

**SIEMENS**

**Discrete Semiconductors  
for Surface Mounting**

**Data Book 1985/86**

# Table of Contents

---

	Page
<b>Summary of types</b> . . . . .	6
Schottky diodes . . . . .	6
Switching diodes . . . . .	6
Tuning diodes . . . . .	6
PIN diodes . . . . .	7
MOSFETs . . . . .	7
RF transistors . . . . .	7
Switching transistors . . . . .	7
High voltage transistors . . . . .	8
SIPMOS small-signal transistors . . . . .	8
Darlington transistors . . . . .	8
AF transistors . . . . .	9
RF broadband transistors . . . . .	9
LEDs . . . . .	10
Position sensors . . . . .	10
Temperature sensors . . . . .	10
<b>Index of ordering codes</b> . . . . .	12
<b>Marking system</b> . . . . .	16
<b>Cross reference index</b> . . . . .	18
<b>Technical information</b> . . . . .	20
<b>Symbols and terms</b> . . . . .	20
<b>Maximum ratings</b> . . . . .	24
<b>Characteristics</b> . . . . .	24
<b>Thermal resistance</b> . . . . .	24
Methods for measuring the temperature of component connections . . . . .	26
<b>Packages</b> . . . . .	27
<b>Quality</b> . . . . .	28
Explanations . . . . .	28
Definition of defects . . . . .	28
Inoperatives . . . . .	28
Remaining defects . . . . .	28
AQL values . . . . .	28
Incoming inspection . . . . .	29
Sampling plan . . . . .	29

	Page
<b>Mounting instructions</b> . . . . .	33
<b>Available packages for surface mounting</b> . . . . .	33
<b>Bulk goods</b> . . . . .	33
Packaging units . . . . .	33
<b>Taped versions</b> . . . . .	33
<b>Blister tape</b> . . . . .	34
Tabulated blister tape dimensions . . . . .	35
Polarity and orientation of components . . . . .	36
Fixing of components . . . . .	37
Storage of tapes . . . . .	37
Break force of fixing tape . . . . .	37
Peel force of fixing tape . . . . .	37
Peel speed of fixing tape . . . . .	37
Reel dimensions . . . . .	37
Packaging units . . . . .	38
Labelling . . . . .	38
Missing components . . . . .	38
Leader and trailer . . . . .	38
Tape packaging of ESD components . . . . .	38
<b>PCB layout</b> . . . . .	39
Recommended minimum solder area dimensions . . . . .	39
Recommended mounting position for wave soldering . . . . .	39
<b>Glueing</b> . . . . .	40
<b>Soldering methods</b> . . . . .	40
Wave soldering . . . . .	40
Reflow soldering . . . . .	41
Iron soldering . . . . .	41
Soldering flux . . . . .	41
PCB cleaning . . . . .	42
<b>Diodes</b> . . . . .	43
<b>Transistors</b> . . . . .	111
<b>LEDs</b> . . . . .	417
<b>Sensors</b> . . . . .	423
<b>Siemens Offices</b> . . . . .	431

## Summary of Types

### Schottky diodes

Type	$V_R$ V	$I_F$ mA	$T_j$ °C	$P_{tot}$ mW	$V_F$ mV	$V_{(BR)}$ V	$I_R$ nA	Page
BAS 40-04	40	> 40	150	100	< 380	> 40	< 1000	67
BAS 40-05	40	> 40	150	100	< 380	> 40	< 1000	67
BAS 40-06	40	> 40	150	100	< 380	> 40	< 1000	67
BAS 70-04	70	> 15	150	100	< 410	> 70	< 200	69
BAS 70-05	70	> 15	150	100	< 410	> 70	< 200	69
BAS 70-06	70	> 15	150	100	< 410	> 70	< 200	69
BAT 17	4	30	150	-	< 600	> 4	< 1250	71

### Switching diodes

Type	$V_R$ V	$I_F$ mA	$T_j$ °C	$P_{tot}$ mW	$V_F$ V	$I_F$ mA	$t_{rr}$ ns	Page
BAL 74	50	250	175	330	≤ 1,0	100	≤ 4	44
BAL 99	70	250	175	330	≤ 1,25	150	≤ 6	48
BAR 74	50	250	175	330	≤ 1,0	100	≤ 4	55
BAR 99	70	250	175	330	≤ 1,25	150	≤ 6	59
BAS 16	75	250	175	330	≤ 1,25	150	≤ 6	63
BAV 70	70	250	175	330	≤ 1,25	150	≤ 6	74
BAV 74	50	250	175	330	≤ 1,0	100	≤ 4	78
BAV 99	70	250	175	330	≤ 1,25	150	≤ 6	82
BAW 56	70	250	175	330	≤ 1,25	150	≤ 6	86
BAW 78 A	50	1000	150	1000	≤ 1,6	1000	1000	90
BAW 78 B	100	1000	150	1000	≤ 1,6	1000	1000	90
BAW 78 C	200	1000	150	1000	≤ 1,6	1000	1000	90
BAW 78 D	400	1000	150	1000	≤ 1,6	1000	1000	90
BAW 79 A	50	1000	150	1000	≤ 1,6	1000	1000	93
BAW 79 B	100	1000	150	1000	≤ 1,6	1000	1000	93
BAW 79 C	200	1000	150	1000	≤ 1,6	1000	1000	93
BAW 79 D	400	1000	150	1000	≤ 1,6	1000	1000	93
BAW 100	70	250	175	330	≤ 1,25	150	≤ 6	96
BAW 101	300	50	150	280	≤ 1,3	100	-	100
BGX 50 A	50	140	150	280	≤ 2,6	100	1	106

### Tuning diode

Type	$V_R$	$I_F$	$I_R$	$V_R$	$C_{D2V}$	$\frac{C_{D2V}}{C_{D8V}}$	$f$	Page
	V	mA	μA	V	pF	-	MHz	
BB 804	18	50	≤ 0,2	16	42 ... 47,5	1,7	1	103



**PIN diodes**

Type	$V_R$ V	$T_j$ °C	$P_{tot}$ mW	$\tau_L$ μs	$r_{F1}$ kΩ	$r_{F2}$ kΩ	$r_{F3}$ Ω	$r_{F4}$ Ω	Page
BAR 14-1	100	150	100	1,5	3,0	0,4	50	9,0	52
BAR 15-1	100	150	100	1,5	3,0	0,4	50	9,0	52
BAR 16-1	100	150	100	1,5	3,0	0,4	50	9,0	52

**MOS field-effect transistors**

Type	$V_{DS}$ V	$I_D$ mA	$T_{ch}$ °C	$P_{tot}$ mW	$g_{fs}$ mS	$G_{ps}$ dB	$NF$ dB	$V_{DS}$ V	$I_D$ mA	$f$ MHz	Page
BF 989	20	30	150	200	12	16,5	2,8	15	7	800	226
BF 989 S	20	30	150	200	12	16,5	2,2	15	7	800	234
BF 993	20	50	150	200	25	25	1,5	15	10	200	241
BF 994	20	30	150	200	17	25	1,5	15	10	200	247
BF 994 S	20	30	150	200	18	25	1	15	10	200	253
BF 995	20	30	150	200	17	23	1,8	15	10	200	259
BF 996	20	30	150	200	17	18	2,8	15	10	800	268
BF 996 S	20	30	150	200	18	18	1,8	15	10	800	275
BF 997	20	30	150	200	18	25	1	15	10	200	282

**RF transistors**

Type		$V_{CE0}$ V	$I_C$ mA	$P_{tot}$ mW	$h_{FE}$ -	$I_C$ mA	$V_{CE}$ V	$I_{CB0}$ nA	$f_T$ MHz	Page
BF 554	N	20	30	280	> 60	1	10	< 100	250	200
BF 599	N	25	25	280	> 38	7	10	< 100	550	209
BF 799	N	20	35	280	> 40	20	10	< 100	800	223
BF 550	P	40	25	280	> 50	1	10	-	350	196
BF 569	P	35	30	280	> 20	3	10	< 100	925	203
BF 579	P	20	30	280	> 20	10	10	< 100	1600	206
BF 660	P	30	25	280	> 30	3	10	< 50	700	220

**Switching transistors**

Type		$V_{CE0}$ V	$I_C$ mA	$P_{tot}$ mW	$h_{FE}$ -	$I_C$ mA	$V_{CE}$ V	$V_{CEsat}$ V	$f_T$ MHz	Page
BSS 64	N	80	100	330	80	10	1	≤ 3,0	100	172
BSS 79	N	40	800	330	40 ... 300	150	10	≤ 0,3	250	356
BSS 81	N	35	800	330	40 ... 300	150	10	≤ 1,3	250	356
BSS 63	P	100	800	330	≥ 30	10	5	≤ 0,9	150	176
BSS 80	P	40	800	330	40 ... 300	150	10	≤ 1,6	250	361
BSS 82	P	60	800	330	40 ... 300	150	10	≤ 1,6	250	361
SMBT 2222	N	30	600	330	100 ... 300	150	10	≤ 0,4	≥ 250	377
SMBT 2222 AN	N	40	600	330	100 ... 300	150	10	≤ 0,3	≥ 300	377
SMBT 3904	N	40	200	330	100 ... 300	10	1	≤ 0,3	≥ 300	389
SMBT 2907	P	40	600	330	100 ... 300	150	10	≤ 0,4	≥ 200	383
SMBT 2907 AP	P	60	600	330	100 ... 300	150	10	≤ 0,4	≥ 200	383
SMBT 3906 P	P	40	200	330	100 ... 300	10	1	≤ 0,4	≥ 250	395

## Summary of Types

### High voltage transistors

Type		$V_{CE0}$ V	$I_C$ mA	$P_{tot}$ mW	$h_{FE}$ —	$I_C$ mA	$V_{CE}$ V	$V_{CEsat}$ V	$f_T$ MHz	Page
BF 622	N	250	50	1000	$\geq 50$	25	20	$\leq 0,5$	100	212
BFN 16	N	250	200	1000	$\geq 40$	10	10	$\leq 0,4$	70	288
BFN 18	N	300	200	1000	$\geq 40$	10	10	$\leq 0,5$	70	288
BFN 20	N	300	50	1000	$\geq 40$	25	20	$\leq 0,5$	100	296
BFN 22	N	250	50	360	$\geq 50$	25	20	$\leq 0,5$	100	304
BFN 24	N	250	200	360	$\geq 40$	10	10	$\leq 0,4$	60	312
BFN 26	N	300	200	360	$\geq 40$	10	10	$\leq 0,5$	60	312
BF 623	P	250	50	1000	$\geq 50$	25	20	$\leq 0,5$	100	216
BFN 17	P	250	200	1000	$\geq 40$	10	10	$\leq 0,4$	100	292
BFN 19	P	300	200	1000	$\geq 40$	10	10	$\leq 0,5$	100	292
BFN 21	P	300	50	1000	$\geq 40$	25	20	$\leq 0,5$	100	300
BFN 23	P	250	50	360	$\geq 50$	25	20	$\leq 0,5$	100	308
BFN 25	P	250	200	360	$\geq 40$	10	10	$\leq 0,4$	100	316
BFN 27	P	300	200	360	$\geq 40$	10	10	$\leq 0,5$	100	316
SMBTA 42	N	300	500	360	$\geq 40$	10	10	$\leq 0,5$	$\geq 50$	409
SMBTA 43	N	200	500	360	$\geq 40$	10	10	$\leq 0,4$	$\geq 50$	409
SMBTA 92	P	300	500	360	$\geq 40$	10	10	$\leq 0,5$	$\geq 50$	413
SMBTA 93	P	200	500	360	$\geq 40$	10	10	$\leq 0,4$	$\geq 50$	413

### SIPMOS small-signal transistors

Type	$V_{DS}$ V	$I_D$ mA	$P_{tot}$ mW	$I_{DSS}$ $\mu A$	$V_{DS}$ V	$R_{DS(on)}$ $\Omega$	$V_{GS(th)}$ V	Page
● BSS 87	200	280	1000	$< 200$	200	$\leq 6$	0,8...2,8	367
● BSS 123	100	170	360	$\leq 15$	100	$\leq 6$	0,8...2,8	372

### Darlington transistors

Type		$V_{CE0}$ V	$I_C$ mA	$P_{tot}$ mW	$h_{FE}$ —	$I_C$ mA	$V_{CE}$ V	$V_{CEsat}$ V	$f_T$ MHz	Page
BCV 27	N	30	500	360	$\geq 20\,000$	100	5	$\leq 1,0$	170	138
BCV 29	N	30	500	1000	$\geq 20\,000$	100	5	$\leq 1,0$	170	146
BCV 47	N	60	500	360	$\geq 10\,000$	100	5	$\leq 1,0$	170	138
BCV 49	N	60	500	1000	$\geq 10\,000$	100	5	$\leq 1,0$	170	146
BCV 26	P	30	500	360	$\geq 20\,000$	100	5	$\leq 1,0$	200	134
BCV 28	P	30	500	1000	$\geq 20\,000$	100	5	$\leq 1,0$	200	142
BCV 46	P	60	500	360	$\geq 10\,000$	100	5	$\leq 1,0$	200	134
BCV 48	P	60	500	1000	$\geq 10\,000$	100	5	$\leq 1,0$	200	142
SMBTA 13	N	30	300	360	$\geq 10\,000$	100	5	$\leq 1,5$	$\geq 125$	401
SMBTA 14	N	30	300	360	$\geq 20\,000$	100	5	$\leq 1,5$	$\geq 125$	401

● Subject to export licensing

**AF transistors**

Type	$V_{CE0}$ V	$I_C$ mA	$P_{tot}$ mW	$h_{FE}$ –	$I_C$ mA	$V_{CE}$ V	$V_{CEsat}$ V	$f_T$ MHz	Page	
BC 817	N	45	800	330	100 ... 630	100	1	≤ 0,7	170	116
BC 818	N	25	800	330	100 ... 630	100	1	≤ 0,7	170	116
BC 846	N	65	100	330	110 ... 450	2	5	≤ 0,6	200	120
BC 847	N	45	100	330	110 ... 800	2	5	≤ 0,6	200	120
BC 848	N	30	100	330	110 ... 800	2	5	≤ 0,6	200	120
BC 849	N	30	100	330	200 ... 800	2	5	≤ 0,6	200	120
BC 850	N	45	100	330	200 ... 800	2	5	≤ 0,6	200	120
BC 807	P	45	800	330	100 ... 630	100	1	≤ 0,7	200	112
BC 808	P	25	800	330	100 ... 630	100	1	≤ 0,7	200	112
BC 856	P	65	100	330	125 ... 475	2	5	≤ 0,65	250	127
BC 857	P	45	100	330	125 ... 800	2	5	≤ 0,65	250	127
BC 858	P	30	100	330	125 ... 800	2	5	≤ 0,65	250	127
BC 859	P	30	100	330	220 ... 800	2	5	≤ 0,65	250	127
BC 860	P	45	100	330	220 ... 800	2	5	≤ 0,65	250	127
BCW 60	N	32	100	330	120 ... 630	2	5	≤ 0,55	200	150
BCW 65	N	32	800	330	100 ... 630	10	5	≤ 0,70	170	164
BCW 66	N	45	800	330	100 ... 630	10	5	≤ 0,70	170	164
BCX 41	N	125	800	330	≥ 63	100	1	≤ 0,90	100	172
BCX 54	N	45	1000	1000	40 ... 250	150	2	≤ 0,5	100	184
BCX 55	N	60	1000	1000	40 ... 160	150	2	≤ 0,5	100	184
BCX 56	N	80	1000	1000	40 ... 160	150	2	≤ 0,5	100	184
BCX 68	N	20	1000	1000	63 ... 400	5	10	≤ 0,50	100	188
BCX 70	N	45	100	330	120 ... 630	2	5	≤ 0,55	200	150
BCW 61	P	32	100	330	120 ... 630	2	5	≤ 0,55	250	157
BCW 67	P	32	800	330	100 ... 630	100	5	≤ 0,70	200	168
BCW 68	P	45	800	330	100 ... 630	100	5	≤ 0,70	200	168
BCX 42	P	125	800	330	≥ 63	100	1	≤ 0,90	150	176
BCX 51	P	45	1000	1000	40 ... 250	150	2	≤ 0,5	125	180
BCX 52	P	60	1000	1000	40 ... 160	150	2	≤ 0,5	125	180
BCX 53	P	80	1000	1000	40 ... 160	150	2	≤ 0,5	125	180
BCX 69	P	20	1000	1000	63 ... 400	500	1	≤ 0,50	100	192
BCX 71	P	45	100	330	100 ... 630	2	5	≤ 0,55	250	157
SMBTA 20N	N	40	100	330	≥ 40	5	10	≤ 0,25	≥ 125	405

**RF broadband transistors**

Type	$V_{CE0}$ V	$I_C$ mA	$P_{tot}$ mW	$f_T$ GHz	NF dB	$I_C$ mA	$V_{CE}$ V	$G_p$ dB	$I_C$ mA	$V_{CE}$ V	$f$ MHz	$R_g$ Ω	Page
BFQ 17 P	N	25	150	1000	1,4	–	70	5	–	–	–	–	320
BFQ 19 P	N	15	75	1000	4,8	3,8	50	10	11,5	70	10	800	$R_{opt}$ 323
BFQ 29 P	N	15	30	280	4,7	0,9	3	6	–	–	10	75	326
BFQ 64	N	20	200	1000	3,0	–	–	10	100	10	800	$R_{opt}$ 329	
BFQ 81	N	16	30	280	5,8	1,5	5	10	15	5	10	800	50 332
BFR 35 AP	N	12	30	280	4,9	2,0	2	6	14	15	6	800	50 335
BFR 92 P	N	15	30	280	5,0	2,0	2	6	14	15	6	800	50 339
BFR 93 P	N	15	50	280	5,0	2,8	10	8	13	25	8	800	50 342
BFS 17 P	N	15	25	280	2,5	3,8	22	5	–	–	–	800	50 345
BFT 92	P	15	25	200	5,0	2,7	2	10	18	14	10	500	$R_{opt}$ 348
BFT 93	P	12	35	200	5,0	2,4	2	5	16,5	30	5	500	$R_{opt}$ 352

## Summary of Types

### Light emitting diodes

Type	$V_R$ V	$I_F$ mA	$P_{tot}$ mW	Color	$\lambda_{peak}$ nm	$\lambda_{dom}$ nm	$\varphi$ De- grees	$V_F$ V	$I_R$ $\mu$ A	$I_V$ mcd	Page
LS S210 (CQV 231)	5,0	30	100	super- red	$635 \pm 15$	628	140	2,0	0,01	$\geq 0,4$	418
LY S210 (CQV 232)	5,0	30	100	yellow	$590 \pm 10$	592	140	2,0	0,01	$\geq 0,4$	418
LG S210 (CQV 233)	5,0	30	100	green	$560 \pm 15$	561	140	2,0	0,01	$\geq 0,4$	418
LU S210 (CQV 234)	5,0	30	200	super- red/ green	635/560	628/561	140	2,0	0,01	$\geq 0,4$	418

### Position sensor

Type	$V_{20}$ mV	$V_{R0}$ mV	$I_{1N}$ mA	$R_{10}$ $\Omega$	Page
● KSY 13	$\approx 100$	$< \pm 30$	5	900 ... 1200	424

### Temperature sensors

Type	$R_{25(max)}$	$R_{25-Tol.}$	$I_{max}$ 25 °C	$\tau$	$T_A$		Page
	$\Omega$	‰	mA	Air s	Oil s	°C	
KTY 13 A	2020	$\pm 1$	8	7	1	-50 ... +150	426
KTY 13 B	2040	$\pm 2$	8	7	1	-50 ... +150	426
KTY 13 C	2100	$\pm 5$	8	7	1	-50 ... +150	426
KTY 13 D	2200	$\pm 10$	8	7	1	-50 ... +150	426

---

**Index of Ordering Codes**  
**Marking System**  
**Cross Reference Index**

---

## Index of Ordering Codes (alphanumerical)

### Bulk goods

Type	Ordering code	Page
BAL 74	Q62702-A614	44
BAL 99	Q62702-A611	48
BAR 14-1	Q62702-A659	52
BAR 15-1	Q62702-A663	52
BAR 16-1	Q62702-A667	52
BAR 74	Q62702-A615	55
BAR 99	Q62702-A610	59
BAS 16	Q62702-A726	63
BAS 40-04	Q62702-D920	67
BAS 40-05	Q62702-D921	67
BAS 40-06	Q62702-D922	67
BAS 70-04	Q62702-A626	69
BAS 70-05	Q62702-A627	69
BAS 70-06	Q62702-A628	69
BAT 17	Q62702-A727	71
BAV 70	Q68000-A3574	74
BAV 74	Q62702-A498	78
BAV 99	Q68000-A1185	82
BAW 56	Q62702-A471	86
BAW 78 A	Q62702-A675	90
BAW 78 B	Q62702-A676	90
BAW 78 C	Q62702-A677	90
BAW 78 D	Q62702-A678	90
BAW 79 A	Q62702-A679	93
BAW 79 B	Q62702-A680	93
BAW 79 C	Q62702-A681	93
BAW 79 D	Q62702-A682	93
BAW 100	Q62702-A3443	96
BAW 101	Q62702-A3444	100
BB 804	Q62702-B328	103
BC 807-16	Q62702-C1330	112
BC 807-25	Q62702-C1331	112
BC 807-40	Q62702-C1332	112
BC 808-16	Q62702-C1334	112
BC 808-25	Q62702-C1335	112
BC 808-40	Q62702-C1336	112
BC 817-16	Q62702-C1338	116
BC 817-25	Q62702-C1339	116
BC 817-40	Q62702-C1340	116
BC 818-16	Q62702-C1342	116
BC 818-25	Q62702-C1343	116
BC 818-40	Q62702-C1344	116
BC 846 A	Q62702-C1346	120
BC 846 B	Q62702-C1347	120
BC 847 A	Q62702-C1349	120
BC 847 B	Q62702-C1350	120
BC 847 C	Q62702-C1751	120
BC 848 A	Q62702-C1352	120
BC 848 B	Q62702-C1353	120
BC 848 C	Q62702-C1354	120

Type	Ordering code	Page
BC 849 B	Q62702-C1356	120
BC 849 C	Q62702-C1357	120
BC 850 B	Q62702-C1359	120
BC 850 C	Q62702-C1360	120
BC 856 A	Q62702-C1362	127
BC 856 B	Q62702-C1363	127
BC 857 A	Q62702-C1365	127
BC 857 B	Q62702-C1366	127
BC 857 C	Q62702-C1752	127
BC 858 A	Q62702-C1368	127
BC 858 B	Q62702-C1369	127
BC 858 C	Q62702-C1370	127
BC 859 A	Q62702-C1372	127
BC 859 B	Q62702-C1373	127
BC 859 C	Q62702-C1374	127
BC 860 B	Q62702-C1377	127
BC 860 C	Q62702-C1378	127
BCV 26	Q62702-C1151	134
BCV 27	Q62702-C1152	138
BCV 28	Q62702-C1683	142
BCV 29	Q62702-C1684	146
BCV 46	Q62702-C1153	134
BCV 47	Q62702-C1154	138
BCV 48	Q62702-C1685	142
BCV 49	Q62702-C1686	146
BCW 60 A	Q62702-C331	150
BCW 60 B	Q62702-C332	150
BCW 60 C	Q62702-C333	150
BCW 60 D	Q62702-C334	150
BCW 60 FF	Q62702-C1052	150
BCW 60 FN	Q62702-C1053	150
BCW 61 A	Q62702-C335	157
BCW 61 B	Q62702-C336	157
BCW 61 C	Q62702-C337	157
BCW 61 D	Q62702-C338	157
BCW 61 FF	Q62702-C1058	157
BCW 61 FN	Q62702-C1059	157
BCW 65 A	Q62702-C457	164
BCW 65 B	Q62702-C458	164
BCW 65 C	Q62702-C459	164
BCW 66 F	Q62702-C460	164
BCW 66 G	Q62702-C461	164
BCW 66 H	Q62702-C462	164
BCW 67 A	Q62702-C463	168
BCW 67 B	Q62702-C464	168
BCW 67 C	Q62702-C465	168
BCW 68 F	Q62702-C466	168
BCW 68 G	Q62702-C467	168
BCW 68 H	Q62702-C468	168
BCX 41	Q62702-C946	172

## Index of Ordering Codes (alphanumerical)

Type	Ordering code	Page
BCX 42	Q62702-C945	176
BCX 51-6	Q62702-C1063	180
BCX 51-10	Q62702-C1064	180
BCX 51-16	Q62702-C1065	180
BCX 52-6	Q62702-C1066	180
BCX 53-6	Q62702-C1068	180
BCX 53-10	Q62702-C1069	180
BCX 54-6	Q62702-C1070	184
BCX 54-10	Q62702-C1071	184
BCX 54-16	Q62702-C1072	184
BCX 55-6	Q62702-C1073	184
BCX 55-10	Q62702-C1074	184
BCX 56-6	Q62702-C1075	184
BCX 56-10	Q62702-C1076	184
BCX 68-10	Q62702-C1077	188
BCX 68-16	Q62702-C1078	188
BCX 68-25	Q62702-C1079	188
BCX 69-10	Q62702-C1080	192
BCX 69-16	Q62702-C1081	192
BCX 69-25	Q62702-C1082	192
BCX 70 G	Q62702-C423	150
BCX 70 H	Q62702-C424	150
BCX 70 J	Q62702-C425	150
BCX 70 K	Q62702-C426	150
BCX 71 G	Q62702-C427	157
BCX 71 H	Q62702-C428	157
BCX 71 J	Q62702-C429	157
BCX 71 K	Q62702-C430	157
BF 550	Q62702-F547	196
BF 554	Q62702-F551	200
BF 569	Q62702-F548	203
BF 579	Q62702-F552	206
BF 599	Q62702-F550	209
BF 622	Q62702-F568	212
BF 623	Q62702-F567	216
BF 660	Q62702-F549	220
BF 799	Q62702-F788	223
BF 989	Q62702-F874	226
BF 989 S	Q62702-F962	234
BF 993	Q62702-F899	241
BF 994	Q62702-F871	247
BF 994 S	Q62702-F963	253
BF 995	Q62702-F872	259
BF 996	Q62702-F873	268
BF 996 S	Q62702-F964	275
BF 997	Q62702-F993	282
BFN 16	Q62702-F694	288
BFN 17	Q62702-F695	292
BFN 18	Q62702-F696	288
BFN 19	Q62702-F697	292
BFN 20	Q62702-F584	296
BFN 21	Q62702-F585	300

Type	Ordering code	Page
BFN 22	Q62702-F596	304
BFN 23	Q62702-F597	308
BFN 24	Q62702-F747	312
BFN 25	Q62702-F749	316
BFN 26	Q62702-F750	312
BFN 27	Q62702-F751	316
BFQ 17 P	Q62702-F836	320
BFQ 19 P	Q62702-F897	323
BFQ 29 P	Q62702-F838	326
BFQ 64	Q62702-F705	329
BFQ 81	Q62702-F996	332
BFR 35 AP	Q62702-F875	335
BFR 92 P	Q62702-F923	339
BFR 93 P	Q62702-F924	342
BFS 17 P	Q62702-F835	345
BFT 92	Q62702-F689	348
BFT 93	Q62702-F691	352
BGX 50 A	Q62702-G35	106
BSS 63	Q62702-S401	176
BSS 64	Q62702-S394	172
BSS 79 B	Q62702-S403	356
BSS 79 C	Q62702-S402	356
BSS 80 B	Q62702-S398	361
BSS 80 C	Q62702-S399	361
BSS 81 B	Q62702-S420	356
BSS 81 C	Q62702-S419	356
BSS 82 B	Q62702-S409	361
BSS 82 C	Q62702-S408	361
BSS 87	Q62702-S453	367
BSS 123	Q62702-S507	372
LS S210	Q62703-Q1516	418
LY S210	Q62703-Q1517	418
LG S210	Q62703-Q1518	418
LU S210	Q62703-Q1519	418
KSY 13	Q62705-K142	424
KTY 13 A	Q62705-K13	426
KTY 13 B	Q62705-K14	426
KTY 13 C	Q62705-K15	426
KTY 13 D	Q62705-K16	426
SMBT 2222	Q68000-A4335	377
SMBT 2222 A	Q68000-A4334	377
SMBT 2907	Q68000-A4336	383
SMBT 2907 A	Q68000-A4337	383
SMBT 3904	Q68000-A4340	389
SMBT 3906	Q68000-A4341	395
SMBTA-13	Q68000-A4331	401
SMBTA-14	Q68000-A4332	401
SMBTA-20	Q68000-A4333	405
SMBTA-42	Q68000-A4329	409
SMBTA-43	Q68000-A4330	409
SMBTA-92	Q68000-A4338	413
SMBTA-93	Q68000-A4339	413

## Index of Ordering Codes (alphanumerical)

### Taped versions

Type	Ordering code	Page
BAL 74	Q62702-A718	44
BAL 99	Q62702-A687	48
BAR 14-1	Q62702-A772	52
BAR 15-1	Q62702-A731	52
BAR 16-1	Q62702-A773	52
BAR 74	Q62702-A704	55
BAR 99	Q62702-A388	59
BAS 16	Q62702-A739	63
BAS 40-04	Q62702-D980	67
BAS 40-05	Q62702-D979	67
BAS 40-06	Q62702-D978	67
BAS 70-04	Q62702-A730	69
BAS 70-05	Q62702-A711	69
BAS 70-06	Q62702-A774	69
BAT 17-04	Q62702-A775	71
BAV 70	Q68000-A6622	74
BAV 74	Q62702-A693	78
BAV 99	Q68000-A549	82
BAW 56	Q62702-A688	86
BAW 78 A	Q62702-A778	90
BAW 78 B	Q62702-A779	90
BAW 78 C	Q62702-A780	90
BAW 78 D	Q62702-A109	90
BAW 79 A	Q62702-A781	93
BAW 79 B	Q62702-A782	93
BAW 79 C	Q62702-A771	93
BAW 79 D	Q62702-A733	93
BAW 100	Q62702-A376	96
BAW 101	Q62702-A712	100
BB 804	Q62702-B356	103
BC 807-16	Q62702-C1735	112
BC 807-25	Q62702-C1689	112
BC 807-40	Q62702-C1721	112
BC 808-16	Q62702-C1736	112
BC 808-25	Q62702-C1504	112
BC 808-40	Q62702-C1692	112
BC 817-16	Q62702-C1732	116
BC 817-25	Q62702-C1690	116
BC 817-40	Q62702-C1738	116
BC 818-16	Q62702-C1739	116
BC 818-25	Q62702-C1740	116
BC 818-40	Q62702-C1505	116
BC 846 A	Q62702-C1772	120
BC 846 B	Q62702-C1746	120
BC 847 A	Q62702-C1884	120
BC 847 B	Q62702-C1687	120
BC 847 C	Q62702-C1715	120
BC 848 A	Q62702-C1741	120
BC 848 B	Q62702-C1704	120
BC 848 C	Q62702-C1506	120

Type	Ordering code	Page
BC 849 B	Q62702-C1727	120
BC 849 C	Q62702-C1713	120
BC 850 B	Q62702-C1885	120
BC 850 C	Q62702-C1712	120
BC 856 A	Q62702-C1773	127
BC 856 B	Q62702-C1886	127
BC 857 A	Q62702-C1850	127
BC 857 B	Q62702-C1688	127
BC 857 C	Q62702-C1851	127
BC 858 A	Q62702-C1742	127
BC 858 B	Q62702-C1764	127
BC 858 C	Q62702-C1507	127
BC 859 A	Q62702-C1887	127
BC 859 B	Q62702-C1774	127
BC 859 C	Q62702-C1761	127
BC 860 B	Q62702-C1888	127
BC 860 C	Q62702-C1889	127
BCV 26	Q62702-C1493	134
BCV 27	Q62702-C1474	138
BCV 28	Q62702-C1852	142
BCV 29	Q62702-C1853	146
BCV 46	Q62702-C1475	134
BCV 47	Q62702-C1501	138
BCV 48	Q62702-C1854	142
BCV 49	Q62702-C1832	146
BCW 60 A	Q62702-C1517	150
BCW 60 B	Q62702-C1497	150
BCW 60 C	Q62702-C1476	150
BCW 60 D	Q62702-C1477	150
BCW 60 FF	Q62702-C1529	150
BCW 60 FN	Q62702-C1567	150
BCW 61 A	Q62702-C452	157
BCW 61 B	Q62702-C1585	157
BCW 61 C	Q62702-C1478	157
BCW 61 D	Q62702-C1556	157
BCW 61 FF	Q62702-C1890	157
BCW 61 FN	Q62702-C1891	157
BCW 65 A	Q62702-C1516	164
BCW 65 B	Q62702-C1612	164
BCW 65 C	Q62702-C1479	164
BCW 66 F	Q62702-C1892	164
BCW 66 G	Q62702-C1526	164
BCW 66 H	Q62702-C1632	164
BCW 67 A	Q62702-C1560	168
BCW 67 B	Q62702-C1480	168
BCW 67 C	Q62702-C1681	168
BCW 68 C	Q62702-C1893	168
BCW 68 G	Q62702-C1322	168
BCW 68 H	Q62702-C1555	168
BCX 41	Q62702-C1659	172



## Index of Ordering Codes (alphanumerical)

Type	Ordering code	Page
BCX 42	Q62702-C1485	176
BCX 51-6	Q62702-C1855	180
BCX 51-10	Q62702-C1856	180
BCX 51-16	Q62702-C1857	180
BCX 52-6	Q62702-C1858	180
BCX 53-6	Q62702-C1859	180
BCX 53-10	Q62702-C1753	180
BCX 54-6	Q62702-C1860	184
BCX 54-10	Q62702-C1861	184
BCX 54-16	Q62702-C1731	184
BCX 55-6	Q62702-C1862	184
BCX 55-10	Q62702-C1730	184
BCX 56-6	Q62702-C1863	184
BCX 56-10	Q62702-C1635	184
BCX 68-10	Q62702-C1864	188
BCX 68-16	Q62702-C1865	188
BCX 68-25	Q62702-C1866	188
BCX 69-10	Q62702-C1867	192
BCX 69-16	Q62702-C1868	192
BCX 69-25	Q62702-C1869	192
BCX 70 G	Q62702-C1539	150
BCX 70 H	Q62702-C1481	150
BCX 70 J	Q62702-C1552	150
BCX 70 K	Q62702-C1571	150
BCX 71 G	Q62702-C1482	157
BCX 71 H	Q62702-C1586	157
BCX 71 J	Q62702-C1554	157
BCX 71 K	Q62702-C1654	157
BF 550	Q62702-F944	196
BF 554	Q62702-F1042	200
BF 569	Q62702-F869	203
BF 579	Q62702-F971	206
BF 599	Q62702-F979	209
BF 622	Q62702-F1052	212
BF 623	Q62702-F1053	216
BF 660	Q62702-F982	220
BF 799	Q62702-F935	223
BF 989	Q62702-F969	226
BF 989 S	Q62702-F1054	234
BF 993	Q62702-F1018	241
BF 994	Q62702-F970	247
BF 994 S	Q62702-F1020	253
BF 995	Q62702-F936	259
BF 996	Q62702-F978	268
BF 996 S	Q62702-F1021	275
BF 997	Q62702-F1055	282
BFN 16	Q62702-F885	288
BFN 17	Q62702-F884	292
BFN 18	Q62702-F1056	288
BFN 19	Q62702-F1057	292

Type	Ordering code	Page
BFN 20	Q62702-F1058	296
BFN 21	Q62702-F1059	300
BFN 22	Q62702-F1024	304
BFN 23	Q62702-F1064	308
BFN 24	Q62702-F1065	312
BFN 25	Q62702-F1066	316
BFN 26	Q62702-F976	312
BFN 27	Q62702-F977	316
BFQ 17 P	Q62702-F983	320
BFQ 19 P	Q62702-F1060	323
BFQ 29 P	Q62702-F659	326
BFQ 64	Q62702-F1061	329
BFQ 81	Q62702-F1049	332
BFR 35 AP	Q62702-F938	335
BFR 92 P	Q62702-F1050	339
BFR 93 P	Q62702-F1051	342
BFS 17 P	Q62702-F940	345
BFT 92	Q62702-F1062	348
BFT 93	Q62702-F1063	352
BGX 50 A	Q62702-G38	106
BSS 63	Q62702-S534	176
BSS 64	Q62702-S535	172
BSS 79 B	Q62702-S503	356
BSS 79 C	Q62702-S501	356
BSS 80 B	Q62702-S557	361
BSS 80 C	Q62702-S492	361
BSS 81 B	Q62702-S555	356
BSS 81 C	Q62702-S559	356
BSS 82 B	Q62702-S560	361
BSS 82 C	Q62702-S482	361
BSS 87	Q62702-S506	367
BSS 123	Q62702-S512	372
LG S210	Q62703-Q1684	418
LS S210	Q62703-Q1640	418
LU S210	Q62703-Q1642	418
LY S210	Q62703-Q1657	418
SMBT 2222	Q68000-A6481	377
SMBT 2222 A	Q68000-A6473	377
SMBT 2907	Q68000-A6501	383
SMBT 2907 A	Q68000-A6474	383
SMBT 3904	Q68000-A4416	389
SMBT 3906	Q68000-A4417	395
SMBTA-13	Q68000-A6475	401
SMBTA-14	Q68000-A6476	401
SMBTA-20	Q68000-A6477	405
SMBTA-42	Q68000-A6478	409
SMBTA-43	Q68000-A6482	409
SMBTA-92	Q68000-A6479	413
SMBTA-93	Q68000-A6483	413

## Marking System

Mark	Type	Package
AA	BCW 60 A	SOT 23
AB	BCW 60 B	SOT 23
AB	BCX 51-6	SOT 89
AC	BCW 60 C	SOT 23
AC	BCX 51-10	SOT 89
AD	BCW 60 D	SOT 23
AD	BCX 51-16	SOT 89
AF	BCX 52-6	SOT 89
AF	BCW 60 FF	SOT 23
AG	BCX 52-10	SOT 89
AG	BCX 70 G	SOT 23
AH	BCX 70 H	SOT 23
AJ	BCX 53-6	SOT 89
AJ	BCX 70 J	SOT 23
AK	BCX 53-10	SOT 89
AK	BCX 70 K	SOT 23
AM	BSS 64	SOT 23
AN	BCW 60 FN	SOT 23
BA	BCW 61 A	SOT 23
BB	BCW 61 B	SOT 23
BB	BCX 54-6	SOT 89
BC	BCW 61 C	SOT 23
BC	BCX 54-10	SOT 89
BD	BCW 61 D	SOT 23
BD	BCW 54-16	SOT 89
BF	BCX 55-6	SOT 89
BF	BCW 61 FF	SOT 23
BG	BCX 55-10	SOT 89
BG	BCX 71 G	SOT 23
BH	BCX 71 H	SOT 23
BJ	BCX 56-6	SOT 89
BJ	BCX 71 J	SOT 23
BK	BCX 56-10	SOT 89
BK	BCX 71 K	SOT 23
BM	BSS 63	SOT 23
BN	BCW 61 FN	SOT 23
CB	BCX 68-10	SOT 89
CC	BCX 68-16	SOT 23
CC	BF 554	SOT 23
CD	BCX 68-25	SOT 89
CD	BSS 81 B	SOT 23
CE	BSS 79 B	SOT 23
F	BCX 69-10	SOT 89
CF	BSS 79 C	SOT 23
CG	BCX 69-16	SOT 89
CG	BSS 81 C	SOT 23
CH	BCX 69-25	SOT 89
CH	BSS 80 B	SOT 23
CJ	BSS 80 C	SOT 23
CL	BSS 82 B	SOT 23
CM	BSS 82 C	SOT 23
DA	BCW 67 A	SOT 23
DA	BF 622	SOT 89

Mark	Type	Package
DB	BCW 67 B	SOT 23
DB	BF 623	SOT 89
DC	BCW 67 C	SOT 23
DC	BFN 20	SOT 89
DD	BFN 16	SOT 89
DE	BFN 18	SOT 89
DF	BCW 68 F	SOT 23
DF	BFN 21	SOT 89
DG	BCW 68 G	SOT 23
DG	BFN 17	SOT 89
DH	BCW 68 H	SOT 23
DH	BFN 19	SOT 89
DK	BCX 42	SOT 23
EA	BCW 65 A	SOT 23
EB	BCW 65 B	SOT 23
EC	BCW 65 C	SOT 23
ED	BCV 28	SOT 89
EE	BCV 48	SOT 89
EF	BCV 29	SOT 89
EF	BCW 66 F	SOT 23
EG	BCV 49	SOT 89
EG	BCW 66 G	SOT 23
EH	BCW 66 H	SOT 23
EK	BCX 41	SOT 23
FD	BFQ 17 P	SOT 89
FC	BFQ 64	SOT 89
FD	BCV 26	SOT 23
FE	BCV 46	SOT 23
FE	BFQ 19 P	SOT 89
FF	BCV 27	SOT 23
FG	BCV 47	SOT 23
FH	BFN 24	SOT 23
FJ	BFN 26	SOT 23
FK	BFN 25	SOT 23
FL	BFN 27	SOT 23
FM	BB 804	SOT 89
GA	BAW 78 A	SOT 89
GB	BAW 78 B	SOT 89
GC	BAW 78 C	SOT 89
GD	BAW 78 D	SOT 89
GE	BAW 79 A	SOT 89
GE	BFR 35 AP	SOT 23
GF	BAW 79 B	SOT 89
GF	BFR 92 P	SOT 23
GG	BAW 79 C	SOT 89
GG	BFR 93 P	SOT 23
GH	BAW 79 D	SOT 89
HB	BFN 22	SOT 23
HC	BFN 23	SOT 23
JA	BAV 74	SOT 23
JB	BAR 74	SOT 23
JC	BAL 74	SOT 23
JD	BAW 56	SOT 23

## Marking System

Mark	Type	Package
JE	BAV 99	SOT 23
JF	BAL 99	SOT 23
JG	BAR 99	SOT 23
JJ	BAV 70	SOT 23
JP	BAW 101	SOT 143
JS	BAW 100	SOT 143
JU	BAS 16	SOT 23
KA	BSS 87	SOT 89
KC	BFQ 29 P	SOT 23
L7	BAR 14-1	SOT 23
L8	BAR 15-1	SOT 23
L9	BAR 16-1	SOT 23
LA	BF 550	SOT 23
LE	BF 660	SOT 23
LH	BF 569	SOT 23
LJ	BF 579	SOT 23
LK	BF 799	SOT 23
M1	BAT 14-39	SOT 23
M2	BAT 14-38	SOT 23
MA	BF 989	SOT 143
MB	BF 995	SOT 143
MC	BF 994	SOT 143
MC	BFS 17 P	SOT 23
MD	BF 996	SOT 143
ME	BF 993	SOT 143
MF	BF 989 S	SOT 143
MG	BF 994 S	SOT 143
MH	BF 996 S	SOT 143
NB	BF 599	SOT 23
RA	BFQ 81	SOT 23
SA	BSS 123	SOT 23
SB	SMBT 2222	SOT 23
SC	SMBT 2222 A	SOT 23
SD	SMBT 2907	SOT 23
SE	SMBT 2907 A	SOT 23
SF	SMBTA 13	SOT 23
SG	SMBTA 14	SOT 23
SH	SMBTA 20	SOT 23
SJ	SMBTA 92	SOT 23
SK	SMBTA 93	SOT 23
SL	SMBTA 42	SOT 23
SM	SMBTA 43	SOT 23
SN	SMBT 3904	SOT 23
SO	SMBT 3906	SOT 23
TA	KTY 13 A	SOT 23
TB	KTY 13 B	SOT 23
TC	KTY 13 C	SOT 23
TD	KTY 13 D	SOT 23

Mark	Type	Package
S13	KSY 13	SOT 143
U1	BGX 50 A	SOT 143
W1	BFT 92	SOT 23
X1	BFT 93	SOT 23
1A	BC 846 A	SOT 23
1B	BC 846 B	SOT 23
1E	BC 847 A	SOT 23
1F	BC 847 B	SOT 23
1G	BC 847 C	SOT 23
1J	BC 848 A	SOT 23
1K	BC 848 B	SOT 23
1L	BC 848 C	SOT 23
2B	BC 849 B	SOT 23
2C	BC 849 C	SOT 23
2F	BC 850 B	SOT 23
2G	BC 850 C	SOT 23
3A	BC 856 A	SOT 23
3B	BC 856 B	SOT 23
3E	BC 857 A	SOT 23
3F	BC 857 B	SOT 23
3G	BC 957 G	SOT 23
3J	BC 858 A	SOT 23
3K	BC 858 B	SOT 23
3L	BC 858 C	SOT 23
4A	BC 859 A	SOT 23
4B	BC 859 B	SOT 23
4C	BC 859 C	SOT 23
4F	BC 860 B	SOT 23
4G	BC 860 C	SOT 23
44	BAS 40-04	SOT 23
45	BAS 40-05	SOT 23
46	BAS 40-06	SOT 23
5A	BC 807-16	SOT 23
5B	BC 807-25	SOT 23
5C	BC 807-40	SOT 23
5F	BC 808-16	SOT 23
5G	BC 808-25	SOT 23
5H	BC 808-40	SOT 23
53	BAT 17	SOT 23
6A	BC 817-16	SOT 23
6B	BC 817-25	SOT 23
6C	BC 817-40	SOT 23
6F	BC 818-16	SOT 23
6G	BC 818-25	SOT 23
6H	BC 818-40	SOT 23
74	BAS 70-04	SOT 23
75	BAS 70-05	SOT 23
76	BAS 70-06	SOT 23

## Cross Reference Index

Conventional technology	SM technology	Conventional technology	SM technology
1N 4148	BAL 99/BAR 99	BCY 67	BCW 61 F
1N 4148 (2x)	BAV 74/BAV 70	BCY 78	BCW 61
	BAV 99/BAW 56	BCY 79	BCX 71
2N 2222	BSS79	BF 199	BF 599
2N 2907	BSS80	BF 254	BF 554
2N 3904	SMBT 3904	BF 420	BFN 20
2N 3906	SMBT 3906	BF 421	BFN 21
BB 304	BB 804	BF 422	BFN 22/BF 622
BC 237	BC 847	BF 423	BFN 23/BF 623
BC 238	BC 848	BF 450	BF 550
BC 239	BC 849	BF 606 A	BF 660
BC 307	BC 857	BF 959	BF 799
BC 308	BC 858	BF 960	BF 989
BC 309	BC 859	BF 960 S	FB 989 S
BC 327	BC 807	BF 961	BF 995
BC 328	BC 808	BF 963	BF 993
BC 337	BC 817	BF 964	BF 994
BC 338	BC 818	BF 964 S	BF 994 S
BC 368	BCX 68	BF 966	BF 996
BC 369	BCX 69	BF 966 S	BF 996 S
BC 413	BC 850	BF 968	BF 568
BC 414	BC 850	BF 970	BF 569
BC 415	BC 860	BF 979 S	BF 579
BC 416	BC 860	BFP 22	BFN 24/17 SMBTA 43
BC 516	BCV 26/46	BFP 23	BFN 25/17 SMBTA 93
BC 517	BCV 27	BFP 25	BFN 26/18 SMBTA 42
BC 546	BC 846	BFP 26	BFN 27/19 SMBTA 92
BC 547	BC 847	BFW 16 A	BFQ 17
BC 548	BC 848	BFQ 23	BFT 93
BC 549	BC 849	BFQ 51	BFT 92
BC 550	BC 850	BFR 34 A	BFR 35 A
BC 556	BC 856	BFR 90	BFR 92
BC 557	BC 857	BFR 91	BFR 93
BC 558	BC 858	BFR 96	BFQ 19
BC 559	BC 859	BFT 65	BFT 75
BC 560	BC 860	BFT 97	BFQ 29
BC 617	BCV 47	BFT 98 T	BFQ 64
BC 618	BCV 47	BFW 92	BFS 17
BC 635	BCX 54	BFX 89	BFS 17
BC 636	BCX 51	BSS 89	BSS 87
BC 637	BCX 55	BSS 91	BSS 87
BC 638	BCX 52	CQV 11/21	LS S 210
BC 639	BCX 56	CQV 13/23	LY S 210
BC 640	BCX 53	CQV 15/25	LG S 210
BCX 22	BCX 41	LD 100	LU S 210
BCX 23	BCX 42	KTY 10	KTY 13A/B/
BCX 58	BCW 60	KSY 10	KSY 13
BCX 59	BCX 70	MPSA 42	SMBTA 42
BCX 78	BCW 61	MPSA 43	SMBTA 43
BCX 79	BCX 71	MPSA 92	SMBTA 92
BCX 58	BCW 60	MPSA 93	SMBTA 93
BCY 59	BCX 70	MPS 2222/A	SMBT 2222/A
BCY 66	BCW 60 F	MPS 2907/A	SMBT 2907/A

---

**Technical Information**  
**Packages**  
**Quality**

---

## Technical Information

---

### Symbols and terms

#### Diodes

$C$	Capacitance
$C_D$	Diode capacitance
$C_{D2V}/C_{D8V}$	Capacitance ratio
$C_j$	Junction capacitance
$D$	Duty cycle
$f$	Frequency
$I_F$	Forward current
$I_{FM}$	Peak forward current
$I_{FAV}$	Max. mean forward current
$I_{FRMS}$	Max. rms forward current
$I_{FSM}$	Max. surge forward current
$I_R$	Reverse current
$NF$	Noise figure
$P_{tot}$	Total power dissipation
$Q$	Quality factor
$R$	Resistance
$R_F$	RF forward resistance
$R_i$	Internal resistance
$R_{thJA}$	Thermal resistance, junction - ambient
$r_f$	Differential forward resistance
$r_s$	Series resistance
$T$	Temperature
$T_C$	Case temperature
$TC_C$	Temperature coefficient of junction capacitance
$T_j$	Junction temperature
$T_{stg}$	Storage temperature range
$t$	Time
$t_p$	Pulse duration
$t_{rr}$	Reverse recovery time
$V$	Voltage
$V_{(BR)}$	Breakdown voltage
$V_F$	Forward voltage
$V_{FR}$	Forward recovery voltage
$V_R$	Reverse voltage
$V_{RRM}$	Max. repetitive peak reverse voltage
$\tau_L$	Charge carrier life time

#### Transistors

$C_{dg1}$	Drain-gate 1 capacitance
$C_{dss}$	Output capacitance
$C_{g1ss}$	Gate 1 input capacitance
$C_{g2ss}$	Gate 2 input capacitance
$C_{ib}$	Input capacitance, common-base configuration
$C_{iss}$	Input capacitance, common-source configuration

$C_{ob}$	Output capacitance, common-base configuration
$C_{oss}$	Output capacitance, common-source configuration
$C_{re}$	Collector-base feedback capacitance
$C_{rb}$	Collector-emitter feedback capacitance
$C_{rss}$	Reverse transfer capacitance
$C_{11e}$	Capacitance of short-circuit input admittance (of parameter $y_{21}$ )
$C_{22e}$	Capacitance of short-circuit output admittance (of parameter $y_{22}$ )
$D$	Duty cycle
$d_{IM}$	Intermodulation distortion
$dv/dt$	Voltage transconductance
$f$	Frequency
$f_{IF}$	Intermediate frequency
$f_T$	Transition frequency
$G_{FSC}$	Mixer gain (multiplicative)
$G_G$	Intrinsic generator inductance
$G_L$	Load conductance
$G_P$	Power gain
$G_{PopT}$	Optimum power gain
$G_{ps}$	Power gain
$\Delta G_{ps}$	Control range
$G_{psC}$	Mixer gain additive
$g_{fs}$	Forward transconductance
$g_{fs1}$	Gate 1 forward transconductance
$g_{11e}$	Effective short-circuit input transconductance (of parameter $y_{11}$ )
$g_{22e}$	Effective short-circuit output transconductance (of parameter $y_{22}$ )
$h_{FE}$	DC current gain
$h_{11e}$	Short-circuit input impedance
$h_{12e}$	Open-circuit reverse voltage transfer ratio
$h_{21e}$	Short-circuit forward current transfer ratio
$h_{22e}$	Open-circuit output admittance
$I_B$	Base current
$I_{BM}$	Peak base current
$I_C$	Collector current
$I_{CB0}$	Collector cutoff current
$I_{CER}$	Collector cutoff current with resistance between base and emitter
$I_{CES}$	Collector cutoff current with short-circuited emitter diode
$I_{CM}$	Peak collector current
$I_D$	Drain current
$I_{Dpuls}$	Pulsed drain current
$I_{DR}$	DC current
$I_{DRM}$	Pulsed dc current
$I_{DSS}$	Zero gate voltage drain current
$I_E$	Emitter current
$I_{EB0}$	Emitter cutoff current
$I_{EM}$	Peak emitter current
$I_F$	Forward current
$I_{GSS}$	Gate-source leakage current
$+ I_{G1/2SM}$	Gate 1/gate 2 peak source current

## Technical Information

---

$\pm I_{G1SS}$	Gate 1 source leakage current
$\pm I_{G2SS}$	Gate 2 source leakage current
$I_R$	Reverse current
$NF$	Noise figure
$P_{tot}$	Total power dissipation
$Q_{rr}$	Reverse recovery charge
$r_{th}$	Thermal resistance
$R_{DS(on)}$	Drain source on-state resistance
$R_G$	Internal resistance of generator
$R_{GS}$	Gate-source resistance
$R_L$	Load resistance
$R_s$	Series resistance
$R_{thJA}$	Thermal resistance, junction - ambient
$\tau_{CB}$	Collector-base time constant
$T_A$	Ambient temperature
$T_C$	Case temperature
$T_{ch}$	Channel temperature
$T_j$	Junction temperature
$T_{stg}$	Storage temperature
$t_d$	Delay time
$t_f$	Fall time
$t_r$	Rise time
$t_{stg}$	Storage time
$t_{off}$	Turn-off time
$t_{on}$	Turn-on time
$V_B$	Base voltage
$V_{BE}$	Base-emitter voltage
$V_{BE(on)}$	Base-emitter voltage
$V_{BE(off)}$	Base-emitter voltage
$V_{BEsat}$	Base-emitter saturation voltage
$V_{(BR)CB0}$	Collector-base breakdown voltage
$V_{(BR)CE0}$	Collector-emitter breakdown voltage
$V_{(BR)CER}$	Collector-emitter breakdown voltage with resistance between base and emitter
$V_{(BR)DSS}$	Drain-source breakdown voltage
$V_{(BR)EB0}$	Emitter-base breakdown voltage
$\pm V_{(BR)G1SS}$	Gate 1 source breakdown voltage
$\pm V_{(BR)G2SS}$	Gate 2 source breakdown voltage
$V_{CB}$	Collector-base voltage
$V_{CB0}$	Collector-base voltage
$V_{CC}$	Collector supply voltage
$V_{CE}$	Collector-emitter voltage
$V_{CEM}$	Peak collector-emitter voltage
$V_{CE0}$	Collector-base voltage
$V_{CER}$	Collector-emitter voltage with resistance between base and emitter
$V_{CES}$	Collector-emitter voltage with short-circuited emitter diode
$V_{CEsat}$	Collector-emitter saturation voltage
$V_{DGR}$	Drain-gate voltage
$V_{DS}$	Drain-source voltage



$V_{EB0}$	Emitter-base reverse voltage
$V_F$	Forward voltage
$V_{GS}$	Gate-source voltage
$V_{GS(th)}$	Gate threshold voltage
$-V_{G1S(p)}$	Gate 1 source pinch-off voltage
$-V_{G2S(p)}$	Gate 2 source pinch-off voltage
$V_{neq}$	Equivalent noise voltage
$V_{SD}$	Diode forward on-voltage
$V_0, V_{01}, V_{02}$	Open-circuit output voltage
$y_{11s}$	Gate 1 input admittance
$y_{12}$	Reverse transfer admittance
$ y_{21e} $	Short-circuit forward transfer admittance
$y_{21s}$	Gate 1 forward transfer admittance
$y_{22}$	Gate 1 output admittance

### Light emitting diodes

$D$	Duty cycle
$I_F$	Forward current
$I_R$	Reverse current
$I_v$	Luminous intensity
$i_{FS}$	Surge current
$P_{tot}$	Total power dissipation
$R_{thJA}$	Thermal resistance, junction - ambient
$T_j$	Junction temperature
$T_{stg}$	Storage temperature range
$V_F$	Forward voltage
$V_R$	Reverse voltage
$\lambda_{peak}$	Wavelength at peak emission
$\lambda_{dom}$	Dominant wavelength
$\varphi$	Viewing angle

### Sensors

$\hat{i}$	Peak current
$I$	Operating dc current
$R_{thJA}$	Thermal resistance, junction - ambient
$R_{25}$	Rated resistance
$T_A$	Ambient temperature
$T_{stg}$	Storage temperature range
$\tau$	Thermal time constant

# Technical Information

## Maximum ratings

The maximum ratings specified in the individual data sheets are absolute ratings and apply to a temperature of 25 °C, unless otherwise specified. Exceeding the maximum ratings may result in the destruction of the component, even if other ratings remain below the specified maximums.

## Characteristics

The characteristics in the data sheets are subdivided into maximum, typical and minimum values which apply to 25 °C as well. The typical values correspond in general to the median. Characteristics describe the component behavior at defined operating points. Static characteristics describe the behavior at dc operation, and dynamic characteristics at ac and pulse operation.

The numerical values and diagrams characterize component types; for reasons of device deviation, they should not be understood as ratings for an individual component. The spread is either specified by way of figures or by characteristic curves.

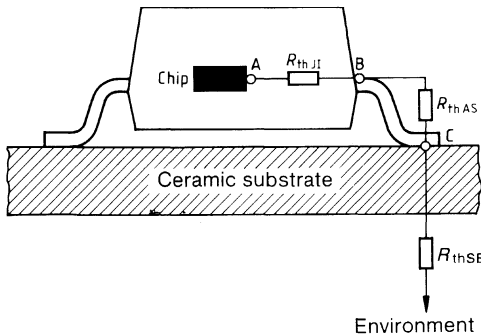
## Thermal resistance

The heat dissipation of SMCs depends on material and thickness of the PC board and of the conductor paths (inherent heating), as well as on the packing density (external heating). Hence, inherent and external heating determine the junction temperature, and thus the permissible thermal stress of SMCs.

The values for thermal resistance given in the data sheets should only be used for rough estimations of the junction temperature  $T_j$ , since they were measured under certain laboratory conditions, where no regard was paid to specific applications.

The thermal resistance can be calculated by:

$$R_{thJA} = R_{thJI} + R_{thAS} + R_{thSE}$$



$R_{thJI}$  = Thermal resistance between junction and terminals of the component

$R_{thAS}$  = Thermal resistance between terminals and soldering surfaces of the substrate

$R_{thSE}$  = Thermal resistance between substrate and environment, e.g. air or cooling area

The **internal thermal resistance**  $R_{thJI}$  is determined by the constructional design of the component and can therefore be exactly specified, whereas the **external thermal resistance**, being the sum of  $R_{thAS} + R_{thSE}$ , depends on the individual application.

## Groups according to total power dissipation

SMCs are grouped according to their max. permissible power dissipation  $P_{\text{tot}}$ :

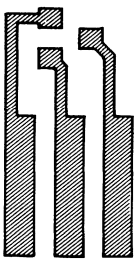
Group	Package: SOT 23, SOT 143
I	RF transistors, small-signal diodes, MOSFETs, sensors
II	AF and switching transistors, LEDs
III	Darlington and power transistors

Group	Package: SOT 89
I	RF transistors
II	AF transistors

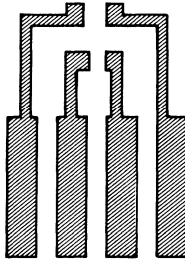
## Groups according to thermal resistances

Thermal resistance	Package: SOT 23, SOT 143			SOT 89	
	Group				
	I	II	III	I	II
$R_{\text{thJl}}$	355 K/W	280 K/W	255 K/W	20 K/W	20 K/W
$R_{\text{thAS}}$	30 K/W	30 K/W	30 K/W	15 K/W	15 K/W
$R_{\text{thSE}}$	65 K/W	65 K/W	65 K/W	90 K/W	90 K/W
$R_{\text{thJA}}^1)$	450 K/W	375 K/W <sup>2)</sup>	350 K/W	125 K/W	125 K/W

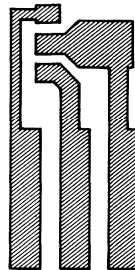
In order to obtain a reduced thermal resistance, the metallic surface for the connection of the collector is enlarged. This is particularly effective when epoxy PCBs with low heat conductivity are used.



SOT 23



SOT 143



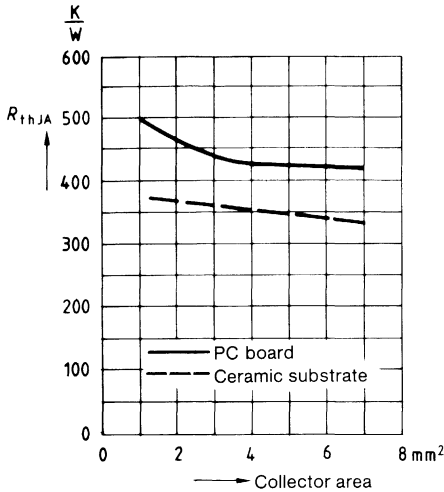
SOT 89

<sup>1)</sup> The data represents a typical value for the various component groups, which relates to a uniform alumina substrate, 15 mm × 16.7 mm × 0.7 mm in size.

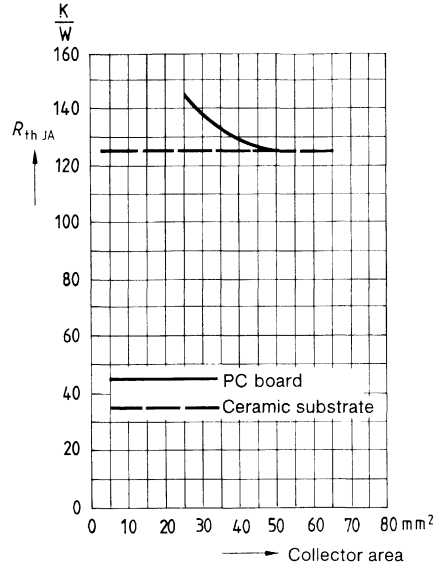
<sup>2)</sup> The value applies to LEDs when operated with two systems (in case of one system: 750 K/W).

## Technical Information

**Thermal resistance for  
SOT 23/SOT 143**



**Thermal resistance for  
SOT 89**



Generally, these specifications suffice to determine the junction temperature  $T_j$ . The determination of the junction temperature via the temperature dependence of the diode path is more exact, however, it is extremely complicated. If it becomes nevertheless necessary to exactly determine the junction temperature  $T_j$ , the temperature  $T_A$  of the component connections has to be measured. Then  $T_j$  can be calculated by:

$$T_j = T_A + R_{thjA} \times P_{tot}$$

### Methods for measuring the temperature at component connections

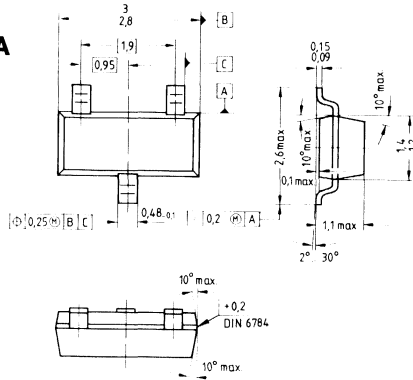
- **Measuring with thermocouple element** (e.g. Thermocoax)

For this method a miniature coated thermocouple element with low thermal capacitance is used. The element, which is coated with a heat-conducting paste, is pressed against the connection with the collector. There is hardly any influence on the device under measurement and deviations do not exceed a few percent.

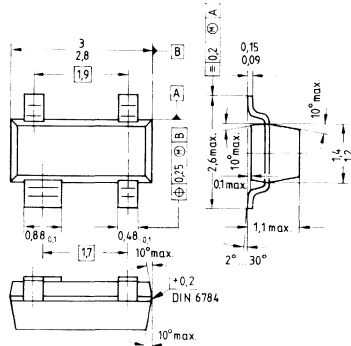
- **Measuring with temperature indicators** (e.g. thermopaper)

Temperature indicators do not cause heat dissipation and thus allow an almost exact determination of temperature. A certain degree of deviations can only result from the rough grade indication of the temperature indicators. This method is quite easy and provides sufficient accuracy. It is particularly suitable for measurement on PC boards.

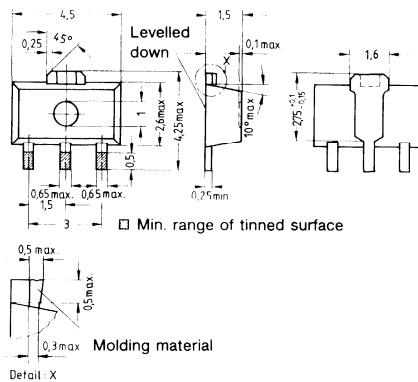
**Package: Version A  
(SOT 23)**



**Package: Version B  
(SOT 143)**



**Package: Version C  
(SOT 89)**



Dimensions in mm

# Quality

---

## AQL values and definitions of defects for electronic components

### Explanations

AQL (acceptable quality level) agreements specify the sampling conditions for the incoming inspection of consignments (conformance test). AQL values in conjunction with the standard sampling inspection plans determine the acceptance or rejection of delivery lots. The size and maximum permissible number of defects of the samples is based on DIN 40080 (identical with MIL Standard 105D and IEC 410), single sampling plan for normal inspection, inspection level II. The sampling instructions of this standard are such that a delivery lot will most probably be accepted (> 90%) if the defect percentage is equal or less than the specified AQL value. Generally, the average defect percentage of the products we deliver is far below the AQL value.

### Definition of defects

A component is considered defective if it does not comply with the characteristics specified in the data sheet or in an agreed upon delivery specification. Defects can be divided into inoperatives, which generally exclude a functional application of the component, and defects of less significance.

### Inoperatives are:

- open or short circuit,
- broken component, package, terminals or encapsulation,
- missing or incorrect marking,
- incorrect identification of terminals,
- intermixing with other component types,
- alternating orientation in a packaging tube or tape.

### The remaining defects can be divided into:

- electrical defects  
(maximum ratings exceeded),
- mechanical defects, e.g. dimensions not adhered to, package damaged, illegible marking, bent leads.

Grouping into major defects and minor defects according to DIN 40080 has been purposely avoided here because these terms are defined primarily on the basis of applications and not specifications. In contrast to this the defect classes that we use – for which AQL values are given below – are clearly outlined by the specification and the mentioned inoperatives.

### AQL values

The AQL values valid for the different product families are comprised in the following table:

Defect type	AQL values
Inoperative (mechanical and electrical)	0.1
Σ electrical defects	0.4
Σ mechanical defects	0.4

for switching times and noise measurements an AQL of 1.5 applies.

**Incoming inspection**

If the user wants to carry out an incoming inspection, the use of a sampling inspection plan is recommended. The test method that is applied must be agreed upon between the user and the supplier.

The following information is necessary for judging any claims that may arise: test circuit, sample size, number of defective items found, sample of evidence, packing list.

**Sampling plan for normal inspection**

in accordance with DIN 40080 or ABC-Std 105D, inspection level II

Lot size	Sample size	AQL value											
		0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	
		A R	A R	A R	A R	A R	A R	A R	A R	A R	A R	A R	
2 to 8	2	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 1	
9 to 15	3	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↑	
16 to 25	5	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↑	↓	
26 to 50	8	↓	↓	↓	↓	↓	↓	↓	0 1	↑	↓	1 2	
51 to 90	13	↓	↓	↓	↓	↓	0 1	↑	↑	↓	1 2	2 3	
91 to 150	20	↓	↓	↓	↓	↓	0 1	↑	↓	1 2	2 3	3 4	
151 to 280	32	↓	↓	↓	↓	0 1	↑	↓	1 2	2 3	3 4	5 6	
281 to 500	50	↓	↓	0 1	↑	↑	↓	1 2	2 3	3 4	5 6	7 8	
501 to 1200	80	↓	↓	0 1	↑	↓	1 2	2 3	3 4	5 6	7 8	10 11	
1201 to 3200	125	↓	0 1	↑	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15	
3201 to 10000	200	0 1	↑	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	
10001 to 35000	315	↑	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	↑	
35001 to 150000	500	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	↑	↑	
150001 to 500000	800	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	↑	↑	↑	
500001 and more	1250	2 3	3 4	5 6	7 8	10 11	14 15	21 22	↑	↑	↑	↑	

A = Acceptance number, i.e. maximum number of defective units in a sample up to which a lot is accepted.

R = Rejection number, i.e. the number of defective units which must be found in a sample as a minimum for rejection of the lot.

## Quality

---

### **Additional conditions:**

As the combination "Acceptance 0/Rejection 1" is not particularly clear, the next largest sample should be taken.

### **Notes**

Stating AQL values is no assurance of characteristics in a legal sense. The agreement of sampling inspections and AQL values does not prevent the customer from carrying out more extensive tests in incoming inspection and claiming replacements for individual defective components under the terms of sale. Any further liability, especially as regards the consequences of component defects, cannot be recognized.



---

**Mounting Instructions**

---



## Supply for automatic assembly

In contrast to leaded components practically all leadless types can be supplied in two package forms:

- Bulk
- Tapes

### Bulk

The most straightforward and low-cost form of how SMCs can be delivered is in bulk. Contrary to leaded components, leadless components can be supplied in this type of packaging for automatic assembly as no bending or interlocking of their terminals can occur. At the assembly machine the components are suitably positioned. In case of need a large quantity of components can thus be supplied in line, i. e. without interrupting the assembly procedure.

### Packaging units

Component	Unit	Packing
Diodes Transistors LEDs Sensors	1000 pieces	Plastic container
MOSFETs	2000 pieces	Antistatic container

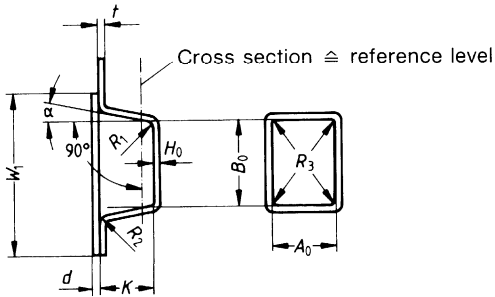
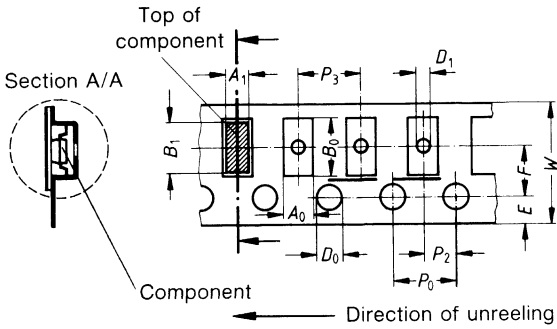
### Tape

The tape is a very frequently used form of supplying surface mounted components. The major benefit of the tape method is that it permits non-interchangeable keeping and meets the requirements of most assembly machines. Cardboard and blister tapes are available tape forms.

The blister tape has preformed compartments corresponding to the component size, which are covered with fixing tape. Blister tapes consist either of plastic material or of plastic-clad aluminum foil. The advantages of the aluminum foil are i. a. its high dimensional stability and its protection against electrostatic charge. For this reason we exclusively use aluminum tapes for packaging our discrete semiconductors. The tapes are internationally standardized in accordance with DIN IEC 286 (at present only draft). This ensures that the tapes are accepted by all machines designed for this kind of assembly. The tape width is generally between 8 mm and 12 mm.

# Mounting Instructions

## Blister tape



## Dimensional table for blister tape

The following table contains only dimensions which are important for taping the components.

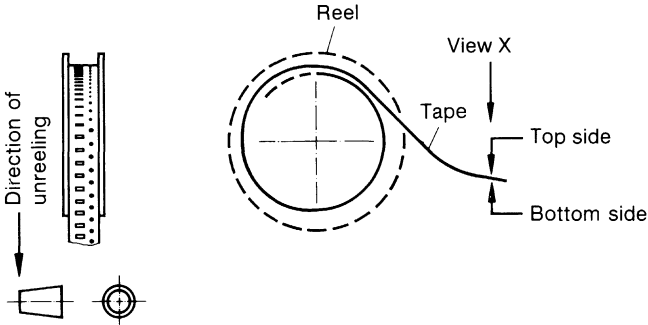
Designation	Symbol	Dimensions (mm)		Notes
		SOT 23 SOT 143	SOT 89	
Tape width	$W$	$8 \pm 0.3$	$12 \pm 0.3$	
Carrier tape thickness	$t$	0.3 max	0.3 max	
Pitch of sprocket holes	$P_0$	$4 \pm 0.1$	$4 \pm 0.1$	Cumulative pitch error + 0.2 mm/10 pitches
Diameter of sprocket holes	$D_0$	$1 + 0.2$	$1.5 + 0.1$	
Distance of sprocket holes	$E$	$1.75 \pm 0.1$	$1.75 \pm 0.1$	
Distance of components	$F$	$3.5 \pm 0.05$	$5.5 \pm 0.1$	Center hole to center compartment
	$P_2$	$2 \pm 0.05$	$2 \pm 0.05$	
Distance compartment to compartment	$P_3$	4	8	Every two pitches (SOT 89)
Compartment dimensions	$K$	2.5 max	4.5 max	Exact dimensions are given with the component dimensions
	$\alpha$	$15^\circ$ max	$15^\circ$ max	
	$R_1, R_2$	0.3 max	0.5 max	
	$H_0$	$0.3 + 0.1$ $- 0.05$	$0.3 + 0.1$ $- 0.05$	Between inner side of the compartment bottom and the reference level for measuring $A_0, B_0$
Compartment	$A_0$ $B_0$	The tolerances are chosen such that the components can change their orientation only within permissible tolerances, but can easily be removed from the tape.		
Hole in compartment	$D_1$	$1 + 0.2$ $- 0.05$	$1.5 + 0.2$	Tolerance to the center of the sprocket hole: 0.1 mm
Width of fixing tape	$W_1$ $d$	5.5 typ 0.1 max	9.5 typ 0.1 max	The fixing tape shall not cover the sprocket holes, nor protrude beyond the carrier tape so that the max. tape width will not be exceeded.
Device tilt in the compart- ment	–	$15^\circ$ max	$15^\circ$ max	
Minimum bending radius	–	30 min	30 min	

# Mounting Instructions

---

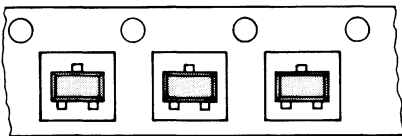
## Polarity and orientation of components

All polarized components are oriented in one direction. The mounting side is oriented to the bottom side of the component compartment. The bottom side is defined as the invisible side of the tape during unreeling.

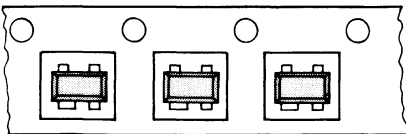


---

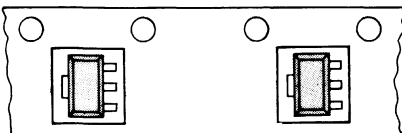
### View X (Top side)



Package  
SOT 23



Package  
SOT 143



Package  
SOT 89

## Fixing of components

Components are prevented from falling out of the component compartment by a transparent fixing tape.

## Storage of tapes

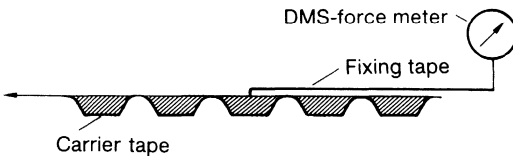
The permissible storage temperature is  $+45^{\circ}\text{C}$  at a relative humidity of  $\leq 95\%$ .

## Break force of fixing tape

The maximum break force of the tape is  $\geq 10\text{ N}$ .

## Peel force of fixing tape

During peel-off the angle between the fixing tape and the direction of unreeling is  $180^{\circ}$ . The peel force of the fixing tape ranges from  $0.2\text{ N}$  to  $1.0\text{ N}$ ; the peel speed is about  $300\text{ mm/min}$ .



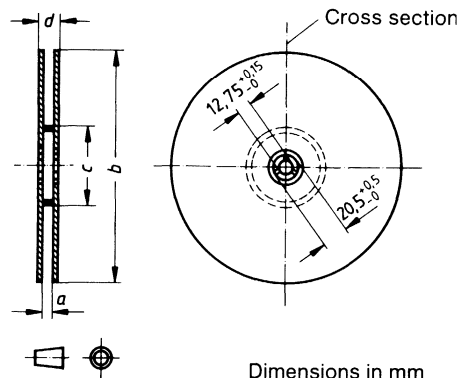
## Peel speed of fixing tape

The fixing tape can be peeled off up to a max. speed of  $5\text{ divisions} \cong 20\text{ mm/s}$ .

## Reel dimensions

Tapes are delivered on reels as shown in the adjacent illustration. The reels are packed in covers for protection from damage.

Dimensions (mm)		
	SOT 23 SOT 143	SOT 89
a	$8.4 + 1.5$	$12.4 + 1.5$
b	180 max	180 max
c	60 min	60 min
d	14.4 max	18,4 max



Dimensions in mm

# Mounting Instructions

## Packaging units

Package	Components per reel
SOT 23, SOT 143	3000 pieces
SOT 89	1000 pieces

## Labelling

Each reel is labelled with manufacturer, type, series number, and date.

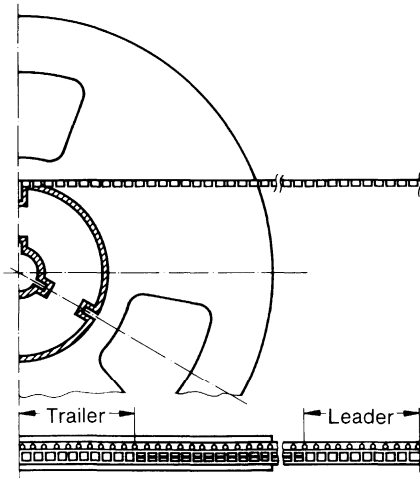
## Missing components

A maximum of two consecutive components may be missing, provided that this gap is followed by six components. The number of empty places shall not exceed 0.25% of the total number of components per reel. Upon request, other agreements are possible.

## Leader and trailer

Fixing tape with carrier tape without components

Leader	Trailer
min. 200 mm (50 pitches)	min. 40 mm (10 pitches)
max. 1400 mm (100 pitches)	max. 100 mm (25 pitches)



## Tape packaging of ESD components

SMCs can also be supplied on tapes including protection against electrostatic charges. When packaging the reel has therefore to be electrically connected with the assembly machine. The assembly machine has to be grounded.

This method of taping complies with IEC/T 640.

ESD = **E**lectrostatically **S**ensitive **D**evelopments

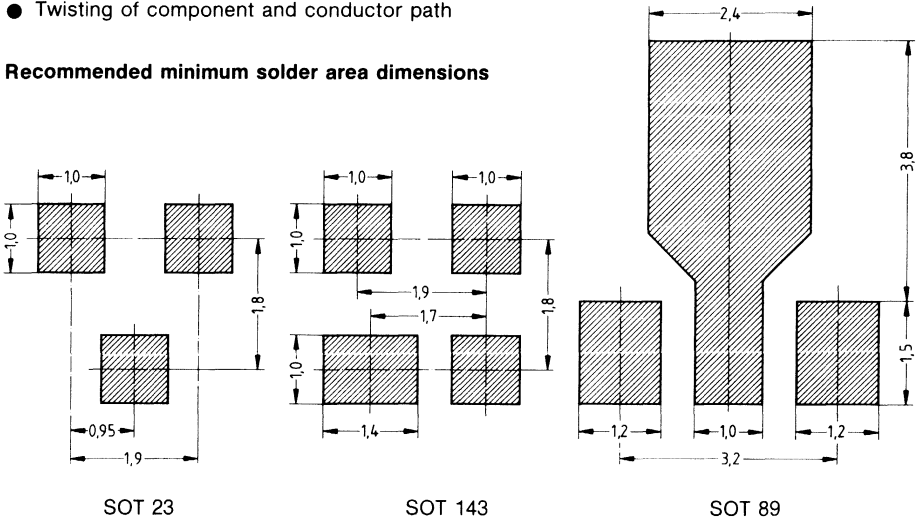


## PCB layout

Upon introduction of surface-mounted components, the PCB layout has to be accommodated to this new technology. This demand should be fulfilled not only to better utilize the packing density but also to meet the requirements resulting from the new inserting and processing system. Some reference points for the PCB design are:

- Distance between conductor paths
- Component tolerances
- Distance between components
- Twisting of component and conductor path

## Recommended minimum solder area dimensions



SOT 23

SOT 143

SOT 89

## Recommended mounting position for wave soldering

Distance of mounting positions (mm)  
 Direction of waving ←

SOT 23 (SOT 143)	1,5	0,6	1,5	1	0,6
SOT 89	2	2	2	1	1

Undue mounting position

## Mounting Instructions

---

### Glueing

Prior to wave soldering, SMCs must be fixed to the PCB by means of an appropriate adhesive. The adhesive (in most cases a multicomponent adhesive) has to fulfill the following demands:

- Uniform viscosity to ensure easy coating
- No chemical reactions upon hardening in order not to deteriorate component and PC board
- Straightforward exchange of components in case of repair

### Soldering methods

The soldering method is particularly important for obtaining good electrical connections and inhibiting short circuits. The choice of the soldering method largely depends on the design of the PC board (single, double-clad, multilayer board, etc.), on the supplied components and the production facilities.

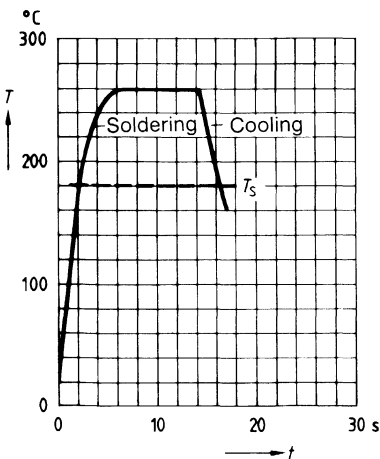
In addition to hand soldering, which should only be used for laboratory and repair purposes, there are mechanical soldering methods such as wave and reflow soldering.

### Wave soldering

Wave soldering is the soldering method which is at present applied in most cases. There are a number of powerful machines which are suitable for the most diversified applications. With a maximum bath temperature of 260 °C the soldering time should not exceed 8 s (see diagram). Prior to the wave the flux is attached by a fluxer.

The previous wave soldering method will be improved by a double-wave solder bath. Under high pressure the first wave then deposits the solder onto all joints to be soldered regardless of possible short circuits. The immediately following second wave now removes the remaining solder and clears the existing short circuits.

### Max. perm. temperature stress at the component (soldering without preheating)



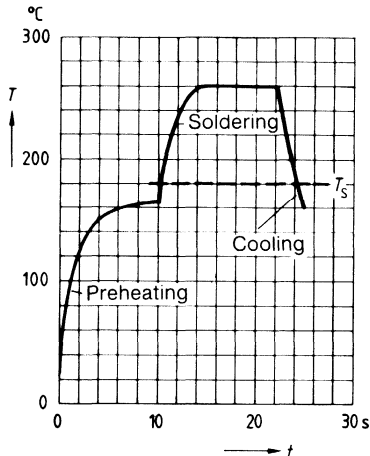
$T_S$  = Melting point of the solder

## Reflow soldering

If reflow soldering is used, the components and soldering pads must at least at one side be wetted or covered with solder or solder paste. In the form of paste the solder can be applied to the footprint pads; this is done in most cases by screen printing or in pattern technique. The most important reflow soldering methods are:

- Vapor phase soldering
- Hot gas soldering
- Solder bridge

### Max. perm. temperature stress at the component (soldering with preheating)



## Iron soldering

Soldering with a temperature-controlled miniature iron, for example, is permissible. It is, however, important to ensure that the tip does not come into contact with the component. This method should nevertheless only be used in exceptional cases (repairs, etc.).

## Soldering flux

- The soldering flux used for wave soldering is not subject to changes, i.e. use of colophony (F-SW 32 in acc. with DIN 8511).
- If solder pastes are used, however, most of them contain aggressive fluxes, the residues of which must be removed in any case by cleaning.

## Mounting Instructions

---

### PCB cleaning

- Cleaning in solvents is permitted at approx. 70 °C to 80 °C for about 15 seconds. Detailed information is available upon request.
- Ultrasonic cleaning (double half-wave operation)  
Ultrasonic cleaning is less advisable; should it, however, be used, the following have to be taken into account:

Cleaning agent:	Isopropanol, Freon
Bath temperature:	approx. 30 °C
Duration of cleaning:	max. 30 s
Ultrasonic frequency:	40 kHz
Ultrasonic changing pressure:	approx. 0.5 bar

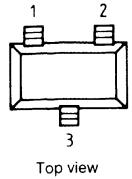
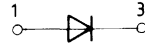
---

**Diodes**

---

**Silicon planar epitaxial diode**

- For high-speed switching applications
- Peak reverse voltage 50 V



Type	Marking	Ordering code	Package
BAL 74	JC	Refer to index	Version A

**Maximum ratings**

Reverse voltage	$V_R$	50 V
Repetitive peak reverse voltage	$V_{RRM}$	50 V
Forward current	$I_F$	250 mA
RMS forward current	$I_{FRMS}$	250 mA
Mean forward current $t = 20 \text{ ms}, t_p = 10 \text{ ms}$	$I_{FAV}$	250 mA
Surge forward current $t = 1 \mu\text{s}$	$I_{FSM}$	4.5 A
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	330 mW
Junction temperature	$T_j$	175 °C
Storage temperature range	$T_{stg}$	-65 ... +150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 450 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

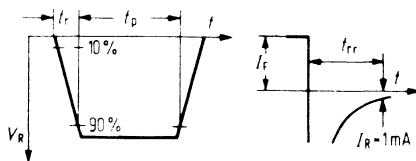
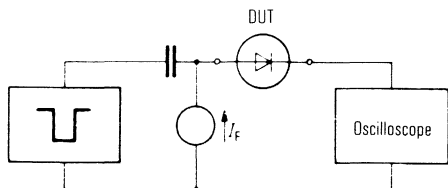
## Characteristics

at  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Breakdown voltage $I_{(BR)} = 100\text{ }\mu\text{A}$	$V_{(BR)}$	50	–	–	V
Max. forward voltage $I_F = 100\text{ mA}$	$V_F$	–	–	1,0	V
Reverse current $V_R = 50\text{ V}$ $V_R = 50\text{ V}, T_A = 150\text{ }^\circ\text{C}$	$I_R$	–	–	0,1 100	$\mu\text{A}$ $\mu\text{A}$

Dynamic characteristics	Symbol	min	typ	max	Unit
Capacitance $V_R = 0\text{ V}, f = 1\text{ MHz}$	$C_0$	–	–	2,0	pF
Reverse recovery time $I_F = 10\text{ mA}, I_R = 10\text{ mA},$ $R_L = 100\text{ }\Omega,$ measured at $I_R = 1\text{ mA}$	$t_{rr}$	–	–	4	ns

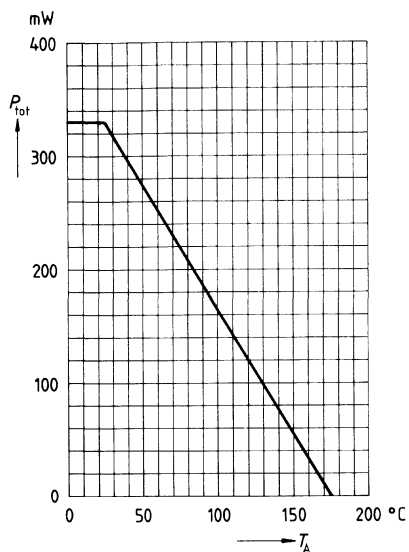
### Test circuit for reverse recovery time



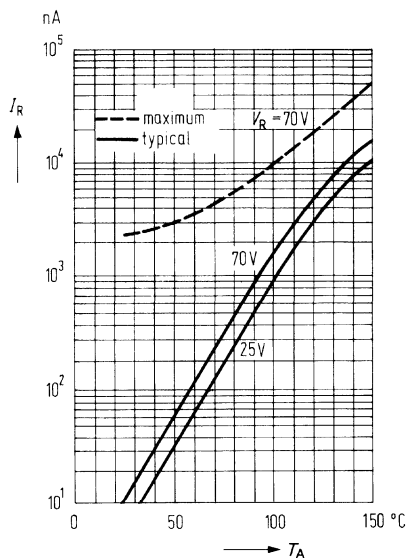
Pulse generator:  $t_p = 100\text{ ns}$ ,  $D = 0,05$   
 $t_r = 0,6\text{ ns}$ ,  $R_i = 50\text{ }\Omega$   
 $V_p = V_R + I_F \times R_i$

Oscilloscope:  $R = 50\text{ }\Omega$   
 $t_r = 0,35\text{ ns}$   
 $C \leq 1\text{ pF}$

**Total power dissipation  $P_{\text{tot}} = f(T_A)$**

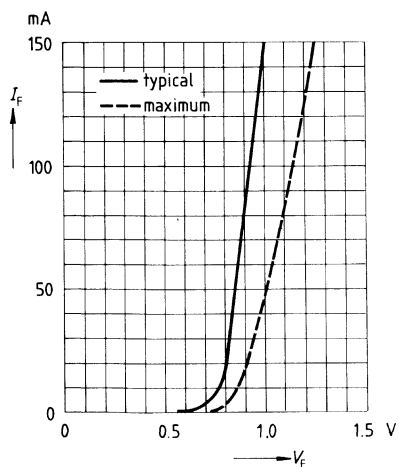


**Reverse current  $I_R = f(T_A)$**

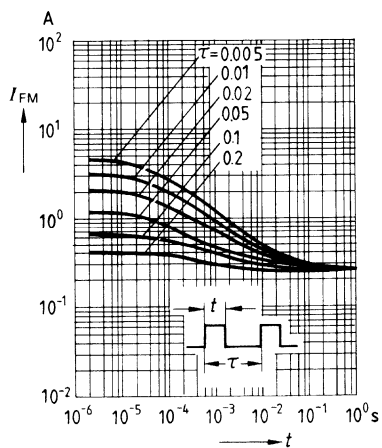


**Forward current  $I_F = f(V_F)$**

$T_A = 25^{\circ}\text{C}$

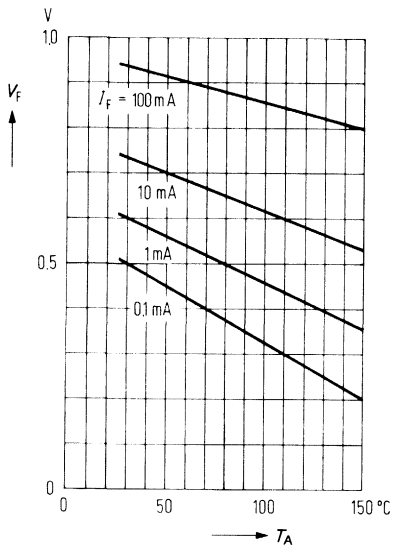


**Peak forward current  $I_{FM} = f(t)$**



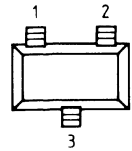
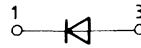


Forward voltage  $V_F = f(T_A)$



**Silicon planar epitaxial diode**

- For high-speed switching applications
- Peak reverse voltage 70 V



Top view

Type	Marking	Ordering code	Package
BAL 99	JF	Refer to index	Version A

**Maximum ratings**

Reverse voltage	$V_R$	70 V
Repetitive peak reverse voltage	$V_{RRM}$	70 V
Forward current	$I_F$	250 mA
RMS forward current	$I_{FRMS}$	250 mA
Mean forward current $t = 20 \text{ ms}, t_p = 10 \text{ ms}$	$I_{FAV}$	250 mA
Surge forward current $t = 1 \mu\text{s}$	$I_{FSM}$	4,5 A
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	330 mW
Junction temperature	$T_j$	175 °C
Storage temperature range	$T_{stg}$	-65 ... +150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.5 mm × 0.7 mm	$R_{thJA}$	≤ 450 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

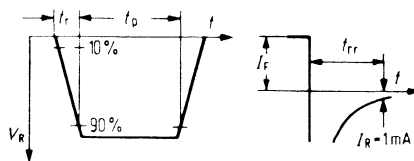
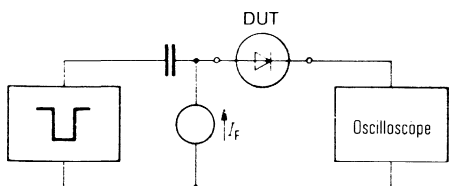
## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Breakdown voltage $I_{(BR)} = 100\ \mu\text{A}$	$V_{(BR)}$	70	–	–	V
Max. forward voltage $I_F = 1\ \text{mA}$	$V_F$	–	–	715	mV
$I_F = 10\ \text{mA}$		–	–	855	mV
$I_F = 50\ \text{mA}$		–	–	1000	mV
$I_F = 150\ \text{mA}$		–	–	1250	mV
Reverse current $V_R = 70\ \text{V}$	$I_R$	–	–	2,5	$\mu\text{A}$
$V_R = 25\ \text{V}, T_A = 150^\circ\text{C}$		–	–	30	$\mu\text{A}$
$V_R = 70\ \text{V}, T_A = 150^\circ\text{C}$		–	–	50	$\mu\text{A}$

Dynamic characteristics	Symbol	min	typ	max	Unit
Capacitance $V_R = 0\ \text{V}, f = 1\ \text{MHz}$	$C_0$	–	–	1,5	pF
Reverse recovery time $I_F = 10\ \text{mA}, I_R = 10\ \text{mA},$ $R_L = 100\ \Omega,$ measured at $I_R = 1\ \text{mA}$	$t_{rr}$	–	–	6	ns

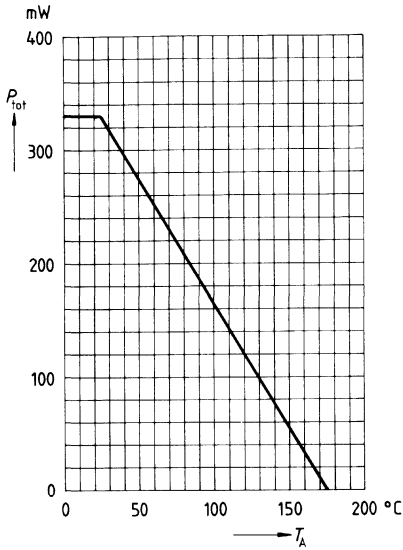
### Test circuit for reverse recovery time



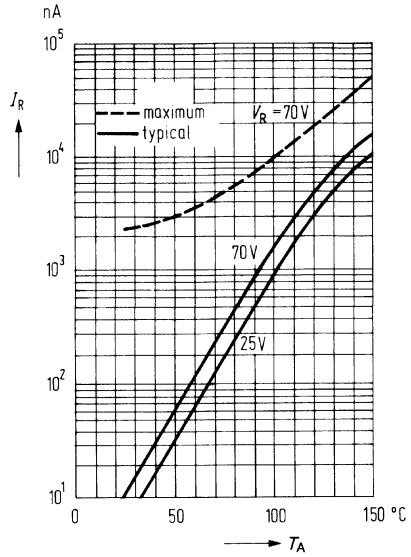
Pulse generator:  $t_p = 100\ \text{ns}, D = 0,05$   
 $t_r = 0,6\ \text{ns}, R_i = 50\ \Omega$   
 $V_p = V_R + I_F \times R_i$

Oscilloscope:  $R = 50\ \Omega$   
 $t_r = 0,35\ \text{ns}$   
 $C \leq 1\ \text{pF}$

**Total power dissipation  $P_{tot} = f(T_A)$**

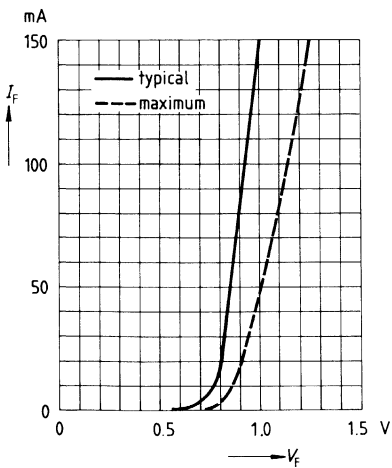


**Reverse current  $I_R = f(T_A)$**

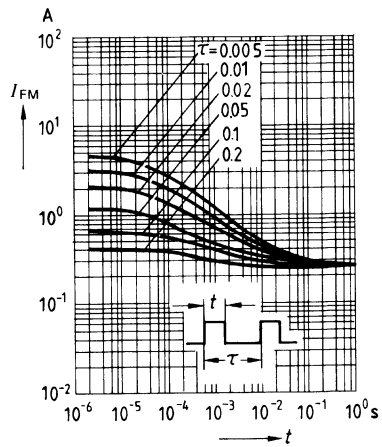


**Forward current  $I_F = f(V_F)$**

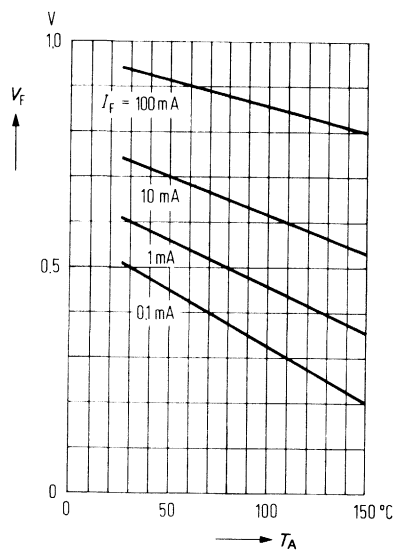
$T_A = 25^\circ\text{C}$



**Peak forward current  $I_{FM} = f(t)$**

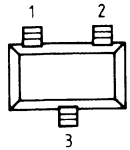


Forward voltage  $V_F = f(T_A)$



**Silicon planar epitaxial dual diodes**

- For general-purpose switching applications
- Low distortion factor
- High long-term stability of electrical characteristics



Type	Marking	Ordering code	Package	Circuit
BAR 14-1	L7	Refer to index	Version A	
BAR 15-1	L8			
BAR 16-1	L9			

**Maximum ratings<sup>1)</sup>**

Reverse voltage	$V_R$	100 V
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	100 mW
Junction temperature range	$T_j$	-55 ... +150 °C
Storage temperature range	$T_{stg}$	-55 ... +125 °C
<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 450 K/W

<sup>1)</sup> Ratings per diode

### Characteristics<sup>1)</sup>

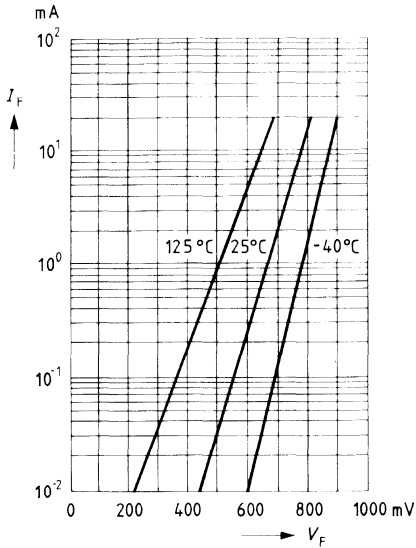
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Characteristics	Symbol	min	typ	max	Unit
Breakdown voltage $I_R = 10\ \mu\text{A}$	$V_{(BR)}$	100	–	–	V
Reverse current $V_R = 50\ \text{V}$	$I_R$	–	–	100	nA
Diode capacitance $V_R = 50\ \text{V}$ , $f = 1\ \text{MHz}$	$C_D$	–	0,35	0,5	pF
Charge carrier life time <sup>2)</sup> $I_F = 10\ \text{mA}$ , $I_R = 6\ \text{mA}$	$\tau_L$	1,0	1,5	–	$\mu\text{s}$
RF forward resistance $f = 100\ \text{MHz}$ , $I_F = 10\ \mu\text{A}$	$r_{F1}$	–	3,0	–	$\text{k}\Omega$
$I_F = 100\ \mu\text{A}$	$r_{F2}$	–	0,4	–	$\text{k}\Omega$
$I_F = 1\ \text{mA}$	$r_{F3}$	–	50	–	$\Omega$
$I_F = 10\ \text{mA}$	$r_{F4}$	–	9,0	–	$\Omega$

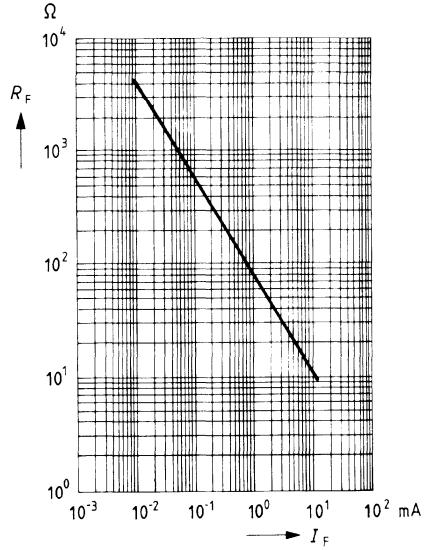
<sup>1)</sup> Ratings per diode.

<sup>2)</sup> Real charge carrier life time, measured by Krakau method.

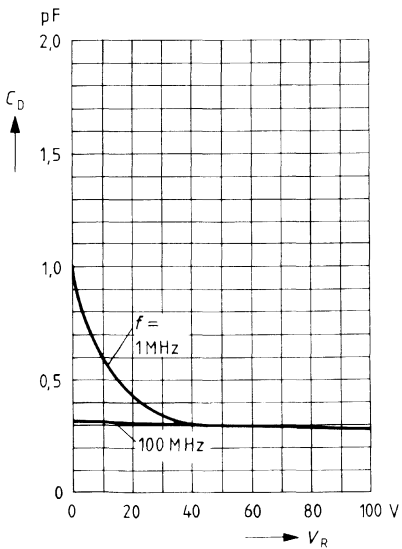
Forward current  $I_F = f(V_F)$   
 $T_A = 25^\circ\text{C}$



Typical RF forward resistance  $R_F = f(I_F)$



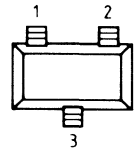
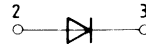
Diode capacitance  $C_D = f(V_R)$





**Silicon planar epitaxial diode**

- For high-speed switching applications
- Peak reverse voltage 50 V



Top view

Type	Marking	Ordering code	Package
BAR 74	JB	Refer to index	Version A

**Maximum ratings**

Reverse voltage	$V_R$	50 V
Repetitive peak reverse voltage	$V_{RRM}$	50 V
Forward current	$I_F$	250 mA
RMS forward current	$I_{FRMS}$	250 mA
Mean forward current $t = 20 \text{ ms}, t_p = 10 \text{ ms}$	$I_{FAV}$	250 mA
Surge forward current $t = 1 \mu\text{s}$	$I_{FSM}$	4,5 A
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	330 mW
Junction temperature	$T_j$	175 °C
Storage temperature range	$T_{stg}$	- 65 ... + 150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 450 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

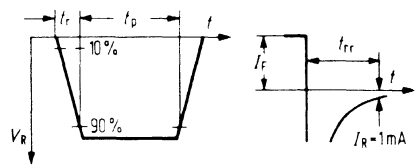
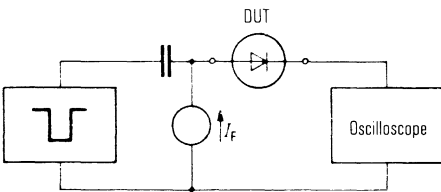
### Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Breakdown voltage $I_{(BR)} = 100 \mu\text{A}$	$V_{(BR)}$	50	–	–	V
Max. forward voltage $I_F = 100 \text{ mA}$	$V_F$	–	–	1,0	V
Reverse current $V_R = 50 \text{ V}$ $V_R = 50 \text{ V}, T_A = 150^\circ\text{C}$	$I_R$	–	–	0,1 100	$\mu\text{A}$ $\mu\text{A}$

Dynamic characteristics	Symbol	min	typ	max	Unit
Capacitance $V_R = 0 \text{ V}, f = 1 \text{ MHz}$	$C_0$	–	–	2	pF
Reverse recovery time $I_F = 10 \text{ mA}, I_R = 10 \text{ mA},$ $R_L = 100 \Omega,$ measured at $I_R = 1 \text{ mA}$	$t_{rr}$	–	–	4	ns

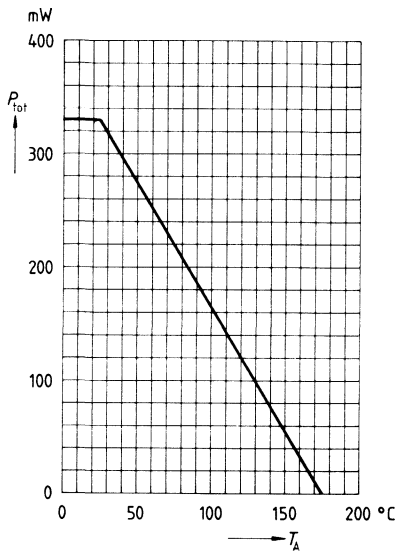
### Test circuit for reverse recovery time



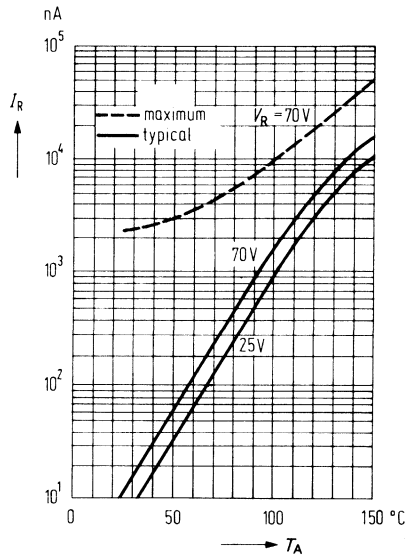
Pulse generator:  $t_p = 100 \text{ ns}, D = 0,05$   
 $t_r = 0,6 \text{ ns}, R_i = 50 \Omega$   
 $V_p = V_R + I_F \times R_i$

Oscilloscope:  $R = 50 \Omega$   
 $t_r = 0,35 \text{ ns}$   
 $C \leq 1 \text{ pF}$

**Total power dissipation  $P_{tot} = f(T_A)$**

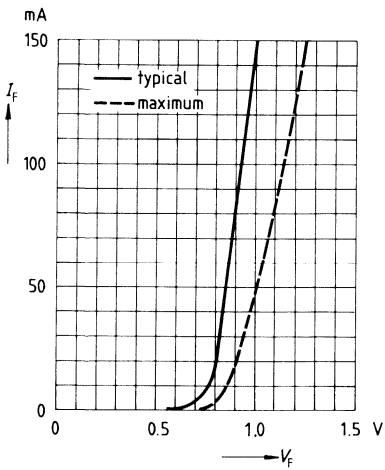


**Reverse current  $I_R = f(T_A)$**

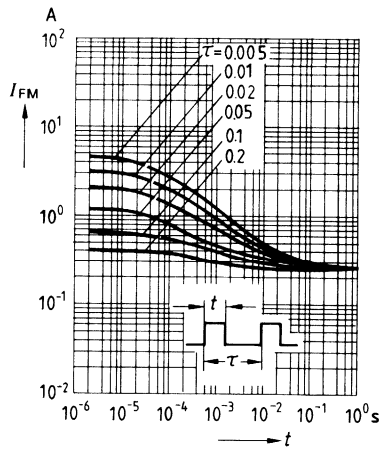


**Forward current  $I_F = f(V_F)$**

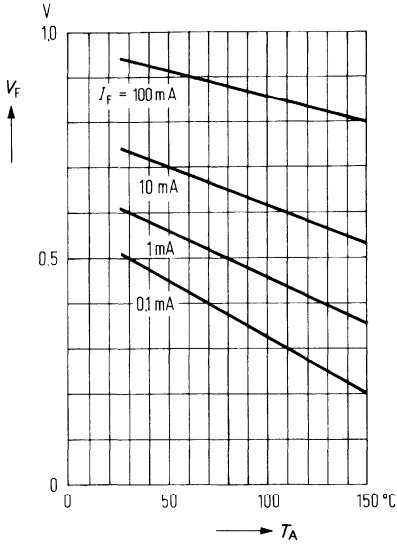
$T_A = 25^\circ C$



**Peak forward current  $I_{FM} = f(t)$**

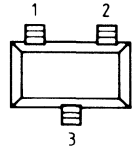


Forward voltage  $V_F = f(T_A)$



**Silicon planar epitaxial diode**

- For high-speed switching applications
- Peak reverse voltage 70 V



Top view

Type	Marking	Ordering code	Package
BAR 99	JG	Refer to index	Version A

**Maximum ratings**

Reverse voltage	$V_R$	70 V
Repetitive peak reverse voltage	$V_{RRM}$	70 V
Forward current	$I_F$	250 mA
RMS forward current	$I_{FRMS}$	250 mA
Mean forward current $t = 20 \text{ ms}, t_p = 10 \text{ ms}$	$I_{FAV}$	250 mA
Surge forward current $t = 1 \mu\text{s}$	$I_{FSM}$	4,5 A
Total power dissipation $T_A = 25 \text{ }^\circ\text{C}$	$P_{tot}$	330 mW
Junction temperature	$T_j$	175 °C
Storage temperature range	$T_{stg}$	- 65 ... + 150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 450 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

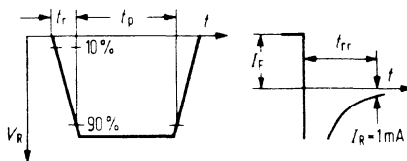
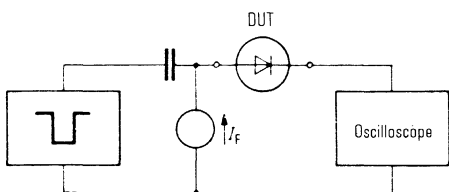
### Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Breakdown voltage $I_{(BR)} = 100 \mu\text{A}$	$V_{(BR)}$	70	–	–	V
Max. forward voltage $I_F = 1 \text{ mA}$	$V_F$	–	–	715	mV
$I_F = 10 \text{ mA}$		–	–	855	mV
$I_F = 50 \text{ mA}$		–	–	1000	mV
$I_F = 150 \text{ mA}$		–	–	1250	mV
Reverse current $V_R = 70 \text{ V}$	$I_R$	–	–	2,5	$\mu\text{A}$
$V_R = 25 \text{ V}, T_A = 150^\circ\text{C}$		–	–	30	$\mu\text{A}$
$V_R = 70 \text{ V}, T_A = 150^\circ\text{C}$		–	–	50	$\mu\text{A}$

Dynamic characteristics	Symbol	min	typ	max	Unit
Capacitance $V_R = 0 \text{ V}, f = 1 \text{ MHz}$	$C_0$	–	–	1,5	pF
Reverse recovery time $I_F = 10 \text{ mA}, I_R = 10 \text{ mA},$ $R_L = 100 \Omega,$ measured at $I_R = 1 \text{ mA}$	$t_{rr}$	–	–	6	ns

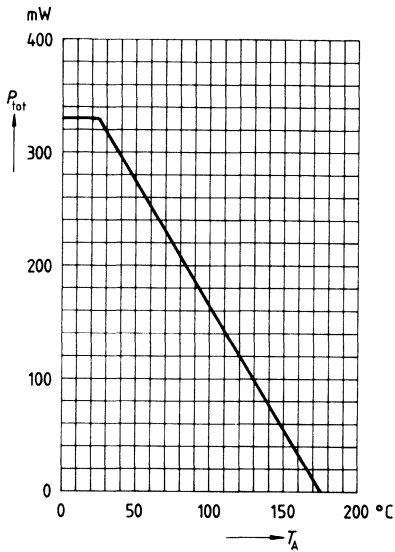
### Test circuit for reverse recovery time



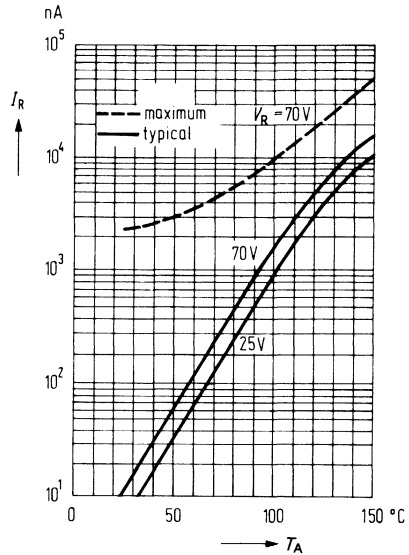
Pulse generator:  $t_p = 100 \text{ ns}, D = 0,05$   
 $t_r = 0,6 \text{ ns}, R_i = 50 \Omega$   
 $V_p = V_R + I_F \times R_i$

Oscilloscope:  $R = 50 \Omega$   
 $t_r = 0,35 \text{ ns}$   
 $C \leq 1 \text{ pF}$

**Total power dissipation  $P_{tot} = f(T_A)$**

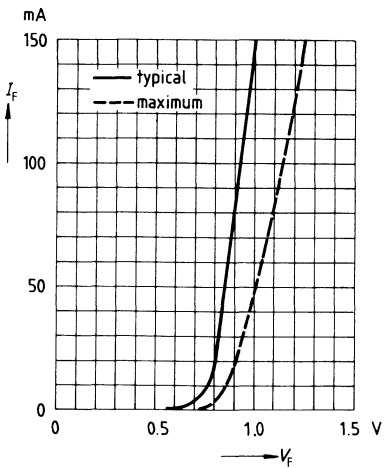


**Reverse current  $I_R = f(T_A)$**

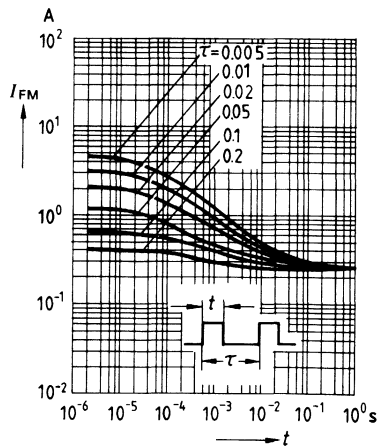


**Forward current  $I_F = f(V_F)$**

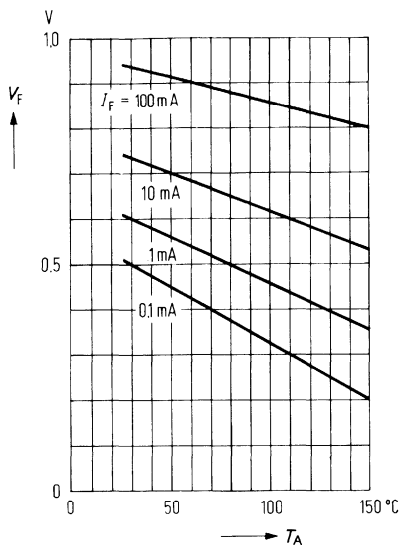
$T_A = 25^{\circ}C$



**Peak forward current  $I_{FM} = f(t)$**



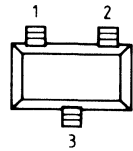
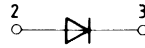
Forward voltage  $V_F = f(T_A)$





**Silicon planar epitaxial diode**

- For high-speed switching applications
- Peak reverse voltage 85 V



Top view

Type	Marking	Ordering code	Package
BAS 16	JU	Refer to index	Version A

**Maximum ratings**

Reverse voltage	$V_R$	75 V
Repetitive peak reverse voltage	$V_{RRM}$	85 V
Forward current	$I_F$	250 mA
RMS forward current	$I_{FRMS}$	250 mA
Mean forward current $t = 20 \text{ ms}$ , $t_p = 10 \text{ ms}$	$I_{FAV}$	250 mA
Surge forward current $t = 1 \mu\text{s}$	$I_{FSM}$	4,5 A
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	330 mW
Junction temperature	$T_j$	175 °C
Storage temperature range	$T_{stg}$	-65 ... +150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 450 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

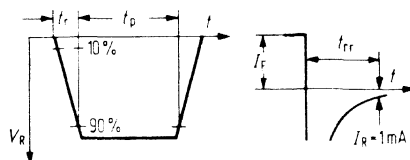
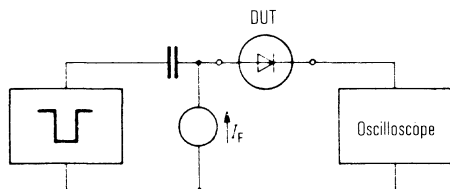
### Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Breakdown voltage $I_{(BR)} = 100\ \mu\text{A}$	$V_{(BR)}$	75	-	-	V
Max. forward voltage $I_F = 1\ \text{mA}$	$V_F$	-	-	715	mV
$I_F = 10\ \text{mA}$		-	-	855	mV
$I_F = 50\ \text{mA}$		-	-	1000	mV
$I_F = 150\ \text{mA}$		-	-	1250	mV
Reverse current $V_R = 75\ \text{V}$	$I_R$	-	-	1,0	$\mu\text{A}$
$V_R = 25\ \text{V}, T_A = 150^\circ\text{C}$		-	-	30	$\mu\text{A}$
$V_R = 75\ \text{V}, T_A = 150^\circ\text{C}$		-	-	50	$\mu\text{A}$
Forward recovery voltage $I_F = 10\ \text{mA}, t_p = 20\ \text{ns}$	$V_{FR}$	-	-	1,75	V

Dynamic characteristics	Symbol	min	typ	max	Unit
Capacitance $V_R = 0\ \text{V}, f = 1\ \text{MHz}$	$C_0$	-	-	2,0	pF
Reverse recovery time $I_F = 10\ \text{mA}, I_R = 10\ \text{mA},$ $R_L = 100\ \Omega,$ measured at $I_R = 1\ \text{mA}$	$t_{rr}$	-	-	6	ns

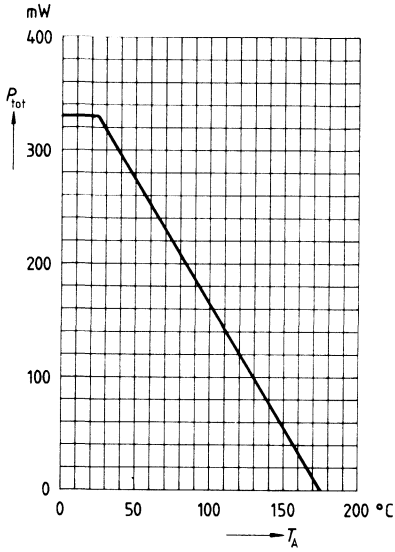
### Test circuit for reverse recovery time



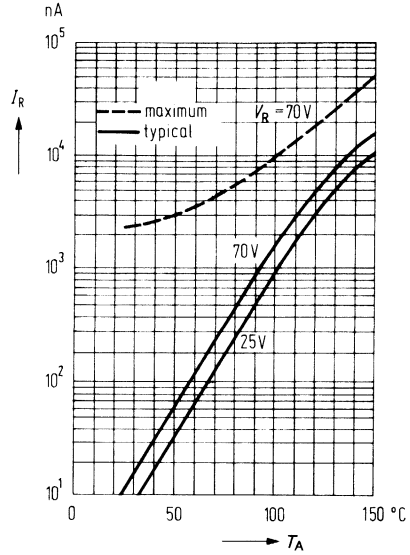
Pulse generator:  $t_p = 100\ \text{ns}, D = 0,05$   
 $t_r = 0,6\ \text{ns}, R_i = 50\ \Omega$   
 $V_p = V_R + I_F \times R_i$

Oscilloscope:  $R = 50\ \Omega$   
 $t_r = 0,35\ \text{ns}$   
 $C \leq 1\ \text{pF}$

**Total power dissipation  $P_{tot} = f(T_A)$**

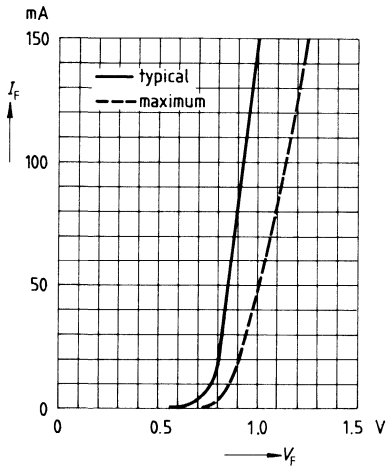


**Reverse current  $I_R = f(T_A)$**

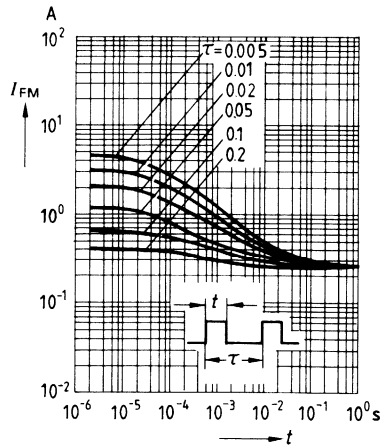


**Forward current  $I_F = f(V_F)$**

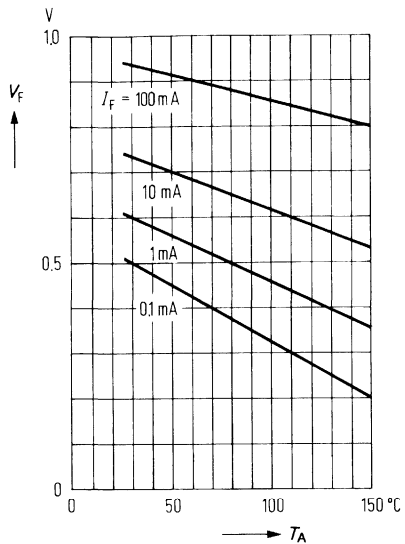
$T_A = 25^\circ\text{C}$



**Peak forward current  $I_{FM} = f(t)$**

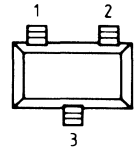


Forward voltage  $V_F = f(T_A)$



**Silicon Schottky dual diodes**

- For ultrafast switching and protecting applications
- High reliability due to titanium-platinum-gold metallization
- Nitride over oxide passivation provides for long-term stability of electrical characteristics
- Single chips are available



Top view

Type	Marking	Ordering code	Package	Circuit
BAS 40-04	44	Refer to index	Version A	
BAS 40-05	45	Refer to index	Version A	
BAS 40-06	46	Refer to index	Version A	

**Maximum ratings<sup>1)</sup>**

Reverse voltage	$V_R$	40 V
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	100 mW
Junction temperature range	$T_j$	- 55 ... + 150 °C
Storage temperature range	$T_{stg}$	- 55 ... + 150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 450 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

<sup>1)</sup> Ratings per diode

### Characteristics<sup>1)</sup>

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

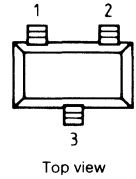
Characteristics	Symbol	min	typ	max	Unit
Breakdown voltage $I_R = 10\ \mu\text{A}$	$V_{(BR)}$	40	–	–	V
Reverse current $V_R = 30\ \text{V}$	$I_R$	–	–	1000	nA
Forward current $V_F = 1\ \text{V}$	$I_F$	40	–	–	mA
Forward voltage $I_F = 1\ \text{mA}$	$V_F$	–	–	380	mV
Diode capacitance $V_R = 0\ \text{V}, f = 1\ \text{MHz}$	$C_D$	–	4,0	5,0	pF
Charge carrier life time <sup>2)</sup> $I_F = 5\ \text{mA}$	$\tau_L$	–	–	100	ps

<sup>1)</sup> Ratings per diode.

