DISCRETE SEMICONDUCTORS

DATA HANDBOOK

Surface mounted semiconductors

BOOK SC10b 1991

Philips Semiconductors

PHILIPS

Surface mounted semiconductors

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GENERAL PURPOSE TRANSISTORS in SOT23/SOT89*/SOT143**/SOT223Δ

TYPE NUMBER	RATINGS				CHARACTERISTICS							PAGE
	V_{CBO} (V)	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE} min.	h_{FE} max.	at I_C (mA)	at V_{CE} (V)	$V_{CE\ sat}$ max. (V)	at I_C/I_B (mA)	f_T typ. (MHz)	
NPN												
BC817	45	45	500	250	100	600	100	1	0.7	500/50	200	229
BC818	25	25	500	250	100	600	100	1	0.7	500/50	200	229
BC846	65	65	100	250	220	800	2	5	0.25	10/0.5	300	235
BC847	45	45	100	250	220	800	2	5	0.25	10/0.5	300	235
BC848	30	30	100	250	220	800	2	5	0.25	10/0.5	300	235
BC868*	20	20	1000	1000	85	375	500	1	0.5	1000/100	60	275
BCP54Δ	45	45	1000	1500	40	250	150	2	0.5	500/50	130	311
BCP55Δ	60	60	1000	1500	40	250	150	2	0.5	500/50	130	311
BCP56Δ	100	80	1000	1500	40	250	150	2	0.5	500/50	130	311
BCP68Δ	-	20	1000	1500	85	375	500	1	0.5	1000/100	60	315
BCV27	40	30	300	250	20000	-	100	5	1.0	100/0.1	220	329
BCV29*	40	30	500	1000	20000	-	100	5	1.0	100/0.1	220	333
BCV47	80	60	500	250	4000	-	10	5	1.0	100/0.1	220	329
BCV49*	80	60	500	1000	10000	-	100	5	1.0	100/0.1	220	333
BCV71	80	60	100	250	110	220	2	5	0.25	10/0.5	300	353
BCV72	80	60	100	250	200	450	2	5	0.25	10/0.5	300	353
BCW31	32	32	100	250	110	220	2	5	0.25	10/0.5	300	361
BCW32	32	32	100	250	200	450	2	5	0.25	10/0.5	300	361
BCW33	32	32	100	250	420	800	2	5	0.25	10/0.5	300	361
BCW60A	32	32	200	250	120	220	2	5	0.35	10/0.25	250	367
BCW60B	32	32	200	250	180	310	2	5	0.35	10/0.25	250	367
BCW60C	32	32	200	250	250	460	2	5	0.35	10/0.25	250	367
BCW60D	32	32	200	250	380	630	2	5	0.35	10/0.25	250	367
BCW71	50	45	100	250	110	220	2	5	0.25	10/0.5	300	381
BCW72	50	45	100	250	220	450	2	5	0.25	10/0.5	300	381
BCW81	50	45	100	250	450	800	2	5	0.25	10/0.5	300	387
BCX19	50	45	500	250	100	600	100	1	0.62	500/50	200	395
BCX20	30	25	500	250	100	600	100	1	0.62	500/50	200	395
BCX54*	45	45	1000	1000	45	250	150	2	0.5	500/50	130	403
BCX55*	60	60	1000	1000	40	160	150	2	0.5	500/50	130	403
BCX56*	100	80	1000	1000	40	160	150	2	0.5	500/50	130	403
BCX70G	45	45	200	250	120	220	2	5	0.35	10/0.25	250	407
BCX70H	45	45	200	250	180	310	2	5	0.35	10/0.25	250	407

TYPE NUMBER	RATINGS				CHARACTERISTICS							PAGE
	V_{CBO} (V)	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE} min.	h_{FE} max.	at I_C (mA)	at V_{CE} (V)	$V_{CE\,sat}$ max. (V)	at I_C/I_B (mA)	f_T typ. (MHz)	
NPN												
BCX70J	45	45	200	250	250	460	2	5	0.35	10/0.25	250	407
BCX70K	45	45	200	250	380	630	2	5	0.35	10/0.25	250	407
BSP40Δ	70	60	1000	1500	40	120	100	5	0.25	150/15	100	905
BSP41Δ	70	60	1000	1500	100	300	100	5	0.25	150/15	100	905
BSP42Δ	90	80	1000	1500	40	120	100	5	0.25	150/15	100	905
BSP43Δ	90	80	1000	1500	100	300	100	5	0.25	150/15	100	905
PMBT4401	60	40	600	250	100	300	150	1	0.75	500/50	250	1233
PMBT5550	160	140	600	300	60	250	10	5	0.25	50/5	200	1247
PMBT6428	60	50	200	350	250	650	-	-	0.2	10/0.5	300	1251
PMBT6429	55	45	200	350	500	1250	-	-	0.2	10/0.5	300	1251
PMBTA05	60	60	500	300	50	-	10	1	0.25	100/10	100	1255
PMBTA06	80	80	500	300	50	-	10	1	0.25	100/10	100	1255
PMBTA13	30	30	300	300	5000	-	10	5	1.5	100/0.1	125	1257
PMBTA14	30	30	300	300	10000	-	10	5	1.5	100/0.1	125	1257
PXT4401*	60	40	600	1000	100	300	150	1	0.75	500/50	250	1313
PXTA14*	30	30	300	1000	20000	-	100	5	1.5	100/0.1	125	1321
PXTA27*	-	60	500	1000	10000	-	100	5	1.5	100/0.1	125	1323
PZTA05Δ	60	60	500	1500	50	-	100	1	0.25	100/10	100	1347
PZTA06Δ	80	80	500	1500	50	-	100	1	0.25	100/10	100	1347
PZTA13Δ	30	30	300	1500	5000	-	10	5	1.5	100/0.1	125	1351
PZTA14Δ	30	30	300	1500	10000	-	10	5	1.5	100/0.1	125	1351
PZTA42Δ	300	300	500	1500	40	-	10	10	0.5	20/2	50	1353
PZTA43Δ	200	200	500	1500	40	-	10	10	0.5	20/2	50	1353
PNP												
BC807	45	45	500	250	100	600	100	1	0.7	500/50	100	223
BC808	25	25	500	250	100	600	100	1	0.7	500/50	100	223
BC856	65	65	100	250	75	475	2	5	0.3	10/0.5	150	257
BC857	45	45	100	250	75	800	2	5	0.3	10/0.5	150	257

Notes

* Types in SOT89 package.

** Types in SOT143 package.

Δ Types in SOT223 package.

TYPE NUMBER	RATINGS				CHARACTERISTICS							PAGE
	V_{CBO} (V)	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE} min.	h_{FE} max.	at I_C (mA)	at V_{CE} (V)	$V_{CE\ sat}$ max. (V)	at I_C/I_B (mA)	f_T typ. (MHz)	
PNP												
BC858	30	30	100	250	75	800	2	5	0.3	10/0.5	150	257
BC869*	20	20	1000	1000	85	375	500	1	0.5	1000/100	60	281
BCP51Δ	45	45	1000	1500	40	250	150	2	0.5	500/50	50	307
BCP52Δ	60	60	1000	1500	40	250	150	2	0.5	500/50	50	307
BCP53Δ	100	80	1000	1500	40	250	150	2	0.5	500/50	50	307
BCP69Δ	-	25	1000	1500	85	375	500	1	0.5	1000/100	60	321
BCV26	40	30	250	350	20000	-	100	5	1.0	100/0.1	220	327
BCV28*	40	30	500	1000	20000	-	100	5	1.0	100/0.1	220	331
BCV46	80	60	250	300	4000	-	10	5	1.0	100/0.1	220	327
BCV48*	80	60	500	1000	10000	-	100	5	1.0	100/0.1	220	331
BCW29	32	32	100	250	120	260	2	5	0.3	10/0.5	150	355
BCW30	32	32	100	250	215	500	2	5	0.3	10/0.5	150	355
BCW61A	32	32	200	250	120	220	2	5	0.25	10/0.25	180	371
BCW61B	32	32	200	250	180	310	2	5	0.25	10/0.25	180	371
BCW61C	32	32	200	250	250	460	2	5	0.25	10/0.25	180	371
BCW61D	32	32	200	250	380	630	2	5	0.25	10/0.25	180	371
BCW69	50	45	100	250	120	260	2	5	0.3	10/0.5	150	375
BCW70	50	45	100	250	120	500	2	5	0.3	10/0.5	150	375
BCW89	80	60	100	250	120	260	2	5	0.3	10/0.5	150	389
BCX17	50	45	500	250	100	600	100	1	0.62	500/50	100	391
BCX18	30	25	500	250	100	600	100	1	0.62	500/50	100	391
BCX51*	45	45	1000	1000	40	250	150	2	0.5	500/50	50	399
BCX52*	60	60	1000	1000	40	160	150	2	0.5	500/50	50	399
BCX53*	100	80	1000	1000	40	160	150	2	0.5	500/50	50	399
BCX71G	45	45	200	250	120	220	2	5	0.25	10/0.25	180	411
BCX71H	45	45	200	250	180	310	2	5	0.25	10/0.25	180	411
BCX71J	45	45	200	250	250	460	2	5	0.25	10/0.25	180	411
BCX71K	45	45	200	250	380	630	2	5	0.25	10/0.25	180	411

Notes

* Types in SOT89 package.

** Types in SOT143 package.

Δ Types in SOT223 package.

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TYPE NUMBER	RATINGS				CHARACTERISTICS							PAGE
	V_{CBO} (V)	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE} min.	h_{FE} max.	at I_C (mA)	at V_{CE} (V)	$V_{CE\ sat}$ max. (V)	at I_C/I_B (mA)	f_T typ. (MHz)	
BSP30Δ	70	60	1000	1500	40	120	100	5	0.25	150/15	100	901
BSP31Δ	70	60	1000	1500	100	300	100	5	0.25	150/15	100	901
BSP32Δ	90	80	1000	1500	40	120	100	5	0.25	150/15	100	901
BSP33Δ	90	80	1000	1500	100	300	100	5	0.25	150/15	100	901
PMBT4403	40	40	600	250	100	300	150	2	0.75	500/50	200	1237
PMBTA55	60	60	500	250	50	-	10	1	0.25	100/10	50	1263
PMBTA56	80	80	500	250	50	-	10	1	0.25	100/10	50	1263
PMBTA63	30	30	500	250	5000	-	10	5	1.5	100/0.1	125	1265
PMBTA64	30	30	500	250	5000	-	10	5	1.5	100/0.1	125	1265
PXT4403*	40	40	600	1000	100	300	150	2	0.4	150/15	200	1317
PXTA64*	30	30	300	1000	20000	-	100	5	1.5	100/0.1	125	1325
PXTA77*	-	60	500	1000	10000	-	100	5	1.5	100/0.1	125	1327
PXTA92*	300	300	500	1500	40	-	10	10	0.5	20/2	50	1329
PXTA93*	200	200	500	1500	40	-	10	10	0.5	20/2	50	1329
PZTA55Δ	60	60	500	1500	50	-	100	1	0.25	100/10	50	1357
PZTA56Δ	80	80	500	1500	50	-	100	1	0.25	100/10	50	1357
PZTA63Δ	30	30	500	1500	10000	-	100	5	1.5	100/0.1	125	1361
PZTA64Δ	30	30	500	1500	10000	-	100	5	1.5	100/0.1	125	1361
PZTA92Δ	300	300	500	1500	40	-	10	10	0.5	20/2	50	1363
PZTA93Δ	200	200	500	1500	40	-	10	10	0.5	20/2	50	1363

Notes

* Types in SOT89 package.
** Types in SOT143 package.
Δ Types in SOT223 package.

HIGH-FREQUENCY TRANSISTORS in SOT23

TYPE NUMBER	RATINGS				CHARACTERISTICS									PAGE
	V_{CBO} (V)	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE} min.	h_{FE} max.	at I_C (mA)	at V_{CE} (V)	F typ. (dB)	at f (MHz)	f_T typ. (MHz)	C_{re} typ. (pF)	
NPN													
BF570	40	15	100	250	40	-	10	1	-	-	> 490	1.6	497
BF840	40	40	25	250	-	-	-	-	-	-	380	0.3	549
BF841	40	40	25	250	-	-	-	-	-	-	380	0.3	549
BFS18	30	20	20	250	35	125	1	10	4	100	200	0.85	839
BFS19	30	20	30	250	65	225	1	10	4	100	260	0.85	839
BFS20	30	20	25	250	40	85	7	10	-	-	450	-	845
PNP													
BF550	40	40	25	250	50	-	1	10	2	0.1	325	0.5	493
BF569	40	35	30	250	25	-	3	10	4.5	800	900	0.33	495
BF579	20	20	25	250	20	-	10	10	4.5	800	1350	0.46	501
BF660	40	30	25	250	30	-	3	10	-	-	650	0.65	513
BF824	30	30	25	250	-	-	-	-	3	100	450	0.1	543

BROADBAND TRANSISTORS in SOT23/SOT89*/SOT143**/SOT223∆

TYPE NUMBER	RATINGS				CHARACTERISTICS									PAGE
	V_{CBO} (V)	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE} min.	h_{FE} max.	at I_C (mA)	at V_{CE} (V)	d_{im} typ. (dB)	at f (MHz)	f_T typ. (GHz)	C_{re} typ. (pF)	
NPN													
BF747	30	20	50	150	40	250	2	10	-	-	1.2	0.5	523
BFG16A∆	40	25	150	1000	25	-	50	5	-	-	1.5	1.8	591
BFG17A**	25	15	50	300	20	-	2	1	60	793.25	2.8	0.6	599
BFG25AX**	8	5	6.5	32	50	200	0.5	1	-	-	5	0.22	607
BFG33**	9	7	20	300	50	-	14	5	-	-	12	-	617
BFG33X**	9	7	20	300	50	-	14	5	-	-	12	-	617
BFG35∆	25	18	150	1000	25	-	100	10	60	793.25	4	1.2	619
BFG67**	20	10	50	300	60	100	15	5	-	-	7.5	0.5	637
BFG67X**	20	10	50	300	60	-	15	5	-	-	7.5	0.5	637
BFG92A**	20	15	25	300	40	-	14	10	-	-	5	0.35	641
BFG92AX**	20	15	25	300	40	-	14	10	-	-	5	0.35	641
BFG93A**	15	12	35	300	40	-	30	5	-	-	6	0.6	647
BFG93AX**	15	12	35	300	40	-	30	5	-	-	6	0.6	647
BFG94∆	15	12	60	700	45	-	30	5	60	793.25	6	0.5	653
BFG97∆	20	15	100	1000	25	-	70	10	60	793.25	5.5	1.0	665

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TYPE NUMBER	RATINGS				CHARACTERISTICS									PAGE
	V_{CBO} (V)	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE} min.	h_{FE} max.	at I_C (mA)	at V_{CE} (V)	d_{im} typ. (dB)	at f (MHz)	f_T typ. (GHz)	C_{re} typ. (pF)	
NPN														
BFG135Δ	25	15	150	1000	80	-	100	10	60	793.25	7.0	1.2	675
BFG197**	20	10	100	300	40	-	50	5	-	-	7.5	0.85	687
BFG197X**	20	10	100	300	40	-	50	5	-	-	7.5	0.85	687
BFG198Δ	20	10	100	1000	40	-	50	5	60	793.25	8.0	0.8	721
BFQ17*	40	25	150	1000	25	-	150	5	-	-	1.2	1.9	731
BFQ18A	25	15	150	1000	25	-	100	10	60	793.25	3.6	1.2	737
BFQ19*	20	15	75	500	25	-	75	10	-	-	5.0	1.3	741
BFQ67	20	10	50	180	100	-	15	5	-	-	7.5	0.5	747
BFR53	18	10	50	250	25	-	50	5	60	217	2.0	0.9	767
BFR92	20	15	25	200	25	-	14	10	60	493.25	5.0	0.7	775
BFR92A	20	15	25	200	40	-	14	10	60	793.25	5.0	0.35	783
BFR93	15	12	35	200	25	-	30	5	60	493.25	5.0	0.8	795
BFR93A	15	12	35	250	40	-	30	5	60	793.25	5.0	0.6	803
BFR106	20	15	100	350	-	-	-	-	-	-	3.7	1.2	817
BFS17	25	15	25	250	20	150	2	1	45	217	1.3	0.65	827
BFS17A	25	15	25	300	20	150	2	1	-	-	2.8	0.6	833
BFT25	8	5	2.5	50	20	-	1	1	-	-	2.3	0.45	851
BFT25A	8	5	6.5	50	-	-	-	-	-	-	5	0.22	859
PNP														
BFG31Δ	20	15	100	1000	25	-	100	10	60	848.25	5	1.6	611
BFG55Δ	25	18	150	1000	25	-	100	10	60	848.25	4	1.7	631
BFQ149*	20	15	75	1000	20	-	50	10	-	-	4.2	1.7	751
BFT92	20	15	25	200	20	-	14	10	60	493.25	5	0.7	869
BFT93	15	12	35	200	20	-	30	5	60	493.25	5	1.0	875

Notes

* Types in SOT89 package.

** Types in SOT143 package.

Δ Types in SOT223 package.

SWITCHING TRANSISTORS in SOT23/SOT89*/SOT223Δ

TYPE NUMBER	RATINGS				CHARACTERISTICS									PAGE
	V_{CBO} (V)	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE} min.	h_{FE} max.	at I_C (mA)	at V_{CE} (V)	$V_{CE\,sat}$ (V) max.	at I_C/I_B (mA)	t_{on}/t_{off} (ns) max.	at I_C/I_B (mA)	
NPN													
BSP50Δ	60	45	500	1500	2000	-	500	10	1.3	500/0.5	400/1500	500/0.5	909
BSP51Δ	80	60	500	1500	2000	-	500	10	1.3	500/0.5	400/1500	500/0.5	909
BSP52Δ	90	80	500	1500	2000	-	500	10	1.3	500/0.5	400/1500	500/0.5	909
BSR13	60	30	800	250	100	300	150	10	1.6	500/50	35/285	150/-	991
BSR14	75	40	800	250	100	300	150	10	1.0	500/50	-	-	991
BSR17A	60	40	200	250	100	300	10	1	0.3	50/5	70/250	10/1	999
BSR40*	70	60	1000	1000	40	120	100	5	0.5	500/50	250/1000	100/5	1019
BSR41*	70	60	1000	1000	100	300	100	5	0.5	500/50	250/1000	100/5	1019
BSR42*	90	80	1000	1000	40	120	100	5	0.5	500/50	250/1000	100/5	1019
BSR43*	90	80	1000	1000	100	300	100	5	0.5	500/50	250/1000	100/5	1019
BSS64	120	80	100	250	20	80	10	1	0.2	50/15	-/1000	15/1	1033
BST50*	60	45	500	1000	1000	-	150	10	1.3	500/50	400/1500	500/0.5	1067
BST51*	80	60	500	1000	1000	-	150	10	1.3	500/50	400/1500	500/0.5	1067
BST52*	90	80	500	1000	1000	-	150	10	1.3	500/50	400/1500	500/0.5	1067
BSV52	20	12	100	250	40	120	10	1	0.2	50/5	12/18	10/3	1099
PMBT2222	60	30	600	250	100	300	150	10	0.4	150/15	10/225	150/-	1215
PMBT2222A	75	40	600	250	100	300	150	10	0.3	150/15	10/225	150/-	1215
PMBT2369	40	40	500	250	40	120	10	1	0.25	10/1	12/18	10/3	1219
PMBT3904	60	40	200	300	100	300	10	1	0.3	50/5	35/200	10/1	1225
PXT2222*	60	30	600	1000	100	300	150	10	0.4	150/15	10/225	150/15	1297
PXT2222A*	75	40	600	1000	100	300	150	10	0.4	150/15	10/225	150/15	1297
PXT3904*	60	40	200	1000	100	300	10	1	0.3	50/5	35/200	10/1	1305
PZT2222Δ	60	30	600	1500	100	300	150	10	0.4	150/15	-	-	1331
PZT2222AΔ	75	40	600	1500	100	300	150	10	0.3	150/10	10/225	150/15	1331
PZT3904Δ	60	40	200	1500	100	300	10	1	0.3	10/1	35/200	10/1	1339

TYPE NUMBER	RATINGS				CHARACTERISTICS								PAGE
	V_{CBO} (V)	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE} min.	h_{FE} max.	at I_C (mA)	at V_{CE} (V)	$V_{CE\ sat}$ (V) max.	at I_C/I_B (mA)	t_{on}/t_{off} (ns) max.	at I_C/I_B (mA)	
PNP													
BSP60Δ	60	45	500	1500	2000	-	500	10	1.3	500/0.5	400/1500	500/0.5	913
BSP61Δ	80	60	500	1500	2000	-	500	10	1.3	500/0.5	400/1500	500/0.5	913
BSP62Δ	90	80	500	1500	2000	-	500	10	1.3	500/0.5	400/1500	500/0.5	913
BSR12	15	15	100	250	30	120	50	1	0.45	100/10	20/30	30/3	985
BSR15	60	40	600	250	100	300	150	10	1.6	500/50	45/100	150/15	995
BSR16	60	60	600	250	100	300	150	10	1.6	500/50	45/100	150/15	995
BSR18A	40	40	200	250	100	300	10	1	0.4	50/5	70/300	10/1	1003
BSR30*	70	60	1000	1000	40	120	100	5	0.5	500/50	500/650	100/5	1015
BSR31*	70	60	1000	1000	100	300	100	5	0.5	500/50	500/650	100/5	1015
BSR32*	90	80	1000	1000	40	120	100	5	0.5	500/50	500/650	100/5	1015
BSR33*	90	80	1000	1000	100	300	100	5	0.5	500/50	500/650	100/5	1015
BSS63	110	100	100	250	30	-	25	1	0.25	25/2.5	-	-	1027
BST60*	60	45	500	1000	1000	-	150	10	1.3	500/0.5	400/1500	500/0.5	1071
BST61*	80	60	500	1000	1000	-	150	10	1.3	500/0.5	400/1500	500/0.5	1071
BST62*	90	80	500	1000	1000	-	150	10	1.3	500/0.5	400/1500	500/0.5	1071
PMBT2907	60	40	600	250	30	50	500	10	0.4	150/15	45/100	150/15	1221
PMBT2907A	60	60	600	250	30	50	500	10	0.4	150/15	45/100	150/15	1221
PMBT3906	40	40	200	250	100	300	10	1	0.25	10/1	35/225	10/1	1229
PXT2907*	60	40	600	1000	100	300	150	10	0.4	150/10	45/100	150/15	1301
PXT2907A*	60	60	600	1000	100	300	150	10	0.4	150/10	45/100	150/15	1301
PXT3906*	40	40	200	1000	100	300	10	1	0.25	10/1	35/225	10/1	1309
PZT2907Δ	60	40	600	1500	100	300	150	10	0.4	150/15	45/100	150/15	1335
PZT2907AΔ	60	60	600	1500	100	300	150	10	0.4	150/15	45/100	150/15	1335
PZT3906Δ	40	40	200	1500	100	300	10	1	0.4	50/5	35/225	10/1	1343

Notes

- * Types in SOT89 package.
- ** Types in SOT143 package.
- Δ Types in SOT223 package.

POWER TRANSISTORS FOR SWITCHING in SOT223

TYPE NUMBER	RATINGS				CHARACTERISTICS										PAGE
	V_{CBO} (V)	V_{CEO} (V)	I_C (A)	P_{tot} (W)	h_{FE} min.	at I_C (A)	at V_{CE} (V)	$V_{CE\,sat}$ (V) max.	at I_C (A)	at I_B (mA)	t_{on} max.	t_{off} max.	at I_C (A)	at I_B (mA)	
NPN															
BDS61	60	60	4	8	1000	1.5	3	1.6	1.5	6	2	8	1.5	6000	421
BDS61A	80	80	4	8	1000	1.5	3	1.6	1.5	6	2	8	1.5	6000	421
BDS61B	100	100	4	8	1000	1.5	3	1.6	1.5	6	2	8	1.5	6000	421
BDS61C	120	120	4	8	1000	1.5	3	1.6	1.5	6	2	8	1.5	6000	421
BDS77	100	80	3	8	30	2	2	1.8	6	600	1	3	2	200	427
BDS201	60	45	3	8	40	3	2	1.8	6	600	1	3	2	200	427
BDS203	60	60	3	8	30	2	2	1.8	6	600	1	3	2	200	427
BDS643	60	45	3	8	1000	3	3	1.8	5	50	2	10	3	12	439
BDS645	80	60	3	8	1000	3	3	1.8	5	50	2	10	3	12	439
BDS647	100	80	3	8	1000	3	3	1.8	5	50	2	10	3	12	439
BDS649	120	100	3	8	1000	3	3	1.8	5	50	1	10	3	12	439
BDS651	140	120	3	8	1000	3	3	1.8	5	50	2	10	3	12	439
BDS933	45	45	3	8	25	1	2	0.5	1	100	1	3	1	100	451
BDS935	60	60	3	8	25	1	2	0.5	1	100	1	3	1	100	451
BDS937	100	80	3	8	25	1	2	0.5	1	100	1	3	1	100	451
BDS939	120	100	3	8	25	1	2	0.5	1	100	1	3	1	100	451
BDS941	140	120	3	8	25	1	2	0.5	1	100	1	3	1	100	451
BDS943	22	22	3	8	50	2	1	0.5	2	200	-	-	-	-	463
BDS945	32	32	3	8	50	2	1	0.5	2	200	-	-	-	-	463
BDS947	45	45	3	8	40	0.25	1	0.5	2	200	-	-	-	-	463
BDS949	60	60	3	8	20	2	4	1	2	200	-	-	-	-	475
BDS951	80	80	3	8	20	2	4	1	2	200	-	-	-	-	475
BDS953	100	100	3	8	20	2	4	1	2	200	-	-	-	-	475
BDS955	120	120	3	8	20	2	4	1	2	200	-	-	-	-	475
PNP															
BDS60	60	60	4	8	1000	1.5	3	1.6	1.5	6	1.5	5	1.5	6000	415
BDS60A	80	80	4	8	1000	1.5	3	1.6	1.5	6	1.5	5	1.5	6000	415
BDS60B	100	100	4	8	1000	1.5	3	1.6	1.5	6	1.5	5	1.5	6000	415
BDS60C	120	120	4	8	1000	1.5	3	1.6	1.5	6	1.5	5	1.5	6000	415
BDS78	100	80	3	8	40	3	2	1.8	6	600	1	3	2	200	433
BDS202	60	45	3	8	40	3	2	1.8	6	600	1	3	2	200	433
BDS204	60	60	3	8	40	3	2	1.8	6	600	1	3	2	200	433
BDS644	60	45	3	8	1000	3	3	1.8	5	50	2	10	3	12	445
BDS646	80	60	3	8	1000	3	3	1.8	5	50	2	10	3	12	445

TYPE NUMBER	RATINGS				CHARACTERISTICS										PAGE
	V_{CBO} (V)	V_{CEO} (V)	I_C (A)	P_{tot} (W)	h_{FE} min.	at I_C (A)	at V_{CE} (V)	$V_{CE\ sat}$ (V) max.	at I_C (A)	at I_B (mA)	t_{on} max.	t_{off} max.	at I_C (A)	at I_B (mA)	
PNP															
BDS648	100	80	3	8	1000	3	3	1.8	5	50	2	10	3	12	445
BDS650	120	100	3	8	1000	3	3	1.8	5	50	2	10	3	12	445
BDS652	140	120	3	8	1000	3	3	1.8	5	50	2	10	3	12	445
BDS934	45	45	3	8	25	1	2	0.5	1	100	0.6	2.4	1	100	457
BDS936	60	60	3	8	25	1	2	0.5	1	100	0.6	2.4	1	100	457
BDS938	100	80	3	8	25	1	2	0.5	1	100	0.6	2.4	1	100	457
BDS940	120	100	3	8	25	1	2	0.5	1	100	0.6	2.4	1	100	457
BDS942	140	120	3	8	25	1	2	0.5	1	100	0.6	2.4	1	100	457
BDS944	22	22	3	8	50	2	1	0.5	2	200	-	-	-	-	469
BDS946	32	32	3	8	50	2	1	0.5	2	200	-	-	-	-	469
BDS948	45	45	3	8	40	2	1	0.5	2	200	-	-	-	-	469
BDS950	60	60	3	8	20	2	4	1	2	200	-	-	-	-	481
BDS952	80	80	3	8	20	2	4	1	2	200	-	-	-	-	481
BDS954	100	100	3	8	20	2	4	1	2	200	-	-	-	-	481
BDS956	120	120	3	8	20	2	4	1	2	200	-	-	-	-	481

LOW-NOISE TRANSISTORS in SOT23 (F > 4 dB at f = 1 kHz; B = 200 Hz)

TYPE NUMBER	RATINGS				CHARACTERISTICS							PAGE
	V_{CBO} (V)	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE} min.	h_{FE} max.	at I_C (mA)	at V_{CE} (V)	$V_{CE\ sat}$ max. (V)	at I_C/I_B (mA)	f_T typ. (MHz)	
NPN												
BC849	30	30	100	250	-	800	2	5	0.25	10/0.5	300	245
BC850	45	45	100	250	-	800	2	5	0.25	10/0.5	300	245
BCF32	32	32	100	250	200	450	2	5	0.25	10/0.5	300	293
BCF33	32	32	100	250	420	800	2	5	0.25	10/0.5	300	293
BCF81	50	45	100	250	420	800	2	5	0.25	10/0.5	300	305
PMBT5088	35	30	50	250	350	-	1	5	0.5	10/1	200	1241
PNP												
BC859	30	30	100	250	125	800	2	5	0.3	10/0.5	150	265
BC860	45	45	100	250	125	800	2	5	0.3	10/0.5	150	265
BCF29	32	32	100	250	120	260	2	5	0.3	10/0.5	150	287
BCF30	32	32	100	250	215	500	2	5	0.3	10/0.5	150	287
BCF70	50	45	100	250	215	500	2	5	0.3	10/0.5	150	299

HIGH-VOLTAGE TRANSISTORS in SOT23/SOT89*/SOT223∆

TYPE NUMBER	RATINGS				CHARACTERISTICS							PAGE
	V_{CBO} (V)	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE} min.	h_{FE} max.	at I_C (mA)	at V_{CE} (V)	$V_{CE\ sat}$ max. (V)	at I_C/I_B (mA)	f_T typ. (MHz)	
NPN												
BF620*	300	-	50	1000	50	-	25	20	0.6	30/5	60	505
BF622*	250	250	50	1000	50	-	25	20	0.6	30/5	60	505
BF720∆	300	-	50	1500	50	-	25	20	0.6	30/5	60	515
BF722∆	250	250	50	1500	50	-	25	20	0.6	30/5	60	515
BF820	300	-	50	310	50	-	25	20	0.6	30/5	60	535
BF822	250	250	50	310	50	-	25	20	0.6	30/5	60	535
BSP19∆	400	350	1000	1500	40	-	10	20	1.3	50/4	70	899
BSP20∆	300	250	1000	1500	40	-	10	20	1.3	50/4	70	899
BSR19	160	140	600	350	60	250	10	5	0.25	50/5	100	1007
BSR19A	180	160	600	360	80	250	10	5	0.2	50/5	100	1007
BST39*	400	350	1000	1000	40	160	20	10	0.5	50/4	70	1063
BST40*	300	250	1000	1000	40	160	20	10	0.5	50/4	70	1063
PMBT5551	180	160	600	250	80	250	10	5	0.2	50/5	100	1249
PMBTA42	300	300	500	250	40	-	30	10	0.5	20/2	50	1259
PMBTA43	200	200	500	250	40	-	30	10	0.5	20/2	50	1259

HIGH-VOLTAGE TRANSISTORS in SOT23/SOT89*/SOT223Δ

TYPE NUMBER	RATINGS				CHARACTERISTICS							PAGE
	V_{CBO} (V)	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE} min.	h_{FE} max.	at I_C (mA)	at V_{CE} (V)	$V_{CE\,sat}$ max. (V)	at I_C/I_B (mA)	f_T typ. (MHz)	
PNP												
BF621*	300	-	20	1000	50	-	25	20	0.8	30/5	60	509
BF623*	250	250	20	1000	50	-	25	20	0.8	30/5	60	509
BF721Δ	300	-	50	1500	50	-	25	20	0.8	30/5	60	519
BF723Δ	250	250	50	1500	50	-	25	20	0.8	30/5	60	519
BF821	300	-	50	250	50	-	25	20	0.8	30/5	60	539
BF823	250	250	50	250	50	-	25	20	0.8	30/5	60	539
BSP15Δ	200	200	1000	1500	30	150	10	50	2.5	50/5	15	897
BSP16Δ	350	300	1000	1500	30	120	10	50	2.0	50/5	15	897
BSR20	130	120	600	250	40	180	10	5	0.5	50/5	100	1011
BSR20A	160	150	600	250	60	240	10	5	0.5	50/5	100	1011
BST15*	200	200	1000	1000	30	150	50	10	2.5	50/5	15	1059
BST16*	350	300	1000	1000	30	120	50	10	2.0	50/5	15	1059
PMBT5401	160	150	500	250	60	240	10	5	0.5	50/5	100	1245
PMBTA92	300	300	500	250	40	-	10	10	0.5	20/2	50	1267
PMBTA93	200	200	500	250	40	-	10	10	0.5	20/2	50	1267

Notes

* Types in SOT89 package.
** Types in SOT143 package.
Δ Types in SOT223 package.

