SMALL SIGNAL TRANSISTORS

DATABOOK

1st EDITION

SGS-THOMSON
MICROELECTRONICS

SMALL SIGNAL TRANSISTORS

DATABOOK

1st EDITION

DECEMBER 1989

TABLE OF CONTENTS

INTRODUCTION

This databook contains datasheets covering the range of discrete devices for small signal consumer, industrial and professional applications, including RF devices.

A selection guide by characteristics and, for RF devices, by application, is provided to enable fast identification of the most suitable devices for your application.

The information on each product has been presented in order that the performance of the product can be readily evaluated within any required equipment design.

ALPHANUMERICAL INDEX

PRODUCT GUIDE

General purpose in TO-39

V_{CEO} V_{CER}* (V)	h_{FE} min/max	@ I_C (mA)	TYPE NPN	TYPE PNP	$V_{CE(sat)}$ max (V)	@ I_C/I_B (mA)	f_T min (MHz)	t_s t_{off}* (ns)	P_{tot} (mW)	Page
20	60/—	150	BFY52		0.35	150/15	50	160 typ	800	187
30	40/—	150	BFY51		0.35	150/15	50	160 typ	800	187
30	40/120	150	2N2218		1.6	500/50	250	—	800	295
30	40/120	150	BSY53		1.2	500/50	100 typ	—	800	259
30	100/300	150	2N2219		1.6	500/50	250	—	800	295
30	100/300	150	BSY54		1.2	500/50	100 typ	—	800	259
35	30/—	150	BFY50		0.2	150/15	60	140 typ	800	187
40	40/120	150		2N2904	0.4	150/15	200	80	600	325
40	40/120	150	2N2218A		1	500/50	250	225	800	297
40	40/120	150	2N3110		0.25	150/15	60	1000*	800	339
40	40/240	500	BC440		1	1000/100	50	—	1000	91
40	40/250	100	BC140		0.35 typ	500/50	50	850*	800	49
40	40/250	500		BC460	1	1000/100	50	—	1000	93
40	50/250	150		2N4037	0.3	150/15	100	110	700	401
40	50/250	150	2N3053		1.4	150/15	100 typ	—	800	337
40	100/230	150		2N2905	0.4	150/15	200	80	600	325
40	100/300	150	2N2219A		1	500/50	300	225	800	297
40	100/300	150	2N3109		0.25	150/15	70	1000*	800	339
45	30/150	150	BFY56		0.3	150/15	40	800*	800	191
45	40/240	150		BC304	0.65	150/15	100 typ	—	850	77
45	120/240	150	BC302		0.5	150/15	100 typ	—	850	73
50	40/250	500		2N5323	1.2	500/50	50	—	1000	415
50	40/250	500	2N5321		0.8	500/50	50	800*	1000	413
50*	40/120	150	2N1613		1.5	150/15	60	—	800	285
50*	100/300	150	2N1711		1.5	150/15	70	—	800	285
55	40/—	100		BFX39	0.5	500/50	100	350	800	163
55	40/120	150	BFY56A		0.25	150/15	60	800*	800	191
55	85/—	100		BFX38	0.5	500/50	100	350	800	163
60	40/120	150		2N2904A	0.4	150/15	200	80	600	327
60	40/120	150	2N3108		1.4	150/15	100 typ	—	800	339
60	40/240	150		BC303	0.65	150/15	75	—	850	77
60	40/240	150	BC301		0.5	150/15	120 typ	—	800	73
60	40/240	500	BC441		1	1000/100	50	—	1000	91
60	40/250	100	BC141		0.35 typ	500/50	50	850*	800	49
60	40/250	500		BC461	1	1000/100	50	—	1000	93
60	100/300	100		2N4032	0.5	500/50	100	350	800	389
60	100/300	150		2N2905A	0.4	150/15	200	80	600	327
60	100/300	150	2N3107		1.4	150/15	100 typ	—	800	339
65	40/120	150	2N2102		0.5	150/15	60	30*	1000	293
65	40/140	150		2N4036	0.65	150/15	60	700*	1000	397
75	30/130	500		2N5322	0.7	500/50	50	1000*	1000	415
75	30/130	500	2N5320		0.5	500/50	50	800*	1000	413
75	40/—	100		BFX41	0.5	500/50	100	350	800	163
75	85/—	100		BFX40	0.5	500/50	100	350	800	163
80	40/120	100		2N4031	0.5	500/50	100	350	800	389
80	40/120	150	2N1893		5	150/15	50	—	800	289
80	40/120	150	2N3020		0.5	500/50	80 typ	—	800	335
80	40/120	150	BSY55		0.6	150/15	100 typ	—	800	263
80	40/240	150	BC300		0.5	150/15	120 typ	—	800	73
80	100/300	100		2N4033	0.5	500/50	100	350	800	389
80	100/300	150	2N3019		0.5	500/50	100 typ	—	800	335
80	100/300	150	BSY56		0.6	150/15	100 typ	—	800	263

General Purpose in TO-18

V_{CEO} V_{CER}* (V)	@		TYPE		@					
	h_{FE} min/max	I_C (mA)	NPN	PNP	$V_{CE(sat)}$ max (V)	I_C/I_B (mA)	f_T min (MHz)	t_s t_{off}* (ns)	P_{tot} (mW)	Page
25	50/—	10		BCY72	0.5	50/5	200	350	350	105
25	75/260	100	BC377		0.7	500/50	300 typ	—	375	81
30	40/120	150	2N2221		1.6	500/50	250	—	500	295
30	90/—	10		BFX48	0.3	50/5	400	160*	360	167
30	100/300	150	2N2222		1.6	500/50	250	—	500	295
30	100/300	150	2N3302		0.6	500/50	—	150*	360	353
40	40/120	150		2N2906	1.6	500/50	200	80	400	325
40	40/120	150	2N2221A		1	500/50	250	225	500	297
40	50/—	10		BCY70	0.5	50/5	250	350	350	105
40	50/150	10		2N3250	0.5	50/5	250	200	360	349
40	75/260	100	BC378		0.7	500/50	300 typ	—	375	81
40	100/300	10		2N3251	0.5	50/5	300	200	360	349
40	100/300	150		2N2907	1.6	500/50	200	80	400	325
40	100/300	150	2N2222A		1	500/50	300	225	500	297
40	150/300	10		2N4035	0.3	50/5	450	150*	360	393
45	100/300	150		2N3504	1.6	500/50	200	100*	400	357
45	100/600	10		BCY71	0.5	50/5	200	—	350	105
50*	40/120	150	2N718A		1.5	150/15	60	—	500	269
50*	100/300	150	2N956		1.5	150/15	70	—	500	269
55	50/—	50	BSX33		0.3	150/15	60	800*	500	239
55	60/180	150	BFR18		0.25	500/50	60	—	500	133
60	40/120	150		2N2906A	1.6	500/50	200	80	400	327
60	100/300	150		2N2907A	1.6	500/50	200	80	400	327
60	100/300	150		2N3505	1.6	500/50	200	100*	400	357
80	40/—	150	2N720A		1.2	50/5	—	—	500	273
80	100/300	150	2N3700		0.5	500/50	400 typ	—	500	359

Low level, low noise transistors in TO-18

V_{CEO} V_{CER}* (V)	@		TYPE		@					
	h_{FE} min/max	I_C (mA)	NPN	PNP	$V_{CE(sat)}$ max (V)	I_C/I_B (mA)	f_T min (MHz)	NF (dB)	P_{tot} (mW)	Page
20	110/800 ■	2	BC108		0.6	100/5	100	10	300	37
20	200/800 ■	2	BC109		0.6	100/5	100	4	300	37
20	240/500 ■	2		BC179	0.25	10/0.5	200 typ	4	300	61
25	125/500 ■	2		BC178	0.25	10/0.5	200 typ	10	300	61
32	120/630	2	BCY58		0.35	10/0.25	200 typ	6	360	101
32	120/460	2		BCY78	0.8	100/2.5	180 typ	6	360	111
40	110/450	2		BC478	0.25	10/0.5	150 typ	6	360	95
40	200/—	2		BC479	0.25	10/0.5	—	4	360	95
45	100/500	0.01	2N930		1	10/0.5	30	3	300	283
45	110/450 ■	2	BC107		0.6	100/5	100	10	300	37
45	120/460	2		BCY79	0.8	100/2.5	180 typ	6	360	111
45	120/630	2	BCY59		0.7	100/2.5	200 typ	6	360	101
45	125/500 ■	2		BC177	0.25	10/0.5	200 typ	10	300	61
45	250/500	0.01		2N3964	0.25	10/0.5	50	2	360	377
60	130/—	0.01	BFR17		1	1/0.1	70	3	360	129
60	100/300	0.01		2N3962	0.25	10/0.5	40	3	360	377
60	100/500	0.01	2N2484		0.35	1/0.1	60	2	360	311
60	150/300	1	BFY76		0.35	1/0.1	100	4	360	199
60	250/500	0.01		2N3965	0.25	10/0.5	50	4	360	377
80	70/230	0.01		BFX37	0.4	50/5	40	3.5	360	159
80	100/300	0.01		2N3963	0.25	10/0.5	40	3	360	377
80	110/250	2		BC477	0.25	10/0.5	150 typ	10	360	95

■ h_{fe} @ 1 KHz

Transistors for fast and ultra-fast switches in TO-18

V_{CEO} V_{CER}* (V)	h_{FE} min/max	@ I_C (mA)	TYPE NPN	TYPE PNP	$V_{CE(sat)}$ max (V)	@ I_C/I_B (mA)	f_T min (MHz)	t_s t_{off}* (ns)	P_{tot} (mW)	Page
12	30/120	10	BSX28		0.25	30/3	400	13	360	227
12	30/120	30		BSX29	0.2	30/3	400	90	360	231
12	40/120	30		2N2894	0.2	100/10	400	90	360	321
15	20/60	10	2N2368		0.25	10/1	400	10	360	303
15	20/60	10	BSX19		0.6	100/10	400	10	360	219
15	25/—	100	2N3013		0.5	300/30	350	18	360	331
15	30/120	10	2N708		0.4	10/1	300	75*	360	267
15	30/120	10	2N914		0.7	200/20	300	20	360	275
15	30/120	30	BSX26		0.5	300/30	350	18	360	223
15	40/120	10	2N2369		0.25	10/1	500	13	360	305
15	40/120	10	2N2369A		0.2	10/1	500	13	360	307
15	40/120	10	BSX20		0.6	100/10	450	13	360	219
15	40/120	10	BSX93		0.2	10/1	400	13	360	255
20	30/—	10	BSX88A		0.39	100/10	350	20	360	251
20	30/120	30		2N3209	0.2	30/3	400	90	360	321
20	30/120	30	2N3014		0.35	100/10	350	18	360	333
20	40/120	30	BSX39		0.28	100/10	350	18	360	243
30	30/120	150	2N2845		0.4	150/15	350	40*	360	315
30	60/150	100	2N4013		0.2	100/10	300	60*	500	381
40	40/—	100	BSS26		0.95	1000/100	250	60*	360	203
50	60/150	100	2N4014		0.52	500/50	300	60*	360	385

Transistors for fast and ultra-fast switches in TO-39

V_{CEO} V_{CER}* (V)	h_{FE} min/max	@ I_C (mA)	TYPE NPN	TYPE PNP	$V_{CE(sat)}$ max (V)	@ I_C/I_B (mA)	f_T min (MHz)	t_s t_{off}* (ns)	P_{tot} (mW)	Page
30	60/150	100	2N3724		0.2	100/10	—	60*	800	361
40	60/150	100	BSX32		0.5	500/50	300	60*	800	235
50	60/150	100	2N3725		0.52	500/50	300	60*	800	365

HIGH VOLTAGE transistors in TO-18

V_{CEO} V_{CER}* (V)	h_{FE} min/max	@ I_C (mA)	TYPE NPN	TYPE PNP	$V_{CE(sat)}$ max (V)	@ I_C/I_B (mA)	f_T min (MHz)	t_s t_{off}* (ns)	P_{tot} (mW)	Page
150	40/—	10		BFW43	0.5	10/1	60	—	400	155
180	30/—	10	BC394		0.3	10/1	50	—	400	87
180	50/—	10		BC393	0.3	10/1	50	—	400	87
180	80/300	10		2N3930	0.25	10/1	40	400		373
180	80/300	10		BFX90	0.25	10/1	160	—	400	181
200	40/250	30		BSS75S	0.4	30/3	50	—	400	213
200	50/—	10	BSS71S		0.5	50/5	50	—	500	207
200	40/250	30	BSS72S		0.5	50/5	50	—	500	209
200	35/150	30		BSS74S	0.5	50/5	50	—	500	211

HIGH VOLTAGE transistors in TO-39

V_{CEO} V_{CER}* (V)	h_{FE} min/max	@ I_C (mA)	TYPE NPN	TYPE PNP	$V_{CE(sat)}$ max (V)	@ I_C/I_B (mA)	f_T min (MHz)	t_s t_{off}* (ns)	P_{tot} (mW)	Page
150	30/—	30	2N3114		1	50/5	40	—	800	343
150	40/—	10		BFW44	0.5	10/1	60	700		155
160	25/—	30	BF257		1	30/6	90 typ	—	1000	117
180	80/300	10		2N3931	0.25	10/1	60	—	700	373
180	80/300	10		BFX91	0.25	10/1	40	—	700	181
200	30/150	10		2N5415S	2.5	50/5	15	—	1000	417
250	25/—	30	BF258		1	30/6	90 typ	—	1000	117
300	25/—	30	BF259		1	30/6	90 typ	—	1000	117

HIGH VOLTAGE transistors in TO-126

V_{CEO} V_{CER}* (V)	h_{FE} min/max	@ I_C (mA)	TYPE NPN	TYPE PNP	$V_{CE(sat)}$ max (V)	@ I_C/I_B (mA)	f_T min (MHz)	t_s t_{off}* (ns)	P_{tot} (mW)	Page
160	30/—	30	BF457		1	50/10	90 typ	—	1250	121
250	30/—	30	BF458		1	50/10	90 typ	—	1250	121
300	30/—	30	BF459		1	50/10	90 typ	—	1250	121

SGS-THOMSON MICROELECTRONICS

Transistor for Radio frequency application

MAX RATING			TYPE/POLARITY		MAIN FUNCTION	TRANS. FREQ.		NOISE FIGURE			GAIN		Package	Page
V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	NPN	PNP		f_t @ (MHz)	I_C (mA)	NF @ (dB)	I_C and (mA)	f (MHz)	PG @ (dB)	f (MHz)		
30	25	200	BFY90		Wide Band VHF/UHF Amplifier	1400	25	5.5	2	800	8	800	TO-72	177
30	25	200	BFX89		Wide Band VHF/UHF Amplifier	1200	25	7	2	500	7	800	TO-72	177
12	50	200	2N5179		VHF/UHF Amplifier	1400	5	3	1.5	200	21	200	TO-72	411
15	50	200	2N918		High frequency oscillator and amplifier	900	4	5	1	60	21	200	TO-72	279
15	50	200	2N3600		High frequency oscillator and amplifier	850	5	5	1	60	21	200	TO-72	171
25	50	225		BFR99	Wide band VHF/UHF amplifier	2000	10	3.5	3	800	10	800	TO-72	143
25	50	225		BFR99A	Wide band VHF/UHF amplifier	2300	10	3.5	3	800	10	800	TO-72	145
25	150	700	BFW16A		CATV-MATV Amplifier	1200	150	6	30	200	6.5	800	TO-39	151
25	150	700	BFW17A		CATV-MATV Amplifier	1100	150	—	—	—	16	200	TO-39	151
30	200	800	BFR36		CATV High Gain Transistor	1400	70	4.5	70	200	16	200	TO-39	137
20	400	1000	2N5109		CATV High Gain Transistor	—	—	—	—	—	—	—	TO-39	407
20	—	1000	2N3137		R.F. Amplifier	750	50	4	30	200	7	250	TO-39	345
20	500	3500	2N4427		VHF Oscillator Power Amplifier	500	50	—	—	—	10	175	TO-39	403
30	500	5000	2N3866		VHF Oscillator Power Amplifier	500	50	—	—	—	10	400	TO-39	369

INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
B1-12		2N4427	403
BC100		BF259	117
BC107	BC107		37
BC108	BC108		37
BC109	BC109		37
BC110		BC394	87
BC113		BFY76	199
BC114		BFR17	129
BC115		BC140	49
BC116		BC160	57
BC117		BC394	87
BC118		BC107	37
BC119	BC119		43
BC120		BC119	43
BC125		BC377	81
BC126		BC298	69
BC129		BC107	37
BC130		BC108	37
BC131		BC108	37
BC132		BC109	37
BC134		BC107	37
BC135		BC107	37
BC136		BC140	49
BC137		BC139	45
BC138		BC140	49
BC139	BC139		45
BC140	BC140		49
BC141	BC141		49
BC142	BC142		53
BC143	BC143		55
BC144		BC140	49
BC145		BC394	87
BC147		BC107	37
BC148		BC108	37
BC149		BC109	37
BC150		BC108	37
BC151		BC108	37
BC152		BC108	37
BC153		BC177	61
BC154		BC177	61
BC157		BC177	61
BC158		BC178	61
BC159		BC179	61
BC160	BC160		57
BC161	BC161		57
BC167		BC107	37
BC168		BC108	37
BC169		BC109	37
BC170		BC108	37
BC171		BC107	37
BC172		BC108	37
BC173		BC109	37
BC174		BFY76	199
BC177	BC177		61
BC181		BC177	61
BC182		BC107	37
BC183		BC107	37
BC184		BC107	37
BC185		BC301	73
BC186		BC177	61
BC187		BC178	61
BC190		BC107	37
BC192		BC298	69
BC200		BC179	61
BC204		BC177	61
BC205		BC178	61
BC206		BC179	61
BC207		BC107	37
BC208		BC108	37
BC209		BC109	37
BC210		BC377	81
BC211		BC141	49
BC212		BC177	61
BC213		BC178	61
BC214		BC179	61
BC215		BC297	69
BC216		BC298	69
BC218		BC108	37
BC220		BC107	37
BC221		BC298	69
BC222		BC378	81
BC223		BC377	81
BC224		BC478	95
BC225		BC478	95
BC226		BC302	73
BC231		BC297	69
BC232		BC377	81
BC236		BC394	87
BC237		BC107	37
BC238		BC108	37
BC239		BC109	37
BC250		BC179	61
BC251		BC177	61
BC252		BC178	61
BC253		BC179	61
BC254		BC394	87
BC255		BC394	87
BC256		BC477	95
BC257		BC177	61
BC258		BC178	61
BC259		BC178	61
BC260		BC179	61
BC261		BC177	61
BC262		BC178	61
BC263		BC178	61
BC266		BC477	95

INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
BC267		BC107	37
BC268		BC108	37
BC269		BC109	37
BC270		BC109	37
BC271		BC378	81
BC272		BC377	81
BC280		BFY76	199
BC281		BC178	61
BC282		BC377	81
BC283		BC297	69
BC284		BC378	81
BC285		BC394	87
BC286	BC286		65
BC287	BC287		67
BC294		BC160	57
BC295		BC108	37
BC297	BC297		69
BC298	BC298		69
BC300	BC300		73
BC301	BC301		73
BC302	BC302		73
BC303	BC303		77
BC304	BC304		77
BC307		BC177	61
BC308		BC178	61
BC309		BC179	61
BC310		BC141	41
BC312		BF258	117
BC313		BC303	77
BC315		BC177	61
BC317		BC107	37
BC318		BC108	37
BC319		BC109	37
BC320		BC177	61
BC321		BC178	61
BC322		BC179	61
BC324		BC301	73
BC327		BC297	69
BC328		BC298	69
BC329		BFY76	199
BC330		BC107	37
BC331		BFY76	199
BC332		BC107	37
BC333		BC108	37
BC334		BC178	61
BC335		BC109	37
BC336		BC178	61
BC337		BC377	81
BC338		BC378	81
BC340		BC140	49
BC341		BC141	49
BC342		BC141	49
BC343		BC161	57
BC344		BC300	73
BC345		BC303	77
BC347		BC107	37
BC348		BC108	37
BC349		BC109	37
BC350		BC177	61
BC351		BC178	61
BC352		BC179	61
BC354		BC478	95
BC355		BC478	95
BC357		BC479	95
BC358		BC109	37
BC360		BC160	57
BC361		BC161	57
BC368		BC440	91
BC369		BC460	93
BC370		BC298	69
BC377	BC377		81
BC378	BC378		81
BC381		BC177	61
BC382		BC107	37
BC383		BC108	37
BC384		BC108	37
BC385		BC107	37
BC386		BC109	37
BC387		BC377	81
BC388		BC297	69
BC393	BC393		83
BC394	BC394		87
BC395		BC141	49
BC396		BC161	57
BC400		BC477	95
BC407		BC107	37
BC408		BC108	37
BC409		BC109	37
BC417		BC177	61
BC418		BC178	61
BC419		BC179	61
BC420		BC393	83
BC429		BC440	91
BC430		BC460	93
BC431		BC301	73
BC432		BC303	77
BC437		BC107	37
BC438		BC108	37
BC439		BC109	37
BC440	BC440		91
BC441	BC441		91
BC446		BC477	95
BC448		BC477	95
BC451		BC107	37
BC452		BC108	37
BC453		BC109	37

INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
BC454		BC177	61
BC455		BC178	61
BC456		BC179	61
BC460	BC460		93
BC461	BC461		93
BC467		BC107	37
BC468		BC108	37
BC469		BC109	37
BC477	BC477		95
BC478	BC478		95
BC479	BC479		95
BC512		BC177	61
BC513		BC178	61
BC514		BC179	61
BC520		BFY76	199
BC521		BFR17	129
BC522		BFR17	129
BC523		BFY76	199
BC524		BC107	37
BC525		BC478	95
BC526		BC477	95
BC529		BC297	69
BC530		BC393	83
BC531		BC393	83
BC532		BC394	87
BC533		BC394	87
BC535		2N3700	359
BC546		BFY76	199
BC547		BC107	37
BC548		BC108	37
BC549		BC109	37
BC550		BC107	37
BC556		BC477	95
BC557		BC478	95
BC558		BC478	95
BC559		BC479	95
BC560		BC478	95
BC582		BC107	37
BC583		BC108	37
BC584		BC109	37
BC585		BFY76	199
BC586		BC177	61
BC635		BC377	81
BC636		BC297	69
BC714		BC177	61
BC727		BC297	69
BC728		BC298	69
BC737		BC377	81
BC738		BC378	81
BCW10		BCY58	101
BCW11		BCY78	111
BCW12		BCY59	101
BCW13		BCY79	111

INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
BCW14		BCY59	101
BCW15		BCY79	111
BCW16		BCY59	101
BCW17		BCY79	111
BCW20		BCY58	101
BCW21		BCY78	111
BCW22		BCY59	101
BCW23		BCY79	111
BCW34		2N2222A	297
BCW35		2N2907A	327
BCW36		2N2222A	297
BCW37		2N2907A	327
BCW44		2N1613	285
BCW45		BFX41	163
BCW50		BC394	87
BCW62		2N3962	377
BCW63		BCY79	111
BCW64		BCY79	111
BCW73		2N2221	295
BCW74		2N2221A	297
BCW75		2N2906	325
BCW76		2N2906A	327
BCW77		2N2219	295
BCW78		2N2219A	297
BCW79		2N2905	325
BCW80		2N2905A	327
BCW82		BFY76	199
BCW83		BCY59	101
BCW84		BCY59	101
BCW85		BFX37	159
BCW86		BC177	61
BCW87		BCY59	101
BCW88		BCY79	111
BCW90		BC377	81
BCW91		BSX33	239
BCW92		BC297	69
BCW93		2N2907A	327
BCW94		2N2222A	297
BCW95		BFR18	133
BCW96		2N2907	325
BCW97		2N2907A	327
BCW98		BCY59	101
BCW99		BCY79	111
BCX25		BCY59	101
BCX26		BCY79	111
BCX40		BC441	91
BCX45		2N2221A	297
BCX46		2N2906A	327
BCX47		2N2222A	297
BCX48		2N2907A	327
BCX58		BCY58	101
BCX59		BCY59	101
BCX60		BC461	93

INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
BCX73		2N2222	295
BCX74		2N2222A	297
BCX75		2N2907	325
BCX76		2N2907A	327
BCX78		BCY78	111
BCX79		BCY79	111
BCY56		BCY59	101
BCY58	BCY58		101
BCY59	BCY59		101
BCY66		BCY59	101
BCY67		BCY79	111
BCY69		BCY58	101
BCY70	BCY70		105
BCY71	BCY71		105
BCY72	BCY72		105
BCY78	BCY78		111
BCY79	BCY79		111
BF120		BC394	87
BF137		BF257	117
BF156		BF257	117
BF157		BF257	117
BF174		BF258	117
BF177		BF257	117
BF178		BF258	117
BF179		BF259	117
BF248		2N2222	295
BF249		2N2907	325
BF250		2N2222	295
BF257	BF257		117
BF258	BF258		117
BF259	BF259		117
BF291		BC107	37
BF292		BF258	117
BF293		BC107	37
BF294		BF257	117
BF297		BF257	117
BF298		BF258	117
BF299		BF259	117
BF305		BF258	117
BF321		BC108	37
BF322		2N2218	295
BF323		2N2904	325
BF336		BF257	117
BF337		BF258	117
BF338		BF259	117
BF355		BF259	117
BF390		BF259	117
BF391		BC394	87
BF456		BF457	121
BF457	BF457		121
BF458	BF458		121
BF459	BF459		121
BFR10		2N2218	295

INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
BFR11		2N2221	295
BFR12		BCY59	101
BFR16		BFY76	199
BFR17	BFR17		129
BFR18	BFR18		133
BFR20		2N3019	335
BFR21		2N1893	289
BFR22		2N1893	289
BFR23		2N4036	397
BFR24		2N4037	401
BFR36	BFR36		137
BFR39		BFR18	133
BFR40		2N3700	359
BFR56		BC440	91
BFR57		BF257	117
BFR58		BF258	117
BFR59		BF259	117
BFR77		2N1893	289
BFR78		2N3020	335
BFR86		BC394	87
BFR97	BFR97		369
BFR98	BFR98		403
BFR99A	BFR99A		143
BFS61		BSX33	239
BFS69		BC178	61
BFS90		BFW44	155
BFS91		BFX91	181
BFS92		BFX41	163
BFS93		BFX40	163
BFS94		BFX39	163
BFS95		BFX38	163
BFS99		BC394	87
BFT17		BFY90	177
BFT22		2N2906	325
BFT30		BSX33	239
BFT31		2N956	269
BFT41		2N5321	413
BFT57		BC394	87
BFT60		2N4033	389
BFT61		2N4030	389
BFT62		2N4030	389
BFT69		2N4031	389
BFT79		2N4031	389
BFT80		2N4033	389
BFT81		2N4032	389
BFV56		BSS26	203
BFV56A		BSS26	203
BFV57A		BSS26	203
BFV64		2N2907	325
BFV64A		2N2907A	327
BFV64B		2N2907	325
BFV65		BSX26	223
BFV66		2N2221A	297

INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
BFV66A		2N2222A	297
BFV68		2N2484	311
BFV68A		2N2484	311
BFV90A		2N2222	295
BFV90B		2N2221	295
BFV99		2N2221A	297
BFW16A	BFW16A		151
BFW17A	BFW17A		151
BFW20		BC477	95
BFW21		BFX37	159
BFW22		BC478	95
BFW24		2N3108	339
BFW25		2N3110	339
BFW26		2N3109	339
BFW29		2N2219	295
BFW31		2N2905	325
BFW32		2N2219	295
BFW33		BSY56	263
BFW36		BF257	117
BFW38		BF257	117
BFW43	BFW43		155
BFW44	BFW44		155
BFW45		BF257	117
BFW63		2N2222	295
BFW63A		2N2222A	297
BFW71		BFW16A	151
BFW73		BFW16A	151
BFW74		BFW17A	151
BFW75		BFW17A	151
BFW76		BFW17A	151
BFW77		BFW16A	151
BFW78		BFW17A	151
BFX12		BFX48	167
BFX13		BFX48	167
BFX23		BSX32	235
BFX29		2N2904A	327
BFX35		2N2907	325
BFX36		2N2907A	327
BFX37	BFX37		159
BFX38	BFX38		163
BFX39	BFX39		163
BFX40	BFX40		163
BFX41	BFX41		163
BFX43		2N2369	305
BFX44		2N2369A	307
BFX48	BFX48		167
BFX50		2N2222A	297
BFX51		2N2221A	297
BFX55		BFR36	137
BFX59		BFX89	177
BFX68		2N1711	285
BFX68A		2N1711	285
BFX69		2N1613	285

INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
BFX69A		2N1613	285
BFX73		2N918	279
BFX74		2N2904	325
BFX74A		BFX39	163
BFX84		2N1893	289
BFX85		2N1893	289
BFX86		2N1711	285
BFX87		2N2905	325
BFX88		2N2905	325
BFX89	BFX89		177
BFX90	BFX90		181
BFX91	BFX91		181
BFX93		2N930	283
BFX94		2N2221	295
BFX94A		2N2221A	297
BFX95		2N2222	295
BFX95A		2N2222A	297
BFX96		2N2218	295
BFX96A		2N2218A	297
BFX97		2N2219	295
BFX97A		2N2219A	297
BFX98		BF257	117
BFY25		2N2219A	297
BFY26		2N2222A	297
BFY33		BFY56	191
BFY34		2N1613	285
BFY40		2N1711	285
BFY41		BF257	117
BFY43		BF257	117
BFY44		BFY56A	191
BFY45		BF257	117
BFY46		2N1711	285
BFY50	BFY50		187
BFY51	BFY51		187
BFY52	BFY52		187
BFY53		2N1613	285
BFY55		2N1613	285
BFY56	BFY56		191
BFY56A	BFY56A		191
BFY56B		BFY56A	191
BFY57		BF257	117
BFY64	BFY64		195
BFY65		BF257	117
BFY67		2N1613	285
BFY68		2N1711	285
BFY70		2N2218A	297
BFY72		2N2218	195
BFY76	BFY76		199
BFY77		2N2484	311
BFY88		BFR36	137
BFY90	BFY90		177
BSS11		BSX20	219
BSS12		BSX28	227

INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
BSS15		2N5320	413
BSS16		2N5321	413
BSS17		2N5322	415
BSS18		2N5323	415
BSS23		BSS26	203
BSS26	BSS26		203
BSS27		2N3725	365
BSS28		BSX32	235
BSS29		BSX32	235
BSS30		2N1893	289
BSS31		2N3019	335
BSS40		BSS26	203
BSS41		BSS26	203
BSS59		2N3700	359
BSS68		BC393	83
BSS71S	BSS71S		207
BSS72S	BSS72S		209
BSS74S	BSS74S		211
BSS75S	BSS75S		213
BSV15	BSV15		215
BSV16	BSV16		215
BSV17		BSV16	215
BSV21		2N2894	321
BSV23		BSX28	227
BSV24		BSX28	227
BSV25		BSX19	219
BSV26		BSX19	219
BSV27		BSX20	219
BSV33		BSX29	231
BSV68		BFW43	155
BSV69		BSX32	235
BSV77		2N3725	365
BSV82		2N5322	415
BSV83		2N5323	415
BSV84		2N5320	413
BSV85		2N5321	413
BSV89		BSX19	219
BSV90		BSX20	219
BSV91		2N2369	305
BSV92		BSX26	203
BSV95		2N3725	365
BSW19		2N2906	325
BSW19A		2N2907	325
BSW20		2N2906	325
BSW20A		2N2907	325
BSW21		BCY78	111
BSW21A		BCY79	111
BSW22		BCY78	111
BSW22A		BCY79	111
BSW23		2N2904	325
BSW24		2N2904A	327
BSW25		BSX29	231
BSW26		BSS26	203

INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
BSW27		2N3725	365
BSW28		BSX32	235
BSW29		BSX32	235
BSW37		2N2894	321
BSW38		BSX19	219
BSW41		2N2221A	297
BSW42		BCY58	101
BSW42A		BCY59	101
BSW43A		BCY59	101
BSW44		BCY78	111
BSW44A		BCY79	111
BSW45		BCY78	111
BSW45A		BCY79	111
BSW49		BSX32	235
BSW51		2N2218	295
BSW52		2N2219	295
BSW53		2N2218A	297
BSW54		2N2219A	297
BSW61		2N2221	295
BSW62		2N2222	295
BSW63		2N2221A	297
BSW64		2N2222A	297
BSW72		2N2906	325
BSW73		2N2907	325
BSW74		2N2906A	327
BSW75		2N2907A	327
BSW82		2N2221	295
BSW83		2N2222	295
BSW84		2N2221	295
BSW85		2N2222A	297
BSX19	BSX19		219
BSX20	BSX20		219
BSX21		BC394	87
BSX22		2N5321	413
BSX23		2N5320	413
BSX24		2N2221	295
BSX25		2N2222	295
BSX26	BSX26		223
BSX28	BSX28		227
BSX29	BSX29		231
BSX30		BSX32	235
BSX33	BSX33		239
BSX38A		BCY58	101
BSX38B		BCY59	101
BSX39	BSX39		243
BSX45	BSX45		247
BSX46	BSX46		247
BSX47		BFY56	191
BSX48		BSS26	203
BSX49		BSS26	203
BSX51		BCY58	101
BSX52	BCY59		101
BSX53	BCY58		101

INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
BSX54	BCY59		101
BSX59	BSX32		235
BSX60	2N3725		365
BSX61	2N3725		365
BSX76	BSX20		219
BSX77	2N2369A		307
BSX78		BSX20	219
BSX87		BSX26	223
BSX87A		BSX26	223
BSX88		BSX39	243
BSX88A	BSX88A		251
BSX89	BSX19		219
BSX90		BSX20	219
BSX91		2N2369A	307
BSX92		2N2369	305
BSX93	BSX93		255
BSX95		2N1613	285
BSX96		2N1711	285
BSX97		2N2221	295
BSY10		2N2218A	297
BSY11		2N2219	295
BSY17		BSX19	219
BSY18		BSX20	219
BSY19		BSX26	223
BSY20		BSX20	219
BSY21		BSX26	223
BSY22		BCY59	101
BSY23		BSX19	219
BSY34		BSX32	235
BSY38		BSX19	219
BSY40		BSX29	231
BSY41		BSX29	231
BSY44		2N1613	285
BSY45		2N1893	289
BSY46		2N1613	285
BSY53	BSY53		259
BSY54	BSY54		259
BSY55	BSY55		263
BSY56	BSY56		263
BSY58		BSX32	235
BSY62A		BSX19	219
BSY62B		BSX20	219
BSY63		BSX93	255
BSY70		BSX39	243
BSY71		2N1711	285
BSY72		BCY58	101
BSY73		BCY58	101
BSY74		BCY59	101
BSY78		2N2222	295
BSY83		BFY56A	191
BSY84		2N1711	285
BSY85		BSX45	247
BSY86		BSX46	247

INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
BSY87		BSY56	263
BSY88		2N3107	339
BSY89		BCY58	101
BSY95		BSX19	219
BSY95A		BSX20	219
MM2193A		2N2218A	297
MM3019		2N3019	335
MM3020		2N3020	335
MM3053		2N3053	337
MM3905		2N3250	349
MM3906		2N3251	349
SD1300		BFY90	177
2N656		BSX46	247
2N657		BC300	73
2N696		BSY53	259
2N697		2N1613	285
2N698		2N1893	289
2N706		BSX26	223
2N706A		BSX19	219
2N707		BSX39	243
2N708	2N708		267
2N718A	2N718A		269
2N720A	2N720A		273
2N721		2N2906	325
2N722		2N2906A	327
2N735		2N2484	311
2N736		BFR18	133
2N743		BSX19	219
2N744		BSX20	219
2N753		2N2369A	307
2N754		2N1893	289
2N760A		BFY76	199
2N780		2N930	283
2N834		BSX20	219
2N869		BSX29	231
2N870		BSX33	239
2N871		BFR18	133
2N910		BFR18	133
2N911		BSX33	239
2N912		BFR18	133
2N914		2N914	275
2N918		2N918	279
2N929		BFY76	199
2N930	2N930		283
2N956	2N956		269
2N978		2N2906	325
2N995		BSX29	231
2N1132		2N2904	325
2N1420		2N2219	295
2N1507		2N2219	295
2N1572		2N1893	289
2N1573		2N1893	289
2N1574		2N3020	335

INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
2N1613	2N1613		285
2N1711	2N1711		285
2N1890		BSY55	263
2N1893	2N1893		289
2N1983		2N2219	295
2N1984		2N2218	295
2N1985		2N1613	285
2N1986		2N2218	295
2N1987		2N1613	285
2N1990		2N1893	289
2N1991		2N2904	325
2N2049		BFY52	187
2N2102	2N2102		293
2N2193		BSX45	247
2N2194A		2N2218A	297
2N2195		2N2218	295
2N2217		2N2218	295
2N2218	2N2218		295
2N2218A	2N2218A		297
2N2219	2N2219		295
2N2219A	2N2219A		297
2N2221	2N2221		295
2N2221A	2N2221A		297
2N2222	2N2222		295
2N2222A	2N2222A		297
2N2297		BFY56	263
2N2368	2N2368		303
2N2369	2N2369		305
2N2369A	2N2369A		307
2N2405		BC300	73
2N2410		BSX32	235
2N2412		BSX29	231
2N2477		2N3725	365
2N2483		BFY76	199
2N2484	2N2484		311
2N2511		BFY76	199
2N2586		BFR17	129
2N2692		BCY59	101
2N2693		BCY59	101
2N2694		BCY59	101
2N2711		BCY58	101
2N2712		BCY58	101
2N2714		BCY59	101
2N2845	2N2845		315
2N2848		BSX32	235
2N2857	2N2857		319
2N2864		BFY50	187
2N2868		BSY53	259
2N2894	2N2894		321
2N2904	2N2904		325
2N2904A	2N2904A		327
2N2905	2N2905		325
2N2905A	2N2905A		327

INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
2N2906	2N2906		325
2N2906A	2N2906A		327
2N2907	2N2907		325
2N2907A	2N2907A		327
2N2927		2N2904A	327
2N2959		2N2219A	297
2N3009		2N3013	331
2N3011		BSX28	227
2N3012		2N2894	321
2N3013	2N3013		331
2N3014	2N3014		333
2N3015		BSX32	235
2N3019	2N3019		335
2N3020	2N3020		335
2N3036		2N1893	289
2N3053	2N3053		337
2N3070		2N2905A	327
2N3073		2N2906A	327
2N3107	2N3107		339
2N3108	2N3108		339
2N3109	2N3109		339
2N3110	2N3110		339
2N3114	2N3114		343
2N3117		BFR17	129
2N3121		2N2906A	327
2N3137	2N3137		345
2N3209	2N3209		321
2N3250	2N3250		349
2N3251	2N3251		349
2N3252		2N3725	365
2N3253		BSX32	235
2N3261		BSX20	219
2N3299		2N2218	295
2N3300		2N2219	295
2N3301	2N3301		353
2N3302	2N3302		353
2N3309		2N2218	295
2N3478		2N5179	411
2N3485		2N2906	325
2N3486		2N2907	325
2N3502	2N3502		357
2N3503	2N3503		357
2N3504	2N3504		357
2N3505	2N3505		357
2N3563		2N918	279
2N3565		BFY76	199
2N3566		2N1711	285
2N3567		2N1613	285
2N3568		BFY56A	191
2N3569		BFY56	191
2N3572		BFY90	177
2N3600	2N3600		171
2N3638		2N2905	325

INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
2N3641		2N2218	295
2N3642		2N2218A	297
2N3643		2N2219	295
2N3644		2N2905	325
2N3645		2N2905A	327
2N3646	BSX26		223
2N3662		2N918	279
2N3663		BFX89	177
2N3700	2N3700		359
2N3712		BF257	117
2N3725	2N3725		365
2N3776		2N5321	413
2N3777		2N5322	415
2N3793		BC107	37
2N3794		BC108	37
2N3825		BC109	37
2N3828		BC107	37
2N3866	2N3866		369
2N3903		2N2222	295
2N3904		2N2221	295
2N3905		2N2906	325
2N3906		2N2907	325
2N3930	2N3930		373
2N3931	2N3931		373
2N3962	2N3962		377
2N3963	2N3963		377
2N3964	2N3964		377
2N3965	2N3965		377
2N4013	2N4013		381
2N4014	2N4014		385
2N4030	2N4030		389
2N4031	2N4031		389
2N4032	2N4032		389
2N4033	2N4033		389
2N4035	2N4035		393
2N4036	2N4036		397
2N4037	2N4037		401
2N4046		BSX32	235
2N4047		2N3725	365
2N4058		BC177	61
2N4059		BC178	61
2N4060		BC177	61
2N4061		BC177	61
2N4062		BC178	61
2N4121		BCY70	105
2N4248		BC177	61
2N4249		BC177	61
2N4250		BC178	61
2N4258		BC179	61
2N4264		BC108	37
2N4265		BC107	37
2N4286		BC107	37
2N4287		BC107	37

INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
2N4288		BC178	61
2N4289		BC177	61
2N4290		BC179	61
2N4291		BC179	61
2N4292		BC109	37
2N4293		BC109	37
2N4358		2N5415S	417
2N4359		BFX37	159
2N4402		2N2906	325
2N4403		2N2907	325
2N4427	2N4427		403
2N4875		BFW16A	151
2N4917		2N3251	349
2N4927		BF258	117
2N5053		BFX89	177
2N5054		BFY90	177
2N5086		BCY79	111
2N5087		BCY79	111
2N5088		BCY59	101
2N5089		BCY59	101
2N5109	2N5109		407
2N5128		2N2219	295
2N5132		BC109	37
2N5135		BCY58	101
2N5136		BC119	43
2N5138		BCY79	111
2N5172		BCY58	101
2N5179		2N5179	411
2N5180		2N5179	411
2N5209		BC107	37
2N5210		BC107	37
2N5219		BC108	37
2N5320	2N5320		413
2N5321	2N5321		413
2N5322	2N5322		415
2N5323	2N5323		415
2N5415S	2N5415S		417
2N5421		2N4427	403
2N5550		BC394	87
2N5551		BC394	87
2N5687		2N4427	415
2N6304		BFY90	177
2N6305		BFX89	177
2SA561		BC297	69
2SA565		BC297	69
2SA578		BC177	61
2SA673		BC297	69
2SA677		BC298	69
2SC80		BC108	37
2SC99		BC109	37
2SC100		2N1613	285
2SC108		2N1711	285
2SC120		2N1711	285

INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE
2SC122		2N2369	305
2SC150		BFY50	187
2SC155		BC108	37
2SC156		BC109	37
2SC172		BSX20	219
2SC188		2N2218	295
2SC189		2N2218A	297
2SC196		BSX20	219
2SC197		BFY51	187
2SC199		BSY54	259
2SC204		BSX19	219
2SC206		BC107	37
2SC228		BSY53	259
2SC233		BSY54	259
2SC237		2N2369	305
2SC266		BC108	37
2SC273		2N1711	285
2SC281		BC107	37
2SC282		BFY50	187
2SC283		2N1613	285
2SC284		2N1711	285
2SC319		2N4427	403
2SC320		BC107	37
2SC368		BC107	37
2SC468		BSX19	219
2SC540		BC109	37
2SC588		2N3107	339
2SC605		2N3108	339
2SC821		2N4427	403
2SC988		BFY90	177
2SC1044		2N2857	319
2SC1254		2N2857	319
2SC1260		BFY90	177
2SC1275		BFY90	177
2SC1807		BFY90	177
40280		2N4427	403
40894		2N5179	411
40895		BFX89	177
40896		BFX89	177
40897		2N5179	411

INDUSTRY STANDARD	SGS-THOMSON	SGS-THOMSON NEAREST	PAGE

PCB Mounting

Frequently lead forming is necessary to allow a suitable fit of a transistor on to a PCB. With or without lead forming these points should be observed.

I) Space the lead holes on the PCB to match the foot print of the transistor

II) Avoid lateral stress or excessive pressure on the ends of the transistor leads.

III) Use a spacer between the transistor and PCB

IV) When lead forming prior to mounting a transistor
   - make the bend at least 3 mm from the transistor body
   - clamp the leads near the transistor body before forming the lead
   - maintain a space between the jig and transistor body
   - follow all the precautions specified in the various standard relating to the transistors

V) When mounting a transistor onto a heat sink:
   - use the correct accessories
   - drill the holes on the heat sink as specified and properly deburr them. Avoid "pitting" the heat sink.
   - use a recommended silicon grease
   - use the correct tightening torque for the mounting screws or use the correct clips for mounting the transistors
   - never use pneumatic screwdrivers to mount transistors

VI) Avoid repeated bending of transistor leads when lead forming.

Soldering

The specified temperatures for soldering transistor leads are 260°C for 10 seconds or 350°C for 3 seconds. Temperature and times in excess of these could adversely effect the transistors.

Use a non corrosive flux

Be sure to

- solder quickly
- avoid appling mechanical stress to the transistor after soldering it, i.e. do not adjust its position
- mount the transistor on its heatsink before soldering the assemply to a PCB
- do not solder the heat radiating metal case, of a metal cased transistor, to a PCB
- use a low leakage soldering iron properly grounded.

Cleaning the PCB

After soldering clean the PCB to remove the flux.
- do not rub identifying marks with a brush or fingers when using a cleaning agent.
  take care using ultrasonic cleaning baths. Under certain circumstances the service life of airtight sealed transistors may be shortened.
  the recommended cleaning method is to adapt steam or jetstream cleaning techniques, where the transistors are mounted on PCB's.

Static Electricity

Maximum parameter ratings for the transistors should in no case be exceeded. However during handling it is possible that excessive static voltages may be applied directly or indirectly while handling them.
High frequency transistors are particularly prone to damages from static charges.
Proper circuit protection procedures should be observed.

QUALITY ASSURANCE

The average outgoing quality level (A0Q) is ultimated with the results of outgoing inspection which carries out a sampling inspection on each lot according to devices specification.
Sampling plan of outgoing inspection (according to MILSTD105D standard).

SUBGROUP	PARAMETERS	LEVEL	AQL
A_1	Visual and mechanical inspection	II	0.04
$A_2 + A_3$	Cumulative static electrical parameter (inoperative + out of specification limits)	II	0.065
A_4	AC Parameters	S4	0.25

Estimator of average outgoing quality level * (see sure 5) AOQ =

$$AOQE = \frac{\sum_{d=1}^{d=c+1} Nd * d}{\sum_{d=O}^{d=c} Nd * n}$$

$$= \frac{\text{Total defective units in samples with } d \leqslant c+1}{\text{Total inspected units in samples of accepted lots}}$$

where: n = sample size
c = acceptance criterion
d = number of defects in sample
Nd = number of lots with d defects on sample n

The value is expressed in:

PPM = Parts per million (10^{-6})

(The sums are applied to all inspected lots: 1st, 2nd inspection)

RELIABILITY ASSURANCE

Continuous reliability auditing with accelerated tests are performed on small signal transistor production in 2 stages:

* internal real time control (RTC)

A great emphasis is given to these process oriented reliability tests performed on a weekly basis. High accelerated conditions are used as often as phisically possible:

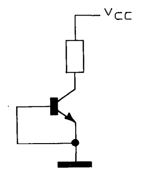
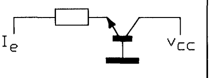
- detection of any slight process shift
- evaluation of the impact of process control continual improvement

* group b and c - long time life tests

they are performed on a periodic basic (usually every 3 months) to complete the information given by RTC tests and to define the long term reliability of the product and failure rate evalutation.

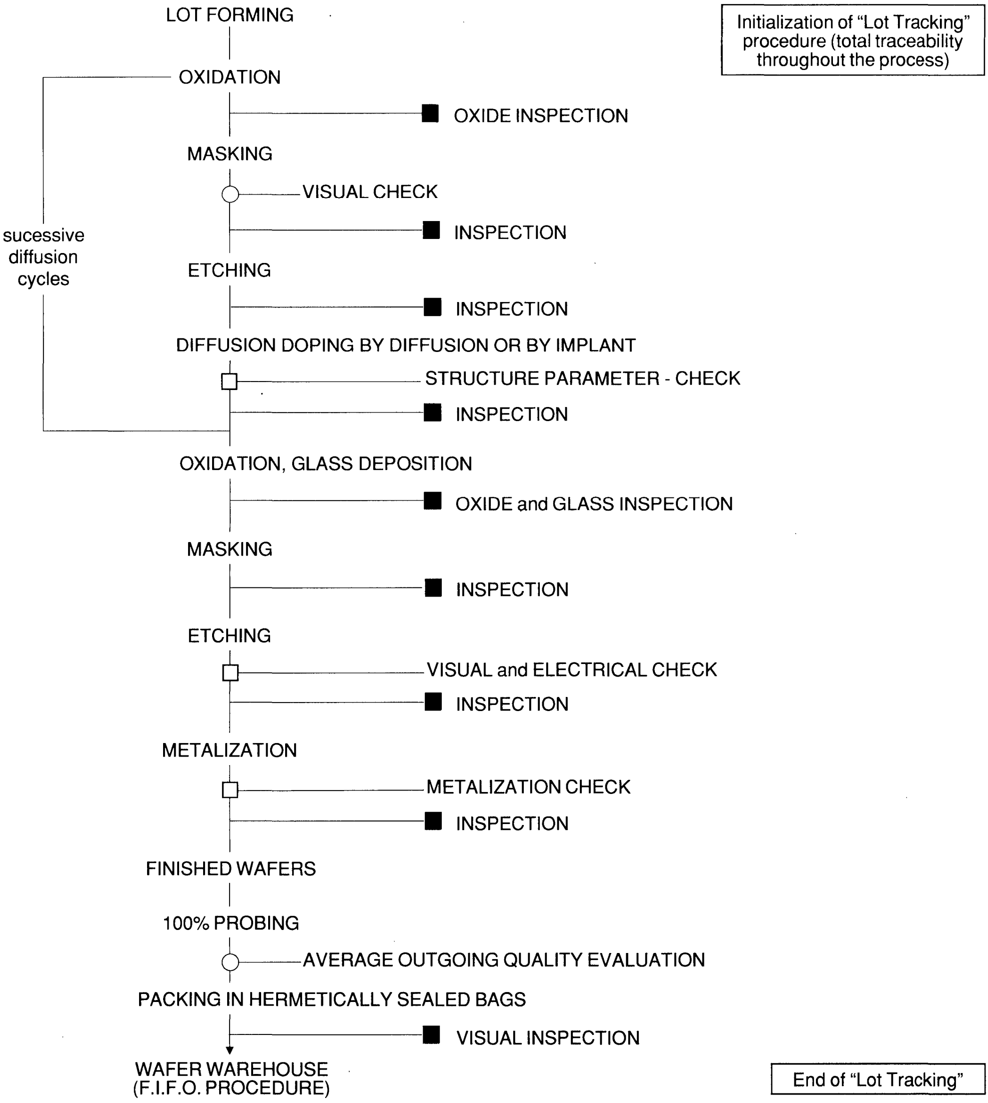
The results are cumulated each year - they are available on request.

Reliability Test Conditions

Test	Conditions	Typical test Circuit	Standard
HTRB	$V_{CC} = 80\%$ V_{CES} maximum rating Ta = 150°C Short term = 168 hours Long term = 1000 hours		MILSTD 750C method 1032
THERMAL CYCLES	−65°C to + 150°C short term = 100 cycles long term = 1000 cycles		MILSTD750C method 1051
OPERATING LIFE	Tj = Tj max. $PD = \frac{Tj\ max. - T\ case}{Rth}$ long term = 1000 hours		
HIGH TEMPERATURE STORAGE	Ta = Tj max. long term = 1000 hours		

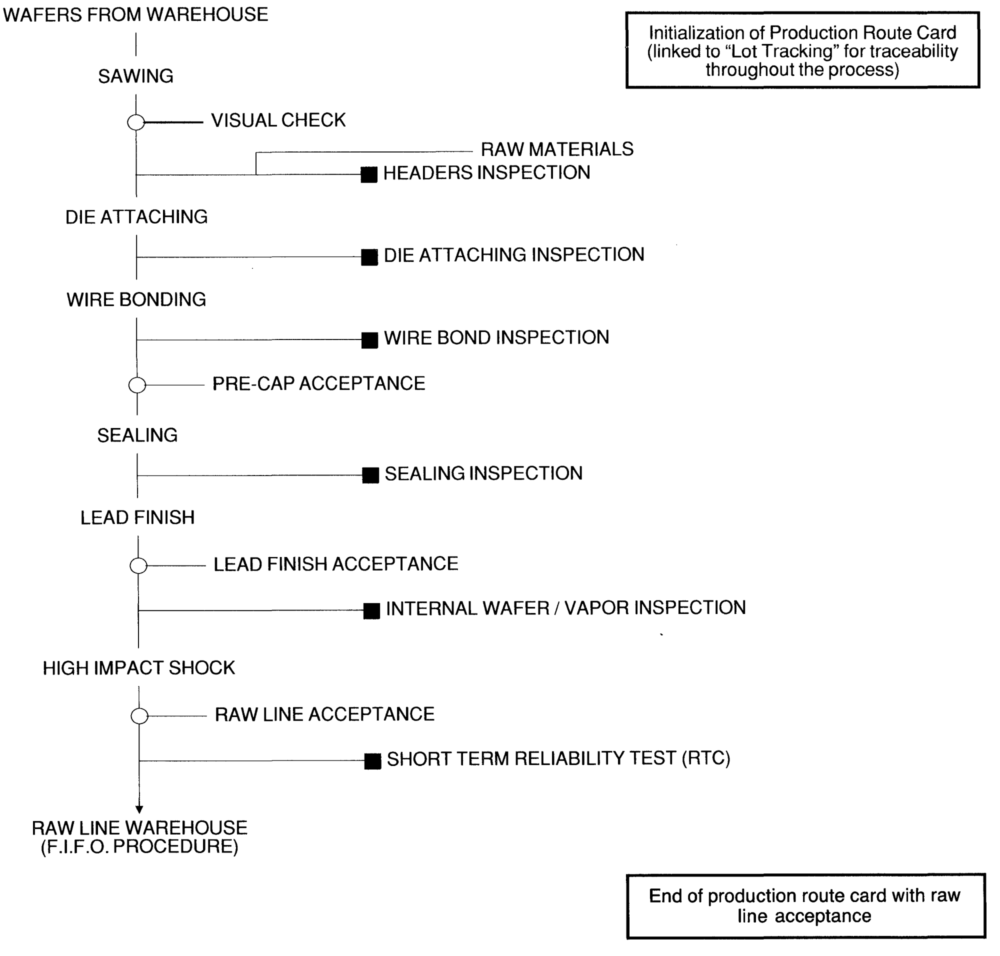
Note: SPC methods are used for Process Control Assurance and continual quality improvement towards Zero defect target.
Hihg values of process control capability (CPK) at each significant step assure reliable results at the end of the process

TYPICAL WAFER FABRICATION FLOW CHART



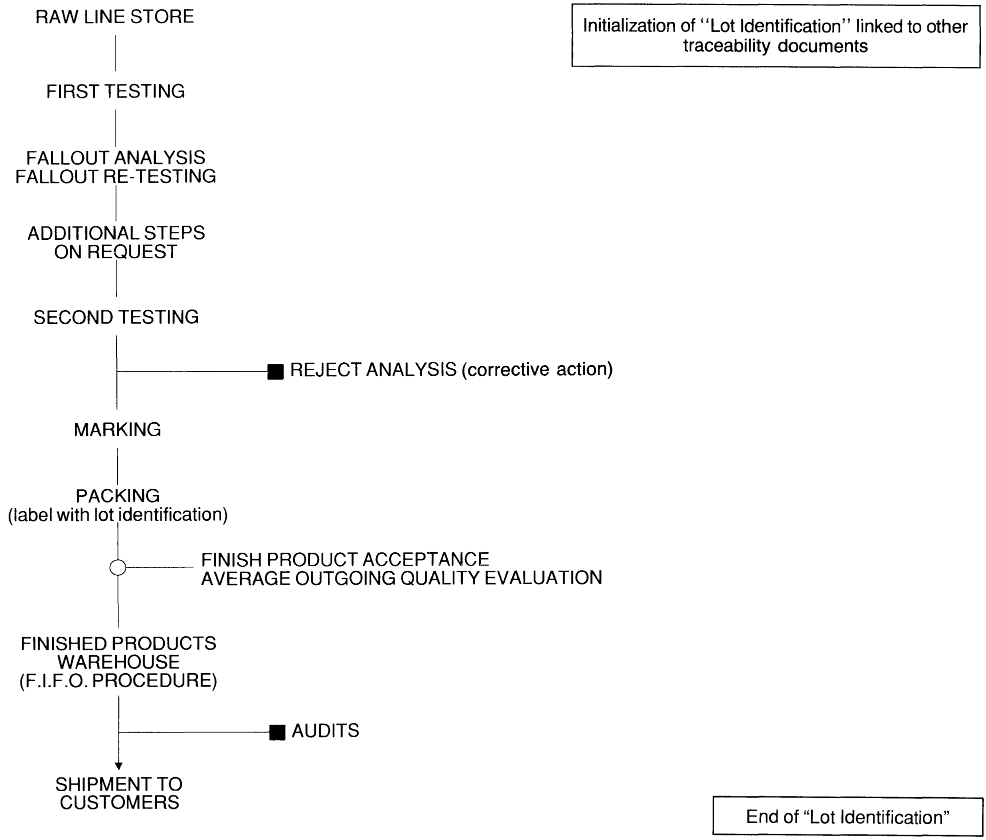
Note: SPC methods are used for Process Control Assurance and continual quality improvement towards Zero defect target.
Hihg values of process control capability (CPK) at each significant step assure reliable results at the end of the process

METAL CASE ASSEMBLY - TYPICAL FLOW CHART



Note: SPC methods are used for Process Control Assurance and continual quality improvement towards Zero defect target.
Hihg values of process control capability (CPK) at each significant step assure reliable results at the end of the process

FINISHING - TYPICAL FLOW CHART



Description

The ever growing electronics equipment market is directed towards the shrinking of equipment size, weight and height, while demanding more diversified functions. To meet these requirements Surface Mounting Techniques (SMTs) are being employed.
The miniaturized components such as capacitances, resisitors, inductors, transistors, diodes, ICs, etc. are mounted on the surface of a board rather than having their leads inserted through holes. The use of micropackage devices offers many advantages compared to conventional assembly techniques.

1) The end product can be made more compact with about three times the mounting density as conventional components.

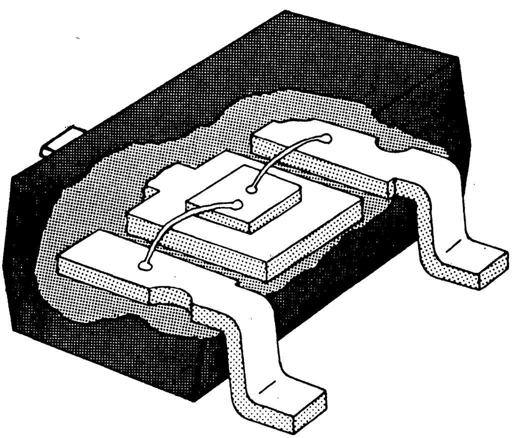
2) Easy handling and automated assembly cut production costs, e save on labour and time.

3) The small size of the packages reduces stray inductance and cpacitance and also improves RF performance.

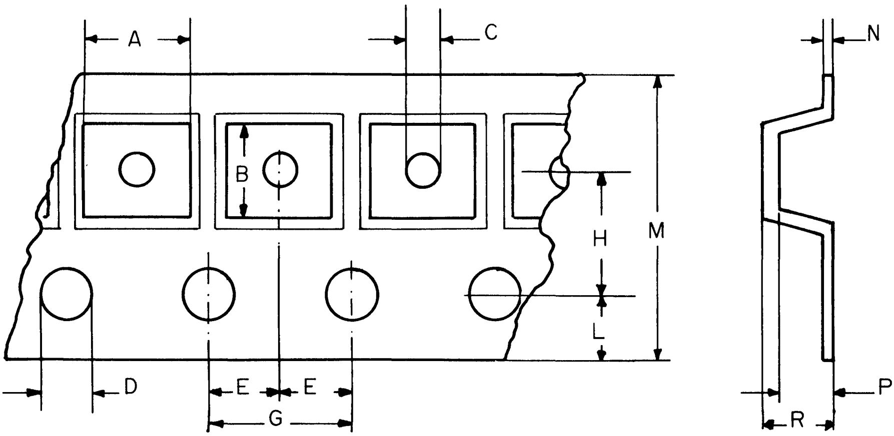
4) The moisture resistance and mechanical ruggedness of the epoxy package ensure high reliability.

Over the last few years SGS-THOMSON has introduced a large number of surface face mounted devices of which the SOT-23 is one of the most popular.

The flat SOT-23 devices are packaged and shipped in super 8 tape & reels. The tapes are made of special conductive vinyl.
These reels are designed to hold and protect thousands of surface mountable components-enough to keep robots busy assembling printed circuit boards for hours at a time!
Datasheets are available on request.



TAPE MECHANICAL DATA

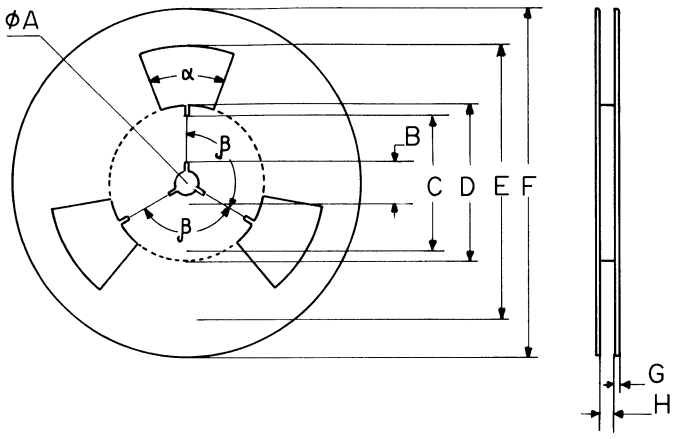


PC-0282

	DIMENSIONS			
	mm		inches	
	min	max	min	max
A	2.95	3.05	0.116	0.120
B	2.55	2.65	0.100	0.104
C	1	1.1	0.039	0.043
D	1.5	1.6	0.059	0.063
E	1.95	2.05	0.076	0.080
G	3.9	4.1	0.153	0.161
H	3.45	3.55	0.135	0.140
L	1.65	1.85	0.065	0.073
M	7.8	8.2	0.307	0.322
N	—	0.3	—	0.012
P	1.3	1.4	0.051	0.055
R	—	1.8	—	0.070

Shear force needed to peel back the tape. 0.2 to 1.3 N at 300 mm/min.

REEL MECHANICAL DATA

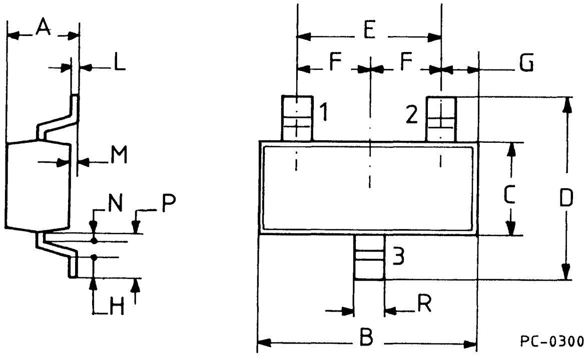


PC-0280

	DIMENSIONS			
	mm		inches	
	min	max	min	max
A	12.5	13.5	0.492	0.531
B	20	22	0.787	0.866
C	68	72	2.677	2.834
D	78	82	3.070	3.228
E	138	142	5.433	5.590
F	176	180	6.929	7.080
G	1.5	2.5	0.059	0.098
H	8.4	9.9	0.330	0.390
α	40°		40°C	
β	120°		120°	

Quantity per Reel = 3000 pieces

PACKAGE



	DIMENSIONS			
	mm		inches	
	min	max	min	max
A	0.93	1.04	0.036	0.041
B	2.8	3	0.110	0.118
C	1.2	1.4	0.047	0.055
D	2.1	2.5	0.082	0.098
E	1.9	2.05	0.074	0.080
F	0.95	1.05	0.037	0.041
G	0.45	0.60	0.017	0.023
H	0.15	—	0.006	—
L	0.065	0.115	0.003	0.004
M	0.013	0.1	0.0005	0.004
N	0.06	—	0.003	—
P	0.45	0.6	0.017	0.023
R	0.37	0.46	0.014	0.018

pin 1 = EMITTER
pin 2 = BASE
pin 3 = COLLECTOR

DATASHEETS

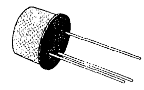
SGS-THOMSON
MICROELECTRONICS

BC107
BC108-BC109

LOW NOISE GENERAL PURPOSE AUDIO AMPLIFIERS

DESCRIPTION

The BC107, BC108 and BC109 are silicon planar epitaxial NPN transistors in TO-18 metal case.They are suitable for use in driver stages, low noise input stages and signal processing circuits of television receivers. The complementary PNP types are respectively the BC177, BC178 and BC179.



TO-18

INTERNAL SCHEMATIC DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		BC107	BC108	BC109	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	50	30	30	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	45	20	20	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	6	5	5	V
I_C	Collector Current	100			mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.3 0.75			W W
T_{stg}	Storage Temperature	– 55 to 175			°C
T_j	Junction Temperature	175			°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	200	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	500	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **BC107**				
		V_{CB} = 40 V			15	nA
		V_{CB} = 40 V T_{amb} = 150 °C			15	µA
		for **BC108-BC 109**				
		V_{CB} = 20 V			15	µA
		V_{CB} = 20 V T_{amb} = 150 °C			15	µA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 10 µA for **BC107**	50			V
		for **BC108**	30			V
		for **BC109**	30			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA for **BC107**	45			V
		for **BC108**	20			V
		for **BC109**	20			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 10 µA for **BC107**	6			V
		for **BC108**	5			V
		for **BC109**	5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10 mA I_B = 0.5 mA		70	250	mV
		I_C = 100 mA I_B = 5 mA		200	600	mV
V_{BE}*	Base-emitter Voltage	I_C = 2 mA V_{CE} = 5 V	550	650	700	mV
		I_C = 10 mA V_{CE} = 5 V		700	700	mV
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 10 mA I_B = 0.5 mA		750		mV
		I_C = 100 mA I_B = 5 mA		900		mV
h_{FE}*	DC Current Gain	I_C = 2 mA V_{CE} = 5 V				
		for **BC107**	110	230	450	
		for **BC107** Gr. A	110	180	220	
		for **BC107** Gr. B	200	290	450	
		for **BC108**	110	350	800	
		for **BC108** Gr. A	110	180	220	
		for **BC108** Gr. B	200	290	450	
		for **BC108** Gr. C	420	520	800	
		for **BC109**	200	350	800	
		for **BC109** Gr. B	200	290	450	
		for **BC109** Gr. C	420	520	800	
		I_C = 10 µA V_{CE} = 5 V				
		for **BC107**		120		
		for **BC107** Gr. A		90		
		for **BC107** Gr. B	40	150		
		for **BC108**		120		
		for **BC108** Gr. A		90		
		for **BC108** Gr. B	40	150		
		for **BC108** Gr. C	100	270		
		for **BC109**	40			
		for **BC109** Gr. B	40	150		
		for **BC109** Gr. C	100	270		

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

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
h_{fe}	Small Signal Current Gain	I_C = 2 mA V_{CE} = 5 V f = 1 kHz				
		for **BC107**		250		
		for **BC107** Gr. A		190		
		for **BC107** Gr. B		300		
		for **BC108**		370		
		for **BC108** Gr. A		190		
		for **BC108** Gr. B		300		
		for **BC108** Gr. C		500		
		for **BC109**		370		
		for **BC109** Gr. B		300		
		for **BC109** Gr. C		550		
		I_C = 10 mA V_{CE} = 10 V f = 100 MHz		2		
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz		4	6	pF
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz		12		pF
NF	Noise Figure	I_C = 0.2 mA V_{CE} = 5 V R_g = 2 kΩ f = 1 kHz B = 200 Hz				
		for **BC107**		2	10	dB
		for **BC108**		2	10	dB
		for **BC109**		1.5	4	dB
		I_C = 0.2 mA V_{CE} = 5 V R_g = 2 kΩ f = 10 Hz to 10 kHz B = 15.7 kHz				
		for **BC109**		1.5	4	dB
h_{ie}	Input Impedance	I_C = 2 mA V_{CE} = 5 V f = 1 kHz				
		for **BC107**		4		kΩ
		for **BC107** Gr. A		3		kΩ
		for **BC107** Gr. B		4.8		kΩ
		for **BC108**		5.5		kΩ
		for **BC108** Gr. A		3		kΩ
		for **BC108** Gr. B		4.8		kΩ
		for **BC108** Gr. C		7		kΩ
		for **BC109**		5.5		kΩ
		for **BC109** Gr. B		4.8		kΩ
		for **BC109** Gr. C		7		kΩ

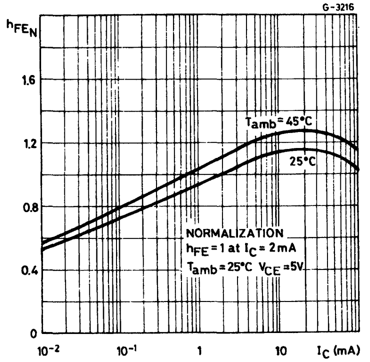
* Pulsed : pulse duration = 300 μs, duty cycle = 1 %.

ELECTRICAL CHARACTERISTICS (continued)

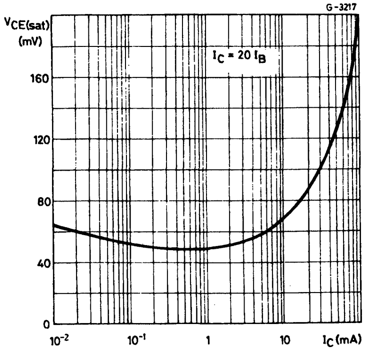
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
h_{re}	Reverse Voltage Ratio	I_C = 2 mA V_{CE} = 5 V f = 1 kHz				
		for **BC107**		2.2×10^{-4}		
		for **BC107** Gr. A		1.7×10^{-4}		
		for **BC107** Gr. B		2.7×10^{-4}		
		for **BC108**		3.1×10^{-4}		
		for **BC108** Gr. A		1.7×10^{-4}		
		for **BC108** Gr. B		2.7×10^{-4}		
		for **BC108** Gr. C		3.8×10^{-4}		
		for **BC109**		3.1×10^{-4}		
		for **BC109** Gr. B		2.7×10^{-4}		
		for **BC109** Gr. C		3.8×10^{-4}		
h_{oe}	Output Admittance	I_C = 2 mA V_{CE} = 5 V f = 1 kHz				
		for **BC107**		20		µS
		for **BC107** Gr. A		13		µS
		for **BC107** Gr. B		26		µS
		for **BC108**		30		µS
		for **BC108** Gr. A		13		µS
		for **BC108** Gr. B		26		µS
		for **BC108** Gr. C		34		µS
		for **BC109**		30		µS
		for **BC109** Gr. B		26		µS
		for **BC109** Gr. C		34		µS

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

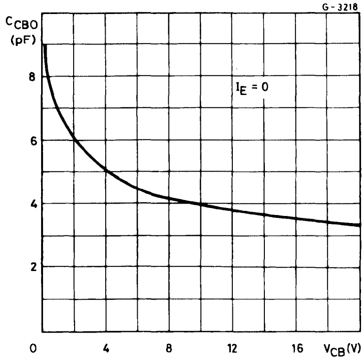
DC Normalized Current Gain.



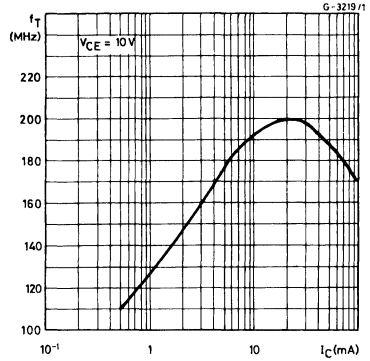
Collector--emitter Saturation Voltage.



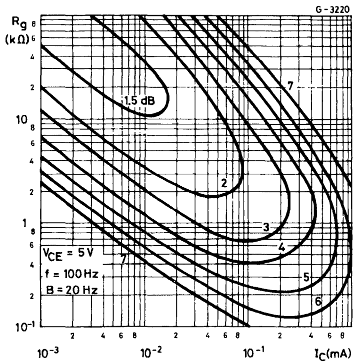
Collector-base Capacitance.



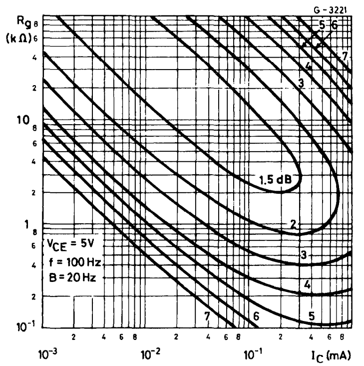
Transition Frequency.



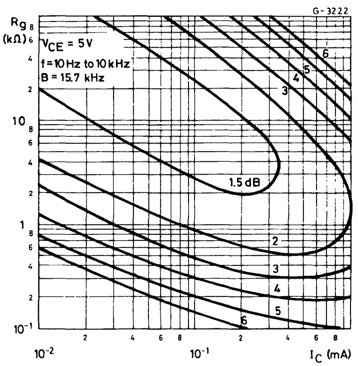
Noise Figure (for **BC 109** only).



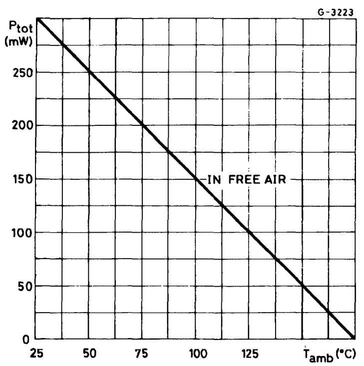
Noise Figure (for **BC 109** only).



Noise Figure (for **BC 109** only).



Power Rating Chart.

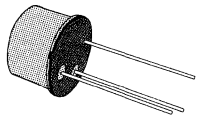


BC119

AUDIO OUTPUT AMPLIFIER

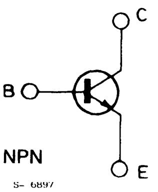
DESCRIPTION

The BC119 is a silicon planar epitaxial NPN transistor in a TO-39 metal case. It is suitable for 1 W class "A" and up to 6 W class "B" audio output stages.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	60	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	30	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5	V
P_{tot}	Total Power Dissipation at $T_{amb} \leq$ 25 °C at $T_{case} \leq$ 25 °C at $T_{case} \leq$ 100 °C	0.8 5 2.8	W W W
T_{stg}	Storage Temperature	– 55 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

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

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

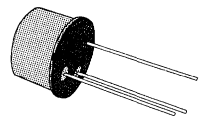
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 40 V V_{CB} = 40 V T_{amb} = 150 °C			100 20	nA μA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 μA	60			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 30 mA	30			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 100 μA	5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA I_C = 500 mA I_B = 50 mA I_C = 1 A I_B = 100 mA		0.15 0.4 0.8	0.35 1.1 1.5	V V V
V_{BE}*	Base-emitter Voltage	I_C = 500 mA V_{CE} = 10 V I_C = 150 mA V_{CE} = 1 V		1 0.85	1.8 1	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA I_C = 1 A I_B = 0.1 A		0.9 1.4	1.2 2	V V
h_{FE}*	DC Current Gain	I_C = 50 mA V_{CE} = 1 V I_C = 150 mA V_{CE} = 1 V I_C = 500 mA V_{CE} = 10 V	40 40 25	100 90 60	 120 	
f_T	Transition Frequency	I_C = 50 mA V_{CE} = 10 V	40			MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V		12	25	pF

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

AUDIO OUTPUT AMPLIFIER

DESCRIPTION

The BC139 is a silicon planar epitaxial PNP transistor in a TO-39 metal case. It is particularly designed for use in audio output and driver stages. The complementary NPN type is the BC119.