<sup>2)</sup> Real charge carrier life time, measured by Krakau method.

**Silicon Schottky dual diodes**

- For ultrafast switching and protecting applications
- High reliability due to titanium-platinum-gold metallization
- Nitride over oxide passivation provides for long-term stability of electrical characteristics
- Single chips are available



Type	Marking	Ordering code	Package	Circuit
BAS 70-04	74	Refer to index	Version A	
BAS 70-05	75			
BAS 70-06	76			

**Maximum ratings<sup>1)</sup>**

Reverse voltage	$V_R$	70 V
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	100 mW
Junction temperature range	$T_j$	- 55 ... + 150 °C
Storage temperature range	$T_{stg}$	- 55 ... + 150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm x 16.7 mm x 0.7 mm	$R_{thJA}$	≤ 450 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

<sup>1)</sup> Ratings per diode

### Characteristics<sup>1)</sup>

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Characteristics	Symbol	min	typ	max	Unit
Breakdown voltage $I_R = 10\ \mu\text{A}$	$V_{(BR)}$	70	–	–	V
Reverse current $V_R = 50\ \text{V}$	$I_R$	–	–	200	nA
Forward current $V_F = 1\ \text{V}$	$I_F$	15	–	–	mA
Forward voltage $I_F = 1\ \text{mA}$	$V_F$	–	–	410	mV
Diode capacitance $V_R = 0\ \text{V}; f = 1\ \text{MHz}$	$C_D$	–	1,5	2,0	pF
Charge carrier life time <sup>2)</sup> $I_F = 5\ \text{mA}$	$\tau_L$	–	–	100	ps

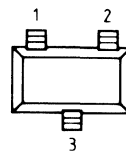
<sup>1)</sup> Ratings per diode.

<sup>2)</sup> Real charge carrier life time, measured by Krakau method.



**Silicon Schottky diode**

- UHF mixer diode
- For high-speed switching applications



Top view

Type	Marking	Ordering code	Package
BAT 17	53	Refer to index	Version A

**Maximum ratings**

Reverse voltage	$V_R$	4 V
Forward current	$I_F$	30 mA
Junction temperature range	$T_j$	-55 ... +150 °C
Storage temperature range	$T_{stg}$	-55 ... +150 °C

**Thermal resistance**

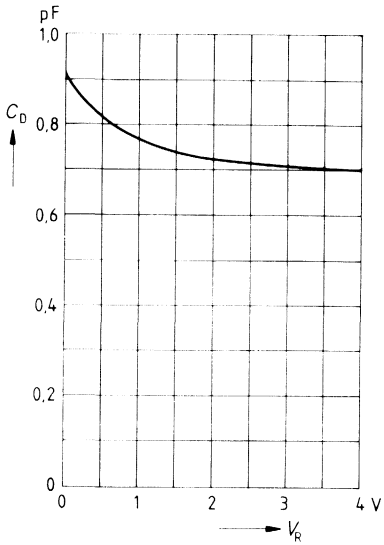
junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 450 K/W
-------------------------------------------------------------------------------	------------	-----------

## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

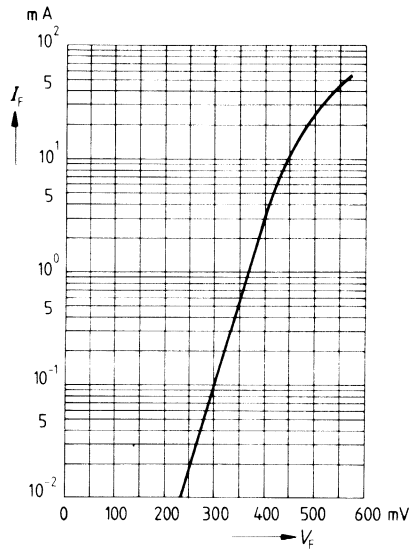
Characteristics	Symbol	min	typ	max	Unit
Breakdown voltage $I_R = 10\ \mu\text{A}$	$V_{(BR)}$	4	–	–	V
Reverse current $V_R = 3\ \text{V}$ , $T_A = 25^\circ\text{C}$ $V_R = 3\ \text{V}$ , $T_A = 60^\circ\text{C}$	$I_R$	– –	– –	0,25 1,25	$\mu\text{A}$ $\mu\text{A}$
Forward voltage $I_F = 100\ \mu\text{A}$ $I_F = 1\ \text{mA}$ $I_F = 10\ \text{mA}$	$V_F$	– – –	– – –	400 450 600	mV mV mV
Diode capacitance $V_R = 0\ \text{V}$ , $f = 1\ \text{MHz}$	$C_D$	0,6	–	1	pF
Differential forward resistance $I_F = 5\ \text{mA}$ , $f = 1\ \text{kHz}$	$r_f$	–	8	15	$\Omega$
Noise figure $f = 900\ \text{MHz}$ , $I_F = 2\ \text{mA}$ , IF amplifier noise: $NF = 1,5\ \text{dB}$ , $f = 35\ \text{MHz}$	$NF$	–	–	8	dB

Diode capacitance  $C_D = f(V_R)$



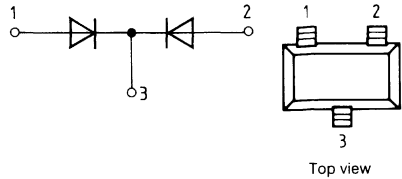
Forward current  $I_F = f(V_F)$

$T_A = 25^\circ\text{C}$



**Silicon planar epitaxial dual diode**

- For high-speed switching applications
- Peak reverse voltage 70 V
- With common cathode



Type	Marking	Ordering code	Package
BAV 70	JJ	Refer to index	Version A

**Maximum ratings<sup>1)</sup>**

Reverse voltage	$V_R$	70 V
Repetitive peak reverse voltage	$V_{RRM}$	70 V
Forward current	$I_F$	250 mA
RMS forward current	$I_{FRMS}$	250 mA
Mean forward current	$I_{FAV}$	250 mA
$t = 20 \text{ ms}, t_p = 10 \text{ ms}$		
Surge forward current	$I_{FSM}$	4,5 A
$t = 1 \mu\text{s}$		
Total power dissipation	$P_{tot}$	330 mW
$T_A = 25^\circ\text{C}$		
Junction temperature	$T_j$	175 °C
Storage temperature range	$T_{stg}$	-65 ... +150 °C
<b>Thermal resistance</b>	$R_{thJA}$	$\leq 450 \text{ K/W}$
junction-ambient		
package mounted		
on alumina		
15 mm × 16.7 mm × 0.7 mm		

<sup>1)</sup> Ratings per diode

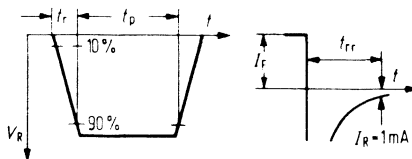
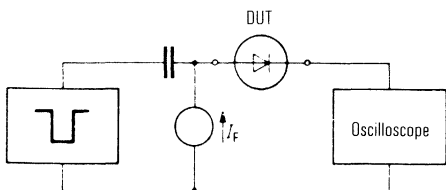
### Characteristics<sup>1)</sup>

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Breakdown voltage $I_{(BR)} = 100\ \mu\text{A}$	$V_{(BR)}$	70	-	-	V
Max. forward voltage $I_F = 1\ \text{mA}$	$V_F$	-	-	715	mV
$I_F = 10\ \text{mA}$		-	-	855	mV
$I_F = 50\ \text{mA}$		-	-	1000	mV
$I_F = 150\ \text{mA}$		-	-	1250	mV
Reverse current $V_R = 70\ \text{V}$	$I_R$	-	-	2,5	$\mu\text{A}$
$V_R = 25\ \text{V}, T_A = 150^\circ\text{C}$		-	-	30	$\mu\text{A}$
$V_R = 70\ \text{V}, T_A = 150^\circ\text{C}$		-	-	50	$\mu\text{A}$

Dynamic characteristics	Symbol	min	typ	max	Unit
Capacitance $V_R = 0\ \text{V}, f = 1\ \text{MHz}$	$C_0$	-	-	1,5	pF
Reverse recovery time $I_F = 10\ \text{mA}, I_R = 10\ \text{mA},$ $R_L = 100\ \Omega,$ measured at $I_R = 1\ \text{mA}$	$t_{rr}$	-	-	6	ns

### Test circuit for reverse recovery time

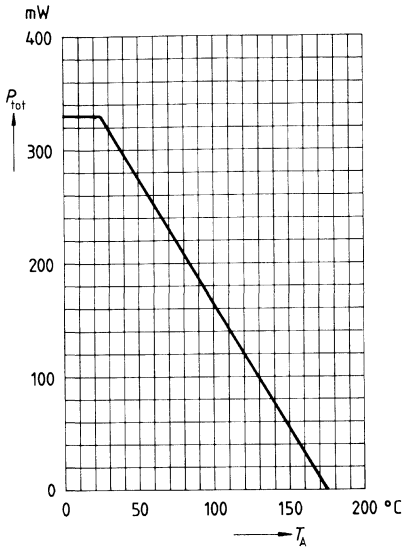


Pulse generator:  $t_p = 100\ \text{ns}, D = 0,05$   
 $t_r = 0,6\ \text{ns}, R_i = 50\ \Omega$   
 $V_p = V_R + I_F \times R_i$

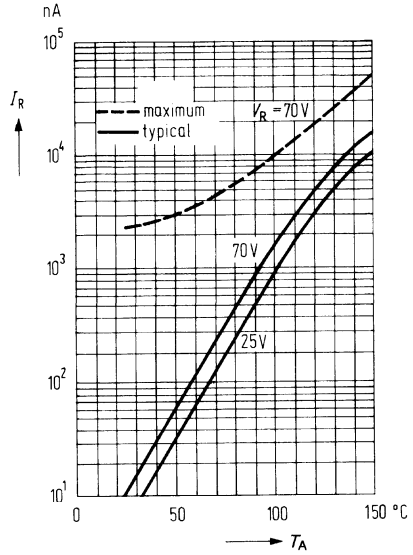
Oscilloscope:  $R = 50\ \Omega$   
 $t_r = 0,35\ \text{ns}$   
 $C \leq 1\ \text{pF}$

<sup>1)</sup> Ratings per diode

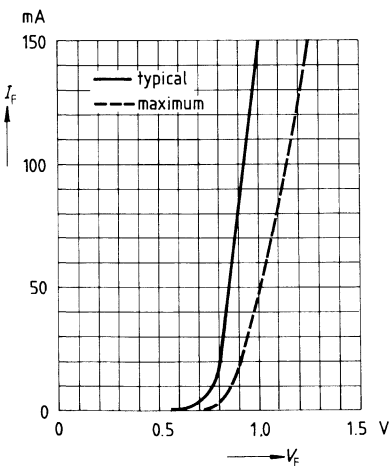
Total power dissipation  $P_{\text{tot}} = f(T_A)$



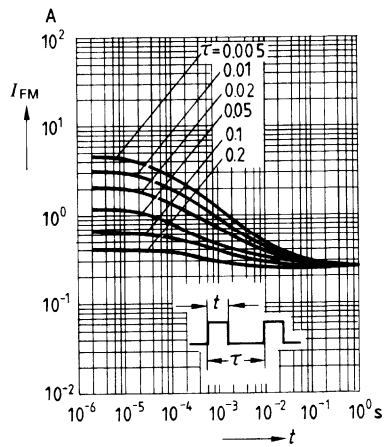
Reverse current  $I_R = f(T_A)$



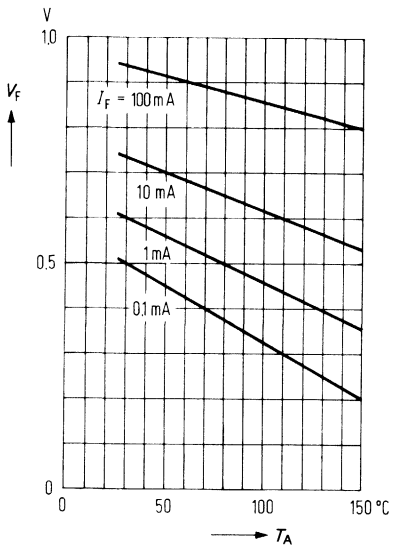
Forward current  $I_F = f(V_F)$



Peak forward current  $I_{FM} = f(t)$

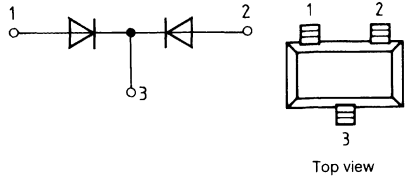


Forward voltage  $V_F = f(T_A)$



**Silicon planar epitaxial dual diode**

- For high-speed switching applications
- Peak reverse voltage 50 V
- With common cathode



Type	Marking	Ordering code	Package
BAV 74	JA	Refer to index	Version A

**Maximum ratings<sup>1)</sup>**

Reverse voltage	$V_R$	50 V
Repetitive peak reverse voltage	$V_{RRM}$	50 V
Forward current	$I_F$	250 mA
RMS forward current	$I_{FRMS}$	250 mA
Mean forward current	$I_{FAV}$	250 mA
$t = 20 \text{ ms}, t_p = 10 \text{ ms}$		
Surge forward current	$I_{FSM}$	4,5 A
$t = 1 \mu\text{s}$		
Total power dissipation	$P_{tot}$	330 mW
$T_A = 25^\circ\text{C}$		
Junction temperature	$T_j$	175 °C
Storage temperature range	$T_{stg}$	-65 ... + 150 °C
<b>Thermal resistance</b>	$R_{thJA}$	$\leq 450 \text{ K/W}$
junction-ambient		
package mounted		
on alumina		
15 mm × 16.7 mm × 0.7 mm		

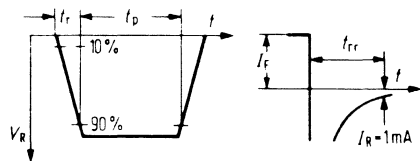
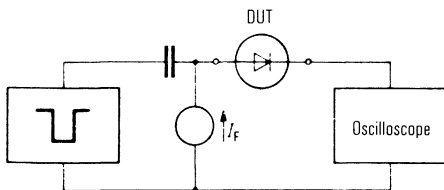
<sup>1)</sup> Ratings per diode



**Characteristics<sup>1)</sup>**at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Breakdown voltage $I_{(BR)} = 100\ \mu\text{A}$	$V_{(BR)}$	50	–	–	V
Max. forward voltage $I_F = 100\ \text{mA}$	$V_F$	–	–	1,0	V
Reverse current $V_R = 50\ \text{V}$ $V_R = 50\ \text{V}, T_A = 150^\circ\text{C}$	$I_R$	– –	– –	0,1 100	$\mu\text{A}$ $\mu\text{A}$

Dynamic characteristics	Symbol	min	typ	max	Unit
Capacitance $V_R = 0\ \text{V}, f = 1\ \text{MHz}$	$C_o$	–	–	2,0	pF
Reverse recovery time $I_F = 10\ \text{mA}, I_R = 10\ \text{mA},$ $R_L = 100\ \Omega,$ measured at $I_R = 1\ \text{mA}$	$t_{rr}$	–	–	4	ns

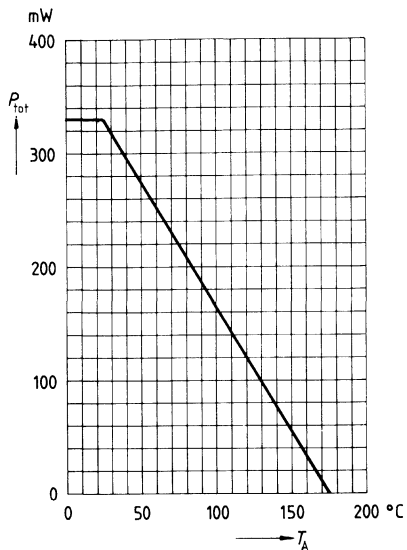
**Test circuit for reverse recovery time**

Pulse generator:  $t_p = 100\ \text{ns}, D = 0,05$   
 $t_r = 0,6\ \text{ns}, R_i = 50\ \Omega$   
 $V_p = V_R + I_F \times R_i$

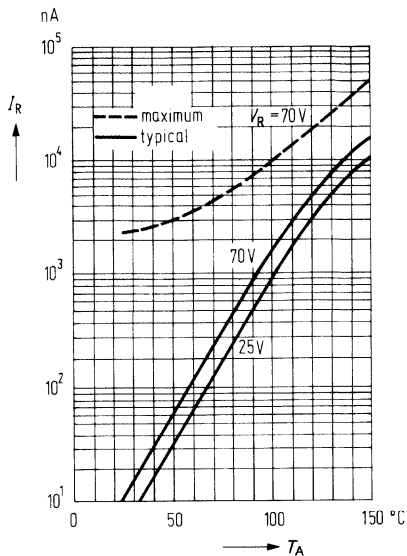
Oscilloscope:  $R = 50\ \Omega$   
 $t_r = 0,35\ \text{ns}$   
 $C \leq 1\ \text{pF}$

<sup>1)</sup> Ratings per diode

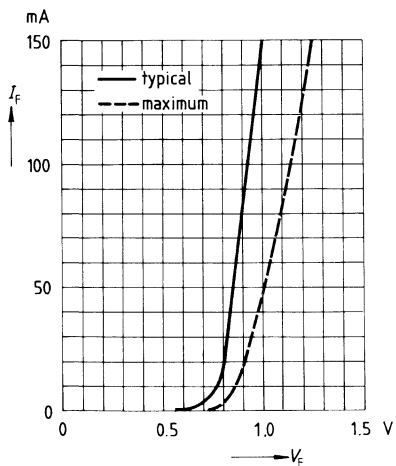
Total power dissipation  $P_{\text{tot}} = f(T_A)$



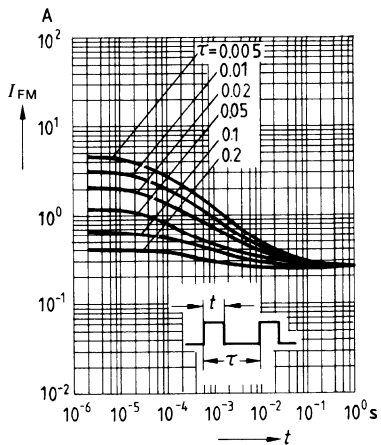
Reverse current  $I_R = f(T_A)$



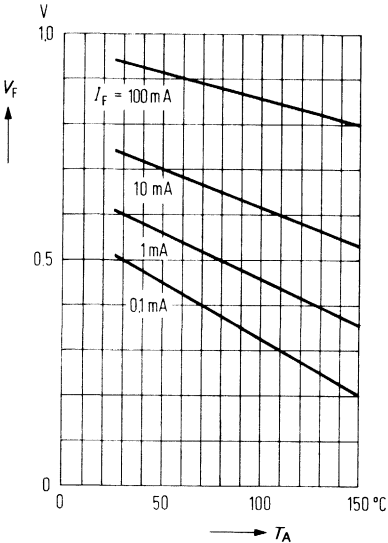
Forward current  $I_F = f(V_F)$



Peak forward current  $I_{FM} = f(t)$

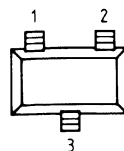
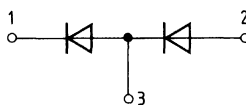


Forward voltage  $V_F = f(T_A)$



## Silicon planar epitaxial dual diode

- For high-speed switching applications
- Peak reverse voltage 70 V
- Series-connected



Top view

Type	Marking	Ordering code	Package
BAV 99	JE	Refer to index	Version A

## Maximum ratings<sup>1)</sup>

Reverse voltage	$V_R$	70 V
Repetitive peak reverse voltage	$V_{RRM}$	70 V
Forward current	$I_F$	250 mA
RMS forward current	$I_{FRMS}$	250 mA
Mean forward current $t = 20 \text{ ms}, t_p = 10 \text{ ms}$	$I_{FAV}$	250 mA
Surge forward current $t = 1 \text{ } \mu\text{s}$	$I_{FSM}$	4,5 A
Total power dissipation $T_A = 25 \text{ } ^\circ\text{C}$	$P_{tot}$	330 mW
Junction temperature	$T_j$	175 $^\circ\text{C}$
Storage temperature range	$T_{stg}$	-65 ... +150 $^\circ\text{C}$

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 450 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

<sup>1)</sup> Ratings per diode

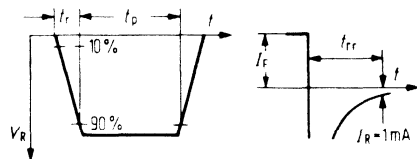
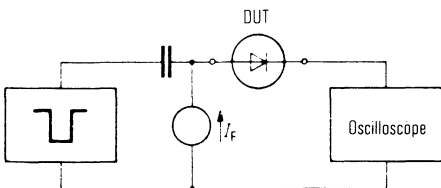
## Characteristics<sup>1)</sup>

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Breakdown voltage $I_{(BR)} = 100\ \mu\text{A}$	$V_{(BR)}$	70	–	–	V
Max. forward voltage $I_F = 1\ \text{mA}$ $I_F = 10\ \text{mA}$ $I_F = 50\ \text{mA}$ $I_F = 150\ \text{mA}$	$V_F$	–	–	715 855 1000 1250	mV mV mV mV
Reverse current $V_R = 70\ \text{V}$ $V_R = 25\ \text{V}, T_A = 150^\circ\text{C}$ $V_R = 70\ \text{V}, T_A = 150^\circ\text{C}$	$I_R$	–	–	2,5 30 50	$\mu\text{A}$ $\mu\text{A}$ $\mu\text{A}$

Dynamic characteristics	Symbol	min	typ	max	Unit
Capacitance $V_R = 0\ \text{V}, f = 1\ \text{MHz}$	$C_0$	–	–	1,5	pF
Reverse recovery time $I_F = 10\ \text{mA}, I_R = 10\ \text{mA},$ $R_L = 100\ \Omega,$ measured at $I_R = 1\ \text{mA}$	$t_{rr}$	–	–	6	ns

### Test circuit for reverse recovery time

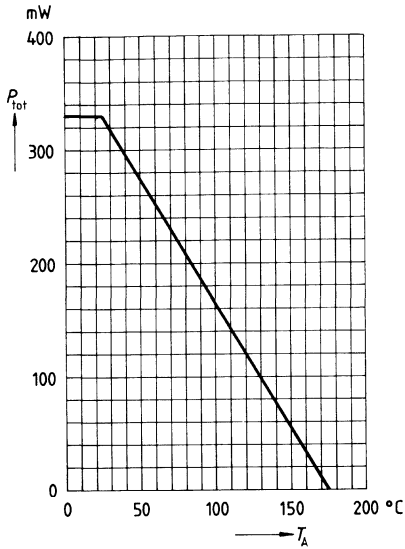


Pulse generator:  $t_p = 100\ \text{ns}$ ,  $D = 0,05$   
 $t_r = 0,6\ \text{ns}$ ,  $R_i = 50\ \Omega$   
 $V_p = V_R + I_F \times R_i$

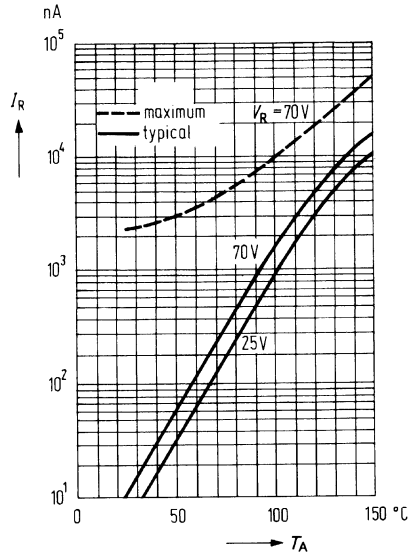
Oscilloscope:  $R = 50\ \Omega$   
 $t_r = 0,35\ \text{ns}$   
 $C \leq 1\ \text{pF}$

<sup>1)</sup> Ratings per diode

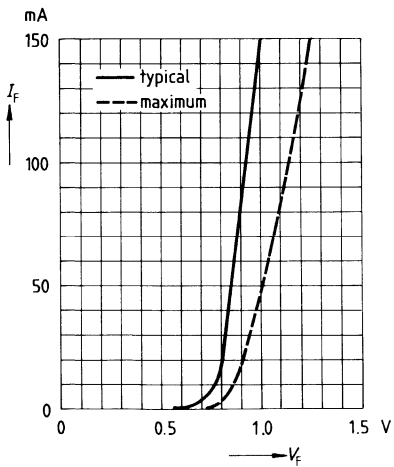
Total power dissipation  $P_{tot} = f(T_A)$



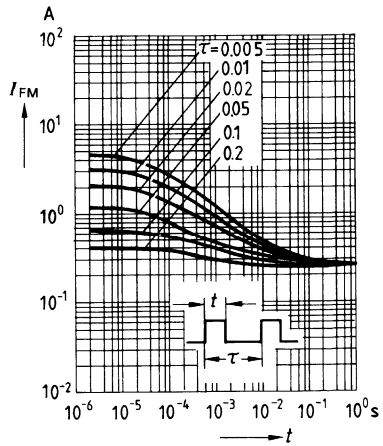
Reverse current  $I_R = f(T_A)$



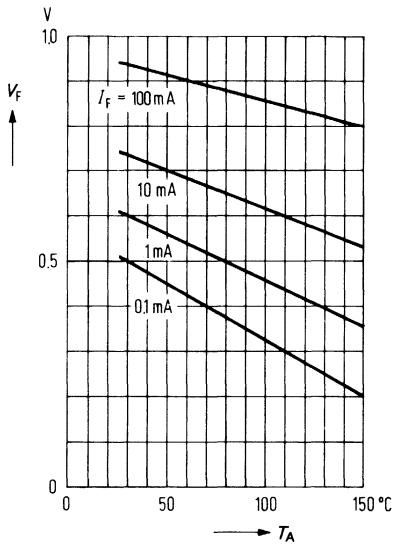
Forward current  $I_F = f(V_F)$



Peak forward current  $I_{FM} = f(t)$

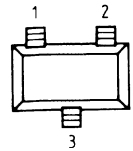
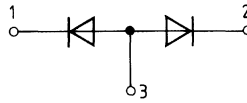


Forward voltage  $V_F = f(T_A)$



**Silicon planar epitaxial dual diode**

- For high-speed switching applications
- Peak reverse voltage 70 V
- With common anode



Top view

Type	Marking	Ordering code	Package
BAW 56	JD	Refer to index	Version A

**Maximum ratings<sup>1)</sup>**

Reverse voltage	$V_R$	70 V
Repetitive peak reverse voltage	$V_{RRM}$	70 V
Forward current	$I_F$	250 mA
RMS forward current	$I_{FRMS}$	250 mA
Mean forward current	$I_{FAV}$	250 mA
$t = 20 \text{ ms}, t_p = 10 \text{ ms}$		
Surge forward current	$I_{FSM}$	4,5 A
$t = 1 \mu\text{s}$		
Total power dissipation	$P_{tot}$	330 mW
$T_A = 25^\circ\text{C}$		
Junction temperature	$T_j$	175 °C
Storage temperature range	$T_{stg}$	- 65 ... + 150 °C

<b>Thermal resistance</b>	$R_{thJA}$	$\leq 450 \text{ K/W}$
junction-ambient		
package mounted		
on alumina		
15 mm × 16.7 mm × 0.7 mm		

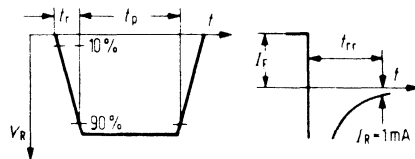
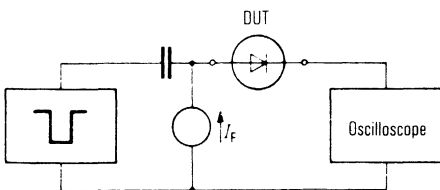
<sup>1)</sup> Ratings per diode



**Characteristics<sup>1)</sup>**at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Breakdown voltage $I_{(BR)} = 100\ \mu\text{A}$	$V_{(BR)}$	70	–	–	V
Max. forward voltage $I_F = 1\ \text{mA}$ $I_F = 10\ \text{mA}$ $I_F = 50\ \text{mA}$ $I_F = 150\ \text{mA}$	$V_F$	–	–	715 855 1000 1250	mV mV mV mV
Reverse current $V_R = 70\ \text{V}$ $V_R = 25\ \text{V}, T_A = 150^\circ\text{C}$ $V_R = 70\ \text{V}, T_A = 150^\circ\text{C}$	$I_R$	–	–	2,5 30 50	$\mu\text{A}$ $\mu\text{A}$ $\mu\text{A}$

Dynamic characteristics	Symbol	min	typ	max	Unit
Capacitance $V_R = 0\ \text{V}, f = 1\ \text{MHz}$	$C_0$	–	–	2,0	pF
Reverse recovery time $I_F = 10\ \text{mA}, I_R = 10\ \text{mA},$ $R_L = 100\ \Omega,$ measured at $I_R = 1\ \text{mA}$	$t_{rr}$	–	–	6	ns

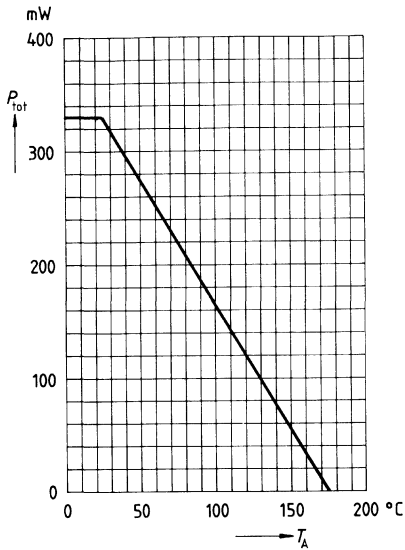
**Test circuit for reverse recovery time**

Pulse generator:  $t_p = 100\ \text{ns}, D = 0,05$   
 $t_r = 0,6\ \text{ns}, R_i = 50\ \Omega$   
 $V_p = V_R + I_F \times R_i$

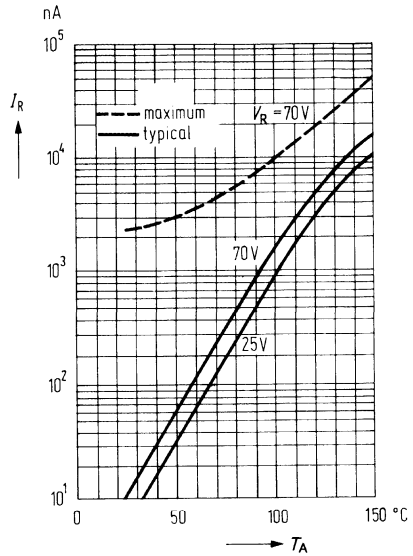
Oscilloscope:  $R = 50\ \Omega$   
 $t_r = 0,35\ \text{ns}$   
 $C \leq 1\ \text{pF}$

<sup>1)</sup> Ratings per diode

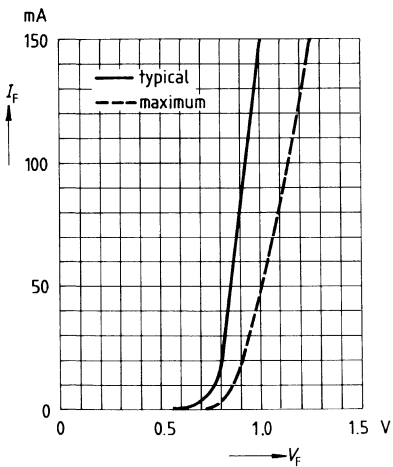
Total power dissipation  $P_{tot} = f(T_A)$



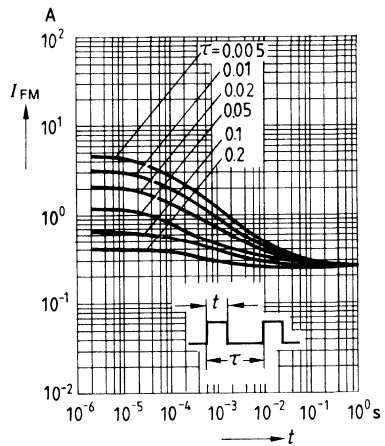
Reverse current  $I_R = f(T_A)$



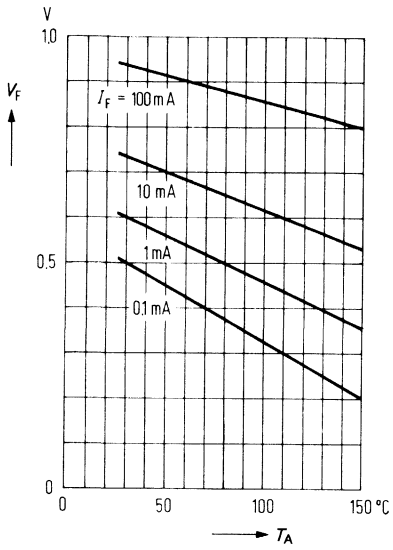
Forward current  $I_F = f(V_F)$



Peak forward current  $I_{FM} = f(t)$

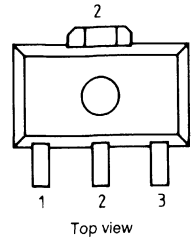
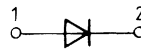


Forward voltage  $V_F = f(T_A)$



## Silicon planar epitaxial diodes

- High reverse voltage: up to 400 V
- High forward current



Type	Marking	Type	Marking	Ordering code	Package
BAW 78 A	GA	BAW 78 C	GC	Refer to index	Version C
BAW 78 B	GB	BAW 78 D	GD		

Maximum ratings		BAW 78 A	BAW 78 B	BAW 78 C	BAW 78 D
Reverse voltage	$V_R$	50 V	100 V	200 V	400 V
Repetitive peak reverse voltage	$V_{RRM}$	50 V	100 V	200 V	400 V
Forward current	$I_F$			1,0 A	
RMS forward current	$I_{FRMS}$			–	
Mean forward current $t = 20 \text{ ms}, t_p = 10 \text{ ms}$	$I_{FAV}$			500 mA	
Surge forward current $t = 1 \mu\text{s}$	$I_{FSM}$			10 A	
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$			1,0 W	
Junction temperature	$T_j$			150 °C	
Storage temperature range	$T_{stg}$			–65 ... +150 °C	
<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$			≤ 125 K/W	

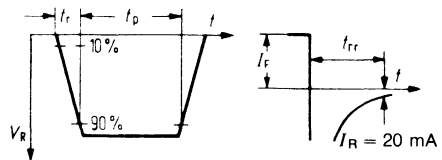
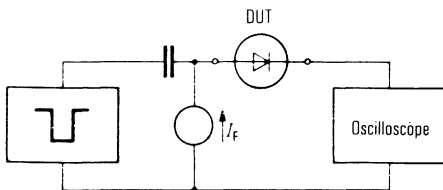
### Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Breakdown voltage $I_{(BR)} = 100 \mu\text{A}$ BAW 78 A BAW 78 B BAW 78 C BAW 78 D	$V_{(BR)}$	50 100 200 400	– – – –	– – – –	V V V V
Max. forward voltage $I_F = 1 \text{ A}$ $I_F = 2 \text{ A}$	$V_F$	– –	– –	1,6 2,0	V
Reverse current $V_R = V_{Rmax}$ $V_R = V_{Rmax}, T_A = 150^\circ\text{C}$	$I_R$	– –	– –	1 50	$\mu\text{A}$ $\mu\text{A}$

Dynamic characteristics	Symbol	min	typ	max	Unit
Capacitance $V_R = 0 \text{ V}, f = 1 \text{ MHz}$	$C_0$	–	10	–	pF
Reverse recovery time $I_F = 200 \text{ mA}, I_R = 200 \text{ mA},$ $R_L = 100 \Omega,$ measured at $I_R = 20 \text{ mA}$	$t_{rr}$	–	1	–	$\mu\text{s}$

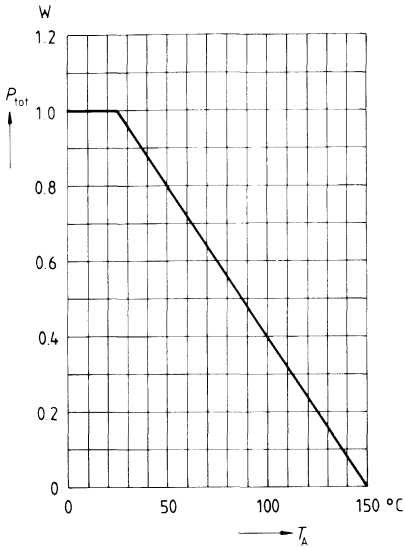
### Test circuit for reverse recovery time



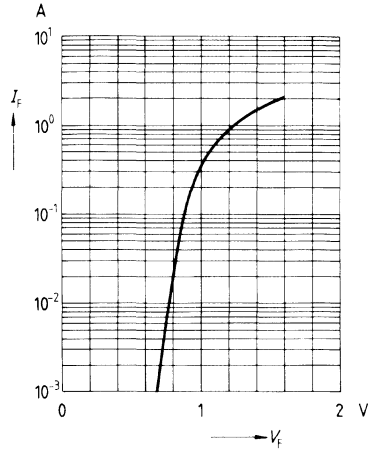
Pulse generator:  $t_p = 100 \text{ ns}, D = 0,05$   
 $t_r = 0,6 \text{ ns}, R_i = 50$   
 $V_p = V_R + I_F \times R_i$

Oscilloscope:  $R = 50 \Omega$   
 $t_r = 0,35 \text{ ns}$   
 $C \leq 1 \text{ pF}$

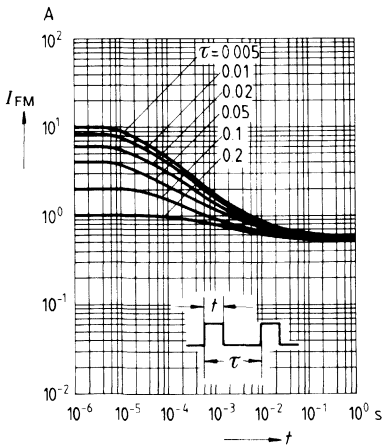
**Total power dissipation  $P_{\text{tot}} = f(T_A)$**



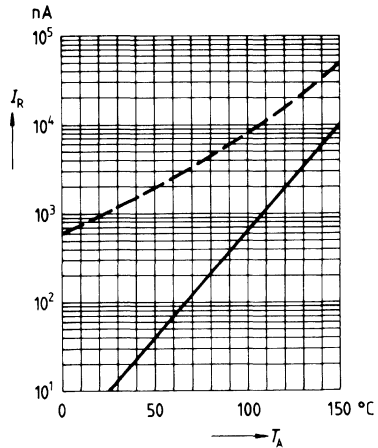
**Forward current  $I_F = f(V_F)$**   
 $T_A = 25^{\circ}\text{C}$



**Peak forward current  $I_{FM} = f(t)$**

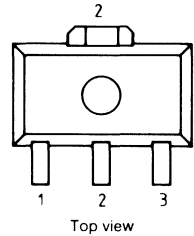
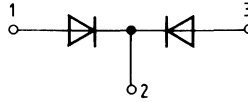


**Reverse current  $I_R = f(T_A)$**   
 $V_R = V_{R \text{ max}}$



**Silicon planar epitaxial dual diodes**

- High reverse voltage: up to 400 V
- High forward current
- With common cathode



Type	Marking	Type	Marking	Ordering code	Package
BAW 79 A	GE	BAW 79 C	GG	Refer to index	Version C
BAW 79 B	GF	BAW 79 D	GH		

**Maximum ratings<sup>1)</sup>**

		BAW 79 A	BAW 79 B	BAW 79 C	BAW 79 D
Reverse voltage	$V_R$	50 V	100 V	200 V	400 V
Repetitive peak reverse voltage					
Forward current	$I_F$			1,0 A	
RMS forward current	$I_{FRMS}$			–	
Mean forward current	$I_{FAV}$			500 mA	
$t = 20 \text{ ms}, t_p = 10 \text{ ms}$					
Surge forward current	$I_{FSM}$			10 A	
$t = 1 \mu\text{s}$					
Total power dissipation	$P_{tot}$			1,0 W	
$T_A = 25^\circ\text{C}$					
Junction temperature	$T_j$			150 °C	
Storage temperature range	$T_{stg}$			–65 ... +150 °C	
<b>Thermal resistance</b>	$R_{thJA}$			≤ 125 K/W	
junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm					

<sup>1)</sup> Ratings per diode

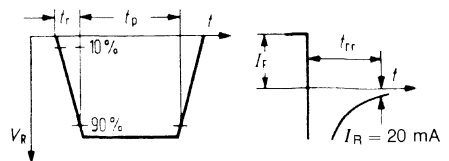
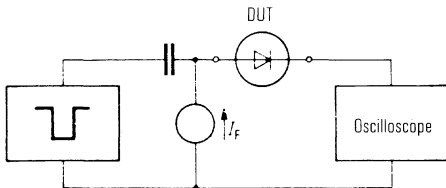
### Characteristics<sup>1)</sup>

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Breakdown voltage $I_{(BR)} = 100\ \mu\text{A}$	$V_{(BR)}$				
BAW 79 A		50	-	-	V
BAW 79 B		100	-	-	V
BAW 79 C		200	-	-	V
BAW 79 D		400	-	-	V
Max. forward voltage $I_F = 1\ \text{A}$ $I_F = 2\ \text{A}$	$V_F$	-	-	1,6 2,0	V V
Reverse current $V_R = V_{Rmax}$ $V_R = V_{Rmax}, T_A = 150^\circ\text{C}$	$I_R$	-	-	1 50	$\mu\text{A}$ $\mu\text{A}$

Dynamic characteristics	Symbol	min	typ	max	Unit
Capacitance $V_R = 0\ \text{V}, f = 1\ \text{MHz}$	$C_0$	-	10	-	pF
Reverse recovery time $I_F = 200\ \text{mA}, I_R = 200\ \text{mA},$ $R_L = 100\ \Omega,$ measured at $I_R = 20\ \text{mA}$	$t_{rr}$	-	1	-	$\mu\text{s}$

### Test circuit for reverse recovery time



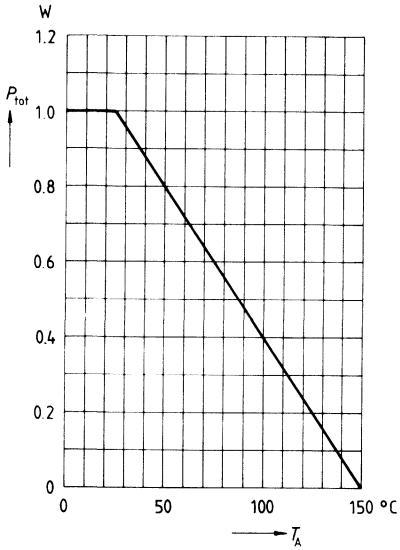
Pulse generator:  $t_p = 100\ \text{ns}, D = 0,05$   
 $t_r = 0,6\ \text{ns}, R_i = 50$   
 $V_p = V_R + I_F \times R_i$

Oscilloscope:  $R = 50\ \Omega$   
 $t_r = 0,35\ \text{ns}$   
 $C \leq 1\ \text{pF}$

<sup>1)</sup> Ratings per diode

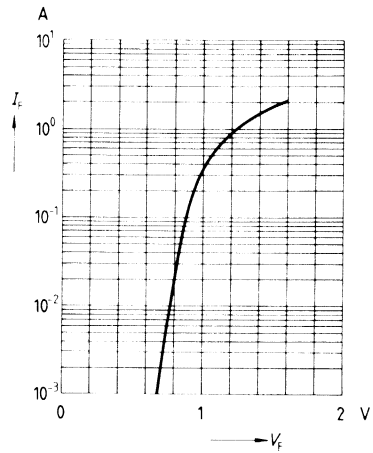


**Total power dissipation  $P_{\text{tot}} = f(T_A)$**

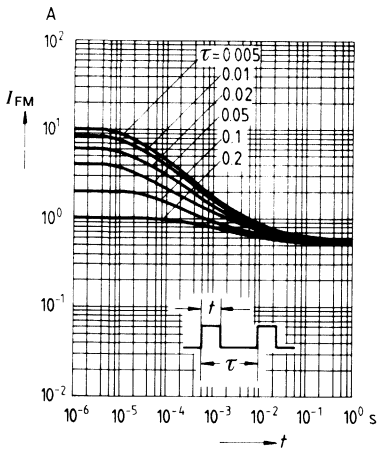


**Forward current  $I_F = f(V_F)$**

$T_A = 25^\circ\text{C}$

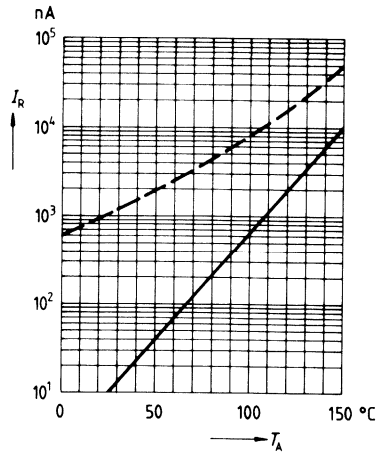


**Peak forward current  $I_{FM} = f(t)$**



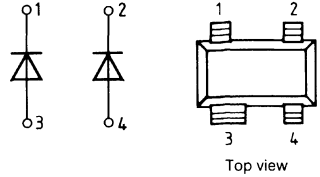
**Reverse current  $I_R = f(T_A)$**

$V_R = V_{R\text{max}}$



**Silicon planar epitaxial dual diode**

- For high-speed switching applications
- Peak reverse voltage 70 V
- Electrically isolated diodes



Type	Marking	Ordering code	Package
BAW 100	JS	Refer to index	Version B

**Maximum ratings**

Reverse voltage	$V_R$	70 V
Repetitive peak reverse voltage	$V_{RRM}$	70 V
Forward current	$I_F$	250 mA
RMS forward current	$I_{FRMS}$	250 mA
Mean forward current	$I_{FAV}$	250 mA
$t = 20 \text{ ms}, t_p = 10 \text{ ms}$		
Surge forward current	$I_{FSM}$	4,5 A
$t = 1 \mu\text{s}$		
Total power dissipation	$P_{tot}$	330 mW
$T_A = 25^\circ\text{C}$		
Junction temperature	$T_j$	175 °C
Storage temperature range	$T_{stg}$	-65 ... +150 °C
<b>Thermal resistance</b>	$R_{thJA}$	$\leq 450 \text{ K/W}$
junction-ambient		
package mounted on alumina		
15 mm × 16.7 mm × 0.7 mm		

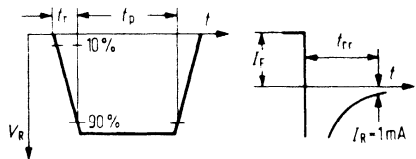
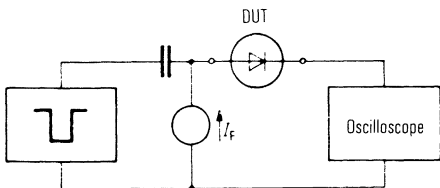
**Characteristics**

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Breakdown voltage $I_{(BR)} = 100 \mu\text{A}$	$V_{(BR)}$	70	–	–	V
Max. forward voltage $I_F = 1 \text{ mA}$	$V_F$	–	–	715	mV
$I_F = 10 \text{ mA}$		–	–	855	mV
$I_F = 50 \text{ mA}$		–	–	1000	mV
$I_F = 150 \text{ mA}$		–	–	1250	mV
Reverse current $V_R = 70 \text{ V}$	$I_R$	–	–	5	$\mu\text{A}$
$V_R = 25 \text{ V}, T_A = 150^\circ\text{C}$		–	–	60	$\mu\text{A}$
$V_R = 70 \text{ V}, T_A = 150^\circ\text{C}$		–	–	100	$\mu\text{A}$

Dynamic characteristics	Symbol	min	typ	max	Unit
Capacitance $V_R = 0 \text{ V}, f = 1 \text{ MHz}$	$C_0$	–	–	1,5	pF
Reverse recovery time $I_F = 10 \text{ mA}, I_R = 10 \text{ mA},$ $R_L = 100 \Omega,$ measured at $I_R = 1 \text{ mA}$	$t_{rr}$	–	–	6	ns

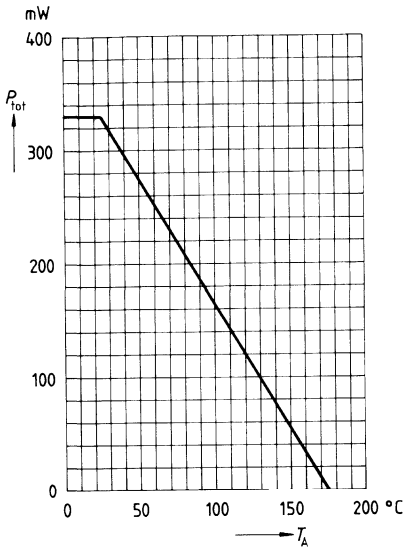
**Test circuit for reverse recovery time**



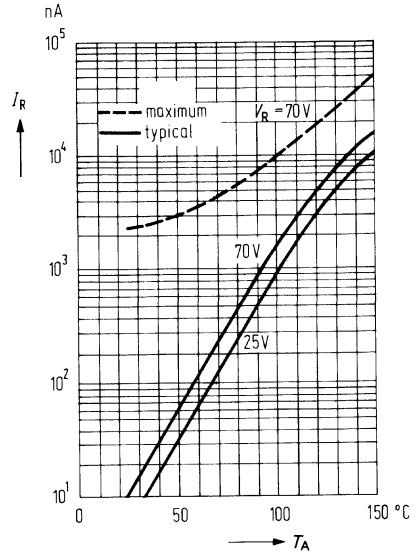
Pulse generator:  $t_p = 100 \text{ ns}, D = 0,05$   
 $t_r = 0,6 \text{ ns}, R_i = 50 \Omega$   
 $V_p = V_R + I_F \times R_i$

Oscilloscope:  $R = 50 \Omega$   
 $t_r = 0,35 \text{ ns}$   
 $C \leq 1 \text{ pF}$

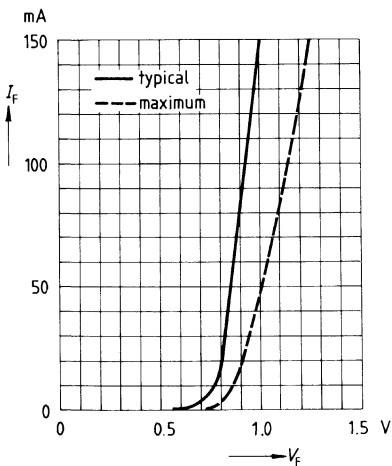
**Total power dissipation  $P_{tot} = f(T_A)$**



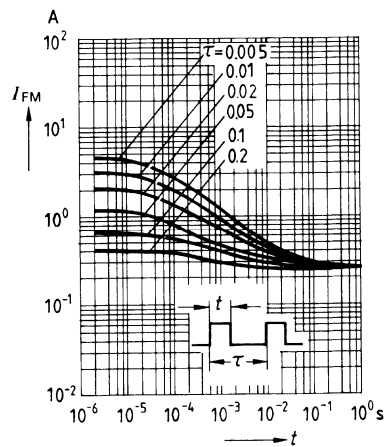
**Reverse current  $I_R = f(T_A)$**



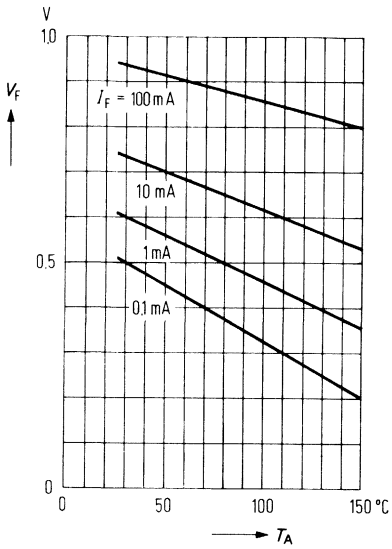
**Forward current  $I_F = f(V_F)$**



**Peak forward current  $I_{FM} = f(t)$**

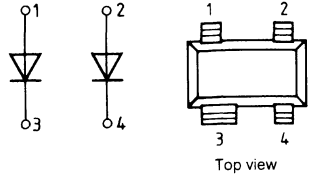


Forward voltage  $V_F = f(T_A)$



**Silicon planar epitaxial dual diode**

- High reverse voltage: 300 V
- Electrically isolated diodes



Type	Marking	Ordering code	Package
BAW 101	JP	Refer to index	Version B

**Maximum ratings**

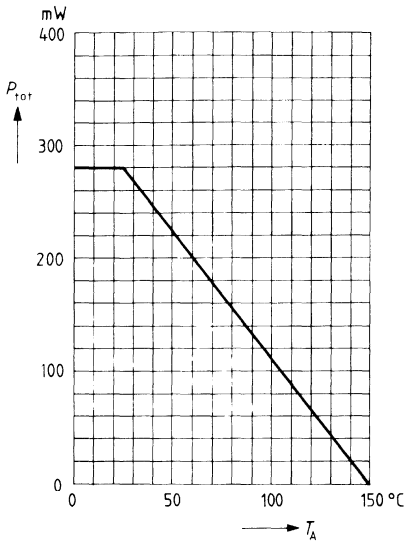
Reverse voltage	$V_R$	300 V
Repetitive peak reverse voltage	$V_{RRM}$	300 V
Forward current	$I_F$	50 mA
RMS forward current	$I_{FRMS}$	–
Mean forward current $t = 20 \text{ ms}, t_p = 10 \text{ ms}$	$I_{FAV}$	35 mA
Surge forward current $t = 1 \mu\text{s}$	$I_{FSM}$	4,5 A
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	280 mW
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	– 65 ... + 150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 450 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

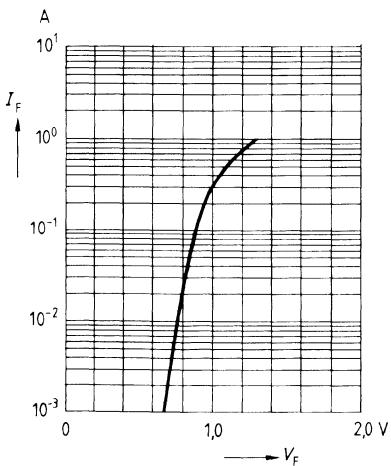
**Characteristics**at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

<b>Static characteristics</b>	<b>Symbol</b>	<b>min</b>	<b>typ</b>	<b>max</b>	<b>Unit</b>
Breakdown voltage $I_{(BR)} = 100\ \mu\text{A}$	$V_{(BR)}$	300	–	–	V
Max. forward voltage $I_F = 100\ \text{mA}$	$V_F$	–	–	1,3	V
Reverse current $V_R = 250\ \text{V}$ $V_R = 250\ \text{V}, T_A = 150^\circ\text{C}$	$I_R$	– –	– –	150 50	nA $\mu\text{A}$

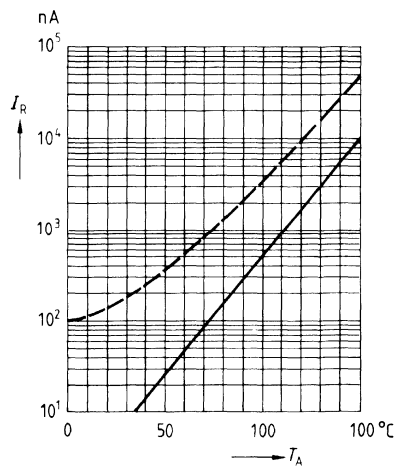
Total power dissipation  $P_{tot} = f(T_A)$



Forward current  $I_F = f(V_F)$



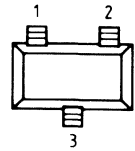
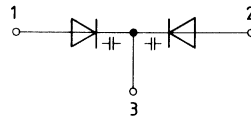
Reverse current  $I_R = f(T_A)$





**Silicon planar epitaxial dual diode**

- For FM tuner applications
- With common cathode



Top view

Type	Marking	Ordering code	Package
BB 804	FM	Refer to index	Version A

**Maximum ratings<sup>1)</sup>**

Reverse voltage	$V_R$	18 V
Repetitive peak reverse voltage	$V_{RRM}$	20 V
Forward current	$I_F$	50 mA
$T_A \leq 60^\circ\text{C}$		
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	-65 ... +150 °C

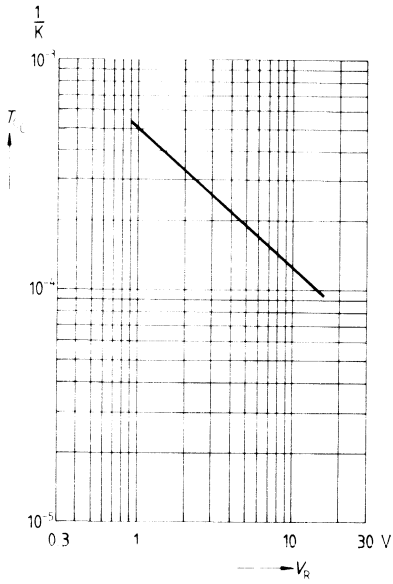
<sup>1)</sup> Ratings per diode

**Characteristics<sup>1)</sup>**at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

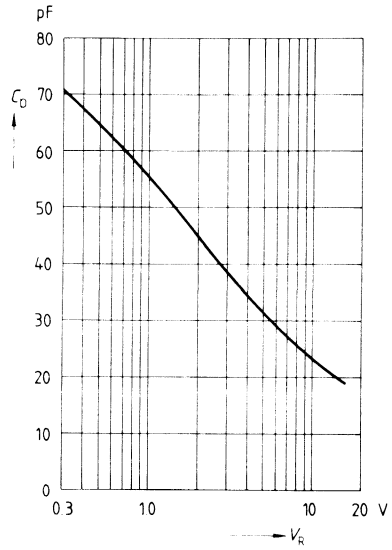
Characteristics	Symbol	min	typ	max	Unit
Reverse current $V_R = 16\text{ V}$ $V_R = 16\text{ V}, T_A = 60^\circ\text{C}$	$I_R$	– –	– –	20 0,2	nA $\mu\text{A}$
Diode capacitance $V_R = 2\text{ V}, f = 1\text{ MHz}$	$C_D$	42	–	47,5	pF
Capacitance ratio $V_R = 2\text{ V}, 8\text{ V}, f = 1\text{ MHz}$	$C_{D2V}/$ $C_{D8V}$	–	1,7	–	–
Series resistance $C = 38\text{ pF}, f = 100\text{ MHz}$	$r_s$	–	0,25	–	$\Omega$
Quality factor $C = 38\text{ pF}, f = 100\text{ MHz}$	$Q$	–	170	–	–
Temperature coefficient of junction capacitance $V_R = 2\text{ V}, f = 1\text{ MHz}$	$TC_C$	–	330	–	ppm/K
Capacitance groups $V_R = 2\text{ V}, f = 1\text{ MHz}$ Group –0 Group –1 Group –2 Group –3 Group –4	$C_D$	42 ... 43,5 43 ... 44,5 44 ... 45,5 45 ... 46,5 46 ... 47,5			pF pF pF pF pF

<sup>1)</sup> Ratings per diode

**Temperature coefficient  $TC_C = f(V_R)$   
of diode capacitance**  
 $f = 1 \text{ MHz}$

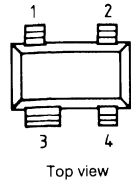
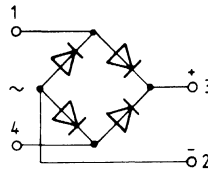


**Diode capacitance  $C_D = f(V_R)$**   
 $f = 1 \text{ MHz}$



**Silicon planar epitaxial diode**

- Peak reverse voltage 70 V
- Forward current 140 mA
- For bridge configuration



Type	Marking	Ordering code	Package
BGX 50 A	U1	Refer to index	Version B

**Maximum ratings<sup>1)</sup>**

Reverse voltage	$V_R$	50 V
Repetitive peak reverse voltage	$V_{RRM}$	70 V
Forward current	$I_F$	140 mA
Surge forward current $t = 1 \mu s$	$I_{FSM}$	4,5 A
Total power dissipation $T_A = 25^\circ C$	$P_{tot}$	280 mW
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	-65 ... +150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 450 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

<sup>1)</sup> Ratings per diode

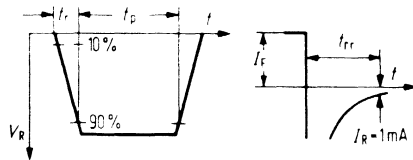
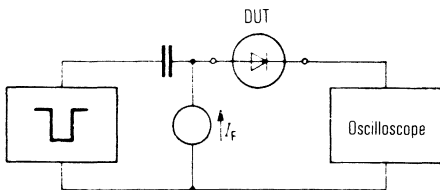
### Characteristics<sup>1)</sup>

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Forward voltage (two diodes connected in series) $I_F = 100\text{ mA}$	$V_F$	–	–	2,6	V
Reverse current $V_R = 50\text{ V}$ $V_R = 50\text{ V}, T_A = 150^\circ\text{C}$	$I_R$	–	–	0,1 100	$\mu\text{A}$ $\mu\text{A}$

Dynamic characteristics	Symbol	min	typ	max	Unit
Capacitance $V_R = 0, f = 1\text{ MHz}$	$C_0$	–	–	1,5	pF
Reverse recovery time $I_F = 10\text{ mA}, I_R = 10\text{ mA}, R_L = 100\ \Omega$ measured at $I_R = 1\text{ mA}$	$t_{rr}$	–	1	–	ns

### Test circuit for reverse recovery time

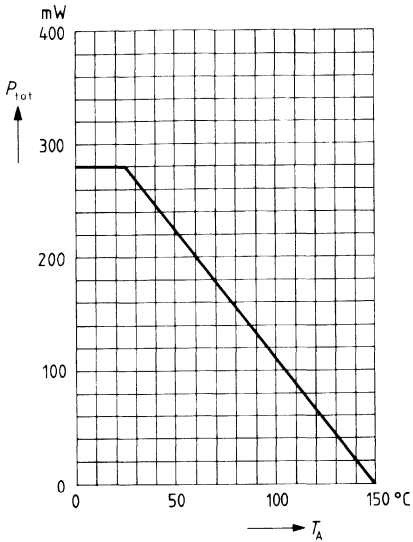


Pulse generator:  $t_p = 100\text{ ns}$ ,  $D = 0,05$   
 $t_r = 0,6\text{ ns}$ ,  $R_i = 50\ \Omega$   
 $V_p = V_R + I_F \times R_i$

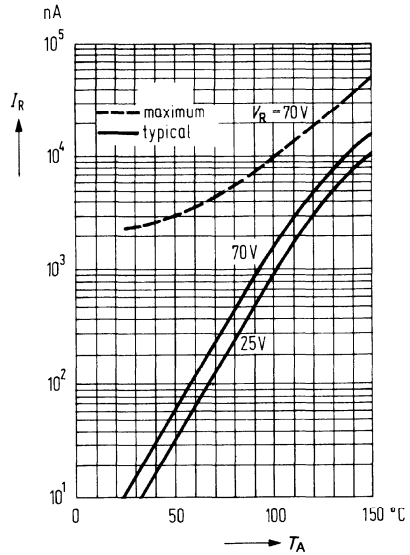
Oscilloscope:  $R = 50\ \Omega$   
 $t_r = 0,35\text{ ns}$   
 $C \leq 1\text{ pF}$

<sup>1)</sup> Ratings per diode

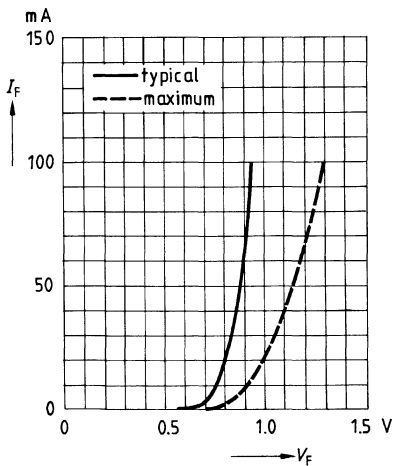
Total power dissipation  $P_{tot} = f(T_A)$



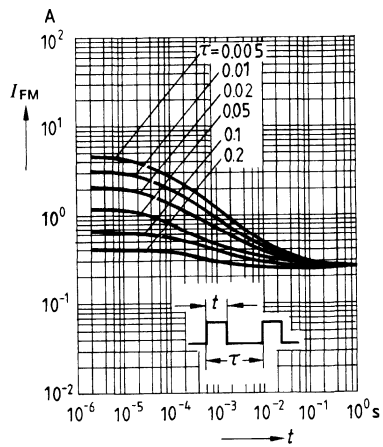
Reverse current  $I_R = f(T_A)$



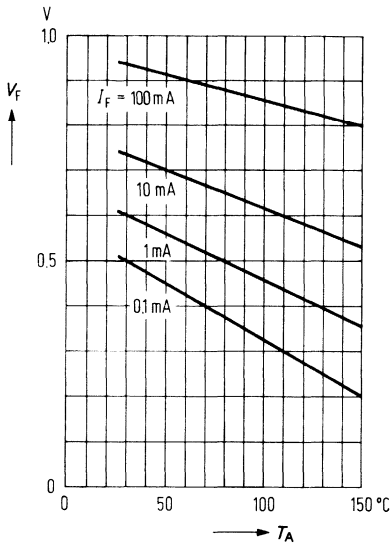
Forward current  $I_F = f(V_F)$



Peak forward current  $I_{FM} = f(t)$



Forward voltage  $V_F = f(T_A)$







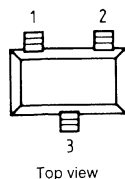
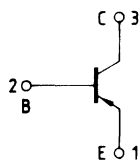
---

## **Transistors**

---

**PNP silicon planar epitaxial transistors**

- High collector current
- High current gain
- Low collector-emitter saturation voltage
- Complementary types: BC 817, BC 818 (NPN)



Type	Marking	Type	Marking	Ordering code	Package
BC 807-16	5A	BC 808-16	5F	Refer to index	Version A
BC 807-25	5B	BC 808-25	5G		
BC 807-40	5C	BC 808-40	5H		

Maximum ratings		BC 807	BC 808
Collector-emitter voltage	$V_{CE0}$	45 V	25 V
Collector-base voltage	$V_{CB0}$	50 V	30 V
Emitter-base voltage	$V_{EB0}$	5 V	5 V
Collector current	$I_C$		800 mA
Peak collector current	$I_{CM}$		1 A
Base current	$I_B$		100 mA
Peak base current	$I_{BM}$		200 mA
Total power dissipation	$P_{Tot}$		330 mW
$T_A = 25^\circ\text{C}$			
Junction temperature	$T_j$		150 °C
Storage temperature range	$T_{stg}$		-65 ... +150 °C
<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$		≤ 375 K/W

## Characteristics

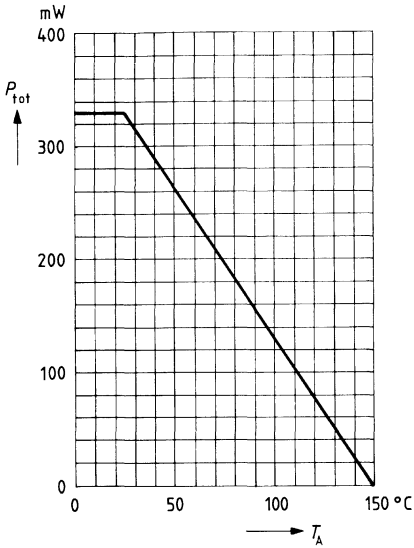
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 10\text{ mA}$ BC 807 BC 808	$V_{(BR) CE0}$	45 25	– –	– –	V V
Collector-base breakdown voltage $I_C = 100\ \mu\text{A}$ BC 807 BC 808	$V_{(BR) CB0}$	50 30	– –	– –	V V
Emitter-base breakdown voltage $I_E = 10\ \mu\text{A}$	$V_{(BR) EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 25\text{ V}$ $V_{CB} = 25\text{ V}, T_A = 150^\circ\text{C}$	$I_{CB0}$	– –	– –	100 5	nA $\mu\text{A}$
Emitter cutoff current $V_{EB} = 4\text{ V}$	$I_{EB0}$	–	–	100	nA
DC current gain <sup>1)</sup> $I_C = 100\text{ mA}, V_{CE} = 1\text{ V}$ BC 807–16, BC 808–16 BC 807–25, BC 808–25 BC 807–40, BC 808–40 $I_C = 300\text{ mA}, V_{CE} = 1\text{ V}$ BC 807–16, BC 808–16 BC 807–25, BC 808–25 BC 807–40, BC 808–40	$h_{FE}$	100 160 250  60 100 170	160 250 350  – – –	250 400 630  – – –	– – –  – – –
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 500\text{ mA}, I_B = 50\text{ mA}$	$V_{CEsat}$	–	–	0,7	V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 500\text{ mA}, I_B = 50\text{ mA}$	$V_{BEsat}$	–	–	2,0	V

Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 50\text{ mA}, V_{CE} = 5\text{ V}, f = 20\text{ MHz}$	$f_T$	–	200	–	MHz
Output capacitance $V_{CB} = 10\text{ V}, f = 1\text{ MHz}$	$C_{ob}$	–	10	–	pF
Input capacitance $V_{EB} = 0,5\text{ V}, f = 1\text{ MHz}$	$C_{ib}$	–	60	–	pF

<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 20\%$ .

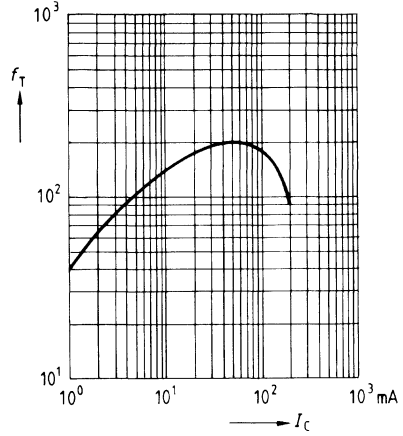
**Total power dissipation  $P_{\text{tot}} = f(T_A)$**



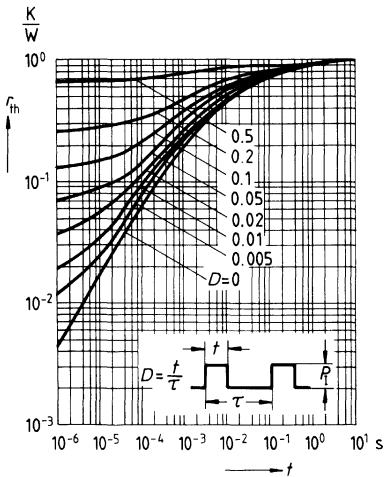
**Transition frequency  $f_T = f(I_C)$**

$V_{CE} = 5 \text{ V}$

MHz

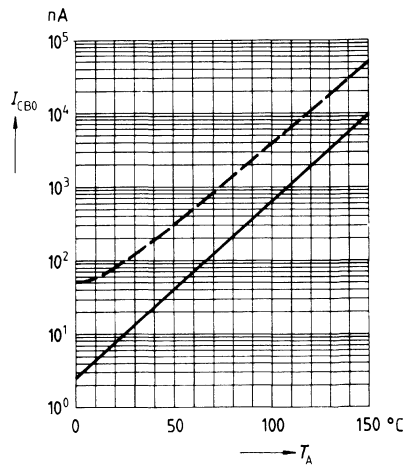


**Pulse handling capability  $r_{th} = f(t)$**   
(standardized)



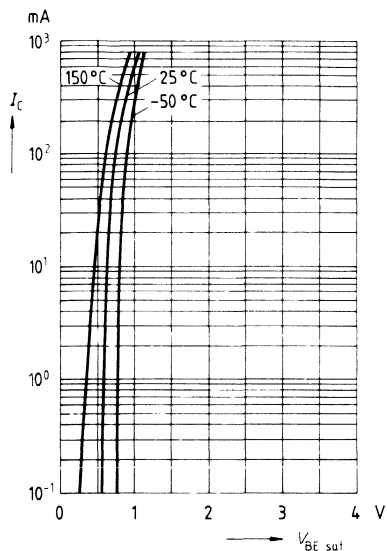
**Collector cutoff current  $I_{CB0} = f(T_A)$**

$V_{CB0} = 60 \text{ V}$



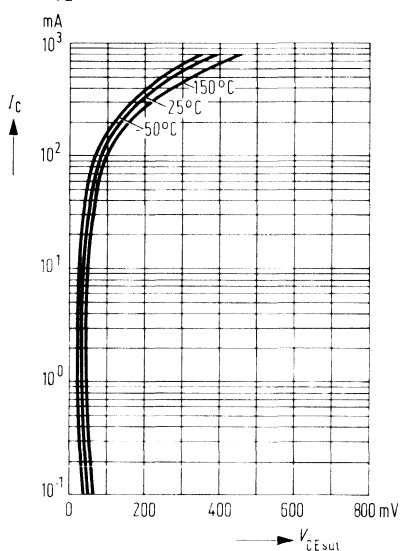
**Base-emitter saturation voltage  $V_{BE\text{sat}} = f(I_C)$**

$h_{FE} = 10$



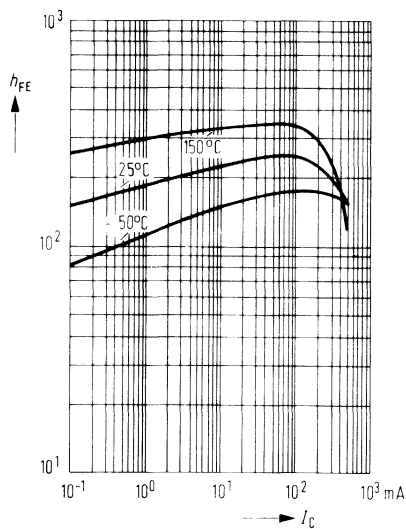
**Collector-emitter saturation voltage  $V_{CE\text{sat}} = f(I_C)$**

$h_{FE} = 10$



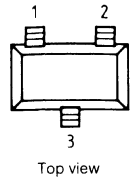
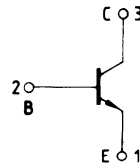
**DC current gain  $h_{FE} = f(I_C)$**

$V_{CE} = 1 \text{ V}$



**NPN silicon planar epitaxial transistors**

- High collector current
- High current gain
- Low collector-emitter saturation voltage
- Complementary types: BC 807, BC 808 (PNP)



Type	Marking	Type	Marking	Ordering code	Package
BC 817-16	6A	BC 818-16	6F	Refer to index	Version A
BC 817-25	6B	BC 818-25	6G		
BC 817-40	6C	BC 818-40	6H		

**Maximum ratings**

		BC 817	BC 818
Collector-emitter voltage	$V_{CE0}$	45 V	25 V
Collector-base voltage	$V_{CB0}$	50 V	30 V
Emitter-base voltage	$V_{EB0}$	5 V	5 V
Collector current	$I_C$		800 mA
Peak collector current	$I_{CM}$		1 A
Base current	$I_B$		100 mA
Peak base current	$I_{BM}$		200 mA
Total power dissipation $T_A = 25\text{ }^\circ\text{C}$	$P_{tot}$		330 mW
Junction temperature	$T_j$		150 °C
Storage temperature range	$T_{stg}$		-65 ... +150 °C
<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$		≤ 375 K/W

## Characteristics

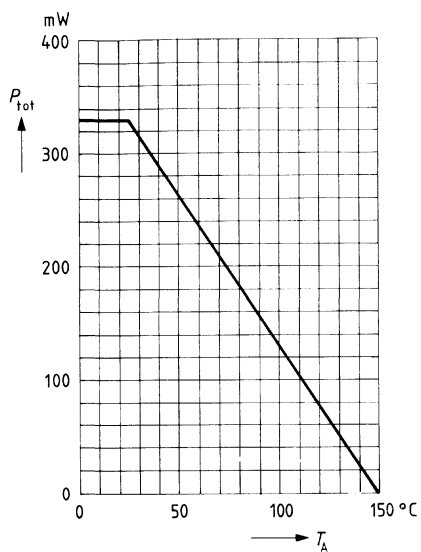
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 10\text{ mA}$ BC 817 BC 818	$V_{(BR) CE0}$	45 25	– –	– –	V V
Collector-base breakdown voltage $I_C = 100\ \mu\text{A}$ BC 817 BC 818	$V_{(BR) CB0}$	50 30	– –	– –	V V
Emitter-base breakdown voltage $I_E = 10\ \mu\text{A}$	$V_{(BR) EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 25\text{ V}$ $V_{CB} = 25\text{ V}, T_A = 150^\circ\text{C}$	$I_{CB0}$	– –	– –	100 5	nA $\mu\text{A}$
Emitter cutoff current $V_{EB} = 4\text{ V}$	$I_{EB0}$	–	–	100	nA
DC current gain <sup>1)</sup> $I_C = 100\text{ mA}, V_{CE} = 1\text{ V}$ BC 817–16, BC 818–16 BC 817–25, BC 818–25 BC 817–40, BC 818–40 $I_C = 300\text{ mA}, V_{CE} = 1\text{ V}$ BC 817–16, BC 818–16 BC 817–25, BC 818–25 BC 817–40, BC 818–40	$h_{FE}$	100 160 250  60 100 170	160 250 350  – – –	250 400 630  – – –	– – –  – – –
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 500\text{ mA}, I_B = 50\text{ mA}$	$V_{CEsat}$	–	–	0,7	V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 500\text{ mA}, I_B = 50\text{ mA}$	$V_{BEsat}$	–	–	2,0	V

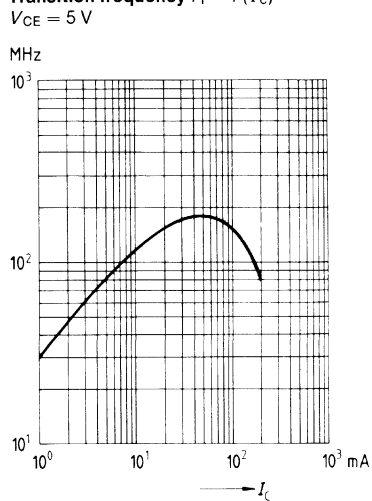
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 50\text{ mA}, V_{CE} = 5\text{ V}, f = 20\text{ MHz}$	$f_T$	–	170	–	MHz
Output capacitance $V_{CB} = 10\text{ V}, f = 1\text{ MHz}$	$C_{ob}$	–	6	–	pF
Input capacitance $V_{EB} = 0,5\text{ V}, f = 1\text{ MHz}$	$C_{ib}$	–	60	–	pF

<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

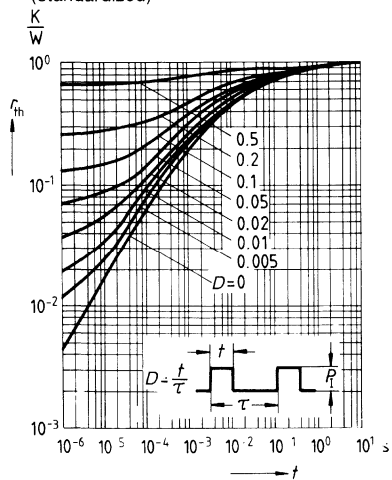
**Total power dissipation**  $P_{\text{tot}} = f(T_A)$



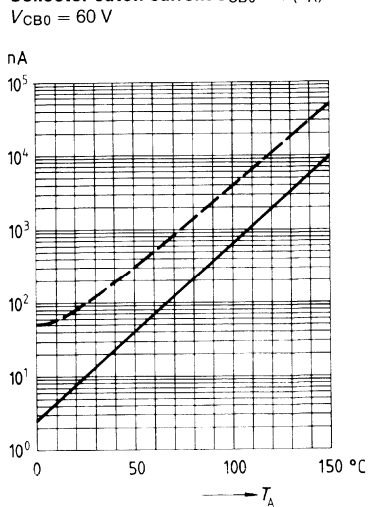
**Transition frequency**  $f_T = f(I_C)$



**Pulse handling capability**  $r_{\text{th}} = f(t)$   
(standardized)

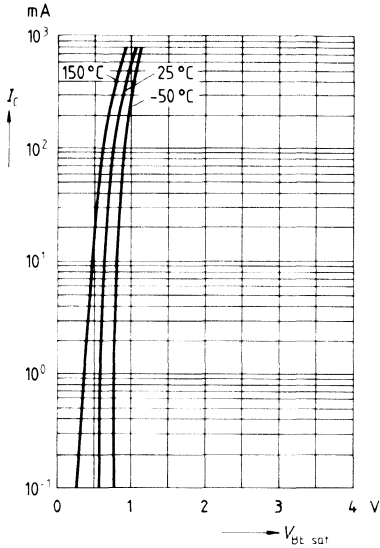


**Collector cutoff current**  $I_{\text{CB0}} = f(T_A)$

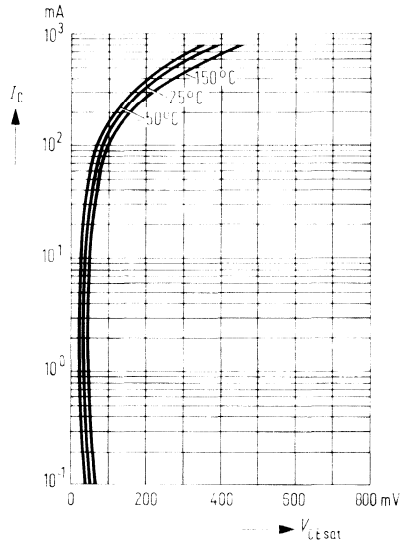




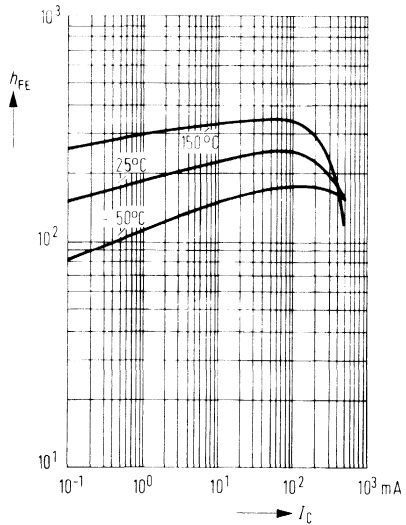
**Base-emitter saturation voltage**  $V_{BE\text{ sat}} = f(I_C)$   
 $h_{FE} = 10$



**Collector-emitter saturation voltage**  $V_{CE\text{ sat}} = f(I_C)$   
 $h_{FE} = 10$

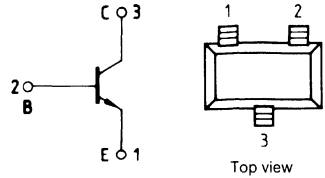


**DC current gain**  $h_{FE} = f(I_C)$   
 $V_{CE} = 1\text{ V}$



**NPN silicon planar epitaxial transistors**

- High current gain
- Low collector-emitter saturation voltage
- Low noise between 30 Hz and 15 kHz
- Complementary to BC 856, BC 857, BC 859, BC 860 (PNP)



Type	Marking	Type	Marking	Ordering code	Package
BC 846 A	1A	BC 848 B	1K	Refer to index	Version A
BC 846 B	1B	BC 848 C	1L		
BC 847 A	1E	BC 849 B	2B		
BC 847 B	1F	BC 849 C	2C		
BC 847 C	1G	BC 850 B	2F		
BC 848 A	1J	BC 850 C	2G		

Maximum ratings		BC 846	BC 847, BC 850	BC 848, BC 849
Collector-emitter-voltage	$V_{CE0}$	65 V	45 V	30 V
Collector-base voltage	$V_{CB0}$	80 V	50 V	30 V
Collector-emitter voltage ( $V_{BE} = 0$ )	$V_{CES}$	80 V	50 V	30 V
Emitter-base voltage	$V_{EB0}$	6 V	6 V	5 V
Collector current	$I_C$		100 mA	
Peak collector current	$I_{CM}$		200 mA	
Peak base current	$I_{BM}$		200 mA	
Peak emitter current	$I_{EM}$		200 mA	
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$		330 mW	
Junction temperature	$T_j$		150 °C	
Storage temperature range	$T_{stg}$		-65 ... + 150 °C	
<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$		≤ 375 K/W	

## Characteristics

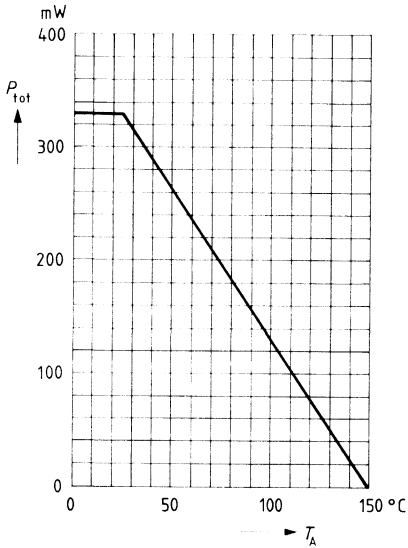
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 10\text{ mA}$ BC 846 BC 847, BC 850 BC 848, BC 849	$V_{(BR) CE0}$	65 45 30	– – –	– – –	V V V
Collector-base breakdown voltage $I_C = 10\ \mu\text{A}$ BC 846 BC 847, BC 850 BC 848, BC 849	$V_{(BR) CB0}$	80 50 30	– – –	– – –	V V V
Collector-emitter breakdown voltage $I_C = 10\ \mu\text{A}$ , $V_{BE} = 0$ BC 846 BC 847, BC 850 BC 848, BC 849	$V_{(BR) CES}$	80 50 30	– – –	– – –	V V V
Emitter-base breakdown voltage $I_E = 1\ \mu\text{A}$ BC 846, BC 847 BC 848, BC 849, BC 850	$V_{(BR) EB0}$	6 5	– –	– –	V V
Collector cutoff current $V_{CB} = 30\text{ V}$ $V_{CB} = 30\text{ V}$ , $T_A = 150^\circ\text{C}$	$I_{CB0}$	– –	– –	15 5	nA $\mu\text{A}$
DC current gain <sup>1)</sup> $I_C = 10\ \mu\text{A}$ , $V_{CE} = 5\text{ V}$ BC 846 A, BC 847 A, BC 848 A BC 846 B ... BC 850 B BC 847 C, BC 848 C, BC 849 C, BC 850 C $I_C = 2\text{ mA}$ , $V_{CE} = 5\text{ V}$ BC 846 A, BC 847 A, BC 848 A BC 846 B ... BC 850 B BC 847 C, BC 848 C, BC 849 C, BC 850 C	$h_{FE}$	– – – 110 200 420	90 150 270 180 290 520	– – – 220 450 800	– – – – – –
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 10\text{ mA}$ , $I_B = 0,5\text{ mA}$ $I_C = 100\text{ mA}$ , $I_B = 5\text{ mA}$	$V_{CEsat}$	– –	90 200	250 600	mV mV
Base-emitter saturation voltage <sup>1)</sup> $I_C = 10\text{ mA}$ , $I_B = 0,5\text{ mA}$ $I_C = 100\text{ mA}$ , $I_B = 5\text{ mA}$	$V_{BEsat}$	– –	700 900	– –	mV mV
Base-emitter voltage $I_C = 2\text{ mA}$ , $V_{CE} = 5\text{ V}$ $I_C = 10\text{ mA}$ , $V_{CE} = 5\text{ V}$	$V_{BE(ON)}$	580 –	660 –	700 770	mV mV

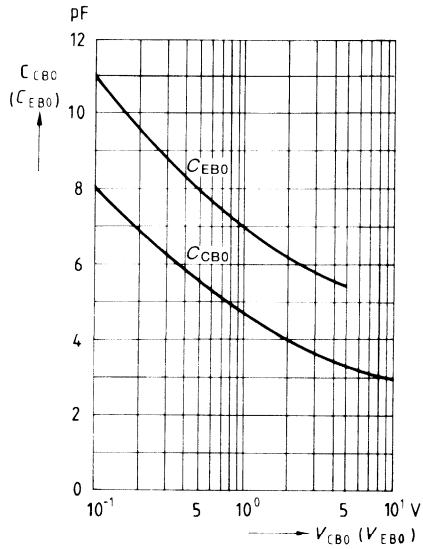
<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

<b>Dynamic characteristics</b>	<b>Symbol</b>	<b>min</b>	<b>typ</b>	<b>max</b>	<b>Unit</b>
Transition frequency $I_C = 20 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $f = 100 \text{ MHz}$	$f_T$	–	200	–	MHz
Output capacitance $V_{CB} = 10 \text{ V}$ , $f = 1 \text{ MHz}$	$C_{ob}$	–	3	–	pF
Input capacitance $V_{CB} = 0,5 \text{ V}$ , $f = 1 \text{ MHz}$	$C_{ib}$	–	8	–	pF
Short-circuit input impedance $I_C = 2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $f = 1 \text{ kHz}$ BC 846 A ... BC 848 A BC 846 B ... BC 850 B BC 847 C ... BC 850 C	$h_{11e}$	–	2,7 4,5 8,7	–	k $\Omega$ k $\Omega$ k $\Omega$
Open-circuit reverse voltage transfer ratio $I_C = 2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $f = 1 \text{ kHz}$ BC 846 A ... BC 848 A BC 846 B ... BC 850 B BC 847 C ... BC 850 C	$h_{12e}$	–	1,5 2,0 3,0	–	$10^{-4}$ $10^{-4}$ $10^{-4}$
Short-circuit forward current transfer ratio $I_C = 2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $f = 1 \text{ kHz}$ BC 846 A ... BC 848 A BC 846 B ... BC 850 B BC 847 C ... BC 850 C	$h_{21e}$	–	200 330 600	–	– – –
Open-circuit output admittance $I_C = 2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $f = 1 \text{ kHz}$ BC 846 A ... BC 848 A BC 846 B ... BC 850 B BC 847 C ... BC 850 C	$h_{22e}$	–	18 30 60	–	$\mu\text{S}$ $\mu\text{S}$ $\mu\text{S}$
Noise figure $I_C = 0,2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $R_G = 2 \text{ k}\Omega$ $f = 30 \text{ Hz} \dots 15 \text{ kHz}$ BC 849 BC 850 $f = 1 \text{ kHz}$ , $\Delta f = 200 \text{ Hz}$ BC 849 BC 850	$NF$	–	1,4 1,4 1,2 1,0	4 3 4 4	dB dB dB dB
Equivalent noise voltage $I_C = 0,2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $R_G = 2 \text{ k}\Omega$ $f = 10 \text{ Hz} \dots 50 \text{ Hz}$ BC 850	$V_{neq}$	–	–	0,135	$\mu\text{V}$

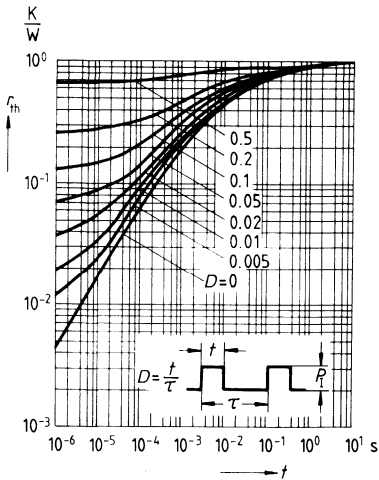
**Total power dissipation**  $P_{\text{tot}} = f(T_A)$



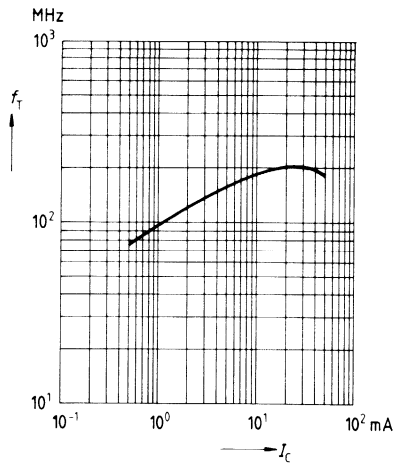
**Capacitance**  $C_{\text{CB0}} = f(V_{\text{CB0}})$   
 $C_{\text{EB0}} = f(V_{\text{EB0}})$



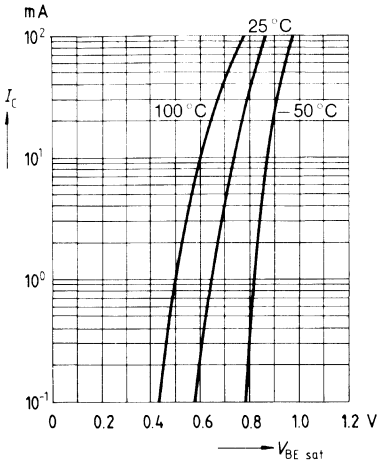
**Pulse handling capability**  $r_{\text{th}} = f(t)$   
(standardized)



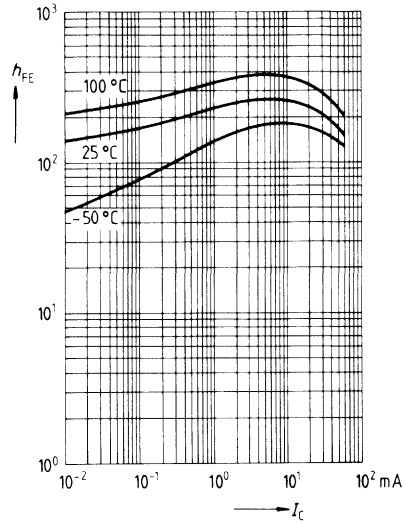
**Transition frequency**  $f_T = f(I_C)$



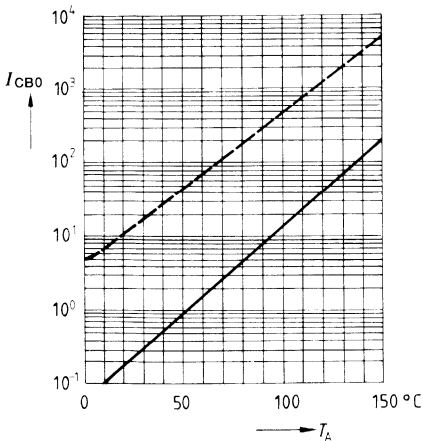
**Base-emitter saturation voltage**  $V_{BE\ sat} = f(I_c)$   
 $h_{FE} = 20$



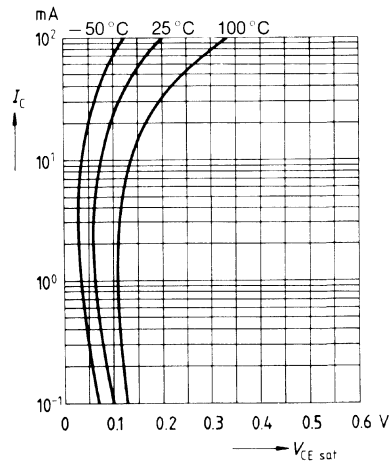
**DC current gain**  $h_{FE} = f(I_c)$   
 $V_{CE} = 1\text{ V}$



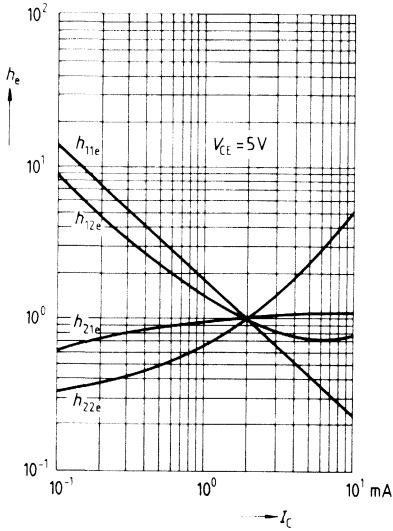
**Collector cutoff current**  $I_{CB0} = f(T_A)$   
 $V_{CB} = 30\text{ V}$



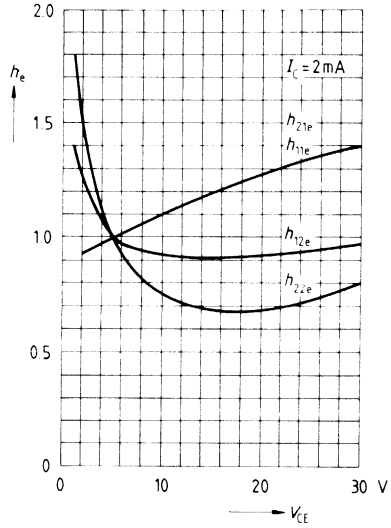
**Collector-emitter saturation voltage**  
 $V_{CE\ sat} = f(I_c)$   
 $h_{FE} = 20$



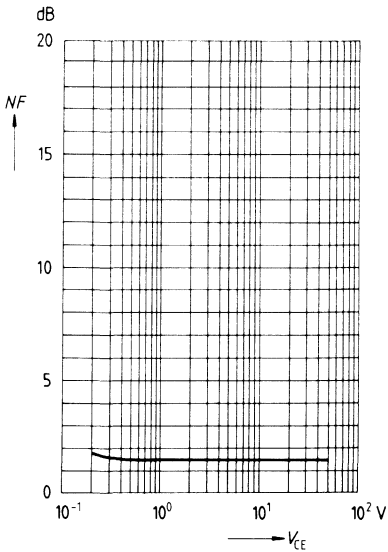
**h parameter  $h_e = f(I_c)$**   
 $V_{CE} = 5 \text{ V}$



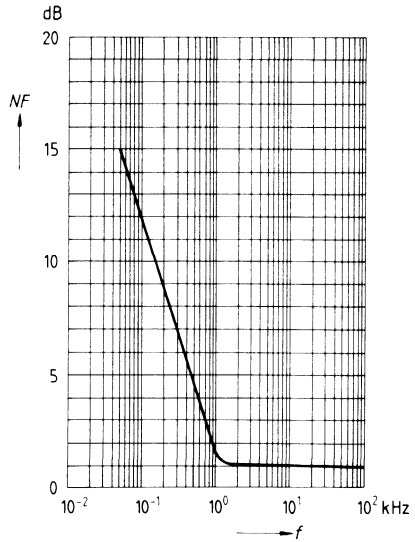
**h parameter  $h_e = f(V_{CE})$**   
 $I_c = 2 \text{ mA}$



**Noise figure  $NF = f(V_{CE})$**   
 $I_c = 0.2 \text{ mA}$ ,  $R_G = 2 \text{ k}\Omega$ ,  $f = 1 \text{ kHz}$

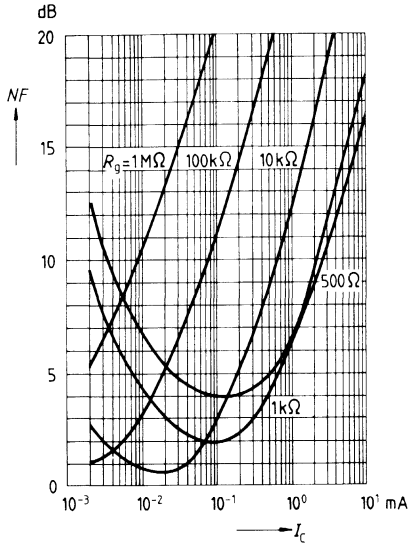


**Noise figure  $NF = f(f)$**   
 $I_c = 0.2 \text{ mA}$ ,  $R_G = 2 \text{ k}\Omega$



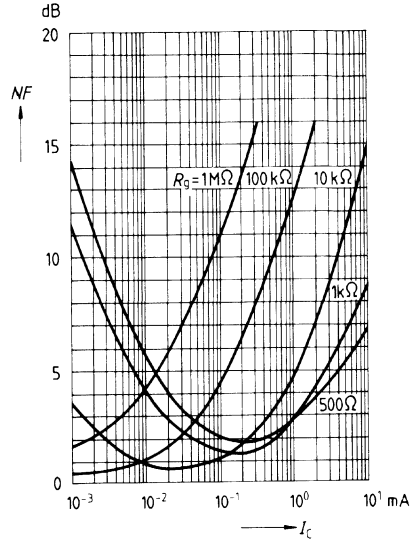
**Noise figure  $NF = f(I_C)$**

$V_{CE} = 5\text{ V}$ ,  $f = 120\text{ Hz}$



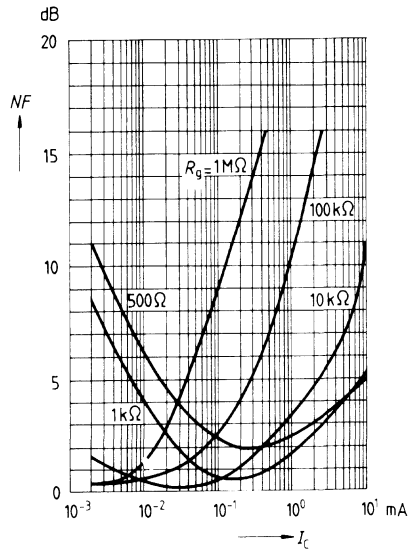
**Noise figure  $NF = f(I_C)$**

$V_{CE} = 5\text{ V}$ ,  $f = 1\text{ kHz}$



**Noise figure  $NF = f(I_C)$**

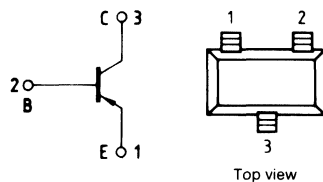
$V_{CE} = 5\text{ V}$ ,  $f = 10\text{ kHz}$





**PNP silicon planar epitaxial transistors**

- High current gain
- Low collector-emitter saturation voltage
- Low noise between 30 Hz and 15 kHz
- Complementary to BC 846, BC 847, BC 849, BC 850 (NPN)



Type	Marking	Type	Marking	Ordering code	Package
BC 856 A	3A	BC 858 C	3L	Refer to index	Version A
BC 856 B	3B	BC 859 A	4A		
BC 857 A	3E	BC 859 B	4B		
BC 857 B	3F	BC 859 C	4C		
BC 857 C	3G	BC 860 B	4F		
BC 858 A	3J	BC 860 C	4G		
BC 858 B	3K				

Maximum ratings		BC 856	BC 857, BC 860	BC 858, BC 859
Collector-emitter voltage	$V_{CE0}$	65 V	45 V	30 V
Collector-base voltage	$V_{CB0}$	80 V	50 V	30 V
Collector-emitter voltage ( $V_{BE} = 0$ )	$V_{CES}$	80 V	50 V	30 V
Emitter-base voltage	$V_{EB0}$	5 V	5 V	5 V
Collector current	$I_C$		100 mA	
Peak collector current	$I_{CM}$		200 mA	
Peak base current	$I_{BM}$		200 mA	
Peak emitter current	$I_{EM}$		200 mA	
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$		330 mW	
Junction temperature	$T_j$		150 °C	
Storage temperature range	$T_{stg}$		-65 ... +150 °C	
<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$		≤ 375 K/W	

## Characteristics

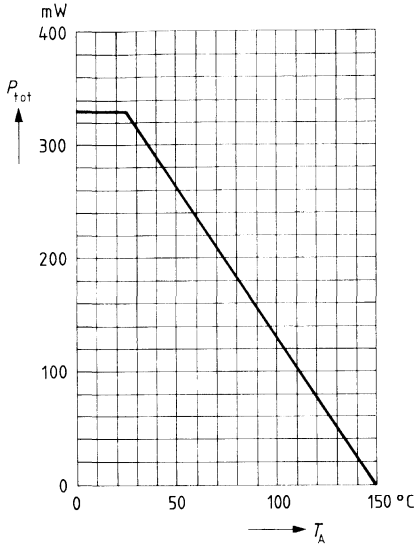
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 10\text{ mA}$ BC 856 BC 857, BC 860 BC 858, BC 859	$V_{(BR) CE0}$	65 45 30	– – –	– – –	V V V
Collector-base breakdown voltage $I_C = 10\ \mu\text{A}$ BC 856 BC 857, BC 860 BC 858, BC 859	$V_{(BR) CB0}$	80 50 30	– – –	– – –	V V V
Collector-emitter breakdown voltage $I_C = 10\ \mu\text{A}$ , $V_{BE} = 0$ BC 856 BC 857, BC 860 BC 858, BC 859	$V_{(BR) CES}$	80 50 30	– – –	– – –	V V V
Emitter-base breakdown voltage $I_E = 1\ \mu\text{A}$	$V_{(BR) EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 30\text{ V}$ $V_{CB} = 30\text{ V}$ , $T_A = 150^\circ\text{C}$	$I_{CB0}$	– –	1 –	15 4	nA $\mu\text{A}$
DC current gain <sup>1)</sup> $I_C = 10\ \mu\text{A}$ , $V_{CE} = 5\text{ V}$ BC 856 A ... BC 858 A BC 856 B ... BC 860 B BC 857 C ... BC 860 C $I_C = 2\text{ mA}$ , $V_{CE} = 5\text{ V}$ BC 856 A ... BC 858 A BC 856 B ... BC 860 B BC 857 C ... BC 860 C	$h_{FE}$	– – – 125 220 420	90 150 270 180 290 520	– – – 250 475 800	– – – – – –
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 10\text{ mA}$ , $I_B = 0,5\text{ mA}$ $I_C = 100\text{ mA}$ , $I_B = 5\text{ mA}$	$V_{CEsat}$	– –	75 250	300 650	mV mV
Base-emitter saturation voltage <sup>1)</sup> $I_C = 10\text{ mA}$ , $I_B = 0,5\text{ mA}$ $I_C = 100\text{ mA}$ , $I_B = 5\text{ mA}$	$V_{BEsat}$	– –	700 850	– –	mV mV
Base-emitter voltage $I_C = 2\text{ mA}$ , $V_{CE} = 5\text{ V}$ $I_C = 10\text{ mA}$ , $V_{CE} = 5\text{ V}$	$V_{BE (on)}$	600 –	650 –	750 820	mV mV