FIELD-EFFECT TRANSISTORS in SOT23/SOT89*/SOT143**/SOT223Δ

TYPE NUMBER	RATINGS				CHARACTERISTICS							PAGE
	$\pm V_{DS}$ (V)	$-V_{GSO}$ (V)	I_D (mA)	P_{tot} (mW)	$-I_{GSS}$ (nA) max.	I_{DSS} (mA) min.	I_{DSS} (mA) max.	$-V_{(P)GS}$ (V) max.	$\|Y_{fs}\|$ (ms) min.	C_{rs} (pF) max.	V_n (μv) max.	
BF510	20	-	30	250	10	0.7	3	0.8	2.5	0.4	-	487
BF511	20	-	30	250	10	2.5	7	1.5	4	0.4	-	487
BF512	20	-	30	250	10	6	12	2.2	6	0.4	-	487
BF513	20	-	30	250	10	10	18	3	7	0.4	-	487
BF989**	20	-	20	200	50	2	20	2.7	9.5	0.025	-	551
BF990A**	18	-	30	200	25	-	-	1.3	17	0.025	-	555
BF991**	20	-	20	200	50	4	25	2.5	10	0.020	-	559
BF992**	20	-	40	200	25	-	-	1.3	20	0.04	-	563

TYPE NUMBER	RATINGS				CHARACTERISTICS							PAGE
	$\pm V_{DS}$ (V)	$-V_{GSO}$ (V)	I_D (mA)	P_{tot} (mW)	$-I_{GSS}$ (nA) max.	I_{DSS} (mA) min.	I_{DSS} (mA) max.	$-V_{(P)GS}$ (V) max.	$\lvert Y_{fs} \rvert$ (ms) min.	C_{rs} (pF) max.	V_n (µv) max.	
BF994S**	20	-	50	300	50	4	20	2.5	15	0.025	-	569
BF996S**	20	-	30	300	50	4	20	2.5	15	0.025	-	573
BF997**	20	-	30	300	10	2	20	2.5	15	0.025	-	577
BF998**	12	-	30	200	50	2	18	2.5	21	-	-	581
BFR30	25	25	10	250	0.2	4	10	5	1	1.5	0.5	757
BFR31	25	-	-	-	-	1	5	2.5	1.5	1.5	0.5	757
BFR101A**	30	30	10	200	5	0.2	1.5	1.0	1.2	-	-	815
BFR101B**	30	30	10	200	5	1	5	2.5	2.5	-	-	815
BFR200**	30	30	20	250	.003	0.2	3.5	-	1.3	-	-	823
BFT46	25	25	10	250	0.2	0.2	1.5	1.2	1.0	1.5	0.5	861
BSD22**	20	-	50	230	1	-	-	2.0	-	0.6	-	893
BSP103Δ	35	20	700	1500	-	-	-	-	-	-	-	917
BSP105Δ	60	20	500	1500	-	-	-	-	-	-	-	917
BSP106Δ	60	20	425	1500	10	-	0.001	-	100	10	-	921
BSP107Δ	200	20	200	1500	10	-	.00003	-	90	10	-	929
BSP108Δ	80	20	500	1500	100	-	0.001	-	150	12	-	937
BSP109Δ	90	20	450	1500	-	-	-	-	-	-	-	917
BSP110Δ	80	20	325	1500	100	-	0.001	-	75	6	-	941
BSP120Δ	200	20	250	1500	100	-	0.001	-	125	10	-	945
BSP121Δ	200	20	350	1500	100	-	0.001	-	200	10	-	949
BSP126Δ	250	20	350	1500	100	-	0.001	-	200	15	-	955
BSP205Δ	60	20	275	1500	100	-	0.001	-	60	10	-	961
BSP206Δ	60	20	350	1500	100	-	0.001	-	100	12	-	965
BSP220Δ	200	20	225	1500	100	-	0.001	-	100	15	-	969
BSP225Δ	250	20	225	1500	100	-	0.001	-	100	15	-	977
BSR56	40	40	-	250	1	50	-	10	-	5	-	1023
BSR57	40	40	-	250	1	20	100	6	-	5	-	1023
BSR58	40	40	-	250	1	8	80	4	-	5	-	1023
BSS83**	10	-	50	230	10	-	-	2	-	0.6	-	1037
BSS84	50	20	130	360	6000	-	0.06	-	50	-	-	1041
BSS87	200	20	280	1000	100	-	0.06	-	140	10	-	1045
BSS131	240	20	100	360	10	-	0.06	-	60	-	-	1049

Notes

- * Types in SOT89 package.
- ** Types in SOT143 package.
- Δ Types in SOT223 package.

TYPE NUMBER	RATINGS				CHARACTERISTICS							PAGE
	$\pm V_{DS}$ (V)	$-V_{GSO}$ (V)	I_D (mA)	P_{tot} (mW)	$-I_{GSS}$ (nA) max.	I_{DSS} (mA)		$-V_{(P)GS}$ (V) max.	$\lvert Y_{fs} \rvert$ (ms) min.	C_{rs} (pF) max.	V_n (μv) max.	
						min.	max.					
BSS192*	200	20	150	1000	100	-	0.06	-	60	15	-	1053
BST80*	80	20	500	1000	100	-	0.01	3.5	300	8	-	1075
BST82	80	20	175	300	100	-	0.001	3.5	150	3	-	1079
BST84*	200	20	250	1000	100	-	0.01	2.8	250	5	-	1083
BST86*	180	20	300	1000	100	-	0.01	2.4	250	6	-	1087
BST120*	60	20	300	1000	100	-	0.01	3.5	200	8	-	1091
BST122*	50	20	250	1000	100	-	0.01	3.5	125	8	-	1095
PMBF170	60	20	250	300	10	-	0.001	-	100	10	-	1191
PMBF4391	40	40	-	250	1	50	150	10	-	3.5	-	1195
PMBF4392	40	40	-	250	1	25	75	5	-	3.5	-	1195
PMBF4393	40	40	-	250	1	5	30	3	-	3.5	-	1195
PMBFJ108	25	25	-	250	3	80	-	-	-	15	-	1199
PMBFJ109	25	25	-	250	3	40	-	-	-	15	-	1199
PMBFJ110	25	25	-	250	3	10	-	-	-	15	-	1199
PMBFJ111	40	40	-	300	1	20	-	-	-	-	-	1205
PMBFJ112	40	40	-	300	1	5	-	-	-	-	-	1205
PMBFJ113	40	40	-	300	1	2	-	-	-	-	-	1205
PMBFJ174	30	30	-	300	1	20	135	10	-	4	-	1211
PMBFJ175	30	30	-	300	1	7	70	6	-	4	-	1211
PMBFJ176	30	30	-	300	1	2	35	4	-	4	-	1211
PMBFJ177	30	30	-	300	1	1.5	20	2.25	-	4	-	1211
2N7002	60	-	180	300	-	-	-	-	-	-	-	1365

Notes

- * Types in SOT89 package.
- ** Types in SOT143 package.

SPECIAL TRANSISTORS IN SOT143

TYPE NUMBER	RATINGS				CHARACTERISTICS							PAGE
	V_{CBO} (V)	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE} min.	h_{FE} max.	at I_C (mA)	at V_{CE} (V)	$V_{CE\ sat}$ max. (V)	at I_C/I_B (mA)	f_T typ. (MHz)	
PNP												
BCV62	30	30	100	250	100	800	2	5	0.65	100/5	150	339
BCV64	30	30	100	250	100	900	2	5	0.3	100/0.5	200	347
NPN												
BCV61	30	30	100	250	110	800	2	5	0.6	100/5	300	335
BCV63	30	30	100	250	100	900	2	5	0.65	100/5	200	343
NPN/PNP												
BCV65	30	30	100	250	75	800	2	5	0.3	10/0.5	100	351

TRIGGER DEVICES

TYPE	ENVELOPE	RATINGS		CHARACTERISTICS		PAGE
		V_{GA} (V) max.	I_A (mA) max.	I_P (μA)	I_V (μA)	
BRY61	SOT23	70	175	5/1	30/50	881
BRY62	SOT143	70	175	-	-	887

DIODES in SOT23/SOD80*/SOT143**

TYPE NUMBER	DESCRIPTION	RATINGS		CHARACTERISTICS				PAGE
		V_R (V)	I_F (MA)	t_{rr} max. (ns)	V_F (V)	at I_F (mA)	C_d max. (pF)	
BA423L*	band switch	20	50	-	0.9	50	2.5	89
BA682*	band switch	35	100	-	1	100	1.5	91
BA683*	band switch	35	100	-	1	100	1.5	91
BAS16	high-speed switch	75	250	6	1.25	150	2	93
BAS17	low-voltage stabilizer	-	250	-	0.87-0.96	100	140	97
BAS19	high-speed switch	100	200	50	1.25	200	5	101
BAS20	high-speed switch	150	200	50	1.25	200	5	101
BAS21	high-speed switch	200	200	50	1.25	200	5	101
BAS28**	fast switch double diode	75	250	6	1.25	150	2	109
BAS29	switch	90	250	50	1.25	400	35	113
BAS31	two diodes in series	90	250	50	1.25	400	35	113
BAS32*	high-speed switch	75	200	4	1	100	2	115
BAS32L*	high-speed switch	75	200	4	1	100	2	123

TYPE NUMBER	DESCRIPTION	RATINGS		CHARACTERISTICS				PAGE
		V_R (V)	I_F (MA)	t_{rr} max. (ns)	V_F (V)	at I_F (mA)	C_d max. (pF)	
BAS35	common diode double diode	90	250	50	1.25	400	35	113
BAS56**	ultra-high speed switch double diode	60	200	6	1.25	500	2.5	131
BAS85*	Schottky barrier	30	200	5	0.8	100	10	135
BAS86	Schottky barrier	50	200	4	0.9	100	-	139
BAT17	Schottky barrier	4	30	-	0.6	10	1	143
BAT18	band switch	35	100		1.2	100	1	147
BAT54	Schottky barrier	30	200	5	1	100	10	151
BAT54A;C;S	Schottky barrier	30	200	5	1	100	10	155
BAT74**	Schottky barrier double diode	30	200	5	1	100	10	157
BAV23**	two diodes	200	200	50	2.5	200	2.5	161
BAV70	common cathode double diode	70	250	6	1.25	150	1.5	163
BAV74	two diodes	50	250	4	1	100	2	167
BAV99	two diodes in series	70	250	6	1.25	150	1.5	171
BAV100*	general purpose	50	250	50	1.25	200	5	175
BAV101*	general purpose	100	250	50	1.25	200	5	175
BAV102*	general purpose	150	250	50	1.25	200	5	175
BAV103*	general purpose	200	250	50	1.25	200	5	175
BAV105*	ultra high speed	60	300	6	1.25	500	2.5	183
BAW56	common anode double diode	70	250	6	1.25	150	2	191
PMBD914	high speed switch	70	200	15	1	10	4	1179
PMBD6050	high speed switch	70	200	15	1.1	100	2.5	1183
PMBD7000	two diodes in series	100	200	15	1.1	100	1.5	1187
PMLL4148*	general purpose	75	200	4	1	10	4	1273
PMLL4150*	general purpose	50	300	6	1	200	2.5	1277
PMLL4151*	general purpose	50	200	2	1	50	2	1277
PMLL4153*	general purpose	50	200	2	0.88	20	2	1277
PMLL4446*	general purpose	75	200	4	1	20	4	1273
PMLL4448*	general purpose	70	200	4	1	100	4	1273

Notes

* Types in SOD80 package.

** Types in SOT143 package.

VARIABLE CAPACITANCE DIODES

TYPE NUMBER	ENVELOPE	RATINGS		CHARACTERISTICS						PAGE
		V_R (V)	I_F (mA)	C_d (pF)	at V_R (V)	C_d ratio (f = 1 MHz)	at V_R	r_D (Ω)		
BB215	SOD80	30	20	1.8 - 2.2	28	typ. 8.3	1/28	typ. 0.63		195
BB219	SOD80	30	20	2.6 - 3.2	28	12 - 15	1/28	typ. 0.7		197
BB240	SOD80	32	20	2.4 - 2.7	28	min. 14	0.5/28	max. 1		199
BB241	SOD80	32	20	2.5 - 3.0	28	min. 21	0.5/28	max. 2		201
BB249	SOD80	30	20	4 - 5	28	8 - 10	1/28	max. 0.6		203
BB804	SOT23	18	50	42 - 47.5	2	1.65 - 1.75	2/8	typ. 0.2		207
BBY31	SOT23	28	20	1.6 - 2	28	typ. 9.7	1/28	max. 1.2		209
BBY39	SOT23	30	20	1 - 2	28	min. 7.6	1/28	max. 0.75		213
BBY40	SOT23	28	20	3.8 - 4.8	28	8 - 12	1/28	max. 0.7		215
BBY42	SOT23	32	20	2.4 - 3	28	12 - 16	1/28	max. 1		219
BBY62	SOT143	28	20	1.6 - 2	28	typ. 9.7	1/28	max. 1.2		221

VOLTAGE REGULATOR DIODES

TYPE NUMBER	ENVELOPE	RATINGS					CHARACTERISTICS		PAGE
		VOLTAGE RANGE (V)	VOLTAGE TOLERANCE (%)	P_{tot} (mW)	I_{ZRM} (mA)	I_{FRM} (mA)	V_F max. (V)	at I_F (mA)	
BZD27	SOD87	7.5 to 510	5	2300	-	-	1.2	200	1125
BZV49	SOT89	2.4 to 75	5	1000	note 1	250	1	50	1131
BZV55	SOD80	2.4 to 75	2, 3, 5	500	-	250	0.9	10	1141
BZV80	SOD80	5.89 to6.51	-	400	50	-	-	-	1155
BZV81	SOD80	5.89 to 6.51	-	400	50	-	-	-	1155
BZX84	SOT23	2.4 to 75	2.5	350	250	250	0.9	10	1161
PMLL5225B to PMLL5267B	SOD80	3.0 to 75	5	500	-	250	1.1	200	1281

Note

1. I_{ZRM} limited by $P_{ZRM\ max}$.

TRANSIENT SUPPRESSION DIODES

TYPE NUMBER	ENVELOPE	CHARACTERISTICS				PAGE
		V_R (V)	$V_{(CL)R}$ (V)	I_{RSM} (A)	P_{RSM} (W)	
BZD27	SOD87	6.2 to 430	11.3 to 707	13.3 to 0.21 note 1	150 note 1	1125

Note

1. Pulse according to IEC60-2, section 6: 10/1000 μs exponential; T_j = 25 °C prior to the pulse.

RECTIFIER DIODES

TYPE NUMBER	ENVELOPE	RATINGS					CHARACTERISTICS			PAGE
		$I_{F(AV)}$ (A)	V_{RRM} (V)	V_R (V)	I_{FRM} (A)	I_{FSM} (A)	t_{rr} (ns)	V_F (V)	at I_F (A)	
BYD17D	SOD87	1.5	200*	200	5.5	20	-	1.05	1	1107
BYD17G	SOD87	1.5	400*	400	5.5	20	-	1.05	1	1107
BYD17J	SOD87	1.5	600*	600	5.5	20	-	1.05	1	1107
BYD17K	SOD87	1.5	800*	800	5.5	20	-	1.05	1	1107
BYD17M	SOD87	1.5	1000*	1000	5.5	20	-	1.05	1	1107
BYD37D	SOD87	1.5	200	200	12	20	250	1.3	1	1115
BYD37G	SOD87	1.5	400	400	12	20	250	1.3	1	1115
BYD37J	SOD87	1.5	600	600	12	20	250	1.3	1	1115
BYD37K	SOD87	1.5	800	800	12	20	300	1.3	1	1115
BYD37M	SOD87	1.5	1000	1000	12	20	300	1.3	1	1115
BYD77A	SOD87	2.0	50	50	15	25	25	0.95	1	1121
BYD77B	SOD87	2.0	100	100	15	25	25	0.95	1	1121
BYD77C	SOD87	2.0	150	150	15	25	25	0.95	1	1121
BYD77D	SOD87	2.0	200	200	15	25	25	0.95	1	1121
BYD77E	SOD87	1.85	250	250	13	25	50	1.05	1	1121
BYD77F	SOD87	1.85	300	300	13	25	50	1.05	1	1121
BYD77G	SOD87	1.85	400	400	13	25	50	1.05	1	1121

Note

* V_{RWM}.

TEMPERATURE SENSORS

TYPE NUMBER	TEMPERATURE RANGE °C	RESISTANCE R at T_{amb} (Ω) note 1	SENSOR CURRENT (mA)	PAGE
KTY85-110	–40 to 125	1000 ± 1%	1	1173
KTY85-120	–40 to 125	1000 ± 2%	1	1173
KTY85-150	–40 to 125	1000 ± 5%	1	1173

Note

1. T_{amb} = 25 °C.

Device data

Philips Components

Data sheet	
status	Product specification
date of issue	April 1991

BFG198

NPN 7 GHz wideband transistor

DESCRIPTION

NPN planar epitaxial transistor in a plastic SOT223 envelope, intended for wideband amplifier applications. The device features a high gain, and excellent output voltage capabilities.

MECHANICAL DATA

SOT223.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	-	-	20	V
V_{CEO}	collector-emitter voltage	open base	-	-	10	V
I_C	collector current (DC)		-	-	100	mA
P_{tot}	total power dissipation	T_{case} = 135 °C note 1	-	-	1	W
T_j	junction temperature		-	-	175	°C
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 5 V	40	-	-	
f_T	transition frequency	f = 1000 MHz; I_C = 50 mA; V_{CE} = 8 V; T_{amb} = 25 °C	-	8.0	-	GHz
G_{UM}	maximum power gain	f = 500 MHz; I_C = 50 mA; V_{CE} = 8 V	-	18	-	dB
G_{UM}	maximum power gain	f = 800 MHz; I_C = 50 mA; V_{CE} = 8 V	-	15	-	dB
V_o	output voltage	d_{im} = −60 dB; I_C = 70 mA; V_{CE} = 8 V; R_L = 75 Ω; $f_{(p+q-r)}$ = 793.25 MHz	-	700	-	mV

Note

1. T_{case} temperature measured on soldering point of collector tab.

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ORDERING AND PACKAGE INFORMATION

EXTENDED TYPE NUMBER	PACKAGE		
	CODE	PACKING METHOD	PACKING QUANTITY
BFG198	SOT223	bulk	500
BFG198	SOT223	12 mm reel	1000

LIMITING VALUES

Limiting values in accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	-	20	V
V_{CEO}	collector-emitter voltage	open base	-	10	V
V_{EBO}	emitter-base voltage	open collector	-	2.5	V
I_C	collector current (DC)		-	100	mA
P_{tot}	total power dissipation	T_{case} = 135 °C	-	1	W
T_{stg}	storage temperature range		−65	+150	°C
T_j	junction temperature		-	175	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	NOM.	UNIT
$R_{th\ j\text{-}c}$	from junction to case	40	K/W

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CHARACTERISTICS

T_j = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 10 V	-	-	100	nA
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 5 V	40	-	-	
f_T	transition frequency	f = 1000 MHz; I_C = 50 mA; V_{CE} = 8 V; T_{amb} = 25 °C	-	8.0	-	GHz
C_c	collector capacitance	f = 1 MHz; $I_e = i_e$ = 0; V_{CB} = 8 V	-	1.5	-	pF
C_e	emitter capacitance	f = 1 MHz; $I_c = i_c$ = 0; V_{EB} = 0.5 V	-	4.0	-	pF
C_{re}	feedback capacitance	f = 1 MHz; I_C = 0; V_{CE} = 8 V	-	0.8	-	pF
G_{UM}	maximum power gain	f = 500 MHz; T_{amb} = 25 °C; I_C = 50 mA; V_{CE} = 8 V	-	18	-	dB
G_{UM}	maximum power gain	f = 800 MHz; T_{amb} = 25 °C; I_C = 50 mA; V_{CE} = 8 V	-	15	-	dB
V_o	output voltage	note 1	-	750	-	mV
V_o	output voltage	note 2	-	700	-	mV

Notes

1. d_{im} = –60 dB (DIN 45004B); T_{amb} = 25 °C; I_C = 70 mA; V_{CE} = 8 V; R_L = 75 Ω; $V_p = V_o$ at d_{im} = –60 dB; $V_q = V_o$ –6 dB; f_p = 445.25 MHz; $V_r = V_o$ –6 dB; f_q = 453.25 MHz; f_r = 445.25 MHz; measured at $f_{(p+q-r)}$ = 443.25 MHz

2. d_{im} = –60 dB (DIN 45004B); T_{amb} = 25 °C; I_C = 70 mA; V_{CE} = 8 V; R_L = 75 Ω; $V_p = V_o$ at d_{im} = –60 dB; $V_q = V_o$ –6 dB; f_p = 795.25 MHz; $V_r = V_o$ –6 dB; f_q = 803.25 MHz; f_r = 805.25 MHz; measured at $f_{(p+q-r)}$ = 793.25 MHz

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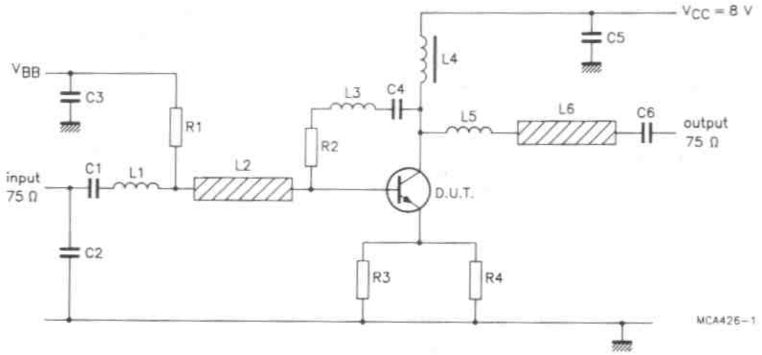

Fig.1 Intermodulation and second harmonic test circuit.

List of components:

R1 = 10 kΩ metal film resistor	(cat. no. 2322 180 73103)
R2 = 220 Ω metal film resistor	(cat. no. 2322 180 73221)
R3 = R4 = 30 Ω metal film resistor	(cat. no. 2322 180 73309)
C2 = C4 = C6 = C7 = 10 nF ceramic multilayer capacitor	(cat. no. 2222 590 08627)
C1 = 1.2 pF ceramic multilayer capacitor	(cat. no. 2222 851 12128)
C3 = 2.2 pF ceramic multilayer capacitor	(cat. no. 2222 851 12128)
C5 = 10 nF miniature ceramic plate capacitor	(cat. no. 2222 629 08103)
C8 = 1.5 pF ceramic multilayer capacitor	(cat. no. 2222 851 12158)
L1 = 1.5 turn Cu wire (0.4 mm), internal diameter 3 mm, winding pitch 1 mm	
L2 = 75 Ω microstripline	(L = 22 mm; W = 2.5 mm)
L3 = 30 mm Cu wire (0.4 mm; L ≈ 24 nH)	
L4 = 4 mm Cu wire (0.4 mm; L ≈ 3.6 nH)	
L5 = 75 Ω microstripline	(L = 19 mm; W = 2.5 mm)
L6 = 5 µH Ferroxcube choke	(cat. no. 3122 108 20153)

The circuit has been built on a double Cu clad printed circuit board with PTFE dielectric ($\varepsilon_r = 2.2$); thickness 1/16 inch; thickness of copper-sheet 2 x 35 µm; see Fig.1.
The components L1, R2, L3, C5 and L4 are mounted on the underside of the PCB.

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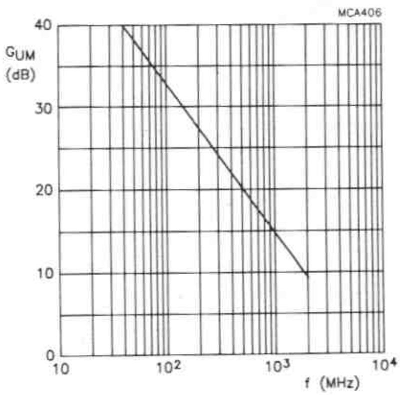

Fig.2 Maximum unilateral power gain; V_{CE} = 8 V; I_C = 50 mA; T_{amb} = 25 °C; typical values.

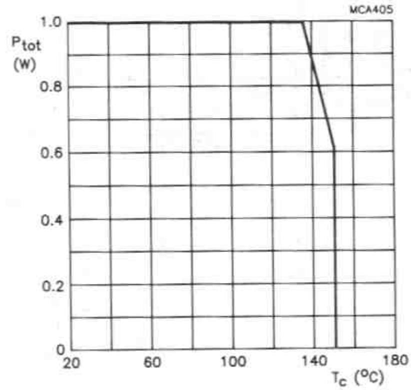

Fig.3 Power derating curve as a function of case temperature.

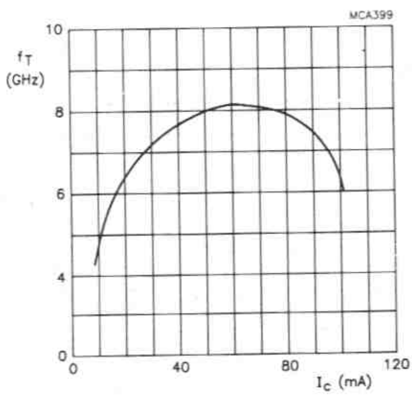

Fig.4 Transition frequency as a function of collector current; V_{CE} = 8 V; f = 1 GHz; T_j = 25 °C; typical values.

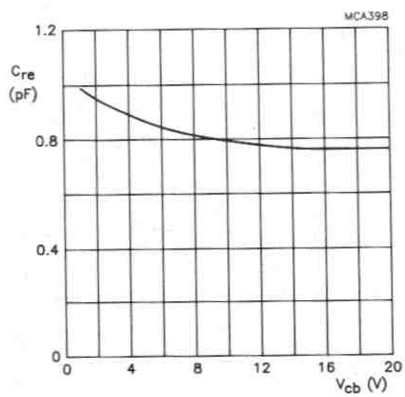

Fig.5 Feedback capacitance as a function of collector-base voltage; I_E = 0; f = 1 MHz; T_j = 25 °C; typical values.

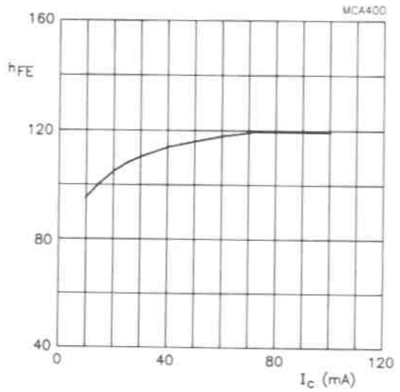

Fig.6 DC current gain as a function of collector current; V_{CE} = 5 V; T_j = 25 °C; typical values.

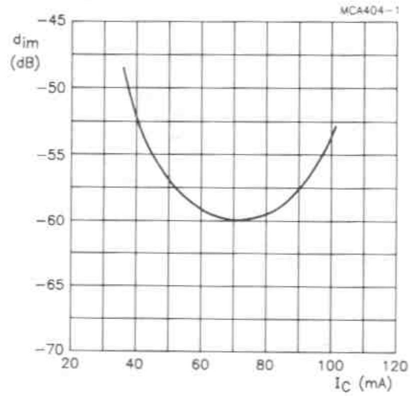

Fig.7 Intermodulation distortion; V_{CE} = 8 V; V_o = 750 mV; $f_{(p+q-r)}$ = 443.25 MHz; T_{amb} = 25 °C; typical values.

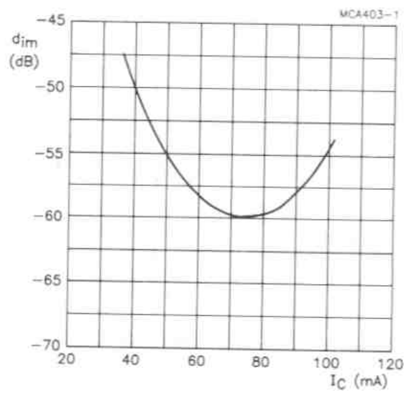

Fig.8 Intermodulation distortion; V_{CE} = 8 V; V_o = 700 mV; $f_{(p+q-r)}$ = 793.25 MHz; T_{amb} = 25 °C; typical values.

