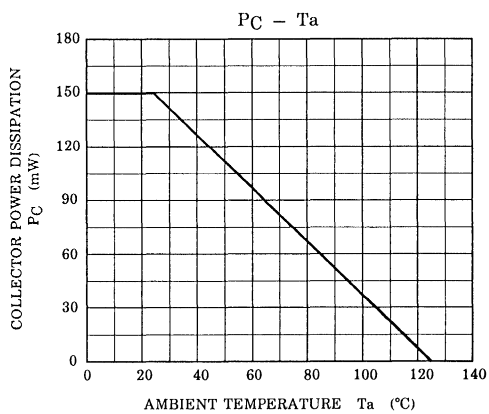

|yrb|, θrb − VCB
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE θrb (°)
REVERSE TRANSFER ADMITTANCE |yrb| (mS)
|y rb|
θ rb
COMMON BASE
IE = −1mA
f = 100MHz
Ta = 25°C
COLLECTOR-BASE VOLTAGE VCB (V)


yie − f
INPUT SUSCEPTANCE bie (mS)
f = 200MHz
150
100
50
27
10.7
COMMON EMITTER
VCE = 6V
IE = −1mA
Ta = 25°C
INPUT CONDUCTANCE gie (mS)


yoe − f
OUTPUT SUSCEPTANCE boe (mS)
COMMON EMITTER
VCE = 6V
IE = −1mA
Ta = 25°C
f = 200MHz
150
100
50
27
10.7
OUTPUT CONDUCTANCE goe (μS)


yfe − f
FORWARD TRANSFER CONDUCTANCE gfe (mS)
FORWARD TRANSFER SUSCEPTANCE bfe (mS)
COOMMON EMITTER
VCE = 6V
IE = −1mA
Ta = 25°C
f = 10.7MHz
27
50
100
150
200

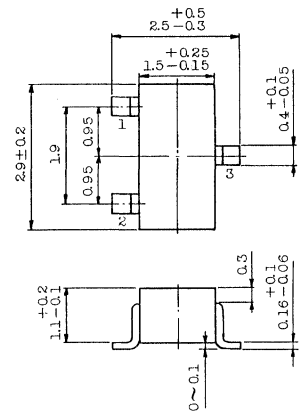

yre − f
REVERSE TRANSFER CONDUCTANCE gre (μS)
REVERSE TRANSFER SUSCEPTANCE bre (μS)
f = 10.7MHz
27
50
100
150
200


PC − Ta
COLLECTOR POWER DISSIPATION PC (mW)
AMBIENT TEMPERATURE Ta (°C)

2SC3011 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

UHF~C BAND LOW NOISE AMPLIFIER APPLICATIONS.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

- High Gain : $|S_{21e}|^2 = 12dB$ (Typ.)
- Low Noise Figure : NF = 2.3dB (Typ.), f = 1GHz
- High f_T : $f_T = 6.5GHz$

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	7	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	30	mA
Base Current	I_B	10	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MICROWAVE CHARACTERISTICS (Ta = 25°C)

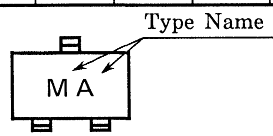
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	$V_{CE} = 5V$, $I_C = 10mA$	—	6.5	—	GHz
Insertion Gain	$\|S_{21e}\|^2$	$V_{CE} = 5V$, $I_C = 10mA$, f = 1GHz	—	12	—	dB
Noise Figure	NF	$V_{CE} = 5V$, $I_C = 5mA$, f = 1GHz	—	2.3	—	dB

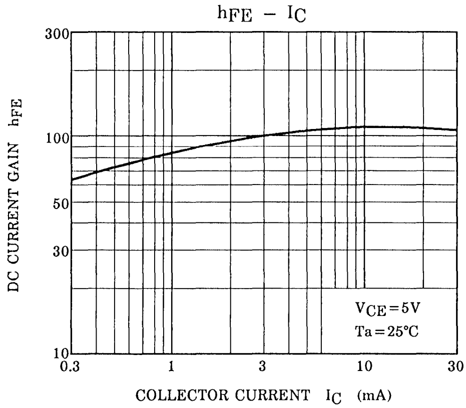
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

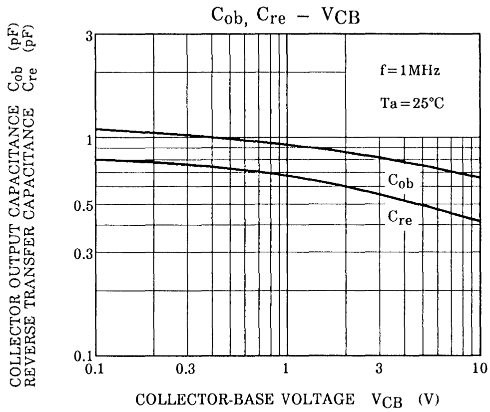
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collecter Cut-off Current	I_{CBO}	$V_{CB} = 10V$, $I_E = 0$	—	—	1.0	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB} = 1.0V$, $I_C = 0$	—	—	1.0	μA
Collecter-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 0.5mA$, $I_B = 0$	7	—	—	V
DC Current Gain	h_{FE}	$V_{CE} = 5V$, $I_C = 10mA$	30	120	—	—
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = 10mA$, $I_B = 1mA$	—	0.1	—	V
Base-Emitter Saturation Voltage	$V_{BE(sat)}$		—	0.87	—	V
Collecter Output Capacitance	C_{ob}	$V_{CB} = 5V$, $I_E = 0$, f = 1MHz (Note)	—	0.7	0.9	pF
Reverse Transfer Capacitance	C_{re}		—	0.5	—	pF
Input Capacitance	C_{ib}	$V_{EB} = 0$, $I_C = 0$, f = 1MHz	—	0.8	—	pF

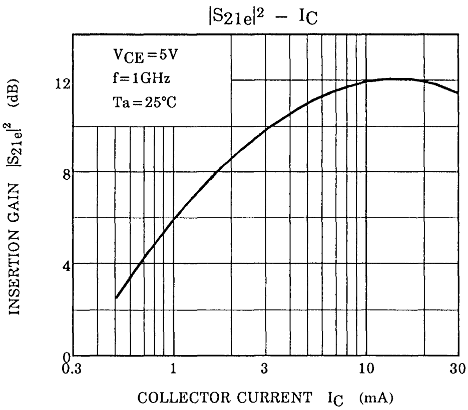
Note: Cre is measured by 3-terminal method with Capacitance Bridge.

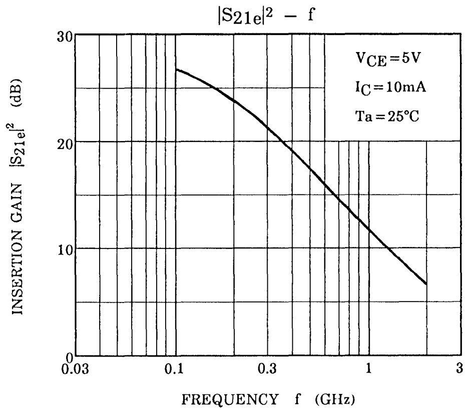
Marking

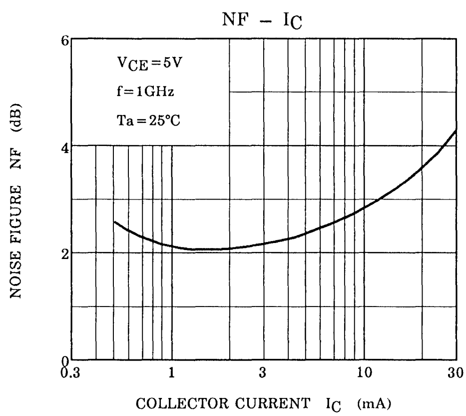


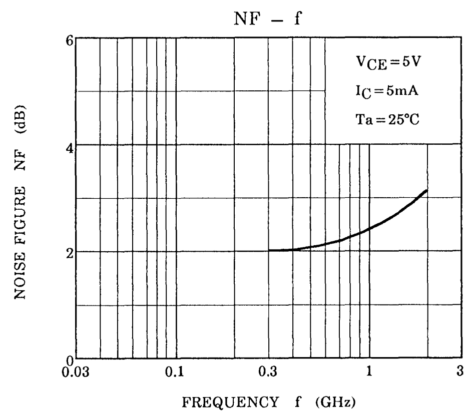

hFE – IC
DC CURRENT GAIN hFE
300
100
50
30
10
0.3
1
3
10
30
VCE=5V
Ta=25°C
COLLECTOR CURRENT IC (mA)


Cob, Cre – VCB
COLLECTOR OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
3
1
0.5
0.3
0.1
0.1
0.3
1
3
10
f=1MHz
Ta=25°C
Cob
Cre
COLLECTOR-BASE VOLTAGE VCB (V)

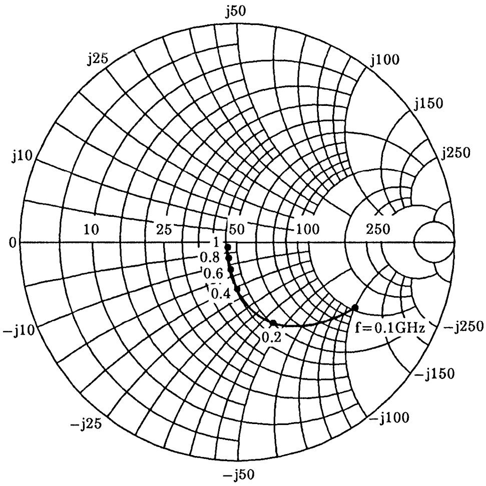

|S21e|2 – IC
INSERTION GAIN |S21e|2 (dB)
12
8
4
0
0.3
1
3
10
30
VCE=5V
f=1GHz
Ta=25°C
COLLECTOR CURRENT IC (mA)


|S21e|2 – f
INSERTION GAIN |S21e|2 (dB)
30
20
10
0
0.03
0.1
0.3
1
3
VCE=5V
IC=10mA
Ta=25°C
FREQUENCY f (GHz)

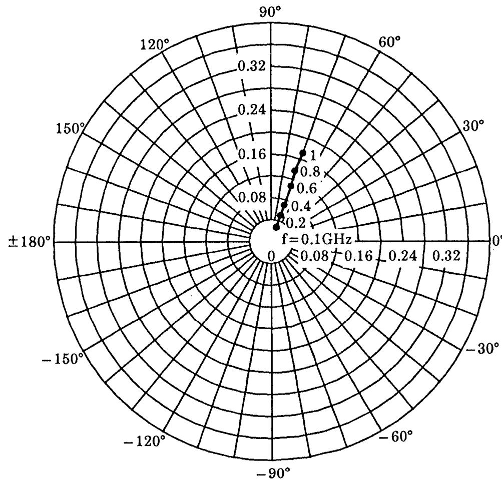

NF – IC
NOISE FIGURE NF (dB)
6
4
2
0
0.3
1
3
10
30
VCE=5V
f=1GHz
Ta=25°C
COLLECTOR CURRENT IC (mA)


NF – f
NOISE FIGURE NF (dB)
6
4
2
0
0.03
0.1
0.3
1
3
VCE=5V
IC=5mA
Ta=25°C
FREQUENCY f (GHz)

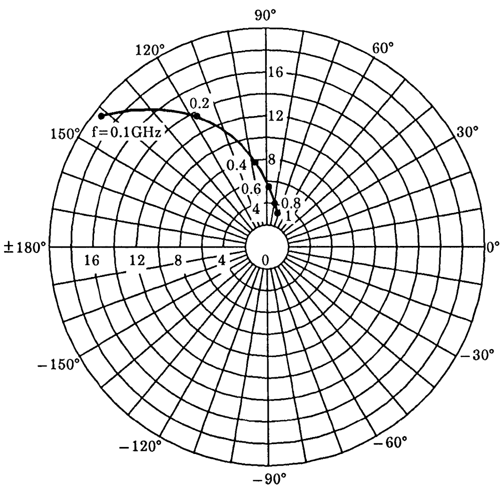
S11e
V_{CE} = 5V
I_C = 10mA
Ta = 25°C
(UNIT : Ω)



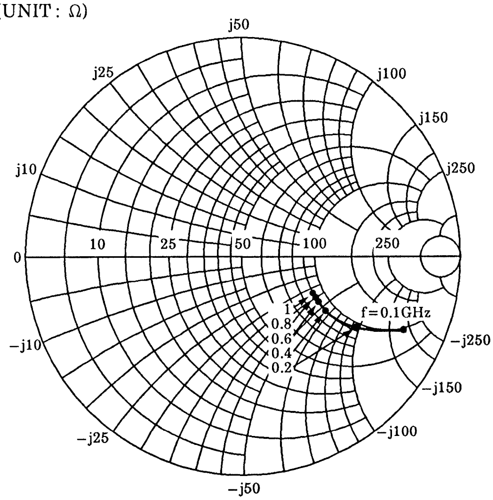
S12e
V_{CE} = 5V
I_C = 10mA
Ta = 25°C



S21e
V_{CE} = 5V
I_C = 10mA
Ta = 25°C



S22e
V_{CE} = 5V
I_C = 10mA
Ta = 25°C
(UNIT : Ω)

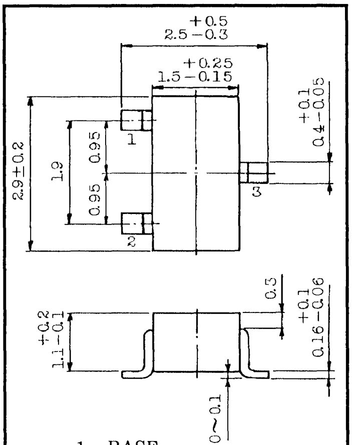


SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC3098

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

- Low Noise Figure.
- NF = 2.5dB, $|S_{21e}|^2$ = 14.5dB (f = 500MHz)
- NF = 3.0dB, $|S_{21e}|^2$ = 9.0dB (f = 1GHz)

MAXIMUM RATINGS (Tc = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	20	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	50	mA
Base Current	I_B	25	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

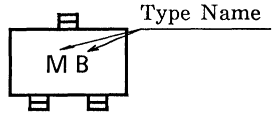
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 10V, I_C = 10mA	—	3.5	—	GHz
Insertion Gain	$|S_{21e}|^2$ (1)	V_{CE} = 10V, I_C = 10mA, f = 500MHz	—	14.5	—	dB
	$|S_{21e}|^2$ (2)	V_{CE} = 10V, I_C = 10mA, f = 1GHz	—	9	—	dB
Noise Figure	NF (1)	V_{CE} = 10V, I_C = 5mA, f = 500MHz	—	2.5	—	dB
	NF (2)	V_{CE} = 10V, I_C = 5mA, f = 1GHz	—	3	—	dB

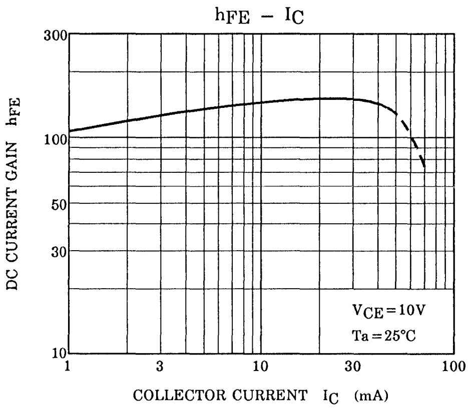
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

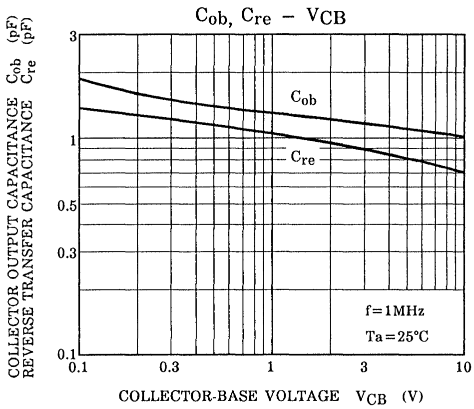
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_C = 0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE} = 10V, I_C = 10mA	30	80	300	—
Collector Output Capacitance	C_{ob}	V_{CE} = 10V, I_E = 0,	—	1.15	—	pF
Reverse Transfer Capacitance	C_{re}	f = 1MHz (Note)	—	0.75	—	pF

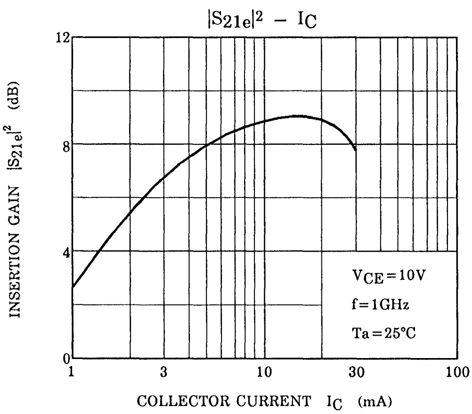
Note: Cre is measured by 3 terminal method with Capacitance Bridge.

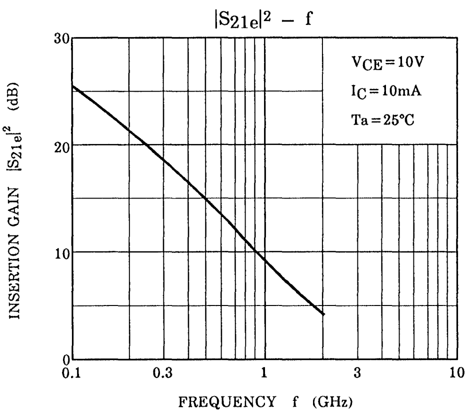
Marking

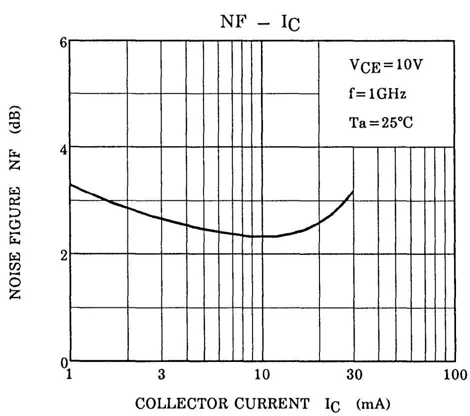


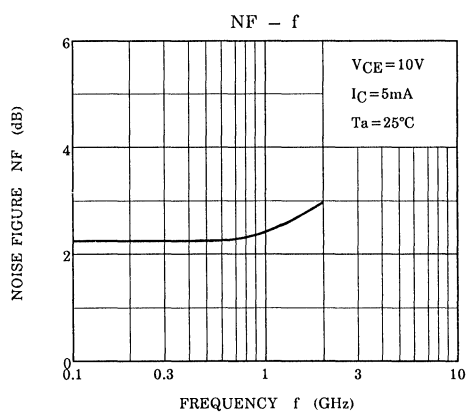

hFE – IC
DC CURRENT GAIN hFE
300
100
50
30
10
1
3
10
30
100
VCE=10V
Ta=25°C
COLLECTOR CURRENT IC (mA)


Cob, Cre – VCB
COLLECTOR OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
3
1
0.5
0.3
0.1
0.1
0.3
1
3
10
Cob
Cre
f=1MHz
Ta=25°C
COLLECTOR-BASE VOLTAGE VCB (V)

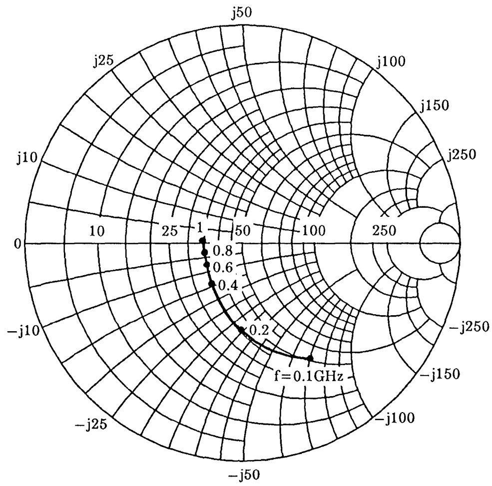

|S21e|2 – IC
INSERTION GAIN |S21e|2 (dB)
12
8
4
0
1
3
10
30
100
VCE=10V
f=1GHz
Ta=25°C
COLLECTOR CURRENT IC (mA)


|S21e|2 – f
INSERTION GAIN |S21e|2 (dB)
30
20
10
0
0.1
0.3
1
3
10
VCE=10V
IC=10mA
Ta=25°C
FREQUENCY f (GHz)

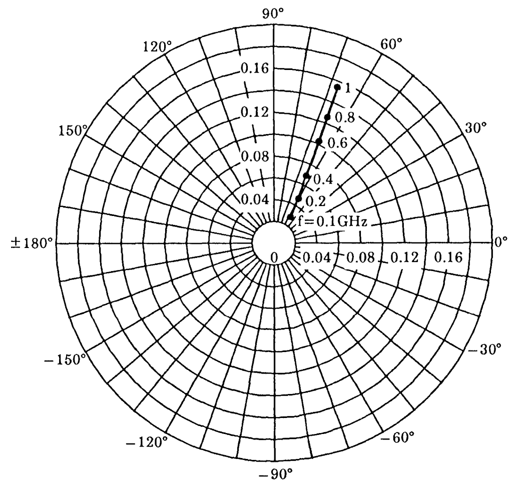

NF – IC
NOISE FIGURE NF (dB)
6
4
2
0
1
3
10
30
100
VCE=10V
f=1GHz
Ta=25°C
COLLECTOR CURRENT IC (mA)


NF – f
NOISE FIGURE NF (dB)
6
4
2
0
0.1
0.3
1
3
10
VCE=10V
IC=5mA
Ta=25°C
FREQUENCY f (GHz)

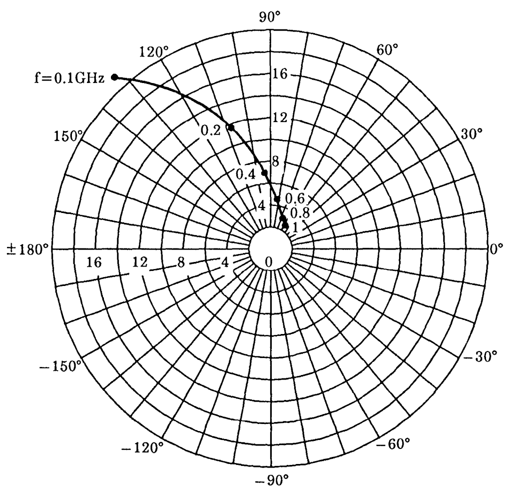
S_{11e}
$V_{CE}=10V$
$I_C=10mA$
$Ta=25°C$
(UNIT : Ω)



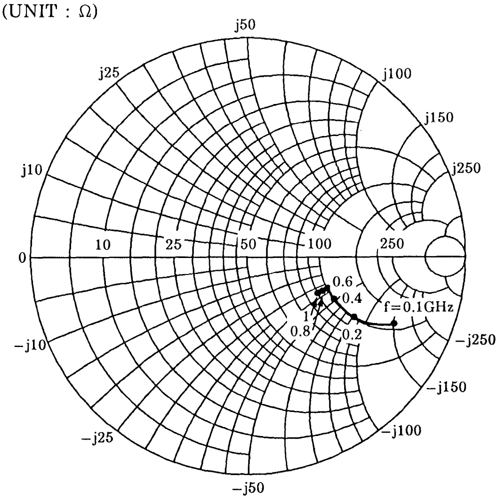
S_{12e}
$V_{CE}=10V$
$I_C=10mA$
$Ta=25°C$



S_{21e}
$V_{CE}=10V$
$I_C=10mA$
$Ta=25°C$



S_{22e}
$V_{CE}=10V$
$I_C=10mA$
$Ta=25°C$
(UNIT : Ω)

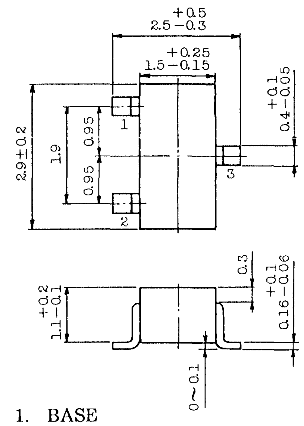


2SC3099 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

VHF ~ UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure.
- NF = 1.7dB, $|S_{21e}|^2$ = 15dB (f = 500MHz)
- NF = 2.5dB, $|S_{21e}|^2$ = 9.5dB (f = 1GHz)

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	20	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	30	mA
Base Current	I_B	15	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MICROWAVE CHARACTERISTICS (Ta = 25°C)

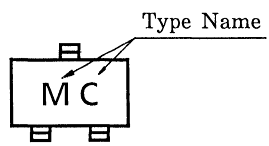
CHARACTERISTIC	SYMBOL	TEST CONSITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 10V, I_C = 10mA	—	4.0	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE} = 10V, I_C = 10mA, f = 500MHz	—	15.0	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE} = 10V, I_C = 10mA, f = 1GHz	—	9.5	—	dB
Noise Figure	NF (1)	V_{CE} = 10V, I_C = 3mA, f = 500MHz	—	1.7	—	dB
	NF (2)	V_{CE} = 10V, I_C = 3mA, f = 1GHz	—	2.5	—	dB

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

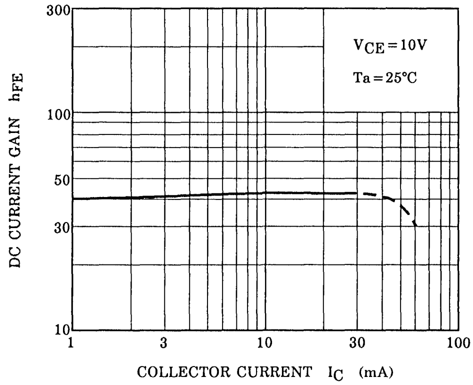
CHARACTERISTIC	SYMBOL	TEST CONSITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_C = 0	—	—	1.0	μA
DC Current Gain	h_{FE}	V_{CE} = 10V, I_C = 5mA	30	—	250	—
Output Capacitance	C_{ob}	V_{CB} = 10V, I_E = 0,	—	0.9	—	pF
Reverse Transfer Capacitance	C_{re}	f = 1MHz (Note)	—	0.6	—	pF

Note : Cre is measured by 3 terminal method with Capacitance Bridge.

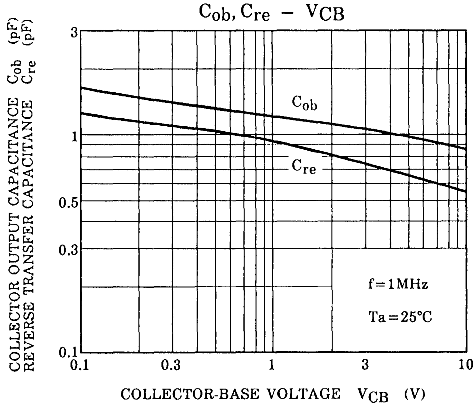
MARKING



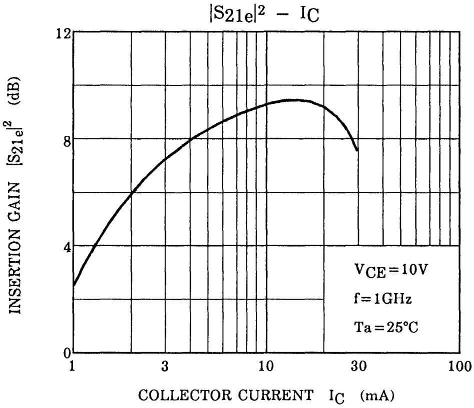
h_{FE} – I_C



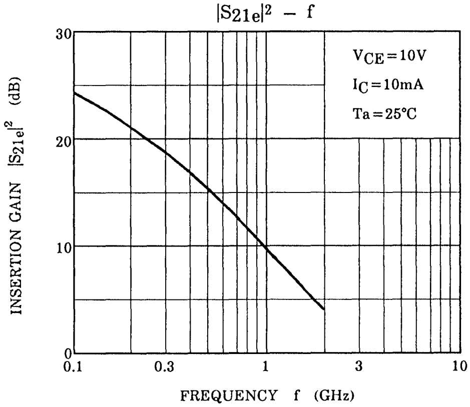
C_{ob}, C_{re} – V_{CB}



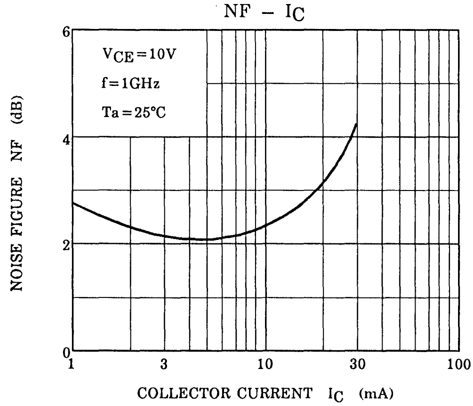
$|S_{21e}|^2$ – I_C



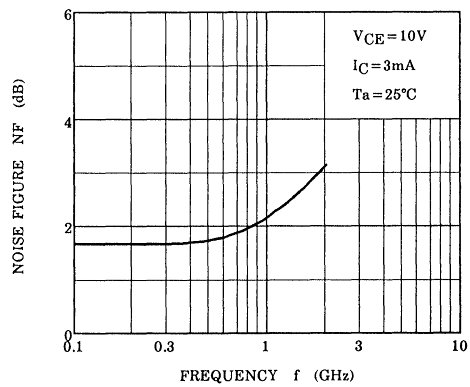
$|S_{21e}|^2$ – f



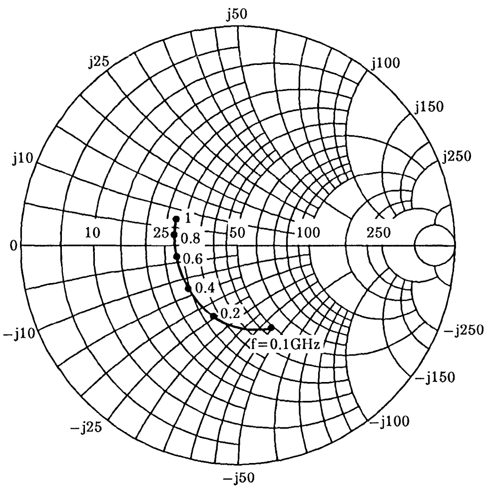
NF – I_C



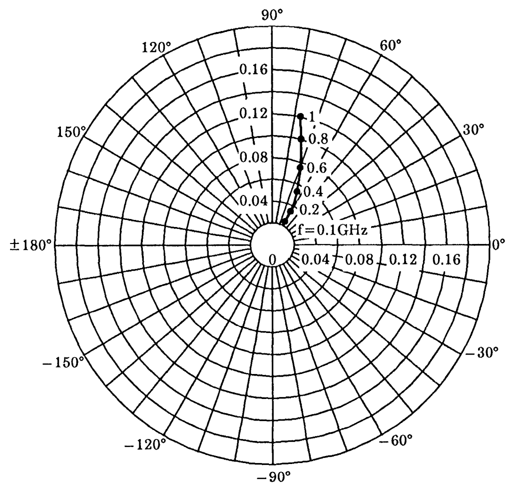
NF – f



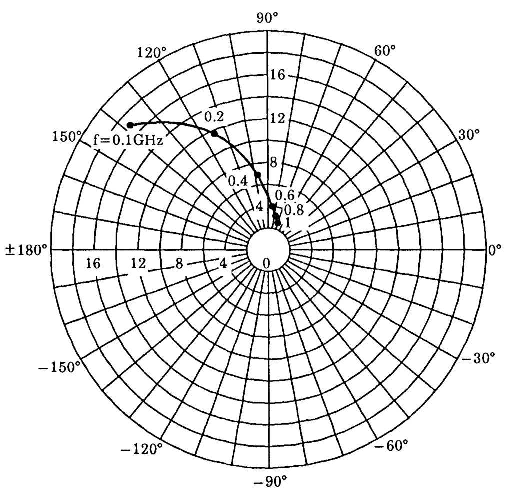
S_{11e}
V_{CE} = 10V
I_C = 10mA
Ta = 25°C
(UNIT : Ω)



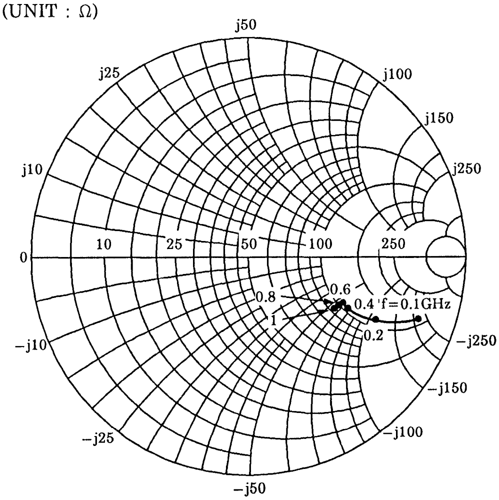
S_{12e}
V_{CE} = 10V
I_C = 10mA
Ta = 25°C



S_{21e}
V_{CE} = 10V
I_C = 10mA
Ta = 25°C



S_{22e}
V_{CE} = 10V
I_C = 10mA
Ta = 25°C
(UNIT : Ω)

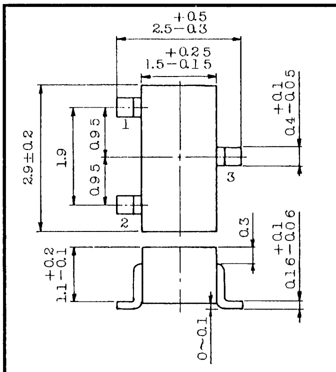


SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC3120

TV TUNER, UHF MIXER APPLICATIONS.
VHF ~ UHF BAND RF AMPLIFIER APPLICATIONS.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	—
TOSHIBA	2-3F1A

Weight : 0.012g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	15	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	50	mA
Base Current	I_B	25	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=30V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=2V$, $I_C=0$	—	—	1.0	μA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA$, $I_B=0$	15	—	—	V
DC Current Gain	h_{FE}	$V_{CE}=10V$, $I_C=5mA$	40	100	200	—
Reverse Transfer Capacitance	C_{re}	$V_{CB}=10V$, $I_E=0$, $f=1MHz$	—	0.6	0.9	pF
Transition Frequency	f_T	$V_{CE}=10V$, $I_C=2mA$	1500	2400	—	MHz
Conversion Gain	G_{ce}	$V_{CC}=10V$, $I_C=2mA$, $f=800MHz$, $f_L=830MHz$ (0dBm) (Fig. 1)	12	17	—	dB
Noise Figure	NF		—	8	—	dB

Marking

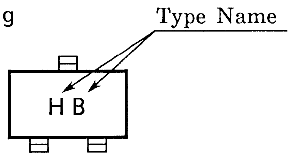
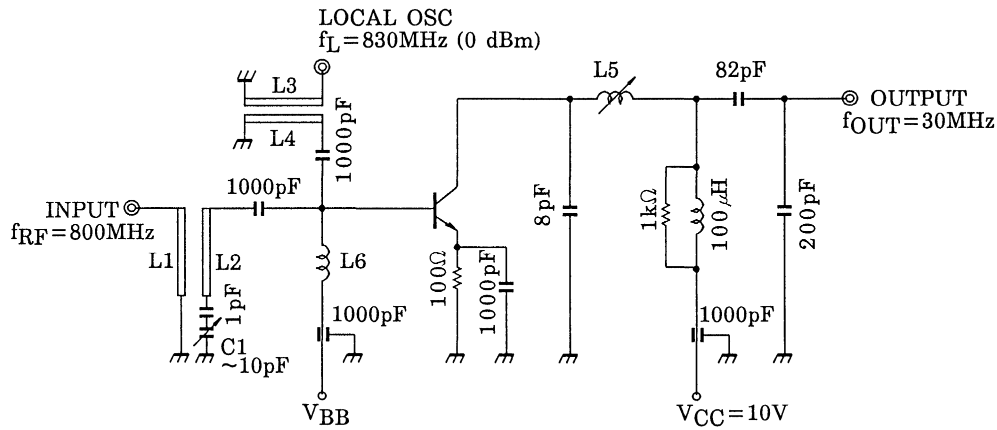
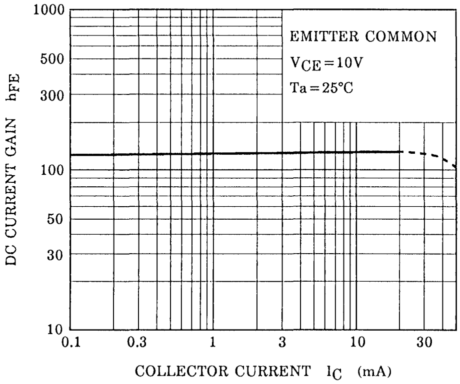


Fig. 1 800MHz G_{ce}, NF TEST CIRCUIT

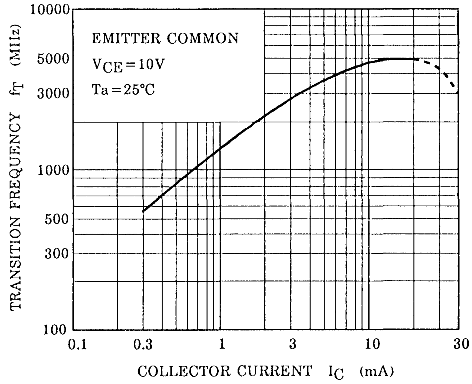


L1~L4 : ϕ0.8mm SILVER PLATED COPPER WIRE
L5 : AIR COIL SCN-5948 ①-③ TOKO OR EQUIVALENT
L6 : ϕ0.2mm COPPER WIRE 10T 5mm ID
C1 : AIR TRIMMER TTA23A100 MURATA MFC. Co., LTD. OR EQUIVALENT

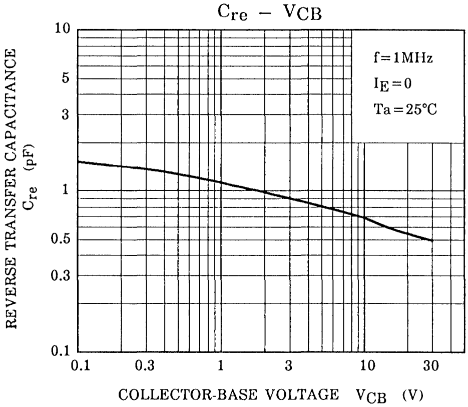
h_{FE} − I_C



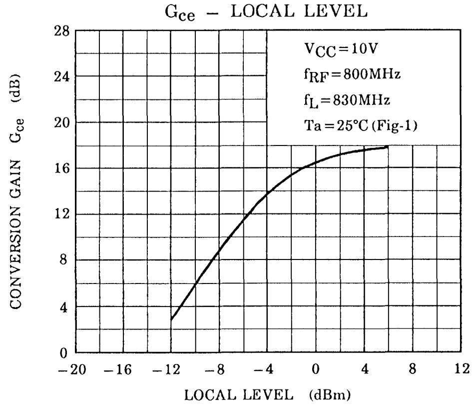
f_T − I_C



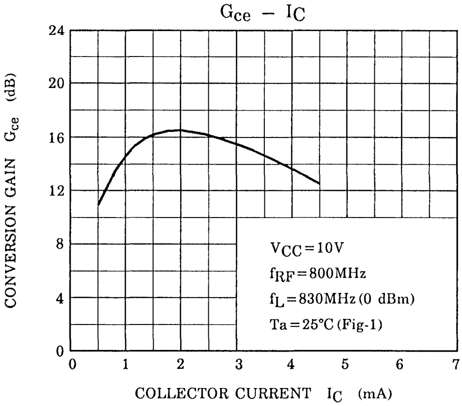
C_{re} − V_{CB}



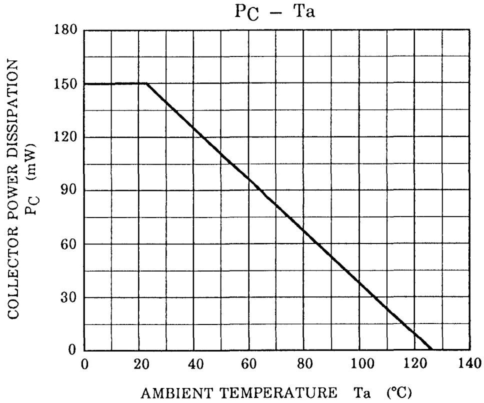
G_{ce} − LOCAL LEVEL



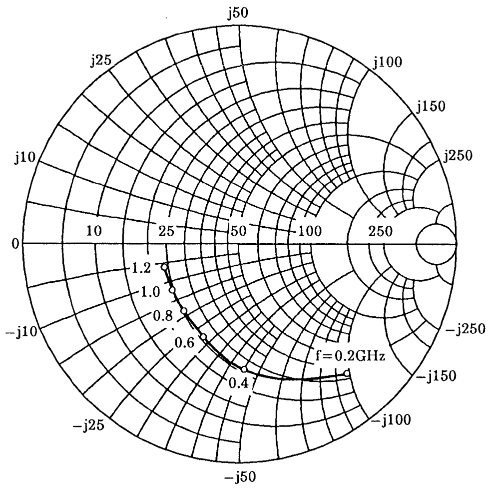
G_{ce} − I_C



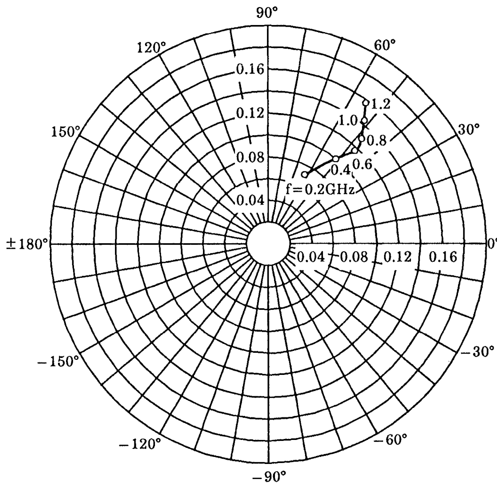
P_C − Ta



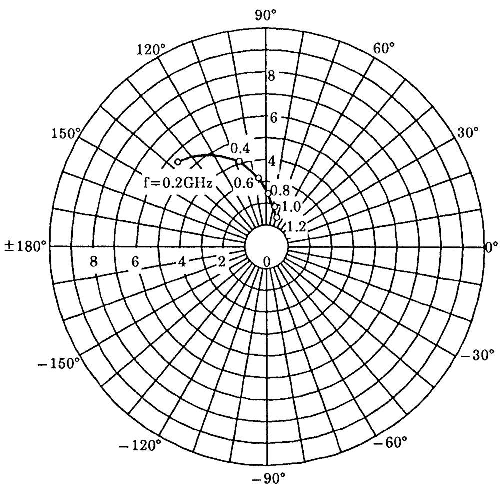
S_{11e}
$V_{CE}=10V$
$I_C=2mA$
$Ta=25°C$
(UNIT : Ω)



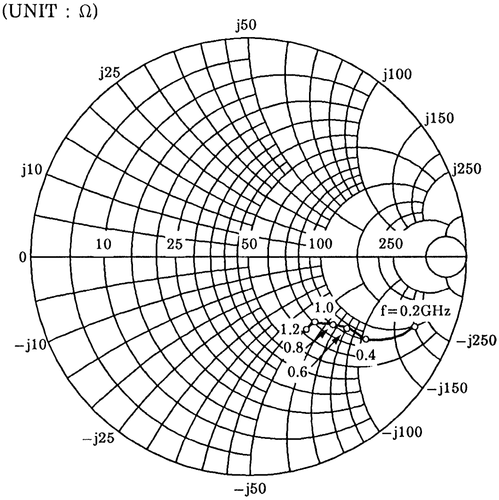
S_{12e}
$V_{CE}=10V$
$I_C=2mA$
$Ta=25°C$



S_{21e}
$V_{CE}=10V$
$I_C=2mA$
$Ta=25°C$



S_{22e}
$V_{CE}=10V$
$I_C=2mA$
$Ta=25°C$
(UNIT : Ω)

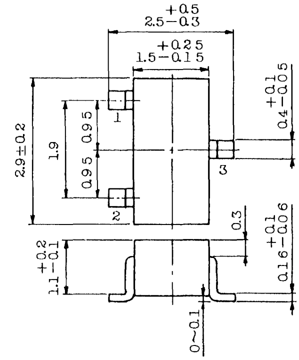


SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC3121

TV TUNER, UHF OSCILLATOR APPLICATIONS. (COMMON BASE)
TV TUNER, UHF CONVERTER APPLICATIONS. (COMMON BASE)

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

FEATURES :

- High Transition Frequency : f_T=1500MHz (Typ.)
- Exellent Linearity

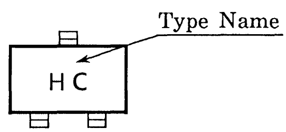
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	15	V
Emitter-Base Voltage	V_{EBO}	3	V
Base Current	I_B	25	mA
Collector Current	I_C	50	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

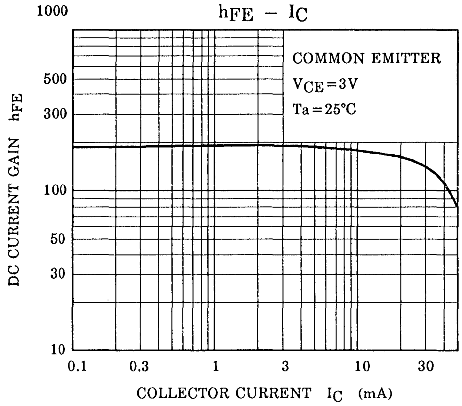
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB}=15V, I_E=0	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB}=3V, I_C=0	—	—	1.0	μA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=1mA, I_B=0	15	—	—	V
DC Current Gain	h_{FE}	V_{CE}=3V, I_C=8mA	60	150	320	
Transition Frequency	f_T	V_{CE}=10V, I_C=8mA	1100	1500	—	MHz
Collecor Output Capacitance	C_{ob}	V_{CB}=10V, I_E=0mA, f=1MHz	—	0.9	1.3	pF
Collector-Base Time Constant	$C_c \cdot rbb'$	V_{CB}=10V, I_C=8mA, f=30MHz	—	7	12	ps

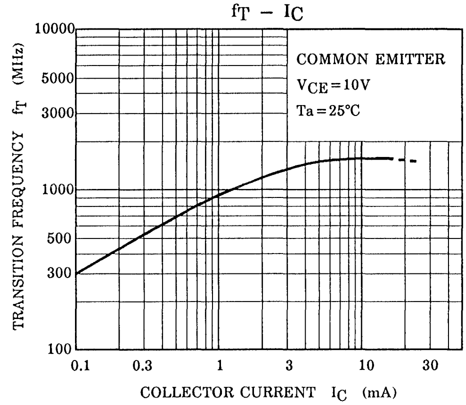
Marking



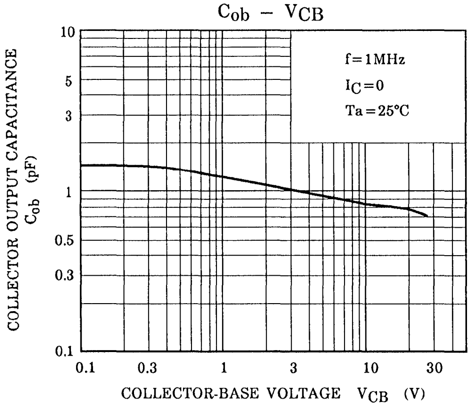
hFE − IC



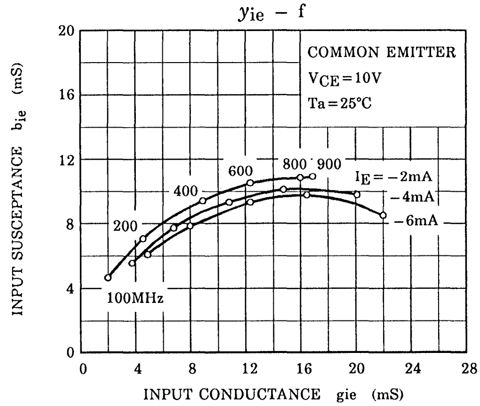
fT − IC



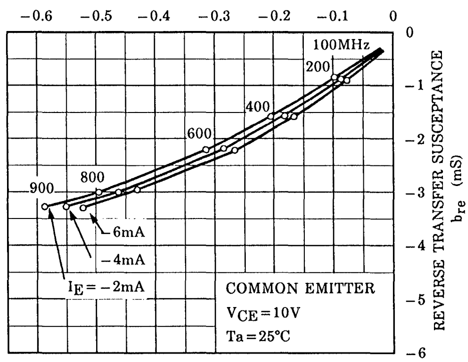
Cob − VCB



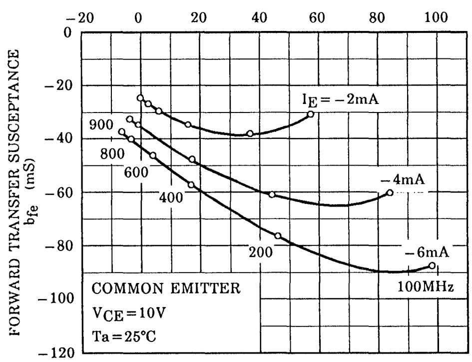
yie − f

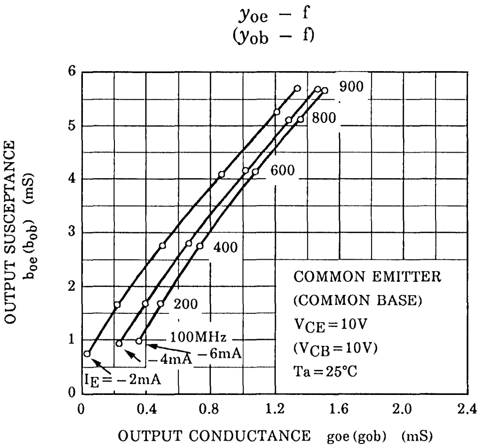


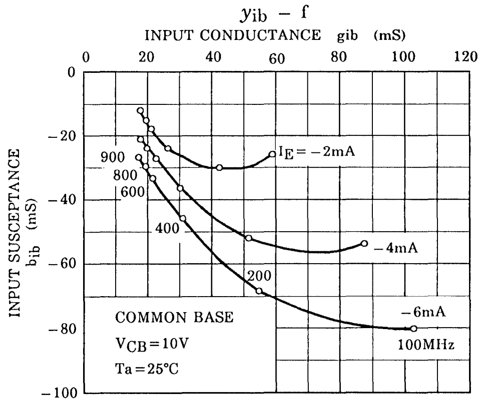
yre − f
REVERSE TRANSFER CONDUCTANCE
gre (mS)

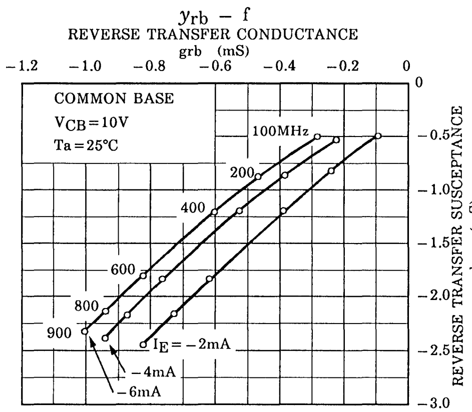


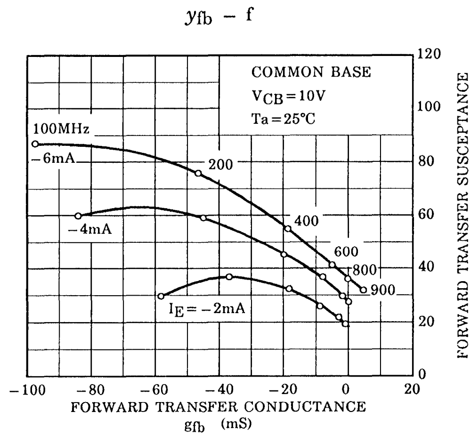
yfe − f
FORWARD TRANSFER CONDUCTANCE
gfe (mS)

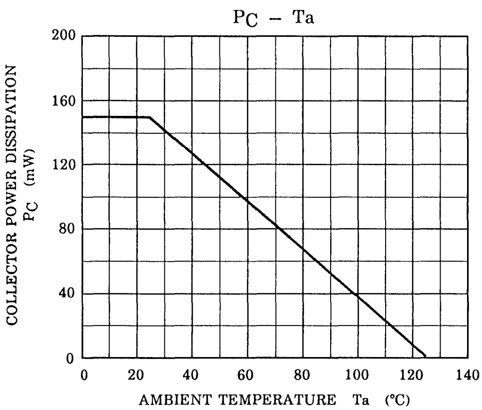



y_{oe} − f
(y_{ob} − f)
OUTPUT SUSCEPTANCE b_{oe} (b_{ob}) (mS)
OUTPUT CONDUCTANCE goe (gob) (mS)
COMMON EMITTER
(COMMON BASE)
V_{CE} = 10V
(V_{CB} = 10V)
Ta = 25°C
900
800
600
400
200
100MHz
I_E = −2mA
−4mA
−6mA


y_{ib} − f
INPUT CONDUCTANCE gib (mS)
INPUT SUSCEPTANCE b_{ib} (mS)
COMMON BASE
V_{CB} = 10V
Ta = 25°C
900
800
600
400
200
100MHz
I_E = −2mA
−4mA
−6mA


y_{rb} − f
REVERSE TRANSFER CONDUCTANCE
grb (mS)
REVERSE TRANSFER SUSCEPTANCE b_{rb} (mS)
COMMON BASE
V_{CB} = 10V
Ta = 25°C
100MHz
200
400
600
800
900
I_E = −2mA
−4mA
−6mA

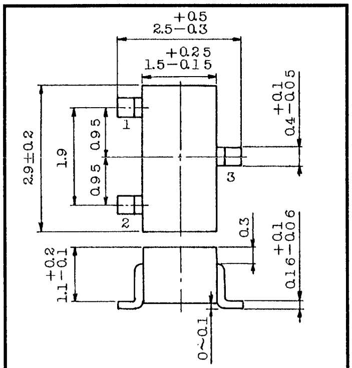

y_{fb} − f
FORWARD TRANSFER CONDUCTANCE
g_{fb} (mS)
FORWARD TRANSFER SUSCEPTANCE b_{fe} (mS)
COMMON BASE
V_{CB} = 10V
Ta = 25°C
100MHz
−6mA
−4mA
I_E = −2mA
200
400
600
800
900


P_C − Ta
COLLECTOR POWER DISSIPATION P_C (mW)
AMBIENT TEMPERATURE Ta (°C)

2SC3122 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

TV VHF RF AMPLIFIER APPLICATIONS.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

FEATURES :

- High Gain : G_{pe} = 24dB (Typ.) (f = 200MHz)
- Low Noise : NF = 2.0dB (Typ.) (f = 200MHz)
- Excellent Forward AGC Characteristics.

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	20	mA
Base Currentt	I_B	10	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 25V, I_E = 0	—	—	100	nA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 2V, I_C = 0	—	—	100	nA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C = 1mA, I_B = 0	30	—	—	V
DC Current Gain	h_{FE}	V_{CE} = 10V, I_C = 2mA	60	150	300	—
Reverse Transfer Capacitance	C_{re}	V_{CB} = 10V, I_E = 0, f = 1MHz	—	0.3	0.45	pF
Transition Frequency	f_T	V_{CE} = 10V, I_C = 2mA	400	650	—	MHz
Power Gain	G_{pe}	V_{CE} = 12V, V_{AGC} = 1.4V, f = 200MHz	20	24	28	dB
Noise Figure	NF		—	2.0	3.2	dB
AGC Voltage (Note)	V_{AGC}	V_{CC} = 12V, GR = 30dB, f = 200MHz	3.6	4.4	5.1	V

Note : V_{AGC} measured by test circuit shown in Fig. 1 when power gain is reduced to 30dB compared that of V_{AGC} at 1.4V.

Marking

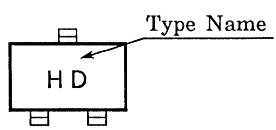
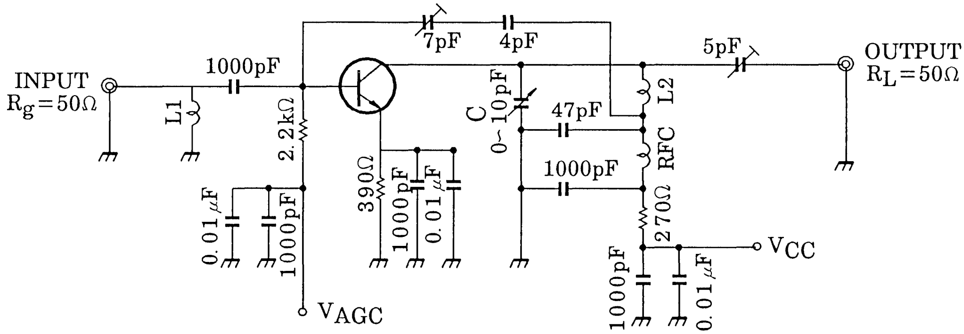
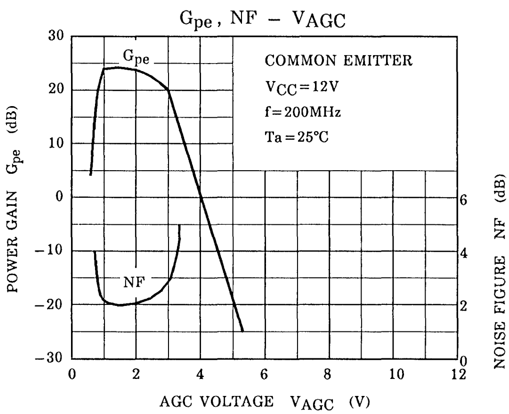
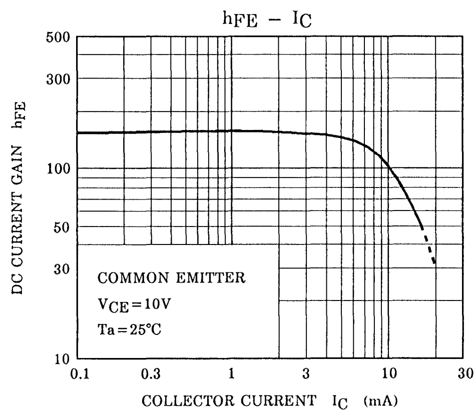


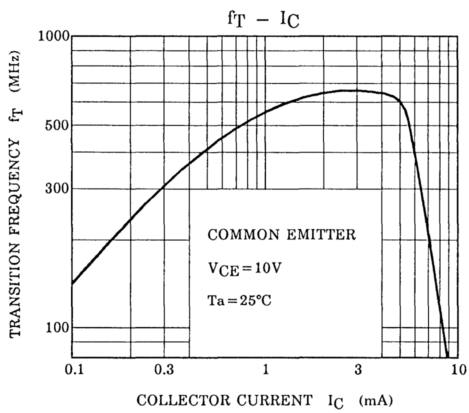
Fig. 1 200MHz G_{pe}, NF TEST CIRCUIT

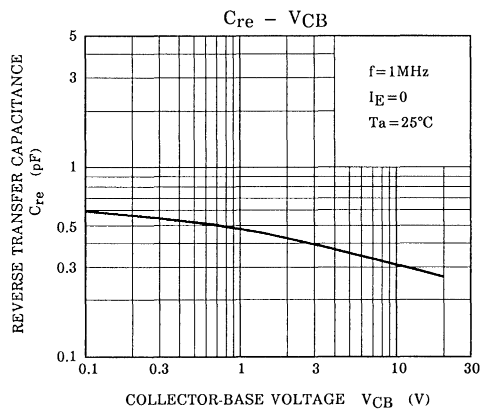


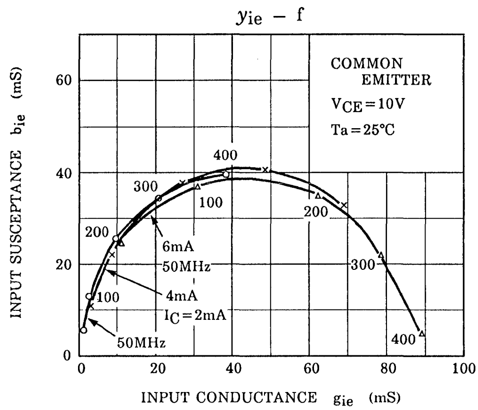
L1 : RF Coil M-15T (TOKO Inc.) or EQUIVALENT
L2 : RF Coil M-25T (TOKO Inc.) or EQUIVALENT



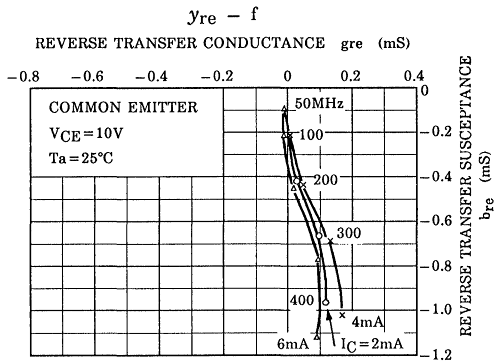




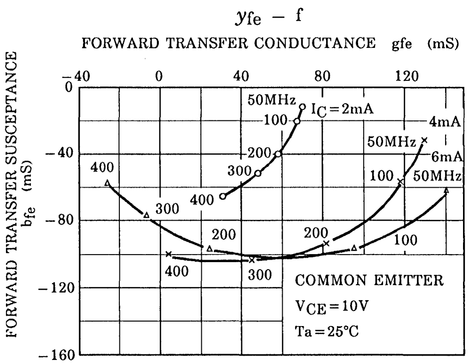




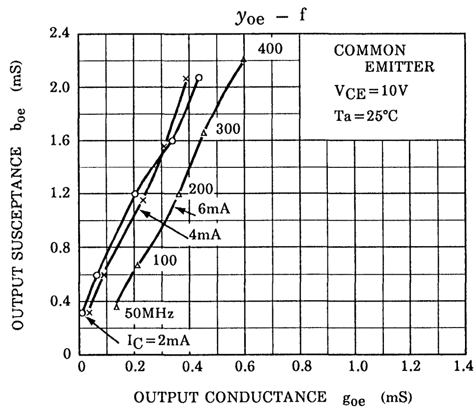
y_{ie} − f
COMMON EMITTER
V_{CE}=10V
Ta=25°C
INPUT SUSCEPTANCE b_{ie} (mS)
INPUT CONDUCTANCE g_{ie} (mS)
I_C=2mA
4mA
6mA
50MHz
100
200
300
400



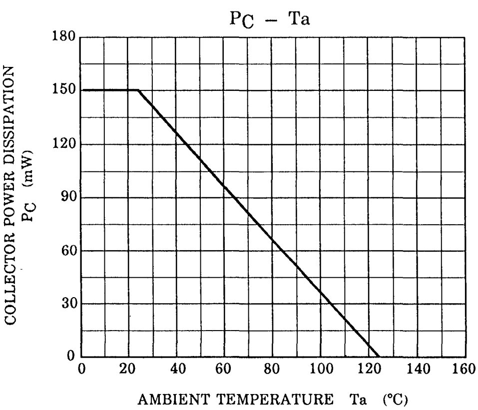
y_{re} − f
REVERSE TRANSFER CONDUCTANCE gre (mS)
REVERSE TRANSFER SUSCEPTANCE b_{re} (mS)
COMMON EMITTER
V_{CE}=10V
Ta=25°C
50MHz
100
200
300
400
6mA
4mA
I_C=2mA



y_{fe} − f
FORWARD TRANSFER CONDUCTANCE gfe (mS)
FORWARD TRANSFER SUSCEPTANCE b_{fe} (mS)
50MHz
I_C=2mA
4mA
6mA
100
200
300
400
COMMON EMITTER
V_{CE}=10V
Ta=25°C



y_{oe} − f
COMMON EMITTER
V_{CE}=10V
Ta=25°C
OUTPUT SUSCEPTANCE b_{oe} (mS)
OUTPUT CONDUCTANCE g_{oe} (mS)
400
300
200
100
50MHz
6mA
4mA
I_C=2mA



P_C − Ta
COLLECTOR POWER DISSIPATION P_C (mW)
AMBIENT TEMPERATURE Ta (°C)

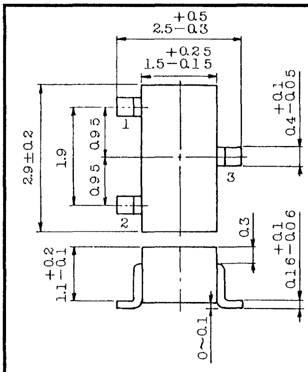
SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC3123

TV VHF MIXER APPLICATIONS.

- High Conversion Gain : G_{ce} = 23dB (Typ.)
- Low Reverse Transfer Capacitance : C_{re} = 0.4pF (Typ.)

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	20	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	50	mA
Base Currentt	I_B	25	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 25V, I_E = 0	—	—	100	nA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 3V, I_C = 0	—	—	1000	nA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C = 1mA, I_B = 0	20	—	—	V
DC Current Gain	h_{FE}	V_{CE} = 10V, I_C = 5mA	40	150	300	
Reverse Transfer Capacitance	C_{re}	V_{CB} = 10V, I_E = 0, f = 1MHz	—	0.4	0.5	pF
Transition Frequency	f_T	V_{CE} = 10V, I_C = 5mA	900	1400	—	MHz
Conversion Gain	G_{ce}	V_{CC} = 12V, f = 200MHz f_L = 260MHz	20	23	—	dB
Noise Figure	NF		—	3.8	5.5	dB

Marking

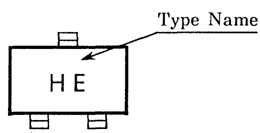
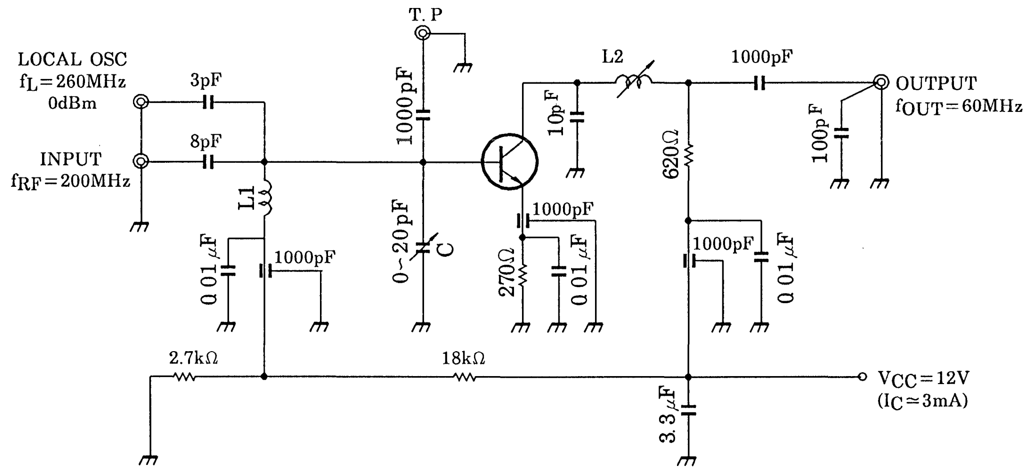
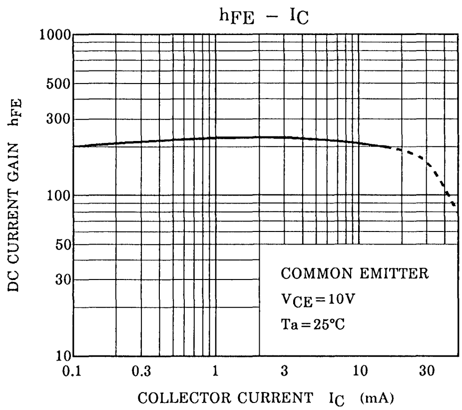
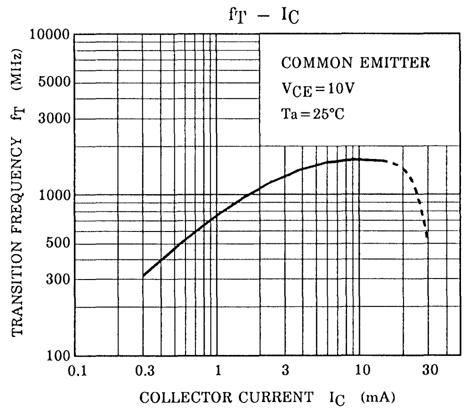


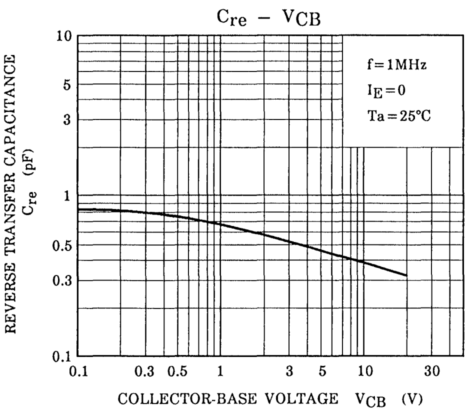
Fig. 1 200MHz G_{ce}, NF TEST CIRCUIT

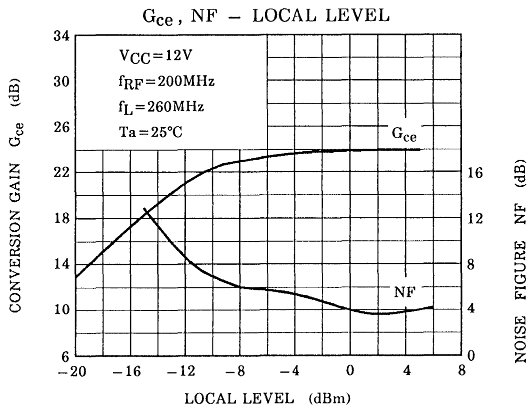


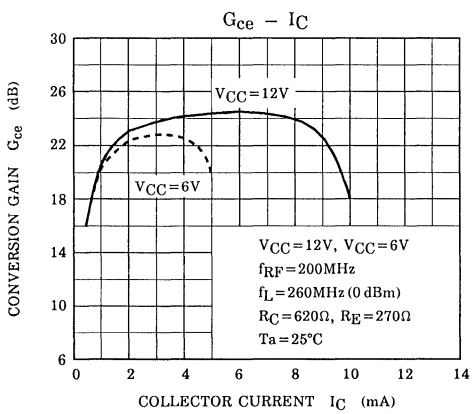
L1 : 0.8mmφ SILVER PLATED COPPER WIRE, 1.5T 5mm ID
L2 : COIL WITH CORE SCN-5962A ① - ③ (TOKO INC.) OR EQUIVALENT
C : AIR TRIMMER TTA25A200A (MURATA MFG, Co., LTD.) OR EQUIVALENT


hFE – IC
DC CURRENT GAIN hFE
1000
500
300
100
50
30
10
0.1
0.3
1
3
10
30
COLLECTOR CURRENT IC (mA)
COMMON EMITTER
VCE=10V
Ta=25°C

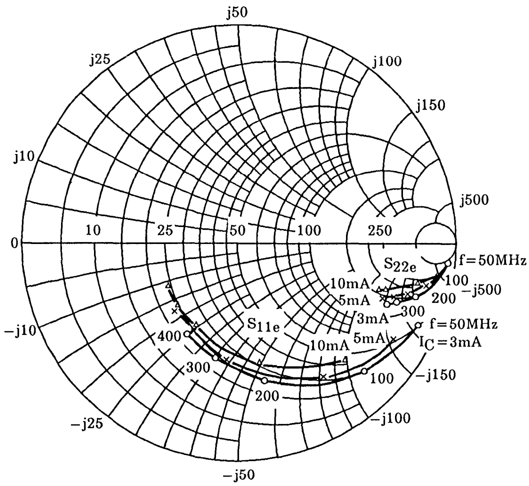

fT – IC
TRANSITION FREQUENCY fT (MHz)
10000
5000
3000
1000
500
300
100
0.1
0.3
1
3
10
30
COLLECTOR CURRENT IC (mA)
COMMON EMITTER
VCE=10V
Ta=25°C


Cre – VCB
REVERSE TRANSFER CAPACITANCE Cre (pF)
10
5
3
1
0.5
0.3
0.1
0.1
0.3
0.5
1
3
5
10
30
COLLECTOR-BASE VOLTAGE VCB (V)
f=1MHz
IE=0
Ta=25°C

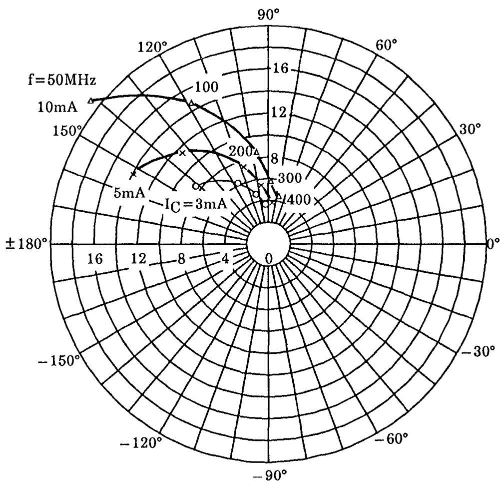

Gce, NF – LOCAL LEVEL
CONVERSION GAIN Gce (dB)
34
30
26
22
18
14
10
6
NOISE FIGURE NF (dB)
16
12
8
4
0
−20
−16
−12
−8
−4
0
4
8
LOCAL LEVEL (dBm)
VCC=12V
fRF=200MHz
fL=260MHz
Ta=25°C
Gce
NF


Gce – IC
CONVERSION GAIN Gce (dB)
30
26
22
18
14
10
6
0
2
4
6
8
10
12
14
COLLECTOR CURRENT IC (mA)
VCC=12V
VCC=6V
VCC=12V, VCC=6V
fRF=200MHz
fL=260MHz (0 dBm)
RC=620Ω, RE=270Ω
Ta=25°C

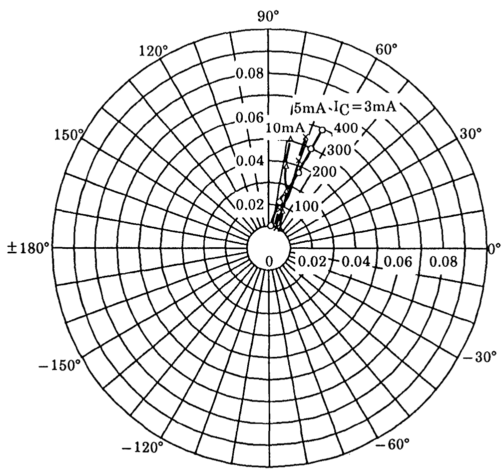
S_{11e}, S_{22e}
$V_{CE}=10V$
$Ta=25°C$
(UNIT : Ω)

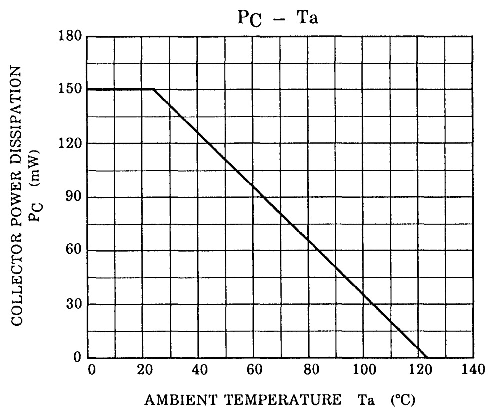


S_{21e}
$V_{CE}=10V$
$Ta=25°C$



S_{12e}
$V_{CE}=10V$
$Ta=25°C$



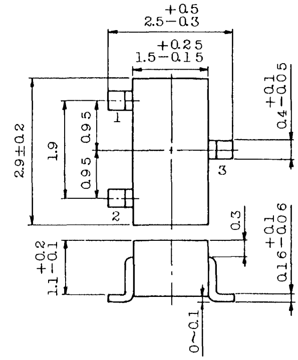


SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC3124

TV TUNER, VHF OSCILLATOR APPLICATIONS.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

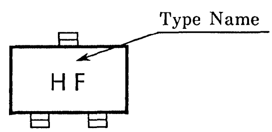
MAXIMUM RATINGS ($Ta = 25°C$)

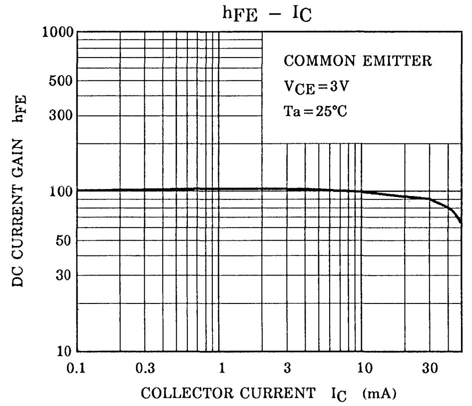
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	15	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	50	mA
Base Current	I_B	25	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

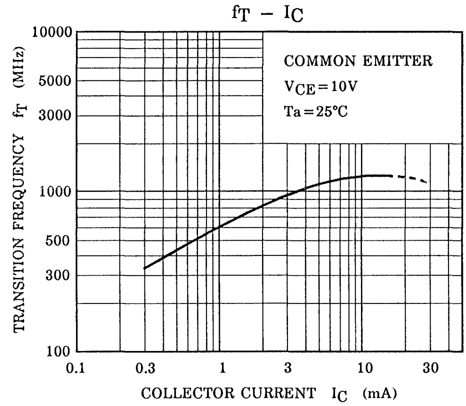
ELECTRICAL CHARACTERISTICS ($Ta = 25°C$)

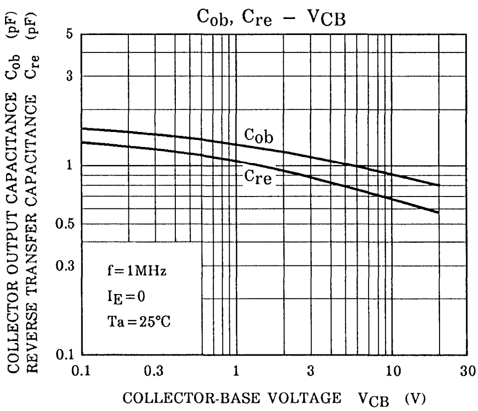
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=15V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=3V$, $I_C=0$	—	—	1.0	μA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA$, $I_B=0$	15	—	—	V
DC Current Gain	h_{FE}	$V_{CE}=3V$, $I_C=8mA$	40	100	200	—
Transition Frequency	f_T	$V_{CE}=10V$, $I_C=8mA$	650	1100	—	MHz
Collector Output Capacitance	C_{ob}	$V_{CB}=10V$, $I_E=0$, $f=1MHz$	—	0.9	1.3	pF
Collector-Base Time Constant	$C_c \cdot rbb'$	$V_{CB}=10V$, $I_C=8mA$, $f=30MHz$	—	7	12	ps

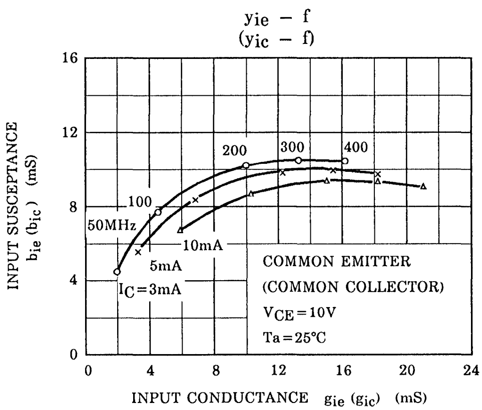
Marking

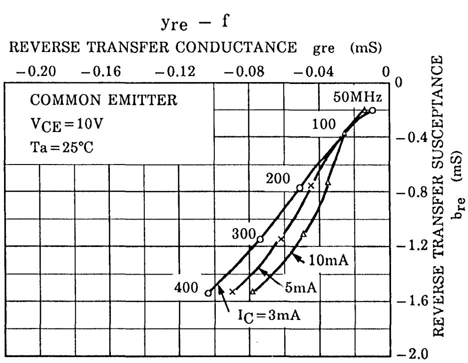


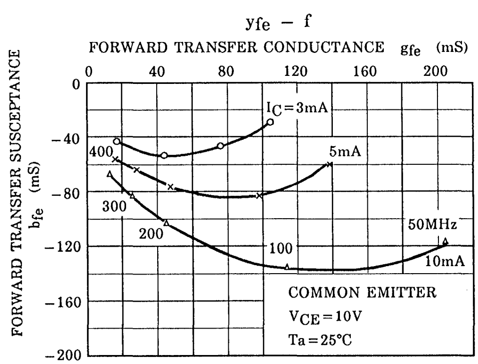

hFE – IC
COMMON EMITTER
VCE=3V
Ta=25°C
DC CURRENT GAIN hFE
1000
500
300
100
50
30
10
0.1
0.3
1
3
10
30
COLLECTOR CURRENT IC (mA)


fT – IC
COMMON EMITTER
VCE=10V
Ta=25°C
TRANSITION FREQUENCY fT (MHz)
10000
5000
3000
1000
500
300
100
0.1
0.3
1
3
10
30
COLLECTOR CURRENT IC (mA)

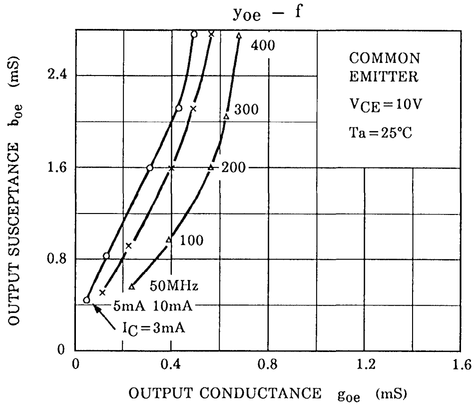

Cob, Cre – VCB
Cob
Cre
f=1MHz
IE=0
Ta=25°C
COLLECTOR OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
5
3
1
0.5
0.3
0.1
0.1
0.3
1
3
10
30
COLLECTOR-BASE VOLTAGE VCB (V)


yie – f
(yic – f)
INPUT SUSCEPTANCE bie (bic) (mS)
16
12
8
4
0
200
300
400
100
50MHz
10mA
5mA
IC=3mA
COMMON EMITTER
(COMMON COLLECTOR)
VCE=10V
Ta=25°C
0
4
8
12
16
20
24
INPUT CONDUCTANCE gie (gic) (mS)

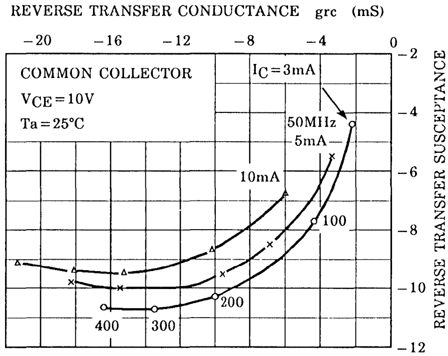

yre – f
REVERSE TRANSFER CONDUCTANCE gre (mS)
−0.20
−0.16
−0.12
−0.08
−0.04
0
COMMON EMITTER
VCE=10V
Ta=25°C
50MHz
100
200
300
400
10mA
5mA
IC=3mA
0
−0.4
−0.8
−1.2
−1.6
−2.0
REVERSE TRANSFER SUSCEPTANCE bre (mS)


yfe – f
FORWARD TRANSFER CONDUCTANCE gfe (mS)
0
40
80
120
160
200
FORWARD TRANSFER SUSCEPTANCE bfe (mS)
0
−40
−80
−120
−160
−200
IC=3mA
5mA
400
300
200
100
50MHz
10mA
COMMON EMITTER
VCE=10V
Ta=25°C

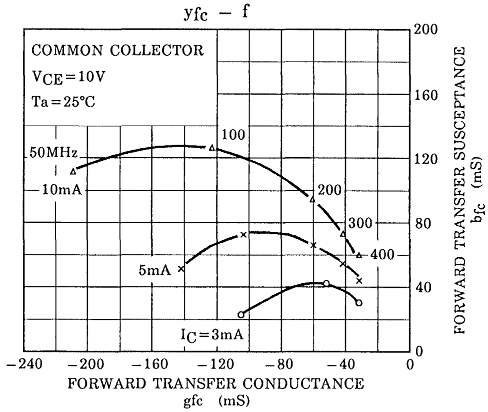
$y_{oe} - f$



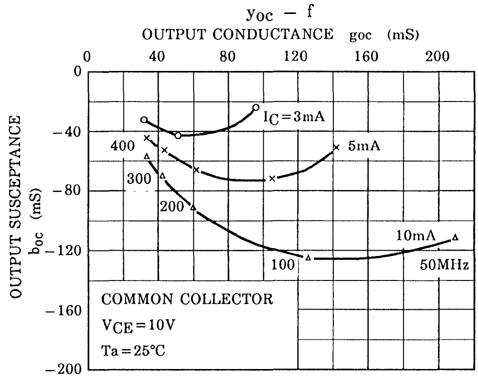
$y_{rc} - f$



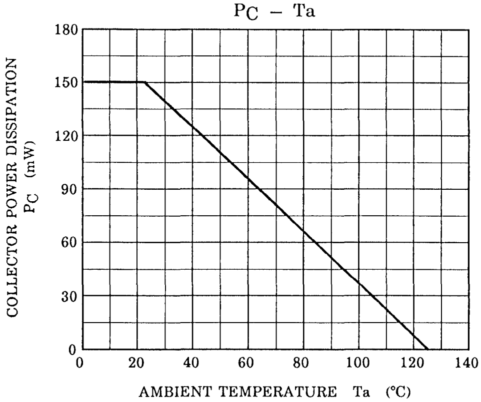
$y_{fc} - f$



$y_{oc} - f$



$P_C - Ta$

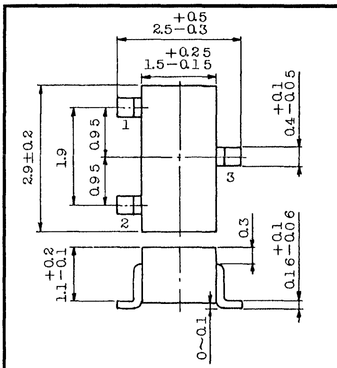


2SC3125 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

TV FINAL PICTURE IF AMPLIFIER APPLICATIONS.

- Good Lineality of f_T

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

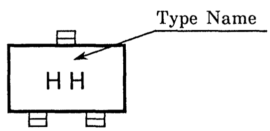
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	25	V
Emitter-Base Voltage	V_{EBO}	4	V
Collector Current	I_C	50	mA
Base Currentt	I_B	25	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

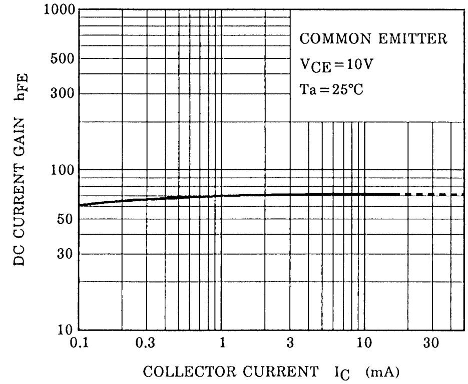
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current		I_{CBO}	$V_{CB}=30V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current		I_{EBO}	$V_{EB}=3V$, $I_C=0$	—	—	0.1	μA
Collector-Emitter Breakdown Voltage		$V_{(BR)CEO}$	$I_C=10mA$, $I_B=0$	25	—	—	V
DC Current Gain		h_{FE}	$V_{CE}=10V$, $I_C=10mA$	20	70	200	—
Saturation Voltage	Collector-Emitter	$V_{CE(sat)}$	$I_C=15mA$, $I_B=1.5mA$	—	—	0.2	V
	Base-Emitter	$V_{BE(sat)}$		—	—	1.5	
Collector Output Capacitance		C_{ob}	$V_{CB}=10V$, $I_E=0$, f=1MHz	—	1.1	1.6	pF
Collector-Base Time Constant		C_c . rbb'	$V_{CB}=10V$, $I_C=1mA$, f=30MHz	—	—	25	ps
Transition Frequency		f_T	$V_{CE}=10V$, $I_C=10mA$	250	600	—	MHz

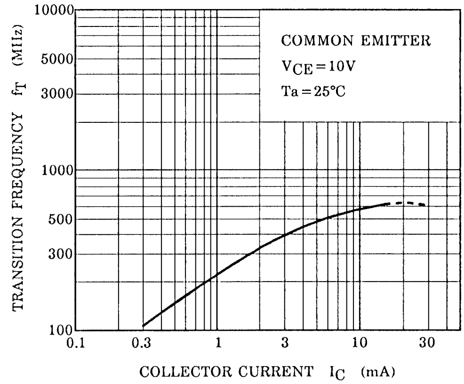
Marking



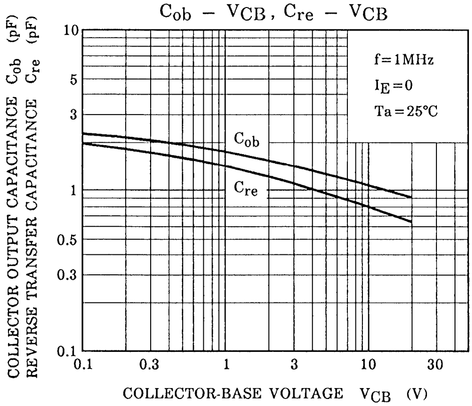
$h_{FE} - I_C$



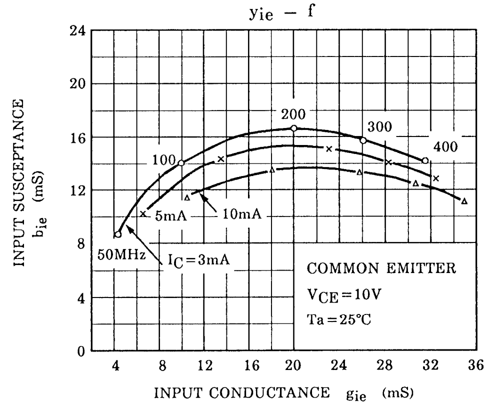
$f_T - I_C$



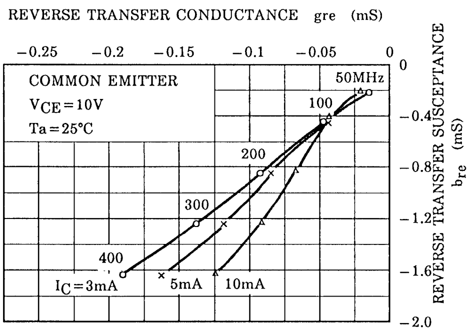
$C_{ob} - V_{CB}$, $C_{re} - V_{CB}$



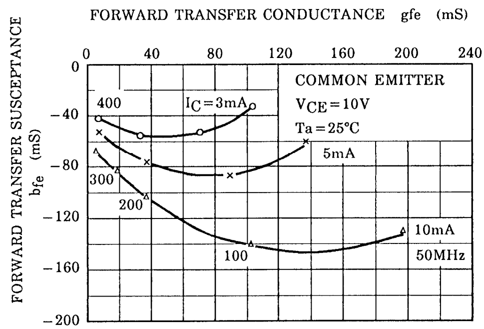
$y_{ie} - f$

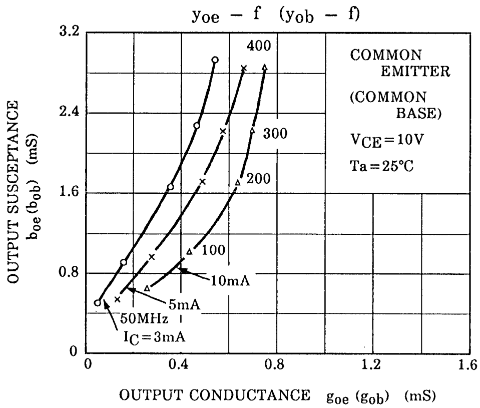


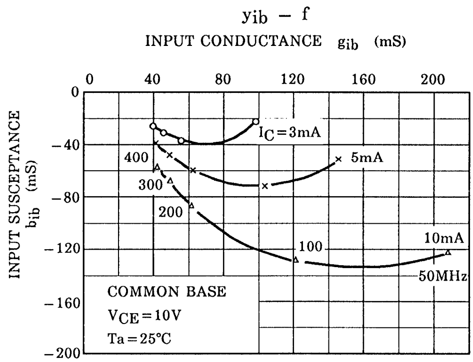
$y_{re} - f$

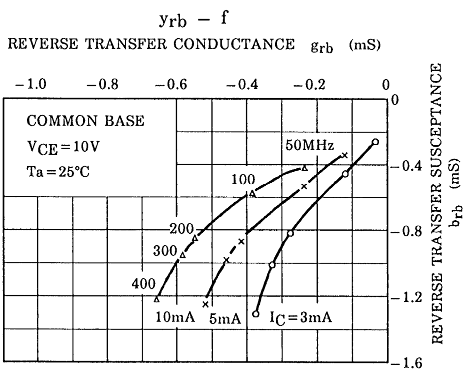


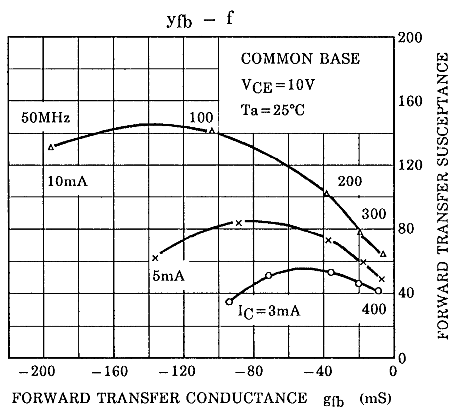
$y_{fe} - f$

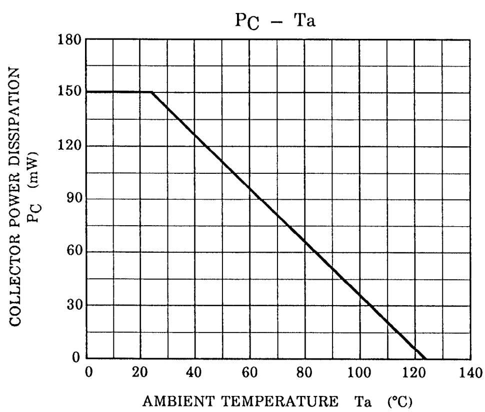



yoe – f (yob – f)
OUTPUT SUSCEPTANCE boe(bob) (mS)
OUTPUT CONDUCTANCE goe (gob) (mS)
COMMON EMITTER
(COMMON BASE)
VCE=10V
Ta=25°C
400
300
200
100
10mA
5mA
50MHz
IC=3mA


yib – f
INPUT CONDUCTANCE gib (mS)
INPUT SUSCEPTANCE bib (mS)
IC=3mA
5mA
10mA
400
300
200
100
50MHz
COMMON BASE
VCE=10V
Ta=25°C


yrb – f
REVERSE TRANSFER CONDUCTANCE grb (mS)
REVERSE TRANSFER SUSCEPTANCE brb (mS)
COMMON BASE
VCE=10V
Ta=25°C
50MHz
100
200
300
400
10mA
5mA
IC=3mA


yfb – f
FORWARD TRANSFER CONDUCTANCE gfb (mS)
FORWARD TRANSFER SUSCEPTANCE bfb (mS)
COMMON BASE
VCE=10V
Ta=25°C
50MHz
100
10mA
200
300
5mA
IC=3mA
400

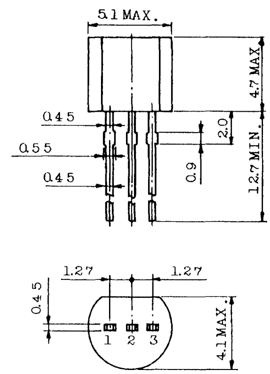

PC – Ta
COLLECTOR POWER DISSIPATION PC (mW)
AMBIENT TEMPERATURE Ta (°C)

SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC3136

TV VHF MIXER APPLICATIONS.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	TO-92
EIAJ	SC-43
TOSHIBA	2-5F1E

Weight : 0.21g

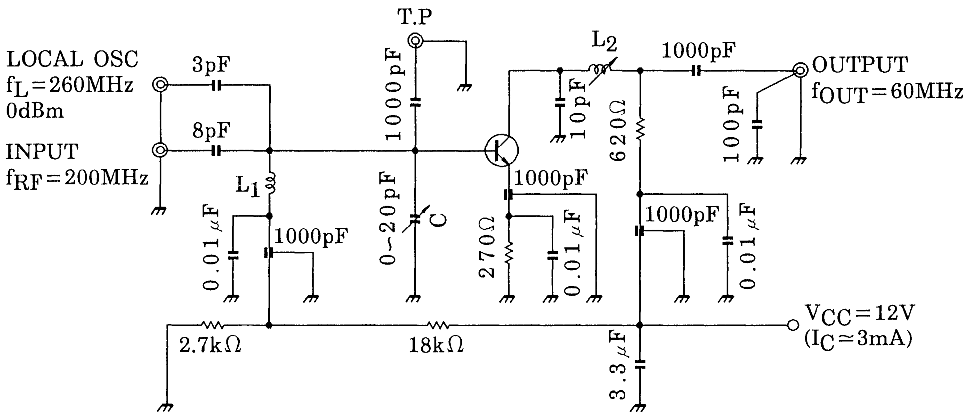
- High Conversion Gain : G_{ce} = 23dB (Typ.)
- Low Reverse Transfer Capacitance : C_{re} = 0.4pF (Typ.)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	20	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	50	mA
Base Current	I_B	25	mA
Collector Power Dissipation	P_C	250	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

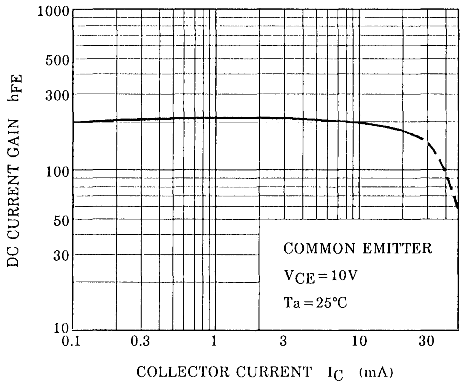
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 25V, I_E = 0	—	—	100	nA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 3V, I_C = 0	—	—	1000	nA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C = 1mA, I_B = 0	20	—	—	V
DC Current Gain	h_{FE}	V_{CE} = 10V, I_C = 5mA	40	150	300	—
Reverse Transfer Capacitance	C_{re}	V_{CB} = 10V, I_E = 0, f = 1MHz	—	0.4	0.5	pF
Transition Frequency	f_T	V_{CE} = 10V, I_C = 5mA	900	1400	—	MHz
Conversion Gain	G_{ce}	V_{CC} = 12V, f = 200MHz, f_L = 260MHz	20	23	—	dB
Noise Figure	NF		—	3.8	5.5	dB



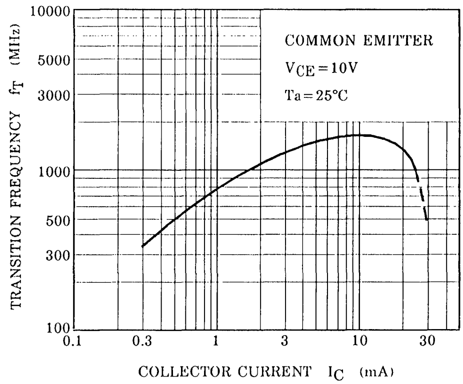
L_1 : 0.8mmφ SILVER PLATED COPPER WIRE, 1.5T 5mm ID
L_2 : COIL WITH CORE SCN-5962A①-③ (TOKO INC.) OR EQUIVALENT
C : AIR TRIMMER TTA25A200A (MURATA MFG. Co., LTD.) OR EQUIVALENT

Fig.1 200MHz G_{ce}, NF TEST CIRCUIT

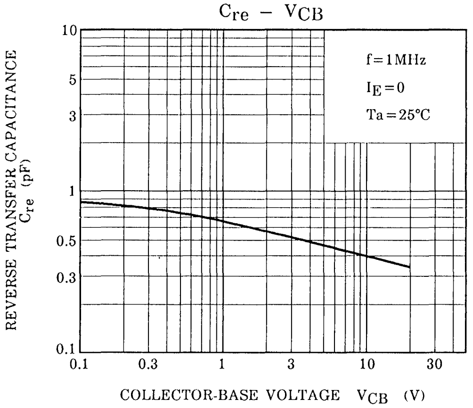
h_{FE} – I_C



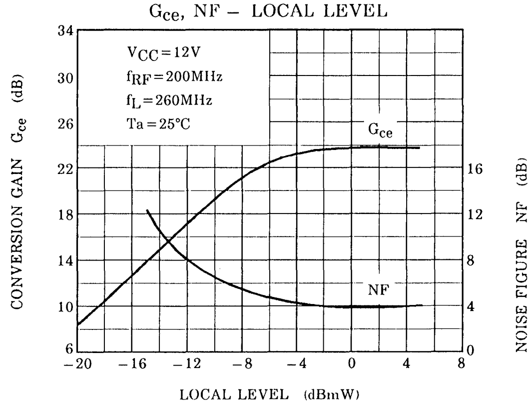
f_T – I_C



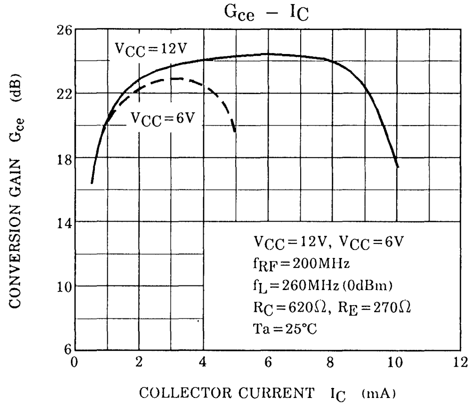
C_{re} – V_{CB}



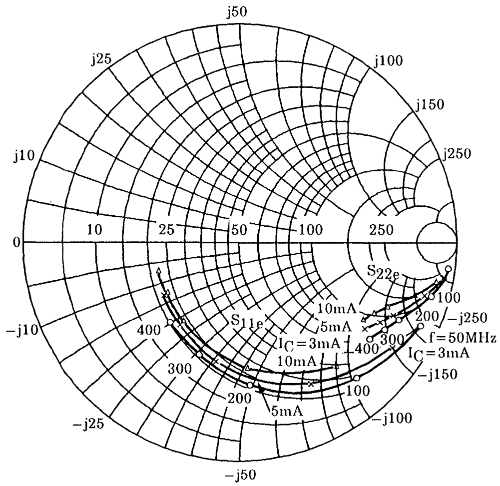
G_{ce}, NF – LOCAL LEVEL



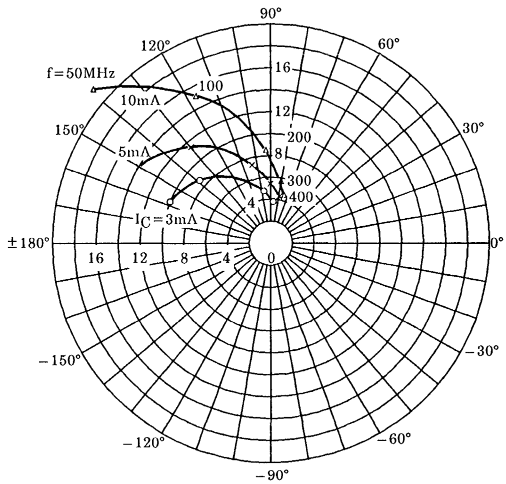
G_{ce} – I_C



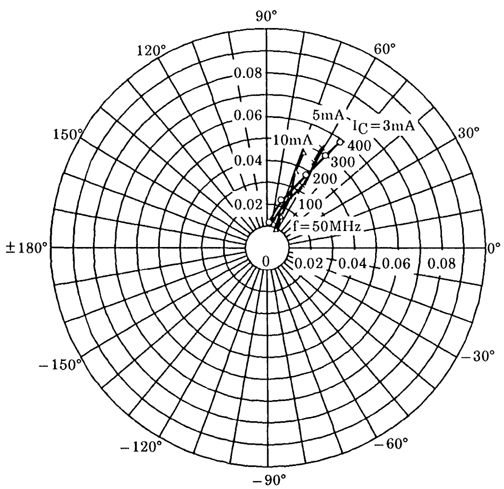
S_{11e}, S_{22e}
$V_{CE}=10V$
Ta = 25°C
(UNIT : Ω)

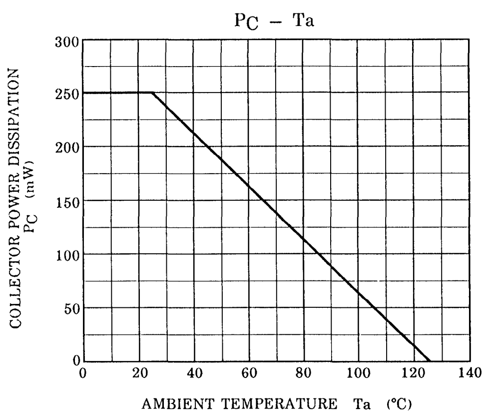


S_{21e}
$V_{CE}=10V$
Ta = 25°C



S_{12e}
$V_{CE}=10V$
Ta = 25°C





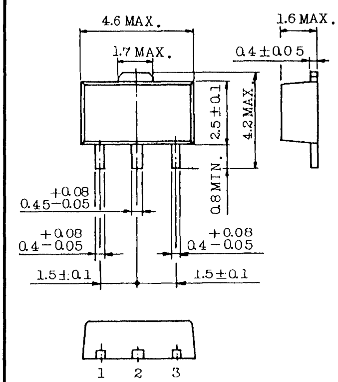
SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC3268

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- NF=1.7dB, $|S_{21e}|^2$=15.0dB (f=500MHz)
- NF=2dB, $|S_{21e}|^2$=9.5dB (f=1000MHz)

Unit in mm



1. BASE
2. COLLECTOR (HEAT SINK)
3. EMITTER

JEDEC	—
EIAJ	—
TOSHIBA	2-5K1A

Weight : 0.052g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	17	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Base Current	I_B	30	mA
Collector Current	I_C	70	mA
Collector Power Dissipation	P_C	300	mW
Collector Power Dissipation	P_C※	800	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~150	°C

P_C※ : When mounted ceramic substrate of 250mm^2×0.8mmt

MICROWAVE CHARACTERISTICS (Ta = 25°C)

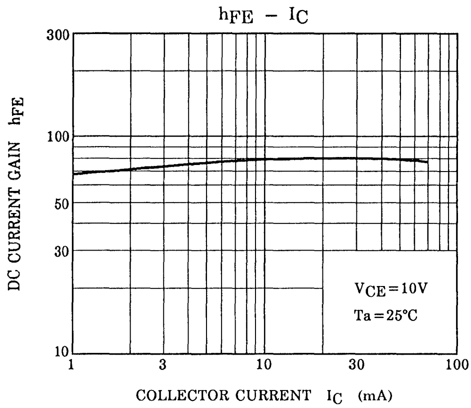
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE}=10V, I_C=20mA	—	5	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE}=10V, I_C=20mA, f=500MHz	—	15.0	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE}=10V, I_C=20mA, f=1GHz	—	9.5	—	dB
Noise Figure	NF (1)	V_{CE}=10V, I_C=5mA, f=500MHz	—	1.7	—	dB
	NF (2)	V_{CE}=10V, I_C=5mA, f=1GHz	—	2.0	—	dB

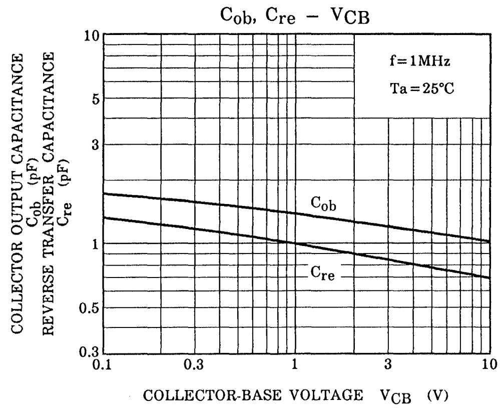
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

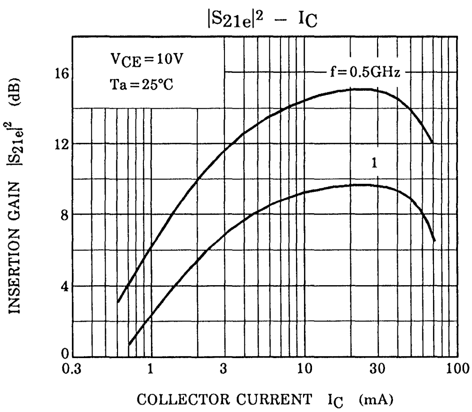
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB}=10V, I_E=0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB}=1V, I_C=0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE}=10V, I_C=20mA	25	—	—	—
Collector Output Capacitance	C_{ob}	V_{CB}=10V, I_E=0, f=1MHz	—	1.05	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.7	—	pF

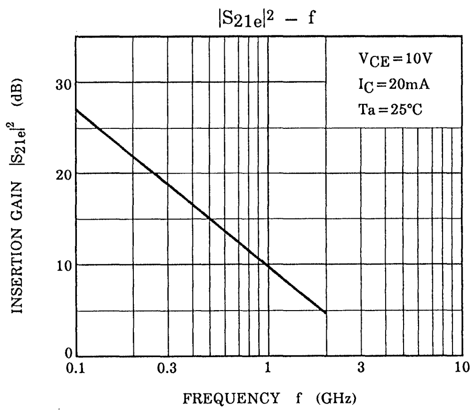
Note : C_{re} is measured by 3 terminal method with Capacitance Bridge.

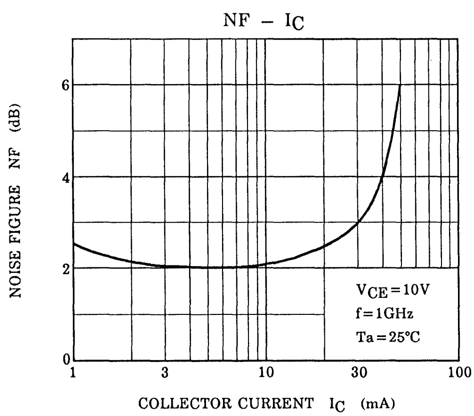
Marking : ME

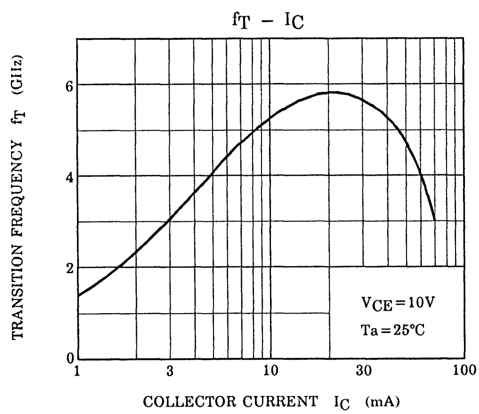

hFE – IC
DC CURRENT GAIN hFE
300
100
50
30
10
1
3
10
30
100
VCE=10V
Ta=25°C
COLLECTOR CURRENT IC (mA)

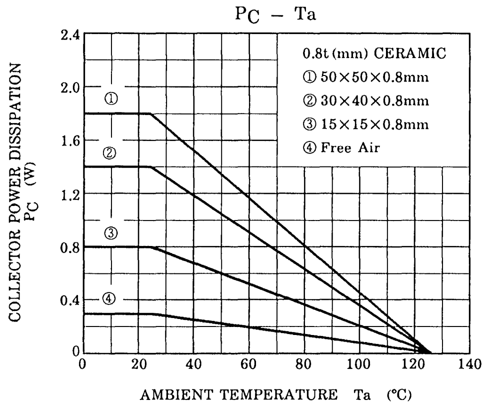

Cob, Cre – VCB
COLLECTOR OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
10
5
3
1
0.5
0.3
0.1
0.3
1
3
10
f=1MHz
Ta=25°C
Cob
Cre
COLLECTOR-BASE VOLTAGE VCB (V)

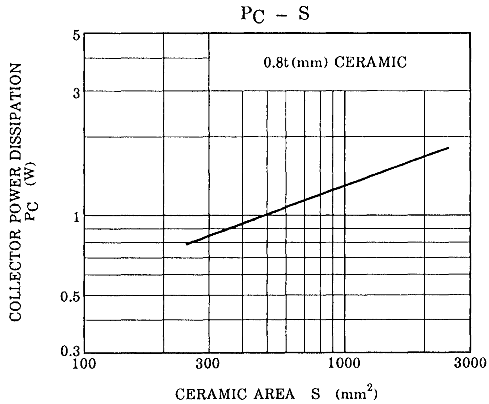

|S21e|2 – IC
INSERTION GAIN |S21e|2 (dB)
16
12
8
4
0
0.3
1
3
10
30
100
VCE=10V
Ta=25°C
f=0.5GHz
1
COLLECTOR CURRENT IC (mA)


|S21e|2 – f
INSERTION GAIN |S21e|2 (dB)
30
20
10
0
0.1
0.3
1
3
10
VCE=10V
IC=20mA
Ta=25°C
FREQUENCY f (GHz)

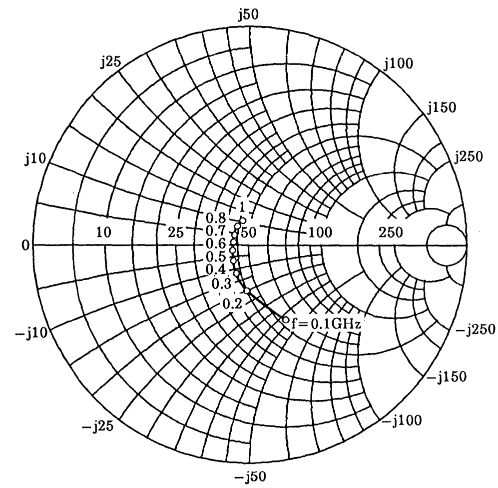

NF – IC
NOISE FIGURE NF (dB)
6
4
2
0
1
3
10
30
100
VCE=10V
f=1GHz
Ta=25°C
COLLECTOR CURRENT IC (mA)


fT – IC
TRANSITION FREQUENCY fT (GHz)
6
4
2
0
1
3
10
30
100
VCE=10V
Ta=25°C
COLLECTOR CURRENT IC (mA)

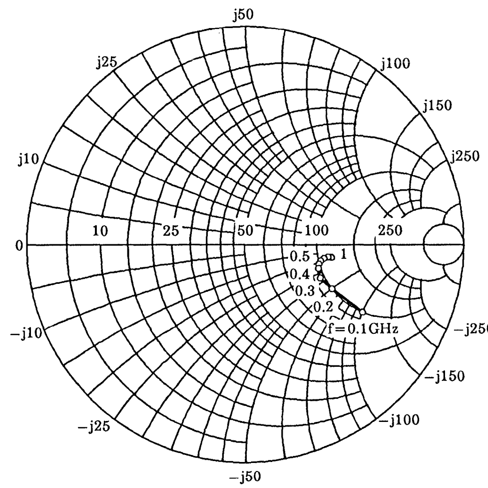

PC – Ta
0.8t (mm) CERAMIC
① 50×50×0.8mm
② 30×40×0.8mm
③ 15×15×0.8mm
④ Free Air
COLLECTOR POWER DISSIPATION PC (W)
AMBIENT TEMPERATURE Ta (°C)
2.4
2.0
1.6
1.2
0.8
0.4
0
20
40
60
80
100
120
140


PC – S
0.8t (mm) CERAMIC
COLLECTOR POWER DISSIPATION PC (W)
CERAMIC AREA S (mm²)
5
3
1
0.5
0.3
100
300
1000
3000

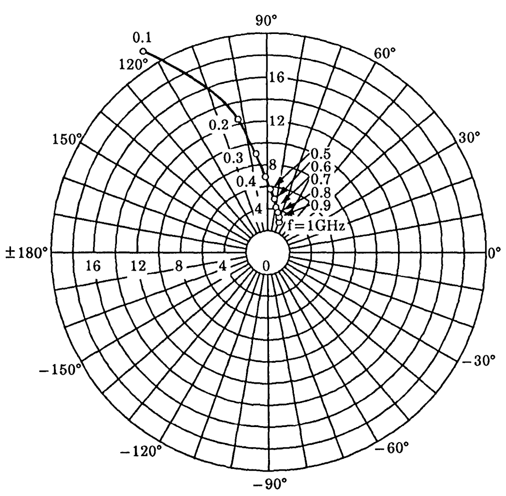
S_{11e}
$V_{CE} = 10V$
$I_C = 20mA$
$Ta = 25°C$
(UNIT : Ω)



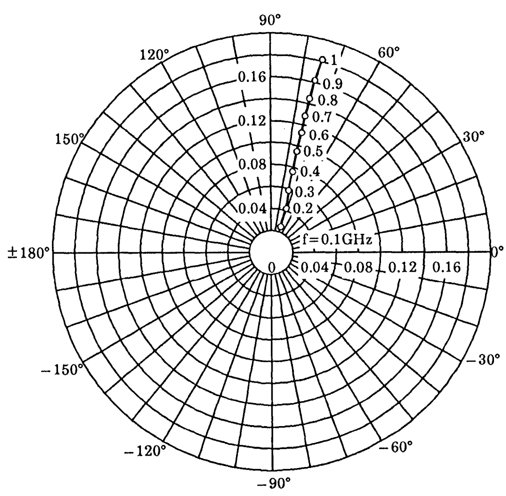
S_{22e}
$V_{CE} = 10V$
$I_C = 20mA$
$Ta = 25°C$
(UNIT : Ω)



S_{21e}
$V_{CE} = 10V$
$I_C = 20mA$
$Ta = 25°C$



S_{12e}
$V_{CE} = 10V$
$I_C = 20mA$
$Ta = 25°C$

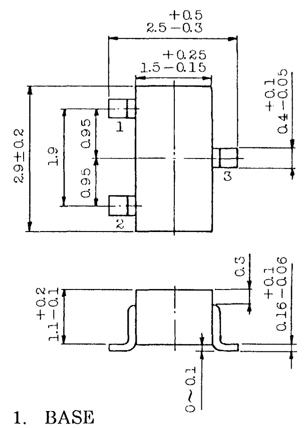


SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR 2SC3429

VHF ~ UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure.
- NF = 1.5dB, $|S_{21e}|^2$ = 16dB (f = 500MHz)
- NF = 1.7dB, $|S_{21e}|^2$ = 10.5dB (f = 1GHz)

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	17	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	70	mA
Base Current	I_B	30	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MICROWAVE CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONSITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 10V, I_C = 20mA	—	5	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE} = 10V, I_C = 20mA, f = 500MHz	—	16	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE} = 10V, I_C = 20mA, f = 1GHz	—	10.5	—	dB
Noise Figure	NF (1)	V_{CE} = 10V, I_C = 5mA, f = 500MHz	—	1.5	—	dB
	NF (2)	V_{CE} = 10V, I_C = 5mA, f = 1GHz	—	1.7	—	dB

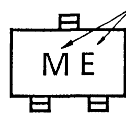
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

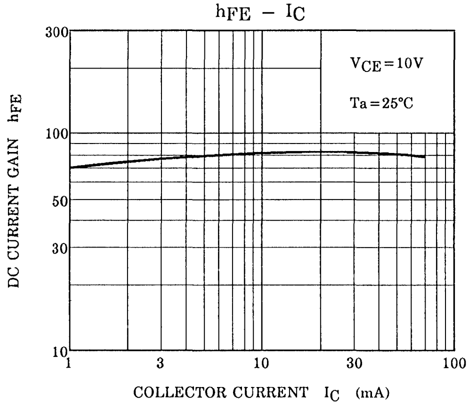
CHARACTERISTIC	SYMBOL	TEST CONSITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_C = 0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE} = 10V, I_C = 20mA	25	—	—	—
Output Capacitance	C_{ob}	V_{CB} = 10V, I_E = 0, f = 1MHz (Note)	—	0.85	—	pF
Reverse Transfer Capacitance	C_{re}		—	0.57	—	pF

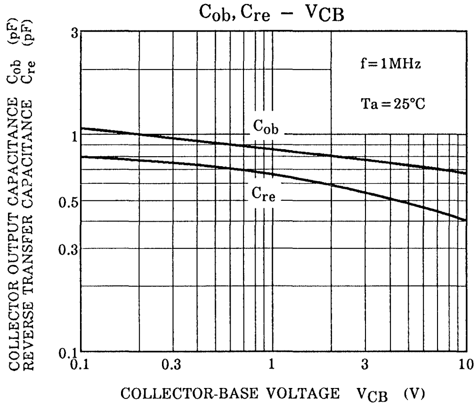
Note : Cre is measured by 3 terminal method with Capacitance Bridge.

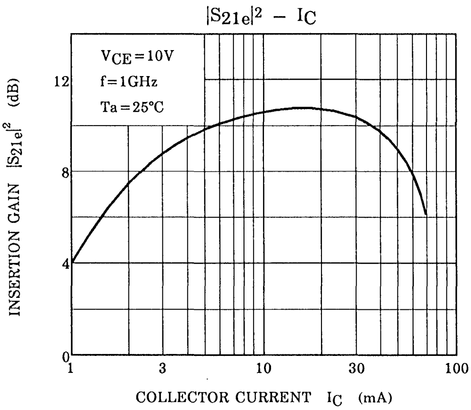
MARKING

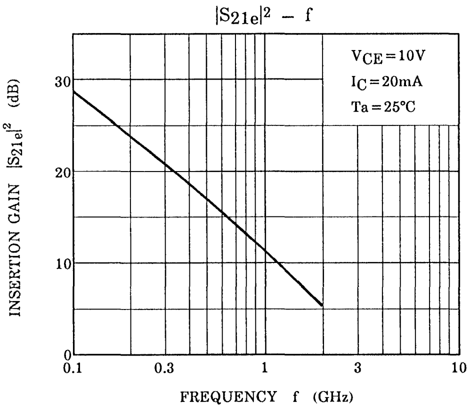
Type Name

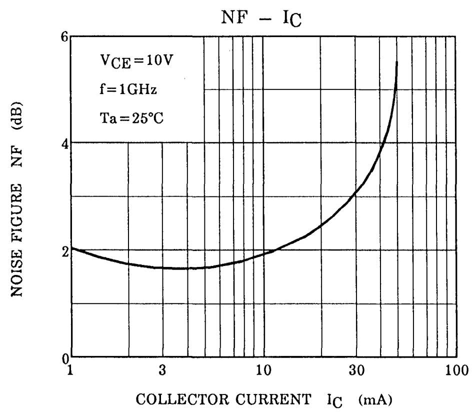


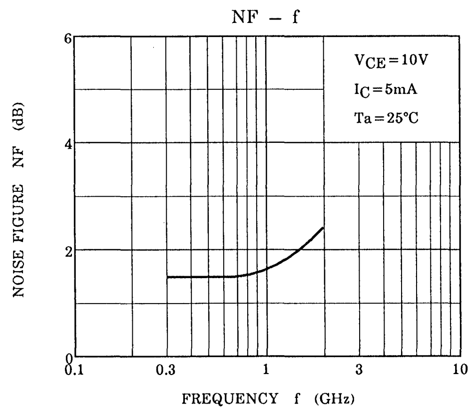

hFE – IC
DC CURRENT GAIN hFE
VCE=10V
Ta=25°C
300
100
50
30
10
1
3
10
30
100
COLLECTOR CURRENT IC (mA)


Cob, Cre – VCB
COLLECTOR OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
f=1MHz
Ta=25°C
Cob
Cre
3
1
0.5
0.3
0.1
0.1
0.3
1
3
10
COLLECTOR-BASE VOLTAGE VCB (V)

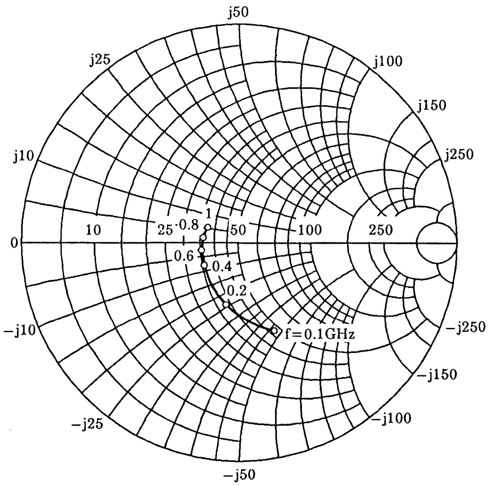

|S21e|2 – IC
INSERTION GAIN |S21e|2 (dB)
VCE=10V
f=1GHz
Ta=25°C
12
8
4
0
1
3
10
30
100
COLLECTOR CURRENT IC (mA)


|S21e|2 – f
INSERTION GAIN |S21e|2 (dB)
VCE=10V
IC=20mA
Ta=25°C
30
20
10
0
0.1
0.3
1
3
10
FREQUENCY f (GHz)

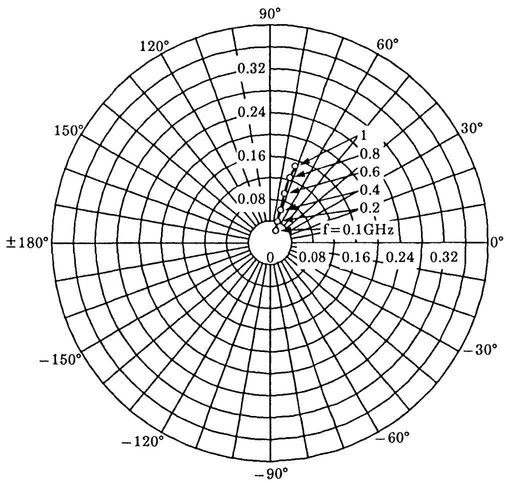

NF – IC
NOISE FIGURE NF (dB)
VCE=10V
f=1GHz
Ta=25°C
6
4
2
0
1
3
10
30
100
COLLECTOR CURRENT IC (mA)


NF – f
NOISE FIGURE NF (dB)
VCE=10V
IC=5mA
Ta=25°C
6
4
2
0
0.1
0.3
1
3
10
FREQUENCY f (GHz)

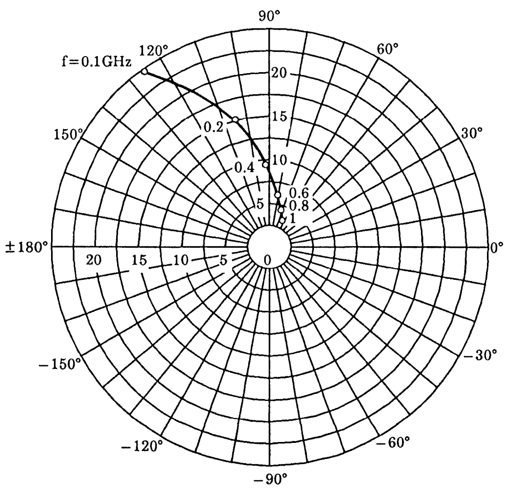
S_{11e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)



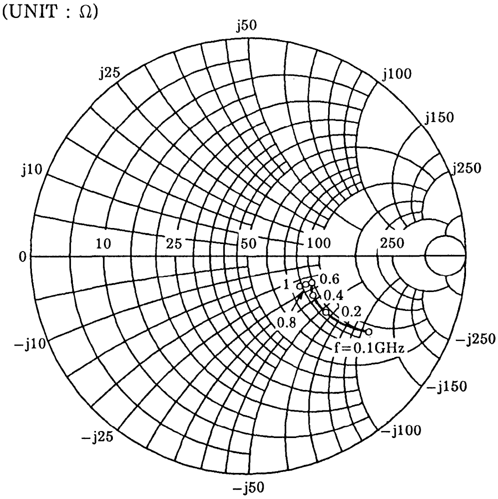
S_{12e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$



S_{21e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$



S_{22e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)

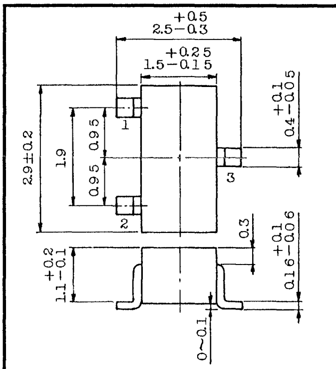


2SC3547A SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

TV TUNER, UHF OSCILLATOR APPLICATIONS.
(COMMON COLLECTOR)

- Transition Frequency is High and Dependent on Current Excellently.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	—
TOSHIBA	2-3F1A

Weight: 0.012g

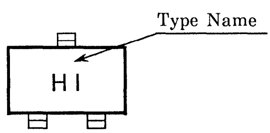
MAXIMUM RATINGS ($Ta = 25°C$)

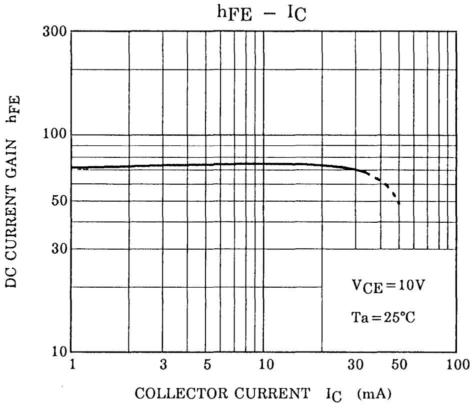
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Base Current	I_B	15	mA
Collector Current	I_C	30	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

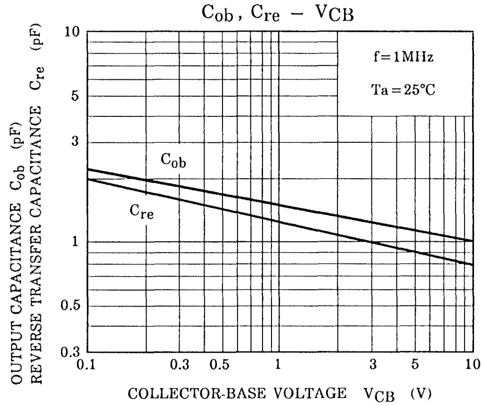
ELECTRICAL CHARACTERISTICS ($Ta = 25°C$)

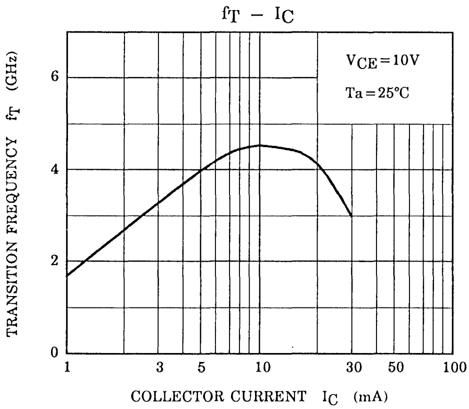
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=10V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=1V$, $I_C=0$	—	—	1.0	μA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA$, $I_B=0$	12	—	—	V
DC Current Gain	h_{FE}	$V_{CE}=10V$, $I_C=5mA$	35	—	130	—
Transition Frequency	f_T	$V_{CE}=10V$, $I_C=10mA$	3	4	—	GHz
Output Capacitance	C_{ob}	$V_{CB}=10V$, $I_E=0$, f=1MHz	—	1.05	1.35	pF
Collector-Base Time Constant	$C_c \cdot rbb'$	$V_{CB}=10V$, $I_C=5mA$, f=30MHz	—	4.5	10	ps

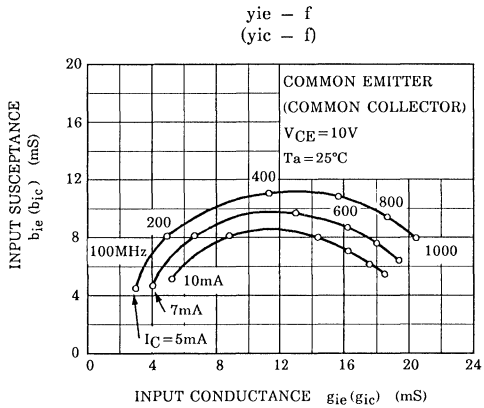
Marking

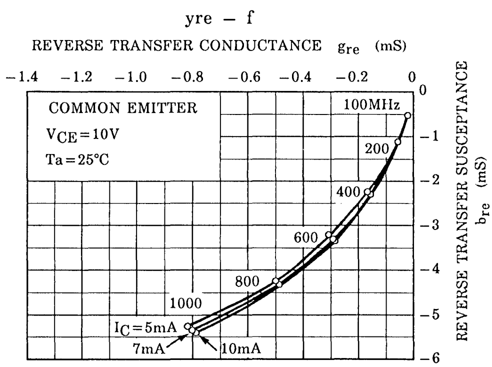


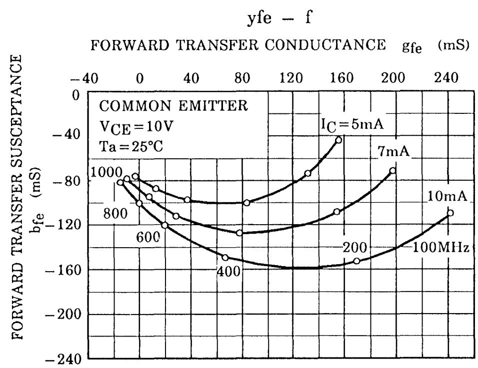

hFE – IC
DC CURRENT GAIN hFE
VCE=10V
Ta=25°C
COLLECTOR CURRENT IC (mA)

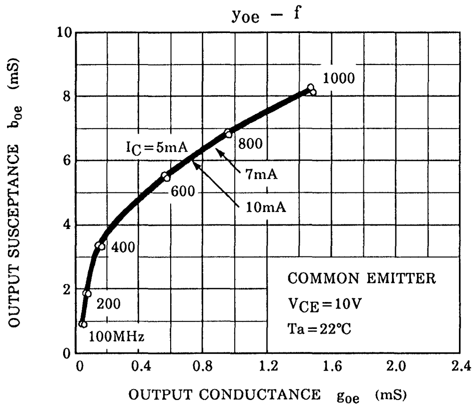

Cob, Cre – VCB
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
f=1MHz
Ta=25°C
Cob
Cre
COLLECTOR-BASE VOLTAGE VCB (V)

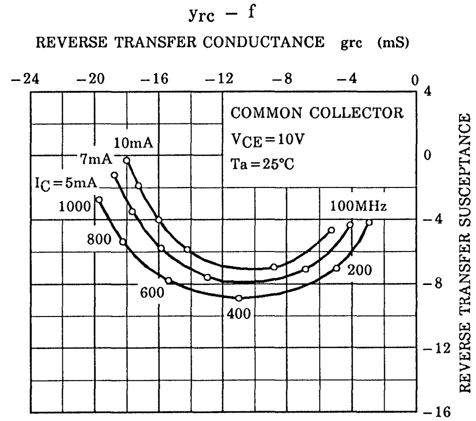

fT – IC
TRANSITION FREQUENCY fT (GHz)
VCE=10V
Ta=25°C
COLLECTOR CURRENT IC (mA)

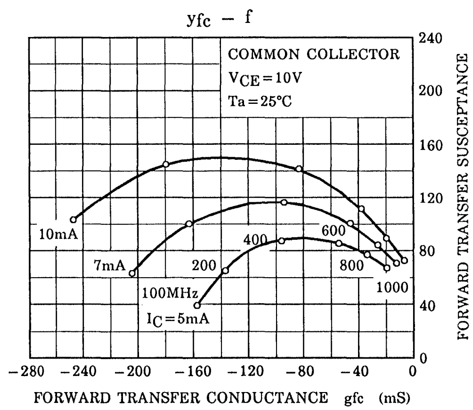

yie – f
(yic – f)
INPUT SUSCEPTANCE bie (bic) (mS)
COMMON EMITTER
(COMMON COLLECTOR)
VCE=10V
Ta=25°C
100MHz
200
400
600
800
1000
10mA
7mA
IC=5mA
INPUT CONDUCTANCE gie (gic) (mS)

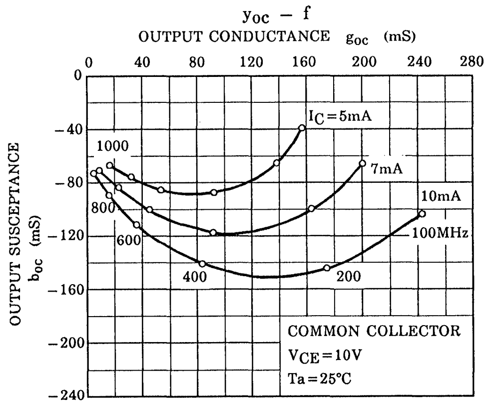

yre – f
REVERSE TRANSFER CONDUCTANCE gre (mS)
REVERSE TRANSFER SUSCEPTANCE bre (mS)
COMMON EMITTER
VCE=10V
Ta=25°C
100MHz
200
400
600
800
1000
IC=5mA
7mA
10mA


yfe – f
FORWARD TRANSFER CONDUCTANCE gfe (mS)
FORWARD TRANSFER SUSCEPTANCE bfe (mS)
COMMON EMITTER
VCE=10V
Ta=25°C
IC=5mA
7mA
10mA
1000
800
600
400
200
100MHz


yoe − f
OUTPUT SUSCEPTANCE boe (mS)
OUTPUT CONDUCTANCE goe (mS)
IC=5mA
7mA
10mA
1000
800
600
400
200
100MHz
COMMON EMITTER
VCE=10V
Ta=22°C


yrc − f
REVERSE TRANSFER CONDUCTANCE grc (mS)
REVERSE TRANSFER SUSCEPTANCE brc (mS)
COMMON COLLECTOR
VCE=10V
Ta=25°C
10mA
7mA
IC=5mA
1000
800
600
400
200
100MHz


yfc − f
FORWARD TRANSFER CONDUCTANCE gfc (mS)
FORWARD TRANSFER SUSCEPTANCE bfc (mS)
COMMON COLLECTOR
VCE=10V
Ta=25°C
10mA
7mA
100MHz
IC=5mA
200
400
600
800
1000

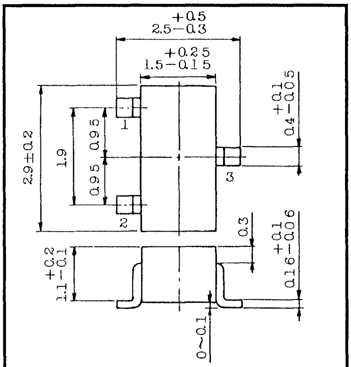

yoc − f
OUTPUT CONDUCTANCE goc (mS)
OUTPUT SUSCEPTANCE boc (mS)
IC=5mA
7mA
10mA
100MHz
1000
800
600
400
200
COMMON COLLECTOR
VCE=10V
Ta=25°C

SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR **2SC3547B**

TV TUNER, UHF OSCILLATOR APPLICATIONS.
(COMMON COLLECTOR)

- Transition Frequency is High and Dependent on Current Excellently.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	—
TOSHIBA	2-3F1A

Weight : 0.012g

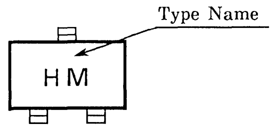
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Base Current	I_B	15	mA
Collector Current	I_C	30	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

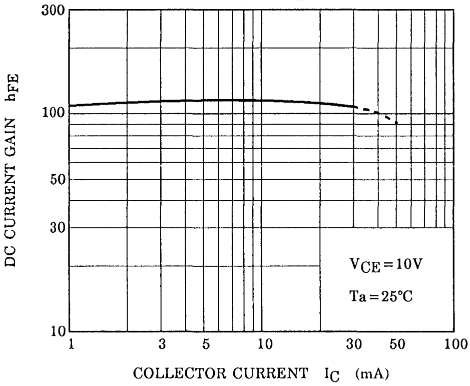
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=10V,\ I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=1V,\ I_C=0$	—	—	1.0	μA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA,\ I_B=0$	12	—	—	V
DC Current Gain	h_{FE}	$V_{CE}=10V,\ I_C=5mA$	70	—	300	—
Transition Frequency	f_T	$V_{CE}=10V,\ I_C=10mA$	3	4	—	GHz
Output Capacitance	C_{ob}	$V_{CB}=10V,\ I_E=0,\ f=1MHz$	—	1.05	1.35	pF
Collector-base Time Constant	$C_c \cdot rbb'$	$V_{CB}=10V,\ I_C=5mA,\ f=30MHz$	—	4.5	9	ps

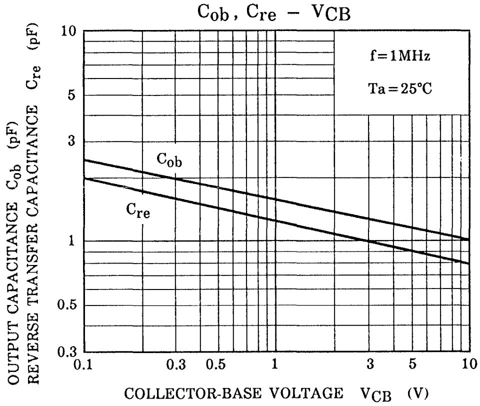
Marking



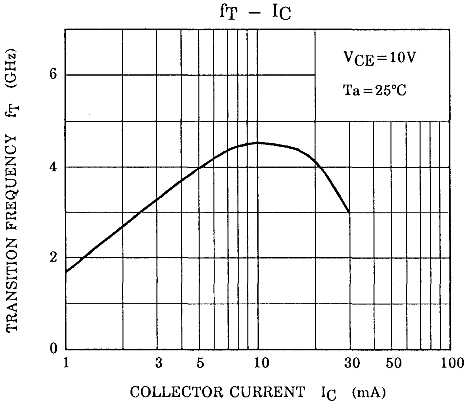
h_{FE} – I_C



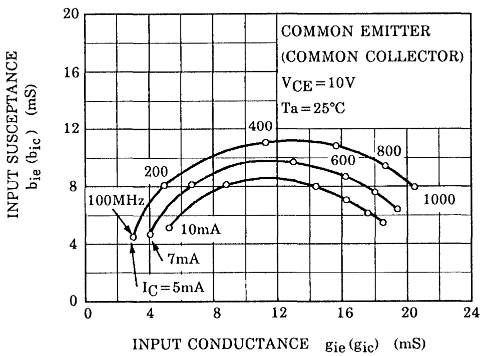
C_{ob}, C_{re} – V_{CB}



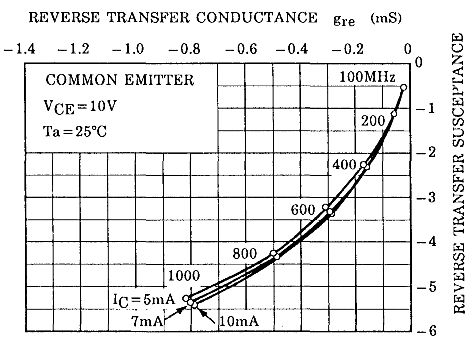
f_T – I_C



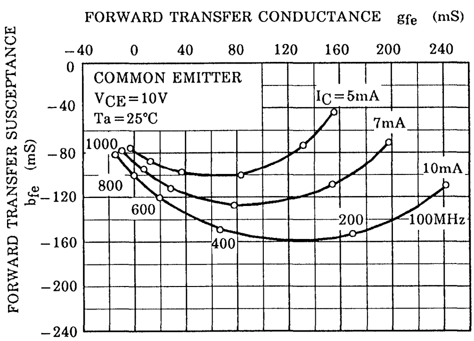
y_{ie} – f
(y_{ic} – f)

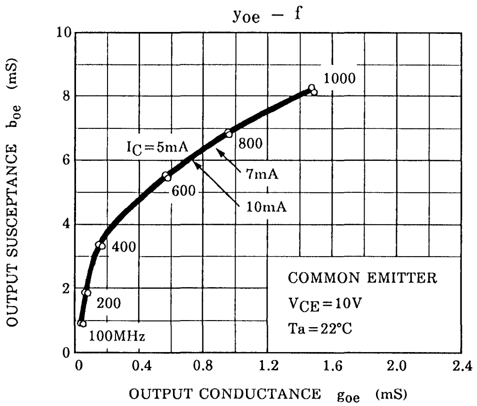


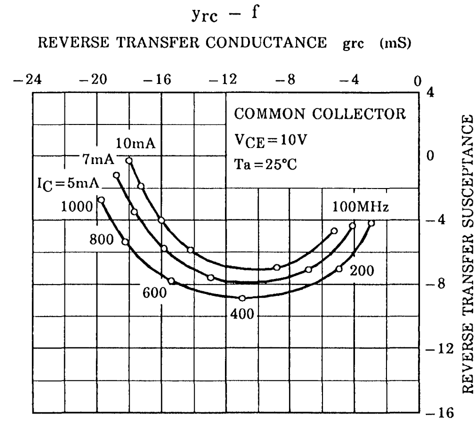
y_{re} – f

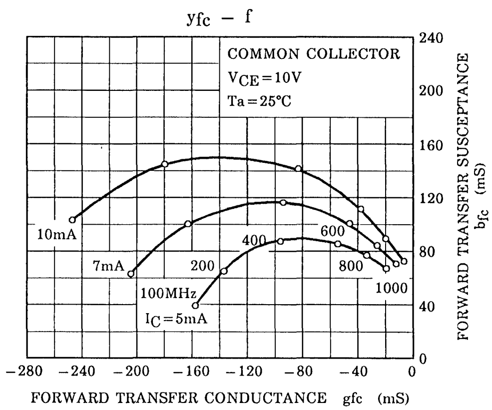


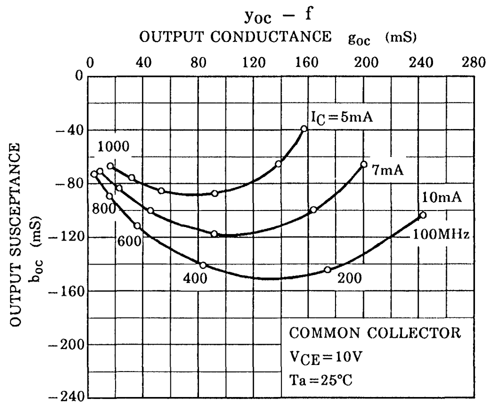
y_{fe} – f




yoe – f
OUTPUT SUSCEPTANCE b_{oe} (mS)
OUTPUT CONDUCTANCE g_{oe} (mS)
0
0.4
0.8
1.2
1.6
2.0
2.4
10
8
6
4
2
0
1000
800
600
400
200
100MHz
I_C=5mA
7mA
10mA
COMMON EMITTER
V_{CE}=10V
Ta=22°C


yrc – f
REVERSE TRANSFER CONDUCTANCE grc (mS)
REVERSE TRANSFER SUSCEPTANCE b_{rc} (mS)
–24
–20
–16
–12
–8
–4
0
4
0
–4
–8
–12
–16
COMMON COLLECTOR
V_{CE}=10V
Ta=25°C
10mA
7mA
I_C=5mA
1000
800
600
400
200
100MHz

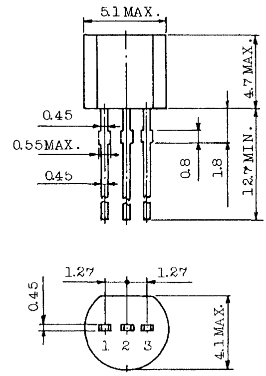

yfc – f
FORWARD TRANSFER CONDUCTANCE gfc (mS)
FORWARD TRANSFER SUSCEPTANCE b_{fc} (mS)
–280
–240
–200
–160
–120
–80
–40
0
240
200
160
120
80
40
0
COMMON COLLECTOR
V_{CE}=10V
Ta=25°C
10mA
7mA
400
600
200
800
1000
100MHz
I_C=5mA


yoc – f
OUTPUT CONDUCTANCE g_{oc} (mS)
OUTPUT SUSCEPTANCE b_{oc} (mS)
0
40
80
120
160
200
240
280
0
–40
–80
–120
–160
–200
–240
I_C=5mA
1000
7mA
10mA
800
100MHz
600
400
200
COMMON COLLECTOR
V_{CE}=10V
Ta=25°C

2SC3605 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	TO-92
EIAJ	SC-43
TOSHIBA	2-5F1E

Weight : 0.21g

FEATURES :

- Low Noise Figure, High Gain
- $NF = 1.1dB$, $|S_{21e}|^2 = 10dB$ (f = 1GHz)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	80	mA
Base Current	I_B	40	mA
Collector Power Dissipation	P_C	600	mW
Junction Temperature	T_j	150	°C
Storage Temperature Range	T_{stg}	−55~150	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

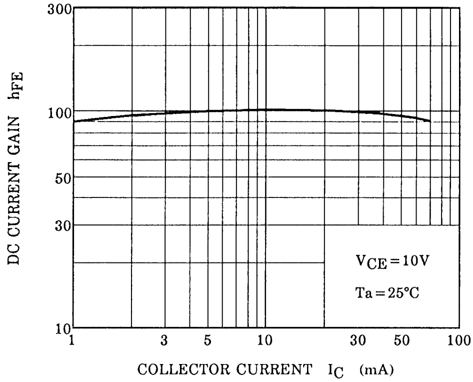
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	$V_{CE} = 10V$, $I_C = 20mA$	5	6.5	—	GHz
Insertion Gain	$\|S_{21e}\|^2(1)$	$V_{CE} = 10V$, $I_C = 20mA$, f = 500MHz	—	16	—	dB
	$\|S_{21e}\|^2(2)$	$V_{CE} = 10V$, $I_C = 20mA$, f = 1GHz	7.5	10	—	dB
Noise Figure	NF(1)	$V_{CE} = 10V$, $I_C = 5mA$, f = 1GHz	—	1.1	—	dB
	NF(2)	$V_{CE} = 10V$, $I_C = 40mA$, f = 1GHz	—	1.8	3	dB

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

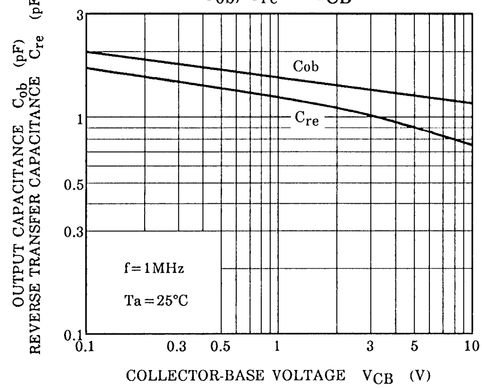
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CE} = 10V$, $I_E = 0$	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB} = 1V$, $I_E = 0$	—	—	1	μA
DC Current Gain	h_{FE}	$V_{CE} = 10V$, $I_C = 20mA$	30	—	250	—
Output Capacitance	C_{ob}	$V_{CB} = 10V$, $I_E = 0$, f = 1MHz	—	1.2	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.75	1.2	pF

Note : C_{re} is measured by 3-terminal method with Capacitance Bridge.

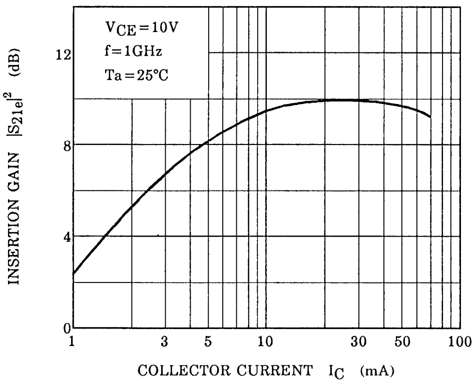
$h_{FE} - I_C$



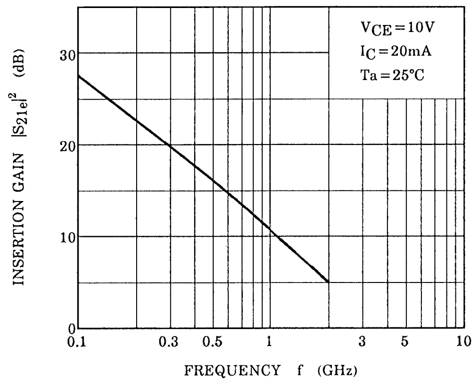
$C_{ob}, C_{re} - V_{CB}$



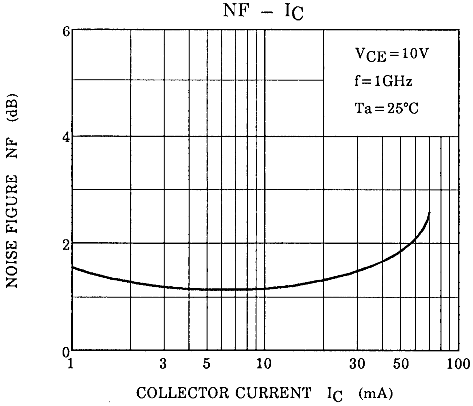
$|S_{21e}|^2 - I_C$



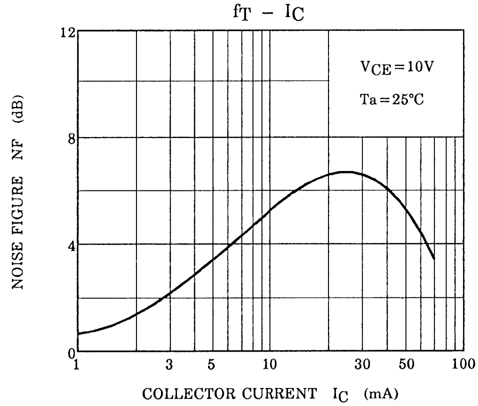
$|S_{21e}|^2 - f$



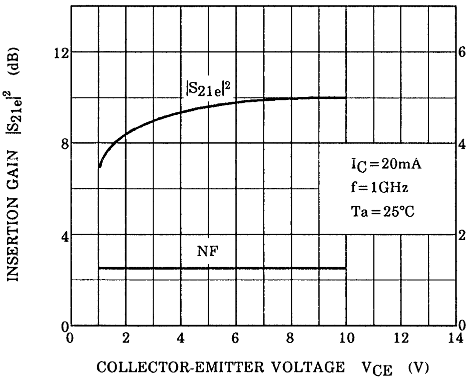
$NF - I_C$



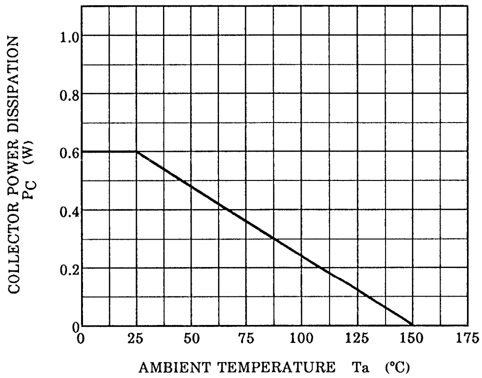
$f_T - I_C$



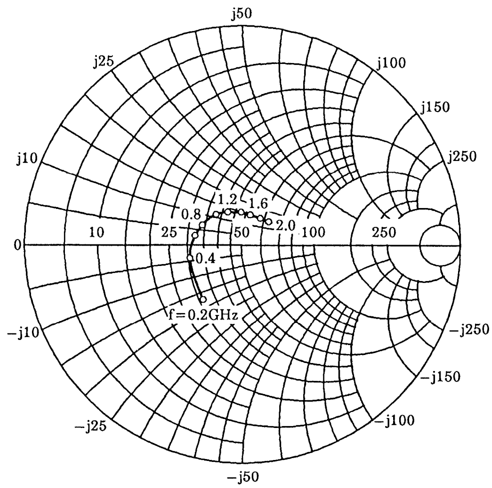
NF, $|S_{21e}|^2$ – V_{CE}



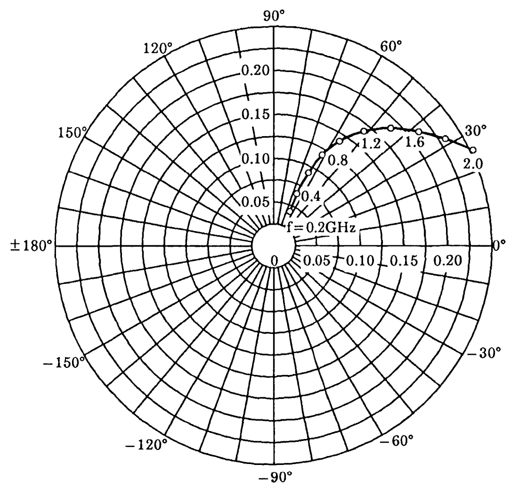
P_C – Ta



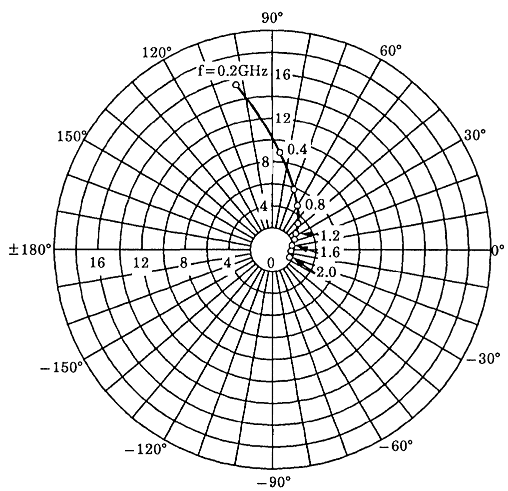
S_{11e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)



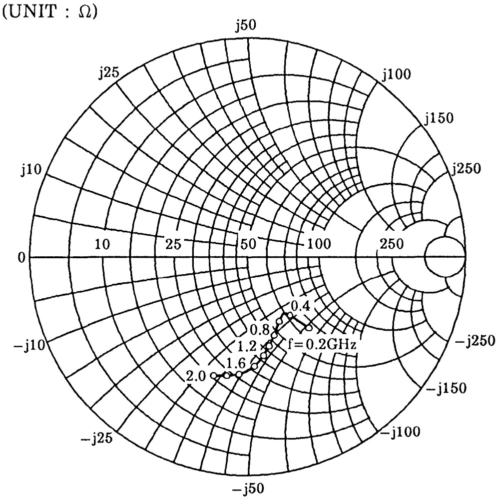
S_{12e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$



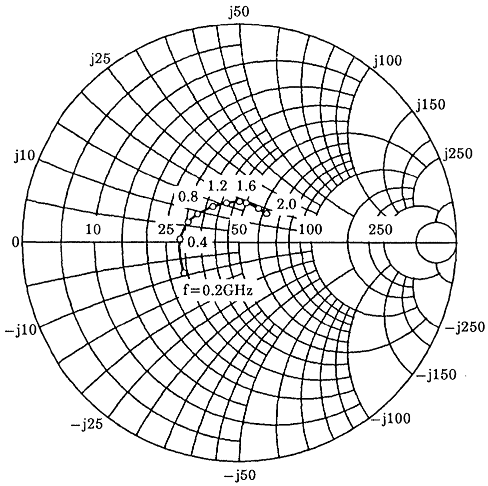
S_{21e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$



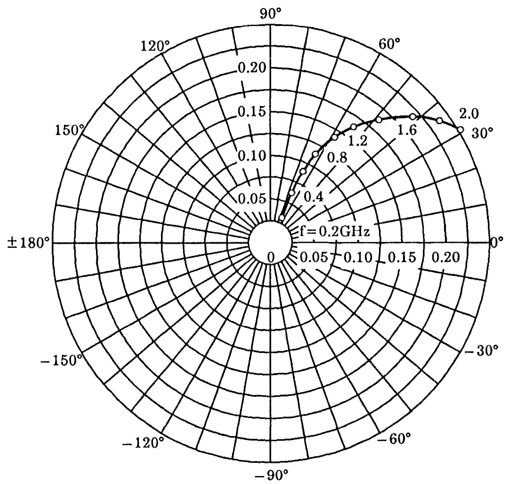
S_{22e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)



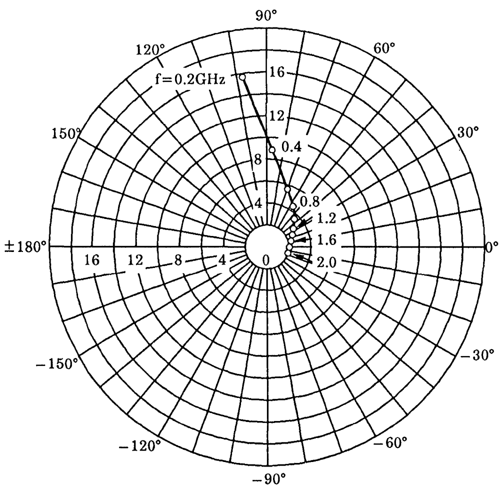
S_{11e}
$V_{CE} = 10V$
$I_C = 40mA$
$Ta = 25°C$
(UNIT : Ω)



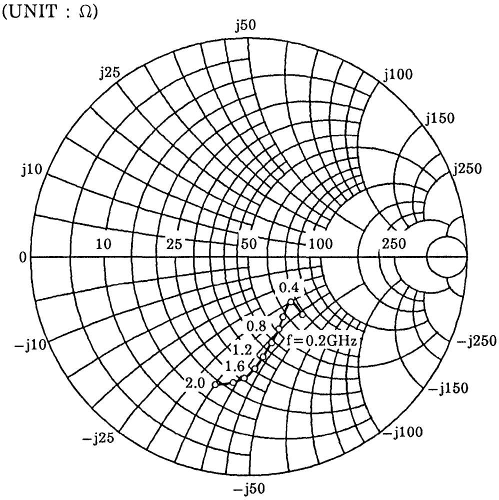
S_{12e}
$V_{CE} = 10V$
$I_C = 40mA$
$Ta = 25°C$



S_{21e}
$V_{CE} = 10V$
$I_C = 40mA$
$Ta = 25°C$



S_{22e}
$V_{CE} = 10V$
$I_C = 40mA$
$Ta = 25°C$
(UNIT : Ω)



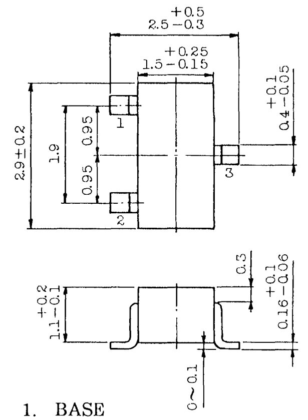
SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC3606

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure, High Gain.
- NF=1.1dB, $|S_{21e}|^2$=11dB (f=1GHz)

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	80	mA
Base Current	I_B	40	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MICROWAVE CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE}=10V, I_C=20mA	5	7	—	GHz
Insertion Gain	$\|S_{21e}\|^2$(1)	V_{CE}=10V, I_C=20mA, f=500MHz	—	16.5	—	dB
	$\|S_{21e}\|^2$(2)	V_{CE}=10V, I_C=20mA, f=1GHz	7.5	11	—	
Noise Figure	NF (1)	V_{CE}=10V, I_C=5mA, f=500MHz	—	1	—	dB
	NF (2)	V_{CE}=10V, I_C=5mA, f=1GHz	—	1.1	2	

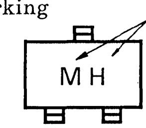
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

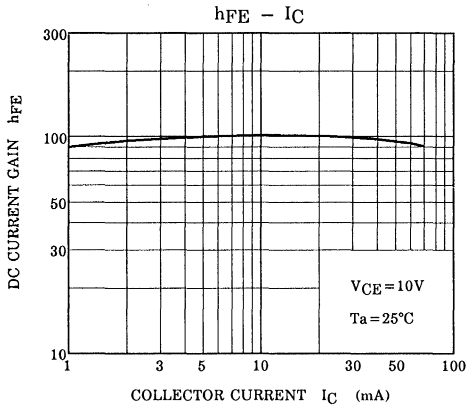
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB}=10V, I_E=0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB}=1V, I_C=0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE}=10V, I_C=20mA	30	—	250	pF
Output Capacitance	C_{ob}	V_{CB}=10V, I_E=0, f=1MHz	—	1.0	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.7	1.15	

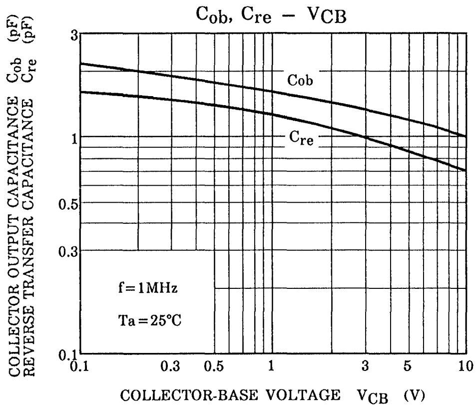
Note : Cre is measured by 3 terminal method with Capacitance Bridge.

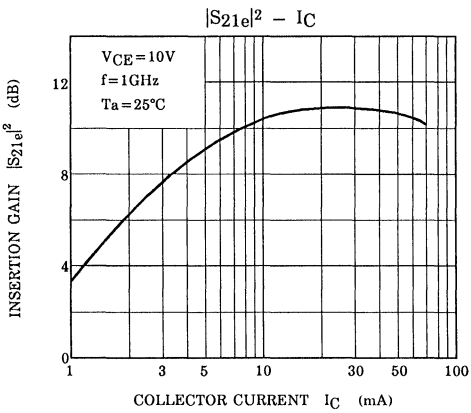
Marking

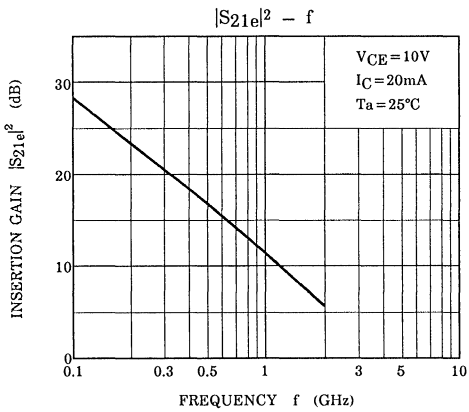
Type Name

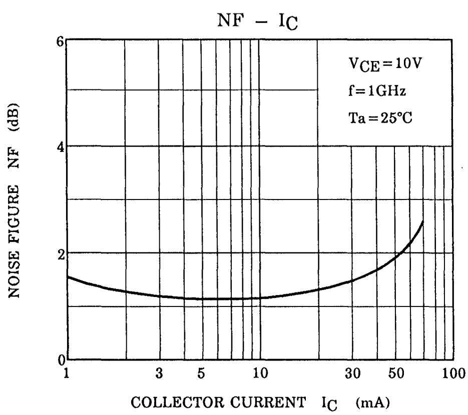


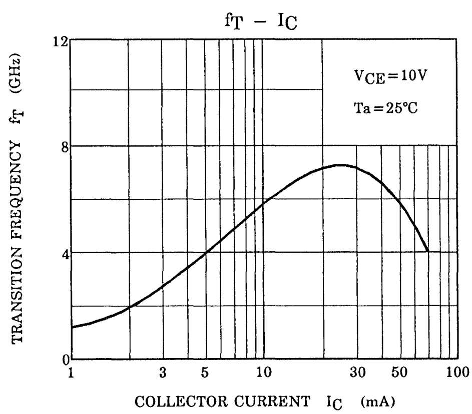

hFE – IC
300
100
50
30
10
DC CURRENT GAIN hFE
VCE=10V
Ta=25°C
1 3 5 10 30 50 100
COLLECTOR CURRENT IC (mA)

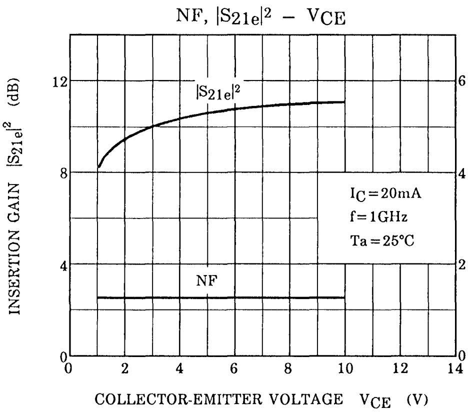

Cob, Cre – VCB
3
1
0.5
0.3
0.1
COLLECTOR OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
Cob
Cre
f=1MHz
Ta=25°C
0.1 0.3 0.5 1 3 5 10
COLLECTOR-BASE VOLTAGE VCB (V)

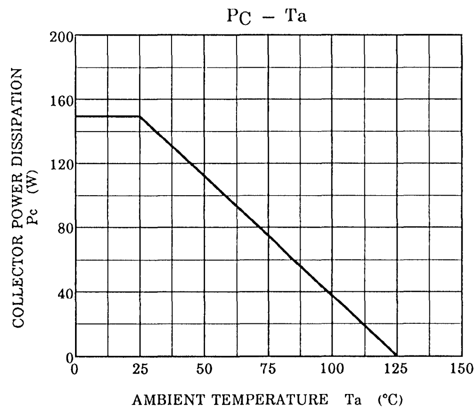

|S21e|2 – IC
12
8
4
0
INSERTION GAIN |S21e|2 (dB)
VCE=10V
f=1GHz
Ta=25°C
1 3 5 10 30 50 100
COLLECTOR CURRENT IC (mA)


|S21e|2 – f
30
20
10
0
INSERTION GAIN |S21e|2 (dB)
VCE=10V
IC=20mA
Ta=25°C
0.1 0.3 0.5 1 3 5 10
FREQUENCY f (GHz)

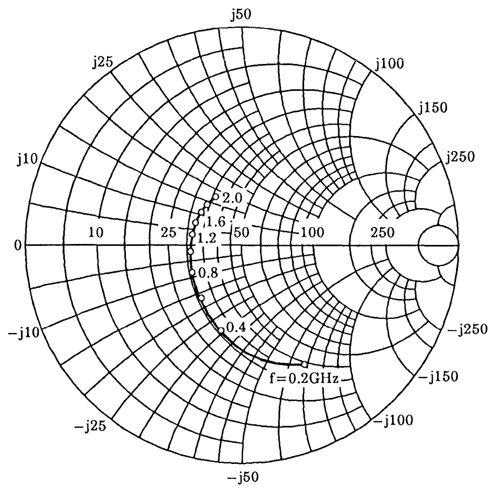

NF – IC
6
4
2
0
NOISE FIGURE NF (dB)
VCE=10V
f=1GHz
Ta=25°C
1 3 5 10 30 50 100
COLLECTOR CURRENT IC (mA)


fT – IC
12
8
4
0
TRANSITION FREQUENCY fT (GHz)
VCE=10V
Ta=25°C
1 3 5 10 30 50 100
COLLECTOR CURRENT IC (mA)

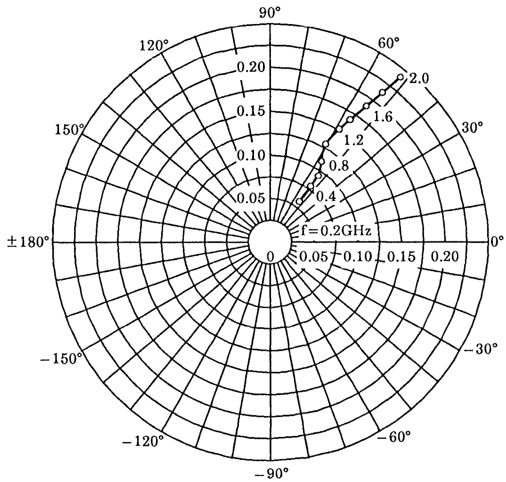

NF, |S21e|2 – VCE
INSERTION GAIN |S21e|2 (dB)
NOISE FIGURE NF (dB)
|S21e|2
NF
IC=20mA
f=1GHz
Ta=25°C
COLLECTOR-EMITTER VOLTAGE VCE (V)


PC – Ta
COLLECTOR POWER DISSIPATION Pc (W)
AMBIENT TEMPERATURE Ta (°C)

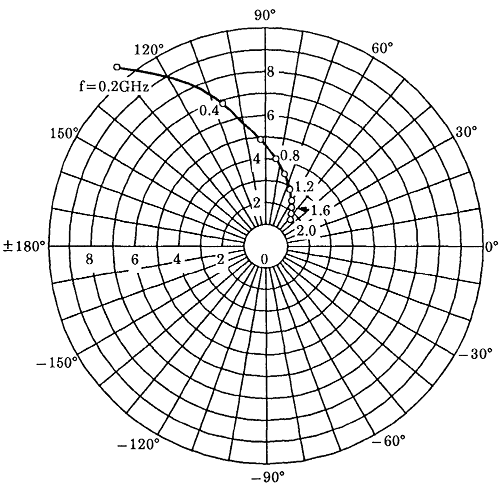
S_{11e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$
(Unit : Ω)



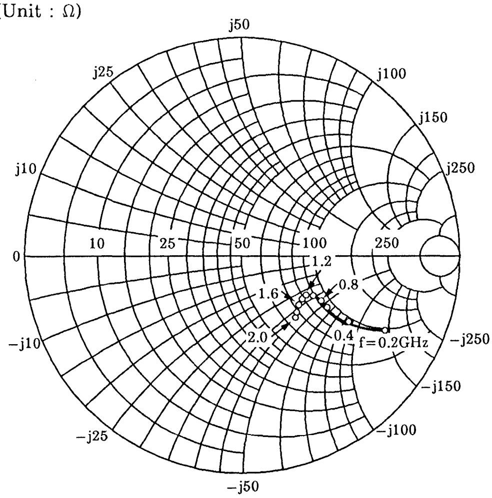
S_{12e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$



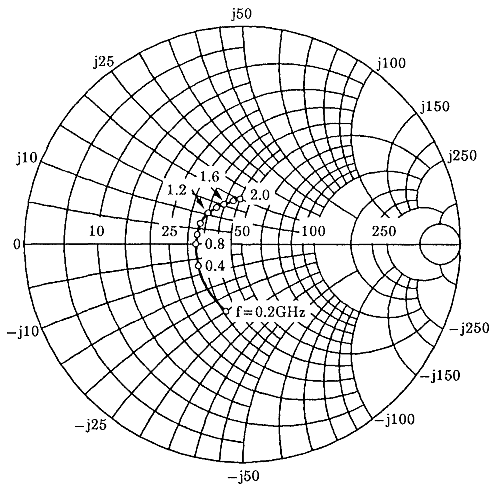
S_{21e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$



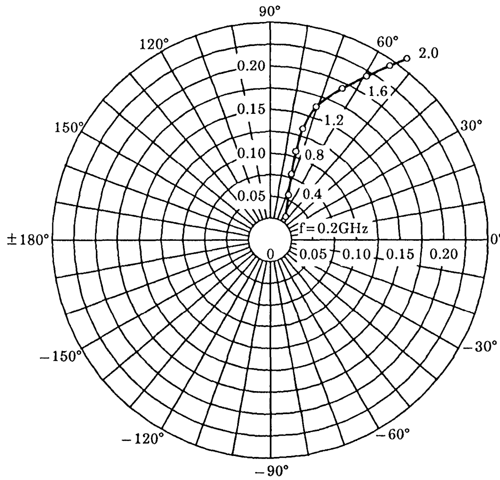
S_{22e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$
(Unit : Ω)



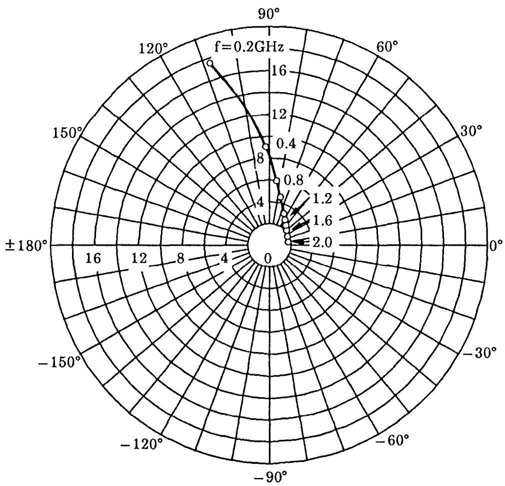
S_{11e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$
(Unit : Ω)



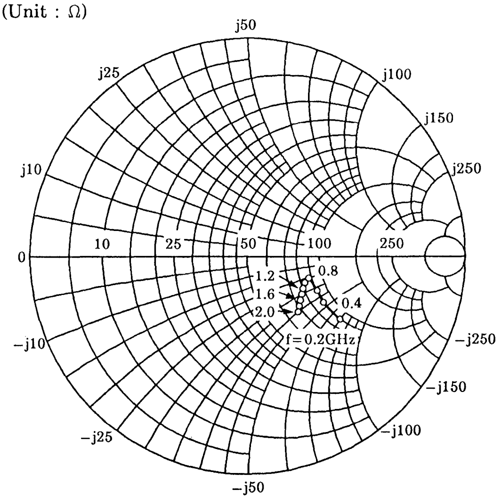
S_{12e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$



S_{21e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$



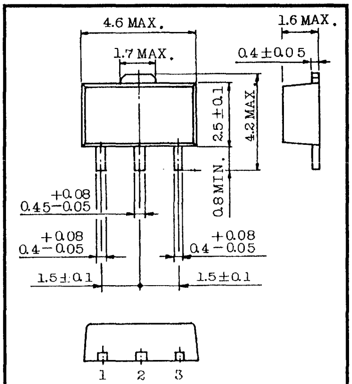
S_{22e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$
(Unit : Ω)



2SC3607 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

Unit in mm



1. BASE
2. COLLECTOR
3. EMITTER

JEDEC	—
EIAJ	—
TOSHIBA	2-5K1A

Weight : 0.05g

- Low Noise Figure, High Gain.
- NF=1.1dB, $|S_{21e}|^2$=9.5dB (f=1GHz)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Base Current	I_B	40	mA
Collector Current	I_C	80	mA
Collector Power Dissipation	P_C	400	mW
Collector Power Dissipation	P_C*	800	mW
Junction Temperature	T_j	150	°C
Storage Temperature Range	T_{stg}	−55~150	°C

P_C* : When mounted ceramic substrate of 250mm^2×0.8t

MICROWAVE CHARACTERISTICS (Ta = 25°C)

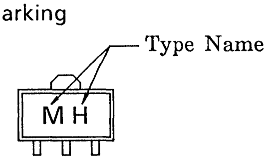
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE}=10V, I_C=20mA	5	6.5	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE}=10V, I_C=20mA, f=500MHz	—	15	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE}=10V, I_C=20mA, f=1GHz	6	9.5	—	
Noise Figure	NF (1)	V_{CE}=10V, I_C=5mA, f=1GHz	—	1.1	—	dB
	NF (2)	V_{CE}=10V, I_C=40mA, f=1GHz	—	1.8	3	

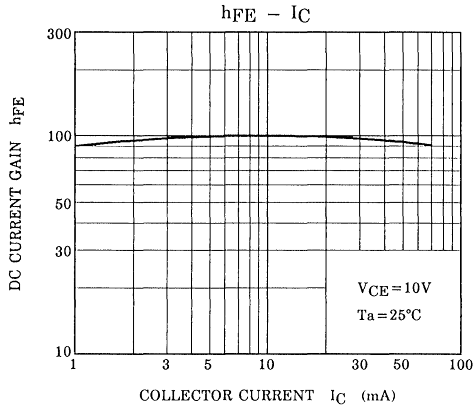
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB}=10V, I_E=0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB}=1V, I_C=0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE}=10V, I_C=20mA	30	—	250	—
Output Capacitance	C_{ob}	V_{CB}=10V, I_E=0, f=1MHz	—	1.15	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.8	1.25	pF

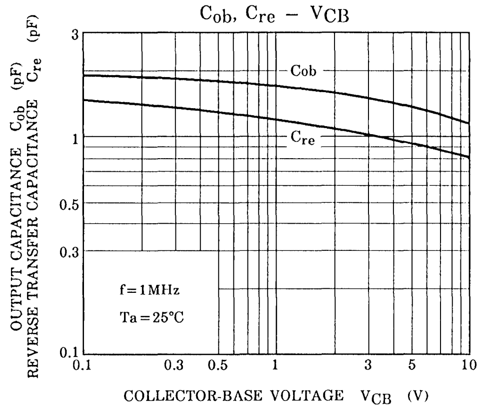
Note : C_{re} is measured by 3 terminal method with Capacitance Bridge.

Marking

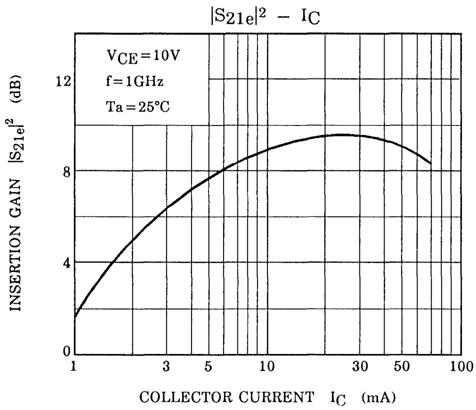




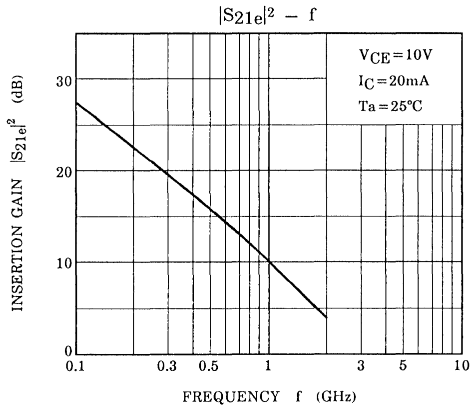
h_{FE} – I_C
DC CURRENT GAIN h_{FE}
300
100
50
30
10
V_{CE}=10V
Ta=25°C
1
3
5
10
30
50
100
COLLECTOR CURRENT I_C (mA)



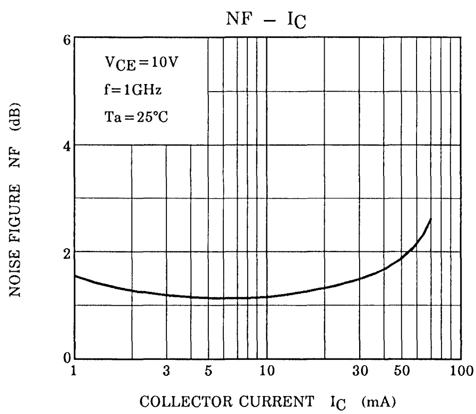
C_{ob}, C_{re} – V_{CB}
OUTPUT CAPACITANCE C_{ob} (pF)
REVERSE TRANSFER CAPACITANCE C_{re} (pF)
3
1
0.5
0.3
0.1
Cob
C_{re}
f=1MHz
Ta=25°C
0.1
0.3
0.5
1
3
5
10
COLLECTOR-BASE VOLTAGE V_{CB} (V)



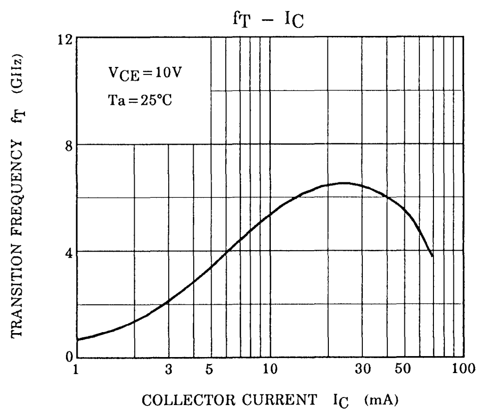
$|S_{21e}|^2$ – I_C
INSERTION GAIN $|S_{21e}|^2$ (dB)
12
8
4
0
V_{CE}=10V
f=1GHz
Ta=25°C
1
3
5
10
30
50
100
COLLECTOR CURRENT I_C (mA)



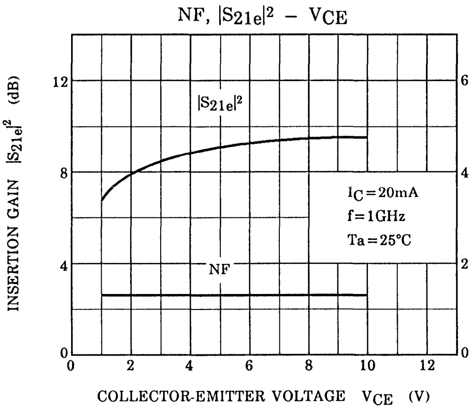
$|S_{21e}|^2$ – f
INSERTION GAIN $|S_{21e}|^2$ (dB)
30
20
10
0
V_{CE}=10V
I_C=20mA
Ta=25°C
0.1
0.3
0.5
1
3
5
10
FREQUENCY f (GHz)

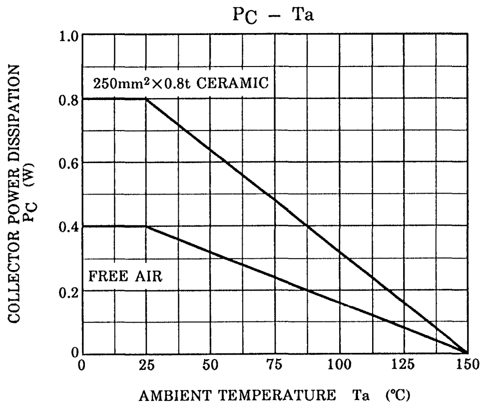


NF – I_C
NOISE FIGURE NF (dB)
6
4
2
0
V_{CE}=10V
f=1GHz
Ta=25°C
1
3
5
10
30
50
100
COLLECTOR CURRENT I_C (mA)

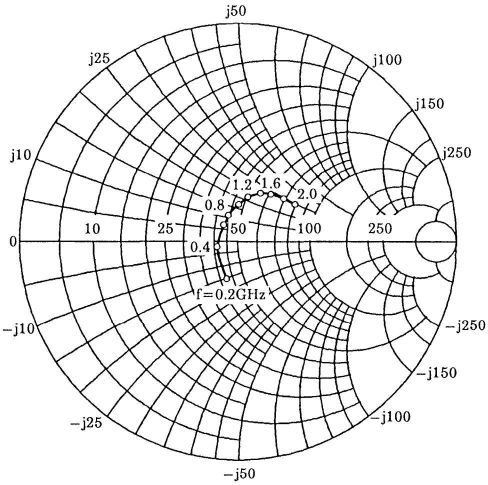


f_T – I_C
TRANSITION FREQUENCY f_T (GHz)
12
8
4
0
V_{CE}=10V
Ta=25°C
1
3
5
10
30
50
100
COLLECTOR CURRENT I_C (mA)

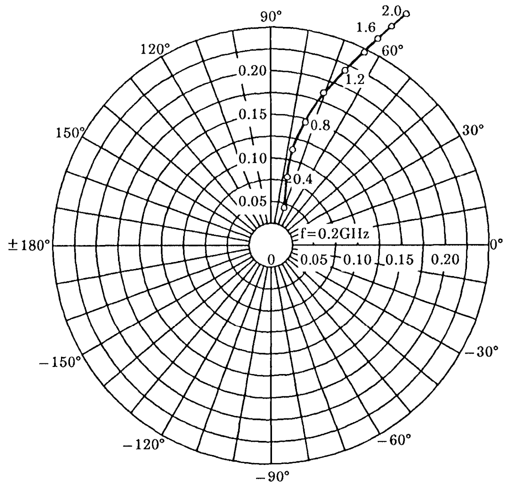

NF, $|S_{21e}|^2$ – V_{CE}
INSERTION GAIN $|S_{21e}|^2$ (dB)
NOISE FIGURE NF (dB)
$|S_{21e}|^2$
NF
I_C=20mA
f=1GHz
Ta=25°C
0
4
8
12
2
6
10
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)


P_C – Ta
COLLECTOR POWER DISSIPATION P_C (W)
250mm²×0.8t CERAMIC
FREE AIR
0
0.2
0.4
0.6
0.8
1.0
25
50
75
100
125
150
AMBIENT TEMPERATURE Ta (°C)

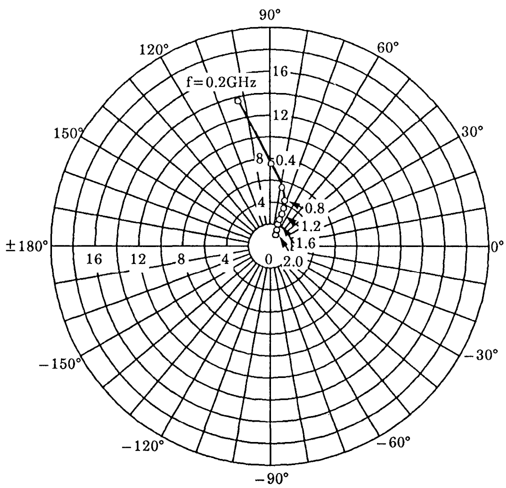
S_{11e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)



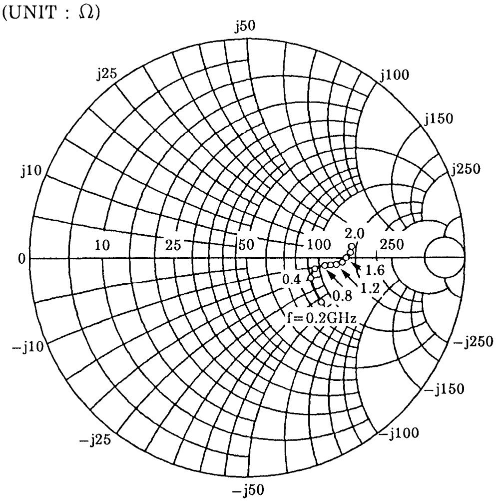
S_{12e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$



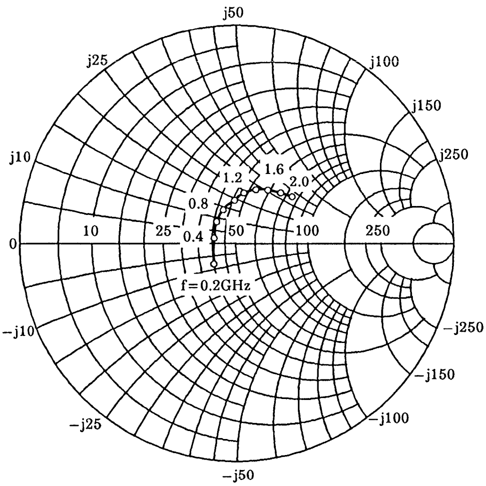
S_{21e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$



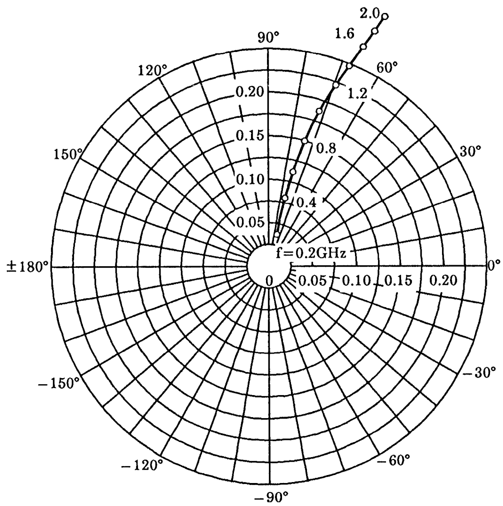
S_{22e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)



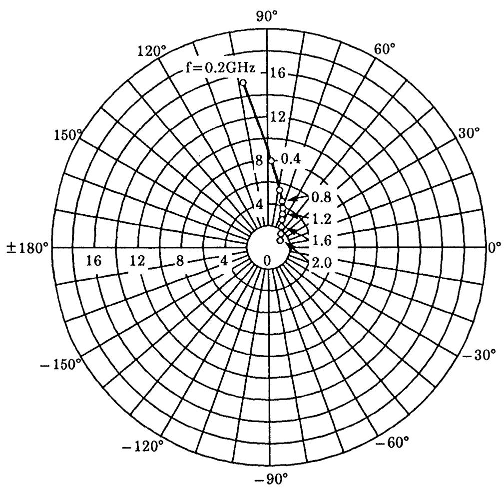
S_{11e}
$V_{CE}=10V$
$I_C=40mA$
$Ta=25°C$
(UNIT : Ω)



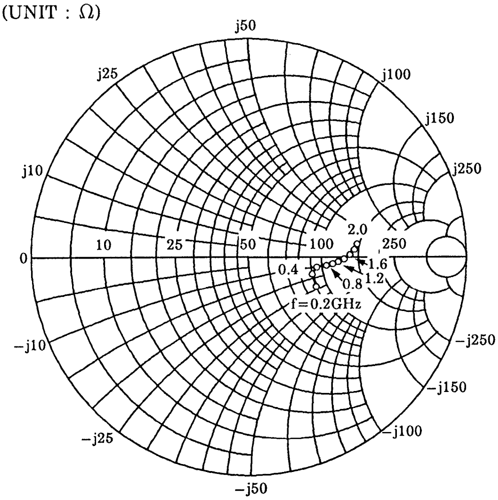
S_{12e}
$V_{CE}=10V$
$I_C=40mA$
$Ta=25°C$



S_{21e}
$V_{CE}=10V$
$I_C=40mA$
$Ta=25°C$



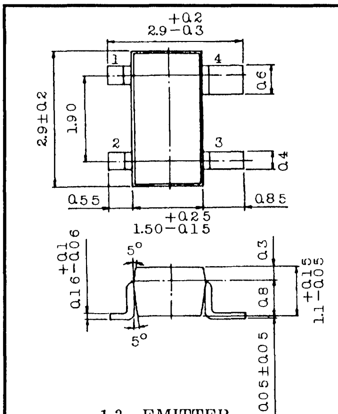
S_{22e}
$V_{CE}=10V$
$I_C=40mA$
$Ta=25°C$
(UNIT : Ω)



SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR **2SC3609**

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

Unit in mm



1,3. EMITTER
2. BASE
4. COLLECTOR

JEDEC	—
EIAJ	—
TOSHIBA	2-3J1C

Weight : 0.012g

- Low Noise Figure, High Gain.
- NF = 1.1dB, $|S_{21e}|^2 = 13$dB (f = 1GHz)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	80	mA
Base Current	I_B	40	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MICROWAVE CHARACTERISTICS (Ta = 25°C)

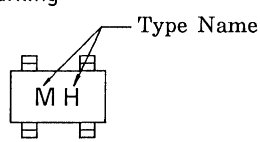
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 10V, I_C = 20mA	5	7	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE} = 10V, I_C = 20mA, f = 500MHz	—	18.5	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE} = 10V, I_C = 20mA, f = 1GHz	9.5	13	—	
Noise Figure	NF (1)	V_{CE} = 10V, I_C = 5mA, f = 500MHz	—	1	—	dB
	NF (2)	V_{CE} = 10V, I_C = 5mA, f = 1GHz	—	1.1	2	

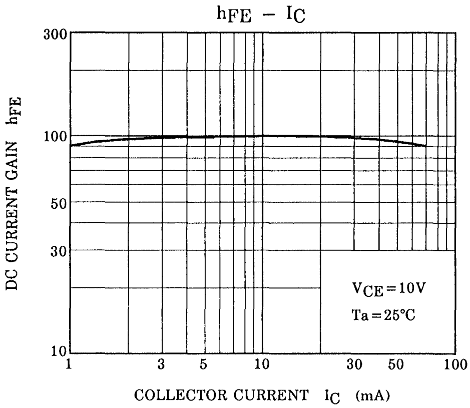
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

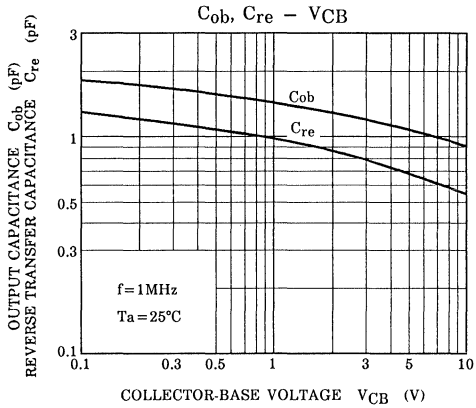
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_C = 0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE} = 10V, I_C = 20mA	30	—	250	—
Output Capacitance	C_{ob}	V_{CB} = 10V, I_E = 0, f = 1MHz	—	0.9	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.55	1	pF

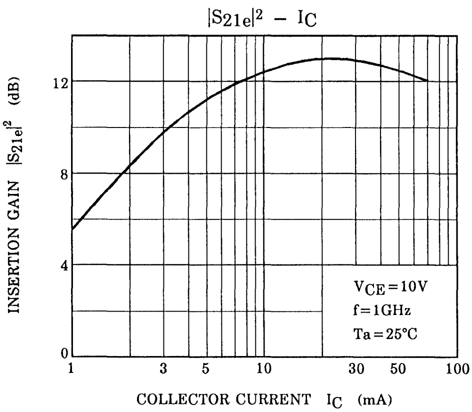
Note : C_{re} is measured by 3 terminal method with Capacitance Bridge.

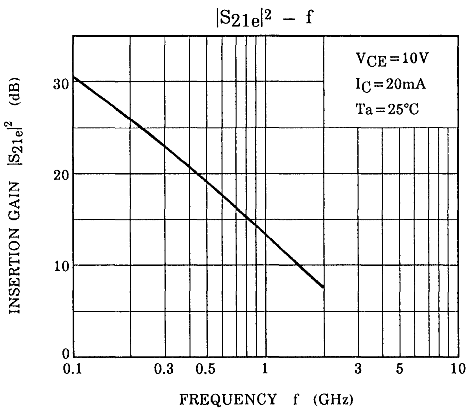
Marking

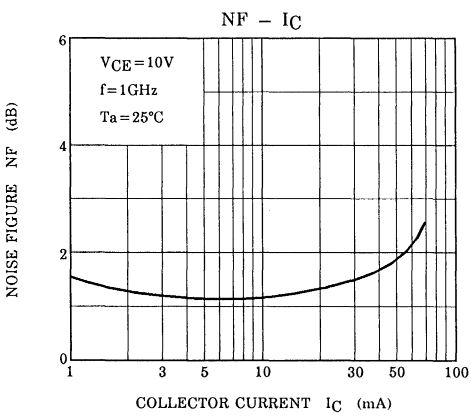


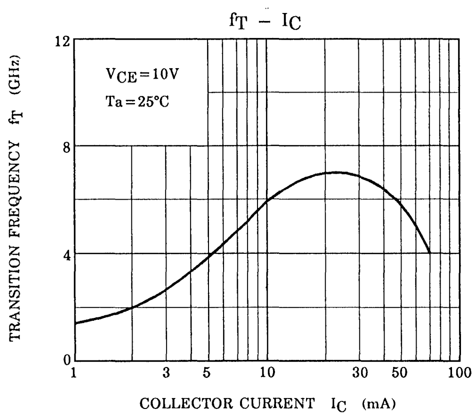

hFE – IC
DC CURRENT GAIN hFE
300
100
50
30
10
1 3 5 10 30 50 100
COLLECTOR CURRENT IC (mA)
VCE=10V
Ta=25°C

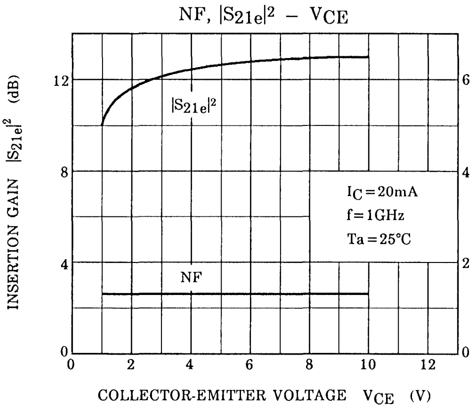

Cob, Cre – VCB
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
3
1
0.5
0.3
0.1
0.1 0.3 0.5 1 3 5 10
COLLECTOR-BASE VOLTAGE VCB (V)
Cob
Cre
f=1MHz
Ta=25°C

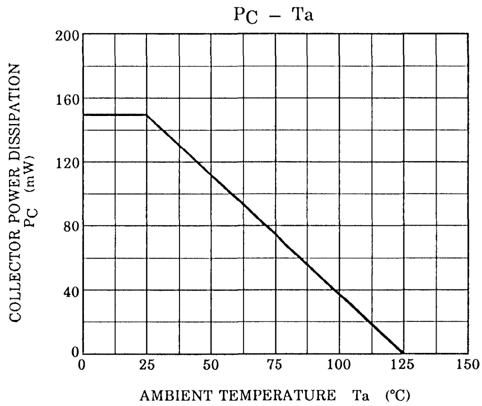

|S21e|2 – IC
INSERTION GAIN |S21e|2 (dB)
12
8
4
0
1 3 5 10 30 50 100
COLLECTOR CURRENT IC (mA)
VCE=10V
f=1GHz
Ta=25°C


|S21e|2 – f
INSERTION GAIN |S21e|2 (dB)
30
20
10
0
0.1 0.3 0.5 1 3 5 10
FREQUENCY f (GHz)
VCE=10V
IC=20mA
Ta=25°C

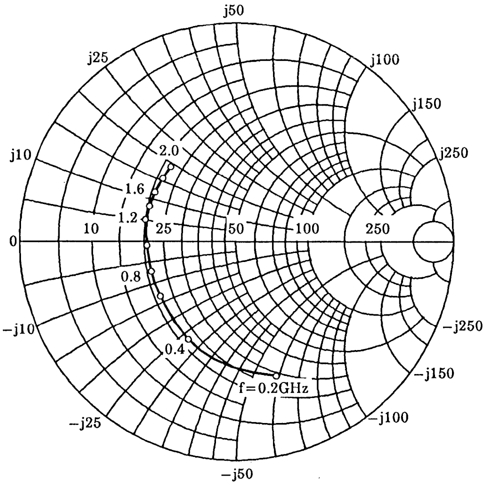

NF – IC
NOISE FIGURE NF (dB)
6
4
2
0
1 3 5 10 30 50 100
COLLECTOR CURRENT IC (mA)
VCE=10V
f=1GHz
Ta=25°C


fT – IC
TRANSITION FREQUENCY fT (GHz)
12
8
4
0
1 3 5 10 30 50 100
COLLECTOR CURRENT IC (mA)
VCE=10V
Ta=25°C

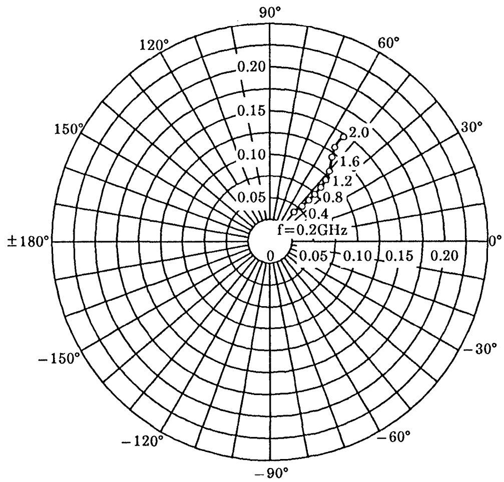

NF, $|S_{21e}|^2$ – V_{CE}
INSERTION GAIN $|S_{21e}|^2$ (dB)
NOISE FIGURE NF (dB)
$|S_{21e}|^2$
NF
I_C=20mA
f=1GHz
Ta=25°C
0
4
8
12
2
6
10
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)


P_C – Ta
COLLECTOR POWER DISSIPATION P_C (mW)
200
160
120
80
40
0
25
50
75
100
125
150
AMBIENT TEMPERATURE Ta (°C)

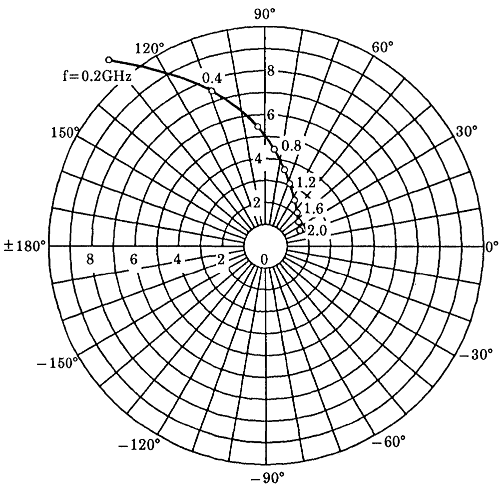
S_{11e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



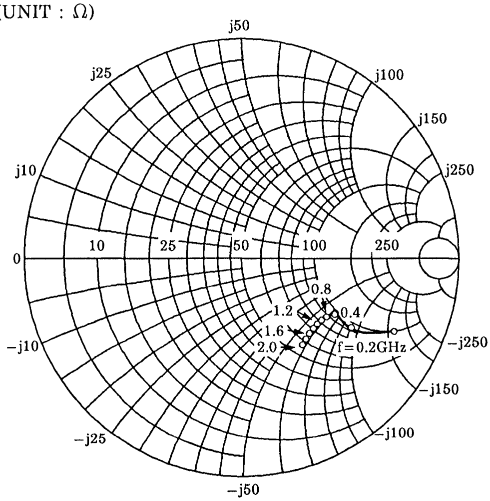
S_{12e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$



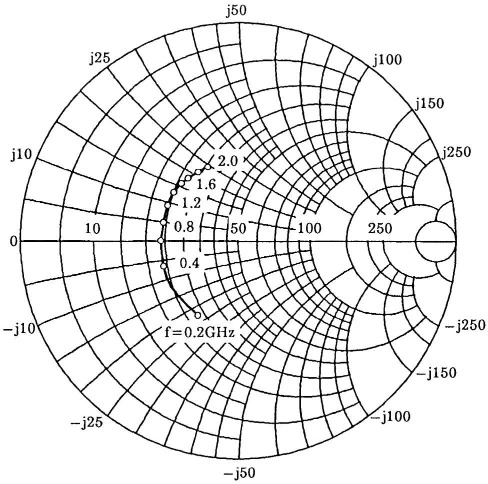
S_{21e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$



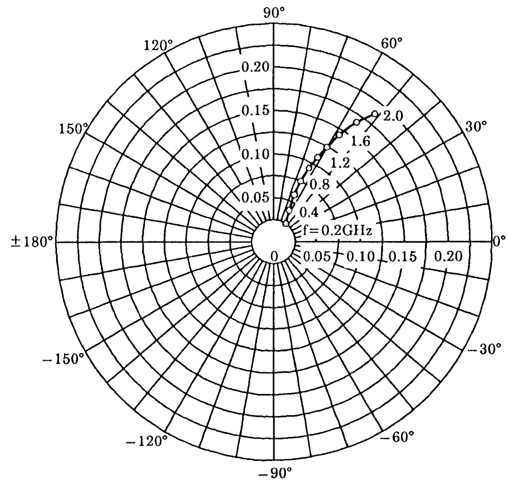
S_{22e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



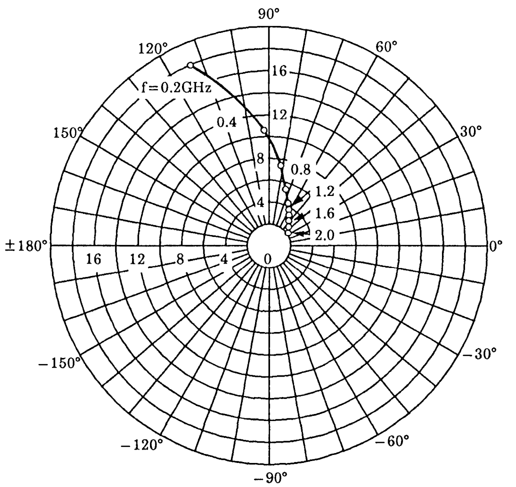
S11e
VCE=10V
IC=20mA
Ta=25°C
(UNIT : Ω)



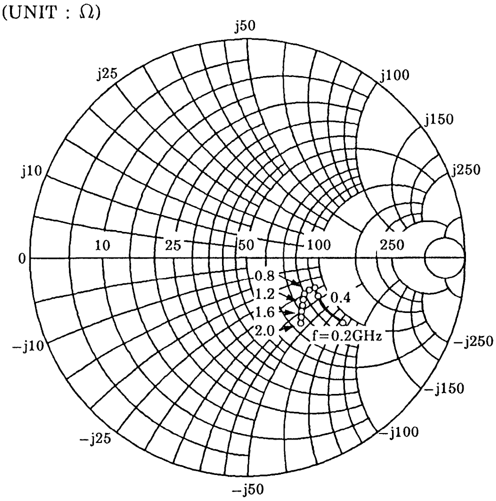
S12e
VCE=10V
IC=20mA
Ta=25°C



S21e
VCE=10V
IC=20mA
Ta=25°C



S22e
VCE=10V
IC=20mA
Ta=25°C
(UNIT : Ω)



2SC3745 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

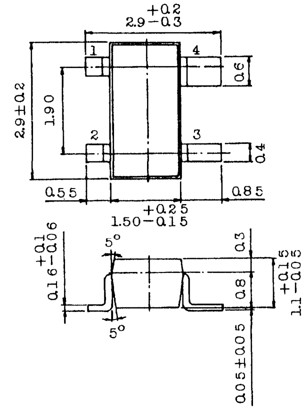
UHF~C BAND LOW NOISE AMPLIFIER APPLICATIONS.