TO-39

INTERNAL SCHEMATIC DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	– 40	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 40	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 5	V
I_C	Collector Current	– 0.5	A
P_{tot}	Total Power Dissipation at $T_{amb} \le 25$ °C at $T_{case} \le 25$ °C	0.7 3	W W
T_{stg}	Storage Temperature	– 55 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

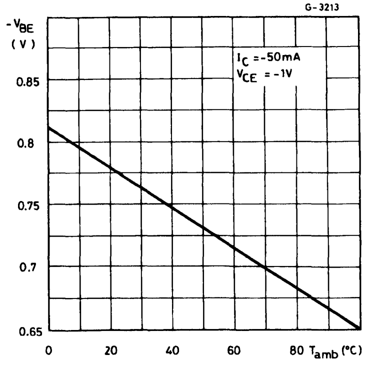
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	58	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	250	°C/W

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

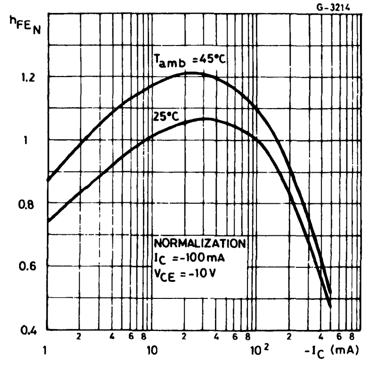
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = – 30 V V_{CB} = – 30 V T_{amb} = 75 °C			– 100 – 50	nA µA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = – 10 µA	– 40			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 10 mA	– 40			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = – 10 µA	– 5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 300 mA I_B = – 30 mA I_C = – 500 mA I_B = – 50 mA		– 0.45 – 1	– 0.8	V V
V_{BE}*	Base-emitter Voltage	I_C = – 10 mA V_{CE} = – 10 V I_C = – 100 mA V_{CE} = – 10 V I_C = – 300 mA V_{CE} = – 1 V		– 0.7 – 0.77 – 0.97		V V V
h_{FE}*	DC Current Gain	I_C = – 10 mA V_{CE} = – 10 V I_C = – 100 mA V_{CE} = – 10 V I_C = – 150 mA V_{CE} = – 1 V I_C = – 300 mA V_{CE} = – 1 V	 40 20	90 90 45 35		
f_T	Transition Frequency	I_C = – 50 mA V_{CE} = – 10 V		200		MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 10 V f = 1 MHz		6		pF

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

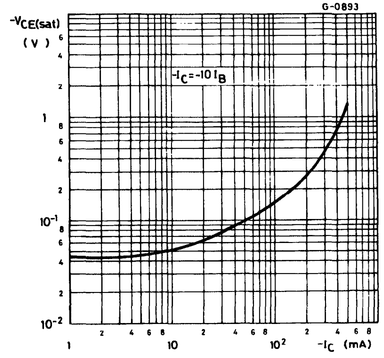
Base-emitter Voltage.



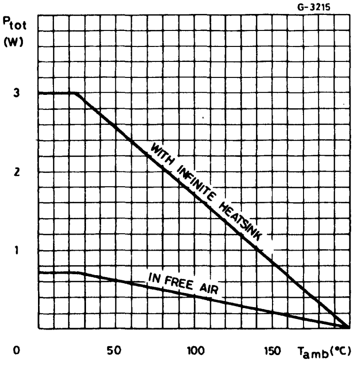
DC Normalized Current Gain.



Collector-emitter Saruration Voltage.



Power Rating Chart.



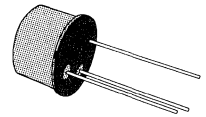
SGS-THOMSON
MICROELECTRONICS

BC140
BC141

GENERAL PURPOSE TRANSISTORS

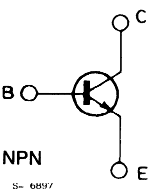
DESCRIPTION

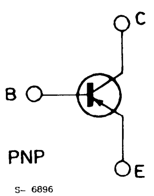
The BC140 and BC141 are silicon planar epitaxial NPN transistors in TO-39 metal case. They are particularly designed for audio amplifiers and switching applications up to 1 A. The complementary PNP types are the BC160 and BC161.



TO-39

INTERNAL SCHEMATIC DIAGRAM





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BC140	BC141	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	80	100	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	40	60	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7		V
I_C	Collector Current	1		A
I_B	Base Current	0.1		A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 45$ °C at $T_{case} \leq 45$ °C	0.65 3.7		W W
T_{stg}	Storage Temperature	– 55 to 175		°C
T_j	Junction Temperature	175		°C

THERMAL DATA

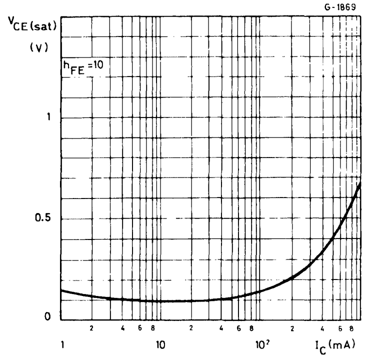
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	35	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	200	°C/W

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

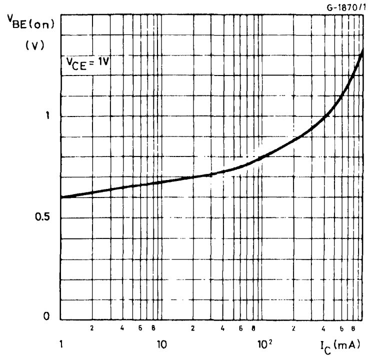
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (I_E = 0)	V_{CES} = 60 V V_{CES} = 60 V T_{amb} = 150 °C			100 100	nA µA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 µA for **BC140** for **BC141**	 80 100			 V V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 30 mA for **BC140** for **BC141**	 40 60			 V V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 100 µA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 100 mA I_B = 10 mA I_C = 500 mA I_B = 50 mA I_C = 1 A I_B = 0.1 A		0.1 0.35 0.6	 1	V V V
V_{BE}*	Base-emitter Voltage	I_C = 1 A V_{CE} = 1 V		1.25	1.8	V
h_{FE}*	DC Current Gain	I_C = 100 µA V_{CE} = 1 V for **BC140-141** for **BC140-141** Gr. 6 for **BC140-141** Gr. 10 for **BC140-141** Gr. 16 I_C = 100 mA V_{CE} = 1 V for **BC140-141** for **BC140-141** Gr. 6 for **BC140-141** Gr.10 for **BC140-141** Gr.16 I_C = 1 A V_{CE} = 1 V for **BC140-141** for **BC140-141** Gr. 6 for **BC140-141** Gr.10 for **BC140-141** Gr.16	 40 40 63 100	 75 28 40 90 140 63 100 160 26 15 20 30	 250 100 160 250	
f_T	Transition Frequency	I_C = 50 mA V_{CE} = 10 V	50			MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz		12	25	pF
t_{on}	Turn-on Time	I_C = 100 mA I_{B1} = 5 mA			250	ns
t_{off}	Turn-off Time	I_C = 100 mA I_{B1} = I_{B2} = 5 mA			850	ns

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

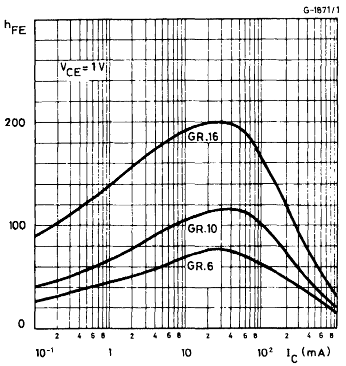
Collector-emitter Saturation Voltage.



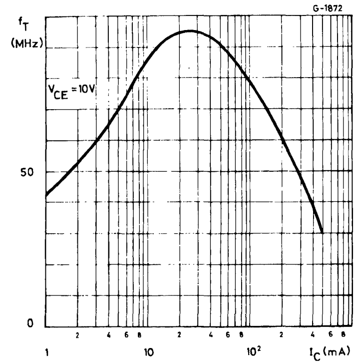
Base-emitter Voltage.



DC Curent Gain.



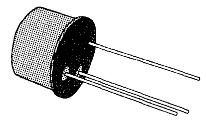
Transiition Frequency.



AUDIO AMPLIFIER

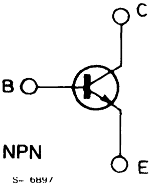
DESCRIPTION

The BC142 is a silicon planar epitaxial NPN transistor in a TO-39 metal case specially intented for use as driver in high power audio amplifier.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	80	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	60	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	1	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.75 4	W W
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 175	°C

THERMAL DATA

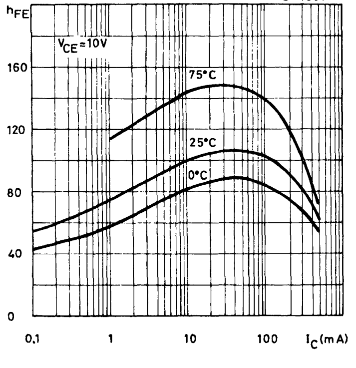
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	37	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	200	°C/W

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

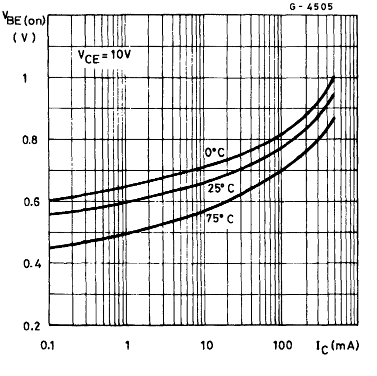
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 40 V V_{CB} = 40 V T_{amb} = 150 °C			50 50	nA μA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 μA	80			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 30 mA	60			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 100 μA	7			V
$V_{CE\ (sat)}$*	Collector-emitter Saturation Voltage	I_C = 200 mA I_C = 20 mA I_B = 500 mA I_B = 50 mA		0.15 0.3	0.4	V V
$V_{BE\ (sat)}$*	Base-emitter Saturation Voltage	I_C = 200 mA I_B = 20 mA			1.5	V
V_{BE}*	Base-emitter Voltage	I_C = 200 mA V_{CE} = 2 V		0.85		V
h_{FE}*	DC Current Gain	I_C = 10 mA V_{CE} = 10 V I_C = 100 mA V_{CE} = 10 V I_C = 200 mA V_{CE} = 2 V I_C = 500 mA V_{CE} = 2 V	 20 	100 100 60 30		
f_T	Transition Frequency	I_C = 50 mA V_{CE} = 10 V f = 20 MHz		80		MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V		12		pF

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

DC Current Gain vs. Collector Current.



Base-emitter on Voltage vs. Collector Current.

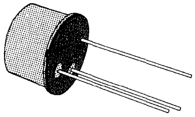


BC143

AUDIO AMPLIFIER

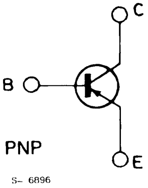
DESCRIPTION

The BC143 is a silicon planar epitaxial PNP transistor specially designed for use in the driver of high power audio amplifiers.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	– 60	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 60	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 5	V
I_C	Collector Current	– 1	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.75 4	W W
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 175	°C

THERMAL DATA

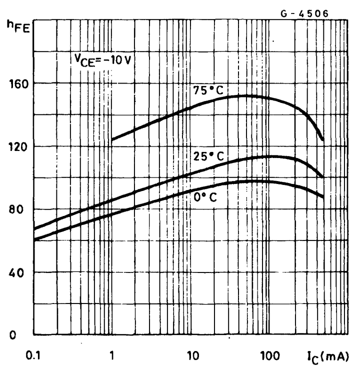
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	37	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	200	°C/W

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

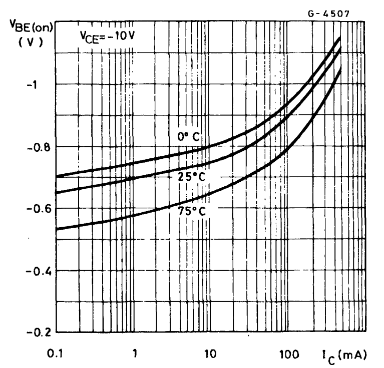
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = – 30 V V_{CB} = – 30 V (T_{amb} = 150 °C)			– 50 – 50	nA µA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 µA	– 60			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	– 60			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 10 µA	– 5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 500 mA I_B = 50 mA I_C = 1A I_B = 100 mA		– 0.25 – 0.7	– 0.5 – 1	V V
V_{BE}*	Base-emitter Voltage	I_C = – 500 mA V_{CE} = – 10 V		– 1.1		V
h_{FE}*	DC Current Gain	I_C = 10 mA V_{CE} = – 10 V I_C = 100 mA V_{CE} = – 10 V I_C = – 300 mA V_{CE} = – 1 V I_C = 500 mA V_{CE} = – 1 V	 20 	110 110 40 25		
h_{fe}	High Frequency Current Gain	I_C = 50 mA V_{CE} = – 10 V f = 100 MHz		1.5		
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 10 V f = 1 MHz		13		pF

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

DC Current Gain vs. Collector Current.



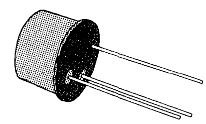
Base-emitter on Voltage vs. Collector Current.



GENERAL PURPOSE TRANSISTORS

DESCRIPTION

The BC160, and BC161 are silicon planar epitaxial PNP transistors in TO-39 metal case.They are particurlarly designed for audio amplifiers and switching applications up to 1A. The complementary NPN types are the BC140 and BC141.



TO-39

INTERNAL SCHEMATIC DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BC160	BC161	
V_{CBO}	Collector-base Voltage (I_E = 0)	– 40	– 60	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 40	– 60	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 5		V
I_C	Collector Current	– 1		A
I_B	Base Current	– 0.1		A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 45$ °C at $T_{case} \leq 45$ °C	0.65 3.7		W W
T_{stg}	Storage Temperature	– 55 to 175		°C
T_j	Junction Temperature	175		°C

THERMAL DATA

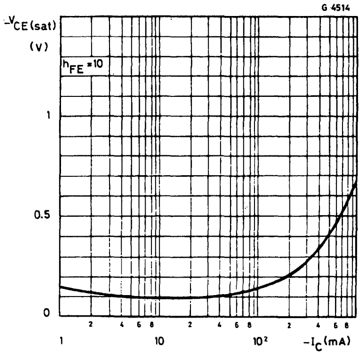
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	35	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	200	°C/W

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

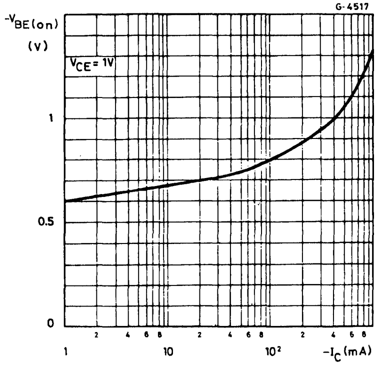
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (I_E = 0)	V_{CES} = 40 V for **BC160** V_{CES} = 60 V for **BC161** V_{CES} = 40 V for **BC160** T_{amb} = 150 °C V_{CES} = 60 V for **BC161** T_{amb} = 150 °C			– 100 – 100 – 100 – 100	nA nA µA µA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = – 100 µA for **BC160** for **BC161**	 – 40 – 60			 V V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 10 mA for **BC160** for **BC161**	 – 40 – 60			 V V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = – 100 µA	– 5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 0.1 A I_B = – 10 mA I_C = – 0.5 A I_B = – 50 mA I_C = – 1 A I_B = – 0.1 A		– 0.1 – 0.35 – 0.6	 – 1	V V V
V_{BE}*	Base-emitter Voltage	I_C = – 1 A V_{CE} = – 1 V		– 1	– 1.7	V
h_{FE}*	DC Current Gain	I_C = – 100 µA V_{CE} = – 1 V for **BC160-161** for **BC160-161** Gr. 6 for **BC160-161** Gr. 10 for **BC160-161** Gr. 16 I_C = – 100 mA V_{CE} = – 1 V for **BC160-161** for **BC160-161** Gr. 6 for **BC160-161** Gr. 10 for **BC160-161** Gr. 16	 40 40 63 100	 110 46 80 120 140 63 100 160	 250 100 160 250	
h_{FE}*	DC Current Gain	I_C = – 1 A V_{CE} = – 1 V for **BC160-161** for **BC160-161** Gr. 6 for **BC160-161** Gr. 10 for **BC160-161** Gr. 16		 26 15 20 30		
f_T	Transition Frequency	I_C = – 50 mA V_{CE} = – 10 V	50			MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 20 V f = 1 MHz		 15	 30	pF
C_{EBO}	Emitter-base Capacitance	V_{EB} = – 0.5 V f = 1 MHz			180	pF
t_{on}	Turn-on Time	I_C = – 100 mA I_{B1} = – 5 mA			 500	ns
t_{off}	Turn-off Time	I_C = – 100 mA I_{B1} = I_{B2} = – 5mA			 650	ns

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

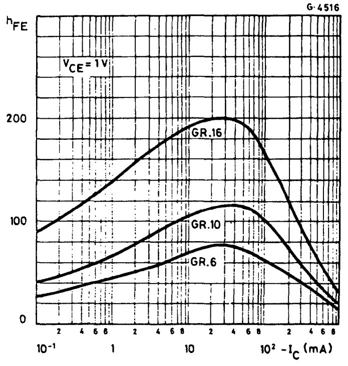
Collector-emitter Saturation Voltage.



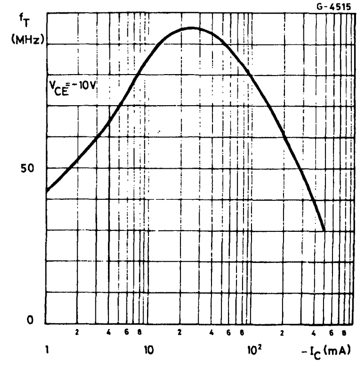
Base-emitter Voltage.



DC Current Gain.



Transition Frequency.



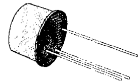
SGS-THOMSON
MICROELECTRONICS

BC177
BC178-BC179

LOW NOISE GENERAL PURPOSE AUDIO AMPLIFIERS

DESCRIPTION

The BC177, BC178 and BC179 are silicon planar epitaxial PNP transistors in TO-18 metal case.They are suitable for use in driver audio stages, low noise input audio stages and as low power, high gain general purpose transistors. The complementary NPN types are respectively the BC107, BC108 and BC109.



TO-18

INTERNAL SCHEMATIC DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		BC177	BC178	BC179	
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	– 50	– 30	– 25	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 45	– 25	– 20	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 5			V
I_C	Collector Current	– 100			mA
I_{CM}	Collector Peak Current	– 200			mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C	300			mW
T_{stg}	Storage Temperature	– 65 to 175			°C
T_j	Junction Temperature	175			°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	200	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	500	°C/W

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

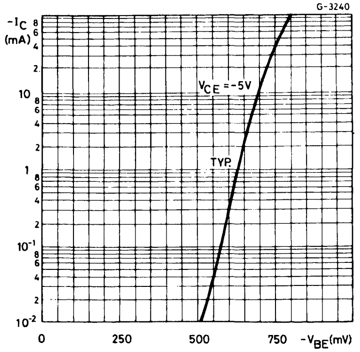
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = – 20 V V_{CE} = – 20 V T_{amb} = 150 °C		– 1	– 100 – 10	nA µA
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 2 mA for **BC177** for **BC178** for **BC179**	 – 45 – 25 – 20			 V V V
$V_{(BR)CES}$	Collector-emitter Breakdown Voltage (V_{BE} = 0)	I_C = – 10 µA for **BC177** for **BC178** for **BC179**	 – 50 – 30 – 25			 V V V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = – 10 µA	– 5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 10 mA I_B = – 0.5 mA I_C = – 100 mA I_B = – 5 mA		– 75 – 200	– 250	mV mV
V_{BE}*	Base-emitter Voltage	I_C = – 2 mA V_{CE} = – 5 V	– 550	– 640	– 750	mV
$V_{BE(sat)}$	Base-emitter Saturation Voltage	I_C = – 10 mA I_B = – 0.5 mA I_C = – 100 mA I_B = – 5 mA		– 720 – 860		mV mV
h_{fe}	Small Signal Current Gain	I_C = – 2 mA V_{CE} = – 5 V f = 1 kHz for **BC177** Gr. A for **BC177** Gr. B for **BC178** Gr. A for **BC178** Gr. B for **BC179** Gr. B	 125 240 125 240 240		 260 500 260 500 500	

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

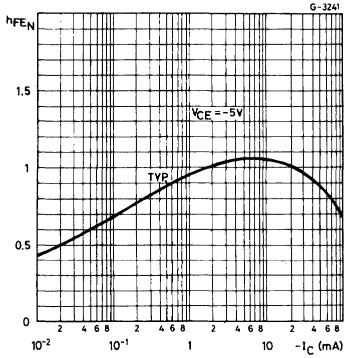
ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
f_T	Transition Frequency	I_C = – 10 mA V_{CE} = – 5 V f = 100 MHz		200		MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 10 V		5.0		pF
NF	Noise Figure	I_C = – 0.2 mA V_{CE} = – 5 V R_g = 2 kΩ f = 1 kHz B = 200 Hz for **BC177** for **BC178** for **BC179**		 2 2 1.2	 10 10 4	 dB dB dB
h_{ie}	Input Impedance	I_C = – 2 mA V_{CE} = – 5 V f = 1 kHz for **BC177** Gr. A for **BC177** Gr. B for **BC178** Gr. A for **BC178** Gr. B for **BC179** Gr. B		 2.7 5.2 2.7 5.2 5.2		 kΩ kΩ kΩ kΩ kΩ
h_{re}	Reverse Voltage Ratio	I_C = – 2 mA V_{CE} = – 5 V f = 1 kHz for **BC177** Gr. A for **BC177** Gr. B for **BC178** Gr. A for **BC178** Gr. B for **BC179** Gr. B		 $2.7x10^{-4}$ $4.5x10^{-4}$ $2.7x10^{-4}$ $4.5x10^{-4}$ $4.5x10^{-4}$		
h_{oe}	Output Admittance	I_C = – 2 mA V_{CE} = – 5 V f = 1 kHz for **BC177** Gr. A for **BC177** Gr. B for **BC178** Gr. A for **BC178** Gr. B for **BC179** Gr. B		 25 35 25 35 35		 µS µS µS µS µS

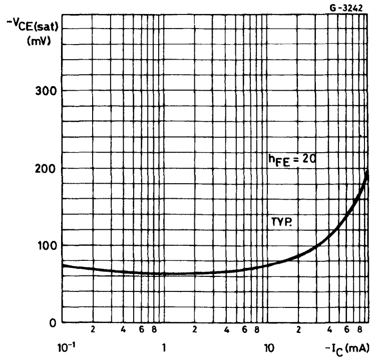
DC Transconductance.



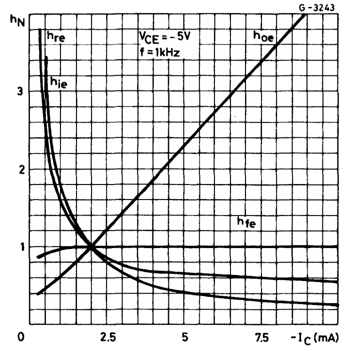
DC Normalized Current Gain.



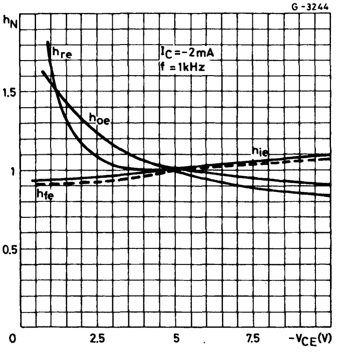
Collector-emitter Saturation Voltage.



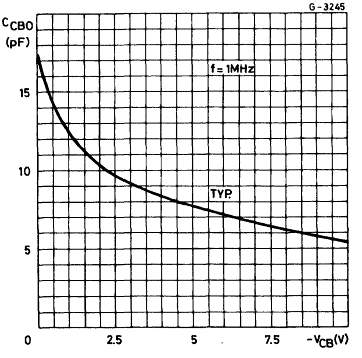
Normalized h Parameters.



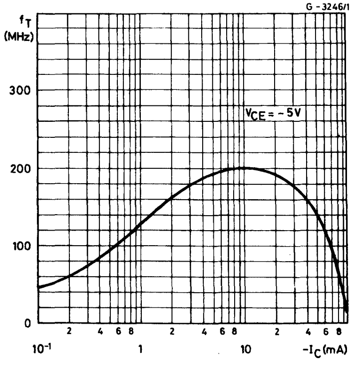
Normalized h Parameters.



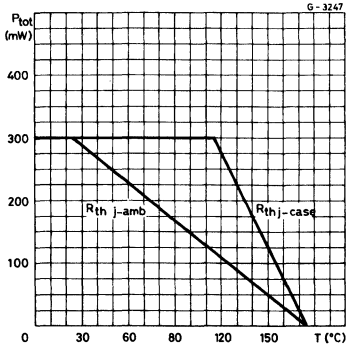
Collector-base Capacitance.



Transition Frequency.



Power Rating Chart.

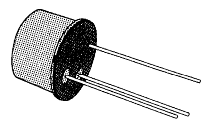


AUDIO AMPLIFIER

DESCRIPTION

The BC286 is a silicon planar epitaxial NPN transistor in Jedec TO-39 metal case. It is mainly intended for use as audio amplifier.

The complementary PNP type is the BC287.



TO-39

INTERNAL SCHEMATIC DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	70	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	60	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5	V
I_C	Collector Current	1	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.75 4	W W
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 175	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	37	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	200	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 30 V			20	nA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 μA	70			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 30 mA	60			V
$V_{(BR)EBO}$	Collector-emitter Breakdown Voltage (I_C = 0)	I_E = 100 μA	5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 500 mA I_B = 50 mA I_C = 1 A I_B = 0.1 A		0.4 0.7	 1	V V
V_{BE}*	Base-emitter Voltage	I_C = 500 mA V_{CE} = 2 V		1		V
h_{FE}*	DC Current Gain	I_C = 100 mA V_{CE} = 2 V I_C = 500 mA V_{CE} = 2 V	 20	90 60		
f_T	Transition Frequency	I_C = 50 mA V_{CE} = 5 V f = 100 MHz		 100		 MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz		12		pF

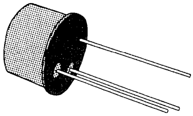
* Pulsed : pulse duration = 300 ms, duty cycle = 1 %.

AUDIO AMPLIFIER

DESCRIPTION

The BC287 is a silicon planar epitaxial PNP transistor in Jedec TO-39 metal case. It is particularly intended for use as audio amplifier.

The complementary NPN type is the BC286.



TO-39

INTERNAL SCHEMATIC DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	– 60	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	– 60	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	– 5	V
I_C	Collector Current	– 1	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.75 4	W W
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 175	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	37	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	200	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = – 30 V		0.1	50	nA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = – 10 μA	– 60			V
$V_{(BR)CEO}$ *	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 10 mA	– 60			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = – 10 μA	– 5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 500 mA I_B = – 50 mA I_C = – 1 mA I_B = – 0.1 mA		– 0.25 – 0.7	 – 1	V V
V_{BE} *	Base-emitter Voltage	I_C = – 500 mA V_{CE} = – 2 V		– 0.93		V
h_{FE}*	DC Current Gain	I_C = – 100 mA V_{CE} = – 2 V I_C = – 500 mA V_{CE} = – 2 V	 20	90 60		
f_T	Transition Frequency	I_C = – 50 mA V_{CE} = – 5 V f = 100 MHz		150		MHz
C_{CBO}	Collector-base Capacitance (I_E = 0)	V_{CB} = – 10 V f = 1 MHz		13		pF

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

SGS-THOMSON MICROELECTRONICS

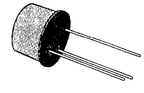
BC297
BC298

AUDIO DRIVERS

DESCRIPTION

The BC297 and BC298 are silicon planar epitaxial PNP transistors in TO-18 metal case. They are particularly intended for use in high current high gain applications, in driver stages of hi-fi equipments or in output stages of low power class B amplifiers.

The complementary NPN types are the BC377 and BC378, respectively.



TO-18

INTERNAL SCHEMATIC DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BC297	BC298	
V_{CES}	Collector-emitter Voltage (V_{EB} = 0)	– 50	– 30	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 45	– 25	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 5		V
I_C	Collector Current	– 1		A
I_B	Base Current	– 0.2		A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 75$ °C	375 1		mW W
T_{stg}	Storage Temperature	– 65 to 175		°C
T_j	Junction Temperature	175		°C

THERMAL DATA

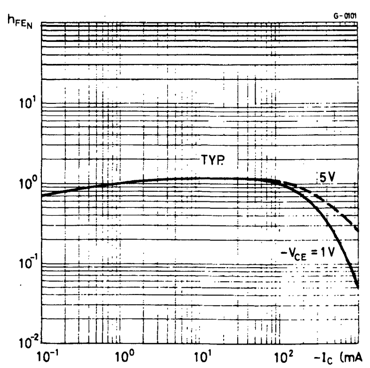
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	100	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	400	°C/W

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

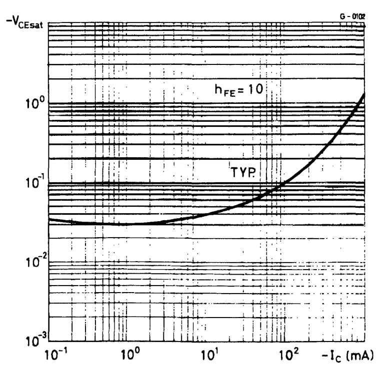
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Curent (V_{BE} = 0)	For **BC297** V_{CE} = – 50 V For **BC298** V_{CE} = – 30 V			– 100 – 100	nA nA
$V_{(BR)\ CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 10 mA For **BC297** For **BC298**	– 45 – 25			V V
$V_{(BR)\ EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = – 10 μA	– 5			V
$V_{CE\ (sat)}$*	Collector-emitter Saturation Voltage	I_C = – 500 mA I_B = – 50 mA			– 0.7	V
V_{BE} *	Base-emitter Voltage	I_C = – 100 mA V_{CE} = – 1 V		– 770		mV
$V_{BE\ (sat)}$ *	Base-emitter Saturation Voltage	I_C = – 500 mA I_B = – 50 mA			– 1.2	V
h_{FE} *	DC Current Gain Gr.7	I_C = – 100 mA V_{CE} = – 1 V I_C = – 100 mA V_{CE} = – 1 V I_C = – 300 mA V_{CE} = – 1 V	75 100 30		260 260	
f_T	Transition Frequency	I_C = – 50 mA V_{CE} = – 10 V		250		MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 10 V		8		pF
C_{EBO}	Emitter-base Capaciatnce	I_C = 0 V_{EB} = – 0.5 V		30		pF

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

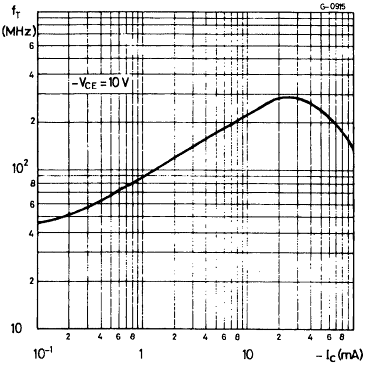
DC Normalized Current Gain.



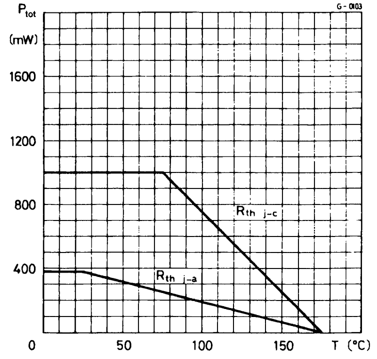
Collector-emitter Saturation Voltage.



Transition Frequency.



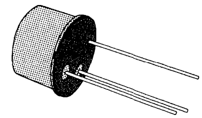
Power Rating Chart.



MEDIUM POWER AUDIO DRIVERS

DESCRIPTION

The BC300, BC301 and BC302 are silicon planar epitaxial NPN transistors in TO-39 metal case.They are intended for audio driver stages in commercial and industrial equipments. In addition they are useful as high speed saturated switches and general purpose amplifiers. The PNP types complementary to BC301 and BC302 are respectively the BC303 and BC304.



TO-39

INTERNAL SCHEMATIC DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		BC300	BC301	BC302	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	120	90	60	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	80	60	45	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7			V
I_C	Collector Current	0.5			A
I_{CM}	Collector Peak Current	1			A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.85 6			W W
T_{stg}	Storage Temperature	– 65 to 175			°C
T_j	Junction Temperature	175			°C

THERMAL DATA

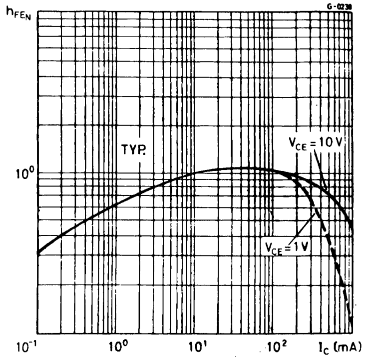
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	25	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

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

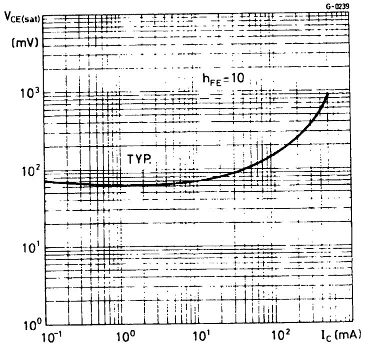
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 60 V			5	20	nA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V				10	nA
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 30 mA	for **BC300** for **BC301** for **BC302**	80 60 45			V V V
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 µA	for **BC300** for **BC301** for **BC302**	120 90 60			V V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 150 mA	I_B = 15 mA		0.2	0.5	V
V_{BE}*	Base-emitter Voltage	I_C = 150 mA	V_{CE} = 10 V		0.78		V
h_{FE}*	DC Current Gain Gr. 4 Gr. 5 Gr. 6	I_C = 150 mA I_C = 150 mA I_C = 150 mA I_C = 0.1 mA I_C = 500 mA	V_{CE} = 10 V V_{CE} = 10 V V_{CE} = 10 V V_{CE} = 10 V V_{CE} = 10 V	40 70 120 20 20		80 140 240	
f_T	Transition Frequency	I_C = 10 mA	V_{CE} = 10 V		100		MHz
C_{CBO}	Collector-base Capacitance	I_E = 0	V_{CB} = 10 V		12		pF
h_{ie}	Input Impedance	I_C = 5 mA f = 1 kHz	V_{CE} = 10 V		1.1		kΩ
h_{re}	Reverse Voltage Ratio	I_C = 5 mA f = 1 kHz	V_{CE} = 10 V		1.7×10^{-4}		
h_{fe}	Small Signal Current Gain	I_C = 5 mA f = 1 kHz	V_{CE} = 10 V		140		
h_{oe}	Output Admittance	I_C = 5 mA f = 1 kHz	V_{CE} = 10 V		14		µS

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

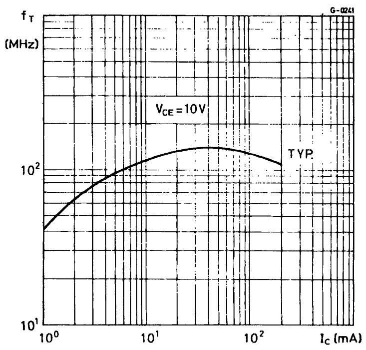
DC Normalized Current Gain.



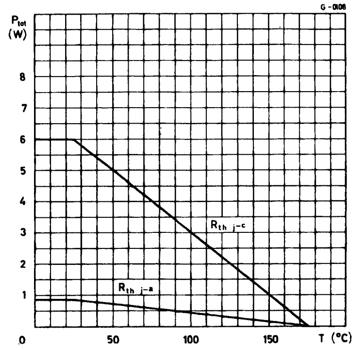
Collector-emitter Saturation Voltage.



Transition Frequency.



Power Rating Chart.

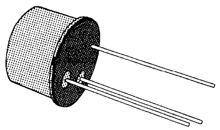


BC303
BC304

MEDIUM POWER AUDIO DRIVERS

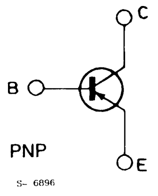
DESCRIPTION

The BC303 and BC304 are silicon planar epitaxial PNP transistors in TO-39 metal case. They are intended particularly as audio driver stages in commercial and professionnel equipments. In addition they are useful as high speed saturated switches and general purpose amplifiers. The complementary NPN types are respectively the BC301 and BC302.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BC303	BC304	
V_{CBO}	Collector-base Voltage (I_E = 0)	– 85	– 60	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 60	– 45	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 6		V
I_C	Collector Current	– 0.5		A
I_{CM}	Collector Peak Current	– 1		A
I_{BM}	Base Peak Current	– 0.5		A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.85 6		W W
T_{stg}	Storage Temperature	– 65 to 175		°C
T_j	Junction Temperature	175		°C

THERMAL DATA

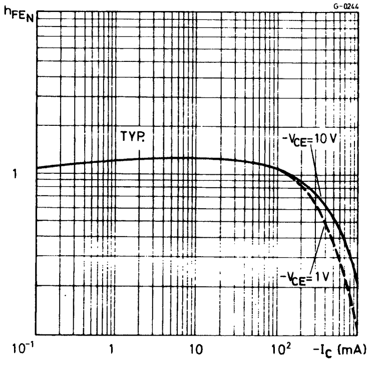
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	25	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

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

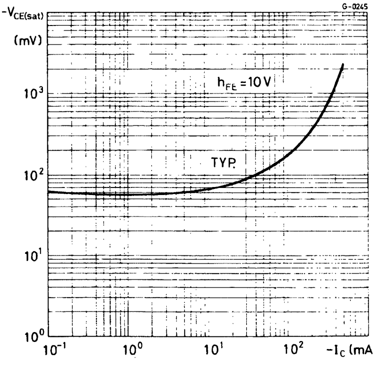
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = – 60 V		– 5	– 20	nA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = – 5 V			– 20	nA
$V_{(BR)\ CEO}$ *	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 10 mA For **BC303** For **BC304**	 – 60 – 45			 V V
$V_{CE\ (sat)}$ *	Collector-emitter Saturation Voltage	I_C = – 150 mA I_B = – 15 mA		–0.25	– 0.65	V
V_{BE} *	Base-emitter Voltage	I_C = – 150 mA V_{CE} = – 10 V		– 0.78		V
h_{FE} *	DC Current Gain Gr.4 Gr.5 Gr.6	I_C = – 150 mA V_{CE} = – 10 V I_C = – 150 mA V_{CE} = – 10 V I_C = – 150 mA V_{CE} = – 10 V I_C = – 0.1 mA V_{CE} = – 10 V I_C = – 500 mA V_{CE} = – 10 V	40 70 120 20 20		80 140 240	
f_T	Transition frequency	I_C = – 50 mA V_{CE} = – 10 V f = 100 MHz		100		MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 10 V		15		pF
h_{ie}	Input Impedance	I_C = – 5 mA V_{CE} = – 10 V f = 1 kHz		0.9		kΩ
h_{re}	Reverse Voltage Ratio	I_C = – 5 mA V_{CE} = – 10 V f = 1 kHz		1.7×10^{-4}		
h_{fe}	Small Signal Current Gain	I_C = – 5 mA V_{CE} = – 10 V f = 1 kHz		140		
h_{oe}	Output Admittance	I_C = – 5 mA V_{CE} = – 10 V f = 1 kHz		45		µs

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

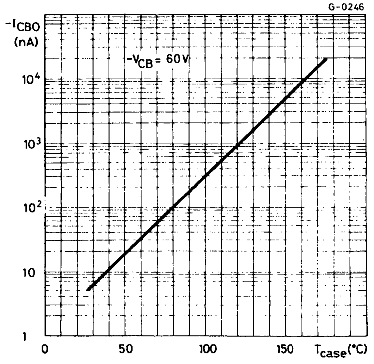
DC Normalized Current Gain.



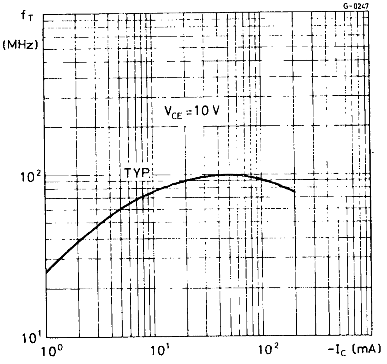
Collector-emitter saturation voltage.



Collector Cutoff Current.



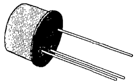
Transition Frequency.



AUDIO DRIVERS

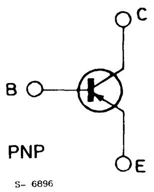
DESCRIPTION

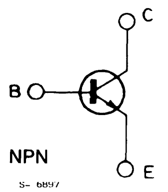
The BC377 and BC378 are silicon planar epitaxial NPN transistors in TO-18 metal case. They are particularly intended for use in high current, high gain applications, in driver stages of hi-fi equipments or in output stages of low power class B amplifiers. The complementary PNP types are the BC297 and BC298 respectively.



TO-18

INTERNAL SCHEMATIC DIAGRAM





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value BC377	Value BC378	Unit
V_{CES}	Collector-emitter Voltage (V_{EB} = 0)	50	30	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	40	25	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	6		V
I_C	Collector Current	1		A
I_B	Base Current	0.2		A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 75$ °C	375 1		W W
T_{stg}	Storage Temperature	– 65 to 175		°C
T_j	Junction Temperature	175		°C

THERMAL DATA

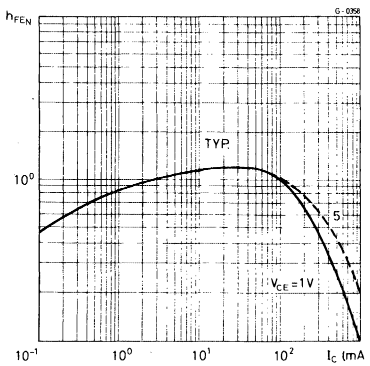
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	100	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	400	°C/W

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

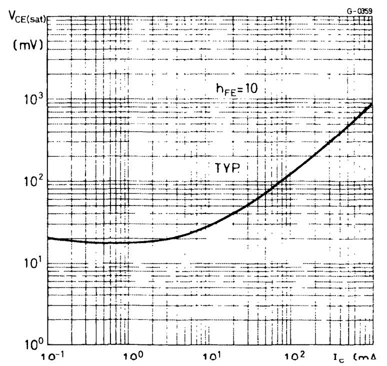
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Curent (V_{BE} = 0)	For **BC377** V_{CE} = 50 V For **BC378** V_{CE} = 30 V			15 15	nA nA
$V_{(BR)\ EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 10 μA	6			V
$V_{(BR)\ CEO}$ *	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 2 mA For **BC377** For **BC378**	40 25			V V
$V_{CE\ (sat)}$ *	Collector-emitter Saturation Voltage	I_C = 500 mA I_B = 50 mA			0.7	V
V_{BE} *	Base-emitter Voltage	I_C = 100 mA V_{CE} = 1 V		740		mV
$V_{BE\ (sat)}$ *	Base-emitter Saturation Voltage	I_C = 500 mA I_B = 50 mA			1.2	V
h_{FE} *	DC Current Gain Gr.7	I_C = 100 mA V_{CE} = 1 V I_C = 100 mA V_{CE} = 1 V I_C = 300 mA V_{CE} = 1 V	75 125 35		260 260	
f_T	Transition Frequency	I_C = 50 mA V_{CE} = 10 V		100		MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V		10		pF
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 0.5 V		30		pF

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

DC Normalized Current Gain.



Collector-emitter Saturation Voltage.



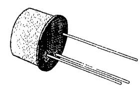
SGS-THOMSON MICROELECTRONICS

HIGH VOLTAGE AMPLIFIER

DESCRIPTION

The BC393 is a silicon planar epitaxial PNP transistor in Jedec TO-18 metal case, designed for general purpose high-voltage and video amplifier applications.

The complementary NPN type is the BC394.



TO-18

INTERNAL SCHEMATIC DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	– 180	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 180	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 6	V
I_C	Collector Current	– 100	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.4 1.4	W W
T_{stg}	Storage Temperature	– 55 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

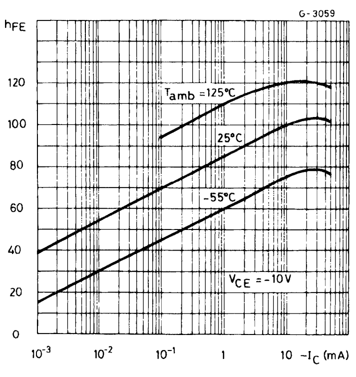
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	125	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	440	°C/W

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

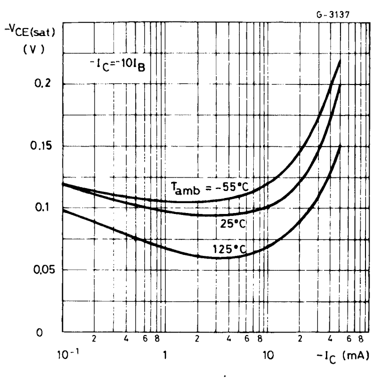
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = – 100 V V_{CB} = – 100 V T_{amb} = 150 °C			50 50	nA μA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = – 10 μA	– 180			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 2 mA	– 180			V
$V_{(BR)EBO}$	Emiter-base Breakdown Voltage (I_C = 0)	I_E = – 10 μA	– 6			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 10 mA I_B = – 1 mA I_C = – 50 mA I_B = – 5 mA		– 100 – 230	– 300	mV mV
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 10 mA I_B = – 1 mA I_C = – 50 mA I_B = – 5 mA		– 750 – 850	– 900	mV mV
h_{FE} *	DC Curent Gain	I_C = – 1 mA V_{CE} = – 10 V I_C = – 10 mA V_{CE} = – 10 V	 50	85 100		
f_T	Transition frequency	I_C = – 10 mA V_{CE} = – 10 V	50	95		MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 10 V f = 1 MHz		4	7	pF

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

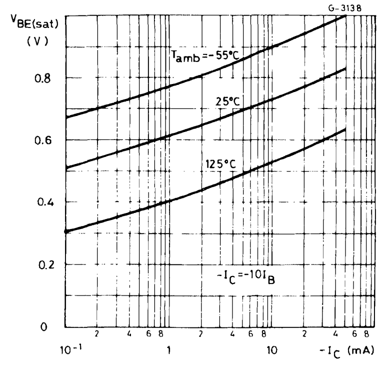
DC Current Gain.



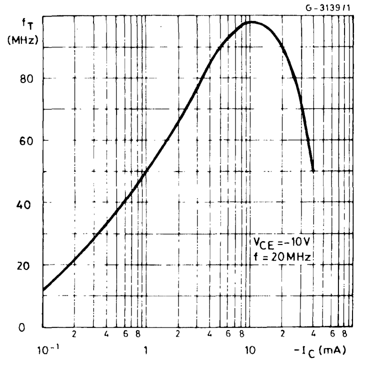
Collector-emitter Saturation Voltage.



Base-emitter Saturation Voltage.



Transition Frequency.

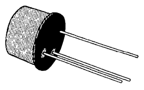


HIGH VOLTAGE AMPLIFIER

DESCRIPTION

The BC394 is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case, designed for general purpose high-voltage and video amplifier applications.

The complementary PNP type is the BC393.



TO-18

INTERNAL SCHEMATIC DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	180	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	180	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	6	V
I_C	Collector Current	100	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.4 1.4	W W
T_{stg}	Storage Temperature	– 55 to 200	°C
T_j	Junction Temperature	200	°C

THERMAL DATA

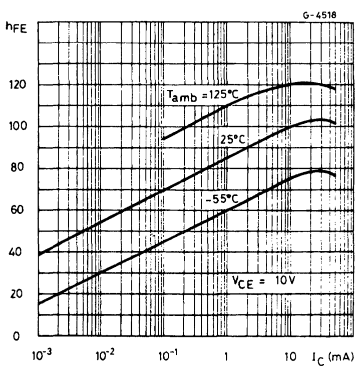
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	125	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	440	°C/W

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

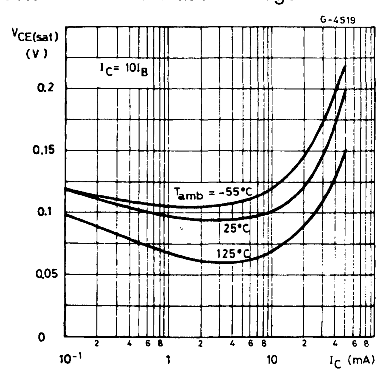
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 100 V V_{CB} = 100 V T_{amb} = 150 °C			50 50	nA µA
$V_{(BR)\ CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 µA	180			V
$V_{(BR)\ CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	180			V
$V_{(BR)\ EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 100 µA	6			V
$V_{CE\ (sat)}$ *	Collector-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA I_C = 50 mA I_B = 5 mA		200 400	300	mV mV
$V_{BE\ (sat)}$ *	Base-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA I_C = 50 mA I_B = 5 mA		750 850	900	mV mV
h_{FE} *	DC Curent Gain	I_C = 1 mA V_{CE} = 10 V I_C = 10 mA V_{CE} = 10 V	 30	85 100		
f_T	Transition frequency	I_C = 10 mA V_{CE} = 10 V	50	95		MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz		5		pF

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

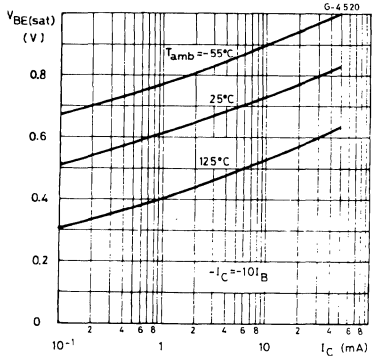
DC Current.



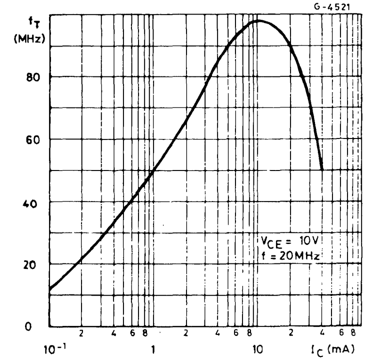
Collector-emitter Saturation Voltage.



Base-emitter Saturation Voltage.



Transition Frequency.



SGS-THOMSON MICROELECTRONICS

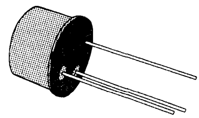
BC440 BC441

MEDIUM POWER AMPLIFIER

DESCRIPTION

The BC440 and BC441 are silicon planar epitaxial NPN transistors in TO-39 metal case. They are intended for general purpose applications, especially for driver stages.

The complementary PNP types are respectively the BC460 and BC461.



TO-39

INTERNAL SCHEMATIC DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BC440	BC441	
V_{CBO}	Collector-base Voltage (I_E = 0)	50	70	V
$V_{CEO(sus)}$	Collector-emitter Voltage (I_B = 0)	40	60	V
V_{CER}	Collector-emitter Voltage ($R_{BE} \leq 100\ \Omega$)	50	70	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5		V
I_{CM}	Collector Peak Current	2		A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	1 10		W W
T_{stg}	Storage Temperature	– 65 to 200		°C
T_j	Junction Temperature	200		°C

THERMAL DATA

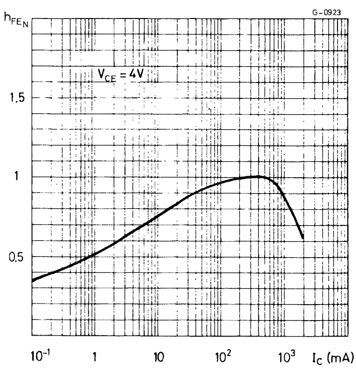
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	17.5	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

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

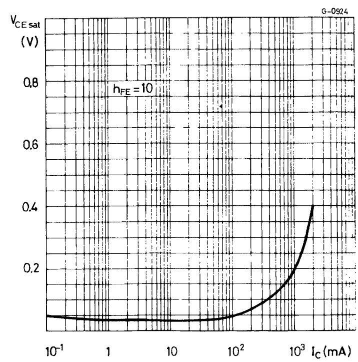
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 40 V			100	nA
I_{CER}	Collector Cutoff Current (R_{BE} = 100 Ω)	For **BC440** V_{CE} = 50 V For **BC441** V_{CE} = 70 V			10 10	µA µA
$V_{(BR)\ EBO}$	Emitter Base Breakdown Voltage (I_C = 0)	I_E = 100 µA	5			V
$V_{(BR)\ CEO}$ *	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA For **BC440** For **BC441**	40 60			V V
$V_{CE\ (sat)}$*	Collector-emitter Saturation Voltage	I_C = 1 A I_B = 100 mA			1	V
$V_{BE\ (sat)}$	Base-emitter Saturation Voltage	I_C = 1 A I_B = 100 mA			1.5	V
h_{FE} *	DC Current Gain Gr. 4	I_C = 500 mA V_{CE} = 4 V	40		70	
	Gr. 5	I_C = 500 mA V_{CE} = 4 V	60		130	
	Gr. 6	I_C = 500 mA V_{CE} = 4 V	115		250	
		I_C = 1 A V_{CE} = 2 V (for **BC440** only)	20			
f_T	Transition frequency	I_C = 50 mA V_{CE} = 4 V	50			MHz

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

DC Normalized Current Gain.



Collector-emitter Saturation Voltage.



SGS-THOMSON MICROELECTRONICS

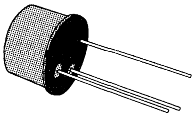
BC460
BC461

MEDIUM POWER AMPLIFIER

DESCRIPTION

The BC460 and BC461 are silicon planar epitaxial PNP transistors in TO-39 metal case. They are intended for general purpose applications, especially for driver stages.

The complementary NPN types are respectively the BC440 and BC441.



TO-39

INTERNAL SCHEMATIC DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BC460	BC461	
V_{CBO}	Collector-base Voltage (I_E = 0)	– 50	– 70	V
V_{CEO}(sus)	Collector-emitter Voltage (I_B = 0)	– 40	– 60	V
V_{CER}	Collector-emitter Voltage ($R_{BE} \leq 100\ \Omega$)	– 50	– 70	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 5		V
I_{CM}	Collector Peak Current	– 2		A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	1 10		W W
T_{stg}	Storage Temperature	– 65 to 200		°C
T_j	Junction Temperature	200		°C

THERMAL DATA

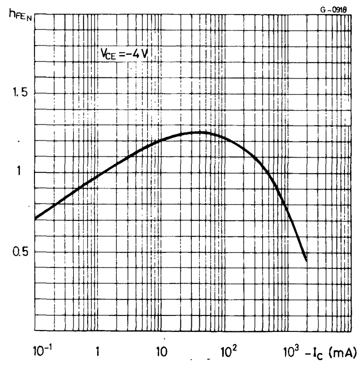
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	17.5	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

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

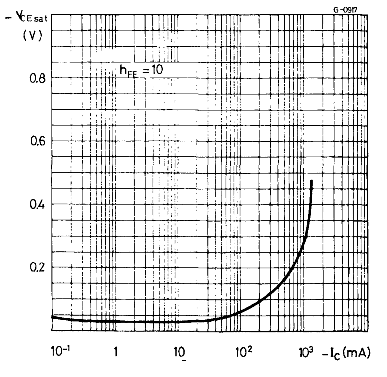
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = – 40 V			– 100	nA
I_{CER}	Collector Cutoff Current (R_{BE} = 100 Ω)	For **BC460** V_{CE} = – 50 V For **BC461** V_{CE} = – 70 V			– 10 – 10	µA µA
$V_{(BR)\ EBO}$	Emitter Base Breakdown Voltage (I_C = 0)	I_E = – 100 µA	– 5			V
$V_{(BR)\ CEO}$ *	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 10 mA For **BC460** For **BC461**	– 40 – 60			V V
$V_{CE\ (sat)}$ *	Collector-emitter Saturation Voltage	I_C = – 1 A I_B = – 100 mA			– 1	V
$V_{BE\ (sat)}$ *	Base-emitter Saturation Voltage	I_C = – 1 A I_B = – 100 mA			– 1.5	V
h_{FE} *	DC Current Gain Gr. 4	I_C = – 500 mA V_{CE} = – 4 V	40		70	
	Gr.5	I_C = – 500 mA V_{CE} = – 4 V	60		130	
	Gr.6	I_C = – 500 mA V_{CE} = – 4 V	115		250	
		I_C = – 1 A V_{CE} = – 2 V (for **BC460** only)	20			
f_T	Transition frequency	I_C = – 50 mA V_{CE} = – 4 V	50			MHz

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

DC Normalized Current Gain.



Collector-emitter Saturation Voltage.

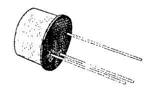


BC477
BC478-BC479

LOW NOISE GENERAL PURPOSE AUDIO AMPLIFIERS

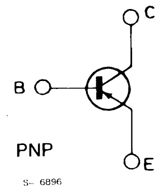
DESCRIPTION

The BC477, BC478 and BC479 are silicon planar epitaxial PNP transistors in TO-18 metal case. The BC477 is a high voltage type designed for use in audio amplifiers or driver stages, and in the signal processing circuits of TV sets. The BC478 and BC479 are respectively low noise and very low noise types, designed for general preamplifier or amplifier applications.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		BC477	BC478	BC479	
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	– 90	– 40	– 40	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 80	– 40	– 40	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 6			V
I_C	Collector Current	– 150			mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.36 1.2			W W
T_{stg}	Storage Temperature	– 55 to 200			°C
T_j	Junction Temperature	200			°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	146	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	485	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	for **BC477**				
		V_{CE} = – 70 V			– 10	nA
		V_{CE} = – 70 V T_{amb} = 125 °C			– 10	µA
		for **BC479-BC478**				
		V_{CE} = – 30 V			– 10	nA
		V_{CE} = – 30 V T_{amb} = 125 °C			– 10	µA
I_{EBO}	Emitter-cutoff Current (I_C = 0)	V_{EB} = – 4 V			– 10	nA
$V_{(BR)CES}$	Collector-emitter Breakdown Voltage (V_{BE} = 0)	I_C = – 10 µA				
		for **BC477**	– 90			V
		for **BC478**	– 40			V
		for **BC479**	– 40			V
$V_{(BR)CEO}$	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 5 mA				
		for **BC477**	– 80			V
		for **BC478**	– 40			V
		for **BC479**	– 40			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = – 10 µA	– 6			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 10 mA I_B = – 0.5 mA		– 0.1	– 0.25	V
		I_C = – 100 mA I_B = – 5 mA		– 0.3		V
V_{BE}*	Base-emitter Voltage	I_C = 2 mA V_{CE} = – 5 V	– 0.55	– 0.65	– 0.75	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 10 mA I_B = – 0.5 mA		– 0.75	– 0.9	V
		I_C = – 100 mA I_B = – 5 mA		– 0.9		V
h_{FE}*	DC Current Gain	I_C = – 10 µA V_{CE} = – 5 V				
		for **BC477**	30	115		
		for **BC478**	50	195		
		for **BC479**	100	290		
		I_C = – 2 mA V_{CE} = – 5 V				
		for **BC477**	110		250	
		for **BC478**	110		450	
		for **BC 479**	200			
		I_C = – 10 mA V_{CE} = – 5 V				
		for **BC477**		160		
		for **BC478**		270		
		for **BC479**		350		
h_{fe}	Small Signal Current Gain	I_C = – 2 mA V_{CE} = – 5 V f = 1 kHz				
		for **BC477**	125		260	
		for **BC478**	125		500	
		for **BC479**	220			
		I_C = – 10 mA V_{CE} = –5 V f = 20 MHz		7.5		

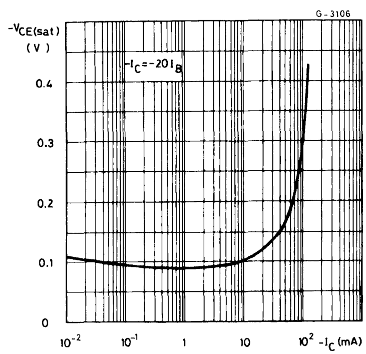
* Pulsed : pulse duration = 300 µs, duty cycle = 1 %.

ELECTRICAL CHARACTERISTICS (continued)

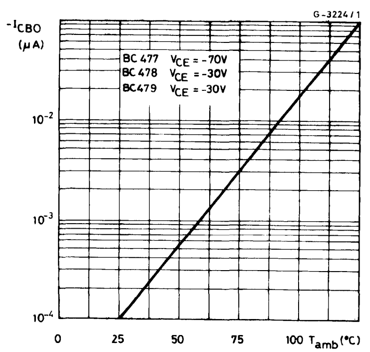
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
C_{CBO}	Collector-base Capacitance	$I_E = 0$ $V_{CB} = -5$ V		4	6	pF
C_{EBO}	Emitter-base Capacitance	$I_C = 0$ $V_{EB} = -0.5$ V		11	15	pF
NF	Noise Figure	$I_C = -20\mu A$ $V_{CE} = -5$ V $R_g = 10k\Omega$ f = 10 Hz to 10 kHz B = 15.7 kHz for **BC479**		0.8	3.5	dB
NF	Noise Figure	$I_C = -200\ \mu A$ $V_{CE} = -5$ V $R_g = 2\ k\Omega$ f = 10 Hz to 10 kHz B = 15.7 kHz for **BC478**		1.5		dB
		for **BC479**		1	4	dB
		$I_C = -20\mu A$ $V_{CE} = -5$ V $R_g = 10\ k\Omega$ f = 1 kHz B = 200 Hz for **BC479**		0.5	2.5	dB
		$I_C = -200\ \mu A$ $V_{CE} = -5$ V $R_g = 2\ k\Omega$ f = 1 kHz B = 200 Hz for **BC477**		2	10	dB
		for **BC478**		1.2	6	dB
		for **BC479**		0.8	4	dB

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

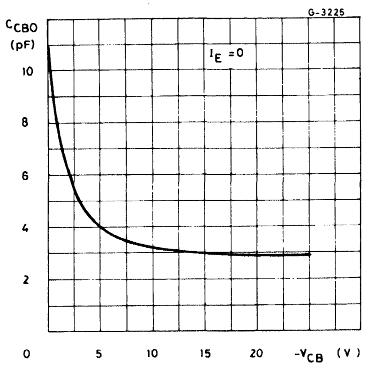
Collector-emitter Saturation Voltage.



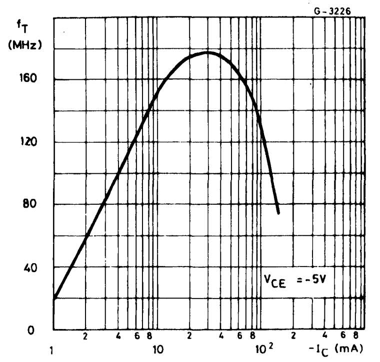
Collector Cutoff Current.



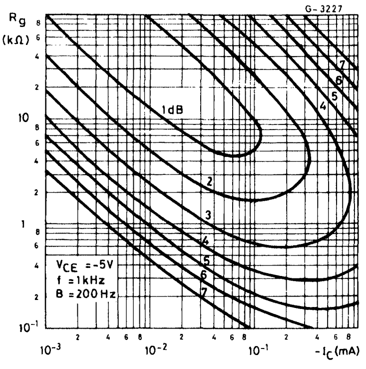
Collector-base Capacitance.



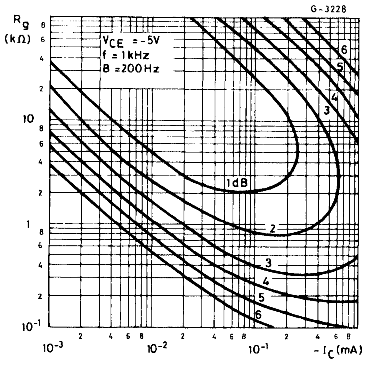
Transition Frequency.



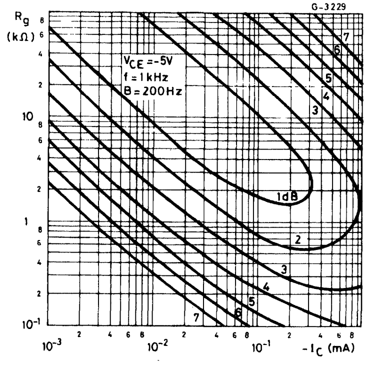
Noise Figure (for **BC477** only).



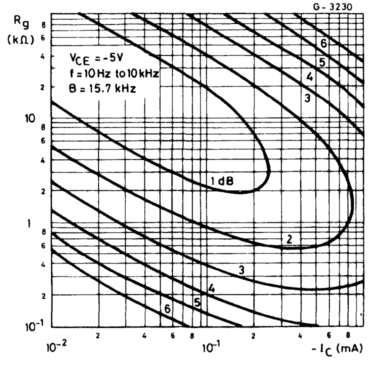
Noise Figure (for **BC478** only).



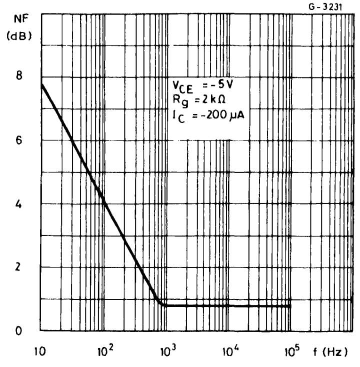
Noise Figure (for **BC479** only).



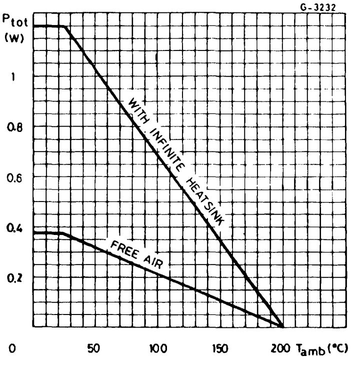
Noise Figure (for **BC479** only).



Noise Figure vs. Frequency (for **BC479** only).



Power Rating Chart.



SGS-THOMSON MICROELECTRONICS

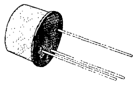
BCY58
BCY59

LOW NOISE AUDIO AMPLIFIERS

DESCRIPTION

The BCY58 and BCY59 are silicon planar epitaxial NPN transistors in Jedec TO-18 metal case.

They are intended for use in audio input stages, driver stages and low-noise input stages. The complementary PNP types are respectively the BCY78 and BCY79.



TO-18

INTERNAL SCHEMATIC DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BCY58	BCY59	
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	32	45	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	32	45	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7		V
I_C	Collector Current	200		mA
I_B	Base Current	50		mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 45$ °C	0.39 1		mW W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200		°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	150	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	450	°C/W

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

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	For **BCY58**					
		V_{CE} = 32 V			0.1	10	nA
		V_{CE} = 32 V	T_{amb} = 150 °C		0.1	10	µA
		For **BCY59**					
		V_{CE} = 45 V			0.1	10	nA
		V_{CE} = 45 V	T_{amb} = 150 °C		0.1	10	µA
I_{CEX}	Collector Cutoff Current (V_{BE} = – 0.2 V)	For **BCY58**					
		V_{CE} = 32 V	T_{amb} = 100 °C			20	µA
		For **BCY59**					
		V_{CE} = 45 V	T_{amb} = 100 °C			20	µA
I_{EBO}	Emitter cutoff Current (I_C = 0)	V_{EB} = 5 V				10	nA
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 2 mA	For **BCY58**	32			V
			For **BCY59**	45			V
$_{(BR)EBO}$*	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 10 µA		7			V
$V_{CE(sat)}$*	Collector-Emitter Saturation Voltage	I_C = 10 mA	I_B = 0.25 mA		0.12	0.35	V
		I_C = 100 mA	I_B = 2.5 mA		0.4	0.7	V
V_{BE}	Base-emitter Voltage	I_C = 2 mA	V_{CE} = 5 V	0.55	0.65	0.7	V
		I_C = 100 mA	V_{CE} = 1 V		0.75		V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 10 mA	I_B = 0.25 mA	0.6	0.7	0.85	V
		I_C = 100 mA	I_B = 2.5 mA	0.75	0.9	1.2	V
h_{FE}*	DC Current Gain	I_C =10 µA	V_{CE} = 5 V		195		
			Gr.VII		100		
			Gr.VIII	20	140		
			Gr.IX	40	195		
			Gr.X	100	280		
		I_C = 2 mA	V_{CE} = 5 V	120	350	630	
			Gr.VII	120	170	220	
			Gr.VIII	180	250	310	
			Gr.IX	250	350	460	
			Gr.X	380	500	630	
		I_C =10 mA	V_{CE} = 1 V	80	365		
			Gr.VII	80	175		
			Gr.VIII	120	260		
			Gr.IX	160	365		
			Gr.X	240	520		
		I_C =100 mA	V_{CE} =1 V	40			
			Gr.VII	40			
			Gr.VIII	45			
			Gr.IX	60			
			Gr.X	60			

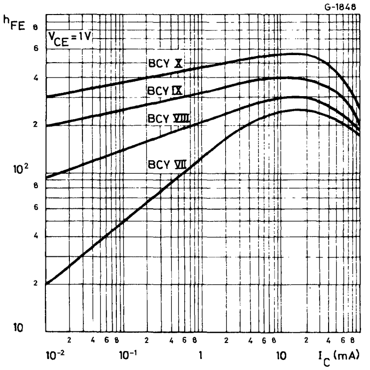
* Pulsed : pulse duration = 300 µs, duty cycle = 1 %.

ELECTRICAL CHARACTERISTICS (continued)

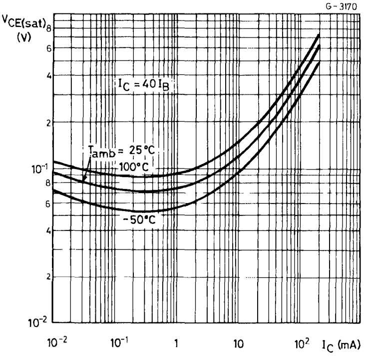
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
h_{fe}	Small Signal Current Gain	I_C = 2 mA f = 1 kHz	V_{CE} = 5 V Gr.VII Gr.VIII Gr.IX Gr.X	 125 125 175 250 350		 250 350 500 700	
f_T	Transition Frequency	I_C =10 mA f = 100 MHz	V_{CE} = 5 V		200		MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 f = 1 MHz	V_{EB} = 0.5 V		11	15	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 f = 1 MHz	V_{CB} = 10 V		3.5	6	pF
NF	Noise Figure	I_C = 0.2 mA R_g = 2 kΩ	V_{CE} = 5 V f = 1 kHz		2	6	dB
t_{on}	Turn-on Time	I_C = 10 mA I_{B1} = 1 mA I_C = 100 mA I_{B1} = 10 mA	V_{CC} = 10 V V_{CC} = 10 V		85 55	150 150	ns ns
t_{off}	Turn-off Time	I_C = 10 mA I_{B1} = – I_{B2} = 1 mA I_C = 100 mA I_{B1} = – I_{B2} = 10 mA	V_{CC} = 10 V V_{CC} = 10 V		480 480	800 800	ns ns

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

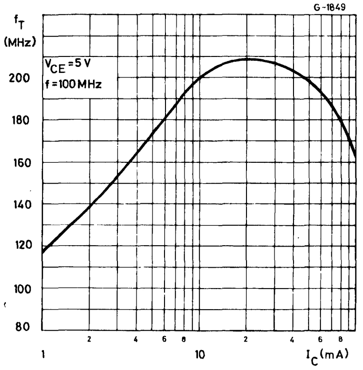
DC Current Gain.



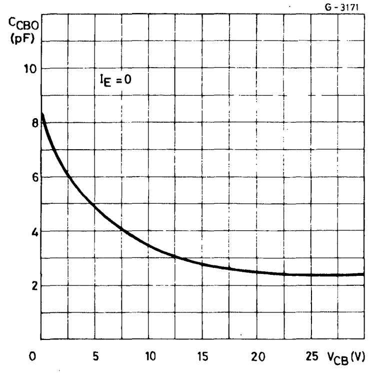
Collector-emitter Saturation Voltage.



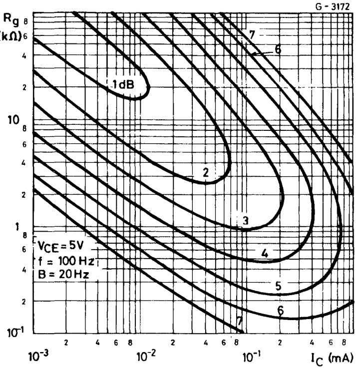
Transition Frequency.



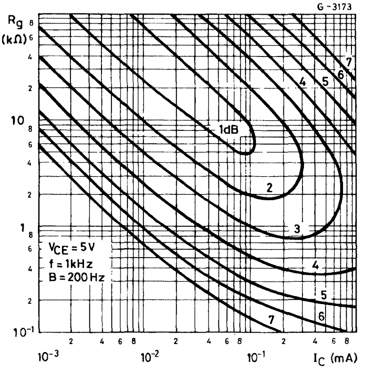
Collector-base Capacitance.



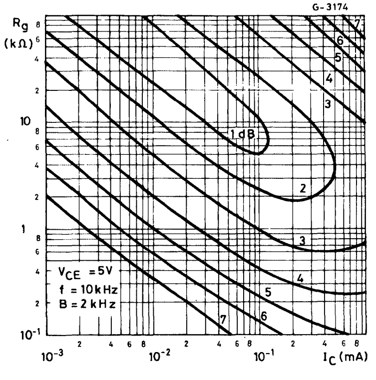
Noise Figure (f = 100 Hz).



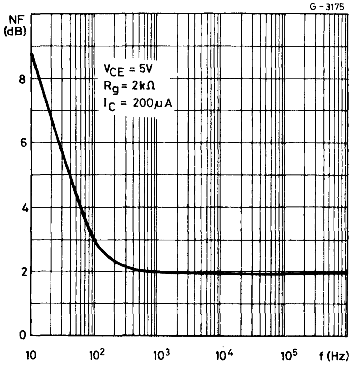
Noise Figure (f = 1 kHz).



Noise Figure (f = 10 kHz).



Noise Figure vs. Frequency.



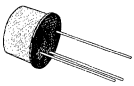
SGS-THOMSON MICROELECTRONICS

BCY70 BCY71/BCY72

GENERAL PURPOSE APPLICATIONS

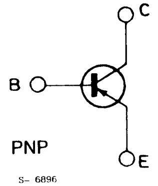
DESCRIPTION

The BCY70, BCY71 and BCY72 are silicon planar epitaxial PNP transistors in Jedec TO-18 metal case.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		BCY70	BCY71	BCY72	
V_{CBO}	Collector-base Voltage (I_E = 0)	– 50	– 45	– 25	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 40	– 45	– 25	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 5			V
I_{CM}	Collector Peak Current	– 200			mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C	350			mW
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200			°C

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

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	150	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	500	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	For **BCY70**				
		V_{CE} = – 20 V			– 10	nA
		V_{CE} = – 50 V			– 500	nA
		For **BCY71**				
		V_{CB} = – 20 V			– 100	nA
		V_{CB} = – 45 V			– 10	µA
		For **BCY72**				
		V_{CB} = – 20 V			– 100	nA
		V_{CB} = – 25 V			– 10	µA
I_{EBO}	Emitter cutoff Current (I_C = 0)	V_{EB} = – 5 V			– 10	µA
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 10 mA I_B = – 1 mA			– 0.25	V
		I_C = – 50 mA I_B = – 5 mA			– 0.5	V
$V_{BE(sat)}$*	Base-Emitter Saturation Voltage	I_C = – 10 mA I_B = – 1 mA For **BCY70** and **BCY71** Only	– 0.6		– 0.9	V
		I_C = – 50 mA I_B = – 5 mA			– 1.2	V
h_{FE}*	DC Current Gain	For **BCY70**				
		I_C = – 0.1 mA V_{CE} = – 1 V	40			
		I_C = – 1 mA V_{CE} = – 1 V	45			
		I_C = – 10 mA V_{CE} = – 1 V	50			
		I_C = – 50 mA V_{CE} = – 1 V	15			
		For **BCY71**				
		I_C = – 0.01 mA V_{CE} = – 1 V		60		
		I_C = – 0.1 mA V_{CE} = – 1 V	80			
		I_C = – 1 mA V_{CE} = – 1 V	90			
		I_C = – 10 mA V_{CE} = – 1 V	100		600	
		I_C = – 50 mA V_{CE} = – 1 V	15			
		For **BCY72**				
		I_C = – 1 mA V_{CE} = – 1 V	40			
		I_C = – 10 mA V_{CE} = – 1 V	50			
h_{fe}	Small Signal Current Gain (for **BCY71** only)	I_C = – 1 mA V_{CE} = – 10 V f = 1 kHz	100		400	
f_T	Transition Frequency	I_C = – 0.1 mA V_{CE} = – 20 V f = 10.7 MHz For **BCY71**	15			MHz
		I_C = – 10 mA V_{CE} = – 20 V f = 100 MHz For **BCY70**	250			MHz
		For **BCY70** and **BCY72**	200			MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = – 1 V f = 1 MHz			8	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 10 V f = 1 MHz			6	pF

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

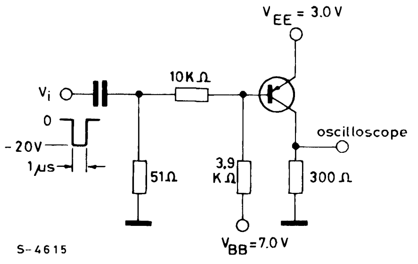
ELECTRICAL CHARACTERISTICS (continued)

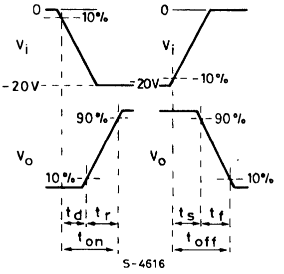
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
NF	Noise Figure	I_C = – 0.1 mA V_{CE} = – 5 V R_g = 2 kΩ f = 10 to 10 000 Hz For **BCY70** and **BCY72** for **BCY71**			6 2	dB dB
h_{ie}	Input Impedance (for **BCY71** only)	I_C = – 1 mA V_{CE} = – 10 V f = 1 kHz	2		12	kΩ
h_{re}	Reverse Voltage Ratio (for **BCY71** only)	I_C = – 1 mA V_{CE} = – 10 V f = 1kHz			$20x10^{-4}$	
h_{oe}	Output Admittance (for **BCY71** only)	I_C = – 1 mA V_{CE} = – 10 V f = 1 kHz	10		60	µS
t_d	Delay Time (for **BCY70** and **BCY72** only)	I_C = – 10 mA V_{EE} = 3 V I_{B1} = – 1 mA		23	35	ns
t_r	Rise Time (for **BCY70** and **BCY72** only)	I_C = – 10 mA V_{EE} = 3 V I_{B1} = – 1 mA		25	35	ns
t_s	Storage Time (for **BCY70** and **BCY72** only)	I_C = – 10 mA V_{EE} = 3 V I_{B1} = – I_{B2} = – 1 mA		270	350	ns
t_f	Fall Time (for **BCY70** and **BCY72** only)	I_C = – 10 mA V_{EE} = 3 V I_{B1} = – I_{B2} = – 1 mA		50	80	ns
t_{on}	Turn-on Time (for **BCY70** and **BCY72** only)	I_C = – 10 mA V_{EE} = 3 V I_{B1} = – 1 mA		48	65	ns
t_{off}	Turn-off Time (for **BCY70** and **BCY72** only)	I_C = – 10 mA V_{EE} = 3 V I_{B1} = – I_{B2} = – 1 mA		320	420	ns

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

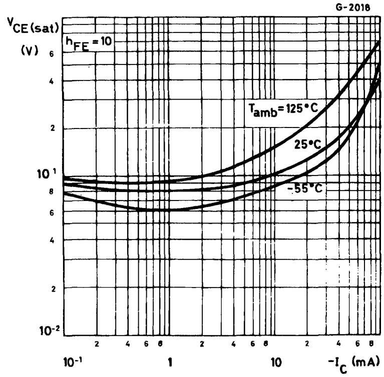
TEST CIRCUIT

Test Circuit for Switching Times.