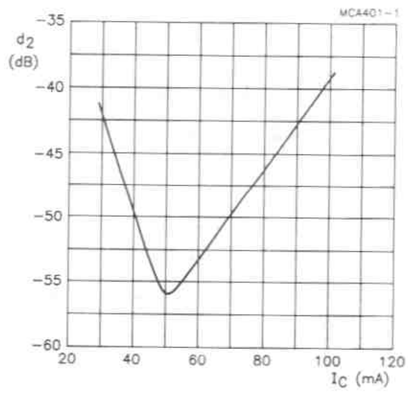

Fig.9 Intermodulation distortion; V_{CE} = 8 V; V_o = 50 dBmV; $f_{(p+q)}$ = 450 MHz; T_{amb} = 25 °C; typical values.

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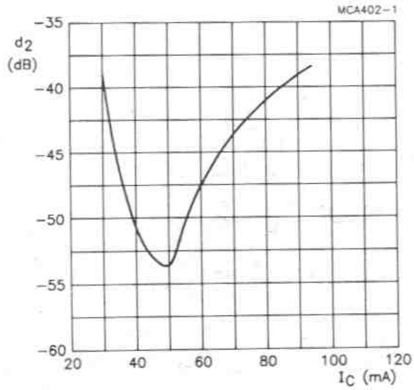

Fig.10 Intermodulation distortion; V_{CE} = 8 V; V_o = 50 dBmV; $f_{(p+q)}$ = 810 MHz; T_{amb} = 25 °C; typical values.

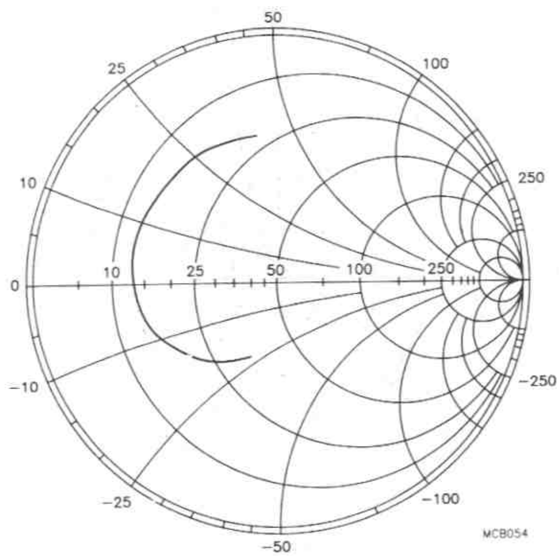

Fig.11 Input reflection coefficient S11; V_{CE} = 8 V; I_C = 50 mA; T_{amb} = 25 °C; typical values.

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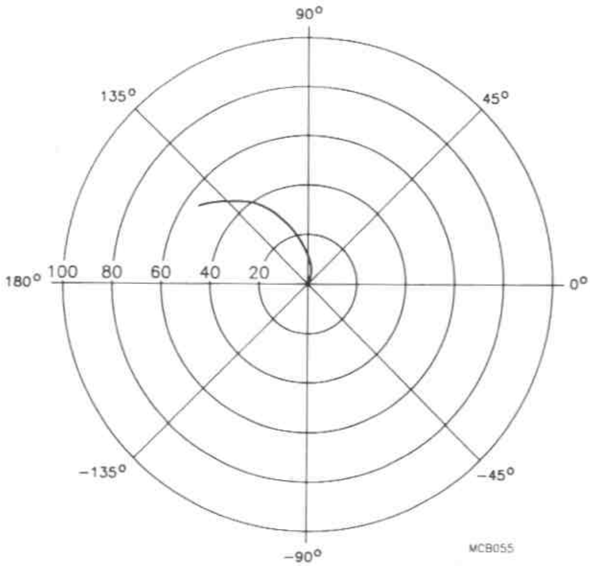

Fig.12 Forward transmission coefficient S21; V_{CE} = 8 V; I_C = 50 mA; T_{amb} = 25 °C; typical values.

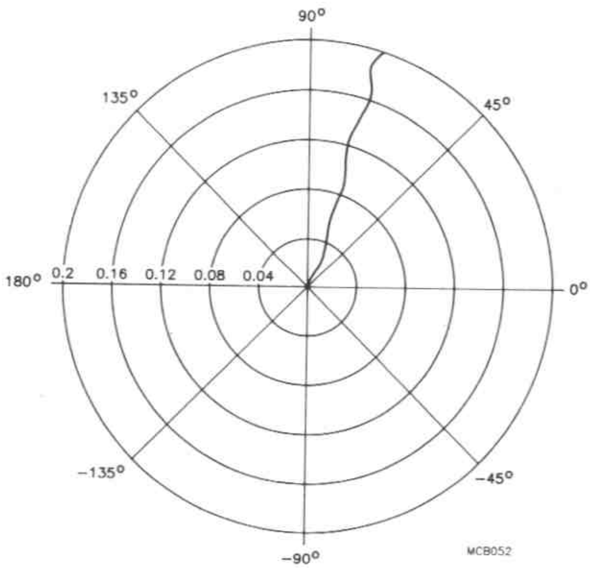

Fig.13 Reverse transmission coefficient S12; V_{CE} = 8 V; I_C = 50 mA; T_{amb} = 25 °C; typical values.

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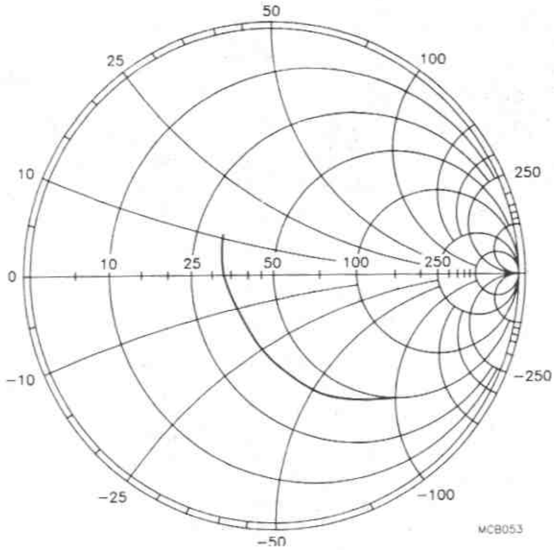


Fig.14 Output reflection coefficient S22; V_{CE} = 8 V; I_C = 50 mA; T_{amb} = 25 °C; typical values.

S-Parameters (common emitter) at V_{CE} = 8 V; T_{amb} = 25 °C; typical values.

I_C (mA)	f (MHz)	S11	S21	S12	S22	G_{UM} (dB)
5	40	0.79/- 25.3	12.7/165.9	0.02/75.7	0.97/- 11.1	38.3
	100	0.77/- 57.4	12.1/146.9	0.04/62.4	0.87/- 25.4	31.7
	200	0.74/-100.7	9.0/125.7	0.06/46.1	0.69/- 41.2	25.3
	500	0.70/-162.7	4.6/ 92.7	0.08/32.6	0.44/- 60.4	17.0
	800	0.70/ 168.5	2.9/ 75.6	0.08/34.3	0.35/- 73.9	12.7
	1000	0.69/ 154.0	2.4/ 65.9	0.08/41.3	0.34/- 82.6	10.8
	1200	0.68/ 141.4	1.9/ 57.5	0.08/50.5	0.33/- 93.4	8.9
	1500	0.67/ 124.7	1.5/ 48.5	0.09/61.3	0.32/-111.5	6.7
	2000	0.64/ 100.0	1.1/ 34.3	0.41/76.3	0.32/-144.0	3.2
10	40	0.61/- 38.7	24.8/159.3	0.02/72.6	0.93/- 17.4	38.7
	100	0.62/- 81.3	18.7/138.5	0.04/57.9	0.74/- 39.9	31.0
	200	0.63/-127.1	13.1/115.7	0.05/45.3	0.53/- 56.9	25.9
	500	0.64/ 174.8	6.0/ 88.8	0.06/44.4	0.32/- 72.4	18.3
	800	0.63/ 159.5	3.7/ 74.8	0.07/54.9	0.22/- 91.6	13.9
	1000	0.64/ 148.2	3.0/ 66.5	0.08/58.2	0.20/-103.6	11.9
	1200	0.63/ 136.6	2.5/ 59.8	0.10/63.9	0.19/-114.9	10.2
	1500	0.62/ 121.5	1.9/ 51.4	0.12/67.9	0.20/-135.1	8.0
	2000	0.62/ 99.8	1.4/ 39.3	0.17/73.3	0.22/-167.3	5.1
30	40	0.36/- 83.2	44.8/148.9	0.01/69.2	0.82/- 33.1	38.4
	100	0.49/-131.0	29.7/123.0	0.02/52.4	0.55/- 62.4	32.2
	200	0.56/-159.8	17.3/104.4	0.03/55.6	0.33/- 86.9	26.9
	500	0.58/ 169.9	7.3/ 84.9	0.05/68.7	0.18/-124.2	19.2
	800	0.60/ 152.0	4.6/ 73.7	0.08/71.1	0.15/-147.1	15.2
	1000	0.59/ 142.0	3.6/ 67.0	0.09/71.1	0.15/-160.5	13.1
	1200	0.59/ 132.6	3.0/ 61.8	0.12/72.1	0.15/-174.7	11.4
	1500	0.59/ 119.1	2.4/ 54.2	0.15/72.3	0.18/-170.8	9.4
	2000	0.59/ 98.3	1.6/ 44.2	0.20/71.1	0.22/ 148.3	6.4
50	40	0.33/-117.0	53.4/143.7	0.01/73.3	0.76/- 39.7	38.8
	100	0.49/-147.8	32.6/117.1	0.02/65.0	0.46/- 74.6	32.5
	200	0.56/-169.3	18.2/101.0	0.03/66.7	0.28/-102.7	27.2
	500	0.58/ 166.0	7.5/ 83.9	0.05/72.8	0.17/-141.6	19.4
	800	0.59/ 149.8	4.7/ 73.2	0.08/73.2	0.16/-164.9	15.4
	1000	0.59/ 140.1	3.7/ 66.8	0.10/72.2	0.17/-177.0	13.4
	1200	0.58/ 131.1	3.0/ 61.9	0.12/73.9	0.17/-173.4	11.6
	1500	0.58/ 117.9	2.4/ 54.5	0.15/71.8	0.20/ 161.2	9.7
	2000	0.58/ 97.8	1.7/ 45.3	0.20/70.6	0.25/ 138.5	6.7
70	40	0.35/-130.4	58.2/140.3	0.01/59.3	0.70/- 44.7	38.8
	100	0.50/-156.7	33.7/114.7	0.02/64.8	0.42/- 79.1	32.7
	200	0.56/-173.5	18.4/ 99.3	0.03/67.8	0.26/-108.5	27.2
	500	0.58/ 164.4	7.6/ 82.9	0.05/75.5	0.18/-150.7	19.5
	800	0.59/ 148.8	4.7/ 72.7	0.08/74.8	0.17/-169.5	15.5
	1000	0.59/ 139.4	3.7/ 66.3	0.10/75.8	0.18/-177.7	13.4
	1200	0.58/ 130.5	3.0/ 61.7	0.12/74.6	0.18/-166.9	11.6
	1500	0.58/ 117.5	2.4/ 54.4	0.16/73.2	0.21/ 156.6	9.8
	2000	0.59/ 97.7	1.7/ 45.1	0.20/70.6	0.26/ 135.2	6.7

NPN 1 GHz WIDEBAND TRANSISTOR

NPN multi-emitter transistor in a SOT89 plastic envelope intended for application in thick and thin-film circuits. The transistor has extremely good intermodulation properties and a high power gain. It is primarily intended for:

- Output and driver stages of channel and band serial amplifiers with high output power for bands I, II, III and IV/V (40–860 MHz).
- Output and driver stages of wideband amplifiers.

QUICK REFERENCE DATA

Collector-base voltage (open emitter; peak value)	V_{CBOM}	max.	40	V
Collector-emitter voltage (open base)	V_{CEO}	max.	25	V
Collector current (peak value; f > 1 MHz)	I_{CM}	max.	300	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1	W
Junction temperature	T_j	max.	175	°C
Transition frequency at f = 500 MHz I_C = 150 mA; V_{CE} = 15 V	f_T	typ.	1.2	GHz
Feedback capacitance at f = 1 MHz I_C = 10 mA; V_{CE} = 15 V	C_{re}	typ.	1.9	pF

MECHANICAL DATA

SOT89

See also *Soldering recommendations*.

Marking code

BFQ17 = FA

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter; peak value)	V_{CBOM}	max.	40	V
Collector emitter voltage ($R_{BE} \leqslant 50\ \Omega$; peak value)	V_{CERM}	max.	40	V*
Collector-emitter voltage (open base)	V_{CEO}	max.	25	V*
Emitter-base voltage (open collector)	V_{EBO}	max.	2	V
Collector current (DC)	I_C	max.	150	mA
Collector current (peak value; $f > 1$ MHz)	I_{CM}	max.	300	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$ mounted on a ceramic substrate area = 2.5 cm^2; thickness = 0.7 mm	P_{tot}	max.	1	W
Storage temperature range	T_{stg}		−65 to + 150	^oC
Junction temperature	T_j	max.	175	^oC

THERMAL RESISTANCE

From junction to collector tab	$R_{th\ j\text{-}tab}$	=	30	K/W
From junction to ambient in free air mounted on a ceramic substrate area = 2.5 cm^2; thickness = 0.7 mm	$R_{th\ j\text{-}a}$	=	125	K/W

* I_C = 10 mA.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

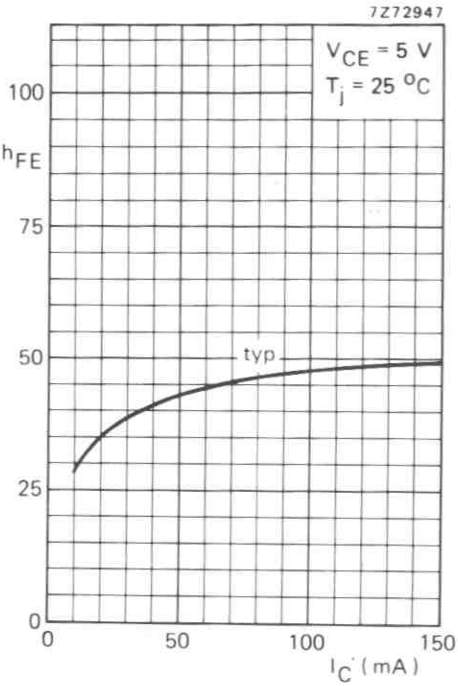
Collector cut-off current			
$I_E = 0$; $V_{CB} = 20$ V; $T_j = 150$ °C	I_{CBO}	max.	20 μA
Saturation voltage			
$I_C = 100$ mA; $I_B = 10$ mA	V_{CEsat}	max.	0.5 V
DC current gain			
$I_C = 50$ mA; $V_{CE} = 5$ V	h_{FE}	min.	25
$I_C = 150$ mA; $V_{CE} = 5$ V	h_{FE}	min.	25
Transition frequency at f = 500 MHz*			
$I_C = 150$ mA; $V_{CE} = 15$ V	f_T	typ.	1.2 GHz
Collector capacitance at f = 1 MHz			
$I_E = I_e = 0$; $V_{CB} = 15$ V	C_c	max.	4 pF
Feedback capacitance at f = 1 MHz			
$I_C = 10$ mA; $V_{CE} = 15$ V; $T_{amb} = 25$ °C	C_{re}	typ.	1.9 pF

Maximum unilateral power gain (S_{12} assumed to be zero)

$$G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$$

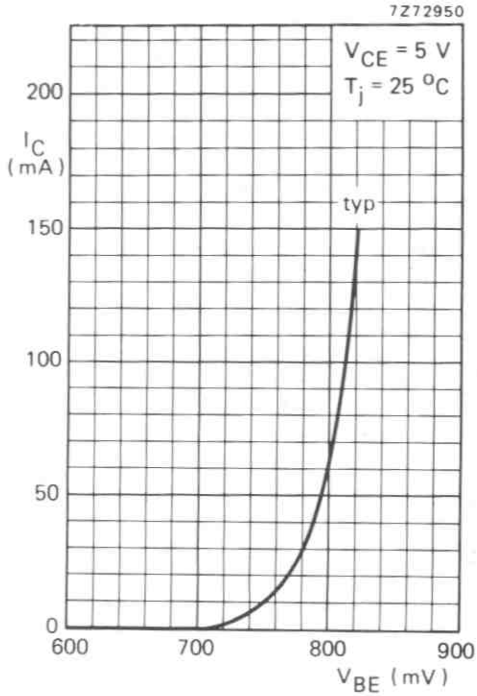
$I_C = 60$ mA; $V_{CE} = 15$ V; $T_{amb} = 25$ °C			
f = 200 MHz	G_{UM}	typ.	16 dB
f = 800 MHz	G_{UM}	typ.	6.5 dB

* Measured under pulse conditions.



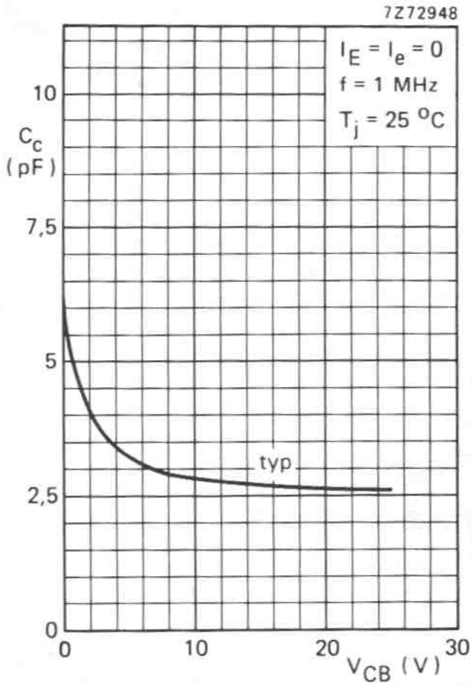
DC current gain as a function of collector current

Fig.1; V_{CE} = 5 V; T_j = 25 °C; typical values.



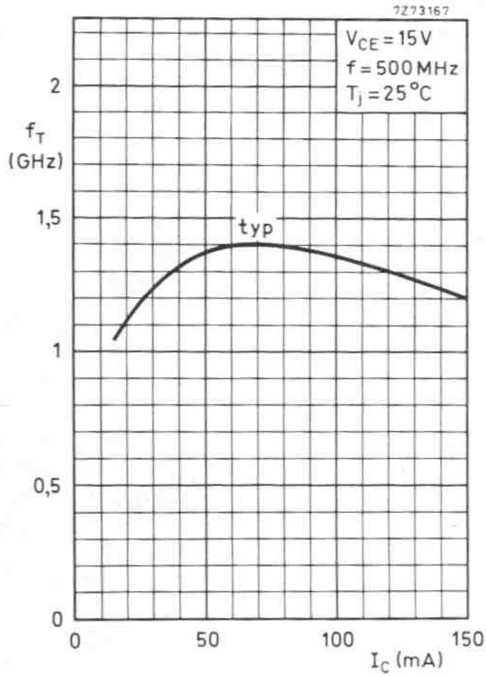
Collector current as a function of base-emitter voltage.

Fig.2; V_{CE} = 5 V; T_j = 25 °C; typical values.



Collector capacitance as a function of collector-base voltage.

Fig.3; $I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C; typical values.



Transition frequency as a function of collector current.

Fig.4; V_{CE} = 15 V; f = 500 MHz; T_j = 25 °C; typical values.

NPN 3 GHz WIDEBAND TRANSISTOR

NPN transistor in a plastic SOT89 envelope intended for application in thick and thin-film circuits. It is primarily intended for MATV purposes.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	25	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	V
Collector current (DC)	I_C	max.	150	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1	W
Junction temperature	T_j	max.	175	°C
Transition frequency at f = 500 MHz I_C = 100 mA; V_{CE} = 10 V	f_T	typ.	3.6	GHz
Feedback capacitance at f = 10.7 MHz I_C = 0; V_{CE} = 10 V	C_{re}	typ.	1.2	pF
Intermodulation distortion I_C = 80 mA; V_{CE} = 10 V; R_L = 75 Ω measured at $f_{(p+q-r)}$ = 793.25 MHz	d_{im}	max.	−60	dB

MECHANICAL DATA

SOT89

See also soldering recommendations.

Marking code

BFQ18A = FF

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	25	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	V
Emitter-base voltage (open collector)	V_{EBO}	max.	2	V
Collector current (DC)	I_C	max.	150	mA
Total power dissipation up to T_{amb} = 25 °C (note 1)	P_{tot}	max.	1	W
Storage temperature range	T_{stg}	−65 to + 150		°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to collector tab	$R_{th\ j\text{-}tab}$	=	25	K/W
From junction to ambient in free air (note 1)	$R_{th\ j\text{-}a}$	=	125	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

DC current gain (note 2)				
I_C = 50 mA; V_{CE} = 10 V	h_{FE}	min.	25	
I_C = 100 mA; V_{CE} = 10 V	h_{FE}	min.	25	
Transition frequency at f = 500 MHz (note 2)				
I_C = 50 mA; V_{CE} = 10 V	f_T	typ.	3.2	GHz
I_C = 100 mA; V_{CE} = 10 V	f_T	typ.	3.6	GHz
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; V_{CB} = 10 V	C_c	typ.	2.0	pF
Emitter capacitance at f = 1 MHz				
$I_C = I_c = 0$; V_{EB} = 0.5 V	C_e	typ.	11	pF
Feedback capacitance at f = 10.7 MHz				
$I_C = 0$; V_{CE} = 10 V	C_{re}	typ.	1.2	pF

Notes

1. The device mounted on a ceramic substrate area = 2.5 cm^2; thickness = 0.7 mm.
2. Measured under pulse conditions.

Intermodulation distortion (see Fig. 1)

I_C = 80 mA; V_{CE} = 10 V; R_L = 75 Ω
$V_p = V_o$ = 700 mV at f_p = 795.25 MHz
$V_q = V_o$ −6 dB at f_q = 803.25 MHz
$V_r = V_o$ −6 dB at f_r = 805.25 MHz
Measured at $f_{(p+q-r)}$ = 793.25 MHz — d_{im} max. −60 dB

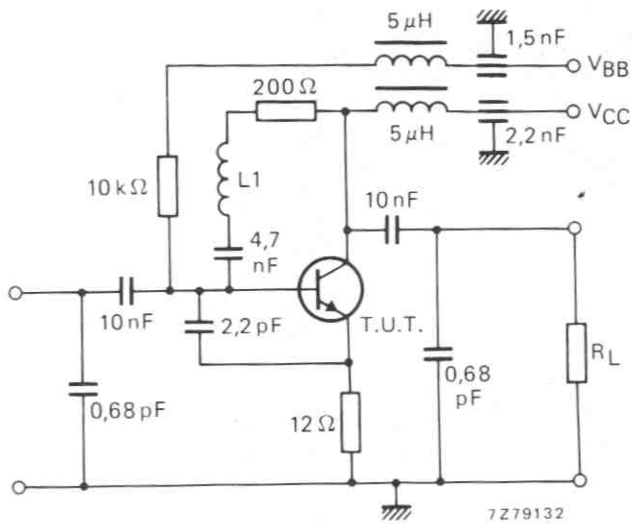


Fig.1 MATV test circuit (40–860 MHz).

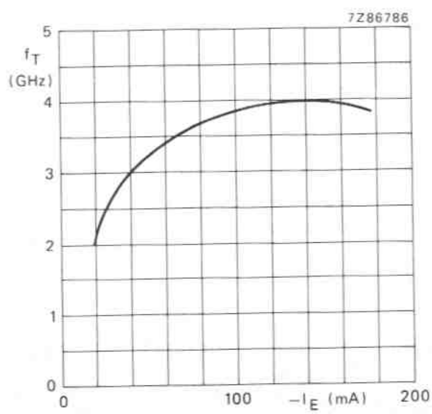


Fig.2 Transition frequency as a function of emitter current.

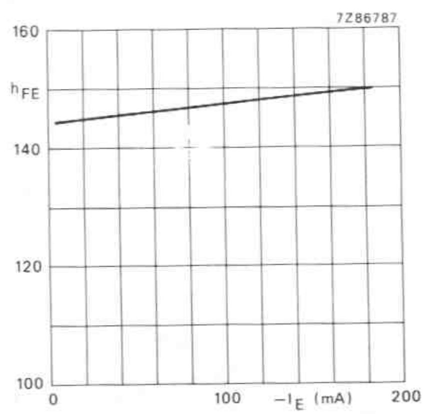


Fig.3 DC current gain as a function of emitter current.

NPN 5 GHz WIDEBAND TRANSISTOR

NPN transistor in a SOT89 plastic envelope intended for application in thick- and thin-film circuits. It is primarily intended for use in UHF and microwave amplifiers such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analysers etc.
The transistor features very low intermodulation distortion and high power gain. Thanks to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	20	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	V
Collector current (DC)	I_C	max.	75	mA
Total power dissipation up to T_{amb} = 87.5 °C	P_{tot}	max.	500	mW
Junction temperature	T_j	max.	175	°C
Transition frequency at f = 500 MHz I_C = 50 mA; V_{CE} = 10 V	f_T	typ.	5	GHz
Feedback capacitance at f = 1 MHz I_C = 10 mA; V_{CE} = 10 V	C_{re}	typ.	1.3	pF
Noise figure at optimum source imperance I_C = 50 mA; V_{CE} = 10 V; f = 500 MHz	F	typ.	3.3	dB

MECHANICAL DATA

SOT89

See also *Soldering recommendations.*

Marking code

BFQ19 = FB

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	20	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	V
Emitter-base voltage (open collector)	V_{EBO}	max.	3.3	V
Collector current (DC)	I_C	max.	75	mA
Collector current (peak value); $f > 1$ MHz	I_{CM}	max.	150	mA
Total power dissipation up to T_{amb} = 87.5 °C mounted on a ceramic substrate area = 2.5 cm^2; thickness = 0.7 mm	P_{tot}	max.	500	mW
Storage temperature	T_{stg}	−65 to + 150		°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to collector tab	$R_{th\ j\text{-}tab}$	=	40	K/W
From junction to ambient in free air mounted on a ceramic substrate area = 2.5 cm^2; thickness = 0.7 mm	$R_{th\ j\text{-}a}$	=	125	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0$; $V_{CB} = 10$ V	I_{CBO}	max.	100 nA
DC current gain (see note)			
$I_C = 50$ mA; $V_{CE} = 10$ V	h_{FE}	min.	25
		typ.	50
$I_C = 75$ mA; $V_{CE} = 10$ V	h_{FE}	min.	25
		typ.	52
Transition frequency at f = 500 MHz (see note)			
$I_C = 50$ mA; $V_{CE} = 10$ V	f_T	min.	4.0 GHz
		typ.	5.0 GHz
$I_C = 75$ mA; $V_{CE} = 10$ V	f_T	min.	4.4 GHz
		typ.	5.5 GHz
Collector capacitance at f = 1 MHz			
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	1.6 pF
Emitter capacitance at f = 1 MHz			
$I_C = I_c = 0$; $V_{EB} = 0.5$ V	C_e	typ.	5.0 pF
Feedback capacitance at f = 1 MHz			
$I_C = 10$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C	C_{re}	typ.	1.3 pF
Noise figure at optimum source impedance			
$I_C = 50$ mA; $V_{CE} = 10$ V; f = 500 MHz; $T_{amb} = 25$ °C	F	typ.	3.3 dB

Maximum unilateral power gain (S_{12} assumed to be zero)

$$G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$$

$I_C = 50$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C			
f = 200 MHz	G_{UM}	typ.	18.5 dB
f = 500 MHz	G_{UM}	typ.	11.5 dB
f = 800 MHz	G_{UM}	typ.	7.5 dB

Note: measured under pulse conditions.

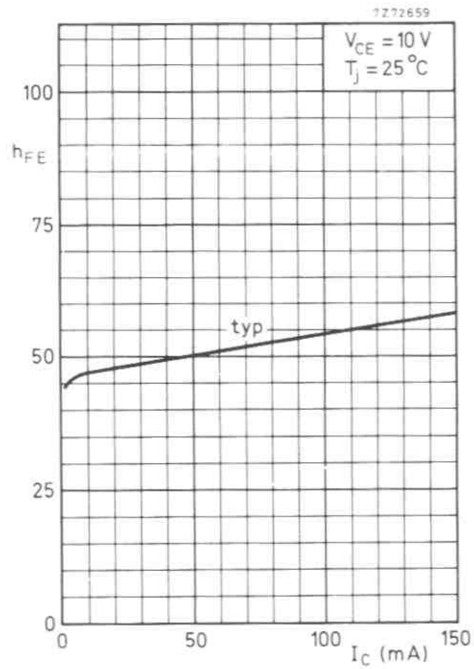


Fig.1 DC current gain as a function of collector current.

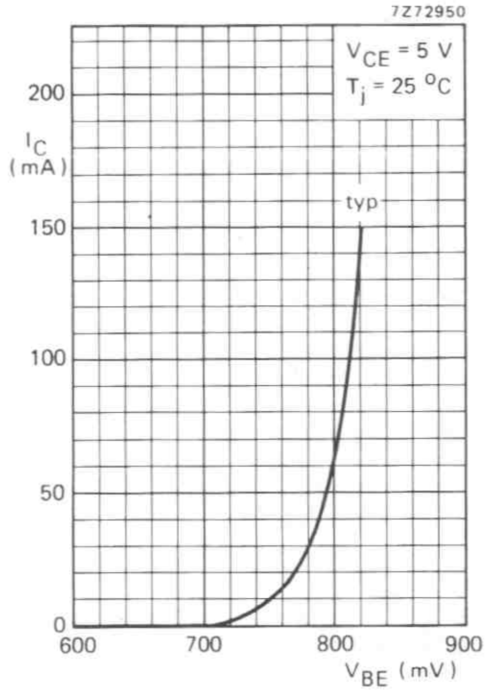


Fig.2 Collector current as a function of base-emitter voltage.