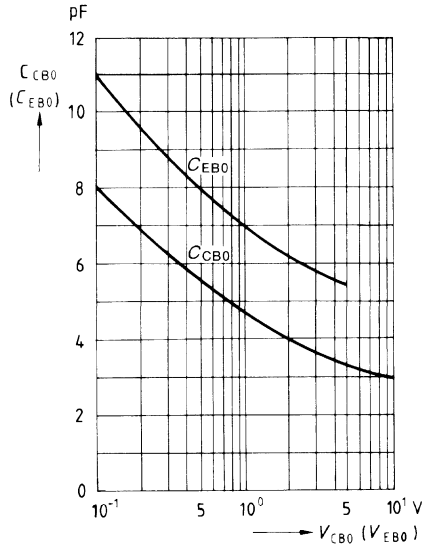
<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 20 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $f = 100 \text{ MHz}$	$f_T$	–	250	–	MHz
Output capacitance $V_{CB} = 10 \text{ V}$ , $f = 1 \text{ MHz}$	$C_{ob}$	–	3	–	pF
Input capacitance $V_{CB} = 0,5 \text{ V}$ , $f = 1 \text{ MHz}$	$C_{ib}$	–	8	–	pF
Short-circuit input impedance $I_C = 2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $f = 1 \text{ kHz}$ BC 856 A ... BC 858 A BC 856 B ... BC 860 B BC 857 C ... BC 860 C	$h_{11e}$	– – –	– 2,7 4,5 8,7	– – –	– k $\Omega$ k $\Omega$ k $\Omega$
Open-circuit reverse voltage transfer ratio $I_C = 2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $f = 1 \text{ kHz}$ BC 856 A ... BC 858 A BC 856 B ... BC 860 B BC 857 C ... BC 860 C	$h_{12e}$	– – –	– 1,5 2,0 3,0	– – –	– $10^{-4}$ $10^{-4}$ $10^{-4}$
Short-circuit forward current transfer ratio $I_C = 2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $f = 1 \text{ kHz}$ BC 856 A ... BC 858 A BC 856 B ... BC 860 B BC 857 C ... BC 860 C	$h_{21e}$	– – –	– 200 330 600	– – –	– – –
Open-circuit output admittance $I_C = 2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $f = 1 \text{ kHz}$ BC 856 A ... BC 858 A BC 856 B ... BC 860 B BC 857 C ... BC 860 C	$h_{22e}$	– – –	– 18 30 60	– – –	– $\mu\text{S}$ $\mu\text{S}$ $\mu\text{S}$
Noise figure $I_C = 0,2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $R_G = 2 \text{ k}\Omega$ $f = 30 \text{ Hz} \dots 15 \text{ kHz}$ BC 859 BC 860 $f = 1 \text{ kHz}$ , $\Delta f = 200 \text{ Hz}$ BC 859 BC 860	NF	– – – –	– 1,2 1,0 1,0 1,0	– 4 3 4 4	– dB dB dB dB
Equivalent noise voltage $I_C = 0,2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $R_G = 2 \text{ k}\Omega$ $f = 10 \text{ Hz} \dots 50 \text{ Hz}$ BC 860	$V_{neq}$	–	–	0,110	$\mu\text{V}$

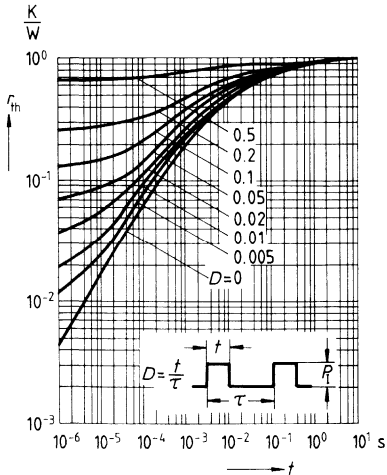
**Total power dissipation**  $P_{tot} = f(T_A)$



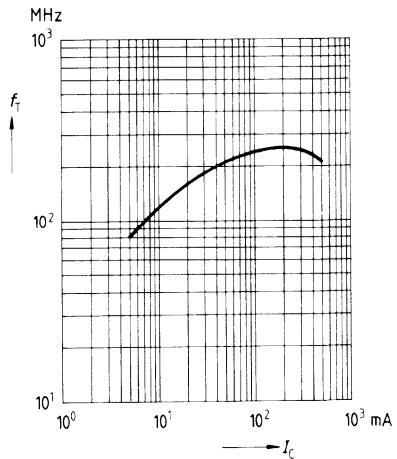
**Capacitance**  $C_{CB0} = f(V_{CB0})$   
 $C_{EB0} = f(V_{EB0})$



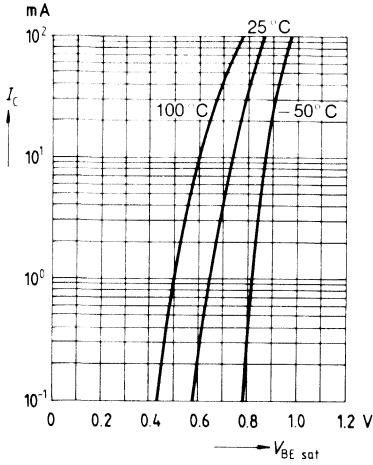
**Pulse handling capability**  $r_{th} = f(t)$   
(standardized)



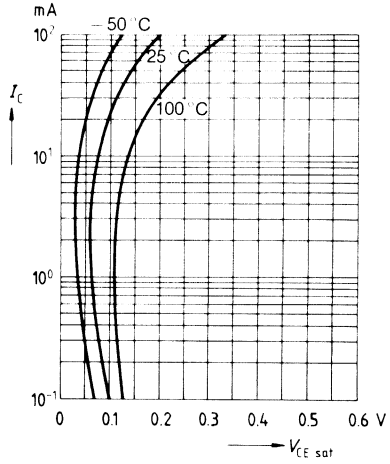
**Transition frequency**  $f_T = f(I_C)$   
 $V_{CE} = 5 V$



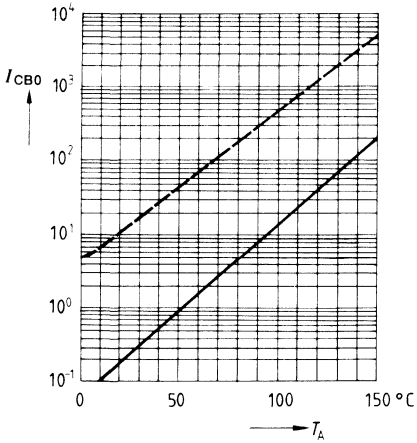
**Base-emitter saturation voltage**  $V_{BE\text{ sat}} = f(I_C)$   
 $h_{FE} = 20$



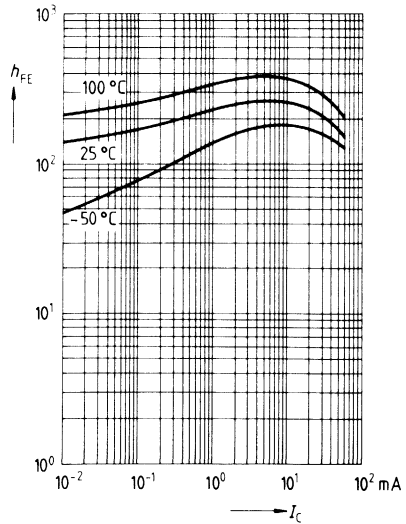
**Collector-emitter saturation voltage**  
 $V_{CE\text{ sat}} = f(I_C)$   
 $h_{FE} = 20$



**Collector cutoff current**  $I_{CB0} = f(T_A)$   
 $V_{CB} = 30\text{ V}$

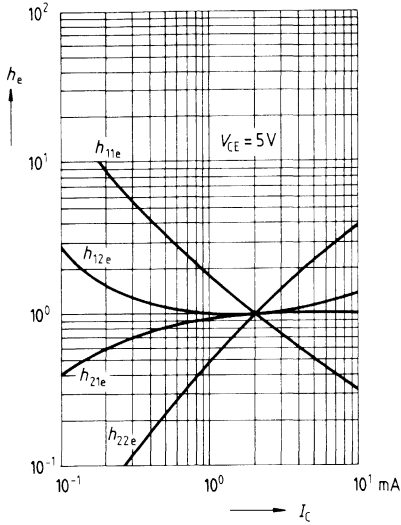


**DC current gain**  $h_{FE} = f(I_C)$   
 $V_{CE} = 1\text{ V}$



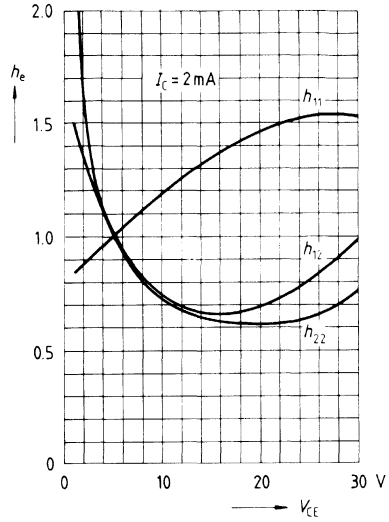
**h parameter  $h_e = f(I_C)$**

$V_{CE} = 5 \text{ V}$



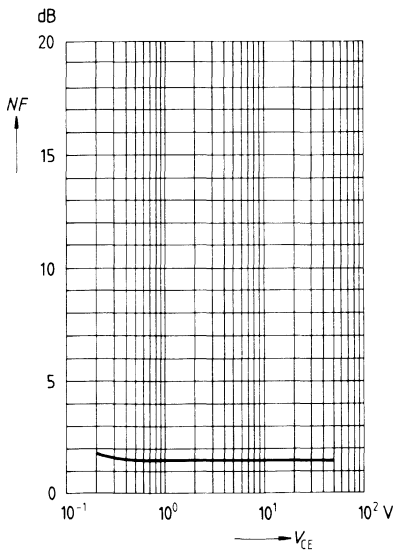
**h parameter  $h_e = f(V_{CE})$**

$I_C = 2 \text{ mA}$



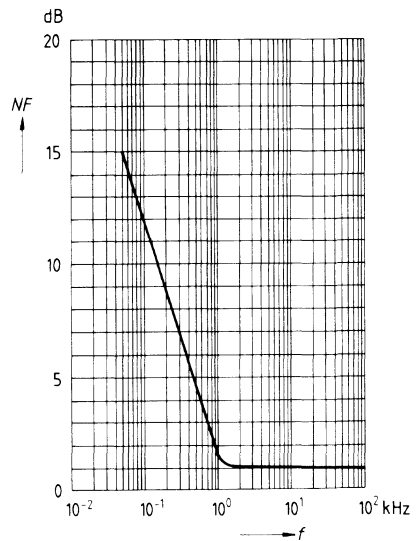
**Noise figure  $NF = f(V_{CE})$**

$I_C = 0,2 \text{ mA}$ ,  $R_G = 2 \text{ k}\Omega$ ,  $f = 1 \text{ kHz}$

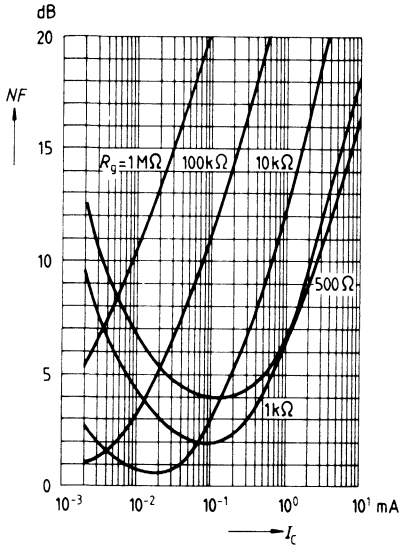


**Noise figure  $NF = f(f)$**

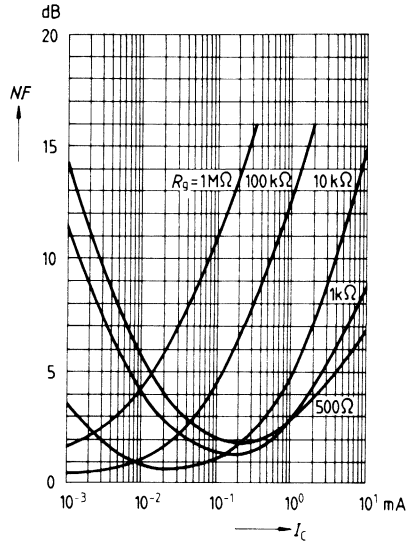
$I_C = 0,2 \text{ mA}$ ,  $R_G = 2 \text{ k}\Omega$ ,  $V_{CE} = 5 \text{ V}$



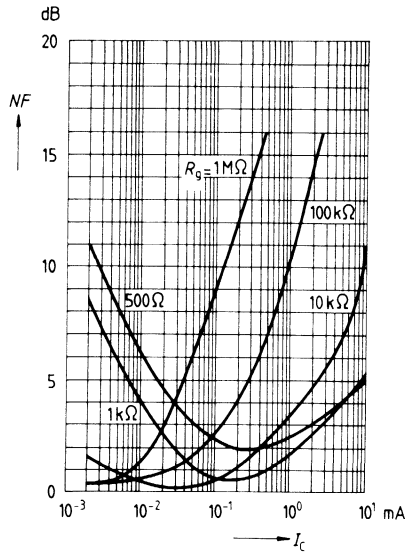
**Noise figure  $NF = f(I_C)$**   
 $V_{CE} = 5\text{ V}, f = 120\text{ Hz}$



**Noise figure  $NF = f(I_C)$**   
 $V_{CE} = 5\text{ V}, f = 1\text{ kHz}$

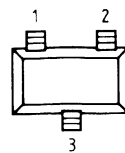
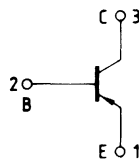


**Noise figure  $NF = f(I_C)$**   
 $V_{CE} = 5\text{ V}, f = 10\text{ kHz}$



**PNP silicon planar epitaxial transistors**

- High collector current
- High current gain
- Complementary types: BCV 27, BCV 47 (NPN)



Top view

Type	Marking	Ordering code	Package
BCV 26	FD	Refer to index	Version A
BCV 46	FE		

Maximum ratings		BCV 26	BCV 46
Collector-emitter voltage	$V_{CE0}$	30 V	60 V
Collector-base voltage	$V_{CB0}$	40 V	80 V
Emitter-base voltage	$V_{EB0}$	10 V	10 V
Collector current	$I_C$		500 mA
Peak collector current	$I_{CM}$		800 mA
Base current	$I_B$		100 mA
Peak base current	$I_{BM}$		200 mA
Total power dissipation	$P_{tot}$		360 mW
$T_A = 25\text{ }^\circ\text{C}$			
Junction temperature	$T_j$		150 °C
Storage temperature range	$T_{stg}$		-65 ... +150 °C
<b>Thermal resistance</b>	$R_{thJA}$		$\leq 350\text{ K/W}$
junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm			



## Characteristics

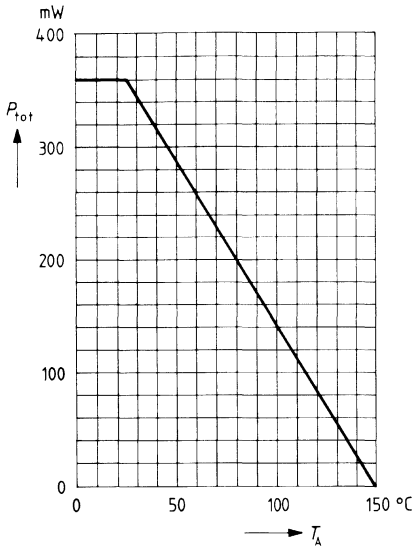
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 10\text{ mA}$ BCV 26 BCV 46	$V_{(BR)CE0}$	30 60	– –	– –	V V
Collector-base breakdown voltage $I_C = 100\ \mu\text{A}$ BCV 26 BCV 46	$V_{(BR)CB0}$	40 80	– –	– –	V V
Emitter-base breakdown voltage $I_E = 10\ \mu\text{A}$	$V_{(BR)EB0}$	10	–	–	V
Collector cutoff current $V_{CB} = 30\text{ V}$ BCV 26 $V_{CB} = 60\text{ V}$ BCV 46 $V_{CB} = 30\text{ V}, T_A = 150^\circ\text{C}$ BCV 26 $V_{CB} = 60\text{ V}, T_A = 150^\circ\text{C}$ BCV 46	$I_{CB0}$	– – – –	– – – –	100 100 10 10	nA nA $\mu\text{A}$ $\mu\text{A}$
Emitter cutoff current $V_{EB} = 4\text{ V}$	$I_{EB0}$	–	–	100	nA
DC current gain <sup>1)</sup> $I_C = 100\ \mu\text{A}, V_{CE} = 1\text{ V}$ BCV 26 BCV 46 $I_C = 10\text{ mA}, V_{CE} = 5\text{ V}$ BCV 26 BCV 46 $I_C = 100\text{ mA}, V_{CE} = 5\text{ V}$ BCV 26 BCV 46 $I_C = 0,5\text{ A}, V_{CE} = 5\text{ V}$ BCV 26 BCV 46	$h_{FE}$	4000 2000 10000 4000 20000 10000 4000 2000	– – – – – – – –	– – – – – – – –	– – – – – – – –
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 100\text{ mA}, I_B = 0,1\text{ mA}$	$V_{CEsat}$	–	–	1,0	V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 100\text{ mA}, I_B = 0,1\text{ mA}$	$V_{BEsat}$	–	–	1,5	V

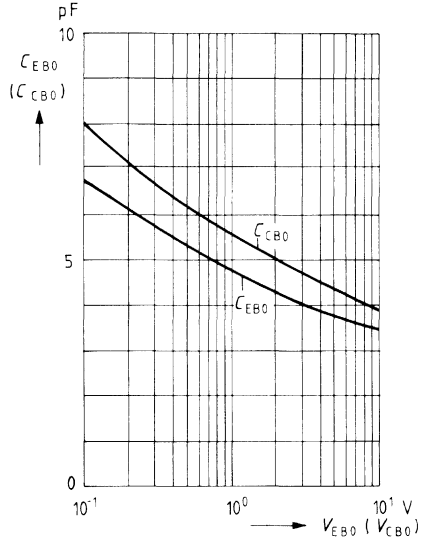
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 50\text{ mA}, V_{CE} = 5\text{ V}, f = 20\text{ MHz}$	$f_T$	–	200	–	MHz
Output capacitance $V_{CB} = 10\text{ V}, f = 1\text{ MHz}$	$C_{ob}$	–	4,5	–	pF

<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$

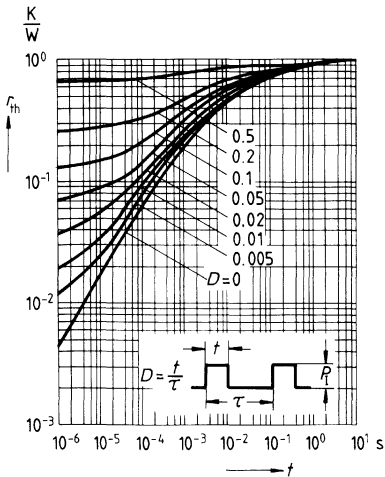
**Total power dissipation**  $P_{\text{tot}} = f(T_A)$



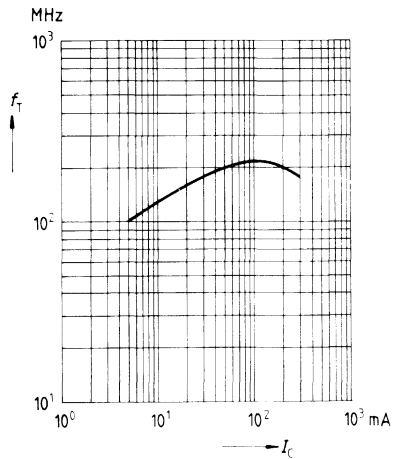
**Capacitance**  $C_{\text{CB0}} = f(V_{\text{CB0}})$   
 $C_{\text{EB0}} = f(V_{\text{EB0}})$



**Pulse handling capability**  $r_{\text{th}} = f(t)$   
(standardized)

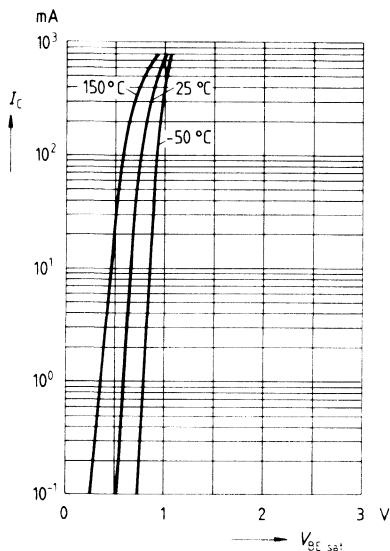


**Transition frequency**  $f_T = f(I_C)$   
 $V_{\text{CE}} = 5 \text{ V}$



**Base-emitter saturation voltage  $V_{BE\text{ sat}} = f(I_C)$**

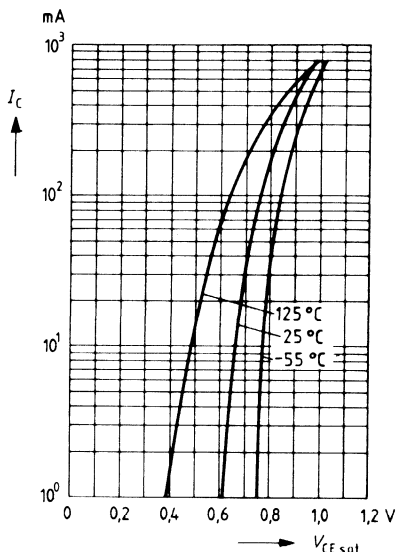
$h_{FE} = 1000$



**Collector-emitter saturation voltage  $V_{CE\text{ sat}} = f(I_C)$**

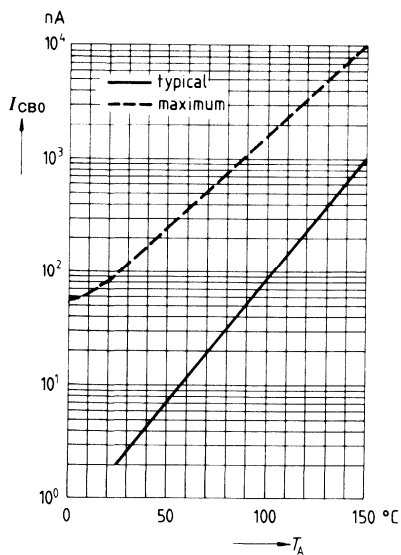
$V_{CE\text{ sat}} = f(I_C)$

$h_{FE} = 1000$



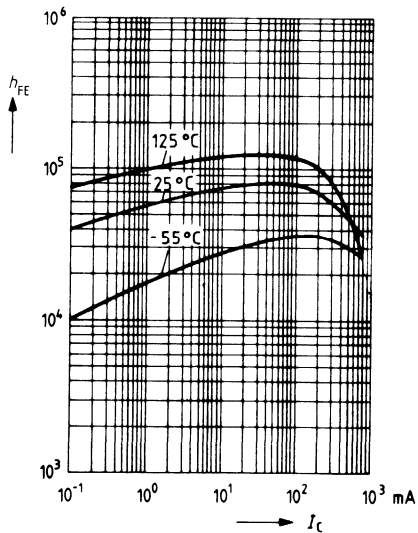
**Collector cutoff current  $I_{CB0} = f(T_A)$**

$V_{CB} = V_{CE\text{ max}}$



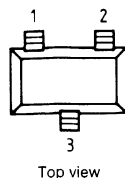
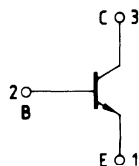
**DC current gain  $h_{FE} = f(I_C)$**

$V_{CE} = 5\text{ V}$



## NPN silicon planar epitaxial transistors

- High collector current
- High current gain
- Complementary types: BCV 26, BCV 46 (PNP)



Type	Marking	Ordering code	Package
BCV 27	FF	Refer to index	Version A
BCV 47	FG		

Maximum ratings		BCV 27	BCV 47
Collector-emitter voltage	$V_{CE0}$	30 V	60 V
Collector-base voltage	$V_{CB0}$	40 V	80 V
Emitter-base voltage	$V_{EB0}$	10 V	10 V
Collector current	$I_C$		500 mA
Peak collector current	$I_{CM}$		800 mA
Base current	$I_B$		100 mA
Peak base current	$I_{BM}$		200 mA
Total power dissipation	$P_{tot}$		360 mW
$T_A = 25\text{ °C}$			
Junction temperature	$T_j$		150 °C
Storage temperature range	$T_{stg}$		-65 ... +150 °C
<b>Thermal resistance</b>	$R_{thJA}$		≤ 350 K/W
junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm			

## Characteristics

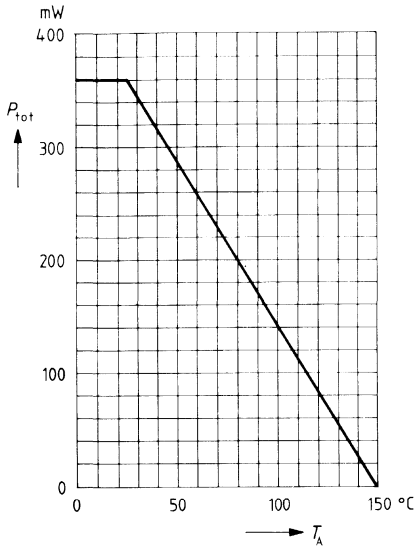
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 10\text{ mA}$ BCV 27 BCV 47	$V_{(BR)CE0}$	30 60	– –	– –	V V
Collector-base breakdown voltage $I_C = 100\ \mu\text{A}$ BCV 27 BCV 47	$V_{(BR)CB0}$	40 80	– –	– –	V V
Emitter-base breakdown voltage $I_E = 10\ \mu\text{A}$	$V_{(BR)EB0}$	10	–	–	V
Collector cutoff current $V_{CB} = 30\text{ V}$ BCV 27 $V_{CB} = 60\text{ V}$ BCV 47 $V_{CB} = 30\text{ V}, T_A = 150^\circ\text{C}$ BCV 27 $V_{CB} = 60\text{ V}, T_A = 150^\circ\text{C}$ BCV 47	$I_{CB0}$	– – – –	– – – –	100 100 10 10	nA nA $\mu\text{A}$ $\mu\text{A}$
Emitter cutoff current $V_{EB} = 4\text{ V}$	$I_{EB0}$	–	–	100	nA
DC current gain <sup>1)</sup> $I_C = 100\ \mu\text{A}, V_{CE} = 1\text{ V}$ BCV 27 BCV 47 $I_C = 10\text{ mA}, V_{CE} = 5\text{ V}$ BCV 27 BCV 47 $I_C = 100\text{ mA}, V_{CE} = 5\text{ V}$ BCV 27 BCV 47 $I_C = 0,5\text{ A}, V_{CE} = 5\text{ V}$ BCV 27 BCV 47	$h_{FE}$	4000 2000 10000 4000 20000 10000 4000 2000	– – – – – – – –	– – – – – – – –	– – – – – – – –
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 100\text{ mA}, I_B = 0,1\text{ mA}$	$V_{CEsat}$	–	–	1,0	V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 100\text{ mA}, I_B = 0,1\text{ mA}$	$V_{BEsat}$	–	–	1,5	V

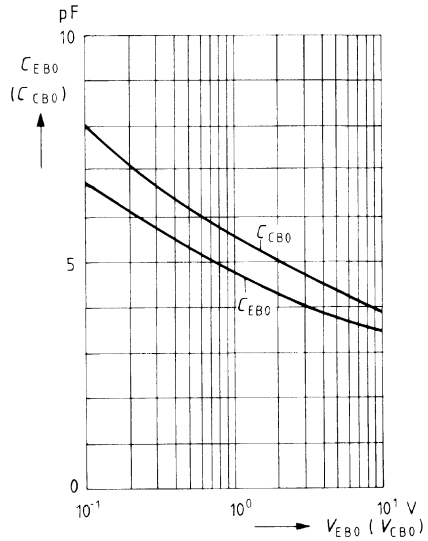
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 50\text{ mA}, V_{CE} = 5\text{ V}, f = 20\text{ MHz}$	$f_T$	–	170	–	MHz
Output capacitance $V_{CB} = 10\text{ V}, f = 1\text{ MHz}$	$C_{ob}$	–	3,5	–	pF

<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

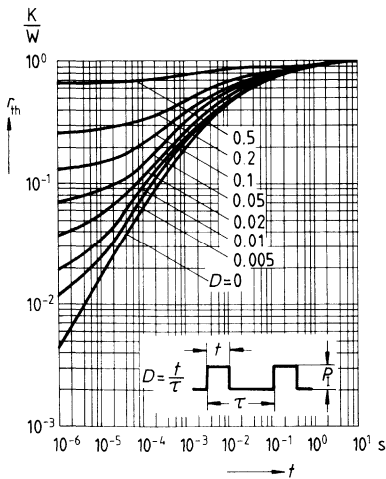
**Total power dissipation**  $P_{tot} = f(T_A)$



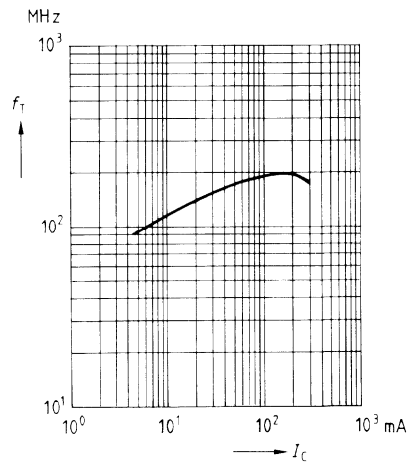
**Capacitance**  $C_{CB0} = f(V_{CB0})$   
 $C_{EB0} = f(V_{EB0})$



**Pulse handling capability**  $r_{th} = f(t)$   
(standardized)

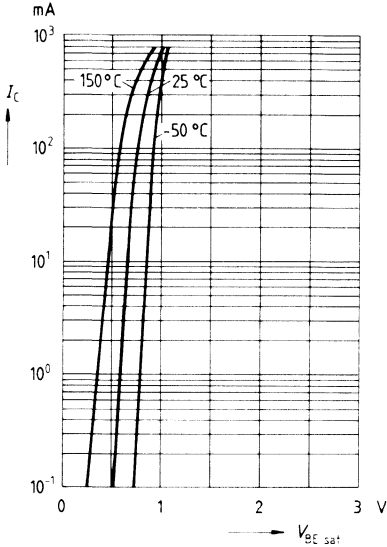


**Transition frequency**  $f_T = f(I_C)$   
 $V_{CE} = 5 V$



**Base-emitter saturation voltage  $V_{BE\text{ sat}} = f(I_C)$**

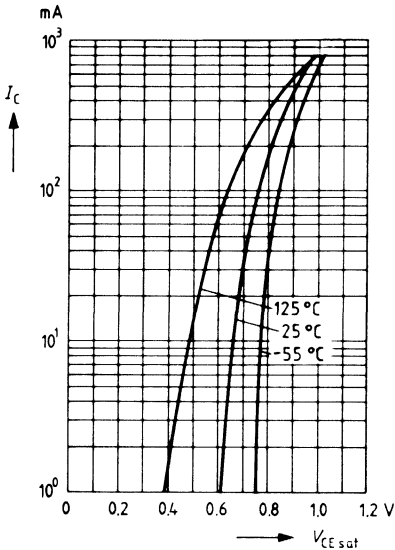
$h_{FE} = 1000$



**Collector-emitter saturation voltage  $V_{CE\text{ sat}} = f(I_C)$**

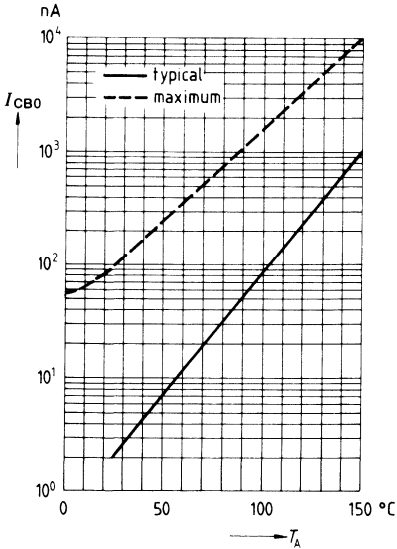
$V_{CE\text{ sat}} = f(I_C)$

$h_{FE} = 1000$



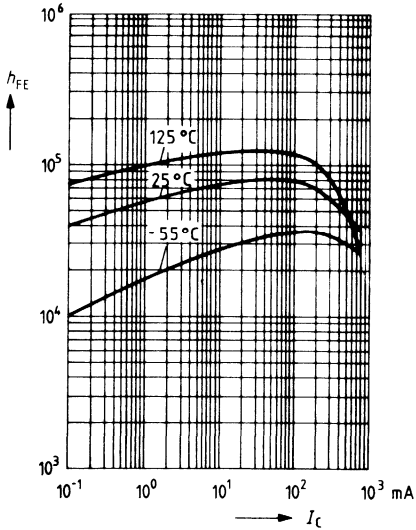
**Collector cutoff current  $I_{CB0} = f(T_A)$**

$V_{CB} = V_{CE\text{ max}}$



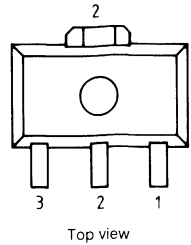
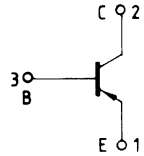
**DC current gain  $h_{FE} = f(I_C)$**

$V_{CE} = 5\text{ V}$



**PNP silicon planar epitaxial transistors**

- High collector current
- High current gain
- Complementary types: BCV 29, BCV 49 (NPN)



Type	Marking	Ordering code	Package
BCV 28	ED	Refer to index	Version C
BCV 48	EE		

Maximum ratings		BCV 28	BCV 48
Collector-emitter voltage	$V_{CE0}$	30 V	60 V
Collector-base voltage	$V_{CB0}$	40 V	80 V
Emitter-base voltage	$V_{EB0}$	10 V	10 V
Collector current	$I_C$		500 mA
Peak collector current	$I_{CM}$		800 mA
Base current	$I_B$		100 mA
Peak base current	$I_{BM}$		200 mA
Total power dissipation	$P_{tot}$		1,0 W
$T_A = 25^\circ\text{C}$			
Junction temperature	$T_j$		150 °C
Storage temperature range	$T_{stg}$		-65 ... +150 °C
<b>Thermal resistance</b>	$R_{thJA}$		≤ 125 K/W
junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm			



## Characteristics

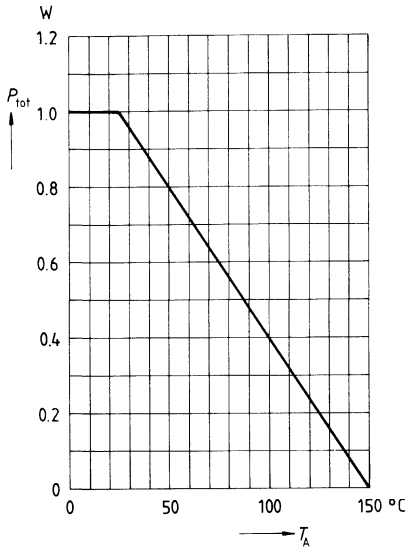
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 10\text{ mA}$ BCV 28 BCV 48	$V_{(BR)CE0}$	30 60	– –	– –	V V
Collector-base breakdown voltage $I_C = 100\ \mu\text{A}$ BCV 28 BCV 48	$V_{(BR)CB0}$	40 80	– –	– –	V V
Emitter base breakdown voltage $I_E = 10\ \mu\text{A}$	$V_{(BR)EB0}$	10	–	–	V
Collector cutoff current $V_{CB} = 30\text{ V}$ BCV 28 $V_{CB} = 60\text{ V}$ BCV 48 $V_{CB} = 30\text{ V}, T_A = 150^\circ\text{C}$ BCV 28 $V_{CB} = 60\text{ V}, T_A = 150^\circ\text{C}$ BCV 48	$I_{CB0}$	– – – –	– – – –	100 100 10 10	nA nA $\mu\text{A}$ $\mu\text{A}$
Emitter cutoff current $V_{EB} = 4\text{ V}$	$I_{EB0}$	–	–	100	nA
DC current gain <sup>1)</sup> $I_C = 100\ \mu\text{A}, V_{CE} = 1\text{ V}$ BCV 28 BCV 48 $I_C = 10\text{ mA}, V_{CE} = 5\text{ V}$ BCV 28 BCV 48 $I_C = 100\text{ mA}, V_{CE} = 5\text{ V}$ BCV 28 BCV 48 $I_C = 0,5\text{ A}, V_{CE} = 5\text{ V}$ BCV 28 BCV 48	$h_{FE}$	4000 2000 10000 4000 20000 10000 4000 2000	– – – – – – – –	– – – – – – – –	– – – – – – – –
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 100\text{ mA}, I_B = 0,1\text{ mA}$	$V_{CEsat}$	–	–	1,0	V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 100\text{ mA}, I_B = 0,1\text{ mA}$	$V_{BEsat}$	–	–	1,5	V

Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 50\text{ mA}, V_{CE} = 5\text{ V}, f = 20\text{ MHz}$	$f_T$	–	200	–	MHz
Output capacitance $V_{CB} = 10\text{ V}, f = 1\text{ MHz}$	$C_{ob}$	–	4,5	–	pF

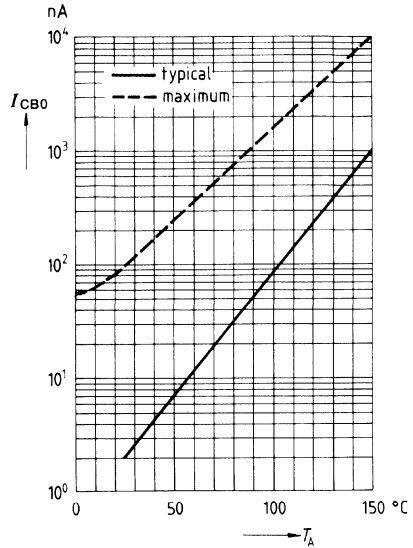
<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

**Total power dissipation**  $P_{tot} = f(T_A)$

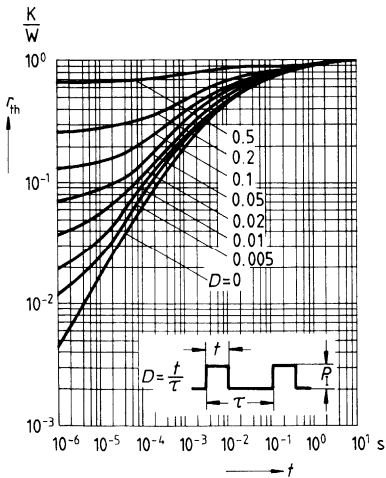


**Collector cutoff current**  $I_{CB0} = f(T_A)$

$V_{CB} = V_{CE\ max}$

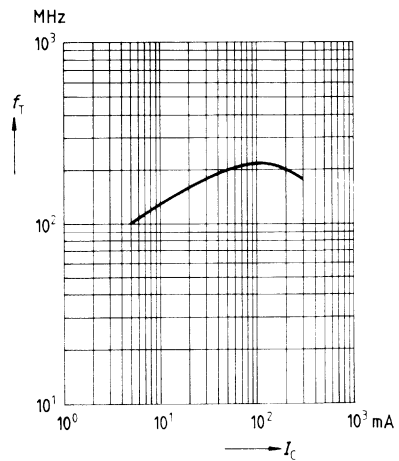


**Pulse handling capability**  $r_{th} = f(t)$   
(standardized)

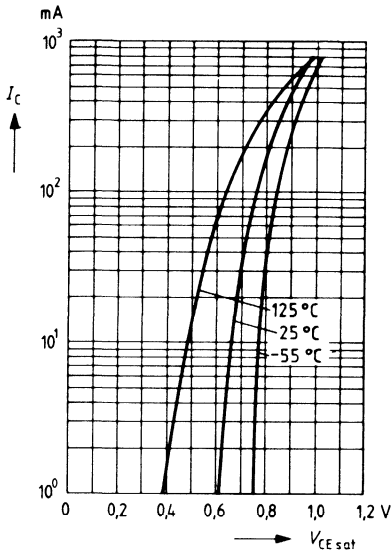


**Transition frequency**  $f_T = f(I_C)$

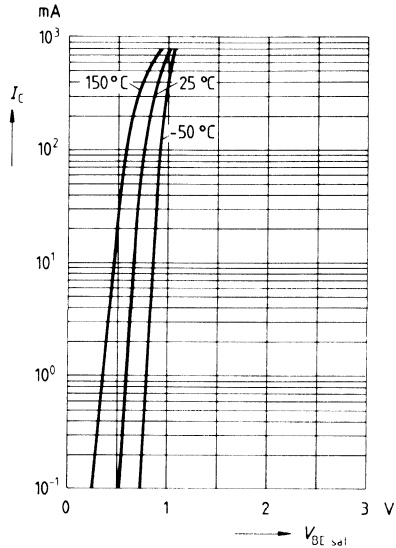
$V_{CE} = 5\ V$



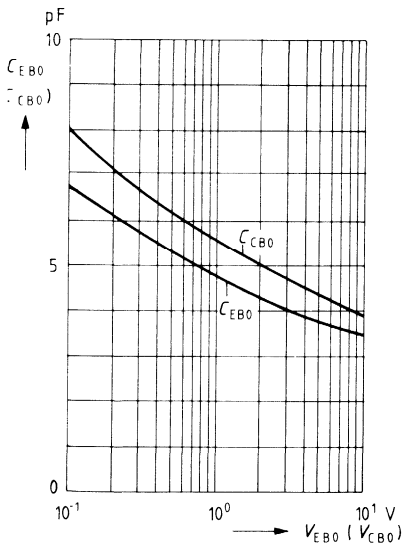
**Collector-emitter saturation voltage**  $V_{CE\text{ sat}} = f(I_C)$   
 $h_{FE} = 1000$



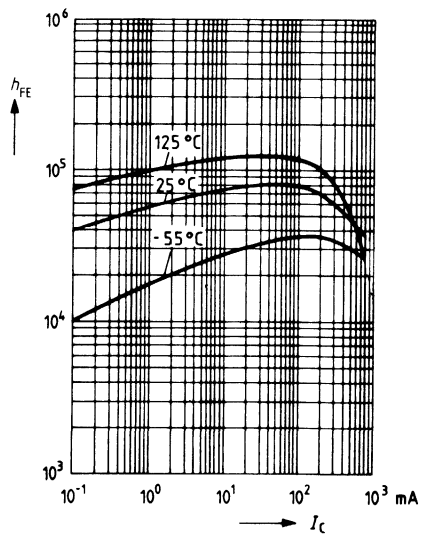
**Base-emitter saturation voltage**  $V_{BE\text{ sat}} = f(I_C)$   
 $h_{FE} = 1000$



**Capacitance**  $C_{CB0} = f(V_{CB0})$   
 $C_{EB0} = f(V_{EB0})$

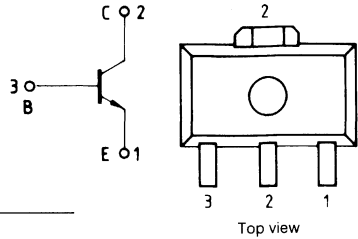


**DC current gain**  $h_{FE} = f(I_C)$   
 $V_{CE} = 5\text{ V}$



**NPN silicon planar epitaxial transistors**

- High collector current
- High current gain
- Complementary to: BCV 28, BCV 48 (PNP)



Type	Marking	Ordering code	Package
BCV 29	EF	Refer to index	Version C
BCV 49	EG		

Maximum ratings		BCV 29	BCV 49
Collector-emitter voltage	$V_{CE0}$	30 V	60 V
Collector-base voltage	$V_{CB0}$	40 V	80 V
Emitter-base voltage	$V_{EB0}$	10 V	10 V
Collector current	$I_C$		500 mA
Peak collector current	$I_{CM}$		800 mA
Base current	$I_B$		100 mA
Peak base current	$I_{BM}$		200 mA
Total power dissipation	$P_{tot}$		1,0 W
$T_A = 25\text{ }^\circ\text{C}$			
Junction temperature	$T_j$		150 °C
Storage temperature range	$T_{stg}$		-65 ... +150 °C
<b>Thermal resistance</b>	$R_{thJA}$		≤ 125 K/W
junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm			

## Characteristics

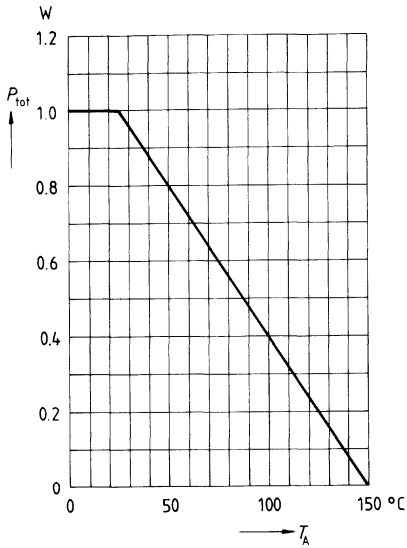
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 10\text{ mA}$ BCV 29 BCV 49	$V_{(BR)CE0}$	30 60	– –	– –	V V
Collector-base breakdown voltage $I_C = 100\ \mu\text{A}$ BCV 29 BCV 49	$V_{(BR)CB0}$	40 80	– –	– –	V V
Emitter-base breakdown voltage $I_E = 10\ \mu\text{A}$	$V_{(BR)EB0}$	10	–	–	V
Collector cutoff current $V_{CB} = 30\text{ V}$ BCV 29 $V_{CB} = 60\text{ V}$ BCV 49 $V_{CB} = 30\text{ V}, T_A = 150^\circ\text{C}$ BCV 29 $V_{CB} = 60\text{ V}, T_A = 150^\circ\text{C}$ BCV 49	$I_{CB0}$	– – – –	– – – –	100 100 10 10	nA nA $\mu\text{A}$ $\mu\text{A}$
Emitter cutoff current $V_{EB} = 4\text{ V}$	$I_{EB0}$	–	–	100	nA
DC current gain <sup>1)</sup> $I_C = 100\ \mu\text{A}, V_{CE} = 1\text{ V}$ BCV 29 BCV 49 $I_C = 10\text{ mA}, V_{CE} = 5\text{ V}$ BCV 29 BCV 49 $I_C = 100\text{ mA}, V_{CE} = 5\text{ V}$ BCV 29 BCV 49 $I_C = 0,5\text{ A}, V_{CE} = 5\text{ V}$ BCV 29 BCV 49	$h_{FE}$	4000 2000 10000 4000 20000 10000 4000 2000	– – – – – – – –	– – – – – – – –	– – – – – – – –
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 100\text{ mA}, I_B = 0,1\text{ mA}$	$V_{CEsat}$	–	–	1,0	V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 100\text{ mA}, I_B = 0,1\text{ mA}$	$V_{BEsat}$	–	–	1,5	V

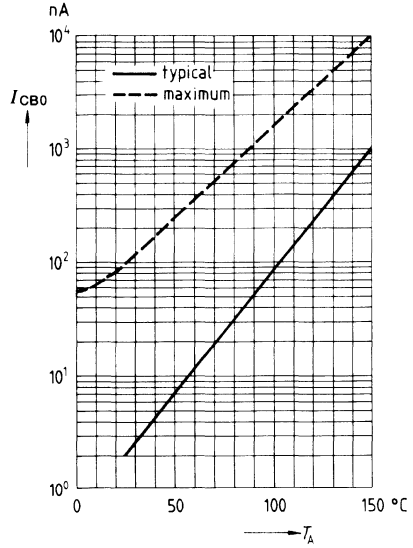
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 50\text{ mA}, V_{CE} = 5\text{ V}, f = 20\text{ MHz}$	$f_T$	–	150	–	MHz
Output capacitance $V_{CB} = 10\text{ V}, f = 1\text{ MHz}$	$C_{ob}$	–	3,5	–	pF

<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 20\%$ .

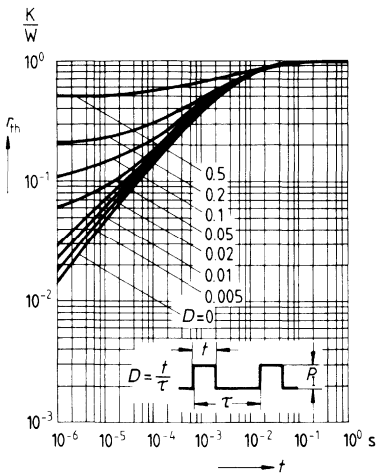
**Total power dissipation  $P_{tot} = f(T_A)$**



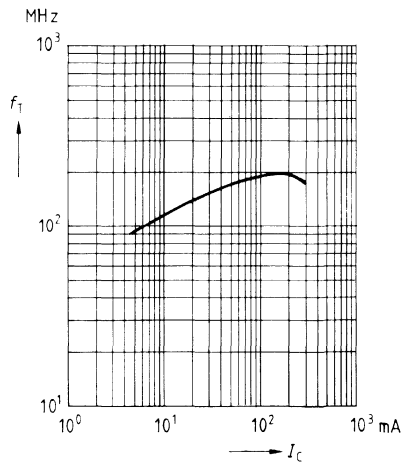
**Collector cutoff current  $I_{CB0} = f(T_A)$**



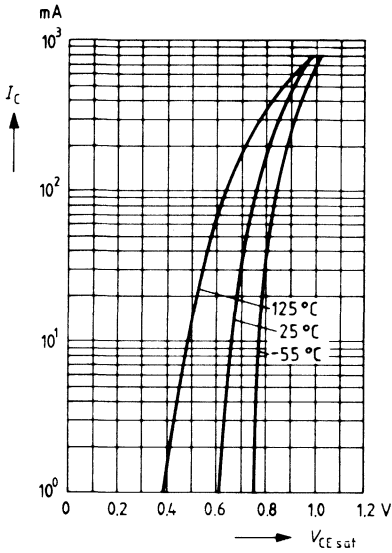
**Pulse handling capability  $r_{th} = f(t)$   
(standardized)**



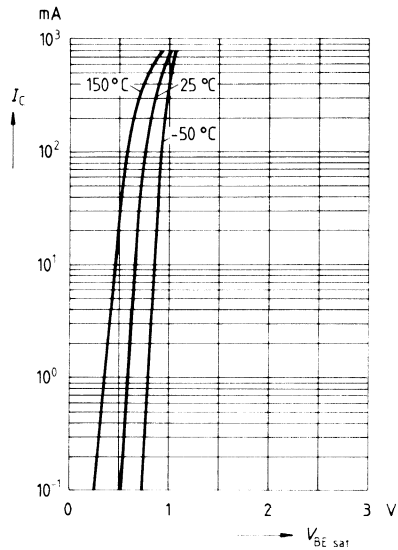
**Transition frequency  $f_T = f(I_C)$   
 $V_{CE} = 5 V$**



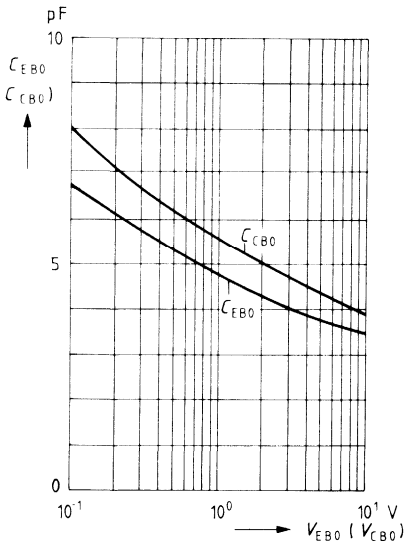
**Collector-emitter saturation voltage**  $V_{CE\ sat} = f(I_C)$   
 $h_{FE} = 1000$



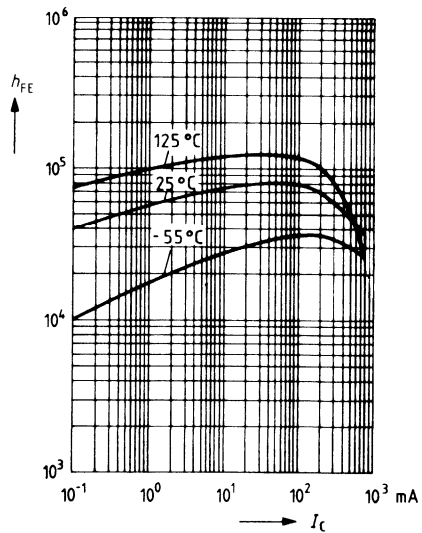
**Base-emitter saturation voltage**  $V_{BE\ sat} = f(I_C)$   
 $h_{FE} = 1000$



**Capacitance**  $C_{CB0} = f(V_{CB0})$   
 $C_{EB0} = f(V_{EB0})$

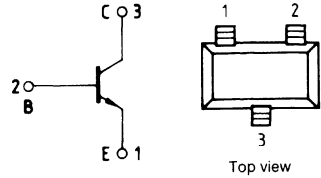


**DC current gain**  $h_{FE} = f(I_C)$   
 $V_{CE} = 5\text{ V}$



**NPN silicon planar epitaxial transistors**

- High current gain
- Low collector-emitter saturation voltage
- Low noise between 30 Hz and 15 kHz
- Complementary to BCW 61, BCX 71 (PNP)



Type	Marking	Type	Marking	Ordering code	Package
BCW 60 A	AA	BCW 60 FN	AN	Refer to index	Version A
BCW 60 B	AB	BCX 70 G	AG		
BCW 60 C	AC	BCX 70 H	AH		
BCW 60 D	AD	BCX 70 J	AJ		
BCW 60 FF	AF	BCX 70 K	AK		

Maximum ratings		BCW 60	BCW 60 F	BCX 70
Collector-emitter voltage	$V_{CE0}$	32 V	32 V	45 V
Collector-base voltage	$V_{CB0}$	32 V	32 V	45 V
Emitter-base voltage	$V_{EB0}$	5 V	5 V	5 V
Collector current	$I_C$		100 mA	
Peak collector current	$I_{CM}$		200 mA	
Peak base current	$I_{BM}$		200 mA	
Total power dissipation $T_A = 25\text{ °C}$	$P_{Tot}$		330 mW	
Junction temperature	$T_j$		150 °C	
Storage temperature range	$T_{stg}$		-65 ... +150 °C	
<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$		≤ 375 K/W	



## Characteristics

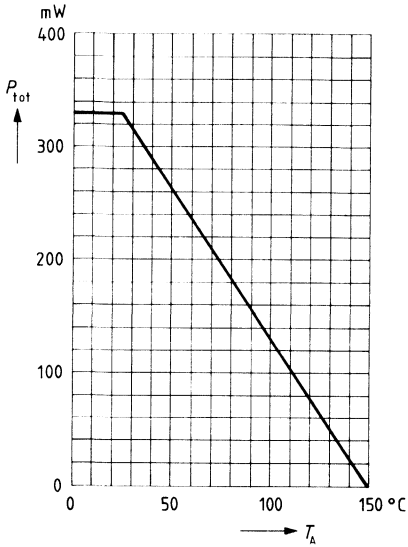
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 10\text{ mA}$ BCW 60, BCW 60 F BCX 70	$V_{(BR)CE0}$	32 45	– –	– –	V V
Collector-base breakdown voltage $I_C = 10\ \mu\text{A}$ BCW 60, BCW 60 F BCX 70	$V_{(BR)CB0}$	32 45	– –	– –	V V
Emitter-base breakdown voltage $I_E = 1\ \mu\text{A}$	$V_{(BR)EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 32\text{ V}$ BCW 60, BCW 60 F $V_{CB} = 45\text{ V}$ BCX 70 $V_{CB} = 32\text{ V}, T_A = 150^\circ\text{C}$ BCW 60, BCW 60 F $V_{CB} = 45\text{ V}, T_A = 150^\circ\text{C}$ BCX 70	$I_{CB0}$	– – – –	– – – –	20 20 20 20	nA nA $\mu\text{A}$ $\mu\text{A}$
Emitter cutoff current $V_{EB} = 4\text{ V}$	$I_{EB0}$	–	–	20	nA
DC current gain <sup>1)</sup> $I_C = 10\ \mu\text{A}, V_{CE} = 5\text{ V}$ BCW 60 A, BCX 70 G BCW 60 B, BCX 70 H BCW 60 FF, BCW 60 C, BCX 70 J BCW 60 FN, BCW 60 D, BCX 70 K $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}$ BCW 60 A, BCX 70 G BCW 60 B, BCX 70 H BCW 60 FF, BCW 60 C, BCX 70 J BCW 60 FN, BCW 60 D, BCX 70 K $I_C = 50\text{ mA}, V_{CE} = 1\text{ V}$ BCW 60 A, BCX 70 G BCW 60 B, BCX 70 H BCW 60 FF, BCW 60 C, BCX 70 J BCW 60 FN, BCW 60 D, BCX 70 K	$h_{FE}$	20 20 40 100  120 180 250 380  50 70 90 100	78 145 220 300  170 250 350 500  – – – –	– – – –  220 310 460 630  – – – –	– – – –  – – – –  – – – –
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 10\text{ mA}, I_B = 0,25\text{ mA}$ $I_C = 50\text{ mA}, I_B = 1,25\text{ mA}$	$V_{CEsat}$	– –	0,12 0,20	0,25 0,55	V V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 10\text{ mA}, I_B = 0,25\text{ mA}$ $I_C = 50\text{ mA}, I_B = 1,25\text{ mA}$	$V_{BEsat}$	– –	0,70 0,83	0,85 1,05	V V
Base-emitter voltage $I_C = 10\ \mu\text{A}, V_{CE} = 5\text{ V}$ $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}$ $I_C = 50\text{ mA}, V_{CE} = 1\text{ V}^1)$	$V_{BE(on)}$	– 0,55 –	0,52 0,65 0,78	– 0,75 –	V V V

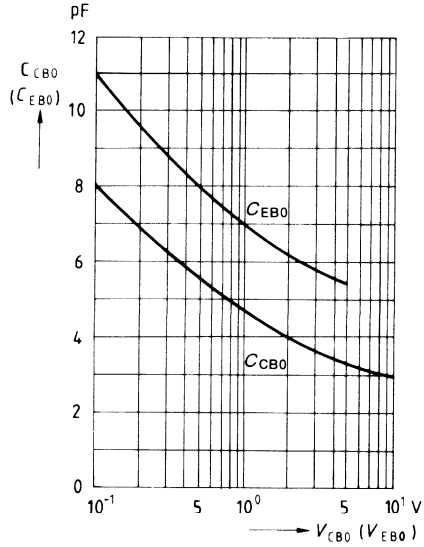
<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

<b>Dynamic characteristics</b>	<b>Symbol</b>	<b>min</b>	<b>typ</b>	<b>max</b>	<b>Unit</b>
Transition frequency $I_C = 20 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $f = 100 \text{ MHz}$	$f_T$	–	200	–	MHz
Output capacitance $V_{CB} = 10 \text{ V}$ , $f = 1 \text{ MHz}$	$C_{ob}$	–	3	–	pF
Input capacitance $V_{CB} = 0,5 \text{ V}$ , $f = 1 \text{ MHz}$	$C_{ib}$	–	8	–	pF
Short-circuit input impedance $I_C = 2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $f = 1 \text{ MHz}$ BCW 60 A, BCX 70 G BCW 60 B, BCX 70 H BCW 60 FF, BCW 60 C, BCX 70 J BCW 60 FN, BCW 60 D, BCX 70 K	$h_{11e}$	– – – –	– 2,7 3,6 4,5 7,5	– – – –	– k $\Omega$ k $\Omega$ k $\Omega$ k $\Omega$
Open-circuit reverse voltage transfer ratio $I_C = 2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $f = 1 \text{ kHz}$ BCW 60 A, BCX 70 G BCW 60 B, BCX 70 H BCW 60 FF, BCW 60 C, BCX 70 J BCW 60 FN, BCW 60 D, BCX 70 K	$h_{12e}$	– – – –	– 1,5 2,0 2,0 3,0	– – – –	– $10^{-4}$ $10^{-4}$ $10^{-4}$ $10^{-4}$
Short-circuit forward current transfer ratio $I_C = 2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $f = 1 \text{ kHz}$ BCW 60 A, BCX 70 G BCW 60 B, BCX 70 H BCW 60 FF, BCW 60 C, BCX 70 J BCW 60 FN, BCW 60 D, BCX 70 K	$h_{21e}$	– – – –	– 200 260 330 520	– – – –	– – – –
Open-circuit output admittance $I_C = 2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $f = 1 \text{ kHz}$ BCW 60 A, BCX 70 G BCW 60 B, BCX 70 H BCW 60 FF, BCW 60 C, BCX 70 J BCW 60 FN, BCW 60 D, BCX 70 K	$h_{22e}$	– – – –	– 18 24 30 50	– – – –	– $\mu\text{S}$ $\mu\text{S}$ $\mu\text{S}$ $\mu\text{S}$
Noise figure $I_C = 0,2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $R_G = 2 \text{ k}\Omega$ $f = 1 \text{ kHz}$ , $\Delta f = 200 \text{ Hz}$ $I_C = 0,2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $R_G = 2 \text{ k}\Omega$ $f = 1 \text{ kHz}$ ; $\Delta f = 200 \text{ Hz}$ BCW 60 FF, BCW 60 FN	$NF$	– –	– 2 1	– – 2	– dB dB
Equivalent noise voltage $I_C = 0,2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $R_G = 2 \text{ k}\Omega$ $f = 10 \text{ Hz} \dots 50 \text{ Hz}$ BCW 60 FF, BCW 60 FN	$V_{neq}$	–	–	0,135	$\mu\text{V}$

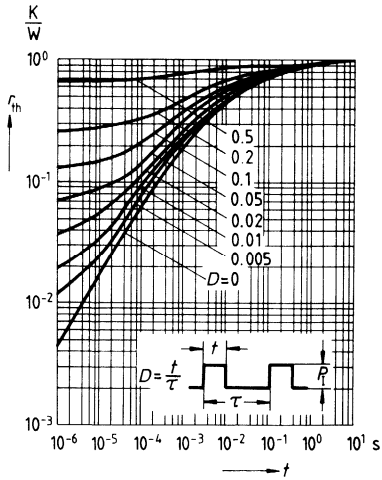
**Total power dissipation  $P_{tot} = f(T_A)$**



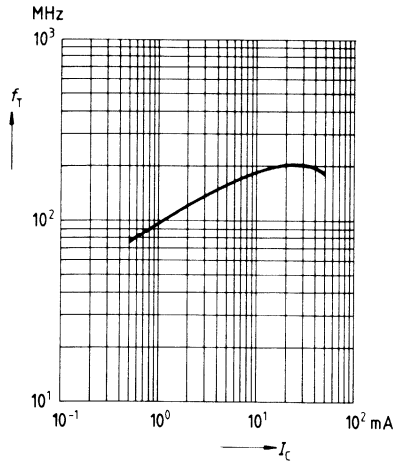
**Capacitance  $C_{CB0} = f(V_{CB0})$   
 $C_{EB0} = f(V_{EB0})$**



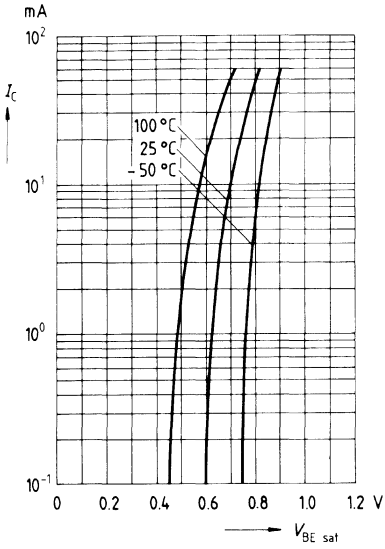
**Pulse handling capability  $r_{th} = f(t)$   
(standardized)**



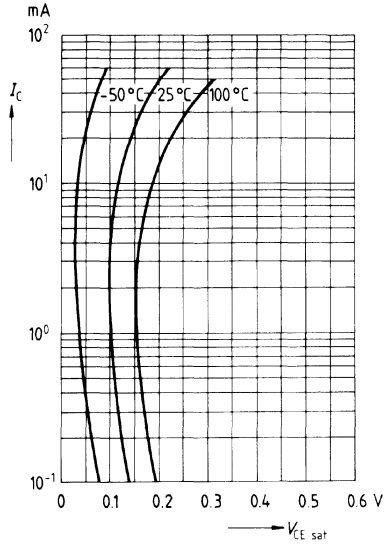
**Transition frequency  $f_T = f(I_C)$   
 $V_{CE} = 5 V$**



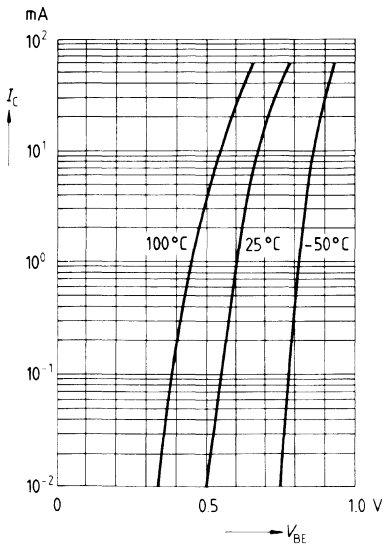
**Base-emitter saturation voltage**  $V_{BE\ sat} = f(I_C)$   
 $h_{FE} = 40$



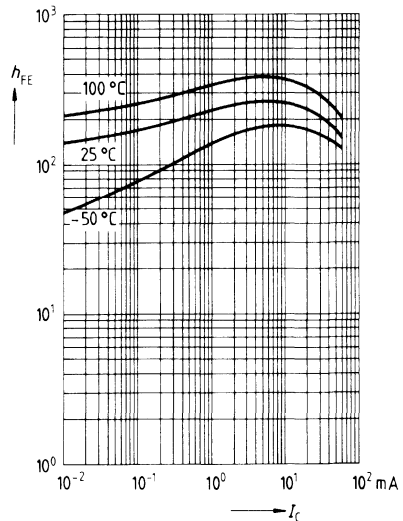
**Collector-emitter saturation voltage**  
 $V_{CE\ sat} = f(I_C)$   
 $h_{FE} = 40$



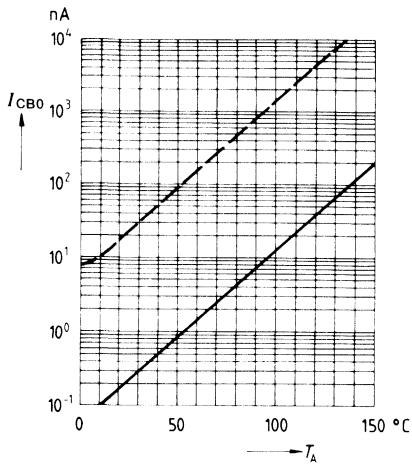
**Collector current**  $I_C = f(V_{BE})$   
 $V_{CE} = 1\ V$



**DC current gain**  $h_{FE} = f(I_C)$   
 $V_{CE} = 1\ V$

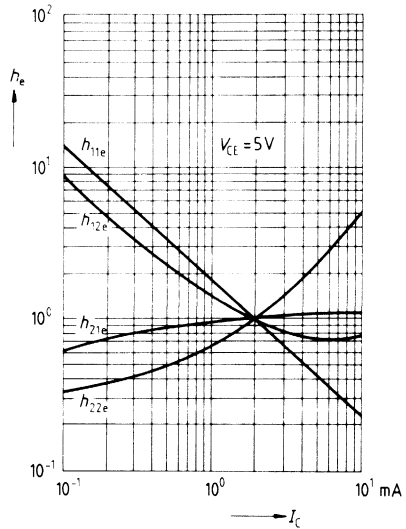


**Collector cutoff current  $I_{CB0} = f(T_A)$**



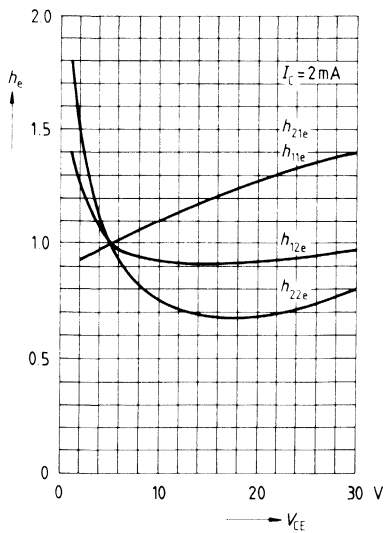
**h parameter  $h_e = f(I_C)$**

$V_{CE} = 5\text{ V}$



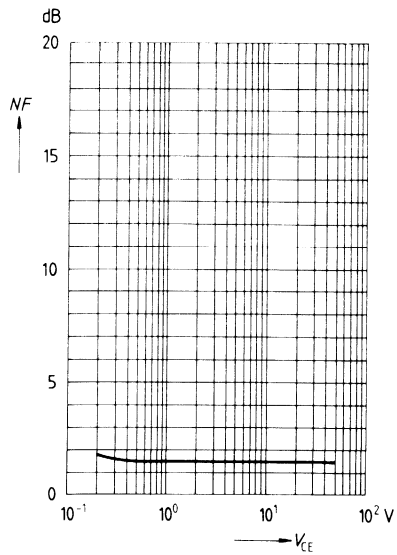
**h parameter  $h_e = f(V_{CE})$**

$I_C = 2\text{ mA}$



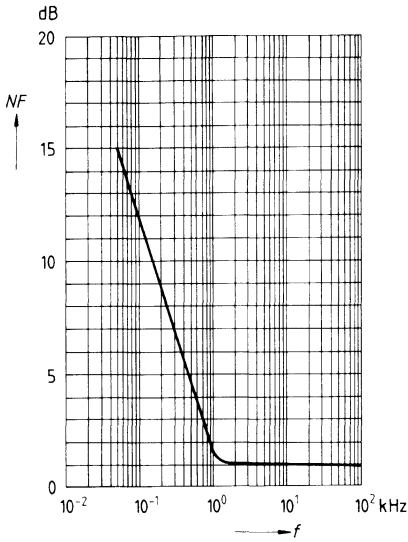
**Noise figure  $NF = f(V_{CE})$**

$I_C = 0,2\text{ mA}$ ,  $R_G = 2\text{ k}\Omega$ ,  $f = 1\text{ kHz}$



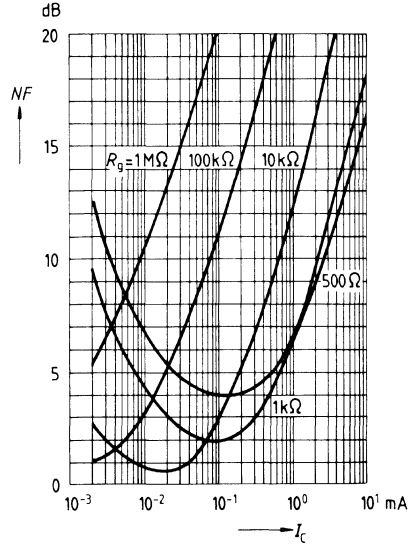
**Noise figure  $NF = f(f)$**

$I_C = 0,2 \text{ mA}$ ,  $R_G = 2 \text{ k}\Omega$ ,  $V_{CE} = 5 \text{ V}$



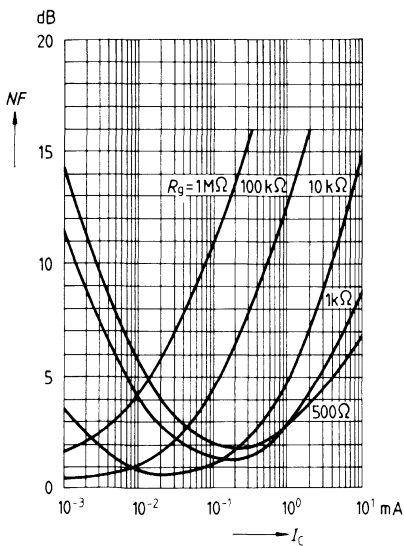
**Noise figure  $NF = f(I_C)$**

$V_{CE} = 5 \text{ V}$ ,  $f = 120 \text{ Hz}$



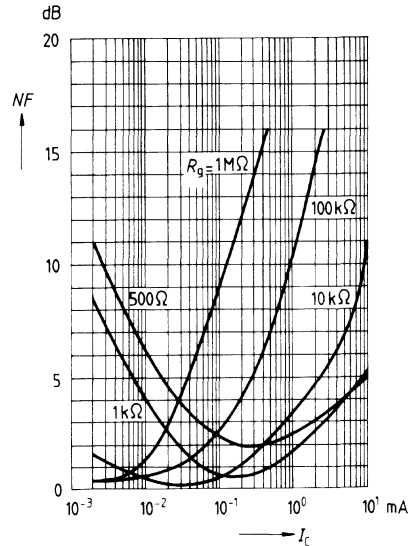
**Noise figure  $NF = f(I_C)$**

$V_{CE} = 5 \text{ V}$ ,  $f = 1 \text{ kHz}$



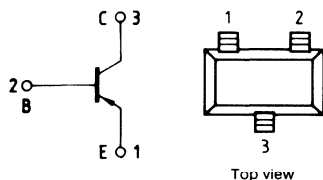
**Noise figure  $NF = f(I_C)$**

$V_{CE} = 5 \text{ V}$ ,  $f = 10 \text{ kHz}$



**PNP silicon planar epitaxial transistors**

- High current gain
- Low collector-emitter saturation voltage
- Low noise between 30 Hz and 15 kHz
- Complementary to BCW 60, BCX 70 (NPN)



Type	Marking	Type	Marking	Ordering code	Package
BCW 61 A	BA	BCX 61 FN	BN	Refer to index	Version A
BCW 61 B	BB	BCX 71 G	BG		
BCW 61 C	BC	BCX 71 H	BH		
BCW 61 D	BD	BCX 71 J	BJ		
BCW 61 FF	BF	BCX 71 K	BK		

<b>Maximum ratings</b>		BCW 61	BCW 61 F	BCX 71
Collector-emitter voltage	$V_{CE0}$	32 V	32 V	45 V
Collector-base voltage	$V_{CB0}$	32 V	32 V	45 V
Emitter-base voltage	$V_{EB0}$	5 V	5 V	5 V
Collector current	$I_C$		100 mA	
Peak collector current	$I_{CM}$		200 mA	
Peak base current	$I_{BM}$		200 mA	
Total power dissipation $T_A = 25\text{ °C}$	$P_{tot}$		330 mW	
Junction temperature	$T_j$		150 °C	
Storage temperature range	$T_{stg}$		-65 ... +150 °C	
<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$		≤ 375 K/W	

## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

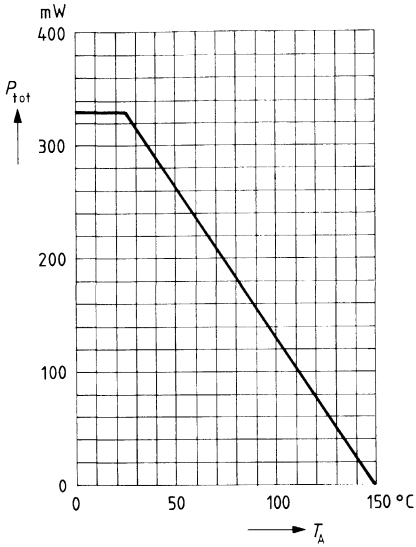
Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 10\text{ mA}$ BCW 61, BCW 61 F BCX 71	$V_{(BR)CE0}$	32 45	- -	- -	V V
Collector-base breakdown voltage $I_C = 10\text{ }\mu\text{A}$ BCW 61, BCW 61 F BCX 71	$V_{(BR)CB0}$	32 45	- -	- -	V V
Emitter-base breakdown voltage $I_E = 1\text{ }\mu\text{A}$	$V_{(BR)EB0}$	5	-	-	V
Collector cutoff current $V_{CB} = 32\text{ V}$ BCW 61, BCW 61 F $V_{CB} = 45\text{ V}$ BCX 71 $V_{CB} = 32\text{ V}, T_A = 150^\circ\text{C}$ BCW 61, BCW 61 F $V_{CB} = 45\text{ V}, T_A = 150^\circ\text{C}$ BCX 71	$I_{CB0}$	- - - -	- - - -	20 20 20 20	nA nA $\mu\text{A}$ $\mu\text{A}$
Emitter cutoff current $V_{EB} = 4\text{ V}$	$I_{EB0}$	-	-	20	nA
DC current gain <sup>1)</sup> $I_C = 10\text{ }\mu\text{A}, V_{CE} = 5\text{ V}$ BCW 61 A, BCX 71 G BCW 61 B, BCX 71 H BCW 61 FF, BCW 61 C, BCX 71 J BCW 61 FN, BCW 61 D, BCX 71 K $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}$ BCW 61 A, BCX 71 G BCW 61 B, BCX 71 H BCW 61 FF, BCW 61 C, BCX 71 J BCW 61 FN, BCW 61 D, BCX 71 K $I_C = 50\text{ mA}, V_{CE} = 1\text{ V}$ BCW 61 A, BCX 71 G BCW 61 B, BCX 71 H BCW 61 FF, BCW 61 C, BCX 71 J BCW 61 FN, BCW 61 D, BCX 71 K	$h_{FE}$	20 30 40 100 120 180 250 380 60 80 100 110	140 200 270 340 170 250 350 500 - - - -	- - - - 220 310 460 630 - - - -	- - - - - - - - - - - -
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 10\text{ mA}, I_B = 0,25\text{ mA}$ $I_C = 50\text{ mA}, I_B = 1,25\text{ mA}$	$V_{CEsat}$	- -	0,12 0,20	0,25 0,55	V V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 10\text{ mA}, I_B = 0,25\text{ mA}$ $I_C = 50\text{ mA}, I_B = 1,25\text{ mA}$	$V_{BEsat}$	- -	0,70 0,83	0,85 1,05	V V
Base-emitter voltage <sup>1)</sup> $I_C = 10\text{ }\mu\text{A}, V_{CE} = 5\text{ V}$ $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}$ $I_C = 50\text{ mA}, V_{CE} = 1\text{ V}$	$V_{BE(on)}$	- 0,55 -	0,52 0,65 0,78	- 0,75 -	V V V

<sup>1)</sup> Pulse test:  $t = 300\text{ }\mu\text{s}$ ,  $D = 2\%$ .

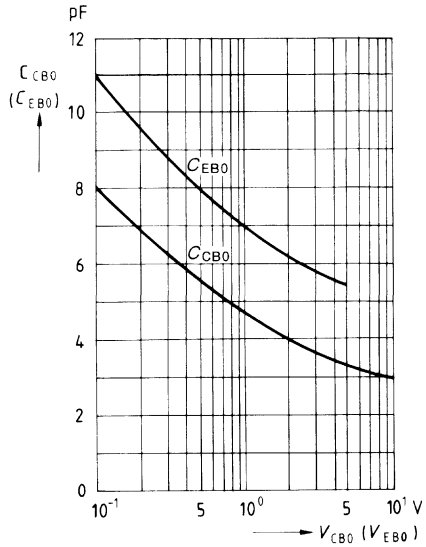


<b>Dynamic characteristics</b>	<b>Symbol</b>	<b>min</b>	<b>typ</b>	<b>max</b>	<b>Unit</b>
Transition frequency $I_C = 20 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $f = 100 \text{ MHz}$	$f_T$	–	250	–	MHz
Output capacitance $V_{CB} = 10 \text{ V}$ , $f = 1 \text{ MHz}$	$C_{ob}$	–	3	–	pF
Input capacitance $V_{CB} = 0,5 \text{ V}$ , $f = 1 \text{ MHz}$	$C_{ib}$	–	8	–	pF
Short-circuit input impedance $I_C = 2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $f = 1 \text{ MHz}$ BCW 61 A, BCX 71 G BCW 61 B, BCX 71 H BCW 61 FF, BCW 61 C, BCX 71 J BCW 61 FN, BCW 61 D, BCX 71 K	$h_{11e}$	–	2,7 3,6 4,5 7,5	–	k $\Omega$ k $\Omega$ k $\Omega$ k $\Omega$
Open-circuit reverse voltage transfer ratio $I_C = 2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $f = 1 \text{ kHz}$ BCW 61 A, BCX 71 G BCW 61 B, BCX 71 H BCW 61 FF, BCW 61 C, BCX 71 J BCW 61 FN, BCW 61 D, BCX 71 K	$h_{12e}$	–	1,5 2,0 2,0 3,0	–	$10^{-4}$ $10^{-4}$ $10^{-4}$ $10^{-4}$
Short-circuit forward current transfer ratio $I_C = 2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $f = 1 \text{ kHz}$ BCW 61 A, BCX 71 G BCW 61 B, BCX 71 H BCW 61 FF, BCW 61 C, BCX 71 J BCW 61 FN, BCW 61 D, BCX 71 K	$h_{21e}$	–	200 260 330 520	–	– – – –
Open-circuit output admittance $I_C = 2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $f = 1 \text{ kHz}$ BCW 61 A, BCX 71 G BCW 61 B, BCX 71 H BCW 61 FF, BCW 61 C, BCX 71 J BCW 61 FN, BCW 61 D, BCX 71 K	$h_{22e}$	–	18 24 30 50	–	$\mu\text{S}$ $\mu\text{S}$ $\mu\text{S}$ $\mu\text{S}$
Noise figure $I_C = 0,2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $R_G = 2 \text{ k}\Omega$ $f = 1 \text{ kHz}$ , $\Delta f = 200 \text{ Hz}$ $I_C = 0,2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $R_G = 2 \text{ k}\Omega$ $f = 1 \text{ kHz}$ , $\Delta f = 200 \text{ Hz}$ BCW 61 F, BCW 61 FN	$NF$	–	2 1	– 2	dB dB
Equivalent noise voltage $I_C = 0,2 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ , $R_G = 2 \text{ k}\Omega$ $f = 10 \text{ Hz} \dots 50 \text{ Hz}$ BCW 61 F, BCW 61 FN	$V_{neq}$	–	–	0,110	$\mu\text{V}$

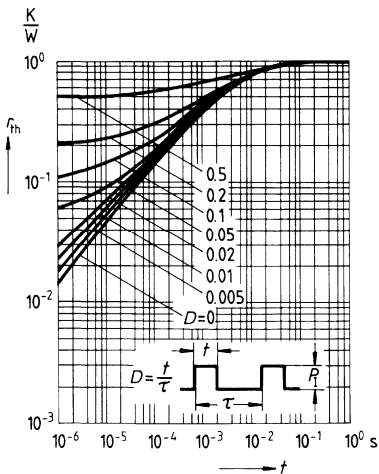
**Total power dissipation**  $P_{tot} = f(T_A)$



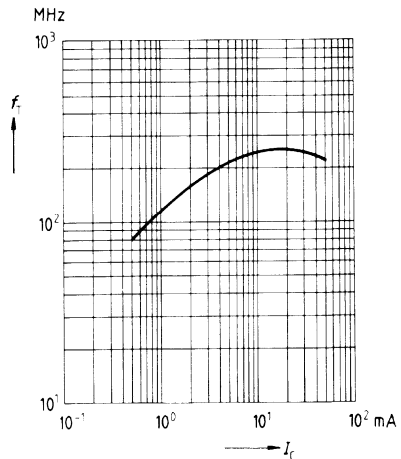
**Capacitance**  $C_{CB0} = f(V_{CB0})$   
 $C_{EB0} = f(V_{EB0})$



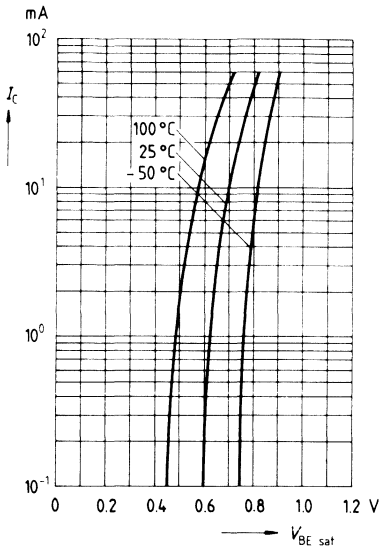
**Pulse handling capability**  $r_{th} = f(t)$   
(standardized)



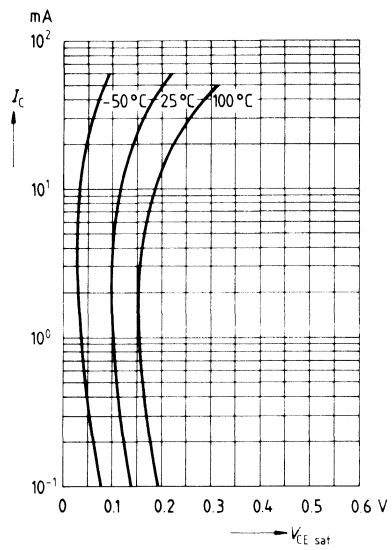
**Transition frequency**  $f_T = f(I_C)$   
 $V_{CE} = 5 V$



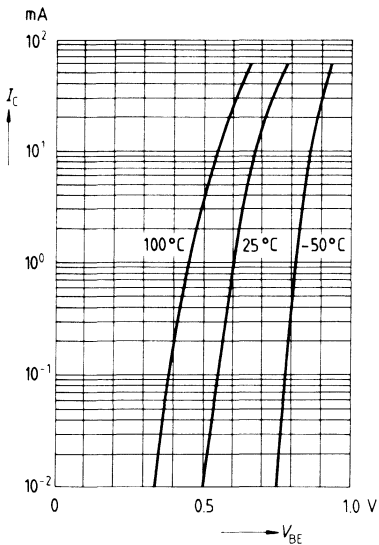
**Base-emitter saturation voltage**  $V_{BE\ sat} = f(I_C)$   
 $h_{FE} = 40$



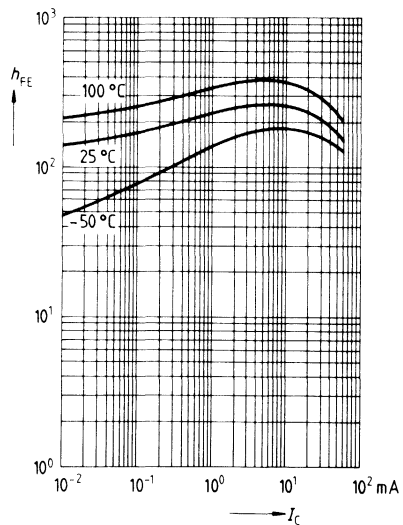
**Collector-emitter saturation voltage**  
 $V_{CE\ sat} = f(I_C)$   
 $h_{FE} = 40$



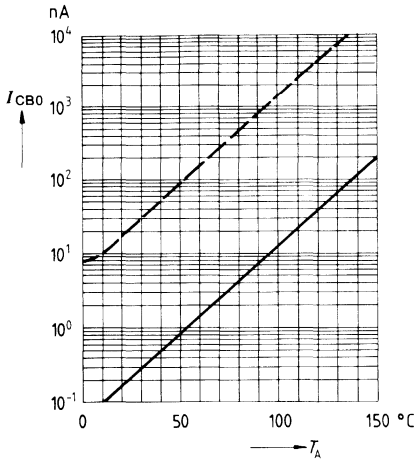
**Collector current**  $I_C = f(V_{BE})$   
 $V_{CE} = 1\text{ V}$



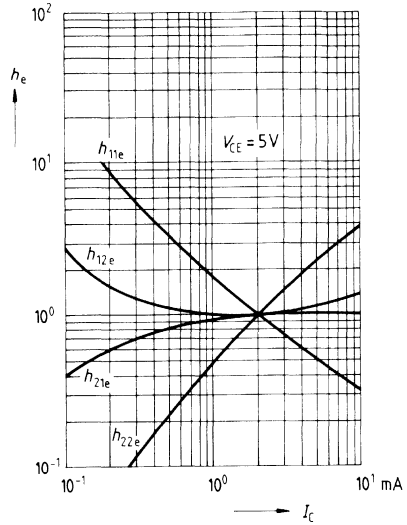
**DC current gain**  $h_{FE} = f(I_C)$   
 $V_{CE} = 1\text{ V}$



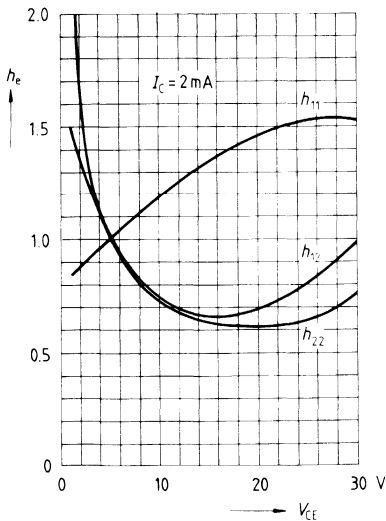
**Collector cutoff current  $I_{CB0} = f(T_A)$**



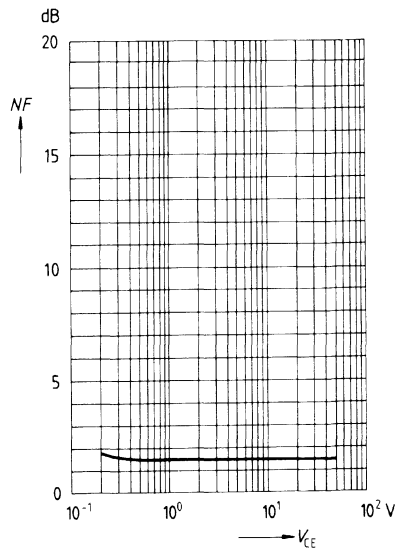
**h parameter  $h_e = f(I_C)$**   
 $V_{CE} = 5 \text{ V}$



**h parameter  $h_e = f(V_{CE})$**   
 $I_C = 2 \text{ mA}$

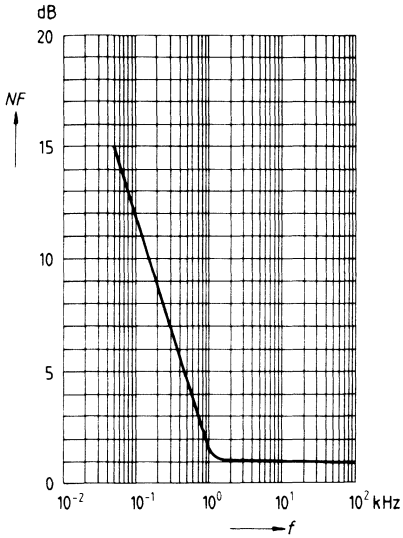


**Noise figure  $NF = f(V_{CE})$**   
 $I_C = 0.2 \text{ mA}$ ,  $R_G = 2 \text{ k}\Omega$ ,  $f = 1 \text{ kHz}$



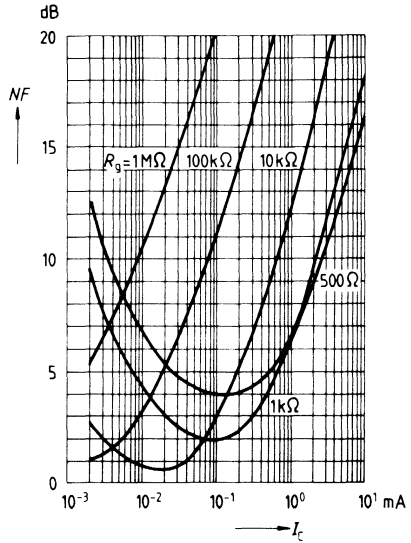
**Noise figure  $NF = f(f)$**

$I_C = 0,2 \text{ mA}$ ,  $R_G = 2 \text{ k}\Omega$ ,  $V_{CE} = 5 \text{ V}$



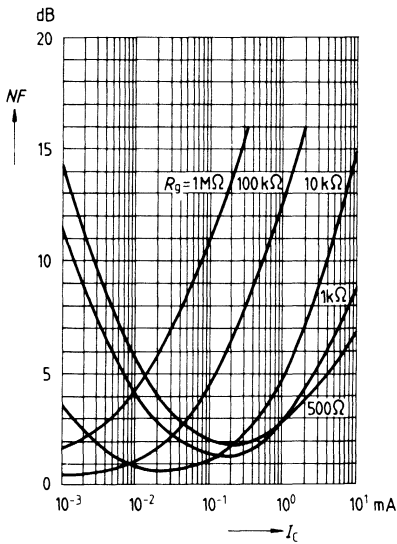
**Noise figure  $NF = f(I_C)$**

$V_{CE} = 5 \text{ V}$ ,  $f = 120 \text{ Hz}$



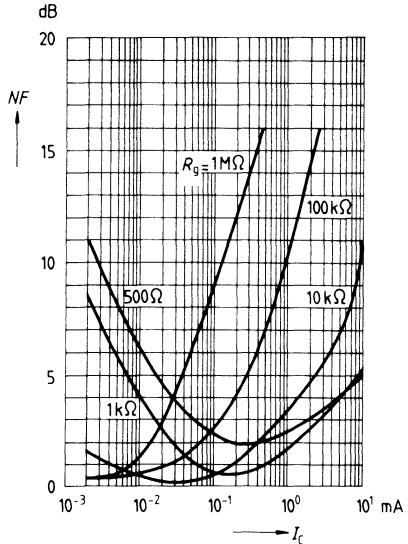
**Noise figure  $NF = f(I_C)$**

$V_{CE} = 5 \text{ V}$ ,  $f = 1 \text{ kHz}$



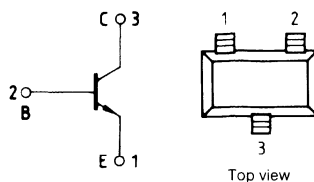
**Noise figure  $NF = f(I_C)$**

$V_{CE} = 5 \text{ V}$ ,  $f = 10 \text{ kHz}$



**NPN silicon planar epitaxial transistors**

- High current gain
- Low collector-emitter saturation voltage
- Complementary to BCW 67, BCW 68 (PNP)



Type	Marking	Type	Marking	Ordering code	Package
BCW 65 A	EA	BCW 66 F	EF	Refer to index	Version A
BCW 65 B	EB	BCW 66 G	EG		
BCW 65 C	EC	BCW 66 H	EH		

Maximum ratings		BCW 65	BCW 66
Collector-emitter voltage	$V_{CE0}$	32 V	45 V
Collector-base voltage	$V_{CB0}$	60 V	75 V
Emitter-base voltage	$V_{EB0}$	5 V	5 V
Collector current	$I_C$		800 mA
Peak collector current	$I_{CM}$		1 A
Base current	$I_B$		100 mA
Peak base current	$I_{BM}$		200 mA
Total power dissipation	$P_{tot}$		330 mW
$T_A = 25\text{ }^\circ\text{C}$			
Junction temperature	$T_j$		150 °C
Storage temperature range	$T_{stg}$		-65 ... +150 °C
<b>Thermal resistance</b>	$R_{thJA}$		$\leq 375\text{ K/W}$
junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm			

**Characteristics**

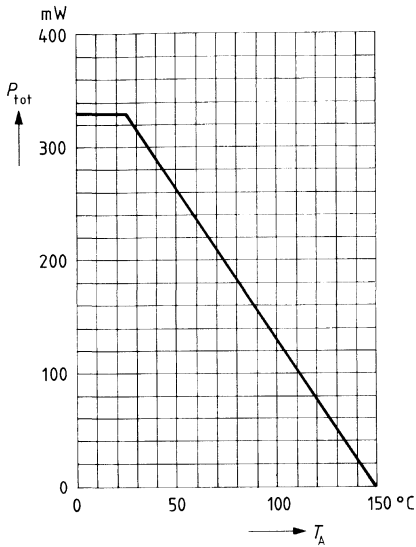
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 10\text{ mA}$	$V_{(BR)CE0}$	32	–	–	V
BCW 65 BCW 66		45	–	–	V
Collector-base breakdown voltage $I_C = 10\ \mu\text{A}$	$V_{(BR)CB0}$	60	–	–	V
BCW 65 BCW 66		75	–	–	V
Emitter-base breakdown voltage $I_E = 10\ \mu\text{A}$	$V_{(BR)EB0}$	5	–	–	V
Collector cutoff current	$I_{CB0}$	–	–	20	nA
$V_{CB} = 32\text{ V}$ BCW 65		–	–	20	nA
$V_{CB} = 45\text{ V}$ BCW 66		–	–	20	$\mu\text{A}$
$V_{CB} = 32\text{ V}, T_A = 150^\circ\text{C}$ BCW 65		–	–	20	$\mu\text{A}$
$V_{CB} = 45\text{ V}, T_A = 150^\circ\text{C}$ BCW 66		–	–	20	$\mu\text{A}$
DC current gain <sup>1)</sup>	$h_{FE}$				
$I_C = 100\ \mu\text{A}, V_{CE} = 10\text{ V}$					
BCW 65 A, BCW 66 F		35	–	–	–
BCW 65 B, BCW 66 G		50	–	–	–
BCW 65 C, BCW 66 H		80	–	–	–
$I_C = 10\text{ mA}, V_{CE} = 5\text{ V}$					
BCW 65 A, BCW 66 F		75	–	–	–
BCW 65 B, BCW 66 G		110	–	–	–
BCW 65 C, BCW 66 H		180	–	–	–
$I_C = 10\text{ mA}, V_{CE} = 5\text{ V}$					
BCW 65 A, BCW 66 F		100	160	250	–
BCW 65 B, BCW 66 G		160	250	400	–
BCW 65 C, BCW 66 H		250	350	630	–
$I_C = 500\text{ mA}, V_{CE} = 2\text{ V}$					
BCW 65 A, BCW 66 F	35	–	–	–	
BCW 65 B, BCW 66 G	60	–	–	–	
BCW 65 C, BCW 66 H	100	–	–	–	
Collector-emitter saturation voltage <sup>1)</sup>	$V_{CEsat}$	–	–	0,3	V
$I_C = 100\text{ mA}, I_B = 10\text{ mA}$ $I_C = 500\text{ mA}, I_B = 50\text{ mA}$		–	–	0,7	V
Base-emitter saturation voltage <sup>1)</sup>	$V_{BEsat}$	–	–	1,25	V
$I_C = 100\text{ mA}, I_B = 10\text{ mA}$ $I_C = 500\text{ mA}, I_B = 50\text{ mA}$		–	–	2,00	V

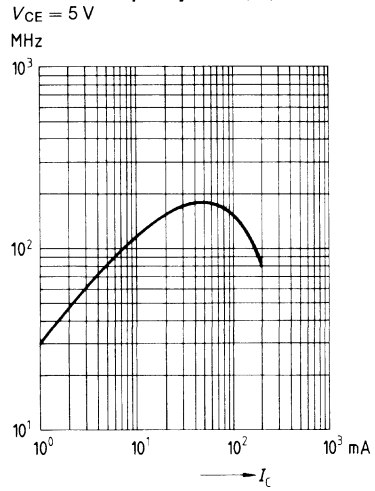
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 50\text{ mA}, V_{CE} = 5\text{ V}, f = 20\text{ MHz}$	$f_T$	–	170	–	MHz
Output capacitance $V_{CB} = 10\text{ V}, f = 1\text{ MHz}$	$C_{ob}$	–	6	–	pF
Input capacitance $V_{EB} = 0,5\text{ V}, f = 1\text{ MHz}$	$C_{ib}$	–	60	–	pF

<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

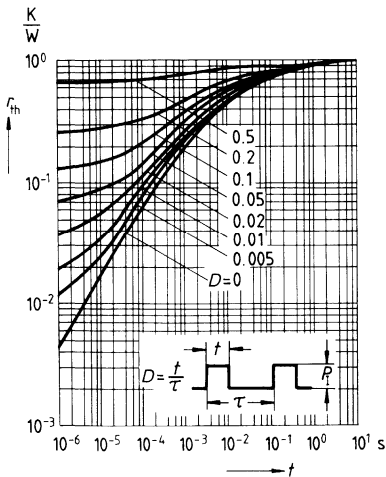
**Total power dissipation  $P_{\text{tot}} = f(T_A)$**



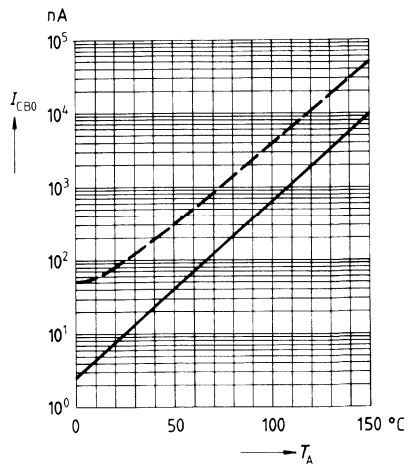
**Transition frequency  $f_T = f(I_C)$**



**Pulse handling capability  $r_{\text{th}} = f(t)$   
(standardized)**

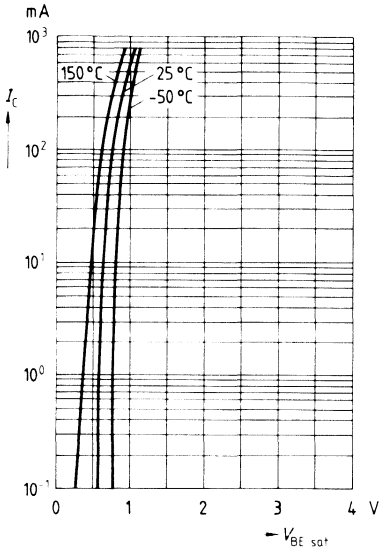


**Collector cutoff current  $I_{CB0} = f(T_A)$   
 $V_{CB} = V_{CE \text{ max}}$**

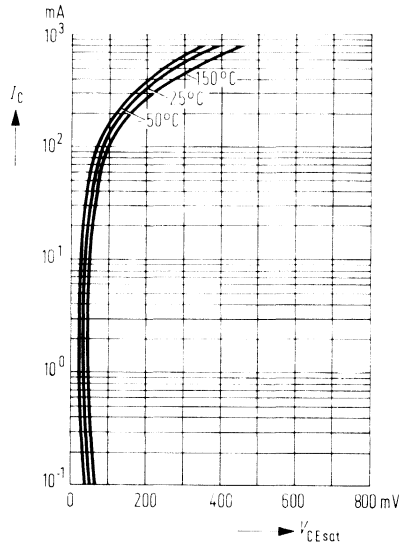




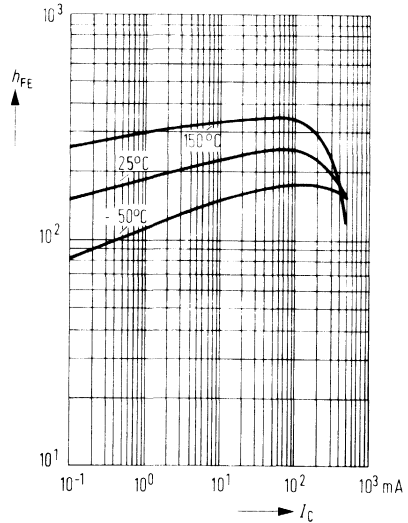
**Base-emitter saturation voltage**  $V_{BE\ sat} = f(I_C)$   
 $h_{FE} = 10$



**Collector-emitter saturation voltage**  $V_{CE\ sat} = f(I_C)$   
 $h_{FE} = 10$

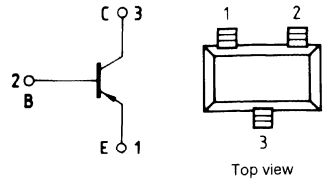


**DC current gain**  $h_{FE} = f(I_C)$   
 $V_{CE} = 1\text{ V}$



**PNP silicon planar epitaxial transistors**

- High current gain
- Low collector-emitter saturation voltage
- Complementary to BCW 65, BCW 66 (NPN)



Type	Marking	Type	Marking	Ordering code	Package
BCW 67 A	DA	BCW 68 F	DF	Refer to index	Version A
BCW 67 B	DB	BCW 68 G	DG		
BCW 67 C	DC	BCW 68 H	DH		

Maximum ratings		BCW 67	BCW 68
Collector-emitter voltage	$V_{CE0}$	32 V	45 V
Collector-base voltage	$V_{CB0}$	45 V	60 V
Emitter-base voltage	$V_{EB0}$	5 V	5 V
Collector current	$I_C$		800 mA
Peak collector current	$I_{CM}$		1 A
Base current	$I_B$		100 mA
Peak base current	$I_{BM}$		200 mA
Total power dissipation	$P_{tot}$		330 mW
$T_A = 25\text{ }^\circ\text{C}$			
Junction temperature	$T_j$		150 °C
Storage temperature range	$T_{stg}$		-65 ... +150 °C
<b>Thermal resistance</b>	$R_{thJA}$		≤ 375 K/W
junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm			

**Characteristics**

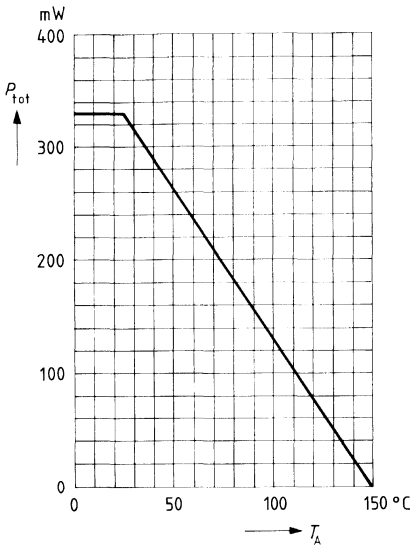
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

<b>Static characteristics</b>	<b>Symbol</b>	<b>min</b>	<b>typ</b>	<b>max</b>	<b>Unit</b>
Collector-emitter breakdown voltage $I_C = 10\text{ mA}$	$V_{(BR)CE0}$	32	–	–	V
BCW 67 BCW 68		45	–	–	V
Collector-base breakdown voltage $I_C = 10\ \mu\text{A}$	$V_{(BR)CB0}$	45	–	–	V
BCW 67 BCW 68		60	–	–	V
Emitter-base breakdown voltage $I_E = 10\ \mu\text{A}$	$V_{(BR)EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 32\text{ V}$	$I_{CBO}$	–	–	20	nA
$V_{CB} = 45\text{ V}$		–	–	20	nA
$V_{CB} = 32\text{ V}, T_A = 150^\circ\text{C}$		–	–	20	$\mu\text{A}$
$V_{CB} = 45\text{ V}, T_A = 150^\circ\text{C}$		–	–	20	$\mu\text{A}$
DC current gain <sup>1)</sup> $I_C = 100\ \mu\text{A}, V_{CE} = 10\text{ V}$	$h_{FE}$	35	–	–	–
BCW 67 A, BCW 68 F		50	–	–	–
BCW 67 B, BCW 68 G		40	–	–	–
BCW 67 C, BCW 68 H		75	–	–	–
$I_C = 10\text{ mA}, V_{CE} = 5\text{ V}$		120	–	–	–
BCW 67 A, BCW 68 F		180	–	–	–
BCW 67 B, BCW 68 G		100	160	250	–
BCW 67 C, BCW 68 H		160	250	400	–
$I_C = 100\text{ mA}, V_{CE} = 5\text{ V}$		250	350	630	–
BCW 67 A, BCW 68 F		35	–	–	–
BCW 67 B, BCW 68 G		60	–	–	–
BCW 67 C, BCW 68 H		100	–	–	–
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 100\text{ mA}, I_B = 10\text{ mA}$	$V_{CEsat}$	–	–	0,3	V
$I_C = 500\text{ mA}, I_B = 50\text{ mA}$		–	–	0,7	V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 100\text{ mA}, I_B = 10\text{ mA}$	$V_{BEsat}$	–	–	1,25	V
$I_C = 500\text{ mA}, I_B = 50\text{ mA}$		–	–	2,00	V

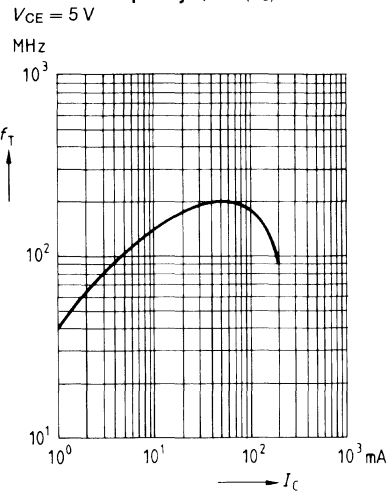
<b>Dynamic characteristics</b>	<b>Symbol</b>	<b>min</b>	<b>typ</b>	<b>max</b>	<b>Unit</b>
Transition frequency $I_C = 50\text{ mA}, V_{CE} = 5\text{ V}, f = 20\text{ MHz}$	$f_T$	–	200	–	MHz
Output capacitance $V_{CB} = 10\text{ V}, f = 1\text{ MHz}$	$C_{ob}$	–	6	–	pF
Input capacitance $V_{EB} = 0,5\text{ V}, f = 1\text{ MHz}$	$C_{ib}$	–	60	–	pF

<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

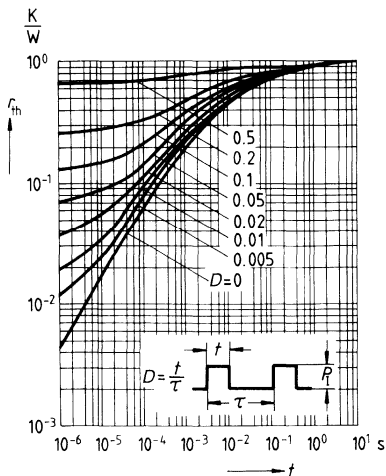
**Total power dissipation  $P_{tot} = f(T_A)$**



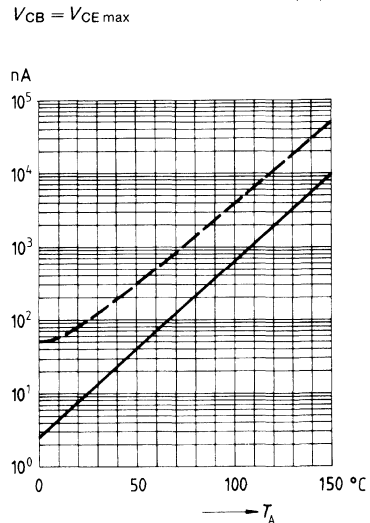
**Transition frequency  $f_T = f(I_C)$**



**Pulse handling capability  $r_{th} = f(t)$**   
(standardized)

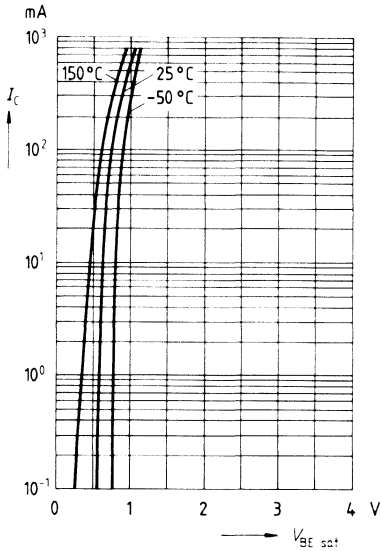


**Collector cutoff current  $I_{CB0} = f(T_A)$**



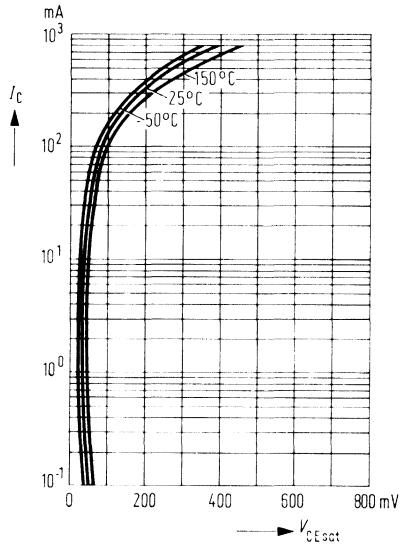
**Base-emitter saturation voltage  $V_{BE\text{ sat}} = f(I_C)$**

$h_{FE} = 10$



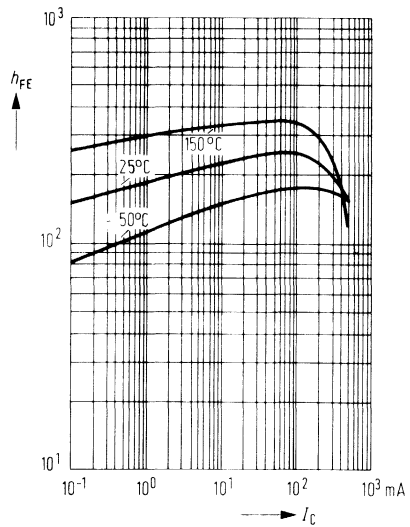
**Collector-emitter saturation voltage  $V_{CE\text{ sat}} = f(I_C)$**

$h_{FE} = 10$



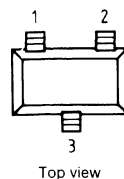
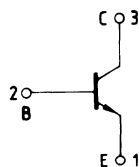
**DC current gain  $h_{FE} = f(I_C)$**

$V_{CE} = 1\text{ V}$



## NPN silicon planar epitaxial transistors

- High breakdown voltage
- Low collector-emitter saturation voltage
- Complementary to BCX 42, BSS 63 (PNP)



Type	Marking	Ordering code	Package
BCX 41	EK	Refer to index	Version A
BSS 64	AM		

Maximum ratings		BSS 64	BCX 41
Collector-emitter voltage	$V_{CE0}$	80 V	125 V
Collector-base voltage	$V_{CB0}$	120 V	125 V
Emitter-base voltage	$V_{EB0}$	5 V	5 V
Collector current	$I_C$		800 mA
Peak collector current	$I_{CM}$		1 A
Base current	$I_B$		100 mA
Peak base current	$I_{BM}$		200 mA
Total power dissipation	$P_{tot}$		330 mW
$T_A = 25^\circ\text{C}$			
Junction temperature	$T_j$		150 °C
Storage temperature range	$T_{stg}$		-65 ... +150 °C
<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$		≤ 375 K/W

## Characteristics

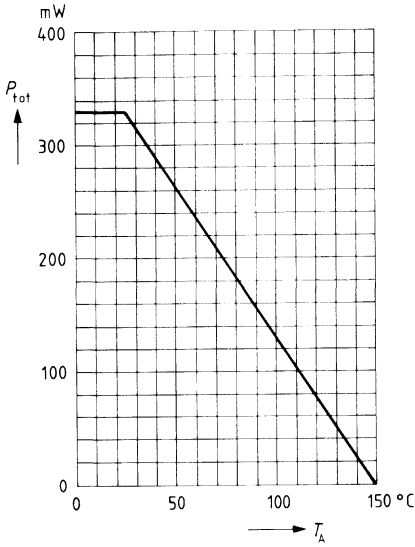
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 10\text{ mA}$	$V_{(BR)CE0}$	80	–	–	V
BSS 64 BCX 41		125	–	–	V
Collector-base breakdown voltage $I_C = 100\ \mu\text{A}$	$V_{(BR)CB0}$	120	–	–	V
BSS 64 BCX 41		125	–	–	V
Emitter-base breakdown voltage $I_E = 10\ \mu\text{A}$	$V_{(BR)EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 80\text{ V}$	$I_{CB0}$	–	–	100	nA
BSS 64 $V_{CB} = 100\text{ V}$		–	–	100	nA
BCX 41 $V_{CB} = 80\text{ V}, T_A = 150^\circ\text{C}$		–	–	20	$\mu\text{A}$
BSS 64 $V_{CB} = 100\text{ V}, T_A = 150^\circ\text{C}$		–	–	20	$\mu\text{A}$
Collector cutoff current $V_{CE} = 100\text{ V}, V_{BE} = 0,2\text{ V}$	$I_{CEX}$	–	–	10	$\mu\text{A}$
BSS 64 $T_A = 85^\circ\text{C}$		–	–	75	$\mu\text{A}$
BCX 41 $T_A = 125^\circ\text{C}$		–	–	–	–
Emitter cutoff current $V_{EB} = 4\text{ V}$	$I_{EB0}$	–	–	100	nA
DC current gain <sup>1)</sup> $I_C = 100\ \mu\text{A}, V_{CE} = 1\text{ V}$	$h_{FE}$	25	–	–	–
BCX 41 $I_C = 1\text{ mA}, V_{CE} = 1\text{ V}$		–	60	–	–
BSS 64 $I_C = 4\text{ mA}, V_{CE} = 1\text{ V}$		20	80	–	–
BSS 64 $I_C = 10\text{ mA}, V_{CE} = 1\text{ V}$		–	80	–	–
BSS 64 $I_C = 20\text{ mA}, V_{CE} = 1\text{ V}$		–	55	–	–
BSS 64 $I_C = 100\text{ mA}, V_{CE} = 1\text{ V}$		63	–	–	–
BCX 41 $I_C = 200\text{ mA}, V_{CE} = 1\text{ V}$		40	–	–	–
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 300\text{ mA}, I_B = 30\text{ mA}$	$V_{CEsat}$	–	–	0,9	V
BCX 41 $I_C = 4\text{ mA}, I_B = 0,4\text{ mA}$		–	–	0,7	V
BSS 64 $I_C = 50\text{ mA}, I_B = 15\text{ mA}$		–	–	3,0	V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 300\text{ mA}, I_B = 30\text{ mA}$	$V_{BEsat}$	–	–	1,4	V

Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 200\text{ mA}, V_{CE} = 5\text{ V}, f = 20\text{ MHz}$	$f_T$	–	100	–	MHz
Output capacitance $V_{CB} = 10\text{ V}, f = 1\text{ MHz}$	$C_{ob}$	–	12	–	pF

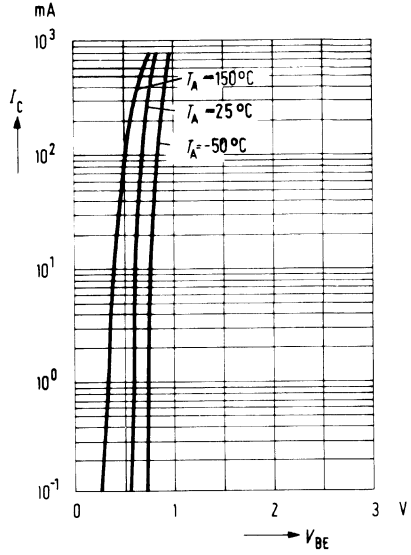
<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

**Total power dissipation  $P_{tot} = f(T_A)$**



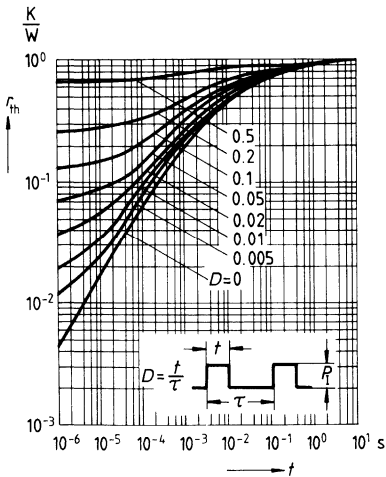
**Collector current  $I_C = f(V_{BE})$**

$V_{CE} = 1\text{ V}$



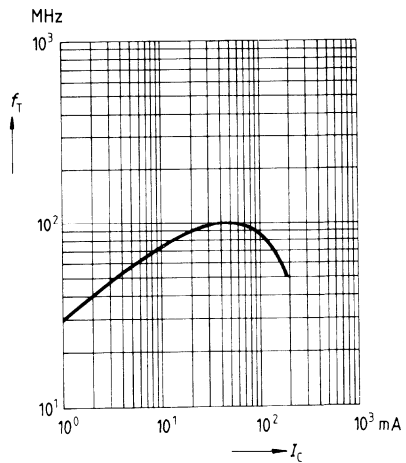
**Pulse handling capability  $r_{th} = f(t)$**

(standardized)



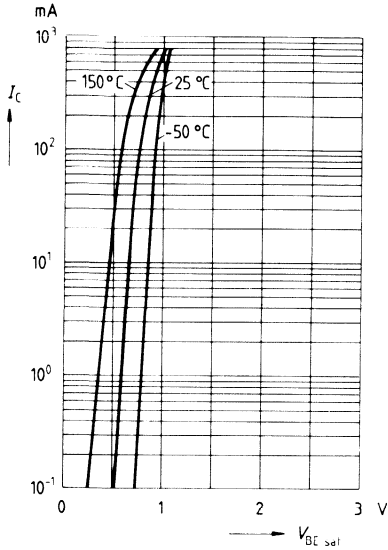
**Transition frequency  $f_T = f(I_C)$**

$V_{CE} = 5\text{ V}$

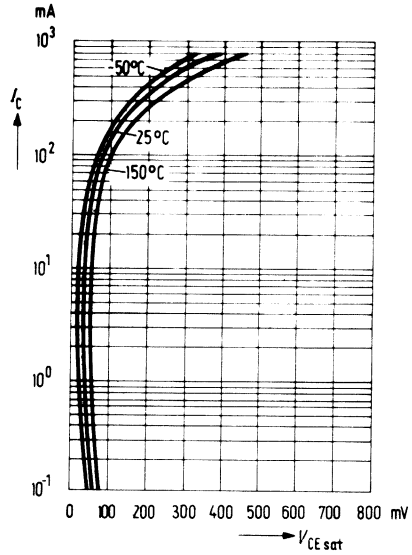




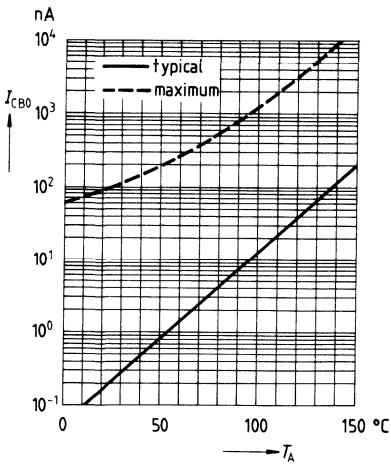
**Base-emitter saturation voltage**  $V_{BE\ sat} = f(I_c)$   
 $h_{FE} = 10$



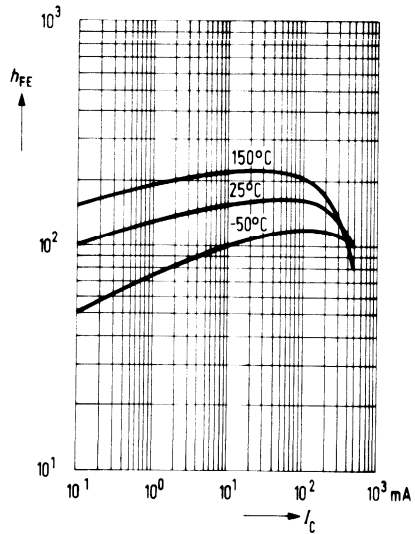
**Collector-emitter saturation voltage**  
 $V_{CE\ sat} = f(I_c)$   
 $h_{FE} = 10$



**Collector cutoff current**  $I_{CB0} = f(T_A)$   
 $V_{CB} = V_{CE\ max}$

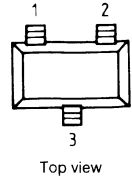
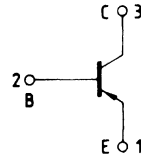


**DC current gain**  $h_{FE} = f(I_c)$   
 $V_{CE} = 1\ V$



**PNP silicon planar epitaxial transistors**

- High breakdown voltage
- Low collector-emitter saturation voltage
- Complementary to BCX 41, BSS 64 (NPN)



Type	Marking	Ordering code	Package
BCX 42	BM	Refer to index	Version A
BSS 63	DK		

Maximum ratings		BSS 63	BCX 42
Collector-emitter voltage	$V_{CE0}$	100 V	125 V
Collector-base voltage	$V_{CB0}$	110 V	125 V
Emitter-base voltage	$V_{EB0}$	5 V	5 V
Collector current	$I_C$		800 mA
Peak collector current	$I_{CM}$		1 A
Base current	$I_B$		100 mA
Peak base current	$I_{BM}$		200 mA
Total power dissipation	$P_{tot}$		330 mW
$T_A = 25^\circ\text{C}$			
Junction temperature	$T_j$		150 °C
Storage temperature range	$T_{stg}$		-65 ... +150 °C
<b>Thermal resistance</b>	$R_{thJA}$		$\leq 375 \text{ K/W}$
junction-ambient			
package mounted			
on alumina			
15 mm × 16.7 mm × 0.7 mm			

## Characteristics

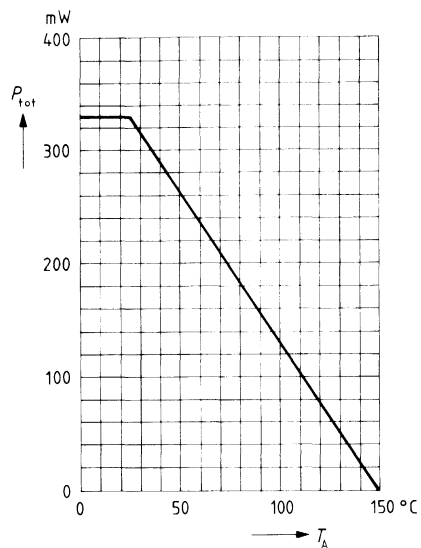
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 10\text{ mA}$	$V_{(BR)CE0}$	125	–	–	V
BCX 42 BSS 63		100	–	–	V
Collector-base breakdown voltage $I_C = 100\text{ }\mu\text{A}$	$V_{(BR)CB0}$	125	–	–	V
BCX 42 BSS 63		110	–	–	V
Emitter-base breakdown voltage $I_E = 10\text{ }\mu\text{A}$	$V_{(BR)EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 80\text{ V}$	$I_{CB0}$	–	–	100	nA
BSS 63 $V_{CB} = 100\text{ V}$		–	–	100	nA
BCX 42 $V_{CB} = 80\text{ V}, T_A = 150^\circ\text{C}$		–	–	20	$\mu\text{A}$
BSS 63 $V_{CB} = 100\text{ V}, T_A = 150^\circ\text{C}$		–	–	20	$\mu\text{A}$
BCX 42		–	–	20	$\mu\text{A}$
Collector cutoff current $V_{CE} = 100\text{ V}, V_{BE} = 0,2\text{ V}$ $T_A = 85^\circ\text{C}$	$I_{CEX}$	–	–	10	$\mu\text{A}$
BCX 42 $T_A = 125^\circ\text{C}$		–	–	75	$\mu\text{A}$
BCX 42					
Emitter cutoff current $V_{EB} = 4\text{ V}$	$I_{EB0}$	–	–	100	nA
DC current gain <sup>1)</sup> $I_C = 100\text{ }\mu\text{A}, V_{CE} = 1\text{ V}$	$h_{FE}$	25	–	–	–
BCX 42 $I_C = 10\text{ mA}, V_{CE} = 5\text{ V}$		30	–	–	–
BSS 63 $I_C = 20\text{ mA}, V_{CE} = 5\text{ V}$		30	–	–	–
BSS 63 $I_C = 100\text{ mA}, V_{CE} = 1\text{ V}$		63	–	–	–
BCX 42 $I_C = 20\text{ mA}, V_{CE} = 1\text{ V}$		40	–	–	–
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 300\text{ mA}, I_B = 30\text{ mA}$	$V_{CEsat}$	–	–	0,9	V
BCX 42 $I_C = 35\text{ mA}, I_B = 7,5\text{ mA}$		BSS 63			
Base-emitter saturation voltage <sup>1)</sup> $I_C = 300\text{ mA}, I_B = 30\text{ mA}$	$V_{BEsat}$	–	–	1,4	V
BCX 42					

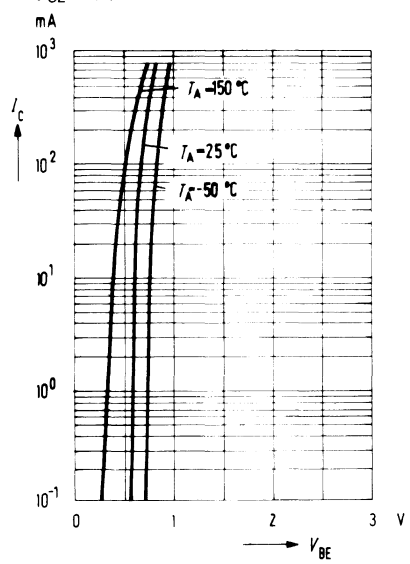
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 20\text{ mA}, V_{CE} = 5\text{ V}, f = 20\text{ MHz}$	$f_T$	–	150	–	MHz
Output capacitance $V_{CB} = 10\text{ V}, f = 1\text{ MHz}$	$C_{ob}$	–	12	–	pF

<sup>1)</sup> Pulse test:  $t = 300\text{ }\mu\text{s}$ ,  $D = 2\%$ .