- High Gain : $|S_{21e}|^2 = 12dB$ (Typ.)
- Low Noise Figure : $NF = 2.0dB$ (Typ.)
- High f_T : $f_T = 6.5GHz$ (Typ.)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	7	V
Emitter-Base Voltage	V_{EBO}	3	V
Base Current	I_B	10	mA
Collector Current	I_C	30	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Unit in mm

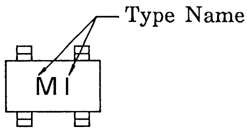


1,3. EMITTER
2. BASE
4. COLLECTOR

JEDEC	—
EIAJ	—
TOSHIBA	2-3J1C

Weight : 0.012g

Marking



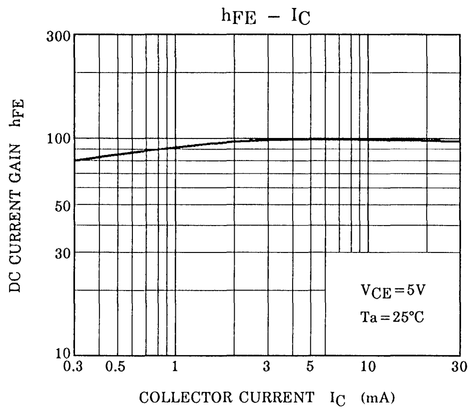
MICROWAVE CHARACTERISTICS (Ta = 25°C)

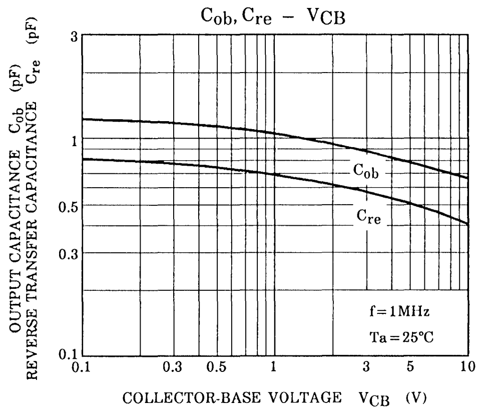
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	$V_{CE} = 5V$, $I_C = 10mA$	—	6.5	—	GHz
Insertion Gain	$\|S_{21e}\|^2$	$V_{CE} = 5V$, $I_C = 10mA$, f = 1GHz	—	12	—	dB
Noise Figure	NF	$V_{CE} = 5V$, $I_C = 5mA$, f = 1GHz	—	2.0	—	dB

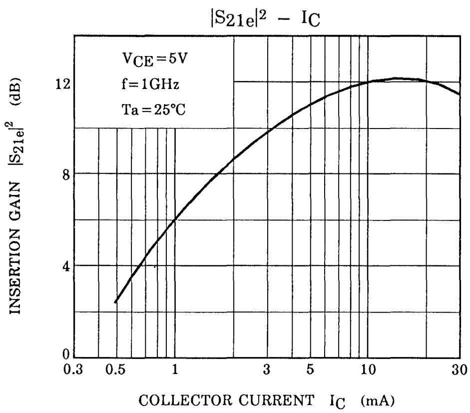
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

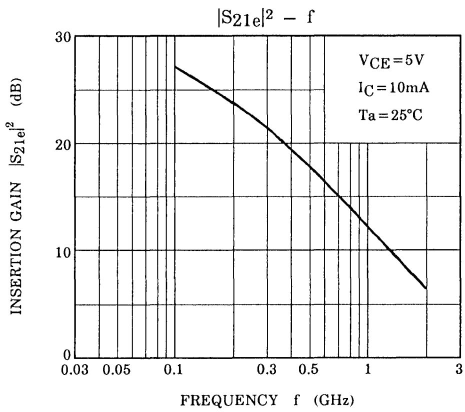
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB} = 10V$, $I_E = 0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB} = 1V$, $I_C = 0$	—	—	1.0	μA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 0.5mA$, $I_B = 0$	7	—	—	V
DC Current Gain	h_{FE}	$V_{CE} = 5V$, $I_C = 10mA$	30	—	200	—
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = 10mA$, $I_B = 1mA$	—	0.1	—	V
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C = 10mA$, $I_B = 1mA$	—	0.87	—	V
Output Capacitance	C_{ob}	$V_{CB} = 5V$, $I_E = 0$ f = 1MHz (Note)	—	0.8	—	pF
Reverse Transfer Capacitance	C_{re}		—	0.5	0.8	pF

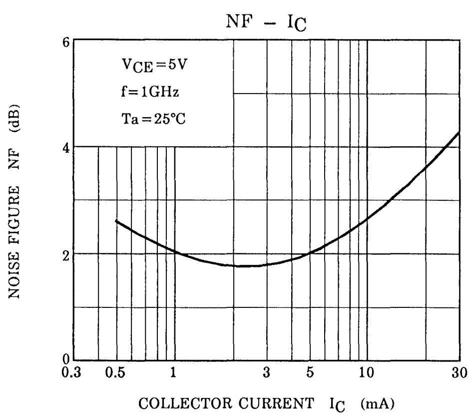
Note : C_{re} is measured by 3-terminal method with Capacitance Bridge.

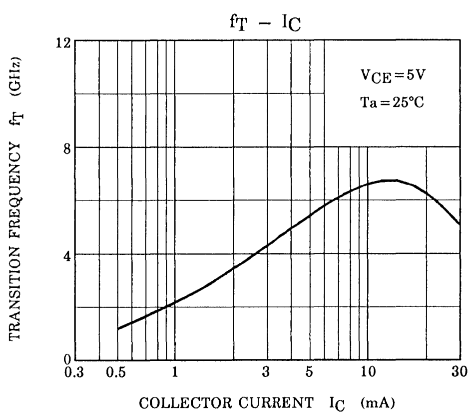

hFE – IC
DC CURRENT GAIN hFE
300
100
50
30
10
VCE=5V
Ta=25°C
0.3 0.5 1 3 5 10 30
COLLECTOR CURRENT IC (mA)


Cob, Cre – VCB
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
3
1
0.5
0.3
0.1
Cob
Cre
f=1MHz
Ta=25°C
0.1 0.3 0.5 1 3 5 10
COLLECTOR-BASE VOLTAGE VCB (V)

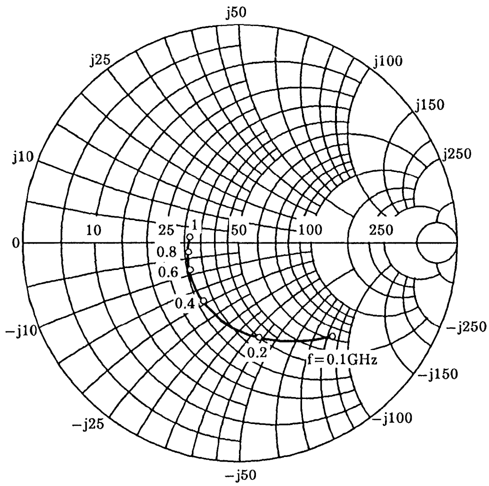

|S21e|2 – IC
INSERTION GAIN |S21e|2 (dB)
12
8
4
0
VCE=5V
f=1GHz
Ta=25°C
0.3 0.5 1 3 5 10 30
COLLECTOR CURRENT IC (mA)


|S21e|2 – f
INSERTION GAIN |S21e|2 (dB)
30
20
10
0
VCE=5V
IC=10mA
Ta=25°C
0.03 0.05 0.1 0.3 0.5 1 3
FREQUENCY f (GHz)

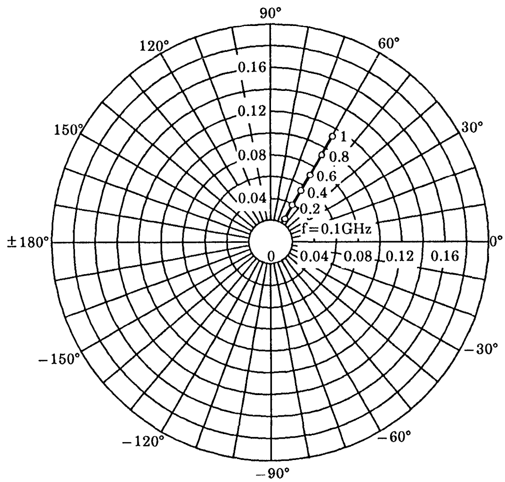

NF – IC
NOISE FIGURE NF (dB)
6
4
2
0
VCE=5V
f=1GHz
Ta=25°C
0.3 0.5 1 3 5 10 30
COLLECTOR CURRENT IC (mA)


fT – IC
TRANSITION FREQUENCY fT (GHz)
12
8
4
0
VCE=5V
Ta=25°C
0.3 0.5 1 3 5 10 30
COLLECTOR CURRENT IC (mA)

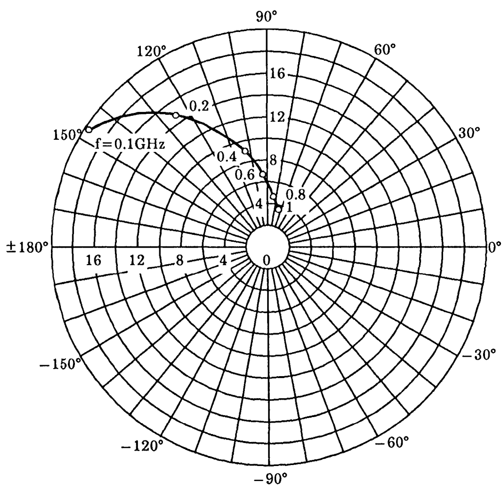
S_{11e}
$V_{CE}=5V$
$I_C=10mA$
$Ta=25°C$
(UNIT : Ω)



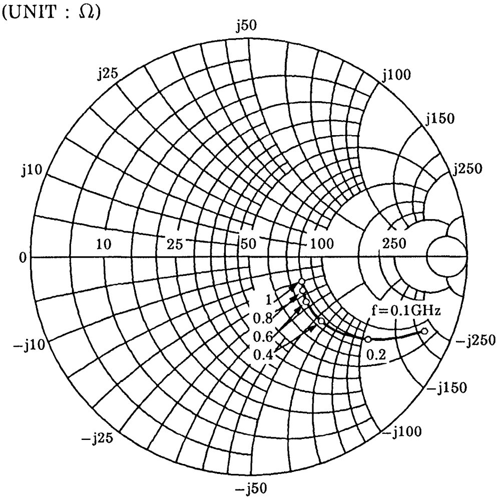
S_{12e}
$V_{CE}=5V$
$I_C=10mA$
$Ta=25°C$



S_{21e}
$V_{CE}=5V$
$I_C=10mA$
$Ta=25°C$



S_{22e}
$V_{CE}=5V$
$I_C=10mA$
$Ta=25°C$
(UNIT : Ω)



SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

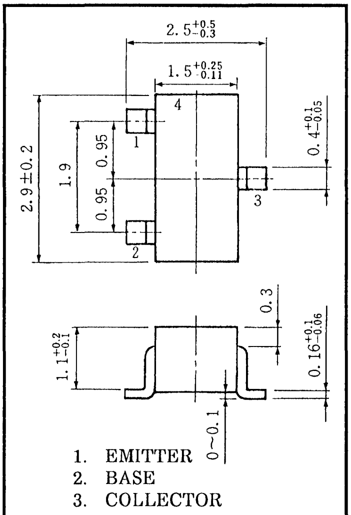
2SC3862

TV TUNER, UHF MIXER APPLICATIONS.

VHF~UHF BAND RF AMPLIFIER APPLICATIONS.

- Exchange of Emitter for Base in 2SC3120

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	2-3F1D

Weight : 0.012g

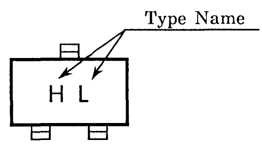
MAXIMUM RATINGS (Ta = 25°C)

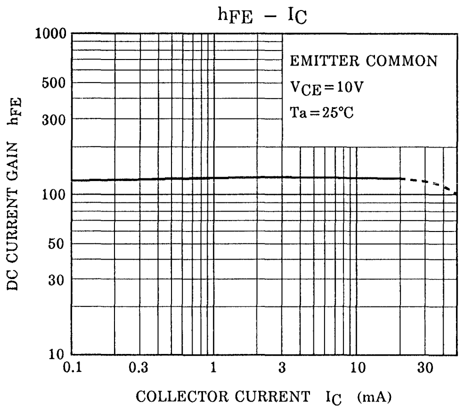
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	15	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	50	mA
Base Current	I_B	25	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

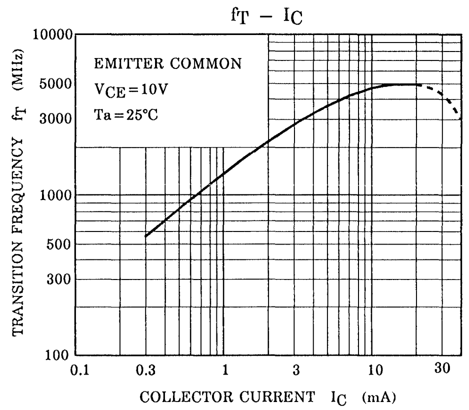
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

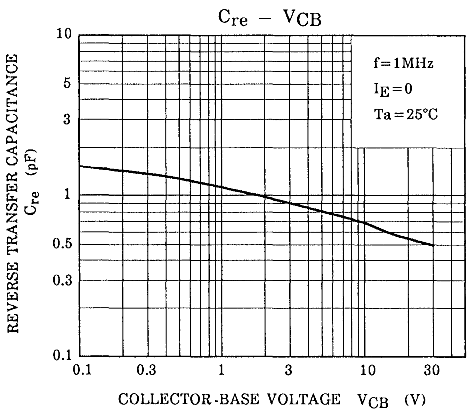
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=30V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=2V$, $I_C=0$	—	—	1.0	μA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA$, $I_B=0$	15	—	—	V
DC Current Gain	h_{FE}	$V_{CE}=10V$, $I_C=5mA$	40	100	200	V
Reverse Transfer Capcitance	C_{re}	$V_{CB}=10V$, $I_E=0V$, $f=1MHz$	—	0.6	0.9	pF
Transition Frequency	f_T	$V_{CE}=10V$, $I_C=2mA$	1500	2400	—	MHz

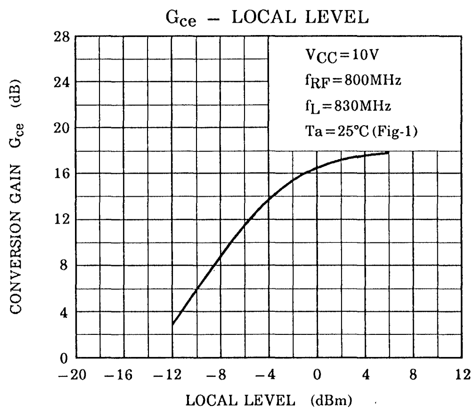
Marking

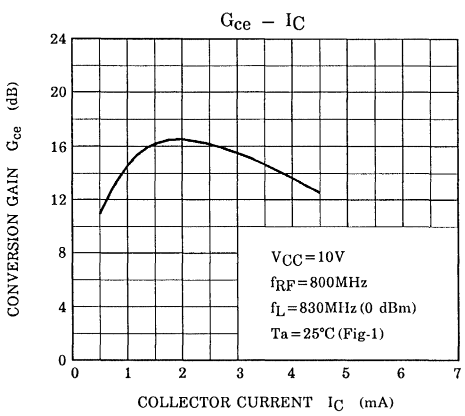


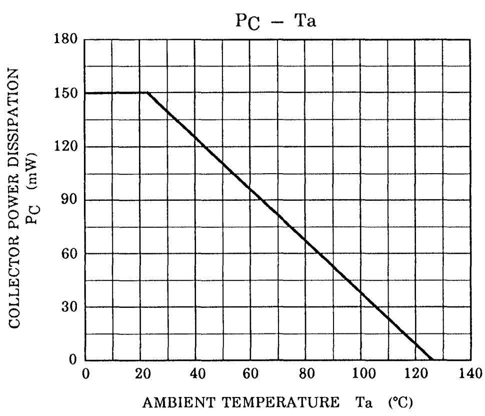

hFE − IC
EMITTER COMMON
VCE=10V
Ta=25°C
DC CURRENT GAIN hFE
1000
500
300
100
50
30
10
0.1
0.3
1
3
10
30
COLLECTOR CURRENT IC (mA)


fT − IC
EMITTER COMMON
VCE=10V
Ta=25°C
TRANSITION FREQUENCY fT (MHz)
10000
5000
3000
1000
500
300
100
0.1
0.3
1
3
10
30
COLLECTOR CURRENT IC (mA)

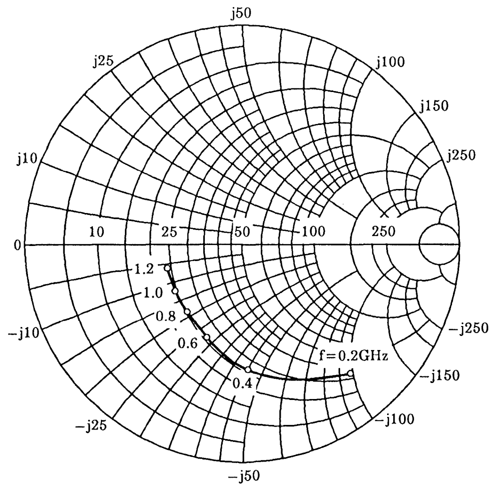

Cre − VCB
f=1MHz
IE=0
Ta=25°C
REVERSE TRANSFER CAPACITANCE Cre (pF)
10
5
3
1
0.5
0.3
0.1
0.1
0.3
1
3
10
30
COLLECTOR-BASE VOLTAGE VCB (V)


Gce − LOCAL LEVEL
VCC=10V
fRF=800MHz
fL=830MHz
Ta=25°C (Fig-1)
CONVERSION GAIN Gce (dB)
28
24
20
16
12
8
4
0
−20
−16
−12
−8
−4
0
4
8
12
LOCAL LEVEL (dBm)

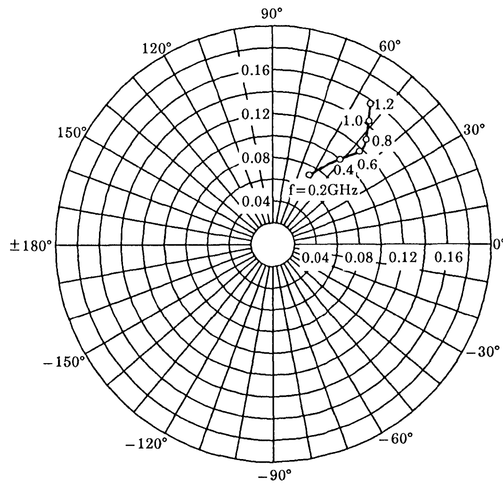

Gce − IC
VCC=10V
fRF=800MHz
fL=830MHz (0 dBm)
Ta=25°C (Fig-1)
CONVERSION GAIN Gce (dB)
24
20
16
12
8
4
0
0
1
2
3
4
5
6
7
COLLECTOR CURRENT IC (mA)


PC − Ta
COLLECTOR POWER DISSIPATION PC (mW)
180
150
120
90
60
30
0
0
20
40
60
80
100
120
140
AMBIENT TEMPERATURE Ta (°C)

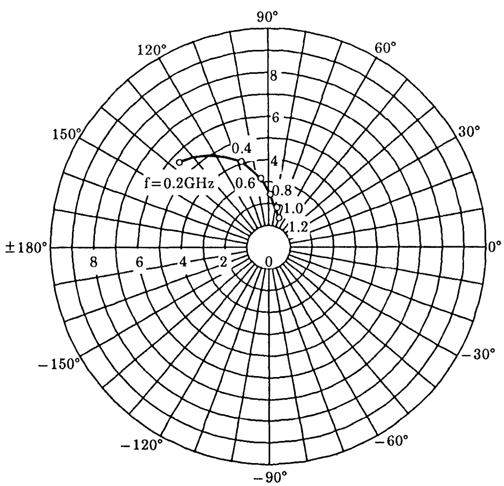
S_{11e}
$V_{CE}=10V$
$I_C=2mA$
$Ta=25°C$
(UNIT : Ω)



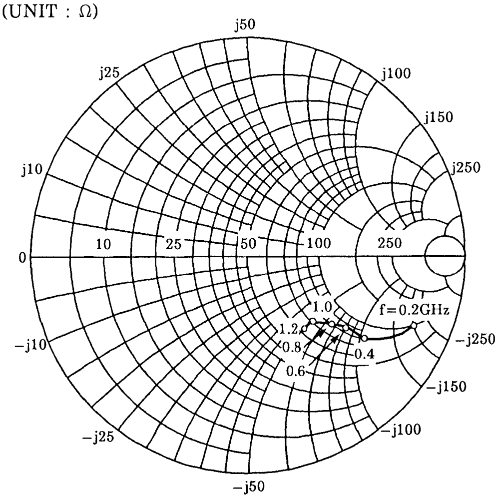
S_{12e}
$V_{CE}=10V$
$I_C=2mA$
$Ta=25°C$



S_{21e}
$V_{CE}=10V$
$I_C=2mA$
$Ta=25°C$



S_{22e}
$V_{CE}=10V$
$I_C=2mA$
$Ta=25°C$
(UNIT : Ω)

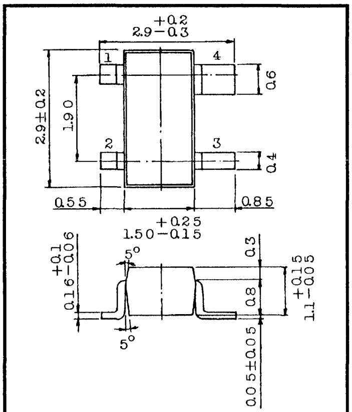


2SC4214 SILICON NPN PLANAR TYPE TRANSISTOR

UHF TV TUNER RF AMPLIFIER APPLICATIONS.

- Low Noise Figure : NF = 2.8dB (Typ.)
- High Power Gain V_{CC} = 4.5V : G_{pb} = 15dB (Typ.)
- Excellent Forward AGC Characteristics

Unit in mm



1. BASE
2. EMITTER
3. BASE
4. COLLECTOR

JEDEC	—
EIAJ	—
TOSHIBA	2-3J1B

Weight : 0.013g

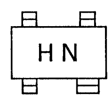
MAXIMUM RATINGS (Ta = 25°C)

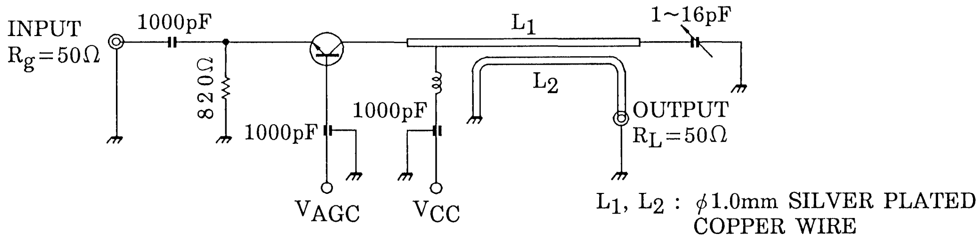
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	25	V
Collector-Emitter Voltage	V_{CEO}	20	V
Emitter-Base Voltage	V_{EBO}	2	V
Base Current	I_B	4	mA
Collector Current	I_C	20	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 2V, I_C = 0	—	—	1	μA
Collector Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C = 1mA, I_B = 0	20	—	—	V
DC Current Gain	h_{FE}	V_{CE} = 3.0V, I_C = 1mA	40	100	—	—
Transition Frequency	f_T	V_{CE} = 3.0V, I_C = 1mA	500	850	—	MHz
Reverse Transfer Capacitance	C_{rb}	V_{CE} = 2.0V, I_B = 0, f = 1MHz	—	0.3	0.5	pF
Power Gain	G_{pb}	V_{CC} = 4.5V, V_{AGC} = 2.0V f = 800MHz (Fig.1)	10	15	—	dB
Noise Figure	NF		—	2.8	4.5	dB
AGC Voltage	V_{AGC}	V_{CC} = 4.5V, G.R. = −20dB f = 800MHz	2.5	3.2	4.0	V

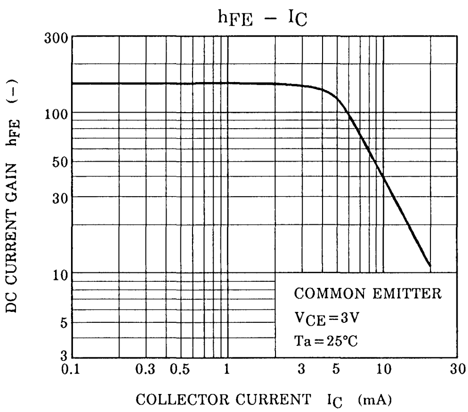
Marking

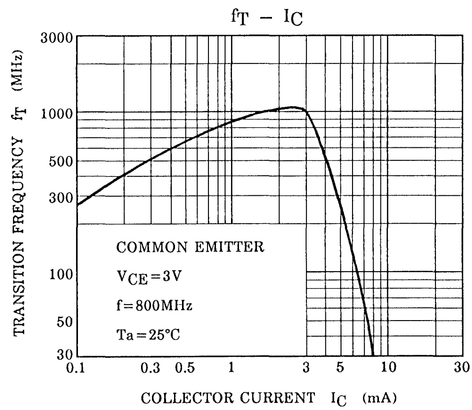


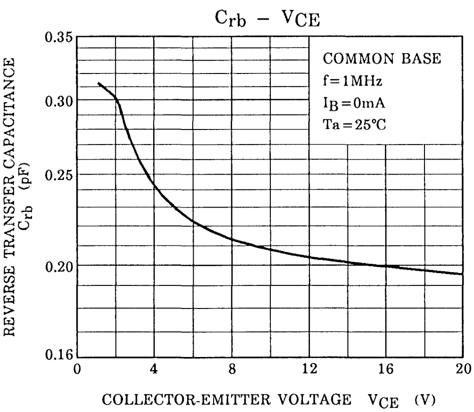


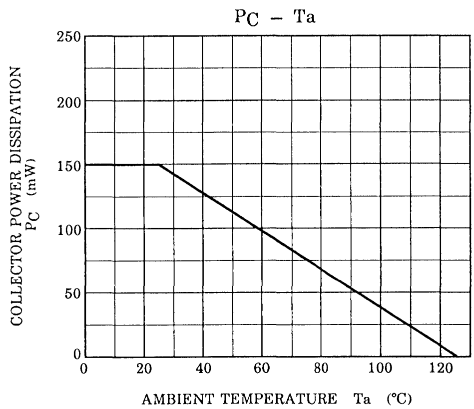
Note. V_{AGC} measured by the test circuit shown in Fig.1, when the power gain is reduced to 20dB compared with G_{pb} shown above Table.

Fig. 1 800MHz G_{pb}, NF TEST CIRCUIT

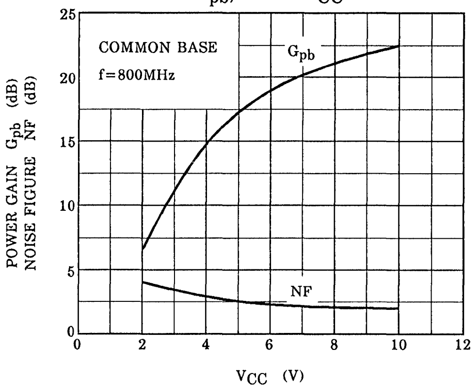




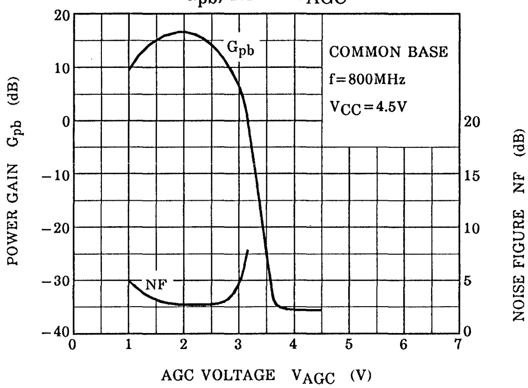




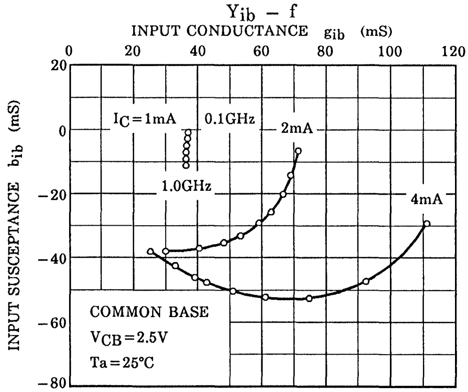
G_{pb}, NF – V_{CC}



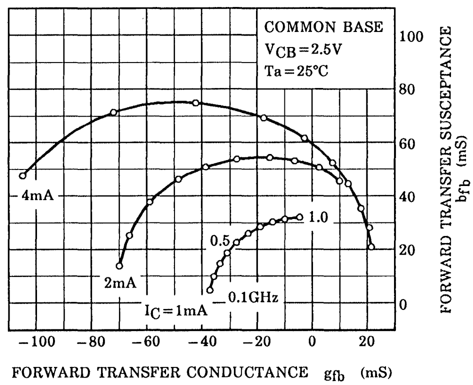
G_{pb}, NF – V_{AGC}



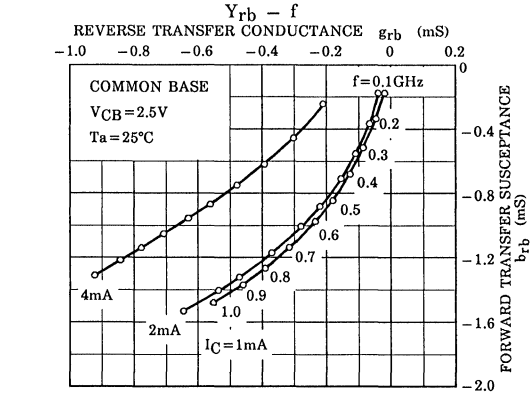
Y_{ib} – f



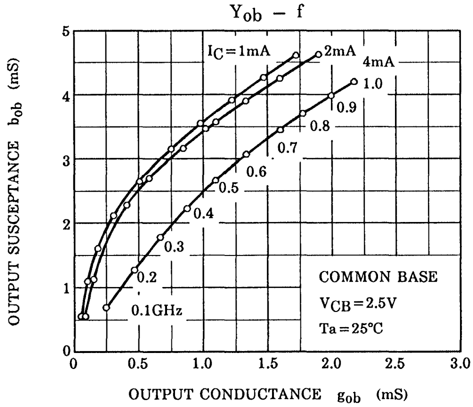
Y_{fb} – f



Y_{rb} – f



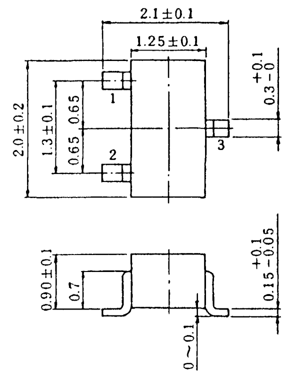
Y_{ob} – f



2SC4215

HIGH FREQUENCY AMPLIFIER APPLICATIONS.
FM, RF, MIX, IF AMPLIFIER APPLICATIONS.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1A

Weight : 0.006g

- Small Reverse Transfer Capacitance
  : C_{re} = 0.55pF (Typ.)
- Low Noise Figure
  : NF = 2dB (Typ.) (f = 100MHz)

MAXIMUM RATINGS (Ta = 25°C)

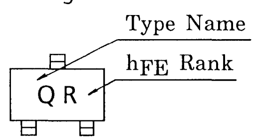
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	40	V
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Base Voltage	V_{EBO}	4	V
Collector Current	I_C	20	mA
Base Current	I_B	4	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

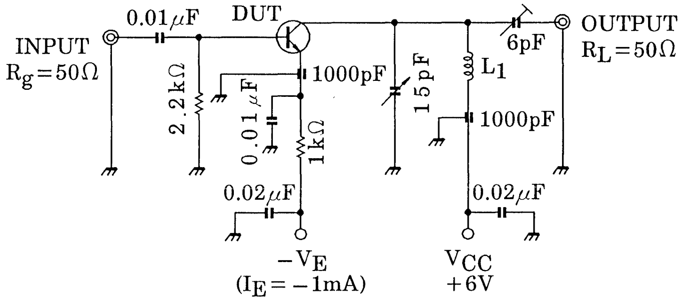
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 40V, I_E = 0	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 4V, I_C = 0	—	—	0.5	μA
DC Current Gain	h_{FE} (Note)	V_{CE} = 6V, I_C = 1mA	40	—	200	—
Reverse Transfer Capacitance	C_{re}	V_{CB} = 10V, f = 1MHz	—	0.55	—	pF
Transition Frequency	f_T	V_{CE} = 6V, I_C = 1mA	260	550	—	MHz
Collector-Base Time Constant	$C_c \cdot r_{bb'}$	V_{CE} = 6V, I_E = −1mA, f = 30MHz	—	—	25	ps
Noise Figure	NF	V_{CC} = 6V, I_E = −1mA, f = 100MHz, Fig.1	—	2	5.0	dB
Power Gain	G_{pe}		17	23	—	dB

Note : h_{FE} Classification R : 40~80, O : 70~140, Y : 100~200

Marking

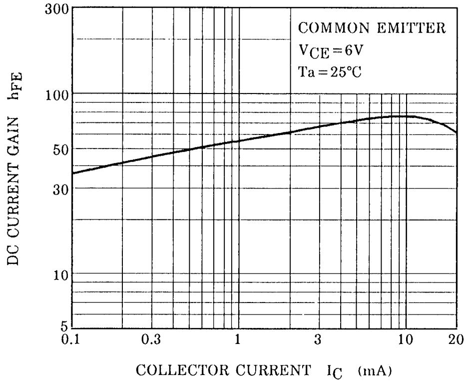




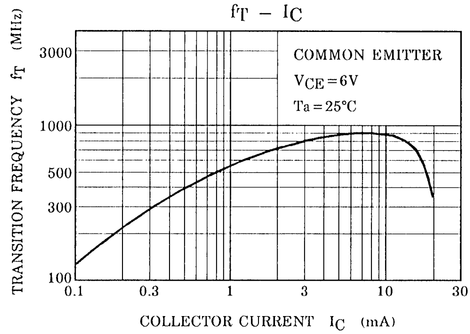
L_1 : 0.8mmϕ SILVER PLATED COPPER WIRE, 4T, 10mm ID, 8mm LENGTH

Fig.1 NF, G_{pe} TEST CIRCUIT

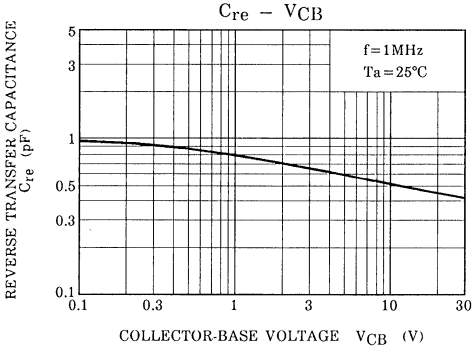
$h_{FE} - I_C$



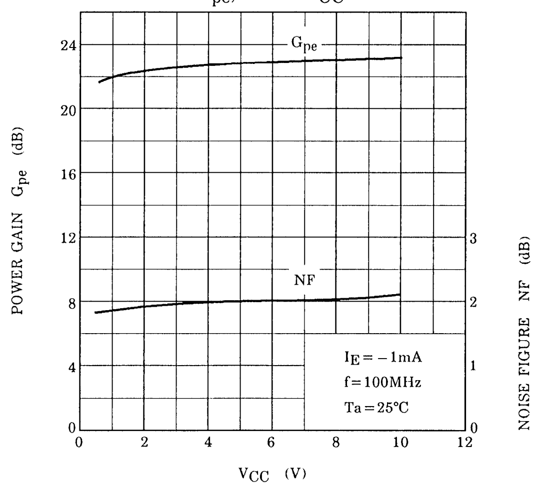
$f_T - I_C$



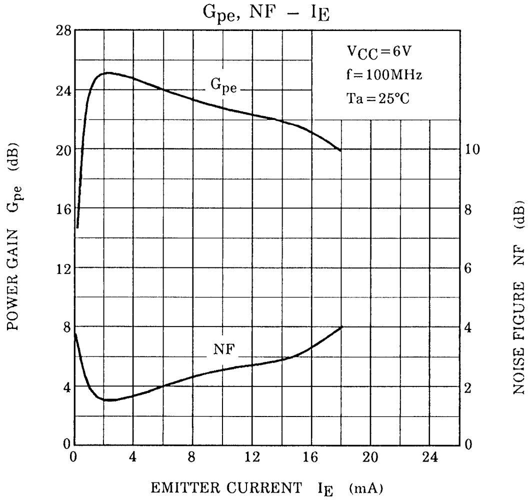
$C_{re} - V_{CB}$



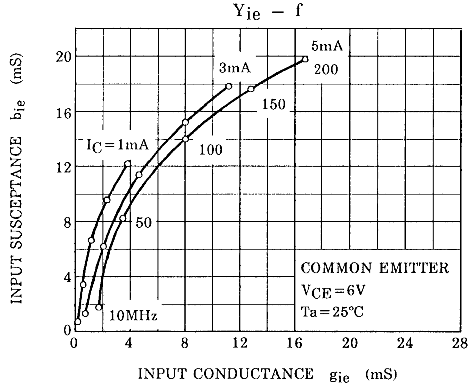
G_{pe}, NF $- V_{CC}$



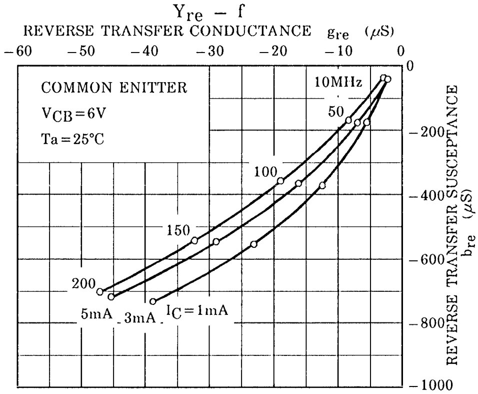
G_{pe}, NF $- I_E$



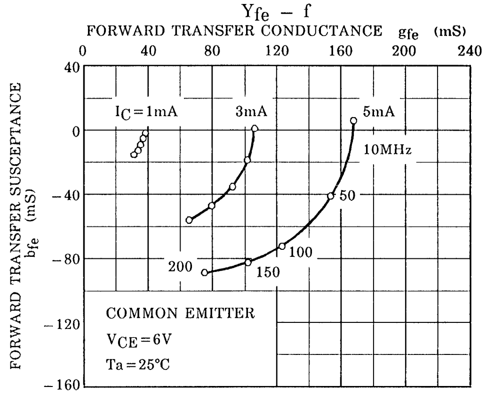
$Y_{ie} - f$



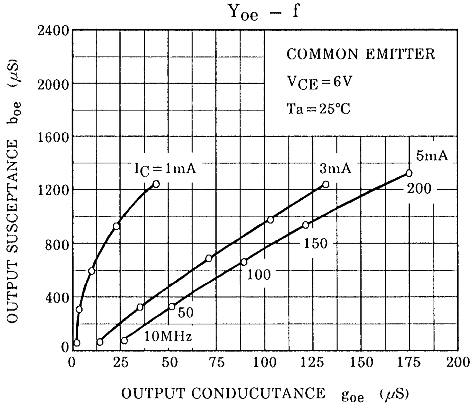
$Y_{re} - f$



$Y_{fe} - f$



$Y_{oe} - f$

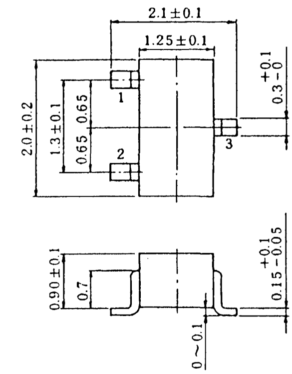


SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC4244

UHF TV TUNER RF AMPLIFIER APPLICATIONS.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1A

Weight : 0.006g

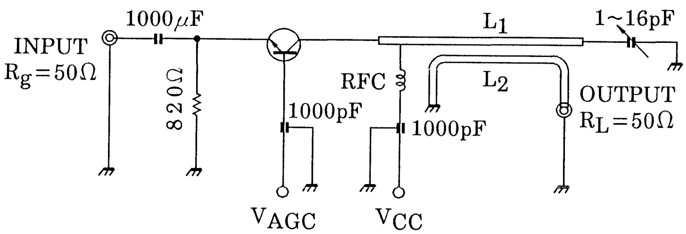
- Low Noise Figure : NF = 4dB (Typ.)
- High Power Gain : Gpb = 17dB (Typ.)
- Excellent Forward AGC Characteristics

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	25	V
Collector-Emitter Voltage	V_{CEO}	20	V
Emitter-Base Voltage	V_{EBO}	2	V
Base Current	I_B	4	mA
Collector Current	I_C	20	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=10V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=2V$, $I_C=0$	—	—	1	μA
Collector Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA$, $I_B=0$	20	—	—	V
DC Current Gain	h_{FE}	$V_{CE}=3V$, $I_C=1mA$	40	100	—	—
Transition Frequency	f_T	$V_{CE}=3V$, $I_C=1mA$	500	850	—	MHz
Reverse Transfer Capacitance	C_{rb}	$V_{CE}=2V$, $I_B=0$, f=1MHz	—	0.4	0.55	pF
Power Gain	G_{pb}	$V_{CC}=4.5V$, $V_{AGC}=2V$ f=800MHz (Fig.1)	12	17	—	dB
Noise Figure	NF		—	4	6	dB
AGC Voltage	V_{AGC}	$V_{CC}=4.5V$, G.R. = −20dB, f=800MHz	2.5	3.2	4.0	V

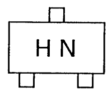


L_1, L_2 : ϕ1.0mm SILVER PLATED COPPER WIRE

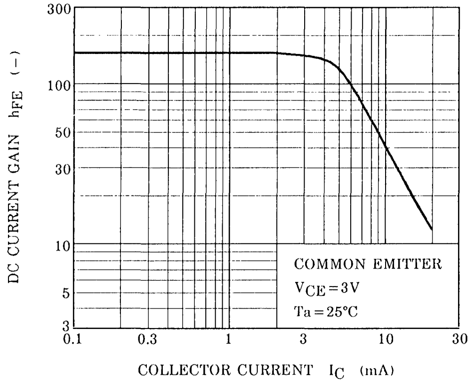
Note. V_{AGC} measured by the test circuit shown in Fig.1, when the power gain is reduced to 20dB compared with G_{pb} shown above Table.

Fig1. 800MHz G_{pb}, NF TEST CIRCUIT

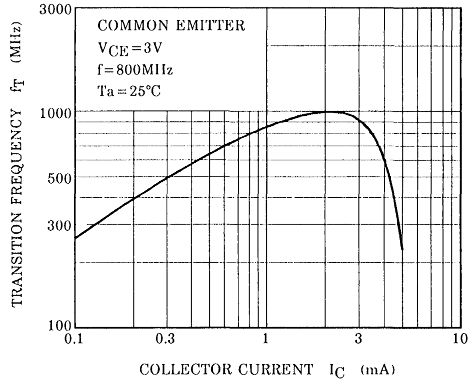
Marking



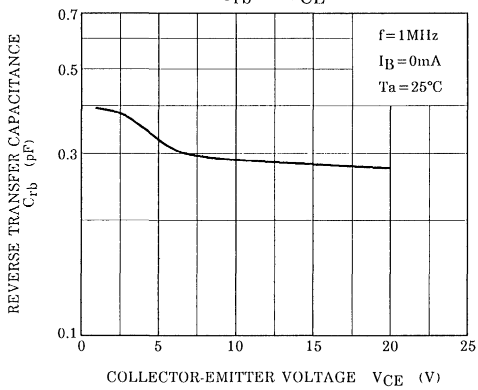
$h_{FE} - I_C$



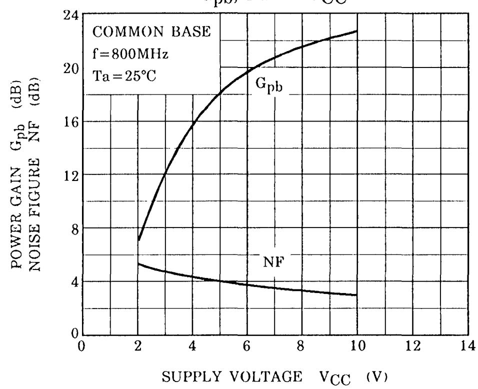
$f_T - I_C$



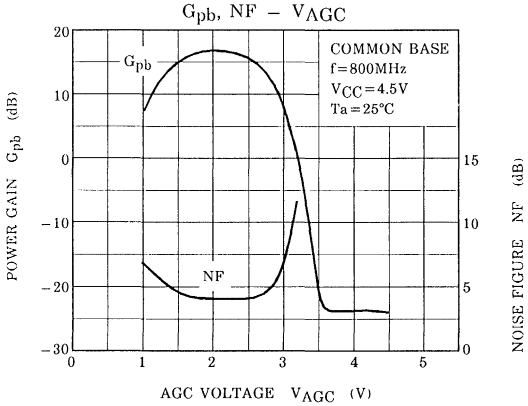
$C_{rb} - V_{CE}$



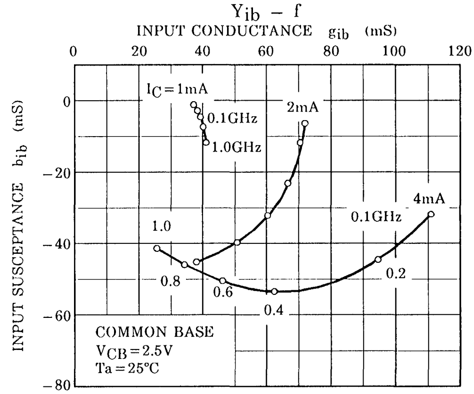
G_{pb}, NF $- V_{CC}$

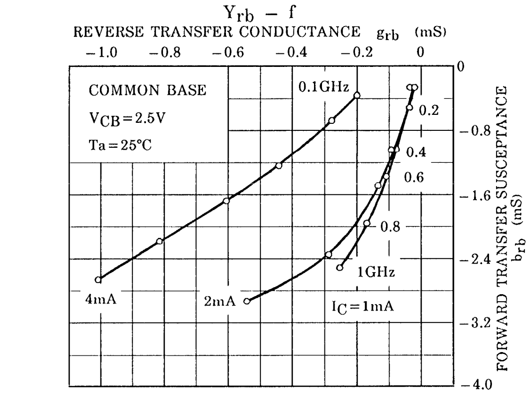


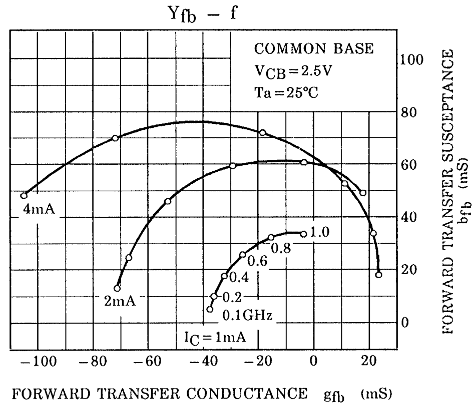
G_{pb}, NF $- V_{AGC}$

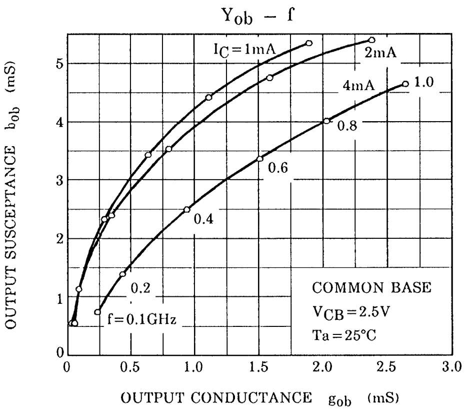


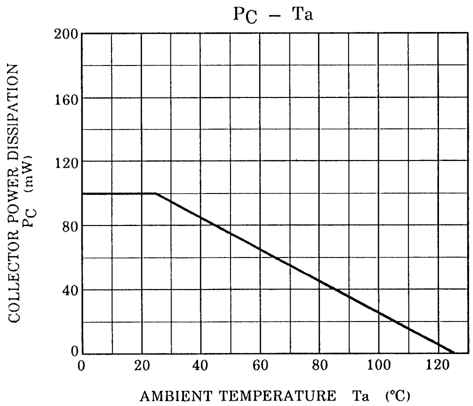
$Y_{ib} - f$




Yrb − f
REVERSE TRANSFER CONDUCTANCE grb (mS)
−1.0 −0.8 −0.6 −0.4 −0.2 0
COMMON BASE
VCB=2.5V
Ta=25°C
0.1GHz
0.2
0.4
0.6
0.8
1GHz
4mA
2mA
IC=1mA
0
−0.8
−1.6
−2.4
−3.2
−4.0
FORWARD TRANSFER SUSCEPTANCE brb (mS)


Yfb − f
COMMON BASE
VCB=2.5V
Ta=25°C
4mA
2mA
1.0
0.8
0.6
0.4
0.2
0.1GHz
IC=1mA
100
80
60
40
20
0
−100 −80 −60 −40 −20 0 20
FORWARD TRANSFER CONDUCTANCE gfb (mS)
FORWARD TRANSFER SUSCEPTANCE bfb (mS)


Yob − f
IC=1mA
2mA
4mA
1.0
0.8
0.6
0.4
0.2
f=0.1GHz
COMMON BASE
VCB=2.5V
Ta=25°C
OUTPUT SUSCEPTANCE bob (mS)
5
4
3
2
1
0
0 0.5 1.0 1.5 2.0 2.5 3.0
OUTPUT CONDUCTANCE gob (mS)

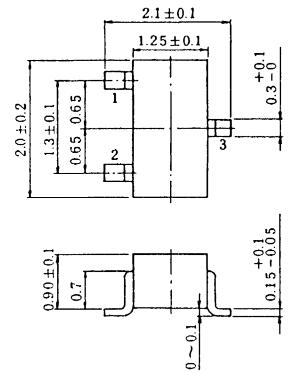

PC − Ta
COLLECTOR POWER DISSIPATION PC (mW)
200
160
120
80
40
0
0 20 40 60 80 100 120
AMBIENT TEMPERATURE Ta (°C)

SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC4245

TV TUNER, UHF MIXER APPLICATIONS.
VHF~UHF BAND RF AMPLIFIER APPLICATIONS.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1A

Weight : 0.006g

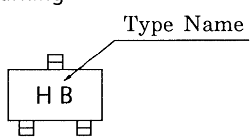
MAXIMUM RATINGS (Ta = 25°C)

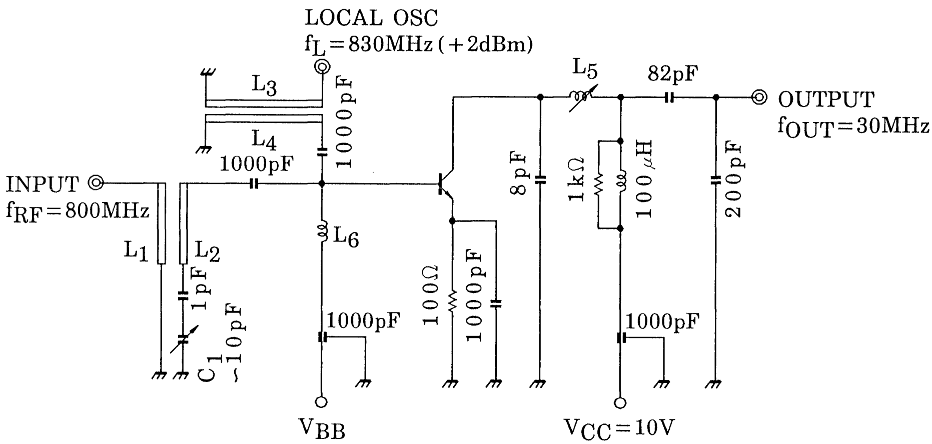
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	15	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	50	mA
Base Current	I_B	25	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=30V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=2V$, $I_C=0$	—	—	1.0	μA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA$, $I_B=0$	15	—	—	V
DC Current Gain	h_{FE}	$V_{CE}=10V$, $I_C=5mA$	40	100	200	—
Reverse Transfer Capacitance	C_{re}	$V_{CB}=10V$, $I_E=0$, f=1MHz	—	0.6	0.9	pF
Transition Frequency	f_T	$V_{CE}=10V$, $I_C=2mA$	1500	2400	—	MHz
Conversion Gain	G_{ce}	$V_{CC}=10V$, $I_C=2mA$, f=800MHz	12	17	—	dB
Noise Figure	NF	$f_L=830MHz$ (+2dBm) (Fig.1)	—	8	13	dB

Marking

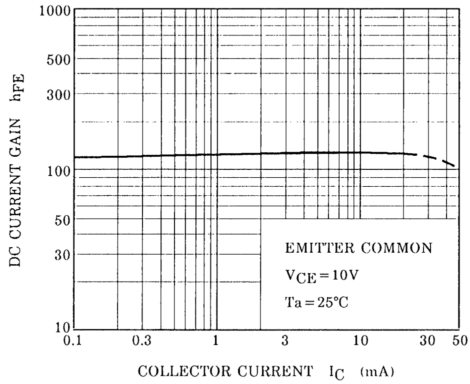




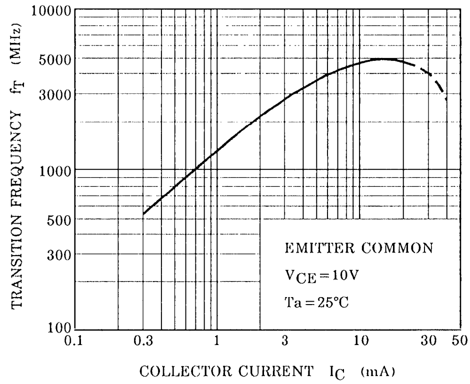
L_1~L_4 : φ0.8mm SILVER PLATED COPPER WIRE
L_5 : COIL WITH CORE SCN-5948①-③ TOKO OR EQUIVALENT
L_6 : φ0.2mm COPPER WIRE 10T 5mm I_D
C_1 : AIR TRIMMER TTA23A100 MURATA MFC. Co., LTD. OR EQUIVALENT

Fig.1 800MHz G_{ce}, NF TEST CIRCUIT

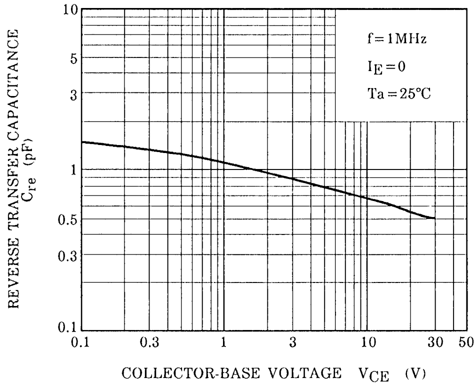
$h_{FE} - I_C$



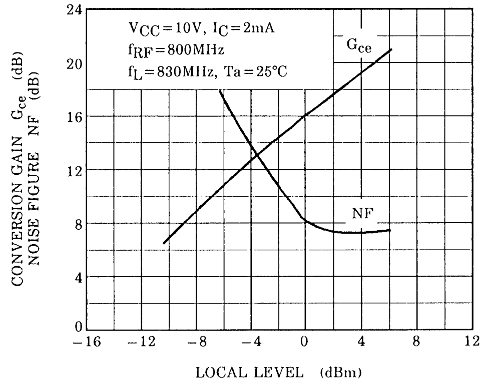
$f_T - I_C$



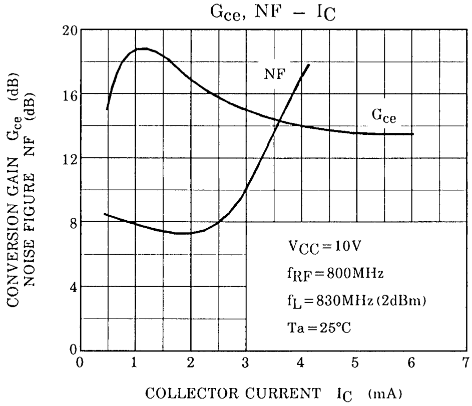
$C_{re} - V_{CB}$



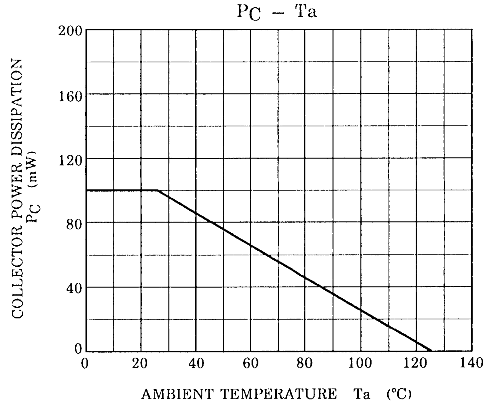
G_{ce}, NF – LOCAL LEVEL



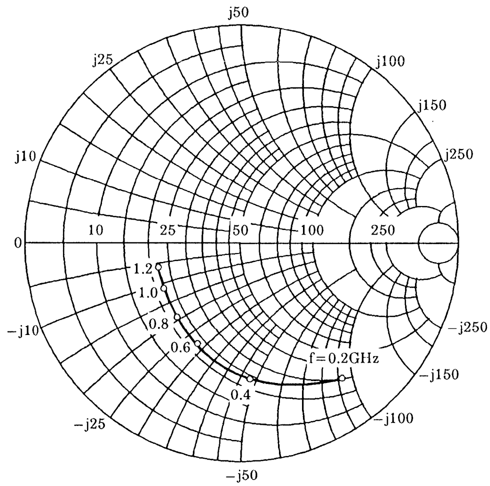
G_{ce}, NF – I_C



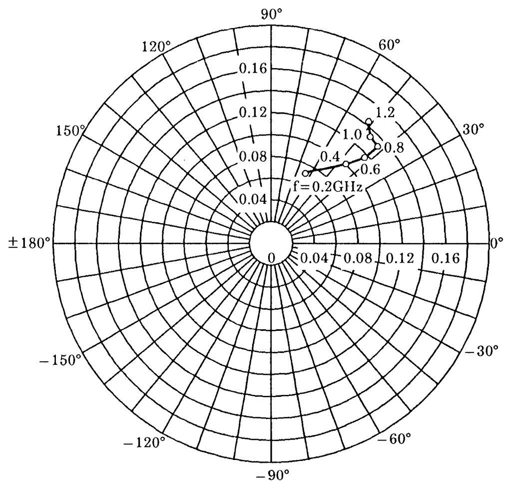
$P_C - Ta$



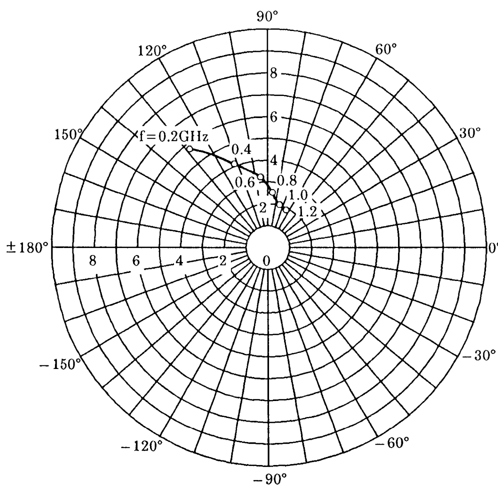
S_{11e}
$V_{CE}=10V$
$I_C=2mA$
$Ta=25°C$
(UNIT : Ω)



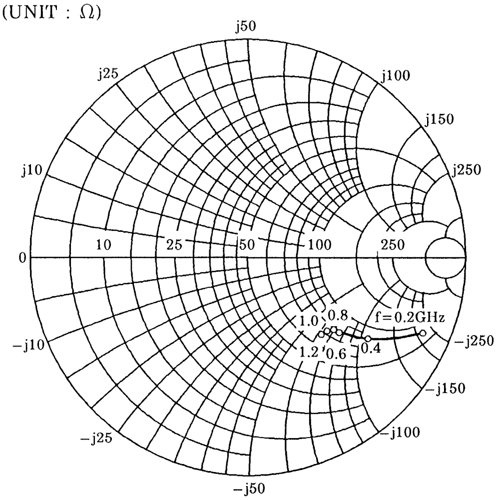
S_{12e}
$V_{CE}=10V$
$I_C=2mA$
$Ta=25°C$



S_{21e}
$V_{CE}=10V$
$I_C=2mA$
$Ta=25°C$



S_{22e}
$V_{CE}=10V$
$I_C=2mA$
$Ta=25°C$
(UNIT : Ω)

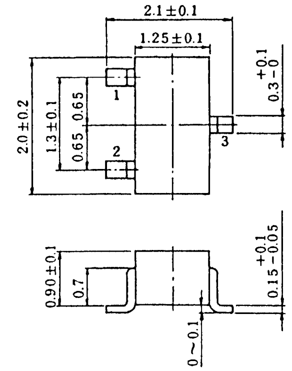


SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC4246

TV TUNER, UHF OSCILLATOR APPLICATIONS. (COMMON BASE)
TV TUNER, UHF CONVERTER APPLICATIONS. (COMMON BASE)

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1A

Weight : 0.006g

- Transition Frequency is High and Dependent on Current Excellently.

MAXIMUM RATINGS (Ta = 25°C)

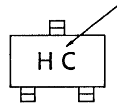
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	15	V
Emitter-Base Voltage	V_{EBO}	3	V
Base Current	I_B	25	mA
Collector Current	I_C	50	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

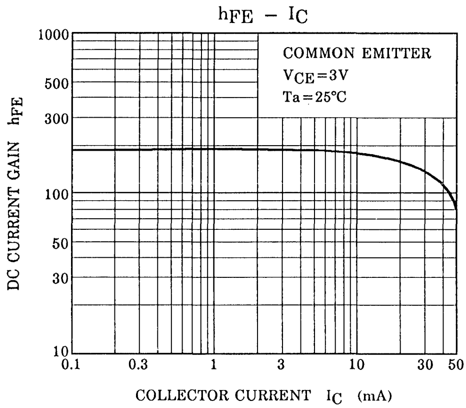
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

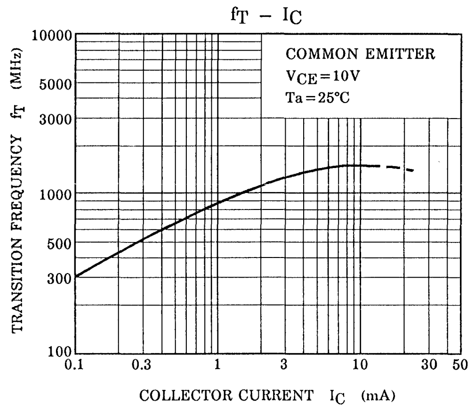
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=15V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=3V$, $I_C=0$	—	—	1.0	μA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA$, $I_B=0$	15	—	—	V
DC Current Gain	h_{FE}	$V_{CE}=3V$, $I_C=8mA$	60	150	320	—
Transition Frequency	f_T	$V_{CE}=10V$, $I_C=8mA$, f=200MHz	1100	1500	—	MHz
Output Capacitance	C_{ob}	$V_{CB}=10V$, $I_E=0$, f=1MHz	—	0.9	1.3	pF
Collector-Base Time Constant	$C_c \cdot r_{bb'}$	$V_{CB}=10V$, $I_C=8mA$ f=30MHz	—	7	12	ps

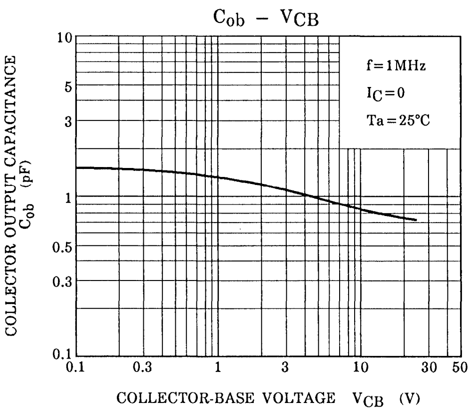
Marking

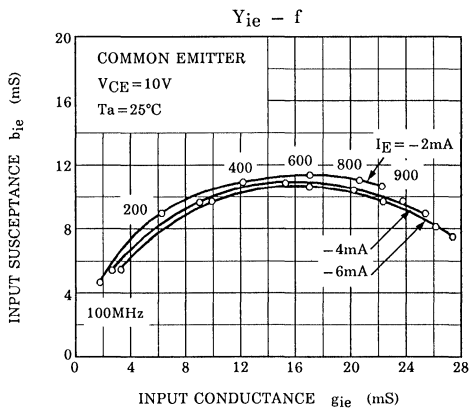
Type Name

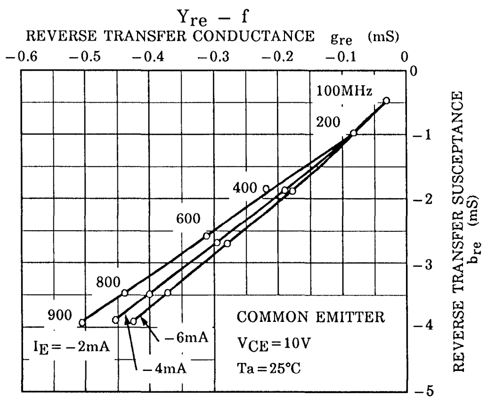


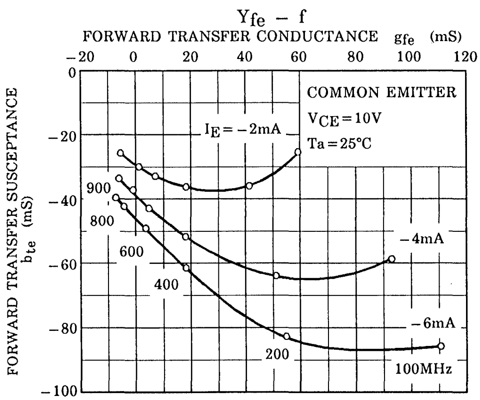

hFE − IC
COMMON EMITTER
VCE=3V
Ta=25°C
DC CURRENT GAIN hFE
COLLECTOR CURRENT IC (mA)

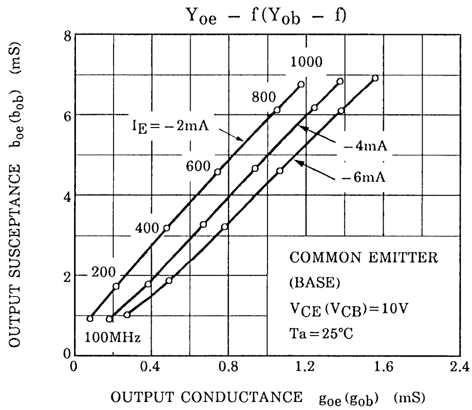

fT − IC
COMMON EMITTER
VCE=10V
Ta=25°C
TRANSITION FREQUENCY fT (MHz)
COLLECTOR CURRENT IC (mA)

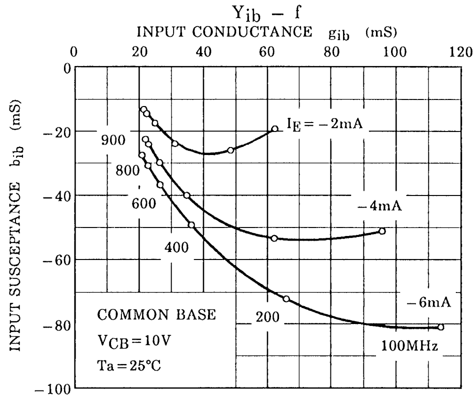

Cob − VCB
f=1MHz
IC=0
Ta=25°C
COLLECTOR OUTPUT CAPACITANCE Cob (pF)
COLLECTOR-BASE VOLTAGE VCB (V)

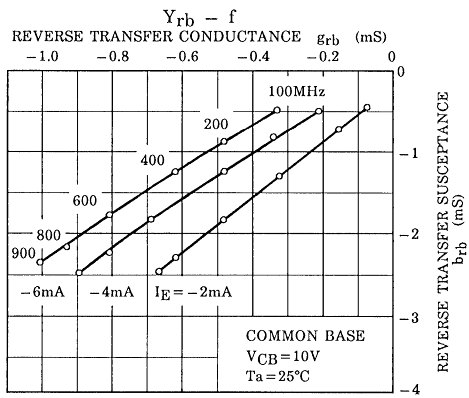

Yie − f
COMMON EMITTER
VCE=10V
Ta=25°C
IE=−2mA
−4mA
−6mA
100MHz
INPUT SUSCEPTANCE bie (mS)
INPUT CONDUCTANCE gie (mS)

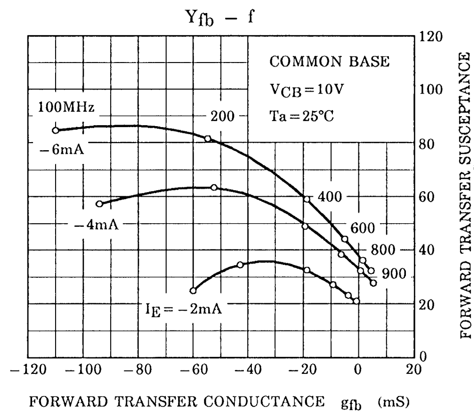

Yre − f
REVERSE TRANSFER CONDUCTANCE gre (mS)
COMMON EMITTER
VCE=10V
Ta=25°C
IE=−2mA
−4mA
−6mA
100MHz
REVERSE TRANSFER SUSCEPTANCE bre (mS)

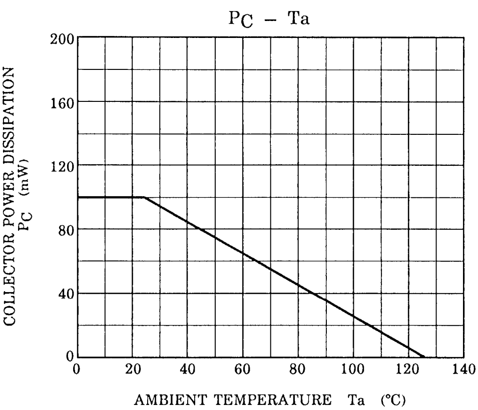

Yfe − f
FORWARD TRANSFER CONDUCTANCE gfe (mS)
COMMON EMITTER
VCE=10V
Ta=25°C
IE=−2mA
−4mA
−6mA
100MHz
FORWARD TRANSFER SUSCEPTANCE bfe (mS)


Yoe – f (Yob – f)
OUTPUT SUSCEPTANCE boe(bob) (mS)
OUTPUT CONDUCTANCE goe(gob) (mS)
COMMON EMITTER
(BASE)
VCE (VCB) = 10V
Ta = 25°C
IE = –2mA
–4mA
–6mA
100MHz
200
400
600
800
1000


Yib – f
INPUT CONDUCTANCE gib (mS)
INPUT SUSCEPTANCE bib (mS)
COMMON BASE
VCB = 10V
Ta = 25°C
IE = –2mA
–4mA
–6mA
100MHz
200
400
600
800
900


Yrb – f
REVERSE TRANSFER CONDUCTANCE grb (mS)
REVERSE TRANSFER SUSCEPTANCE brb (mS)
COMMON BASE
VCB = 10V
Ta = 25°C
IE = –2mA
–4mA
–6mA
100MHz
200
400
600
800
900


Yfb – f
FORWARD TRANSFER CONDUCTANCE gfb (mS)
FORWARD TRANSFER SUSCEPTANCE bfb (mS)
COMMON BASE
VCB = 10V
Ta = 25°C
IE = –2mA
–4mA
–6mA
100MHz
200
400
600
800
900

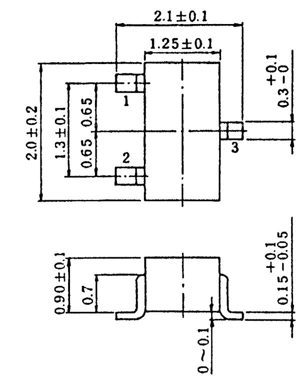

PC – Ta
COLLECTOR POWER DISSIPATION PC (mW)
AMBIENT TEMPERATURE Ta (°C)

2SC4247 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

TV TUNER, UHF OSCILLATOR APPLICATIONS. (COMMON COLLECTOR)

- Transition Frequency is High and Dependent on Current Excellently.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1A

Weight : 0.006g

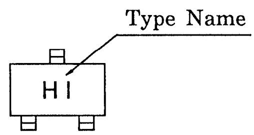
MAXIMUM RATINGS (Ta = 25°C)

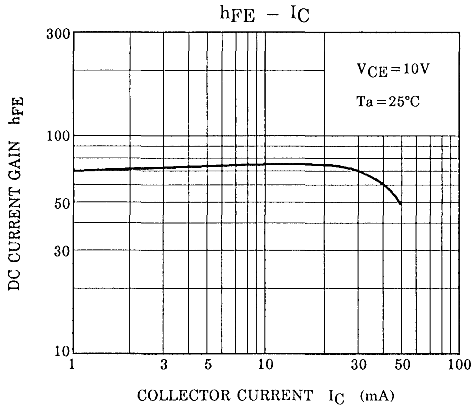
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Base Current	I_B	15	mA
Collector Current	I_C	30	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

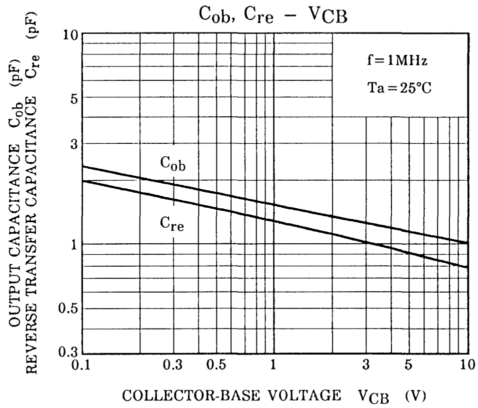
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

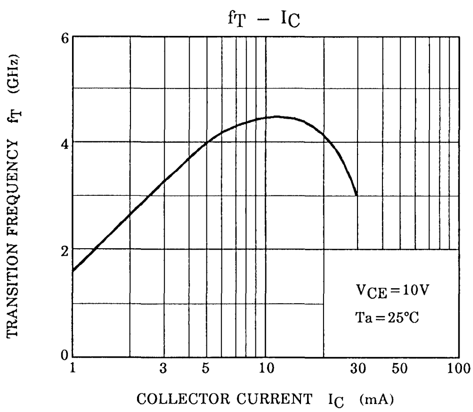
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=10V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=2V$, $I_C=0$	—	—	1.0	μA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA$, $I_B=0$	12	—	—	V
DC Current Gain	h_{FE}	$V_{CE}=10V$, $I_C=5mA$	35	—	130	—
Transition Frequency	f_T	$V_{CE}=10V$, $I_C=10mA$, f=1000MHz	2.6	4	—	GHz
Output Capacitance	C_{ob}	$V_{CB}=10V$, $I_E=0$, f=1MHz	—	1.05	1.35	pF
Collector-Base Time Constant	$C_c \cdot r_{bb'}$	$V_{CB}=10V$, $I_C=5mA$ f=30MHz	—	4.5	9.0	ps

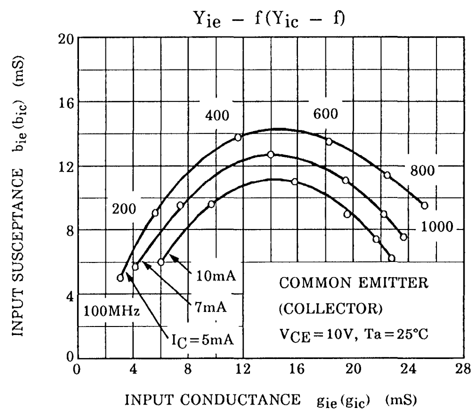
Marking

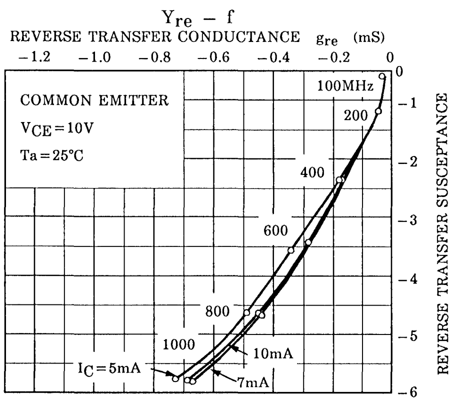


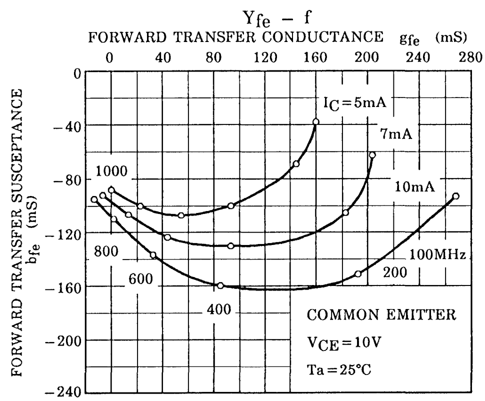

hFE – IC
VCE=10V
Ta=25°C
DC CURRENT GAIN hFE
COLLECTOR CURRENT IC (mA)

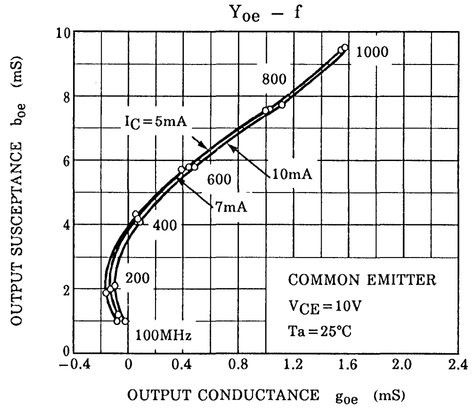

Cob, Cre – VCB
f=1MHz
Ta=25°C
Cob
Cre
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
COLLECTOR-BASE VOLTAGE VCB (V)

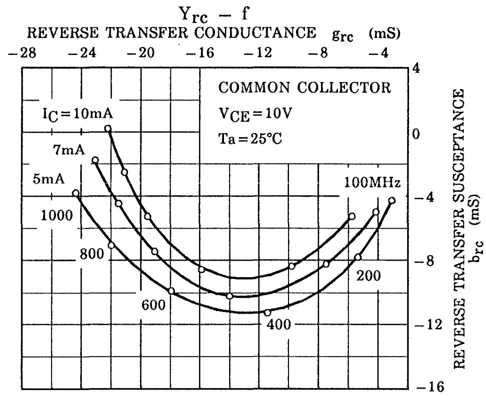

fT – IC
VCE=10V
Ta=25°C
TRANSITION FREQUENCY fT (GHz)
COLLECTOR CURRENT IC (mA)

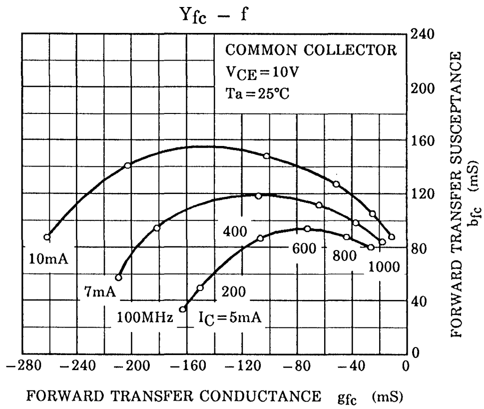

Yie – f(Yic – f)
COMMON EMITTER
(COLLECTOR)
VCE=10V, Ta=25°C
10mA
7mA
IC=5mA
100MHz
INPUT SUSCEPTANCE bie(bic) (mS)
INPUT CONDUCTANCE gie(gic) (mS)

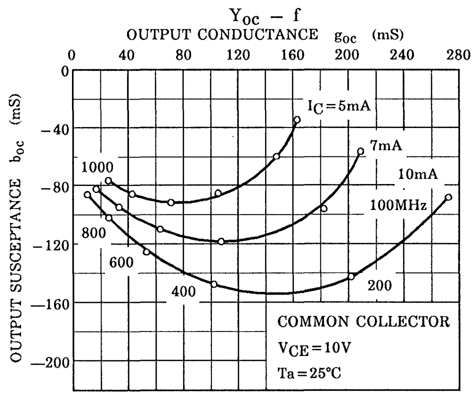

Yre – f
REVERSE TRANSFER CONDUCTANCE gre (mS)
COMMON EMITTER
VCE=10V
Ta=25°C
100MHz
IC=5mA
10mA
7mA
REVERSE TRANSFER SUSCEPTANCE bre (mS)

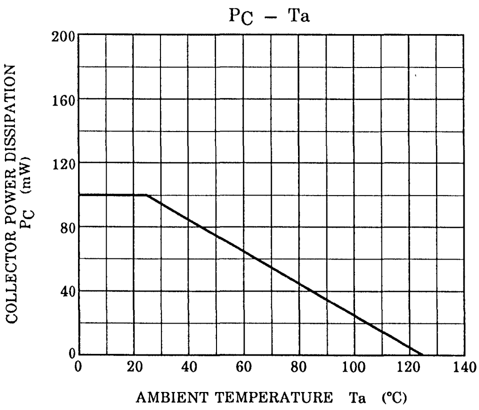

Yfe – f
FORWARD TRANSFER CONDUCTANCE gfe (mS)
IC=5mA
7mA
10mA
100MHz
COMMON EMITTER
VCE=10V
Ta=25°C
FORWARD TRANSFER SUSCEPTANCE bfe (mS)


Yoe − f
OUTPUT SUSCEPTANCE boe (mS)
OUTPUT CONDUCTANCE goe (mS)
IC=5mA
10mA
7mA
1000
800
600
400
200
100MHz
COMMON EMITTER
VCE=10V
Ta=25°C
10
8
6
4
2
0
−0.4
0
0.4
0.8
1.2
1.6
2.0
2.4


Yrc − f
REVERSE TRANSFER CONDUCTANCE grc (mS)
REVERSE TRANSFER SUSCEPTANCE brc (mS)
COMMON COLLECTOR
VCE=10V
Ta=25°C
IC=10mA
7mA
5mA
1000
800
600
400
200
100MHz
−28
−24
−20
−16
−12
−8
−4
4
0
−4
−8
−12
−16


Yfc − f
FORWARD TRANSFER CONDUCTANCE gfc (mS)
FORWARD TRANSFER SUSCEPTANCE bfc (mS)
COMMON COLLECTOR
VCE=10V
Ta=25°C
10mA
7mA
IC=5mA
100MHz
200
400
600
800
1000
−280
−240
−200
−160
−120
−80
−40
0
240
200
160
120
80
40
0


Yoc − f
OUTPUT CONDUCTANCE goc (mS)
OUTPUT SUSCEPTANCE boc (mS)
IC=5mA
7mA
10mA
100MHz
1000
800
600
400
200
COMMON COLLECTOR
VCE=10V
Ta=25°C
0
40
80
120
160
200
240
280
0
−40
−80
−120
−160
−200


PC − Ta
COLLECTOR POWER DISSIPATION PC (mW)
AMBIENT TEMPERATURE Ta (°C)
200
160
120
80
40
0
0
20
40
60
80
100
120
140

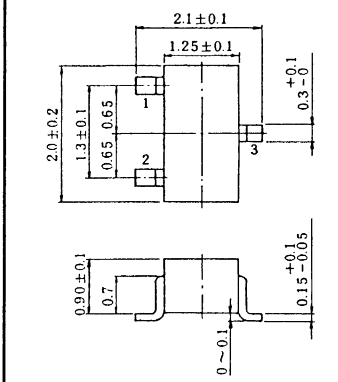
SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC4248

TV TUNER, UHF OSCILLATOR APPLICATIONS. (COMMON COLLECTOR)

- Transition Frequency is High and Dependent on Current Excellently.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1A

Weight : 0.006g

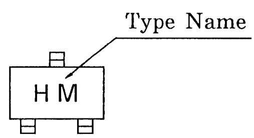
MAXIMUM RATINGS (Ta = 25°C)

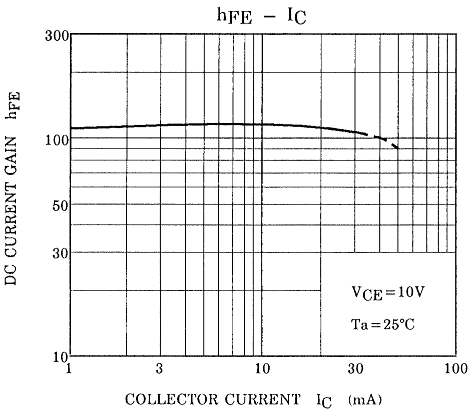
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Base Current	I_B	15	mA
Collector Current	I_C	30	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

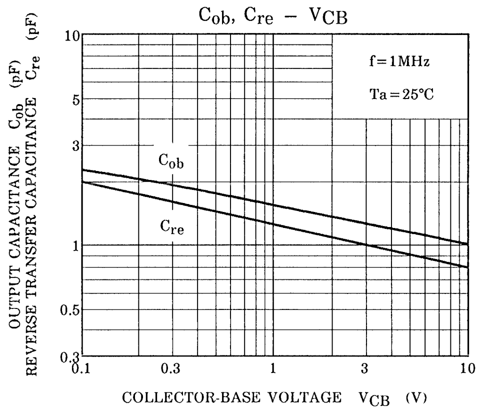
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

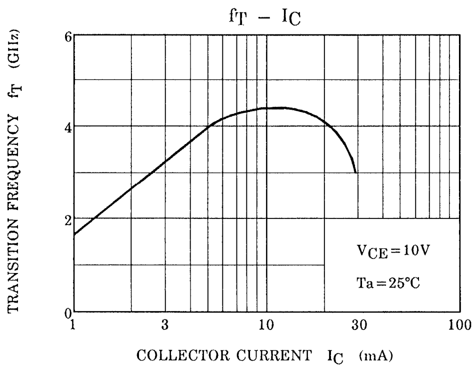
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=10V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=2V$, $I_C=0$	—	—	1.0	μA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA$, $I_B=0$	12	—	—	V
DC Current Gain	h_{FE}	$V_{CE}=10V$, $I_C=5mA$	70	—	130	—
Transition Frequency	f_T	$V_{CE}=10V$, $I_C=10mA$, f=1000MHz	3	4	—	GHz
Output Capacitance	C_{ob}	$V_{CB}=10V$, $I_E=0$, f=1MHz	—	1.05	1.35	pF
Collector-Base Time Constant	$C_c \cdot r_{bb'}$	$V_{CB}=10V$, $I_C=5mA$ f=30MHz	—	4.5	9.0	ps

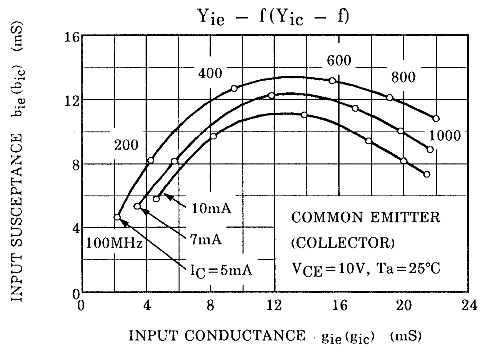
Marking

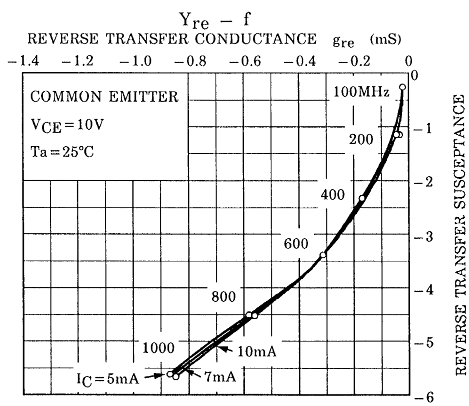


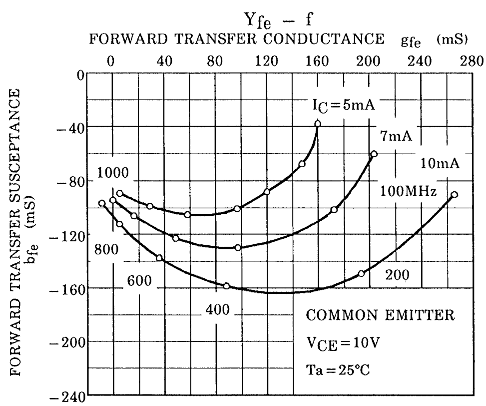

hFE – IC
DC CURRENT GAIN hFE
COLLECTOR CURRENT IC (mA)
VCE=10V
Ta=25°C

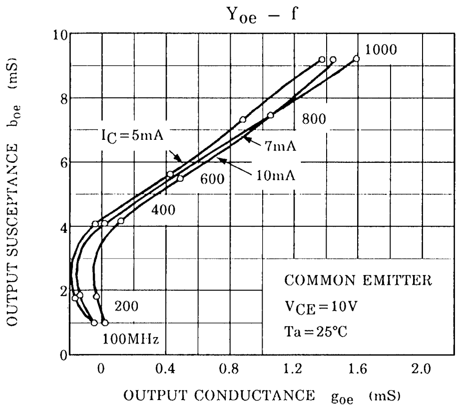

Cob, Cre – VCB
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
COLLECTOR-BASE VOLTAGE VCB (V)
f=1MHz
Ta=25°C
Cob
Cre

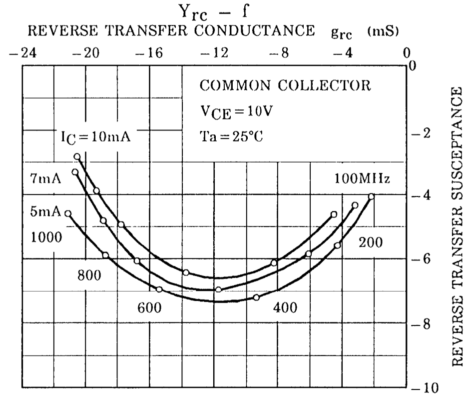

fT – IC
TRANSITION FREQUENCY fT (GHz)
COLLECTOR CURRENT IC (mA)
VCE=10V
Ta=25°C

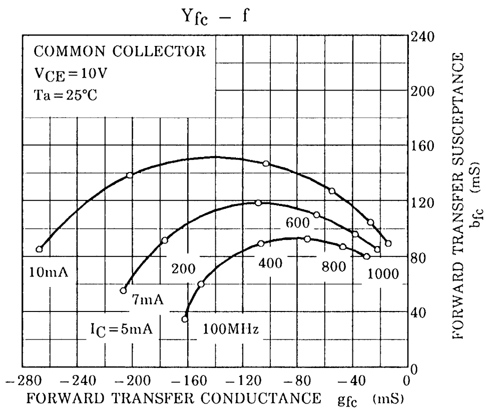

Yie – f(Yic – f)
INPUT SUSCEPTANCE bie(bic) (mS)
INPUT CONDUCTANCE gie(gic) (mS)
COMMON EMITTER
(COLLECTOR)
VCE=10V, Ta=25°C
100MHz
200
400
600
800
1000
10mA
7mA
IC=5mA

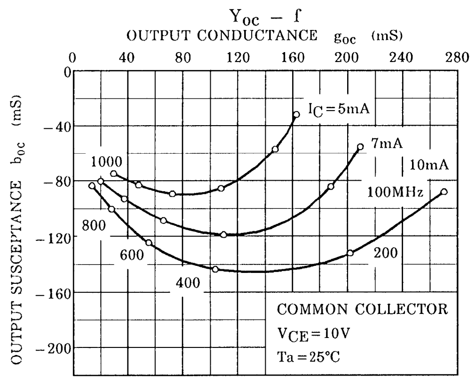

Yre – f
REVERSE TRANSFER CONDUCTANCE gre (mS)
REVERSE TRANSFER SUSCEPTANCE bre (mS)
COMMON EMITTER
VCE=10V
Ta=25°C
100MHz
200
400
600
800
1000
10mA
7mA
IC=5mA

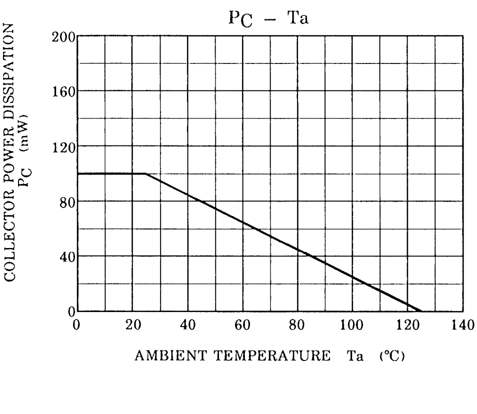

Yfe – f
FORWARD TRANSFER CONDUCTANCE gfe (mS)
FORWARD TRANSFER SUSCEPTANCE bfe (mS)
COMMON EMITTER
VCE=10V
Ta=25°C
IC=5mA
7mA
10mA
100MHz
200
400
600
800
1000


Yoe – f
OUTPUT SUSCEPTANCE boe (mS)
OUTPUT CONDUCTANCE goe (mS)
IC=5mA
7mA
10mA
1000
800
600
400
200
100MHz
COMMON EMITTER
VCE=10V
Ta=25°C


Yrc – f
REVERSE TRANSFER CONDUCTANCE grc (mS)
REVERSE TRANSFER SUSCEPTANCE brc (mS)
COMMON COLLECTOR
VCE=10V
Ta=25°C
IC=10mA
7mA
5mA
1000
800
600
400
200
100MHz


Yfc – f
COMMON COLLECTOR
VCE=10V
Ta=25°C
FORWARD TRANSFER SUSCEPTANCE bfc (mS)
FORWARD TRANSFER CONDUCTANCE gfc (mS)
10mA
7mA
IC=5mA
100MHz
200
400
600
800
1000


Yoc – f
OUTPUT CONDUCTANCE goc (mS)
OUTPUT SUSCEPTANCE boc (mS)
IC=5mA
7mA
10mA
100MHz
1000
800
600
400
200
COMMON COLLECTOR
VCE=10V
Ta=25°C

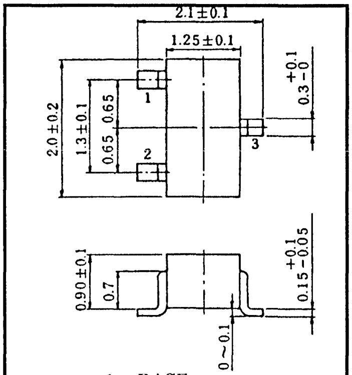

PC – Ta
COLLECTOR POWER DISSIPATION PC (mW)
AMBIENT TEMPERATURE Ta (°C)

2SC4249 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

TV VHF RF AMPLIFIER APPLICATIONS.

- High Gain : G_{pe}=24dB (Typ.) (f=200MHz)
- Low Noise : NF=2.0dB (Typ.) (f=200MHz)
- Excellent Forward AGC Characteristics.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1A

Weight : 0.006g

MAXIMUM RATINGS (Ta = 25°C)

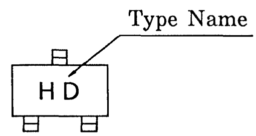
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	20	mA
Base Current	I_B	10	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

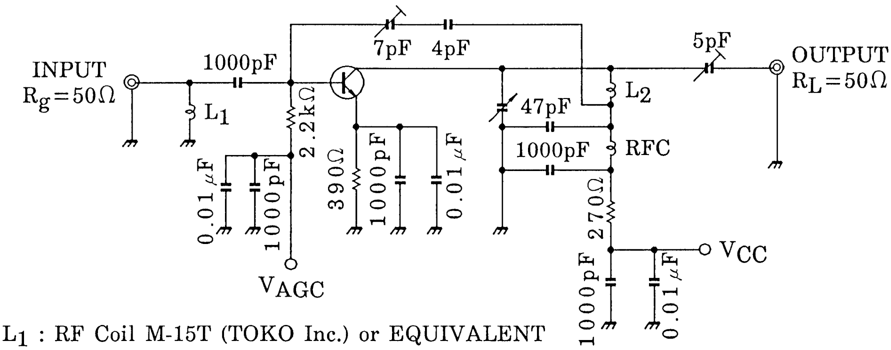
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB}=25V, I_E=0	—	—	100	nA
Emitter Cut-off Current	I_{EBO}	V_{EB}=2V, I_C=0	—	—	100	nA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=1mA, I_B=0	30	—	—	V
DC Current Gain	h_{FE}	V_{CE}=10V, I_C=2mA	60	150	300	—
Reverse Transfer Capacitance	C_{re}	V_{CB}=10V, I_E=0, f=1MHz	—	0.35	0.5	pF
Transition Frequency	f_T	V_{CE}=10V, I_C=2mA	400	650	—	MHz
Power Gain	G_{pe}	V_{CC}=12V, V_{AGC}=1.4V f=200MHz (Fig.1)	20	24	28	dB
Noise Figure	NF		—	2.0	3.2	dB
AGC Voltage (Note)	V_{AGC}	V_{CC}=12V, GR=30dB f=200MHz	3.6	4.4	5.1	V

Note : V_{AGC} measured by test circuit shown in Fig.1 when power gain is reduced to 30dB compared that of V_{AGC} at 1.4V.

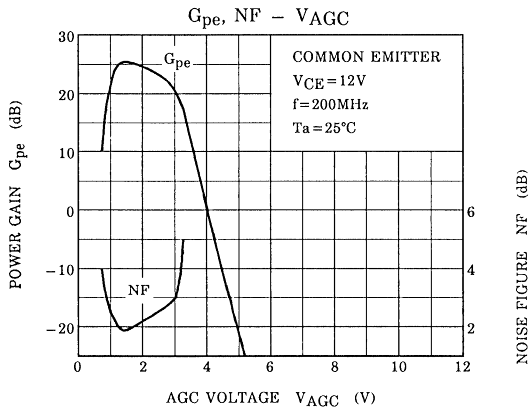
Marking

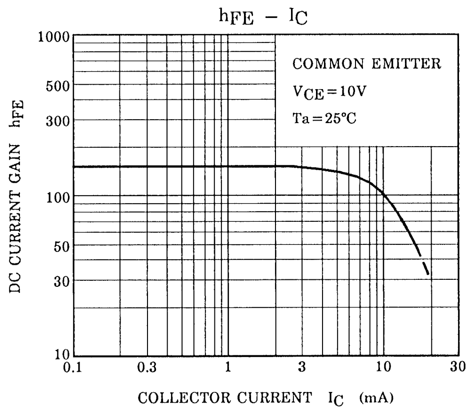


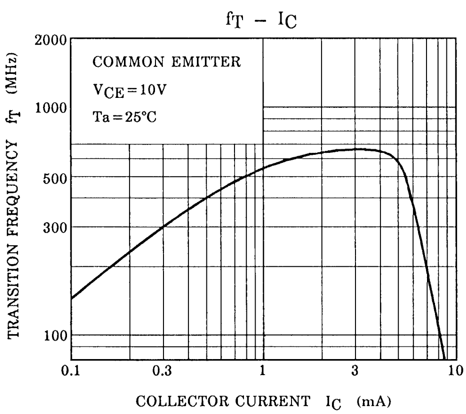


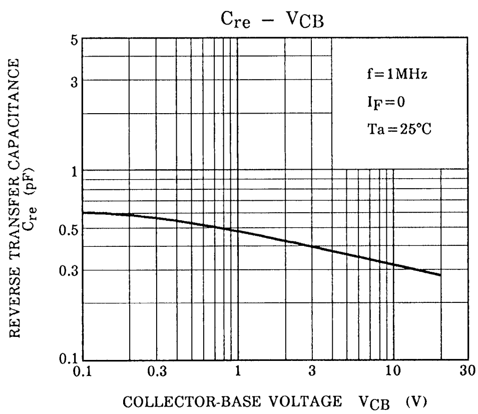
L1 : RF Coil M-15T (TOKO Inc.) or EQUIVALENT
L2 : RF Coil M-25T (TOKO Inc.) or EQUIVALENT

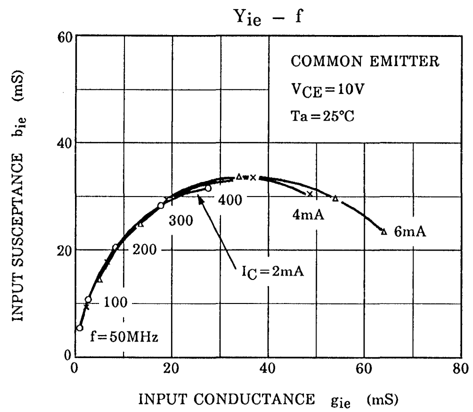
Fig.1 200MHz G_{pe}, NF TEST CIRCUIT

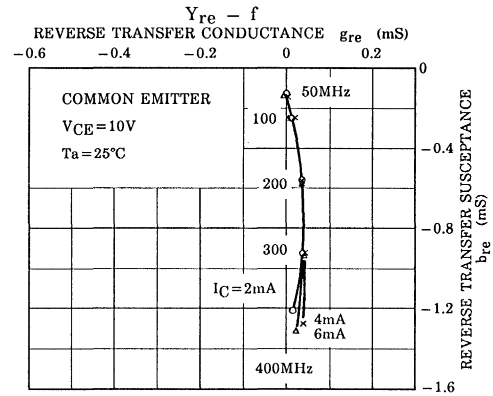


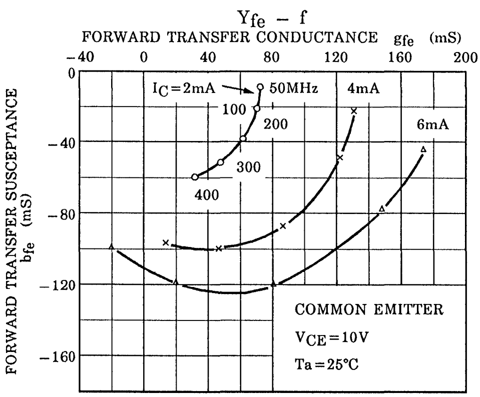


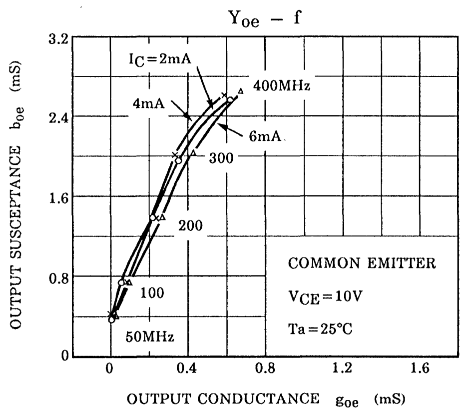


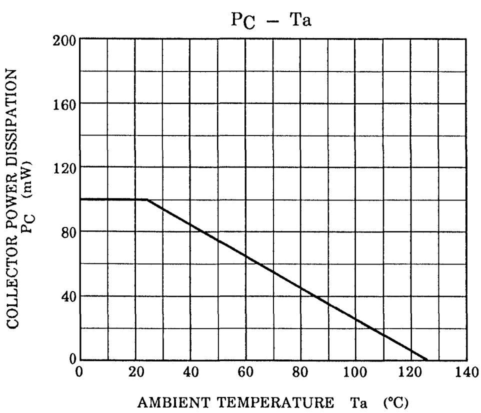



Yie − f
COMMON EMITTER
VCE=10V
Ta=25°C
f=50MHz
100
200
300
400
IC=2mA
4mA
6mA
INPUT SUSCEPTANCE bie (mS)
INPUT CONDUCTANCE gie (mS)


Yre − f
REVERSE TRANSFER CONDUCTANCE gre (mS)
COMMON EMITTER
VCE=10V
Ta=25°C
50MHz
100
200
300
IC=2mA
4mA
6mA
400MHz
REVERSE TRANSFER SUSCEPTANCE bre (mS)


Yfe − f
FORWARD TRANSFER CONDUCTANCE gfe (mS)
IC=2mA
50MHz
4mA
100
200
6mA
300
400
COMMON EMITTER
VCE=10V
Ta=25°C
FORWARD TRANSFER SUSCEPTANCE bfe (mS)


Yoe − f
IC=2mA
400MHz
4mA
6mA
300
200
100
50MHz
COMMON EMITTER
VCE=10V
Ta=25°C
OUTPUT SUSCEPTANCE boe (mS)
OUTPUT CONDUCTANCE goe (mS)

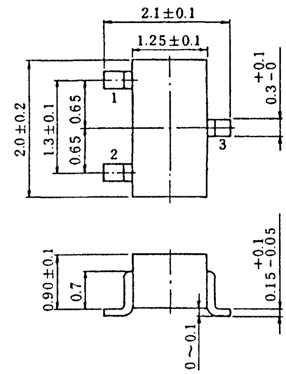

PC − Ta
COLLECTOR POWER DISSIPATION PC (mW)
AMBIENT TEMPERATURE Ta (°C)

SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC4250

TV VHF MIXER APPLICATIONS.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1A

Weight : 0.006g

- High Conversion Gain : G_{ce} = 25dB (Typ.)
- Low Reverse Transfer Capacitance : C_{re} = 0.45pF (Typ.)

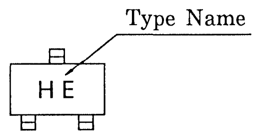
MAXIMUM RATINGS (Ta = 25°C)

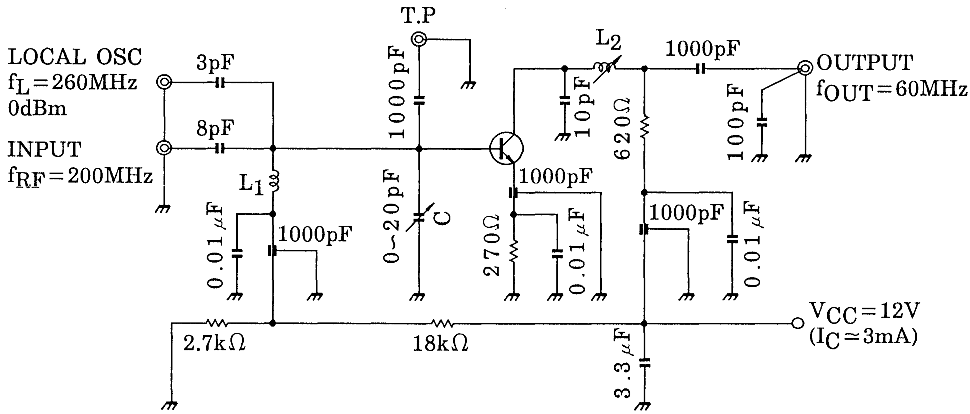
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	20	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	50	mA
Base Current	I_B	25	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 25V, I_E = 0	—	—	100	nA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 3V, I_C = 0	—	—	1000	nA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C = 1mA, I_B = 0	20	—	—	V
DC Current Gain	h_{FE}	V_{CE} = 10V, I_C = 5mA	40	150	300	—
Reverse Transfer Capacitance	C_{re}	V_{CB} = 10V, I_E = 0, f = 1MHz	—	0.45	0.6	pF
Transition Frequency	f_T	V_{CE} = 10V, I_C = 5mA	900	1400	—	MHz
Conversion Gain	G_{ce}	V_{CC} = 12V, f = 200MHz f_L = 260MHz (Fig.1)	20	25	—	dB.
Noise Figure	NF		—	4.3	6	dB

Marking

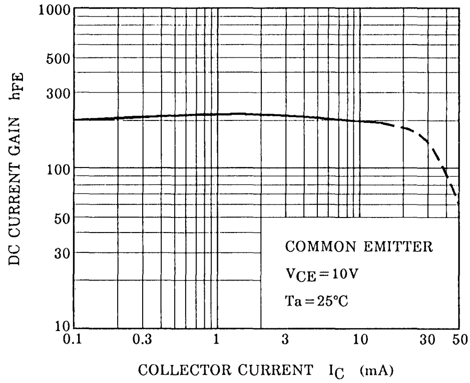




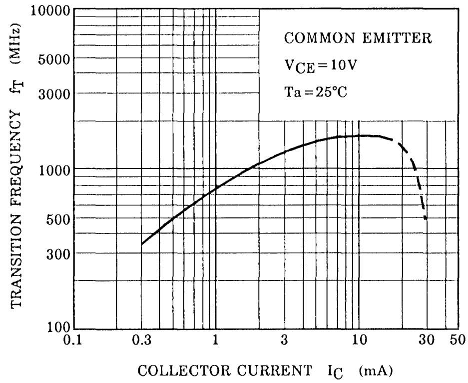
L_1 : 0.8mmϕ SILVER PLATED COPPER WIRE, 1.5T 5mm ID
L_2 : COIL WITH CORE SCN-5962A①-③ (TOKO INC.) OR EQUIVALENT
C : AIR TRIMMER TTA25A200A (MURATA MFG. Co., LTD.) OR EQUIVALENT

Fig.1 200MHz G_{ce}, NF TEST CIRCUIT

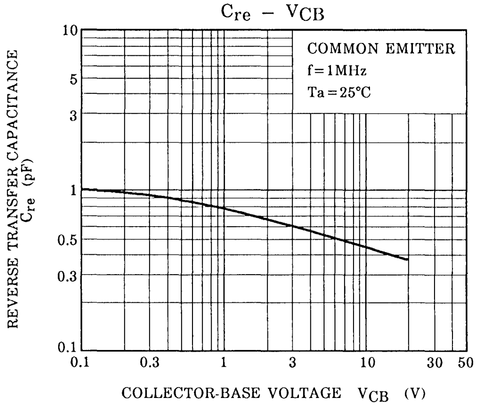
$h_{FE} - I_C$



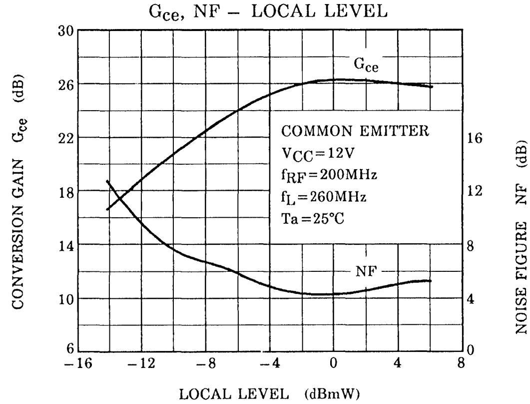
$f_T - I_C$



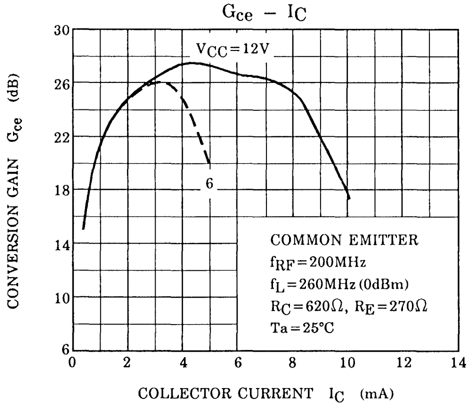
$C_{re} - V_{CB}$



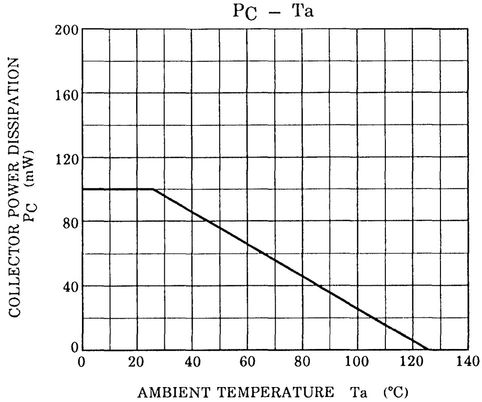
G_{ce}, NF – LOCAL LEVEL



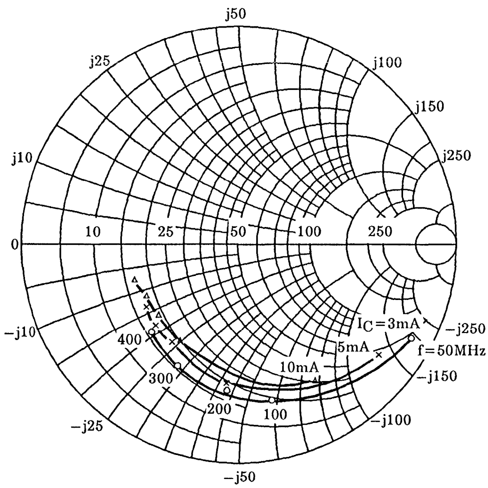
$G_{ce} - I_C$



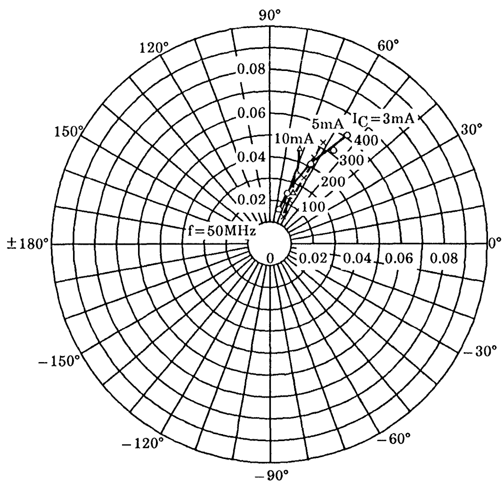
$P_C - Ta$



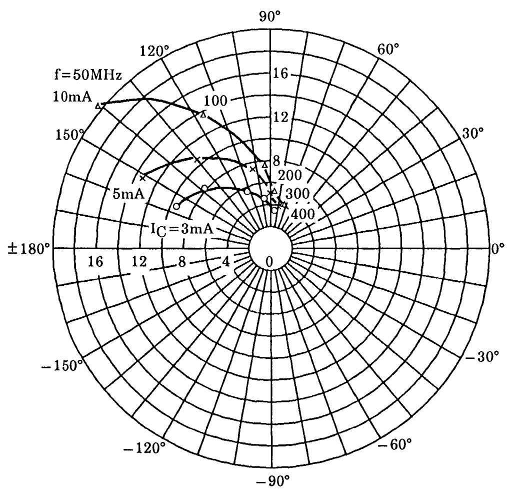
S_{11e}
$V_{CE}=10V$
$Ta=25°C$
(UNIT : Ω)



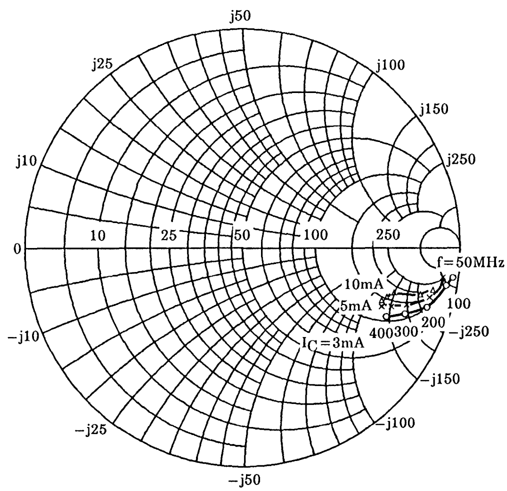
S_{12e}
$V_{CE}=10V$
$Ta=25°C$



S_{21e}
$V_{CE}=10V$
$Ta=25°C$



S_{22e}
$V_{CE}=10V$
$Ta=25°C$
(UNIT : Ω)

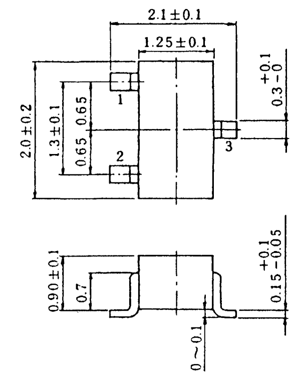


SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC4251

TV TUNER, VHF OSCILLATOR APPLICATIONS.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1A

Weight : 0.006g

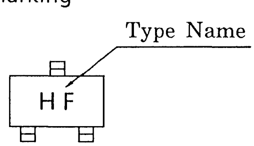
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	15	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	50	mA
Base Current	I_B	25	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

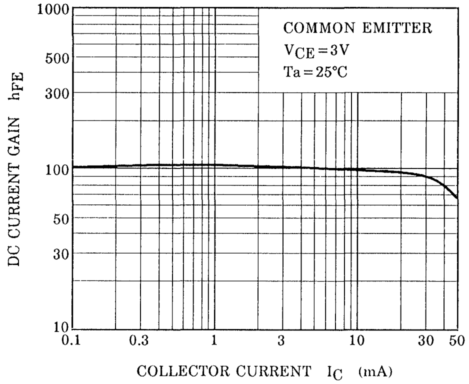
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=15V,\ I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=3V,\ I_C=0$	—	—	1.0	μA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA,\ I_B=0$	15	—	—	V
DC Current Gain	h_{FE}	$V_{CE}=3V,\ I_C=8mA$	40	100	200	—
Transition Frequency	f_T	$V_{CE}=10V,\ I_C=8mA$	650	1100	—	MHz
Collector Output Capacitance	C_{ob}	$V_{CB}=10V,\ I_E=0,\ f=1MHz$	—	0.9	1.3	pF
Collector-Base Time Constant	$C_c \cdot r_{bb'}$	$V_{CB}=10V,\ I_C=8mA$ f=30MHz	—	7	12	ps

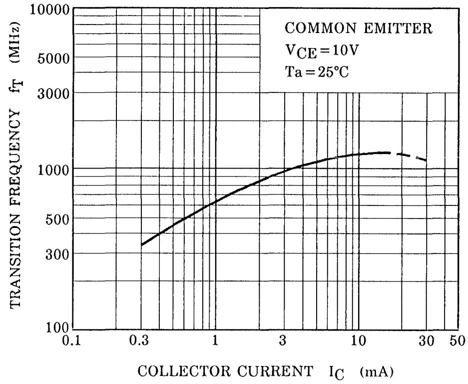
Marking



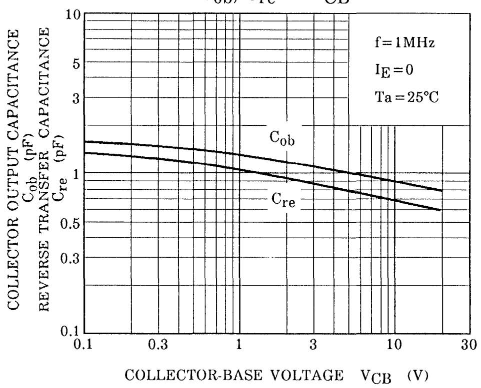
h_{FE} – I_C



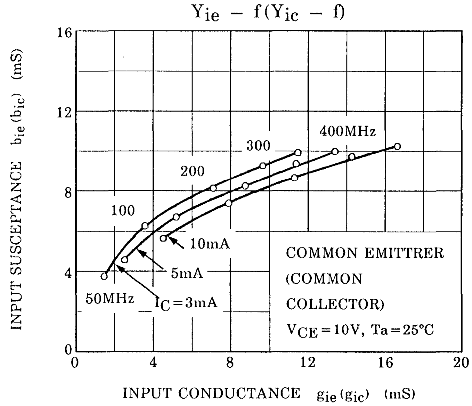
f_T – I_C



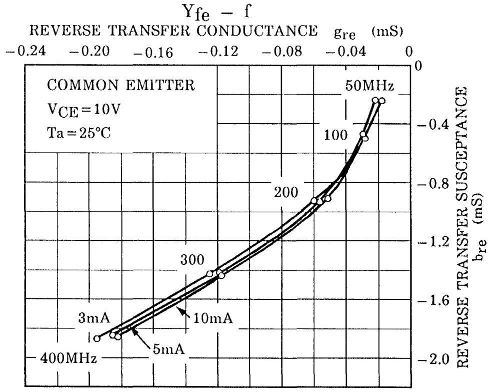
C_{ob}, C_{re} – V_{CB}



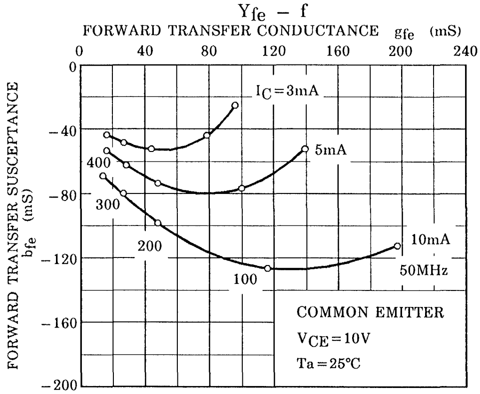
Y_{ie} – f(Y_{ic} – f)



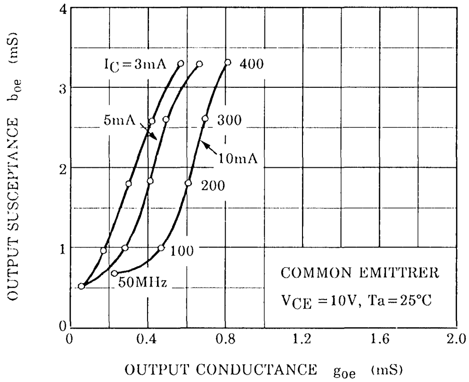
Y_{fe} – f



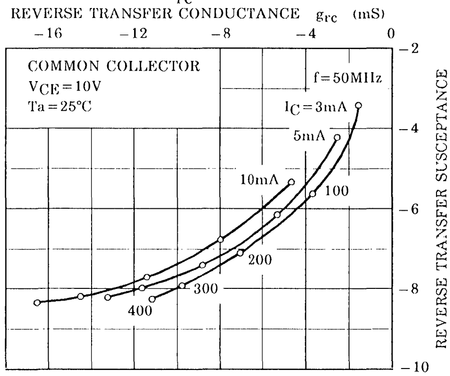
Y_{fe} – f



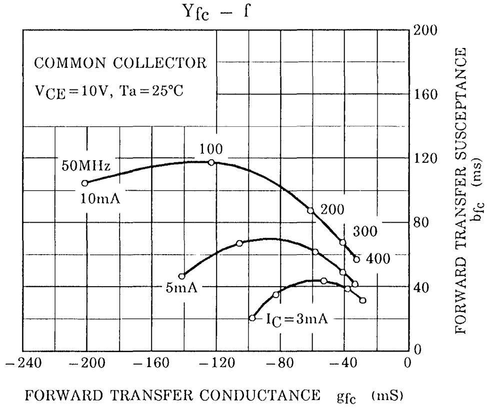
Yoe – f



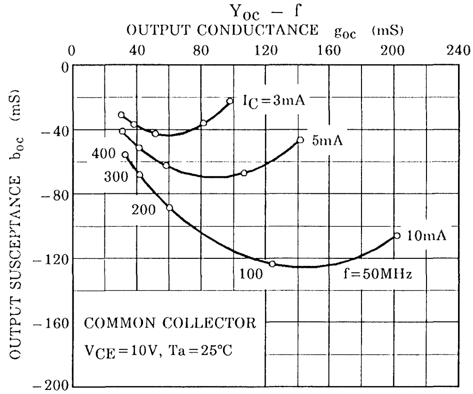
Yrc – f



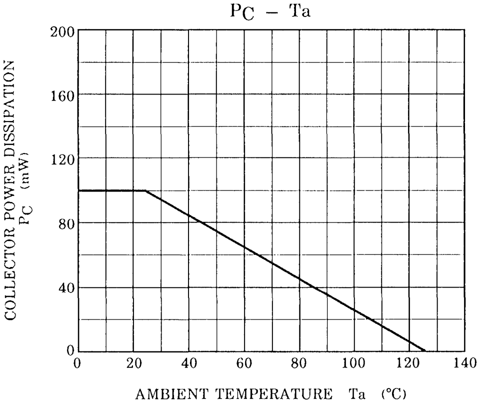
Yfc – f



Yoc – f



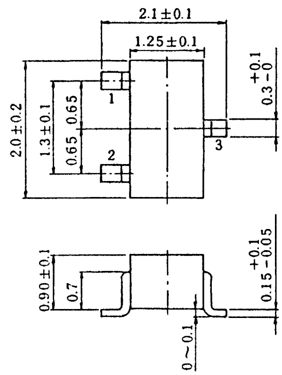
PC – Ta



2SC4252 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

TV TUNER, VHF OSCILLATOR APPLICATIONS. (COMMON COLLECTOR)

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1A

Weight : 0.006g

- Transition Frequency is High and Dependent on Current Excellently.

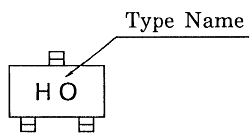
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Base Current	I_B	15	mA
Collector Current	I_C	30	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

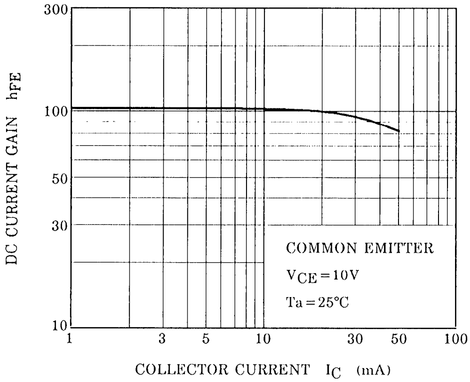
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=20V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=3V$, $I_C=0$	—	—	1.0	μA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA$, $I_B=0$	12	—	—	V
DC Current Gain	h_{FE}	$V_{CE}=10V$, $I_C=5mA$	40	100	250	—
Transition Frequency	f_T	$V_{CE}=10V$, $I_C=5mA$, f=500MHz	1.5	2.1	—	GHz
Output Capacitance	C_{ob}	$V_{CB}=10V$, $I_E=0$, f=1MHz	—	1.1	1.4	pF
Collector-Base Time Constant	$C_c \cdot r_{bb'}$	$V_{CB}=10V$, $I_C=5mA$ f=30MHz	—	4.3	10	ps

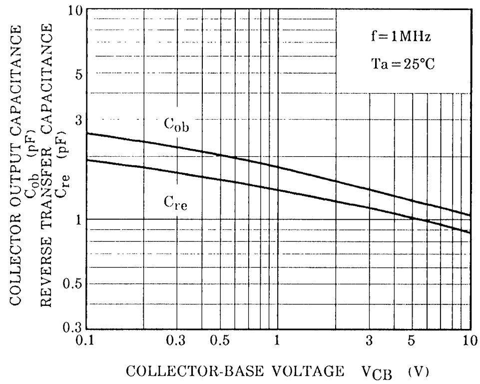
Marking



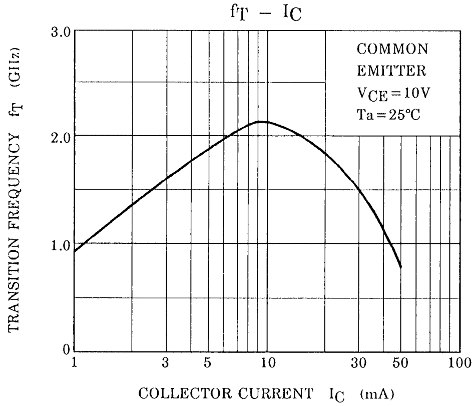
$h_{FE} - I_C$



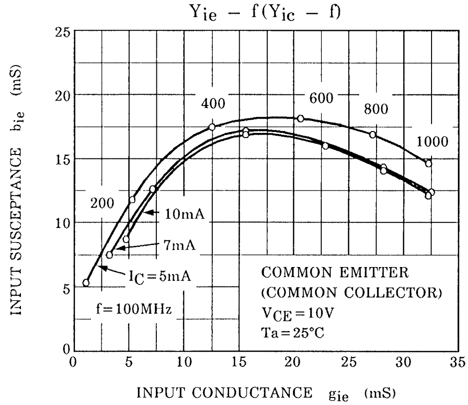
$C_{ob}, C_{re} - V_{CB}$



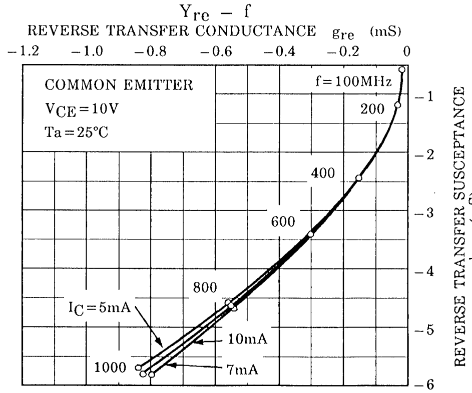
$f_T - I_C$



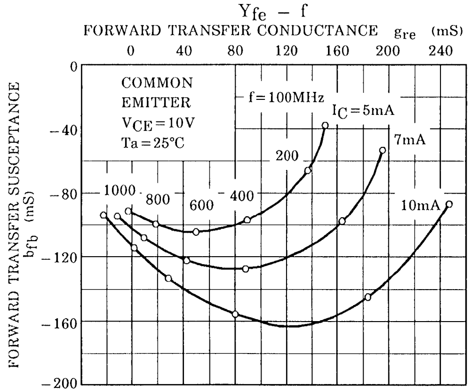
$Y_{ie} - f (Y_{ic} - f)$

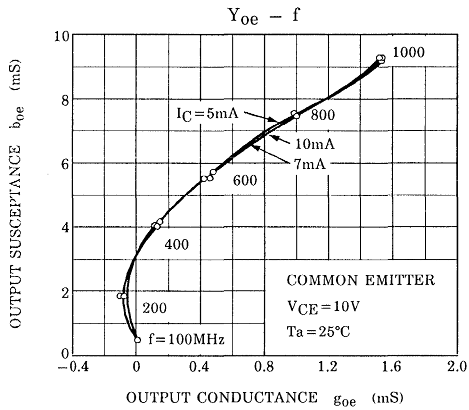


$Y_{re} - f$

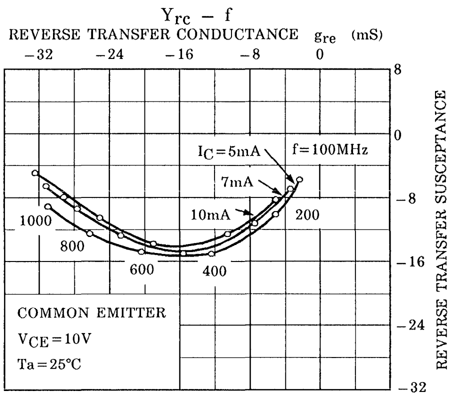


$Y_{fe} - f$

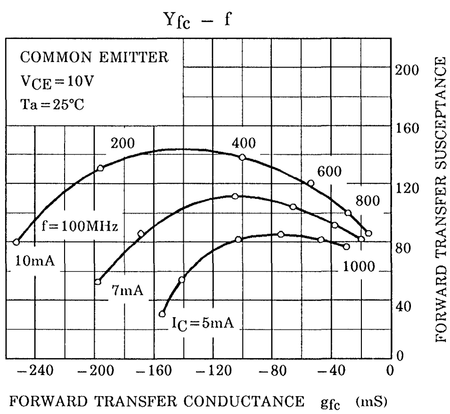




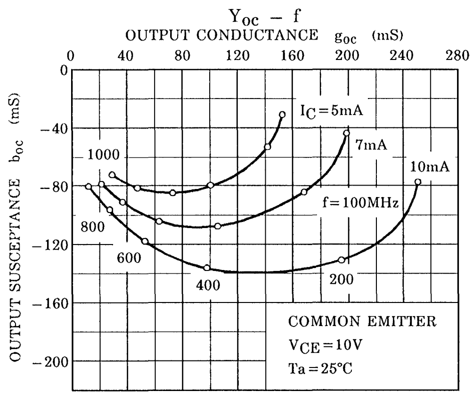
Yoe − f
OUTPUT SUSCEPTANCE boe (mS)
OUTPUT CONDUCTANCE goe (mS)
IC=5mA
10mA
7mA
1000
800
600
400
200
f=100MHz
COMMON EMITTER
VCE=10V
Ta=25°C



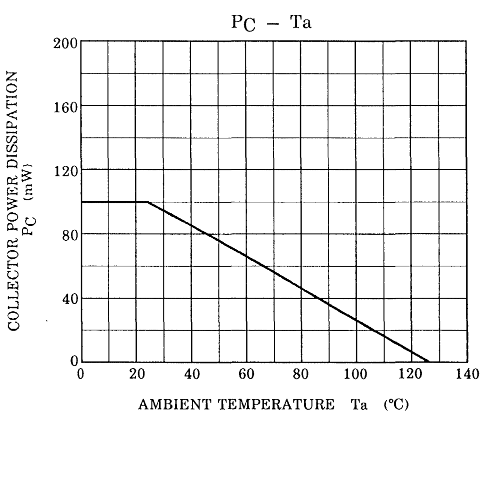
Yrc − f
REVERSE TRANSFER CONDUCTANCE gre (mS)
REVERSE TRANSFER SUSCEPTANCE brc (mS)
IC=5mA
f=100MHz
7mA
10mA
1000
800
600
400
200
COMMON EMITTER
VCE=10V
Ta=25°C



Yfc − f
COMMON EMITTER
VCE=10V
Ta=25°C
FORWARD TRANSFER SUSCEPTANCE bfc (mS)
FORWARD TRANSFER CONDUCTANCE gfc (mS)
200
400
600
800
1000
f=100MHz
10mA
7mA
IC=5mA



Yoc − f
OUTPUT CONDUCTANCE goc (mS)
OUTPUT SUSCEPTANCE boc (mS)
IC=5mA
7mA
10mA
1000
800
600
400
200
f=100MHz
COMMON EMITTER
VCE=10V
Ta=25°C

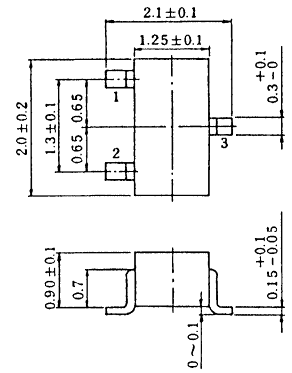


PC − Ta
COLLECTOR POWER DISSIPATION PC (mW)
AMBIENT TEMPERATURE Ta (°C)

SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR 2SC4253

TV FINAL PICTURE IF AMPLIFIER APPLICATIONS.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1A

Weight : 0.006g

- Good Linearity of f_T.

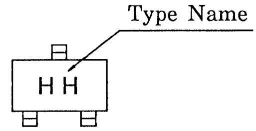
MAXIMUM RATINGS (Ta = 25°C)

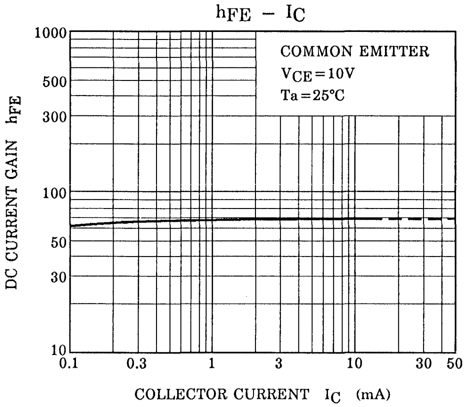
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	25	V
Emitter-Base Voltage	V_{EBO}	4	V
Collector Current	I_C	50	mA
Base Current	I_B	25	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

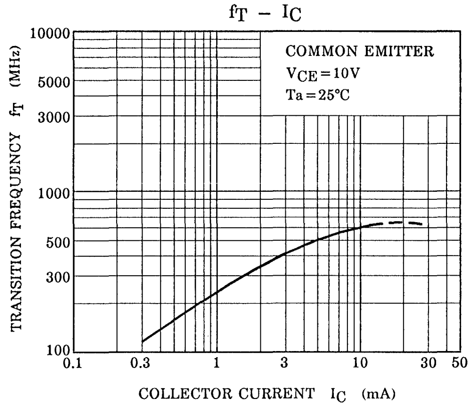
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

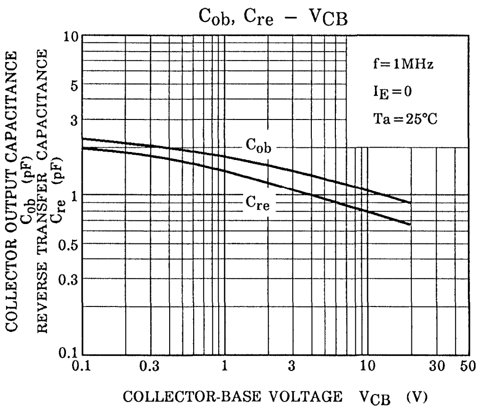
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current		I_{CBO}	$V_{CB}=30V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current		I_{EBO}	$V_{EB}=3V$, $I_C=0$	—	—	0.1	μA
Collector-Emitter Breakdown Voltage		$V_{(BR)CEO}$	$I_C=1mA$, $I_B=0$	25	—	—	V
DC Current Gain		h_{FE}	$V_{CE}=10V$, $I_C=10mA$	20	70	200	—
Saturation Voltage	Collector-Emitter	$V_{CE(sat)}$	$I_C=15mA$, $I_B=1.5mA$	—	—	0.2	V
	Base-Emitter	$V_{BE(sat)}$		—	—	1.5	
Collector Output Capacitance		C_{ob}	$V_{CB}=10V$, $I_E=0$, $f=1MHz$	—	1.1	1.6	pF
Collector-Base Time Constant		$C_c \cdot r_{bb'}$	$V_{CB}=10V$, $I_C=1mA$ $f=30MHz$	—	—	25	ps
Transition Frequency		f_T	$V_{CE}=10V$, $I_C=10mA$	250	600	—	MHz

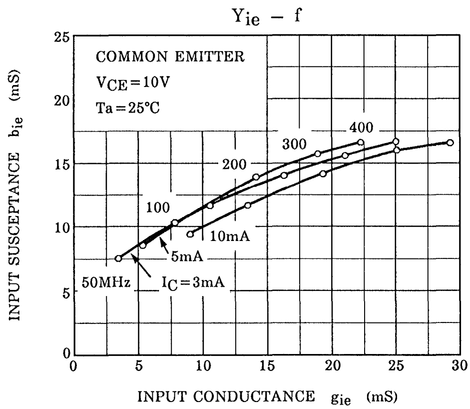
Marking

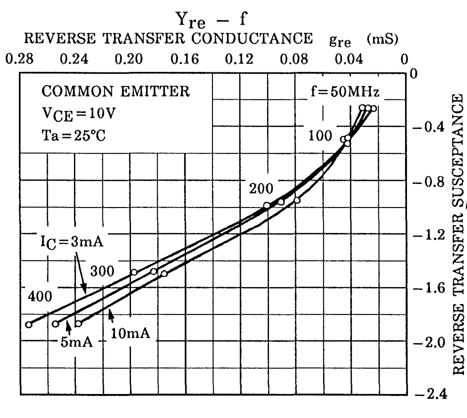


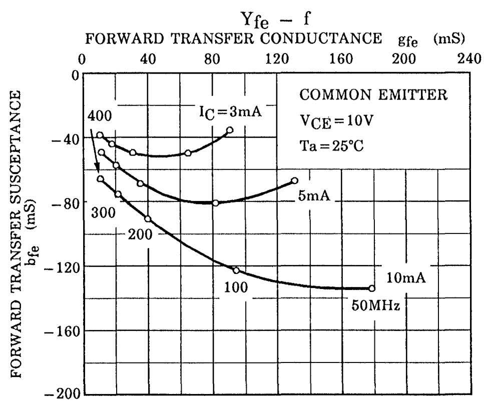

hFE – IC
COMMON EMITTER
VCE=10V
Ta=25°C
DC CURRENT GAIN hFE
COLLECTOR CURRENT IC (mA)


fT – IC
COMMON EMITTER
VCE=10V
Ta=25°C
TRANSITION FREQUENCY fT (MHz)
COLLECTOR CURRENT IC (mA)

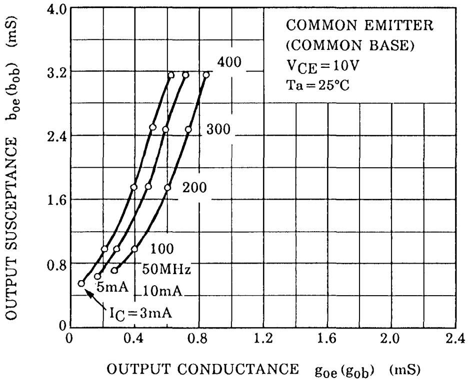

Cob, Cre – VCB
f=1MHz
IE=0
Ta=25°C
Cob
Cre
COLLECTOR OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
COLLECTOR-BASE VOLTAGE VCB (V)


Yie – f
COMMON EMITTER
VCE=10V
Ta=25°C
400
300
200
100
10mA
5mA
50MHz
IC=3mA
INPUT SUSCEPTANCE bie (mS)
INPUT CONDUCTANCE gie (mS)

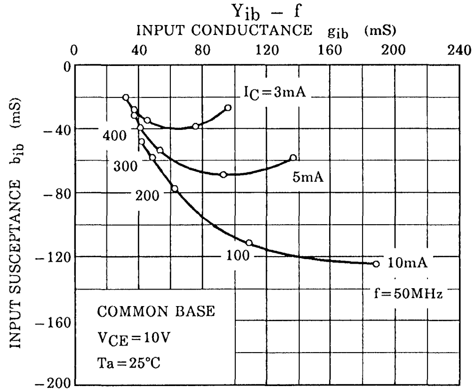

Yre – f
REVERSE TRANSFER CONDUCTANCE gre (mS)
COMMON EMITTER
VCE=10V
Ta=25°C
f=50MHz
100
200
IC=3mA
300
400
5mA
10mA
REVERSE TRANSFER SUSCEPTANCE bre (mS)


Yfe – f
FORWARD TRANSFER CONDUCTANCE gfe (mS)
COMMON EMITTER
VCE=10V
Ta=25°C
400
IC=3mA
5mA
300
200
100
10mA
50MHz
FORWARD TRANSFER SUSCEPTANCE bfe (mS)

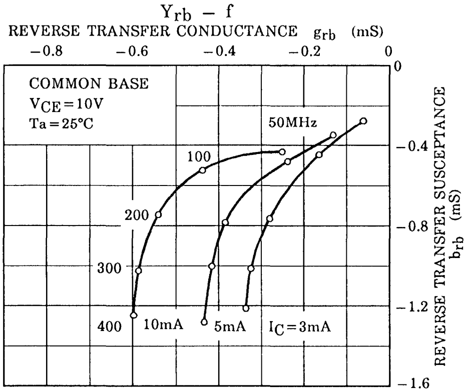
Y_{oe} – f (Y_{ob} – f)



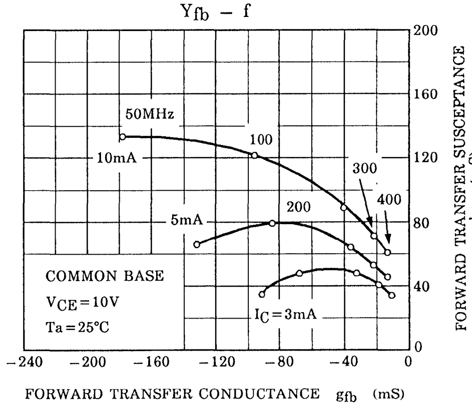
Y_{ib} – f



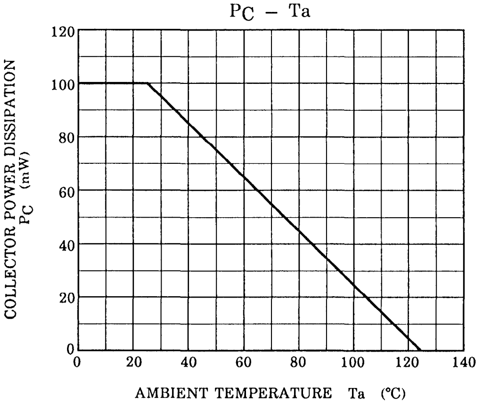
Y_{rb} – f



Y_{fb} – f



P_C – Ta

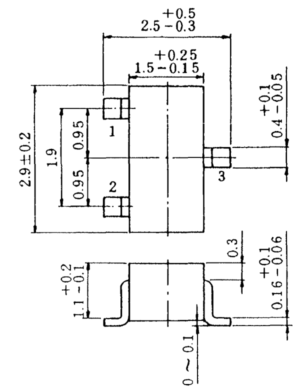


2SC4255

SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

TV TUNER, UHF OSCILLATOR APPLICATIONS (COMMON COLLECTOR)

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

- Transition Frequency is High and Dependent on Current Excellently.

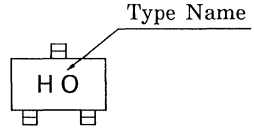
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Base Current	I_B	15	mA
Collector Current	I_C	30	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

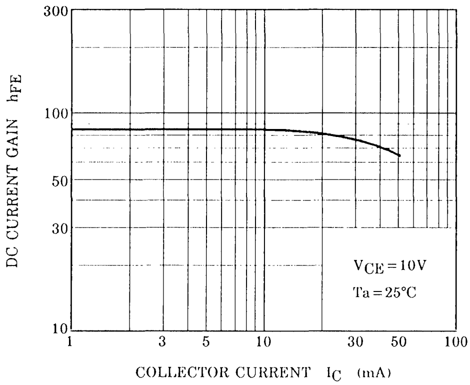
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=20V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=2V$, $I_C=0$	—	—	1.0	μA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA$, $I_B=0$	12	—	—	V
DC Current Gain	h_{FE}	$V_{CE}=10V$, $I_C=5mA$	40	100	250	—
Transition Frequency	f_T	$V_{CE}=10V$, $I_C=5mA$	1.5	2.0	—	GHz
Output Capacitance	C_{ob}	$V_{CB}=10V$, $I_E=0$, f=1MHz	—	1.05	1.35	pF
Collector-Base Time Constant	$C_c \cdot r_{bb'}$	$V_{CB}=10V$, $I_C=5mA$ f=30MHz	—	4.3	10	ps

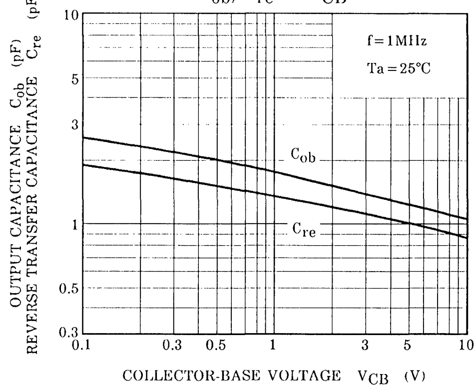
Marking



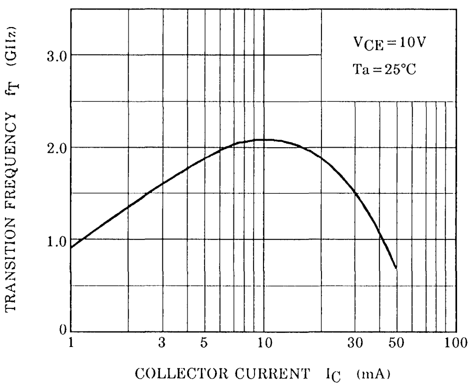
h_{FE} – I_C



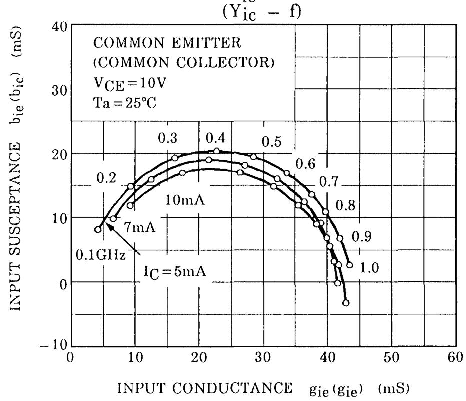
C_{ob}, C_{re} – V_{CB}



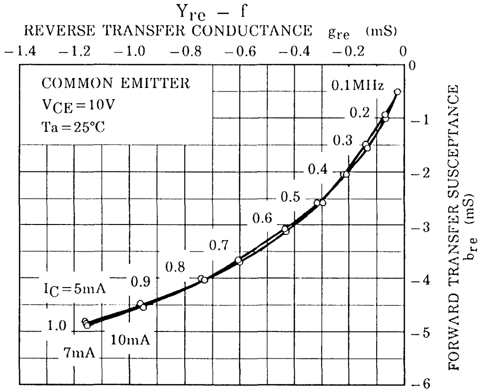
f_T – I_C



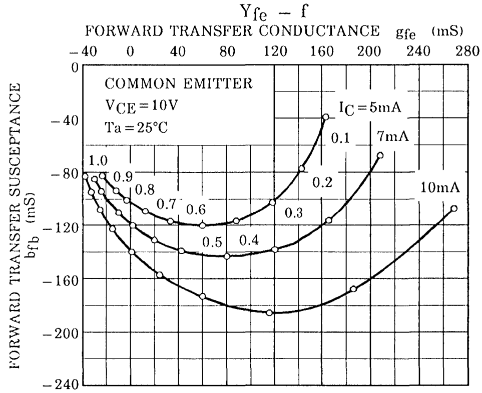
Y_{ie} – f
(Y_{ic} – f)



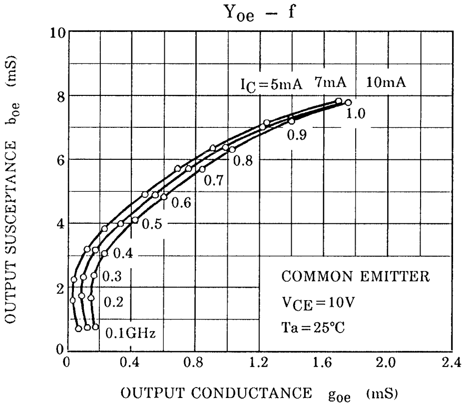
Y_{re} – f



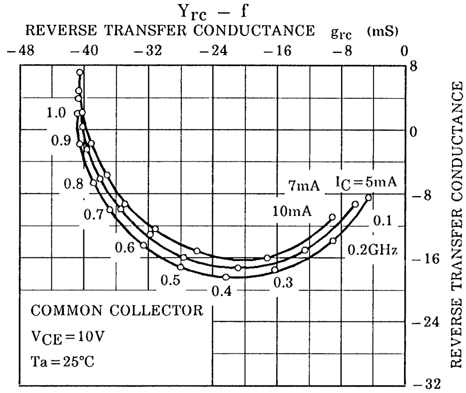
Y_{fe} – f



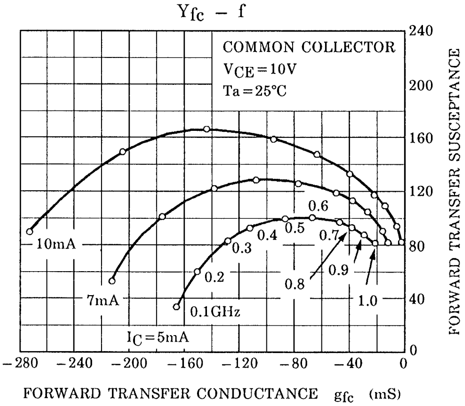
Y_{oe} – f



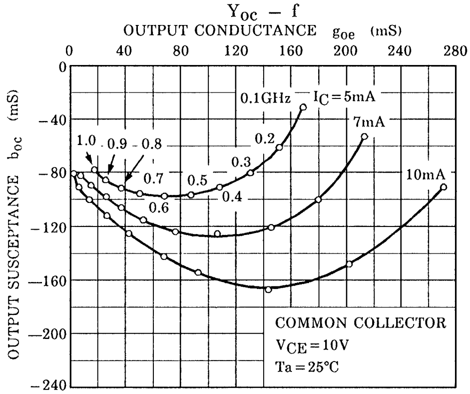
Y_{rc} – f



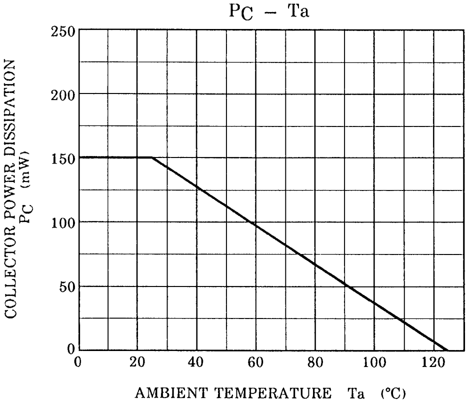
Y_{fc} – f



Y_{oc} – f



P_C – Ta



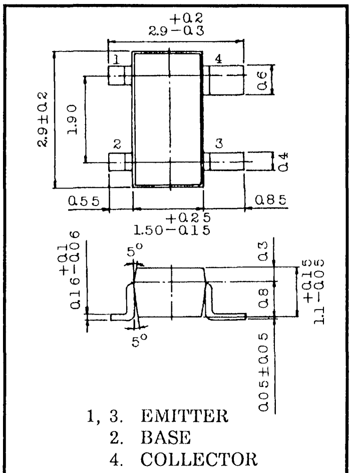
SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC4315

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure, High Gain.
- NF = 1.1dB, $|S_{21e}|^2$ = 14dB (f = 1GHz)

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	2-3J1C

Weight : 0.012g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	80	mA
Base Current	I_B	40	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MICROWAVE CHARACTERISTICS (Ta = 25°C)

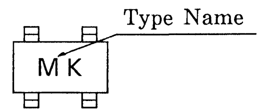
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 10V, I_C = 20mA	5	7	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE} = 10V, I_C = 20mA, f = 500MHz	—	19.5	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE} = 10V, I_C = 20mA, f = 1GHz	10.5	14	—	
Noise Figure	NF (1)	V_{CE} = 10V, I_C = 5mA, f = 500MHz	—	1	—	dB
	NF (2)	V_{CE} = 10V, I_C = 5mA, f = 1GHz	—	1.1	2	

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

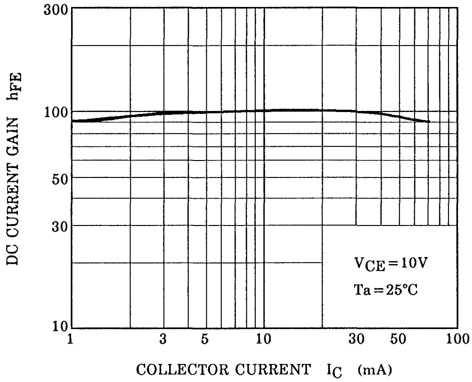
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_C = 0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE} = 10V, I_C = 20mA	30	—	250	—
Output Capacitance	C_{ob}	V_{CB} = 10V, I_E = 0, f = 1MHz	—	1	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.55	1	pF

Note : C_{re} is measured by 3 terminal method with Capacitance Bridge.

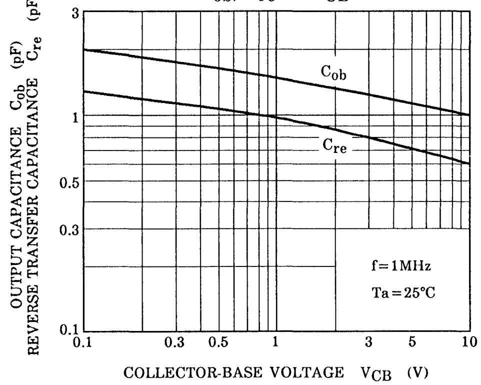
Marking



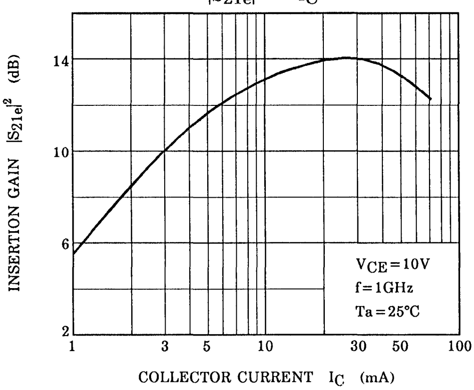
$h_{FE} - I_C$



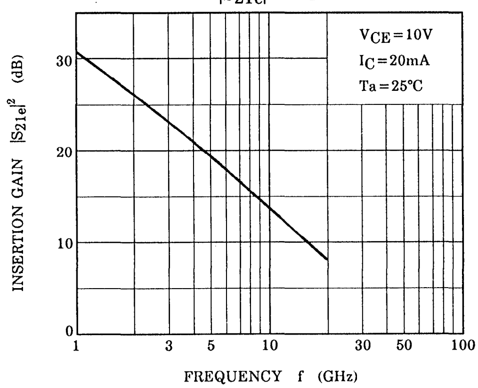
$C_{ob}, C_{re} - V_{CB}$



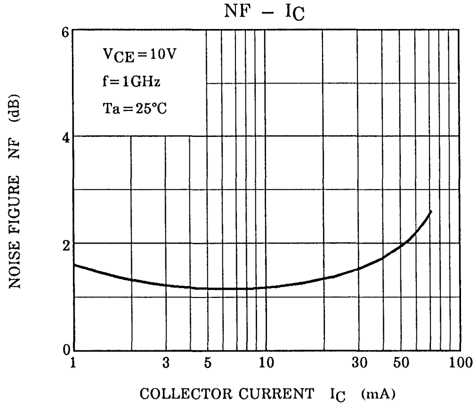
$|S_{21e}|^2 - I_C$



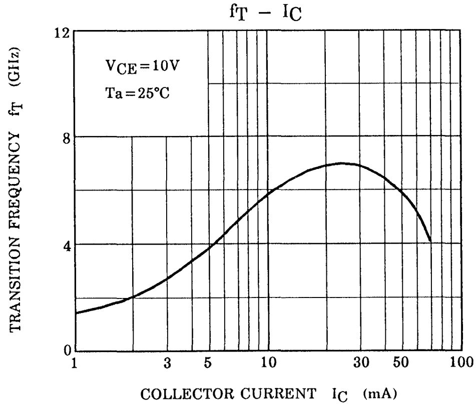
$|S_{21e}|^2 - f$

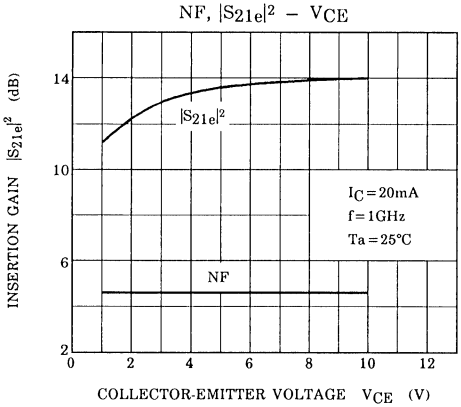


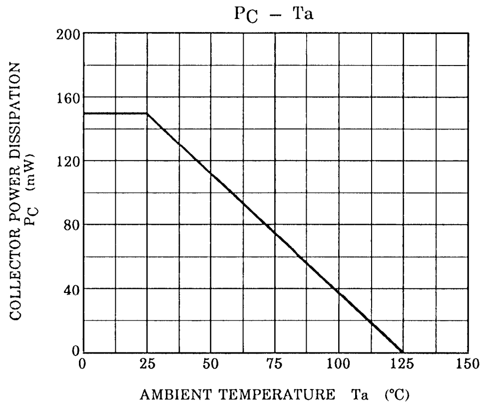
$NF - I_C$



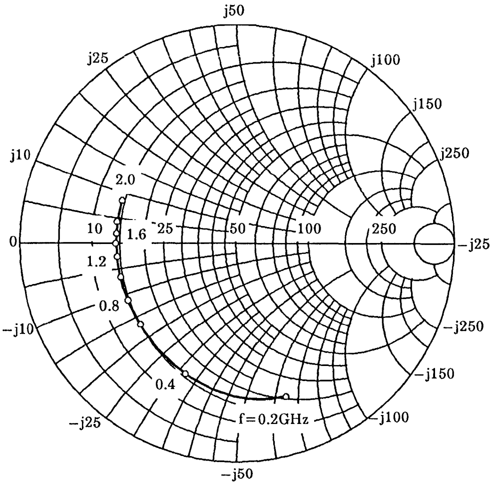
$f_T - I_C$



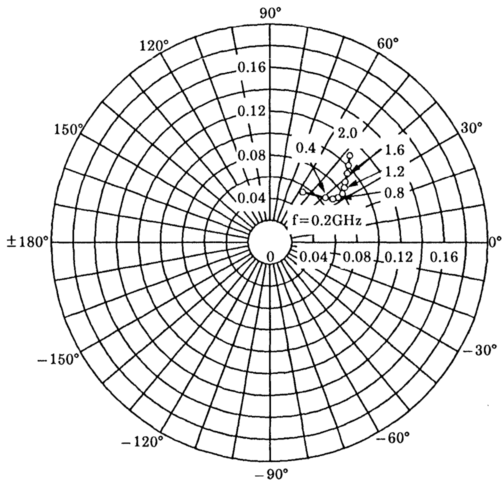

NF, $|S_{21e}|^2$ – V_{CE}
INSERTION GAIN $|S_{21e}|^2$ (dB)
14
10
6
2
$|S_{21e}|^2$
I_C=20mA
f=1GHz
Ta=25°C
NF
0
2
4
6
8
10
12
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)


P_C – Ta
COLLECTOR POWER DISSIPATION P_C (mW)
200
160
120
80
40
0
0
25
50
75
100
125
150
AMBIENT TEMPERATURE Ta (°C)

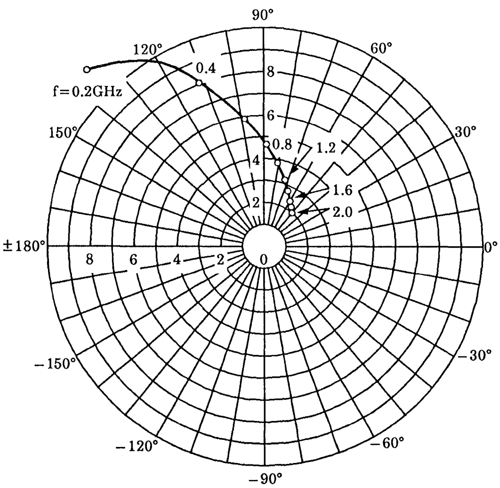
S_{11e}
$V_{CE} = 10V$
$I_C = 5mA$
$Ta = 25°C$
(UNIT : Ω)



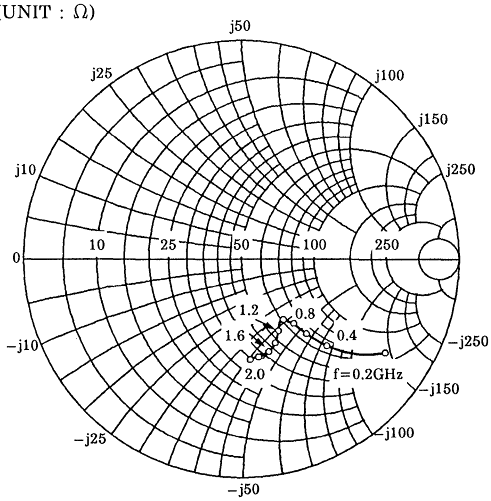
S_{12e}
$V_{CE} = 10V$
$I_C = 5mA$
$Ta = 25°C$



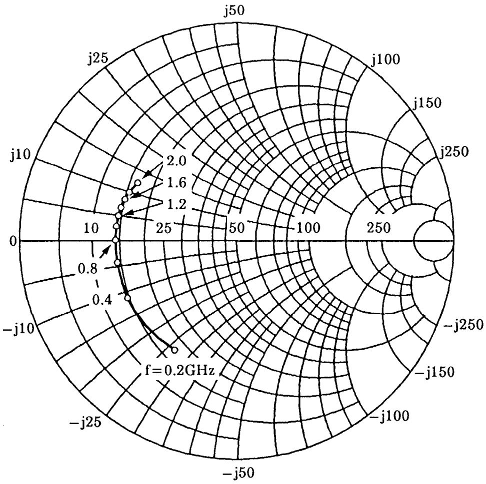
S_{21e}
$V_{CE} = 10V$
$I_C = 5mA$
$Ta = 25°C$



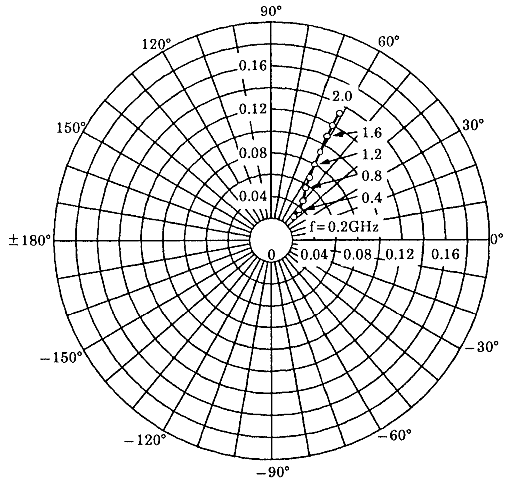
S_{22e}
$V_{CE} = 10V$
$I_C = 5mA$
$Ta = 25°C$
(UNIT : Ω)



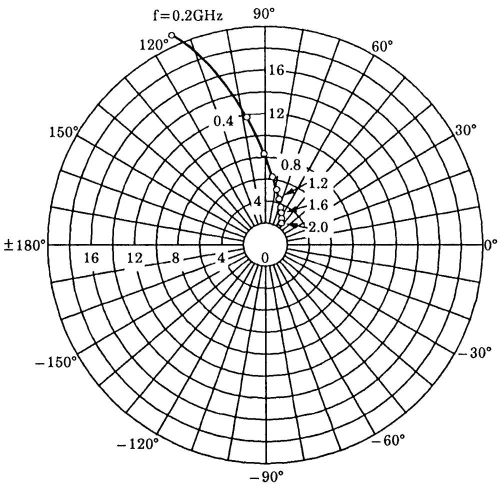
S_{11e}
V_{CE} = 10V
I_C = 20mA
Ta = 25°C
(UNIT : Ω)



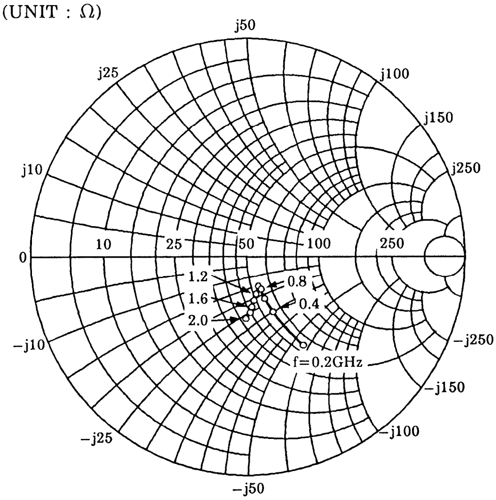
S_{12e}
V_{CE} = 10V
I_C = 20mA
Ta = 25°C



S_{21e}
V_{CE} = 10V
I_C = 20mA
Ta = 25°C



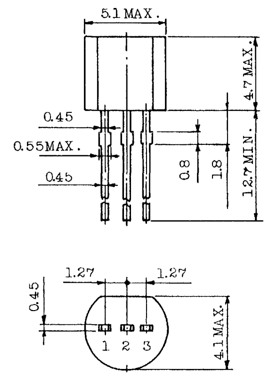
S_{22e}
V_{CE} = 10V
I_C = 20mA
Ta = 25°C
(UNIT : Ω)



2SC4316 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	TO-92
EIAJ	SC-43
TOSHIBA	2-5F1E

Weight : 0.21g

- Low Noise Figure, High Gain
- NF = 1.1dB, $|S_{21e}|^2$ = 12dB (f = 1GHz)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Collector Current	I_C	40	mA
Base Current	I_B	20	mA
Collector Power Dissipation	P_C	400	mW
Junction Temperature	T_j	150	°C
Storage Temperature Range	T_{stg}	−55~150	°C

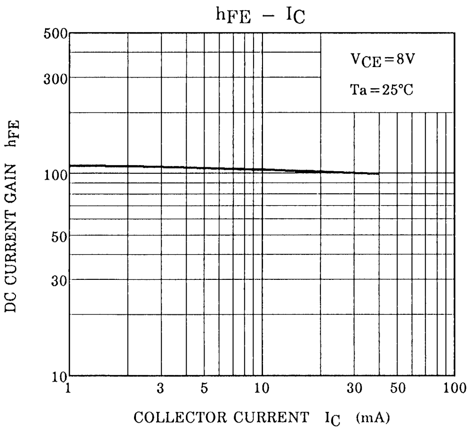
MICROWAVE CHARACTERISTICS (Ta = 25°C)

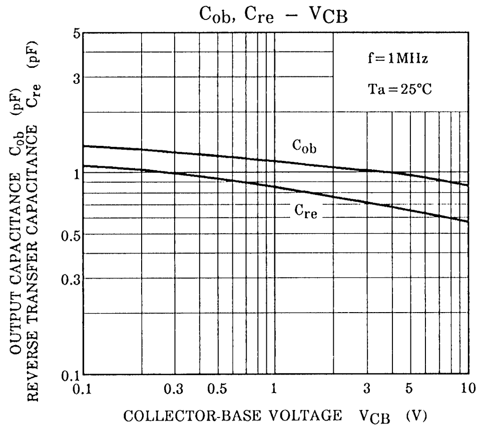
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 8V, I_C = 20mA	6	9	—	GHz
Insertion Gain	$\|S_{21e}\|^2(1)$	V_{CE} = 8V, I_C = 20mA, f = 1MHz	9	12	—	dB
	$\|S_{21e}\|^2(2)$	V_{CE} = 8V, I_C = 20mA, f = 2GHz	—	6	—	dB
Noise Figure	NF(1)	V_{CE} = 8V, I_C = 5mA, f = 1GHz	—	1.1	2.5	dB
	NF(2)	V_{CE} = 8V, I_C = 5mA, f = 2GHz	—	1.7	—	dB

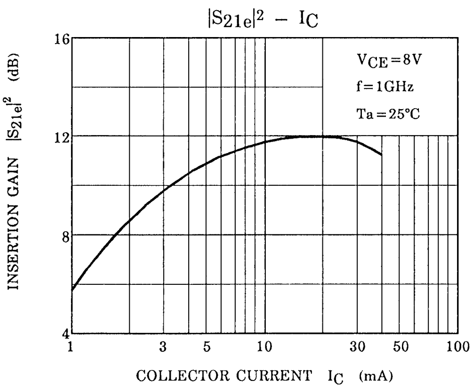
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

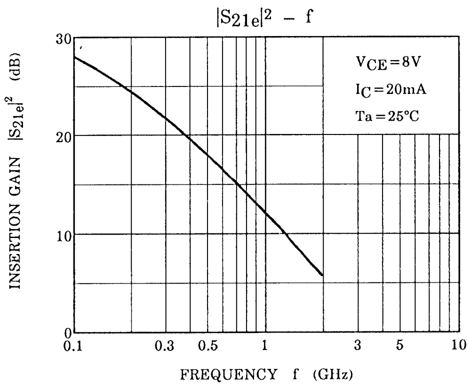
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CE} = 10V, I_E = 0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_C = 0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE} = 8V, I_C = 20mA	50	—	250	—
Output Capacitance	C_{ob}	V_{CB} = 10V, I_E = 0, f = 1MHz	—	0.85	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.5	1.0	pF

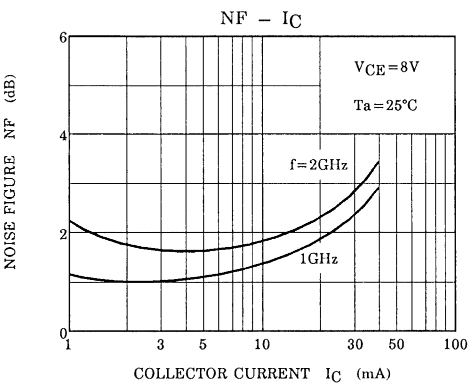
Note : C_{re} is measured by 3 terminal method with Capacitance Bridge.

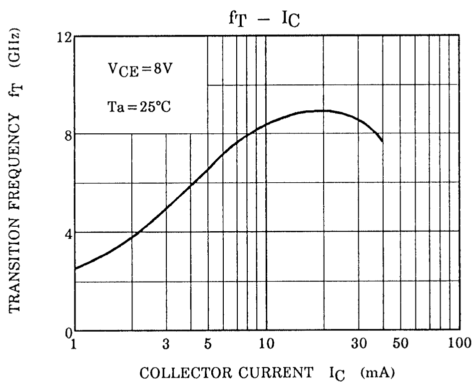

hFE – IC
VCE=8V
Ta=25°C
DC CURRENT GAIN hFE
500
300
100
50
30
10
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)

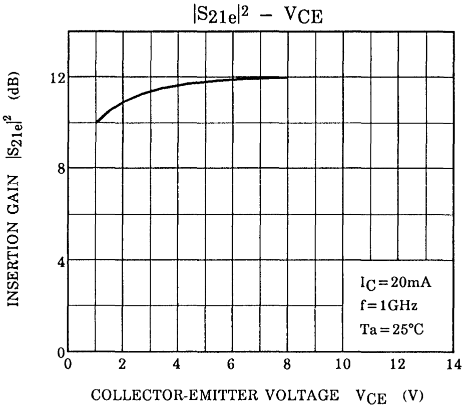

Cob, Cre – VCB
f=1MHz
Ta=25°C
Cob
Cre
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
5
3
1
0.5
0.3
0.1
0.1
0.3
0.5
1
3
5
10
COLLECTOR-BASE VOLTAGE VCB (V)

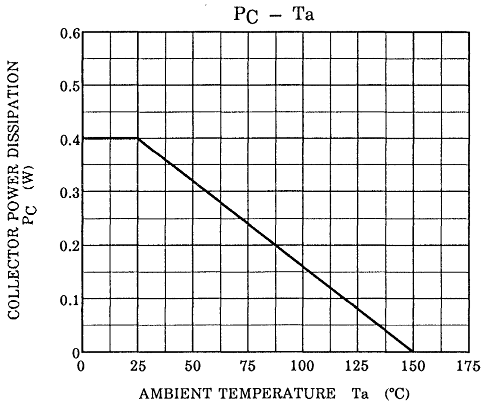

|S21e|2 – IC
VCE=8V
f=1GHz
Ta=25°C
INSERTION GAIN |S21e|2 (dB)
16
12
8
4
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)


|S21e|2 – f
VCE=8V
IC=20mA
Ta=25°C
INSERTION GAIN |S21e|2 (dB)
30
20
10
0
0.1
0.3
0.5
1
3
5
10
FREQUENCY f (GHz)


NF – IC
VCE=8V
Ta=25°C
f=2GHz
1GHz
NOISE FIGURE NF (dB)
6
4
2
0
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)


fT – IC
VCE=8V
Ta=25°C
TRANSITION FREQUENCY fT (GHz)
12
8
4
0
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)





S-PARAMETER $Z_O=50\Omega$, $Ta=25°C$

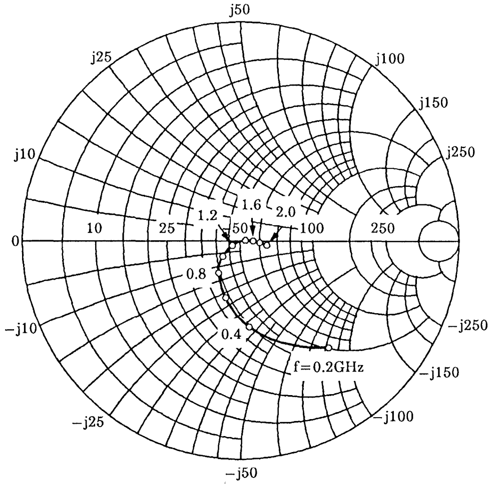
$V_{CE}=8V$, $I_C=5mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.626	−51.9	10.792	133.3	0.050	64.1	0.795	−34.1
400	0.403	−83.9	7.276	106.9	0.076	56.0	0.598	−49.6
600	0.264	−104.6	5.311	90.5	0.097	53.0	0.504	−57.5
800	0.165	−122.6	4.154	78.2	0.118	52.0	0.461	−63.4
1000	0.102	−132.6	3.418	68.0	0.139	50.0	0.449	−68.9
1200	0.044	−134.2	2.894	58.9	0.161	47.6	0.453	−75.0
1400	0.019	−7.5	2.517	50.2	0.182	44.9	0.462	−81.3
1600	0.060	−10.8	2.253	42.8	0.204	42.0	0.477	−88.2
1800	0.094	−11.3	2.029	35.2	0.227	38.8	0.496	−95.2
2000	0.135	−10.5	1.913	29.4	0.251	35.8	0.522	−104.8

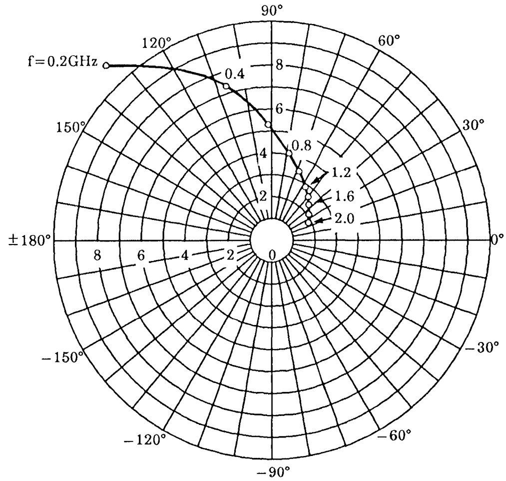
$V_{CE}=8V$, $I_C=20mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.246	−78.5	16.317	111.5	0.036	69.5	0.553	−39.2
400	0.102	−112.1	8.994	91.0	0.064	68.3	0.412	−42.8
600	0.038	−151.5	6.142	78.7	0.091	65.5	0.377	−45.9
800	0.032	91.9	4.668	68.9	0.119	61.6	0.372	−50.5
1000	0.054	47.8	3.787	60.3	0.145	57.3	0.378	−56.2
1200	0.096	24.4	3.177	52.5	0.171	52.9	0.389	−63.4
1400	0.137	13.4	2.754	44.6	0.195	48.2	0.403	−71.4
1600	0.166	−1.0	2.418	37.8	0.219	43.7	0.414	−80.0
1800	0.194	−11.3	2.177	30.8	0.244	39.0	0.425	−88.7
2000	0.193	−14.5	1.999	24.8	0.265	34.1	0.440	−100.1

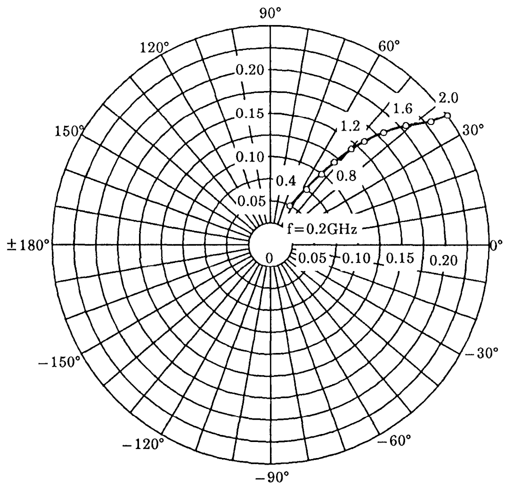
S_{11e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



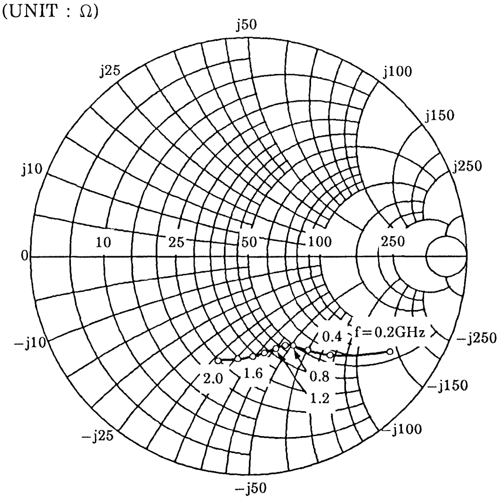
S_{21e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$



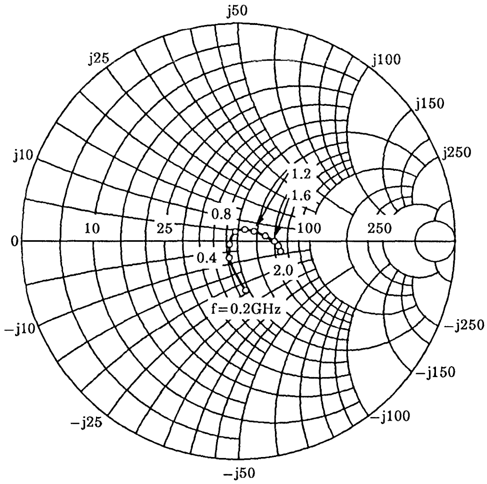
S_{12e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$



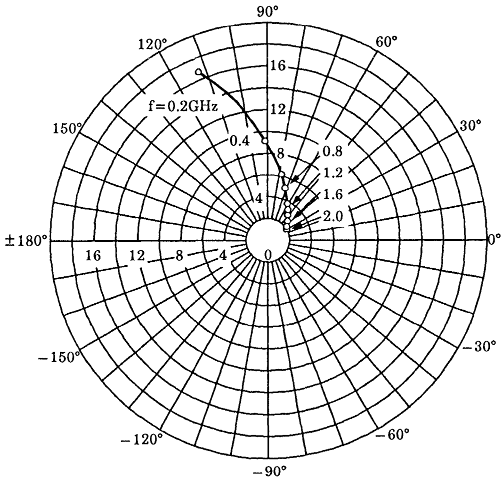
S_{22e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



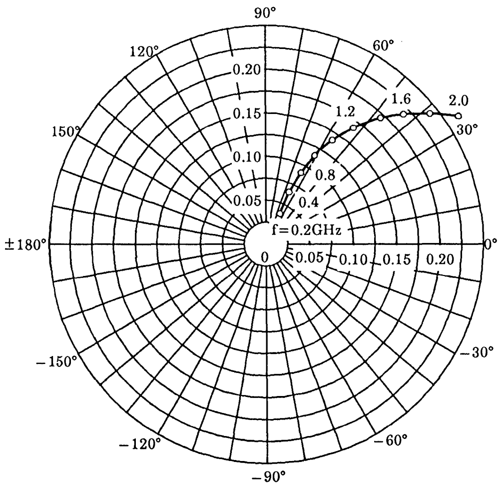
S11e
VCE = 8V
IC = 20mA
Ta = 25°C
(UNIT : Ω)



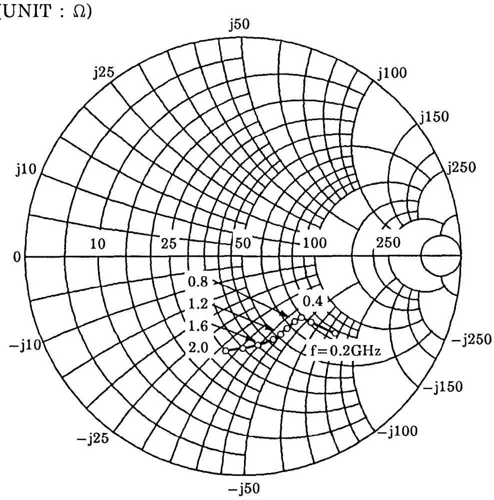
S21e
VCE = 8V
IC = 20mA
Ta = 25°C



S12e
VCE = 8V
IC = 20mA
Ta = 25°C



S22e
VCE = 8V
IC = 20mA
Ta = 25°C
(UNIT : Ω)



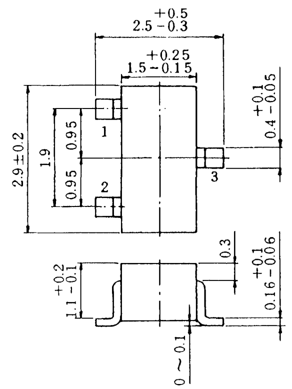
SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC4317

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure, High Gain.
- NF=1.1dB, $|S_{21e}|^2$=13dB (f=1GHz)

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Base Current	I_B	20	mA
Collector Current	I_C	40	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MICROWAVE CHARACTERISTICS (Ta = 25°C)

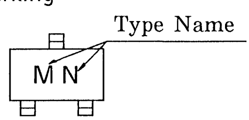
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE}=8V, I_C=20mA	7	10	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE}=8V, I_C=20mA, f=1GHz	10	13	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE}=8V, I_C=20mA, f=2GHz	—	7	—	
Noise Figure	NF (1)	V_{CE}=8V, I_C=5mA, f=1GHz	—	1.1	2.5	dB
	NF (2)	V_{CE}=8V, I_C=5mA, f=2GHz	—	1.7	—	

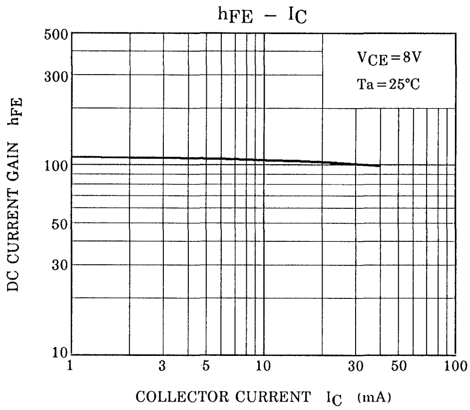
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

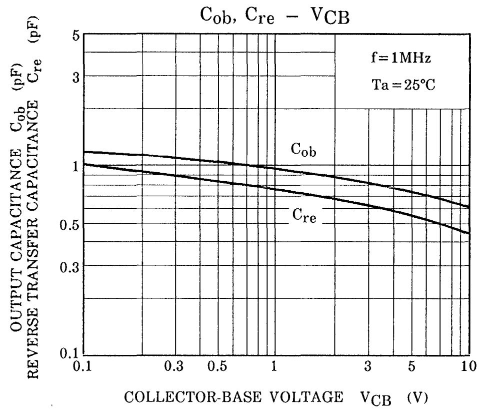
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB}=10V, I_E=0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB}=1V, I_C=0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE}=8V, I_C=20mA	50	—	250	—
Output Capacitance	C_{ob}	V_{CB}=10V, I_E=0, f=1MHz	—	0.65	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.45	0.9	pF

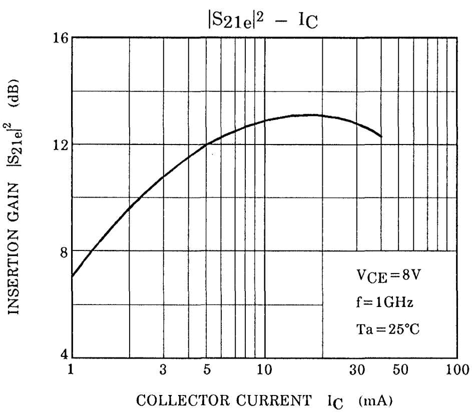
Note : C_{re} is measured by 3 terminal method with Capacitance Bridge.

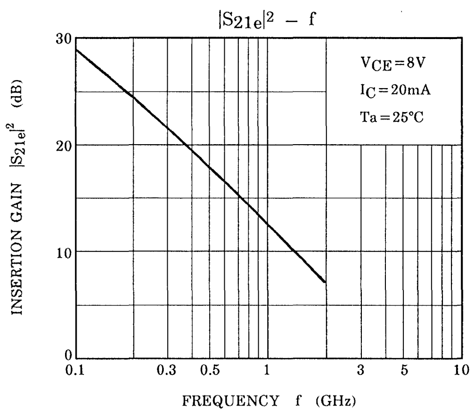
Marking

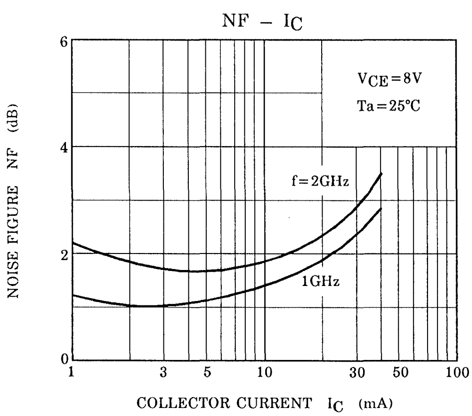


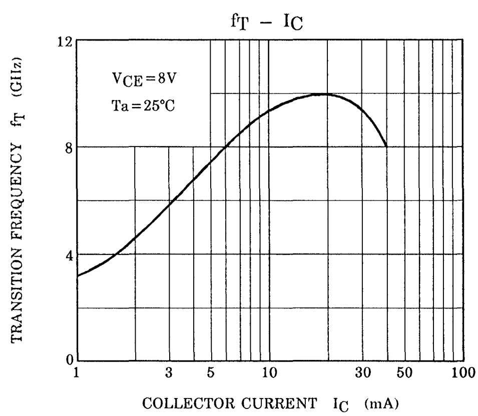

hFE − IC
500
300
100
50
30
10
1
3
5
10
30
50
100
VCE=8V
Ta=25°C
DC CURRENT GAIN hFE
COLLECTOR CURRENT IC (mA)

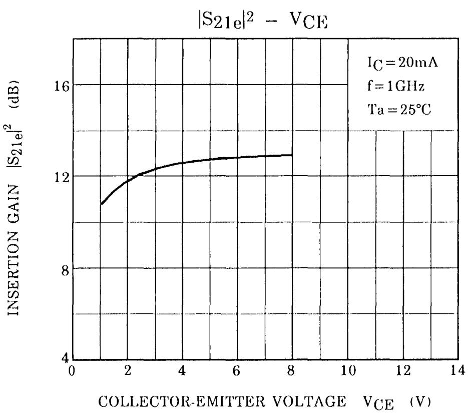

Cob, Cre − VCB
5
3
1
0.5
0.3
0.1
0.1
0.3
0.5
1
3
5
10
f=1MHz
Ta=25°C
Cob
Cre
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
COLLECTOR-BASE VOLTAGE VCB (V)

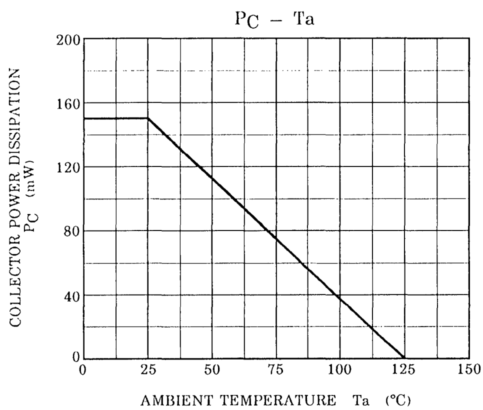

|S21e|2 − IC
16
12
8
4
1
3
5
10
30
50
100
VCE=8V
f=1GHz
Ta=25°C
INSERTION GAIN |S21e|2 (dB)
COLLECTOR CURRENT IC (mA)


|S21e|2 − f
30
20
10
0
0.1
0.3
0.5
1
3
5
10
VCE=8V
IC=20mA
Ta=25°C
INSERTION GAIN |S21e|2 (dB)
FREQUENCY f (GHz)


NF − IC
6
4
2
0
1
3
5
10
30
50
100
VCE=8V
Ta=25°C
f=2GHz
1GHz
NOISE FIGURE NF (dB)
COLLECTOR CURRENT IC (mA)


fT − IC
12
8
4
0
1
3
5
10
30
50
100
VCE=8V
Ta=25°C
TRANSITION FREQUENCY fT (GHz)
COLLECTOR CURRENT IC (mA)





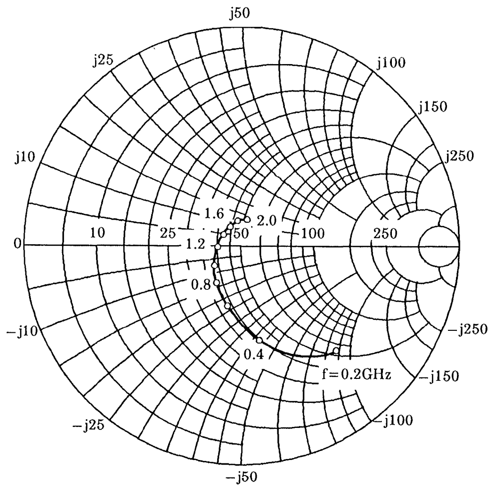
S-PARAMETER $Z_O = 50\Omega$, Ta = 25°C
$V_{CE} = 8V$, $I_C = 5mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.649	−46.9	11.454	139.7	0.044	67.8	0.823	−26.1
400	0.426	−78.5	8.028	116.2	0.068	61.0	0.623	−36.4
600	0.282	−100.9	5.965	102.6	0.085	60.4	0.513	−39.5
800	0.192	−122.5	4.688	92.7	0.103	61.5	0.452	−40.3
1000	0.131	−147.7	3.856	85.4	0.121	62.6	0.422	−41.1
1200	0.099	−175.5	3.308	78.9	0.140	63.2	0.406	−42.0
1400	0.096	145.6	2.871	72.7	0.159	63.2	0.404	−43.5
1600	0.091	116.0	2.562	68.0	0.179	63.0	0.402	−45.9
1800	0.111	93.4	2.341	62.9	0.199	62.5	0.406	−49.1
2000	0.115	78.3	2.106	59.5	0.218	62.0	0.409	−53.1

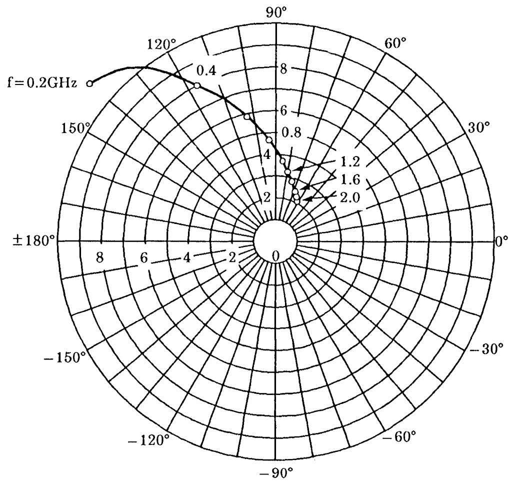
$V_{CE} = 8V$, $I_C = 20mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.278	−78.9	18.400	118.0	0.031	71.1	0.586	−33.3
400	0.138	−120.1	10.350	99.6	0.053	73.5	0.426	−32.4
600	0.088	−159.6	7.137	90.4	0.076	74.1	0.379	−30.1
800	0.084	157.2	5.433	83.4	0.100	73.9	0.361	−29.1
1000	0.096	122.5	4.401	78.0	0.123	73.1	0.356	−29.7
1200	0.117	99.7	3.719	73.0	0.147	71.5	0.357	−31.3
1400	0.141	84.9	3.216	67.9	0.170	69.9	0.364	−33.6
1600	0.152	69.0	2.849	63.9	0.192	68.3	0.372	−37.0
1800	0.167	59.2	2.577	59.6	0.215	66.3	0.381	−41.3
2000	0.169	49.4	2.304	56.3	0.235	64.7	0.386	−46.3

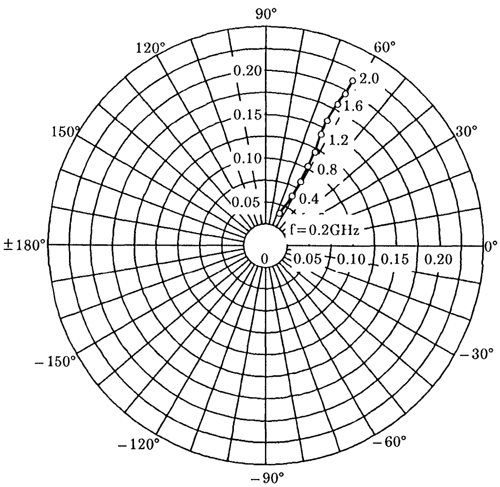
S11e
$V_{CE}=8V$
$I_C=5mA$
Ta=25°C
(UNIT : Ω)



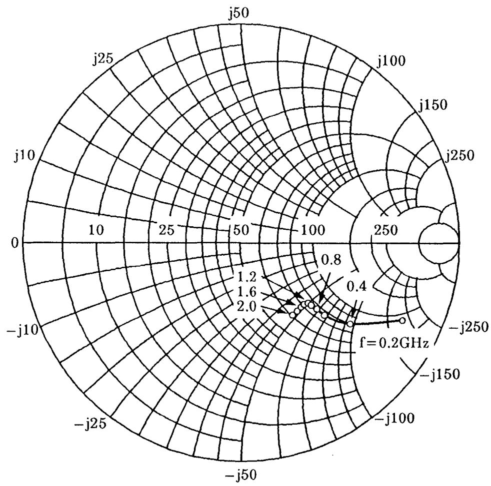
S21e
$V_{CE}=8V$
$I_C=5mA$
Ta=25°C



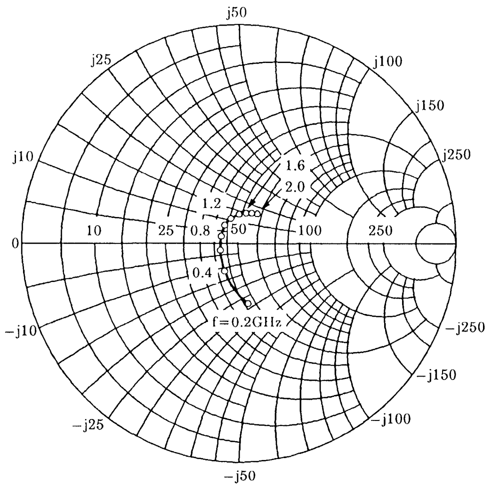
S12e
$V_{CE}=8V$
$I_C=5mA$
Ta=25°C



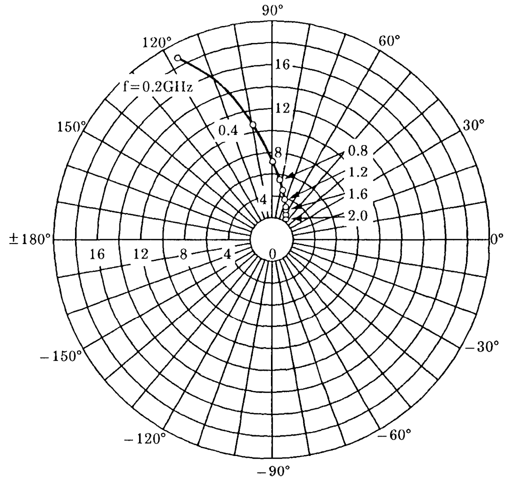
S22e
$V_{CE}=8V$
$I_C=5mA$
Ta=25°C
(UNIT : Ω)



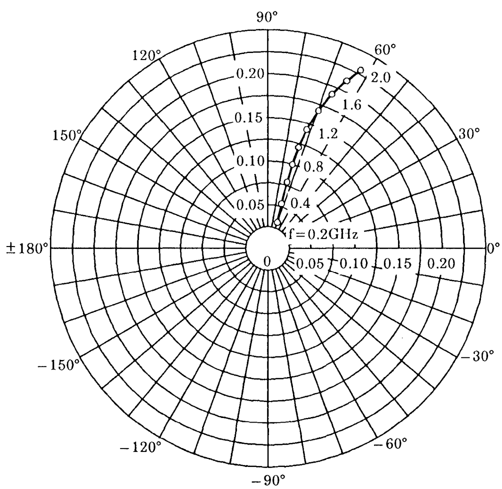
S11e
VCE = 8V
IC = 20mA
Ta = 25°C
(UNIT : Ω)



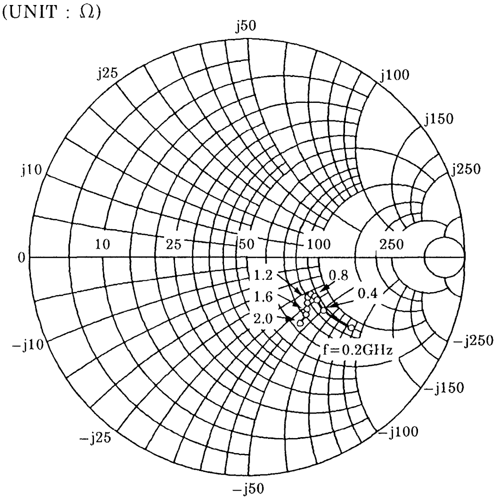
S21e
VCE = 8V
IC = 20mA
Ta = 25°C



S12e
VCE = 8V
IC = 20mA
Ta = 25°C



S22e
VCE = 8V
IC = 20mA
Ta = 25°C
(UNIT : Ω)

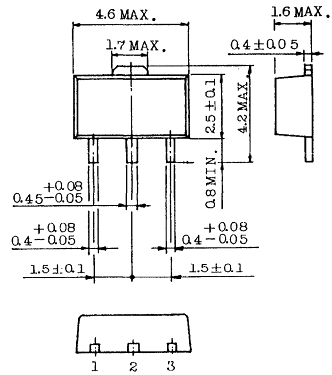


2SC4318 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure, High Gain.
- NF=1.1dB, $|S_{21e}|^2$=11dB (f=1GHz)

Unit in mm



1. BASE
2. COLLECTOR (HEAT SINK)
3. EMITTER

JEDEC	—
EIAJ	—
TOSHIBA	2-5K1A

Weight : 0.05g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Base Current	I_B	20	mA
Collector Current	I_C	40	mA
Collector Power Dissipation	P_C	300	mW
Junction Temperature	T_j	150	°C
Storage Temperature Range	T_{stg}	−55~150	°C

MICROWAVE CHARACTERISTICS (Ta = 25°C)

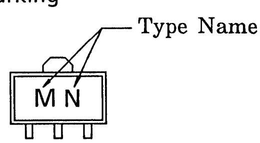
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE}=8V, I_C=20mA	6	9	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE}=8V, I_C=20mA, f=1GHz	8	11	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE}=8V, I_C=20mA, f=2GHz	—	5.5	—	
Noise Figure	NF (1)	V_{CE}=8V, I_C=5mA, f=1GHz	—	1.1	2.5	dB
	NF (2)	V_{CE}=8V, I_C=5mA, f=2GHz	—	1.7	—	

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

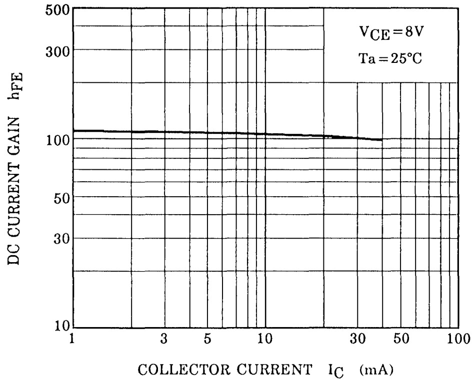
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB}=10V, I_E=0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB}=1V, I_C=0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE}=8V, I_C=20mA	50	—	250	—
Output Capacitance	C_{ob}	V_{CB}=10V, I_E=0, f=1MHz	—	0.75	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.55	1.0	pF

Note : C_{re} is measured by 3 terminal method with Capacitance Bridge.