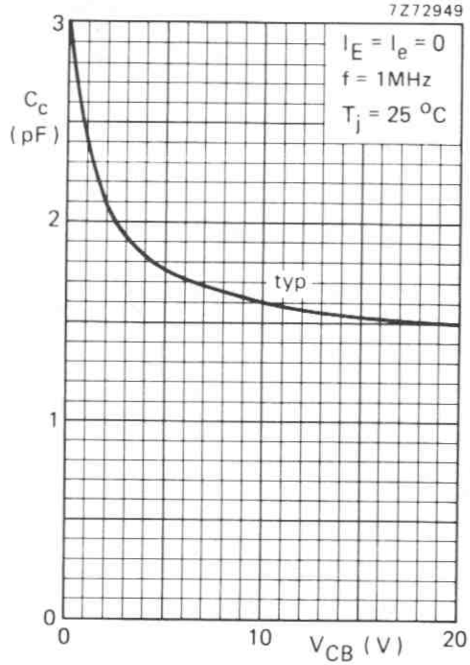


Fig.3 Collector capacitance as a function of collector-base voltage.

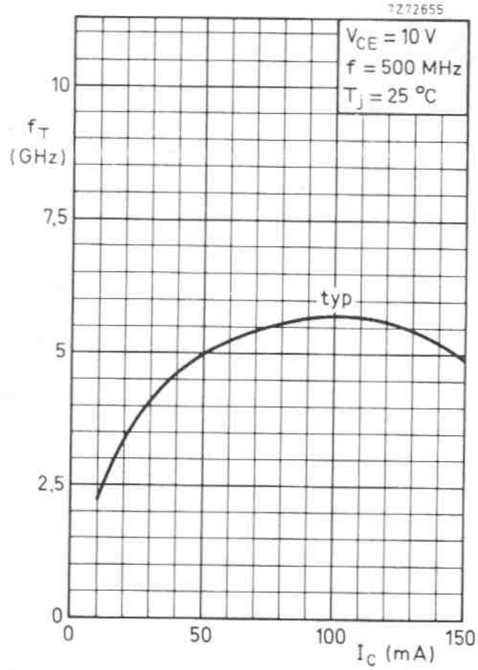


Fig.4 Transition frequency as a function of collector current.

N-P-N 7.5 GHz WIDEBAND TRANSISTOR

N-P-N transistor in a plastic SOT-23 envelope. It is designed for wideband application in the GHz range, such as satellite TV systems (SATV) and repeater amplifiers in fibre-optical systems. The device features a very high transition frequency and a very low noise figure up to high frequencies.

QUICK REFERENCE DATA

Collector-base voltage, open emitter	V_{CBO}	max.	20	V
Collector-emitter voltage, open base	V_{CEO}	max.	10	V
Collector current (d.c.)	I_C	max.	50	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Junction temperature	T_j	max.	150	°C
D.C. current gain I_C = 15 mA; V_{CB} = 5 V	h_{FE}	typ.	100	
Transition frequency at f = 500 MHz I_C = 15 mA; V_{CE} = 8 V	f_T	typ.	7,5	GHz
Maximum unilateral power gain at f = 2 GHz I_C = 15 mA; V_{CE} = 8 V	G_{UM}	typ.	8,0	dB

MECHANICAL DATA

Dimensions in mm

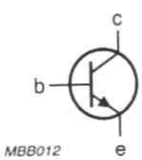
Fig. 1 SOT-23.

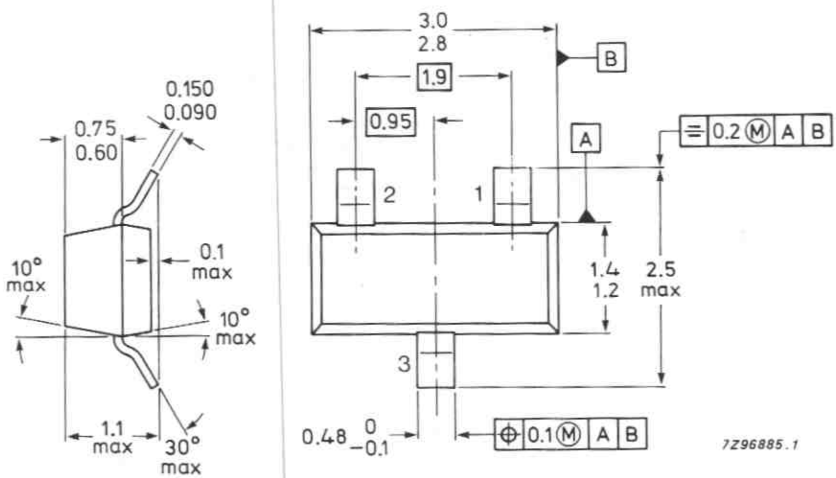
Marking code

$BFQ67 = V2_p$

Pinning

1 = base
2 = emitter
3 = collector





TOP VIEW

If required, the R-version (reverse pinning) is available on request.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	20 V
Collector-emitter voltage (open base)	V_{CEO}	max.	10 V
Emitter-base voltage (open collector)	V_{EBO}	max.	2,5 V
Collector current (d.c.)	I_C	max.	50 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300 mW
Storage temperature	T_{stg}	−65 to + 150 °C	
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient in free air*	$R_{th\,j\text{-}a}$	=	430 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current $I_E = 0$; V_{CB} = 5 V	I_{CBO}	max.	50 nA
D.C. current gain I_C = 15 mA; V_{CB} = 5 V	h_{FE}	typ.	100
Transition frequency at f = 500 mHz I_C = 15 mA; V_{CE} = 8 V	f_T	typ.	7,5 GHz
Collector capacitance at f = 1 MHz $I_E = i_e = 0$; V_{CB} = 8 V	C_c	typ.	0,7 pF
Emitter capacitance at f = 1 MHz $I_C = i_c = 0$; V_{EB} = 0,5 V	C_e	typ.	1,3 pF
Feedback capacitance at f = 1 MHz $I_C = 0$; V_{CE} = 8 V	C_{re}	typ.	0,5 pF

Maximum unilateral power gain (s_{12} assumed to be zero)

$$G_{UM} = 10 \log \frac{|s_{21}|^2}{[1-|s_{11}|^2]\,[1-|s_{22}|^2]}$$

I_C = 15 mA; V_{CE} = 8 V; f = 2 GHz; T_{amb} = 25 °C	G_{UM}	typ.	8,0 dB
Noise figure at f = 2 GHz; Z_S = 60 Ω; T_{amb} = 25 °C			
I_C = 5 mA; V_{CE} = 8 V	F	typ.	2,5 dB
I_C = 15 mA; V_{CE} = 8 V	F	typ.	3,0 dB
Noise figure at f = 800 MHz; Z_S = optimum; T_{amb} = 25 °C			
I_C = 5 mA; V_{CE} = 8 V	F	typ.	0.8 dB
I_C = 15 mA; V_{CE} = 8 V	F	typ.	1.5 dB

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

s-parameters (common emitter) at V_{CE} = 8 V; typical values.

I_C mA	f MHz	s_{11}	s_{21}	s_{12}	s_{22}	G_{UM} dB
2	40	0,93/ −9,5°	7,07/174,6°	0,01/83,2°	1,00/ −4,5°	46,7
	100	0,90/ −22,8°	6,96/163,5°	0,03/76,3°	0,97/−10,4°	36,4
	200	0,84/ −42,1°	6,35/150,4°	0,06/66,4°	0,91/−17,9°	29,2
	500	0,61/ −90,7°	4,40/117,2°	0,10/45,7°	0,67/−32,6°	17,5
	800	0,55/−118,0°	3,24/102,6°	0,12/42,2°	0,60/−38,2°	13,7
	1000	0,54/−135,5°	2,78/ 93,5°	0,12/41,2°	0,55/−43,6°	11,9
	2000	0,47/ 177,3°	1,57/ 64,5°	0,15/60,0°	0,47/−65,3°	6,1
5	40	0,84/ −14,9°	15,47/170,5°	0,01/80,7°	0,99/ −7,9°	44,5
	100	0,78/ −36,1°	14,35/154,8°	0,03/71,1°	0,92/−18,0°	35,4
	200	0,68/ −63,3°	11,97/137,7°	0,05/60,6°	0,79/−29,0°	28,5
	500	0,45/−119,8°	6,74/106,1°	0,08/49,7°	0,47/−40,1°	18,6
	800	0,42/−143,5°	4,55/ 94,7°	0,09/53,8°	0,41/−41,5°	14,8
	1000	0,43/−155,4°	3,80/ 87,4°	0,10/56,1°	0,37/−46,7°	13,1
	2000	0,35/ 169,2°	2,04/ 63,5°	0,18/69,4°	0,34/−63,3°	7,3
10	40	0,74/ −22,8°	25,66/165,6°	0,01/77,5°	0,96/−12,1°	43,0
	100	0,65/ −51,2°	22,19/145,5°	0,03/66,8°	0,84/−26,3°	34,6
	200	0,53/ −85,2°	16,35/126,4°	0,04/58,1°	0,64/−38,4°	28,0
	500	0,38/−144,4°	8,01/ 99,5°	0,06/58,0°	0,33/−42,8°	19,2
	800	0,36/−161,9°	5,29/ 90,0°	0,09/64,0°	0,30/−41,2°	15,5
	1000	0,38/ 169,9°	4,27/ 84,0°	0,10/66,0°	0,27/−47,0°	13,6
	2000	0,30/ 160,0°	2,29/ 62,8°	0,20/72,6°	0,27/−61,2°	7,9
15	40	0,67/ −28,3°	32,67/162,1°	0,01/75,8°	0,94/−14,9°	42,5
	100	0,57/ −62,8°	26,66/139,6°	0,02/64,6°	0,78/−31,4°	34,2
	200	0,46/ −99,5°	18,35/120,6°	0,04/58,7°	0,56/−42,8°	27,9
	500	0,36/−154,8°	8,49/ 96,8°	0,06/62,9°	0,27/−42,8°	19,5
	800	0,34/ 169,3°	5,55/ 88,4°	0,09/68,4°	0,26/−39,7°	15,7
	1000	0,36/ 176,8°	4,47/ 82,5°	0,10/69,7°	0,23/−46,3°	13,9
	2000	0,29/ 155,7°	2,37/ 62,3°	0,21/73,4°	0,25/−59,8°	8,2
20	40	0,63/ −32,5°	37,50/159,4°	0,01/74,2°	0,93/−17,2°	42,0
	100	0,52/ −70,8°	29,23/135,5°	0,02/63,4°	0,73/−34,7°	34,0
	200	0,42/−108,8°	19,22/117,4°	0,03/59,7°	0,50/−45,0°	27,8
	500	0,35/−162,0°	8,69/ 95,0°	0,06/64,9°	0,23/−41,6°	19,6
	800	0,33/−175,1°	5,62/ 86,9°	0,09/70,7°	0,24/−38,1°	15,7
	1000	0,36/−178,7°	4,57/ 81,7°	0,10/71,6°	0,21/−45,0°	14,0
	2000	0,28/−153,5°	2,40/ 62,0°	0,21/73,8°	0,24/−58,9°	8,2

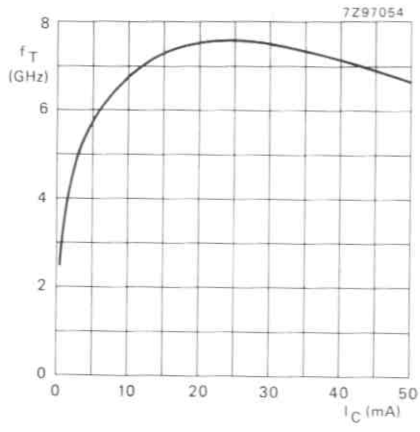


Fig. 2 $V_{CE} = 8$ V; f = 500 MHz; typical values.

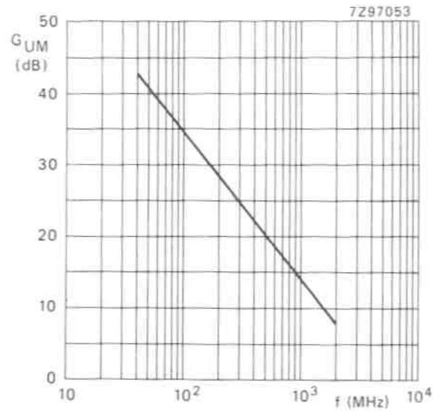


Fig. 3 $V_{CE} = 8$ V; $I_C = 15$ mA; $T_{amb} = 25\ ^oC$; typical values.

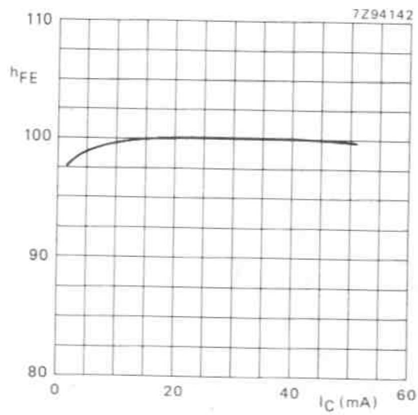


Fig.4 DC current gain as a function of collector current.

SILICON PLANAR EPITAXIAL TRANSISTOR

The BFQ149 is a PNP transistor in a SOT89 envelope, containing a BFQ32 crystal. The transistor is intended for use in UHF applications such as broadband aerial amplifiers (30 MHz to 860 MHz) and in microwave amplifiers such as radar systems, spectrum analyzers etc. using SMD technology.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	20 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	15 V
Collector current (DC)	$-I_C$	max.	75 mA
Total power dissipation up to T_{amb} = 25 °C mounted on a ceramic substrate, area 2.5 cm², thickness = 0.7 mm	P_{tot}	max.	1 W
Junction temperature	T_j	max.	150 °C
DC current gain			
$-I_C$ = 50 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	20
$-I_C$ = 75 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	20
Transition frequency at f = 500 MHz			
$-I_C$ = 50 mA; $-V_{CE}$ = 10 V	f_T	min.	3.6 GHz
		typ.	4.2 GHz
$-I_C$ = 75 mA; $-V_{CE}$ = 10 V	f_T	min.	4.0 GHz
		typ.	4.6 GHz
Noise figure at f = 500 MHz, R_s = 60 Ω			
$-I_C$ = 50 mA; $-V_{CE}$ = 10 V; T_{amb} = 25 °C	F	typ.	3.75 dB
Maximum unilateral power gain at f = 500 MHz			
$-I_C$ = 50 mA; $-V_{CE}$ = 10 V; T_{amb} = 25 °C	G_{um}	typ.	12 dB

MECHANICAL DATA

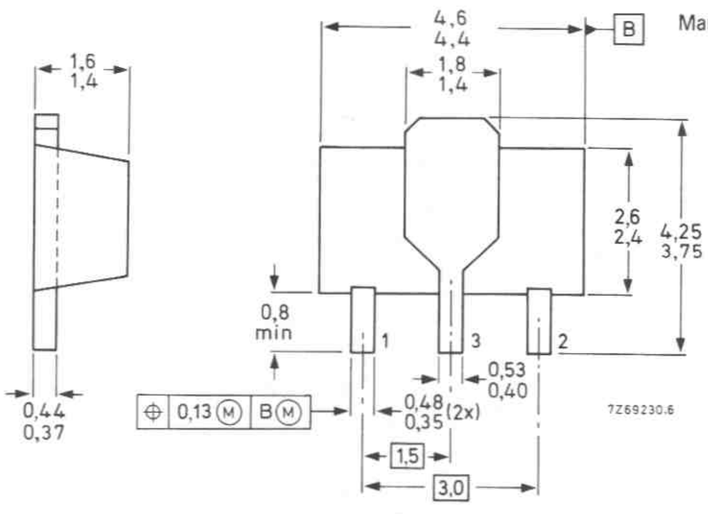
Dimensions in mm

Fig.1 SOT89.

Marking code: FG

Pinning

1 = emitter
2 = base
3 = collector



BOTTOM VIEW

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134).

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	20 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	15 V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	3.0 V
Collector current (DC)	$-I_C$	max.	75 mA
Collector current (peak value); f > 1 MHz	$-I_{CM}$	max.	150 mA
Total power dissipation up to T_{amb} = 25 °C mounted on a ceramic substrate, area = 2.5 cm^2, thickness = 0.7 mm	P_{tot}	max.	1 W
Storage temperature range	T_{stg}		–65 to 150 °C
Junction temperature	T_j	max.	175 °C

THERMAL RESISTANCE

From junction to ambient mounted on a ceramic substrate, area = 2.5 cm^2, thickness = 0.7 mm	$R_{th\,j-a}$		125 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

Collector cut off current			
$I_E = 0$, $-V_{CB} = 10$ V	I_{CBO}	max.	100 nA
DC current gain			
$-I_C = 50$ mA; $-V_{CE} = 10$ V	h_{FE}	min.	20
$-I_C = 75$ mA; $-V_{CE} = 10$ V	h_{FE}	min.	20
Transition frequency at f = 500 MHz			
$-I_C = 50$ mA; $-V_{CE} = 10$ V; $T_{amb} = 25$ °C	f_T	min.	3.6 GHz
		typ.	4.2 GHz
$-I_C = 75$ mA; $-V_{CE} = 10$ V; $T_{amb} = 25$ °C	f_T	min.	4.0 GHz
		typ.	4.6 GHz
Collector capacitance			
$-V_{CB} = 10$ V; $I_E = 0$; f = 1 MHz	C_c	typ.	2.0 pF
Emitter capacitance			
$-V_{EB} = 0.5$ V; $I_C = 0$; f = 1 MHz	C_e	typ.	4.0 pF
Feedback capacitance			
$-V_{CE} = 10$ V; $I_C = 0$; f = 1 MHz	C_{re}	typ.	1.7 pF
Noise figure at f = 500 MHz; $R_s = 60\ \Omega$			
$-V_{CE} = 10$ V; $-I_C = 50$ mA; $T_{amb} = 25$ °C	F	typ.	3.75 dB
Maximum unilateral power gain (S_{12} assumed to be zero)			
$-V_{CE} = 10$ V; $-I_C = 50$ mA; f = 500 MHz; $T_{amb} = 25$ °C			
$G_{UM} = 10 \log \frac{\lvert S_{21}\rvert^2}{(1-\lvert S_{11}\rvert^2)(1-\lvert S_{22}\rvert^2)}$	G_{UM}	typ.	12 dB

Table 1 S-parameters (common emitter) at V_{CE} = 10 V; typical values.

I_C mA	f MHz	S_{11} M(X)/ANG.	S_{21} M(X)/ANG.	S_{12} M(X)/ANG.	S_{22} M(X)/ANG.	G_{UM} dB
10	40	0.42/−56.8	18.15/153.9	0.02/71.9	0.90/−21.2	33.3
	100	0.48/−115.9	12.21/123.6	0.04/56.5	0.64/−44.0	25.1
	200	0.49/−151.0	6.99/103.3	0.06/55.7	0.40/−53.0	18.8
	500	0.51/−176.5	2.99/78.0	0.11/63.6	0.27/−62.6	11.1
	800	0.52/159.3	1.98/63.7	0.17/66.1	0.27/−70.6	7.6
	1000	0.54/149.0	1.60/55.6	0.20/66.2	0.27/−76.0	5.9
	1200	0.57/137.7	1.37/50.3	0.24/66.7	0.27/−82.1	4.7
	1500	0.53/129.6	1.17/40.7	0.30/63.2	0.30/−89.4	3.2
	2000	0.56/104.4	0.96/31.2	0.41/58.9	0.31/−104.4	1.7
20	40	0.29/−88.4	24.14/148.1	0.02/70.4	0.84/−28.7	33.4
	100	0.43/−139.9	14.51/117.6	0.03/61.0	0.52/−54.8	25.5
	200	0.46/−164.5	7.95/99.7	0.05/65.6	0.31/−64.8	19.5
	500	0.49/170.8	3.31/77.5	0.12/70.0	0.20/−79.5	11.7
	800	0.50/155.9	2.18/64.4	0.18/68.6	0.20/−85.6	8.2
	1000	0.51/146.2	1.77/57.0	0.22/67.1	0.20/−91.5	6.5
	1200	0.54/135.0	1.51/52.1	0.26/66.3	0.20/−95.1	5.3
	1500	0.50/128.5	1.30/42.2	0.32/61.3	0.24/−100.2	3.8
	2000	0.52/103.8	1.08/32.3	0.42/56.1	0.25/−112.2	2.3
30	40	0.27/−111.5	27.56/144.5	0.02/69.9	0.79/−33.3	33.5
	100	0.43/−151.5	15.55/114.5	0.03/64.3	0.46/−60.8	25.8
	200	0.46/−170.6	8.30/97.8	0.05/70.2	0.26/−71.5	19.7
	500	0.48/168.5	3.42/77.0	0.12/72.0	0.17/−89.8	11.9
	800	0.49/154.4	2.25/64.4	0.19/69.6	0.18/−94.2	8.4
	1000	0.51/145.0	1.82/57.3	0.22/67.3	0.18/13.1	6.7
	1200	0.53/133.0	1.56/52.4	0.27/66.1	0.17/−103.9	5.5
	1500	0.49/128.0	1.34/42.7	0.33/60.7	0.22/−106.9	4.0
	2000	0.50/103.4	1.11/32.6	0.43/55.0	0.23/−117.2	2.4
50	40	0.29/−134.0	30.36/140.3	0.02/68.9	0.73/−38.2	33.3
	100	0.44/−161.4	16.10/111.3	0.03/69.8	0.40/−66.3	25.8
	200	0.46/−175.9	8.44/95.8	0.05/74.5	0.22/−77.6	19.8
	500	0.48/166.6	3.44/76.4	0.12/73.9	0.16/−98.7	12.0
	800	0.49/153.2	2.27/64.0	0.19/70.2	0.17/−101.6	8.4
	1000	0.51/144.2	1.84/57.0	0.23/67.7	0.17/−107.5	6.7
	1200	0.54/133.2	1.58/52.3	0.27/66.3	0.16/−111.6	5.5
	1500	0.49/127.5	1.36/42.5	0.34/60.2	0.21/−112.3	4.0
	2000	0.50/103.1	1.12/32.5	0.43/54.5	0.22/−121.6	2.5
70	40	0.32/−144.1	31.28/137.7	0.02/69.0	0.68/−40.8	33.0
	100	0.46/−165.9	15.91/109.3	0.03/72.2	0.36/−68.2	25.6
	200	0.47/−178.2	8.24/94.5	0.05/75.9	0.20/−78.3	19.6
	500	0.49/165.8	3.35/75.7	0.12/74.6	0.15/−99.6	11.8
	800	0.50/152.8	2.21/63.2	0.19/70.6	0.17/−101.9	8.2
	1000	0.52/143.9	1.78/56.3	0.23/68.0	0.17/−107.6	6.5
	1200	0.54/133.0	1.53/51.6	0.27/66.6	0.16/−112.0	5.4
	1500	0.50/127.2	1.32/41.7	0.34/60.5	0.21/−122.9	3.9
	2000	0.52/102.9	1.09/32.0	0.44/54.7	0.23/−122.7	2.3

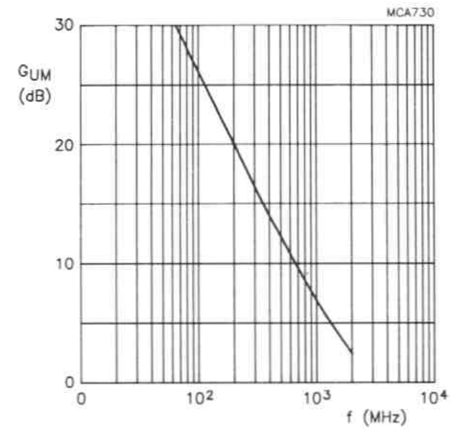


Fig.2 Maximum unilateral power gain as a function of frequency. $-V_{CE}$ = 10 V; I_C = 50 mA; T_{amb} = 25 °C.

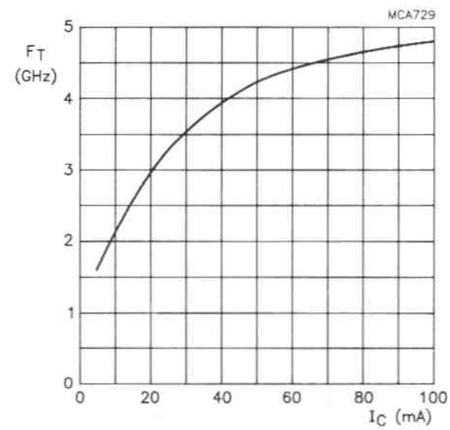


Fig.3 Transition frequency as a function of collector current. $-V_{CE}$ = 10 V; f = 500 MHz; T_j = 25 °C.

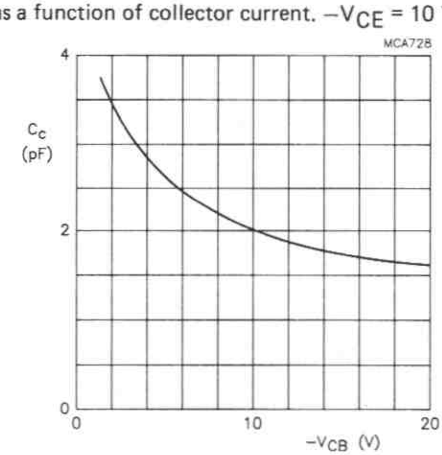


Fig.4 Collector capacitance as a function of collector base voltage. I_E = 0; f = 1 MHz; T_j = 25 °C.

N-CHANNEL SILICON FIELD-EFFECT TRANSISTORS

Planar epitaxial symmetrical junction field effect transistor in a microminiature plastic envelope. It is intended for low level general purpose amplifiers in thick and thin-film circuits.

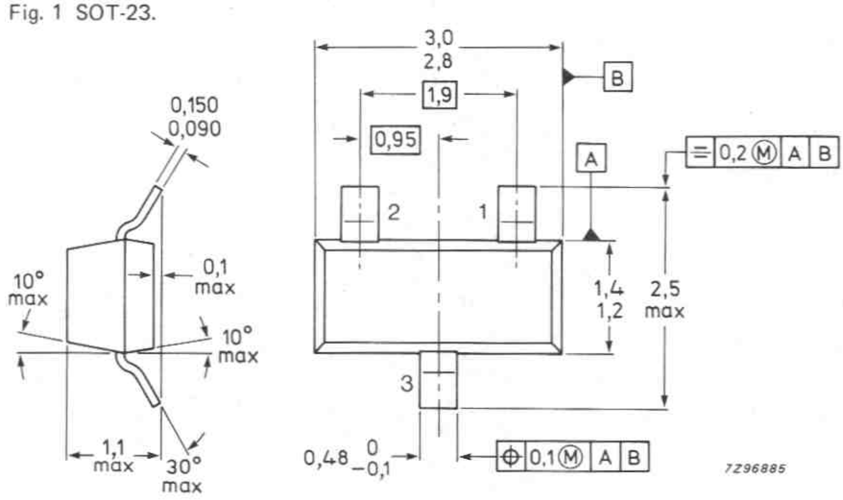
QUICK REFERENCE DATA

			BFR30	BFR31	
Drain-source voltage	$\pm V_{DS}$	max.	25		V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	25		V
Total power dissipation up to T_{amb} = 40 °C	P_{tot}	max.	250		mW
Drain current V_{DS} = 10 V; V_{GS} = 0	I_{DSS}	min.	4	1	mA
		max.	10	5	mA
Transfer admittance (common source) I_D = 1 mA; V_{DS} = 10 V; f = 1 kHz	$\lvert y_{fs} \rvert$	min.	1.0	1.5	mS
		max.	4.0	4.5	mS

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-23.



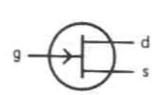
TOP VIEW

Marking code

BFR30 = M1p
BFR31 = M2p

Pinning

1 = drain
2 = source
3 = gate



Note: Drain and source are interchangeable.

See also *Soldering recommendations.*

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	$\pm V_{DS}$	max.	25	V
Drain-gate voltage (open source)	V_{DGO}	max.	25	V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	25	V
Drain current	I_D	max.	10	mA
Gate current	I_G	max.	5	mA
Total power dissipation up to T_{amb} = 40 °C*	P_{tot}	max.	250	mW
Storage temperature range	T_{stg}		−65 to + 150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	430	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BFR30	BFR31	
Gate cut-off current $-V_{GS}$ = 10 V; V_{DS} = 0	$-I_{GSS}$	max.	0.2	0.2	nA
Drain current V_{DS} = 10 V; V_{GS} = 0	I_{DSS}	min. max.	4 10	1 5	mA mA
Gate-source voltage I_D = 1 mA; V_{DS} = 10 V	$-V_{GS}$	min. max.	0.7 3.0	0 1.3	V V
I_D = 50 μA; V_{DS} = 10 V	$-V_{GS}$	max.	4.0	2.0	V
Gate-source cut-off voltage I_D = 0,5 nA; V_{DS} = 10 V	$-V_{(P)GS}$	max.	5	2.5	V
y parameters					
Transfer admittance at f = 1 kHz; T_{amb} = 25 °C I_D = 1 mA; V_{DS} = 10 V	$\|y_{fs}\|$	min. max.	1.0 4.0	1.5 4.5	mS mS
I_D = 200 μA; V_{DS} = 10 V	$\|y_{fs}\|$	min.	0.5	0.75	mS
Output admittance at f = 1 kHz I_D = 1 mA; V_{DS} = 10 V	$\|y_{os}\|$	max.	40	25	μS
I_D = 200 μA; V_{DS} = 10 V	$\|y_{os}\|$	max.	20	15	μS

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.

y parameters (continued)

			BFR30	BFR31	
Input capacitance at f = 1 MHz					
I_D = 1 mA; V_{DS} = 10 V	C_{is}	max.	4	4	pF
I_D = 200 μA; V_{DS} = 10 V	C_{is}	max.	4	4	pF
Feedback capacitance at f = 1 MHz; T_{amb} = 25 °C					
I_D = 1 mA; V_{DS} = 10 V	C_{rs}	max.	1.5	1.5	pF
I_D = 200 μA; V_{DS} = 10 V	C_{rs}	max.	1.5	1.5	pF
Equivalent noise voltage					
I_D = 200 μA; V_{DS} = 10 V B = 0.6 to 100 Hz	V_n	max.	0.5	0.5	μV

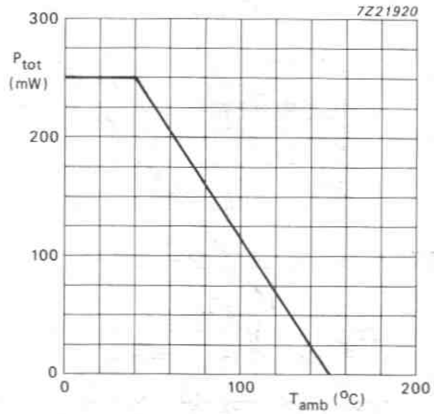


Fig.2 Power derating curve.