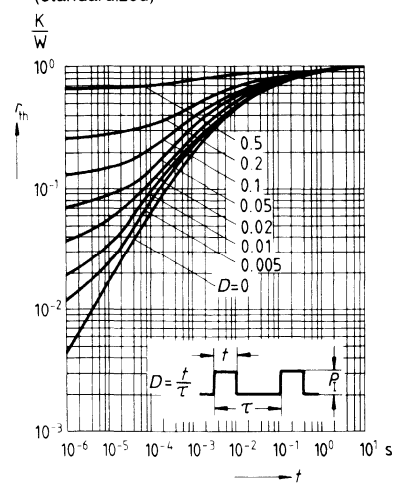
**Total power dissipation  $P_{tot} = f(T_A)$**



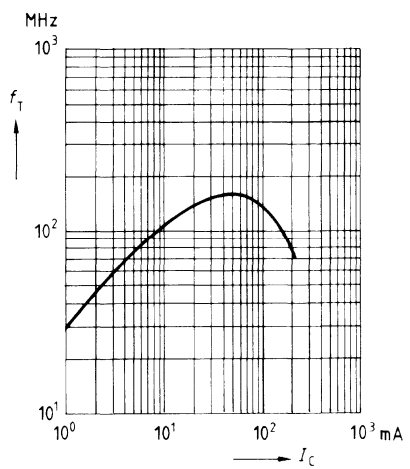
**Collector current  $I_C = f(V_{BE})$**   
 $V_{CE} = 1\text{ V}$



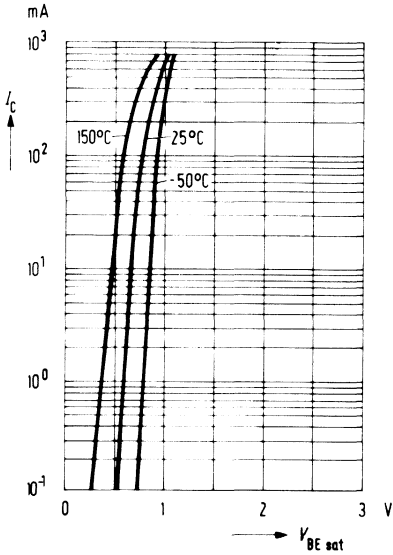
**Pulse handling capability  $r_{th} = f(t)$**   
(standardized)



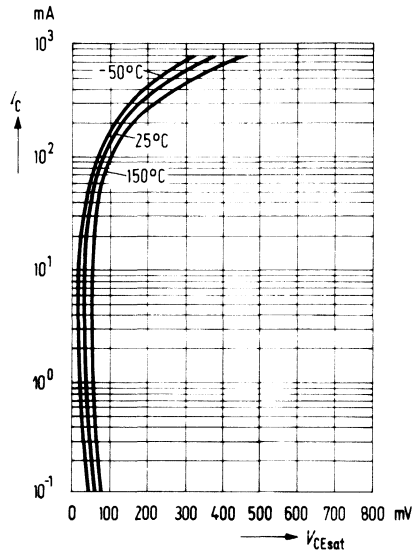
**Transition frequency  $f_T = f(I_C)$**   
 $V_{CE} = 5\text{ V}$



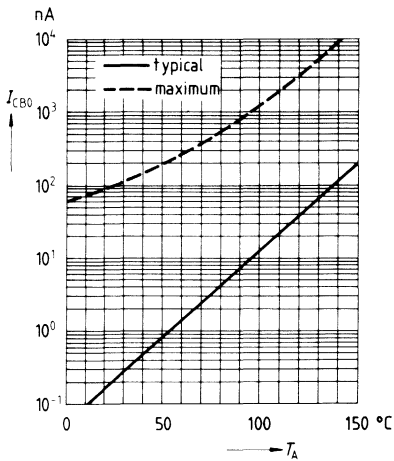
**Base-emitter saturation voltage**  $V_{BE\ sat} = f(I_C)$   
 $h_{FE} = 10$



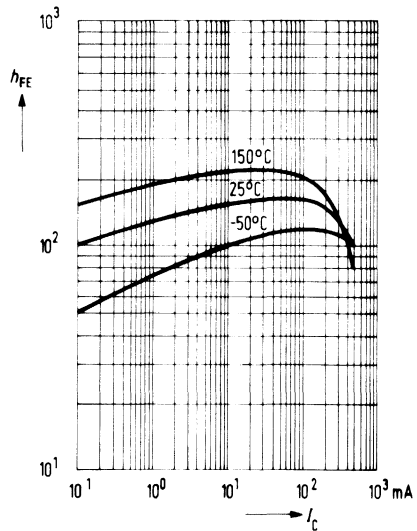
**Collector-emitter saturation voltage**  
 $V_{CE\ sat} = f(I_C)$   
 $h_{FE} = 10$



**Collector cutoff current**  $I_{CB0} = f(T_A)$   
 $V_{CB} = V_{CE\ max}$

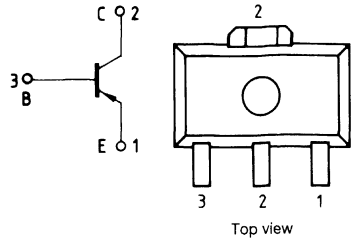


**DC current gain**  $h_{FE} = f(I_C)$   
 $V_{CE} = 1\ V$



**PNP silicon planar epitaxial transistors**

- High collector current
- Low collector-emitter saturation voltage
- Complementary to BCX 54 ... BCX 56 (NPN)



Type	Marking	Type	Marking	Ordering code	Package
BCX 51-6	AB	BCX 52-10	AG	Refer to index	Version C
BCX 51-10	AC	BCX 53-6	AJ		
BCX 51-16	AD	BCX 53-10	AK		
BCX 52-6	AF				

<b>Maximum ratings</b>		BCX 51	BCX 52	BCX 53
Collector-emitter voltage	$V_{CE0}$	45 V	60 V	80 V
Collector-base voltage	$V_{CB0}$	45 V	60 V	100 V
Emitter-base voltage	$V_{EB0}$	5 V	5 V	5 V
Collector current	$I_C$		1 A	
Peak collector current	$I_{CM}$		1,5 A	
Base current	$I_B$		100 mA	
Peak base current	$I_{BM}$		200 mA	
Total power dissipation	$P_{tot}$		1,0 W	
$T_A = 25^\circ\text{C}$				
Junction temperature	$T_j$		150 °C	
Storage temperature range	$T_{stg}$		-65 ... +150 °C	
<b>Thermal resistance</b>	$R_{thJA}$		≤ 125 K/W	
junction-ambient				
package mounted				
on alumina				
15 mm × 16.7 mm × 0.7 mm				

## Characteristics

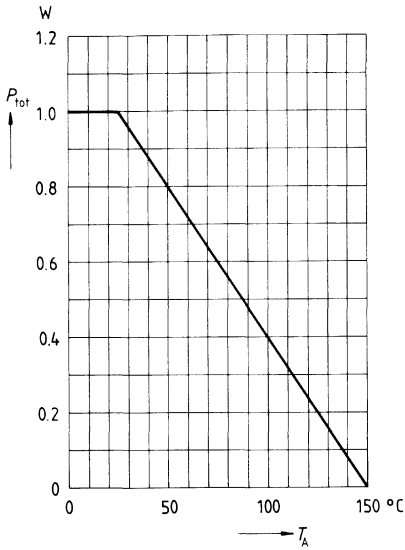
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 10\text{ mA}$ BCX 51 BCX 52 BCX 53	$V_{(BR)CE0}$	45 60 80	– – –	– – –	V V V
Collector-base breakdown voltage $I_C = 100\text{ }\mu\text{A}$ BCX 51 BCX 52 BCX 53	$V_{(BR)CB0}$	45 60 100	– – –	– – –	V V V
Emitter-base breakdown voltage $I_E = 10\text{ }\mu\text{A}$	$V_{(BR)EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 30\text{ V}$ $V_{CB} = 30\text{ V}$ , $T_A = 150^\circ\text{C}$	$I_{CB0}$	– –	– –	100 20	nA nA
Emitter cutoff current $V_{EB} = 4\text{ V}$	$I_{EB0}$	–	–	20	nA
DC current gain <sup>1)</sup> $I_C = 5\text{ mA}$ , $V_{CE} = 2\text{ V}$ $I_C = 150\text{ mA}$ , $V_{CE} = 2\text{ V}$ BCX 51, BCX 52, BCX 53–6 BCX 51, BCX 52, BCX 53–10 BCX 51–16 $I_C = 500\text{ mA}$ , $V_{CE} = 2\text{ V}$	$h_{FE}$	25 40 63 100 25	– 63 100 160 –	– 100 160 250 –	– – – – –
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 500\text{ mA}$ , $I_B = 50\text{ mA}$	$V_{CEsat}$	–	–	0,5	V
Base-emitter voltage <sup>1)</sup> $I_C = 500\text{ mA}$ , $V_{CE} = 2\text{ V}$	$V_{BE}$	–	–	1,0	V

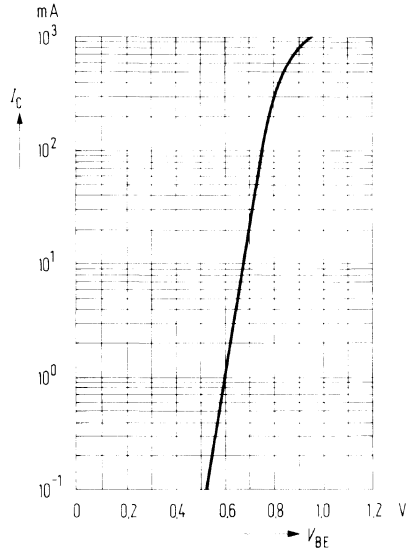
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 50\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 20\text{ MHz}$	$f_T$	–	125	–	MHz

<sup>1)</sup> Pulse test:  $t = 300\text{ }\mu\text{s}$ ,  $D = 2\%$ .

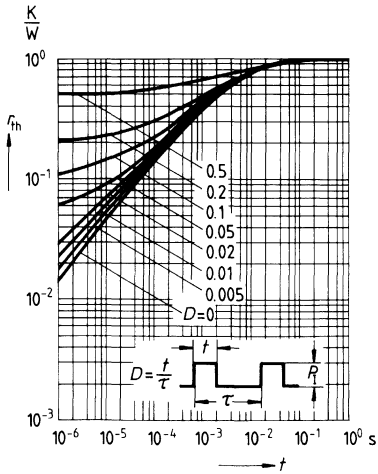
**Total power dissipation**  $P_{\text{tot}} = f(T_A)$



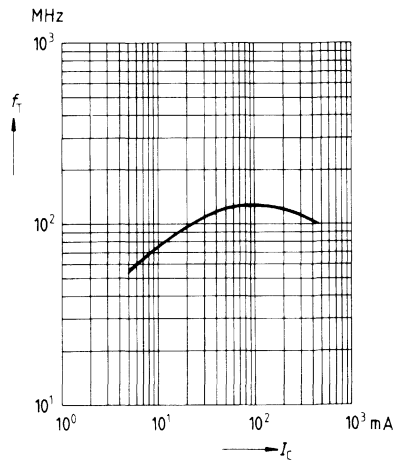
**Collector current**  $I_C = f(V_{\text{BE}})$   
 $V_{\text{CE}} = 2 \text{ V}$



**Pulse handling capability**  $r_{\text{th}} = f(t)$   
(standardized)



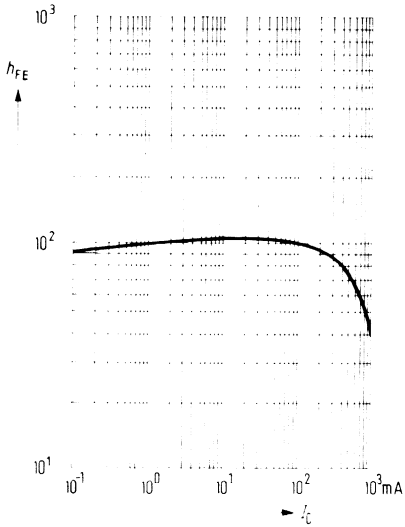
**Transition frequency**  $f_T = f(I_C)$   
 $V_{\text{CE}} = 10 \text{ V}$





**DC current gain  $h_{FE} = f(I_C)$**

$V_{CE} = 2 \text{ V}$

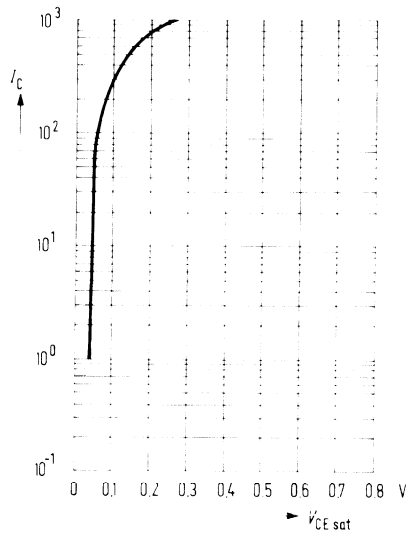


**Collector-emitter saturation voltage**

$V_{CE\text{ sat}} = f(I_C)$

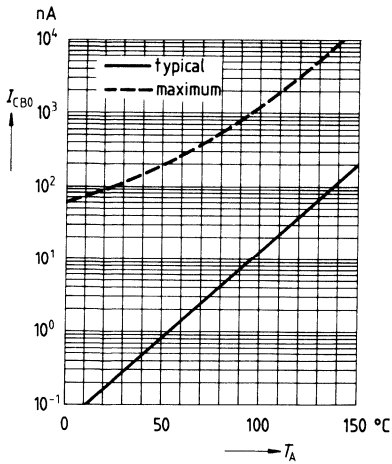
$h_{FE} = 10$

mA



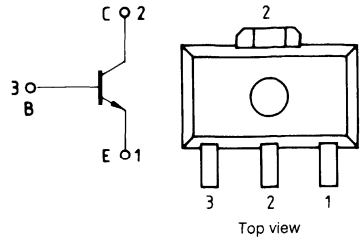
**Collector cutoff current  $I_{CB0} = f(T_A)$**

$V_{CB} = 30 \text{ V}$



**NPN silicon planar epitaxial transistors**

- High collector current
- Low collector-emitter saturation voltage
- Complementary to BCX 51... BCX 53 (PNP)



Type	Marking	Type	Marking	Ordering code	Package
BCX 54-6	BB	BCX 55-10	BG	Refer to index	Version A
BCX 54-10	BC	BCX 56-6	BJ		
BCX 54-16	BD	BCX 56-10	BK		
BCX 55-6	BF				

Maximum ratings		BCX 54	BCX 55	BCX 56
Collector-emitter voltage	$V_{CE0}$	45 V	60 V	80 V
Collector-base voltage	$V_{CB0}$	45 V	60 V	100 V
Emitter-base voltage	$V_{EB0}$	5 V	5 V	5 V
Collector current	$I_C$		1 A	
Peak collector current	$I_{CM}$		1,5 A	
Base current	$I_B$		100 mA	
Peak base current	$I_{BM}$		200 mA	
Total power dissipation	$P_{tot}$		1,0 W	
$T_A = 25^\circ\text{C}$				
Junction temperature	$T_j$		150 °C	
Storage temperature range	$T_{stg}$		-65 ... +150 °C	
<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$		≤ 125 K/W	

## Characteristics

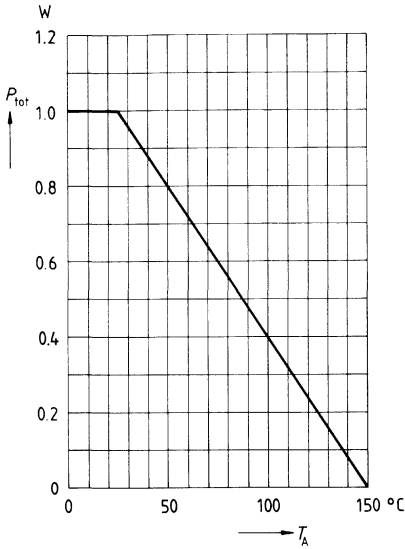
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 10\text{ mA}$ BCX 54 BCX 55 BCX 56	$V_{(BR)CE0}$	45 60 80	– – –	– – –	V V V
Collector-base breakdown voltage $I_C = 100\ \mu\text{A}$ BCX 54 BCX 55 BCX 56	$V_{(BR)CB0}$	45 60 100	– – –	– – –	V V V
Emitter-base breakdown voltage $I_E = 10\ \mu\text{A}$	$V_{(BR)EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 30\text{ V}$ $V_{CB} = 30\text{ V}$ , $T_A = 150^\circ\text{C}$	$I_{CB0}$	– –	– –	100 20	nA $\mu\text{A}$
Emitter cutoff current $V_{EB} = 4\text{ V}$	$I_{EB0}$	–	–	20	nA
DC current gain <sup>1)</sup> $I_C = 5\text{ mA}$ , $V_{CE} = 2\text{ V}$ $I_C = 150\text{ mA}$ , $V_{CE} = 2\text{ V}$ BCX 54, BCX 55, BCX 56–6 BCX 54, BCX 55, BCX 56–10 BCX 54–16 $I_C = 500\text{ mA}$ , $V_{CE} = 2\text{ V}$	$h_{FE}$	25 40 63 100 25	– 63 100 160 –	– 100 160 250 –	– – – – –
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 500\text{ mA}$ , $I_B = 50\text{ mA}$	$V_{CEsat}$	–	–	0,5	V
Base-emitter voltage <sup>1)</sup> $I_C = 500\text{ mA}$ , $V_{CE} = 2\text{ V}$	$V_{BE}$	–	–	1,0	V

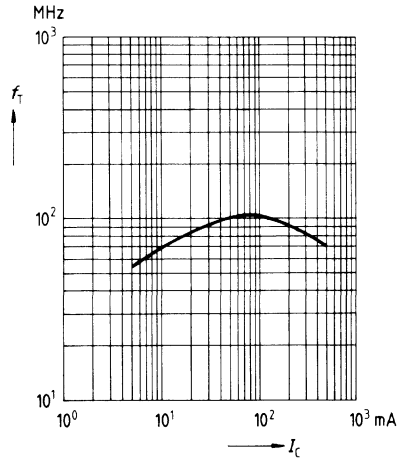
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 50\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 20\text{ MHz}$	$f_T$	–	100	–	MHz

<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

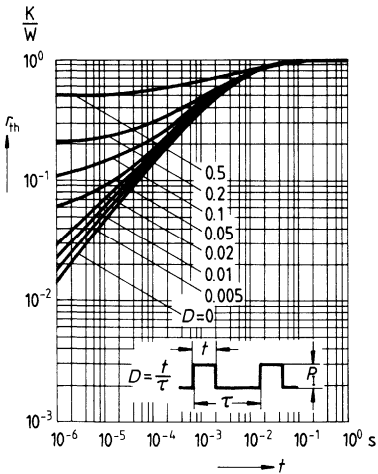
**Total power dissipation**  $P_{\text{tot}} = f(T_A)$



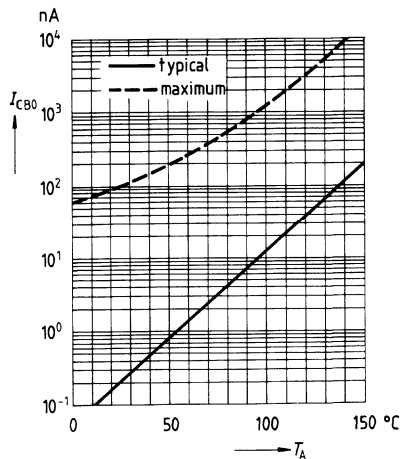
**Transition frequency**  $f_T = f(I_C)$   
 $V_{\text{CE}} = 10 \text{ V}$



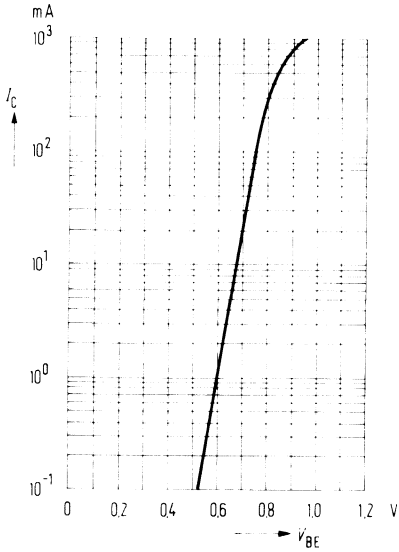
**Pulse handling capability**  $r_{\text{th}} = f(t)$   
(standardized)



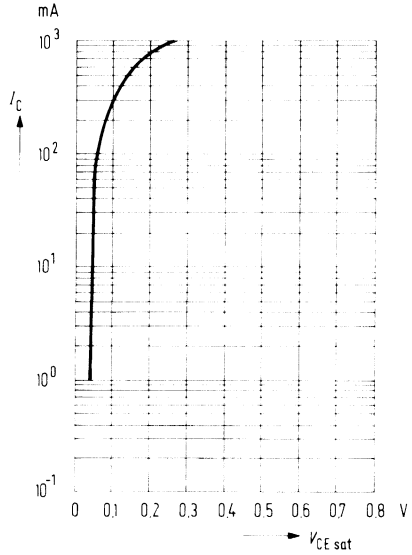
**Collector cutoff current**  $I_{\text{CB0}} = f(T_A)$   
 $V_{\text{CB}} = 30 \text{ V}$



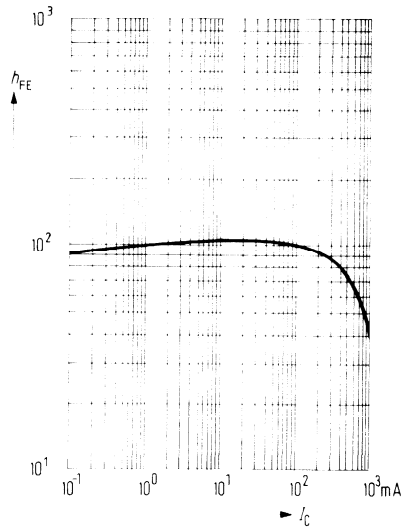
**Collector current  $I_C = f(V_{BE})$**   
 $V_{CE} = 2\text{ V}$



**Collector-emitter saturation voltage  $V_{CE\text{ sat}} = f(I_C)$**   
 $h_{FE} = 10$

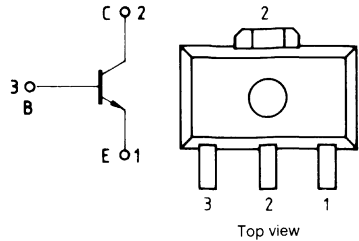


**DC current gain  $h_{FE} = f(I_C)$**   
 $V_{CE} = 2\text{ V}$



**NPN silicon planar epitaxial transistors**

- High collector current
- High current gain
- Low collector-emitter saturation voltage
- Complementary to BCX 69 (PNP)



Type	Marking	Ordering code	Package
BCX 68-10	CB	Refer to index	Version C
BCX 68-16	CC		
BCX 68-25	CD		

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	20 V
Collector-base voltage	$V_{CB0}$	25 V
Emitter-base-voltage	$V_{EB0}$	5 V
Collector current	$I_C$	1 A
Peak collector current	$I_{CM}$	2 A
Base current	$I_B$	100 mA
Peak base current	$I_{BM}$	200 mA
Total power dissipation	$P_{tot}$	1,0 W
$T_A = 25^\circ\text{C}$		
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	- 65 ... + 150 °C

<b>Thermal resistance</b>	$R_{thJA}$	≤ 125 K/W
junction-ambient		
package mounted		
on alumina		
15 mm × 16.7 mm × 0.7 mm		

## Characteristics

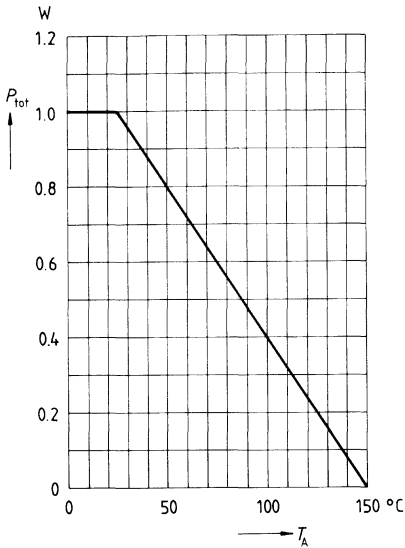
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 30\text{ mA}$	$V_{(BR)CE0}$	20	–	–	V
Collector-base breakdown voltage $I_C = 10\ \mu\text{A}$	$V_{(BR)CB0}$	25	–	–	V
Emitter-base breakdown voltage $I_E = 1\ \mu\text{A}$	$V_{(BR)EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 25\text{ V}$ $V_{CB} = 25\text{ V}, T_A = 150^\circ\text{C}$	$I_{CB0}$	– –	– –	100 10	nA $\mu\text{A}$
Emitter cutoff current $V_{EB} = 5\text{ V}$	$I_{EB0}$	–	–	10	$\mu\text{A}$
DC current gain <sup>1)</sup> $I_C = 5\text{ mA}, V_{CE} = 10\text{ V}$ $I_C = 500\text{ mA}, V_{CE} = 1\text{ V}$ BCX 68–10 BCX 68–16 BCX 68–25 $I_C = 1\text{ A}, V_{CE} = 1\text{ V}$	$h_{FE}$	50 63 100 160 60	– 100 160 250 –	– 160 250 400 –	– – – – –
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 1\text{ A}, I_B = 100\text{ mA}$	$V_{CEsat}$	–	–	0,5	V
Base-emitter voltage <sup>1)</sup> $I_C = 5\text{ mA}, V_{CE} = 10\text{ V}$ $I_C = 1\text{ A}, V_{CE} = 1\text{ V}$	$V_{BE}$	– –	0,6 –	– 1	V V

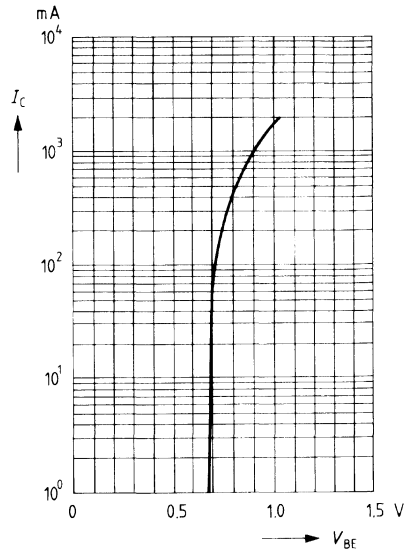
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 100\text{ mA}, V_{CE} = 5\text{ V}, f = 20\text{ MHz}$	$f_T$	–	100	–	MHz

<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

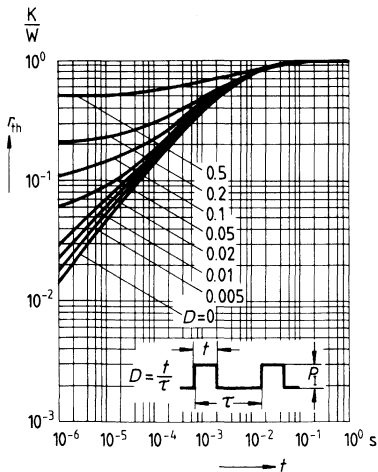
**Total power dissipation**  $P_{\text{tot}} = f(T_A)$



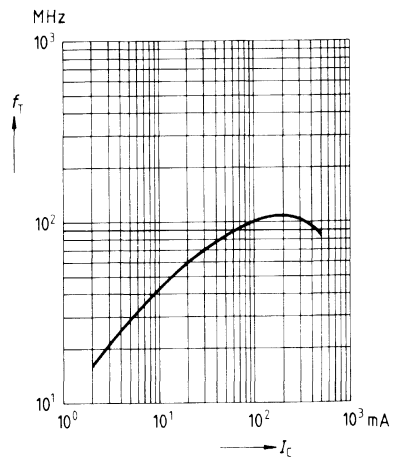
**Collector current**  $I_C = f(V_{\text{BE}})$   
 $V_{\text{CE}} = 1 \text{ V}$



**Pulse handling capability**  $r_{\text{th}} = f(t)$   
(standardized)



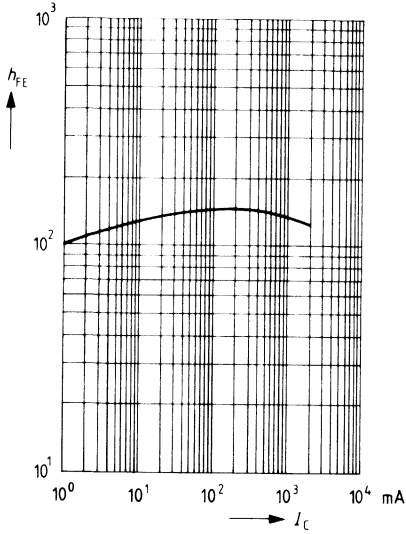
**Transition frequency**  $f_T = f(I_C)$   
 $V_{\text{CE}} = 5 \text{ V}$





**DC current gain  $h_{FE} = f(I_C)$**

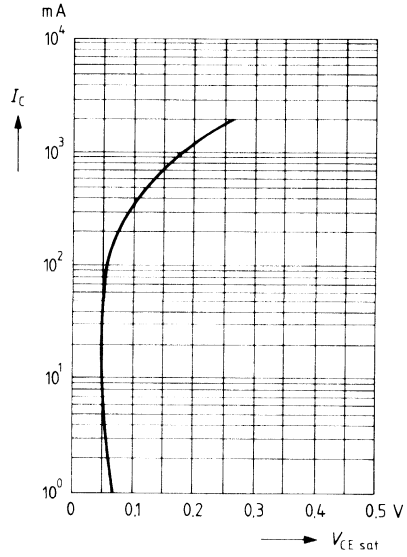
$V_{CE} = 1\text{ V}$



**Collector-emitter saturation voltage  $V_{CE\text{ sat}} = f(I_C)$**

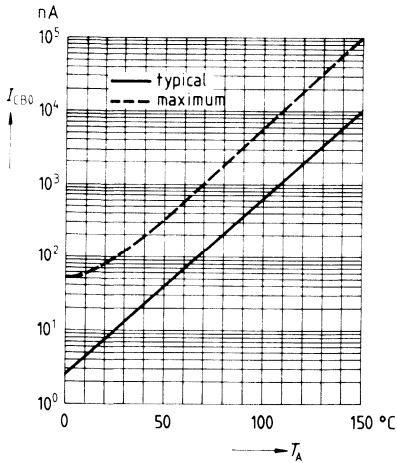
$V_{CE\text{ sat}} = f(I_C)$

$h_{FE} = 10$



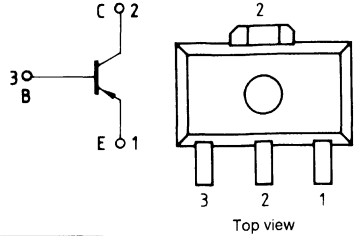
**Collector cutoff current  $I_{CB0} = f(T_A)$**

$V_{CB} = 25\text{ V}$



**PNP silicon planar epitaxial transistors**

- High collector current
- High current gain
- Low collector-emitter saturation voltage
- Complementary to BCX 68 (NPN)



Type	Marking	Ordering code	Package
BCX 69-10	CF	Refer to index	Version C
BCX 69-16	CG		
BCX 69-25	CH		

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	20 V
Collector-base voltage	$V_{CB0}$	25 V
Emitter-base voltage	$V_{EB0}$	5 V
Collector current	$I_C$	1 A
Peak collector current	$I_{CM}$	2 A
Base current	$I_B$	100 mA
Peak base current	$I_{BM}$	200 mA
Total power dissipation	$P_{tot}$	1,0 W
$T_A = 25\text{ }^\circ\text{C}$		
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	-65 ... +150 °C

<b>Thermal resistance</b>	$R_{thJA}$	≤ 125 K/W
junction-ambient		
package mounted		
on alumina		
15 mm × 16.7 mm × 0.7 mm		

## Characteristics

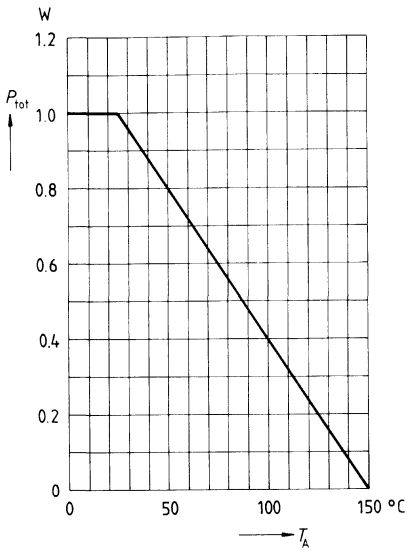
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 30\text{ mA}$	$V_{(BR)CE0}$	20	–	–	V
Collector-base breakdown voltage $I_C = 10\ \mu\text{A}$	$V_{(BR)CB0}$	25	–	–	V
Emitter-base breakdown voltage $I_E = 1\ \mu\text{A}$	$V_{(BR)EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 25\text{ V}$ $V_{CB} = 25\text{ V}, T_A = 150^\circ\text{C}$	$I_{CB0}$	– –	– –	100 10	nA $\mu\text{A}$
Emitter cutoff current $V_{EB} = 5\text{ V}$	$I_{EB0}$	–	–	10	$\mu\text{A}$
DC current gain <sup>1)</sup> $I_C = 5\text{ mA}, V_{CE} = 10\text{ V}$ $I_C = 500\text{ mA}, V_{CE} = 1\text{ V}$ BCX 69–10 BCX 69–16 BCX 69–25 $I_C = 1\text{ A}, V_{CE} = 1\text{ V}$	$h_{FE}$	50  63 100 160 60	–  100 160 250 –	–  160 250 400 –	–  – – – –
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 1\text{ A}, I_B = 100\text{ mA}$	$V_{CEsat}$	–	–	0,5	V
Base-emitter voltage <sup>1)</sup> $I_C = 5\text{ mA}, V_{CE} = 10\text{ V}$ $I_C = 1\text{ A}, V_{CE} = 1\text{ V}$	$V_{BE}$	– –	0,6 –	– 1,0	V V

Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 100\text{ mA}, V_{CE} = 5\text{ V}, f = 20\text{ MHz}$	$f_T$	–	100	–	MHz

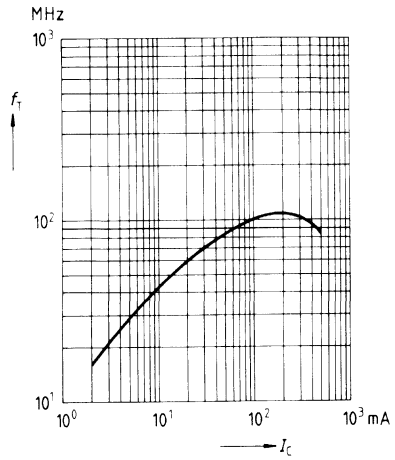
<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

**Total power dissipation  $P_{tot} = f(T_A)$**



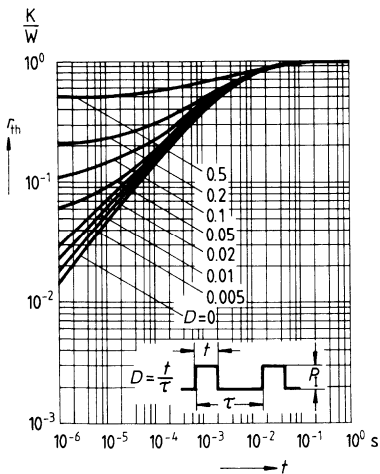
**Transition frequency  $f_T = f(I_C)$**

$V_{CE} = 5 \text{ V}$



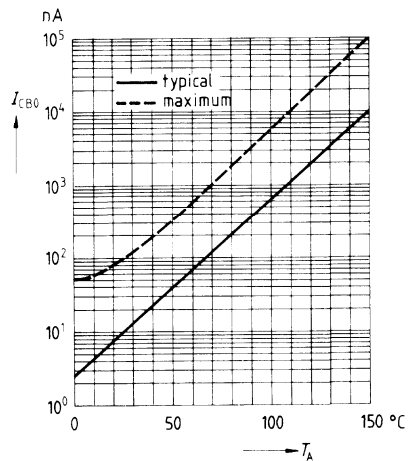
**Pulse handling capability  $r_{th} = f(t)$**

(standardized)



**Collector cutoff current  $I_{CB0} = f(T_A)$**

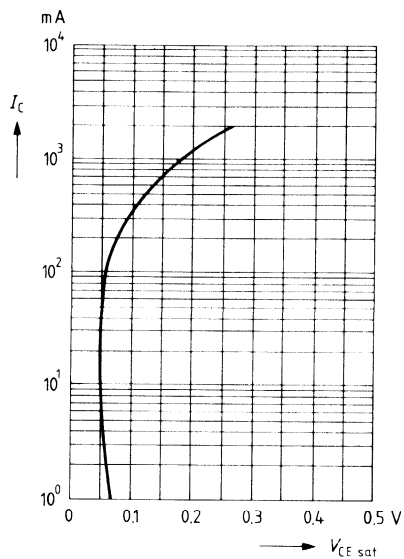
$V_{CB} = 25 \text{ V}$



**Collector-emitter saturation voltage**

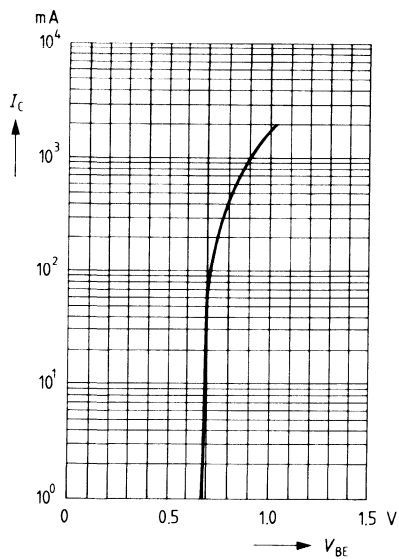
$V_{CE\ sat} = f(I_C)$

$h_{FE} = 10$



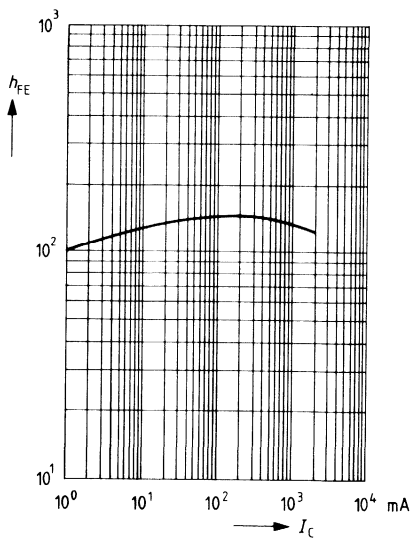
**Collector current  $I_C = f(V_{BE})$**

$V_{CE} = 1\ V$



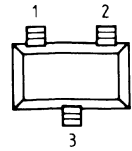
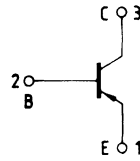
**DC current gain  $h_{FE} = f(I_C)$**

$V_{CE} = 1\ V$



**PNP silicon planar epitaxial transistor**

- Low collector-base capacitance
- Low output admittance
- Suitable for IF/RF amplifiers in common emitter configuration and for mixer applications in AM/FM radios and VHF/TV tuners



Top view

Type	Marking	Ordering code	Package
BF 550	LA	Refer to index	Version A

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	40 V
Collector-base voltage	$V_{CB0}$	40 V
Emitter-base voltage	$V_{EB0}$	4 V
Collector current	$I_C$	25 mA
Base current	$I_B$	5 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	280 mW
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	- 65 ... + 150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 450 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

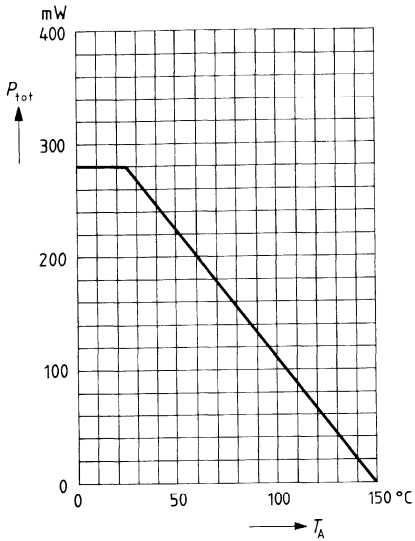
### Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

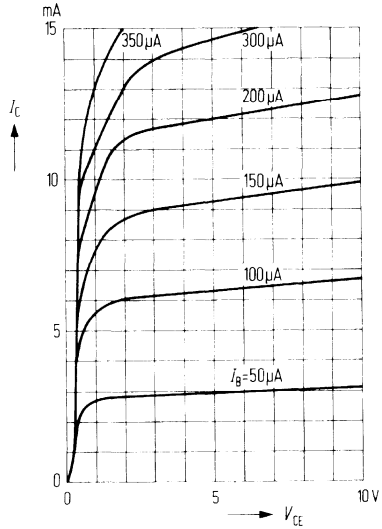
Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$	$V_{(BR)CE0}$	40	–	–	V
Collector-base breakdown voltage $I_C = 10\ \mu\text{A}$	$V_{(BR)CB0}$	40	–	–	V
Emitter-base breakdown voltage $I_E = 10\ \mu\text{A}$	$V_{(BR)EB0}$	4	–	–	V
DC current gain $I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$	$h_{FE}$	50	–	250	–
Base-emitter voltage $I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$	$V_{BE}$	–	0,72	–	V

Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 100\text{ MHz}$	$f_T$	–	350	–	MHz
Collector-base feedback capacitance $V_{CB} = 10\text{ V}$ , $V_{BE} = 0$ , $f = 1\text{ MHz}$	$C_{re}$	–	0,33	–	pF
Collector-emitter feedback capacitance $V_{CB} = 10\text{ V}$ , $V_{BE} = 0$ , $f = 1\text{ MHz}$	$C_{rb}$	–	0,67	–	pF
Noise figure $I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 100\text{ kHz}$ , $R_G = 300\ \Omega$	$NF$	–	2	–	dB
$I_C = 2\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 100\text{ kHz}$ , $R_G = 60\ \Omega$		–	3,4	–	dB
Four-pole characteristics $I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$ $f = 0,45 \dots 10\text{ MHz}$	$g_{11e}$	–	550	–	$\mu\text{s}$
	$c_{11e}$	–	17	–	pF
	$ y_{21e} $	–	35	–	ms
	$c_{22e}$	–	1,3	–	pF
$f = 450\text{ kHz}$	$g_{22e}$	–	5	8	$\mu\text{s}$
$f = 10\text{ MHz}$	$g_{22e}$	–	5	10	$\mu\text{s}$

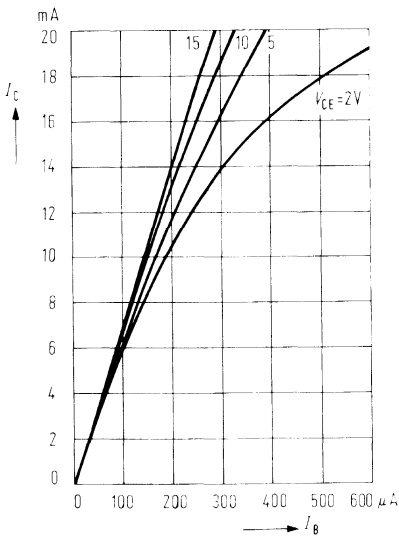
**Total power dissipation  $P_{tot} = f(T_A)$**



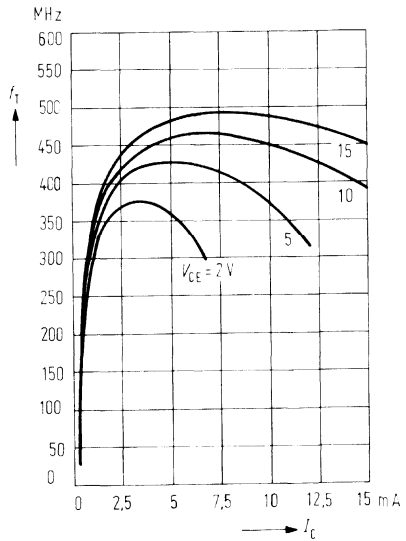
**Output characteristics  $I_C = f(V_{CE})$**



**Collector current  $I_C = f(I_B)$**

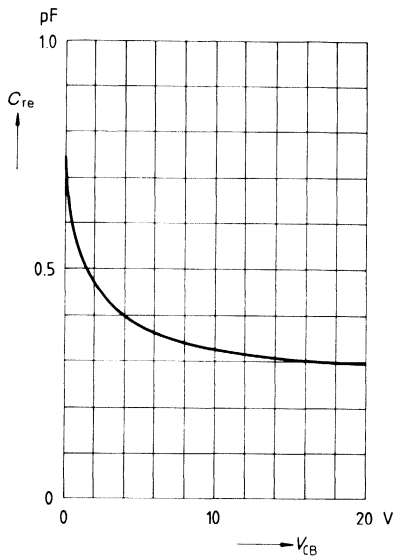


**Transition frequency  $f_T = f(I_C)$   
 $f = 100$  MHz**

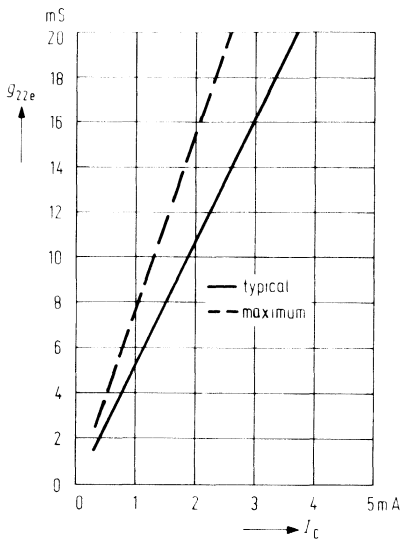




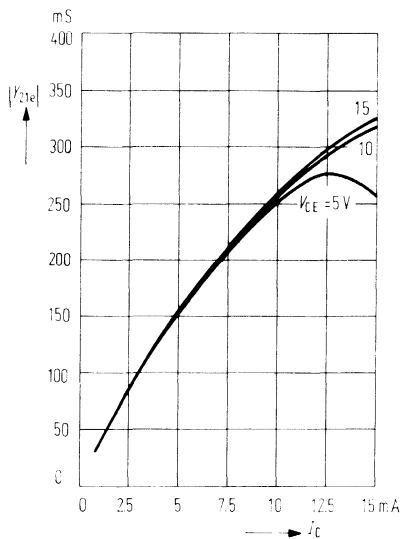
**Feedback capacitance  $C_{re} = f(V_{CB})$**   
 $f = 1 \text{ MHz}$



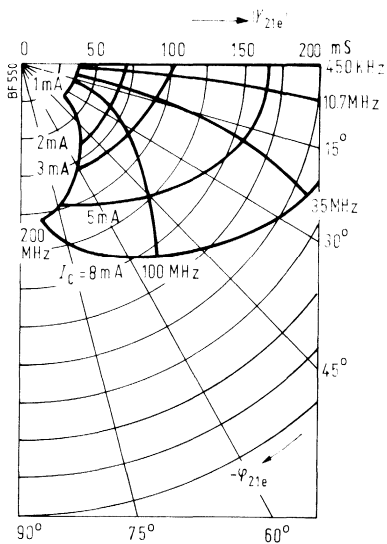
**Output transconductance  $g_{22e} = f(I_C)$**   
 $V_{CE} = 10 \text{ V}, f = 500 \text{ kHz}$



**Forward transfer admittance  $|Y_{21e}| = f(I_C)$**   
 $f = 10,7 \text{ MHz}$

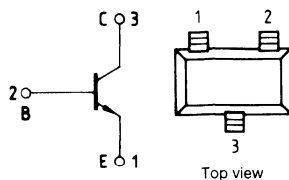


**Forward transfer admittance  $|Y_{21e}|$**   
 $V_{CE} = 10 \text{ V}$



**NPN silicon planar epitaxial transistor**

- General RF applications up to 300 MHz



Type	Marking	Ordering code	Package
BF 554	CC	Refer to index	Version A

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	20 V
Collector-base voltage	$V_{CB0}$	30 V
Emitter-base voltage	$V_{EB0}$	5 V
Collector current	$I_C$	30 mA
Total power dissipation	$P_{Tot}$	280 mW
$T_A = 25^\circ\text{C}$		
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	- 65 ... + 150 °C

<b>Thermal resistance</b>	$R_{thJA}$	$\leq 450$ K/W
junction-ambient		
package mounted		
on alumina		
15 mm × 16.7 mm × 0.7 mm		

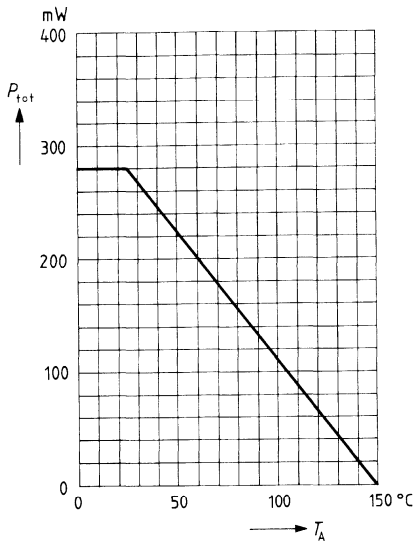
## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$ , $I_B = 0$	$V_{(BR) CE0}$	20	–	–	V
Collector cutoff current $V_{CB} = 20\text{ V}$ , $I_E = 0$	$I_{CB0}$	–	–	100	nA
DC current gain $I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$	$h_{FE}$	60	–	250	–
Base-emitter voltage $I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$	$V_{BE}$	–	0,68	–	V

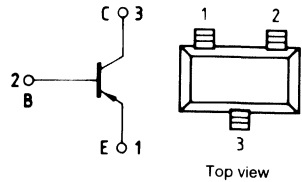
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 100\text{ MHz}$	$f_T$	–	250	–	MHz
Noise figure $V_{CE} = 10\text{ V}$ , $I_C = 1\text{ mA}$ $f = 200\text{ kHz}$ , $g_S = 2\text{ mS}$ $f = 1\text{ MHz}$ , $g_S = 1,5\text{ mS}$ $f = 100\text{ kHz}$ , $g_S = 10\text{ mS}$	$NF$	–	1,5 1,2 4	–	dB dB dB
Collector-base feedback capacitance $I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 450\text{ kHz}$	$C_{re}$	–	0,85	–	pF
Output transconductance $I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 0,5 \dots 10\text{ MHz}$	$g_{22e}$	–	4	–	$\mu\text{S}$

Total power dissipation  $P_{\text{tot}} = f(T_A)$



**PNP silicon planar epitaxial transistor**

- Suitable for oscillators, mixers and self-oscillating mixer stages in UHF TV tuners



Type	Marking	Ordering code	Package
BF 569	LH	Refer to index	Version A

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	35 V
Collector-base voltage	$V_{CB0}$	40 V
Emitter-base voltage	$V_{EB0}$	3 V
Collector current	$I_C$	30 mA
Base current	$I_B$	5 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	280 mW
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	-55 ... +150 °C

**Thermal resistance**

junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 450 K/W
-------------------------------------------------------------------------------	------------	-----------

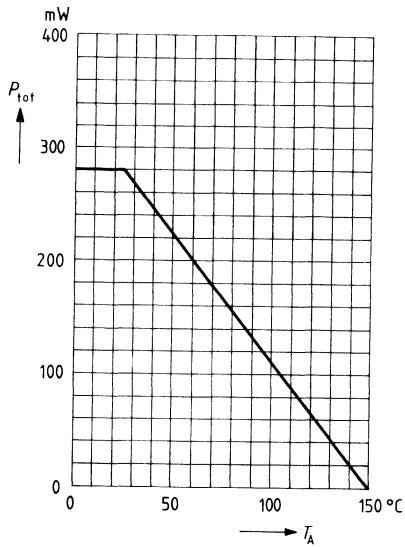
## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

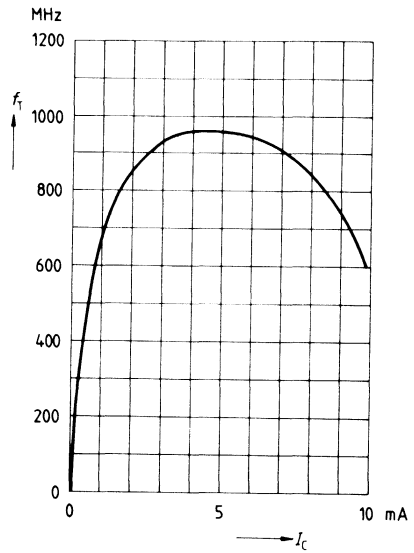
Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$ , $I_B = 0$	$V_{(BR)CE0}$	35	–	–	V
Collector cutoff current $V_{CB} = 20\text{ V}$ , $I_E = 0$	$I_{CB0}$	–	–	100	nA
DC current gain $I_C = 3\text{ mA}$ , $V_{CE} = 10\text{ V}$	$h_{FE}$	20	50	–	–

Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 3\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ MHz}$	$f_T$	–	925	–	MHz
Collector-base feedback capacitance $V_{CB} = 10\text{ V}$ , $V_{BE} = 0$ , $f = 1\text{ MHz}$	$C_{re}$	–	0,32	–	pF
Collector-emitter feedback capacitance $V_{CE} = 10\text{ V}$ , $V_{BE} = 0$ , $f = 1\text{ MHz}$	$C_{rb}$	–	0,15	–	pF
Power gain, common base $I_C = 3\text{ mA}$ , $V_{CB} = 10\text{ V}$ , $f = 800\text{ MHz}$ $R_L = 500\ \Omega$	$G_p$	–	14	–	dB
Noise figure $I_C = 3\text{ mA}$ , $V_{CB} = 10\text{ V}$ , $f = 800\text{ MHz}$ $R_G = 60\ \Omega$	$NF$	–	4,5	–	dB

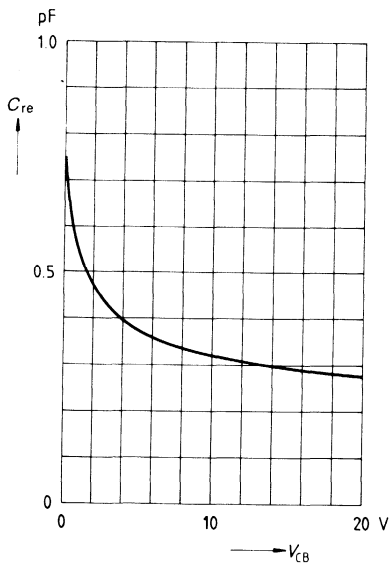
**Total power dissipation  $P_{\text{tot}} = f(T_A)$**



**Transition frequency  $f_T = f(I_C)$**   
 $f = 100 \text{ MHz}, V_{\text{CE}} = 10 \text{ V}$

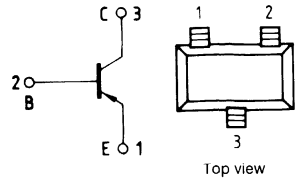


**Feedback capacitance  $C_{re} = f(V_{\text{CB}})$**   
 $f = 1 \text{ MHz}$



**PNP silicon planar epitaxial transistor**

- High transition frequency
- Suitable for low distortion, low noise VHF/UHF amplifier and mixer applications and for UHF oscillator applications in TV tuners
- High collector current,  $I_C = 10 \text{ mA typ}$



Type	Marking	Ordering code	Package
BF 579	LJ	Refer to index	Version A

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	20 V
Collector-base voltage	$V_{CB0}$	25 V
Emitter-base voltage	$V_{EB0}$	3 V
Collector current	$I_C$	30 mA
Base current	$I_B$	5 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	280 mW
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	- 55 ... + 150 °C

**Thermal resistance**

junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 450 K/W
-------------------------------------------------------------------------------	------------	-----------



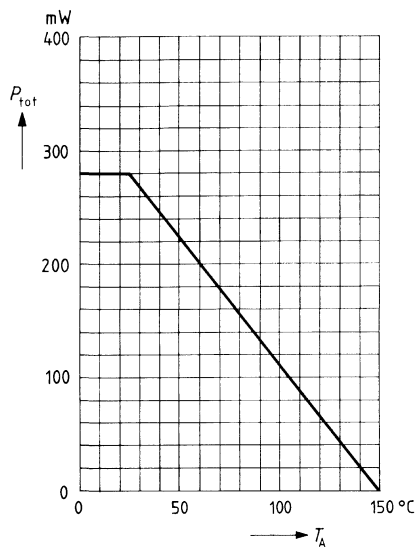
## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

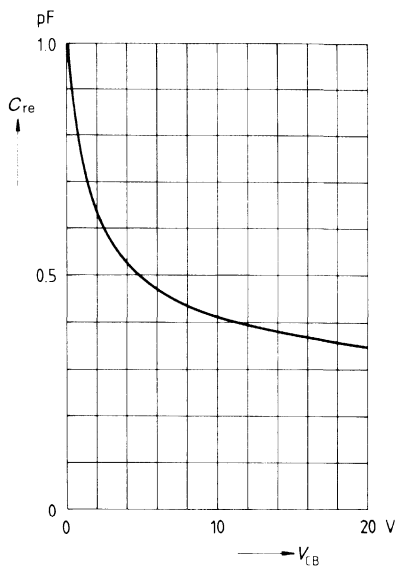
Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$ , $I_B = 0$	$V_{(BR)CE0}$	20	–	–	V
Collector cutoff current $V_{CB} = 20\text{ V}$ , $I_E = 0$	$I_{CB0}$	–	–	100	nA
DC current gain $I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$	$h_{FE}$	20	–	–	–

Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 100\text{ MHz}$	$f_T$	–	1,6	–	GHz
Collector-base feedback capacitance $V_{CB} = 10\text{ V}$ , $V_{BE} = 0$ , $f = 1\text{ MHz}$	$C_{re}$	–	0,41	–	pF
Collector-emitter feedback capacitance $V_{CE} = 10\text{ V}$ , $V_{BE} = 0$ , $f = 1\text{ MHz}$	$C_{rb}$	–	0,16	–	pF
Power gain, common base $I_C = 10\text{ mA}$ , $V_{CB} = 10\text{ V}$ , $f = 800\text{ MHz}$ $R_L = 500\ \Omega$	$G_D$	–	16	–	dB
Noise figure $I_C = 10\text{ mA}$ , $V_{CB} = 10\text{ V}$ , $f = 800\text{ MHz}$ $R_G = 60\ \Omega$	$NF$	–	4	–	dB
$I_C = 10\text{ mA}$ , $V_{CB} = 10\text{ V}$ , $f = 200\text{ MHz}$ $R_G = 60\ \Omega$		–	2,9	–	dB

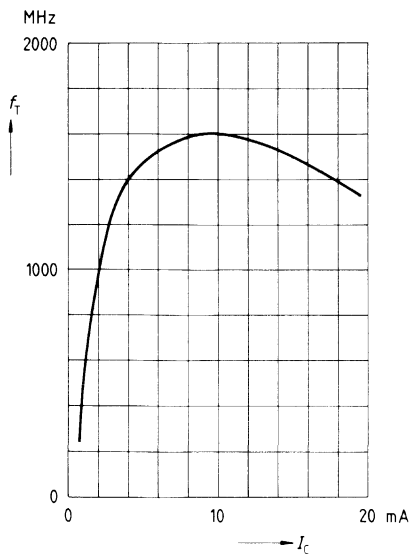
**Total power dissipation**  $P_{tot} = f(T_A)$



**Feedback capacitance**  $C_{re} = f(V_{CB})$   
 $f = 1$  MHz

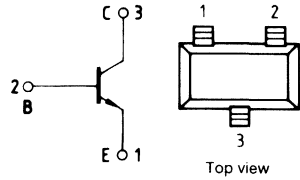


**Transition frequency**  $f_T = f(I_C)$   
 $f = 100$  MHz,  $V_{CE} = 10$  V



**NPN silicon planar epitaxial transistor**

- Suitable for RF amplifiers in common emitter configuration
- Low collector-base capacitance due to contact shield diffusion



Type	Marking	Ordering code	Package
BF 599	NB	Refer to index	Version A

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	25 V
Collector-base voltage	$V_{CB0}$	40 V
Emitter-base voltage	$V_{EB0}$	4 V
Collector current	$I_C$	25 mA
Base current	$I_B$	5 mA
Total power dissipation $T_A = 25\text{ °C}$	$P_{tot}$	280 mW
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	-65 ... +150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 450 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

## Characteristics

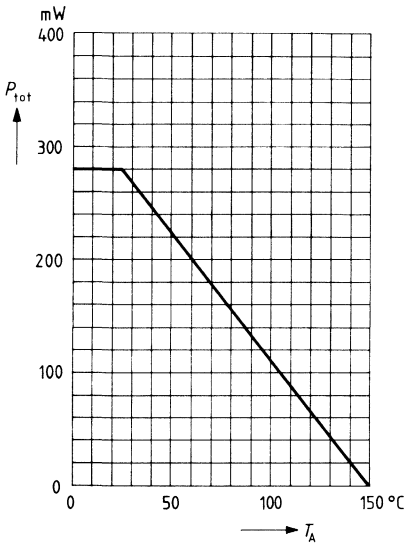
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$ , $I_B = 0$	$V_{(BR)CE0}$	25	–	–	V
Collector cutoff current $V_{CB} = 20\text{ V}$ , $I_E = 0$	$I_{CB0}$	–	–	100	nA
DC current gain $I_C = 7\text{ mA}$ , $V_{CE} = 10\text{ V}$	$h_{FE}$	38	70	–	–
Collector-emitter saturation voltage $I_C = 10\text{ mA}$ , $I_B = 1\text{ mA}$	$V_{CEsat}$	–	0,2	–	V
Base-emitter voltage $I_C = 7\text{ mA}$ , $V_{CE} = 10\text{ V}$	$V_{BE(on)}$	–	0,78	–	V

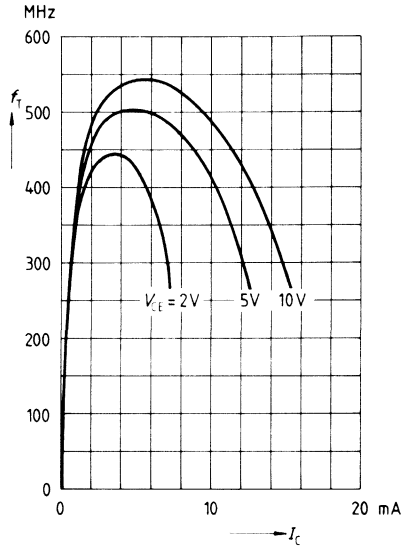
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 5\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 100\text{ MHz}$	$f_T$	–	550	–	MHz
Collector-base feedback capacitance $V_{CB} = 10\text{ V}$ , $V_{BE} = 0$ , $f = 1\text{ MHz}$	$C_{re}$	–	0,35	–	pF
Collector-emitter feedback capacitance $V_{CE} = 10\text{ V}$ , $V_{BE} = 0$ , $f = 1\text{ MHz}$	$C_{rb}$	–	0,68	–	pF
Optimum power gain <sup>1)</sup> $I_C = 7\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 35\text{ MHz}$	$G_{peopt}$	–	43	–	dB
Forward transfer admittance $I_C = 7\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 35\text{ MHz}$	$ Y_{21e} $	–	175	–	dB

$$1) G_{peopt} = \frac{|Y_{21e}|^2}{4g_{11e} \cdot g_{22e}}$$

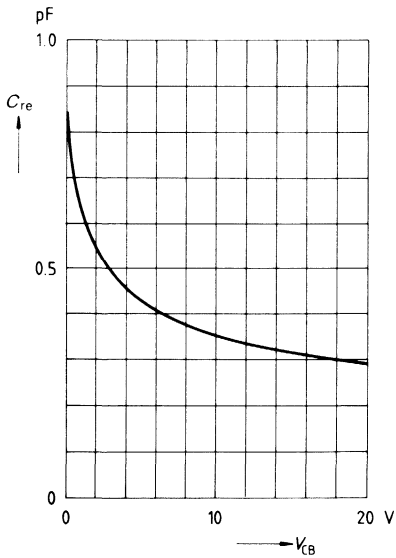
**Total power dissipation  $P_{tot} = f(T_A)$**



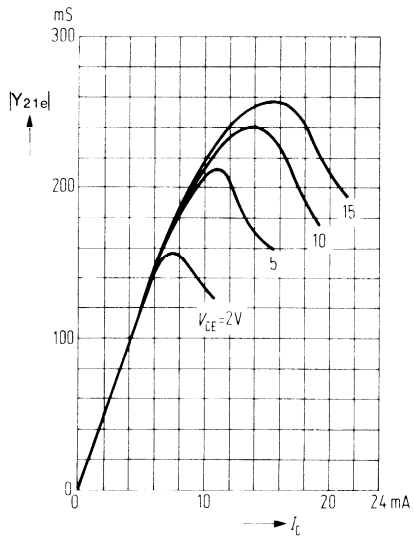
**Transition frequency  $f_T = f(I_C)$**



**Feedback capacitance  $C_{re} = f(V_{CB})$**

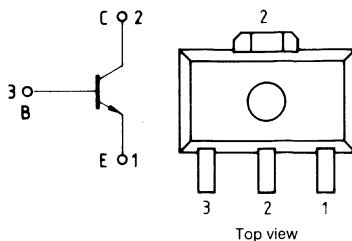


**Forward transfer admittance  $|Y_{21e}| = f(I_C)$   
 $f = 35$  MHz**



## NPN silicon planar epitaxial transistor

- High breakdown voltage
- Low collector-emitter saturation voltage
- Low capacitance
- Complementary to BF 623 (PNP)



Type	Marking	Ordering code	Package
BF 622	DA	Refer to index	Version C

## Maximum ratings

Collector-emitter voltage	$V_{CE0}$	250 V
Collector-base voltage	$V_{CB0}$	250 V
Collector-emitter voltage ( $R_{BE} = 2,7 \text{ k}\Omega$ )	$V_{CER}$	250 V
Emitter-base voltage	$V_{EB0}$	5 V
Collector current	$I_C$	50 mA
Peak collector current	$I_{CM}$	100 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	1,0 W
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	-65 ... +150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 125 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

## Characteristics

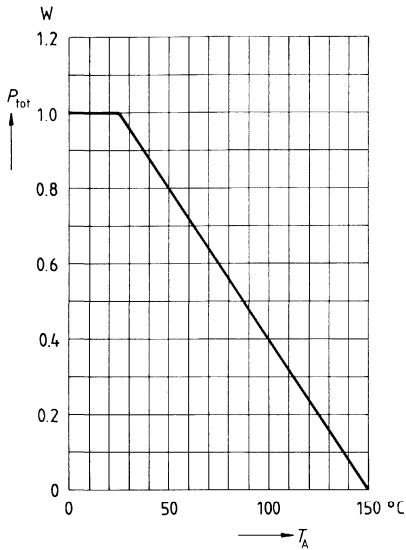
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$	$V_{(BR)CE0}$	250	–	–	V
$I_C = 10\text{ }\mu\text{A}$ , $R_{BE} = 2,7\text{ k}\Omega$	$V_{(BR)CER}$	250	–	–	V
Collector-base breakdown voltage $I_C = 10\text{ }\mu\text{A}$	$V_{(BR)CB0}$	250	–	–	V
Emitter-base breakdown voltage $I_E = 10\text{ }\mu\text{A}$	$V_{(BR)EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 200\text{ V}$	$I_{CB0}$	–	–	100	nA
$V_{CB} = 200\text{ V}$ , $T_A = 150^\circ\text{C}$		–	–	20	$\mu\text{A}$
Collector cutoff current $V_{CE} = 200\text{ V}$ , $R_{BE} = 2,7\text{ k}\Omega$	$I_{CER}$	–	–	1	$\mu\text{A}$
$V_{CE} = 200\text{ V}$ , $R_{BE} = 2,7\text{ k}\Omega$ , $T_A = 150^\circ\text{C}$		–	–	50	$\mu\text{A}$
Emitter cutoff current $V_{EB} = 5\text{ V}$	$I_{EB0}$	–	–	10	nA
DC current gain <sup>1)</sup> $I_C = 25\text{ mA}$ , $V_{CE} = 20\text{ V}$	$h_{FE}$	50	–	–	–
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 10\text{ mA}$ , $I_B = 1\text{ mA}$	$V_{CEsat}$	–	–	0,5	V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 10\text{ mA}$ , $I_B = 1\text{ mA}$	$V_{BEsat}$	–	–	1	V

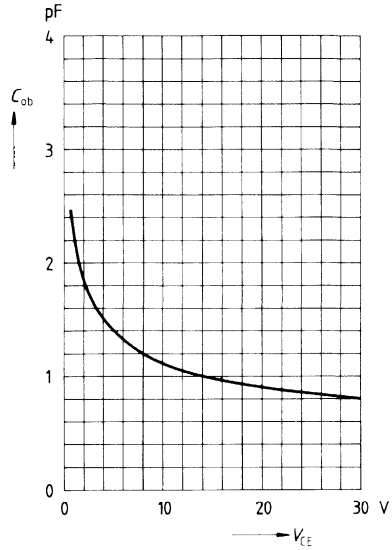
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 20\text{ MHz}$	$f_T$	–	100	–	MHz
Output capacitance $V_{CB} = 30\text{ V}$ , $f = 1\text{ MHz}$	$C_{ob}$	–	0,8	–	pF

<sup>1)</sup> Pulse test:  $t = 300\text{ }\mu\text{s}$ ,  $D = 2\%$ .

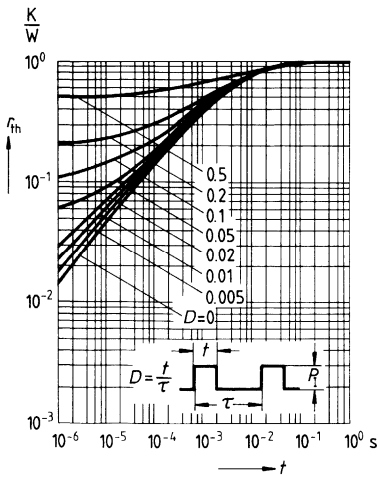
**Total power dissipation**  $P_{tot} = f(T_A)$



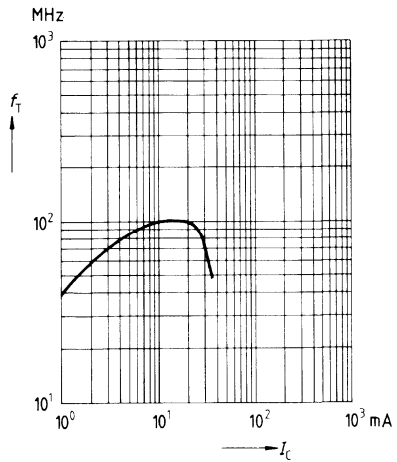
**Output capacitance**  $C_{ob} = f(V_{CE})$   
 $f = 1 \text{ MHz}$



**Pulse handling capability**  $r_{th} = f(t)$   
(standardized)



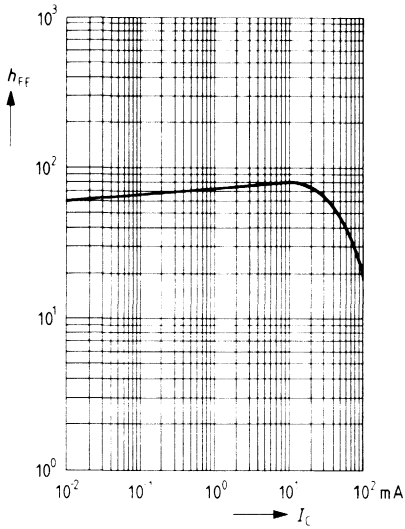
**Transition frequency**  $f_T = f(I_C)$   
 $V_{CE} = 10 \text{ V}, f = 20 \text{ MHz}$





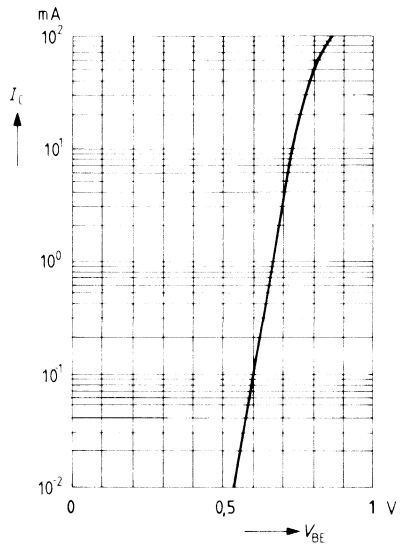
**DC current gain  $h_{FE} = f(I_C)$**

$V_{CE} = 20 \text{ V}$



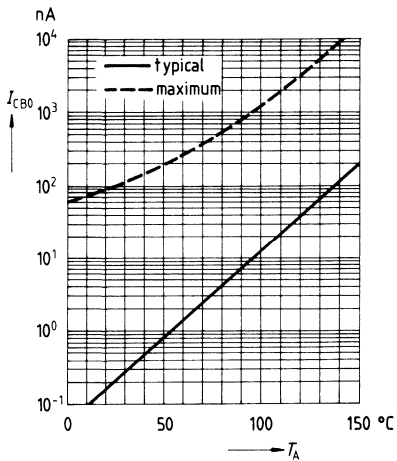
**Collector current  $I_C = f(V_{BE})$**

$V_{CE} = 20 \text{ V}$



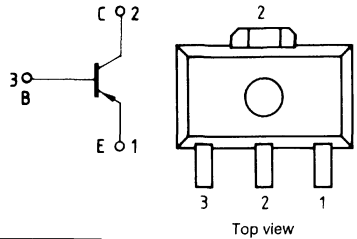
**Collector cutoff current  $I_{CB0} = f(T_A)$**

$V_{CB} = 200 \text{ V}$



## PNP silicon planar epitaxial transistor

- High breakdown voltage
- Low collector-emitter saturation voltage
- Low capacitance
- Complementary to BF 622 (NPN)



Type	Marking	Ordering code	Package
BF 623	DB	Refer to index	Version C

### Maximum ratings

Collector-emitter voltage	$V_{CE0}$	250 V
Collector-base voltage	$V_{CB0}$	250 V
Collector-emitter voltage ( $R_{BE} = 2,7 \text{ k}\Omega$ )	$V_{CER}$	250 V
Emitter-base voltage	$V_{EB0}$	5 V
Collector current	$I_C$	50 mA
Peak collector current	$I_{CM}$	100 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	1,0 W
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	-65 ... +150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 125 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

## Characteristics

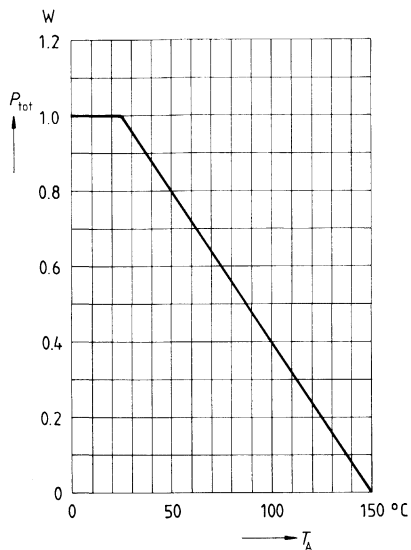
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$	$V_{(BR)CE0}$	250	–	–	V
$I_C = 10\text{ }\mu\text{A}$ , $V_{BE} = 2,7\text{ k}\Omega$	$V_{(BR)CER}$	250	–	–	V
Collector-base breakdown voltage $I_C = 10\text{ }\mu\text{A}$	$V_{(BR)CB0}$	250	–	–	V
Emitter-base breakdown voltage $I_E = 10\text{ }\mu\text{A}$	$V_{(BR)EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 200\text{ V}$	$I_{CB0}$	–	–	100	$\mu\text{A}$
$V_{CB} = 200\text{ V}$ , $T_A = 150^\circ\text{C}$		–	–	20	$\mu\text{A}$
Collector cutoff current $V_{CE} = 200\text{ V}$ , $R_{BE} = 2,7\text{ k}\Omega$	$I_{CER}$	–	–	1	$\mu\text{A}$
$V_{CE} = 200\text{ V}$ , $R_{BE} = 2,7\text{ k}\Omega$ , $T_A = 150^\circ\text{C}$		–	–	50	$\mu\text{A}$
Emitter cutoff current $V_{EB} = 5\text{ V}$	$I_{EB0}$	–	–	10	$\mu\text{A}$
DC current gain <sup>1)</sup> $I_C = 25\text{ mA}$ , $V_{CE} = 20\text{ V}$	$h_{FE}$	50	–	–	–
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 10\text{ mA}$ , $I_B = 1\text{ mA}$	$V_{CEsat}$	–	–	0,5	V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 10\text{ mA}$ , $I_B = 1\text{ mA}$	$V_{BEsat}$	–	–	1	V

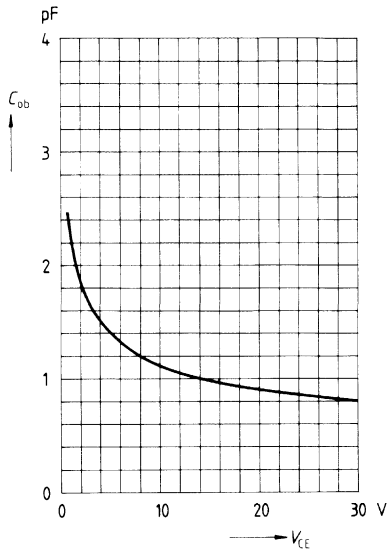
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 20\text{ MHz}$	$f_T$	–	100	–	MHz
Output capacitance $V_{CB} = 30\text{ V}$ , $f = 1\text{ MHz}$	$C_{ob}$	–	1,2	–	pF

<sup>1)</sup> Pulse test:  $t = 300\text{ }\mu\text{s}$ ,  $D = 20\%$ .

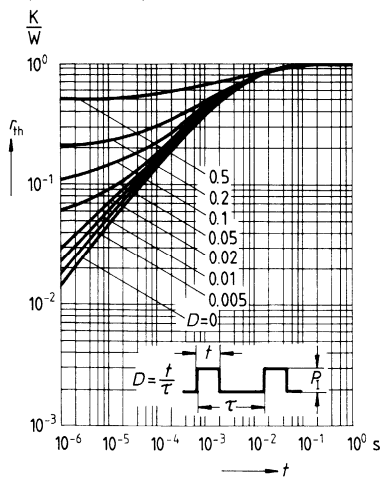
**Total power dissipation**  $P_{tot} = f(T_A)$



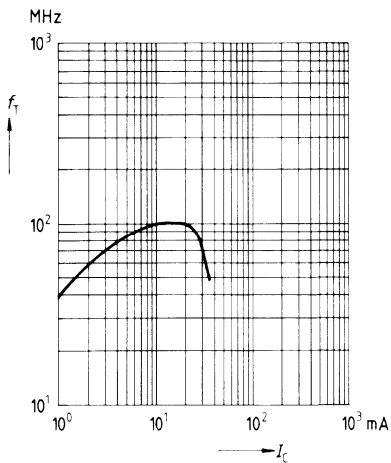
**Output capacitance**  $C_{ob} = f(V_{CE})$   
 $f = 1 \text{ MHz}$



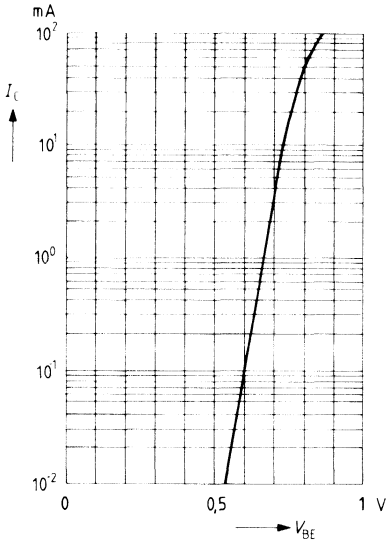
**Pulse handling capability**  $r_{th} = f(t)$   
(standardized)



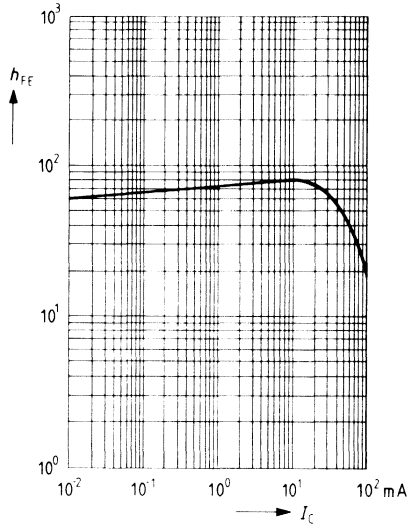
**Transition frequency**  $f_T = f(I_C)$   
 $V_{CE} = 10 \text{ V}, f = 20 \text{ MHz}$



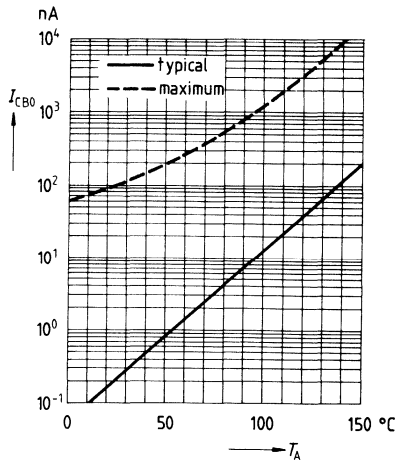
**Collector current**  $I_C = f(V_{BE})$   
 $V_{CE} = 20 \text{ V}$



**DC current gain**  $h_{FE} = f(I_C)$   
 $V_{CE} = 20 \text{ V}$

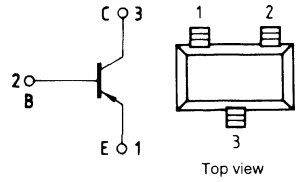


**Collector cutoff current**  $I_{CB0} = f(T_A)$   
 $V_{CB} = 200 \text{ V}$



**PNP silicon planar epitaxial transistor**

- For general-purpose RF amplifier applications up to 300 MHz
- Particularly suitable for application in VHF tuner oscillators



Type	Marking	Ordering code	Package
BF 660	LE	Refer to index	Version A

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	30 V
Collector-base voltage	$V_{CB0}$	40 V
Emitter-base voltage	$V_{EB0}$	4 V
Collector current	$I_C$	25 mA
Emitter current	$I_E$	30 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	280 mW
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	-65 ... +150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 450 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

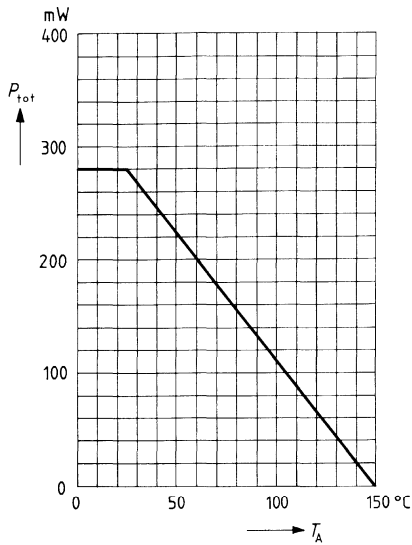
## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}, I_E = 0$	$V_{(BR)CE0}$	30	–	–	V
Collector-base breakdown voltage $I_C = 10\text{ }\mu\text{A}, I_E = 0$	$V_{(BR)CB0}$	40	–	–	V
Emitter-base breakdown voltage $I_E = 10\text{ }\mu\text{A}, I_C = 0$	$V_{(BR)EB0}$	4	–	–	V
Collector cutoff current $V_{CB} = 20\text{ V}, I_E = 0$	$I_{CB0}$	–	–	50	nA
DC current gain $I_C = 3\text{ mA}, V_{CE} = 10\text{ V}$	$h_{FE}$	30	–	–	–

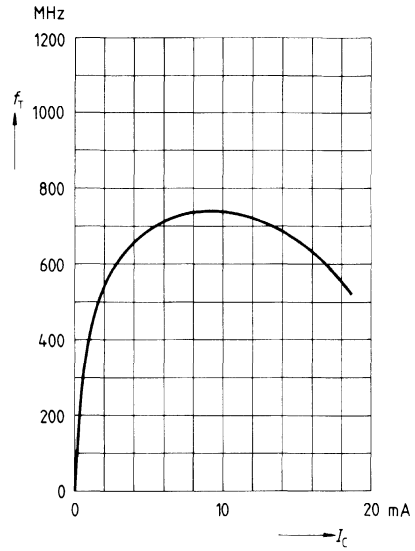
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 5\text{ mA}, V_{CE} = 10\text{ V}, f = 100\text{ MHz}$	$f_T$	–	700	–	MHz
Collector-base feedback capacitance $V_{CB} = 10\text{ V}, V_{BE} = 0, f = 1\text{ MHz}$	$C_{re}$	–	0,6	–	pF
Collector-emitter feedback capacitance $V_{CE} = 10\text{ V}, V_{BE} = 0, f = 1\text{ MHz}$	$C_{rb}$	–	0,28	–	pF

**Total power dissipation  $P_{tot} = f(T_A)$**



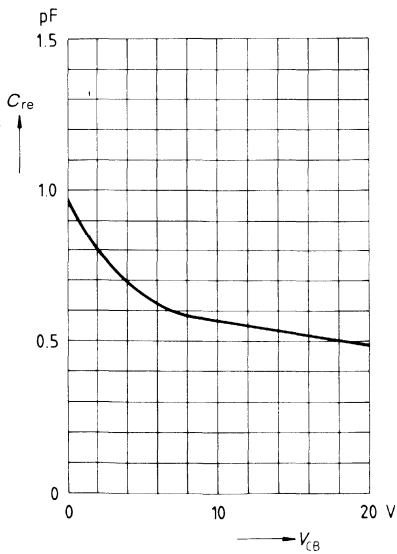
**Transition frequency  $f_T = f(I_C)$**

$V_{CE} = 10 \text{ V}, f = 100 \text{ MHz}$



**Feedback capacitance  $C_{re} = f(V_{CB})$**

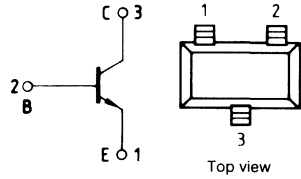
$f = 1 \text{ MHz}$





**NPN silicon planar epitaxial transistor**

- Suitable for linear broadband RF amplifiers up to 500 MHz and for TV tuners
- Particularly suitable for SAW filter drivers



Type	Marking	Ordering code	Package
BF 799	LK	Refer to index	Version A

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	20 V
Collector-base voltage	$V_{CB0}$	30 V
Collector-emitter voltage	$V_{CES}$	30 V
Emitter-base voltage	$V_{EB0}$	3 V
Collector current	$I_C$	35 mA
Peak collector current	$I_{CM}$	50 mA
Peak base current	$I_{BM}$	15 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	280 mW
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	-65 ... +150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 450 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

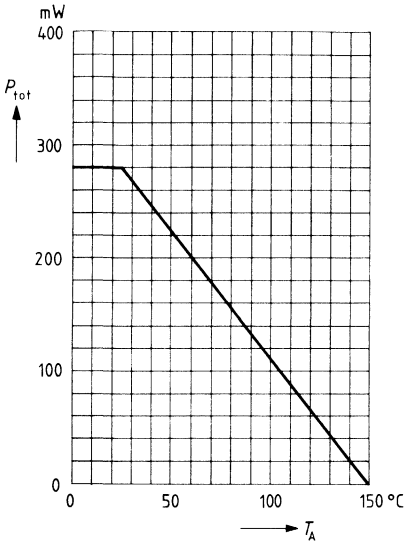
## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

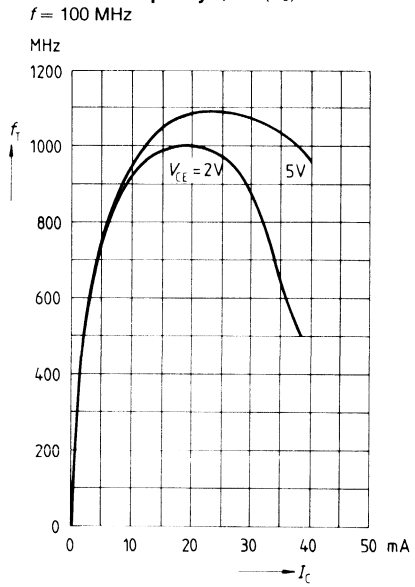
Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$ , $I_B = 0$	$V_{(BR) CE0}$	20	–	–	V
Collector-base breakdown voltage $I_C = 10\ \mu\text{A}$ , $I_E = 0$	$V_{(BR) CB0}$	30	–	–	V
Emitter-base breakdown voltage $I_E = 10\ \mu\text{A}$	$V_{(BR) EB0}$	3	–	–	V
Collector cutoff current $V_{CB} = 20\text{ V}$	$I_{CB0}$	–	–	100	nA
DC current gain $I_C = 5\text{ mA}$ , $V_{CE} = 10\text{ V}$ $I_C = 20\text{ mA}$ , $V_{CE} = 10\text{ V}$	$h_{FE}$	35 40	95 100	– 250	– –
Collector-emitter saturation voltage $I_C = 20\text{ mA}$ , $I_B = 2\text{ mA}$	$V_{CEsat}$	–	0,15	0,5	V
Base-emitter saturation voltage $I_C = 20\text{ mA}$ , $I_B = 2\text{ mA}$	$V_{BEsat}$	–	–	0,95	V

Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 5\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 100\text{ MHz}$ $I_C = 20\text{ mA}$ , $V_{CE} = 8\text{ V}$ , $f = 100\text{ MHz}$	$f_T$	– –	800 1100	– –	MHz MHz
Output capacitance $V_{CB} = 10\text{ V}$ , $f = 1\text{ MHz}$ , $V_{BE} = 0\text{ V}$	$C_{ob}$	–	0,96	–	pF
Collector-base feedback capacitance $V_{CE} = 10\text{ V}$ , $V_{BE} = 0\text{ V}$ , $f = 1\text{ MHz}$	$C_{re}$	–	0,7	–	pF
Collector-emitter feedback capacitance $V_{CE} = 10\text{ V}$ , $V_{BE} = 0\text{ V}$ , $f = 1\text{ MHz}$	$C_{rb}$	–	0,28	–	pF
Noise figure $I_C = 5\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 100\text{ MHz}$ , $R_G = 50\ \Omega$	$NF$	–	3	–	dB
Output transconductance $I_C = 20\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 35\text{ MHz}$	$g_{22e}$	–	60	–	$\mu\text{S}$

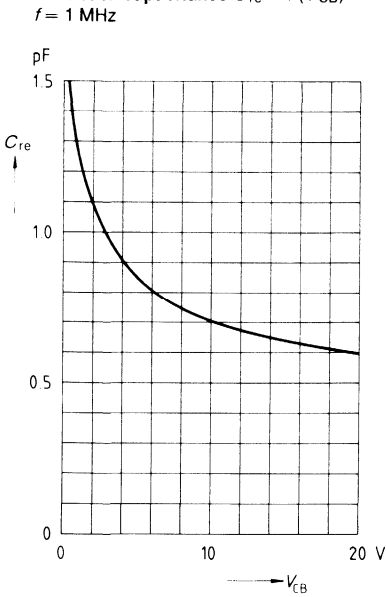
**Total power dissipation  $P_{tot} = f(T_A)$**



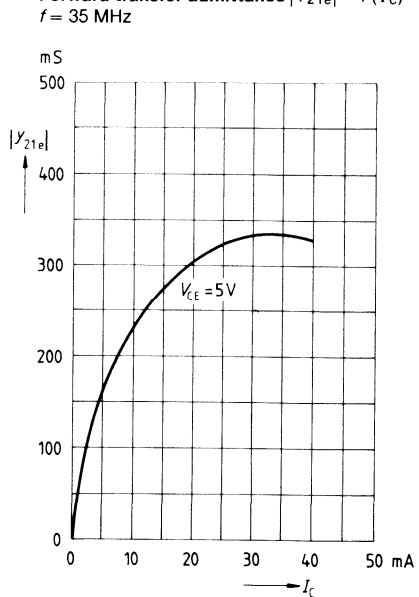
**Transition frequency  $f_T = f(I_C)$**



**Feedback capacitance  $C_{re} = f(V_{CB})$**

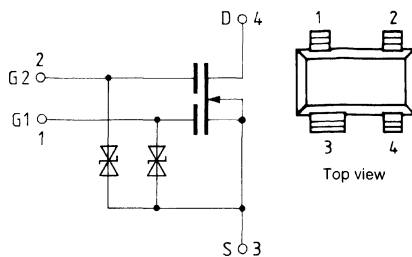


**Forward transfer admittance  $|Y_{21e}| = f(I_C)$**



**Silicon dual-gate MOS field-effect tetrode**

- For UHF input stages and for applications throughout the frequency range between 200 MHz and 1 GHz



Type	Marking	Ordering code	Package
BF 989	MA	Refer to index	Version B

**Maximum ratings**

Drain-source voltage	$V_{DS}$	20 V
Drain current	$I_D$	30 mA
Gate 1/Gate 2 source peak current	$\pm I_{G1/2SM}$	10 mA
Total power dissipation $T_A = 60^\circ\text{C}$	$P_{tot}$	200 mW
Storage temperature range	$T_{stg}$	$-55 \dots +150^\circ\text{C}$
Channel temperature	$T_{ch}$	$150^\circ\text{C}$

**Thermal resistance**

junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	$\leq 450 \text{ K/W}$
-------------------------------------------------------------------------------	------------	------------------------

## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

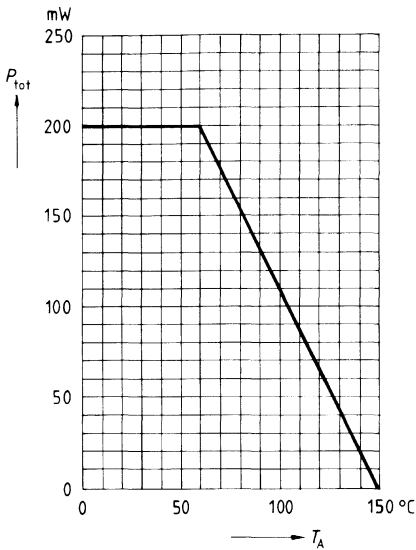
Static characteristics	Symbol	min	typ	max	Unit
Drain-source breakdown voltage $I_D = 10\ \mu\text{A}$ , $-V_{G1S} = -V_{G2S} = 4\ \text{V}$	$V_{(BR)DS}$	20	–	–	V
Gate 1 source breakdown voltage $\pm I_{G1S} = 10\ \text{mA}$ , $V_{G2S} = V_{DS} = 0$	$\pm V_{(BR)G1SS}$	6	–	20	V
Gate 2 source breakdown voltage $\pm I_{G2S} = 10\ \text{mA}$ , $V_{G1S} = V_{DS} = 0$	$\pm V_{(BR)G2SS}$	6	–	20	V
Gate 1 source leakage current $\pm V_{G1S} = 5\ \text{V}$ , $V_{G2S} = V_{DS} = 0$	$\pm I_{G1SS}$	–	–	50	nA
Gate 2 source leakage current $\pm V_{G2S} = 5\ \text{V}$ , $V_{G1S} = V_{DS} = 0$	$\pm I_{G2SS}$	–	–	50	nA
Drain current $V_{DS} = 15\ \text{V}$ , $V_{G1S} = 0$ , $V_{G2S} = 4\ \text{V}$	$I_{DSS}$	2	–	20	mA
Gate 1 source pinch-off voltage $V_{DS} = 15\ \text{V}$ , $V_{G2S} = 4\ \text{V}$ , $I_D = 20\ \mu\text{A}$	$-V_{G1S(p)}$	–	–	2,7	V
Gate 2 source pinch-off voltage $V_{DS} = 15\ \text{V}$ , $V_{G1S} = 0$ , $I_D = 20\ \mu\text{A}$	$-V_{G2S(p)}$	–	–	2,7	V

Dynamic characteristics	Symbol	min	typ	max	Unit
Forward transconductance $V_{DS} = 15\ \text{V}$ , $I_D = 7\ \text{mA}$ , $V_{G2S} = 4\ \text{V}$ , $f = 1\ \text{kHz}$	$g_{fs}$	9,5	12	–	mS
Gate 1 input capacitance $V_{DS} = 15\ \text{V}$ , $I_D = 7\ \text{mA}$ , $V_{G2S} = 4\ \text{V}$ , $f = 1\ \text{MHz}$	$C_{g1ss}$	1,3	1,8	2,3	pF
Gate 2 input capacitance $V_{DS} = 15\ \text{V}$ , $I_D = 7\ \text{mA}$ , $V_{G2S} = 4\ \text{V}$ , $f = 1\ \text{MHz}$	$C_{g2ss}$	–	1	–	pF
Reverse transfer capacitance <sup>1)</sup> $V_{DS} = 15\ \text{V}$ , $I_D = 7\ \text{mA}$ , $V_{G2S} = 4\ \text{V}$ , $f = 1\ \text{MHz}$	$C_{dg1}$	–	25	–	fF
Output capacitance $V_{DS} = 15\ \text{V}$ , $I_D = 7\ \text{mA}$ , $V_{G2S} = 4\ \text{V}$ , $f = 1\ \text{MHz}$	$C_{dss}$	0,65	0,8	1,2	pF
Power gain $V_{DS} = 15\ \text{V}$ , $I_D = 7\ \text{mA}$ , $f = 200\ \text{MHz}$ , $G_G = 2\ \text{mS}$ , $G_L = 0,5\ \text{mS}$ $f = 800\ \text{MHz}$ , $G_G = 3,3\ \text{mS}$ , $G_L = 1\ \text{mS}$	$G_{ps}$	– 13	23 16,5	– 20	dB dB
Noise figure $V_{DS} = 15\ \text{V}$ , $I_D = 7\ \text{mA}$ , $f = 200\ \text{MHz}$ , $G_G = 2\ \text{mS}$ , $G_L = 0,5\ \text{mS}$ $f = 800\ \text{MHz}$ , $G_G = 3,3\ \text{mS}$ , $G_L = 1\ \text{mS}$	$NF$	– –	1,6 2,8	2,8 3,9	dB dB
Control range $V_{DS} = 15\ \text{V}$ , $V_{G2S} = 4 \dots -2\ \text{V}$ , $f = 800\ \text{MHz}$	$\Delta G_{ps}$	40	–	–	dB
Mixer gain $V_{DS} = 15\ \text{V}$ , $V_{G2S} = 4\ \text{V}$ , $f = 800\ \text{MHz}$ , $f_{IF} = 36\ \text{MHz}$ , $2\ \Delta f_{IF} = 5\ \text{MHz}$ , $V_{OSC} = 800\ \text{mV}$	$G_{psc}$	–	16	–	dB

<sup>1)</sup> G2 and S on screen potential.