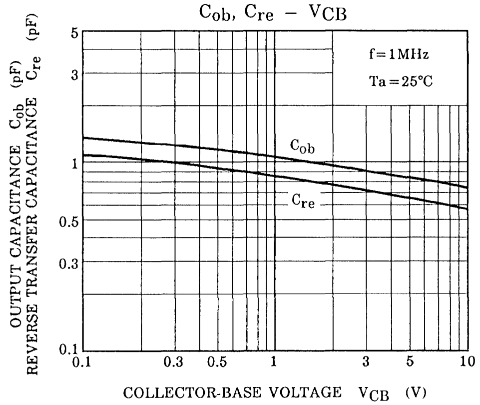
Marking



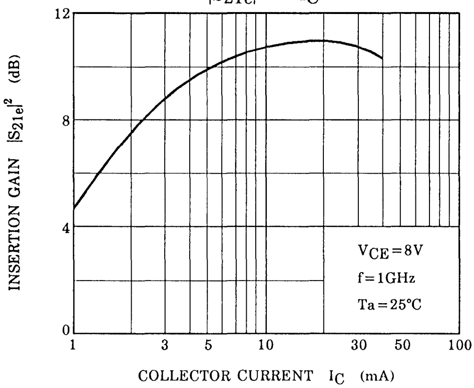
$h_{FE} - I_C$



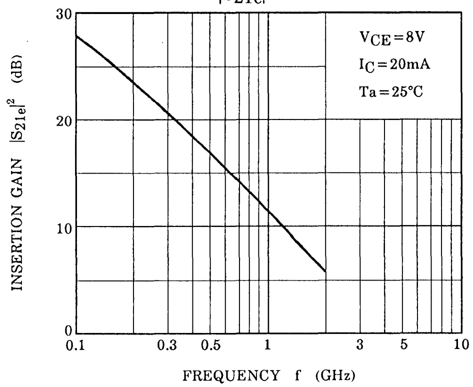
$C_{ob}, C_{re} - V_{CB}$



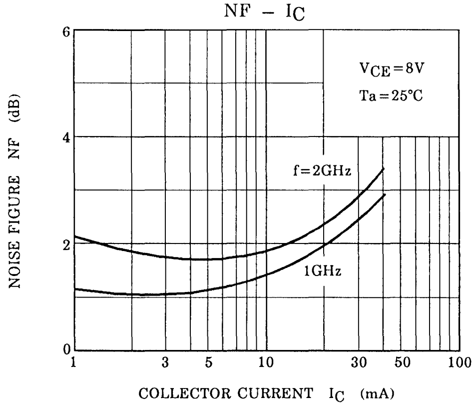
$|S_{21e}|^2 - I_C$



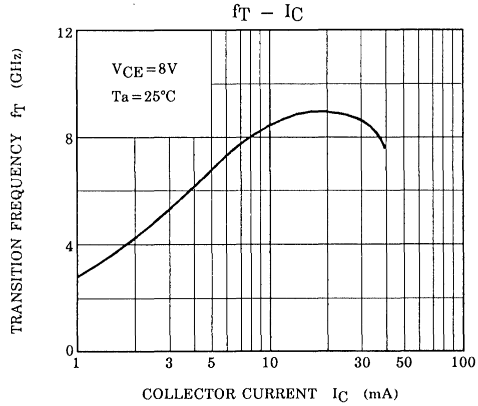
$|S_{21e}|^2 - f$

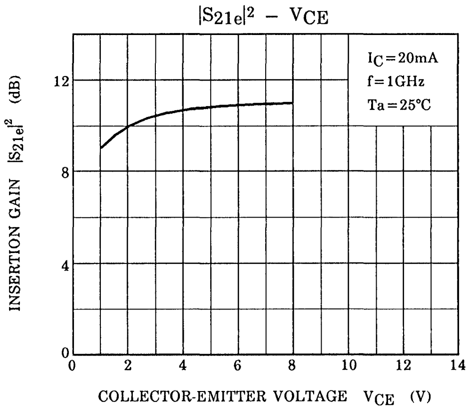


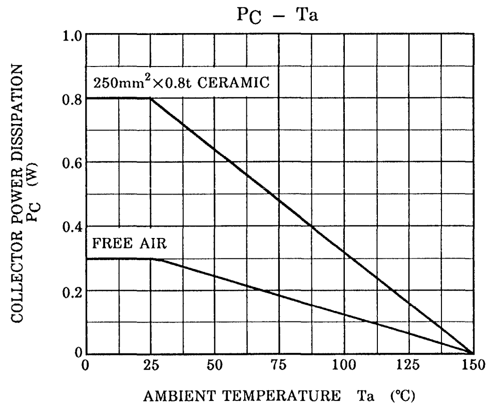
$NF - I_C$



$f_T - I_C$







S-PARAMETER $Z_O = 50\Omega$, Ta = 25°C

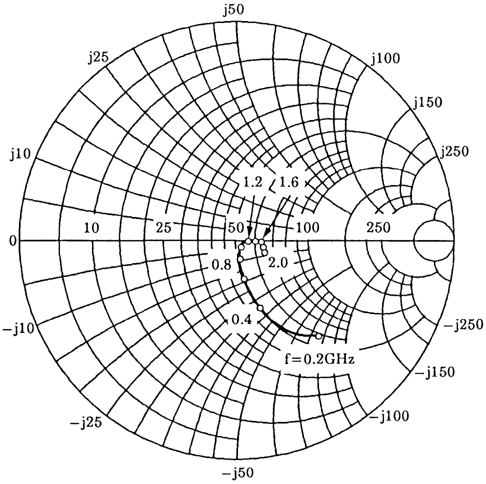
$V_{CE} = 8V$, $I_C = 5mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.572	−48.7	10.244	131.4	0.055	66.6	0.752	−30.7
400	0.322	−70.6	6.610	108.6	0.085	62.8	0.542	−38.9
600	0.178	−79.2	4.777	95.9	0.111	63.9	0.451	−39.9
800	0.093	−74.0	3.743	86.8	0.137	64.7	0.412	−39.8
1000	0.055	−37.8	3.100	79.9	0.163	65.1	0.401	−40.2
1200	0.077	−6.5	2.659	73.7	0.189	64.6	0.403	−41.9
1400	0.099	−2.4	2.341	68.2	0.213	63.8	0.413	−44.4
1600	0.121	−2.0	2.116	63.7	0.236	63.2	0.428	−47.9
1800	0.133	−13.5	1.955	59.5	0.259	62.2	0.443	−52.5
2000	0.136	−19.4	1.799	56.8	0.275	60.5	0.459	−56.6

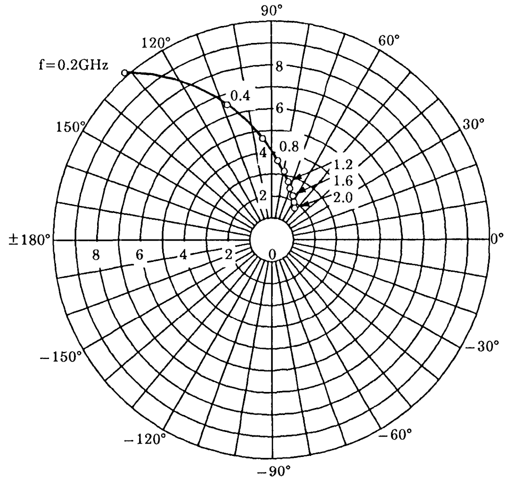
$V_{CE} = 8V$, $I_C = 20mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.202	−69.0	15.121	111.1	0.041	74.1	0.504	−35.3
400	0.054	−74.9	8.195	94.9	0.074	75.9	0.376	−31.6
600	0.034	36.2	5.632	86.2	0.108	75.6	0.348	−28.9
800	0.086	46.7	4.314	79.4	0.141	74.0	0.345	−28.8
1000	0.131	39.9	3.532	73.8	0.172	72.2	0.354	−30.4
1200	0.165	29.6	2.999	68.4	0.203	70.0	0.368	−33.6
1400	0.183	18.0	2.614	64.0	0.230	67.4	0.385	−37.6
1600	0.191	10.1	2.340	60.0	0.254	65.9	0.406	−42.4
1800	0.202	−1.8	2.121	56.5	0.279	63.9	0.423	−48.1
2000	0.195	−10.2	1.944	54.6	0.294	61.3	0.440	−53.0

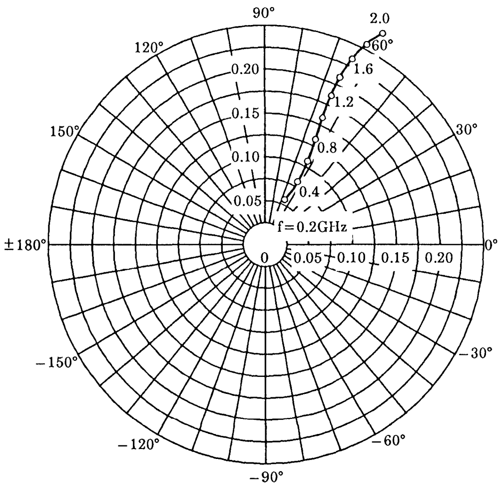
S11e
V_{CE} = 8V
I_C = 5mA
Ta = 25°C
(UNIT : Ω)



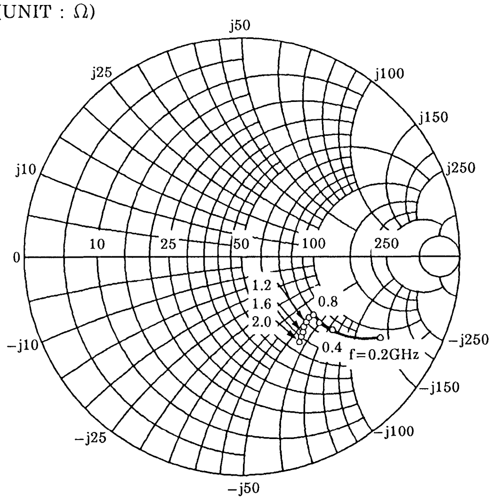
S21e
V_{CE} = 8V
I_C = 5mA
Ta = 25°C



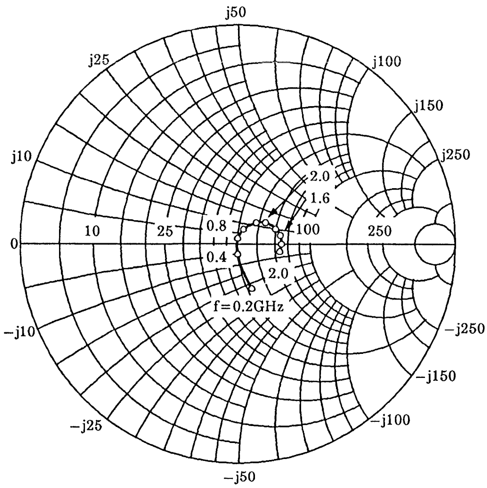
S12e
V_{CE} = 8V
I_C = 5mA
Ta = 25°C



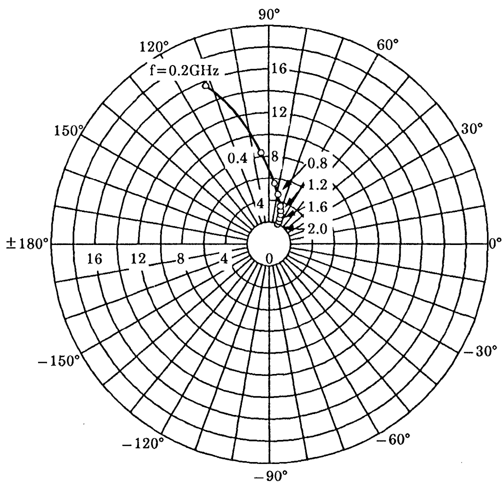
S22e
V_{CE} = 8V
I_C = 5mA
Ta = 25°C
(UNIT : Ω)



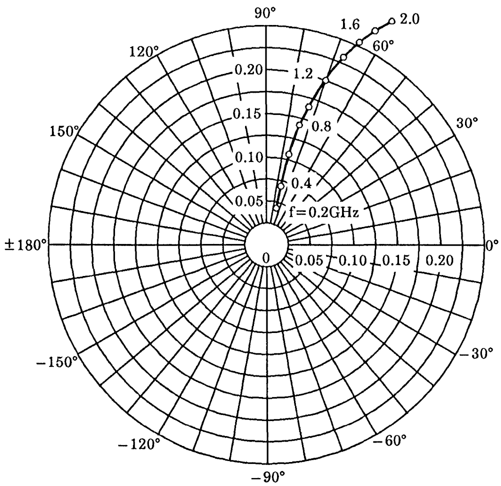
S_{11e}
$V_{CE}=8V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)



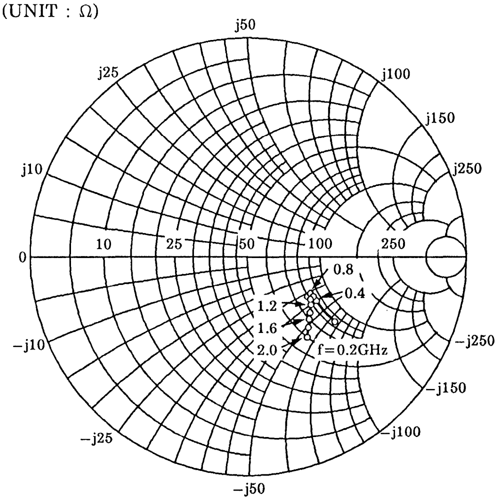
S_{21e}
$V_{CE}=8V$
$I_C=20mA$
$Ta=25°C$



S_{12e}
$V_{CE}=8V$
$I_C=20mA$
$Ta=25°C$



S_{22e}
$V_{CE}=8V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)



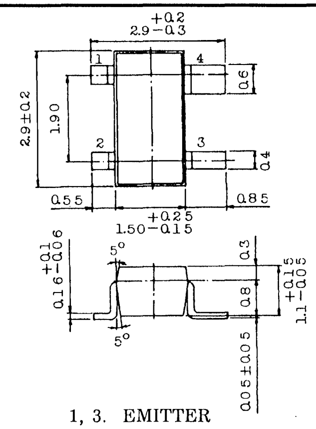
SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC4320

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

Unit in mm

- Low Noise Figure, High Gain.
- NF = 1.1dB, $|S_{21e}|^2$ = 15dB (f = 1GHz)



1, 3. EMITTER
2. BASE
4. COLLECTOR

JEDEC	—
EIAJ	—
TOSHIBA	2-3J1C

Weight : 0.012g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Base Current	I_B	20	mA
Collector Current	I_C	40	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MICROWAVE CHARACTERISTICS (Ta = 25°C)

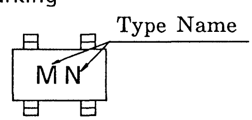
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 8V, I_C = 20mA	7	10	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE} = 8V, I_C = 20mA, f = 1GHz	12	15	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE} = 8V, I_C = 20mA, f = 2GHz	—	9	—	
Noise Figure	NF (1)	V_{CE} = 8V, I_C = 5mA, f = 1GHz	—	1.1	2.5	dB
	NF (2)	V_{CE} = 8V, I_C = 5mA, f = 2GHz	—	1.7	—	

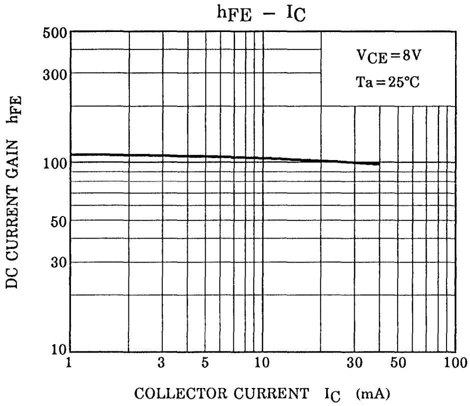
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

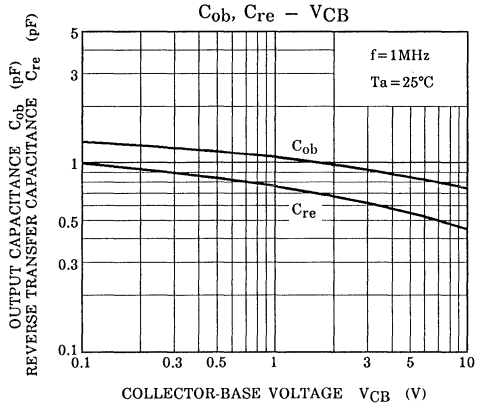
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_C = 0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE} = 8V, I_C = 20mA	50	—	250	—
Output Capacitance	C_{ob}	V_{CB} = 10V, I_E = 0, f = 1MHz	—	0.75	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.45	0.9	pF

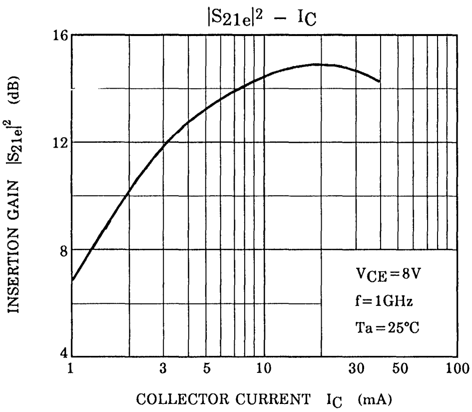
Note : C_{re} is measured by 3 terminal method with Capacitance Bridge.

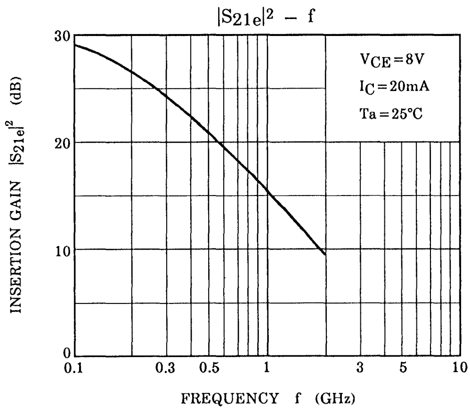
Marking

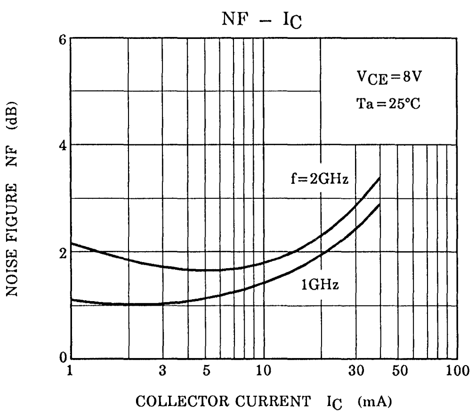


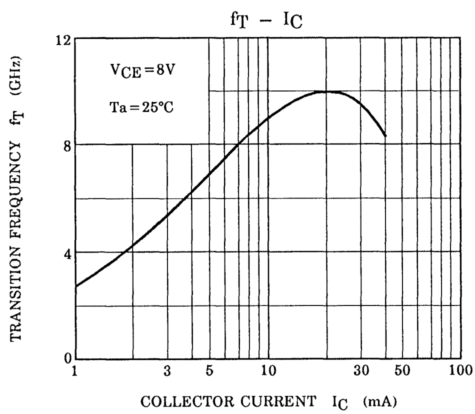

hFE – IC
VCE=8V
Ta=25°C
DC CURRENT GAIN hFE
500
300
100
50
30
10
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)

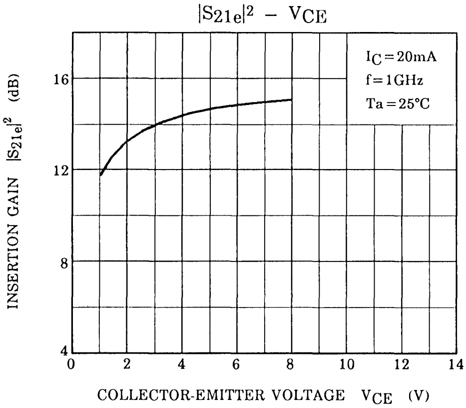

Cob, Cre – VCB
f=1MHz
Ta=25°C
Cob
Cre
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
5
3
1
0.5
0.3
0.1
0.1
0.3
0.5
1
3
5
10
COLLECTOR-BASE VOLTAGE VCB (V)

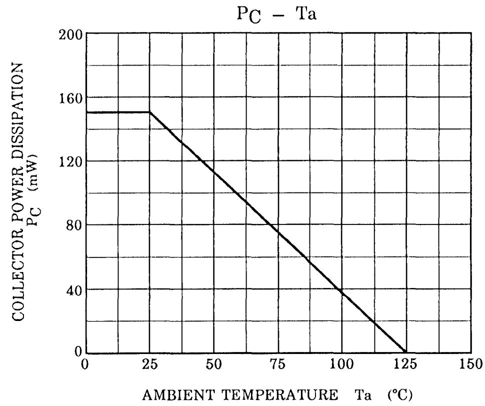

|S21e|2 – IC
VCE=8V
f=1GHz
Ta=25°C
INSERTION GAIN |S21e|2 (dB)
16
12
8
4
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)


|S21e|2 – f
VCE=8V
IC=20mA
Ta=25°C
INSERTION GAIN |S21e|2 (dB)
30
20
10
0
0.1
0.3
0.5
1
3
5
10
FREQUENCY f (GHz)


NF – IC
VCE=8V
Ta=25°C
f=2GHz
1GHz
NOISE FIGURE NF (dB)
6
4
2
0
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)


fT – IC
VCE=8V
Ta=25°C
TRANSITION FREQUENCY fT (GHz)
12
8
4
0
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)





S-PARAMETER $Z_O = 50\Omega$, $Ta = 25°C$

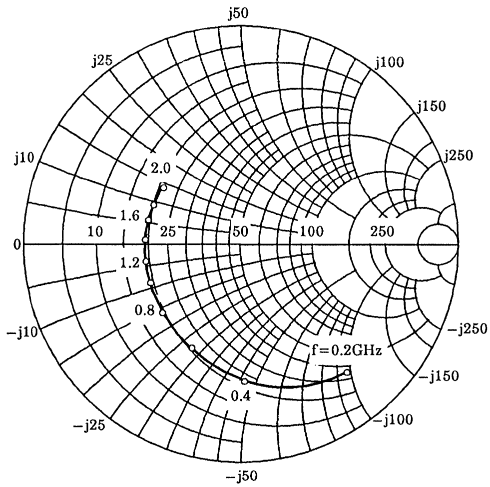
$V_{CE} = 8V$, $I_C = 5mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.764	−49.6	11.754	147.1	0.047	64.2	0.869	−29.4
400	0.624	−87.9	8.966	124.6	0.072	48.9	0.669	−48.3
600	0.532	−115.7	6.947	110.5	0.084	42.1	0.526	−59.5
800	0.485	−137.5	5.581	100.4	0.091	39.3	0.429	−66.6
1000	0.446	−155.0	4.636	92.9	0.097	38.6	0.370	−71.3
1200	0.441	−169.2	4.003	86.3	0.102	38.8	0.330	−75.3
1400	0.432	177.1	3.487	80.1	0.107	39.6	0.305	−77.6
1600	0.426	166.1	3.144	75.1	0.114	40.1	0.288	−80.7
1800	0.431	154.4	2.900	70.0	0.119	41.9	0.276	−83.9
2000	0.425	145.2	2.652	65.5	0.127	43.1	0.272	−87.3

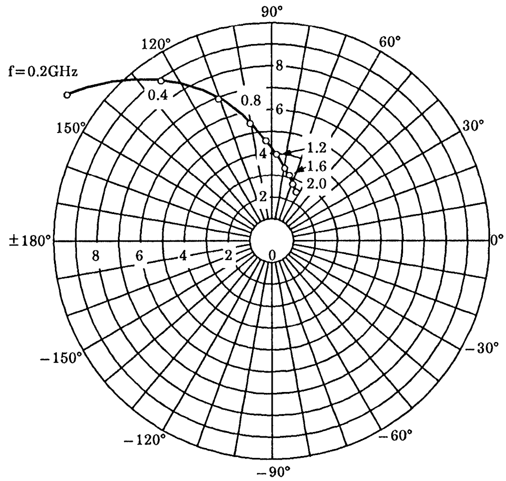
$V_{CE} = 8V$, $I_C = 20mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.540	−90.3	21.037	129.7	0.033	55.7	0.670	−46.8
400	0.479	−134.8	13.017	108.7	0.046	50.0	0.417	−64.5
600	0.461	−159.4	9.230	98.1	0.054	51.2	0.297	−71.9
800	0.454	−176.0	7.117	90.5	0.063	54.1	0.230	−75.4
1000	0.454	170.7	5.816	85.1	0.073	56.1	0.191	−76.7
1200	0.452	160.0	4.944	79.8	0.084	57.9	0.168	−77.0
1400	0.461	149.1	4.299	74.7	0.094	58.7	0.156	−75.7
1600	0.459	140.7	3.838	70.6	0.105	59.0	0.151	−75.8
1800	0.461	131.9	3.483	66.0	0.117	59.4	0.154	−76.6
2000	0.450	124.2	3.171	61.8	0.130	59.0	0.161	−79.3

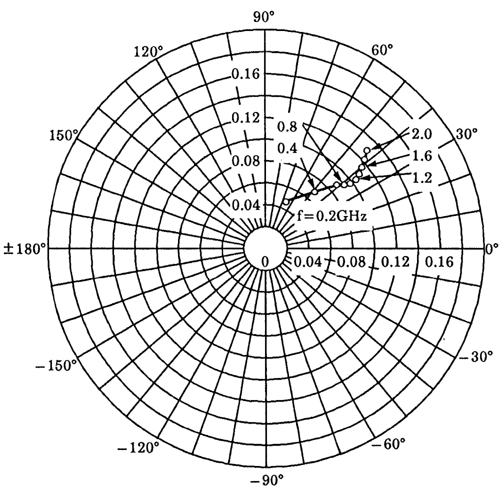
S_{11e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



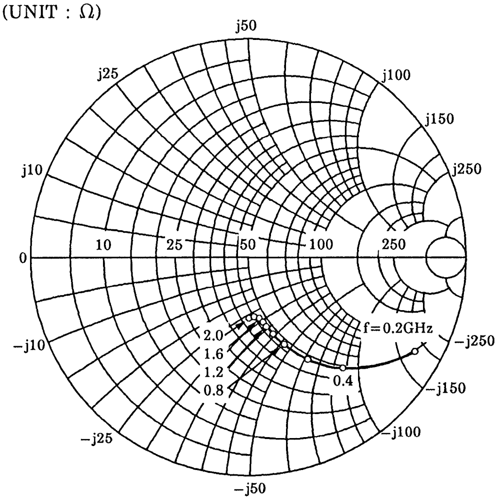
S_{21e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$



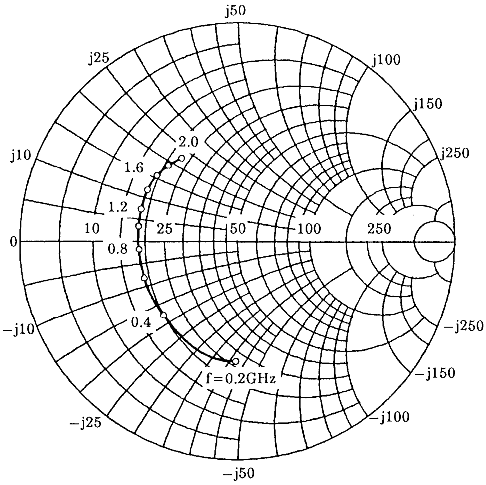
S_{12e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$



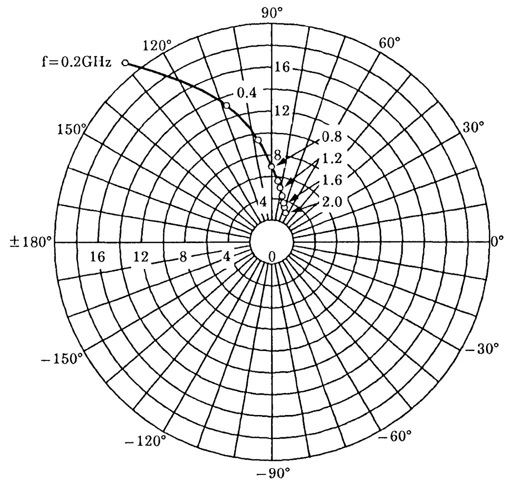
S_{22e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



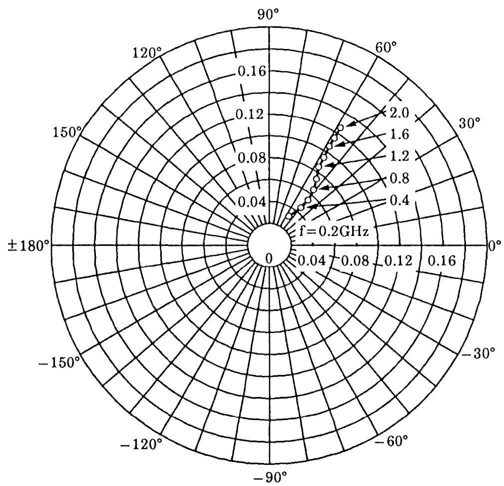
S_{11e}
$V_{CE}=8V$
$I_C=20mA$
Ta=25°C
(UNIT : Ω)



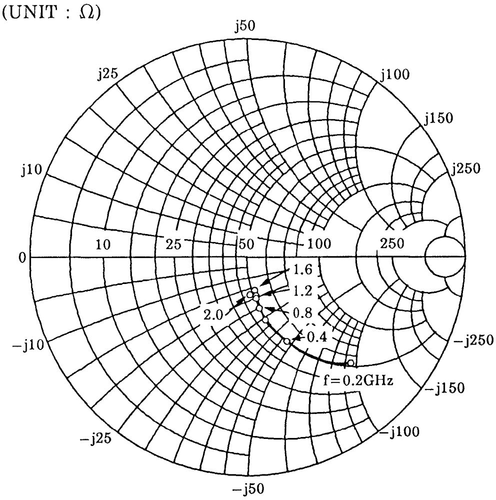
S_{21e}
$V_{CE}=8V$
$I_C=20mA$
Ta=25°C



S_{12e}
$V_{CE}=8V$
$I_C=20mA$
Ta=25°C



S_{22e}
$V_{CE}=8V$
$I_C=20mA$
Ta=25°C
(UNIT : Ω)

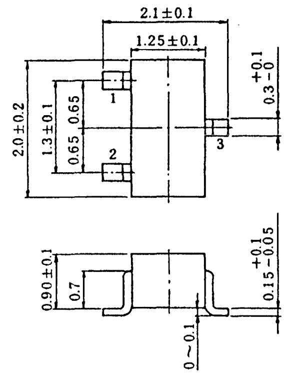


2SC4321 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure, High Gain.
- $NF = 1.1dB$, $|S_{21e}|^2 = 13dB$ (f=1GHz)

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1A

Weight : 0.006g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Base Current	I_B	20	mA
Collector Current	I_C	40	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MICROWAVE CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	$V_{CE}=8V$, $I_C=20mA$	7	10	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	$V_{CE}=8V$, $I_C=20mA$, f=1GHz	10	13	—	dB
	$\|S_{21e}\|^2$ (2)	$V_{CE}=8V$, $I_C=20mA$, f=2GHz	—	7	—	
Noise Figure	NF (1)	$V_{CE}=8V$, $I_C=5mA$, f=1GHz	—	1.1	2.5	dB
	NF (2)	$V_{CE}=8V$, $I_C=5mA$, f=2GHz	—	1.7	—	

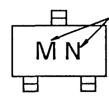
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

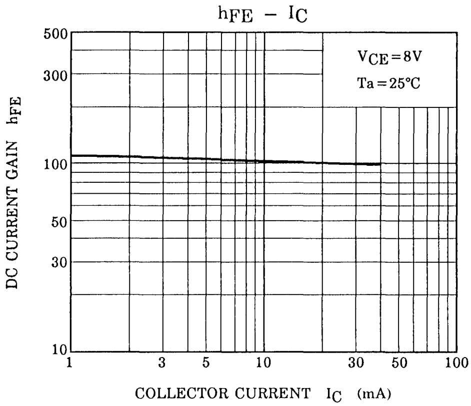
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=10V$, $I_E=0$	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=1V$, $I_C=0$	—	—	1	μA
DC Current Gain	h_{FE}	$V_{CE}=8V$, $I_C=20mA$	50	—	250	—
Output Capacitance	C_{ob}	$V_{CB}=10V$, $I_E=0$, f=1MHz	—	0.65	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.45	0.9	pF

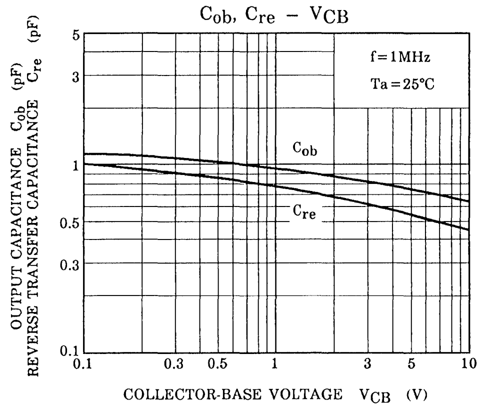
Note : C_{re} is measured by 3 terminal method with Capacitance Bridge.

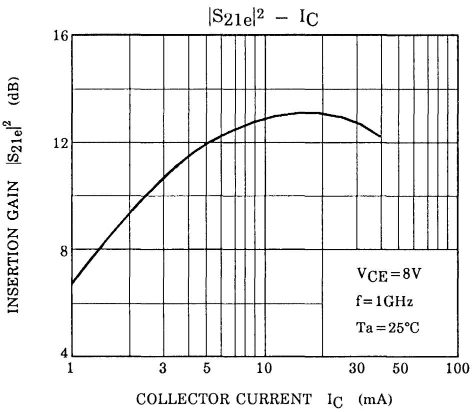
Marking

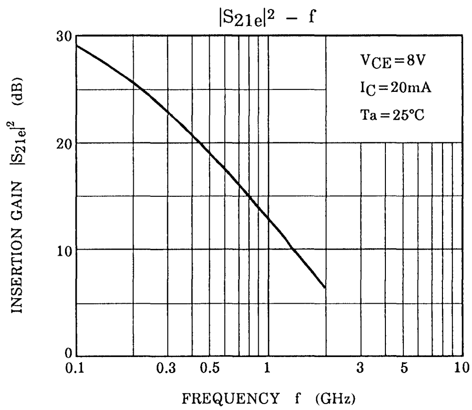
Type Name

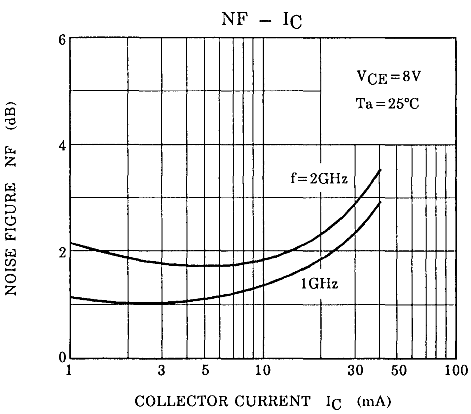


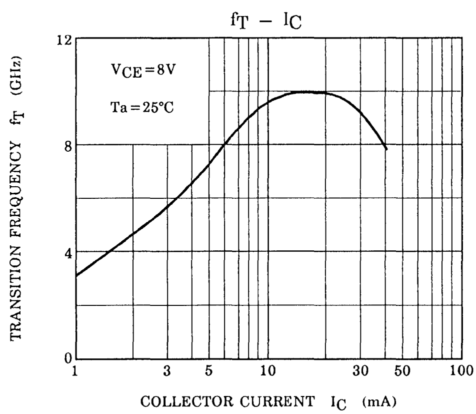

hFE – IC
DC CURRENT GAIN hFE
VCE=8V
Ta=25°C
COLLECTOR CURRENT IC (mA)

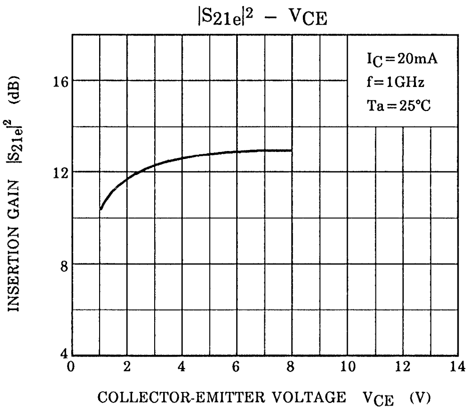

Cob, Cre – VCB
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
f=1MHz
Ta=25°C
Cob
Cre
COLLECTOR-BASE VOLTAGE VCB (V)

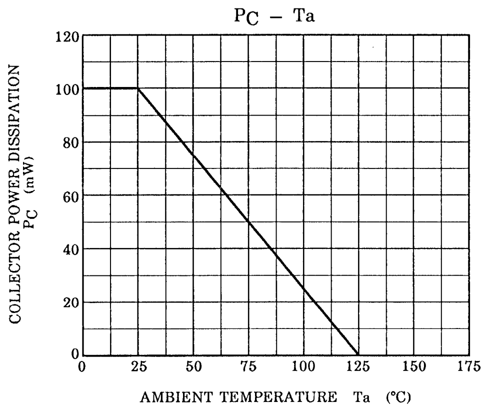

|S21e|2 – IC
INSERTION GAIN |S21e|2 (dB)
VCE=8V
f=1GHz
Ta=25°C
COLLECTOR CURRENT IC (mA)


|S21e|2 – f
INSERTION GAIN |S21e|2 (dB)
VCE=8V
IC=20mA
Ta=25°C
FREQUENCY f (GHz)


NF – IC
NOISE FIGURE NF (dB)
VCE=8V
Ta=25°C
f=2GHz
1GHz
COLLECTOR CURRENT IC (mA)


fT – IC
TRANSITION FREQUENCY fT (GHz)
VCE=8V
Ta=25°C
COLLECTOR CURRENT IC (mA)





S-PARAMETER $Z_O = 50\Omega$, Ta = 25°C

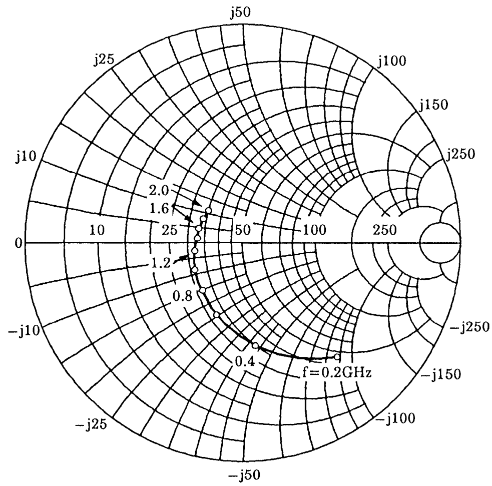
$V_{CE} = 8V$, $I_C = 5mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.680	−49.6	11.448	140.0	0.048	67.0	0.820	−28.4
400	0.478	−83.2	8.076	116.6	0.073	59.6	0.613	−41.1
600	0.353	−108.3	5.992	102.7	0.092	59.1	0.495	−46.2
800	0.281	−129.2	4.711	93.0	0.109	60.1	0.428	−48.9
1000	0.240	−149.0	3.875	85.8	0.127	61.1	0.389	−51.0
1200	0.216	−169.1	3.294	79.6	0.146	62.1	0.364	−53.3
1400	0.202	175.1	2.876	73.8	0.166	62.6	0.350	−55.6
1600	0.194	158.9	2.572	69.0	0.186	62.6	0.339	−58.4
1800	0.193	142.9	2.349	64.5	0.207	62.4	0.332	−61.7
2000	0.202	130.9	2.128	61.1	0.227	62.3	0.325	−65.7

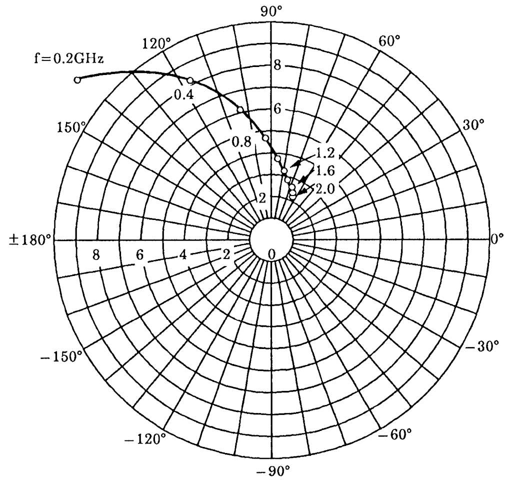
$V_{CE} = 8V$, $I_C = 20mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.332	−83.7	18.406	118.0	0.034	68.8	0.565	−38.2
400	0.212	−123.3	10.378	100.0	0.057	71.1	0.393	−39.9
600	0.173	−150.7	7.130	90.7	0.080	73.0	0.336	−39.3
800	0.157	−175.3	5.442	84.3	0.104	73.0	0.309	−39.6
1000	0.161	167.5	4.394	79.1	0.128	72.4	0.295	−41.0
1200	0.162	149.7	3.728	74.3	0.152	71.7	0.285	−43.2
1400	0.169	138.2	3.240	69.5	0.175	70.5	0.280	−46.0
1600	0.177	125.9	2.877	65.7	0.200	68.9	0.278	−48.9
1800	0.178	113.5	2.595	61.8	0.223	67.4	0.279	−53.0
2000	0.190	104.3	2.352	58.6	0.246	65.8	0.275	−57.8

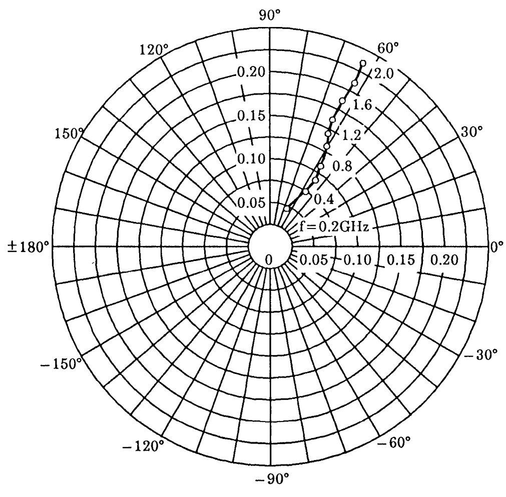
S_{11e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



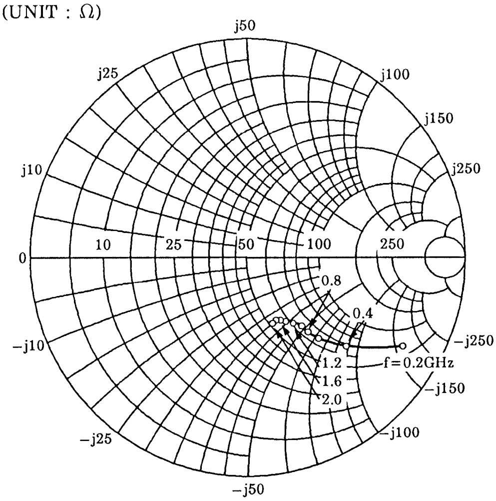
S_{21e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$



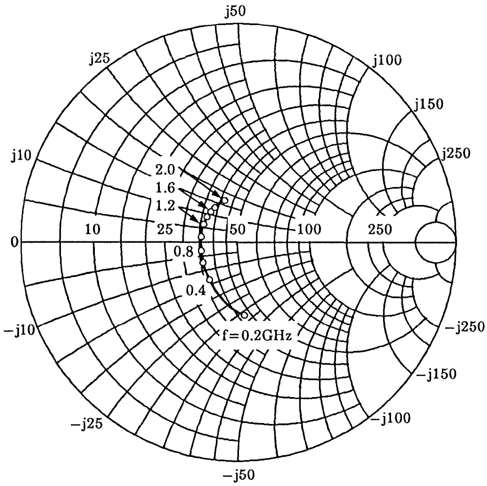
S_{12e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$



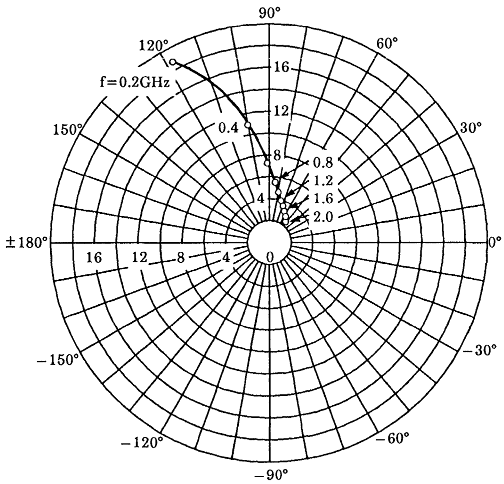
S_{22e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



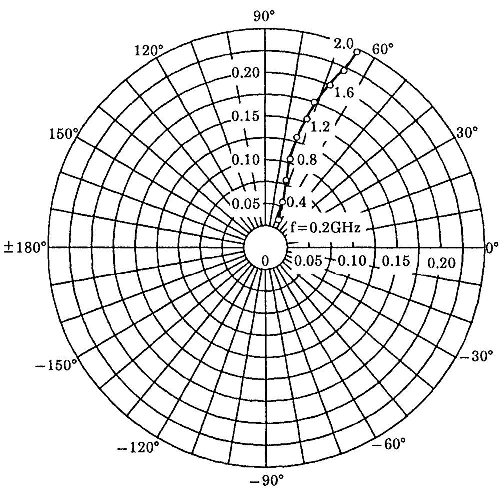
S_{11e}
$V_{CE}=8V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)



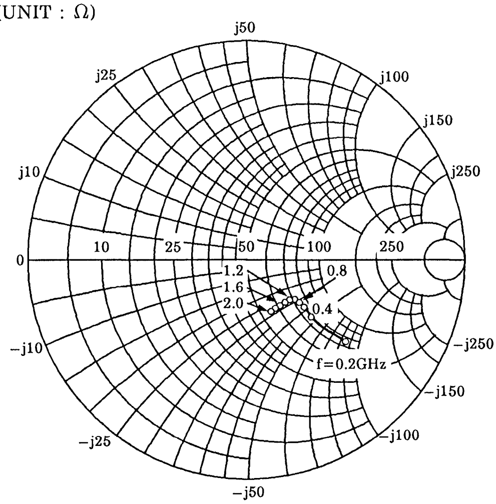
S_{21e}
$V_{CE}=8V$
$I_C=20mA$
$Ta=25°C$



S_{12e}
$V_{CE}=8V$
$I_C=20mA$
$Ta=25°C$



S_{22e}
$V_{CE}=8V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)



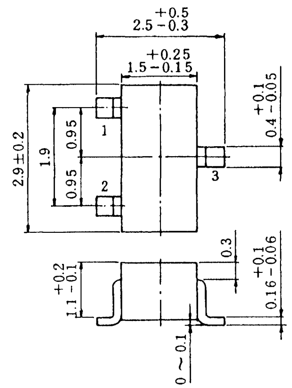
SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC4322

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure, High Gain.
- $NF = 1.8dB$, $|S_{21e}|^2 = 7.5dB$ $(f = 2GHz)$

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Base Current	I_B	7	mA
Collector Current	I_C	15	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MICROWAVE CHARACTERISTICS (Ta = 25°C)

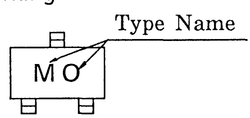
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	$V_{CE} = 6V$, $I_C = 7mA$	7	10	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	$V_{CE} = 6V$, $I_C = 7mA$, $f = 1GHz$	—	13	—	dB
	$\|S_{21e}\|^2$ (2)	$V_{CE} = 6V$, $I_C = 7mA$, $f = 2GHz$	4.5	7.5	—	
Noise Figure	NF (1)	$V_{CE} = 6V$, $I_C = 3mA$, $f = 1GHz$	—	1.4	—	dB
	NF (2)	$V_{CE} = 6V$, $I_C = 3mA$, $f = 2GHz$	—	1.8	3.0	

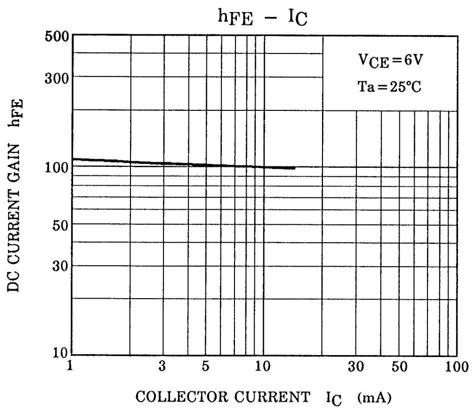
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

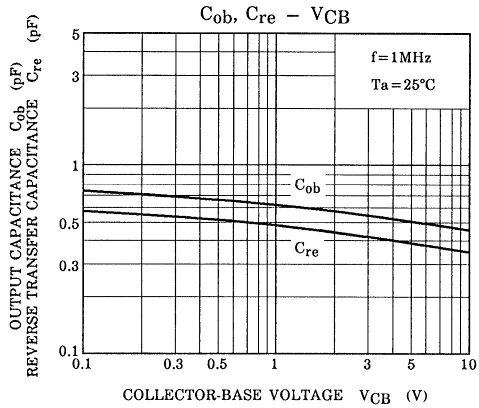
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB} = 10V$, $I_E = 0$	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB} = 1V$, $I_C = 0$	—	—	1	μA
DC Current Gain	h_{FE}	$V_{CE} = 6V$, $I_C = 7mA$	50	—	250	—
Output Capacitance	C_{ob}	$V_{CB} = 10V$, $I_E = 0$, $f = 1MHz$	—	0.45	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.35	0.8	pF

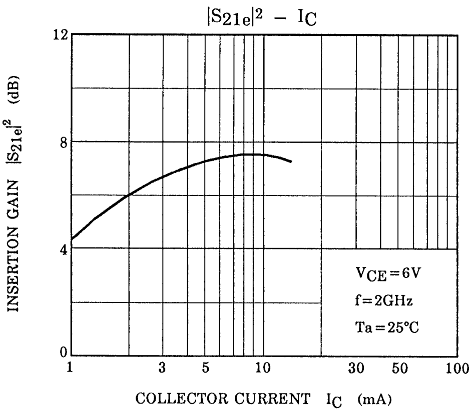
Note : C_{re} is measured by 3 terminal method with Capacitance Bridge.

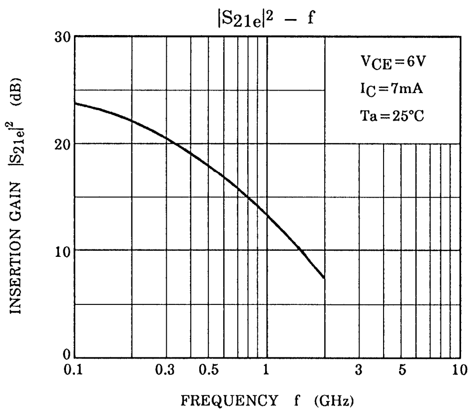
Marking

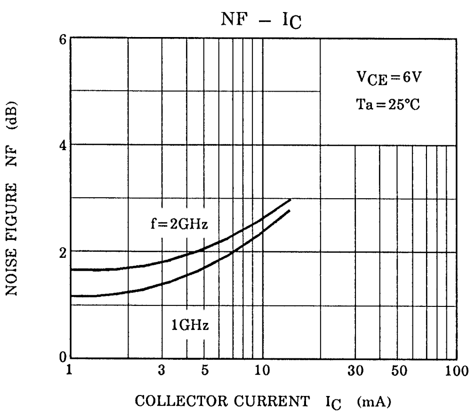


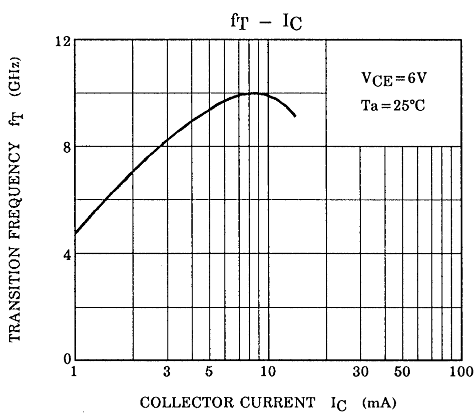

hFE – IC
VCE=6V
Ta=25°C
DC CURRENT GAIN hFE
500
300
100
50
30
10
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)

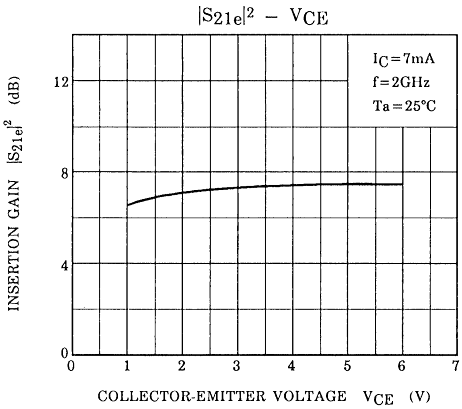

Cob, Cre – VCB
f=1MHz
Ta=25°C
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
Cob
Cre
5
3
1
0.5
0.3
0.1
0.1
0.3
0.5
1
3
5
10
COLLECTOR-BASE VOLTAGE VCB (V)

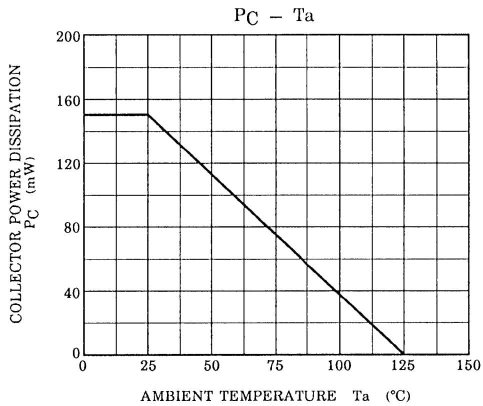

|S21e|2 – IC
VCE=6V
f=2GHz
Ta=25°C
INSERTION GAIN |S21e|2 (dB)
12
8
4
0
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)


|S21e|2 – f
VCE=6V
IC=7mA
Ta=25°C
INSERTION GAIN |S21e|2 (dB)
30
20
10
0
0.1
0.3
0.5
1
3
5
10
FREQUENCY f (GHz)


NF – IC
VCE=6V
Ta=25°C
NOISE FIGURE NF (dB)
f=2GHz
1GHz
6
4
2
0
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)


fT – IC
VCE=6V
Ta=25°C
TRANSITION FREQUENCY fT (GHz)
12
8
4
0
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)





S-PARAMETER $Z_O = 50\Omega$, Ta = 25°C

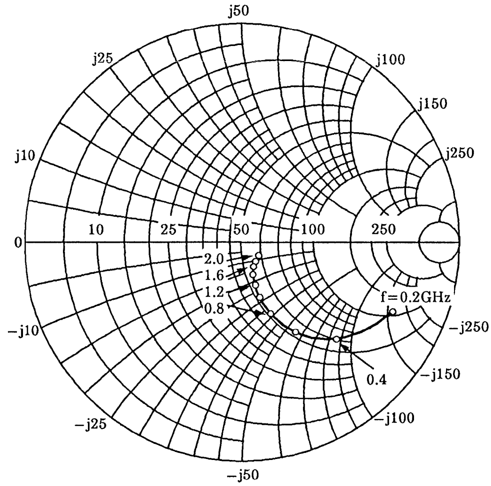
$V_{CE} = 6V$, $I_C = 3mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.764	−25.0	7.758	153.8	0.037	76.2	0.934	−16.4
400	0.613	−44.9	6.493	132.9	0.065	67.0	0.808	−27.7
600	0.473	−57.9	5.331	117.9	0.085	62.8	0.702	−34.3
800	0.356	−66.9	4.433	106.2	0.102	61.2	0.623	−38.0
1000	0.261	−70.4	3.738	97.7	0.117	60.4	0.575	−40.6
1200	0.198	−71.7	3.266	90.1	0.132	60.2	0.544	−42.4
1400	0.147	−66.3	2.853	83.0	0.147	60.1	0.529	−44.1
1600	0.129	−54.9	2.555	78.2	0.163	60.3	0.519	−46.4
1800	0.114	−41.8	2.348	72.8	0.179	60.0	0.514	−49.0
2000	0.124	−34.5	2.108	69.2	0.192	60.1	0.513	−52.4

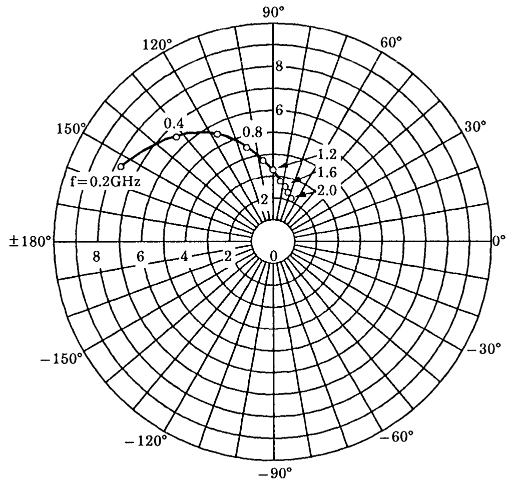
$V_{CE} = 6V$, $I_C = 7mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.560	−35.3	12.525	142.0	0.032	74.2	0.853	−21.5
400	0.367	−54.1	8.958	118.8	0.055	69.5	0.678	−30.1
600	0.248	−63.4	6.693	105.3	0.073	68.4	0.581	−32.7
800	0.158	−62.4	5.270	95.5	0.091	68.6	0.530	−33.6
1000	0.101	−47.8	4.319	88.5	0.110	68.4	0.506	−34.7
1200	0.088	−27.3	3.687	82.1	0.128	67.9	0.493	−36.0
1400	0.099	−4.3	3.188	76.2	0.146	67.0	0.491	−37.8
1600	0.131	−0.7	2.813	71.9	0.165	66.2	0.492	−40.5
1800	0.152	0.4	2.563	67.4	0.183	65.2	0.498	−43.7
2000	0.167	−1.7	2.276	64.5	0.198	64.5	0.500	−47.5

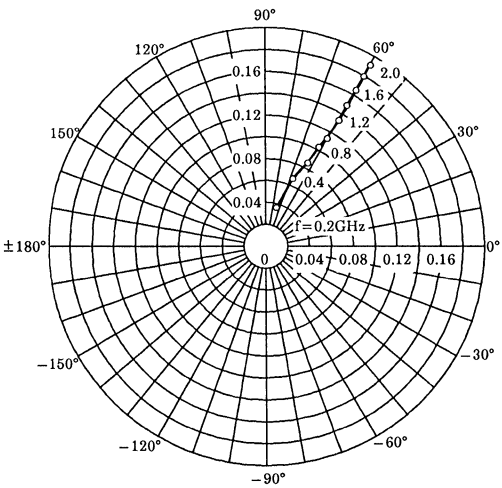
S_{11e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$
(UNIT : Ω)



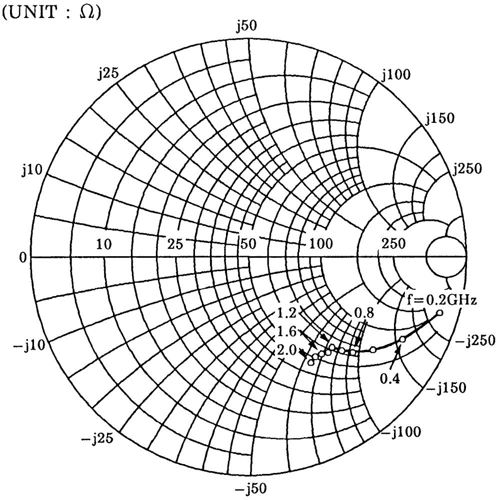
S_{21e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$



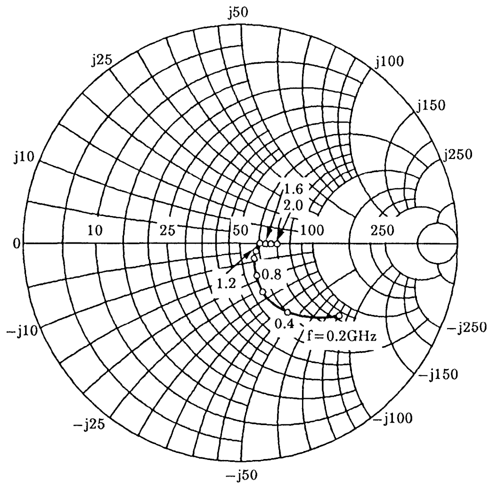
S_{12e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$



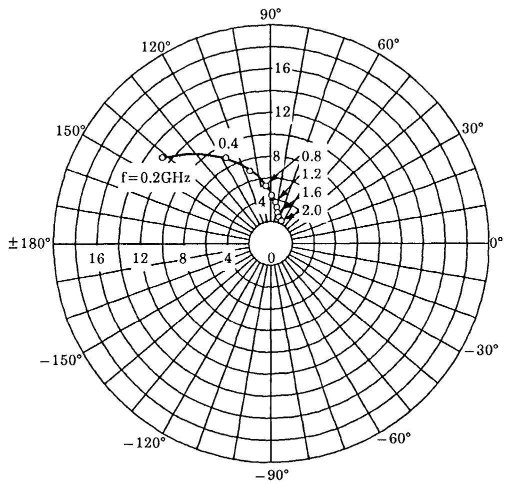
S_{22e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$
(UNIT : Ω)



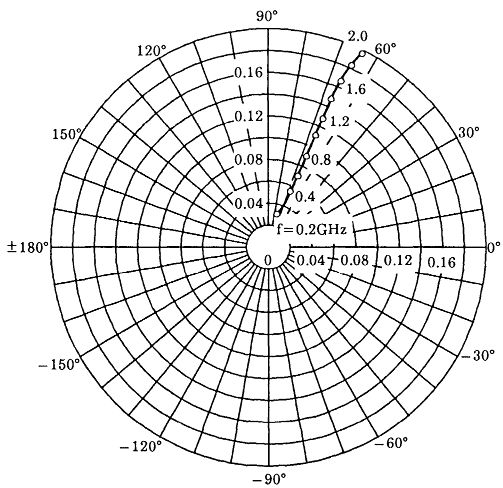
S11e
$V_{CE}=6V$
$I_C=7mA$
Ta=25°C
(UNIT : Ω)



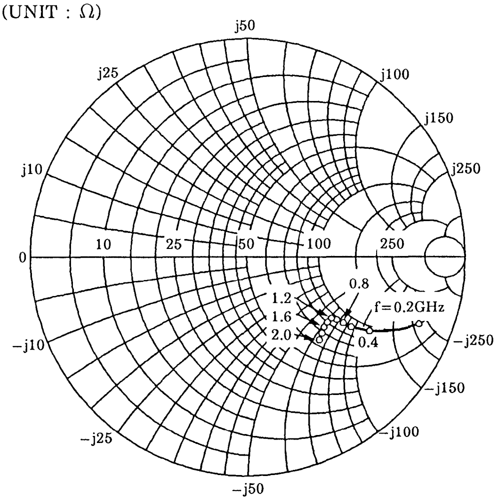
S21e
$V_{CE}=6V$
$I_C=7mA$
Ta=25°C



S12e
$V_{CE}=6V$
$I_C=7mA$
Ta=25°C



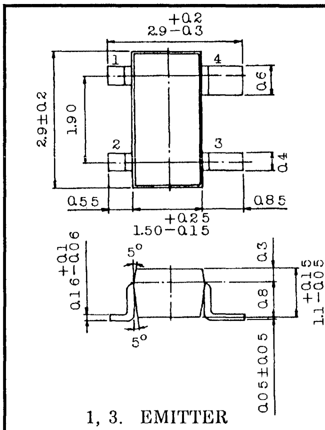
S22e
$V_{CE}=6V$
$I_C=7mA$
Ta=25°C
(UNIT : Ω)



2SC4324 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

Unit in mm



- Low Noise Figure, High Gain.
- NF=1.8dB, $|S_{21e}|^2$=9.5dB (f=2GHz)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Base Current	I_B	7	mA
Collector Current	I_C	15	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

1, 3. EMITTER
2. BASE
4. COLLECTOR

JEDEC	—
EIAJ	—
TOSHIBA	2-3J1C

Weight : 0.012g

MICROWAVE CHARACTERISTICS (Ta = 25°C)

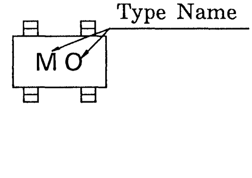
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE}=6V, I_C=7mA	7	10	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE}=6V, I_C=7mA, f=1GHz	—	15	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE}=6V, I_C=7mA, f=2GHz	6.5	9.5	—	
Noise Figure	NF (1)	V_{CE}=6V, I_C=3mA, f=1GHz	—	1.4	—	dB
	NF (2)	V_{CE}=6V, I_C=3mA, f=2GHz	—	1.8	3.0	

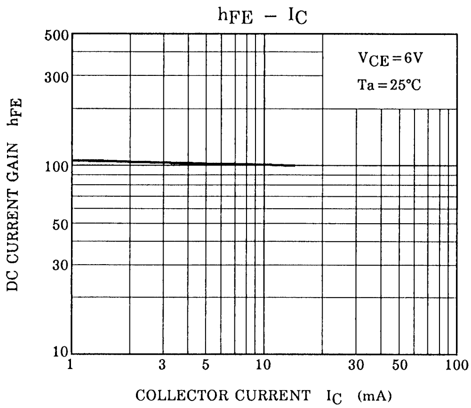
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

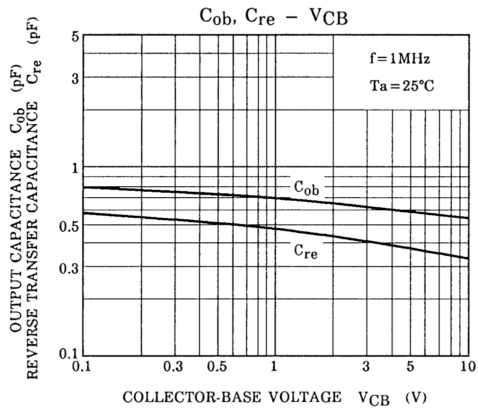
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB}=10V, I_E=0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB}=1V, I_C=0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE}=6V, I_C=7mA	50	—	250	—
Output Capacitance	C_{ob}	V_{CB}=10V, I_E=0, f=1MHz	—	0.55	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.35	0.8	pF

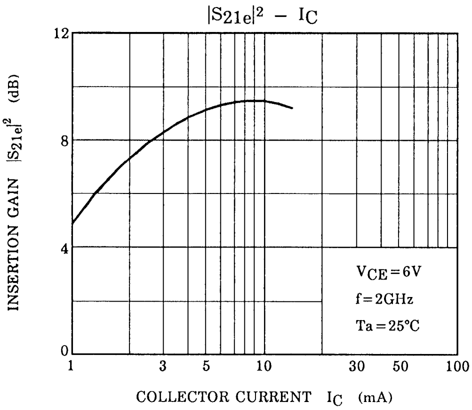
Note : C_{re} is measured by 3 terminal method with Capacitance Bridge.

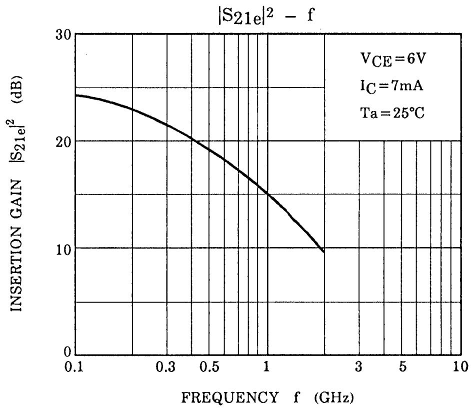
Marking

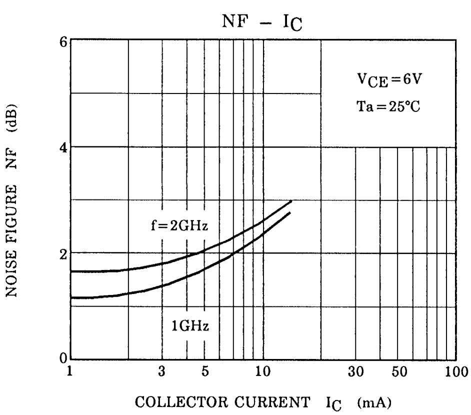


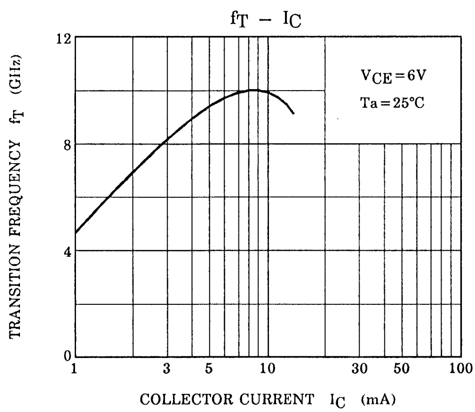

hFE – IC
VCE=6V
Ta=25°C
DC CURRENT GAIN hFE
500
300
100
50
30
10
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)

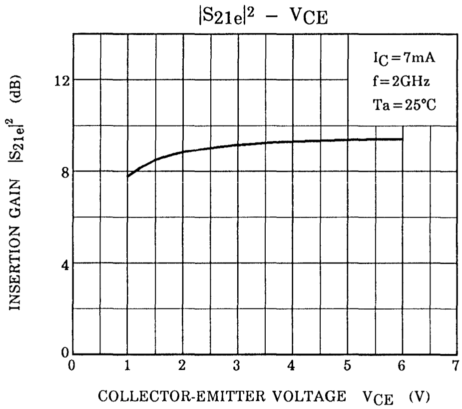

Cob, Cre – VCB
f=1MHz
Ta=25°C
Cob
Cre
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
5
3
1
0.5
0.3
0.1
0.1
0.3
0.5
1
3
5
10
COLLECTOR-BASE VOLTAGE VCB (V)

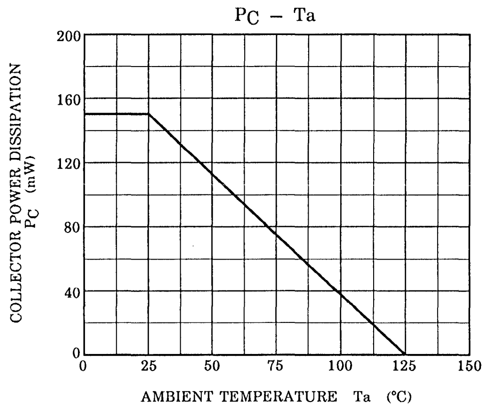

|S21e|2 – IC
VCE=6V
f=2GHz
Ta=25°C
INSERTION GAIN |S21e|2 (dB)
12
8
4
0
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)


|S21e|2 – f
VCE=6V
IC=7mA
Ta=25°C
INSERTION GAIN |S21e|2 (dB)
30
20
10
0
0.1
0.3
0.5
1
3
5
10
FREQUENCY f (GHz)


NF – IC
VCE=6V
Ta=25°C
f=2GHz
1GHz
NOISE FIGURE NF (dB)
6
4
2
0
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)


fT – IC
VCE=6V
Ta=25°C
TRANSITION FREQUENCY fT (GHz)
12
8
4
0
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)





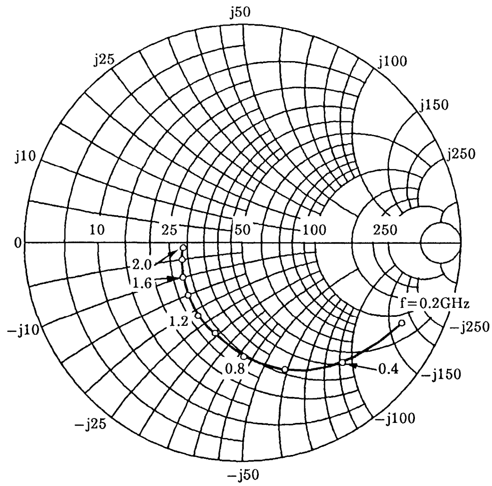
S-PARAMETER $Z_O = 50\Omega$, Ta = 25°C
$V_{CE} = 6V$, $I_C = 3mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.831	–26.6	7.776	156.8	0.042	74.0	0.939	–19.5
400	0.719	–50.1	6.775	139.2	0.074	61.6	0.833	–35.5
600	0.618	–70.8	5.857	125.4	0.097	52.5	0.724	–48.1
800	0.515	–88.5	5.063	113.9	0.111	46.5	0.627	–58.0
1000	0.434	–104.0	4.381	105.3	0.122	42.3	0.553	–65.6
1200	0.374	–119.2	3.886	97.2	0.130	39.6	0.495	–71.6
1400	0.332	–134.7	3.425	89.8	0.137	37.8	0.453	–76.1
1600	0.293	–147.5	3.135	84.4	0.145	36.5	0.423	–81.0
1800	0.267	–163.2	2.926	78.2	0.150	35.8	0.397	–85.1
2000	0.248	–175.3	2.709	73.7	0.157	35.7	0.382	–89.4

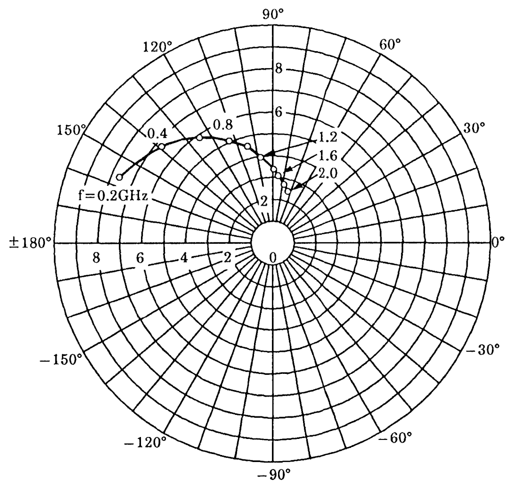
$V_{CE} = 6V$, $I_C = 7mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.683	–43.5	13.639	148.7	0.037	68.4	0.876	–27.8
400	0.541	–78.5	10.619	126.8	0.060	55.8	0.688	–46.4
600	0.437	–105.5	8.350	112.6	0.072	49.8	0.547	–57.7
800	0.365	–128.4	6.752	102.1	0.082	47.6	0.447	–65.1
1000	0.319	–148.8	5.640	94.4	0.090	47.0	0.383	–70.0
1200	0.293	–166.3	4.877	87.5	0.098	47.1	0.338	–73.3
1400	0.280	174.4	4.248	81.3	0.107	46.9	0.308	–75.4
1600	0.269	162.3	3.813	76.4	0.116	47.4	0.292	–78.0
1800	0.272	148.6	3.489	70.8	0.124	47.5	0.283	–80.3
2000	0.264	137.2	3.182	66.5	0.134	47.6	0.278	–83.7

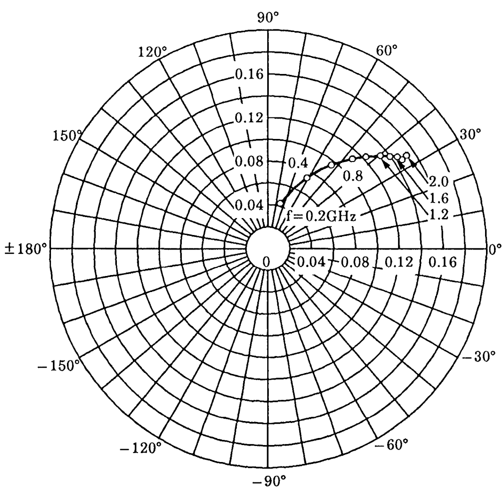
S_{11e}
$V_{CE} = 6V$
$I_C = 3mA$
$Ta = 25°C$
(UNIT : Ω)



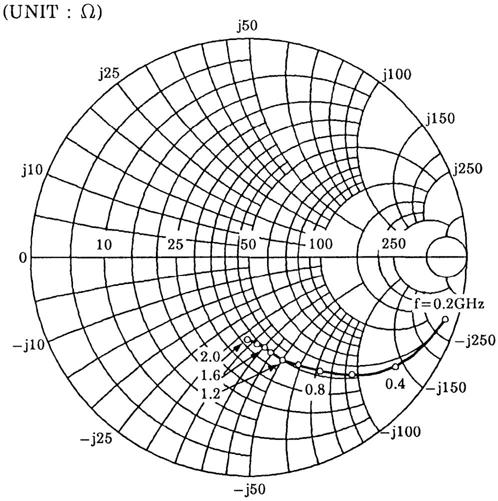
S_{21e}
$V_{CE} = 6V$
$I_C = 3mA$
$Ta = 25°C$



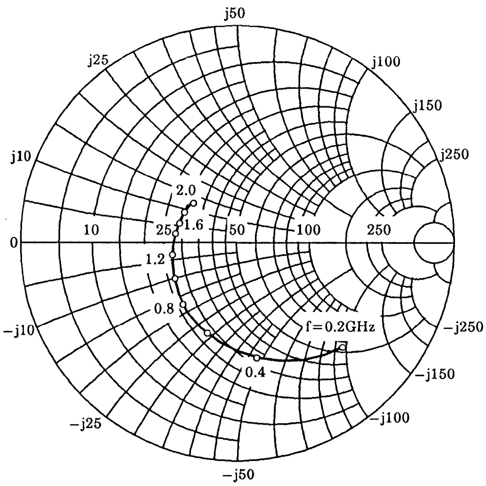
S_{12e}
$V_{CE} = 6V$
$I_C = 3mA$
$Ta = 25°C$



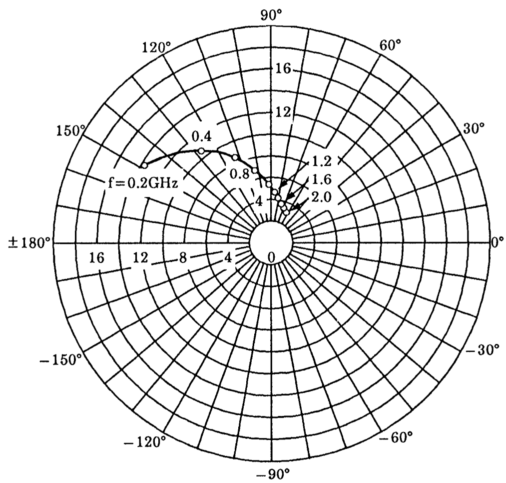
S_{22e}
$V_{CE} = 6V$
$I_C = 3mA$
$Ta = 25°C$
(UNIT : Ω)



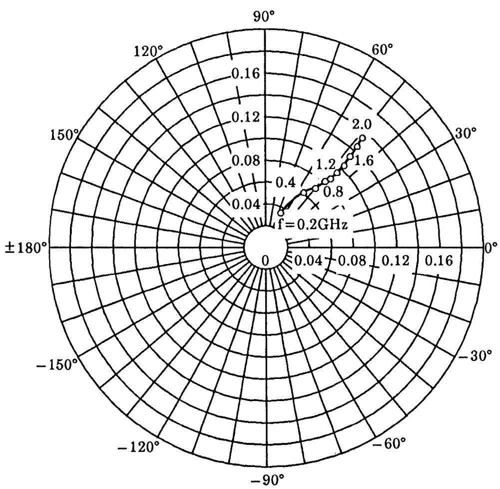
S_{11e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$
(UNIT : Ω)



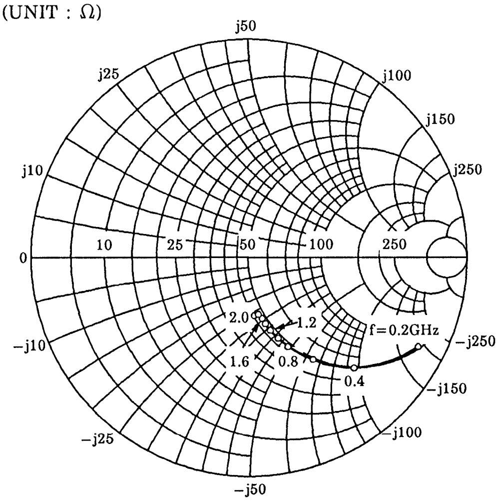
S_{21e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$



S_{12e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$



S_{22e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$
(UNIT : Ω)



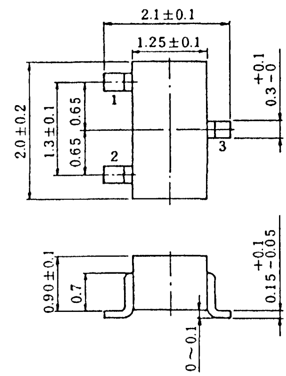
SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC4325

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure, High Gain.
- NF = 1.8dB, $|S_{21e}|^2$ = 7.5dB (f = 2GHz)

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1A

Weight : 0.006g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Base Current	I_B	7	mA
Collector Current	I_C	15	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MICROWAVE CHARACTERISTICS (Ta = 25°C)

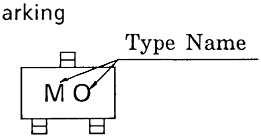
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 6V, I_C = 7mA	7	10	—	GHz
Insertion Gain	$|S_{21e}|^2$ (1)	V_{CE} = 6V, I_C = 7mA, f = 1GHz	—	13	—	dB
	$|S_{21e}|^2$ (2)	V_{CE} = 6V, I_C = 7mA, f = 2GHz	4.5	7.5	—	
Noise Figure	NF (1)	V_{CE} = 6V, I_C = 3mA, f = 1GHz	—	1.4	—	dB
	NF (2)	V_{CE} = 6V, I_C = 3mA, f = 2GHz	—	1.8	3.0	

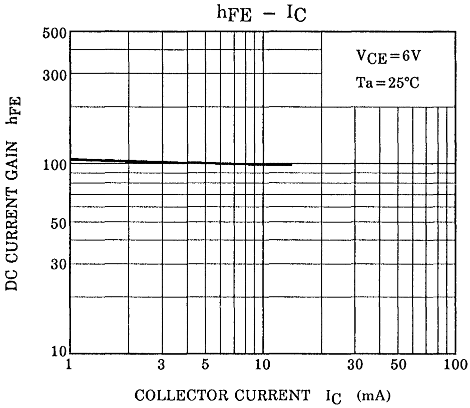
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

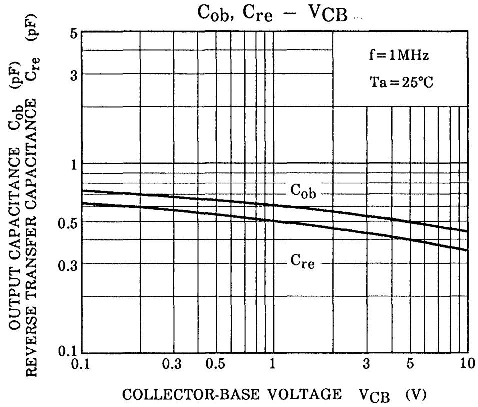
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_C = 0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE} = 6V, I_C = 7mA	50	—	250	—
Output Capacitance	C_{ob}	V_{CB} = 10V, I_E = 0, f = 1MHz	—	0.45	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.35	0.8	pF

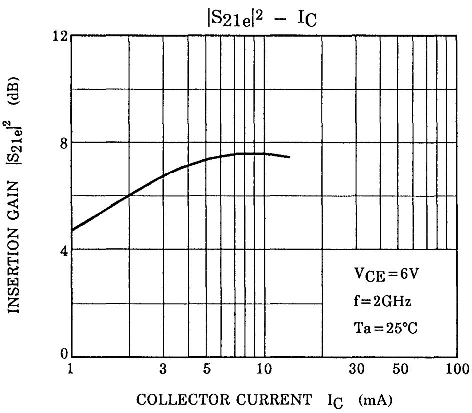
Note : C_{re} is measured by 3 terminal method with Capacitance Bridge.

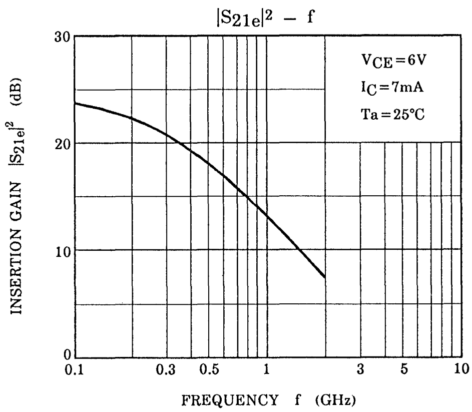
Marking

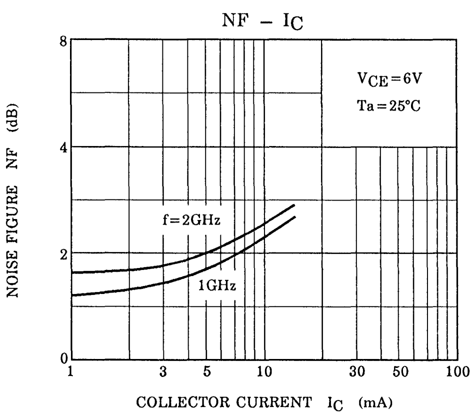


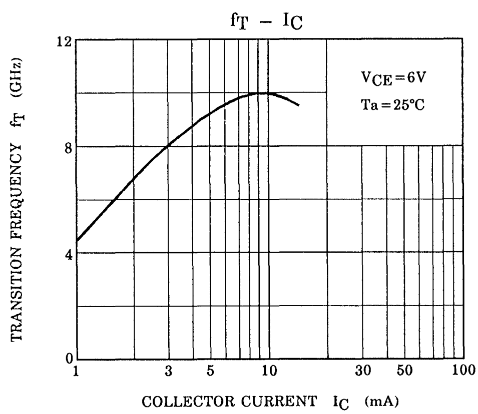

hFE – IC
VCE=6V
Ta=25°C
DC CURRENT GAIN hFE
500
300
100
50
30
10
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)

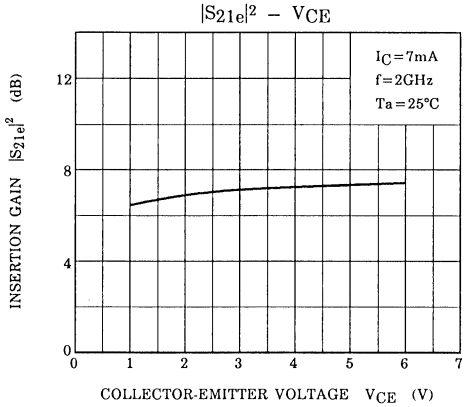

Cob, Cre – VCB
f=1MHz
Ta=25°C
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
Cob
Cre
5
3
1
0.5
0.3
0.1
0.1
0.3
0.5
1
3
5
10
COLLECTOR-BASE VOLTAGE VCB (V)

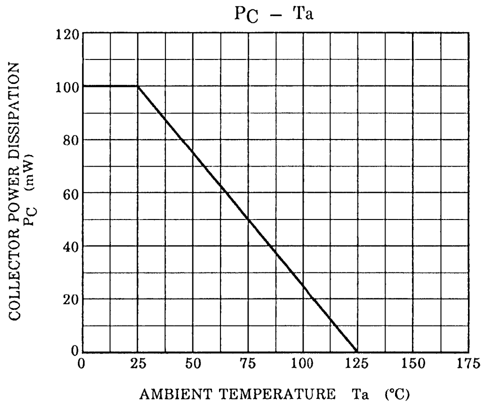

|S21e|2 – IC
VCE=6V
f=2GHz
Ta=25°C
INSERTION GAIN |S21e|2 (dB)
12
8
4
0
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)


|S21e|2 – f
VCE=6V
IC=7mA
Ta=25°C
INSERTION GAIN |S21e|2 (dB)
30
20
10
0
0.1
0.3
0.5
1
3
5
10
FREQUENCY f (GHz)


NF – IC
VCE=6V
Ta=25°C
f=2GHz
1GHz
NOISE FIGURE NF (dB)
8
4
2
0
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)


fT – IC
VCE=6V
Ta=25°C
TRANSITION FREQUENCY fT (GHz)
12
8
4
0
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)





S-PARAMETER $Z_O = 50\Omega$, $Ta = 25°C$

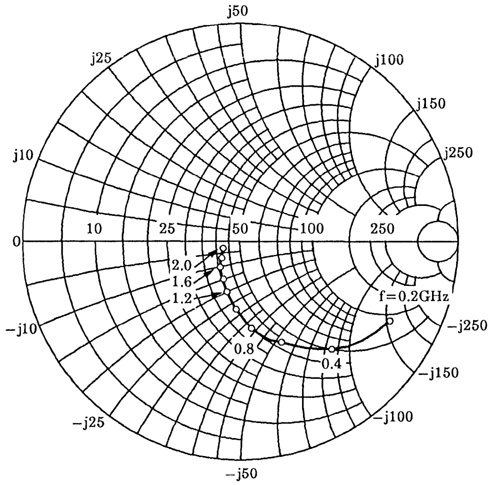
$V_{CE} = 6V$, $I_C = 3mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.778	−27.1	7.781	154.1	0.043	75.7	0.932	−18.5
400	0.641	−49.4	6.538	133.4	0.075	66.5	0.800	−31.9
600	0.500	−67.1	5.409	118.1	0.097	61.9	0.683	−40.4
800	0.394	−80.5	4.508	106.6	0.115	59.9	0.595	−45.8
1000	0.311	−93.1	3.809	97.9	0.132	59.4	0.536	−49.6
1200	0.238	−103.0	3.314	90.6	0.149	59.3	0.492	−52.7
1400	0.194	−114.5	2.909	84.0	0.165	59.3	0.465	−55.3
1600	0.146	−122.2	2.619	78.7	0.183	59.4	0.444	−57.9
1800	0.102	−135.3	2.409	73.5	0.199	59.4	0.428	−60.8
2000	0.074	−150.4	2.188	70.0	0.216	59.6	0.415	−64.2

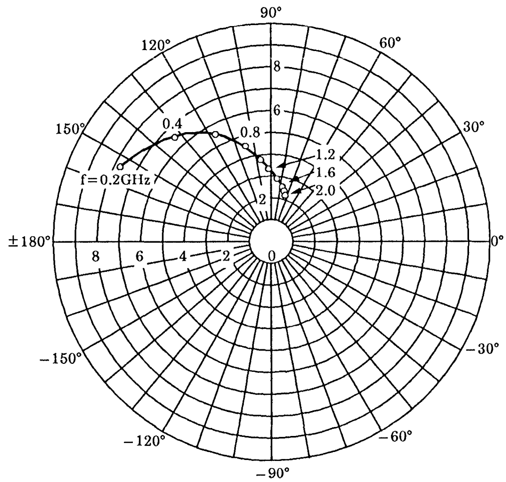
$V_{CE} = 6V$, $I_C = 7mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.581	−39.7	12.614	141.9	0.037	73.0	0.842	−24.8
400	0.397	−64.8	9.040	119.2	0.061	67.7	0.652	−36.1
600	0.278	−82.1	6.744	105.5	0.081	67.3	0.541	−40.4
800	0.194	−94.9	5.328	96.2	0.101	67.7	0.477	−42.6
1000	0.137	−109.4	4.364	89.2	0.121	67.8	0.440	−44.3
1200	0.096	−123.2	3.733	83.2	0.141	67.8	0.417	−46.4
1400	0.062	−140.8	3.254	77.9	0.162	67.1	0.403	−48.5
1600	0.041	−169.5	2.899	73.4	0.183	66.6	0.394	−50.9
1800	0.030	137.0	2.634	68.9	0.203	65.6	0.389	−54.0
2000	0.038	99.1	2.377	66.1	0.222	65.1	0.382	−57.6

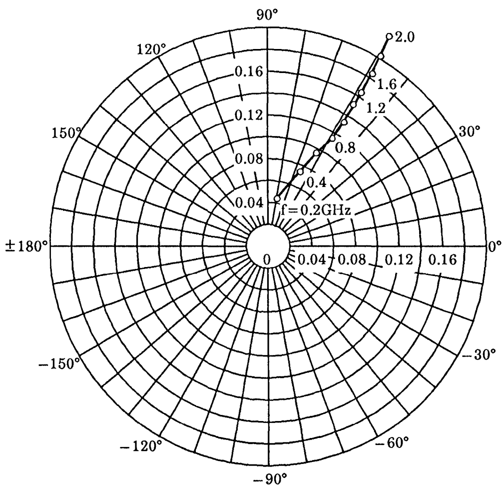
S_{11e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$
(UNIT : Ω)



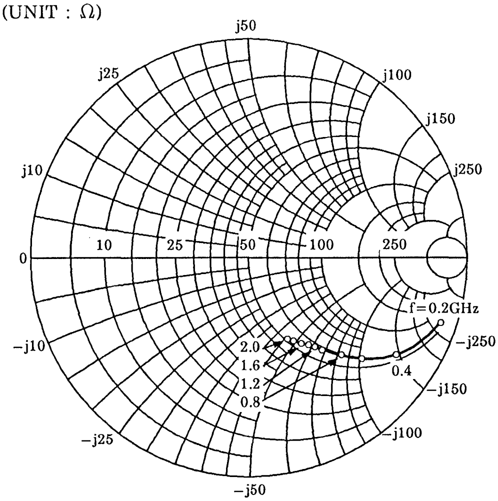
S_{21e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$



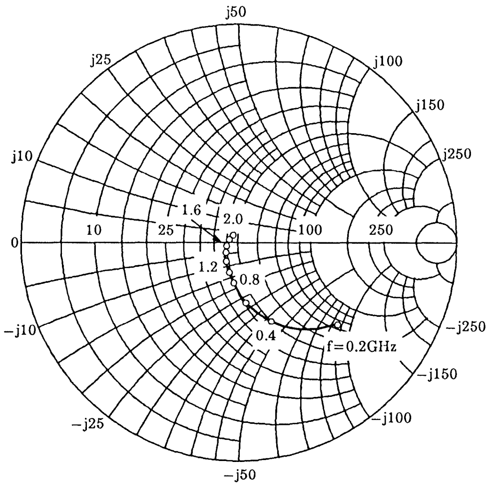
S_{12e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$



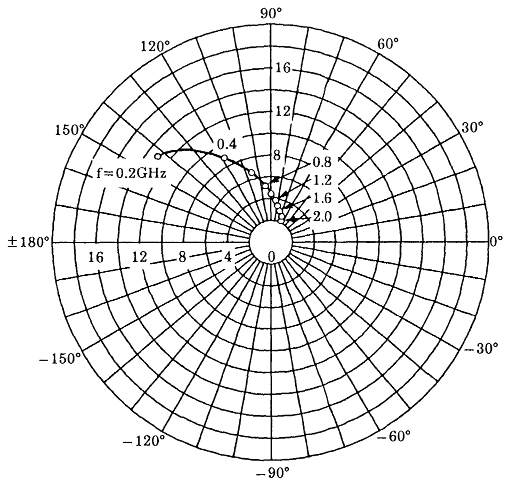
S_{22e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$
(UNIT : Ω)



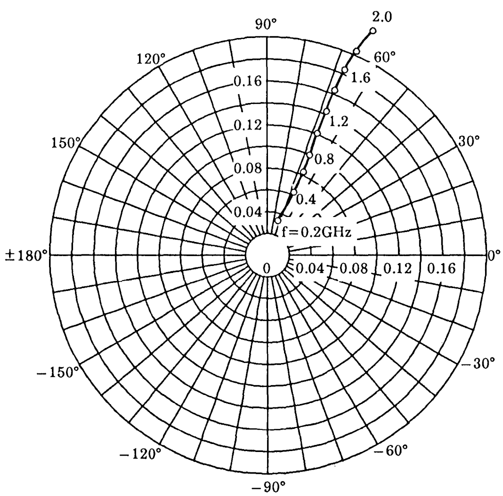
S_{11e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$
(UNIT : Ω)



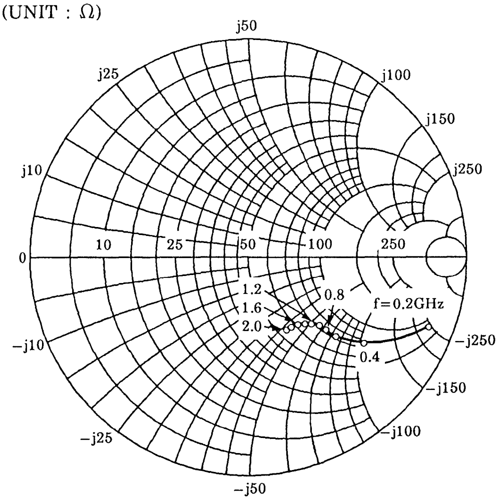
S_{21e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$



S_{12e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$



S_{22e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$
(UNIT : Ω)

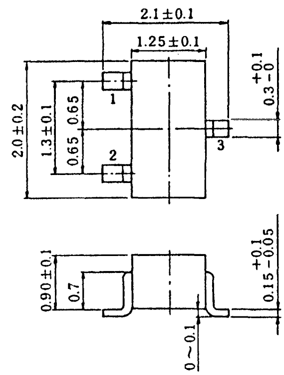


2SC4392 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

UHF~C BAND LOW NOISE AMPLIFIER APPLICATIONS.

Unit in mm

- High Gain : $|S_{21e}|^2 = 12dB$ (Typ.)
- Low Noise Figure : $NF = 2.3dB$ (Typ.)
- High f_T : $f_T = 6.5GHz$ (Typ.)



1. BASE
2. EMITTER
3. COLLECTOR

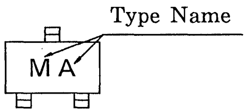
JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1A

Weight : 0.006g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	7	V
Emitter-Base Voltage	V_{EBO}	3	V
Base Current	I_B	10	mA
Collector Current	I_C	30	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Marking



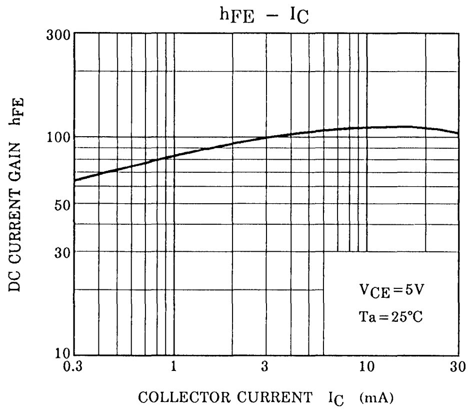
MICROWAVE CHARACTERISTICS (Ta = 25°C)

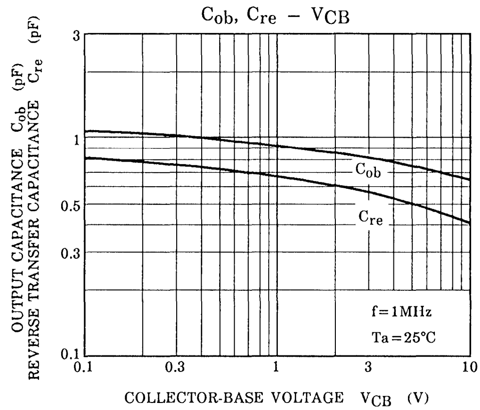
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX	UNIT
Transition Frequency	f_T	$V_{CE} = 5V$, $I_C = 10mA$	—	6.5	—	GHz
Insertion Gain	$\|S_{21e}\|^2$	$V_{CE} = 5V$, $I_C = 10mA$, $f = 1GHz$	—	12	—	dB
Noise Figure	NF	$V_{CE} = 5V$, $I_C = 5mA$, $f = 1GHz$	—	2.3	—	dB

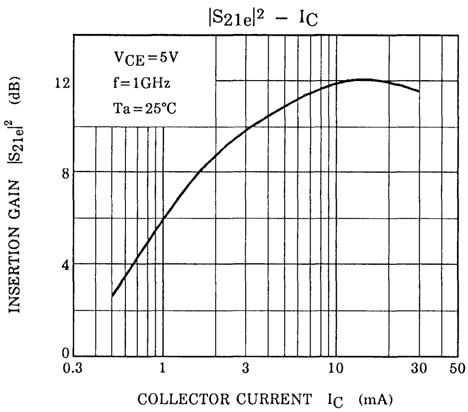
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

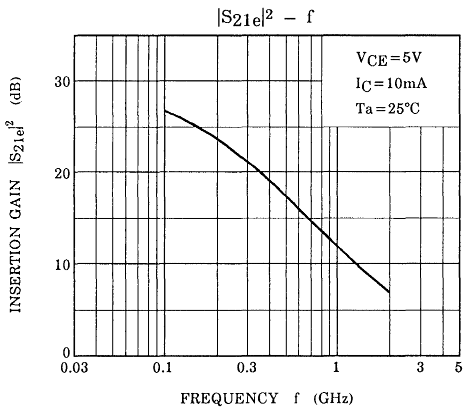
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB} = 10V$, $I_E = 0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB} = 1V$, $I_C = 0$	—	—	1.0	μA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 0.5mA$, $I_B = 0$	7	—	—	V
DC Current Gain	h_{FE}	$V_{CE} = 5V$, $I_C = 10mA$	30	120	—	—
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = 10mA$, $I_B = 1mA$	—	0.1	—	V
Base-Emitter Saturation Voltage	$V_{BE(sat)}$		—	0.87	—	V
Output Capacitance	C_{ob}	$V_{CB} = 5V$, $I_E = 0$,	—	0.7	0.9	pF
Reverse Transfer Capacitance	C_{re}	$f = 1MHz$ (Note)	—	0.5	—	pF
Input Capacitance	C_{ib}	$V_{EB} = 0$, $I_C = 0$, $f = 1MHz$	—	0.8	—	pF

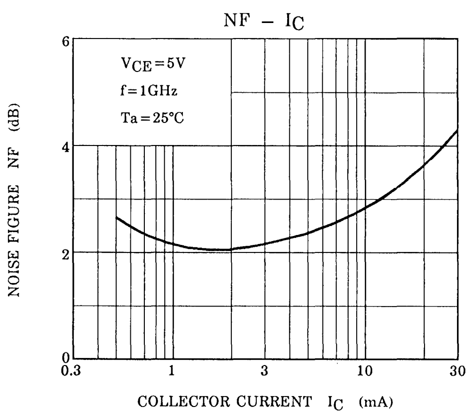
Note : C_{re} is measured by 3 terminal method with capacitance bridge.

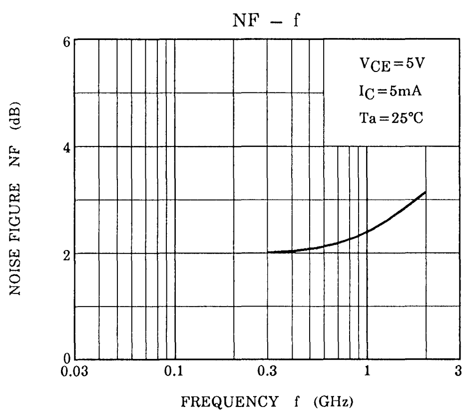

hFE – IC
DC CURRENT GAIN hFE
300
100
50
30
10
0.3
1
3
10
30
VCE=5V
Ta=25°C
COLLECTOR CURRENT IC (mA)


Cob, Cre – VCB
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
3
1
0.5
0.3
0.1
0.1
0.3
1
3
10
Cob
Cre
f=1MHz
Ta=25°C
COLLECTOR-BASE VOLTAGE VCB (V)

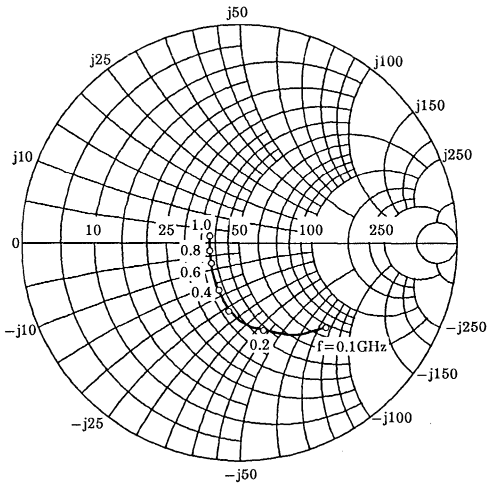

|S21e|2 – IC
INSERTION GAIN |S21e|2 (dB)
12
8
4
0
0.3
1
3
10
30
50
VCE=5V
f=1GHz
Ta=25°C
COLLECTOR CURRENT IC (mA)


|S21e|2 – f
INSERTION GAIN |S21e|2 (dB)
30
20
10
0
0.03
0.1
0.3
1
3
5
VCE=5V
IC=10mA
Ta=25°C
FREQUENCY f (GHz)

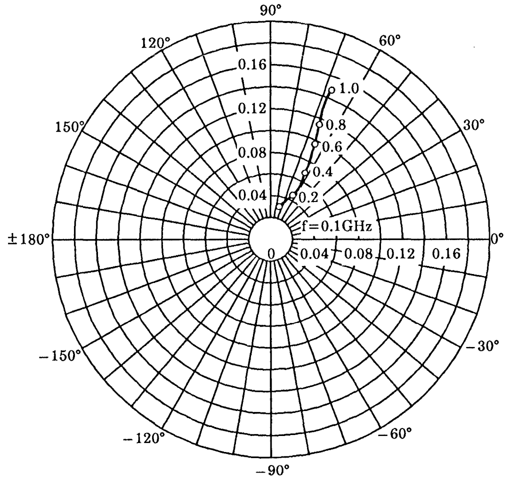

NF – IC
NOISE FIGURE NF (dB)
6
4
2
0
0.3
1
3
10
30
VCE=5V
f=1GHz
Ta=25°C
COLLECTOR CURRENT IC (mA)


NF – f
NOISE FIGURE NF (dB)
6
4
2
0
0.03
0.1
0.3
1
3
VCE=5V
IC=5mA
Ta=25°C
FREQUENCY f (GHz)

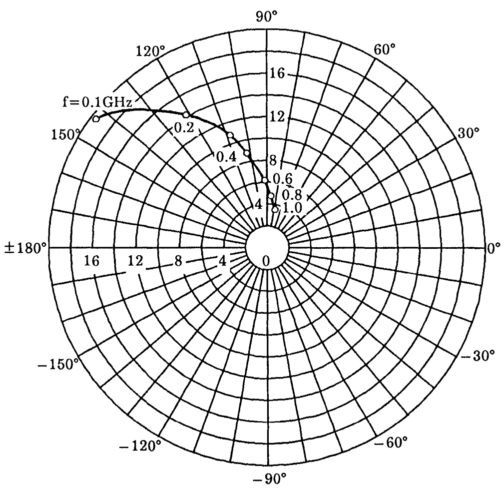
S_{11e}
$V_{CE}=5V$
$I_C=10mA$
Ta=25°C
(UNIT : Ω)



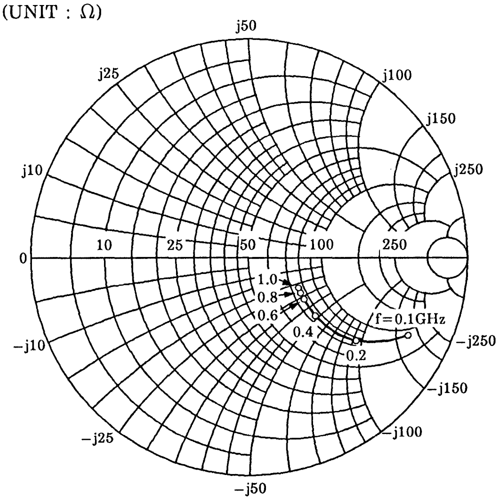
S_{12e}
$V_{CE}=5V$
$I_C=10mA$
Ta=25°C



S_{21e}
$V_{CE}=5V$
$I_C=10mA$
Ta=25°C



S_{22e}
$V_{CE}=5V$
$I_C=10mA$
Ta=25°C
(UNIT : Ω)

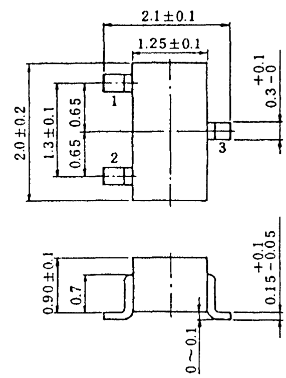


SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC4393

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1A

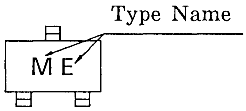
Weight : 0.006g

- Low Noise Figure.
- NF = 1.5dB, $|S_{21e}|^2$ = 16dB (f = 500MHz)
- NF = 1.7dB, $|S_{21e}|^2$ = 10.5dB (f = 1000MHz)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	17	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	70	mA
Base Current	I_B	30	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Marking



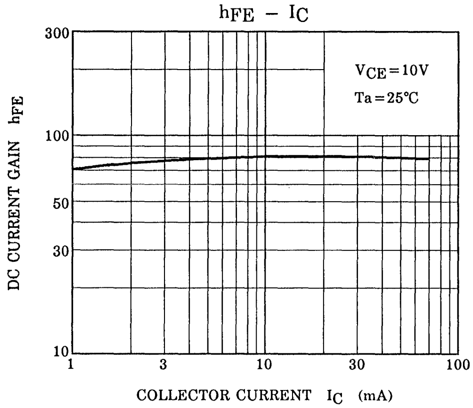
MICROWAVE CHARACTERISTICS (Ta = 25°C)

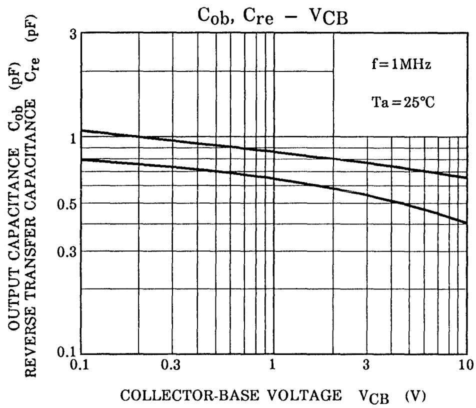
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 10V, I_C = 20mA	—	5	—	GHz
Insertion Gain	$\lvert S_{21e}\rvert^2$ (1)	V_{CE} = 10V, I_C = 20mA, f = 500MHz	—	16	—	dB
	$\lvert S_{21e}\rvert^2$ (2)	V_{CE} = 10V, I_C = 20mA, f = 1GHz	—	10.5	—	
Noise Figure	NF (1)	V_{CE} = 10V, I_C = 5mA, f = 500MHz	—	1.5	—	dB
	NF (2)	V_{CE} = 10V, I_C = 5mA, f = 1GHz	—	1.7	—	

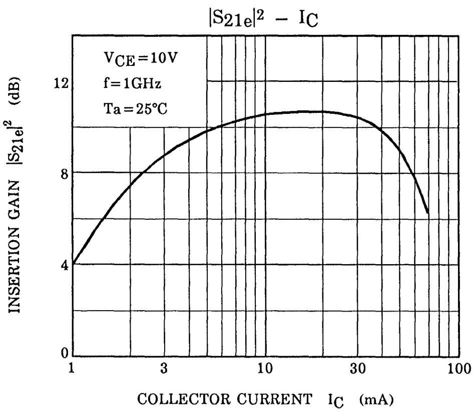
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

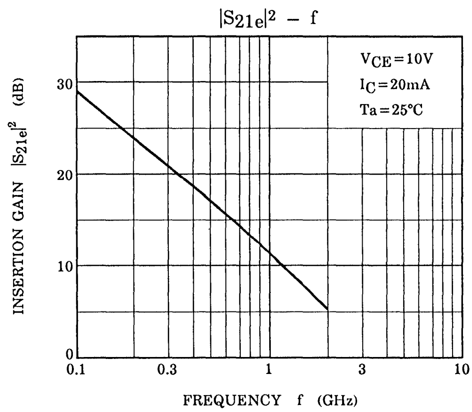
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_C = 0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE} = 10V, I_C = 20mA	25	—	—	—
Output Capacitance	C_{ob}	V_{CB} = 10V, I_E = 0, f = 1MHz	—	0.85	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.57	—	pF

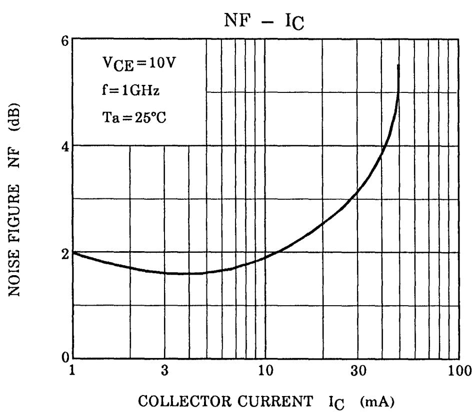
Note : C_{re} is measured by 3 terminal method with capacitance bridge.

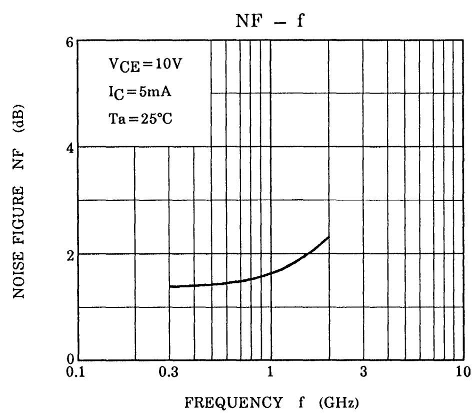

hFE − IC
VCE=10V
Ta=25°C
DC CURRENT GAIN hFE
300
100
50
30
10
1
3
10
30
100
COLLECTOR CURRENT IC (mA)


Cob, Cre − VCB
f=1MHz
Ta=25°C
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
3
1
0.5
0.3
0.1
0.1
0.3
1
3
10
COLLECTOR-BASE VOLTAGE VCB (V)

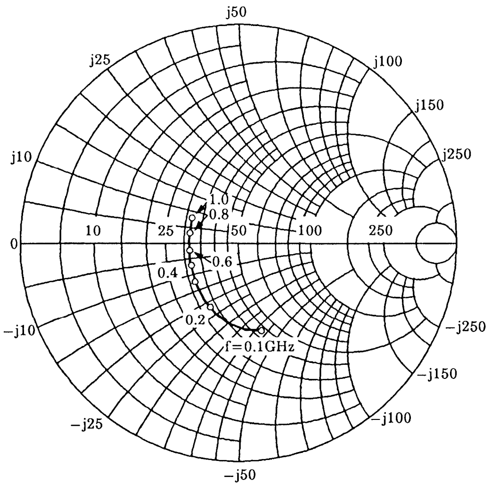

|S21e|2 − IC
VCE=10V
f=1GHz
Ta=25°C
INSERTION GAIN |S21e|2 (dB)
12
8
4
0
1
3
10
30
100
COLLECTOR CURRENT IC (mA)


|S21e|2 − f
VCE=10V
IC=20mA
Ta=25°C
INSERTION GAIN |S21e|2 (dB)
30
20
10
0
0.1
0.3
1
3
10
FREQUENCY f (GHz)

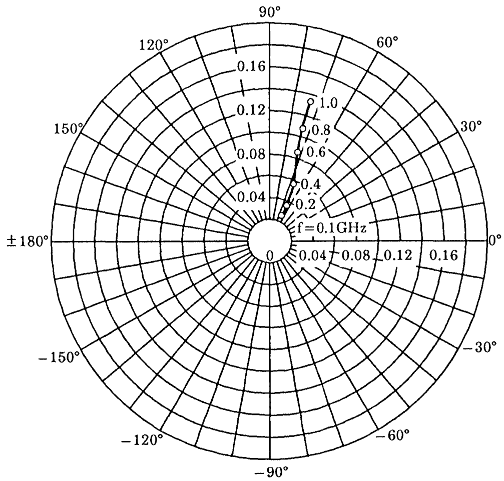

NF − IC
VCE=10V
f=1GHz
Ta=25°C
NOISE FIGURE NF (dB)
6
4
2
0
1
3
10
30
100
COLLECTOR CURRENT IC (mA)


NF − f
VCE=10V
IC=5mA
Ta=25°C
NOISE FIGURE NF (dB)
6
4
2
0
0.1
0.3
1
3
10
FREQUENCY f (GHz)

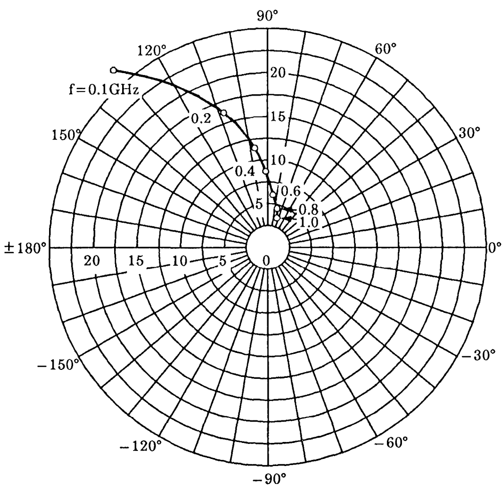
S_{11e}
$V_{CE} = 10V$
$I_C = 20mA$
$Ta = 25°C$
(UNIT : Ω)



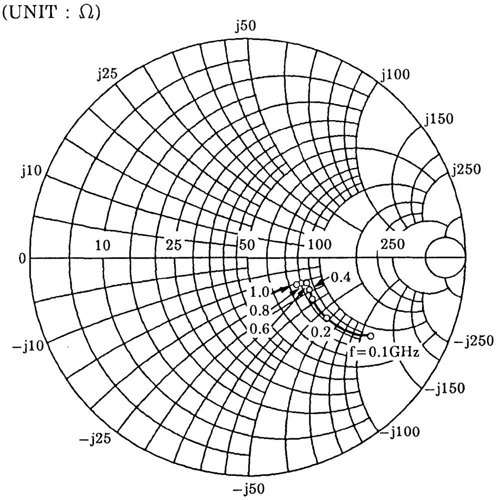
S_{12e}
$V_{CE} = 10V$
$I_C = 20mA$
$Ta = 25°C$



S_{21e}
$V_{CE} = 10V$
$I_C = 20mA$
$Ta = 25°C$



S_{22e}
$V_{CE} = 10V$
$I_C = 20mA$
$Ta = 25°C$
(UNIT : Ω)

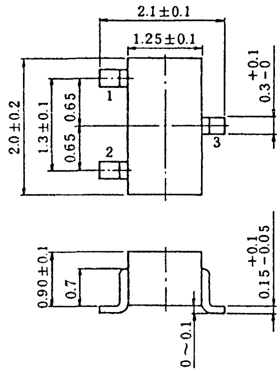


2SC4394 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure, High Cain.
- NF=1.1dB, $|S_{21e}|^2$=11dB (f=1GHz)

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

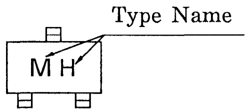
JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1A

Weight : 0.006g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	80	mA
Base Current	I_B	40	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Marking



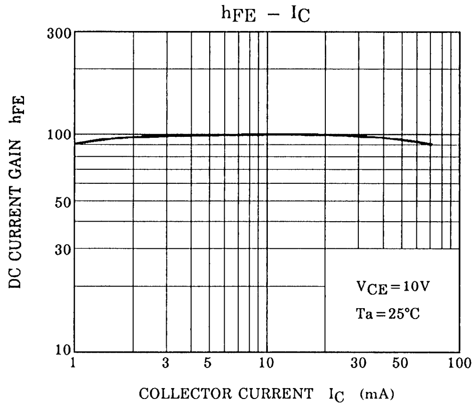
MICROWAVE CHARACTERISTICS (Ta = 25°C)

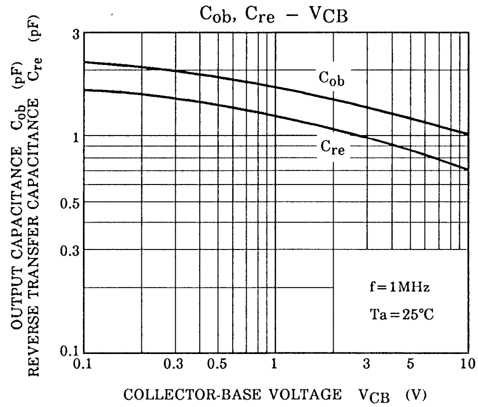
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE}=10V, I_C=20mA	5	7	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE}=10V, I_C=20mA, f=500MHz	—	16.5	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE}=10V, I_C=20mA, f=1GHz	7.5	11	—	
Noise Figure	NF (1)	V_{CE}=10V, I_C=5mA, f=500MHz	—	1	—	dB
	NF (2)	V_{CE}=10V, I_C=5mA, f=1GHz	—	1.1	2	

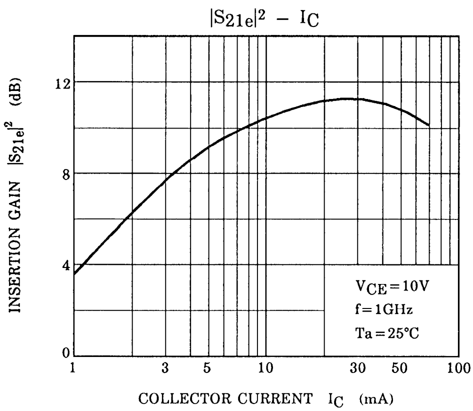
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

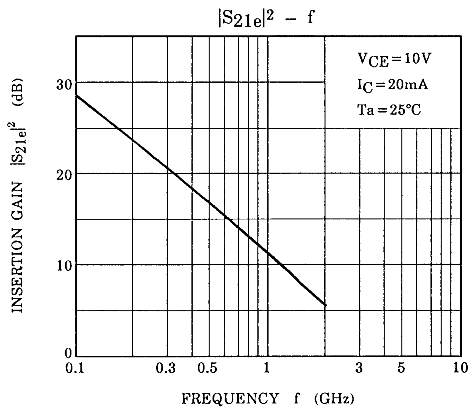
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB}=10V, I_E=0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB}=1V, I_C=0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE}=10V, I_C=20mA	30	—	250	—
Output Capacitance	C_{ob}	V_{CB}=10V, I_E=0, f=1MHz	—	1.0	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.7	1.15	pF

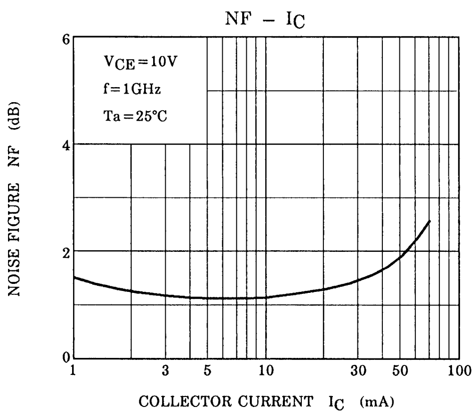
Note : C_{re} is measured by 3 terminal method with capacitance bridge.

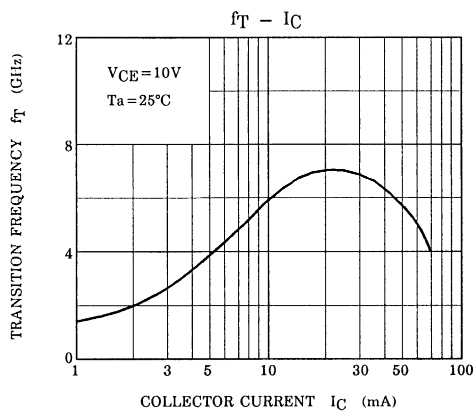

h_{FE} – I_C
DC CURRENT GAIN h_{FE}
300
100
50
30
10
1
3
5
10
30
50
100
COLLECTOR CURRENT I_C (mA)
V_{CE}=10V
Ta=25°C

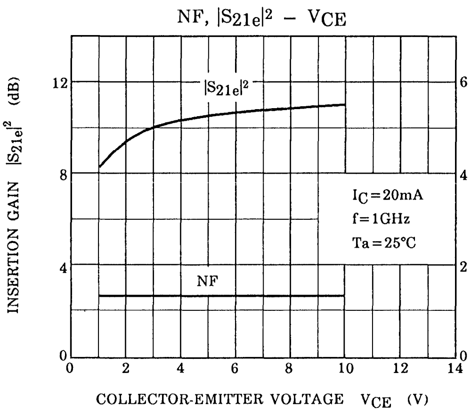

C_{ob}, C_{re} – V_{CB}
OUTPUT CAPACITANCE C_{ob} (pF)
REVERSE TRANSFER CAPACITANCE C_{re} (pF)
3
1
0.5
0.3
0.1
0.1
0.3
0.5
1
3
5
10
COLLECTOR-BASE VOLTAGE V_{CB} (V)
C_{ob}
C_{re}
f=1MHz
Ta=25°C

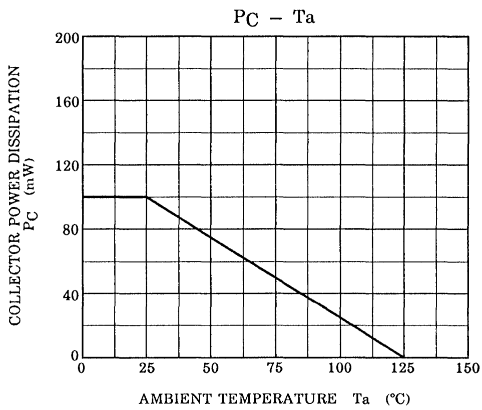

$|S_{21e}|^2$ – I_C
INSERTION GAIN $|S_{21e}|^2$ (dB)
12
8
4
0
1
3
5
10
30
50
100
COLLECTOR CURRENT I_C (mA)
V_{CE}=10V
f=1GHz
Ta=25°C


$|S_{21e}|^2$ – f
INSERTION GAIN $|S_{21e}|^2$ (dB)
30
20
10
0
0.1
0.3
0.5
1
3
5
10
FREQUENCY f (GHz)
V_{CE}=10V
I_C=20mA
Ta=25°C

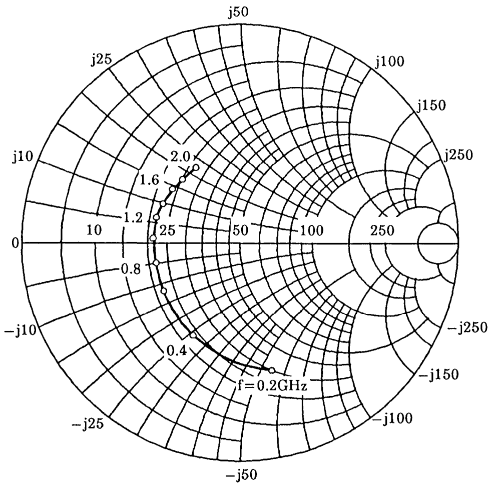

NF – I_C
NOISE FIGURE NF (dB)
6
4
2
0
1
3
5
10
30
50
100
COLLECTOR CURRENT I_C (mA)
V_{CE}=10V
f=1GHz
Ta=25°C


f_T – I_C
TRANSITION FREQUENCY f_T (GHz)
12
8
4
0
1
3
5
10
30
50
100
COLLECTOR CURRENT I_C (mA)
V_{CE}=10V
Ta=25°C

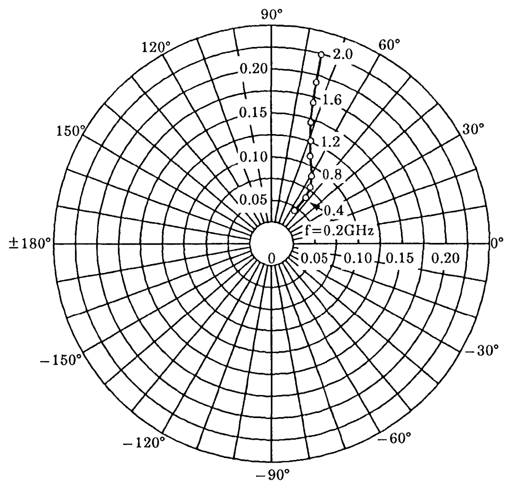

NF, $|S_{21e}|^2$ – V_{CE}
INSERTION GAIN $|S_{21e}|^2$ (dB)
NOISE FIGURE NF (dB)
$|S_{21e}|^2$
NF
I_C=20mA
f=1GHz
Ta=25°C
0
4
8
12
0
2
4
6
0
2
4
6
8
10
12
14
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)


P_C – Ta
COLLECTOR POWER DISSIPATION P_C (mW)
0
40
80
120
160
200
0
25
50
75
100
125
150
AMBIENT TEMPERATURE Ta (°C)

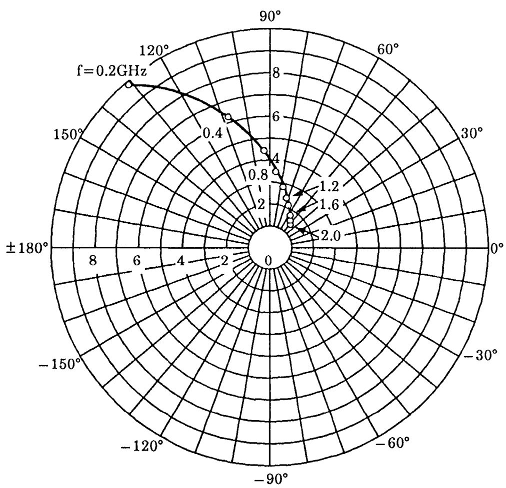
S11e
$V_{CE}=10V$
$I_C=5mA$
Ta=25°C
(UNIT : Ω)



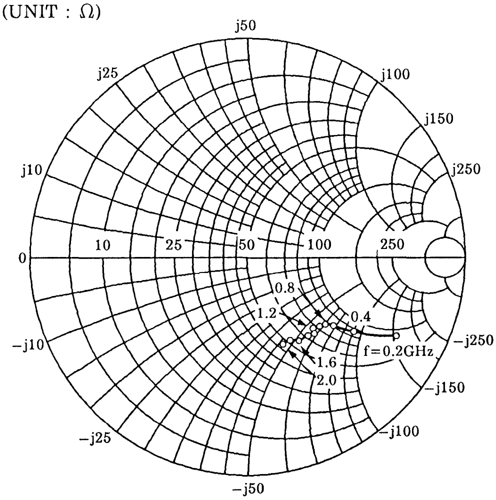
S12e
$V_{CE}=10V$
$I_C=5mA$
Ta=25°C



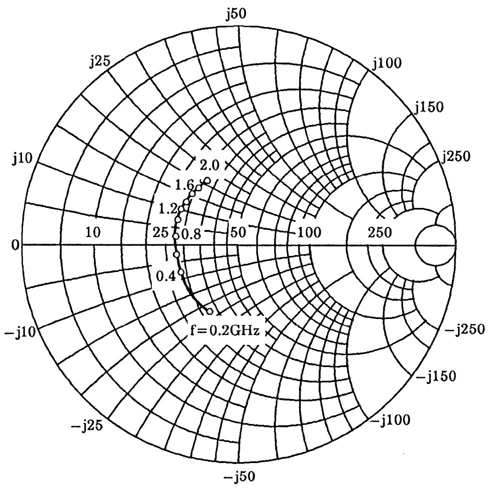
S21e
$V_{CE}=10V$
$I_C=5mA$
Ta=25°C



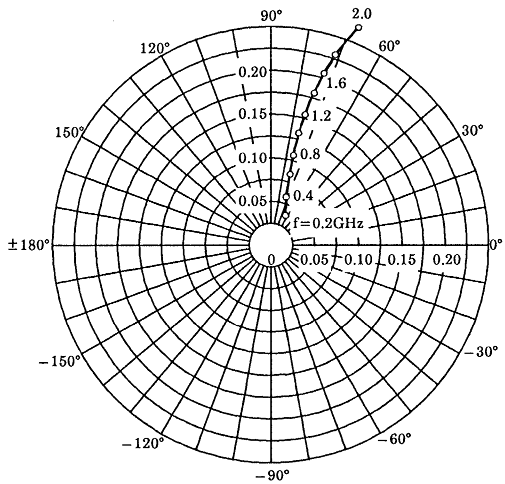
S22e
$V_{CE}=10V$
$I_C=5mA$
Ta=25°C
(UNIT : Ω)



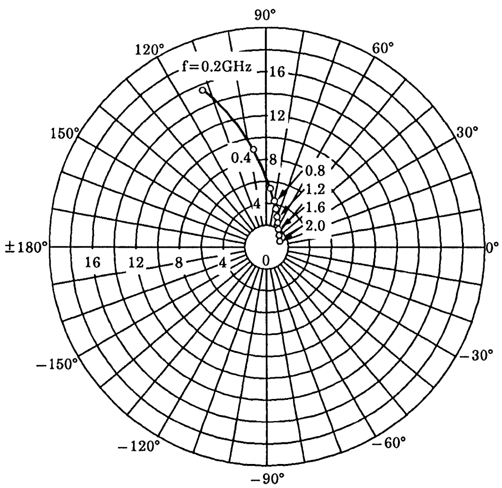
S_{11e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)



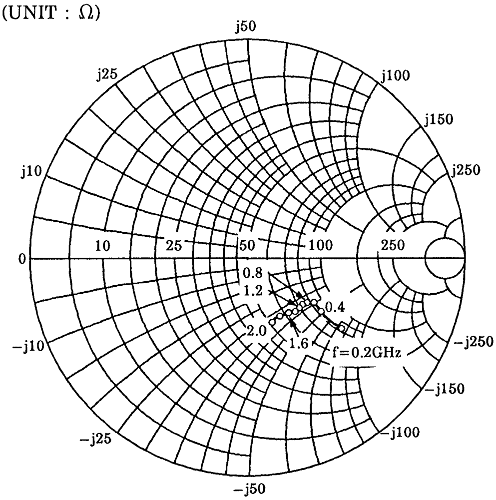
S_{12e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$



S_{21e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$



S_{22e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)



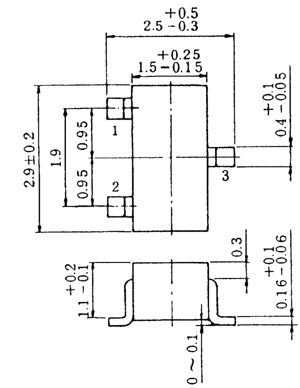
SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC4470

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure, High Gain.
- $NF = 1.1dB$, $|S_{21e}|^2 = 11dB$ (f=1GHz)

Unit in mm



1. EMITTER
2. BASE
3. COLLECTOR

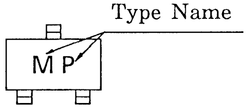
JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1D

Weight : 0.012g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	80	mA
Base Current	I_B	40	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Marking



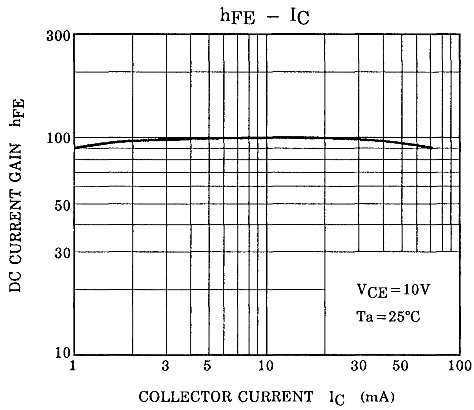
MICROWAVE CHARACTERISTICS (Ta = 25°C)

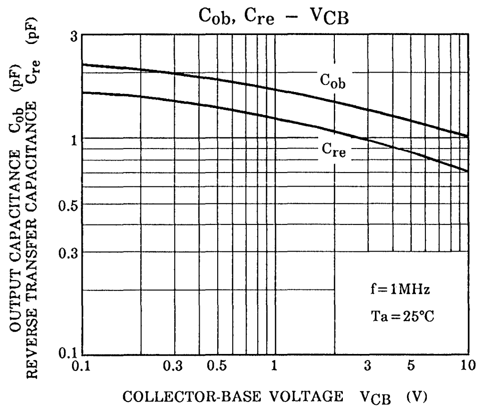
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	$V_{CE} = 10V$, $I_C = 20mA$	5	7	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	$V_{CE} = 10V$, $I_C = 20mA$, f=500MHz	—	16.5	—	dB
	$\|S_{21e}\|^2$ (2)	$V_{CE} = 10V$, $I_C = 20mA$, f=1GHz	7.5	11	—	
Noise Figure	NF (1)	$V_{CE} = 10V$, $I_C = 5mA$, f=500MHz	—	1	—	dB
	NF (2)	$V_{CE} = 10V$, $I_C = 5mA$, f=1GHz	—	1.1	2	

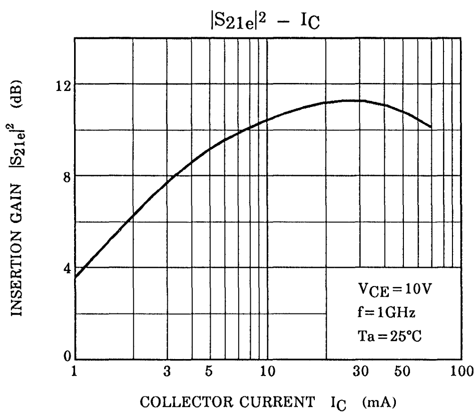
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

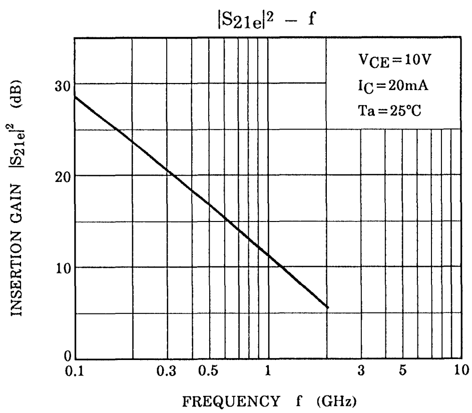
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB} = 10V$, $I_E = 0$	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB} = 1V$, $I_C = 0$	—	—	1	μA
DC Current Gain	h_{FE}	$V_{CE} = 10V$, $I_C = 20mA$	30	—	250	—
Output Capacitance	C_{ob}	$V_{CB} = 10V$, $I_E = 0$, f=1MHz	—	1.0	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.7	1.15	pF

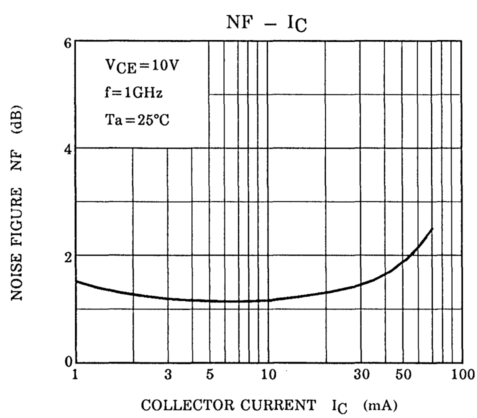
Note : C_{re} is measured by 3 terminal method with capacitance bridge.

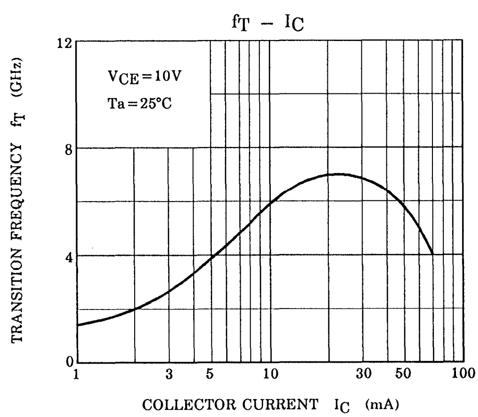

hFE – IC
DC CURRENT GAIN hFE
300
100
50
30
10
1
3
5
10
30
50
100
VCE=10V
Ta=25°C
COLLECTOR CURRENT IC (mA)

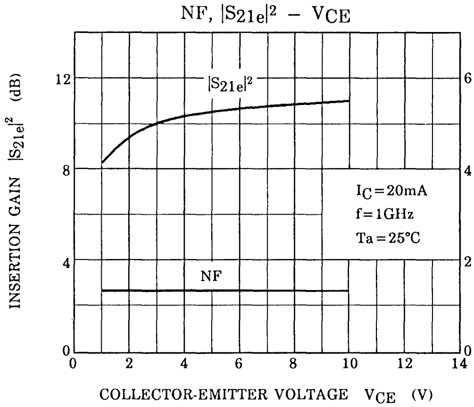

Cob, Cre – VCB
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
3
1
0.5
0.3
0.1
0.1
0.3
0.5
1
3
5
10
Cob
Cre
f=1MHz
Ta=25°C
COLLECTOR-BASE VOLTAGE VCB (V)

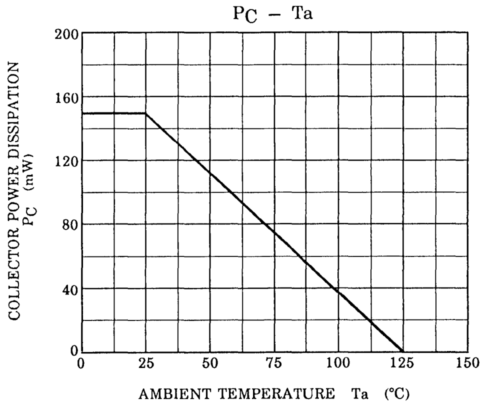

|S21e|2 – IC
INSERTION GAIN |S21e|2 (dB)
12
8
4
0
1
3
5
10
30
50
100
VCE=10V
f=1GHz
Ta=25°C
COLLECTOR CURRENT IC (mA)


|S21e|2 – f
INSERTION GAIN |S21e|2 (dB)
30
20
10
0
0.1
0.3
0.5
1
3
5
10
VCE=10V
IC=20mA
Ta=25°C
FREQUENCY f (GHz)

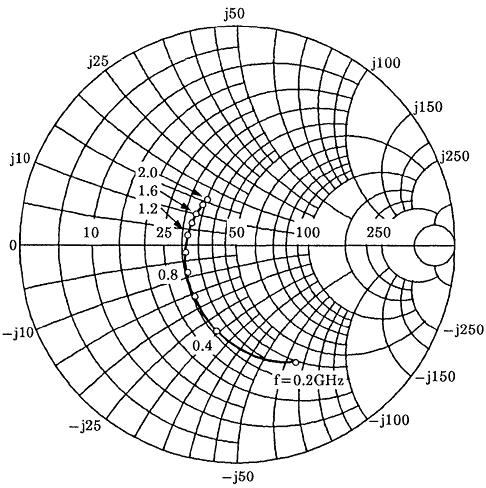

NF – IC
NOISE FIGURE NF (dB)
6
4
2
0
1
3
5
10
30
50
100
VCE=10V
f=1GHz
Ta=25°C
COLLECTOR CURRENT IC (mA)


fT – IC
TRANSITION FREQUENCY fT (GHz)
12
8
4
0
1
3
5
10
30
50
100
VCE=10V
Ta=25°C
COLLECTOR CURRENT IC (mA)

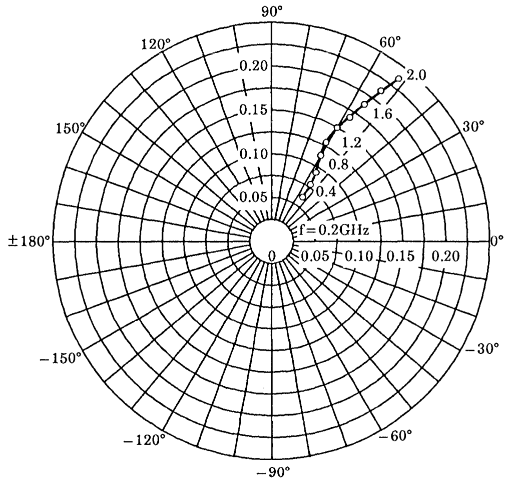

NF, |S21e|² − VCE
INSERTION GAIN |S21e|² (dB)
NOISE FIGURE NF (dB)
|S21e|²
NF
IC = 20mA
f = 1GHz
Ta = 25°C
0
2
4
6
8
10
12
14
COLLECTOR-EMITTER VOLTAGE VCE (V)


PC − Ta
COLLECTOR POWER DISSIPATION PC (mW)
200
160
120
80
40
0
25
50
75
100
125
150
AMBIENT TEMPERATURE Ta (°C)

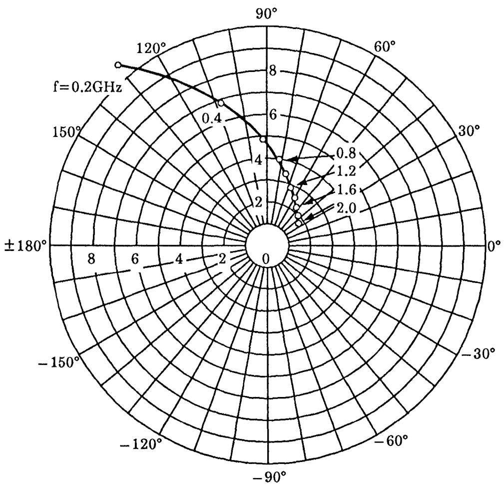
S_{11e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



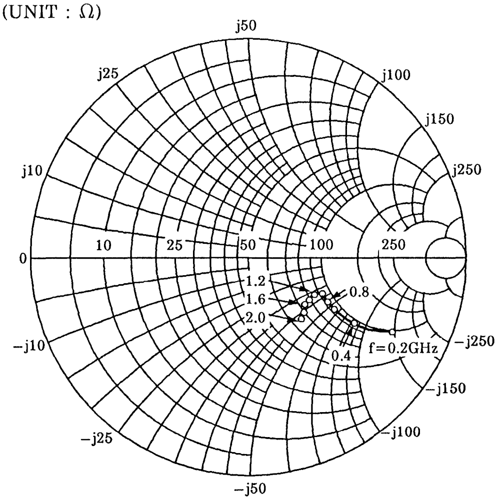
S_{12e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$



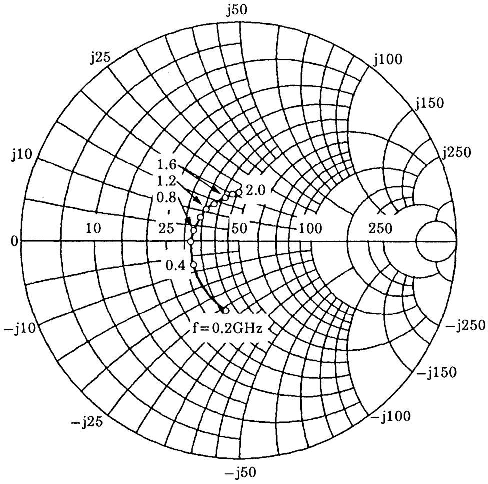
S_{21e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$



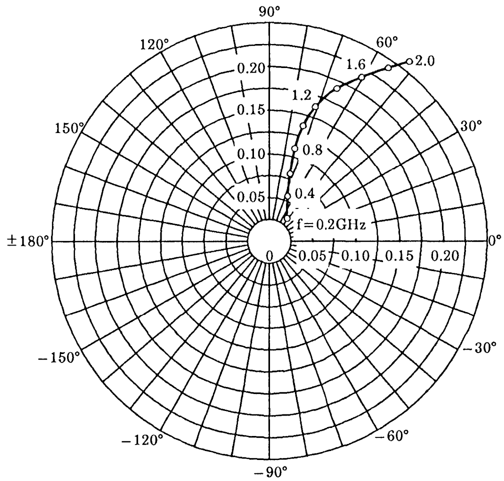
S_{22e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



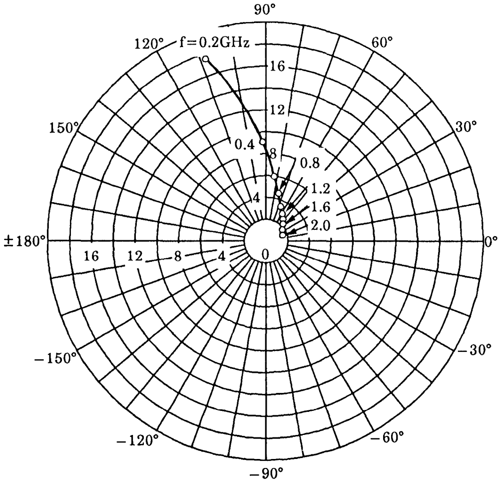
S_{11e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)



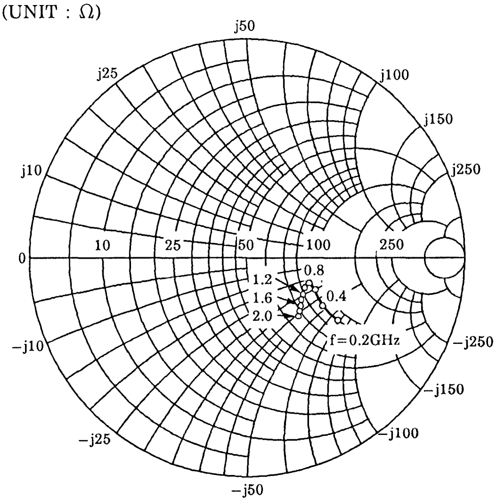
S_{12e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$



S_{21e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$



S_{22e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)

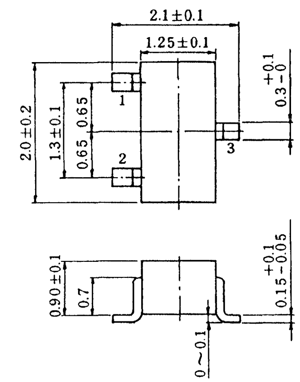


2SC4527 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

TV TUNER, UHF OSCILLATOR APPLICATIONS. (COMMON BASE)
TV TUNER, UHF CONVERTER APPLICATIONS. (COMMON BASE)

- Transition Frequency is High and Dependent on Current Excellently.
- Exchange of Emitter for Base in 2SC4246.

Unit in mm



1. EMITTER
2. BASE
3. COLLECTOR

JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1D

Weight : 0.006g

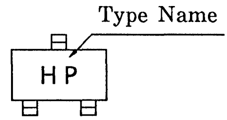
MAXIMUM RATINGS ($Ta = 25°C$)

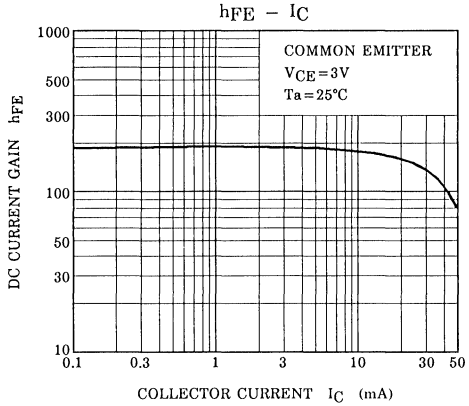
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	15	V
Emitter-Base Voltage	V_{EBO}	3	V
Base Current	I_B	25	mA
Collector Current	I_C	50	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

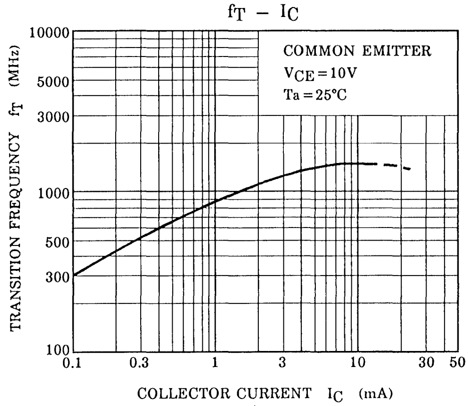
ELECTRICAL CHARACTERISTICS ($Ta = 25°C$)

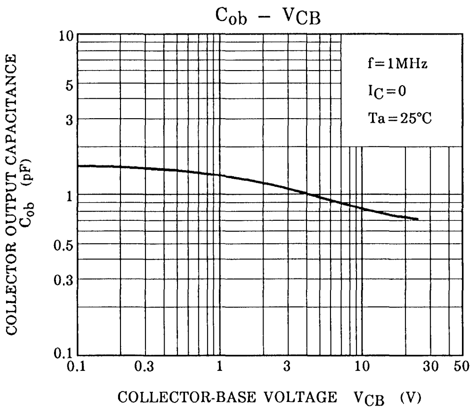
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=15V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=3V$, $I_C=0$	—	—	1.0	μA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA$, $I_B=0$	15	—	—	V
DC Current Gain	h_{FE}	$V_{CE}=3V$, $I_C=8mA$	60	150	320	—
Transition Frequency	f_T	$V_{CE}=10V$, $I_C=8mA$	1100	1500	—	MHz
Output Capacitance	C_{ob}	$V_{CB}=10V$, $I_E=0$, $f=1MHz$	—	0.9	1.3	pF
Collector-Base Time Constant	$C_c \cdot r_{bb'}$	$V_{CB}=10V$, $I_C=8mA$, $f=30MHz$	—	7	12	ps

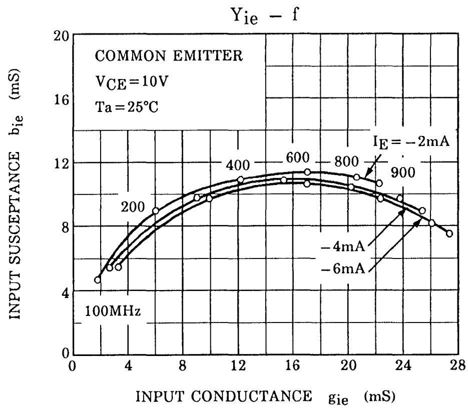
Marking

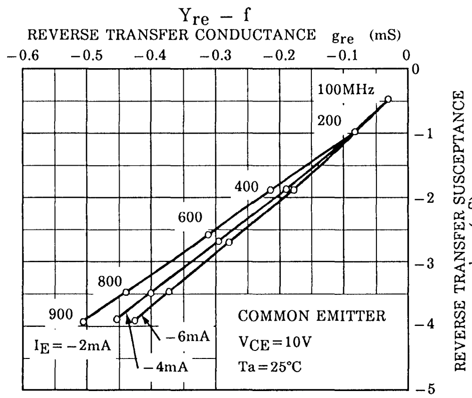


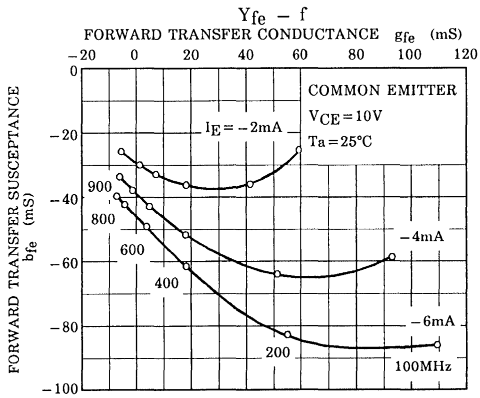

hFE – IC
COMMON EMITTER
VCE=3V
Ta=25°C
DC CURRENT GAIN hFE
COLLECTOR CURRENT IC (mA)

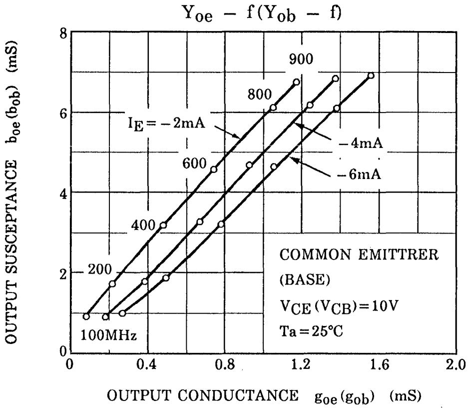

fT – IC
COMMON EMITTER
VCE=10V
Ta=25°C
TRANSITION FREQUENCY fT (MHz)
COLLECTOR CURRENT IC (mA)

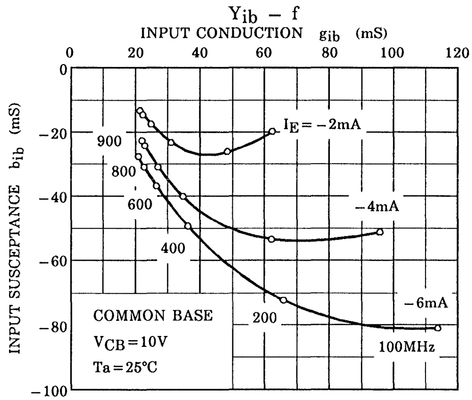

Cob – VCB
f=1MHz
IC=0
Ta=25°C
COLLECTOR OUTPUT CAPACITANCE Cob (pF)
COLLECTOR-BASE VOLTAGE VCB (V)

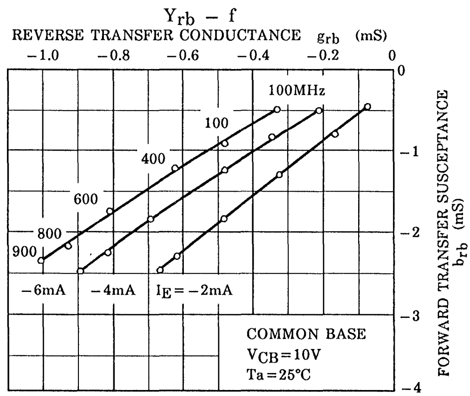

Yie – f
COMMON EMITTER
VCE=10V
Ta=25°C
IE=–2mA
–4mA
–6mA
100MHz
200
400
600
800
900
INPUT SUSCEPTANCE bie (mS)
INPUT CONDUCTANCE gie (mS)

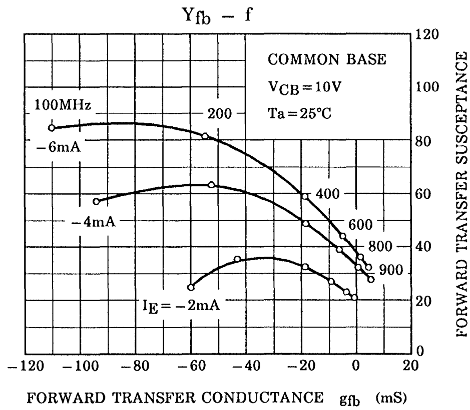

Yre – f
REVERSE TRANSFER CONDUCTANCE gre (mS)
100MHz
200
400
600
800
900
IE=–2mA
–4mA
–6mA
COMMON EMITTER
VCE=10V
Ta=25°C
REVERSE TRANSFER SUSCEPTANCE bre (mS)

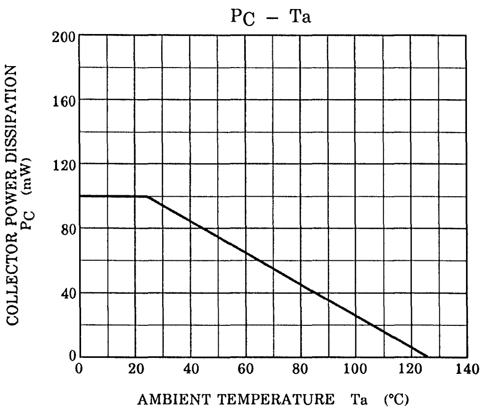

Yfe – f
FORWARD TRANSFER CONDUCTANCE gfe (mS)
COMMON EMITTER
VCE=10V
Ta=25°C
IE=–2mA
–4mA
–6mA
900
800
600
400
200
100MHz
FORWARD TRANSFER SUSCEPTANCE bfe (mS)


Yoe – f(Yob – f)
OUTPUT SUSCEPTANCE boe(bob) (mS)
OUTPUT CONDUCTANCE goe(gob) (mS)
IE = –2mA
–4mA
–6mA
100MHz
200
400
600
800
900
COMMON EMITTRER
(BASE)
VCE (VCB) = 10V
Ta = 25°C


Yib – f
INPUT CONDUCTION gib (mS)
INPUT SUSCEPTANCE bib (mS)
IE = –2mA
–4mA
–6mA
900
800
600
400
200
100MHz
COMMON BASE
VCB = 10V
Ta = 25°C


Yrb – f
REVERSE TRANSFER CONDUCTANCE grb (mS)
FORWARD TRANSFER SUSCEPTANCE brb (mS)
100MHz
100
400
600
800
900
–6mA
–4mA
IE = –2mA
COMMON BASE
VCB = 10V
Ta = 25°C


Yfb – f
COMMON BASE
VCB = 10V
Ta = 25°C
100MHz
200
–6mA
400
–4mA
600
800
900
IE = –2mA
FORWARD TRANSFER SUSCEPTANCE bfb (mS)
FORWARD TRANSFER CONDUCTANCE gfb (mS)


PC – Ta
COLLECTOR POWER DISSIPATION PC (mW)
AMBIENT TEMPERATURE Ta (°C)

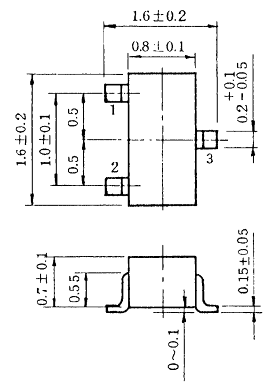
SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC4839

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

Unit in mm

- Low Noise Figure, High Gain.
- $NF = 1.1dB$, $|S_{21e}|^2 = 12dB$ (f = 1GHz)



1. BASE
2. EMITTER
3. COLLECTOR

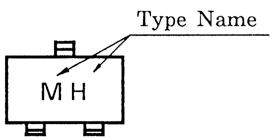
JEDEC	—
EIAJ	—
TOSHIBA	2-2H1A

Weight : 2.4mg

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	80	mA
Base Current	I_B	40	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Marking



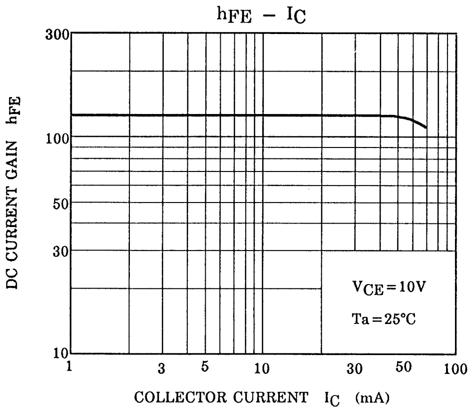
MICROWAVE CHARACTERISTICS (Ta = 25°C)

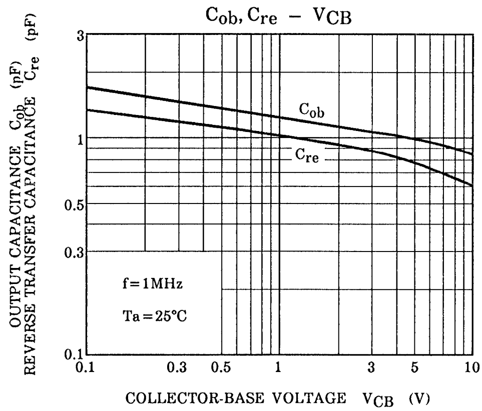
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	$V_{CE} = 10V$, $I_C = 20mA$	5	7	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	$V_{CE} = 10V$, $I_C = 20mA$, f = 500MHz	—	18	—	dB
	$\|S_{21e}\|^2$ (2)	$V_{CE} = 10V$, $I_C = 20mA$, f = 1GHz	7.5	12	—	
Noise Figure	NF (1)	$V_{CE} = 10V$, $I_C = 5mA$, f = 500MHz	—	1	—	dB
	NF (2)	$V_{CE} = 10V$, $I_C = 5mA$, f = 1GHz	—	1.1	2	

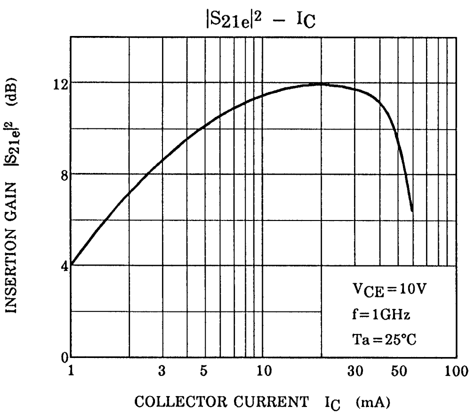
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

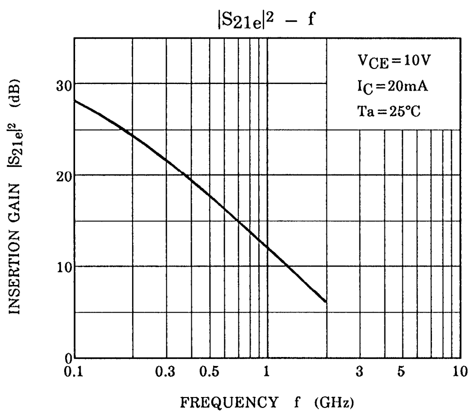
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB} = 10V$, $I_E = 0$	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB} = 1V$, $I_C = 0$	—	—	1	μA
DC Current Gain	h_{FE}	$V_{CE} = 10V$, $I_C = 20mA$	30	—	250	—
Output Capacitance	C_{ob}	$V_{CB} = 10V$, $I_E = 0$, f = 1MHz	—	0.85	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.6	1.15	pF

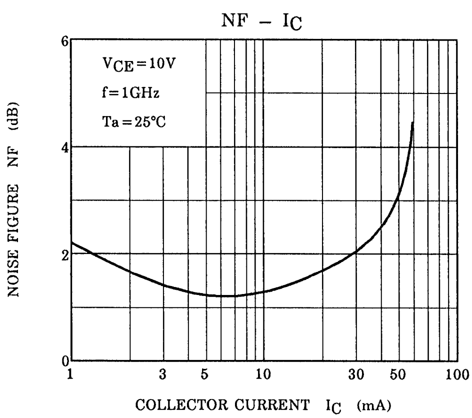
Note : C_{re} is measured by 3 terminal method with capacitance bridge.

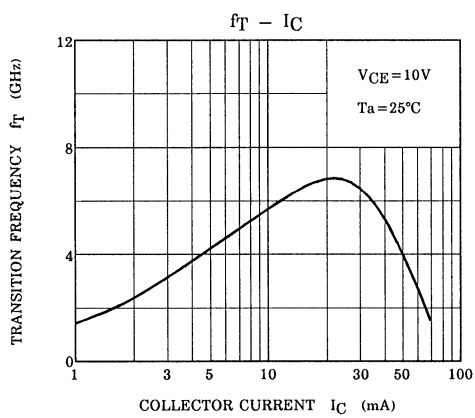

hFE – IC
DC CURRENT GAIN hFE
300
100
50
30
10
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)
VCE = 10V
Ta = 25°C

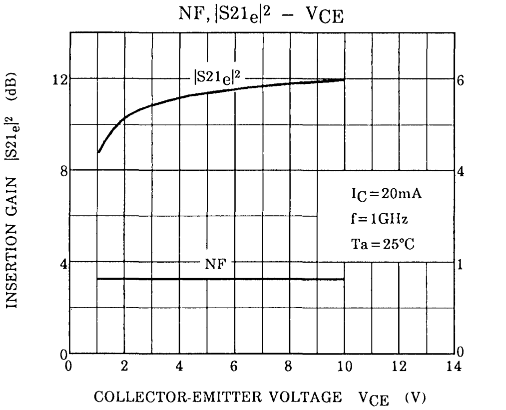

Cob, Cre – VCB
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
3
1
0.5
0.3
0.1
0.1
0.3
0.5
1
3
5
10
COLLECTOR-BASE VOLTAGE VCB (V)
Cob
Cre
f = 1MHz
Ta = 25°C

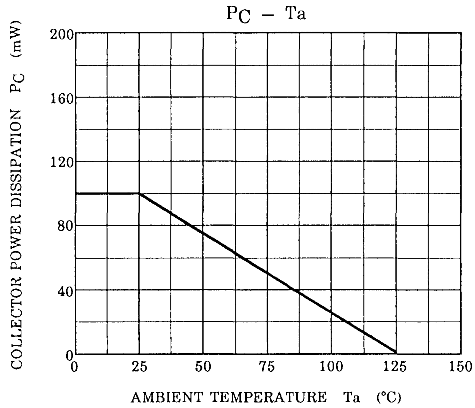

|S21e|2 – IC
INSERTION GAIN |S21e|2 (dB)
12
8
4
0
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)
VCE = 10V
f = 1GHz
Ta = 25°C


|S21e|2 – f
INSERTION GAIN |S21e|2 (dB)
30
20
10
0
0.1
0.3
0.5
1
3
5
10
FREQUENCY f (GHz)
VCE = 10V
IC = 20mA
Ta = 25°C


NF – IC
NOISE FIGURE NF (dB)
6
4
2
0
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)
VCE = 10V
f = 1GHz
Ta = 25°C


fT – IC
TRANSITION FREQUENCY fT (GHz)
12
8
4
0
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)
VCE = 10V
Ta = 25°C





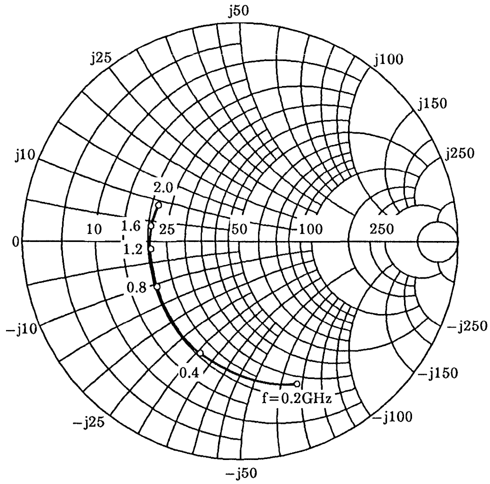
S-PARAMETER $Z_O = 50\Omega$, Ta = 25°C
$V_{CE} = 10V$, $I_C = 5mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.705	−67.0	9.702	132.700	0.048	57.9	0.769	−27.9
400	0.536	−109.6	6.665	109.300	0.066	50.8	0.591	−34.7
600	0.467	−135.0	4.880	96.100	0.077	52.3	0.518	−36.9
800	0.440	−151.6	3.799	87.500	0.088	56.2	0.486	−39.0
1000	0.426	−164.9	3.136	80.600	0.100	60.3	0.475	−41..5
1200	0.417	−175.0	2.668	75.000	0.113	64.2	0.469	−44.5
1400	0.412	176.5	2.349	69.800	0.129	67.6	0.469	−47.8
1600	0.405	169.0	2.099	65.100	0.147	70.4	0.470	−51.2
1800	0.399	162.8	1.916	61.100	0.168	72.2	0.474	−54.1
2000	0.393	157.9	1.777	56.900	0.190	73.5	0.474	−57.8

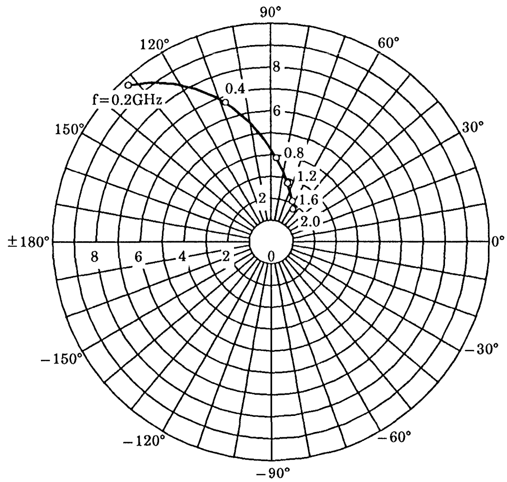
$V_{CE} = 10V$, $I_C = 20mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.416	−111.00	16.818	111.100	0.032	61.30	0.504	−36.4
400	0.352	−145.90	9.121	95.900	0.051	67.10	0.382	−34.9
600	0.343	−163.20	6.289	87.800	0.070	70.90	0.352	−34.7
800	0.341	−174.70	4.772	81.800	0.090	72.80	0.342	−36.3
1000	0.341	−175.50	3.903	76.400	0.111	73.70	0.341	−39.2
1200	0.338	167.80	3.294	72.300	0.132	73.90	0.346	−41.9
1400	0.333	160.90	2.898	67.800	0.154	73.90	0.349	−45.8
1600	0.325	154.60	2.563	63.800	0.176	73.60	0.355	−49.0
1800	0.314	150.30	2.322	60.300	0.200	72.90	0.361	−51.9
2000	0.301	147.30	2.132	56.600	0.223	72.10	0.363	−55.0

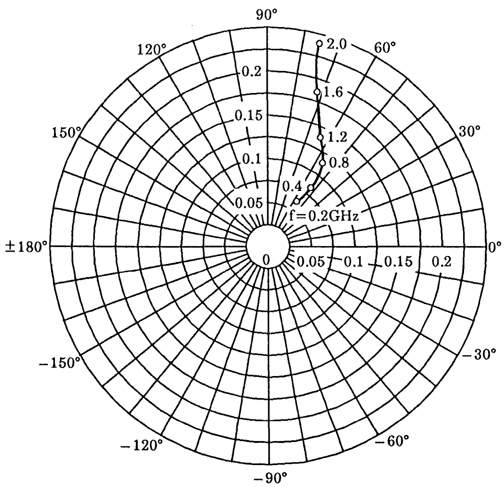
S_{11e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



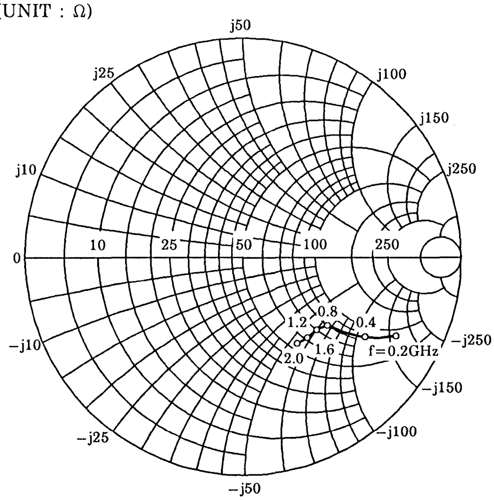
S_{21e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$



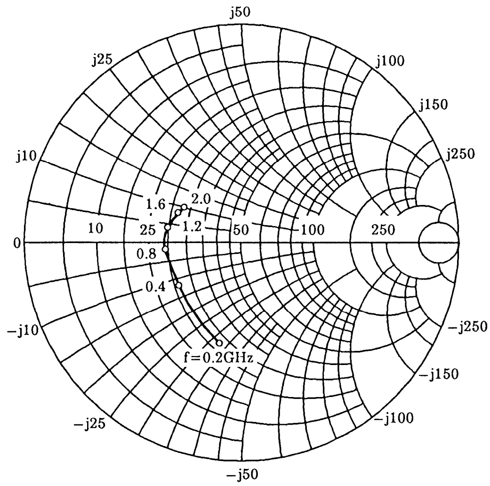
S_{12e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$



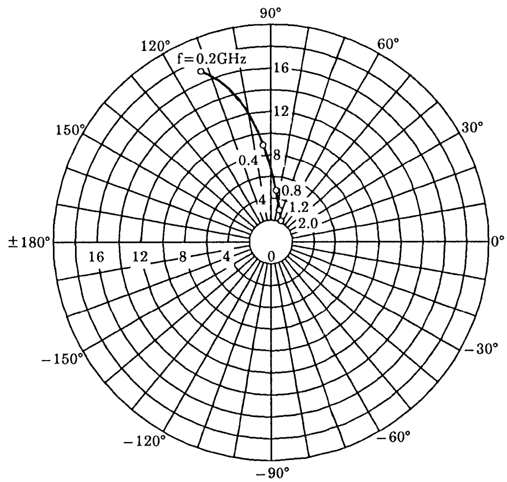
S_{22e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



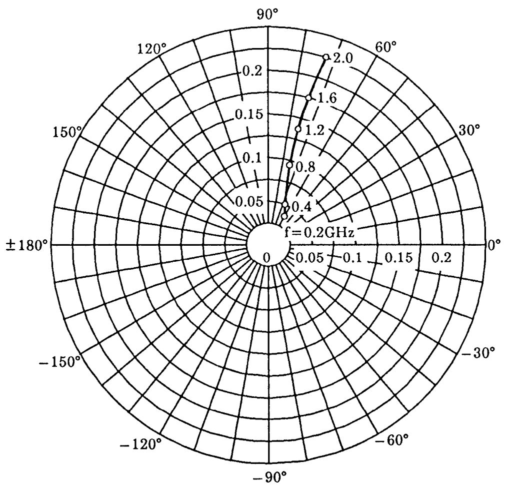
S11e
V_{CE} = 10V
I_C = 20mA
Ta = 25°C
(UNIT : Ω)



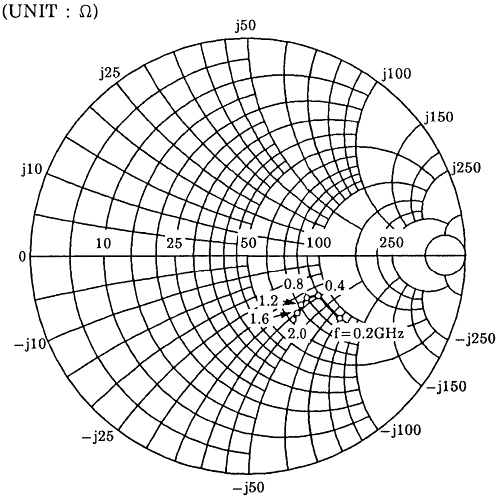
S21e
V_{CE} = 10V
I_C = 20mA
Ta = 25°C



S12e
V_{CE} = 10V
I_C = 20mA
Ta = 25°C



S22e
V_{CE} = 10V
I_C = 20mA
Ta = 25°C
(UNIT : Ω)

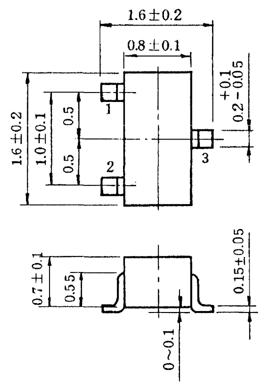


2SC4840 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure, High Gain.
- NF = 1.1dB, $|S_{21e}|^2$ = 13dB (f = 1GHz)

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

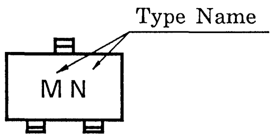
JEDEC	—
EIAJ	—
TOSHIBA	2-2H1A

Weight : 2.4mg

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Base Current	I_B	20	mA
Collector Current	I_C	40	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Marking



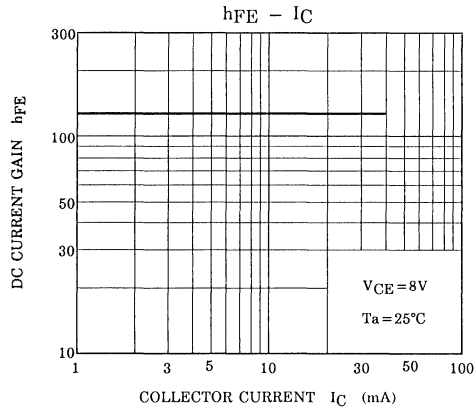
MICROWAVE CHARACTERISTICS (Ta = 25°C)

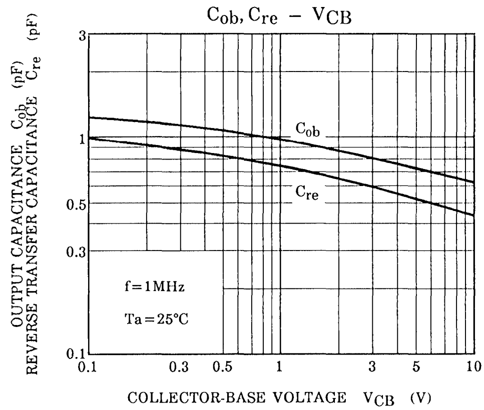
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 8V, I_C = 20mA	7	10	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE} = 8V, I_C = 20mA, f = 1GHz	10	13	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE} = 8V, I_C = 20mA, f = 2GHz	—	7	—	
Noise Figure	NF (1)	V_{CE} = 8V, I_C = 5mA, f = 1GHz	—	1.1	2.5	dB
	NF (2)	V_{CE} = 8V, I_C = 5mA, f = 2GHz	—	1.7	—	

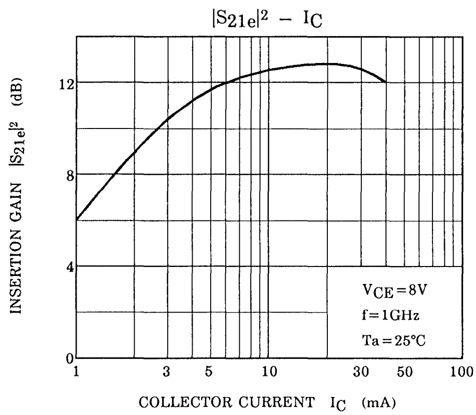
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

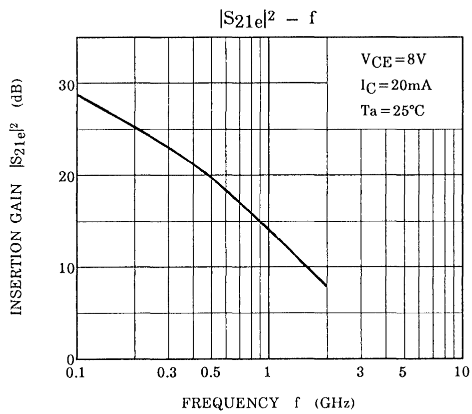
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_C = 0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE} = 8V, I_C = 20mA	50	—	250	—
Output Capacitance	C_{ob}	V_{CB} = 10V, I_E = 0, f = 1MHz	—	0.6	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.45	0.9	pF

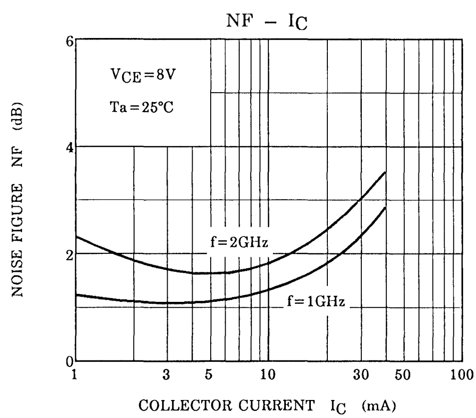
Note : C_{re} is measured by 3 terminal method with capacitance bridge.

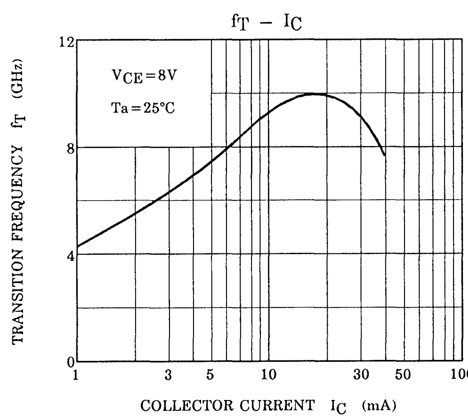

hFE – IC
300
100
50
30
10
1
3
5
10
30
50
100
DC CURRENT GAIN hFE
COLLECTOR CURRENT IC (mA)
VCE=8V
Ta=25°C

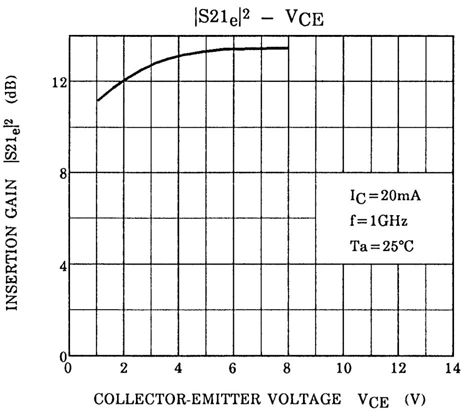

Cob, Cre – VCB
3
1
0.5
0.3
0.1
0.1
0.3
0.5
1
3
5
10
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
COLLECTOR-BASE VOLTAGE VCB (V)
Cob
Cre
f=1MHz
Ta=25°C

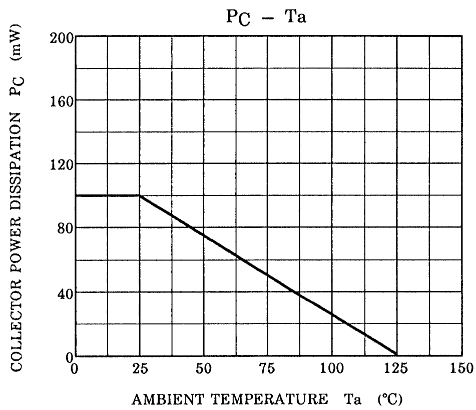

|S21e|2 – IC
12
8
4
0
1
3
5
10
30
50
100
INSERTION GAIN |S21e|2 (dB)
COLLECTOR CURRENT IC (mA)
VCE=8V
f=1GHz
Ta=25°C


|S21e|2 – f
30
20
10
0
0.1
0.3
0.5
1
3
5
10
INSERTION GAIN |S21e|2 (dB)
FREQUENCY f (GHz)
VCE=8V
IC=20mA
Ta=25°C


NF – IC
6
4
2
0
1
3
5
10
30
50
100
NOISE FIGURE NF (dB)
COLLECTOR CURRENT IC (mA)
VCE=8V
Ta=25°C
f=2GHz
f=1GHz


fT – IC
12
8
4
0
1
3
5
10
30
50
100
TRANSITION FREQUENCY fT (GHz)
COLLECTOR CURRENT IC (mA)
VCE=8V
Ta=25°C





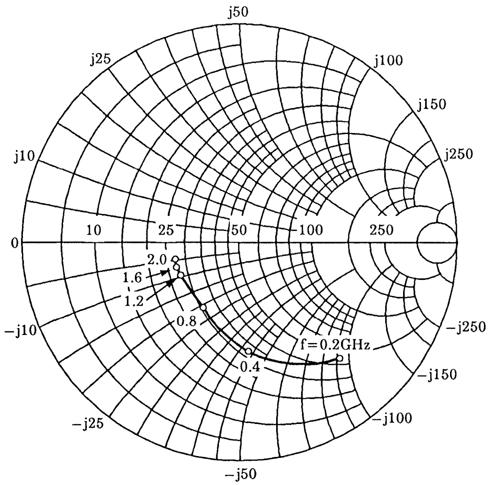
S-PARAMETER $Z_O = 50\Omega$, Ta = 25°C
$V_{CE} = 8V$, $I_C = 5mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.710	−49.8	10.366	140.1	0.043	63.4	0.805	−24.9
400	0.513	−85.6	7.744	118.2	0.063	55.6	0.609	−32.5
600	0.400	−109.8	5.844	105.6	0.076	55.0	0.507	−33.3
800	0.347	−126.2	4.634	97.8	0.087	57.4	0.456	−32.4
1000	0.319	−138.6	3.851	91.9	0.099	60.2	0.427	−31.8
1200	0.303	−148.0	3.310	87.4	0.112	62.9	0.411	−31.5
1400	0.299	−155.5	2.914	83.3	0.126	64.4	0.401	−32.6
1600	0.294	−160.5	2.610	80.0	0.139	65.9	0.389	−33.8
1800	0.296	−160.3	2.367	77.4	0.153	68.7	0.380	−34.8
2000	0.300	−163.9	2.184	75.0	0.171	69.3	0.376	−36.4

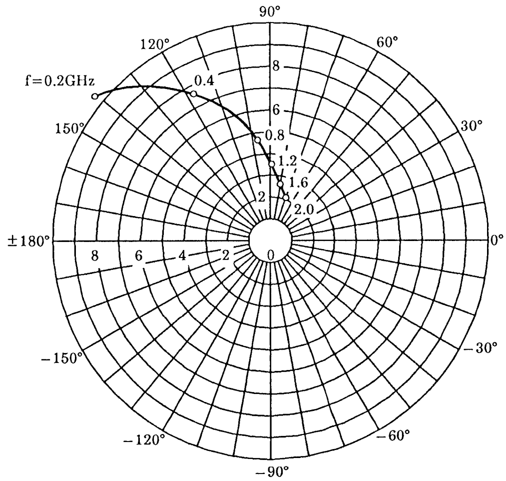
$V_{CE} = 8V$, $I_C = 20mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.383	−98.8	19.474	117.1	0.043	63.5	0.538	−34.2
400	0.292	−134.7	10.899	100.9	0.063	55.5	0.384	−30.2
600	0.270	−154.3	7.496	93.5	0.076	55.0	0.341	−25.5
800	0.262	−165.3	5.727	88.7	0.087	57.3	0.327	−22.9
1000	0.256	−173.1	4.663	84.6	0.099	60.1	0.321	−21.8
1200	0.254	−178.3	3.972	81.4	0.112	62.7	0.322	−22.3
1400	0.257	178.1	3.462	78.3	0.126	64.4	0.320	−23.7
1600	0.258	176.3	3.088	75.7	0.138	66.0	0.315	−25.3
1800	0.258	176.5	2.786	73.7	0.153	68.5	0.314	−26.2
2000	0.265	177.7	2.569	71.6	0.171	69.4	0.308	−28.3

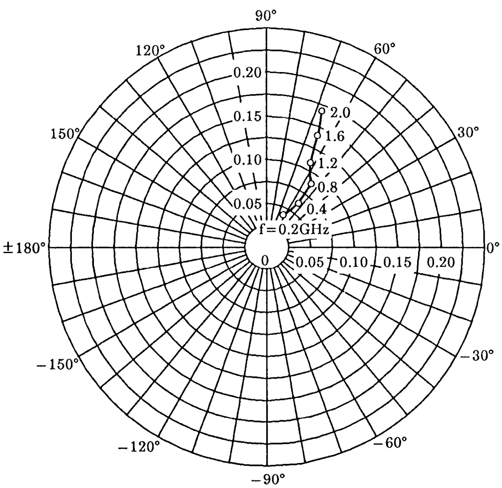
S11e
$V_{CE}=8V$
$I_C=5mA$
Ta = 25°C
(UNIT : Ω)



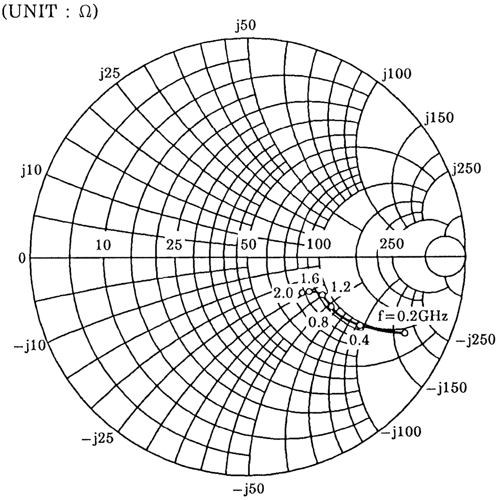
S21e
$V_{CE}=8V$
$I_C=5mA$
Ta = 25°C



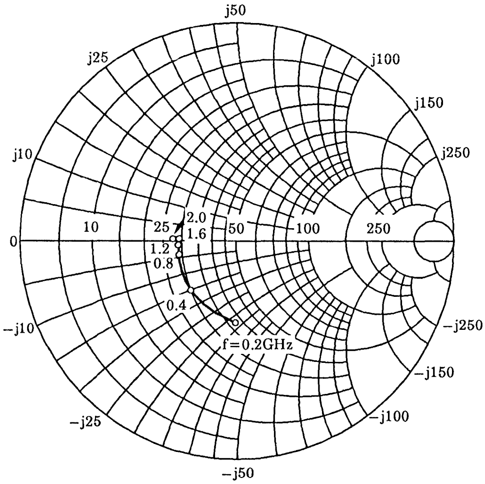
S12e
$V_{CE}=8V$
$I_C=5mA$
Ta = 25°C



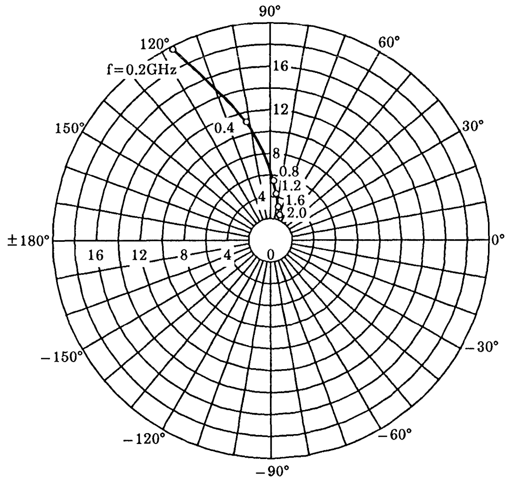
S22e
$V_{CE}=8V$
$I_C=5mA$
Ta = 25°C
(UNIT : Ω)



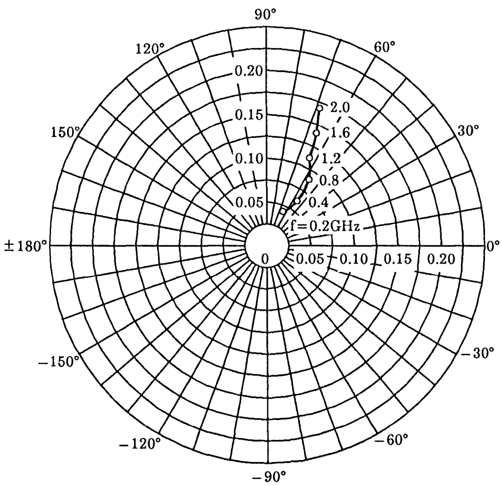
S_{11e}
$V_{CE}=8V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)



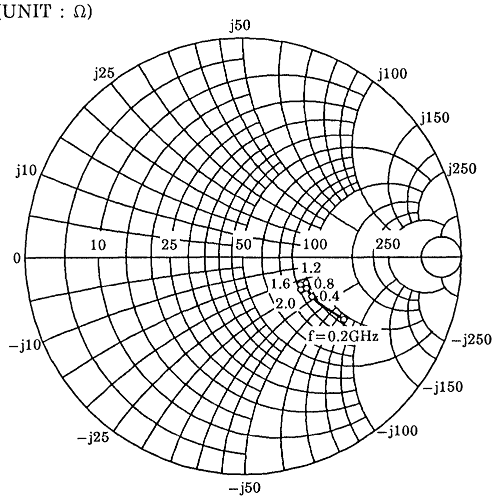
S_{21e}
$V_{CE}=8V$
$I_C=20mA$
$Ta=25°C$



S_{12e}
$V_{CE}=8V$
$I_C=20mA$
$Ta=25°C$



S_{22e}
$V_{CE}=8V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)



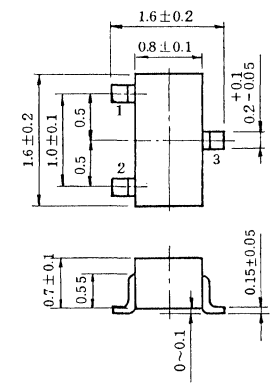
SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC4841

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure, High Gain.
- NF = 1.8dB, $|S_{21e}|^2$ = 8.5dB (f = 2GHz)

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

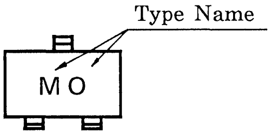
JEDEC	—
EIAJ	—
TOSHIBA	2-2H1A

Weight : 2.4mg

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Base Current	I_B	7	mA
Collector Current	I_C	15	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Marking



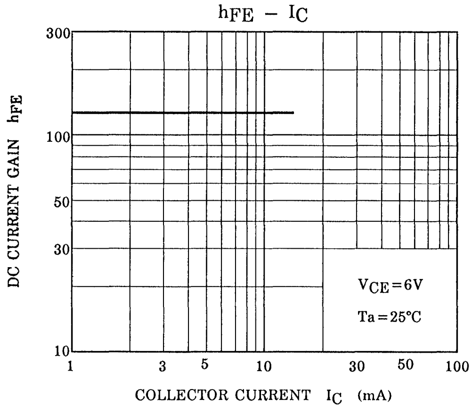
MICROWAVE CHARACTERISTICS (Ta = 25°C)

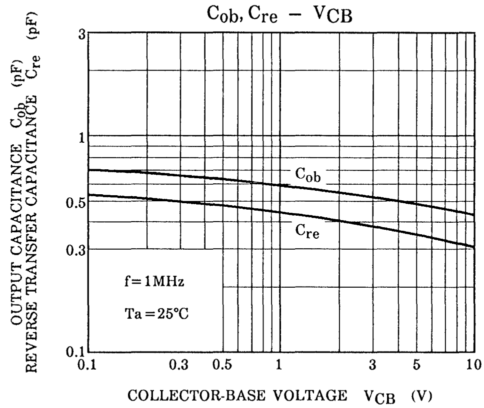
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 6V, I_C = 7mA	7	10	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE} = 6V, I_C = 7mA, f = 1GHz	—	13.5	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE} = 6V, I_C = 7mA, f = 2GHz	4.5	8.5	—	
Noise Figure	NF (1)	V_{CE} = 6V, I_C = 3mA, f = 1GHz	—	1.4	—	dB
	NF (2)	V_{CE} = 6V, I_C = 3mA, f = 2GHz	—	1.8	3.0	

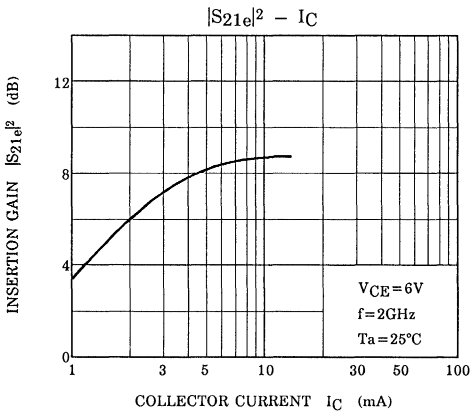
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

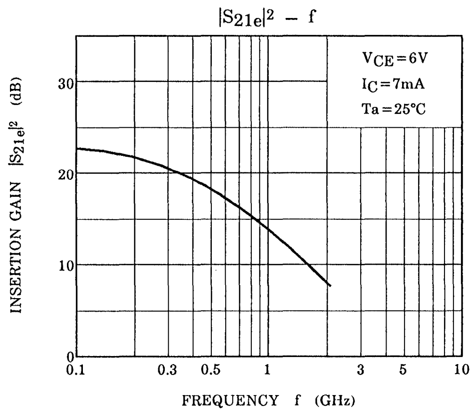
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_C = 0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE} = 6V, I_C = 7mA	50	—	250	—
Output Capacitance	C_{ob}	V_{CB} = 10V, I_E = 0, f = 1MHz	—	0.45	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.35	0.8	pF

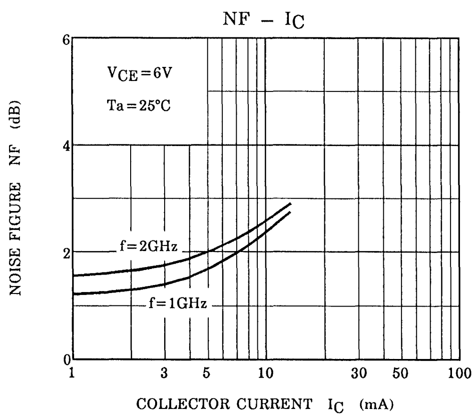
Note : C_{re} is measured by 3 terminal method with capacitance bridge.