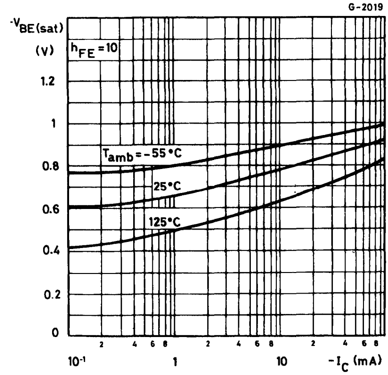


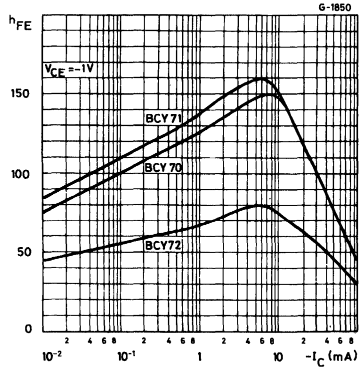


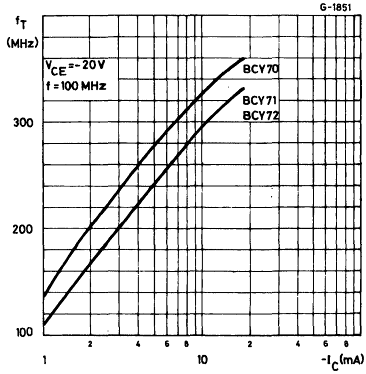
Collector-emitter Saturation Voltage.



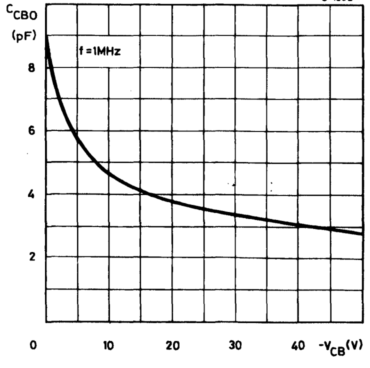
Base-emitter Saturation Voltage.



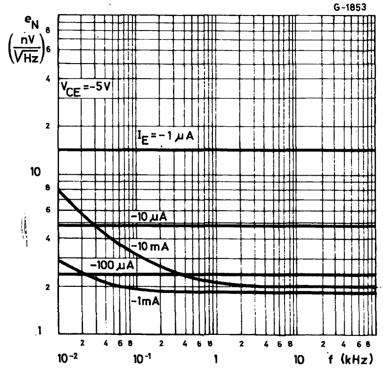




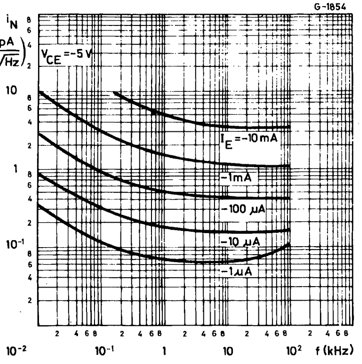
Collector-base Capacitance.



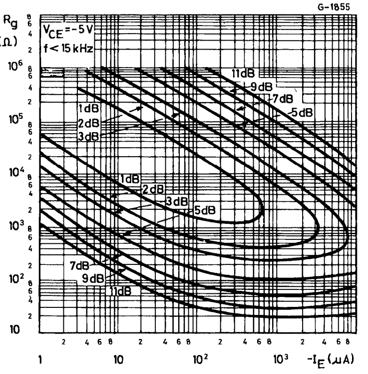
Equivalent Input Noise Voltage (for BCY71 only).



Equivalent Input Noise Current (for BCY71 only).



Countours of Constant White Noise Figure (for BCY71 only).



SGS-THOMSON MICROELECTRONICS

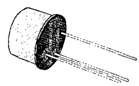
BCY78
BCY79

LOW NOISE AUDIO AMPLIFIERS

DESCRIPTION

The BCY78 and BCY79 are silicon planar epitaxial PNP transistors in Jedec TO-18 metal case.They are designed for use in audio driver and low-noise input stages.

The complementary NPN types are respectively the BCY58 and BCY59.



TO-18

INTERNAL SCHEMATIC DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BCY78	BCY79	
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	– 32	– 45	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 32	– 45	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 5		V
I_C	Collector Current	– 200		mA
I_B	Base Current	– 20		mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 45$ °C	390 1		mW W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200		°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	150	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	450	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	For **BCY78** V_{CE} = – 25 V V_{CE} = – 32 V V_{CE} = – 25 V T_{amb} = 150 °C For **BCY79** V_{CE} = – 35 V V_{CE} = – 45 V V_{CE} = – 35 V T_{amb} = 150 °C		 – 2 – 2	 – 20 – 100 – 10 – 20 – 100 – 10	 nA nA µA nA nA µA
I_{CEX}	Collector Cutoff Current (V_{BE} = 0.2 V)	For **BCY78** V_{CE} = – 32 V T_{amb} = 100 °C For **BCY79** V_{CE} = – 45 V T_{amb} = 100 °C			 – 20 – 20	 µA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = – 4 V			– 20	nA
$V_{(BR)CES}$	Collector-emitter Breakdown Voltage (V_{BE} = 0)	I_C = – 10 µA For **BCY78** For **BCY79**	– 32 – 45			V V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 2 mA For **BCY78** For **BCY79**	 – 32 – 45			 V V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = – 1 µA	– 5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 10 mA I_B = - 0.25 mA I_C = – 100 mA I_B = – 2.5 mA		– 0.12 – 0.4	– 0.25 – 0.8	V V
V_{BE}*	Base-emitter Voltage	I_C = –10 µA V_{CE} = – 5 V I_C = – 2 mA V_{CE} = – 5 V I_C = –10 mA V_{CE} = – 1 V I_C = –100 mA V_{CE} = – 1 V	 – 0.6	– 0.55 – 0.65 – 0.68 – 0.75	 – 0.75	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 10 mA I_B = – 0.25 mA I_C = – 100 mA I_B = – 2.5 mA	– 0.6 – 0.7	– 0.7 – 0.85	– 0.85 – 1.2	V V

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

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
h_{FE}*	DC Current Gain	I_C = – 10 μA	V_{CE} = – 5 V				
			Gr.VII		140		
			Gr.VIII	30	200		
			Gr.IX	40	270		
		I_C = – 2 mA	V_{CE} = – 5 V				
			Gr.VII	120	170	220	
			Gr.VIII	180	250	310	
			Gr.IX	250	350	460	
		I_C = – 10 mA	V_{CE} = – 1 V				
			Gr.VII	80	180		
			Gr.VIII	120	260	400	
			Gr.IX	160	360	630	
		I_C = – 100 mA	V_{CE} = – 1 V				
			Gr.VII	40			
			Gr.VIII	45			
			Gr.IX	60			
		For **BCY78** Only					
			Gr.X				
		I_C = – 0.01 mA	V_{CE} = – 5 V	100	340		
		I_C = – 2 mA	V_{CE} = – 5 V	380	500	630	
		I_C = – 10 mA	V_{CE} = – 1 V	240	500	1000	
		I_C = – 100 mA	V_{CE} = – 1 V	60			
h_{fe}	Small Signal Current Gain	I_C = – 2 mA	V_{CE} = – 5 V				
		f = 1 kHz					
			Gr.VII	125	200	250	
			Gr.VIII	175	260	350	
			Gr.IX	250	330	500	
		for **BCY78** Only					
			Gr.X	350	520	700	
f_T	Transition Frequency	I_C = – 10 mA	V_{CE} = – 5 V				
		f = 100 MHz			180		MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0	V_{EB} = – 0.5 V				
		f = 1 MHz			11	15	pF
C_{CBO}	Collector-base Capacitance	I_E = 0	V_{CB} = – 10 V				
		f = 1 MHz			4.5	7	pF
NF	Noise Figure	I_C = – 0.2 mA	V_{CE} = – 5 V				
		R_g = 2 kΩ	f = 1 kHz		2	6	dB
h_{ie}	Input Impedance	I_C = – 2 mA	V_{CE} = – 5 V				
		f = 1 kHz					
			Gr.VII		2.7		kΩ
			Gr.VIII		3.6		kΩ
			Gr.IX		4.5		kΩ
		For **BCY78** Only					
			Gr.X		7.5		kΩ
h_{re}	Reverse Voltage Ratio	I_C = – 2 mA	V_{CE} = – 5 V				
		f = 1 kHz					
			Gr.VII		1.5×10^{-4}		
			Gr.VIII		2×10^{-4}		
			Gr.IX		2×10^{-4}		
		For **BCY78** Only					
			Gr.X		3×10^{-4}		

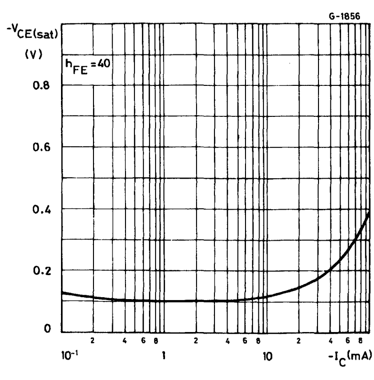
* Pulsed : pulse duration = 300 μs, duty cycle = 1 %.

ELECTRICAL CHARACTERISTICS (continued)

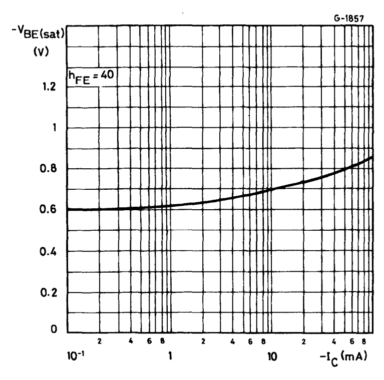
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
h_{oe}	Output Admittance	$I_C = -2$ mA $V_{CE} = -5$ V f = 1 kHz Gr.VII Gr.VIII Gr.IX For **BCY78** Only Gr.X		 18 24 30 50	 30 50 60 100	 µS µS µS µS
t_d	Delay Time	$I_C = -10$ mA $V_{CC} = -10$ V $I_{B1} = -1$ mA $I_C = -100$ mA $V_{CC} = -10$ V $I_{B1} = -10$ mA		 35 5		 ns ns
t_r	Rise Time	$I_C = -10$ mA $V_{CC} = -10$ V $I_{B1} = -1$ mA $I_C = -100$ mA $V_{CC} = -10$ V $I_{B1} = -10$ mA		 50 50		 ns ns
t_s	Storage Time	$I_C = -10$ mA $V_{CC} = -10$ V $I_{B1} = -I_{B2} = -1$ mA $I_C = -100$ mA $V_{CC} = -10$ V $I_{B1} = -I_{B2} = -10$ mA		 400 250		 ns ns
t_f	Fall Time	$I_C = -10$ mA $V_{CC} = -10$ V $I_{B1} = -I_{B2} = -1$ mA $I_C = -100$ mA $V_{CC} = -10$ V $I_{B1} = -I_{B2} = -10$ mA		 80 200		 ns ns
t_{on}	Turn-on Time	$I_C = -10$ mA $V_{CC} = -10$ V $I_{B1} = -1$ mA $I_C = -100$ mA $V_{CC} = -10$ V $I_{B1} = -10$ mA		 85 55	 150 150	 ns ns
t_{off}	Turn-off Time	$I_C = -10$ mA $V_{CC} = -10$ V $I_{B1} = -I_{B2} = -1$ mA $I_C = -100$ mA $V_{CC} = -10$ V $I_{B1} = -I_{B2} = -10$ mA		 480 450	 800 800	 ns ns

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

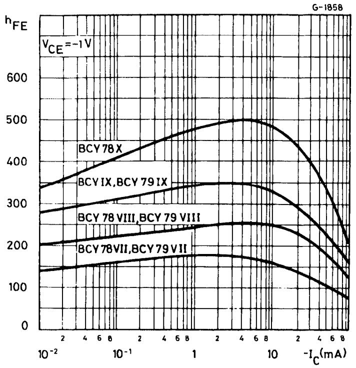
Collector-emitter Saturation Voltage.



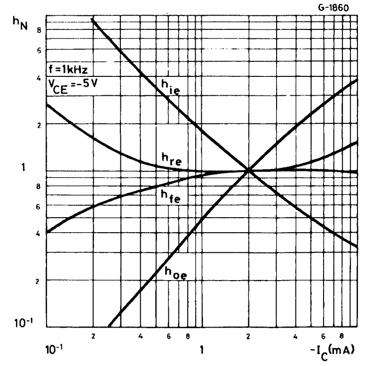
Base-emitter Saturation Voltage.



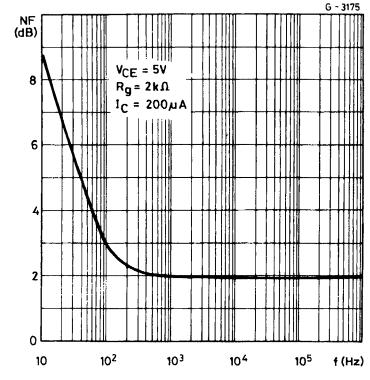
DC Current Gain.



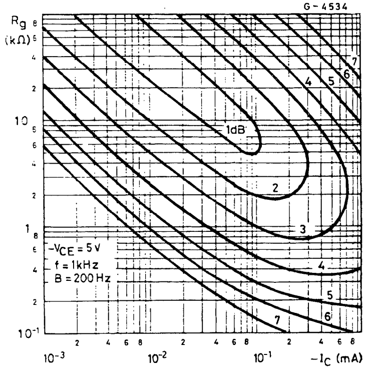
Normalized h Parameters.



Noise Figure vs. Frequency.



Noise Figure (f = 1 kHz).



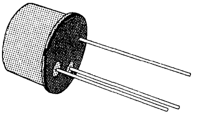
SGS-THOMSON
MICROELECTRONICS

BF257
BF258-BF259

HIGH VOLTAGE VIDEO AMPLIFIERS

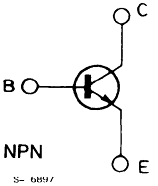
DESCRIPTION

The BF257, BF258 and BF259 are silicon planar epitaxial NPN transistors in Jedec TO-39 metal case. They are particularly designed for video output stages in CTV and MTV sets, class A audio output stages and drivers for horizontal deflection circuits.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		BF257	BF258	BF259	
V_{CBO}	Collector-base Voltage (I_E = 0)	160	250	300	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	160	250	300	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5			V
I_C	Collector Current	100			mA
I_{CM}	Collector Peak Current	200			mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 50$ °C	5			W
T_{stg}	Storage Temperature	– 55 to 200			°C
T_j	Junction Temperature	200			°C

THERMAL DATA

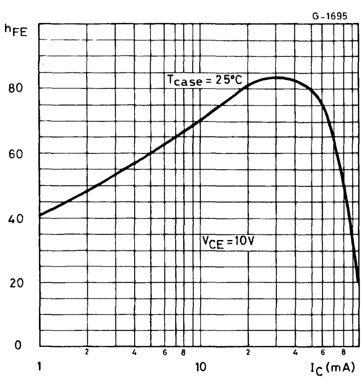
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	30	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

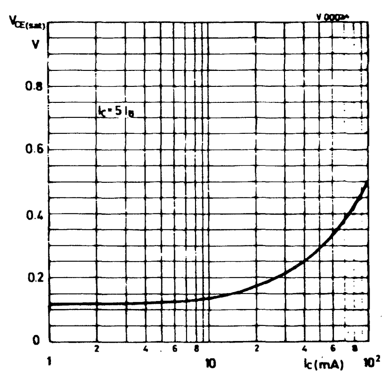
ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **BF257** V_{CB} = 100 V for **BF258** V_{CB} = 200 V for **BF259** V_{CB} = 250 V			50 50 50	nA nA nA
$V_{(BR)\ CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 µA for **BF257** for **BF258** for **BF259**	160 250 300			V V V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA for **BF257** for **BF258** for **BF259**	160 250 300			V V V
$V_{(BR)\ EBO}$	Emittter-base Breakdown Voltage (I_C = 0)	I_E = 100 µA	5			V
$V_{CE\ (sat)}$*	Collector-emitter Saturation Voltage	I_C = 30 mA I_B = 6 mA			1	V
h_{FE}*	DC Current Gain	I_C = 30 mA V_{CE} = 10 V	25			
f_T	Transition Frequency	I_C = 15 mA V_{CE} = 10 V		90		MHz
C_{re}	Reverse Capacitance	I_C = 0 V_{CE} = 30 V f = 1 MHz		3		pF

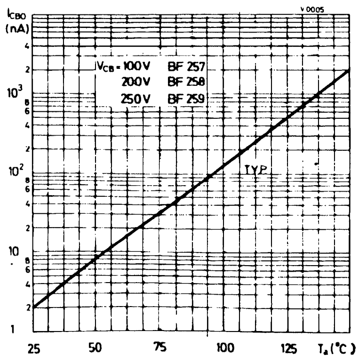
* Pulsed : pulse duration = 300 µs, duty cycle = 1 %.

DC Current Gain.

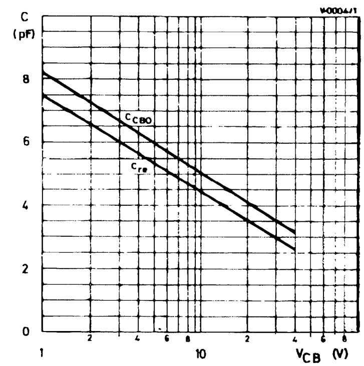




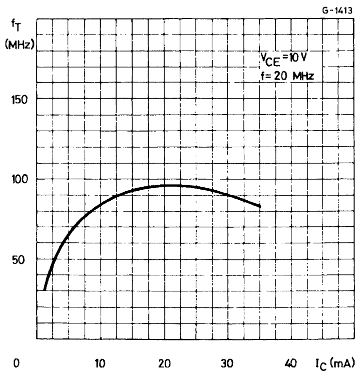
Collector Cutoff Current.



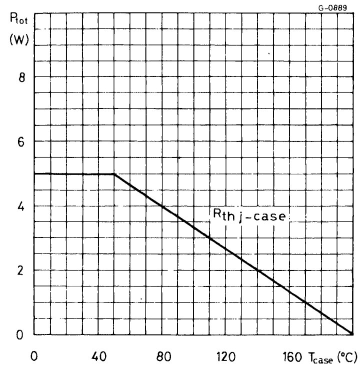
Collector-base Capacitance.



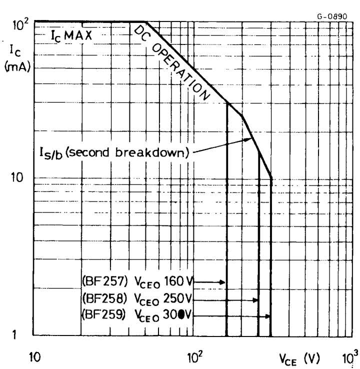
Transition Frequency.



Power Rating Chart.



Safe Operating Area.



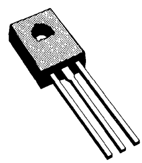
SGS-THOMSON MICROELECTRONICS

BF457
BF458-BF459

HIGH VOLTAGE VIDEO AMPLIFIERS

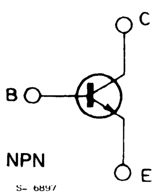
DESCRIPTION

The BF457, BF458 and BF459 are silicon planar epitaxial NPN transistors in Jedec TO-126 plastic package. They are particularly intended for use as video output stages in colour and black and white TV receivers, class A output stages and drivers for horizontal deflection circuits. These transistors have been studied in order to guarantee the maximum resistance against flash over.



TO-126

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		BF 457	BF 458	BF 459	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	160	250	300	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	160	250	300	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5			V
I_{CM}	Collector Peak Current	300			mA
I_{BM}	Base Peak Current	50			mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C $T_{case} \leq 25$ °C	1.25 12.5			W W
T_{stg}	Storage Temperature	– 55 to 150			°C
T_j	Junction Temperature	150			°C

THERMAL DATA

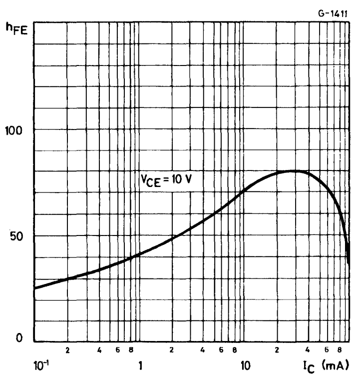
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	10	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	100	°C/W

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

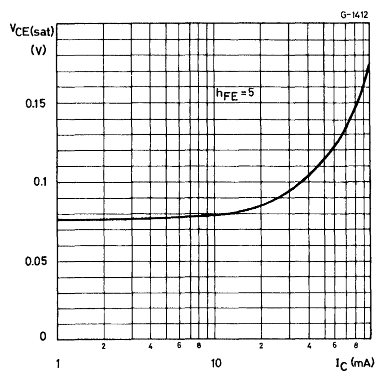
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **BF 457** V_{CB} = 100 V for **BF 458** V_{CB} = 200 V for **BF 459** V_{CB} = 250 V			50 50 50	nA nA nA
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA for **BF 457** for **BF 458** for **BF 459**	160 250 300			V V V
$V_{(BR)\ EBO}$	Emittter-base Breakdown Voltage (I_C = 0)	I_E = 100 μA	5			V
$V_{CE\ (sat)}$*	Collector-emitter Saturation Voltage	I_C = 50 mA I_B = 10 mA			1	V
h_{FE}*	DC Current Gain	I_C = 30 mA V_{CE} = 10 V	30	80		
f_T	Transition Frequency	I_C = 30 mA V_{CE} = 10 V		90		MHz
C_{re}	Reverse Capacitance	I_C = 0 f = 1 MHz V_{CE} = 30 V		4		pF
C_{oe}	Output Capacitance	I_C = 0 f = 1 MHz V_{CE} = 30 V		5		pF

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

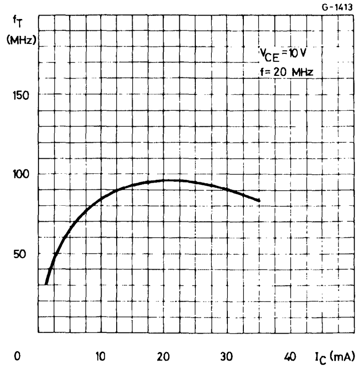
DC Current Gain.



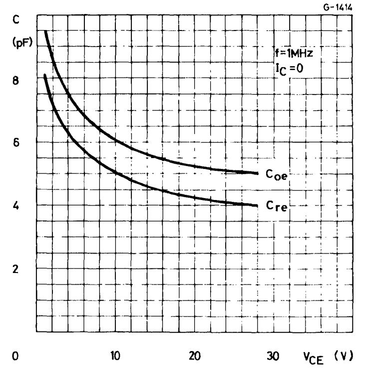
Collector-emitter Saturation Voltage.



Transition Frequency.



Output and Reverse Capacitance.



SGS-THOMSON MICROELECTRONICS

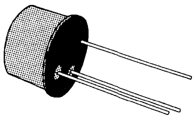
BF657 BF658-BF659

MEDIUM POWER VIDEO AMPLIFIERS

DESCRIPTION

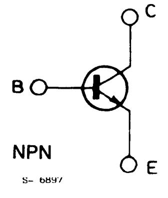
The BF657, BF658 and BF659 are silicon planar epitaxial NPN transistors in Jedec TO-39 metal case.

They are particularly designed for application with precision "IN-LINE" large screen CRT (thermal resis-tance ≤ 20 ° C/W).



TO-39

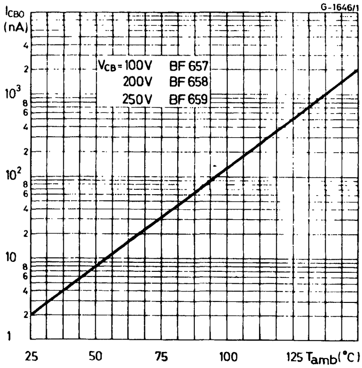
INTERNAL SCHEMATIC DIAGRAM



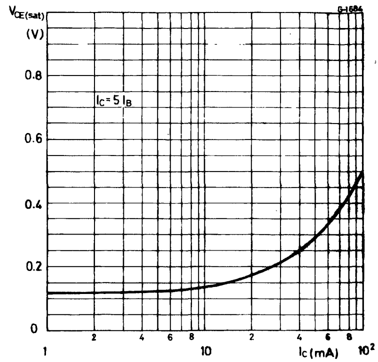
ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		BF657	BF658	BF659	
V_{CBO}	Collector-base Voltage (I_E = 0)	160	250	300	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	160	250	300	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5			V
I_C	Collector Current	100			mA
I_{CM}	Collector Peak Current	200			mA
P_{tot}	Total Power Dissipation at T_{case} ≤ 60 °C at T_{case} ≤ 140 °C	7 3			W W
T_{stg}	Storage Temperature	– 55 to 200			°C
T_j	Junction Temperature	200			°C

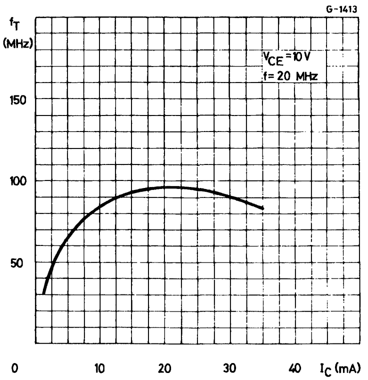
Collector Cutoff Current.



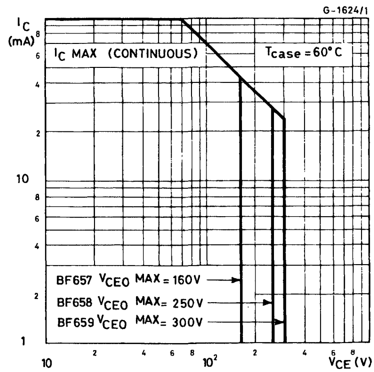
Collector-base and Reverse Capacitances.



Transition Frequency.



Safe Operating Areas.



THERMAL DATA

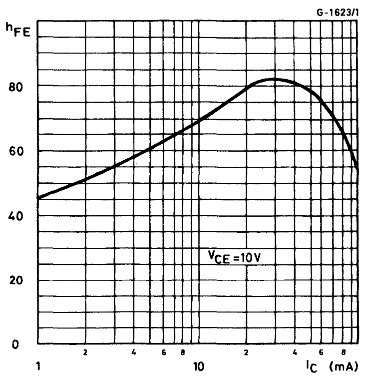
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	20	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

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

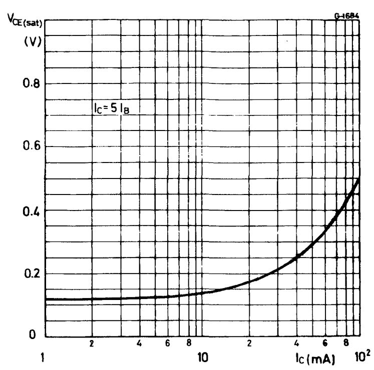
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **BF657** V_{CB} = 100 V for **BF658** V_{CB} = 200 V for **BF659** V_{CB} = 250 V			50 50 50	nA nA nA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 μA for **BF657** for **BF658** for **BF659**	160 250 300			V V V
$V_{(BR)CEO}$*	Collector-emittter Breakdown Voltage (I_B = 0)	I_C = 10 mA for **BF657** for **BF658** for **BF659**	160 250 300			V V V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 100 μA	5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 30 mA I_B = 6 mA			1	V
h_{FE}*	DC Current Gain	I_C = 30 mA V_{CE} = 10 V	25			
f_T	Transition Frequency	I_C = 15 mA V_{CE} = 10 V		90		MHz
C_{re}	Reverse Capacitance	I_C = 0 V_{CE} = 30 V f = 1 MHz		3		pF

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

DC Current Gain.



Collector-emitter Saturation Voltage.



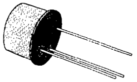
SGS-THOMSON
MICROELECTRONICS

BFR17

LOW-LEVEL, LOW-NOISE, VERY HIGH GAIN AMPLIFIER

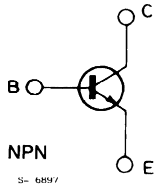
DESCRIPTION

The BFR17 is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case, designed for use in high performance low level, low noise amplifier applications.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CES}	Collector–emitter Voltage (V_{BE} = 0)	60	V
V_{CEO}	Collector–emitter Voltage (I_B = 0)	60	V
V_{EBO}	Emitter–base Voltage (I_C = 0)	8	V
I_C	Collector Current	50	mA
P_{tot}	Total Power Dissipation at T_{amb} = 25 °C at T_{case} = 25 °C	0.36 1.2	W W
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 200	°C

THERMAL DATA

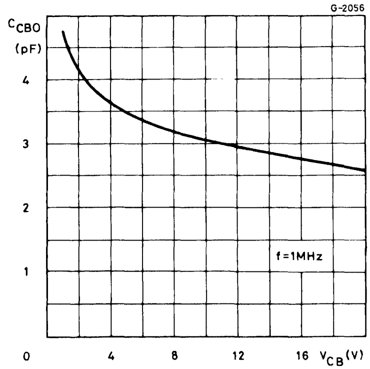
$R_{th\ j-case}$	Thermal Resistance Junction–case	Max	146	°C/W
$R_{th\ j-amb}$	Thermal Resistance Junction–ambient	Max	486	°C/W

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

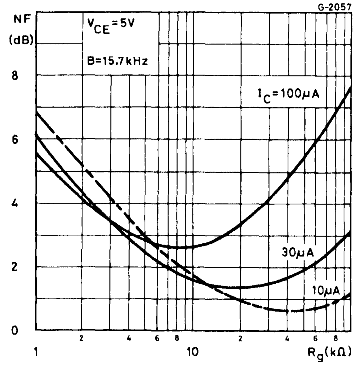
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 50 V V_{CE} = 50 V T_{amb} = 150 °C		0.1 0.1	20 20	nA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V		0.1	20	nA
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	60			V
$V_{(BR)CES}$	Collector-emitter Breakdown Voltage (V_{BE} = 0)	I_C = 10 µA	60			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 10 µA	8			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 1 mA I_B = 0.1 mA		0.15	0.35	V
V_{BE}*	Base-emitter Voltage	I_C = 1 mA V_{CE} = 5 V I_C = 100 µA V_{CE} = 5 V		0.64 0.58	 0.7	V V
h_{FE}*	DC Current Gain	I_C = 10 µA V_{CE} = 5 V I_C = 100 µA V_{CE} = 5 V I_C = 1 mA V_{CE} = 5 V I_C = 10 mA V_{CE} = 5 V	130 220 450	220 300 530 530		
h_{fe}	Small Signal Current Gain	I_C = 1 mA V_{CE} = 5 V f = 20 kHz		530		
f_T	Transition Frequency	I_C = 1 mA V_{CE} = 5 V f = 20 MHz	70	100		MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 5 V		3.5	6	pF
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 5 V		3.5	6	pF
NF	Noise Figure	I_C = 10 µA R_g = 10 kΩ f = 10 Hz to 10 kHz V_{CE} = 5 V f = 1 kHz f = 10 kHz		1.8 1 1	4 3 3	dB dB dB
h_{ie}	Input Impedance	I_C = 1 mA V_{CE} = 5 V f = 1 kHz		10		kΩ
h_{oe}	Output Admittance	I_C = 1 mA V_{CE} = 5 V f = 1 kHz		20		µS
h_{re}	Reverse Voltage Ratio	I_C = 1 mA V_{CE} = 5 V f = 1 kHz		4.5×10^{-4}		

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

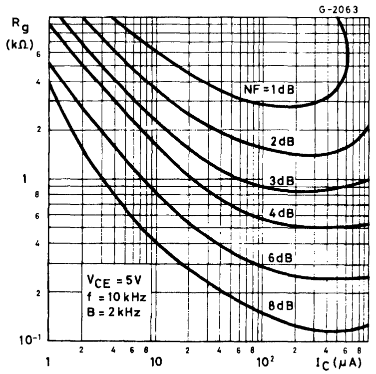
Collector-base Capacitance.



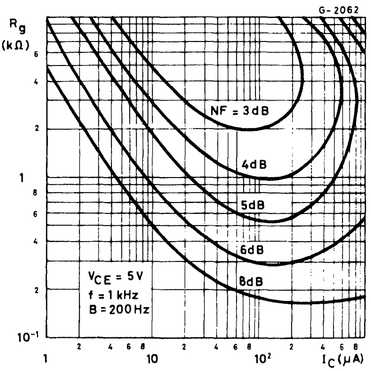
Noise Figure vs. Source Resistance.



Contours of Constant Noise Figure f = 10kHz.



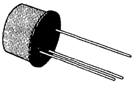
Contours of Constant Noise Figure f = 1kHz.



HIGH-VOLTAGE, HIGH-CURRENT AMPLIFIER

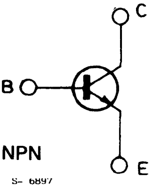
DESCRIPTION

The BFR18 is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case. This device is designed for amplifier applications over a wide range of voltage and current.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CES}	Collector–emitter Voltage (V_{BE} = 0)	85	V
V_{CEO}	Collector–emitter Voltage (I_B = 0)	55	V
V_{EBO}	Emitter–base Voltage (I_C = 0)	7	V
I_C	Collector Current	1	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.5 1.8	W W
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 200	°C

THERMAL DATA

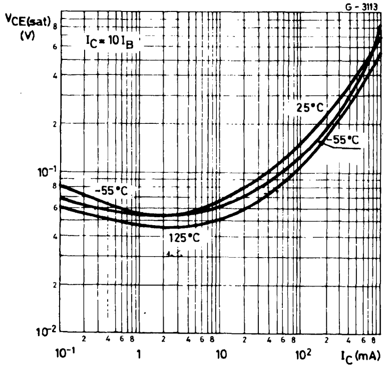
$R_{th\ j\text{-}case}$	Thermal Resistance Junction–case	Max	97	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction–ambient	Max	350	°C/W

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

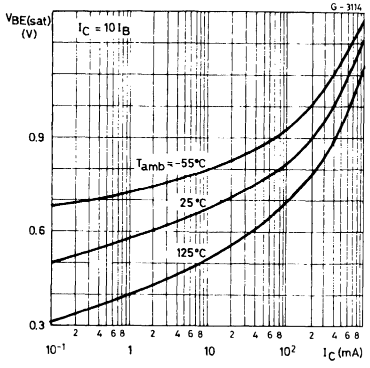
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 60 V V_{CE} = 60 V T_{amb} = 150 °C		0.2 0.2	10 10	nA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V		0.1	10	nA
$V_{(BR)\ CES}$	Collector–emitter Breakdown Voltage (V_{BE} = 0)	I_C = 100 µA	85			V
$V_{(BR)\ CEO}$*	Collector–emitter Breakdown Voltage (I_B = 0)	I_C = 30 mA	55			V
$V_{(BR)\ EBO}$	Emitter–base Breakdown Voltage (I_C = 0)	I_E = 100 µA	7			V
$V_{CE(sat)}$*	Collector–emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA I_C = 500 mA I_B = 50 mA I_C = 1 A I_B = 0.1 A		0.13 0.3 0.65	0.25 1	V V V
V_{BE}*	Base–emitter Voltage	I_C = 10 mA V_{CE} = 1 V		0.66		V
$V_{BE(sat)}$*	Base–emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA I_C = 500 mA I_B = 50 mA I_C = 1 A I_B = 0.1 A		0.85 1.1 1.35	1 1.6	V V V
h_{FE}*	DC Current Gain	I_C = 100 µA V_{CE} = 1 V I_C = 10 mA V_{CE} = 1 V I_C = 150 mA V_{CE} = 1 V I_C = 500 mA V_{CE} = 1 V I_C = 150 mA V_{CE} = 1 V T_{amb} = – 55 °C	30 70 60 30 15	75 120 90 45	 180 180	
h_{fe}	Small Signal Current Gain	I_C = 1 mA V_{CE} = 5 V f = 1 kHz		120		
f_T	Transition Frequency	I_C = 50 mA V_{CE} = 10 V f = 20 MHz	60	90		MHz
C_{EBO}	Emitter–base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz		50	80	pF
C_{CBO}	Collector–base Capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz		12	20	pF
NF	Noise Figure	I_C = 30 µA V_{CE} = 10 V R_g = 1 kΩ f = 1 kHz		2	8	dB
h_{ie}	Input Impedance	I_C = 1 mA V_{CE}= 5 V f = 1 kHz		2.2		kΩ
h_{re}	Reverse Voltage Ratio	I_C = 1 mA V_{CE} = 5 V f = 1 kHz		2.4×10^{-4}		
h_{oe}	Output Admitance	I_C = 1 mA V_{CE} = 5 V f = 1 kHz		8.5		µS

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

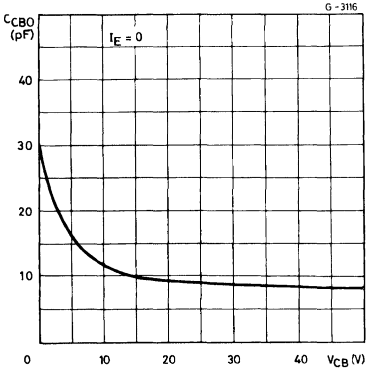
Collector-emitter Saturation Voltage.



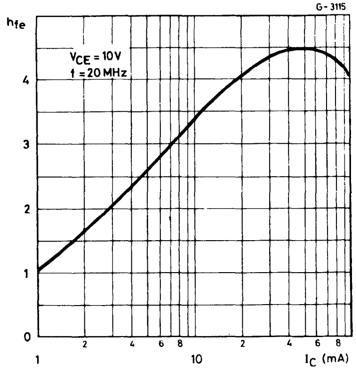
Base-emitter Saturation Voltage.



Collector-base Capacitance.



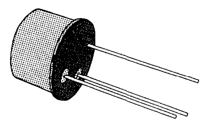
High Frequency Current Gain.



CATV ULTRA-LINEAR HIGH GAIN TRANSISTOR

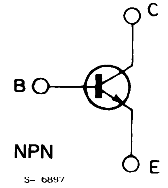
DESCRIPTION

The BFR36 is a multi-emitter silicon planar epitaxial NPN transistor in Jedec TO-39 metal case. It is designed for CATV-MATV amplifier applications over a wide frequency range (40 to 860MHz). The device features very good intermodulation properties, very low reverse capacitance, high power gain and high power dissipation.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector–base Voltage ($I_E = 0$)	40	V
V_{CEO}	Collector–Emitter Voltage ($I_B = 0$)	30	V
V_{EBO}	Emitter–base Voltage ($I_C = 0$)	3	V
I_C	Collector Current	200	mA
I_{CM}	Collector Peak Current	400	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 40$ °C at $T_{case} \leq 50$ °C	0.8 5	W W
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction–case	Max	30	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction–ambient	Max	200	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 20 V V_{CB} = 20 V T_{amb} = 150 °C			150 20	nA μA
$V_{(BR)CBO}$	Collector–base Breakdown Voltage (I_E = 0)	I_C = 100 μA	40			V
$V_{CEO(sus)}$*	Collector–emitter Sustaining Voltage (I_B = 0)	I_C = 10 mA	30			V
$V_{(BR)EBO}$	Emitter–base Breakdown Voltage (I_C = 0)	I_E = 100 μA	3			V
V_{CEK}**	Collector–emitter Knee Voltage	I_C = 100 mA		700	750	mV
V_{BE}	Base–emitter Voltage	I_C = 70 mA V_{CE} = 5 V		750		mV
h_{FE}*	DC Current Gain	I_C = 70 mA V_{CE} = 5 V I_C = 150 mA V_{CE} = 5 V I_C = 70 mA V_{CE} = 15 V I_C = 150 mA V_{CE} = 15 V	60 60 65 65	130		
f_T	Transition Frequency	V_{CE} = 15 V f = 100 MHz I_C = 70 mA I_C = 150 mA	1	1.4 1.2		GHz GHz
C_{EBO}	Emitter–base Capacitance	I_C = 0 V_{EB} = 0.4 V f = 1 MHz		7		pF
C_{CBO}	Collector–base Capacitance	I_E = 0 V_{CB} = 15 V f = 1 MHz			3	pF
C_{re}	Reverse Capacitance	I_C = 0 V_{CE} = 15 V f = 1 MHz		1.7	2.2	pF
NF	Noise Figure	V_{CE} = 15 V R_g = 50 Ω f = 200 MHz I_C = 30 mA I_C = 70 mA		4 4.5		dB dB
G_{pe}	Power Gain (see test circuit)	I_C = 70 mA V_{CE} = 18 V f = 200 MHz f = 500 MHz f = 800 MHz		16 9.5 6.5		dB dB dB
P_o (1)	Output Power (see test circuit)	I_C = 70 mA V_{CE} = 18 V f = 200 MHz f = 800 MHz	130 70	150 90		mW mW

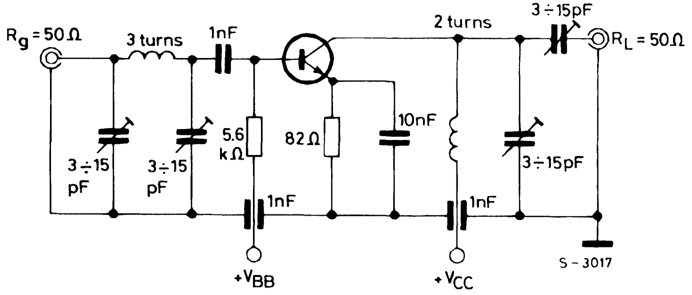
* Pulsed : pulse duration = 300μs, duty cycle = 1%.

** I_B = Value corresponding to I_C = 110mA and V_{CE} = 1V.

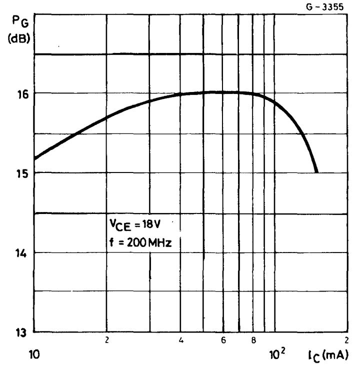
(1) Output VSMR < 2, d_{im} = – 30dB @ f = 2 (f_q – f_p), f_p = 798MHz and f_q = 802MHz.

TEST CIRCUIT

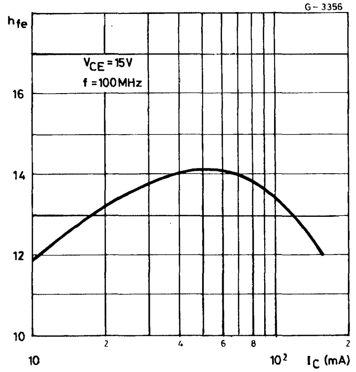
RF amplifier circuit for power gain test (f = 200MHz).



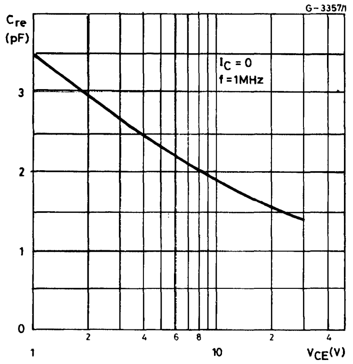
Power Gain vs. Collector Current.



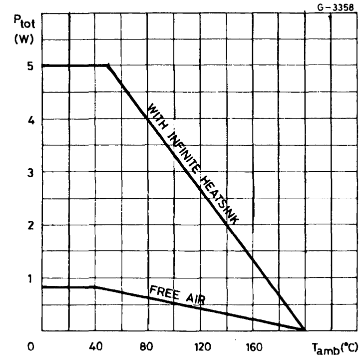
High Frequency Current Gain vs. Collector Current.



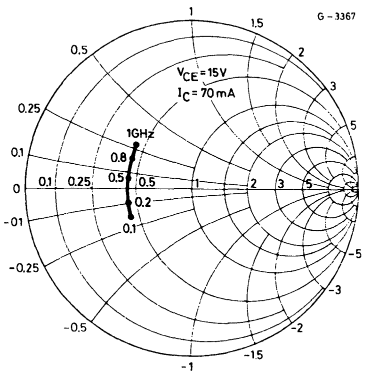
Reverse Capitance.



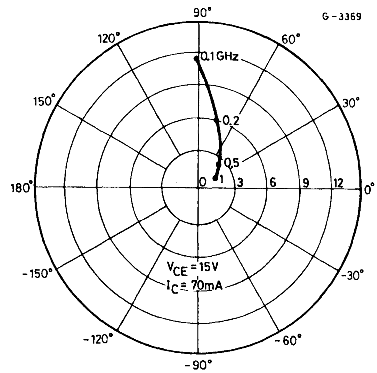
Power Rating Chart.



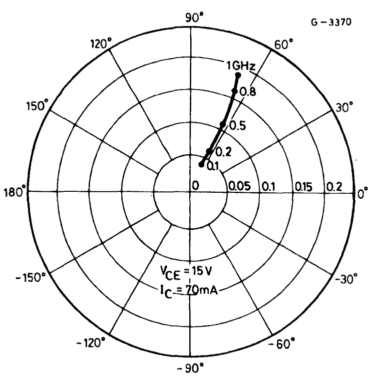
Input Impedance S_{11e} (normalized 50Ω).



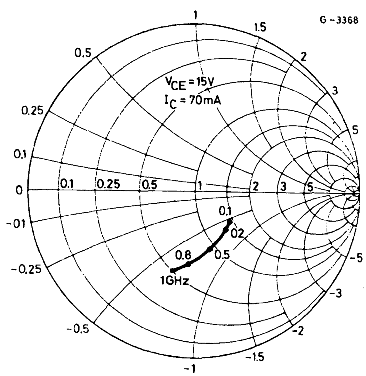
Forward Transfer Coefficient S_{21e}.



Reverse Transfer Coefficient S_{12e}.

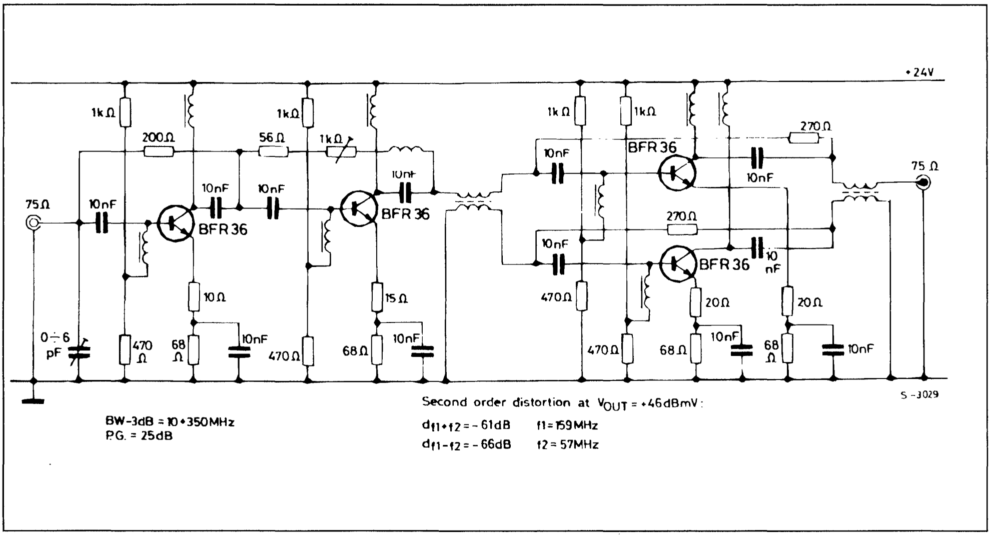


Output Impedance S_{22e} (normalized 50Ω).

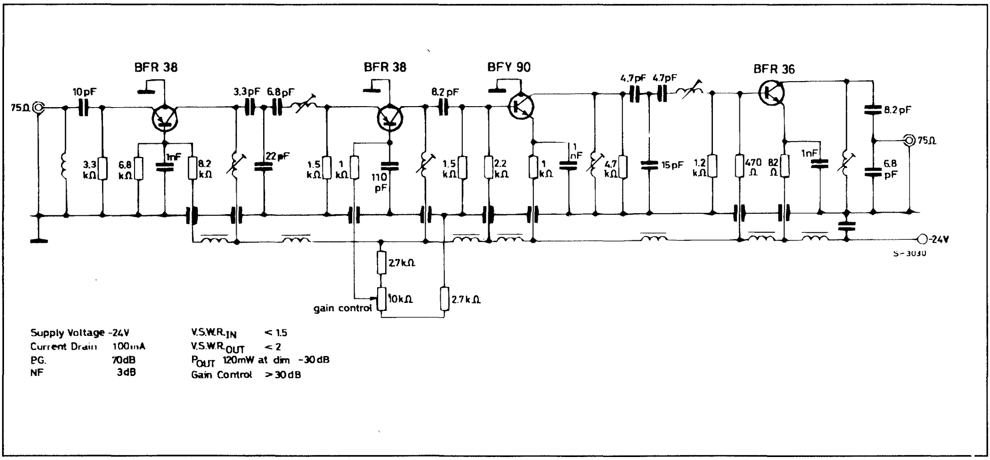


TYPICAL APPLICATIONS

CATV-extender line amplifier.



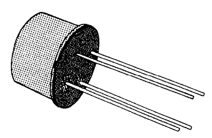
MATV-200MHz channel amplifier.



BFR99

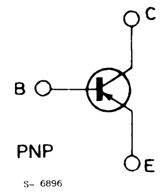
DESCRIPTION

The BFR99 is a silicon planar epitaxial PNP transistor in Jedec TO-72 metal case, particularly designed for wide band common-emitter linear amplifier applications up to 1GHz. It features high fT, low reverse capacitance, good cross-modulation properties and low noise.



TO-72

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector–base Voltage ($I_E = 0$)	– 25	V
V_{CEO}	Collector–emitter Voltage ($I_B = 0$)	– 25	V
V_{EBO}	Emitter–base Voltage ($I_C = 0$)	– 3	V
I_C	Collector Current	– 50	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	225 360	mW mW
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction–case	Max	486	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction–ambient	Max	777	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = – 15 V			– 100	nA
$V_{(BR)CBO}$	Collector–base Breakdowm Voltage (I_E = 0)	I_C = – 100 μA	– 25			V
$V_{CEO(sus)}$*	Collector–emitter Sustaining Voltage (I_B = 0)	I_C = – 5 mA	– 25			V
$V_{(BR)EBO}$	Emitter–base Breakdown Voltage (I_C = 0)	I_E = – 10 μA	– 3			V
V_{BE}	Base–emitter Voltage	I_C = – 10 mA V_{CE} = – 10 V		– 0.75		V
h_{FE}*	DC Current Gain	I_C = – 1 mA V_{CE} = – 10 V I_C = – 10 mA V_{CE} = – 10 V I_C = – 20 mA V_{CE} = – 10 V	 25 20	75 80		
f_T	Transition Frequency	I_C = – 10 mA V_{CE} = – 15 V f = 200 MHz		2		GHz
C_{re}	Reverse Capacitance	I_C = 0 V_{CE} = – 15 V f = 1 MHz		0.4		pF
NF	Noise Figure	I_C = – 3 mA V_{CE} = – 15 V R_g = 50 Ω f = 200 MHz f = 800 MHz I_C = – 10 mA V_{CE} = – 15 V R_g = 50 Ω f = 200 MHz f = 800 MHz		 2.5 3.5 3 4	 5	 dB dB dB dB

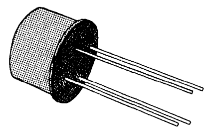
* Pulsed : pulse duration = 300μs, duty cycle = 1%.

WIDE BAND VHF/UHF AMPLIFIER

- SILICON PLANAR EPITAXAL TRANSISTOR
- TO-72 METAL CASE
- VERY LOW NOISE

APPLICATIONS :

- TELECOMMUNICATIONS
- WIDE BAND UHF AMPLIFIER
- RADIO COMMUNICATIONS

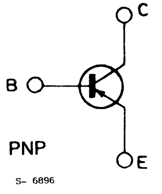


TO-72

DESCRIPTION

The BRF99A is a silicon planar epitaxial PNP transistor produced using interdigitated base emitter geometry. It is particulary designed for use in wide band common-emitter linear amplifiers up to 1GHz. It features very high f_T, low reverse capacitance, excellent cross modulation properties and very low noise performance. The BFR99A is complementary to the BFY90. Typical applications include telecommunication and radio communication equipment.

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector–base Voltage (I_E = 0)	– 25	V
V_{CEO}	Collector–emitter Voltage (I_B = 0)	– 25	V
V_{EBO}	Emitter–base Voltage (I_C = 0)	– 3	V
I_C	Collector Current	– 50	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	225 360	mW mW
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 200	°C

THERMAL DATA

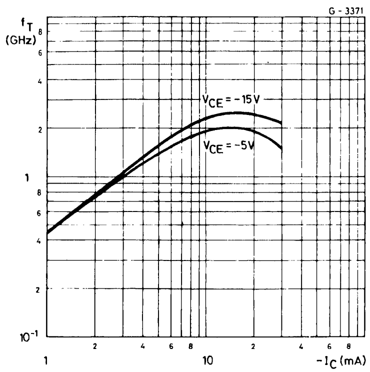
$R_{th\ j-case}$	Thermal Resistance Junction–case	Max	486	°C/W
$R_{th\ j-amb}$	Thermal Resistance Junction–ambient	Max	777	°C/W

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

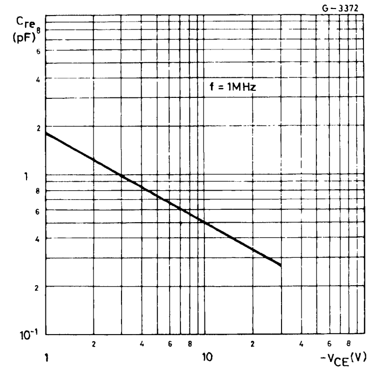
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current ($I_E = 0$)	$V_{CB} = -15$ V			– 100	nA
$V_{(BR)\ CBO}$	Collector–base Breakdown Voltage ($I_E = 0$)	$I_C = -100\ \mu A$	– 25			V
$V_{CEO\ (sus)}$*	Collector–emitter Sustaining Voltage ($I_B = 0$)	$I_C = -5$ mA	– 25			V
$V_{(BR)\ EBO}$	Emitter–base Breakdown Voltage ($I_C = 0$)	$I_E = -10\ \mu A$	– 3			V
V_{CEK}**	Collector–emitter Knee Voltage	$I_C = -20$ mA		– 0.8		V
V_{BE}	Base–emitter Voltage	$I_C = -10$ mA $V_{CE} = -10$ V		– 0.75		V
h_{FE}*	DC Current Gain	$I_C = -1$ mA $V_{CE} = -10$ V $I_C = -10$ mA $V_{CE} = -10$ V $I_C = -20$ mA $V_{CE} = -10$ V	 25 20	75 80		
f_T	Transition Frequency	$I_C = -10$ mA $V_{CE} = -15$ V f = 100 MHz	1.4	2.3		GHz
C_{re}	Reverse Capacitance	$I_C = 0$ $V_{CE} = -15$ V f = 1 MHz		0.4		pF
NF	Noise Figure	$I_C = -3$ mA $V_{CE} = -15$ V $R_g = 50\ \Omega$ f = 200 MHz f = 800 MHz $I_C = -10$ mA $V_{CE} = -15$ V $R_g = 50\ \Omega$ f = 200 MHz f = 800 MHz		 2.5 3.5 3 4	 4 5	 dB dB dB dB
G_{pe}	Power Gain	$I_C = -10$ mA $V_{CE} = -15$ V f = 800 MHz		10		dB
P_o	Output Power	$I_C = -10$ mA $V_{CE} = -15$ V f = 800 MHz		14		mW
$\|S_{21e}\|^2$	Transcuder Power Gain	$I_C = -10$ mA $V_{CE} = -15$ V $R_g = R_L = 50\ \Omega$ f = 800 MHz		8		dB

* Pulsed : pulse duration = 300µs, duty cycle = 1%
* * I_B = value corresponding to $I_C = -22$mA and $V_{CE} = -1$V.

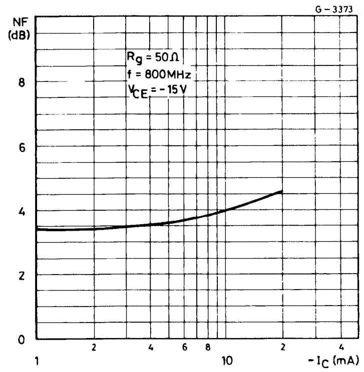
Transition Frequency.



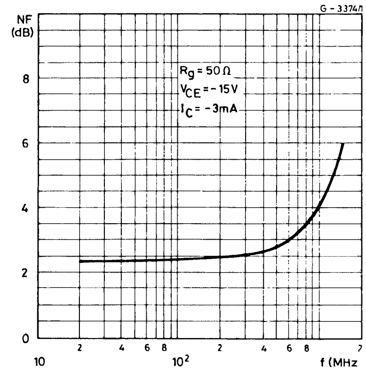
Reverse Capacitance.



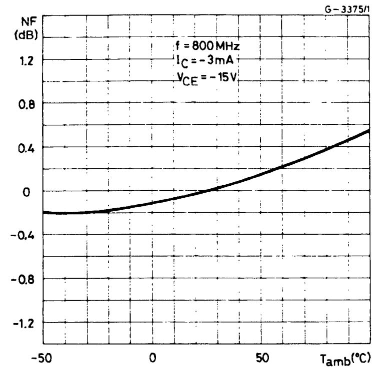
Noise Figure vs. Collector Current.



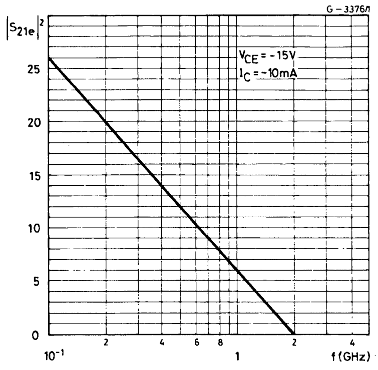
Noise Figure vs. Frequency.



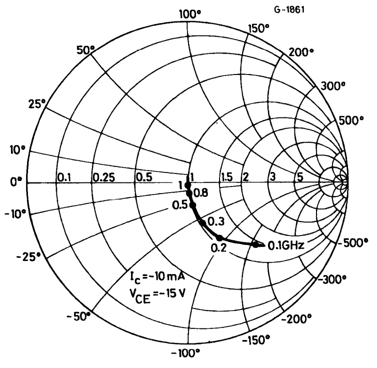
Noise Figure vs. Ambient Temperature.



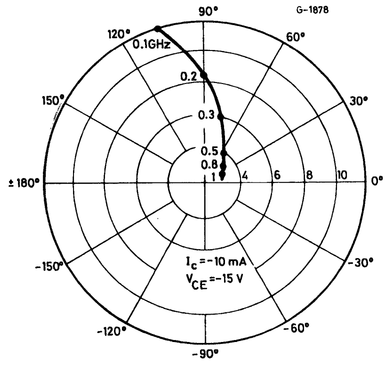
Transducer Power Gain.



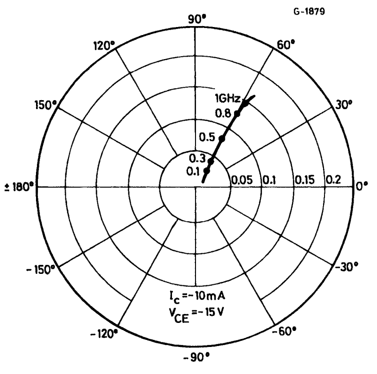
Input Impedance S_{11e} (50Ω normalized).



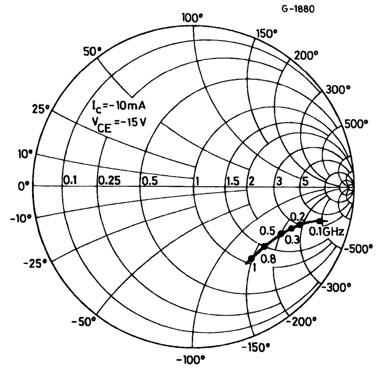
Forward Transfer Coefficient S_{21e}.



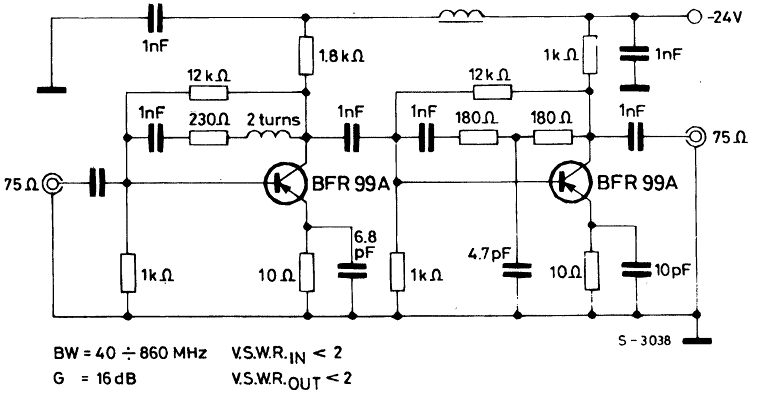
Reverse Transfer Coefficient S_{12e}.



Output Impedance S_{22e} (50Ω normalized).



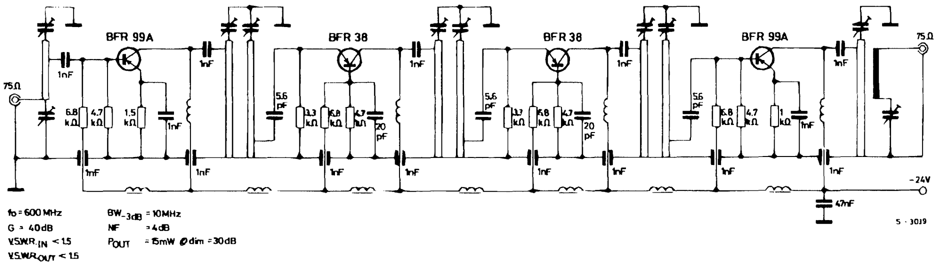
Wide Band MATV Amplifier.



BW = 40 ÷ 860 MHz
G = 16 dB
NF < 5dB

V.S.W.R.$_{IN}$ < 2
V.S.W.R.$_{OUT}$ < 2
V_{OUT} = 100mV for 1% Crossmodulation

MATV Channel Amplifier.



SGS-THOMSON
MICROELECTRONICS

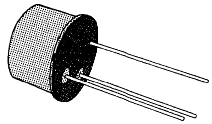
BFW16A
BFW17A

CATV-MATV AMPLIFIERS

DESCRIPTION

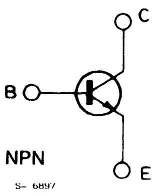
The BFW 16A and BFW 17A are multi-emitter silicon planar epitaxial NPN transistors in Jedec TO-39 metal case, with extremely good intermodulation properties and high power gain. They are primarily intended for final and driver stages in channel-and band-aerial amplifiers with high output power from 40 to 860 MHz.

Another possible application is as the final stage of the wide band vertical amplifier in high speed oscilloscopes.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	40	V
V_{CER}	Collector-emitter Voltage ($R_{BE} \leq 50\ \Omega$)	40	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	25	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	3	V
I_C	Collector Current	150	mA
I_{CM}	Collector Peak Current	300	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 125$ °C	0.7 1.5	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	50	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	250	°C/W

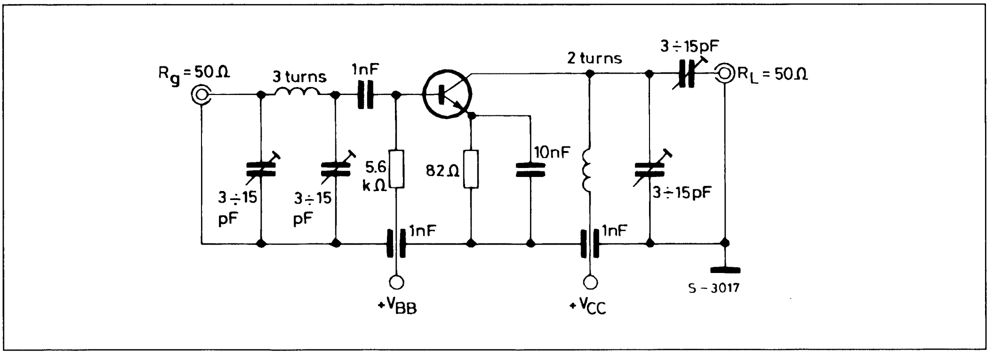
ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 20 V T_{amb} = 150 °C			20	μA
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 100 μA	3			V
V_{CEK}*/**	Collector-emitter Knee Voltage	I_C = 100 mA			0.75	V
h_{FE}*	DC Current Gain	I_C = 50 mA V_{CE} = 5 V I_C = 150 mA V_{CE} = 5 V	25 25			
f_T	Transition Frequency	I_C = 150 mA V_{CE} = 15 V f = 500 MHz for **BFW 16A** for **BFW 17A**		 1.2 1.1		 GHz GHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 15 V f = 1 MHz			4	pF
C_{re}	Reverse Capacitance	I_C = 10 mA V_{CE} = 15 V f = 1 MHz		1.7		pF
NF	Noise Figure (for **BFW 16A** only)	I_C = 30 mA V_{CE} = 15 V R_g = 75 Ω f = 200 MHz			6	dB
G_{pe}	Power Gain (not neutralized)	I_C = 70 mA V_{CE} = 18 V f = 200 MHz for **BFW 16A** and **BFW 17A** f = 800 MHz For **BFW 16A** only		 16 6.5		 dB dB
P_0	Output Power	I_C = 70 mA V_{CE} = 18 V Channel 9(1) for **BFW 16A** for **BFW 17A** Channel 62(2) For **BFW 16A** only	 130 70	 150 150 90		 mW mW mW

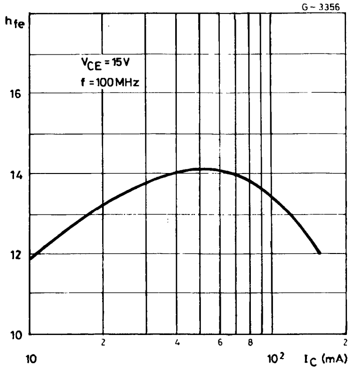
* Pulsed : pulse duration = 300 μs, duty cycle = 1 %.
** I_B = value for which I_C = 110 mA at V_{CE} = 1V.
(1) f_p = 202 MHz, f_q = 205 MHz, $f_{(2q-p)}$ = 208 MHz.
(2) f_p = 798 MHz, f_q = 802 MHz, $f_{(2q-p)}$ = 806 MHz.

TEST CIRCUIT

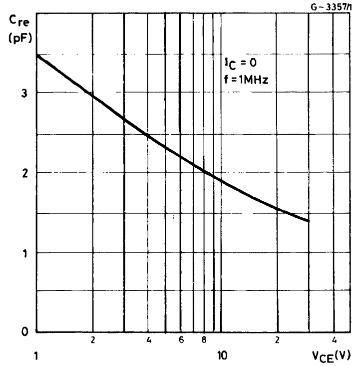
Test Circuit for Power Gain and Output Power Measurements (f = 200 MHz).



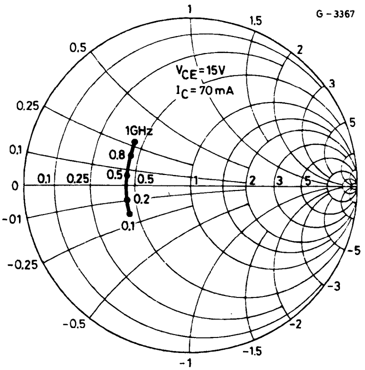
High Frequency Current Gain.



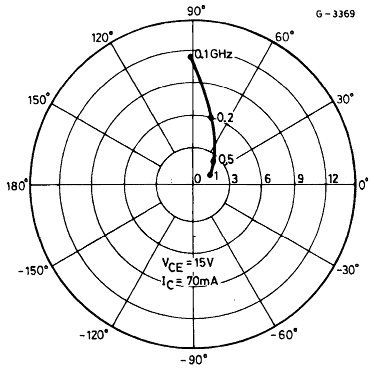
Reverse Capacitance.



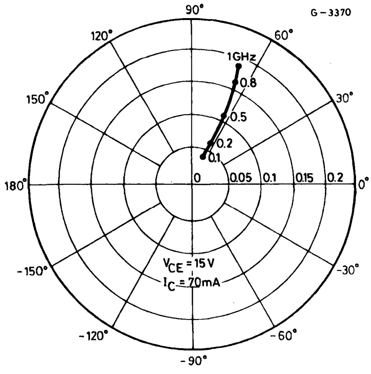
Input Impedance S_{11e} (normalized 50 Ω).



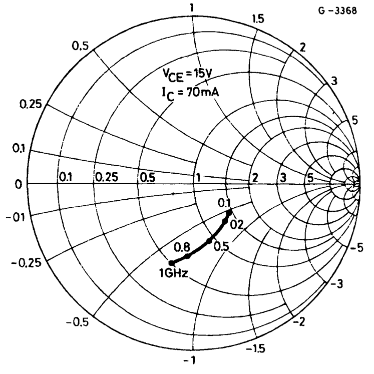
Forward Transfer Coefficient S_{21e}.



Reverse Transfer Coefficient S_{12e}.



Output Impedance S_{22e} (normalized 50 Ω).

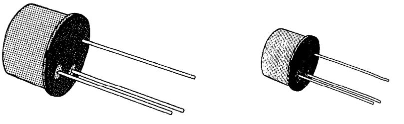


HIGH VOLTAGE AMPLIFIERS

DESCRIPTION

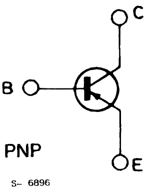
The BFW43 and BFW44 are silicon planar epitaxial PNP transistors in Jedec TO-18 (BFW43) and Jedec TO-39 (BFW44) metal cases.

Both devices are designed for use in amplifiers where high voltage and high gain are necessary. In particular, they feature a V_{CEO} of 150 V and are specified over a wide range of currents.



TO-39 TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-Base Voltage (I_E = 0)	– 150	V
V_{CEO}	Collector-Emitter Voltage (I_B = 0)	– 150	V
V_{EBO}	Emitter-Base Voltage (I_C = 0)	– 6	V
I_C	Collector Current	– 100	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C for **BFW 43** for **BFW 44** at $T_{case} \leq 25$ °C for **BFW 43** for **BFW 44**	 0.4 0.7 1.4 2.5	 W W W W
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 200	°C

THERMAL DATA

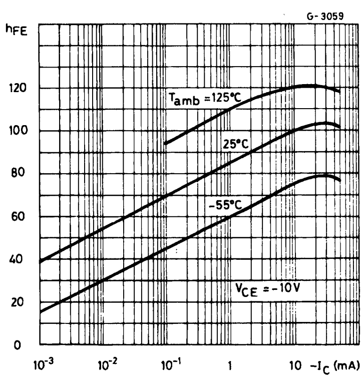
			BFW43	BFW44
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	125 °C/W	70 °C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	438 °C/W	250 °C/W

ELECTRICAL CHARACTERISITCS (T_{amb} = 25 °C unless otherwise specified)

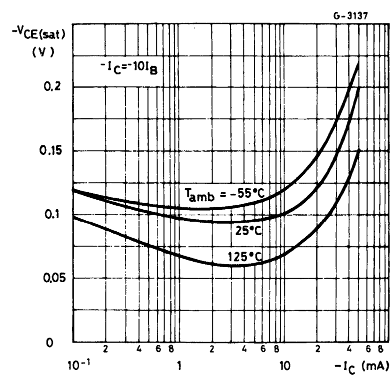
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = – 100 V V_{CB} = – 100 V T_{amb} = 125 °C		– 0.2 – 0.03	– 10 – 10	nA µA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = – 10 µA	– 150			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 2 mA	– 150			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = – 10 µA	– 6			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 10 mA I_B = – 1 mA		– 0.1	– 0.5	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 10 mA I_B = – 1 mA		– 0.74	– 0.9	V
h_{FE}*	DC Current Gain	I_C = – 1 mA V_{CE} = – 10 V I_C = – 10 mA V_{CE} = – 10 V I_C = – 10 µA V_{CE} = – 10 V T_{amb} = – 55 °C	40 40	85 100 30		
f_T	Transition Frequency	V_{CE} = – 10 V f = 20 MHz I_C = – 1 mA I_C = – 10 mA	 60	 50		 MHz MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = – 0.5 V f = 1 MHz		20	25	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 5 V f = 1 MHz		5	7	pF

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

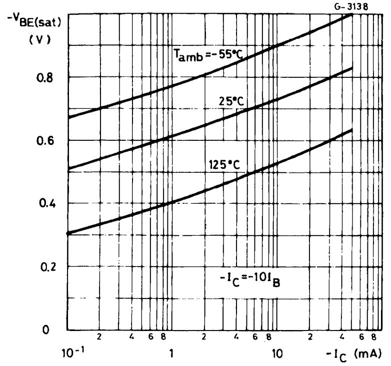
DC Current Gain.



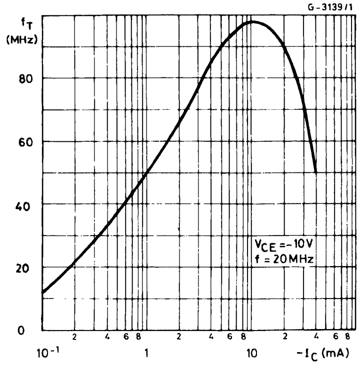
Collector-emitter Saturation Voltage.



Base-emitter Saturation Voltage.



Transition Frequency.