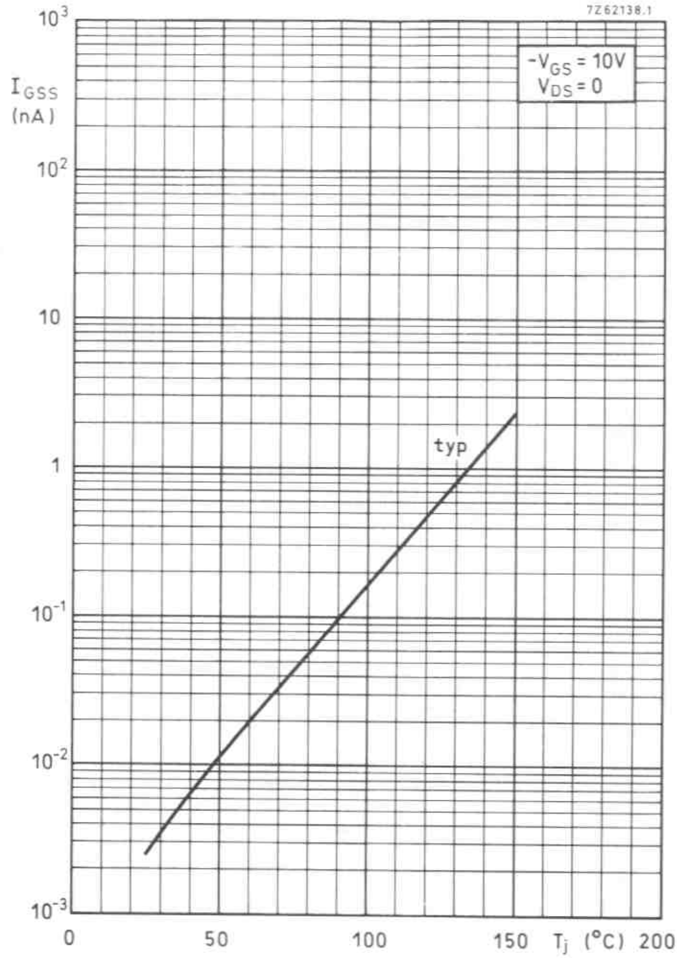

7Z62138.1
I_{GSS} (nA)
10^3
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
$-V_{GS} = 10V$
$V_{DS} = 0$
typ
0
50
100
150
T_j (°C)
200

Fig.3.

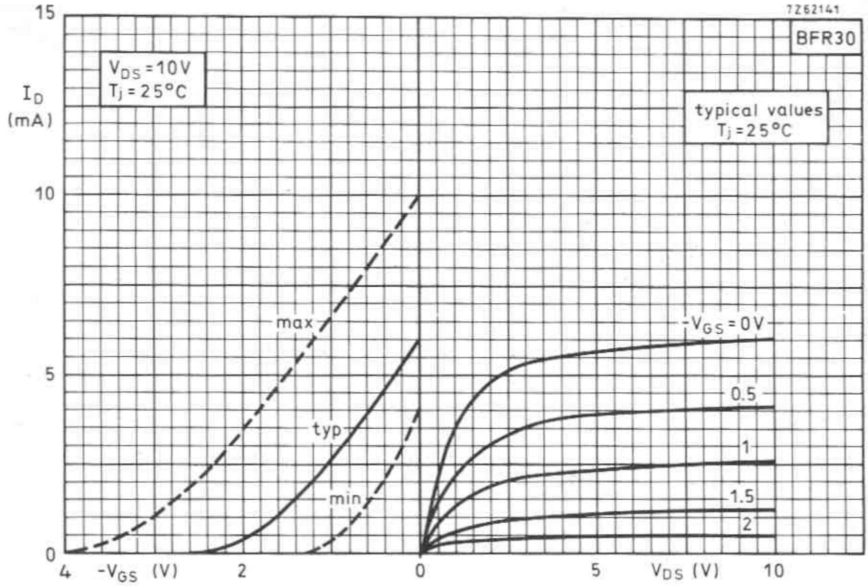

7Z62141
BFR30
V_{DS} = 10 V
T_j = 25 °C
I_D
(mA)
typical values
T_j = 25 °C
max
typ
min
$-V_{GS}$ = 0 V
0.5
1
1.5
2
15
10
5
0
4
$-V_{GS}$ (V)
2
0
5
V_{DS} (V)
10

Fig.4.

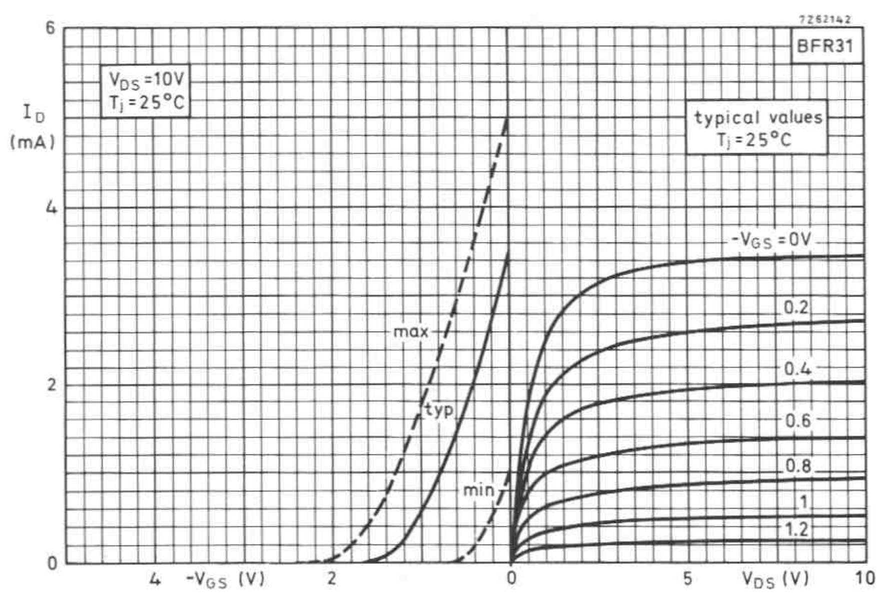

7Z62142
BFR31
V_{DS} = 10V
T_j = 25 °C
I_D
(mA)
typical values
T_j = 25 °C
max
typ
min
$-V_{GS}$ = 0V
0.2
0.4
0.6
0.8
1
1.2
6
4
2
0
4
$-V_{GS}$ (V)
2
0
5
V_{DS} (V)
10

Fig.5.

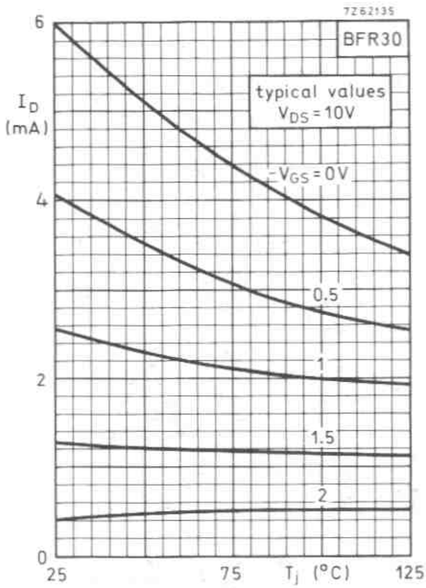


Fig.6.

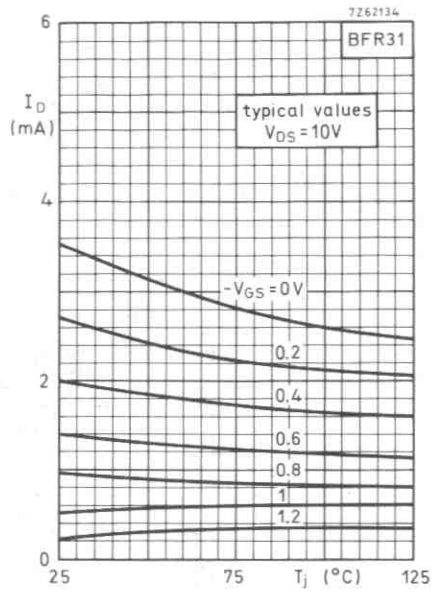


Fig.7.

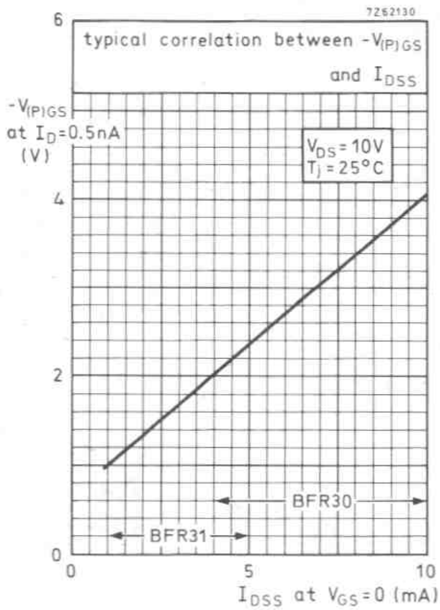


Fig.8.

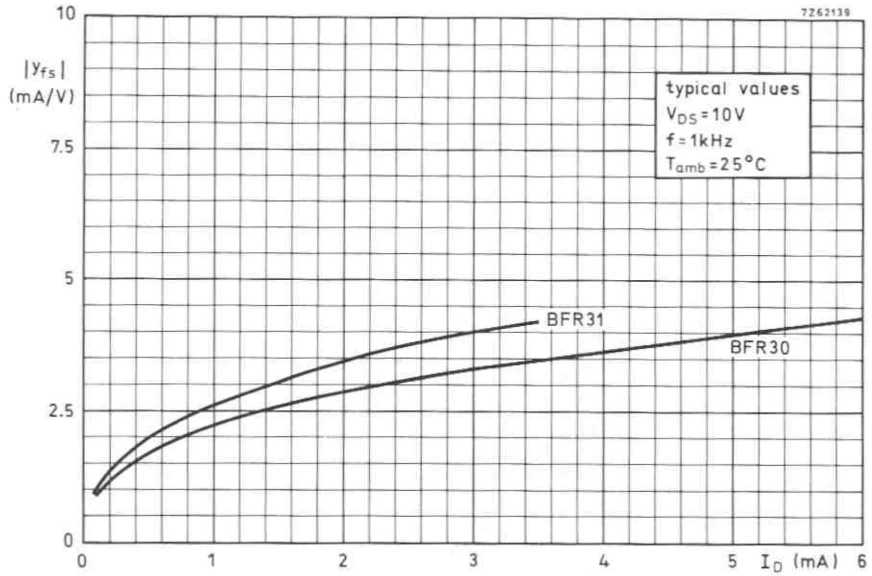

7Z62139
$|y_{fs}|$ (mA/V)
10
7.5
5
2.5
0
typical values
V_{DS} = 10 V
f = 1 kHz
T_{amb} = 25 °C
BFR31
BFR30
0
1
2
3
4
5
I_D (mA)
6

Fig.9.

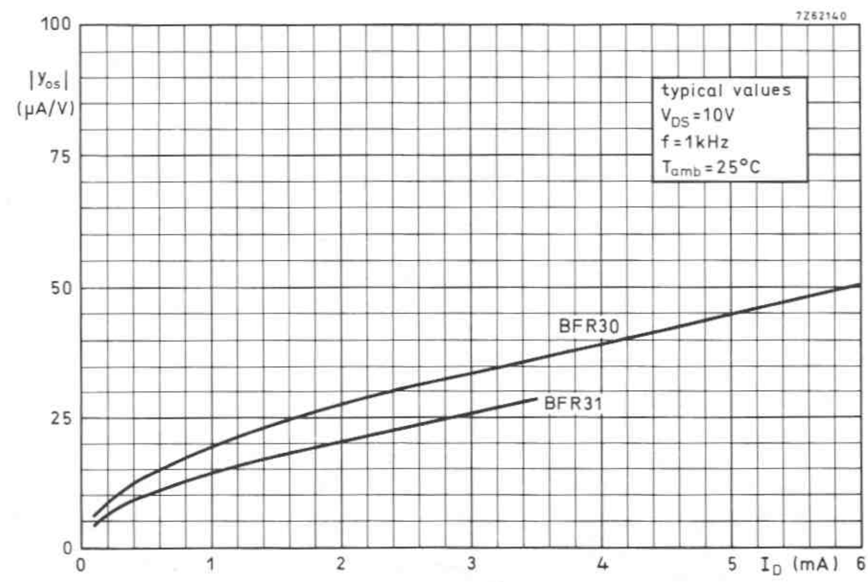

7Z62140
$|y_{os}|$ (μA/V)
100
75
50
25
0
typical values
V_{DS} = 10 V
f = 1 kHz
T_{amb} = 25 °C
BFR30
BFR31
0
1
2
3
4
5
I_D (mA)
6

Fig.10.

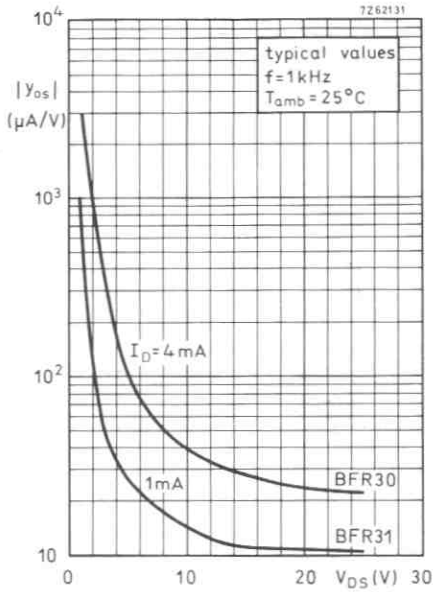


Fig.11.

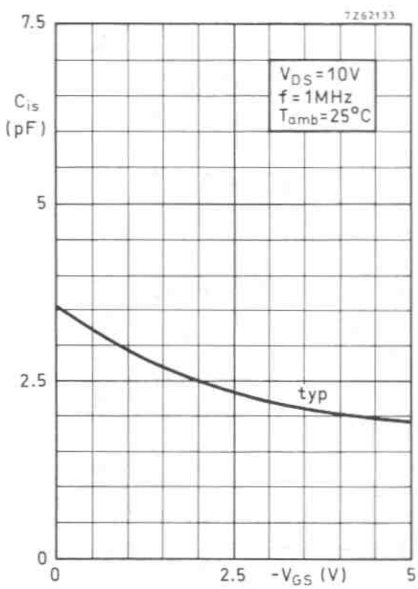


Fig.12.

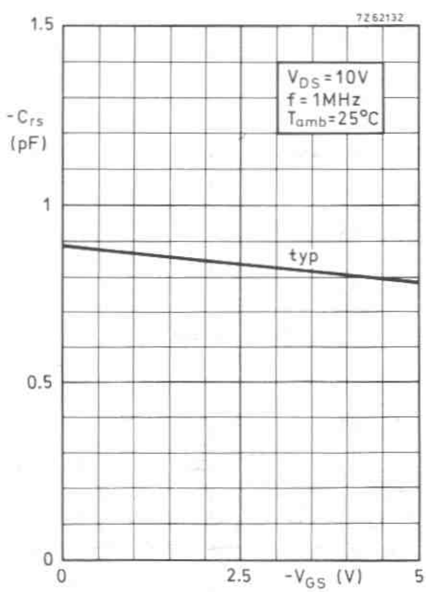


Fig.13.

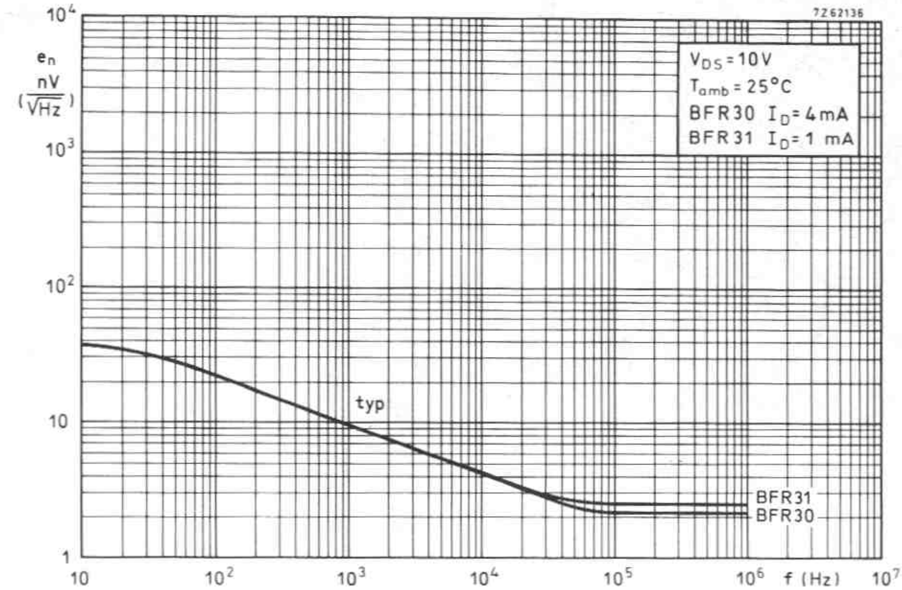

7Z62136
e_n
$(\frac{nV}{\sqrt{Hz}})$
10^4
10^3
10^2
10
1
V_{DS} = 10 V
T_{amb} = 25 °C
BFR30 I_D = 4 mA
BFR31 I_D = 1 mA
typ
BFR31
BFR30
10
10^2
10^3
10^4
10^5
10^6
f (Hz)
10^7

Fig. 14.

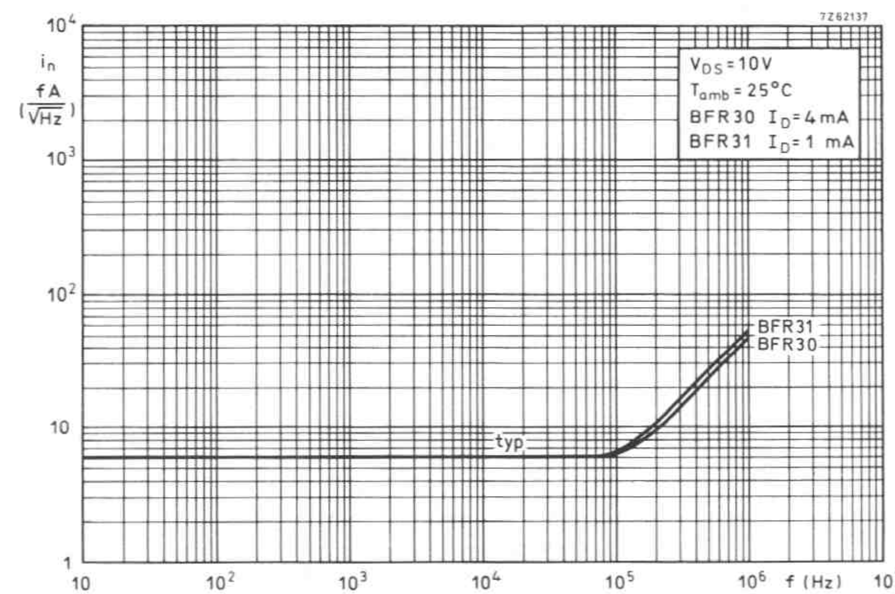

7Z62137
i_n
$(\frac{fA}{\sqrt{Hz}})$
10^4
10^3
10^2
10
1
V_{DS} = 10 V
T_{amb} = 25 °C
BFR30 I_D = 4 mA
BFR31 I_D = 1 mA
typ
BFR31
BFR30
10
10^2
10^3
10^4
10^5
10^6
f (Hz)
10^7

Fig. 15.

N-P-N 2 GHz WIDEBAND TRANSISTOR

N-P-N multi-emitter transistor in a plastic SOT-23 envelope intended for application in thick and thin-film circuits. The transistor has very low intermodulation distortion and very high power gain. It is primarily intended for:

- Wideband vertical amplifiers in high speed oscilloscopes.
- Television distribution amplifiers.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	18 V
Collector-emitter voltage (open base)	V_{CEO}	max.	10 V
Collector current (peak value; $f > 1$ MHz)	I_{CM}	max.	100 mA
Total power dissipation up to $T_{amb} = 25$ °C	P_{tot}	max.	300 mW
Junction temperature	T_j	max.	150 °C
Feedback capacitance at f = 1 MHz $I_C = 2$ mA; $V_{CE} = 5$ V	C_{re}	typ.	0,9 pF
Transition frequency at f = 500 MHz $I_C = 25$ mA; $V_{CE} = 5$ V	f_T	typ.	2,0 GHz
Max. unilateral power gain $I_C = 30$ mA; $V_{CE} = 5$ V; f = 200 MHz	G_{UM}	typ.	22 dB
$I_C = 30$ mA; $V_{CE} = 5$ V; f = 800 MHz	G_{UM}	typ.	10,5 dB
Intermodulation distortion at $T_{amb} = 25$ °C $I_C = 30$ mA; $V_{CE} = 5$ V; $R_L = 37{,}5\ \Omega$ $V_o = 100$ mV at $f_p = 183$ MHz $V_o = 100$ mV at $f_q = 200$ MHz measured at $f_{(2q-p)} = 217$ MHz	d_{im}	typ.	−60 dB

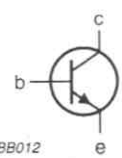
MECHANICAL DATA

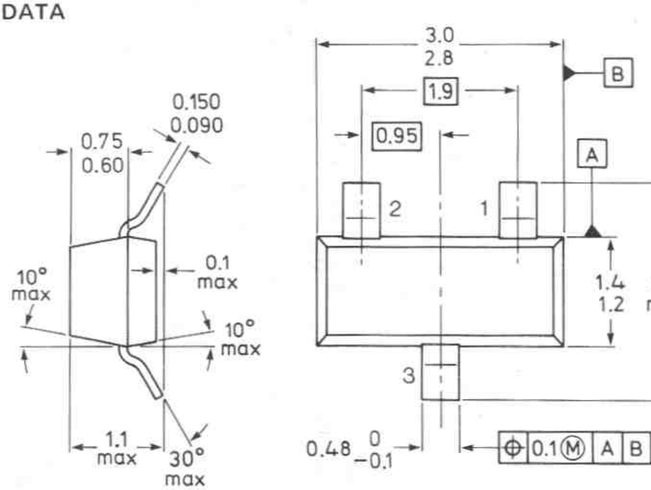
Dimensions in mm

Fig. 1 SOT-23.

Pinning

1 = base
2 = emitter
3 = collector





Marking code

BFR53 = N1

If required, the R-version (reverse pinning) is available on request.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	18 V
Collector-emitter voltage (open base)	V_{CEO}	max.	10 V
Emitter-base voltage (open collector)	V_{EBO}	max.	2,5 V
Collector current (d.c.)	I_C	max.	50 mA
Collector current (peak value: f > 1 MHz)	I_{CM}	max.	100 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300 mW
Storage temperature	T_{stg}	−65 to	+150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	430 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
I_E = 0; V_{CB} = 10 V	I_{CBO}	max.	50 nA
D.C. current gain			
I_C = 25 mA; V_{CE} = 5 V	h_{FE}	min.	25
I_C = 50 mA; V_{CE} = 5 V	h_{FE}	min.	25
Transition frequency at f = 500 MHz			
I_C = 25 mA; V_{CE} = 5 V	f_T	typ.	2,0 GHz
Collector capacitance at f = 1 MHz			
$I_E = I_e$ = 0; V_{CB} = 5 V	C_c	typ.	0,9 pF
Emitter capacitance at f = 1 MHz			
$I_C = I_c$ = 0; V_{EB} = 0,5 V	C_e	typ.	1,5 pF
Feedback capacitance at f = 1 MHz			
I_C = 2 mA; V_{CE} = 5 V; T_{amb} = 25 °C	C_{re}	typ.	0,9 pF

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

Noise figure at f = 500 MHz *

I_C = 2 mA; V_{CE} = 5 V; T_{amb} = 25 °C; G_S = 20 mS; B_S is tuned	F	max.	5,0 dB

Max. unilateral power gain (s_{12} assumed to be zero)

$$G_{UM} = 10 \log \frac{|s_{21}|^2}{[1-|s_{11}|^2]\,[1-|s_{22}|^2]}$$

I_C = 30 mA; V_{CE} = 5 V; f = 200 MHz; T_{amb} = 25 °C	G_{UM}	typ.	22 dB
I_C = 30 mA; V_{CE} = 5 V; f = 800 MHz; T_{amb} = 25 °C	G_{UM}	typ.	10,5 dB

Intermodulation distortion *

I_C = 30 mA; V_{CE} = 5 V; R_L = 37,5 Ω

V_o = 100 mV at f_p = 183 MHz

V_o = 100 mV at f_q = 200 MHz

measured at $f_{(2q-p)}$ = 217 MHz	d_{im}	typ.	−60 dB

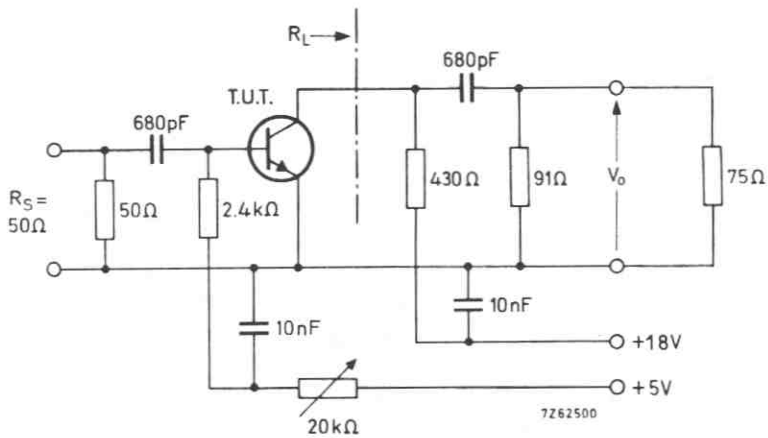


Fig. 2 Test circuit.

* Crystal moun ed in a BFW30 envelope.

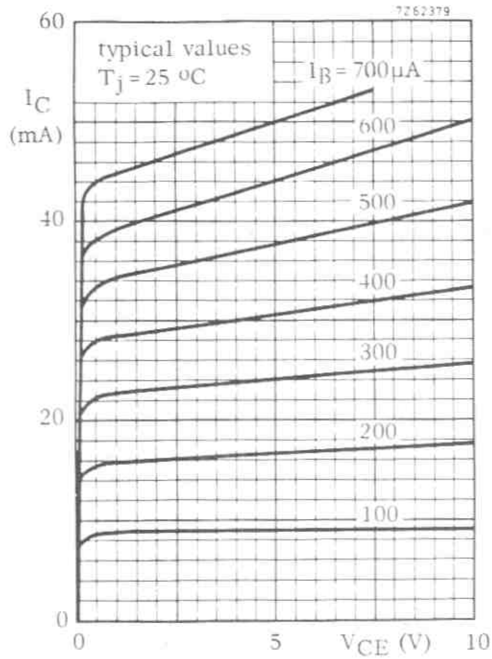


Fig. 3 T_j = 25 °C; typical values.

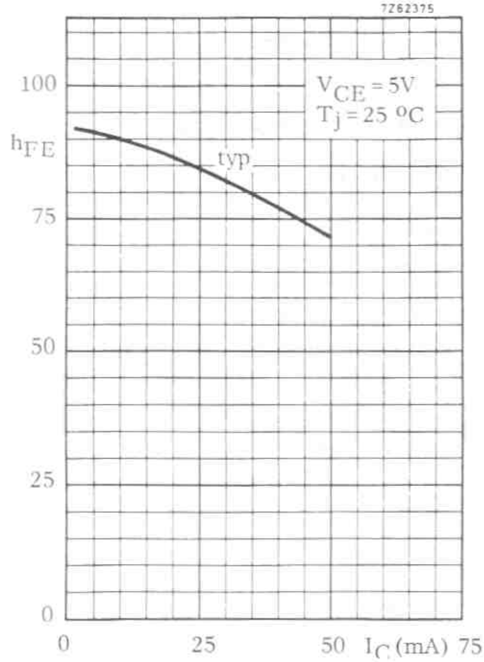


Fig. 4 V_{CE} = 5 V; T_j = 25 °C; typical values.

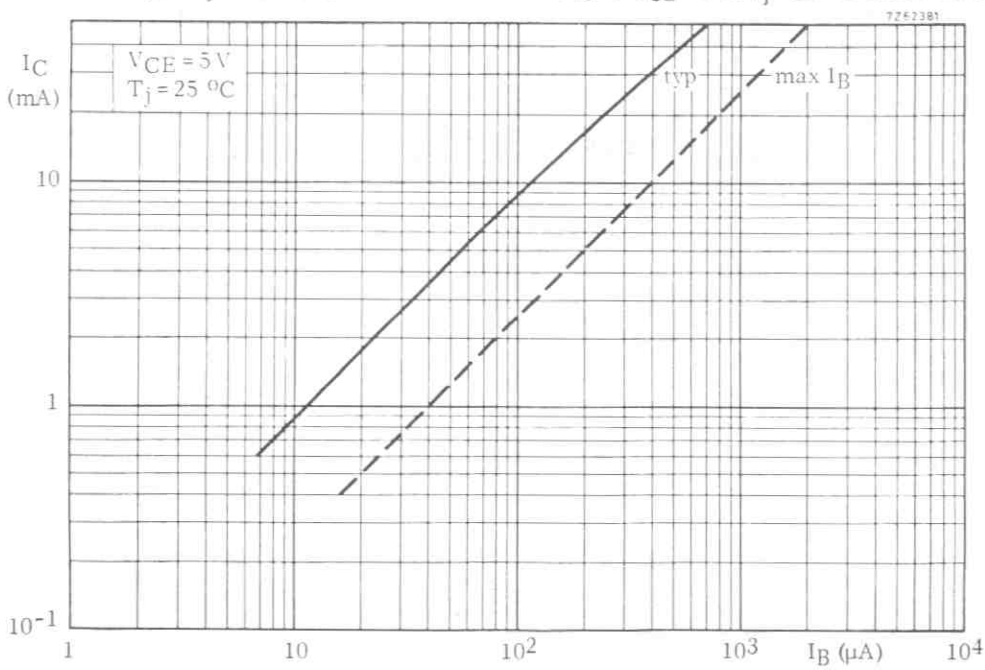


Fig. 5 V_{CE} = 5 V; T_j = 25 °C.