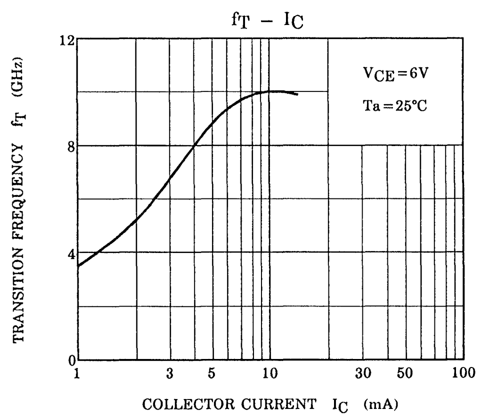

hFE – IC
DC CURRENT GAIN hFE
300
100
50
30
10
1
3
5
10
30
50
100
VCE=6V
Ta=25°C
COLLECTOR CURRENT IC (mA)

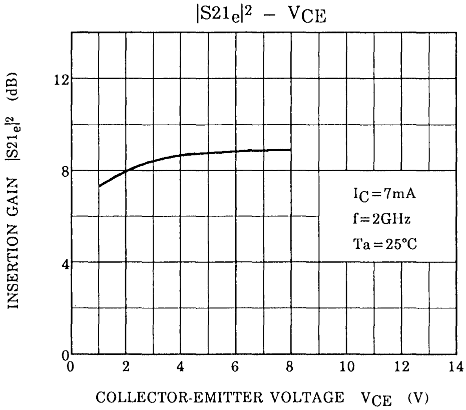

Cob, Cre – VCB
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
3
1
0.5
0.3
0.1
0.1
0.3
0.5
1
3
5
10
Cob
Cre
f=1MHz
Ta=25°C
COLLECTOR-BASE VOLTAGE VCB (V)

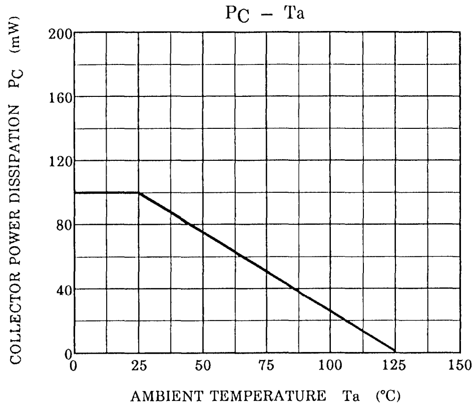

|S21e|2 – IC
INSERTION GAIN |S21e|2 (dB)
12
8
4
0
1
3
5
10
30
50
100
VCE=6V
f=2GHz
Ta=25°C
COLLECTOR CURRENT IC (mA)


|S21e|2 – f
INSERTION GAIN |S21e|2 (dB)
30
20
10
0
0.1
0.3
0.5
1
3
5
10
VCE=6V
IC=7mA
Ta=25°C
FREQUENCY f (GHz)


NF – IC
NOISE FIGURE NF (dB)
6
4
2
0
1
3
5
10
30
50
100
VCE=6V
Ta=25°C
f=2GHz
f=1GHz
COLLECTOR CURRENT IC (mA)


fT – IC
TRANSITION FREQUENCY fT (GHz)
12
8
4
0
1
3
5
10
30
50
100
VCE=6V
Ta=25°C
COLLECTOR CURRENT IC (mA)





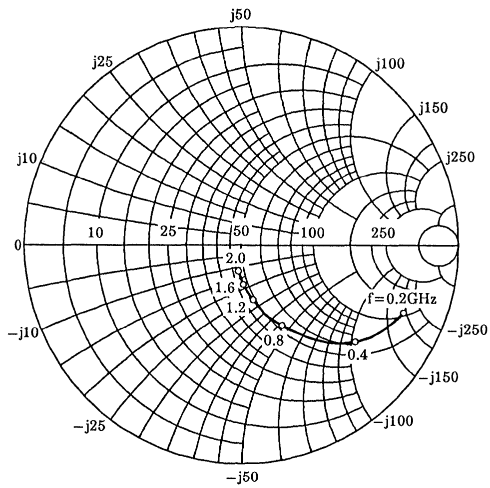
S-PARAMETER Z_O = 50Ω, Ta = 25°C
V_{CE} = 6V, I_C = 3mA

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.823	−22.5	7.186	154.4	0.036	74.8	0.928	−14.5
400	0.685	−40.5	6.252	136.4	0.063	65.5	0.805	−23.6
600	0.537	−54.5	5.378	122.5	0.080	60.8	0.700	−28.1
800	0.428	−64.4	4.567	112.6	0.094	59.3	0.627	−30.0
1000	0.343	−71.9	3.961	104.8	0.107	59.3	0.578	−30.7
1200	0.267	−77.4	3.486	98.6	0.119	59.7	0.544	−31.1
1400	0.227	−83.4	3.104	93.3	0.131	60.2	0.518	−31.8
1600	0.187	−86.9	2.793	88.9	0.141	60.6	0.497	−32.2
1800	0.157	−90.6	2.534	85.1	0.153	62.3	0.481	−32.7
2000	0.130	−94.1	2.336	81.2	0.167	62.7	0.466	−33.2

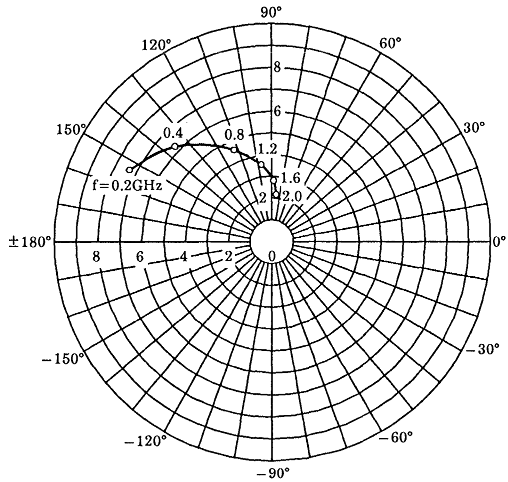
V_{CE} = 6V, I_C = 7mA

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.653	−34.3	12.924	144.3	0.032	71.8	0.840	−20.9
400	0.447	−57.1	9.858	122.7	0.051	66.3	0.657	−28.3
600	0.304	−70.0	7.513	109.8	0.066	66.0	0.552	−28.9
800	0.220	−77.9	5.971	101.8	0.081	67.2	0.500	−27.9
1000	0.164	−83.4	4.955	95.6	0.096	68.5	0.470	−26.9
1200	0.123	−87.1	4.225	91.0	0.112	69.1	0.454	−26.3
1400	0.094	−93.7	3.721	86.8	0.127	69.2	0.441	−26.4
1600	0.070	−97.1	3.302	83.3	0.142	69.1	0.430	−26.8
1800	0.054	−102.8	2.974	80.2	0.156	70.1	0.423	−27.0
2000	0.039	−115.8	2.732	76.9	0.174	69.5	0.414	−27.7

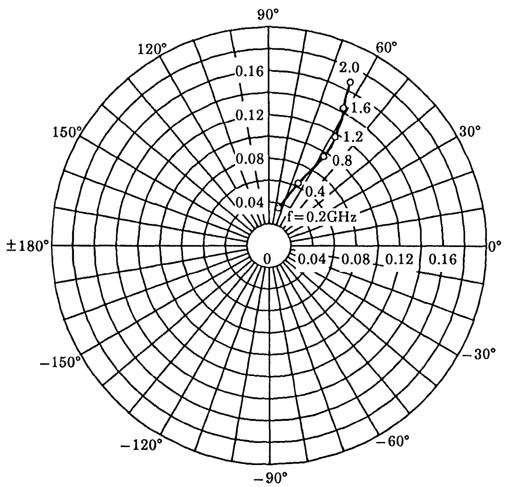
S_{11e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$
(UNIT : Ω)



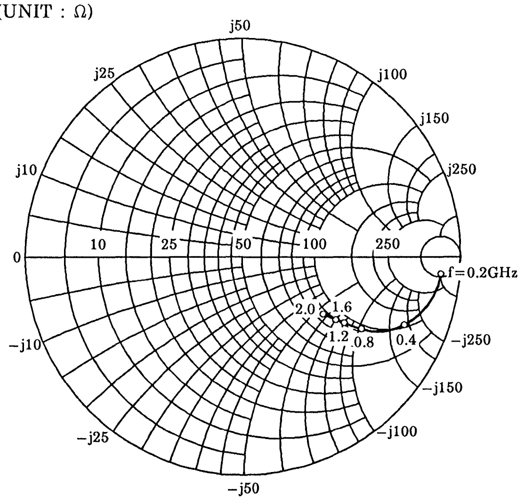
S_{21e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$



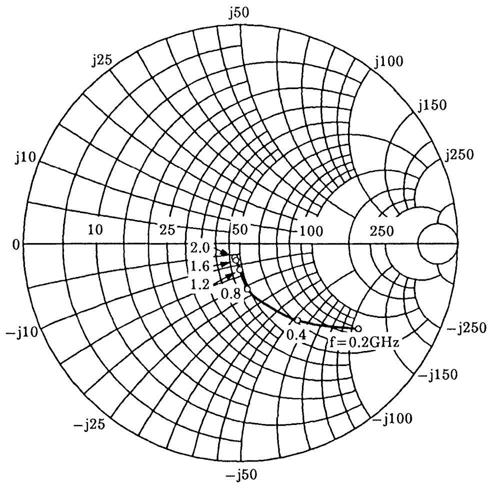
S_{12e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$



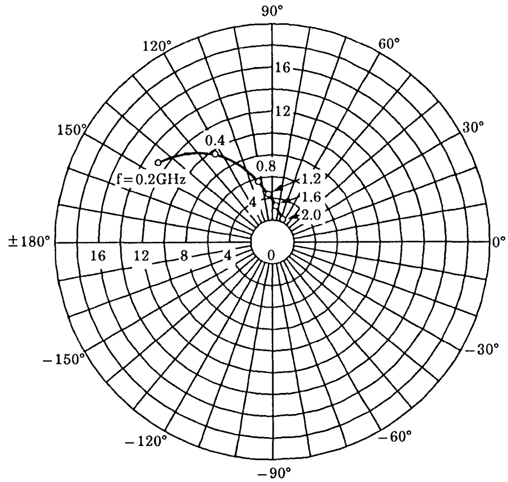
S_{22e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$
(UNIT : Ω)



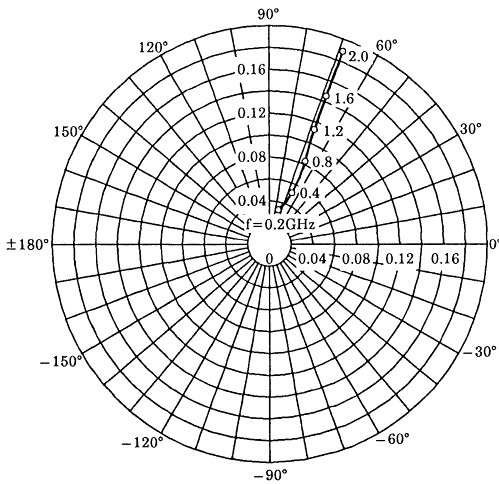
S_{11e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$
(UNIT : Ω)



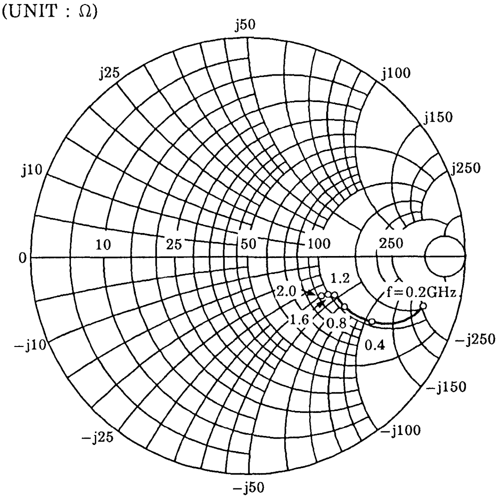
S_{21e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$



S_{12e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$



S_{22e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$
(UNIT : Ω)



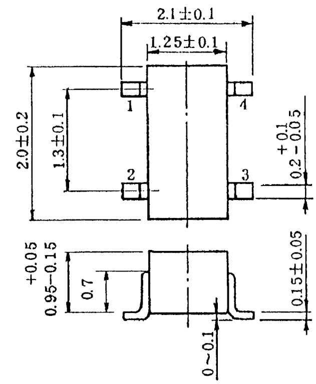
2SC4842

SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure, High Gain.
- NF = 1.1dB, $|S_{21e}|^2$ = 14dB (f = 1GHz)

Unit in mm



1, 3. EMITTER
2. BASE
4. COLLECTOR

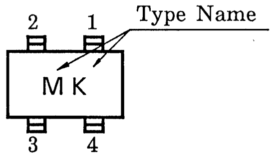
JEDEC	—
EIAJ	—
TOSHIBA	2-2K1A

Weight : 0.006g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	80	mA
Base Current	I_B	40	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Marking



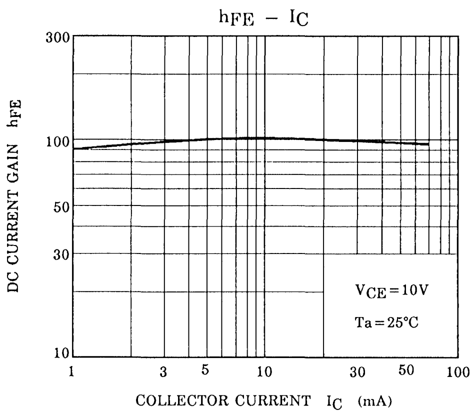
MICROWAVE CHARACTERISTICS (Ta = 25°C)

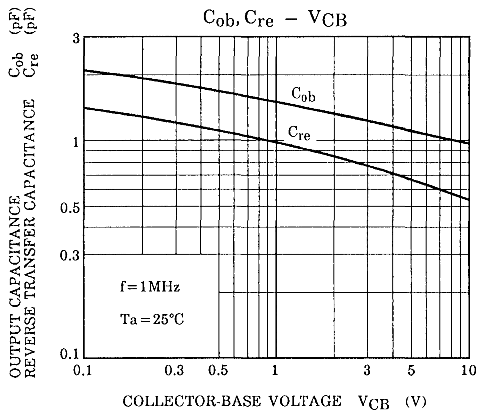
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 10V, I_C = 20mA	5	7	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE} = 10V, I_C = 20mA, f = 500MHz	—	19.5	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE} = 10V, I_C = 20mA, f = 1GHz	10.5	14	—	
Noise Figure	NF (1)	V_{CE} = 10V, I_C = 5mA, f = 500MHz	—	1	—	dB
	NF (2)	V_{CE} = 10V, I_C = 5mA, f = 1GHz	—	1.1	2	

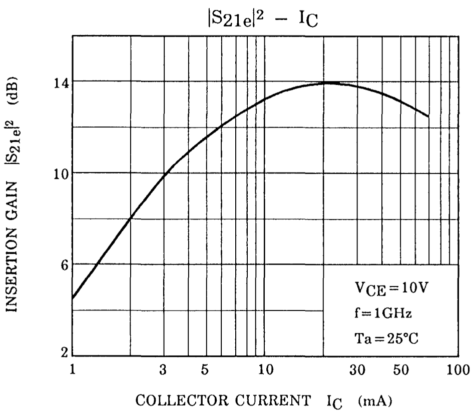
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

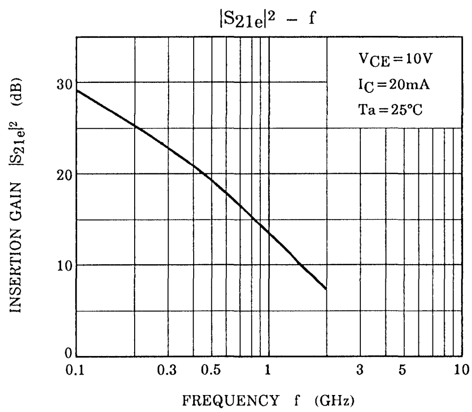
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_C = 0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE} = 10V, I_C = 20mA	30	—	250	—
Output Capacitance	C_{ob}	V_{CB} = 10V, I_E = 0, f = 1MHz (Note)	—	0.8	—	pF
Reverse Transfer Capacitance	C_{re}		—	0.55	1	pF

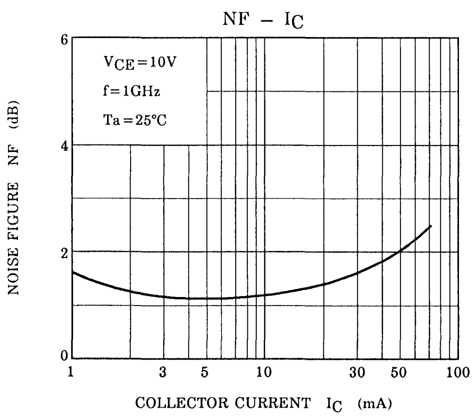
Note : C_{re} is measured by 3 terminal method with capacitance bridge.

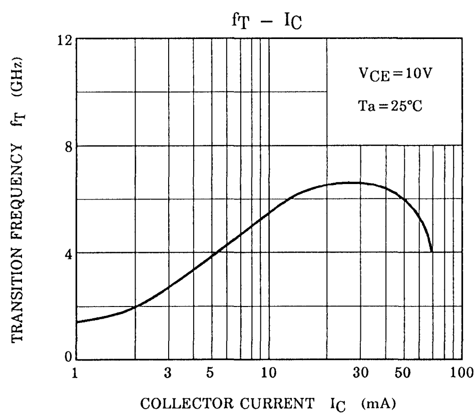

hFE – IC
DC CURRENT GAIN hFE
300
100
50
30
10
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)
VCE=10V
Ta=25°C

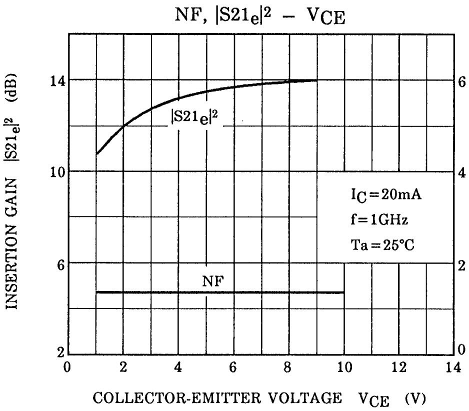

Cob, Cre – VCB
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
3
1
0.5
0.3
0.1
0.1
0.3
0.5
1
3
5
10
COLLECTOR-BASE VOLTAGE VCB (V)
Cob
Cre
f=1MHz
Ta=25°C

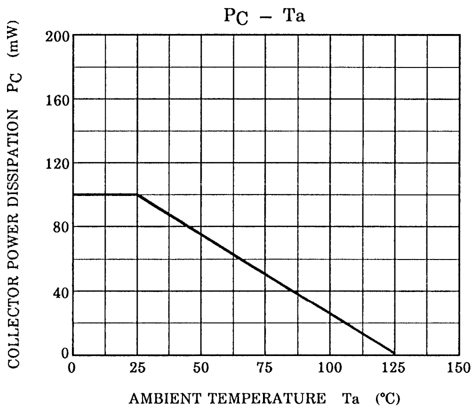

|S21e|2 – IC
INSERTION GAIN |S21e|2 (dB)
14
10
6
2
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)
VCE=10V
f=1GHz
Ta=25°C


|S21e|2 – f
INSERTION GAIN |S21e|2 (dB)
30
20
10
0
0.1
0.3
0.5
1
3
5
10
FREQUENCY f (GHz)
VCE=10V
IC=20mA
Ta=25°C


NF – IC
NOISE FIGURE NF (dB)
6
4
2
0
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)
VCE=10V
f=1GHz
Ta=25°C


fT – IC
TRANSITION FREQUENCY fT (GHz)
12
8
4
0
1
3
5
10
30
50
100
COLLECTOR CURRENT IC (mA)
VCE=10V
Ta=25°C





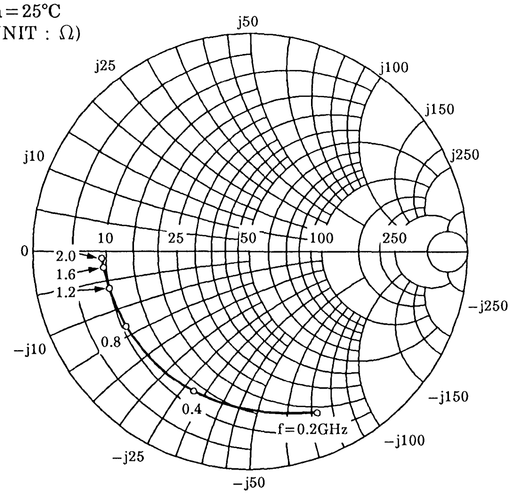
S-PARAMETER $Z_O = 50\Omega$, Ta = 25°C
$V_{CE} = 10V$, $I_C = 5mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.794	−68.9	10.322	137.8	0.048	54.1	0.798	−29.8
400	0.722	−112.7	7.453	114.8	0.065	38.7	0.599	−41.1
600	0.699	−136.4	5.534	101.5	0.070	33.4	0.500	−45.9
800	0.683	−150.6	4.321	92.9	0.072	32.5	0.450	−49.3
1000	0.678	−160.9	3.499	86.1	0.073	33.7	0.425	−53.1
1200	0.680	−168.2	2.967	81.2	0.073	36.5	0.412	−57.1
1400	0.688	−173.8	2.584	76.5	0.074	40.7	0.408	−61.5
1600	0.692	−178.4	2.291	72.6	0.075	45.7	0.406	−66.2
1800	0.702	−177.5	2.071	68.8	0.078	50.8	0.409	−70.6
2000	0.709	−173.7	1.902	64.9	0.082	56.0	0.416	−75.4

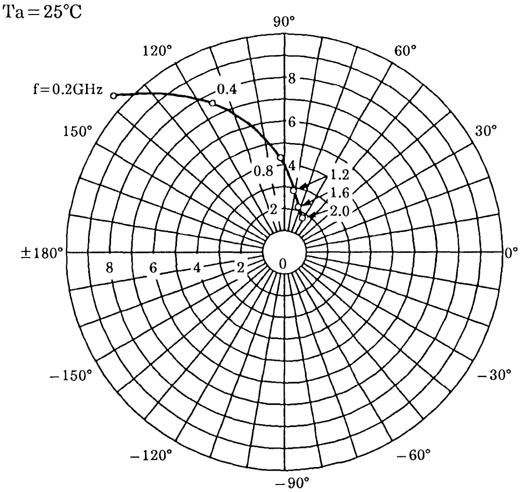
$V_{CE} = 10V$, $I_C = 20mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.645	−117.4	19.826	117.5	0.029	45.7	0.517	−47.9
400	0.637	−150.2	11.127	100.3	0.037	46.1	0.334	−53.2
600	0.643	−163.3	7.616	91.9	0.043	51.2	0.273	−54.3
800	0.646	−171.5	5.780	86.7	0.050	56.4	0.247	−56.6
1000	0.653	−177.7	4.629	82.0	0.057	60.7	0.237	−60.2
1200	0.662	178.1	3.903	78.7	0.065	64.0	0.235	−64.2
1400	0.668	174.2	3.399	75.0	0.073	66.8	0.237	−69.2
1600	0.678	170.7	3.006	71.7	0.082	69.1	0.241	−74.1
1800	0.679	167.5	2.711	68.7	0.091	71.1	0.248	−78.5
2000	0.631	164.6	2.475	65.2	0.100	72.7	0.259	−83.1

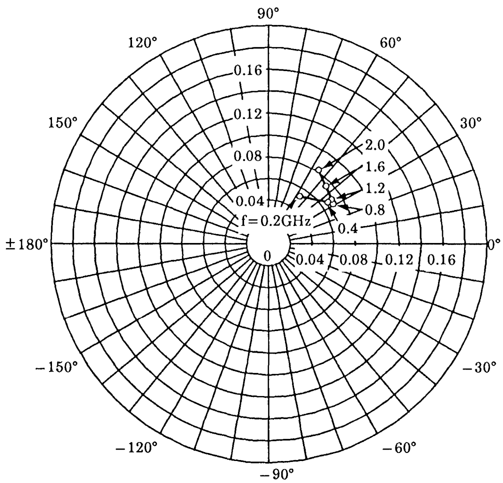
S_{11e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



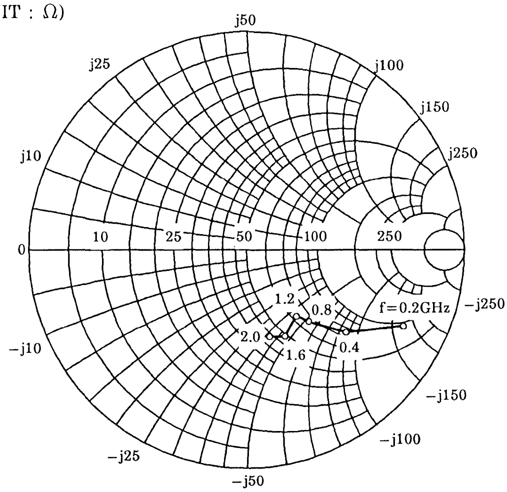
S_{21e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$



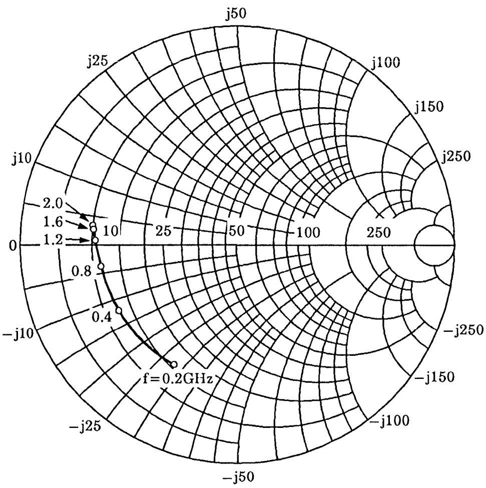
S_{12e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$



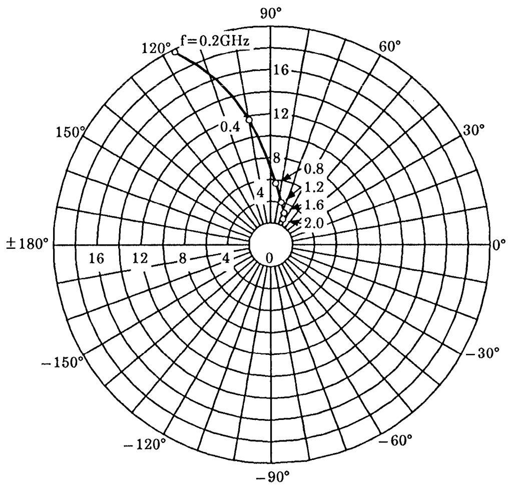
S_{22e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



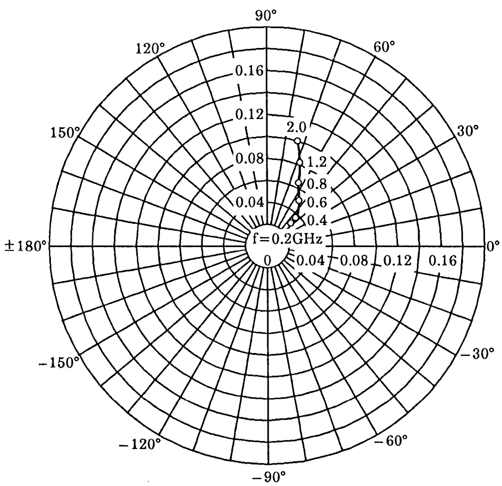
S_{11e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)



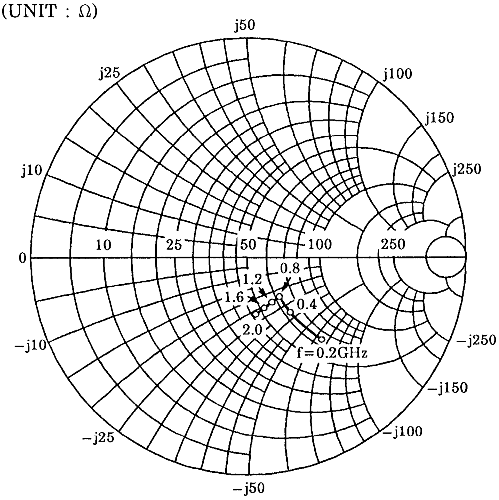
S_{21e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$



S_{12e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$



S_{22e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)

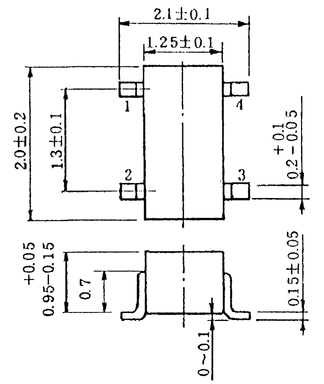


SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC4843

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

Unit in mm



1, 3. EMITTER
2. BASE
4. COLLECTOR

JEDEC	—
EIAJ	—
TOSHIBA	2-2K1A

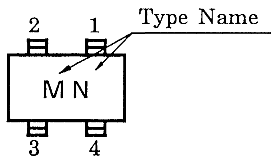
Weight : 0.006g

- Low Noise Figure, High Gain.
- NF = 1.1dB, $|S_{21e}|^2$ = 15.5dB (f = 1GHz)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Base Current	I_B	20	mA
Collector Current	I_C	40	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Marking



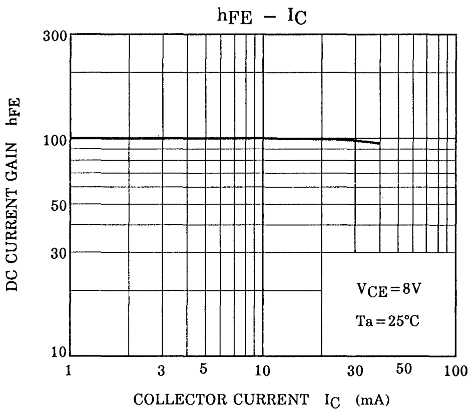
MICROWAVE CHARACTERISTICS (Ta = 25°C)

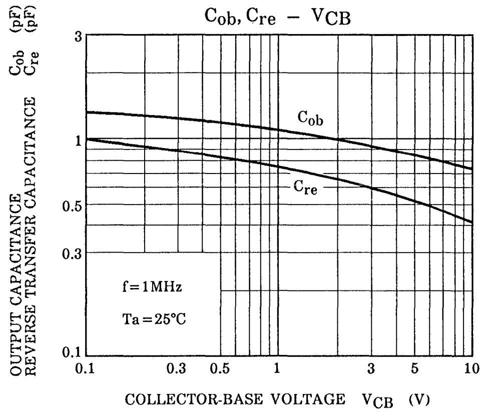
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 8V, I_C = 20mA	7	10	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE} = 8V, I_C = 20mA, f = 1GHz	12	15.5	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE} = 8V, I_C = 20mA, f = 2GHz	—	9	—	dB
Noise Figure	NF (1)	V_{CE} = 8V, I_C = 5mA, f = 1GHz	—	1.1	2.5	dB
	NF (2)	V_{CE} = 8V, I_C = 5mA, f = 2GHz	—	1.7	—	dB

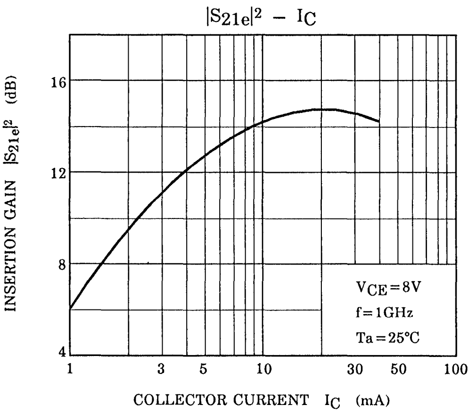
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

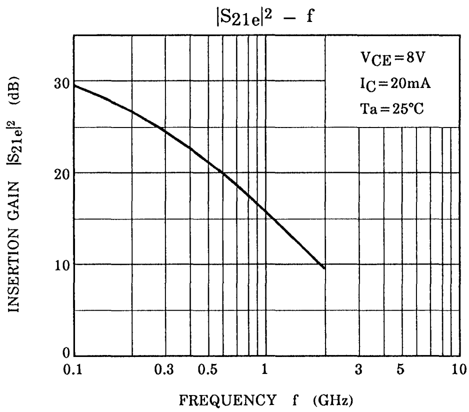
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_C = 0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE} = 8V, I_C = 20mA	50	—	250	—
Output Capacitance	C_{ob}	V_{CB} = 10V, I_E = 0, f = 1MHz (Note)	—	0.8	—	pF
Reverse Transfer Capacitance	C_{re}		—	0.45	0.9	pF

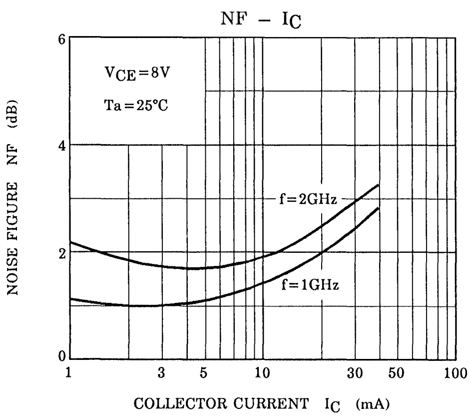
Note : C_{re} is measured by 3 terminal method with capacitance bridge.

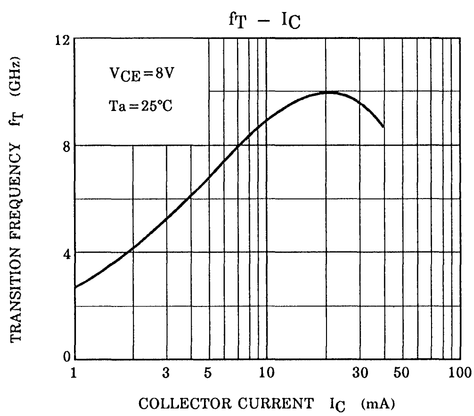

hFE − IC
DC CURRENT GAIN hFE
COLLECTOR CURRENT IC (mA)
VCE=8V
Ta=25°C
300
100
50
30
10
1
3
5
10
30
50
100

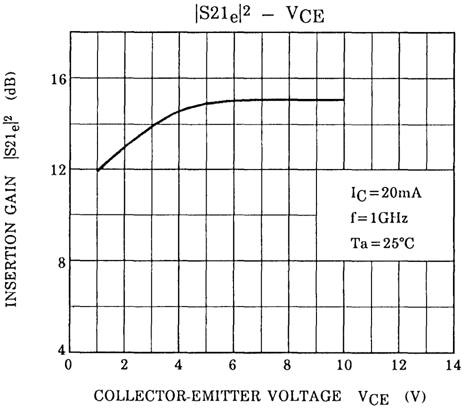

Cob, Cre − VCB
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
COLLECTOR-BASE VOLTAGE VCB (V)
Cob
Cre
f=1MHz
Ta=25°C
3
1
0.5
0.3
0.1
0.1
0.3
0.5
1
3
5
10

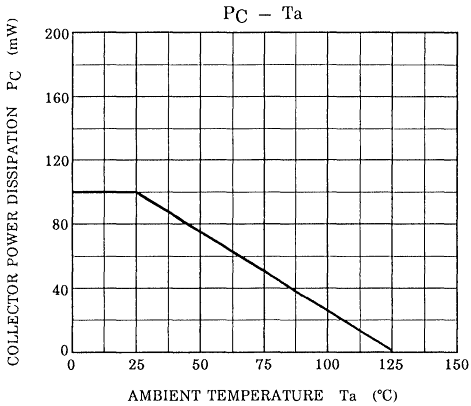

|S21e|2 − IC
INSERTION GAIN |S21e|2 (dB)
COLLECTOR CURRENT IC (mA)
VCE=8V
f=1GHz
Ta=25°C
16
12
8
4
1
3
5
10
30
50
100


|S21e|2 − f
INSERTION GAIN |S21e|2 (dB)
FREQUENCY f (GHz)
VCE=8V
IC=20mA
Ta=25°C
30
20
10
0
0.1
0.3
0.5
1
3
5
10


NF − IC
NOISE FIGURE NF (dB)
COLLECTOR CURRENT IC (mA)
VCE=8V
Ta=25°C
f=2GHz
f=1GHz
6
4
2
0
1
3
5
10
30
50
100


fT − IC
TRANSITION FREQUENCY fT (GHz)
COLLECTOR CURRENT IC (mA)
VCE=8V
Ta=25°C
12
8
4
0
1
3
5
10
30
50
100





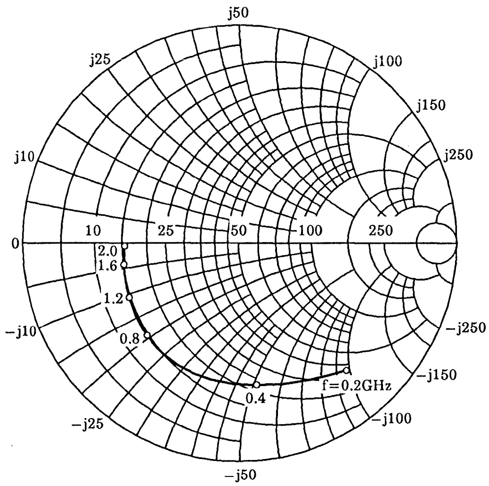
S-PARAMETER $Z_O = 50\Omega$, Ta = 25°C
V_{CE} = 8V, I_C = 5mA

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.760	−47.2	10.933	146.8	0.043	63.8	0.859	−27.2
400	0.651	−83.8	8.697	125.2	0.068	50.1	0.671	−42.8
600	0.629	−112.6	6.938	111.4	0.079	43.6	0.545	−51.3
800	0.590	−132.4	5.621	102.2	0.085	41.6	0.463	−56.5
1000	0.579	−148.9	4.645	94.4	0.091	41.0	0.413	−60.8
1200	0.559	−157.4	3.953	89.1	0.095	41.7	0.382	−64.5
1400	0.547	−166.0	3.457	84.5	0.099	43.3	0.362	−68.1
1600	0.521	−170.2	3.052	80.5	0.103	45.3	0.350	−71.8
1800	0.512	−174.5	2.752	76.9	0.107	47.2	0.344	−75.2
2000	0.536	−177.5	2.534	73.6	0.113	49.3	0.341	−78.7

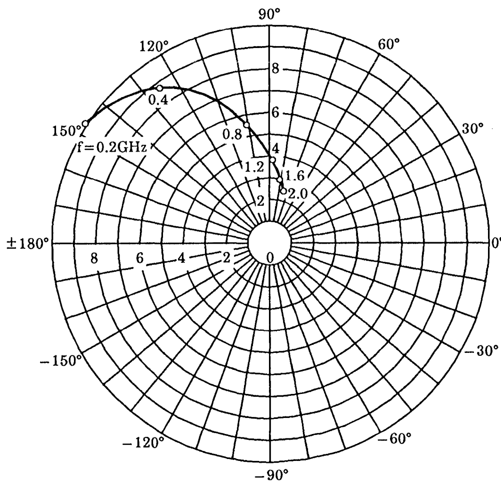
V_{CE} = 8V, I_C = 20mA

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.551	−93.3	22.441	127.0	0.030	55.6	0.622	−46.5
400	0.511	−132.8	13.552	107.5	0.040	52.6	0.393	−59.9
600	0.517	−151.6	9.551	98.0	0.049	55.2	0.299	−65.0
800	0.514	−163.6	7.326	92.1	0.057	58.7	0.250	−68.7
1000	0.520	−172.3	5.966	87.3	0.067	60.8	0.225	−72.2
1200	0.527	−178.0	4.961	84.0	0.077	62.7	0.211	−75.6
1400	0.526	−176.6	4.322	80.6	0.086	64.1	0.206	−80.0
1600	0.528	−172.9	3.820	77.5	0.096	65.4	0.203	−84.1
1800	0.534	−169.3	3.428	74.3	0.105	66.3	0.203	−87.4
2000	0.529	−166.7	3.132	71.6	0.115	67.0	0.209	−91.1

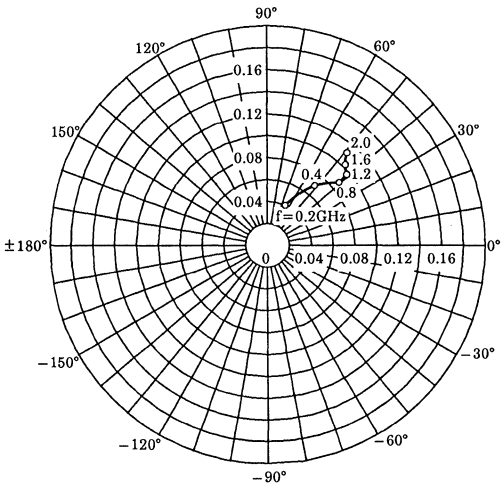
S_{11e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



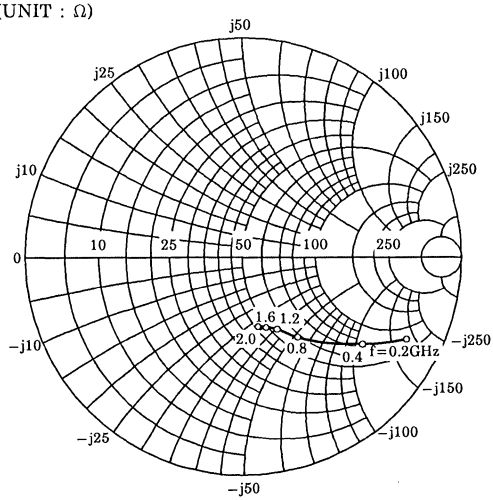
S_{21e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$



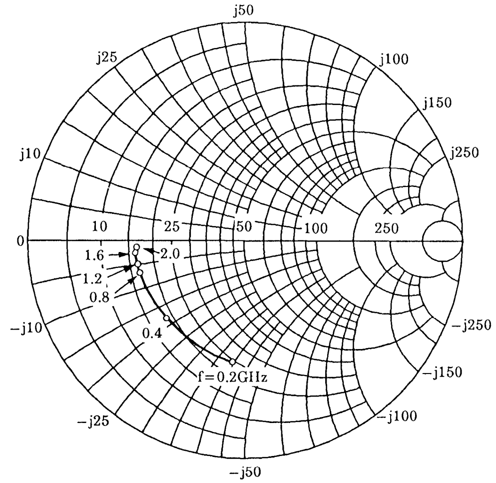
S_{12e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$



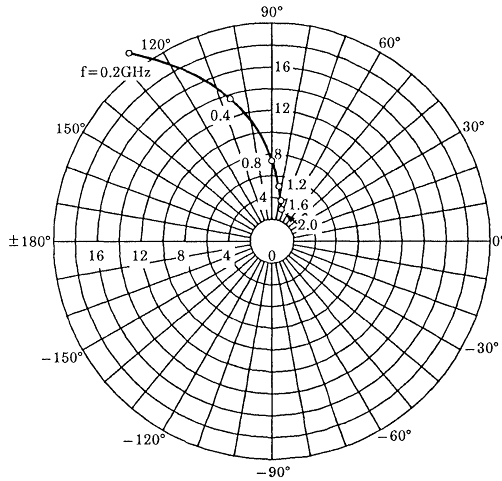
S_{22e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



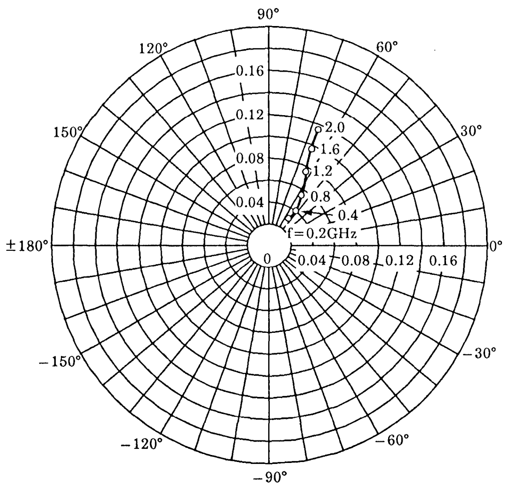
S_{11e}
$V_{CE}=8V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)



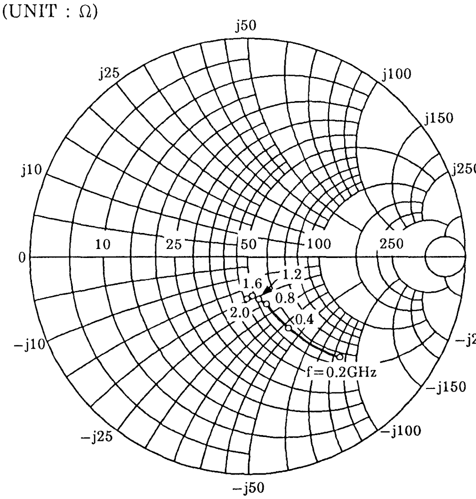
S_{21e}
$V_{CE}=8V$
$I_C=20mA$
$Ta=25°C$



S_{12e}
$V_{CE}=8V$
$I_C=20mA$
$Ta=25°C$



S_{22e}
$V_{CE}=8V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)

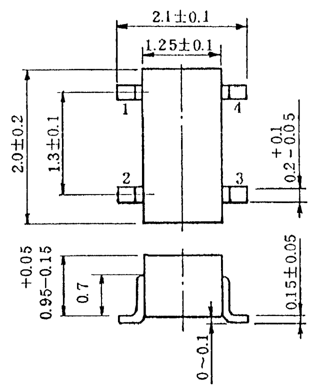


2SC4844 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure, High Gain.
- NF=1.8dB, $|S_{21e}|^2$=9.5dB (f=2GHz)

Unit in mm



1, 3. EMITTER
2. BASE
4. COLLECTOR

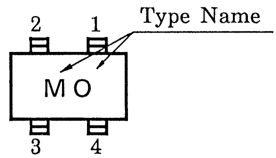
JEDEC	—
EIAJ	—
TOSHIBA	2-2K1A

Weight : 0.006g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Base Current	I_B	7	mA
Collector Current	I_C	15	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Marking



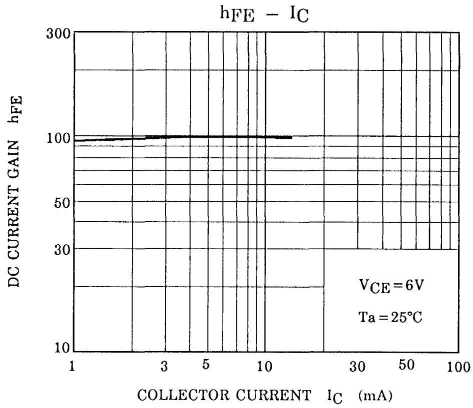
MICROWAVE CHARACTERISTICS (Ta = 25°C)

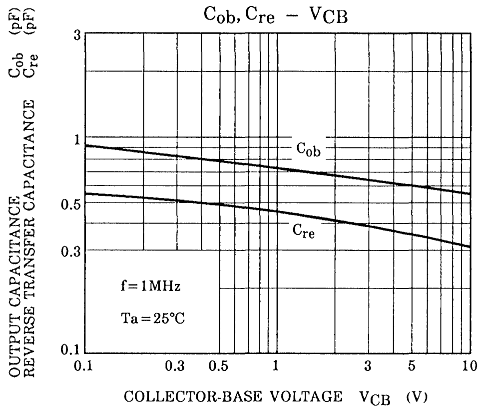
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE}=6V, I_C=7mA	7	10	—	GHz
Insertion Gain	$|S_{21e}|^2$ (1)	V_{CE}=6V, I_C=7mA, f=1GHz	—	15	—	dB
	$|S_{21e}|^2$ (2)	V_{CE}=6V, I_C=7mA, f=2GHz	6.5	9.5	—	
Noise Figure	NF (1)	V_{CE}=6V, I_C=3mA, f=1GHz	—	1.4	—	dB
	NF (2)	V_{CE}=6V, I_C=3mA, f=2GHz	—	1.8	3.0	

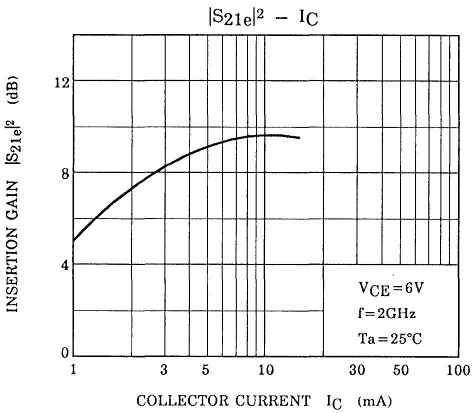
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

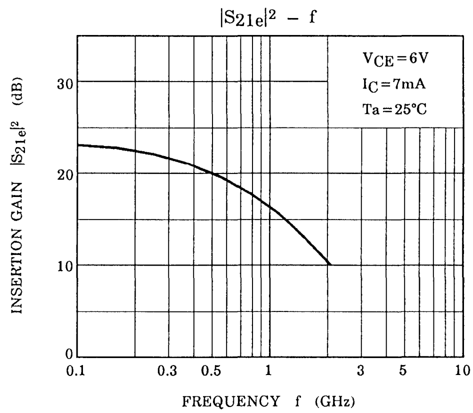
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB}=10V, I_E=0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB}=1V, I_C=0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE}=6V, I_C=7mA	50	—	250	—
Output Capacitance	C_{ob}	V_{CB}=10V, I_E=0, f=1MHz (Note)	—	0.55	—	pF
Reverse Transfer Capacitance	C_{re}		—	0.35	0.8	pF

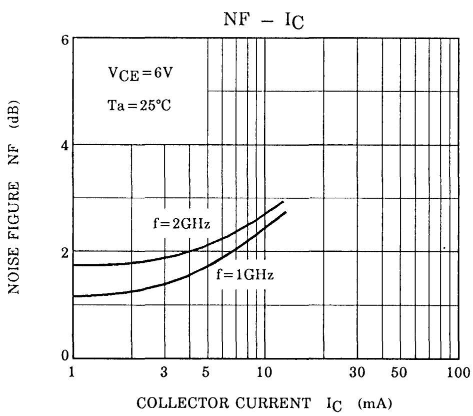
Note : C_{re} is measured by 3 terminal method with capacitance bridge.

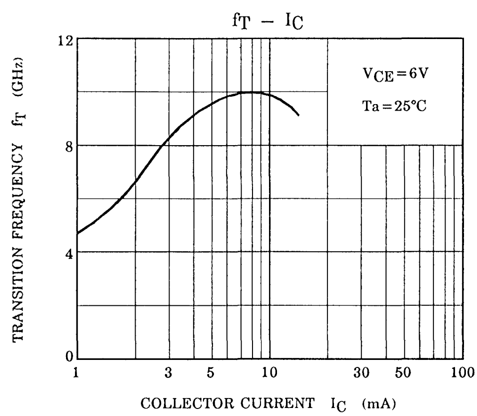

hFE – IC
DC CURRENT GAIN hFE
VCE=6V
Ta=25°C
COLLECTOR CURRENT IC (mA)

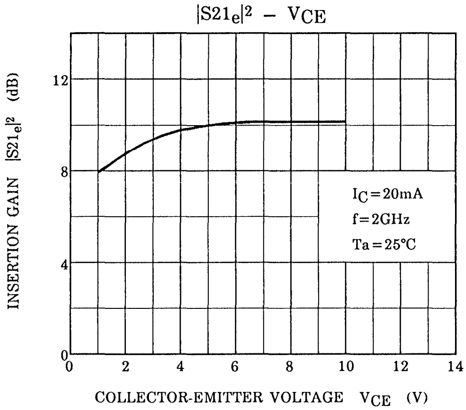

Cob, Cre – VCB
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
Cob
Cre
f=1MHz
Ta=25°C
COLLECTOR-BASE VOLTAGE VCB (V)

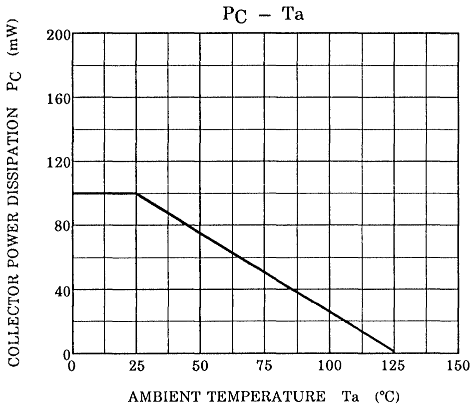

|S21e|2 – IC
INSERTION GAIN |S21e|2 (dB)
VCE=6V
f=2GHz
Ta=25°C
COLLECTOR CURRENT IC (mA)


|S21e|2 – f
INSERTION GAIN |S21e|2 (dB)
VCE=6V
IC=7mA
Ta=25°C
FREQUENCY f (GHz)


NF – IC
NOISE FIGURE NF (dB)
VCE=6V
Ta=25°C
f=2GHz
f=1GHz
COLLECTOR CURRENT IC (mA)


fT – IC
TRANSITION FREQUENCY fT (GHz)
VCE=6V
Ta=25°C
COLLECTOR CURRENT IC (mA)





S-PARAMETER $Z_O = 50\Omega$, Ta = 25°C

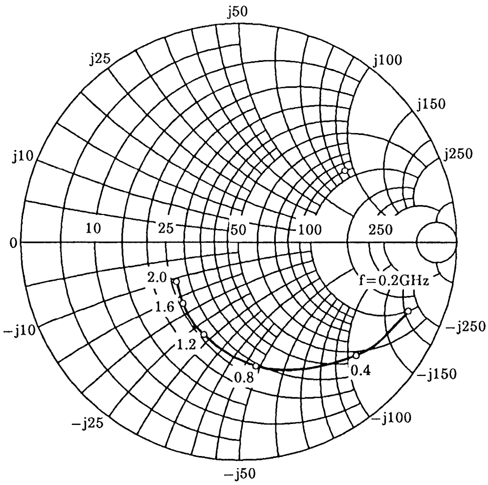
$V_{CE} = 6V$, $I_C = 3mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.847	−22.2	7.290	159.9	0.037	75.5	0.954	−16.2
400	0.767	−43.8	6.718	143.8	0.066	64.5	0.857	−29.3
600	0.666	−63.7	6.064	129.8	0.087	56.5	0.765	−39.3
800	0.573	−80.8	5.332	119.0	0.102	51.3	0.680	−47.0
1000	0.492	−96.6	4.642	109.6	0.113	47.5	0.612	−53.3
1200	0.435	−111.0	4.133	102.7	0.121	45.1	0.560	−58.2
1400	0.393	−122.1	3.671	96.6	0.126	44.0	0.518	−62.6
1600	0.366	−132.7	3.314	92.1	0.131	43.5	0.486	−66.5
1800	0.351	−141.5	3.051	88.0	0.136	43.4	0.466	−70.2
2000	0.340	−149.6	2.820	83.7	0.141	43.8	0.450	−73.2

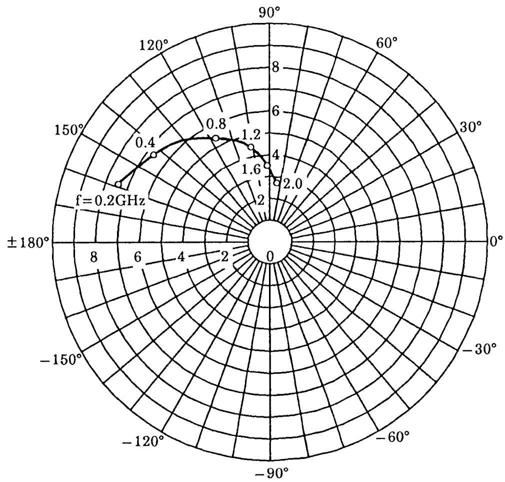
$V_{CE} = 6V$, $I_C = 7mA$

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.708	−36.8	13.239	151.4	0.032	70.2	0.890	−23.8
400	0.582	−69.7	11.041	131.1	0.053	59.2	0.718	−39.1
600	0.491	−96.0	8.920	116.6	0.066	54.3	0.589	−48.1
800	0.425	−116.4	7.290	107.1	0.074	52.7	0.502	−53.8
1000	0.386	−133.3	6.049	99.4	0.082	52.7	0.442	−58.0
1200	0.368	−147.0	5.176	94.3	0.090	53.5	0.405	−61.3
1400	0.353	−157.1	4.527	89.3	0.097	54.5	0.378	−64.7
1600	0.347	−166.1	4.007	85.7	0.105	55.7	0.359	−67.9
1800	0.345	−172.9	3.634	82.2	0.113	56.7	0.347	−70.7
2000	0.344	−179.0	3.333	78.8	0.120	57.9	0.340	−74.1

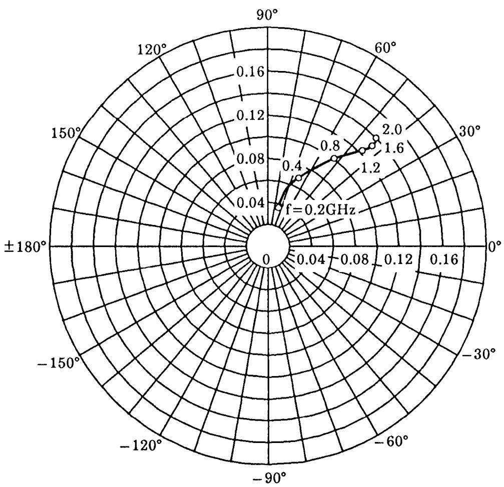
S_{11e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$
(UNIT : Ω)



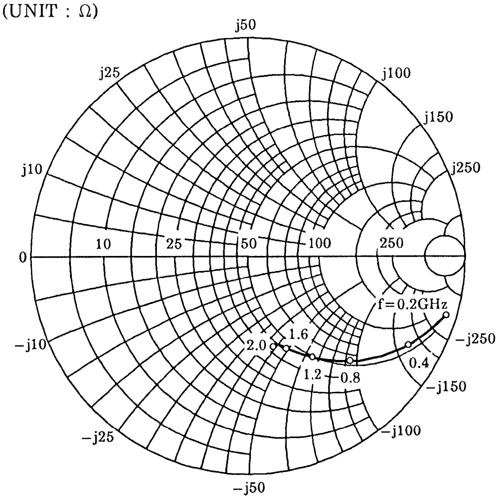
S_{21e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$



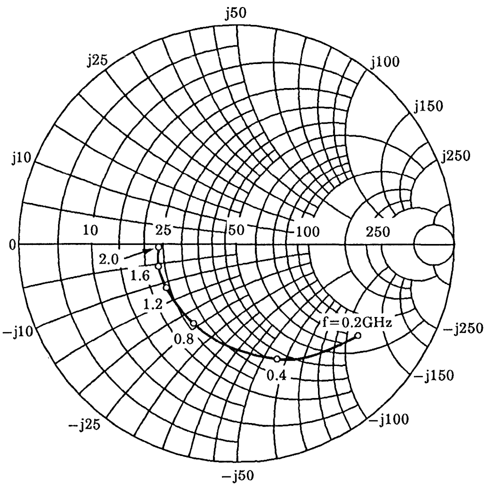
S_{12e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$



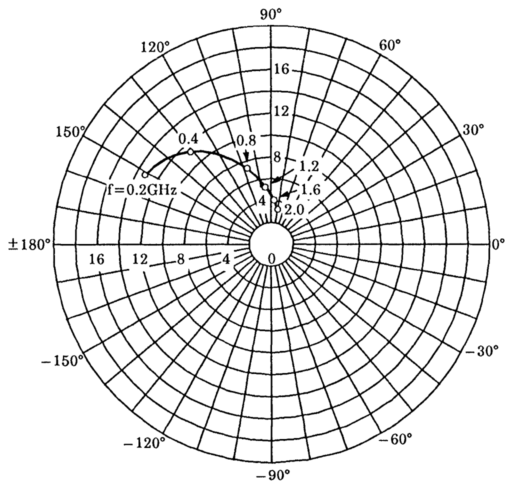
S_{22e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$
(UNIT : Ω)



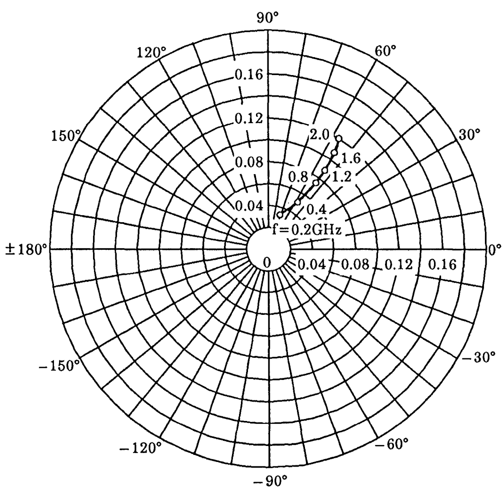
S_{11e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$
(単位：Ω)



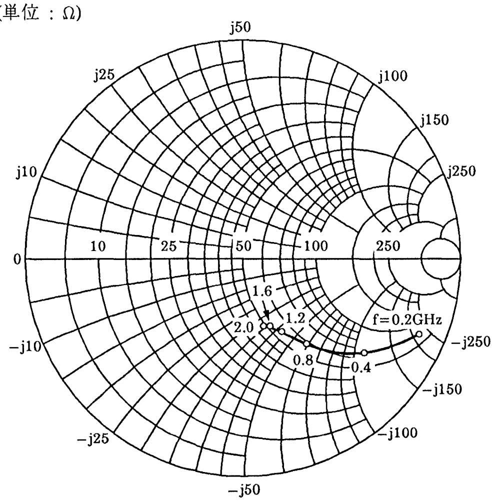
S_{21e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$



S_{12e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$



S_{22e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$
(単位：Ω)

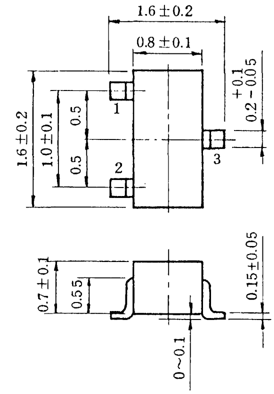


SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR **2SC4915**

HIGH FREQUENCY AMPLIFIER APPLICATIONS.
FM, RF, MIX, IF AMPLIFIER APPLICATIONS.

- Small Reverse Transfer Capacitance : C_{re} = 0.55pF (Typ.)
- Low Noise Figure : NF = 2.3dB (Typ.)

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

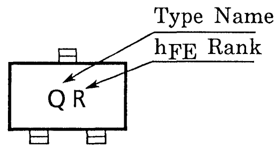
JEDEC	—
EIAJ	—
TOSHIBA	2-2H1A

Weight : 2.4mg

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	40	V
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Base Voltage	V_{EBO}	4	V
Collector Current	I_C	20	mA
Base Current	I_B	4	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Marking

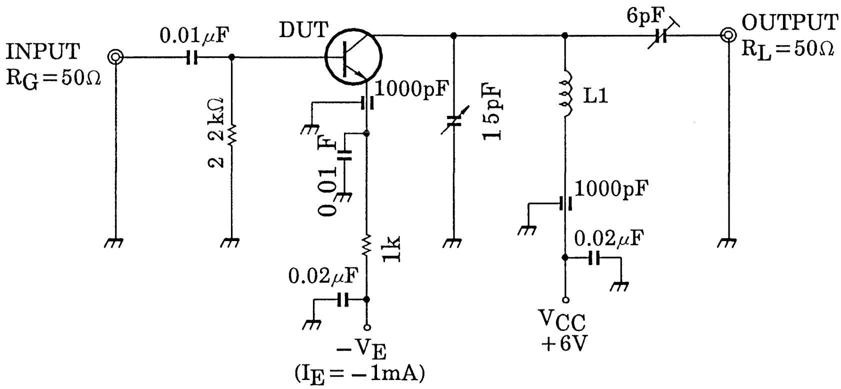


ELECTRICAL CHARACTERISTICS (Ta = 25°C)

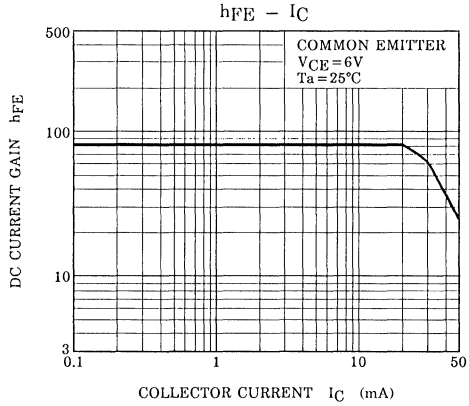
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 40V, I_E = 0A	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 4V, I_C = 0A	—	—	0.5	μA
DC Current Gain	h_{FE} (Note)	V_{CE} = 6V, I_C = 1mA	40	—	200	
Reverse Transfer Capacitance	C_{re}	V_{CB} = 6V, f = 1MHz	—	0.55	—	pF
Transition Frequency	f_T	V_{CE} = 6V, I_C = 1mA	260	550	—	MHz
Collector-Base Time Constant	$C_c \cdot r_{bb'}$	V_{CE} = 6V, I_E = −1mA, f = 30MHz	—	—	20	ps
Noise Figure	NF	V_{CC} = 6V, I_E = −1mA	—	2.3	5.0	dB
Power Gain	G_{pe}	f = 100MHz, Fig.1	17	23	—	dB

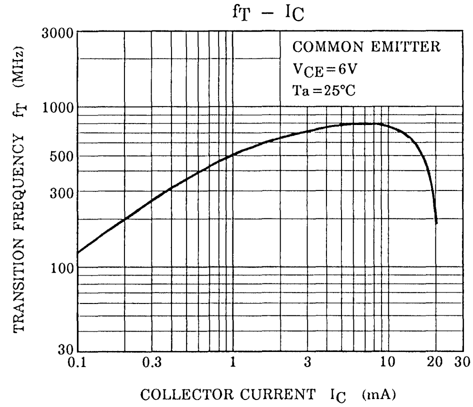
Note : h_{FE} Classification R : 40~80, O : 70~140, Y : 100~200

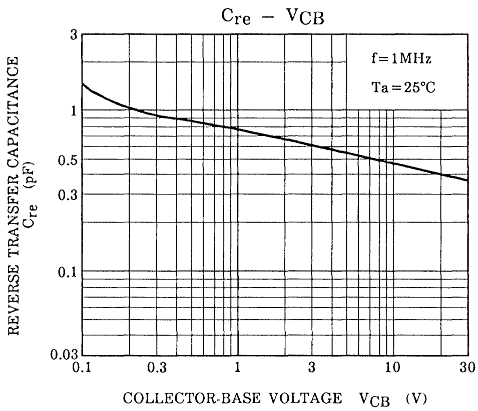
Fig.1 NF, G_{pe} TEST CIRCUIT

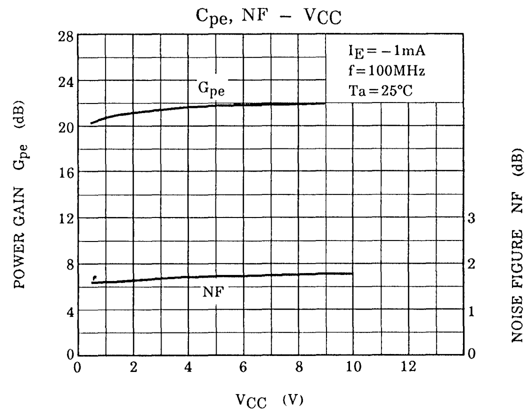


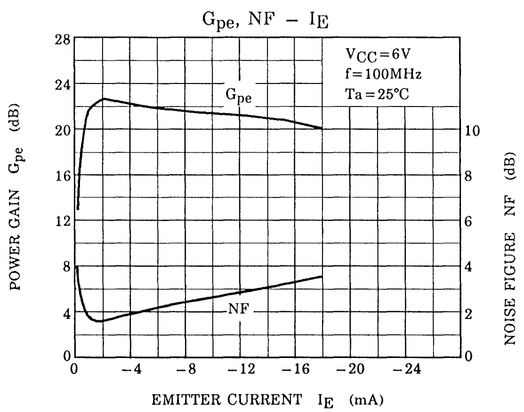
L1 : 0.8mmϕ SILVER PLATED COPPER WIRE, 4T, 10mm ID, 8mm LENGTH

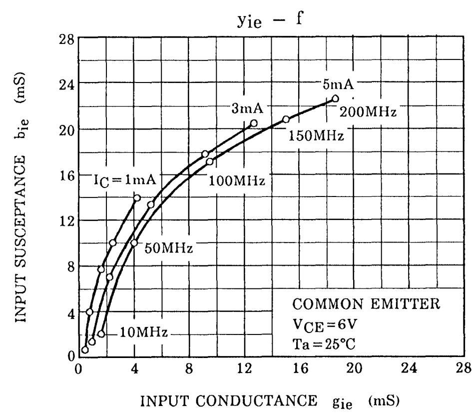

hFE – IC
COMMON EMITTER
VCE=6V
Ta=25°C
DC CURRENT GAIN hFE
COLLECTOR CURRENT IC (mA)


fT – IC
COMMON EMITTER
VCE=6V
Ta=25°C
TRANSITION FREQUENCY fT (MHz)
COLLECTOR CURRENT IC (mA)

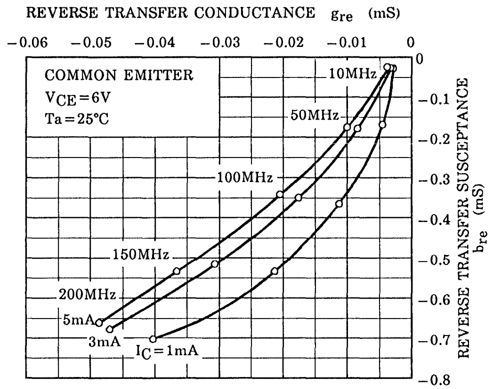

Cre – VCB
f=1MHz
Ta=25°C
REVERSE TRANSFER CAPACITANCE Cre (pF)
COLLECTOR-BASE VOLTAGE VCB (V)


Cpe, NF – VCC
IE=−1mA
f=100MHz
Ta=25°C
Gpe
NF
POWER GAIN Gpe (dB)
NOISE FIGURE NF (dB)
VCC (V)

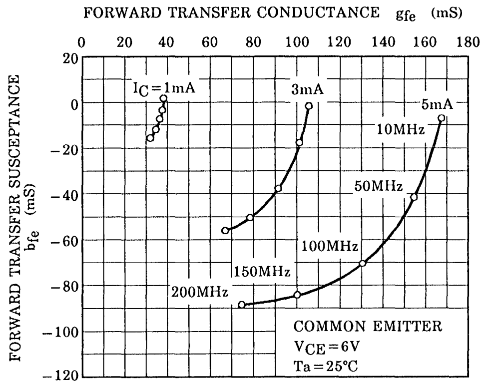

Gpe, NF – IE
VCC=6V
f=100MHz
Ta=25°C
Gpe
NF
POWER GAIN Gpe (dB)
NOISE FIGURE NF (dB)
EMITTER CURRENT IE (mA)


yie – f
5mA
3mA
200MHz
150MHz
IC=1mA
100MHz
50MHz
10MHz
COMMON EMITTER
VCE=6V
Ta=25°C
INPUT SUSCEPTANCE bie (mS)
INPUT CONDUCTANCE gie (mS)

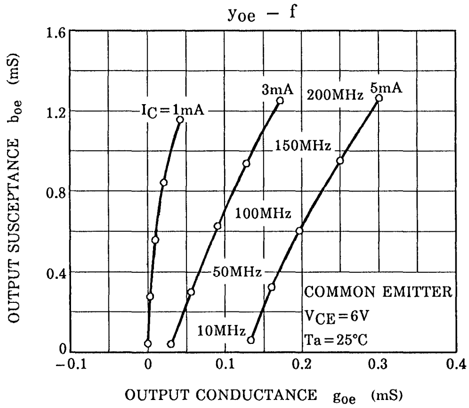
y_{re} – f



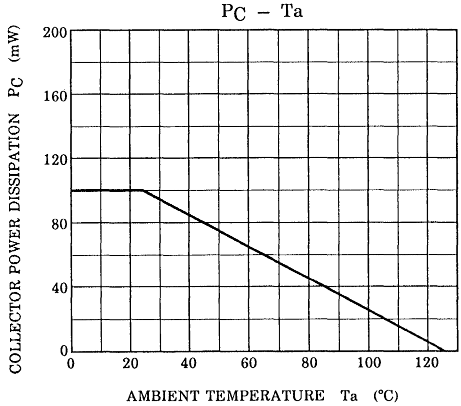
y_{fe} – f



y_{oe} – f



P_C – Ta

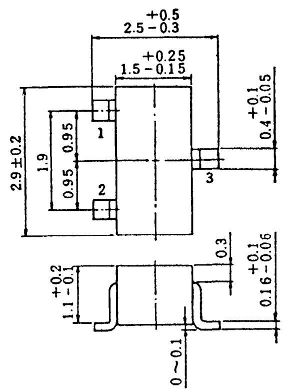


SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR 2SC5064

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure, High Gain.
- $NF = 1.1dB$, $|S_{21e}|^2 = 12dB$ ($f = 1GHz$)

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

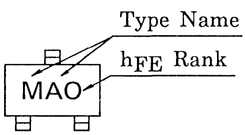
S-MINI	
JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

MAXIMUM RATINGS ($Ta = 25°C$)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Base Current	I_B	30	mA
Collector Current	I_C	15	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MARKING



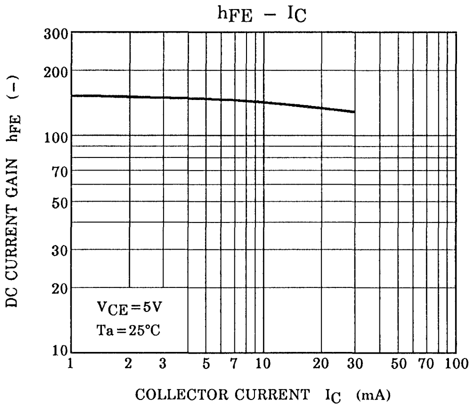
MICROWAVE CHARACTERISTICS ($Ta = 25°C$)

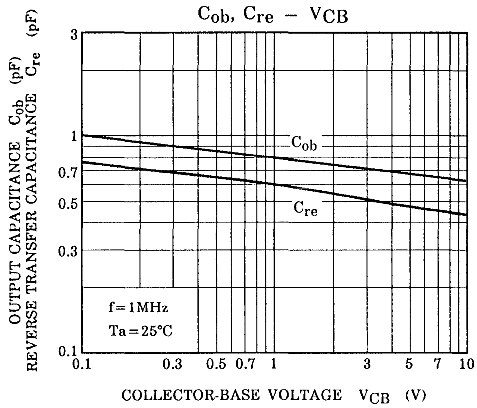
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	$V_{CE} = 5V$, $I_C = 10mA$	5	7	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	$V_{CE} = 5V$, $I_C = 10mA$, $f = 500MHz$	—	17	—	dB
	$\|S_{21e}\|^2$ (2)	$V_{CE} = 5V$, $I_C = 10mA$, $f = 1GHz$	8.5	12	—	
Noise Figure	NF (1)	$V_{CE} = 5V$, $I_C = 3mA$, $f = 500MHz$	—	1	—	dB
	NF (2)	$V_{CE} = 5V$, $I_C = 3mA$, $f = 1GHz$	—	1.1	2.0	

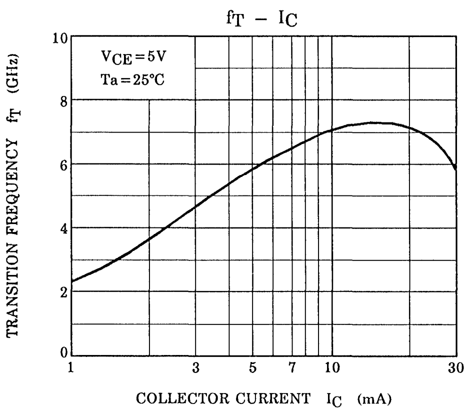
ELECTRICAL CHARACTERISTICS ($Ta = 25°C$)

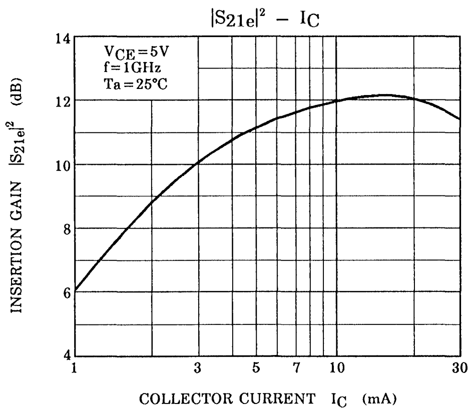
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB} = 10V$, $I_E = 0$	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB} = 1V$, $I_C = 0$	—	—	1	μA
DC Current Gain	h_{FE} (Note 1)	$V_{CE} = 5V$, $I_C = 10mA$	80	—	240	—
Output Capacitance	C_{ob}	$V_{CB} = 5V$, $I_E = 0$, $f = 1MHz$	—	0.7	—	pF
Reverse Transfer Capacitance	C_{re}	(Note 2)	—	0.45	0.9	pF

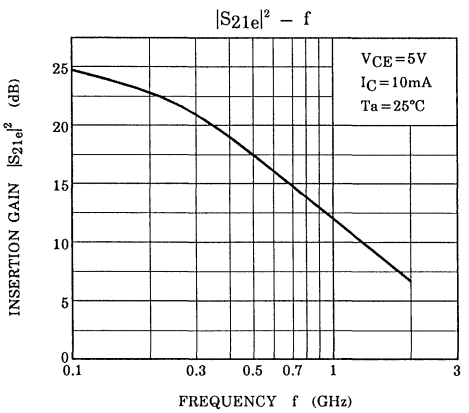
(Note 1) : h_{FE} Classification O : 80~160, Y : 120~240
(Note 2) : C_{re} is measured by 3 terminal method with capacitance bridge.

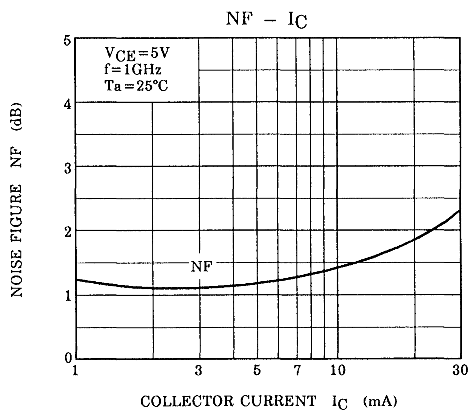

hFE − IC
DC CURRENT GAIN hFE (−)
300
200
100
70
50
30
20
10
VCE=5V
Ta=25°C
1 2 3 5 7 10 20 30 50 70 100
COLLECTOR CURRENT IC (mA)

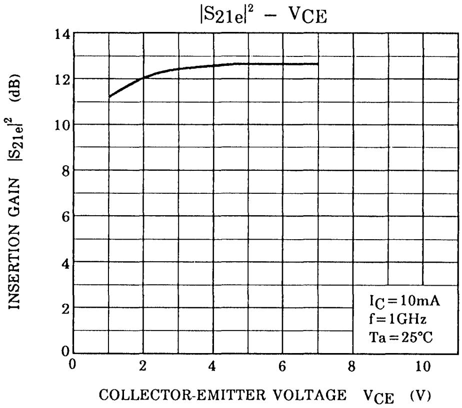

Cob, Cre − VCB
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
3
1
0.7
0.5
0.3
0.1
Cob
Cre
f=1MHz
Ta=25°C
0.1 0.3 0.5 0.7 1 3 5 7 10
COLLECTOR-BASE VOLTAGE VCB (V)

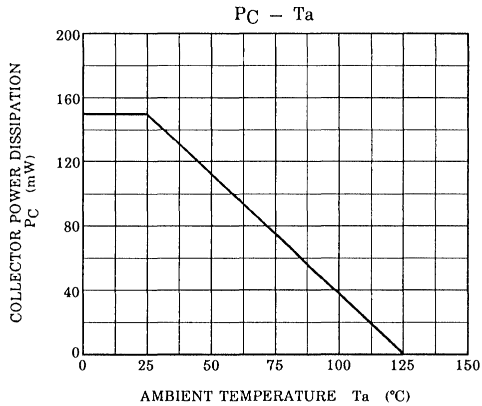

fT − IC
TRANSITION FREQUENCY fT (GHz)
10
8
6
4
2
0
VCE=5V
Ta=25°C
1 3 5 7 10 30
COLLECTOR CURRENT IC (mA)


|S21e|² − IC
INSERTION GAIN |S21e|² (dB)
14
12
10
8
6
4
VCE=5V
f=1GHz
Ta=25°C
1 3 5 7 10 30
COLLECTOR CURRENT IC (mA)


|S21e|² − f
INSERTION GAIN |S21e|² (dB)
25
20
15
10
5
0
VCE=5V
IC=10mA
Ta=25°C
0.1 0.3 0.5 0.7 1 3
FREQUENCY f (GHz)


NF − IC
NOISE FIGURE NF (dB)
5
4
3
2
1
0
VCE=5V
f=1GHz
Ta=25°C
NF
1 3 5 7 10 30
COLLECTOR CURRENT IC (mA)





S-Parameter $Z_O = 50\Omega$, Ta = 25°C

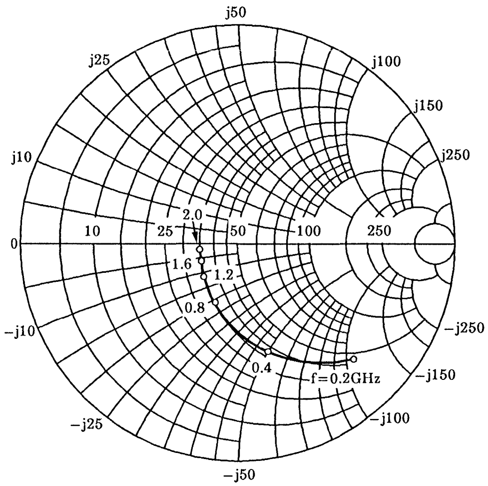
$V_{CE} = 5V$, $I_C = 5mA$

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.753	−43.7	10.247	140.6	0.040	65.6	0.827	−22.6
400	0.531	−75.1	7.684	117.1	0.060	57.1	0.648	−30.3
600	0.384	−96.4	5.815	103.0	0.074	56.1	0.551	−32.0
800	0.305	−112.6	4.523	93.6	0.086	57.0	0.500	−32.3
1000	0.255	−126.5	3.788	86.3	0.099	58.9	0.472	−32.4
1200	0.224	−138.4	3.244	80.7	0.112	60.2	0.455	−32.2
1400	0.203	−150.1	2.833	75.4	0.127	60.3	0.442	−32.6
1600	0.187	−159.4	2.529	70.6	0.139	60.0	0.434	−33.0
1800	0.174	−166.5	2.283	66.7	0.150	60.3	0.429	−32.6
2000	0.176	−171.2	2.107	63.0	0.164	59.2	0.428	−32.2

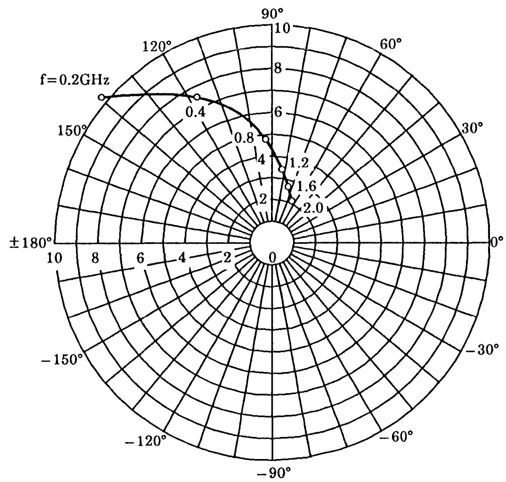
$V_{CE} = 5V$, $I_C = 10mA$

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.591	−58.0	14.955	129.6	0.034	64.3	0.714	−27.5
400	0.367	−90.3	9.581	107.5	0.052	61.9	0.534	−30.8
600	0.260	−110.7	6.781	96.1	0.067	63.9	0.462	−30.1
800	0.209	−126.9	5.207	88.6	0.083	65.2	0.428	−29.2
1000	0.178	−141.8	4.269	82.5	0.100	66.4	0.412	−28.6
1200	0.160	−153.7	3.618	77.7	0.117	66.7	0.403	−28.3
1400	0.150	−166.3	3.152	72.7	0.135	65.4	0.398	−28.8
1600	0.141	−175.2	2.801	68.7	0.149	64.0	0.393	−29.4
1800	0.130	178.2	2.521	65.0	0.163	63.4	0.392	−29.0
2000	0.133	174.0	2.314	61.7	0.179	61.3	0.395	−28.6

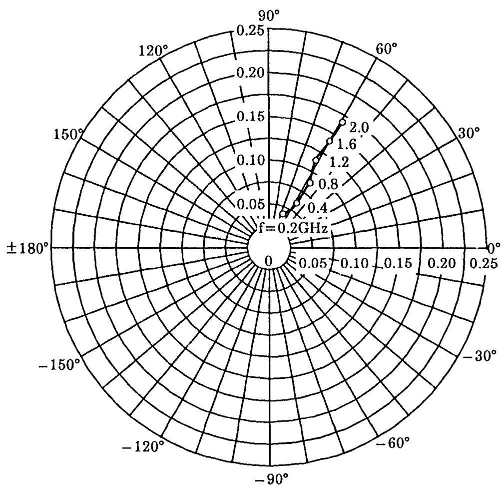
S_{11e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



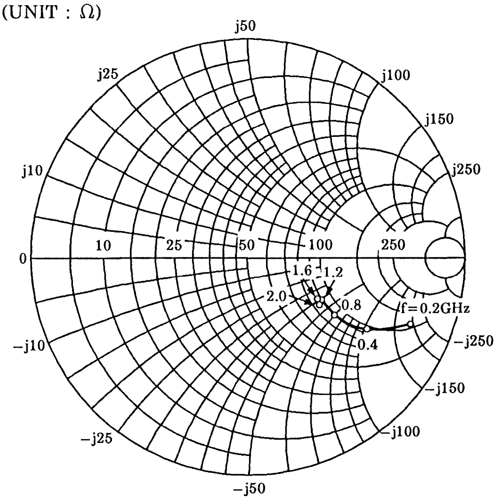
S_{21e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$



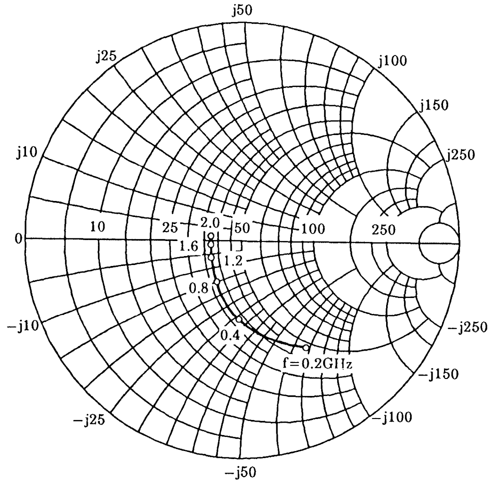
S_{12e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$



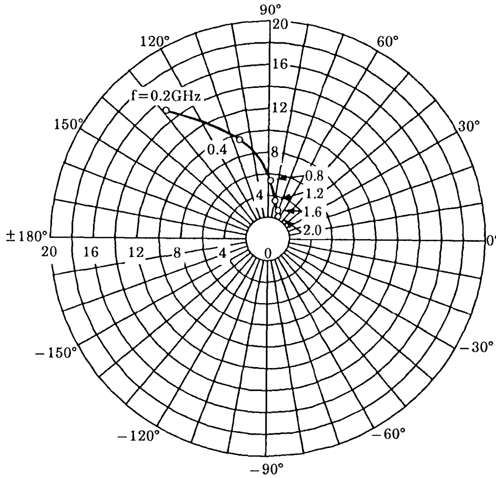
S_{22e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



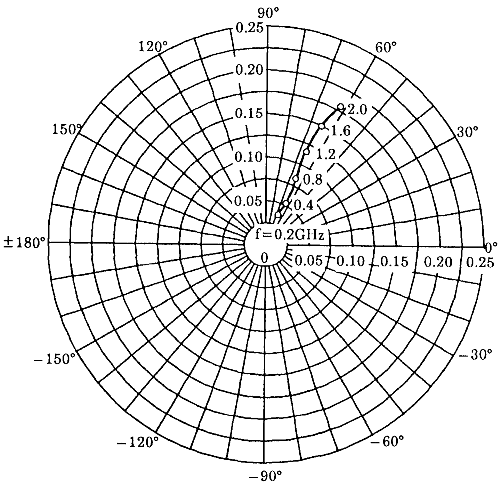
S_{11e}
$V_{CE}=5V$
$I_C=10mA$
$Ta=25°C$
(UNIT : Ω)



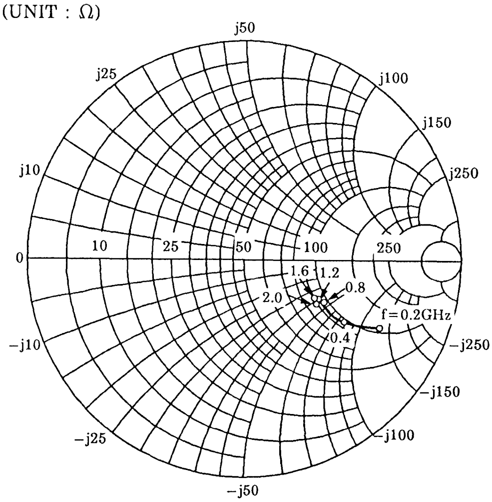
S_{21e}
$V_{CE}=5V$
$I_C=10mA$
$Ta=25°C$



S_{12e}
$V_{CE}=5V$
$I_C=10mA$
$Ta=25°C$



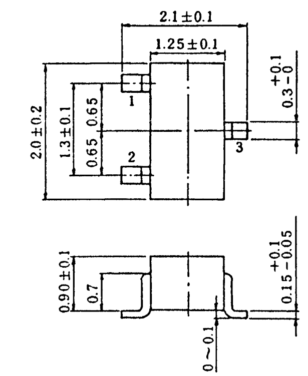
S_{22e}
$V_{CE}=5V$
$I_C=10mA$
$Ta=25°C$
(UNIT : Ω)



2SC5065 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

Unit in mm



USM	1. BASE 2. EMITTER 3. COLLECTOR
JEDEC	—
EIAJ	SC-70
TOSHIBA	2-3E1A

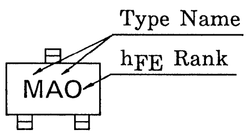
Weight : 0.006g

- Low Noise Figure, High Gain.
- NF=1.1dB, $|S_{21e}|^2$=12dB (f=1GHz)

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Base Current	I_B	30	mA
Collector Current	I_C	15	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MARKING



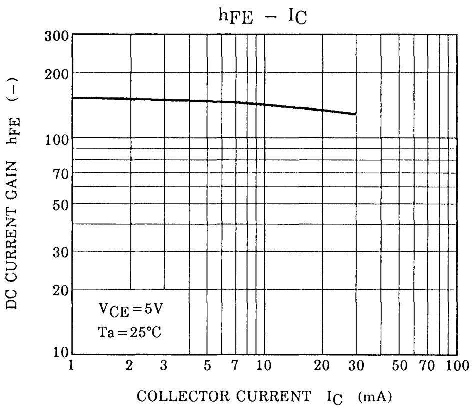
MICROWAVE CHARACTERISTICS (Ta=25°C)

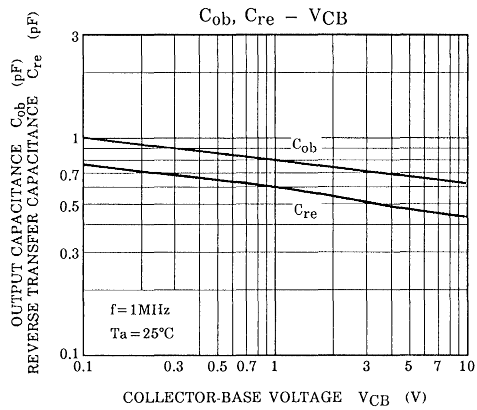
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE}=5V, I_C=10mA	5	7	—	GHz
Insertion Gain	$|S_{21e}|^2$ (1)	V_{CE}=5V, I_C=10mA, f=500MHz	—	17	—	dB
	$|S_{21e}|^2$ (2)	V_{CE}=5V, I_C=10mA, f=1GHz	8.5	12	—	dB
Noise Figure	NF (1)	V_{CE}=5V, I_C=3mA, f=500MHz	—	1	—	dB
	NF (2)	V_{CE}=5V, I_C=3mA, f=1GHz	—	1.1	2.0	dB

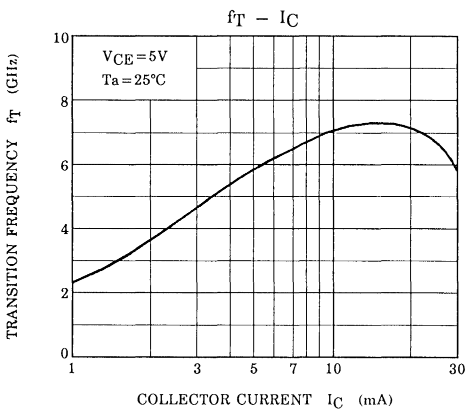
ELECTRICAL CHARACTERISTICS (Ta=25°C)

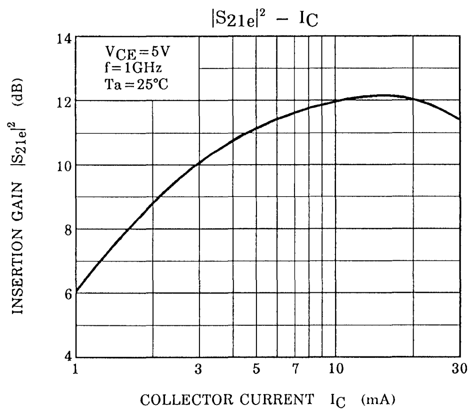
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB}=10V, I_E=0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB}=1V, I_C=0	—	—	1	μA
DC Current Gain	h_{FE} (Note 1)	V_{CE}=5V, I_C=10mA	80	—	240	—
Output Capacitance	C_{ob}	V_{CB}=5V, I_E=0, f=1MHz	—	0.7	—	pF
Reverse Transfer Capacitance	C_{re}	(Note 2)	—	0.45	0.9	pF

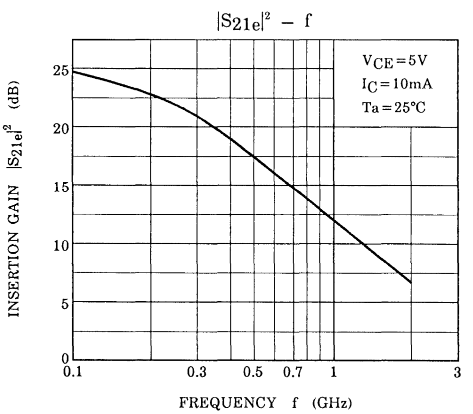
(Note 1) : h_{FE} Classification O : 80~160, Y : 120~240
(Note 2) : C_{re} is measured by 3 terminal method with capacitance bridge.

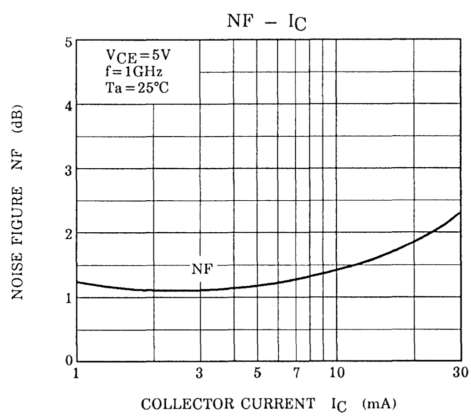

hFE – IC
DC CURRENT GAIN hFE (–)
VCE=5V
Ta=25°C
COLLECTOR CURRENT IC (mA)

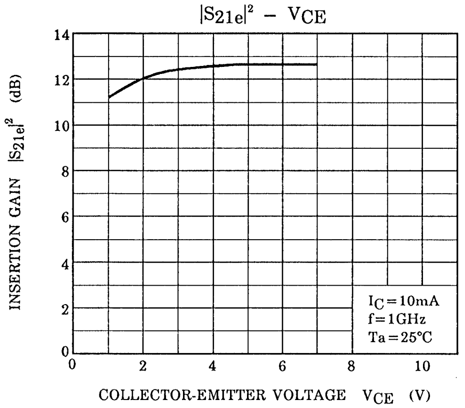

Cob, Cre – VCB
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
Cob
Cre
f=1MHz
Ta=25°C
COLLECTOR-BASE VOLTAGE VCB (V)

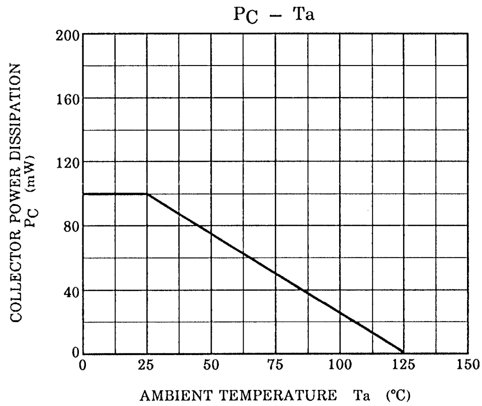

fT – IC
TRANSITION FREQUENCY fT (GHz)
VCE=5V
Ta=25°C
COLLECTOR CURRENT IC (mA)


|S21e|² – IC
INSERTION GAIN |S21e|² (dB)
VCE=5V
f=1GHz
Ta=25°C
COLLECTOR CURRENT IC (mA)


|S21e|² – f
INSERTION GAIN |S21e|² (dB)
VCE=5V
IC=10mA
Ta=25°C
FREQUENCY f (GHz)


NF – IC
NOISE FIGURE NF (dB)
VCE=5V
f=1GHz
Ta=25°C
NF
COLLECTOR CURRENT IC (mA)





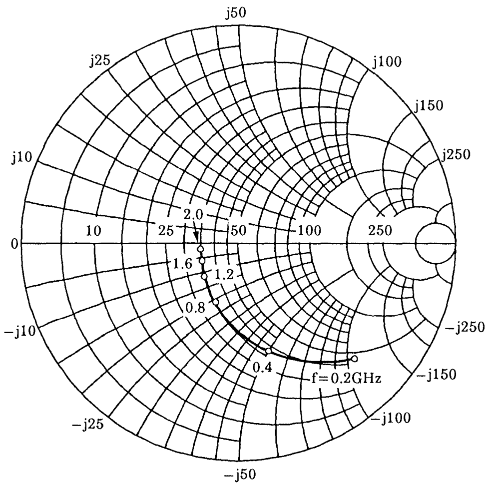
S-Parameter $Z_O = 50\Omega$, Ta = 25°C
$V_{CE} = 5V$, $I_C = 5mA$

frequency (MHz)	S11 Mag.	S11 Ang.	S21 Mag.	S21 Ang.	S12 Mag.	S12 Ang.	S22 Mag.	S22 Ang.
200	0.753	−43.7	10.247	140.6	0.040	65.6	0.827	−22.6
400	0.531	−75.1	7.684	117.1	0.060	57.1	0.648	−30.3
600	0.384	−96.4	5.815	103.0	0.074	56.1	0.551	−32.0
800	0.305	−112.6	4.523	93.6	0.086	57.0	0.500	−32.3
1000	0.255	−126.5	3.788	86.3	0.099	58.9	0.472	−32.4
1200	0.224	−138.4	3.244	80.7	0.112	60.2	0.455	−32.2
1400	0.203	−150.1	2.833	75.4	0.127	60.3	0.442	−32.6
1600	0.187	−159.4	2.529	70.6	0.139	60.0	0.434	−33.0
1800	0.174	−166.5	2.283	66.7	0.150	60.3	0.429	−32.6
2000	0.176	−171.2	2.107	63.0	0.164	59.2	0.428	−32.2

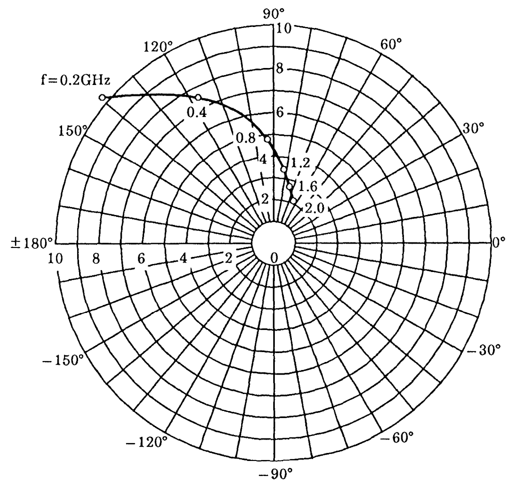
$V_{CE} = 5V$, $I_C = 10mA$

frequency (MHz)	S11 Mag.	S11 Ang.	S21 Mag.	S21 Ang.	S12 Mag.	S12 Ang.	S22 Mag.	S22 Ang.
200	0.591	−58.0	14.955	129.6	0.034	64.3	0.714	−27.5
400	0.367	−90.3	9.581	107.5	0.052	61.9	0.534	−30.8
600	0.260	−110.7	6.781	96.1	0.067	63.9	0.462	−30.1
800	0.209	−126.9	5.207	88.6	0.083	65.2	0.428	−29.2
1000	0.178	−141.8	4.269	82.5	0.100	66.4	0.412	−28.6
1200	0.160	−153.7	3.618	77.7	0.117	66.7	0.403	−28.3
1400	0.150	−166.3	3.152	72.7	0.135	65.4	0.398	−28.8
1600	0.141	−175.2	2.801	68.7	0.149	64.0	0.393	−29.4
1800	0.130	178.2	2.521	65.0	0.163	63.4	0.392	−29.0
2000	0.133	174.0	2.314	61.7	0.179	61.3	0.395	−28.6

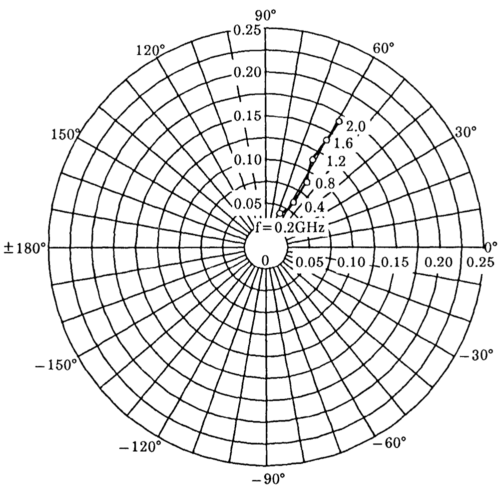
S_{11e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



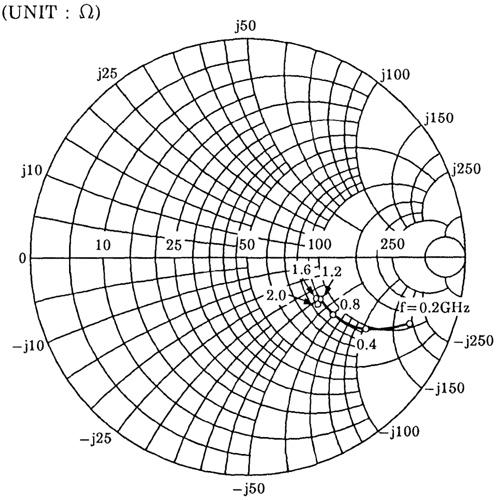
S_{21e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$



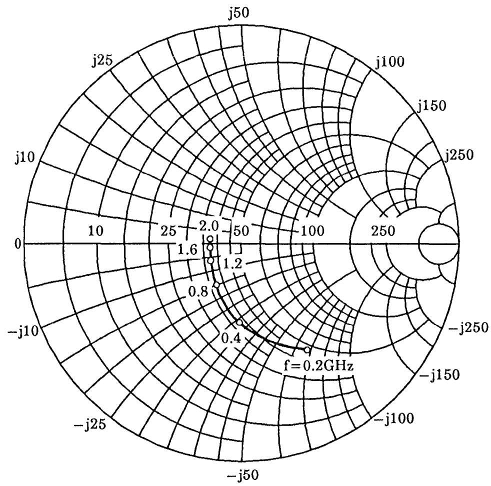
S_{12e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$



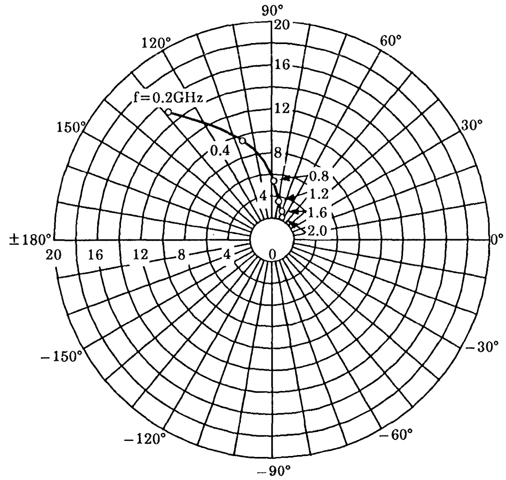
S_{22e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



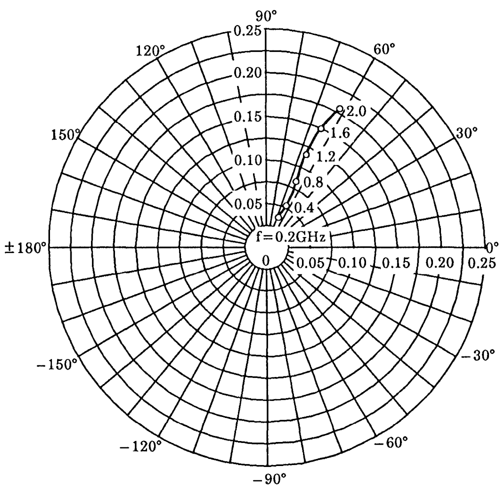
S_{11e}
$V_{CE}=5V$
$I_C=10mA$
$Ta=25°C$
(UNIT : Ω)



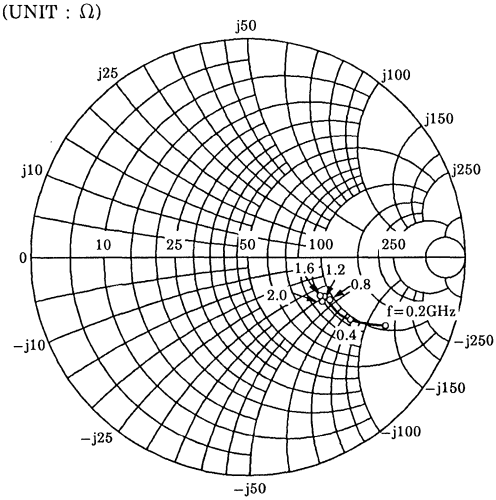
S_{21e}
$V_{CE}=5V$
$I_C=10mA$
$Ta=25°C$



S_{12e}
$V_{CE}=5V$
$I_C=10mA$
$Ta=25°C$



S_{22e}
$V_{CE}=5V$
$I_C=10mA$
$Ta=25°C$
(UNIT : Ω)



SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC5066

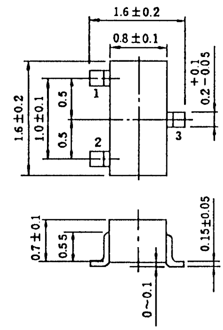
VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

Unit in mm

- Low Noise Figure, High Gain.
- NF=1.1dB, $|S_{21e}|^2$=12dB (f=1GHz)

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Base Current	I_B	30	mA
Collector Current	I_C	15	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C



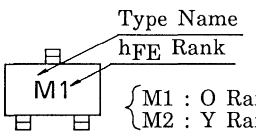
1. BASE
2. EMITTER
3. COLLECTOR

SSM

JEDEC	—
EIAJ	—
TOSHIBA	2-2H1A

Weight : 2.4mg

MARKING



{M1 : O Rank
 M2 : Y Rank

MICROWAVE CHARACTERISTICS (Ta=25°C)

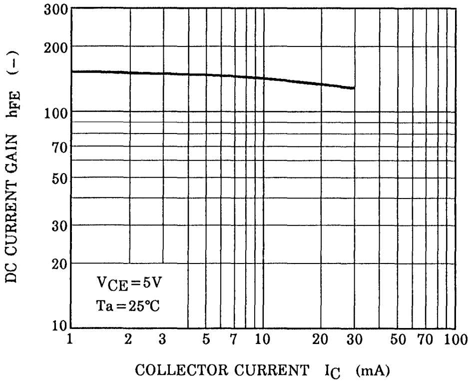
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE}=5V, I_C=10mA	5	7	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE}=5V, I_C=10mA, f=500MHz	—	17	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE}=5V, I_C=10mA, f=1GHz	8.5	12	—	
Noise Figure	NF (1)	V_{CE}=5V, I_C=3mA, f=500MHz	—	1	—	dB
	NF (2)	V_{CE}=5V, I_C=3mA, f=1GHz	—	1.1	2.0	

ELECTRICAL CHARACTERISTICS (Ta=25°C)

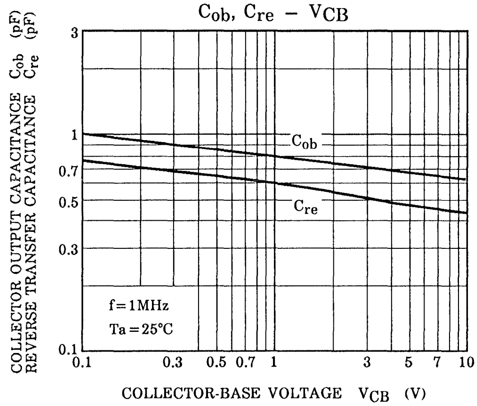
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB}=10V, I_E=0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB}=1V, I_C=0	—	—	1	μA
DC Current Gain	h_{FE} (Note 1)	V_{CE}=5V, I_C=10mA	80	—	240	—
Output Capacitance	C_{ob}	V_{CB}=5V, I_E=0, f=1MHz	—	0.7	—	pF
Reverse Transfer Capacitance	C_{re}	(Note 2)	—	0.45	0.9	pF

(Note 1) : h_{FE} Classification O : 80~160, Y : 120~240
(Note 2) : C_{re} is measured by 3 terminal method with capacitance bridge.

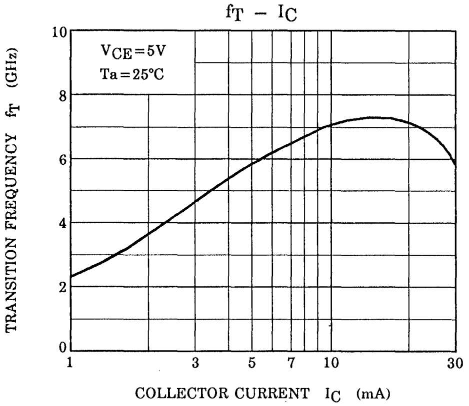
h_{FE} – I_C



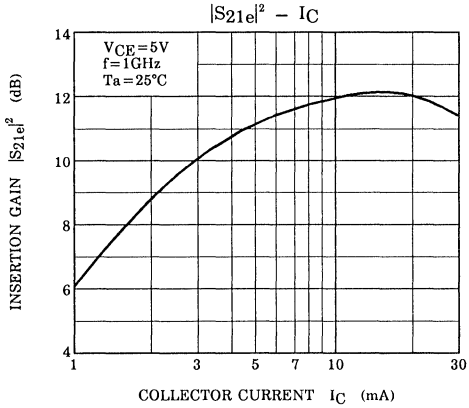
C_{ob}, C_{re} – V_{CB}



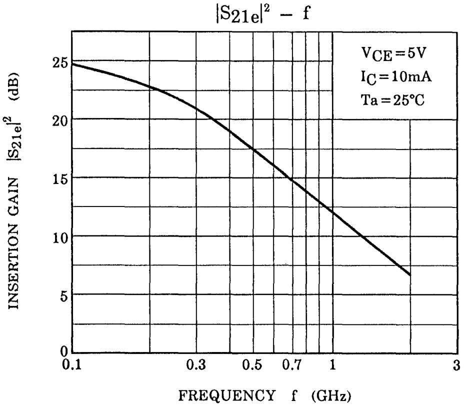
f_T – I_C



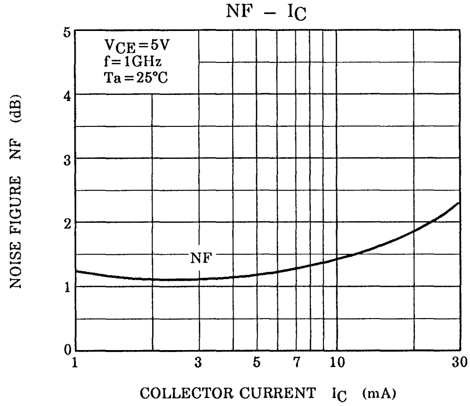
$|S_{21e}|^2$ – I_C

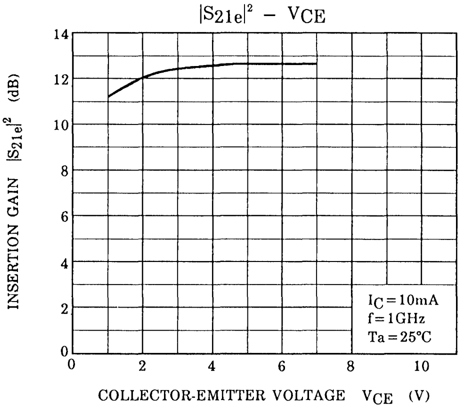


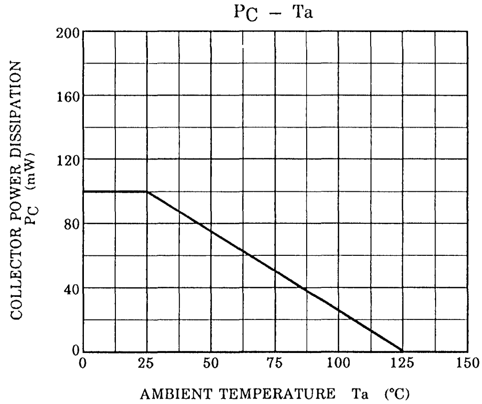
$|S_{21e}|^2$ – f



NF – I_C







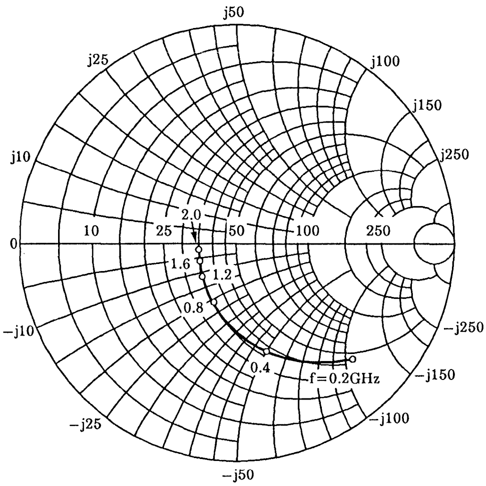
S-Parameter $Z_O = 50\Omega$, Ta = 25°C
V_{CE} = 5V, I_C = 5mA

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.753	−43.7	10.247	140.6	0.040	65.6	0.827	−22.6
400	0.531	−75.1	7.684	117.1	0.060	57.1	0.648	−30.3
600	0.384	−96.4	5.815	103.0	0.074	56.1	0.551	−32.0
800	0.305	−112.6	4.523	93.6	0.086	57.0	0.500	−32.3
1000	0.255	−126.5	3.788	86.3	0.099	58.9	0.472	−32.4
1200	0.224	−138.4	3.244	80.7	0.112	60.2	0.455	−32.2
1400	0.203	−150.1	2.833	75.4	0.127	60.3	0.442	−32.6
1600	0.187	−159.4	2.529	70.6	0.139	60.0	0.434	−33.0
1800	0.174	−166.5	2.283	66.7	0.150	60.3	0.429	−32.6
2000	0.176	−171.2	2.107	63.0	0.164	59.2	0.428	−32.2

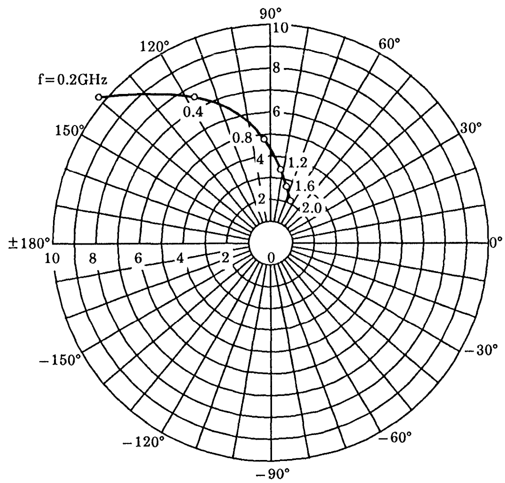
V_{CE} = 5V, I_C = 10mA

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.591	−58.0	14.955	129.6	0.034	64.3	0.714	−27.5
400	0.367	−90.3	9.581	107.5	0.052	61.9	0.534	−30.8
600	0.260	−110.7	6.781	96.1	0.067	63.9	0.462	−30.1
800	0.209	−126.9	5.207	88.6	0.083	65.2	0.428	−29.2
1000	0.178	−141.8	4.269	82.5	0.100	66.4	0.412	−28.6
1200	0.160	−153.7	3.618	77.7	0.117	66.7	0.403	−28.3
1400	0.150	−166.3	3.152	72.7	0.135	65.4	0.398	−28.8
1600	0.141	−175.2	2.801	68.7	0.149	64.0	0.393	−29.4
1800	0.130	178.2	2.521	65.0	0.163	63.4	0.392	−29.0
2000	0.133	174.0	2.314	61.7	0.179	61.3	0.395	−28.6

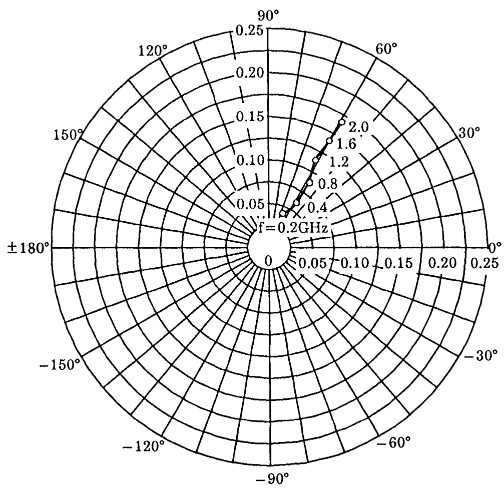
S_{11e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



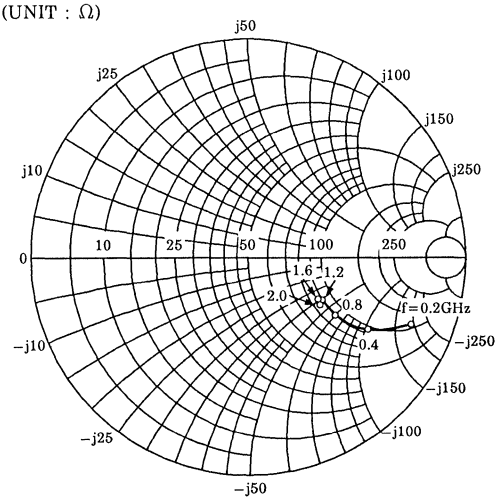
S_{21e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$



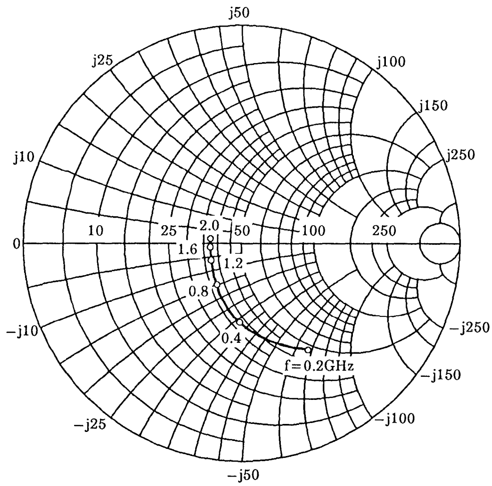
S_{12e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$



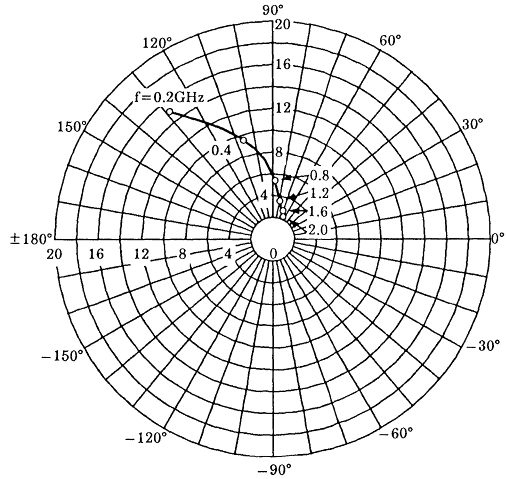
S_{22e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



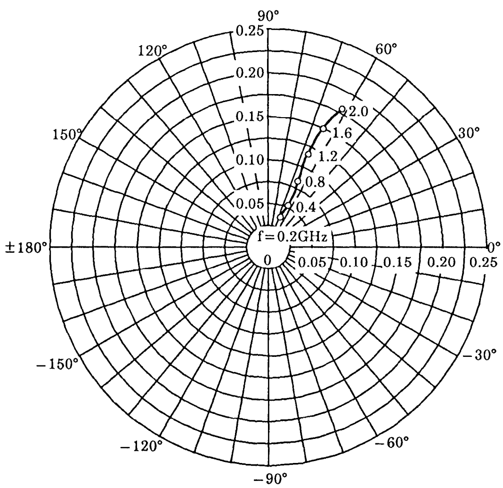
S_{11e}
$V_{CE} = 5V$
$I_C = 10mA$
$Ta = 25°C$
(UNIT : Ω)



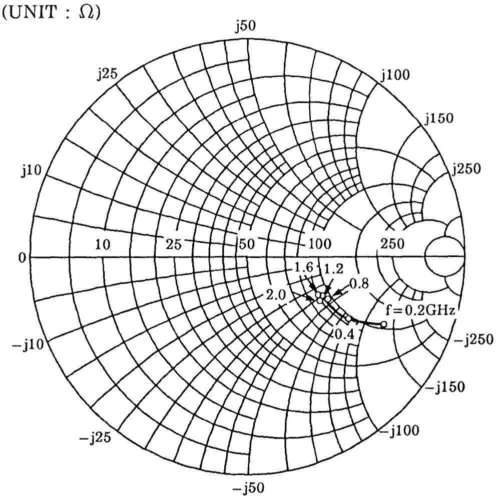
S_{21e}
$V_{CE} = 5V$
$I_C = 10mA$
$Ta = 25°C$



S_{12e}
$V_{CE} = 5V$
$I_C = 10mA$
$Ta = 25°C$



S_{22e}
$V_{CE} = 5V$
$I_C = 10mA$
$Ta = 25°C$
(UNIT : Ω)



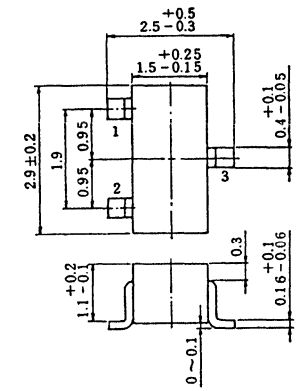
2SC5084

SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure, High Gain.
- NF = 1.1dB, $|S_{21e}|^2 = 11$dB (f = 1GHz)

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

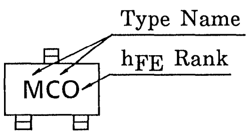
JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	80	mA
Base Current	I_B	40	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MARKING



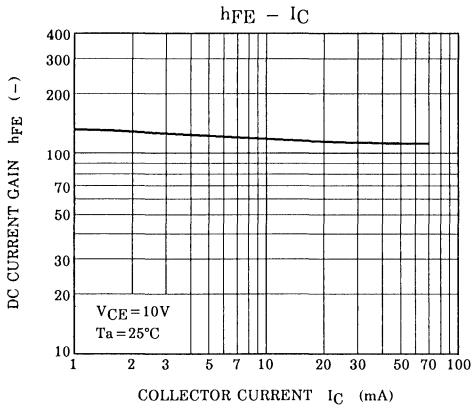
MICROWAVE CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	$V_{CE} = 10$V, $I_C = 20$mA	5	7	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	$V_{CE} = 10$V, $I_C = 20$mA, f = 500MHz	—	16.5	—	dB
	$\|S_{21e}\|^2$ (2)	$V_{CE} = 10$V, $I_C = 20$mA, f = 1GHz	7.5	11	—	
Noise Figure	NF (1)	$V_{CE} = 10$V, $I_C = 5$mA, f = 500MHz	—	1	—	dB
	NF (2)	$V_{CE} = 10$V, $I_C = 5$mA, f = 1GHz	—	1.1	2	

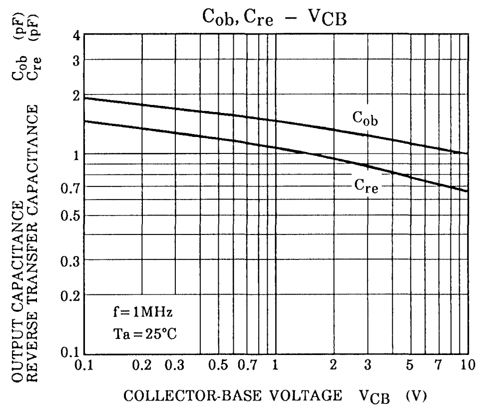
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB} = 10$V, $I_E = 0$	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB} = 1$V, $I_C = 0$	—	—	1	μA
DC Current Gain	h_{FE} Note	$V_{CE} = 10$V, $I_C = 20$mA	80	—	240	—
Output Capacitance	C_{ob}	$V_{CB} = 10$V, $I_E = 0$, f = 1MHz	—	1.0	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.65	1.15	pF

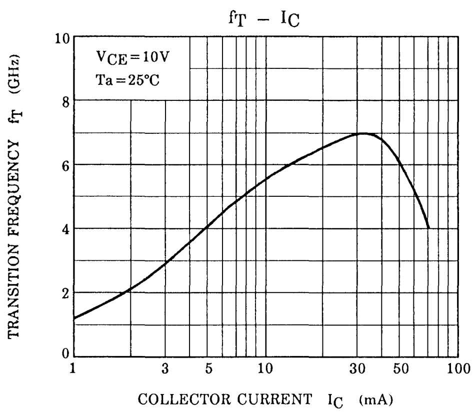
Note : C_{re} is measured by 3 terminal method with capacitance bridge.
Note : h_{FE} Classification O : 80~160, Y : 120~240



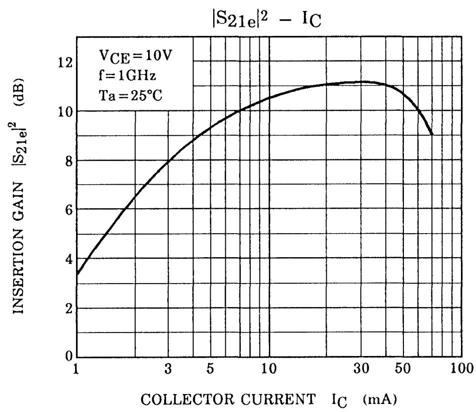
hFE − IC
DC CURRENT GAIN hFE (−)
VCE=10V
Ta=25°C
COLLECTOR CURRENT IC (mA)



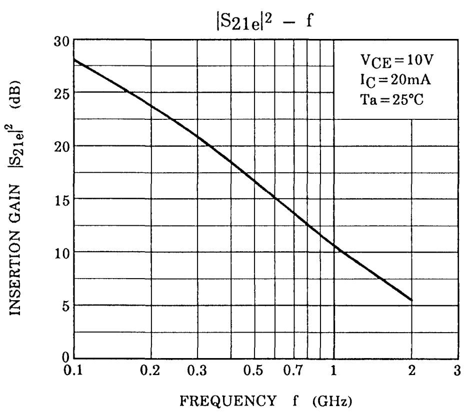
Cob, Cre − VCB
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
Cob
Cre
f=1MHz
Ta=25°C
COLLECTOR-BASE VOLTAGE VCB (V)



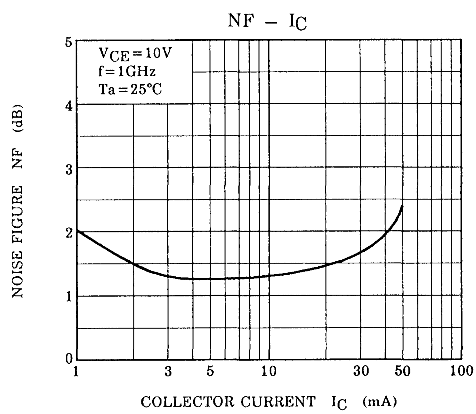
fT − IC
TRANSITION FREQUENCY fT (GHz)
VCE=10V
Ta=25°C
COLLECTOR CURRENT IC (mA)



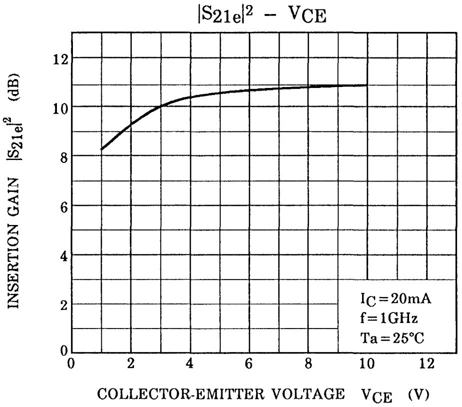
|S21e|2 − IC
INSERTION GAIN |S21e|2 (dB)
VCE=10V
f=1GHz
Ta=25°C
COLLECTOR CURRENT IC (mA)

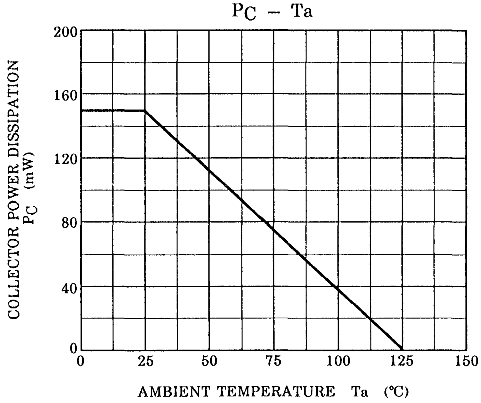


|S21e|2 − f
INSERTION GAIN |S21e|2 (dB)
VCE=10V
IC=20mA
Ta=25°C
FREQUENCY f (GHz)



NF − IC
NOISE FIGURE NF (dB)
VCE=10V
f=1GHz
Ta=25°C
COLLECTOR CURRENT IC (mA)





S-Parameter $Z_O = 50\Omega$, Ta = 25°C

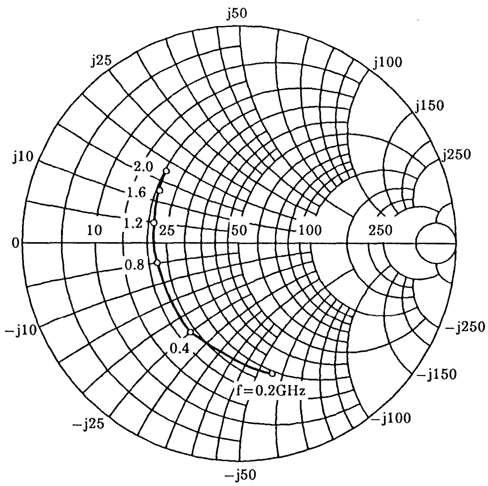
$V_{CE} = 10V$, $I_C = 5mA$

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.628	−77.1	9.254	126.5	0.051	53.3	0.695	−31.0
400	0.471	−122.1	6.027	103.3	0.067	48.4	0.509	−34.9
600	0.417	−149.1	4.341	90.3	0.077	51.9	0.441	−35.2
800	0.404	−167.3	3.381	81.2	0.090	56.9	0.412	−36.0
1000	0.402	178.1	2.798	73.3	0.104	62.0	0.398	−37.7
1200	0.412	166.6	2.393	66.7	0.122	66.4	0.390	−40.3
1400	0.427	156.6	2.108	60.4	0.145	69.1	0.385	−44.3
1600	0.440	147.3	1.881	54.8	0.170	69.8	0.376	−48.8
1800	0.455	140.0	1.713	49.4	0.194	70.2	0.373	−54.3
2000	0.482	132.6	1.586	44.6	0.223	71.3	0.367	−60.0

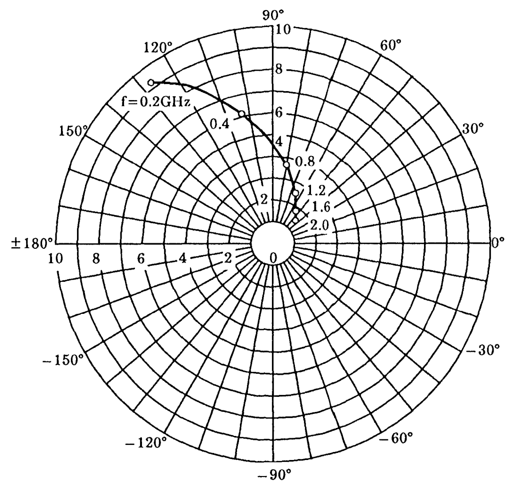
$V_{CE} = 10V$, $I_C = 20mA$

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.340	−122.7	15.443	107.4	0.034	62.7	0.415	−40.5
400	0.299	−158.7	8.266	92.4	0.056	69.3	0.293	−34.2
600	0.293	−178.0	5.664	84.0	0.080	71.7	0.265	−30.4
800	0.294	169.0	4.334	77.3	0.104	72.1	0.255	−29.9
1000	0.299	157.9	3.528	71.2	0.129	72.0	0.252	−30.6
1200	0.310	149.5	3.002	66.0	0.155	71.4	0.254	−32.5
1400	0.321	142.0	2.629	61.0	0.183	69.7	0.255	−36.1
1600	0.332	134.9	2.336	56.3	0.209	67.6	0.248	−40.6
1800	0.341	129.5	2.121	51.7	0.234	65.6	0.242	−45.9
2000	0.366	124.3	1.958	47.3	0.260	64.6	0.236	−51.7

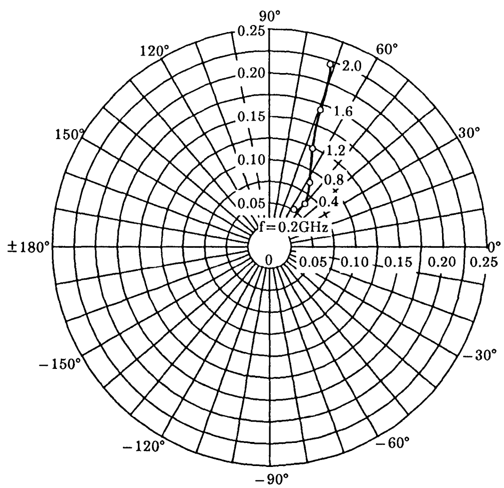
S_{11e}
$V_{CE} = 10V$
$I_C = 5mA$
$Ta = 25°C$
(UNIT : Ω)



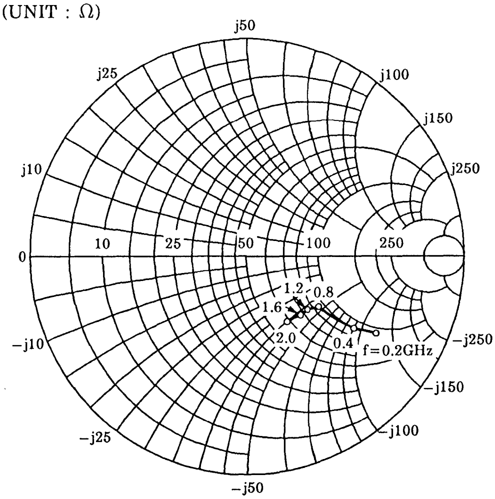
S_{21e}
$V_{CE} = 10V$
$I_C = 5mA$
$Ta = 25°C$



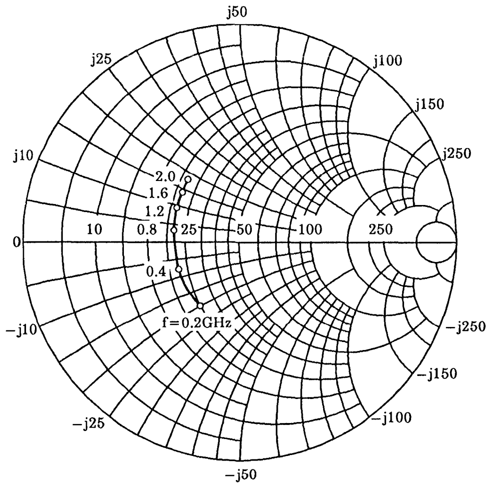
S_{12e}
$V_{CE} = 10V$
$I_C = 5mA$
$Ta = 25°C$



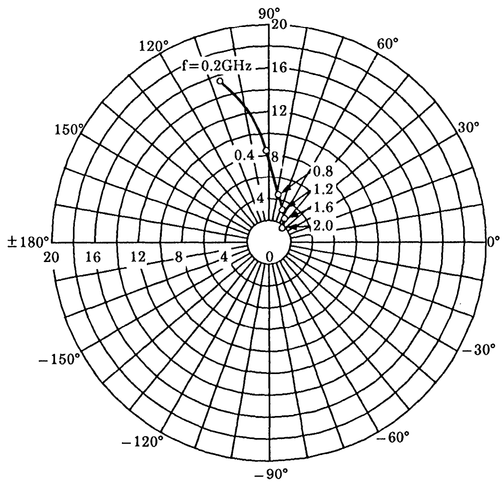
S_{22e}
$V_{CE} = 10V$
$I_C = 5mA$
$Ta = 25°C$
(UNIT : Ω)



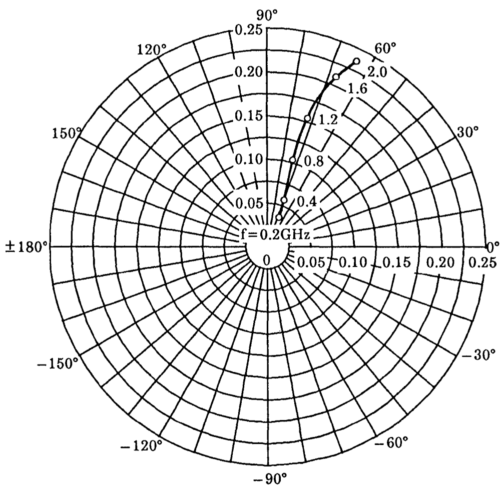
S_{11e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)



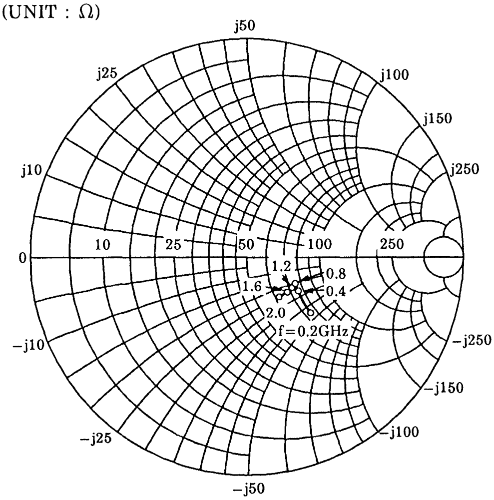
S_{21e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$



S_{12e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$



S_{22e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)

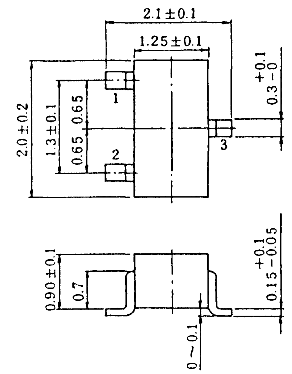


SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC5085

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1A

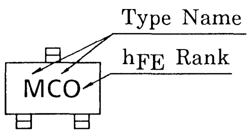
Weight : 0.006g

- Low Noise Figure, High Gain.
- NF = 1.1dB, $|S_{21e}|^2$ = 11dB (f = 1GHz)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	80	mA
Base Current	I_B	40	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MARKING



MICROWAVE CHARACTERISTICS (Ta = 25°C)

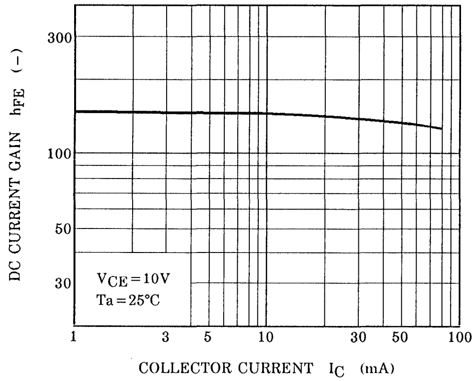
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 10V, I_C = 20mA	5	7	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE} = 10V, I_C = 20mA, f = 500MHz	—	16.5	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE} = 10V, I_C = 20mA, f = 1GHz	7.5	11	—	
Noise Figure	NF (1)	V_{CE} = 10V, I_C = 5mA, f = 500MHz	—	1	—	dB
	NF (2)	V_{CE} = 10V, I_C = 5mA, f = 1GHz	—	1.1	2	

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

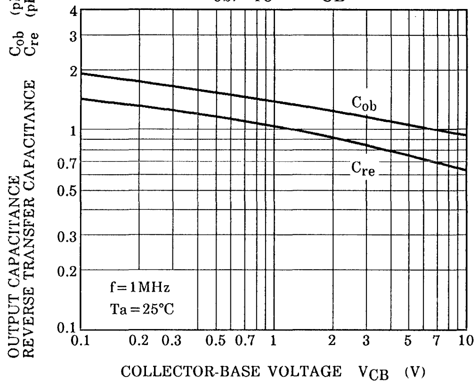
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_C = 0	—	—	1	μA
DC Current Gain	h_{FE} Note	V_{CE} = 10V, I_C = 20mA	80	—	240	—
Output Capacitance	C_{ob}	V_{CB} = 10V, I_E = 0, f = 1MHz	—	1.0	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.65	1.15	pF

Note : C_{re} is measured by 3 terminal method with capacitance bridge.
Note : h_{FE} Classification O : 80~160, Y : 120~240

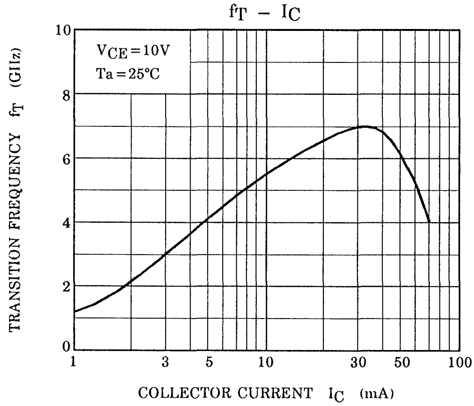
h_{FE} – I_C



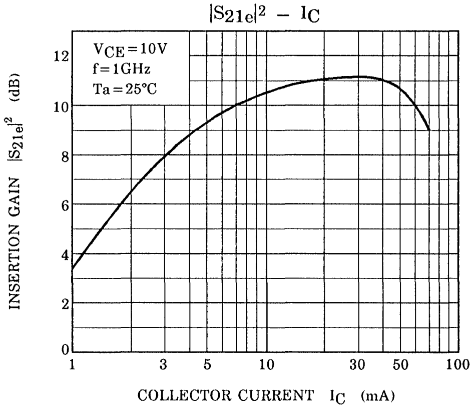
C_{ob}, C_{re} – V_{CB}



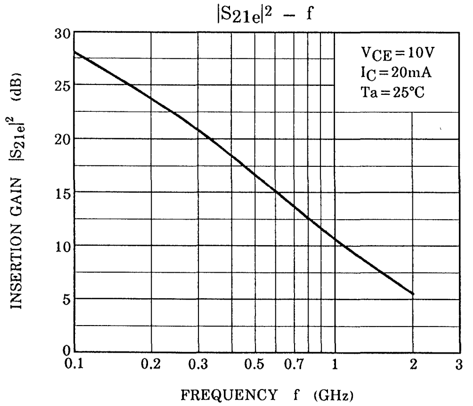
f_T – I_C



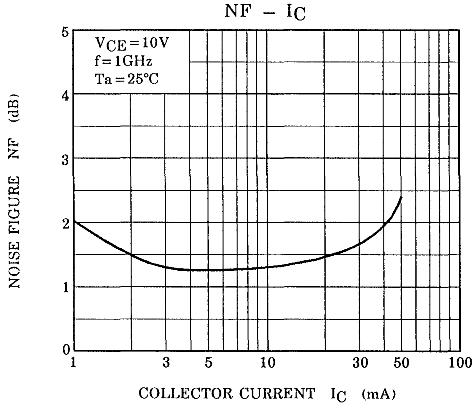
$|S_{21e}|^2$ – I_C

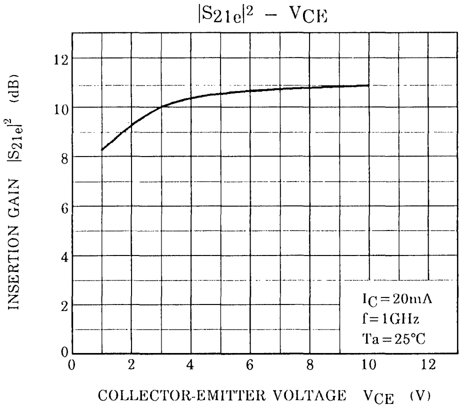


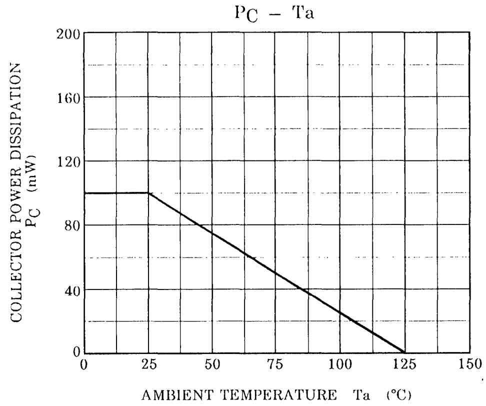
$|S_{21e}|^2$ – f



NF – I_C







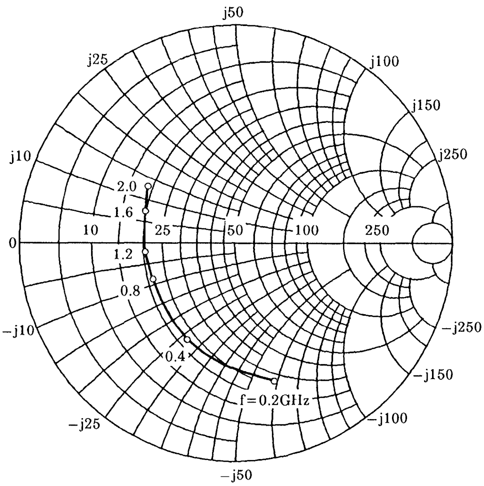
S-Parameter $Z_O = 50\Omega$, Ta = 25°C
V_{CE} = 10V, I_C = 5mA

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.672	−73.0	9.460	128.6	0.052	53.6	0.707	−31.3
400	0.498	−115.9	6.268	105.9	0.068	46.8	0.513	−36.2
600	0.443	−141.7	4.554	93.3	0.078	49.0	0.437	−36.6
800	0.426	−158.7	3.556	84.5	0.088	53.2	0.401	−36.8
1000	0.422	−171.9	2.948	77.5	0.099	57.9	0.383	−38.3
1200	0.428	177.5	2.526	71.1	0.113	62.7	0.373	−40.6
1400	0.437	168.3	2.240	65.5	0.133	65.8	0.367	−43.9
1600	0.449	159.9	1.997	60.1	0.152	67.6	0.362	−48.2
1800	0.464	153.1	1.821	55.0	0.171	68.7	0.358	−52.8
2000	0.485	146.7	1.686	50.9	0.195	70.6	0.350	−57.6

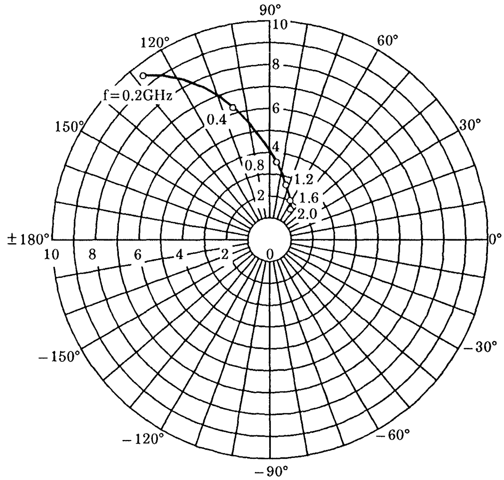
V_{CE} = 10V, I_C = 20mA

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.392	−116.4	16.247	109.3	0.034	59.7	0.420	−43.7
400	0.329	−152.1	8.775	94.5	0.054	66.0	0.280	−38.4
600	0.321	−170.6	6.018	86.3	0.075	69.5	0.244	−33.7
800	0.321	177.5	4.598	80.2	0.097	70.7	0.231	−31.7
1000	0.324	167.9	3.767	74.8	0.119	71.2	0.225	−31.3
1200	0.332	160.3	3.191	70.0	0.142	71.3	0.225	−32.7
1400	0.341	153.5	2.812	65.2	0.168	70.0	0.225	−36.2
1600	0.352	146.6	2.502	60.7	0.190	68.4	0.222	−40.3
1800	0.362	142.2	2.264	56.5	0.212	66.8	0.217	−44.9
2000	0.379	137.7	2.092	52.8	0.236	66.3	0.212	−49.4

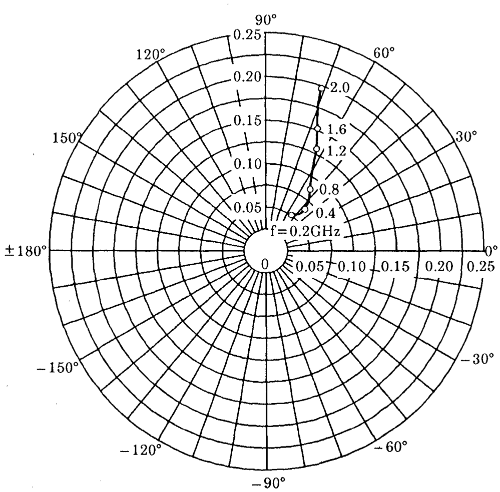
S11e
VCE = 10V
IC = 5mA
Ta = 25°C
(UNIT : Ω)



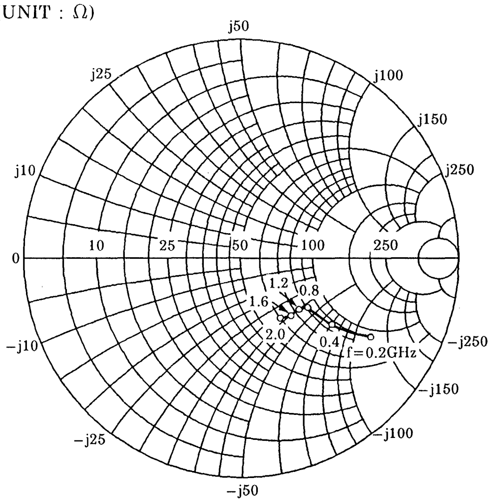
S21e
VCE = 10V
IC = 5mA
Ta = 25°C



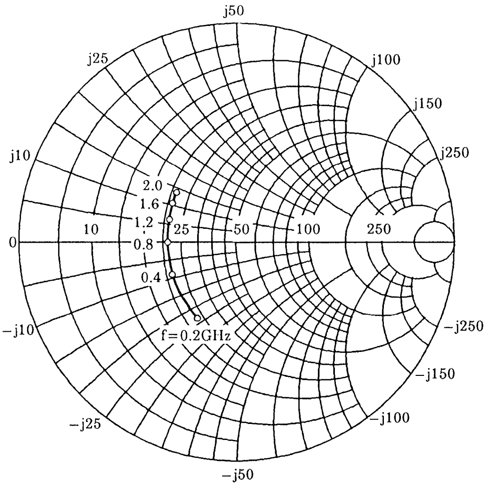
S12e
VCE = 10V
IC = 5mA
Ta = 25°C



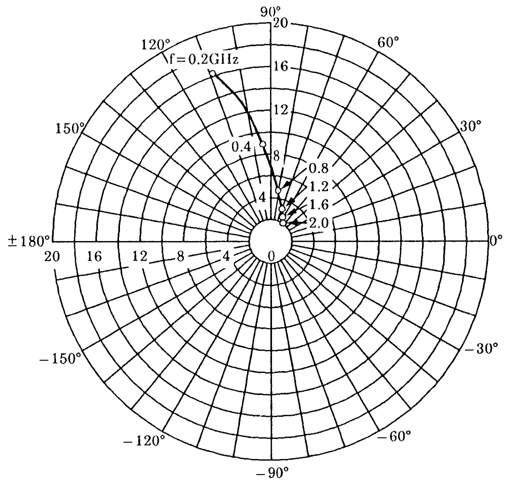
S22e
VCE = 10V
IC = 5mA
Ta = 25°C
(UNIT : Ω)



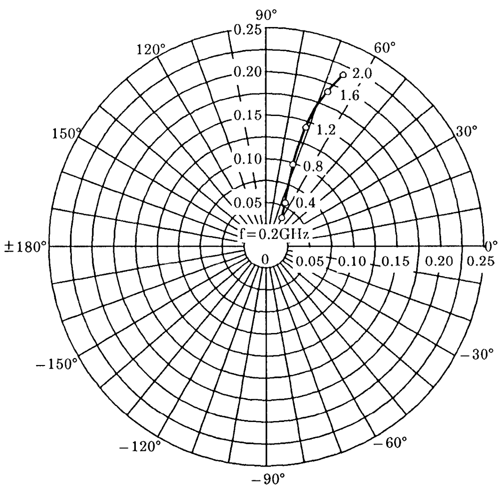
S_{11e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)



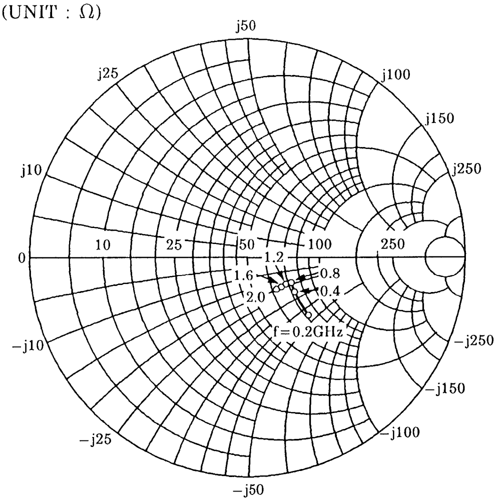
S_{21e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$



S_{12e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$



S_{22e}
$V_{CE}=10V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)

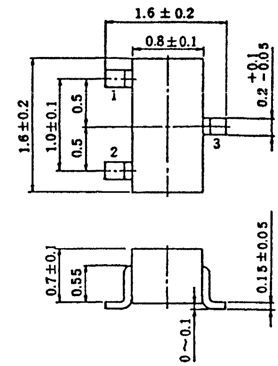


2SC5086 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure, High Gain.
- $NF = 1.1dB$, $|S_{21e}|^2 = 11dB$ (f = 1GHz)

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	—
TOSHIBA	2-2H1A

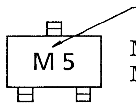
Weight : 2.4mg

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	80	mA
Base Current	I_B	40	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MARKING

Type Name and h_{FE} Rank



M5 : O Rank
M6 : Y Rank

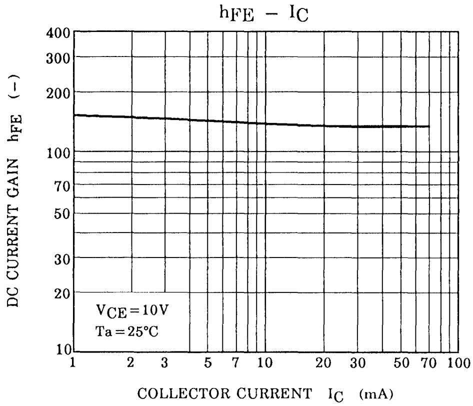
MICROWAVE CHARACTERISTICS (Ta = 25°C)

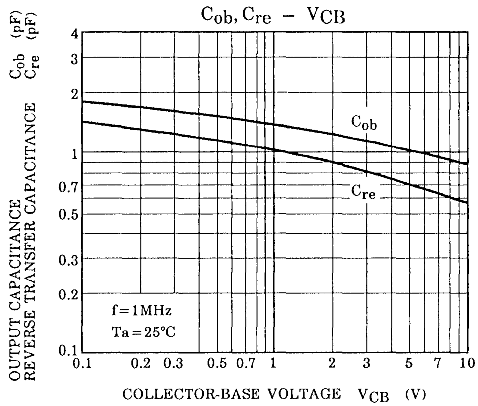
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	$V_{CE} = 10V$, $I_C = 20mA$	5	7	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	$V_{CE} = 10V$, $I_C = 20mA$, f = 500MHz	—	16.5	—	dB
	$\|S_{21e}\|^2$ (2)	$V_{CE} = 10V$, $I_C = 20mA$, f = 1GHz	7.5	11	—	
Noise Figure	NF (1)	$V_{CE} = 10V$, $I_C = 5mA$, f = 500MHz	—	1	—	dB
	NF (2)	$V_{CE} = 10V$, $I_C = 5mA$, f = 1GHz	—	1.1	2	

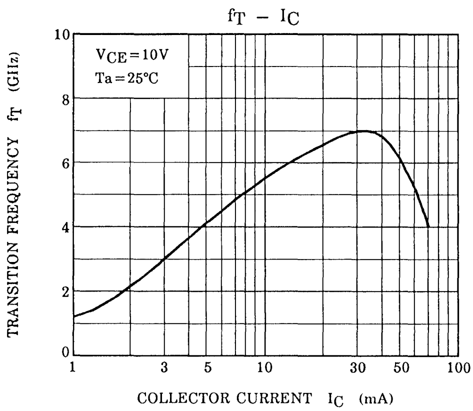
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

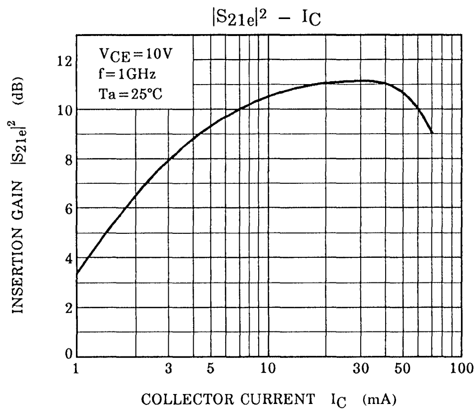
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB} = 10V$, $I_E = 0$	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB} = 1V$, $I_C = 0$	—	—	1	μA
DC Current Gain	h_{FE} Note	$V_{CE} = 10V$, $I_C = 20mA$	80	—	240	—
Output Capacitance	C_{ob}	$V_{CB} = 10V$, $I_E = 0$, f = 1MHz	—	1.0	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.65	1.15	pF

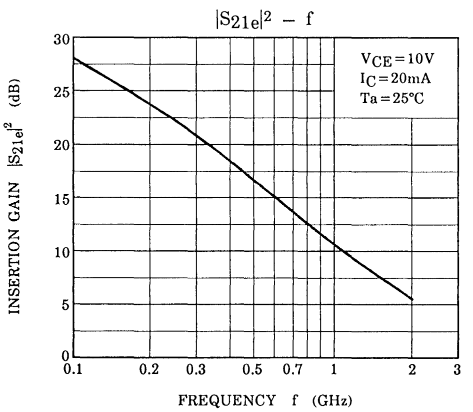
Note : C_{re} is measured by 3 terminal method with capacitance bridge.
Note : h_{FE} Classification O : 80~160, Y : 120~240

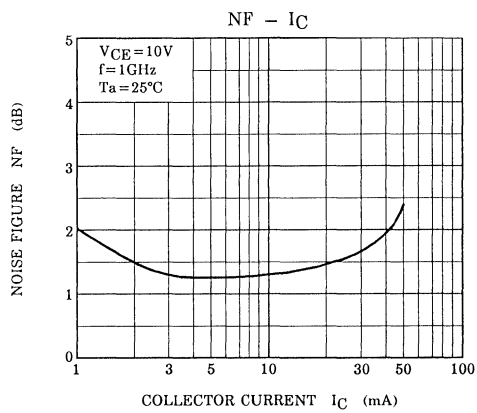

hFE – IC
VCE=10V
Ta=25°C
DC CURRENT GAIN hFE (–)
COLLECTOR CURRENT IC (mA)

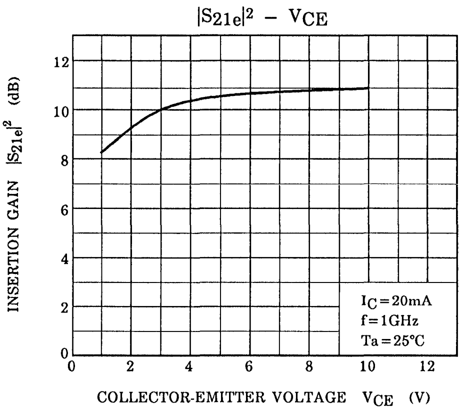

Cob, Cre – VCB
Cob
Cre
f=1MHz
Ta=25°C
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
COLLECTOR-BASE VOLTAGE VCB (V)

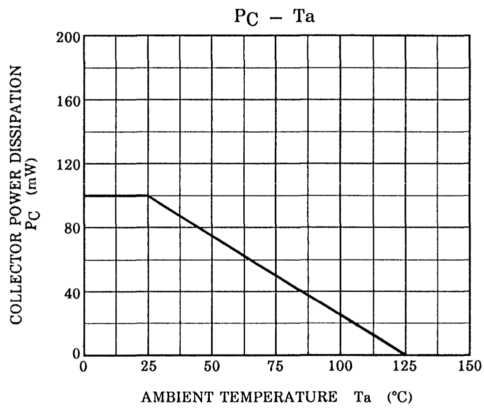

fT – IC
VCE=10V
Ta=25°C
TRANSITION FREQUENCY fT (GHz)
COLLECTOR CURRENT IC (mA)


|S21e|2 – IC
VCE=10V
f=1GHz
Ta=25°C
INSERTION GAIN |S21e|2 (dB)
COLLECTOR CURRENT IC (mA)


|S21e|2 – f
VCE=10V
IC=20mA
Ta=25°C
INSERTION GAIN |S21e|2 (dB)
FREQUENCY f (GHz)


NF – IC
VCE=10V
f=1GHz
Ta=25°C
NOISE FIGURE NF (dB)
COLLECTOR CURRENT IC (mA)





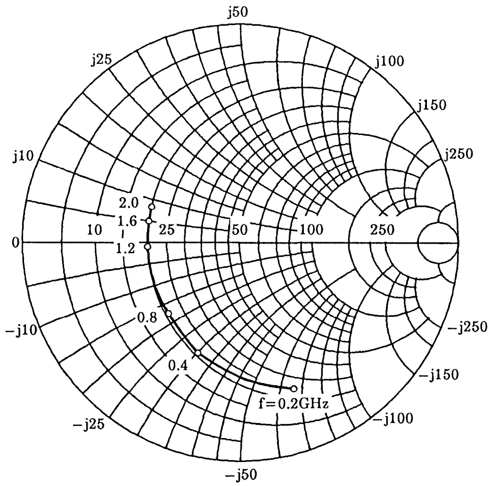
S-Parameter $Z_O = 50\Omega$, Ta = 25°C
V_{CE} = 10V, I_C = 5mA

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.715	−69.3	9.495	132.1	0.051	55.2	0.747	−29.0
400	0.542	−112.4	6.482	108.5	0.068	46.8	0.555	−35.1
600	0.476	−137.7	4.717	95.8	0.077	47.9	0.478	−36.2
800	0.447	−154.4	3.691	87.1	0.086	51.6	0.442	−37.1
1000	0.435	−166.8	3.049	79.9	0.096	55.9	0.424	−38.9
1200	0.433	−176.6	2.611	73.9	0.108	60.4	0.418	−41.8
1400	0.435	174.8	2.294	68.3	0.123	64.2	0.411	−45.0
1600	0.439	167.3	2.050	63.2	0.140	66.9	0.407	−49.0
1800	0.444	160.6	1.860	58.7	0.159	68.7	0.406	−53.6
2000	0.454	154.2	1.713	53.9	0.180	70.5	0.404	−57.8

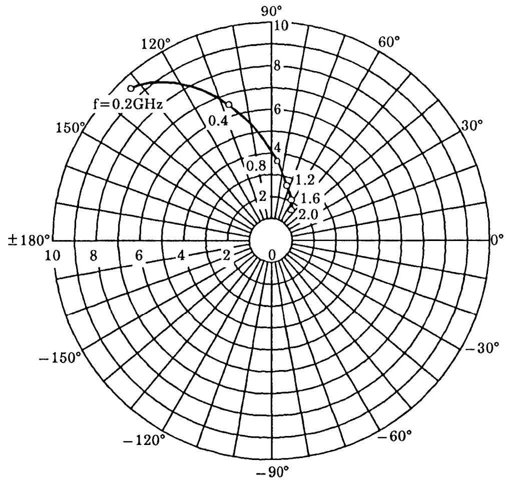
V_{CE} = 10V, I_C = 20mA

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.465	−107.8	16.512	113.2	0.035	56.7	0.484	−40.9
400	0.375	−145.6	9.090	96.5	0.052	62.2	0.331	−37.8
600	0.351	−164.4	6.252	88.1	0.070	66.5	0.291	−34.1
800	0.343	−176.7	4.762	81.9	0.089	68.9	0.277	−33.3
1000	0.338	174.8	3.875	76.6	0.109	70.2	0.273	−34.0
1200	0.337	167.9	3.285	71.8	0.130	70.8	0.274	−36.2
1400	0.343	161.6	2.874	67.2	0.152	70.6	0.274	−39.3
1600	0.343	156.2	2.553	62.9	0.173	69.8	0.274	−43.4
1800	0.348	151.2	2.317	58.8	0.195	68.9	0.273	−47.8
2000	0.354	146.2	2.113	55.0	0.218	68.2	0.272	−52.1

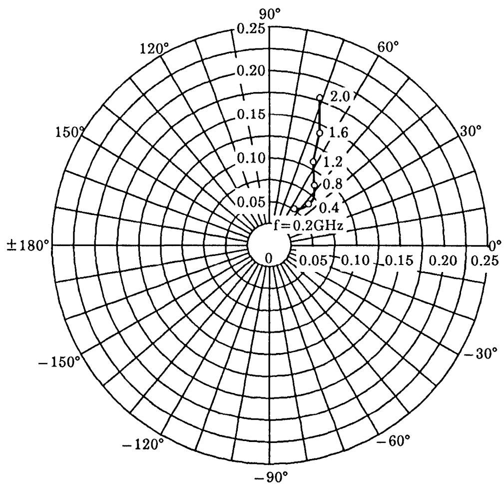
S_{11e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



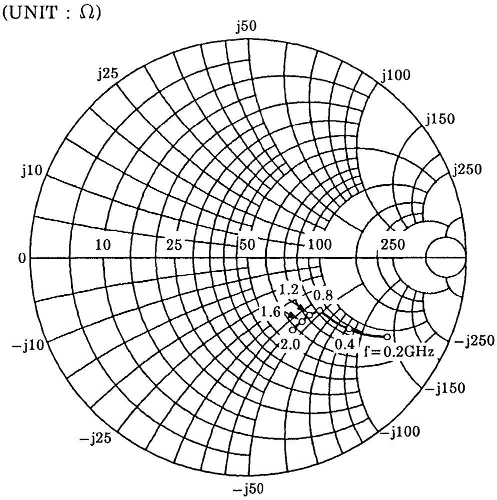
S_{21e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$



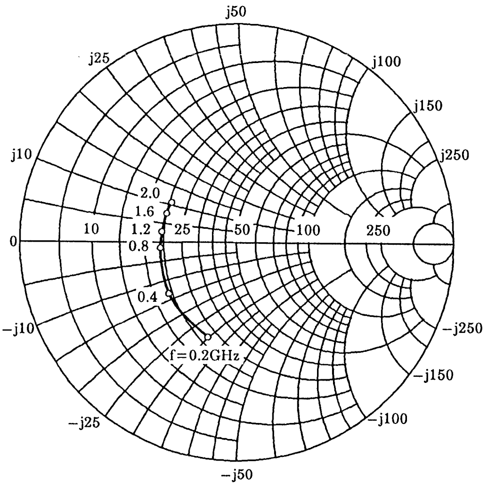
S_{12e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$



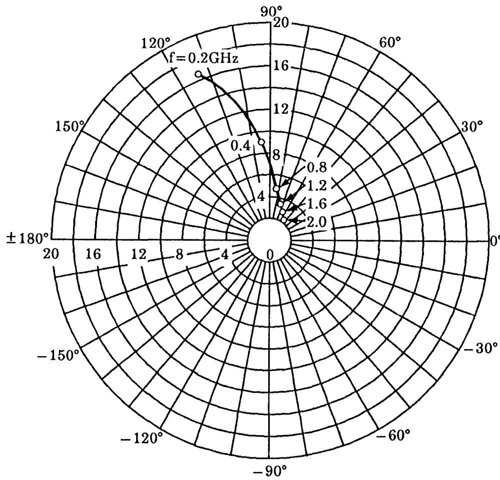
S_{22e}
$V_{CE}=10V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



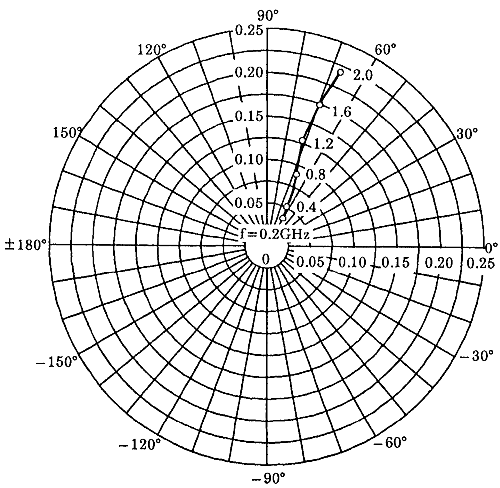
S_{11e}
V_{CE} = 10V
I_C = 20mA
Ta = 25°C
(UNIT : Ω)



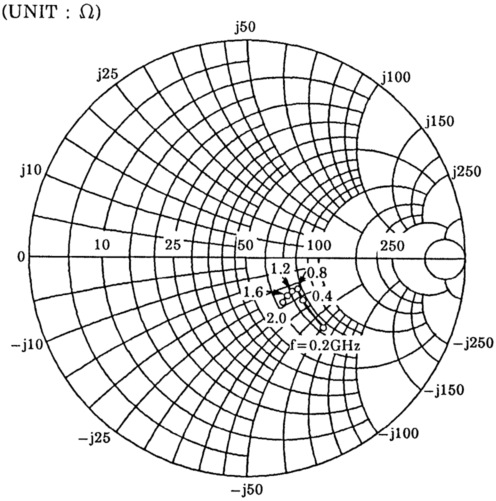
S_{21e}
V_{CE} = 10V
I_C = 20mA
Ta = 25°C



S_{12e}
V_{CE} = 10V
I_C = 20mA
Ta = 25°C



S_{22e}
V_{CE} = 10V
I_C = 20mA
Ta = 25°C
(UNIT : Ω)



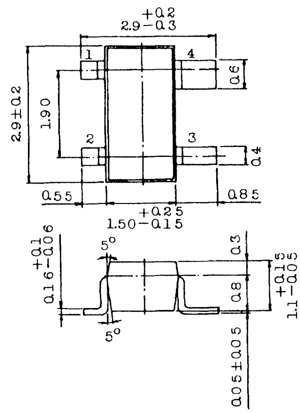
SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC5087

TENTATIVE DATA

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

Unit in mm



1, 3. EMITTER
2. BASE
4. COLLECTOR

SMQ	
JEDEC	—
EIAJ	—
TOSHIBA	2-3J1C

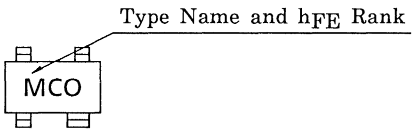
Weight : 0.012g

- Low Noise Figure, High Gain.
- NF = 1.1dB, $|S_{21e}|^2$ = 14dB (f = 1GHz)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	80	mA
Base Current	I_B	40	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MARKING



MICROWAVE CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 10V, I_C = 20mA	5	7	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE} = 10V, I_C = 20mA, f = 500MHz	—	19.5	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE} = 10V, I_C = 20mA, f = 1GHz	10.5	14	—	
Noise Figure	NF (1)	V_{CE} = 10V, I_C = 5mA, f = 500MHz	—	1	—	dB
	NF (2)	V_{CE} = 10V, I_C = 5mA, f = 1GHz	—	1.1	2	

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_C = 0	—	—	1	μA
DC Current Gain	h_{FE} (Note 1)	V_{CE} = 10V, I_C = 20mA	80	—	240	—
Output Capacitance	C_{ob}	V_{CB} = 10V, I_E = 0, f = 1MHz	—	10	—	pF
Reverse Transfer Capacitance	C_{re}	(Note 2)	—	0.55	1	pF

(Note 1) : h_{FE} Classification   O : 80~160, Y : 120~240

(Note 2) : C_{re} is measured by 3 terminal method with capacitance bridge.

2SC5088

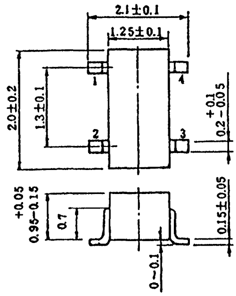
SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

TENTATIVE DATA

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure, High Gain.
- NF=1.1dB, $|S_{21e}|^2$=14dB (f=1GHz)

Unit in mm



1, 3. EMITTER
2. BASE
4. COLLECTOR

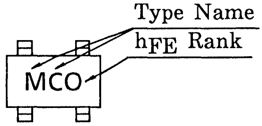
USQ	
JEDEC	—
EIAJ	—
TOSHIBA	2-2K1A

Weight : 0.006g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	80	mA
Base Current	I_B	40	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MARKING



MICROWAVE CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE}=10V, I_C=20mA	5	7	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE}=10V, I_C=20mA, f=500MHz	—	19.5	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE}=10V, I_C=20mA, f=1GHz	10.5	14	—	
Noise Figure	NF (1)	V_{CE}=10V, I_C=5mA, f=500MHz	—	1	—	dB
	NF (2)	V_{CE}=10V, I_C=5mA, f=1GHz	—	1.1	2	

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB}=10V, I_E=0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB}=1V, I_C=0	—	—	1	μA
DC Current Gain	h_{FE} (Note 1)	V_{CE}=10V, I_C=20mA	80	—	240	—
Output Capacitance	C_{ob}	V_{CB}=10V, I_E=0, f=1MHz	—	10	—	pF
Reverse Transfer Capacitance	C_{re}	(Note 2)	—	0.55	1	pF

(Note 1) : h_{FE} Classification O : 80~160, Y : 120~240
(Note 2) : C_{re} is measured by 3 terminal method with capacitance bridge.

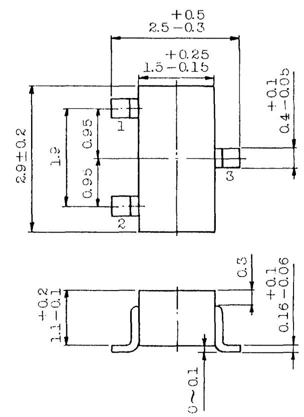
SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC5089

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure, High Gain.
- $NF = 1.1dB$, $|S_{21e}|^2 = 13dB$ ($f = 1GHz$)

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

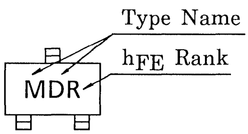
JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Base Current	I_B	20	mA
Collector Current	I_C	40	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MARKING



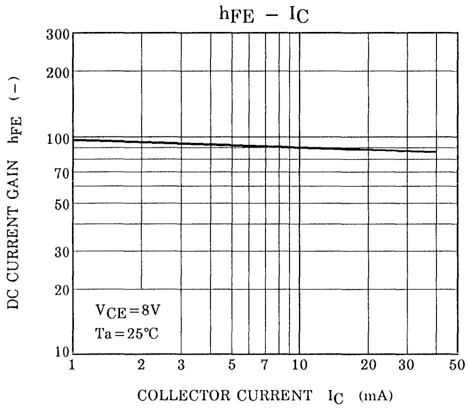
MICROWAVE CHARACTERISTICS (Ta = 25°C)

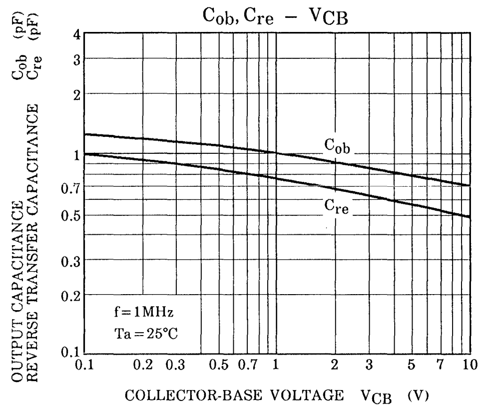
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	$V_{CE} = 8V$, $I_C = 20mA$	7	10	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	$V_{CE} = 8V$, $I_C = 20mA$, $f = 1GHz$	10	13	—	dB
	$\|S_{21e}\|^2$ (2)	$V_{CE} = 8V$, $I_C = 20mA$, $f = 2GHz$	—	7	—	
Noise Figure	NF (1)	$V_{CE} = 8V$, $I_C = 5mA$, $f = 1GHz$	—	1.1	2.5	dB
	NF (2)	$V_{CE} = 8V$, $I_C = 5mA$, $f = 2GHz$	—	1.7	—	

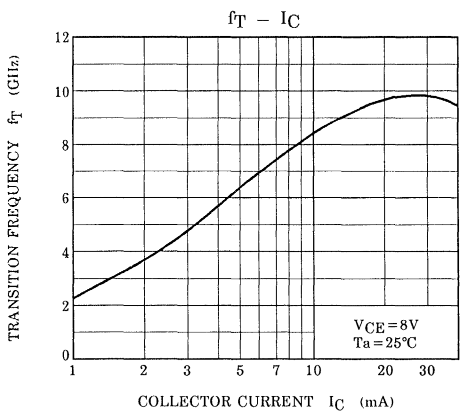
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

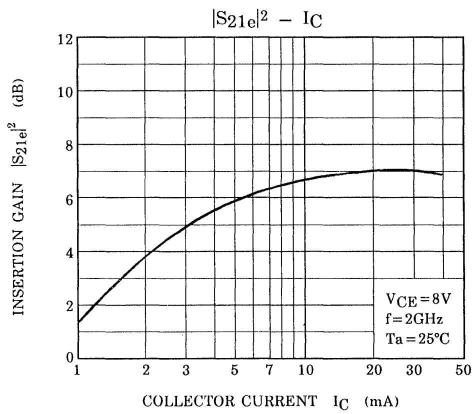
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB} = 10V$, $I_E = 0$	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB} = 1V$, $I_C = 0$	—	—	1	μA
DC Current Gain	h_{FE} Note	$V_{CE} = 8V$, $I_C = 20mA$	50	—	160	—
Output Capacitance	C_{ob}	$V_{CB} = 10V$, $I_E = 0$, $f = 1MHz$	—	0.7	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.5	0.95	pF

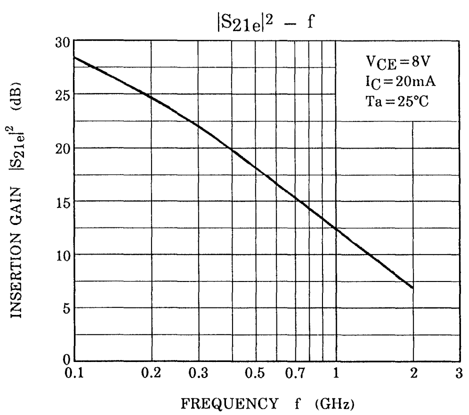
Note : C_{re} is measured by 3 terminal method with capacitance bridge.
Note : h_{FE} Classification R : 50~100, O : 80~160

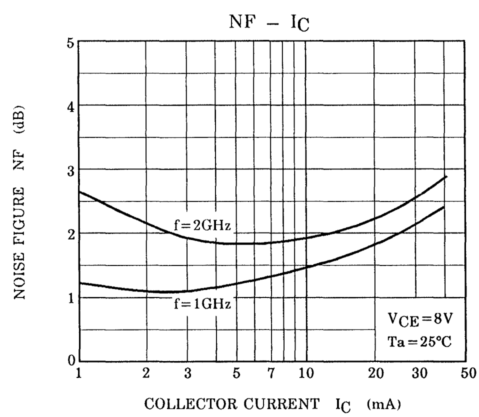

hFE – IC
DC CURRENT GAIN hFE (–)
300
200
100
70
50
30
20
10
VCE=8V
Ta=25°C
1 2 3 5 7 10 20 30 50
COLLECTOR CURRENT IC (mA)

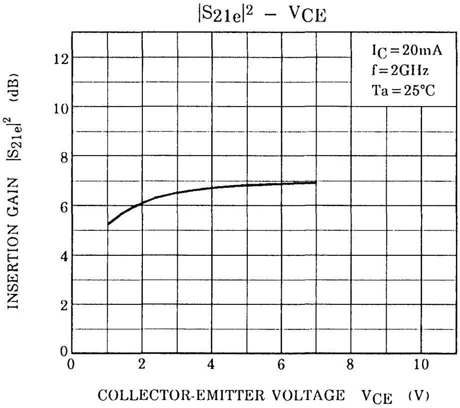

Cob, Cre – VCB
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
4
3
2
1
0.7
0.5
0.3
0.2
0.1
Cob
Cre
f=1MHz
Ta=25°C
0.1 0.2 0.3 0.5 0.7 1 2 3 5 7 10
COLLECTOR-BASE VOLTAGE VCB (V)

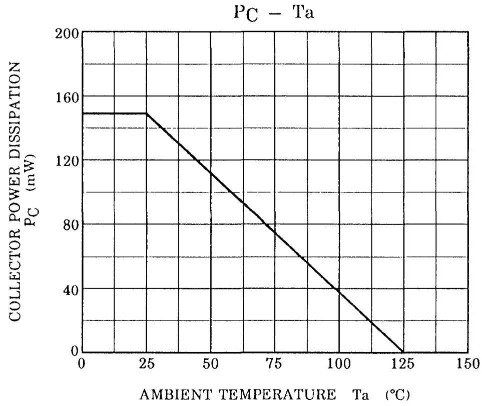

fT – IC
TRANSITION FREQUENCY fT (GHz)
12
10
8
6
4
2
0
VCE=8V
Ta=25°C
1 2 3 5 7 10 20 30
COLLECTOR CURRENT IC (mA)


|S21e|2 – IC
INSERTION GAIN |S21e|2 (dB)
12
10
8
6
4
2
0
VCE=8V
f=2GHz
Ta=25°C
1 2 3 5 7 10 20 30 50
COLLECTOR CURRENT IC (mA)


|S21e|2 – f
INSERTION GAIN |S21e|2 (dB)
30
25
20
15
10
5
0
VCE=8V
IC=20mA
Ta=25°C
0.1 0.2 0.3 0.5 0.7 1 2 3
FREQUENCY f (GHz)


NF – IC
NOISE FIGURE NF (dB)
5
4
3
2
1
0
f=2GHz
f=1GHz
VCE=8V
Ta=25°C
1 2 3 5 7 10 20 30 50
COLLECTOR CURRENT IC (mA)





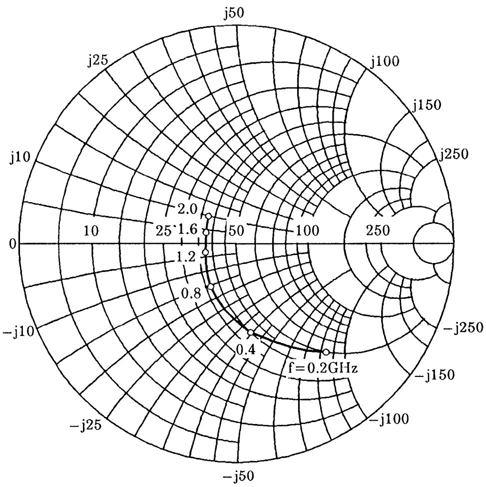
S-Parameter $Z_O = 50\Omega$, $Ta = 25°C$
$V_{CE} = 8V$, $I_C = 5mA$

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.653	−48.5	10.080	136.2	0.046	63.5	0.766	−27.9
400	0.420	−82.1	7.242	112.7	0.069	57.6	0.561	−35.0
600	0.284	−105.7	5.393	98.9	0.086	57.9	0.466	−35.4
800	0.214	−126.0	4.245	89.7	0.103	59.4	0.420	−34.9
1000	0.169	−146.7	3.508	82.2	0.121	60.6	0.394	−34.7
1200	0.155	−166.4	3.012	75.9	0.140	61.9	0.382	−35.1
1400	0.152	174.1	2.645	70.2	0.162	62.1	0.374	−36.1
1600	0.154	156.7	2.350	65.0	0.182	61.3	0.363	−38.5
1800	0.161	145.9	2.136	60.2	0.202	60.5	0.355	−41.0
2000	0.181	134.5	1.972	55.8	0.224	60.6	0.345	−44.0

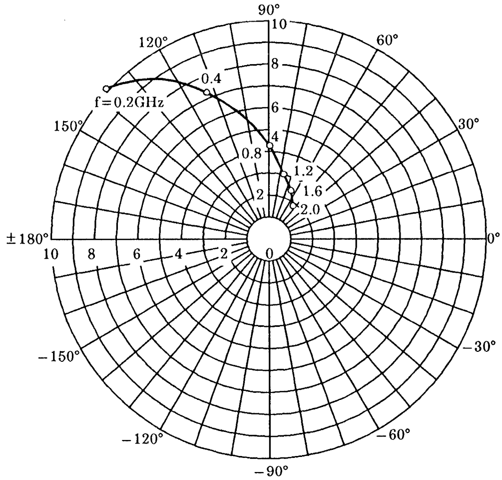
$V_{CE} = 8V$, $I_C = 20mA$

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.275	−80.2	17.464	114.7	0.033	68.9	0.506	−36.6
400	0.147	−116.5	9.693	97.8	0.057	72.0	0.353	−32.4
600	0.097	−150.0	6.680	88.8	0.082	72.7	0.313	−27.9
800	0.083	179.5	5.088	82.3	0.106	72.1	0.300	−25.9
1000	0.084	151.3	4.141	76.7	0.131	71.2	0.295	−25.2
1200	0.095	135.6	3.497	72.2	0.156	69.8	0.295	−25.7
1400	0.108	124.2	3.058	67.7	0.182	67.7	0.297	−27.3
1600	0.121	113.8	2.699	63.2	0.206	65.2	0.289	−30.1
1800	0.128	108.4	2.432	59.2	0.228	63.0	0.283	−33.2
2000	0.146	104.2	2.241	55.5	0.253	61.6	0.274	−36.5

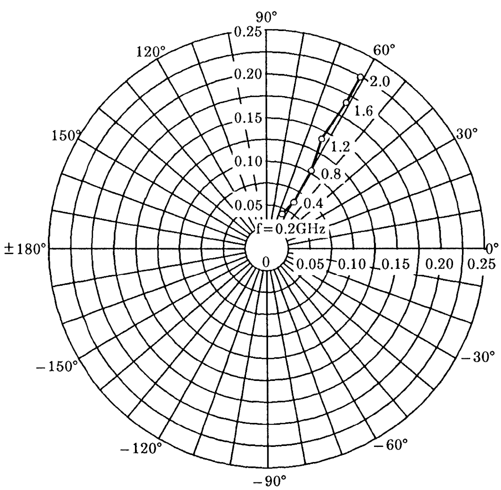
S_{11e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



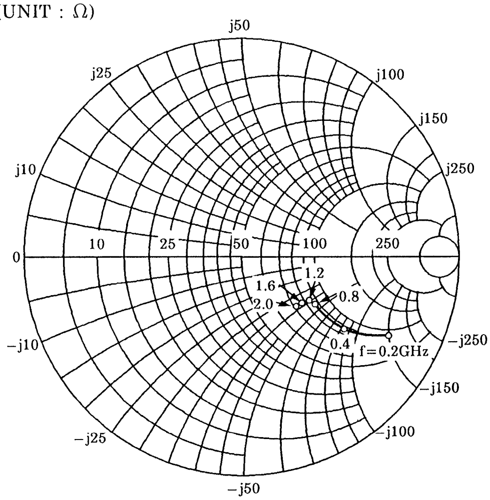
S_{21e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$



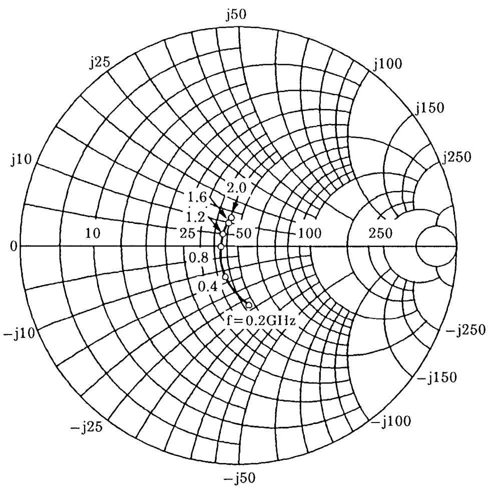
S_{12e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$



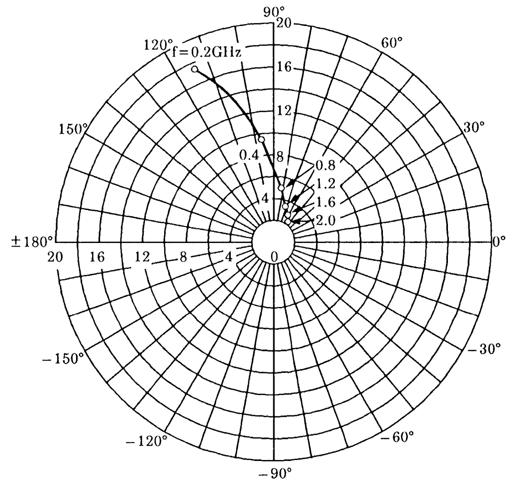
S_{22e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



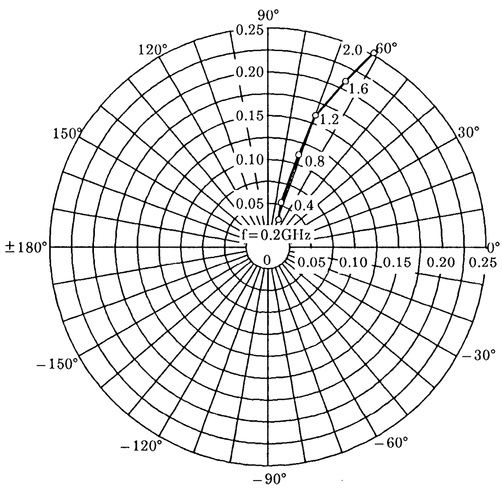
S_{11e}
$V_{CE} = 8V$
$I_C = 20mA$
$Ta = 25°C$
(UNIT : Ω)



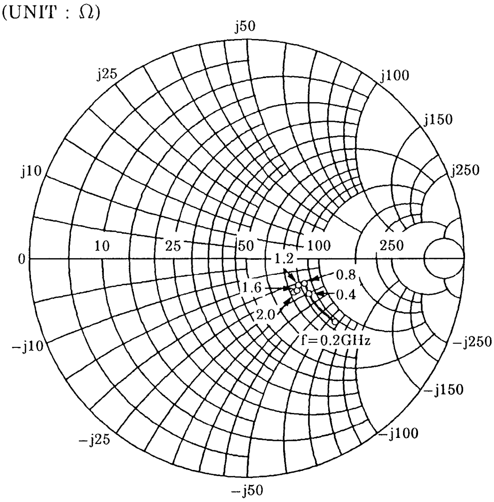
S_{21e}
$V_{CE} = 8V$
$I_C = 20mA$
$Ta = 25°C$



S_{12e}
$V_{CE} = 8V$
$I_C = 20mA$
$Ta = 25°C$



S_{22e}
$V_{CE} = 8V$
$I_C = 20mA$
$Ta = 25°C$
(UNIT : Ω)

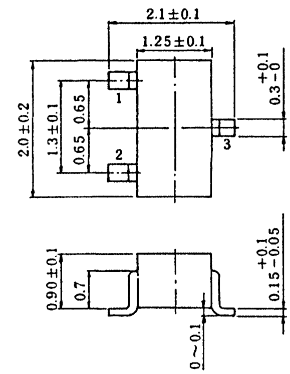


2SC5090

SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1A

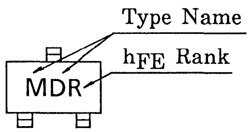
Weight : 0.006g

- Low Noise Figure, High Gain.
- NF = 1.1dB, $|S_{21e}|^2$ = 13dB (f = 1GHz)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Base Current	I_B	20	mA
Collector Current	I_C	40	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MARKING



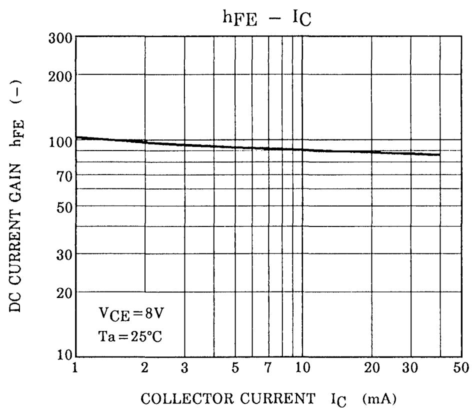
MICROWAVE CHARACTERISTICS (Ta = 25°C)

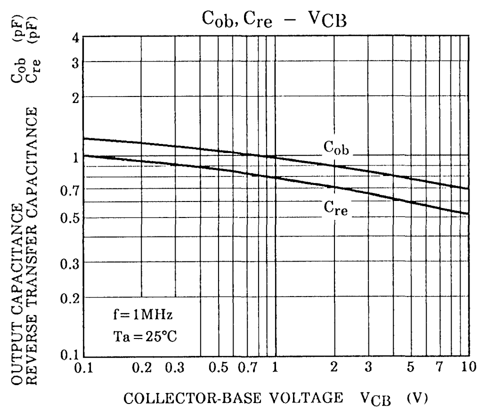
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 8V, I_C = 20mA	7	10	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE} = 8V, I_C = 20mA, f = 1GHz	10	13	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE} = 8V, I_C = 20mA, f = 2GHz	—	7	—	dB
Noise Figure	NF (1)	V_{CE} = 8V, I_C = 5mA, f = 1GHz	—	1.1	2.5	dB
	NF (2)	V_{CE} = 8V, I_C = 5mA, f = 2GHz	—	1.7	—	dB

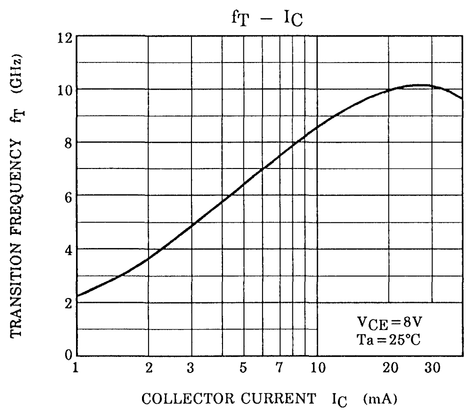
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

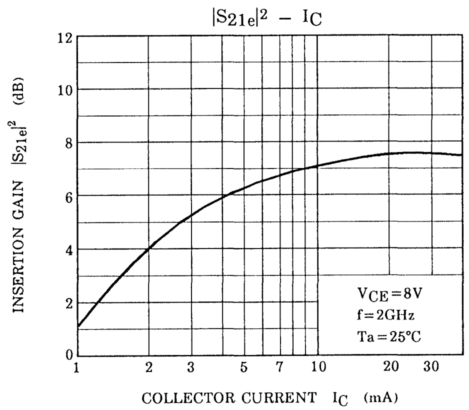
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_C = 0	—	—	1	μA
DC Current Gain	h_{FE} Note	V_{CE} = 8V, I_C = 20mA	50	—	160	—
Output Capacitance	C_{ob}	V_{CB} = 10V, I_E = 0, f = 1MHz	—	0.7	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.5	0.95	pF

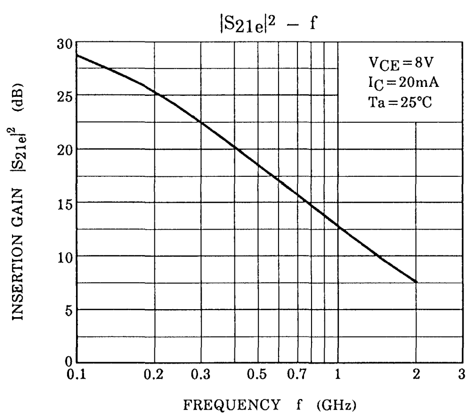
Note : C_{re} is measured by 3 terminal method with capacitance bridge.
Note : h_{FE} Classification R : 50~100, O : 80~160

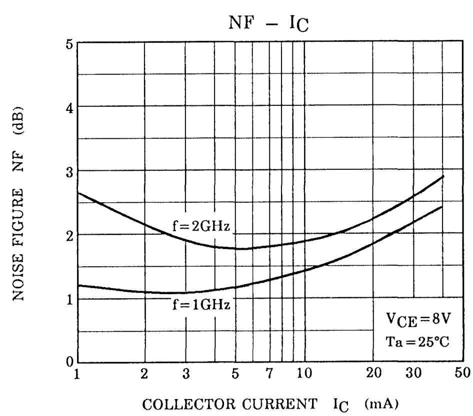

hFE – IC
DC CURRENT GAIN hFE (–)
VCE=8V
Ta=25°C
COLLECTOR CURRENT IC (mA)

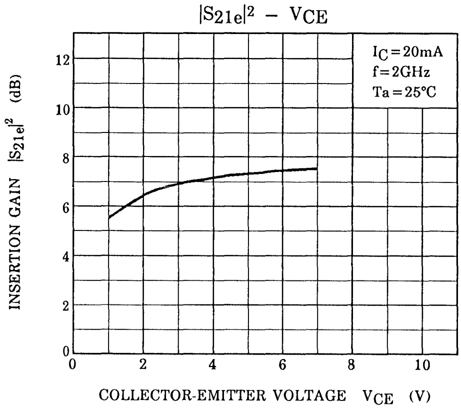

Cob, Cre – VCB
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
Cob
Cre
f=1MHz
Ta=25°C
COLLECTOR-BASE VOLTAGE VCB (V)

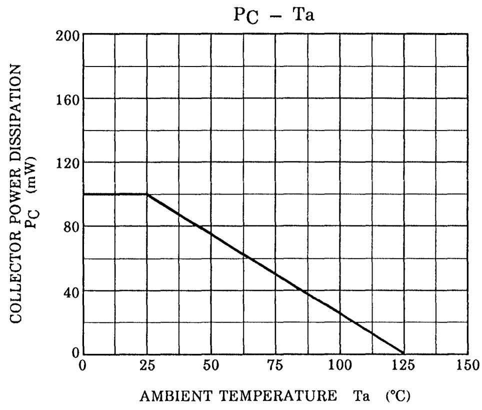

fT – IC
TRANSITION FREQUENCY fT (GHz)
VCE=8V
Ta=25°C
COLLECTOR CURRENT IC (mA)


|S21e|2 – IC
INSERTION GAIN |S21e|2 (dB)
VCE=8V
f=2GHz
Ta=25°C
COLLECTOR CURRENT IC (mA)


|S21e|2 – f
INSERTION GAIN |S21e|2 (dB)
VCE=8V
IC=20mA
Ta=25°C
FREQUENCY f (GHz)


NF – IC
NOISE FIGURE NF (dB)
f=2GHz
f=1GHz
VCE=8V
Ta=25°C
COLLECTOR CURRENT IC (mA)





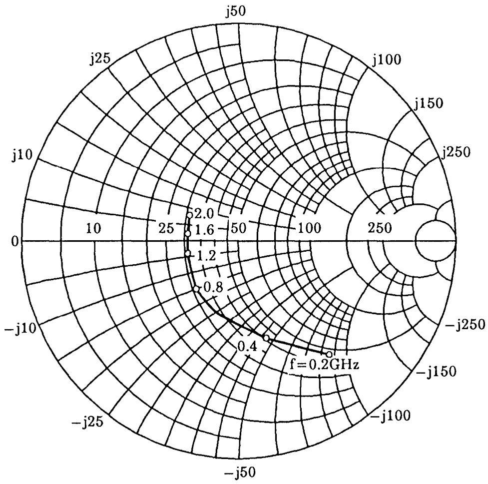
S-Parameter $Z_O = 50\Omega$, Ta = 25°C
$V_{CE} = 8V$, $I_C = 5mA$

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.683	−50.1	10.186	138.3	0.049	62.0	0.773	−30.0
400	0.462	−86.9	7.472	114.6	0.071	54.3	0.556	−39.6
600	0.343	−113.1	5.618	100.9	0.086	53.8	0.448	−41.7
800	0.282	−133.6	4.407	91.7	0.101	55.3	0.392	−41.6
1000	0.249	−151.0	3.663	84.7	0.115	57.2	0.360	−41.7
1200	0.236	−166.6	3.128	78.7	0.131	58.9	0.339	−41.7
1400	0.233	179.7	2.759	73.1	0.150	60.1	0.330	−42.8
1600	0.234	168.3	2.457	68.2	0.168	60.0	0.319	−45.0
1800	0.238	158.6	2.224	63.4	0.185	60.0	0.311	−47.9
2000	0.251	149.6	2.038	59.4	0.203	60.4	0.302	−50.2

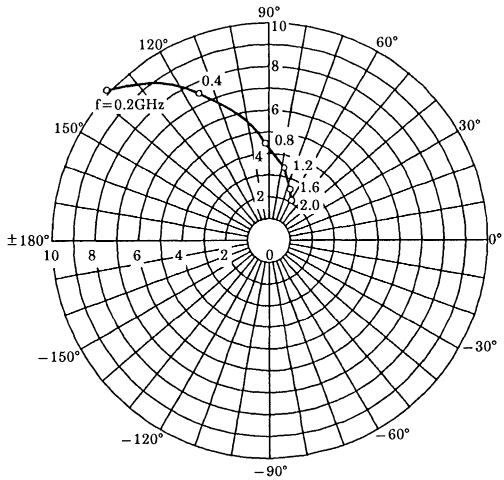
$V_{CE} = 8V$, $I_C = 20mA$

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.319	−91.9	18.338	116.7	0.033	65.3	0.494	−43.5
400	0.213	−134.2	10.303	99.2	0.054	68.9	0.312	−42.4
600	0.185	−160.0	7.111	90.3	0.076	70.8	0.258	−37.6
800	0.176	−178.2	5.415	84.3	0.098	71.2	0.236	−34.3
1000	0.174	167.8	4.400	79.2	0.120	71.1	0.228	−32.0
1200	0.178	156.8	3.712	74.8	0.143	70.3	0.226	−31.5
1400	0.186	147.5	3.236	70.3	0.168	68.7	0.226	−32.8
1600	0.194	139.7	2.874	66.3	0.190	66.6	0.223	−35.9
1800	0.199	133.7	2.583	62.6	0.211	64.9	0.216	−39.0
2000	0.215	127.8	2.369	58.8	0.232	63.5	0.211	−41.9

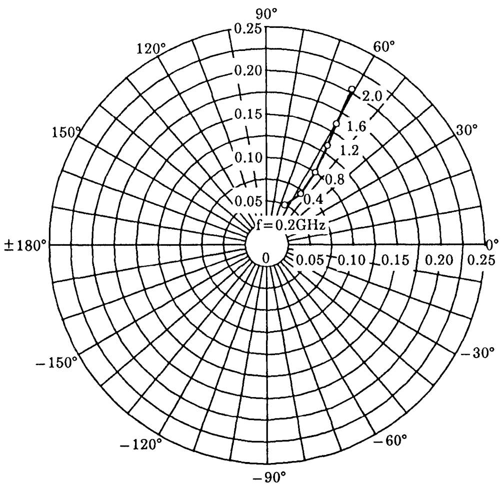
S11e
$V_{CE} = 8V$
$I_C = 5mA$
Ta = 25°C
(UNIT : Ω)



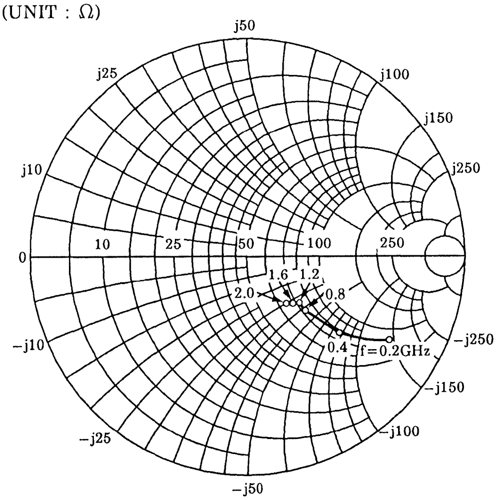
S21e
$V_{CE} = 8V$
$I_C = 5mA$
Ta = 25°C



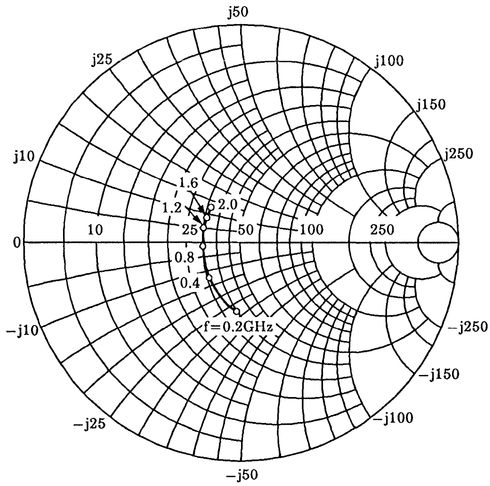
S12e
$V_{CE} = 8V$
$I_C = 5mA$
Ta = 25°C



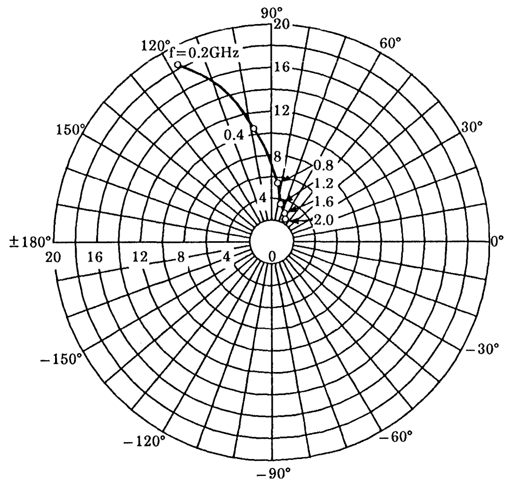
S22e
$V_{CE} = 8V$
$I_C = 5mA$
Ta = 25°C
(UNIT : Ω)



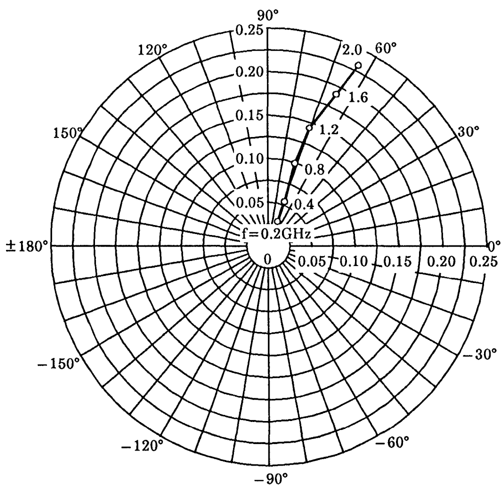
S11e
VCE=8V
IC=20mA
Ta=25°C
(UNIT : Ω)



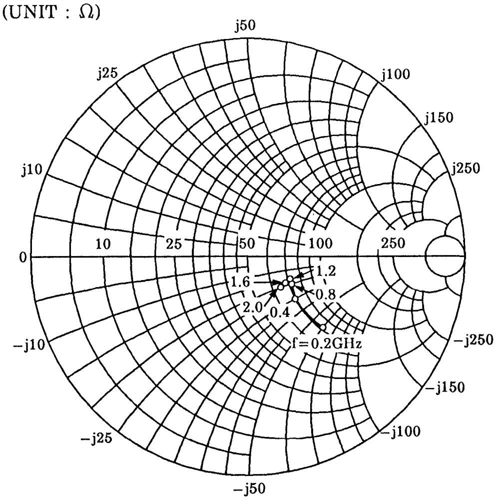
S21e
VCE=8V
IC=20mA
Ta=25°C



S12e
VCE=8V
IC=20mA
Ta=25°C



S22e
VCE=8V
IC=20mA
Ta=25°C
(UNIT : Ω)



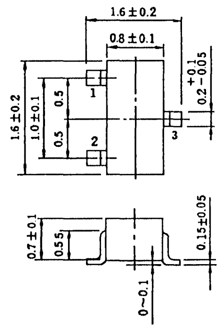
SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC5091

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure, High Gain.
- NF = 1.1dB, $|S_{21e}|^2$ = 7dB (f = 1GHz)

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

SSM

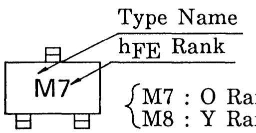
JEDEC	—
EIAJ	—
TOSHIBA	2-2H1A

Weight : 2.4mg

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Base Current	I_B	40	mA
Collector Current	I_C	20	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MARKING



M7 : O Rank
M8 : Y Rank

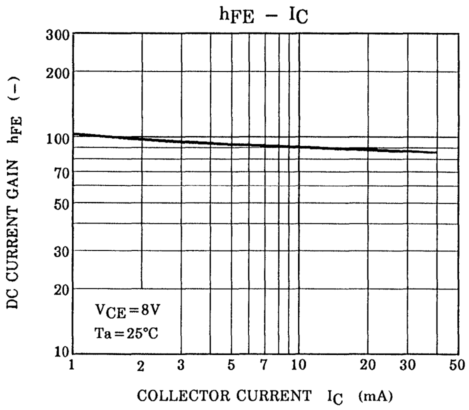
MICROWAVE CHARACTERISTICS (Ta = 25°C)

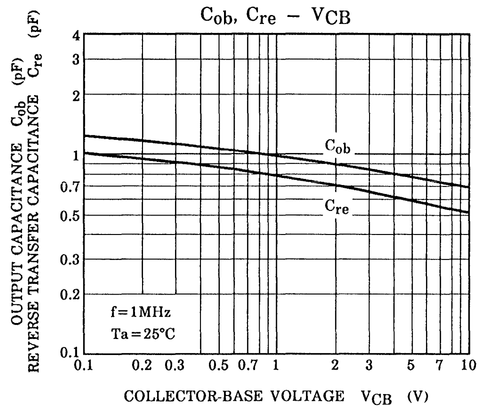
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 8V, I_C = 20mA	7	10	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE} = 8V, I_C = 20mA, f = 1GHz	10	13	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE} = 8V, I_C = 20mA, f = 2GHz	—	7	—	
Noise Figure	NF (1)	V_{CE} = 8V, I_C = 5mA, f = 1GHz	—	1.1	2.5	dB
	NF (2)	V_{CE} = 8V, I_C = 5mA, f = 2GHz	—	1.7	—	

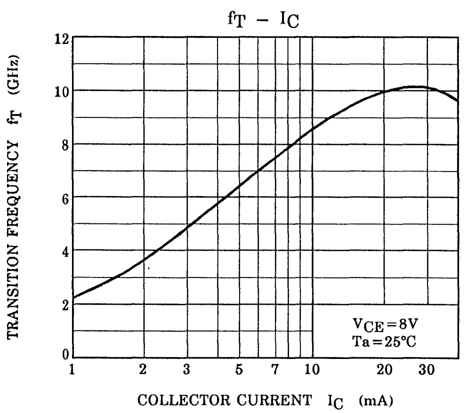
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

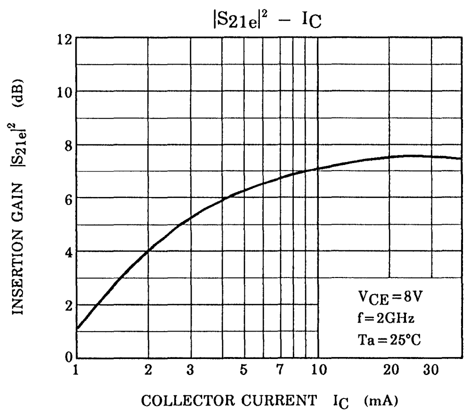
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_C = 0	—	—	1	μA
DC Current Gain	h_{FE} (Note 1)	V_{CE} = 8V, I_C = 20mA	50	—	160	—
Output Capacitance	C_{ob}	V_{CB} = 10V, I_E = 0, f = 1MHz	—	0.7	—	pF
Reverse Transfer Capacitance	C_{re}	(Note 2)	—	0.5	0.95	pF

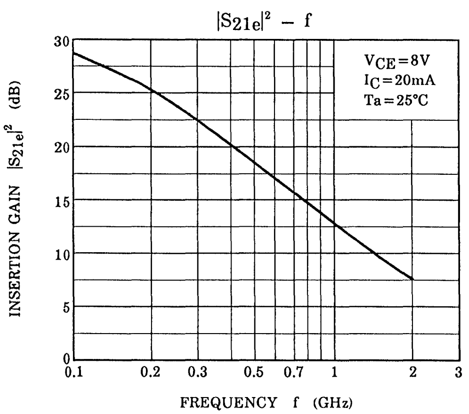
(Note 1) : h_{FE} Classification R : 50~100, O : 80~160
(Note 2) : C_{re} is measured by 3 terminal method with capacitance bridge.