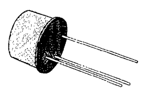
SGS-THOMSON
MICROELECTRONICS

BFX37

LOW-LEVEL, LOW-NOISE AMPLIFIER

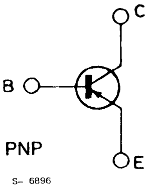
DESCRIPTION

The BFX37 is a silicon planar epitaxial PNP transistor in Jedec TO-18 metal case, designed for use in high performance, low-noise amplifiers over a wide frequency range. It features high current gain over the range from 1 µA to 100 mA and excellent NF at low frequency.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	– 90	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 80	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 6	V
I_C	Collector Current	– 100	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.36 1.2	W W
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 200	°C

THERMAL DATA

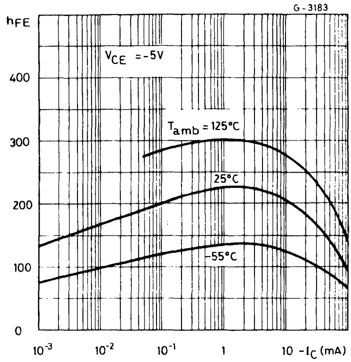
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	146	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

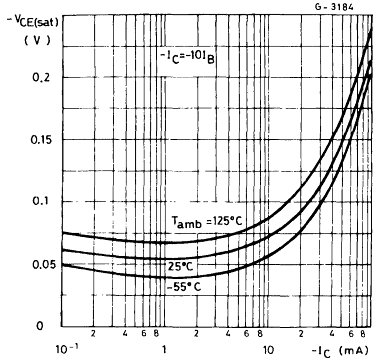
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = – 70 V V_{CE} = – 70 V T_{amb} = 150 °C		– 0.1 – 0.1	– 10 – 10	nA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = – 4 V		– 0.1	– 10	nA
$V_{(BR)CES}$	Collector-emitter Breakdown Voltage (V_{BE} = 0)	I_C = – 10 µA	– 90			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 5 mA	– 80			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = – 10 µA	– 6			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 10 mA I_B = – 0.5 mA I_C = – 50 mA I_B = – 5 mA		– 0.1 – 0.15	– 0.25 – 0.4	V V
V_{BE}	Base-emitter Voltage	I_C = – 1 mA V_{CE} = – 5 V		– 0.65		V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 10 mA I_B = – 0.5 mA I_C = – 50 mA I_B = – 5 mA		– 0.73 – 0.82	– 0.9 – 0.95	V V
h_{FE}*	DC Current Gain	I_C = – 1µA V_{CE} = – 5 V I_C = – 10 µA V_{CE} = – 5 V I_C = – 100 µA V_{CE} = – 5 V I_C = – 1 mA V_{CE} = – 5 V I_C = – 10 mA V_{CE} = – 5 V	 70 125 125 125	130 170 200 220 200	 230 280 	
h_{fe}	Small Signal Current Gain	I_C = – 1 mA V_{CE} = – 5 V f = 1 kHz		250		
f_T	Transition Frequency	I_C = – 0.5 mA V_{CE} = – 5 V f = 20 MHz	40	70		MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = – 0.5 V f = 1 MHz		12	15	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 5 V f = 1 MHz		4.5	6	pF
NF	Noise Figure	I_C = – 20 µA V_{CE} = 5 V R_g = 10 kΩ f = 1 kHz f = 10 to 10000 Hz		 0.8 1	 2.5 3.5	 dB dB
h_{ie}	Input Impedance	I_C = – 1 mA V_{CE} = – 5 V f = 1 kHz		6.5		kΩ
h_{re}	Reverse Voltage Ratio	I_C = – 1 mA V_{CE} = – 5 V f = 1 kHz		2.5×10^{-4}		
h_{oe}	Output Admittance	I_C = – 1 mA V_{CE} = – 5 V f = 1 kHz		15		µS

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

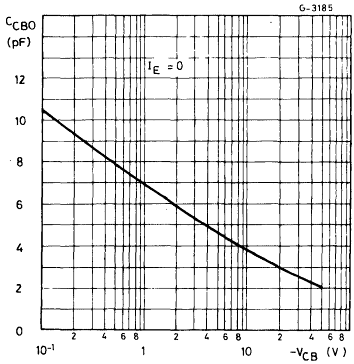
DC Current Gain.



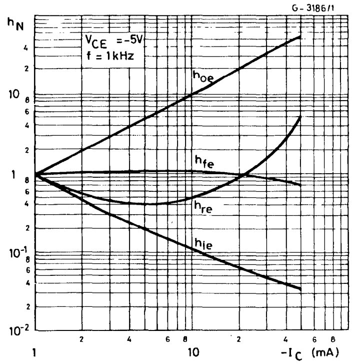
Collector-emitter Saturation Voltage.



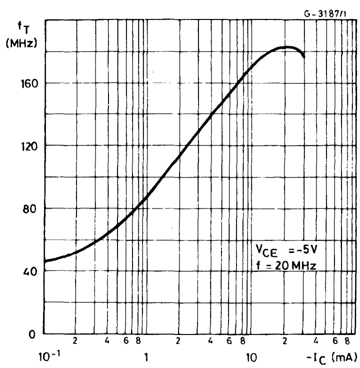
Collector-base Capacitance.



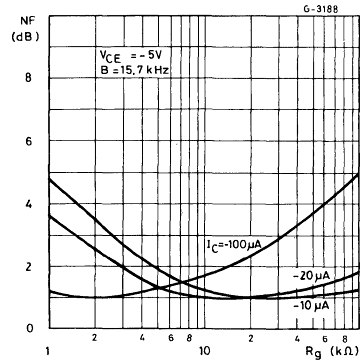
Normalized h Parameters.



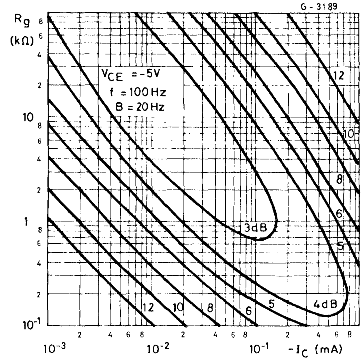
Transition Frequency.



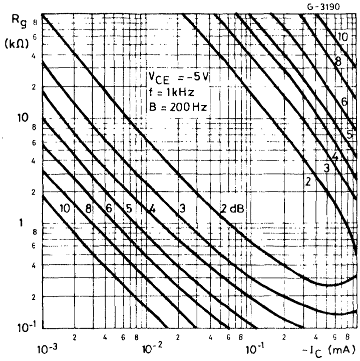
Noise Figure vs. Source Resistance.



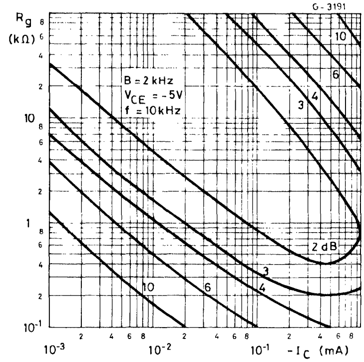
Contours of Constant Noise Figure (f = 100 Hz).



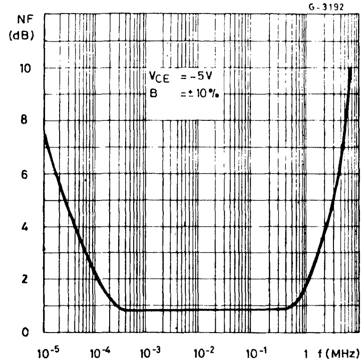
Countours of Constant Noise Figure (f = 1 kHz).



Contours of Constant Noise Figure (f = 10 kHz).



Noise Figure vs. Frequency.



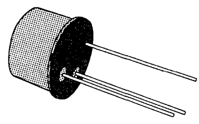
SGS-THOMSON MICROELECTRONICS

BFX38/BFX39 BFX40/BFX41

HIGH VOLTAGE, GENERAL PURPOSE TYPES

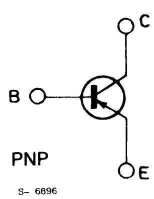
DESCRIPTION

The BFX38, BFX39, BFX40 and BFX41 are silicon planar epitaxial PNP transistors in Jedec TO-39 metal case, designed for a wide variety of applications. They are particulary useful as complementary drivers (BFY56A is a good complement) in output and switching applications where high voltage and high current are required.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BFX38 BFX39	BFX40 BFX41	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	– 55	– 75	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	– 55	– 75	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	– 5		V
I_C	Collector Current	– 1		A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.8 4		W
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 200		°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	44	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	219	°C/W

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

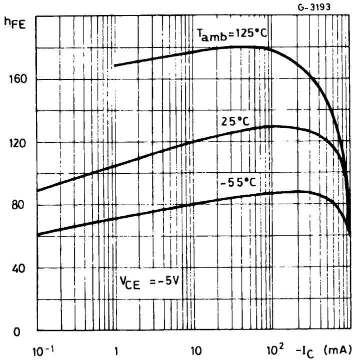
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **BFX38 – BFX39**				
		V_{CB} = – 40 V		– 0.2	– 50	nA
		V_{CB} = – 40 V T_{amb} = 125 °C		– 0.25	– 50	μA
		for **BFX40 – BFX41**				
		V_{CB} = – 50 V		– 0.2	– 50	nA
		V_{CB} = – 50 V T_{amb} = 125 °C		– 0.25	– 50	μA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = – 10 μA				
		for **BFX38 – BFX39**	– 55			V
		for **BFX40 – BFX41**	– 75			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 10 mA				
		for **BFX38 – BFX39**	– 55			V
		for **BFX40 – BFX41**	– 75			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = – 10 μA	– 5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_c = – 150 mA I_B = – 15 mA		– 0.12	– 0.15	V
		I_c = – 500 mA I_B = – 50 mA		– 0.3	– 0.5	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 150 mA I_B = – 15 mA		– 0.8	– 0.9	V
		I_C = – 500 mA I_B = – 50 mA		– 0.9	– 1.1	V
h_{FE}*	DC Current Gain	for **BFX38 – BFX40**				
		I_C = – 100 μA V_{CE} = – 5 V	60	90		
		I_C = – 100 mA V_{CE} = – 5 V	85	130		
		I_C = – 500 mA V_{CE} = – 5 V	60	120		
		for **BFX39 – BFX41**				
		I_C = – 100 μA V_{CE} = – 5 V	30	45		
		I_C = – 100 mA V_{CE} = – 5 V	40	70		
		I_C = – 500 mA V_{CE} = – 5 V	25	65		
h_{FE}*	DC Current Gain	I_C = – 1 A V_{CE} = – 5 V				
		for **BFX38**	30			
		for **BFX39**	15			
		for **BFX40**	25			
		for **BFX41**	10			
		I_C = – 100 mA V_{CE} = – 5 V T_{amb} = – 55 °C				
		for **BFX38 – BFX40**	30			
		for **BFX39 – BFX41**	15			
f_T	Transition Frequency	I_C = – 50 mA V_{CE} = – 10 V f = 100 MHz	100	150		MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 f = 1 MHz V_{EB} = – 0.5 V		75	120	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 f = 1 MHz V_{CB} = – 0.5 V		15	20	pF
t_{on}**	Turn-on Time	I_C = – 500 mA I_{B1} = – 50 mA V_{CC} = – 30 V		33	100	ns

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

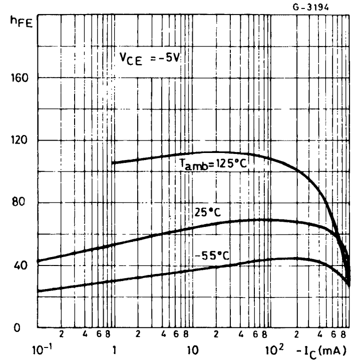
ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s**	Storage Time	$I_C = -500$ mA $V_{CC} = -30$ V $I_{B1} = I_{B2} = -50$ mA		160	350	ns
t_f**	Fall Time	$I_C = -500$ mA $V_{CC} = -30$ V $I_{B1} = -I_{B2} = -50$ mA		27	50	ns

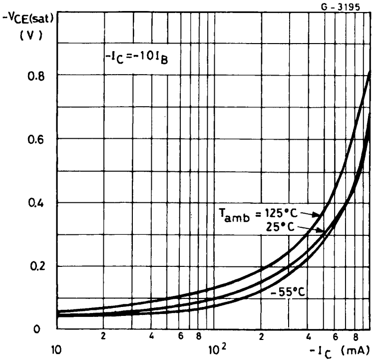
DC Current Gain (for BFX38 and BFX40 only).



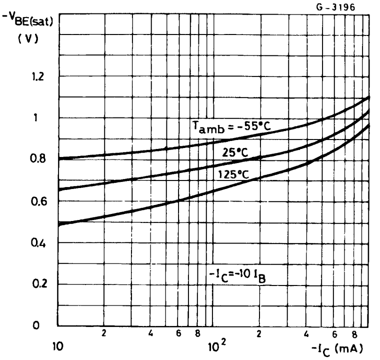
DC Current Gain (for BFX39 and BFX41 only).



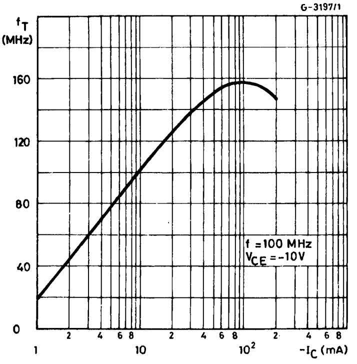
Collector-emitter Saturation Voltage.



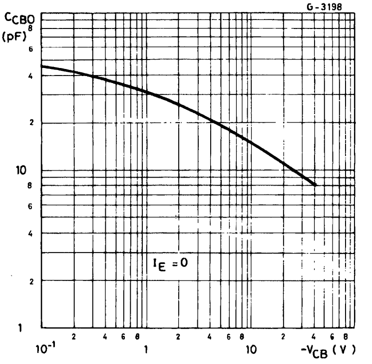
Base-emitter Saturation Voltage.



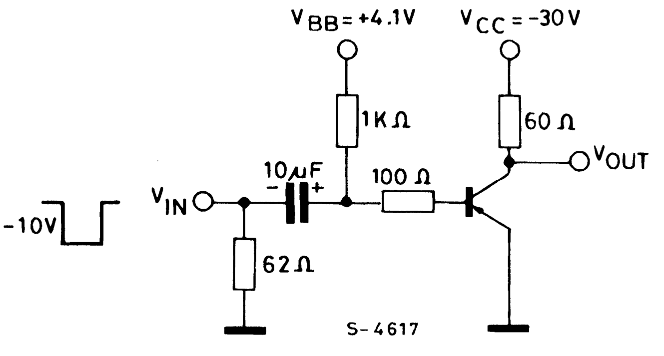
Transition Frequency.



Collector-base Capacitance.



Test Circuit for t_{on}, t_s, and t_f.



PULSE GENERATOR :
t_r, t_f < 20 ns
PW = 10 μs
Z_{IN} = 50 Ω
DC < 2 %

TO OSCILLOSCOPE:
t_r ≈ 10 ns
Z_{IN} > 100 KΩ

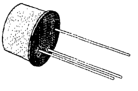
SGS-THOMSON
MICROELECTRONICS

BFX48

HIGH-FREQUENCY AMPLIFIER

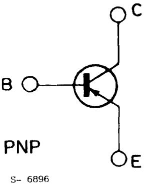
DESCRIPTION

The BFX48 is a silicon planar epitaxial PNP transistor in Jedec TO-18 metal case. It is suitable for a wide range of applications including low noise, low current high gain RF and wide band pulse amplifiers.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	– 30	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	– 30	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	– 5	V
I_C	Collector Current	– 100	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.36 1	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

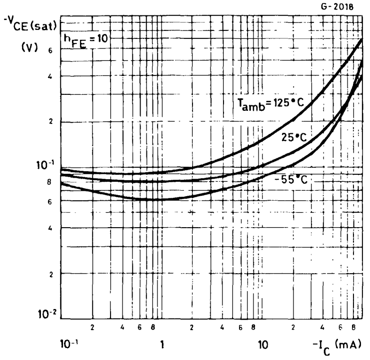
$R_{th\ j-case}$	Thermal Resistance Junction-case	Max	175	°C/W
$R_{th\ j-amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

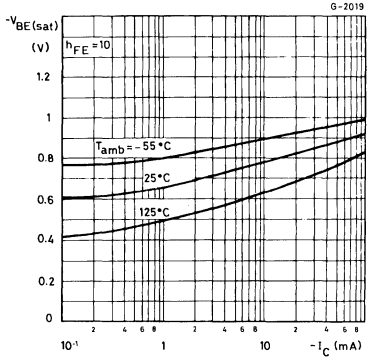
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = – 20 V V_{CE} = – 20 V T_{amb} = 125 °C			– 15 – 15	nA µA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = – 10 µA	– 30			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 10 mA	– 30			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = – 10 µA	– 5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 1 mA I_B = – 0.1 mA I_C = – 10 mA I_B = – 1 mA I_C = – 50 mA I_B = – 5 mA		– 0.1	– 0.13 – 0.14 – 0.3	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 1 mA I_B = – 0.1 mA I_C = – 10 mA I_B = – 1 mA I_C = – 50 mA I_B = – 5 mA		– 0.77	– 0.75 – 0.9 – 1.1	V V V
h_{FE}*	DC Current Gain	I_C = – 10 µA V_{CE} = – 1 V I_C = – 100 µA V_{CE} = – 1 V I_C = – 10 mA V_{CE} = – 1 V I_C = – 50 mA V_{CE} = – 1 V I_C = – 10 mA V_{CE} = – 1 V T_{amb} = – 55 °C	40 70 90 20 30	80 130 160 40		
f_T	Transition Frequency	I_C = – 10 mA V_{CE} = – 20 V f = 100 MHz	400	550		MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = – 0.5 V f = 1 MHz		4	5.5	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 10 V f = 1 MHz		2.2	3.5	pF
NF	Noise Figure	I_C = – 1 mA V_{CE} = – 5 V f = 100 MHz R_g = 100 Ω		3.5	6	dB
t_{on}	Turn-on Time	I_C = – 50 mA I_{B1} = – 5 mA		20	50	ns
t_{off}	Turn-off Time	I_C = – 50 mA I_{B1} = – I_{B2} = – 5 mA		95	160	ns
$r_{bb'}C_{b'c}$	Feedback Time Constant	I_C = – 10 mA V_{CE} = – 20 V f = 80 MHz			40	ps

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

Collector-emitter Saturation Voltage.



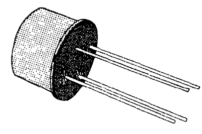
Base-emitter Saturation Voltage.



HIGH-FREQUENCY OSCILLATORS AND AMPLIFIERS

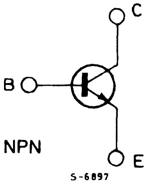
The BFX73, 2N918 and 2N3600 are silicon planar epitaxial NPN transistors in Jedec TO-72 metal case.

They are designed for low-noise VHF amplifiers, oscillators up to 1 GHz, non-neutralized IF amplifiers and non-saturating circuits with rise and fall times of less than 2.5 ns.



TO-72

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	30	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	15	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	3	V
I_C	Collector Current	50	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{amb} \leq 25$ °C	200 300	mW mW
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	584	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	875	°C/W

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

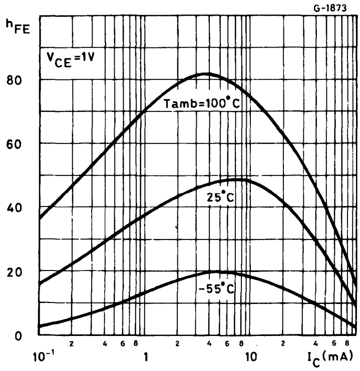
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 15 V V_{CB} = 15 V T_{amb} = 150 °C			10 1	nA μA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 1 μA	30			V
$V_{CEO\ (sus)}$	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 3 mA	15			V
$V_{(BR)\ EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 10 μA	3			V
$V_{CE\ (sat)}$	Collector-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA			0.4	V
$V_{BE\ (sat)}$	Base-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA			1	V
h_{FE}	DC Current Gain	I_C = 3 mA V_{CE} = 1 V for **2N918/BFX73** for **2N3600**	 20 20	 50	 150	
f_T	Transition Frequency	for **2N918/BFX73** I_C = 4 mA V_{CE} = 10 V f = 100 MHz for **2N3600** I_C = 5 mA V_{CE} = 6 V f = 100 MHz	 600 850	 900	 1500	 MHz MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz for **2N918/BFX73** for **2N3600**		 1.4	 2	 pF pF
C_{CBO}	Collector-base Capacitance (for **2N918/BFX73** only)	I_E = 0 f = 1 MHz V_{CE} = 0 V V_{CE} = 10 V		 1.8 1	 3 1.7	 pF pF
C_{re}	Reverse Capacitance (for **2N3600** only)	I_C = 0 V_{CB} = 10 V f = 1 MHz			 1	 pF
NF	Noise Figure	I_C = 1.5 mA V_{CE} = 6 V R_g = 50 Ω f = 200 MHz for **2N3600** I_C = 1 mA V_{CE} = 6 V R_g = 400 Ω f = 60 MHz for **2N918/BFX73** for **2N3600**			 4.5 6 3	 dB dB dB
G_{pe}	Power Gain	R_g = 50 Ω f = 200 MHz for **2N918/BFX73** I_C = 6 mA V_{CE} = 12 V for **2N3600** I_C = 5 mA V_{CE} = 6 V	 15 17	 21	 24	 dB dB

* See test circuits.

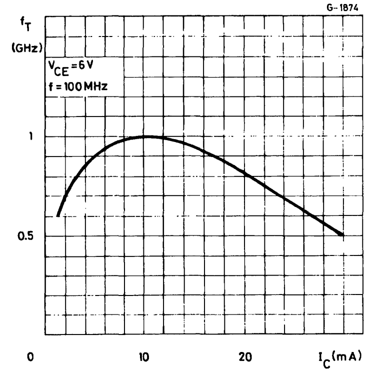
ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
P_o*	Output Power	I_C = 12 mA V_{CB} = 10 V f = 500MHz for **2N918/BFX73** for **2N3600**	 30 20	 40		 mW mW
π	Collector Efficiency (for **2N918/BFX73** only)	I_C = 12 mA V_{CB} = 10 V f = 500 MHz	 25			 %
$r_{b'b}, C_{b'c}$	Feedback Time Constant (for **2N3600** only)	I_C = 5 mA V_{CB} = 6 V f = 31.9 MHz	 4		 15	 ps

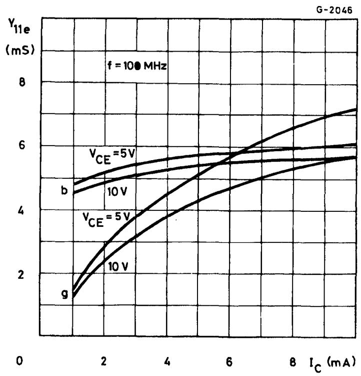
DC Current Gain.



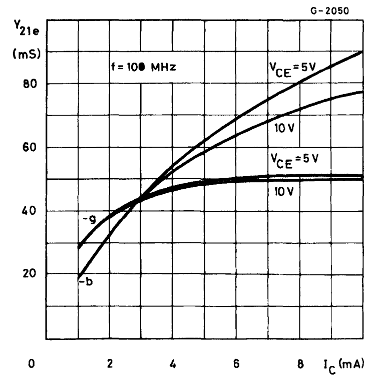
Transition Frequency.



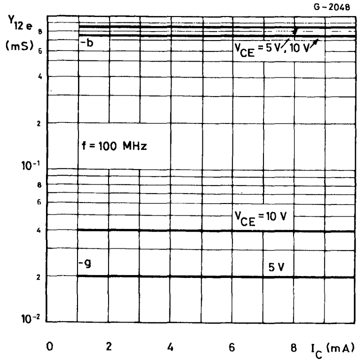
Input Admittance vs. Collector Current.



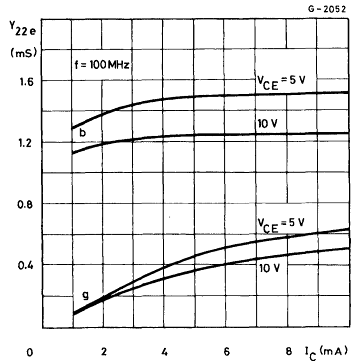
Forward Transadmittance vs. Collector Current.



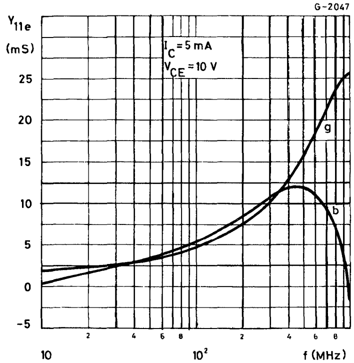
Reverse Transadmittance vs. Collector Current.



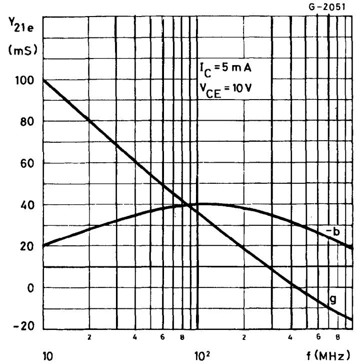
Output Admittance vs. Collector Current.



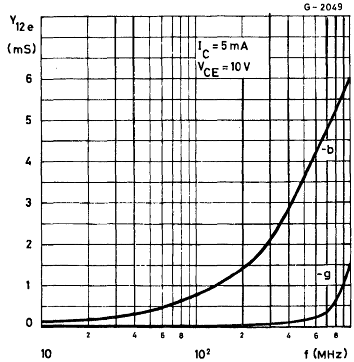
Input Admittance vs. Frequency.



Forward Transadmittance vs. Frequency.



Reverse Transadmittance vs. Frequency.



Output Admittance vs. Frequency.

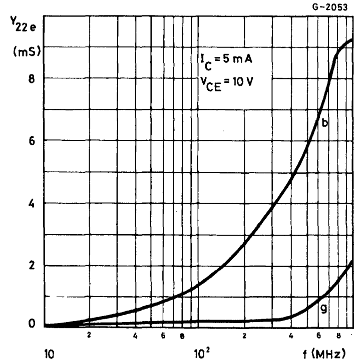
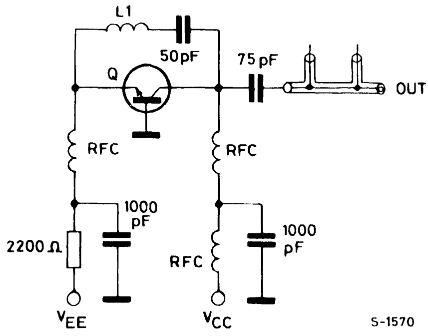


Figure 1 : 500 MHz Oscillator Test Circuit.



SGS-THOMSON
MICROELECTRONICS

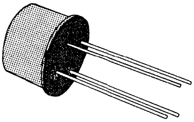
BFX89
BFY90

WIDE BAND VHF/UHF AMPLIFIER

- SILICON PLANAR EPITAXIAL TRANSISTORS
- TO-72 METAL CASE
- VERY LOW NOISE

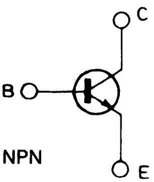
APPLICATIONS :

- TELECOMMUNICATIONS
- WIDE BAND UHF AMPLIFIER
- RADIO COMMUNICATIONS



TO-72

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

The BFX89 and BFY90 are silicon planar epitaxial NPN transistors produced using interdigitated base emitter geometry. They are particulary designed for use in wide band common-emitter linear amplifiers up to 1 GHz. They feature very high f_T, low reverse capacitance, excellent cross modulation properties and very low noise performance. The BFY90 is complementary to the BFR99A. Typical applications include telecommunication and radio communication equipment.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	30	V
V_{CER}	Collector-emitter Voltage ($R_{BE} \leq 50\ \Omega$)	30	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	15	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	2.5	V
I_C	Collector Current	25	mA
I_{CM}	Collector Peak Current (f ≥ 1 MHz)	50	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C	200	mW
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	580	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	880	°C/W

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

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 15 V				10	nA
V_{CEK}*	Collector-emitter Knee Voltage	I_C = 20 mA				0.75	V
h_{FE}	DC Current Gain	I_C = 2 mA	V_{CE} = 1 V				
			for **BFX89**	20		150	
			for **BFY90**	25		150	
		I_C = 25 mA	V_{CE} = 1 V	20		125	
f_T	Transition Frequency	V_{CE} = 5 V	f = 500 MHz				
		I_C = 2 mA					
			for **BFX89**		1		GHz
			for **BFY90**	1	1.1		GHz
		I_C = 25 mA					
			for **BFX89**		1.2		GHz
			for **BFY90**	1.3	1.4		GHz
C_{CBO}(1)	Collector-base Capacitance	I_E = 0	V_{CB} = 10 V				
		f = 1 MHz	for **BFX89**			1.7	pF
			for **BFY90**			1.5	pF
C_{re}(2)	Reverse Capacitance	I_C = 2 mA	V_{CE} = 5 V				
		f = 1 MHz	for **BFX89**		0.6		pF
			for **BFY90**		0.6	0.8	pF
NF(2)	Noise Figure	I_C = 2 mA	V_{CE} = 5 V				
		R_g = Optimized	f = 100 kHz				
			for **BFY90** Only			4	dB
			f = 200 MHz				
		R_g = Optimized	for **BFX89**				
			for **BFY90**		3.3	4	dB
			f = 500 MHz		2.5	3.5	dB
		R_g = 50 Ω	for **BFX89**				
			for **BFY90**			6.5	dB
			f = 800 MHz			5	dB
		R_g = Optimized	for **BFX89**				
			for **BFY90**		7		dB
					5.5		dB
G_{pe}(2)	Power Gain (not neutralized)	for **BFX89**					
		I_C = 8 mA	V_{CE} = 10 V				
			f = 200 MHz	19	22		dB
			f = 800 MHz		7		dB
		for **BFY90**					
		I_C = 14 mA	V_{CE} = 10 V				
			f = 200 MHz	21	23		dB
			f = 800 MHz		8		dB

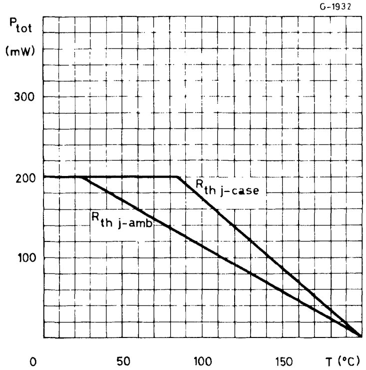
* I_B = value for which I_C = 22 mA at V_{CE} = 1 V
(1) Shield lead not grounded
(2) Shield lead grounded
(3) f_p = 202 MHz, f_q = 205 MHz, $f_{(2q-p)}$ = 208 MHz
(4) f_p = 798 MHz, f_q = 802 MHz, $f_{(2q-p)}$ = 806 MHz

ELECTRICAL CHARACTERISTICS (continued)

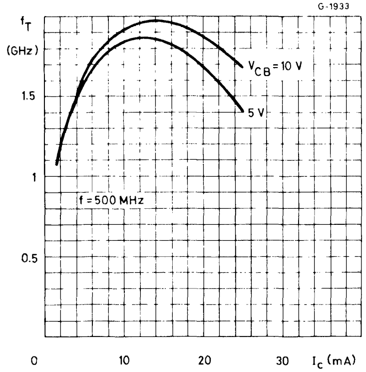
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
P_o	Output Power	for **BFX89** I_C = 8 mA V_{CE} = 10 V d_{im} = – 30 dB (3) Channel 9 (4) Channel 62 for **BFY90** I_C = 14 mA V_{CE} = 10 V d_{im} = – 30 dB (3) Channel 9 (4) Channel 62	 10	 6 6 12 12		 mW mW mW mW

* I_B = value for witch I_C = 22 mA at V_{CE} = 1 V
(1) Shield lead not grounded
(2) Shield lead grounded
(3) f_p = 202 MHz, f_q = 205 MHz, $f_{(2q-p)}$ = 208 MHz
(4) f_p = 798 MHz, f_q = 802 MHz, $f_{(2q-p)}$ = 806 MHz

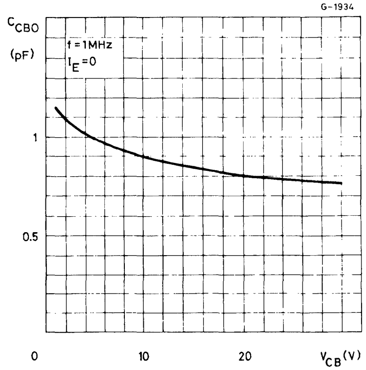
Power Rating Chart.



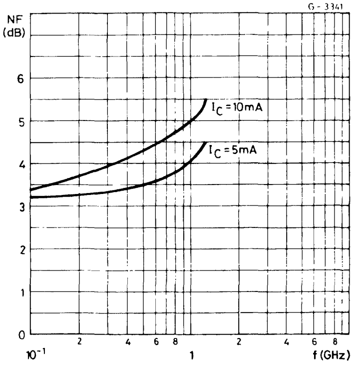
Transition Frequency.



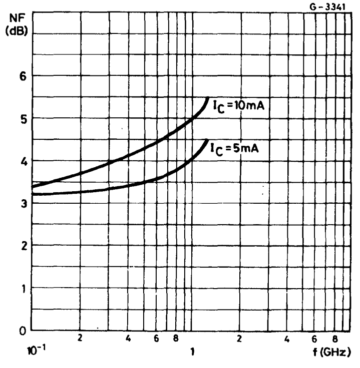
Collector-base Capacitance.



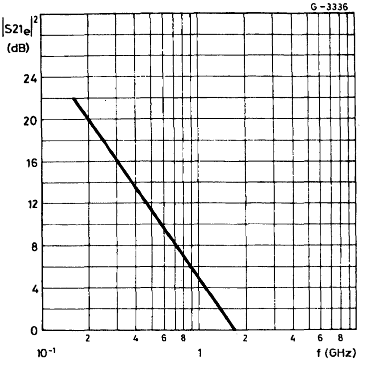
Noise Figure vs. Collector Current.



Noise Figure vs. Frequency.



Forward Transmission Gain vs. Frequency.



SGS-THOMSON MICROELECTRONICS

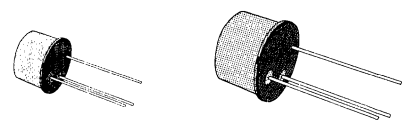
BFX90
BFX91

HIGH-VOLTAGE AMPLIFIERS

DESCRIPTION

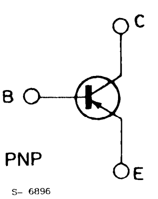
The BFX90 and BFX91 are silicon planar epitaxial PNP transistors in Jedec TO-18 (BFX90) and Jedec TO-39 (BFX91) metal cases.

Both devices feature high voltage, high gain, low noise and excellent current gain linearity from 10 µA to 50 mA.



TO–18 TO–39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	– 180	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 180	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 6	V
I_C	Collector Current	– 100	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C		
	for **BFX90**	0.4	W
	for **BFX91**	0.7	W
	at $T_{case} \leq 25$ °C		
	for **BFX90**	1.4	W
	for **BFX91**	2.5	W
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 200	°C

THERMAL DATA

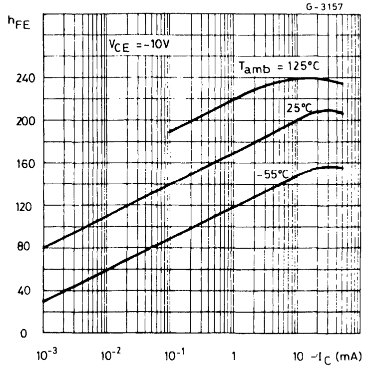
			BFX90	BFX91	Unit
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	125	70	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	438	250	°C/W

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

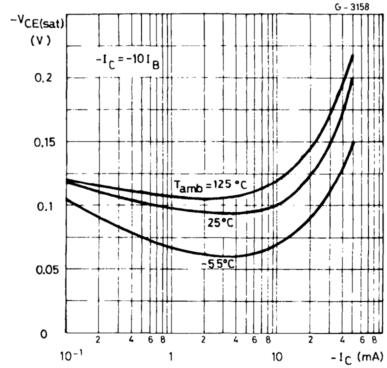
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = – 100 V V_{CB} = – 100 V T_{amb} = 125 °C			– 10 – 10	nA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = – 4 V			– 10	nA
$V_{(BR)\ CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = – 10 µA	– 180			V
$V_{(BR)\ CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 2 mA	– 180			V
$V_{(BR)\ EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = – 10 µA	– 6			V
$V_{CE\ (sat)}$*	Collector-emitter Saturation Voltage	I_C = – 10 mA I_B = – 1 mA		– 0.1	– 0.25	V
$V_{BE\ (sat)}$ *	Base-emitter Saturation Voltage	I_C = – 10 mA I_B = – 1 mA		– 0.74	– 0.9	V
h_{FE}*	DC Current Gain	I_C = – 10 µA V_{CE} = – 10 V I_C = – 1 mA V_{CE} = – 10 V I_C = – 10 mA V_{CE} = – 10 V I_C = – 10 µA V_{CE} = – 10 V T_{amb} = – 55 °C I_C = – 100 µA V_{CE} = – 10 V T_{amb} = – 55 °C	60 80 80 15 30	110 170 200 60 90	 300	
h_{fe}	Small Signal Current Gain	I_C = – 1 mA f = 1 kHz V_{CE} = – 10 V	80		400	
f_T	Transition Frequency	I_C = – 1 mA f = 20 MHz V_{CE} = – 10 V	40	60	160	MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 f = 1 MHz V_{EB} = – 0.5 V		20	25	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 f = 1 MHz V_{CB} = – 5 V		5	7	pF
NF	Noise Figure	I_C = – 10 µA V_{CE} = – 5 V R_g = 10 kΩ f = 10 kHz B = 2 kHz f = 1 kHz B = 200 Hz f = 100 Hz B = 20 Hz		 1 1 2	 3 3 10	 dB dB dB
h_{ie}	Input Impedance	I_C = – 1 mA f = 1 kHz V_{CE} = – 10 V	2.5		12	kΩ
h_{oe}	Output Admittance	I_C = – 1 mA f = 1 kHz V_{CE} = – 10 V	5		25	µS

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

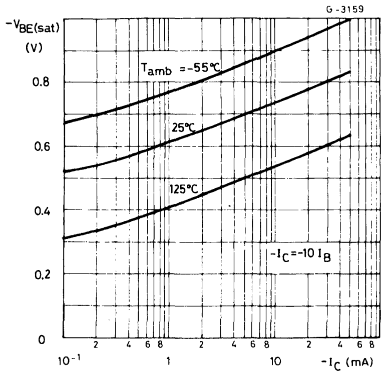
DC Current Gain.



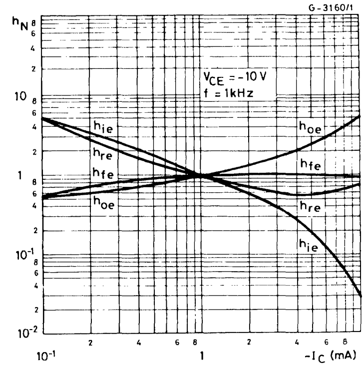
Collector-emitter Saturation Voltage.



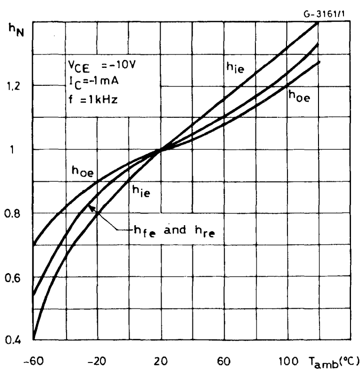
Base-emitter Saturation Voltage.



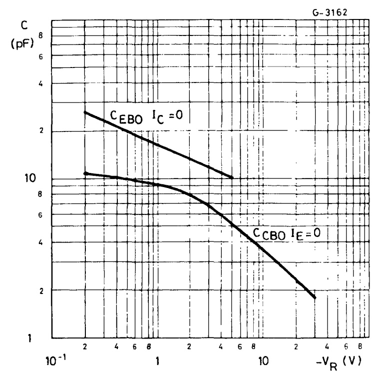
Normalized h Parameters vs. Collector Current.



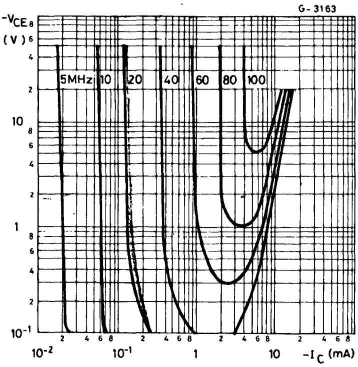
Normalized h Parameters vs. Ambient Temperature.



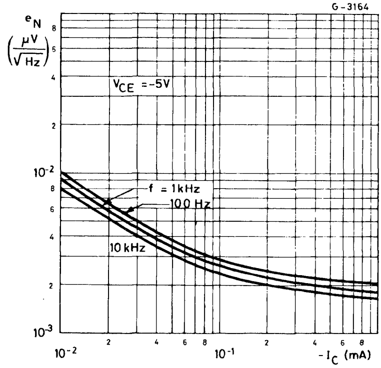
Emitter-base and Collector-base Capacitances.



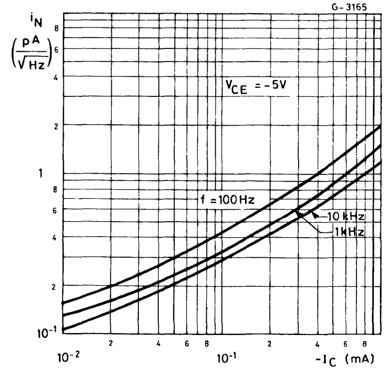
Contours of Constant Transition Frequency.



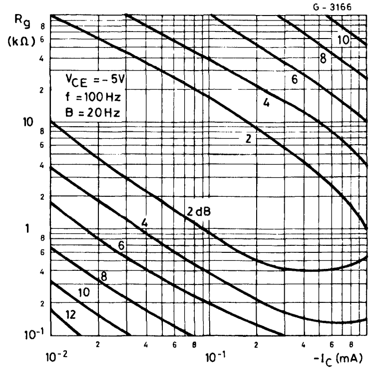
Equivalent Input Noise Voltage.



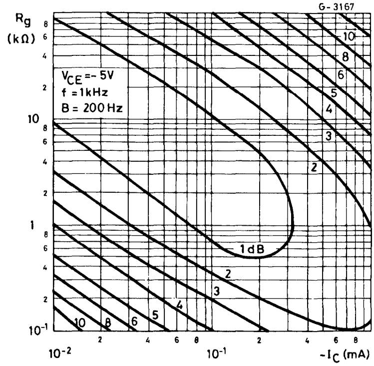
Equivalent Input Noise Current.



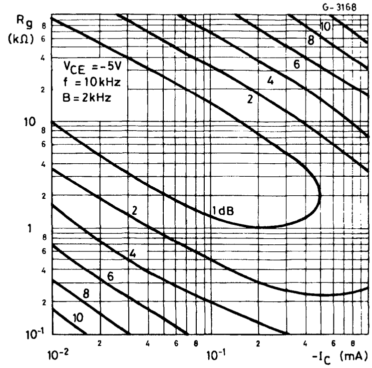
Contours of Constant Noise Figure (f = 100 Hz).



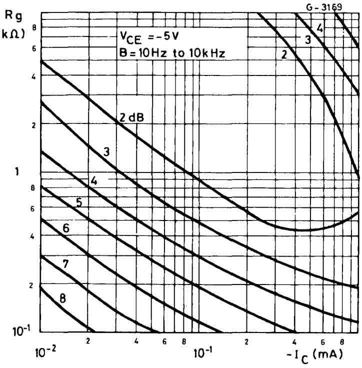
Contours of Constant Noise Figure (f = 1 kHz).



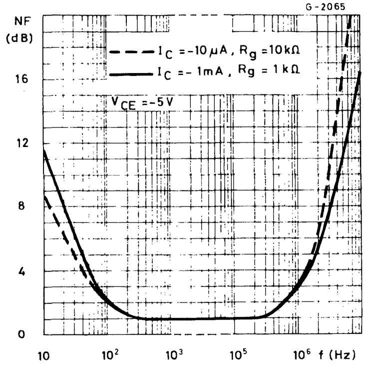
Contours of Constant Noise Figure (f = 10 kHz).



Contours of Constant Wide Band Noise Figure.



Noise Figure vs. Frequency.



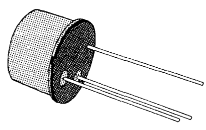
SGS-THOMSON
MICROELECTRONICS

BFY50-BFY51
BFY52

MEDIUM-POWER AMPLIFIERS

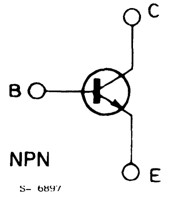
DESCRIPTION

The BFY50, BFY51 and BFY52 are silicon planar epitaxial NPN transistors in Jedec TO-39 metal case. They are intended for general purpose linear and switching applications.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	BFY50	BFY51	BFY52
V_{CBO}	Collector-base Voltage ($I_E = 0$)	80 V	60 V	40 V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	35 V	30 V	20 V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	6 V		
I_C	Collector Current	1 A		
I_{CM}	Collector Peak Current	1.5 A		
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.8 W 5 W		
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200 °C		

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	35	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	218	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	for **BFY50**				
		V_{CB} = 60 V			50	nA
		V_{CB} = 60 V T_{case} = 100 °C			2.5	μA
		for **BFY51**				
		V_{CB} = 40 V			50	nA
		V_{CB} = 40 V T_{case} = 100 °C			2.5	μA
		for **BFY52**				
		V_{CB} = 30 V			50	nA
		V_{CB} = 30 V T_{case} = 100 °C			2.5	μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			50	nA
		V_{EB} = 5 V T_{case} = 100 °C			2.5	μA
$V_{(BR)CBO}$*	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 μA for **BFY50**	80			V
		for **BFY51**	60			V
		for **BFY52**	40			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 30 mA for **BFY50**	35			V
		for **BFY51**	30			V
		for **BFY52**	20			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 100 μA	6			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA				
		for **BFY50**		0.14	0.2	V
		for **BFY51** and **BFY52**		0.14	0.35	V
		I_C = 1 A I_B = 0.1 A				
		for **BFY50**		0.7	1	V
		for **BFY51** and **BFY52**		0.7	1.6	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA		0.95	1.3	V
		I_C = 1 A I_B = 0.1 A		1.5	2	V
h_{FE}*	DC Current Gain	for **BFY50**				
		I_C = 10 mA V_{CE} = 10 V	20	40		
		I_C = 150 mA V_{CE} = 10 V	30	55		
		I_C = 1 A V_{CE} = 10 V	15	30		
		for **BFY51**				
		I_C = 10 mA V_{CE} = 10 V	30	55		
		I_C = 150 mA V_{CE} = 10 V	40	70		
		I_C = 1 A V_{CE} = 10 V	15	40		
		for **BFY52**				
		I_C = 10 mA V_{CE} = 10 V	30	80		
		I_C = 150 mA V_{CE} = 10 V	60	130		
		I_C = 1 A V_{CE} = 10 V	15	60		
h_{fe}	Small Signal Current Gain	V_{CE} = 6 V f = 1 kHz				
		I_C = 1 mA				
		for **BFY50**		25		
		for **BFY51**		30		
		for **BFY52**		40		
		I_C = 10 mA				
		for **BFY50**		45		
		for **BFY51**		60		
		for **BFY52**		120		

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

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
f_T	Transition Frequency	I_C = 50 mA	V_{CE} = 10 V				
			for **BFY50**	60	100		MHz
			for **BFY51**	50	110		MHz
			for **BFY52**	50	120		MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 f = 1 MHz	V_{CB} = 10 V		10		pF
h_{ie}	Input Impedance	I_C = 10 mA f = 1 kHz	V_{CE} = 5 V				
			for **BFY50**		180		Ω
			for **BFY51**		220		Ω
			for **BFY52**		400		Ω
h_{re}	Reserve Voltage Ratio	I_C = 10 mA f = 1 kHz	V_{CE} = 5 V				
			for **BFY50**		55×10^{-6}		
			for **BFY51**		70×10^{-6}		
			for **BFY52**		130×10^{-6}		
h_{oe}	Output Admittance	I_C = 10 mA f = 1 kHz	V_{CE} = 5 V				
			for **BFY50**		30		μS
			for **BFY51**		35		μS
			for **BFY52**		70		μS
t_d	Delay Time	I_C = 150 mA I_{B1} = 15 mA	V_{CC} = 10 V V_{BE} = – 2 V		15		ns
t_r	Rise Time	I_C = 150 mA I_{B1} = 15 mA	V_{CC} = 10 V V_{BE} = – 2 V		40		ns
t_s	Storage Time	I_C = 150 mA I_{B1} = – I_{B2} = 15 mA	V_{CC} = 10 V		300		ns
t_f	Fall Time	I_C = 150 mA I_{B1} = – I_{B2} = 15 mA	V_{CC} = 10 V		60		ns

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

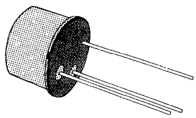
SGS-THOMSON
MICROELECTRONICS

BFY56
BFX56A

AMPLIFIERS AND SWITCHES

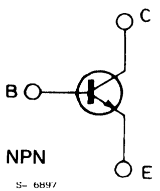
DESCRIPTION

The BFX56 and BFY56A are silicon planar epitaxial NPN transistors in Jedec TO-39 metal case. They are designed for amplifier and switching applications over a wide range of voltage and current.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	BFY56	BFY56A	Unit
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	85	85	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	45	55	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7		V
I_C	Collector Current	1		A
P_{tot}	Total Power Dissipation at $T_{amb} \le 25$ °C at $T_{case} \le 25$ °C	0.8 5		W W
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 200		°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	35	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	219	°C/W

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

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 50 V V_{CE} = 50 V	 T_{amb} = 150 °C		0.2 0.2	20 20	nA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			0.1	20	nA
$V_{(BR)CES}$	Collector-emitter Breakdown Voltage (V_{BE} = 0)	I_C = 100 µA		85			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 30 mA	for **BFY56** for **BFY56A**	45 55			V V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 100 µA		7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	for **BFY56** I_C = 150 mA I_C = 1 A for **BFY56A** I_C = 10 mA I_C = 150 mA I_C = 1 A	 I_B = 15 mA I_B = 0.1 A I_B = 1 mA I_B = 15 mA I_B = 0.1 mA		 0.13 0.65 0.05 0.13 0.65	 0.3 1.2 0.25 1	 V V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	for **BFY56** I_C = 150 mA I_C = 1 A for **BFY56A** I_C = 10 mA I_C = 150 mA I_C = 1 A	 I_B = 15 mA I_B = 0.1 A I_B = 1 mA I_B = 15 mA I_B = 0.1 A		 0.85 1.5 0.68 0.85 1.3	 1.5 2.3 0.8 1 1.6	 V V V V V
h_{FE}*	DC Current Gain	for **BFY56** I_C = 0.1 mA I_C = 500 mA I_C = 150 mA for **BFY56A** I_C = 0.1 mA I_C = 5 mA I_C = 150 mA I_C = 500 mA	 V_{CE} = 10 V V_{CE} = 10 V V_{CE} = 1 V V_{CE} = 1 V V_{CE} = 1 V V_{CE} = 1 V V_{CE} = 10 V	 15 20 30 20 50 40 25	 50 55 70 50 85 80 55	 150 120 	
h_{fe}	Small Signal Current Gain	I_C = 1 mA f = 1 MHz	V_{CE} = 5 V for **BFY56** for **BFY56A**		 60 80		
f_T	Transition Frequency	I_C = 50 mA f = 20 MHz	V_{CE} = 10 V for **BFY56** for **BFY56A**	 40 60	 90 90		 MHz MHz

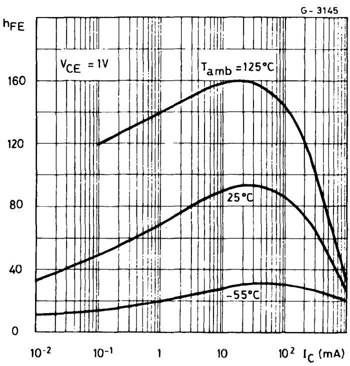
* Pulsed : pulse duration = 300 µs, duty cycle = 1 %.

ELECTRICAL CHARACTERISTICS (continued)

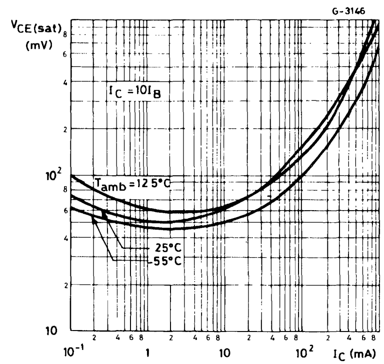
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
C_{EBO}	Emitter-base Capacitance	$I_C = 0$ f = 1 MHz	$V_{EB} = 0.5$ V		50	80	pF
C_{CBO}	Collector-base Capacitance	$I_E = 0$ f = 1 MHz	$V_{CB} = 10$ V		14	25	pF
h_{ie}	Input Impedance	$I_C = 1$ mA f = 1 kHz	$V_{CE} = 5$ V for **BFY56** for **BFY56A**		 1.8 2		 kΩ kΩ
h_{re}	Reverse Voltage Ratio	$I_C = 1$ mA f = 1 kHz	$V_{CE} = 5$ V		2.1×10^{-4}		

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

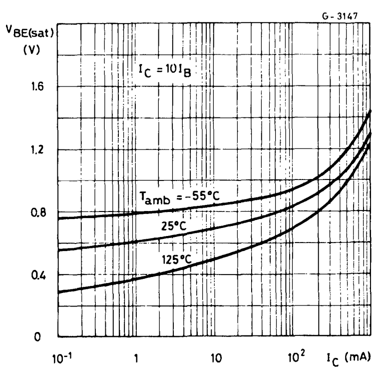
DC Current Gain.



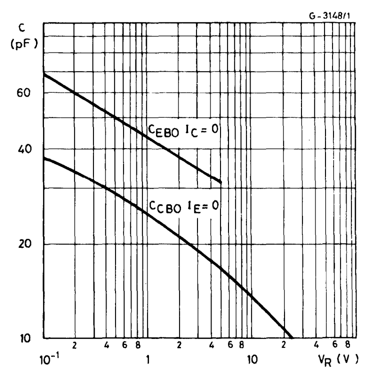
Collector-emitter Saturation Voltage.



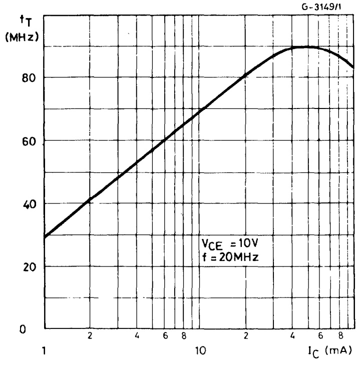
Base-emitter Saturation Voltage.



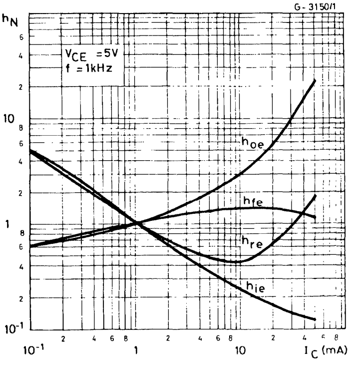
Emitter-base and Collector-base Capacitances.



Transition Frequency.



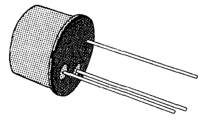
Normalized h Parameters.



HIGH-CURRENT GENERAL PURPOSE TRANSISTOR

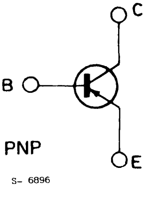
DESCRIPTION

The BFX64 is a silicon planar epitaxial PNP transistor in Jedec TO-39 metal case. It is designed for digital and analog applications at current levels up to 500 mA, line driver, memory applications and in low-noise amplifiers.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	– 40	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 40	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 5	V
I_C	Collector Current	– 500	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.7 3	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

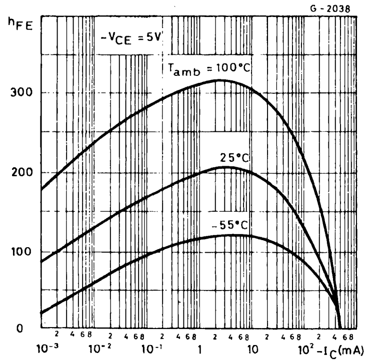
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	58	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	250	°C/W

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

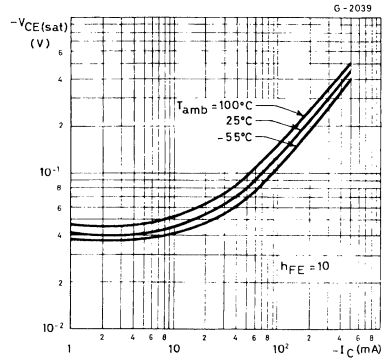
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = – 25 V			– 30	nA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = – 10 μA	– 40			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 10 mA	– 40			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_c = 0)	I_E = –10 μA	– 5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 50 mA I_B = – 2.5 mA I_C = – 150 mA I_B = – 15 mA I_C = – 500 mA I_B = – 50 mA		– 0.08 – 0.18 – 0.6	– 0.3 – 0.5 – 1.8	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 50 mA I_B = – 2.5 mA I_C = – 150 mA I_B = – 15 mA I_C = – 500 mA I_B = – 50 mA		– 0.92 – 1	– 1.1 – 1.4 – 2.2	V V V
h_{FE}	DC Current Gain	I_C = – 10 μA V_{CE} = – 10 V I_C = – 1 mA V_{CE} = – 10 V * I_C = – 10 mA V_{CE} = – 10 V * I_C = – 50 mA V_{CE} = – 1 V * I_C = – 150 mA V_{CE} = – 10 V	 80	130 200 200 150 130		
h_{fe}	Small Signal Current Gain	I_C = – 10 mA V_{CE} = – 10 V f = 1 kHz		200		
f_T	Transition Frequency	I_C = – 50 mA V_{CE} = – 20 V f = 100 MHz	200	250		MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = – 2 V f = 1 MHz		15	30	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 10 V f = 1 MHz		6	10	pF
NF	Noise Figure	I_C = – 30 μA V_{CE} = – 5 V R_g = 10 kΩ f = 1 kHz		1		dB
h_{ie}	Input Impedance	I_C = – 10 mA V_{CE} = – 10 V f = 1 kHz		1		kΩ
h_{re}	Reverse Voltage Ratio	I_C = – 10 mA V_{CE} = – 10 V f = 1 kHz		2.4×10^{-4}		
h_{oe}	Output Admittance	I_C = – 10 mA V_{CE} = – 10 V f = 1 kHz		110		μS
t_{on}	Turn-on Time	I_C = – 300 mA V_{CC} = – 30 V I_{B1} = – 30 mA		35	50	ns
t_{off}	Turn-off Time	I_C = – 300 mA V_{CC} = – 30 V I_{B1} = – I_{B2} = – 30 mA		70	120	ns

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

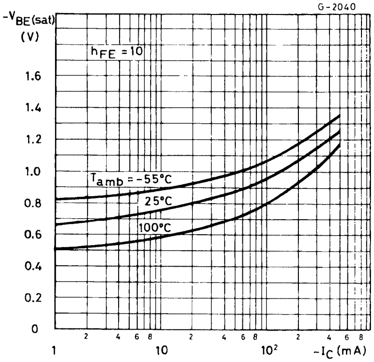
DC Current Gain.



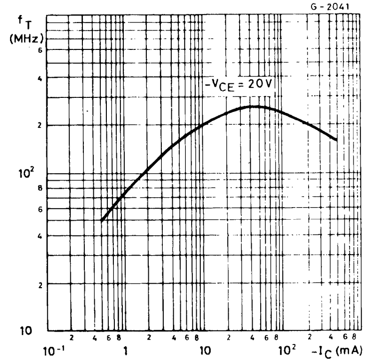
Collector-emitter Saturation Voltage.



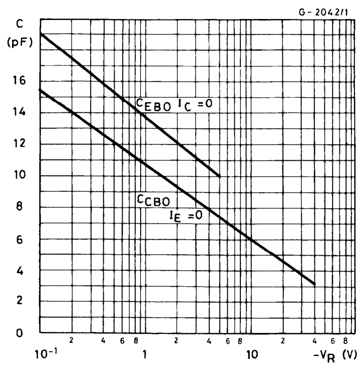
Base-emitter Saturation Voltage.



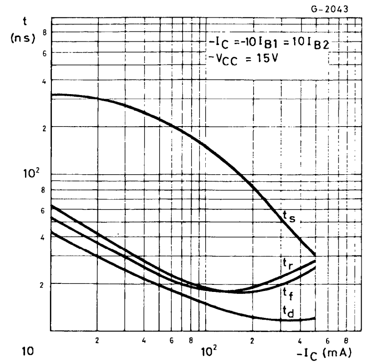
Transition Frequency.



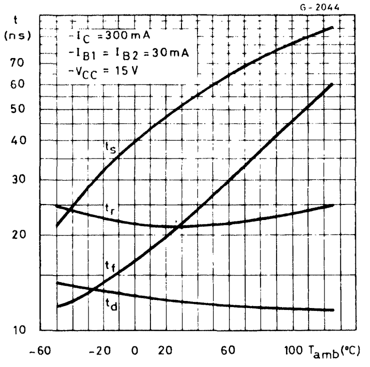
Emitter-base and Collector-base Capacitances.



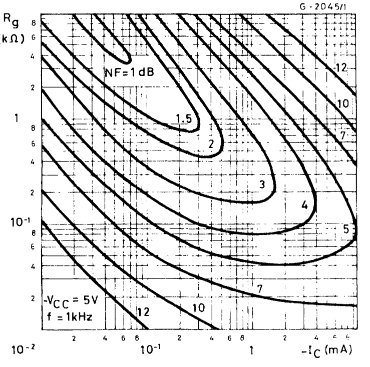
Switching Characteristics.



Switching Characteristics vs. Ambient Temperature.



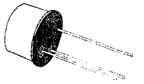
Countours of Constant Noise Figure.



LOW-LEVEL, LOW-NOISE AMPLIFIER

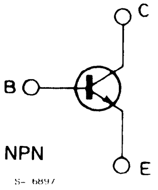
DESCRIPTION

The BFY76 is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case. It is designed for use in high performance, low-level, low-noise amplifier circuits from audio to high frequencies.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	60	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	60	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	8	V
I_C	Collector Current	50	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.36 1.2	W W
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 200	°C

THERMAL DATA

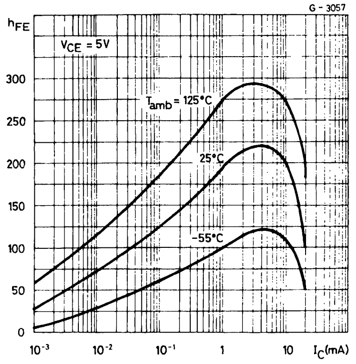
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	146	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

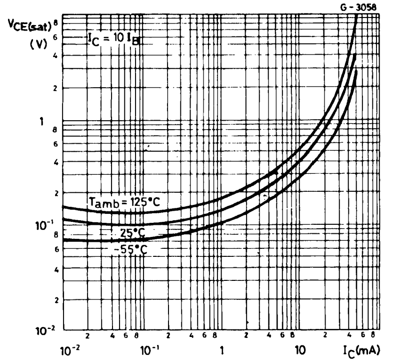
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 50 V V_{CE} = 50 V T_{amb} = 150 °C			20 20	nA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			20	nA
$V_{(BR)CES}$	Collector-emitter Breakdown Voltage (V_{BE} = 0)	I_C = 10 µA	60			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	60			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 10 µA	8			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 1 mA I_B = 0.1 mA		0.15	0.35	V
V_{BE}	Base-emitter Voltage	I_C = 100 µA V_{CE} = 5 V	0.5	0.58	0.7	V
h_{FE}*	DC Current Gain	I_C = 10 µA V_{CE} = 5 V I_C = 100 µA V_{CE} = 5 V I_C = 1 mA V_{CE} = 5 V I_C = 5 mA V_{CE} = 5 V	30 150 	70 120 190 220	 300 	
h_{fe}	Small Signal Current Gain	I_C = 1 mA V_{CE} = 5 V f = 1 kHz	80	220	350	
f_T	Transition Frequency	I_C = 1 mA V_{CE} = 5 V f = 20 MHz	70	100		MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz		3.5	6	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 5 V f = 1 MHz		3.5	6	pF
NF	Noise Figure	I_C = 10 µA V_{CE} = 5 V R_g = 10 kΩ f = 100 Hz f = 1 kHz f = 10 to 10 000 Hz	 4 1.5 1.9		 15 4 4	 dB dB dB
h_{ie}	Imput Impedance	I_C = 1 mA V_{CE} = 5 V f = 1 kHz		8		kΩ
h_{re}	Reverse Voltage Ratio	I_C = 1 mA V_{CE} = 5 V f = 1 kHz		3x10–4		
h_{oe}	Output Admittance	I_C = 1 mA V_{CE} = 5 V f = 1 kHz		11		µS

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

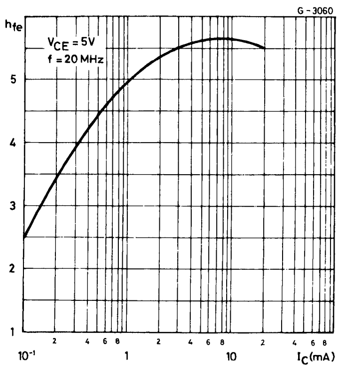
DC Current Gain.



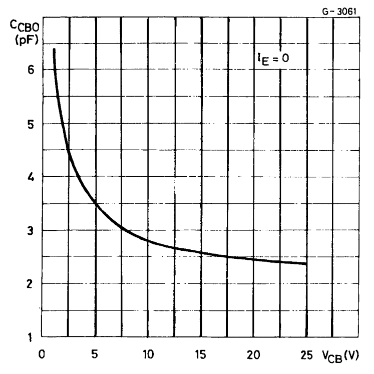
Collector-emitter Saturation Voltage.



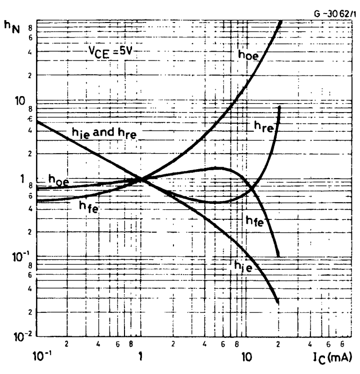
High Frequency Current Gain.



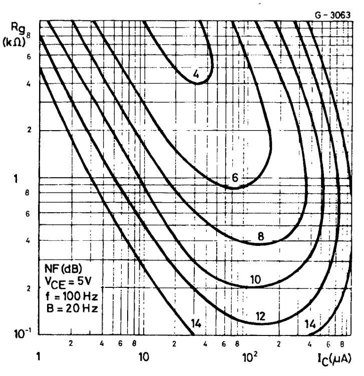
Collector-base capacitance.



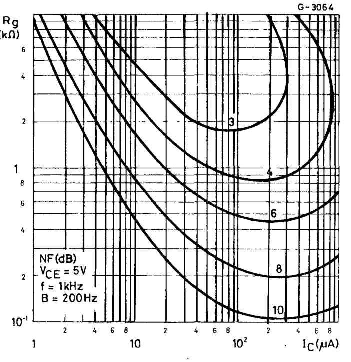
Normalized h Parameters.



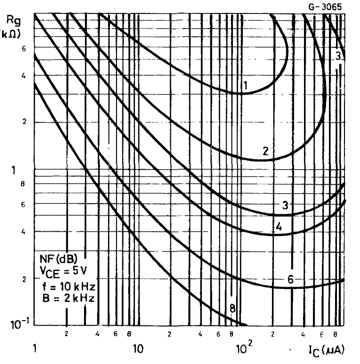
Contours of Constant Noise Figure (f = 100 kHz).



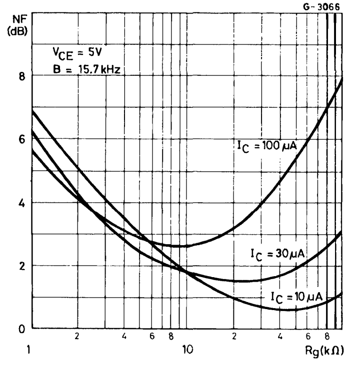
Contours of Constant Noise Figure (f = 1 kHz).



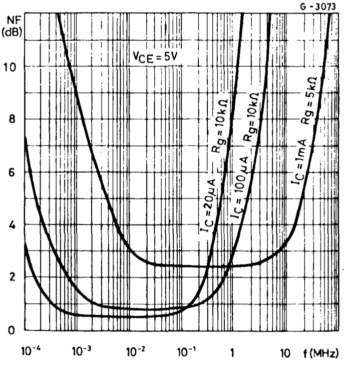
Countours of Constant Noise Figure (f = 10 kHz).



Noise Figure vs. Source Resistance.



Noise Figure vs. Frequency.



SGS-THOMSON MICROELECTRONICS

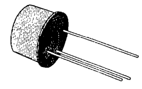
SGS-THOMSON MICROELECTRONICS

BSS26

HIGH -VOLTAGE, HIGH-CURRENT SWITCH

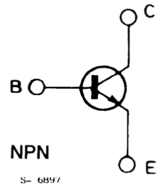
DESCRIPTION

The BSS 26 is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case. It is intended for high voltage, high current switching applications.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	60	V
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	60	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	40	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	6	V
I_C	Collector Current	1	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.36 1.2	W W
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 200	°C

THERMAL DATA

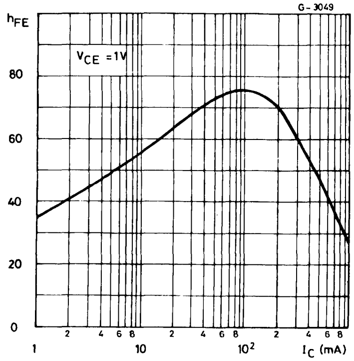
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	146	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

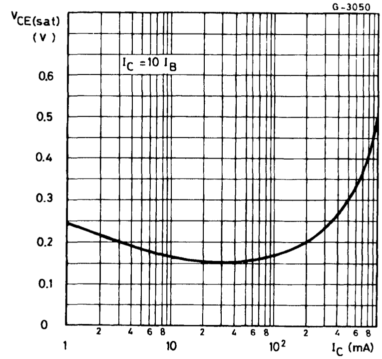
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 40 V V_{CB} = 40 V T_{amb} = 100 °C			1.7 120	μA μA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 10 μA	60			V
$V_{(BR)CES}$	Collector-emitter Breakdown Voltage (V_{BE} = 0)	I_C = 10 μA	60			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	40			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 10 μA	6			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 100 mA I_B = 10 mA I_C = 500 mA I_B = 50 mA I_C = 1 A I_B = 0.1 A		0.17 0.3 0.5	0.3 0.5 0.95	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 100 mA I_B = 10 mA I_C = 500 mA I_B = 50 mA I_C = 1 A I_B = 0.1 A	 0.8 	0.78 0.95 1.05	0.9 1.2 1.7	V V V
h_{FE}*	DC Current Gain	I_C = 10 mA V_{CE} = 1 V I_C = 100 mA V_{CE} = 1 V I_C = 500 mA V_{CE} = 1 V I_C = 1 A V_{CE} = 5 V	25 40 25 	55 75 45 45		
f_T	Transition Frequency	I_C = 50 mA V_{CE} = 10 V f = 100 MHz	250	400		MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz		40	55	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz		4.8	12	pF
t_{on}**	Turn-on Time	I_C = 500 mA V_{CC} = 30 V I_{B1} = 50 mA		15	35	ns
t_{off}**	Turn-off Time	I_C = 500 mA V_{CC} = 30 V I_{B1} = − I_{B2} = 50 mA		40	60	ns

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

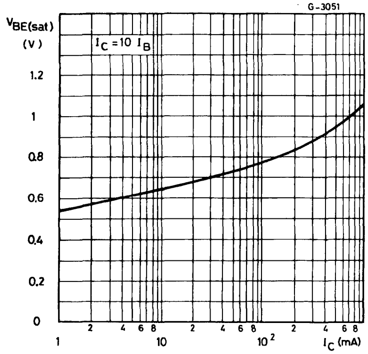
DC Current Gain.



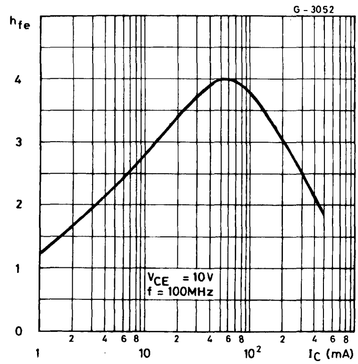
Collector-emitter Saturation Voltage.



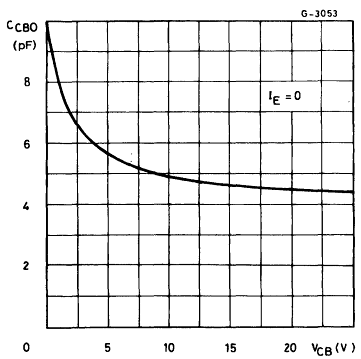
Base-emitter Saturation Voltage.



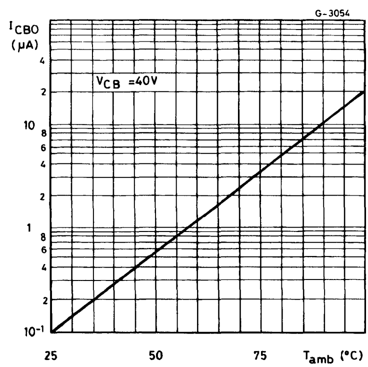
High Frequency Current Gain.



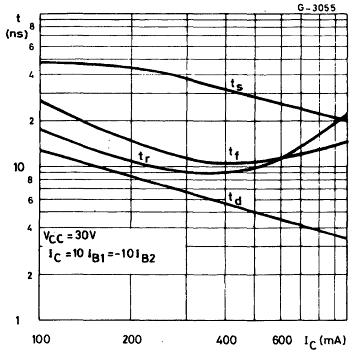
Collector-base Capacitance.

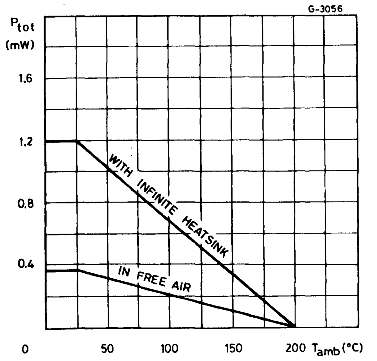


Collector Cutoff Current.

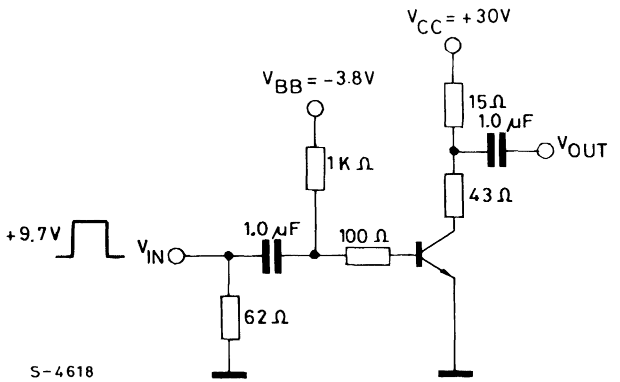


Switching Characteristics.





Test Circuit for t_{on}, t_{off}.



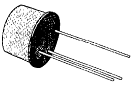
Pulse generator :
t_r, $t_f \leq 1.0$ ns
PW ≈ 10 μs
$Z_{IN} = 50\ \Omega$
DC < 2 %

To oscilloscope :
$t_r < 1.0$ ns
$Z_{IN} \geq 100$ kΩ.

HIGH VOLTAGE AMPLIFIER

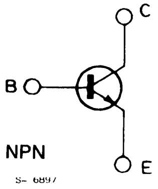
DESCRIPTION

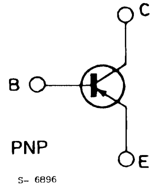
The BSS71S is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case. It is designed for high voltage amplifier and switching applications at current levels from 100 μA to 100 mA. The complementary PNP type is the BSS74S.



TO-18

INTERNAL SCHEMATIC DIAGRAM





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage	200	V
V_{CEO}	Collector-emitter Voltage	200	V
V_{EBO}	Emitter-base Voltage	6	V
I_C	Collector Current	200	mA
I_B	Base Current	50	mA
P_{tot}	Total Device Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.5 2.5	W W
T_{stg}, T_j	Storage and Junction Temperature	200	°C

THERMAL DATA

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

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

Symbol	Parameter	Test Conditons	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = – 150 V			– 50	nA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = – 150 V			– 500	nA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{BE} = 5 V			– 50	nA
$V_{(BR)CBO}$	Collector-emitter Saturation Voltage (I_E = 0)	I_C = – 100 μA	– 200			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 2 mA	– 200			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = – 100 μA	– 6			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 10 mA I_B = – 1 mA I_C = – 30 mA I_B = – 3 mA I_C = – 50 mA I_B = – 5 mA			– 0.3 – 0.4 – 0.5	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 10 mA I_B = – 1 mA I_C = – 30 mA I_B = – 3 mA I_C = – 50 mA I_B = – 5 mA			– 0.8 – 0.9 – 1	V V V
h_{FE}*	DC Current Gain	I_C = – 1 mA V_{CE} = – 10 V I_C = – 10 mA V_{CE} = – 10 V I_C = – 30 mA V_{CE} = – 10 V	30 50 40		 250	
f_T	Transition Frequency	I_C = – 20 mA V_{CE} = – 20 V f = 20 MHz	50		200	MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 20 V f = 1 MHz		3.5		pF
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = – 0.5 V f = 1 MHz		45		pF
t_{on}	Turn-on Time	I_C = – 50 mA I_{B1} = – 10 mA V_{CC} = – 100 V		100		ns
t_{off}	Turn-off Time	I_C = – 50 mA I_{B1} = – I_{B2} = – 10 mA V_{CC} = – 100 V		400		ns

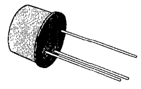
* Pulsed : pulse duration = 300 μs, duty cycle = 1 %.

HIGH VOLTAGE AMPLIFIER

PRELIMINARY DATA

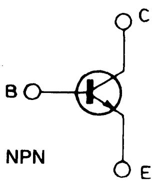
DESCRIPTION

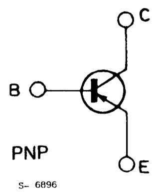
The BSS72S is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case. It is designed for high voltage amplifier and switching applications at current levels from 100 µA to 100 mA. The complementary PNP type is the BSS75S.