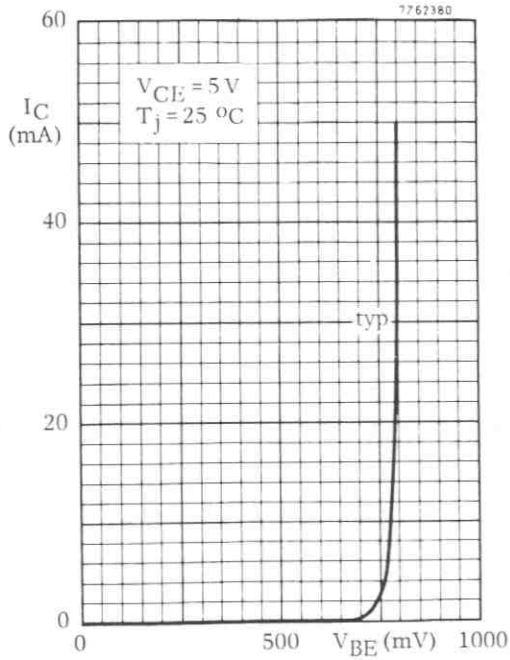


Fig. 6 V_{CE} = 5 V; T_j = 25 °C; typical values.

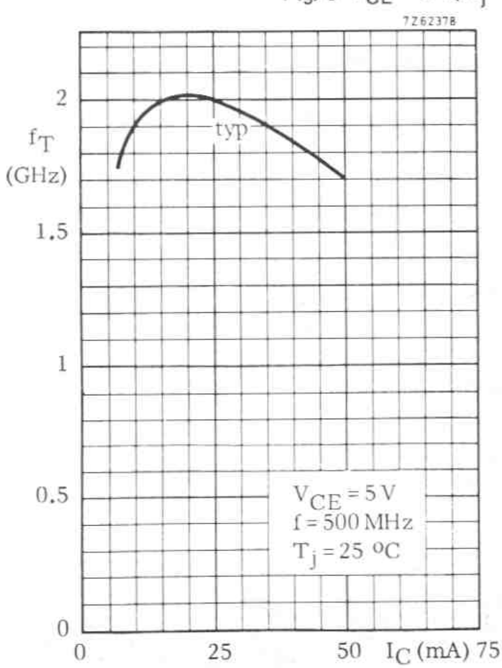


Fig. 7 V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C; typical values.

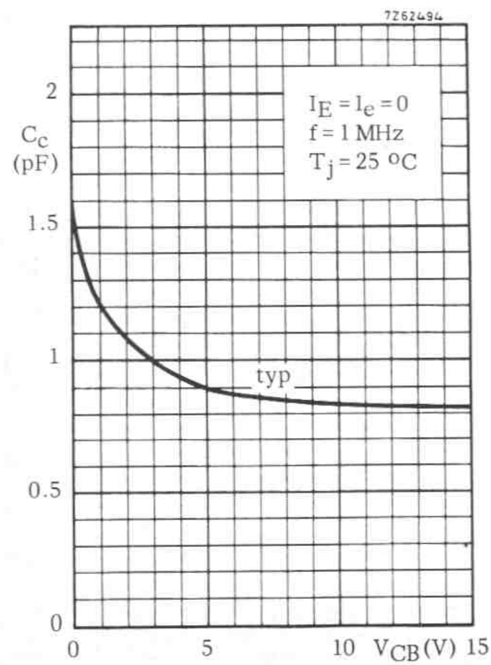


Fig. 8 $I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C; typical values.

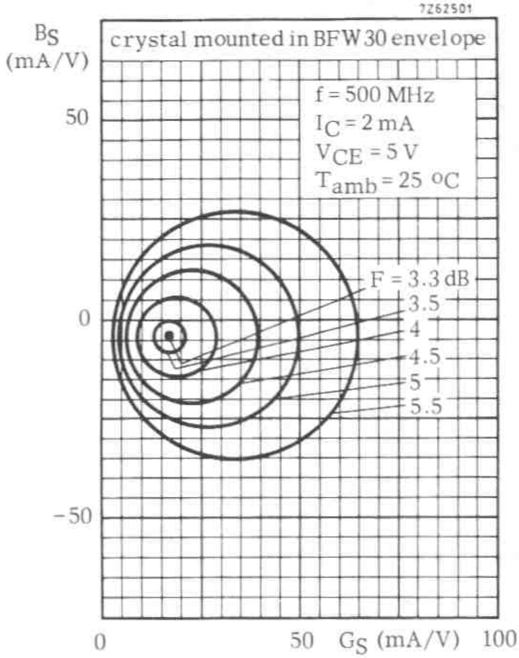


Fig. 9 Circles of constant noise figure; V_{CE} = 5 V; I_C = 2 mA; f = 500 MHz; T_{amb} = 25 °C; typ. values.

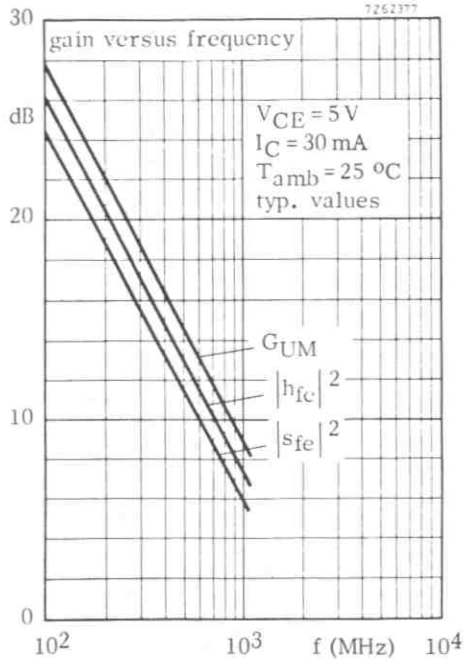


Fig. 10 V_{CE} = 5 V; I_C = 30 mA; T_{amb} = 25 °C; typical values.

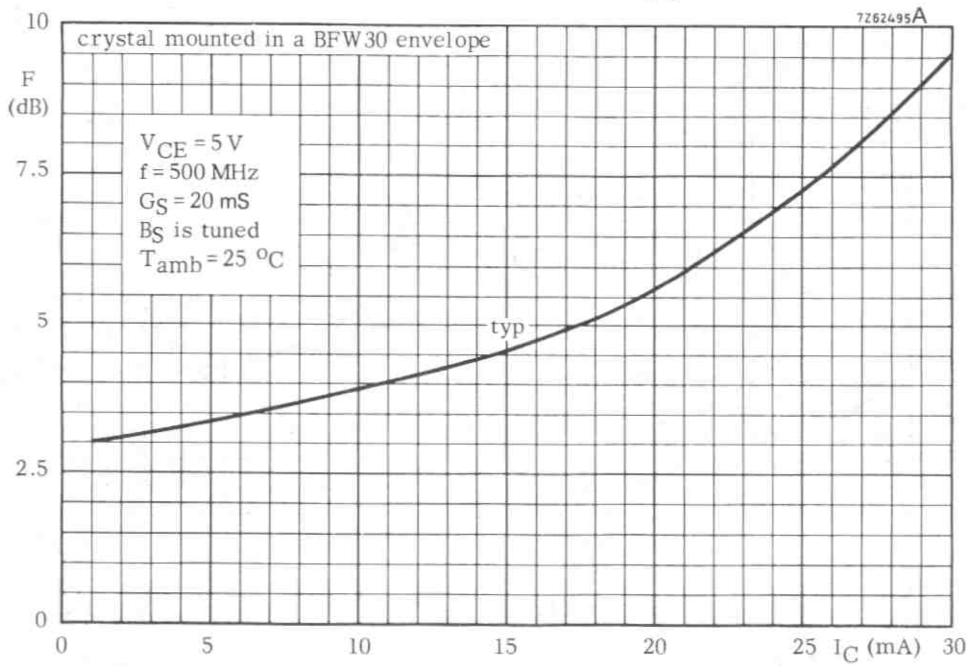


Fig. 11 V_{CE} = 5 V; f = 500 MHz; G_S = 20 mS; B_S = tuned; T_{amb} = 25 °C; typical values.

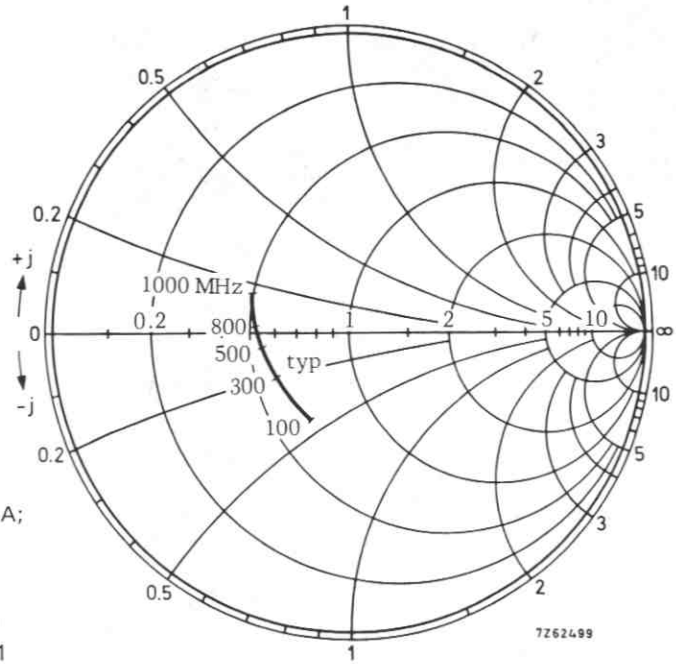


Fig. 12 $V_{CE} = 5$ V; $I_C = 30$ mA; $T_{amb} = 25$ °C; typical values.

Input impedance derived from input reflection coefficient s_{11} coordinates in ohm x 50.

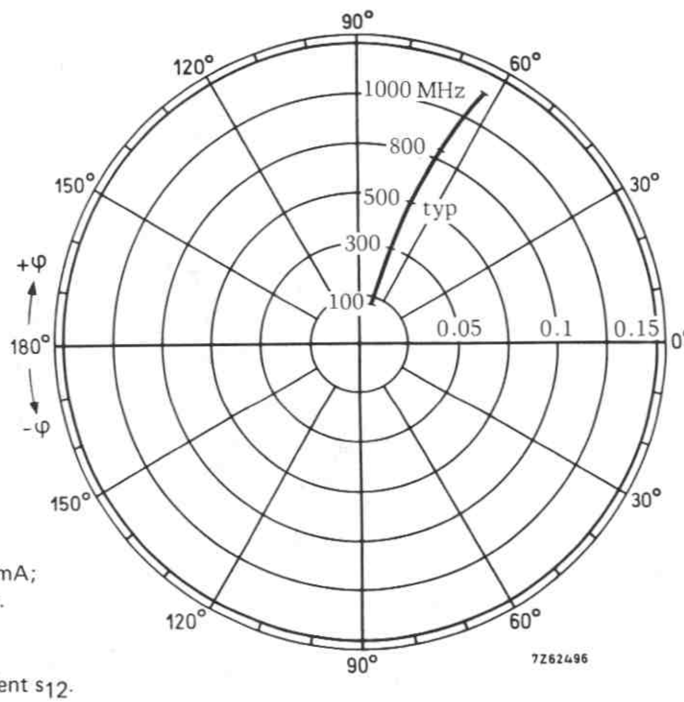


Fig. 13 $V_{CE} = 5$ V; $I_C = 30$ mA; $T_{amb} = 25$ °C; typical values.

Reverse transmission coefficient s_{12}.

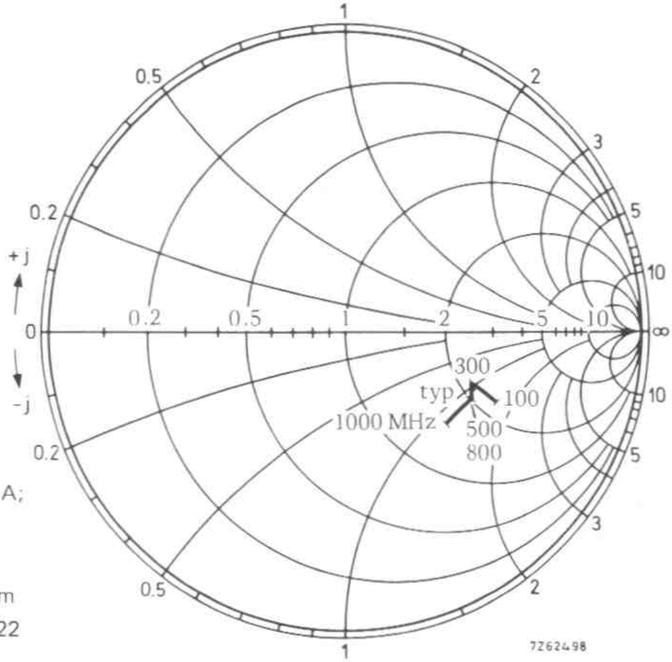


Fig. 14 V_{CE} = 5 V; I_C = 30 mA; T_{amb} = 25 °C; typical values.

Output impedance derived from output reflection coefficient s_{22} coordinates in ohm x 50.

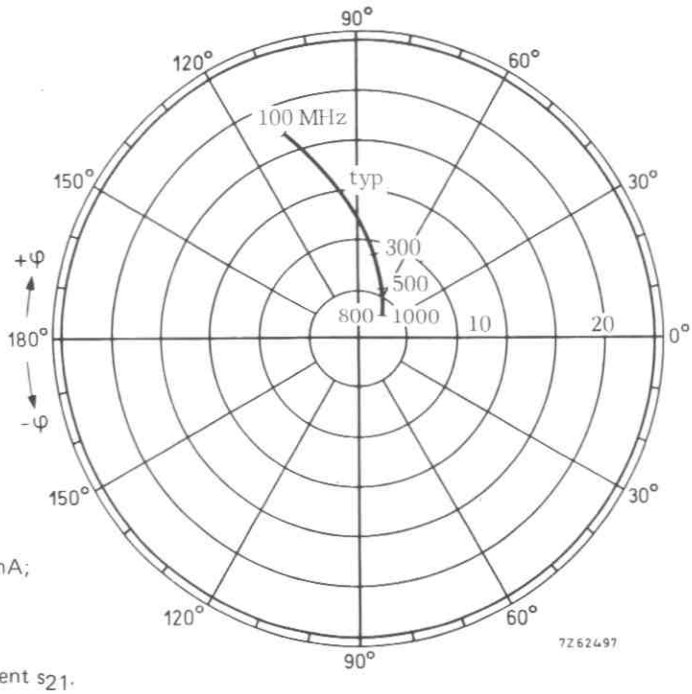


Fig. 15 V_{CE} = 5 V; I_C = 30 mA; T_{amb} = 25 °C; typical values.

Forward transmission coefficient s_{21}.

N-P-N 5 GHz WIDEBAND TRANSISTOR

N-P-N transistor in a plastic SOT-23 envelope.* It is primarily intended for use in u.h.f. and microwave amplifiers in thick and thin-film circuits, such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analysers etc. The transistor features low intermodulation distortion and high power gain; thanks to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

P-N-P complement is BFT92.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	20 V
Collector-emitter voltage (open base)	V_{CEO}	max.	15 V
Collector current (d.c.)	I_C	max.	25 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300 mW
Junction temperature	T_j	max.	150 °C
Transition frequency at f = 500 MHz I_C = 14 mA; V_{CE} = 10 V	f_T	typ.	5,0 GHz
Feedback capacitance at f = 1 MHz I_C = 2 mA; V_{CE} = 10 V	C_{re}	typ.	0,4 pF
Noise figure at optimum source impedance I_C = 2 mA; V_{CE} = 10 V; f = 500 MHz	F	typ.	2,4 dB
Max. unilateral power gain I_C = 14 mA; V_{CE} = 10 V; f = 500 MHz	G_{UM}	typ.	18,0 dB
Output voltage at d_{im} = −60 dB (see Fig. 2) I_C = 14 mA; V_{CE} = 10 V; R_L = 75 Ω; T_{amb} = 25 °C $f_{(p+q-r)}$ = 493,25 MHz	V_o	typ.	150 mV

MECHANICAL DATA

Dimensions in mm

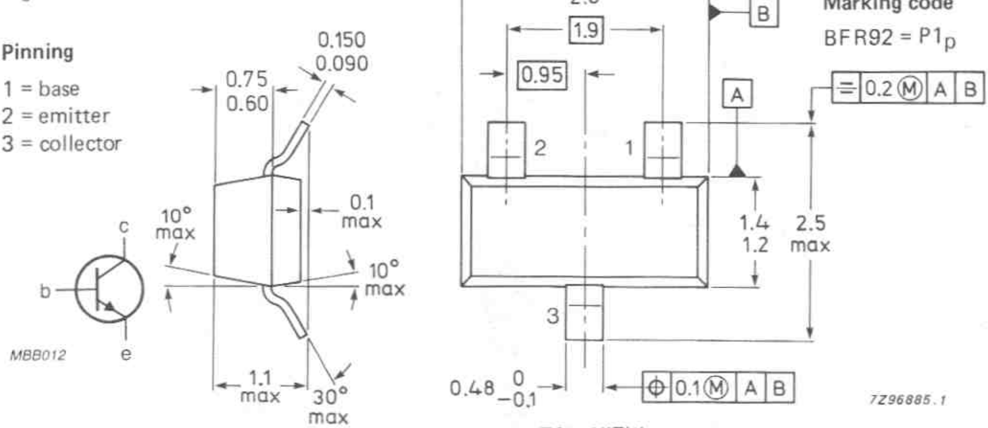
Fig. 1 SOT-23.

Pinning

1 = base
2 = emitter
3 = collector

Marking code

BFR92 = $P1_p$



* If required, the R-version (reverse pinning) is available on request.
TO92 version is also available on request: ref. ON4183.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	20 V
Collector-emitter voltage (open base)	V_{CEO}	max.	15 V
Emitter-base voltage (open collector)	V_{EBO}	max.	2 V
Collector current (d.c.)	I_C	max.	25 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300 mW
Storage temperature	T_{stg}	−65 to +150 °C	
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	=	430 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current $I_E = 0$; V_{CB} = 10 V	I_{CBO}	max.	50 nA
D.C. current gain I_C = 14 mA; V_{CE} = 10 V	h_{FE}	min. typ.	25 50
Transition frequency at f = 500 MHz I_C = 14 mA; V_{CE} = 10 V	f_T	typ.	5,0 GHz
Collector capacitance at f = 1 MHz $I_E = I_e = 0$; V_{CB} = 10 V	C_c	typ.	0,75 pF
Emitter capacitance at f = 1 MHz $I_C = I_c = 0$; V_{EB} = 0,5 V	C_e	typ.	0,8 pF
Feedback capacitance at f = 1 MHz I_C = 2 mA; V_{CE} = 10 V; T_{amb} = 25 °C	C_{re}	typ.	0,4 pF

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

Noise figure at optimum source impedance*			
I_C = 2 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C	F	typ.	2,4 dB
Max. unilateral power gain (s_{12} assumed to be zero)			
$G_{UM} = 10 \log \dfrac{\lvert s_{21}\rvert^2}{[1-\lvert s_{11}\rvert^2]\,[1-\lvert s_{22}\rvert^2]}$			
I_C = 14 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C	G_{UM}	typ.	18,0 dB
Output voltage at d_{im} = −60 dB (see Fig. 2)			
(DIN 45004B; par. 6.3.: 3-tone)			
I_C = 14 mA; V_{CE} = 10 V; R_L = 75 Ω			
$V_p = V_o$ at d_{im} = −60 dB ; f_p = 495,25 MHz			
$V_q = V_o$ −6 dB ; f_q = 503,25 MHz			
$V_r = V_o$ −6 dB ; f_r = 505,25 MHz			
measured at $f_{(p+q-r)}$ = 493,25 MHz	V_o	typ.	150 mV

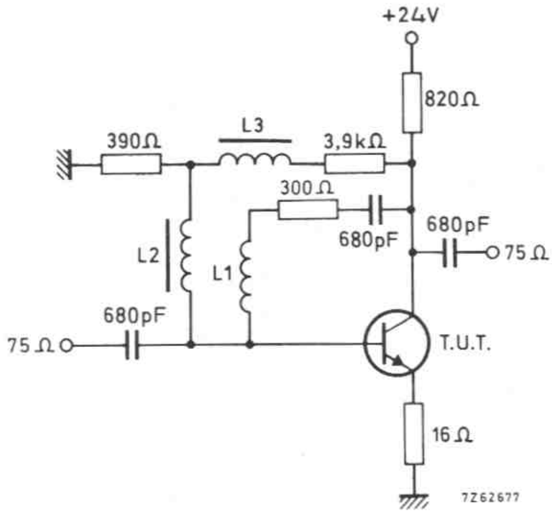


Fig. 2 Intermodulation test circuit.

L1 = 4 turns Cu wire (0,35 mm); winding pitch 1 mm; int. dia. 4 mm
L2 = L3 = 5 μH (code number: 3122 108 20150)

* Crystal mounted in a BFR90 envelope.

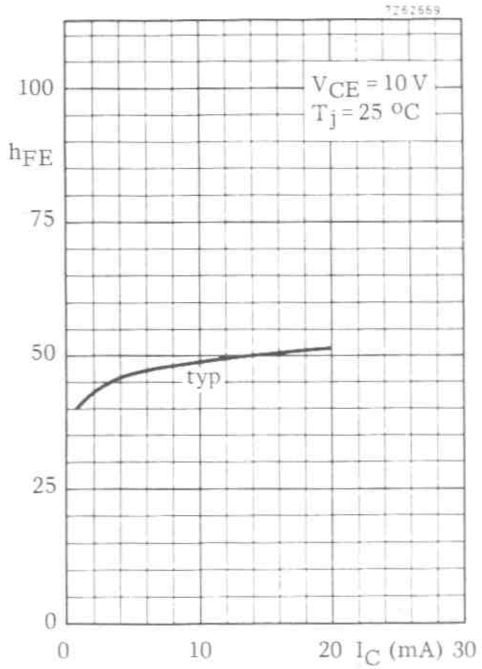


Fig. 3 V_{CE} = 10 V; T_j = 25 °C; typical values.

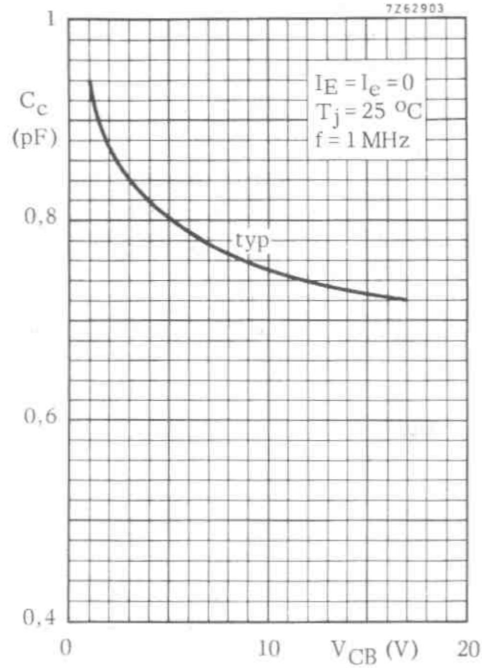


Fig. 4 $I_E = I_e = 0$; f = 1 MHz; T_j = 25 °C; typical values.

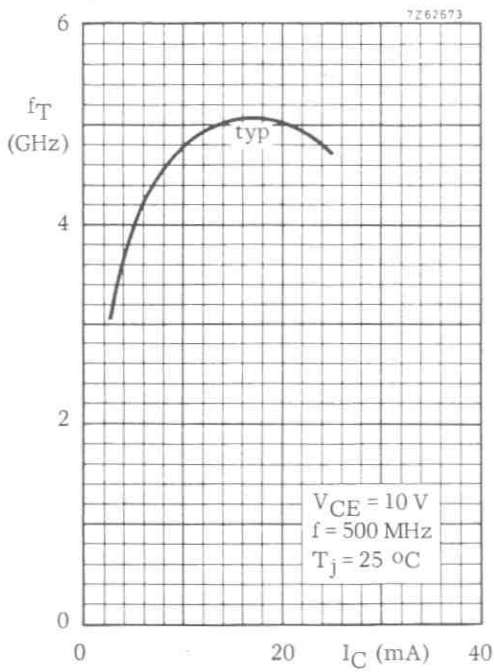


Fig. 5 V_{CE} = 10 V; f = 500 MHz; T_j = 25 °C; typical values.

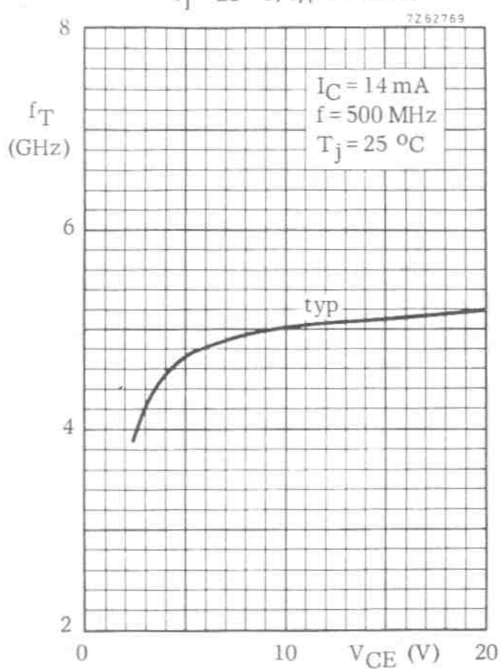


Fig. 6 I_C = 14 mA; f = 500 MHz; T_j = 25 °C; typical values.

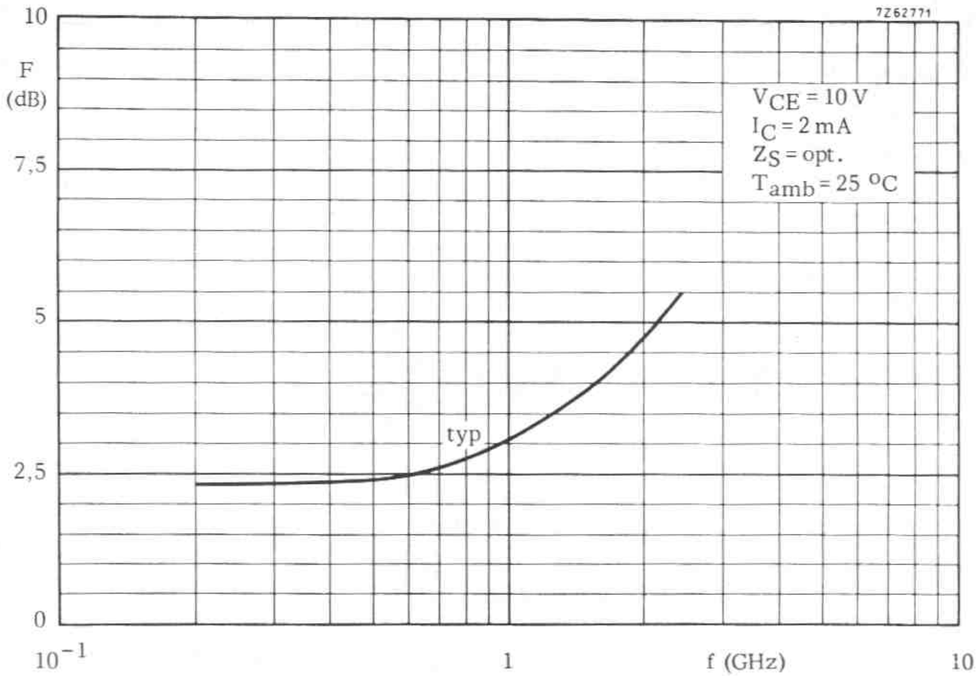


Fig. 7 V_{CE} = 10 V; I_C = 2 mA; Z_S = opt.; T_{amb} = 25 °C; typical values.

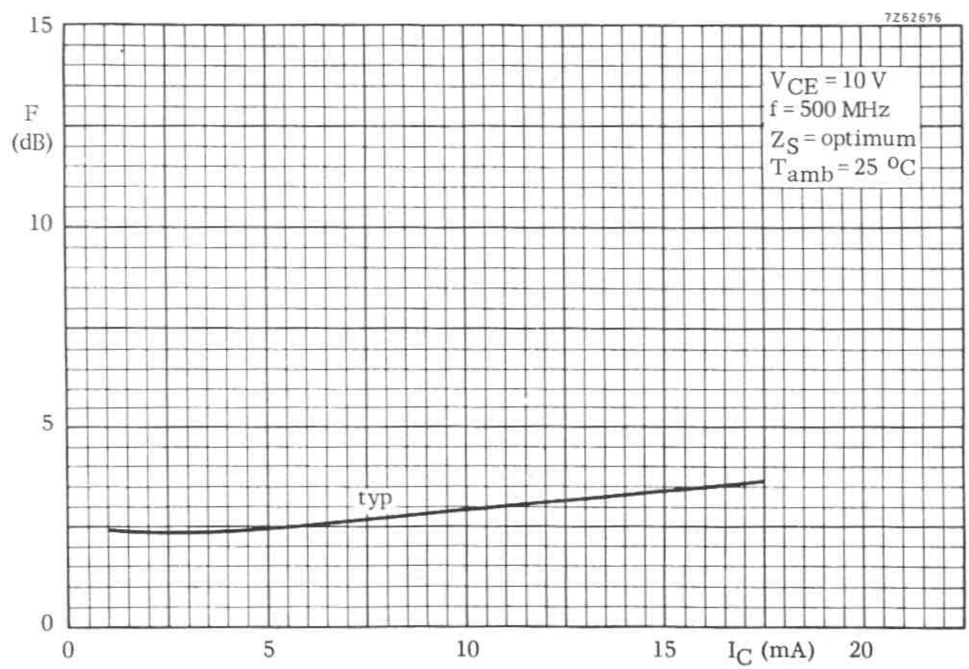


Fig. 8 V_{CE} = 10 V; f = 500 MHz; Z_S = opt.; T_{amb} = 25 °C; typical values.

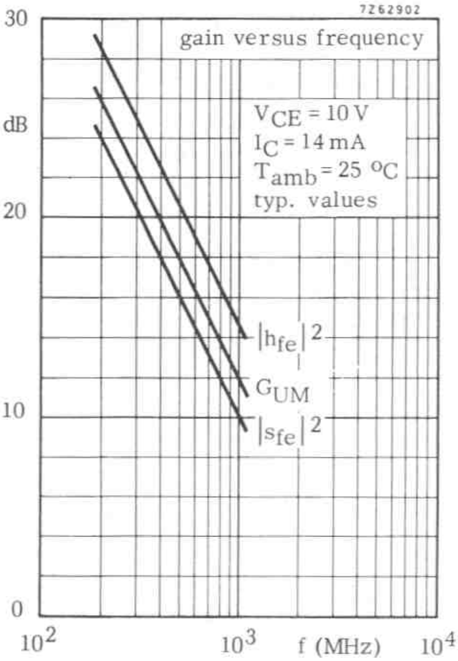


Fig. 9 V_{CE} = 10 V; I_C = 14 mA; T_{amb} = 25 °C; typical values.