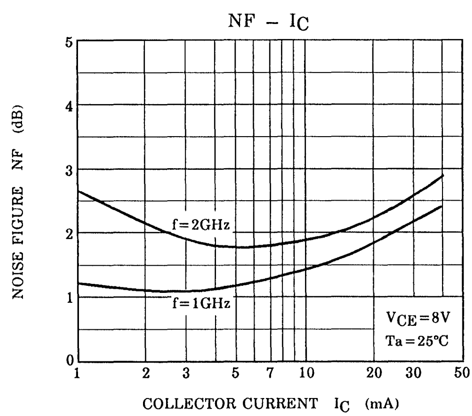

hFE – IC
DC CURRENT GAIN hFE (–)
VCE=8V
Ta=25°C
COLLECTOR CURRENT IC (mA)

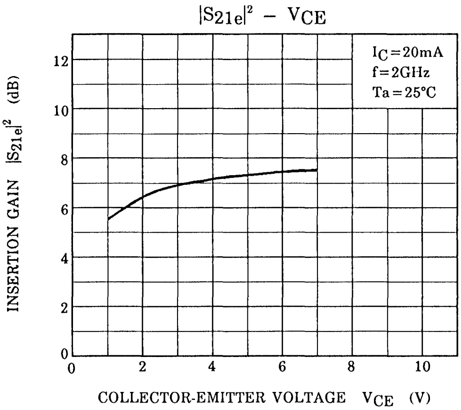

Cob, Cre – VCB
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
Cob
Cre
f=1MHz
Ta=25°C
COLLECTOR-BASE VOLTAGE VCB (V)

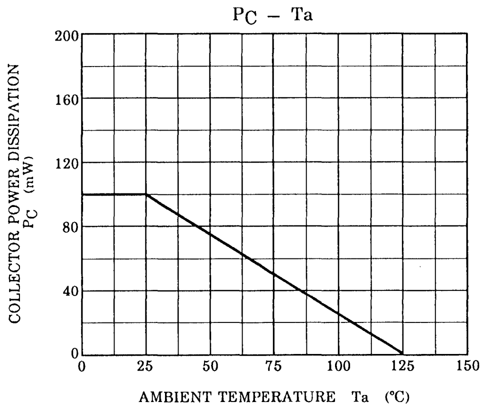

fT – IC
TRANSITION FREQUENCY fT (GHz)
VCE=8V
Ta=25°C
COLLECTOR CURRENT IC (mA)


|S21e|² – IC
INSERTION GAIN |S21e|² (dB)
VCE=8V
f=2GHz
Ta=25°C
COLLECTOR CURRENT IC (mA)


|S21e|² – f
INSERTION GAIN |S21e|² (dB)
VCE=8V
IC=20mA
Ta=25°C
FREQUENCY f (GHz)


NF – IC
NOISE FIGURE NF (dB)
f=2GHz
f=1GHz
VCE=8V
Ta=25°C
COLLECTOR CURRENT IC (mA)





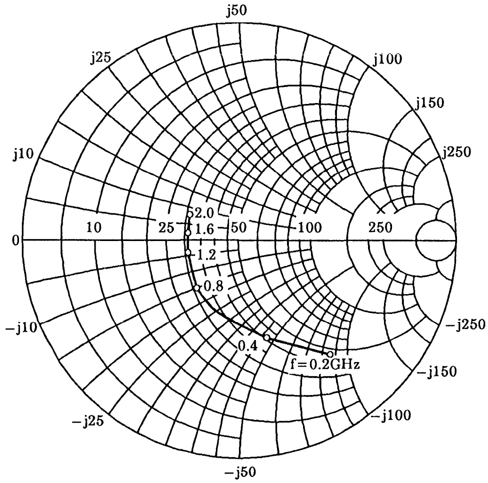
S-Parameter $Z_O = 50\Omega$, Ta = 25°C
$V_{CE} = 8V$, $I_C = 5mA$

frequency (MHz)	S11 Mag.	S11 Ang.	S21 Mag.	S21 Ang.	S12 Mag.	S12 Ang.	S22 Mag.	S22 Ang.
200	0.683	−50.1	10.186	138.3	0.049	62.0	0.773	−30.0
400	0.462	−86.9	7.472	114.6	0.071	54.3	0.556	−39.6
600	0.343	−113.1	5.618	100.9	0.086	53.8	0.448	−41.7
800	0.282	−133.6	4.407	91.7	0.101	55.3	0.392	−41.6
1000	0.249	−151.0	3.663	84.7	0.115	57.2	0.360	−41.7
1200	0.236	−166.6	3.128	78.7	0.131	58.9	0.339	−41.7
1400	0.233	179.7	2.759	73.1	0.150	60.1	0.330	−42.8
1600	0.234	168.3	2.457	68.2	0.168	60.0	0.319	−45.0
1800	0.238	158.6	2.224	63.4	0.185	60.0	0.311	−47.9
2000	0.251	149.6	2.038	59.4	0.203	60.4	0.302	−50.2

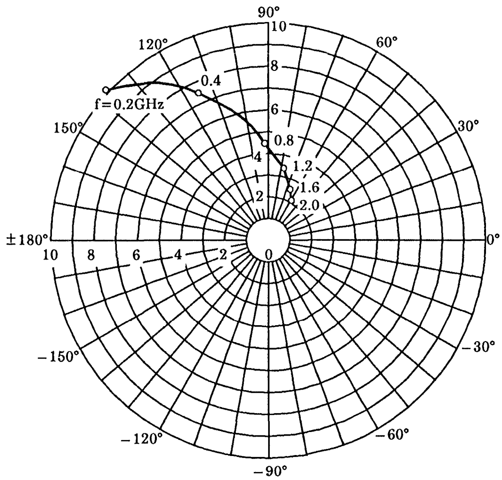
$V_{CE} = 8V$, $I_C = 20mA$

frequency (MHz)	S11 Mag.	S11 Ang.	S21 Mag.	S21 Ang.	S12 Mag.	S12 Ang.	S22 Mag.	S22 Ang.
200	0.319	−91.9	18.338	116.7	0.033	65.3	0.494	−43.5
400	0.213	−134.2	10.303	99.2	0.054	68.9	0.312	−42.4
600	0.185	−160.0	7.111	90.3	0.076	70.8	0.258	−37.6
800	0.176	−178.2	5.415	84.3	0.098	71.2	0.236	−34.3
1000	0.174	167.8	4.400	79.2	0.120	71.1	0.228	−32.0
1200	0.178	156.8	3.712	74.8	0.143	70.3	0.226	−31.5
1400	0.186	147.5	3.236	70.3	0.168	68.7	0.226	−32.8
1600	0.194	139.7	2.874	66.3	0.190	66.6	0.223	−35.9
1800	0.199	133.7	2.583	62.6	0.211	64.9	0.216	−39.0
2000	0.215	127.8	2.369	58.8	0.232	63.5	0.211	−41.9

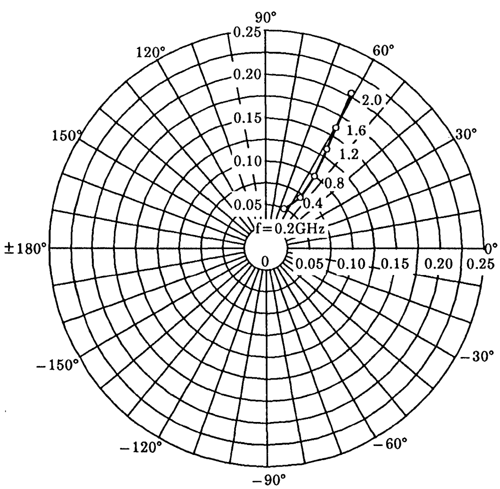
S_{11e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



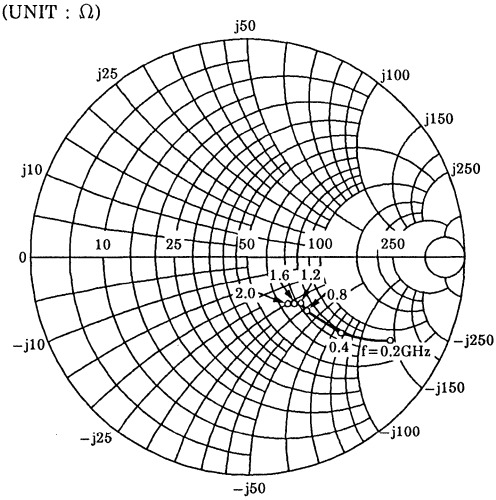
S_{21e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$



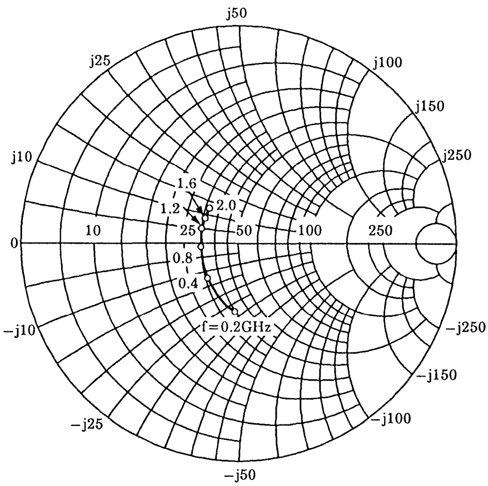
S_{12e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$



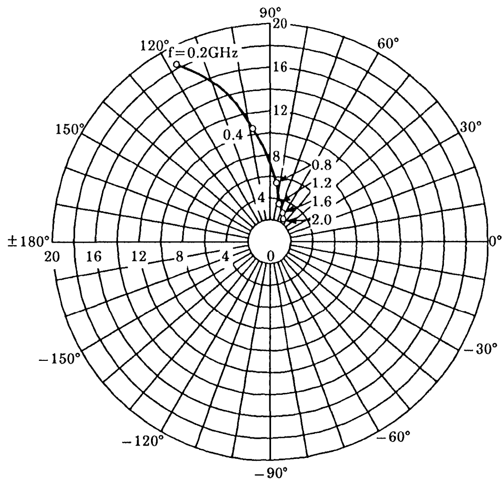
S_{22e}
$V_{CE}=8V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



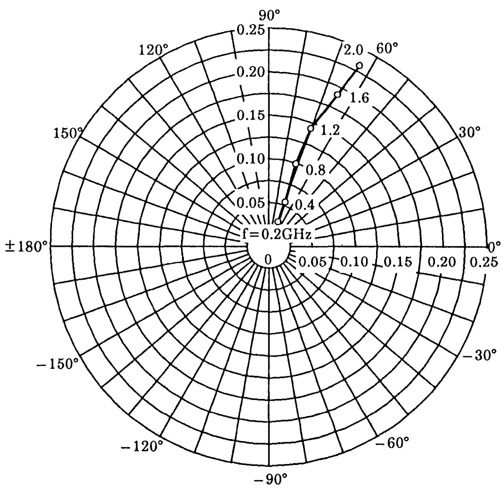
S_{11e}
$V_{CE}=8V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)



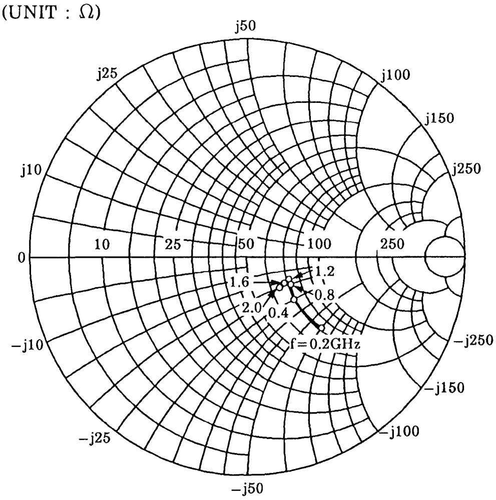
S_{21e}
$V_{CE}=8V$
$I_C=20mA$
$Ta=25°C$



S_{12e}
$V_{CE}=8V$
$I_C=20mA$
$Ta=25°C$



S_{22e}
$V_{CE}=8V$
$I_C=20mA$
$Ta=25°C$
(UNIT : Ω)



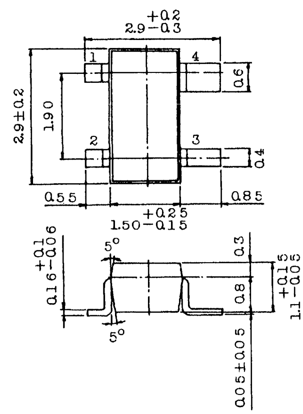
2SC5092 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

TENTATIVE DATA

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

Unit in mm

- Low Noise Figure, High Gain.
- NF = 1.1dB, $|S_{21e}|^2$ = 13dB (f = 1GHz)



1, 3. EMITTER
2. BASE
4. COLLECTOR

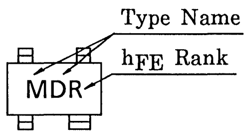
SMQ	
JEDEC	—
EIAJ	—
TOSHIBA	2-3J1C

Weight : 0.012g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Base Current	I_B	40	mA
Collector Current	I_C	20	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MARKING



MICROWAVE CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 8V, I_C = 20mA	7	10	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE} = 8V, I_C = 20mA, f = 1GHz	10	13	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE} = 8V, I_C = 20mA, f = 2GHz	—	7	—	
Noise Figure	NF (1)	V_{CE} = 8V, I_C = 5mA, f = 1GHz	—	1.1	2.5	dB
	NF (2)	V_{CE} = 8V, I_C = 5mA, f = 2GHz	—	1.7	—	

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_C = 0	—	—	1	μA
DC Current Gain	h_{FE} (Note 1)	V_{CE} = 8V, I_C = 20mA	50	—	160	—
Output Capacitance	C_{ob}	V_{CB} = 10V, I_E = 0, f = 1MHz	—	0.7	—	pF
Reverse Transfer Capacitance	C_{re}	(Note 2)	—	0.5	0.95	pF

(Note 1) : h_{FE} Classification R : 50~100, O : 80~160
(Note 2) : C_{re} is measured by 3 terminal method with capacitance bridge.

SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC5093

TENTATIVE DATA

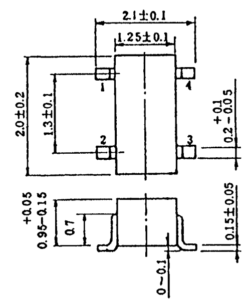
VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure, High Gain.
- NF = 1.1dB, $|S_{21e}|^2$ = 13dB (f = 1GHz)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Base Current	I_B	40	mA
Collector Current	I_C	20	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Unit in mm

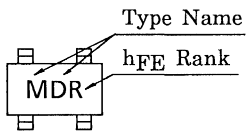


1. BASE
2. EMITTER
3. COLLECTOR

USQ	
JEDEC	—
EIAJ	—
TOSHIBA	2-2K1A

Weight : 0.006g

MARKING



MICROWAVE CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 8V, I_C = 20mA	7	10	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE} = 8V, I_C = 20mA, f = 1GHz	10	13	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE} = 8V, I_C = 20mA, f = 2GHz	—	7	—	
Noise Figure	NF (1)	V_{CE} = 8V, I_C = 5mA, f = 1GHz	—	1.1	2.5	dB
	NF (2)	V_{CE} = 8V, I_C = 5mA, f = 2GHz	—	1.7	—	

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_C = 0	—	—	1	μA
DC Current Gain	h_{FE} (Note 1)	V_{CE} = 8V, I_C = 20mA	50	—	160	—
Output Capacitance	C_{ob}	V_{CB} = 5V, I_E = 0, f = 1MHz (Note 2)	—	0.7	—	pF
Reverse Transfer Capacitance	C_{re}		—	0.5	0.95	pF

(Note 1) : h_{FE} Classification R : 50~100, O : 80~160
(Note 2) : C_{re} is measured by 3 terminal method with capacitance bridge.

2SC5094 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

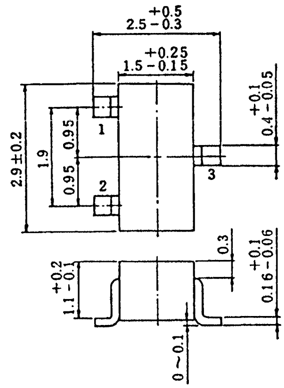
VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

Unit in mm

- Low Noise Figure, High Gain.
- NF=1.8dB, $|S_{21e}|^2$=7.5dB (f=2GHz)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Base Current	I_B	7	mA
Collector Current	I_C	15	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

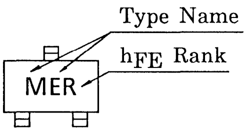


1. BASE
2. EMITTER
3. COLLECTOR

JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

MARKING



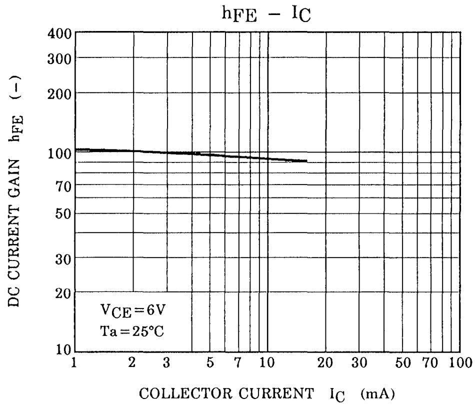
MICROWAVE CHARACTERISTICS (Ta = 25°C)

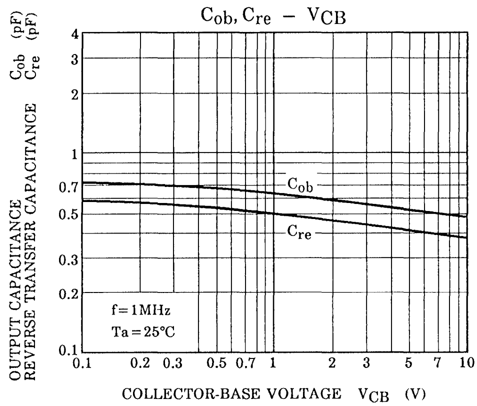
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE}=6V, I_C=7mA	7	10	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE}=6V, I_C=7mA, f=1GHz	—	13	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE}=6V, I_C=7mA, f=2GHz	4.5	7.5	—	
Noise Figure	NF (1)	V_{CE}=6V, I_C=3mA, f=1GHz	—	1.4	—	dB
	NF (2)	V_{CE}=6V, I_C=3mA, f=2GHz	—	1.8	3.0	

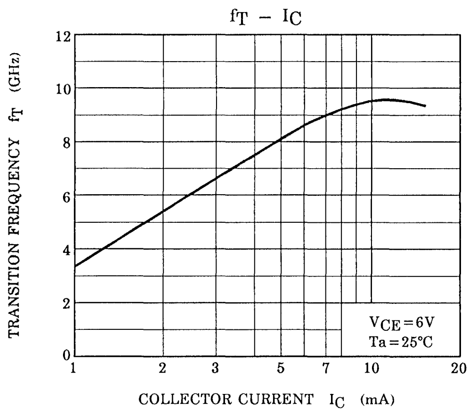
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

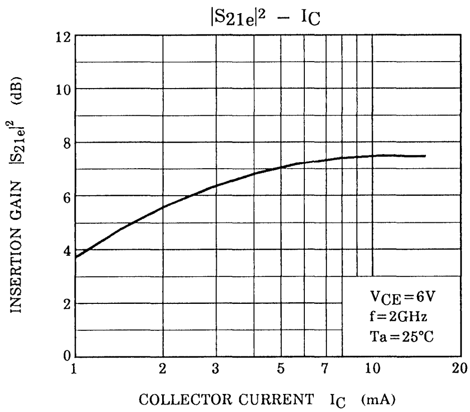
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB}=10V, I_E=0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB}=1V, I_C=0	—	—	1	μA
DC Current Gain	h_{FE} Note	V_{CE}=6V, I_C=7mA	50	—	160	—
Output Capacitance	C_{ob}	V_{CB}=10V, I_E=0, f=1MHz	—	0.5	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.4	0.85	pF

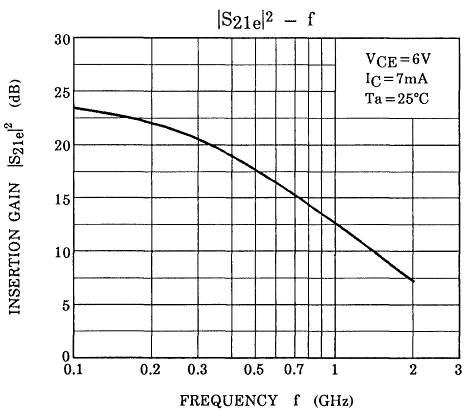
Note : C_{re} is measured by 3 terminal method with capacitance bridge.
Note : h_{FE} Classification R : 50~100, O : 80~160

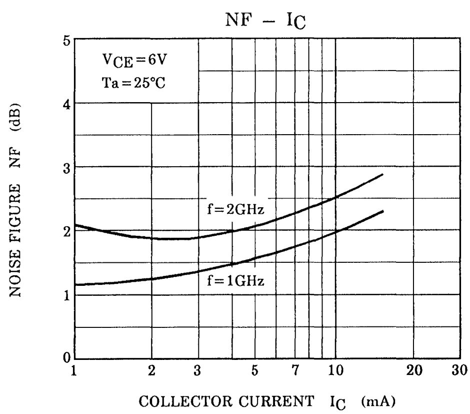

hFE – IC
DC CURRENT GAIN hFE (–)
VCE=6V
Ta=25°C
COLLECTOR CURRENT IC (mA)

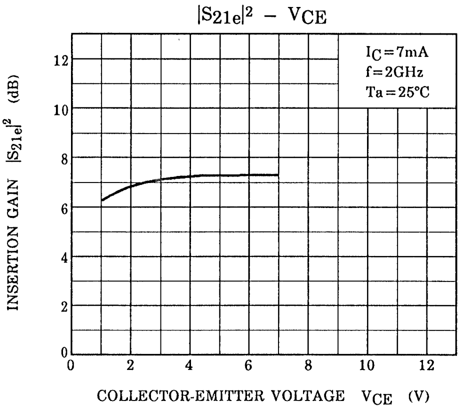

Cob, Cre – VCB
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
Cob
Cre
f=1MHz
Ta=25°C
COLLECTOR-BASE VOLTAGE VCB (V)

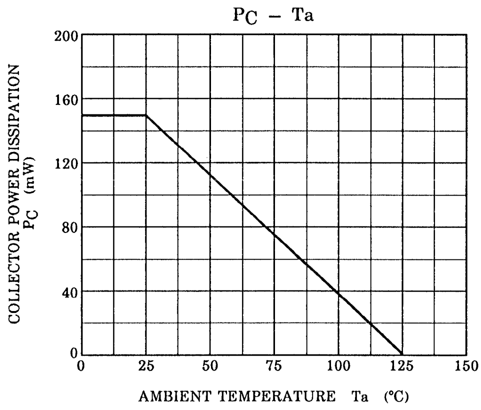

fT – IC
TRANSITION FREQUENCY fT (GHz)
VCE=6V
Ta=25°C
COLLECTOR CURRENT IC (mA)


|S21e|2 – IC
INSERTION GAIN |S21e|2 (dB)
VCE=6V
f=2GHz
Ta=25°C
COLLECTOR CURRENT IC (mA)


|S21e|2 – f
INSERTION GAIN |S21e|2 (dB)
VCE=6V
IC=7mA
Ta=25°C
FREQUENCY f (GHz)


NF – IC
NOISE FIGURE NF (dB)
VCE=6V
Ta=25°C
f=2GHz
f=1GHz
COLLECTOR CURRENT IC (mA)





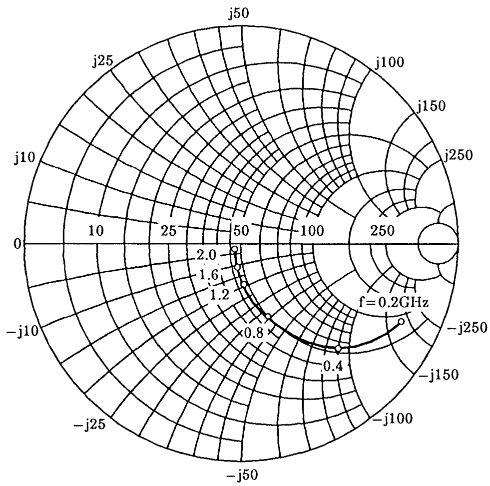
S-Parameter $Z_O = 50\Omega$, Ta = 25°C
$V_{CE} = 6V$, $I_C = 3mA$

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.817	−25.8	7.113	150.2	0.044	71.4	0.898	−18.6
400	0.647	−46.3	6.028	129.5	0.073	61.8	0.746	−28.7
600	0.477	−61.4	5.061	113.9	0.092	57.2	0.636	−33.4
800	0.356	−71.3	4.197	102.8	0.108	55.7	0.565	−35.4
1000	0.265	−78.9	3.583	93.9	0.123	55.3	0.518	−36.8
1200	0.194	−85.6	3.135	86.7	0.137	55.7	0.486	−37.5
1400	0.136	−90.5	2.778	80.2	0.153	55.8	0.467	−38.8
1600	0.093	−97.7	2.490	74.4	0.169	55.3	0.449	−40.4
1800	0.058	−109.0	2.260	69.6	0.183	54.8	0.433	−42.6
2000	0.028	−134.7	2.089	65.2	0.199	55.2	0.418	−43.9

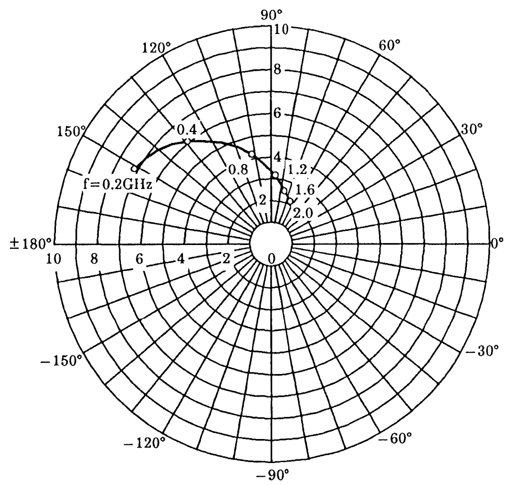
$V_{CE} = 6V$, $I_C = 7mA$

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.630	−39.7	12.332	138.1	0.037	68.5	0.783	−25.6
400	0.392	−64.1	8.847	114.7	0.059	64.3	0.586	−31.8
600	0.248	−78.3	6.514	101.4	0.077	64.1	0.495	−32.0
800	0.161	−87.5	5.094	92.6	0.096	64.7	0.449	−31.2
1000	0.105	−95.3	4.213	85.9	0.114	64.9	0.423	−30.5
1200	0.060	−106.3	3.589	80.3	0.133	65.0	0.412	−30.8
1400	0.028	−121.7	3.139	74.9	0.154	64.0	0.406	−32.1
1600	0.021	−158.4	2.786	70.1	0.173	62.5	0.398	−34.0
1800	0.035	171.6	2.498	66.0	0.190	61.2	0.387	−36.7
2000	0.054	144.0	2.300	62.3	0.210	60.7	0.377	−38.4

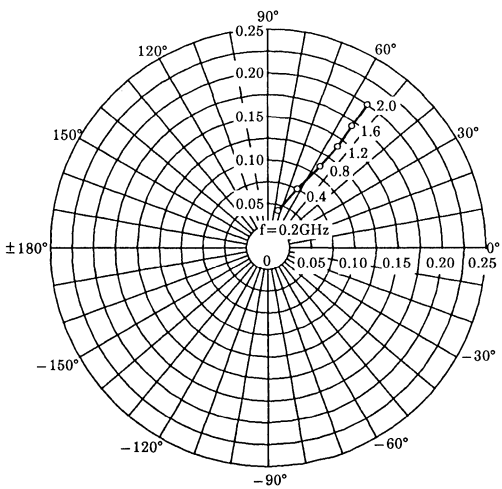
S_{11e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$
(UNIT : Ω)



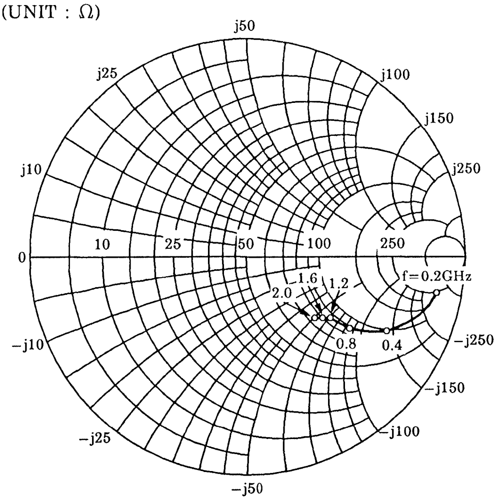
S_{21e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$



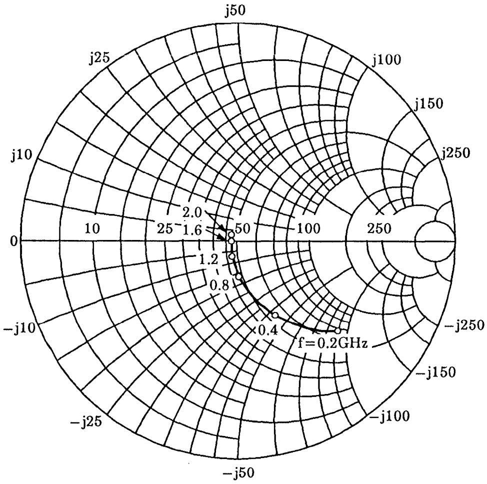
S_{12e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$



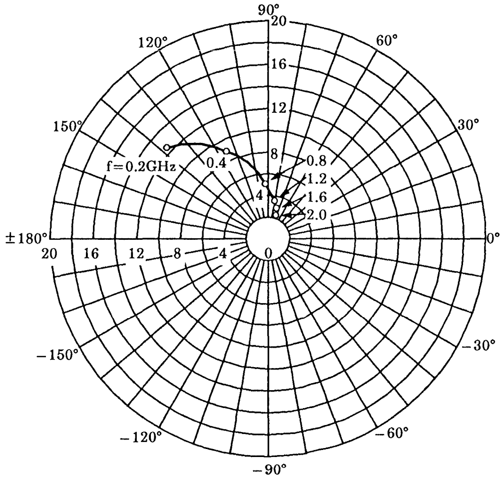
S_{22e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$
(UNIT : Ω)



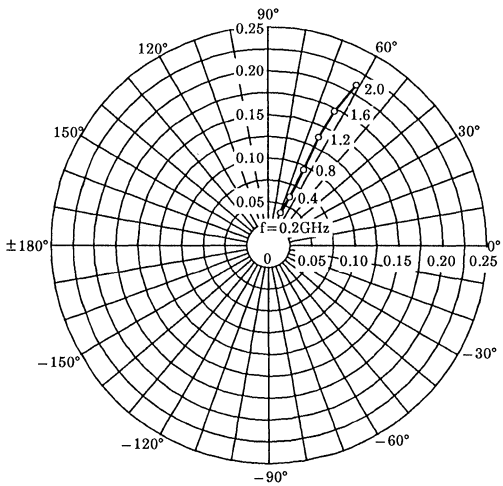
S_{11e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$
(UNIT : Ω)



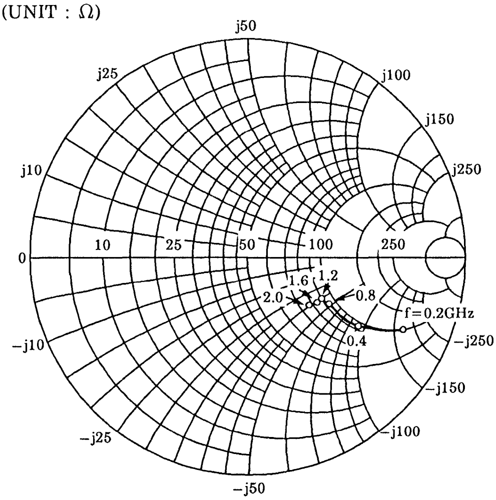
S_{21e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$



S_{12e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$



S_{22e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$
(UNIT : Ω)



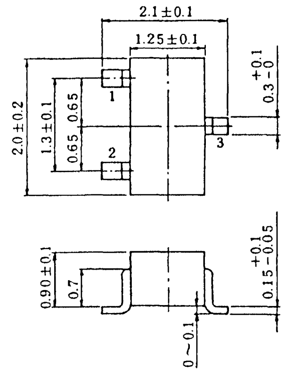
SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC5095

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure, High Gain.
- $NF = 1.8dB$, $|S_{21e}|^2 = 7.5dB$ ($f = 2GHz$)

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

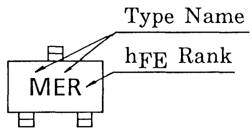
JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1A

Weight : 0.006g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Base Current	I_B	7	mA
Collector Current	I_C	15	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MARKING



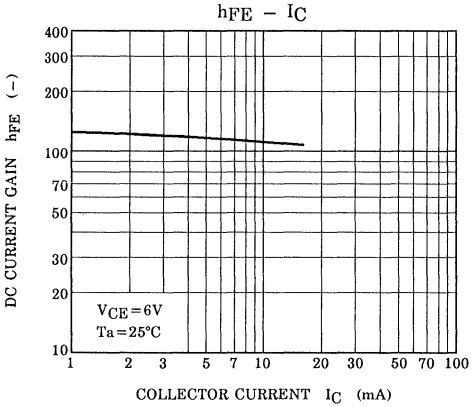
MICROWAVE CHARACTERISTICS (Ta = 25°C)

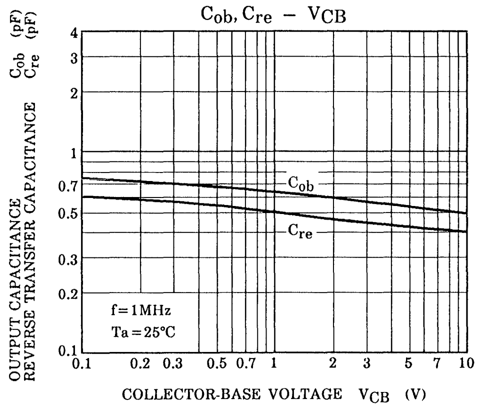
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	$V_{CE} = 6V$, $I_C = 7mA$	7	10	—	GHz
Insertion Gain	$\lvert S_{21e}\rvert^2$ (1)	$V_{CE} = 6V$, $I_C = 7mA$, $f = 1GHz$	—	13	—	dB
	$\lvert S_{21e}\rvert^2$ (2)	$V_{CE} = 6V$, $I_C = 7mA$, $f = 2GHz$	4.5	7.5	—	
Noise Figure	NF (1)	$V_{CE} = 6V$, $I_C = 3mA$, $f = 1GHz$	—	1.4	—	dB
	NF (2)	$V_{CE} = 6V$, $I_C = 3mA$, $f = 2GHz$	—	1.8	3.0	

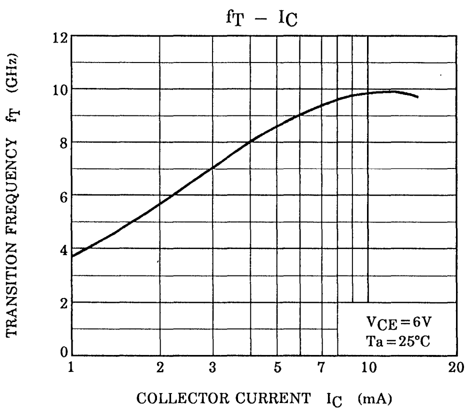
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

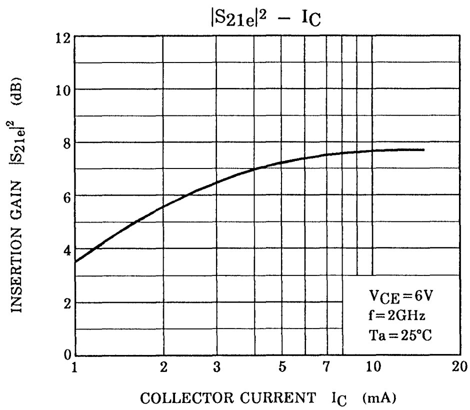
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB} = 10V$, $I_E = 0$	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB} = 1V$, $I_C = 0$	—	—	1	μA
DC Current Gain	h_{FE} Note	$V_{CE} = 6V$, $I_C = 7mA$	50	—	160	—
Output Capacitance	C_{ob}	$V_{CB} = 10V$, $I_E = 0$, $f = 1MHz$	—	0.5	—	pF
Reverse Transfer Capacitance	C_{re}	(Note)	—	0.4	0.85	pF

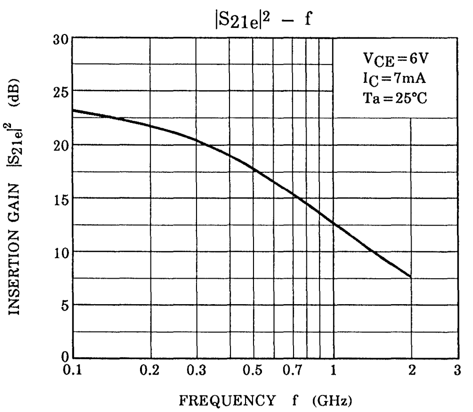
Note : C_{re} is measured by 3 terminal method with capacitance bridge.
Note : h_{FE} Classification R : 50~100, O : 80~160

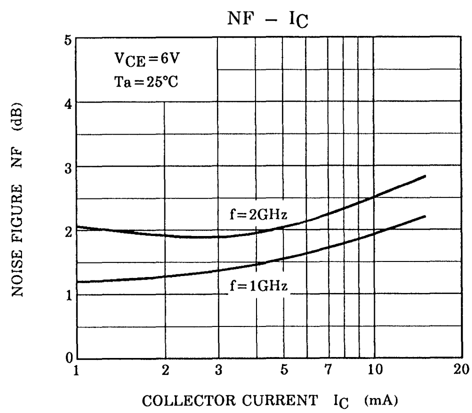

hFE – IC
DC CURRENT GAIN hFE (–)
COLLECTOR CURRENT IC (mA)
VCE=6V
Ta=25°C

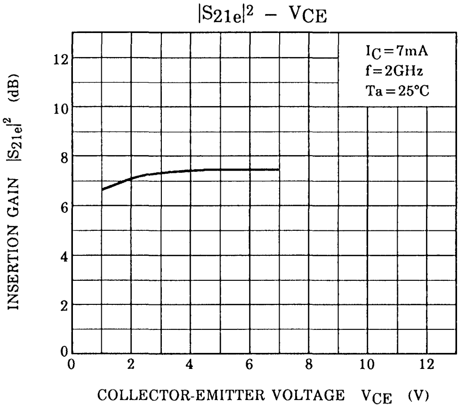

Cob, Cre – VCB
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
COLLECTOR-BASE VOLTAGE VCB (V)
Cob
Cre
f=1MHz
Ta=25°C

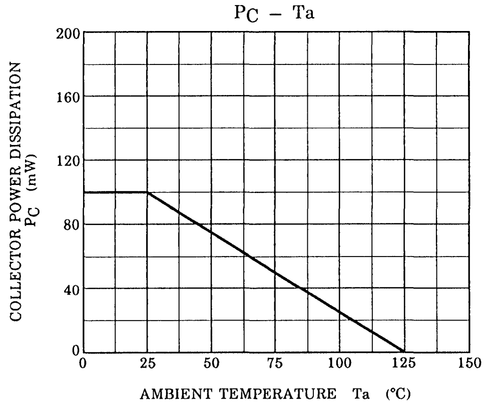

fT – IC
TRANSITION FREQUENCY fT (GHz)
COLLECTOR CURRENT IC (mA)
VCE=6V
Ta=25°C


|S21e|2 – IC
INSERTION GAIN |S21e|2 (dB)
COLLECTOR CURRENT IC (mA)
VCE=6V
f=2GHz
Ta=25°C


|S21e|2 – f
INSERTION GAIN |S21e|2 (dB)
FREQUENCY f (GHz)
VCE=6V
IC=7mA
Ta=25°C


NF – IC
NOISE FIGURE NF (dB)
COLLECTOR CURRENT IC (mA)
VCE=6V
Ta=25°C
f=2GHz
f=1GHz





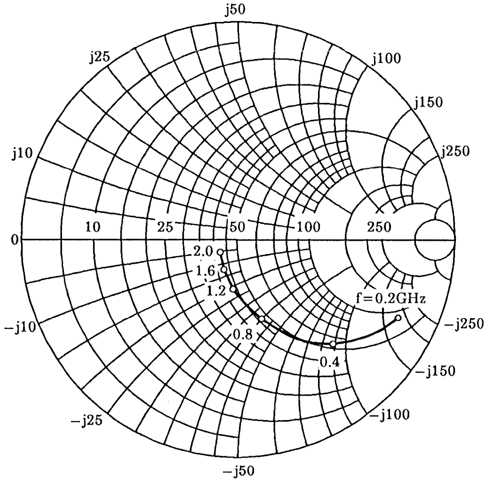
S-Parameter $Z_O = 50\Omega$, Ta = 25°C
$V_{CE} = 6V$, $I_C = 3mA$

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.835	–26.1	7.069	150.4	0.046	71.0	0.899	–19.3
400	0.665	–46.5	5.948	130.4	0.076	60.5	0.745	–30.3
600	0.501	–62.7	5.021	115.2	0.095	55.7	0.630	–35.9
800	0.386	–74.3	4.173	104.3	0.111	53.7	0.552	–38.5
1000	0.297	–83.7	3.592	95.6	0.124	53.2	0.500	–39.9
1200	0.226	–92.7	3.140	88.5	0.137	53.6	0.465	–41.1
1400	0.175	–101.9	2.808	82.3	0.152	54.1	0.442	–42.2
1600	0.130	–113.4	2.514	76.6	0.165	54.2	0.421	–43.8
1800	0.103	–128.0	2.293	71.7	0.179	53.9	0.405	–45.7
2000	0.081	–147.4	2.114	67.3	0.193	54.8	0.388	–47.4

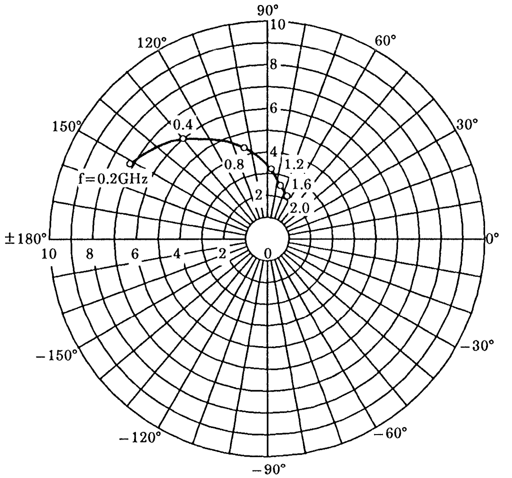
$V_{CE} = 6V$, $I_C = 7mA$

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.668	–40.0	12.306	138.9	0.040	67.3	0.786	–27.0
400	0.427	–64.4	8.852	116.1	0.061	61.6	0.579	–35.0
600	0.280	–79.5	6.591	102.9	0.078	61.8	0.476	–35.9
800	0.193	–89.7	5.191	94.3	0.096	62.5	0.420	–35.0
1000	0.134	–99.3	4.288	87.8	0.112	63.2	0.390	–34.2
1200	0.088	–112.3	3.661	81.9	0.130	63.8	0.374	–34.0
1400	0.056	–129.8	3.232	76.9	0.150	63.4	0.366	–34.8
1600	0.035	–169.0	2.857	72.1	0.168	62.5	0.356	–36.6
1800	0.040	157.0	2.574	68.1	0.185	61.4	0.347	–39.0
2000	0.054	131.5	2.363	64.3	0.203	61.3	0.338	–40.2

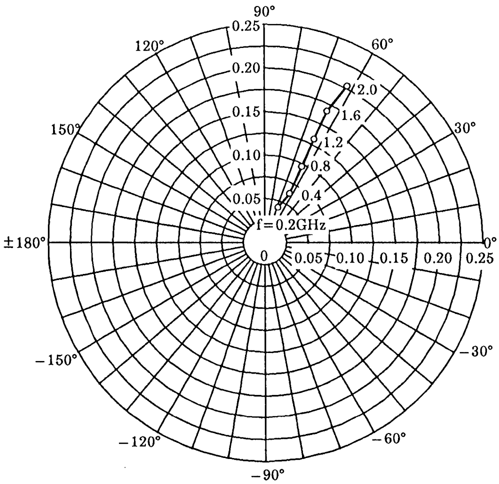
S_{11e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$
(UNIT : Ω)



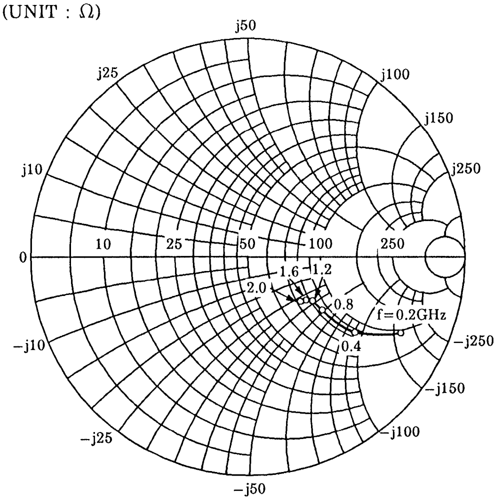
S_{21e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$



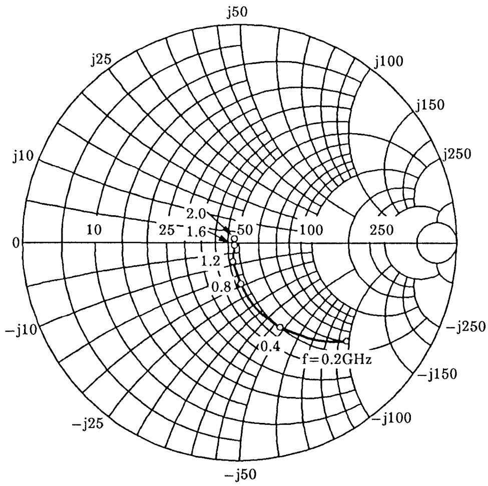
S_{12e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$



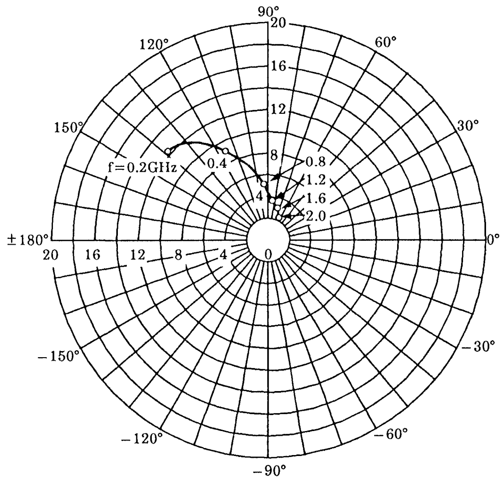
S_{22e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$
(UNIT : Ω)



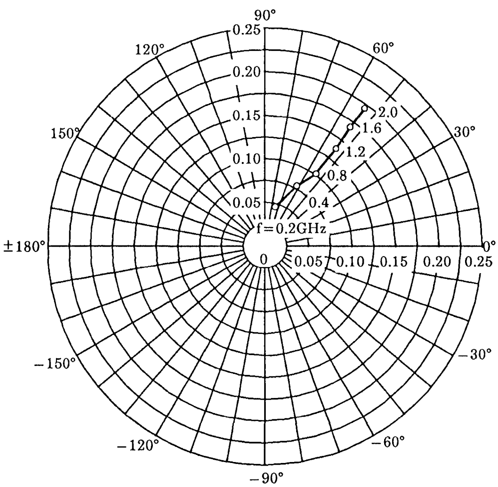
S_{11e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$
(UNIT : Ω)



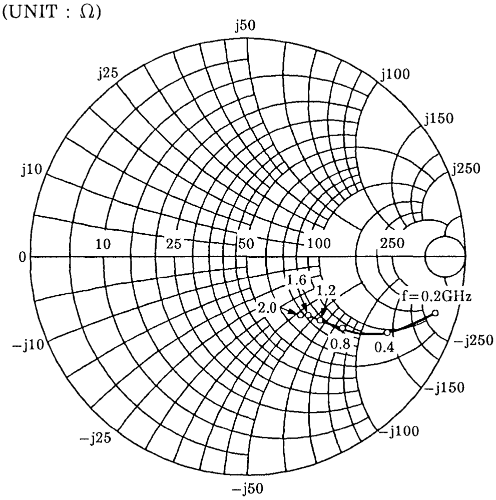
S_{21e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$



S_{12e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$



S_{22e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$
(UNIT : Ω)

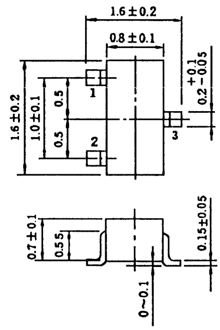


2SC5096 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

Unit in mm

- Low Noise Figure, High Gain.
- NF = 1.8dB, $|S_{21e}|^2$ = 7.5dB (f = 2GHz)



1. BASE
2. EMITTER
3. COLLECTOR

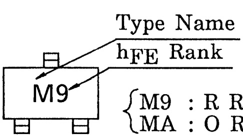
SSM	
JEDEC	—
EIAJ	—
TOSHIBA	2-2H1A

Weight : 2.4mg

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Base Current	I_B	7	mA
Collector Current	I_C	15	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MARKING



M9 : R Rank
MA : O Rank

MICROWAVE CHARACTERISTICS (Ta = 25°C)

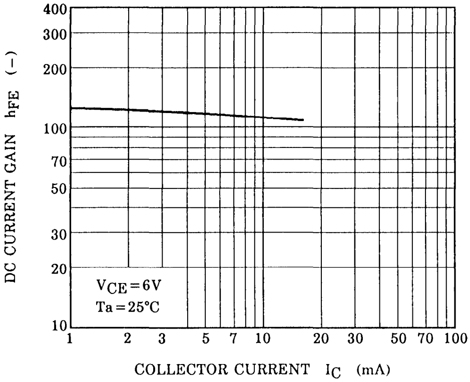
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 6V, I_C = 7mA	7	10	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE} = 6V, I_C = 7mA, f = 1GHz	—	13	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE} = 6V, I_C = 7mA, f = 2GHz	4.5	7.5	—	
Noise Figure	NF (1)	V_{CE} = 6V, I_C = 3mA, f = 1GHz	—	1.4	—	dB
	NF (2)	V_{CE} = 6V, I_C = 3mA, f = 2GHz	—	1.8	3.0	

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

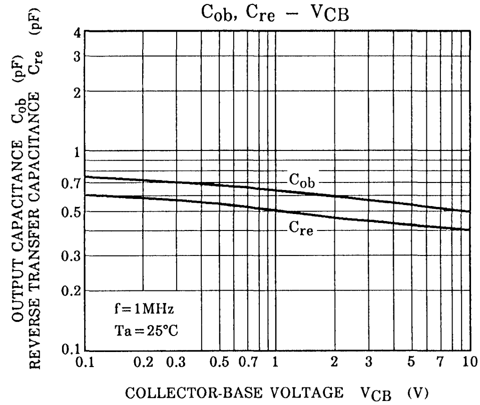
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_C = 0	—	—	1	μA
DC Current Gain	h_{FE} (Note 1)	V_{CE} = 6V, I_C = 7mA	50	—	160	—
Output Capacitance	C_{ob}	V_{CB} = 10V, I_E = 0, f = 1MHz	—	0.5	—	pF
Reverse Transfer Capacitance	C_{re}	(Note 2)	—	0.4	0.85	pF

(Note 1) : h_{FE} Classification R : 50~100, O : 80~160
(Note 2) : C_{re} is measured by 3 terminal method with capacitance bridge.

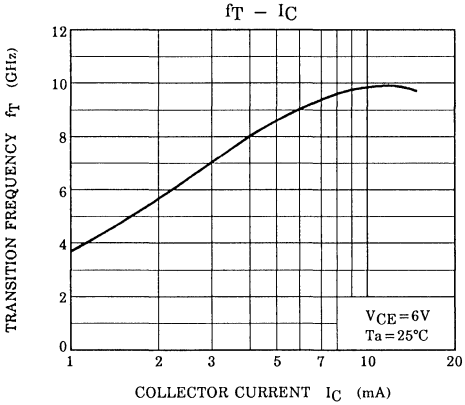
h_{FE} − I_C



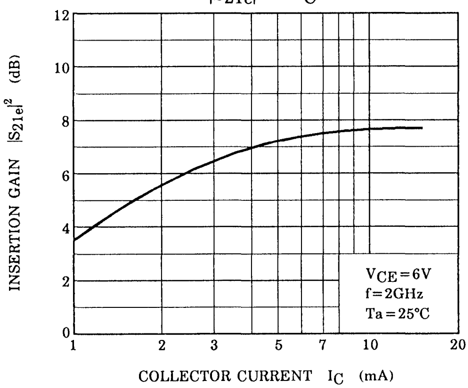
C_{ob}, C_{re} − V_{CB}



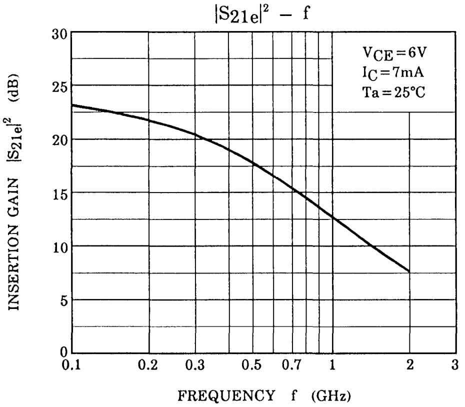
f_T − I_C



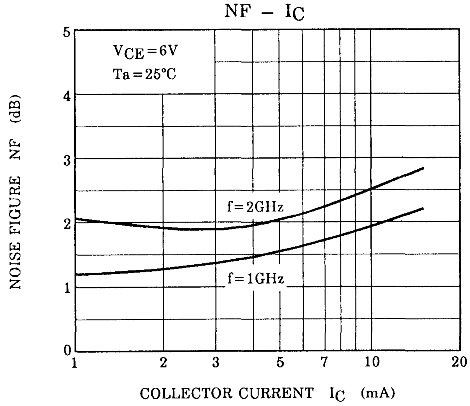
$|S_{21e}|^2$ − I_C

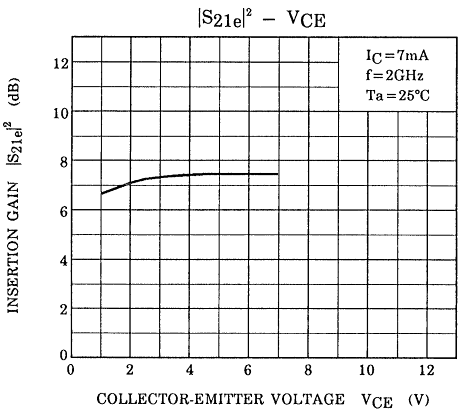


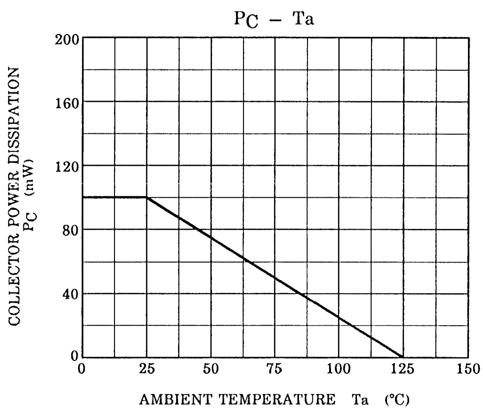
$|S_{21e}|^2$ − f



NF − I_C







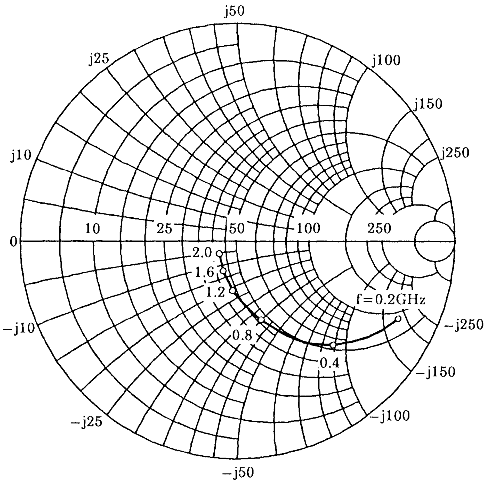
S-Parameter $Z_O = 50\Omega$, Ta = 25°C
V_{CE} = 6V, I_C = 3mA

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.835	−26.1	7.069	150.4	0.046	71.0	0.899	−19.3
400	0.665	−46.5	5.948	130.4	0.076	60.5	0.745	−30.3
600	0.501	−62.7	5.021	115.2	0.095	55.7	0.630	−35.9
800	0.386	−74.3	4.173	104.3	0.111	53.7	0.552	−38.5
1000	0.297	−83.7	3.592	95.6	0.124	53.2	0.500	−39.9
1200	0.226	−92.7	3.140	88.5	0.137	53.6	0.465	−41.1
1400	0.175	−101.9	2.808	82.3	0.152	54.1	0.442	−42.2
1600	0.130	−113.4	2.514	76.6	0.165	54.2	0.421	−43.8
1800	0.103	−128.0	2.293	71.7	0.179	53.9	0.405	−45.7
2000	0.081	−147.4	2.114	67.3	0.193	54.8	0.388	−47.4

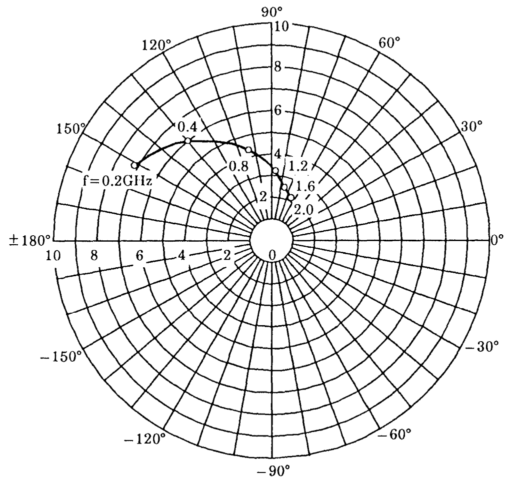
V_{CE} = 6V, I_C = 7mA

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.668	−40.0	12.306	138.9	0.040	67.3	0.786	−27.0
400	0.427	−64.4	8.852	116.1	0.061	61.6	0.579	−35.0
600	0.280	−79.5	6.591	102.9	0.078	61.8	0.476	−35.9
800	0.193	−89.7	5.191	94.3	0.096	62.5	0.420	−35.0
1000	0.134	−99.3	4.288	87.8	0.112	63.2	0.390	−34.2
1200	0.088	−112.3	3.661	81.9	0.130	63.8	0.374	−34.0
1400	0.056	−129.8	3.232	76.9	0.150	63.4	0.366	−34.8
1600	0.035	−169.0	2.857	72.1	0.168	62.5	0.356	−36.6
1800	0.040	157.0	2.574	68.1	0.185	61.4	0.347	−39.0
2000	0.054	131.5	2.363	64.3	0.203	61.3	0.338	−40.2

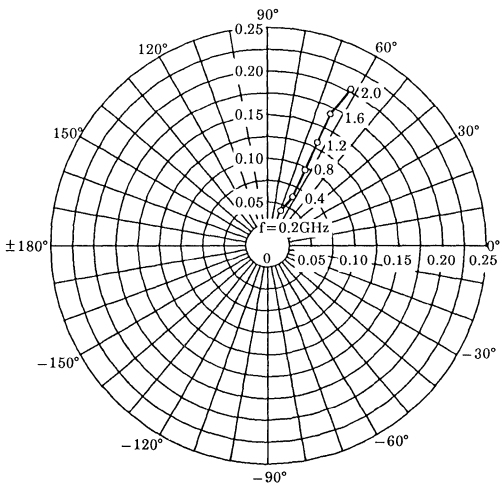
S_{11e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$
(UNIT : Ω)



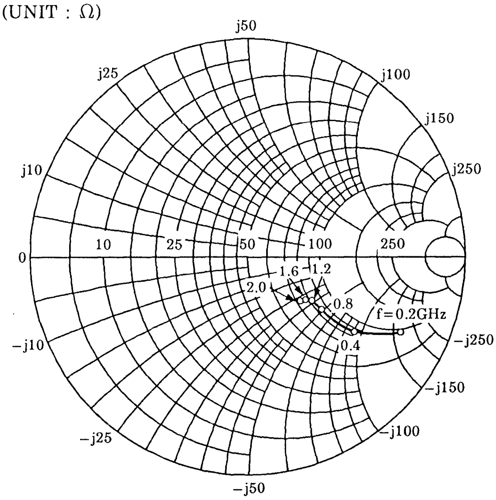
S_{21e}
$V_{CE}=6V$
$I_C=3mA$
$Ta=25°C$



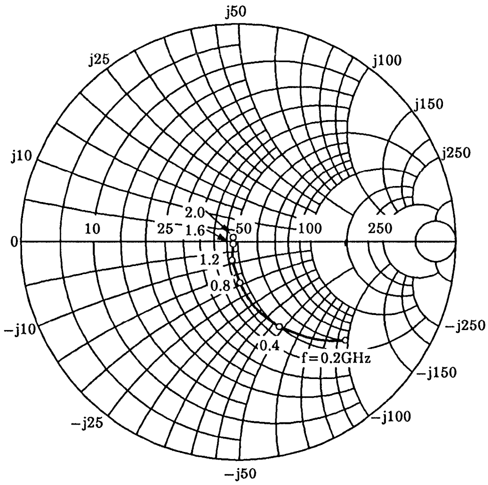
S_{12e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$



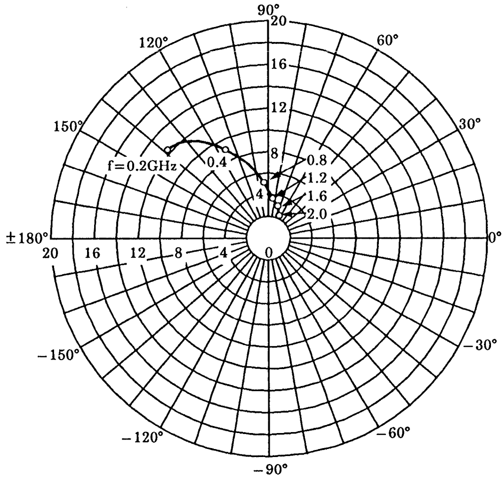
S_{22e}
$V_{CE}=6V$
$I_C=7mA$
$Ta=25°C$
(UNIT : Ω)



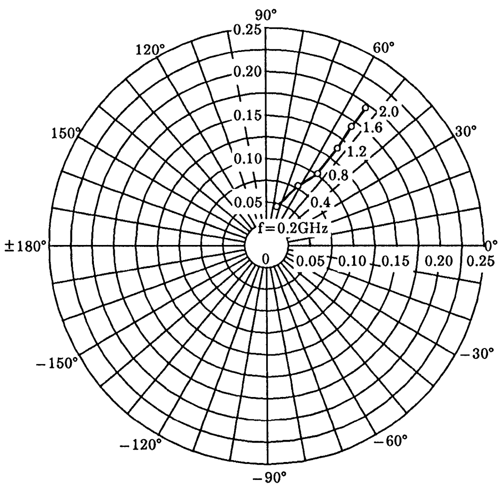
S11e
$V_{CE} = 6V$
$I_C = 7mA$
$Ta = 25°C$
(UNIT : Ω)



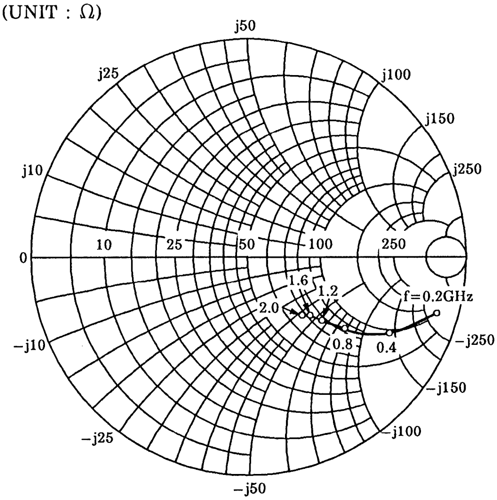
S21e
$V_{CE} = 6V$
$I_C = 7mA$
$Ta = 25°C$



S12e
$V_{CE} = 6V$
$I_C = 3mA$
$Ta = 25°C$



S22e
$V_{CE} = 6V$
$I_C = 3mA$
$Ta = 25°C$
(UNIT : Ω)



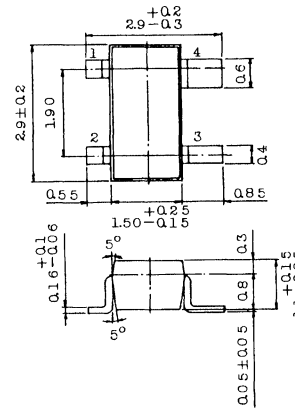
SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR 2SC5097

TENTATIVE DATA

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure, High Gain.
- NF=1.8dB, $|S_{21e}|^2$=9.5dB (f=2GHz)

Unit in mm



1, 3. EMITTER
2. BASE
4. COLLECTOR

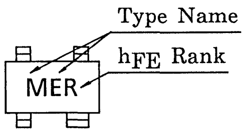
SMQ	
JEDEC	—
EIAJ	—
TOSHIBA	2-3J1C

Weight : 0.012g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Base Current	I_B	7	mA
Collector Current	I_C	15	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MARKING



MICROWAVE CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE}=6V, I_C=7mA	7	10	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE}=6V, I_C=7mA, f=1GHz	—	15	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE}=6V, I_C=7mA, f=2GHz	6.5	9.5	—	
Noise Figure	NF (1)	V_{CE}=6V, I_C=3mA, f=1GHz	—	1.4	—	dB
	NF (2)	V_{CE}=6V, I_C=3mA, f=2GHz	—	1.8	3.0	

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB}=10V, I_E=0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB}=1V, I_C=0	—	—	1	μA
DC Current Gain	h_{FE} (Note 1)	V_{CE}=6V, I_C=7mA	50	—	160	—
Output Capacitance	C_{ob}	V_{CB}=10V, I_E=0, f=1MHz	—	0.6	—	pF
Reverse Transfer Capacitance	C_{re}	(Note 2)	—	0.4	0.85	pF

(Note 1) : h_{FE} Classification R : 50~100, O : 80~160
(Note 2) : C_{re} is measured by 3 terminal method with capacitance bridge.

2SC5098 SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

TENTATIVE DATA

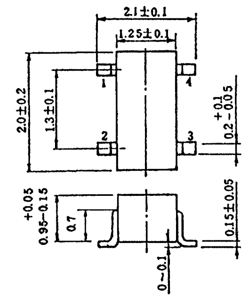
VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

Unit in mm

- Low Noise Figure, High Gain.
- NF=1.8dB, $|S_{21e}|^2$=9.5dB (f=2GHz)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Base Current	I_B	7	mA
Collector Current	I_C	15	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

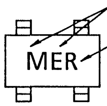


1, 3. EMITTER
2. BASE
4. COLLECTOR

USQ	
JEDEC	—
EIAJ	—
TOSHIBA	2-2K1A

Weight : 0.006g

MARKING



Type Name

h_{FE} Rank

MICROWAVE CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE}=6V, I_C=7mA	7	10	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE}=6V, I_C=7mA, f=1GHz	—	15	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE}=6V, I_C=7mA, f=2GHz	6.5	9.5	—	
Noise Figure	NF (1)	V_{CE}=6V, I_C=3mA, f=1GHz	—	1.4	—	dB
	NF (2)	V_{CE}=6V, I_C=3mA, f=2GHz	—	1.8	3.0	

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB}=10V, I_E=0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB}=1V, I_C=0	—	—	1	μA
DC Current Gain	h_{FE} (Note 1)	V_{CE}=6V, I_C=7mA	50	—	160	—
Output Capacitance	C_{ob}	V_{CB}=10V, I_E=0, f=1MHz	—	0.6	—	pF
Reverse Transfer Capacitance	C_{re}	(Note 2)	—	0.4	0.85	pF

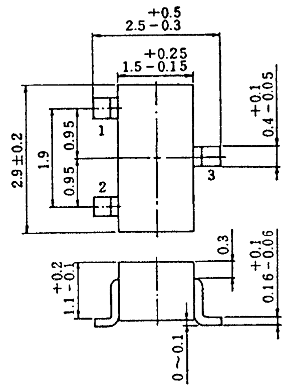
(Note 1) : h_{FE} Classification R : 50~100, O : 80~160
(Note 2) : C_{re} is measured by 3 terminal method with capacitance bridge.

SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC5106

FOR VCO APPLICATION

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

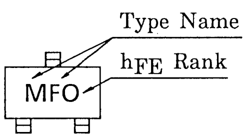
S-MINI	
JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

MAXIMUM RATINGS ($Ta = 25°C$)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	30	mA
Base Current	I_B	15	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

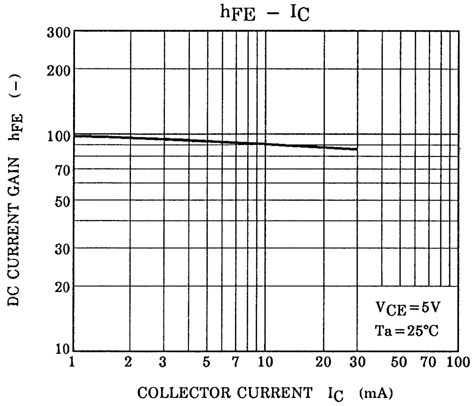
MARKING

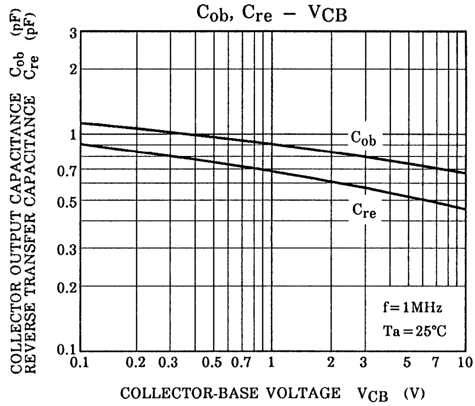


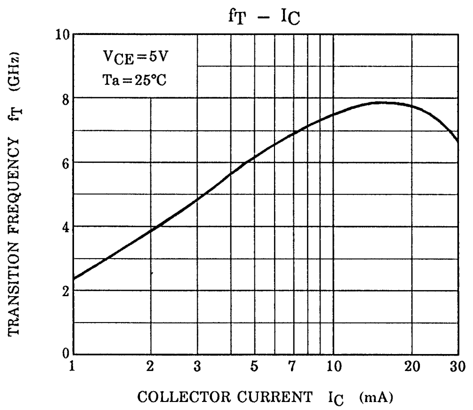
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB} = 10V$, $I_E = 0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB} = 1V$, $I_C = 0$	—	—	0.1	μA
DC Current Gain	h_{FE} (Note 1)	$V_{CE} = 5V$, $I_C = 5mA$	80	—	240	—
Transition Frequency	f_T	$V_{CE} = 5V$, $I_C = 5mA$	4	6	—	GHz
Insertion Gain	$\|S_{21e}\|^2$	$V_{CE} = 5V$, $I_C = 5mA$, $f = 1GHz$	7	11	—	dB
Output Capacitance	C_{ob}	$V_{CB} = 5V$, $I_E = 0$, $f = 1MHz$ (Note 2)	—	0.7	—	pF
Reverse Transfer Capacitance	C_{re}		—	0.5	0.9	pF
Collector-Base Time Constant	$C_c \cdot r_{bb'}$	$V_{CB} = 5V$, $I_C = 3mA$, $f = 30MHz$	—	5.5	10	ps

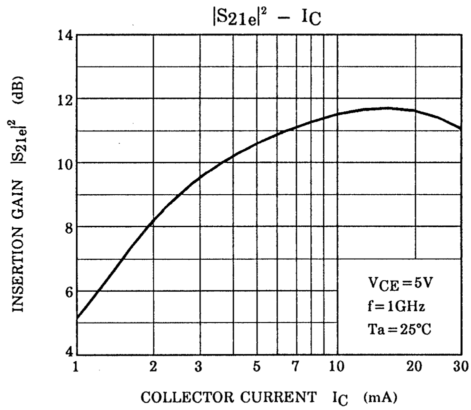
(Note 1) : h_{FE} Classification O : 80~160, Y : 120~240

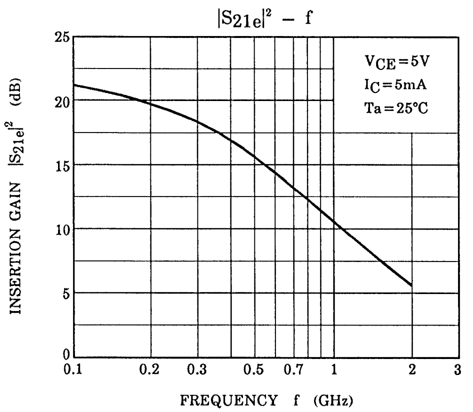
(Note 2) : C_{re} is measured by 3 terminal method with capacitance bridge.

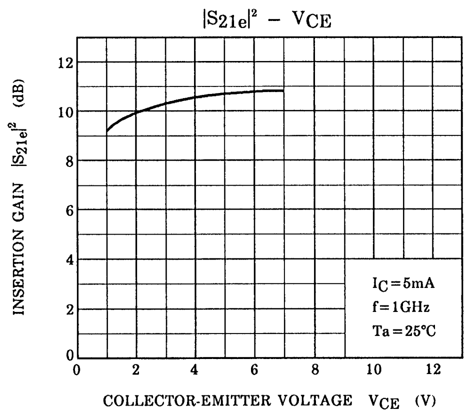

hFE – IC
DC CURRENT GAIN hFE (–)
COLLECTOR CURRENT IC (mA)
VCE=5V
Ta=25°C
300 200 100 70 50 30 20 10
1 2 3 5 7 10 20 30 50 70 100

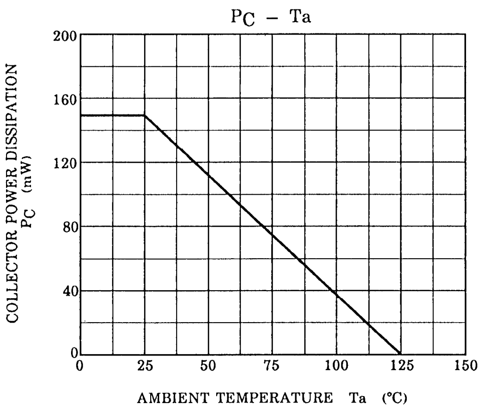

Cob, Cre – VCB
COLLECTOR OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
COLLECTOR-BASE VOLTAGE VCB (V)
Cob
Cre
f=1MHz
Ta=25°C
3 2 1 0.7 0.5 0.3 0.2 0.1
0.1 0.2 0.3 0.5 0.7 1 2 3 5 7 10


fT – IC
TRANSITION FREQUENCY fT (GHz)
COLLECTOR CURRENT IC (mA)
VCE=5V
Ta=25°C
10 8 6 4 2 0
1 2 3 5 7 10 20 30


|S21e|² – IC
INSERTION GAIN |S21e|² (dB)
COLLECTOR CURRENT IC (mA)
VCE=5V
f=1GHz
Ta=25°C
14 12 10 8 6 4
1 2 3 5 7 10 20 30


|S21e|² – f
INSERTION GAIN |S21e|² (dB)
FREQUENCY f (GHz)
VCE=5V
IC=5mA
Ta=25°C
25 20 15 10 5 0
0.1 0.2 0.3 0.5 0.7 1 2 3

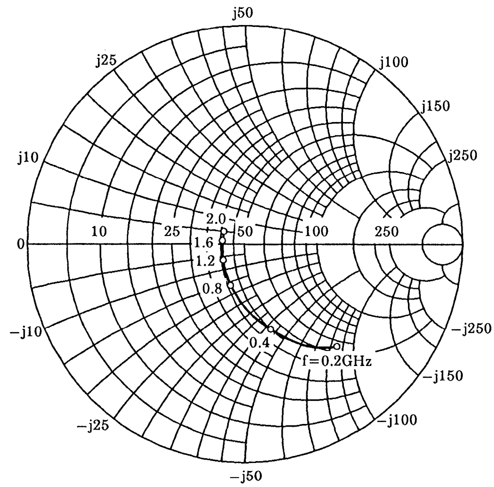

|S21e|² – VCE
INSERTION GAIN |S21e|² (dB)
COLLECTOR-EMITTER VOLTAGE VCE (V)
IC=5mA
f=1GHz
Ta=25°C
12 10 8 6 4 2 0
0 2 4 6 8 10 12



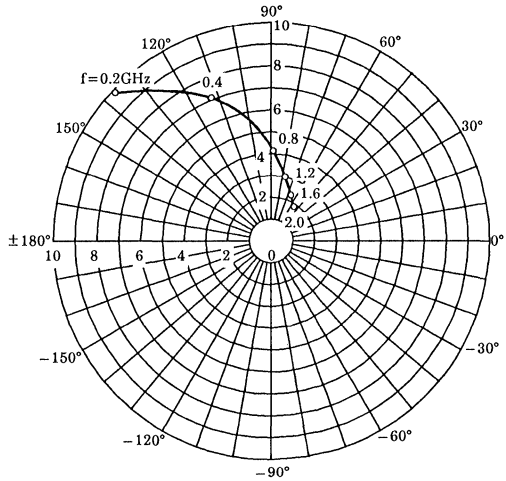
S-Parameter $Z_O = 50\Omega$, $Ta = 25°C$
$V_{CE} = 5V$, $I_C = 5mA$

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.654	−45.3	9.794	136.6	0.047	64.8	0.775	−27.8
400	0.414	−75.6	7.062	112.6	0.071	58.7	0.570	−35.0
600	0.273	−94.9	5.232	98.7	0.090	58.5	0.472	−35.8
800	0.193	−111.7	4.118	89.4	0.108	59.5	0.424	−35.5
1000	0.146	−128.1	3.412	82.0	0.127	60.4	0.398	−35.5
1200	0.116	−147.4	2.927	75.5	0.147	61.0	0.381	−36.2
1400	0.101	−169.6	2.571	69.8	0.169	60.7	0.373	−37.9
1600	0.098	171.6	2.299	64.4	0.189	59.5	0.363	−40.4
1800	0.105	155.8	2.079	59.8	0.208	58.6	0.351	−43.5
2000	0.118	142.1	1.928	55.4	0.230	58.4	0.338	−46.1

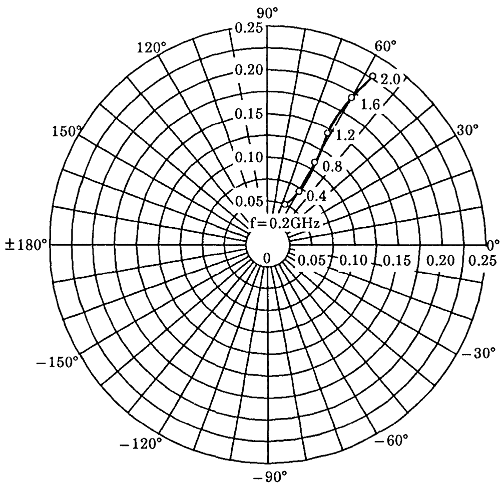
S_{11e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



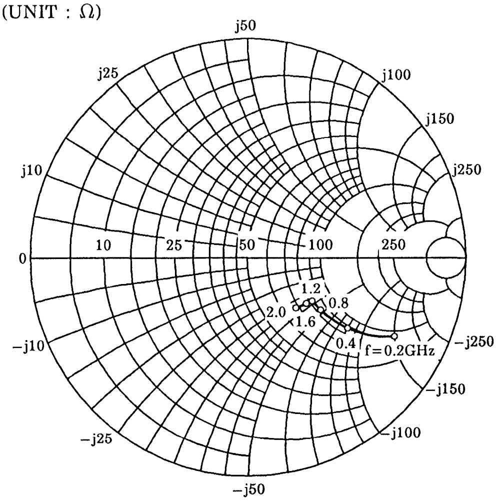
S_{21e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$



S_{12e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$



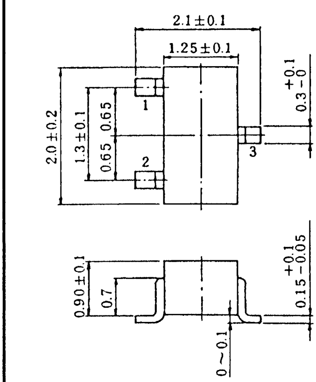
S_{22e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR 2SC5107

FOR VCO APPLICATION

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

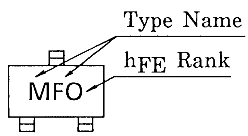
USM	
JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1A

Weight : 0.006g

MAXIMUM RATINGS ($Ta = 25°C$)

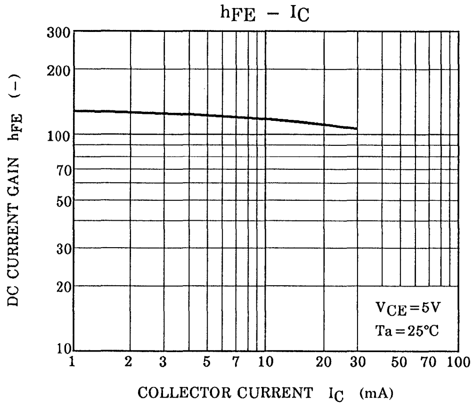
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	30	mA
Base Current	I_B	15	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

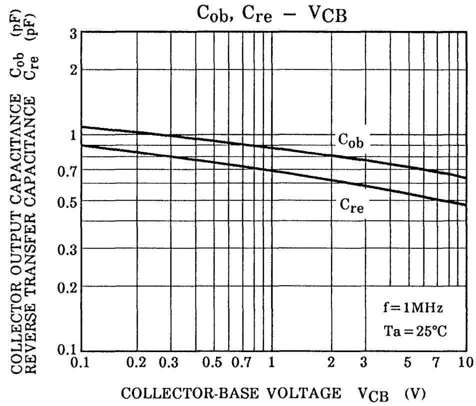
MARKING

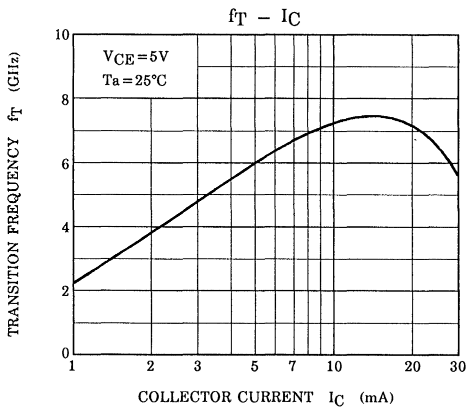


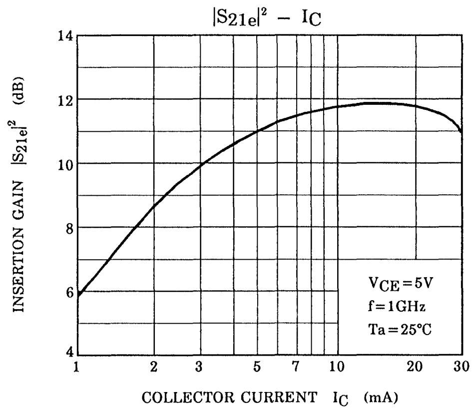
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB} = 10V$, $I_E = 0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB} = 1V$, $I_C = 0$	—	—	0.1	μA
DC Current Gain	h_{FE} (Note 1)	$V_{CE} = 5V$, $I_C = 5mA$	80	—	240	—
Transition Frequency	f_T	$V_{CE} = 5V$, $I_C = 5mA$	4	6	—	GHz
Insertion Gain	$\vert S_{21e}\vert^2$	$V_{CE} = 5V$, $I_C = 5mA$, $f = 1GHz$	7	11	—	dB
Output Capacitance	C_{ob}	$V_{CB} = 5V$, $I_E = 0$, $f = 1MHz$	—	0.7	—	pF
Reverse Transfer Capacitance	C_{re}	(Note 2)	—	0.5	0.9	pF
Collector-Base Time Constant	$C_c \cdot r_{bb}'$	$V_{CB} = 5V$, $I_C = 3mA$, $f = 30MHz$	—	5.5	10	ps

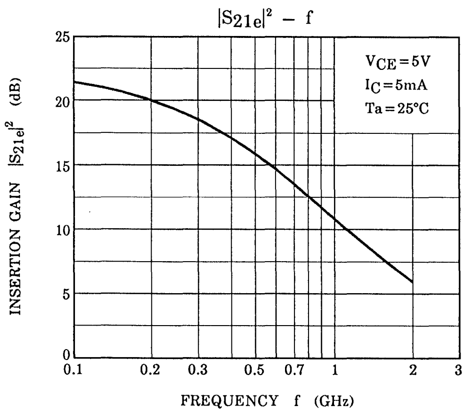
(Note 1) : h_{FE} Classification O : 80~160, Y : 120~240
(Note 2) : C_{re} is measured by 3 terminal method with capacitance bridge.

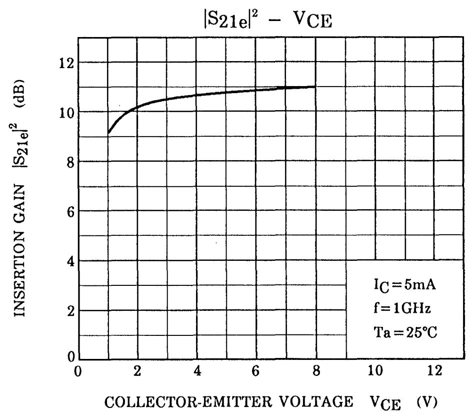

hFE – IC
DC CURRENT GAIN hFE (–)
COLLECTOR CURRENT IC (mA)
VCE=5V
Ta=25°C

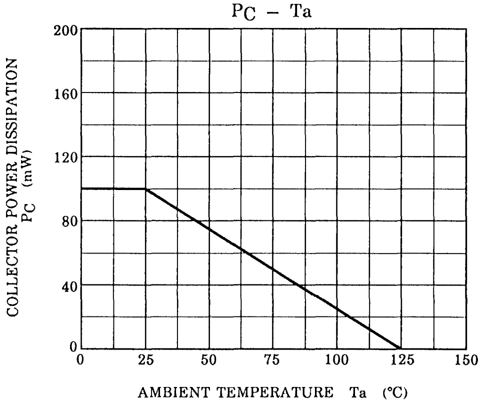

Cob, Cre – VCB
COLLECTOR OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
COLLECTOR-BASE VOLTAGE VCB (V)
Cob
Cre
f=1MHz
Ta=25°C


fT – IC
TRANSITION FREQUENCY fT (GHz)
COLLECTOR CURRENT IC (mA)
VCE=5V
Ta=25°C


|S21e|² – IC
INSERTION GAIN |S21e|² (dB)
COLLECTOR CURRENT IC (mA)
VCE=5V
f=1GHz
Ta=25°C


|S21e|² – f
INSERTION GAIN |S21e|² (dB)
FREQUENCY f (GHz)
VCE=5V
IC=5mA
Ta=25°C

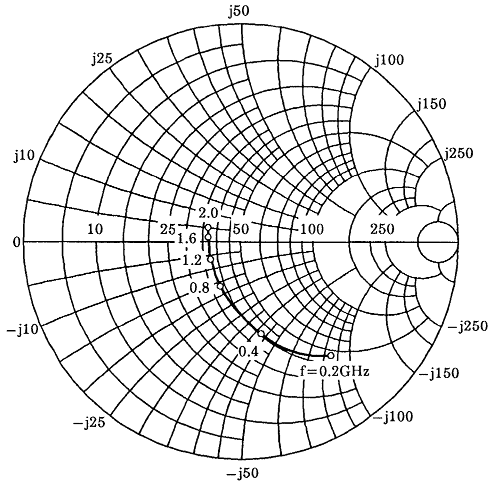

|S21e|² – VCE
INSERTION GAIN |S21e|² (dB)
COLLECTOR-EMITTER VOLTAGE VCE (V)
IC=5mA
f=1GHz
Ta=25°C



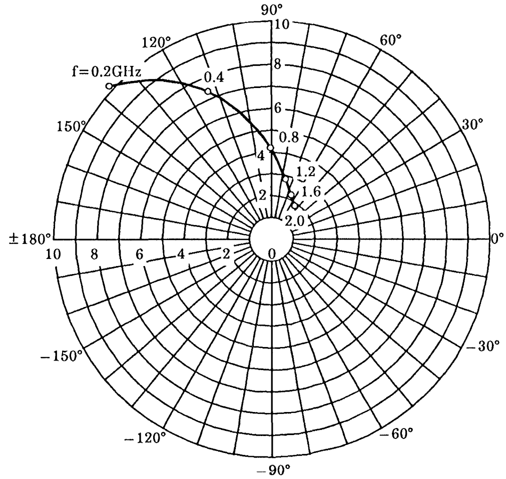
S-Parameter $Z_O = 50\Omega$, $Ta = 25°C$
$V_{CE} = 5V$, $I_C = 5mA$

周波数	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.684	−47.0	10.116	136.8	0.049	63.1	0.765	−29.5
400	0.438	−79.2	7.260	112.9	0.072	56.5	0.553	−37.8
600	0.301	−101.2	5.388	99.1	0.090	56.5	0.452	−39.1
800	0.226	−119.2	4.227	90.0	0.107	57.6	0.402	−39.0
1000	0.182	−136.2	3.494	82.7	0.124	58.8	0.374	−38.9
1200	0.159	−153.3	2.988	76.9	0.142	59.6	0.359	−39.4
1400	0.147	−170.3	2.632	71.2	0.163	59.9	0.348	−40.7
1600	0.145	174.4	2.345	66.0	0.182	59.2	0.339	−43.2
1800	0.149	162.6	2.128	61.4	0.200	58.4	0.329	−46.3
2000	0.161	150.9	1.967	57.1	0.219	58.1	0.318	−49.5

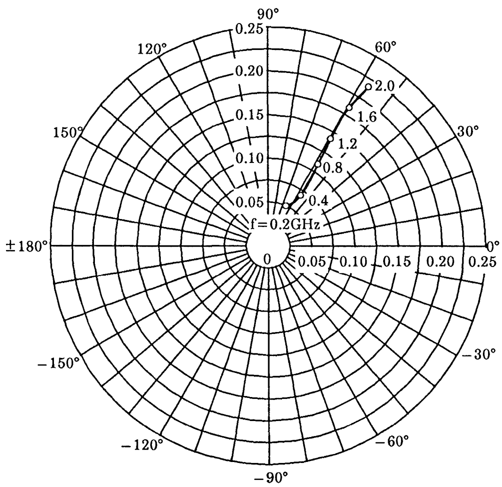
S_{11e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



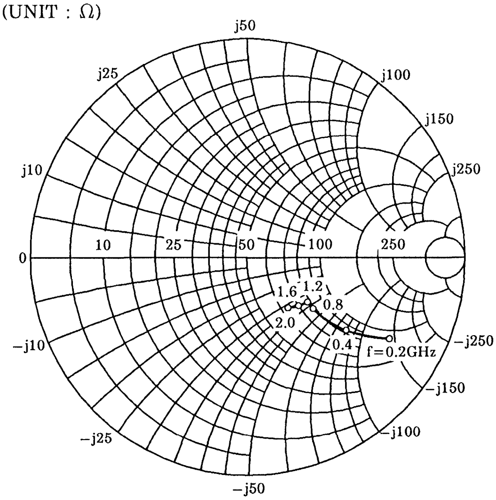
S_{21e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$



S_{12e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$



S_{22e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)

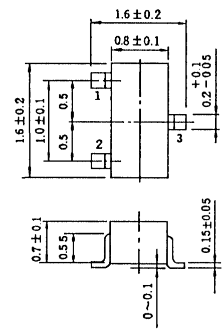


SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC5108

FOR VCO APPLICATION

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

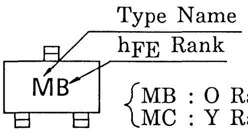
SSM	
JEDEC	—
EIAJ	—
TOSHIBA	2-2H1A

Weight : 2.4mg

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	30	mA
Base Current	I_B	15	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

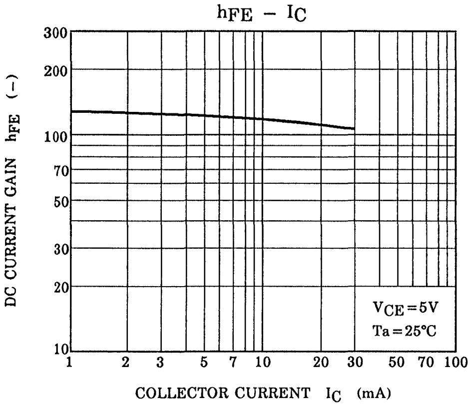
MARKING



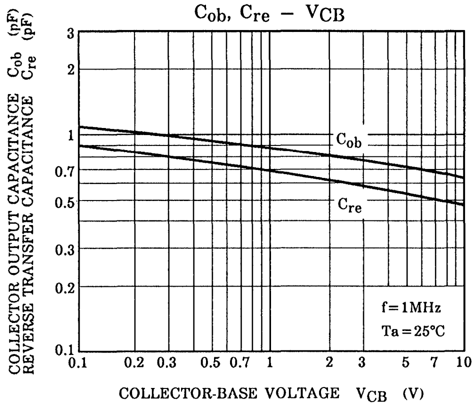
{MB : O Rank
{MC : Y Rank

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=10V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=1V$, $I_C=0$	—	—	0.1	μA
DC Current Gain	h_{FE} (Note 1)	$V_{CE}=5V$, $I_C=5mA$	80	—	240	—
Transition Frequency	f_T	$V_{CE}=5V$, $I_C=5mA$	4	6	—	GHz
Insertion Gain	$\|S_{21e}\|^2$	$V_{CE}=5V$, $I_C=5mA$, f=1GHz	7	11	—	dB
Output Capacitance	C_{ob}	$V_{CB}=5V$, $I_E=0$, f=1MHz (Note 2)	—	0.7	—	pF
Reverse Transfer Capacitance	C_{re}		—	0.5	0.9	pF
Collector-Base Time Constant	$C_c \cdot r_{bb'}$	$V_{CB}=5V$, $I_C=3mA$, f=30MHz	—	5.5	10	ps

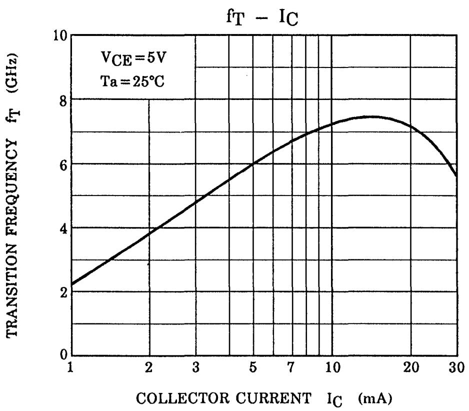
(Note 1) : h_{FE} Classification O : 80~160, Y : 120~240
(Note 2) : C_{re} is measured by 3 terminal method with capacitance bridge.



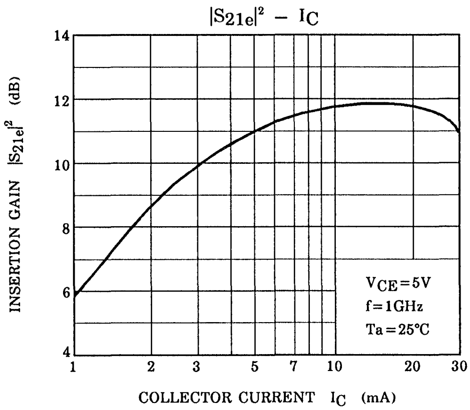
h_{FE} – I_C
DC CURRENT GAIN h_{FE} (–)
COLLECTOR CURRENT I_C (mA)
V_{CE}=5V
Ta=25°C
300 200 100 70 50 30 20 10
1 2 3 5 7 10 20 30 50 70 100



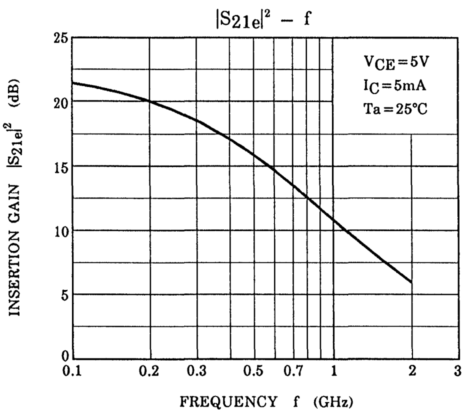
C_{ob}, C_{re} – V_{CB}
COLLECTOR OUTPUT CAPACITANCE C_{ob} (pF)
REVERSE TRANSFER CAPACITANCE C_{re} (pF)
COLLECTOR-BASE VOLTAGE V_{CB} (V)
C_{ob}
C_{re}
f=1MHz
Ta=25°C
3 2 1 0.7 0.5 0.3 0.2 0.1
0.1 0.2 0.3 0.5 0.7 1 2 3 5 7 10



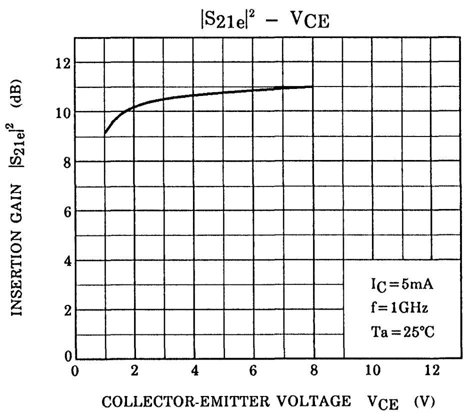
f_T – I_C
TRANSITION FREQUENCY f_T (GHz)
COLLECTOR CURRENT I_C (mA)
V_{CE}=5V
Ta=25°C
10 8 6 4 2 0
1 2 3 5 7 10 20 30



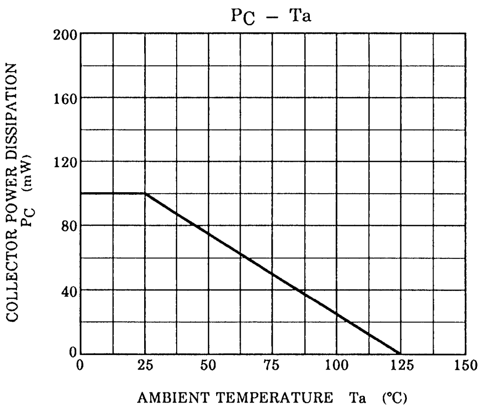
$|S_{21e}|^2$ – I_C
INSERTION GAIN $|S_{21e}|^2$ (dB)
COLLECTOR CURRENT I_C (mA)
V_{CE}=5V
f=1GHz
Ta=25°C
14 12 10 8 6 4
1 2 3 5 7 10 20 30



$|S_{21e}|^2$ – f
INSERTION GAIN $|S_{21e}|^2$ (dB)
FREQUENCY f (GHz)
V_{CE}=5V
I_C=5mA
Ta=25°C
25 20 15 10 5 0
0.1 0.2 0.3 0.5 0.7 1 2 3



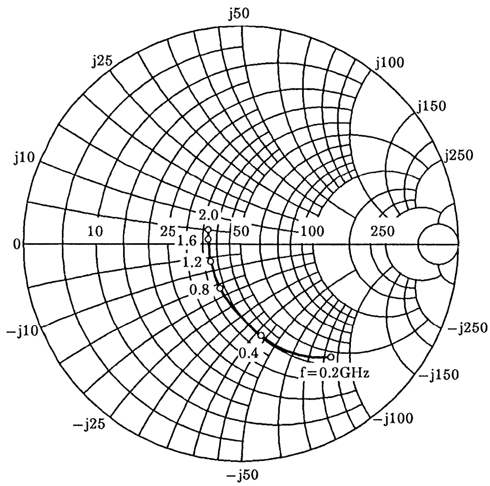
$|S_{21e}|^2$ – V_{CE}
INSERTION GAIN $|S_{21e}|^2$ (dB)
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)
I_C=5mA
f=1GHz
Ta=25°C
12 10 8 6 4 2 0
0 2 4 6 8 10 12



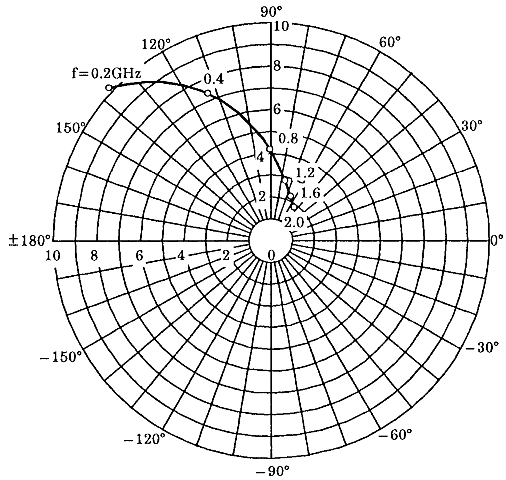
S-Parameter $Z_O = 50\Omega$, $Ta = 25°C$
$V_{CE} = 5V$, $I_C = 5mA$

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.684	−47.0	10.116	136.8	0.049	63.1	0.765	−29.5
400	0.438	−79.2	7.260	112.9	0.072	56.5	0.553	−37.8
600	0.301	−101.2	5.388	99.1	0.090	56.5	0.452	−39.1
800	0.226	−119.2	4.227	90.0	0.107	57.6	0.402	−39.0
1000	0.182	−136.2	3.494	82.7	0.124	58.8	0.374	−38.9
1200	0.159	−153.3	2.988	76.9	0.142	59.6	0.359	−39.4
1400	0.147	−170.3	2.632	71.2	0.163	59.9	0.348	−40.7
1600	0.145	174.4	2.345	66.0	0.182	59.2	0.339	−43.2
1800	0.149	162.6	2.128	61.4	0.200	58.4	0.329	−46.3
2000	0.161	150.9	1.967	57.1	0.219	58.1	0.318	−49.5

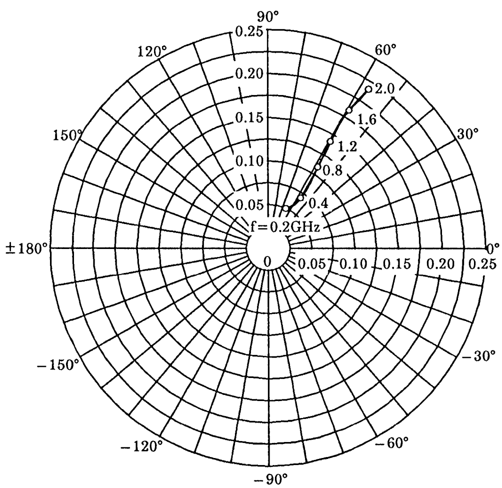
S_{11e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



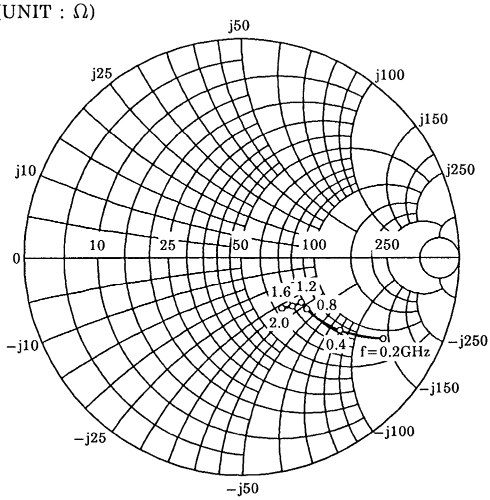
S_{21e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$



S_{12e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$



S_{22e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)

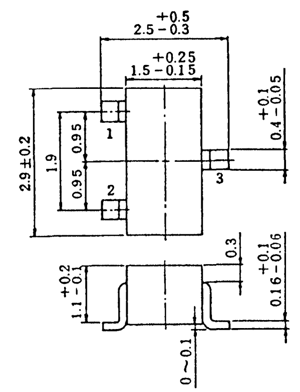


SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC5109

FOR VCO APPLICATION

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

S-MINI

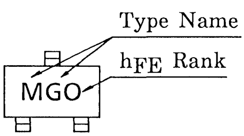
JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1A

Weight : 0.012g

MAXIMUM RATINGS (Ta = 25°C)

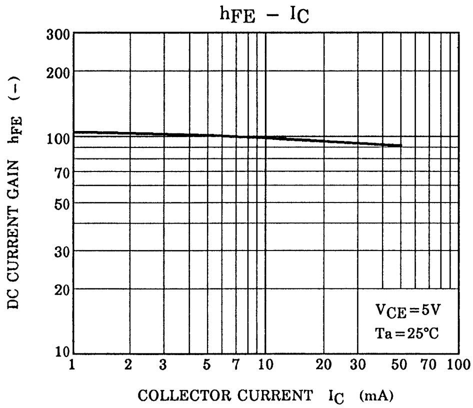
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	60	mA
Base Current	I_B	30	mA
Collector Power Dissipation	P_C	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

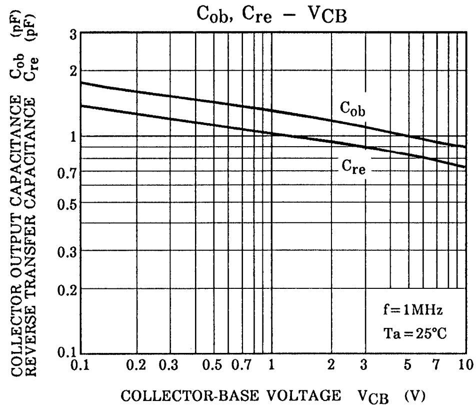
MARKING

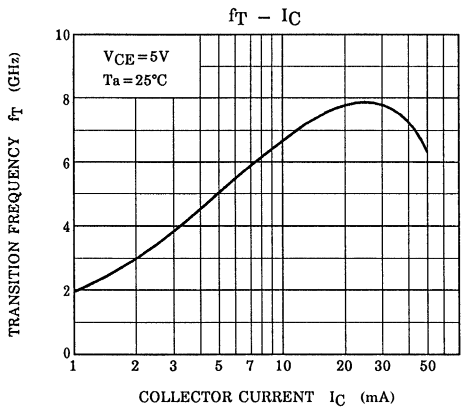


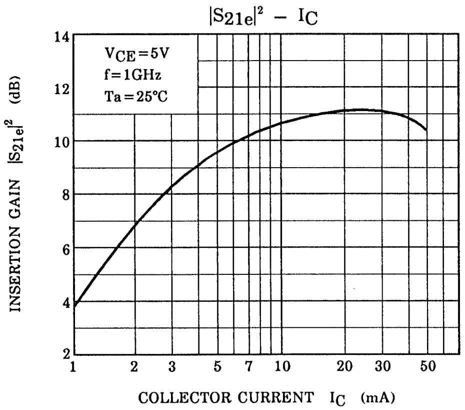
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=10V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=1V$, $I_C=0$	—	—	0.1	μA
DC Current Gain	h_{FE} (Note 1)	$V_{CE}=5V$, $I_C=5mA$	80	—	240	—
Transition Frequency	f_T	$V_{CE}=5V$, $I_C=5mA$	4	6	—	GHz
Insertion Gain	$\lvert S_{21e}\rvert^2$	$V_{CE}=5V$, $I_C=5mA$, f=1GHz	7	11	—	dB
Output Capacitance	C_{ob}	$V_{CB}=5V$, $I_E=0$, f=1MHz (Note 2)	—	0.7	—	pF
Reverse Transfer Capacitance	C_{re}		—	0.5	0.9	pF
Collector-Base Time Constant	$C_c \cdot r_{bb}'$	$V_{CB}=5V$, $I_C=3mA$, f=30MHz	—	5.5	10	ps

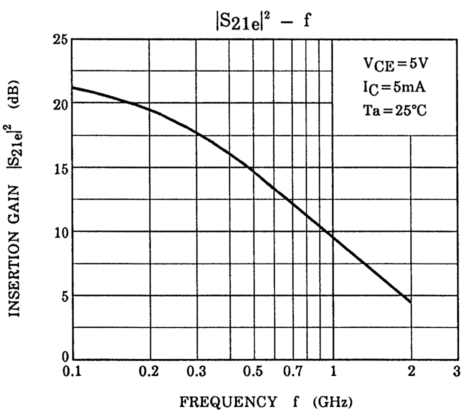
(Note 1) : h_{FE} Classification O : 80~160, Y : 120~240
(Note 2) : C_{re} is measured by 3 terminal method with capacitance bridge.

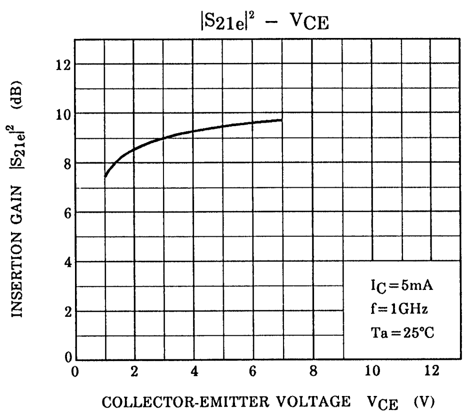

hFE – IC
DC CURRENT GAIN hFE (–)
VCE=5V
Ta=25°C
COLLECTOR CURRENT IC (mA)

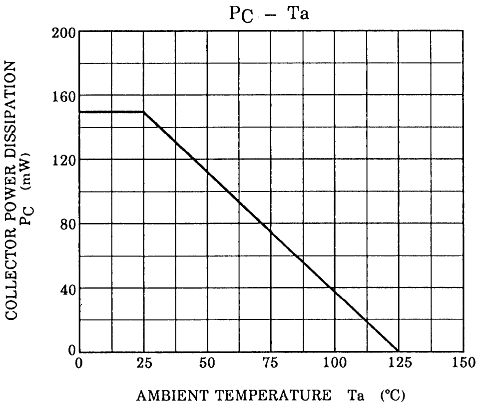

Cob, Cre – VCB
COLLECTOR OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
Cob
Cre
f=1MHz
Ta=25°C
COLLECTOR-BASE VOLTAGE VCB (V)


fT – IC
TRANSITION FREQUENCY fT (GHz)
VCE=5V
Ta=25°C
COLLECTOR CURRENT IC (mA)


|S21e|² – IC
INSERTION GAIN |S21e|² (dB)
VCE=5V
f=1GHz
Ta=25°C
COLLECTOR CURRENT IC (mA)


|S21e|² – f
INSERTION GAIN |S21e|² (dB)
VCE=5V
IC=5mA
Ta=25°C
FREQUENCY f (GHz)

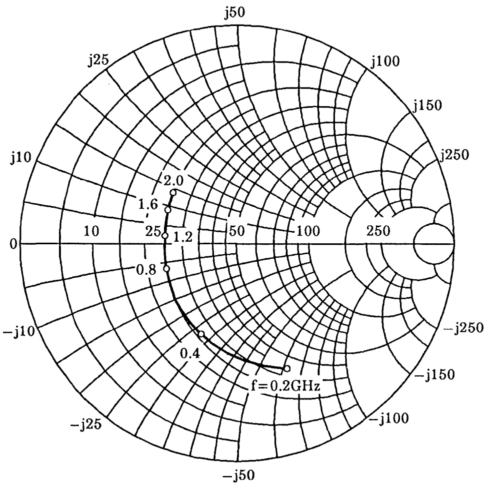

|S21e|² – VCE
INSERTION GAIN |S21e|² (dB)
IC=5mA
f=1GHz
Ta=25°C
COLLECTOR-EMITTER VOLTAGE VCE (V)



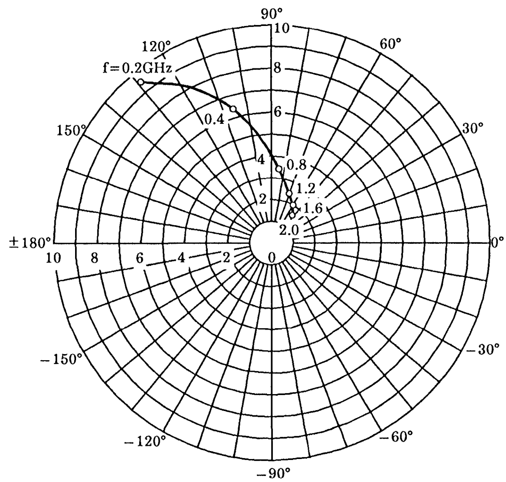
S-Parameter $Z_O = 50\Omega$, Ta = 25°C
V_{CE} = 5V, I_C = 5mA

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.631	−67.7	9.526	129.8	0.062	55.9	0.687	−38.7
400	0.441	−111.7	6.393	106.3	0.084	49.5	0.459	−48.5
600	0.363	−139.8	4.611	93.6	0.100	50.6	0.360	−50.6
800	0.338	−159.8	3.599	84.6	0.117	52.9	0.312	−51.1
1000	0.331	−175.0	2.990	77.5	0.134	55.1	0.286	−51.6
1200	0.337	171.9	2.556	71.2	0.152	57.2	0.271	−53.0
1400	0.344	161.7	2.252	65.3	0.174	58.6	0.265	−55.7
1600	0.359	152.1	2.011	60.3	0.196	58.5	0.259	−59.5
1800	0.373	144.6	1.845	55.4	0.217	57.9	0.254	−63.6
2000	0.391	138.5	1.691	50.8	0.238	58.3	0.249	−68.8

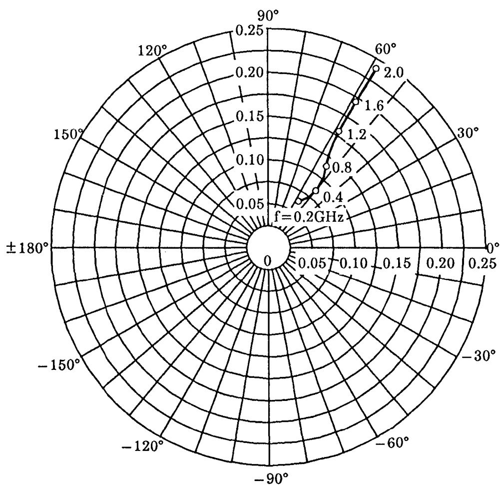
S11e
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



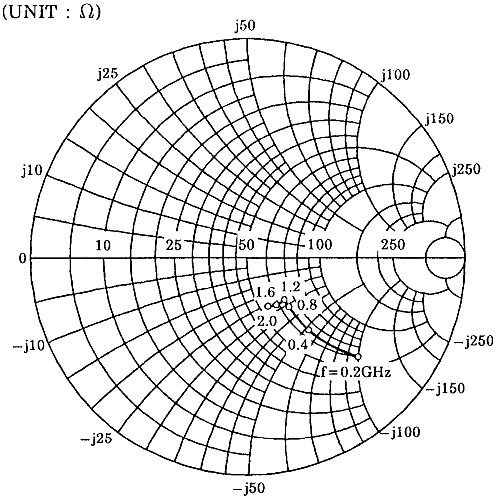
S21e
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$



S12e
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$



S22e
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)

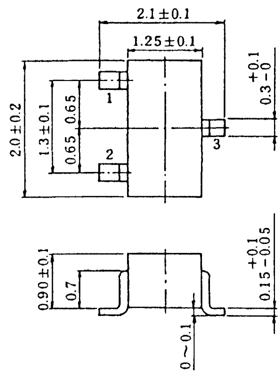


SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC5110

FOR VCO APPLICATION

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

USM

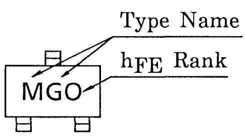
JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1A

Weight : 0.006g

MAXIMUM RATINGS (Ta = 25°C)

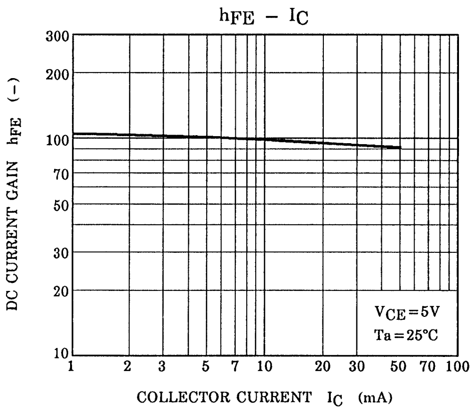
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	60	mA
Base Current	I_B	30	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

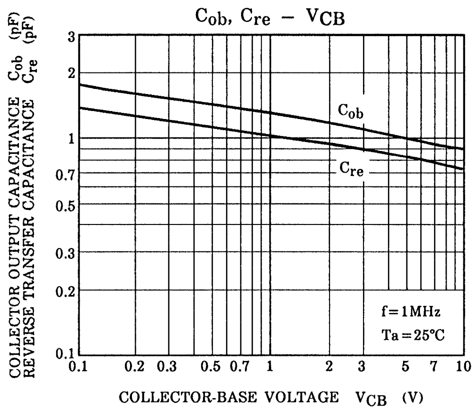
MARKING

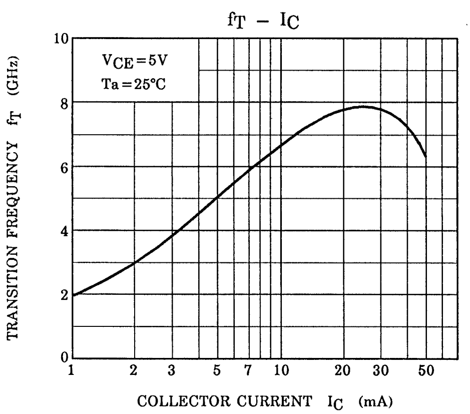


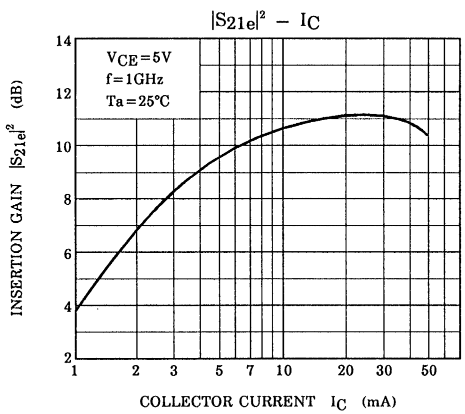
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=10V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=1V$, $I_C=0$	—	—	0.1	μA
DC Current Gain	h_{FE} (Note 1)	$V_{CE}=5V$, $I_C=5mA$	80	—	240	—
Transition Frequency	f_T	$V_{CE}=5V$, $I_C=5mA$	4	6	—	GHz
Insertion Gain	$\lvert S_{21e}\rvert^2$	$V_{CE}=5V$, $I_C=5mA$, f=1GHz	7	11	—	dB
Output Capacitance	C_{ob}	$V_{CB}=5V$, $I_E=0$, f=1MHz (Note 2)	—	0.7	—	pF
Reverse Transfer Capacitance	C_{re}		—	0.5	0.9	pF
Collector-Base Time Constant	$C_c \cdot r_{bb'}$	$V_{CB}=5V$, $I_C=3mA$, f=30MHz	—	5.5	10	ps

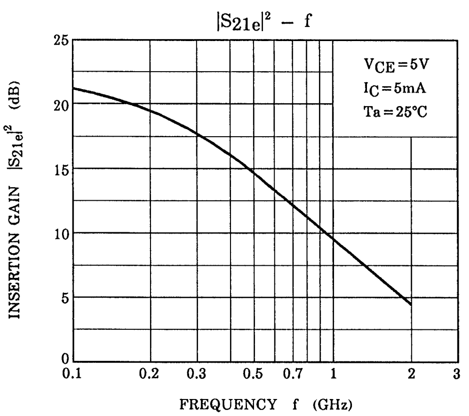
(Note 1) : h_{FE} Classification O : 80~160, Y : 120~240
(Note 2) : C_{re} is measured by 3 terminal method with capacitance bridge.

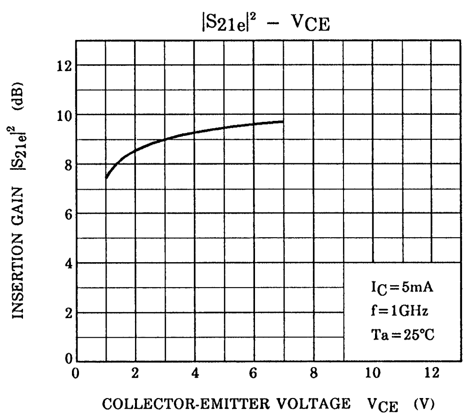

hFE – IC
DC CURRENT GAIN hFE (–)
COLLECTOR CURRENT IC (mA)
VCE=5V
Ta=25°C

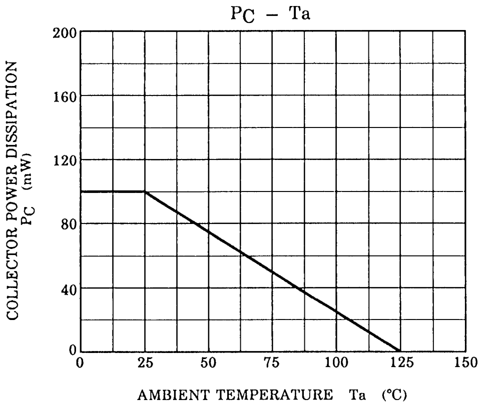

Cob, Cre – VCB
COLLECTOR OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
COLLECTOR-BASE VOLTAGE VCB (V)
Cob
Cre
f=1MHz
Ta=25°C


fT – IC
TRANSITION FREQUENCY fT (GHz)
COLLECTOR CURRENT IC (mA)
VCE=5V
Ta=25°C


|S21e|² – IC
INSERTION GAIN |S21e|² (dB)
COLLECTOR CURRENT IC (mA)
VCE=5V
f=1GHz
Ta=25°C


|S21e|² – f
INSERTION GAIN |S21e|² (dB)
FREQUENCY f (GHz)
VCE=5V
IC=5mA
Ta=25°C

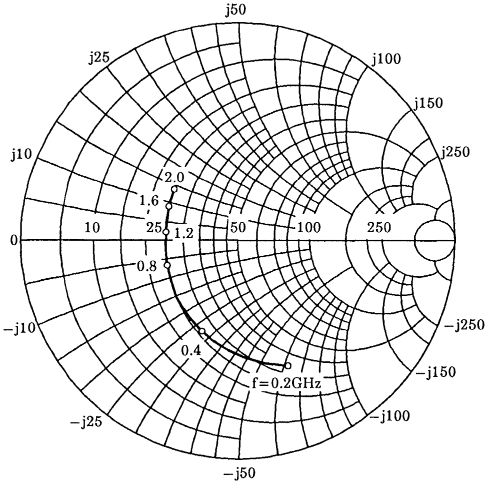

|S21e|² – VCE
INSERTION GAIN |S21e|² (dB)
COLLECTOR-EMITTER VOLTAGE VCE (V)
IC=5mA
f=1GHz
Ta=25°C



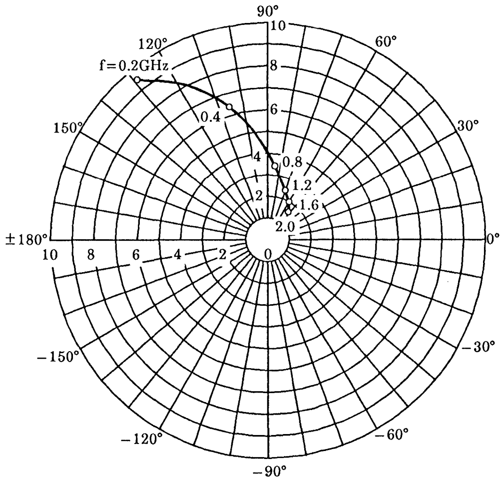
S-Parameter $Z_O = 50\Omega$, $Ta = 25°C$
$V_{CE} = 5V$, $I_C = 5mA$

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.631	−67.7	9.526	129.8	0.062	55.9	0.687	−38.7
400	0.441	−111.7	6.393	106.3	0.084	49.5	0.459	−48.5
600	0.363	−139.8	4.611	93.6	0.100	50.6	0.360	−50.6
800	0.338	−159.8	3.599	84.6	0.117	52.9	0.312	−51.1
1000	0.331	−175.0	2.990	77.5	0.134	55.1	0.286	−51.6
1200	0.337	171.9	2.556	71.2	0.152	57.2	0.271	−53.0
1400	0.344	161.7	2.252	65.3	0.174	58.6	0.265	−55.7
1600	0.359	152.1	2.011	60.3	0.196	58.5	0.259	−59.5
1800	0.373	144.6	1.845	55.4	0.217	57.9	0.254	−63.6
2000	0.391	138.5	1.691	50.8	0.238	58.3	0.249	−68.8

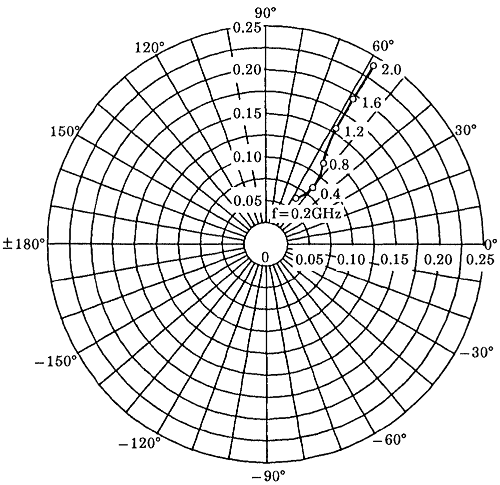
S11e
VCE=5V
IC=5mA
Ta=25°C
(UNIT : Ω)



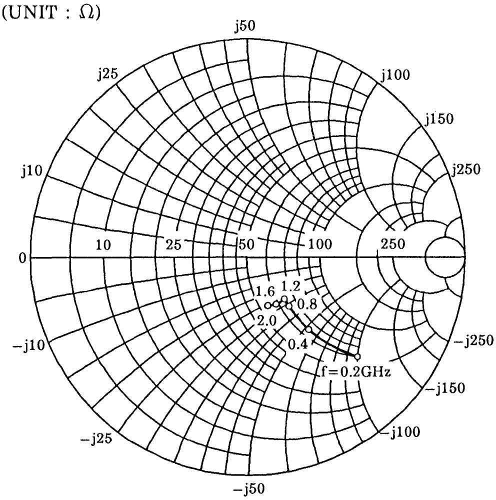
S21e
VCE=5V
IC=5mA
Ta=25°C



S12e
VCE=5V
IC=5mA
Ta=25°C



S22e
VCE=5V
IC=5mA
Ta=25°C
(UNIT : Ω)

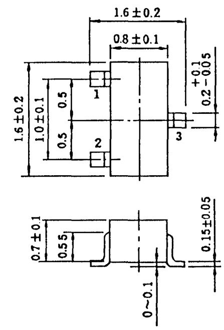


SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

2SC5111

FOR VCO APPLICATION

Unit in mm



1. BASE
2. EMITTER
3. COLLECTOR

SSM

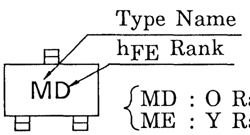
JEDEC	—
EIAJ	—
TOSHIBA	2-2H1A

Weight : 2.4mg

MAXIMUM RATINGS ($Ta = 25°C$)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	60	mA
Base Current	I_B	30	mA
Collector Power Dissipation	P_C	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MARKING

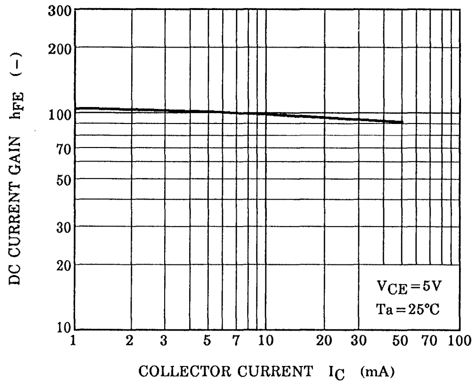


MD : O Rank
ME : Y Rank

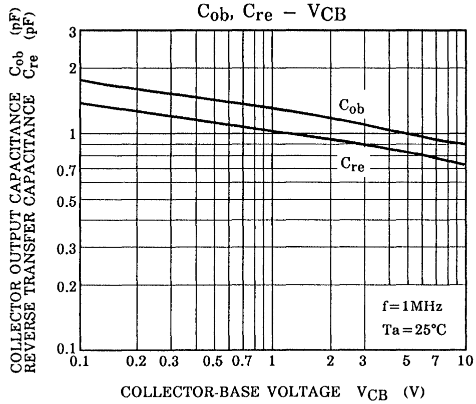
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB} = 10V$, $I_E = 0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB} = 1V$, $I_C = 0$	—	—	0.1	μA
DC Current Gain	h_{FE} (Note 1)	$V_{CE} = 5V$, $I_C = 5mA$	80	—	240	—
Transition Frequency	f_T	$V_{CE} = 5V$, $I_C = 5mA$	4	6	—	GHz
Insertion Gain	$\|S_{21e}\|^2$	$V_{CE} = 5V$, $I_C = 5mA$, $f = 1GHz$	7	11	—	dB
Output Capacitance	C_{ob}	$V_{CB} = 5V$, $I_E = 0$, $f = 1MHz$ (Note 2)	—	0.7	—	pF
Reverse Transfer Capacitance	C_{re}		—	0.5	0.9	pF
Collector-Base Time Constant	$C_c \cdot r_{bb'}$	$V_{CB} = 5V$, $I_C = 3mA$, $f = 30MHz$	—	5.5	10	ps

(Note 1) : h_{FE} Classification O : 80~160, Y : 120~240
(Note 2) : C_{re} is measured by 3 terminal method with capacitance bridge.

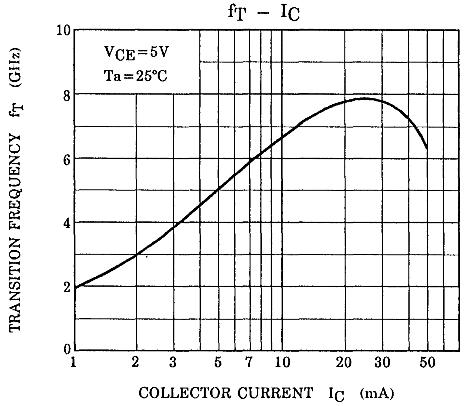
h_{FE} – I_C



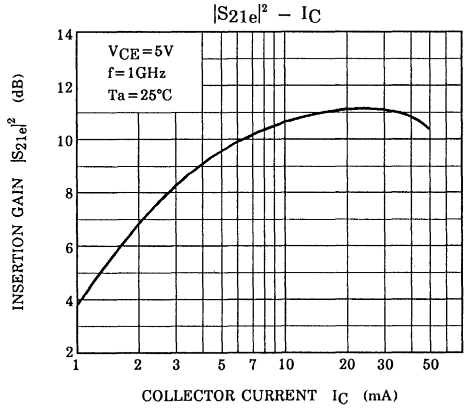
C_{ob}, C_{re} – V_{CB}



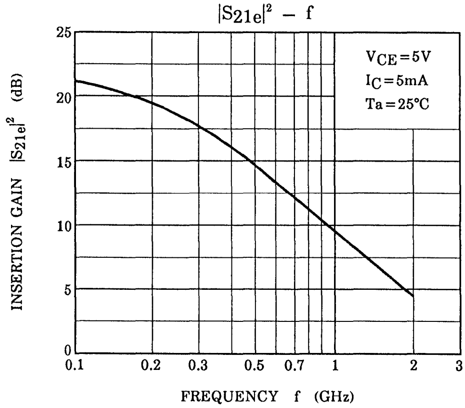
f_T – I_C



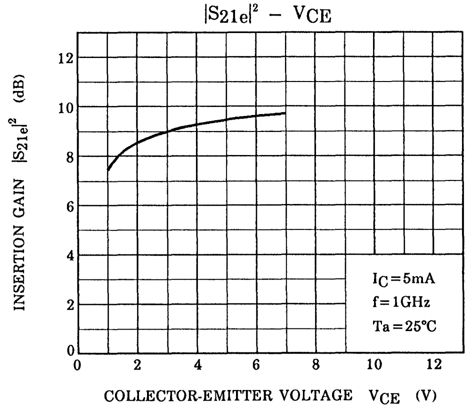
$|S_{21e}|^2$ – I_C

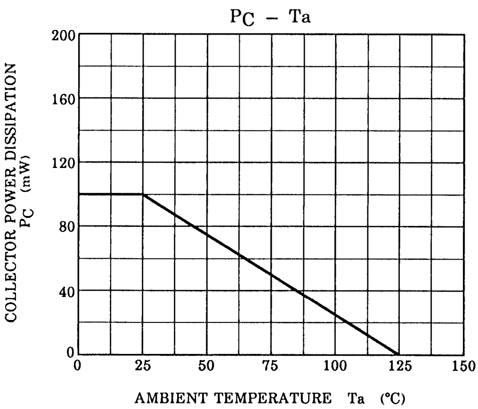


$|S_{21e}|^2$ – f



$|S_{21e}|^2$ – V_{CE}

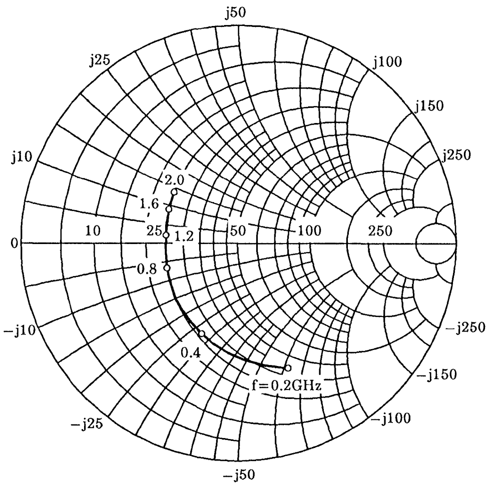




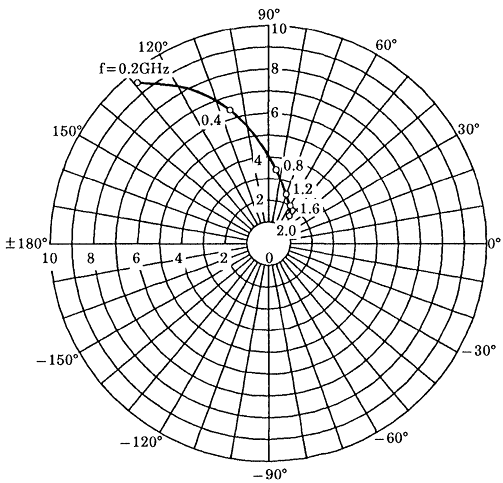
S-Parameter $Z_O = 50\Omega$, Ta = 25°C
$V_{CE} = 5V$, $I_C = 5mA$

frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.631	−67.7	9.526	129.8	0.062	55.9	0.687	−38.7
400	0.441	−111.7	6.393	106.3	0.084	49.5	0.459	−48.5
600	0.363	−139.8	4.611	93.6	0.100	50.6	0.360	−50.6
800	0.338	−159.8	3.599	84.6	0.117	52.9	0.312	−51.1
1000	0.331	−175.0	2.990	77.5	0.134	55.1	0.286	−51.6
1200	0.337	171.9	2.556	71.2	0.152	57.2	0.271	−53.0
1400	0.344	161.7	2.252	65.3	0.174	58.6	0.265	−55.7
1600	0.359	152.1	2.011	60.3	0.196	58.5	0.259	−59.5
1800	0.373	144.6	1.845	55.4	0.217	57.9	0.254	−63.6
2000	0.391	138.5	1.691	50.8	0.238	58.3	0.249	−68.8

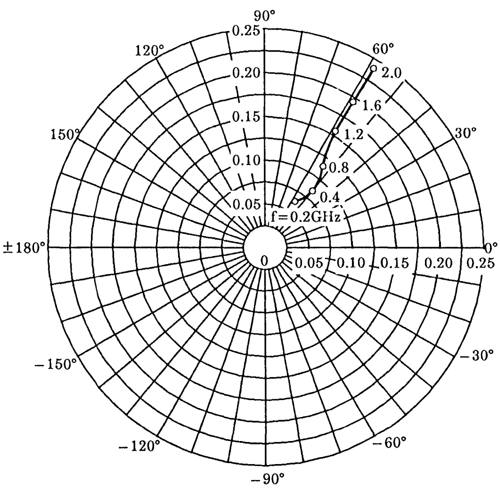
S_{11e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)



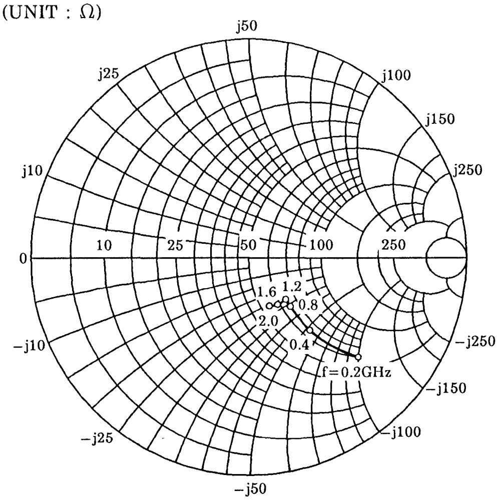
S_{21e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$



S_{12e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$



S_{22e}
$V_{CE}=5V$
$I_C=5mA$
$Ta=25°C$
(UNIT : Ω)

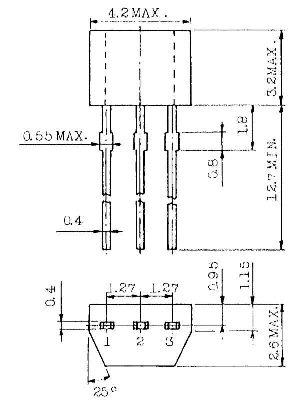


SILICON N CHANNEL JUNCTION TYPE
FIELD EFFECT TRANSISTOR

2SK161

FM TUNER APPLICATIONS.
VHF BAND AMPLIFIER APPLICATIONS.

Unit in mm



1. DRAIN
2. SOURCE
3. GATE

JEDEC	—
EIAJ	—
TOSHIBA	2-4E1D

Weight : 0.13g

- Low Noise Figure : NF = 2.5dB (Typ.) (f = 100MHz)
- High Forward Transfer Admittance : $|Y_{fs}|$ = 9mS (Typ.)
- Extremely Low Reverse Transfer Capacitance : C_{rss} = 0.1pF (Typ.)

MAXIMUM RATINGS (Ta = 25°C)

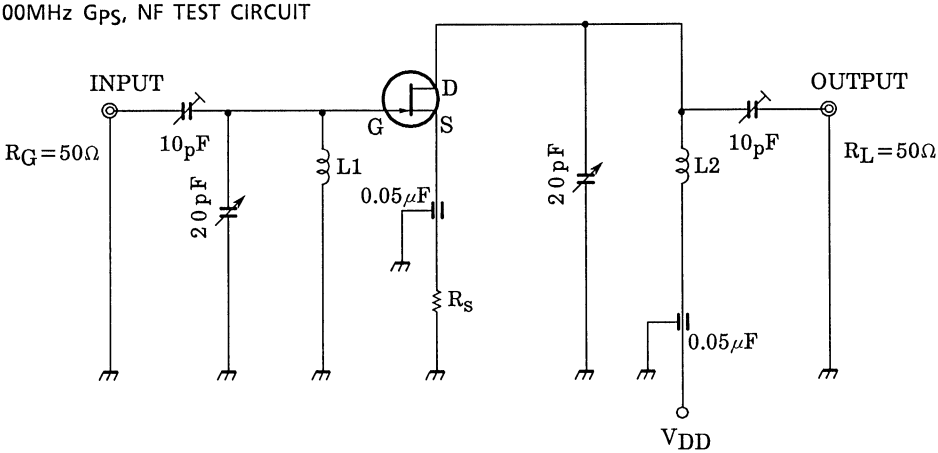
CHARACTERISTIC	SYMBOL	RATING	UNIT
Gate-Drain Voltage	V_{GDO}	−18	V
Gate Current	I_G	10	mA
Drain Power Dissipation	P_D	200	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate Leakage Current	I_{GSS}	$V_{GS} = -0.5V$, $V_{DS} = 0$	—	—	−10	nA
Gate-Drain Breakdown Voltage	$V_{(BR)GDO}$	$I_G = -100\mu A$	−18	—	—	V
Drain Current	I_{DSS} (Note)	$V_{GS} = 0$, $V_{DS} = 10V$	1.0	—	10	mA
Gate-Source Cut-off Voltage	$V_{GS(OFF)}$	$V_{DS} = 10V$, $I_D = 1\mu A$	−0.4	—	−4.0	V
Forward Transfer Admittance	$\lvert Y_{fs}\rvert$	$V_{GS} = 0$, $V_{DS} = 10V$, f = 1kHz	—	9	—	mS
Input Capacitance	C_{iss}	$V_{DS} = 10V$, $V_{GS} = 0$, f = 1MHz	—	6.0	—	pF
Reverse Transfer Capacitance	C_{rss}	$V_{GD} = -10V$, f = 1MHz	—	0.10	0.15	pF
Power Gain	G_{PS}	$V_{DD} = 10V$, f = 100MHz (Fig.)	—	18	—	dB
Noise Figure	NF	$V_{DD} = 10V$, f = 100MHz (Fig.)	—	2.5	3.5	dB

Note : I_{DSS} Classification O : 1.0~3.0mA, Y : 2.5~6.0mA, GR : 5.0~10.0mA

図1. 100MHz G_{PS}, NF TEST CIRCUIT



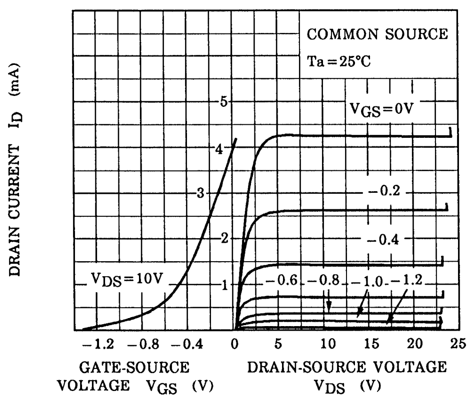
L_1 : 0.8mmφ Ag PLATED Cu WIRE, 3 TURNS, 10mm ID, 10mm LENGTH.

L_2 : 0.8mmφ Ag PLATED Cu WIRE, 3 TURNS, 10mm ID, 10mm LENGTH.

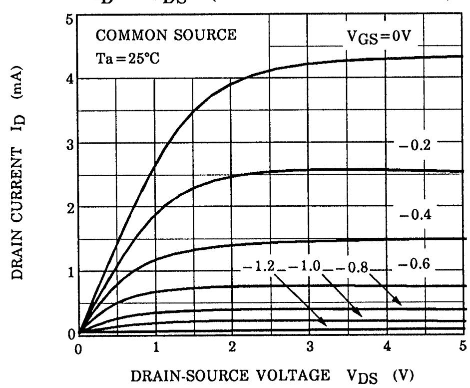
2SK161 is measured at each group by changing R_S

GROUP	R_S (Ω)
2SK161-O	0
2SK161-Y	18Ω±5%
2SK161-GR	100Ω±5%

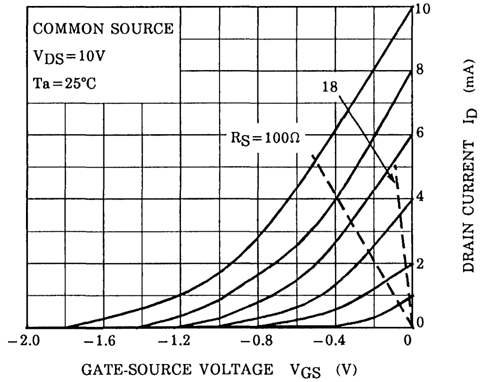
STATIC CHARACTERISTICS



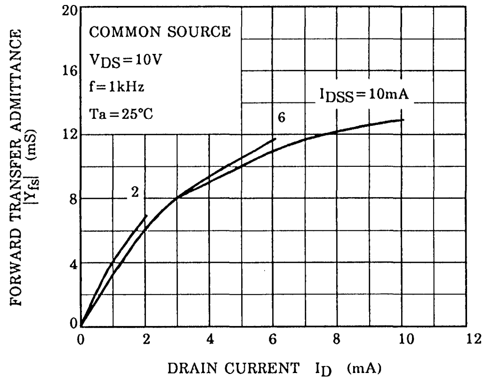
I_D – V_{DS} (LOW VOLTAGE REGION)



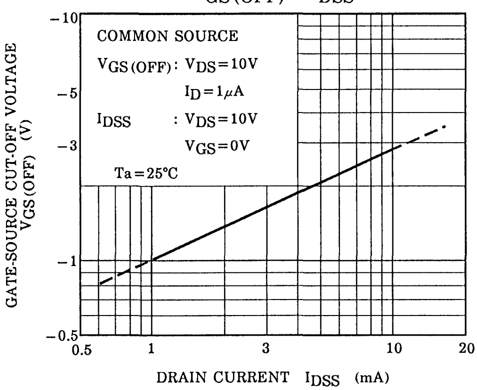
$I_D - V_{GS}$



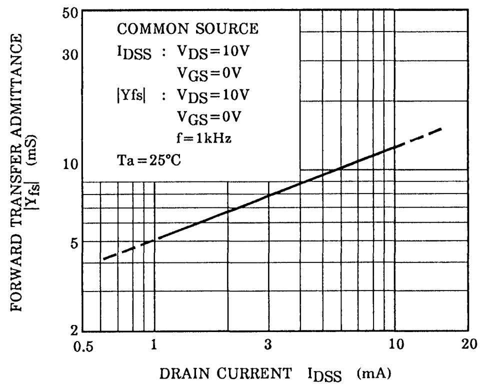
$|Y_{fs}| - I_D$



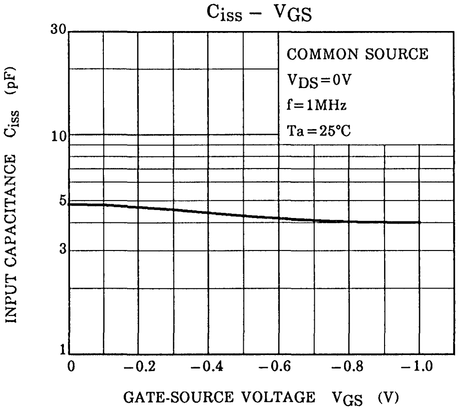
$V_{GS(OFF)} - I_{DSS}$



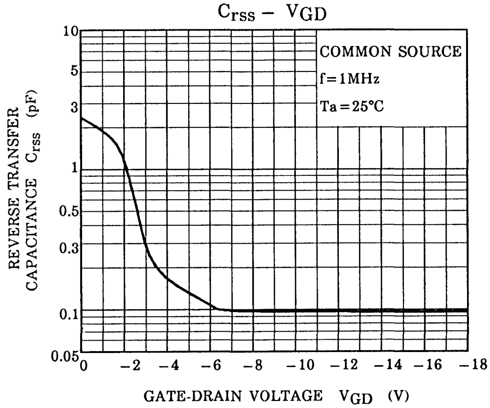
$|Y_{fs}| - I_{DSS}$

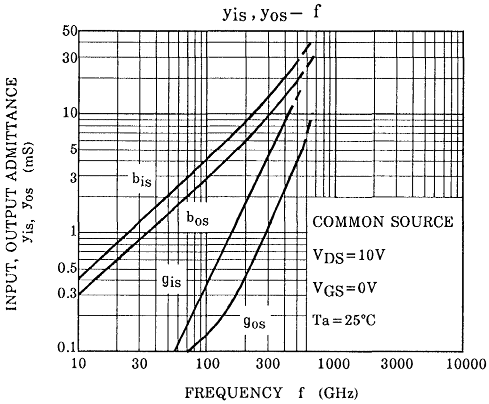


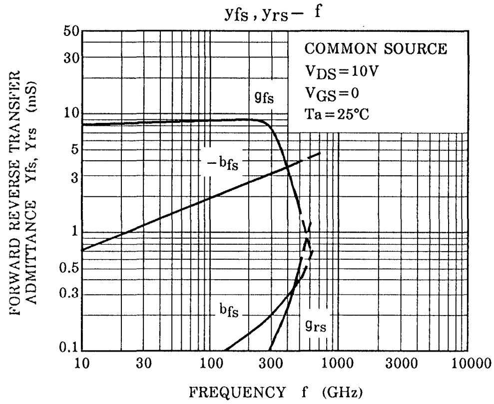
$C_{iss} - V_{GS}$

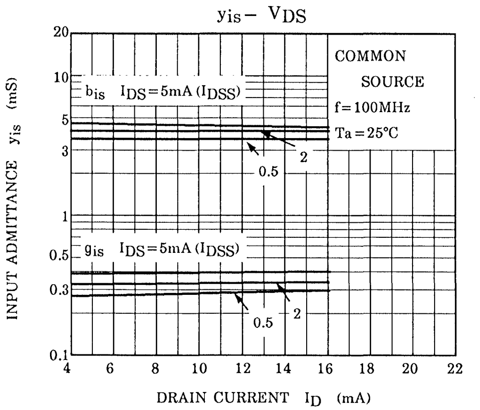


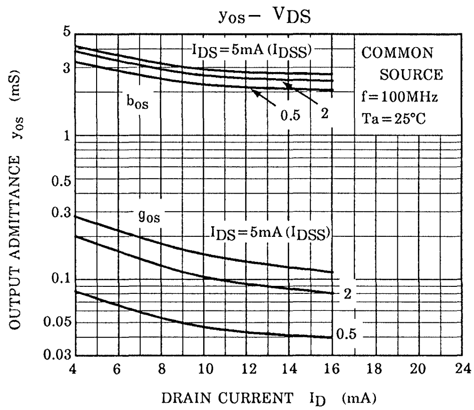
$C_{rss} - V_{GD}$

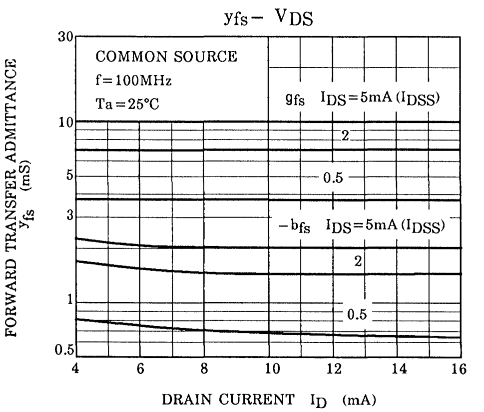


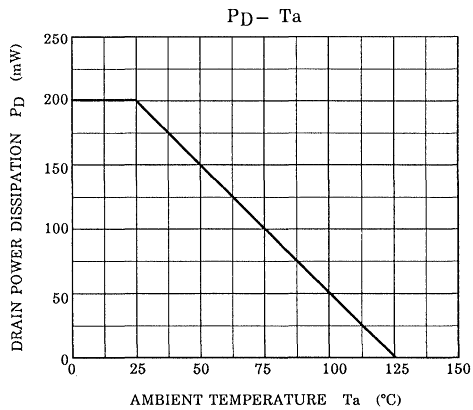

yis , yos – f
INPUT, OUTPUT ADMITTANCE yis, yos (mS)
bis
bos
gis
gos
COMMON SOURCE
VDS=10V
VGS=0V
Ta=25°C
FREQUENCY f (GHz)


yfs , yrs – f
FORWARD REVERSE TRANSFER ADMITTANCE Yfs, Yrs (mS)
COMMON SOURCE
VDS=10V
VGS=0
Ta=25°C
gfs
–bfs
bfs
grs
FREQUENCY f (GHz)


yis – VDS
INPUT ADMITTANCE yis (mS)
COMMON SOURCE
f=100MHz
Ta=25°C
bis IDS=5mA (IDSS)
gis IDS=5mA (IDSS)
DRAIN CURRENT ID (mA)


yos – VDS
OUTPUT ADMITTANCE yos (mS)
COMMON SOURCE
f=100MHz
Ta=25°C
IDS=5mA (IDSS)
bos
gos
DRAIN CURRENT ID (mA)


yfs – VDS
FORWARD TRANSFER ADMITTANCE yfs (mS)
COMMON SOURCE
f=100MHz
Ta=25°C
gfs IDS=5mA (IDSS)
–bfs IDS=5mA (IDSS)
DRAIN CURRENT ID (mA)


PD – Ta
DRAIN POWER DISSIPATION PD (mW)
AMBIENT TEMPERATURE Ta (°C)

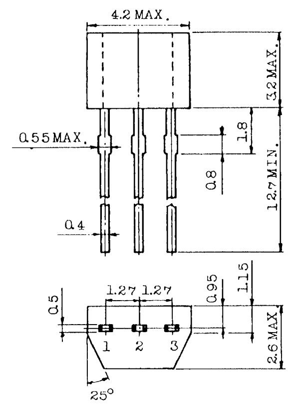
SILICON N CHANNEL JUNCTION TYPE
FIELD EFFECT TRANSISTOR

2SK192A

FM TUNER APPLICATIONS.
VHF BAND AMPLIFIER APPLICATIONS.

- High Power Gain : $G_{PS}=24dB$ (Typ.) (f=100MHz)
- Low Noise Figure : NF=1.8dB (Typ.) (f=100MHz)
- High Forward Transfer Admittance
  : $|y_{fs}|=7mS$ (Typ.) (f=1kHz)

Unit in mm



1. DRAIN
2. SOURCE
3. GATE

JEDEC	—
EIAJ	—
TOSHIBA	2-4E1D

Weight : 0.13g

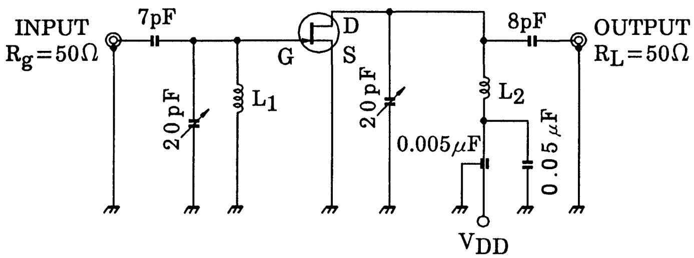
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Gate-Drain Voltage	V_{GDO}	−18	V
Gate Current	I_G	10	mA
Drain Power Dissipation	P_D	200	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate Leakage Current	I_{GSS}	$V_{GS}=-1.0V$, $V_{DS}=0$	—	—	−10	nA
Gate-Drain Breakdown Voltage	$V_{(BR)GDO}$	$I_G=-100\mu A$	−18	—	—	V
Drain Current	I_{DSS} (Note)	$V_{GS}=0$, $V_{DS}=10V$	3	—	24	mA
Gate-Source Cut-off Voltage	$V_{GS(OFF)}$	$V_{DS}=10V$, $I_D=1\mu A$	−1.2	−3	—	V
Forward Transfer Admittance	$\|y_{fs}\|$	$V_{GS}=0$, $V_{DS}=10V$, f=1kHz	—	7	—	mS
Input Capacitance	C_{iss}	$V_{DS}=10V$, $V_{GS}=0$, f=1MHz	—	3.5	—	pF
Reverse Transfer Capacitance	C_{rss}	$V_{DS}=-10V$, f=1MHz	—	–	0.65	pF
Power Gain	G_{PS}	$V_{DD}=10V$, f=100MHz (Fig.1)	—	24	—	dB
Noise Figure	NF	$V_{DD}=10V$, f=100MHz (Fig.1)	—	1.8	3.5	dB

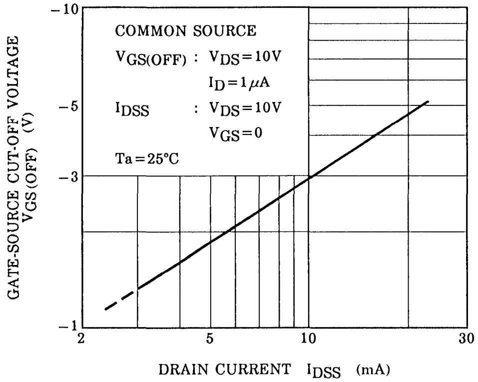
Note : I_{DSS} Classification Y : 3.0~7.0, GR : 6.0~14.0, BL : 12.0~24.0



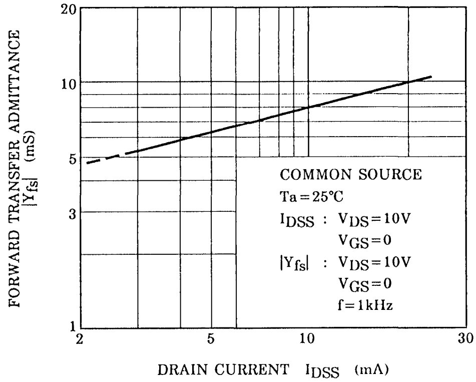
L1 : 0.8mmϕ Ag PLATED Cu WIRE 3 TURNS, 10mm I_D, 10mm LENGTH
L2 : 0.8mmϕ Ag PLATED Cu WIRE 3.5 TURNS, 10mm I_D, 10mm LENGTH

Fig.1 100MHz G_{ps}, NF TEST CIRCUIT

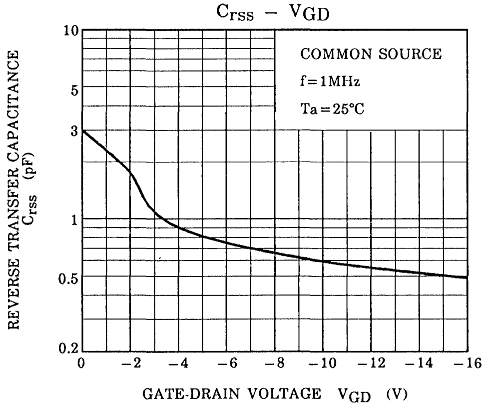
$V_{GS(OFF)}$ – I_{DSS}



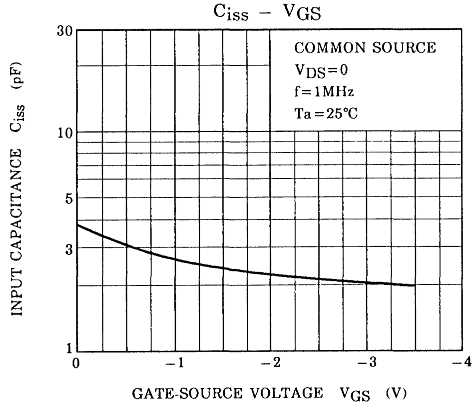
$|Y_{fs}|$ – I_{DSS}



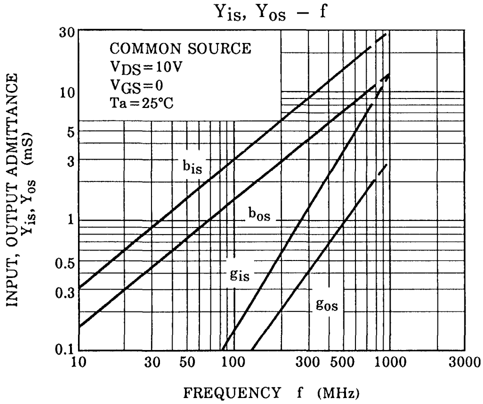
C_{rss} – V_{GD}



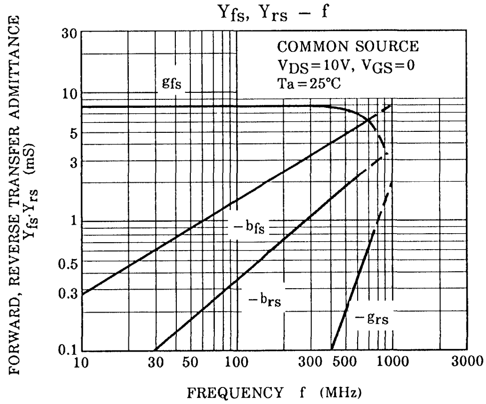
C_{iss} – V_{GS}

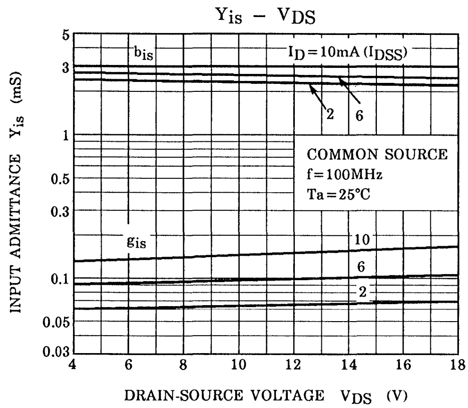


Y_{is}, Y_{os} – f

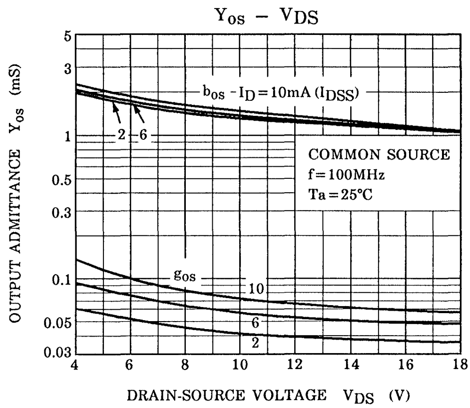


Y_{fs}, Y_{rs} – f

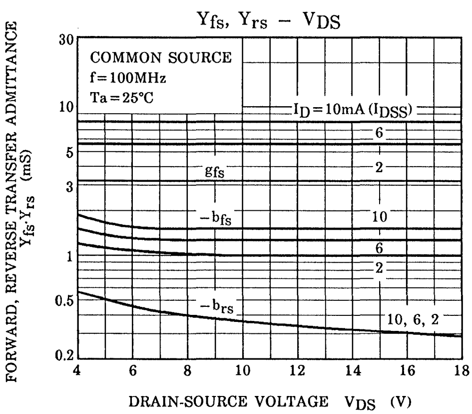




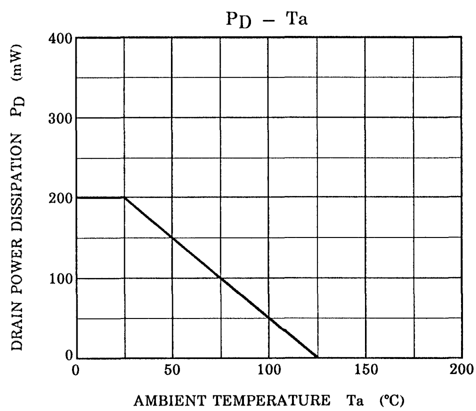
Yis – VDS
bis
ID = 10mA (IDSS)
2
6
COMMON SOURCE
f = 100MHz
Ta = 25°C
gis
10
6
2
INPUT ADMITTANCE Yis (mS)
DRAIN-SOURCE VOLTAGE VDS (V)



Yos – VDS
bos - ID = 10mA (IDSS)
2
6
COMMON SOURCE
f = 100MHz
Ta = 25°C
gos
10
6
2
OUTPUT ADMITTANCE Yos (mS)
DRAIN-SOURCE VOLTAGE VDS (V)



Yfs, Yrs – VDS
COMMON SOURCE
f = 100MHz
Ta = 25°C
ID = 10mA (IDSS)
6
gfs
2
–bfs
10
6
2
–brs
10, 6, 2
FORWARD, REVERSE TRANSFER ADMITTANCE Yfs·Yrs (mS)
DRAIN-SOURCE VOLTAGE VDS (V)



PD – Ta
DRAIN POWER DISSIPATION PD (mW)
AMBIENT TEMPERATURE Ta (°C)

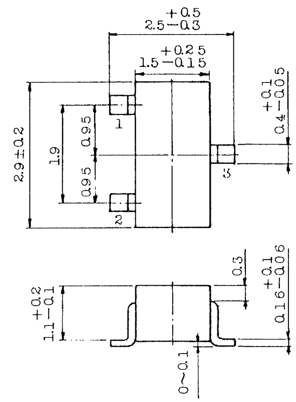
SILICON N CHANNEL JUNCTION TYPE
FIELD EFFECT TRANSISTOR

2SK210

FM TUNER APPLICATIONS.
VHF BAND AMPLIFIER APPLICATIONS.

Unit in mm

- High Power Gain : G_{PS} = 24dB (Typ.) (f = 100MHz)
- Low Noise Figure : NF = 1.8dB (Typ.) (f = 100MHz)
- High Forward Transfer Admitance : $|Y_{fs}|$ = 7mS (Typ.) (f = 1kHz)



1. DRAIN
2. GATE
3. SOURCE

JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1C

Weight : 0.012g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Gate-Drain Voltage	V_{GDO}	−18	V
Gate Current	I_G	10	mA
Drain Power Dissipation	P_D	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate Leakage Current	I_{GSS}	V_{GS} = −1.0V, V_{DS} = 0V	—	—	−10	nA
Gate-Drain Breakdown Voltage	$V_{(BR)GDO}$	I_G = −100μA	−18	—	—	V
Drain Current	I_{DSS} (Note)	V_{GS} = 0V, V_{DS} = 10V	3	—	24	mA
Gate-Source Cut-off Voltage	$V_{GS(OFF)}$	V_{DS} = 10V, I_D = 1μA	−1.2	−3	—	V
Forward Transfer Admittance	$\|Y_{fs}\|$	V_{GS} = 0V, V_{DS} = 10V, f = 1kHz	—	7	—	mS
Input Capacitance	C_{iss}	V_{DS} = 10V, V_{GS} = 0V, f = 1MHz	—	3.5	—	pF
Reverse Transfer Capacitance	C_{rss}	V_{GD} = 10V, f = 1MHz	—	—	0.65	pF
Power Gain	G_{PS}	V_{DD} = 10V, f = 100MHz (Fig.)	—	24	—	dB
Noise Figure	NF	V_{DD} = 10V, f = 100MHz (Fig.)	—	1.8	3.5	dB

Note : I_{DSS} Classificatopn Y : 3.0~7.0mA, GR(R) : 6.0~14.0mA, BL(L) : 12.0~24.0mA

Marking

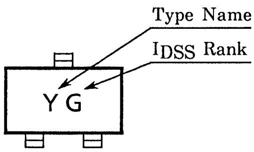
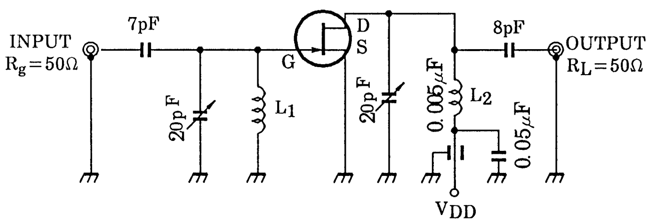


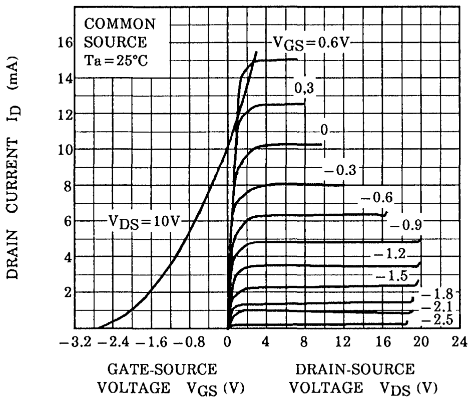
Fig. 100MHz G_{ps} NF TEST CIRCUIT



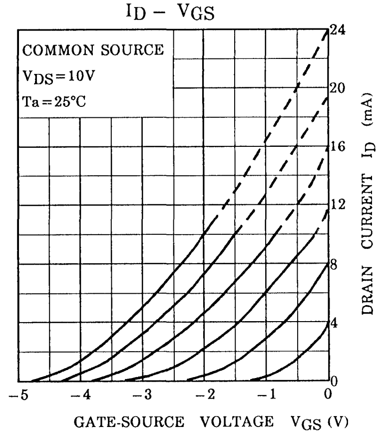
L_1 : 0.8mmϕ Ag PLATED Cu WIRE 3 TURNS, 10mm ID, 10mm LENGTH

L_2 : 0.8mmϕ Ag PLATED Cu WIRE 3.5 TURNS, 10mm ID, 10mm LENGTH

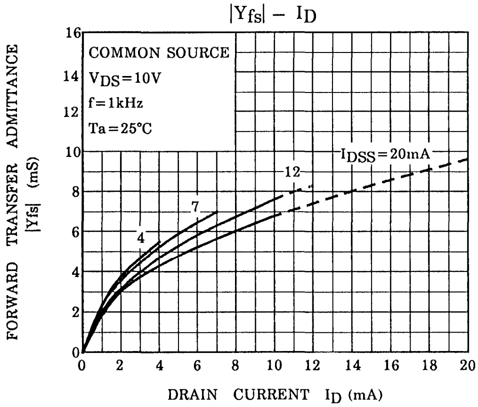
STATIC CHARACTERISTICS



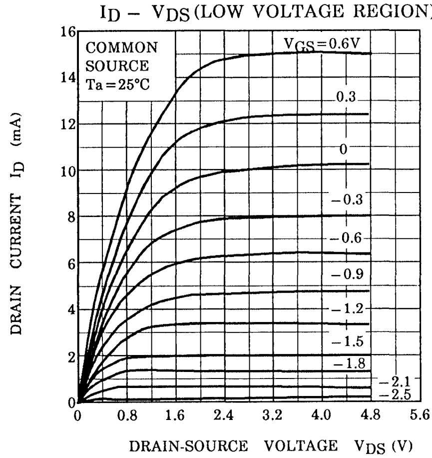
ID − VGS



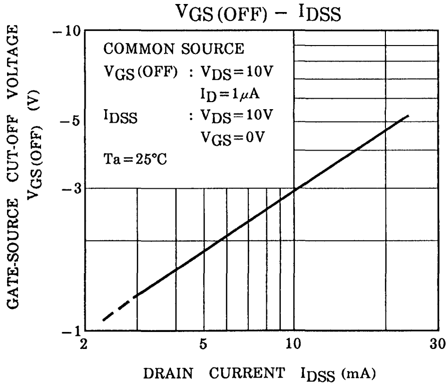
|Yfs| − ID



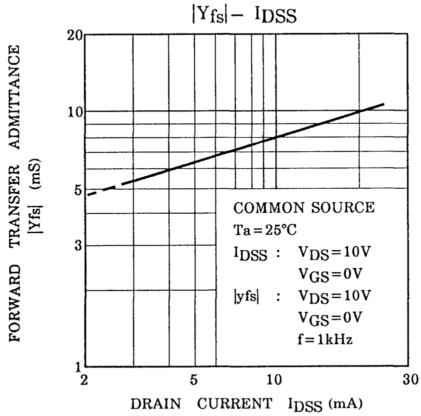
ID − VDS (LOW VOLTAGE REGION)

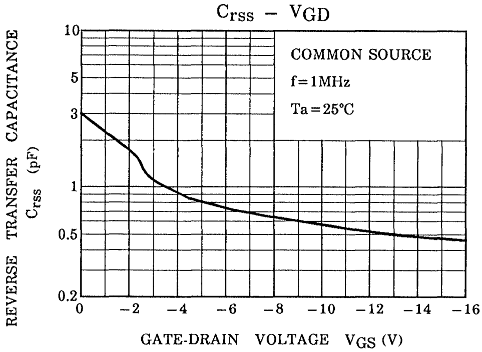


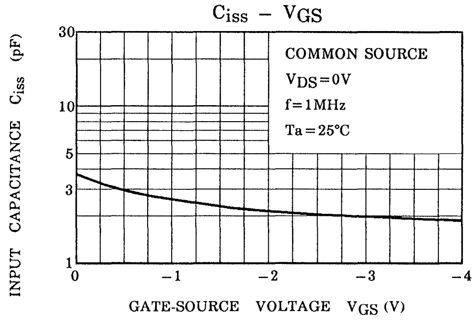
VGS (OFF) − IDSS

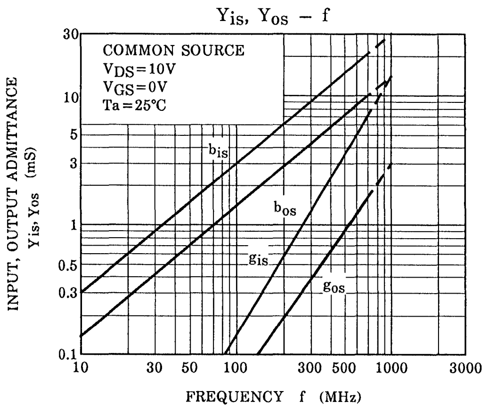


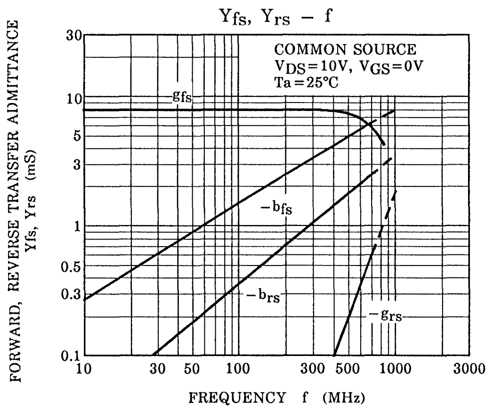
|Yfs| − IDSS

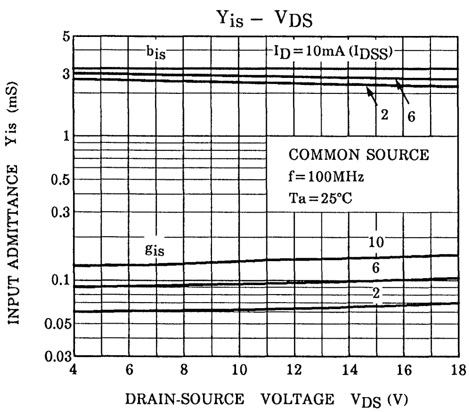


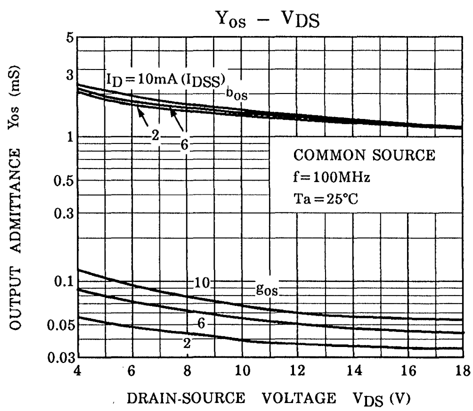

Crss – VGD
COMMON SOURCE
f=1MHz
Ta=25°C
REVERSE TRANSFER CAPACITANCE Crss (pF)
GATE-DRAIN VOLTAGE VGS (V)

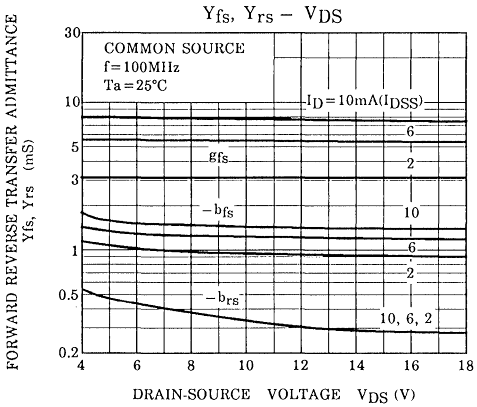

Ciss – VGS
COMMON SOURCE
VDS=0V
f=1MHz
Ta=25°C
INPUT CAPACITANCE Ciss (pF)
GATE-SOURCE VOLTAGE VGS (V)

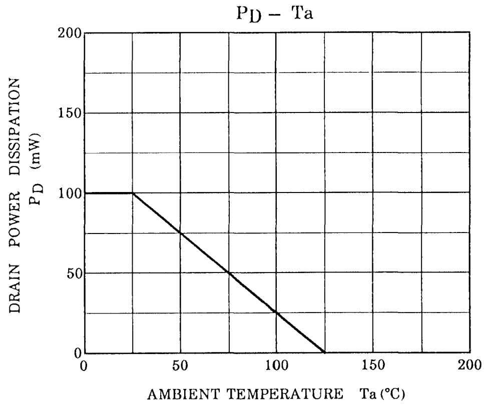

Yis, Yos – f
COMMON SOURCE
VDS=10V
VGS=0V
Ta=25°C
bis
bos
gis
gos
INPUT, OUTPUT ADMITTANCE Yis, Yos (mS)
FREQUENCY f (MHz)


Yfs, Yrs – f
COMMON SOURCE
VDS=10V, VGS=0V
Ta=25°C
gfs
–bfs
–brs
–grs
FORWARD, REVERSE TRANSFER ADMITTANCE Yfs, Yrs (mS)
FREQUENCY f (MHz)


Yis – VDS
bis
ID=10mA (IDSS)
2
6
COMMON SOURCE
f=100MHz
Ta=25°C
gis
10
6
2
INPUT ADMITTANCE Yis (mS)
DRAIN-SOURCE VOLTAGE VDS (V)


Yos – VDS
ID=10mA (IDSS)
bos
2
6
COMMON SOURCE
f=100MHz
Ta=25°C
10
gos
6
2
OUTPUT ADMITTANCE Yos (mS)
DRAIN-SOURCE VOLTAGE VDS (V)


Yfs, Yrs – VDS
COMMON SOURCE
f=100MHz
Ta=25°C
ID=10mA(IDSS)
6
2
gfs
-bfs
10
6
2
-brs
10, 6, 2
FORWARD REVERSE TRANSFER ADMITTANCE
Yfs, Yrs (mS)
30
10
5
3
1
0.5
0.2
4
6
8
10
12
14
16
18
DRAIN-SOURCE VOLTAGE VDS (V)

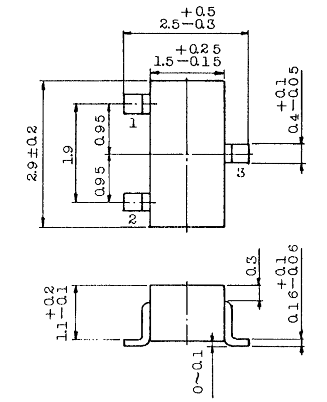

PD – Ta
DRAIN POWER DISSIPATION
PD (mW)
200
150
100
50
0
0
50
100
150
200
AMBIENT TEMPERATURE Ta (°C)

2SK211

SILICON N CHANNEL JUNCTION TYPE
FIELD EFFECT TRANSISTOR

FM TUNER APPLICATIONS.
VHF BAND AMPLIFIER APPLICATIONS.

Unit in mm



1. DRAIN
2. GATE
3. SOURCE

JEDEC	—
EIAJ	SC-59
TOSHIBA	2-3F1C

Weight : 0.012g

- Low Noise Figure : NF = 2.5dB (Typ.) (f = 100MHz)
- High Forward Transfer Admitance : $|Y_{fs}|$ = 9mS (Typ.)
- Extremely Low Reverse Transfer Capacitance : C_{rss} = 0.1pF (Typ.)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Gate-Drain Voltage	V_{GDO}	−18	V
Gate Current	I_G	10	mA
Drain Power Dissipation	P_D	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate Leakage Current	I_{GSS}	V_{GS} = −0.5V, V_{DS} = 0V	—	—	−10	nA
Gate-Drain Breakdown Voltage	$V_{(BR)GDO}$	I_G = −100μA	−18	—	—	V
Drain Current	I_{DSS} (Note)	V_{GS} = 0V, V_{DS} = 10V	1.0	—	10	mA
Gate-Source Cut-off Voltage	$V_{GS(OFF)}$	V_{DS} = 10V, I_D = 1μA	−0.4	—	−4.0	V
Forward Transfer Admittance	$\|Y_{fs}\|$	V_{GS} = 0V, V_{DS} = 10V, f = 1kHz	—	9	—	mS
Input Capacitance	C_{iss}	V_{DS} = 10V, V_{GS} = 0V, f = 1MHz	—	6.0	—	pF
Reverse Transfer Capacitance	C_{rss}	V_{GD} = −10V, f = 1MHz	—	0.10	0.15	pF
Power Gain	G_{PS}	V_{DD} = 10V, f = 100MHz (Fig.)	—	18	—	dB
Noise Figure	NF	V_{DD} = 10V, f = 100MHz (Fig.)	—	2.5	3.5	dB

Note : I_{DSS} Classificatopn O : 1.0~3.0mA, Y : 2.5~6.0mA, GR (G) : 5.0~10.0mA

Marking

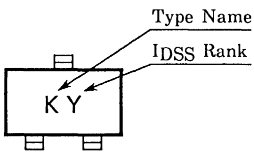
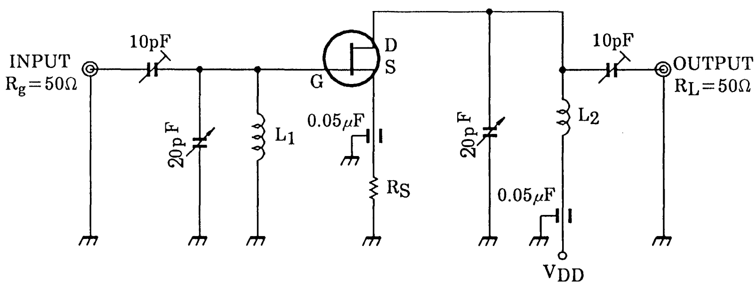


Fig. 100MHz G_{ps}, NF TEST CIRCUIT



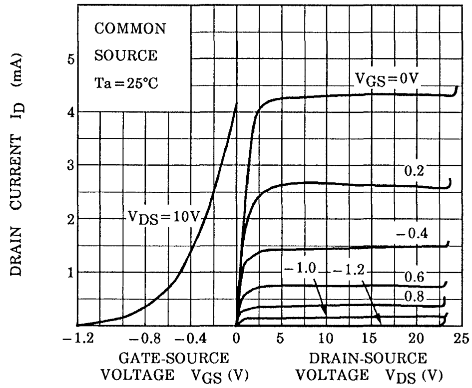
L_1 : 0.8mmϕ Ag PLATED Cu WIRE 3 TURNS, 10mm ID, 10mm LENGTH

L_2 : 0.8mmϕ Ag PLATED Cu WIRE 3.5 TURNS, 10mm ID, 10mm LENGTH

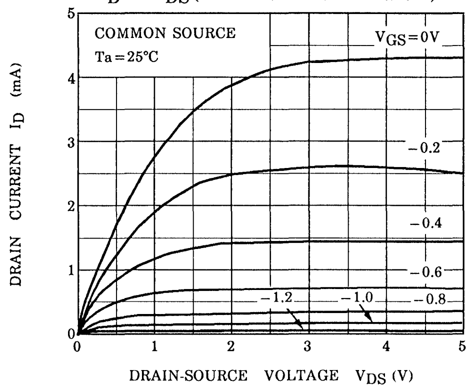
2SK211 is measured at each group by changing R_S.

GROUP	RS (Ω)
2SK211-O	0
2SK211-Y	18Ω±5%
2SK211-GR	100Ω±5%

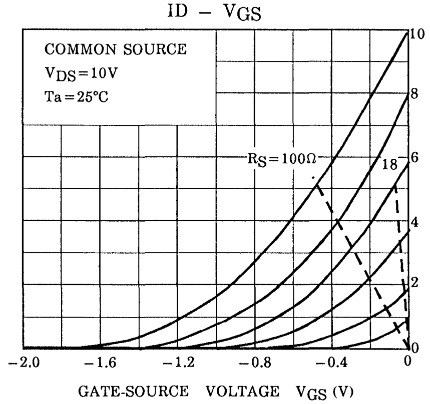
STATIC CHARACTERISTICS



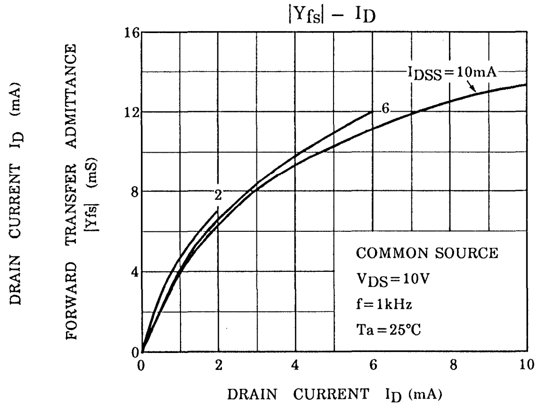
I_D – V_{DS} (LOW VOLTAGE REGION)



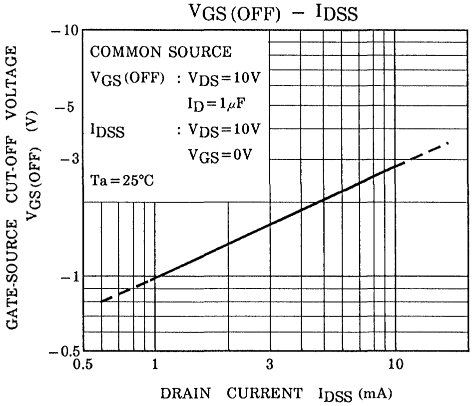
ID – V_{GS}



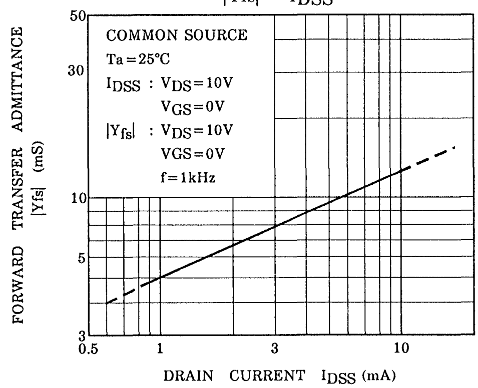
$|Y_{fs}|$ – I_D

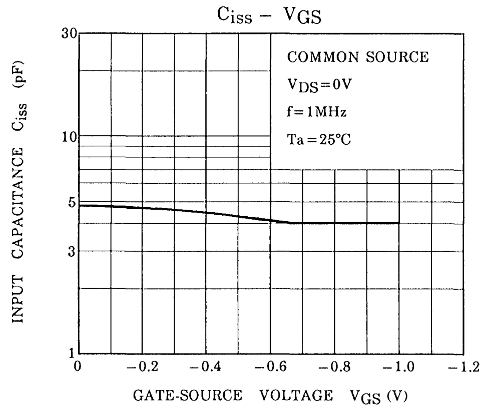


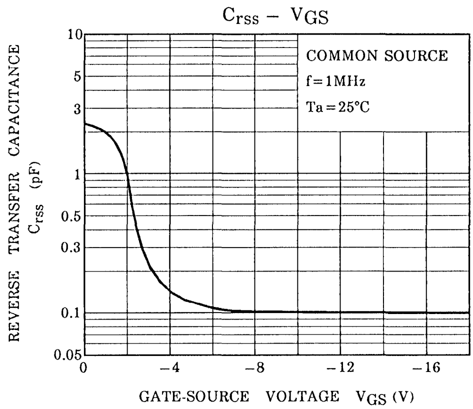
$V_{GS(OFF)}$ – I_{DSS}

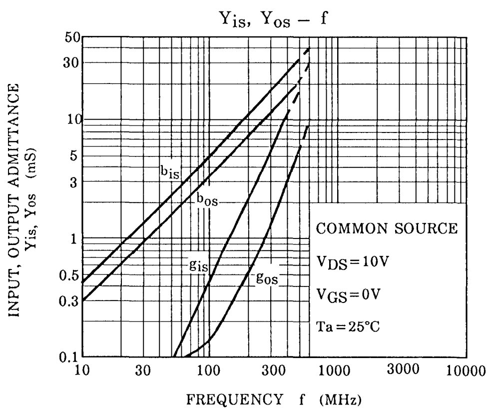


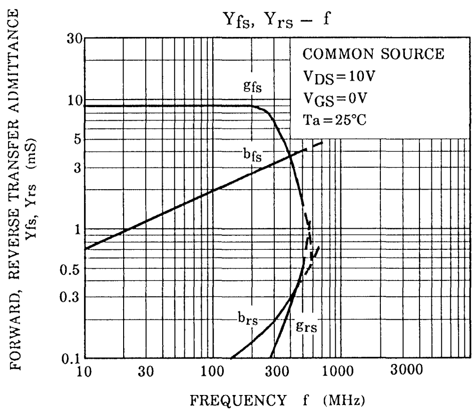
$|Y_{fs}|$ – I_{DSS}

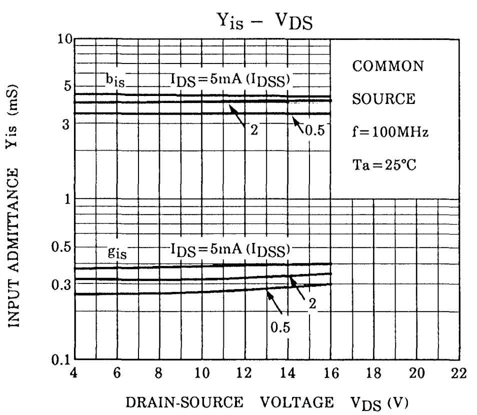


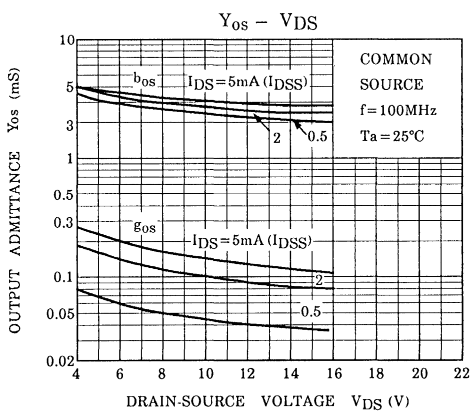

Ciss – VGS
COMMON SOURCE
VDS=0V
f=1MHz
Ta=25°C
INPUT CAPACITANCE Ciss (pF)
30
10
5
3
1
0
−0.2
−0.4
−0.6
−0.8
−1.0
−1.2
GATE-SOURCE VOLTAGE VGS (V)

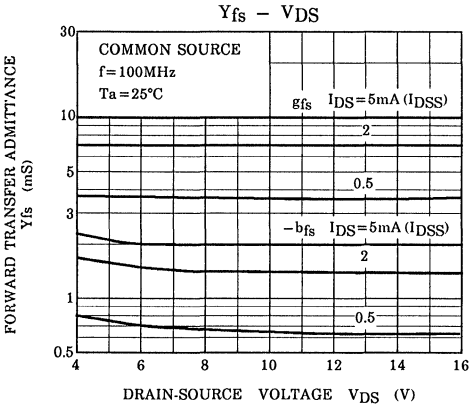

Crss – VGS
COMMON SOURCE
f=1MHz
Ta=25°C
REVERSE TRANSFER CAPACITANCE Crss (pF)
10
5
3
1
0.5
0.3
0.1
0.05
0
−4
−8
−12
−16
GATE-SOURCE VOLTAGE VGS (V)

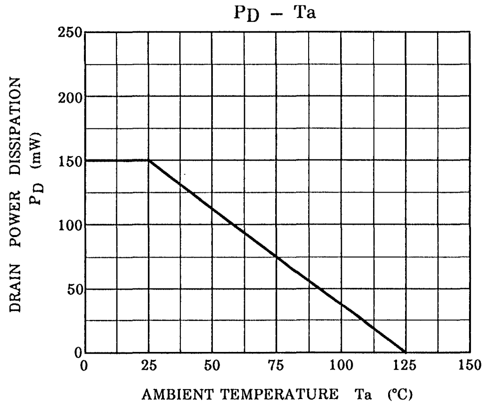

Yis, Yos – f
bis
bos
gis
gos
COMMON SOURCE
VDS=10V
VGS=0V
Ta=25°C
INPUT, OUTPUT ADMITTANCE Yis, Yos (mS)
50
30
10
5
3
1
0.5
0.3
0.1
10
30
100
300
1000
3000
10000
FREQUENCY f (MHz)


Yfs, Yrs – f
COMMON SOURCE
VDS=10V
VGS=0V
Ta=25°C
gfs
bfs
brs
grs
FORWARD, REVERSE TRANSFER ADMITTANCE Yfs, Yrs (mS)
30
10
5
3
1
0.5
0.3
0.1
10
30
100
300
1000
3000
FREQUENCY f (MHz)


Yis – VDS
COMMON
SOURCE
f=100MHz
Ta=25°C
bis
IDS=5mA (IDSS)
2
0.5
gis
IDS=5mA (IDSS)
2
0.5
INPUT ADMITTANCE Yis (mS)
10
5
3
1
0.5
0.3
0.1
4
6
8
10
12
14
16
18
20
22
DRAIN-SOURCE VOLTAGE VDS (V)


Yos – VDS
COMMON
SOURCE
f=100MHz
Ta=25°C
bos
IDS=5mA (IDSS)
2
0.5
gos
IDS=5mA (IDSS)
2
0.5
OUTPUT ADMITTANCE Yos (mS)
10
5
3
1
0.5
0.3
0.1
0.05
0.02
4
6
8
10
12
14
16
18
20
22
DRAIN-SOURCE VOLTAGE VDS (V)


Yfs – VDS
COMMON SOURCE
f=100MHz
Ta=25°C
gfs IDS=5mA (IDSS)
2
0.5
–bfs IDS=5mA (IDSS)
2
0.5
FORWARD TRANSFER ADMITTANCE Yfs (mS)
30
10
5
3
1
0.5
4
6
8
10
12
14
16
DRAIN-SOURCE VOLTAGE VDS (V)


PD – Ta
DRAIN POWER DISSIPATION PD (mW)
250
200
150
100
50
0
0
25
50
75
100
125
150
AMBIENT TEMPERATURE Ta (°C)

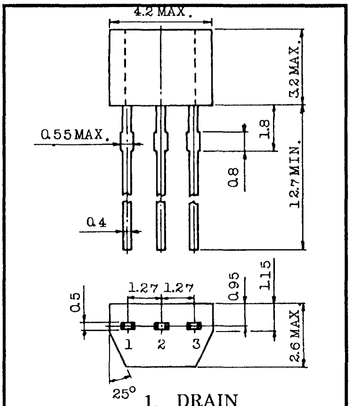
SILICON N CHANNEL MOS TYPE FIELD EFFECT TRANSISTOR

2SK241

FM TUNER, VHF AND RF AMPLIFIER APPLICATIONS.