**Total power dissipation**

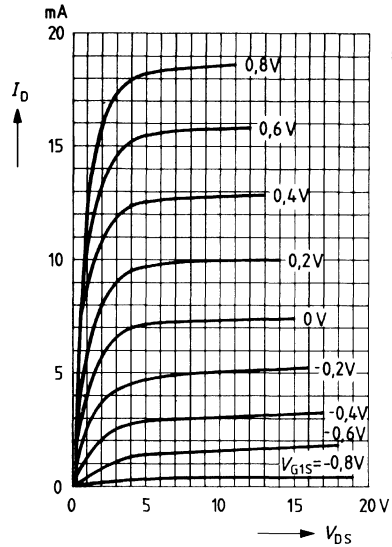
$P_{tot} = f(T_A)$



**Family of output characteristics**

$I_D = f(V_{DS})$

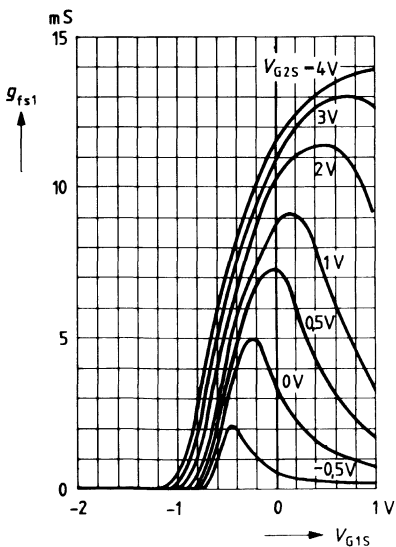
$V_{G2S} = 4\text{ V}$



**Gate 1 forward transconductance  $g_{fs1} = f(V_{G1S})$**

$V_{DS} = 15\text{ V}$

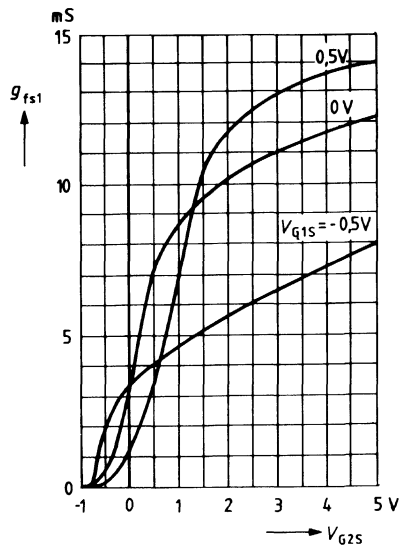
$I_{DSS} = 7\text{ mA}, f = 1\text{ kHz}$



**Gate 1 forward transconductance  $g_{fs1} = f(V_{G2S})$**

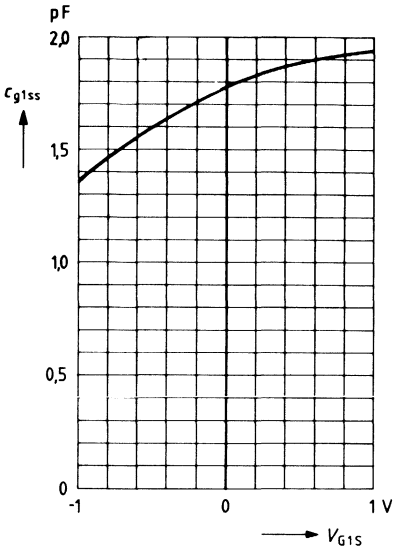
$V_{DS} = 15\text{ V}$

$I_{DSS} = 7\text{ mA}, f = 1\text{ kHz}$



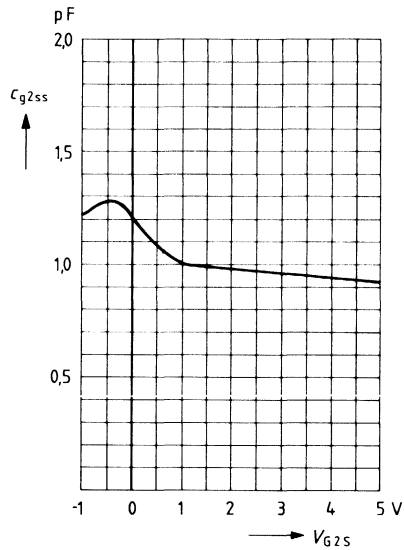
**Gate 1 input capacitance**

$C_{g1ss} = f(V_{G1S})$   
 $V_{G2S} = 4\text{ V}, V_{DS} = 15\text{ V}$   
 $I_{DSS} = 7\text{ mA}, f = 1\text{ MHz}$



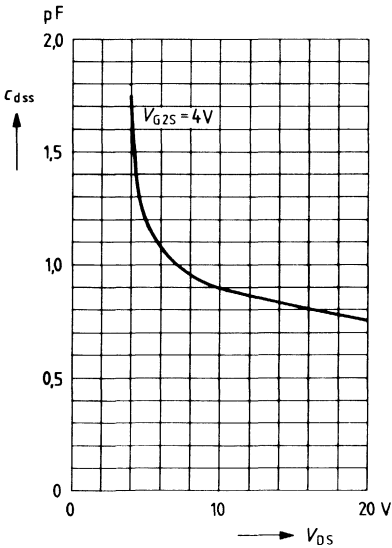
**Gate 2 input capacitance**

$C_{g2ss} = f(V_{G2S})$   
 $V_{G1S} = 0\text{ V}, V_{DS} = 15\text{ V}$   
 $I_{DSS} = 7\text{ mA}, f = 1\text{ MHz}$



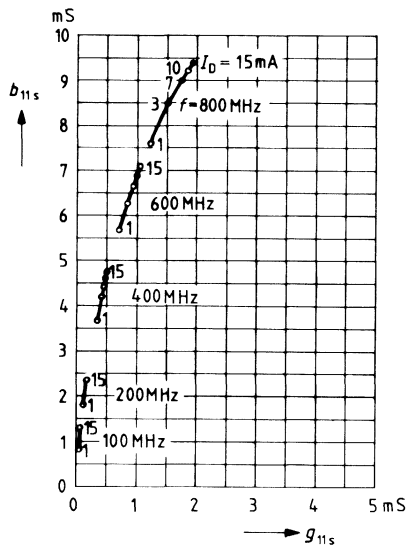
**Output capacitance**

$C_{dss} = f(V_{DS})$   
 $V_{G1S} = 0\text{ V}, V_{G2S} = 4\text{ V}$   
 $I_{DSS} = 7\text{ mA}, f = 1\text{ MHz}$

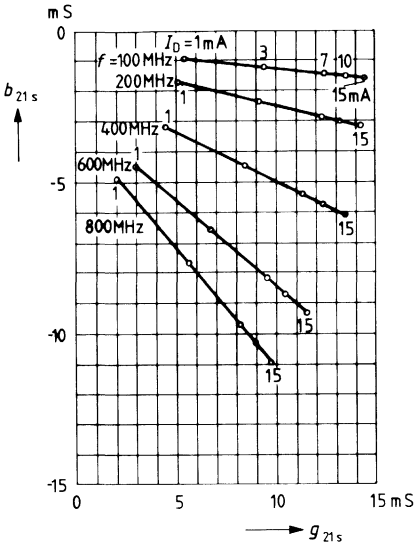


**Gate 1 input admittance  $y_{11s}$**

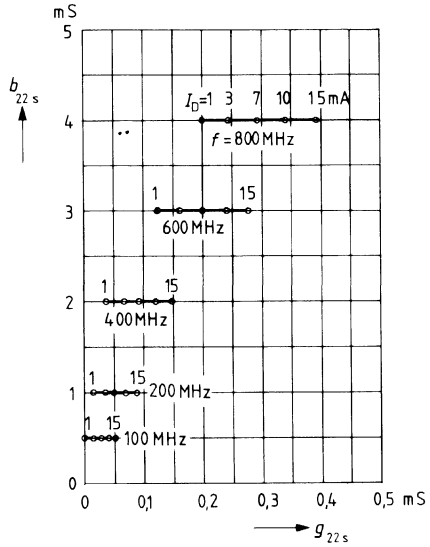
$V_{DS} = 15\text{ V}, V_{G2S} = 4\text{ V}$   
 (common-source)



**Gate 1 forward transfer admittance  $Y_{21s}$**   
 $V_{DS} = 15 \text{ V}$ ,  $V_{G2S} = 4 \text{ V}$   
 (common-source)

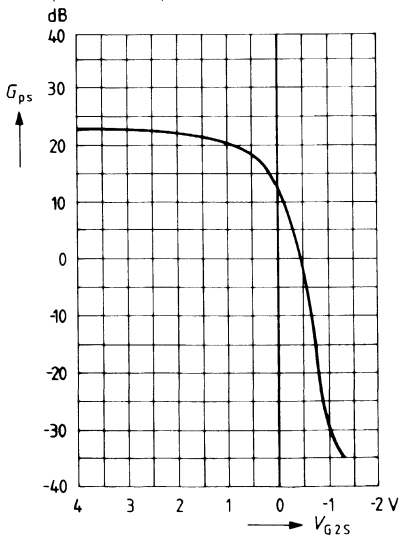


**Output admittance  $Y_{22s}$**   
 $V_{DS} = 15 \text{ V}$ ,  $V_{G2S} = 4 \text{ V}$   
 (common-source)



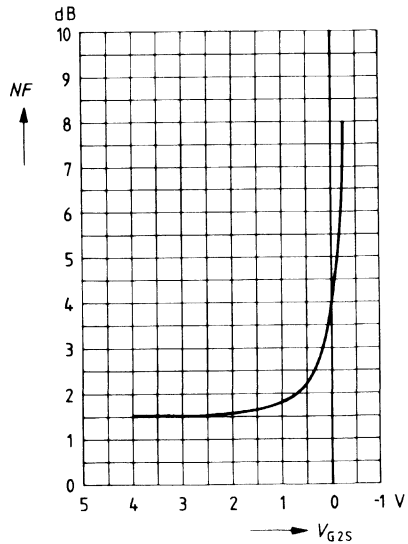
**Power gain**

$G_{ps} = f(V_{G2S})$   
 $V_{DS} = 15 \text{ V}$ ,  $V_{G1S} = 0$ ;  
 $I_{DSS} = 7 \text{ mA}$ ,  $f = 200 \text{ MHz}$   
 (test circuit 1)



**Noise figure**

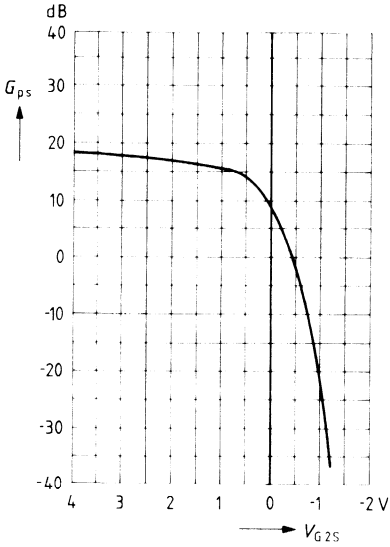
$NF = f(V_{G2S})$   
 $V_{DS} = 15 \text{ V}$ ,  $V_{G1S} = 0$ ;  
 $I_{DSS} = 7 \text{ mA}$ ,  $f = 200 \text{ MHz}$   
 (test circuit 1)





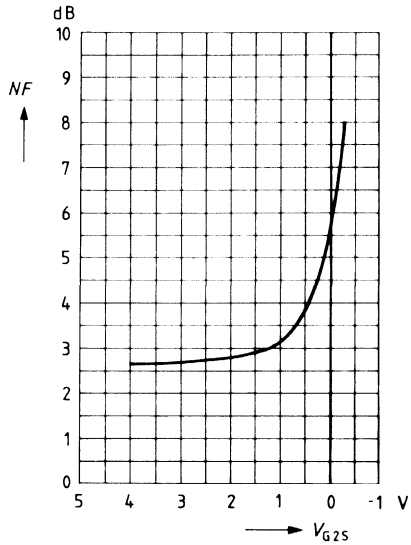
**Power gain  $G_{ps} = f(V_{G2S})$**

$V_{DS} = 15 \text{ V}$ ;  $V_{G1S} = 0$ ;  
 $I_{DSS} = 7 \text{ mA}$ ;  $f = 800 \text{ MHz}$ ;  $R_S = 0$   
 (test circuit 2)



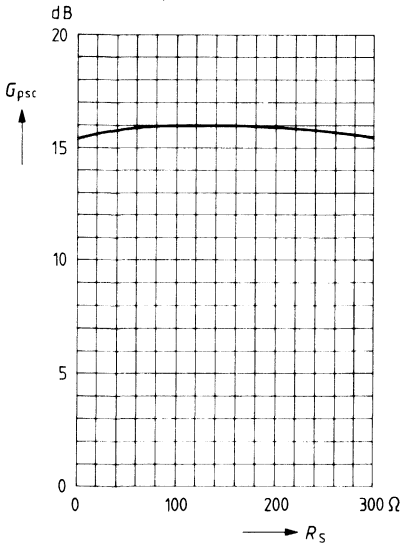
**Noise figure  $NF = f(V_{G2S})$**

$V_{DS} = 15 \text{ V}$ ;  $V_{G1S} = 0$ ;  
 $I_{DSS} = 7 \text{ mA}$ ;  $f = 800 \text{ MHz}$ ;  $R_S = 0$   
 (test circuit 2)



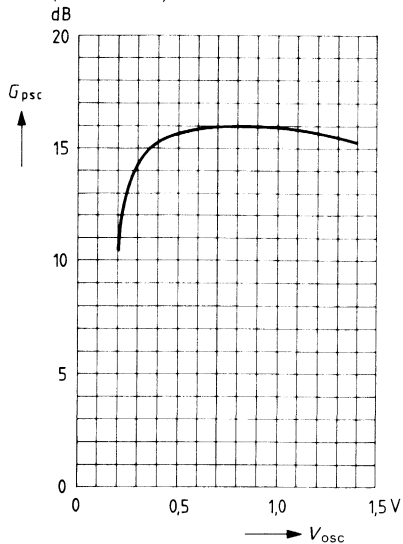
**Mixer gain  $G_{psc} = f(R_S)$**

$f_e = 800 \text{ MHz}$ ;  $f_{osc} = 836 \text{ MHz}$   
 $V_{osc} = 800 \text{ mV}$ ;  $V_{DS} = 15 \text{ V}$   
 $V_{G2S} = 4 \text{ V}$ ;  $I_{DSS} = 7 \text{ mA}$   
 (test circuit 3)



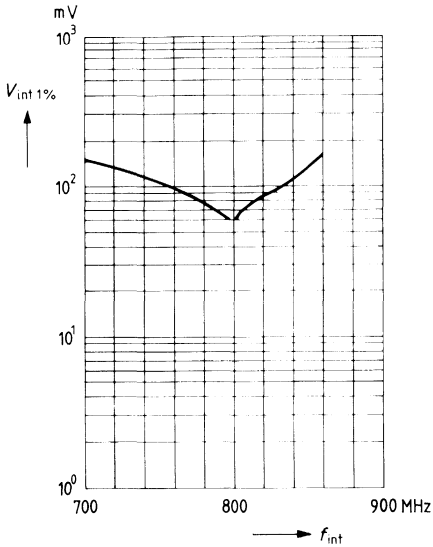
**Mixer gain  $G_{psc} = f(V_{osc})$**

$f_e = 800 \text{ MHz}$ ;  $f_{osc} = 836 \text{ MHz}$   
 $V_{DS} = 15 \text{ V}$ ;  $V_{G2S} = 4 \text{ V}$ ;  
 $I_{DSS} = 7 \text{ mA}$ ;  $R_S = 150$   
 (test circuit 3)



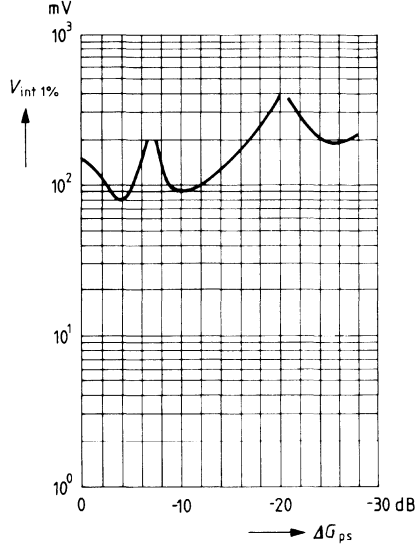
**Interference voltage for 1% cross modulation**

$V_{int(1\%)} = f(f_{int})^1$ ;  $m_{int} = 100\%$ ;  
 $V_{DS} = 15\text{ V}$ ;  $V_{G2S} = 4\text{ V}$ ,  
 $V_{G1S} = 1\text{ V}$ ;  $R_S = 150\ \Omega$   
 (test circuit 2)



**Interference voltage for 1% cross modulation**

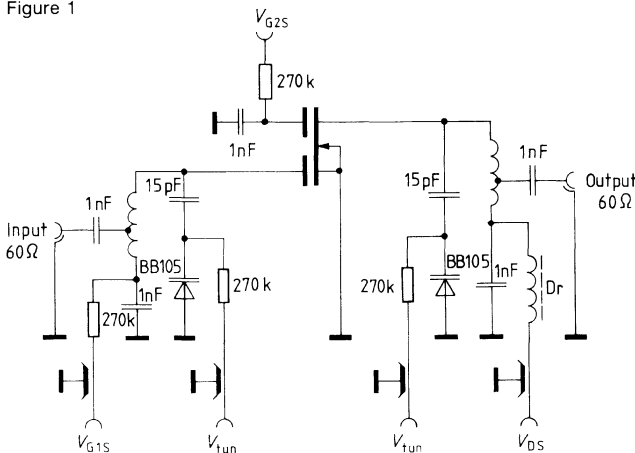
$V_{int(1\%)} = f(\Delta G_{ps})^1$ ;  $f_e = 800\text{ MHz}$ ;  
 $f_{int} = 700\text{ MHz}$ ;  $m_{int} = 100\%$ ;  
 $V_{DS} = 15\text{ V}$ ;  $V_{G1S} = 1\text{ V}$ ;  $R_S = 150\ \Omega$   
 (test circuit 2)



**Test circuit for power gain and noise figure**

$f = 200\text{ MHz}$ ;  $G_G = 2\text{ ms}$ ,  $G_L = 0,5\text{ mS}$

Figure 1

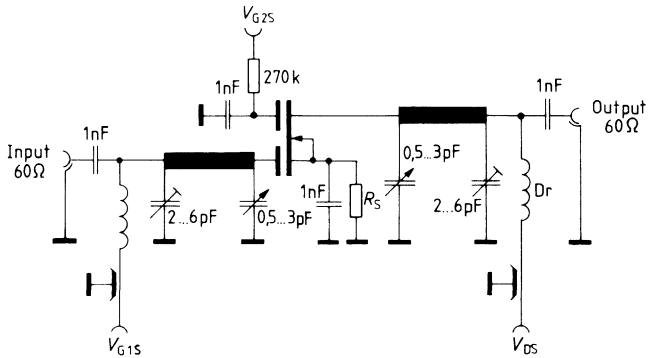


<sup>1)</sup>  $V_{int(1\%)}$  is the rms value of half the EMC (terminal voltage at matching) of a 100% sine modulated TV carrier at an internal generator resistance of  $60\ \Omega$ , causing 1% amplitude modulation on the active carrier.

**Test circuit for power gain, noise figure and cross modulation**

$f = 800 \text{ MHz}$ ,  $G_G = 3,3 \text{ mS}$ ,  $G_L = 1 \text{ mS}$

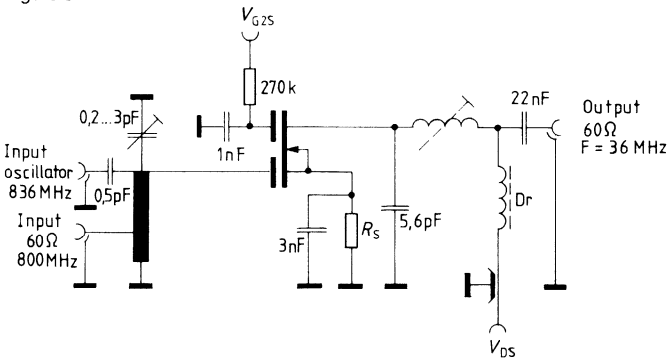
Figure 2



**Test circuit for mixer gain**

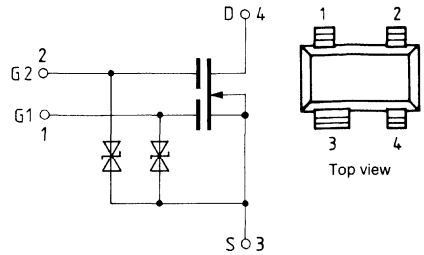
$f = 800/36 \text{ MHz}$

Figure 3



**Silicon dual-gate-MOS field-effect tetraode**

- For UHF input stages and for applications throughout the frequency range between 200 MHz and 1 GHz



Type	Marking	Ordering code	Package
BF 989 S	MF	Refer to index	Version B

**Maximum ratings**

Drain-source voltage	$V_{DS}$	20 V
Drain current	$I_D$	30 mA
Gate 1/Gate 2 source peak current	$\pm I_{G1/2SM}$	10 mA
Total power dissipation $T_A = 60^\circ C$	$P_{tot}$	200 mW
Storage temperature range	$T_{stg}$	$-55 \dots +150^\circ C$
Channel temperature	$T_{ch}$	150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	$\leq 450$ K/W
------------------------------------------------------------------------------------------------------------	------------	----------------

## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

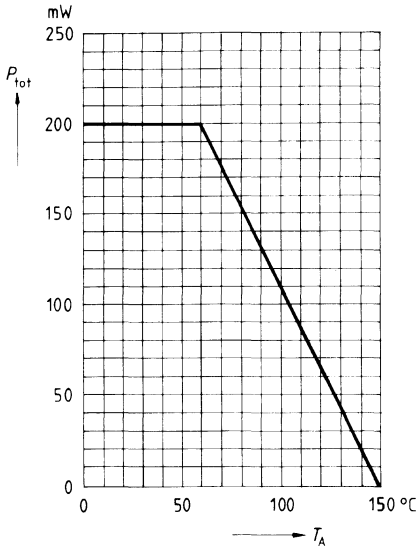
Static characteristics	Symbol	min	typ	max	Unit
Drain-source breakdown voltage $I_D = 10\ \mu\text{A}$ , $-V_{G1S} = -V_{G2S} = 4\ \text{V}$	$V_{(BR)DS}$	20	-	-	V
Gate 1 source breakdown voltage $\pm I_{G1S} = 10\ \text{mA}$ , $V_{G2S} = V_{DS} = 0$	$\pm V_{(BR)G1SS}$	6	-	20	V
Gate 2 source breakdown voltage $\pm I_{G2S} = 10\ \text{mA}$ , $V_{G1S} = V_{DS} = 0$	$\pm V_{(BR)G2SS}$	6	-	20	V
Gate 1 source leakage current $\pm V_{G1S} = 5\ \text{V}$ , $V_{G2S} = V_{DS} = 0$	$\pm I_{G1SS}$	-	-	50	nA
Gate 2 source leakage current $\pm V_{G2S} = 5\ \text{V}$ , $V_{G1S} = V_{DS} = 0$	$\pm I_{G2SS}$	-	-	50	nA
Drain current $V_{DS} = 15\ \text{V}$ , $V_{G1S} = 0$ , $V_{G2S} = 4\ \text{V}$	$I_{DSS}$	2	-	20	mA
Gate 1 source pinch-off voltage $V_{DS} = 15\ \text{V}$ , $V_{G2S} = 4\ \text{V}$ , $I_D = 20\ \mu\text{A}$	$-V_{G1S(p)}$	-	-	2,7	V
Gate 2 source pinch-off voltage $V_{DS} = 15\ \text{V}$ , $V_{G1S} = 0$ , $I_D = 20\ \mu\text{A}$	$-V_{G2S(p)}$	-	-	2,7	V

Dynamic characteristics	Symbol	min	typ	max	Unit
Forward transconductance $V_{DS} = 15\ \text{V}$ , $I_D = 7\ \text{mA}$ , $V_{G2S} = 4\ \text{V}$ , $f = 1\ \text{kHz}$	$g_{fs}$	10	12	-	mS
Gate 1 input capacitance $V_{DS} = 15\ \text{V}$ , $I_D = 7\ \text{mA}$ , $V_{G2S} = 4\ \text{V}$ , $f = 1\ \text{MHz}$	$C_{g1ss}$	-	1,8	-	pF
Gate 2 input capacitance $V_{DS} = 15\ \text{V}$ , $I_D = 7\ \text{mA}$ , $V_{G2S} = 4\ \text{V}$ , $f = 1\ \text{MHz}$	$C_{g2ss}$	-	1	-	pF
Reverse transfer capacitance <sup>1)</sup> $V_{DS} = 15\ \text{V}$ , $I_D = 7\ \text{mA}$ , $V_{G2S} = 4\ \text{V}$ , $f = 1\ \text{MHz}$	$C_{dg1}$	-	25	-	fF
Output capacitance $V_{DS} = 15\ \text{V}$ , $I_D = 7\ \text{mA}$ , $V_{G2S} = 4\ \text{V}$ , $f = 1\ \text{MHz}$	$C_{dss}$	-	0,8	-	pF
Power gain $V_{DS} = 15\ \text{V}$ , $I_D = 7\ \text{mA}$ , $f = 200\ \text{MHz}$ , $G_G = 2\ \text{mS}$ , $G_L = 0,5\ \text{mS}$ $f = 800\ \text{MHz}$ , $G_G = 3,3\ \text{mS}$ , $G_L = 1\ \text{mS}$	$G_{ps}$	-	23 16,5	-	dB dB
Noise figure $V_{DS} = 15\ \text{V}$ , $I_D = 7\ \text{mA}$ $f = 200\ \text{MHz}$ , $G_G = 2\ \text{mS}$ , $G_L = 0,5\ \text{mS}$ $f = 800\ \text{MHz}$ , $G_G = 3,3\ \text{mS}$ , $G_L = 1\ \text{mS}$	$NF$	-	1,3 2,2	-	dB dB
Control range $V_{DS} = 15\ \text{V}$ , $V_{G2S} = 4 \dots -2\ \text{V}$ , $f = 800\ \text{MHz}$	$\Delta G_{ps}$	40	-	-	dB

<sup>1)</sup> G2 and S on screen potential.

**Total power dissipation**

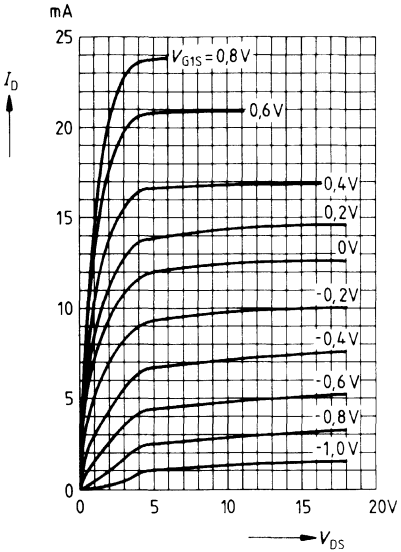
$P_{tot} = f(T_A)$



**Family of output characteristics**

$I_D = f(V_{DS})$

$V_{G2S} = 4V$



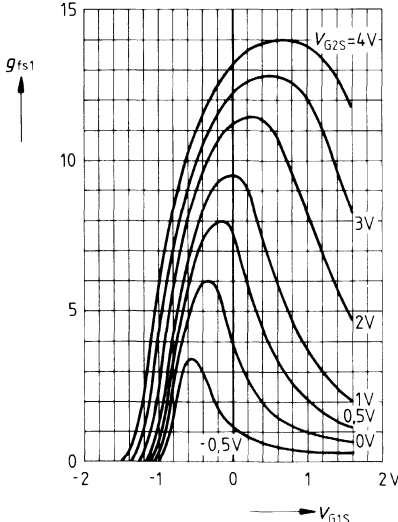
**Gate 1 forward transconductance**

$g_{fs1} = f(V_{G1S})$

$V_{DS} = 15V$

$I_{DSS} = 7mA, f = 1kHz$

mS



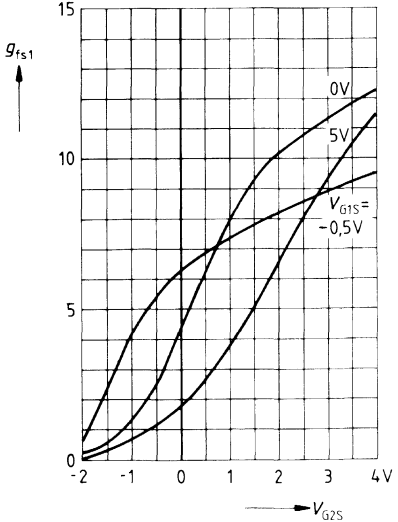
**Gate 1 forward transconductance**

$g_{fs1} = f(V_{G2S})$

$V_{DS} = 15V$

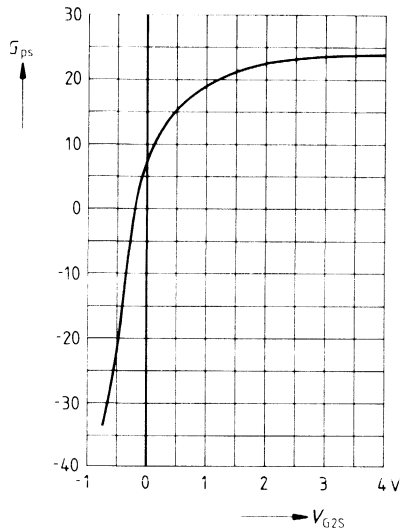
$I_{DSS} = 7mA, f = 1kHz$

mS



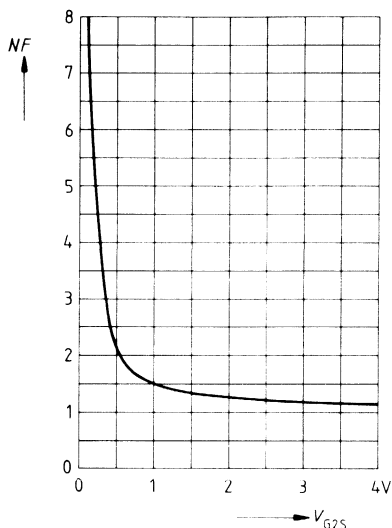
**Power gain**

$G_{ps} = f(V_{G2S})$   
 $V_{DS} = 15\text{ V}, V_{G1S} = 0\text{ V}$   
 $I_{DSS} = 7\text{ mA}, f = 200\text{ MHz}$   
 (test circuit 1)  
 dB



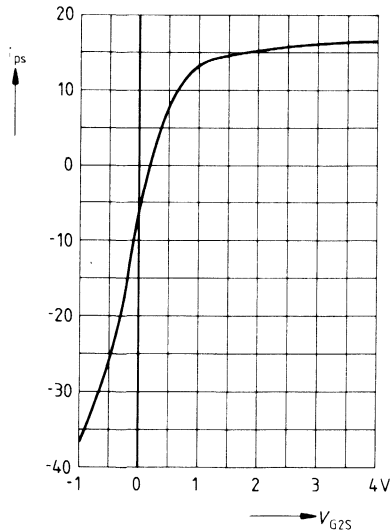
**Noise figure**

$NF = f(V_{G2S})$   
 $V_{DS} = 15\text{ V}, V_{G1S} = 0\text{ V}$   
 $I_{DSS} = 7\text{ mA}, f = 200\text{ MHz}$   
 (test circuit 1)  
 dB



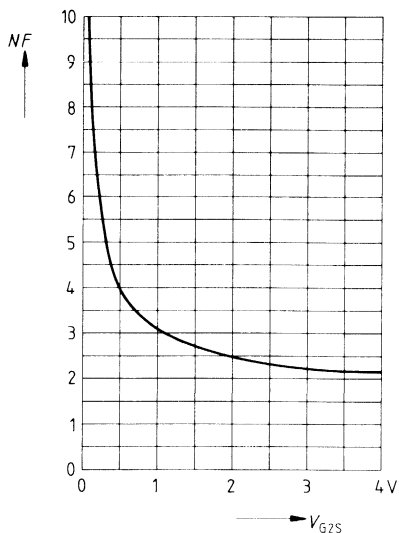
**Power gain**

$G_{ps} = f(V_{G2S})$   
 $V_{DS} = 15\text{ V}, V_{G1S} = 0\text{ V}$   
 $I_{DSS} = 7\text{ mA}, f = 800\text{ MHz}$   
 (test circuit 2)  
 dB



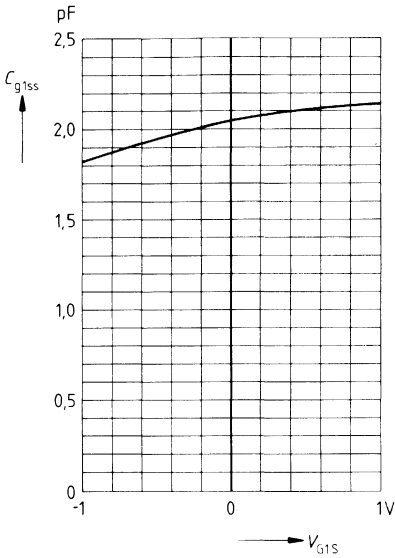
**Noise figure**

$NF = f(V_{G2S})$   
 $V_{DS} = 15\text{ V}, V_{G1S} = 0\text{ V}$   
 $I_{DSS} = 7\text{ mA}, f = 800\text{ MHz}$   
 (test circuit 2)  
 dB



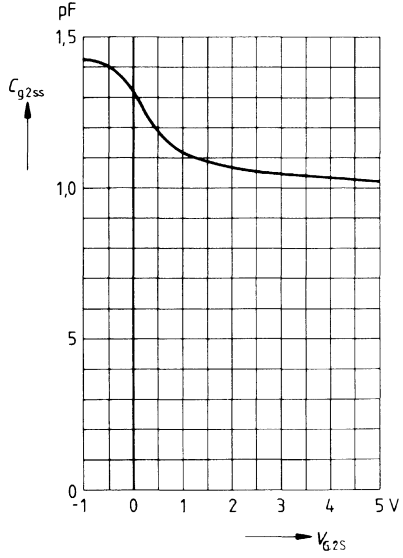
**Gate 1 input capacitance**

$C_{g1ss} = f(V_{G1S})$   
 $V_{G2S} = 4\text{ V}, V_{DS} = 15\text{ V}$   
 $I_{DSS} = 7\text{ mA}, f = 1\text{ MHz}$



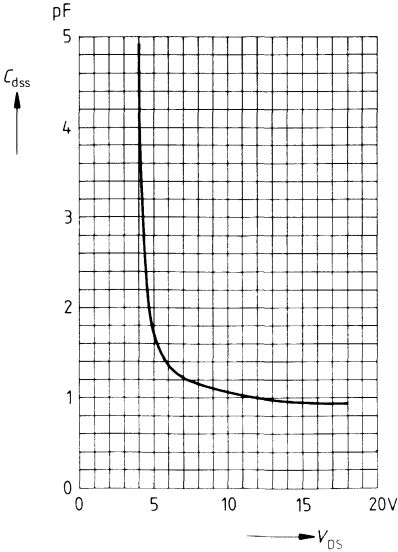
**Gate 2 input capacitance**

$C_{g2ss} = f(V_{G2S})$   
 $V_{G1S} = 0\text{ V}, V_{DS} = 15\text{ V}$   
 $I_{DSS} = 7\text{ mA}, f = 1\text{ MHz}$



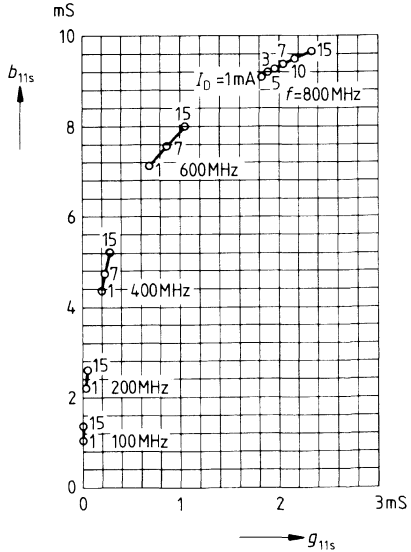
**Output capacitance**

$C_{dss} = f(V_{DS})$   
 $V_{G1S} = 0\text{ V}, V_{G2S} = 4\text{ V}$   
 $I_{DSS} = 7\text{ mA}, f = 1\text{ MHz}$



**Gate 1 input admittance  $y_{11s}$**

$V_{DS} = 15\text{ V}, V_{G2S} = 4\text{ V}$   
 (common-source)



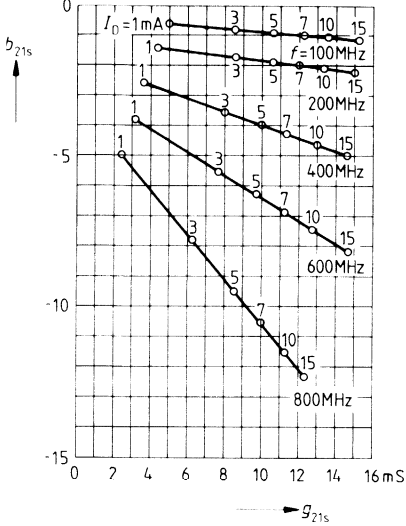


**Gate 1 forward transfer admittance  $Y_{21s}$**

$V_{DS} = 15\text{ V}$ ,  $V_{G2S} = 4\text{ V}$

(common-source)

mS

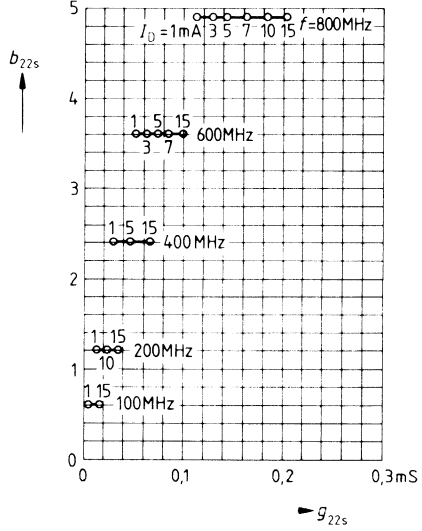


**Output admittance  $Y_{22s}$**

$V_{DS} = 15\text{ V}$ ,  $V_{G2S} = 4\text{ V}$

(common-source)

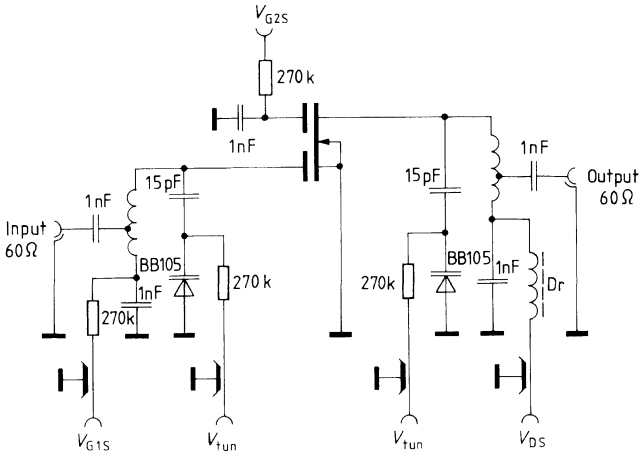
mS



**Test circuit for power gain and noise figure**

$f = 200 \text{ MHz}$ ;  $G_G = 2 \text{ mS}$ ,  $G_L = 0,5 \text{ mS}$

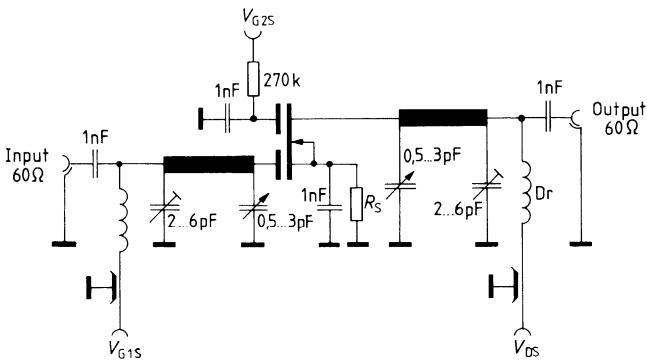
Figure 1



**Test circuit for power gain, noise figure and cross modulation**

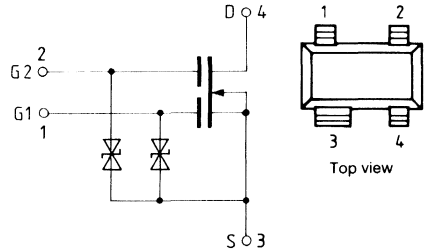
$f = 800 \text{ MHz}$ ,  $G_G = 3,3 \text{ mS}$ ,  $G_L = 1 \text{ mS}$ .

Figure 2



**Silicon dual-gate MOS field-effect tetrode**

- For FM/TV and VHF input stages



Type	Marking	Ordering code	Package
BF 993	ME	Refer to index	Version B

**Maximum ratings**

Drain-source voltage	$V_{DS}$	20 V
Drain current	$I_D$	50 mA
Gate 1/Gate 2 source peak current	$\pm I_{G1/2SM}$	10 mA
Total power dissipation $T_A = 60^\circ\text{C}$	$P_{tot}$	200 mW
Storage temperature range	$T_{stg}$	$-55 \dots +150^\circ\text{C}$
Channel temperature	$T_{ch}$	150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	$\leq 450 \text{ K/W}$
------------------------------------------------------------------------------------------------------------	------------	------------------------

## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

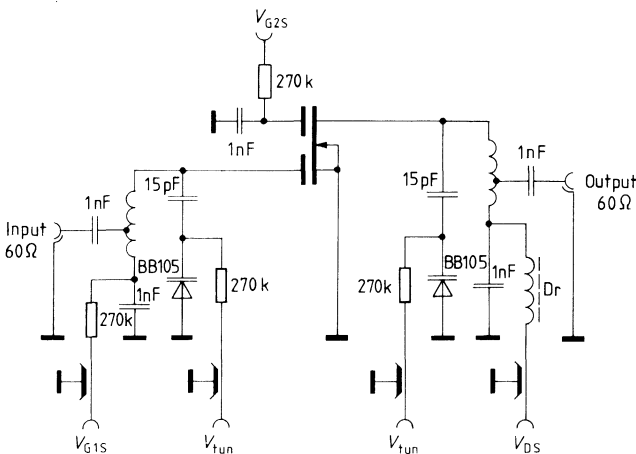
Static characteristics	Symbol	min	typ	max	Unit
Drain-source breakdown voltage $I_D = 10\ \mu\text{A}$ , $-V_{G1S} = -V_{G2S} = 4\ \text{V}$	$V_{(BR)DS}$	20	–	–	V
Gate 1 source breakdown voltage $\pm I_{G1S} = 10\ \text{mA}$ , $V_{G2S} = V_{DS} = 0$	$\pm V_{(BR)G1SS}$	6	–	–	V
Gate 2 source breakdown voltage $\pm I_{G2S} = 10\ \text{mA}$ , $V_{G1S} = V_{DS} = 0$	$\pm V_{(BR)G2SS}$	6	–	–	V
Gate 1 source leakage current $\pm V_{G1S} = 5\ \text{V}$ , $V_{G2S} = V_{DS} = 0$	$\pm I_{G1SS}$	–	–	50	nA
Gate 2 source leakage current $\pm V_{G2S} = 5\ \text{V}$ , $V_{G1S} = V_{DS} = 0$	$\pm I_{G2SS}$	–	–	50	nA
Drain current $V_{DS} = 15\ \text{V}$ , $V_{G1S} = 0$ , $V_{G2S} = 4\ \text{V}$	$I_{DSS}$	6	–	40	mA
Gate 1 source pinch-off voltage $V_{DS} = 15\ \text{V}$ , $V_{G2S} = 4\ \text{V}$ , $I_D = 20\ \mu\text{A}$	$-V_{G1S(p)}$	–	–	3,5	V
Gate 2 source pinch-off voltage $V_{DS} = 15\ \text{V}$ , $V_{G1S} = 0$ , $I_D = 20\ \mu\text{A}$	$-V_{G2S(p)}$	–	–	3,0	V

Dynamic characteristics	Symbol	min	typ	max	Unit
Forward transconductance $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ kHz}$	$g_{fs}$	16	25	–	mS
Gate 1 input capacitance $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ MHz}$	$C_{g1ss}$	–	6	–	pF
Gate 2 input capacitance $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ MHz}$	$C_{g2ss}$	–	2,5	–	pF
Reverse transfer capacitance <sup>1)</sup> $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ MHz}$	$C_{dg1}$	–	50	–	fF
Output capacitance $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ MHz}$	$C_{dss}$	–	2,5	–	pF
Power gain $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $f = 200\text{ MHz}$ , $G_G = 2\text{ mS}$ , $G_L = 0,5\text{ mS}$ $2\Delta f = 12\text{ MHz}$ (test circuit)	$G_{ps}$	–	25	–	dB
Noise figure $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ $f = 200\text{ MHz}$ , $G_G = 2\text{ mS}$ , $G_L = 0,5\text{ mS}$ (test circuit)	$NF$	–	1,5	–	dB

<sup>1)</sup> G2 and S on screen potential.

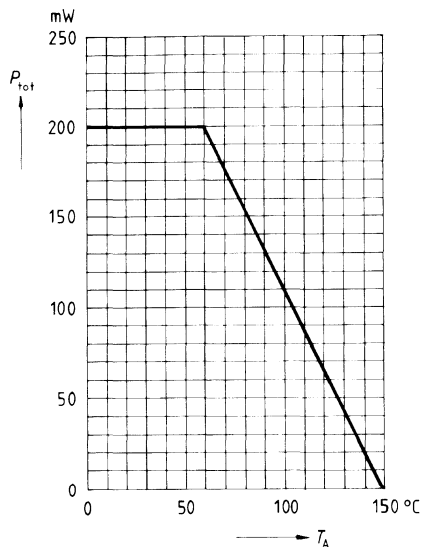
**Test circuit for power gain and noise figure**

$f = 200\text{ MHz}$ ;  $G_G = 2\text{ mS}$ ,  $G_L = 0,5\text{ mS}$



**Total power dissipation**

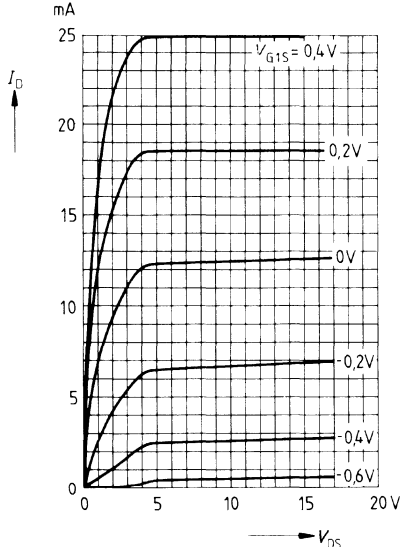
$P_{tot} = f(T_A)$



**Family of output characteristics**

$I_D = f(V_{DS})$

$V_{G2S} = 4\text{ V}$



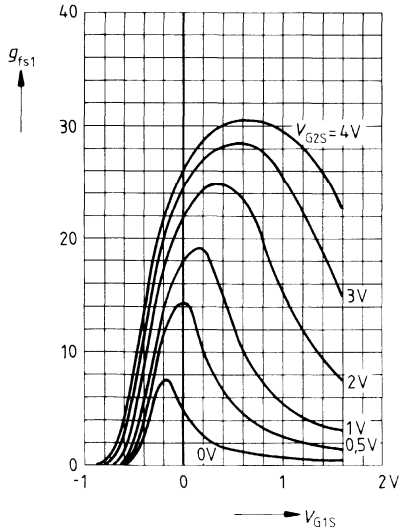
**Gate 1 forward transconductance**

$g_{fs1} = f(V_{G1S})$

$V_{DS} = 15\text{ V}$

$I_{DSS} = 10\text{ mA}, f = 1\text{ kHz}$

mS



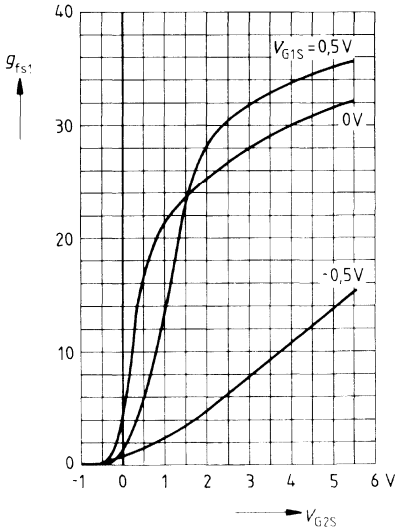
**Gate 1 forward transconductance**

$g_{fs1} = f(V_{G2S})$

$V_{DS} = 15\text{ V}$

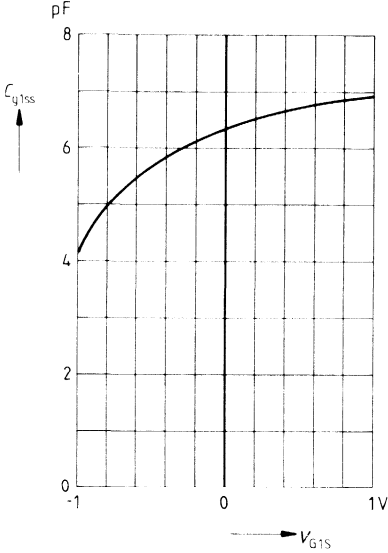
$I_{DSS} = 10\text{ mA}, f = 1\text{ kHz}$

mS



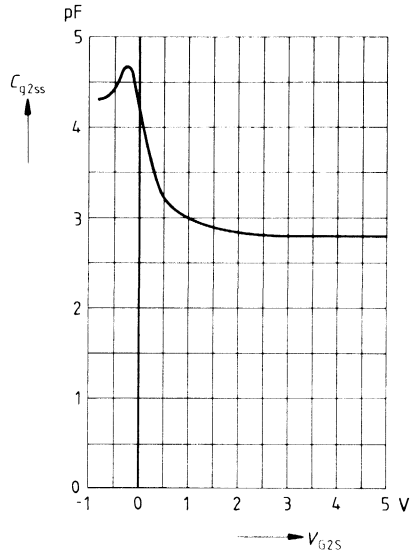
**Gate 1 input capacitance**

$C_{g1ss} = f(V_{G1S})$   
 $V_{G2S} = 4\text{ V}, V_{DS} = 15\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 1\text{ MHz}$



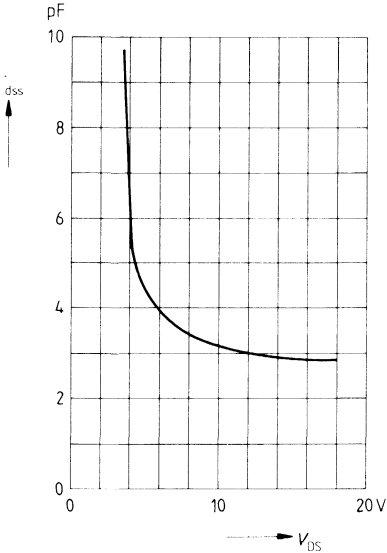
**Gate 2 input capacitance**

$C_{g2ss} = f(V_{G2S})$   
 $V_{G1S} = 0\text{ V}, V_{DS} = 15\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 1\text{ MHz}$



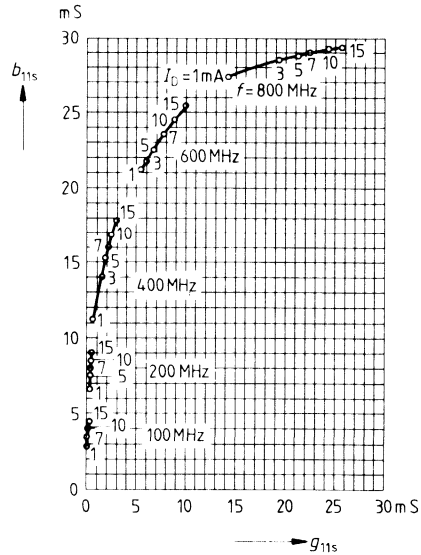
**Output capacitance**

$C_{dss} = f(V_{DS})$   
 $V_{G1S} = 0\text{ V}, V_{G2S} = 4\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 1\text{ MHz}$



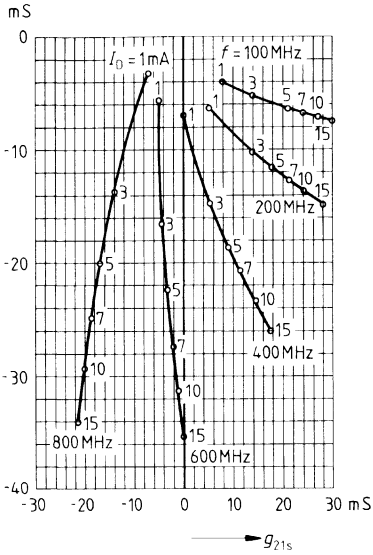
**Gate 1 input admittance  $y_{11s}$**

$V_{DS} = 15\text{ V}, V_{G2S} = 4\text{ V}$   
 (common-source)



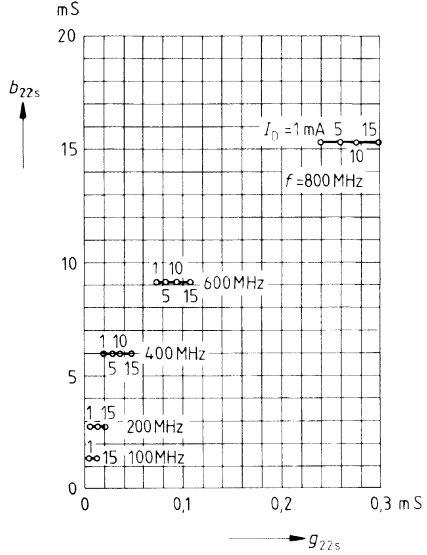
**Gate 1 forward transfer admittance  $Y_{21s}$**

$V_{DS} = 15\text{ V}$ ,  $V_{G2s} = 4\text{ V}$   
(common-source)



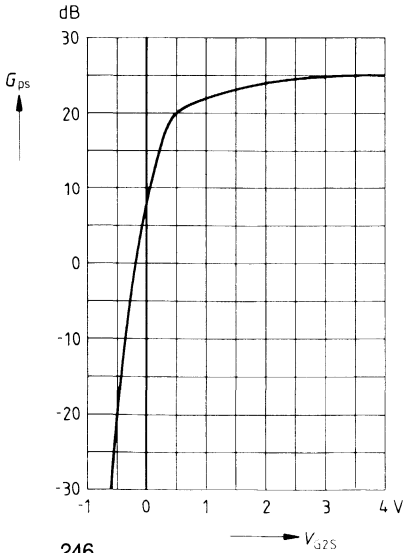
**Output admittance  $Y_{22s}$**

$V_{DS} = 15\text{ V}$ ,  $V_{G2s} = 4\text{ V}$   
(common-source)



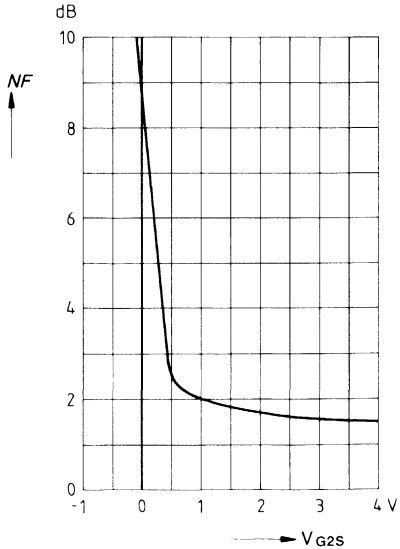
**Power gain**

$G_{ps} = f(V_{G2s})$   
 $V_{DS} = 15\text{ V}$ ,  $V_{G1s} = 0\text{ V}$   
 $I_{DSS} = 10\text{ mA}$ ,  $f = 200\text{ MHz}$   
(test circuit)



**Noise figure**

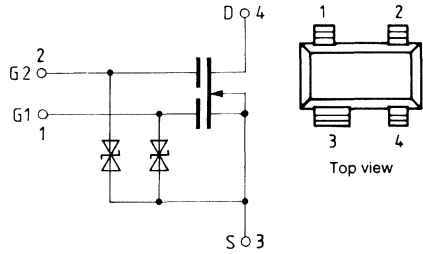
$NF = f(V_{G2s})$   
 $V_{DS} = 15\text{ V}$ ,  $V_{G1s} = 0\text{ V}$   
 $I_{DSS} = 10\text{ mA}$ ,  $f = 200\text{ MHz}$   
(test circuit)





**Silicon dual-gate MOS field-effect tetrode**

- For use in VHF input and mixer stages featuring a wide tuning range (CATV tuners)



Type	Marking	Ordering code	Package
BF 994	MC	Refer to index	Version B

**Maximum ratings**

Drain-source voltage	$V_{DS}$	20 V
Drain current	$I_D$	30 mA
Gate 1/Gate 2 source peak current	$\pm I_{G1/2SM}$	10 mA
Total power dissipation $T_A = 60^\circ\text{C}$	$P_{tot}$	200 mW
Storage temperature range	$T_{stg}$	$-55 \dots +150^\circ\text{C}$
Channel temperature	$T_{ch}$	$150^\circ\text{C}$

<b>Thermal resistance</b> junction-ambient package mounted on alumina $15\text{ mm} \times 16.7\text{ mm} \times 0.7\text{ mm}$	$R_{thJA}$	$\leq 450\text{ K/W}$
---------------------------------------------------------------------------------------------------------------------------------------------	------------	-----------------------

## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

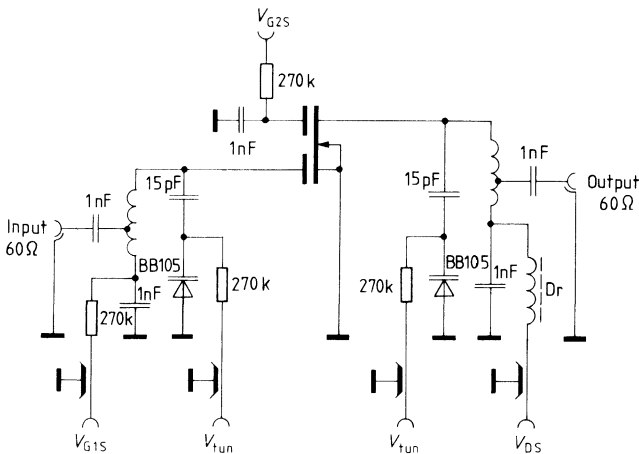
Static characteristics	Symbol	min	typ	max	Unit
Drain-source breakdown voltage $I_D = 10\ \mu\text{A}$ , $-V_{G1S} = -V_{G2S} = 4\ \text{V}$	$V_{(BR)DS}$	20	–	–	V
Gate 1 source breakdown voltage $\pm I_{G1S} = 10\ \text{mA}$ , $V_{G2S} = V_{DS} = 0$	$\pm V_{(BR)G1SS}$	6	–	20	V
Gate 2 source breakdown voltage $\pm I_{G2S} = 10\ \text{mA}$ , $V_{G1S} = V_{DS} = 0$	$\pm V_{(BR)G2SS}$	6	–	20	V
Gate 1 source leakage current $\pm V_{G1S} = 5\ \text{V}$ , $V_{G2S} = V_{DS} = 0$	$\pm I_{G1SS}$	–	–	50	nA
Gate 2 source leakage current $\pm V_{G2S} = 5\ \text{V}$ , $V_{G1S} = V_{DS} = 0$	$\pm I_{G2SS}$	–	–	50	nA
Drain current $V_{DS} = 15\ \text{V}$ , $V_{G1S} = 0$ , $V_{G2S} = 4\ \text{V}$	$I_{DSS}$	2	–	20	mA
Gate 1 source pinch-off voltage $V_{DS} = 15\ \text{V}$ , $V_{G2S} = 4\ \text{V}$ , $I_D = 20\ \mu\text{A}$	$-V_{G1S(p)}$	–	–	2,5	V
Gate 2 source pinch-off voltage $V_{DS} = 15\ \text{V}$ , $V_{G1S} = 0$ , $I_D = 20\ \mu\text{A}$	$-V_{G2S(p)}$	–	–	2,0	V

Dynamic characteristics	Symbol	min	typ	max	Unit
Forward transconductance $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ kHz}$	$g_{fs}$	15	17	–	mS
Gate 1 input capacitance $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ MHz}$	$C_{g1ss}$	–	2,5	3	pF
Gate 2 input capacitance $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ MHz}$	$C_{g2ss}$	–	1,2	–	pF
Reverse transfer capacitance <sup>1)</sup> $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ MHz}$	$C_{dg1}$	–	25	–	fF
Output capacitance $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ MHz}$	$C_{dss}$	–	1	1,3	pF
Power gain $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $f = 200\text{ MHz}$ , $G_G = 2\text{ mS}$ , $G_L = 0,5\text{ mS}$ (test circuit)	$G_{ps}$	–	25	–	dB
Noise figure $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $f = 200\text{ MHz}$ , $G_G = 2\text{ mS}$ , $G_L = 0,5\text{ mS}$ (test circuit)	$NF$	–	1,5	2,8	dB
Control range $V_{DS} = 15\text{ V}$ , $V_{G2S} = 4 \dots -2\text{ V}$ , $f = 200\text{ MHz}$	$\Delta G_{ps}$	50	–	–	dB

<sup>1)</sup> G2 and S on screen potential.

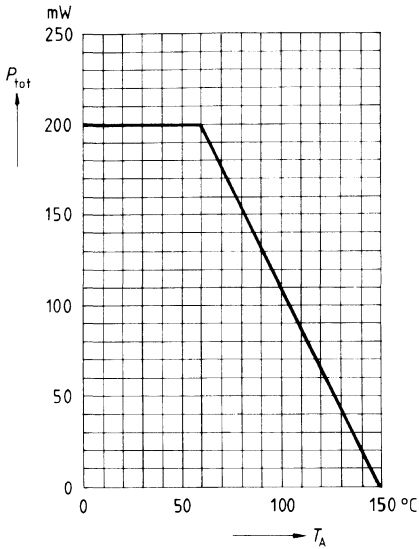
**Test circuit for power gain and noise figure**

$f = 200\text{ MHz}$ ;  $G_G = 2\text{ mS}$ ,  $G_L = 0,5\text{ mS}$



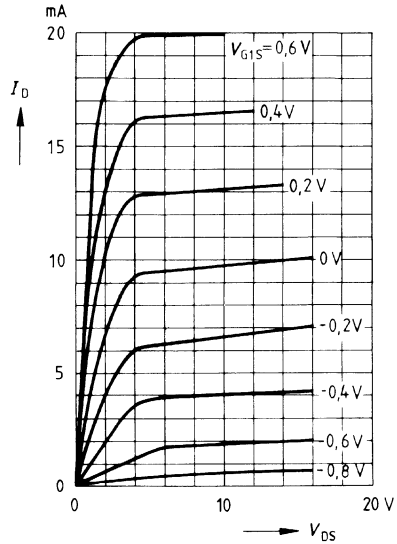
**Total power dissipation**

$P_{tot} = f(T_A)$



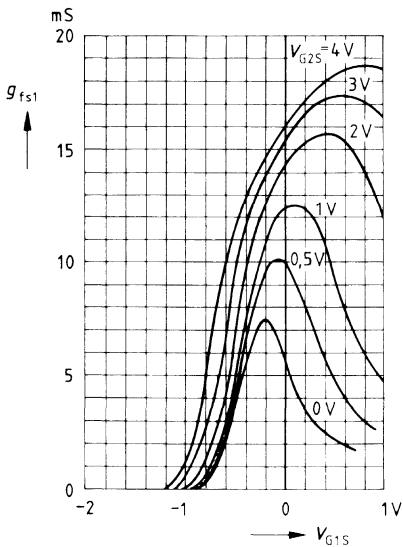
**Family of output characteristics**

$I_D = f(V_{DS})$   
 $V_{G2S} = 4\text{ V}$



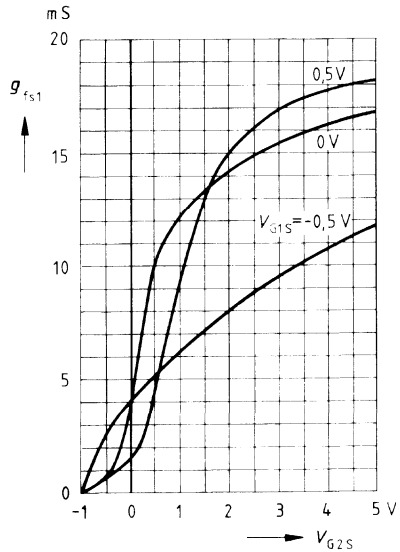
**Gate 1 forward transconductance**

$g_{fs1} = f(V_{G1S})$   
 $V_{DS} = 15\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 1\text{ kHz}$



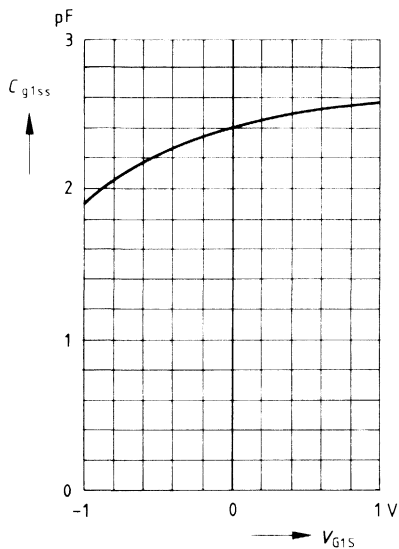
**Gate 1 forward transconductance**

$g_{fs1} = f(V_{G2S})$   
 $V_{DS} = 15\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 1\text{ kHz}$



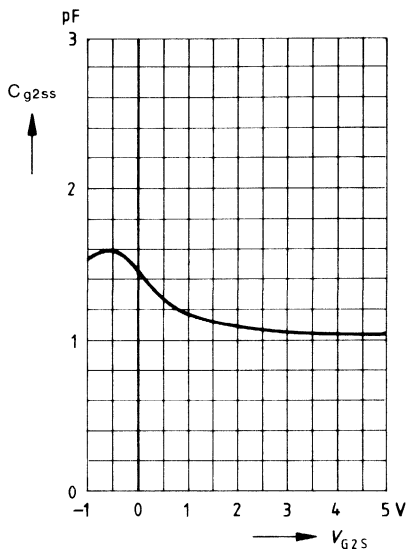
**Gate 1 input capacitance**

$C_{g1ss} = f(V_{G1S})$   
 $V_{G2S} = 4\text{ V}, V_{DS} = 15\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 1\text{ MHz}$



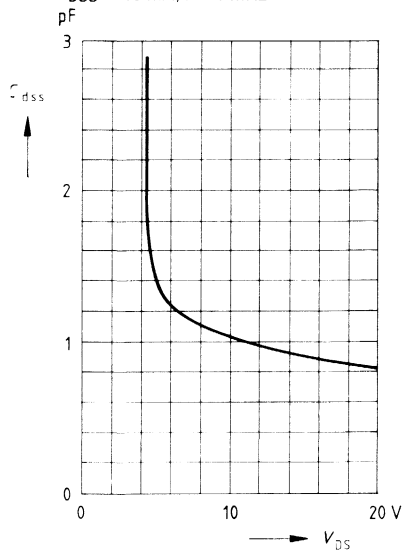
**Gate 2 input capacitance**

$C_{g2ss} = f(V_{G2S})$   
 $V_{G1S} = 0\text{ V}, V_{DS} = 15\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 1\text{ MHz}$



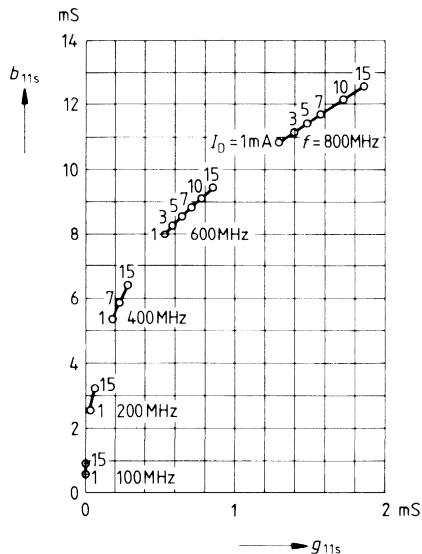
**Output capacitance**

$C_{dss} = f(V_{DS})$   
 $V_{G1S} = 0\text{ V}, V_{G2S} = 4\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 1\text{ MHz}$



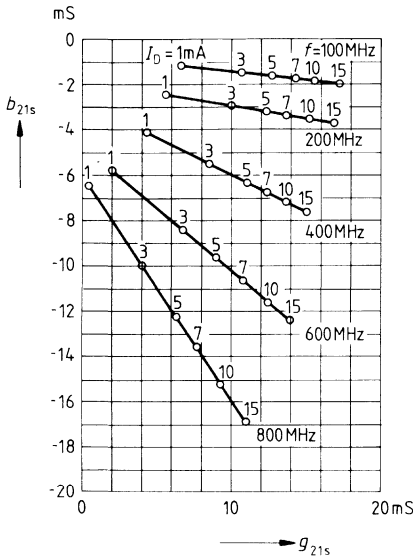
**Gate 1 input admittance  $y_{11s}$**

$V_{DS} = 15\text{ V}, V_{G2S} = 4\text{ V}$   
 (common-source)



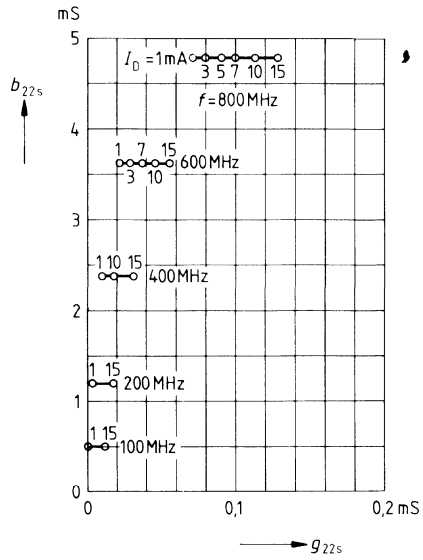
**Gate 1 forward transfer admittance  $Y_{21s}$**

$V_{DS} = 15\text{ V}$ ,  $V_{G2S} = 4\text{ V}$   
(common-source)



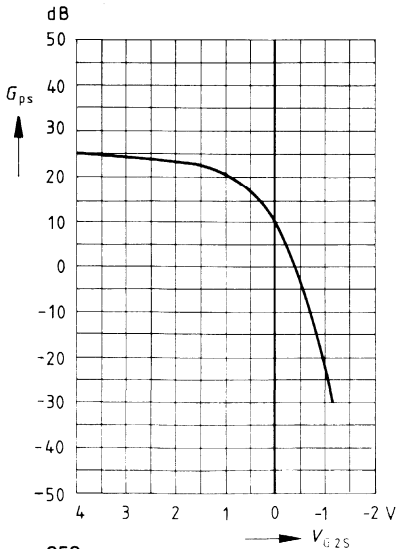
**Output admittance  $Y_{22s}$**

$V_{DS} = 15\text{ V}$ ,  $V_{G2S} = 4\text{ V}$   
(common-source)



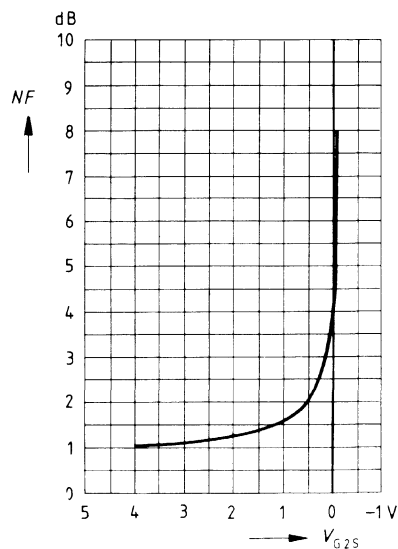
**Power gain**

$G_{ps} = f(V_{G2S})$   
 $V_{DS} = 15\text{ V}$ ,  $V_{G1S} = 0\text{ V}$   
 $I_{DSS} = 10\text{ mA}$ ,  $f = 200\text{ MHz}$   
(test circuit)



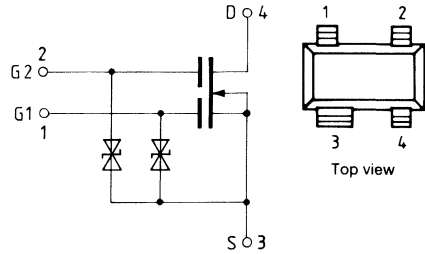
**Noise figure**

$NF = f(V_{G2S})$   
 $V_{DS} = 15\text{ V}$ ,  $V_{G1S} = 0\text{ V}$   
 $I_{DSS} = 10\text{ mA}$ ,  $f = 200\text{ MHz}$   
(test circuit)



**Silicon dual-gate MOS field-effect tetrode**

- For use in VHF input and mixer stages featuring a wide tuning range (CATV tuners)



Type	Marking	Ordering code	Package
BF 994 S	MG	Refer to index	Version B

**Maximum ratings**

Drain-source voltage	$V_{DS}$	20 V
Drain current	$I_D$	30 mA
Gate 1/Gate 2 source peak current	$\pm I_{G1/2SM}$	10 mA
Total power dissipation $T_A = 60^\circ\text{C}$	$P_{tot}$	200 mW
Storage temperature range	$T_{stg}$	$-55 \dots +150^\circ\text{C}$
Channel temperature	$T_{ch}$	150 °C

**Thermal resistance**

junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	$\leq 450 \text{ K/W}$
-------------------------------------------------------------------------------	------------	------------------------

## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Drain-source breakdown voltage $I_D = 10\ \mu\text{A}$ , $-V_{G1S} = -V_{G2S} = 4\ \text{V}$	$V_{(\text{BR})\text{DS}}$	20	-	-	V
Gate 1 source breakdown voltage $\pm I_{G1S} = 10\ \text{mA}$ , $V_{G2S} = V_{DS} = 0$	$\pm V_{(\text{BR})\text{G1SS}}$	6	-	20	V
Gate 2 source breakdown voltage $\pm I_{G2S} = 10\ \text{mA}$ , $V_{G1S} = V_{DS} = 0$	$\pm V_{(\text{BR})\text{G2SS}}$	6	-	20	V
Gate 1 source leakage current $\pm V_{G1S} = 5\ \text{V}$ , $V_{G2S} = V_{DS} = 0$	$\pm I_{G1SS}$	-	-	50	nA
Gate 2 source leakage current $\pm V_{G2S} = 5\ \text{V}$ , $V_{G1S} = V_{DS} = 0$	$\pm I_{G2SS}$	-	-	50	nA
Drain current $V_{DS} = 15\ \text{V}$ , $V_{G1S} = 0$ , $V_{G2S} = 4\ \text{V}$	$I_{DSS}$	2	-	20	mA
Gate 1 source pinch-off voltage $V_{DS} = 15\ \text{V}$ , $V_{G2S} = 4\ \text{V}$ , $I_D = 20\ \mu\text{A}$	$-V_{G1S(p)}$	-	-	2,5	V
Gate 2 source pinch-off voltage $V_{DS} = 15\ \text{V}$ , $V_{G1S} = 0$ , $I_D = 20\ \mu\text{A}$	$-V_{G2S(p)}$	-	-	2,0	V

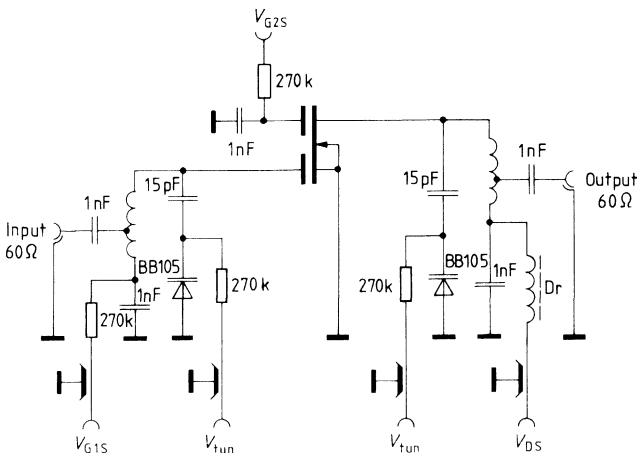


Dynamic characteristics	Symbol	min	typ	max	Unit
Forward transconductance $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ kHz}$	$g_{fs}$	15	18	–	mS
Gate 1 input capacitance $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ MHz}$	$C_{g1ss}$	–	2,5	–	pF
Gate 2 input capacitance $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ MHz}$	$C_{g2ss}$	–	1,2	–	pF
Reverse transfer capacitance <sup>1)</sup> $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ MHz}$	$C_{dg1}$	–	25	–	fF
Output capacitance $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ MHz}$	$C_{dss}$	–	1	–	pF
Power gain $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $f = 200\text{ MHz}$ , $G_G = 2\text{ mS}$ , $G_L = 0,5\text{ mS}$ (test circuit)	$G_{ps}$	–	25	–	dB
Noise figure $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $f = 200\text{ MHz}$ , $G_G = 2\text{ mS}$ , $G_L = 0,5\text{ mS}$ (test circuit)	$NF$	–	1	–	dB
Control range $V_{DS} = 15\text{ V}$ , $V_{G2S} = 4 \dots -2\text{ V}$ , $f = 200\text{ MHz}$	$\Delta G_{ps}$	50	–	–	dB

<sup>1)</sup> G2 and S on screen potential.

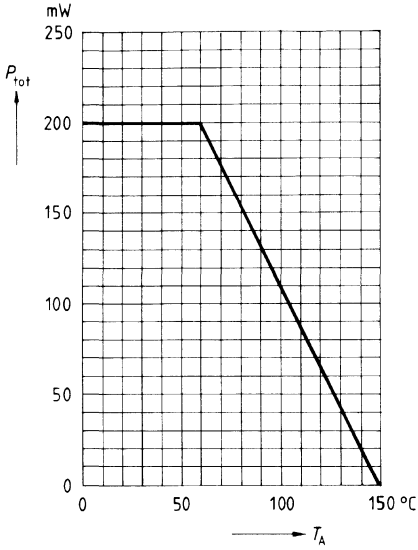
**Test circuit for power gain and noise figure**

$f = 200\text{ MHz}$ ;  $G_G = 2\text{ mS}$ ,  $G_L = 0,5\text{ mS}$



**Total power dissipation**

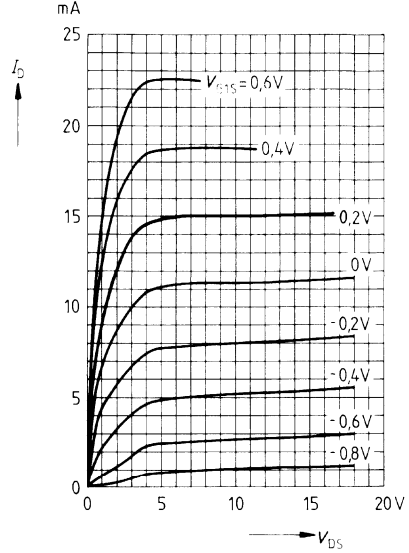
$P_{tot} = f(T_A)$



**Family of output characteristics**

$I_D = f(V_{DS})$

$V_{G2S} = 4\text{ V}$



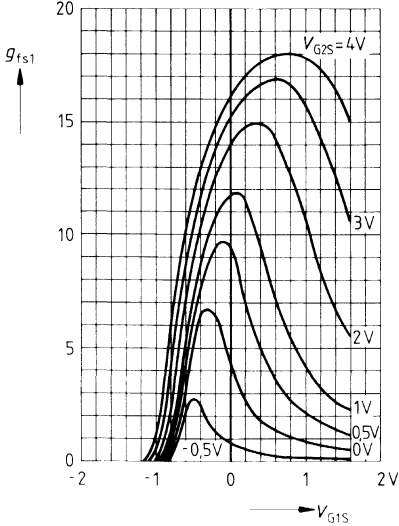
**Gate 1 forward transconductance**

$g_{fs1} = f(V_{G1S})$

$V_{DS} = 15\text{ V}$

$I_{DSS} = 10\text{ mA}, f = 1\text{ kHz}$

mS



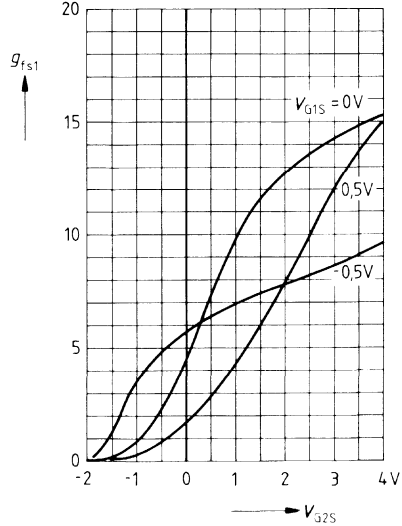
**Gate 1 forward transconductance**

$g_{fs1} = f(V_{G2S})$

$V_{DS} = 15\text{ V}$

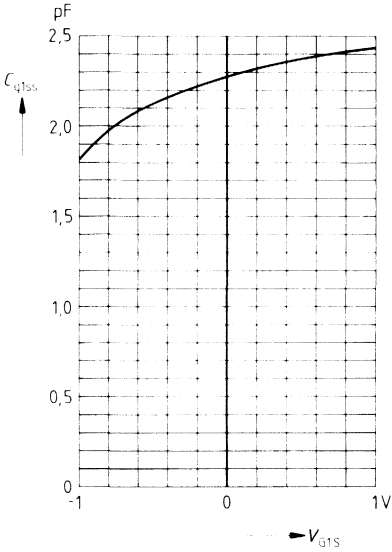
$I_{DSS} = 10\text{ mA}, f = 1\text{ kHz}$

mS



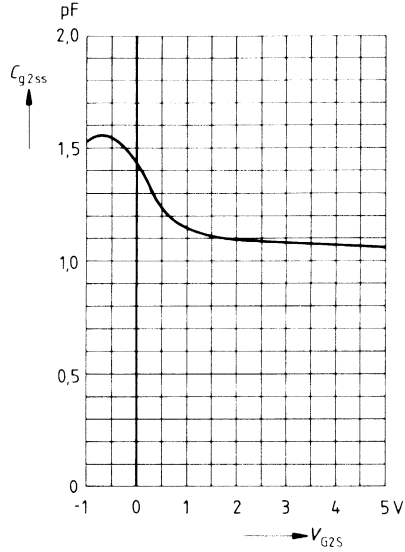
**Gate 1 input capacitance**

$C_{g1ss} = f(V_{G1S})$   
 $V_{G2S} = 4\text{ V}, V_{DS} = 15\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 1\text{ MHz}$



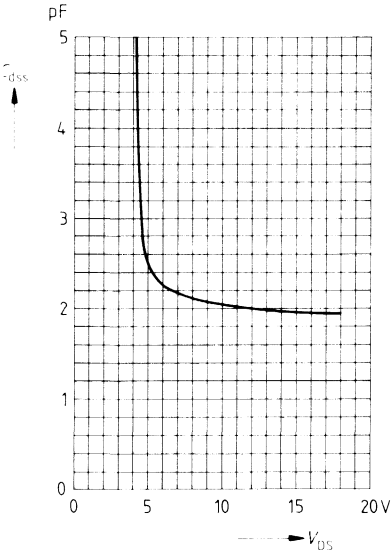
**Gate 2 input capacitance**

$C_{g2ss} = f(V_{G2S})$   
 $V_{G1S} = 0\text{ V}, V_{DS} = 15\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 1\text{ MHz}$



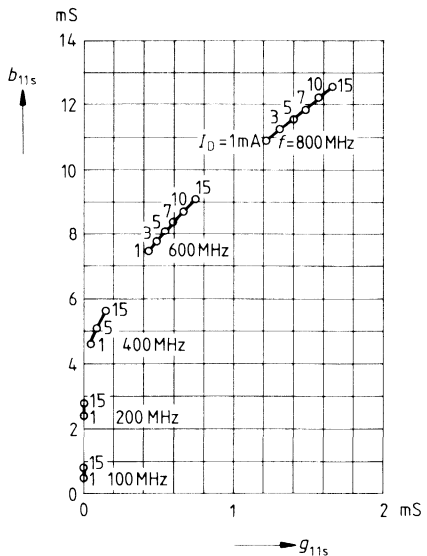
**Output capacitance**

$C_{dss} = f(V_{DS})$   
 $V_{G1S} = 0\text{ V}, V_{G2S} = 4\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 1\text{ MHz}$



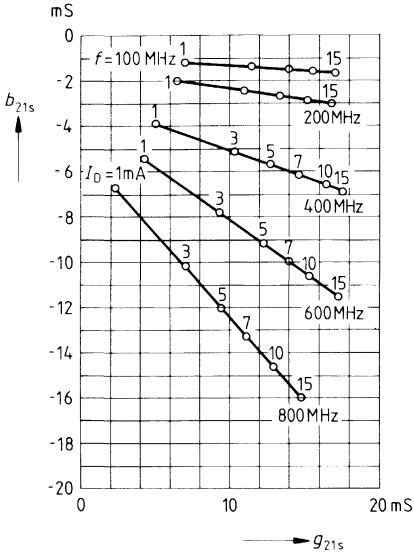
**Gate 1 input admittance  $y_{11s}$**

$V_{DS} = 15\text{ V}, V_{G2S} = 4\text{ V}$   
 (common-source)



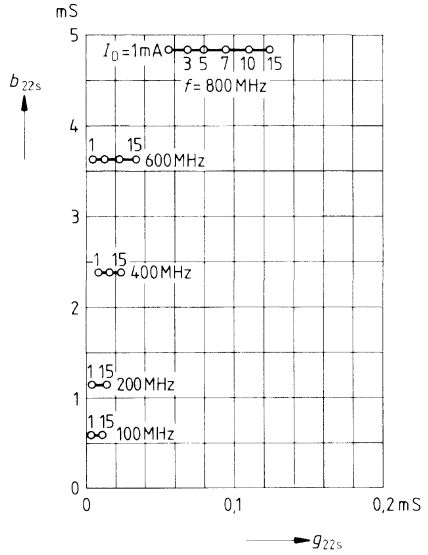
**Gate 1 forward transfer admittance  $Y_{21s}$**

$V_{DS} = 15\text{ V}$ ,  $V_{G2S} = 4\text{ V}$   
(common-source)



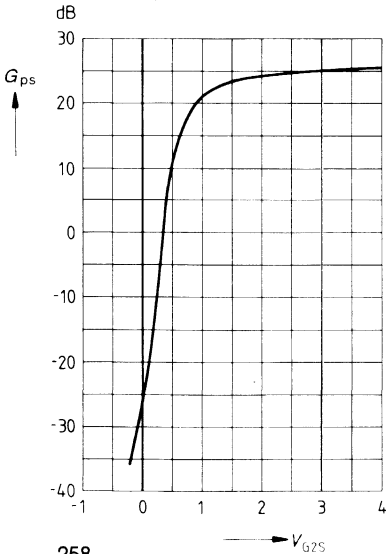
**Output admittance  $Y_{22s}$**

$V_{DS} = 15\text{ V}$ ,  $V_{G2S} = 4\text{ V}$   
(common-source)



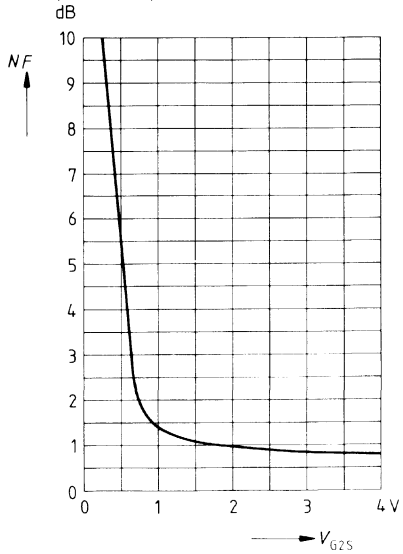
**Power gain**

$G_{ps} = f(V_{G2S})$   
 $V_{DS} = 15\text{ V}$ ,  $V_{G1S} = 0\text{ V}$   
 $I_{DSS} = 10\text{ mA}$ ,  $f = 200\text{ MHz}$   
(test circuit)



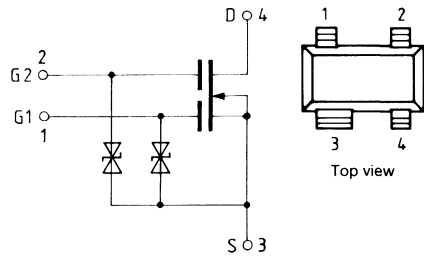
**Noise figure**

$NF = f(V_{G2S})$   
 $V_{DS} = 15\text{ V}$ ,  $V_{G1S} = 0\text{ V}$   
 $I_{DSS} = 10\text{ mA}$ ,  $f = 200\text{ MHz}$   
(test circuit)



**Silicon dual-gate MOS field-effect tetrode**

- For FM and VHF input and mixer stages



Type	Marking	Ordering code	Package
BF 995	MB	Refer to index	Version B

**Maximum ratings**

Drain-source voltage	$V_{DS}$	20 V
Drain current	$I_D$	30 mA
Gate 1/Gate 2 source peak current	$\pm I_{G1/2SM}$	10 mA
Total power dissipation $T_A = 60^\circ\text{C}$	$P_{tot}$	200 mW
Storage temperature range	$T_{stg}$	$-55 \dots +150^\circ\text{C}$
Channel temperature	$T_{ch}$	$150^\circ\text{C}$

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	$\leq 450 \text{ K/W}$
------------------------------------------------------------------------------------------------------------	------------	------------------------

## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

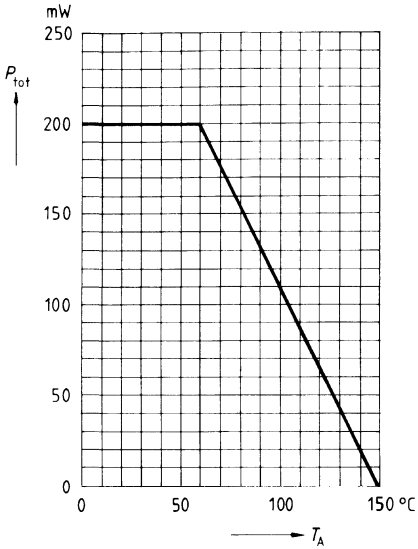
Static characteristics	Symbol	min	typ	max	Unit
Drain-source breakdown voltage $I_D = 10\ \mu\text{A}$ , $-V_{G1S} = -V_{G2S} = 4\ \text{V}$	$V_{(\text{BR})\text{DS}}$	20	–	–	V
Gate 1 source breakdown voltage $\pm I_{G1S} = 10\ \text{mA}$ , $V_{G2S} = V_{DS} = 0$	$\pm V_{(\text{BR})\text{G1SS}}$	6	–	20	V
Gate 2 source breakdown voltage $\pm I_{G2S} = 10\ \text{mA}$ , $V_{G1S} = V_{DS} = 0$	$\pm V_{(\text{BR})\text{G2SS}}$	6	–	20	V
Gate 1 source leakage current $\pm V_{G1S} = 5\ \text{V}$ , $V_{G2S} = V_{DS} = 0$	$\pm I_{G1SS}$	–	–	50	nA
Gate 2 source leakage current $\pm V_{G2S} = 5\ \text{V}$ , $V_{G1S} = V_{DS} = 0$	$\pm I_{G2SS}$	–	–	50	nA
Drain current $V_{DS} = 15\ \text{V}$ , $V_{G1S} = 0$ , $V_{G2S} = 4\ \text{V}$	$I_{\text{DSS}}$	4	–	20	mA
Gate 1 source pinch-off voltage $V_{DS} = 15\ \text{V}$ , $V_{G2S} = 4\ \text{V}$ , $I_D = 20\ \mu\text{A}$	$-V_{G1S(p)}$	–	–	3,5	V
Gate 2 source pinch-off voltage $V_{DS} = 15\ \text{V}$ , $V_{G1S} = 0$ , $I_D = 20\ \mu\text{A}$	$-V_{G2S(p)}$	–	–	3,5	V

Dynamic characteristics	Symbol	min	typ	max	Unit
Forward transconductance $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ kHz}$	$g_{fs}$	12	17	–	mS
Gate 1 input capacitance $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ MHz}$	$C_{g1ss}$	3	3,6	4,5	pF
Gate 2 input capacitance $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ MHz}$	$C_{g2ss}$	–	1,6	–	pF
Reverse transfer capacitance <sup>1)</sup> $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ MHz}$	$C_{dg1}$	–	25	–	fF
Output capacitance $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ MHz}$	$C_{dss}$	1,2	1,6	2,2	pF
Power gain $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $f = 200\text{ MHz}$ , $G_G = 2\text{ mS}$ , $G_L = 0,5\text{ mS}$ $2\Delta f = 12\text{ MHz}$	$G_{ps}$	19	23	–	dB
Noise figure $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ $f = 200\text{ MHz}$ , $G_G = 2\text{ mS}$ , $G_L = 0,5\text{ mS}$ (test circuit 1)	$NF$	–	1,8	2,8	dB
Control range $V_{DS} = 15\text{ V}$ , $V_{G2S} = 4 \dots -2\text{ V}$ , $f = 200\text{ MHz}$ (test circuit 1)	$\Delta G_{ps}$	–	50	–	dB
Mixer gain (additive) $V_{DS} = 15\text{ V}$ , $V_{G2S} = 6\text{ V}$ , $R_S = 220\ \Omega$ $f = 200\text{ MHz}$ , $f_{IF} = 36\text{ MHz}$ $2\Delta f_{IF} = 5\text{ MHz}$ , $V_{OSC} = 0,5\text{ V}$ (test circuit 2)	$G_{psc}$	–	16	–	dB
Mixer gain (multiplicative) $V_{DS} = 15\text{ V}$ , $V_{G1S} = 1,7\text{ V}$ , $V_{G2S} = 2,5\text{ V}$ $R_S = 220\ \Omega$ , $f = 200\text{ MHz}$ , $f_{IF} = 36\text{ MHz}$ $2\Delta f_{IF} = 5\text{ MHz}$ , $V_{OSC} = 2\text{ V}$ (test circuit 3)	$G_{Fsc}$	–	18	–	dB

<sup>1)</sup> G2 and S on screen potential.

**Total power dissipation**

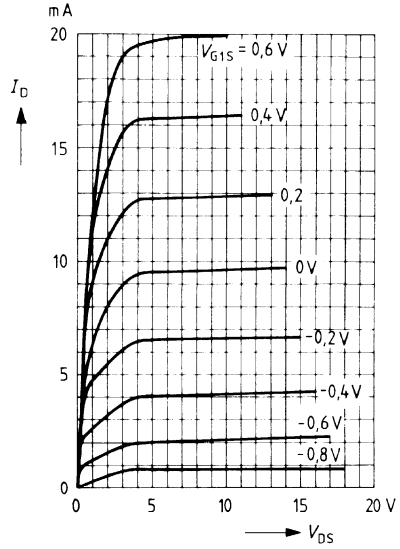
$P_{tot} = f(T_A)$



**Family of output characteristics**

$I_D = f(V_{DS})$

$V_{G2S} = 4 \text{ V}$



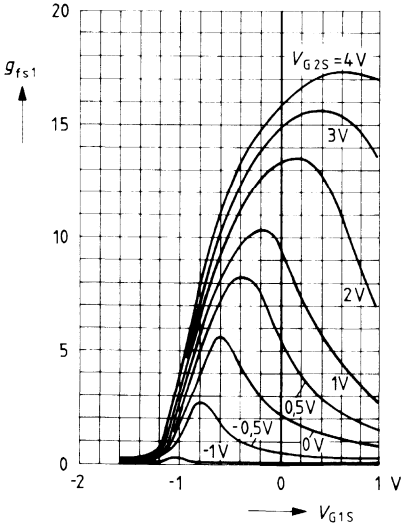
**Gate 1 forward transconductance**

$g_{fs1} = f(V_{G1S})$

$V_{DS} = 15 \text{ V}$

$I_{DSS} = 10 \text{ mA}, f = 1 \text{ kHz}$

mS



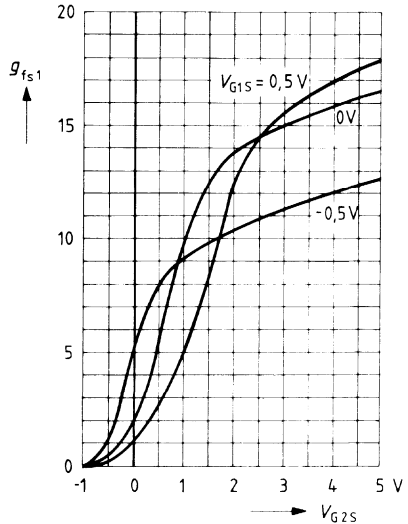
**Gate 1 forward transconductance**

$g_{fs1} = f(V_{G2S})$

$V_{DS} = 15 \text{ V}$

$I_{DSS} = 10 \text{ mA}, f = 1 \text{ kHz}$

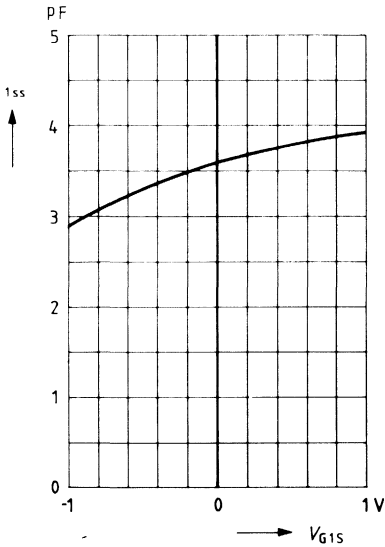
mS





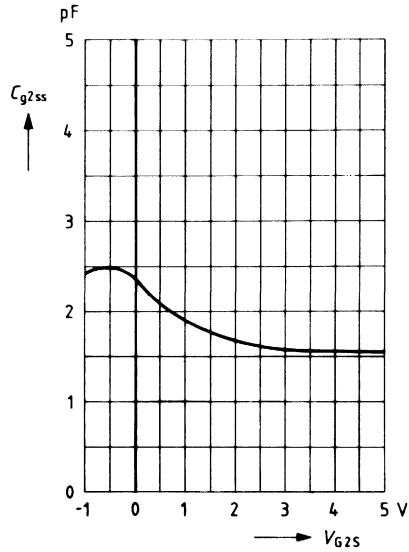
**Gate 1 input capacitance**

$C_{g1ss} = f(V_{G1S})$   
 $V_{G2S} = 4\text{ V}, V_{DS} = 15\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 1\text{ MHz}$



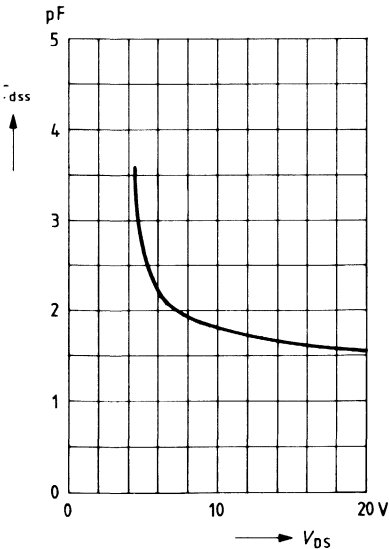
**Gate 2 input capacitance**

$C_{g2ss} = f(V_{G2S})$   
 $V_{G1S} = 0\text{ V}, V_{DS} = 15\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 1\text{ MHz}$



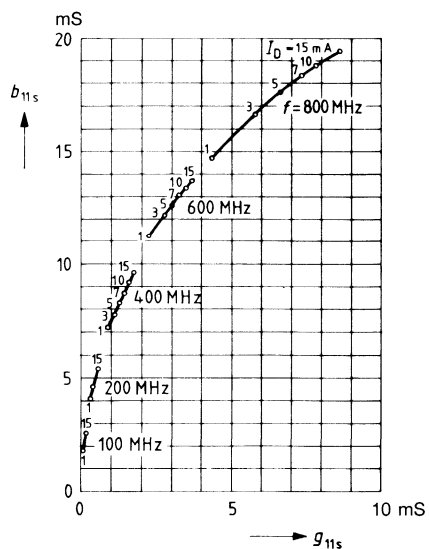
**Output capacitance**

$C_{dss} = f(V_{DS})$   
 $V_{G1S} = 0\text{ V}, V_{G2S} = 4\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 1\text{ MHz}$



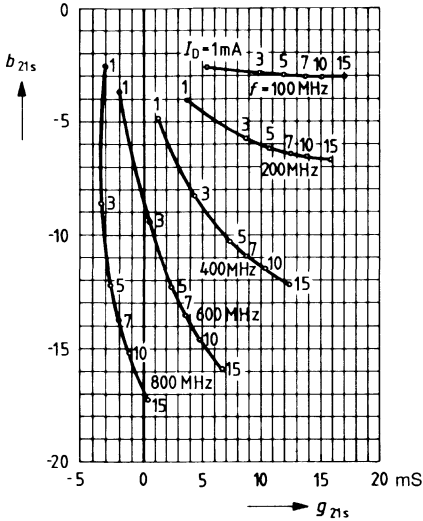
**Gate 1 input admittance  $Y_{11s}$**

$V_{DS} = 15\text{ V}, V_{G2S} = 4\text{ V}, I_{DS} = 10\text{ mA}$   
 (common-source circuit)



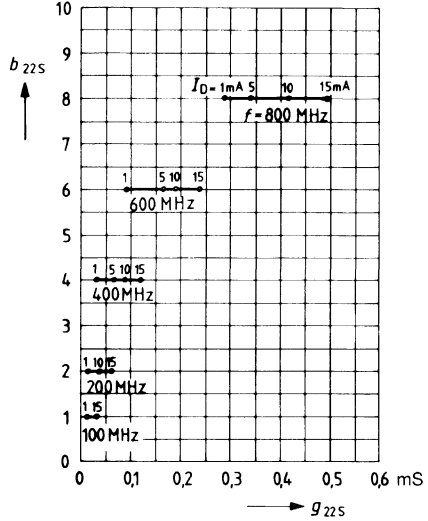
**Gate 1 forward transfer admittance  $Y_{21s}$**

$V_{DS} = 15\text{ V}$ ,  $V_{G2S} = 4\text{ V}$ ;  $I_{DS} = 10\text{ mA}$   
(common-source)  
mS



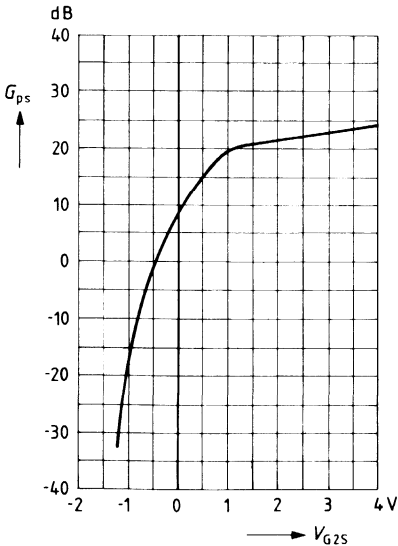
**Output admittance  $Y_{22s}$**

$V_{DS} = 15\text{ V}$ ,  $V_{G2S} = 4\text{ V}$ ;  $I_{DS} = 10\text{ mA}$   
(common-source)  
mS



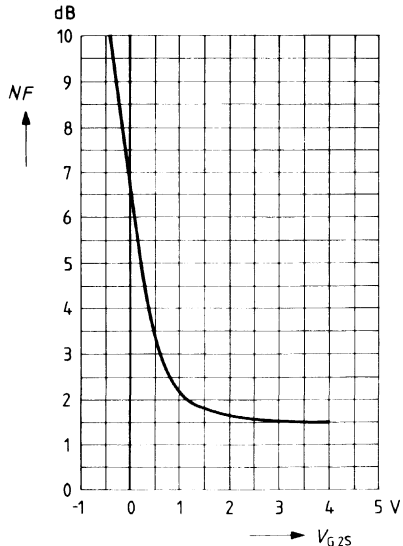
**Power gain**

$G_{ps} = f(V_{G2S})$   
 $V_{DS} = 15\text{ V}$ ,  $V_{G1S} = 0\text{ V}$   
 $I_{DSS} = 10\text{ mA}$ ,  $f = 200\text{ MHz}$   
(test circuit 1)  
dB



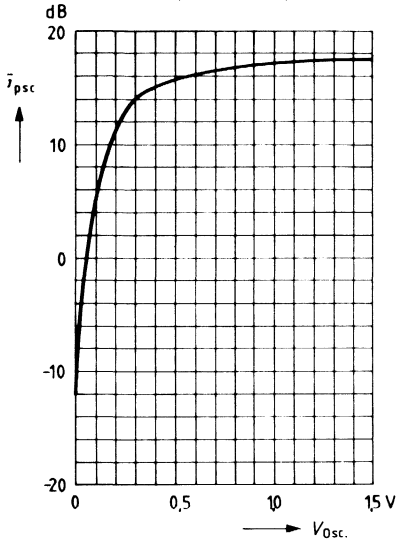
**Noise figure**

$NF = f(V_{G2S})$   
 $V_{DS} = 15\text{ V}$ ,  $V_{G1S} = 0\text{ V}$   
 $I_{DSS} = 10\text{ mA}$ ,  $f = 200\text{ MHz}$   
(test circuit 1)  
dB



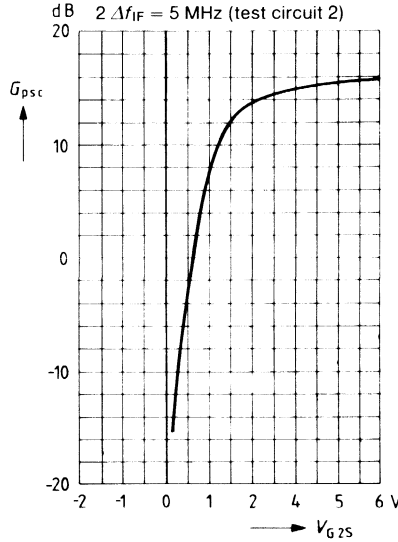
**Mixer gain (additive)**

$G_{psc} = f(V_{osc})$ ;  $V_D = 15\text{ V}$ ;  $V_{G1S} = 0$ ;  
 $V_{G2S} = 6\text{ V}$ ;  $R_S = 220\ \Omega$ ;  $I_{DSS} = 10\text{ mA}$ ;  
 $f = 200\text{ MHz}$ ;  $f_{IF} = 36\text{ MHz}$ ;  
 $2\ \Delta f_{IF} = 5\text{ MHz}$  (test circuit 2)



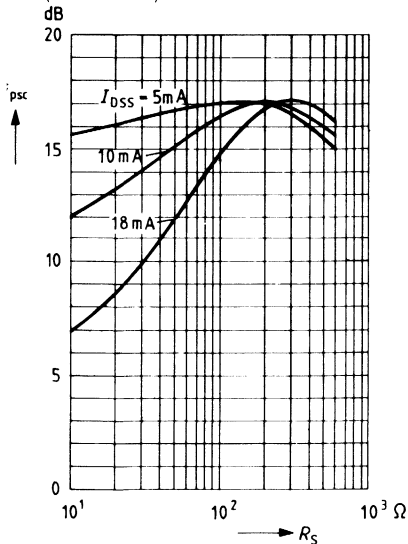
**Mixer gain (additive)**

$G_{psc} = f(V_{G2S})$ ;  $V_D = 15\text{ V}$ ;  $V_{G1S} = 0$ ;  
 $R_S = 220\ \Omega$ ;  $V_{osc} = 0,5\text{ V}$ ;  
 $I_{DSS} = 10\text{ mA}$ ;  $f = 200\text{ MHz}$ ;  
 $f_{IF} = 36\text{ MHz}$ ;  
 $2\ \Delta f_{IF} = 5\text{ MHz}$  (test circuit 2)



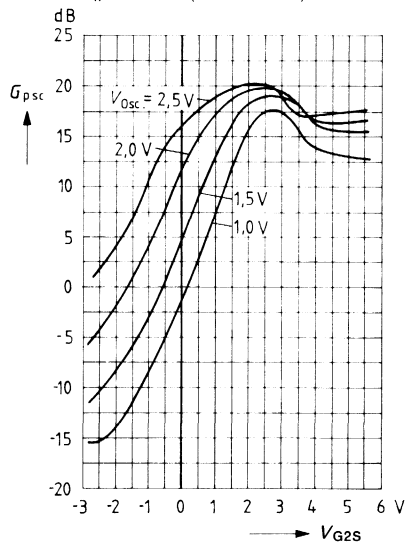
**Mixer gain (additive)**

$G_{psc} = f(R_S)$ ;  $V_D = 15\text{ V}$ ;  $V_{G1S} = 0$ ;  
 $V_{G2S} = 6\text{ V}$ ;  $V_{osc} = 0,5\text{ V}$ ;  $f = 200\text{ MHz}$ ;  
 $f_{IF} = 36\text{ MHz}$ ;  $2\ \Delta f_{IF} = 5\text{ MHz}$   
 (test circuit 2)



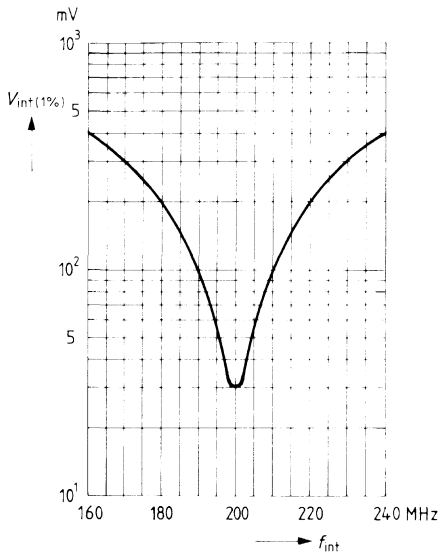
**Mixer gain (multiplicative)**

$G_{psc} = f(V_{G2S})$ ;  $V_D = 15\text{ V}$ ;  $V_{G1S} = 1,7\text{ V}$ ;  
 $R_S = 200\ \Omega$ ;  $I_{DSS} = 10\text{ mA}$ ;  
 $f = 200\text{ MHz}$ ;  $f_{IF} = 36\text{ MHz}$ ;  
 $2\ \Delta f_{IF} = 5\text{ MHz}$  (test circuit 3)



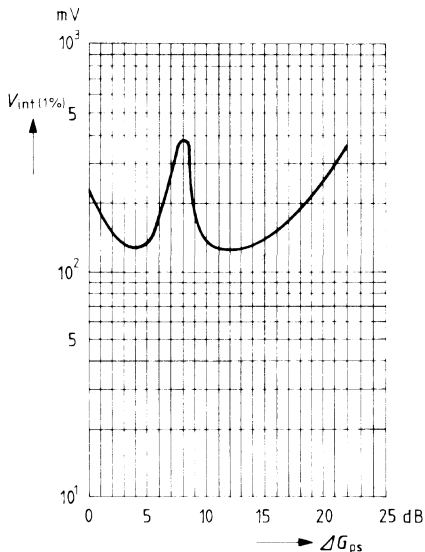
**Interference voltage for 1% cross modulation**

$V_{int(1\%)} = f(f_{int})^1$ ;  $m_{int} = 100\%$ ;  
 $f_e = 200$  MHz;  $V_{DS} = 15$  V;  $V_{G2S} = 4$  V,  
 $V_{G1S} = 0$ ;  $I_{DSS} = 10$  mA  
 (test circuit 1)



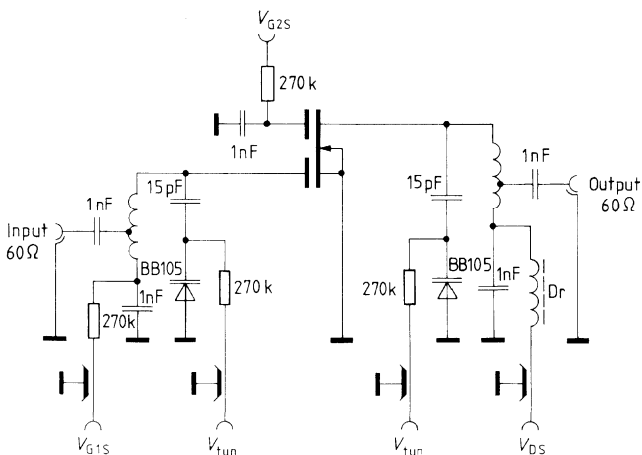
**Interference voltage for 1% cross modulation**

$V_{int(1\%)} = f(\Delta G_{ps})^1$ ;  $f_e = 200$  MHz;  
 $f_{int} = 221$  MHz;  $m_{int} = 100\%$ ;  
 $V_{DS} = 15$  V;  $V_{G1S} = 0$ ;  $I_{DSS} = 10$  mA  
 (test circuit 1)



**Test circuit for power gain, noise figure and cross modulation at  $f = 200$  MHz;  $G_G = 2$  mS,  $G_L = 0,5$  mS**

Figure 1

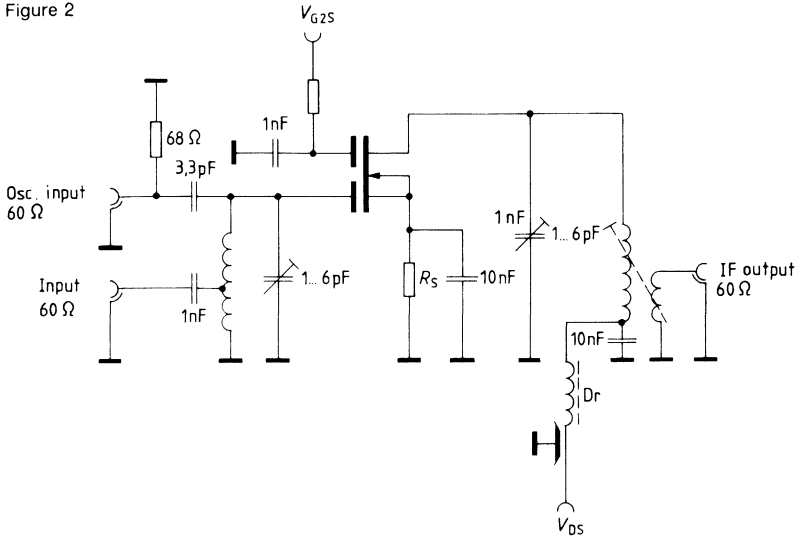


<sup>1)</sup>  $V_{int(1\%)}$  is the rms value of half the EMC (terminal voltage at matching) of a 100% sine modulated TV carrier at an internal generator resistance of 60 Ω, causing 1% amplitude modulation on the active carrier.

**Test circuit for mixer gain (additive)**

$f = 200 \text{ MHz}$ ;  $f_{\text{osc}} = 236 \text{ MHz}$ ;  $2 \Delta f_{\text{IF}} = 5 \text{ MHz}$

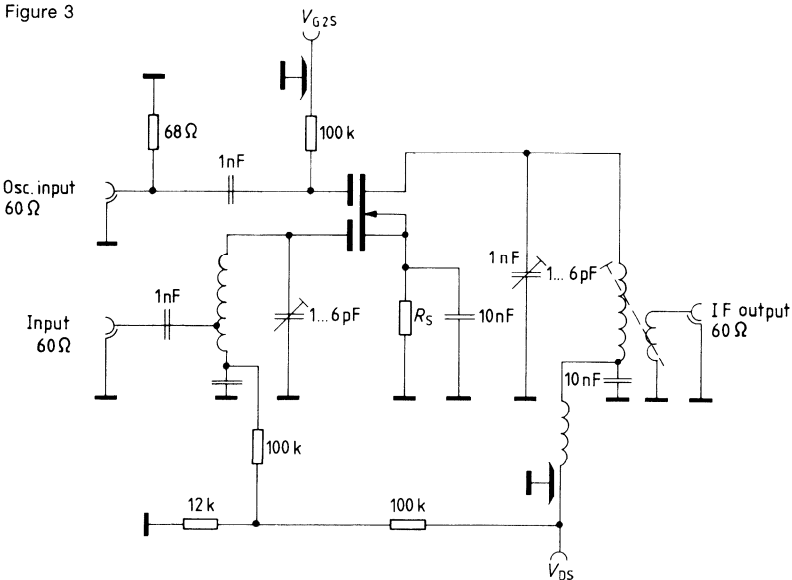
Figure 2



**Test circuit for mixer gain (multiplicative)**

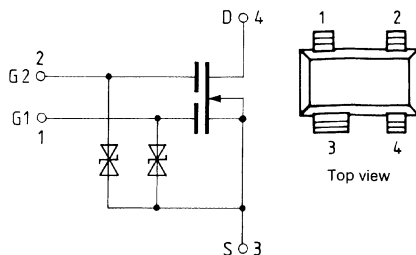
$f = 200 \text{ MHz}$ ;  $f_{\text{osc}} = 236 \text{ MHz}$ ;  $2 \Delta f_{\text{IF}} = 5 \text{ MHz}$

Figure 3



**Silicon dual-gate MOS field-effect tetrode**

- For input stages in UHF/TV tuners



Type	Marking	Ordering code	Package
BF 996	MD	Refer to index	Version B

**Maximum ratings**

Drain-source voltage	$V_{DS}$	20 V
Drain current	$I_D$	30 mA
Gate 1/Gate 2 source peak current	$\pm I_{G1/2SM}$	10 mA
Total power dissipation $T_A = 60^\circ C$	$P_{tot}$	200 mW
Storage temperature range	$T_{stg}$	$-55 \dots +150^\circ C$
Channel temperature	$T_{ch}$	$150^\circ C$

**Thermal resistance**

junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	$\leq 450 K/W$
-------------------------------------------------------------------------------	------------	----------------

## Characteristics

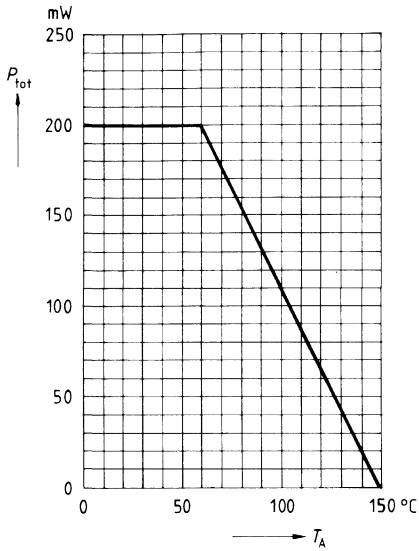
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Drain-source breakdown voltage $I_D = 10\ \mu\text{A}$ , $-V_{G1S} = -V_{G2S} = 4\ \text{V}$	$V_{(BR)DS}$	20	–	–	V
Gate 1 source breakdown voltage $\pm I_{G1S} = 10\ \text{mA}$ , $V_{G2S} = V_{DS} = 0$	$\pm V_{(BR)G1SS}$	6	–	20	V
Gate 2 source breakdown voltage $\pm I_{G2S} = 10\ \text{mA}$ , $V_{G1S} = V_{DS} = 0$	$\pm V_{(BR)G2SS}$	6	–	20	V
Gate 1 source leakage current $\pm V_{G1S} = 5\ \text{V}$ , $V_{G2S} = V_{DS} = 0$	$\pm I_{G1SS}$	–	–	50	nA
Gate 2 source leakage current $\pm V_{G2S} = 5\ \text{V}$ , $V_{G1S} = V_{DS} = 0$	$\pm I_{G2SS}$	–	–	50	nA
Drain current $V_{DS} = 15\ \text{V}$ , $V_{G1S} = 0$ , $V_{G2S} = 4\ \text{V}$	$I_{DSS}$	2	–	20	mA
Gate 1 source pinch-off voltage $V_{DS} = 15\ \text{V}$ , $V_{G2S} = 4\ \text{V}$ , $I_D = 20\ \mu\text{A}$	$-V_{G1S(p)}$	–	–	2,5	V
Gate 2 source pinch-off voltage $V_{DS} = 15\ \text{V}$ , $V_{G1S} = 0$ , $I_D = 20\ \mu\text{A}$	$-V_{G2S(p)}$	–	–	2,0	V
Dynamic characteristics	Symbol	min	typ	max	Unit
Forward transconductance $V_{DS} = 15\ \text{V}$ , $I_D = 10\ \text{mA}$ , $V_{G2S} = 4\ \text{V}$ , $f = 1\ \text{kHz}$	$g_{fs}$	15	17	–	mS
Gate 1 input capacitance $V_{DS} = 15\ \text{V}$ , $I_D = 10\ \text{mA}$ , $V_{G2S} = 4\ \text{V}$ , $f = 1\ \text{MHz}$	$C_{g1ss}$	–	2,2	2,6	pF
Gate 2 input capacitance $V_{DS} = 15\ \text{V}$ , $I_D = 10\ \text{mA}$ , $V_{G2S} = 4\ \text{V}$ , $f = 1\ \text{MHz}$	$C_{g2ss}$	–	1,1	–	pF
Reverse transfer capacitance <sup>1)</sup> $V_{DS} = 15\ \text{V}$ , $I_D = 10\ \text{mA}$ , $V_{G2S} = 4\ \text{V}$ , $f = 1\ \text{MHz}$	$C_{dg1}$	–	25	–	fF
Output capacitance $V_{DS} = 15\ \text{V}$ , $I_D = 10\ \text{mA}$ , $V_{G2S} = 4\ \text{V}$ , $f = 1\ \text{MHz}$	$C_{dss}$	–	0,8	1,2	pF
Power gain $V_{DS} = 15\ \text{V}$ , $I_D = 10\ \text{mA}$ , $f = 200\ \text{MHz}$ , $G_G = 2\ \text{mS}$ , $G_L = 0,5\ \text{mS}$ $f = 800\ \text{MHz}$ , $G_G = 3,3\ \text{mS}$ , $G_L = 1\ \text{mS}$	$G_{ps}$	–	25 18	–	dB dB
Noise figure $V_{DS} = 15\ \text{V}$ , $I_D = 10\ \text{mA}$ $f = 200\ \text{MHz}$ , $G_G = 2\ \text{mS}$ , $G_L = 0,5\ \text{mS}$ $f = 800\ \text{MHz}$ , $G_G = 3,3\ \text{mS}$ , $G_L = 1\ \text{mS}$	$NF$	–	1,5 2,8	– 3,9	dB dB
Control range $V_{DS} = 15\ \text{V}$ , $V_{G2S} = 4 \dots -2\ \text{V}$ , $f = 800\ \text{MHz}$	$\Delta G_{ps}$	40	–	–	dB

<sup>1)</sup> G2 and S on screen potential.