TO-18

INTERNAL SCHEMATIC DIAGRAM





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage	200	V
V_{CEO}	Collector-emitter Voltage	200	V
V_{EBO}	Emitter-base Voltage	6	V
I_C	Collector Current	200	mA
I_B	Base Current	50	mA
P_{tot}	Total Device Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.5 2.5	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

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

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

Symbol	Parameter	Test Conditons	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 150 V			50	nA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 150 V			500	nA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{BE} = 5 V			50	nA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 μA	200			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	200			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 100 μA	6			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA I_C = 30 mA I_B = 3 mA I_C = 50 mA I_B = 5 mA			0.3 0.4 0.5	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA I_C = 30 mA I_B = 3 mA I_C = 50 mA I_B = 5 mA			0.8 0.9 1	V V V
h_{FE}*	DC Current Gain	I_C = 1 mA V_{CE} = 10 V I_C = 10 mA V_{CE} = 10 V I_C = 30 mA V_{CE} = 10 V	30 50 40		 250	
f_T	Transition Frequency	I_C = 20 mA V_{CE} = 20 V f = 20 MHz	50		200	MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 20 V f = 1 MHz		3.5		pF
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz		45		pF
t_{on}	Turn-on Time	I_C = 50 mA I_{B1} = 10 mA V_{CC} = 100 V		100		ns
t_{off}	Turn-off Time	I_C = 50 mA I_{B1} = – I_{B2} = – 10 mA V_{CC} = 100 V		400		ns

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

SGS-THOMSON MICROELECTRONICS

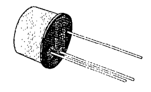
BSS74S

HIGH VOLTAGE AMPLIFIER

PRELIMINARY DATA

DESCRIPTION

The BSS74S is a silicon planar epitaxial PNP transistor in Jedec TO-18 metal case. It is designed for high voltage amplifier and switching applications at current levels from 100 μA to 100 mA. The complementary NPN type is the BSS71S.



TO-18

INTERNAL SCHEMATIC DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage	– 200	V
V_{CEO}	Collector-emitter Voltage	– 200	V
V_{EBO}	Emitter-base Voltage	– 6	V
I_C	Collector Current	– 100	mA
I_B	Base Current	– 50	mA
P_{tot}	Total Device Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.5 2.5	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

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

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

Symbol	Parameter	Test Conditons	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = – 150 V			– 50	nA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = – 150 V			– 500	nA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{BE} = 5 V			– 50	nA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = – 100 µA	– 200			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 2 mA	– 200			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = – 100 µA	– 6			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 10 mA I_B = – 1 mA I_C = – 30 mA I_B = – 3 mA I_C = – 50 mA I_B = – 5 mA			– 0.3 – 0.4 – 0.5	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 10 mA I_B = – 1 mA I_C = – 30 mA I_B = – 3 mA I_C = – 50 mA I_B = – 5 mA			– 0.8 – 0.9 – 1	V V V
h_{FE}*	DC Current Gain	I_C = – 100 µA V_{CE} = – 1 V I_C = – 1 mA V_{CE} = – 10 V I_C = – 10 mA V_{CE} = – 10 V I_C = – 30 mA V_{CE} = – 10 V	20 30 50 35		 150	
f_T	Transition Frequency	I_C = – 20 mA V_{CE} = – 20 V f = 20 MHz	50		200	MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 20 V f = 1 MHz		3.5		pF
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = – 0.5 V f = 1 MHz		45		pF
t_{on}	Turn-on Time	I_C = – 50 mA I_{B1} = – 10 mA V_{CC} = – 100 V		100		ns
t_{off}	Turn-off Time	I_C = – 500 mA I_{B1} = – I_{B2} = – 10 mA V_{CC} = – 100 V		400		ns

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

SGS-THOMSON
MICROELECTRONICS

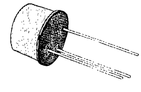
BSS75S

HIGH VOLTAGE AMPLIFIER

PRELIMINARY DATA

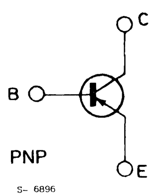
DESCRIPTION

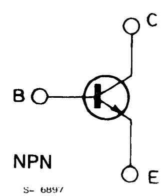
The BSS75S is a silicon planar epitaxial PNP transistor in Jedec TO-18 metal case. It is designed for high voltage amplifier and switching applications at current levels from 100 μA to 100 mA. The complementary NPN type is the BSS72S.



TO-18

INTERNAL SCHEMATIC DIAGRAM





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage	– 200	V
V_{CEO}	Collector-emitter Voltage	– 200	V
V_{EBO}	Emitter-base Voltage	– 6	V
I_C	Collector Current	– 100	mA
I_B	Base Current	– 50	mA
P_{tot}	Total Device Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.5 2.5	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

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

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

Symbol	Parameter	Test Conditons	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = – 150 V			– 50	nA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = – 150 V			– 500	nA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{BE} = 5 V			– 50	nA
$V_{(BR)CBO}$	Collector-emitter Saturation Voltage (I_E = 0)	I_C = – 100 µA	– 200			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 2 mA	– 200			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = – 100 µA	– 6			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 10 mA I_B = – 1 mA I_C = – 30 mA I_B = – 3 mA I_C = – 50 mA I_B = – 5 mA			– 0.3 – 0.4 – 0.5	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 10 mA I_B = – 1 mA I_C = – 30 mA I_B = – 3 mA I_C = – 50 mA I_B = – 5 mA			– 0.8 – 0.9 – 1	V V V
h_{FE}*	DC Current Gain	I_C = – 1 mA V_{CE} = – 10 V I_C = – 10 mA V_{CE} = – 10 V I_C = – 30 mA V_{CE} = – 10 V	30 50 40		 250	
f_T	Transition Frequency	I_C = – 20 mA V_{CE} = – 20 V f = 20 MHz	50		200	MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 20 V f = 1 MHz		3.5		pF
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = – 0.5 V f = 1 MHz		45		pF
t_{on}	Turn-on Time	I_C = – 50 mA I_{B1} = – 10 mA V_{CC} = – 100 V		100		ns
t_{off}	Turn-off Time	I_C = – 50 mA I_{B1} = – I_{B2} = – 10 mA V_{CC} = – 100 V		400		ns

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

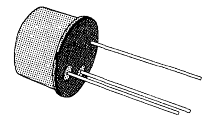
SGS-THOMSON
MICROELECTRONICS

BSV15
BSV16

MEDIUM POWER AMPLIFIERS

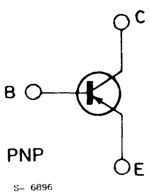
DESCRIPTION

The BSV15 and BSV16 are silicon planar epitaxial PNP transistors in Jedec TO-39 metal case, intended for use in medium power general industrial applications.



TO–39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BSV15	BSV16	
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	– 40	– 60	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 40	– 60	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 5		V
I_C	Collector Current	– 1		A
I_B	Base Current	– 0.2		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	5		W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200		°C

THERMAL DATA

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

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	for **BSV 15** V_{CE} = – 40 V V_{CE} = – 40 V T_{amb} = 150 °C for **BSV 16** V_{CE} = - 60 V V_{CE} = - 60 V T_{amb} = 150 °C			 – 0.1 – 50 – 0.1 – 50	 µA µA µA µA
I_{CEX}	Collector Cutoff Current (V_{BE} = 0.2 V)	for **BSV 15** V_{CE} = – 40 V T_{amb} = 100 °C for **BSV 16** V_{CE} = – 60 V T_{amb} = 100 °C			 – 50 – 50	 µA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = – 4 V			– 50	nA
$V_{(BR)\ CES}$	Collector-emitter Breakdown Voltage (V_{BE} = 0)	I_C = – 10 µA for **BSV 15** for **BSV 16**	– 40 – 60			V V
$V_{CEO\ (sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = – 10 mA for **BSV 15** for **BSV 16**	– 40 – 60			V V
$V_{(BR)\ EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = – 10 µA	– 5			V
$V_{CE\ (sat)}$	Collector-emitter Saturation Voltage	I_C = – 500 mA I_B = – 25 mA	– 0.25		– 1	V
V_{BE}	Base-emitter Voltage	I_C = – 100 mA V_{CE} = – 1 V I_C = – 500 mA V_{CE} = – 1 V	 – 0.7	 – 0.85	– 1 – 1.4	V V
h_{FE}	DC Current Gain	I_C = – 0.1 mA V_{CE} = – 1 V Gr. 6 Gr. 10 Gr. 16 I_C = – 100 mA V_{CE} = – 1 V Gr. 6 Gr. 10 Gr. 16	 15 20 30 40 63 100	 44 75 120 63 100 160	 100 160 250	

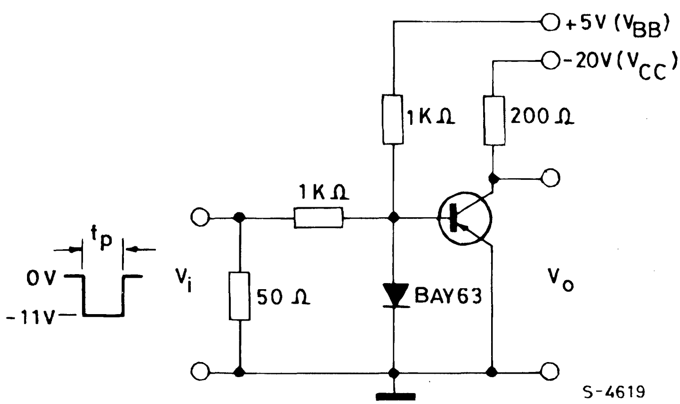
* Pulsed : pulse duration = 300 µs, duty cycle = 1 %.

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain	$I_C = -500$ mA $V_{CE} = -1$ V Gr. 6 Gr. 10 Gr. 16	 20 25 35	 40 55 85		
h_{fe}	Small Signal Current Gain	$I_C = -1$ mA $V_{CE} = -5$ V f = 1 KHz	20			
f_T	Transition Frequency	$I_C = -50$ mA $V_{CE} = -1$ V f = 20 MHz	50			MHz
C_{EBO}	Emitter-base Capacitance	$I_C = 0$ $V_{EB} = -0.5$ V f = 1 MHz		180		pF
C_{CBO}	Collector-base Capacitance	$I_E = 0$ $V_{CB} = -10$ V f = 1 MHz		20	30	pF
t_s **	Storage Time	$I_C = -100$ mA $V_{CC} = -20$ V $I_{B1} = -I_{B2} = -5$ mA			500	ns
t_f **	Fall Time	$I_C = -100$ mA $V_{CC} = -20$ V $I_{B1} = -I_{B2} = -5$ mA			150	ns
t_{on} **	Turn-on Time	$I_C = -100$ mA $V_{CC} = -20$ V $I_{B1} = -5$ mA			500	ns

** See test circuit.

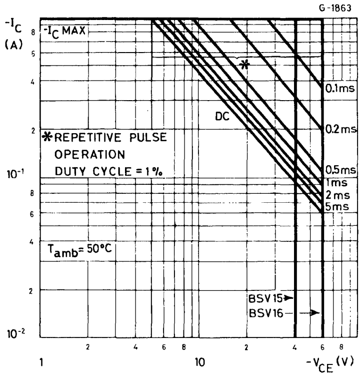
Test Circuit for t_s, t_f and t_{on}.



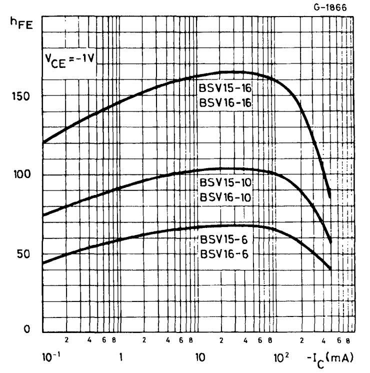
PULSE GENERATOR :
$t_p \geq 10$ µs
$t_r \leq 15$ ns
$t_f \leq 15$ ns
$Z_s = 50\ \Omega$

TO OSCILLOSCOPE :
tr ≤ 15 ns
$Z_{IN} \geq 100$ KΩ

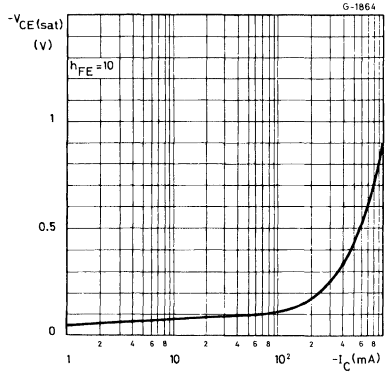
Safe Operating Areas.



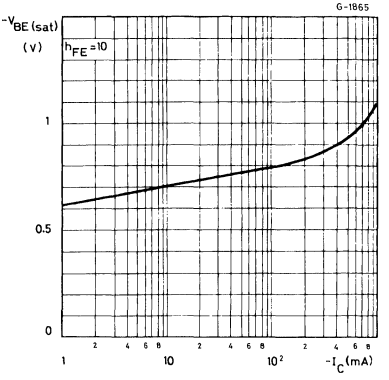
DC Current Gain.



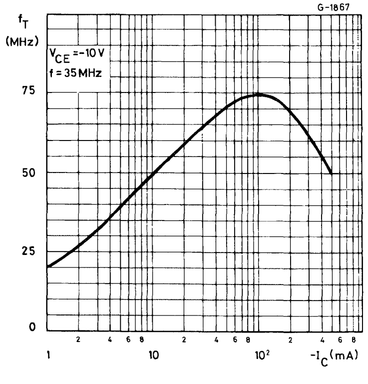
Collector-emitter Saturation Voltage.



Base-emitter Saturation Voltage.



Transition Frequency.

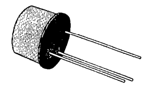


SGS-THOMSON MICROELECTRONICS

HIGH-SPEED SATURATED SWITCHES

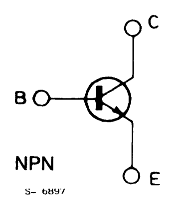
DESCRIPTION

The BSX19 and BSX20 are silicon planar epitaxial NPN transistors in Jedec TO-18 metal case. They are primarily intended for very high speed saturated switching applications.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	40	V
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	40	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	15	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	4.5	V
I_{CM}	Collector Peak Current (t = 10 μs)	0.5	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.36 1.2	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	146	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

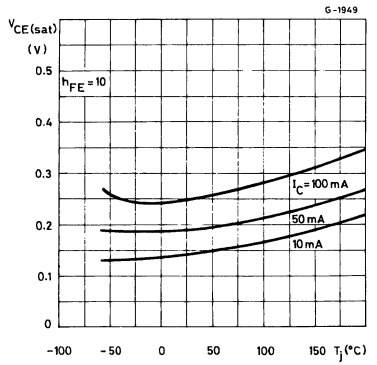
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 20 V V_{CB} = 20 V T_{amb} = 150 °C			0.4 30	µA µA
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 15 V T_{amb} = 55 °C V_{CE} = 40 V			0.4 1	µA µA
I_{CEX}	Collector Cutoff Current (V_{BE} = – 3 V)	V_{CE} = 15 V T_{amb} = 55 °C			0.6	µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 4.5 V			10	µA
I_{BEX}	Base Cutoff Current (V_{BE} = – 3 V)	V_{CE} = 15 V T_{amb} = 55 °C			0.6	µA
$V_{CER\ (sus)}$*	Collector-emitter Sustaining Voltage (R_{BE} = 10 Ω)	I_C = 10 mA	20			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	15			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA I_C = 100 mA I_B = 10 mA for **BSX19** I_C = 10 mA I_B = 0.6 mA for **BSX20** I_C = 10 mA I_B = 0.3 mA			0.25 0.6 0.3 0.3	V V V V
V_{BE}	Base-emitter Voltage	I_C = 30 µA V_{CE} = 20 V T_{amb} = 100 °C	 0.35			 V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA I_C = 100 mA I_B = 10 mA	0.7		0.85 1.5	V V
h_{FE}*	DC Current Gain	for **BSX19** I_C = 10 mA V_{CE} = 1 V I_C = 100 mA V_{CE} = 2 V I_C = 10 mA V_{CE} = 1 V T_{amb} = – 55 °C for **BSX20** I_C = 10 mA V_{CE} = 1 V I_C = 100 mA V_{CE} = 2 V I_C = 10 mA V_{CE} = 1 V T_{amb} = – 55 °C	 20 10 10 40 20 20		 60 120	
f_T	Transition Frequency	I_C = 10 mA V_{CE} = 10 V for **BSX19** for **BSX20**	 400 500	 500 600		 MHz MHz
C_{EBO}	Emitter–base Capacitance	I_C = 0 V_{EB} = 1 V			4.5	pF
C_{BO}	Collector–base Capacitance	I_E = 0 V_{CB} = 5 V			4	pF
t_s**	Storage Time	I_C = 10 mA V_{CC} = 10 V I_{B1} = – I_{B2} = 10 mA for **BSX19** for **BSX20**		 5 6	 10 13	 ns ns

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

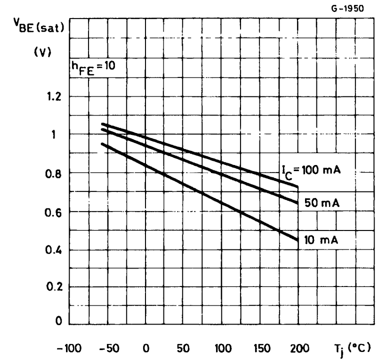
ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	I_C = 10 mA	V_{CC} = 3 V				
		I_{B1} = 3 mA				12	ns
		I_C = 100 mA	V_{CC} = 6 V				
		I_{B1} = 40 mA				7	ns
t_{off}	Turn-off Time	I_C = 10 mA	V_{CC} = 3 V				
		I_{B1} = 3 mA	I_{B2} = – 1.5 mA				
			for **BSX19**			15	ns
			for **BSX20**			18	ns
		I_C = 100 mA	V_{CC} = 6 V				
		I_{B1} = 40 mA	I_{B2} = – 20 mA				
			for **BSX19**			18	ns
			for **BSX20**			21	ns

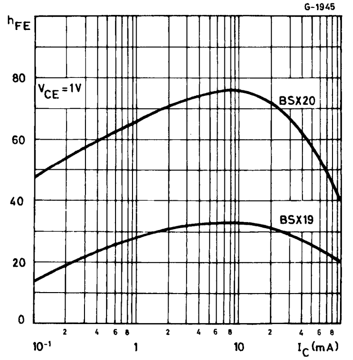
Collector-emitter Saturation Voltage.



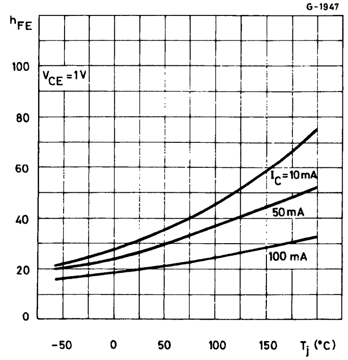
Base-emitter Saturation Voltage.



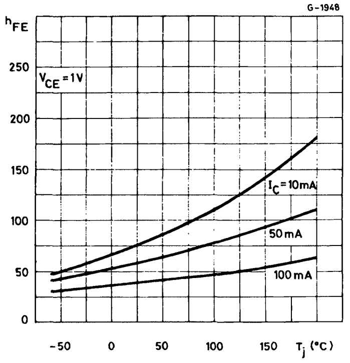
DC Current Gain.



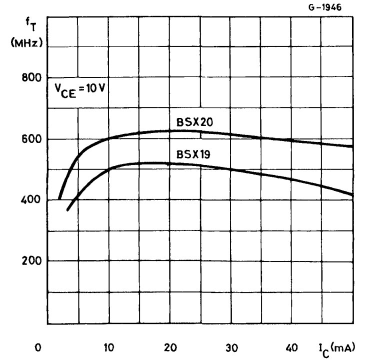
DC Current Gain (for BSX19 only).



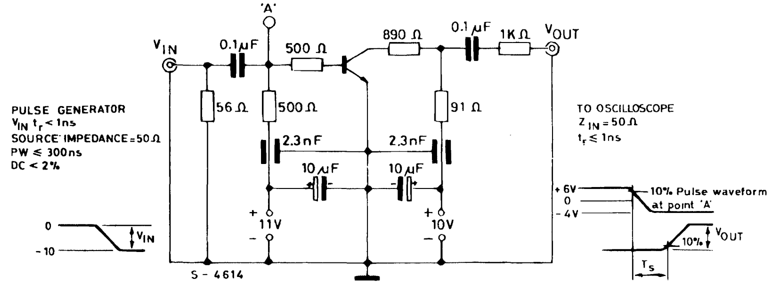
DC Current Gain (for BSX20 only).



Transition Frequency.



Test circuit for t_S.



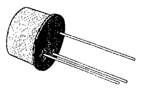
SGS-THOMSON
MICROELECTRONICS

BSX26

HIGH-SPEED SATURATED SWITCH

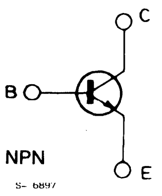
DESCRIPTION

The BSX26 is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case. It is designed for switching applications up to 500 mA.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	40	V
V_{CES}	Collector-emitter Voltage ($V_{BE} = 0$)	40	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	15	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	4	V
I_C	Collector Current	500	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C at $T_{case} \leq 100$ °C	0.36 1.2 0.68	W W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

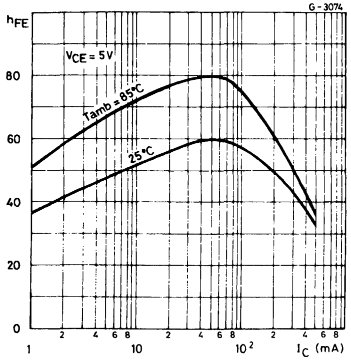
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	146	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

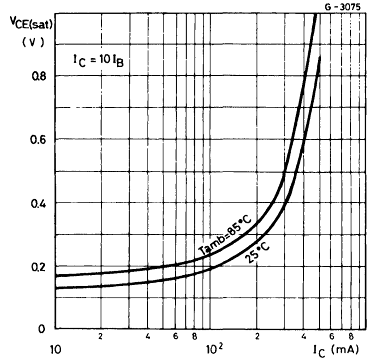
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 20 V V_{CE} = 20 V T_{amb} = 85 °C			0.5 15	µA µA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 µA	40			V
$V_{(BR)CES}$	Collector-emitter Breakdown Voltage (V_{BE} = 0)	I_C = 100 µA	40			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	15			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 100 µA	4			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 30 mA I_B = 3 mA I_C = 100 mA I_B = 10 mA I_C = 300 mA I_B = 30 mA I_C = 30 mA I_B = 3 mA T_{amb} = 85 °C		0.16 0.18 0.39 0.18	0.18 0.28 0.5 0.3	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 30 mA I_B = 3 mA I_C = 100 mA I_B = 10 mA I_C = 300 mA I_B = 30 mA	0.75	0.82 0.97 1.3	0.95 1.2 1.7	V V V
h_{FE}*	DC Current Gain	I_C = 30 mA V_{CE} = 0.4 V I_C = 100 mA V_{CE} = 0.5 V I_C = 300 mA V_{CE} = 1 V	30 25 15	60 55	120	
f_T	Transition Frequency	I_C = 30 mA V_{CE} = 10 V f = 100 MHz	350	550		MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz		6.5	8	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 5 V f = 1 MHz		3.3	5	pF
t_s	Storage Time	I_C = 10 mA V_{CC} = 10 V I_{B1} = – I_{B2} = 10 mA		8	18	ns
t_{on}**	Turn-on Time	I_C = 300 mA V_{CC} = 15 V I_{B1} = 30 mA		9	15	ns
t_{off}**	Turn-off Time	I_C = 300 mA V_{CC} = 15 V I_{B1} = – I_{B2} = 30 mA		15	25	ns

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

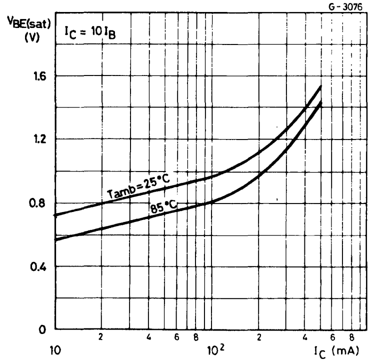
DC Current Gain.



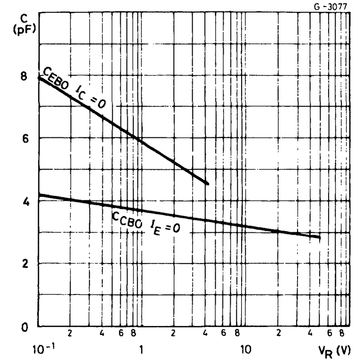
Collector-emitter Saturation Voltage.



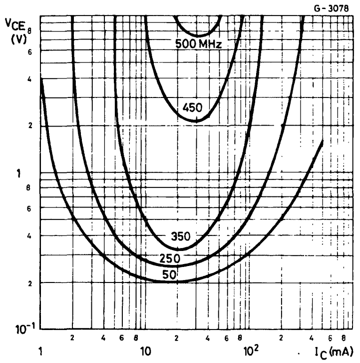
Base-emitter Saturation Voltage.



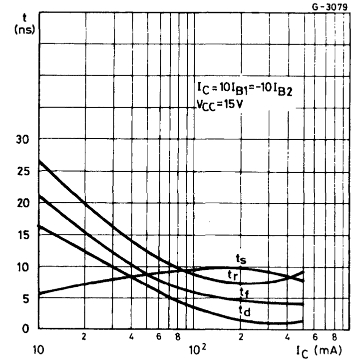
Emitter-base and Collector-base Capacitances.



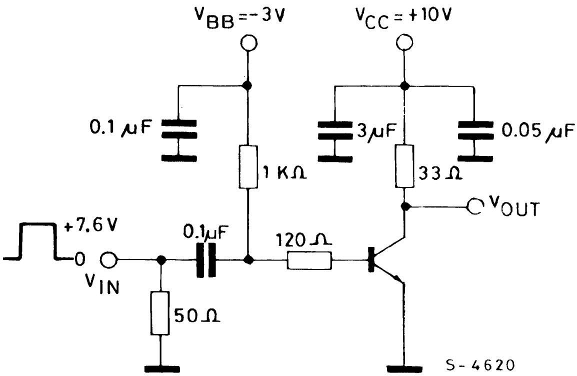
Contours of Constant Transition Frequency.



Switching Characteristics.



Test circuit for t_{on}, t_{off}.



PULSE GENERATOR :
t_r, t_f < 1.0ns
PW ≥ 240ns
Z_{IN} = 50Ω

TO OSCILLOSCOPE :
t_r < 1.0ns
Z_{IN} ≈ 100KΩ

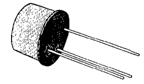
SGS-THOMSON
MICROELECTRONICS

BSX28

HIGH-SPEED SATURATED SWITCH

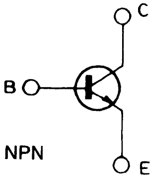
DESCRIPTION

The BSX28 is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case. It is designed specifically for high speed saturated switching applications.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	30	V
V_{CES}	Collector-emitter Voltage ($V_{BE} = 0$)	30	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	12	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	4.5	V
I_C	Collector Current	500	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C at $T_{case} \leq 100$ °C	0.36 1.2 0.68	W W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

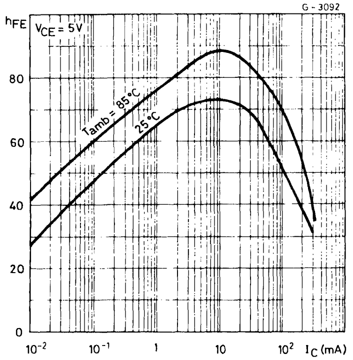
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	146	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

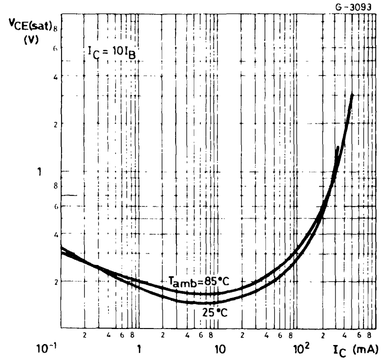
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 20 V V_{CE} = 20 V T_{amb} = 85 °C			0.4 10	µA µA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 10 µA	30			V
$V_{(BR)CES}$	Collector-emitter Breakdown Voltage (V_{BE} = 0)	I_C = 10 µA	30			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	12			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 100 µA	4.5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA I_C = 30 mA I_B = 3 mA I_C = 100 mA I_B = 10 mA I_C = 10 mA I_B = 1 mA T_{amb} = 85 °C		0.15 0.18 0.3 0.17	0.2 0.25 0.5 0.3	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA I_C = 30 mA I_B = 3 mA I_C = 100 mA I_B = 10 mA	0.72	0.8 0.9 1.1	0.87 1.15 1.6	V V V
h_{FE}*	DC Current Gain	I_C = 10 mA V_{CE} = 0.35 V I_C = 30 mA V_{CE} = 0.4 V I_C = 100 mA V_{CE} = 1 V	30 25 15	70 70 50	120	
f_T	Transition Frequency	I_C = 20 mA V_{CE} = 10 V f = 100 MHz	400	650		MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 5 V f = 1 MHz		2.3	4	pF
t_s	Storage Time	I_C = 10 mA V_{CC} = 10 V I_{B1} = – I_{B2} = 10 mA		6.5	13	ns
t_{on}	Turn-on Time	I_C = 30 mA V_{CC} = 2 V I_{B1} = 3 mA		9	15	ns
t_{off}	Turn-off Time	I_C = 30 mA V_{CC} = 2 V I_{B1} – I_{B2} = 3 mA		13	20	ns

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

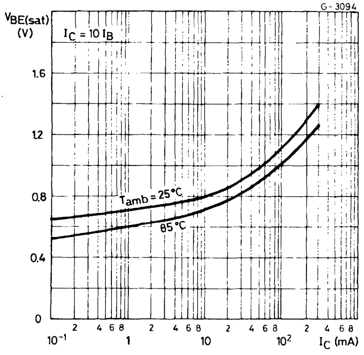
DC Current Gain.



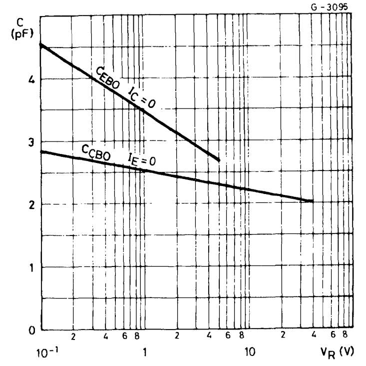
Collector-emitter Saturation Voltage.



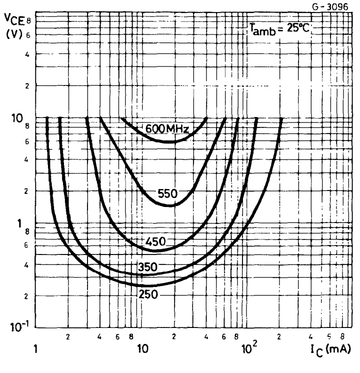
Base-emitter Saturation Voltage.



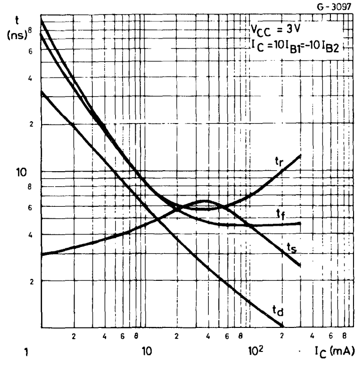
Emitter-base and Collector-base Capacitances.



Contours of Constant Transition Frequency.



Switching Characteristics.

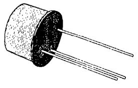


BSX29

SWITCH AND RF AMPLIFIER

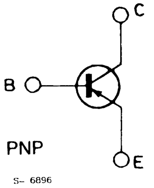
DESCRIPTION

The BSX29 is a silicon planar epitaxial PNP transistor in Jedec TO-18 metal case. It is designed for saturated and nonsaturated switching circuits requiring up to 200mA of collector current.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	– 12	V
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	– 12	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 12	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 4	V
I_C	Collector Current	– 200	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.36 1.2	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

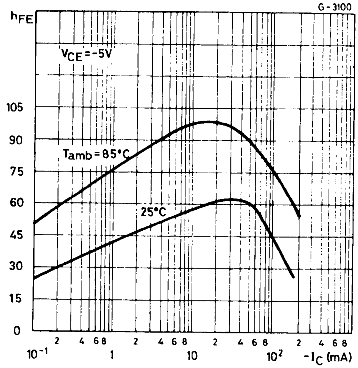
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	146	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

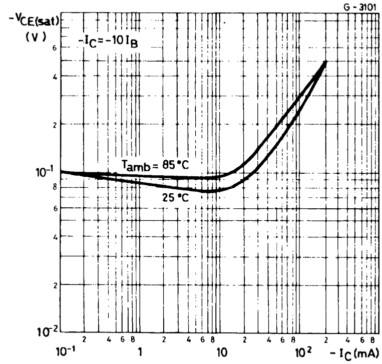
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = – 6 V V_{CE} = – 6 V T_{amb} = 85 °C			– 80 – 5	nA µA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = – 10 µA	– 12			V
$V_{(BR)CES}$	Collector-emitter Breakdown Voltage (V_{BE} = 0)	I_C = – 10 µA	– 12			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 10 mA	– 12			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = – 100 µA	– 4			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 10 mA I_B = – 1 mA I_C = – 30 mA I_B = – 3 mA I_C = – 100 mA I_B = – 10 mA I_C = – 30 mA I_B = – 3 mA T_{amb} = 85 °C		– 0.07 – 0.1 – 0.25 – 0.15	– 0.15 – 0.2 – 0.5 – 0.4	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 10 mA I_B = – 1 mA I_C = – 30 mA I_B = – 3 mA I_C = – 100 mA I_B = – 10 mA	– 0.75 – 0.80	 – 1.4	– 0.95 – 1 – 1.7	V V V
h_{FE}*	DC Current Gain	I_C = – 10 mA V_{CE} = – 0.3 V I_C = – 30 mA V_{CE} = – 0.5 V I_C = – 100 mA V_{CE} = – 1 V	25 30 20	50 60 40	 120	
f_T	Transition Frequency	I_C = – 30 mA V_{CE} = – 10 V f = 100 MHz	400	700		MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = – 0.5 V f = 1 MHz		3.8	6	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 5 V f = 1 MHz		3.3	6	pF
t_{on}**	Turn-on Time	I_C = – 30 mA V_{CC} = – 2 V I_{B1} = – 1.5 mA		25	60	ns
t_{off}**	Turn-off Time	I_C = – 30 mA V_{CC} = – 2 V I_{B1} = – I_{B2} = – 1.5 mA		35	90	ns

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

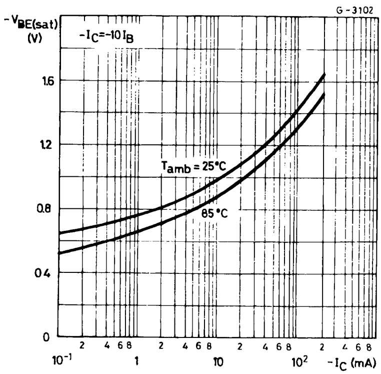
DC Current Gain.



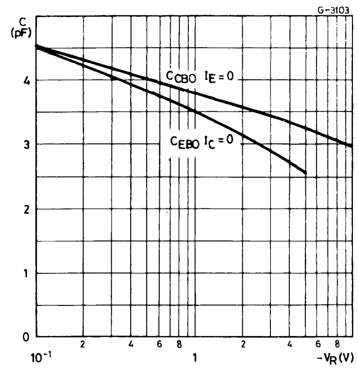
Collector-emitter Saturation Voltage.



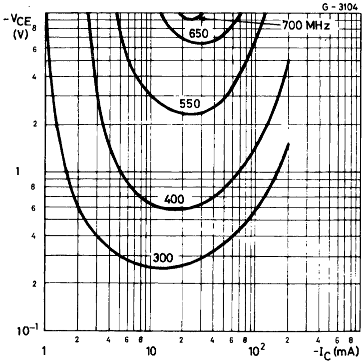
Base-emitter Saturation Voltage.



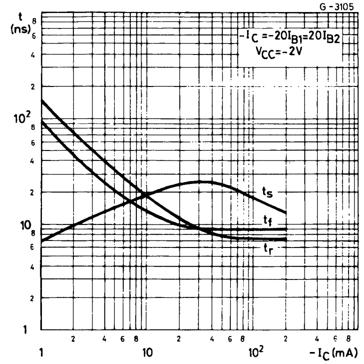
Emitter-base and Collector-base Capacitances.



Contours of Constant Transition Frequency.

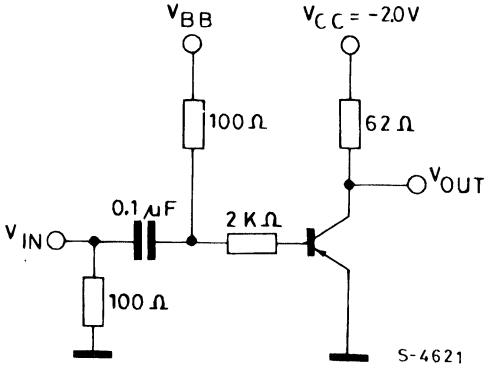


Switching Characteristics.



TEST CIRCUIT

Test circuit for t_{on}, t_{off}.



PULSE GENERATOR :
t_r, ≤ 1.0ns
PW = 400ns
Z_{IN} = 50Ω

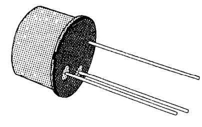
t_{on} V_{BB} = + 3.0V, V_{IN} = − 7.0V
t_{off} V_{BB} = − 4.0V, V_{IN} = + 6.0V

TO OSCILLOSCOPE :
t_r ≤ 1.0ns
Z_{IN} ≥ 100KΩ

HIGH-VOLTAGE, HIGH-CURRENT SWITCH

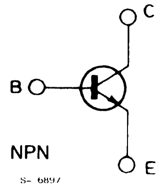
DESCRIPTION

The BSX32 is a silicon planar epitaxial NPN tran- sistor in Jedec TO-39 metal case. It is designed for high voltage, high current switching appli-



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	65	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	40	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	6	V
I_C	Collector Current	1	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.8 3.5	W W
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 200	°C

THERMAL DATA

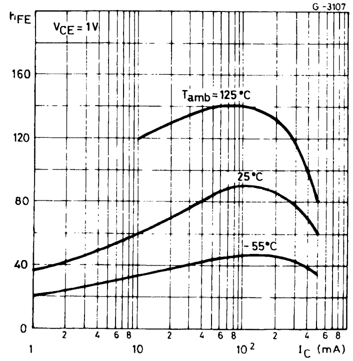
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	50	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	219	°C/W

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

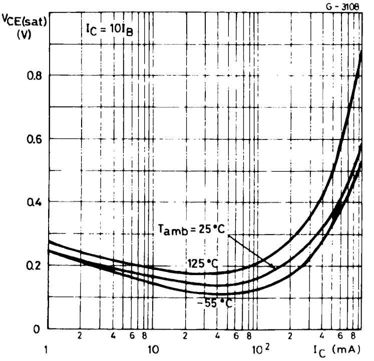
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 50 V			0.25	4	μA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 μA		65			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA		40			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 100 μA		6			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 100 mA	I_B = 10 mA		0.17	0.25	V
		I_C = 500 mA	I_B = 50 mA		0.36	0.5	V
		I_C = 1A	I_B = 100 mA		0.6	0.85	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 100 mA	I_B = 10 mA		0.8	0.9	V
		I_C = 500 mA	I_B = 50 mA			1.5	V
		I_C = 1 A	I_B = 100 mA			2	V
h_{FE}*	DC Current Gain	I_C = 10 mA	V_{CE} = 1 V	30	60		
		I_C = 100 mA	V_{CE} = 1 V	60	90	150	
		I_C = 500 mA	V_{CE} = 1 V	25	60		
		I_C = 1 A	V_{CE} = 5 V	20	60		
		V_{CE} = 1 V	T_{amb} = – 55 °C				
			I_C = 100 mA	30	45		
			I_C = 500 mA	15	35		
f_T	Transition Frequency	I_C = 50 mA, f = 100 MHz	V_{CE} = 10 V		400		MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0, f = 1 MHz	V_{EB} = 0.5 V		40	55	pF
C_{CBO}	Collector-base Capacitance	I_E = 0, f = 1 MHz	V_{CB} = 10 V		6	10	pF
t_{on}**	Turn-on Time	I_C = 500 mA, I_{B1} = 50 mA	V_{CC} = 30 V		22	35	ns
t_{off}**	Turn-off Time	I_C = 500 mA, I_{B1} = – I_{B2} = 50 mA	V_{CC} = 30 V		40	60	ns

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

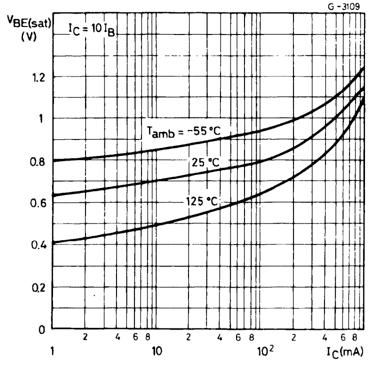
DC Current Gain.



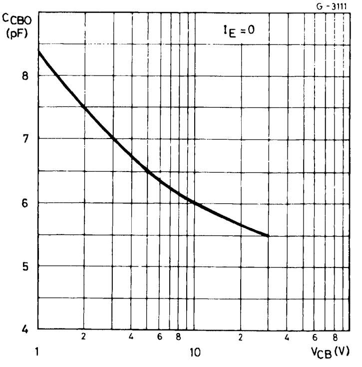
Collector-emitter Saturation Voltage.



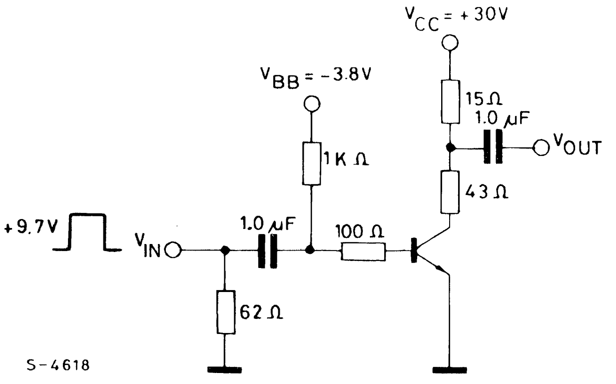
Base-emitter Saturation Voltage.



Collector-base Capacitance.



Test circuit for t_{on}, t_{off}.



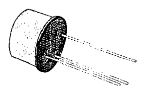
PULSE GENERATOR :
t_r, $t_f \leq 1.0$ ns
PW ≈ 1.0 μs
Z_{IN} = 50 Ω
DC < 2 %

TO OSCILLOSCOPE :
$t_r <$ 1.0 ns
$Z_{IN} \geq$ 100 KΩ

HIGH-VOLTAGE, HIGH-CURRENT SWITCH

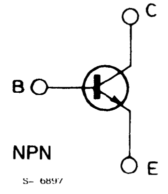
DESCRIPTION

The BSX33 is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case, designed for high voltage and high current switching applications. It features useful current gain from 100μA to 500mA and a low saturation voltage allowing switching operation at 1A.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	85	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	55	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	1	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.5 1.8	W W
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 200	°C

THERMAL DATA

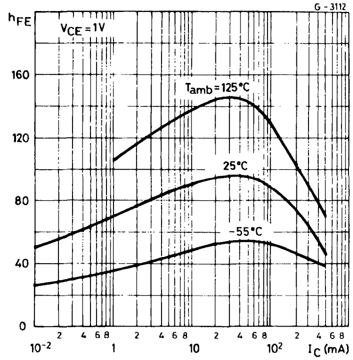
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	97	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	350	°C/W

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

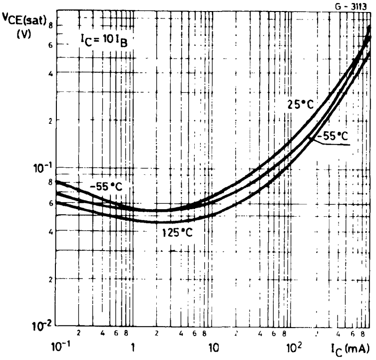
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 60 V V_{CB} = 60 V T_{amb} = 150 °C			10 10	nA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			10	nA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 µA	85			V
$V_{(BR)CEO}$ *	Collector–emitter Breakdown Voltage (I_B = 0)	I_C = 30 mA	55			V
$V_{(BR)EBO}$	Emitter–base Breakdown Voltage (I_C = 0)	I_E = 100 µA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 50 mA I_B = 5 mA I_C = 150 mA I_B = 15 mA I_C = 1 A I_B = 0.1 mA		0.08 0.15 0.6	 0.3 1	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 50 mA I_B = 5 mA I_C = 150 mA I_B = 15 mA I_C = 1 A I_B = 0.1 mA		0.76 0.85 1.2	 1.1 1.6	V V V
h_{FE}*	DC Current Gain	I_C = 100 µA V_{CE} = 1 V I_C = 10 mA V_{CE} = 1 V I_C = 50 mA V_{CE} = 1 V I_C = 150 mA V_{CE} = 1 V I_C = 500 mA V_{CE} = 1 V	20 50 50 40 20	50 85 95 80 45		
h_{fe}	Small Signal Current Gain	I_C = 1 mA V_{CE} = 5 V f = 1 kHz		85		
f_T	Transition Frequency	I_C = 50 mA V_{CE} = 10 V f = 20 MHz	60	90		MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz		50	80	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V f =1 MHz		12	20	pF
h_{ie}	Input Impedance	I_C = 1 mA V_{CE} = 5 V f = 1 kHz		2		kΩ
h_{re}	Reverse Voltage Transfer Ratio	I_C = 1 mA V_{CE} = 5 V f = 1 kHz		2.2×10^{-4}		
h_{oe}	Output Admittance	I_C = 1 mA V_{CE} = 5 V f = 1 kHz		8		µs
t_{on}	Turn-on Time	I_C = 150 mA V_{CC} = 20 V I_{B1} = 7.5 mA		120	200	ns
t_{off}	Turn-off Time	I_C = 150 mA V_{CC} = 20 V IB1 = – IB2 = 7.5 mA		350	800	ns

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

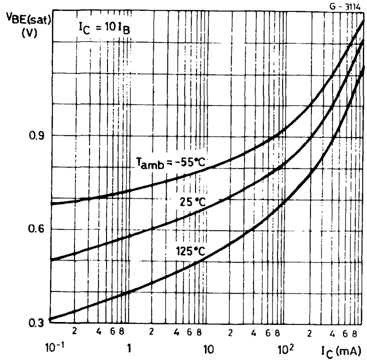
DC Current Gain.



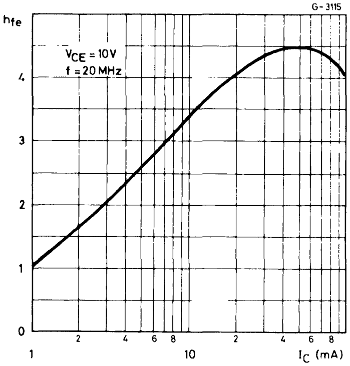
Collector-emitter Saturation Voltage .



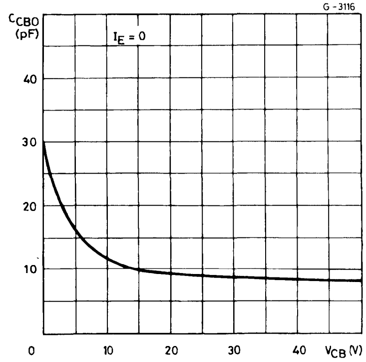
Base-emitter Saturation Voltage.



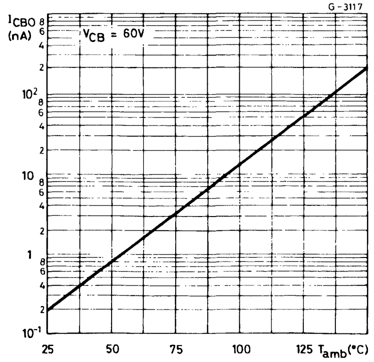
High Frequency Current Gain.



Collector-base Capacitance.



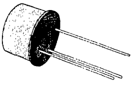
Collector Cutoff Current.



HIGH-SPEED SATURATED SWITCH

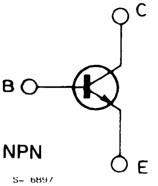
DESCRIPTION

The BSX39 is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case. It is designed for very fast switching applications up to 500 mA.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	45	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	20	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5	V
I_C	Collector Current	500	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C at $T_{case} \leq 100$ °C	0.36 1.2 0.68	W W W
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 200	°C

THERMAL DATA

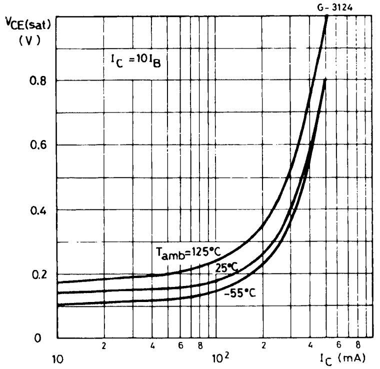
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	146	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

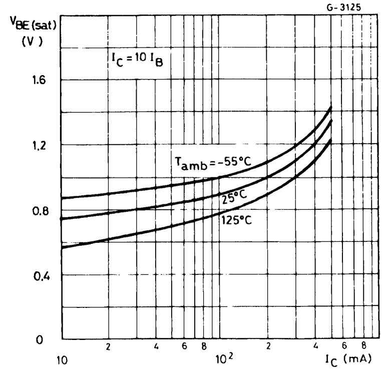
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 20 V V_{CE} = 20 V T_{amb} = 125 °C			0.1 30	μA μA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_c = 10 μA	45			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_c = 10 mA	20			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_c = 0)	I_E = 100 μA	5			V
$V_{CE(sat)}$*	Collectro-emitter Saturation Voltage	I_c = 30 mA I_B = 3 mA I_c = 100 mA I_B = 10 mA I_c = 300 mA I_B = 30 mA I_c = 30 mA I_B = 3 mA T_{amb} = 85 °C		0.15 0.18 0.39 0.17	0.18 0.28 0.5 0.3	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_c = 30 mA I_B = 3 mA I_c = 100 mA I_B = 10 mA I_c = 300 mA I_B = 30 mA	0.75	0.8 0.9 1.1	0.95 1.2 1.7	V V V
h_{FE}*	DC Current Gain	I_c = 30 mA V_{CE} = 0.4 V I_c = 100 mA V_{CE} = 0.5 V I_c = 300 mA V_{CE} = 1 V I_c = 30 mA V_{CE} = 0.4 V T_{amb} = – 55 °C	40 25 15 12	60 55 40	120	
f_T	Transition Frequency	I_c = 30 mA V_{CE} = 10 V f = 100 MHz	350	600		MHz
C_{EBO}	Emitter-base Capacitance	I_c = 0 V_{EB} = 0.5 V f = 1 MHz		7	8	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 5 V f = 1 MHz		4	5	pF
t_s	Storage Time	I_c = 10 mA V_{CC} = 10 V I_{B1} = – I_{B2} = 10 mA		8	18	ns
t_{on}**	Turn-on Time	I_c = 300 mA V_{CC} = 10 V I_{B1} = 30 mA		9	15	ns
t_{off}**	Turn-off Time	I_c = 300 mA V_{CC} = 10 V I_{B1} – I_{B2} = 30 mA		15	25	ns

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

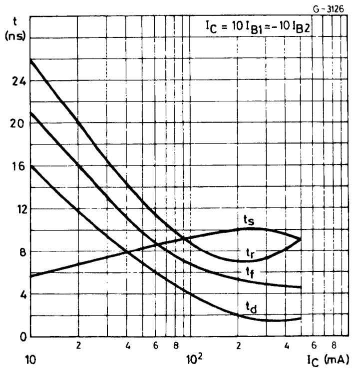
Collector-emitter Saturation Voltage.



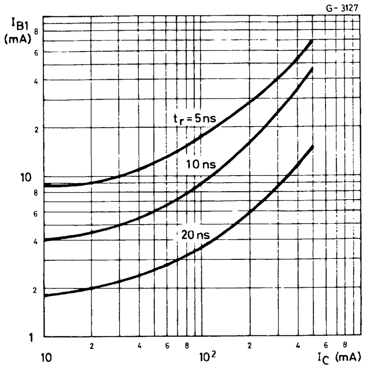
Base-emitter Saturation Voltage.



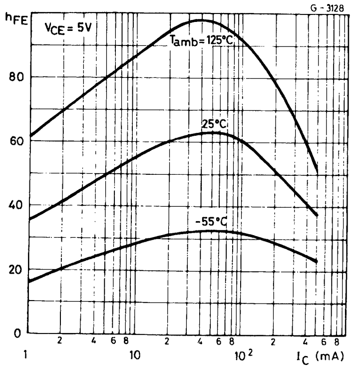
Switching Characteristics.



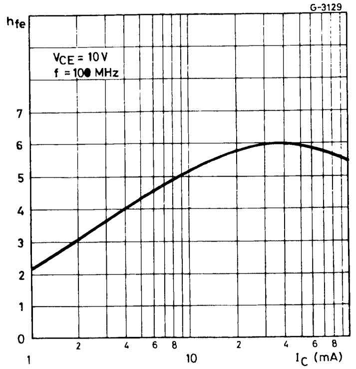
Switching Characteristics.



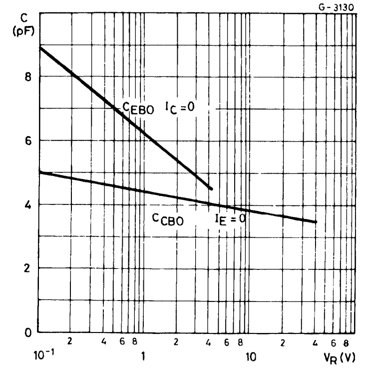
CD Current Gain.



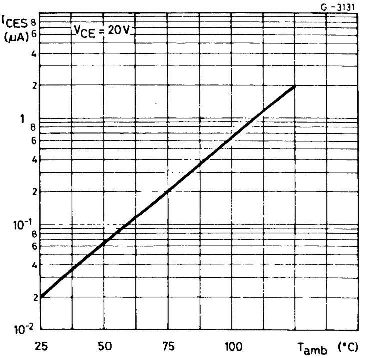
High Frequency Current Gain.



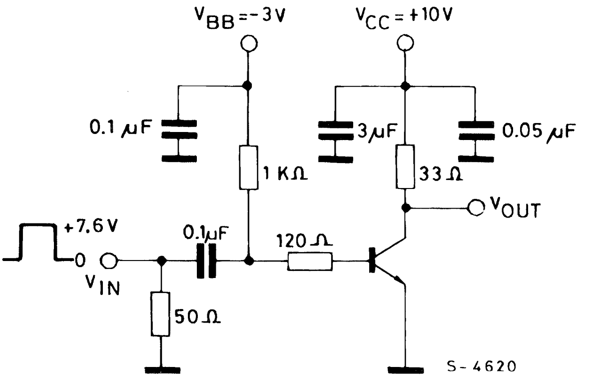
Emitter-base and Collector-base Capacitances.



Collector Cut off Current.



Test circuit for t_{on}, t_{off}.



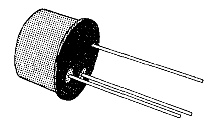
PULSE GENERATOR :
t_r, t_f < 1.0 ns
PW ≥ 240 ns
Z_{IN} = 50 Ω

TO OSCILLOSCOPE :
t_r < 1.0 ns
Z_{IN} ≈ 100 KΩ

MEDIUM POWER AMPLIFIERS

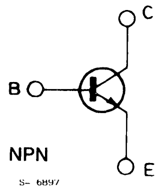
DESCRIPTION

The BSX45 and BSX46 are silicon planar epitaxial NPN transistors in Jedec TO-39 metal case, intended for use in medium power general industrial applications.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	BSX45	BSX46	Unit
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	80	100	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	40	60	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7		V
I_C	Collector Current	1		A
I_B	Base Current	0.2		A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	5		W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200		°C

THERMAL DATA

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

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

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 60 V V_{CE} = 60 V	 T_{amb} = 150 °C			30 10	nA µA
I_{CEX}	Collector Cutoff Current (V_{BE} = – 0.2 V)	V_{CE} = 60 V	T_{amb} = 100 °C			50	µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V				10	nA
$V_{(BR)CES}$	Collector-emitter Breakdown Voltage (V_{BE} = 0)	I_C = 100 µA	for **BSX45** for **BSX46**	80 100			V V
$V_{(BR)CEO}$ *	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 30 mA	for **BSX45** for **BSX46**	40 60			V V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 100 µA		7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 1 A	I_B = 0.1 A		0.7	1	V
V_{BE} *	Base-emitter Voltage	I_C = 0.1 A I_C = 0.5 A I_C = 1 A	V_{CE} = 1 V V_{CE} = 1 V V_{CE} = 1 V	 0.75 	 1.3	1 1.5 2	V V V
h_{FE} *	DC Current Gain	I_C = 0.1 mA	V_{CE} = 1 V Gr. 6 Gr. 10 Gr. 16	 10 15 25	 28 40 90		
		I_C = 100 mA	V_{CE} = 1 V Gr. 6 Gr. 10 Gr. 16	 40 63 100	 63 100 160	 100 160 250	
		I_C = 500 mA	V_{CE} = 1 V Gr. 6 Gr. 10 Gr. 16	 15 25 35	 25 40 60		
		I_C = 1 A	V_{CE} = 1 V Gr. 6 Gr. 10 Gr. 16		 15 20 30		
f_T	Transition Frequency	I_C = 50 mA f = 20 MHz	V_{CE} = 10 V	50			MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 f = 1 MHz	V_{EB} = 0.5 V			80	pF

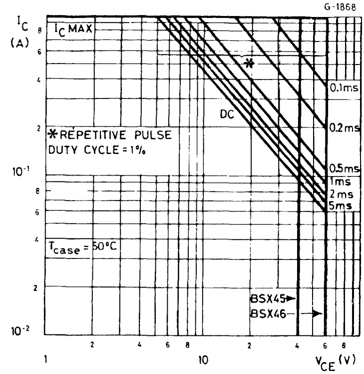
* Pulsed : pulse duration = 300µs, duty cycle = 1%.
** See test circuit.

ELECTRICAL CHARACTERISTICS (continued)

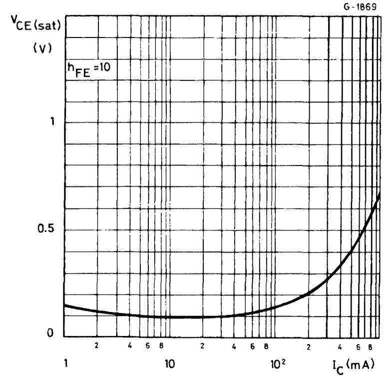
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
C_{CBO}	Collector-base Capacitance	$I_E = 0$ $V_{CB} = 10$ V f = 1 MHz for **BSX45** for **BSX46**			25 20	pF pF
NF	Noise Figure	$I_C = 100$ µA $V_{CE} = 10$ V $R_g = 1$ kΩ f = 1 kHz		3.5		dB
t_{on} **	Turn–on Time	$I_C = 100$ mA $V_{CC} = 20$ V $I_{B1} = 5$ mA			200	ns
t_{off} **	Turn–off Time	$I_C = 100$ mA $V_{CC} = 20$ V $I_{B1} = -I_{B2} = 5$ mA			850	ns

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

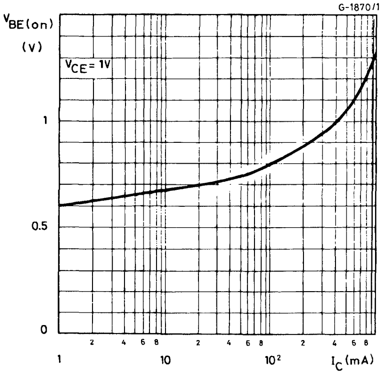
Safe operating areas



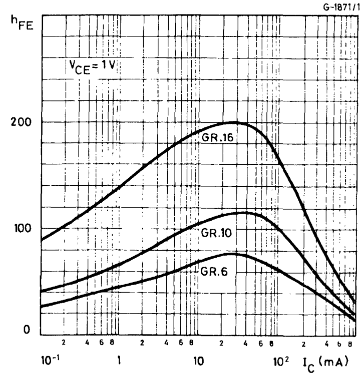
Collector-emitter Saturation Voltage.



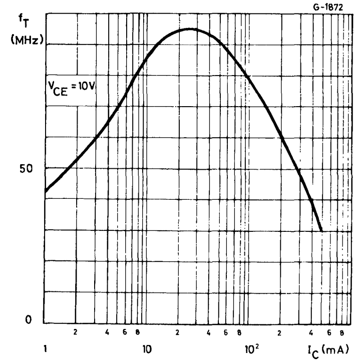
Base-emitter Saturation Voltage.



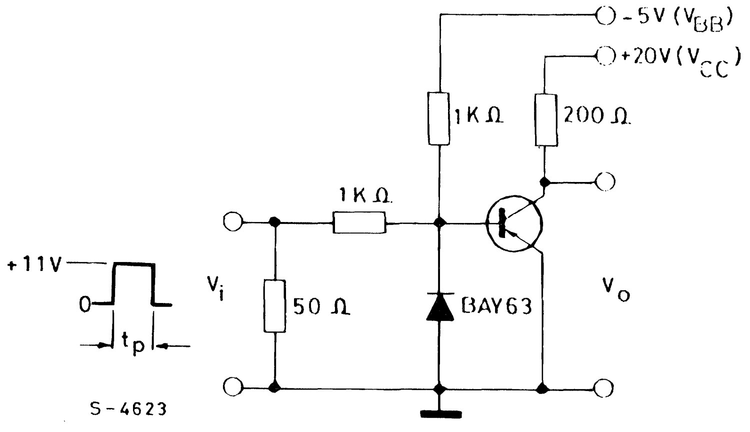
DC Current Gain.



Transition Frequency.



Test circuit for t_{on}, t_{off}.



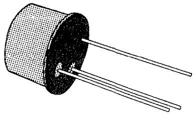
PULSE GENERATOR :
$t_p \geq 10$ µs
$t_r \leq 15$ ns
$t_f \leq 15$ ns
Z_s = 50 Ω

TO OSCILLOSCOPE :
$t_r \leq 15$ ns
$Z_{IN} \geq 100$ KΩ

HIGH FREQUENCY, HIGH SPEED

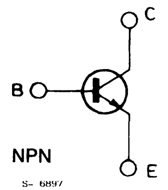
DESCRIPTION

The BSX88A is a silicon planar epitaxial NPN transistor specially designed as high speed saturated logic switch. It features 20 Volt. V_{CEO}, low saturation voltage and fast switching times from 10 to 300mA.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	40	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	20	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5.5	V
I_C	Collector Current	500	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.36 1.2	W W
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 200	°C

THERMAL DATA

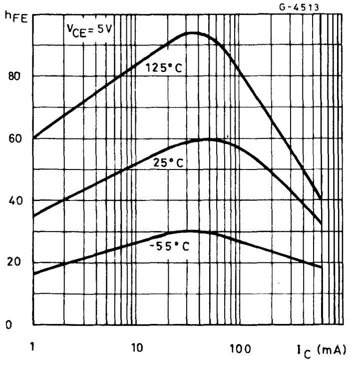
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	145	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

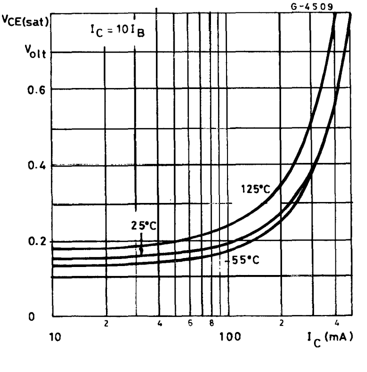
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{EB} = 0)	V_{CE} = 20 V			0.3	µA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 µA	40			V
$V_{(BR)EBO}$	Emitter–base Breakdown Voltage (I_C = 0)	I_E = 100 µA	5.5			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	20			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA I_C = 100 mA I_B = 10 mA			0.18 0.39	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA I_C = 100 mA I_B = 10 mA	0.72	0.77	0.8 1.2	V V
h_{FE}*	DC Current Gain	I_C = 0.5 mA V_{CE} = 1 V I_C = 10 mA V_{CE} = 1 V I_C = 100 mA V_{CE} = 1 V	15 30 35	30 50 55		
h_{fe}	High Frequency Current Gain (f = 100 MHz)	I_C = 30 mA V_{CE} = 10 V	3.5	5.8		
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 0.5 V f = 1 MHz		3	5	pF
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz		7	8	pF
t_s **	Change Storage Time Constant	I_C = I_{B1} = I_{B2} = 10 mA			20	ns
t_{on}**	Turn-on Time	I_C = 10 mA I_{B1} = 3 mA V_{BE} = − 2 V			30	ns
t_{off}**	Turn-off Time	I_C = 10 mA I_{B1} = 3 mA V_{BE} = − 2 V			70	ns

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

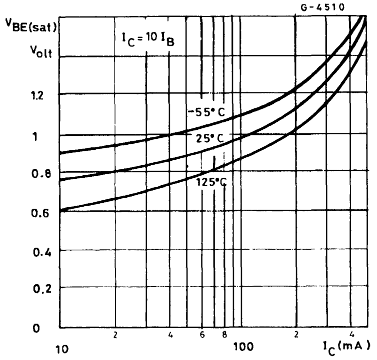
DC Pulse Current Gain vs. Collector Current.



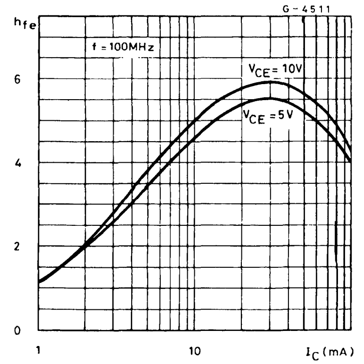
Collector Saturation Voltage vs. Collector Current.



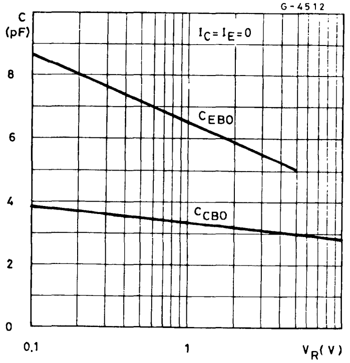
Base Saturation Voltage vs. Collector Current.



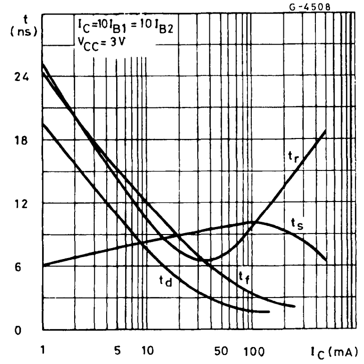
High Frequency Current Gain vs. Collector Current.



Input and Output Capacitance vs. Reverse Bias Voltage.

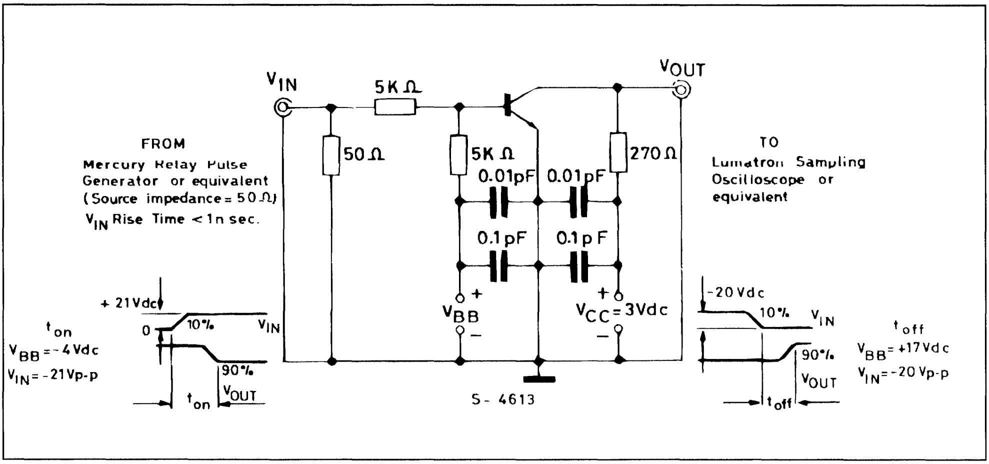


Switching Times vs. Collector Current.

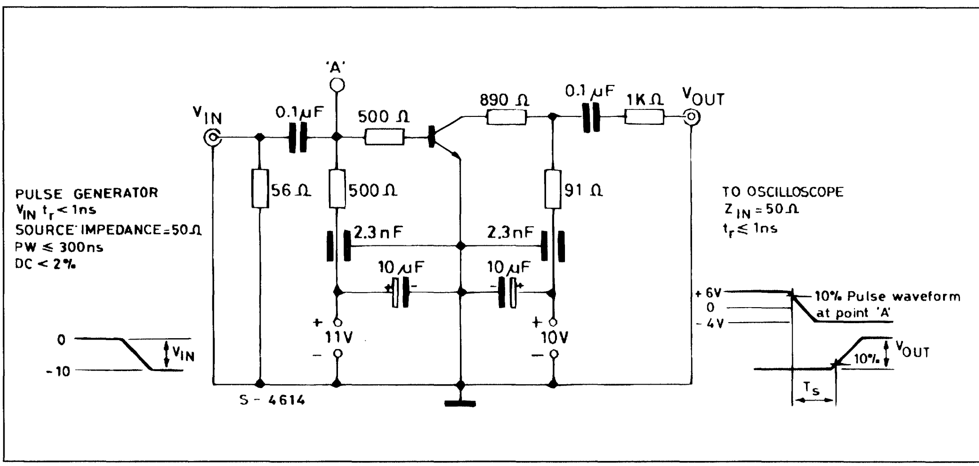


TEST CIRCUITS

Test circuit for t_{on}, t_{off}.



Test circuit for t_S.



SGS-THOMSON MICROELECTRONICS

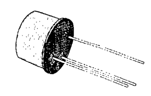
SGS-THOMSON
MICROELECTRONICS

BSX93

HIGH-FREQUENCY SATURATED SWITCH

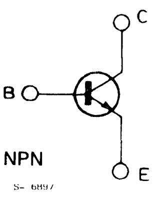
DESCRIPTION

The BSX93 is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case. It is designed specifically for high-speed saturated switching applications.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	40	V
V_{CES}	Collector-emitter Voltage ($V_{BE} = 0$)	40	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	15	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5	V
I_C	Collector Current	150	mA
I_{CM}	Collector Peak Current (t = 10 μs)	500	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.36 1	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

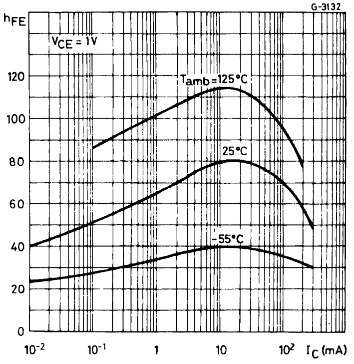
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	175	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

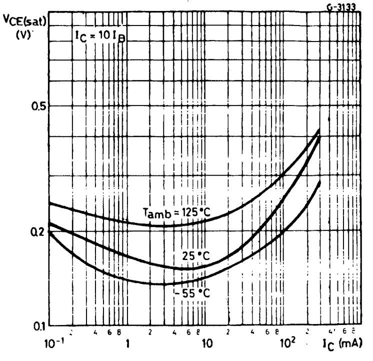
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 20 V V_{CB} = 20 V T_{amb} = 150 °C			0.2 70	µA µA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 10 µA	40			V
$V_{(BR)CES}$*	Collector-emitter Breakdown Voltage (V_{BE} = 0)	Ic = 10 µA	40			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	15			V
$V_{(BR)EBO}$	Collector-emitter Breakdown Voltage (I_c = 0)	I_E = 10 µA	5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA		0.15	0.2	V
V_{BE}*	Base-emitter Voltage	I_C = 10 mA V_{CE} = 1 V		0.7		V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA	0.72	0.75	0.85	V
h_{FE}*	DC Current Gain	I_C = 10 mA V_{CE} = 1 V I_C = 100 mA V_{CE} = 1 V I_C = 10 mA V_{CE} = 1 V T_{amb} = – 55 °C	40 20 20	80 70 40	120	
f_T	Transition Frequency	I_C = 10 mA V_{CE} = 10 V f = 100 MHz	400	650		MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz		3.8	6	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 5 V f = 1 MHz		2.5	4	pF
t_s	Storage Time	I_C = 10 mA V_{CC} = 10 V I_{B1} = – I_{B2} = 10 mA		6	13	ns
t_{on}**	Turn-on Time	I_C = 10 mA V_{CC} = 3 V I_{B1} = 3 mA		9	12	ns
t_{off}**	Turn-off Time	I_C = 10 mA V_{CC} = 3 V I_{B1} = 3 mA I_{B2} = – 1.5 mA		13	18	ns

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

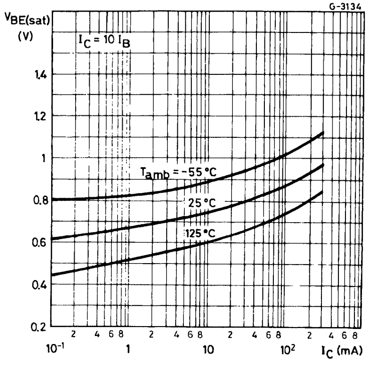
DC Current Gain.



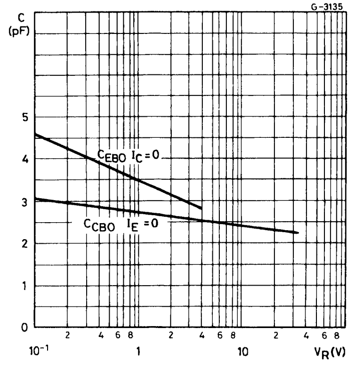
Collector-emitter Saturation Voltage.



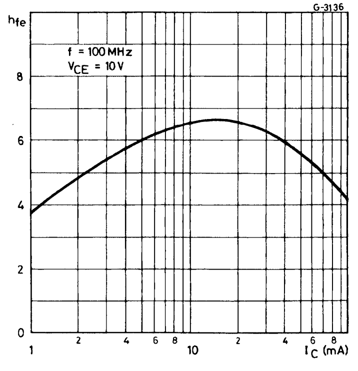
Base-emitter Saturation Voltage.



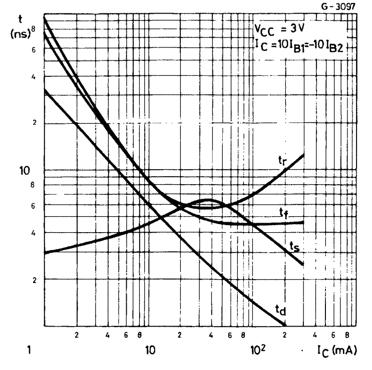
Emitter-base and Collector-base Capacitances.



High Frequency Current Gain.

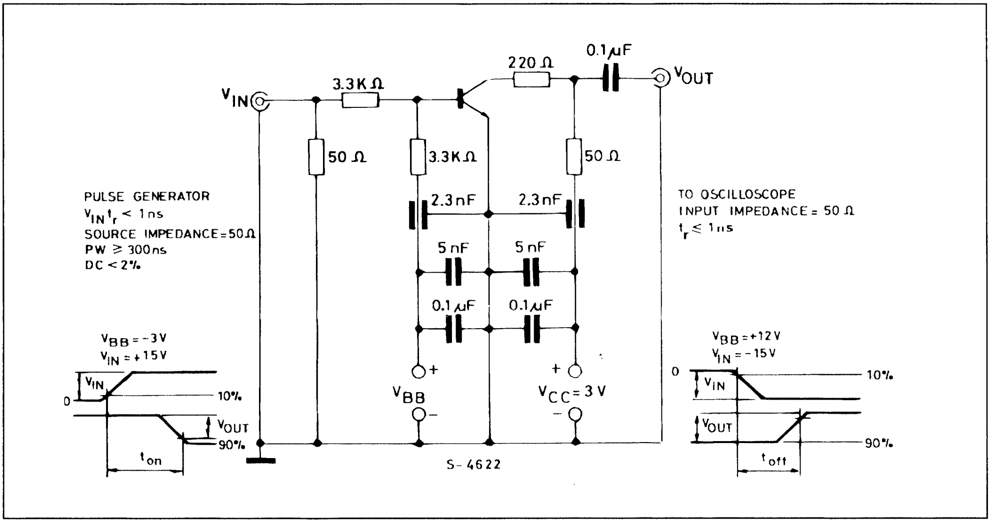


Switching Characteristics.



TEST CIRCUIT

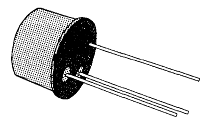
Test Circuit for t_{on}, t_{off}.