- Low Reverse Transfer Capacitance : C_{rss} = 0.035pF (Typ.)
- Low Noise Figure : NF = 1.7dB (Typ.)
- High Power Gain : G_{PS} = 28dB (Typ.)
- Recommend Operation Voltage : 5~15V

Unit in mm



1. DRAIN
2. SOURCE
3. GATE

JEDEC	—
EIAJ	—
TOSHIBA	2-4E1D

Weight : 0.13g

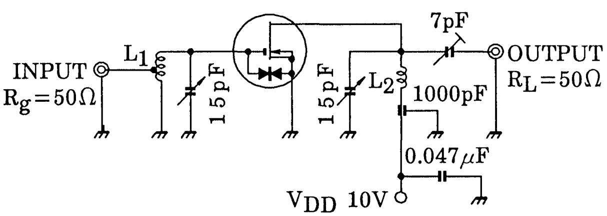
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Drain-Source Voltage	V_{DS}	20	V
Gate-Source Voltage	V_{GS}	±5	V
Drain Current	I_D	30	mA
Drain Power Dissipation	P_D	200	mW
Chanel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate Leakage Current	I_{GSS}	V_{DS}=0, V_{GS}=±5V	—	—	±50	nA
Drain-Source Voltage	V_{DSX}	V_{GS}=−4V, I_D=100μA	20	—	—	V
Drain Current	I_{DSS}	V_{DS}=10V, V_{GS}=0 (Note)	1.5	—	14	mA
Gate-Source Cut-off Voltage	$V_{GS(OFF)}$	V_{DS}=10V, I_D=100μA	—	—	−2.5	V
Forward Transfer Admittance	$\lvert y_{fs} \rvert$	V_{DS}=10V, V_{GS}=0, f=1kHz	—	10	—	mS
Input Capacitance	C_{iss}	V_{DS}=10V, V_{GS}=0, f=1MHz	—	3.0	—	pF
Reverse Transfer Capacitance	C_{rss}		—	0.035	0.050	pF
Power Gain	G_{ps}	V_{DS}=10V, V_{GS}=0, f=100MHz (Fig.1)	—	28	—	dB
Noise Figure	NF		—	1.7	3.0	dB

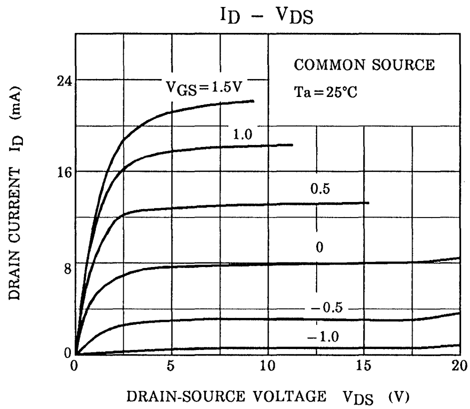
Note : I_{DSS} Classification O : 1.5~3.5, Y : 3.0~7.0, GR : 6.0~14.0



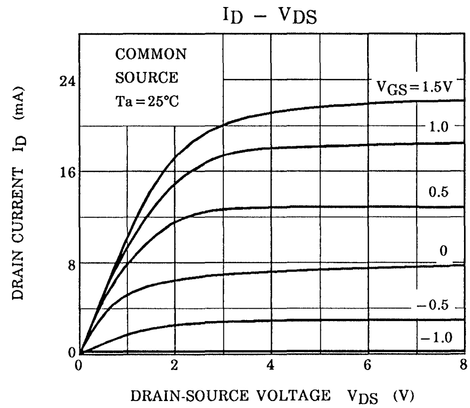
L_1 : 1.0mmϕ SILVER PLATED COPPER WIRE 4.0T, 8mmϕ ID TAPAT 1.0T FROM COLD END

L_2 : 1.0mmϕ SILVER PLATED COPPER WIRE 3.0T, 8mmϕ ID, 10mm LENGTH

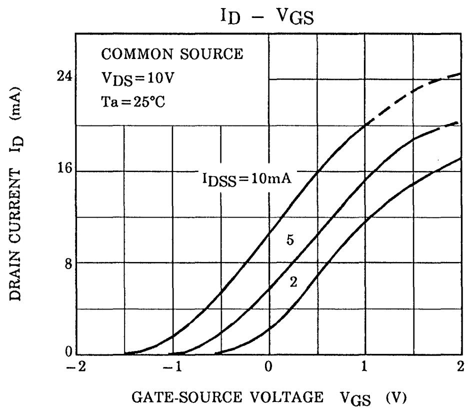
Fig.1 G_{ps}, NF TEST CIRCUIT



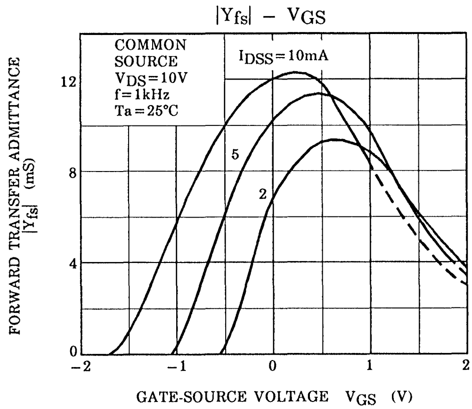
I_D – V_{DS}
COMMON SOURCE
Ta=25°C
V_{GS}=1.5V
1.0
0.5
0
−0.5
−1.0
DRAIN CURRENT I_D (mA)
DRAIN-SOURCE VOLTAGE V_{DS} (V)



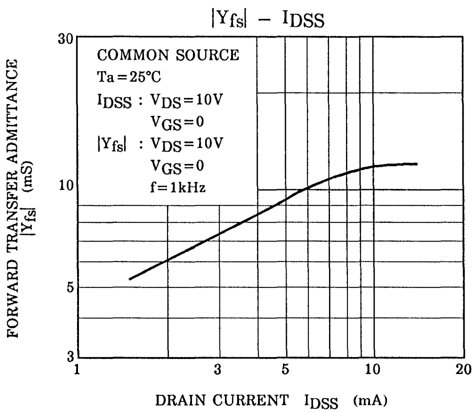
I_D – V_{DS}
COMMON
SOURCE
Ta=25°C
V_{GS}=1.5V
1.0
0.5
0
−0.5
−1.0
DRAIN CURRENT I_D (mA)
DRAIN-SOURCE VOLTAGE V_{DS} (V)



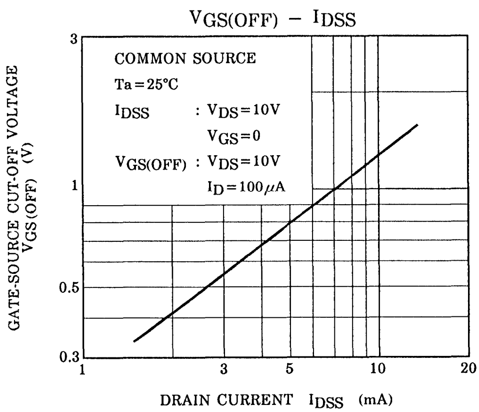
I_D – V_{GS}
COMMON SOURCE
V_{DS}=10V
Ta=25°C
I_{DSS}=10mA
5
2
DRAIN CURRENT I_D (mA)
GATE-SOURCE VOLTAGE V_{GS} (V)



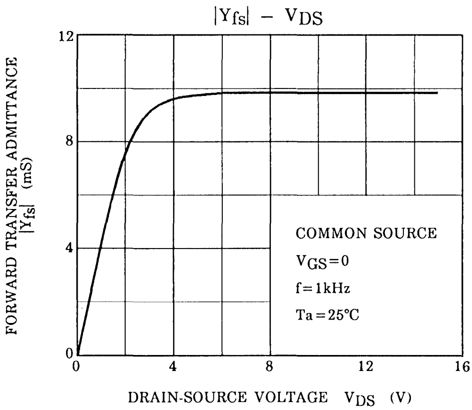
$|Y_{fs}|$ – V_{GS}
COMMON
SOURCE
V_{DS}=10V
f=1kHz
Ta=25°C
I_{DSS}=10mA
5
2
FORWARD TRANSFER ADMITTANCE $|Y_{fs}|$ (mS)
GATE-SOURCE VOLTAGE V_{GS} (V)

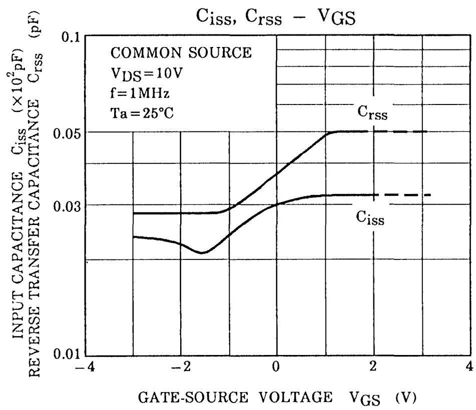


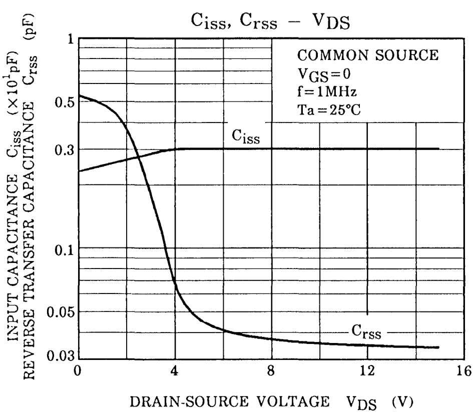
$|Y_{fs}|$ – I_{DSS}
COMMON SOURCE
Ta=25°C
I_{DSS} : V_{DS}=10V
V_{GS}=0
$|Y_{fs}|$: V_{DS}=10V
V_{GS}=0
f=1kHz
FORWARD TRANSFER ADMITTANCE $|Y_{fs}|$ (mS)
DRAIN CURRENT I_{DSS} (mA)

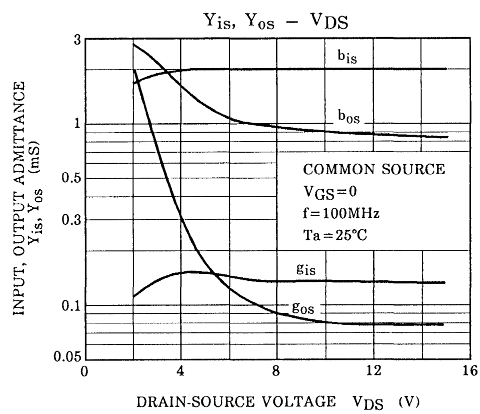


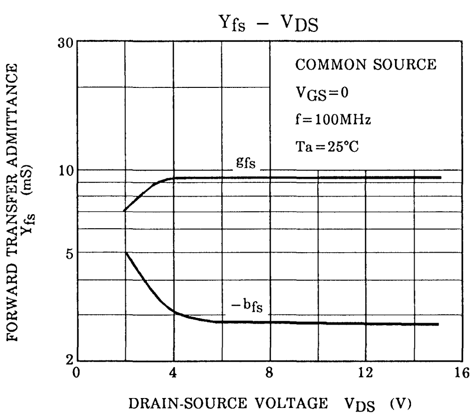
$V_{GS(OFF)}$ – I_{DSS}
COMMON SOURCE
Ta=25°C
I_{DSS} : V_{DS}=10V
V_{GS}=0
$V_{GS(OFF)}$: V_{DS}=10V
I_D=100μA
GATE-SOURCE CUT-OFF VOLTAGE $V_{GS(OFF)}$ (V)
DRAIN CURRENT I_{DSS} (mA)

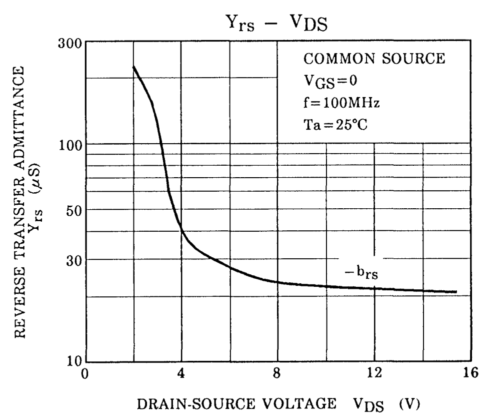

|Yfs| – VDS
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)
12
8
4
0
0 4 8 12 16
COMMON SOURCE
VGS=0
f=1kHz
Ta=25°C
DRAIN-SOURCE VOLTAGE VDS (V)

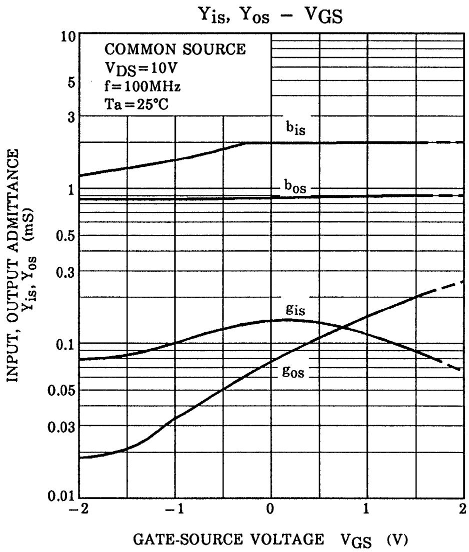

Ciss, Crss – VGS
INPUT CAPACITANCE Ciss (×10²pF)
REVERSE TRANSFER CAPACITANCE Crss (pF)
0.1
0.05
0.03
0.01
−4 −2 0 2 4
COMMON SOURCE
VDS=10V
f=1MHz
Ta=25°C
Crss
Ciss
GATE-SOURCE VOLTAGE VGS (V)

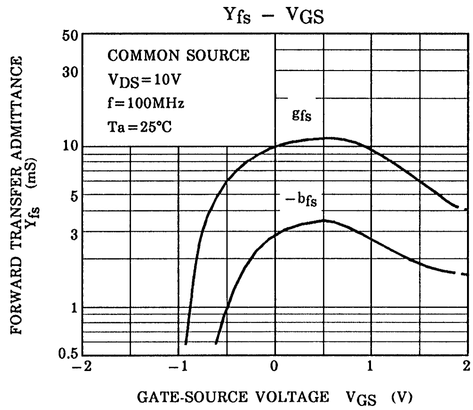

Ciss, Crss – VDS
INPUT CAPACITANCE Ciss (×10¹pF)
REVERSE TRANSFER CAPACITANCE Crss (pF)
1
0.5
0.3
0.1
0.05
0.03
0 4 8 12 16
COMMON SOURCE
VGS=0
f=1MHz
Ta=25°C
Ciss
Crss
DRAIN-SOURCE VOLTAGE VDS (V)

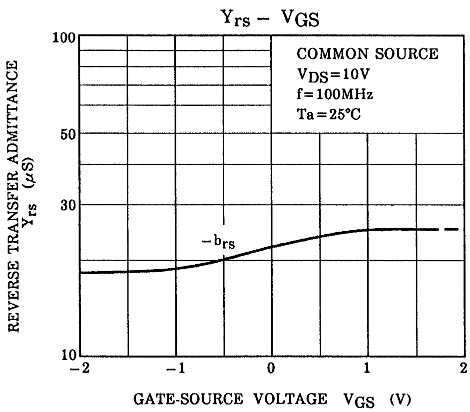

Yis, Yos – VDS
INPUT, OUTPUT ADMITTANCE Yis, Yos (mS)
3
1
0.5
0.3
0.1
0.05
0 4 8 12 16
bis
bos
COMMON SOURCE
VGS=0
f=100MHz
Ta=25°C
gis
gos
DRAIN-SOURCE VOLTAGE VDS (V)

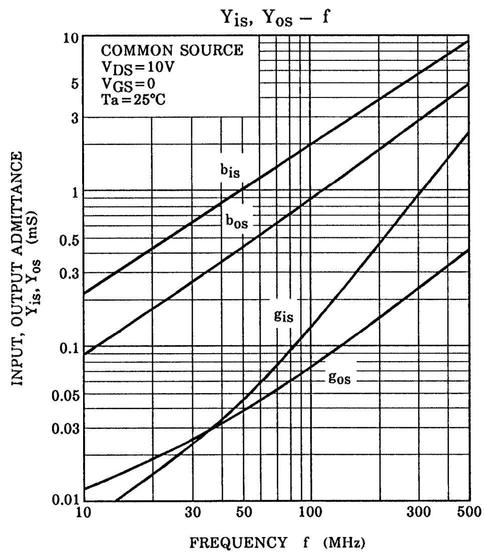

Yfs – VDS
FORWARD TRANSFER ADMITTANCE Yfs (mS)
30
10
5
2
0 4 8 12 16
COMMON SOURCE
VGS=0
f=100MHz
Ta=25°C
gfs
−bfs
DRAIN-SOURCE VOLTAGE VDS (V)

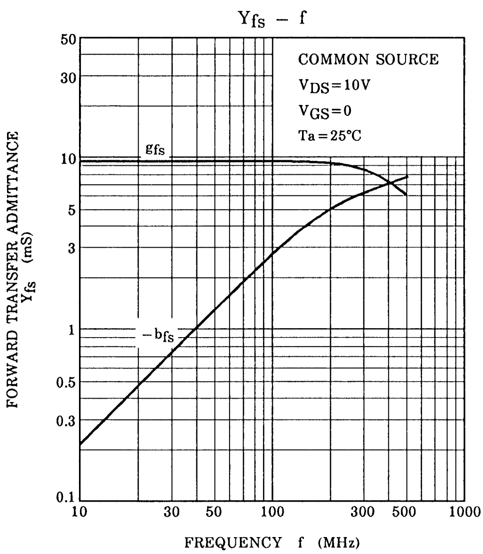

Yrs – VDS
REVERSE TRANSFER ADMITTANCE Yrs (μS)
300
100
50
30
10
0 4 8 12 16
COMMON SOURCE
VGS=0
f=100MHz
Ta=25°C
−brs
DRAIN-SOURCE VOLTAGE VDS (V)

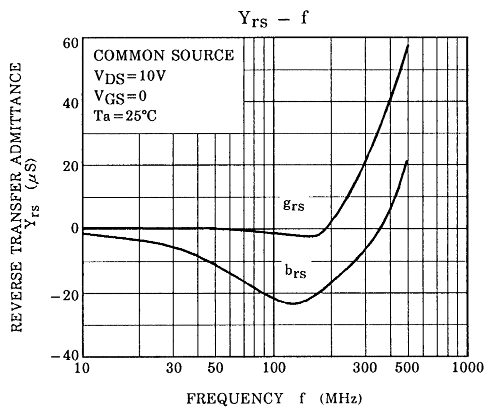

Yis, Yos – VGS
COMMON SOURCE
VDS=10V
f=100MHz
Ta=25°C
bis
bos
gis
gos
INPUT, OUTPUT ADMITTANCE Yis, Yos (mS)
10
5
3
1
0.5
0.3
0.1
0.05
0.03
0.01
−2
−1
0
1
2
GATE-SOURCE VOLTAGE VGS (V)

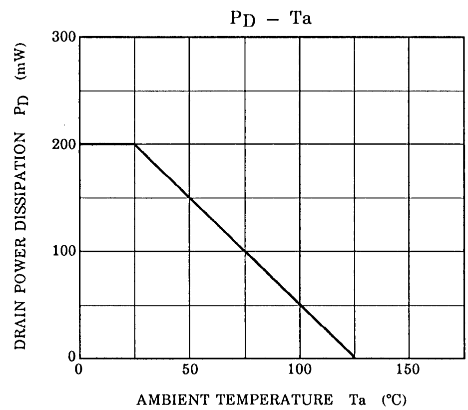

Yfs – VGS
COMMON SOURCE
VDS=10V
f=100MHz
Ta=25°C
gfs
−bfs
FORWARD TRANSFER ADMITTANCE Yfs (mS)
50
30
10
5
3
1
0.5
−2
−1
0
1
2
GATE-SOURCE VOLTAGE VGS (V)


Yrs – VGS
COMMON SOURCE
VDS=10V
f=100MHz
Ta=25°C
−brs
REVERSE TRANSFER ADMITTANCE Yrs (μS)
100
50
30
10
−2
−1
0
1
2
GATE-SOURCE VOLTAGE VGS (V)


Yis, Yos – f
COMMON SOURCE
VDS=10V
VGS=0
Ta=25°C
bis
bos
gis
gos
INPUT, OUTPUT ADMITTANCE Yis, Yos (mS)
10
5
3
1
0.5
0.3
0.1
0.05
0.03
0.01
10
30
50
100
300
500
FREQUENCY f (MHz)


Yfs – f
COMMON SOURCE
VDS=10V
VGS=0
Ta=25°C
gfs
–bfs
FORWARD TRANSFER ADMITTANCE Yfs (mS)
FREQUENCY f (MHz)
50
30
10
5
3
1
0.5
0.3
0.1
10
30
50
100
300
500
1000


Yrs – f
COMMON SOURCE
VDS=10V
VGS=0
Ta=25°C
grs
brs
REVERSE TRANSFER ADMITTANCE Yrs (μS)
FREQUENCY f (MHz)
60
40
20
0
–20
–40
10
30
50
100
300
500
1000


PD – Ta
DRAIN POWER DISSIPATION PD (mW)
AMBIENT TEMPERATURE Ta (°C)
300
200
100
0
0
50
100
150

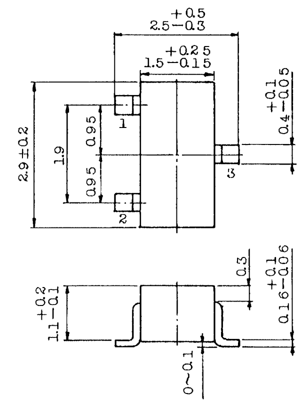
2SK302

SILICON N CHANNEL MOS TYPE
FIELD EFFECT TRANSISTOR

FM TUNER, VHF RF AMPLIFIER APPLICATIONS.

Unit in mm

- Low Reverse Transfer Capacitance : C_{rss} = 0.035pF (Typ.)
- Low Noise Figure : NF = 1.7dB (Typ.)
- High Power Gain : G_{ps} = 28dB (Typ.)
- Recommend Operation Voltage : 5~15V



1. DRAIN
2. GATE
3. SOURCE

JEDEC	TO—236
EIAJ	—
TOSHIBA	2-3F1C

Weight : 0.012g

MAXIMUM RATINGS (Ta = 25°C)

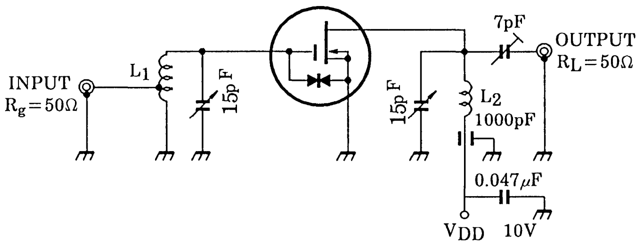
CHARACTERISTIC	SYMBOL	RATING	UNIT
Drain-Source Voltage	V_{DS}	20	V
Gate-Source Voltage	V_{GS}	±5	V
Drain Current	I_D	30	mA
Drain Power Dissipation	P_D	150	mW
Channel Temperature	T_{ch}	125	°C
Storage Temperature	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate Leakage Current	I_{GSS}	V_{DS} = 0V, V_{GS} = ±5V	—	—	±50	nA
Drain-Sorce Voltage	V_{DSX}	V_{GS} = −4V, I_D = 100μA	20	—	—	V
Drain Current	I_{DSS} (Note)	V_{DS} = 10V, V_{GS} = 0V	1.5	—	14	mA
Gate-Source Cut-off Voltage	$V_{GS(OFF)}$	V_{DS} = 10V, I_D = 100μA	—	—	−2.5	V
Forward Transfer Admittance	$\|Y_{fs}\|$	V_{DS} = 10V, V_{GS} = 0V, f = 1kHz	—	10	—	mS
Input Capacitance	C_{iss}	V_{DS} = 10V, V_{GS} = 0V, f = 1MHz	—	3.0	—	pF
Reverse Transfer Capacitance	C_{rss}		—	0.035	0.050	pF
Power Gain	G_{PS}	V_{DS} = 10V, V_{GS} = 0V, f = 100MHz (Fig. 1)	—	28	—	dB
Noise Figure	NF		—	1.7	3.0	dB

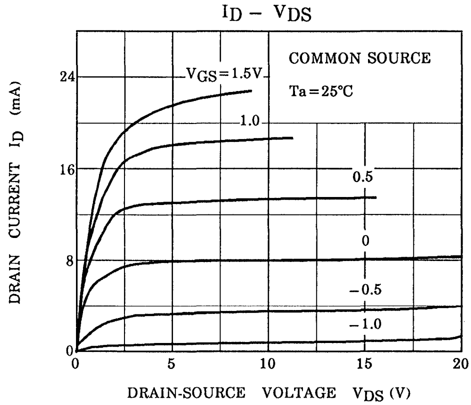
Note : I_{DSS} Classification O : 1.5~3.5mA, Y : 3.0~7.0mA, GR : 6.0~14.0mA

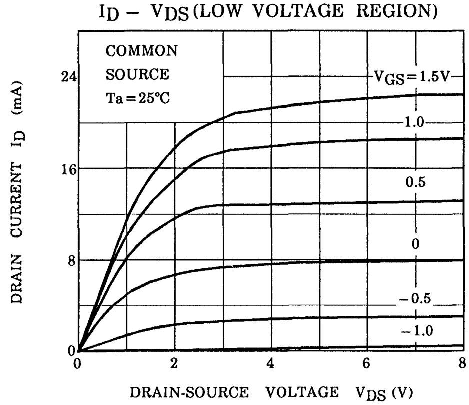
Fig. 1 G_{ps}, NF TEST CIRCUIT

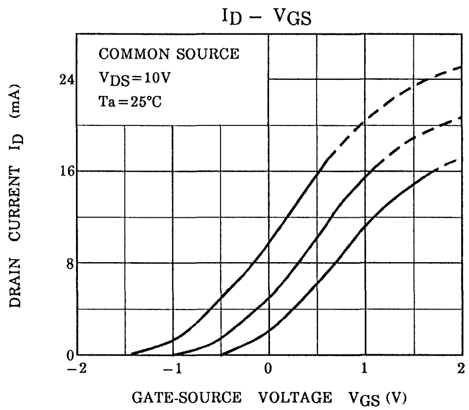


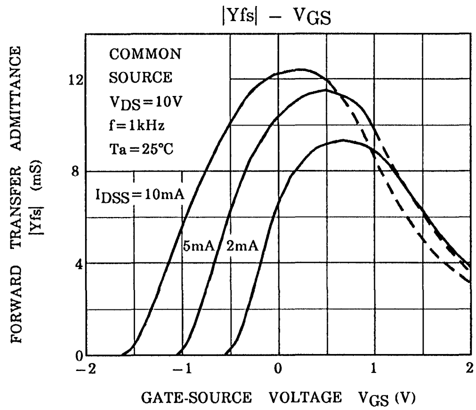
L_1 : 1.0mmϕ SILVER PLATED COPPER WIRE 4.0T, 8mmϕ ID TAP AT 1.0T EROM COLD END

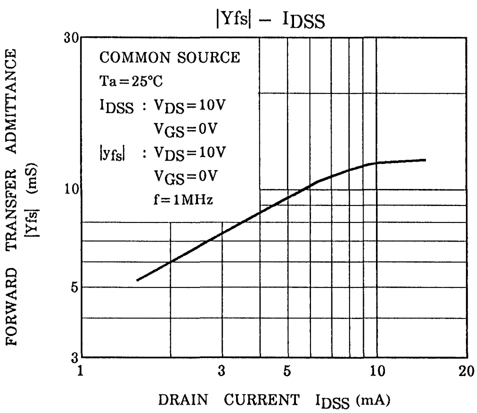
L_2 : 1.0mmϕ SILVER PLATED COPPER WIRE 3.0T, 8mmϕ ID, 10mm LENGTH

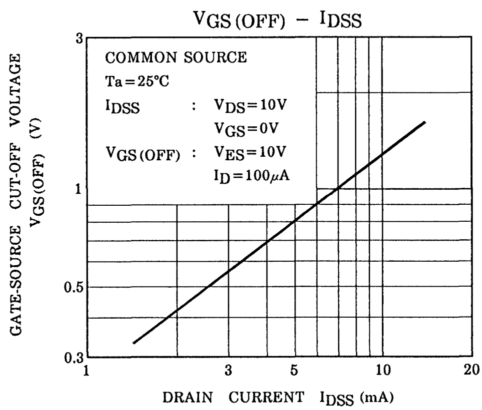

ID – VDS
COMMON SOURCE
Ta=25°C
VGS=1.5V
1.0
0.5
0
−0.5
−1.0
DRAIN CURRENT ID (mA)
DRAIN-SOURCE VOLTAGE VDS (V)


ID – VDS (LOW VOLTAGE REGION)
COMMON SOURCE
Ta=25°C
VGS=1.5V
1.0
0.5
0
−0.5
−1.0
DRAIN CURRENT ID (mA)
DRAIN-SOURCE VOLTAGE VDS (V)

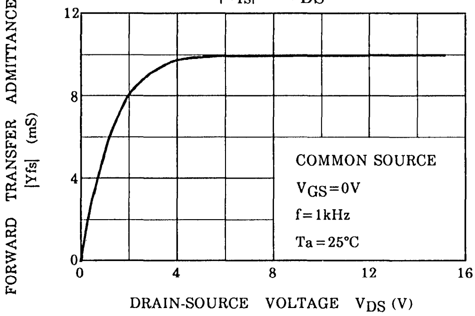

ID – VGS
COMMON SOURCE
VDS=10V
Ta=25°C
DRAIN CURRENT ID (mA)
GATE-SOURCE VOLTAGE VGS (V)


|Yfs| – VGS
COMMON SOURCE
VDS=10V
f=1kHz
Ta=25°C
IDSS=10mA
5mA
2mA
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)
GATE-SOURCE VOLTAGE VGS (V)

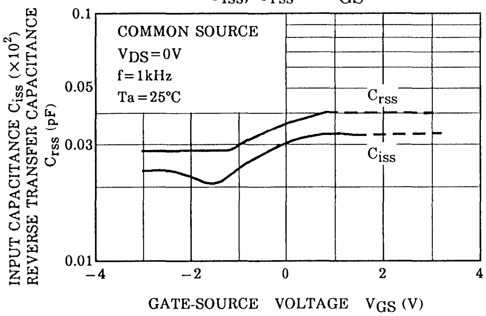

|Yfs| – IDSS
COMMON SOURCE
Ta=25°C
IDSS : VDS=10V
VGS=0V
|yfs| : VDS=10V
VGS=0V
f=1MHz
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)
DRAIN CURRENT IDSS (mA)


VGS (OFF) – IDSS
COMMON SOURCE
Ta=25°C
IDSS : VDS=10V
VGS=0V
VGS (OFF) : VES=10V
ID=100μA
GATE-SOURCE CUT-OFF VOLTAGE VGS (OFF) (V)
DRAIN CURRENT IDSS (mA)

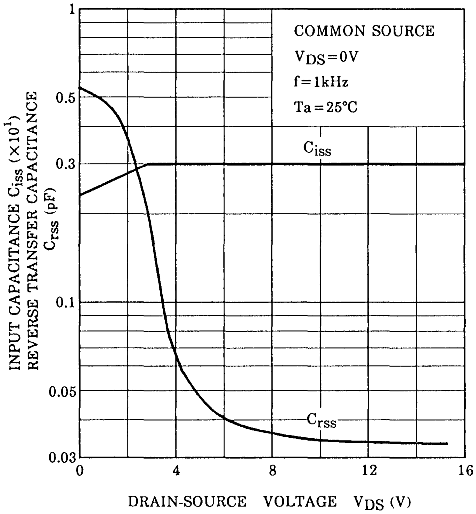
$|Y_{fs}| - V_{DS}$



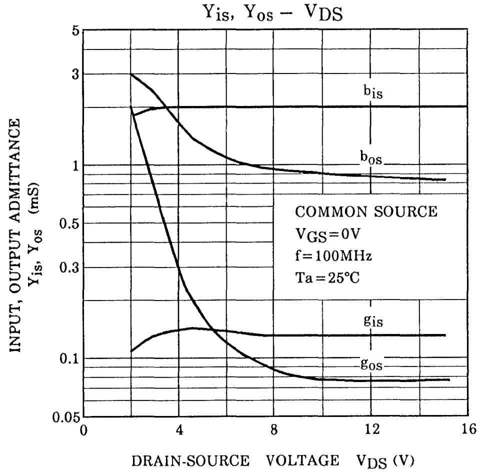
$C_{iss}, C_{rss} - V_{GS}$



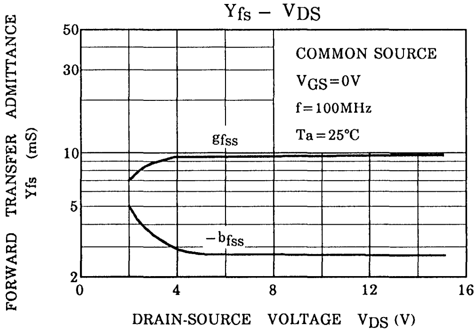
$C_{iss}, C_{rss} - V_{DS}$



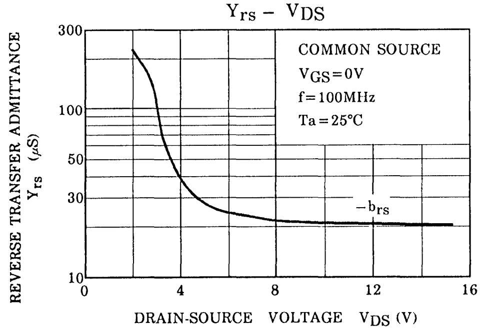
$Y_{is}, Y_{os} - V_{DS}$

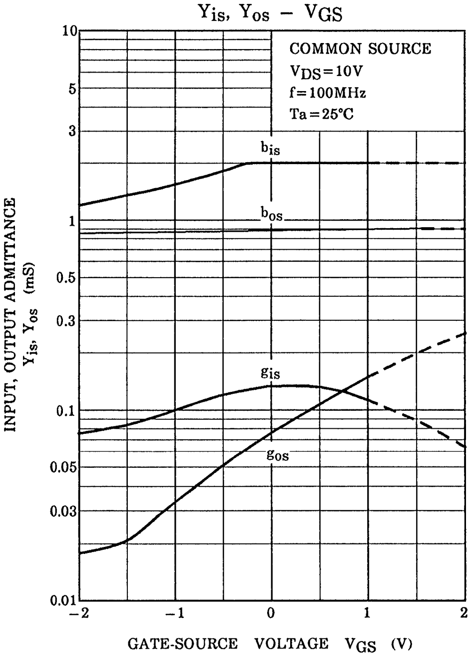


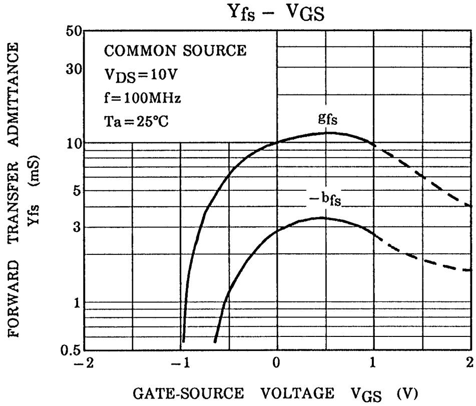
$Y_{fs} - V_{DS}$

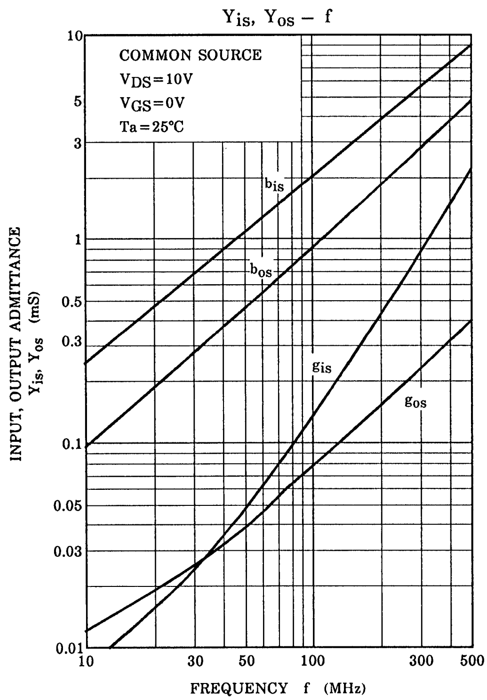


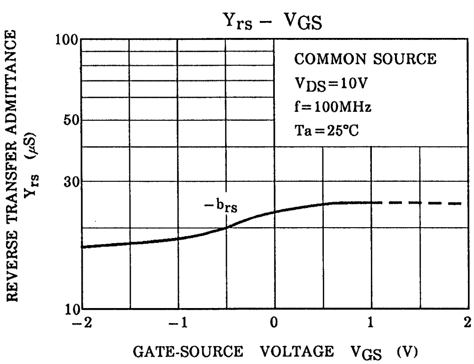
$Y_{rs} - V_{DS}$

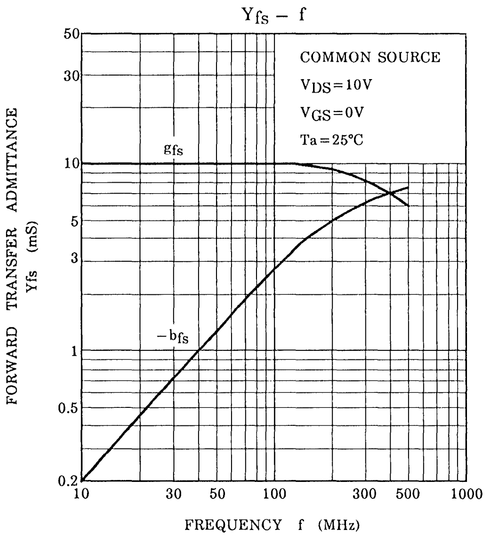



Yis, Yos − VGS
COMMON SOURCE
VDS=10V
f=100MHz
Ta=25°C
bis
bos
gis
gos
INPUT, OUTPUT ADMITTANCE Yis, Yos (mS)
GATE-SOURCE VOLTAGE VGS (V)

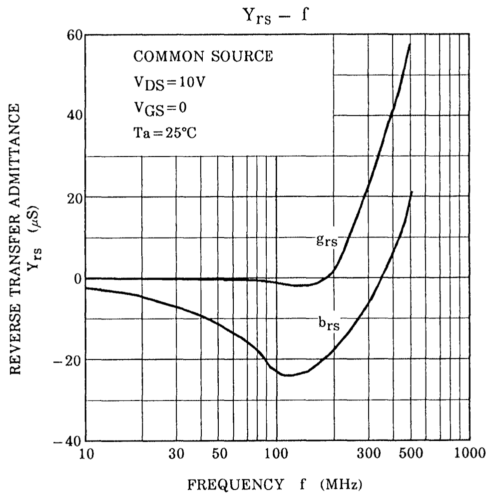

Yfs − VGS
COMMON SOURCE
VDS=10V
f=100MHz
Ta=25°C
gfs
−bfs
FORWARD TRANSFER ADMITTANCE Yfs (mS)
GATE-SOURCE VOLTAGE VGS (V)


Yis, Yos − f
COMMON SOURCE
VDS=10V
VGS=0V
Ta=25°C
bis
bos
gis
gos
INPUT, OUTPUT ADMITTANCE Yis, Yos (mS)
FREQUENCY f (MHz)

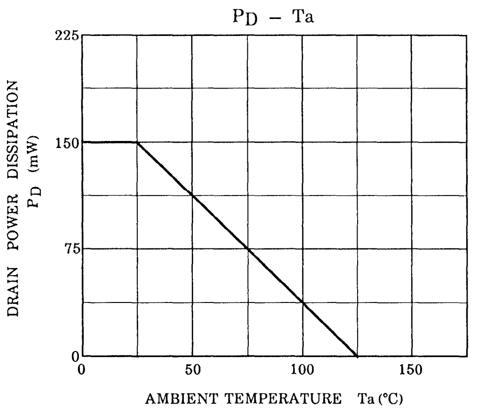

Yrs − VGS
COMMON SOURCE
VDS=10V
f=100MHz
Ta=25°C
−brs
REVERSE TRANSFER ADMITTANCE Yrs (μS)
GATE-SOURCE VOLTAGE VGS (V)



Y_{fs} – f
COMMON SOURCE
V_{DS}=10V
V_{GS}=0V
Ta=25°C
g_{fs}
$-b_{fs}$
FORWARD TRANSFER ADMITTANCE
Yfs (mS)
50
30
10
5
3
1
0.5
0.2
10
30
50
100
300
500
1000
FREQUENCY f (MHz)

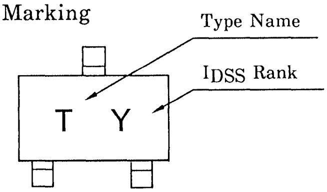


Y_{rs} – f
COMMON SOURCE
V_{DS}=10V
V_{GS}=0
Ta=25°C
g_{rs}
b_{rs}
REVERSE TRANSFER ADMITTANCE
Y_{rs} (μS)
60
40
20
0
−20
−40
10
30
50
100
300
500
1000
FREQUENCY f (MHz)



P_D – Ta
DRAIN POWER DISSIPATION
P_D (mW)
225
150
75
0
0
50
100
150
AMBIENT TEMPERATURE Ta (°C)

Marking



Type Name
IDSS Rank
T
Y

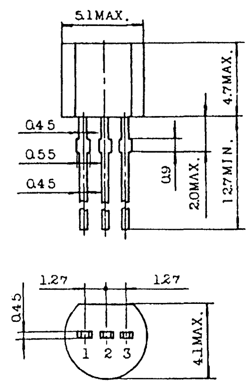
2SK709

SILICON N CHANNEL JUNCTION TYPE FIELD EFFECT TRANSISTOR

HIGH FREQUENCY AMPLIFIER APPLICATIONS.
AM HIGH FREQUENCY AMPLIFIER APPLICATIONS.
AUDIO FREQUENCY AMPLIFIER APPLICATIONS.

- High $|Y_{fs}|$: $|Y_{fs}|=25mS$ (Typ.)
- Low C_{iss} : $C_{iss}=7.5pF$ (Typ.)
- Low Noise

Unit in mm



1. DRAIN
2. SOURCE
3. GATE

JEDEC	TO-92
EIAJ	SC-43
TOSHIBA	2-5F1A

Weight : 0.21g

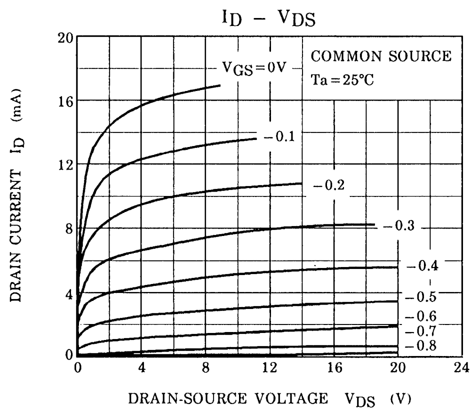
MAXIMUM RATINGS (Ta = 25°C)

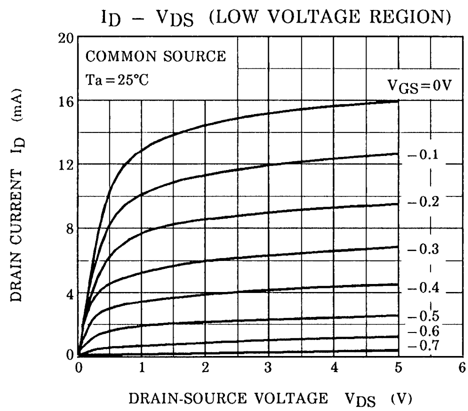
CHARACTERISTIC	SYMBOL	RATING	UNIT
Gate-Drain Voltage	V_{GDS}	−20	V
Gate Current	I_G	10	mA
Drain Power Dissipation	P_D	300	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

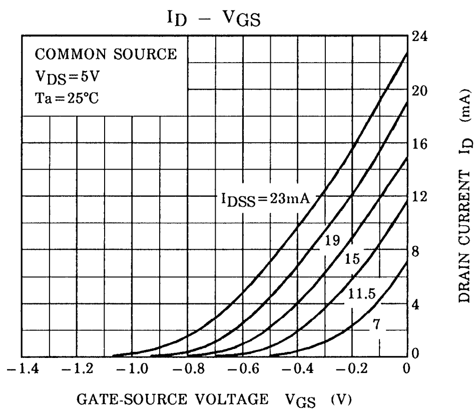
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

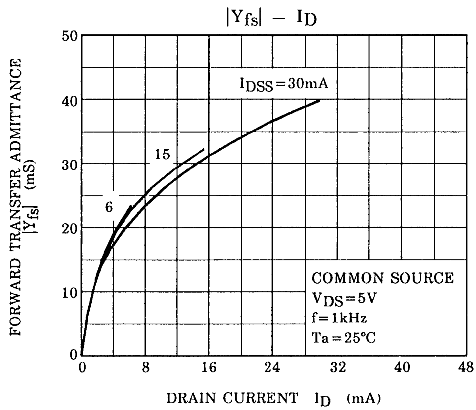
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate Leakage Current	I_{GSS}	$V_{GS}=-15V$, $V_{DS}=0$	—	—	−1.0	nA
Gate-Drain Breakdown Voltage	$V_{(BR)GDS}$	$V_{DS}=0$, $I_G=-100\mu A$	−20	—	—	V
Drain Current	I_{DSS} (Note)	$V_{DS}=5V$, $V_{GS}=0$	6	—	32	mA
Gate-Source Cut-off Voltage	$V_{GS(OFF)}$	$V_{DS}=5V$, $I_D=1\mu A$	—	—	−2.5	V
Forward Transfer Admittance	$\|Y_{fs}\|$	$V_{DS}=5V$, $V_{GS}=0$, $f=1kHz$	15	25	—	mS
Input Capacitance	C_{iss}	$V_{DS}=5V$, $V_{GS}=0$, $f=1MHz$	—	7.5	10	pF
Reverse Transfer Capacitance	C_{rss}	$V_{DG}=5V$, $I_D=0$, $f=1MHz$	—	2	3	pF
Noise Figure	NF	$V_{DS}=5V$, $I_D=1mA$ $R_g=1k\Omega$, $f=1kHz$	—	0.5	3	dB

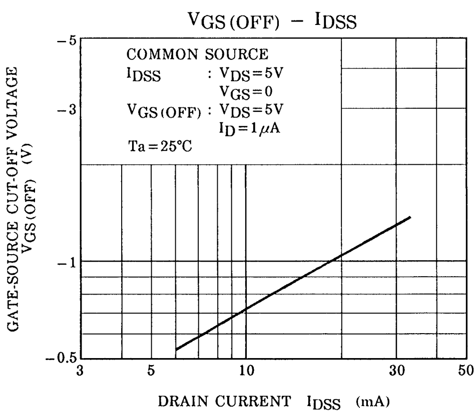
(Note) : I_{DSS} Classification GR : 6~12mA, BL : 10~20mA, V : 16~32mA

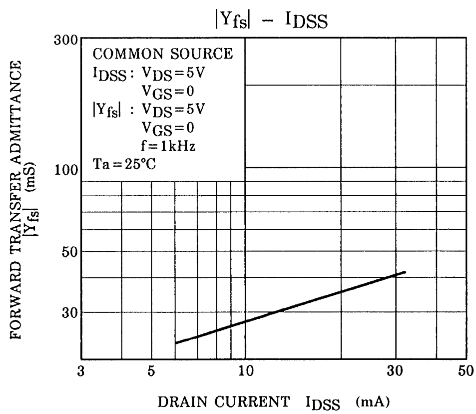

ID – VDS
COMMON SOURCE
Ta=25°C
VGS=0V
−0.1
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
DRAIN CURRENT ID (mA)
DRAIN-SOURCE VOLTAGE VDS (V)

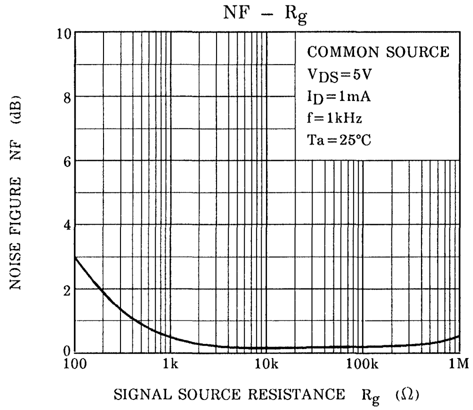

ID – VDS (LOW VOLTAGE REGION)
COMMON SOURCE
Ta=25°C
VGS=0V
−0.1
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
DRAIN CURRENT ID (mA)
DRAIN-SOURCE VOLTAGE VDS (V)

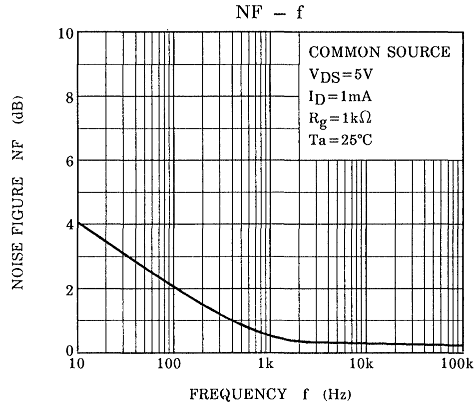

ID – VGS
COMMON SOURCE
VDS=5V
Ta=25°C
IDSS=23mA
19
15
11.5
7
DRAIN CURRENT ID (mA)
GATE-SOURCE VOLTAGE VGS (V)

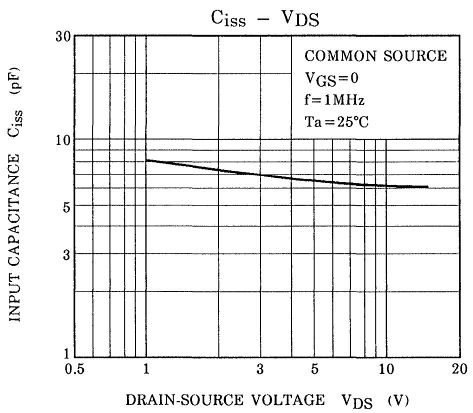

|Yfs| – ID
IDSS=30mA
15
6
COMMON SOURCE
VDS=5V
f=1kHz
Ta=25°C
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)
DRAIN CURRENT ID (mA)

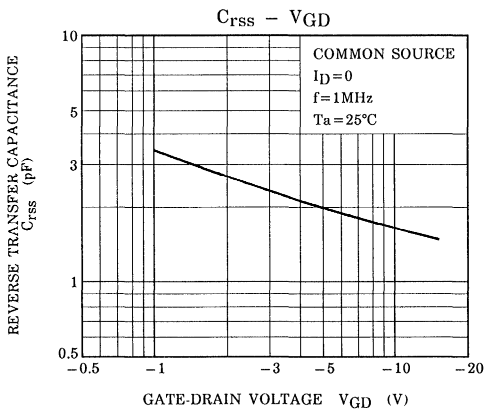

VGS(OFF) – IDSS
COMMON SOURCE
IDSS : VDS=5V
VGS=0
VGS(OFF) : VDS=5V
ID=1μA
Ta=25°C
GATE-SOURCE CUT-OFF VOLTAGE VGS(OFF) (V)
DRAIN CURRENT IDSS (mA)

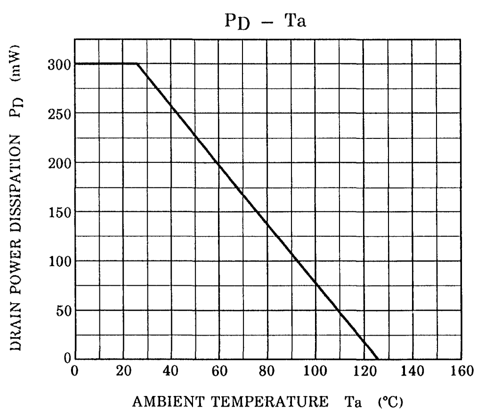

|Yfs| – IDSS
COMMON SOURCE
IDSS : VDS=5V
VGS=0
|Yfs| : VDS=5V
VGS=0
f=1kHz
Ta=25°C
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)
DRAIN CURRENT IDSS (mA)


NF – Rg
COMMON SOURCE
VDS=5V
ID=1mA
f=1kHz
Ta=25°C
NOISE FIGURE NF (dB)
10
8
6
4
2
0
100
1k
10k
100k
1M
SIGNAL SOURCE RESISTANCE Rg (Ω)


NF – f
COMMON SOURCE
VDS=5V
ID=1mA
Rg=1kΩ
Ta=25°C
NOISE FIGURE NF (dB)
10
8
6
4
2
0
10
100
1k
10k
100k
FREQUENCY f (Hz)


Ciss – VDS
COMMON SOURCE
VGS=0
f=1MHz
Ta=25°C
INPUT CAPACITANCE Ciss (pF)
30
10
5
3
1
0.5
1
3
5
10
20
DRAIN-SOURCE VOLTAGE VDS (V)


Crss – VGD
COMMON SOURCE
ID=0
f=1MHz
Ta=25°C
REVERSE TRANSFER CAPACITANCE Crss (pF)
10
5
3
1
0.5
–0.5
–1
–3
–5
–10
–20
GATE-DRAIN VOLTAGE VGD (V)

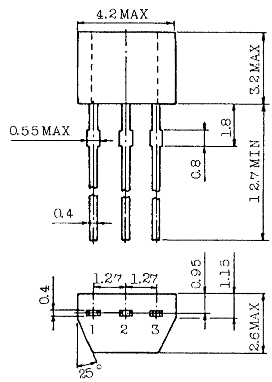

PD – Ta
DRAIN POWER DISSIPATION PD (mW)
300
250
200
150
100
50
0
0
20
40
60
80
100
120
140
160
AMBIENT TEMPERATURE Ta (°C)

SILICON N CHANNEL JUNCTION TYPE FIELD EFFECT TRANSISTOR

2SK710

HIGH FREQUENCY AMPLIFIER APPLICATIONS.
AM HIGH FREQUENCY AMPLIFIER APPLICATIONS.
AUDIO FREQUENCY AMPLIFIER APPLICATIONS.

Unit in mm



MINI	1. DRAIN 2. GATE 3. SOURCE
JEDEC	—
EIAJ	—
TOSHIBA	2-4E1C

Weight : 0.13g

- High $|Y_{fs}|$: $|Y_{fs}|=25mS$ (Typ.)
- Low C_{iss} : $C_{iss}=7.5pF$ (Typ.)
- Low Noise

MAXIMUM RATINGS (Ta = 25°C)

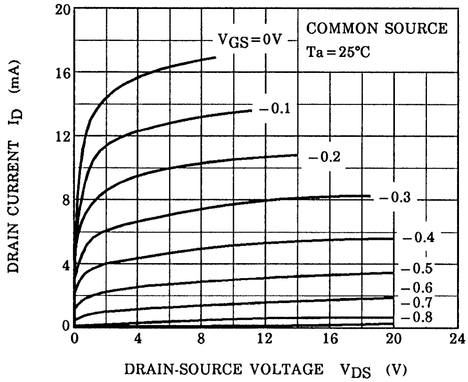
CHARACTERISTIC	SYMBOL	RATING	UNIT
Gate-Drain Voltage	V_{GDS}	−20	V
Gate Current	I_G	100	mA
Drain Power Dissipation	P_D	200	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

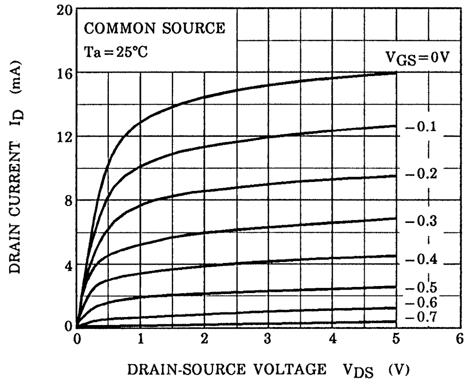
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate Leakage Current	I_{GSS}	$V_{GS}=-15V$, $V_{DS}=0$	—	—	−1.0	nA
Gate-Drain Breakdown Voltage	$V_{(BR)GDS}$	$V_{DS}=0$, $I_G=-100\mu A$	−20	—	—	V
Drain Current	I_{DSS} (Note)	$V_{DS}=5V$, $V_{GS}=0$	6	—	32	mA
Gate-Source Cut-off Voltage	$V_{GS(OFF)}$	$V_{DS}=5V$, $I_D=1\mu A$	—	—	−2.5	V
Forward Transfer Admittance	$\lvert Y_{fs}\rvert$	$V_{DS}=5V$, $V_{GS}=0$, $f=1kHz$	15	25	—	mS
Input Capacitance	C_{iss}	$V_{DS}=5V$, $V_{GS}=0$, $f=1MHz$	—	7.5	10	pF
Reverse Transfer Capacitance	C_{rss}	$V_{DG}=5V$, $I_D=0$, $f=1MHz$	—	2	3	pF
Noise Figure	NF	$V_{DS}=5V$, $I_D=1mA$ $R_g=1k\Omega$, $f=1kHz$	—	0.5	3	dB

(Note) : I_{DSS} Classification GR : 6~12mA, BL : 10~20mA, V : 16~32mA

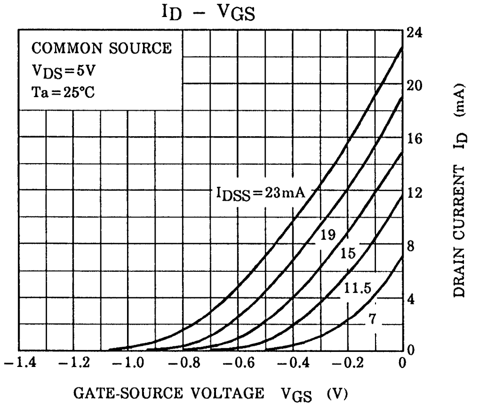
$I_D - V_{DS}$



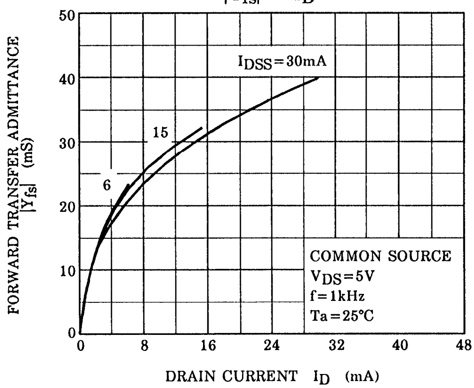
$I_D - V_{DS}$ (LOW VOLTAGE REGION)



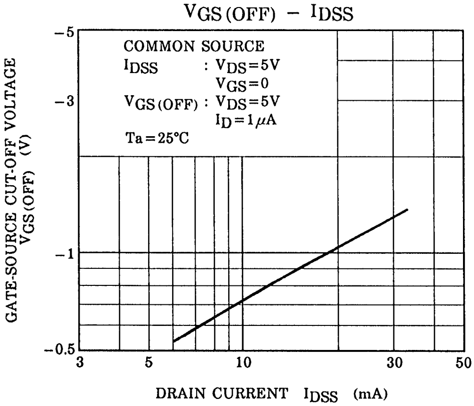
$I_D - V_{GS}$



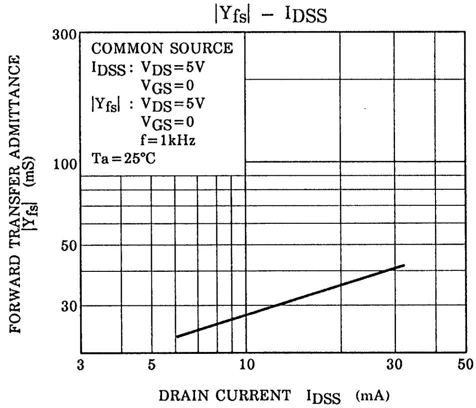
$|Y_{fs}| - I_D$

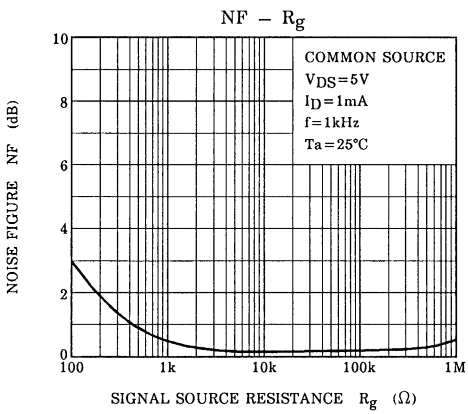


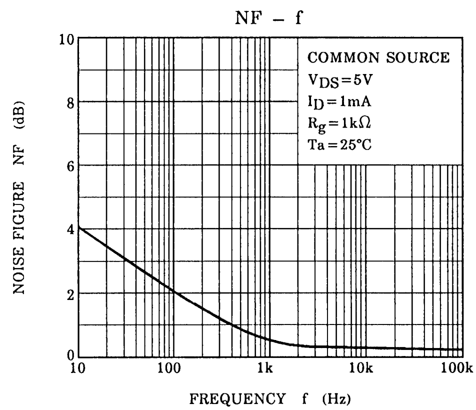
$V_{GS(OFF)} - I_{DSS}$

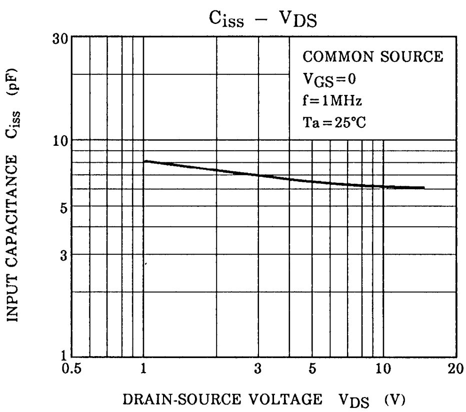


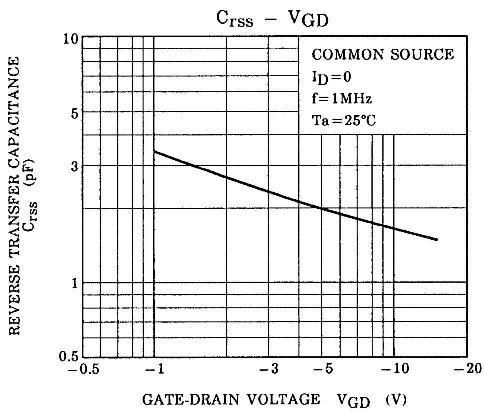
$|Y_{fs}| - I_{DSS}$

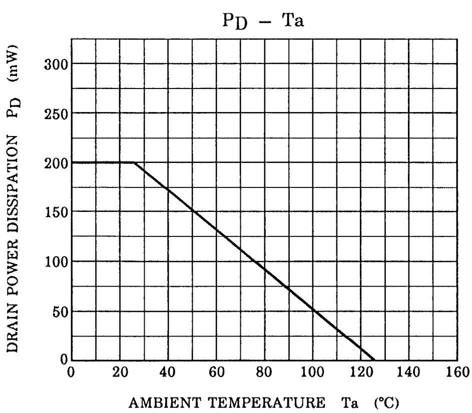



NF – Rg
COMMON SOURCE
VDS=5V
ID=1mA
f=1kHz
Ta=25°C
NOISE FIGURE NF (dB)
SIGNAL SOURCE RESISTANCE Rg (Ω)
0
2
4
6
8
10
100
1k
10k
100k
1M


NF – f
COMMON SOURCE
VDS=5V
ID=1mA
Rg=1kΩ
Ta=25°C
NOISE FIGURE NF (dB)
FREQUENCY f (Hz)
0
2
4
6
8
10
10
100
1k
10k
100k


Ciss – VDS
COMMON SOURCE
VGS=0
f=1MHz
Ta=25°C
INPUT CAPACITANCE Ciss (pF)
DRAIN-SOURCE VOLTAGE VDS (V)
1
3
5
10
30
0.5
1
3
5
10
20


Crss – VGD
COMMON SOURCE
ID=0
f=1MHz
Ta=25°C
REVERSE TRANSFER CAPACITANCE Crss (pF)
GATE-DRAIN VOLTAGE VGD (V)
0.5
1
3
5
10
−0.5
−1
−3
−5
−10
−20


PD – Ta
DRAIN POWER DISSIPATION PD (mW)
AMBIENT TEMPERATURE Ta (°C)
0
50
100
150
200
250
300
0
20
40
60
80
100
120
140
160

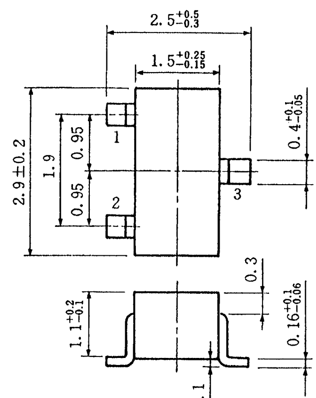
2SK711

SILICON N CHANNEL JUNCTION TYPE
FIELD EFFECT TRANSISTOR

HIGH FREQUENCY AMPLIFIER APPLICATIONS.
AM HIGH FREQUENCY AMPLIFIER APPLICATIONS.
AUDIO FREQUENCY AMPLIFIER APPLICATIONS.

- High $|Y_{fs}|$: $|Y_{fs}|$ = 25mS (Typ.)
- Low C_{iss} : C_{iss} = 7.5pF (Typ.)

Unit in mm



1. SOURCE
2. DRAIN
3. GATE

JEDEC	TO-236MOD
EIAJ	SC-59
TOSHIBA	2-3F1B

Weight : 0.012g

MAXIMUM RATINGS (Ta = 25°C)

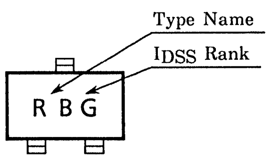
CHARACTERISTIC	SYMBOL	RATING	UNIT
Gate-Drain Voltage	V_{GDS}	−20	V
Gate Current	I_G	10	mA
Drain Power Dissipation	P_D	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

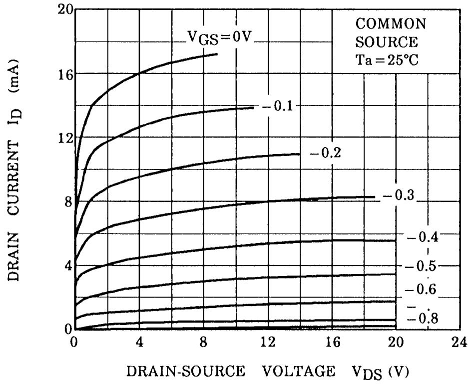
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate Leakage Current	I_{GSS}	$V_{GS}=-15V$, $V_{DS}=0V$	—	—	−1.0	nA
Gate-Drain Breakdown Voltage	$V_{(BR)GDS}$	$V_{DS}=0V$, $I_G=-100\mu A$	−20	—	—	V
Drain Current	I_{DSS} (Note)	$V_{DS}=5V$, $V_{GS}=0V$	6	—	32	mA
Gate-Source Cut-off Voltage	$V_{GS(OFF)}$	$V_{DS}=5V$, $I_D=1\mu A$	—	—	−2.5	V
Forward Transfer Admittance	$\|Y_{fs}\|$	$V_{DS}=5V$, $V_{GS}=0V$, f=1kHz	15	25	—	mS
Input Capacitance	C_{iss}	$V_{DS}=5V$, $V_{GS}=0V$, f=1MHz	—	7.5	10	pF
Reverse Transfer Capacitance	C_{rss}	$V_{DS}=5V$, $I_D=0mA$, f=1MHz	—	2	3	pF

Note : I_{DSS} Classification
GR : 6~12mA, BL : 10~20mA, V : 16~32mA
(G) (L) (V)
( ) ··· I_{DSS} Rank Markng

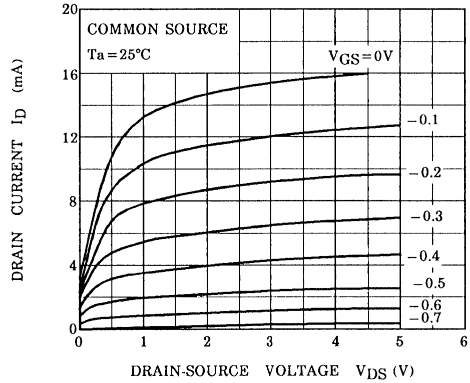
Marking



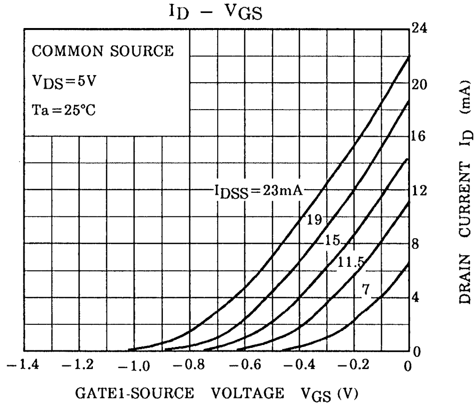
$I_D - V_{DS}$



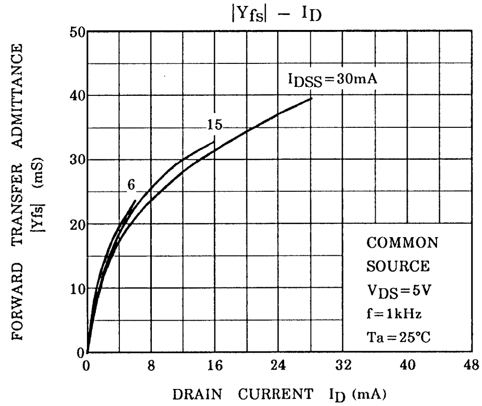
$I_D - V_{DS}$ (LOW VOLTAGE REGION)



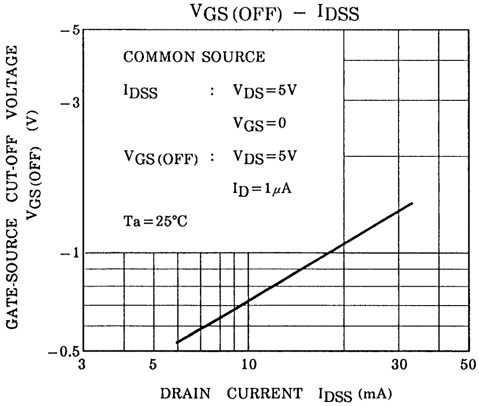
$I_D - V_{GS}$



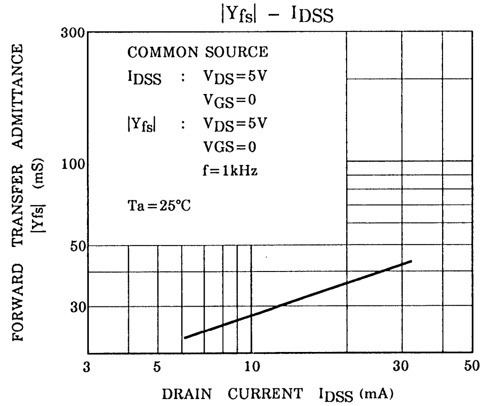
$|Y_{fs}| - I_D$

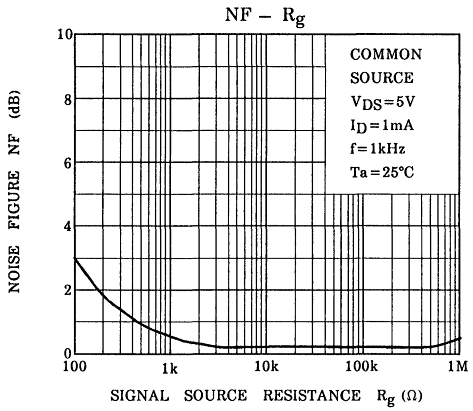


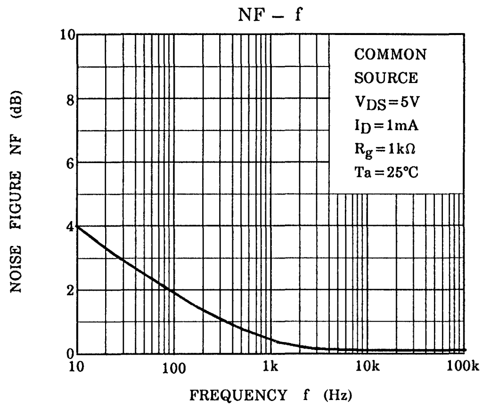
$V_{GS(OFF)} - I_{DSS}$

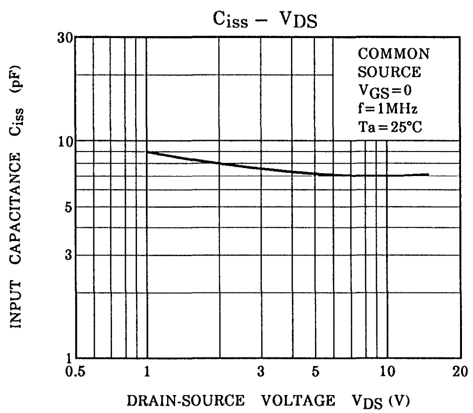


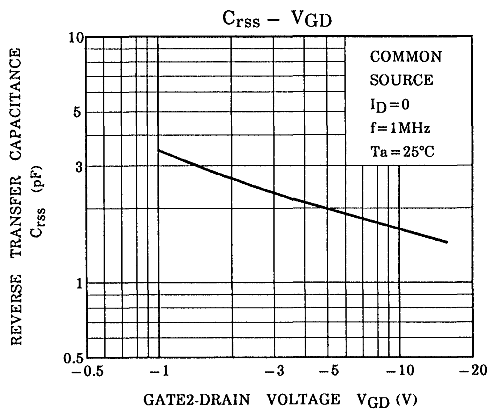
$|Y_{fs}| - I_{DSS}$

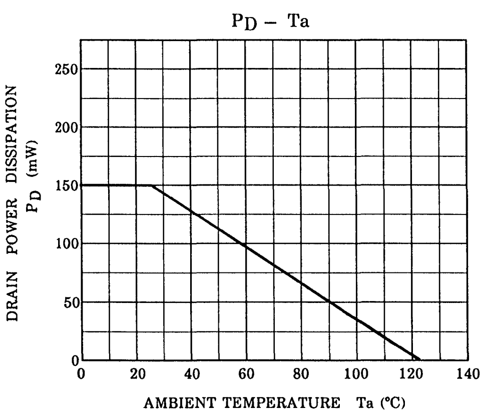



NF – Rg
COMMON SOURCE
VDS=5V
ID=1mA
f=1kHz
Ta=25°C
NOISE FIGURE NF (dB)
SIGNAL SOURCE RESISTANCE Rg (Ω)
100
1k
10k
100k
1M


NF – f
COMMON SOURCE
VDS=5V
ID=1mA
Rg=1kΩ
Ta=25°C
NOISE FIGURE NF (dB)
FREQUENCY f (Hz)


Ciss – VDS
COMMON SOURCE
VGS=0
f=1MHz
Ta=25°C
INPUT CAPACITANCE Ciss (pF)
DRAIN-SOURCE VOLTAGE VDS (V)


Crss – VGD
COMMON SOURCE
ID=0
f=1MHz
Ta=25°C
REVERSE TRANSFER CAPACITANCE Crss (pF)
GATE2-DRAIN VOLTAGE VGD (V)

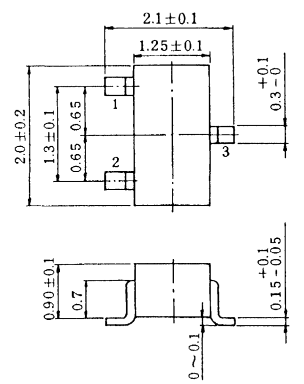

PD – Ta
DRAIN POWER DISSIPATION PD (mW)
AMBIENT TEMPERATURE Ta (°C)

SILICON N CHANNEL JUNCTION TYPE FIELD EFFECT TRANSISTOR

2SK881

FM TUNER APPLICATIONS.
VHF BAND AMPLIFIER APPLICATIONS.

Unit in mm



1. DRAIN
2. GATE
3. SOURCE

JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1C

Weight : 0.006g

- Low Noise Figure : NF = 2.5dB (Typ.) (f = 100MHz)
- High Forward Transfer Admittance
  : $|y_{fs}|$ = 9mS (Typ.)

MAXIMUM RATINGS (Ta = 25°C)

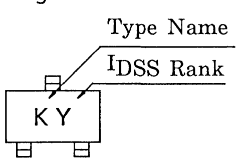
CHARACTERISTIC	SYMBOL	RATING	UNIT
Gate-Drain Voltage	V_{GDO}	−18	V
Gate Current	I_G	10	mA
Drain Power Dissipation	P_D	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

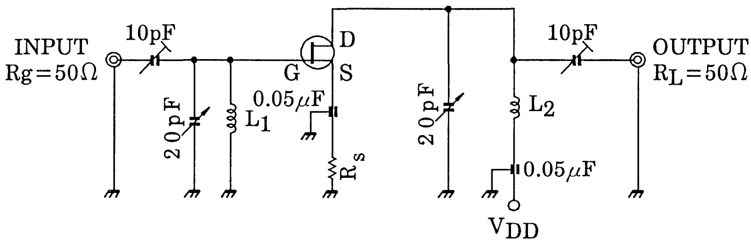
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate Leakage Current	I_{GSS}	$V_{GS} = -0.5V$, $V_{DS} = 0$	—	—	−10	nA
Gate-Drain Breakdown Voltage	$V_{(BR)GDO}$	$I_G = -10\mu A$	−18	—	—	V
Drain Current	I_{DSS} (Note)	$V_{GS} = 0$, $V_{DS} = 10V$	1.0	—	10	mA
Gate-Source Cut-off Voltage	$V_{GS(OFF)}$	$V_{DS} = 10V$, $I_D = 1\mu A$	−0.4	—	−4.0	V
Forward Transfer Admittance	$\|y_{fs}\|$	$V_{GS} = 0$, $V_{DS} = 10V$, f = 1kHz	—	9	—	mS
Input Capacitance	C_{iss}	$V_{DS} = 10V$, $V_{GS} = 0$, f = 1MHz	—	6.0	—	pF
Reverse Transfer Capacitance	C_{rss}	$V_{DS} = 10V$, $V_{GS} = 0$, f = 1MHz	—	–	0.15	pF
Power Gain	G_{ps}	$V_{DD} = 10V$, f = 100MHz (Fig.1)	10	18	—	dB
Noise Figure	NF	$V_{DD} = 10V$, f = 100MHz (Fig.1)	—	2.5	3.5	dB

Note : I_{DSS} Classification O : 1.0~3.0, Y : 2.5~6.0, GR : 5.0~10.0

Marking



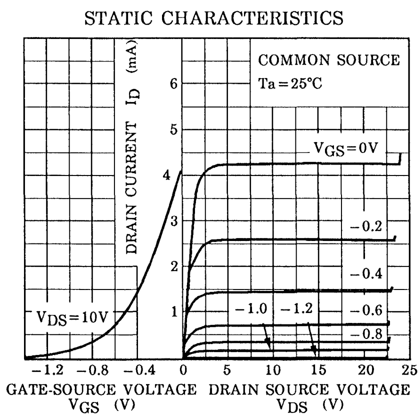


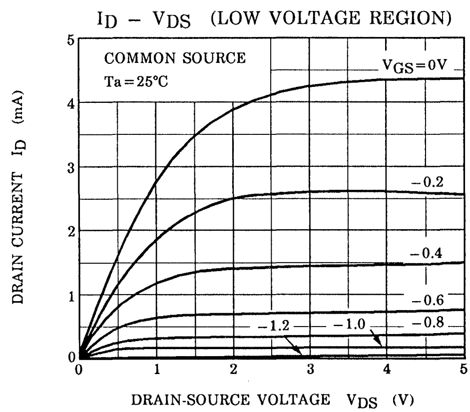
L_1 : 0.8mmϕ Ag PLATED Cu WIRE, 3. TURNS, 10mm ID, 10mm LENGTH.
L_2 : 0.8mmϕ Ag PLATED Cu WIRE, 3.5 TURNS, 10mm ID, 10mm LENGTH.

Fig.1 100MHz G_{PS}, NF TEST CIRCUIT

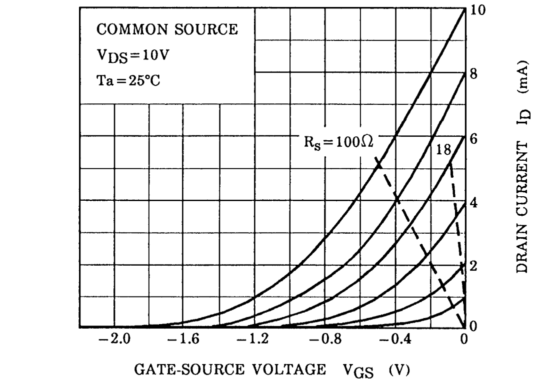
2SK881 is measured at each group by changing R_S.

GROUP	R_S (Ω)
2SK881-O	0
2SK881-Y	18Ω±5%
2SK881-GR	100Ω±5%

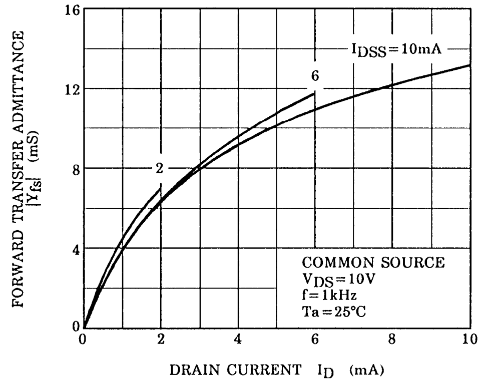




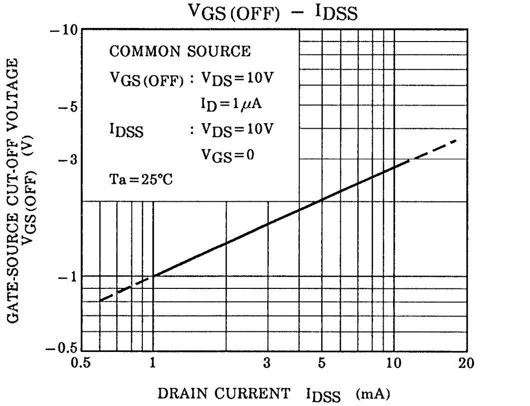
$I_D - V_{GS}$



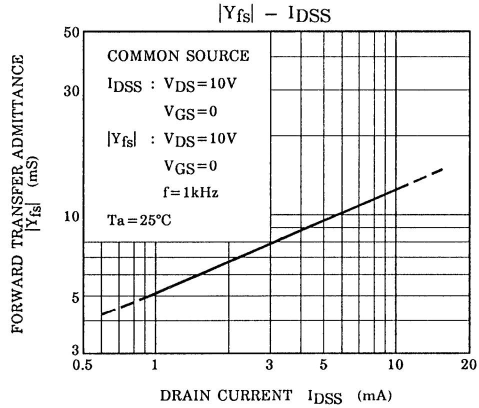
$|Y_{fs}| - I_D$



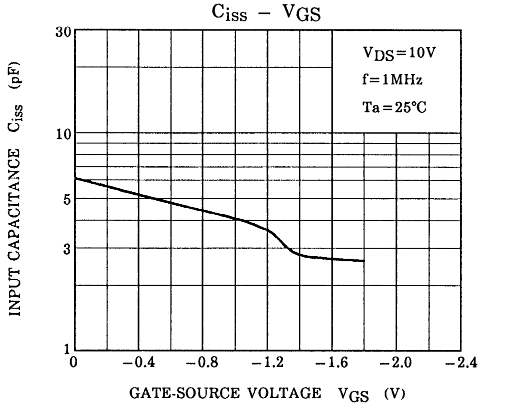
$V_{GS(OFF)} - I_{DSS}$



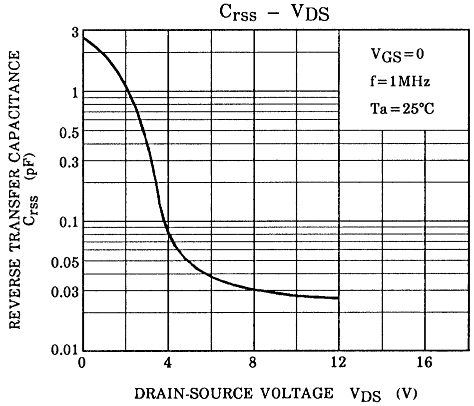
$|Y_{fs}| - I_{DSS}$

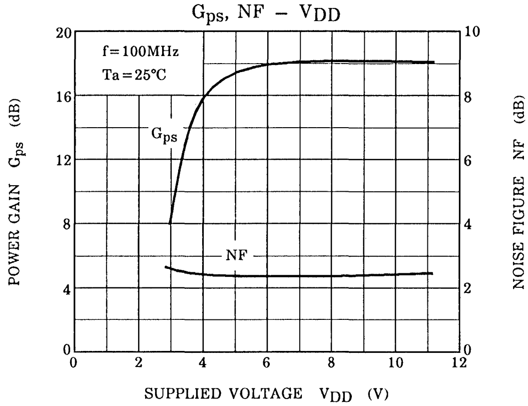


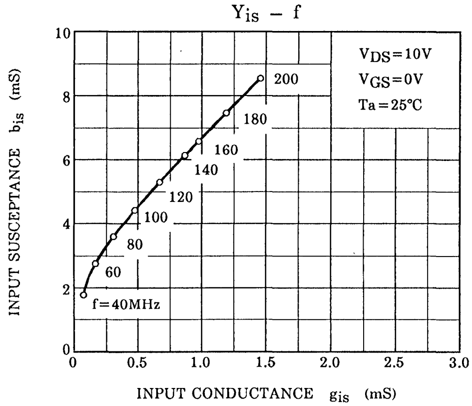
$C_{iss} - V_{GS}$

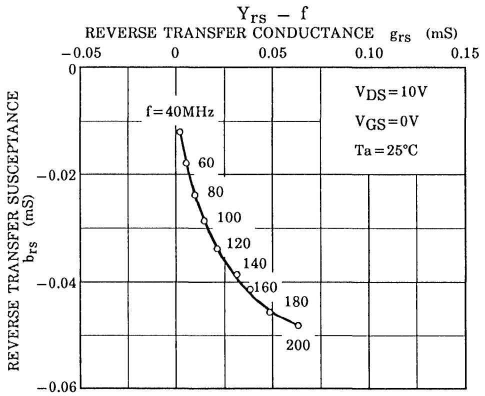


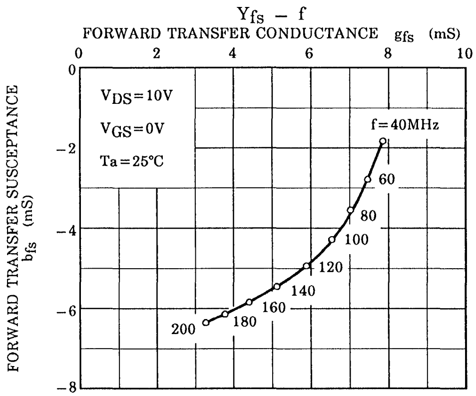
$C_{rss} - V_{DS}$

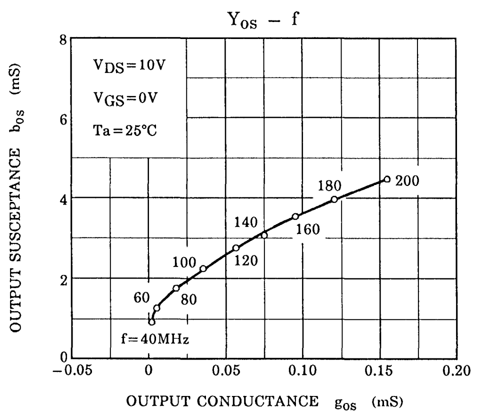


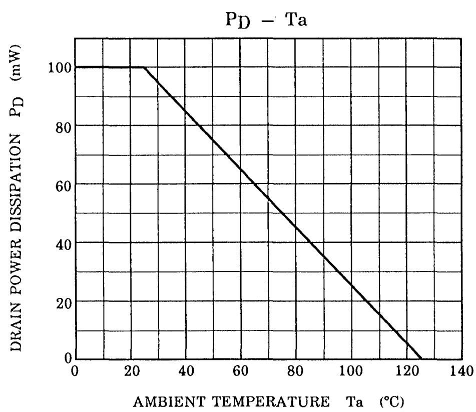

Gps, NF – VDD
f=100MHz
Ta=25°C
Gps
NF
POWER GAIN Gps (dB)
NOISE FIGURE NF (dB)
SUPPLIED VOLTAGE VDD (V)
20
16
12
8
4
0
10
8
6
4
2
0
0 2 4 6 8 10 12


Yis – f
VDS=10V
VGS=0V
Ta=25°C
f=40MHz
60
80
100
120
140
160
180
200
INPUT SUSCEPTANCE bis (mS)
INPUT CONDUCTANCE gis (mS)
10
8
6
4
2
0
0 0.5 1.0 1.5 2.0 2.5 3.0


Yrs – f
REVERSE TRANSFER CONDUCTANCE grs (mS)
−0.05 0 0.05 0.10 0.15
VDS=10V
VGS=0V
Ta=25°C
f=40MHz
60
80
100
120
140
160
180
200
REVERSE TRANSFER SUSCEPTANCE brs (mS)
0
−0.02
−0.04
−0.06


Yfs – f
FORWARD TRANSFER CONDUCTANCE gfs (mS)
0 2 4 6 8 10
VDS=10V
VGS=0V
Ta=25°C
f=40MHz
60
80
100
120
140
160
180
200
FORWARD TRANSFER SUSCEPTANCE bfs (mS)
0
−2
−4
−6
−8


Yos – f
VDS=10V
VGS=0V
Ta=25°C
f=40MHz
60
80
100
120
140
160
180
200
OUTPUT SUSCEPTANCE bos (mS)
OUTPUT CONDUCTANCE gos (mS)
8
6
4
2
0
−0.05 0 0.05 0.10 0.15 0.20


PD – Ta
DRAIN POWER DISSIPATION PD (mW)
AMBIENT TEMPERATURE Ta (°C)
100
80
60
40
20
0
0 20 40 60 80 100 120 140

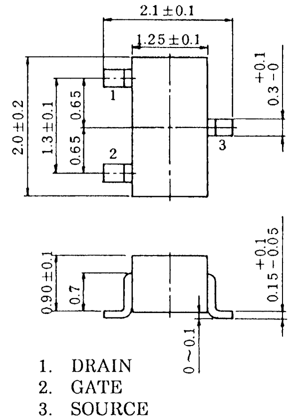
SILICON N CHANNEL MOS TYPE FIELD EFFECT TRANSISTOR

2SK882

FM TUNER, VHF RF AMPLIFIER APPLICATIONS.

- Low Reverse Transfer Capacitance : $C_{rss}=0.025pF$ (Typ.)
- Low Noise Figure : NF=1.7dB (Typ.)
- High Power Gain : $G_{ps}=28dB$ (Typ.)
- Recommend Operation Voltage : 5~15V

Unit in mm



USM	
JEDEC	—
EIAJ	SC-70
TOSHIBA	2-2E1C

Weight : 0.006g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Drain-Source Voltage	V_{DS}	20	V
Gate-Source Voltage	V_{GS}	±5	V
Drain Current	I_D	30	mA
Drain Power Dissipation	P_D	100	mW
Channel Temperature	Tch	125	°C
Storage Temperature	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate Leakage Current	I_{GSS}	$V_{DS}=0$, $V_{GS}=\pm5V$	—	—	±50	nA
Drain-Source Voltage	V_{DSX}	$V_{GS}=-4V$, $I_D=100\mu A$	20	—	—	V
Drain Current	I_{DSS} (Note)	$V_{DS}=10V$, $V_{GS}=0$	3	—	14	mA
Gate-Source Cut-off Voltage	$V_{GS(OFF)}$	$V_{DS}=10V$, $I_D=100\mu A$	—	—	−2.5	V
Forward Transfer Admittance	$\lvert Y_{fs}\rvert$	$V_{DS}=10V$, $V_{GS}=0$, f=1kHz	—	10	—	mS
Input Capacitance	C_{iss}	$V_{DS}=10V$, $V_{GS}=0$, f=1MHz	—	3.0	4.3	pF
Reverse Transfer Capacitance	C_{rss}		—	0.025	0.04	pF
Power Gain	G_{ps}	$V_{DD}=10V$, f=100MHz (Fig.1)	20	28	—	dB
Noise Figure	NF		—	1.7	3.0	dB

Note : I_{DSS} Classification Y : 3.0~7.0mA GR : 6.0~14.0mA

Marking

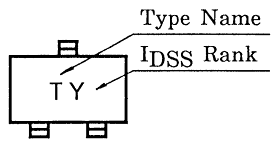
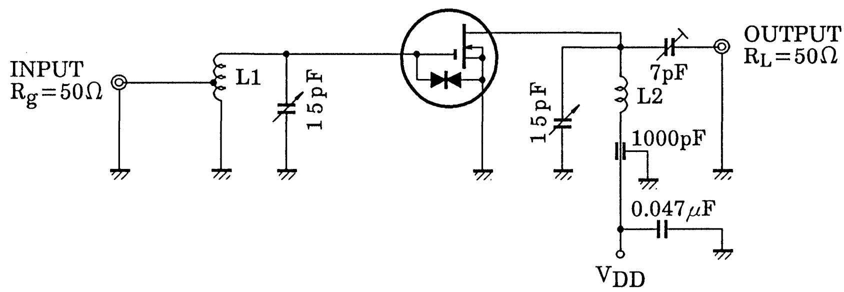
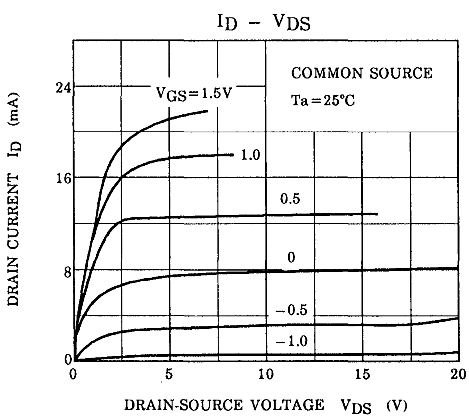


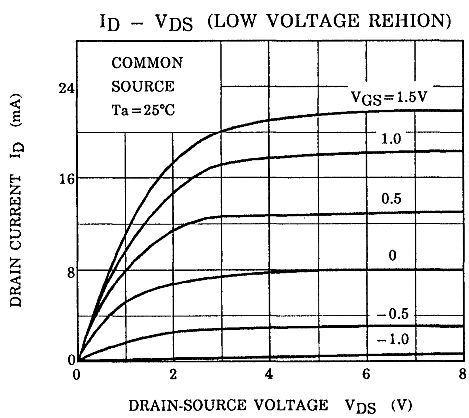
Fig.1 : G_{ps}, NF TEST CIRCUIT



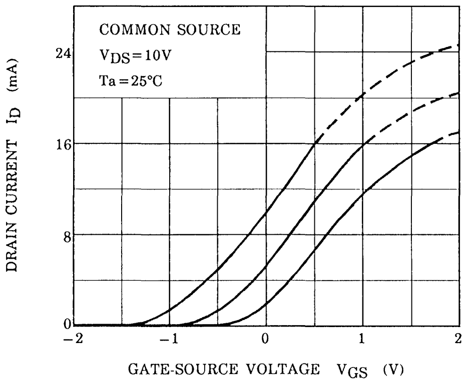
L1 : 1.0mmϕ SILVER PLATED COPPER WIRE
4.0T, 8mmϕ ID
TAP at 1.0T FROM COIL END

L2 : 1.0mmϕ SILVER PLATED COPPER WIRE
3.0T, 8mmϕ ID, 10mm LENGTH

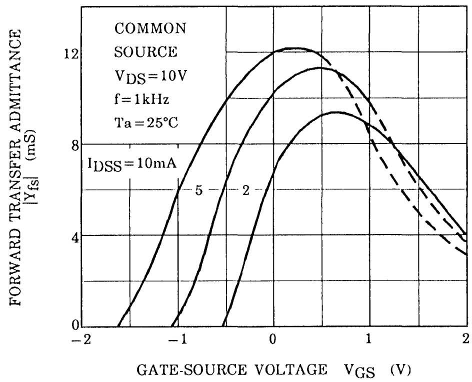




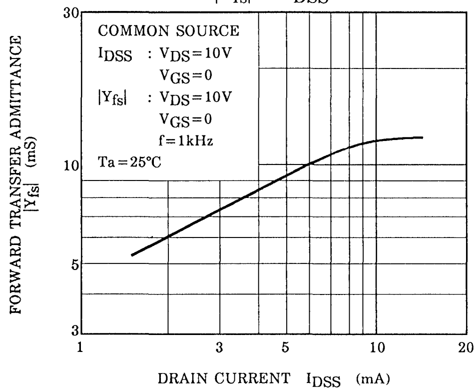
$I_D - V_{GS}$



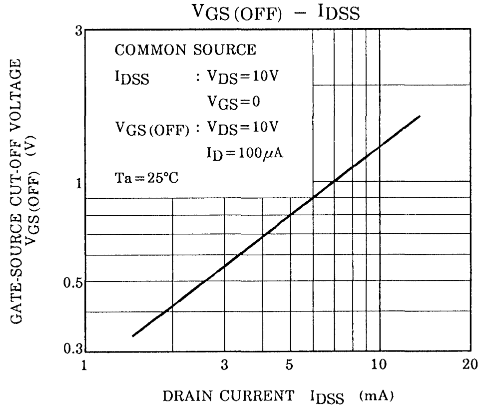
$|Y_{fs}| - V_{GS}$



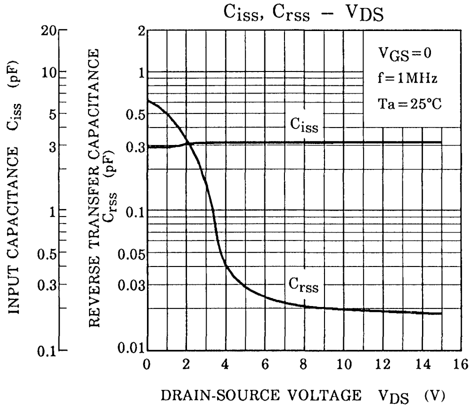
$|Y_{fs}| - I_{DSS}$



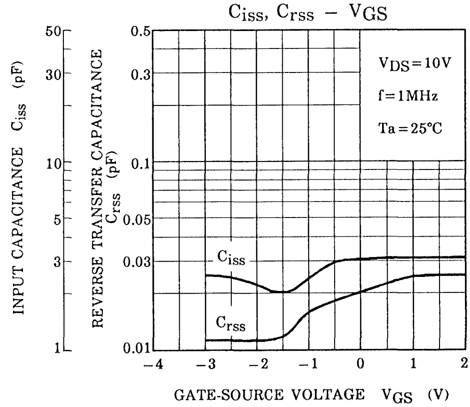
$V_{GS(OFF)} - I_{DSS}$

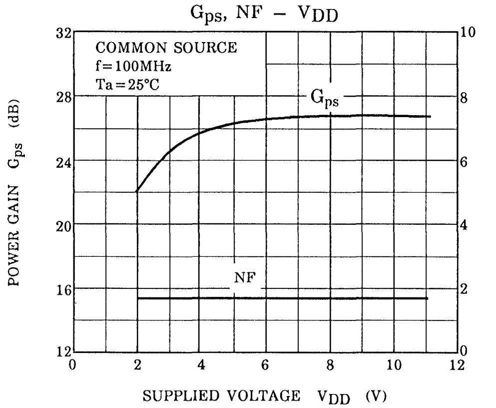


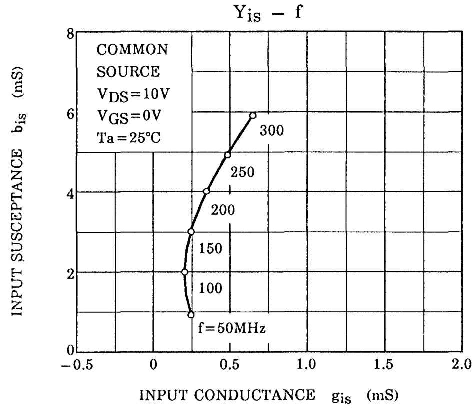
$C_{iss}, C_{rss} - V_{DS}$

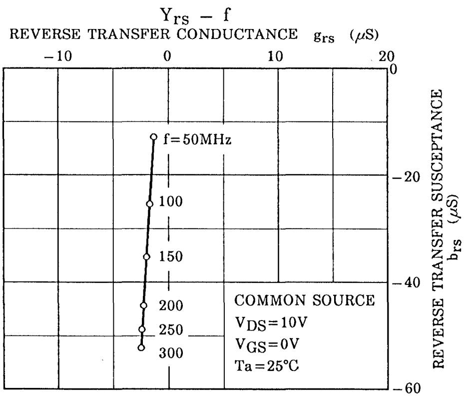


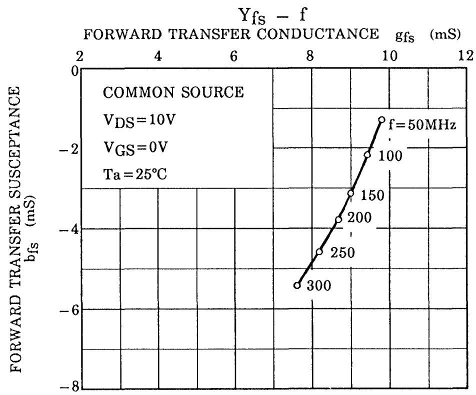
$C_{iss}, C_{rss} - V_{GS}$

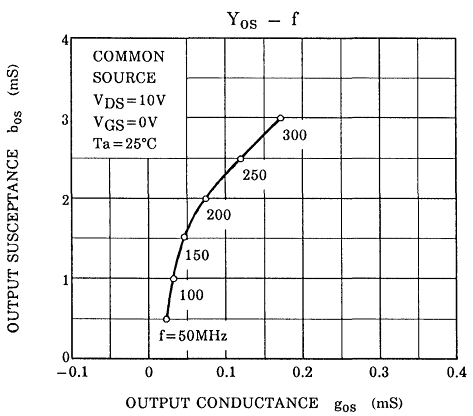


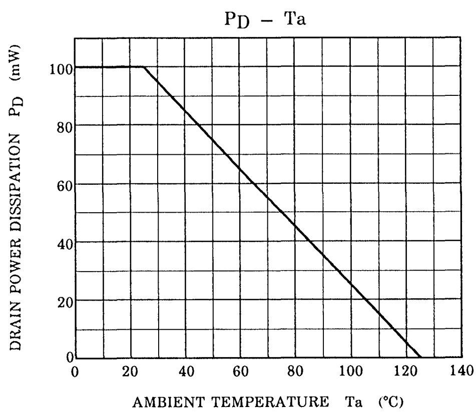

G_{ps}, NF – V_{DD}
COMMON SOURCE
f=100MHz
Ta=25°C
G_{ps}
NF
POWER GAIN G_{ps} (dB)
NOISE FIGURE NF (dB)
SUPPLIED VOLTAGE V_{DD} (V)
32
28
24
20
16
12
10
8
6
4
2
0
0
2
4
6
8
10
12


Y_{is} – f
COMMON
SOURCE
V_{DS}=10V
V_{GS}=0V
Ta=25°C
300
250
200
150
100
f=50MHz
INPUT SUSCEPTANCE b_{is} (mS)
INPUT CONDUCTANCE g_{is} (mS)
8
6
4
2
0
−0.5
0
0.5
1.0
1.5
2.0


Y_{rs} – f
REVERSE TRANSFER CONDUCTANCE g_{rs} (μS)
−10
0
10
20
f=50MHz
100
150
200
250
300
COMMON SOURCE
V_{DS}=10V
V_{GS}=0V
Ta=25°C
REVERSE TRANSFER SUSCEPTANCE b_{rs} (μS)
0
−20
−40
−60


Y_{fs} – f
FORWARD TRANSFER CONDUCTANCE g_{fs} (mS)
2
4
6
8
10
12
COMMON SOURCE
V_{DS}=10V
V_{GS}=0V
Ta=25°C
f=50MHz
100
150
200
250
300
FORWARD TRANSFER SUSCEPTANCE b_{fs} (mS)
0
−2
−4
−6
−8


Y_{os} – f
COMMON
SOURCE
V_{DS}=10V
V_{GS}=0V
Ta=25°C
300
250
200
150
100
f=50MHz
OUTPUT SUSCEPTANCE b_{os} (mS)
OUTPUT CONDUCTANCE g_{os} (mS)
4
3
2
1
0
−0.1
0
0.1
0.2
0.3
0.4

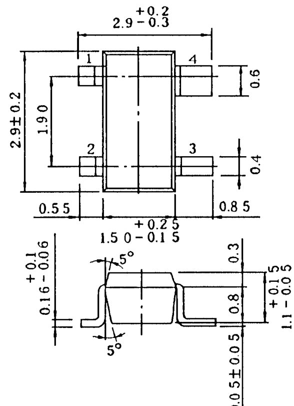

P_D – Ta
DRAIN POWER DISSIPATION P_D (mW)
AMBIENT TEMPERATURE Ta (°C)
100
80
60
40
20
0
0
20
40
60
80
100
120
140

SILICON N CHANNEL MOS TYPE FIELD EFFECT TRANSISTOR

2SK1771

FM TUNER, VHF RF AMPLIFIER APPLICATIONS.

Unit in mm



SMQ
1. GATE
2. OPEN
3. DRAIN
4. SOURCE

JEDEC	—
EIAJ	—
TOSHIBA	2-3J1D

Weight : 0.013g

- Superior Inter Modulation Performance.
- Low Noise Figure. : NF = 1.0dB (Typ.)

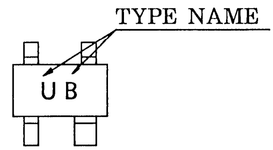
MAXIMUM RATINGS (Ta = 25°C)

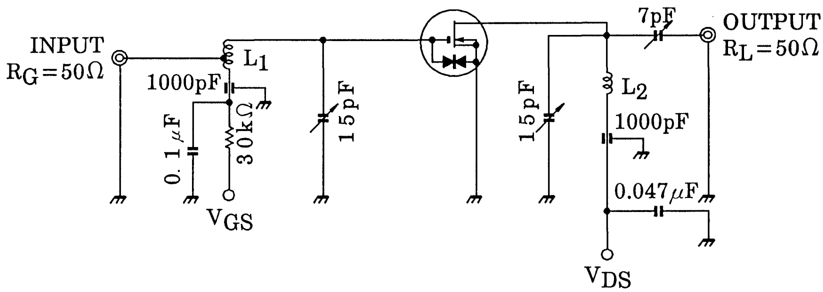
CHARACTERISTIC	SYMBOL	RATING	UNIT
Drain-Source Voltage	V_{DS}	12.5	V
Gate-Source Voltage	V_{GS}	±8	V
Drain Current	I_D	30	mA
Drain Power Dissipation	P_D	150	mW
Chanel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate Leakage Current	I_{GSS}	$V_{DS}=0$, $V_{GS}=\pm6V$	—	—	±50	nA
Drain-Source Voltage	$V_{(BR)DSX}$	$V_{GS}=-4V$, $I_D=100\mu A$	12.5	—	—	V
Drain Current	I_{DSS}	$V_{DS}=8V$, $V_{GS}=0$	0	—	0.1	mA
Gate-Source Cut-off Voltage	$V_{GS(OFF)}$	$V_{DS}=8V$, $I_D=100\mu A$	0.5	1.0	1.5	V
Forward Transfer Admittance	$\|Y_{fs}\|$	$V_{DS}=8V$, $I_D=10mA$, f=1kHz	—	15	20	mS
Input Capacitance	C_{iss}	$V_{DS}=8V$, $I_D=10mA$, f=1MHz	2.9	3.5	4.1	pF
Reverse Transfer Capacitance	C_{rss}		—	0.3	0.8	pF
Power Gain	G_{ps}	$V_{DS}=8V$, $I_D=10mA$, f=100MHz	18	23	28	dB
Noise Figure	NF		—	1.0	2.2	dB

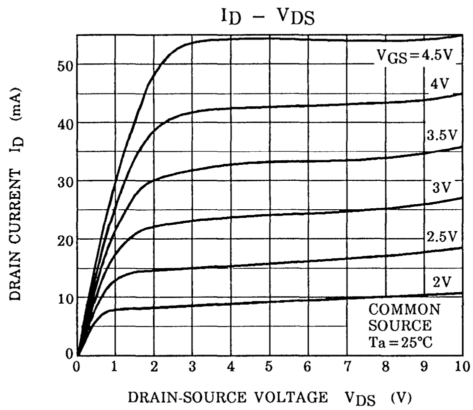
Marking



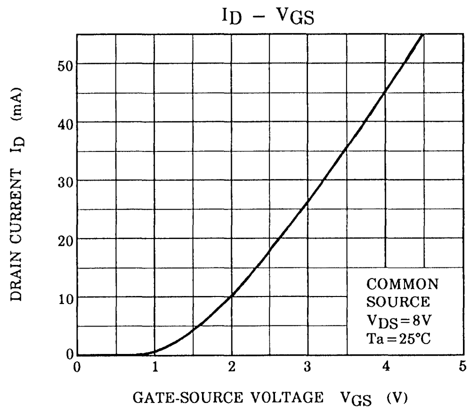


L_1 : 1.0mmϕ SILVER PLATED COPPER WIRE
4.0T, 8mmϕ ID
TAP at 1.0T FROM COIL END
L_2 : 1.0mmϕ SILVER PLATED COPPER WIRE
3.0T, 8mmϕ ID, 10mm LENGTH

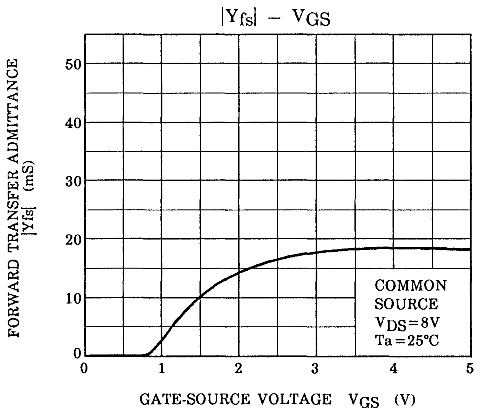
Fig.1 G_{ps}, NF TEST CIRCUIT



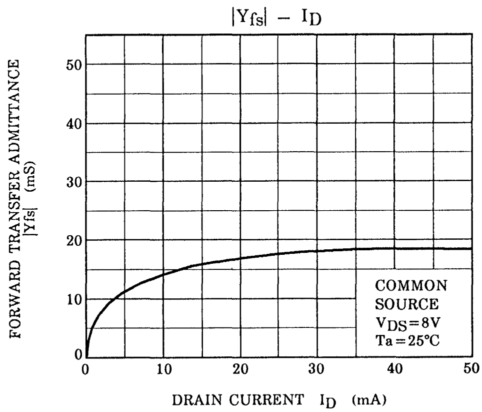
I_D – V_{DS}
DRAIN CURRENT I_D (mA)
DRAIN-SOURCE VOLTAGE V_{DS} (V)
V_{GS}=4.5V
4V
3.5V
3V
2.5V
2V
COMMON SOURCE Ta=25°C



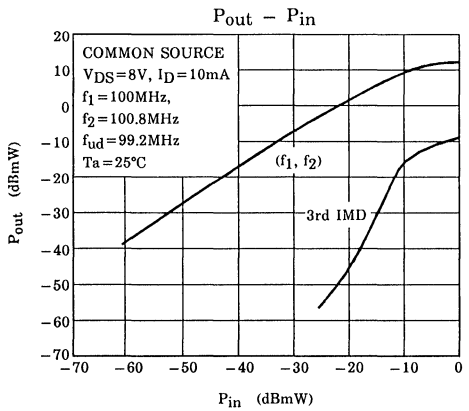
I_D – V_{GS}
DRAIN CURRENT I_D (mA)
GATE-SOURCE VOLTAGE V_{GS} (V)
COMMON SOURCE V_{DS}=8V Ta=25°C



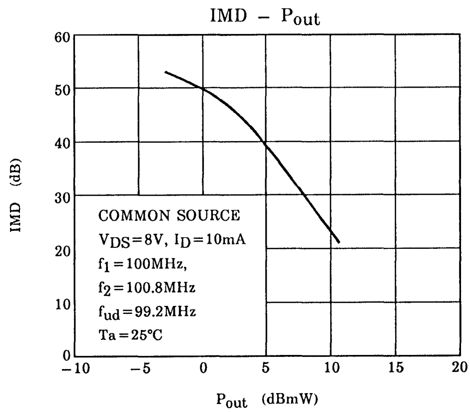
$|Y_{fs}|$ – V_{GS}
FORWARD TRANSFER ADMITTANCE $|Y_{fs}|$ (mS)
GATE-SOURCE VOLTAGE V_{GS} (V)
COMMON SOURCE V_{DS}=8V Ta=25°C



$|Y_{fs}|$ – I_D
FORWARD TRANSFER ADMITTANCE $|Y_{fs}|$ (mS)
DRAIN CURRENT I_D (mA)
COMMON SOURCE V_{DS}=8V Ta=25°C



P_{out} – P_{in}
P_{out} (dBmW)
P_{in} (dBmW)
COMMON SOURCE
V_{DS}=8V, I_D=10mA
f_1=100MHz,
f_2=100.8MHz
f_{ud}=99.2MHz
Ta=25°C
(f_1, f_2)
3rd IMD



IMD – P_{out}
IMD (dB)
P_{out} (dBmW)
COMMON SOURCE
V_{DS}=8V, I_D=10mA
f_1=100MHz,
f_2=100.8MHz
f_{ud}=99.2MHz
Ta=25°C

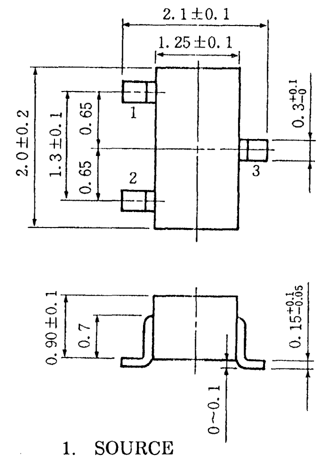
2SK1875

SILICON N CHANNEL JUNCTION TYPE
FIELD EFFECT TRANSISTOR

HIGH FREQUENCY AMPLIFIER APPLICATIONS.
AM HIGH FREQUENCY AMPLIFIER APPLICATIONS.
AUDIO FREQUENCY AMPLIFIER APPLICATIONS.

- High $|Y_{fs}|$: $|Y_{fs}|$ = 25mS (Typ.)
- Low C_{iss} : C_{iss} = 7.5pF (Typ.)

Unit in mm



1. SOURCE
2. DRAIN
3. GATE

JEDEC	—
EIAJ	—
TOSHIBA	2-2E1B

Weight : 0.006 g

MAXIMUM RATINGS (Ta = 25°C)

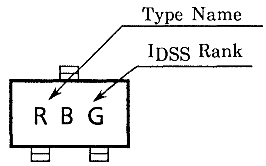
CHARACTERISTIC	SYMBOL	RATING	UNIT
Gate-Drain Voltage	V_{GDS}	−20	V
Gate Current	I_G	10	mA
Drain Power Dissipation	P_D	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

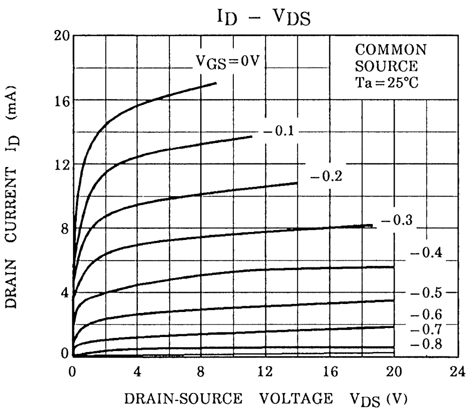
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

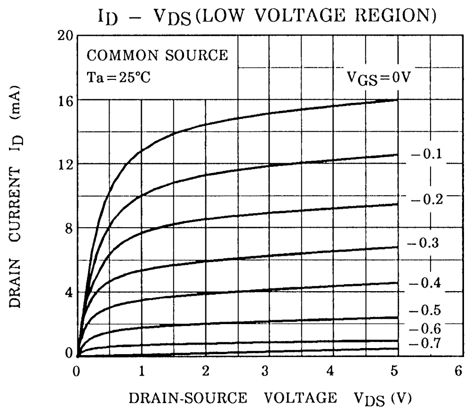
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate Leakage Current	I_{GSS}	V_{GS} = −15V, V_{DS} = 0V	—	—	−1.0	nA
Gate-Drain Breakdown Voltage	$V_{(BR)GDS}$	V_{DS} = 0V, I_G = −100μA	−20	—	—	V
Drain Current	I_{DSS} (Note)	V_{DS} = 5V, V_{GS} = 0V	6	—	32	mA
Gate-Source Cut-off Voltage	$V_{GS(OFF)}$	V_{DS} = 5V, I_D = 1μA	—	—	−2.5	V
Forward Transfer Admittance	$\|Y_{fs}\|$	V_{DS} = 5V, V_{GS} = 0V, f = 1kHz	15	25	—	mS
Input Capacitance	C_{iss}	V_{DS} = 5V, V_{GS} = 0V, f = 1MHz	—	7.5	10	pF
Reverse Transfer Capcitance	C_{rss}	V_{DG} = 5V, I_D = 0V, f = 1MHz	—	2	3	pF

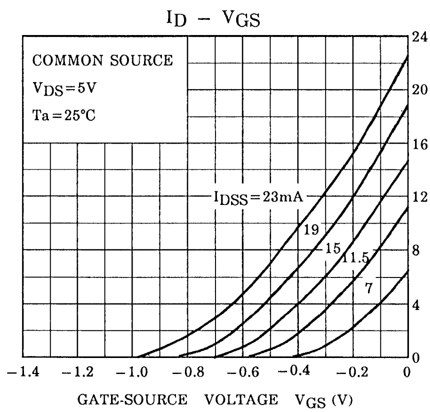
Note : I_{DSS} Classification
GR : 6~12mA, BL : 10~20mA, V : 16~32mA
(G) (L) (V)
( )····I_{DSS} Rank Marking

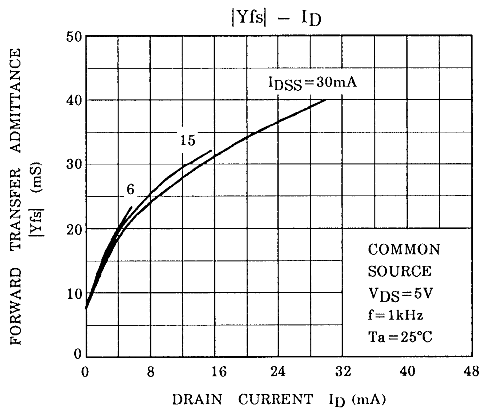
Marking

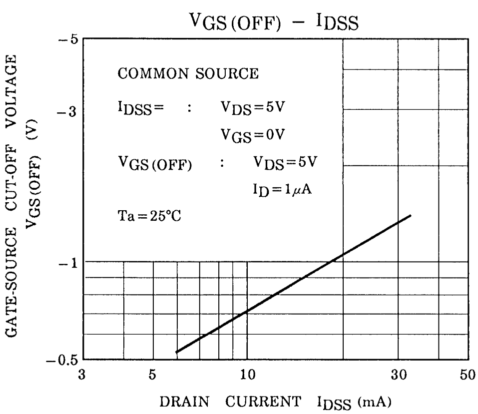


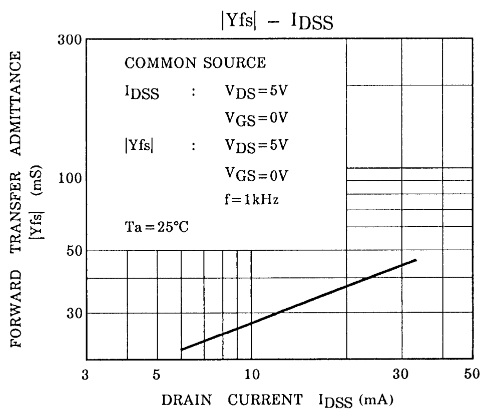

I_D – V_{DS}
COMMON SOURCE
Ta=25°C
V_{GS}=0V
−0.1
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
DRAIN CURRENT I_D (mA)
DRAIN-SOURCE VOLTAGE V_{DS} (V)

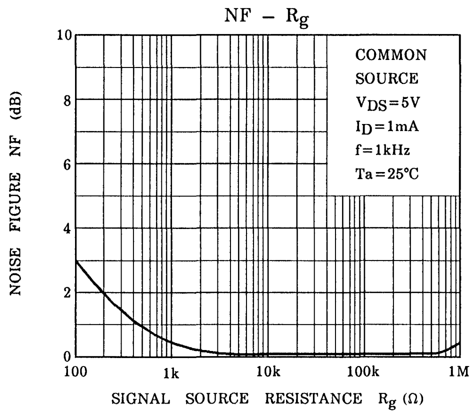

I_D – V_{DS} (LOW VOLTAGE REGION)
COMMON SOURCE
Ta=25°C
V_{GS}=0V
−0.1
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
DRAIN CURRENT I_D (mA)
DRAIN-SOURCE VOLTAGE V_{DS} (V)

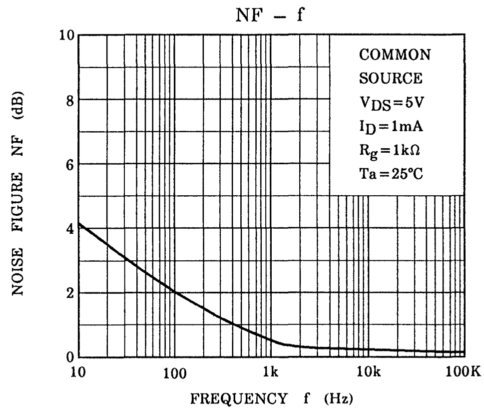

I_D – V_{GS}
COMMON SOURCE
V_{DS}=5V
Ta=25°C
I_{DSS}=23mA
19
15
11.5
7
DRAIN CURRENT I_D (mA)
GATE-SOURCE VOLTAGE V_{GS} (V)

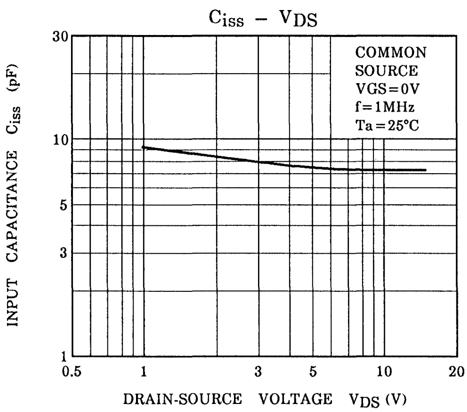

|Yfs| – I_D
I_{DSS}=30mA
15
6
COMMON SOURCE
V_{DS}=5V
f=1kHz
Ta=25°C
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)
DRAIN CURRENT I_D (mA)

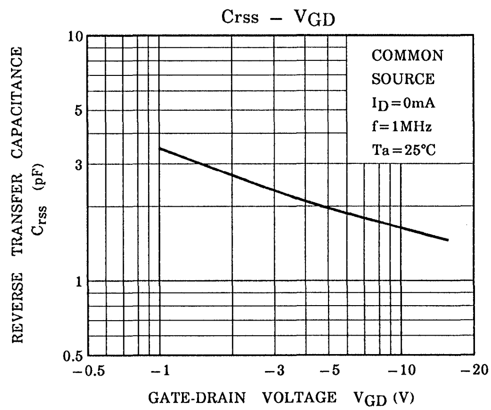

$V_{GS(OFF)}$ – I_{DSS}
COMMON SOURCE
I_{DSS}= : V_{DS}=5V
V_{GS}=0V
$V_{GS(OFF)}$: V_{DS}=5V
I_D=1μA
Ta=25°C
GATE-SOURCE CUT-OFF VOLTAGE $V_{GS(OFF)}$ (V)
DRAIN CURRENT I_{DSS} (mA)

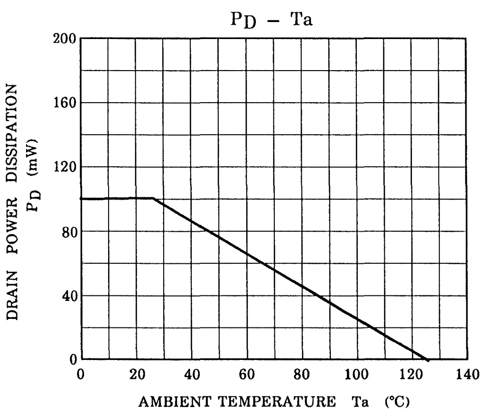

|Yfs| – I_{DSS}
COMMON SOURCE
I_{DSS} : V_{DS}=5V
V_{GS}=0V
|Yfs| : V_{DS}=5V
V_{GS}=0V
f=1kHz
Ta=25°C
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)
DRAIN CURRENT I_{DSS} (mA)


NF – Rg
COMMON SOURCE
VDS=5V
ID=1mA
f=1kHz
Ta=25°C
NOISE FIGURE NF (dB)
SIGNAL SOURCE RESISTANCE Rg (Ω)
0
2
4
6
8
10
100
1k
10k
100k
1M


NF – f
COMMON SOURCE
VDS=5V
ID=1mA
Rg=1kΩ
Ta=25°C
NOISE FIGURE NF (dB)
FREQUENCY f (Hz)
0
2
4
6
8
10
10
100
1k
10k
100K


Ciss – VDS
COMMON SOURCE
VGS=0V
f=1MHz
Ta=25°C
INPUT CAPACITANCE Ciss (pF)
DRAIN-SOURCE VOLTAGE VDS (V)
1
3
5
10
30
0.5
1
3
5
10
20


Crss – VGD
COMMON SOURCE
ID=0mA
f=1MHz
Ta=25°C
REVERSE TRANSFER CAPACITANCE Crss (pF)
GATE-DRAIN VOLTAGE VGD (V)
0.5
1
3
5
10
–0.5
–1
–3
–5
–10
–20


PD – Ta
DRAIN POWER DISSIPATION PD (mW)
AMBIENT TEMPERATURE Ta (°C)
0
40
80
120
160
200
0
20
40
60
80
100
120
140

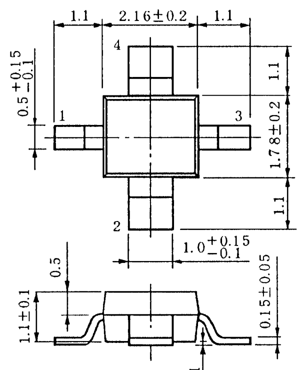
GaAs N CHANNEL SINGLE GATE MODULATION DOPE TYPE
FIELD EFFECT TRANSISTOR

2SK2331

SHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

Unit in mm

- Low Noise Figure : NF = 0.45dB (f = 12GHz)
- High Gain : Ga = 11dB (f = 12GHz)



1. GATE
2. SOURCE
3. DRAIN
4. SOURCE

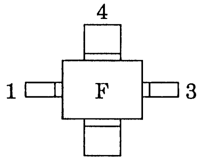
JEDEC	—
EIAJ	—
TOSHIBA	2-2M1A

Weight : 0.016g (Typ.)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Gate-Drain Voltage	V_{GDO}	−3	V
Gate-Source Voltage	V_{GSO}	−3	V
Drain Current	I_D	120	mA
Power Dissipation	P_D	150	mW
Channel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Marking



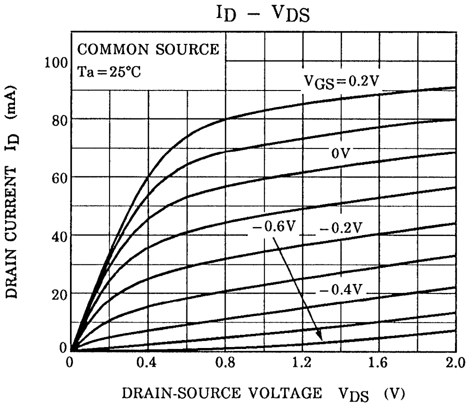
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate Leakage Current	I_{GSS}	$V_{DS}=0$, $V_{GS}=-2V$	—	—	−20	μA
Drain Current	I_{DSS}	$V_{DS}=1V$, $V_{GS}=0$	25	70	120	mA
Gate-Source Cut-off Voltage	$V_{GS\,(OFF)}$	$V_{DS}=1V$, $I_D=100\mu A$	−0.2	−0.8	−2	V
Forward Transfer Admittance	$\lvert Y_{fs}\rvert$	$V_{DS}=1V$, $I_D=20mA$, f=1kHz	—	100	—	mS
Noise Figure	NF	$V_{DS}=1V$, $I_D=20mA$, f=12GHz	—	0.45	0.6	dB
Associated Gain	Ga	$V_{DS}=1V$, $I_D=20mA$, f=12GHz	10	11	—	dB

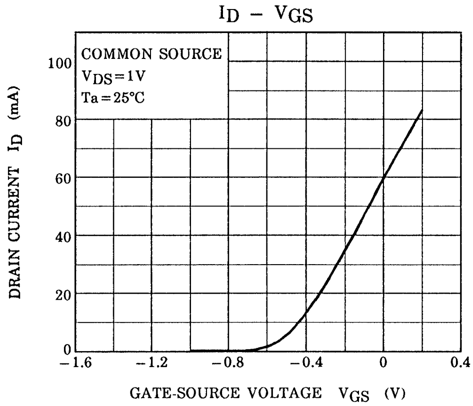
CAUTION

GaAs (Gallium Arsenide) is used in this product. The dust or vapor can be dangerous to humans. Do not break, cut, crush or dissolve chemically. Dispose of this product properly according to law. Do not intermingle with normal industrial or domestic waste.

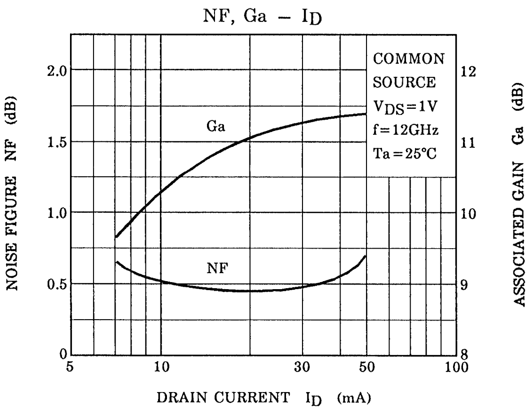
This device electrostatic sensitivity. Please handle with caution.



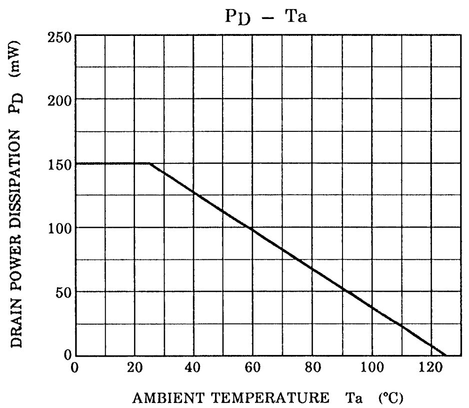
I_D – V_{DS}
COMMON SOURCE
Ta = 25°C
V_{GS} = 0.2V
0V
–0.6V
–0.2V
–0.4V
DRAIN CURRENT I_D (mA)
0
20
40
60
80
100
0
0.4
0.8
1.2
1.6
2.0
DRAIN-SOURCE VOLTAGE V_{DS} (V)



I_D – V_{GS}
COMMON SOURCE
V_{DS} = 1V
Ta = 25°C
DRAIN CURRENT I_D (mA)
0
20
40
60
80
100
–1.6
–1.2
–0.8
–0.4
0
0.4
GATE-SOURCE VOLTAGE V_{GS} (V)



NF, Ga – I_D
COMMON SOURCE
V_{DS} = 1V
f = 12GHz
Ta = 25°C
Ga
NF
NOISE FIGURE NF (dB)
0
0.5
1.0
1.5
2.0
ASSOCIATED GAIN Ga (dB)
8
9
10
11
12
5
10
30
50
100
DRAIN CURRENT I_D (mA)

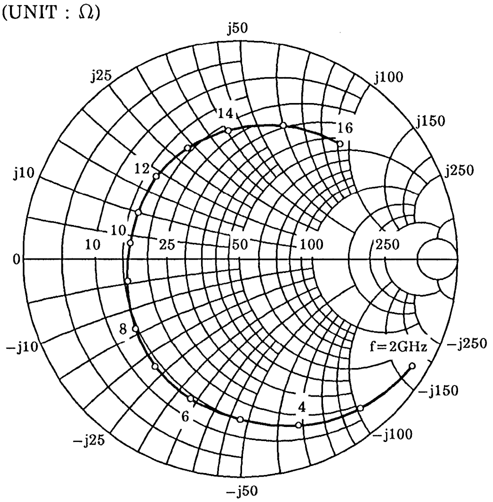


P_D – Ta
DRAIN POWER DISSIPATION P_D (mW)
0
50
100
150
200
250
0
20
40
60
80
100
120
AMBIENT TEMPERATURE Ta (°C)

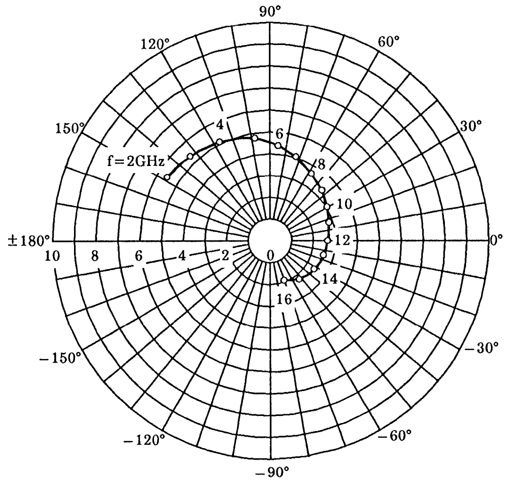
S-PARAMETER
COMMON SOURCE
(V_{DS}=1V, I_D=20mA, Ta=25°C, Z_o=50Ω)

FREQ. (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
2000	0.935	−32	5.581	148	0.037	77	0.143	−11
3000	0.871	−51	5.352	133	0.054	71	0.117	−26
4000	0.803	−70	5.050	117	0.070	61	0.084	−40
5000	0.734	−90	4.741	98	0.087	51	0.042	−81
6000	0.670	−110	4.377	84	0.098	43	0.047	−166
7000	0.622	−128	3.969	71	0.108	34	0.071	166
8000	0.570	−147	3.637	57	0.117	25	0.086	139
9000	0.525	−168	3.310	42	0.120	13	0.133	114
10000	0.518	172	3.062	29	0.128	5	0.177	104
11000	0.526	156	2.874	17	0.136	−4	0.206	95
12000	0.541	135	2.696	−1	0.143	−18	0.245	81
13000	0.564	115	2.523	−15	0.146	−29	0.287	69
14000	0.588	95	2.401	−32	0.150	−42	0.318	57
15000	0.637	71	2.200	−52	0.156	−59	0.384	41
16000	0.688	48	1.887	−70	0.146	−74	0.469	25

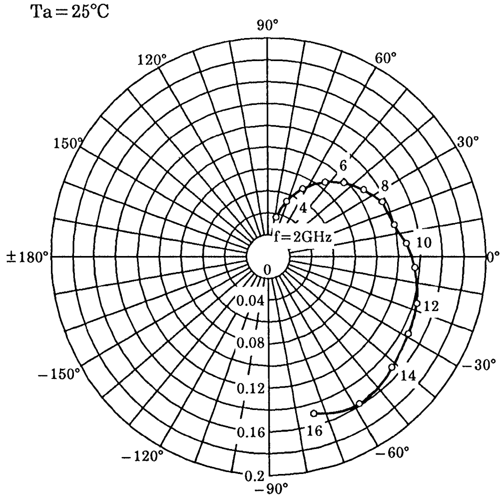
S_{11}
COMMON SOURCE
$V_{DS}=1V$
$I_D=20mA$
$Ta=25°C$
(UNIT : Ω)



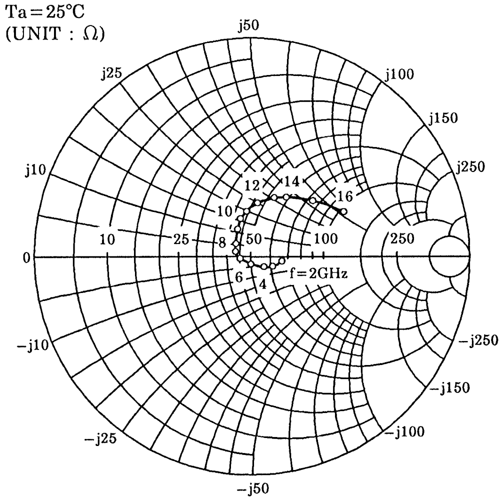
S_{21}
COMMON SOURCE
$V_{DS}=1V$
$I_D=20mA$
$Ta=25°C$



S_{12}
COMMON SOURCE
$V_{DS}=1V$
$I_D=20mA$
$Ta=25°C$

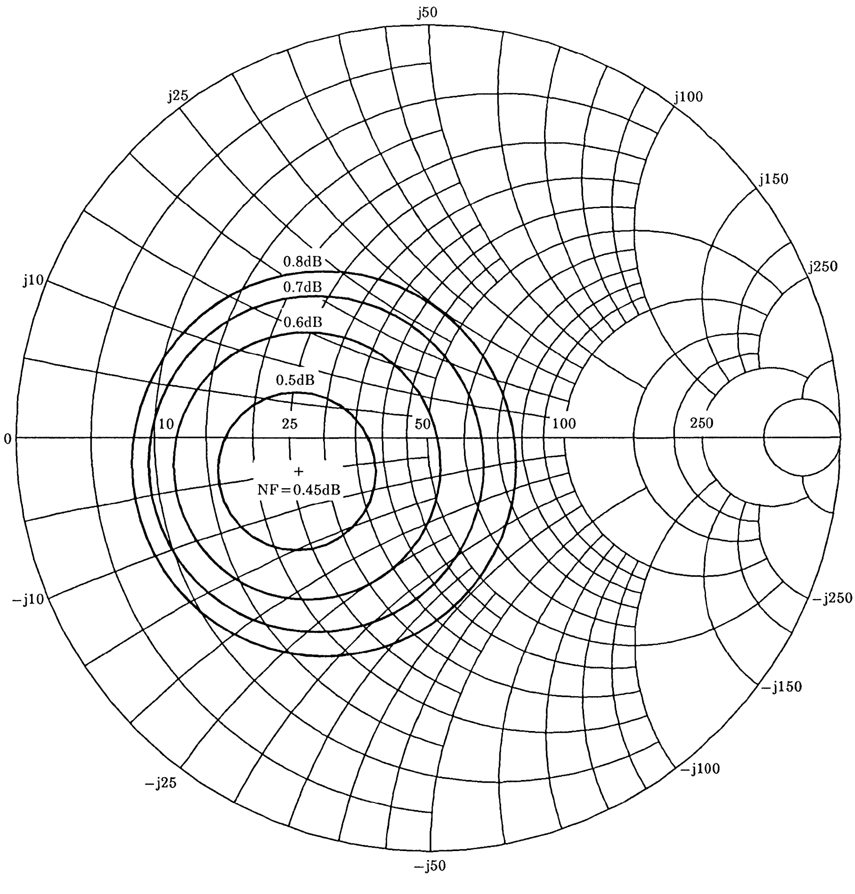


S_{22}
COMMON SOURCE
$V_{DS}=1V$
$I_D=20mA$
$Ta=25°C$
(UNIT : Ω)



CONSTANT NOISE FIGURE

NF min = 0.45dB, Γ_{opt} = 0.33 ∠ −167, R_n = 1.7Ω
@ V_{DS} = 1V, I_D = 20mA, f = 12GHz
Z_o = 50Ω, Ta = 25°C



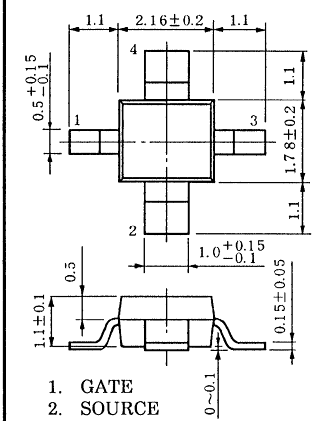
2SK2332

GaAs N CHANNEL SINGLE GATE MODULATION DOPE TYPE FIELD EFFECT TRANSISTOR

SHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Low Noise Figure : NF = 0.65dB (f = 12GHz)
- High Gain : Ga = 11dB (f = 12GHz)

Unit in mm



1. GATE
2. SOURCE
3. DRAIN
4. SOURCE

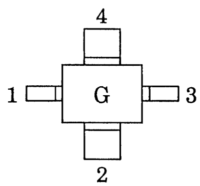
JEDEC	—
EIAJ	—
TOSHIBA	2-2M1A

Weight : 0.016g (Typ.)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Gate-Drain Voltage	V_{GDO}	−3	V
Gate-Source Voltage	V_{GSO}	−3	V
Drain Current	I_D	80	mA
Power Dissipation	P_D	150	mW
Channel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Marking



ELECTRICAL CHARACTERISTICS (Ta = 25°C)

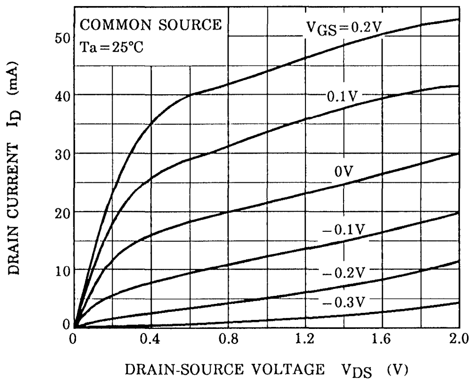
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate Leakage Current	I_{GSS}	$V_{DS}=0$, $V_{GS}=-2V$	—	—	−20	μA
Drain Current	I_{DSS}	$V_{DS}=2V$, $V_{GS}=0$	20	40	80	mA
Gate-Source Cut-off Voltage	$V_{GS(OFF)}$	$V_{DS}=2V$, $I_D=100\mu A$	−0.2	−0.8	−2	V
Forward Transfer Admittance	$\|Y_{fs}\|$	$V_{DS}=2V$, $I_D=15mA$, f=1kHz	—	90	—	mS
Noise Figure	NF	$V_{DS}=2V$, $I_D=15mA$, f=12GHz	—	0.65	0.8	dB
Associated Gain	Ga	$V_{DS}=2V$, $I_D=15mA$, f=12GHz	10	11	—	dB

CAUTION

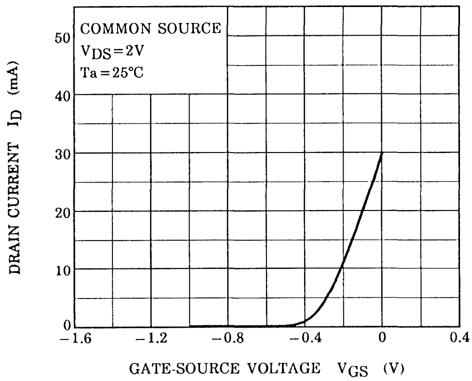
GaAs (Gallium Arsenide) is used in this product. The dust or vapor can be dangerous to humans. Do not break, cut, crush or dissolve chemically. Dispose of this product properly according to law. Do not intermingle with normal industrial or domestic waste.

This device electrostatic sensitivity. Please handle with caution.

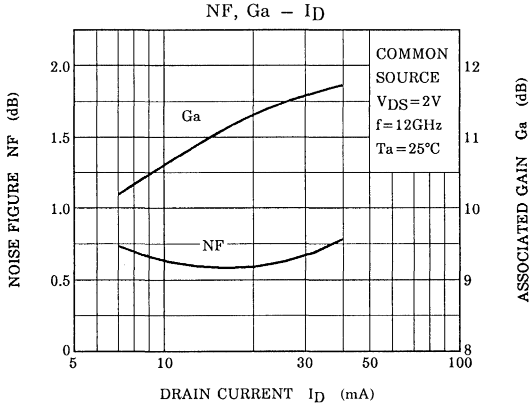
$I_D - V_{DS}$



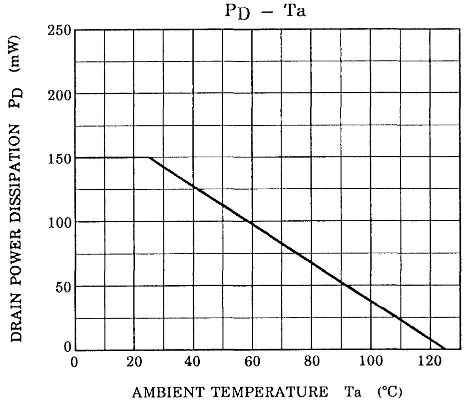
$I_D - V_{GS}$



NF, Ga − I_D



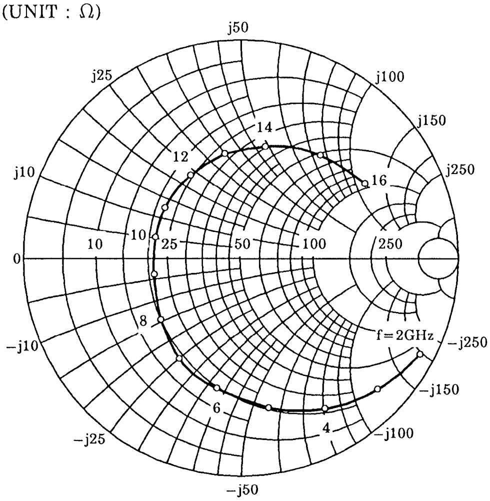
P_D − Ta



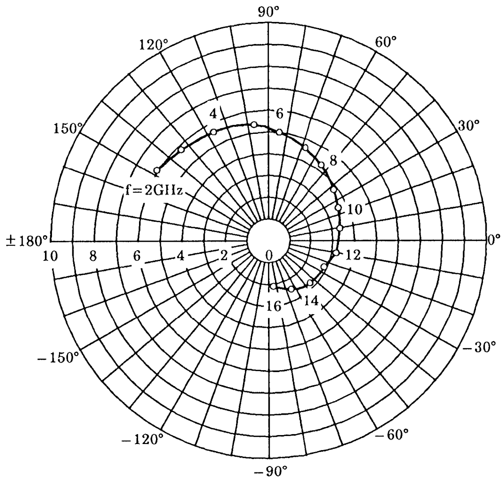
S-PARAMETER
COMMON SOURCE
(V_{DS}=2V, I_D=15mA, Ta=25°C, Z_0=50Ω)

FREQ. (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
2000	0.936	−28	6.008	148	0.035	76	0.420	−14
3000	0.867	−44	5.833	133	0.051	71	0.385	−24
4000	0.787	−61	5.617	117	0.066	60	0.344	−34
5000	0.696	−80	5.363	97	0.088	49	0.279	−45
6000	0.608	−100	4.996	83	0.094	40	0.211	−58
7000	0.539	−121	4.579	68	0.104	31	0.163	−72
8000	0.468	−142	4.204	53	0.112	20	0.112	−83
9000	0.410	−169	3.839	37	0.116	7	0.032	−108
10000	0.399	166	3.546	23	0.122	−2	0.043	118
11000	0.417	146	3.365	9	0.129	−11	0.086	100
12000	0.441	121	3.141	−10	0.135	−25	0.145	78
13000	0.478	98	2.921	−25	0.136	−37	0.210	63
14000	0.524	77	2.740	−44	0.140	−52	0.262	51
15000	0.594	52	2.465	−65	0.143	−69	0.354	34
16000	0.662	31	2.099	−82	0.130	−83	0.453	18

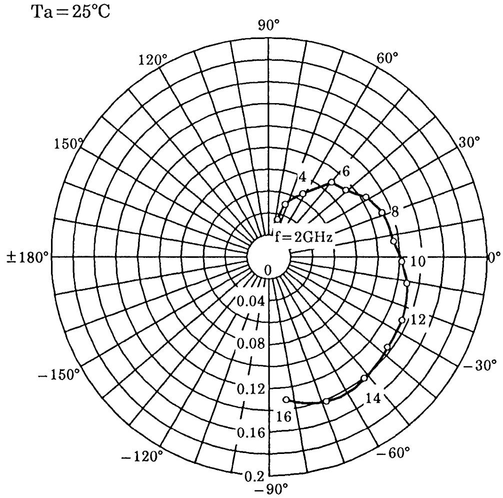
S_{11}
COMMON SOURCE
$V_{DS}=2V$
$I_D=15mA$
$Ta=25°C$
(UNIT : Ω)



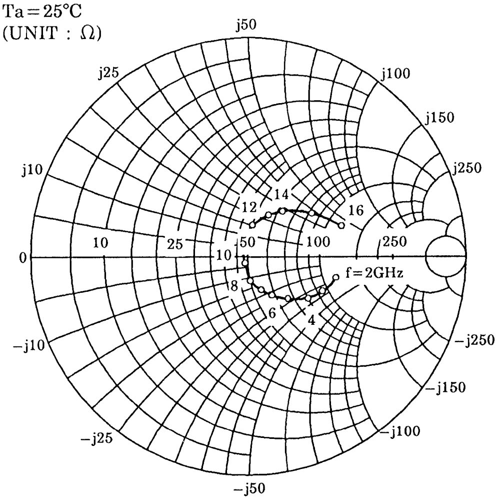
S_{21}
COMMON SOURCE
$V_{DS}=2V$
$I_D=15mA$
$Ta=25°C$



S_{12}
COMMON SOURCE
$V_{DS}=2V$
$I_D=15mA$
$Ta=25°C$

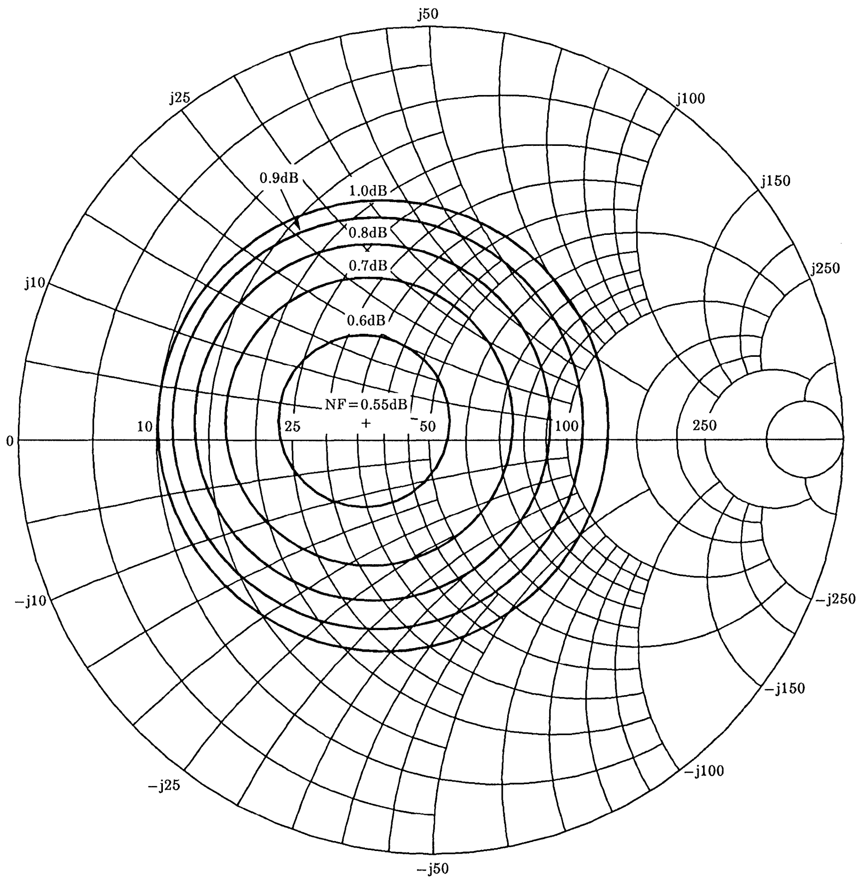


S_{22}
COMMON SOURCE
$V_{DS}=2V$
$I_D=15mA$
$Ta=25°C$
(UNIT : Ω)



CONSTANT NOISE FIGURE

NF min = 0.55dB, Γ_{opt} = 0.17 ∠166, R_n = 2.6Ω
@ V_{DS} = 2V, I_D = 15mA, f = 12GHz
Z_o = 50Ω, Ta = 25°C

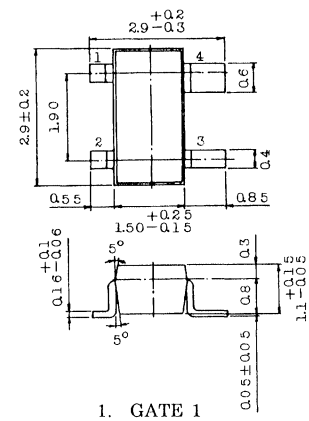


SILICON N CHANNEL DUAL GATE MOS TYPE
FIELD EFFECT TRANSISTOR

3SK126

TV TUNER, VHF RF AMPLIFIER APPLICATIONS.
TV TUNER VHF MIXER APPLICATIONS.

Unit in mm



1. GATE 1
2. GATE 2
3. DRAIN
4. SOURCE

JEDEC	—
EIAJ	—
TOSHIBA	2-3J1A

Weight : 0.013g

- Superior Cross Modulation Performance.
- Low Reverse Transfer Capacitance : C_{rss} = 0.03pF (Typ.)
- Low Noise Figure : NF = 1.4dB (Typ.)

MAXIMUM RATINGS (Ta = 25°C)

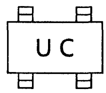
CHARACTERISTIC	SYMBOL	RATING	UNIT
Drain-Source Voltage	V_{DS}	15	V
Gate 1-Source Voltage	V_{G1S}	±9	V
Gate 2-Source Voltage	V_{G2S}	±9	V
Drain Current	I_D	30	mA
Drain Power Dissipation	P_D	150	mW
Chanel Temperature	Tch	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

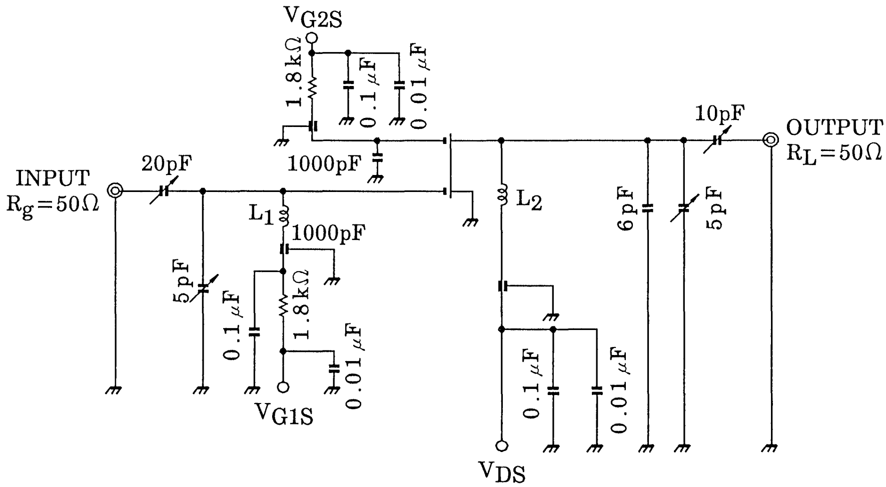
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate 1 Leakage Current	I_{G1SS}	$V_{DS}=0$, $V_{G1S}=\pm7V$, $V_{G2S}=0$	—	—	±50	nA
Gate 2 Leakage Current	I_{G2SS}	$V_{DS}=0$, $V_{G1S}=0$, $V_{G2S}=\pm7V$	—	—	±50	nA
Drain-Source Voltage	$V_{(BR)DSX}$	$V_{G1S}=-4V$, $V_{G2S}=-4V$, $I_D=100\mu A$	15	—	—	V
Drain Current	I_{DSS} (Note)	$V_{DS}=6V$, $V_{G1S}=0$, $V_{G2S}=3V$	0	—	6	mA
Gate 1-Source Cut-off Voltage	$V_{G1S(OFF)}$	$V_{DS}=6V$, $V_{G2S}=3V$, $I_D=100\mu A$	−1	—	1	V
Gate 2-Source Cut-off Voltage	$V_{G2S(OFF)}$	$V_{DS}=6V$, $V_{G1S}=3V$, $I_D=100\mu A$	−0.5	—	1	V
Forward Transfer Admittance	$\lvert y_{fs}\rvert$	$V_{DS}=6V$, $V_{G2S}=3V$ $I_D=10mA$, f=1kHz	13	20	—	mS
Input Capacitance	C_{iss}	$V_{DS}=6V$, $V_{G2S}=3V$ $I_D=10mA$, f=1MHz	—	4.25	5.5	pF
Reverse Transfer Capacitance	C_{rss}		—	0.03	0.05	pF
Power Gain	G_{ps}	$V_{DS}=6V$, $V_{G2S}=3V$ $I_D=10mA$, f=200MHz	20	25	—	dB
Noise Figure	NF		—	1.4	2.8	dB

Note : I_{DSS} Classification O : 0~2mA, Y : 1~6mA

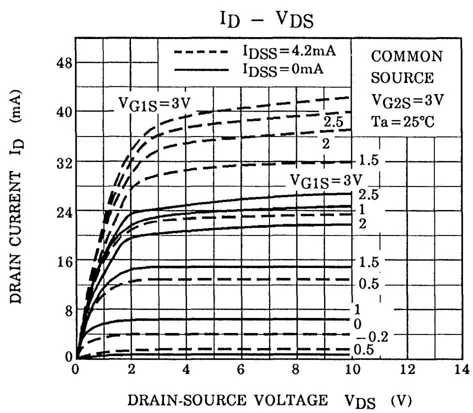
Marking

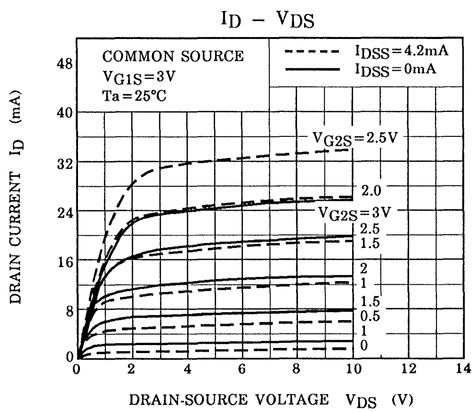




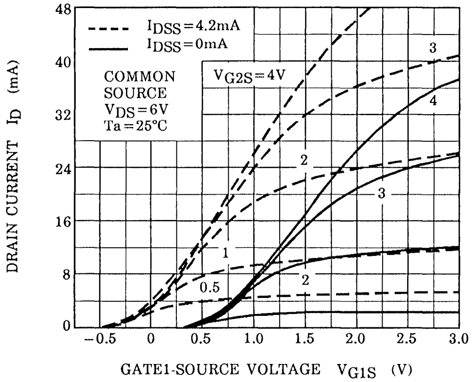
L_1 : 1mmϕ Ag Plated Copper Wire, 2 Turns, 8mm I_D
L_2 : 1mmϕ Ag Plated Copper Wire, 2.5 Turns, 8mm I_D

Fig.1 200MHz G_{ps}, NF TEST CIRCUIT

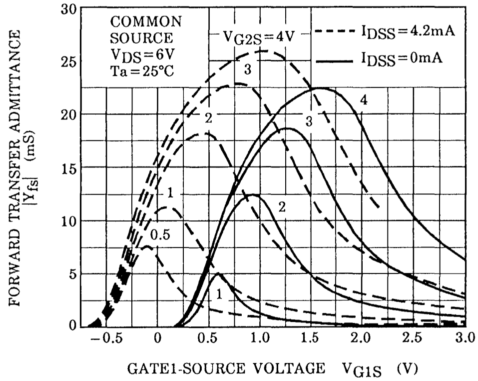




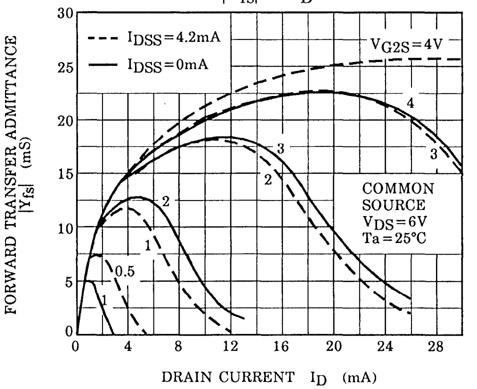
I_D – V_{G1S}



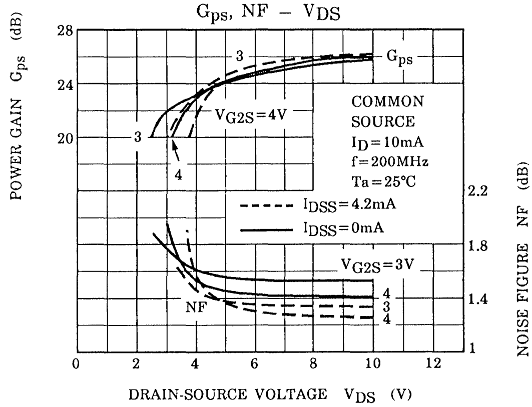
|Y_{fs}| – V_{G1S}



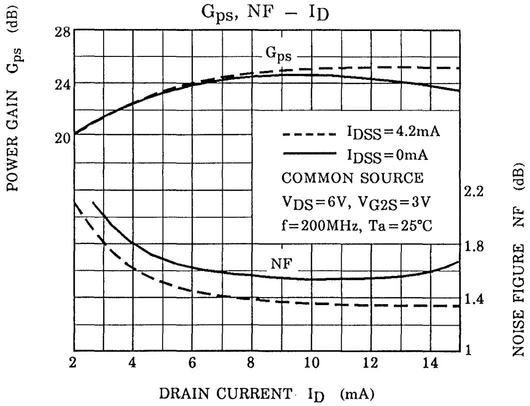
|Y_{fs}| – I_D



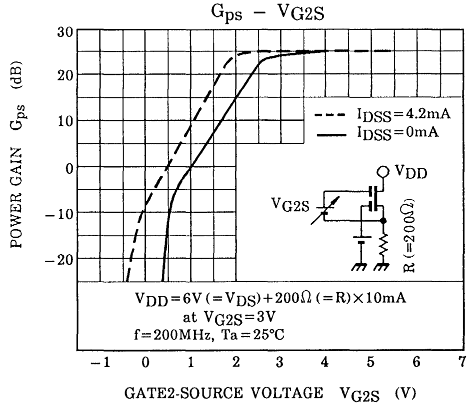
G_{ps}, NF – V_{DS}

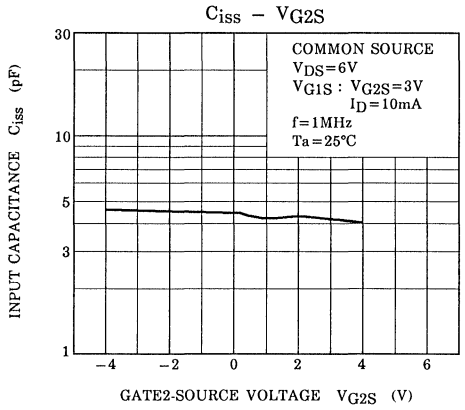


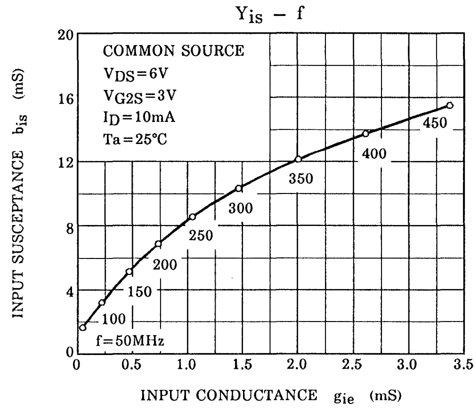
G_{ps}, NF – I_D

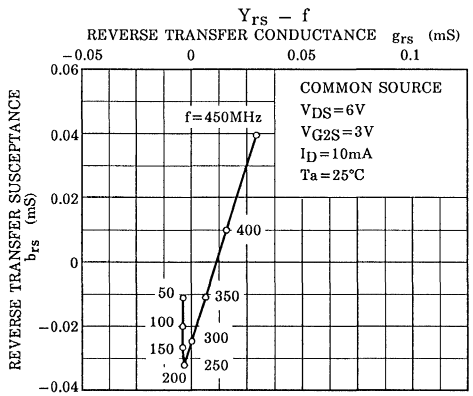


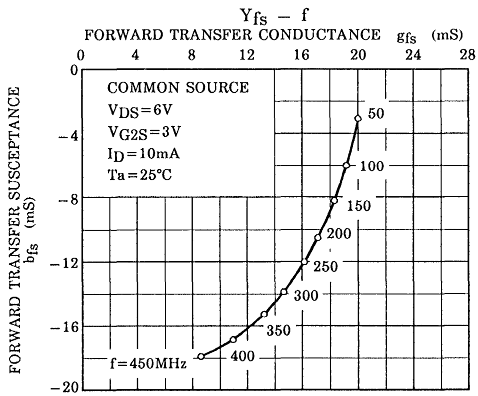
G_{ps} – V_{G2S}

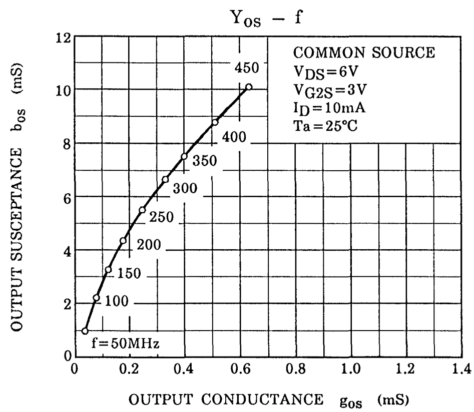


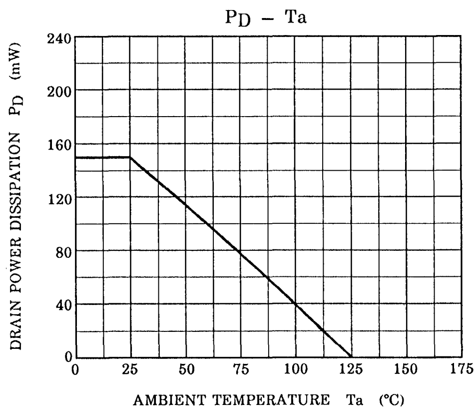

Ciss − VG2S
COMMON SOURCE
VDS=6V
VG1S : VG2S=3V
ID=10mA
f=1MHz
Ta=25°C
INPUT CAPACITANCE Ciss (pF)
GATE2-SOURCE VOLTAGE VG2S (V)


Yis − f
COMMON SOURCE
VDS=6V
VG2S=3V
ID=10mA
Ta=25°C
f=50MHz
INPUT SUSCEPTANCE bis (mS)
INPUT CONDUCTANCE gie (mS)


Yrs − f
REVERSE TRANSFER CONDUCTANCE grs (mS)
COMMON SOURCE
VDS=6V
VG2S=3V
ID=10mA
Ta=25°C
f=450MHz
REVERSE TRANSFER SUSCEPTANCE brs (mS)


Yfs − f
FORWARD TRANSFER CONDUCTANCE gfs (mS)
COMMON SOURCE
VDS=6V
VG2S=3V
ID=10mA
Ta=25°C
f=450MHz
FORWARD TRANSFER SUSCEPTANCE bfs (mS)


Yos − f
COMMON SOURCE
VDS=6V
VG2S=3V
ID=10mA
Ta=25°C
f=50MHz
OUTPUT SUSCEPTANCE bos (mS)
OUTPUT CONDUCTANCE gos (mS)

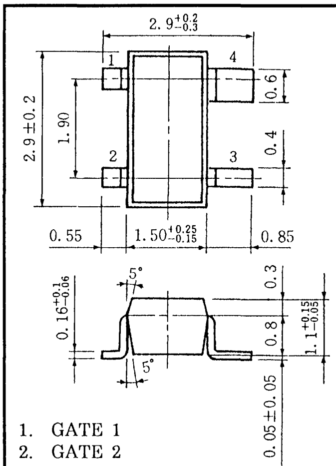

PD − Ta
DRAIN POWER DISSIPATION PD (mW)
AMBIENT TEMPERATURE Ta (°C)

SILICON N CHANNEL DUAL GATE MOS TYPE FIELD EFFECT TRANSISTOR

3SK127

TV TUNER, UHF RF AMPLIFIER APPLICATIONS.
TV TUNER, UHF MIXER APPLICATIONS.

Unit in mm



1. GATE 1
2. GATE 2
3. DRAIN
4. SOURCE

JEDEC	—
EIAJ	—
TOSHIBA	2-3J1A

Weight : 0.013g

- Superior Cross Modulation Performance.
- Low Reverse Transfer Capacitance : C_{rss} = 0.03pF (Max.)
- Low Noise Figure : NF = 3.2dB (Typ.)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Drain-Source Voltage	V_{DS}	15	V
Gate 1 - Source Voltage	V_{G1S}	±8	V
Gate 2 - Source Voltage	V_{G2S}	±8	V
Drain Current	I_D	30	mA
Drain Power Dissipation	P_D	150	mW
Channel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate 1 Leakage Current	I_{G1SS}	V_{DS}=0V, V_{G1S}=±6V, V_{G2S}=0V	—	—	±50	nA
Gate 2 Leakage Current	I_{G2SS}	V_{DS}=0V, V_{G1S}=0V, V_{G2S}=±6V	—	—	±50	nA
Drain-Source Voltage	$V_{(BR)DSX}$	V_{G1S}=−4V, V_{G2S}=−4V I_D=100μA	15	—	—	V
Drain Current	I_{DSS} (Note)	V_{DS}=6V, V_{G1S}=0V, V_{G2S}=3V	0	—	6	mA
Gate 1-Source Cut-off Voltage	$V_{G1S(OFF)}$	V_{DS}=6V, V_{G2S}=3V, I_D=100μA	−1.5	—	1.0	V
Gate 2-Source Cut-off Voltage	$V_{G2S(OFF)}$	V_{DS}=6V, V_{G1S}=3V, I_D=100μA	−1.0	—	1.0	V
Forward Transfer Admittance	$\|Y_{fs}\|$	V_{DS}=6V, V_{G2S}=3V, I_D=10mA f=1kHz	—	17	—	mS
Input Capacitance	C_{iss}	V_{DS}=6V, V_{G2S}=3V, I_D=10mA f=1MHz	—	2.0	—	pF
Reverse Transfer Capacitance	C_{rss}		—	—	0.03	pF
Power Gain	G_{ps}	V_{DS}=6V, V_{G2S}=3V, I_D=10mA f=800MHz (Fig.1)	—	16	—	dB
Noise Figure	NF		—	3.2	—	dB

Note : I_{DSS} Classification O : 0~2mA, Y : 1~6mA

Marking

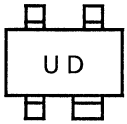
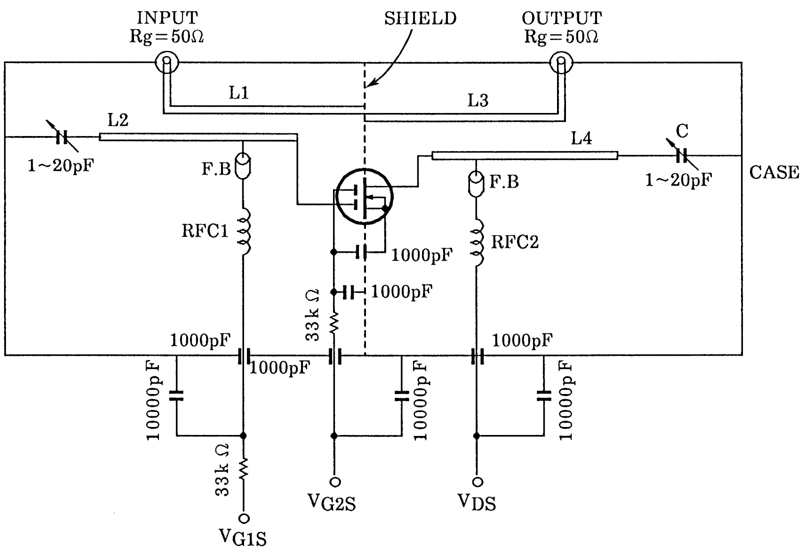
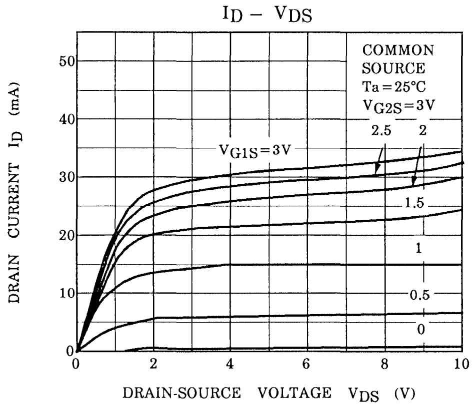
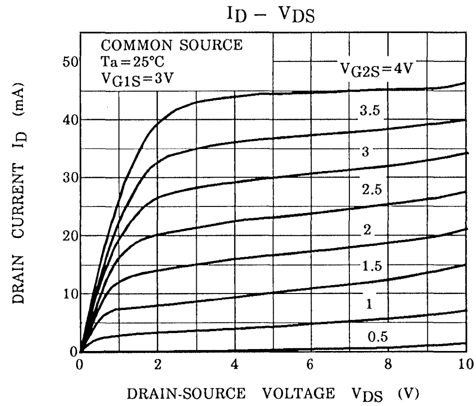


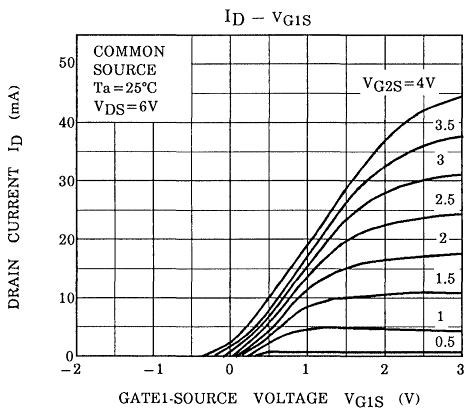
Fig. 1 800MHz Gps, NF TEST CIRCUIT

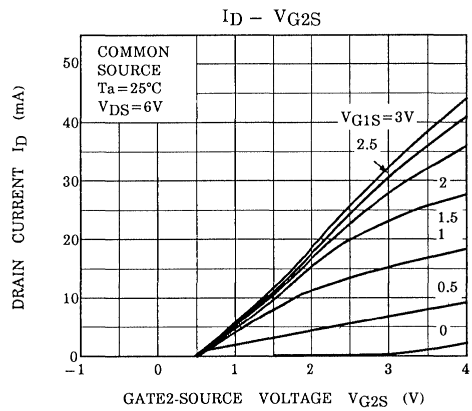


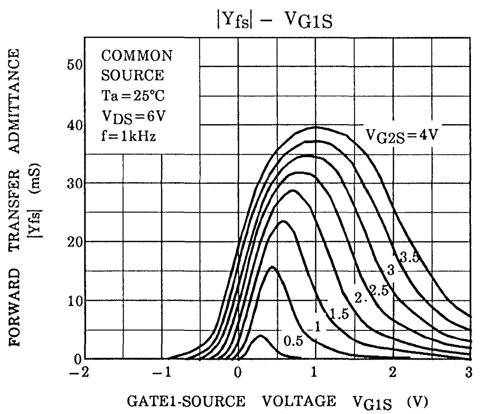
L1~L4	:	ϕ0.8mm SILVER PLATED COPPER WIRE
C	:	AIR TRIMMER TTA25A200A (MURATA MFG, Co., Ltd.)
RFC 1	:	ϕ0.35mm COPPER WIRE 3mm ID, 7T
RFC 2	:	ϕ0.35mm COPPER WIRE 3mm ID, 10T

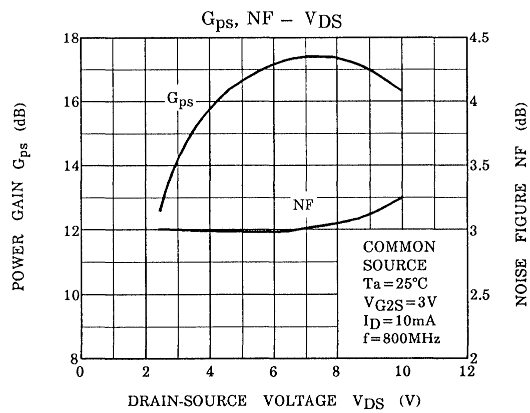

ID – VDS
COMMON SOURCE
Ta=25°C
VG2S=3V
VG1S=3V
2.5
2
1.5
1
0.5
0
DRAIN CURRENT ID (mA)
DRAIN-SOURCE VOLTAGE VDS (V)


ID – VDS
COMMON SOURCE
Ta=25°C
VG1S=3V
VG2S=4V
3.5
3
2.5
2
1.5
1
0.5
DRAIN CURRENT ID (mA)
DRAIN-SOURCE VOLTAGE VDS (V)

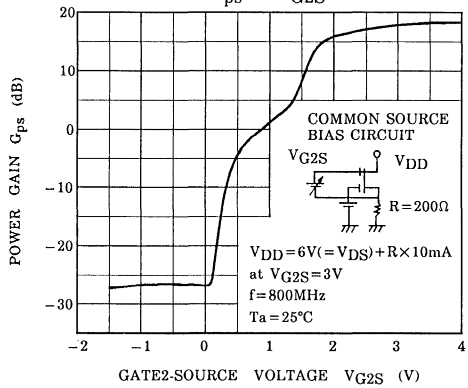

ID – VG1S
COMMON SOURCE
Ta=25°C
VDS=6V
VG2S=4V
3.5
3
2.5
2
1.5
1
0.5
DRAIN CURRENT ID (mA)
GATE1-SOURCE VOLTAGE VG1S (V)


ID – VG2S
COMMON SOURCE
Ta=25°C
VDS=6V
VG1S=3V
2.5
2
1.5
1
0.5
0
DRAIN CURRENT ID (mA)
GATE2-SOURCE VOLTAGE VG2S (V)

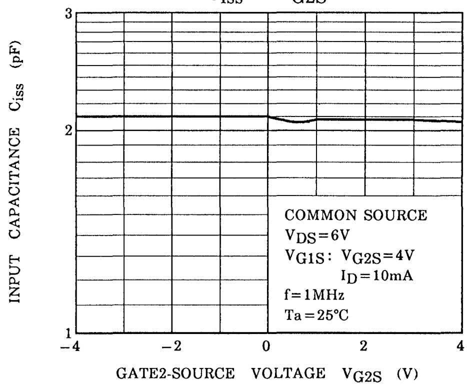

|Yfs| – VG1S
COMMON SOURCE
Ta=25°C
VDS=6V
f=1kHz
VG2S=4V
3.5
3
2.5
2
1.5
1
0.5
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)
GATE1-SOURCE VOLTAGE VG1S (V)


Gps, NF – VDS
Gps
NF
COMMON SOURCE
Ta=25°C
VG2S=3V
ID=10mA
f=800MHz
POWER GAIN Gps (dB)
NOISE FIGURE NF (dB)
DRAIN-SOURCE VOLTAGE VDS (V)

G_{ps} – V_{G2S}

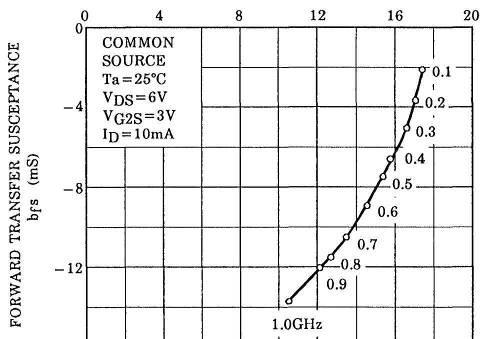


C_{iss} – V_{G2S}

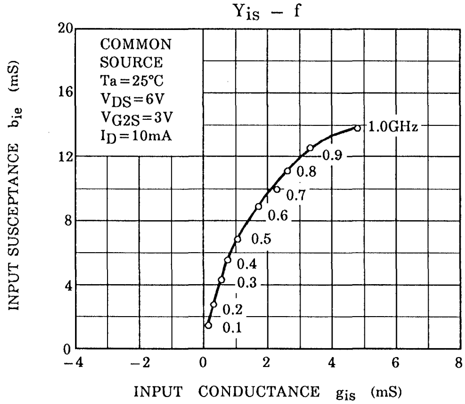


Y_{fs} – f

FORWARD TRANSFER CONDUCTANCE g_{fe} (mS)

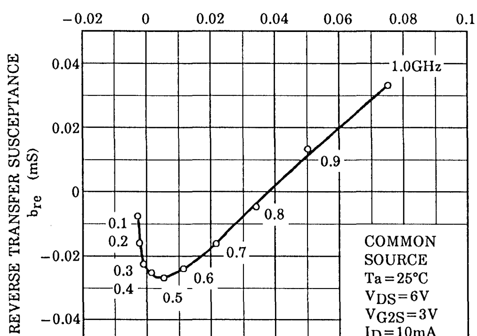


Y_{is} – f

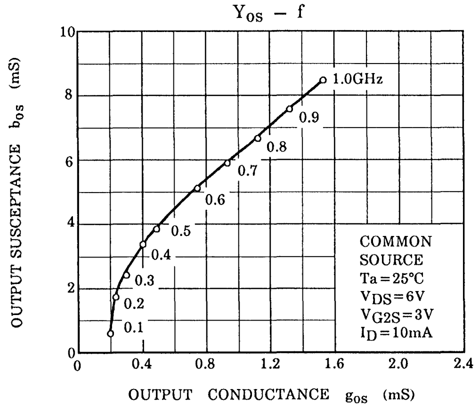


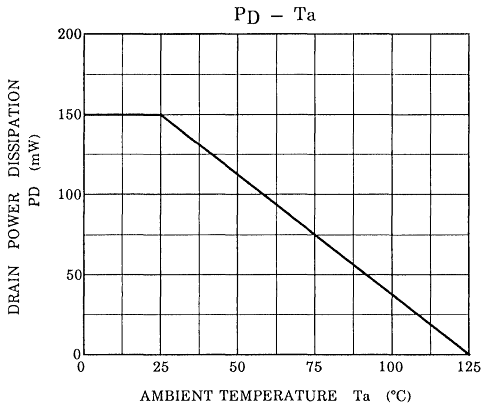
Y_{rs} – f

REVERSE TRANSFER CONDUCTANCE g_{re} (mS)



Y_{os} – f





P_D – Ta
200
150
100
50
0
DRAIN POWER DISSIPATION
PD (mW)
0
25
50
75
100
125
AMBIENT TEMPERATURE Ta (°C)

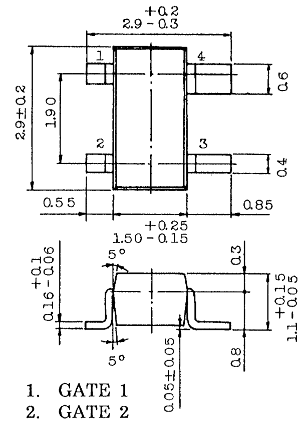
3SK146

SILICON N CHANNEL DUAL GATE MOS TYPE FIELD EFFECT TRANSISTOR

TV TUNER, UHF RF AMPLIFIER APPLICATIONS.
TV TUNER UHF MIXER APPLICATIONS.

- Superior Cross Modulation Performance.
- Low Reverse Transfer Capacitance : C_{rss}=0.02pF (Typ.)
- Low Noise Figure : NF=2.6dB (Typ.)

Unit in mm



1. GATE 1
2. GATE 2
3. DRAIN
4. SOURCE

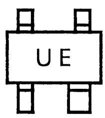
SMQ	
JEDEC	—
EIAJ	—
TOSHIBA	2-3J1A

Weight : 0.013g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Drain-Source Voltage	V_{DS}	13.5	V
Gate 1-Source Voltage	V_{G1S}	±8	V
Gate 2-Source Voltage	V_{G2S}	±8	V
Drain Current	I_D	30	mA
Drain Power Dissipation	P_D	150	mW
Channel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

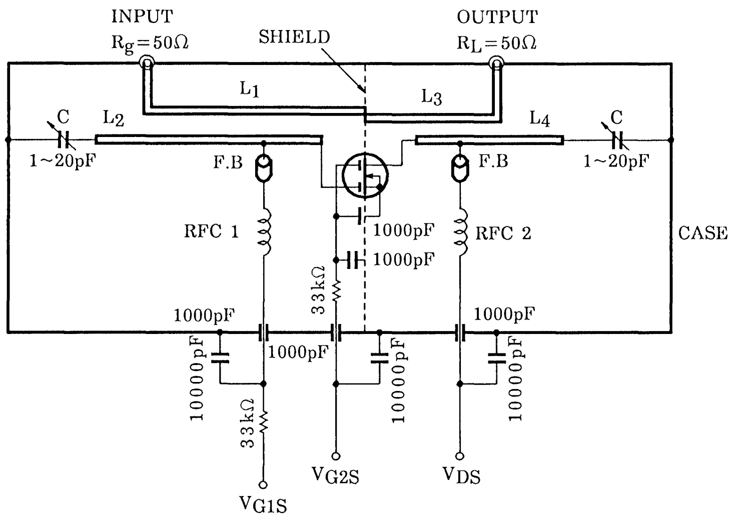
Marking



ELECTRICAL CHARACTERISTICS (Ta = 25°C)

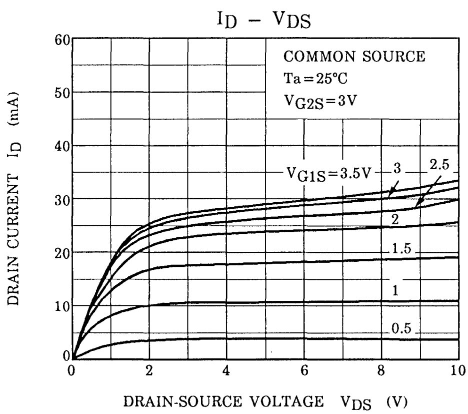
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate 1 Leakage Current	I_{G1SS}	V_{DS}=0, V_{G1S}=±6V, V_{G2S}=0	—	—	±50	nA
Gate 2 Leakage Current	I_{G2SS}	V_{DS}=0, V_{G1S}=0, V_{G2S}=±6V	—	—	±50	nA
Drain-Source Voltage	$V_{(BR)DSX}$	V_{G1S}=−4V, V_{G2S}=−4V, I_D=100μA	13.5	—	—	V
Drain Current	I_{DSS} (Note)	V_{DS}=6V, V_{G1S}=0, V_{G2S}=3V	0	—	2	mA
Gate 1-Source Cut-off Voltage	$V_{G1S(OFF)}$	V_{DS}=6V, V_{G2S}=3V, I_D=100μA	−1.5	—	1	V
Gate 2-Source Cut-off Voltage	$V_{G2S(OFF)}$	V_{DS}=6V, V_{G1S}=3V, I_D=100μA	−0.8	—	1.2	V
Forward Transfer Admittance	$\|Y_{fs}\|$	V_{DS}=6V, V_{G2S}=3V, I_D=10mA, f=1kHz	—	16	—	mS
Input Capacitance	C_{iss}	V_{DS}=6V, V_{G2S}=3V, I_D=10mA, f=1MHz	1.3	2.0	2.8	pF
Reverse Transfer Capacitance	C_{rss}		—	0.02	0.03	pF
Power Gain	G_{ps}	V_{DS}=6V, V_{G2S}=3V, I_D=10mA, f=800MHz (Fig.1)	14	17.5	—	dB
Noise Figure	NF		—	2.6	4.0	dB

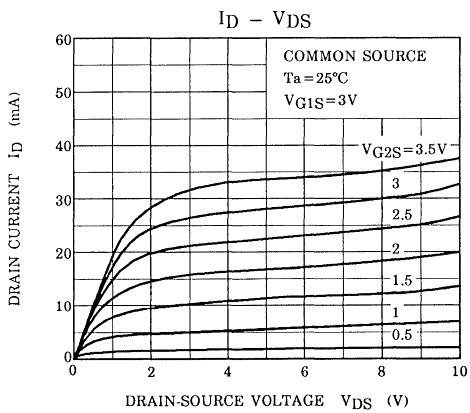
Note : I_{DSS} Classification 0 : 0~2mA

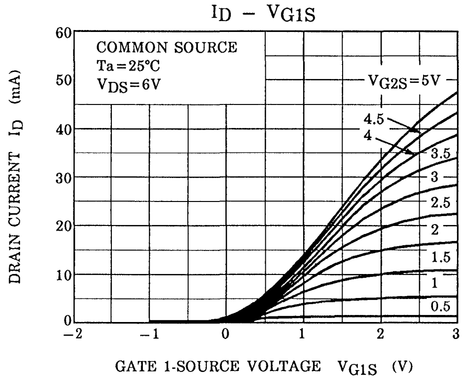


L_1~L_4 : ϕ0.8mm SILVER PLATED COPPER WIRE
C : AIR TRIMMER TTA25A200A (MURATA MFG. Co., LTD.)
RFC 1 : ϕ0.35mm COPPER WIRE 3mm ID, 7T
RFC 2 : ϕ0.35mm COPPER WIRE 3mm ID, 10T

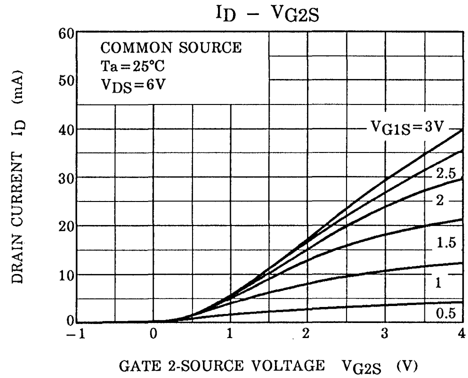
Fig.1 800MHz G_{ps}, NF TEST CIRCUIT



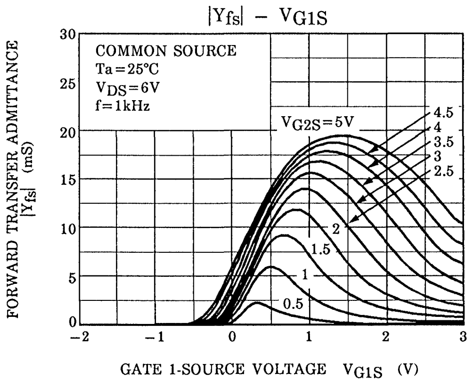




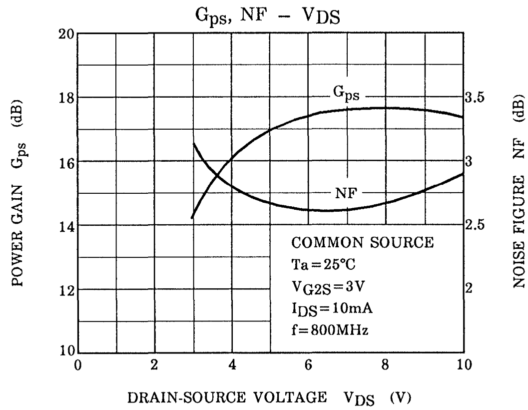
I_D – V_{G1S}
COMMON SOURCE
Ta=25°C
V_{DS}=6V
V_{G2S}=5V
4.5
4
3.5
3
2.5
2
1.5
1
0.5
DRAIN CURRENT I_D (mA)
GATE 1-SOURCE VOLTAGE V_{G1S} (V)



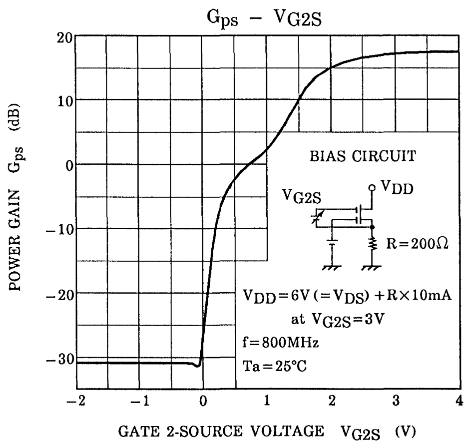
I_D – V_{G2S}
COMMON SOURCE
Ta=25°C
V_{DS}=6V
V_{G1S}=3V
2.5
2
1.5
1
0.5
DRAIN CURRENT I_D (mA)
GATE 2-SOURCE VOLTAGE V_{G2S} (V)



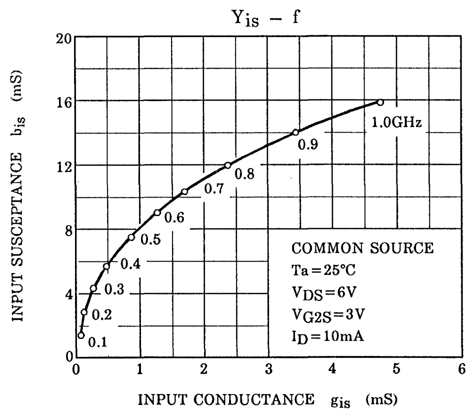
$|Y_{fs}|$ – V_{G1S}
COMMON SOURCE
Ta=25°C
V_{DS}=6V
f=1kHz
V_{G2S}=5V
4.5
4
3.5
3
2.5
2
1.5
1
0.5
FORWARD TRANSFER ADMITTANCE $|Y_{fs}|$ (mS)
GATE 1-SOURCE VOLTAGE V_{G1S} (V)



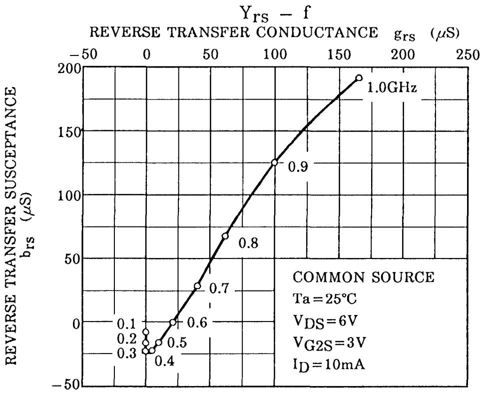
G_{ps}, NF – V_{DS}
G_{ps}
NF
COMMON SOURCE
Ta=25°C
V_{G2S}=3V
I_{DS}=10mA
f=800MHz
POWER GAIN G_{ps} (dB)
NOISE FIGURE NF (dB)
DRAIN-SOURCE VOLTAGE V_{DS} (V)

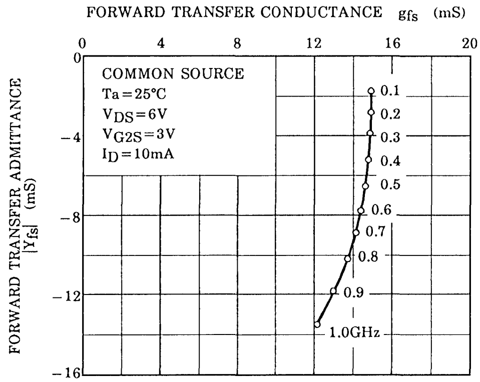


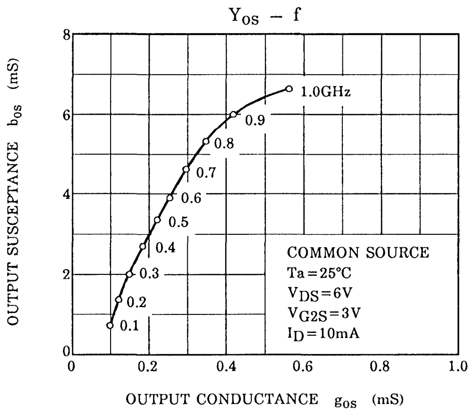
G_{ps} – V_{G2S}
BIAS CIRCUIT
V_{G2S}
V_{DD}
R=200Ω
V_{DD}=6V (=V_{DS}) +R×10mA
at V_{G2S}=3V
f=800MHz
Ta=25°C
POWER GAIN G_{ps} (dB)
GATE 2-SOURCE VOLTAGE V_{G2S} (V)

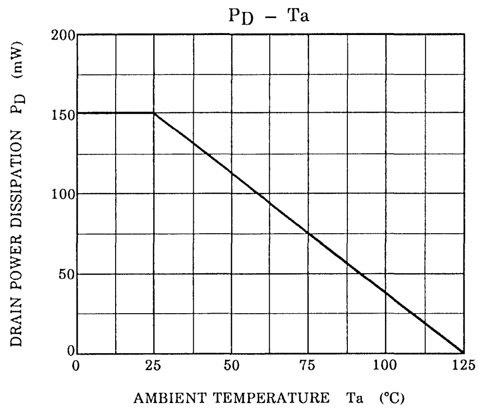


Y_{is} – f
1.0GHz
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
COMMON SOURCE
Ta=25°C
V_{DS}=6V
V_{G2S}=3V
I_D=10mA
INPUT SUSCEPTANCE b_{is} (mS)
INPUT CONDUCTANCE g_{is} (mS)


Yrs – f
REVERSE TRANSFER CONDUCTANCE grs (μS)
REVERSE TRANSFER SUSCEPTANCE brs (μS)
1.0GHz
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
COMMON SOURCE
Ta=25°C
VDS=6V
VG2S=3V
ID=10mA


FORWARD TRANSFER CONDUCTANCE gfs (mS)
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)
COMMON SOURCE
Ta=25°C
VDS=6V
VG2S=3V
ID=10mA
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0GHz


Yos – f
OUTPUT SUSCEPTANCE bos (mS)
OUTPUT CONDUCTANCE gos (mS)
1.0GHz
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
COMMON SOURCE
Ta=25°C
VDS=6V
VG2S=3V
ID=10mA


PD – Ta
DRAIN POWER DISSIPATION PD (mW)
AMBIENT TEMPERATURE Ta (°C)

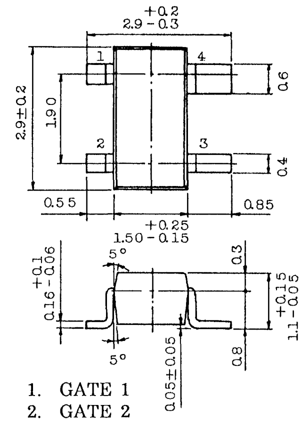
3SK151

SILICON N CHANNEL DUAL GATE MOS TYPE
FIELD EFFECT TRANSISTOR

TV TUNER VHF MIXER APPLICATIONS.
VHF RF AMPLIFIER APPLICATIONS.

- High Conversion Fain : G_{CS}=24.5dB (Typ.)
- Low Noise Figure : NF_{CS}=3.3dB (Typ.)

Unit in mm



1. GATE 1
2. GATE 2
3. DRAIN
4. SOURCE

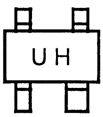
SMQ	
JEDEC	—
EIAJ	—
TOSHIBA	2-3J1A

Weight : 0.013g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Drain-Source Voltage	V_{DS}	15	V
Gate 1-Source Voltage	V_{G1S}	±8	V
Gate 2-Source Voltage	V_{G2S}	±8	V
Drain Current	I_D	30	mA
Drain Power Dissipation	P_D	150	mW
Channel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

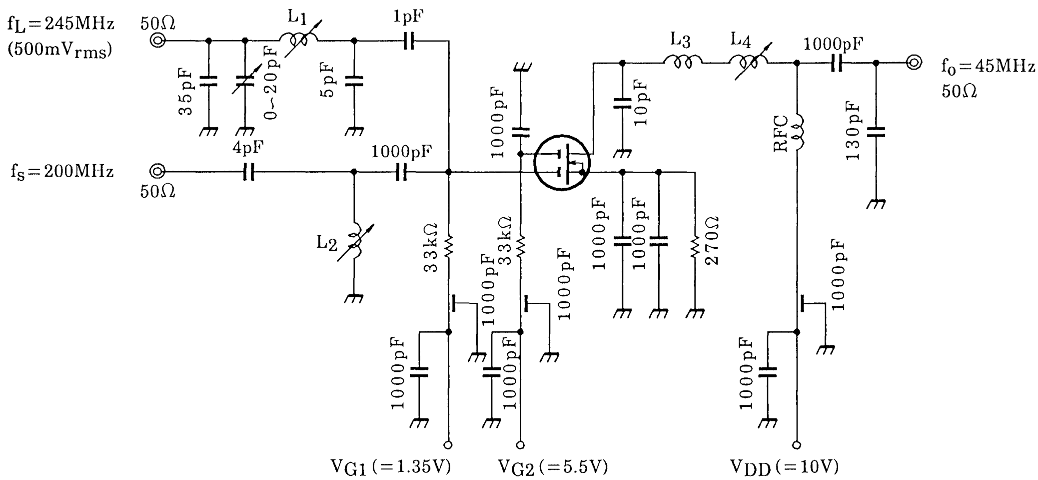
Marking



ELECTRICAL CHARACTERISTICS (Ta = 25°C)

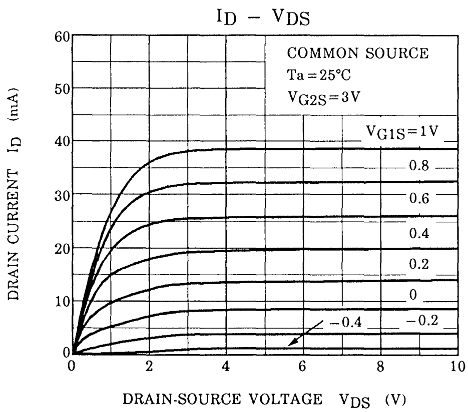
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate 1 Leakage Current	I_{G1SS}	V_{DS}=0, V_{G1S}=±6V, V_{G2S}=0	—	—	±50	nA
Gate 2 Leakage Current	I_{G2SS}	V_{DS}=0, V_{G1S}=0, V_{G2S}=±6V	—	—	±50	nA
Drain-Source Voltage	$V_{(BR)DSX}$	V_{G1S}=−4V, V_{G2S}=−4V, I_D=100μA	15	—	—	V
Drain Current	I_{DSS} (Note)	V_{DS}=6V, V_{G1S}=0, V_{G2S}=3V	3	—	14	mA
Gate 1-Source Cut-off Voltage	$V_{G1S(OFF)}$	V_{DS}=6V, V_{G2S}=3V, I_D=100μA	−0.15	—	−1.5	V
Gate 2-Source Cut-off Voltage	$V_{G2S(OFF)}$	V_{DS}=6V, V_{G1S}=3V, I_D=100μA	0	—	−1.0	V
Forward Transfer Admittance	$\|Y_{fe}\|$	V_{DS}=6V, V_{G2S}=3V, I_D=10mA, f=1kHz	—	27	—	mS
Input Capacitance	C_{iss}	V_{DS}=6V, V_{G2S}=3V, I_D=10mA, f=1MHz	—	2.7	3.6	pF
Reverse Transfer Capacitance	C_{rss}		—	0.025	0.04	pF
Conversion Gain	G_{CS}	V_{DD}=10V, f=200MHz f_L=245MHz (500mV_{rms}) (Fig.1)	21	24.5	—	dB
Noise Figure	NF_{CS}		—	3.3	5.5	dB

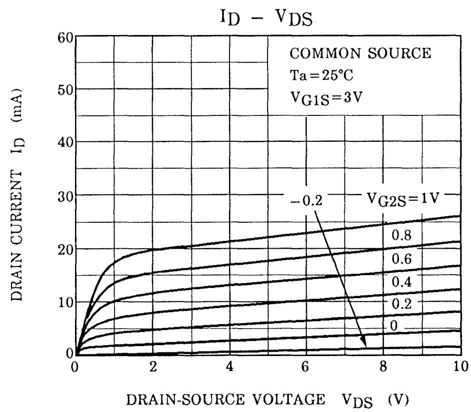
Note : I_{DSS} Classification Y : 3~7mA, GR : 6~14mA

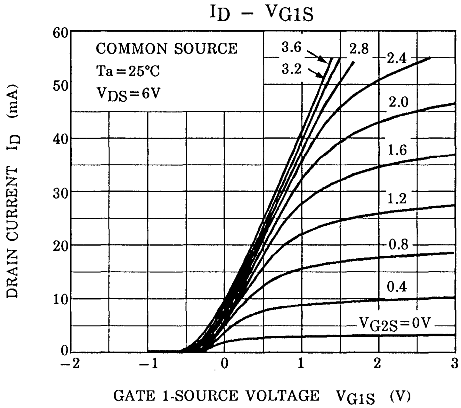


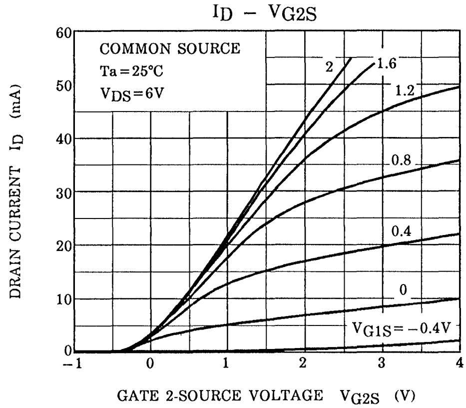
L1 : ϕ6.5mm BOBBIN WITH FERRITE CORE, ϕ0.7mm UEW, 2T
L2 : ϕ6.5mm BOBBIN WITH FERRITE CORE, ϕ0.7mm UEW, 2T
L3 : 3mm ID, ϕ0.5mm UEW, 4T
L4 : ϕ8mm BOBBIN WITH FERRITE CORE, ϕ0.35mm UEW, 7T
RFC : 100μH

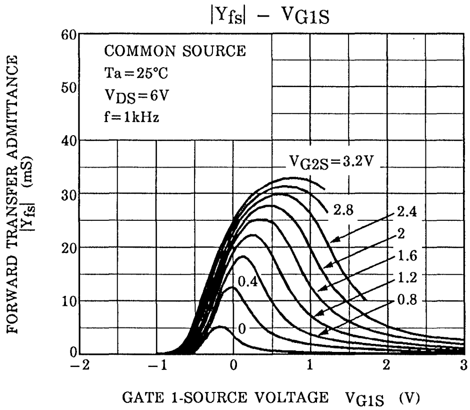
Fig.1 200MHz G_{CS}, NF_{CS} TEST CIRCUIT

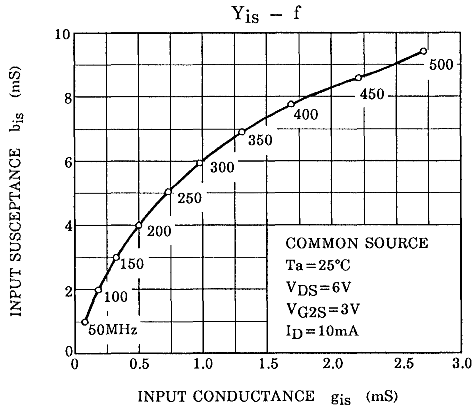


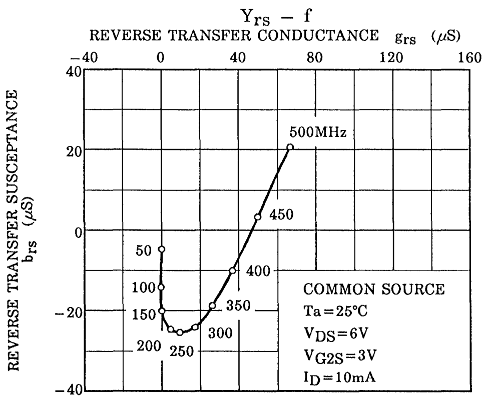


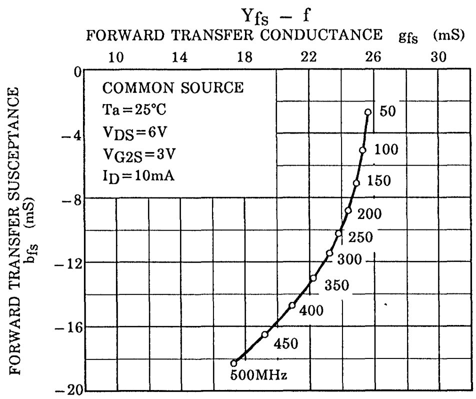

ID – VG1S
COMMON SOURCE
Ta=25°C
VDS=6V
3.6
3.2
2.8
2.4
2.0
1.6
1.2
0.8
0.4
VG2S=0V
DRAIN CURRENT ID (mA)
GATE 1-SOURCE VOLTAGE VG1S (V)

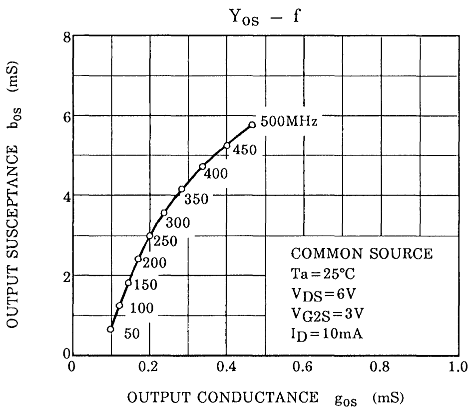

ID – VG2S
COMMON SOURCE
Ta=25°C
VDS=6V
2
1.6
1.2
0.8
0.4
0
VG1S=–0.4V
DRAIN CURRENT ID (mA)
GATE 2-SOURCE VOLTAGE VG2S (V)

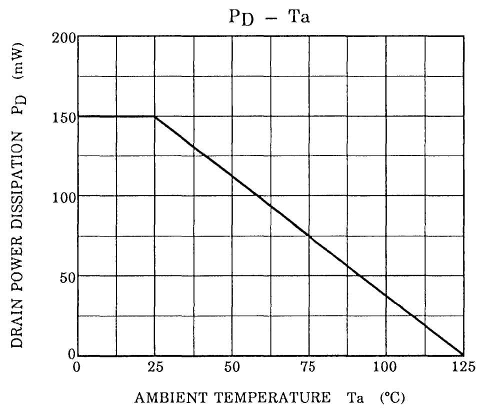

|Yfs| – VG1S
COMMON SOURCE
Ta=25°C
VDS=6V
f=1kHz
VG2S=3.2V
2.8
2.4
2
1.6
1.2
0.8
0.4
0
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)
GATE 1-SOURCE VOLTAGE VG1S (V)

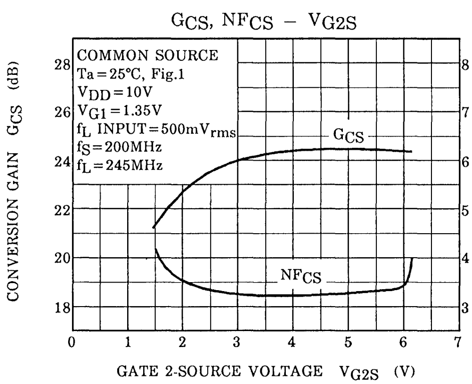

Yis – f
COMMON SOURCE
Ta=25°C
VDS=6V
VG2S=3V
ID=10mA
50MHz
100
150
200
250
300
350
400
450
500
INPUT SUSCEPTANCE bis (mS)
INPUT CONDUCTANCE gis (mS)

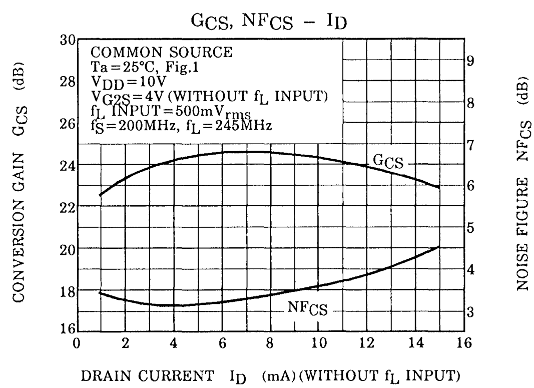

Yrs – f
REVERSE TRANSFER CONDUCTANCE grs (μS)
COMMON SOURCE
Ta=25°C
VDS=6V
VG2S=3V
ID=10mA
50
100
150
200
250
300
350
400
450
500MHz
REVERSE TRANSFER SUSCEPTANCE brs (μS)

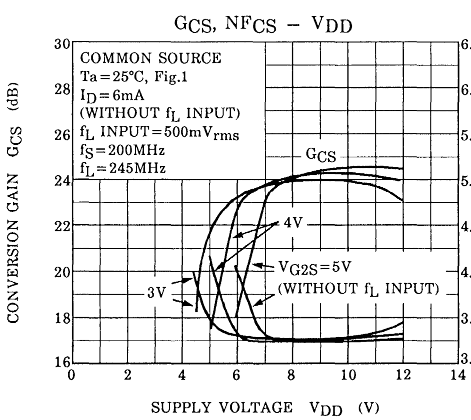

Yfs – f
FORWARD TRANSFER CONDUCTANCE gfs (mS)
COMMON SOURCE
Ta=25°C
VDS=6V
VG2S=3V
ID=10mA
50
100
150
200
250
300
350
400
450
500MHz
FORWARD TRANSFER SUSCEPTANCE bfs (mS)

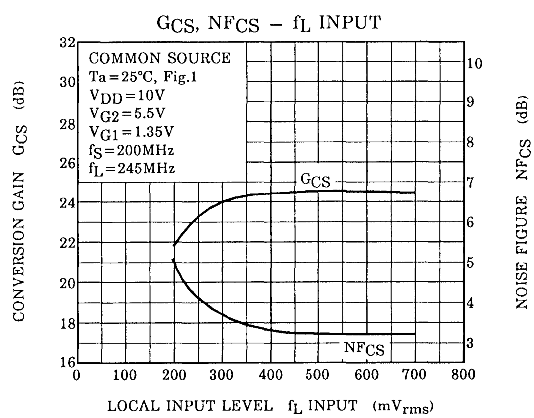

Yos – f
OUTPUT SUSCEPTANCE bos (mS)
OUTPUT CONDUCTANCE gos (mS)
500MHz
450
400
350
300
250
200
150
100
50
COMMON SOURCE
Ta=25°C
VDS=6V
VG2S=3V
ID=10mA


PD – Ta
DRAIN POWER DISSIPATION PD (mW)
AMBIENT TEMPERATURE Ta (°C)


GCS, NFCS – VG2S
COMMON SOURCE
Ta=25°C, Fig.1
VDD=10V
VG1=1.35V
fL INPUT=500mVrms
fS=200MHz
fL=245MHz
GCS
NFCS
CONVERSION GAIN GCS (dB)
NOISE FIGURE NFCS (dB)
GATE 2-SOURCE VOLTAGE VG2S (V)


GCS, NFCS – ID
COMMON SOURCE
Ta=25°C, Fig.1
VDD=10V
VG2S=4V (WITHOUT fL INPUT)
fL INPUT=500mVrms
fS=200MHz, fL=245MHz
GCS
NFCS
CONVERSION GAIN GCS (dB)
NOISE FIGURE NFCS (dB)
DRAIN CURRENT ID (mA) (WITHOUT fL INPUT)


GCS, NFCS – VDD
COMMON SOURCE
Ta=25°C, Fig.1
ID=6mA
(WITHOUT fL INPUT)
fL INPUT=500mVrms
fS=200MHz
fL=245MHz
GCS
4V
VG2S=5V
(WITHOUT fL INPUT)
3V
CONVERSION GAIN GCS (dB)
NOISE FIGURE NFCS (dB)
SUPPLY VOLTAGE VDD (V)


GCS, NFCS – fL INPUT
COMMON SOURCE
Ta=25°C, Fig.1
VDD=10V
VG2=5.5V
VG1=1.35V
fS=200MHz
fL=245MHz
GCS
NFCS
CONVERSION GAIN GCS (dB)
NOISE FIGURE NFCS (dB)
LOCAL INPUT LEVEL fL INPUT (mVrms)

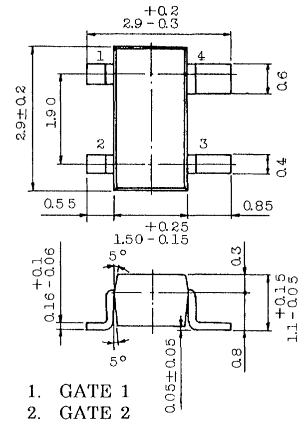
3SK153

SILICON N CHANNEL DUAL GATE MOS TYPE FIELD EFFECT TRANSISTOR

TV TUNER, UHF RF AMPLIFIER APPLICATIONS.
TV TUNER VHF WIDE BAND RF AMPLIFIER APPLICATIONS.