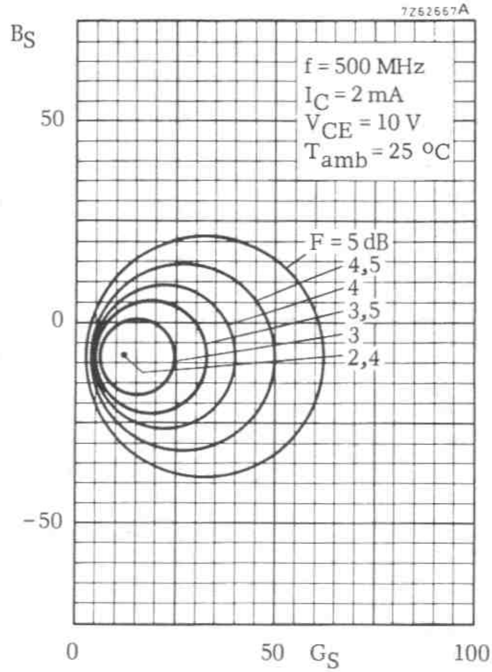


Fig. 10 Circles of constant noise figure; V_{CE} = 10 V; I_C = 2 mA; f = 500 MHz; T_{amb} = 25 °C; typical values.

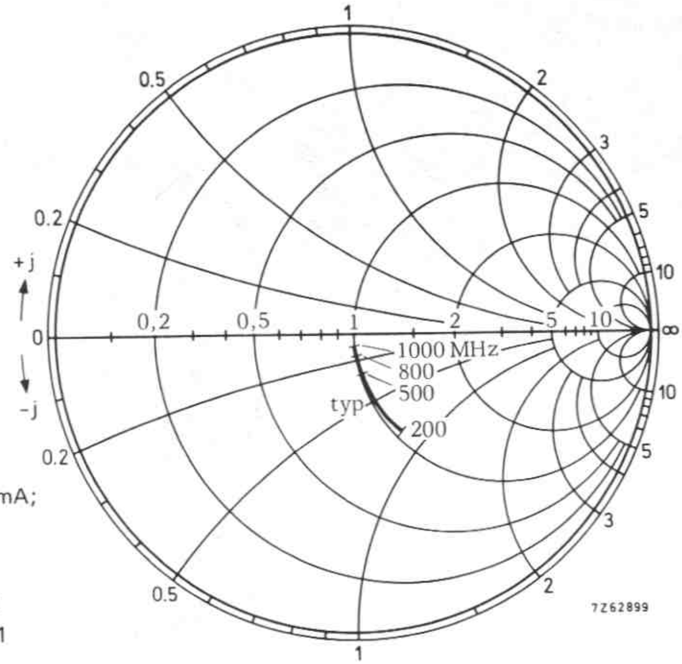


Fig. 11 V_{CE} = 10 V; I_C = 14 mA; T_{amb} = 25 ^oC; typical values.

Input impedance derived from input reflection coefficient s_{11} coordinates in ohm x 50

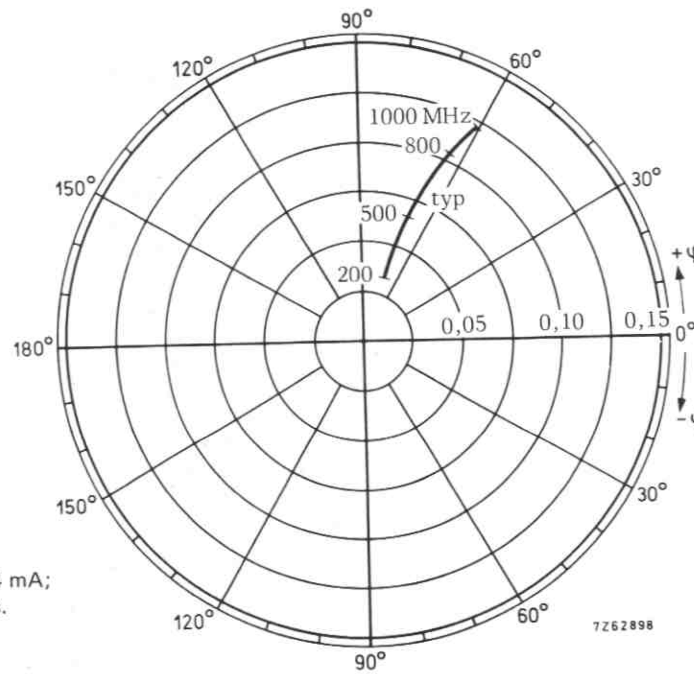


Fig. 12 V_{CE} = 10 V; I_C = 14 mA; T_{amb} = 25 ^oC; typical values.

Reverse transmission coefficient s_{12}

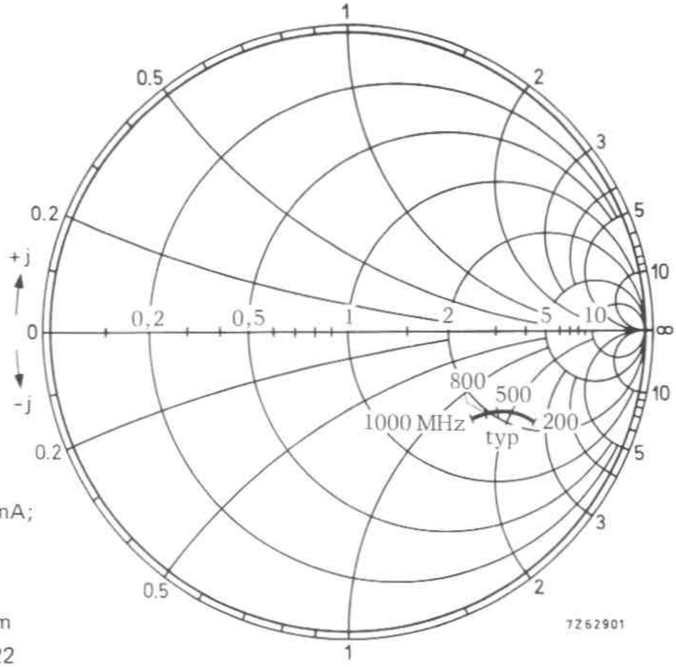


Fig. 13 V_{CE} = 10 V; I_C = 14 mA; T_{amb} = 25 °C; typical values.

Output impedance derived from output reflection coefficient s_{22} coordinates in ohm x 50

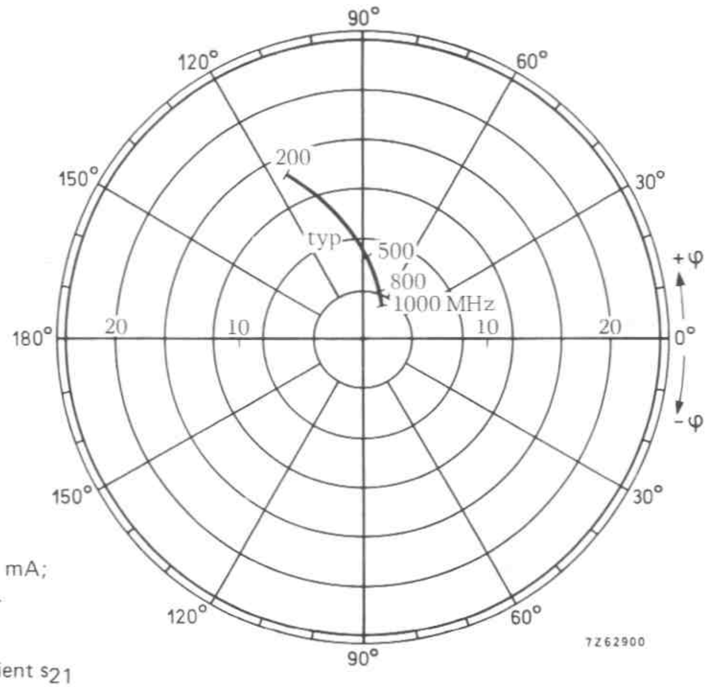


Fig. 14 V_{CE} = 10 V; I_C = 14 mA; T_{amb} = 25 °C; typical values.

Forward transmission coefficient s_{21}

N-P-N 5 GHz WIDEBAND TRANSISTOR

N-P-N transistor in a plastic SOT-23 envelope.* It is primarily intended for use in v.h.f./u.h.f. broadband amplifiers. The transistor features:

- low noise;
- low intermodulation distortion;
- high power gain.

P-N-P complement is BFT92

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	20	V
Collector-emitter voltage (open-base)	V_{CEO}	max.	15	V
Collector current (d.c.)	I_C	max.	25	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Junction temperature	T_j	max.	150	°C
Transition frequency at f = 500 MHz I_C = 14 mA; V_{CE} = 10 V	f_T	typ.	5,0	GHz
Feedback capacitance at f = 1 MHz I_C = 0; V_{CE} = 10 V	C_{re}	typ.	0,35	pF
Noise figure at R_S = 60 Ω I_C = 4 mA; V_{CE} = 10 V; f = 800 MHz	F	typ.	1,8	dB
Output voltage at d_{im} = −60 dB I_C = 14 mA; V_{CE} = 10 V; R_L = 75 Ω $f_{(p+q-r)}$ = 793,25 MHz	V_o	typ.	150	mV

MECHANICAL DATA

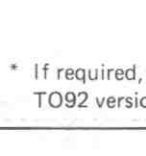
Fig. 1 SOT-23.

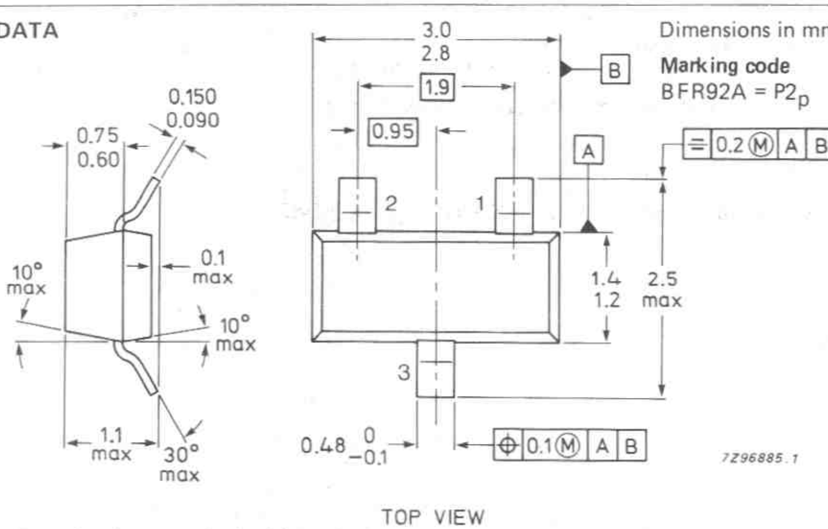
Dimensions in mm

Marking code
BFR92A = $P2_p$

Pinning

1 = base
2 = emitter
3 = collector





* If required, the R-version (reverse pinning) is available on request.
TO92 version is also available on request: ref. ON4184.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	20 V
Collector-emitter voltage (open base)	V_{CEO}	max.	15 V
Emitter-base voltage (open collector)	V_{EBO}	max.	2,0 V
Collector current (d.c.)	I_C	max.	25 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300 mW
Storage temperature	T_{stg}		−65 to +150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	430 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current $I_E = 0$; $V_{CB} = 10$ V	I_{CBO}	max.	60 nA
D.C. current gain $I_C = 14$ mA; $V_{CE} = 10$ V	h_{FE}	min. typ.	40 90
Transition frequency at f = 500 MHz $I_C = 14$ mA; $V_{CE} = 10$ V	f_T	typ.	5,0 GHz
Collector capacitance at f = 1 MHz $I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	0,6 pF
Emitter capacitance at f = 1 MHz $I_C = I_c = 0$; $V_{EB} = 0{,}5$ V	C_e	typ.	1,2 pF
Feedback capacitance at f = 1 MHz $I_C = 0$; $V_{CE} = 10$ V; $T_{amb} = 25$ °C	C_{re}	typ.	0,35 pF
Noise figure at $T_{amb} = 25$ °C $I_C = 4$ mA; $V_{CE} = 10$ V; $R_S = 60\ \Omega$; f = 800 MHz	F	typ.	1,8 dB

Maximum unilateral power gain (s_{12} assumed to be zero)

$$G_{UM} = 10 \log \frac{|s_{21}|^2}{[1-|s_{11}|^2]\,[1-|s_{22}|^2]}$$

$I_C = 14$ mA; $V_{CE} = 10$ V; f = 800 MHz; $T_{amb} = 25$ °C	G_{UM}	typ.	15,5 dB

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

Output voltage at d_{im} = −60 dB (see Figs 2 and 16)*
(DIN 45004B, par. 6.3: 3-tone)
I_C = 14 mA; V_{CE} = 10 V; R_L = 75 Ω; VSWR < 2; T_{amb} = 25 °C
$V_p = V_o$ at d_{im} = −60 dB; f_p = 795,25 MHz
$V_q = V_o$ −6 dB ; f_q = 803,25 MHz
$V_r = V_o$ −6 dB ; f_r = 805,25 MHz
Measured at $f_{(p+q-r)}$ = 793,25 MHz — V_o typ. 150 mV

Second harmonic distortion (see Figs 2 and 18)*
I_C = 14 mA; V_{CE} = 10 V; R_L = 75 Ω; VSWR < 2; T_{amb} = 25 °C
V_p = 60 mV at f_p = 250 MHz
V_q = 60 mV at f_q = 560 MHz
measured at $f_{(p+q)}$ = 810 MHz — d_2 typ. −50 dB

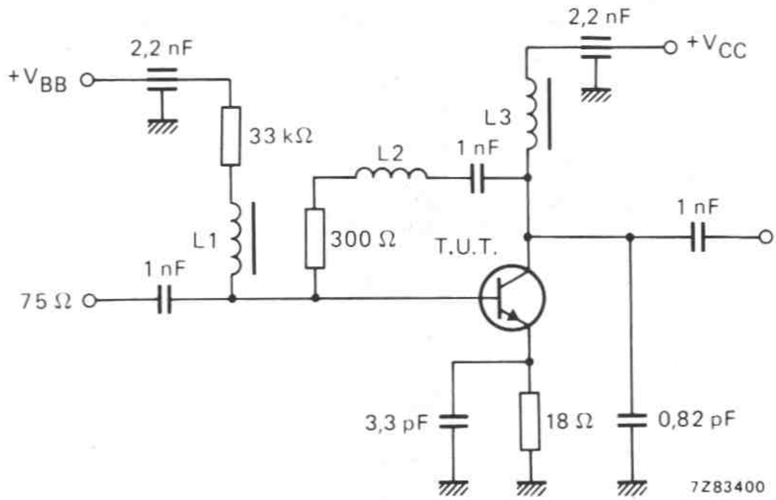


Fig. 2 Intermodulation distortion and second harmonic distortion MATV test circuit.

L1 = L3 = 5 μH micro choke
L2 = 3 turns Cu wire (0,4 mm); internal diameter 3 mm; winding pitch 1 mm

* Measured on same crystal in a SOT-37 envelope (BFR90A).

s-parameters (common emitter) at V_{CE} = 5 V; T_{amb} = 25 °C; typical values.

I_C mA	f MHz	s_{11}	s_{12}	s_{21}	s_{22}
2	40	0,88/ −8,9°	0,009/83,6°	6,7/174,2°	1,00/ −2,7°
	100	0,86/ −21,9°	0,022/78,3°	6,5/164,2°	0,98/ −6,6°
	200	0,80/ −42,2°	0,041/69,0°	6,0/149,2°	0,94/−12,2°
	500	0,61/ −87,2°	0,073/54,9°	4,2/119,1°	0,81/−20,2°
	800	0,48/−117,4°	0,086/52,7°	3,1/100,5°	0,74/−22,9°
	1000	0,44/−133,8°	0,092/54,2°	2,6/ 91,4°	0,71/−24,2°
	1200	0,41/−147,6°	0,099/57,5°	2,2/ 84,3°	0,70/−25,7°
5	40	0,75/ −14,4°	0,008/81,8°	14,4/170,2°	0,99/ −4,9°
	100	0,70/ −34,0°	0,020/74,2°	13,3/155,3°	0,94/−11,2°
	200	0,60/ −61,7°	0,034/65,0°	10,9/135,8°	0,84/−17,9°
	500	0,40/−111,1°	0,057/61,1°	6,2/106,9°	0,67/−21,9°
	800	0,32/−139,7°	0,074/65,5°	4,2/ 92,4°	0,62/−22,2°
	1000	0,30/−153,2°	0,086/68,2°	3,4/ 85,3°	0,61/−22,8°
	1200	0,29/−166,2°	0,100/70,9°	2,9/ 79,6°	0,60/−24,0°
10	40	0,61/ −21,1°	0,008/79,7°	22,9/165,2°	0,97/ −7,3°
	100	0,54/ −48,5°	0,017/71,4°	19,8/145,8°	0,88/−15,5°
	200	0,42/ −82,1°	0,028/65,2°	14,4/124,7°	0,74/−20,8°
	500	0,30/−132,3°	0,050/69,0°	7,1/ 99,6°	0,59/−20,5°
	800	0,26/−158,0°	0,072/73,7°	4,7/ 87,8°	0,56/−20,3°
	1000	0,25/−168,3°	0,088/75,2°	3,8/ 82,2°	0,56/−20,9°
	1200	0,25/−179,3°	0,104/76,6°	3,2/ 77,5°	0,55/−22,1°
14	40	0,53/ −26,0°	0,007/78,6°	27,7/162,4°	0,96/ −8,7°
	100	0,45/ −58,1°	0,016/70,5°	22,6/140,7°	0,85/−17,2°
	200	0,36/ −94,4°	0,025/66,6°	15,6/119,7°	0,70/−21,0°
	500	0,27/−142,8°	0,049/72,5°	7,3/ 96,9°	0,57/−19,1°
	800	0,25/−166,0°	0,072/76,5°	4,7/ 86,1°	0,55/−19,1°
	1000	0,24/−174,8°	0,088/77,4°	3,8/ 80,5°	0,55/−19,9°
	1200	0,24/ 174,8°	0,105/78,4°	3,2/ 76,2°	0,54/−21,3°
20	40	0,45/ −33,1°	0,007/77,0°	32,3/158,8°	0,94/−10,1°
	100	0,38/ −71,8°	0,015/69,5°	24,7/135,0°	0,80/−18,4°
	200	0,31/−110,6°	0,023/68,3°	16,0/114,6°	0,66/−20,1°
	500	0,26/−154,5°	0,047/75,5°	7,2/ 94,3°	0,56/−17,3°
	800	0,25/−174,2°	0,071/78,7°	4,7/ 84,3°	0,55/−17,8°
	1000	0,25/ 178,5°	0,088/79,3°	3,7/ 79,1°	0,54/−18,9°
	1200	0,26/ 169,9°	0,104/80,0°	3,2/ 74,9°	0,54/−20,5°

s-parameters (common emitter) at V_{CE} = 10 V; T_{amb} = 25 °C; typical values.

I_C mA	f MHz	s_{11}	s_{12}	s_{21}	s_{22}
2	40	0,89/ −8,7°	0,008/83,6°	6,8/174,4°	1,00/ −2,5°
	100	0,86/ −21,2°	0,021/78,5°	6,5/164,6°	0,98/ −6,1°
	200	0,80/ −40,9°	0,038/69,5°	6,0/149,6°	0,94/−11,3°
	500	0,61/ −85,3°	0,069/55,8°	4,3/119,8°	0,82/−18,7°
	800	0,48/−115,4°	0,081/53,8°	3,1/101,2°	0,75/−21,3°
	1000	0,44/−131,4°	0,086/55,5°	2,6/ 92,1°	0,73/−22,5°
	1200	0,40/−145,6°	0,093/58,9°	2,2/ 85,0°	0,72/−23,9°
5	40	0,77/ −13,6°	0,008/81,8°	14,2/170,5°	0,99/ −4,5°
	100	0,73/ −32,3°	0,019/74,7°	13,2/155,8°	0,95/−10,3°
	200	0,62/ −58,8°	0,032/65,6°	11,0/136,8°	0,85/−16,6°
	500	0,41/−107,2°	0,054/61,4°	6,3/107,7°	0,69/−20,4°
	800	0,32/−135,9°	0,071/65,9°	4,2/ 92,9°	0,64/−20,8°
	1000	0,30/−150,0°	0,082/68,6°	3,5/ 86,1°	0,63/−21,3°
	1200	0,28/−162,9°	0,095/71,5°	2,9/ 80,5°	0,62/−22,4°
10	40	0,66/ −19,4°	0,007/80,1°	22,5/165,9°	0,97/ −6,6°
	100	0,58/ −44,7°	0,017/71,8°	19,5/147,0°	0,90/−14,1°
	200	0,45/ −76,2°	0,027/65,4°	14,5/126,0°	0,76/−19,3°
	500	0,29/−125,1°	0,049/68,7°	7,2/100,6°	0,62/−19,2°
	800	0,24/−151,8°	0,070/73,5°	4,7/ 88,8°	0,59/−19,0°
	1000	0,24/−162,9°	0,084/75,2°	3,8/ 82,6°	0,58/−19,7°
	1200	0,23/−174,8°	0,099/76,8°	3,2/ 78,3°	0,58/−20,9°
14	40	0,60/ −23,2°	0,007/78,6°	27,2/163,0°	0,96/ −7,9°
	100	0,51/ −52,5°	0,016/70,6°	22,6/141,8°	0,86/−15,8°
	200	0,38/ −86,2°	0,025/66,4°	15,7/120,7°	0,72/−19,6°
	500	0,26/−134,3°	0,047/72,0°	7,5/ 97,8°	0,60/−18,0°
	800	0,22/−159,3°	0,069/76,2°	4,8/ 86,8°	0,57/−18,0°
	1000	0,22/−169,0°	0,085/77,3°	3,9/ 81,3°	0,57/−18,7°
	1200	0,22/ 179,8°	0,100/78,5°	3,3/ 76,8°	0,57/−20,1°
20	40	0,54/ −28,2°	0,007/77,4°	31,7/159,9°	0,95/ −9,1°
	100	0,45/ −61,7°	0,015/69,5°	24,7/136,8°	0,82/−16,8°
	200	0,33/ −97,5°	0,023/67,5°	16,3/116,2°	0,68/−18,8°
	500	0,24/−143,7°	0,046/74,4°	7,4/ 95,3°	0,59/−16,4°
	800	0,22/−166,4°	0,069/78,0°	4,8/ 85,2°	0,57/−16,9°
	1000	0,22/−174,7°	0,084/78,7°	3,8/ 80,1°	0,57/−17,8°
	1200	0,22/ 176,3°	0,100/79,7°	3,3/ 76,0°	0,57/−19,4°

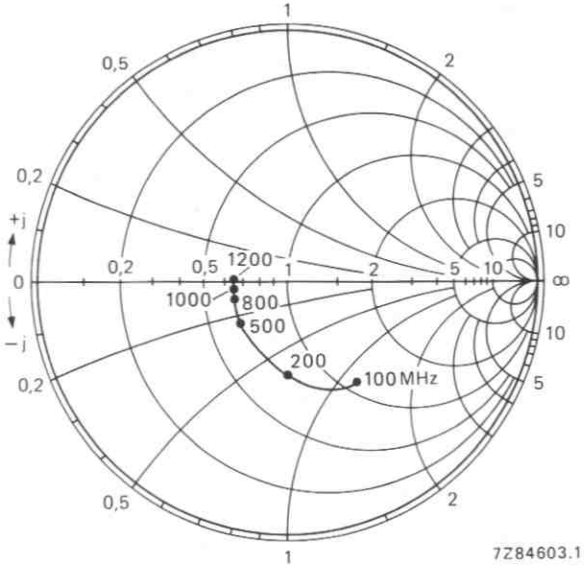


Fig. 3 Input impedance derived from input reflection coefficient s_{11} co-ordinates in ohm x 50.
V_{CE} = 10 V; I_C = 14 mA; T_{amb} = 25 °C; typical values.

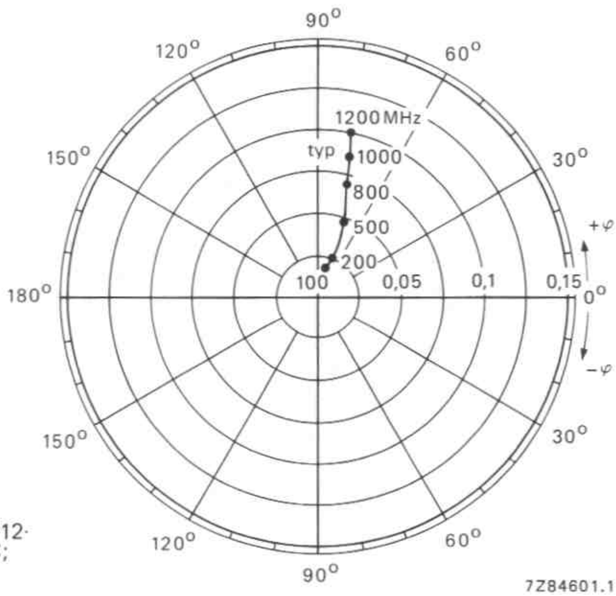


Fig. 4 Reverse transmission coefficient s_{12}.
V_{CE} = 10 V; I_C = 14 mA; T_{amb} = 25 °C; typical values.

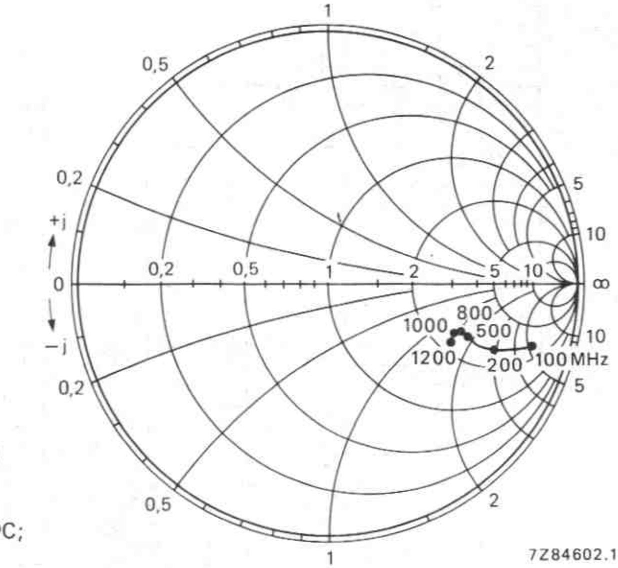


Fig. 5 Output impedance derived from output reflection coefficient s_{22} co-ordinates in ohm x 50.
V_{CE} = 10 V; I_C = 14 mA; T_{amb} = 25 °C; typical values.

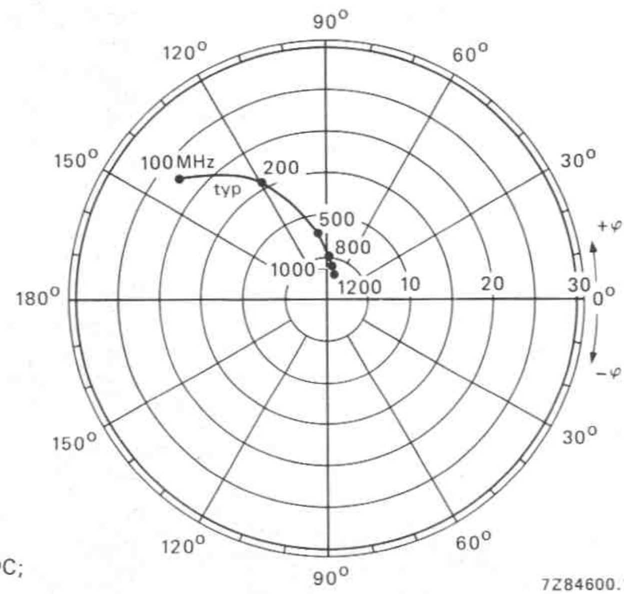


Fig. 6 Forward transmission coefficient s_{21}.
V_{CE} = 10 V; I_C = 14 mA; T_{amb} = 25 °C; typical values.

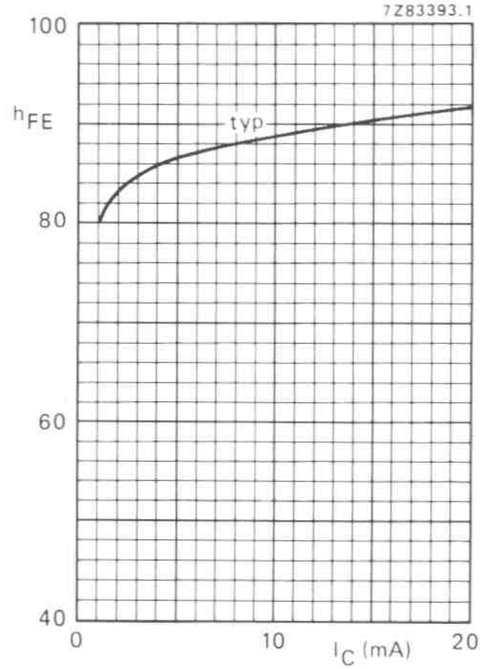


Fig. 7 V_{CE} = 10 V; T_j = 25 °C; typical values.

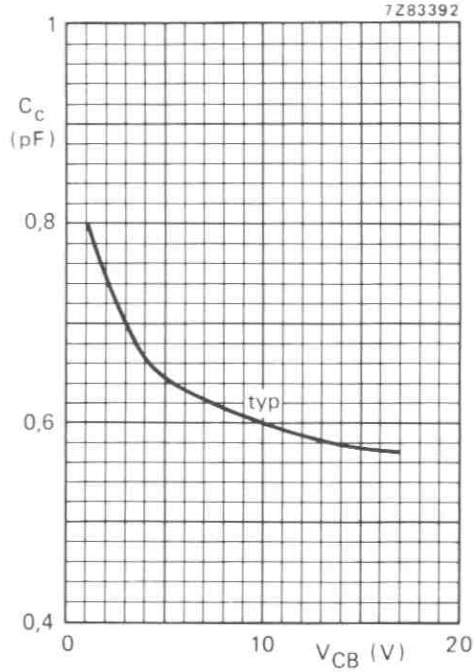


Fig. 8 $I_E = I_e = 0$; f = 1 MHz; T_j = 25 °C; typical values.