**Total power dissipation**

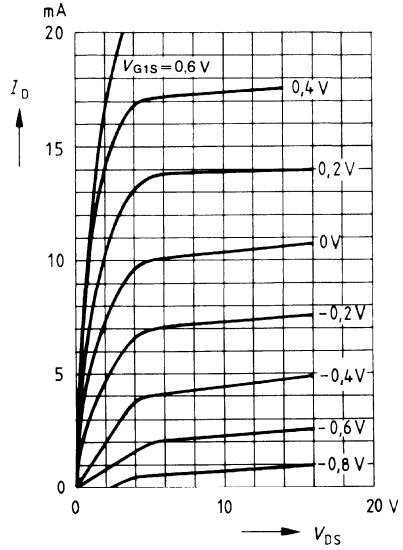
$P_{tot} = f(T_A)$



**Family of output characteristics**

$I_D = f(V_{DS})$

$V_{G2S} = 4V$



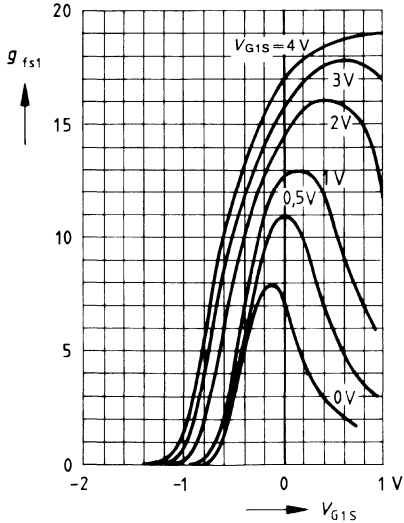
**Gate 1 forward transconductance**

$g_{fs1} = f(V_{G1S})$

$V_{DS} = 15V$

$I_{DSS} = 10mA, f = 1kHz$

mS



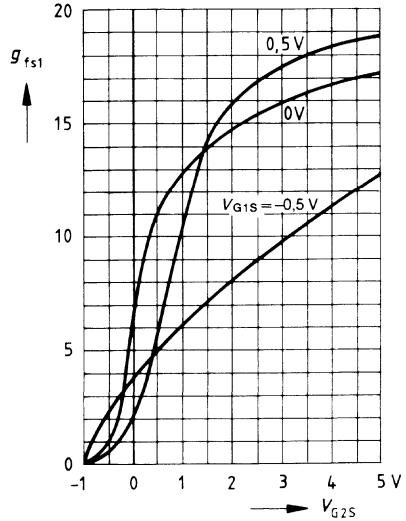
**Gate 1 forward transconductance**

$g_{fs1} = f(V_{G2S})$

$V_{DS} = 15V$

$I_{DSS} = 10mA, f = 1kHz$

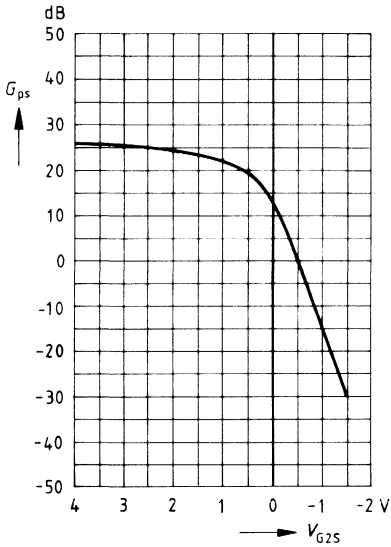
mS





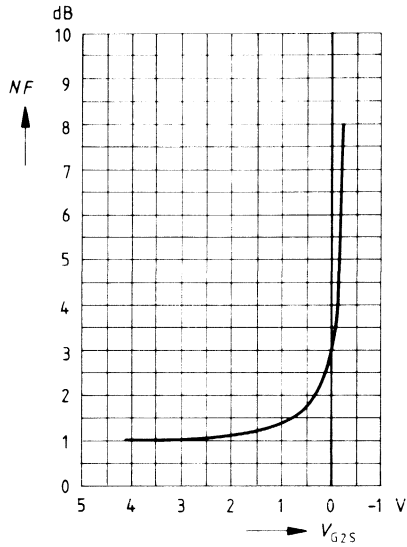
**Power gain**

$G_{ps} = f(V_{G2S})$   
 $V_{DS} = 15 \text{ V}, V_{G1S} = 0 \text{ V}$   
 $I_{DSS} = 10 \text{ mA}, f = 200 \text{ MHz}$   
 (test circuit 1)



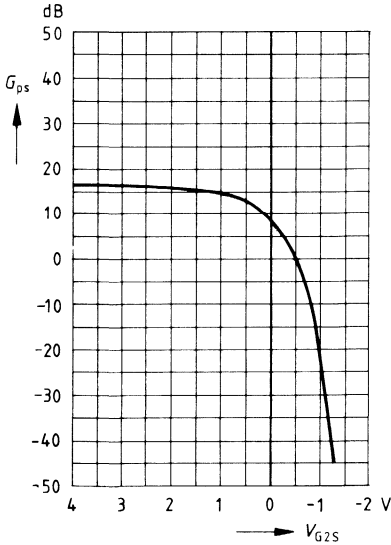
**Noise figure**

$NF = f(V_{G2S})$   
 $V_{DS} = 15 \text{ V}, V_{G1S} = 0 \text{ V}$   
 $I_{DSS} = 10 \text{ mA}, f = 200 \text{ MHz}$   
 (test circuit 1)



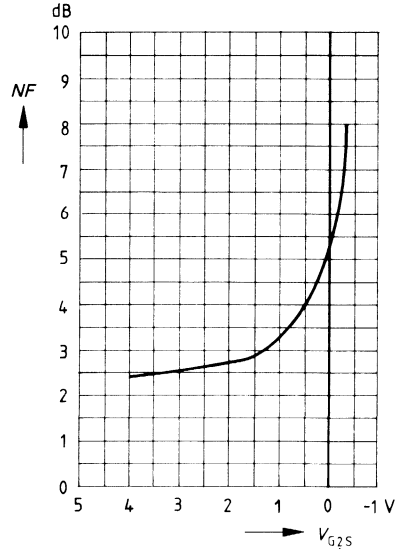
**Power gain**

$G_{ps} = f(V_{G2S})$   
 $V_{DS} = 15 \text{ V}, V_{G1S} = 0 \text{ V}$   
 $I_{DSS} = 10 \text{ mA}, f = 800 \text{ MHz}$   
 (test circuit 2)



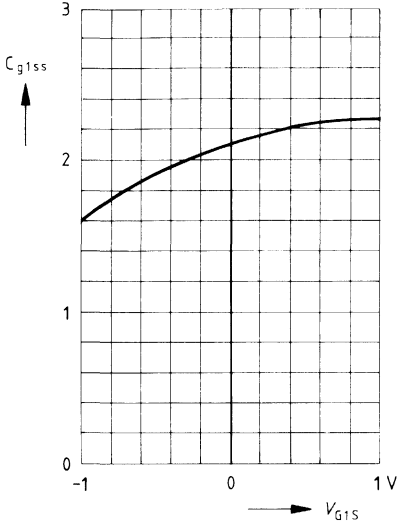
**Noise figure**

$NF = f(V_{G2S})$   
 $V_{DS} = 15 \text{ V}, V_{G1S} = 0 \text{ V}$   
 $I_{DSS} = 10 \text{ mA}, f = 800 \text{ MHz}$   
 (test circuit 2)



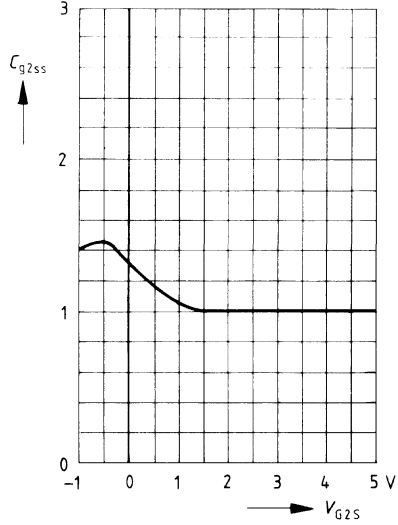
**Gate 1 input capacitance**

$C_{g1ss} = f(V_{G1S})$   
 $V_{G2S} = 4\text{ V}, V_{DS} = 15\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 1\text{ MHz}$   
 pF



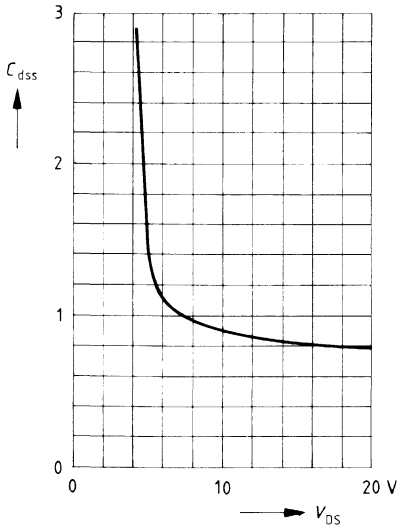
**Gate 2 input capacitance**

$C_{g2ss} = f(V_{G2S})$   
 $V_{G1S} = 0\text{ V}, V_{DS} = 15\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 1\text{ MHz}$   
 pF



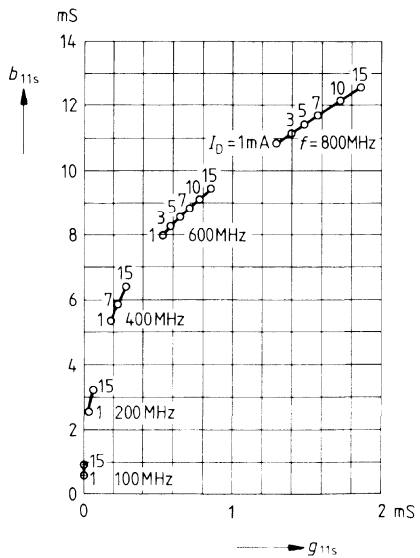
**Output capacitance**

$C_{dss} = f(V_{DS})$   
 $V_{G1S} = 0\text{ V}, V_{G2S} = 4\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 1\text{ MHz}$   
 pF



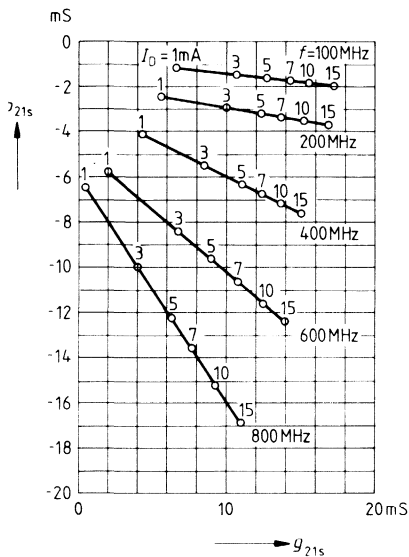
**Gate 1 input admittance  $Y_{11s}$**

$V_{DS} = 15\text{ V}, V_{G2S} = 4\text{ V}$   
 (common-source)



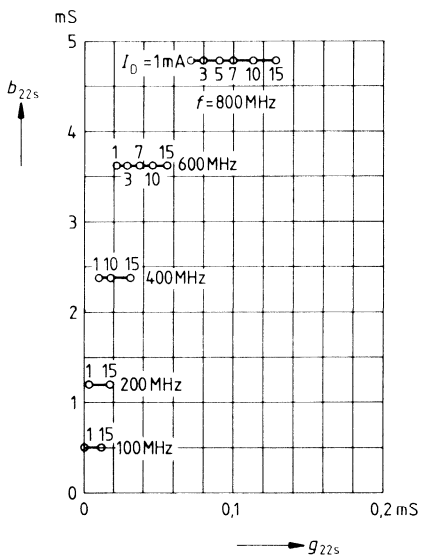
**Gate 1 forward transfer admittance  $Y_{21s}$**

$V_{DS} = 15\text{ V}$ ,  $V_{GS} = 4\text{ V}$   
(common-source)



**Output admittance  $Y_{22s}$**

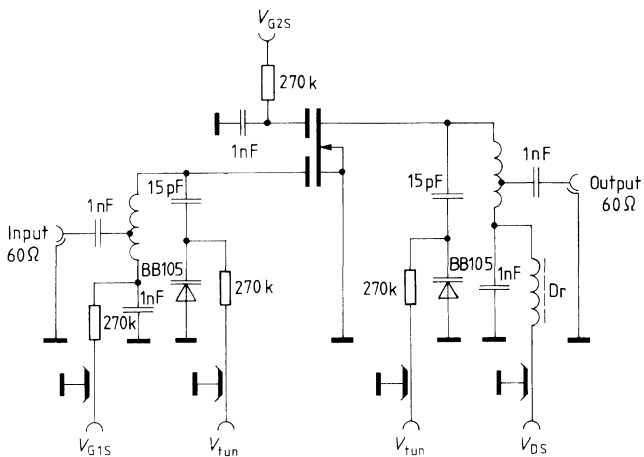
$V_{DS} = 15\text{ V}$ ,  $V_{GS} = 4\text{ V}$   
(common-source)



**Test circuit for power gain and noise figure**

$f = 200 \text{ MHz}$ ;  $G_G = 2 \text{ mS}$ ;  $G_L = 0,5 \text{ mS}$

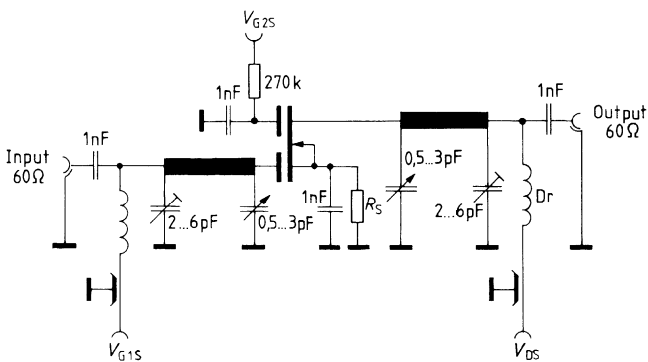
Figure 1



**Test circuit for power gain, noise figure and cross modulation**

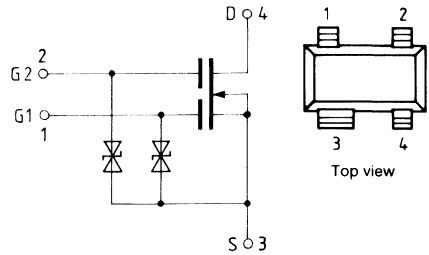
$f = 800 \text{ MHz}$ ;  $G_G = 3,3 \text{ mS}$ ;  $G_L = 1 \text{ mS}$

Figure 2



**Silicon dual-gate MOS field-effect tetrode**

- For input stages in UHF/TV tuners



Type	Marking	Ordering code	Package
BF 996 S	MH	Refer to index	Version B

**Maximum ratings**

Drain-source voltage	$V_{DS}$	20 V
Drain current	$I_D$	30 mA
Gate 1/Gate 2 source peak current	$\pm I_{G1/2SM}$	10 mA
Total power dissipation $T_A = 60^\circ\text{C}$	$P_{tot}$	200 mW
Storage temperature range	$T_{stg}$	$-55 \dots +150^\circ\text{C}$
Channel temperature	$T_{ch}$	$150^\circ\text{C}$

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	$\leq 450 \text{ K/W}$
------------------------------------------------------------------------------------------------------------	------------	------------------------

## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

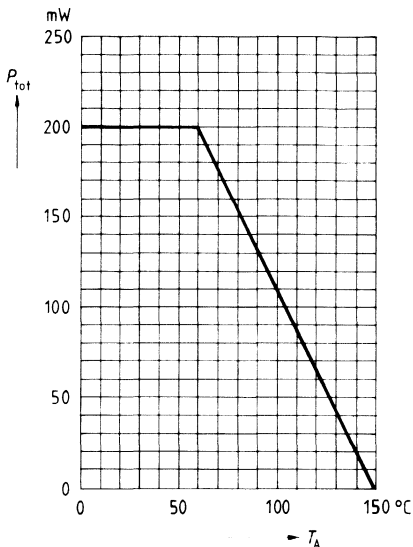
Static characteristics	Symbol	min	typ	max	Unit
Drain-source breakdown voltage $I_D = 10\ \mu\text{A}$ , $-V_{G1S} = -V_{G2S} = 4\ \text{V}$	$V_{(BR)DS}$	20	–	–	V
Gate 1 source breakdown voltage $\pm I_{G1S} = 10\ \text{mA}$ , $V_{G2S} = V_{DS} = 0$	$\pm V_{(BR)G1SS}$	6	–	20	V
Gate 2 source breakdown voltage $\pm I_{G2S} = 10\ \text{mA}$ , $V_{G1S} = V_{DS} = 0$	$\pm V_{(BR)G2SS}$	6	–	20	V
Gate 1 source leakage current $\pm V_{G1S} = 5\ \text{V}$ , $V_{G2S} = V_{DS} = 0$	$\pm I_{G1SS}$	–	–	50	nA
Gate 2 source leakage current $\pm V_{G2S} = 5\ \text{V}$ , $V_{G1S} = V_{DS} = 0$	$\pm I_{G2SS}$	–	–	50	nA
Drain current $V_{DS} = 15\ \text{V}$ , $V_{G1S} = 0$ , $V_{G2S} = 4\ \text{V}$	$I_{DSS}$	2	–	20	mA
Gate 1 source pinch-off voltage $V_{DS} = 15\ \text{V}$ , $V_{G2S} = 4\ \text{V}$ , $I_D = 20\ \mu\text{A}$	$-V_{G1S(p)}$	–	–	2,5	V
Gate 2 source pinch-off voltage $V_{DS} = 15\ \text{V}$ , $V_{G1S} = 0$ , $I_D = 20\ \mu\text{A}$	$-V_{G2S(p)}$	–	–	2,0	V

Dynamic characteristics	Symbol	min	typ	max	Unit
Forward transconductance $V_{DS} = 15\ \text{V}$ , $I_D = 10\ \text{mA}$ , $V_{G2S} = 4\ \text{V}$ , $f = 1\ \text{kHz}$	$g_{fs}$	15	18	–	mS
Gate 1 input capacitance $V_{DS} = 15\ \text{V}$ , $I_D = 10\ \text{mA}$ , $V_{G2S} = 4\ \text{V}$ , $f = 1\ \text{MHz}$	$C_{g1ss}$	–	2,3	–	pF
Gate 2 input capacitance $V_{DS} = 15\ \text{V}$ , $I_D = 10\ \text{mA}$ , $V_{G2S} = 4\ \text{V}$ , $f = 1\ \text{MHz}$	$C_{g2ss}$	–	1,1	–	pF
Reverse transfer capacitance <sup>1)</sup> $V_{DS} = 15\ \text{V}$ , $I_D = 10\ \text{mA}$ , $V_{G2S} = 4\ \text{V}$ , $f = 1\ \text{MHz}$	$C_{dg1}$	–	25	–	fF
Output capacitance $V_{DS} = 15\ \text{V}$ , $I_D = 10\ \text{mA}$ , $V_{G2S} = 4\ \text{V}$ , $f = 1\ \text{MHz}$	$C_{dss}$	–	0,8	–	pF
Power gain $V_{DS} = 15\ \text{V}$ , $I_D = 10\ \text{mA}$ , $f = 200\ \text{MHz}$ , $G_G = 2\ \text{mS}$ , $G_L = 0,5\ \text{mS}$ $f = 800\ \text{MHz}$ , $G_G = 3,3\ \text{mS}$ , $G_L = 1\ \text{mS}$	$G_{ps}$	–	25 18	– –	dB dB
Noise figure $V_{DS} = 15\ \text{V}$ , $I_D = 10\ \text{mA}$ $f = 200\ \text{MHz}$ , $G_G = 2\ \text{mS}$ , $G_L = 0,5\ \text{mS}$ $f = 800\ \text{MHz}$ , $G_G = 3,3\ \text{mS}$ , $G_L = 1\ \text{mS}$	$NF$	–	1 1,8	– –	dB dB
Control range $V_{DS} = 15\ \text{V}$ , $V_{G2S} = 4 \dots -2\ \text{V}$ , $f = 800\ \text{MHz}$	$\Delta G_{ps}$	40	–	–	dB

<sup>1)</sup> G2 and S on screen potential.

**Total power dissipation**

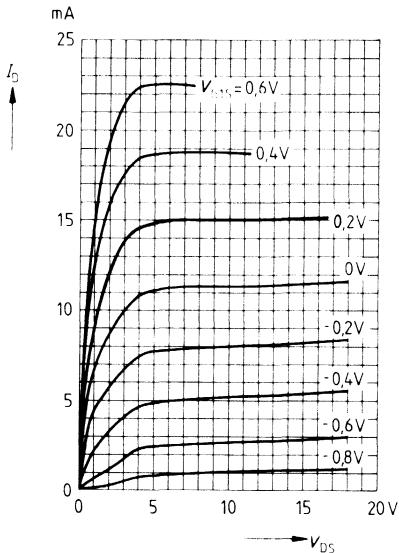
$P_{Tot} = f(T_A)$



**Family of output characteristics**

$I_D = f(V_{DS})$

$V_{G2S} = 4V$



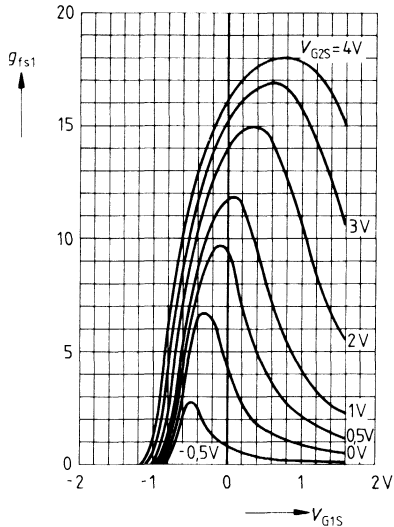
**Gate 1 forward transconductance**

$g_{fs1} = f(V_{G1S})$

$V_{DS} = 15V$

$I_{DSS} = 10mA, f = 1kHz$

mS



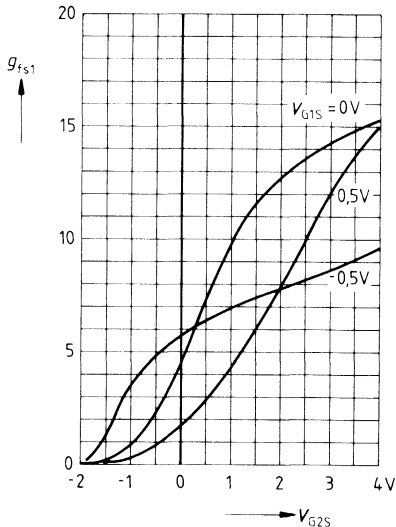
**Gate 1 forward transconductance**

$g_{fs1} = f(V_{G2S})$

$V_{DS} = 15V$

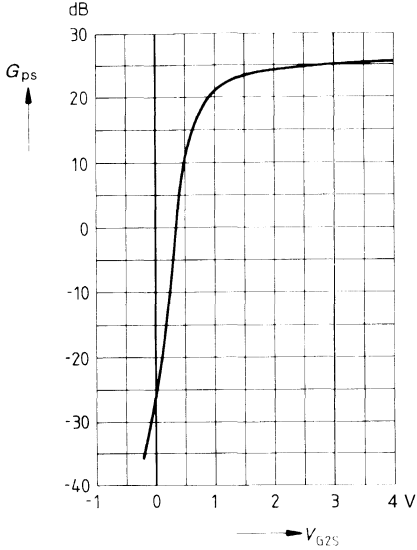
$I_{DSS} = 10mA, f = 1kHz$

mS



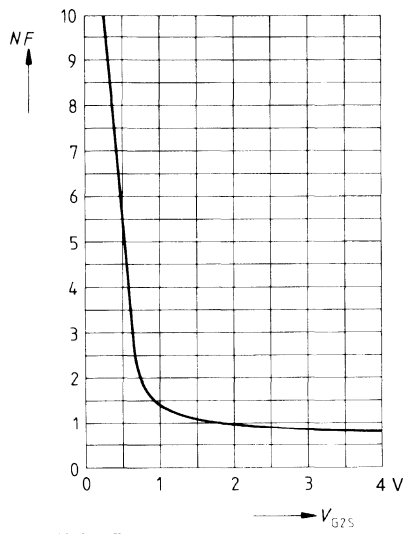
**Power gain**

$G_{ps} = f(V_{G2S})$   
 $V_{DS} = 15\text{ V}, V_{G1S} = 0\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 200\text{ MHz}$   
 (test circuit 1)



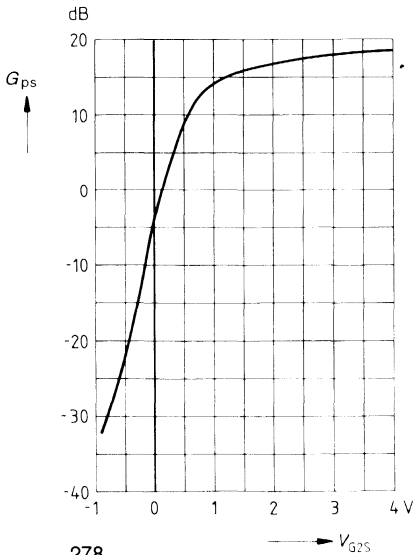
**Noise figure**

$NF = f(V_{G2S})$   
 $V_{DS} = 15\text{ V}, V_{G1S} = 0\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 200\text{ MHz}$   
 (test circuit 1)



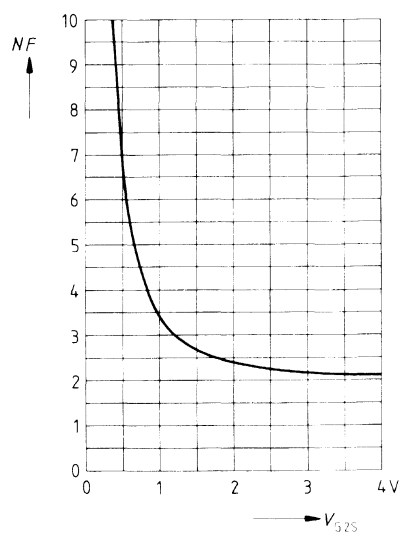
**Power gain**

$G_{ps} = f(V_{G2S})$   
 $V_{DS} = 15\text{ V}, V_{G1S} = 0\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 800\text{ MHz}$   
 (test circuit 2)



**Noise figure**

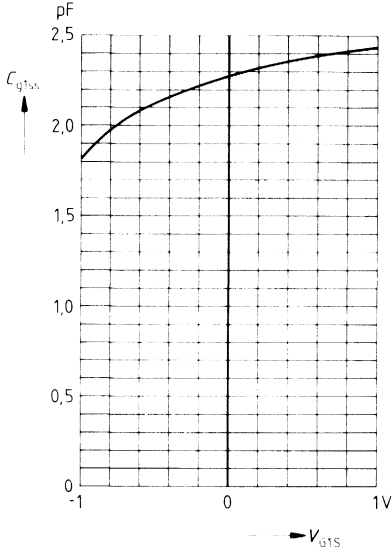
$NF = f(V_{G2S})$   
 $V_{DS} = 15\text{ V}, V_{G1S} = 0\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 800\text{ MHz}$   
 (test circuit 2)





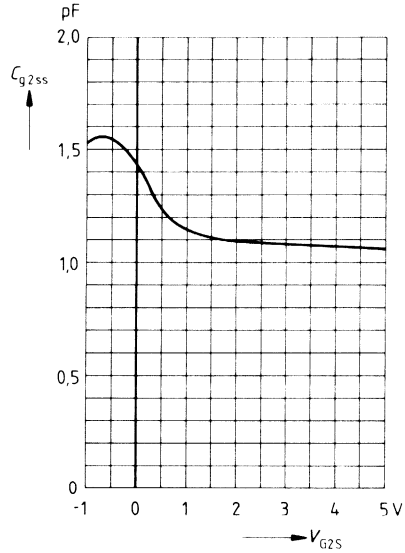
**Gate 1 input capacitance**

$C_{g1ss} = f(V_{G1S})$   
 $V_{G2S} = 4\text{ V}, V_{DS} = 15\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 1\text{ MHz}$



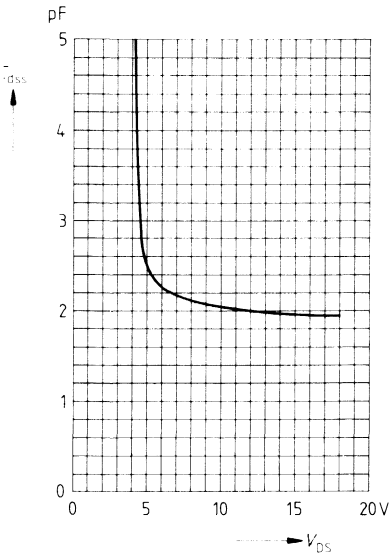
**Gate 2 input capacitance**

$C_{g2ss} = f(V_{G2S})$   
 $V_{G1S} = 0\text{ V}, V_{DS} = 15\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 1\text{ MHz}$



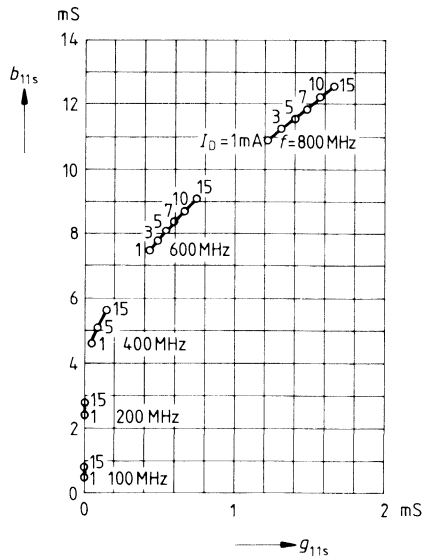
**Output capacitance**

$C_{dss} = f(V_{DS})$   
 $V_{G1S} = 0\text{ V}, V_{G2S} = 4\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 1\text{ MHz}$



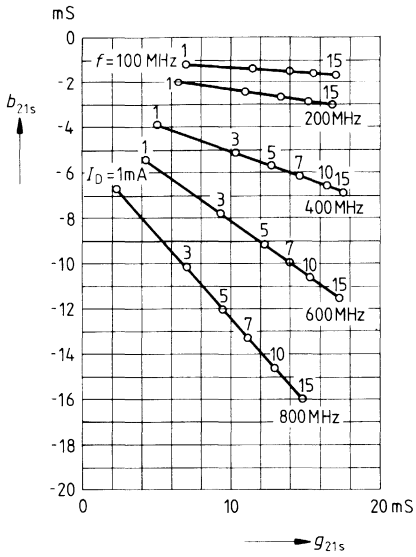
**Gate 1 input admittance  $y_{11s}$**

$V_{DS} = 15\text{ V}, V_{G2S} = 4\text{ V}$   
 (common-source)



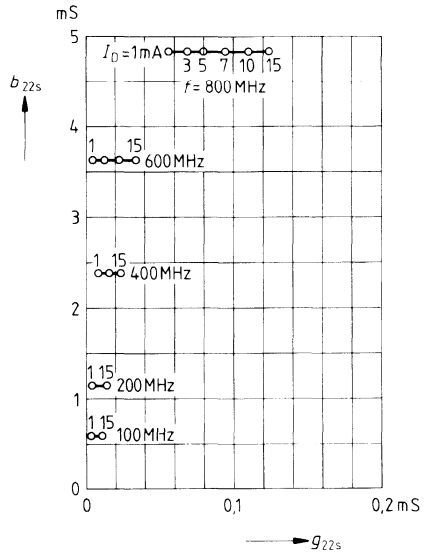
**Gate 1 forward transfer admittance  $Y_{21s}$**

$V_{DS} = 15\text{ V}$ ,  $V_{G2s} = 4\text{ V}$   
(common-source)



**Output admittance  $Y_{22s}$**

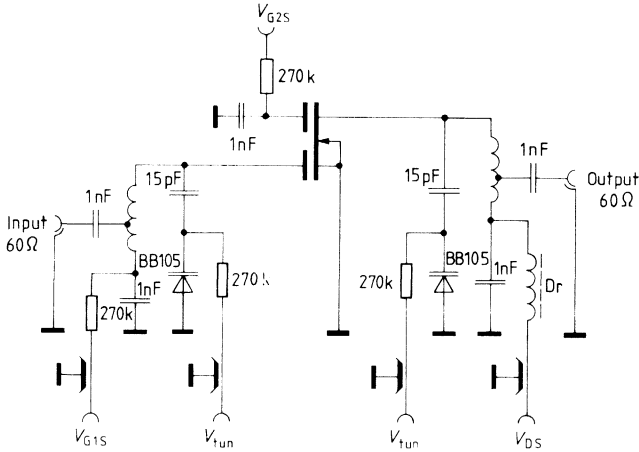
$V_{DS} = 15\text{ V}$ ,  $V_{G2s} = 4\text{ V}$   
(common-source)



**Test circuit for power gain and noise figure**

$f = 200 \text{ MHz}$ ,  $G_G = 2 \text{ mS}$ ,  $G_L = 0.5 \text{ mS}$

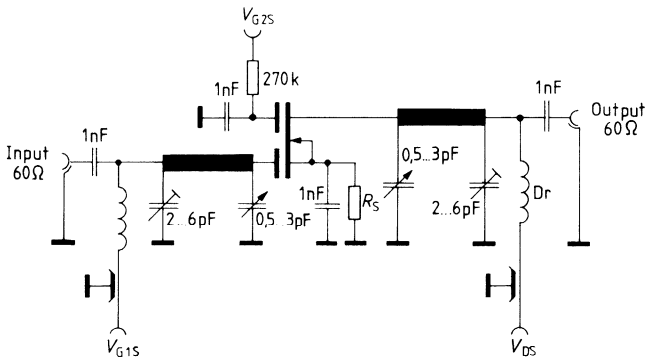
Figure 1



**Test circuit for power gain, noise figure and cross modulation**

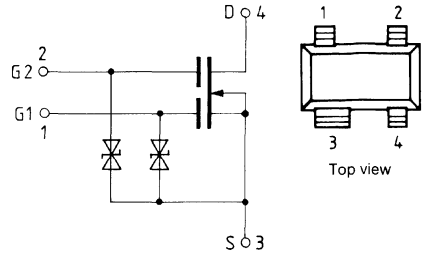
$f = 800 \text{ MHz}$ ,  $G_G = 2 \text{ mS}$ ,  $G_L = 1 \text{ mS}$

Figure 2



**Silicon dual-gate MOS field-effect tetrode**

- For applications in VHF input and mixer stages, covering a wide tuning range up to approx. 500 MHz (CATV tuners);
- Integrated oscillation rejection for frequencies exceeding 1 GHz



Type	Marking	Ordering code	Package
BF 997	MK	Refer to index	Version B

**Maximum ratings**

Drain-source voltage	$V_{DS}$	20 V
Drain current	$I_D$	30 mA
Gate 1/Gate 2 source peak current	$\pm I_{G1/2SM}$	10 mA
Total power dissipation $T_A = 60^\circ C$	$P_{tot}$	200 mW
Storage temperature range	$T_{stg}$	$-55 \dots +150^\circ C$
Channel temperature	$T_{ch}$	150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	$\leq 450 \text{ K/W}$
------------------------------------------------------------------------------------------------------------	------------	------------------------

## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

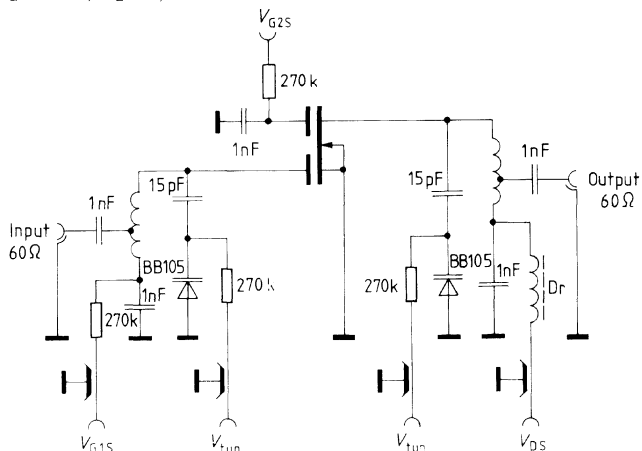
Static characteristics	Symbol	min	typ	max	Unit
Drain-source breakdown voltage $I_D = 10\ \mu\text{A}$ , $-V_{G1S} = -V_{G2S} = 4\ \text{V}$	$V_{(BR)DS}$	20	–	–	V
Gate 1 source breakdown voltage $\pm I_{G1S} = 10\ \text{mA}$ , $V_{G2S} = V_{DS} = 0$	$\pm V_{(BR)G1SS}$	6	–	20	V
Gate 2 source breakdown voltage $\pm I_{G2S} = 10\ \text{mA}$ , $V_{G1S} = V_{DS} = 0$	$\pm V_{(BR)G2SS}$	6	–	20	V
Gate 1 source leakage current $\pm V_{G1S} = 5\ \text{V}$ , $V_{G2S} = V_{DS} = 0$	$\pm I_{G1SS}$	–	–	50	nA
Gate 2 source leakage current $\pm V_{G2S} = 5\ \text{V}$ , $V_{G1S} = V_{DS} = 0$	$\pm I_{G2SS}$	–	–	50	nA
Drain current $V_{DS} = 15\ \text{V}$ , $V_{G1S} = 0$ , $V_{G2S} = 4\ \text{V}$	$I_{DSS}$	2	–	20	mA
Gate 1 source pinch-off voltage $V_{DS} = 15\ \text{V}$ , $V_{G2S} = 4\ \text{V}$ , $I_D = 20\ \mu\text{A}$	$-V_{G1S(p)}$	–	–	2,5	V
Gate 2 source pinch-off voltage $V_{DS} = 15\ \text{V}$ , $V_{G1S} = 0$ , $I_D = 20\ \mu\text{A}$	$-V_{G2S(p)}$	–	–	2,0	V

Dynamic characteristics	Symbol	min	typ	max	Unit
Forward transconductance $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ kHz}$	$g_{fs}$	15	18	–	mS
Gate 1 input capacitance $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ MHz}$	$C_{g1ss}$	–	2,5	–	pF
Gate 2 input capacitance $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ MHz}$	$C_{g2ss}$	–	1,2	–	pF
Reverse transfer capacitance <sup>1)</sup> $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ MHz}$	$C_{dg1}$	–	25	–	fF
Output capacitance $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $V_{G2S} = 4\text{ V}$ , $f = 1\text{ MHz}$	$C_{dss}$	–	1	–	pF
Power gain $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $f = 200\text{ MHz}$ , $G_G = 2\text{ mS}$ , $G_L = 0,5\text{ mS}$ (test circuit)	$G_{ps}$	–	25	–	dB
Noise figure $V_{DS} = 15\text{ V}$ , $I_D = 10\text{ mA}$ , $f = 200\text{ MHz}$ , $G_G = 2\text{ mS}$ , $G_L = 0,5\text{ mS}$ (test circuit)	$NF$	–	1	–	dB
Control range $V_{DS} = 15\text{ V}$ , $V_{G2S} = 4 \dots -2\text{ V}$ , $f = 200\text{ MHz}$	$\Delta G_{ps}$	50	–	–	dB

<sup>1)</sup> G2 and S on screen potential.

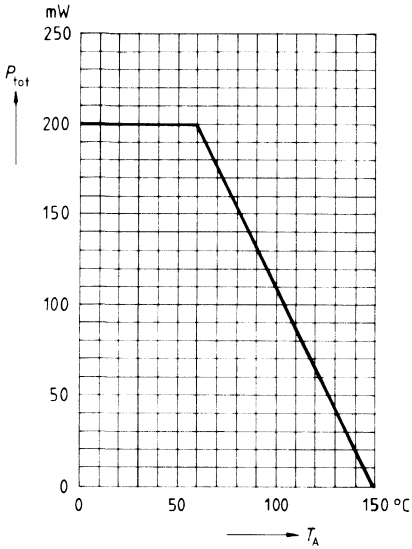
**Test circuit for power gain and noise figure**

$f = 200\text{ MHz}$ ;  $G_G = 2\text{ mS}$ ,  $G_L = 0,5\text{ mS}$



**Total power dissipation**

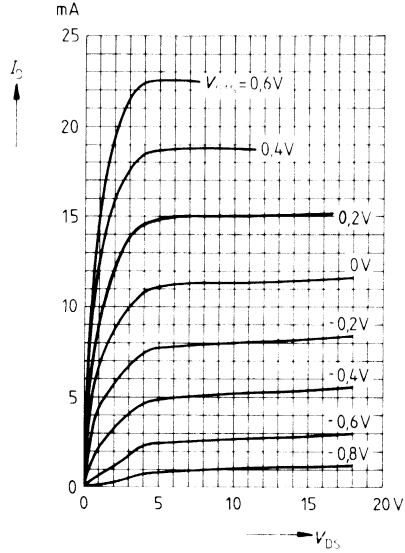
$P_{tot} = f(T_A)$



**Family of output characteristics**

$I_D = f(V_{DS})$

$V_{G2S} = 4\text{ V}$



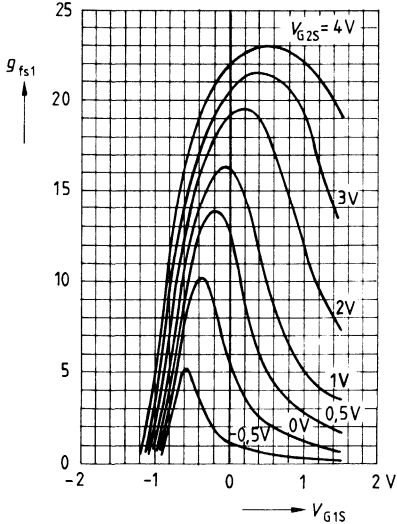
**Gate 1 forward transconductance**

$g_{fs1} = f(V_{G1S})$

$V_{DS} = 15\text{ V}$

$I_{DSS} = 10\text{ mA}, f = 1\text{ kHz}$

mS



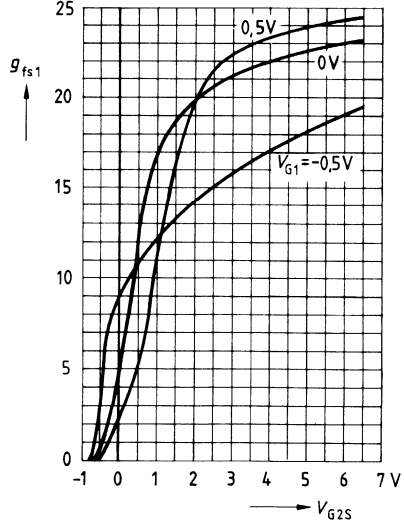
**Gate 1 forward transconductance**

$g_{fs1} = f(V_{G2S})$

$V_{DS} = 15\text{ V}$

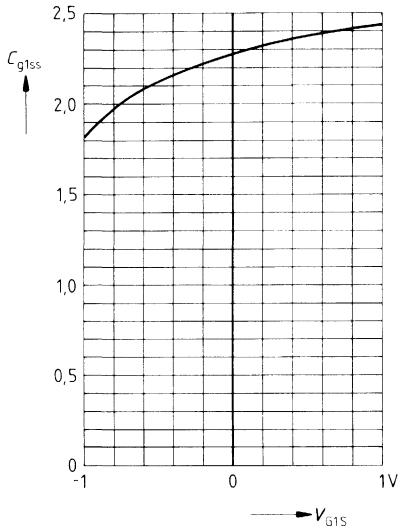
$I_{DSS} = 10\text{ mA}, f = 1\text{ kHz}$

mS



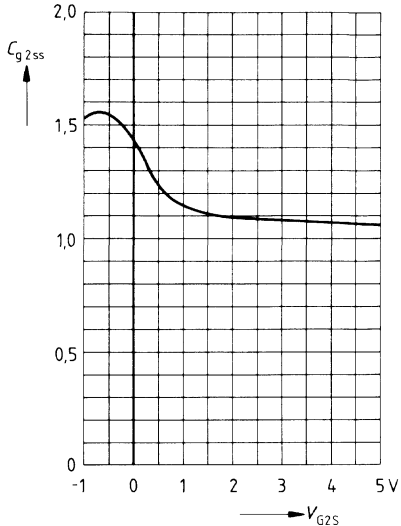
**Gate 1 input capacitance**

$C_{g1ss} = f(V_{G1S})$   
 $V_{G2S} = 4\text{ V}, V_{DS} = 15\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 1\text{ MHz}$   
 pF



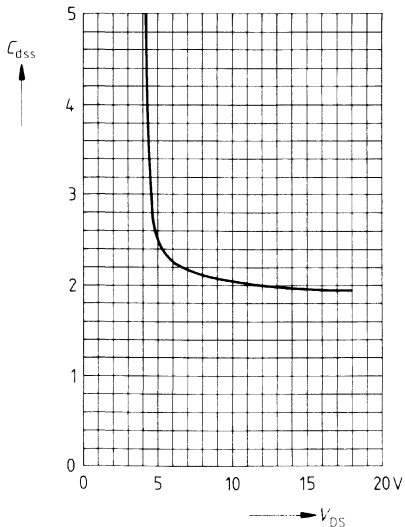
**Gate 2 input capacitance**

$C_{g2ss} = f(V_{G2S})$   
 $V_{G1S} = 0\text{ V}, V_{DS} = 15\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 1\text{ MHz}$   
 pF



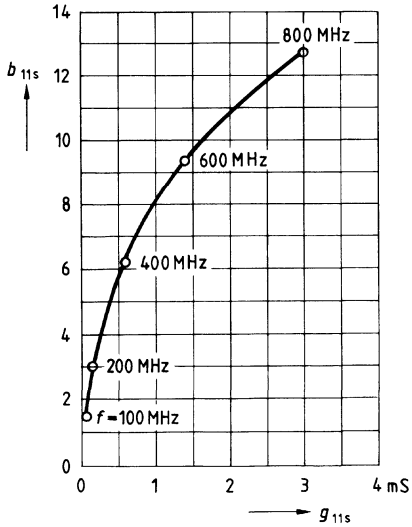
**Output capacitance**

$C_{dss} = f(V_{DS})$   
 $V_{G1S} = 0\text{ V}, V_{G2S} = 4\text{ V}$   
 $I_{DSS} = 10\text{ mA}, f = 1\text{ MHz}$   
 pF



**Gate 1 input admittance  $y_{11s}$**

$V_{DS} = 15\text{ V}, V_{G2S} = 4\text{ V}$   
 $V_{G1S} = 0\text{ V}, I_{DSS} = 10\text{ mA}$   
 (common-source)  
 mS

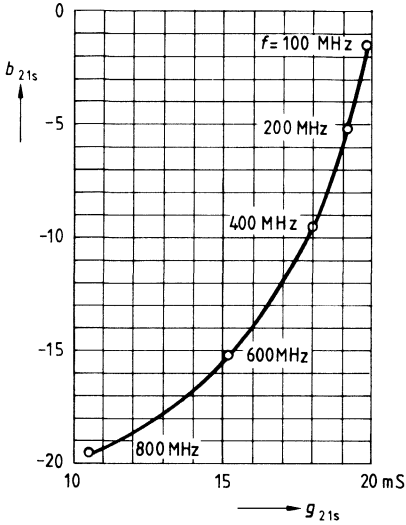




**Gate 1 forward transfer admittance  $Y_{21s}$**

$V_{DS} = 15\text{ V}$ ,  $V_{G2S} = 4\text{ V}$   
 $V_{G1S} = 0\text{ V}$ ,  $I_{DSS} = 10\text{ mA}$   
 (common-source)

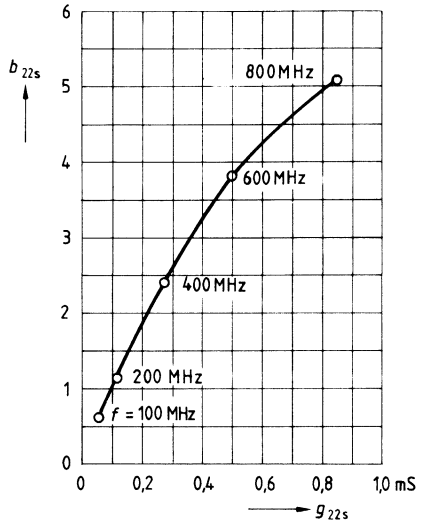
mS



**Output admittance  $Y_{22s}$**

$V_{DS} = 15\text{ V}$ ,  $V_{G2S} = 4\text{ V}$   
 $V_{G1S} = 0\text{ V}$ ,  $I_{DSS} = 10\text{ mA}$   
 (common-source)

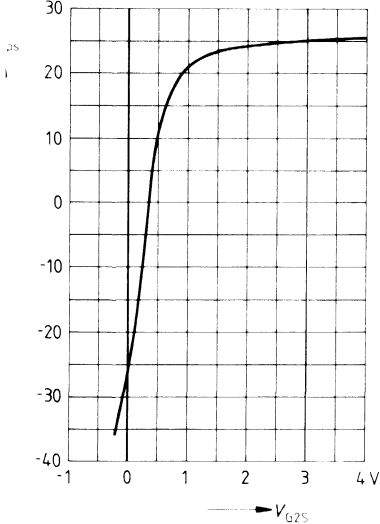
mS



**Power gain**

$G_{ps} = f(V_{G2S})$   
 $V_{DS} = 15\text{ V}$ ,  $V_{G1S} = 0\text{ V}$   
 $I_{DSS} = 10\text{ mA}$ ,  $f = 200\text{ MHz}$   
 (test circuit)

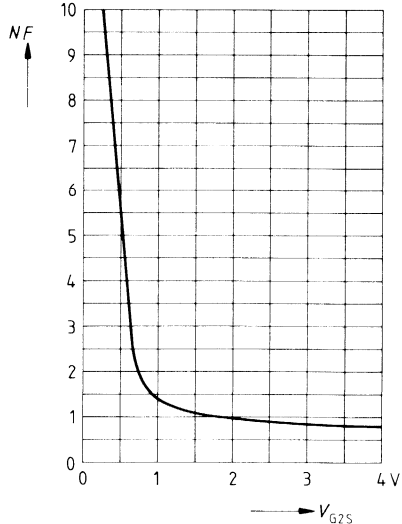
dB



**Noise figure**

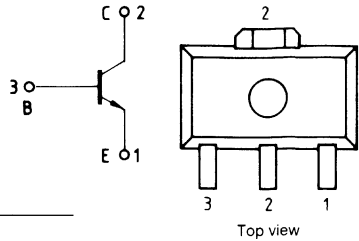
$NF = f(V_{G2S})$   
 $V_{DS} = 15\text{ V}$ ,  $V_{G1S} = 0\text{ V}$   
 $I_{DSS} = 10\text{ mA}$ ,  $f = 200\text{ MHz}$   
 (test circuit)

dB



## NPN silicon planar epitaxial transistors

- High breakdown voltage
- Low collector-emitter saturation voltage
- Complementary PNP types: BFN 17, BFN 19



Type	Marking	Ordering code	Package
BFN 16	DD	Refer to index	Version C
BFN 18	DE		

Maximum ratings		BFN 16	BFN 18
Collector-emitter voltage	$V_{CE0}$	250 V	300 V
Collector-base voltage	$V_{CB0}$	250 V	300 V
Emitter-base voltage	$V_{EB0}$		5 V
Collector current	$I_C$		200 mA
Peak collector current	$I_{CM}$		500 mA
Base current	$I_B$		100 mA
Peak base current	$I_{BM}$		200 mA
Total power dissipation	$P_{tot}$		1.0 W
$T_A = 25^\circ\text{C}$			
Junction temperature	$T_j$		150 °C
Storage temperature range	$T_{stg}$		-65 ... +150 °C
<b>Thermal resistance</b>	$R_{thJA}$		≤ 125 K/W
junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm			

## Characteristics

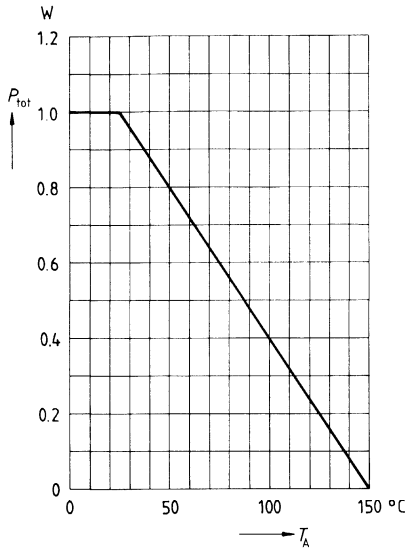
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$	$V_{(BR)CE0}$				
BFN 16		250	–	–	V
BFN 18		300	–	–	V
Collector-base breakdown voltage $I_C = 100\ \mu\text{A}$	$V_{(BR)CB0}$				
BFN 16		250	–	–	V
BFN 18		300	–	–	V
Emitter-base breakdown voltage $I_E = 100\ \mu\text{A}$	$V_{(BR)EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 200\text{ V}$	$I_{CB0}$				
BFN 16		–	–	100	nA
$V_{CB} = 250\text{ V}$	BFN 18	–	–	100	nA
$V_{CB} = 200\text{ V}, T_A = 150^\circ\text{C}$	BFN 16	–	–	20	$\mu\text{A}$
$V_{CB} = 250\text{ V}, T_A = 150^\circ\text{C}$	BFN 18	–	–	20	$\mu\text{A}$
Emitter cutoff current $V_{EB} = 3\text{ V}$	$I_{EB0}$	–	–	100	nA
DC current gain $I_C = 1\text{ mA}, V_{CE} = 10\text{ V}$	$h_{FE}$				
$I_C = 10\text{ mA}, V_{CE} = 10\text{ V}^1)$		25	–	–	–
$I_C = 30\text{ mA}, V_{CE} = 10\text{ V}^1)$	BFN 16	40	–	–	–
	BFN 18	40	–	–	–
		30	–	–	–
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 20\text{ mA}, I_B = 2\text{ mA}$	$V_{CEsat}$				
BFN 16		–	–	0,4	V
BFN 18		–	–	0,5	V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 20\text{ mA}, I_B = 2\text{ mA}$	$V_{BEsat}$	–	–	0,9	V

Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 20\text{ mA}, V_{CE} = 10\text{ V}, f = 20\text{ MHz}$	$f_T$	–	70	–	MHz
Output capacitance $V_{CB} = 30\text{ V}, f = 1\text{ MHz}$	$C_{ob}$	–	1,5	–	pF

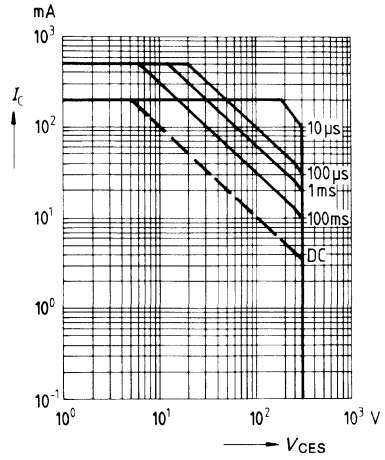
<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

**Total power dissipation  $P_{\text{tot}} = f(T_A)$**

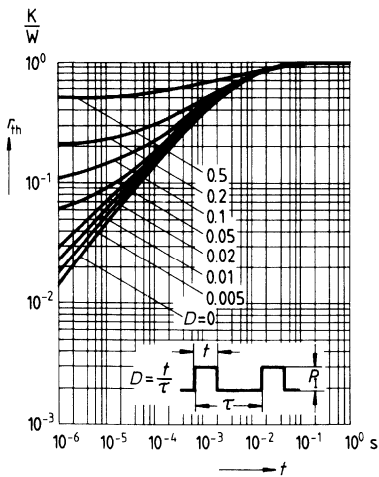


**Operating range  $I_C = f(V_{\text{CES}})$**

$T_A = 25^{\circ}\text{C}$ .  $D = 0$

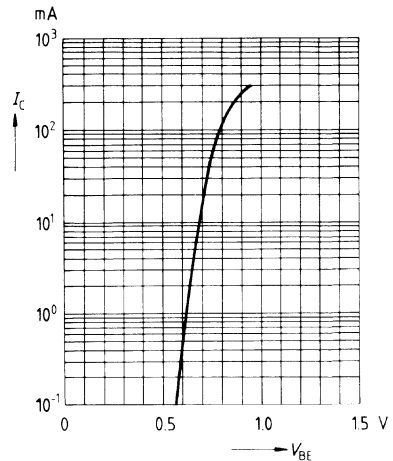


**Pulse handling capability  $r_{\text{th}} = f(t)$**



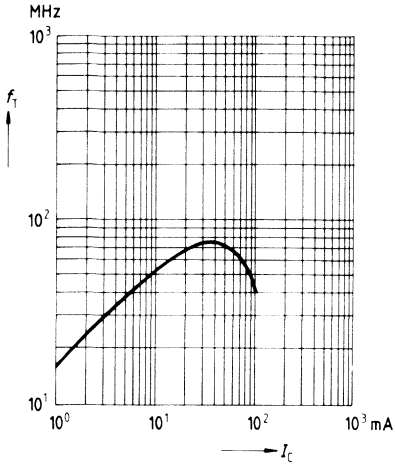
**Collector current  $I_C = f(V_{\text{BE}})$**

$V_{\text{CE}} = 10\text{ V}$



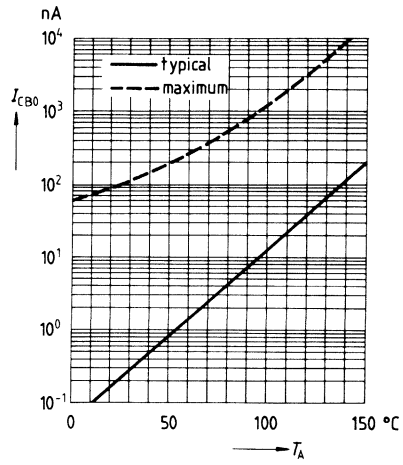
**Transition frequency  $f_T = f(I_C)$**

$V_{CE} = 10 \text{ V}$



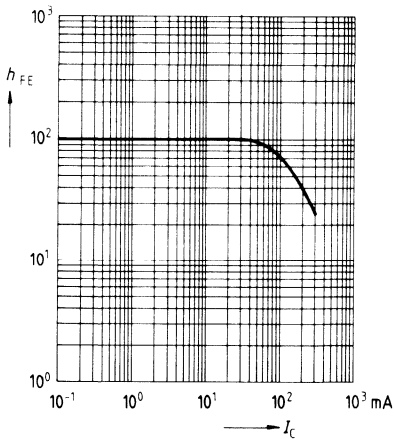
**Collector cutoff current  $I_{CB0} = f(T_A)$**

$V_{CB} = 200 \text{ V}$



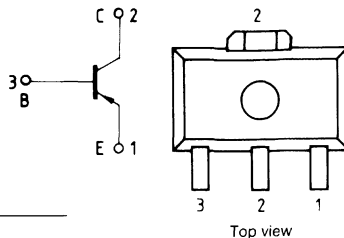
**DC current gain  $h_{FE} = f(I_C)$**

$V_{CE} = 10 \text{ V}$



## PNP silicon planar epitaxial transistors

- High breakdown voltage
- Low collector-emitter saturation voltage
- Complementary NPN types: BFN 16, BFN 18



Type	Marking	Ordering code	Package
BFN 17	DG	Refer to index	Version C
BFN 19	DH		

Maximum ratings		BFN 17	BFN 19
Collector-emitter voltage	$V_{CE0}$	250 V	300 V
Collector-base voltage	$V_{CB0}$	250 V	300 V
Emitter-base voltage	$V_{EB0}$		5 V
Collector current	$I_C$		200 mA
Peak collector current	$I_{CM}$		500 mA
Base current	$I_B$		100 mA
Peak base current	$I_{BM}$		200 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$		1,0 W
Junction temperature	$T_j$		150 °C
Storage temperature range	$T_{stg}$		-65 ... +150 °C
<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$		≤ 125 K/W

## Characteristics

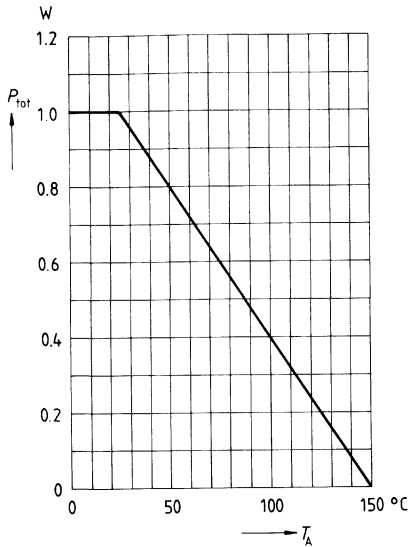
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$	$V_{(BR)CE0}$				
BFN 17		250	–	–	V
BFN 19		300	–	–	V
Collector-base breakdown voltage $I_C = 100\ \mu\text{A}$	$V_{(BR)CB0}$				
BFN 17		250	–	–	V
BFN 19		300	–	–	V
Emitter-base breakdown voltage $I_E = 100\ \mu\text{A}$	$V_{(BR)EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 200\text{ V}$	$I_{CB0}$				
BFN 17		–	–	100	nA
$V_{CB} = 250\text{ V}$	BFN 19	–	–	100	nA
$V_{CB} = 200\text{ V}, T_A = 150^\circ\text{C}$	BFN 17	–	–	20	$\mu\text{A}$
$V_{CB} = 250\text{ V}, T_A = 150^\circ\text{C}$	BFN 19	–	–	20	$\mu\text{A}$
Emitter cutoff current $V_{EB} = 3\text{ V}$	$I_{EB0}$	–	–	100	nA
DC current gain $I_C = 1\text{ mA}, V_{CE} = 10\text{ V}$	$h_{FE}$	25	–	–	–
$I_C = 10\text{ mA}, V_{CE} = 10\text{ V}^1)$		40	–	–	–
$I_C = 30\text{ mA}, V_{CE} = 10\text{ V}^1)$	BFN 17	40	–	–	–
	BFN 19	30	–	–	–
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 20\text{ mA}, I_B = 2\text{ mA}$	$V_{CEsat}$				
BFN 17		–	–	0,4	V
BFN 19		–	–	0,5	V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 20\text{ mA}, I_B = 2\text{ mA}$	$V_{BEsat}$	–	–	0,9	V

Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 20\text{ mA}, V_{CE} = 10\text{ V}, f = 20\text{ MHz}$	$f_T$	–	100	–	MHz
Output capacitance $V_{CB} = 30\text{ V}, f = 1\text{ MHz}$	$C_{ob}$	–	2,5	–	pF

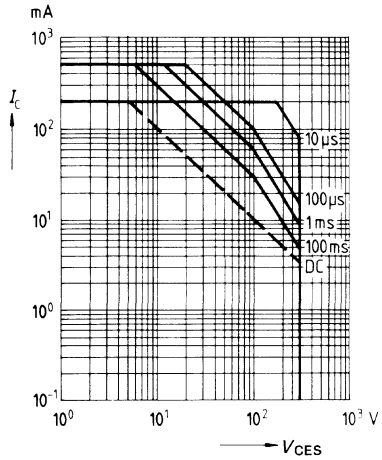
<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

**Total power dissipation  $P_{\text{tot}} = f(T_A)$**

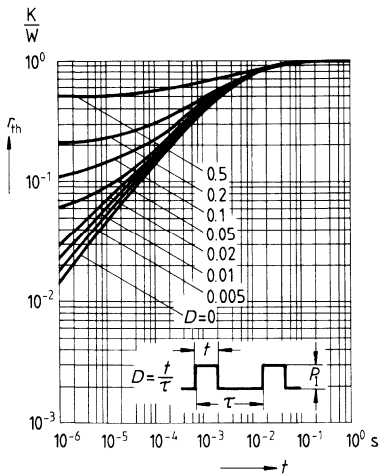


**Operating range  $I_c = f(V_{\text{CES}})$**

$T_A = 25^\circ\text{C}, D = 0$

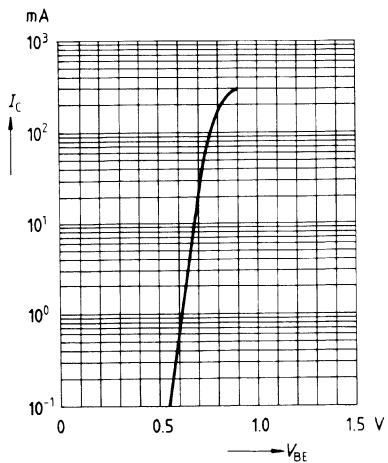


**Pulse handling capability  $r_{\text{th}} = f(t)$**



**Collector current  $I_c = f(V_{\text{BE}})$**

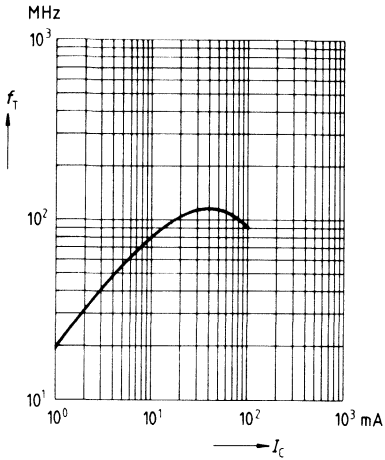
$V_{\text{CE}} = 10 \text{ V}$





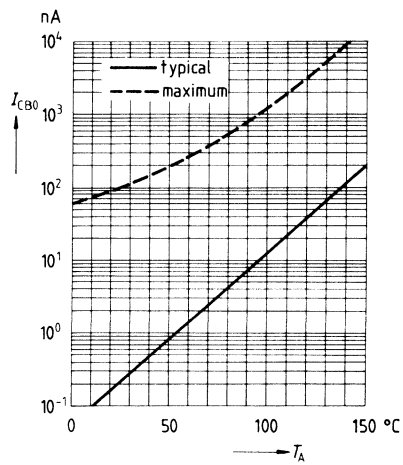
**Transition frequency  $f_T = f(I_C)$**

$V_{CE} = 10 \text{ V}$



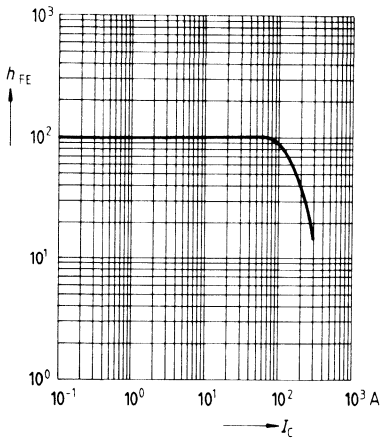
**Collector cutoff current  $I_{CB0} = f(T_A)$**

$V_{CB} = 200 \text{ V}$



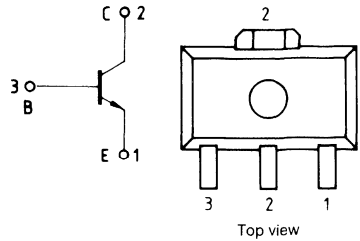
**DC current gain  $h_{FE} = f(I_C)$**

$V_{CE} = 10 \text{ V}$



**NPN silicon planar epitaxial transistor**

- High breakdown voltage
- Low collector-emitter saturation voltage
- Low capacitance
- Complementary PNP type: BFN 21



Type	Marking	Ordering code	Package
BFN 20	DC	Refer to index	Version C

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	300 V
Collector-base voltage	$V_{CB0}$	300 V
Collector-emitter voltage $R_{BE} = 2,7 \text{ k}\Omega$	$V_{CER}$	300 V
Emitter-base voltage	$V_{EB0}$	5 V
Collector current	$I_C$	50 mA
Peak collector current	$I_{CM}$	100 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	1,0 W
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	- 65 ... + 150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 125 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

## Characteristics

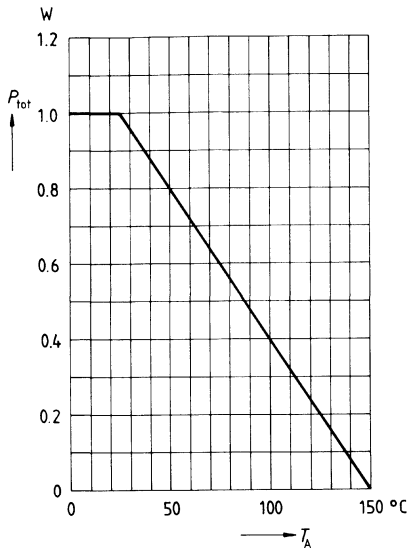
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$	$V_{(BR)CE0}$	300	–	–	V
Collector-base breakdown voltage $I_C = 10\ \mu\text{A}$	$V_{(BR)CB0}$	300	–	–	V
Collector-emitter breakdown voltage $I_C = 10\ \mu\text{A}$ , $R_{BE} = 2,7\ \text{k}\Omega$	$V_{(BR)CER}$	300	–	–	V
Emitter-base breakdown voltage $I_E = 10\ \mu\text{A}$	$V_{(BR)EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 250\ \text{V}$ $V_{CB} = 250\ \text{V}$ , $T_A = 150^\circ\text{C}$	$I_{CB0}$	– –	– –	100 20	nA $\mu\text{A}$
Collector cutoff current $V_{CE} = 300\ \text{V}$ , $R_{BE} = 2,7\ \text{k}\Omega$ $V_{CE} = 300\ \text{V}$ , $T_A = 150^\circ\text{C}$ , $R_{BE} = 2,7\ \text{k}\Omega$	$I_{CER}$	– –	– –	1 50	$\mu\text{A}$ $\mu\text{A}$
Emitter cutoff current $V_{EB} = 5\ \text{V}$	$I_{EB0}$	–	–	10	$\mu\text{A}$
DC current gain <sup>1)</sup> $I_C = 25\ \text{mA}$ , $V_{CE} = 20\ \text{V}$	$h_{FE}$	40	–	–	–
Collector-emitter-saturation voltage <sup>1)</sup> $I_C = 10\ \text{mA}$ , $I_B = 1\ \text{mA}$	$V_{CEsat}$	–	–	0,5	V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 10\ \text{mA}$ , $I_B = 1\ \text{mA}$	$V_{BEsat}$	–	–	1	V

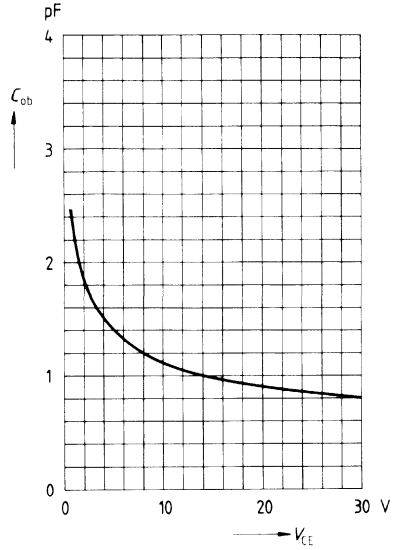
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 10\ \text{mA}$ , $V_{CE} = 10\ \text{V}$ , $f = 20\ \text{MHz}$	$f_T$	–	100	–	MHz
Output capacitance $V_{CB} = 30\ \text{V}$ , $f = 1\ \text{MHz}$	$C_{ob}$	–	0,8	–	pF

<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

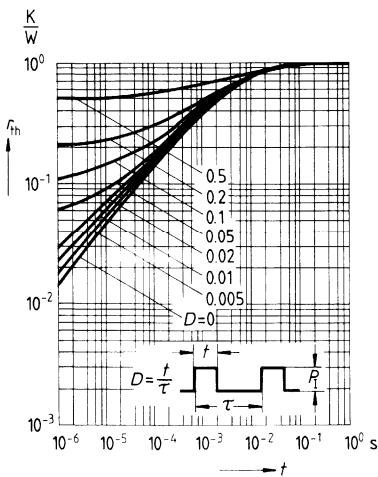
**Total power dissipation  $P_{tot} = f(T_A)$**



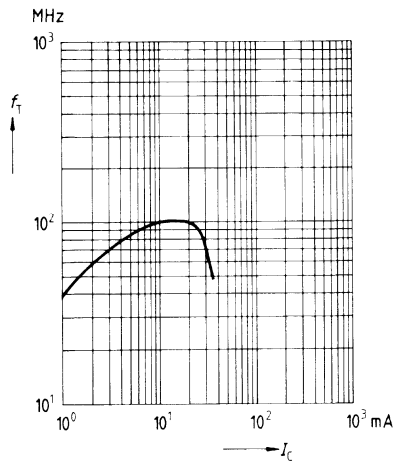
**Output capacitance  $C_{ob} = f(V_{CE})$   
 $f = 1 \text{ MHz}$**



**Pulse handling capability  $r_{th} = f(t)$   
(standardized)**

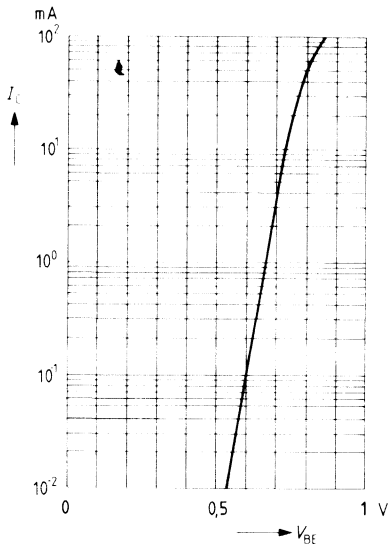


**Transition frequency  $f_T = f(I_C)$   
 $V_{CE} = 10 \text{ V}$**



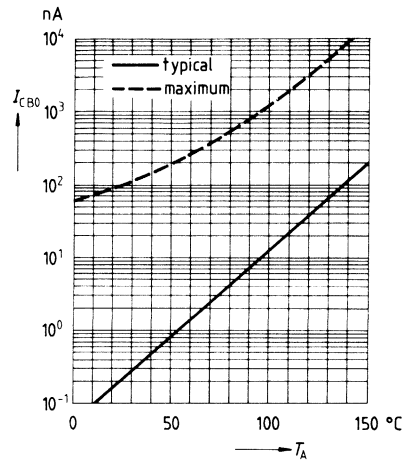
**Collector current  $I_C = f(V_{BE})$**

$V_{CE} = 20\text{ V}$



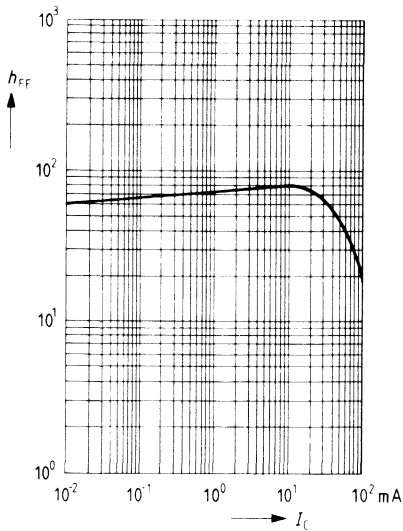
**Collector cutoff current  $I_{CB0} = f(T_A)$**

$V_{CB} = 250\text{ V}$



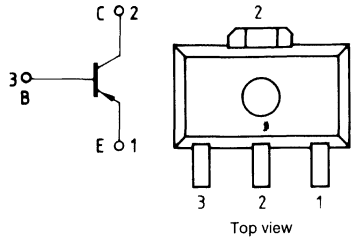
**DC current gain  $h_{FE} = f(I_C)$**

$V_{CE} = 20\text{ V}$



**PNP silicon planar epitaxial transistor**

- High breakdown voltage
- Low collector-emitter saturation voltage
- Low capacitance
- Complementary NPN type: BFN 20



Type	Marking	Ordering code	Package
BFN 21	DF	Refer to index	Version C

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	300 V
Collector-base voltage	$V_{CB0}$	300 V
Collector-emitter voltage	$V_{CER}$	300 V
$R_{BE} = 2,7 \text{ k}\Omega$		
Emitter-base voltage	$V_{EB0}$	5 V
Collector current	$I_C$	50 mA
Peak collector current	$I_{CM}$	100 mA
Total power dissipation	$P_{tot}$	1,0 W
$T_A = 25^\circ\text{C}$		
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	- 65 ... + 150 °C

<b>Thermal resistance</b>	$R_{thJA}$	$\leq 125 \text{ K/W}$
junction-ambient		
package mounted on alumina		
15 mm × 16.7 mm × 0.7 mm		

## Characteristics

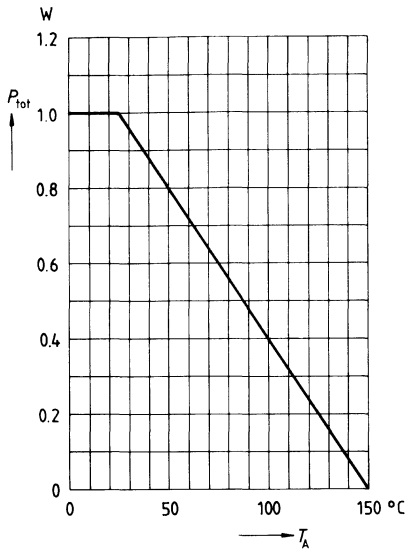
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$	$V_{(BR)CE0}$	300	–	–	V
Collector-base breakdown voltage $I_C = 10\ \mu\text{A}$	$V_{(BR)CB0}$	300	–	–	V
Collector-emitter breakdown voltage $I_C = 10\ \mu\text{A}$ , $R_{BE} = 2,7\ \text{k}\Omega$	$V_{(BR)CER}$	300	–	–	V
Emitter-base breakdown voltage $I_E = 10\ \mu\text{A}$	$V_{(BR)EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 250\ \text{V}$ $V_{CB} = 250\ \text{V}$ , $T_A = 150^\circ\text{C}$	$I_{CB0}$	– –	– –	100 20	nA $\mu\text{A}$
Collector cutoff current $V_{CE} = 300\ \text{V}$ , $R_{BE} = 2,7\ \text{k}\Omega$ $V_{CE} = 300\ \text{V}$ , $T_A = 150^\circ\text{C}$ , $R_{BE} = 2,7\ \text{k}\Omega$	$I_{CER}$	– –	– –	1 50	$\mu\text{A}$ $\mu\text{A}$
Emitter cutoff current $V_{EB} = 5\ \text{V}$	$I_{EB0}$	–	–	10	$\mu\text{A}$
DC current gain <sup>1)</sup> $I_C = 25\ \text{mA}$ , $V_{CE} = 20\ \text{V}$	$h_{FE}$	40	–	–	–
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 10\ \text{mA}$ , $I_B = 1\ \text{mA}$	$V_{CEsat}$	–	–	0,5	V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 10\ \text{mA}$ , $I_B = 1\ \text{mA}$	$V_{BEsat}$	–	–	1	V

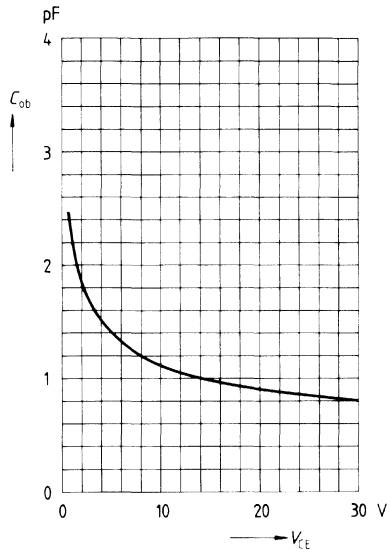
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 10\ \text{mA}$ , $V_{CE} = 10\ \text{V}$ , $f = 20\ \text{MHz}$	$f_T$	–	100	–	MHz
Output capacitance $V_{CB} = 30\ \text{V}$ , $f = 1\ \text{MHz}$	$C_{ob}$	–	1,2	–	pF

<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

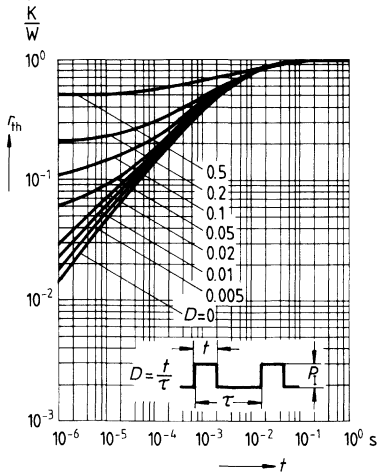
**Total power dissipation**  $P_{tot} = f(T_A)$



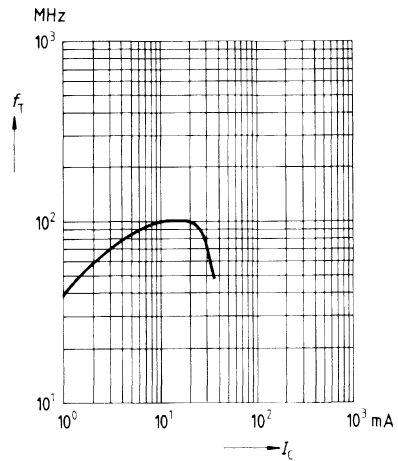
**Output capacitance**  $C_{ob} = f(V_{CE})$   
 $f = 1 \text{ MHz}$



**Pulse handling capability**  $r_{th} = f(t)$   
(standardized)



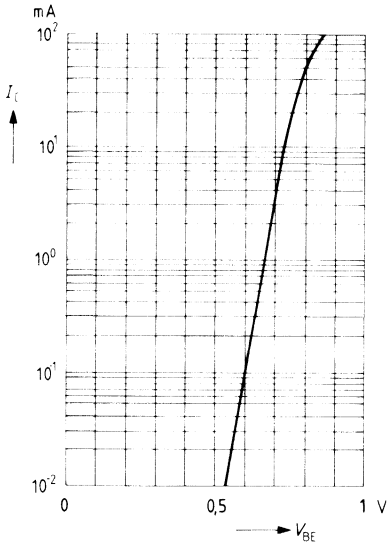
**Transition frequency**  $f_T = f(I_C)$   
 $V_{CE} = 10 \text{ V}$





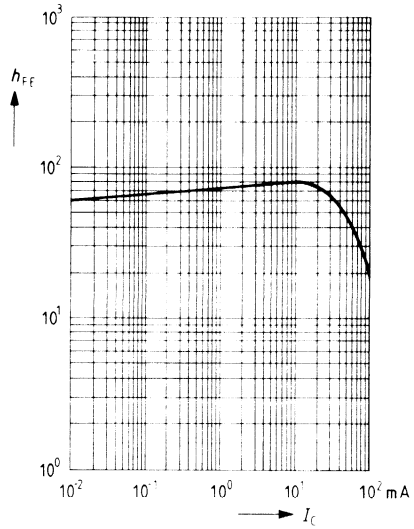
**Collector current  $I_C = f(V_{BE})$**

$V_{CE} = 20 \text{ V}$



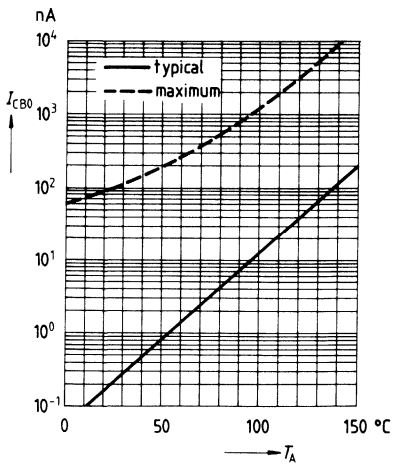
**DC current gain  $h_{FE} = f(I_C)$**

$V_{CE} = 20 \text{ V}$



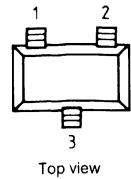
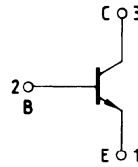
**Collector cutoff current  $I_{CB0} = f(T_A)$**

$V_{CB} = 250 \text{ V}$



**NPN silicon planar epitaxial transistor**

- High breakdown voltage
- Low collector-emitter saturation voltage
- Low capacitance
- Complementary PNP type: BFN 23



Type	Marking	Ordering code	Package
BFN 22	HB	Refer to index	Version A

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	250 V
Collector-base voltage	$V_{CB0}$	250 V
Collector-emitter voltage $R_{BE} = 2,7 \text{ k}\Omega$	$V_{CER}$	250 V
Emitter-base voltage	$V_{EB0}$	5 V
Collector current	$I_C$	50 mA
Peak collector current	$I_{CM}$	100 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	360 mW
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	-65 ... +150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 350 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

## Characteristics

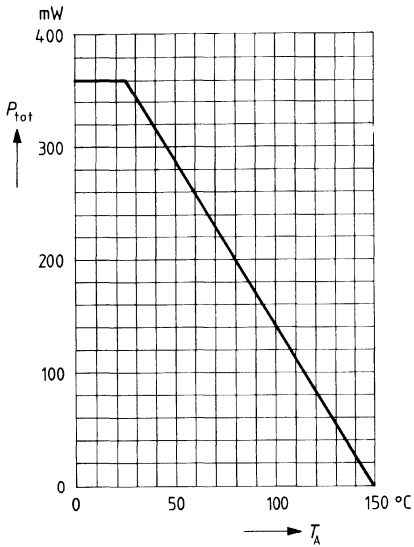
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$	$V_{(BR)CE0}$	250	–	–	V
Collector-base breakdown voltage $I_C = 10\text{ }\mu\text{A}$	$V_{(BR)CB0}$	250	–	–	V
Collector-emitter breakdown voltage $I_C = 10\text{ }\mu\text{A}$ , $R_{BE} = 2,7\text{ k}\Omega$	$V_{(BR)CER}$	250	–	–	V
Emitter-base breakdown voltage $I_E = 10\text{ }\mu\text{A}$	$V_{(BR)EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 200\text{ V}$ $V_{CB} = 200\text{ V}$ , $T_A = 150^\circ\text{C}$	$I_{CB0}$	– –	– –	100 20	nA $\mu\text{A}$
Collector cutoff current $V_{CE} = 250\text{ V}$ , $R_{BE} = 2,7\text{ k}\Omega$ $V_{CE} = 250\text{ V}$ , $T_A = 150^\circ\text{C}$ , $R_{BE} = 2,7\text{ k}\Omega$	$I_{CER}$	– –	– –	1 50	$\mu\text{A}$ $\mu\text{A}$
Emitter cutoff current $V_{EB} = 5\text{ V}$	$I_{EB0}$	–	–	10	$\mu\text{A}$
DC current gain <sup>1)</sup> $I_C = 25\text{ mA}$ , $V_{CE} = 20\text{ V}$	$h_{FE}$	50	–	–	–
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 10\text{ mA}$ , $I_B = 1\text{ mA}$	$V_{CEsat}$	–	–	0,5	V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 10\text{ mA}$ , $I_B = 1\text{ mA}$	$V_{BEsat}$	–	–	1	V

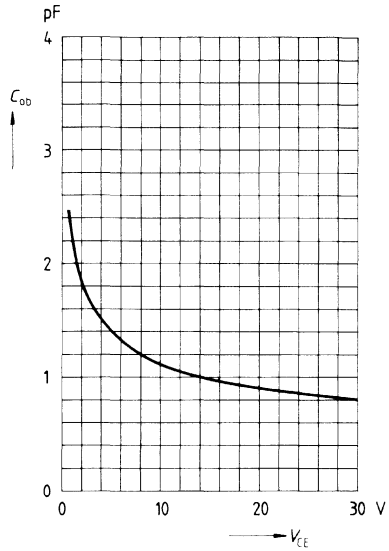
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 20\text{ MHz}$	$f_T$	–	100	–	MHz
Output capacitance $V_{CB} = 30\text{ V}$ , $f = 1\text{ MHz}$	$C_{ob}$	–	0,8	–	pF

<sup>1)</sup> Pulse test:  $t = 300\text{ }\mu\text{s}$ ,  $D = 2\%$ .

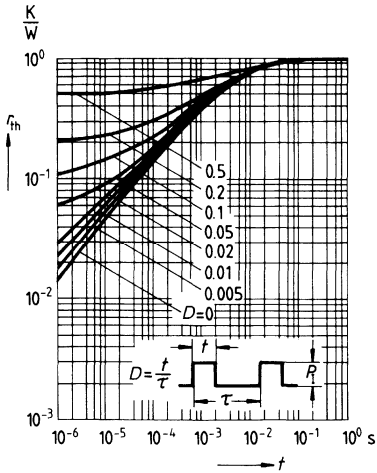
**Total power dissipation**  $P_{\text{tot}} = f(T_A)$



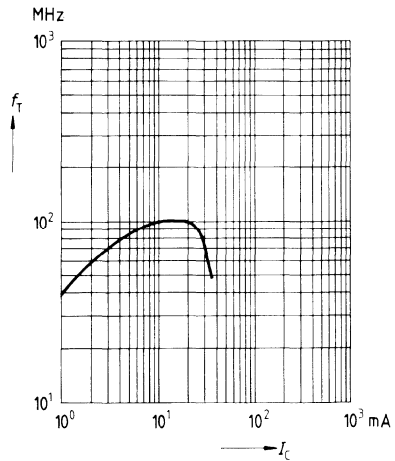
**Output capacitance**  $C_{\text{ob}} = f(V_{\text{CE}})$   
 $f = 1 \text{ MHz}$



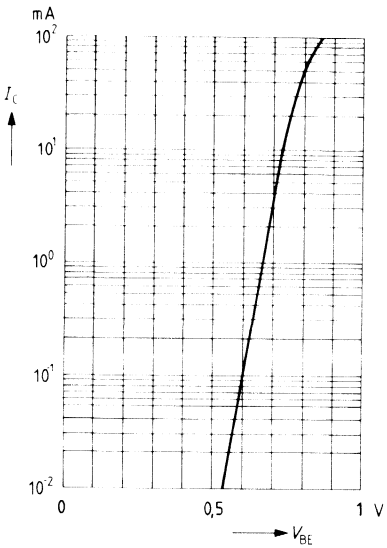
**Pulse handling capability**  $r_{\text{th}} = f(t)$   
(standardized)



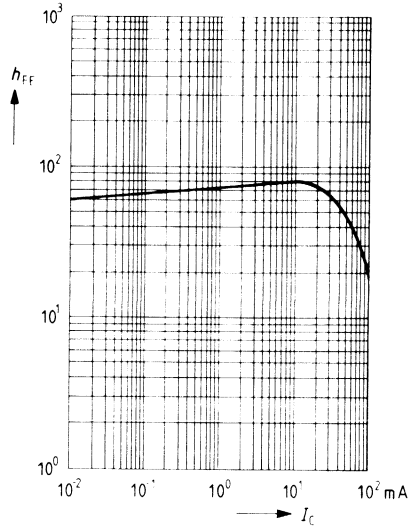
**Transition frequency**  $f_T = f(I_C)$   
 $V_{\text{CE}} = 10 \text{ V}$



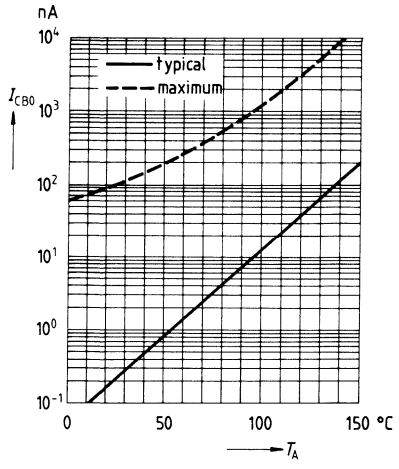
**Collector current  $I_C = f(V_{BE})$**   
 $V_{CE} = 20\text{ V}$



**DC current gain  $h_{FE} = f(I_C)$**   
 $V_{CE} = 20\text{ V}$

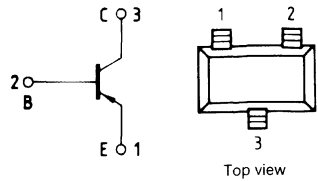


**Collector cutoff current  $I_{CB0} = f(T_A)$**   
 $V_{CB} = 200\text{ V}$



## PNP silicon planar epitaxial transistor

- High breakdown voltage
- Low collector-emitter saturation voltage
- Low capacitance
- Complementary NPN type: BFN 22



Type	Marking	Ordering code	Package
BFN 23	HC	Refer to index	Version A

## Maximum ratings

Collector-emitter voltage	$V_{CE0}$	250 V
Collector-base voltage	$V_{CB0}$	250 V
Collector-emitter voltage $R_{BE} = 2,7 \text{ k}\Omega$	$V_{CER}$	250 V
Emitter-base voltage	$V_{EB0}$	5 V
Collector current	$I_C$	50 mA
Peak collector current	$I_{CM}$	100 mA
Total power dissipation $T_A = 25 \text{ }^\circ\text{C}$	$P_{tot}$	360 mW
Junction temperature	$T_j$	150 $^\circ\text{C}$
Storage temperature range	$T_{stg}$	-65 ... +150 $^\circ\text{C}$

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 350 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

**Characteristics**

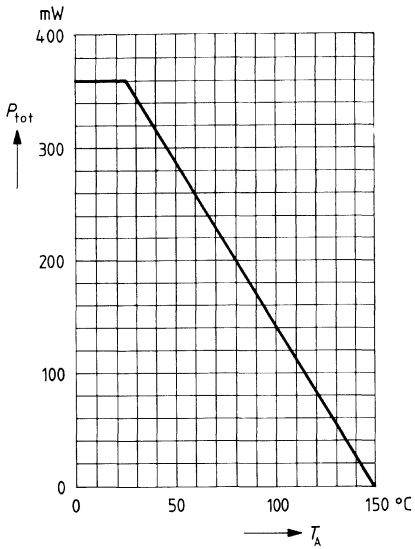
at  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise specified

<b>Static characteristics</b>	<b>Symbol</b>	<b>min</b>	<b>typ</b>	<b>max</b>	<b>Unit</b>
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$	$V_{(BR)CE0}$	250	–	–	V
Collector-base breakdown voltage $I_C = 10\text{ }\mu\text{A}$	$V_{(BR)CB0}$	250	–	–	V
Collector-emitter breakdown voltage $I_C = 10\text{ }\mu\text{A}$ , $R_{BE} = 2,7\text{ k}\Omega$	$V_{(BR)CER}$	250	–	–	V
Emitter-base breakdown voltage $I_E = 10\text{ }\mu\text{A}$	$V_{(BR)EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 200\text{ V}$ $V_{CB} = 200\text{ V}$ , $T_A = 150\text{ }^\circ\text{C}$	$I_{CB0}$	– –	– –	100 20	nA $\mu\text{A}$
Collector cutoff current $V_{CE} = 250\text{ V}$ , $R_{BE} = 2,7\text{ k}\Omega$ $V_{CE} = 250\text{ V}$ , $T_A = 150\text{ }^\circ\text{C}$ , $R_{BE} = 2,7\text{ k}\Omega$	$I_{CER}$	– –	– –	1 50	$\mu\text{A}$ $\mu\text{A}$
Emitter cutoff current $V_{EB} = 5\text{ V}$	$I_{EB0}$	–	–	10	$\mu\text{A}$
DC current gain <sup>1)</sup> $I_C = 25\text{ mA}$ , $V_{CE} = 20\text{ V}$	$h_{FE}$	50	–	–	–
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 10\text{ mA}$ , $I_B = 1\text{ mA}$	$V_{CEsat}$	–	–	0,5	V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 10\text{ mA}$ , $I_B = 1\text{ mA}$	$V_{BEsat}$	–	–	1	V

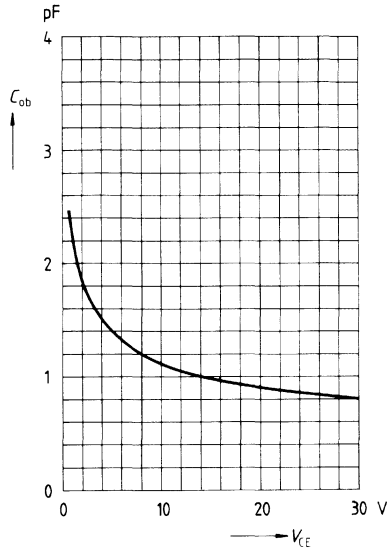
<b>Dynamic characteristics</b>	<b>Symbol</b>	<b>min</b>	<b>typ</b>	<b>max</b>	<b>Unit</b>
Transition frequency $I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 20\text{ MHz}$	$f_T$	–	100	–	MHz
Output capacitance $V_{CB} = 30\text{ V}$ , $f = 1\text{ MHz}$	$C_{ob}$	–	1,2	–	pF

<sup>1)</sup> Pulse test:  $t = 300\text{ }\mu\text{s}$ ,  $D = 2\%$ .

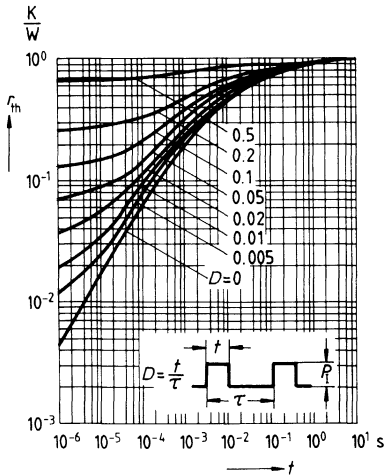
**Total power dissipation  $P_{tot} = f(T_A)$**



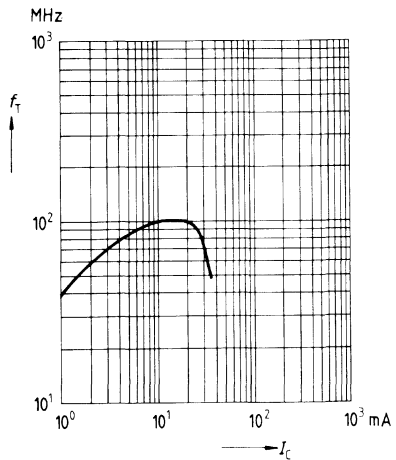
**Output capacitance  $C_{ob} = f(V_{CE})$   
 $f = 1$  MHz**



**Pulse handling capability  $r_{th} = f(t)$   
(standardized)**



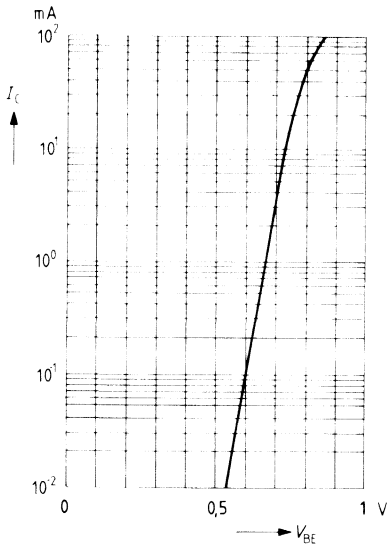
**Transition frequency  $f_T = f(I_C)$   
 $V_{CE} = 10$  V**





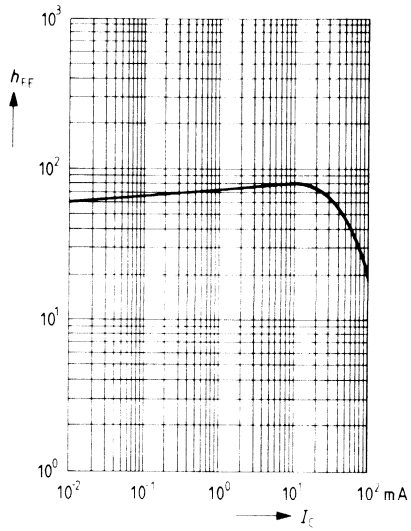
**Collector current  $I_C = f(V_{BE})$**

$V_{CE} = 20 \text{ V}$



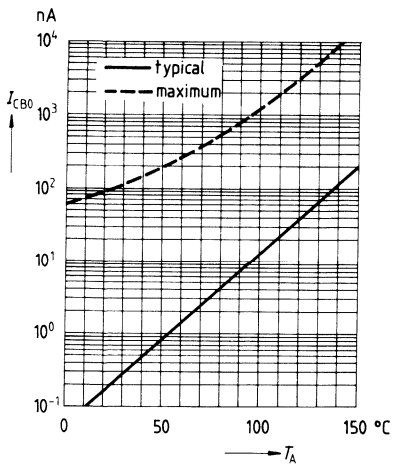
**DC current gain  $h_{FE} = f(I_C)$**

$V_{CE} = 20 \text{ V}$



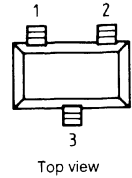
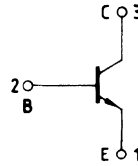
**Collector cutoff current  $I_{CB0} = f(T_A)$**

$V_{CB} = 200 \text{ V}$



## NPN silicon planar epitaxial transistors

- High breakdown voltage
- Low collector-emitter saturation voltage
- Complementary PNP types: BFN 25, BFN 27



Type	Marking	Ordering code	Package
BFN 24	FH	Refer to index	Version A
BFN 26	FJ		

Maximum ratings		BFN 24	BFN 26
Collector-emitter voltage	$V_{CE0}$	250 V	300 V
Collector-base voltage	$V_{CB0}$	250 V	300 V
Emitter-base voltage	$V_{EB0}$		5 V
Collector current	$I_C$		200 mA
Peak collector current	$I_{CM}$		500 mA
Base current	$I_B$		100 mA
Peak base current	$I_{BM}$		200 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$		360 mW
Junction temperature	$T_j$		150 °C
Storage temperature range	$T_{stg}$		-65 ... +150 °C
<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$		≤ 350 K/W

## Characteristics

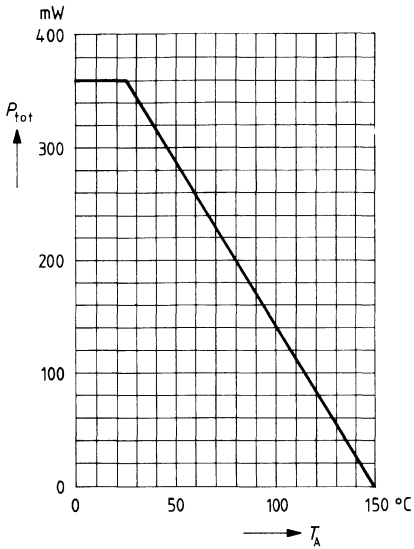
at  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$ BFN 24 BFN 26	$V_{(BR)CE0}$	250 300	– –	– –	V V
Collector-base breakdown voltage $I_C = 100\text{ }\mu\text{A}$ BFN 24 BFN 26	$V_{(BR)CB0}$	250 300	– –	– –	V V
Emitter-base breakdown voltage $I_E = 100\text{ }\mu\text{A}$	$V_{(BR)EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 200\text{ V}$ BFN 24 $V_{CB} = 250\text{ V}$ BFN 26 $V_{CB} = 200\text{ V}, T_A = 150\text{ }^\circ\text{C}$ BFN 24 $V_{CB} = 250\text{ V}, T_A = 150\text{ }^\circ\text{C}$ BFN 26	$I_{CB0}$	– – – –	– – – –	100 100 20 20	nA nA $\mu\text{A}$ $\mu\text{A}$
Emitter cutoff current $V_{EB} = 3\text{ V}$	$I_{EB0}$	–	–	100	nA
DC current gain $I_C = 1\text{ mA}, V_{CE} = 10\text{ V}$ $I_C = 10\text{ mA}, V_{CE} = 10\text{ V}^1)$ $I_C = 30\text{ mA}, V_{CE} = 10\text{ V}^1)$ BFN 24 BFN 26	$h_{FE}$	25 40 40 30	– – – –	– – – –	– – – –
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 20\text{ mA}, I_B = 2\text{ mA}$ BFN 24 BFN 26	$V_{CEsat}$	– –	– –	0,4 0,5	V V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 20\text{ mA}, I_B = 2\text{ mA}$	$V_{BEsat}$	–	–	0,9	V

Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 20\text{ mA}, V_{CE} = 10\text{ V}, f = 20\text{ MHz}$	$f_T$	–	70	–	MHz
Output capacitance $V_{CB} = 30\text{ V}, f = 1\text{ MHz}$	$C_{ob}$	–	1,5	–	pF

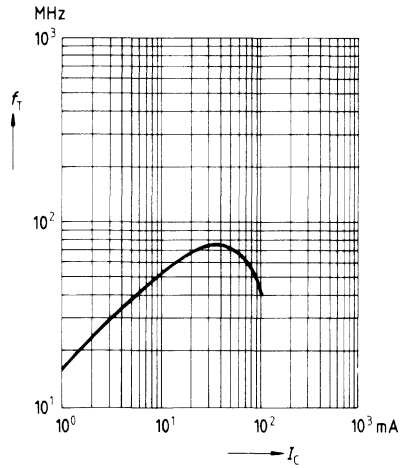
<sup>1)</sup> Pulse test:  $t = 300\text{ }\mu\text{s}$ ,  $D = 2\%$ .