GENERAL PURPOSE AMPLIFIERS

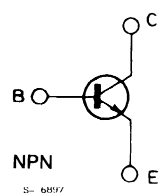
DESCRIPTION

The BSY53 and BSY54 are silicon planar epitaxial NPN transistors in Jedec TO-39 metal case, intended for use in general purpose amplifiers.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	75	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	30	V
V_{EBO}	Emitter-base Voltage (I_E = 0)	7	V
I_C	Collector Current	750	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.8 3	mW mW
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

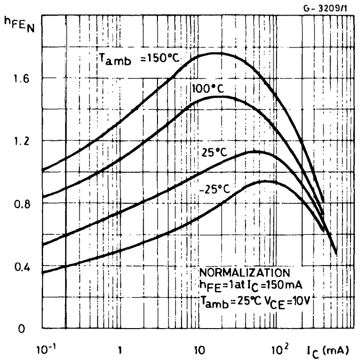
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	58	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	220	°C/W

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

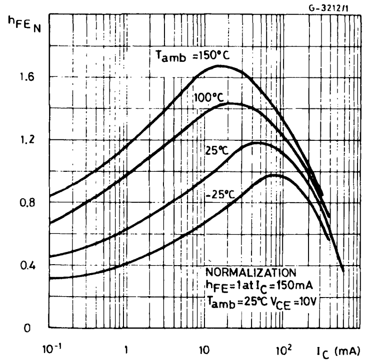
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 60 V V_{CB} = 60 V	 T_{amb} = 150 °C			10 10	nA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V				10	nA
$V_{CE\ (sat)}$*	Collector-emitter Saturation Voltage	I_C = 150 mA I_C = 500 mA	I_B = 15 mA I_B = 50 mA		0.15 0.5	0.6 1.2	V V
$V_{BE\ (sat)}$*	Base-emitter Saturation Voltage	I_C = 150 mA	I_B = 15 mA		0.95	1.2	V
h_{FE}*	DC Current Gain	for **BSY53**					
		I_C = 0.1 mA	V_{CE} = 10 V	20	40		
		I_C = 1 mA	V_{CE} = 10 V		50		
		I_C = 10 mA	V_{CE} = 10 V	35	65		
		I_C = 150 mA	V_{CE} = 10 V	40		120	
		I_C = 500 mA	V_{CE} = 10 V	20	35		
		for **BSY54**					
		I_C = 0.01 mA	V_{CE} = 10 V	20	55		
		I_C = 0.1 mA	V_{CE} = 10 V	35	80		
		I_C = 1 mA	V_{CE} = 10 V		100		
		I_C = 10 mA	V_{CE} = 10 V	75	135		
		I_C = 150 mA	V_{CE} = 10 V	100		300	
		I_C = 500 mA	V_{CE} = 10 V	40	60		
f_T	Transition Frequency	I_C = 50 mA f = 50 MHz	V_{CE} = 10 V		100		MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 f = 1 MHz	V_{CB} = 10 V		10		pF
C_{EBO}	Emitter-base Capacitance	I_C = 0 f = 1 MHz	V_{EB} = 0.5 V		23		pF
NF	Noise Figure	I_C = 0.3 mA R_g = 1.5 kΩ f = 30 Hz to 15 kHz	 V_{CE} = 10 V		3	8	dB
h_{fe}	Small Signal Current Gain	I_C = 1 mA f = 1 kHz	V_{CE} = 10 V for **BSY53** for **BSY54**	 30 50		 150 250	
h_{ie}	Input Impedance	I_C = 1 mA f = 1 kHz	V_{CE} = 10 V for **BSY53** for **BSY54**	 0.8 1.6		 4.5 9	 kΩ kΩ
h_{re}	Reverse Voltage Ratio	I_C = 1 mA f = 1 kHz	V_{CE} = 10 V			3×10^{-4}	
h_{oe}	Output Impedance	I_C = 1 mA f = 1 kHz	V_{CE} = 10 V for **BSY53** for **BSY54**	 3.5 4.5		 10 12.5	 µS µS

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

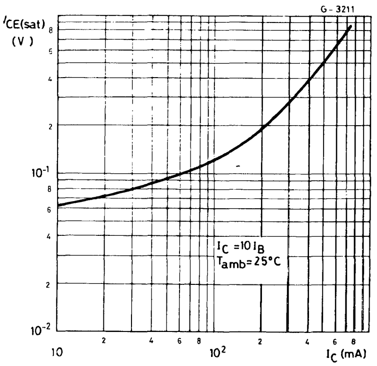
DC Normalized Current Gain (for BSY53 only).



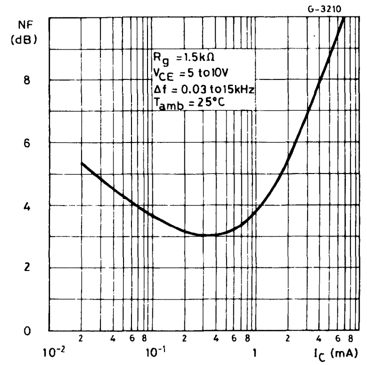
DC Normalized Current Gain (for BSY54 only).



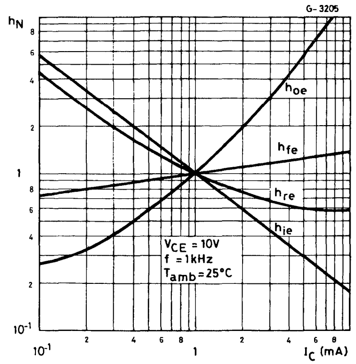
Collector-emitter Saturation Voltage.



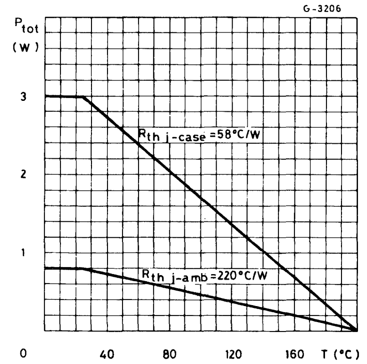
NF vs. Collector Current



Normalized h Parameters.



Power Rating Chart.



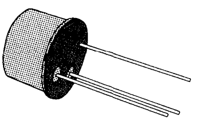
SGS-THOMSON MICROELECTRONICS

BSY55
BSY56

GENERAL PURPOSE AMPLIFIERS

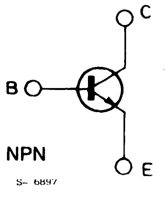
DESCRIPTION

The BSY55 and BSY56 are silicon planar epitaxial NPN transistors in Jedec TO-39 metal case, intended for use in high performance amplifier, oscillator and switching circuits.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	120	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	80	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	500	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.8 3	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

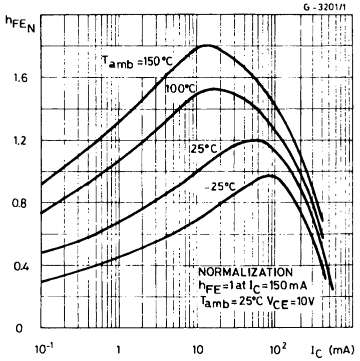
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	58	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	220	°C/W

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

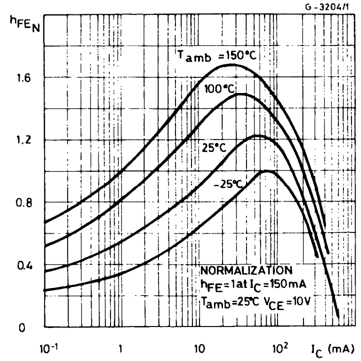
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 90 V V_{CB} = 90 V T_{amb} = 150 °C			10 10	nA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			10	nA
V_{CE} (sat)*	Collector-emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA		0.2	0.6	V
V_{BE} (sat)*	Base-emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA		1	1.3	V
h_{FE}*	DC Current Gain	for **BSY55** I_C = 0.1 mA V_{CE} = 10 V I_C = 1 mA V_{CE} = 10 V I_C = 10 mA V_{CE} = 10 V I_C = 150 mA V_{CE} = 10 V I_C = 500 mA V_{CE} = 10 V for **BSY56** I_C = 0.1 mA V_{CE} = 10 V I_C = 1 mA V_{CE} = 10 V I_C = 10 mA V_{CE} = 10 V I_C = 150 mA V_{CE} = 10 V I_C = 500 mA V_{CE} = 10 V	 20 35 40 35 75 100 	 50 60 65 20 100 125 180 35	 120 300 	
f_T	Transition Frequency	I_C = 50 mA V_{CE} = 10 V f = 50 MHz		100		MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz		10		pF
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz		23		pF
NF	Noise Figure	I_C = 0.3 mA R_g = 1.5 kΩ V_{CE} = 10 V f = 30 Hz to 15 kHz		6		dB
h_{fe}	Small Signal Current Gain	I_C = 1 mA V_{CE} = 10 V f = 1 kHz for **BSY55** for **BSY56**	 30 60		 150 250	
h_{ie}	Input Impedance	I_C = 1 mA V_{CE} = 10 V f = 1 kHz for **BSY55** for **BSY56**	 0.8 1.6		 5 9	 kΩ kΩ
h_{re}	Reverse Voltage Ratio	I_C = 1 mA V_{CE} = 10 V f = 1 kHz			3×10^{-4}	
h_{oe}	Output Admittance	I_C = 1 mA V_{CE} = 10 V f = 1 kHz for **BSY55** for **BSY56**	 2 3		 7 10	 µS µS

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

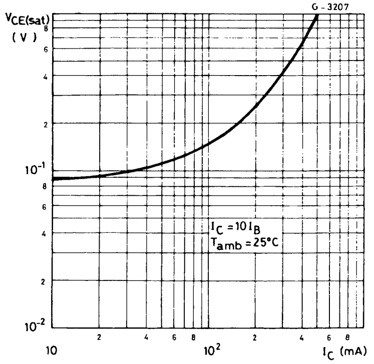
DC Normalized Current Gain (for BSY55 only).



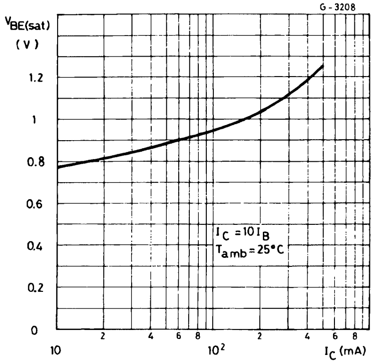
DC Normalized Current Gain (for BSY56 only).



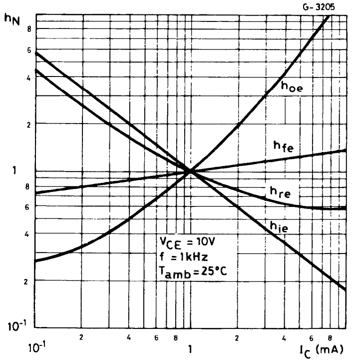
Collector-emitter Saturation Voltage.



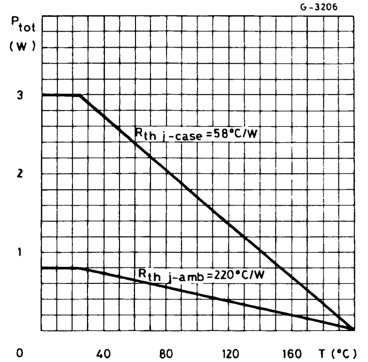
Base-emitter Saturation Voltage.



Normalized h Parameters.



Power Rating Chart.

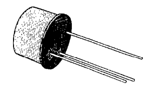


2N708

HIGH-SPEED SATURATED SWITCH

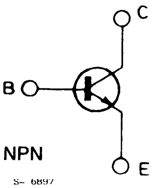
DESCRIPTION

The 2N708 is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case, designed for very fast switching applications.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	40	V
V_{CEO}	Collector–emitter Voltage ($I_B = 0$)	15	V
V_{EBO}	Emitter–base Voltage ($I_C = 0$)	5	V
I_C	Collector Current	200	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.36 1.2	W W
T_{stg}, T_g	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	146	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 20 V V_{CB} = 20 V T_{amb} = 150 °C			25 15	nA µA
$V_{(BR)CBO}$	Collector–base Breakdown Voltage (I_E = 0)	I_C = 100 µA	40			V
$V_{(BR)CEO}$*	Collector–emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	15			V
$V_{(BR)EBO}$	Emitter–base Breakdown Voltage (I_C = 0)	I_E = 10 µA	5			V
I_{EBO}	Emitter Cutoff Current (Ic = 0)	V_{EB} = 4 V			100	nA
$V_{CE(sat)}$*	Collector–emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA			0.4	V
$V_{BE(sat)}$*	Base–emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA			0.9	V
h_{FE}*	DC Current Gain	I_C = 0.5 mA V_{CE} = 1 V I_C = 10 mA V_{CE} = 1 V T_{amb} = – 55 °C I_C = 10 mA V_{CE} = 1 V	15 30 15		 120	– – –
h_{fe}	High Frequency Current Gain	I_C = 10 mA V_{CE} = 10 V f = 100 MHz	3			–
C_{CBO}	Collector–base Capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz			6	pF
t_s	Storage Time	I_C = 10 mA V_{CC} = 10 V I_{B1} = – I_{B2} = 10 mA			25	ns
t_{on}	Turn–on Time	I_C = 10 mA V_{CC} = 10 V I_{B1} = 3 mA			40	ns
t_{off}	Turn–off Time	I_C = 10 mA V_{CC} = 10 V I_{B1} = 3 mA I_{B2} = – 1 mA			75	ns

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

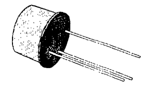
SGS-THOMSON MICROELECTRONICS

2N718A
2N956

AMPLIFIERS AND SWITCHES

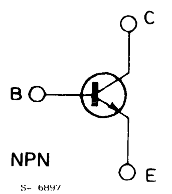
DESCRIPTION

The 2N718A and 2N956 are silicon planar epitaxial NPN transistors in Jedec TO-18 metal case, intended for high-speed switching and amplifier applications.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	75	V
V_{CER}	Collector–emitter Voltage ($R_{BE} \leq 10\ \Omega$)	50	V
V_{EBO}	Emitter–base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	1	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.5 1.8	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	97	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	350	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 60 V V_{CB} = 60 V T_{amb} = 150 °C			10 10	nA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V for **2N718A** for **2N956**			 10 5	 nA nA
$V_{(BR)CBO}$	Collector–base Breakdown Voltage (I_E = 0)	I_C = 100 µA	75			V
$V_{(BR)CER}$*	Collector–emitter Breakdown Voltage ($R_{BE} \leq 10\ \Omega$)	I_C = 10 mA	50			V
$V_{(BR)EBO}$	Emitter–base Breakdown Voltage (I_C = 0)	I_E = 100 µA	7			V
$V_{CE(sat)}$*	Collector–emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA		0.24	1.5	V
$V_{BE(sat)}$*	Base–emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA		1	1.3	V
h_{FE}*	DC Current Gain	for **2N718A** I_C = 0.1 mA V_{CE} = 10 V I_C = 10 mA V_{CE} = 10 V I_C = 150 mA V_{CE} = 10 V I_C = 500 mA V_{CE} = 10 V I_C = 10 mA V_{CE} = 10 V T_{amb} = – 55 °C for **2N956** I_C = 0.01 mA V_{CE} = 10 V I_C = 0.1 mA V_{CE} = 10 V	 20 35 40 20 20 20 35		 120	– – – – – – –

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

ELECTRICAL CHARACTERISTICS (continued)

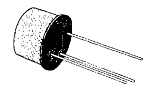
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
h_{FE}*	DC Current Gain	for **2N956**					–
		I_C = 10 mA	V_{CE} = 10 V	75			–
		I_C = 150 mA	V_{CE} = 10 V	100		300	–
		I_C = 500 mA	V_{CE} = 10 V	40			
		I_C = 10 mA	V_{CE} = 10 V				
		T_{amb} = – 55 °C		35			–
h_{fe}	Small Signal Current Gain	for **2N718A**					
		I_C = 1 mA	V_{CE} = 5 V	30		150	–
		I_C = 5 mA	V_{CE} = 10 V	35		150	–
		for **2N956**					
		I_C = 1 mA	V_{CE} = 5 V	50		300	–
		I_C = 5 mA	V_{CE} = 10 V	70		300	–
f_T	Transition Frequency	I_C = 50 mA	V_{CE} = 10 V				
		f = 20 MHz					
			for **2N718A**	60			MHz
			for **2N956**	70			MHz
C_{EBO}	Emitter–base Capacitance	I_C = 0	V_{EB} = 0.5 V				
		f = 1 MHz				80	pF
C_{CBO}	Collector–base Capacitance	I_E = 0	V_{CB} = 10 V				
		f = 1 MHz				25	pF
NF	Noise Figure	I_C = 300 µA	V_{CE} = 10 V				
		f = 1 kHz					
			for **2N718A**			12	dB
			for **2N956**			8	dB

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

HIGH VOLTAGE GENERAL PURPOSE

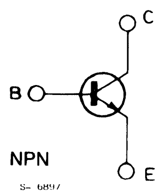
DESCRIPTION

The 2N720A is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case. It is suitable for a wide variety of amplifier and switching applications.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	120	V
V_{CEO}	Collector–emitter Voltage ($I_R = 0$)	80	V
V_{EBO}	Emitter–base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	500	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.5 1.8	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	97.2	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	350	°C/W

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

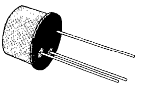
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 90 V				10	nA
$V_{(BR)CBO}$	Collector–base Breakdown Voltage (I_E = 0)	I_C = 100 µA		120			V
$V_{(BR)CEO}$*	Collector–emitter Breakdown Voltage (I_B = 0)	I_C = 30 mA		80			V
$V_{(BR)EBO}$	Emitter–base Breakdown Voltage (I_E = 0)	I_E = 100 µA		7			V
I_{EBO}	Emitter Cuttoff Current (I_E = 0)	V_{EB} = 5 V				10	nA
$V_{CE(sat)}$*	Collector–emitter Saturation Voltage	I_C = 50 mA I_C = 150 mA	I_B = 5 mA I_B = 15 mA			1.2 5	V V
$V_{BE(sat)}$*	Base–emitter Saturation Voltage	I_C = 50 mA I_C = 150 mA	I_B = 5 mA I_B = 15 mA			0.9 1.3	V V
h_{FE}*	DC Current Gain	I_C = 100 µA I_C = 10 mA I_C = 150 mA	V_{CE} = 10 V V_{CE} = 10 V V_{CE} = 10 V	20 35 40		 120	– – –
h_{fe}	High Frequency Current Gain	I_C = 50 mA f = 20 MHz	V_{CE} = 10 V	2.5			–
C_{CBO}	Collector–base Capacitance	I_E = 0 f = 1 MHz	V_{CB} = 10 V			15	pF
C_{EBO}	Emitter–base Capacitance	I_C = 0 f = 1 MHz	V_{EB} = 0.5 V			85	pF

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

SATURATED LOGIC SWITCH AND VHF AMPLIFIER

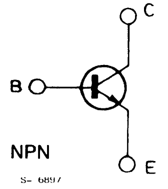
DESCRIPTION

The 2N914 is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case. It is primarily a universal switch but it is also an excellent high speed, high gain logic and memory driver at collector currents up to 500 mA.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	40	V
V_{CER}	Collector-emitter Voltage ($R_{BE} \leq 10\ \Omega$)	20	V
V_{CEO}	Collector–emitter Voltage (I_B = 0)	15	V
V_{EBO}	Emitter–base Voltage (I_C = 0)	5	V
I_c	Collector Current	500	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C at $T_{case} \leq 100$ °C	0.36 1.2 0.68	W W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

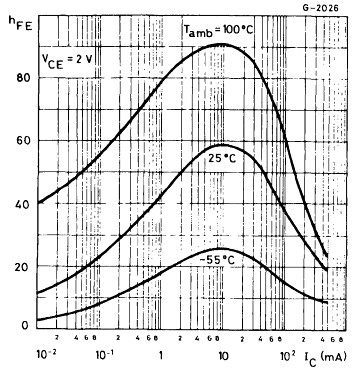
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	146	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

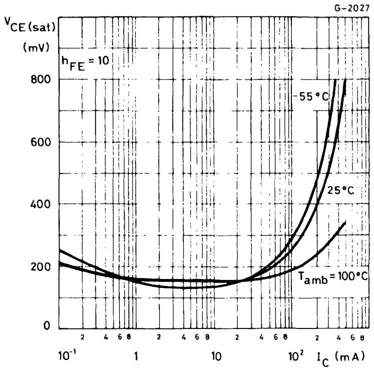
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 20 V V_{CB} = 20 V T_{amb} = 150 °C			25 15	nA μA
I_{CEX}	Collector Cutoff Current (V_{BE} = – 0.25 V)	V_{CE} = 20 V T_{amb} = 125 °C			10	μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 4 V			100	nA
$V_{(BR)CBO}$	Collector–base Breakdown Voltage (I_E = 0)	I_C = 1 μA	40			V
$V_{(BR)CES}$	Collector–emitter Breakdown Voltage (R_{BE} ≤ 10 Ω)	I_C = 10 mA	20			V
$V_{(BR)CEO}$*	Collector–emitter Breakdown Voltage (I_B = 0)	I_C = 30 mA	15			V
$V_{(BR)EBO}$	Emitter–base Breakdown Voltage (I_C = 0)	I_E = 10 μA	5			V
$V_{CE(sat)}$*	Collector–emitter Saturation Voltage	I_C = 20 mA I_B = 2 mA I_C = 200 mA I_B = 20 mA		0.2 0.4	0.25 0.7	V V
$V_{BE(sat)}$*	Base–emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA	0.7	0.74	0.8	V
h_{FE}*	DC Current Gain	I_C = 10 mA V_{CE} = 1 V I_C = 500 mA V_{CE} = 5 V I_C = 10 mA V_{CE} = 1 V T_{amb} = – 55 °C	30 10 12	55 17 28	120	– – –
f_T	Transition Frequency	I_C = 20 mA V_{CE} = 10 V f = 100 MHz	300	370		MHz
C_{EBO}	Emitter–base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz			9	pF
C_{CBO}	Collector–base Capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz		4.5	6	pF
t_s	Storage Time	I_C = 20 mA V_{CC} = 5 V I_{B1} = – I_{B2} = 20 mA		13	20	ns
t_{on}	Turn–on Time	I_C = 200 mA V_{CC} = 5 V I_{B1} = 40 mA		25	40	ns
t_{off}	Turn–off Time	I_C = 200 mA V_{CC} = 5 V I_{B1} = 40 mA I_{B2} = – 20 mA		25	40	ns

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

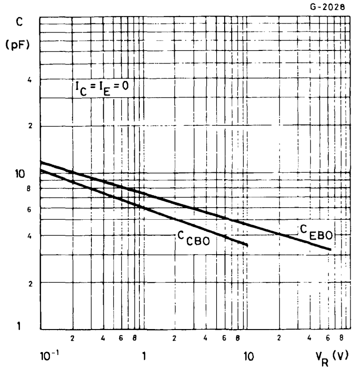
DC Current Gain.



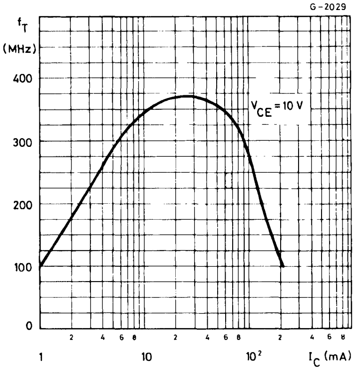
Collector-emitter Saturation Voltage.



Collector-base and Emitter-base Capacitances.



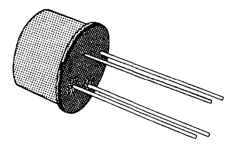
Transition Frequency.



HIGH-FREQUENCY OSCILLATORS AND AMPLIFIERS

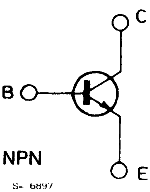
DESCRIPTION

The 2N918 is a silicon planar epitaxial NPN transistors in Jedec TO-72 metal case. It is designed for low-noise VHF amplifiers, oscillators up to 1 GHz, non-neutralized IF amplifiers and non-saturating circuits with rise and fall times of less than 2.5 ns.



TO-72

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	30	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	15	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	3	V
I_C	Collector Current	50	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	200 300	mW mW
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

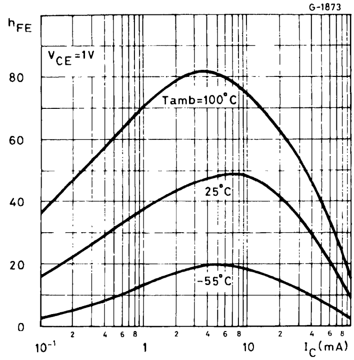
$R_{th\ j\text{-}case}$ $R_{th\ j\text{-}amb}$	Thermal Resistance Junction-case Thermal Resistance Junction-ambient	Max Max	584 875	°C/W °C/W

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

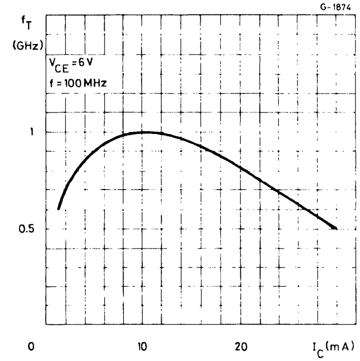
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 15 V V_{CB} = 15 V T_{amb} = 150 °C			10 1	nA μA
$V_{(BR)CBO}$	Collector–base Breakdown Voltage (I_E = 0)	I_C = 1 μA	30			V
$V_{CEO(sus)}$	Collector–emitter Sustaining Voltage (I_B = 0)	I_C = 3 mA	15			V
$V_{(BR)EBO}$	Emitter–base Breakdown Voltage (I_C = 0)	I_E = 10 μA	3			V
$V_{CE(sat)}$	Collector–emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA			0.4	V
$V_{BE(sat)}$	Base–emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA			1	V
h_{FE}	DC Current Gain	I_C = 3 mA V_{CE} = 1 V	20	50		–
f_T	Transition Frequency	I_C = 4 mA f = 100 MHz V_{CE} = 10 V	600	900		MHz
C_{EBO}	Emitter–base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz			2	pF
C_{CBO}	Collector–base Capacitance	I_E = 0 f = 1 MHz V_{CE} = 0 V_{CE} = 10 V		1.8 1	3 1.7	pF pF
NF	Noise Figure	I_C = 1 mA V_{CE} = 6 V R_g = 400 Ω f = 60 MHz			6	dB
G_{pe}	Power Gain	R_g = 50 Ω f = 200 MHz I_C = 6 mA V_{CE} = 12 V	15	21		dB
P_o*	Output Power	I_C = 12 mA V_{CB} = 10 V f = 500 MHz	30	40		mW
η	Collector Efficiency	I_C = 12 mA V_{CB} = 10 V f = 500 MHz	25			%

* See test circuit.

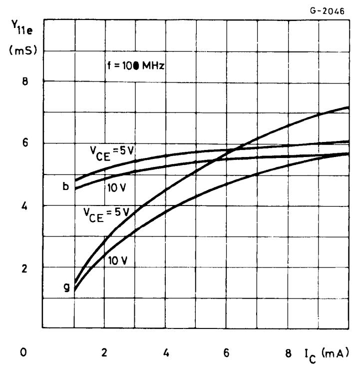
DC Current Gain.



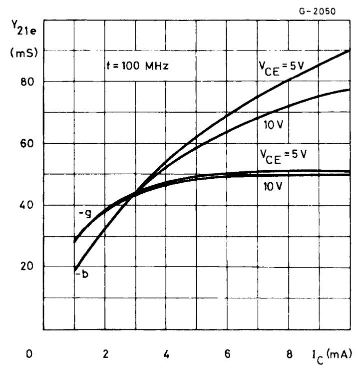
Transition Frequency.



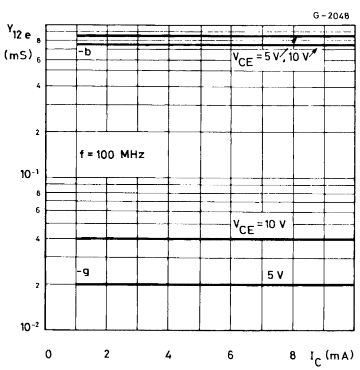
Input Admittance vs. Collector Current.



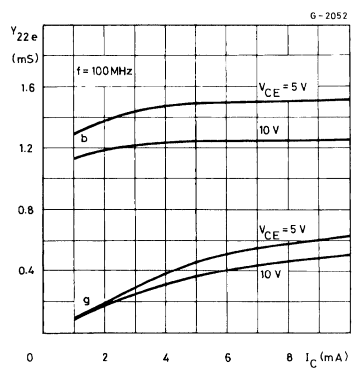
Forward Transadmittance vs. Collector Current.



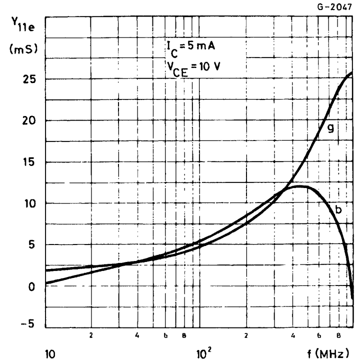
Reverse Transadmittance vs. Collector Current.



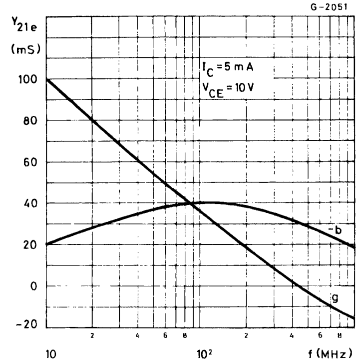
Output Admittance vs. Collector Current.



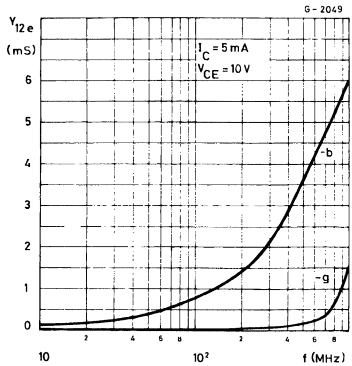
Input Admittance vs. Frequency.



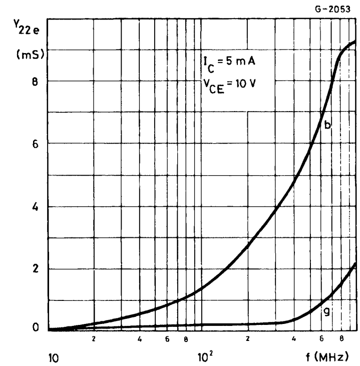
Forward Transadmittance vs. Frequency.



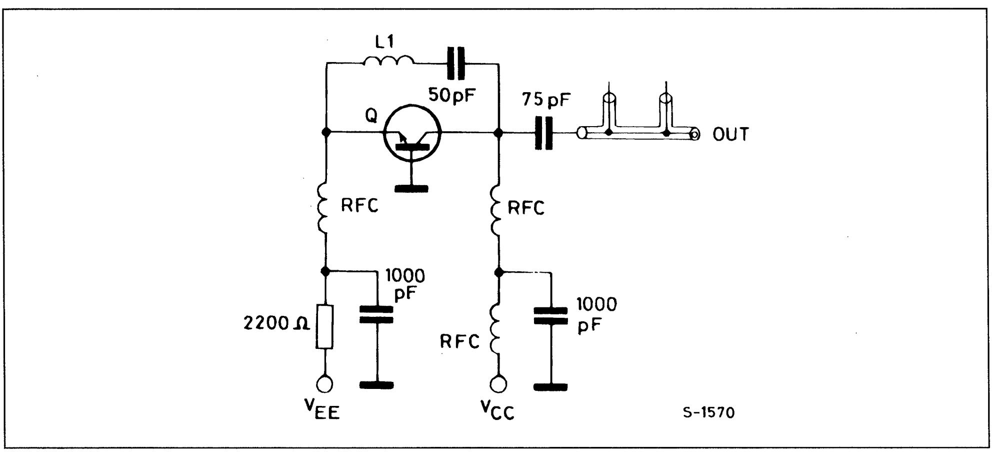
Reverse Transadmittance vs. Frequency.



Output Admittance vs. Frequency.



500 MHz Oscillator Test Circuit.



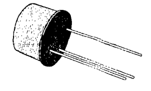
SGS-THOMSON MICROELECTRONICS

2N930

LOW-LEVEL, LOW-NOISE AMPLIFIERS

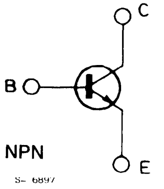
DESCRIPTION

The 2N930 is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case, designed for use in high performance, low-level, low-noise amplifier applications.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	45	V
V_{CEO}	Collector–emitter Voltage ($I_B = 0$)	45	V
V_{EBO}	Emitter–base Voltage ($I_C = 0$)	5	V
I_C	Collector Current	30	mA
P_{tot}	Total Power Dissipation at $T_{amb} = 25$ °C at $T_{case} = 25$ °C	0.3 0.6	W W
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$ $R_{th\ j\text{-}amb}$	Thermal Resistance Junction-case Thermal Resistance Junction-ambient	Max Max	292 583	°C/W °C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 45 V			10	nA
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 45 V V_{CE} = 45 V T_{amb} = 150 °C			10 10	nA µA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 5 V			2	nA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			10	nA
$V_{(BR)CEO}$*	Collector–emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	45			V
$V_{(BR)EBO}$	Emitter–base Breakdown Voltage (I_C = 0)	I_E = 10 nA	5			V
$V_{CE(sat)}$*	Collector–emitter Sustaining Voltage	I_C = 10 mA I_B = 0.5 mA			1	V
V_{BE}*	Base–emitter Voltage	I_C = 10 mA I_B = 0.5 mA	0.6		1	V
h_{FE}*	DC Current Gain	I_C = 10 µA V_{CE} = 5 V I_C = 0.5 mA V_{CE} = 5 V I_C = 10 mA V_{CE} = 5 V I_C = 10 µA V_{CE} = 5 V T_{amb} = – 55 °C	100 150 20		300 600	– – – –
h_{fe}	Small Signal Current Gain	I_C = 1 mA V_{CE} = 5 V f = 1 kHz	150		600	–
f_T	Transition Frequency	I_C = 0.5 mA V_{CE} = 5 V f = 30 MHz	30			MHz
C_{CBO}	Collector–base Capacitance	I_E = 0 V_{CB} = 5 V f = 1 MHz			8	pF
NF	Noise Figure	I_C = 10 µA V_{CE} = 5 V f = 1 kHz R_g = 10 kΩ			3	dB

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

SGS-THOMSON MICROELECTRONICS

2N1613
2N1711

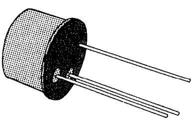
SWITCHES AND UNIVERSAL AMPLIFIERS

DESCRIPTION

The 2N1613 and 2N1711 are silicon planar epitaxial NPN transistors in Jedec TO-39 metal case. They are designed for use in high-performance amplifier, oscillator and switching circuits.

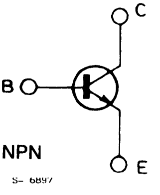
The 2N1711 is also used to advantage in amplifiers where low noise is an important factor.

Products approved to CECC 50002-104 available on request.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	75	V
V_{CER}	Collector-emitter Voltage ($R_{BE} \leq 10\ \Omega$)	50	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	500	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C at $T_{case} \leq 100$ °C	0.8 3 1.7	W W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	58	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	219	°C/W

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

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 60 V V_{CB} = 60 V	 T_{amb} = 150 °C			10 10	nA μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V	for **2N1613** for **2N1711**			10 5	nA nA
$V_{(BR)\ CBO}$	Collector-base Breakdown Voltage	I_C = 0.1 mA		75			V
$V_{(BR)CER}$*	Collector-emitter Breakdown Voltage (R_{BE} ≤ 10 Ω)	I_C = 10 mA		50			V
$V_{(BR)\ EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 0.1 mA		7			V
$V_{CE\ (sat)}$*	Collector-emitter Saturation Voltage	I_C = 150 mA	I_B = 15 mA		0.5	1.5	V
$V_{BE\ (sat)}$*	Base-emitter Saturation Voltage	I_C = 150 mA	I_B = 15 mA		0.95	1.3	V
h_{FE}*	DC Current Gain	for **2N1613** I_C = 0.01 mA I_C = 0.1 mA I_C = 10 mA I_C = 150 mA I_C = 500 mA I_C = 10 mA T_{amb} = –55 °C	 V_{CE} = 10 V V_{CE} = 10 V V_{CE} = 10 V V_{CE} = 10 V V_{CE} = 10 V V_{CE} = 10 V	 20 35 40 20 20	 35 50 80 80 55 35	 120	
h_{FE}*	DC Current Gain	for **2N1711** I_C = 0.01 mA I_C = 0.1 mA I_C = 10 mA I_C = 150 mA I_C = 500 mA I_C = 10 mA T_{amb} = 55 °C	 V_{CE} = 10 V V_{CE} = 10 V V_{CE} = 10 V V_{CE} = 10 V V_{CE} = 10 V V_{CE} = 10 V	 20 35	 60 80 130 130 75 65	 300	
h_{fe}	Small Signal Current Gain	for **2N1613** I_C = 1 mA f = 1 kHz for **2N1711** I_C = 1 mA f = 1 kHz	 V_{CE} = 10 V V_{CE} = 10 V	 30 70	 70 135	 150 300	
f_t	Transition Frequency	I_C = 50 mA f = 20 MHz	V_{CE} = 10 V for **2N1613** for **2N1711**	 60 70	 80 100		 MHz MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 f = 1 MHz	V_{EB} = 0.5 V		50	80	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 f = 1 MHz	V_{CB} = 10 V		18	25	pF

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

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
NF	Noise Figure	I_C = 0.3 mA R_9 = 510 Ω	V_{CE} = 10 V f = 1 kHz for **2N1613** for **2N1711**		 6 3.5	 12 8	 dB dB
h_{ie}	Input Impedance	I_C = 1 mA f = 1 KHz	V_{CE} = 5 V for **2N1613** for **2N1711**		 2.2 4.4		 kΩ kΩ
h_{re}	Reverse Voltage Ratio	I_C = 1 mA f = 1 kHz	V_{CE} = 5 V for **2N1613** for **2N1711**		 $3.6x10^{-4}$ $7.3x10^{-4}$		
h_{oe}	Output Admittance	I_C = 1 mA f = 1 kHz	V_{CE} = 5 V for **2N1613** for **2N1711**		 12.5 23.8		 µS µS

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

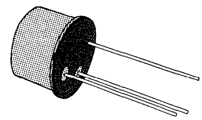
GENERAL PURPOSE HIGH-VOLTAGE TYPE

DESCRIPTION

The 2N1893 is a silicon planar epitaxial NPN transistor in Jedec TO-39 metal case, designed for use in high-performance amplifier, oscillator and switching circuits.

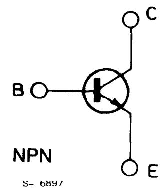
It provides greater voltage swings in oscillator and amplifier circuits and more protection in inductive switching circuits due to its 120 V collector-to-base voltage rating.

Products approved to CECC 50002-104 available on request.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	120	V
V_{CER}	Collector-emitter Voltage ($R_{BE} \leq 10\ \Omega$)	100	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	0.5	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C at $T_{case} \leq 100$ °C	0.8 3 1.7	W W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

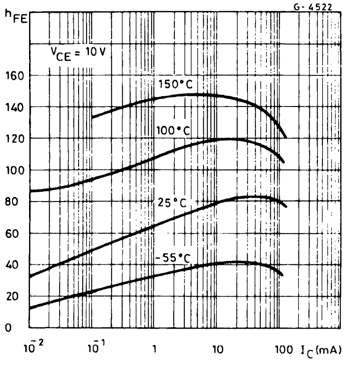
$R_{th\ j-case}$	Thermal Resistance Junction-case	Max	58	°C/W
$R_{th\ j-amb}$	Thermal Resistance Junction-ambient	Max	219	°C/W

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

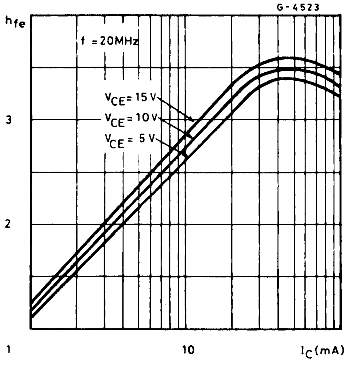
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 90 V V_{CB} = 90 V T_{amb} = 150 °C			10 15	nA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			10	nA
$V_{(BR)\ CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 µA	120			V
$V_{(BR)CER}$*	Collector-emitter Breakdown Voltage ($R_{BE} \le 10\ \Omega$)	I_C = 10 mA	100			V
$V_{(BR)CEO}$	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	80			V
$V_{(BR)\ EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 100 µA	7			V
$V_{CE\ (sat)}$*	Collector-emitter Saturation Voltage	I_C = 50 mA I_B = 5 mA I_C = 150 mA I_B = 15 mA			1.2 5	V V
$V_{BE\ (sat)}$ *	Base-emitter Saturation Voltage	I_C = 50 mA I_B = 5 mA I_C = 150 mA I_B = 15 mA		0.82 0.96	0.9 1.3	V V
h_{FE}*	DC Current Gain	I_C = 0.1 mA V_{CE} = 10 V I_C = 10 mA V_{CE} = 10 V I_C = 150 mA V_{CE} = 10 V I_C = 10 mA V_{CE} = 10 V T_{amb} = − 55 °C	20 35 40 20	50 80 80 40	 120	
h_{fe}	Small Signal Current Gain	I_C = 1 mA V_{CE} = 5 V f = 1 kHz I_C = 5 mA V_{CE} = 10 V f = 1 kHz	 30 45	 70 85	 150	
f_T	Transition Frequency	I_C = 50 mA V_{CE} = 10 V f = 20 MHz	50	70		MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz		55	85	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz		13	15	pF

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

DC Current Gain.



High-frequency Current Gain.



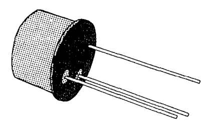
SGS-THOMSON
MICROELECTRONICS

2N2102

GENERAL PURPOSE AMPLIFIER AND SWITCH

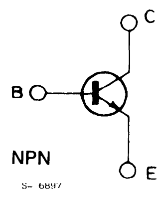
DESCRIPTION

The 2N2102 is a silicon planar epitaxial NPN transistor in Jedec TO-39 metal case. It is intended for a wide variety of small-signal and medium power applications in military and industrial equipments.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	120	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	65	V
V_{CER}	Collector-emitter Voltage ($R_{BE} \leq 10\ \Omega$)	80	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7	V
I_C	Collector Current	1	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	1 5	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	35	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 60 V V_{CB} = 60 V T_{amb} = 150 °C			2 2	nA μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			5	nA
$V_{(BR)\ CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 μA	120			V
$V_{CEO\ (sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 30 mA	65			V
$V_{CE\ (sat)}$*	Collector-emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA			0.5	V
$V_{BE\ (sat)}$*	Base-emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA			1.1	V
h_{FE}*	DC Current Gain	I_C = 10 μA V_{CE} = 10 V I_C = 100 μA V_{CE} = 10 V I_C = 10 mA V_{CE} = 10 V I_C = 150 mA V_{CE} = 10 V I_C = 500 mA V_{CE} = 10 V I_C = 1 A V_{CE} = 10 V	10 20 35 40 25 10		 120 	
h_{fe}	High Frequency Current Gain	I_C = 50 mA V_{CE} = 10 V f = 20 MHz		6		
NF	Noise Figure	I_C = 300 μA V_{CE} = 10 V BW = 1 Hz f = 1 KHz R_G = 510 Ω			8	dB
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz			15	pF
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz			80	pF

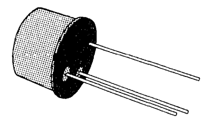
* Pulsed : pulse duration = 300 μs, duty cycle = 1 %.

HIGH-SPEED SWITCHES

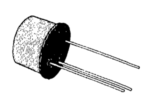
DESCRIPTION

The 2N2218, 2N2219, 2N2221 and 2N2222 are silicon planar epitaxial NPN transistors in Jedec TO-39 (for 2N2218 and 2N2219) and in Jedec TO-18 (for 2N2221 and 2N2222) metal cases. They are designed for high-speed switching applications at collector currents up to 500 mA, and feature useful current gain over a wide range of collector current, low leakage currents and low saturation voltages.

2N2218/2N2219 approved to CECC 50002-100, 2N2221/2N2222 approved to CECC 50002-101 available on request.

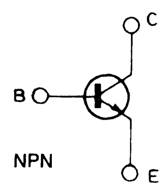


TO-39



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	60	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	30	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5	V
I_C	Collector Current	0.8	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C for **2N2218** and **2N2219** for **2N2221** and **2N2222** at $T_{case} \leq 25$ °C for **2N2218** and **2N2219** for **2N2221** and **2N2222**	 0.8 0.5 3 1.8	 W W W W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	175	°C

THERMAL DATA

			2N2218 2N2219	2N2221 2N2222
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	50 °C/W	83.3 °C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	187.5 °C/W	300 °C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 50 V V_{CB} = 50 V T_{amb} = 150 °C			10 10	nA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 3 V			10	nA
$V_{(BR)\ CBO}$	Colllector-base Breakdown Voltage (I_E = 0)	I_C = 10 µA	60			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	30			V
$V_{(BR)\ EBO}$	Emittter-base Breakdown Voltage (I_C = 0)	I_E = 10 µA	5			V
$V_{CE\ (sat)}$*	Collector-emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA I_C = 500 mA I_B = 50 mA			0.4 1.6	V V
$V_{BE\ (sat)}$*	Base-emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA I_C = 500 mA I_B = 50 mA			1.3 2.6	V V
h_{FE}*	DC Current Gain	for **2N2218** and **2N2221** I_C = 0.1 mA V_{CE} = 10 V I_C = 1 mA V_{CE} = 10 V I_C = 10 mA V_{CE} = 10 V I_C = 150 mA V_{CE} = 10 V I_C = 500 mA V_{CE} = 10 V I_C = 150 mA V_{CE} = 1 V for **2N2219** and **2N2222** I_C = 0.1 mA V_{CE} = 10 V I_C = 1 mA V_{CE} = 10 V I_C = 10 mA V_{CE} = 10 V I_C = 150 mA V_{CE} = 10 V I_C = 500 mA V_{CE} = 10 V I_C = 150 mA V_{CE} = 1 V	 20 25 35 40 20 20 35 50 75 100 30 50		 120 300	
f_T	Transition Frequency	I_C = 20 mA V_{CE} = 20 V f = 100 MHz	250			MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V f = 100 kHz			8	pF
$R_{e(hie)}$	Real Part of Input Impedance	I_C = 20 mA V_{CE} = 20 V f = 300 MHz			60	Ω

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

SGS-THOMSON MICROELECTRONICS

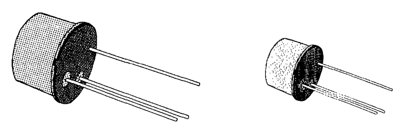
2N2218A-2N2219A 2N2221A-2N2222A

HIGH SPEED SWITCHES

DESCRIPTION

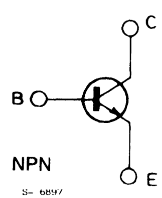
The 2N2218A, 2N2219A, 2N2221A and 2N2222A are silicon planar epitaxial NPN transistors in Jedec TO-39 (for 2N2218A and 2N2219A) and in Jedec TO-18 (for 2N2221A and 2N2222A) metal cases. They are designed for high-speed switching applications at collector currents up to 500 mA, and feature useful current gain over a wide range of collector current, low leakage currents and low saturation voltages.

2N2218A/2N2219A approved to CECC 50002-100, 2N2221A/2N2222A approved to CECC 50002-101 available on request.



TO-39 TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	75	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	40	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	6	V
I_C	Collector Current	0.8	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C		
	for **2N2218A** and **2N2219A**	0.8	W
	for **2N2221A** and **2N2222A**	0.5	W
	at $T_{case} \leq 25$ °C		
	for **2N2218A** and **2N2219A**	3	W
	for **2N2221A** and **2N2222A**	1.8	W
T_{stg}	Storage Temperature	– 65 to 200	°C
T_j	Junction Temperature	175	°C

THERMAL DATA

			2N2218A 2N2219A	2N2221A 2N2222A
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	50 °C/W	83.3 °C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	187.5 °C/W	300 °C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current ($I_E = 0$)	$V_{CB} = 60$ V $V_{CB} = 60$ V $T_{amb} = 150$ °C			10 10	nA µA
I_{CEX}	Collector Cutoff Current ($V_{BE} = -3$ V)	$V_{CE} = 60$ V			10	nA
I_{EBO}	Emitter Cutoff Current ($I_C = 0$)	$V_{EB} = 3$ V			10	nA
I_{BEX}	Base Cutoff Current ($V_{BE} = -3$ V)	$V_{CE} = 60$ V			20	nA
$V_{(BR)\ CBO}$	Collector-base Breakdown Voltage ($I_E = 0$)	$I_C = 10$ µA	75			V
$V_{(BR)\ CEO}$*	Collector-emitter Breakdown Voltage ($I_B = 0$)	$I_C = 10$ mA	40			V
$V_{(BR)\ EBO}$	Emittter-base Breakdown Voltage ($I_C = 0$)	$I_E = 10$ µA	6			V
$V_{CE\ (sat)}$*	Collector-emitter Saturation Voltage	$I_C = 150$ mA $I_B = 15$ mA $I_C = 500$ mA $I_B = 50$ mA			0.3 1	V V
$V_{BE\ (sat)}$*	Base-emitter Saturation Voltage	$I_C = 150$ mA $I_B = 15$ mA $I_C = 500$ mA $I_B = 50$ mA	0.6		1.2 2	V V
h_{FE}*	DC Current Gain	for **2N2218A** and **2N2221A** $I_C = 0.1$ mA $V_{CE} = 10$ V $I_C = 1$ mA $V_{CE} = 10$ V $I_C = 10$ mA $V_{CE} = 10$ V $I_C = 150$ mA $V_{CE} = 10$ V $I_C = 500$ mA $V_{CE} = 10$ V $I_C = 150$ mA $V_{CE} = 1$ V $I_C = 10$ mA $V_{CE} = 10$ V $T_{amb} = -55$ °C	 20 25 35 40 25 20 15		120	
h_{FE} *	DC Current Gain	for **2N2219A** and **2N2222A** $I_C = 0.1$ mA $V_{CE} = 10$ V $I_C = 1$ mA $V_{CE} = 10$ V $I_C = 10$ mA $V_{CE} = 10$ V $I_C = 150$ mA $V_{CE} = 10$ V $I_C = 500$ mA $V_{CE} = 10$ V $I_C = 150$ mA $V_{CE} = 1$ V $I_C = 10$ mA $V_{CE} = 10$ V $T_{amb} = -55$ °C	 35 50 75 100 40 50 35		300	

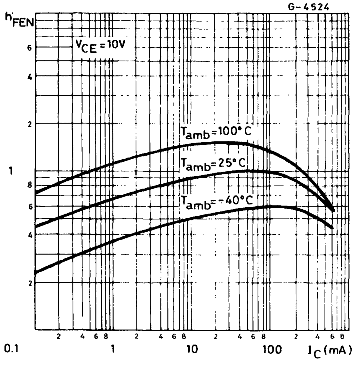
* Pulsed : pulse duration = 300 µs, duty cycle = 1 %.

ELECTRICAL CHARACTERISTICS (continued)

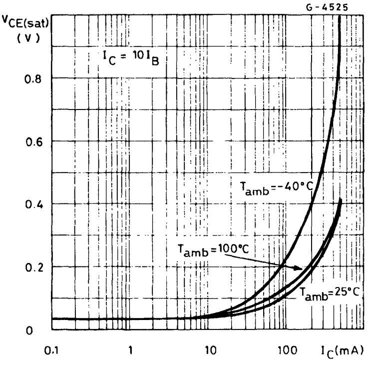
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
h_{fe}	Small Signal Current Gain	I_C = 1 mA V_{CE} = 10 V f = 1 kHz for **2N2218A** and **2N2221A** for **2N2219A** and **2N2222A** I_C = 10 mA V_{CE} = 10 V f = 1 kHz for **2N2218A** and **2N2221A** for **2N2219A** and **2N2222A**	 30 50 50 75		 150 300 300 375	
f_T	Transition Frequency	I_C = 20 mA V_{CE} = 20 V f = 100 MHz for **2N2218A** and **2N2221A** for **2N2219A** and **2N2222A**	 250 300			 MHz MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 100 kHz			25	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V f = 100 kHz			8	pF
$R_{e(hie)}$	Real Part of Input Impedance	I_C = 20 mA V_{CE} = 20 V f = 300 MHz			60	Ω
NF	Noise Figure	I_C = 100 µA V_{CE} = 10 V R_9 = 1 kΩ f = 1 kHz		4		dB
h_{ie}**	Input Impedance	I_C = 1 mA V_{CE} = 10 V for **2N2218A** and **2N2221A** for **2N2219A** and **2N2222A** I_C = 10 mA V_{CE} = 10 V for **2N2218A** and **2N2221A** for **2N2219A** and **2N2222A**	 1 2 0.2 0.25		 3.5 8 1 1.25	 Ω Ω Ω Ω
h_{re}**	Reverse Voltage Ratio	I_C = 1 mA V_{CE} = 10 V for **2N2218A** and **2N2221A** for **2N2219A** and **2N2222A** I_C = 10 mA V_{CE} = 10 V for **2N2218A** and **2N2221A** for **2N2219A** and **2N2222A**			 $5x10^{-4}$ $8x10^{-4}$ $2.5x10^{-4}$ $4x10^{-4}$	
h_{oe}**	Output Admittance	I_C = 1 mA V_{CE} = 10 V for **2N2218A** and **2N2221A** for **2N2219A** and **2N2222A** I_C = 10 mA V_{CE} = 10 V for **2N2218A** and **2N2221A** for **2N2219A** and **2N2222A**	 3 5 10 25		 15 35 100 200	 µS µS µS µS
t_d***	Delay Time	I_C = 150 mA V_{CC} = 30 V I_{B1} = 15 mA V_{BB} = – 0.5 V			10	ns
t_r***	Rise Time	I_C = 150 mA V_{CC} = 30 V I_{B1} = 15 mA V_{BB} = – 0.5 V			25	ns
t_s***	Storage Time	I_C = 150 mA V_{CC} = 30 V I_{B1} = – I_{B2} = 15 mA			225	ns
t_f***	Fall Time	I_C = 150 mA V_{CC} = 30 V I_{B1} = – I_{B2} = 15 mA			60	ns
$r_{bb'}C_{b'c}$	Feedback Time Constant	I_C = 20 mA V_{CE} = 20 V f = 31.8 MHz			150	ps

** f = 1 kHz
*** see test circuit.

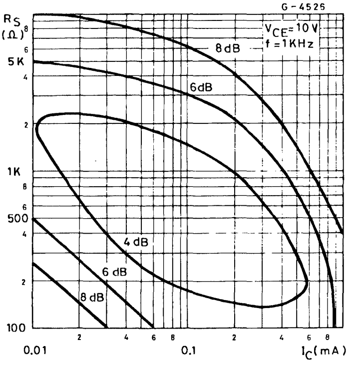
Normalized DC Current Gain.



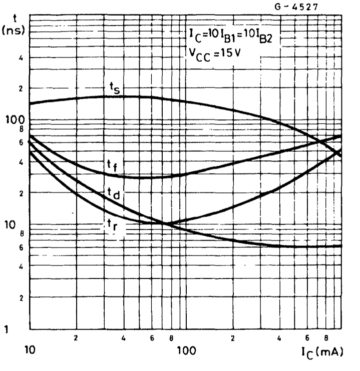
Collector-emitter Saturation Voltage.



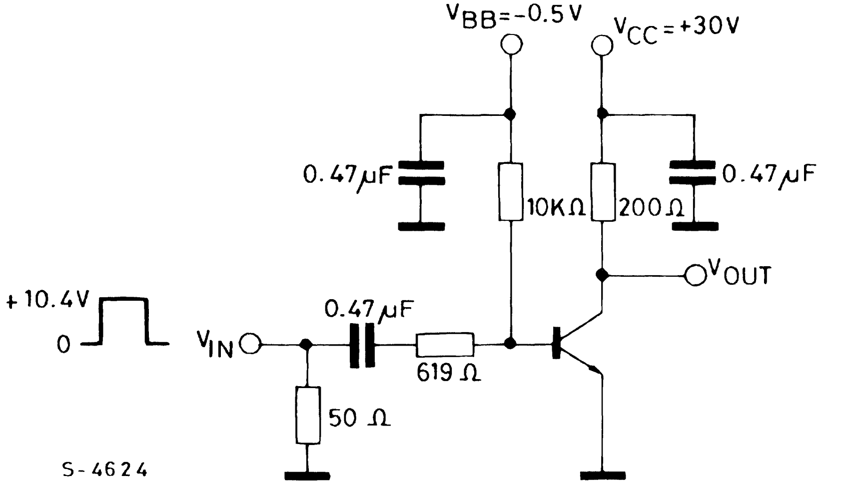
Contours of Constant Narrow Band Noise Figure.



Switching Time vs. Collector Current.



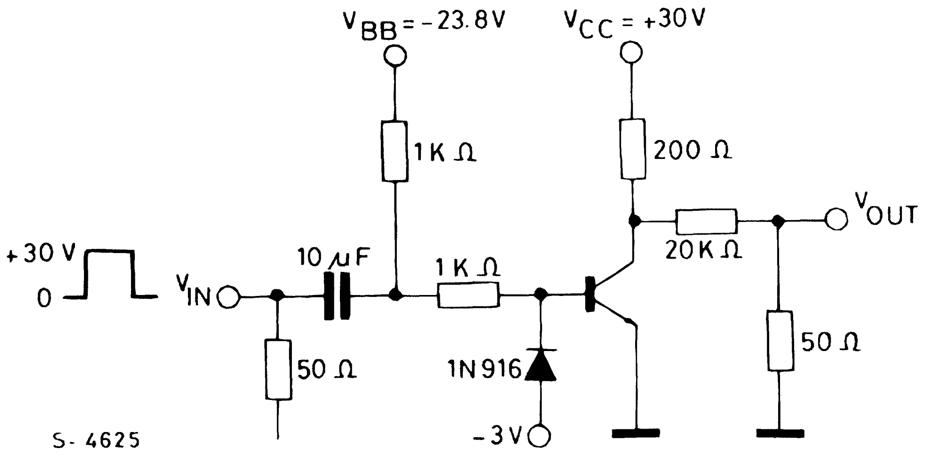
Test Circuit fot t_d, t_r.



PULSE GENERATOR :
$t_r \leq 20$ ns
PW ≤ 200 ns
$Z_{IN} = 50\ \Omega$

TO OSCILLOSCOPE :
$t_r \leq 5.0$ ns
$Z_{IN} < 100\ K\Omega$
$C_{IN} \leq 12$ pF

Test Circuit fot t_d, t_r.



PULSE GENERATOR :
PW ≈ 10 μs
$Z_{IN} = 50\ \Omega$
$T_C \leq 5.0$ ns

TO OSCILLOSCOPE :
$t_r < 5.0$ ns
$Z_{IN} > 100\ K\Omega$
$C_{IN} \leq 12$ pF

SGS-THOMSON MICROELECTRONICS

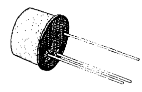
2N2368

HIGH-FREQUENCY SATURATED SWITCH

DESCRIPTION

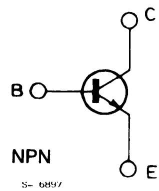
The 2N2368 is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case. It is designed specifically for high-speed saturated switching applications at current levels from 100 μA to 100 mA.

Products approved to CECC 50004-022/023 available on request.



TO-18

INTERNAL SCHEMATIC DIAGRAM



S- 6897

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	40	V
V_{CES}	Collector-emitter Voltage ($I_{BE} = 0$)	40	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	15	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	4.5	V
I_{CM}	Collector Peak Current ($t = 10$ μs)	0.5	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C at $T_{case} \leq 100$ °C	0.36 1.2 0.68	W W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	146	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

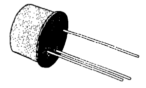
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 20 V V_{CB} = 20 V T_{amb} = 150 °C			0.4 30	μA μA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 10 μA	40			V
$V_{(BR)CES}$	Collector-emitter Breakdown Voltage (V_{BE} = 0)	I_C = 10 μA	40			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	15			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 10 μA	4.5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA		0.2	0.25	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA	0.7	0.75	0.85	V
h_{FE}*	DC Current Gain	I_C = 10 mA V_{CE} = 1 V I_C = 100 mA V_{CE} = 2 V I_C = 10 mA V_{CE} = 1 V T_{amb} = – 55 °C	20 10 10		60	
f_T	Transition Frequency	I_C = 10 mA V_{CE} = 10 V f = 100 MHz	400	550		MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 5 V f = 1 MHz		2.5	4	pF
t_s	Storage Time	I_C = 10 mA V_{CC} = 10 V I_{B1} = – I_{B2} = 10 mA		5	10	ns
t_{on}	Turn-on Time	I_C = 10 mA V_{CC} = 3 V I_{B1} = 3 mA		9	12	ns
t_{off}	Turn-off Time	I_C = 10 mA V_{CC} = 3 V I_{B1} = 3 mA I_{B2} = – 1.5 mA		10	15	ns

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

HIGH-FREQUENCY SATURATED SWITCH

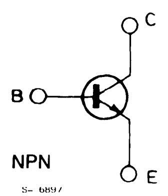
DESCRIPTION

The 2N2369 is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case. It is designed specifically for high-speed saturated switching applications at current levels from 100 μA to 100 mA.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	40	V
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	40	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	15	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	4.5	V
I_{CM}	Collector Peak Current (t = 10 μs)	0.5	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C at $T_{case} \leq 100$ °C	0.36 1.2 0.68	W W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

Products approved to CECC 50004-022/023 available on request.

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	146	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 20 V V_{CB} = 20 V T_{amb} = 150 °C			0.4 30	μA μA
$V_{(BR)\ CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 10 μA	40			V
$V_{(BR)\ CES}$	Collector-emitter Breakdown Voltage (V_{BE} = 0)	I_C = 10 μA	40			V
$V_{(BR)\ CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	15			V
$V_{(BR)\ EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 10 μA	4.5			V
$V_{CE\ (sat)}$*	Collector-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA		0.2	0.25	V
$V_{BE\ (sat)}$ *	Base-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA	0.7	0.75	0.85	V
h_{FE}*	DC Current Gain	I_C = 10 mA V_{CE} = 1 V I_C = 100 mA V_{CE} = 2 V I_C = 10 mA V_{CE} = 1 V T_{amb} = – 55 °C	40 20 20		120	
f_T	Transition Frequency	I_C = 10 mA V_{CE} = 10 V f = 100 MHz	500	650		MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 5 V f = 1 MHz		2.5	4	pF
t_s	Storage Time	I_C = 10 mA V_{CC} = 10 V I_{B1} = – I_{B2} = 10 mA		6	13	ns
t_{on}	Turn-on Time	I_C = 10 mA V_{CC} = 3 V I_{B1} = 3 mA		9	12	ns
t_{off}	Turn-off Time	I_C = 10 mA V_{CC} = 3 V I_{B1} = 3 mA I_{B2} = – 1.5 mA		13	18	ns

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

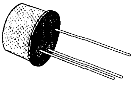
SGS-THOMSON MICROELECTRONICS

2N2369A

HIGH-SPEED SATURATED SWITCH

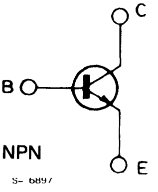
DESCRIPTION

The 2N2369A is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case. It is designed specifically for high-speed saturated switching applications at current levels from 100 μA to 100 mA.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	40	V
V_{CES}	Collector-emitter Voltage ($V_{BE} = 0$)	40	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	15	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	4.5	V
I_C	Collector Current	0.2	A
I_{CM}	Collector Current (10 μs pulse)	0.5	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C at $T_{case} \leq 100$ °C	0.36 1.2 0.68	W W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

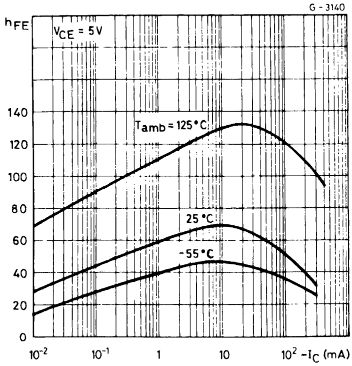
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	146	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

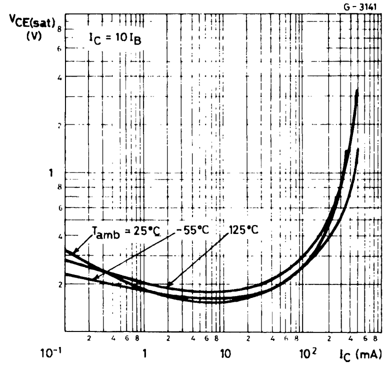
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 20 V T_{amb} = 150 °C			30	µA
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 20 V			0.4	µA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 10 µA	40			V
$V_{(BR)CES}$	Collector-emitter Breakdown Voltage (V_{BE} = 0)	I_C = 10 µA	40			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	15			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 10 µA	4.5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA I_C = 30 mA I_B = 3 mA I_C = 100 mA I_B = 10 mA I_C = 10 mA I_B = 1 mA T_{amb} = 125 °C		0.14 0.17 0.28 0.19	0.2 0.25 0.5 0.3	V V V V
$V_{BE(sat)}$ *	Base-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA I_B = 30 mA I_B = 3 mA I_C = 100 mA I_B = 10 mA I_C = 10 mA I_B = 1 mA T_{amb} = – 55 to 125 °C	0.7 0.59	0.8 0.9 1.1	0.85 1.15 1.6 1.02	V V V V
h_{FE}*	DC Current Gain	I_C = 10 mA V_{CE} = 0.35 V I_C = 10 mA V_{CE} = 1 V I_C = 30 mA V_{CE} = 0.4 V I_C = 100 mA V_{CE} = 1 V	40 40 30 20	63 66 71	120 120	
h_{FE}*	DC Current Gain	I_C = 10 mA V_{CE} = 0.35 V T_{amb} = – 55 °C	20	50		
f_T	Transition Frequency	I_C = 10 mA V_{CE} = 10 V f = 100 MHz	500	675		MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 5 V f = 1 MHz		2.3	4	pF
t_s **	Storage Time	I_C = 10 mA V_{CC} = 10 V I_{B1} = – I_{B2} = 10 mA		6	13	ns
t_{on} **	Turn-on Time	I_C = 10 mA V_{CC} = 3 V I_{B1} = 3 mA		9	12	ns
t_{off}**	Turn-off Time	I_C = 10 mA V_{CC} = 3 V I_{B1} = 3 mA I_{B2} = – 1.5 mA		13	18	ns

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

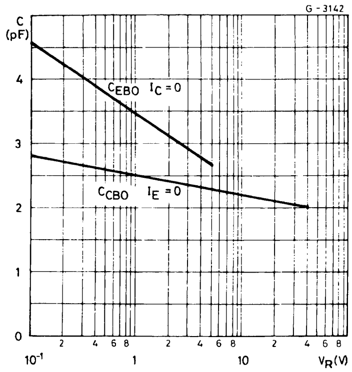
DC Current Gain.



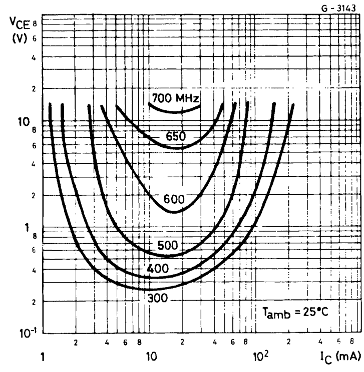
Collector-emitter Saturation Voltage.



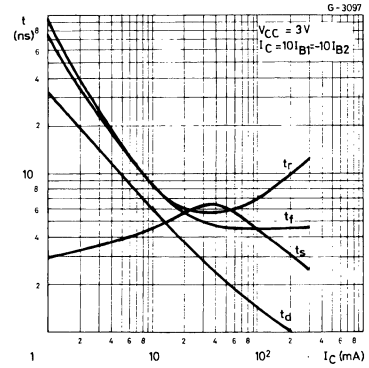
Collector-base and Emitter-base capacitances.



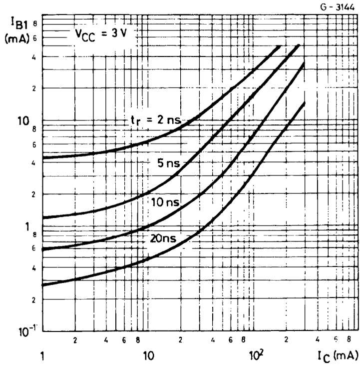
Contours of Constant Transition Frequency.



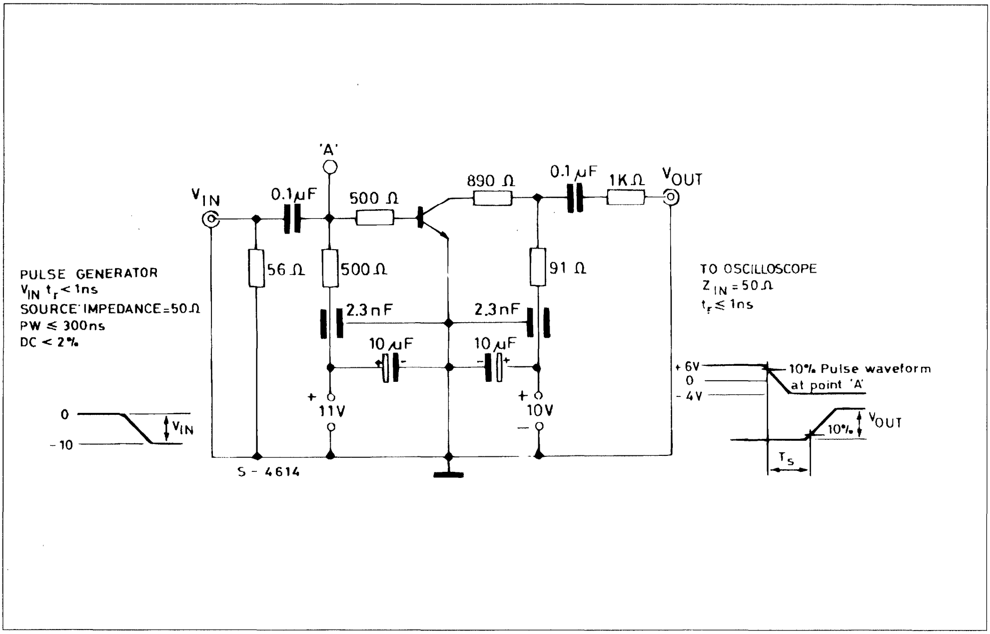
Switching Characteristics.



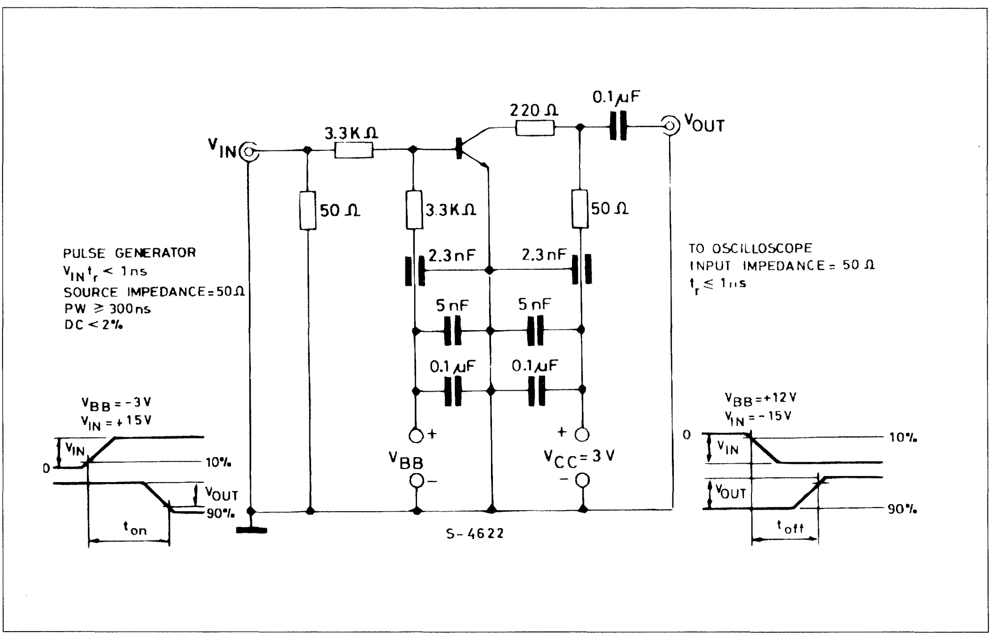
Switching Characteristics.



Test Circuit for t_s



Test Circuit for t_{on}, t_{off}

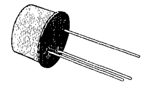


LOW-LEVEL, LOW-NOISE AMPLIFIERS

DESCRIPTION

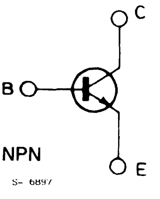
The 2N2484 is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case. It is designed for use in high-performance, low-noise amplifier circuits from audio to high-frequency.

Products approved to CECC50002-129 available on request.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	60	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	60	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	6	V
I_C	Collector Current	50	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C at $T_{case} \leq 100$ °C	0.36 1.2 0.68	W W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

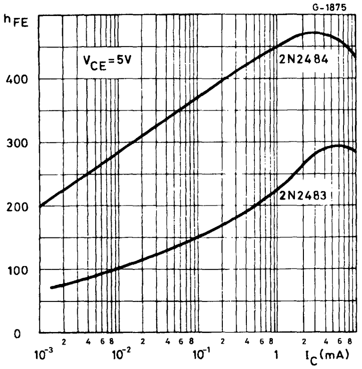
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	146	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

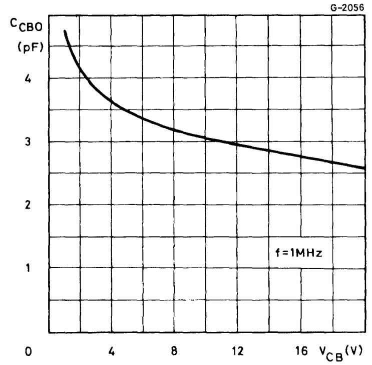
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 45 V V_{CB} = 45 V T_{amb} = 150 °C			10 10	nA μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			10	nA
$V_{(BR)CBO}$	Colllector-base Breakdown Voltage (I_E = 0)	I_C = 10 μA	60			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	60			V
$V_{(BR)\ EBO}$	Emittter-base Breakdown Voltage (I_C = 0)	I_E = 10 μA	6			V
$V_{CE\ (sat)}$	Collector-emitter Saturation Voltage	I_C = 1 mA I_B = 0.1 mA		0.2	0.35	V
V_{BE}	Base-emitter Voltage	I_C = 100 μA V_{CE} = 5 V	0.5	0.57	0.7	V
h_{FE}*	DC Current Gain	I_C = 1 μA V_{CE} = 5 V I_C = 10 μA V_{CE} = 5 V I_C = 100 μA V_{CE} = 5 V I_C = 500 μA V_{CE} = 5 V I_C = 1 mA V_{CE} = 5 V I_C = 10 mA V_{CE} = 5 V I_C = 10 μA V_{CE} = 5 V T_{amb} = – 55 °C	30 100 175 200 250 20	200 290 375 430 450 430	 500 800	
h_{fe}	Small Signal Current Gain	I_C = 1 mA V_{CE} = 5 V f = 1 kHz	150	400	900	
f_T	Transition Frequency	I_C = 50 μA V_{CE} = 5 V f = 5 MHz I_C = 500 μA V_{CE} = 5 V f = 30 MHz	 15 60	 20 78		 MHz MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz		3.5	6	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 5 V f = 1 MHz		3.5	6	pF
NF	Noise Figure	I_C = 10 μA V_{CE} = 5 V R_9 = 10 kΩ f = 100 Hz f = 1 kHz f = 10 kHz f = 10 to 10000 Hz		 4 1.8 0.6 1.8	 10 3 2 3	 dB dB dB dB
h_{ie}**	Input Impedance	I_C = 1 mA V_{CE} = 5 V	3.5	15	24	kΩ
h_{re}**	Reverse Voltage Ratio	I_C = 1 mA V_{CE} = 5 V		4.25	8	10^{-4}
h_{oe}**	Output Admittance	I_C = 1 mA V_{CE} = 5 V		15	40	μS

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

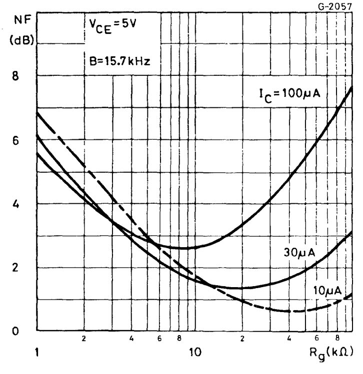
DC Current Gain.



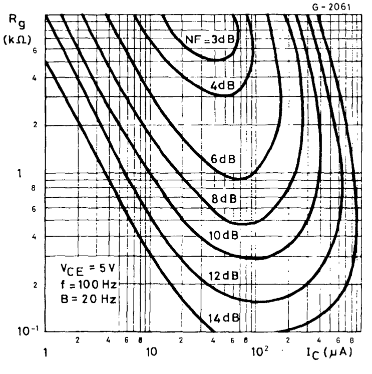
Collector-base Capacitance.