- Superior Cross Modulation Performance.
- Low Reverse Transfer Capacitance : C_{rss} = 0.025pF (Typ.)
- Low Noise Figure : NF = 2.6dB (Typ.)

Unit in mm



1. GATE 1
2. GATE 2
3. DRAIN
4. SOURCE

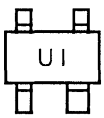
SMQ	
JEDEC	—
EIAJ	—
TOSHIBA	2-3J1A

Weight : 0.013g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Drain-Source Voltage	V_{DS}	13.5	V
Gate 1-Source Voltage	V_{G1S}	±8	V
Gate 2-Source Voltage	V_{G2S}	±8	V
Drain Current	I_D	30	mA
Drain Power Dissipation	P_D	150	mW
Channel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

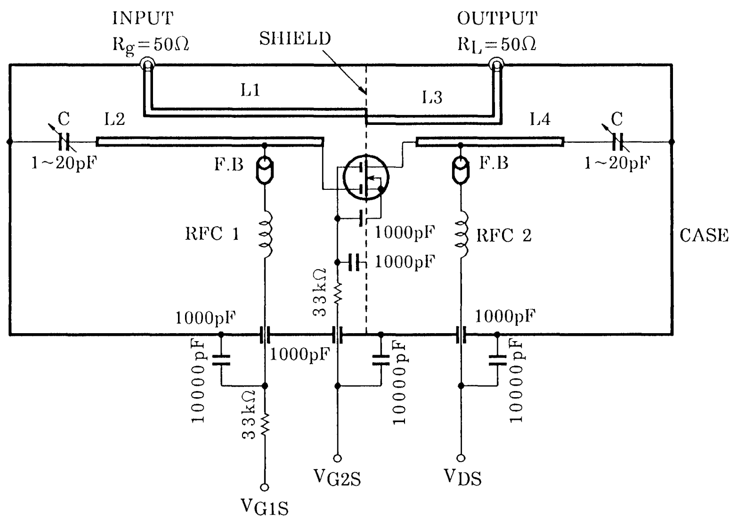
Marking



ELECTRICAL CHARACTERISTICS (Ta = 25°C)

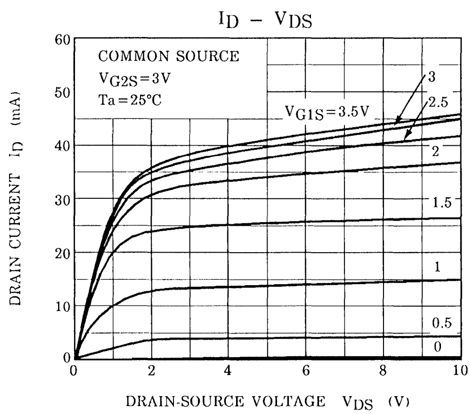
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate 1 Leakage Current	I_{G1SS}	$V_{DS}=0$, $V_{G1S}=\pm6V$, $V_{G2S}=0$	—	—	±50	nA
Gate 2 Leakage Current	I_{G2SS}	$V_{DS}=0$, $V_{G1S}=0$, $V_{G2S}=\pm6V$	—	—	±50	nA
Drain-Source Voltage	$V_{(BR)DSX}$	$V_{G1S}=-4V$, $V_{G2S}=-4V$, $I_D=100\mu A$	13.5	—	—	V
Drain Current	I_{DSS} (Note)	$V_{DS}=6V$, $V_{G1S}=0$, $V_{G2S}=3V$	0	—	2	mA
Gate 1-Source Cut-off Voltage	$V_{G1S(OFF)}$	$V_{DS}=6V$, $V_{G2S}=3V$, $I_D=100\mu A$	−1.5	—	1	V
Gate 2-Source Cut-off Voltage	$V_{G2S(OFF)}$	$V_{DS}=6V$, $V_{G1S}=3V$, $I_D=100\mu A$	−1.0	—	1	V
Forward Transfer Admittance	$\|Y_{fs}\|$	$V_{DS}=6V$, $V_{G2S}=3V$, $I_D=10mA$, $f=1kHz$	—	21	—	mS
Input Capacitance	C_{iss}	$V_{DS}=6V$, $V_{G2S}=3V$, $I_D=10mA$, $f=1MHz$	1.8	2.7	3.6	pF
Reverse Transfer Capacitance	C_{rss}		—	0.025	0.05	pF
Power Gain	G_{ps}	$V_{DS}=6V$, $V_{G2S}=3V$, $I_D=10mA$, $f=800MHz$ (Fig.1)	14	18.5	—	dB
Noise Figure	NF		—	2.6	4.0	dB

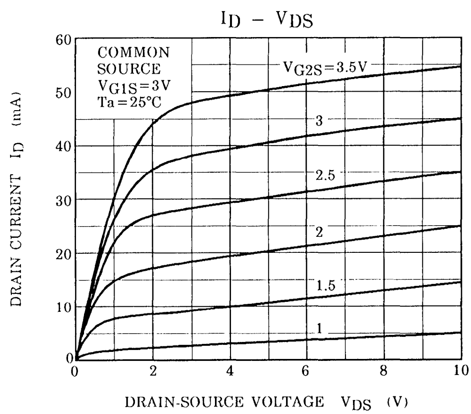
Note : I_{DSS} Classification 0 : 0~2mA



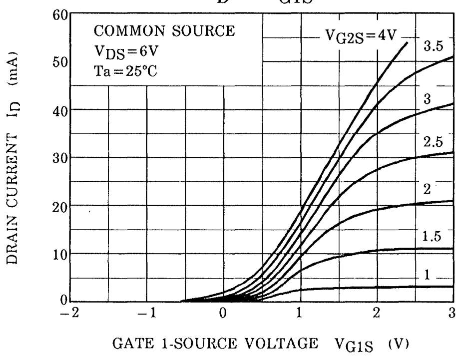
L1~L4 : ϕ0.8mm SILVER PLATED COPPER WIRE
C : AIR TRIMMER TTA25A200A (MURATA MFG. Co., LTD.)
RFC 1 : ϕ0.35mm COPPER WIRE 3mm ID, 7T
RFC 2 : ϕ0.35mm COPPER WIRE 3mm ID, 10T

Fig.1 800MHz G_{ps}, NF TEST CIRCUIT

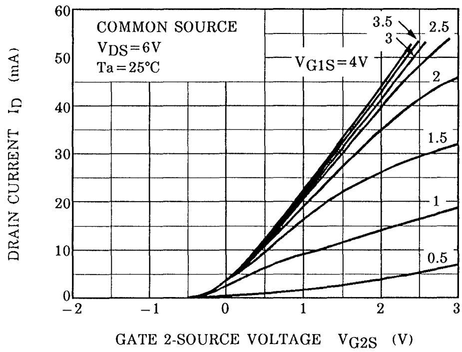




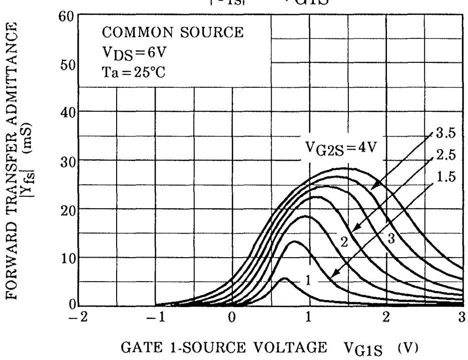
$I_D - V_{G1S}$



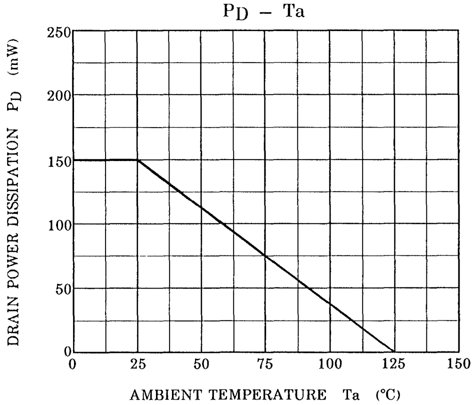
$I_D - V_{G2S}$



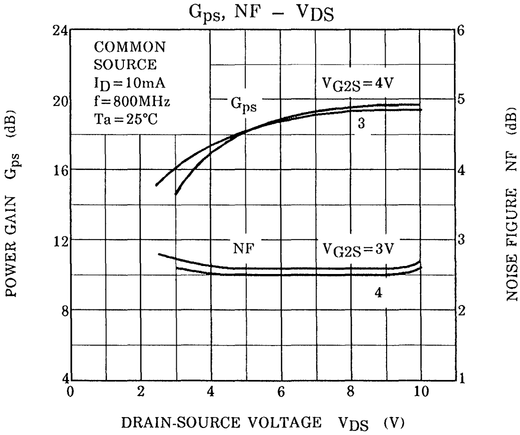
$|Y_{fs}| - V_{G1S}$



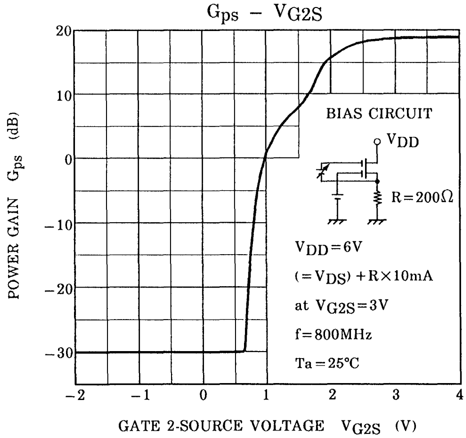
$P_D - T_a$



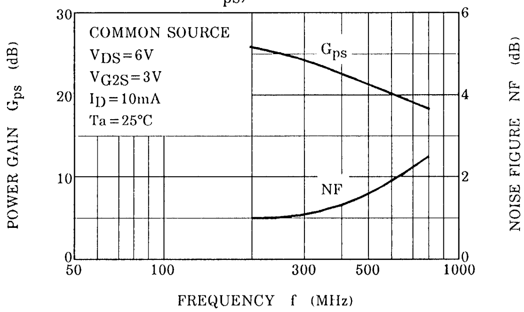
G_{ps}, $NF - V_{DS}$



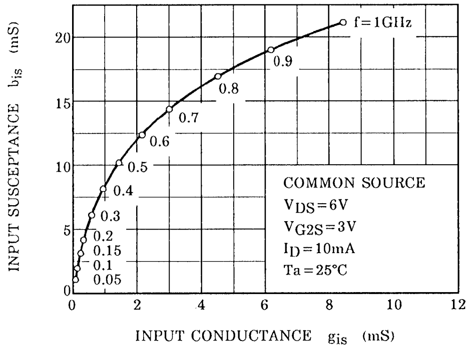
$G_{ps} - V_{G2S}$



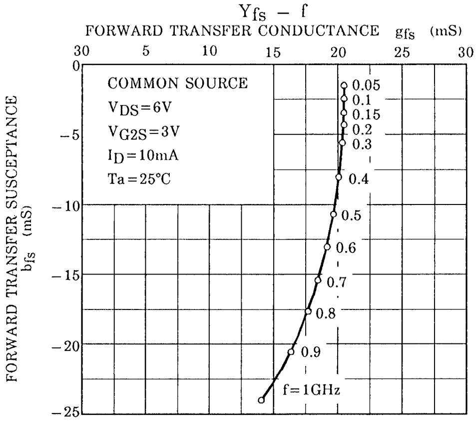
G_{ps}, NF − f



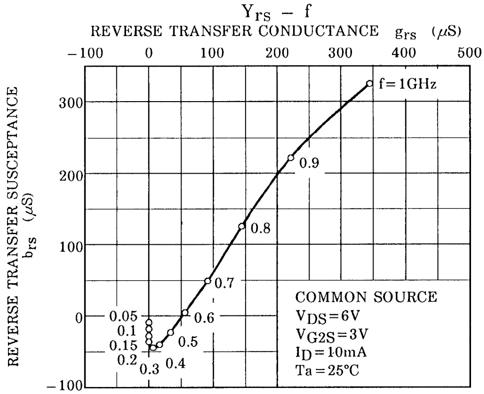
Y_{is} − f



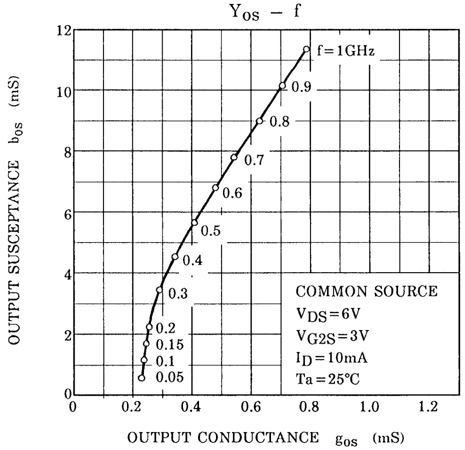
Y_{fs} − f



Y_{rs} − f



Y_{os} − f



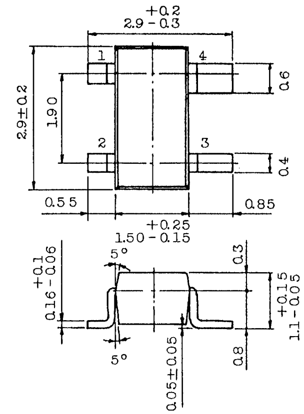
3SK160

SILICON N CHANNEL DUAL GATE MOS TYPE
FIELD EFFECT TRANSISTOR

TV TUNER, VHF RF AMPLIFIER APPLICATIONS.
TV TUNER VHF MIXER APPLICATIONS.

- Superior Cross Modulation Performance.
- Low Noise Figure : NF=2.1dB (Typ.)

Unit in mm



1. GATE 1
2. GATE 2
3. DRAIN
4. SOURCE

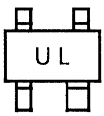
SMQ	
JEDEC	—
EIAJ	—
TOSHIBA	2-3J1A

Weight : 0.013g

MAXIMUM RATINGS (T_a = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Drain-Source Voltage	V_{DS}	13.5	V
Gate 1-Source Voltage	V_{G1S}	±8	V
Gate 2-Source Voltage	V_{G2S}	±8	V
Drain Current	I_D	30	mA
Drain Power Dissipation	P_D	150	mW
Channel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

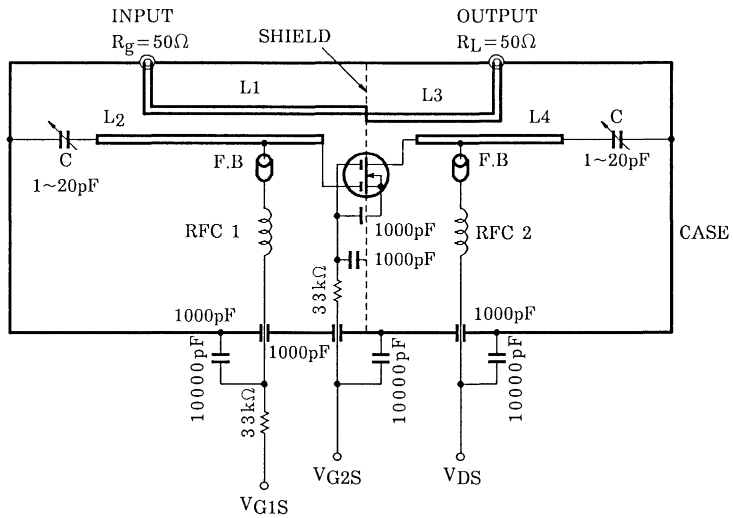
Marking



ELECTRICAL CHARACTERISTICS (T_a = 25°C)

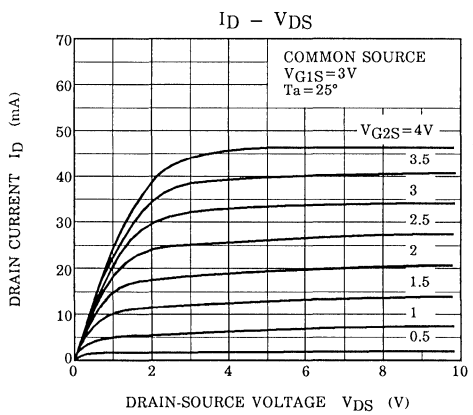
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate 1 Leakage Current	I_{G1SS}	$V_{DS}=0$, $V_{G1S}=\pm6V$, $V_{G2S}=0$	—	—	±50	nA
Gate 2 Leakage Current	I_{G2SS}	$V_{DS}=0$, $V_{G1S}=0$, $V_{G2S}=\pm6V$	—	—	±50	nA
Drain-Source Voltage	$V_{(BR)DSX}$	$V_{G1S}=-4V$, $V_{G2S}=-4V$, $I_D=100\mu A$	13.5	—	—	V
Drain Current	I_{DSS} (Note)	$V_{DS}=6V$, $V_{G1S}=0$, $V_{G2S}=3V$	0	—	2	mA
Gate 1-Source Cut-off Voltage	$V_{G1S(OFF)}$	$V_{DS}=6V$, $V_{G2S}=3V$, $I_D=100\mu A$	−1.5	—	1	V
Gate 2-Source Cut-off Voltage	$V_{G2S(OFF)}$	$V_{DS}=6V$, $V_{G1S}=3V$, $I_D=100\mu A$	−1.0	—	1	V
Forward Transfer Admittance	$\|Y_{fs}\|$	$V_{DS}=6V$, $V_{G2S}=3V$, $I_D=10mA$, f=1kHz	—	18	—	mS
Input Capacitance	C_{iss}	$V_{DS}=6V$, $V_{G2S}=3V$, $I_D=10mA$, f=1MHz	—	3.4	4.4	pF
Reverse Transfer Capacitance	C_{rss}		—	0.035	0.05	pF
Power Gain	G_{ps}	$V_{DS}=6V$, $V_{G2S}=3V$, $I_D=10mA$, f=500MHz (Fig.1)	14.5	18	—	dB
Noise Figure	NF		—	2.1	3.5	dB

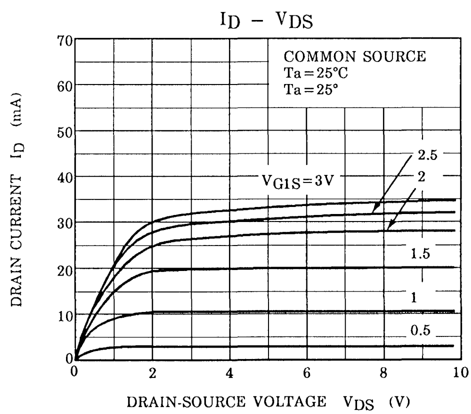
Note : I_{DSS} Classification 0 : 0~2mA

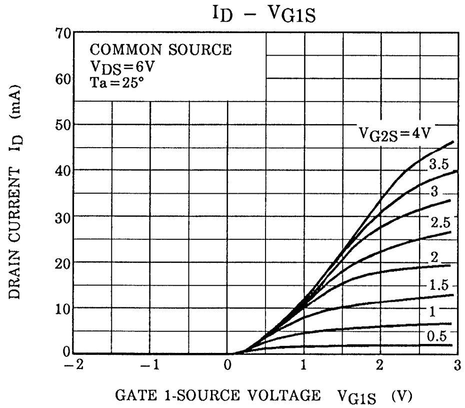


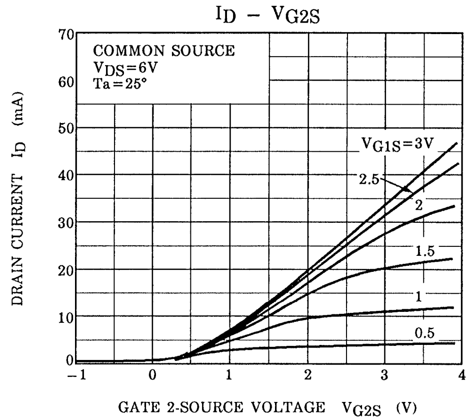
L1~L4 : ϕ0.8mm SILVER PLATED COPPER WIRE
C : AIR TRIMMER TTA25A200A (MURATA MFG. Co., LTD.)
RFC 1 : ϕ0.35mm COPPER WIRE 3mm ID, 7T
RFC 2 : ϕ0.35mm COPPER WIRE 3mm ID, 10T

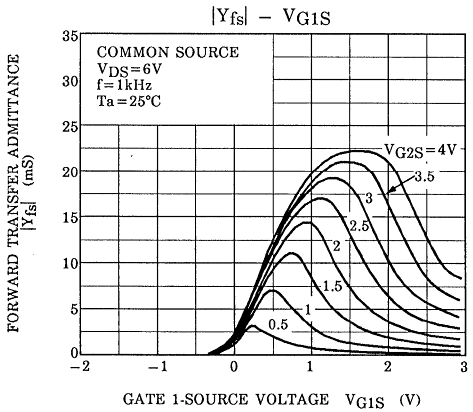
Fig.1 500MHz Gps, NF TEST CIRCUIT

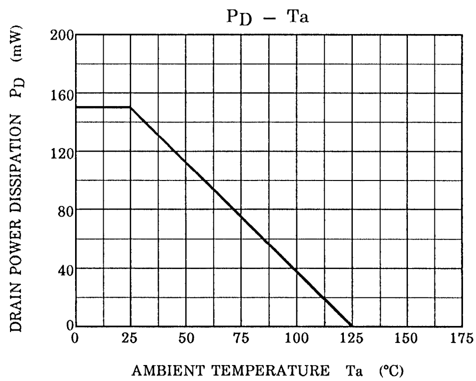


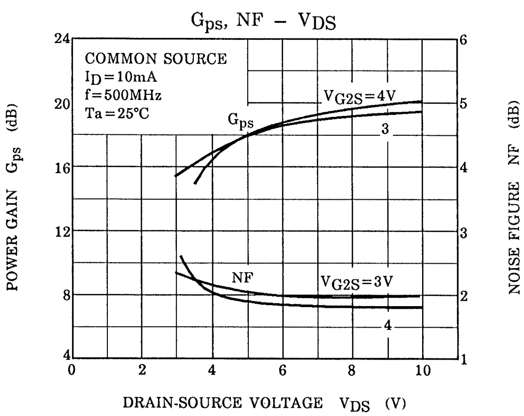


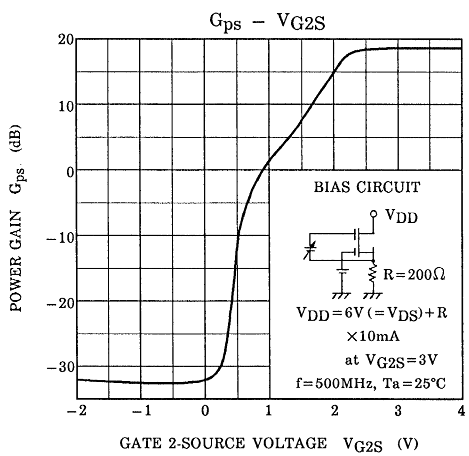

ID – VG1S
COMMON SOURCE
VDS=6V
Ta=25°
VG2S=4V
3.5
3
2.5
2
1.5
1
0.5
DRAIN CURRENT ID (mA)
GATE 1-SOURCE VOLTAGE VG1S (V)

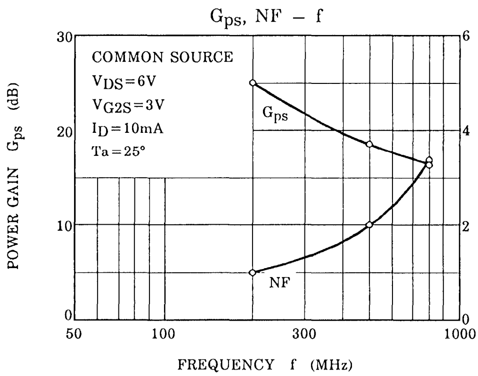

ID – VG2S
COMMON SOURCE
VDS=6V
Ta=25°
VG1S=3V
2.5
2
1.5
1
0.5
DRAIN CURRENT ID (mA)
GATE 2-SOURCE VOLTAGE VG2S (V)

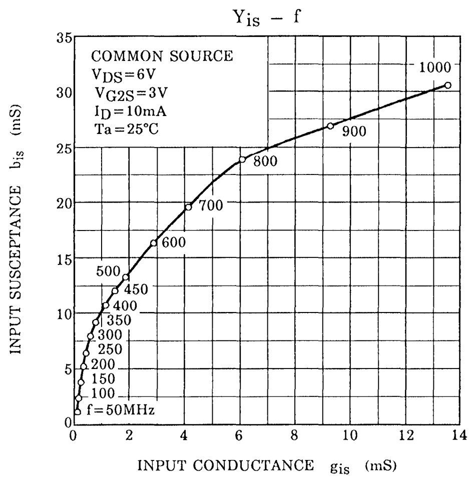

|Yfs| – VG1S
COMMON SOURCE
VDS=6V
f=1kHz
Ta=25°C
VG2S=4V
3.5
3
2.5
2
1.5
1
0.5
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)
GATE 1-SOURCE VOLTAGE VG1S (V)

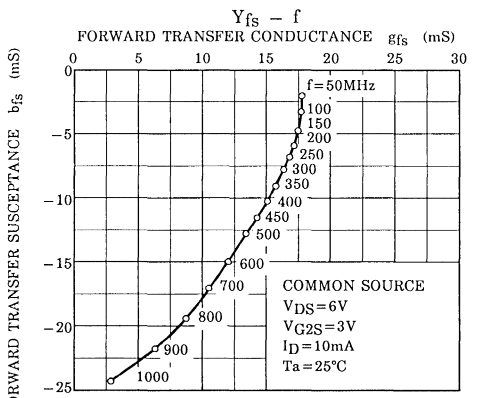

PD – Ta
DRAIN POWER DISSIPATION PD (mW)
AMBIENT TEMPERATURE Ta (°C)

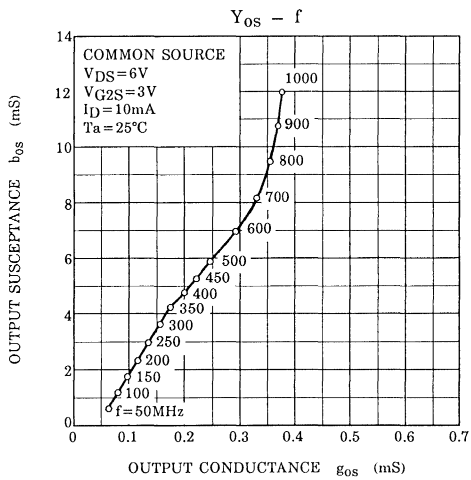

Gps, NF – VDS
COMMON SOURCE
ID=10mA
f=500MHz
Ta=25°C
Gps
VG2S=4V
3
NF
VG2S=3V
4
POWER GAIN Gps (dB)
NOISE FIGURE NF (dB)
DRAIN-SOURCE VOLTAGE VDS (V)

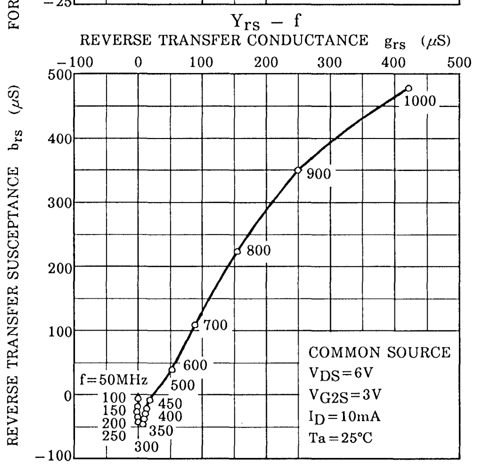

Gps – VG2S
BIAS CIRCUIT
VDD
R=200Ω
VDD=6V (=VDS)+R ×10mA
at VG2S=3V
f=500MHz, Ta=25°C
POWER GAIN Gps (dB)
GATE 2-SOURCE VOLTAGE VG2S (V)


Gps, NF – f
COMMON SOURCE
VDS=6V
VG2S=3V
ID=10mA
Ta=25°
Gps
NF
POWER GAIN Gps (dB)
NOISE FIGURE NF (dB)
FREQUENCY f (MHz)


Yis – f
COMMON SOURCE
VDS=6V
VG2S=3V
ID=10mA
Ta=25°C
INPUT SUSCEPTANCE bis (mS)
INPUT CONDUCTANCE gis (mS)


Yfs – f
FORWARD TRANSFER CONDUCTANCE gfs (mS)
COMMON SOURCE
VDS=6V
VG2S=3V
ID=10mA
Ta=25°C
FORWARD TRANSFER SUSCEPTANCE bfs (mS)


Yos – f
COMMON SOURCE
VDS=6V
VG2S=3V
ID=10mA
Ta=25°C
OUTPUT SUSCEPTANCE bos (mS)
OUTPUT CONDUCTANCE gos (mS)


Yrs – f
REVERSE TRANSFER CONDUCTANCE grs (μS)
COMMON SOURCE
VDS=6V
VG2S=3V
ID=10mA
Ta=25°C
REVERSE TRANSFER SUSCEPTANCE brs (μS)

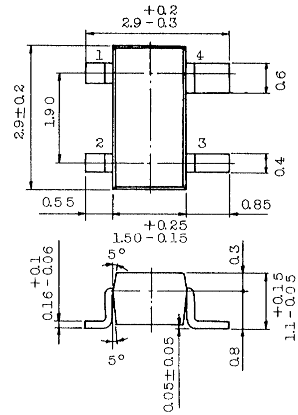
3SK195

SILICON N CHANNEL DUAL GATE MOS TYPE
FIELD EFFECT TRANSISTOR

TV TUNER, VHF RF AMPLIFIER APPLICATIONS.
FM TUNER APPLICATIONS.

- Superior Cross Modulation Performance.
- Low Reverse Transfer Capacitance : C_{rss} = 0.015pF (Typ.)
- Low Noise Figure : NF = 1.1dB (Typ.)

Unit in mm



1. GATE 1
2. GATE 2
3. DRAIN
4. SOURCE

SMQ

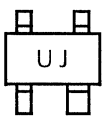
JEDEC	—
EIAJ	—
TOSHIBA	2-3J1A

Weight : 0.013g

MAXIMUM RATINGS (Ta = 25°C)

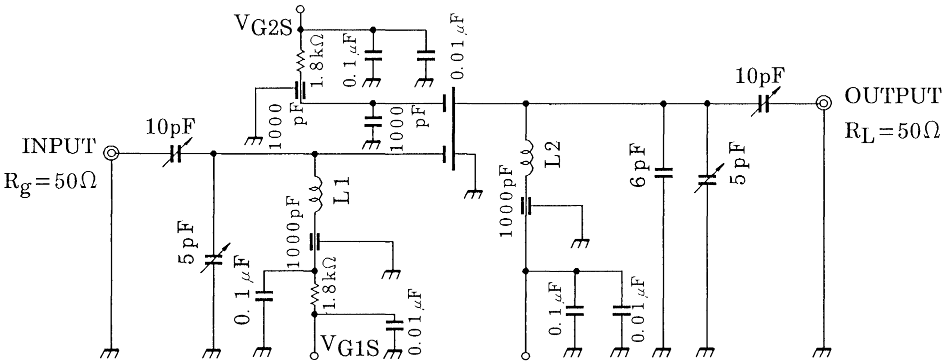
CHARACTERISTIC	SYMBOL	RATING	UNIT
Drain-Source Voltage	V_{DS}	13.5	V
Gate 1-Source Voltage	V_{G1S}	±8	V
Gate 2-Source Voltage	V_{G2S}	±8	V
Drain Current	I_D	30	mA
Drain Power Dissipation	P_D	150	mW
Channel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Marking

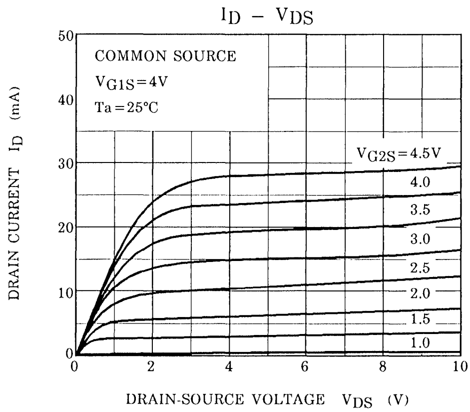


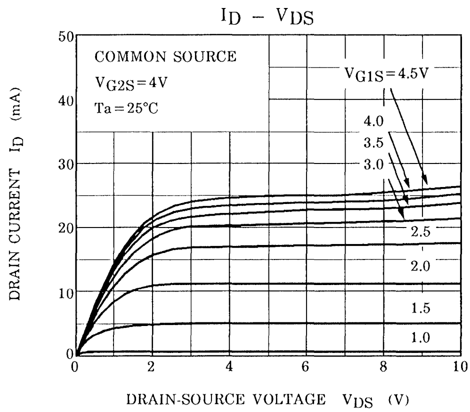
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

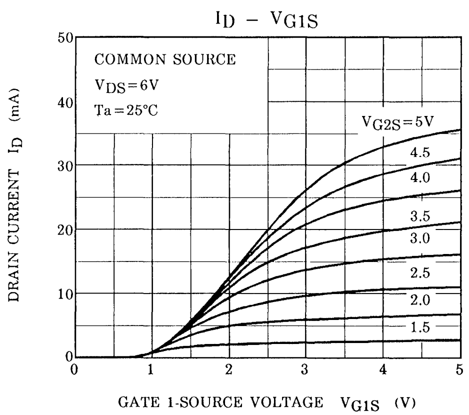
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate 1 Leakage Current	I_{G1SS}	V_{DS}=0, V_{G1S}=±4V, V_{G2S}=0	—	—	±50	nA
Gate 2 Leakage Current	I_{G2SS}	V_{DS}=0, V_{G1S}=0, V_{G2S}=±4V	—	—	±50	nA
Drain-Source Voltage	$V_{(BR)DSX}$	V_{G1S}=−4V, V_{G2S}=−4V, I_D=100μA	13.5	—	—	V
Drain Current	I_{DSS}	V_{DS}=6V, V_{G1S}=0, V_{G2S}=4V	0	—	0.1	mA
Gate 1-Source Cut-off Voltage	$V_{G1S(OFF)}$	V_{DS}=6V, V_{G2S}=4V, I_D=100μA	0	—	1.0	V
Gate 2-Source Cut-off Voltage	$V_{G2S(OFF)}$	V_{DS}=6V, V_{G1S}=4V, I_D=100μA	0	—	1.2	V
Forward Transfer Admittance	$\|Y_{fs}\|$	V_{DS}=6V, V_{G2S}=4V, I_D=10mA, f=1kHz	—	13	—	mS
Input Capacitance	C_{iss}	V_{DS}=6V, V_{G2S}=4V, I_D=10mA, f=1MHz	2.0	2.7	3.4	pF
Reverse Transfer Capacitance	C_{rss}		—	0.015	0.03	pF
Power Gain	G_{ps}	V_{DS}=6V, V_{G2S}=4V, I_D=10mA, f=200MHz (Fig.1)	22	27	—	dB
Noise Figure	NF		—	1.1	2.2	dB

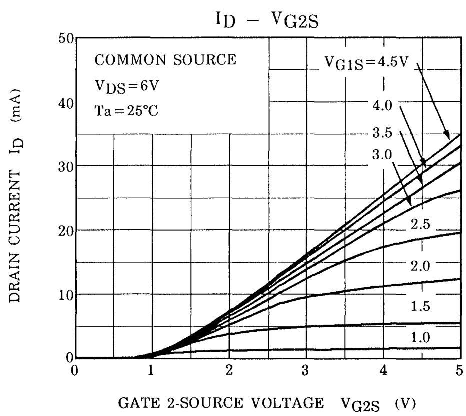


L1 : 1mmφ Silver Plated Copper Wire, 2 Turns, 8mm ID
L2 : 1mmφ Silver Plated Copper Wire, 2.5 Turns, 8mm ID
Fig.1 200MHz, Gps NF TEST CIRCUIT

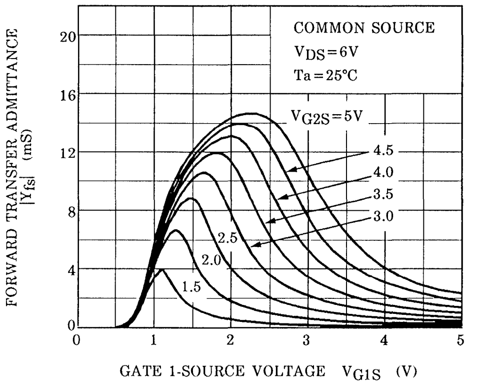




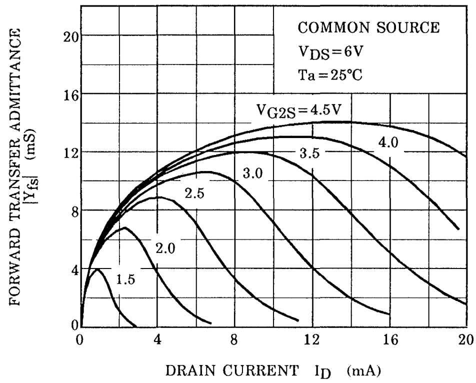




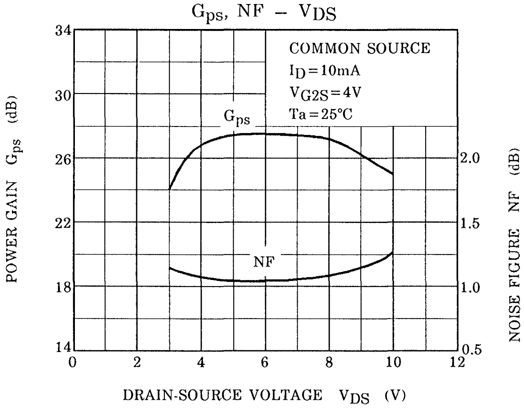
$|Y_{fs}|$ – V_{G1S}



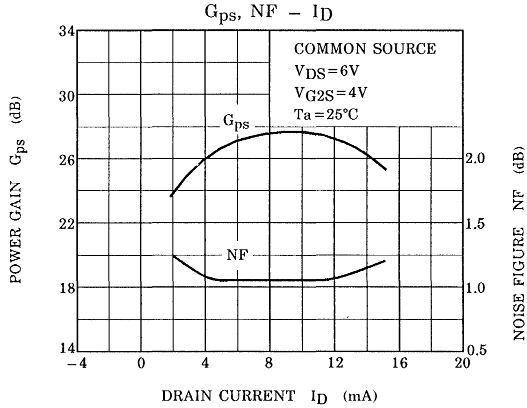
$|Y_{fs}|$ – I_D



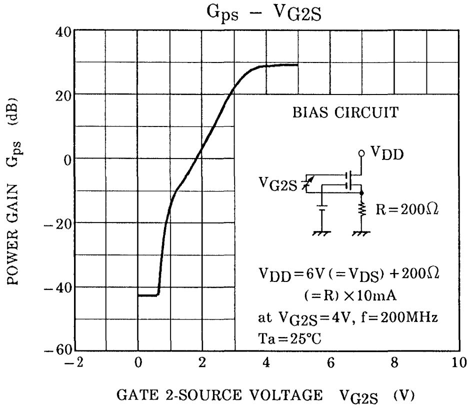
G_{ps}, NF – V_{DS}



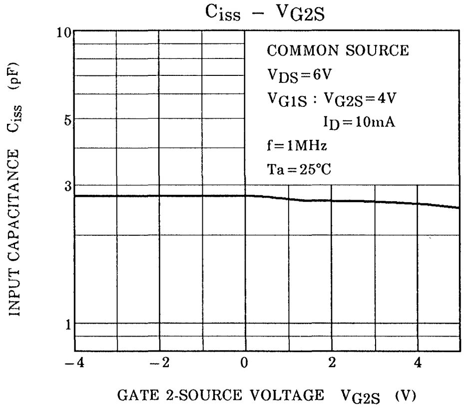
G_{ps}, NF – I_D

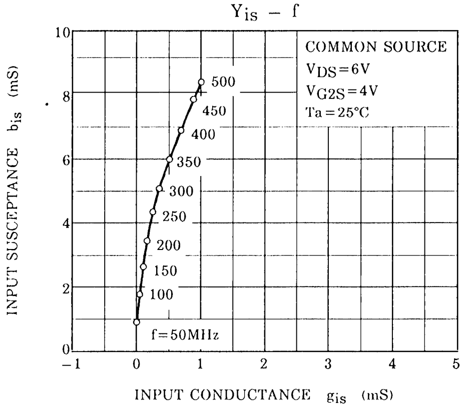


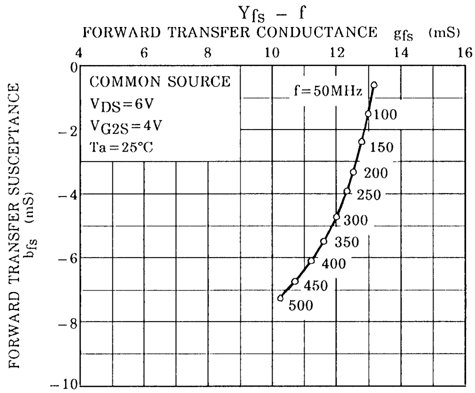
G_{ps} – V_{G2S}

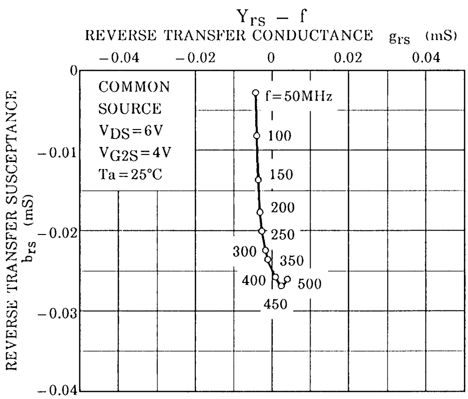


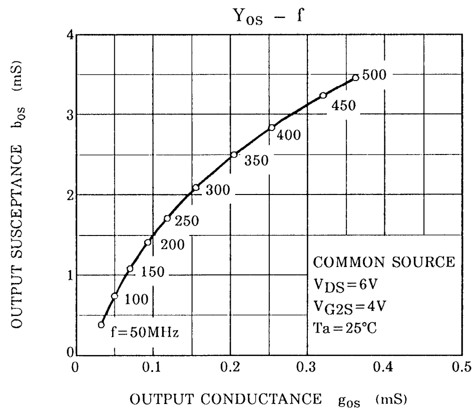
C_{iss} – V_{G2S}

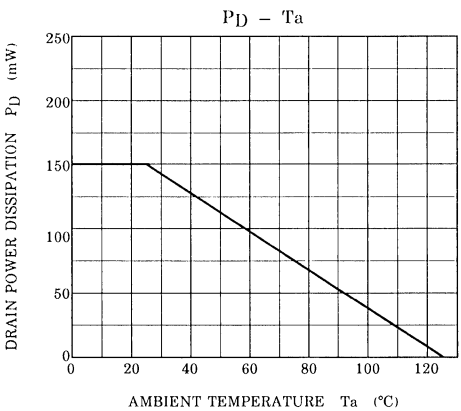



Yis – f
COMMON SOURCE
VDS=6V
VG2S=4V
Ta=25°C
f=50MHz
INPUT SUSCEPTANCE bis (mS)
INPUT CONDUCTANCE gis (mS)


Yfs – f
FORWARD TRANSFER CONDUCTANCE gfs (mS)
COMMON SOURCE
VDS=6V
VG2S=4V
Ta=25°C
f=50MHz
FORWARD TRANSFER SUSCEPTANCE bfs (mS)


Yrs – f
REVERSE TRANSFER CONDUCTANCE grs (mS)
COMMON
SOURCE
VDS=6V
VG2S=4V
Ta=25°C
f=50MHz
REVERSE TRANSFER SUSCEPTANCE brs (mS)


Yos – f
COMMON SOURCE
VDS=6V
VG2S=4V
Ta=25°C
f=50MHz
OUTPUT SUSCEPTANCE bos (mS)
OUTPUT CONDUCTANCE gos (mS)


PD – Ta
DRAIN POWER DISSIPATION PD (mW)
AMBIENT TEMPERATURE Ta (°C)

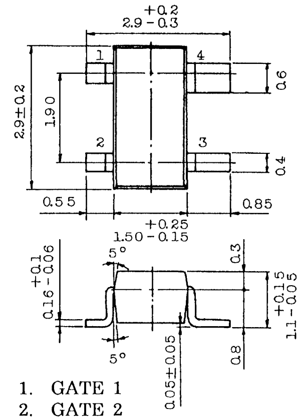
3SK199

SILICON N CHANNEL DUAL GATE MOS TYPE FIELD EFFECT TRANSISTOR

TV TUNER, UHF RF AMPLIFIER APPLICATIONS.

- Superior Cross Modulation Performance.
- Low Reverse Transfer Capacitance : $C_{rss}=0.015pF$ (Typ.)
- Low Noise Figure : NF = 1.9dB (Typ.)

Unit in mm



1. GATE 1
2. GATE 2
3. DRAIN
4. SOURCE

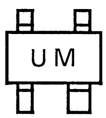
SMQ	
JEDEC	—
EIAJ	—
TOSHIBA	2-3J1A

Weight : 0.013g

MAXIMUM RATINGS (Ta = 25°C)

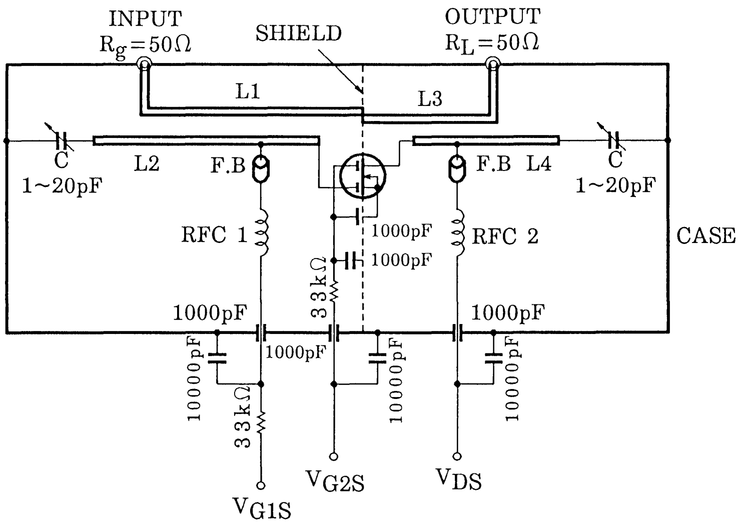
CHARACTERISTIC	SYMBOL	RATING	UNIT
Drain-Source Voltage	V_{DS}	13.5	V
Gate 1-Source Voltage	V_{G1S}	±8	V
Gate 2-Source Voltage	V_{G2S}	±8	V
Drain Current	I_D	30	mA
Drain Power Dissipation	P_D	150	mW
Channel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Marking



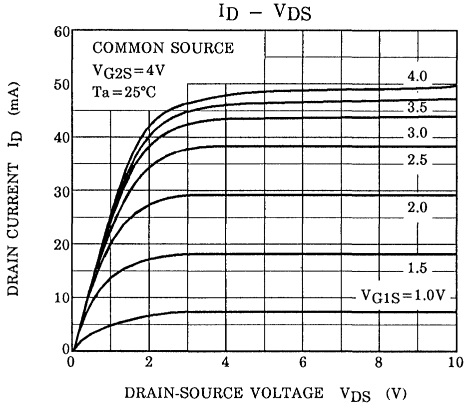
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

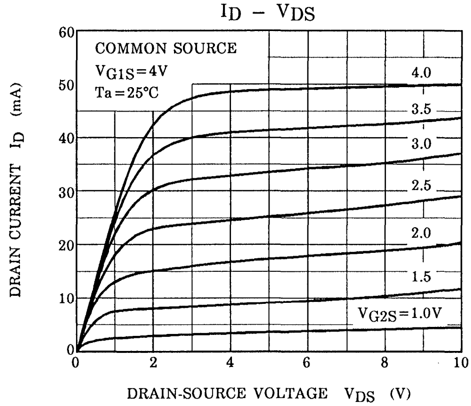
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate 1 Leakage Current	I_{G1SS}	$V_{DS}=0$, $V_{G1S}=\pm6V$, $V_{G2S}=0$	—	—	±50	nA
Gate 2 Leakage Current	I_{G2SS}	$V_{DS}=0$, $V_{G1S}=0$, $V_{G2S}=\pm6V$	—	—	±50	nA
Drain-Source Voltage	$V_{(BR)DSX}$	$V_{G1S}=-4V$, $V_{G2S}=-4V$, $I_D=100\mu A$	13.5	—	—	V
Drain Current	I_{DSS}	$V_{DS}=6V$, $V_{G1S}=0$, $V_{G2S}=4V$	0	—	0.1	mA
Gate 1-Source Cut-off Voltage	$V_{G1S(OFF)}$	$V_{DS}=6V$, $V_{G2S}=4V$, $I_D=100\mu A$	0	—	1.0	V
Gate 2-Source Cut-off Voltage	$V_{G2S(OFF)}$	$V_{DS}=6V$, $V_{G1S}=4V$, $I_D=100\mu A$	0	—	1.2	V
Forward Transfer Admittance	$\|Y_{fs}\|$	$V_{DS}=6V$, $V_{G2S}=4V$, $I_D=10mA$, f=1kHz	—	21.5	—	mS
Input Capacitance	C_{iss}	$V_{DS}=6V$, $V_{G2S}=4V$, $I_D=10mA$, f=1MHz	1.0	1.6	2.4	pF
Reverse Transfer Capacitance	C_{rss}		—	0.015	0.03	pF
Power Gain	G_{ps}	$V_{DS}=6V$, $V_{G2S}=4V$, $I_D=10mA$, f=800MHz (Fig.1)	18	19.5	—	dB
Noise Figure	NF		—	1.9	3.0	dB

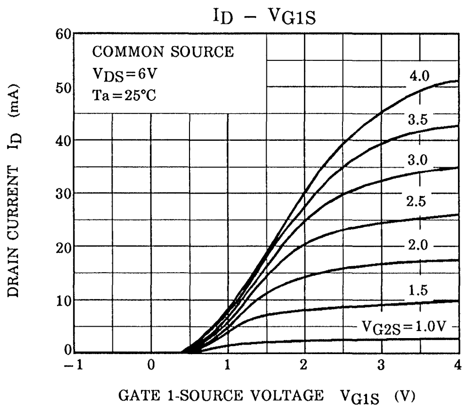


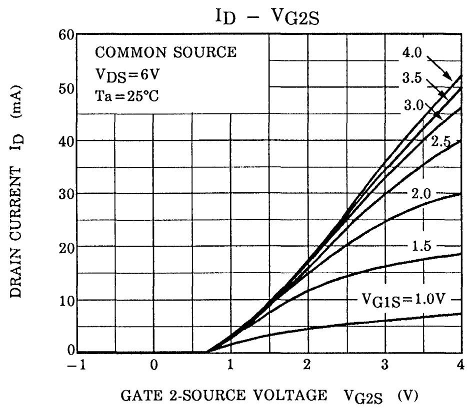
L1~L4 : φ0.8mm SILVER PLATED COPPER WIRE
C : AIR TRIMMER TTA25A200A (MURATA MFG. Co., Ltd.)
RFC 1 : φ0.35mm COPPER WIRE 3mm ID, 7T
RFC 2 : φ0.35mm COPPER WIRE 3mm ID, 10T

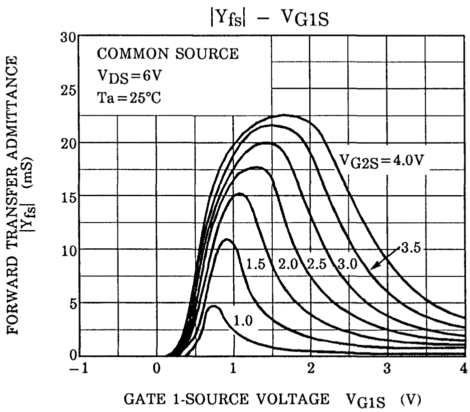
Fig.1 800MHz G_{ps}, NF TEST CIRCUIT

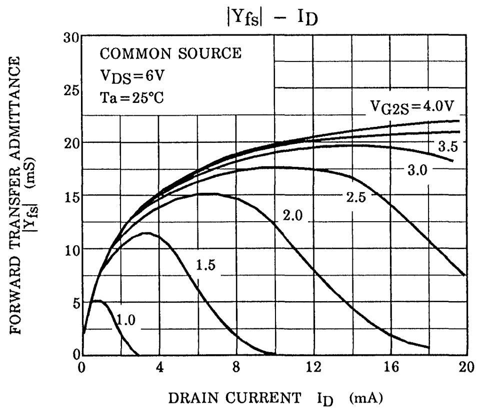

ID – VDS
COMMON SOURCE
VG2S=4V
Ta=25°C
4.0
3.5
3.0
2.5
2.0
1.5
VG1S=1.0V
DRAIN CURRENT ID (mA)
DRAIN-SOURCE VOLTAGE VDS (V)


ID – VDS
COMMON SOURCE
VG1S=4V
Ta=25°C
4.0
3.5
3.0
2.5
2.0
1.5
VG2S=1.0V
DRAIN CURRENT ID (mA)
DRAIN-SOURCE VOLTAGE VDS (V)

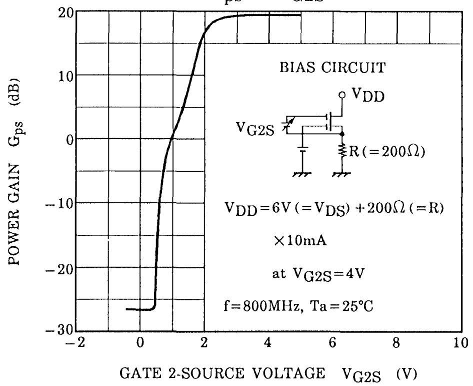

ID – VG1S
COMMON SOURCE
VDS=6V
Ta=25°C
4.0
3.5
3.0
2.5
2.0
1.5
VG2S=1.0V
DRAIN CURRENT ID (mA)
GATE 1-SOURCE VOLTAGE VG1S (V)


ID – VG2S
COMMON SOURCE
VDS=6V
Ta=25°C
4.0
3.5
3.0
2.5
2.0
1.5
VG1S=1.0V
DRAIN CURRENT ID (mA)
GATE 2-SOURCE VOLTAGE VG2S (V)

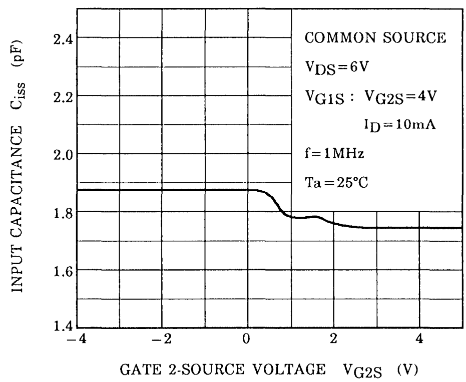

|Yfs| – VG1S
COMMON SOURCE
VDS=6V
Ta=25°C
VG2S=4.0V
3.5
1.0
1.5
2.0
2.5
3.0
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)
GATE 1-SOURCE VOLTAGE VG1S (V)


|Yfs| – ID
COMMON SOURCE
VDS=6V
Ta=25°C
VG2S=4.0V
3.5
3.0
2.5
2.0
1.5
1.0
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)
DRAIN CURRENT ID (mA)

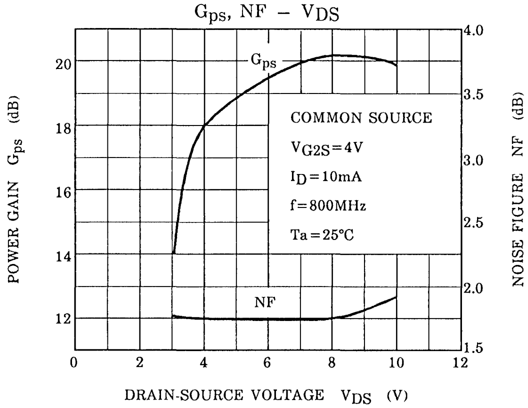
G_{ps} – V_{G2S}



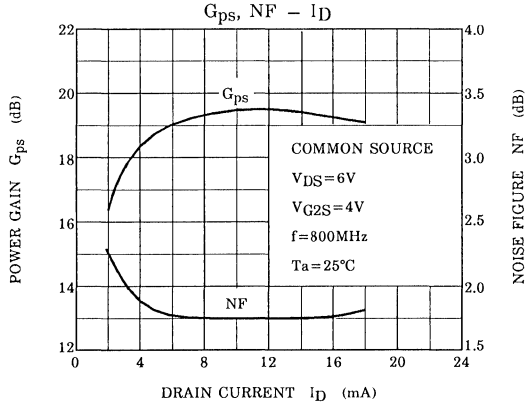
C_{iss} – V_{G2S}



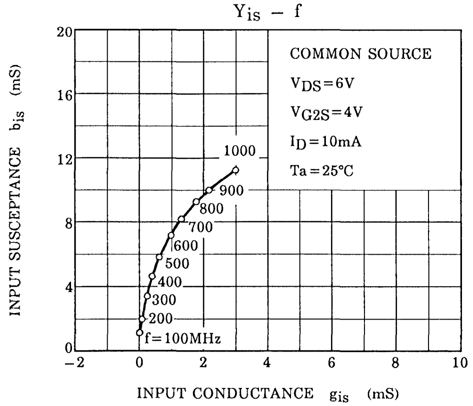
G_{ps}, NF – V_{DS}



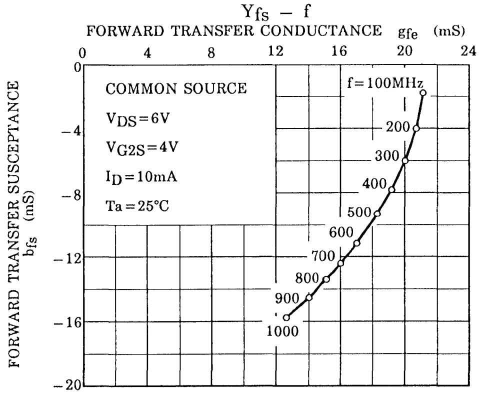
G_{ps}, NF – I_D

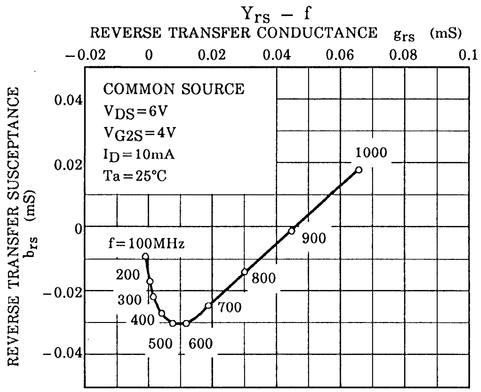


Y_{is} – f

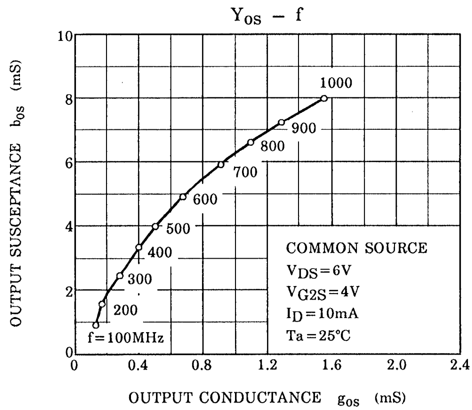


Y_{fs} – f

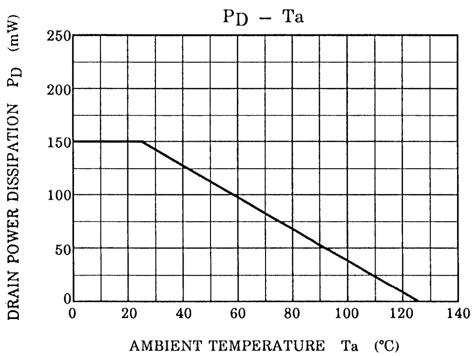




Yrs – f
REVERSE TRANSFER CONDUCTANCE grs (mS)
−0.02
0
0.02
0.04
0.06
0.08
0.1
0.04
0.02
0
−0.02
−0.04
REVERSE TRANSFER SUSCEPTANCE brs (mS)
COMMON SOURCE
VDS=6V
VG2S=4V
ID=10mA
Ta=25°C
f=100MHz
200
300
400
500
600
700
800
900
1000



Yos – f
10
8
6
4
2
0
OUTPUT SUSCEPTANCE bos (mS)
0
0.4
0.8
1.2
1.6
2.0
2.4
OUTPUT CONDUCTANCE gos (mS)
COMMON SOURCE
VDS=6V
VG2S=4V
ID=10mA
Ta=25°C
f=100MHz
200
300
400
500
600
700
800
900
1000



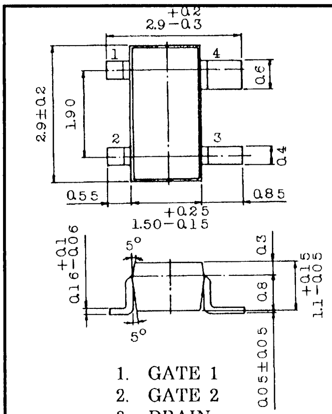
PD – Ta
250
200
150
100
50
0
DRAIN POWER DISSIPATION PD (mW)
0
20
40
60
80
100
120
140
AMBIENT TEMPERATURE Ta (°C)

SILICON N CHANNEL DUAL GATE MOS TYPE FIELD EFFECT TRANSISTOR

3SK207

TV TUNER, UHF RF AMPLIFIER APPLICATIONS.

Unit in mm



1. GATE 1
2. GATE 2
3. DRAIN
4. SOURCE

JEDEC	—
EIAJ	—
TOSHIBA	2-3J1A

Weight : 0.013g

- Superior Cross Modulation Performance.
- Low Reverse Transfer Capacitance : C_{rss} = 0.015pF (Typ.)
- Low Noise Figure : NF = 1.9dB (Typ.)

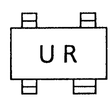
MAXIMUM RATINGS (Ta = 25°C)

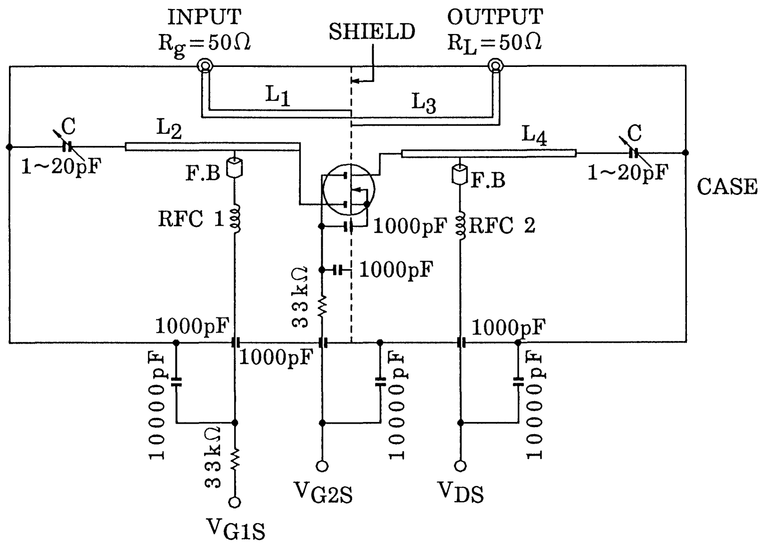
CHARACTERISTIC	SYMBOL	RATING	UNIT
Drain-Source Voltage	V_{DS}	13.5	V
Gate 1-Source Voltage	V_{G1S}	±8	V
Gate 2-Source Voltage	V_{G2S}	±8	V
Drain Current	I_D	30	mA
Drain Power Dissipation	P_D	150	mW
Chanel Temperature	Tch	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate 1 Leakage Current	I_{G1SS}	$V_{DS}=0$, $V_{G1S}=\pm6V$, $V_{G2S}=0$	—	—	±50	nA
Gate 2 Leakage Current	I_{G2SS}	$V_{DS}=0$, $V_{G1S}=0$, $V_{G2S}=\pm6V$	—	—	±50	nA
Drain-Source Voltage	$V_{(BR)DSX}$	$V_{G1S}=-4V$, $V_{G2S}=-4V$ $I_D=100\mu A$	13.5	—	—	V
Drain Current	I_{DSS}	$V_{DS}=6V$, $V_{G1S}=0$, $V_{G2S}=4.5V$	0	—	0.1	mA
Gate 1-Source Cut-off Voltage	$V_{G1S(OFF)}$	$V_{DS}=6V$, $V_{G2S}=4.5V$, $I_D=100\mu A$	0	—	1.0	V
Gate 2-Source Cut-off Voltage	$V_{G2S(OFF)}$	$V_{DS}=6V$, $V_{G1S}=4V$, $I_D=100\mu A$	0.5	1.0	1.5	V
Forward Transfer Admittance	$\|y_{fs}\|$	$V_{DS}=6V$, $V_{G2S}=4.5V$ $I_D=10mA$, f=1kHz	—	21.5	—	mS
Input Capacitance	C_{iss}	$V_{DS}=6V$, $V_{G2S}=4.5V$ $I_D=10mA$, f=1MHz	1.0	1.6	2.4	pF
Reverse Transfer Capacitance	C_{rss}		—	0.015	0.03	pF
Power Gain	G_{ps}	$V_{DS}=6V$, $V_{G2S}=4.5V$ $I_D=10mA$, f=800MHz (Fig.1)	18	19.5	—	dB
Noise Figure	NF		—	1.9	3.0	dB

Marking

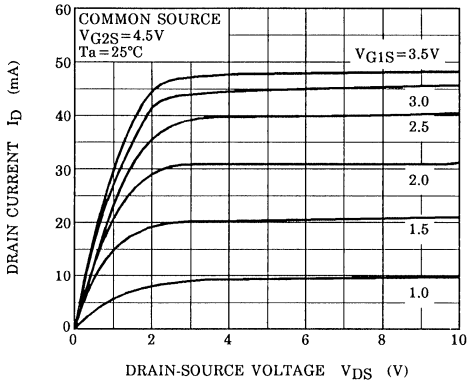




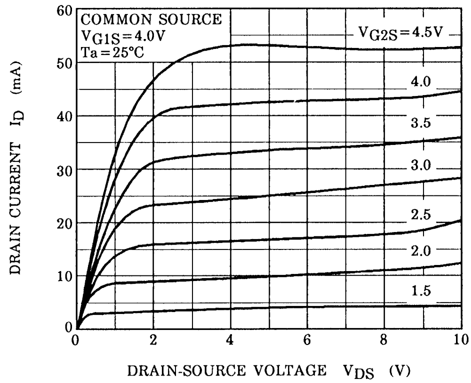
$L_1 \sim L_4$: ϕ0.8mm SILVER PLATED COPPER WIRE
C : AIR TRIMMER TTA25A200A (MURATA MFG. Co., Ltd.)
RFC 1 : ϕ0.35mm COPPER WIRE 3mm ID, 7T
RFC 2 : ϕ0.35mm COPPER WIRE 3mm ID, 10T

Fig.1 800MHz G_{ps}, NF TEST CIRCUIT

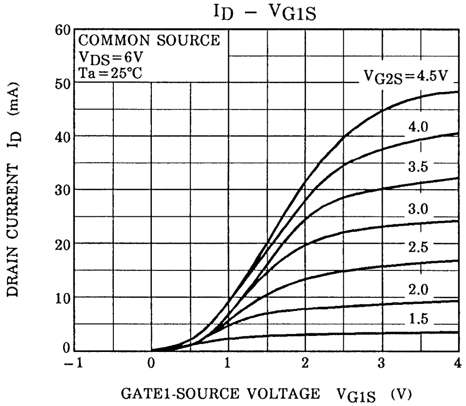
I_D – V_{DS}



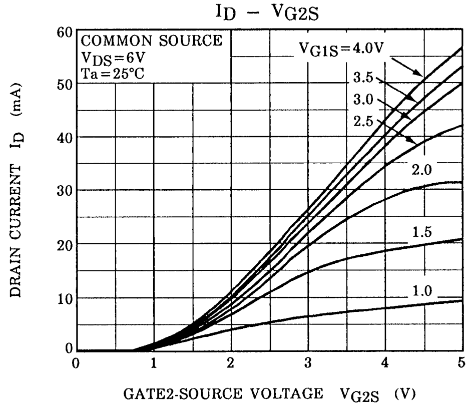
I_D – V_{DS}



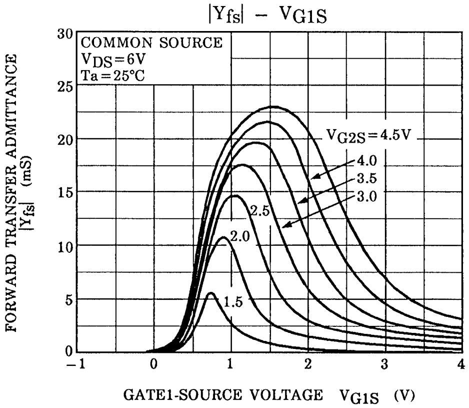
I_D – V_{G1S}



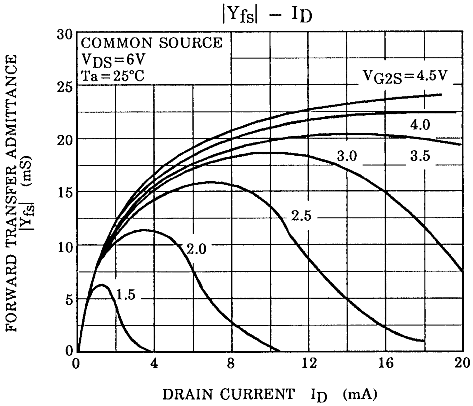
I_D – V_{G2S}

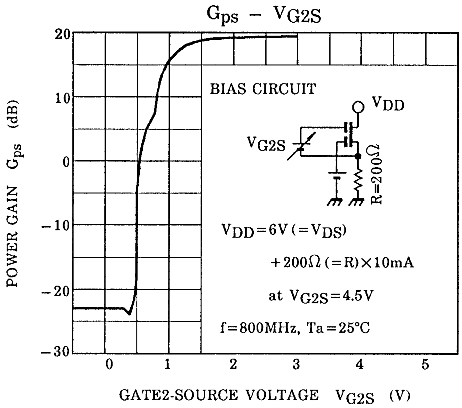


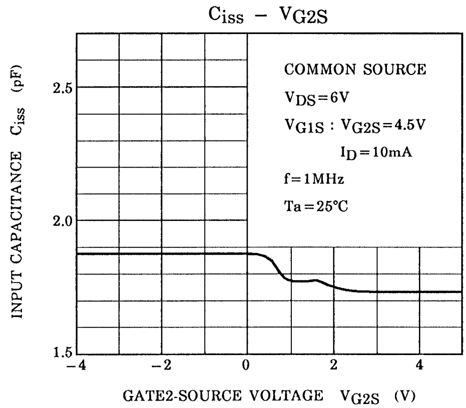
$|Y_{fs}|$ – V_{G1S}

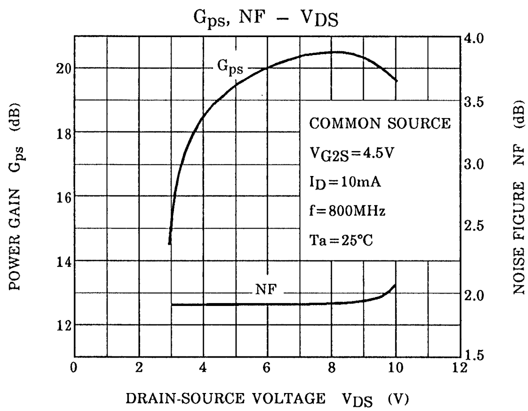


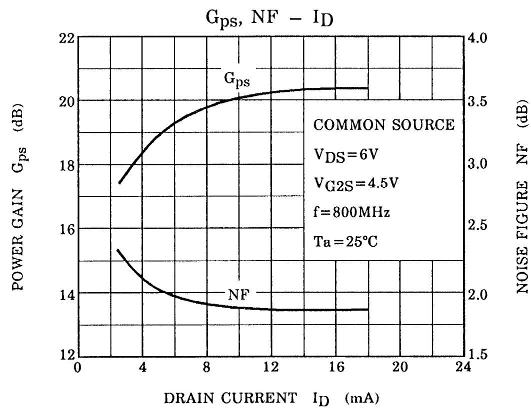
$|Y_{fs}|$ – I_D

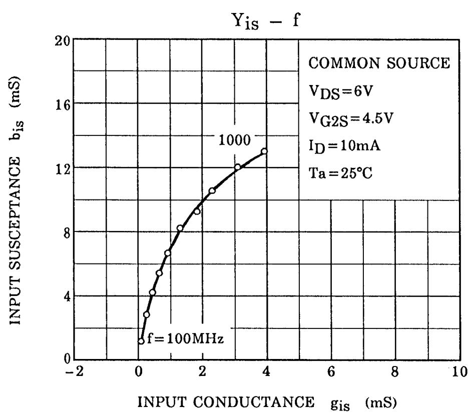


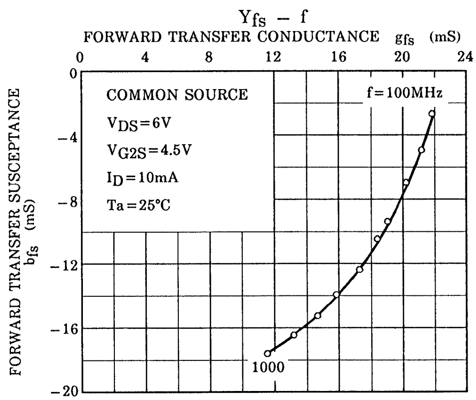

Gps – VG2S
BIAS CIRCUIT
VDD
VG2S
R=200Ω
VDD=6V (=VDS)
+200Ω (=R)×10mA
at VG2S=4.5V
f=800MHz, Ta=25°C
POWER GAIN Gps (dB)
GATE2-SOURCE VOLTAGE VG2S (V)


Ciss – VG2S
COMMON SOURCE
VDS=6V
VG1S : VG2S=4.5V
ID=10mA
f=1MHz
Ta=25°C
INPUT CAPACITANCE Ciss (pF)
GATE2-SOURCE VOLTAGE VG2S (V)

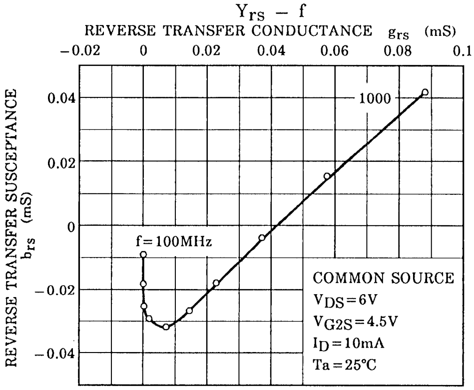

Gps, NF – VDS
Gps
NF
COMMON SOURCE
VG2S=4.5V
ID=10mA
f=800MHz
Ta=25°C
POWER GAIN Gps (dB)
NOISE FIGURE NF (dB)
DRAIN-SOURCE VOLTAGE VDS (V)


Gps, NF – ID
Gps
NF
COMMON SOURCE
VDS=6V
VG2S=4.5V
f=800MHz
Ta=25°C
POWER GAIN Gps (dB)
NOISE FIGURE NF (dB)
DRAIN CURRENT ID (mA)

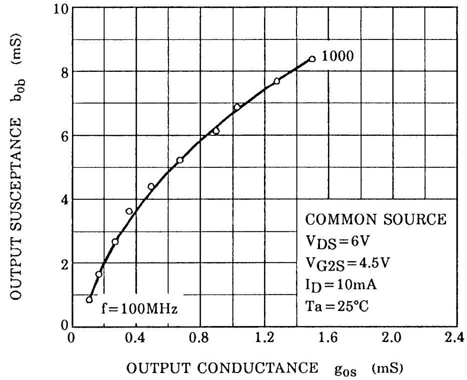

Yis – f
COMMON SOURCE
VDS=6V
VG2S=4.5V
ID=10mA
Ta=25°C
1000
f=100MHz
INPUT SUSCEPTANCE bis (mS)
INPUT CONDUCTANCE gis (mS)


Yfs – f
FORWARD TRANSFER CONDUCTANCE gfs (mS)
COMMON SOURCE
VDS=6V
VG2S=4.5V
ID=10mA
Ta=25°C
f=100MHz
1000
FORWARD TRANSFER SUSCEPTANCE bfs (mS)

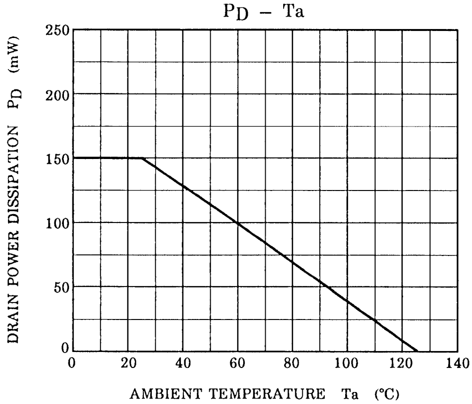
Yrs – f



Yos – f



PD – Ta



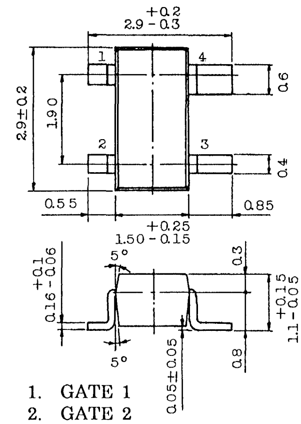
3SK225

SILICON N CHANNEL DUAL GATE MOS TYPE
FIELD EFFECT TRANSISTOR

TV TUNER, VHF RF AMPLIFIER APPLICATIONS.
FM TUNER APPLICATIONS.
TV TUNER, UHF RF AMPLIFIER APPLICATIONS.

- Superior Cross Modulation Performance.
- Low Noise Figure : NF=2.0dB (Typ.)

Unit in mm



1. GATE 1
2. GATE 2
3. DRAIN
4. SOURCE

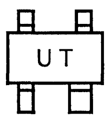
SMQ	
JEDEC	—
EIAJ	—
TOSHIBA	2-3J1A

Weight : 0.013g

MAXIMUM RATINGS (Ta = 25°C)

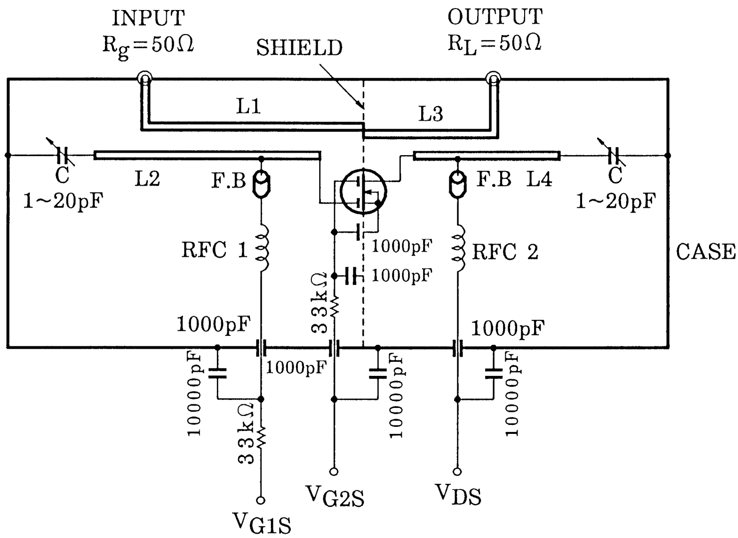
CHARACTERISTIC	SYMBOL	RATING	UNIT
Drain-Source Voltage	V_{DS}	13.5	V
Gate 1-Source Voltage	V_{G1S}	±8	V
Gate 2-Source Voltage	V_{G2S}	±8	V
Drain Current	I_D	30	mA
Drain Power Dissipation	P_D	150	mW
Channel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Marking



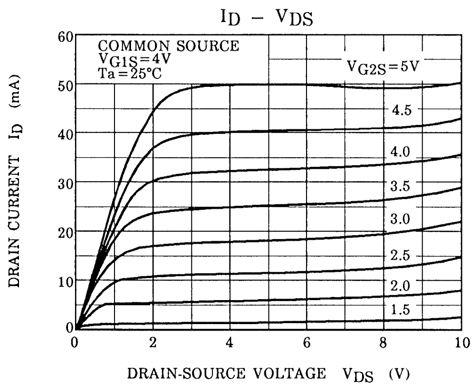
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

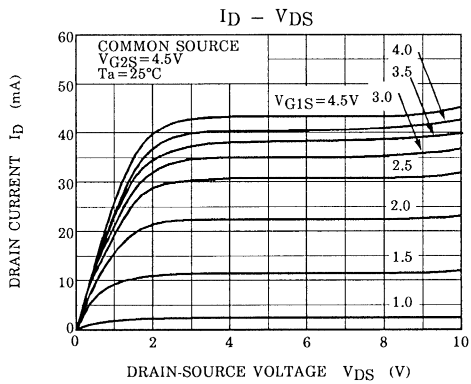
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate 1 Leakage Current	I_{G1SS}	$V_{DS}=0$, $V_{G1S}=\pm 6V$, $V_{G2S}=0$	—	—	±50	nA
Gate 2 Leakage Current	I_{G2SS}	$V_{DS}=0$, $V_{G1S}=0$, $V_{G2S}=\pm 6V$	—	—	±50	nA
Drain-Source Voltage	$V_{(BR)DSX}$	$V_{G1S}=-4V$, $V_{G2S}=-4V$, $I_D=100\mu A$	13.5	—	—	V
Drain Current	I_{DSS}	$V_{DS}=6V$, $V_{G1S}=0$, $V_{G2S}=4.5V$	0	—	0.1	mA
Gate 1-Source Cut-off Voltage	$V_{G1S(OFF)}$	$V_{DS}=6V$, $V_{G2S}=4.5V$, $I_D=100\mu A$	0	—	1.0	V
Gate 2-Source Cut-off Voltage	$V_{G2S(OFF)}$	$V_{DS}=6V$, $V_{G1S}=4V$, $I_D=100\mu A$	0.5	1.0	1.5	V
Forward Transfer Admittance	$\|Y_{fs}\|$	$V_{DS}=6V$, $V_{G2S}=4.5V$, $I_D=10mA$, $f=1kHz$	—	21	—	mS
Input Capacitance	C_{iss}	$V_{DS}=6V$, $V_{G2S}=4.5V$, $I_D=10mA$, $f=1MHz$	—	3.4	4.4	pF
Reverse Transfer Capacitance	C_{rss}		—	0.020	0.05	pF
Power Gain	G_{ps}	$V_{DS}=6V$, $V_{G2S}=4.5V$, $I_D=10mA$, $f=500MHz$ (Fig.1)	19	22	—	dB
Noise Figure	NF		—	2.0	3.5	dB



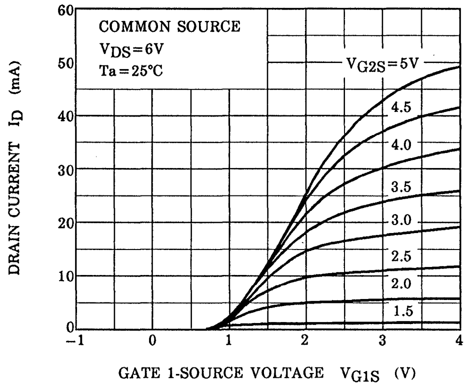
L1 L4 : ϕ0.8mm SILVER PLATED COPPER WIRE
C : AIR TRIMMER TTA25A200A (MURATA MFG. Co., Ltd.)
RFC 1 : ϕ0.35mm COPPER WIRE 3mm ID, 7T
RFC 2 : ϕ0.35mm COPPER WIRE 3mm ID, 10T

Fig.1 500MHz, G_{ps}, NF TEST CIRCUIT

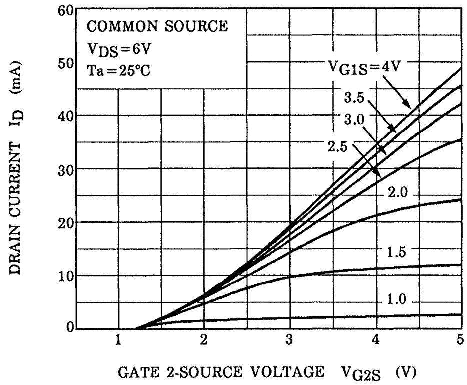




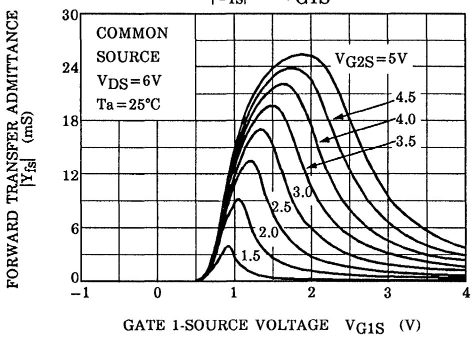
ID – VG1S



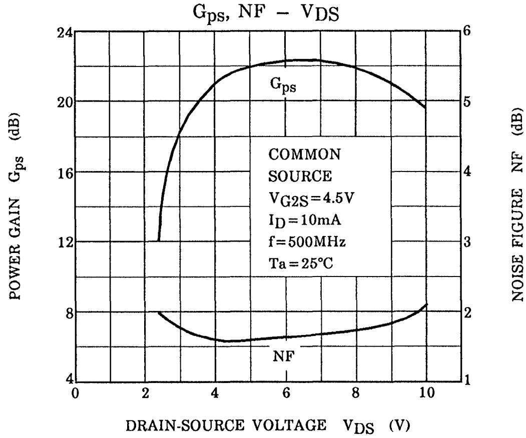
ID – VG2S



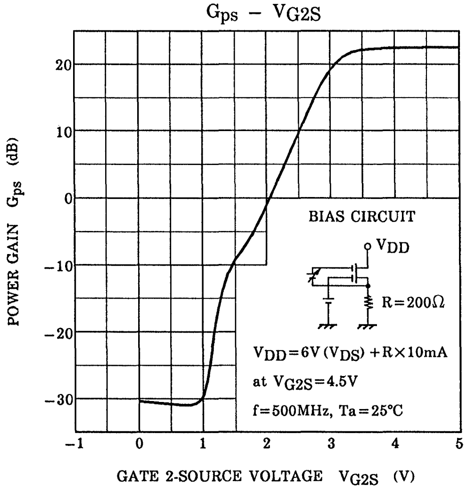
|Yfs| – VG1S



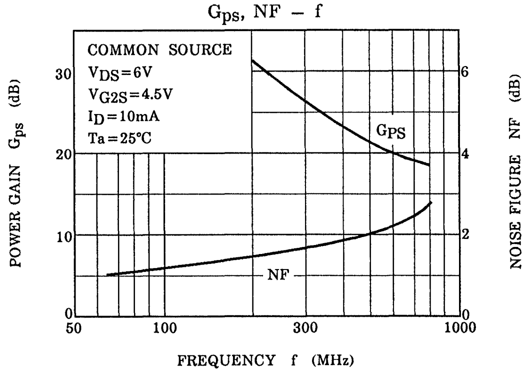
Gps, NF – VDS



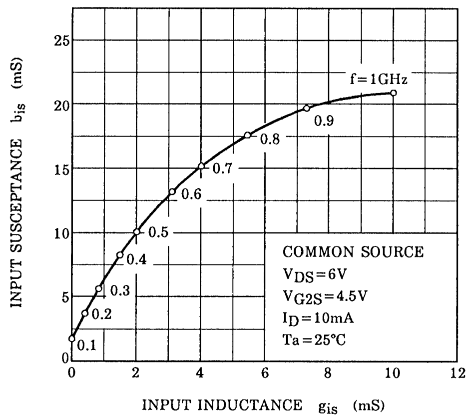
Gps – VG2S



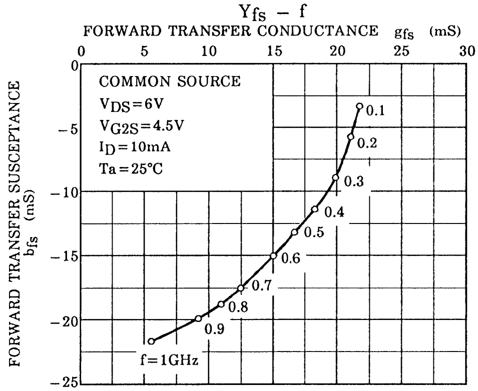
Gps, NF – f



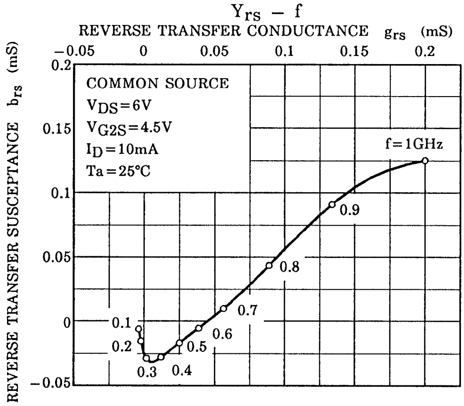
$Y_{is} - f$



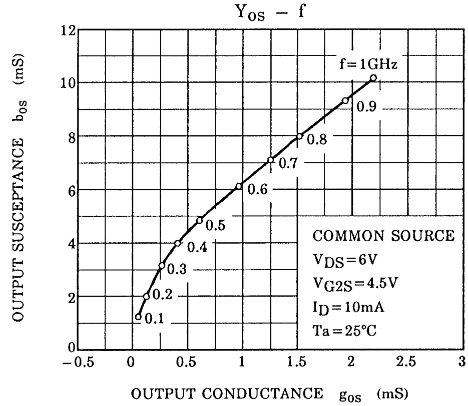
$Y_{fs} - f$



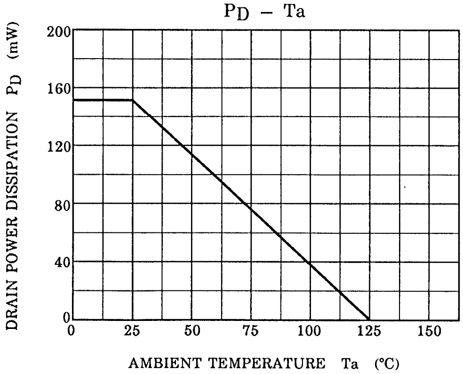
$Y_{rs} - f$



$Y_{os} - f$



$P_D - Ta$



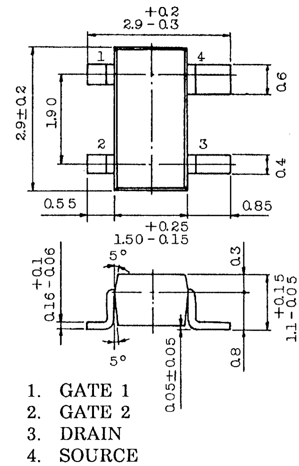
3SK226

SILICON N CHANNEL DUAL GATE MOS TYPE
FIELD EFFECT TRANSISTOR

TV TUNER, VHF RF AMPLIFIER APPLICATIONS.
FM TUNER APPLICATIONS.

- Superior Cross Modulation Performance.
- Low Reverse Transfer Capacitance : C_{rss} = 0.015pF (Typ.)
- Low Noise Figure : NF = 1.1dB (Typ.)

Unit in mm



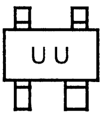
SMQ	
JEDEC	—
EIAJ	—
TOSHIBA	2-3J1A

Weight : 0.013g

MAXIMUM RATINGS (Ta = 25°C)

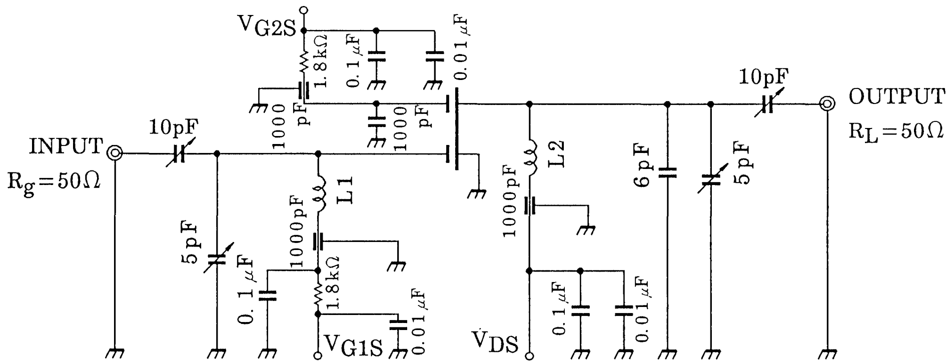
CHARACTERISTIC	SYMBOL	RATING	UNIT
Drain-Source Voltage	V_{DS}	13.5	V
Gate 1-Source Voltage	V_{G1S}	±8	V
Gate 2-Source Voltage	V_{G2S}	±8	V
Drain Current	I_D	30	mA
Drain Power Dissipation	P_D	150	mW
Channel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Marking



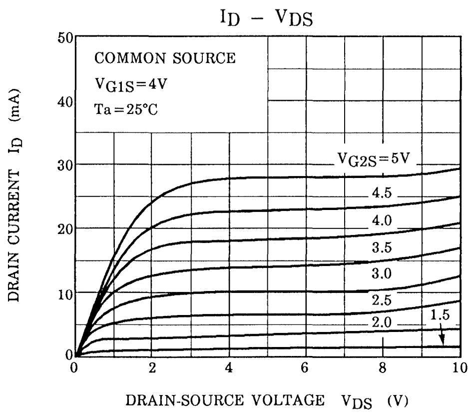
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

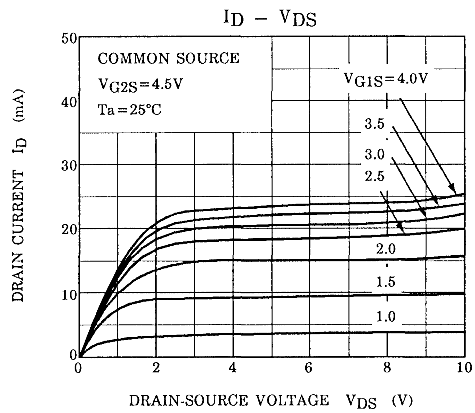
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate 1 Leakage Current	I_{G1SS}	V_{DS}=0, V_{G1S}=±6V, V_{G2S}=0	—	—	±50	nA
Gate 2 Leakage Current	I_{G2SS}	V_{DS}=0, V_{G1S}=0, V_{G2S}=±6V	—	—	±50	nA
Drain-Source Voltage	$V_{(BR)DSX}$	V_{G1S}=−4V, V_{G2S}=−4V, I_D=100μA	13.5	—	—	V
Drain Current	I_{DSS}	V_{DS}=6V, V_{G1S}=0, V_{G2S}=4.5V	0	—	0.1	mA
Gate 1-Source Cut-off Voltage	$V_{G1S(OFF)}$	V_{DS}=6V, V_{G2S}=4.5V, I_D=100μA	0	—	1.0	V
Gate 2-Source Cut-off Voltage	$V_{G2S(OFF)}$	V_{DS}=6V, V_{G1S}=4V, I_D=100μA	0.5	1.0	1.5	V
Forward Transfer Admittance	$\|Y_{fs}\|$	V_{DS}=6V, V_{G2S}=4.5V, I_D=10mA, f=1kHz	—	13	—	mS
Input Capacitance	C_{iss}	V_{DS}=6V, V_{G2S}=4.5V, I_D=10mA, f=1MHz	2.1	2.7	3.3	pF
Reverse Transfer Capacitance	C_{rss}		—	0.015	0.03	pF
Power Gain	G_{ps}	V_{DS}=6V, V_{G2S}=4.5V, I_D=10mA, f=200MHz (Fig.1)	23	27	—	dB
Noise Figure	NF		—	1.1	2.2	dB

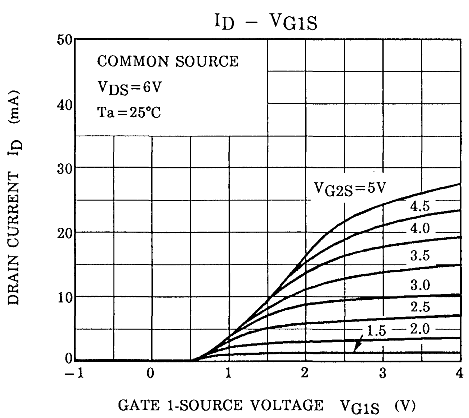


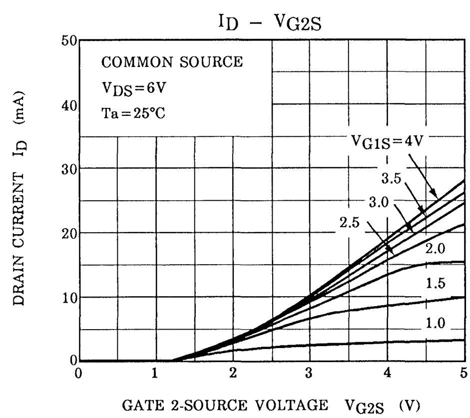
L1 : 1mmϕ Ag Plated Copper Wire, 2 Turns, 8mm ID
L2 : 1mmϕ Ag Plated Copper Wire, 2.5 Turns, 8mm ID

Fig.1 200MHz, G_{ps} NF TEST CIRCUIT

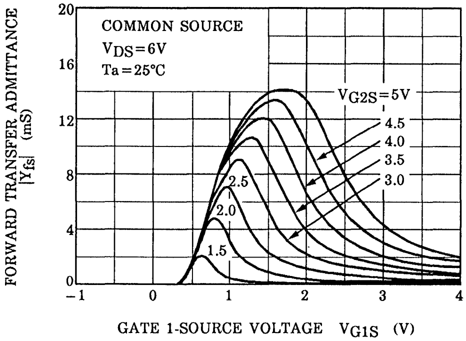




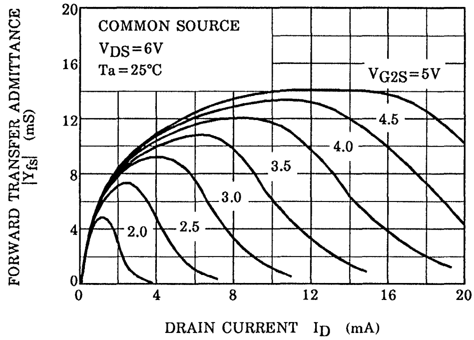




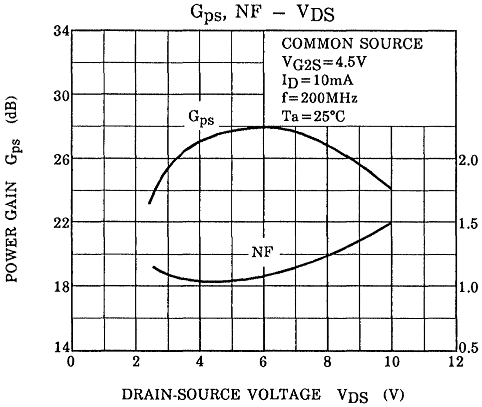
$|Y_{fs}| - V_{G1S}$



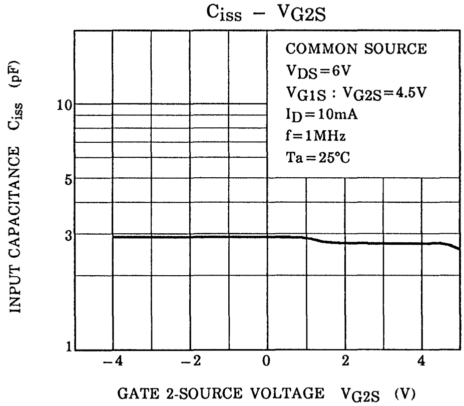
$|Y_{fs}| - I_D$



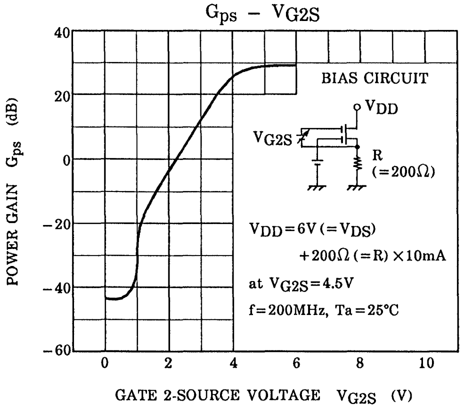
G_{ps}, NF $- V_{DS}$



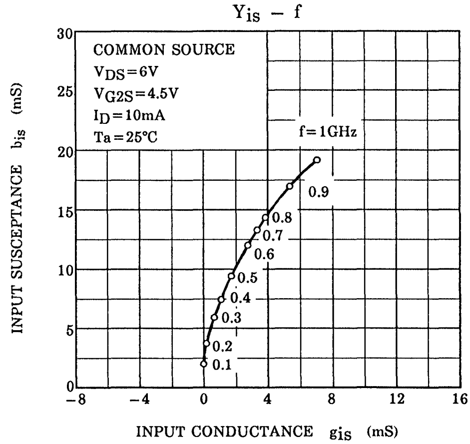
$C_{iss} - V_{G2S}$

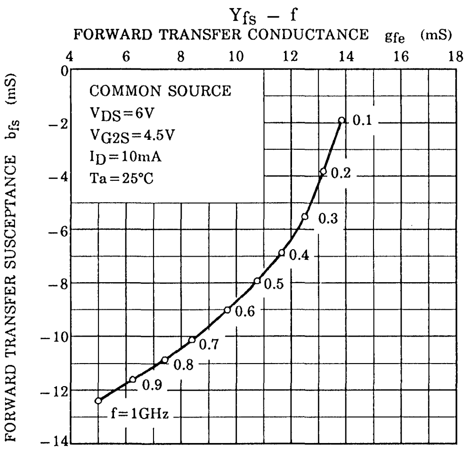


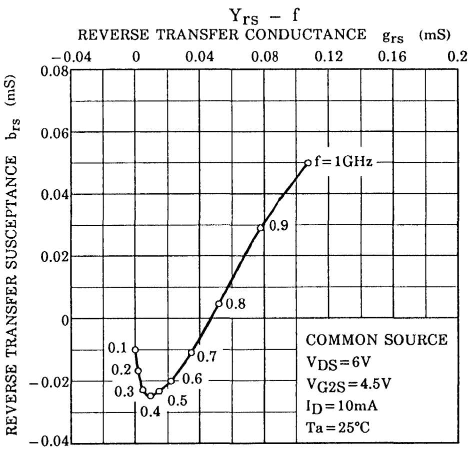
$G_{ps} - V_{G2S}$

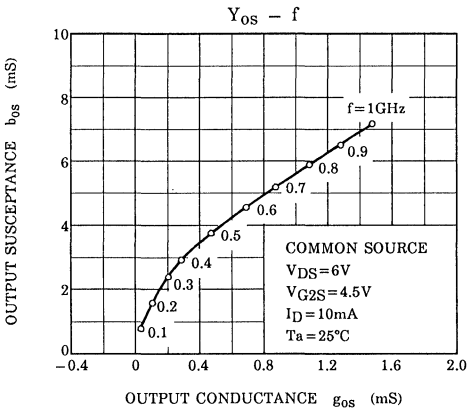


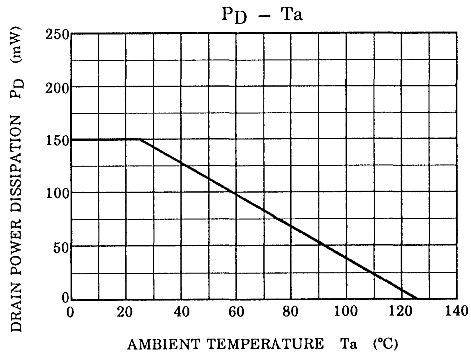
$Y_{is} - f$




Yfs – f
FORWARD TRANSFER CONDUCTANCE gfe (mS)
FORWARD TRANSFER SUSCEPTANCE bfs (mS)
COMMON SOURCE
VDS=6V
VG2S=4.5V
ID=10mA
Ta=25°C
f=1GHz


Yrs – f
REVERSE TRANSFER CONDUCTANCE grs (mS)
REVERSE TRANSFER SUSCEPTANCE brs (mS)
f=1GHz
COMMON SOURCE
VDS=6V
VG2S=4.5V
ID=10mA
Ta=25°C


Yos – f
OUTPUT SUSCEPTANCE bos (mS)
f=1GHz
COMMON SOURCE
VDS=6V
VG2S=4.5V
ID=10mA
Ta=25°C
OUTPUT CONDUCTANCE gos (mS)


PD – Ta
DRAIN POWER DISSIPATION PD (mW)
AMBIENT TEMPERATURE Ta (°C)

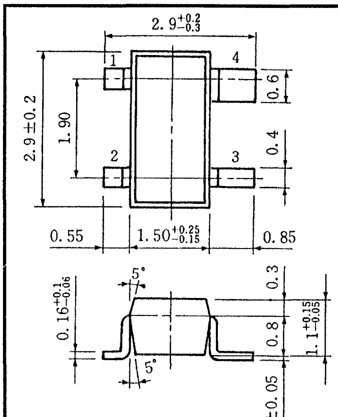
3SK232

SILICON N CHANNEL DUAL GATE MOS TYPE FIELD EFFECT TRANSISTOR

○ TV TUNER, UHF RF AMPLIFIER APPLICATIONS.

- Superior Cross Modulation Performance.
- Low Reverse Transfer Capacitance. : C_{rss}=20fF (TYP.)
- Low Noise Figure. : NF=1.5dB (TYP.)

Unit in mm



1. GATE 1
2. GATE 2
3. DRAIN
4. SOURCE

JEDEC	—
EIAJ	—
TOSHIBA	2-3J1A

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Drain-Source Voltage	V_{DS}	12.5	V
Gate 1-Source Voltage	V_{G1S}	±8	V
Gate 2-Source Voltage	V_{G2S}	±8	V
Drain Current	I_D	30	mA
Drain Power Dissipation	P_D	150	mW
Channel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate 1 Leakage Current	I_{G1SS}	V_{DS}=0, V_{G1S}=±6V, V_{G2S}=0	—	—	±50	nA
Gate 2 Leakage Current	I_{G2SS}	V_{DS}=0, V_{G1S}=0, V_{G2S}=±6V	—	—	±50	nA
Drain-Source Voltage	$V_{(BR)DSX}$	V_{G1S}=−0.5V, V_{G2S}=−0.5V I_D=100μA	12.5	—	—	V
Drain Current	I_{DSS}	V_{DS}=6V, V_{G2S}=4.5V, V_{G1S}=0V	—	—	0.1	mA
Gate 1-Source Cut-off Voltage	$V_{G1S(OFF)}$	V_{DS}=6V, V_{G2S}=4.5V, I_D=100μA	0.4	0.9	1.4	V
Gate 2-Source Cut-off Voltage	$V_{G2S(OFF)}$	V_{DS}=6V, V_{G1S}=4.0V, I_D=100μA	0.5	1.0	1.5	V
Forward Transfer Admittance	|Yfs|	V_{DS}=6V, V_{G2S}=4.5V, I_D=10mA f=1kHz	17	21	—	mS
Input Capacitance	C_{iss}	V_{DS}=6V, V_{G2S}=4.5V, I_D=10mA f=1MHz	0.9	1.5	2.1	pF
Reverse Transfer Capacitance	C_{rss}		—	20	40	fF
Power Gain	G_{ps}	V_{DS}=6V, V_{G2S}=4.5V, I_D=10mA f=800MHz (Fig 1)	18	20	—	dB
Noise Figure	NF		—	1.5	2.5	dB

Marking

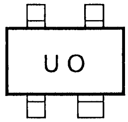
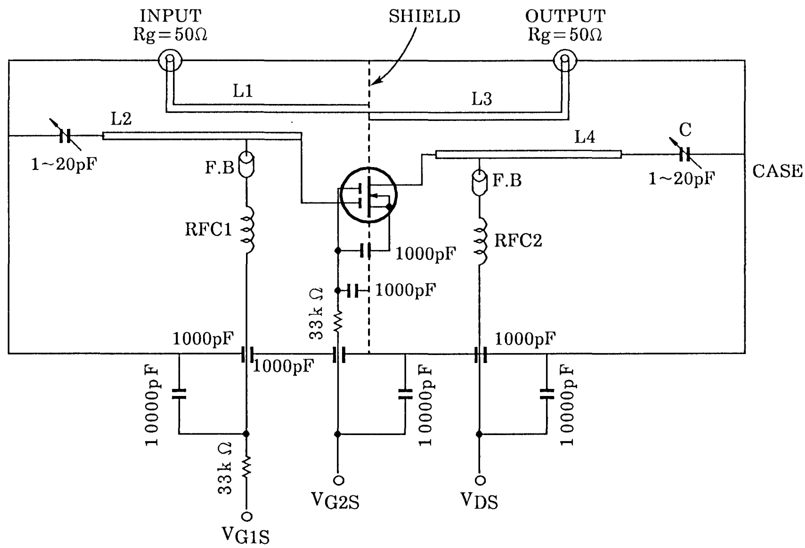
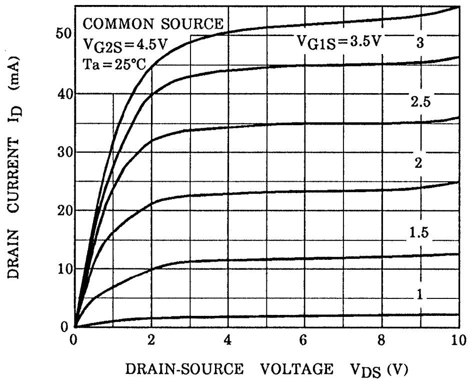


Fig. 1 800MHz Gps, NF TEST CIRCUIT

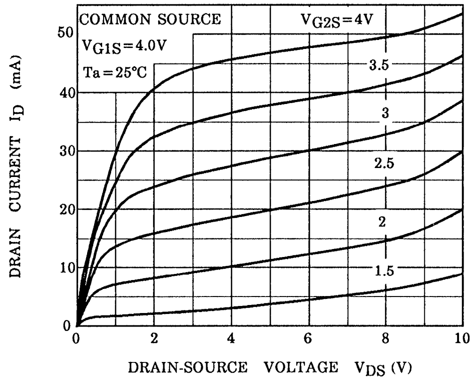


L1~L4 : ϕ0.8mm SILVER PLATED COPPER WIRE
C : AIR TRIMMER TTA25A200A (MURATA MFG, Co., Ltd.)
RFC 1 : ϕ0.35mm COPPER WIRE 3mm ID, 7T
RFC 2 : ϕ0.35mm COPPER WIRE 3mm ID, 10T

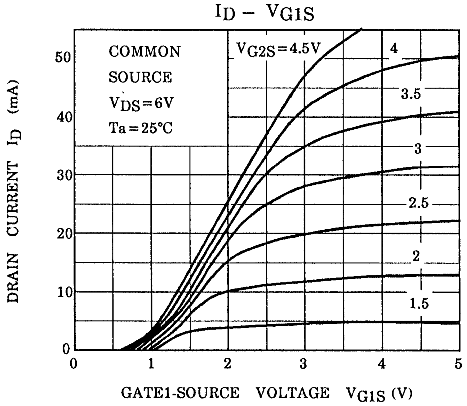
$I_D - V_{DS}$



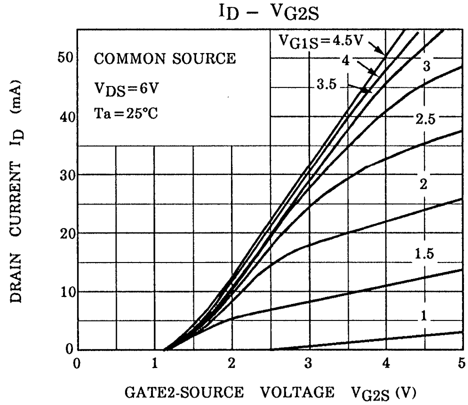
$I_D - V_{DS}$



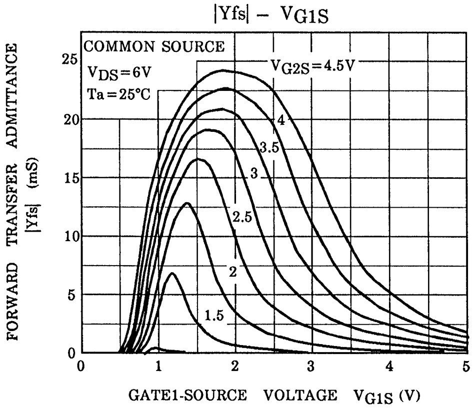
$I_D - V_{G1S}$



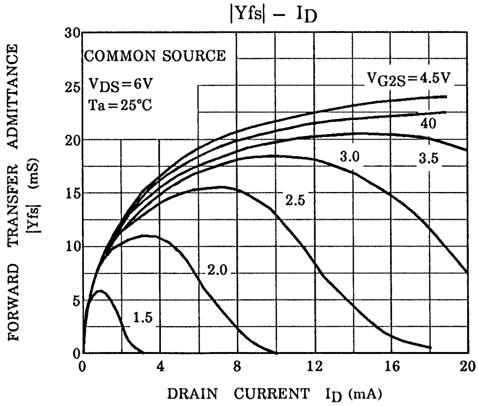
$I_D - V_{G2S}$



$|Y_{fs}| - V_{G1S}$



$|Y_{fs}| - I_D$

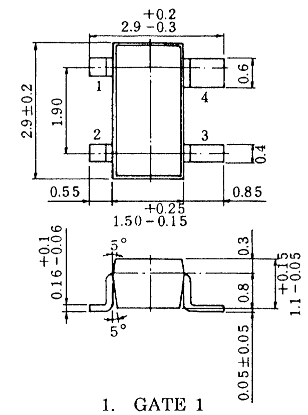


GaAs N CHANNEL DUAL GATE MES TYPE
FIELD EFFECT TRANSISTOR

3SK240

TV TUNER, UHF RF AMPLIFIER APPLICATIONS.

Unit in mm



1. GATE 1
2. GATE 2
3. DRAIN
4. SOURCE

JEDEC	—
EIAJ	—
TOSHIBA	2-3J1A

Weight : 0.013g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Gate1-Drain Voltage	V_{G1D0}	−9	V
Gate2-Drain Voltage	V_{G2D0}	−9	V
Gate1-Source Voltage	V_{G1S}	−4	V
Gate2-Source Voltage	V_{G2S}	−4	V
Gate1 Current	I_{G1}	1	mA
Gate2 Current	I_{G2}	1	mA
Power Dissipation	P_D	150	mW
Channel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate1 Leakage Current	I_{G1SS}	$V_{DS}=0$, $V_{G1S}=-3V$, $V_{G2S}=0$	—	—	−4	μA
Gate2 Leakage Current	I_{G2SS}	$V_{DS}=0$, $V_{G1S}=0$, $V_{G2S}=-3V$	—	—	−4	μA
Drain Current	I_{DSS}	$V_{DS}=3V$, $V_{G1S}=0$, $V_{G2S}=0$	6	—	20	mA
Gate1-Source Cut-off Voltage	$V_{G1S(OFF)}$	$V_{DS}=3V$, $V_{G2S}=0$, $I_D=100\mu A$	−0.7	—	−1.8	V
Gate2-Source Cut-off Voltage	$V_{G2S(OFF)}$	$V_{DS}=3V$, $V_{G1S}=0$, $I_D=100\mu A$	−0.7	—	−1.8	V
Forward Transfer Admittance	$\|Y_{fs}\|$	$V_{DS}=3V$, $V_{G2S}=1V$, $I_D=5mA$ f=1kHz	—	19	—	ms
Input Capacitance	C_{iss}	$V_{DS}=3V$, $V_{G2S}=1V$, $I_D=5mA$	—	0.6	1.4	pF
Reverse Transfer Capacitance	C_{rss}	f=1kHz	—	0.013	0.030	
Power Gain	G_{ps}	$V_{DS}=3V$, $V_{G2S}=1V$, $I_D=5mA$	17	20.5	—	dB
Noise Figure	NF	f=800MHz (Fig.1)	—	1.0	2.0	

MARKING

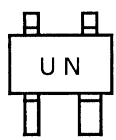
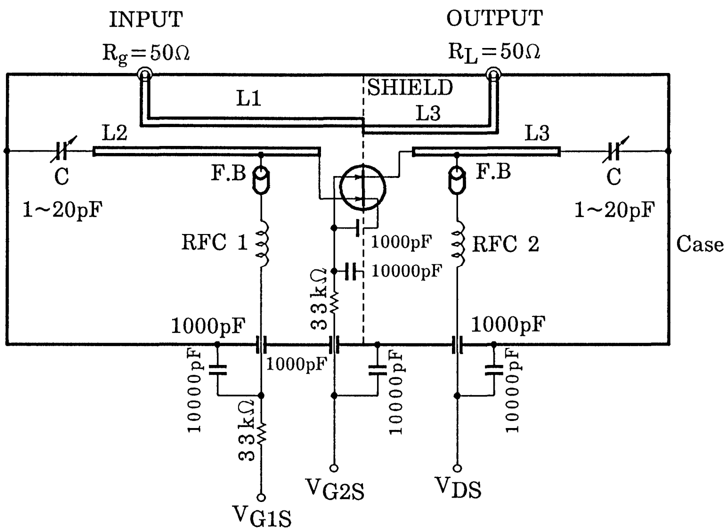


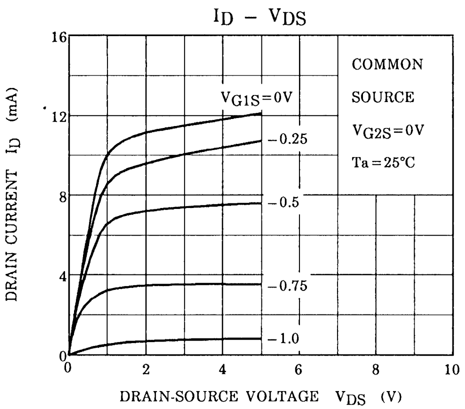
Fig.1 800MHz Gps, NF TEST CIRCUIT

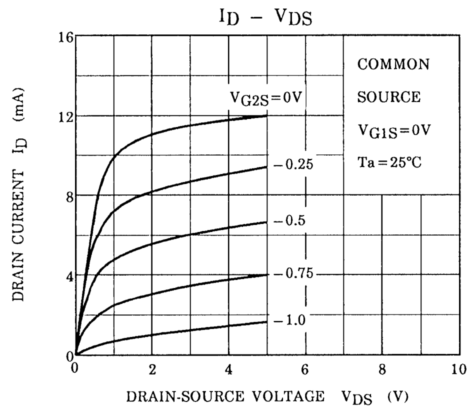


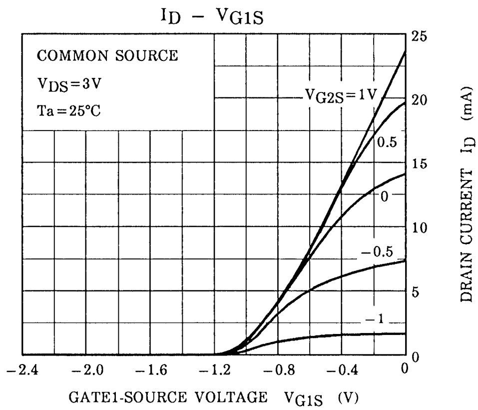
L1~L4 : ϕ1.0mm SILVER PLATED COPPER WIRE
C : AIR TRIMMER TTA25A200A (MURATA MFG. Co., LTD.)
RFC 1 : ϕ0.35mm COPPER WIRE 3mm ID, 7T
RFC 2 : ϕ0.35mm COPPER WIRE 3mm ID, 10T

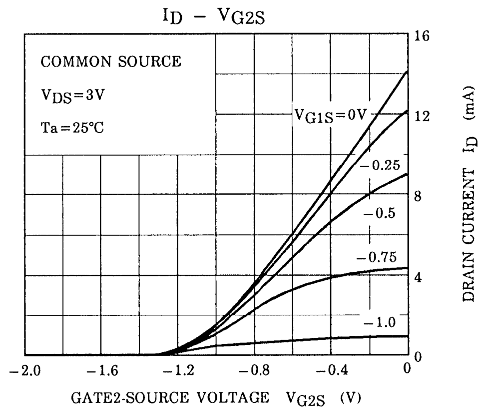
CAUTION

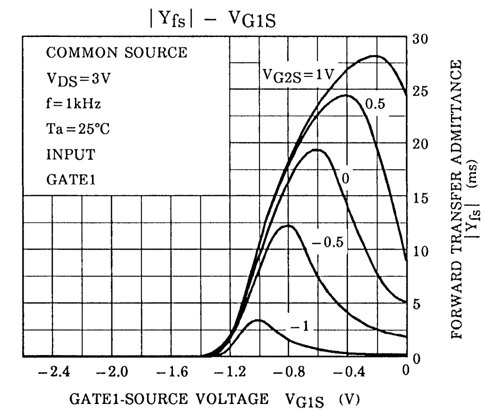
GaAs (Gallium Arsenide) is used in this product. The dust or vapor can be dangerous to humans. Do not break, cut, crush or dissolve chemically. Dispose of this product properly according to law. Do not intermingle with normal industrial or domestic waste.

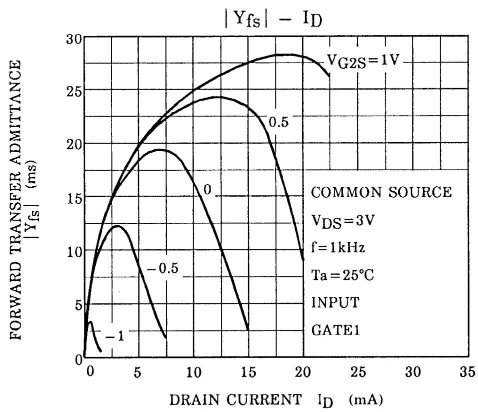

ID – VDS
COMMON
SOURCE
VG2S=0V
Ta=25°C
VG1S=0V
−0.25
−0.5
−0.75
−1.0
DRAIN CURRENT ID (mA)
DRAIN-SOURCE VOLTAGE VDS (V)


ID – VDS
COMMON
SOURCE
VG1S=0V
Ta=25°C
VG2S=0V
−0.25
−0.5
−0.75
−1.0
DRAIN CURRENT ID (mA)
DRAIN-SOURCE VOLTAGE VDS (V)

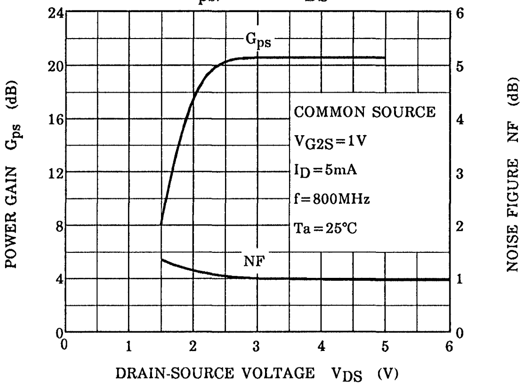

ID – VG1S
COMMON SOURCE
VDS=3V
Ta=25°C
VG2S=1V
0.5
0
−0.5
−1
DRAIN CURRENT ID (mA)
GATE1-SOURCE VOLTAGE VG1S (V)


ID – VG2S
COMMON SOURCE
VDS=3V
Ta=25°C
VG1S=0V
−0.25
−0.5
−0.75
−1.0
DRAIN CURRENT ID (mA)
GATE2-SOURCE VOLTAGE VG2S (V)

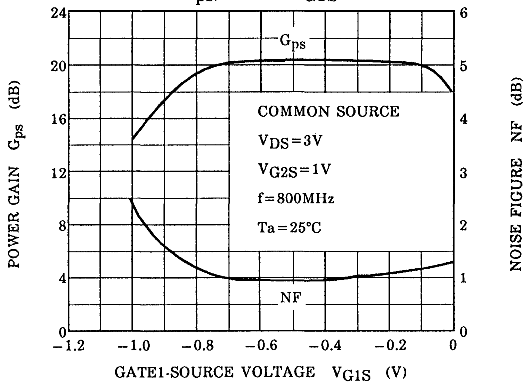

|Yfs| – VG1S
COMMON SOURCE
VDS=3V
f=1kHz
Ta=25°C
INPUT
GATE1
VG2S=1V
0.5
0
−0.5
−1
FORWARD TRANSFER ADMITTANCE |Yfs| (ms)
GATE1-SOURCE VOLTAGE VG1S (V)


|Yfs| – ID
VG2S=1V
0.5
0
−0.5
−1
COMMON SOURCE
VDS=3V
f=1kHz
Ta=25°C
INPUT
GATE1
FORWARD TRANSFER ADMITTANCE |Yfs| (ms)
DRAIN CURRENT ID (mA)

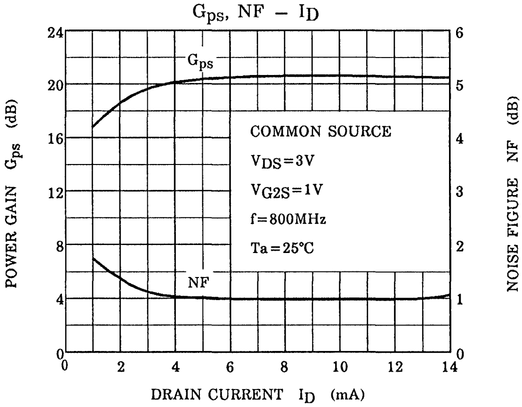
G_{ps}, NF – V_{DS}



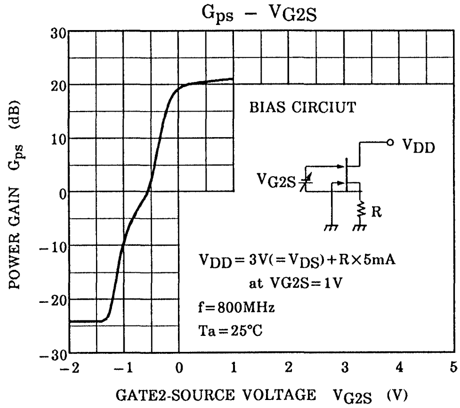
G_{ps}, NF – V_{G1S}



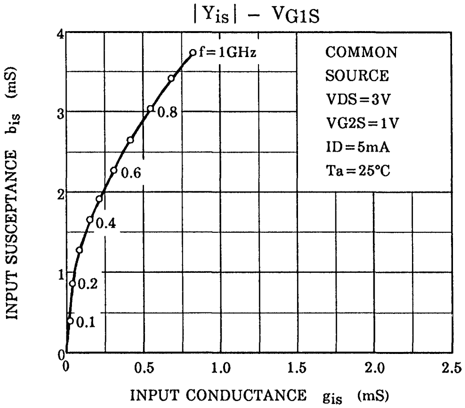
G_{ps}, NF – I_D



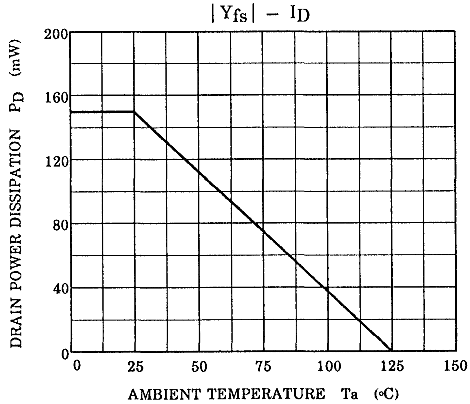
G_{ps} – V_{G2S}

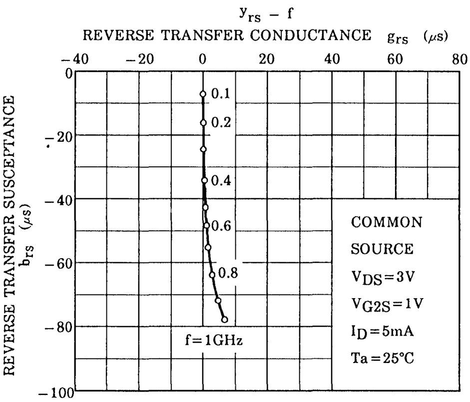


$|Y_{is}|$ – V_{G1S}

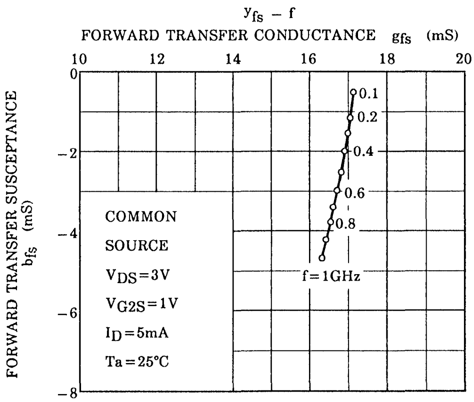


$|Y_{fs}|$ – I_D

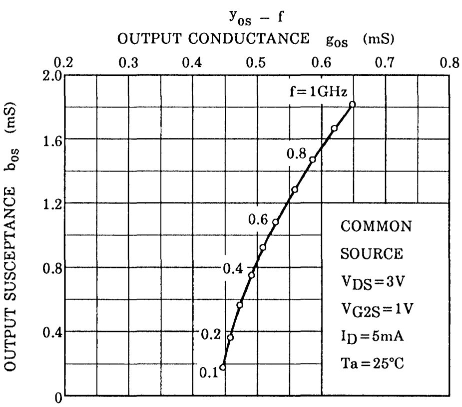




y_{rs} – f
REVERSE TRANSFER CONDUCTANCE g_{rs} (μs)
–40 –20 0 20 40 60 80
REVERSE TRANSFER SUSCEPTANCE b_{rs} (μs)
0 –20 –40 –60 –80 –100
0.1
0.2
0.4
0.6
0.8
f=1GHz
COMMON
SOURCE
V_{DS}=3V
V_{G2S}=1V
I_D=5mA
Ta=25°C



y_{fs} – f
FORWARD TRANSFER CONDUCTANCE g_{fs} (mS)
10 12 14 16 18 20
FORWARD TRANSFER SUSCEPTANCE b_{fs} (mS)
0 –2 –4 –6 –8
0.1
0.2
0.4
0.6
0.8
f=1GHz
COMMON
SOURCE
V_{DS}=3V
V_{G2S}=1V
I_D=5mA
Ta=25°C



y_{os} – f
OUTPUT CONDUCTANCE g_{os} (mS)
0.2 0.3 0.4 0.5 0.6 0.7 0.8
OUTPUT SUSCEPTANCE b_{os} (mS)
2.0 1.6 1.2 0.8 0.4 0
f=1GHz
0.8
0.6
0.4
0.2
0.1
COMMON
SOURCE
V_{DS}=3V
V_{G2S}=1V
I_D=5mA
Ta=25°C

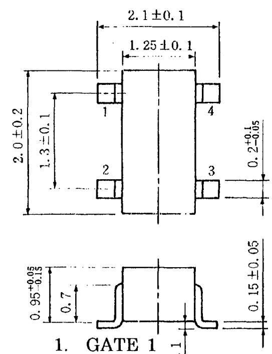
3SK249

SILICON N CHANNEL DUAL GATE MOS TYPE FIELD EFFECT TRANSISTOR

TV TUNER, UHF RF AMPLIFIER APPLICATIONS.

- Superior Cross Modulation Performance.
- Low Reverse Transfer Capacitance. : C_{rss} = 20fF (Typ.)
- Low Noise Figure. : NF = 1.5dB (Typ.)

Unit in mm



1. GATE 1
2. GATE 2
3. DRAIN
4. SOURCE

USQ	
JEDEC	—
EIAJ	—
TOSHIBA	2-2K1B

Weight : 0.006g

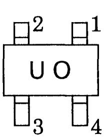
MAXIMUM RATINGS (Ta = 25°C)

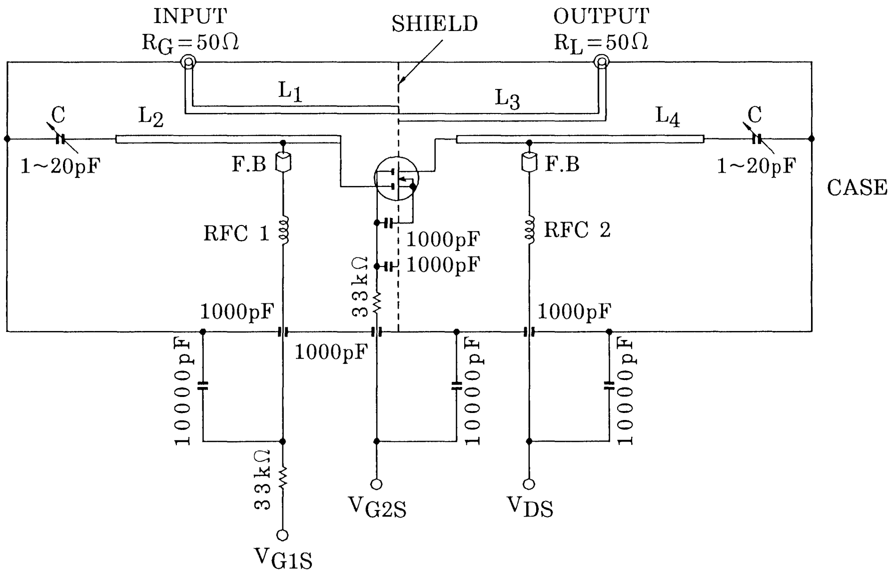
CHARACTERISTIC	SYMBOL	RATING	UNIT
Drain-Source Voltage	V_{DS}	12.5	V
Gate 1-Source Voltage	V_{G1S}	±8	V
Gate 2-Source Voltage	V_{G2S}	±8	V
Drain Current	I_D	30	mA
Drain Power Dissipation	P_D	100	mW
Chanel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate 1 Leakage Current	I_{G1SS}	$V_{DS}=0$, $V_{G1S}=\pm6V$, $V_{G2S}=0$	—	—	±50	nA
Gate 2 Leakage Current	I_{G2SS}	$V_{DS}=0$, $V_{G1S}=0$, $V_{G2S}=\pm6V$	—	—	±50	nA
Drain-Source Voltage	$V_{(BR)DSX}$	$V_{G1S}=-0.5V$, $V_{G2S}=-0.5V$ $I_D=100\mu A$	12.5	—	—	V
Drain Current	I_{DSS}	$V_{DS}=6V$, $V_{G2S}=4.5V$, $V_{G1S}=0V$	0	—	0.1	mA
Gate 1-Source Cut-off Voltage	$V_{G1S(OFF)}$	$V_{DS}=6V$, $V_{G2S}=4.5V$, $I_D=100\mu A$	0.4	0.9	1.4	V
Gate 2-Source Cut-off Voltage	$V_{G2S(OFF)}$	$V_{DS}=6V$, $V_{G1S}=4.0V$, $I_D=100\mu A$	0.5	1.0	1.5	V
Forward Transfer Admittance	$\|Y_{fs}\|$	$V_{DS}=6V$, $V_{G2S}=4.5V$, $I_D=10mA$ f=1kHz	17	21	—	mS
Input Capacitance	C_{iss}	$V_{DS}=6V$, $V_{G2S}=4.5V$, $I_D=10mA$ f=1MHz	0.9	1.5	2.1	pF
Reverse Transfer Capacitance	C_{rss}		—	20	40	fF
Power Gain	G_{ps}	$V_{DS}=6V$, $V_{G2S}=4.5V$, $I_D=10mA$ f=800MHz	18	20	—	dB
Noise Figure	NF		—	1.5	2.5	dB

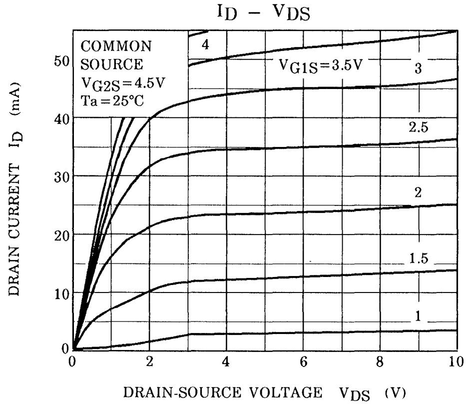
Marking

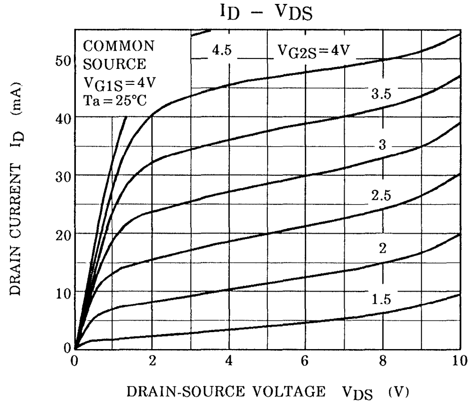


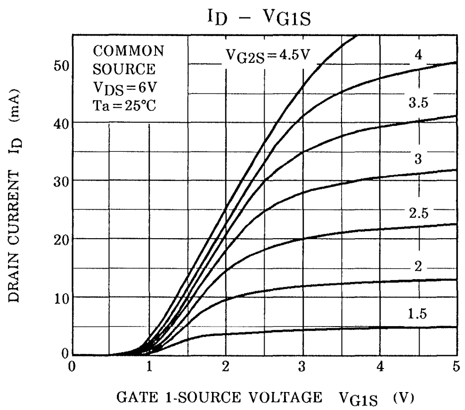


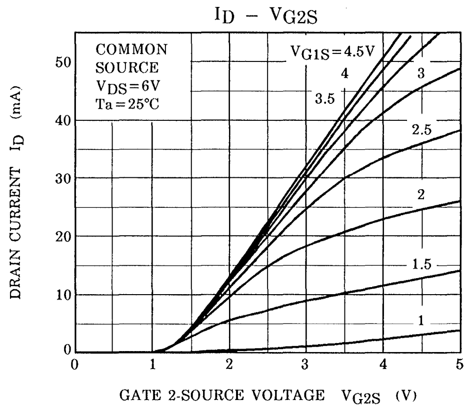
$L_1 \sim L_4$: ϕ0.8mm SILVER PLATED COPPER WIRE
C : AIR TRIMMER TTA25A200A (MURATA MFG. Co., Ltd.)
RFC 1 : ϕ0.35mm COPPER WIRE 3mm ID, 7T
RFC 2 : ϕ0.35mm COPPER WIRE 3mm ID, 10T

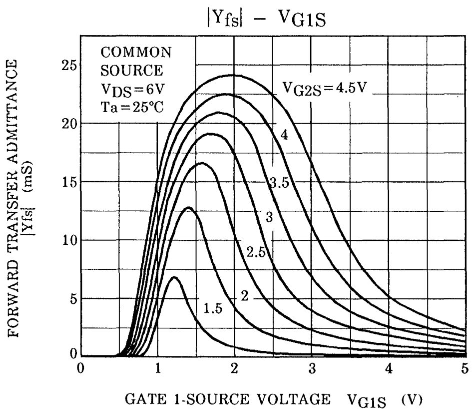
Fig.1 800MHz G_{ps}, NF TEST CIRCUIT

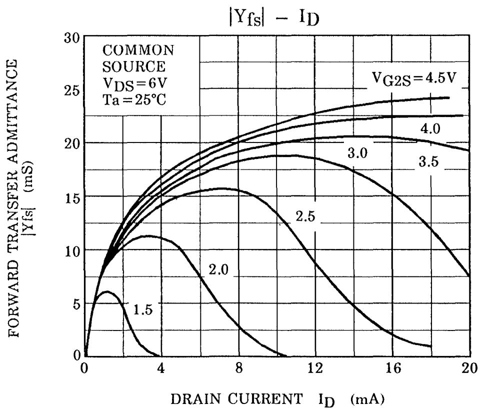

ID – VDS
COMMON SOURCE
VG2S=4.5V
Ta=25°C
VG1S=3.5V
4
3
2.5
2
1.5
1
DRAIN CURRENT ID (mA)
DRAIN-SOURCE VOLTAGE VDS (V)


ID – VDS
COMMON SOURCE
VG1S=4V
Ta=25°C
VG2S=4V
4.5
3.5
3
2.5
2
1.5
DRAIN CURRENT ID (mA)
DRAIN-SOURCE VOLTAGE VDS (V)

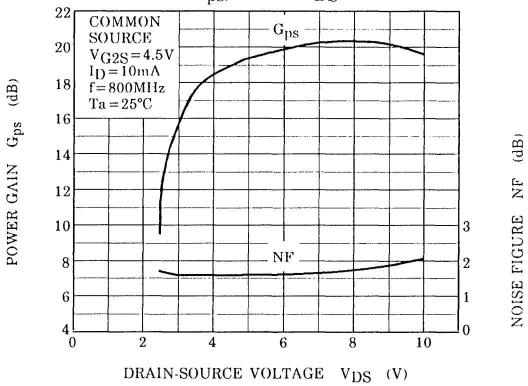

ID – VG1S
COMMON SOURCE
VDS=6V
Ta=25°C
VG2S=4.5V
4
3.5
3
2.5
2
1.5
DRAIN CURRENT ID (mA)
GATE 1-SOURCE VOLTAGE VG1S (V)


ID – VG2S
COMMON SOURCE
VDS=6V
Ta=25°C
VG1S=4.5V
4
3.5
3
2.5
2
1.5
1
DRAIN CURRENT ID (mA)
GATE 2-SOURCE VOLTAGE VG2S (V)

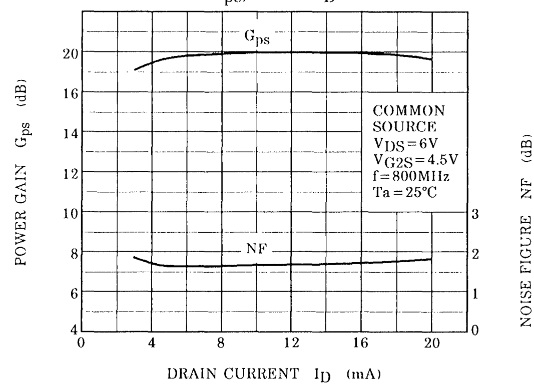

|Yfs| – VG1S
COMMON SOURCE
VDS=6V
Ta=25°C
VG2S=4.5V
4
3.5
3
2.5
2
1.5
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)
GATE 1-SOURCE VOLTAGE VG1S (V)


|Yfs| – ID
COMMON SOURCE
VDS=6V
Ta=25°C
VG2S=4.5V
4.0
3.5
3.0
2.5
2.0
1.5
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)
DRAIN CURRENT ID (mA)

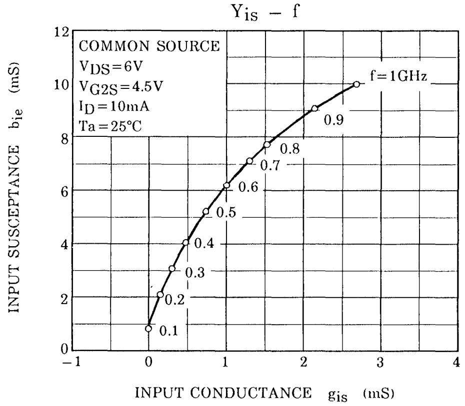
G_{ps}, NF – V_{DS}



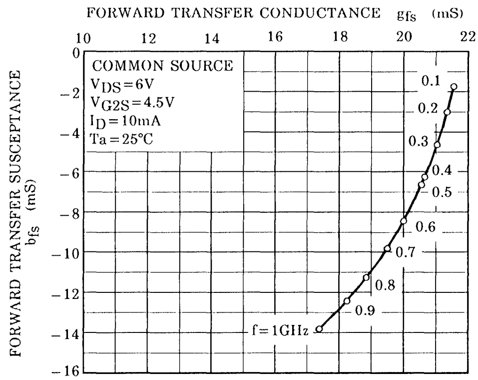
G_{ps}, NF – I_D



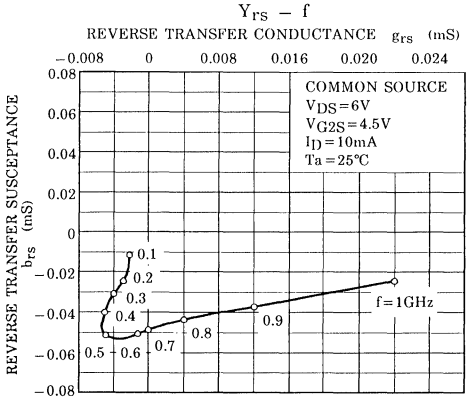
Y_{is} – f



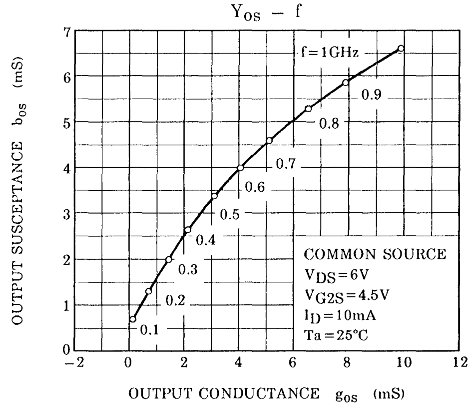
Y_{fs} – f

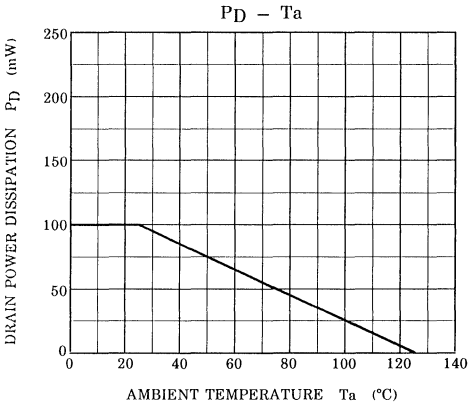


Y_{rs} – f



Y_{os} – f




PD – Ta
DRAIN POWER DISSIPATION PD (mW)
250
200
150
100
50
0
0
20
40
60
80
100
120
140
AMBIENT TEMPERATURE Ta (°C)

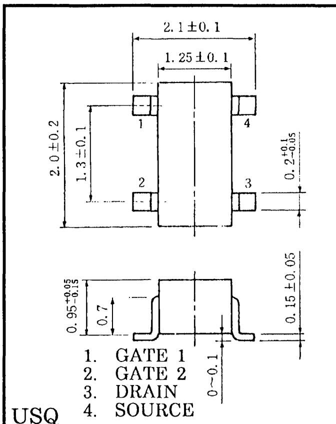
SILICON N CHANNEL DUAL GATE MOS TYPE FIELD EFFECT TRANSISTOR

3SK256

TV TUNER, UHF RF AMPLIFIER APPLICATIONS.

- Superior Cross Modulation Performance.
- Low Reverse Transfer Capacitance : C_{rss} = 0.015pF (Typ.)
- Low Noise Figure : NF = 1.9dB (Typ.)

Unit in mm



USQ	
JEDEC	—
EIAJ	—
TOSHIBA	2-2K1B

Weight : 0.006g

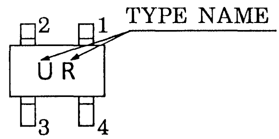
MAXIMUM RATINGS (Ta = 25°C)

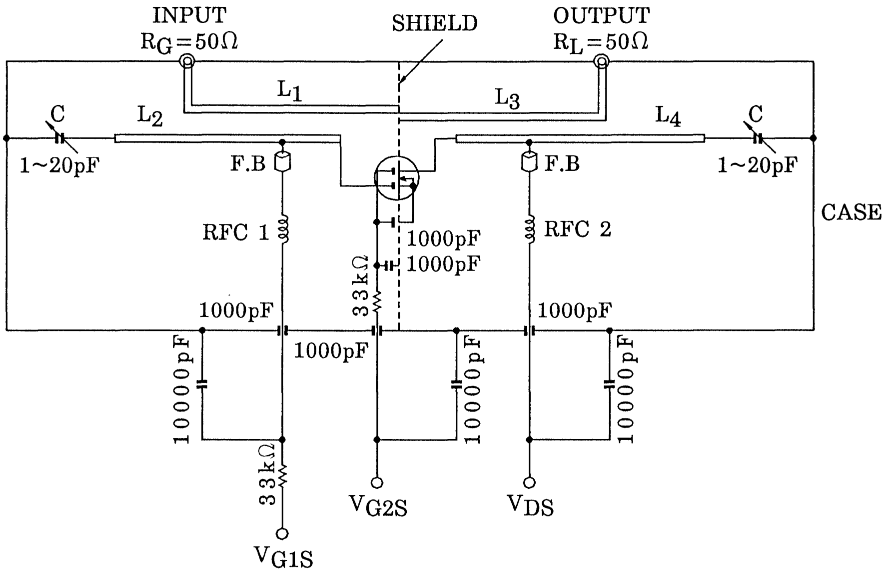
CHARACTERISTIC	SYMBOL	RATING	UNIT
Drain-Source Voltage	V_{DS}	13.5	V
Gate 1-Source Voltage	V_{G1S}	±8	V
Gate 2-Source Voltage	V_{G2S}	±8	V
Drain Current	I_D	30	mA
Drain Power Dissipation	P_D	100	mW
Chanel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate 1 Leakage Current	I_{G1SS}	V_{DS}=0, V_{G1S}=±6V, V_{G2S}=0	—	—	±50	nA
Gate 2 Leakage Current	I_{G2SS}	V_{DS}=0, V_{G1S}=0, V_{G2S}=±6V	—	—	±50	nA
Drain-Source Voltage	$V_{(BR)DSX}$	V_{G1S}=−1V, V_{G2S}=−1V I_D=100μA	13.5	—	—	V
Drain Current	I_{DSS}	V_{DS}=6V, V_{G1S}=0, V_{G2S}=4.5V	0	—	0.1	mA
Gate 1-Source Cut-off Voltage	$V_{G1S(OFF)}$	V_{DS}=6V, V_{G2S}=4.5V, I_D=100μA	0	—	1.0	V
Gate 2-Source Cut-off Voltage	$V_{G2S(OFF)}$	V_{DS}=6V, V_{G1S}=4V, I_D=100μA	0.5	1.0	1.5	V
Forward Transfer Admittance	$\|Y_{fs}\|$	V_{DS}=6V, V_{G2S}=4.5V I_D=10mA, f=1kHz	—	21.5	—	mS
Input Capacitance	C_{iss}	V_{DS}=6V, V_{G2S}=4.5V I_D=10mA, f=1MHz	1.0	1.6	2.4	pF
Reverse Transfer Capacitance	C_{rss}		—	0.015	0.03	pF
Power Gain	G_{ps}	V_{DS}=6V, V_{G2S}=4.5V I_D=10mA, f=800MHz (Fig.1)	18	19.5	—	dB
Noise Figure	NF		—	1.9	3.0	dB

Marking

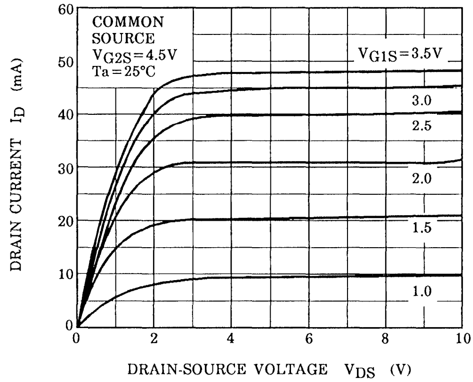




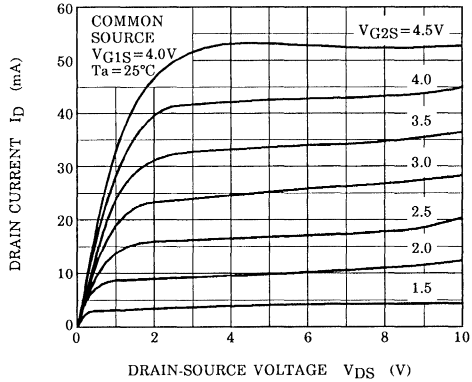
L_1~L_4 : ϕ0.8mm SILVER PLATED COPPER WIRE
C : AIR TRIMMER TTA25A200A (MURATA MFG. Co., Ltd.)
RFC 1 : ϕ0.35mm COPPER WIRE 3mm ID, 7T
RFC 2 : ϕ0.35mm COPPER WIRE 3mm ID, 10T

Fig.1 800MHz G_{ps}, NF TEST CIRCUIT

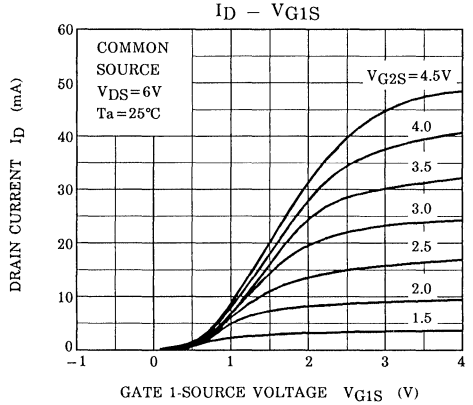
I_D – V_{DS}



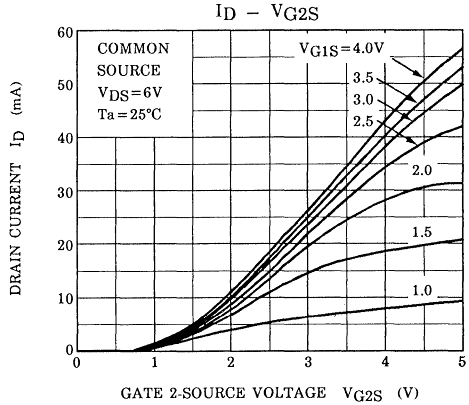
I_D – V_{DS}



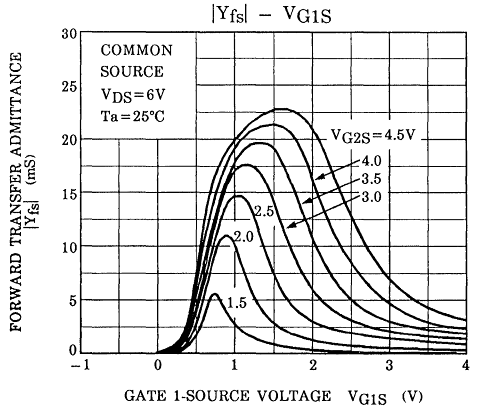
I_D – V_{G1S}



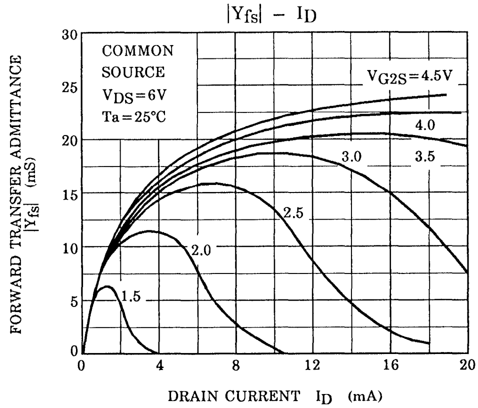
I_D – V_{G2S}

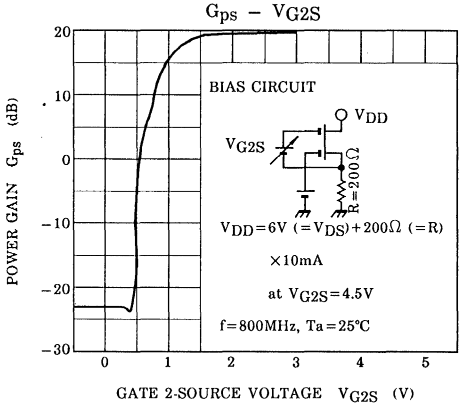


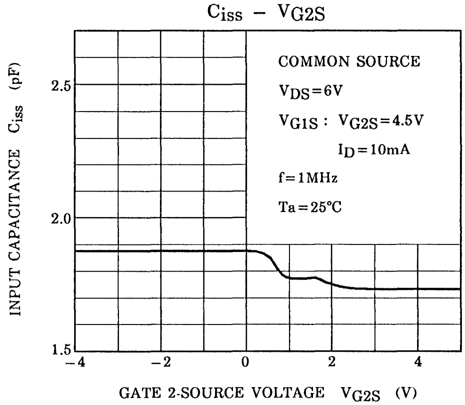
$|Y_{fs}|$ – V_{G1S}

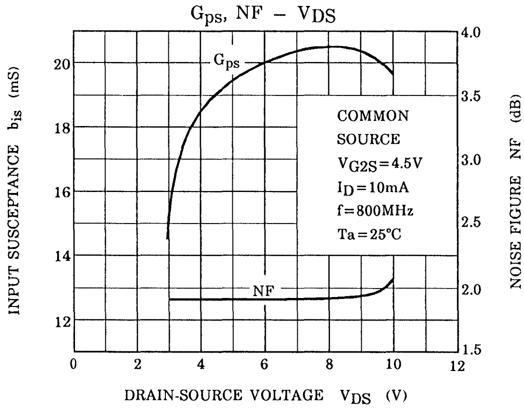


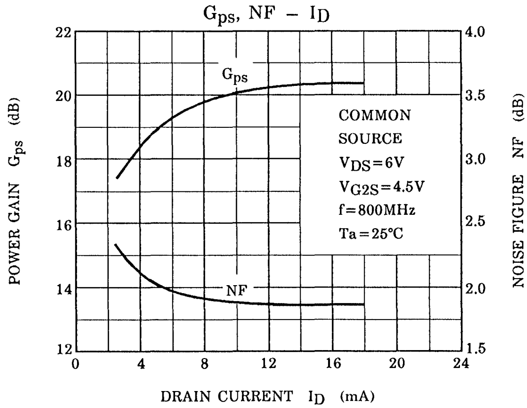
$|Y_{fs}|$ – I_D

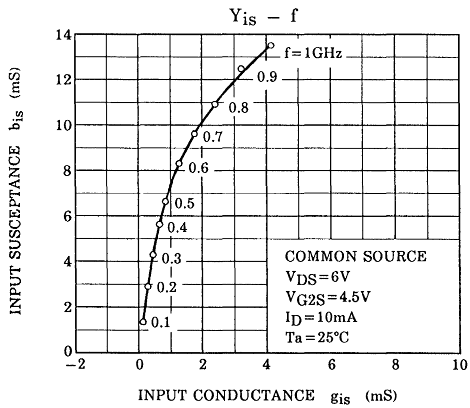


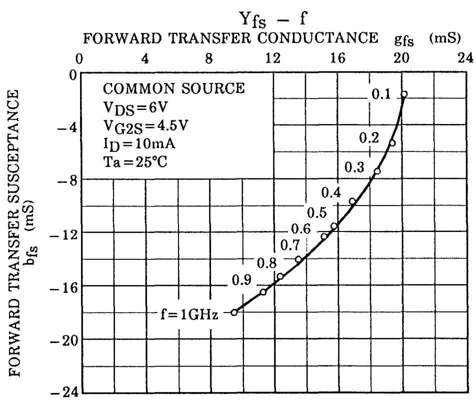

Gps – VG2S
POWER GAIN Gps (dB)
GATE 2-SOURCE VOLTAGE VG2S (V)
BIAS CIRCUIT
VDD
VG2S
R=200Ω
VDD=6V (=VDS)+200Ω (=R)
×10mA
at VG2S=4.5V
f=800MHz, Ta=25°C

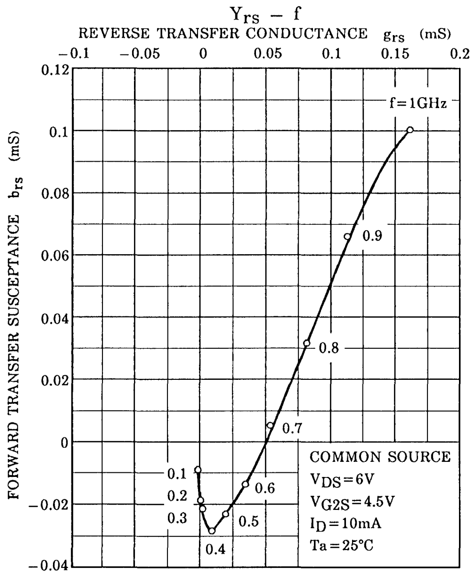

Ciss – VG2S
INPUT CAPACITANCE Ciss (pF)
GATE 2-SOURCE VOLTAGE VG2S (V)
COMMON SOURCE
VDS=6V
VG1S : VG2S=4.5V
ID=10mA
f=1MHz
Ta=25°C


Gps, NF – VDS
INPUT SUSCEPTANCE bis (mS)
NOISE FIGURE NF (dB)
DRAIN-SOURCE VOLTAGE VDS (V)
Gps
NF
COMMON
SOURCE
VG2S=4.5V
ID=10mA
f=800MHz
Ta=25°C

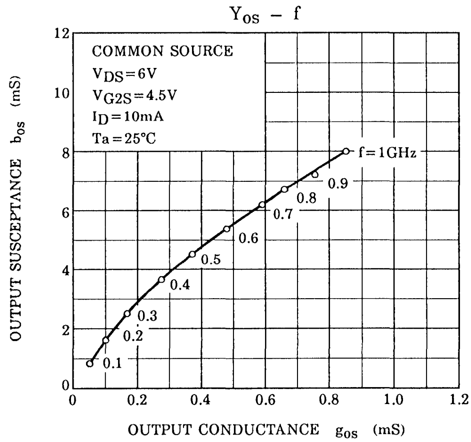

Gps, NF – ID
POWER GAIN Gps (dB)
NOISE FIGURE NF (dB)
DRAIN CURRENT ID (mA)
Gps
NF
COMMON
SOURCE
VDS=6V
VG2S=4.5V
f=800MHz
Ta=25°C


Yis – f
INPUT SUSCEPTANCE bis (mS)
INPUT CONDUCTANCE gis (mS)
f=1GHz
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
COMMON SOURCE
VDS=6V
VG2S=4.5V
ID=10mA
Ta=25°C

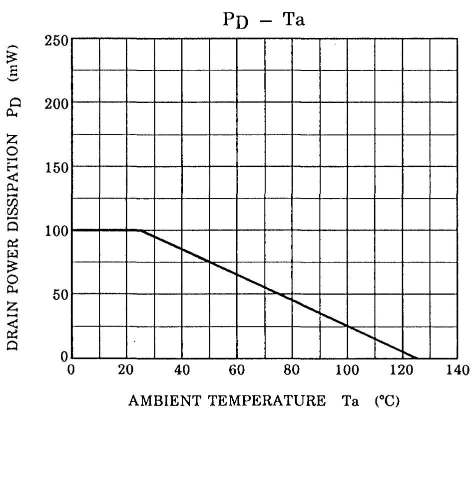

Yfs – f
FORWARD TRANSFER CONDUCTANCE gfs (mS)
FORWARD TRANSFER SUSCEPTANCE bfs (mS)
COMMON SOURCE
VDS=6V
VG2S=4.5V
ID=10mA
Ta=25°C
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
f=1GHz



$Y_{rs} - f$
REVERSE TRANSFER CONDUCTANCE g_{rs} (mS)
−0.1 −0.05 0 0.05 0.1 0.15 0.2
FORWARD TRANSFER SUSCEPTANCE b_{rs} (mS)
0.12 0.1 0.08 0.06 0.04 0.02 0 −0.02 −0.04
f=1GHz
0.9
0.8
0.7
0.6
0.5
0.4
0.1
0.2
0.3
COMMON SOURCE
V_{DS}=6V
V_{G2S}=4.5V
I_D=10mA
Ta=25°C



$Y_{os} - f$
COMMON SOURCE
V_{DS}=6V
V_{G2S}=4.5V
I_D=10mA
Ta=25°C
OUTPUT SUSCEPTANCE b_{os} (mS)
12 10 8 6 4 2 0
f=1GHz
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0 0.2 0.4 0.6 0.8 1.0 1.2
OUTPUT CONDUCTANCE g_{os} (mS)



P_D − Ta
DRAIN POWER DISSIPATION P_D (mW)
250 200 150 100 50 0
0 20 40 60 80 100 120 140
AMBIENT TEMPERATURE Ta (°C)

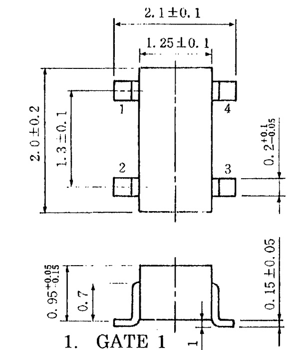
3SK257

SILICON N CHANNEL DUAL GATE MOS TYPE
FIELD EFFECT TRANSISTOR

TV TUNER, VHF RF AMPLIFIER APPLICATIONS.
FM TUNER APPLICATIONS.
TV TUNER, UHF RF AMPLIFIER APPLICATIONS.

- Superior Cross Modulation Performance.
- Low Noise Figure : NF = 2.0dB (Typ.)

Unit in mm



1. GATE 1
2. GATE 2
3. DRAIN
4. SOURCE

USQ	
JEDEC	—
EIAJ	—
TOSHIBA	2-2K1B

Weight : 0.006g

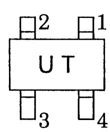
MAXIMUM RATINGS (Ta = 25°C)

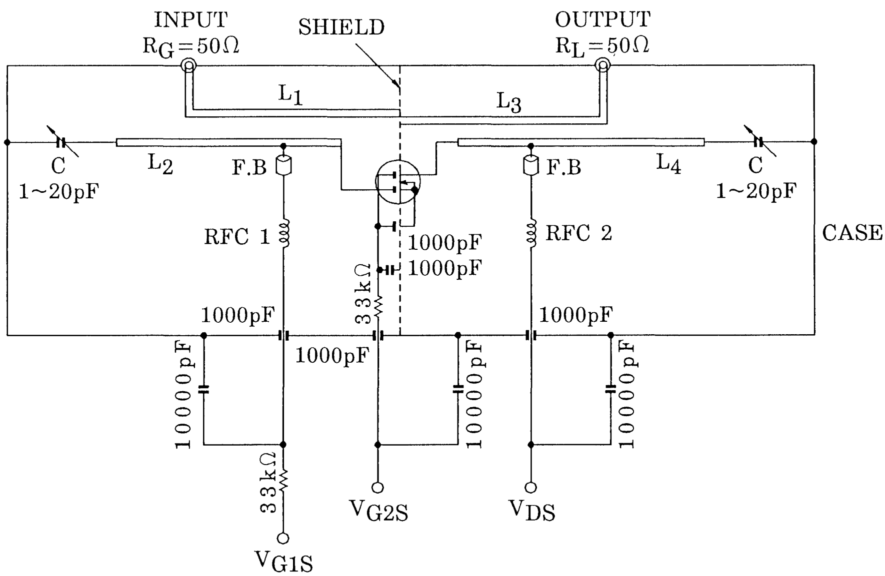
CHARACTERISTIC	SYMBOL	RATING	UNIT
Drain-Source Voltage	V_{DS}	13.5	V
Gate 1-Source Voltage	V_{G1S}	±8	V
Gate 2-Source Voltage	V_{G2S}	±8	V
Drain Current	I_D	30	mA
Drain Power Dissipation	P_D	100	mW
Chanel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate 1 Leakage Current	I_{G1SS}	$V_{DS}=0$, $V_{G1S}=\pm6V$, $V_{G2S}=0$	—	—	±50	nA
Gate 2 Leakage Current	I_{G2SS}	$V_{DS}=0$, $V_{G1S}=0$, $V_{G2S}=\pm6V$	—	—	±50	nA
Drain-Source Voltage	$V_{(BR)DSX}$	$V_{G1S}=-1V$, $V_{G2S}=-1V$ $I_D=100\mu A$	13.5	—	—	V
Drain Current	I_{DSS}	$V_{DS}=6V$, $V_{G1S}=0$, $V_{G2S}=4.5V$	0	—	0.1	mA
Gate 1-Source Cut-off Voltage	$V_{G1S(OFF)}$	$V_{DS}=6V$, $V_{G2S}=4.5V$, $I_D=100\mu A$	0	—	1.0	V
Gate 2-Source Cut-off Voltage	$V_{G2S(OFF)}$	$V_{DS}=6V$, $V_{G1S}=4V$, $I_D=100\mu A$	0.5	1.0	1.5	V
Forward Transfer Admittance	$\|Y_{fs}\|$	$V_{DS}=6V$, $V_{G2S}=4.5V$ $I_D=10mA$, $f=1kHz$	—	21	—	mS
Input Capacitance	C_{iss}	$V_{DS}=6V$, $V_{G2S}=4.5V$ $I_D=10mA$, $f=1MHz$	—	3.4	4.4	pF
Reverse Transfer Capacitance	C_{rss}		—	0.020	0.05	pF
Power Gain	G_{ps}	$V_{DS}=6V$, $V_{G2S}=4.5V$ $I_D=10mA$, $f=500MHz$ (Fig.1)	19	22	—	dB
Noise Figure	NF		—	2.0	3.5	dB

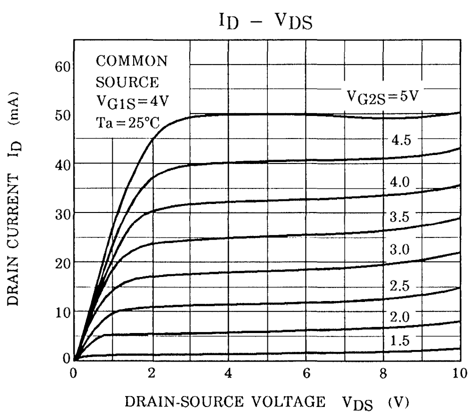
Marking

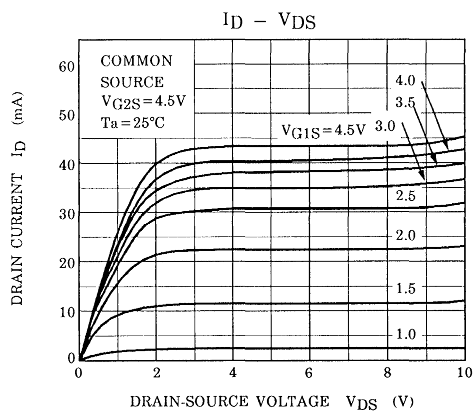




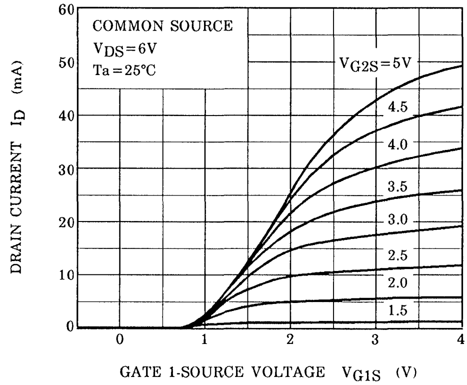
L_1~L_4 : ϕ0.8mm SILVER PLATED COPPER WIRE
C : AIR TRIMMER TTA25A200A (MURATA MFG. Co., Ltd.)
RFC 1 : ϕ0.35mm COPPER WIRE 3mm ID, 7T
RFC 2 : ϕ0.35mm COPPER WIRE 3mm ID, 10T

Fig.1 500MHz, G_{ps}, NF TEST CIRCUIT

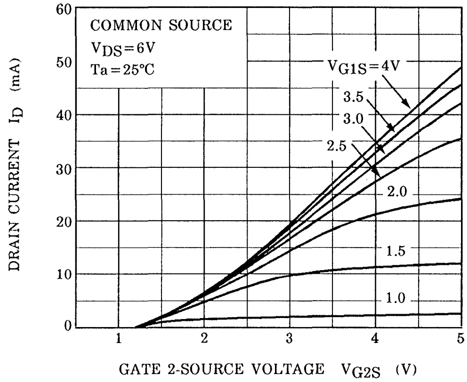




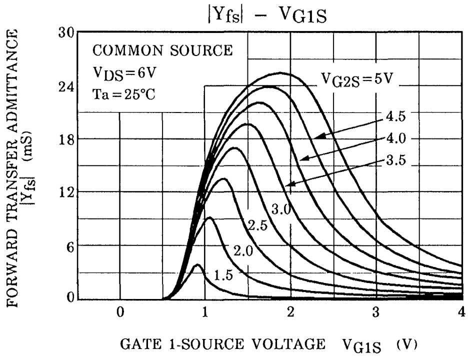
I_D – V_{G1S}



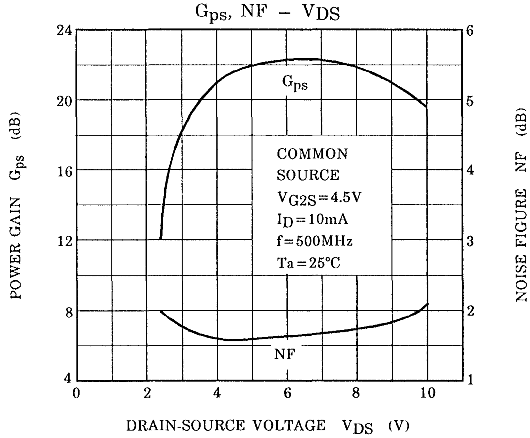
I_D – V_{G2S}



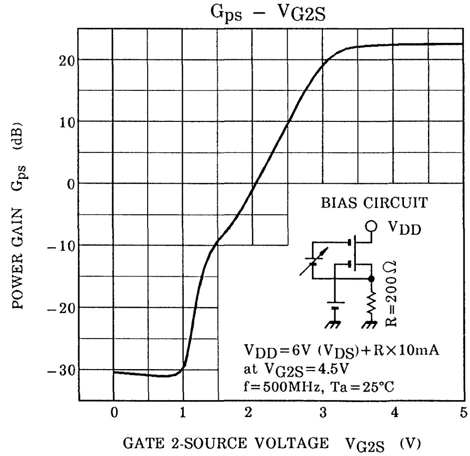
$|Y_{fs}|$ – V_{G1S}



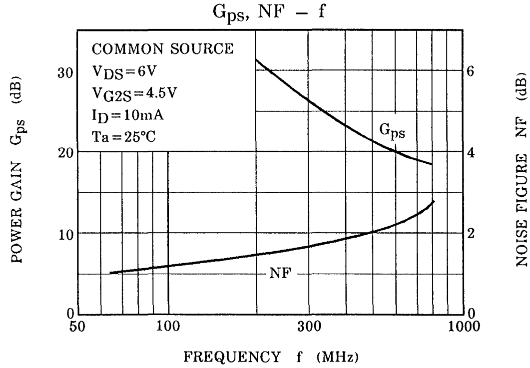
G_{ps}, NF – V_{DS}



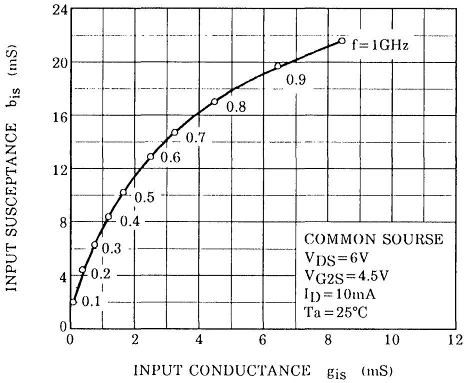
G_{ps} – V_{G2S}



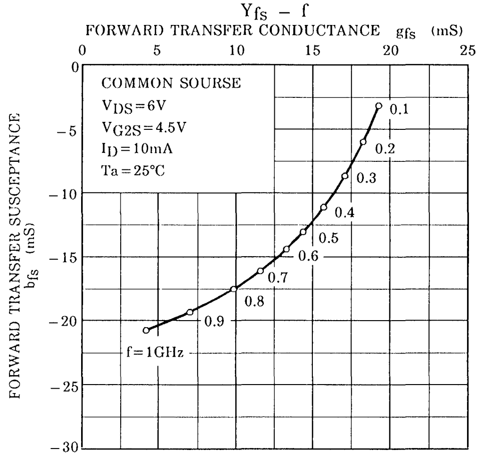
G_{ps}, NF – f



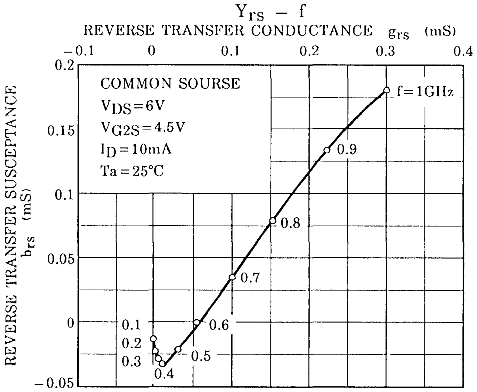
$Y_{is} - f$



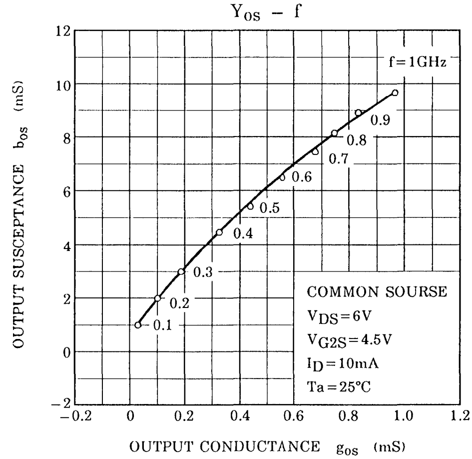
$Y_{fs} - f$



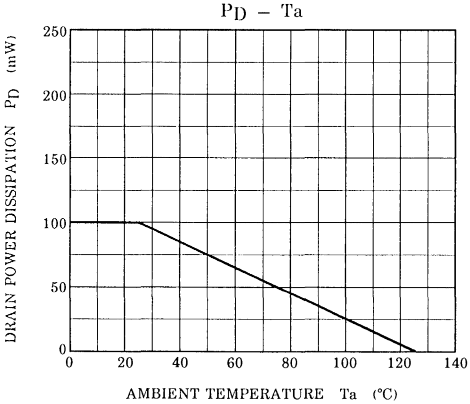
$Y_{rs} - f$



$Y_{os} - f$



$P_D - Ta$



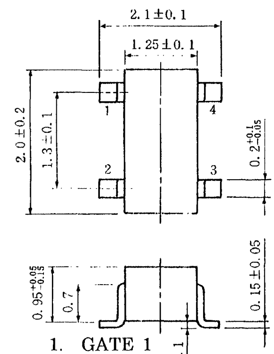
3SK258

SILICON N CHANNEL DUAL GATE MOS TYPE FIELD EFFECT TRANSISTOR

TV TUNER, VHF RF AMPLIFIER APPLICATIONS.
FM TUNER APPLICATIONS.

- Superior Cross Modulation Performance.
- Low Reverse Transfer Capacitance : C_{rss} = 0.015pF (Typ.)
- Low Noise Figure : NF = 1.1dB (Typ.)

Unit in mm



1. GATE 1
2. GATE 2
3. DRAIN
4. SOURCE

USQ	
JEDEC	—
EIAJ	—
TOSHIBA	2-2K1B

Weight : 0.006g

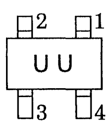
MAXIMUM RATINGS (Ta = 25°C)

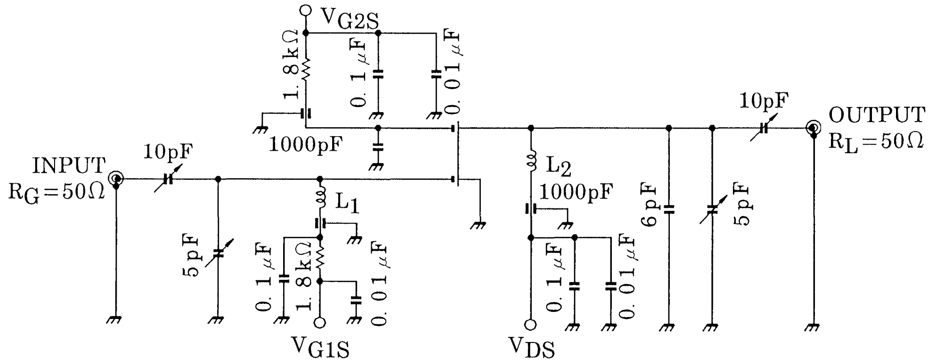
CHARACTERISTIC	SYMBOL	RATING	UNIT
Drain-Source Voltage	V_{DS}	13.5	V
Gate 1-Source Voltage	V_{G1S}	±8	V
Gate 2-Source Voltage	V_{G2S}	±8	V
Drain Current	I_D	30	mA
Drain Power Dissipation	P_D	100	mW
Chanel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate 1 Leakage Current	I_{G1SS}	V_{DS}=0, V_{G1S}=±6V, V_{G2S}=0	—	—	±50	nA
Gate 2 Leakage Current	I_{G2SS}	V_{DS}=0, V_{G1S}=0, V_{G2S}=±6V	—	—	±50	nA
Drain-Source Voltage	$V_{(BR)DSX}$	V_{G1S}=−1V, V_{G2S}=−1V I_D=100μA	13.5	—	—	V
Drain Current	I_{DSS}	V_{DS}=6V, V_{G1S}=0, V_{G2S}=4.5V	0	—	0.1	mA
Gate 1-Source Cut-off Voltage	$V_{G1S(OFF)}$	V_{DS}=6V, V_{G2S}=4.5V, I_D=100μA	0	—	1.0	V
Gate 2-Source Cut-off Voltage	$V_{G2S(OFF)}$	V_{DS}=6V, V_{G1S}=4V, I_D=100μA	0.5	1.0	1.5	V
Forward Transfer Admittance	$\lvert Y_{fs}\rvert$	V_{DS}=6V, V_{G2S}=4.5V I_D=10mA, f=1kHz	—	13	—	mS
Input Capacitance	C_{iss}	V_{DS}=6V, V_{G2S}=4.5V I_D=10mA, f=1MHz	2.1	2.7	3.3	pF
Reverse Transfer Capacitance	C_{rss}		—	0.015	0.03	pF
Power Gain	G_{ps}	V_{DS}=6V, V_{G2S}=4.5V I_D=10mA, f=200MHz (Fig.1)	23	27	—	dB
Noise Figure	NF		—	1.1	2.2	dB

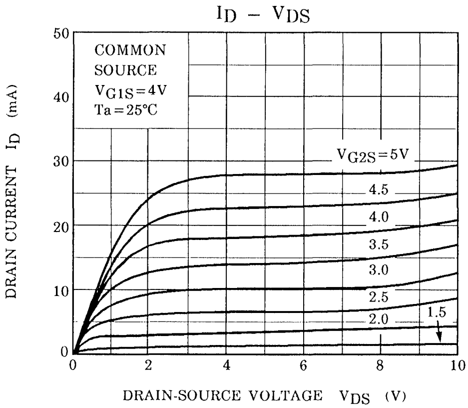
Marking

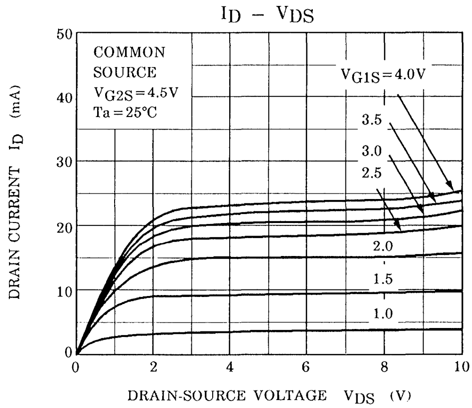


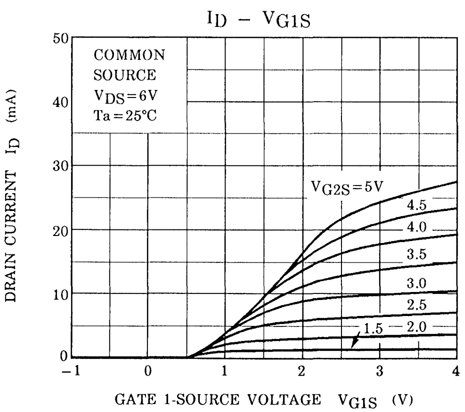


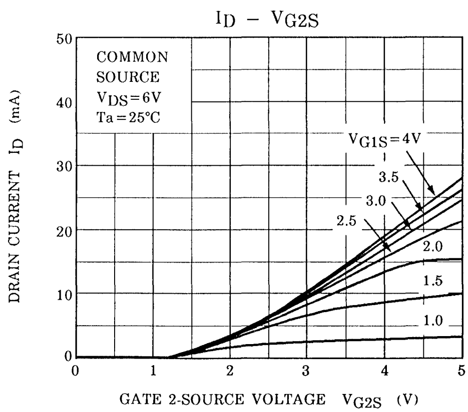
L_1 : 1mmϕ Ag Plated Copper Wire, 2 Turns, 8mm ID
L_2 : 1mmϕ Ag Plated Copper Wire, 2.5 Turns, 8mm ID

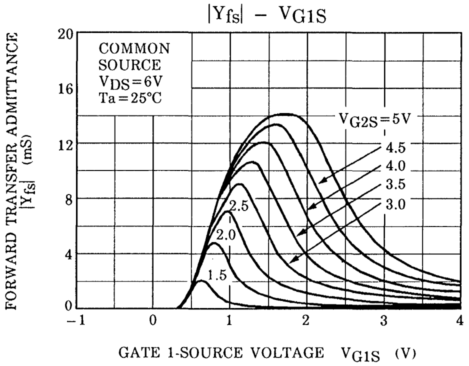
Fig.1 200MHz, G_{ps}, NF TEST CIRCUIT

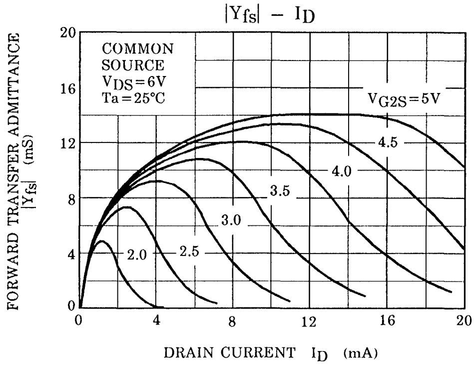


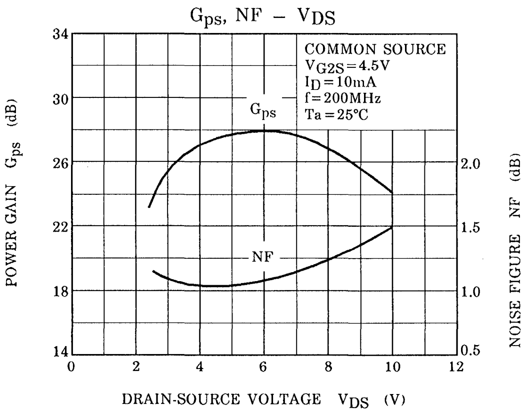


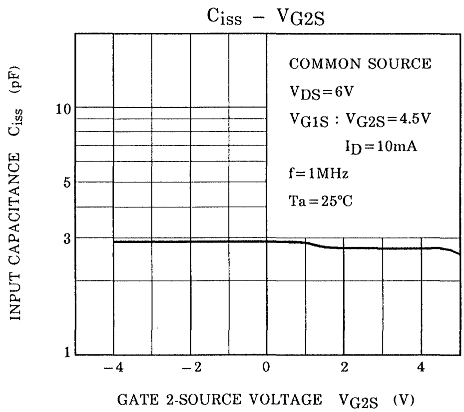


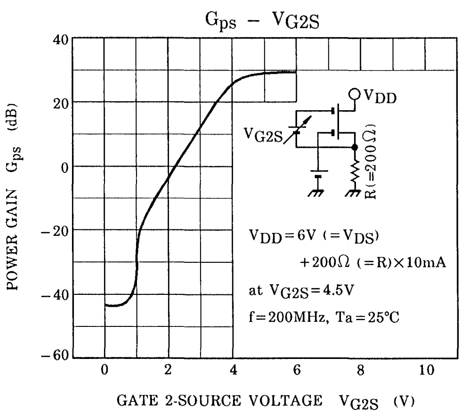


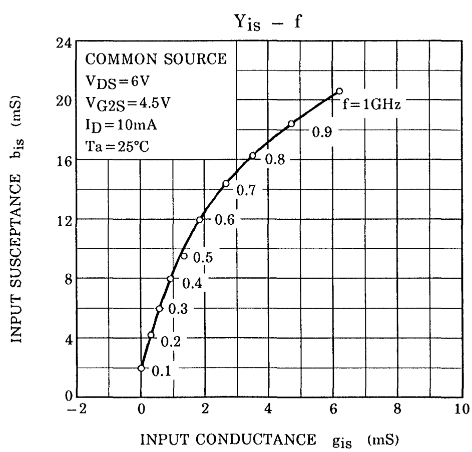

|Yfs| – VG1S
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)
COMMON SOURCE
VDS=6V
Ta=25°C
VG2S=5V
4.5
4.0
3.5
3.0
2.5
2.0
1.5
GATE 1-SOURCE VOLTAGE VG1S (V)

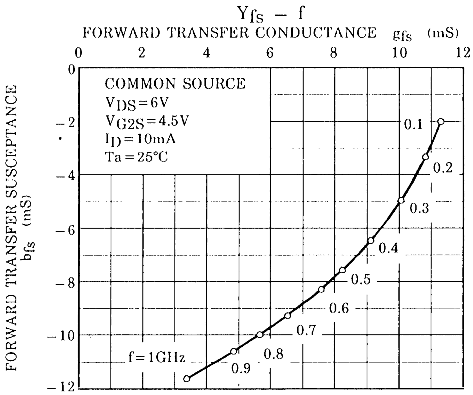

|Yfs| – ID
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)
COMMON SOURCE
VDS=6V
Ta=25°C
VG2S=5V
4.5
4.0
3.5
3.0
2.5
2.0
DRAIN CURRENT ID (mA)


Gps, NF – VDS
POWER GAIN Gps (dB)
NOISE FIGURE NF (dB)
COMMON SOURCE
VG2S=4.5V
ID=10mA
f=200MHz
Ta=25°C
Gps
NF
DRAIN-SOURCE VOLTAGE VDS (V)

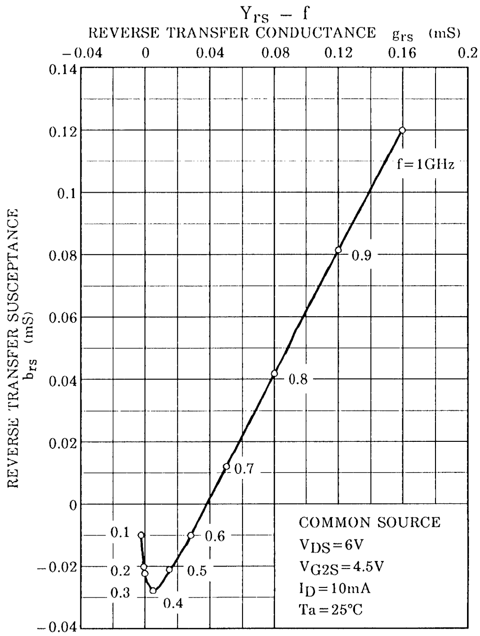

Ciss – VG2S
INPUT CAPACITANCE Ciss (pF)
COMMON SOURCE
VDS=6V
VG1S : VG2S=4.5V
ID=10mA
f=1MHz
Ta=25°C
GATE 2-SOURCE VOLTAGE VG2S (V)


Gps – VG2S
POWER GAIN Gps (dB)
VDD
VG2S
R(=200Ω)
VDD=6V (=VDS)
+200Ω (=R)×10mA
at VG2S=4.5V
f=200MHz, Ta=25°C
GATE 2-SOURCE VOLTAGE VG2S (V)

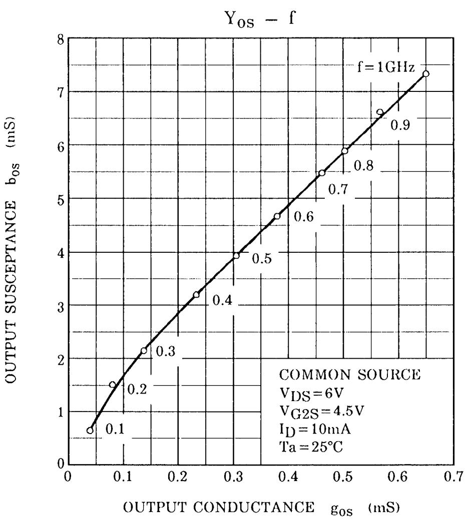

Yis – f
INPUT SUSCEPTANCE bis (mS)
COMMON SOURCE
VDS=6V
VG2S=4.5V
ID=10mA
Ta=25°C
f=1GHz
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
INPUT CONDUCTANCE gis (mS)



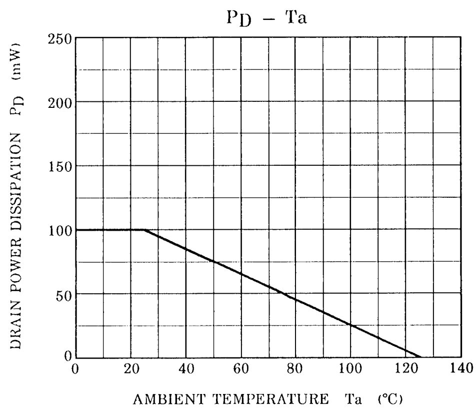
Yfs – f
FORWARD TRANSFER CONDUCTANCE gfs (mS)
FORWARD TRANSFER SUSCEPTANCE bfs (mS)
COMMON SOURCE
VDS=6V
VG2S=4.5V
ID=10mA
Ta=25°C
f=1GHz



Yrs – f
REVERSE TRANSFER CONDUCTANCE grs (mS)
REVERSE TRANSFER SUSCEPTANCE brs (mS)
f=1GHz
COMMON SOURCE
VDS=6V
VG2S=4.5V
ID=10mA
Ta=25°C



Yos – f
OUTPUT SUSCEPTANCE bos (mS)
OUTPUT CONDUCTANCE gos (mS)
f=1GHz
COMMON SOURCE
VDS=6V
VG2S=4.5V
ID=10mA
Ta=25°C



PD – Ta
DRAIN POWER DISSIPATION PD (mW)
AMBIENT TEMPERATURE Ta (°C)

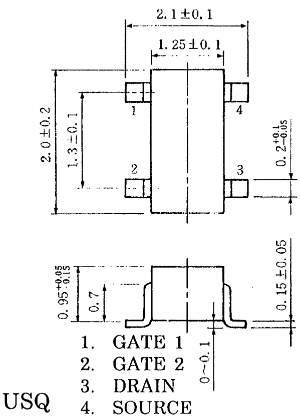
3SK259

SILICON N CHANNEL DUAL GATE MOS TYPE FIELD EFFECT TRANSISTOR

TV TUNER, UHF RF AMPLIFIER APPLICATIONS.
TV TUNER VHF WIDE BAND RF AMPLIFIER APPLICATIONS.

- Superior Cross Modulation Performance.
- Low Reverse Transfer Capacitance : C_{rss}=0.025pF (Typ.)
- Low Noise Figure : NF=2.6dB (Typ.)