**Total power dissipation  $P_{tot} = f(T_A)$**

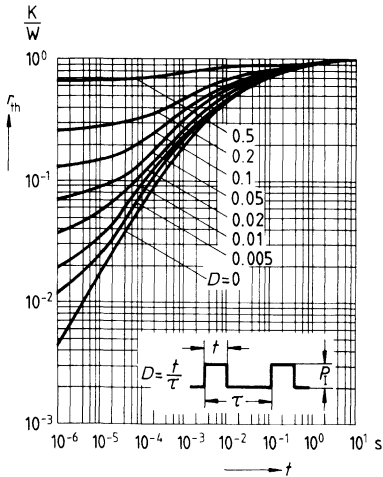


**Transition frequency  $f_T = f(I_C)$**

$V_{CE} = 10 \text{ V}$

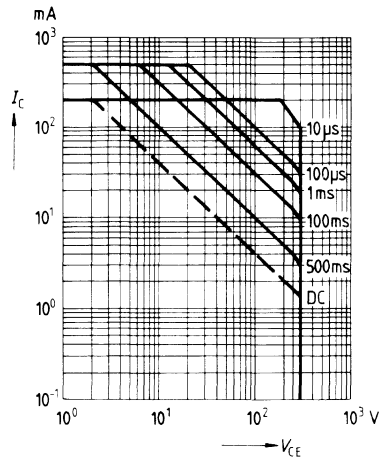


**Pulse handling capability  $r_{th} = f(t)$**   
(standardized)



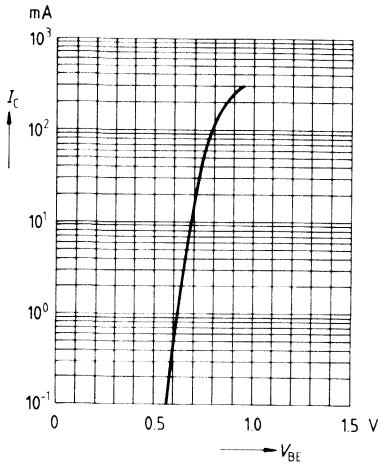
**Operating range  $I_C = f(V_{CE})$**

$T_A = 25^\circ \text{C}, D = 0$



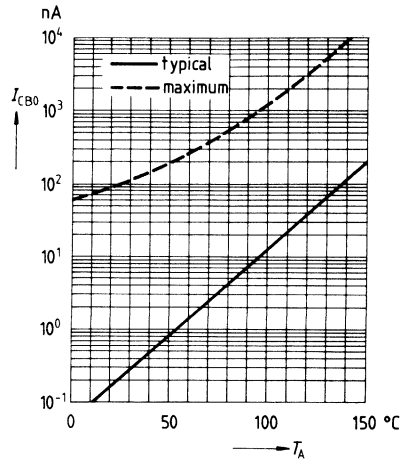
**Collector current  $I_C = f(V_{BE})$**

$V_{CE} = 10\text{ V}$



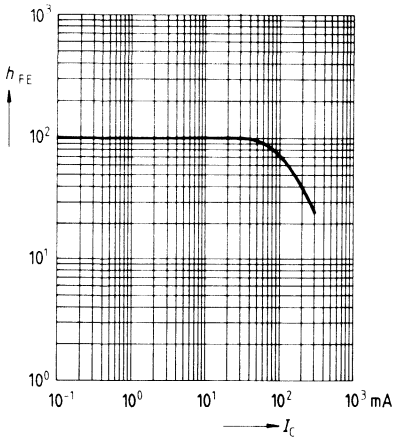
**Collector cutoff current  $I_{CB0} = f(T_A)$**

$V_{CB} = 200\text{ V}$



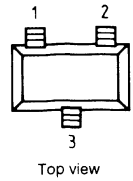
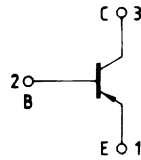
**DC current gain  $h_{FE} = f(I_C)$**

$V_{CE} = 10\text{ V}$



## PNP silicon planar epitaxial transistors

- High breakdown voltage
- Low collector-emitter saturation voltage
- Complementary NPN types: BFN 24, BFN 26



Type	Marking	Ordering code	Package
BFN 25	FK	Refer to index	Version A
BFN 27	FL		

Maximum ratings		BFN 25	BFN 27
Collector-emitter voltage	$V_{CE0}$	250 V	300 V
Collector-base voltage	$V_{CB0}$	250 V	300 V
Emitter-base voltage	$V_{EB0}$		5 V
Collector current	$I_C$		200 mA
Peak collector current	$I_{CM}$		500 mA
Base current	$I_B$		100 mA
Peak base current	$I_{BM}$		200 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$		360 mW
Junction temperature	$T_j$		150 °C
Storage temperature range	$T_{stg}$		-65 ... +150 °C
<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$		≤ 350 K/W

## Characteristics

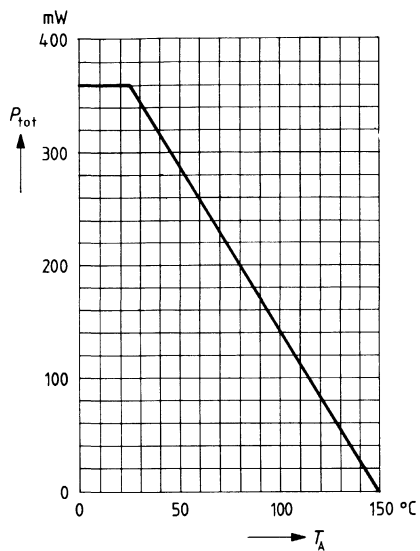
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$ BFN 25 BFN 27	$V_{(BR)CE0}$	250 300	– –	– –	V V
Collector-base breakdown voltage $I_C = 100\ \mu\text{A}$ BFN 25 BFN 27	$V_{(BR)CB0}$	250 300	– –	– –	V V
Emitter-base breakdown voltage $I_E = 100\ \mu\text{A}$	$V_{(BR)EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 200\text{ V}$ BFN 25 $V_{CB} = 250\text{ V}$ BFN 27 $V_{CB} = 200\text{ V}, T_A = 150^\circ\text{C}$ BFN 25 $V_{CB} = 250\text{ V}, T_A = 150^\circ\text{C}$ BFN 27	$I_{CB0}$	– – – –	– – – –	100 100 20 20	nA nA $\mu\text{A}$ $\mu\text{A}$
Emitter cutoff current $V_{EB} = 3\text{ V}$	$I_{EB0}$	–	–	100	nA
DC current gain $I_C = 1\text{ mA}, V_{CE} = 10\text{ V}$ $I_C = 10\text{ mA}, V_{CE} = 10\text{ V}^1)$ $I_C = 30\text{ mA}, V_{CE} = 10\text{ V}^1)$ BFN 25 BFN 27	$h_{FE}$	25 40 40 30	– – – –	– – – –	– – – –
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 20\text{ mA}, I_B = 2\text{ mA}$ BFN 25 BFN 27	$V_{CEsat}$	– –	– –	0,4 0,5	V V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 20\text{ mA}, I_B = 2\text{ mA}$	$V_{BEsat}$	–	–	0,9	V

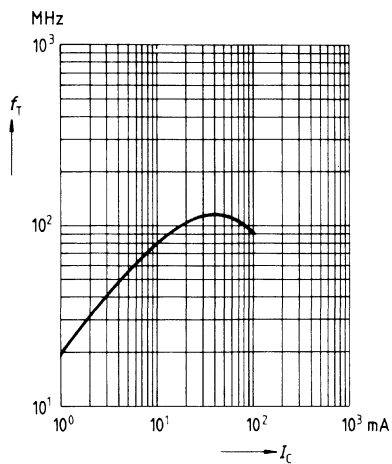
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 20\text{ mA}, V_{CE} = 10\text{ V}, f = 20\text{ MHz}$	$f_T$	–	100	–	MHz
Output capacitance $V_{CB} = 30\text{ V}, f = 1\text{ MHz}$	$C_{ob}$	–	2,5	–	pF

<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

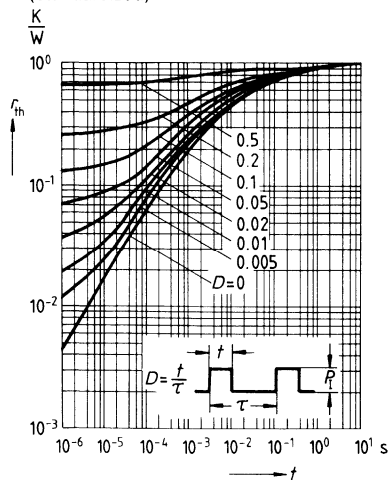
**Total power dissipation  $P_{tot} = f(T_A)$**



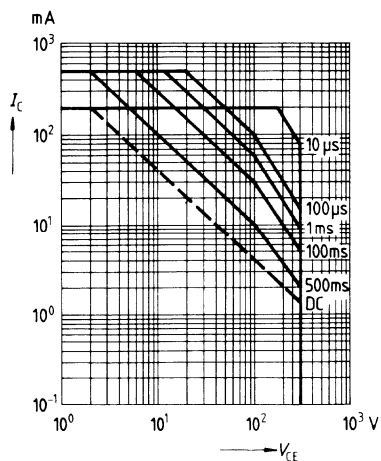
**Transition frequency  $f_T = f(I_C)$**   
 $V_{CE} = 10 \text{ V}$



**Pulse handling capability  $r_{th} = f(t)$**   
(standardized)

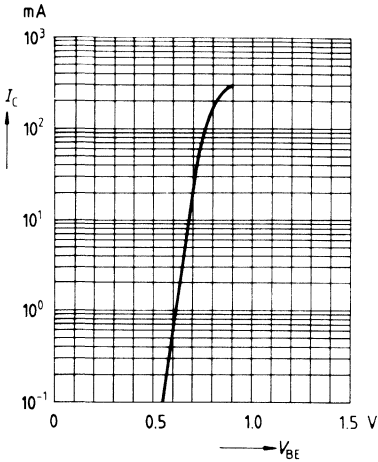


**Operating range  $I_C = f(V_{CE})$**   
 $T_A = 25^\circ\text{C}, D = 0$

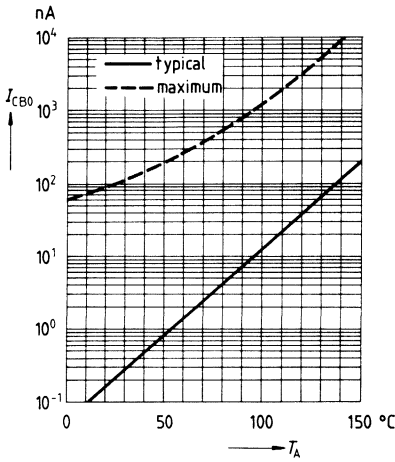




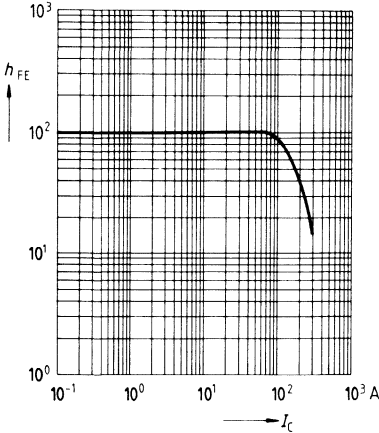
**Collector current  $I_C = f(V_{BE})$**   
 $V_{CE} = 10 \text{ V}$



**Collector cutoff current  $I_{CB0} = f(T_A)$**   
 $V_{CB} = 200 \text{ V}$

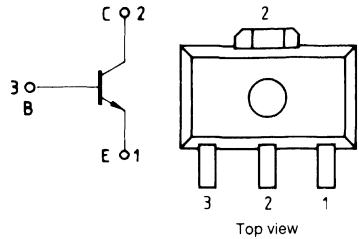


**DC current gain  $h_{FE} = f(I_C)$**   
 $V_{CE} = 10 \text{ V}$



**NPN silicon planar epitaxial transistor**

- For VHF and UHF broadband amplifier output stages



Type	Marking	Ordering code	Package
BFQ 17 P	FA	Refer to index	Version C

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	25 V
Collector-base voltage	$V_{CB0}$	40 V
Collector-emitter voltage $R_{BE} \leq 50 \Omega$	$V_{CER}$	40 V
Emitter-base voltage	$V_{EB0}$	2 V
Collector current	$I_C$	150 mA
Peak collector current $f \geq 1 \text{ MHz}$	$I_{CM}$	300 mA
Total power dissipation $T_A \leq 25^\circ\text{C}$	$P_{tot}$	1,0 W
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	- 65 ... + 150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	$\leq 125 \text{ K/W}$
------------------------------------------------------------------------------------------------------------	------------	------------------------

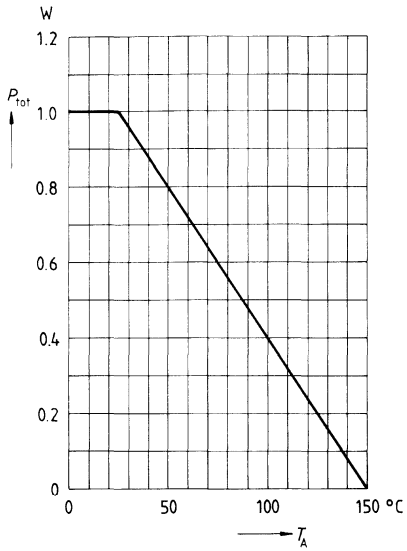
## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 10\text{ mA}$ , $V_B = 0$	$V_{(BR)CE0}$	25	–	–	V
Collector cutoff current $V_{CB} = 20\text{ V}$ , $I_E = 0$ $V_{CB} = 20\text{ V}$ , $I_E = 0$ , $T_A = 125^\circ\text{C}$	$I_{CB0}$	– –	– –	100 20	nA $\mu\text{A}$
Emitter cutoff current $V_{EB} = 1\text{ V}$ , $I_C = 0$	$I_{EB0}$	–	–	100	nA
DC current gain $I_C = 50\text{ mA}$ , $V_{CE} = 5\text{ V}$ $I_C = 150\text{ mA}$ , $V_{CE} = 5\text{ V}$	$h_{FE}$	25 25	– –	– –	– –
Collector-emitter saturation voltage $I_C = 100\text{ mA}$ , $I_B = 10\text{ mA}$	$V_{CEsat}$	–	0,2	0,5	V

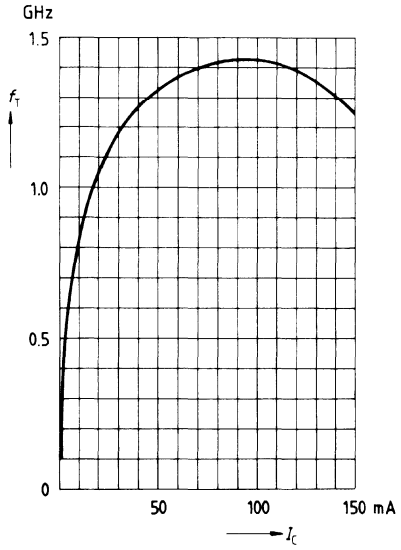
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 70\text{ mA}$ , $V_{CE} = 5\text{ V}$ , $f = 200\text{ MHz}$ $I_C = 150\text{ mA}$ , $V_{CE} = 5\text{ V}$ , $f = 200\text{ MHz}$	$f_T$	– –	1,4 1,2	– –	GHz GHz
Output capacitance $V_{CB} = 15\text{ V}$ , $f = 1\text{ MHz}$ $I_E = i_e = 0$	$C_{ob}$	–	–	4	pF
Collector-base feedback capacitance $V_{CB} = 10\text{ V}$ , $V_{BE} = 0$ , $f = 1\text{ MHz}$	$C_{re}$	–	1,9	–	pF
Output voltage (two tone intermodulation test) $d_{iM} = 60\text{ dB}$ , $I_C = 60\text{ mA}$ , $V_{CE} = 15\text{ V}$ , $R_G = R_L = 50\ \Omega$ , $f_1 = 206\text{ MHz}$ , $f_2 = 210\text{ MHz}$	$V_{01} = V_{02}$	–	480	–	mV

**Total power dissipation  $P_{\text{tot}} = f(T_A)$**

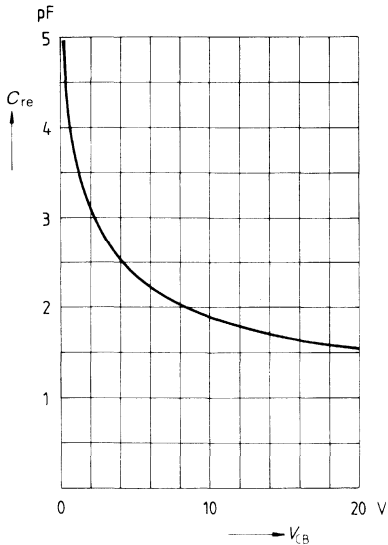


**Transition frequency  $f_T = f(I_C)$**

$V_{CE} = 5 \text{ V}, f = 200 \text{ MHz}$

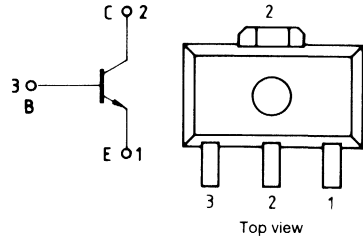


**Collector-base feedback capacitance  $C_{re} = f(V_{CB})$**



**NPN silicon planar epitaxial transistor**

- For broadband amplifier stages up to 1 GHz



Type	Marking	Ordering code	Package
BFQ 19 P	FE	Refer to index	Version C

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	15 V
Collector-base voltage	$V_{CB0}$	20 V
Emitter-base voltage	$V_{EB0}$	3 V
Collector current	$I_C$	75 mA
Peak collector current $f \geq 1$ MHz	$I_{CM}$	150 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	1,0 W
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	-65 ... +150 °C

<b>Thermal resistance</b>	$R_{thJA}$	$\leq 125$ K/W
junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm		

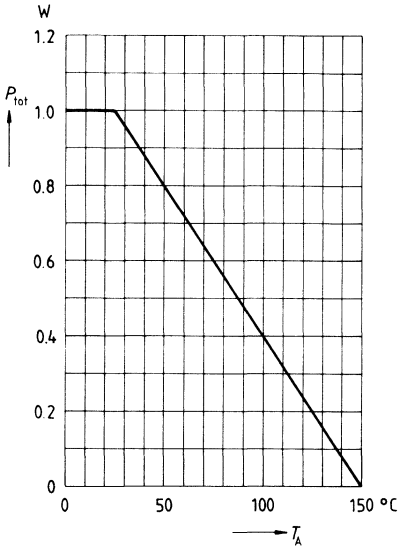
## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$ , $I_B = 0$	$V_{(BR)CE0}$	15	–	–	V
Collector cutoff current $V_{CB} = 10\text{ V}$ , $I_E = 0$	$I_{CB0}$	–	–	100	nA
DC current gain $I_C = 50\text{ mA}$ , $V_{CE} = 10\text{ V}$	$h_{FE}$	25	70	–	–
Collector-emitter saturation voltage $I_C = 75\text{ mA}$ , $I_B = 7,5\text{ mA}$	$V_{CEsat}$	–	0,2	0,5	V

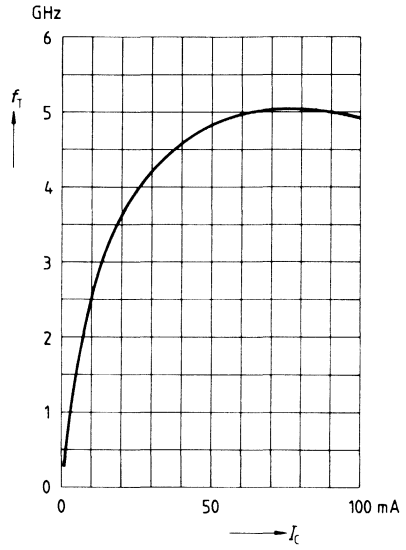
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 50\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 200\text{ MHz}$ $I_C = 75\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 200\text{ MHz}$	$f_T$	4 4,4	4,8 5,1	– –	GHz GHz
Output capacitance $V_{CB} = 10\text{ V}$ , $f = 1\text{ MHz}$ , $I_E = i_e = 0$	$C_{ob}$	–	1,5	–	pF
Collector-base feedback capacitance $V_{CB} = 10\text{ V}$ , $V_{BE} = 0$ , $f = 1\text{ MHz}$	$C_{re}$	–	1,1	1,5	pF
Power gain $I_C = 70\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 800\text{ MHz}$	$G_{pe}$	–	11,5	–	dB
Noise figure $I_C = 50\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 800\text{ MHz}$ $R_{Gopt}$	$NF$	–	3,8	–	dB
Output voltage (two tone intermodulation test) $f_1 = 806\text{ MHz}$ , $f_2 = 810\text{ MHz}$ , $d_{IM} = 60\text{ dB}$ , $I_C = 70\text{ mA}$ , $V_{CE} = 10\text{ V}$ $R_G = R_L = 50\ \Omega$	$V_{01} = V_{02}$	–	500	–	mV

**Total power dissipation  $P_{tot} = f(T_A)$**



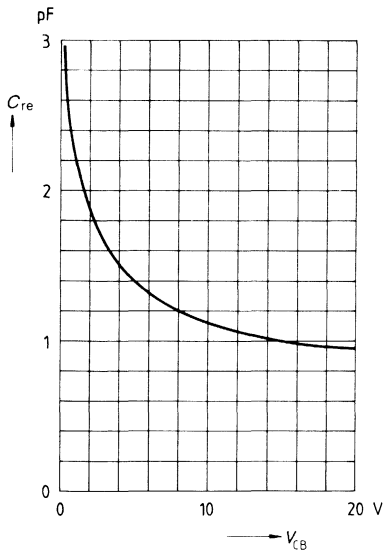
**Transition frequency  $f_T = f(I_C)$**

$V_{CE} = 10 \text{ V}$



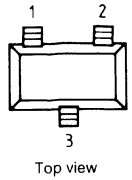
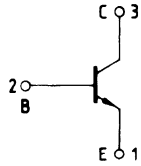
**Collector-base feedback capacitance  $C_{re} = f(V_{CB})$**

$f = 1 \text{ MHz}$



**NPN silicon planar epitaxial transistor**

- For low noise IF and broadband amplifiers up to 1 GHz
- Low noise version (typ. 0.9 dB at 10 MHz)
- High transition frequency



Type	Marking	Ordering code	Package
BFQ 29 P	KC	Refer to index	Version A

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	15 V
Collector-base voltage	$V_{CB0}$	20 V
Emitter-base voltage	$V_{EB0}$	3 V
Collector current	$I_C$	30 mA
Base current	$I_B$	4 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	280 mW
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	- 65 ... + 150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 450 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------



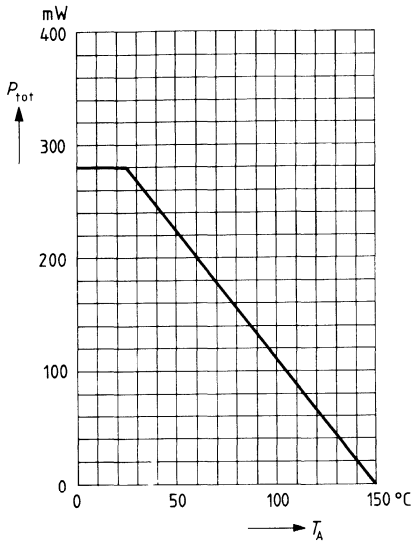
## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

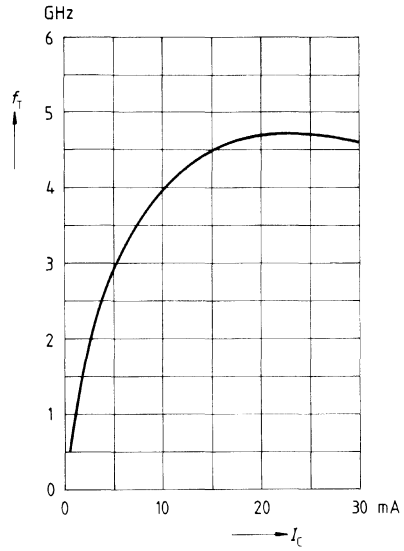
Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$ , $I_B = 0$	$V_{(BR) CE0}$	15	–	–	V
Collector-base breakdown voltage $I_C = 10\ \mu\text{A}$ , $I_E = 0$	$V_{(BR) CB0}$	20	–	–	V
Collector cutoff current $V_{CB} = 10\text{ V}$ , $I_E = 0$	$I_{CB0}$	–	–	50	nA
DC current gain $I_C = 3\text{ mA}$ , $V_{CE} = 6\text{ V}$ $I_C = 10\text{ mA}$ , $V_{CE} = 6\text{ V}$	$h_{FE}$	50 50	– 140	250 –	– –
Collector-emitter saturation voltage $I_C = 20\text{ mA}$ , $I_B = 1\text{ mA}$	$V_{CEsat}$	–	0,1	0,4	V

Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 20\text{ mA}$ , $V_{CE} = 6\text{ V}$ , $f = 200\text{ MHz}$	$f_T$	3,6	4,7	–	GHz
Collector-base feedback capacitance $V_{CB} = 10\text{ V}$ , $V_{BE} = 0$ , $f = 1\text{ MHz}$	$C_{re}$	–	0,5	0,65	pF
Collector-emitter feedback capacitance $V_{CE} = 10\text{ V}$ , $V_{BE} = 0$ , $f = 1\text{ MHz}$	$C_{rb}$	–	0,28	–	pF
Noise figure $I_C = 3\text{ mA}$ , $V_{CE} = 6\text{ V}$ , $f = 10\text{ MHz}$ , $R_G = 75\ \Omega$ $I_C = 4\text{ mA}$ , $V_{CE} = 6\text{ V}$ , $f = 800\text{ MHz}$ , $R_G = 50\ \Omega$	$NF$	– –	0,9 1,8	1,2 –	dB dB
Linear output voltage (two tone intermodulation test) $f_1 = 806\text{ MHz}$ , $f_2 = 810\text{ MHz}$ , $d_{IM} = 60\text{ dB}$ , $I_C = 20\text{ mA}$ , $V_{CE} = 6\text{ V}$ , $R_S = R_L = 50\ \Omega$	$V_{01} = V_{02}$	–	180	–	mV

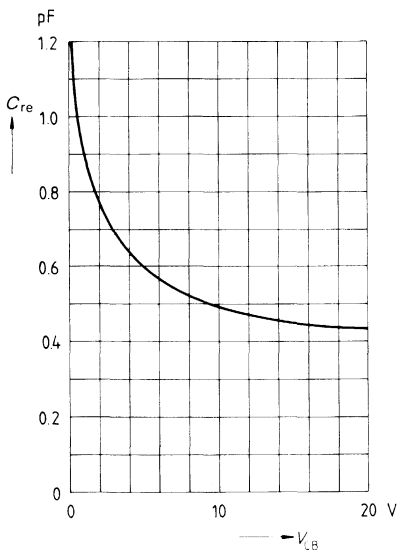
**Total power dissipation  $P_{Tot} = f(T_A)$**



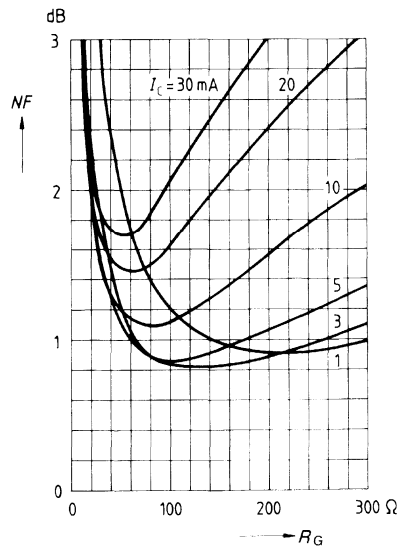
**Transition frequency  $f_T = f(I_C)$**   
 $V_{CE} = 6\text{ V}$



**Collector-base feedback capacitance  $C_{re} = f(V_{CB})$**

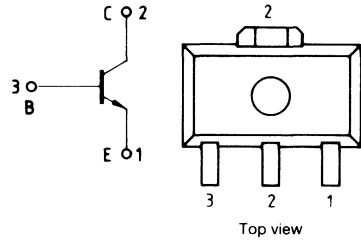


**Noise figure  $NF = f(R_G)$**   
 $V_{CE} = 6\text{ V}$



**NPN silicon planar epitaxial transistor**

- For low-distortion broadband amplifiers, preferably in antenna amplifiers up to 1 GHz



Type	Marking	Ordering code	Package
BFQ 64	FC	Refer to index	Version C

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	20 V
Collector-base voltage	$V_{CB0}$	30 V
Emitter-base voltage	$V_{EB0}$	3 V
Collector current	$I_C$	200 mA
Peak collector current	$I_{CM}$	250 mA
Peak base current	$I_{BM}$	25 mA
Total power dissipation $T_A \leq 25^\circ\text{C}$	$P_{Tot}$	1,0 W
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	- 65 ... + 150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 125 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

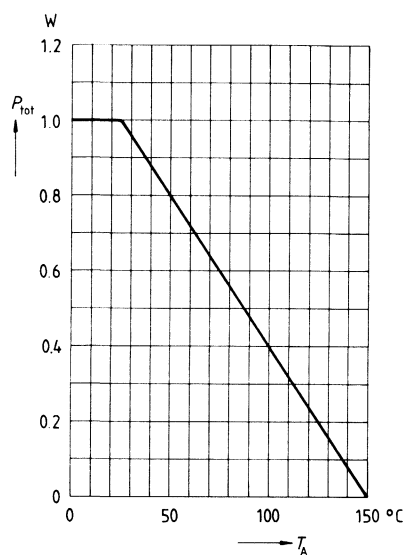
## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector cutoff current $V_{CB} = 15\text{ V}, I_E = 0$	$I_{CB0}$	–	–	200	nA
Collector cutoff current $V_{CE} = 30\text{ V}, V_{BE} = 0$	$I_{CES}$	–	–	1	mA
DC current gain $I_C = 120\text{ mA}, V_{CE} = 5\text{ V}$	$h_{FE}$	25	–	–	–

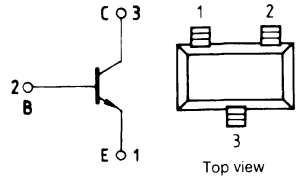
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 100\text{ mA}, V_{CE} = 5\text{ V}, f = 200\text{ MHz}$	$f_T$	–	3	–	GHz
Collector-base feedback capacitance $V_{CB} = 10\text{ V}, V_{BE} = 0, f = 1\text{ MHz}$	$C_{re}$	–	0,9	–	pF
Optimum power gain $I_C = 100\text{ mA}, V_{CE} = 10\text{ V}, f = 800\text{ MHz}$	$G_{p\text{ opt}}$	–	10	–	dB
Output voltage (two tone intermodulation test) $f_1 = 806\text{ MHz}, f_2 = 810\text{ MHz},$ $d_{iM} = 60\text{ dB}, I_C = 100\text{ mA}, V_{CE} = 10\text{ V}$ $R_G = R_L = 50\ \Omega$	$V_0$	–	0,6	–	V

Total power dissipation  $P_{\text{tot}} = f(T_A)$



**NPN silicon planar epitaxial transistor**

- For low noise broadband amplifiers up to 2 GHz
- High transition frequency,  $f_T = 5.8$  GHz typ
- Low noise figure  $NF = 2.8$  dB at 2 GHz
- Low collector capacitance



Type	Marking	Ordering code	Package
BFQ 81	RA	Refer to index	Version A

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	16 V
Collector-base voltage	$V_{CB0}$	25 V
Emitter-base voltage	$V_{EB0}$	2 V
Collector current	$I_C$	30 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	280 mW
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	- 65 ... + 150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm x 16.7 mm x 0.7 mm	$R_{thJA}$	$\leq 450$ K/W
------------------------------------------------------------------------------------------------------------	------------	----------------

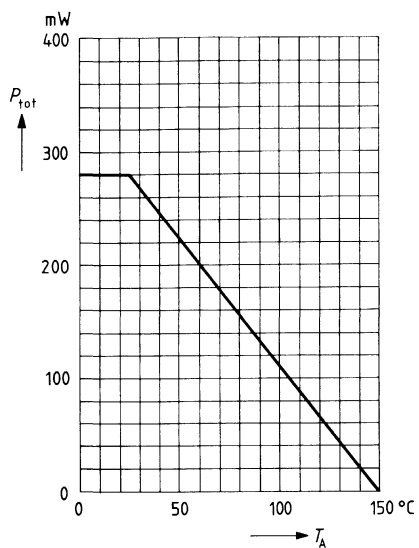
## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$ , $I_B = 0$	$V_{(BR)CE0}$	16	–	–	V
Collector cutoff current $V_{CB} = 15\text{ V}$ , $I_E = 0$	$I_{CB0}$	–	–	100	nA
DC current gain $I_C = 5\text{ mA}$ , $V_{CE} = 10\text{ V}$ $I_C = 15\text{ mA}$ , $V_{CE} = 10\text{ V}$	$h_{FE}$	50 50	– –	– –	– –
Collector-emitter saturation voltage $I_C = 30\text{ mA}$ , $I_B = 3\text{ mA}$	$V_{CEsat}$	–	0,2	0,5	V

Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 5\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 200\text{ MHz}$ $I_C = 15\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 200\text{ MHz}$	$f_T$	– –	4,2 5,8	– –	GHz GHz
Collector base feedback capacitance $V_{CB} = 10\text{ V}$ , $V_{BE} = 0$ , $f = 1\text{ MHz}$	$C_{re}$	–	0,4	–	pF
Power gain $I_C = 5\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 800\text{ MHz}$	$G_{pe}$	–	15	–	dB
Noise figure $I_C = 3\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 10\text{ MHz}$ , $R_G = 75\ \Omega$ $I_C = 5\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 800\text{ MHz}$ , $R_G = 50\ \Omega$ $I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 2\text{ GHz}$ , $R_{G\text{opt}}$	$NF$	– – –	0,9 1,5 2,8	– – –	dB dB dB

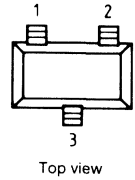
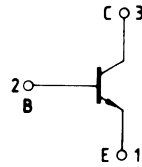
Total power dissipation  $P_{\text{tot}} = f(T_A)$





**NPN silicon planar epitaxial transistor**

- For broadband amplifier input stages up to 2 GHz and fast non-saturated switching applications
- Collector-current range 0.5 mA ... 20 mA



Type	Marking	Ordering code	Package
BFR 35 AP	GE	Refer to index	Version A

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	12 V
Collector-emitter voltage	$V_{CES}$	20 V
Emitter-base voltage	$V_{EB0}$	2,5 V
Collector current	$I_C$	30 mA
Base current	$I_B$	4 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	280 mW
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	- 65 ... + 150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm x 16.7 mm x 0.7 mm	$R_{thJA}$	$\leq 450$ K/W
------------------------------------------------------------------------------------------------------------	------------	----------------

## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

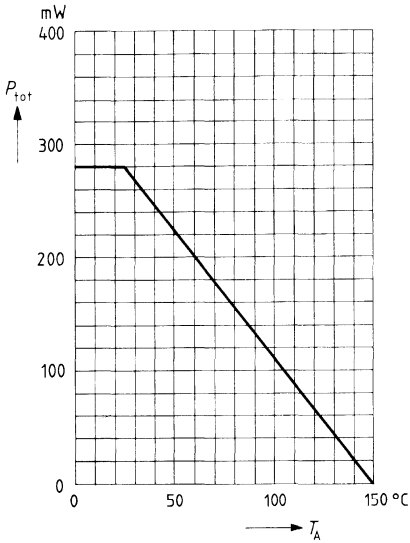
Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$ , $I_B = 0$	$V_{(BR)CE0}$	12	–	–	V
Collector-emitter breakdown voltage $I_C = 100\ \mu\text{A}$ , $V_{BE} = 0$	$V_{(BR)CES}$	20	–	–	V
Emitter-base breakdown voltage $I_E = 100\ \mu\text{A}$ , $I_C = 0$	$V_{(BR)EB0}$	2,5	–	–	V
Collector cutoff current $V_{CB} = 10\text{ V}$ , $I_E = 0$	$I_{CB0}$	–	–	50	nA
DC current gain $I_C = 5\text{ mA}$ , $V_{CE} = 6\text{ V}$ $I_C = 20\text{ mA}$ , $V_{CE} = 6\text{ V}$	$h_{FE}$	40 40	90 100	– –	– –
Collector-emitter saturation voltage $I_C = 30\text{ mA}$ , $I_B = 3\text{ mA}$	$V_{CEsat}$	–	0,16	0,4	V

Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 5\text{ mA}$ , $V_{CE} = 6\text{ V}$ , $f = 200\text{ MHz}$ $I_C = 20\text{ mA}$ , $V_{CE} = 6\text{ V}$ , $f = 200\text{ MHz}$	$f_T$	– 3,6	3,8 4,9	– –	GHz GHz
Collector-base feedback capacitance $V_{CB} = 6\text{ V}$ , $V_{BE} = 0$ , $f = 1\text{ MHz}$	$C_{re}$	–	0,55	0,7	pF
Collector-emitter feedback capacitance $V_{CE} = 6\text{ V}$ , $V_{BE} = 0$ , $f = 1\text{ MHz}$	$C_{rb}$	–	0,27	–	pF
Power gain $I_C = 15\text{ mA}$ , $V_{CE} = 6\text{ V}$ , $f = 800\text{ MHz}$ $R_G = 50\ \Omega$	$G_{pe}$	–	14	–	dB
Noise figure $I_C = 5\text{ mA}$ , $V_{CE} = 6\text{ V}$ , $f = 10\text{ MHz}$ , $R_G = 75\ \Omega$ $I_C = 2\text{ mA}$ , $V_{CE} = 6\text{ V}$ , $f = 800\text{ MHz}$ , $R_G = 60\ \Omega$ $I_C = 3\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 2\text{ GHz}$ , $R_{Gopt}$	$NF$	– – –	1,5 2 3,9	– 3 –	dB dB dB
Output voltage (two tone intermodulation test) $f_1 = 806\text{ MHz}$ , $f_2 = 810\text{ MHz}$ , $d_{IM} = 60\text{ dB}$ , $I_C = 15\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $R_G = R_L = 50\ \Omega$	$V_{01} = V_{02}$	–	110	–	mV

**S parameters**common emitter,  $V_{CE} = 6 \text{ V}$ ;  $I_C = 5 \text{ mA}$ ;  $Z_0 = 50 \Omega$ 

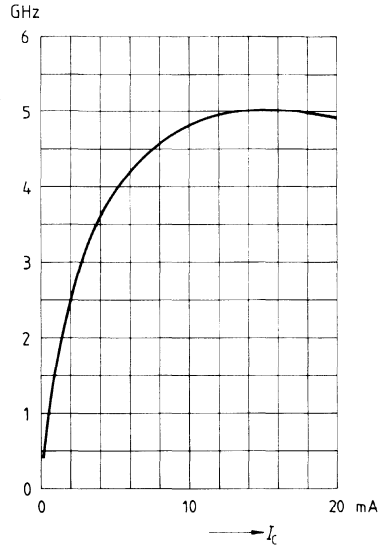
$f$ (GHz)	$ S_{11} $	$\varphi$	$ S_{21} $	$\varphi$	$ S_{12} $	$\varphi$	$ S_{22} $	$\varphi$
0,1	0,771	- 29	12,75	150	0,025	73	0,971	- 14
0,2	0,639	- 55	10,70	130	0,041	63	0,807	- 21
0,3	0,486	- 72	8,34	115	0,052	57	0,697	- 27
0,4	0,400	- 87	6,92	104	0,063	57	0,650	- 26
0,5	0,326	- 97	5,78	97	0,071	57	0,582	- 29
0,6	0,289	- 105	4,88	91	0,079	57	0,591	- 31
0,7	0,232	- 112	4,30	85	0,089	56	0,585	- 25
0,8	0,206	- 123	3,79	80	0,098	56	0,501	- 27
0,9	0,180	129	3,47	76	0,109	57	0,527	- 34
1,0	0,168	- 142	3,12	73	0,116	57	0,560	- 31
1,1	0,151	- 146	2,88	68	0,125	56	0,505	- 29
1,2	0,124	- 163	2,65	64	0,136	55	0,512	- 39
1,3	0,131	- 174	2,50	60	0,147	54	0,541	- 35
1,4	0,124	173	2,34	57	0,157	54	0,474	- 36
1,5	0,128	164	2,20	53	0,167	53	0,521	- 45
1,6	0,132	148	2,08	49	0,174	51	0,539	- 38
1,7	0,160	142	1,98	47	0,188	51	0,425	- 40
1,8	0,158	140	1,83	43	0,192	49	0,460	- 60
1,9	0,160	131	1,81	40	0,207	47	0,586	- 51
2,0	0,180	123	1,73	37	0,216	47	0,480	- 43

**Total power dissipation**  $P_{tot} = f(T_A)$



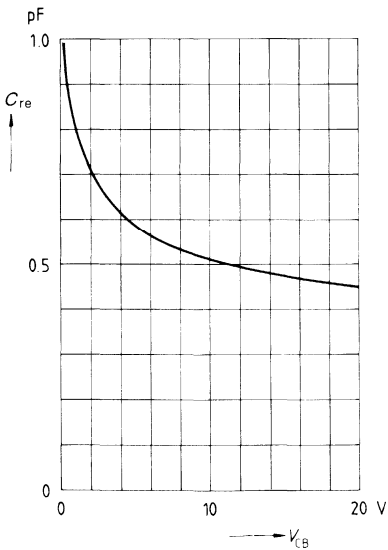
**Transition frequency**  $f_T = f(I_C)$

$V_{CE} = 6\text{ V}$ ,  $f = 200\text{ MHz}$



**Collector-base feedback capacitance**  $C_{re} = f(V_{CB})$

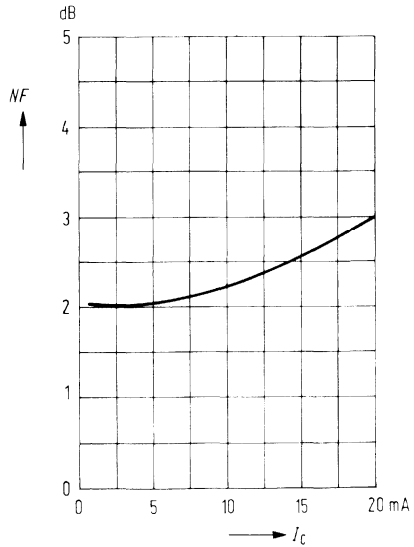
$f = 1\text{ MHz}$



**Noise figure**  $NF = f(I_C)$

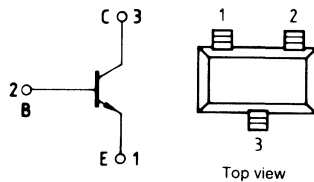
$V_{CE} = 6\text{ V}$ ,  $f = 800\text{ MHz}$ ,

$R_G = 60\ \Omega$



**NPN silicon planar epitaxial transistor**

- For broadband amplifiers up to 2 GHz and non-saturated switching applications



Top view

Type	Marking	Ordering code	Package
BFR 92 P	GF	Refer to index	Version A

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	15 V
Collector-base voltage	$V_{CB0}$	20 V
Emitter-base voltage	$V_{EB0}$	2,5 V
Collector current	$I_C$	30 mA
Base current	$I_B$	4 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	280 mW
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	- 65 ... + 150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 450 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

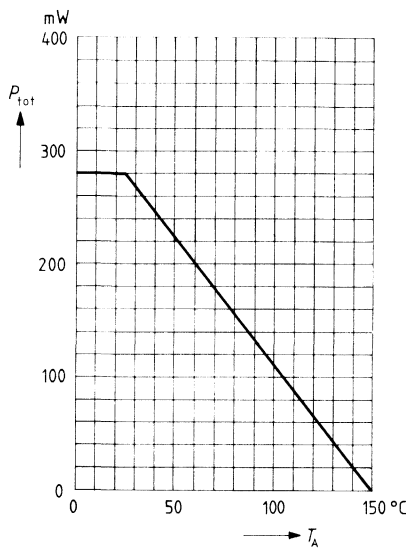
## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$ , $I_B = 0$	$V_{(BR)CE0}$	12	–	–	V
Collector-base breakdown voltage $I_C = 10\text{ }\mu\text{A}$ , $I_E = 0$	$V_{(BR)CB0}$	20	–	–	V
Emitter-base breakdown voltage $I_E = 100\text{ }\mu\text{A}$ , $I_C = 0$	$V_{(BR)EB0}$	2,5	–	–	V
Collector cutoff current $V_{CB} = 10\text{ V}$ , $I_E = 0$	$I_{CB0}$	–	–	50	nA
DC current gain $I_C = 14\text{ mA}$ , $V_{CE} = 10\text{ V}$	$h_{FE}$	40	100	–	–
Collector-emitter saturation voltage $I_C = 30\text{ mA}$ , $I_B = 3\text{ mA}$	$V_{CEsat}$	–	–	0,4	V

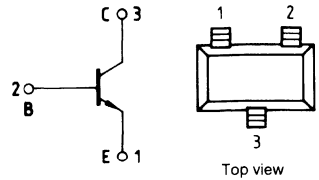
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 5\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 200\text{ MHz}$ $I_C = 14\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 200\text{ MHz}$	$f_T$	–	3,8 5	–	GHz GHz
Collector-base feedback capacitance $V_{CB} = 10\text{ V}$ , $V_{BE} = 0$ , $f = 1\text{ MHz}$	$C_{re}$	–	0,5	0,7	pF
Collector-emitter feedback capacitance $V_{CE} = 10\text{ V}$ , $V_{BE} = 0$ , $f = 1\text{ MHz}$	$C_{rb}$	–	0,27	–	pF
Power gain $I_C = 15\text{ mA}$ , $V_{CE} = 6\text{ V}$ , $f = 800\text{ MHz}$ $R_G = 50\text{ }\Omega$	$G_{pe}$	–	14	–	dB
Noise figure $I_C = 5\text{ mA}$ , $V_{CE} = 6\text{ V}$ , $f = 10\text{ MHz}$ , $R_G = 75\text{ }\Omega$ $I_C = 2\text{ mA}$ , $V_{CE} = 6\text{ V}$ , $f = 800\text{ MHz}$ , $R_G = 60\text{ }\Omega$ $I_C = 3\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 2\text{ GHz}$ , $R_{Gopt}$	$NF$	–	1,5 2 3,9	– 3 –	dB dB dB
Output voltage (two tone intermodulation test) $f_1 = 806\text{ MHz}$ , $f_2 = 810\text{ MHz}$ , $d_{IM} = 60\text{ dB}$ , $I_C = 15\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $R_G = R_L = 50\text{ }\Omega$	$V_{01} = V_{02}$	–	110	–	mV

Total power dissipation  $P_{tot} = f(T_A)$



**NPN silicon planar epitaxial transistor**

- For broadband amplifiers up to 1 GHz
- Low intermodulation distortion



Type	Marking	Ordering code	Package
BFR 93 P	GG	Refer to index	Version A

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	15 V
Collector-base voltage	$V_{CB0}$	20 V
Emitter-base voltage	$V_{EB0}$	2,5 V
Collector current	$I_C$	50 mA
Base current	$I_B$	10 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	280 mW
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	- 65 ... + 150 °C
<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 450 K/W



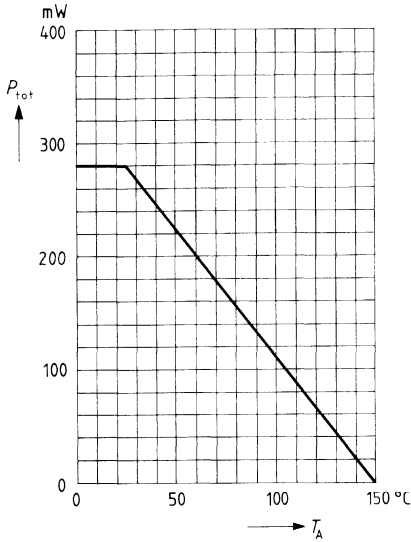
## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

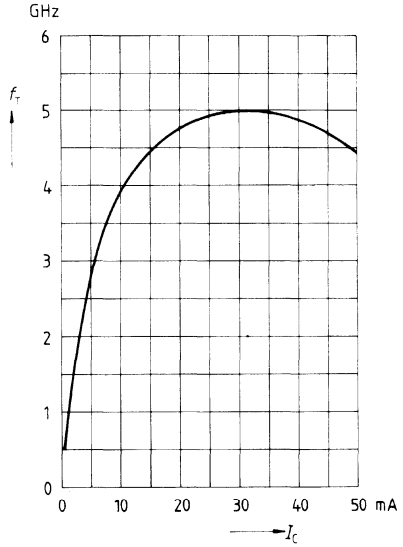
Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$ , $I_B = 0$	$V_{(BR)CE0}$	15	–	–	V
Collector-base breakdown voltage $I_C = 10\ \mu\text{A}$ , $I_E = 0$	$V_{(BR)CB0}$	20	–	–	V
Emitter-base breakdown voltage $I_E = 100\ \mu\text{A}$ , $I_C = 0$	$V_{(BR)EB0}$	2,5	–	–	V
Collector cutoff current $V_{CB} = 10\text{ V}$ , $I_E = 0$	$I_{CB0}$	–	–	50	nA
DC current gain $I_C = 25\text{ mA}$ , $V_{CE} = 5\text{ V}$	$h_{FE}$	30	100	–	–
Collector-emitter saturation voltage $I_C = 50\text{ mA}$ , $I_B = 5\text{ mA}$	$V_{CEsat}$	–	0,2	0,5	V

Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 30\text{ mA}$ , $V_{CE} = 5\text{ V}$ , $f = 200\text{ MHz}$	$f_T$	–	5	–	GHz
Collector-base feedback capacitance $V_{CB} = 10\text{ V}$ , $V_{BE} = 0$ , $f = 1\text{ MHz}$	$C_{re}$	–	0,6	0,75	pF
Collector-emitter feedback capacitance $V_{CE} = 10\text{ V}$ , $V_{BE} = 0$ , $f = 1\text{ MHz}$	$C_{rb}$	–	0,28	–	pF
Power gain $I_C = 25\text{ mA}$ , $V_{CE} = 8\text{ V}$ , $f = 800\text{ MHz}$	$G_p$	–	13	–	dB
Noise figure $I_C = 10\text{ mA}$ , $V_{CE} = 8\text{ V}$ , $f = 10\text{ MHz}$ , $R_G = 50\ \Omega$ $I_C = 5\text{ mA}$ , $V_{CE} = 8\text{ V}$ , $f = 500\text{ MHz}$ , $R_{Gopt}$ $I_C = 10\text{ mA}$ , $V_{CE} = 8\text{ V}$ , $f = 800\text{ MHz}$ , $R_G = 50\ \Omega$	$NF$	–	1,8	–	dB
Output voltage (two tone intermodulation test) $f_1 = 806\text{ MHz}$ , $f_2 = 810\text{ MHz}$ , $d_{IM} = 60\text{ dB}$ , $I_C = 25\text{ mA}$ , $V_{CE} = 8\text{ V}$ , $R_G = R_L = 50\ \Omega$	$V_{01} = V_{02}$	–	240	–	mV

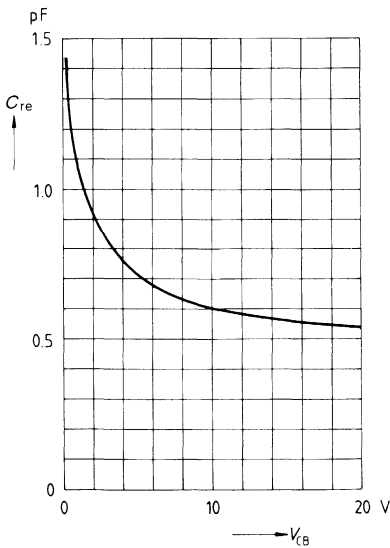
**Total power dissipation  $P_{tot} = f(T_A)$**



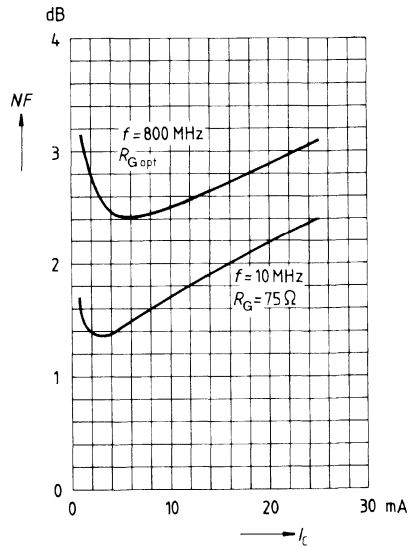
**Transition frequency  $f_T = f(I_C)$**   
 $V_{CE} = 5 \text{ V}, f = 200 \text{ MHz}$



**Collector-base feedback capacitance  $C_{re} = f(V_{CB})$**   
 $f = 1 \text{ MHz}$

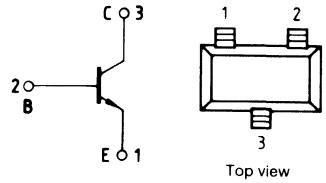


**Noise figure  $NF = f(I_C)$**   
 $V_{CE} = 8 \text{ V}$



**NPN silicon planar epitaxial transistor**

- For broadband amplifiers up to 1 GHz



Type	Marking	Ordering code	Package
BFS 17 P	MC	Refer to index	Version A

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	15 V
Collector-base voltage	$V_{CB0}$	25 V
Emitter-base voltage	$V_{EB0}$	2,5 V
Collector current	$I_C$	25 mA
Peak collector current	$I_{CM}$	50 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	280 mW
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	- 65 ... + 150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 450 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

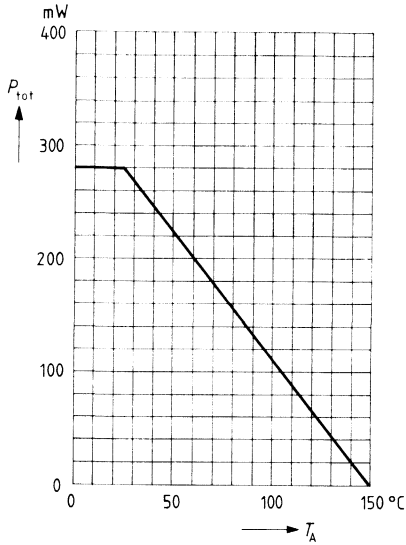
## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$ , $I_B = 0$	$V_{(BR)CE0}$	15	–	–	V
Collector-base breakdown voltage $I_C = 10\ \mu\text{A}$ , $I_E = 0$	$V_{(BR)CB0}$	25	–	–	V
Emitter-base breakdown voltage $I_E = 100\ \mu\text{A}$ , $I_C = 0$	$V_{(BR)EB0}$	2,5	–	–	V
Collector cutoff current $V_{CB} = 15\text{ V}$ , $I_E = 0$	$I_{CB0}$	–	–	50	nA
DC current gain $I_C = 2\text{ mA}$ , $V_{CE} = 1\text{ V}$ $I_C = 25\text{ mA}$ , $V_{CE} = 1\text{ V}$	$h_{FE}$	20 20	– 70	150 –	– –
Collector-emitter saturation voltage $I_C = 10\text{ mA}$ , $I_B = 1\text{ mA}$	$V_{CEsat}$	–	0,1	0,4	V

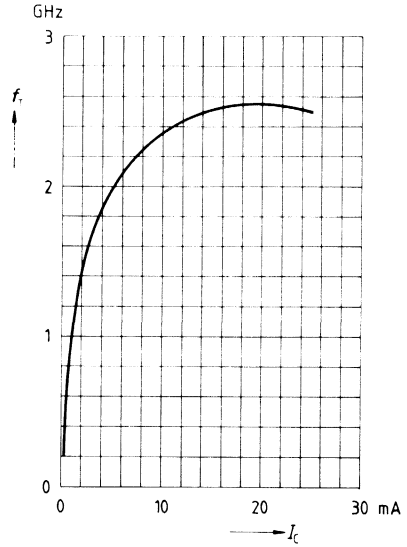
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 2\text{ mA}$ , $V_{CE} = 5\text{ V}$ , $f = 100\text{ MHz}$ $I_C = 25\text{ mA}$ , $V_{CE} = 5\text{ V}$ , $f = 100\text{ MHz}$	$f_T$	1 1,3	1,4 2,5	– –	GHz GHz
Output capacitance $V_{CB} = 10\text{ V}$ , $I_E = I_e = 0$ , $f = 1\text{ MHz}$	$C_{ob}$	–	–	1,5	pF
Collector-base feedback capacitance $V_{CB} = 5\text{ V}$ , $V_{BE} = 0$ , $f = 1\text{ MHz}$	$C_{re}$	–	0,55	0,8	pF
Noise figure $I_C = 2\text{ mA}$ , $V_{CE} = 5\text{ V}$ , $f = 800\text{ MHz}$ , $R_G = 50\ \Omega$	$NF$	–	3,8	5	dB
Output voltage (two tone intermodulation test) $f_1 = 806\text{ MHz}$ , $f_2 = 810\text{ MHz}$ , $d_{iM} = 60\text{ dB}$ , $I_C = 14\text{ mA}$ , $V_{CE} = 5\text{ V}$ , $R_G = R_L = 50\ \Omega$	$V_{01} = V_{02}$	–	100	–	mV

**Total power dissipation  $P_{tot} = f(T_A)$**



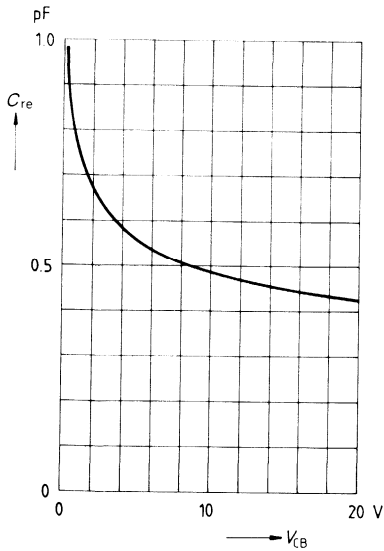
**Transition frequency  $f_T = f(I_C)$**

$V_{CE} = 5 \text{ V}, f = 200 \text{ MHz}$



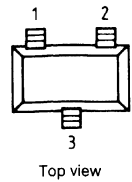
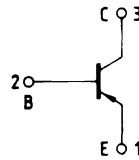
**Collector-base feedback capacitance  $C_{re} = f(V_{CB})$**

$f = 1 \text{ MHz}$



**PNP silicon planar epitaxial transistor**

- For UHF broadband amplifiers
- Complementary NPN type: BFR 92 P



Type	Marking	Ordering code	Package
BFT 92	W1	Refer to index	Version A

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	15 V
Collector-base voltage	$V_{CB0}$	20 V
Emitter-base voltage	$V_{EB0}$	2 V
Collector current	$I_C$	25 mA
Peak collector current $f \geq 1$ MHz	$I_{CM}$	35 mA
Total power dissipation $T_A \leq 60^\circ\text{C}$	$P_{tot}$	200 mW
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	- 65 ... + 150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 440 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

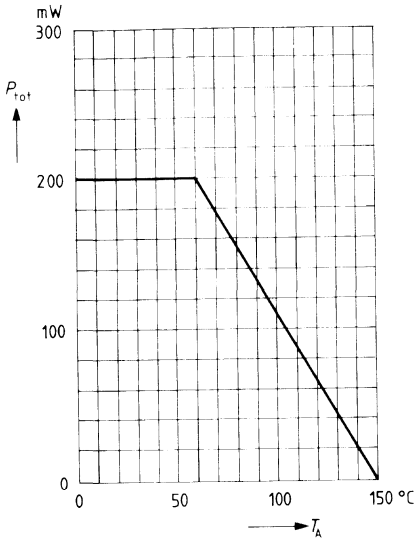
## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}, I_B = 0$	$V_{(BR)CE0}$	15	–	–	V
Collector cutoff current $V_{CB} = 10\text{ V}, I_E = 0$	$I_{CB0}$	–	–	50	nA
DC current gain $I_C = 14\text{ mA}, V_{CE} = 10\text{ V}$	$h_{FE}$	20	50	–	–

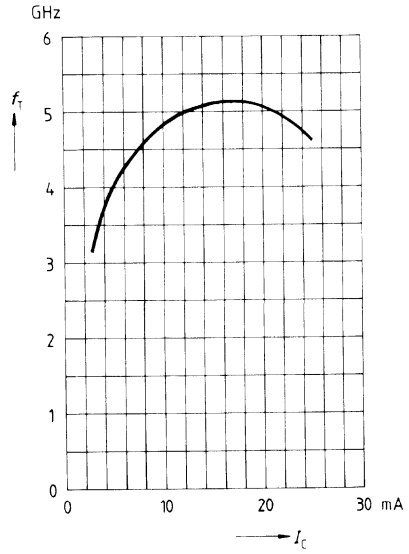
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 14\text{ mA}, V_{CE} = 10\text{ V}, f = 500\text{ MHz}$	$f_T$	–	5	–	GHz
Output capacitance $V_{CB} = 10\text{ V}, f = 1\text{ MHz}, I_E = i_e = 0$	$C_{ob}$	–	0,75	–	pF
Input capacitance $V_{CB} = 0,5\text{ V}, f = 1\text{ MHz}, I_C = i_C = 0$	$C_{ib}$	–	0,8	–	pF
Collector-base feedback capacitance $V_{CB} = 10\text{ V}, V_{BE} = 0, f = 1\text{ MHz}$	$C_{re}$	–	0,7	–	pF
Optimum power gain $I_C = 14\text{ mA}, V_{CE} = 10\text{ V}, f = 500\text{ MHz}$	$G_{p\text{ opt}}$	–	18	–	dB
Noise figure $I_C = 2\text{ mA}, V_{CE} = 10\text{ V}, f = 500\text{ MHz}$ $R_{G\text{ opt}}$	$NF$	–	2,7	–	dB
Intermodulation distortion (three tone intermodulation test) $f_1 = 495,25\text{ MHz}, f_2 = 503,25\text{ MHz},$ $f_3 = 505,25\text{ MHz}, V_1 = 150\text{ mV},$ $I_C = 14\text{ mA}, V_{CE} = 10\text{ V}, R_G = R_L = 75\ \Omega$	$d_{IM}$	–	60	–	dB

**Total power dissipation  $P_{tot} = f(T_A)$**



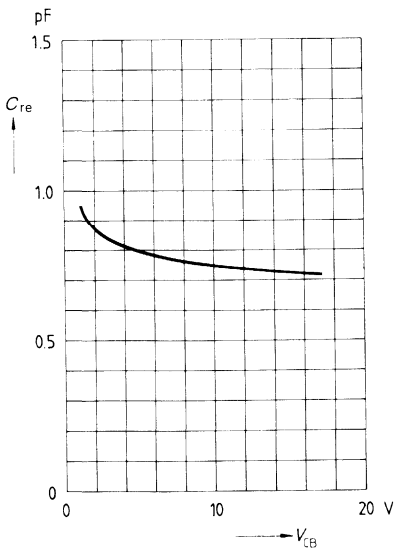
**Transition frequency  $f_T = f(I_C)$**

$V_{CE} = 10\text{ V}$ ,  $f = 500\text{ MHz}$



**Collector-base feedback capacitance  $C_{re} = f(V_{CB})$**

$f = 1\text{ MHz}$ ,  $I_E = 0$

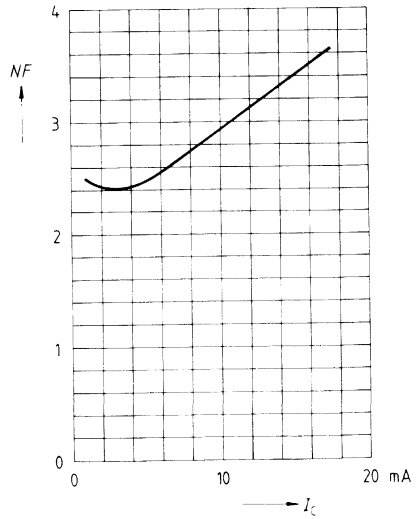


**Noise figure  $NF = f(I_C)$**

$V_{CE} = 10\text{ V}$ ,  $f = 500\text{ MHz}$ ,

$R_G = R_{G\text{opt}}$

dB



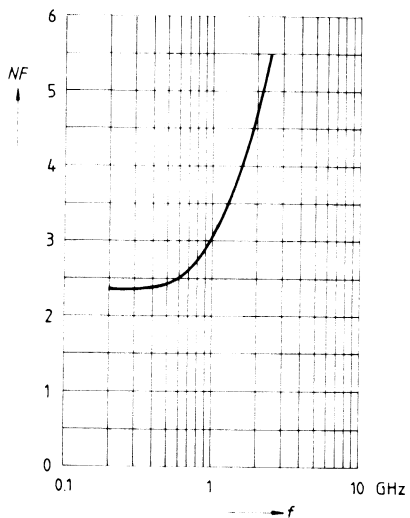


**Noise figure  $NF = f(f)$**

$V_{CE} = 10\text{ V}$ ,  $I_C = 2\text{ mA}$

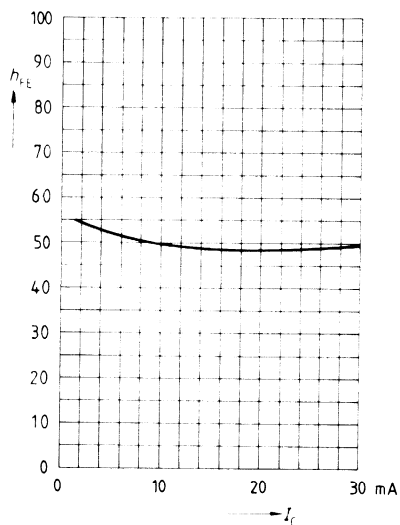
$R_G = R_{G_{opt}}$

dB



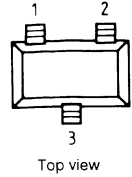
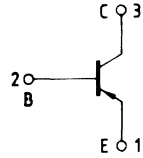
**DC current gain  $h_{FE} = f(I_C)$**

$V_{CE} = 10\text{ V}$



**PNP silicon planar epitaxial transistor**

- For UHF broadband amplifiers
- Complementary NPN type: BFR 93 P



Type	Marking	Ordering code	Package
BFT 93	X1	Refer to index	Version A

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	12 V
Collector-base voltage	$V_{CB0}$	15 V
Emitter-base voltage	$V_{EB0}$	2 V
Collector current	$I_C$	35 mA
Peak collector current $f \geq 1$ MHz	$I_{CM}$	50 mA
Total power dissipation $T_A \leq 60^\circ\text{C}$	$P_{tot}$	200 mW
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	-65 ... +150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 440 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

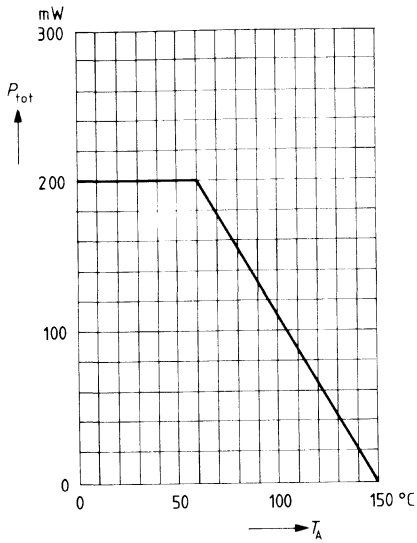
## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector cutoff current $V_{CB} = 5\text{ V}, I_E = 0$	$I_{CB0}$	–	–	50	nA
DC current gain $I_C = 30\text{ mA}, V_{CE} = 5\text{ V}$	$h_{FE}$	20	50	–	–

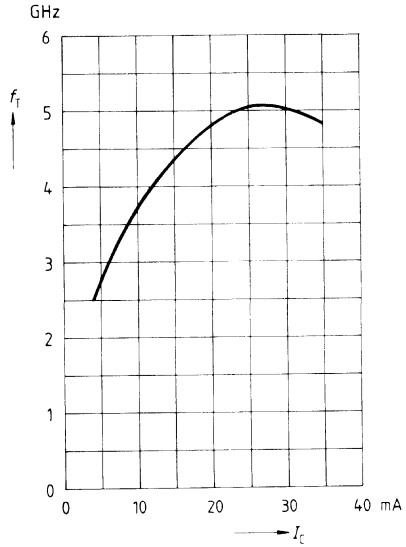
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 30\text{ mA}, V_{CE} = 5\text{ V}, f = 500\text{ MHz}$	$f_T$	–	5	–	GHz
Output capacitance $V_{CB} = 10\text{ V}, f = 1\text{ MHz}, I_E = i_e = 0$	$C_{ob}$	–	0,95	–	pF
Input capacitance $V_{CB} = 10\text{ V}, f = 1\text{ MHz}, I_C = i_C = 0$	$C_{ib}$	–	1,8	–	pF
Collector-base feedback capacitance $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}, f = 1\text{ MHz}$	$C_{re}$	–	1	–	pF
Optimum power gain $I_C = 30\text{ mA}, V_{CE} = 5\text{ V}, f = 500\text{ MHz}$	$G_{p\text{opt}}$	–	16,5	–	dB
Noise figure $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}, f = 500\text{ MHz}$ $R_{G\text{opt}}$	$NF$	–	2,4	–	dB
Intermodulation distortion (three tone intermodulation test) $f_1 = 495,25\text{ MHz}, f_2 = 503,25\text{ MHz},$ $f_3 = 505,25\text{ MHz}, V_1 = 300\text{ mV},$ $I_C = 30\text{ mA}, V_{CE} = 5\text{ V}, R_G = R_L = 75\ \Omega$	$d_{IM}$	–	60	–	dB

**Total power dissipation  $P_{tot} = f(T_A)$**



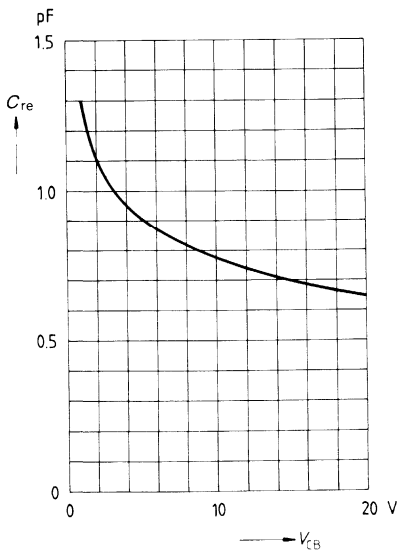
**Transition frequency  $f_T = f(I_C)$**

$V_{CE} = 5\text{ V}, f = 500\text{ MHz}$



**Collector-base feedback capacitance  $C_{re} = f(V_{CB})$**

$f = 1\text{ MHz}, I_C = 0$

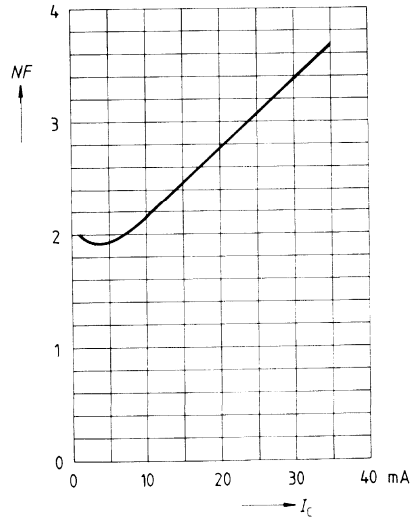


**Noise figure  $NF = f(I_C)$**

$V_{CE} = 5\text{ V}, f = 500\text{ MHz},$

$R_G = R_{G\text{opt}}$

dB

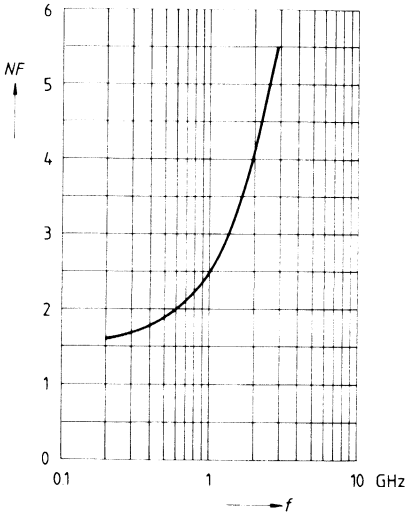


**Noise figure  $NF = f(f)$**

$V_{CE} = 5\text{ V}$ ,  $I_C = 2\text{ mA}$ ,

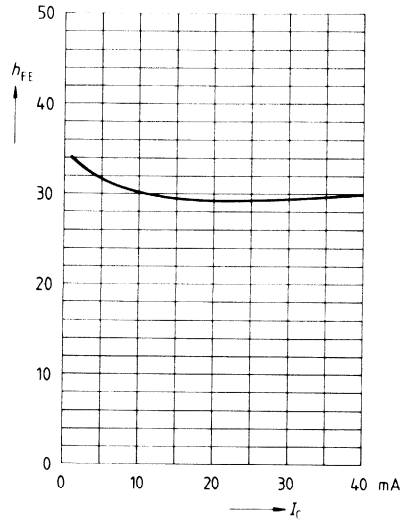
$R_G = R_{G\text{opt}}$

dB



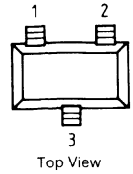
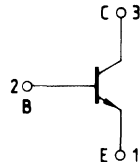
**DC current gain  $h_{FE} = f(I_C)$**

$V_{CE} = 5\text{ V}$ ,  $f = 500\text{ MHz}$



**NPN silicon planar epitaxial transistors**

- High DC current gain
- Low collector-emitter saturation voltage
- Complementary PNP types: BSS 80, BSS 82



Type	Marking	Type	Marking	Ordering code	Package
BSS 79 B	CE	BSS 81 B	CD	Refer to index	Version A
BSS 79 C	CF	BSS 81 C	CG		

**Maximum ratings**

		BSS 79	BSS 81
Collector-emitter voltage	$V_{CE0}$	40 V	35 V
Collector-base voltage	$V_{CB0}$		75 V
Emitter-base voltage	$V_{EB0}$		6 V
Collector current	$I_C$		800 mA
Peak collector current	$I_{CM}$		1 A
Base current	$I_B$		100 mA
Peak base current	$I_{BM}$		200 mA
Total power dissipation	$P_{tot}$		330 mW
$T_A = 25^\circ\text{C}$			
Junction temperature	$T_j$		150 °C
Storage temperature range	$T_{stg}$		-65 ... +150 °C
<b>Thermal resistance</b>	$R_{thJA}$		≤ 375 K/W
junction-ambient			
package mounted			
on alumina			
15 mm × 16.7 mm × 0.7 mm			

## Characteristics

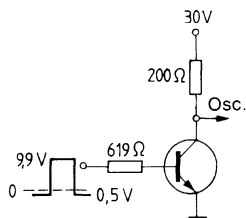
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 10\text{ mA}$ BSS 79 BSS 81	$V_{(BR) CE0}$	40 35	– –	– –	V V
Collector-base breakdown voltage $I_C = 10\ \mu\text{A}$	$V_{(BR) CB0}$	75	–	–	V
Emitter-base breakdown voltage $I_E = 10\ \mu\text{A}$	$V_{(BR) EB0}$	6	–	–	V
Collector cutoff current $V_{CB} = 60\text{ V}$ $V_{CB} = 60\text{ V}, T_A = 150^\circ\text{C}$	$I_{CB0}$	– –	– –	10 10	nA $\mu\text{A}$
Emitter cutoff current $V_{EB} = 3\text{ V}$	$I_{EB0}$	–	–	10	nA
DC current gain $I_C = 100\ \mu\text{A}, V_{CE} = 10\text{ V}$ BSS 79 B/81 B BSS 79 C/81 C $I_C = 1\text{ mA}, V_{CE} = 10\text{ V}$ BSS 79 B/81 B BSS 79 C/81 C $I_C = 10\text{ mA}, V_{CE} = 10\text{ V}^1)$ BSS 79 B/81 B BSS 79 C/81 C $I_C = 150\text{ mA}, V_{CE} = 10\text{ V}^1)$ BSS 79 B/81 B BSS 79 C/81 C $I_C = 500\text{ mA}, V_{CE} = 10\text{ V}^1)$ BSS 79 B/81 B BSS 79 C/81 C	$h_{FE}$	20 35 25 50 35 75 40 100 25 40	– – – – – – – – – –	– – – – – – 120 300 – –	– – – – – – – – – –
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 150\text{ mA}, I_B = 15\text{ mA}$ $I_C = 500\text{ mA}, I_B = 50\text{ mA}$	$V_{CEsat}$	– –	– –	0,3 1,3	V V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 150\text{ mA}, I_B = 15\text{ mA}$ $I_C = 500\text{ mA}, I_B = 50\text{ mA}$	$V_{BEsat}$	– –	– –	1,2 2,0	V V

<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

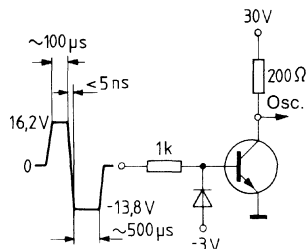
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 20 \text{ mA}$ , $V_{CE} = 20 \text{ V}$ , $f = 100 \text{ MHz}$	$f_T$	–	250	–	MHz
Open-circuit output capacitance $V_{CB} = 10 \text{ V}$ , $f = 1 \text{ MHz}$	$C_{ob}$	–	6	–	pF
$V_{CC} = 30 \text{ V}$ , $I_C = 150 \text{ mA}$ , $I_{B1} = I_{B2} = 15 \text{ mA}$ , $V_{BE} = 0,5 \text{ V}$					
Delay time	$t_d$	–	–	10	ns
Rise time	$t_r$	–	–	25	ns
Storage time	$t_s$	–	–	250	ns
Fall time	$t_f$	–	–	60	ns

**Test circuit for delay time and rise time**



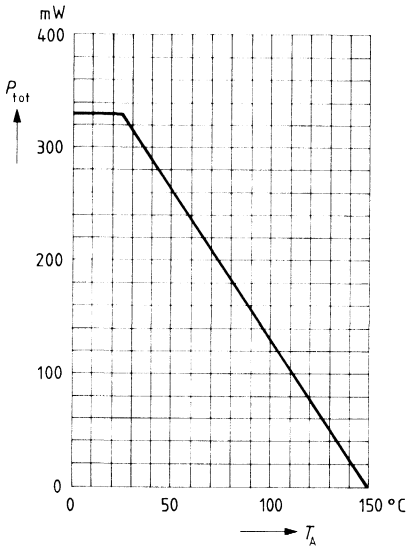
Oscilloscope:  $R > 100 \text{ k}\Omega$   
 $C < 12 \text{ pF}$   
 $t_r < 5 \text{ ns}$

**Test circuit for storage time and fall time**

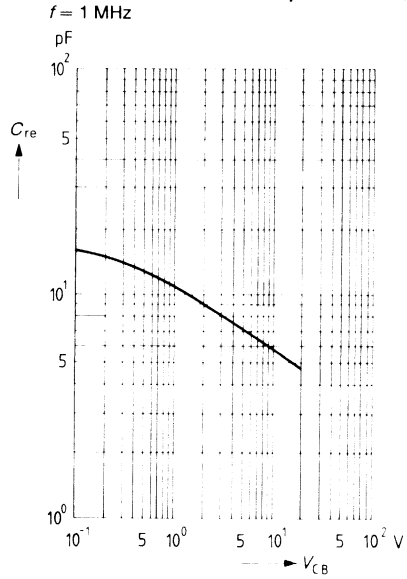




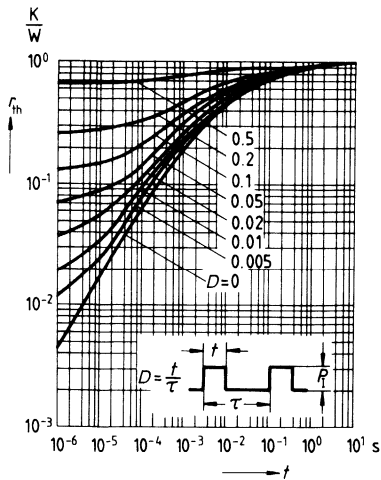
**Total power dissipation  $P_{tot} = f(T_A)$**



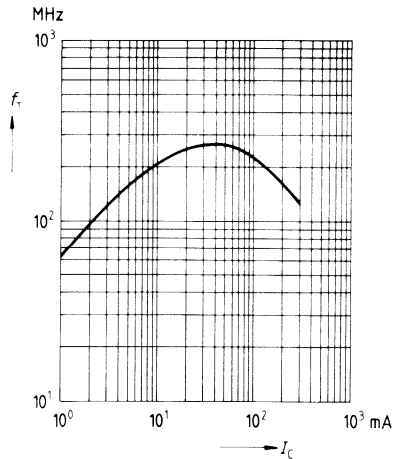
**Collector-base feedback capacitance  $C_{re} = f(V_{CB})$**



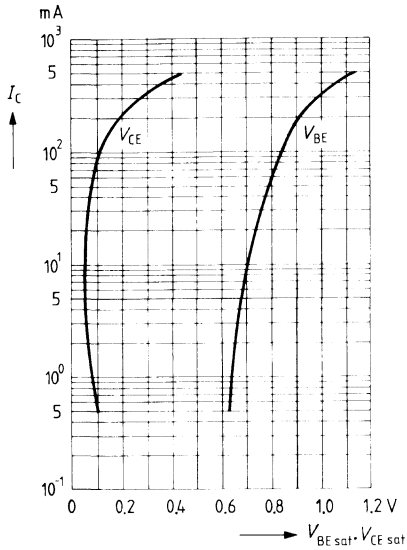
**Pulse handling capability  $r_{th} = f(t)$**   
(standardized)



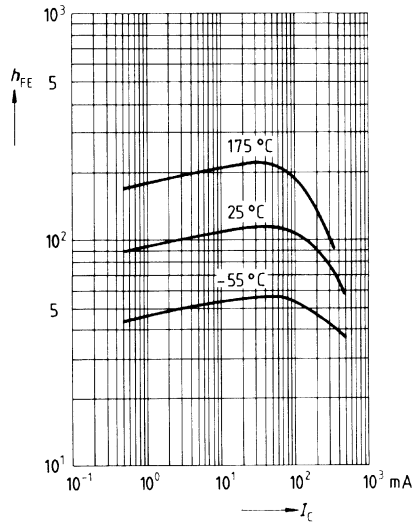
**Transition frequency  $f_T = f(I_C)$**   
 $V_{CE} = 20\text{ V}$



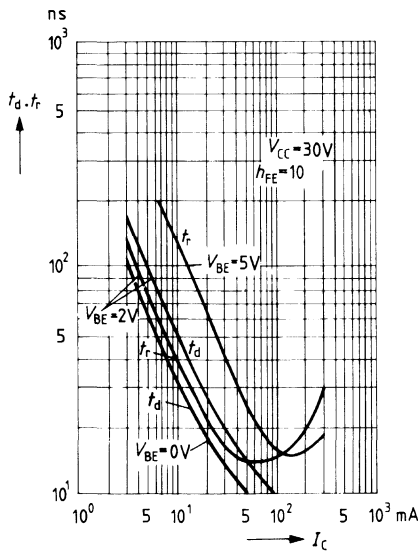
**Saturation voltage**  $V_{BE\ sat} = f(I_C)$   
 $h_{FE} = 10$   $V_{CE\ sat} = f(I_C)$



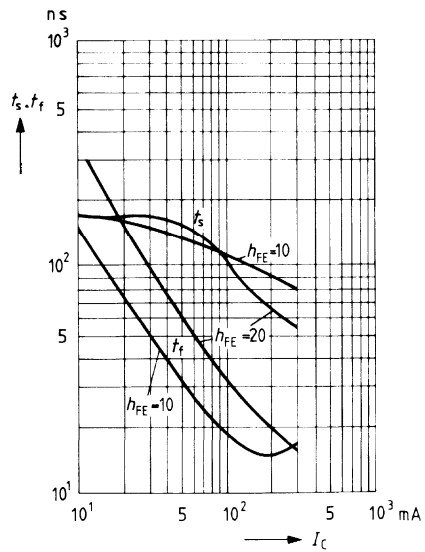
**DC current gain**  $h_{FE} = f(I_C)$   
 $V_{CE} = 10\text{ V}$



**Turn-on time**  $t_{on} = f(I_C)$   
 $h_{FE} = 10$ ;  $V_{CC} = 30\text{ V}$

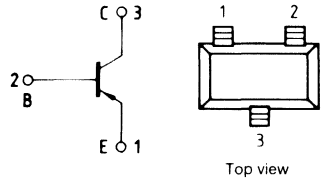


**Storage time**  $t_s = f(I_C)$   
**Fall time**  $t_f = f(I_C)$



**PNP silicon planar epitaxial transistors**

- High DC current gain
- Low collector-emitter saturation voltage
- Complementary NPN types: BSS 79, BSS 81



Type	Marking	Type	Marking	Ordering code	Package
BSS 80 B	CH	BSS 82 B	CL	Refer to index	Version A
BSS 80 C	CJ	BSS 82 C	CM		

**Maximum ratings**

		BSS 80	BSS 82
Collector-emitter voltage	$V_{CE0}$	40 V	60 V
Collector-base voltage	$V_{CB0}$		60 V
Emitter-base voltage	$V_{EB0}$		5 V
Collector current	$I_C$		800 mA
Peak collector current	$I_{CM}$		1 A
Base current	$I_B$		100 mA
Peak base current	$I_{BM}$		200 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$		330 mW
Junction temperature	$T_j$		150 °C
Storage temperature range	$T_{stg}$		-65 ... +150 °C
<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$		≤ 375 K/W

## Characteristics

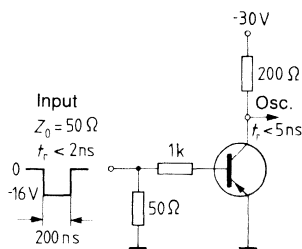
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 10\text{ mA}$ BSS 80 BSS 82	$V_{(BR) CE0}$	40 60	– –	– –	V V
Collector-base breakdown voltage $I_C = 10\ \mu\text{A}$	$V_{(BR) CB0}$	60	–	–	V
Emitter-base breakdown voltage $I_E = 10\ \mu\text{A}$	$V_{(BR) EB0}$	6	–	–	V
Collector cutoff current $V_{CB} = 50\text{ V}$ $V_{CB} = 50\text{ V}, T_A = 150^\circ\text{C}$	$I_{CB0}$	– –	– –	10 10	nA $\mu\text{A}$
Emitter cutoff current $V_{EB} = 3\text{ V}$	$I_{EB0}$	–	–	10	nA
DC current gain $I_C = 100\ \mu\text{A}, V_{CE} = 10\text{ V}$ BSS 80 B/82 B BSS 80 C/82 C $I_C = 1\text{ mA}, V_{CE} = 10\text{ V}$ BSS 80 B/82 B BSS 80 C/82 C $I_C = 10\text{ mA}, V_{CE} = 10\text{ V}^1)$ BSS 80 B/82 B BSS 80 C/82 C $I_C = 150\text{ mA}, V_{CE} = 10\text{ V}^1)$ BSS 80 B/82 B BSS 80 C/82 C $I_C = 500\text{ mA}, V_{CE} = 10\text{ V}^1)$ BSS 80 B/82 B BSS 80 C/82 C	$h_{FE}$	40 75 40 100 40 100 40 100 40 50	– – – – – – – – – –	– – – – – – 120 300 – –	– – – – – – – – – –
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 150\text{ mA}, I_B = 15\text{ mA}$ $I_C = 500\text{ mA}, I_B = 50\text{ mA}$	$V_{CEsat}$	– –	– –	0,4 1,6	V V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 150\text{ mA}, I_B = 15\text{ mA}$ $I_C = 500\text{ mA}, I_B = 50\text{ mA}$	$V_{BEsat}$	– –	– –	1,3 2,6	V V

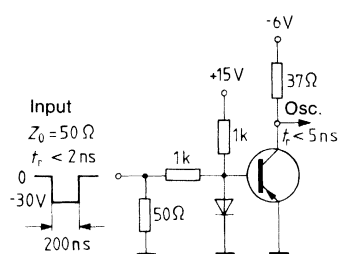
<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 20 \text{ mA}$ , $V_{CE} = 20 \text{ V}$ , $f = 100 \text{ MHz}$	$f_T$	–	250	–	MHz
Open-circuit output capacitance $V_{CB} = 10 \text{ V}$ , $f = 1 \text{ MHz}$	$C_{ob}$	–	6	–	pF
$V_{CC} = 30 \text{ V}$ , $I_C = 150 \text{ mA}$ , $I_{B1} = 150 \text{ mA}$					
Delay time	$t_d$	–	–	10	ns
Rise time	$t_r$	–	–	40	ns
$V_{CC} = 6 \text{ V}$ , $I_C = 150 \text{ mA}$ , $I_{B1} = I_{B2} = 15 \text{ mA}$					
Storage time	$t_s$	–	–	80	ns
Fall time	$t_f$	–	–	30	ns

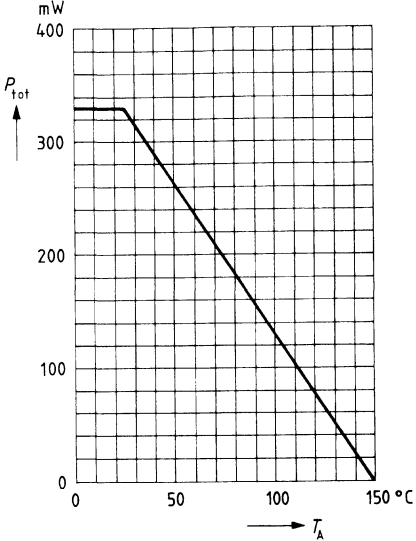
**Test circuit for delay time and rise time**



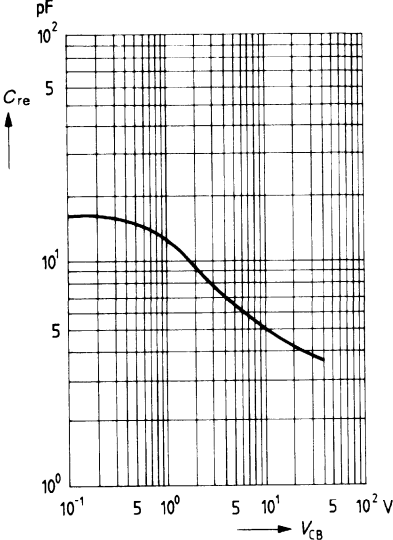
**Test circuit for storage time and fall time**



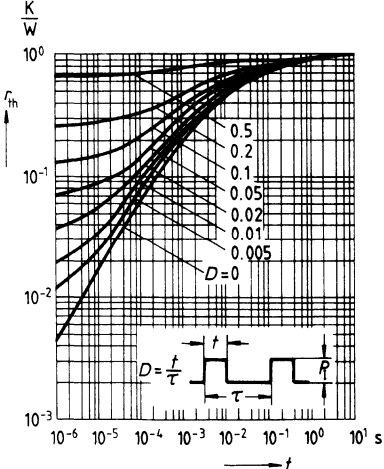
**Total power dissipation  $P_{tot} = f(T_A)$**



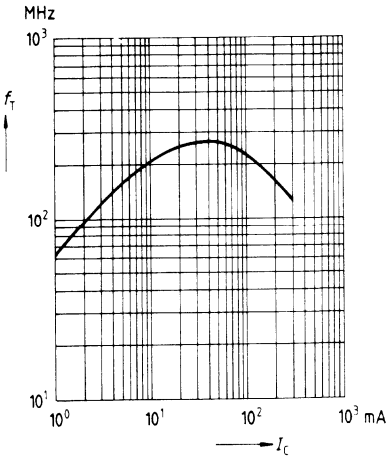
**Collector-base feedback capacitance  $C_{re} = f(V_{CB})$**   
 $f = 1 \text{ MHz}$



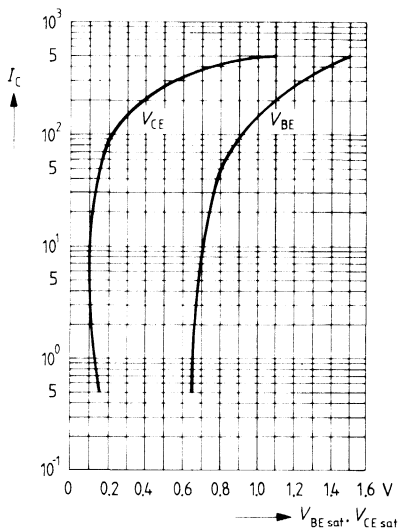
**Pulse handling capability  $r_{th} = f(t)$**   
(standardized)



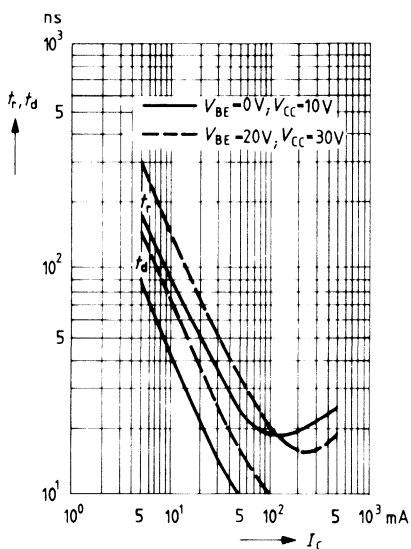
**Transition frequency  $f_T = f(I_C)$**   
 $V_{CE} = 20 \text{ V}$



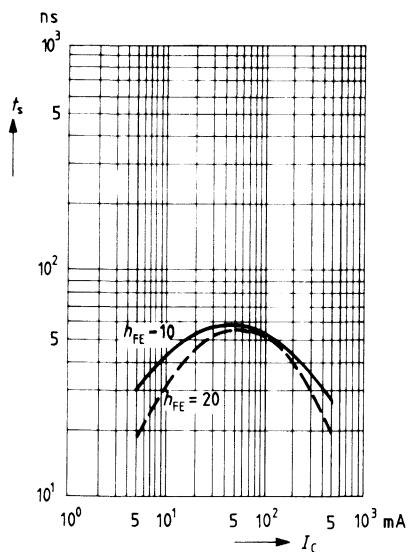
**Saturation voltage**  $V_{BE\text{ sat}} = f(I_C)$   
 $h_{FE} = 10$   $V_{CE\text{ sat}} = f(I_C)$



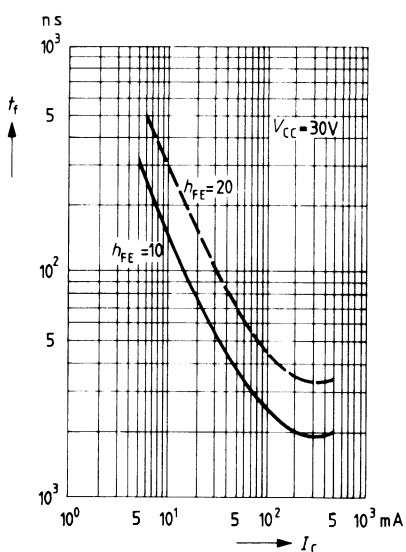
**Turn-on time**  $t_{on} = f(I_C)$



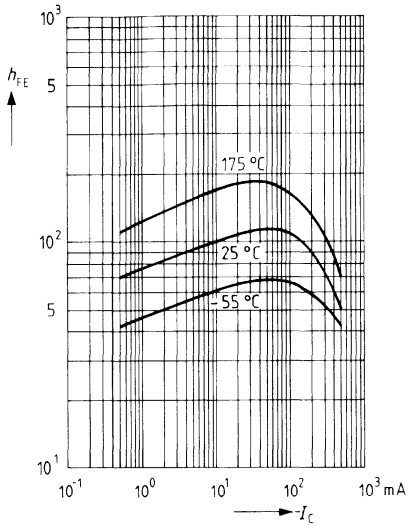
**Storage time**  $t_s = f(I_C)$



**Fall time**  $t_f = f(I_C)$



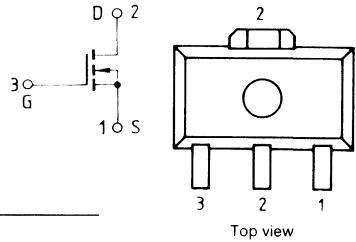
**DC current gain  $h_{FE} = f(I_c)$**   
 $V_{CE} = 10\text{ V}$





**MOSFET in N channel enhancement mode**

- Drain-source voltage  $V_{DS} = 200\text{ V}$
- Continuous drain current  $I_D = 0,28\text{ A}$
- Drain-source on-resistance  $R_{DS(on)} = 5,5\ \Omega$



Type	Marking	Ordering code	Package
BSS 87	KA	Refer to index	Version C

**Maximum ratings**

Drain-source voltage	$V_{DS}$	200 V
Drain-gate voltage	$V_{DGR}$	200 V
$R_{GS} = 20\text{ k}\Omega$		
Continuous drain current	$I_D$	0,28 A
$T_A = 30\text{ }^\circ\text{C}$		
Pulsed drain current	$I_{Dpuls}$	1,1 A
$T_A = 25\text{ }^\circ\text{C}$		
Gate-source voltage	$V_{GS}$	$\pm 20\text{ V}$
Total power dissipation	$P_{tot}$	1 W
$T_A = 25\text{ }^\circ\text{C}$		
Operating and storage temperature range	$T_j$	
	$T_{stg}$	$-55\text{ }^\circ\text{C} \dots +150\text{ }^\circ\text{C}$

<b>Thermal resistance</b>	$R_{thJA}$	$\leq 125\text{ K/W}$
junction-ambient		
package mounted on alumina		
15 mm $\times$ 16.7 mm $\times$ 0.7 mm		

## Characteristics

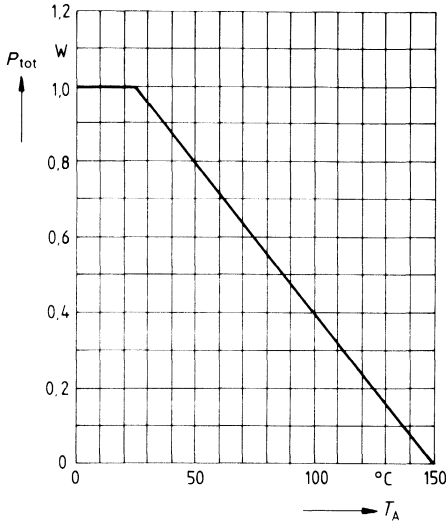
at  $T_C = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Drain-source breakdown voltage $V_{GS} = 0\text{ V}$ , $I_D = 0,5\text{ mA}$	$V_{(BR)DSS}$	200	–	–	V
Gate threshold voltage $V_{DS} = V_{GS}$ , $I_D = 1\text{ mA}$	$V_{GS(th)}$	0,8	2,2	2,8	V
Zero gate voltage drain current $T_j = 25^\circ\text{C}$ $T_j = 125^\circ\text{C}$ $V_{DS} = 200\text{ V}$ , $V_{GS} = 0\text{ V}$ $T_j = 25^\circ\text{C}$ $V_{DS} = 60\text{ V}$ $V_{GS} = 0\text{ V}$	$I_{DSS}$	– –	4 8	60 200	$\mu\text{A}$ $\mu\text{A}$
Gate-source leakage current $V_{GS} = 20\text{ V}$ , $V_{DS} = 0\text{ V}$	$I_{GSS}$	–	10	100	nA
Drain-source on-state resistance $V_{GS} = 10\text{ V}$ , $I_D = 0,4\text{ A}$	$R_{DS(on)}$	–	5,5	6,0	$\Omega$

Dynamic characteristics	Symbol	min	typ	max	Unit
Forward transconductance $V_{DS} = 25\text{ V}$ , $I_D = 0,4\text{ A}$	$g_{fs}$	0,14	0,2	–	S
Input capacitance	$C_{iss}$	–	110	–	pF
Output capacitance	$C_{oss}$	–	20	–	pF
Reverse transfer capacitance $V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$	$C_{rss}$	–	5	–	pF
Turn-on time $t_{on}$ ( $t_{on} = t_{d(on)} + t_r$ )	$t_{d(on)}$ $t_r$	– –	15 40	20 60	ns ns
Turn-off time $t_{off}$ ( $t_{off} = t_{d(off)} + t_f$ ) $V_{CC} = 30\text{ V}$ , $I_D = 0,28\text{ A}$ $V_{GS} = 10\text{ V}$ , $R_{GS} = 50\text{ }\Omega$	$t_{d(off)}$ $t_f$	– –	70 40	90 55	ns ns

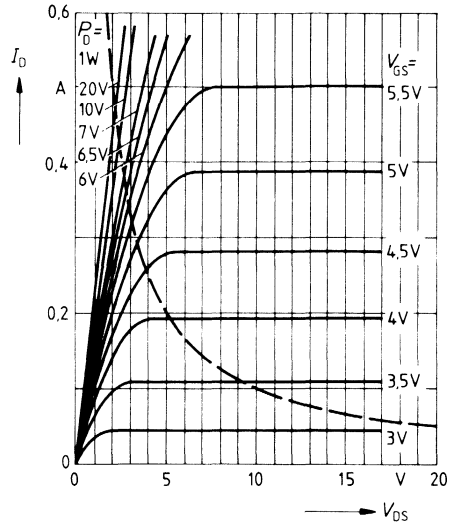
Reverse diode	Symbol	min	typ	max	Unit
Continuous reverse drain current $T_C = 25^\circ\text{C}$	$I_{DR}$	–	–	0,28	A
Pulsed reverse drain current $T_C = 25^\circ\text{C}$	$I_{DRM}$	–	–	1,1	A
Diode forward on-voltage $I_F = 2 \times I_{DR}$ , $V_{GS} = 0\text{ V}$ , $T_j = 25^\circ\text{C}$	$V_{SD}$	–	1,0	1,4	V
Reverse recovery time	$t_{rr}$	–	–	–	ns
Reverse recovery charge $T_j = 25^\circ\text{C}$ , $I_F = I_{DR}$ , $dI_F/dt = 100\text{ A}/\mu\text{s}$	$Q_{rr}$	–	–	–	$\mu\text{C}$

**Total power dissipation  $P_{tot} = f(T_A)$**



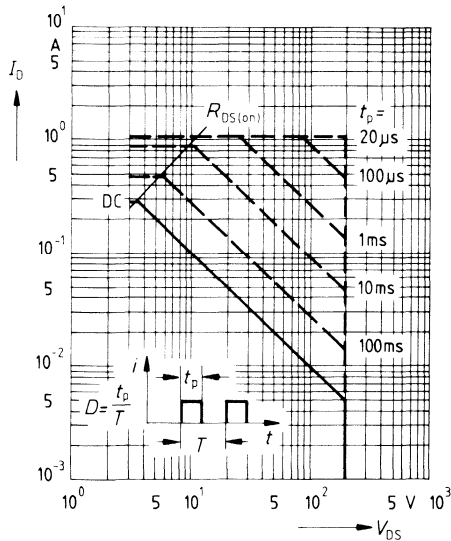
**Typical output characteristics  $I_D = f(V_{DS})$**

parameter: 80  $\mu$ s pulse test,  
 $T_j = 25^\circ\text{C}$



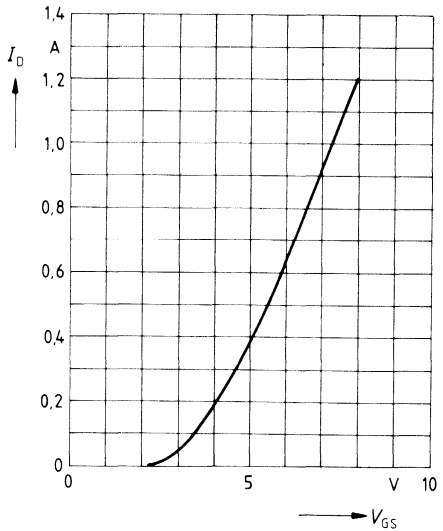
**Safe operating area  $I_D = f(V_{DS})$**

parameter:  $D = 0,01$ ,  $T_c = 25^\circ\text{C}$



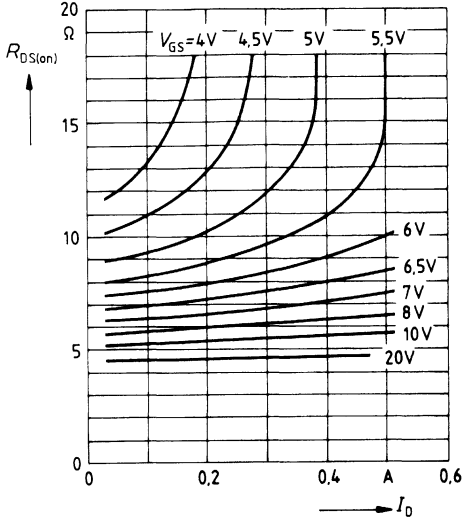
**Typical transfer characteristic  $I_D = f(V_{GS})$**

parameter: 80  $\mu$ s pulse test,  
 $V_{DS} = 25\text{ V}$ ,  $T_j = 25^\circ\text{C}$



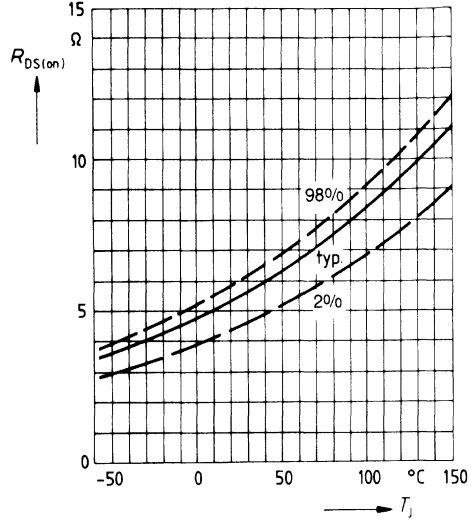
**Typical drain-source on-state resistance**

$R_{DS(on)} = f(I_D)$   
parameter:  $V_{GS} = 10V$ ;  $T_j = 25^\circ C$

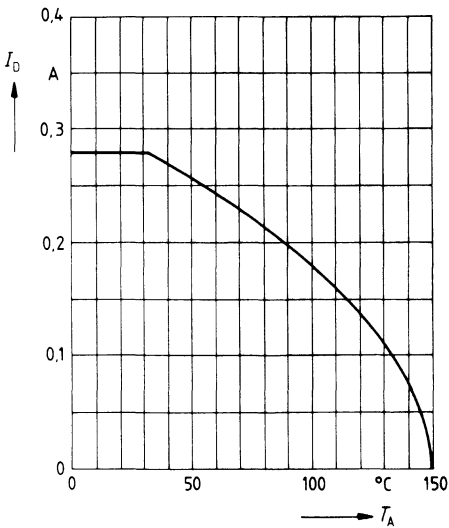


**Drain-source on-state resistance  $R_{DS(on)} = f(T_j)$  (spread)**

$I_D = 0,4 A$ ,  $V_{GS} = 10 V$

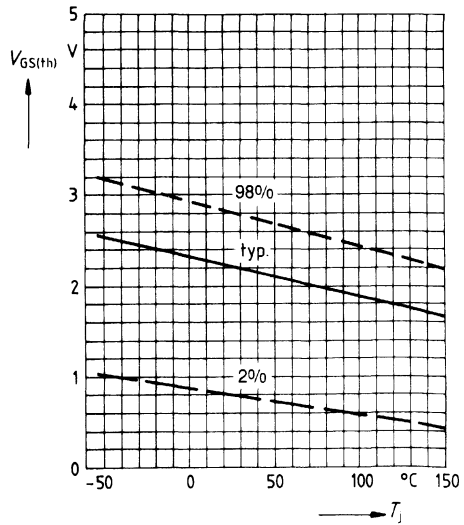


**Continuous drain current  $I_D = f(T_A)$**



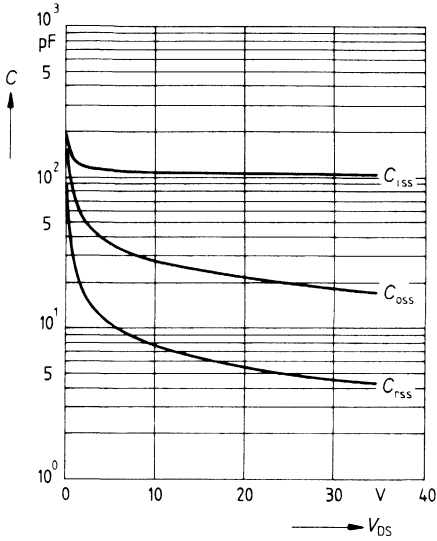
**Gate threshold voltage  $V_{GS(th)} = f(T_j)$**

parameter:  $V_{DS} = V_{GS}$ ,  $I_D = 1 mA$



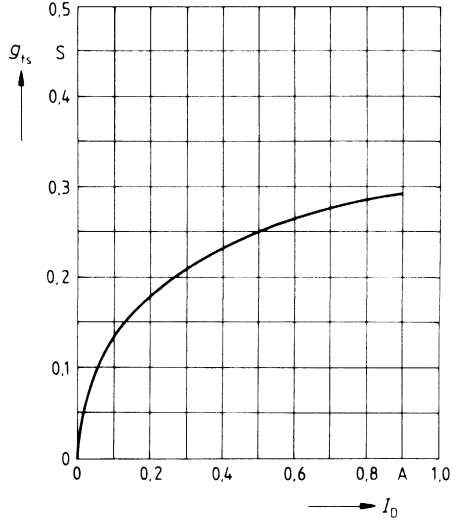
**Typical capacitances  $C = f(V_{DS})$**

parameter:  $V_{GS} = 0, f = 1 \text{ MHz}$



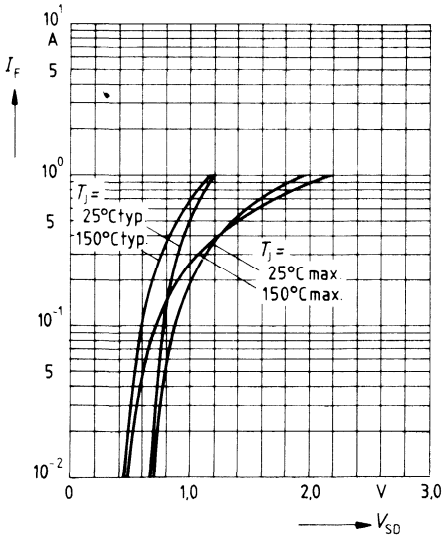
**Typical transconductance  $g_{fs} = f(I_D)$**

parameter: 80  $\mu\text{s}$  pulse test,  
 $V_{DS} = 25 \text{ V}, T_j = 25^\circ\text{C}$



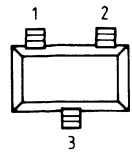
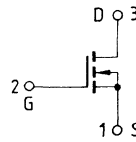
**Forward characteristic of reverse diode  $I_F = f(V_{SD})$**

parameter:  $T_j, t_p = 80 \mu\text{s}$



**MOSFET in N channel enhancement mode**

- Drain-source voltage  $V_{DS} = 100\text{ V}$
- Continuous drain current  $I_D = 0,17\text{ A}$
- Drain-source on-resistance  $R_{DS(on)} = 5,0\ \Omega$



Top view

Type	Marking	Ordering code	Package
BSS 123	SA	Refer to index	Version A

**Maximum ratings**

Drain-source voltage	$V_{DS}$	100 V
Drain-gate voltage	$V_{DGR}$	100 V
$R_{GS} = 20\text{ k}\Omega$		
Continuous drain current	$I_D$	0,16 A
$T_{SR} = 60\text{ }^\circ\text{C}$		
Pulsed drain current	$I_{Dpuls}$	0,68 A
$T_{SR} = 25\text{ }^\circ\text{C}$		
Gate-source voltage	$V_{GS}$	$\pm 20\text{ V}$
Total power dissipation	$P_{tot}$	0,33 W
$T_A = 25\text{ }^\circ\text{C}$		
Operating and storage temperature range	$T_j$	$-55\text{ }^\circ\text{C} \dots +150\text{ }^\circ\text{C}$

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	$\leq 375\text{ K/W}$
------------------------------------------------------------------------------------------------------------	------------	-----------------------

## Characteristics

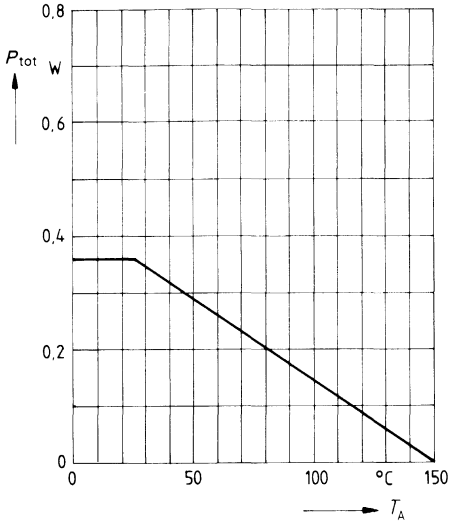
at  $T_C = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Drain-source breakdown voltage $V_{GS} = 0\text{ V}$ , $I_D = 0,5\text{ mA}$	$V_{(BR)DSS}$	100	–	–	V
Gate threshold voltage $V_{DS} = V_{GS}$ , $I_D = 1\text{ mA}$	$V_{GS(th)}$	0,8	2,2	2,8	V
Zero gate voltage drain current $T_j = 25^\circ\text{C}$ $T_j = 125^\circ\text{C}$ $V_{DS} = 100\text{ V}$ , $V_{GS} = 0\text{ V}$ $T_j = 25^\circ\text{C}$ $V_{DS} = 20\text{ V}$ $V_{GS} = 0\text{ V}$	$I_{DSS}$	– –	1 2	15 60	$\mu\text{A}$ $\mu\text{A}$
Gate-source leakage current $V_{GS} = 20\text{ V}$ , $V_{DS} = 0\text{ V}$	$I_{GSS}$	–	10	50	nA
Drain-source on-state resistance $V_{GS} = 10\text{ V}$ , $I_D = 100\text{ mA}$	$R_{DS(on)}$	–	5,0	6,0	$\Omega$

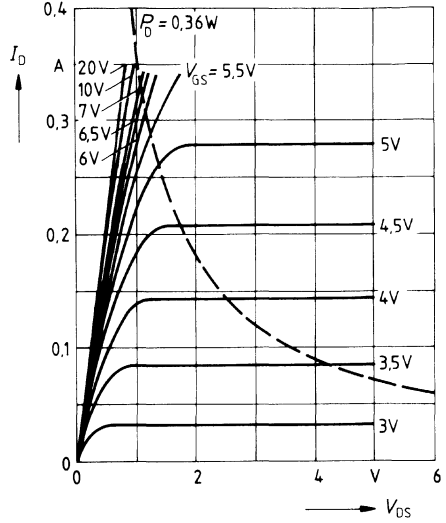
Dynamic characteristics	Symbol	min	typ	max	Unit
Forward transconductance $V_{DS} = 25\text{ V}$ , $I_D = 100\text{ mA}$	$g_{fs}$	0,08	0,12	–	S
Input capacitance	$C_{iss}$	–	20	–	pF
Output capacitance	$C_{oss}$	–	9	–	pF
Reverse transfer capacitance $V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$	$C_{rss}$	–	4	–	pF
Turn-on time $t_{on}$ ( $t_{on} = t_{d(on)} + t_r$ )	$t_{d(on)}$	–	10	–	ns
Turn-off time $t_{off}$ ( $t_{off} = t_{d(off)} + t_f$ )	$t_r$	–	10	–	ns
$V_{CC} = 30\text{ V}$ , $I_D = 0,28\text{ A}$ $V_{GS} = 10\text{ V}$ , $R_{GS} = 50\ \Omega$	$t_{d(off)}$	–	15	–	ns
	$t_f$	–	25	–	ns

Reverse diode	Symbol	min	typ	max	Unit
Continuous reverse drain current $T_C = 25^\circ\text{C}$	$I_{DR}$	–	–	0,17	A
Pulsed reverse drain current $T_C = 25^\circ\text{C}$	$I_{DRM}$	–	–	0,68	A
Diode forward on-voltage $I_F = 2 \times I_{DR}$ , $V_{GS} = 0\text{ V}$ , $T_j = 25^\circ\text{C}$	$V_{SD}$	–	1,1	1,3	V
Reverse recovery time	$t_{rr}$	–	–	–	ns
Reverse recovery charge $T_j = 25^\circ\text{C}$ , $I_F = I_{DR}$ , $dI_F/dt = 100\text{ A}/\mu\text{s}$	$Q_{rr}$	–	–	–	$\mu\text{C}$

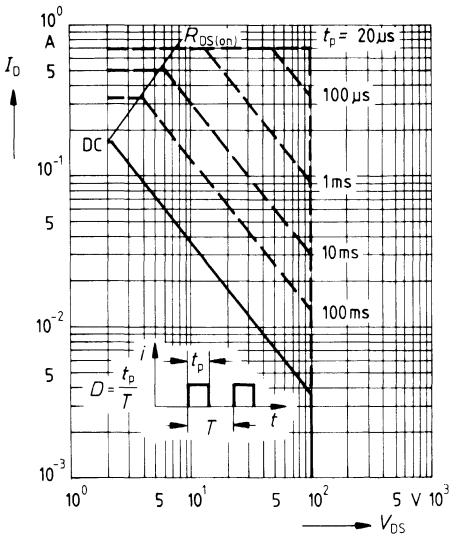
**Total power dissipation**  $P_{tot} = f(T_A)$



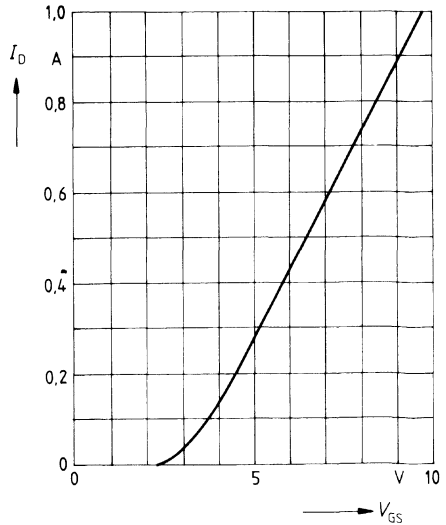
**Typical output characteristics**  $I_D = f(V_{DS})$   
parameter: 80  $\mu$ s pulse test,  
 $T_i = 25^\circ\text{C}$



**Safe operating area**  $I_D = f(V_{DS})$   
parameter:  $D = 0.01$ ,  $T_c = 25^\circ\text{C}$



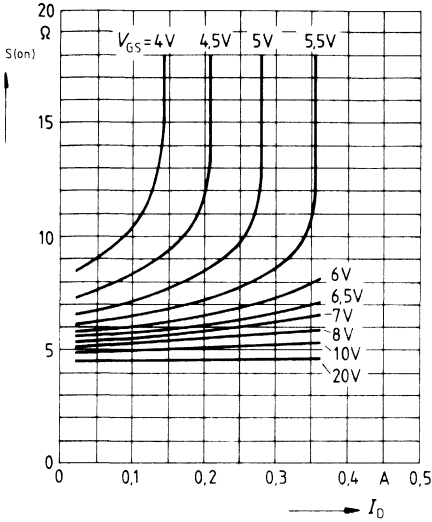
**Typical transfer characteristic**  $I_D = f(V_{GS})$   
parameter: 80  $\mu$ s pulse test,  
 $V_{DS} = 25\text{ V}$ ,  $T_i = 25^\circ\text{C}$





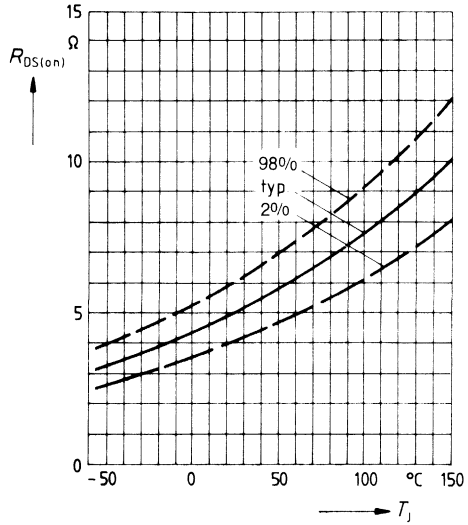
**Typical drain-source on-state resistance**

$R_{DS(on)} = f(I_D)$   
 parameter:  $V_{GS} = 10V$ ;  $T_j = 25^\circ C$

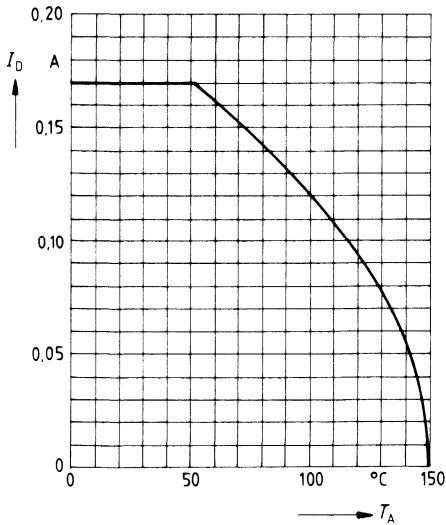


**Drain-source on-state resistance  $R_{DS(on)} = f(T_j)$  (spread)**

$I_D = 100\text{ mA}$ ,  $V_{GS} = 10V$

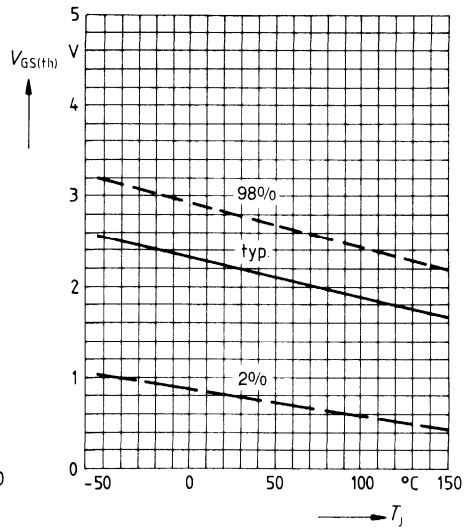


**Continuous drain current  $I_D = f(T_A)$**

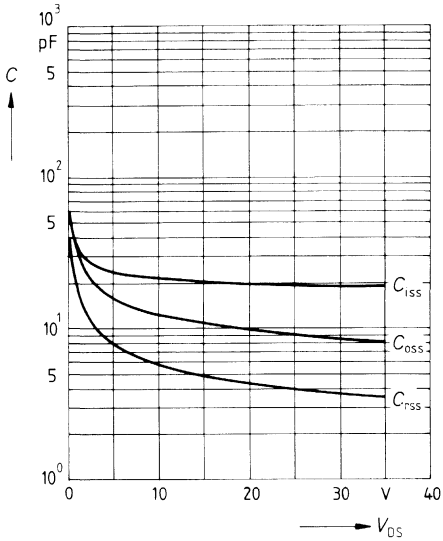


**Gate threshold voltage  $V_{GS(th)} = f(T_j)$**

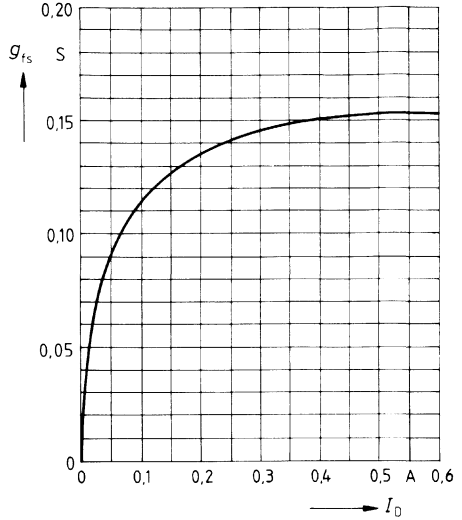
parameter:  $V_{DS} = V_{GS}$ ,  $I_D = 1\text{ mA}$