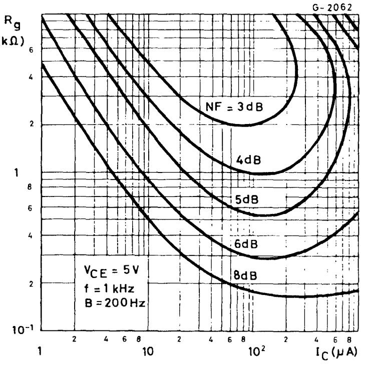
Noise Figure vs. Source Resistance.



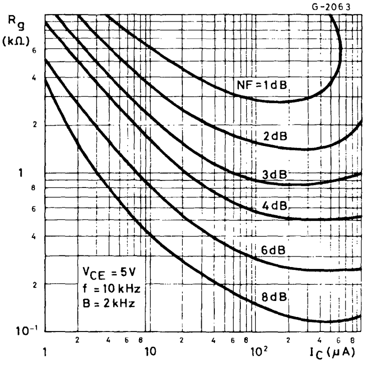
Contours of Constant Noise Figure
f = 100 Hz.



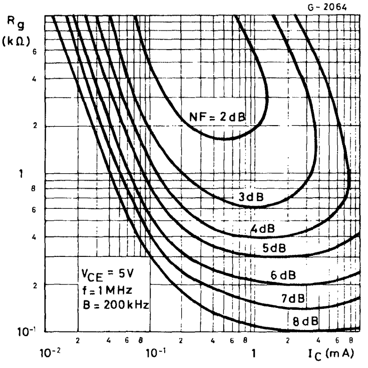
Contours of Constant Noise Figure
f = 1 kHz.



Contours of Constant Noise Figure
f = 10 kHz.



Contours of Constant Noise Figure
f = 1 MHz.

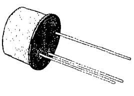


2N2845

HIGH-SPEED SATURATED SWITCH

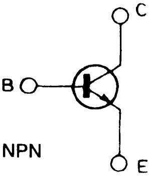
DESCRIPTION

The 2N2845 is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case. It is intended for high speed switching applications at collector currents up to 500 mA.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	60	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	30	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5	V
I_C	Collector Current	500	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C at $T_{case} \leq 100$ °C	0.36 1.2 0.68	W W W
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 200	°C

THERMAL DATA

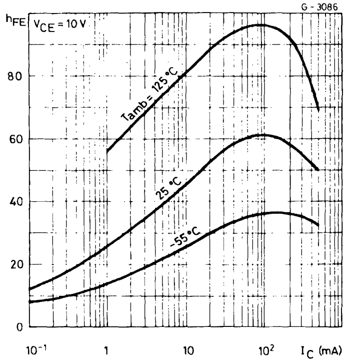
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	146	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

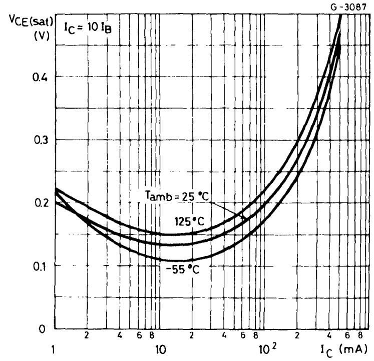
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 30 V V_{CB} = 30 V T_{amb} = 125 °C			200 200	nA µA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 0.1 mA	60			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 30 mA	30			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 0.1 mA	5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 50 mA I_B = 5 mA I_C = 150 mA I_B = 15 mA I_C = 500 mA I_B = 50 mA		0.16 0.22 0.48	 0.4 1	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 50 mA I_B = 5 mA I_C = 150 mA I_B = 15 mA I_C = 500 mA I_B = 50 mA		0.78 0.85 1.12	 1.2 1.6	V V V
h_{FE}*	DC Current Gain	I_C = 50 mA V_{CE} = 10 V I_C = 150 mA V_{CE} = 10 V I_C = 500 mA V_{CE} = 10 V I_C = 500 mA V_{CE} = 1 V	 30 20 10	60 60 50 30	 120	
f_T	Transition Frequency	I_C = 50 mA V_{CE} = 10 V f = 100 MHz	250	350		MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz		6	8	pF
t_{on}	Turn-on Time	I_C = 150 mA V_{CC} = 10 V I_{B1} = 15 mA		18	40	ns
t_{off}	Turn-off Time	I_C = 150 mA V_{CC} = 10 V I_{B1} = $-I_{B2}$ = 15 mA		25	40	ns

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

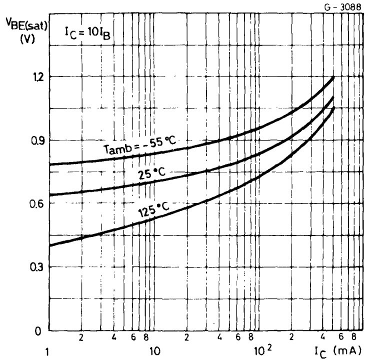
DC Current Gain.



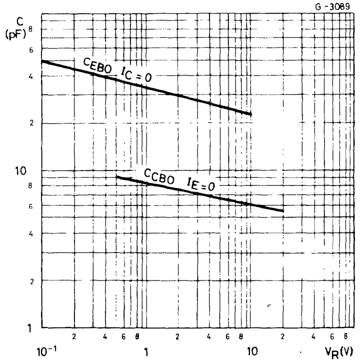
Collector-emitter Saturation Voltage.



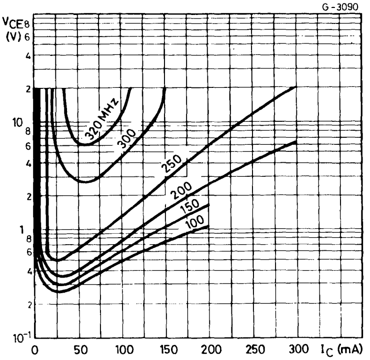
Base-emitter Saturation Voltage.



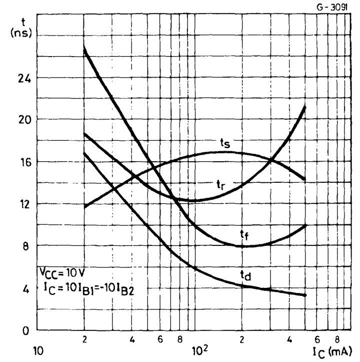
Emitter-base and Collector-base Capacitances.



Contours of Constant Transition Frequency.



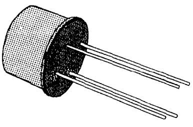
Switching Characteristics.



VHF/UHF AMPLIFIERS

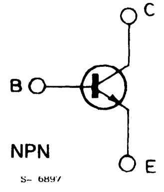
DESCRIPTION

The 2N2857 is a silicon planar epitaxial NPN transistors in Jedec TO-72 metal case, intended for amplifier, oscillator and converter applications up to 500 MHz.



TO-72

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	30	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	15	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	2.5	V
I_C	Collector Current	40	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	200 300	mW mW
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	583	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	875	°C/W

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

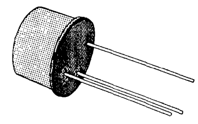
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 15 V V_{CB} = 15 V T_{amb} = 150 °C			10 1	nA μA
$V_{(BR)\ CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 1 μA	30			V
$V_{(BR)\ CEO}$	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 3 mA	15			V
$V_{(BR)\ EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 10 μA	2.5			V
h_{FE}	DC Current Gain	I_C = 3 mA V_{CE} = 1 V	30		150	
f_T	Transition Frequency	I_C = 5 mA V_{CE} = 6 V f = 100 MHz	1		1.9	GHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz		1.4		pF
C_{re}	Reverse Capacitance	I_C = 0 V_{CE} = 10 V f = 1 MHz		0.6	1	pF
NF	Noise Figure	I_C = 1.5 mA V_{CE} = 6 V f = 450 MHz R_9 = 50 Ω		3.8	4.5	dB
G_{pe}	Power Gain (neutralized)	I_C = 1.5 mA V_{CE} = 6 V f = 450 MHz R_9 = 50 Ω	12.5		19	dB
P_o	Oscillator Power Output	I_C = 12 mA V_{CB} = 10 V f = 500 MHz	30			mW
$r_{bb}'C_{b'c}$	Feedback Time Constant	I_C = 2 mA V_{CB} = 6 V f = 31.9 MHz	4	7	15	ps

HIGH-SPEED SATURATED SWITCHES

DESCRIPTION

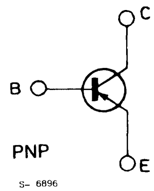
The 2N2894, and 2N3209 are silicon planar epitaxial PNP transistors in Jedec TO-18 metal case, intended for high speed, low saturation switching applications up to 100 mA.

Products approved to CECC 50004-022/023 available on request.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		2N2894	2N3209	
V_{CBO}	Collector-base Voltage ($I_E = 0$)	– 12	– 20	V
V_{CES}	Collector-emitter Voltage ($V_{BE} = 0$)	– 12	– 20	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	– 12	– 20	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	– 4		V
I_C	Collector Current	– 200		mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.36 1.2		W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200		°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	146	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0) (for **2N2894** only)	V_{CB} = – 6 V T_{amb} = 125 °C			– 10	µA
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	for **2N2894** V_{CE} = – 6 V for **2N3209** V_{CE} = – 10 V V_{CE} = – 10 V T_{amb} = 125 °C			 – 80 – 80 – 10	 nA nA µA
$V_{(BR)CBO}$	Colllector-base Breakdown Voltage (I_E = 0)	I_C = – 10 µA for **2N2894** for **2N3209**	 – 12 – 20			 V V
$V_{(BR)CES}$	Collector-emitter Breakdown Voltage (V_{BE} = 0)	I_C = – 10 µA for **2N2894** for **2N3209**	 – 12 – 20			 V V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 10 mA for **2N2894** for **2N3209**	 – 12 – 20			 V V
$V_{(BR)EBO}$	Emittter-base Breakdown Voltage (I_C = 0)	I_E = – 100 µA	– 4			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	for **2N2894** I_C = – 10 mA I_B = – 1 mA I_C = – 30 mA I_B = – 3 mA I_C = – 100 mA I_B = – 10 mA for **2N3209** I_C = – 10 mA I_B = – 1 mA I_C = – 30 mA I_B = – 3 mA I_C = – 100 mA I_B = – 10 mA			 – 0.15 – 0.2 – 0.5 – 0.15 – 0.2 – 0.6	 V V V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 10 mA I_B = – 1 mA I_C = – 30 mA I_B = – 3 mA I_C = – 100 mA I_B = – 10 mA	– 0.78 – 0.85		– 0.98 – 1.2 – 1.7	V V V
h_{FE}*	DC Current Gain	I_C = – 10 mA V_{CE} = – 0.3 V for **2N2894** for **2N3209** I_C = – 30 mA V_{CE} = – 0.5 V for **2N2894** for **2N3209** I_C = – 100 mA V_{CE} = – 1 V for **2N2894** for **2N3209** I_C = – 30 mA V_{CE} = – 0.5 V T_{amb} = – 55 °C for **2N2894** for **2N3209**	 30 25 40 30 25 15 17 12		 150 120	
f_T	Transition Frequency	I_C = – 30 mA V_{CE} = – 10 V f = 100 MHz	400			MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = – 0.5 V f = 1 MHz			6	pF

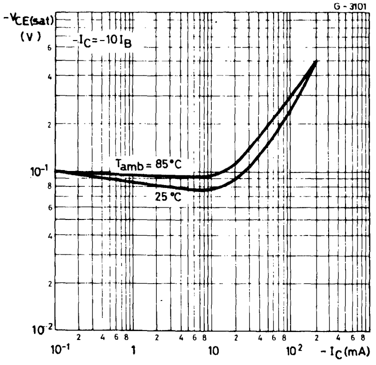
* Pulsed : pulse duration = 300 µs, duty cycle = 1 %.

ELECTRICAL CHARACTERISTICS (continued)

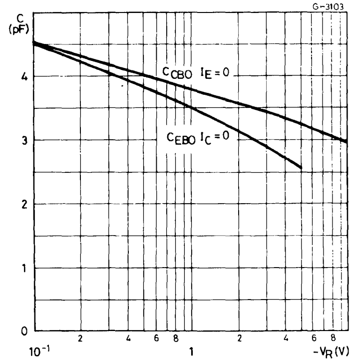
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
C_{CBO}	Collector-base Capacitance	$I_E = 0$ f = 1 MHz $V_{CB} = -5$ V for **2N2894** for **2N3209**			6 5	pF pF
t_{on} **	Turn-on Time	$I_C = -30$ mA $V_{CC} = -2$ V $I_{B1} = -1.5$ mA			60	ns
t_{off} **	Turn-off Time	$I_C = -30$ mA $V_{CC} = -2$ V $I_{B1} = -I_{B2} = -1.5$ mA			90	ns

** See test circuit.

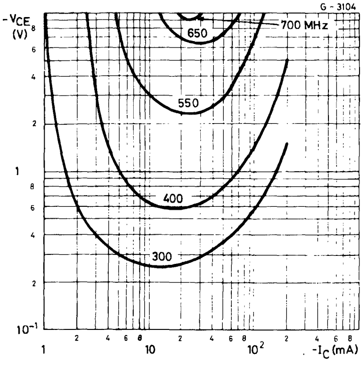
Collector-emitter Saturation Voltage.



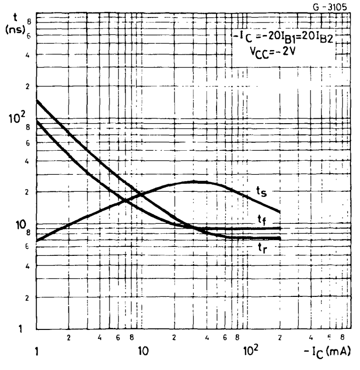
Emitter-base and Collector-base capacitance.



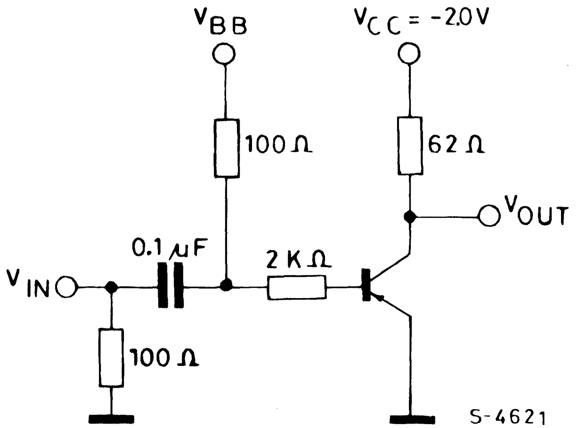
Contours of Constant Transition Frequency.



Switching Characteristics.



Test Circuit for t_{on}, t_{off}.



PULSE GENERATOR :
t_r, ≤ 1.0 ns
DC < 2 %
PW ≈ 400 ns
Z_{IN} = 50 Ω
t_{on} V_{BB} = + 3.0 V, V_{IN} = – 7.0 V
t_{off} V_{BB} = – 4 V, V_{IN} = + 6 V

TO OSCILLOSCOPE :
t_r < 1.0 ns
Z_{IN} ≥ 100 KΩ

SGS-THOMSON
MICROELECTRONICS

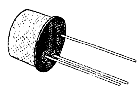
2N2904/2N2905
2N2906/2N2907

GENERAL PURPOSE AMPLIFIERS AND SWITCHES

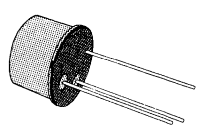
DESCRIPTION

The 2N2904, 2N2905, 2N2906 and 2N2907 are silicon planar epitaxial PNP transistors in Jedec TO-39 (for 2N2904, 2N2905) and in Jedec TO-18 (for 2N2906 and 2N2907) metal cases. They are designed for high-speed saturated switching and general purpose applications.

2N2904/2N2905 approved to CECC 50002-102, 2N2906/2N2907 approved to CECC 50002-103 available on request.

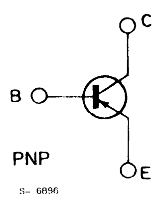


TO-18



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	– 60	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 40	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 5	V
I_C	Collector Current	– 600	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C for **2N2904** and **2N2905** for **2N2906** and **2N2907** at $T_{case} \leq 25$ °C for **2N2904** and **2N2905** for **2N2906** and **2N2907**	 0.6 0.4 3 1.8	 W W W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

			2N2904 2N2905	2N2906 2N2907
$R_{th\ j\text{-}case}$ $R_{th\ j\text{-}amb}$	Thermal Resistance Junction-case Thermal Resistance Junction-ambient	Max Max	58.3 °C/W 292 °C/W	97.3 °C/W 437.5 °C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = – 50 V V_{CB} = – 50 V T_{amb} = 150 °C			– 20 – 20	nA μA
I_{CEX}	Collector Cutoff Current (V_{BE} = 0.5 V)	V_{CE} = – 30 V			– 50	nA
I_{BEX}	Base Cutoff Current (V_{BE} = 0.5 V)	V_{CE} = – 30 V			– 50	nA
$V_{(BR)\ CBO}$	Colllector-base Breakdown Voltage (I_E = 0)	I_C = – 10 μA	– 60			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 10 mA	– 40			V
$V_{(BR)\ EBO}$	Emittter-base Breakdown Voltage (I_C = 0)	I_E = – 10 μA	– 5			V
$V_{CE\ (sat)}$*	Collector-emitter Saturation Voltage	I_C = – 150 mA I_B = – 15 mA I_C = – 500 mA I_B = – 50 mA			– 0.4 – 1.6	V V
$V_{BE\ (sat)}$*	Base-emitter Saturation Voltage	I_C = – 150 mA I_B = – 16 mA I_C = – 500 mA I_B = – 50 mA			– 1.3 – 2.6	V V
h_{FE}*	DC Current Gain	for **2N2904** and **2N2906** I_C = – 0.1 mA V_{CE} = – 10 V I_C = – 1 mA V_{CE} = – 10 V I_C = – 10 mA V_{CE} = – 10 V I_C = – 150 mA V_{CE} = – 10 V I_C = – 500 mA V_{CE} = – 10 V	 20 25 35 40 20		 120 	
h_{FE}*	DC Current Gain	for **2N2905** and **2N2907** I_C = – 0.1 mA V_{CE} = – 10 V I_C = – 1 mA V_{CE} = – 10 V I_C = – 10 mA V_{CE} = – 10 V I_C = – 150 mA V_{CE} = – 10 V I_C = – 500 mA V_{CE} = – 10 V	 35 50 75 100 30		 300 	
f_T	Transition Frequency	I_C = – 50 mA V_{CE} = – 20 V f = 100 MHz	200			MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = – 2 V f = 1 MHz			30	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 10 V f = 1 MHz			8	pF
t_d	Delay Time	I_C = – 150 mA V_{CC} = – 30 V I_{B1} = – 15 mA			10	ns
t_r	Rise Time	I_C = – 150 mA V_{CC} = – 30 V I_{B1} = – 15 mA			40	ns
t_s	Storage Time	I_C = – 150 mA V_{CC} = – 6 V I_{B1} = – I_{B2} = – 15 mA			80	ns
t_f	Fall Time	I_C = – 150 mA V_{CC} = – 6 V I_{B1} = – I_{B2} = – 15 mA			30	ns

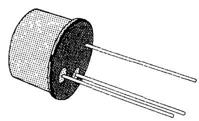
* Pulsed : pulse duration = 300 μs, duty cycle = 1 %.

GENERAL PURPOSE AMPLIFIERS AND SWITCHES

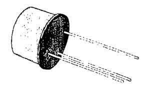
DESCRIPTION

The 2N2904A, 2N2905A, 2N2906A and 2N2907A are silicon planar epitaxial PNP transistors in Jedec TO-39 (for 2N2904A and 2N2905A) and in Jedec TO-18 (for 2N2906A and 2N2907A) metal cases. They are designed for high-speed saturated switching and general purpose applications.

2N2904A/2N2905A approved to CECC 50002-100, 2N2906A/2N2907A approved to CECC 50002-103 available on request.

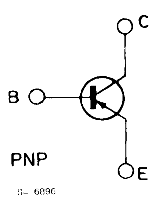


TO-39



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	– 60	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	– 60	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	– 5	V
I_C	Collector Current	– 600	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C		
	for **2N2904A** and **2N2905A**	0.6	W
	for **2N2906A** and **2N2907A**	0.4	W
	at $T_{case} \leq 25$ °C		
	for **2N2904A** and **2N2905A**	3	W
	for **2N2906A** and **2N2907A**	1.8	W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

			2N2904A 2N2905A	2N2906A 2N2907A
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	58.3 °C/W	97.3 °C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	292 °C/W	437.5 °C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = – 50 V V_{CB} = – 50 V T_{amb} = 150 °C			– 10 – 10	nA µA
I_{CEX}	Collector Cutoff Current (V_{BE} = 0.5 V)	V_{CE} = – 30 V			– 50	nA
I_{BEX}	Base Cutoff Current (V_{BE} = 0.5 V)	V_{CE} = – 30 V			– 50	nA
$V_{(BR)\ CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = – 10 µA	– 60			V
$V_{(BR)\ CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 10 mA	– 60			V
$V_{(BR)\ EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = – 10 µA	– 5			V
$V_{CE\ (sat)}$*	Collector-emitter Saturation Voltage	I_C = – 150 mA I_B = – 15 mA I_C = – 500 mA I_B = – 50 mA			– 0.4 – 1.6	V V
$V_{BE\ (sat)}$*	Base-emitter Saturation Voltage	I_C = – 150 mA I_B = – 16 mA I_C = – 500 mA I_B = – 50 mA			– 1.3 – 2.6	V V
h_{FE}*	DC Current Gain	for **2N2904A** and **2N2906A** I_C = – 0.1 mA V_{CE} = – 10 V I_C = – 1 mA V_{CE} = – 10 V I_C = – 10 mA V_{CE} = – 10 V I_C = – 150 mA V_{CE} = – 10 V I_C = – 500 mA V_{CE} = – 10 V	 40 40 40 40 40		 120 	
h_{FE} *	DC Current Gain	for **2N2905A** and **2N2907A** I_C = – 0.1 mA V_{CE} = – 10 V I_C = – 1 mA V_{CE} = – 10 V I_C = – 10 mA V_{CE} = – 10 V I_C = – 150 mA V_{CE} = – 10 V I_C = – 500 mA V_{CE} = – 10 V	 75 100 100 100 50		 300 	
f_T	Transition Frequency	I_C = – 50 mA V_{CE} = – 20 V f = 100 MHz	200			MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = – 2 V f = 1 MHz			30	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 10 V f = 1 MHz			8	pF
t_d **	Delay Time	I_C = – 150 mA V_{CC} = – 30 V I_{B1} = – 15 mA			10	ns
t_r **	Rise Time	I_C = – 150 mA V_{CC} = – 30 V I_{B1} = – 15 mA			40	ns
t_s **	Storage Time	I_C = – 150 mA V_{CC} = – 6 V I_{B1} = – I_{B2} = – 15 mA			80	ns

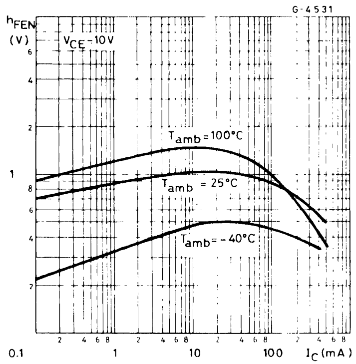
* Pulsed : pulse duration = 300 µs, duty cycle = 1.5 %.
** See test circuit.

ELECTRICAL CHARACTERISTICS (continued)

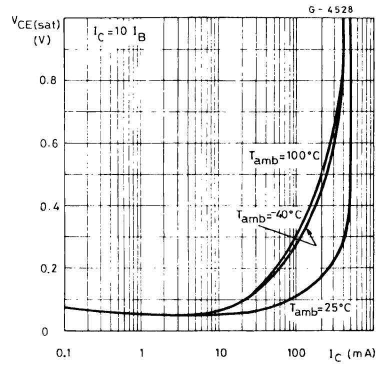
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_f **	Fall Time	$I_C = -150$ mA $V_{CC} = -6$ V $I_{B1} = -I_{B2} = -15$ mA			30	ns
t_{on} **	Turn-on Time	$I_C = -150$ mA $V_{CC} = -30$ V $I_{B1} = -15$ mA			45	ns
t_{off} **	Turn-off Time	$I_C = -150$ mA $V_{CC} = -6$ V $I_{B1} = -I_{B2} = -15$ mA			100	ns

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

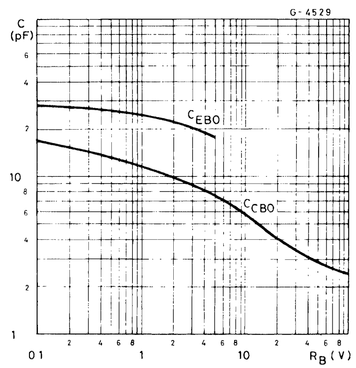
Normalized DC Current Gain.



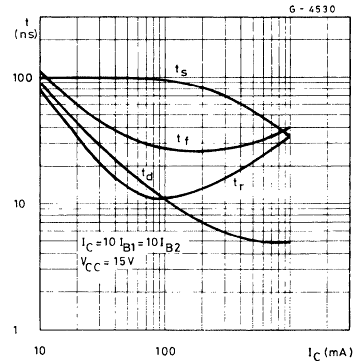
Collector-emitter Saturation Voltage.



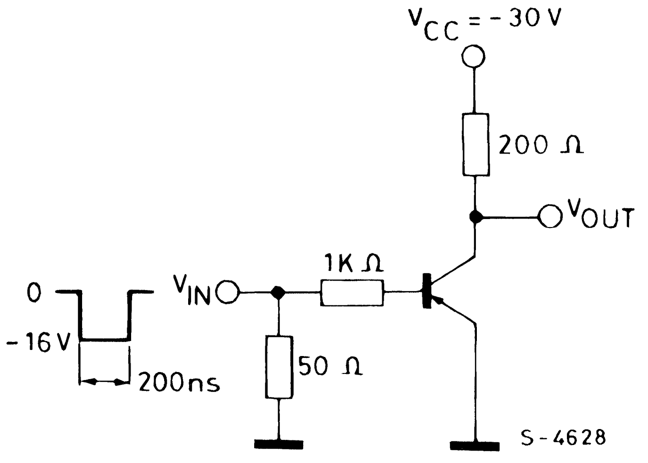
Collector-base and Emitter-base capacitances.



Switching Characteristics.



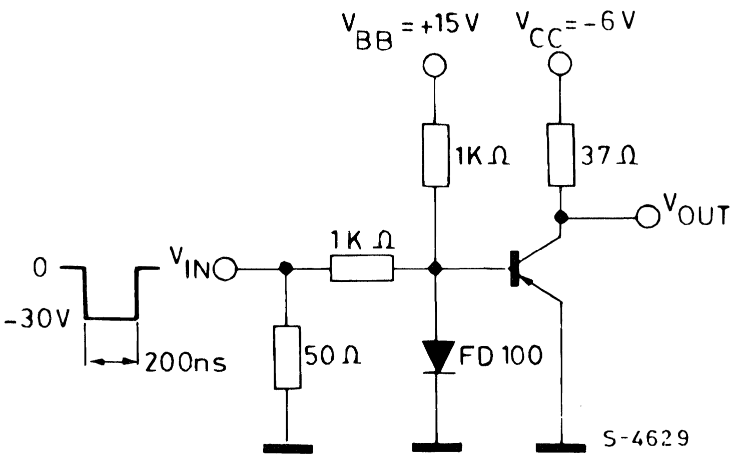
Test Circuit for t_{on}, t_r, t_d.



PULSE GENERATOR :
$t_r \leq 2.0$ ms
Frequency = 150 Hz
$Z_o = 50\ \Omega$

TO OSCILLOSCOPE :
$t_r < 5.0$ ns
$Z_{IN} > 10\ M\Omega$

Test Circuit for t_{off}, t_o, t_f.



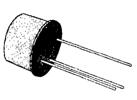
PULSE GENERATOR :
$t_r \leq 2.0$ ns
Frequency = 150 Hz
$Z_o = 50\ \Omega$

TO OSCILLOSCOPE :
$t_r < 5.0$ ns
$Z_{IN} > 100\ M\Omega$

HIGH SPEED SATURATED SWITCHES

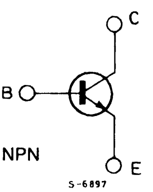
DESCRIPTION

The 2N3013 is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case intended for high speed low saturation switching application up to 300 mA.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	40	V
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	40	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	15	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5	V
I_C	Collector Current	200	mA
I_C	Collector Peak Current (t < 10 μs)	500	mA
P_{tot}	Total Power Dissipation at T_{amb} < 25 °C at T_{case} < 25 °C at T_{case} < 100 °C	360 1200 680	mW mW mW
T_{stg}	Storage Temperature	– 55 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	146	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

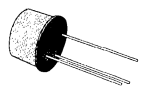
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 20 V V_{CE} = 20 V T_{amb} = 125 °C			300 40	nA μA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage	I_C = 100 μA I_E = 0	40			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage	I_C = 10 mA I_B = 0	15			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage	I_E = 100 μA I_C = 0	5			V
h_{FE}*	DC Current Gain	V_{CE} = 0.4 V I_C = 30 mA V_{CE} = 0.5 V I_C = 100 mA V_{CE} = 1 V I_C = 300 mA V_{CE} = 0.4 V I_C = 30 mA T_{amb} = 55 °C	30 25 15 12		120	
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 30 mA I_B = 3 mA I_C = 100 mA I_B = 10 mA I_C = 300 mA I_B = 30 mA I_C = 30 mA I_B = 3 mA T_{amb} = 125 °C			0.18 0.28 0.50 0.25	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 30 mA I_B = 3 mA I_C = 100 mA I_B = 10 mA I_C = 300 mA I_B = 30 mA	0.75		0.95 1.20 1.70	V V V
f_T	Transition Frequency	V_{CE} = 10 V I_C = 30 mA f = 100 MHz	350			MHz
C_{CBO}	Collector-base Capacitance	V_{CB} = 5 V; I_E = 0 f = 1 MHz			5	pF
C_{EBO}	Emitter-base Capacitance	V_{EB} = 0.5 V; I_C = 0 f = 1 MHz			8	pF
t_{on}	Turn-on Time	V_{CC} = 15 V I_C = 300 mA I_{B1} = 30 mA			15	ns
t_{off}	Turn-off Time	V_{CC} = 15 V I_C = 300 mA I_{B1} = − I_{B2} = 30 mA			25	ns
t_s	Storage Time	V_{CC} = 10 V I_C = 10 mA I_{B1} = − I_{B2} = 10 mA			18	ns

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

HIGH SPEED SATURATED SWITCHES

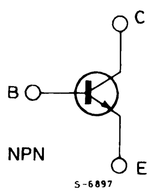
DESCRIPTION

The 2N3014 is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case intended for high speed low saturation switching application up to 300 mA.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	40	V
V_{CES}	Collector-emitter Voltage ($V_{BE} = 0$)	40	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	20	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5	V
I_C	Collector Current	200	mA
I_C	Collector Peak Current ($t < 10\ \mu s$)	500	mA
P_{tot}	Total Dissipation at $T_{amb} < 25$ °C at $T_{case} < 25$ °C at $T_{case} < 100$ °C	360 1200 680	mW mW mW
T_{stg}	Storage Temperature	– 55 to 200	°C
T_j	Maximum Operating Junction Temperature	200	°C

THERMAL DATA

			Value	Unit
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	146	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

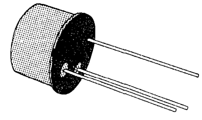
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 20 V V_{CE} = 20 V T_{amb} = 125 °C			300 40	nA µA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage	I_C = 100 µA I_E = 0	40			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage	I_C = 10 A I_B = 0	20			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage	I_E = 100 µA I_C = 0	5			V
h_{FE}*	DC Current Gain	V_{CE} = 0.4 V I_C = 10 mA V_{CE} = 0.4 V I_C = 30 mA V_{CE} = 1 V I_C = 100 mA V_{CE} = 0.4 V I_C = 30 mA T_{amb} = − 55 °C	25 30 25 12		 120	
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA I_C = 30 mA I_B = 3 mA I_C = 100 mA I_B = 10 mA I_C = 30 mA I_B = 3 mA T_{amb} = 125 °C			0.18 0.18 0.35 0.25	V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA I_C = 30 mA I_B = 3 mA I_C = 100 mA I_B = 10 mA	0.70 0.75		0.80 0.95 1.20	V V V
f_T	Transition Frequency	V_{CE} = 10 V I_C = 30 mA f = 100 MHz	350			MHz
C_{CBO}	Collector-base Capacitance	V_{CB} = 5 V; I_E = 0 f = 1 MHz			5	pF
C_{EBO}	Emitter-base Capacitance	V_{EB} = 0.5 V; I_C = 0 f = 1 MHz			8	pF
t_{on}	Turn-on Time	V_{CC} = 2 V I_C = 30 mA I_{B1} = 3 mA			16	ns
t_{off}	Turn-off Time	V_{CC} = 2 V I_C = 30 mA I_{B1} = − I_{B2} = 3 mA			25	ns
t_s	Storage Time	V_{CC} = 10 V I_C = 10 mA I_{B1} = − I_{B2} = 10 mA			18	ns

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

HIGH CURRENT, HIGH FREQUENCY AMPLIFIERS

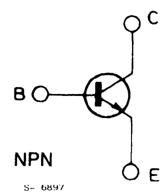
DESCRIPTION

The 2N3019 and 2N3020 are silicon planar epitaxial NPN transistors in Jedec TO-39 metal case, designed for high-current, high-frequency amplifier applications. They feature high gain and low saturation voltages.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	140	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	1	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.8 5	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	35	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	219	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 90 V V_{CB} = 90 V T_{amb} = 150 °C			10 10	nA μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			10	nA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 μA	140			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	80			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 100 μA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA I_C = 500 mA I_B = 50 mA			0.2 0.5	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA			1.1	V
h_{FE}*	DC Current Gain	I_C = 0.1 mA V_{CE} = 10 V For **2N3019** For **2N3020** I_C = 10 mA V_{CE} = 10 V For **2N3019** For **2N3020** I_C = 150 mA V_{CE} = 10 V For **2N3019** For **2N3020** I_C = 500 mA V_{CE} = 10 V For **2N3019** For **2N3020** I_C = 1 A V_{CE} = 10 V I_C = 150 mA V_{CE} = 10 V T_{amb} = – 55 °C For **2N3019**	 50 30 90 40 100 40 50 30 15 40		 100 120 300 120 100	
h_{fe}	Small Signal Current Gain	I_C = 1 mA V_{CE} = 5 V f = 1 kHz For **2N3019** For **2N3020**	 80 30		 400 200	
f_T	Transition Frequency	I_C = 50 mA V_{CE} = 10 V f = 20 MHz For **2N3019** For **2N3020**	 100 80			 MHz MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz			60	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz			12	pF
NF	Noise Figure for (**2N3019**) only	I_C = 100 μA V_{CE} = 10 V f = 1 kHz R_g = 1 KΩ			4	dB
$r_{bb'}C_{b'c}$	Feedback Time Constant	I_C = 10 mA V_{CE} = 10 V f = 4 MHz			400	ps

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

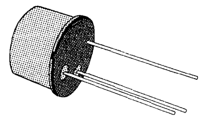
SGS-THOMSON
MICROELECTRONICS

2N3053

AMPLIFIERS AND SWITCH

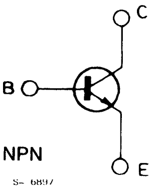
DESCRIPTION

The 2N3053 is a silicon planar epitaxial NPN transistor in Jedec TO-39 metal case, intended for medium-current switching and amplifier applications.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	60	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	40	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5	V
I_C	Collector Current	700	mA
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	5	W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

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

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEX}	Collector Cutoff Current (V_{BE} = – 1.5 V)	V_{CE} = 60 V			250	nA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 μA	60			V
$V_{(BR)CEO}$	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 100 μA	40			V
$V_{(BR)CER}$*	Collector-emitter Breakdown Voltage ($R_{BE} \leq 10\ \Omega$)	I_C = 10 mA	50			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 100 μA	5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA			1.4	V
V_{BE}*	Base-emitter Voltage	I_C = 150 mA V_{CE} = 2.5 V			1.7	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA			1.7	V
h_{FE}*	DC Current Gain	I_C = 150 mA V_{CE} = 2.5 V I_C = 150 mA V_{CE} = 10 V	25 50		 250	
f_T	Transition Frequency	I_C = 50 mA V_{CE} = 10 V f = 20 MHz		100		MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz			80	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz			15	pF

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

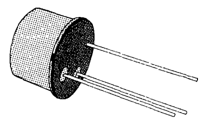
SGS-THOMSON
MICROELECTRONICS

2N3107/2N3108
2N3109/2N3110

GENERAL PURPOSE AMPLIFIERS AND SWITCHES

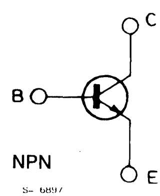
DESCRIPTION

The 2N3107, 2N3108, 2N3109 and 2N3110 are silicon planar epitaxial NPN transistors in Jedec TO-39 metal case primarily intended for large signal, low noise industrial applications.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		2N 3109 2N 3110	2N 3107 2N 3108	
V_{CBO}	Collector-base Voltage (I_E = 0)	80	100	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	40	60	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	7		V
I_C	Collector Current	1		A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.8 5		W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200		°C

THERMAL DATA

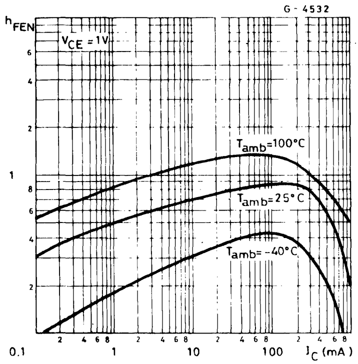
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	35	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	219	°C/W

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

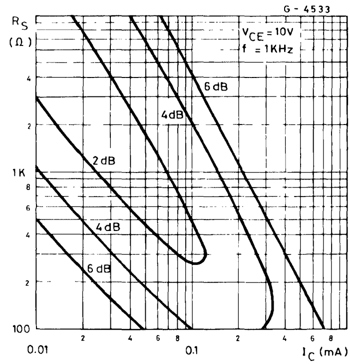
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 60 V T_{amb} = 150 °C			10	µA
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = 60 V			10	nA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			10	nA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 µA For **2N 3109** and **2N 3110** For **2N 3107** and **2N 3108**	 80 100			 V V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 30 mA For **2N 3109** and **2N 3110** For **2N 3107** and **2N 3108**	 40 60			 V V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 100 µA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA I_C = 1 A I_B = 100 mA			0.25 1	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA I_C = 1 A I_B = 100 mA			1.1 2	V V
h_{FE}*	DC Current Gain	For **2N 3107** and **2N 3109** I_C = 150 mA V_{CE} = 1 V I_C = 0.1 mA V_{CE} = 10 V I_C = 500 mA V_{CE} = 10 V I_C = 150 mA V_{CE} = 10 V T_{amb} = – 55 °C For **2N 3108** and **2N 3110** I_C = 150 mA V_{CE} = 1 V I_C = 0.1 mA V_{CE} = 10 V I_C = 500 mA V_{CE} = 10 V I_C = 150 mA V_{CE} = 10 V T_{amb} = – 55 °C	 100 35 40 30 40 20 25 15		 300 120	
f_T	Transition Frequency	I_C = 50 mA V_{CE} = 10 V f = 20 MHz For **2N 3107** and **2N 3109** For **2N 3108** and **2N 3110**	 70 60			 MHz MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz			80	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz For **2N 3107** and **2N 3108** For **2N 3109** and **2N 3110**			 20 25	 pF pF
NF	Noise Figure	I_C = 30 µA V_{CE} = 10 V f = 1 kHz R_g = 1 KΩ			8	dB
t_{on}**	Turn-on Time	I_C = 150 mA V_{CC} = 20 V I_{B1} = 7.5 mA			200	ns
t_{off}**	Turn-off Time	I_C = 150 mA V_{CC} = 20 V I_{B1} = – I_{B2} = 7.5 mA			1000	ns

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

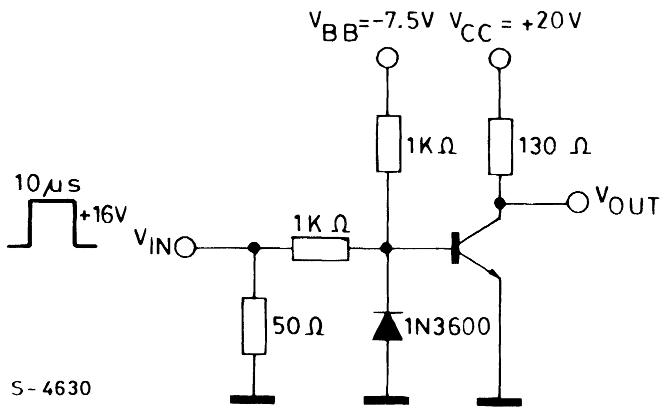
Normalized DC Current Gain.



Contours of Constant Narrow Band Noise Figure.



Test Circuit for t_{on}, t_{off}.



PULSE GENERATOR :
t_r of input pulse < 15 ns
t_r of input pulse < 15 ns

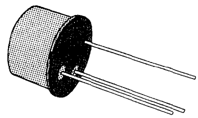
TO OSCILLOSCOPE :
t_r > 15 ns
Z_{IN} ≈ 100 KΩ

2N3114

HIGH VOLTAGE AMPLIFIER

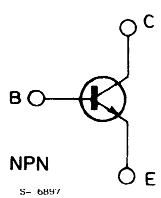
DESCRIPTION

The 2N3114 is a silicon planar epitaxial NPN transistor in Jedec TO-39 metal case. It is primarily intended for high voltage, medium power applications.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	150	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	150	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	5	V
I_C	Collector Current	150	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.8 5	W W
T_{stg}, T_j	Storage and Junction Temperature	65 to 200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	35	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	219	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 100 V V_{CB} = 100 V T_{amb} = 150 °C			10 10	nA μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 4 V			100	nA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 μA	150			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	150			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 100 μA	5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 50 mA I_B = 5 mA			1	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 50 mA I_B = 5 mA			0.9	V
h_{FE}*	DC Current Gain	I_C = 100 μA V_{CE} = 10 V I_C = 30 mA V_{CE} = 10 V T_{amb} = – 55 °C I_C = 30 mA V_{CE} = 10 V	15 30 12	35 60 24	 120	
h_{fe}	High Frequency Current Gain	I_C = 30 mA V_{CE} = 10 V f = 20 MHz	2			
C_{EBO}	Emitter-base Capacitance	V_{EB} = 0.5 V f = 1 MHz			80	pF
C_{CBO}	Collector-base Capacitance	V_{CB} = 20 V f = 1 MHz			9	pF

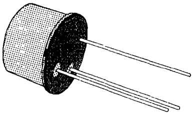
* Pulsed : pulse duration = 300 μs, duty cycle = 1 %.

2N3137

RF AMPLIFIER

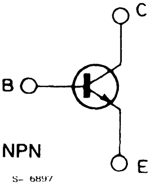
DESCRIPTION

The 2N3137 is a silicon planar epitaxial NPN transistor in a TO-39 metal case. It is a primarily designed for application as a Class-C, RF power amplifier. In addition to the large signal capabilities, the low noise and high transition frequency of the 2N3137 provide excellent performance in a variety of linear amplifier for telecommunication applications.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	40	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	20	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	4	V
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.6 1	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

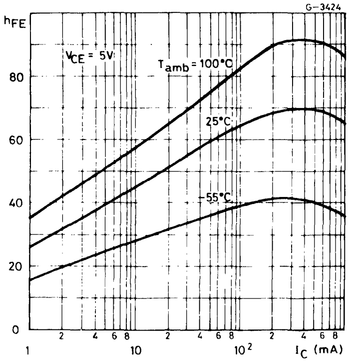
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	175	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	292	°C/W

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

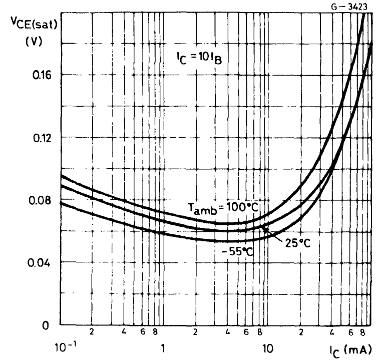
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 20 V V_{CB} = 20 V	 T_{amb} = 150 °C		0.12 0.1	50 50	nA μA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 μA		40			V
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 15 mA		20			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 100 μA		4			V
$V_{CE(sat)}$	Collector-emitter Saturation Voltage	I_C = 50 mA	I_B = 5 mA		0.12	0.3	V
h_{FE}*	DC Current Gain	I_C = 50 mA	V_{CE} = 5 V	20	70	120	
G_{pe}	Power Gain (class-C)	V_{CE} = 20 V f = 250 MHz	P_i = 100 mW	6	7		dB
NF	Noise Figure	V_{CE} = 10 V f = 200 MHz	I_C = 30 mA R_g = 50 Ω		4		dB
C_{CBO}	Collector-base Capacitance	V_{CB} = 10 V	f = 1 MHz		2.8	3.5	pF
f_T	Transition Frequency	I_C = 50 mA	V_{CE} = 10 V	500	750		MHz
η	Collector Efficiency	V_{CE} = 20 V f = 250 MHz	P_i = 100 mW	40	60		%

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

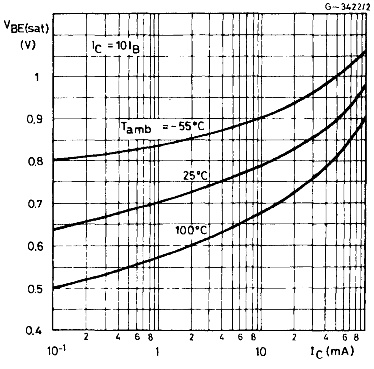
DC Current Gain.



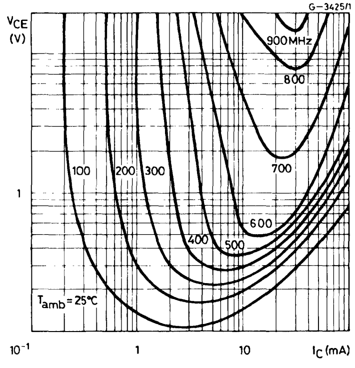
Collector-emitter Saturation Voltage.



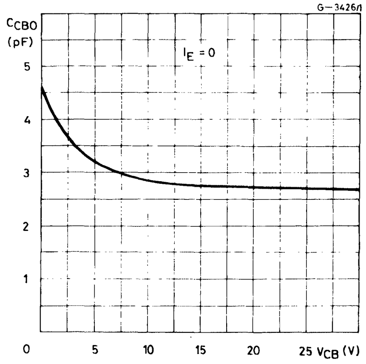
Base-emitter Saturation Voltage.



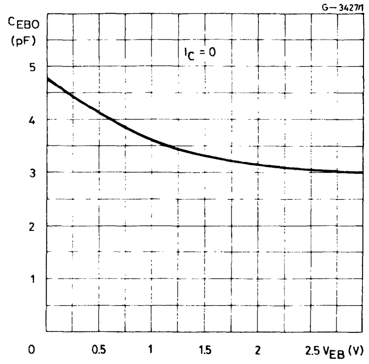
Contours of Constant Transition Frequency.



Collector-base capacitance.



Emitter-base capacitance.



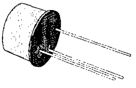
SGS-THOMSON MICROELECTRONICS

2N3250
2N3251

AMPLIFIERS AND SWITCHES

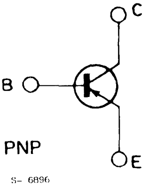
DESCRIPTION

The 2N3250 and 2N3251 are silicon planar epitaxial PNP transistors in Jedec TO-18 metal case. They are suited for switching and amplifier applications.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	– 50	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	– 40	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	– 5	V
I_C	Collector Current	– 200	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.36 1.2	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	146	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	487	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEX}	Collector Cutoff Current (V_{BE} = 3 V)	V_{CE} = – 40 V			– 20	nA
I_{BEX}	Base Cutoff Current (V_{BE} = 3 V)	V_{CE} = – 40 V			– 50	nA
$V_{(BR)CBO}$	Colllector-base Breakdown Voltage (I_E = 0)	I_C = –10 μA	– 50			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 10 mA	– 40			V
$V_{(BR)EBO}$	Emittter-base Breakdown Voltage (I_C = 0)	I_E = – 10 μA	– 5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 10 mA I_B = – 1 mA I_C = – 50 mA I_B = – 5 mA			0.25 0.5	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 10 mA I_B = – 1 mA I_C = – 50 mA I_B = – 5 mA	0.6		0.9 1.2	V V
h_{FE}*	DC Current Gain	for **2N3250** I_C = – 0.1 mA V_{CE} = – 1 V I_C = – 1 mA V_{CE} = – 1 V I_C = – 10 mA V_{CE} = – 1 V I_C = – 50 mA V_{CE} = – 1 V for **2N3251** I_C = – 0.1 mA V_{CE} = – 1 V I_C = – 1 mA V_{CE} = – 1 V I_C = – 10 mA V_{CE} = – 1 V I_C = – 50 mA V_{CE} = – 1 V	 40 45 50 15 80 90 100 30		 150 300 	
h_{fe}	Small Signal Current Gain	I_C = – 1 mA V_{CE} = – 10 V f = 1 kHz for **2N3250** for **2N3251**	 50 100		 200 400	
f_T	Transition Frequency	I_C = – 10 mA V_{CE} = – 20 V f = 100 MHz for **2N3250** for **2N3251**	 250 300			 MHz MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 f = 1 MHz V_{EB} = – 1 V			8	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 f = 1 MHz V_{CB} = – 10 V			6	pF
NF	Noise Figure	I_C = – 100 μA V_{CE} = – 5 V f = 100 Hz R_g = 1 kΩ			6	dB
h_{ie}	Input Impedance	I_C = – 1 mA V_{CE} = – 10 V f = 1 kHz for **2N3250** for **2N3251**	 1 2		 6 12	 kΩ kΩ
h_{re}	Reverse Voltage Ratio	I_C = – 1 mA V_{CE} = – 10 V f = 1 kHz for **2N3250** for **2N3251**			 10^{-3} $2x10^{-3}$	

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

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
h_{oe}	Output Admittance	I_C = – 1 mA V_{CE} = – 10 V f = 1 kHz for **2N3250** for **2N3251**	 4 10		 40 60	 µS µS
t_d	Delay Time	I_C = 10 mA V_{CC} = 3 V I_{B1} = 1 mA			35	ns
t_r	Delay Time	I_C = 10 mA V_{CC} = 3 V I_{B1} = 1 mA			35	ns
t_s	Storage Time	I_C = 10 mA V_{CC} = 3 V I_{B1} = – I_{B2} = 1 mA			200	ns
t_f	Fall Time	I_C = 10 mA V_{CC} = 3 V I_{B1} = – I_{B2} = 1 mA			50	ns
$r_{bb'}C_{b'c}$	Feedback Time Constant	I_C = – 10 mA V_{CE} = – 20 V			250	ps

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

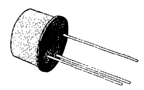
SGS-THOMSON
MICROELECTRONICS

2N3301
2N3302

GENERAL PURPOSE AMPLIFIERS AND SWITCHES

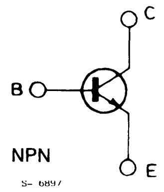
DESCRIPTION

The 2N3301 and 2N3302 are silicon planar epitaxial NPN transistors in Jedec TO-18 metal case. They are designed to cover a wide range of amplifier and switching applications.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	60	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	30	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	5	V
I_C	Collector Current	0.5	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.36 1.8	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

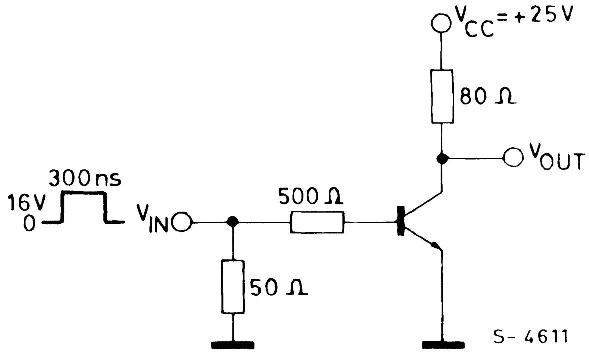
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	97.2	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CB} = 50 V V_{CB} = 50 V T_{amb} = 150 °C			10 10	nA µA
I_{EBO}	Emitter-cutoff Current (I_C = 0)	V_{EB} = 3 V			10	nA
$V_{(BR)CBO}$	Colllector-base Breakdown Voltage (I_E = 0)	I_C = 10 µA	60			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	30			V
$V_{(BR)EBO}$	Emittter-base Breakdown Voltage (I_C = 0)	I_E = 10 µA	5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA I_C = 500 mA I_B = 50 mA			0.22 0.6	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA I_C = 500 mA I_B = 50 mA			1.1 1.5	V V
h_{FE}*	DC Current Gain	for **2N3301** I_C = 0.1 mA V_{CE} = 10 V I_C = 1 mA V_{CE} = 10 V I_C = 10 mA V_{CE} = 10 V I_C = 150 mA V_{CE} = 10 V I_C = 500 mA V_{CE} = 10 V I_C = 150 mA V_{CE} = 1 V for **2N3302** I_C = 0.1 mA V_{CE} = 10 V I_C = 1 mA V_{CE} = 10 V I_C = 10 mA V_{CE} = 10 V I_C = 150 mA V_{CE} = 10 V I_C = 500 mA V_{CE} = 10 V I_C = 150 mA V_{CE} = 1 V	 20 25 35 40 20 20 35 50 75 100 50 50	 40 60 70 60 50 80 140 200 125 75	 120 300	
h_{fe}	High Frequency Current Gain	I_C = 50 mA V_{CE} = 10 V f = 100 MHz	2.5			
C_{EBO}	Emitter-base Capacitance	V_{EB} = 2 V f = 1 MHz			20	pF
C_{CBO}	Collector-base Capacitance	V_{CB} = 10 V f = 1 MHz			8	pF
t_{on}**	Turn-on Time	I_C = 300 mA V_{CC} = 25 V I_{B1} = 30 mA			60	ns
t_{off}**	Turn-off Time	I_C = 300 mA V_{CC} = 25 V I_{B1} = $-I_{B2}$ = 30 mA			150	ns

* Pulsed : pulse duration = 300 µs, duty cycle = 1 %.
** See test circuits.

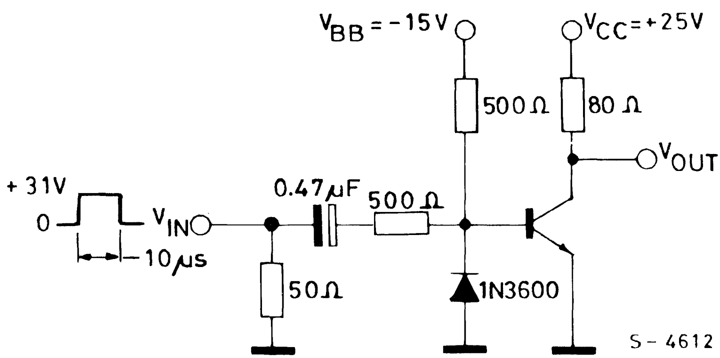
Test Circuit for t_{on}.



PULSE GENERATOR:
$t_r \leq 1.0$ ns
$Z_{IN} = 50\ \Omega$

TO OSCILLOSCOPE :
t_r 1.0 ns
ZIN ≈ 100 kΩ

Test Circuit for t_{off}.



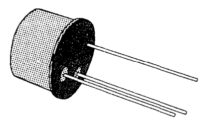
PULSE GENERATOR:
$t_r \leq 20$ ns
$Z_{IN} = 50\ \Omega$

TO OSCILLOSCOPE :
$t_r \leq 1.0$ ns
ZIN ≈ 100 kΩ

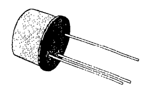
GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DESCRIPTION

The 2N3502, 2N3503, 2N3504 and 2N3505 are silicon planar epitaxial PNP transistors in Jedec TO-39 (2N3502, 2N3503) and in Jedec TO-18 (2N3504, 2N3505) metal cases. They are designed for high-speed saturated switching and general purpose applications.

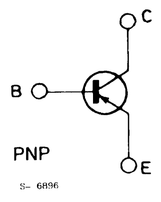


TO-39



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		2N3502 2N3504	2N3503 2N3505	
V_{CBO}	Collector-base Voltage (I_E = 0)	– 45	– 60	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 45	– 60	V
V_{EBO}	Emitter-base Voltage (IC = 0)	5		V
I_C	Collector Current	600		mA
P_{tot}	Total power Dissipation at Tamb ≤ 25 °C For **2N3504, 2N3505** For **2N3502, 2N3503** at Tcase ≤ 25 °C For **2N3504, 2N3505** For **2N3502, 2N3503**	 0.4 0.7 1.3 3		 W W W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200		°C

THERMAL DATA

			2N3502 2N3503	2N3504 2N3505
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	132 °C/W	58.3 °C/W
$R_{th\ j\text{-}amb}$	Thermal Rsistance Junction-ambient	Max	437 °C/W	250 °C/W

ELECTRICAL CHARATERISTICS (T_{amb} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	For **2N3503** and **2N3505** V_{CE} = – 50 V For **2N3502** and **2N3504** V_{CE} = – 30 V			 – 10 – 10	 nA nA
I_{CBO}	Collector Cutoff Current (I_E = 0)	For **2N3503** and **2N3505** V_{CE} = – 50 V T_{amb} = 150 °C For **2N3502** and **2N3504** V_{CE} = – 30 V T_{amb} = 150 °C			 – 10 – 10	 nA nA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = – 10 µA For **2N3503** and **2N3505** For **2N3502** and **2N3504**	 – 60 – 45			 V V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 10 mA For **2N3503** and **2N3505** For **2N3502** and **2N3504**	 – 60 – 45			 V V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = – 10 µA	– 5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 50 mA I_B = – 2.5 mA I_C = – 150 mA I_B = – 15 mA I_C = – 500 mA I_B = – 50 mA			– 0.25 – 0.4 – 1.6	V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 50 mA I_B = – 2.5 mA I_C = – 150 mA I_B = – 15 mA I_C = – 500 mA I_B = – 50 mA			– 1 – 1.3 – 2	V V V
h_{FE}*	DC Current Gain	I_C = – 0.01 mA V_{CE} = – 10 V I_C = – 0.1 mA V_{CE} = – 10 V I_C = – 1 mA V_{CE} = – 10 V I_C = – 10 mA V_{CE} = – 10 V I_C = – 150 mA V_{CE} = – 10 V I_C = – 500 mA V_{CE} = – 10 V T_{amb} = – 55 °C I_C = 50 mA V_{CE} = – 10 V	80 120 135 140 100 50 50		 300	
f_T	Transition Frequency	I_C = – 50 mA V_{CE} = – 20 V f = 100 MHz	200			MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = – 0.5 V f = 100 kHz			30	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 10 V f = 1 MHz			8	pF
NF	Noise Figure	I_C = – 30 µA V_{CE} = – 5 V f = 1 MHz R_G = 10 KΩ			4	dB
t_{on}	Turn-on Time	I_C = – 300 mA V_{CC} = – 30 V I_{B1} = – 30 mA			40	ns
t_{off}	Turn-off Time	I_C = – 300 mA V_{CC} = – 30 V I_{B1} = – I_{B2} = – 30 mA			100	ns

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

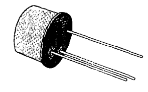
SGS-THOMSON MICROELECTRONICS

2N3700

GENERAL PURPOSE AMPLIFIERS

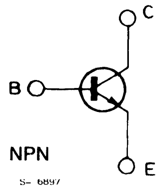
DESCRIPTION

The 2N3700 is a silicon planar epitaxial NPN transistor in Jedec TO-18 metal case, intended for small signal, low noise industrial applications.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	140	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	80	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	7	V
I_C	Collector Current	1	A
P_{tot}	Total Power Dissipation at $T_{amb} \le 25$ °C at $T_{case} \le 25$ °C at $T_{case} \le 100$ °C	0.5 1.8 1	W W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	97	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	350	°C/W

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

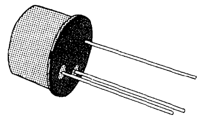
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 90 V V_{CB} = 90 V T_{amb} = 150 °C			10 10	nA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			10	nA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 µA	140			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 30 mA	80			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 100 µA	7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA I_C = 500 mA I_B = 50 mA			0.2 0.5	V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 150 mA I_B = 15 mA			1.1	V
h_{FE}*	DC Current Gain	I_C = 0.1 mA V_{CE} = 10 V I_C = 10 mA V_{CE} = 10 V I_C = 150 mA V_{CE} = 10 V I_C = 500 mA V_{CE} = 10 V I_C = 1 A V_{CE} = 10 V I_C = 150 mA V_{CE} = 10 V T_{amb} = – 55 °C	50 90 100 50 15 40		 300	
h_{fe}	Small Signal Current Gain	I_C = 1 mA V_{CE} = 5 V f = 1 kHz	80		400	
f_T	Transition Frequency	I_C = 50 mA V_{CE} = 10 V f = 20 MHz		100		MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz		60		pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz		12		pF
$r_{bb'}C_{b'c}$	Feedback Time Constant	I_C = 10 mA V_{CB} = 10 V f = 4 MHz	25		400	ps

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

HIGH-CURRENT SWITCH

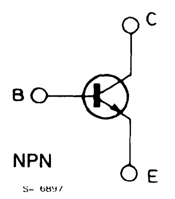
DESCRIPTION

The 2N3724 is a silicon planar epitaxial transistor in TO-39 metal case. It is a high-current switch used for memory applications requiring breakdown voltages up to 30 V and operating currents to 1 A.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	50	V
V_{CES}	Collector-emitter Voltage ($V_{BE} = 0$)	50	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	30	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	6	V
I_C	Collector Current	1	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.8 3.5	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

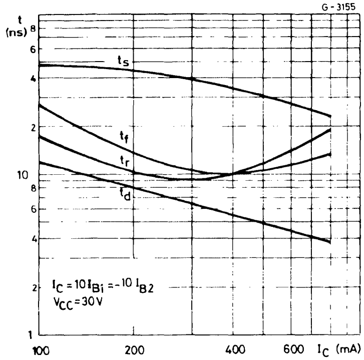
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	50	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	220	°C/W

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

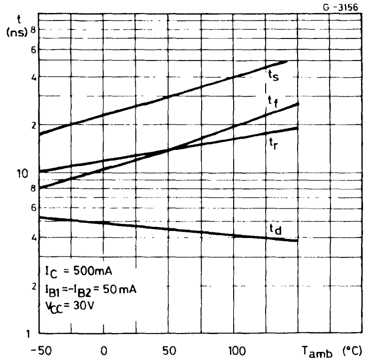
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 40 V V_{CB} = 40 V T_{amb} = 100 °C			1.7 120	μA μA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 10 μA	50			V
$V_{(BR)CES}$	Collector-emitter Breakdown Voltage (V_{BE} = 0)	I_C = 10 μA	50			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	30			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 10 μA	6			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA I_C = 100 mA I_B = 10 mA I_C = 300 mA I_B = 30 mA I_C = 500 mA I_B = 50 mA I_C = 800 mA I_B = 80 mA I_C = 1000 mA I_B = 100 mA			0.25 0.20 0.32 0.42 0.65 0.75	V V V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA I_C = 100 mA I_B = 10 mA I_C = 300 mA I_B = 30 mA I_C = 500 mA I_B = 50 mA I_C = 800 mA I_B = 80 mA I_C = 1000 mA I_B = 100 mA	 0.9 	0.64 0.75 0.89 1.0 1.1	0.76 0.86 1.1 1.2 1.5 1.7	V V V V V V
h_{FE}*	DC Current Gain	I_C = 10 mA V_{CE} = 1 V I_C = 100 mA V_{CE} = 1 V I_C = 300 mA V_{CE} = 1 V I_C = 1000 mA V_{CE} = 5 V I_C = 800 mA V_{CE} = 2 V I_C = 500 mA V_{CE} = 1 V	30 60 40 30 25 35	60 90 60 	 150 	
h_{fe}	High Frequency Current Gain	I_C = 50 mA V_{CE} = 10 V f = 100 MHz	3			
C_{CBO}	Collector-base Capacitance	I_C = 0 V_{CB} = 10 V f = 1 MHz			12	pF
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz			55	pF
t_{on}**	Turn-on Time	I_C = 500 mA V_{CC} = 30 V I_B = 50 mA			35	ns
t_{off}**	Turn off Time	I_C = 500 mA V_{CC} = 30 V I_{B1} = − I_{B2} = 50 mA			60	ns

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

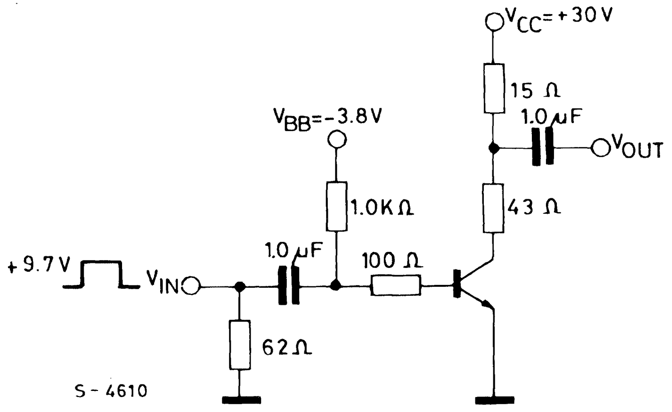
Switching Characteristics.



Switching Characteristics.



Test Circuit for t_{on}, t_{off}.



PULSE GENERATOR :

t_r, t_f ≤ 1.0 ns
PW ≈ 1.0 ms
Z_{IN} = 50 W
DC < 2 %

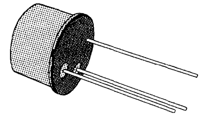
TO OSCILLOCOPE :

t_r < 1.0 ns
Z_{IN} ≥ 100 KW

HIGH VOLTAGE, HIGH CURRENT SWITCH

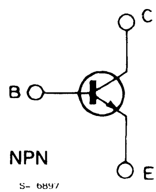
DESCRIPTION

The 2N3725 is a silicon planar epitaxial transistor in TO-39 metal case It is a high-voltage, high current switch used for memory applications requiring breakdown voltages up to 50 V and operating currents to 1 A. Fast switching times are assured because of the high minimum f_T (300 MHz) and tight control on storage time.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	80	V
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	80	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	50	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	6	V
I_C	Collector Current	1	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.8 3.5	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

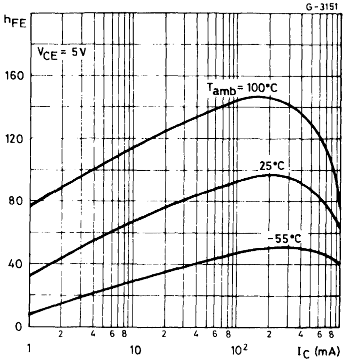
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	50	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	220	°C/W

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

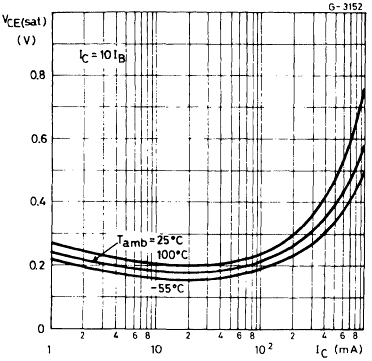
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 60 V V_{CB} = 60 V T_{amb} = 100 °C			1.7 120	µA µA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 10 µA	80			V
$V_{(BR)CES}$	Collector-emitter Breakdown Voltage (V_{BE} = 0)	I_C = 10 µA	80			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	50			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 10 µA	6			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA I_C = 100 mA I_B = 10 mA I_C = 300 mA I_B = 30 mA I_C = 500 mA I_B = 50 mA I_C = 800 mA I_B = 80 mA I_C = 1000 mA I_B = 100 mA		0.19 0.21 0.31 0.4 0.5 0.6	0.25 0.26 0.4 0.52 0.8 0.95	V V V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA I_C = 100 mA I_B = 10 mA I_C = 300 mA I_B = 30 mA I_C = 500 mA I_B = 50 mA I_C = 800 mA I_B = 80 mA I_C = 1000 mA I_B = 100 mA	 0.9 	0.64 0.75 0.89 1.0 1.1	0.76 0.86 1.1 1.2 1.5 1.7	V V V V V V
h_{FE}*	DC Current Gain	I_C = 10 mA V_{CE} = 1 V I_C = 100 mA V_{CE} = 1 V I_C = 300 mA V_{CE} = 1 V I_C = 1000 mA V_{CE} = 5 V I_C = 800 mA V_{CE} = 2 V I_C = 500 mA V_{CE} = 1 V	30 60 40 25 20 35	60 90 60 65 40 	 150 	
h_{fe}	High Frequency Current Gain	I_C = 50 mA V_{CE} = 10 V f = 100 MHz	3			
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz			10	pF
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{CB} = 0.5 V f = 1 MHz			55	pF
t_{on} **	Turn-on Time	I_C = 500 mA V_{CC} = 30 V I_B = 50 mA			35	ns
t_{off}**	Turn off Time	I_C = 500 mA V_{CC} = 30 V I_{B1} = − I_{B2} = 50 mA			60	ns

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

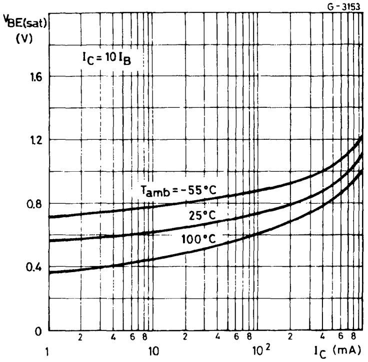
DC Current Gain.



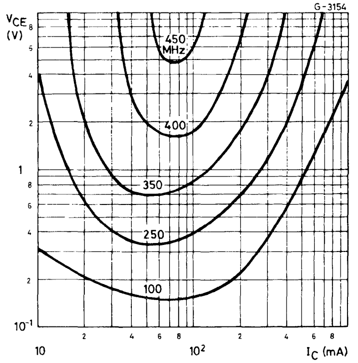
Collector-emitter Saturation Voltage.



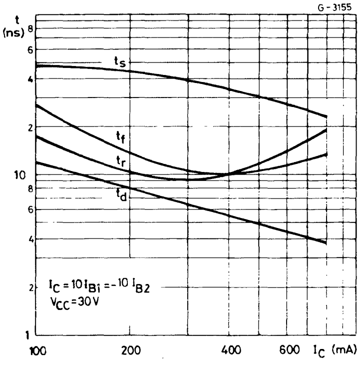
Base-emitter Saturation Voltage.



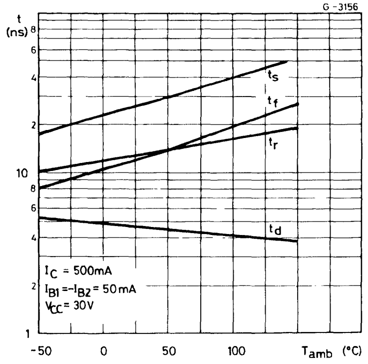
Contours of Constant Transition Frequency.



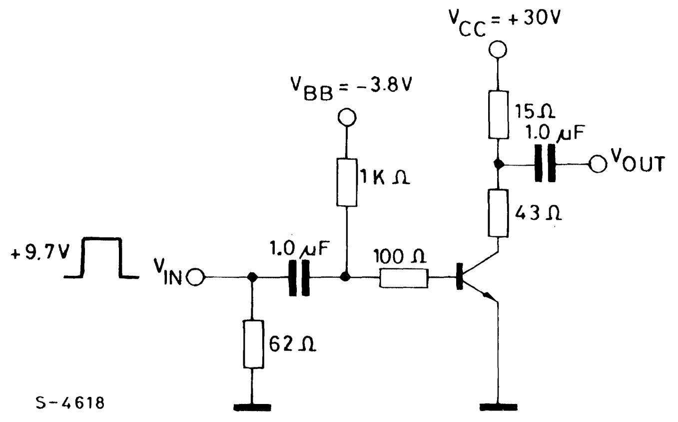
Switching Characteristics.



Switching Characteristics.



Test Circuit for t_{on}, t_{off}.



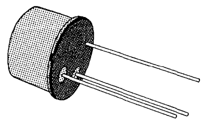
PULSE GENERATOR :
t_r, $t_f \leq 1.0$ ns
PW ≈ 1.0 µs
$Z_{IN} = 50\ \Omega$
DC < 2 %

TO OSCILLOSCOPE :
$t_r < 1.0$ ns
$Z_{IN} \geq 100\ K\Omega$

VHF-UHF POWER AMPLIFIER

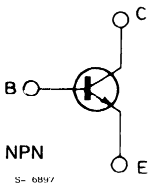
DESCRIPTION

The 2N3866 and BFR97 are silicon planar epitaxial NPN transistor in Jedec TO-39 metal case. They are designed for VHF-UHF class A, B, or C amplifier circuits and oscillator applications.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CES}	Collector–emitter Voltage (V_{BE} = 0)	55	V
V_{CEO}	Collector–emitter Voltage (I_B = 0)	30	V
V_{EBO}	Emitter–base Voltage (I_C = 0)	3.5	V
I_C	Collector Current	0.5	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	5	W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

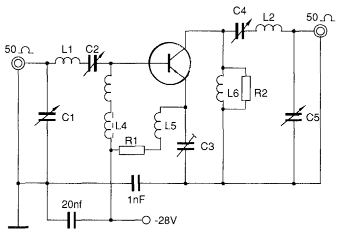
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	35	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 28 V			20	μA
$V_{(BR)CES}$	Collector–emitter Breakdown Voltage (V_{BE} = 0)	I_C = 0.1 mA	55			V
$V_{CEO\ (sus)}$*	Collector–emitter Sustaining Voltage (I_B = 0)	I_c = 5 mA	30			V
$V_{(BR)EBO}$	Emitter–base Breakdown Voltage (I_C = 0)	I_E = 100 μA	3.5			V
$V_{CE(sat)}$*	Collector–emitter Saturation Voltage	I_c = 100 mA I_B = 20 mA			1	V
h_{FE}*	DC Current Gain	I_c = 50 mA V_{CE} = 5 V I_c = 360 mA V_{CE} = 5 V	10 5		200	
f_T	Transition Frequency	I_c = 50 mA V_{CE} = 15 V f = 200 MHz	500			MHz
C_{CBO}	Collector–base Capacitance	I_E = 0 V_{CB} = –28 V f = 1 MHz			3	pF
P_o**	Output Power	V_{CC} = – 28 V P_i = 100 mW f = 400 MHz	1			W
η**	Collector Efficiency	V_{CC} = – 28 V P_o = 1 W f = 400 MHz	45			%

* Plused : pulse duration = 300 ms, duty cycle = 1 %.
** See test circuit.

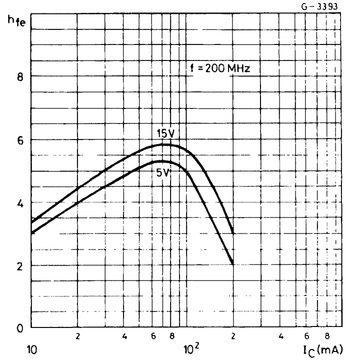
Test Circuit for Power Output Measurement (f = 400 MHz).



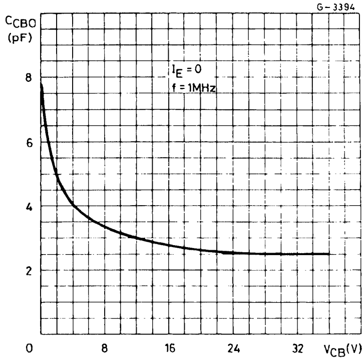
C_1, C_2, C_4, C_5 = 3 – 25 pF
C_3 = 7 – 15 pF
R_1 = 5.6 Ω
R_2 = 1 kΩ

L_1, L_2 = 5 cm Line (2 x 5 mm)
L_3, L_5, L_6 = RF choke 0.1 μH
L_4 = Ferrite choke 1 mm

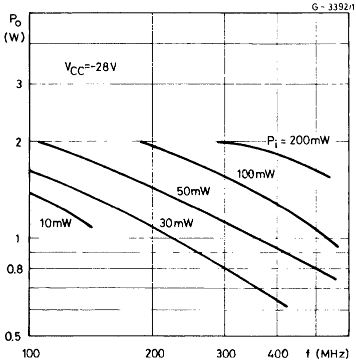
High Frequency Current Drain.



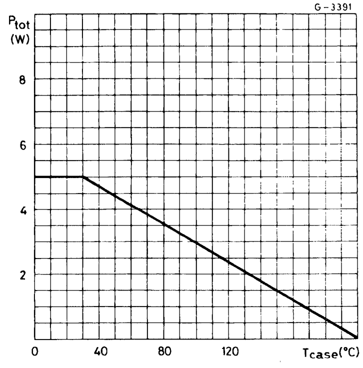
Collector-base Capacitance.