Unit in mm



USQ	
JEDEC	—
EIAJ	—
TOSHIBA	2-2K1B

Weight : 0.006g

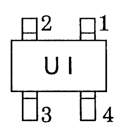
MAXIMUM RATINGS (Ta = 25°C)

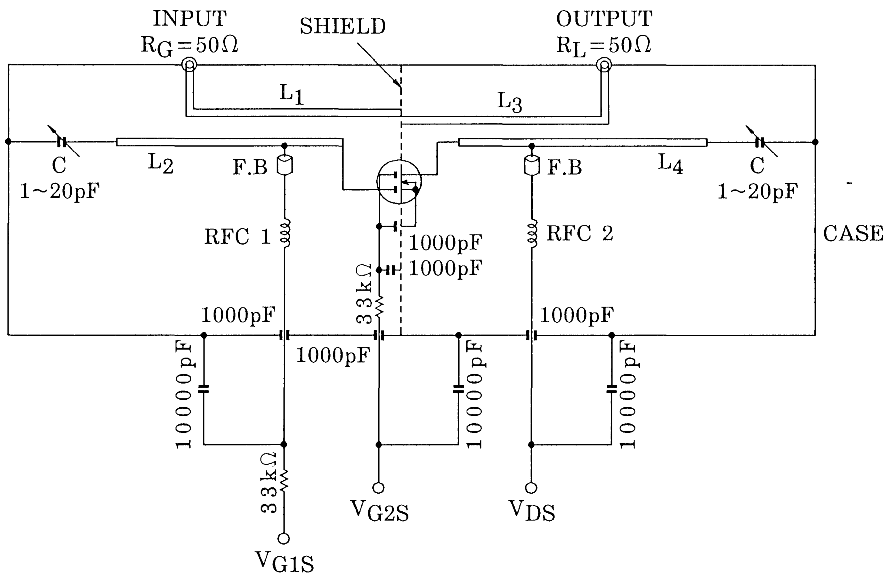
CHARACTERISTIC	SYMBOL	RATING	UNIT
Drain-Source Voltage	V_{DS}	13.5	V
Gate 1-Source Voltage	V_{G1S}	±8	V
Gate 2-Source Voltage	V_{G2S}	±8	V
Drain Current	I_D	30	mA
Drain Power Dissipation	P_D	100	mW
Chanel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate 1 Leakage Current	I_{G1SS}	V_{DS}=0, V_{G1S}=±6V, V_{G2S}=0	—	—	±50	nA
Gate 2 Leakage Current	I_{G2SS}	V_{DS}=0, V_{G1S}=0, V_{G2S}=±6V	—	—	±50	nA
Drain-Source Voltage	$V_{(BR)DSX}$	V_{G1S}=−4V, V_{G2S}=−4V I_D=100μA	13.5	—	—	V
Drain Current	I_{DSS}	V_{DS}=6V, V_{G1S}=0, V_{G2S}=3V	0	—	2	mA
Gate 1-Source Cut-off Voltage	$V_{G1S(OFF)}$	V_{DS}=6V, V_{G2S}=3V, I_D=100μA	−1.5	—	1	V
Gate 2-Source Cut-off Voltage	$V_{G2S(OFF)}$	V_{DS}=6V, V_{G1S}=3V, I_D=100μA	−1.0	—	1	V
Forward Transfer Admittance	$\|Y_{fs}\|$	V_{DS}=6V, V_{G2S}=3V I_D=10mA, f=1kHz	—	21	—	mS
Input Capacitance	C_{iss}	V_{DS}=6V, V_{G2S}=3V I_D=10mA, f=1MHz	1.9	2.7	3.5	pF
Reverse Transfer Capacitance	C_{rss}		—	0.025	0.04	pF
Power Gain	G_{ps}	V_{DS}=6V, V_{G2S}=3V I_D=10mA, f=800MHz (Fig.1)	15	19	—	dB
Noise Figure	NF		—	2.6	4.0	dB

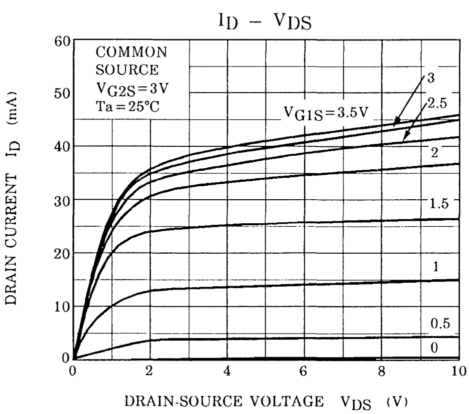
Marking

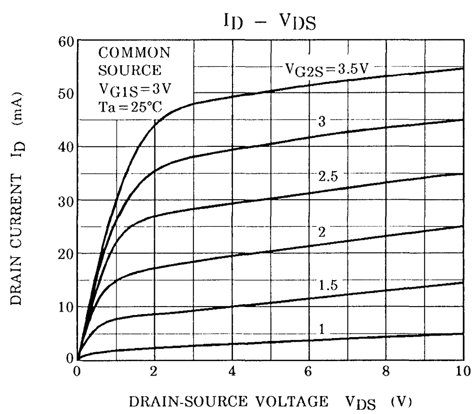


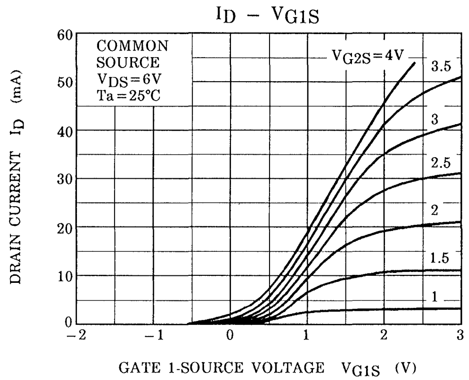


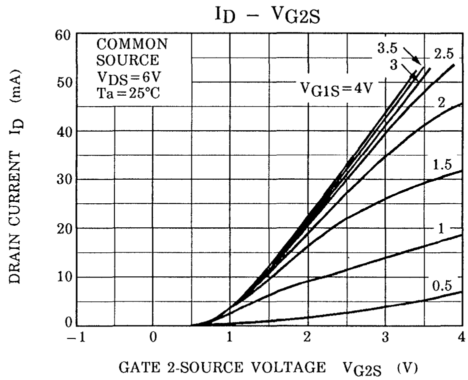
L_1~L_4 : φ0.8mm SILVER PLATED COPPER WIRE
C : AIR TRIMMER TTA25A200A (MURATA MFG. Co., LTD.)
RFC 1 : φ0.35mm COPPER WIRE 3mm ID, 7T
RFC 2 : φ0.35mm COPPER WIRE 3mm ID, 10T

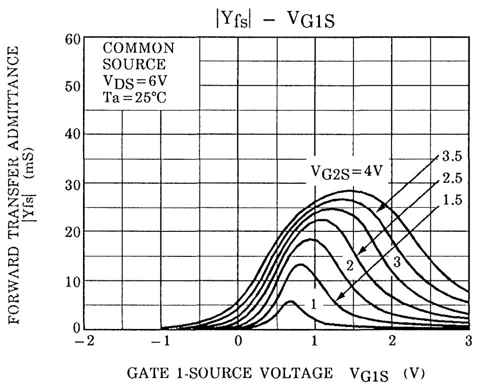
Fig.1 800MHz G_{ps}, NF TEST CIRCUIT

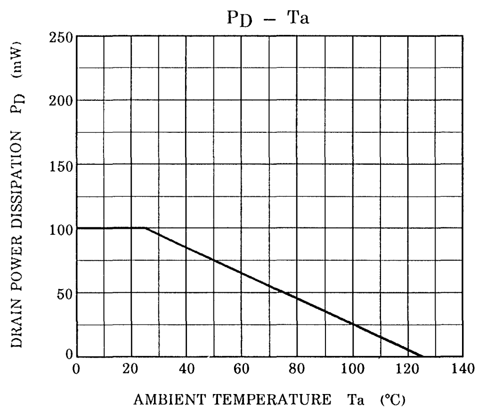


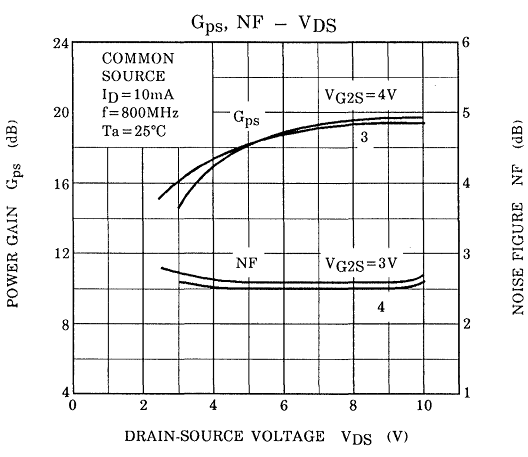


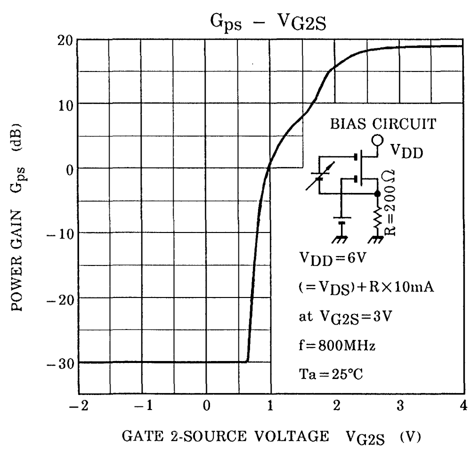

ID − VG1S
COMMON SOURCE
VDS=6V
Ta=25°C
VG2S=4V
3.5
3
2.5
2
1.5
1
DRAIN CURRENT ID (mA)
GATE 1-SOURCE VOLTAGE VG1S (V)

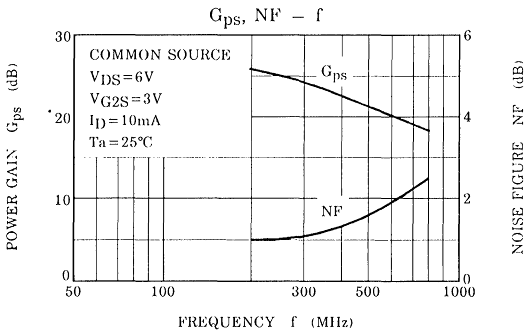

ID − VG2S
COMMON SOURCE
VDS=6V
Ta=25°C
VG1S=4V
3.5
3
2.5
2
1.5
1
0.5
DRAIN CURRENT ID (mA)
GATE 2-SOURCE VOLTAGE VG2S (V)

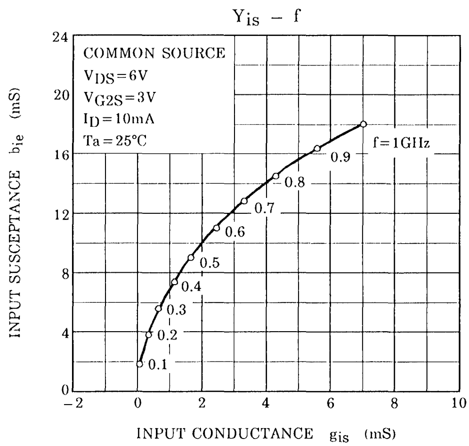

|Yfs| − VG1S
COMMON SOURCE
VDS=6V
Ta=25°C
VG2S=4V
3.5
2.5
1.5
3
2
1
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)
GATE 1-SOURCE VOLTAGE VG1S (V)

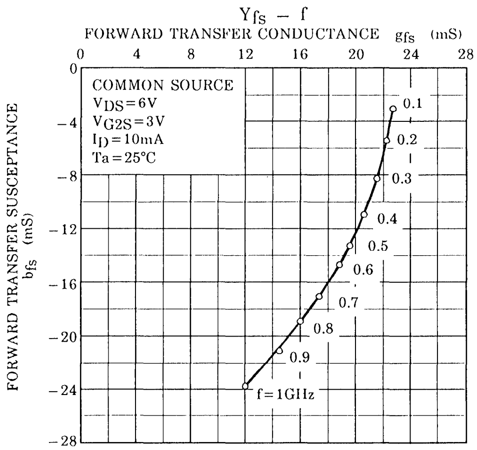

PD − Ta
DRAIN POWER DISSIPATION PD (mW)
AMBIENT TEMPERATURE Ta (°C)

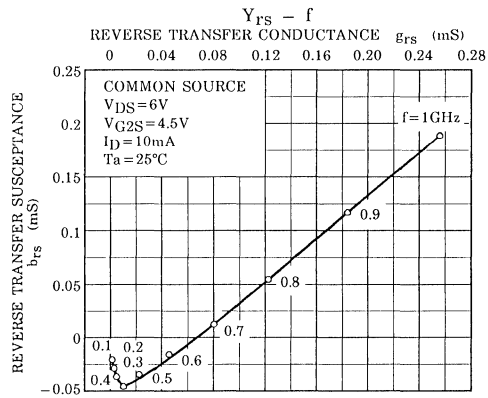

Gps, NF − VDS
COMMON SOURCE
ID=10mA
f=800MHz
Ta=25°C
Gps
VG2S=4V
3
NF
VG2S=3V
4
POWER GAIN Gps (dB)
NOISE FIGURE NF (dB)
DRAIN-SOURCE VOLTAGE VDS (V)

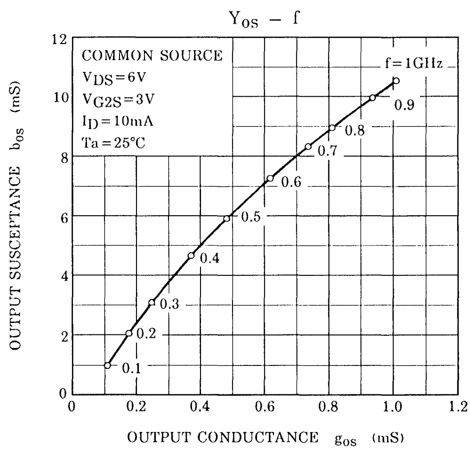

Gps − VG2S
BIAS CIRCUIT
VDD
R=200Ω
VDD=6V
(=VDS)+R×10mA
at VG2S=3V
f=800MHz
Ta=25°C
POWER GAIN Gps (dB)
GATE 2-SOURCE VOLTAGE VG2S (V)


Gps, NF – f
COMMON SOURCE
VDS=6V
VG2S=3V
ID=10mA
Ta=25°C
Gps
NF
POWER GAIN Gps (dB)
NOISE FIGURE NF (dB)
FREQUENCY f (MHz)
30
20
10
0
6
4
2
0
50
100
300
500
1000


Yis – f
COMMON SOURCE
VDS=6V
VG2S=3V
ID=10mA
Ta=25°C
f=1GHz
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
INPUT SUSCEPTANCE bie (mS)
INPUT CONDUCTANCE gis (mS)
24
20
16
12
8
4
0
–2
0
2
4
6
8
10


Yfs – f
FORWARD TRANSFER CONDUCTANCE gfs (mS)
0
4
8
12
16
20
24
28
COMMON SOURCE
VDS=6V
VG2S=3V
ID=10mA
Ta=25°C
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
f=1GHz
FORWARD TRANSFER SUSCEPTANCE bfs (mS)
0
–4
–8
–12
–16
–20
–24
–28


Yrs – f
REVERSE TRANSFER CONDUCTANCE grs (mS)
0
0.04
0.08
0.12
0.16
0.20
0.24
0.28
COMMON SOURCE
VDS=6V
VG2S=4.5V
ID=10mA
Ta=25°C
f=1GHz
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
REVERSE TRANSFER SUSCEPTANCE brs (mS)
0.25
0.2
0.15
0.1
0.05
0
–0.05


Yos – f
COMMON SOURCE
VDS=6V
VG2S=3V
ID=10mA
Ta=25°C
f=1GHz
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
OUTPUT SUSCEPTANCE bos (mS)
OUTPUT CONDUCTANCE gos (mS)
12
10
8
6
4
2
0
0
0.2
0.4
0.6
0.8
1.0
1.2

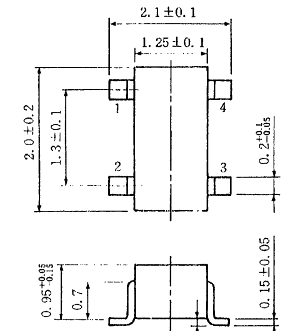
3SK260

SILICON N CHANNEL DUAL GATE MOS TYPE
FIELD EFFECT TRANSISTOR

TV TUNER VHF MIXER APPLICATIONS.
VHF RF AMPLIFIER APPLICATIONS.

- High Conversion Gain : G_{CS} = 24.5dB (Typ.)
- Low Noise Figure : NF_{CS} = 3.3dB (Typ.)

Unit in mm



1. GATE 1
2. GATE 2
3. DRAIN
4. SOURCE

USQ	
JEDEC	—
EIAJ	—
TOSHIBA	2-2K1B

MAXIMUM RATINGS (Ta = 25°C)

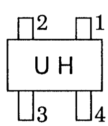
CHARACTERISTIC	SYMBOL	RATING	UNIT
Drain-Source Voltage	V_{DS}	15	V
Gate 1-Source Voltage	V_{G1S}	±8	V
Gate 2-Source Voltage	V_{G2S}	±8	V
Drain Current	I_D	30	mA
Drain Power Dissipation	P_D	100	mW
Chanel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

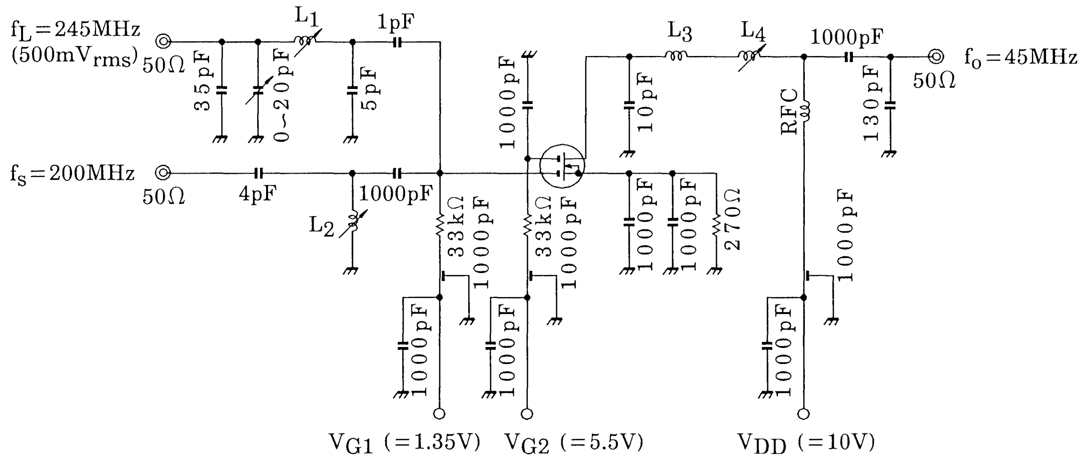
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate 1 Leakage Current	I_{G1SS}	$V_{DS}=0$, $V_{G1S}=\pm6V$, $V_{G2S}=0$	—	—	±50	nA
Gate 2 Leakage Current	I_{G2SS}	$V_{DS}=0$, $V_{G1S}=0$, $V_{G2S}=\pm6V$	—	—	±50	nA
Drain-Source Voltage	$V_{(BR)DSX}$	$V_{G1S}=-4V$, $V_{G2S}=-4V$, $I_D=100\mu A$	15	—	—	V
Drain Current	I_{DSS} (Note)	$V_{DS}=6V$, $V_{G1S}=0$, $V_{G2S}=3V$	3	—	14	mA
Gate 1-Source Cut-off Voltage	$V_{G1S(OFF)}$	$V_{DS}=6V$, $V_{G2S}=3V$, $I_D=100\mu A$	−0.15	—	−1.5	V
Gate 2-Source Cut-off Voltage	$V_{G2S(OFF)}$	$V_{DS}=6V$, $V_{G1S}=0V$, $I_D=100\mu A$	0	—	−1.0	V
Forward Transfer Admittance	$\|Y_{fs}\|$	$V_{DS}=6V$, $V_{G2S}=3V$, $I_D=10mA$, $f=1kHz$	—	27	—	mS
Input Capacitance	C_{iss}	$V_{DS}=6V$, $V_{G2S}=3V$, $I_D=10mA$, $f=1MHz$	—	2.7	3.8	pF
Reverse Transfer Capacitance	C_{rss}		—	0.025	0.04	pF
Conversion Gain	G_{CS}	$V_{DD}=10V$, $f=200MHz$ $f_L=245MHz$ ($500mV_{rms}$) (Fig.1)	21	24.5	—	dB
Noise Figure	NF_{CS}		—	3.3	5.5	dB

Note : I_{DSS} Classification Y : 3~7mA, GR : 6~14mA

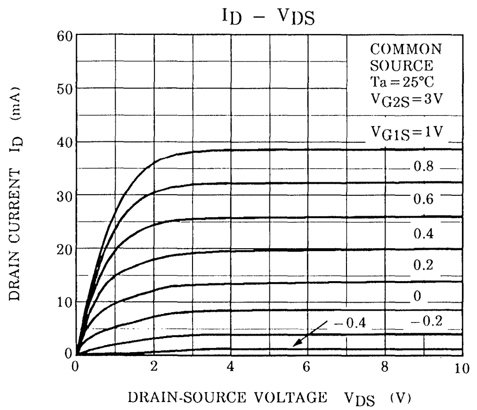
Marking

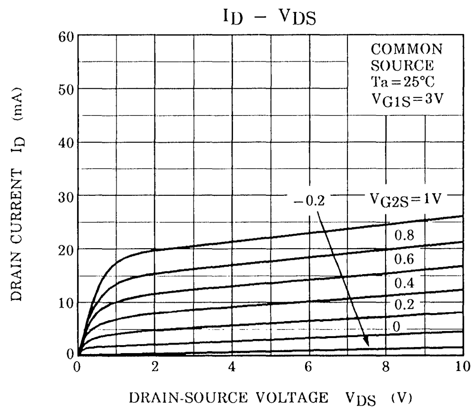




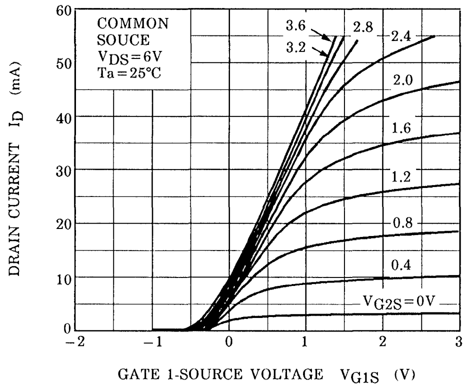
L_1 : ϕ6.5mm BOBBIN WITH FERRITE CORE, ϕ0.7mm UEW, 2T
L_2 : ϕ6.5mm BOBBIN WITH FERRITE CORE, ϕ0.7mm UEW, 2T
L_3 : 3mm ID, ϕ0.5mm UEW, 4T
L_4 : ϕ8mm BOBBIN WITH FERRITE CORE, ϕ0.35mm UEW, 7T
RFC : 100μH

Fig.1 200MHz G_{CS}, NF_{CS} TEST CIRCUIT

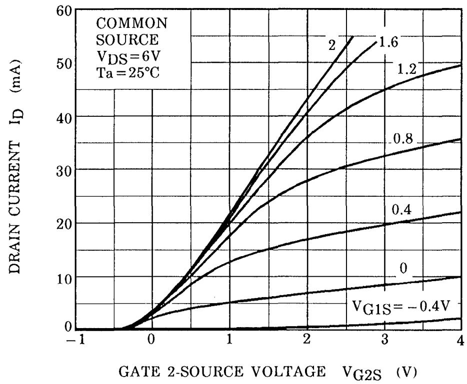




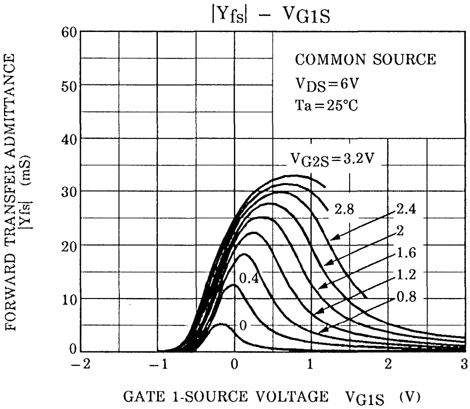
I_D – V_{G1S}



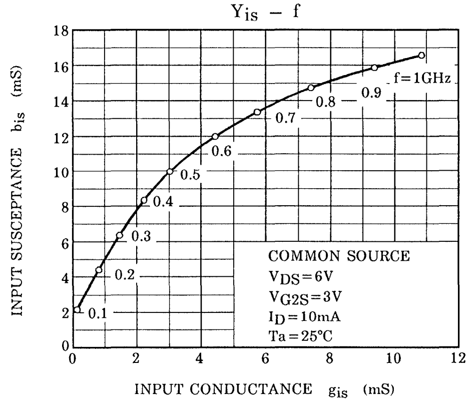
I_D – V_{G2S}



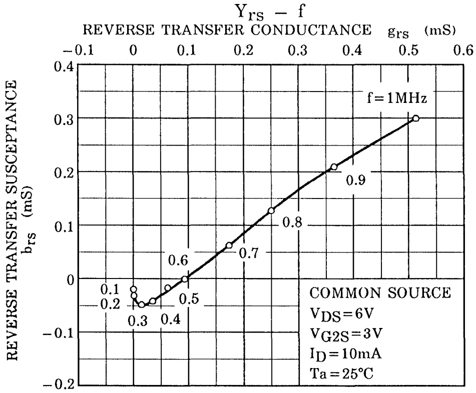
$|Y_{fs}|$ – V_{G1S}



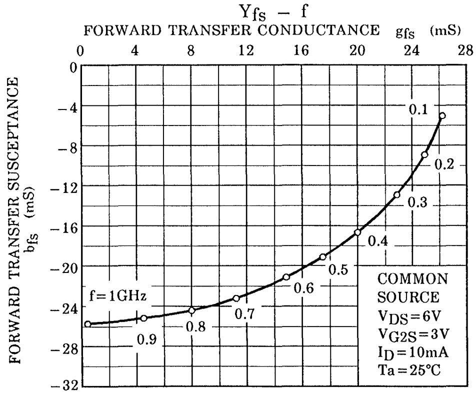
Y_{is} – f

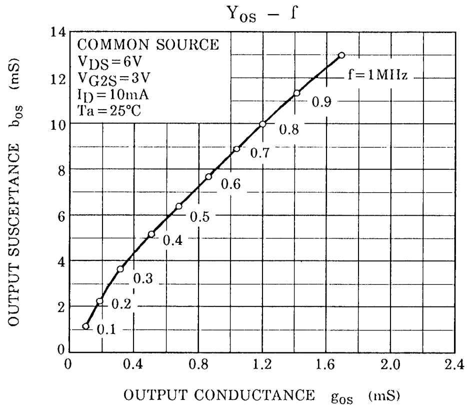


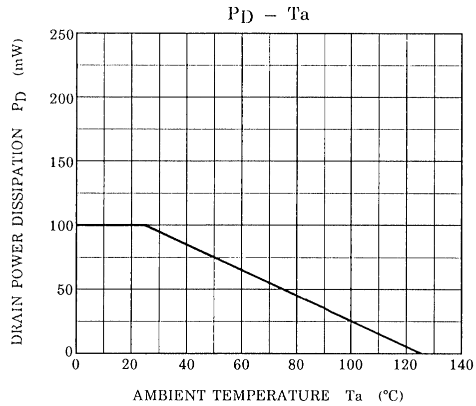
Y_{rs} – f

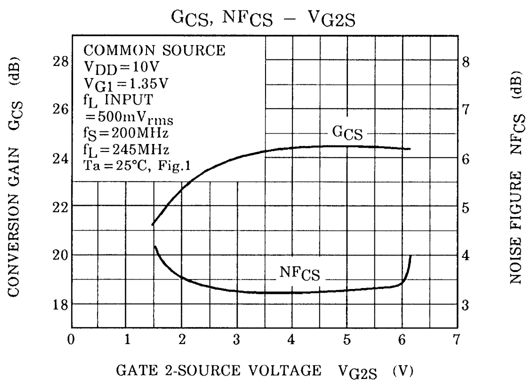


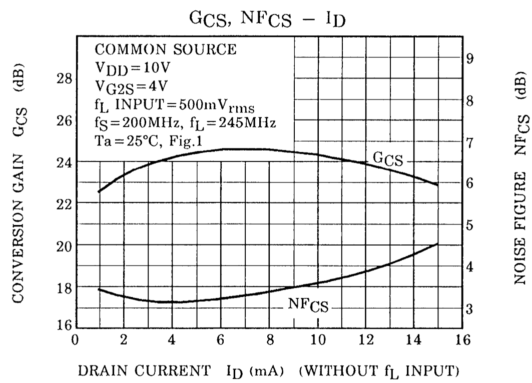
Y_{fs} – f

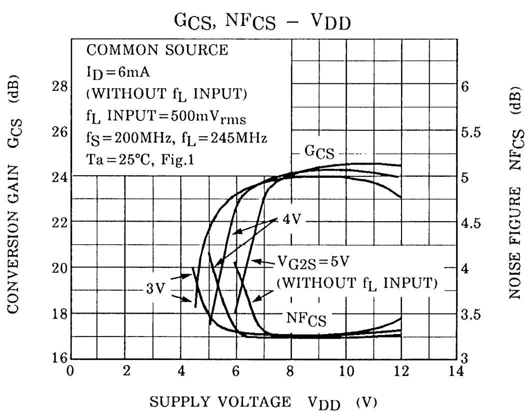


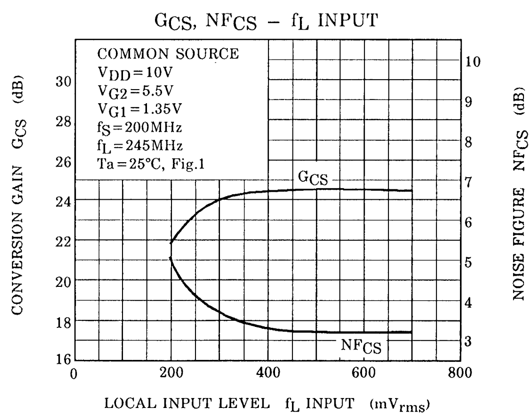

Yos − f
COMMON SOURCE
VDS=6V
VG2S=3V
ID=10mA
Ta=25°C
f=1MHz
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
OUTPUT SUSCEPTANCE bos (mS)
OUTPUT CONDUCTANCE gos (mS)


PD − Ta
DRAIN POWER DISSIPATION PD (mW)
AMBIENT TEMPERATURE Ta (°C)


GCS, NFCS − VG2S
COMMON SOURCE
VDD=10V
VG1=1.35V
fL INPUT
=500mVrms
fS=200MHz
fL=245MHz
Ta=25°C, Fig.1
GCS
NFCS
CONVERSION GAIN GCS (dB)
NOISE FIGURE NFCS (dB)
GATE 2-SOURCE VOLTAGE VG2S (V)


GCS, NFCS − ID
COMMON SOURCE
VDD=10V
VG2S=4V
fL INPUT=500mVrms
fS=200MHz, fL=245MHz
Ta=25°C, Fig.1
GCS
NFCS
CONVERSION GAIN GCS (dB)
NOISE FIGURE NFCS (dB)
DRAIN CURRENT ID (mA) (WITHOUT fL INPUT)


GCS, NFCS − VDD
COMMON SOURCE
ID=6mA
(WITHOUT fL INPUT)
fL INPUT=500mVrms
fS=200MHz, fL=245MHz
Ta=25°C, Fig.1
GCS
4V
VG2S=5V
(WITHOUT fL INPUT)
3V
NFCS
CONVERSION GAIN GCS (dB)
NOISE FIGURE NFCS (dB)
SUPPLY VOLTAGE VDD (V)

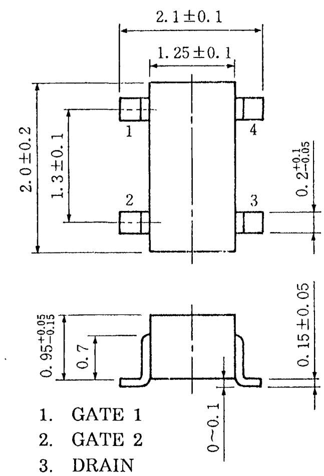

GCS, NFCS − fL INPUT
COMMON SOURCE
VDD=10V
VG2=5.5V
VG1=1.35V
fS=200MHz
fL=245MHz
Ta=25°C, Fig.1
GCS
NFCS
CONVERSION GAIN GCS (dB)
NOISE FIGURE NFCS (dB)
LOCAL INPUT LEVEL fL INPUT (mVrms)

3SK274

GaAs N CHANNEL DUAL GATE MES TYPE FIELD EFFECT TRANSISTOR

TV TUNER, UHF RF AMPLIFIER APPLICATIONS.

Unit in mm



1. GATE 1
2. GATE 2
3. DRAIN
4. SOURCE

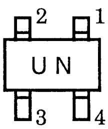
JEDEC	—
EIAJ	—
TOSHIBA	2-2K1B

Weight : 0.006g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Gate1-Drain Voltage	V_{G1DO}	−9	V
Gate2-Drain Voltage	V_{G2DO}	−9	V
Gate1-Source Voltage	V_{G1S}	−4	V
Gate2-Source Voltage	V_{G2S}	−4	V
Gate1 Current	I_{G1}	1	mA
Gate2 Current	I_{G2}	1	mA
Power Dissipation	P_D	100	mW
Channel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

MARKING



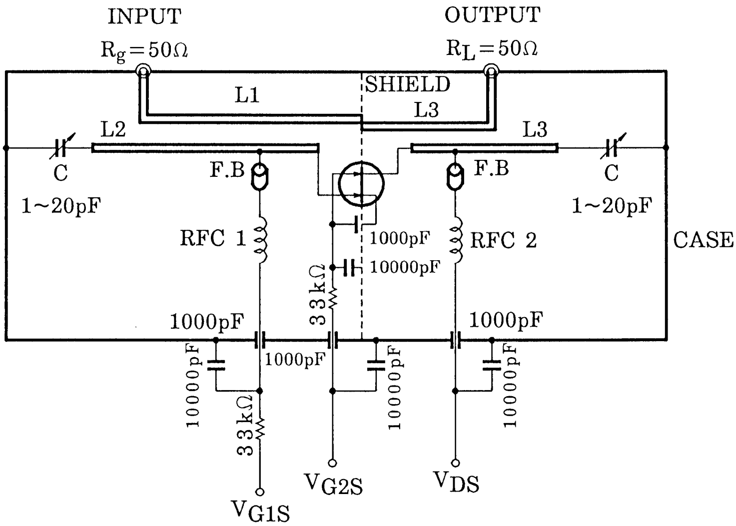
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate1 Leakage Current	I_{G1SS}	$V_{DS}=0, V_{G1S}=-3V, V_{G2S}=0$	—	—	−4	μA
Gate2 Leakage Current	I_{G2SS}	$V_{DS}=0, V_{G1S}=0, V_{G2S}=-3V$	—	—	−4	μA
Drain Current	I_{DSS}	$V_{DS}=3V, V_{G1S}=0, V_{G2S}=0$	6	—	20	mA
Gate1-Source Cut-off Voltage	$V_{G1S(OFF)}$	$V_{DS}=3V, V_{G2S}=0, I_D=100\mu A$	−0.7	—	−1.8	V
Gate2-Source Cut-off Voltage	$V_{G2S(OFF)}$	$V_{DS}=3V, V_{G1S}=0, I_D=100\mu A$	−0.7	—	−1.8	V
Forward Transfer Admittance	$\|Y_{fs}\|$	$V_{DS}=3V$, $V_{G2S}=1V$ $I_D=5mA$, $f=1kHz$	—	19	—	mS
Input Capacitance	C_{iss}	$V_{DS}=3V$, $V_{G2S}=1V$ $I_D=5mA$, $f=1MHz$	—	0.6	1.4	pF
Reverse Transfer Capacitance	C_{rss}		—	0.013	0.030	
Power Gain	G_{ps}	$V_{DS}=3V$, $V_{G2S}=1V$ $I_D=5mA$, $f=800MHz$ (Fig 1)	17	20.5	—	dB
Noise Figure	NF		—	1.0	2.0	

CAUTION

GaAs (Gallium Arsenide) is used in this product. The dust or vapor can be dangerous to humans. Do not break, cut, crush or dissolve chemically. Dispose of this product properly according to law. Do not intermingle with normal industrial or domestic waste.

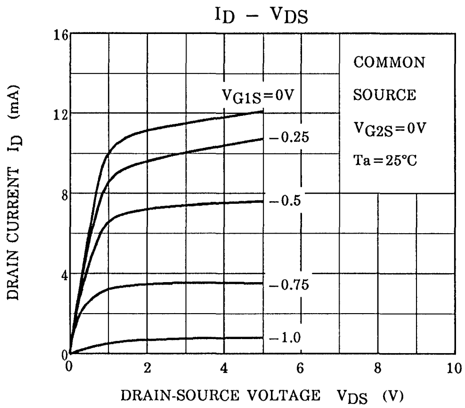
Fig.1 800MHz Gps, NF TEST CIRCUIT

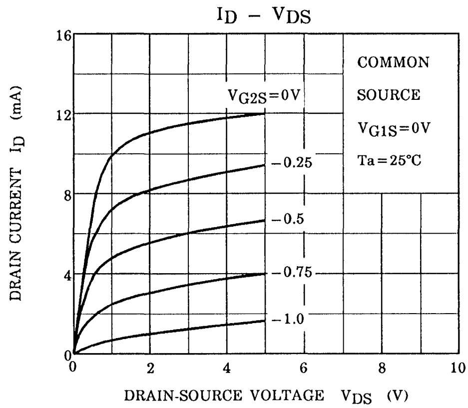


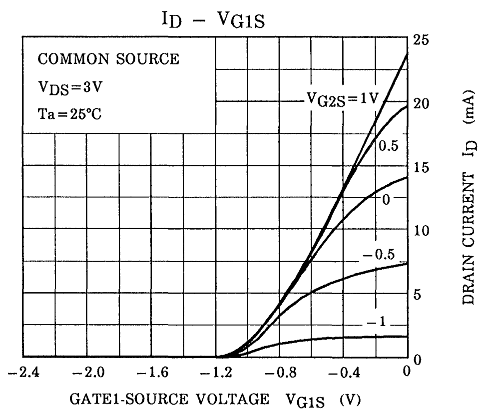
L1~L4 : φ0.8mm SILVER PLATED COPPER WIRE
C : AIR TRIMMER TTA25A 200A (MURATA MFG. Co., LTD.)
RFC 1 : φ0.35mm UEW 3mm ID, 7T
RFC 2 : φ0.35mm UEW 3mm ID, 10T

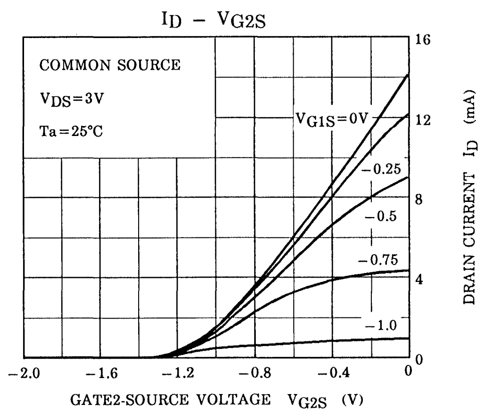
CAUTION

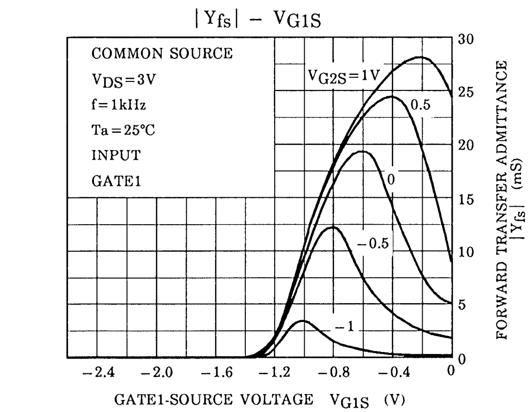
GaAs (Gallium Arsenide) is used in this product. The dust or vapor can be dangerous to humans. Do not break, cut, crush or dissolve chemically. Dispose of this product properly according to law. Do not intermingle with normal industrial or domestic waste.

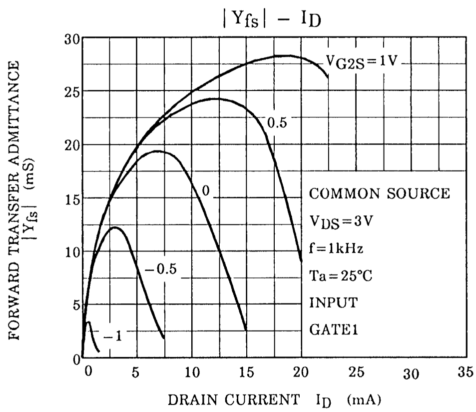

ID – VDS
COMMON SOURCE
VG2S=0V
Ta=25°C
VG1S=0V
−0.25
−0.5
−0.75
−1.0
DRAIN CURRENT ID (mA)
DRAIN-SOURCE VOLTAGE VDS (V)

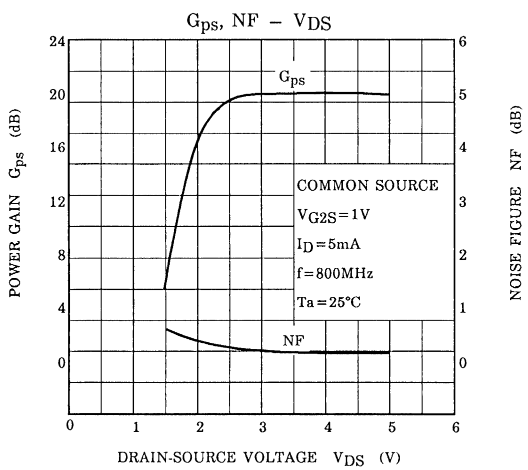

ID – VDS
COMMON SOURCE
VG1S=0V
Ta=25°C
VG2S=0V
−0.25
−0.5
−0.75
−1.0
DRAIN CURRENT ID (mA)
DRAIN-SOURCE VOLTAGE VDS (V)

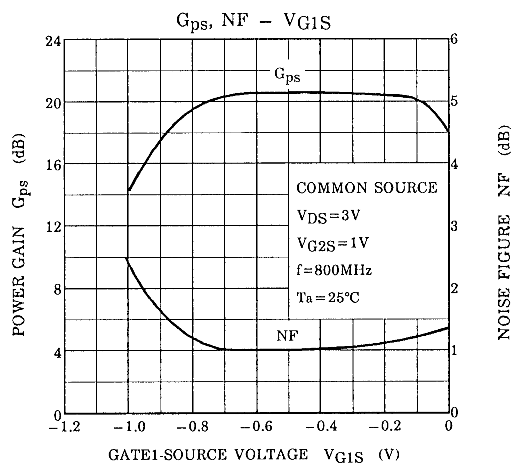

ID – VG1S
COMMON SOURCE
VDS=3V
Ta=25°C
VG2S=1V
0.5
0
−0.5
−1
DRAIN CURRENT ID (mA)
GATE1-SOURCE VOLTAGE VG1S (V)


ID – VG2S
COMMON SOURCE
VDS=3V
Ta=25°C
VG1S=0V
−0.25
−0.5
−0.75
−1.0
DRAIN CURRENT ID (mA)
GATE2-SOURCE VOLTAGE VG2S (V)

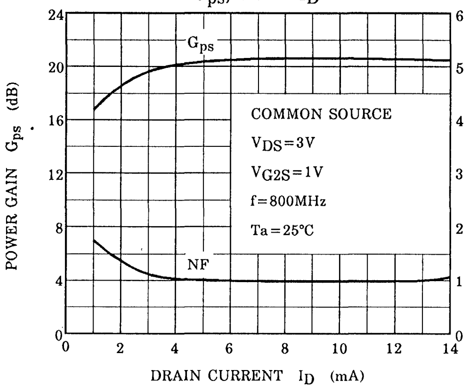

|Yfs| – VG1S
COMMON SOURCE
VDS=3V
f=1kHz
Ta=25°C
INPUT
GATE1
VG2S=1V
0.5
0
−0.5
−1
30
25
20
15
10
5
0
−2.4
−2.0
−1.6
−1.2
−0.8
−0.4
0
GATE1-SOURCE VOLTAGE VG1S (V)
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)


|Yfs| – ID
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)
VG2S=1V
0.5
0
−0.5
−1
COMMON SOURCE
VDS=3V
f=1kHz
Ta=25°C
INPUT
GATE1
30
25
20
15
10
5
0
0
5
10
15
20
25
30
35
DRAIN CURRENT ID (mA)

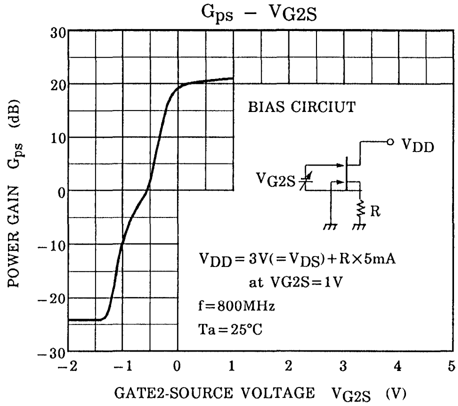

Gps, NF – VDS
POWER GAIN Gps (dB)
Gps
COMMON SOURCE
VG2S=1V
ID=5mA
f=800MHz
Ta=25°C
NF
24
20
16
12
8
4
0
6
5
4
3
2
1
0
0
1
2
3
4
5
6
DRAIN-SOURCE VOLTAGE VDS (V)
NOISE FIGURE NF (dB)


Gps, NF – VG1S
POWER GAIN Gps (dB)
Gps
COMMON SOURCE
VDS=3V
VG2S=1V
f=800MHz
Ta=25°C
NF
24
20
16
12
8
4
0
6
5
4
3
2
1
0
−1.2
−1.0
−0.8
−0.6
−0.4
−0.2
0
GATE1-SOURCE VOLTAGE VG1S (V)
NOISE FIGURE NF (dB)

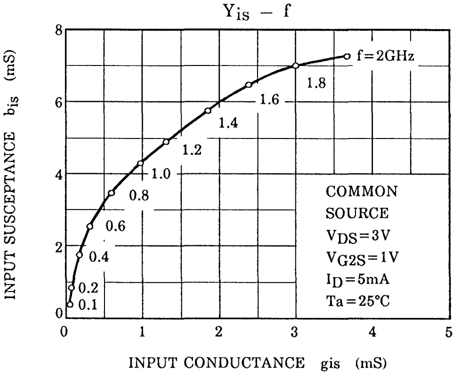
G_{ps}, NF – I_D



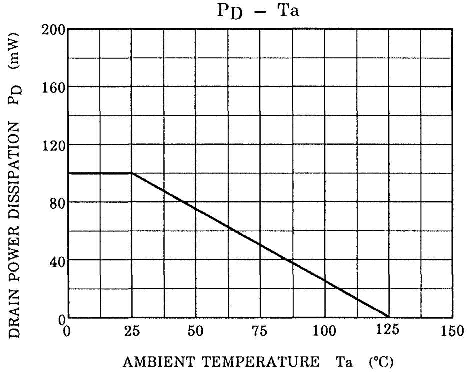
G_{ps} – V_{G2S}



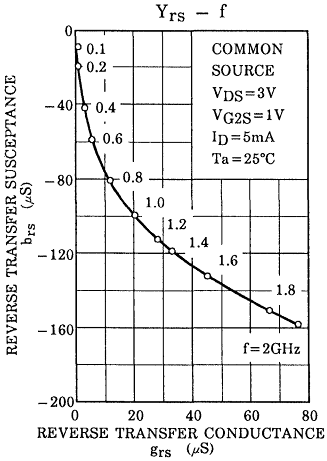
Y_{is} – f



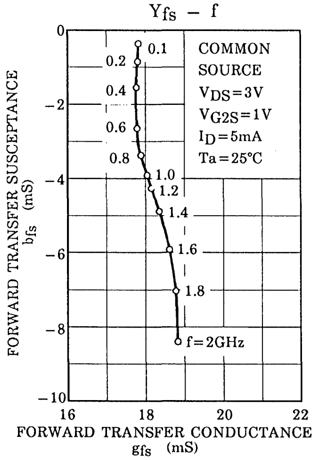
P_D – Ta



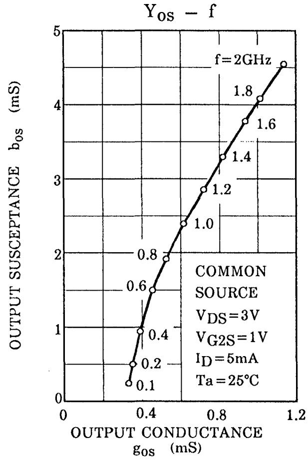
Y_{rs} – f



Y_{fs} – f



Y_{os} – f

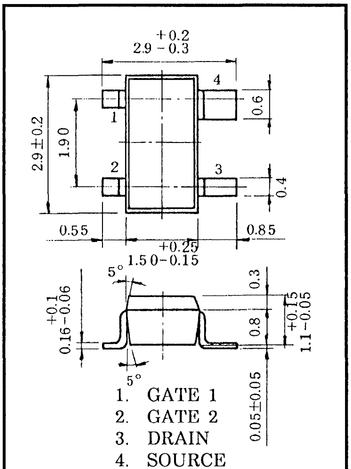


GaAs N CHANNEL DUAL GATE MES TYPE FIELD EFFECT TRANSISTOR

3SK283

TV TUNER, UHF RF AMPLIFIER APPLICATIONS.

Unit in mm



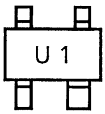
JEDEC	—
EIAJ	—
TOSHIBA	2-3J1A

Weight : 0.013g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Gate 1-Drain Voltage	V_{G1DO}	−6	V
Gate 2-Drain Voltage	V_{G2DO}	−6	V
Gate 1-Source Voltage	V_{G1S}	−4	V
Gate 2-Source Voltage	V_{G2S}	−4	V
Gate 1 Current	I_{G1}	1	mA
Gate 2 Current	I_{G2}	1	mA
Power Dissipation	P_D	150	mW
Channel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Marking



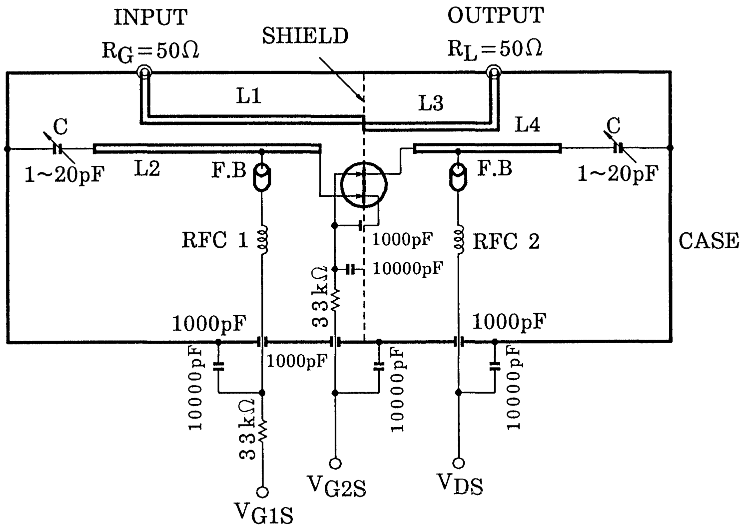
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate 1 Leakage Current	I_{G1SS}	$V_{DS}=0$, $V_{G1S}=-3V$, $V_{G2S}=0$	—	—	−4	μA
Gate 2 Leakage Current	I_{G2SS}	$V_{DS}=0$, $V_{G1S}=0$, $V_{G2S}=-3V$	—	—	−4	μA
Drain Current	I_{DSS}	$V_{DS}=2V$, $V_{G1S}=0$, $V_{G2S}=0$	4	—	16	mA
Gate 1-Source Cut-off Voltage	$V_{G1S(OFF)}$	$V_{DS}=2V$, $V_{G2S}=0$, $I_D=100\mu A$	−0.5	—	−1.5	V
Gate 2-Source Cut-off Voltage	$V_{G2S(OFF)}$	$V_{DS}=2V$, $V_{G1S}=0$, $I_D=100\mu A$	−0.5	—	−1.5	V
Forward Transfer Admittance	$\|Y_{fs}\|$	$V_{DS}=2V$, $V_{G2S}=0.5V$, $I_D=2mA$, f=1kHz	—	12	—	mS
Input Capacitance	C_{iss}	$V_{DS}=2V$, $V_{G2S}=0.5V$, $I_D=2mA$, f=1MHz	—	0.65	1.3	pF
Reverse Transfer Capacitance	C_{rss}		—	0.015	0.03	
Power Gain	G_{ps}	$V_{DS}=2V$, $V_{G2S}=0.5V$, $I_D=2mA$, f=800MHz (Fig.1)	15	18.5	—	dB
Noise Figure	NF		—	1.3	2.5	

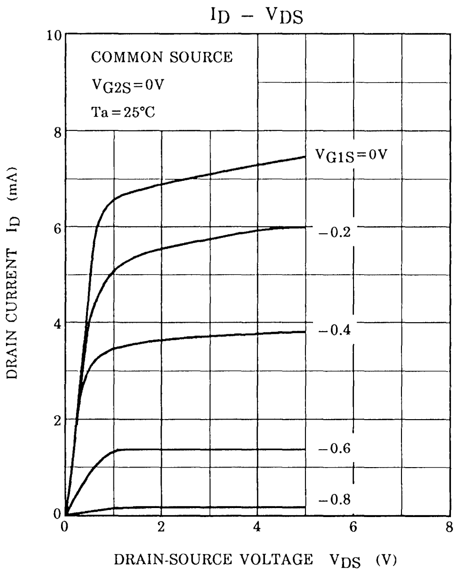
CAUTION

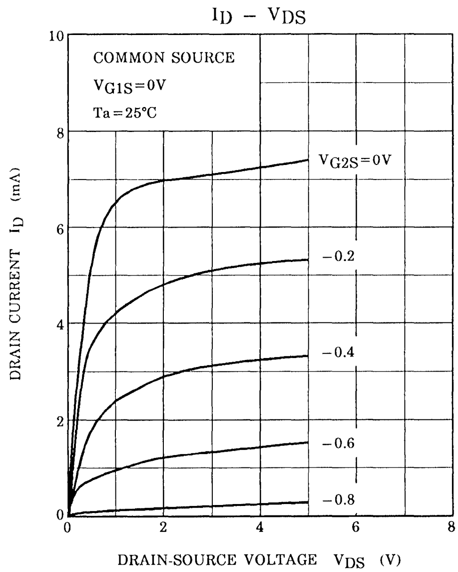
GaAs (Gallium Arsenide) is used in this product. The dust or vapor can be dangerous to humans. Do not break, cut, crush or dissolve chemically. Dispose of this product properly according to law. Do not intermingle with normal industrial or domestic waste.

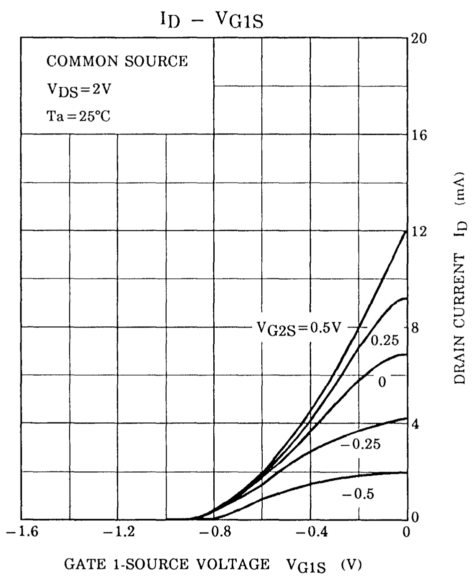
FIG.1 800MHz G_{ps}, NF TEST CIRCUIT

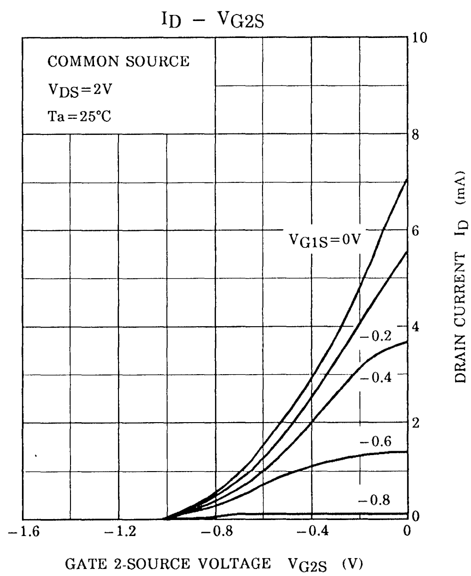


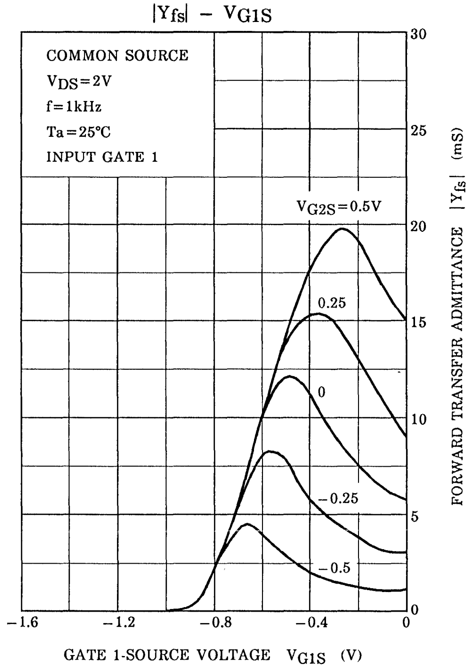
L1~L4 : ϕ1.0mm SILVER PLATED COPPER WIRE
C : AIR TRIMMER TTA25A200A (MURATA MFG. Co., LTD.)
RFC 1 : ϕ0.35mm COPPER WIRE 3mm ID, 7T
RFC 2 : ϕ0.35mm COPPER WIRE 3mm ID, 10T


I_D – V_{DS}
COMMON SOURCE
V_{G2S}=0V
Ta=25°C
V_{G1S}=0V
−0.2
−0.4
−0.6
−0.8
DRAIN CURRENT I_D (mA)
DRAIN-SOURCE VOLTAGE V_{DS} (V)
0
2
4
6
8
10

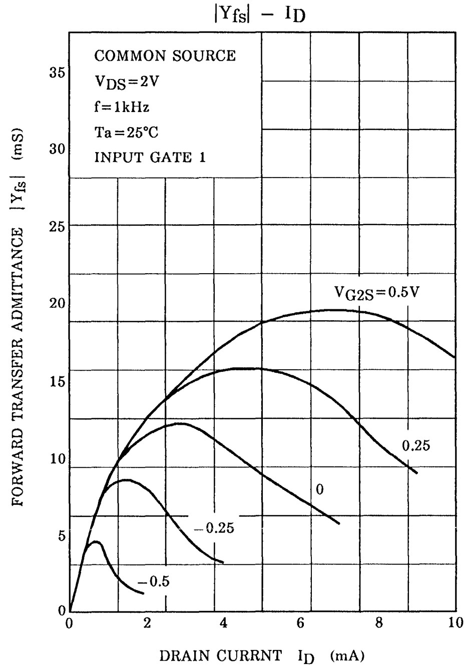

I_D – V_{DS}
COMMON SOURCE
V_{G1S}=0V
Ta=25°C
V_{G2S}=0V
−0.2
−0.4
−0.6
−0.8
DRAIN CURRENT I_D (mA)
DRAIN-SOURCE VOLTAGE V_{DS} (V)
0
2
4
6
8
10


I_D – V_{G1S}
COMMON SOURCE
V_{DS}=2V
Ta=25°C
V_{G2S}=0.5V
0.25
0
−0.25
−0.5
DRAIN CURRENT I_D (mA)
GATE 1-SOURCE VOLTAGE V_{G1S} (V)
−1.6
−1.2
−0.8
−0.4
0
4
8
12
16
20

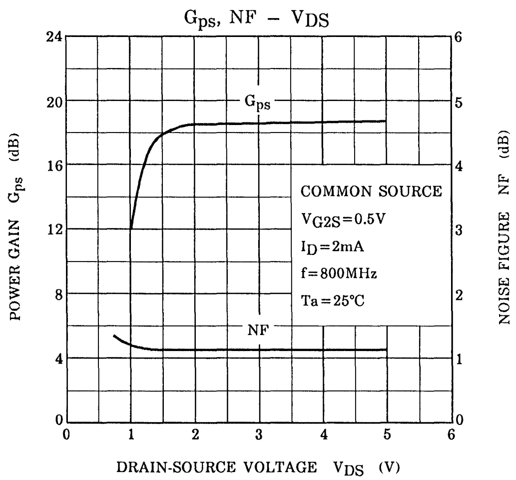

I_D – V_{G2S}
COMMON SOURCE
V_{DS}=2V
Ta=25°C
V_{G1S}=0V
−0.2
−0.4
−0.6
−0.8
DRAIN CURRENT I_D (mA)
GATE 2-SOURCE VOLTAGE V_{G2S} (V)
−1.6
−1.2
−0.8
−0.4
0
2
4
6
8
10



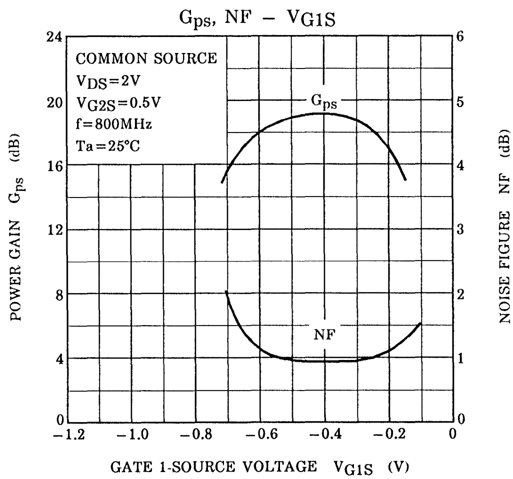
|Yfs| – VG1S
COMMON SOURCE
VDS=2V
f=1kHz
Ta=25°C
INPUT GATE 1
VG2S=0.5V
0.25
0
–0.25
–0.5
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)
GATE 1-SOURCE VOLTAGE VG1S (V)



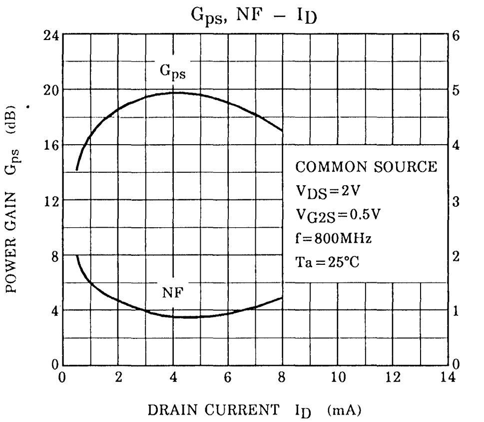
|Yfs| – ID
COMMON SOURCE
VDS=2V
f=1kHz
Ta=25°C
INPUT GATE 1
VG2S=0.5V
0.25
0
–0.25
–0.5
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)
DRAIN CURRNT ID (mA)

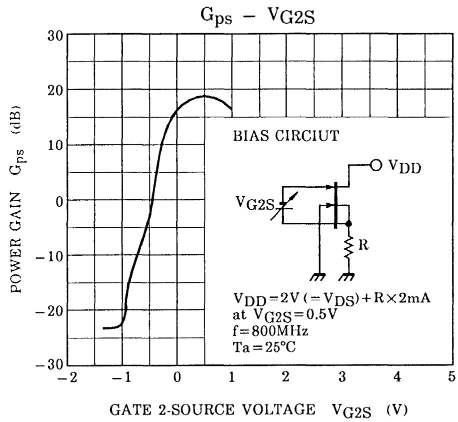


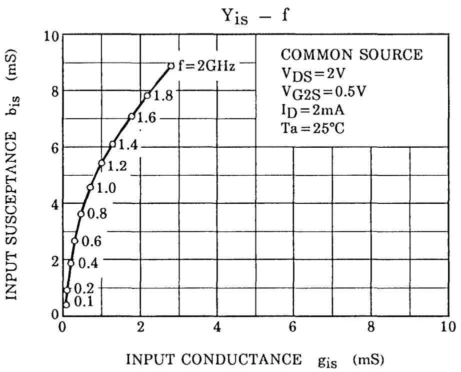
Gps, NF – VDS
Gps
NF
COMMON SOURCE
VG2S=0.5V
ID=2mA
f=800MHz
Ta=25°C
POWER GAIN Gps (dB)
NOISE FIGURE NF (dB)
DRAIN-SOURCE VOLTAGE VDS (V)

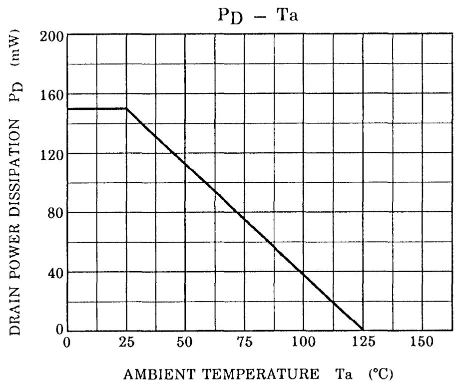


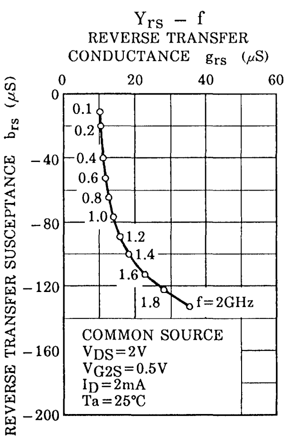
Gps, NF – VG1S
COMMON SOURCE
VDS=2V
VG2S=0.5V
f=800MHz
Ta=25°C
Gps
NF
POWER GAIN Gps (dB)
NOISE FIGURE NF (dB)
GATE 1-SOURCE VOLTAGE VG1S (V)

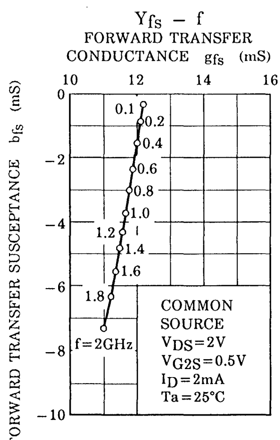

Gps, NF − ID
Gps
NF
COMMON SOURCE
VDS=2V
VG2S=0.5V
f=800MHz
Ta=25°C
POWER GAIN Gps (dB)
NOISE FIGURE NF (dB)
DRAIN CURRENT ID (mA)

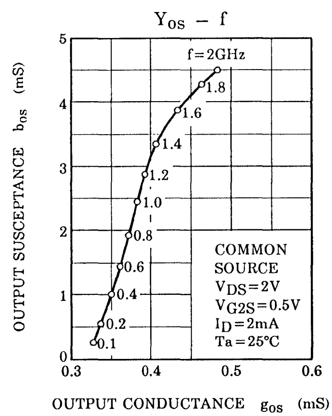

Gps − VG2S
BIAS CIRCUIT
VDD
VG2S
R
VDD=2V (=VDS)+R×2mA
at VG2S=0.5V
f=800MHz
Ta=25°C
POWER GAIN Gps (dB)
GATE 2-SOURCE VOLTAGE VG2S (V)


Yis − f
f=2GHz
COMMON SOURCE
VDS=2V
VG2S=0.5V
ID=2mA
Ta=25°C
INPUT SUSCEPTANCE bis (mS)
INPUT CONDUCTANCE gis (mS)


PD − Ta
DRAIN POWER DISSIPATION PD (mW)
AMBIENT TEMPERATURE Ta (°C)


Yrs − f
REVERSE TRANSFER
CONDUCTANCE grs (μS)
f=2GHz
COMMON SOURCE
VDS=2V
VG2S=0.5V
ID=2mA
Ta=25°C
REVERSE TRANSFER SUSCEPTANCE brs (μS)


Yfs − f
FORWARD TRANSFER
CONDUCTANCE gfs (mS)
f=2GHz
COMMON
SOURCE
VDS=2V
VG2S=0.5V
ID=2mA
Ta=25°C
FORWARD TRANSFER SUSCEPTANCE bfs (mS)

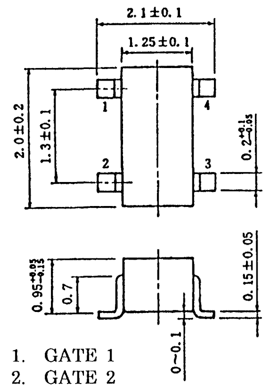

Yos − f
f=2GHz
COMMON
SOURCE
VDS=2V
VG2S=0.5V
ID=2mA
Ta=25°C
OUTPUT SUSCEPTANCE bos (mS)
OUTPUT CONDUCTANCE gos (mS)

3SK284

GaAs N CHANNEL DUAL GATE MES TYPE
FIELD EFFECT TRANSISTOR

TV TUNER, UHF RF AMPLIFIER APPLICATIONS.

Unit in mm



1. GATE 1
2. GATE 2
3. DRAIN
4. SOURCE

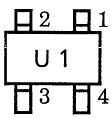
JEDEC	—
EIAJ	—
TOSHIBA	2-2K1B

Weight : 0.006g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Gate 1-Drain Voltage	V_{G1DO}	−6	V
Gate 2-Drain Voltage	V_{G2DO}	−6	V
Gate 1-Source Voltage	V_{G1S}	−4	V
Gate 2-Source Voltage	V_{G2S}	−4	V
Gate 1 Current	I_{G1}	1	mA
Gate 2 Current	I_{G2}	1	mA
Power Dissipation	P_D	100	mW
Channel Temperature	T_{ch}	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

Marking



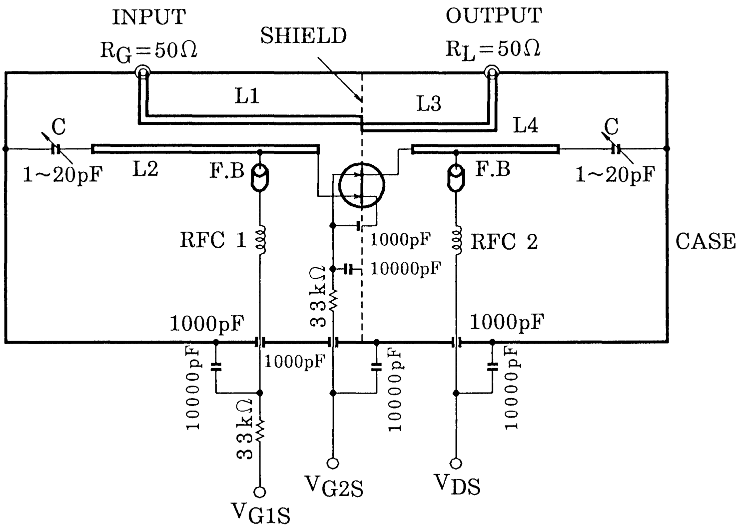
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate 1 Leakage Current	I_{G1SS}	$V_{DS}=0$, $V_{G1S}=-3V$, $V_{G2S}=0$	—	—	−4	μA
Gate 2 Leakage Current	I_{G2SS}	$V_{DS}=0$, $V_{G1S}=0$, $V_{G2S}=-3V$	—	—	−4	μA
Drain Current	I_{DSS}	$V_{DS}=2V$, $V_{G1S}=0$, $V_{G2S}=0$	4	—	16	mA
Gate 1-Source Cut-off Voltage	$V_{G1S(OFF)}$	$V_{DS}=2V$, $V_{G2S}=0$, $I_D=100\mu A$	−0.5	—	−1.5	V
Gate 2-Source Cut-off Voltage	$V_{G2S(OFF)}$	$V_{DS}=2V$, $V_{G1S}=0$, $I_D=100\mu A$	−0.5	—	−1.5	V
Forward Transfer Admittance	$\|Y_{fs}\|$	$V_{DS}=2V$, $V_{G2S}=0.5V$, $I_D=2mA$, f=1kHz	—	12	—	mS
Input Capacitance	C_{iss}	$V_{DS}=2V$, $V_{G2S}=0.5V$, $I_D=2mA$, f=1MHz	—	0.65	1.3	pF
Reverse Transfer Capacitance	C_{rss}		—	0.015	0.03	
Power Gain	G_{ps}	$V_{DS}=2V$, $V_{G2S}=0.5V$, $I_D=2mA$, f=800MHz (Fig.1)	15	18.5	—	dB
Noise Figure	NF		—	1.3	2.5	

CAUTION

GaAs (Gallium Arsenide) is used in this product. The dust or vapor can be dangerous to humans. Do not break, cut, crush or dissolve chemically. Dispose of this product properly according to law. Do not intermingle with normal industrial or domestic waste.

FIG.1 800MHz G_{ps}, NF TEST CIRCUIT

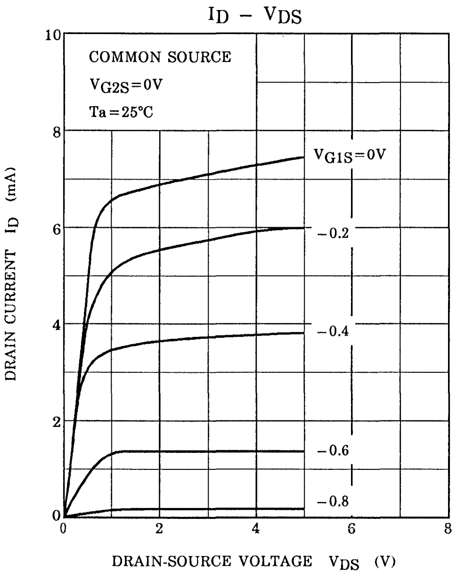


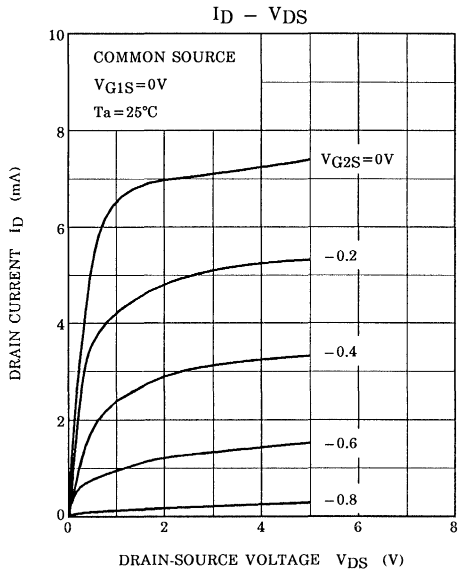
L1~L4 : ϕ1.0mm SILVER PLATED COPPER WIRE

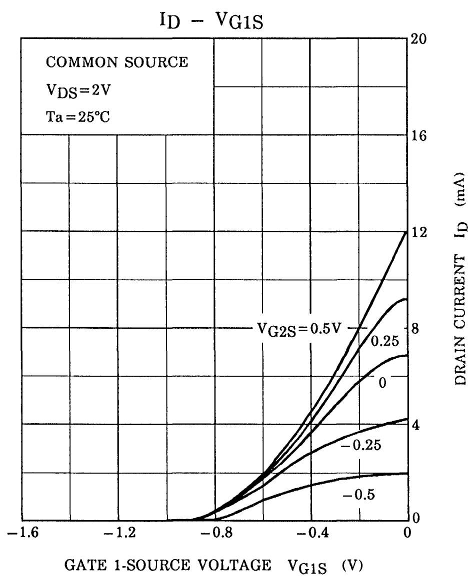
C : AIR TRIMMER TTA25A200A (MURATA MFG. Co., LTD.)

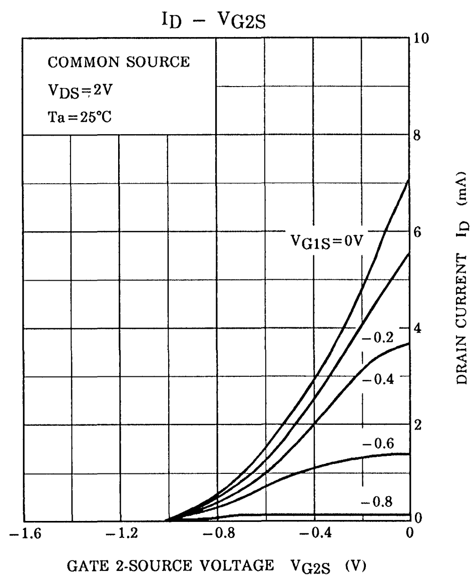
RFC 1 : ϕ0.35mm COPPER WIRE 3mm ID, 7T

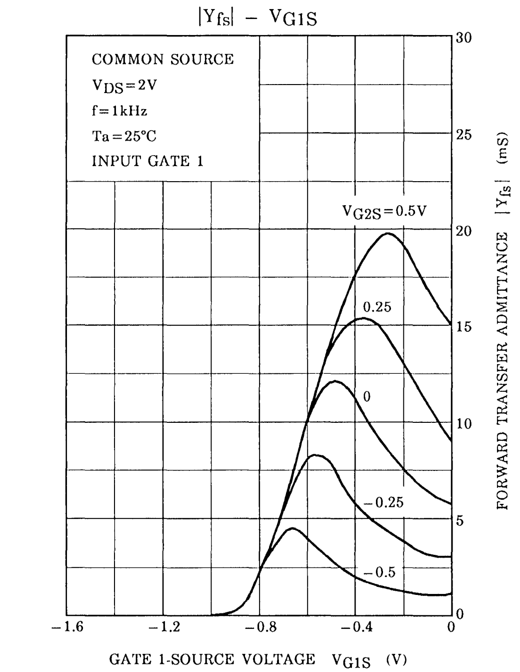
RFC 2 : ϕ0.35mm COPPER WIRE 3mm ID, 10T

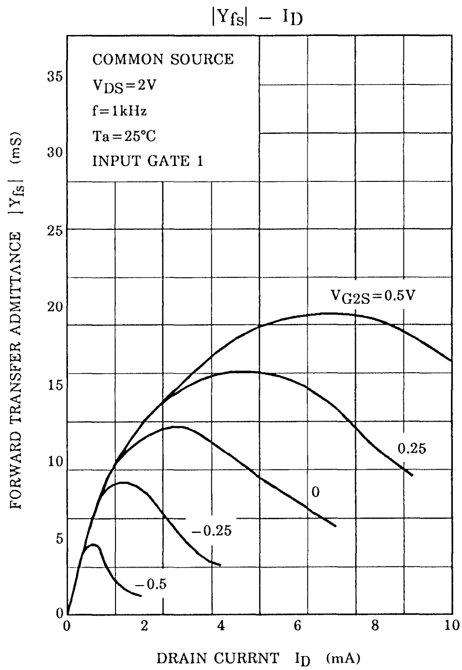

$I_D - V_{DS}$
COMMON SOURCE
$V_{G2S}=0V$
$Ta=25°C$
$V_{G1S}=0V$
−0.2
−0.4
−0.6
−0.8
DRAIN CURRENT I_D (mA)
DRAIN-SOURCE VOLTAGE V_{DS} (V)

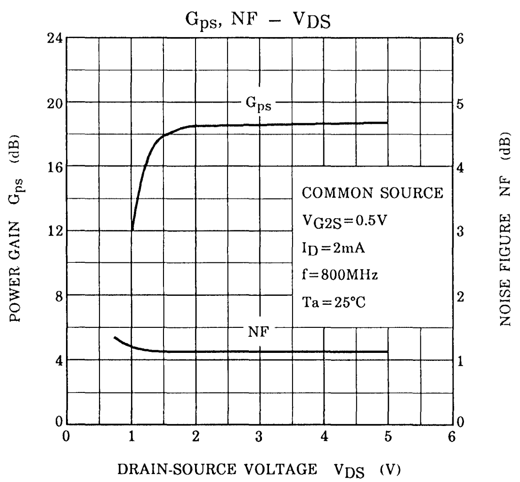

$I_D - V_{DS}$
COMMON SOURCE
$V_{G1S}=0V$
$Ta=25°C$
$V_{G2S}=0V$
−0.2
−0.4
−0.6
−0.8
DRAIN CURRENT I_D (mA)
DRAIN-SOURCE VOLTAGE V_{DS} (V)

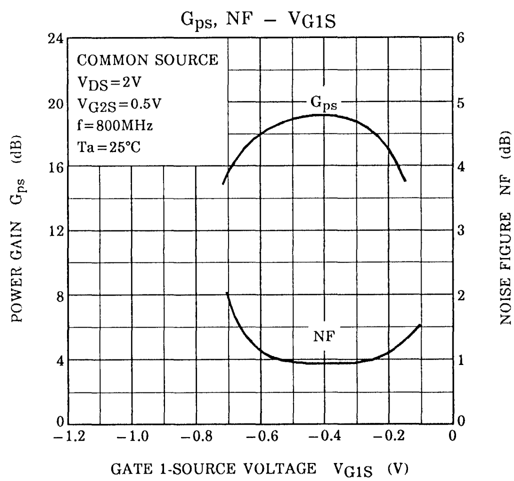

$I_D - V_{G1S}$
COMMON SOURCE
$V_{DS}=2V$
$Ta=25°C$
$V_{G2S}=0.5V$
0.25
0
−0.25
−0.5
DRAIN CURRENT I_D (mA)
GATE 1-SOURCE VOLTAGE V_{G1S} (V)


$I_D - V_{G2S}$
COMMON SOURCE
$V_{DS}=2V$
$Ta=25°C$
$V_{G1S}=0V$
−0.2
−0.4
−0.6
−0.8
DRAIN CURRENT I_D (mA)
GATE 2-SOURCE VOLTAGE V_{G2S} (V)

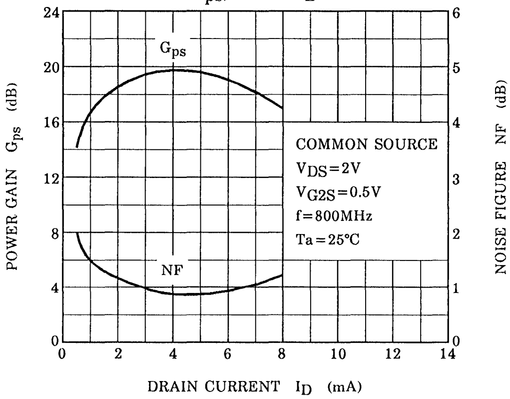

|Yfs| – VG1S
COMMON SOURCE
VDS=2V
f=1kHz
Ta=25°C
INPUT GATE 1
VG2S=0.5V
0.25
0
–0.25
–0.5
30
25
20
15
10
5
0
–1.6
–1.2
–0.8
–0.4
0
GATE 1-SOURCE VOLTAGE VG1S (V)
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)


|Yfs| – ID
COMMON SOURCE
VDS=2V
f=1kHz
Ta=25°C
INPUT GATE 1
VG2S=0.5V
0.25
0
–0.25
–0.5
35
30
25
20
15
10
5
0
0
2
4
6
8
10
DRAIN CURRNT ID (mA)
FORWARD TRANSFER ADMITTANCE |Yfs| (mS)

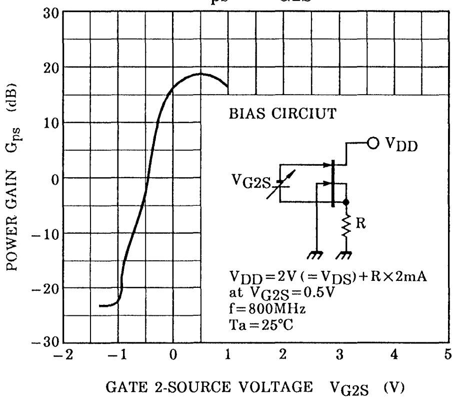

Gps, NF – VDS
Gps
NF
COMMON SOURCE
VG2S=0.5V
ID=2mA
f=800MHz
Ta=25°C
24
20
16
12
8
4
0
6
5
4
3
2
1
0
0
1
2
3
4
5
6
DRAIN-SOURCE VOLTAGE VDS (V)
POWER GAIN Gps (dB)
NOISE FIGURE NF (dB)


Gps, NF – VG1S
COMMON SOURCE
VDS=2V
VG2S=0.5V
f=800MHz
Ta=25°C
Gps
NF
24
20
16
12
8
4
0
6
5
4
3
2
1
0
–1.2
–1.0
–0.8
–0.6
–0.4
–0.2
0
GATE 1-SOURCE VOLTAGE VG1S (V)
POWER GAIN Gps (dB)
NOISE FIGURE NF (dB)

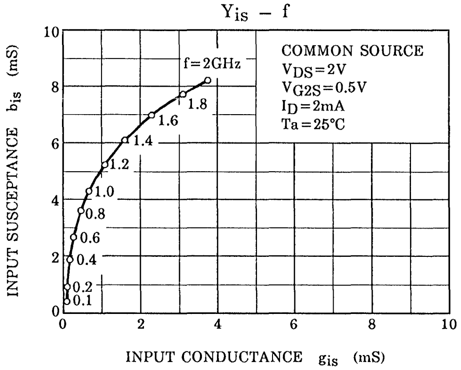
G_{ps}, NF – I_D



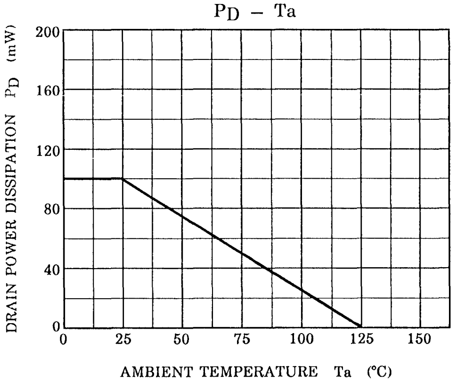
G_{ps} – V_{G2S}



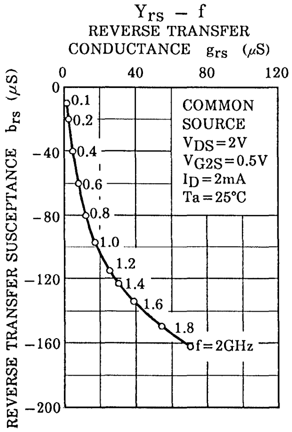
Y_{is} – f



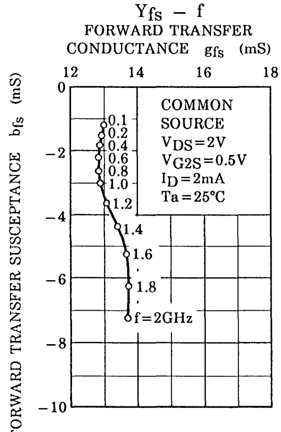
P_D – Ta



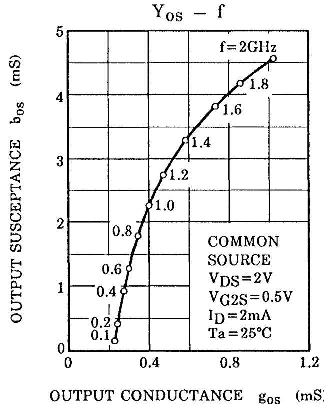
Y_{rs} – f



Y_{fs} – f



Y_{os} – f



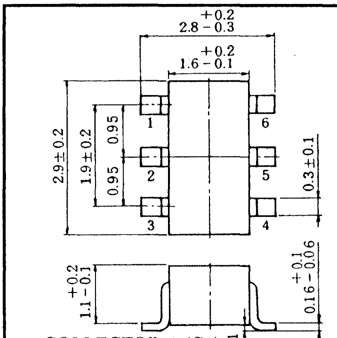
SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

HN3C01F

TV TUNER, VHF CONVERTER APPLICATION.
TV VHF RF AMPLIFIER APPLICATION.

- Including Two Devices in SM6 (Super Mini Type with 6Leads)
- Low Reverse Transfer Capacitance : C_{re} = 0.38pF (Typ.)
- High Transition Frequency : f_T = 1400MHz (Typ.)

Unit in mm



1. COLLECTOR 1 (C1)
2. EMITTER 1 (E1)
3. COLLECTOR 2 (C2)
4. EMITTER 2 (E2)
5. BASE 2 (B2)
6. BASE 1 (B1)

JEDEC	—
EIAJ	—
TOSHIBA	2-3N1B

MAXIMUM RATINGS (Ta = 25°C) (Q_1, Q_2)

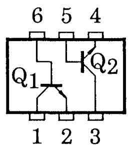
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	20	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	50	mA
Base Current	I_B	25	mA
Collector Power Dissipation	P_C*	300	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

* Total

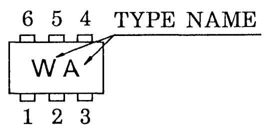
ELECTRICAL CHARACTERISTICS (Ta = 25°C) (Q_1, Q_2)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB}=25V, I_E=0	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB}=3V, I_C=0	—	—	1.0	μA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=1mA, I_B=0	20	—	—	V
DC Current Gain	h_{FE}	V_{CE}=10V, I_C=5mA	40	150	300	—
Transition Frequency	f_T	V_{CE}=10V, I_C=5mA, f=200MHz	900	1400	—	MHz
Reverse Transfer Capacitance Q_1	$C_{re\,(1)}$	V_{CB}=10V, I_E=0, f=1MHz	—	0.38	0.53	pF
Reverse Transfer Capacitance Q_2	$C_{re\,(2)}$	V_{CB}=10V, I_E=0, f=1MHz	—	0.31	0.46	pF
Collector-Base Time Constant Q_1	$C_c \cdot r_{bb'}(1)$	V_{CB}=10V, I_C=5mA, f=30MHz	—	6.0	12	ps
Collector-Base Time Constant Q_2	$C_c \cdot r_{bb'}(2)$	V_{CB}=10V, I_C=5mA, f=30MHz	—	5.5	11.5	ps

PIN ASSIGNMENT (TOP VIEW)



MARKING

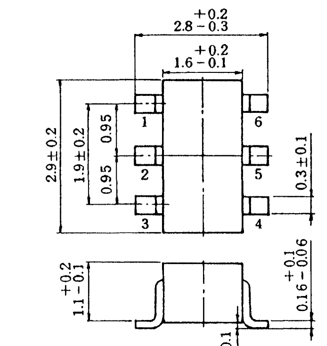


HN3C02F SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

TV TUNER, UHF OSCILLATOR APPLICATION.
TV TUNER, UHF CONVERTER APPLICATION.

- Including Two Devices in SM6 (Super Mini Type with 6Leads)
- High Transition Frequency : f_T=2400MHz (Typ.)

Unit in mm



1. COLLECTOR 1 (C1)
2. EMITTER 1 (E1)
3. COLLECTOR 2 (C2)
4. EMITTER 2 (E2)
5. BASE 2 (B2)
6. BASE 1 (B1)

JEDEC	—
EIAJ	—
TOSHIBA	2-3N1B

MAXIMUM RATINGS (T_a = 25°C) (Q_1, Q_2)

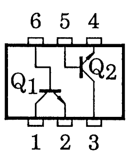
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	15	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	50	mA
Base Current	I_B	25	mA
Collector Power Dissipation	P_C*	300	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

* Total

ELECTRICAL CHARACTERISTICS (T_a = 25°C) (Q_1, Q_2)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB}=30V, I_E=0	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB}=2V, I_C=0	—	—	1.0	μA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=1mA, I_B=0	15	—	—	V
DC Current Gain	h_{FE}	V_{CE}=10V, I_E=5mA	40	—	200	—
Transition Frequency	f_T	V_{CE}=10V, I_C=2mA, f=800MHz	1500	2400	—	MHz
Reverse Transfer Capacitance Q_1	$C_{re(1)}$	V_{CB}=10V, I_E=0, f=1MHz	—	0.53	0.85	pF
Reverse Transfer Capacitance Q_2	$C_{re(2)}$	V_{CB}=10V, I_E=0, f=1MHz	—	0.48	0.80	pF
Collector-Base Time Constant Q_1	$C_c \cdot r_{bb'}(1)$	V_{CB}=10V, I_C=2mA, f=30MHz	—	15.0	22.0	ps
Collector-Base Time Constant Q_2	$C_c \cdot r_{bb'}(2)$	V_{CB}=10V, I_C=2mA, f=30MHz	—	14.5	21.5	ps

PIN ASSIGNMENT (TOP VIEW)



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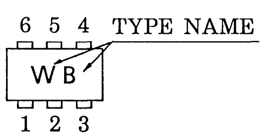


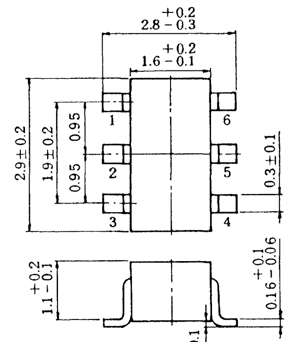
SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

HN3C03F

TV TUNER, UHF OSCILLATOR APPLICATION.
TV TUNER, UHF CONVERTER APPLICATION.

- Including Two Devices in SM6 (Super Mini Type with 6Leads)
- High Transition Frequency : $f_T = 4.0\text{GHz}$ (Typ.)

Unit in mm



1. COLLECTOR 1 (C1)
2. EMITTER 1 (E1)
3. COLLECTOR 2 (C2)
4. EMITTER 2 (E2)
5. BASE 2 (B2)
6. BASE 1 (B1)

JEDEC	—
EIAJ	—
TOSHIBA	2-3N1B

MAXIMUM RATINGS (Ta = 25°C) (Q_1, Q_2)

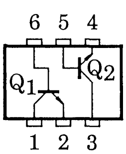
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	30	mA
Base Current	I_B	15	mA
Collector Power Dissipation	P_C*	300	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

* Total

ELECTRICAL CHARACTERISTICS (Ta = 25°C) (Q_1, Q_2)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=10V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=1V$, $I_C=0$	—	—	1.0	μA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA$, $I_B=0$	12	—	—	V
DC Current Gain	h_{FE}	$V_{CE}=10V$, $I_E=5mA$	35	—	130	—
Transition Frequency	f_T	$V_{CE}=10V$, $I_C=10mA$, f=1GHz	2.6	4.0	—	GHz
Reverse Transfer Capacitance Q_1	$C_{ob\,(1)}$	$V_{CB}=10V$, $I_E=0$, f=1MHz	—	1.20	1.55	pF
Reverse Transfer Capacitance Q_2	$C_{ob\,(2)}$	$V_{CB}=10V$, $I_E=0$, f=1MHz	—	1.00	1.35	pF
Collector-Base Time Constant Q_1	$C_c \cdot r_{bb'}$ (1)	$V_{CB}=10V$, $I_C=5mA$, f=30MHz	—	3.2	8.5	ps
Collector-Base Time Constant Q_2	$C_c \cdot r_{bb'}$ (2)	$V_{CB}=10V$, $I_C=5mA$, f=30MHz	—	2.7	8.0	ps

PIN ASSIGNMENT (TOP VIEW)



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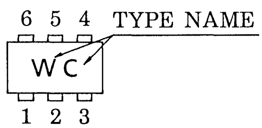


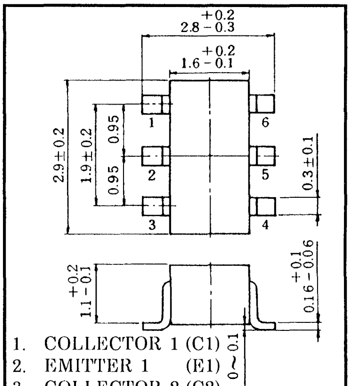
HN3C06F

SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

- Including Two Devices in SM6 (Super Mini Type with 6Leads)
- Low Noise Figure, High Gain.
- NF = 1.1dB, $|S_{21e}|^2$ = 12dB (f = 1GHz)

Unit in mm



1. COLLECTOR 1 (C1)
2. EMITTER 1 (E1)
3. COLLECTOR 2 (C2)
4. EMITTER 2 (E2)
5. BASE 2 (B2)
6. BASE 1 (B1)

JEDEC	—
EIAJ	—
TOSHIBA	2-3N1B

MAXIMUM RATINGS (Ta = 25°C) (Q_1, Q_2)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	80	mA
Base Current	I_B	40	mA
Collector Power Dissipation	P_C*	300	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

* Total

MICROWAVE CHARACTERISTICS (Ta = 25°C) (Q_1, Q_2)

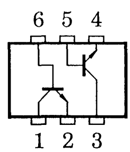
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 10V, I_C = 20mA	5	7	—	GHz
Insertion Gain	$|S_{21e}|^2$ (1)	V_{CE} = 10V, I_C = 20mA, f = 500MHz	—	17.5	—	dB
	$|S_{21e}|^2$ (2)	V_{CE} = 10V, I_C = 20mA, f = 1GHz	7.5	12	—	
Noise Figure	NF (1)	V_{CE} = 10V, I_C = 5mA, f = 500MHz	—	1	—	dB
	NF (2)	V_{CE} = 10V, I_C = 5mA, f = 1GHz	—	1.1	2	

ELECTRICAL CHARACTERISTICS (Ta = 25°C) (Q_1, Q_2)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_C = 0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE} = 10V, I_C = 20mA	30	—	250	—
Reverse Transfer Capacitance Q_1	$C_{re\,(1)}$	V_{CB} = 10V, I_E = 0, f = 1MHz (Note)	—	0.55	1.0	pF
Reverse Transfer Capacitance Q_2	$C_{re\,(2)}$		—	0.5	0.95	pF

Note : C_{re} is measured by 3 terminal method with Capacitance Bridge.

PIN ASSIGNMENT (TOP VIEW)



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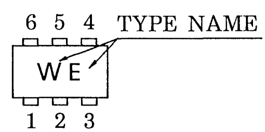
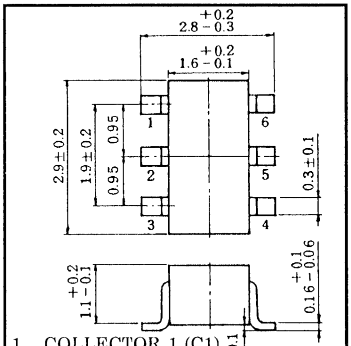


SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

HN3C07F

VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS.

Unit in mm



1. COLLECTOR 1 (C1)
2. EMITTER 1 (E1)
3. COLLECTOR 2 (C2)
4. EMITTER 2 (E2)
5. BASE 2 (B2)
6. BASE 1 (B1)

JEDEC	—
EIAJ	—
TOSHIBA	2-3N1B

- Including Two Devices in SM6 (Super Mini Type with 6Leads)
- Low Noise Figure, High Gain.
- NF = 1.1dB, $|S_{21e}|^2$ = 13dB (f = 1GHz)

MAXIMUM RATINGS (Ta = 25°C) (Q_1, Q_2)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Base Current	I_B	20	mA
Collector Current	I_C	40	mA
Collector Power Dissipation	P_C*	300	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

* Total

MICROWAVE CHARACTERISTICS (Ta = 25°C) (Q_1, Q_2)

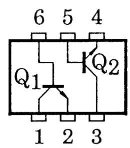
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 8V, I_C = 20mA	7	10	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE} = 8V, I_C = 20mA, f = 1GHz	10	13	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE} = 8V, I_C = 20mA, f = 2GHz	—	7	—	
Noise Figure	NF (1)	V_{CE} = 8V, I_C = 5mA, f = 1GHz	—	1.1	2.5	dB
	NF (2)	V_{CE} = 8V, I_C = 5mA, f = 2GHz	—	1.7	—	

ELECTRICAL CHARACTERISTICS (Ta = 25°C) (Q_1, Q_2)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_C = 0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE} = 8V, I_C = 20mA	50	—	250	—
Reverse Transfer Capacitance Q_1	C_{re} (1)	V_{CB} = 10V, I_E = 0, f = 1MHz (Note)	—	0.45	0.9	pF
Reverse Transfer Capacitance Q_2	C_{re} (2)		—	0.37	0.82	pF

Note : C_{re} is measured by 3 terminal method with Capacitance Bridge.

PIN ASSIGNMENT (TOP VIEW)



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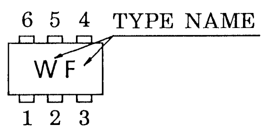


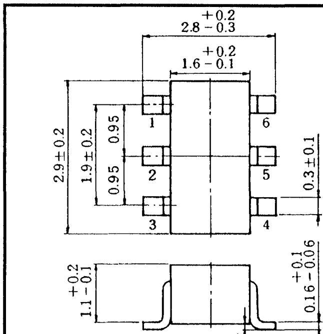
HN3C08F

SILICON NPN EPITAXIAL PLANAR TYPE TRANSISTOR

VHF~UHF BNAD LOW NOISE AMPLIFIER APPLICATIONS.

- Including Two Devices in SM6 (Super Mini Type with 6Leads)
- Low Noise Figure, High Gain.
- NF = 1.8dB, $|S_{21e}|^2$ = 7.5dB (f = 2GHz)

Unit in mm



1. COLLECTOR 1 (C1)
2. EMITTER 1 (E1)
3. COLLECTOR 2 (C2)
4. EMITTER 2 (E2)
5. BASE 2 (B2)
6. BASE 1 (B1)

JEDEC	—
EIAJ	—
TOSHIBA	2-3N1B

MAXIMUM RATINGS (Ta = 25°C) (Q_1, Q_2)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CEO}	10	V
Emitter-Base Voltage	V_{EBO}	1.5	V
Base Current	I_B	7	mA
Collector Current	I_C	15	mA
Collector Power Dissipation	P_C*	300	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

* Total

MICROWAVE CHARACTERISTICS (Ta = 25°C) (Q_1, Q_2)

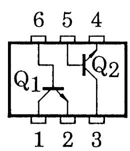
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Transition Frequency	f_T	V_{CE} = 6V, I_C = 7mA	7	10	—	GHz
Insertion Gain	$\|S_{21e}\|^2$ (1)	V_{CE} = 6V, I_C = 7mA, f = 1GHz	—	13	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE} = 6V, I_C = 7mA, f = 2GHz	4.5	7.5	—	
Noise Figure	NF (1)	V_{CE} = 6V, I_C = 3mA, f = 1GHz	—	1.4	—	dB
	NF (2)	V_{CE} = 6V, I_C = 3mA, f = 2GHz	—	1.8	3.0	

ELECTRICAL CHARACTERISTICS (Ta = 25°C) (Q_1, Q_2)

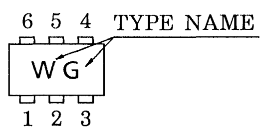
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 10V, I_E = 0	—	—	1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1V, I_C = 0	—	—	1	μA
DC Current Gain	h_{FE}	V_{CE} = 6V, I_C = 7mA	50	—	250	—
Reverse Transfer Capacitance Q_1	$C_{re\,(1)}$	V_{CB} = 10V, I_E = 0, f = 1MHz (Note)	—	0.31	0.75	pF
Reverse Transfer Capacitance Q_2	$C_{re\,(2)}$		—	0.26	0.7	pF

Note : C_{re} is measured by 3 terminal method with Capacitance Bridge.

PIN ASSIGNMENT (TOP VIEW)



MARKING

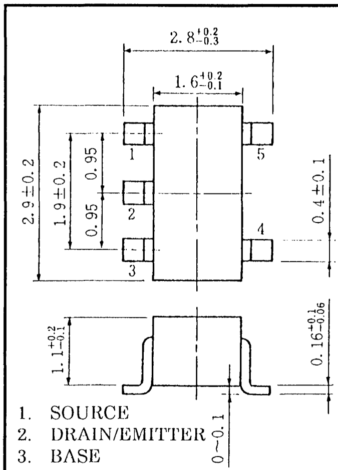


SILICON N CHANNEL JUNCTION TYPE FET
SILICON NPN EPITAXIAL TYPE TRANSISTOR

HN3G01J

HIGH FREQUENCY AMPLIFIER APPLICATIONS.
AM HIGH FREQUENCY AMPLIFIER APPLICATIONS.
AUDIO FREQUENCY AMPLIFIER APPLICATIONS.

Unit in mm



1. SOURCE
2. DRAIN/EMITTER
3. BASE
4. COLLECTOR
5. GATE

JEDEC	—
EIAJ	—
TOSHIBA	2-3L1B

MAXIMUM RATINGS ($T_a = 25°C$)

Q1

CHARACTERISTIC	SYMBOL	RATING	UNIT
Gate-Drain Voltage	V_{GDS}	−20	V
Gate Current	I_G	10	mA

Q2

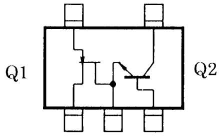
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	60	V
Collector-Emitter Voltage	V_{CEO}	50	V
Emitter-Base Voltage	C_{EBO}	5	V
Collector Current	I_C	150	mA
Base Current	I_B	30	mA

COMMON RATINGS

CHARACTERISTIC	SYMBOL	RATING	UNIT
Power Dissipation	P*	200	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

* Total Rating

PIN ASSIGNMENT (TOP VIEW)



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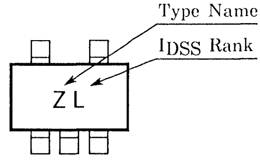


ELECTRICAL CHARACTERISTICS (Ta = 25°C)

Q1

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate Leakage Current	I_{GSS}	$V_{GS}=-15V$, $V_{DS}=0$	—	—	−1.0	nA
Gate-Drain Breakdown Voltage	$V_{(BR)GDS}$	$V_{DS}=0$, $I_G=-100\mu A$	−20	—	—	V
Drain Current	I_{DSS} (Note)	$V_{DS}=5V$, $V_{GS}=0$	6	—	32	mA
Gate-Source Cut-off Voltage	$V_{GS(OFF)}$	$V_{DS}=5V$, $I_D=10\mu A$	—	—	−2.5	V
Forward Transfer Admittance	$\|Y_{fs}\|$	$V_{DS}=5V$, $V_{GS}=0$, f=1kHz	15	25	—	mS
Input Capacitance	C_{iss}	$V_{DS}=5V$, $V_{GS}=0$, f=1MHz	—	7.5	10	pF
Reverse Transfer Capacitance	C_{rss}	$V_{DG}=5V$, $I_D=0$, f=1MHz	—	2	3	pF

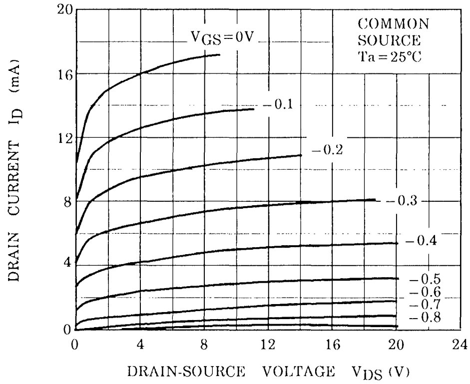
Note : I_{DSS} Classification
GR : 6~12mA, BL : 10~20mA, V : 16~32mA
(G) (L) (V)
( )... I_{DSS} Rank Marking

Q2

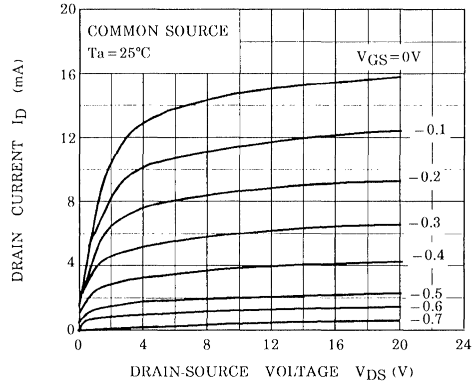
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB}=60V$, $I_E=0$	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=5V$, $I_C=0$	—	—	0.1	μA
DC Current Gain	h_{FE}	$V_{CE}=6V$, $I_C=2mA$	120	—	400	
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=100mA$, $I_B=10mA$	—	0.1	0.25	V
Transition Frequency	f_T	$V_{CE}=10V$, $I_C=1mA$	60	—	—	MHz
Collector Output Capacitance	C_{ob}	$V_{CB}=10V$, $I_E=0$, f=1MHz	—	2.0	3.5	pF

* Q1 CHARACTERISTICS

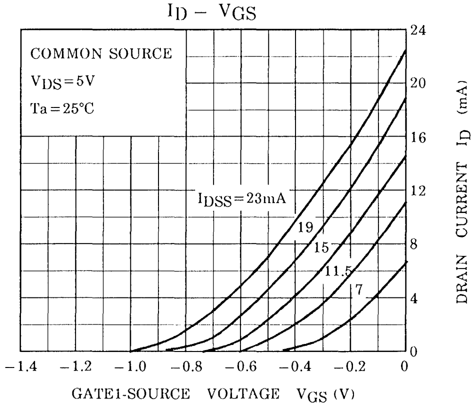
$I_D - V_{DS}$



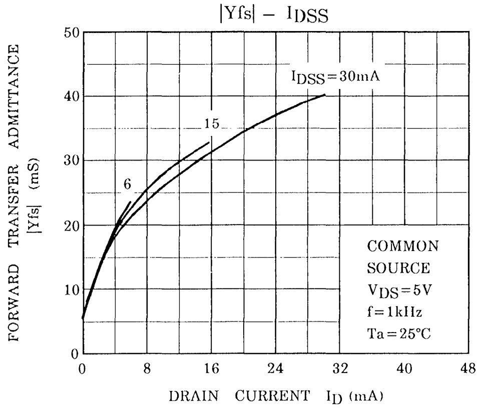
$I_D - V_{DS}$ (LOW VOLTAGE REGION)



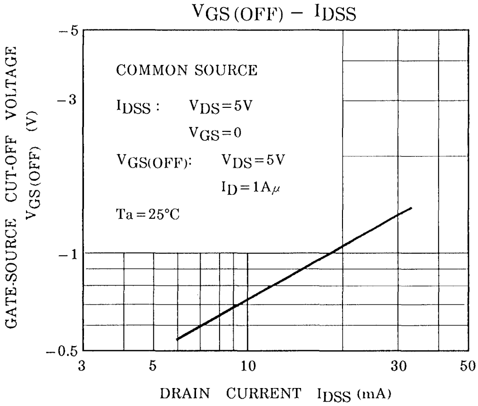
$I_D - V_{GS}$



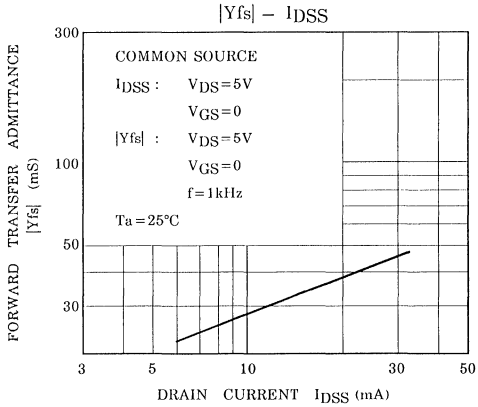
$|Y_{fs}| - I_{DSS}$

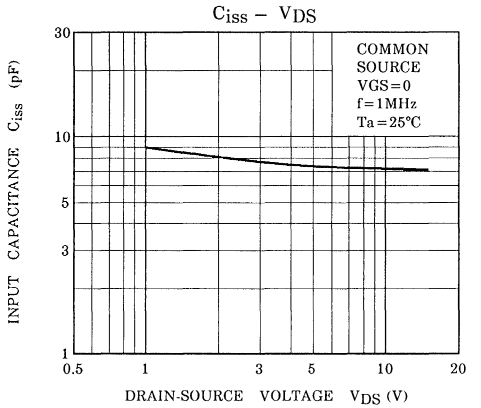


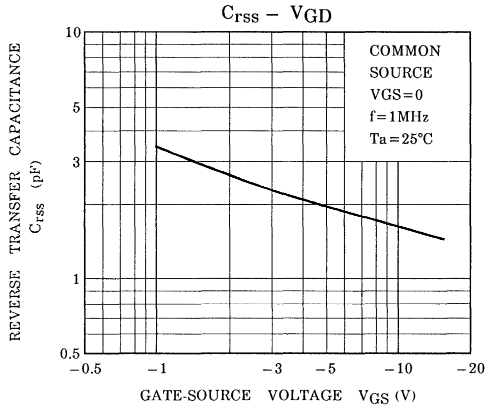
$V_{GS(OFF)} - I_{DSS}$



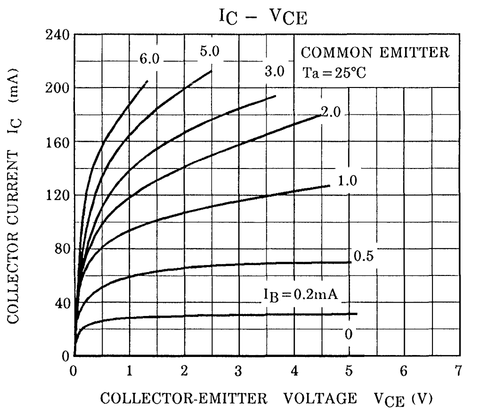
$|Y_{fs}| - I_{DSS}$

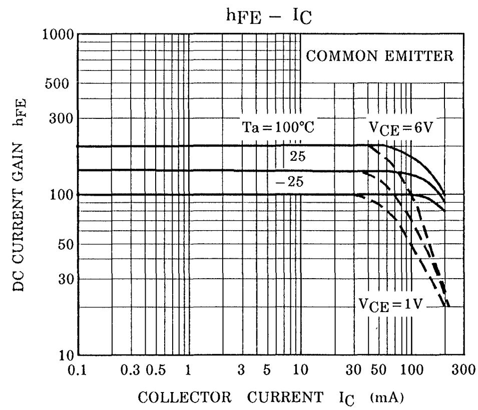


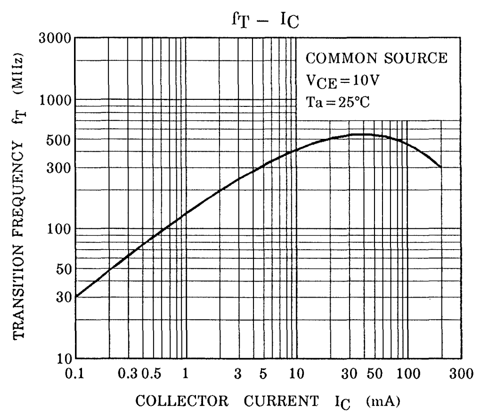




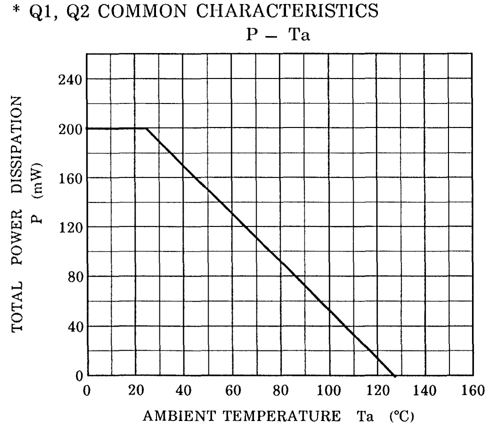
* Q2 CHARACTERISTIC







* Q1, Q2 COMMON CHARACTERISTICS



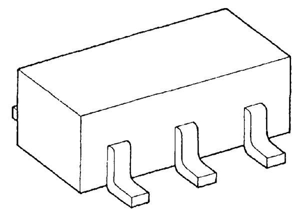
SILICON MONOLITHIC BIPOLAR
LINEAR INTEGRATED CIRCUIT

TA4000F

VHF~UHF WIDE BAND AMPLIFIER APPLICATIONS

FEATURES

- Band Width 700MHz (Min.) @3dB down
- Low Noise 4dB (Typ.) @f = 400MHz
- Small Package



SSOP6-P (SM6)

Weight : 0.014g (Typ.)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	6	V
Total Power Dissipation	P_D*	300	mW
Operating Temperature	T_{opr}	−40~85	°C
Storage Temperature	T_{stg}	−55~125	°C

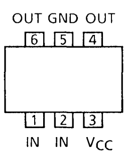
* When mounted on the glass epoxy board of $2.5cm^2 \times 1.6t$

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

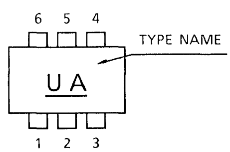
CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Circuit Current	I_{CC}	—	V_{CC} = 5V, ZERO Carrier	9	12	15	mA
Gain	$\lvert S_{21}\rvert^2$	—	V_{CC} = 5V, f = 400MHz	11	15	18	dB
Noise Figure	NF	—	V_{CC} = 5V, f = 400MHz	—	4	7	dB
Band Width	BW	—	V_{CC} = 5V (Note)	0.7	1.3	—	GHz
Maximum Output Level	P_o	—	V_{CC} = 5V, f = 400MHz Pin = −10dBmW	−8	−2	—	dBmW

(Note) Frequency of 3dB down to $\lvert S_{21}\rvert^2$ (at f = 400MHz)

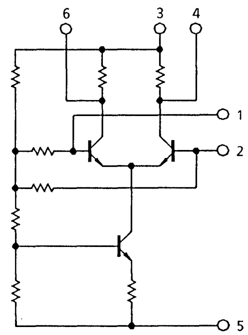
PIN ASSIGNMENT (TOP VIEW)



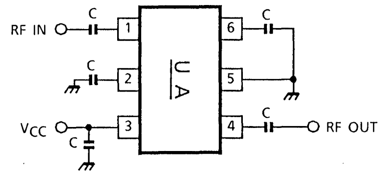
Marking



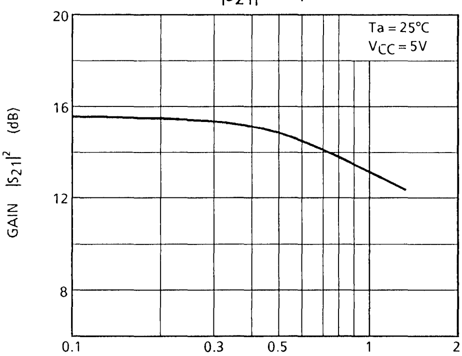
EQUIVALENT CIRCUIT

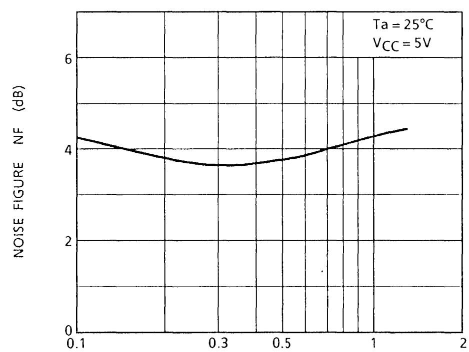


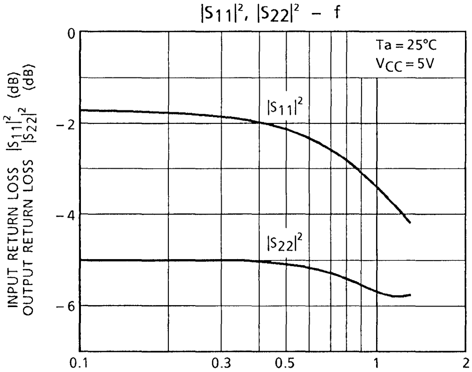
RF MEASURE CIRCUIT

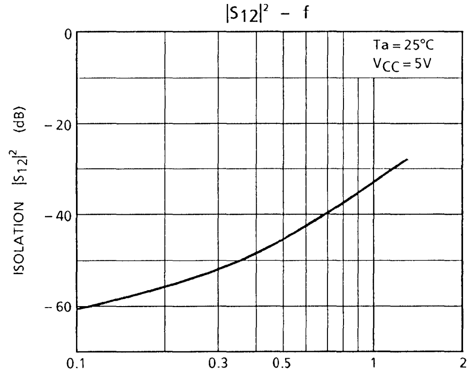


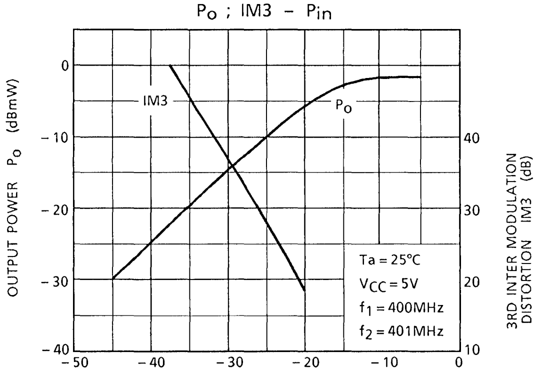
(*) C : 1000pF & 10000pF

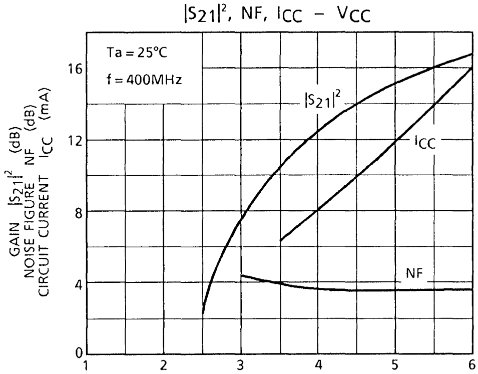

$|S_{21}|^2$ – f
Ta = 25°C
V_{CC} = 5V
GAIN $|S_{21}|^2$ (dB)
FREQUENCY f (GHz)


NF – f
Ta = 25°C
V_{CC} = 5V
NOISE FIGURE NF (dB)
FREQUENCY f (GHz)


$|S_{11}|^2$, $|S_{22}|^2$ – f
Ta = 25°C
V_{CC} = 5V
$|S_{11}|^2$
$|S_{22}|^2$
INPUT RETURN LOSS $|S_{11}|^2$ (dB)
OUTPUT RETURN LOSS $|S_{22}|^2$ (dB)
FREQUENCY f (GHz)


$|S_{12}|^2$ – f
Ta = 25°C
V_{CC} = 5V
ISOLATION $|S_{12}|^2$ (dB)
FREQUENCY f (GHz)


P_o ; IM3 – P_{in}
IM3
P_o
Ta = 25°C
V_{CC} = 5V
f_1 = 400MHz
f_2 = 401MHz
OUTPUT POWER P_o (dBmW)
3RD INTER MODULATION DISTORTION IM3 (dB)
INPUT POWER P_{in} (dBmW)


$|S_{21}|^2$, NF, I_{CC} – V_{CC}
Ta = 25°C
f = 400MHz
$|S_{21}|^2$
I_{CC}
NF
GAIN $|S_{21}|^2$ (dB)
NOISE FIGURE NF (dB)
CIRCUIT CURRENT I_{CC} (mA)
SUPPLY VOLTAGE V_{CC} (V)

TA4001F

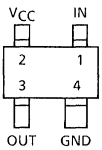
SILICON MONOLITHIC BIPOLAR LINEAR INTEGRATED CIRCUIT

VHF UHF WIDE BAND AMPLIFIER

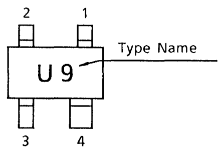
FEATURES

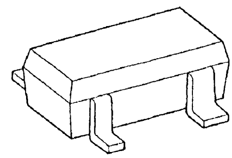
- Band Width 2.4GHz (Typ.) (3dB down)
- High Gain : $|S_{21}|^2$ = 12.5dB (Typ.) (f = 500MHz)
- 50Ω Input and Output Impedance
- Small Package

PIN ASSIGNMENT (TOP VIEW)



Marking





ESOP4-P (SMQ)

Weight : 0.013g (Typ.)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	6	V
Total Power Dissipation	P_D*	300	mW
Operating Temperature	T_{opr}	−40~85	°C
Storage Temperature	T_{stg}	−55~125	°C

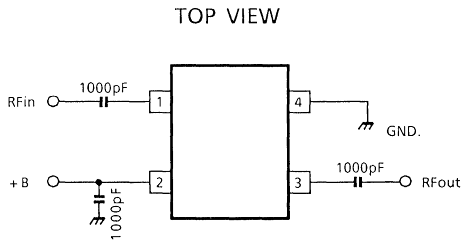
* When mounted glass epoxy of 2.5cm² × 1.6t

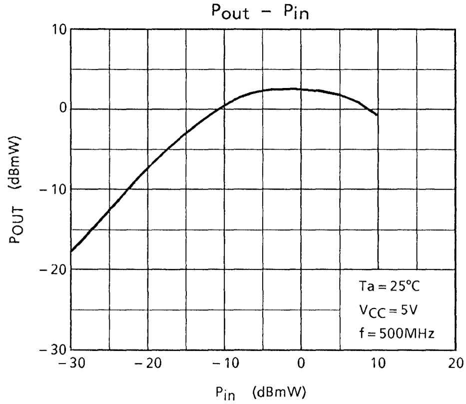
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

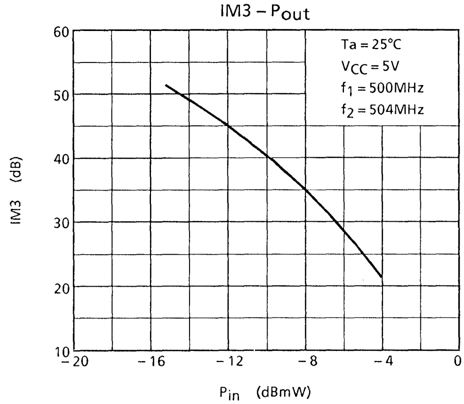
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Circuit Current	I_{CC}	—	V_{CC} = 5V, Non carrier	14	18	24	mA
Insertion Gain	$\|S_{21}\|^2$	1	V_{CC} = 5V, f = 500MHz	9	12.5	16	dB
Band Width	BW	1	V_{CC} = 5V (Note 1)	1.9	2.4	—	GHz
Noise Figure	NF	1	V_{CC} = 5V, f = 500MHz	—	5.2	7	dB
Input Return Loss	$\|S_{11}\|^2$	1	V_{CC} = 5V, f = 500MHz	—	−18	—	dB
Output Return Loss	$\|S_{22}\|^2$	1	V_{CC} = 5V, f = 500MHz	—	−21	—	dB
Isolation	$\|S_{12}\|^2$	1	V_{CC} = 5V, f = 500MHz	—	−22	—	dB
Maximum Output Level	P_o	1	V_{CC} = 5V, f = 500MHz, Pin = 0dBmW	—	2	—	dBmW

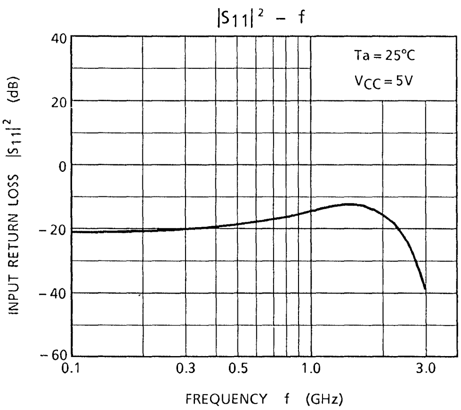
Note 1 : BW is frequency of 3dB down from $|S_{21}|^2$ at 500MHz.

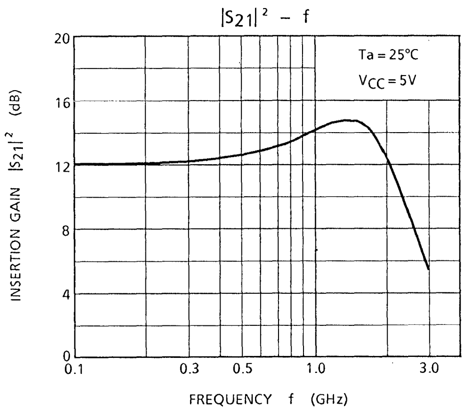
TEST CIRCUIT 1

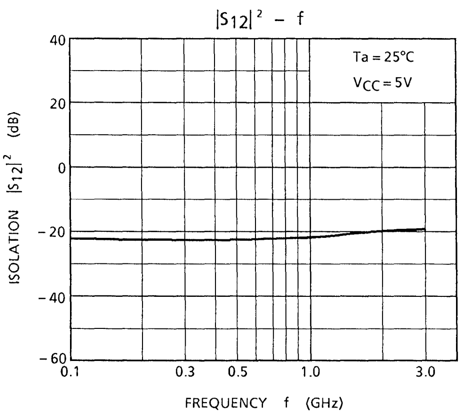


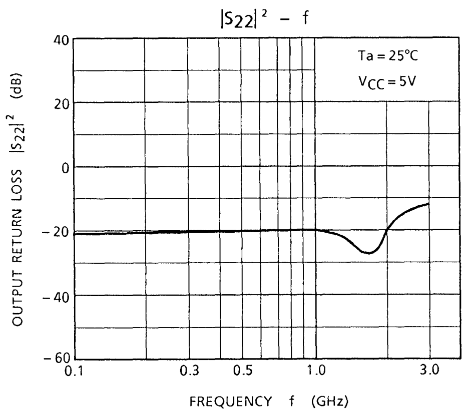

Pout – Pin
POUT (dBmW)
Pin (dBmW)
Ta = 25°C
VCC = 5V
f = 500MHz
10
0
– 10
– 20
– 30
– 30
– 20
– 10
0
10
20


IM3 – Pout
IM3 (dB)
Pin (dBmW)
Ta = 25°C
VCC = 5V
f1 = 500MHz
f2 = 504MHz
60
50
40
30
20
10
– 20
– 16
– 12
– 8
– 4
0


|S11|2 – f
INPUT RETURN LOSS |S11|2 (dB)
FREQUENCY f (GHz)
Ta = 25°C
VCC = 5V
40
20
0
– 20
– 40
– 60
0.1
0.3
0.5
1.0
3.0


|S21|2 – f
INSERTION GAIN |S21|2 (dB)
FREQUENCY f (GHz)
Ta = 25°C
VCC = 5V
20
16
12
8
4
0
0.1
0.3
0.5
1.0
3.0


|S12|2 – f
ISOLATION |S12|2 (dB)
FREQUENCY f (GHz)
Ta = 25°C
VCC = 5V
40
20
0
– 20
– 40
– 60
0.1
0.3
0.5
1.0
3.0


|S22|2 – f
OUTPUT RETURN LOSS |S22|2 (dB)
FREQUENCY f (GHz)
Ta = 25°C
VCC = 5V
40
20
0
– 20
– 40
– 60
0.1
0.3
0.5
1.0
3.0

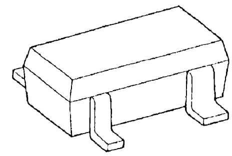
SILICON MONOLITHIC BIPOLAR
LINEAR INTEGRATED CIRCUIT

TA4002F

VHF~UHF WIDE BAND AMPLIFIER

FEATURES

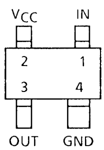
- Band Width 1.3GHz (Typ.) (3dB down)
- High Gain : $|S_{21}|^2$ = 23dB (Typ.) (f = 500MHz)
- 50Ω Input and Output Impedance
- Small Package



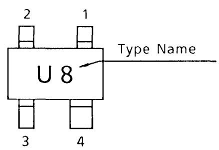
ESOP4-P (SMQ)

Weight : 0.013g (Typ.)

PIN ASSIGNMENT (TOP VIEW)



Marking



MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	6	V
Total Power Dissipation	P_D*	300	mW
Operating Temperature	T_{opr}	−40~85	°C
Storage Temperature	T_{stg}	−55~125	°C

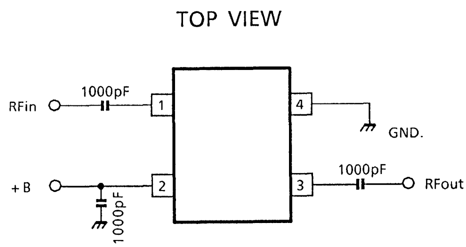
* When mounted glass epoxy of 2.5cm² × 1.6t

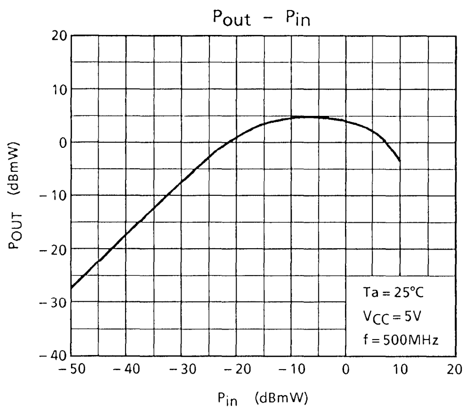
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

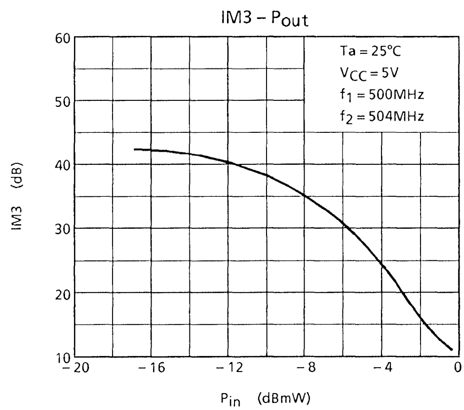
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Circuit Current	I_{CC}	—	V_{CC} = 5V, Non carrier	10	14	20	mA
Insertion Gain	$\|S_{21}\|^2$	1	V_{CC} = 5V, f = 500MHz	20	23	26	dB
Band Width	BW	1	V_{CC} = 5V (Note 1)	0.8	1.3	—	GHz
Noise Figure	NF	1	V_{CC} = 5V, f = 500MHz	—	4.7	7	dB
Input Return Loss	$\|S_{11}\|^2$	1	V_{CC} = 5V, f = 500MHz	—	−8	—	dB
Output Return Loss	$\|S_{22}\|^2$	1	V_{CC} = 5V, f = 500MHz	—	−15	—	dB
Isolation	$\|S_{12}\|^2$	1	V_{CC} = 5V, f = 500MHz	—	−33	—	dB
Maximum Output Level	P_o	1	V_{CC} = 5V, f = 500MHz, Pin = 0dBmW	—	5	—	dBmW

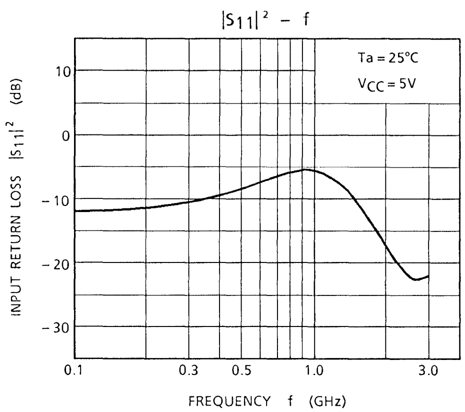
Note 1 : BW is frequency of 3dB down from $|S_{21}|^2$ at 500MHz.

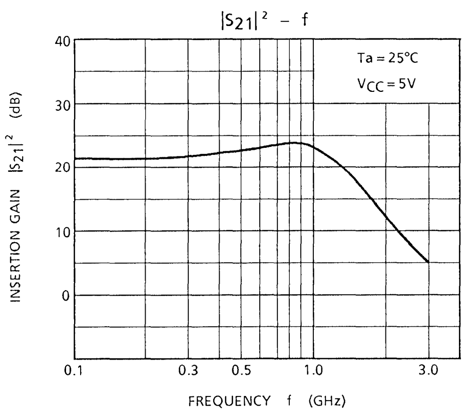
TEST CIRCUIT 1

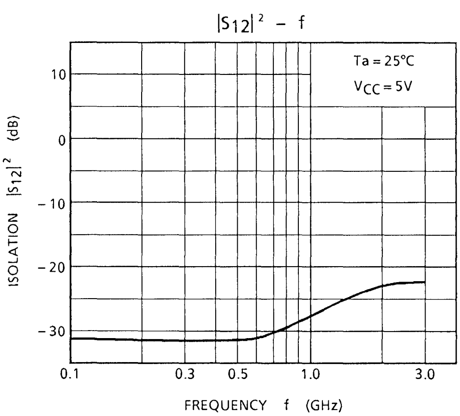


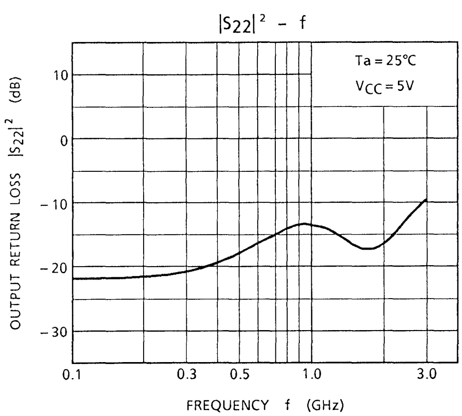

Pout – Pin
POUT (dBmW)
Pin (dBmW)
Ta = 25°C
VCC = 5V
f = 500MHz
20
10
0
– 10
– 20
– 30
– 40
– 50
– 40
– 30
– 20
– 10
0
10
20


IM3 – Pout
IM3 (dB)
Pin (dBmW)
Ta = 25°C
VCC = 5V
f1 = 500MHz
f2 = 504MHz
60
50
40
30
20
10
– 20
– 16
– 12
– 8
– 4
0


|S11|² – f
INPUT RETURN LOSS |S11|² (dB)
FREQUENCY f (GHz)
Ta = 25°C
VCC = 5V
10
0
– 10
– 20
– 30
0.1
0.3
0.5
1.0
3.0


|S21|² – f
INSERTION GAIN |S21|² (dB)
FREQUENCY f (GHz)
Ta = 25°C
VCC = 5V
40
30
20
10
0
0.1
0.3
0.5
1.0
3.0


|S12|² – f
ISOLATION |S12|² (dB)
FREQUENCY f (GHz)
Ta = 25°C
VCC = 5V
10
0
– 10
– 20
– 30
0.1
0.3
0.5
1.0
3.0


|S22|² – f
OUTPUT RETURN LOSS |S22|² (dB)
FREQUENCY f (GHz)
Ta = 25°C
VCC = 5V
10
0
– 10
– 20
– 30
0.1
0.3
0.5
1.0
3.0

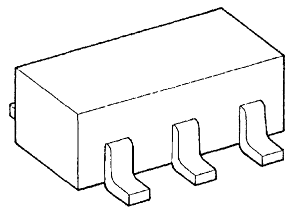
SILICON MONOLITHIC BIPOLAR
LINEAR INTEGRATED CIRCUIT

TA4003F

VHF~UHF WIDE BAND AMPLIFIER

FEATURES

- Band Width 1.5CHz (Typ.) (3dB down, V_{CC} = 2V)
- High Gain : $|S_{21}|^2$ = 11dB (Typ.), (f = 500MHz, V_{CC} = 2V)
- Operating Supply Voltage : V_{CC} = 2~3V
- Low Current Operation : I_{CC} = 3.5mA (Typ.) (V_{CC} = 2V)
- Small Package



SSOP5-P (SMV)

Weight : 0.014g (Typ.)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	4	V
Total Power Dissipation	P_D*	300	mW
Operating Temperature	T_{opr}	−40~85	°C
Storage Temperature	T_{stg}	−55~125	°C

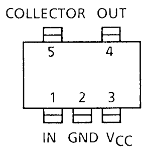
* When mounted glass epoxy of 2.5cm² × 1.6t

ELECTRICAL CHARACTERISTICS (Ta = 25°C) (Note 1)

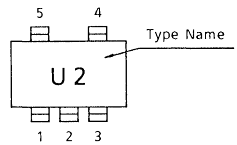
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Circuit Current	I_{CC}	—	V_{CC} = 2V, Non carrier	2.5	3.5	4.5	mA
Insertion Gain	$\|S_{21}\|^2$	1	V_{CC} = 2V, f = 500MHz	9	11	14	dB
Band Width	BW	1	V_{CC} = 2V (Note 2)	1.2	1.5	—	GHz
Noise Figure	NF	1	V_{CC} = 2V, f = 500MHz	—	5.2	7	dB
Input Return Loss	$\|S_{11}\|^2$	1	V_{CC} = 2V, f = 500MHz	—	−7.5	—	dB
Output Return Loss	$\|S_{22}\|^2$	1	V_{CC} = 2V, f = 500MHz	—	−7.5	—	dB
Isolation	$\|S_{12}\|^2$	1	V_{CC} = 2V, f = 500MHz	—	−24	—	dB
Maximum Output Level	P_O	1	V_{CC} = 2V, f = 500MHz, Pin = 0dBmW	—	0	—	dBmW

Note 1 : Have use for connect inductance between terminal 4 and 5 8nH at V_{CC} = 2V
Note 2 : BW is frequency of 3dB down from $|S_{21}|^2$ at 500MHz.

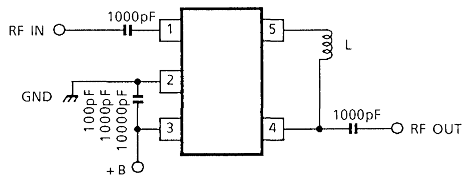
PIN ASSIGNMENT (TOP VIEW)



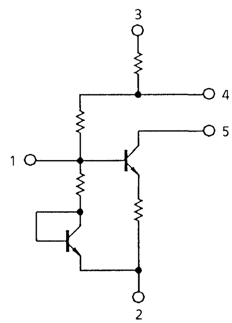
Marking

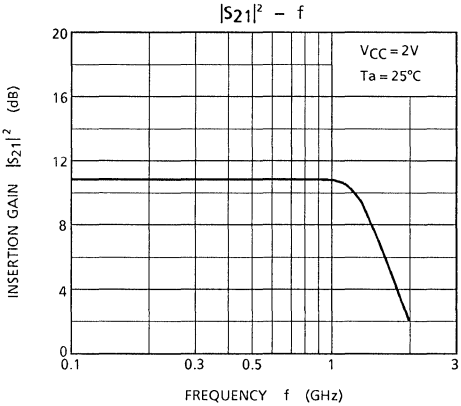


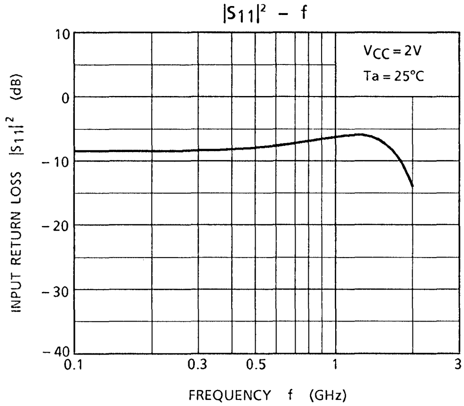
TEST CIRCUIT 1. (TOP VIEW)

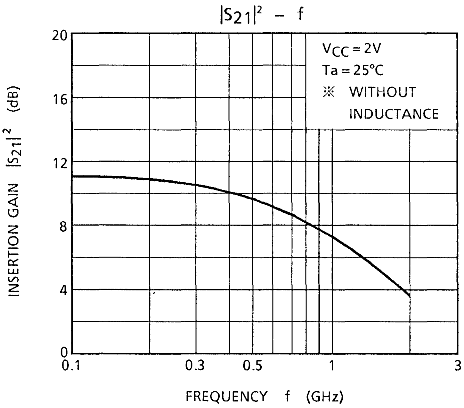


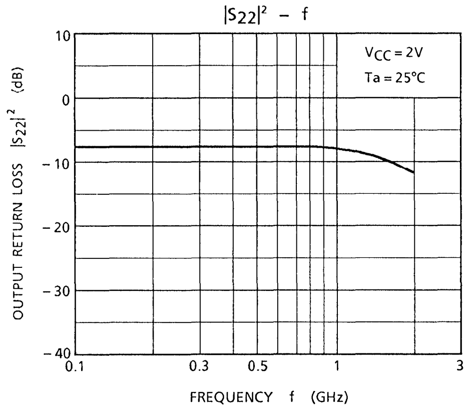
EQUIVALENT CIRCUIT

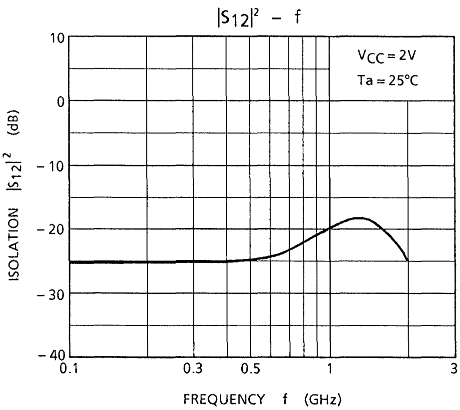


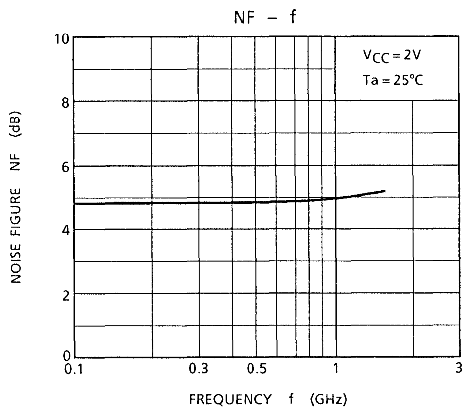

|S21|² – f
VCC = 2V
Ta = 25°C
INSERTION GAIN |S21|² (dB)
FREQUENCY f (GHz)

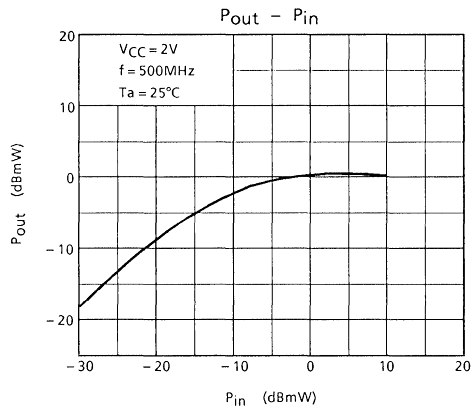

|S11|² – f
VCC = 2V
Ta = 25°C
INPUT RETURN LOSS |S11|² (dB)
FREQUENCY f (GHz)

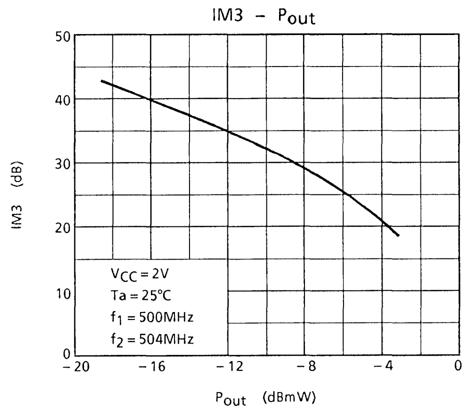

|S21|² – f
VCC = 2V
Ta = 25°C
※ WITHOUT INDUCTANCE
INSERTION GAIN |S21|² (dB)
FREQUENCY f (GHz)

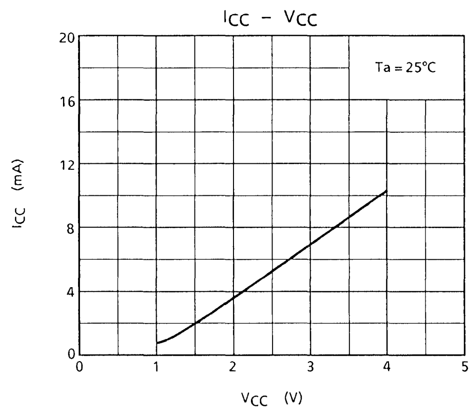

|S22|² – f
VCC = 2V
Ta = 25°C
OUTPUT RETURN LOSS |S22|² (dB)
FREQUENCY f (GHz)


|S12|² – f
VCC = 2V
Ta = 25°C
ISOLATION |S12|² (dB)
FREQUENCY f (GHz)


NF – f
VCC = 2V
Ta = 25°C
NOISE FIGURE NF (dB)
FREQUENCY f (GHz)


Pout - Pin
VCC = 2V
f = 500MHz
Ta = 25°C
20
10
0
-10
-20
-30
-20
-10
0
10
20
Pout (dBmW)
Pin (dBmW)


IM3 - Pout
VCC = 2V
Ta = 25°C
f1 = 500MHz
f2 = 504MHz
50
40
30
20
10
0
-20
-16
-12
-8
-4
0
IM3 (dB)
Pout (dBmW)


ICC - VCC
Ta = 25°C
20
16
12
8
4
0
0
1
2
3
4
5
ICC (mA)
VCC (V)

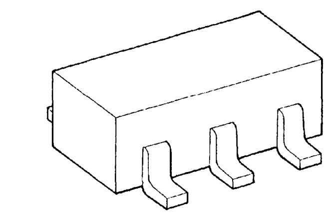
SILICON MONOLITHIC BIPOLAR
LINEAR INTEGRATED CIRCUIT

TA4004F

VHF~UHF WIDE BAND AMPLIFIER

FEATURES

- Band Width 1.2GHz (Typ.) (3dB down, $V_{CC}=2V$)
- High Gain : $|S_{21}|^2=10.5dB$ (Typ.) ($f=500MHz$, $V_{CC}=2V$)
- Operating Supply Voltage : $V_{CC}=2\sim5V$
- Low Current Operation : $I_{CC}=3.1mA$ (Typ.) ($V_{CC}=2V$)
- Small Package



SSOP5-P (SMV)

Weight : 0.014g (Typ.)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	6	V
Total Power Dissipation	P_D*	300	mW
Operating Temperature	T_{opr}	−40~85	°C
Storage Temperature	T_{stg}	−55~125	°C

* When mounted glass epoxy of 2.5cm² × 1.6t

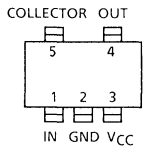
ELECTRICAL CHARACTERISTICS (Ta = 25°C) (Note 1)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Circuit Current	I_{CC}	—	$V_{CC}=2V$, Non carrier	2.5	3.1	4	mA
			$V_{CC}=5V$, Non carrier	10	12.5	16	
Insertion Gain	$\|S_{21}\|^2$	1	$V_{CC}=2V$, f = 500MHz	8.5	10.5	13.5	dB
			$V_{CC}=5V$, f = 500MHz	13	15	18	
Band Width	BW	1	$V_{CC}=2V$ (Note 2)	0.9	1.2	—	GHz
			$V_{CC}=5V$ (Note 2)	0.7	1	—	
Noise Figure	NF	1	$V_{CC}=2V$, f = 500MHz	—	4.2	6	dB
			$V_{CC}=5V$, f = 500MHz	—	4.7	6.5	
Input Return Loss	$\|S_{11}\|^2$	1	$V_{CC}=2V$, f = 500MHz	—	−7	—	dB
			$V_{CC}=5V$, f = 500MHz	—	−9	—	
Output Return Loss	$\|S_{22}\|^2$	1	$V_{CC}=2V$, f = 500MHz	—	−7	—	dB
			$V_{CC}=5V$, f = 500MHz	—	−9	—	
Isolation	$\|S_{12}\|^2$	1	$V_{CC}=2V$, f = 500MHz	—	−23	—	dB
			$V_{CC}=5V$, f = 500MHz	—	−24	—	
Maximum Output Level	P_o	1	$V_{CC}=2V$, f = 500MHz, Pin = 0dBmW	—	0	—	dBmW
			$V_{CC}=5V$, f = 500MHz, Pin = 0dBmW	—	8	—	

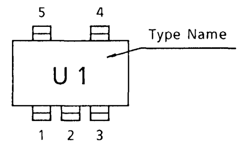
Note 1 : Have use for connect inductance between terminal 4 and 5 — 9nH at $V_{CC}=2V$, 10.5nH at $V_{CC}=5V$

Note 2 : BW is frequency of 3dB down from $|S_{21}|^2$ at 500MHz.

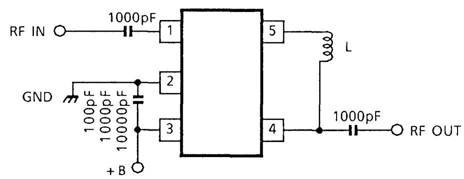
PIN ASSIGNMENT (TOP VIEW)



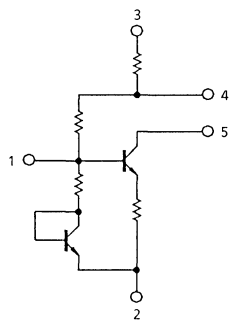
Marking

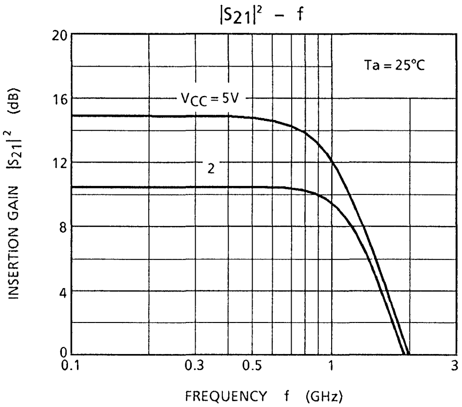


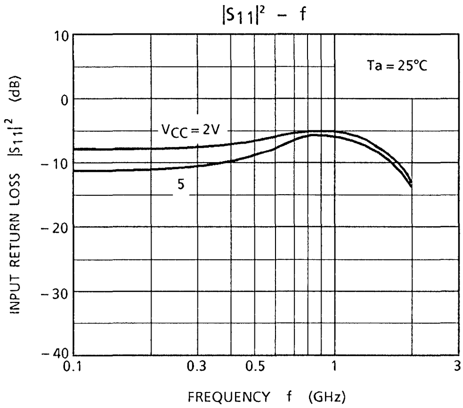
TEST CIRCUIT 1. (TOP VIEW)

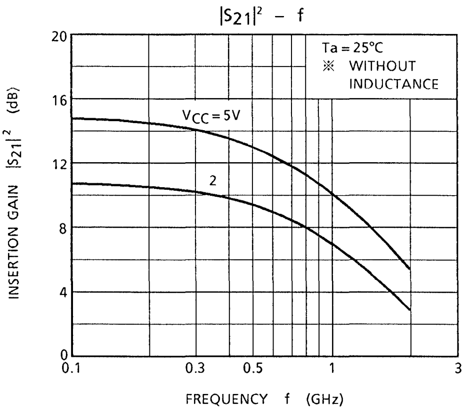


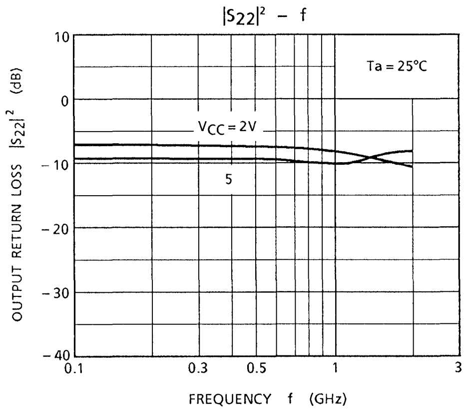
EQUIVALENT CIRCUIT

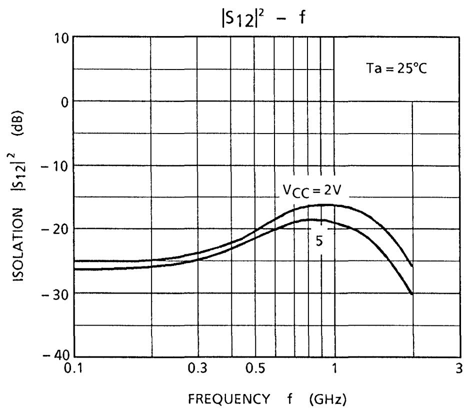


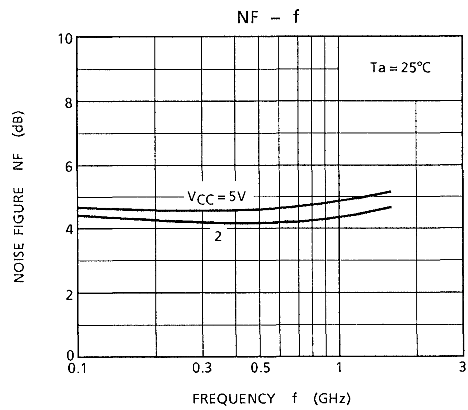

|S21|² – f
Ta = 25°C
VCC = 5V
2
INSERTION GAIN |S21|² (dB)
FREQUENCY f (GHz)

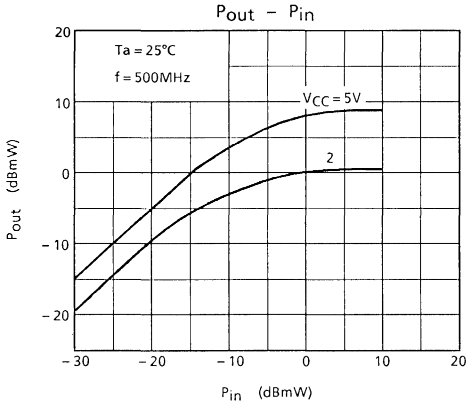

|S11|² – f
Ta = 25°C
VCC = 2V
5
INPUT RETURN LOSS |S11|² (dB)
FREQUENCY f (GHz)

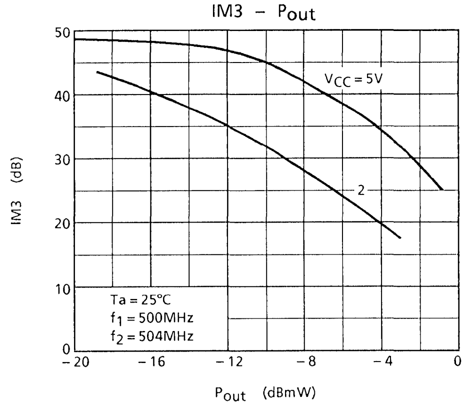

|S21|² – f
Ta = 25°C
※ WITHOUT INDUCTANCE
VCC = 5V
2
INSERTION GAIN |S21|² (dB)
FREQUENCY f (GHz)

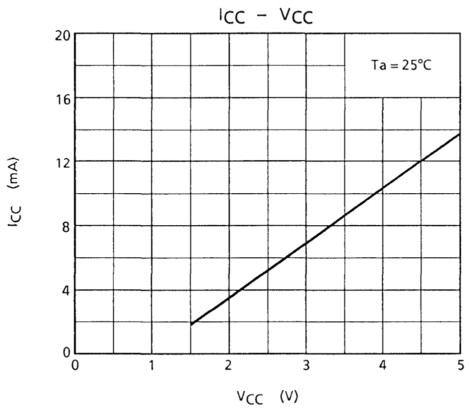

|S22|² – f
Ta = 25°C
VCC = 2V
5
OUTPUT RETURN LOSS |S22|² (dB)
FREQUENCY f (GHz)


|S12|² – f
Ta = 25°C
VCC = 2V
5
ISOLATION |S12|² (dB)
FREQUENCY f (GHz)


NF – f
Ta = 25°C
VCC = 5V
2
NOISE FIGURE NF (dB)
FREQUENCY f (GHz)


Pout - Pin
Ta = 25°C
f = 500MHz
VCC = 5V
2
Pout (dBmW)
Pin (dBmW)
20
10
0
-10
-20
-30
-20
-10
0
10
20


IM3 - Pout
VCC = 5V
2
Ta = 25°C
f1 = 500MHz
f2 = 504MHz
IM3 (dB)
Pout (dBmW)
50
40
30
20
10
0
-20
-16
-12
-8
-4
0


ICC - VCC
Ta = 25°C
ICC (mA)
VCC (V)
20
16
12
8
4
0
0
1
2
3
4
5

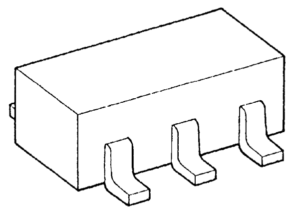
TA4006F

SILICON MONOLITHIC MOS TYPE
LINEAR INTEGRATED CIRCUIT

TV TUNER VHF RF AMPLIFIER APPLICATIONS.
TV TUNER UHF RF AMPLIFIER APPLICATIONS.
FM TUNER RF AMPLIFIER APPLICATIONS.

FEATURES

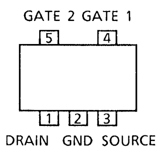
- On account of this Device Built-in Bias Circuit, Cut down number of articles.
- Low Noise Figure : NF = 2.0dB (Typ.)
- Operating Voltage : V_{DD} = 6~11V



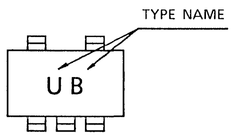
SSOP5-P (SMV)

Weight : 0.014g (Typ.)

PIN ASSIGNMENT (TOP VIEW)



MARKING



MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{DD}	11	V
Gate 2-Source Voltage	V_{G2S}	±8	V
Supply Current	I_{DD}	30	mA
Power Dissipation	P_D*	250	mW
Operating Temperature	T_{opr}	−40~85	°C
Storage Temperature	T_{stg}	−55~125	°C

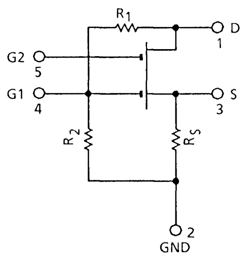
* When mounted on the glass epoxy board of 2.5cm^2 × 1.6t

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate 2 Leakage Current	I_{G2SS}	—	$V_{DS}=0$, $V_{G1S}=0$, $V_{G2S}=\pm 6V$	—	—	±50	nA
Gate 2-Source Cut-off Voltage	$V_{G2S\,(OFF)}$	—	$V_{DD}=5V$, $I_{DD}=150\mu A$	0.5	1.0	1.5	V
Supply Current	I_{DD}	—	$V_{DD}=9V$, $V_{G2}=7V$	6	—	14	mA
Input Capacitance	C_{iss}	—	$V_{DD}=9V$, $V_{G2}=7V$ f = 1MHz	1.5	2.2	2.9	pF
Output Capacitance	C_{oss}	—		0.8	1.4	2.0	pF
Power Gain	G_{ps}	1	$V_{DD}=9V$, $V_{G2}=7V$ f = 500MHz	19	24.0	—	dB
Noise Figure	NF	1		—	2.0	2.9	dB

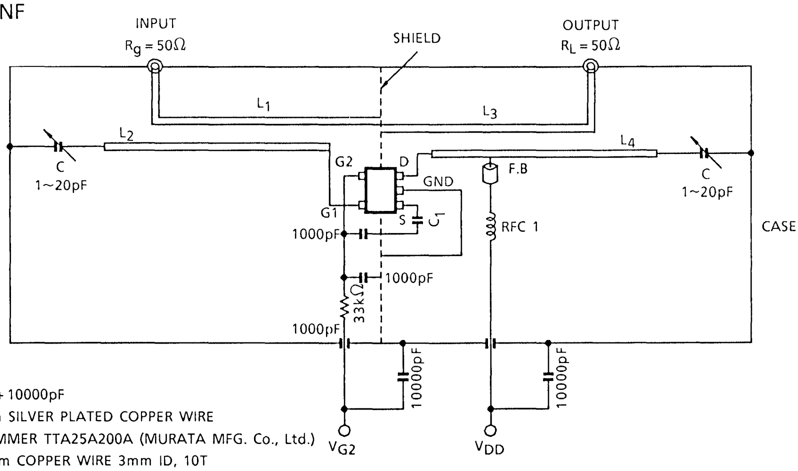
I_{DD} Classifications : Y : 6~10mA, GR : 8~12mA, BL : 10~14mA.

EQUIVALENT CIRCUIT

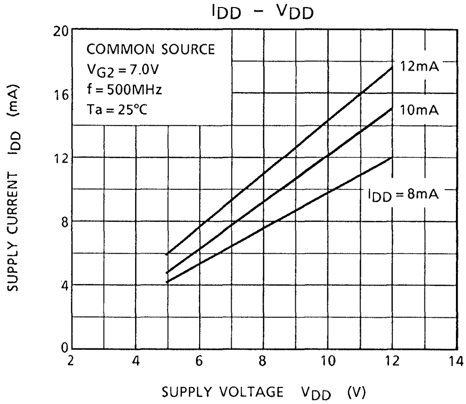


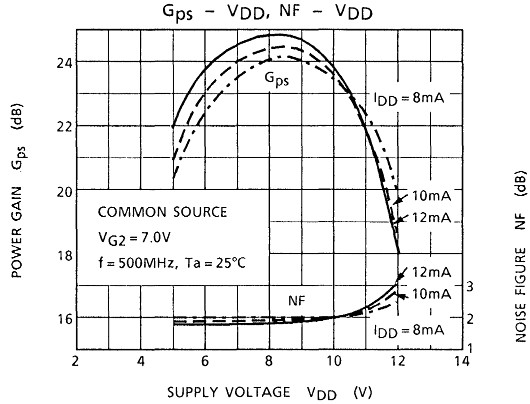
TEST CIRCUIT 1

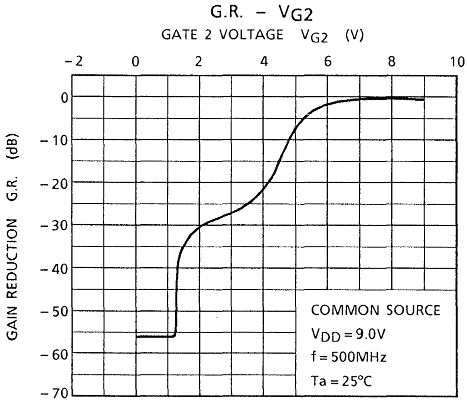
500MHz, G_{ps}, NF

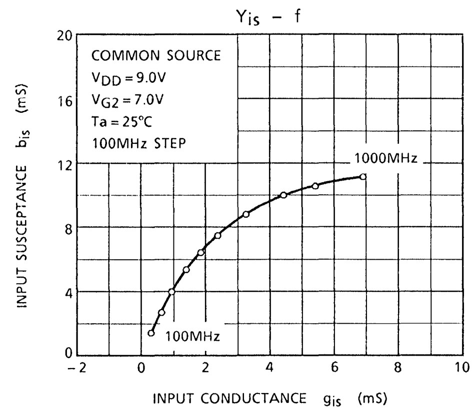


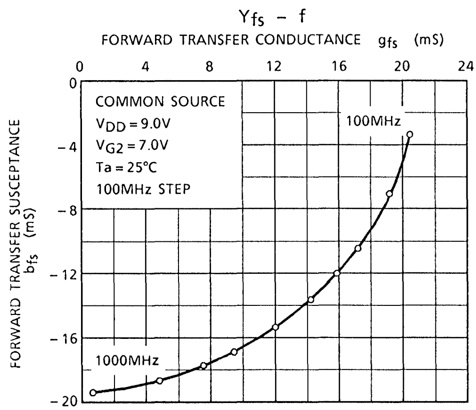
C_1 : 1000pF + 10000pF
L_1, L_4 : ϕ0.8mm SILVER PLATED COPPER WIRE
C : AIR TRIMMER TTA25A200A (MURATA MFG. Co., Ltd.)
RFC 1 : ϕ0.35mm COPPER WIRE 3mm ID, 10T

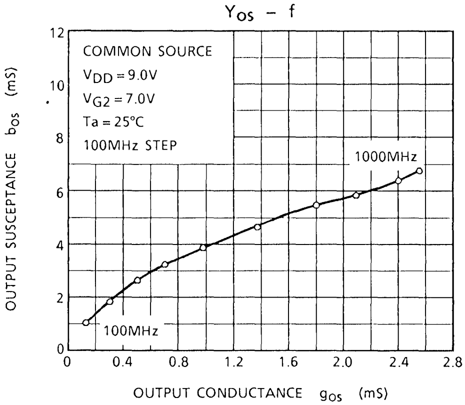

IDD – VDD
COMMON SOURCE
VG2 = 7.0V
f = 500MHz
Ta = 25°C
12mA
10mA
IDD = 8mA
SUPPLY CURRENT IDD (mA)
SUPPLY VOLTAGE VDD (V)

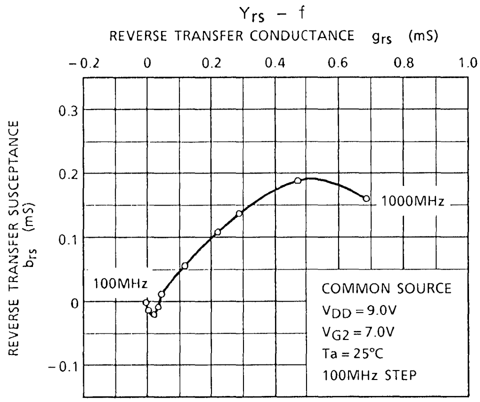

Gps – VDD, NF – VDD
Gps
IDD = 8mA
10mA
12mA
COMMON SOURCE
VG2 = 7.0V
f = 500MHz, Ta = 25°C
NF
12mA
10mA
IDD = 8mA
POWER GAIN Gps (dB)
NOISE FIGURE NF (dB)
SUPPLY VOLTAGE VDD (V)


G.R. – VG2
GATE 2 VOLTAGE VG2 (V)
GAIN REDUCTION G.R. (dB)
COMMON SOURCE
VDD = 9.0V
f = 500MHz
Ta = 25°C


Yis – f
COMMON SOURCE
VDD = 9.0V
VG2 = 7.0V
Ta = 25°C
100MHz STEP
1000MHz
100MHz
INPUT SUSCEPTANCE bis (mS)
INPUT CONDUCTANCE gis (mS)


Yfs – f
FORWARD TRANSFER CONDUCTANCE gfs (mS)
COMMON SOURCE
VDD = 9.0V
VG2 = 7.0V
Ta = 25°C
100MHz STEP
100MHz
1000MHz
FORWARD TRANSFER SUSCEPTANCE bfs (mS)

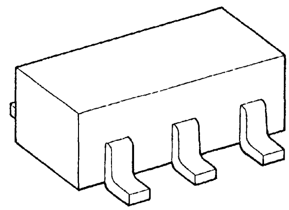

Yos – f
COMMON SOURCE
VDD = 9.0V
VG2 = 7.0V
Ta = 25°C
100MHz STEP
1000MHz
100MHz
OUTPUT SUSCEPTANCE bos (mS)
OUTPUT CONDUCTANCE gos (mS)
0
2
4
6
8
10
12
0.4
0.8
1.2
1.6
2.0
2.4
2.8


Yrs – f
REVERSE TRANSFER CONDUCTANCE grs (mS)
–0.2
0
0.2
0.4
0.6
0.8
1.0
REVERSE TRANSFER SUSCEPTANCE brs (mS)
0.3
0.2
0.1
0
–0.1
1000MHz
100MHz
COMMON SOURCE
VDD = 9.0V
VG2 = 7.0V
Ta = 25°C
100MHz STEP

SILICON MONOLITHIC MOS TYPE
LINEAR INTEGRATED CIRCUIT

TA4007F

TV TUNER VHF RF AMPLIFIER APPLICATIONS.
FM TUNER RF AMPLIFIER APPLICATIONS.



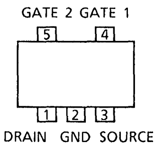
SSOP5-P (SMV)

Weight : 0.014g (Typ.)

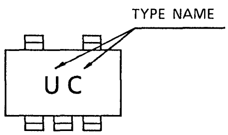
FEATURES

- On account of this Device built in Bias Circuit, Cut down number of articles.
- Low Noise Figure : NF = 1.3dB (Typ.)
- Operating Voltage : $V_{DD} = 6 \sim 11V$

PIN ASSIGNMENT (TOP VIEW)



MARKING



MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{DD}	11	V
Gate 2-Source Voltage	V_{G2S}	±8	V
Supply Current	I_{DD}	30	mA
Power Dissipation	P_D*	250	mW
Operating Temperature	T_{opr}	−40~85	°C
Storage Temperature Range	T_{stg}	−55~125	°C

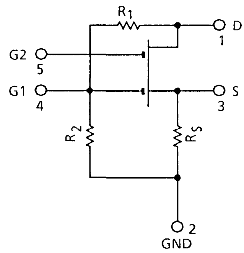
* When mounted on the glass epoxy board of $2.5cm^2 \times 1.6t$

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate 2 Leakage Current	I_{G2SS}	—	$V_{DS} = 0$, $V_{G1S} = 0$, $V_{G2S} = \pm 6V$	—	—	±50	nA
Gate 2-Source Cut-off Voltage	$V_{G2S\,(OFF)}$	—	$V_{DD} = 5V$, $I_{DD} = 150\mu A$	0.5	1.0	1.5	V
Supply Current	I_{DD}	—	$V_{DD} = 9V$, $V_{G2} = 7V$	6	—	14	mA
Input Capacitance	C_{iss}	—	$V_{DD} = 9V$, $V_{G2} = 7V$ f = 1MHz	2.4	3.4	4.0	pF
Output Capacitance	C_{oss}	—		1.5	2.0	2.5	pF
Power Gain	G_{ps}	1	$V_{DD} = 9V$, $V_{G2} = 7V$ f = 200MHz	24	28.0	—	dB
Noise Figure	NF	1		—	1.3	2.2	dB

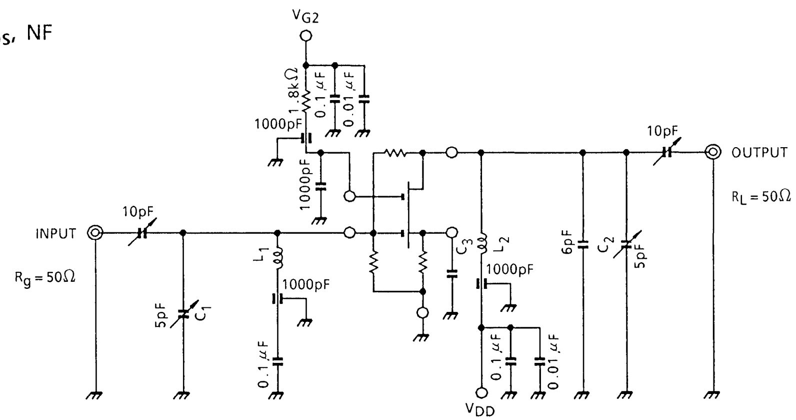
I_{DD} Classifications : Y : 6~10mA, GR : 8~12mA, BL : 10~14mA.

EQUIVALENT CIRCUIT



TEST CIRCUIT 1

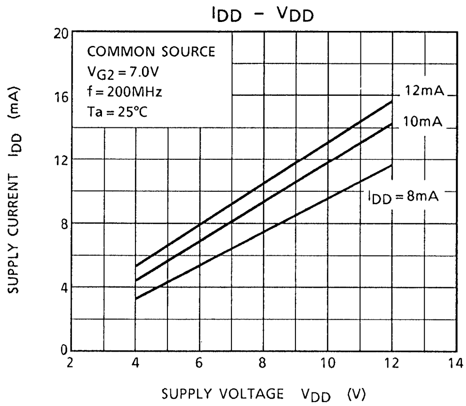
200MHz, G_{ps}, NF

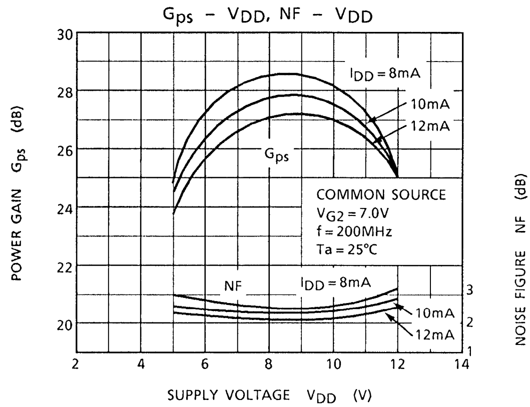


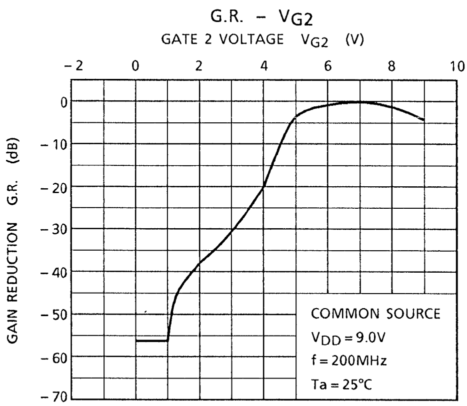
C_3 : 1000pF + 10000pF

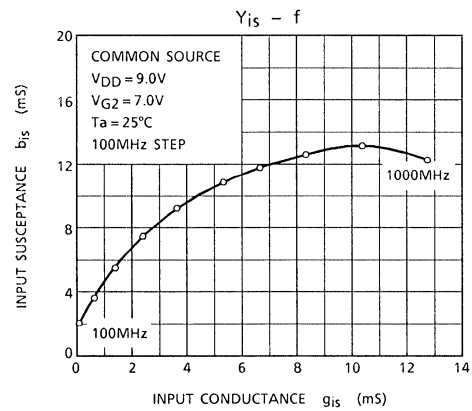
L_1 : 1mmϕ Ag Plated Copper Wire, 2 Turns, 8mm ID

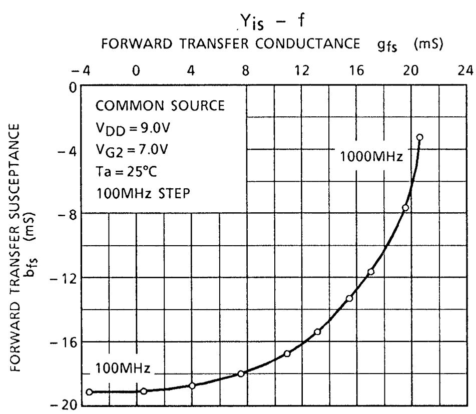
L_2 : 1mmϕ Ag Plated Copper Wire, 2.5 Turns, 8mm ID

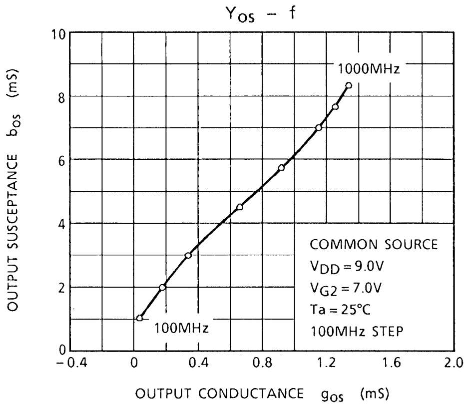

IDD - VDD
COMMON SOURCE
VG2 = 7.0V
f = 200MHz
Ta = 25°C
12mA
10mA
IDD = 8mA
SUPPLY CURRENT IDD (mA)
SUPPLY VOLTAGE VDD (V)

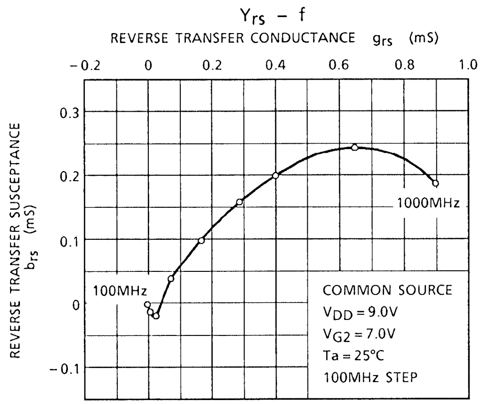

Gps - VDD, NF - VDD
IDD = 8mA
10mA
12mA
Gps
COMMON SOURCE
VG2 = 7.0V
f = 200MHz
Ta = 25°C
NF
IDD = 8mA
10mA
12mA
POWER GAIN Gps (dB)
NOISE FIGURE NF (dB)
SUPPLY VOLTAGE VDD (V)


G.R. - VG2
GATE 2 VOLTAGE VG2 (V)
COMMON SOURCE
VDD = 9.0V
f = 200MHz
Ta = 25°C
GAIN REDUCTION G.R. (dB)


Yis - f
COMMON SOURCE
VDD = 9.0V
VG2 = 7.0V
Ta = 25°C
100MHz STEP
1000MHz
100MHz
INPUT SUSCEPTANCE bis (mS)
INPUT CONDUCTANCE gis (mS)


Yis - f
FORWARD TRANSFER CONDUCTANCE gfs (mS)
COMMON SOURCE
VDD = 9.0V
VG2 = 7.0V
Ta = 25°C
100MHz STEP
1000MHz
100MHz
FORWARD TRANSFER SUSCEPTANCE bfs (mS)


Yos – f
OUTPUT SUSCEPTANCE bos (mS)
OUTPUT CONDUCTANCE gos (mS)
1000MHz
100MHz
COMMON SOURCE
VDD = 9.0V
VG2 = 7.0V
Ta = 25°C
100MHz STEP


Yrs – f
REVERSE TRANSFER CONDUCTANCE grs (mS)
REVERSE TRANSFER SUSCEPTANCE brs (mS)
100MHz
1000MHz
COMMON SOURCE
VDD = 9.0V
VG2 = 7.0V
Ta = 25°C
100MHz STEP

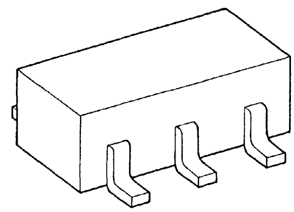
SILICON MONOLITHIC BIPOLAR
LINEAR INTEGRATED CIRCUIT

TA4100F

UHF VHF RF, MIX APPLICATION

FEATURES

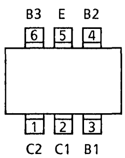
- High f_T. (f_T = 5GHz)
- Differential Circuit is Composed of 3 Transistors.



SSOP6-P (SM6)

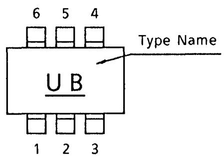
Weight : 0.013g (Typ.)

PIN ASSIGNMENT (TOP VIEW)



C ... COLLECTOR
B ... BASE
E ... EMITTER

MARKING



MAXIMUM RATING (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	10	V
Collector-Emitter Voltage	V_{CEO}	5	V
Collector Current	I_C	15 (*1), 30 (*2)	mA
Total Power Dissipation	P_D (*3)	300	mW
Operating Temperature	T_{opr}	−40~85	°C
Storage Temperature Range	T_{stg}	−55~125	°C

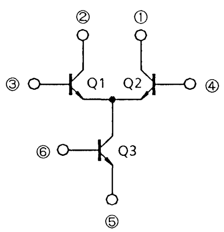
(*1) Q1, Q2 (*2) Q3
(*3) When mounted on the glass epoxy board of $2.5cm^2 \times 1.6t$

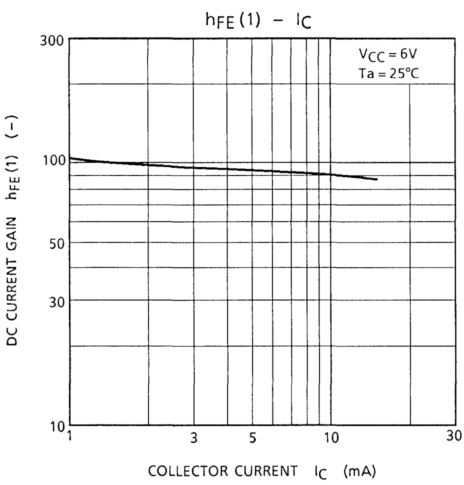
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

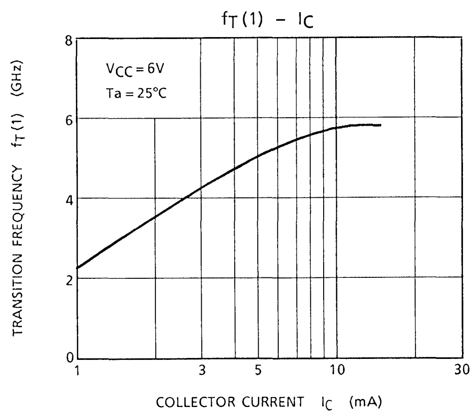
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector-Emitter Voltage	V_{CEO} (1)	—	I_{C1} = 1.0mA, (I_{B3} = 1mA)	5	—	—	V
	V_{CEO} (2)	—	I_{C2} = 1.0mA, (I_{B3} = 1mA)	5	—	—	
	V_{CEO} (3)	—	I_{B1} (I_{C3}) = 1.0mA	5	—	—	
DC Current Gain	h_{FE} (1)	—	V_{C1} = 6V, I_{C1} = 5mA, (I_{B3} = 1mA)	50	100	160	—
	h_{FE} (2)	—	V_{C2} = 6V, I_{C1} = 5mA, (I_{B3} = 1mA)	50	100	160	
	h_{FE} (3)	—	V_{B1} (V_{C3}) = 6V, I_{B1} (I_{C3}) = 10mA	70	140	250	
Transition Frequency	f_T (1)	—	V_{C1} = 6V, I_{C1} = 5mA, (I_{B3} = 1mA)	3.5	5.0	7.0	GHz
	f_T (2)	—	V_{C2} = 6V, I_{C2} = 5mA, (I_{B3} = 1mA)	3.5	5.0	7.0	
	f_T (3)	—	V_{B1} (V_{C3}) = 4V, I_{B1} (I_{C3}) = 10mA	3.5	5.0	7.0	

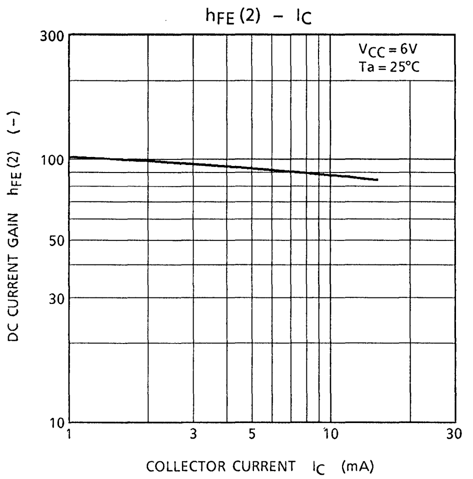
※ (1) ... Characteristics of Q1
(2) ... Characteristics of Q2
(3) ... Characteristics of Q3

EQUIVALENT CIRCUIT

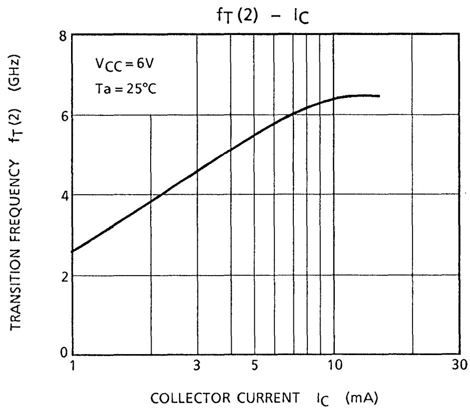




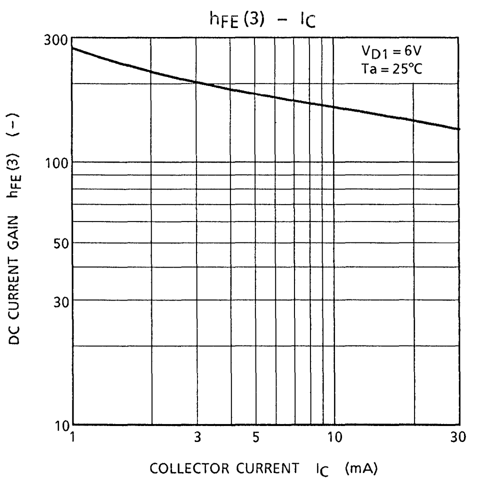




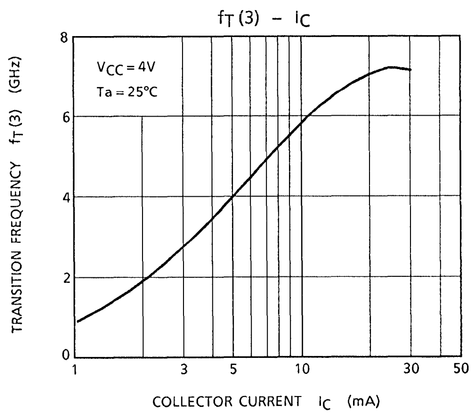
$h_{FE}(2)$ – I_C
V_{CC} = 6V
Ta = 25°C
DC CURRENT GAIN $h_{FE}(2)$ (–)
300
100
50
30
10
1
3
5
10
30
COLLECTOR CURRENT I_C (mA)



$f_T(2)$ – I_C
V_{CC} = 6V
Ta = 25°C
TRANSITION FREQUENCY $f_T(2)$ (GHz)
8
6
4
2
0
1
3
5
10
30
COLLECTOR CURRENT I_C (mA)



$h_{FE}(3)$ – I_C
V_{D1} = 6V
Ta = 25°C
DC CURRENT GAIN $h_{FE}(3)$ (–)
300
100
50
30
10
1
3
5
10
30
COLLECTOR CURRENT I_C (mA)



$f_T(3)$ – I_C
V_{CC} = 4V
Ta = 25°C
TRANSITION FREQUENCY $f_T(3)$ (GHz)
8
6
4
2
0
1
3
5
10
30
50
COLLECTOR CURRENT I_C (mA)

SILICON MONOLITHIC BIPOLAR
LINEAR INTEGRATED CIRCUIT

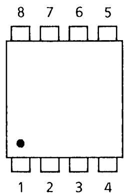
TA4101F

UHF VHF MIX APPLICATION

FEATURES

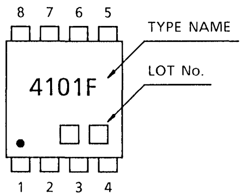
- Double Balance circuit

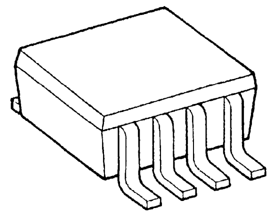
PIN ASSIGNMENT (TOP VIEW)



1. IF OUT
2. V_{CC}
3. OSC IN
4. Base
5. Base
6. Base
7. GND
8. Collector

MARKING





SSOP8-P (SM8)

Weight : 0.02g (Typ.)

MAXIMUM RATING (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	6	V
Total Power Dissipation	P_D (*)	300	mW
Operating Temperature	T_{opr}	−40~85	°C
Storage Temperature Range	T_{stg}	−55~125	°C

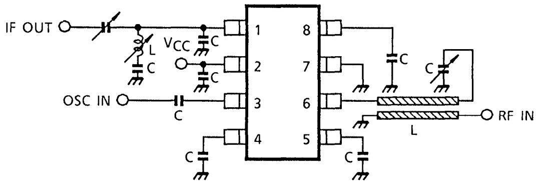
(*) When mounted the glass epoxy board of $2.5cm^2 \times 1.6t$

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

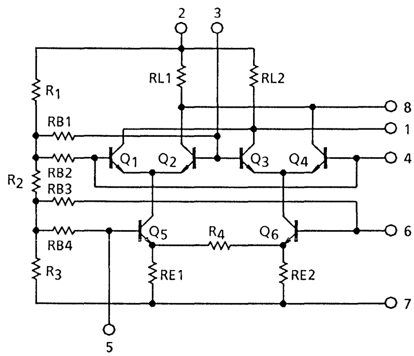
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Circuit Current	I_{CC}	—	V_{CC} = 5V	3.9	5.7	7.5	mA
MIXER Gain	G_{MIX}	1	V_{CC} = 5V, (*)	−6.0	−3.5	—	dB
MIXER NOISE Figure	NF_{MIX}	1	V_{CC} = 5V, (*)	—	9.0	12.0	dB
Maximum Output Level	P_O	1	V_{CC} = 5V, (*)	−12	−9	—	dBmW

(*) : f_{RF} = 800MHz, f_{LO} = 860MHz (0dBm), I_F = 60MHz

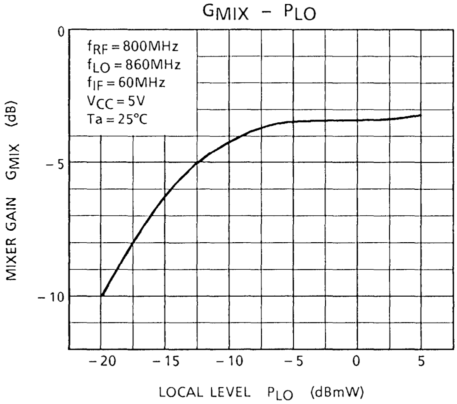
MEASUREMENT CIRCUIT 1.



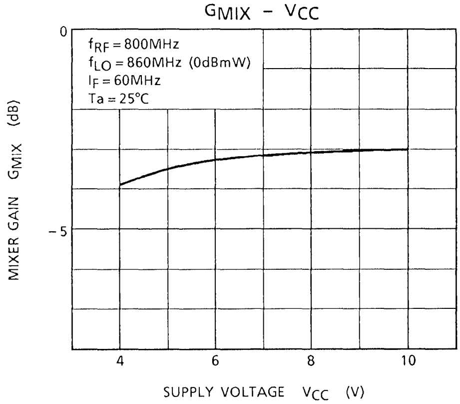
EQUIVALENT CIRCUIT



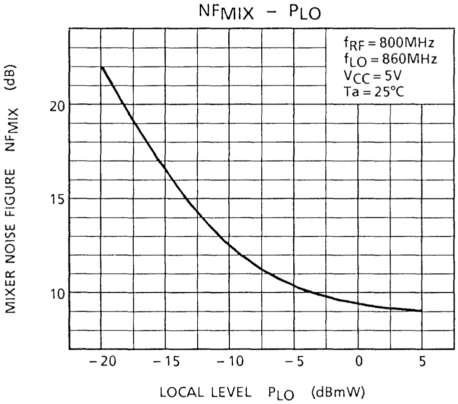
G_{MIX} – P_{LO}



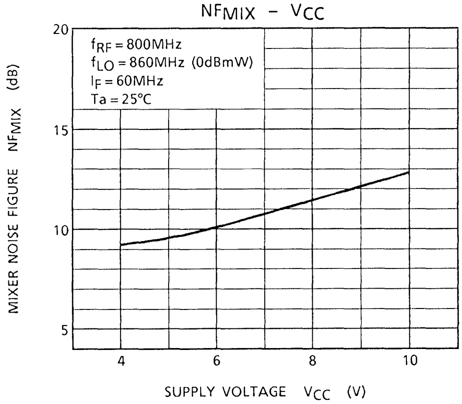
G_{MIX} – V_{CC}



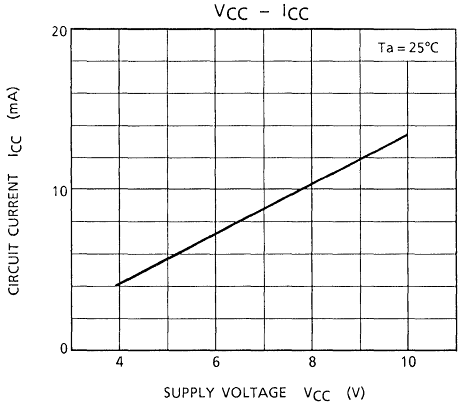
NF_{MIX} – P_{LO}



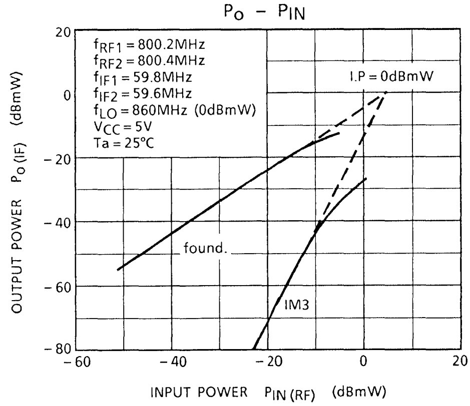
NF_{MIX} – V_{CC}



V_{CC} – I_{CC}



P_o – P_{IN}



GaAs MONOLITHIC MES TYPE
LINEAR INTEGRATED CIRCUIT

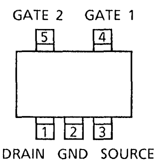
TG2000F

TV TUNER, UHF RF AMPLIFIER APPLICATIONS.

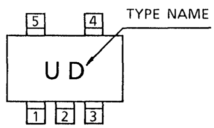
FEATURES

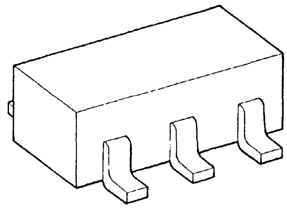
- On account of this Device build in Bias Circuit, Cut down number of articles.
- Low Noise Figure. : NF = 1.5dB (Typ.)
- Operating Voltage. : V_{DD} = 4~5V

PIN ASSIGNMENT (TOP VIEW)



MARKING





SSOP5-P (SMV)

Weight : 0.014g (Typ.)

MAXIMUM RATING (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{DD}	6	V
Gate 2-Drain Voltage	V_{G2DO}	−6	V
Gate 2-Source Voltage	V_{G2S}	−4	V
Gate 2 Current	I_{G2}	1	mA
Drain Power Dissipation	P_D	150	mW
Operating Temperature Range	T_{opr}	−40~85	°C
Storage Temperature Range	T_{stg}	−55~125	°C

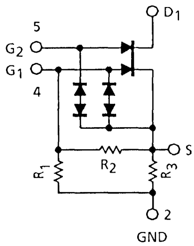
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate 2 Leakage Current	I_{G2SS}	—	V_{DS} = 0, V_{G1S} = 0, V_{G2S} = −3V	—	—	−4	μA
Drain Current	I_{DSS}	—	V_{DS} = 2V, V_{G1S} = 0, V_{G2S} = 0	4	—	16	mA
Gate 2-Source Cut-off Voltage	$V_{G2S\,(OFF)}$	—	V_{DS} = 2V, V_{G1S} = 0 I_D = 100μA	−0.75	—	−1.3	V
Forward Transfer Admittance	$\lvert Y_{fs}\rvert$	—	V_{DS} = 2V, V_{G2S} = 0.5V I_D = 2mA, f = 1kHz	—	12	—	mS
Drain Current	I_{DD}	1	V_{DD} = 4.5V, V_{G2} = 2.5V R = 390Ω	—	11	—	mA
Power Gain	G_{ps}	—	V_{DD} = 4.5V, V_{G2} = 2.5V f = 800MHz, R = 390Ω	15	19	—	dB
Noise Figure	NF	2		—	1.5	2.5	dB

CAUTION

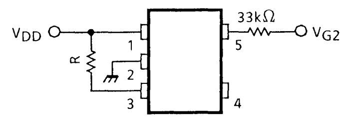
GaAs (Gallium Arsenide) is used in this product. The dust or vapor cam be dangerous to humans. Do not break, cut, crush or dissolve chemically. Dispose of this product properly according to law. Do not intermingle with normal industrial or domestic waste.
This device is electrostatic sensitivity. Please handle with caution.

EQUIVALENT CIRCUIT



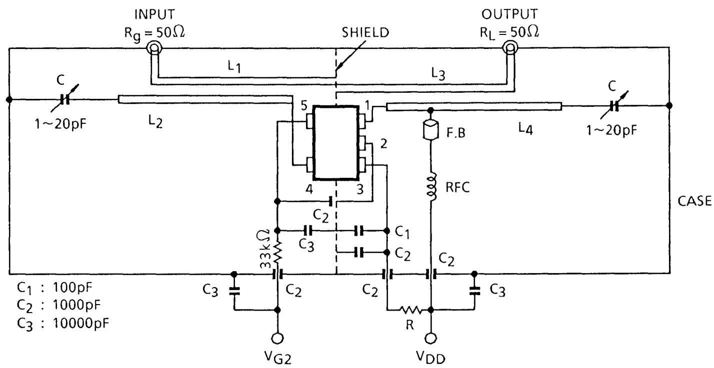
TEST CIRCUIT 1

IDD

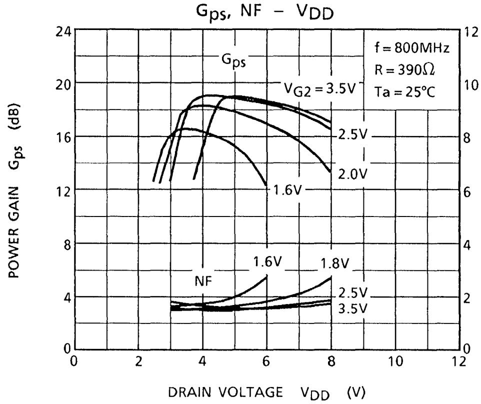


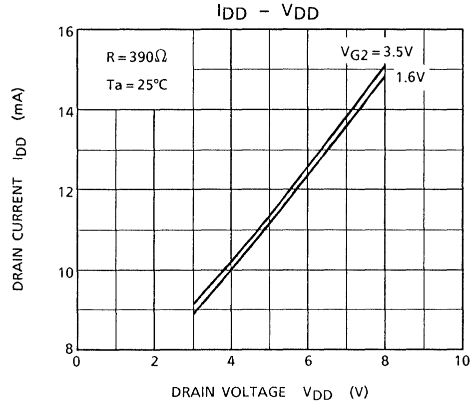
TEST CIRCUIT 2

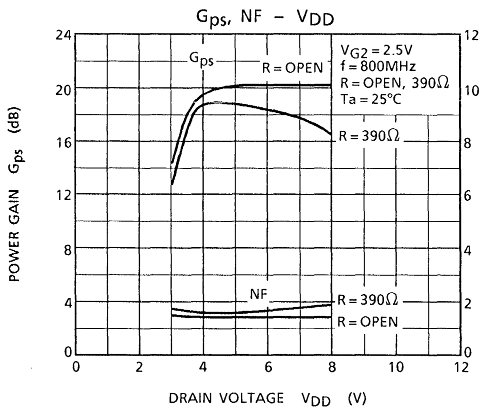
800MHz G_{ps}, NF

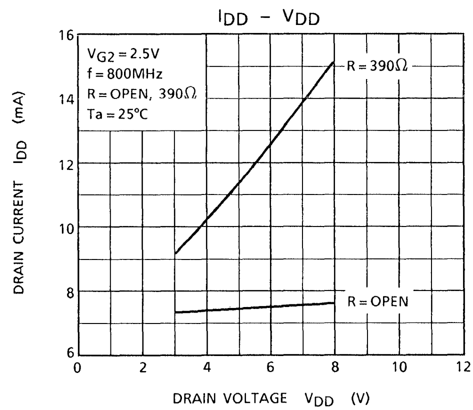


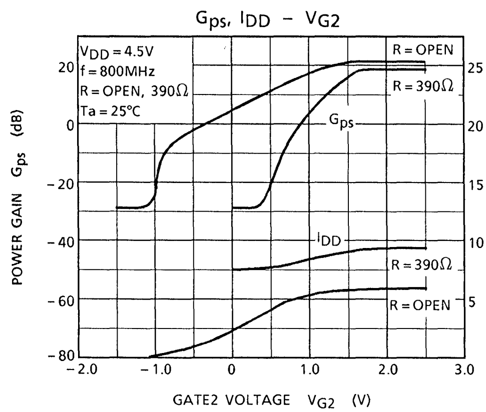
L1~L4 : φ0.8mm SILVER PLATED COPPER WIRE
C : AIR TRIMMER TTA25A200A (MURATA MFG. Co., LTD.)
RFC : φ0.35mm COPPER WIRE 3mm ID, 10T

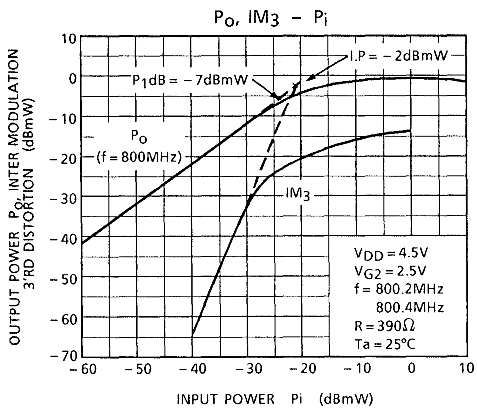

Gps, NF – VDD
f = 800MHz
R = 390Ω
Ta = 25°C
Gps
VG2 = 3.5V
2.5V
2.0V
1.6V
NF
1.6V
1.8V
2.5V
3.5V
POWER GAIN Gps (dB)
NOISE FIGURE NF (dB)
DRAIN VOLTAGE VDD (V)


IDD – VDD
R = 390Ω
Ta = 25°C
VG2 = 3.5V
1.6V
DRAIN CURRENT IDD (mA)
DRAIN VOLTAGE VDD (V)

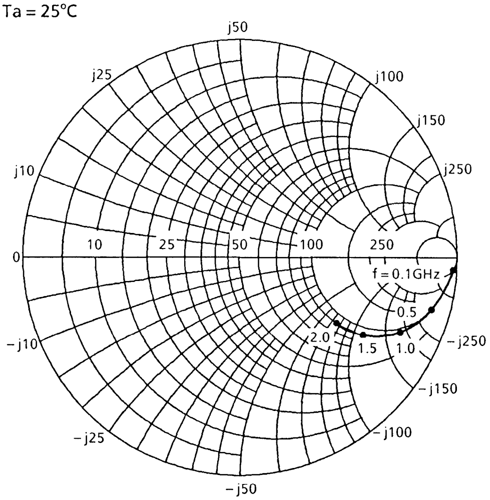

Gps, NF – VDD
VG2 = 2.5V
f = 800MHz
R = OPEN, 390Ω
Ta = 25°C
Gps
R = OPEN
R = 390Ω
NF
R = 390Ω
R = OPEN
POWER GAIN Gps (dB)
NOISE FIGURE NF (dB)
DRAIN VOLTAGE VDD (V)


IDD – VDD
VG2 = 2.5V
f = 800MHz
R = OPEN, 390Ω
Ta = 25°C
R = 390Ω
R = OPEN
DRAIN CURRENT IDD (mA)
DRAIN VOLTAGE VDD (V)

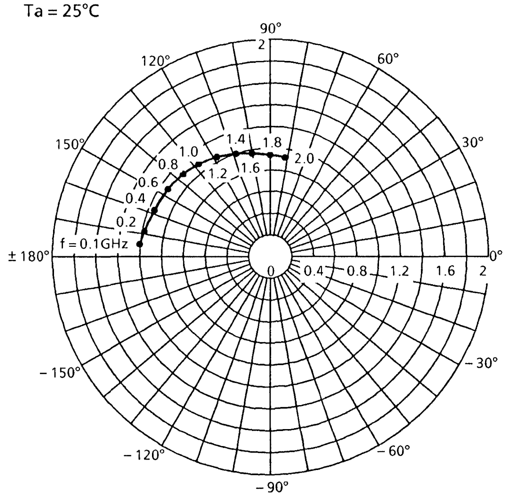

Gps, IDD – VG2
VDD = 4.5V
f = 800MHz
R = OPEN, 390Ω
Ta = 25°C
R = OPEN
R = 390Ω
Gps
IDD
R = 390Ω
R = OPEN
POWER GAIN Gps (dB)
DRAIN CURRENT IDD (mA)
GATE2 VOLTAGE VG2 (V)


Po, IM3 – Pi
I.P = –2dBmW
P1dB = –7dBmW
Po
(f = 800MHz)
IM3
VDD = 4.5V
VG2 = 2.5V
f = 800.2MHz
800.4MHz
R = 390Ω
Ta = 25°C
OUTPUT POWER Po, INTER MODULATION 3'RD DISTORTION (dBmW)
INPUT POWER Pi (dBmW)

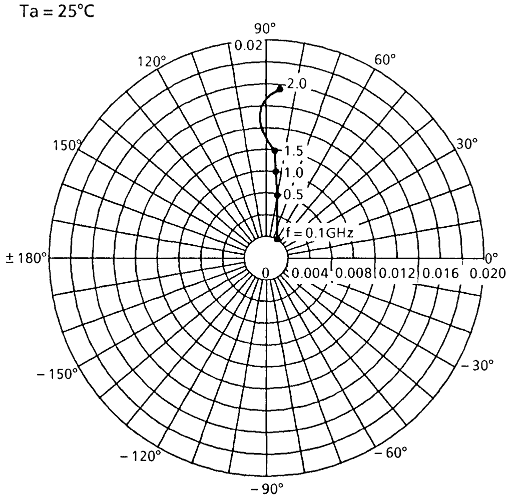
S_{11}
$V_{DD} = 4.5V$
$V_{G2} = 2.5V$
f = 800MHz
R = 390Ω
Ta = 25°C



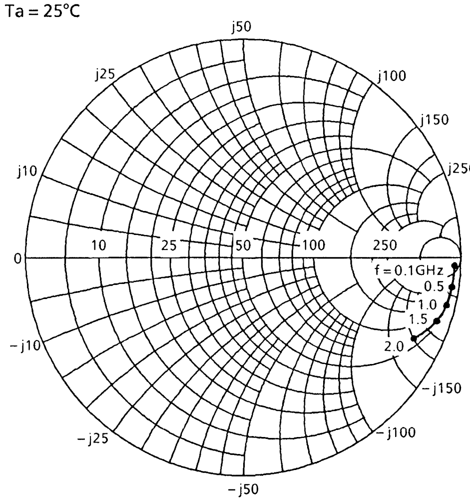
S_{21}
$V_{DD} = 4.5V$
$V_{G2} = 2.5V$
f = 800MHz
R = 390Ω
Ta = 25°C



S_{12}
$V_{DD} = 4.5V$
$V_{G2} = 2.5V$
f = 800MHz
R = 390Ω
Ta = 25°C



S_{22}
$V_{DD} = 4.5V$
$V_{G2} = 2.5V$
f = 800MHz
R = 390Ω
Ta = 25°C



HIGH-FREQUENCY DEVICE DATA BOOK

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