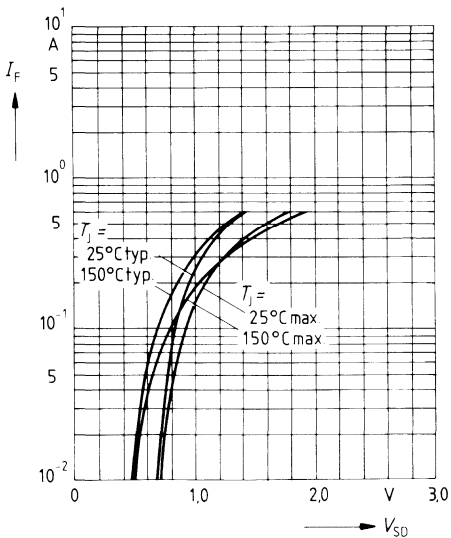
**Typical capacitances  $C = f(V_{DS})$**   
 parameter:  $V_{GS} = 0$ ,  $f = 1$  MHz



**Typical transconductance  $g_{fs} = f(I_D)$**   
 parameter: 80  $\mu$ s pulse test,  
 $V_{DS} = 25$  V,  $T_J = 25$  °C

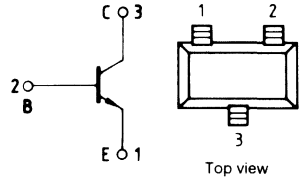


**Forward characteristic of reverse diode  $I_F = f(V_{SD})$**   
 parameter:  $T_J, t_p = 80$   $\mu$ s



## NPN silicon planar epitaxial transistors

- High DC current gain: 0.1 ... 500 mA
- Low collector-emitter saturation voltage
- Complementary PNP types: SMBT 2907, SMBT 2907 A



Type	Marking	Ordering code	Package
SMBT 2222	SB	Refer to index	Version A
SMBT 2222 A	SC		

Maximum ratings		SMBT 2222	SMBT 2222 A
Collector-emitter voltage	$V_{CE0}$	30 V	40 V
Collector-base voltage	$V_{CB0}$	60 V	75 V
Emitter-base voltage	$V_{EB0}$	5 V	6 V
Collector current	$I_C$		600 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$		330 mW
Junction temperature	$T_j$		150 °C
Storage temperature range	$T_{stg}$		-65 ... +150 °C
<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$		≤ 375 K/W

## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

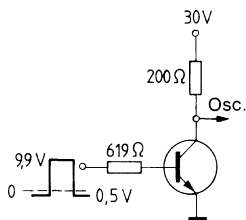
Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 10\text{ mA}$	$V_{(BR)CE0}$	30	–	–	V
SMBT 2222 SMBT 2222 A		40	–	–	V
Collector-base breakdown voltage $I_C = 10\ \mu\text{A}$	$V_{(BR)CB0}$	60	–	–	V
SMBT 2222 SMBT 2222 A		75	–	–	V
Emitter-base breakdown voltage $I_E = 10\ \mu\text{A}$	$V_{(BR)EB0}$	5	–	–	V
SMBT 2222 SMBT 2222 A		6	–	–	V
Collector cutoff current $V_{CB} = 50\text{ V}$	$I_{CB0}$	–	–	10	nA
$V_{CB} = 60\text{ V}$		–	–	10	nA
$V_{CB} = 50\text{ V}, T_A = 150^\circ\text{C}$		–	–	10	$\mu\text{A}$
$V_{CB} = 60\text{ V}, T_A = 150^\circ\text{C}$		–	–	10	$\mu\text{A}$
Emitter cutoff current $V_{EB} = 3\text{ V}$	$I_{EB0}$	–	–	10	nA
DC current gain $I_C = 100\ \mu\text{A}, V_{CE} = 10\text{ V}$	$h_{FE}$	35	–	–	–
$I_C = 1\text{ mA}, V_{CE} = 10\text{ V}$		50	–	–	–
$I_C = 10\text{ mA}, V_{CE} = 10\text{ V}^1)$		75	–	–	–
$I_C = 150\text{ mA}, V_{CE} = 1\text{ V}^1)$		50	–	–	–
$I_C = 150\text{ mA}, V_{CE} = 10\text{ V}^1)$		100	–	300	–
$I_C = 500\text{ mA}, V_{CE} = 10\text{ V}^1)$ SMBT 2222		30	–	–	–
SMBT 2222 A		40	–	–	–
$I_C = 10\text{ mA}, V_{CE} = 10\text{ V},$ $T_A = 55^\circ\text{C}$	SMBT 2222 A	35	–	–	–
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 150\text{ mA}, I_B = 15\text{ mA}$	$V_{CEsat}$	–	–	0,4	V
SMBT 2222		–	–	0,3	V
SMBT 2222 A		–	–	1,6	V
$I_C = 500\text{ mA}, I_B = 50\text{ mA}$		–	–	1,0	V
SMBT 2222 A					
Base-emitter saturation voltage <sup>1)</sup> $I_C = 150\text{ mA}, I_B = 15\text{ mA}$	$V_{BEsat}$	–	–	1,3	V
SMBT 2222		0,6	–	1,2	V
SMBT 2222 A		–	–	2,6	V
$I_C = 500\text{ mA}, I_B = 50\text{ mA}$		–	–	2,0	V
SMBT 2222 A					

<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

<b>Dynamic characteristics</b>	<b>Symbol</b>	<b>min</b>	<b>typ</b>	<b>max</b>	<b>Unit</b>
Transition frequency $I_C = 20 \text{ mA}$ , $V_{CE} = 20 \text{ V}$ , $f = 100 \text{ MHz}$ SMBT 2222 SMBT 2222 A	$f_T$	250 300	– –	– –	MHz MHz
Output capacitance $V_{CB} = 10 \text{ V}$ , $f = 1 \text{ MHz}$	$C_{ob}$	–	–	8	pF
Input capacitance $V_{EB} = 0,5 \text{ V}$ , $f = 1 \text{ MHz}$ SMBT 2222 SMBT 2222 A	$C_{ib}$	– –	– –	30 25	pF pF
Short-circuit input impedance $I_C = 1 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ , $f = 1 \text{ kHz}$ SMBT 2222 A $I_C = 10 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ , $f = 1 \text{ kHz}$ SMBT 2222 A	$h_{11e}$	2,0 0,25	– –	8,0 1,25	k $\Omega$ k $\Omega$
Open-circuit reverse voltage transfer ratio $I_C = 1 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ , $f = 1 \text{ kHz}$ SMBT 2222 A $I_C = 10 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ , $f = 1 \text{ kHz}$ SMBT 2222 A	$h_{12e}$	– –	– –	8,0 4,0	$10^{-4}$ $10^{-4}$
Short-circuit forward current transfer ratio $I_C = 1 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ , $f = 1 \text{ kHz}$ SMBT 2222 A $I_C = 10 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ , $f = 1 \text{ kHz}$ SMBT 2222 A	$h_{21e}$	50 75	– –	300 375	– –
Open-circuit output admittance $I_C = 1 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ , $f = 1 \text{ kHz}$ SMBT 2222 $I_C = 10 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ , $f = 1 \text{ kHz}$ SMBT 2222 A	$h_{22e}$	5,0 25	– –	35 200	$\mu\text{S}$ $\mu\text{S}$
Collector-base time constant $I_E = 20 \text{ mA}$ , $V_{CB} = 10 \text{ V}$ , $f = 31,8 \text{ MHz}$ SMBT 2222 A	$r_b' C_C$	–	–	150	ps
Noise figure $I_C = 100 \mu\text{A}$ , $V_{CE} = 10 \text{ V}$ , $R_G = 1 \text{ k}\Omega$ $f = 1 \text{ kHz}$ SMBT 2222 A	$NF$	–	–	4,0	dB

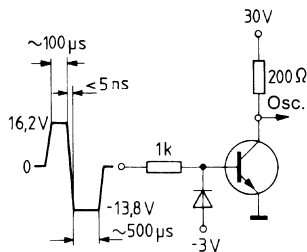
Dynamic characteristics	Symbol	min	typ	max	Unit
$V_{CC} = 30\text{ V}$ , $I_C = 150\text{ mA}$ , $I_{B1} = 15\text{ mA}$ $V_{BE(off)} = 0,5\text{ V}$					
Delay time	$t_d$	–	–	10	ns
Rise time	$t_r$	–	–	25	ns
$V_{CC} = 30\text{ V}$ , $I_C = 150\text{ mA}$ , $I_{B1} = I_{B2} = 15\text{ mA}$					
Storage time	$t_s$	–	–	225	ns
Fall time	$t_f$	–	–	60	ns

**Test circuit for delay time and rise time**

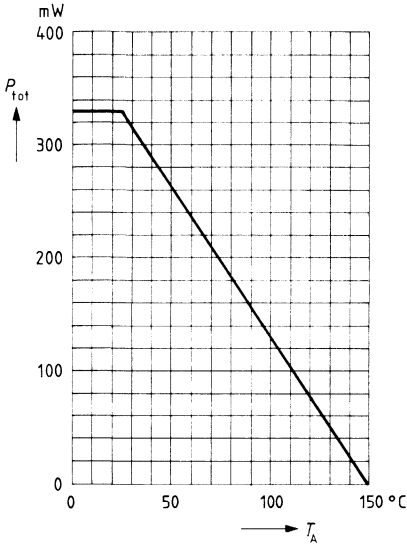


Oscilloscope:  $R > 100\text{ k}\Omega$   
 $C < 12\text{ pF}$   
 $t_r < 5\text{ ns}$

**Test circuit for storage time and fall time**



**Total power dissipation  $P_{tot} = f(T_A)$**

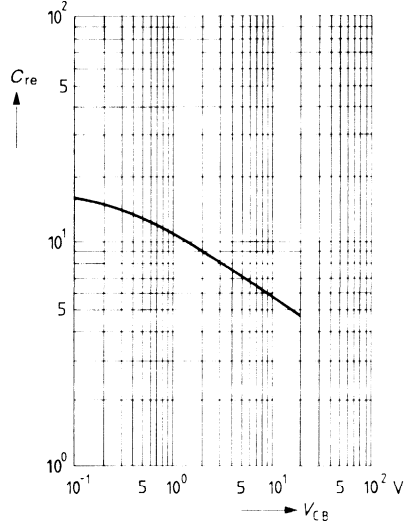


**Collector-base feedback capacitance**

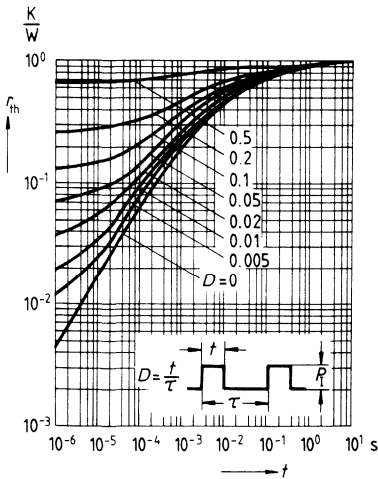
$C_{re} = f(V_{CB})$

$f = 1 \text{ MHz}$

pF

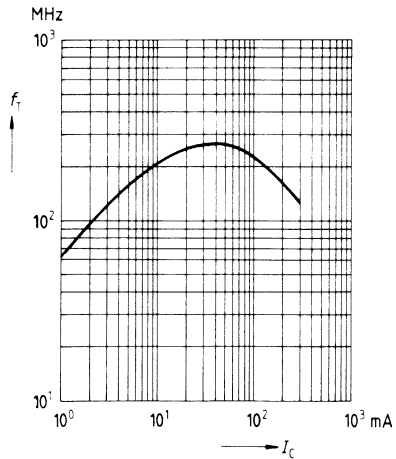


**Pulse handling capability  $r_{th} = f(t)$   
(standardized)**

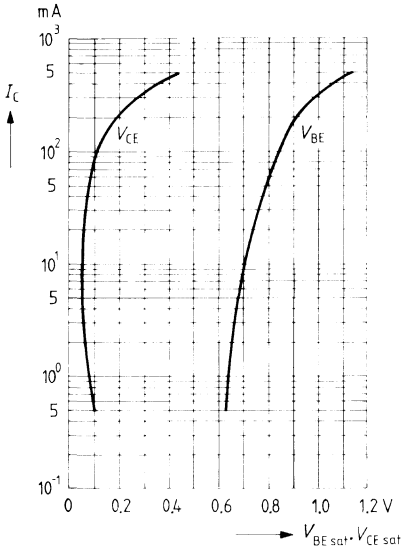


**Transition frequency  $f_T = f(I_C)$**

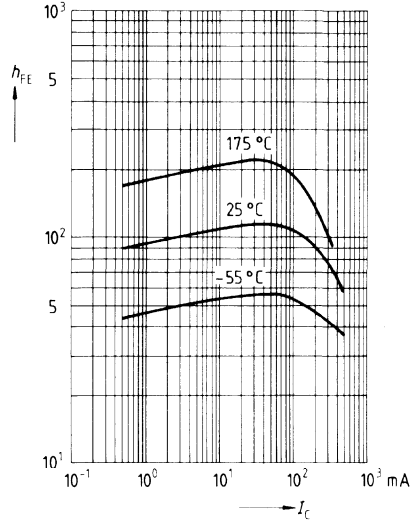
$C_{CE} = 20 \text{ V}$



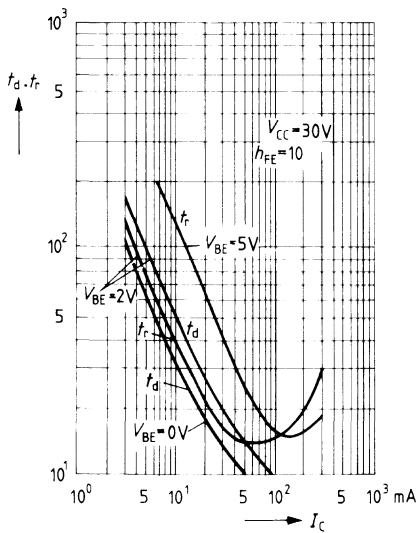
**Saturation voltage**  $V_{BE\text{ sat}} = f(I_C)$   
 $h_{FE} = 10$   $V_{CE\text{ sat}} = f(I_C)$



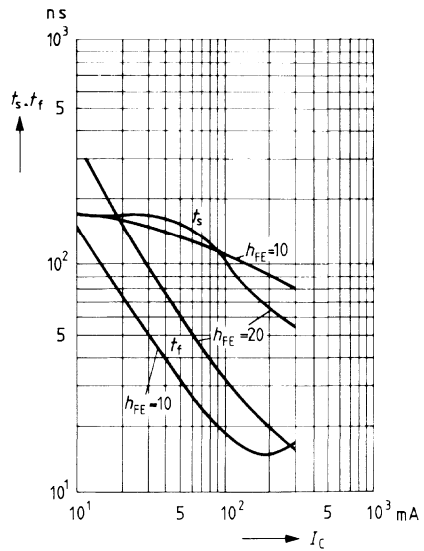
**DC current gain**  $h_{FE} = f(I_C)$   
 $V_{CE} = 10\text{ V}$



**Turn-on time**  $t_d = f(I_C)$   
 $t_r = f(I_C)$



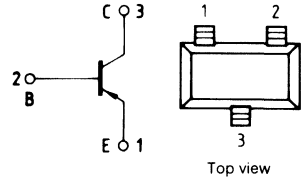
**Storage time**  $t_s = f(I_C)$   
**Fall time**  $t_f = f(I_C)$





**PNP silicon planar epitaxial transistors**

- High DC current gain: 0.1 ... 500 mA
- Low collector-emitter saturation voltage
- Complementary NPN types: SMBT 2222, SMBT 2222 A



Type	Marking	Ordering code	Package
SMBT 2907	SD	Refer to index	Version A
SMBT 2907 A	SE		

Maximum ratings		SMBT 2907	SMBT 2907 A
Collector-emitter voltage	$V_{CE0}$	40 V	60 V
Collector-base voltage	$V_{CB0}$		60 V
Emitter-base voltage	$V_{EB0}$		5 V
Collector current	$I_C$		600 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$		330 mW
Junction temperature	$T_j$		150 °C
Storage temperature range	$T_{stg}$		-65 ... +150 °C
<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$		≤ 375 K/W

## Characteristics

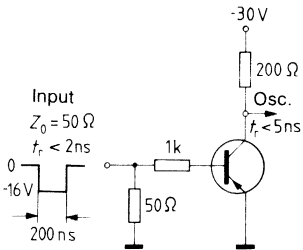
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 10\text{ mA}$	$V_{(BR) CE0}$	40	–	–	V
SMBT 2907		60	–	–	V
SMBT 2907 A					
Collector-base breakdown voltage $I_C = 10\ \mu\text{A}$	$V_{(BR) CB0}$	60	–	–	V
SMBT 2907		60	–	–	V
SMBT 2907 A					
Emitter-base breakdown voltage $I_E = 10\ \mu\text{A}$	$V_{(BR) EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 50\text{ V}$	$I_{CB0}$	–	–	20	nA
SMBT 2907		–	–	10	nA
SMBT 2907 A		–	–	20	$\mu\text{A}$
$V_{CB} = 50\text{ V}, T_A = 150^\circ\text{C}$		–	–	10	$\mu\text{A}$
SMBT 2907		–	–		
SMBT 2907 A		–	–		
Emitter cutoff current $V_{EB} = 3\text{ V}$	$I_{EB0}$	–	–	10	nA
DC current gain	$h_{FE}$				
$I_C = 100\ \mu\text{A}, V_{CE} = 10\text{ V}$		35	–	–	–
SMBT 2907		75	–	–	–
SMBT 2907 A		50	–	–	–
$I_C = 1\text{ mA}, V_{CE} = 10\text{ V}$		100	–	–	–
SMBT 2907		75	–	–	–
SMBT 2907 A		100	–	–	–
$I_C = 10\text{ mA}, V_{CE} = 10\text{ V}^1)$		100	–	–	–
SMBT 2907		100	–	300	–
SMBT 2907 A		100	–	300	–
$I_C = 150\text{ mA}, V_{CE} = 10\text{ V}^1)$		30	–	–	–
SMBT 2907		50	–	–	–
SMBT 2907 A					
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 150\text{ mA}, I_B = 15\text{ mA}$	$V_{CEsat}$	–	–	0,4	V
$I_C = 500\text{ mA}, I_B = 50\text{ mA}$		–	–	1,6	V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 150\text{ mA}, I_B = 15\text{ mA}$	$V_{BEsat}$	–	–	1,3	V
$I_C = 500\text{ mA}, I_B = 50\text{ mA}$		–	–	2,6	V

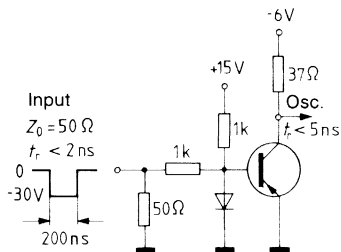
<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 20 \text{ mA}$ , $V_{CE} = 20 \text{ V}$ , $f = 100 \text{ MHz}$	$f_T$	200	–	–	MHz
Output capacitance $V_{CB} = 10 \text{ V}$ , $f = 1 \text{ MHz}$	$C_{ob}$	–	–	8	pF
Input capacitance $V_{EB} = 0,5 \text{ V}$ , $f = 1 \text{ MHz}$	$C_{ib}$	–	–	30	pF
$V_{CC} = 30 \text{ V}$ , $I_C = 150 \text{ mA}$ , $I_{B1} = 15 \text{ mA}$					
Delay time	$t_d$	–	–	10	ns
Rise time	$t_r$	–	–	40	ns
$V_{CC} = 6 \text{ V}$ , $I_C = 150 \text{ mA}$ , $I_{B1} = I_{B2} = 15 \text{ mA}$					
Storage time	$t_s$	–	–	80	ns
Fall time	$t_f$	–	–	30	ns

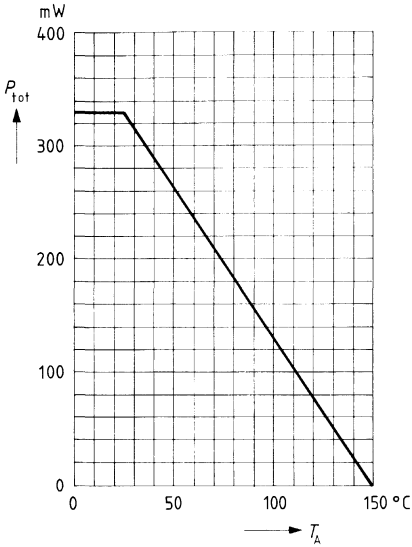
**Test circuit for delay time and rise time**



**Test circuit for storage time and fall time**



**Total power dissipation  $P_{tot} = f(T_A)$**

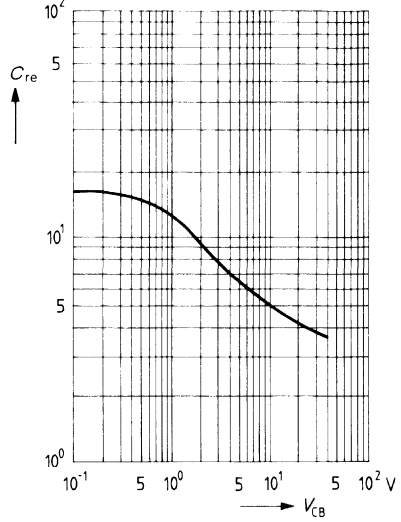


**Collector-base feedback capacitance**

$C_{re} = f(V_{CB})$

$f = 1 \text{ MHz}$

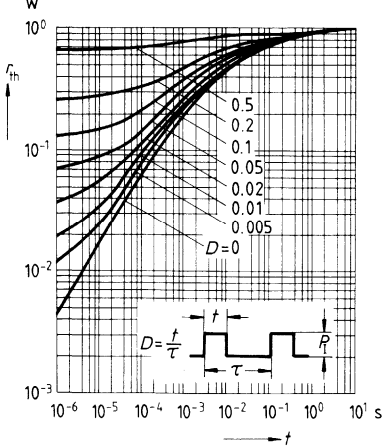
pF



**Pulse handling capability  $r_{th} = f(t)$**

(standardized)

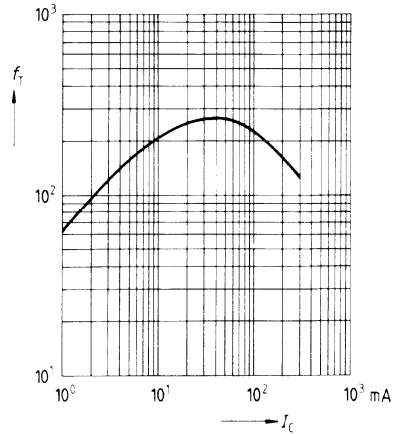
$\frac{K}{W}$



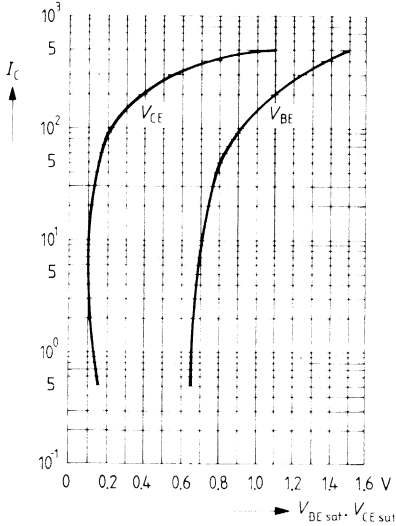
**Transition frequency  $f_T = f(I_C)$**

$V_{CE} = 20 \text{ V}$

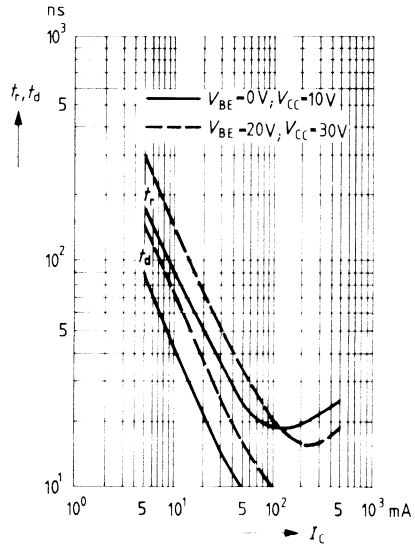
MHz



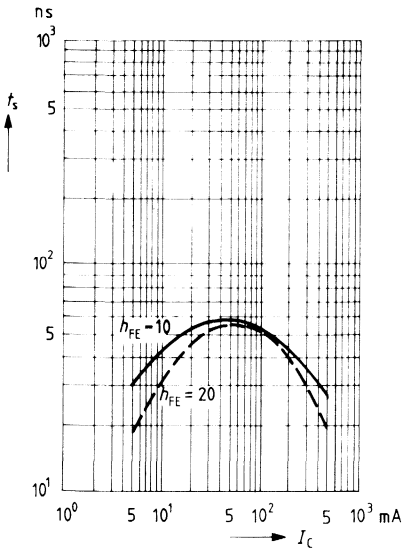
**Saturation voltage**  $V_{BE\text{ sat}} = f(I_C)$   
 $h_{FE} = 10$   $V_{CE\text{ sat}} = f(I_C)$



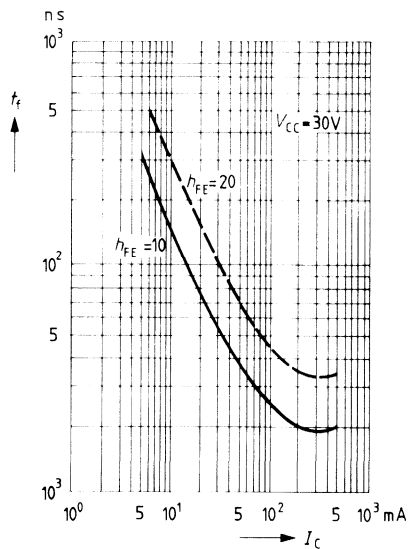
**Turn-on time**  $t_r, t_d = f(I_C)$



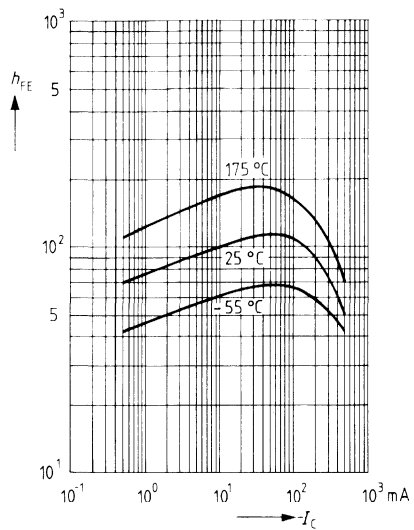
**Storage time**  $t_s = f(I_C)$



**Fall time**  $t_f = f(I_C)$

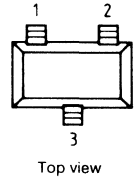
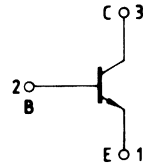


DC current gain  $h_{FE} = f(I_C)$



**NPN silicon planar epitaxial transistor**

- High DC current gain: 0.1... 100 mA
- Low collector-emitter saturation voltage
- Complementary PNP type: SMBT 3906



Type	Marking	Ordering code	Package
SMBT 3904	SN	Refer to index	Version A

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	40 V
Collector-base voltage	$V_{CB0}$	60 V
Emitter-base voltage	$V_{EB0}$	6 V
Collector current	$I_C$	200 mA
Total power dissipation $T_A = 25\text{ }^\circ\text{C}$	$P_{tot}$	330 mW
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	- 65 ... + 150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 375 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

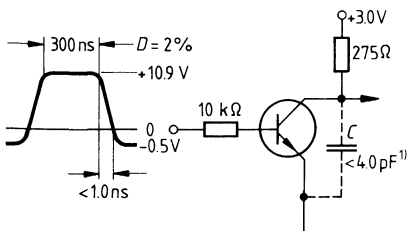
Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$	$V_{(BR)CE0}$	40	–	–	V
Collector-base breakdown voltage $I_C = 10\text{ }\mu\text{A}$	$V_{(BR)CB0}$	60	–	–	V
Emitter-base breakdown voltage $I_E = 10\text{ }\mu\text{A}$	$V_{(BR)EB0}$	6	–	–	V
Collector cutoff current $V_{CB} = 30\text{ V}$	$I_{CB0}$	–	–	50	nA
DC current gain $I_C = 100\text{ }\mu\text{A}$ , $V_{CE} = 1\text{ V}$ $I_C = 1\text{ mA}$ , $V_{CE} = 1\text{ V}$ $I_C = 10\text{ mA}$ , $V_{CE} = 1\text{ V}^1)$ $I_C = 50\text{ mA}$ , $V_{CE} = 1\text{ V}^1)$ $I_C = 100\text{ mA}$ , $V_{CE} = 1\text{ V}^1)$	$h_{FE}$	40 70 100 60 30	– – – – –	– – 300 – –	– – – – –
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 10\text{ mA}$ , $I_B = 1\text{ mA}$ $I_C = 50\text{ mA}$ , $I_B = 5\text{ mA}$	$V_{CEsat}$	– –	– –	0,2 0,3	V V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 10\text{ mA}$ , $I_B = 1\text{ mA}$ $I_C = 50\text{ mA}$ , $I_B = 5\text{ mA}$	$V_{BEsat}$	0,65 –	– –	0,85 0,95	V V

<sup>1)</sup> Pulse test:  $t = 300\text{ }\mu\text{s}$ ,  $D = 2\%$ .

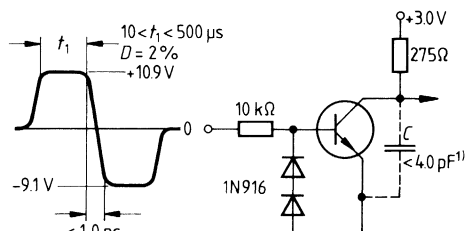


Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 10 \text{ mA}, V_{CE} = 20 \text{ V}, f = 100 \text{ MHz}$	$f_T$	300	–	–	MHz
Output capacitance $V_{CB} = 5 \text{ V}, f = 1 \text{ MHz}$	$C_{ob}$	–	–	4	pF
Input capacitance $V_{EB} = 0,5 \text{ V}, f = 1 \text{ MHz}$	$C_{ib}$	–	–	8	pF
Short-circuit input impedance $I_C = 1 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1 \text{ kHz}$	$h_{11e}$	1,0	–	10	k $\Omega$
Open-circuit reverse voltage transfer ratio $I_C = 1 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1 \text{ kHz}$	$h_{12e}$	0,5	–	8,0	$10^{-4}$
Short-circuit forward current transfer ratio $I_C = 1 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1 \text{ kHz}$	$h_{21e}$	100	–	400	–
Open-circuit output admittance $I_C = 1 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1 \text{ kHz}$	$h_{22e}$	1,0	–	40	$\mu\text{S}$
Noise figure $I_C = 100 \mu\text{A}, V_{CE} = 5 \text{ V}, R_G = 1 \text{ k}\Omega$ $f = 1 \text{ kHz}$	$NF$	–	–	5,0	dB
$V_{CC} = 3 \text{ V}, I_C = 10 \text{ mA}, I_{B1} = 1 \text{ mA}$ $V_{BE(\text{off})} = 0,5 \text{ V}$ Delay time	$t_d$	–	–	35	ns
Rise time	$t_r$	–	–	35	ns
$V_{CC} = 3 \text{ V}, I_C = 10 \text{ mA},$ $I_{B1} = I_{B2} = 1 \text{ mA}$ Storage time	$t_s$	–	–	200	ns
Fall time	$t_f$	–	–	50	ns

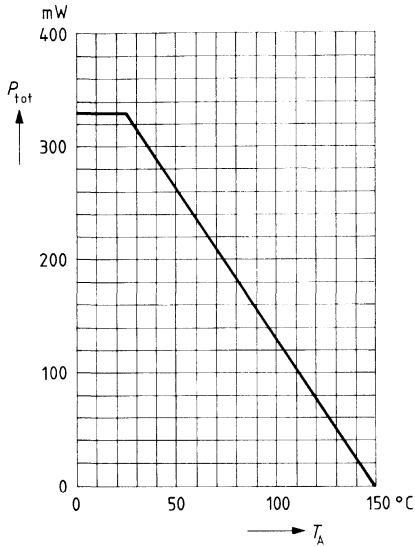
Test circuit for delay time and rise time



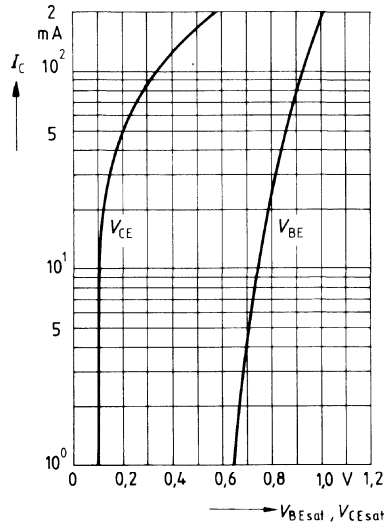
Test circuit for storage time and fall time



**Total power dissipation**  $P_{tot} = f(T_A)$

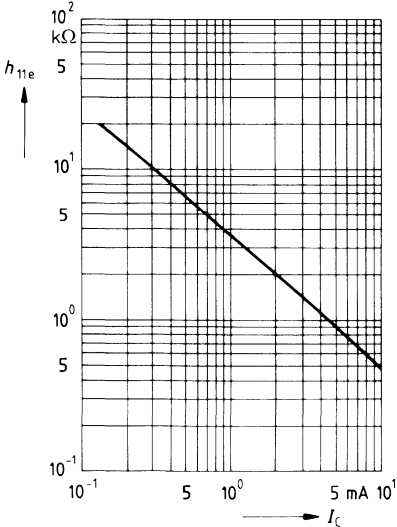


**Saturation voltage**  $V_{BE\ sat} = f(I_C)$   
 $V_{CE\ sat} = f(I_C)$



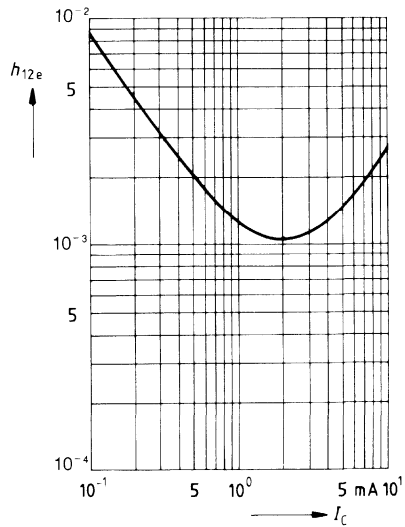
**Short-circuit input impedance**

$h_{11e} = f(I_C)$   
 $V_{CE} = 10\text{ V}, f = 1\text{ kHz}$



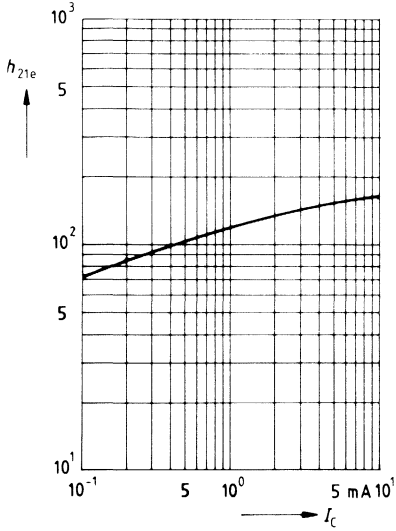
**Open-circuit reverse voltage transfer ratio**

$h_{12e} = f(I_C)$   
 $V_{CE} = 10\text{ V}, f = 1\text{ kHz}$



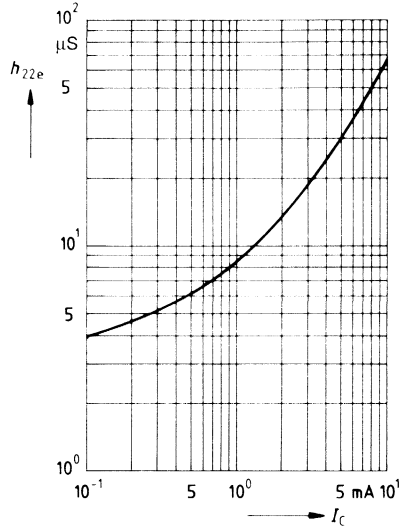
**Short-circuit forward current transfer ratio  $h_{21e} = f(I_C)$**

$V_{CE} = 10 \text{ V}$ ,  $f = 1 \text{ MHz}$

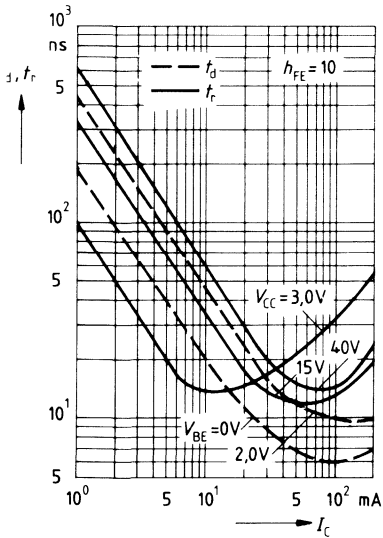


**Open-circuit output admittance  $h_{22e} = f(I_C)$**

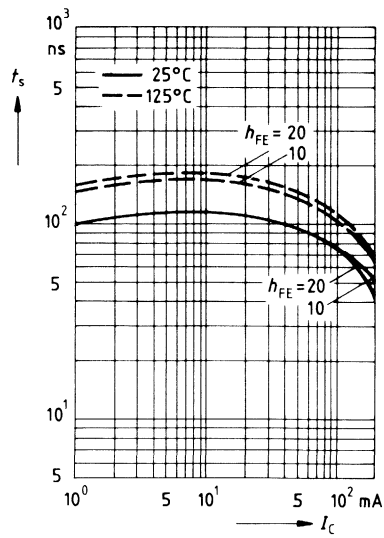
$V_{CE} = 10 \text{ V}$ ,  $f = 1 \text{ MHz}$



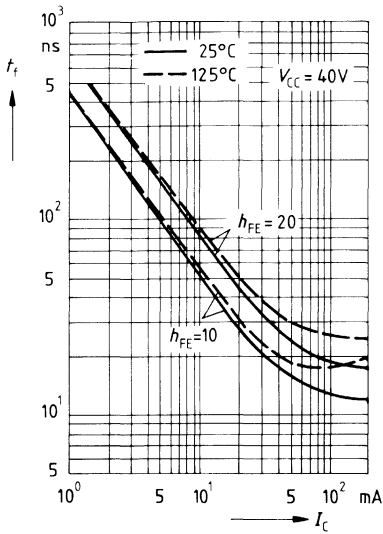
**Turn-on time  $t_d, t_r = f(I_C)$**



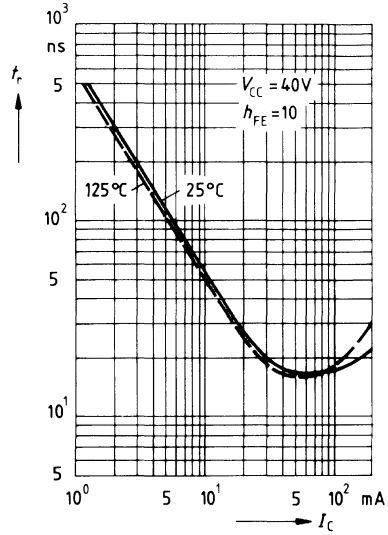
**Storage time  $t_s = f(I_C)$**



Fall time  $t_f = f(I_C)$

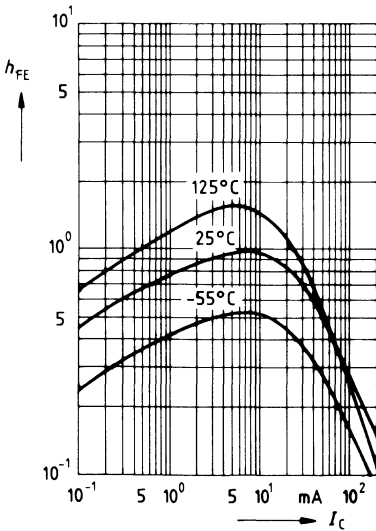


Rise time  $t_r = f(I_C)$



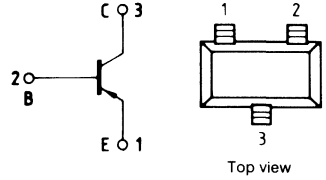
DC current gain  $h_{FE} = f(I_C)$

$V_{CE} = 10V$



**PNP silicon planar epitaxial transistor**

- High DC current gain: 0.1 ... 100 mA
- Low collector-emitter saturation voltage
- Complementary NPN type: SMBT 3904



Type	Marking	Ordering code	Package
SMBT 3906	SO	Refer to index	Version A

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	40 V
Collector-base voltage	$V_{CB0}$	40 V
Emitter-base voltage	$V_{EB0}$	5 V
Collector current	$I_C$	200 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	330 mW
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	-65 ... +150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 375 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

## Characteristics

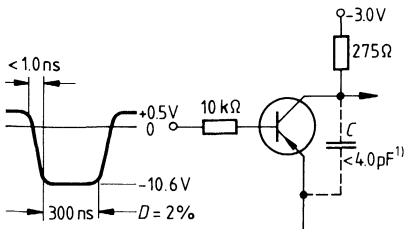
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$	$V_{(BR) CE0}$	40	–	–	V
Collector-base breakdown voltage $I_C = 10\ \mu\text{A}$	$V_{(BR) CB0}$	40	–	–	V
Emitter-base breakdown voltage $I_E = 10\ \mu\text{A}$	$V_{(BR) EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 30\text{ V}$	$I_{CB0}$	–	–	50	nA
DC current gain $I_C = 100\ \mu\text{A}, V_{CE} = 1\text{ V}$ $I_C = 1\text{ mA}, V_{CE} = 1\text{ V}$ $I_C = 10\text{ mA}, V_{CE} = 1\text{ V}^1)$ $I_C = 50\text{ mA}, V_{CE} = 1\text{ V}^1)$ $I_C = 100\text{ mA}, V_{CE} = 1\text{ V}^1)$	$h_{FE}$	60 80 100 60 30	– – – – –	– – 300 – –	– – – – –
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 10\text{ mA}, I_B = 1\text{ mA}$ $I_C = 50\text{ mA}, I_B = 5\text{ mA}$	$V_{CEsat}$	– –	– –	0,25 0,4	V V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 10\text{ mA}, I_B = 1\text{ mA}$ $I_C = 50\text{ mA}, I_B = 5\text{ mA}$	$V_{BEsat}$	0,65 –	– –	0,85 0,95	V V

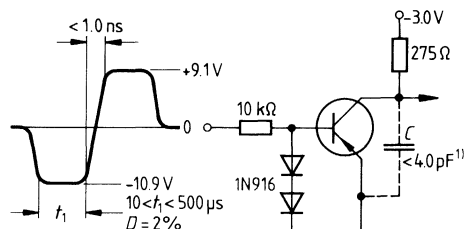
<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 10 \text{ mA}, V_{CE} = 20 \text{ V}, f = 100 \text{ MHz}$	$f_T$	250	–	–	MHz
Output capacitance $V_{CB} = 5 \text{ V}, f = 1 \text{ MHz}$	$C_{ob}$	–	–	4,5	pF
Input capacitance $V_{EB} = 0,5 \text{ V}, f = 1 \text{ MHz}$	$C_{ib}$	–	–	10	pF
Short-circuit input impedance $I_C = 1 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1 \text{ kHz}$	$h_{11e}$	2,0	–	12	k $\Omega$
Open-circuit reverse voltage transfer ratio $I_C = 1 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1 \text{ kHz}$	$h_{12e}$	0,1	–	10	$10^{-4}$
Short-circuit forward current transfer ratio $I_C = 1 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1 \text{ kHz}$	$h_{21e}$	100	–	400	–
Open-circuit output admittance $I_C = 1 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1 \text{ kHz}$	$h_{22e}$	3,0	–	60	$\mu\text{S}$
Noise figure $I_C = 100 \mu\text{A}, V_{CE} = 5 \text{ V}, R_G = 1 \text{ k}\Omega$ $f = 1 \text{ kHz}$	$NF$	–	–	4,0	dB
$V_{CC} = 3 \text{ V}, I_C = 10 \text{ mA}, I_{B1} = 1 \text{ mA}$ $V_{BE(\text{off})} = 0,5 \text{ Vdc}$					
Delay time	$t_d$	–	–	35	ns
Rise time	$t_r$	–	–	35	ns
$V_{CC} = 3 \text{ V}, I_C = 10 \text{ mA},$ $I_{B1} = I_{B2} = 1 \text{ mA}$					
Storage time	$t_s$	–	–	225	ns
Fall time	$t_f$	–	–	75	ns

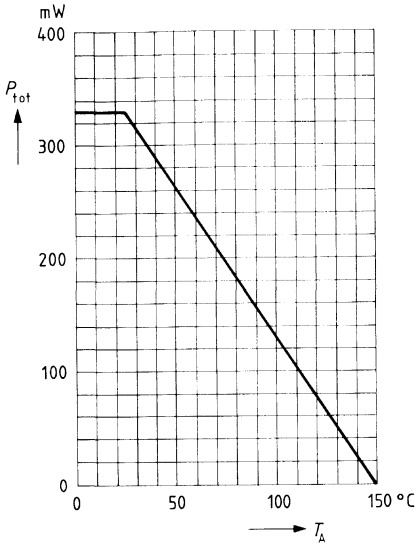
Test circuit for delay time and rise time



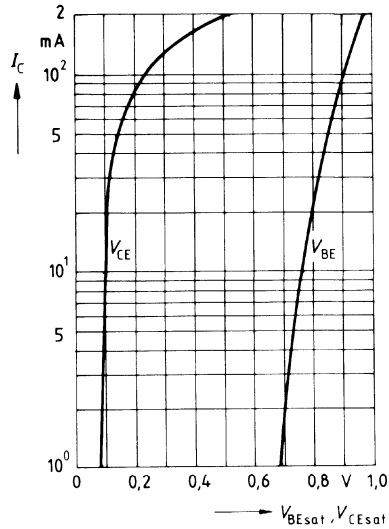
Test circuit for storage time and fall time



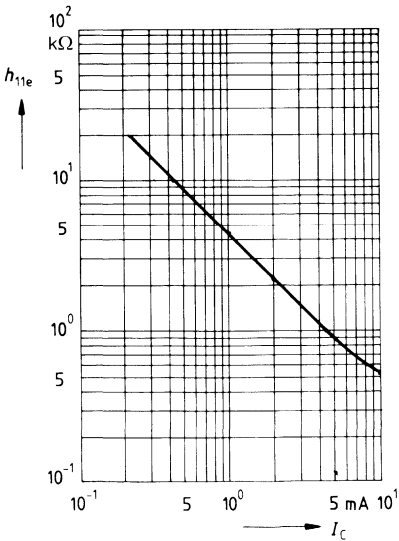
**Total power dissipation**  $P_{tot} = f(T_A)$



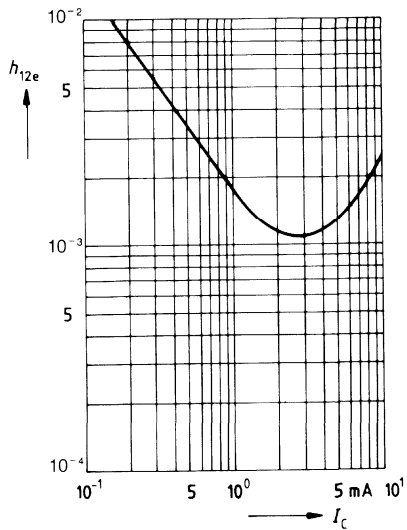
**Saturation voltage**  $V_{BE sat} = f(I_C)$   
 $V_{CE sat} = f(I_C)$



**Short-circuit input impedance**  $h_{11e} = f(I_C)$   
 $V_{CE} = 10 \text{ V}, f = 1 \text{ kHz}$



**Open-circuit reverse voltage transfer ratio**  $h_{12e} = f(I_C)$

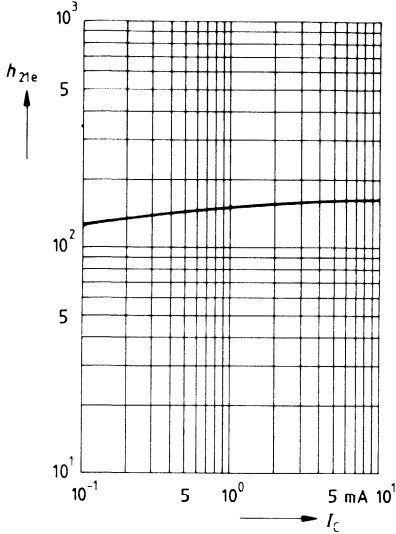




**Short-circuit forward current transfer ratio**

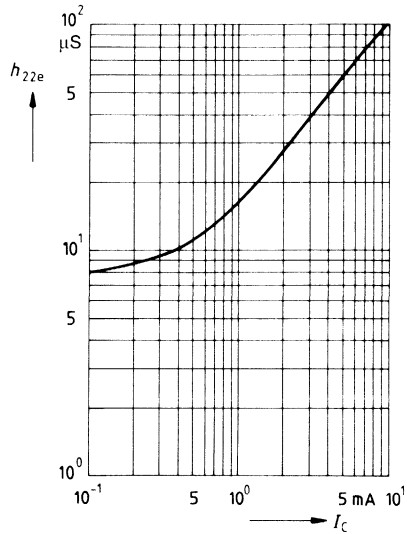
$h_{21e} = f(I_C)$

$V_{CE} = 10\text{ V}, f = 1\text{ MHz}$

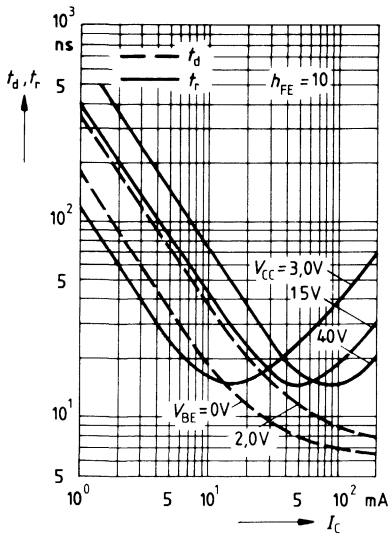


**Open-circuit output admittance**  $h_{22e} = f(I_C)$

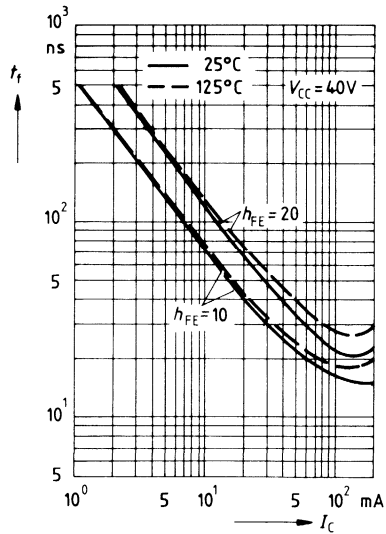
$V_{CE} = 10\text{ V}, f = 1\text{ MHz}$



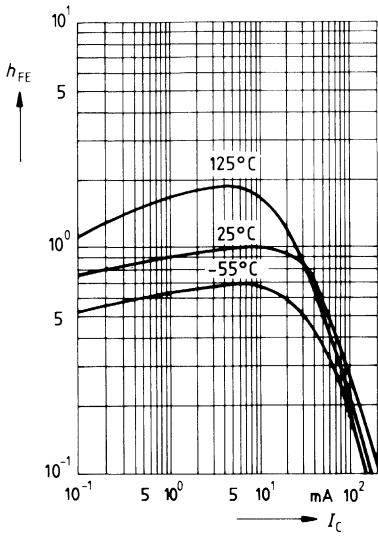
**Turn-on time**  $t_d, t_r = f(I_C)$



**Fall time**  $t_f = f(I_C)$

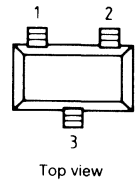
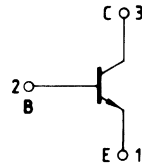


DC current gain  $h_{FE} = f(I_C)$



**NPN silicon planar epitaxial transistors**

- High DC current gain
- High collector current



Type	Marking	Ordering code	Package
SMBTA 13	SF	Refer to index	Version A
SMBTA 14	SG		

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	30 V
Collector-base voltage	$V_{CB0}$	30 V
Emitter-base voltage	$V_{EB0}$	10 V
Collector current	$I_C$	300 mA
Peak collector current	$I_{CM}$	500 mA
Base current	$I_B$	100 mA
Peak base current	$I_{BM}$	200 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	330 mW
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	- 65 ... + 150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 375 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

## Characteristics

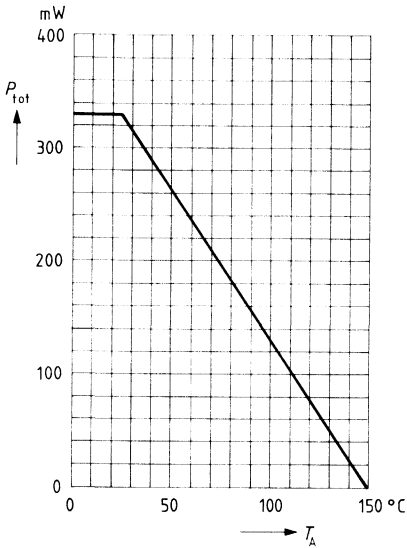
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 10\ \mu\text{A}$	$V_{(BR)CE0}$	30	–	–	V
Collector-base breakdown voltage $I_C = 10\ \mu\text{A}$	$V_{(BR)CB0}$	30	–	–	V
Emitter-base breakdown voltage $I_E = 10\ \mu\text{A}$	$V_{(BR)EB0}$	10	–	–	V
Collector cutoff current $V_{CB} = 30\ \text{V}$	$I_{CB0}$	–	–	100	nA
Emitter cutoff current $V_{EB} = 10\ \text{V}$	$I_{EB0}$	–	–	100	nA
DC current gain $I_C = 10\ \text{mA}$ , $V_{CE} = 5\ \text{V}^1)$ SMBTA 13 SMBTA 14 $I_C = 100\ \text{mA}$ , $V_{CE} = 5\ \text{V}^1)$ SMBTA 13 SMBTA 14	$h_{FE}$	5000 10000 10000 20000	– – – –	– – – –	– – – –
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 100\ \text{mA}$ , $I_B = 0,1\ \text{mA}$	$V_{CEsat}$	–	–	1,5	V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 100\ \text{mA}$ , $I_B = 0,1\ \text{mA}$	$V_{BEsat}$	–	–	2,0	V

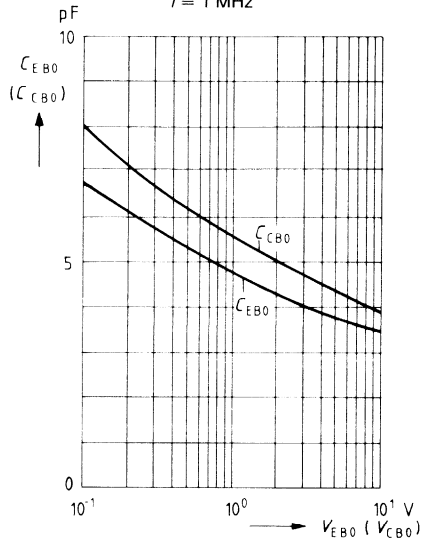
Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 50\ \text{mA}$ , $V_{CE} = 5\ \text{V}$ , $f = 20\ \text{MHz}$	$f_T$	125	–	–	MHz

<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

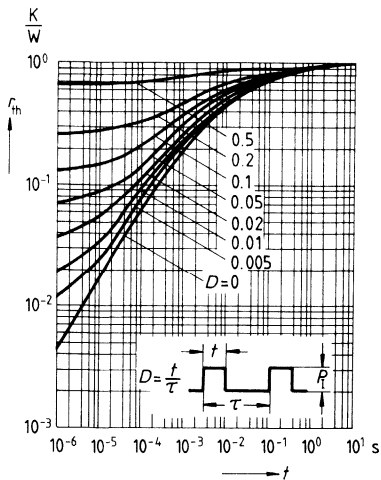
**Total power dissipation**  $P_{\text{tot}} = f(T_A)$



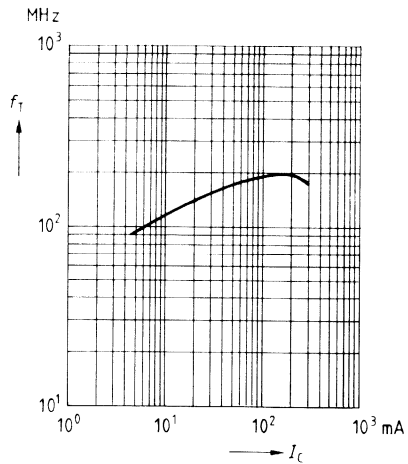
**Capacitance**  $C_{\text{CB0}} = f(V_{\text{CB0}})$   
 $C_{\text{EB0}} = f(V_{\text{EB0}})$   
 $f = 1 \text{ MHz}$



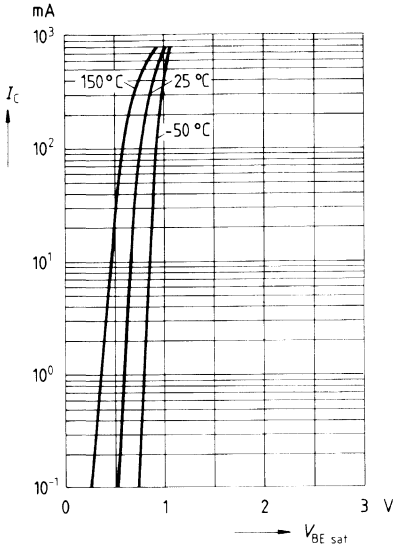
**Pulse handling capability**  $r_{\text{th}} = f(t)$   
standardized)



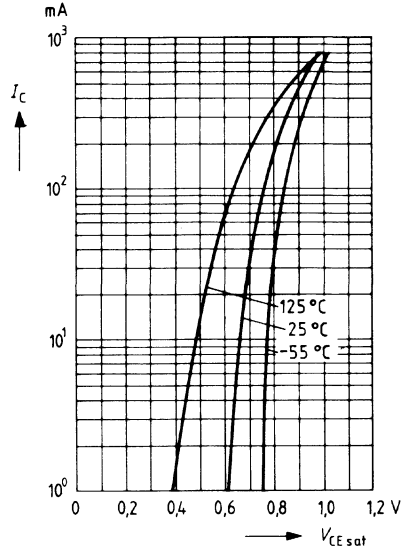
**Transition frequency**  $f_T = f(I_C)$   
 $V_{\text{CE}} = 5 \text{ V}, f = 20 \text{ MHz}$



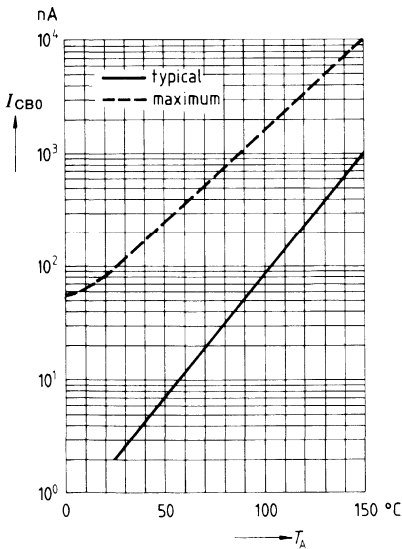
**Base-emitter saturation voltage**  $V_{BE\ sat} = f(I_C)$   
 $h_{FE} = 1000$



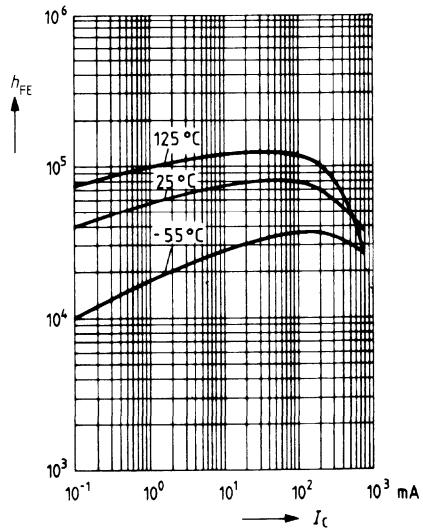
**Collector-emitter saturation voltage**  
 $V_{CE\ sat} = f(I_C)$   
 $h_{FE} = 1000$



**Collector cutoff current**  $I_{CB0} = f(T_A)$   
 $V_{CB} = 30$  V

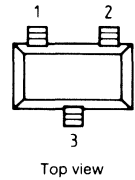
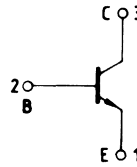


**DC current gain**  $h_{FE} = f(I_C)$   
 $V_{CE} = 5$  V



**NPN silicon planar epitaxial transistor**

- High DC current gain
- Low collector-emitter saturation voltage



Type	Marking	Ordering code	Package
SMBTA 20	SA	Refer to index	Version A

**Maximum ratings**

Collector-emitter voltage	$V_{CE0}$	40 V
Emitter-base voltage	$V_{EB0}$	4 V
Collector current	$I_C$	100 mA
Peak collector current	$I_{CM}$	200 mA
Peak base current	$I_{BM}$	200 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	330 mW
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	-65 ... +150 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 375 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

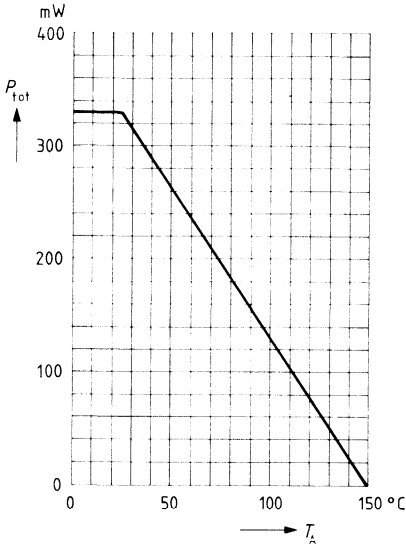
Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$	$V_{(BR) CE0}$	40	–	–	V
Emitter-base breakdown voltage $I_E = 100\ \mu\text{A}$	$V_{(BR) EB0}$	4	–	–	V
Collector cutoff current $V_{CB} = 30\text{ V}$ $V_{CB} = 30\text{ V}$ , $T_A = 150^\circ\text{C}$	$I_{CB0}$	– –	– –	100 20	nA $\mu\text{A}$
Emitter cutoff current $V_{EB} = 4\text{ V}$	$I_{EB0}$	–	–	20	nA
DC current gain $I_C = 5\text{ mA}$ , $V_{CE} = 10\text{ V}$	$h_{FE}$	40	–	400	–
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 10\text{ mA}$ , $I_B = 1\text{ mA}$	$V_{CEsat}$	–	–	0,25	V

Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 20\text{ mA}$ , $V_{CE} = 5\text{ V}$ , $f = 100\text{ MHz}$	$f_T$	125	–	–	MHz
Output capacitance $V_{CB} = 10\text{ V}$ , $f = 1\text{ MHz}$	$C_{ob}$	–	–	4	pF

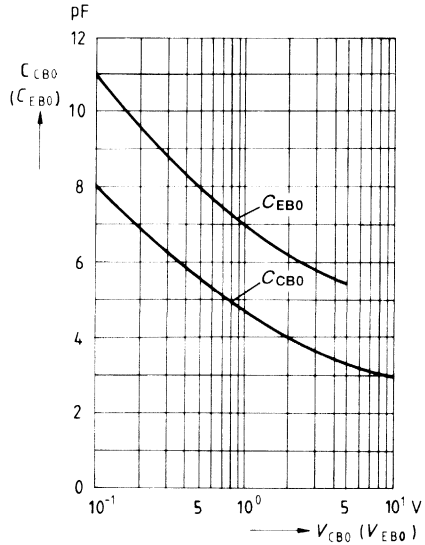
<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .



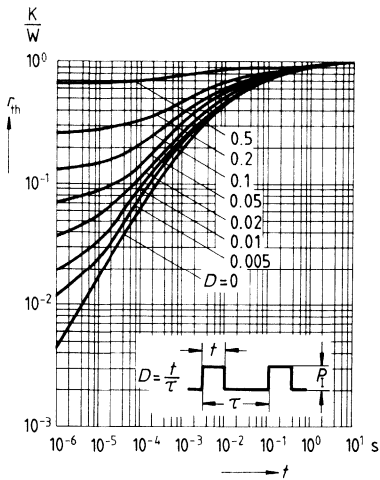
**Total power dissipation**  $P_{tot} = f(T_A)$



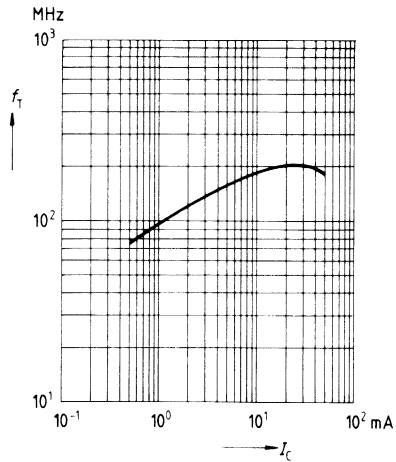
**Capacitance**  $C_{CB0} = f(V_{CB0})$   
 $C_{EB0} = f(V_{EB0})$   
 $f = 1 \text{ MHz}$



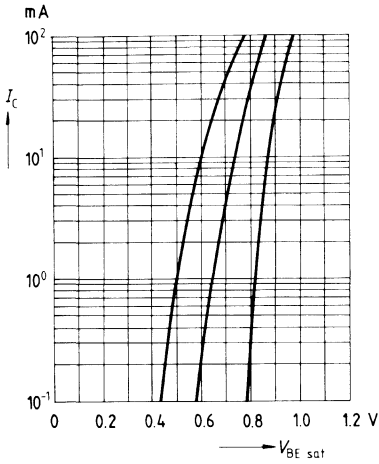
**Pulse handling capability**  $r_{th} = f(t)$   
 (standardized)



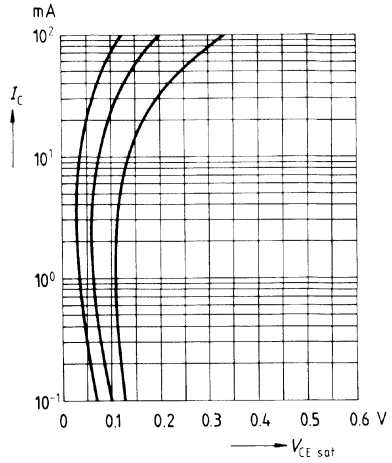
**Transition frequency**  $f_T = f(I_C)$   
 $V_{CE} = 5 \text{ V}, f = 100 \text{ MHz}$



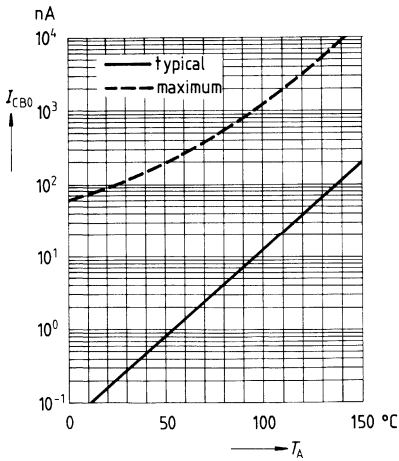
**Base-emitter saturation voltage**  $V_{BE\ sat} = f(I_C)$   
 $h_{FE} = 20$



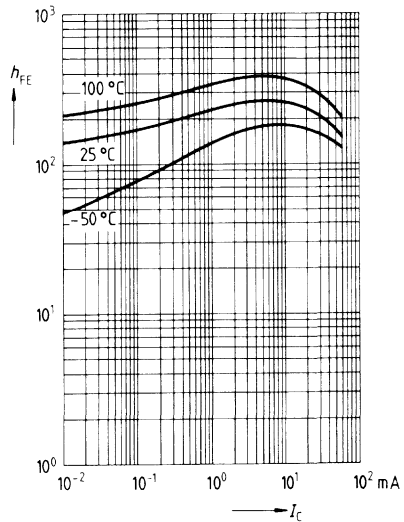
**Collector-emitter saturation voltage**  
 $V_{CE\ sat} = f(I_C)$   
 $h_{FE} = 20$



**Collector cutoff current**  $I_{CB0} = f(T_A)$   
 $V_{CB} = 30\ V$

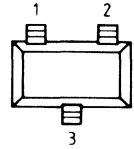
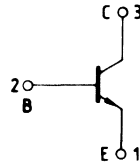


**DC current gain**  $h_{FE} = f(I_C)$   
 $V_{CE} = 1\ V$



**NPN silicon planar epitaxial transistors**

- High breakdown voltage
- Low collector-emitter saturation voltage
- Complementary PNP types: SMBTA 92, SMBTA 93



Top view

Type	Marking	Ordering code	Package
SMBTA 42	SL	Refer to index	Version A
SMBTA 43	SM		

**Maximum ratings**

	SMBTA 42	SMBTA 43
Collector-emitter voltage	$V_{CE0}$ 300 V	200 V
Collector-base voltage	$V_{CB0}$ 300 V	200 V
Emitter-base voltage	$V_{EB0}$	6 V
Collector current	$I_C$	500 mA
Base current	$I_B$	100 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$	360 mW
Junction temperature	$T_j$	150 °C
Storage temperature range	$T_{stg}$	-65 ... +150 °C
<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≤ 350 K/W

## Characteristics

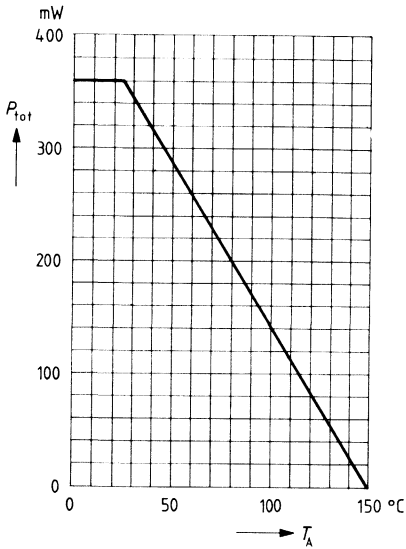
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$ SMBTA 42 SMBTA 43	$V_{(BR)CE0}$	300 200	- -	- -	V V
Collector-base breakdown voltage $I_C = 100\ \mu\text{A}$ SMBTA 42 SMBTA 43	$V_{(BR)CB0}$	300 200	- -	- -	V V
Emitter-base breakdown voltage $I_E = 100\ \mu\text{A}$	$V_{(BR)EB0}$	6	-	-	V
Collector cutoff current $V_{CB} = 200\text{ V}$ SMBTA 42 $V_{CB} = 160\text{ V}$ SMBTA 43 $V_{CB} = 200\text{ V}, T_A = 150^\circ\text{C}$ SMBTA 42 $V_{CB} = 160\text{ V}, T_A = 150^\circ\text{C}$ SMBTA 43	$I_{CB0}$	- - - -	- - - -	100 100 20 20	nA nA $\mu\text{A}$ $\mu\text{A}$
Emitter cutoff current $V_{EB} = 3\text{ V}$	$I_{EB0}$	-	-	100	nA
DC current gain $I_C = 1\text{ mA}, V_{CE} = 10\text{ V}$ $I_C = 10\text{ mA}, V_{CE} = 10\text{ V}^1)$ $I_C = 30\text{ mA}, V_{CE} = 10\text{ V}^1)$ SMBTA 42 SMBTA 43	$h_{FE}$	25 40 40 40	- - - -	- - - -	- - - -
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 20\text{ mA}, I_B = 2\text{ mA}$ SMBTA 42 SMBTA 43	$V_{CEsat}$	- -	- -	0,5 0,4	V V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 20\text{ mA}, I_B = 2\text{ mA}$	$V_{BEsat}$	-	-	0,9	V

Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 10\text{ mA}, V_{CE} = 20\text{ V}, f = 100\text{ MHz}$	$f_T$	50	-	-	MHz
Output capacitance $V_{CB} = 20\text{ V}, f = 1\text{ MHz}$ SMBTA 42 SMBTA 43	$C_{ob}$	- -	- -	3 4	pF pF

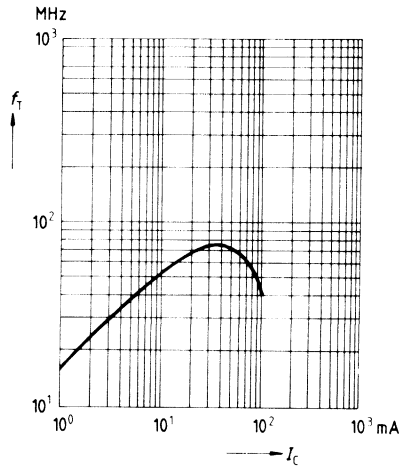
<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

**Total power dissipation  $P_{tot} = f(T_A)$**

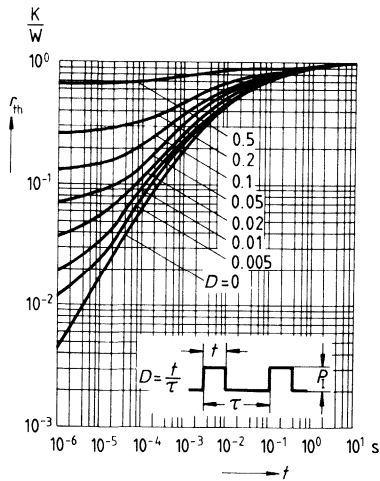


**Transition frequency  $f_T = f(I_C)$**

$V_{CE} = 10\text{ V}, f = 100\text{ MHz}$

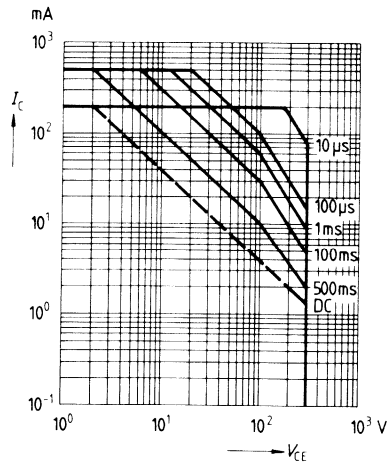


**Pulse handling capability  $r_{th} = f(t)$**   
(standardized)

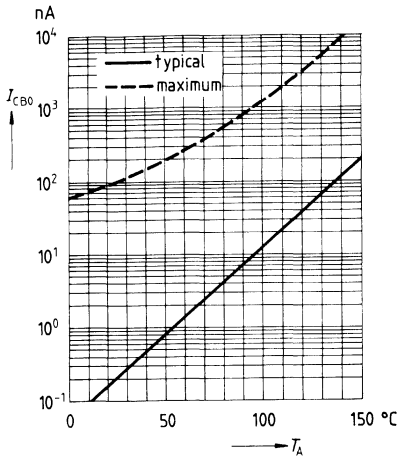


**Operating range  $I_C = f(V_{CE})$**

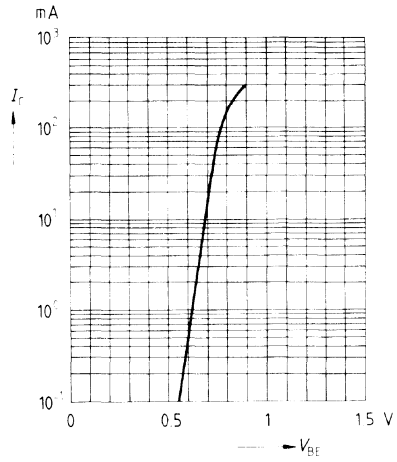
$T_A = 25^\circ\text{C}, D = 0$



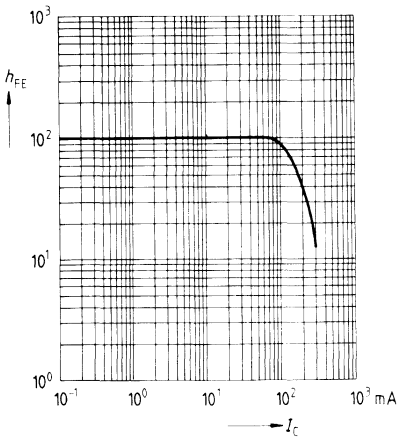
**Collector cutoff current  $I_{CB0} = f(T_A)$**   
 $V_{CB} = 160 \text{ V}$



**Collector current  $I_C = f(V_{BE})$**   
 $V_{CE} = 10 \text{ V}$

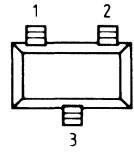
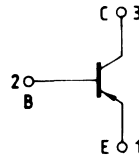


**DC current gain  $h_{FE} = f(I_C)$**   
 $V_{CE} = 10 \text{ V}$



**PNP silicon planar epitaxial transistors**

- High breakdown voltage
- Low collector-emitter saturation voltage
- Complementary NPN types: SMBTA 42, SMBTA 43



Top view

Type	Marking	Ordering code	Package
SMBTA 92	SJ	Refer to index	Version A
SMBTA 93	SK		

Maximum ratings		SMBTA 92	SMBTA 93
Collector-emitter voltage	$V_{CE0}$	300 V	200 V
Collector-base voltage	$V_{CB0}$	300 V	200 V
Emitter-base voltage	$V_{EB0}$		5 V
Collector current	$I_C$		500 mA
Base current	$I_B$		100 mA
Total power dissipation $T_A = 25^\circ\text{C}$	$P_{tot}$		360 mW
Junction temperature	$T_j$		150 °C
Storage temperature range	$T_{stg}$		-65 ... +150 °C
<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$		≤ 350 K/W

## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

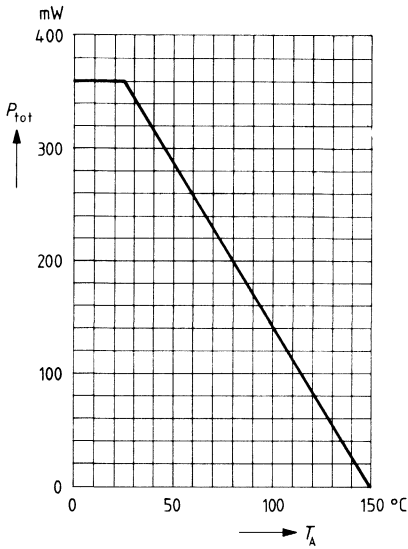
Static characteristics	Symbol	min	typ	max	Unit
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$ SMBTA 92 SMBTA 93	$V_{(BR) CE0}$	300 200	– –	– –	V V
Collector-base breakdown voltage $I_C = 100\ \mu\text{A}$ SMBTA 92 SMBTA 93	$V_{(BR) CB0}$	300 200	– –	– –	V V
Emitter-base breakdown voltage $I_E = 100\ \mu\text{A}$	$V_{(BR) EB0}$	5	–	–	V
Collector cutoff current $V_{CB} = 200\text{ V}$ SMBTA 92 $V_{CB} = 160\text{ V}$ SMBTA 93 $V_{CB} = 200\text{ V}, T_A = 150^\circ\text{C}$ SMBTA 92 $V_{CB} = 160\text{ V}, T_A = 150^\circ\text{C}$ SMBTA 93	$I_{CB0}$	– – – –	– – – –	250 250 20 20	nA nA $\mu\text{A}$ $\mu\text{A}$
Emitter cutoff current $V_{EB} = 3\text{ V}$	$I_{EB0}$	–	–	100	nA
DC current gain $I_C = 1\text{ mA}, V_{CE} = 10\text{ V}$ $I_C = 10\text{ mA}, V_{CE} = 10\text{ V}^1)$ $I_C = 30\text{ mA}, V_{CE} = 10\text{ V}^1)$ SMBTA 92 SMBTA 93	$h_{FE}$	25 40 25 25	– – – –	– – – –	– – – –
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 20\text{ mA}, I_B = 2\text{ mA}$ SMBTA 92 SMBTA 93	$V_{CEsat}$	– –	– –	0,5 0,4	V V
Base-emitter saturation voltage <sup>1)</sup> $I_C = 20\text{ mA}, I_B = 2\text{ mA}$	$V_{BEsat}$	–	–	0,9	V

Dynamic characteristics	Symbol	min	typ	max	Unit
Transition frequency $I_C = 10\text{ mA}, V_{CE} = 20\text{ V}, f = 100\text{ MHz}$	$f_T$	50	–	–	MHz
Output capacitance $V_{CB} = 20\text{ V}, f = 1\text{ MHz}$ SMBTA 92 SMBTA 93	$C_{ob}$	– –	– –	6 8	pF pF

<sup>1)</sup> Pulse test:  $t = 300\ \mu\text{s}$ ,  $D = 2\%$ .

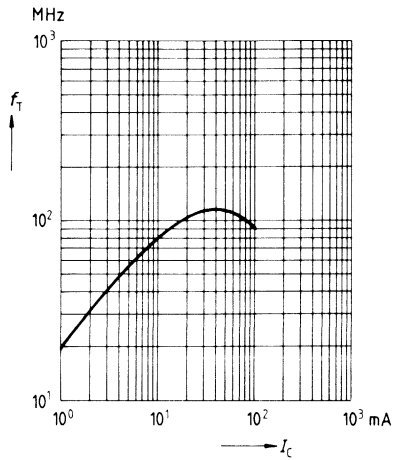


**Total power dissipation  $P_{tot} = f(T_A)$**

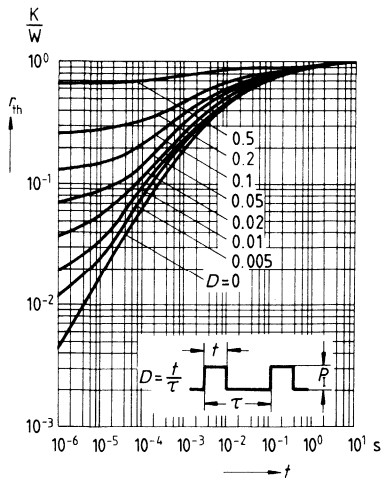


**Transition frequency  $f_T = f(I_C)$**

$V_{CE} = 20\text{ V}, f = 100\text{ MHz}$

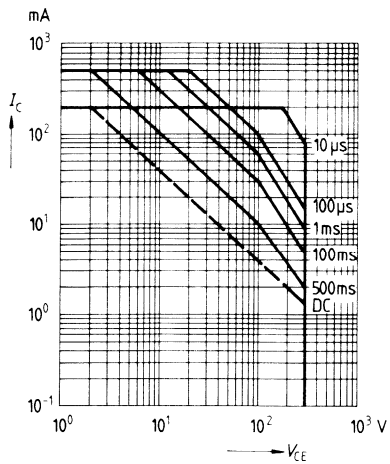


**Pulse handling capability  $r_{th} = f(t)$**   
(standardized)

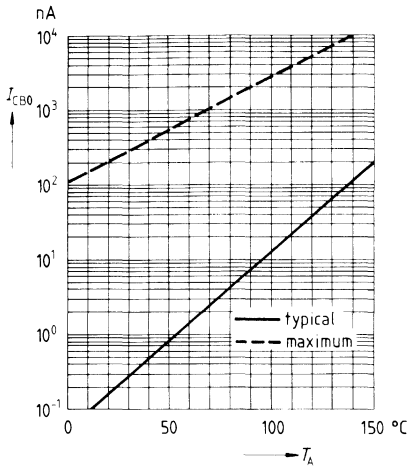


**Operating range  $I_C = f(V_{CE})$**

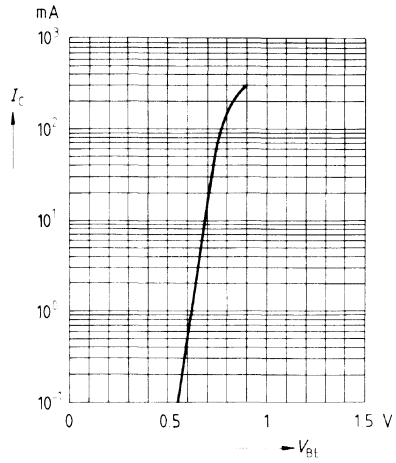
$T_A = 25\text{ °C}, D = 0$



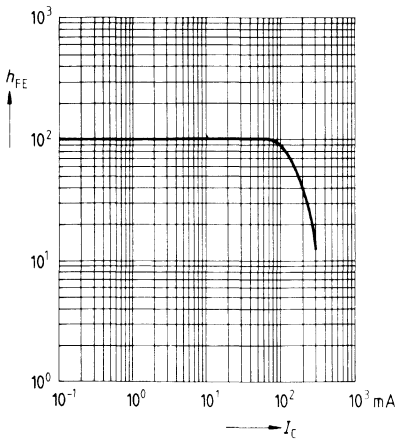
**Collector cutoff current  $I_{CB0} = f(T_A)$**   
 $V_{CB} = 160 \text{ V}$



**Collector current  $I_C = f(V_{BE})$**   
 $V_{CE} = 10 \text{ V}$



**DC current gain  $h_{FE} = f(I_C)$**   
 $V_{CE} = 10 \text{ V}$



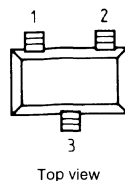
---

**LEDs**

---

## LEDs – single and double diodes

- Backlighting of LCDs
- Proximity switches
- Touch keyboards
- Failure indicators on SMC PC boards
- Electronic scales
- Moving sign



Type	Color	Ordering code	Package	Circuit
LS S210 (CQV 231)	super-red	Refer to index	Version A	
LY S210 (CQV 232)	yellow			
LG S210 (CQV 233)	green			
LU S210 (CQV 234)	super-red/ green			

## Maximum ratings

		LU S210	LS S210 LG S210 LY S210
Reverse voltage	$V_R$	5 V	5 V
Forward current	$I_F$	30 mA	30 mA
Surge current	$I_{FS}$	0,5 A	0,5 A
$\tau = 10 \mu\text{s}/D = 0$			
Total power dissipation	$P_{\text{tot}}$	200 mW <sup>1)</sup>	100 mW
Junction temperature	$T_j$	100 °C	100 °C
Storage temperature range	$T_{\text{stg}}$	- 55 ... + 100 °C	- 55 ... + 100 °C
<b>Thermal resistance</b> junction-ambient package mounted on Al <sub>2</sub> O <sub>3</sub> ceramic substrate 15 mm × 16.7 mm × 0.7 mm	$R_{\text{thJA}}$	375 K/W <sup>1)</sup>	750 K/W

<sup>1)</sup> In case of parallel operation of both chips.

In case of only 1 color being lit on, the characteristics of single color LEDs are applicable.

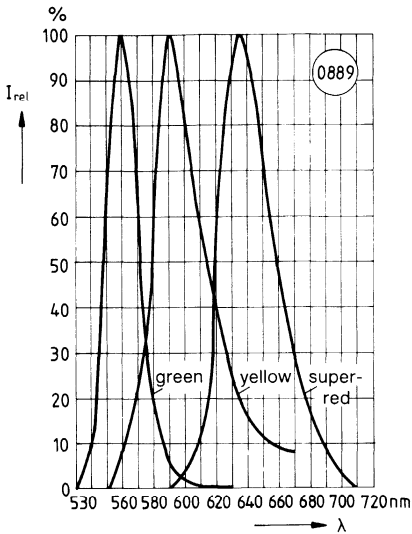
## Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Characteristics	Symbol	min	typ	max	Unit
Wavelength at peak emission	$\lambda_{\text{peak}}$				
LS S210		620	635	650	nm
LY S210		580	590	600	nm
LG S210		545	560	575	nm
Dominant wavelength	$\lambda_{\text{dom}}$				
LS S210		–	628	–	nm
LY S210		–	592	–	nm
LG S210		–	561	–	nm
Viewing angle	$\varphi$	–	140	–	de- grees
Limits for 50% of luminous intensity $I_V$					
Forward voltage	$V_F$	–	2,0	2,7	V
$I_F = 10 \text{ mA}$					
Reverse current	$I_R$	–	0,01	10	$\mu\text{A}$
$V_R = 5 \text{ V}$					
Luminous intensity	$I_V$	0,4	1,0	–	mcd
$I_F = 10 \text{ mA}$					

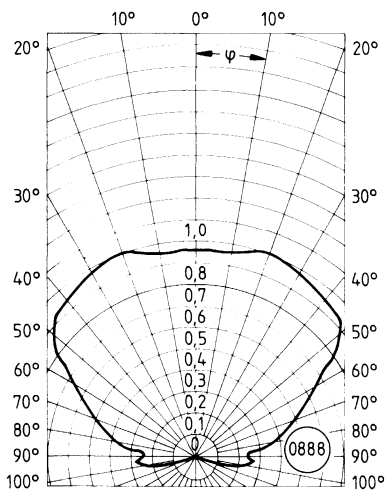
**Relative spectral emission**

$I_{rel} = f(\lambda)$



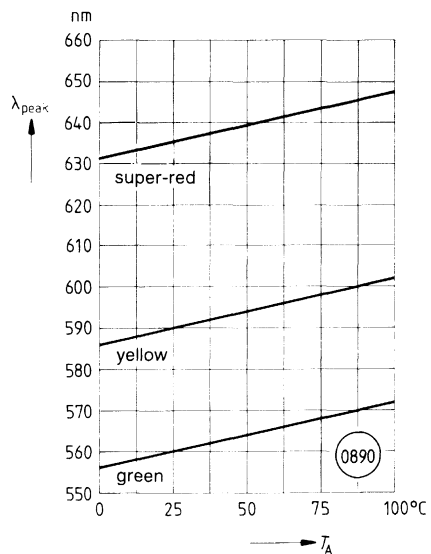
**Radiation characteristic**

$I_{rel} = f(\varphi)$

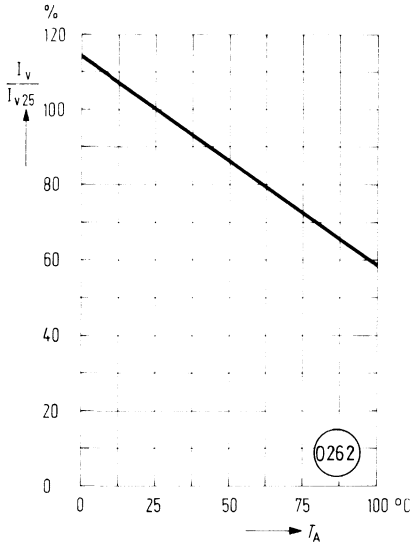


**Wavelength at peak emission**

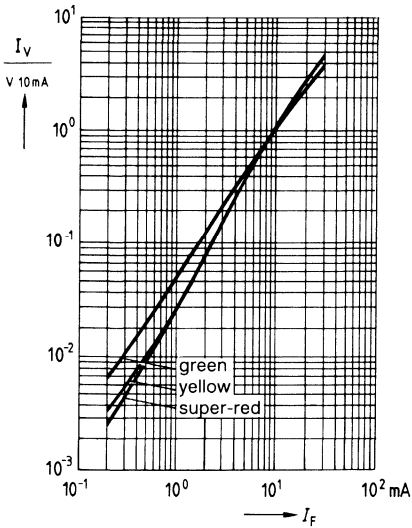
$\lambda_{peak} = f(T_A)$



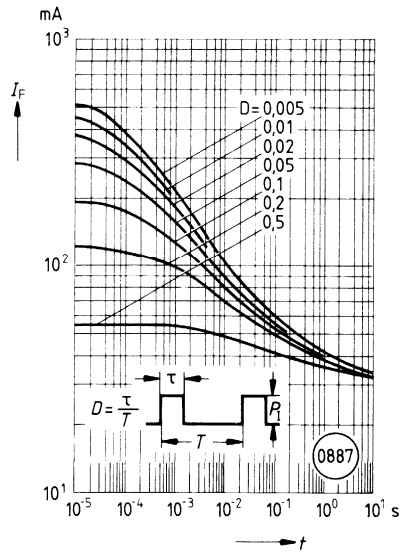
Rel. luminous intensity  $\frac{I_V}{I_{V25}} = f(T_A)$



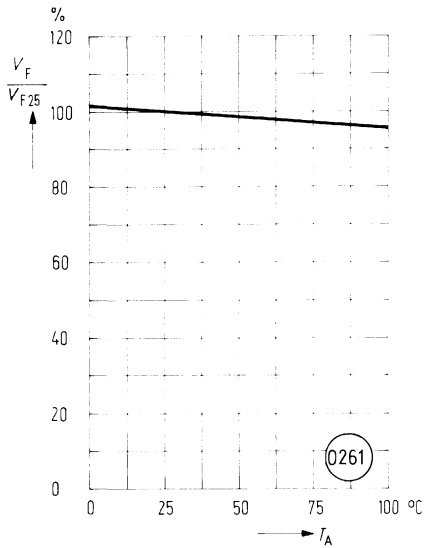
Rel. luminous intensity  $\frac{I_V}{I_{V10\text{ mA}}} = f(I_F)$



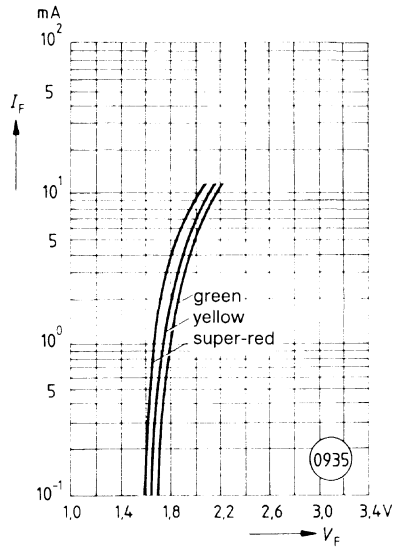
Permissible pulse handling capability  $I_F = f(t)$   
Duty cycle  $D$ ,  $T_A = 25^\circ\text{C}$



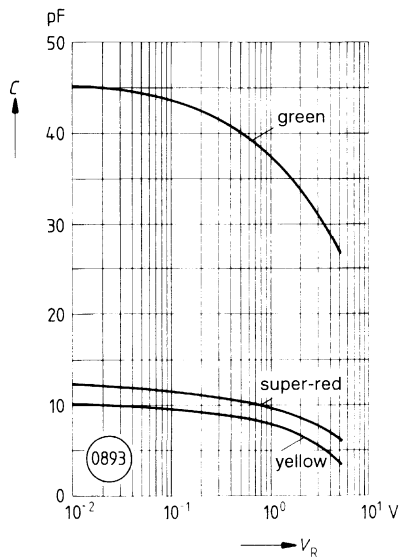
Forward voltage  $\frac{V_F}{V_{F25}} = f(T_A)$



Forward current  $I_F = f(V_F)$



Capacitance  $C = f(V_R)$





---

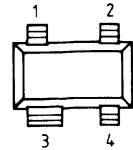
**Sensors**

---

**GaAs Hall Sensor**

- For digital speed and position measurement
- High sensitivity and operating temperature
- Low offset voltage
- Low  $TC$  of sensitivity and internal resistance

1 } Hall voltage  
4 } terminals  
3+ } Control current  
2- } terminals



Top view

Type	Marking	Ordering code	Package
KSY 13	S13	Refer to index	Version B

**Maximum ratings**

Control current	$I_{1\max}$	7 mA
Operating temperature range	$T_A$	-40 ... +150 °C
Storage temperature range	$T_{stg}$	-50 ... +160 °C

<b>Thermal resistance</b> junction-ambient package mounted on alumina 15 mm × 16.7 mm × 0.7 mm	$R_{thJA}$	≈ 375 K/W
------------------------------------------------------------------------------------------------------------	------------	-----------

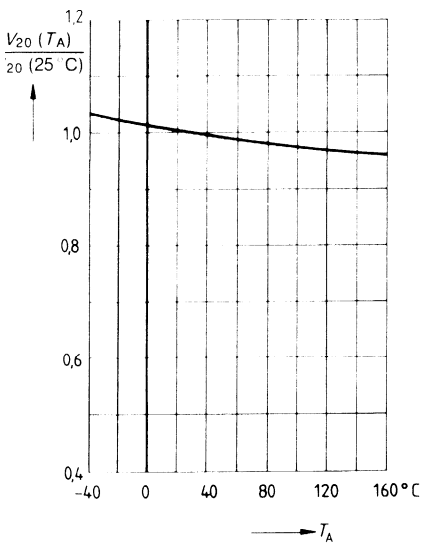
### Characteristics

at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

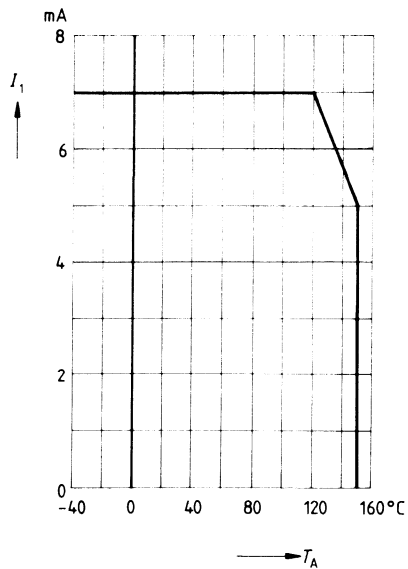
Characteristics	Symbol	Values	Unit
Rated control current	$I_{1N}$	5	mA
Open-circuit Hall voltage $I_1 = I_{1N}, B = 0,1\text{ T}$	$V_{20}$	95 ... 145	mV
Ohmic offset voltage <sup>1)</sup> $I_{1N} = 5\text{ mA}, B = 0$	$V_{RO}$	$\leq \pm 30$	mV
Internal resistance at the control side at the Hall side	$R_{10}$ $R_{20}$	900 ... 1200 900 ... 1200	$\Omega$ $\Omega$
Temperature coefficient of $V_{20}$ $I_1 = I_{1N}, B = 0,2\text{ T}$	$TC_{V20}$	$\approx -0,05$	%/K
Temperature coefficient of $R_{10}, R_{20}$ $I_1 = 1\text{ mA}, B = 0,2\text{ T}$	$TC_{R10/R20}$	$\approx 0,08$	%/K

#### Open-circuit Hall voltage

$$\frac{V_{20}(T_A)}{V_{20}(25^\circ\text{C})} = f(T_A)$$



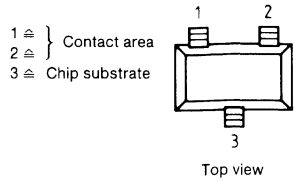
#### Max. control current $I_1 = f(T_A)$



<sup>1)</sup> Grouping upon request.

**NPN silicon planar epitaxial sensors**

- Suitable for measuring, controlling and regulating air, non-aggressive gases and liquids
- To be used as element for temperature compensation
- High reliability due to multilayer gold contacts



Type	Marking	Type	Marking	Ordering code	Package
KTY 13 A	TA	KTY 13 C	TC	Refer to index	Version A
KTY 13 B	TB	KTY 13 D	TD		

**Maximum ratings**

Max. dc control current	$I$	3 mA
Peak current	$\hat{I}$	8 mA
$t = 10$ ms		
Ambient temperature range	$T_A$	$-50 \dots +150^\circ\text{C}$
Storage temperature range	$T_{\text{stg}}$	$-50 \dots +160^\circ\text{C}$

## Characteristics

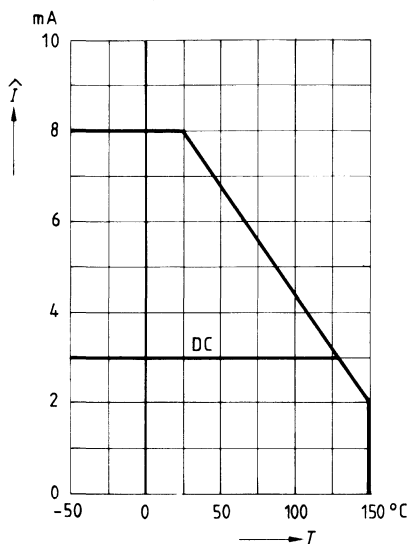
at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Characteristics	Symbol	Values	Unit
Basic resistance <sup>1)</sup> $I_N = 1 \text{ mA}$ KTY 13 A KTY 13 B KTY 13 C KTY 13 D	$R_{25}$	1980 ... 2020 1960 ... 2040 1900 ... 2100 1800 ... 2200	$\Omega$ $\Omega$ $\Omega$ $\Omega$
Tolerance of basic resistance $R_{25}$ referred to $R_{25} = 2000 \Omega$ KTY 13 A KTY 13 B KTY 13 C KTY 13 D	$R_{25\text{-tol.}}$	$\pm 1$ $\pm 2$ $\pm 5$ $\pm 10$	% % % %
Resistance unbalance at polarity change $I_N = 1 \text{ mA}$ $I_N = 0,1 \text{ mA}$	$M$	$\leq 0,3$ $\leq 0,1$	% %
Thermal time constant 63% value in air in oil	$T_{\text{Air}}$ $T_{\text{Oil}}$	7 1	s s

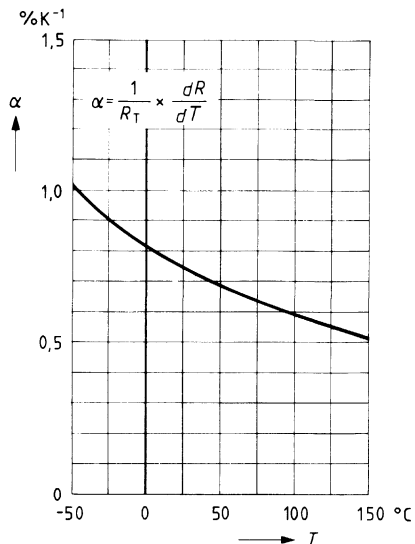
<sup>1)</sup> An operating current of 0.1 mA is recommended for precision measurements, as the inherent temperature rise becomes negligible and the unbalance decreases.

**Limited charging current versus ambient temperature  $\hat{I} = f(T)$**

Parameter: air,  $t \leq 10$  ms

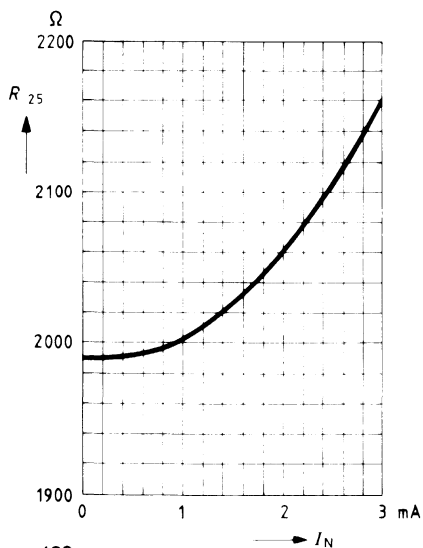


**Temperature coefficient versus ambient temperature  $\alpha = f(T)$**



**Typical resistance of the sensor versus impressed operating current  $R_{25} = f(I_N)$**

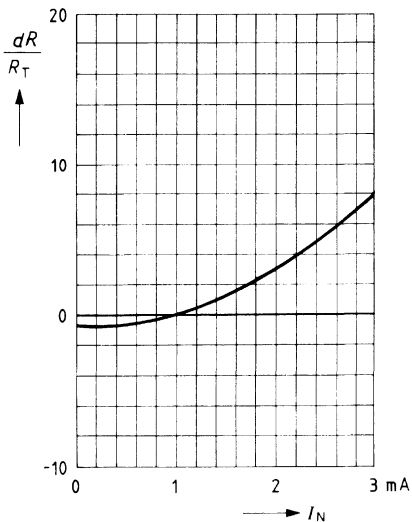
$R_{25} = f(I_N)$



**Typical difference of the sensor resistance  $\frac{dR}{R_T} = f(I_N)$  from the base resistance  $R_T$  at  $I_N = 1$  mA versus impressed operating current**

$T_A = 25 \dots 100$  °C

%



### Analytic expression of the regression parabola for the median temperature factor ( $I_N = 1 \text{ mA}$ )

$$k_T = \frac{R_T}{R_{25}} = [1 + \alpha(\Delta T) + \beta(\Delta T)^2]$$

### Analytic expression for calculating the sensor temperature

$$T(^{\circ}\text{C}) = 25 + \frac{\sqrt{\alpha^2 - 4\beta} + 4\beta \cdot k_T - \alpha}{2\beta}$$

$$\alpha = 7,64 \cdot 10^{-3} \text{ (K}^{-1}\text{)}$$

$$\beta = 1,66 \cdot 10^{-5} \text{ (K}^{-1}\text{)}$$

$R_{25}$  = resistance value at  $T_A = 25^{\circ}\text{C}$  (e. g. 2000  $\Omega$ )

$R_T$  = resistance value at temperature  $T(^{\circ}\text{C})$

$\Delta T$  = temperature difference between  $T_{25}$  and  $T$

### Tolerance of the temperature factor

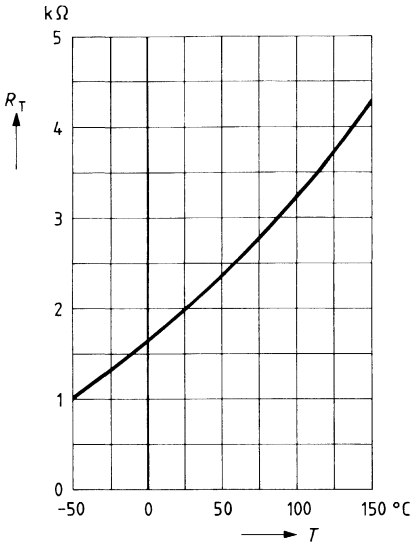
Temperature $T$	Temperature factor $k$ ( $I_N = 1 \text{ mA}$ )
+ 150 $^{\circ}\text{C}$	2,18 ... 2,25
+ 125 $^{\circ}\text{C}$	1,90 ... 1,96
+ 100 $^{\circ}\text{C}$	1,65 ... 1,69 <sup>1)</sup>
+ 75 $^{\circ}\text{C}$	1,41 ... 1,43
+ 50 $^{\circ}\text{C}$	1,19 ... 1,21
+ 25 $^{\circ}\text{C}$	1,00
0 $^{\circ}\text{C}$	0,81 ... 0,83
- 25 $^{\circ}\text{C}$	0,65 ... 0,67
- 50 $^{\circ}\text{C}$	0,51 ... 0,53

<sup>1)</sup> AQL = 0,65

**Resistance of the sensor  
versus temperature**

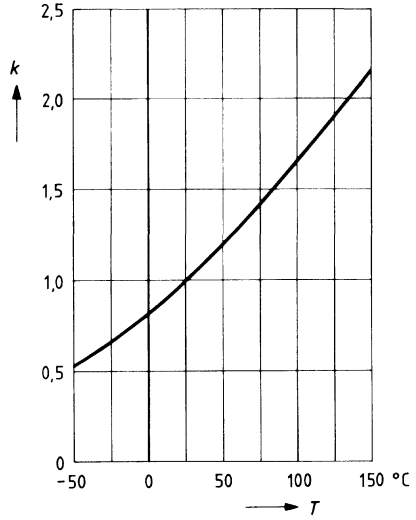
$$R_T = f(T)$$

Parameter:  $I_R = 1 \text{ mA}$



**Typical behavior  
of the temperature factor**

$$k = \frac{R_T}{R_{25}} = f(T)$$





**Siemens AG**, Bereich Bauelemente  
Balanstraße 73, Postfach 80 17 09, **D-8000 München 80**  
☎ (089) 4144-0 | ☎ 52108-0 | FAX (089) 4144-2689

## Siemens Worldwide

### Federal Republic of Germany and Berlin (West)

Siemens AG  
Salzhofer 6-8  
**1000 Berlin 10**  
☎ (030) 3939-1, Tx 1810-278  
FAX (030) 3939-2630  
Tx 308190 sie.nb

Siemens AG  
Contrescarpe 72  
Postfach 107827  
**2800 Bremen**  
☎ (0421) 364-0, Tx 245451  
FAX (0421) 364-2687

Siemens AG  
Lahnweg 10  
Postfach 1115  
**4000 Düsseldorf 1**  
☎ (0211) 399-0, Tx 8581301  
FAX (0211) 399-2506

Siemens AG  
Rodelheimer Landstraße 5-9  
Postfach 111733  
**6000 Frankfurt 1**  
☎ (069) 797-0, Tx 414131  
FAX (069) 797-2253

Siemens AG  
Lindenplatz 2  
Postfach 105609  
**2000 Hamburg 1**  
☎ (040) 282-1, Tx 215584-0  
FAX (040) 282-2210

Siemens AG  
Am Maschpark 1  
Postfach 5329  
**3000 Hannover 1**  
☎ (0511) 129-0, Tx 922333  
FAX (0511) 129-2799

Siemens AG  
Richard-Strauss-Straße 76  
Postfach 202109  
**8000 München**  
☎ (089) 9221-0  
Tx 529421-19  
FAX (089) 9221-4390

Siemens AG  
Von-der-Lann-Straße 30  
Postfach 4844  
**8500 Nürnberg 1**  
☎ (0911) 654-1, Tx 622251  
FAX (0911) 654-3436, 3464

Siemens AG  
Geschwister-Scholl-Straße 24  
Postfach 120  
**7000 Stuttgart 1**  
☎ (0711) 2076-1, Tx 723941  
FAX (0711) 2076-706

### EUROPE

#### Austria

Siemens Aktiengesellschaft  
Osterreich  
Postfach 326  
**A-1031 Wien**  
☎ (0222) 7293-0, Tx 1372-0

#### Belgium

Siemens S.A.  
chaussée de Charleroi 116  
**B-1060 Bruxelles**  
☎ (02) 536-2111, Tx 21347

#### Denmark

Siemens A/S  
Borupvang 3  
**DK-2750 Ballerup**  
☎ (02) 656565, Tx 35313

#### Finland

Siemens Osakeyhtiö  
Mikonkatu 8  
Fach 8  
**SF-00101 Helsinki 10**  
☎ (0) 1626-1, Tx 124465

#### France

Siemens S.A.  
B.P. 109  
**F-93203 Saint-Denis CEDEX 1**  
☎ (1) 8206120, Tx 620853

#### Great Britain

Siemens Ltd.  
Siemens House  
Windmill Road  
**GB-Sunbury-on-Thames**  
Middlesex TW 16 7HS  
☎ (09327) 85691, Tx 8951091

#### Greece

Siemens AE  
Voulas 7  
P.O.B. 3601  
**GR-10210 Athen**  
☎ (01) 3293-1, Tx 216291

#### Ireland

Siemens Ltd.  
8, Raglan Road  
**Dublin 4**  
☎ (01) 684727, Tx 5341

#### Italy

Siemens Elettra S.p.A.  
Via Fabio Filzi, 29  
Casella Postale 10388  
**I-20100 Milano**  
☎ (02) 6992, Tx 330261

#### Netherlands

Siemens Nederland N.V.  
Postb. 16068  
**NL-2500 BB Den Haag**  
☎ (070) 782782, Tx 31373

#### Norway

Siemens A/S  
Østre Aker vei 90  
Postboks 10, Veitvet  
**N-Oslo 5**  
☎ (02) 153090, Tx 18477

#### Portugal

Siemens S.A.R.L.  
Avenida Almirante Reis, 65  
Apartado 1380  
**P-1100 Lisboa-1**  
☎ (011) 538805, Tx 12563

## Spain

Siemens S.A.  
Orense, 2  
Apartado 155  
**E-28020 Madrid**  
☎ (01) 4552500, Tx 43320

## Sweden

Siemens AB  
Norra Stationsgatan 63-65  
Box 23141  
**S-10435 Stockholm**  
☎ (08) 161100, Tx 19880

## Switzerland

Siemens-Albis AG  
Freilagerstraße 28  
Postfach  
**CH-8047 Zürich**  
☎ (01) 495-3111, Tx 558911

## Turkey

ETMAS Elektrik Tesisati ve  
Muhendislik A.Ş.  
Meclisi Mebusan Caddesi 55/35  
Findikli  
P.K. 213 Findikli  
**Istanbul**  
☎ 009011/452090, Tx 24233

## AFRICA

### South African Republic

Siemens Limited  
Siemens House,  
P.O.B. 4583  
**2000 Johannesburg**  
☎ (011) 7159111, Tx 4-22524

## AMERICA

### Argentina

Siemens S.A.  
Avenida Pte. Julio A. Roca 516  
Casilla Correo Central 1232  
**RA-1000 Buenos Aires**  
☎ (01) 00541/300411, Tx 21812

## Brazil

Siemens S.A.  
Sede Central  
Caixa Postal 1375,  
**01051 São Paulo-SP**  
☎ (011) 833-2211  
Tx 11-23641

## Canada

Siemens Electric Limited  
7300 Trans-Canada Highway  
P.O.B. 7300, Pointe Claire,  
**Québec H9R 4R6**  
☎ (514) 6957300,  
Tx 05822778

## U.S.A.

Power semiconductors:  
Siemens Components, Inc.  
Colorado Components Division  
800 Hoyt Street  
Broomfield, Colorado 80020  
☎ (303) 469-2161  
Tx 454357 sie colo

Intelligent displays:  
Siemens Components, Inc.  
Optoelectronics Division  
19000 Homestead Road  
Cupertino, California 95014  
☎ (408) 257-7910  
Tx 352084 sie lit opto

All other products:  
Siemens Components, Inc.  
Special Products Division  
186 Wood Avenue South  
Iselin, New Jersey 08830  
☎ (201) 321-3400  
Tx 844491 sie isln a

## ASIA

### Hongkong

Jebsen & Co., Ltd.  
Siemens Division  
P.O.B. 97  
**Hongkong**  
☎ (05) 8233777, Tx 73221

## India

Siemens India Ltd.  
Head Office  
134-A, Dr. Annie Besant Road,  
Worli  
P.O.B. 6597  
**Bombay 400018**  
☎ 379906, Tx 0112373

## Japan

Fuji Electronic Components Ltd.  
New Yurakucho Bldg., 8F  
12-1, Yurakucho 1-Chome,  
Chiyoda-ku  
**Tokyo 100**  
☎ (03) 201-2401, Tx 26374

## Korea

Siemens Electrical  
Engineering Co., Ltd.  
C.P.O.B. 3001  
**Seoul**  
☎ (02) 7783431, Tx 23229

## Singapore

Siemens Components Pte. Ltd.  
Promotion Office  
10-15 E, 5th floor  
47 Ayer Rajah Crescent No.06-12  
**Singapore 0513**  
☎ 7760044, Tx RS 21000

## Taiwan

TAI Engineering Co. Ltd.  
6th Floor Central Building  
108, Chung Shan N. Rd. Sec. 2  
P.O.Box 68-1882  
**Taipei**  
☎ 5363171, Tx 27860

## AUSTRALIA

Siemens Ltd.  
544 Church Street, Richmond  
**Melbourne, Vic. 3121**  
☎ (03) 4297111, Tx 30425