RF Output Power.



Power Rating Chart.



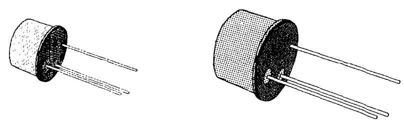
SGS-THOMSON MICROELECTRONICS

2N3930
2N3931

HIGH-VOLTAGE AMPLIFIERS

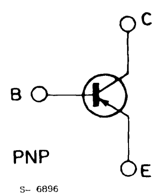
DESCRIPTION

The 2N3930 and 2N3931 are silicon planar epitaxial PNP transistors in Jedec TO-18 (2N3930) and Jedec TO-39 (2N3931) metal cases.
Both devices feature high voltage, high gain, low noise and excellent current gain linearity from 10 μA to 50 mA.



TO-18 **TO-39**

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	– 180	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	– 180	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	– 6	V
I_C	Collector Current	– 100	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C		
	For **2N3930**	0.4	W
	For **2N3931**	0.7	W
	at $T_{case} \leq 25$ °C		
	For **2N3930**	1.4	W
	For **2N3931**	2.5	W
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 200	°C

THERMAL DATA

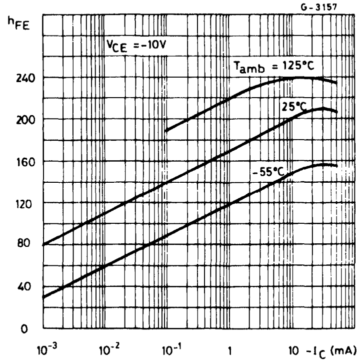
			2N3930	2N3931
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	125 °C/W	70 °C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	438 °C/W	250 °C/W

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

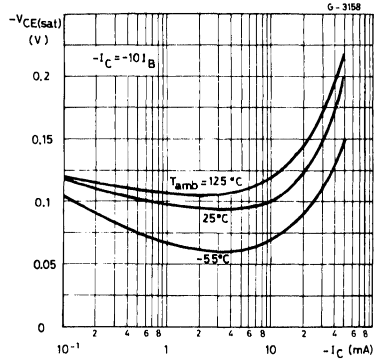
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = – 100 V V_{CB} = – 100 V T_{amb} = 125 °C			– 10 – 10	nA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = – 4 V			– 10	nA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = – 10 µA	– 180			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 2 mA	– 180			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = – 10 µA	– 6			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 10 mA I_B = – 1 mA		– 0.1	– 0.25	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 10 mA I_B = – 1 mA		– 0.74	– 0.9	V
h_{FE}*	DC Current Gain	I_C = – 10 µA V_{CE} = – 10 V I_C = – 1 mA V_{CE} = – 10 V I_C = – 10 mA V_{CE} = – 10 V I_C = – 10 µA V_{CE} = – 10 V T_{amb} = – 55 °C I_C = – 100 µA V_{CE} = – 10 V T_{amb} = – 55 °C	60 80 80 15 30	110 170 200 60 90	 300 	
f_T	Transition Frequency	I_C = – 1 mA V_{CE} = – 10 V f = 20 MHz	40	60	160	MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = – 0.5 V f = 1 MHz		20	25	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 5 V f = 1 MHz		5	7	pF
NF	Noise Figure	I_C = – 10 µA V_{CE} = – 5 V R_g = 10 kΩ f = 10 kHz B = 2 kHz f = 1 kHz B = 200 Hz f = 100 Hz B = 20 Hz		 1 1 2	 3 3 10	 dB dB dB

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

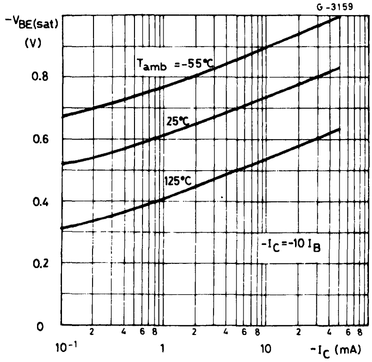
DC Current Gain.



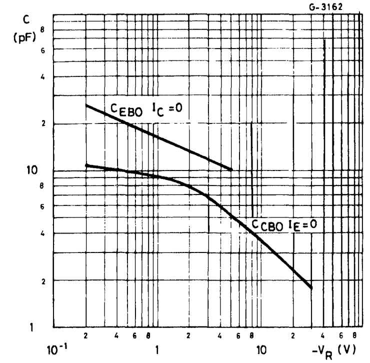
Collector-emitter Saturation Voltage.



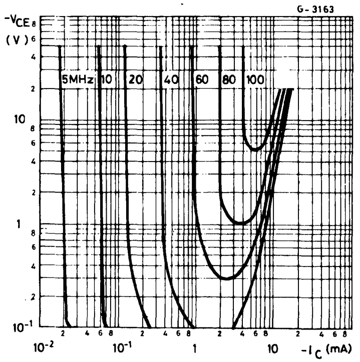
Base-emitter Saturation Voltage.



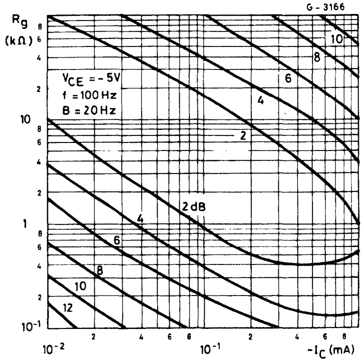
Emitter-base and collector-base capacitances.



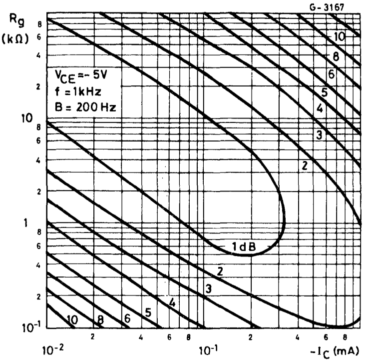
Contours of Constant Transition Frequency.



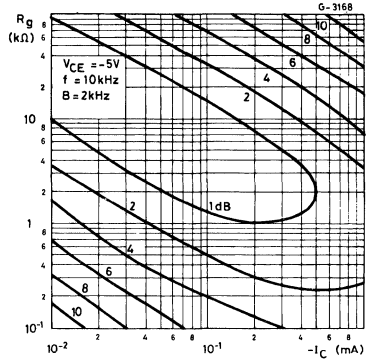
Contours of Constant Noise Figure (f = 100 Hz).



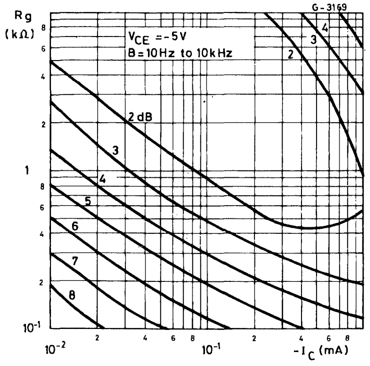
Contours of Constant Noise Figure (f = 1 kHz).



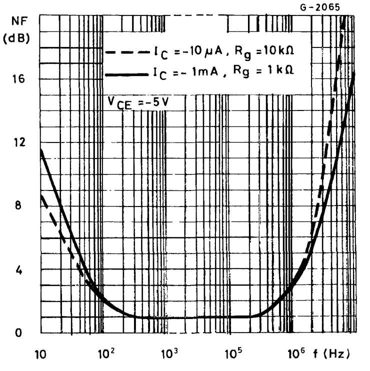
Contours of Constant Noise Figure (f = 10 kHz).



Contours of Constant Wide Band Noise Figure.



Noise Figure vs. Frequency.



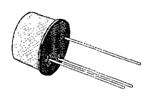
SGS-THOMSON
MICROELECTRONICS

2N3962/2N3963
2N3964/2N3965

LOW NOISE, LOW LEVEL AMPLIFIERS

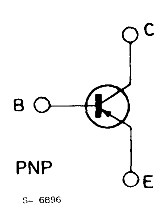
DESCRIPTION

The 2N3962, 2N3963, 2N3964 and 2N3965 are silicon planar epitaxial PNP transistors in Jedec TO-18 me-tal case particularly intended for use in low noise applications. They features are excellent current gain linearity from 1 μA to 50 mA.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		2N3964	2N3962 2N3965	2N3963	
V_{CBO}	Collector-base Voltage (I_E = 0)	– 45	– 60	– 80	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 45	– 60	– 80	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 6			V
I_C	Collector Current	– 200			mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.36 1.2			W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200			°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	146	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	487	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	For **2N3964**				
		V_{CE} = – 40 V			– 10	nA
		V_{CE} = – 40 V T_{amb} = 150 °C			– 10	µA
		For **2N3962** and **2N3965**				
		V_{CE} = – 50 V			– 10	nA
		V_{CE} = – 50 V T_{amb} = 150 °C			– 10	µA
		For **2N3963**				
		V_{CE} = – 70 V			– 10	nA
		V_{CE} = – 70 V T_{amb} = 150 °C			– 10	µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = – 4 V			– 10	nA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = – 10 µA				
		For **2N3964**	– 45			V
		For **2N3962** and **2N3965**	– 60			V
		For **2N3963**	– 80			V
$V_{(BR)CES}$	Collector-base Breakdown Voltage (V_{BE} = 0)	I_C = – 10 µA				
		For **2N3964**	– 45			V
		For **2N3962** and **2N3965**	– 60			V
		For **2N3963**	– 80			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 5 mA				
		For **2N3964**	– 45			V
		For **2N3962** and **2N3965**	– 60			V
		For **2N3963**	– 80			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = – 10 µA	– 6			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 10 mA I_B = – 0.5 mA			– 0.25	V
		I_C = – 50 mA I_B = – 5 mA			– 0.4	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 10 mA I_B = – 0.5 mA			– 0.9	V
		I_C = – 50 mA I_B = – 5 mA			– 0.95	V
h_{FE}*	DC Current Gain	For **2N3962** and **2N3963**				
		I_C = – 1 µA V_{CE} = – 5 V	60			
		I_C = – 10 µA V_{CE} = – 5 V	100		300	
		I_C = – 100 µA V_{CE} = – 5 V	100			
		I_C = – 1 mA V_{CE} = – 5 V	100		450	
		I_C = – 10 mA V_{CE} = – 5 V	100			
		I_C = – 50 mA V_{CE} = – 5 V	90			
		I_C = – 10 µA V_{CE} = – 5 V T_{amb} = – 55 °C	40			

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

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
h_{FE}*	DC Current Gain	For **2N3962** and **2N3963**				
		I_C = – 50 mA V_{CE} = – 5 V	45			
		T_{amb} = – 55 °C				
		I_C = – 1 mA V_{CE} = – 5 V			600	
		T_{amb} = 100 °C				
		For **2N3964** and **2N3965**	180			
		I_C = – 1 μA V_{CE} = – 5 V	250		500	
		I_C = – 10 μA V_{CE} = – 5 V	250			
		I_C = – 100 μA V_{CE} = – 5 V	250		600	
		I_C = – 1 mA V_{CE} = – 5 V	200			
		I_C = – 10 mA V_{CE} = – 5 V	180			
		I_C = – 50 mA V_{CE} = – 5 V				
		I_C = – 10 μA V_{CE} = – 5 V	100			
		T_{amb} = – 55 °C				
		I_C = – 50 mA V_{CE} = – 5 V	90			
		T_{amb} = – 55 °C				
		I_C = – 1 mA V_{CE} = – 5 V				
		T_{amb} = 100 °C			800	
h_{fe}	Small Signal Current Gain	I_C = – 1 mA V_{CE} = – 5 V				
		f = 1 kHz				
		For **2N3962** and **2N3963**	100		550	
		For **2N3964** and **2N3965**	250		700	
f_T	Transition Frequency	I_C = – 0.5 mA V_{CE} = – 5 V				
		f = 20 MHz				
		For **2N3962** and **2N3963**	40		160	MHz
		For **2N3964** and **2N3965**	50		160	MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = – 0.5 V				pF
		f = 1 MHz			15	
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 5 V				pF
		f = 1 MHz			6	
NF	Noise Figure	I_C = – 20 μA V_{CE} = – 5 V				2
		R_G = 10 kΩ				
		For **2N3962** and **2N3963**				
		f = 10 to 10 000 Hz			3	
		f = 100 Hz B = 15 Hz			10	dB
		f = 1 kHz B = 150 Hz			3	dB
		f = 10 kHz B = 1.5 kHz			3	dB
		For **2N3964** and **2N3965**				dB
		f = 10 to 10 000 Hz			2	
		f = 10 Hz B = 2 Hz			8	dB
		f = 100 Hz B = 15 Hz			4	dB
		f = 1 kHz B = 150 Hz			2	dB
		f = 10 kHz B = 1.5 kHz				dB

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

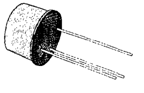
SGS-THOMSON MICROELECTRONICS

2N4013

HIGH-CURRENT SWITCH

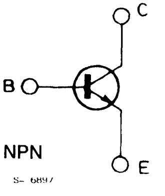
DESCRIPTION

The 2N4013 is a silicon planar epitaxial transistor in TO-18 metal case. It is a high-current switch used for memory applications requiring breakdown voltages up to 30 V and operating currents to 1 A.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	50	V
V_{CES}	Collector-emitter Voltage ($V_{BE} = 0$)	50	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	30	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	6	V
I_C	Collector Current	1	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.36 1.2	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

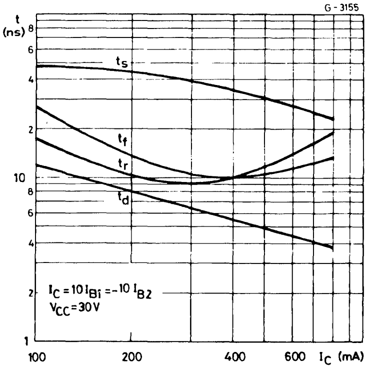
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	146	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

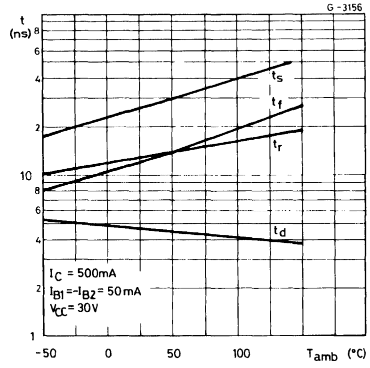
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 40 V V_{CB} = 40 V T_{amb} = 100 °C			1.7 120	μA μA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 10 μA	50			V
$V_{(BR)CES}$	Collector-emitter Breakdown Voltage (V_{BE} = 0)	I_C = 10 μA	50			V
$V_{(BR)CEO}$*	Collector-Emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	30			V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage (I_C = 0)	I_E = 10 μA	6			V
$V_{CE(sat)}$*	Collector-Emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA I_C = 100 mA I_B = 10 mA I_C = 300 mA I_B = 30 mA I_C = 500 mA I_B = 50 mA I_C = 800 mA I_B = 80 mA I_C = 1000 mA I_B = 100 mA			0.25 0.20 0.32 0.42 0.65 0.75	V V V V V V
$V_{BE(sat)}$*	Base-Emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA I_C = 100 mA I_B = 10 mA I_C = 300 mA I_B = 30 mA I_C = 500 mA I_B = 50 mA I_C = 800 mA I_B = 80 mA I_C = 1000 mA I_B = 100 mA	 0.9 	0.64 0.75 0.89 1.0 1.1	0.76 0.86 1.1 1.2 1.5 1.7	V V V V V V
h_{FE}*	DC Current Gain	I_C = 10 mA V_{CE} = 1 V I_C = 100 mA V_{CE} = 1 V I_C = 300 mA V_{CE} = 1 V I_C = 1000 mA V_{CE} = 5 V I_C = 800 mA V_{CE} = 2 V I_C = 500 mA V_{CE} = 1 V	30 60 40 30 25 35		 150	
h_{fe}	High Frequency Current Gain	I_C = 50 mA V_{CE} = 10 V f = 100 MHz	3			
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz			12	pF
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz			55	pF
t_{on}**	Turn-on Time	I_C = 500 mA V_{CC} = 30 V I_B = 50 mA			35	ns
t_{off}**	Turn-off Time	I_C = 500 mA V_{CC} = 30 V I_{B1} = − I_{B2} = 50 mA			60	ns

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

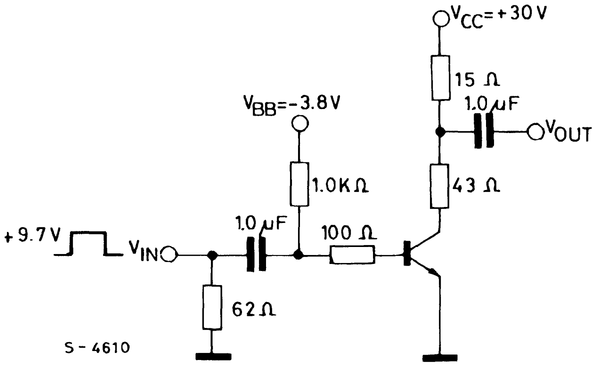
Switching Characteristics.



Switching Characteristics.



Test Circuit for t_{on}, t_{off}.



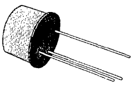
PULSE GENERATOR :
t_r, $t_f \leq 1.0$ ns
PW ≈ 1.0 μs
Z_{IN} = 50 Ω
DC < 2 %

TO OSCILLOSCOPE :
t_r < 1.0 ns
$Z_{IN} \geq$ 100 KΩ

HIGH-VOLTAGE, HIGH CURRENT SWITCH

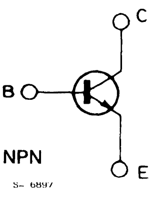
DESCRIPTION

The 2N4014 is a silicon planar epitaxial transistor in TO-18 metal case. It is a high-voltage, high current switch used for memory applications requiring breakdown voltages up to 50 V and operating currents to 1 A. Fast switching times are assured because of the high minimum fT (300 MHz) and tight control on storage time.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	80	V
V_{CES}	Collector-emitter Voltage (V_{BE} = 0)	80	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	50	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	6	V
I_C	Collector Current	1	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.36 1.2	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

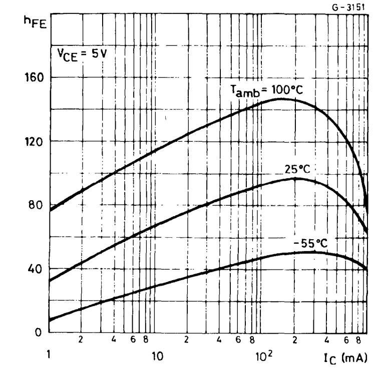
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	146	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

ELECTRICAL CHARACTERISITCS(T_{amb} = 25 °C unless otherwise specified)

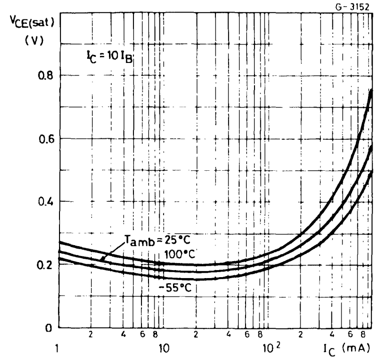
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 60 V V_{CB} = 60 V T_{amb} = 100 °C			1.7 120	μA μA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 10 μA	80			V
$V_{(BR)CES}$	Collector-emitter Breakdown Voltage (V_{BE} = 0)	I_C =10 μA	80			V
$V_{(BR)CEO}$*	Collector-Emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA	50			V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage (I_C = 0)	I_E =10 μA	6			V
$V_{CE(sat)}$*	Collector-Emitter Saturation Voltage	I_C = 10 mA I_B =1 mA I_C = 100 mA I_B =10 mA I_C = 300 mA I_B = 30 mA I_C = 500 mA I_B = 50 mA I_C = 800 mA I_B = 80 mA I_C = 1000 mA I_B = 100 mA		0.19 0.21 0.31 0.4 0.5 0.6	0.25 0.26 0.4 0.52 0.8 0.95	V V V V V V
$V_{BE(sat)}$*	Base-Emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA I_C = 100 mA I_B = 10 mA I_C = 300 mA I_B = 30 mA I_C = 500 mA I_B = 50 mA I_C = 800 mA I_B = 80 mA I_C = 1000 mA I_B = 100 mA	 0.9 	0.64 0.75 0.89 1.0 1.1	0.76 0.86 1.1 1.2 1.5 1.7	V V V V V V
h_{FE}*	DC Current Gain	I_C = 10 mA V_{CE} = 1 V I_C = 100 mA V_{CE} = 1 V I_C = 300 mA V_{CE} = 1 V I_C = 1000 mA V_{CE} = 5 V I_C = 800 mA V_{CE} = 2 V I_C = 500 mA V_{CE} = 1 V	30 60 40 25 20 35	60 90 60 65 40 	 150 	
h_{fe}	High Frequency Current Gain	I_C = 50 mA V_{CE} = 10 V f = 100 MHz	3			
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 10 V f = 1 MHz			10	pF
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = 0.5 V f = 1 MHz			55	pF
t_{on}**	Turn-on Time	I_C = 500 mA I_B = 50 mA V_{CC} = 30 V			35	ns
t_{off}**	Turn-off Time	I_C = 500 mA V_{CC} = 30 V I_{B1} = − I_{B2} = 50 mA			60	ns

* Pulsed : pulse duration = 300 ms, duty cycle = 1 %.
** See test circuit.

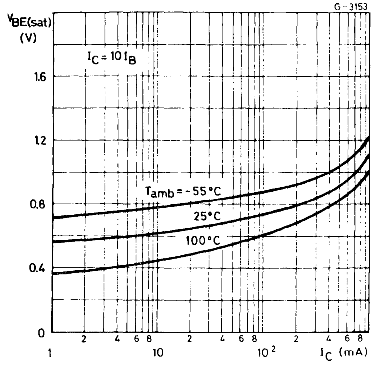
DC Current Gain.



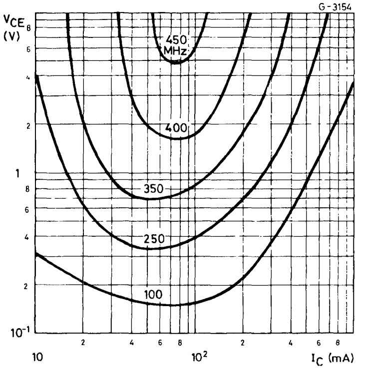
Collector-emitter Saturation Voltage.



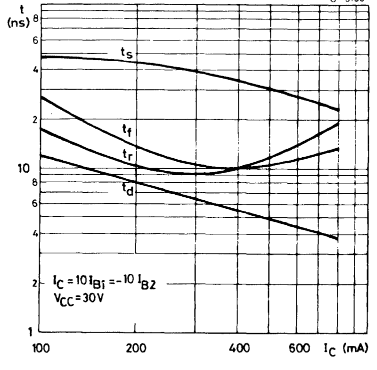
Base-emitter Saturation Voltage.



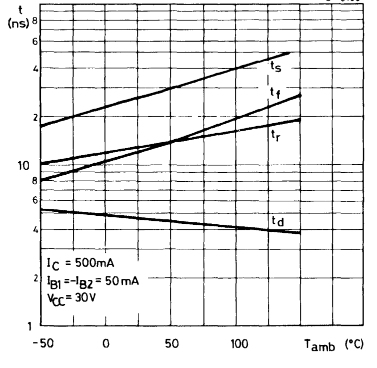
Contours of Constant Transition Frequency.



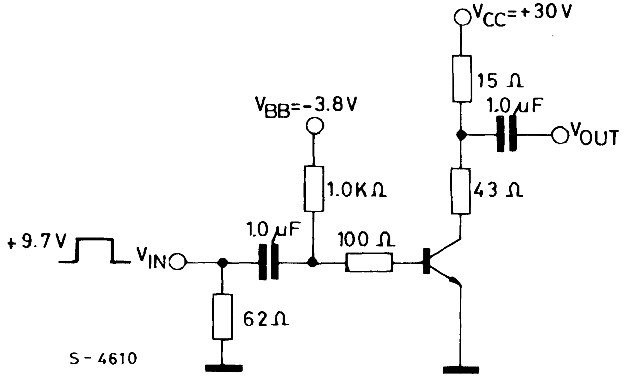
Switching Characteristics.



Switching Characteristics.



Test Circuit for t_{on}, t_{off}.



PULSE GENERATOR :
t_r, t_f < 1.0 ns
PW ≈ 1.0 μs
Z_{IN} = 50 Ω
DC < 2 %

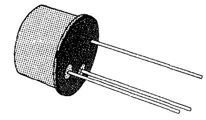
TO OSCILLOSCOPE :
t_r ≈ 1.0 ns
Z_{IN} > 100 KΩ

2N4030-2N4031 2N4032-2N4033

GENERAL PURPOSE AMPLIFIERS AND SWITCHES

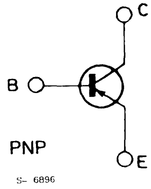
DESCRIPTION

The 2N4030, 2N4031, 2N4032, and 2N4033 are silicon planar epitaxial PNP transistors in Jedec TO-39 metal case primarily intended for large signal, low noise industrial applications.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		2N4030 2N4032	2N4031 2N4033	
V_{CBO}	Collector-base Voltage (I_E = 0)	– 60	– 80	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 60	– 80	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 5		V
I_C	Collector Current	– 1		A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.8 4		W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200		°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	44	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	218	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	For **2N4030** and **2N4032**				
		V_{CB} = – 50 V			– 50	nA
		V_{CB} = – 50 V T_{amb} = 150 °C			– 50	μA
		For **2N4031** and **2N4033**				
		V_{CB} = – 60 V			– 50	nA
		V_{CB} = – 60 V T_{amb} = 150 °C			– 50	μA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = – 10 μA				
		For **2N4030** and **2N4032**	– 60			V
		For **2N4031** and **2N4033**	– 80			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 10 mA				
		For **2N4030** and **2N4032**	– 60			V
		For **2N4031** and **2N4033**	– 80			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = –10 μA	– 5			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 150 mA I_B = – 15 mA			– 0.15	V
		I_C = – 500 mA I_B = – 50 mA			– 0.5	V
		I_C = – 1 A I_B = – 100 mA				
		For **2N4030** and **2N4032**			– 1	V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	I_C = – 150 mA I_B = – 15 mA			– 0.9	V
		I_C = – 500 mA I_B = – 50 mA			– 1.1	V
		I_C = – 1 A I_B = – 100 mA				
		For **2N4030** and **2N4032**			– 1.2	V
h_{FE}*	DC Current Gain	I_C = – 100 μA V_{CE} = – 5 V				
		For **2N4030** and **2N4031**	30			
		For **2N4032** and **2N4033**	75			
		I_C = – 100 mA V_{CE} = – 5 V				
		For **2N4030** and **2N4031**	40		120	
		For **2N4032** and **2N4033**	100		300	
		I_C = – 500 mA V_{CE} = – 5 V				
		For **2N4030** and **2N4031**	25			
		For **2N4032** and **2N4033**	70			
		I_C = – 1 A V_{CE} = – 5 V				
		For **2N4030**	15			
		For **2N4031**	10			
		For **2N4032**	40			
		For **2N4033**	25			
		I_C = – 100 mA V_{CE} = – 5 V				
		T_{amb} = – 55 °C				
		For **2N4030** and **2N4031**	15			
		For **2N4032** and **2N4033**	40			

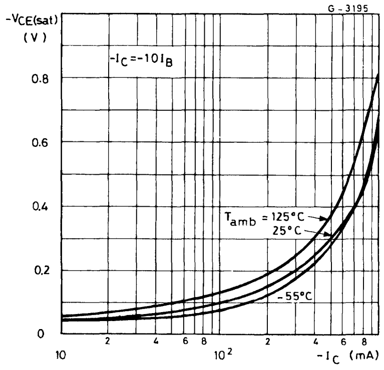
* Pulsed : pulse duration = 300 ms, duty cycle = 1 %.
** See test circuit.

ELECTRICAL CHARACTERISTICS (continued)

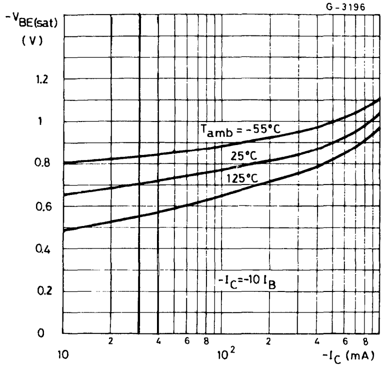
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
f_T	Transition Frequency	I_C = – 50 mA V_{CE} = – 10 V f = 100 MHz For **2N4030** and **2N4031** For **2N4032** and **2N4033**	 100 150		 400 500	 MHz MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = – 0.5 V f = 1 MHz			110	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 10 V f = 1 MHz			20	pF
t_s**	Storage Time	I_C = – 500 mA V_{CC} = – 30 V I_{B1} = – I_{B2} = – 50 mA			350	ns
t_f**	Fall Time	I_C = – 500 mA V_{CC} = – 30 V I_{B1} = – I_{B2} = – 50 mA			50	ns
t_{on}**	Turn-on Time	I_C = – 500 mA V_{CC} = – 30 V I_{B1} = – I_{B2} = – 50 mA			100	ns

* Pulsed : pulse duration = 300 ms, duty cycle = 1 %.
** See test circuit.

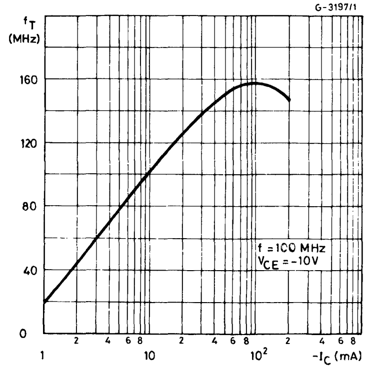
Collector-emitter Saturation Voltage.



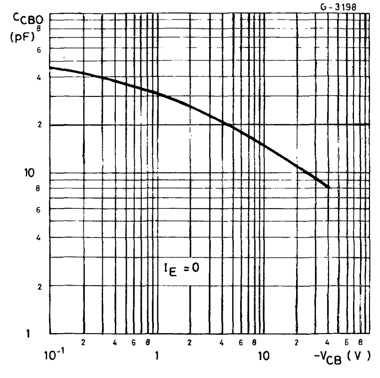
Base-emitter Saturation Voltage.



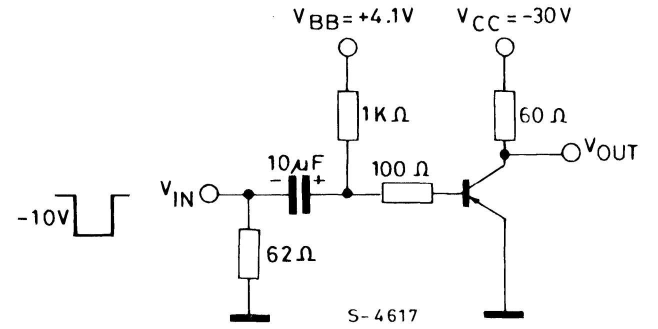
Transition Frequency.



Collector-base Capacitance.



Test Circuit for t_{on}, t_s, t_f.



PULSE GENERATOR :
t_r, t_f < 20 ns
PW = 1.0 µs
Z_{IN} = 50 Ω
DC < 2 %

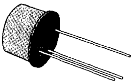
TO OSCILLOSCOPE :
t_r ≈ 10 ns
Z_{IN} > 100 KΩ

2N4035

GENERAL PURPOSE AMPLIFIERS AND SWITCHES

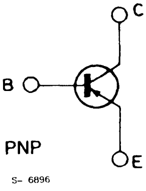
DESCRIPTION

The 2N4035 is a silicon planar epitaxial PNP transistors in Jedec TO-18 metal case, primarily intended for small signal, low noise industrial applications.



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	– 40	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 40	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 5	V
I_C	Collector Current	– 100	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	0.36 1	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	175	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	486	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	V_{CE} = – 30 V V_{CE} = – 30 V T_{amb} = 125 °C			– 15 – 15	nA µA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = – 10 µA	– 40			V
$V_{(BR)CES}$	Collector-emitter Breakdown Voltage (V_{BE} = 0)	I_C = – 10 µA	– 40			V
$V_{(BR)CEO}$*	Collector-Emitter Breakdown Voltage (I_B = 0)	I_C = – 10 mA	– 40			V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage (I_C = 0)	I_E = – 10 µA	– 5			V
$V_{CE(sat)}$*	Collector-Emitter Saturation Voltage	I_C = – 1 mA I_B = – 0.1 mA I_C = – 10 mA I_B = – 1 mA I_C = – 50 mA I_B = – 5 mA			– 0.13 – 0.14 – 0.3	V V V
$V_{BE(sat)}$*	Base-Emitter Saturation Voltage	I_C = – 1 mA I_B = – 0.1 mA I_C = – 10 mA I_B = – 1 mA I_C = – 50 mA I_B = – 5 mA	 – 0.7 		– 0.75 – 0.9 – 1.1	V V V
h_{FE}*	DC Current Gain	I_C = – 10 µA V_{CE} = – 1 V I_C = – 100 µA V_{CE} = – 1 V I_C = – 1 mA V_{CE} = – 1 V I_C = – 10 mA V_{CE} = – 1 V I_C = – 50 mA V_{CE} = – 1 V I_C = – 10 mA V_{CE} = – 1 V T_{amb} = – 55 °C	70 140 150 150 30 70		 300 	
h_{fe}	Small Signal Current Gain	I_C = – 1 mA V_{CE} = – 10 V f = 1 kHz	150		450	
f_T	Transition Frequency	I_C = – 10 mA V_{CE} = – 20 V f = 100 MHz	450			MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = – 0.5 V f = 1 MHz			5.5	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 10 V f = 1 MHz			3.5	pF
NF	Noise Figure	I_C = – 1 mA V_{CE} = – 5 V f = 100 MHz R_g = 100 Ω			6	dB
t_{on}	Turn-on Time	I_C = – 50 mA V_{CC} = – 30 V I_{B1} = – 5 mA			40	ns
t_{off}	Turn-off Time	I_C = – 50 mA V_{CC} = – 30 V I_{B1} = – I_{B2} = –5 mA			150	ns
h_{ie}	Input Impedance	I_C = – 1 mA V_{CE} = – 10 V f = 1 kHz	4		12	kΩ

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

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
h_{re}	Reverse Voltage Ratio	I_C = – 1 mA V_{CE} = – 10 V f = 1 kHz			$4x10^{-4}$	
h_{oe}	Output Admittance	I_C = – 1 mA V_{CE} = – 10 V f = 1 kHz	8		40	µS
$r_{bb'}C_{b'c}$	Feedback Time Constant	I_C = – 10 mA V_{CE} = – 20 V f = 80 MHz			40	ps

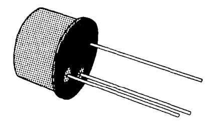
SGS-THOMSON
MICROELECTRONICS

2N4036

MEDIUM-SPEED SWITCH

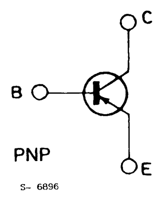
DESCRIPTION

The 2N4036 is a silicon planar epitaxial PNP transistor in Jedec TO-39 metal case. It is intended particularly as medium speed saturated switch and general purpose amplifier.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	– 90	V
V_{CEX}	Collector-emitter Voltage ($V_{BE} = 1.5$ V)	– 85	V
V_{CER}	Collector-emitter Voltage ($R_{BE} \leq 200\ \Omega$)	– 85	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	– 65	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	– 6	V
I_C	Collector Current	– 1	A
I_B	Base Current	– 0.5	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	1 7	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

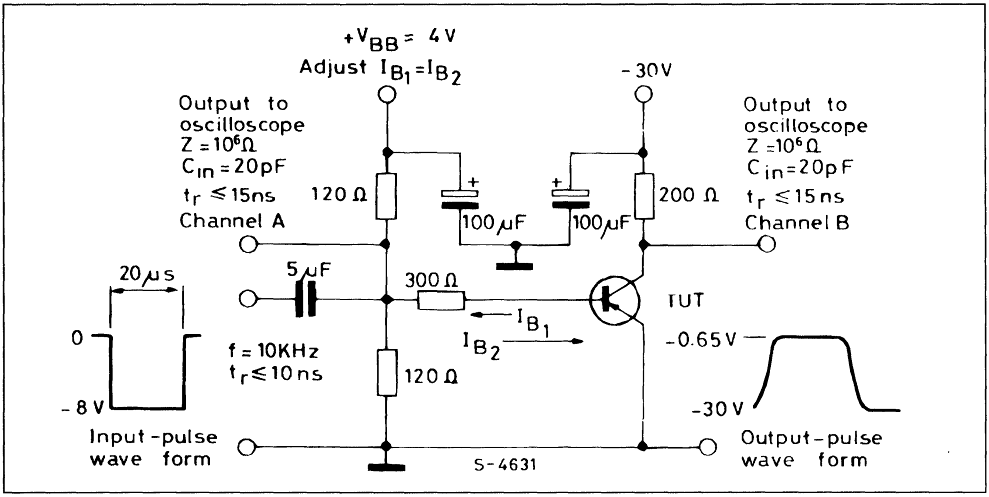
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	25	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = – 60 V			– 20	nA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = – 30 V			– 0.5	µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = – 5 V			– 20	nA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = – 100 µA	– 90			V
$V_{(BR)CEX}$*	Collector-emitter Breakdown Voltage (V_{BE} = 1.5 V)	I_C = – 10 mA	– 85			V
$V_{(BR)CER}$*	Collector-emitter Breakdown Voltage (R_{BE} = 200 Ω)	I_C = – 10 mA	– 85			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 10 mA	– 65			V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = – 100 µA	– 7			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 150 mA I_B = – 15 mA			– 0.65	V
V_{BE}*	Base-emitter Voltage	I_C = – 150 mA V_{CE} = – 10 V			– 1.1	V
h_{FE}*	DC Current Gain	I_C = – 0.1 mA V_{CE} = – 10 V I_C = – 150 mA V_{CE} = – 10 V I_C = – 500 mA V_{CE} = – 10 V	20 40 20		 140 	
f_T	Transition Frequency	I_C = – 50 mA V_{CE} = – 10 V f = 20 MHz	60			MHz
C_{EBO}	Emitter-base Capacitance	I_C = 0 V_{EB} = – 0.5 V f = 1 MHz			90	pF
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 10 V f = 1 MHz			30	pF
t_{on}**	Turn-on Time	I_C = – 150 mA V_{CC} = – 30V I_{B1} = – 15 mA			110	ns
t_{off}**	Turn-off Time	I_C = – 150 mA V_{CC} = – 30 V I_{B1} = – I_{B2} = – 15 mA			700	ns

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

Test Circuit for t_{on}, t_{off}.



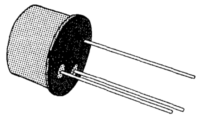
SGS-THOMSON
MICROELECTRONICS

2N4037

MEDIUM SPEED SWITCH

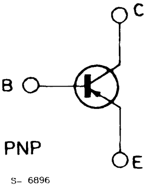
DESCRIPTION

The 2N4037 is a silicon planar epitaxial PNP transistor in a Jedec TO-39 metal case. It is intended particularly as medium speed saturated switch and general purpose amplifier.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	– 60	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	– 40	V
V_{CER}	Collector-emitter Voltage ($R_{BE} \leq 200\ \Omega$)	– 60	V
V_{CEV}	Collector-emitter Voltage ($V_{BE} = 1.5$ V)	– 60	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	– 6	V
I_C	Collector Current	– 1	A
I_B	Base Current	– 0.5	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C	7	W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	25	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = – 60 V			– 250	nA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = – 30 V			– 5	μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = – 5 V			– 1	μA
V_{EBO}	Emitter-base Voltage	I_E = – 100 μA I_C = 0	– 7			V
V_{CBO}	Collector-base Voltage (I_E = 0)	I_C = – 100 μA	– 60			V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 10 mA	– 40			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 150 mA I_B = – 15 mA			– 1.4	V
$V_{(BR)CEV}$*	Collector-emitter Breakdown Voltage	I_C = – 10 mA V_{BE} = 1.5 V	– 60			V
$V_{(BR)CER}$*	Collector-emitter Breakdown Voltage	I_C = – 10 mA R_{BE} = 200 Ω	– 60			V
V_{BE}*	Base-emitter Voltage	I_C = – 150 mA V_{CE} = – 10 V			– 1.5	V
h_{FE}*	DC Current Gain	I_C = – 1 mA V_{CE} = – 10 V I_C = – 150 mA V_{CE} = – 10 V	15 50		 250	
h_{fe}	Small Signal Current Gain	I_C = – 50 mA V_{CE} = – 10 V f = 20 MHz	3			
C_{CBO}	Collector-base Capacitance (I_E = 0)	V_{CB} = – 10 V			30	pF
C_{EBO}	Emitter-base Capacitance (I_E = 0)	V_{EB} = – 0.5 V			90	pF

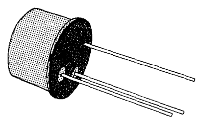
* Pulsed : pulse duration = 300 μs, duty cycle = 1,5 %.

2N4427
BFR98

VHF OSCILLATOR POWER AMPLIFIER

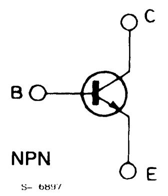
DESCRIPTION

The 2N4427 and BFR98 are silicon planar epitaxial NPN transistor in Jedec TO-39 metal case. They are designed for VHF class A, B, or C amplifier and oscillator applications.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	40	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	20	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	3.5	V
I_C	Collector Current	0.5	A
P_{tot}	Total Power Dissipation at $T_{case} \leq 25$ °C	3.5	W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

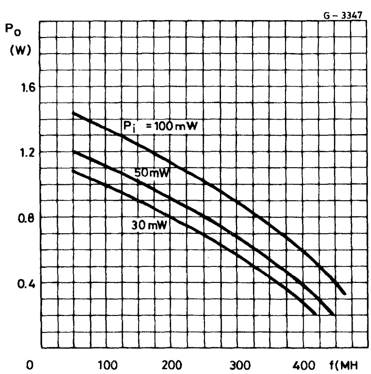
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	50	°C/W

ELECTRICAL CHARACTERISITCS (T_{amb} = 25 °C unless otherwise specified)

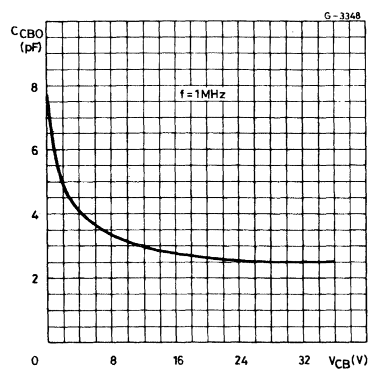
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 12 V			20	µA
$V_{(BR)CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 100 µA	40			V
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 5 mA	20			V
$V_{CER(sus)}$*	Collector-Emitter Sustaining Voltage (R_{BE} = 10 Ω)	I_C = 5 mA	40			V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage (I_C = 0)	I_E =100 µA	3.5			V
$V_{CE(sat)}$*	Collector-Emitter Saturation Voltage	I_C =100 mA I_B = 20 mA			0.5	V
h_{FE}*	DC Current Gain	I_C =100 mA V_{CE} = 5 V I_C = 360 mA V_{CE} = 5 V	10 5		200	
f_T	Transition Frequency	I_C = 50 mA V_{CE} = 15 V f = 200 MHz	500			MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 12 V f = 1 MHz			4	pF
P_o**	Output Power	V_{CC} = 12 V P_I = 100 mW f = 175 MHz	1			W
η**	Collector Efficiency	V_{CC} = 12 V P_o = 1 W f = 175 MHz	50			%

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

RF Output Power.

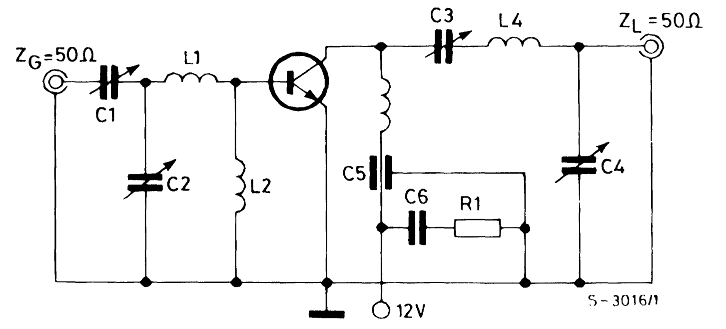


Collector-base Capacitance.



TEST CIRCUIT

Test Circuit for Power Output Measurement (f = 175 MHz).



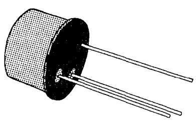
C1, C2, C3, C4	=	3 ÷ 30 pF	L1 = 2 turns 16 wire, 3/16" ID, 1/4" long
C5	=	1000 pF	L2 = ferrite choke, Z = 450 W
C6	=	20 kpF	L3 = 2 turns 16 wire, 1/4" ID, 1/4" long
R1	=	10 W	L4 = 4 turns 16 wire, 3/8" ID, 3/8" long

2N5109

EPITAXIAL PLANAR NPN

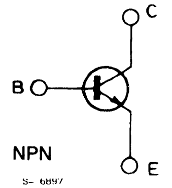
CATV ULTRA-LINEAR HIGH GAIN TRANSISTOR

The 2N5109 is a multi-emitter silicon planar epitaxial NPN transistor in Jedec TO-39 metal case. It is designed for CATV-MATV amplifier applications over a wide frequency range (40 to 860 MHz).



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	40	V
V_{CER}	Collector-emitter Voltage ($R_{BE} \leq 10\ \Omega$)	40	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	20	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	3	V
I_C	Collector Current	0.4	A
I_B	Base Current	0.4	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 75$ °C	1 2.5	W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	175	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	50	°C/W

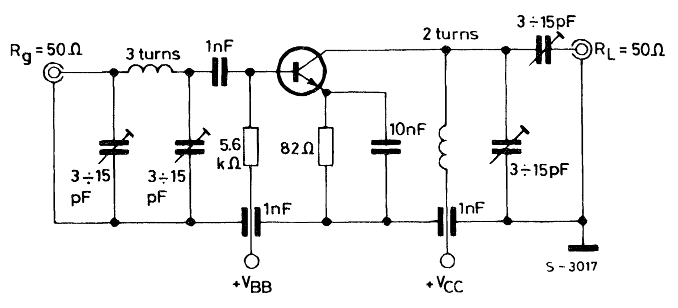
ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEX}	Collector Cutoff Current (V_{BE} = – 1.5 V)	V_{CE} = 35 V V_{CE} = 15 V T_{amb} = 150 °C			5 5	mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = 15 V			20	μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 3 V			0.1	mA
$V_{(BR)\ CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 0.1 mA	40			V
$V_{CER\ (sus)}$ *	Collector-emitter Sustaining Voltage (R_{BE} = 10 Ω)	I_C = 5 mA	40			V
$V_{CEO\ (sus)}$	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 5 mA	20			V
$V_{CE\ (sat)}$	Collector-emitter Saturation Voltage	I_C = 100 mA I_B = 10 mA			0.5	V
h_{FE} *	DC Current Gain	I_C = 50 mA V_{CE} = 15 V I_C = 360 mA V_{CE} = 5 V	70 5		210	
f_T	Transition Frequency	I_C = 50 mA V_{CE} = 15 V f = 200 MHz	1.2			GHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = 15 V f = 1 MHz			3.5	pF
NF	Noise Figure	I_C = 10 mA V_{CE} = 15 V R_g = 50 Ω f = 200 MHz		3		dB
G_{pe}	Power Gain (see test circuit)	I_C = 10 mA V_{CE} = 15 V f = 200 MHz P_i = – 10 dBm	11			dB

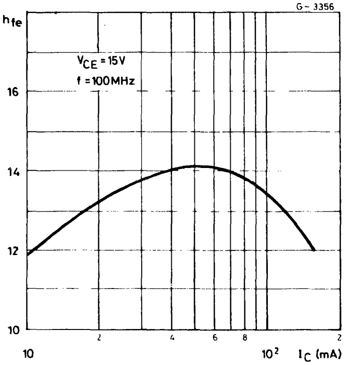
* Pulsed : pulse duration = 300 μs, duty cycle = 1 %.

TEST CIRCUIT

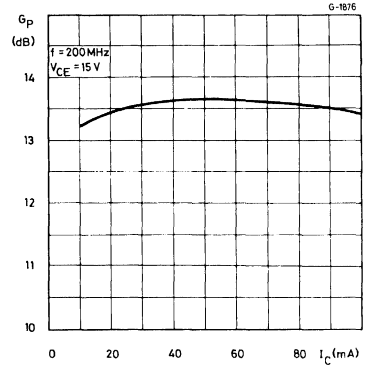
Test Circuit for Power Gain Measurement (f = 200 MHz).



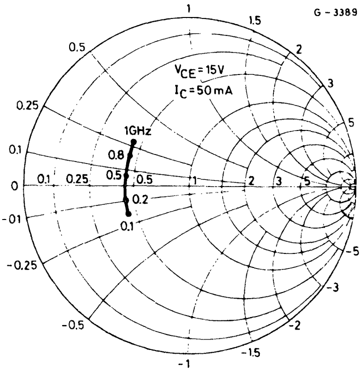
High Frequency Current Gain.



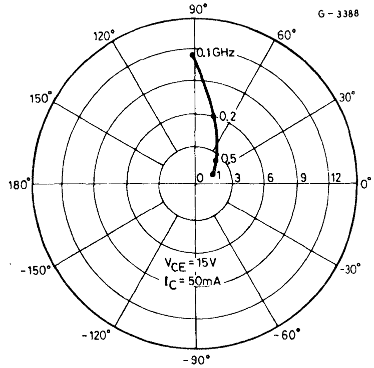
Power Gain vs. Collector Current.



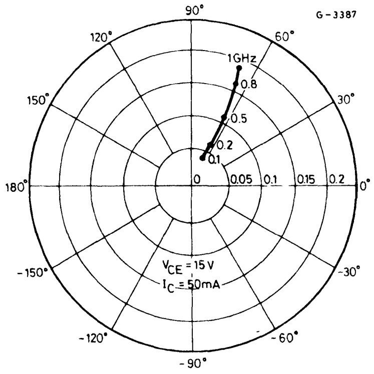
Input Impedance S_{11e} (normalized 50 Ω).



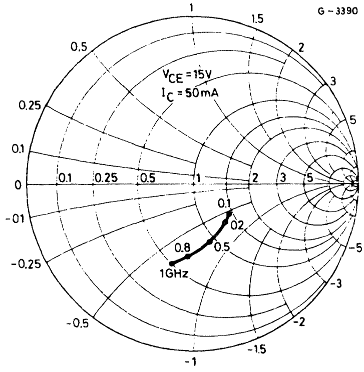
Forward Transfer Coefficient S_{21e}.



Reverse Transfer Coefficient S_{12e}.



Output Impedance S_{22e} (normalized 50 Ω).

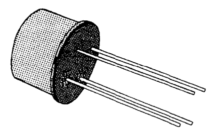


2N5179

VHF/UHF AMPLIFIER

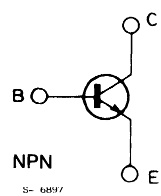
DESCRIPTION

The 2N5179 is a silicon planar epitaxial NPN transistor in Jedec TO-72 metal case, intended for low-noise tuned-amplifier and converter applications up to 500 MHz.



TO-72

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	20	V
V_{CEO}	Collector-ermitter Voltage (I_B = 0)	12	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	2.5	V
I_C	Collector Current	50	mA
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	200 300	mW mW
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	583	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	875	°C/W

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

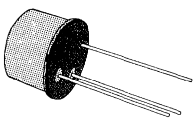
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = 15 V V_{CB} = 15 V T_{amb} = 150 °C			20 1	nA µA
$V_{(BR)\ CBO}$	Collector-base Breakdown Voltage (I_E = 0)	I_C = 1 µA	20			V
$V_{CEO(sus)}$	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 3 mA	12			V
$V_{(BR)EBO}$ *	Emitter-base Breakdown Voltage (I_C = 0)	I_E = 10 µA	2.5			V
$V_{CE\ (sat)}$	Collector-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA			0.4	V
$V_{BE(sat)}$	Base-emitter Saturation Voltage	I_C = 10 mA I_B = 1 mA			1	V
h_{FE}	DC Current Gain	I_C = 3 mA V_{CE} = 1 V	25	70	250	
h_{fe}	Small Signal Current Gain	I_C = 2 mA V_{CE} = 6 V f = 1 kHz	25	90	300	
f_T	Transition Frequency	I_C = 5 mA V_{CE} = 6 V f = 100 MHz	0.9	1.4	2	GHz
C_{re}	Reverse Capacitance	I_C = 0 V_{CE} = 6 V f = 1 MHz		0.7	1	pF
NF	Noise Figure	I_C = 1.5 mA V_{CE} = 6 V f = 200 MHz R_g = 125 Ω		3	4.5	dB
G_{pe}	Power Gain (neutralized)	I_C = 5 mA V_{CE} = 12 V f = 200 MHz R_g = 50 Ω	15	21		dB
P_o	Oscillator Power Output	I_C = 12 mA V_{CB} = 10 V f = 500 MHz	20			mW
$r_{bb'}C_{b'c}$	Feedback Time Constant	I_C = 2 mA V_{CB} = 6 V f = 31.9 MHz	3	7	14	ps

MEDIUM-POWER AMPLIFIERS

DESCRIPTION

The 2N5320 and 2N5321 are silicon planar epitaxial NPN transistors in Jedec TO-39 metal case. They are especially intended for high-voltage medium power applications in industrial and commercial equipments.

The complementary PNP types are respectively the 2N5322 and 2N5323.



TO-39

INTERNAL SCHEMATIC DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		2N 5320	2N 5321	
V_{CBO}	Collector-base Voltage (I_E = 0)	100	75	V
V_{CEV}	Collector-emitter Voltage (V_{BE} = 1.5 V)	100	75	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	75	50	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	6	5	V
I_C	Collector Current	2		A
I_B	Base Current	1		A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	1 10		W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200		°C

THERMAL DATA

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

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	For **2N5320** V_{CB} = 80 V For **2N5321** V_{CB} = 60 V			0.5 5	μA μA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	For **2N5320** V_{EB} = 5 V For **2N5321** V_{EB} = 4 V		0.1 0.5		μA μA
$V_{(BR)CEV}$	Collector-emitter Breakdown Voltage (V_{BE} = 1.5 V)	I_C = 0.1 mA For **2N5320** For **2N5321**	100 75			V V
$V_{(BR)CEO}$*	Collector-Emitter Breakdown Voltage (I_B = 0)	I_C = 10 mA For **2N5320** For **2N5321**	75 50			V V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage (I_C = 0)	I_E = 0.1 mA For **2N5320** For **2N5321**	6 5			V V
$V_{CE(sat)}$*	Collector-Emitter Saturation Voltage	I_C = 500 mA I_B = 50 mA For **2N5320** For **2N5321**			0.5 0.8	V V
V_{BE}*	Base-Emitter Voltage	I_C = 500 mA V_{CE} = 4 V For **2N5320** For **2N5321**			1.1 1.4	V V
h_{FE}*	DC Current Gain	For **2N5320** I_C = 500 mA V_{CE} = 4 V I_C = 1 A V_{CE} = 2 V For **2N5321** I_C = 500 mA V_{CE} = 4 V	30 10 40		130 250	
f_T	Transition Frequency	I_C = 50 mA V_{CE} = 4 V f = 10 MHz	50			MHz
t_{on}	Turn-on Time	I_C = 500 mA V_{CC} = 30 V I_{B1} = 50 mA			80	ns
t_{off}	Turn-off Time	I_C = 500 mA V_{CC} = 30 V I_{B1} = − I_{B2} = 50 mA			800	ns

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

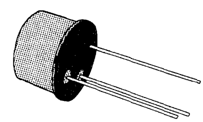
SGS-THOMSON MICROELECTRONICS

2N5322 2N5323

MEDIUM-POWER AMPLIFIERS

DESCRIPTION

The 2N5322 and 2N5323 are silicon planar epitaxial PNP transistors in Jedec TO-39 metal case. They are especially intended for high-voltage medium power applications in industrial and commercial equipments.



TO-39

INTERNAL SCHEMATIC DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		2N5322	2N5323	
V_{CBO}	Collector-base Voltage (I_E = 0)	– 100	– 75	V
V_{CEV}	Collector-emitter Voltage (V_{BE} = 1.5 V)	– 100	– 75	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 75	– 50	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 6	– 5	V
I_C	Collector Current	– 2		A
I_B	Base Current	– 1		A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	1 10		W W
T_{stg}, T_j	Storage and Junction Temperature	– 65 to 200		°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	17.5	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	For **2N5322** V_{CB} = – 80 V For **2N5323** V_{CB} = – 60 V			– 0.5 – 5	µA µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	For **2N5322** V_{EB} = – 5 V For **2N5323** V_{EB} = – 4 V		– 0.1 – 0.5		µA µA
$V_{(BR)CEV}$	Collector-emitter Breakdown Voltage (V_{BE} = 1.5 V)	I_C = – 0.1 mA For **2N5322** For **2N5323**	– 100 – 75			V V
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 10 mA For **2N5322** For **2N5323**	– 75 – 50			V V
$V_{(BR)EBO}$	Emitter-base Breakdown Voltage (I_C = 0)	I_E = –0.1 mA For **2N5322** For **2N5323**	– 6 – 5			V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 500 mA I_B = – 50 mA For **2N5322** For **2N5323**			– 0.7 – 1.2	V V
V_{BE}*	Base-emitter Voltage	I_C = – 500 mA V_{CE} = – 4 V For **2N5322** For **2N5323**			– 1.1 – 1.4	V V
h_{FE}*	DC Current Gain	For **2N5322** I_C = – 500 mA V_{CE} = – 4 V I_C = – 1 A V_{CE} = – 2 V For **2N5323** I_C = – 500 mA V_{CE} = – 4 V	30 10 40		130 250	
f_T	Transition Frequency	I_C = – 50 mA V_{CE} = – 4 V f = 10 MHz	50			MHz
t_{on}	Turn-on Time	I_C = – 500 mA V_{CC} = – 30 V I_{B1} = – 50 mA			100	ns
t_{off}	Turn-off Time	I_C = – 500 mA V_{CC} = – 30 V I_{B1} = – I_{B2} = –50 mA			1000	ns

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

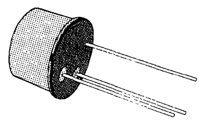
SGS-THOMSON
MICROELECTRONICS

2N5415S

HIGH-VOLTAGE AMPLIFIER

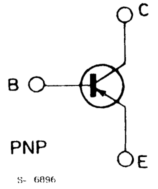
DESCRIPTION

The 2N5415S is a silicon planar epitaxial PNP transistor in Jedec TO-39 metal case, intended for high vol-tage switching and linear amplifier applications.



TO-39

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage (I_E = 0)	– 200	V
V_{CEO}	Collector-emitter Voltage (I_B = 0)	– 200	V
V_{EBO}	Emitter-base Voltage (I_C = 0)	– 4	V
I_{CM}	Collector Peak Current	– 1	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25$ °C at $T_{case} \leq 25$ °C	1 10	W W
T_{stg}, T_j	Storage and Junction Temperature	– 55 to 200	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	17.5	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	175	°C/W

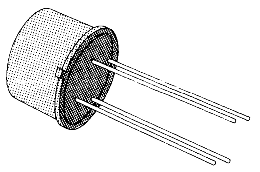
ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current (I_E = 0)	V_{CB} = – 175 V			– 50	µA
I_{CEO}	Collector Cutoff Current (I_B = 0)	V_{CE} = – 150 V			– 50	µA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = – 4 V			– 20	µA
$V_{(BR)CEO}$*	Collector-emitter Breakdown Voltage (I_B = 0)	I_C = – 2 mA	– 200			V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	I_C = – 50 mA I_B = – 5 mA			– 2.5	V
V_{BE}*	Base-Emitter Voltage	I_C = – 50 mA V_{CE} = – 10 V			– 1.5	V
h_{FE}*	DC Current Gain	I_C = – 50 mA V_{CE} = – 10 V	30		150	
f_T	Transition Frequency	I_C = – 10 mA V_{CE} = – 10 V f = 5 MHz	15			MHz
C_{CBO}	Collector-base Capacitance	I_E = 0 V_{CB} = – 10 V f = 1 MHz			15	pF

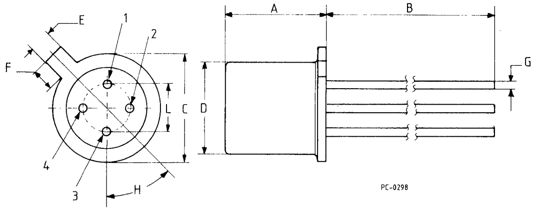
* Pulsed : pulse duration = 300 µs, duty cycle = 1 %.

PACKAGES

TO-72



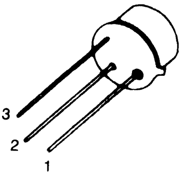
MECHANICAL DATA



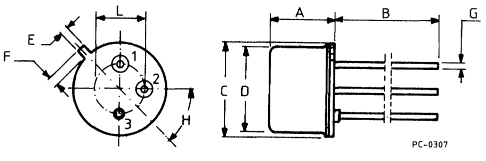
	DIMENSIONS			
	mm		inches	
	min	max	min	max
A	—	5.3	—	0.208
B	12.7	—	0.500	—
C	—	5.8	—	0.228
D	—	4.9	—	0.193
E	—	1.16	—	0.045
G	—	0.49	—	0.019
H	typ. 45°		typ. 45°	
L	typ. 2.54		typ. 0.100	

pin 1: EMITTER - pin 2: BASE
pin 3: COLLECTOR - pin 4: SHIELD

TO-39



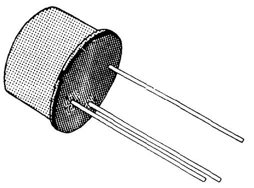
MECHANICAL DATA



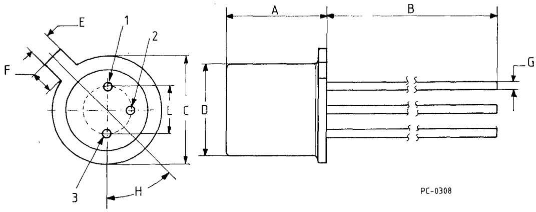
	DIMENSIONS			
	mm		inches	
	min	max	min	max
A	—	6.6	—	0.260
B	12.7	—	0.500	—
C	—	9.4	—	0.370
D	—	8.5	—	0.334
E	—	0.9	—	0.035
F	—	1.2	—	0.047
G	—	0.49	—	0.019
H	45° typ		45° typ	
L	5.08 typ		0.200 typ	

pin 1: Emitter - pin 2: Base - pin 3: Collector

TO-18



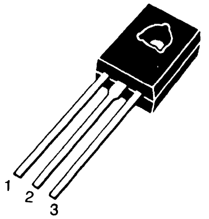
MECHANICAL DATA



	DIMENSIONS			
	mm		inches	
	min	max	min	max
A	—	5.3	—	0.208
B	12.7	—	0.500	—
C	—	5.8	—	0.228
D	—	4.9	—	0.193
E	—	1.16	—	0.045
G	—	0.49	—	0.019
H	typ. 45°		typ. 45°	
L	typ. 2.54		typ. 0.100	

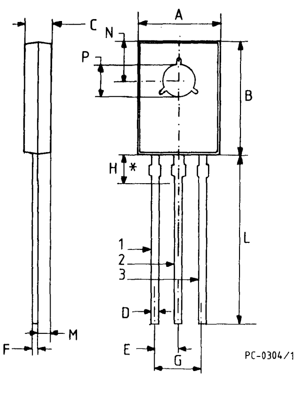
pin 1: Emitter - pin 2: Base - pin 3: Collector

SOT-32



MINIATURE PACKAGE WITH REVERSED TO-220 PINOUT

MECHANICAL DATA

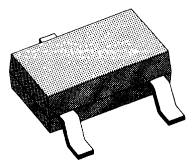


*: WITHIN THIS REGION THE CROSS-SECTION OF THE LEADS IS UNCONTROLLED

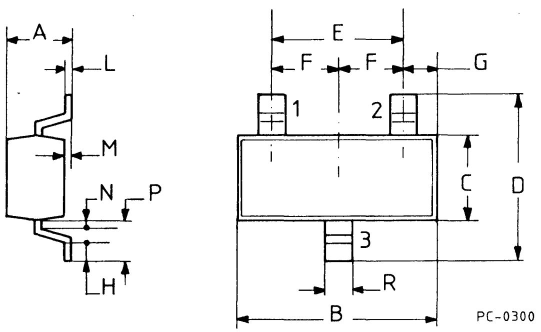
	DIMENSIONS			
	mm		inches	
	min	max	min	max
A	7.4	7.8	0.295	0.307
B	10.5	10.8	0.413	0.425
C	2.4	2.7	0.094	0.106
D	0.7	0.9	0.027	0.035
E	2.2 typ.		0.087 typ.	
F	0.49	0.75	0.019	0.029
G	4.4 typ.		0.173 typ.	
H	2.54 typ.		0.100 typ.	
L	15.7 typ.		0.618 typ.	
M	1.2 typ.		0.047 typ.	
N	3.8 typ.		0.149 typ.	
P	3.0	3.2	0.118	0.126

pin 1: Emitter - pin 2: Collector - pin 3: Base

SOT-23



MECHANICAL DATA



	DIMENSIONS			
	mm		inches	
	min	max	min	max
A	0.93	1.04	0.036	0.041
B	2.8	3	0.110	0.118
C	1.2	1.4	0.047	0.055
D	2.1	2.5	0.082	0.098
E	1.9	2.05	0.074	0.080
F	0.95	1.05	0.037	0.041
G	0.45	0.60	0.017	0.023
H	0.15	—	0.006	—
L	0.065	0.115	0.003	0.004
M	0.013	0.1	0.0005	0.004
N	0.06	—	0.003	—
P	0.45	0.6	0.017	0.023
R	0.37	0.46	0.014	0.018

pin 1: Emitter - pin 2: Base - pin 3: Collector

NOTES

NOTES

NOTES

NOTES

EUROPE

DENMARK

2730 HERLEV
Herlev Torv, 4
Tel. (45-42) 94.85.33
Telex: 35411
Telefax: (45-42) 948694

FINLAND

LOHJA SF-08150
Karjalankatu, 2
Tel. 12.155.11
Telefax. 12.155.66

FRANCE

94253 GENTILLY Cedex
7 - avenue Gallieni - BP. 93
Tel.: (33-1) 47.40.75.75
Telex: 632570 STMHQ
Telefax: (33-1) 47.40.79.10

67000 STRASBOURG
20, Place des Halles
Tel. (33) 88.75.50.66
Telex: 870001F
Telefax: (33) 88.22.29.32

GERMANY

6000 FRANKFURT
Gutleutstrabe 322
Tel. (49-69) 237492
Telex: 176997 689
Telefax: (49-69) 231957
Teletex: 6997689=STVBP

8011 GRASBRUNN
Bretonischer Ring 4
Neukeferloh Technopark
Tel.: (49-89) 46006-0
Telex: 528211
Telefax: (49-89) 4605454
Teletex: 897107=STDISTR

3000 HANNOVER 1
Eckenerstrasse 5
Tel. (49-511) 634191
Telex 175118418
Teletex: 5118418 csfbeh
Telefax: (49-511) 633552

8500 NÜRNBERG 20
Erlenstegenstrasse, 72
Tel.: (49-911) 59893-0
Telex: 626243
Telefax: (49-911) 5980701

5200 SIEGBURG
Frankfurter Str. 22a
Tel. (49-2241) 660 84-86
Telex: 889510
Telefax: (49-2241) 67584

7000 STUTTGART
Oberer Kirchhaldenweg 135
Tel. (49-711) 692041
Telex: 721718
Telefax: (49-711) 691408

ITALY

20090 ASSAGO (MI)
V.le Milanofiori - Strada 4 - Palazzo A/4/A
Tel. (39-2) 89213.1 (10 linee)
Telex: 330131 - 330141 SGSAGR
Telefax: (39-2) 8250449

40033 CASALECCHIO DI RENO (BO)
Via R. Fucini, 12
Tel. (39-51) 591914
Telex: 512442
Telefax: (39-51) 591305

00161 ROMA
Via A. Torlonia, 15
Tel. (39-6) 8443341
Telex: 620653 SGSATE I
Telefax: (39-6) 8444474

NETHERLANDS

5652 AR EINDHOVEN
Meerenakkerweg 1
Tel.: (31-40) 550015
Telex: 51186
Telefax: (31-40) 528835

SPAIN

08021 BARCELONA
Calle Platon, 6 4th Floor, 5th Door
Tel. (34-3) 4143300-4143361
Telefax: (34-3) 2021461

28027 MADRID
Calle Albacete, 5
Tel. (34-1) 4051615
Telex: 27060 TCCEE
Telefax: (34-1) 4031134

SWEDEN

S-16421 KISTA
Borgarfjordsgatan, 13 - Box 1094
Tel.: (46-8) 7939220
Telex: 12078 THSWS
Telefax: (46-8) 7504950

SWITZERLAND

1218 GRAND-SACONNEX (GENEVA)
Chemin Francois-Lehmann, 18/A
Tel. (41-22) 7986462
Telex: 415493 STM CH
Telefax: (41-22) 7984869

UNITED KINGDOM and EIRE

MARLOW, BUCKS
Planar House, Parkway
Globe Park
Tel.: (44-628) 890800
Telex: 847458
Telefax: (44-628) 890391

AMERICAS

BRAZIL

05413 SÃO PAULO
R. Henrique Schaumann 286-CJ33
Tel. (55-11) 883-5455
Telex: (391)11-37988 "UMBR BR"
Telefax : 11-551-128-22367

CANADA

BRAMPTON, ONTARIO
341 Main St. North
Tel. (416) 455-0505
Telefax: 416-455-2606

U.S.A.

NORTH & SOUTH AMERICAN
MARKETING HEADQUARTERS
1000 East Bell Road
Phoenix, AZ 85022
(1)-(602) 867-6100

SALES COVERAGE BY STATE

ALABAMA
Huntsville - (205) 533-5995

ARIZONA
Phoenix - (602) 867-6340

CALIFORNIA
Santa Ana - (714) 957-6018
San Jose - (408) 452-8585

COLORADO
Boulder (303) 449-9000

ILLINOIS
Schaumburg - (708) 517-1890

INDIANA
Kokomo - (317) 459-4700

MASSACHUSETTS
Lincoln - (617) 259-0300

MICHIGAN
Livonia - (313) 462-4030

NEW JERSEY
Voorhees - (609) 772-6222

NEW YORK
Poughkeepsie - (914) 454-8813

NORTH CAROLINA
Raleigh - (919) 787-6555

TEXAS
Carrollton - (214) 466-8844

FOR RF AND MICROWAVE
POWER TRANSISTORS CON-
TACT
THE FOLLOWING REGIONAL
OFFICE IN THE U.S.A.

PENNSYLVANIA
Montgomeryville - (215) 362-8500

ASIA / PACIFIC

AUSTRALIA

NSW 2027 EDGECLIFF
Suite 211, Edgecliff centre
203-233, New South Head Road
Tel. (61-2) 327.39.22
Telex: 071 126911 TCAUS
Telefax: (61-2) 327.61.76

CHINA

BEIJING
Liason Office
Beijing No. 5 Semiconductor
Device Factory
14 Wu Lu Tong Road
Da Sheng Man Wai
Tel. (861) 2024378
Telex 222722 STM CH

HONG KONG

WANCHAI
22nd Floor - Hopewell centre
183 Queen's Road East
Tel. (852-5) 8615788
Telex: 60955 ESGIES HX
Telefax: (852-5) 8656589

INDIA

NEW DELHI 110001
LiasonOffice
62, Upper Ground Floor
World Trade Centre
Barakhamba Lane
Tel. 3715191
Telex: 031-66816 STMI IN
Telefax: 3715192

MALAYSIA

PULAU PINANG 10400
4th Floor - Suite 4-03
Bangunan FOP-123D Jalan Anson
Tel. (04) 379735
Telefax (04) 379816

KOREA

SEOUL 121
8th floor Shinwon Building
823-14, Yuksam-Dong
Kang-Nam-Gu
Tel. (82-2) 553-0399
Telex: SGSKOR K29998
Telefax: (82-2) 552-1051

SINGAPORE

SINGAPORE 2056
28 Ang Mo Kio - Industrial Park 2
Tel. (65) 4821411
Telex: RS 55201 ESGIES
Telefax: (65) 4820240

TAIWAN

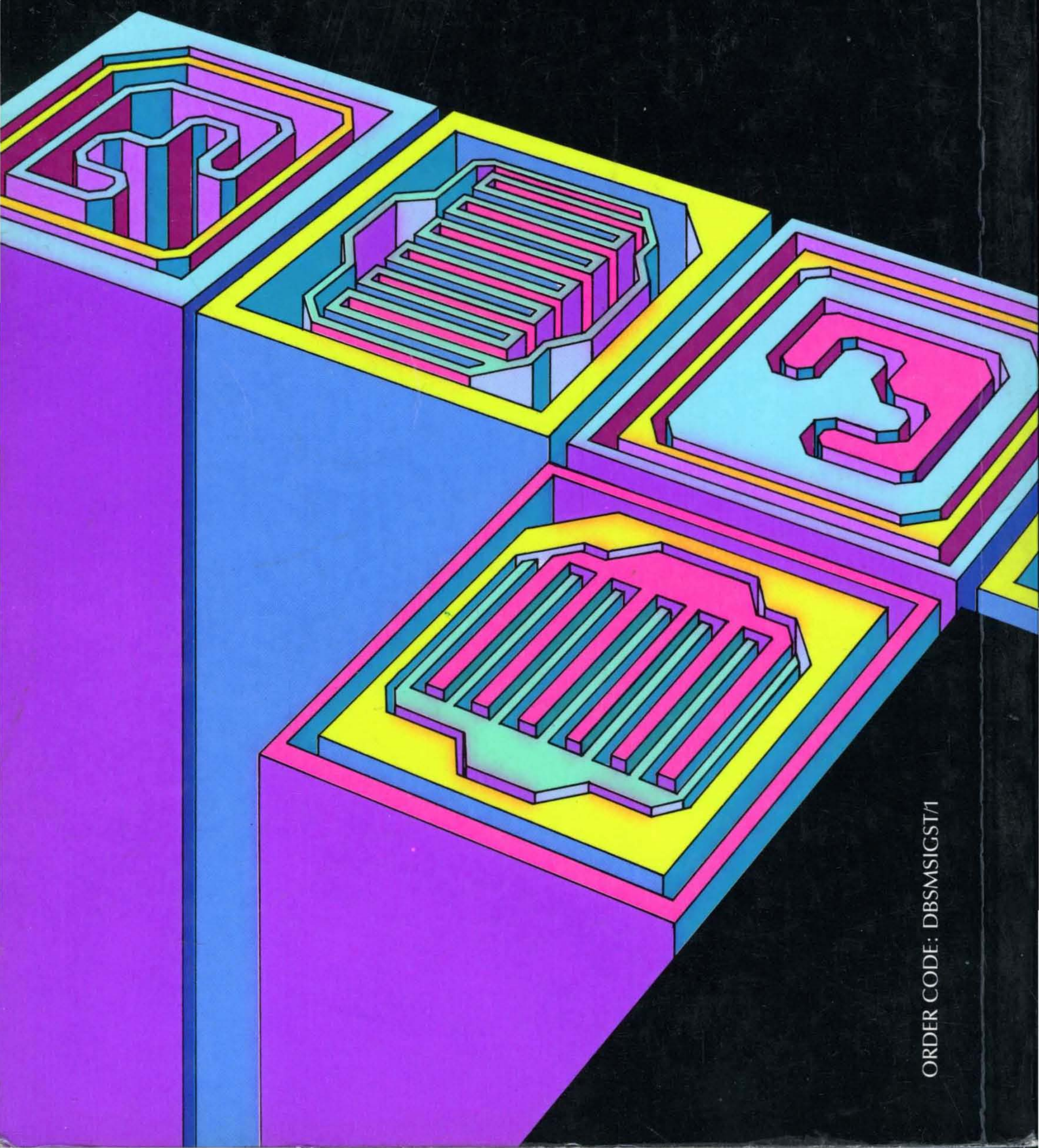
TAIPEI
12th Floor
571, Tun Hua South Road
Tel. (886-2) 755-4111
Telex: 10310 ESGIE TW
Telefax: (886-2) 755-4008

JAPAN

TOKYO 108
Nisseki - Takanawa Bld. 4F
2-18-10 Takanawa
Minato-Ku
Tel. (81-3) 280-4121
Telefax: (81-3) 280-4131

Cover design by Keit & Koppel, Segrate, Italy
Typesetting and layout on Desk Top Publishing
by AZIMUT, Hénin Bt., France
Printed by Garzanti, Cernusco S./N., Italy

SGS-THOMSON Microelectronics GROUP OF COMPANIES
Australia - Brazil - China - France - Germany - Hong Kong - Italy - Japan - Korea - Malaysia - Malta - Morocco - The Netherlands - Singapore - Spain - Sweden - Switzerland - Taiwan - United Kingdom - U.S.A.



ORDER CODE: DBSMSIGST/1