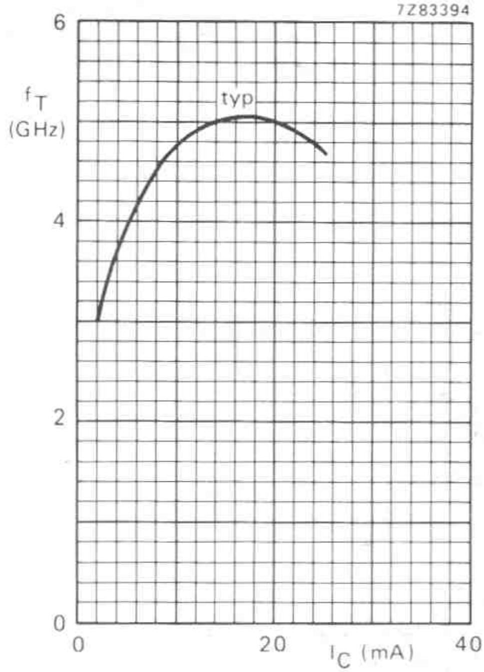


Fig. 9 V_{CE} = 10 V; f = 500 MHz; T_j = 25 °C; typical values.

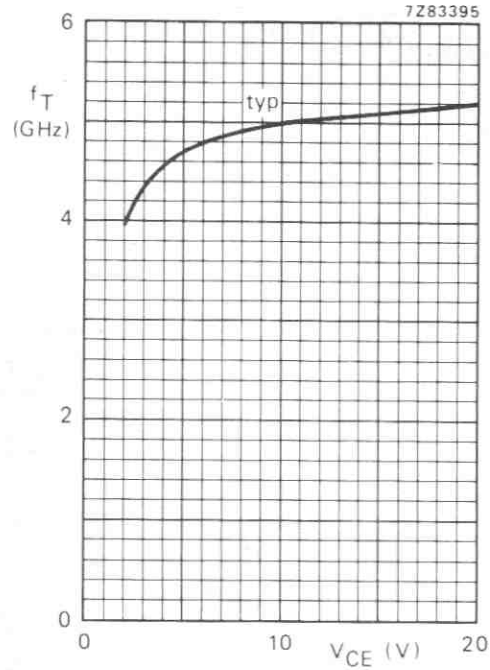


Fig. 10 I_C = 14 mA; f = 500 MHz; T_j = 25 °C; typical values.

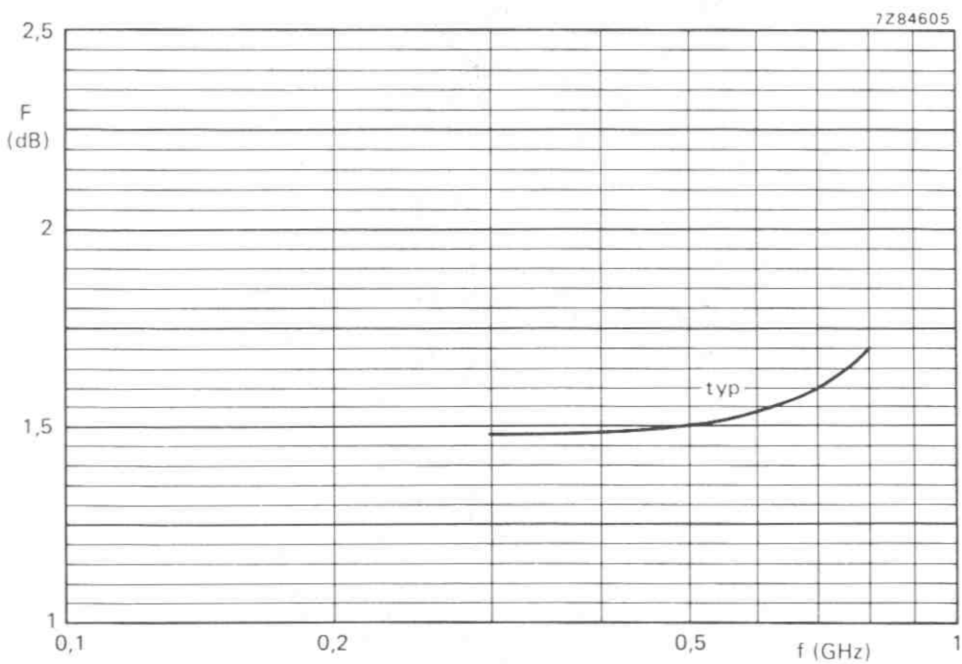


Fig. 11 V_{CE} = 10 V; I_C = 4 mA; Z_S = optimum; T_{amb} = 25 °C; typical values.

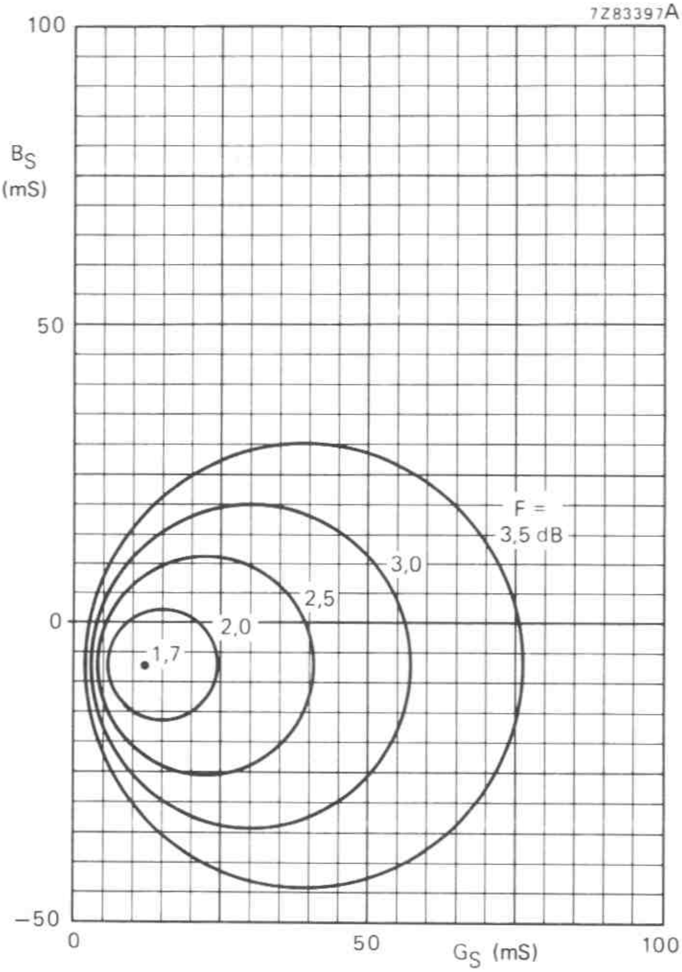


Fig. 12 Circles of constant noise figure.
V_{CE} = 10 V; I_C = 4 mA; f = 800 MHz; T_{amb} = 25 °C;
typical values.

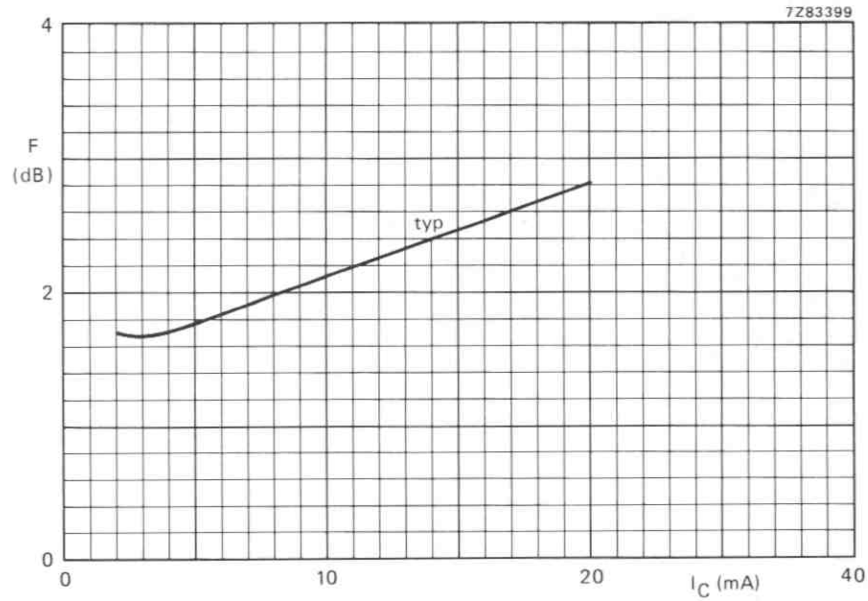


Fig. 13 V_{CE} = 10 V; f = 800 MHz; Z_S = optimum; T_{amb} = 25 °C; typical values.

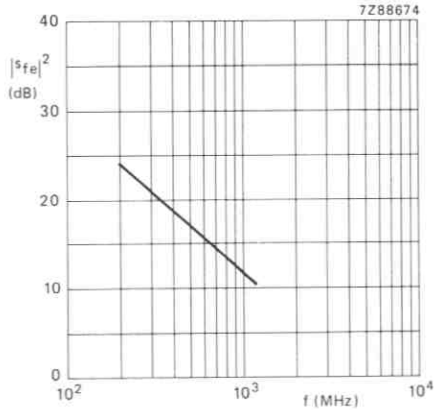


Fig. 14 V_{CE} = 10 V; I_C = 14 mA; T_{amb} = 25 °C; typical values.

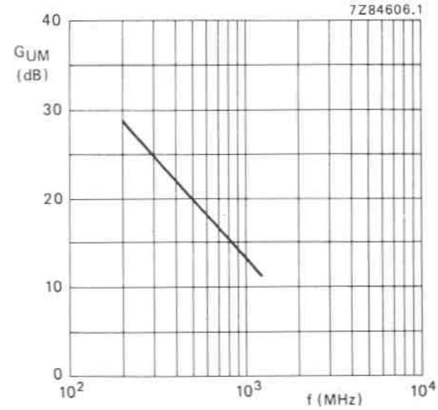


Fig. 15 V_{CE} = 10 V; I_C = 14 mA; T_{amb} = 25 °C; typical values.

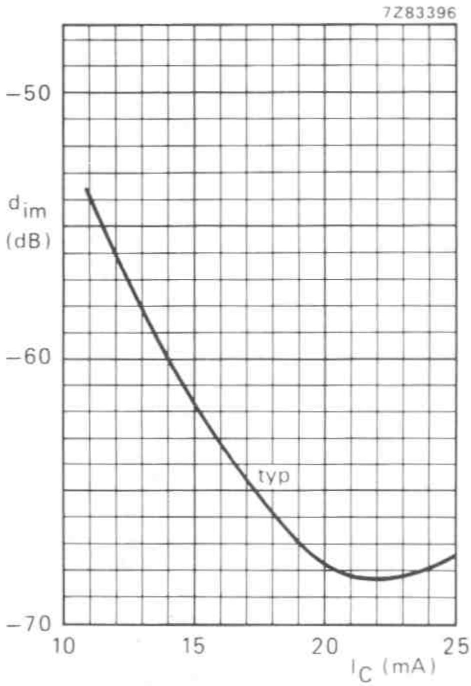


Fig. 16 V_{CE} = 10 V; V_o = 43,5 dBmV = 150 mV; $f_{(p+q-r)}$ = 793,25 MHz; T_{amb} = 25 °C; measured in MATV test circuit (see Fig. 2); typical values.

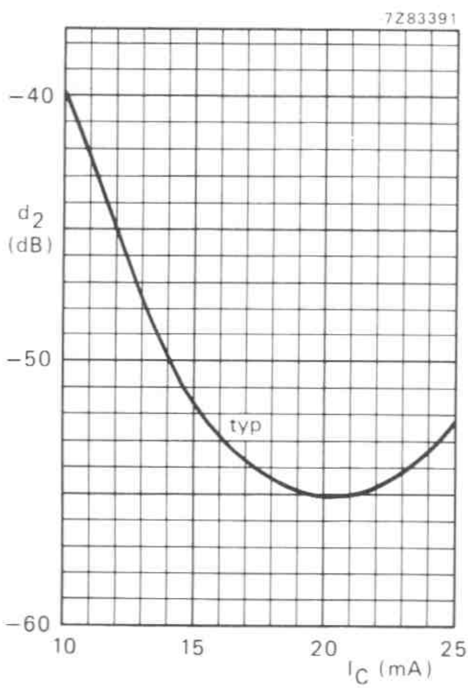


Fig. 17 V_{CE} = 10 V; V_o = 60 mV; $f_{(p+q)}$ = 810 MHz; T_{amb} = 25 °C; measured in MATV test circuit (see Fig. 2); typical values.

N-P-N 5 GHz WIDEBAND TRANSISTOR

N-P-N transistor in a SOT-23 plastic envelope.* It is primarily intended for use in u.h.f. and microwave amplifiers in thick and thin-film circuits, such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analysers etc. The transistor features very low intermodulation distortion and high power gain; thanks to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

P-N-P complement is the BFT93.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	15	V
Collector-emitter voltage (open base)	V_{CEO}	max.	12	V
Collector current (d.c.)	I_C	max.	35	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Junction temperature	T_j	max.	150	°C
Transition frequency at f = 500 MHz I_C = 30 mA; V_{CE} = 5 V	f_T	typ.	5	GHz
Feedback capacitance at f = 1 MHz I_C = 2 mA; V_{CE} = 5 V	C_{re}	typ.	0,8	pF
Noise figure at optimum source impedance I_C = 2 mA; V_{CE} = 5 V; f = 500 MHz;	F	typ.	1,9	dB
Max. unilateral power gain I_C = 30 mA; V_{CE} = 5 V; f = 500 MHz;	G_{UM}	typ.	16,5	dB
Intermodulation distortion at T_{amb} = 25 °C I_C = 30 mA; V_{CE} = 5 V; R_L = 75 Ω; V_o = 300 mV $f_{(p+q-r)}$ = 493,25 MHz	d_{im}	typ.	−60	dB

MECHANICAL DATA

Dimensions in mm

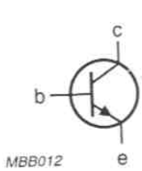
Marking code

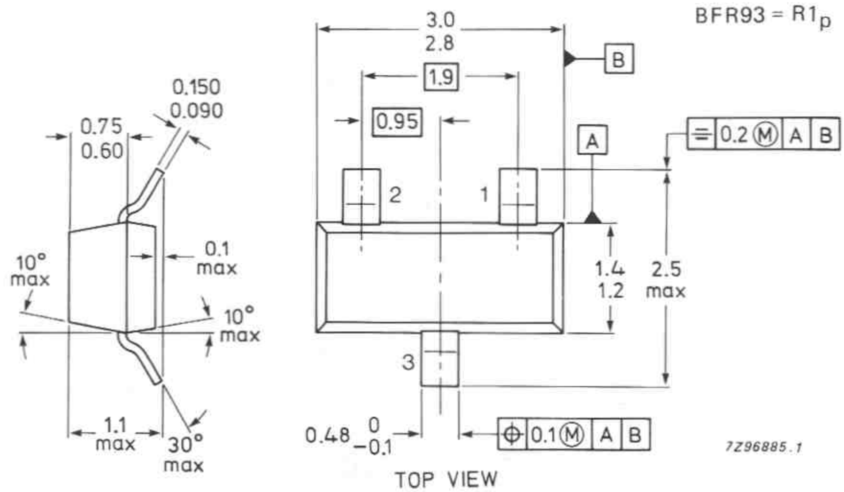
BFR93 = $R1_p$

Fig. 1 SOT-23.

Pinning

1 = base
2 = emitter
3 = collector





* If required, the R-version (reverse pinning) is available on request.
TO92 version is also available on request: ref. ON4186.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	15 V
Collector-emitter voltage (open base)	V_{CEO}	max.	12 V
Emitter-base voltage (open collector)	V_{EBO}	max.	2,0 V
Collector current (d.c.)	I_C	max.	35 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300 mW
Storage temperature	T_{stg}	−65 to +150 °C	
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	430 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current $I_E = 0$; V_{CB} = 10 V	I_{CBO}	max.	50 nA
D.C. current gain ** I_C = 30 mA; V_{CE} = 5 V	h_{FE}	min. typ.	25 50
Transition frequency at f = 500 MHz ** I_C = 30 mA; V_{CE} = 5 V	f_T	typ.	5 GHz
Collector capacitance at f = 1 MHz $I_E = I_e = 0$; V_{CB} = 10 V	C_c	typ.	0,7 pF
Emitter capacitance at f = 1 MHz $I_C = I_c = 0$; V_{EB} = 0,5 V	C_e	typ.	1,8 pF
Feedback capacitance at f = 1 MHz I_C = 2 mA; V_{CE} = 5 V; T_{amb} = 25 °C	C_{re}	typ.	0,8 pF

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.
** Measured under pulse conditions.

Noise figure at optimum source impedance *

I_C = 2 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C | F | typ. | 1,9 dB

Max. unilateral power gain (s_{12} assumed to be zero)

$$G_{UM} = 10 \log \frac{|s_{21}|^2}{[1-|s_{11}|^2][1-|s_{22}|^2]}$$

I_C = 30 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C | G_{UM} | typ. | 16,5 dB

Intermodulation distortion at T_{amb} = 25 °C *

I_C = 30 mA; V_{CE} = 5 V; R_L = 75 Ω; V.S.W.R. < 2

$V_p = V_o$ = 300 mV at f_p = 495,25 MHz
$V_q = V_o$ − 6 dB at f_q = 503,25 MHz
$V_r = V_o$ − 6 dB at f_r = 505,25 MHz

Measured at $f_{(p+q-r)}$ = 493,25 MHz | d_{im} | typ. | −60 dB

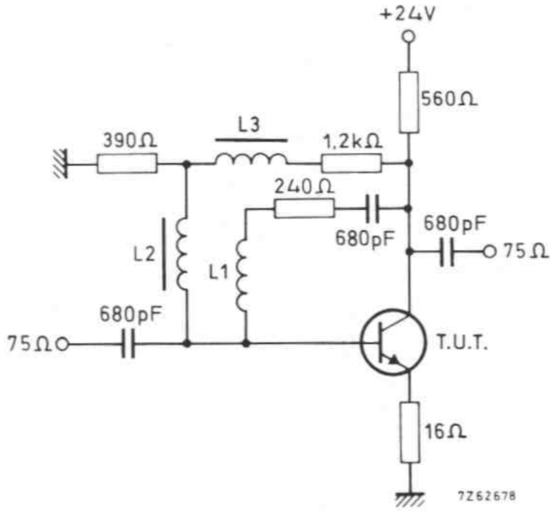


Fig. 2 Intermodulation test circuit.

L1 = 4 turns Cu wire (0,35); winding pitch 1 mm; int. dia. 4 mm
L2 and L3 5 μH (code number: 3122 108 20150)

* Crystal mounted in a BFR91 envelope.

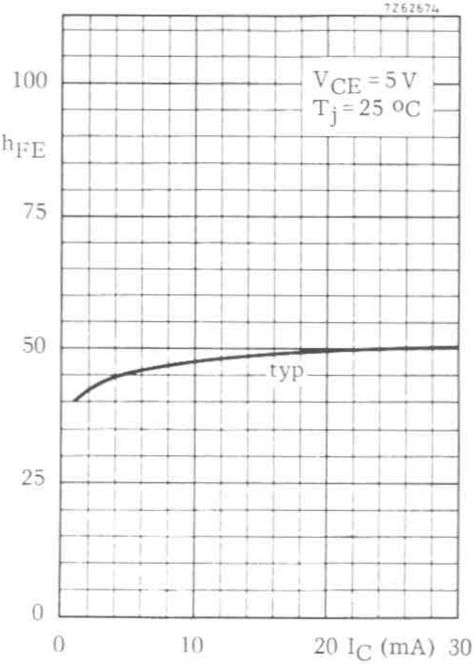


Fig. 3.

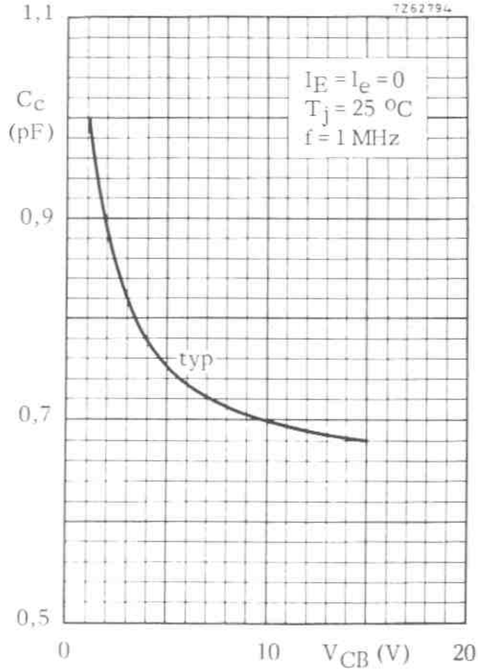


Fig. 4.

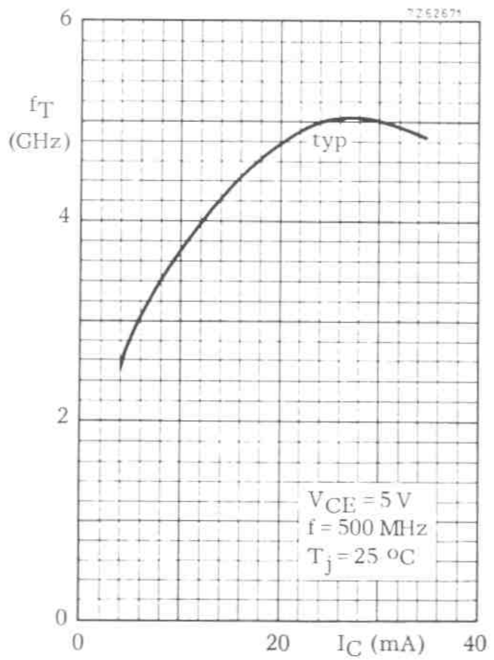


Fig. 5.

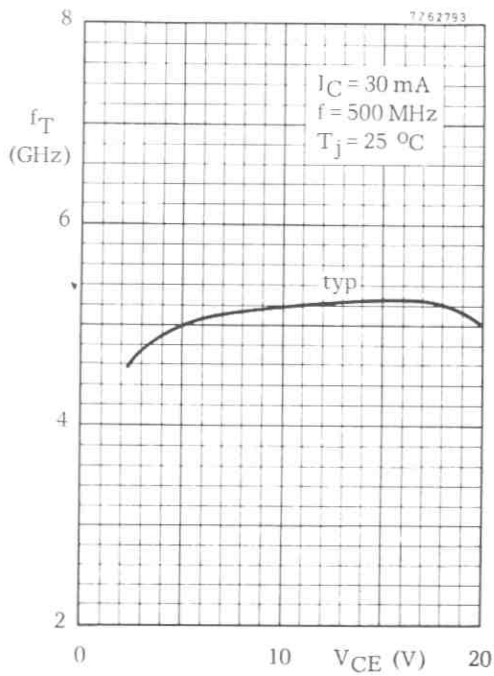
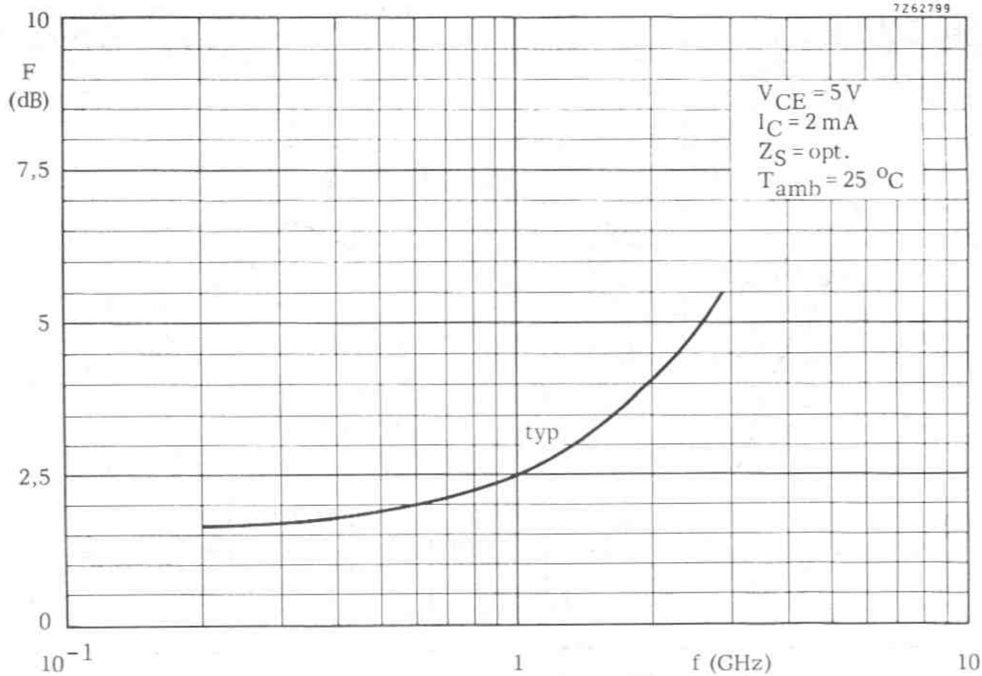
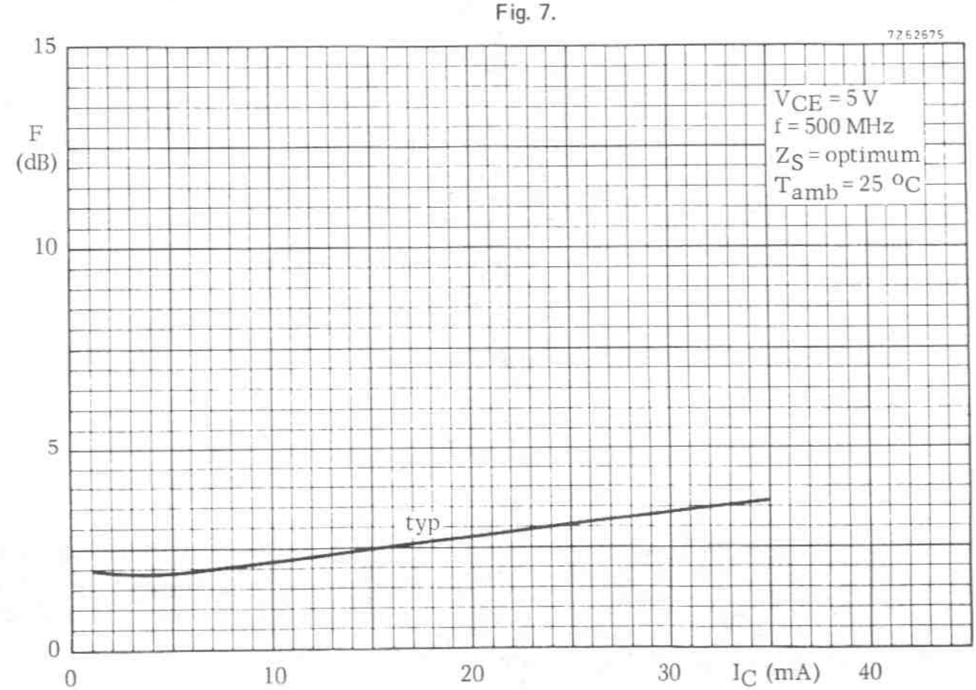


Fig. 6.


7Z62799
10
F
(dB)
7,5
5
2,5
0
$V_{CE} = 5$ V
$I_C = 2$ mA
Z_S = opt.
$T_{amb} = 25$ °C
typ
10^{-1}
1
f (GHz)
10
Fig. 7.


7Z62675
15
F
(dB)
10
5
0
$V_{CE} = 5$ V
f = 500 MHz
Z_S = optimum
$T_{amb} = 25$ °C
typ
0
10
20
30
I_C (mA)
40
Fig. 8.

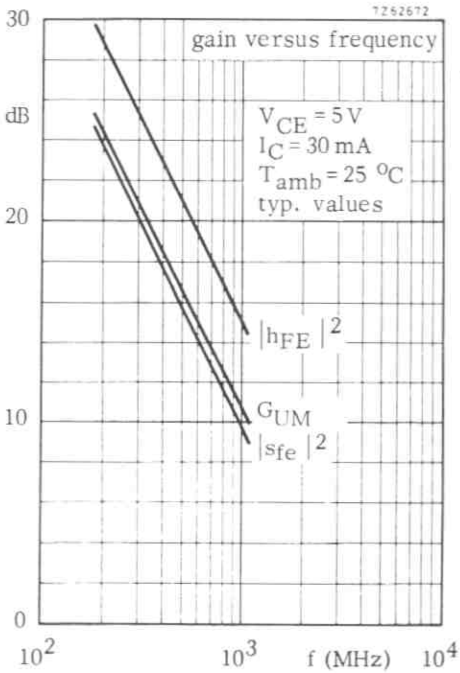

7Z62672
gain versus frequency
30
dB
20
10
0
V_{CE} = 5 V
I_C = 30 mA
T_{amb} = 25 °C
typ. values
$|h_{FE}|^2$
G_{UM}
$|s_{fe}|^2$
10^2
10^3
f (MHz)
10^4

Fig. 9.

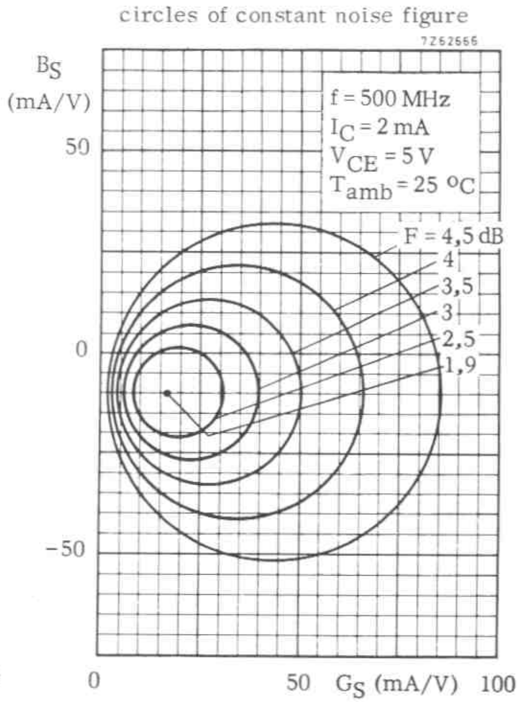

circles of constant noise figure
7Z62666
B_S (mA/V)
50
0
−50
f = 500 MHz
I_C = 2 mA
V_{CE} = 5 V
T_{amb} = 25 °C
F = 4,5 dB
4
3,5
3
2,5
1,9
0
50
G_S (mA/V)
100

Fig. 10.

V_{CE} = 5 V
I_C = 30 mA
T_{amb} = 25 °C

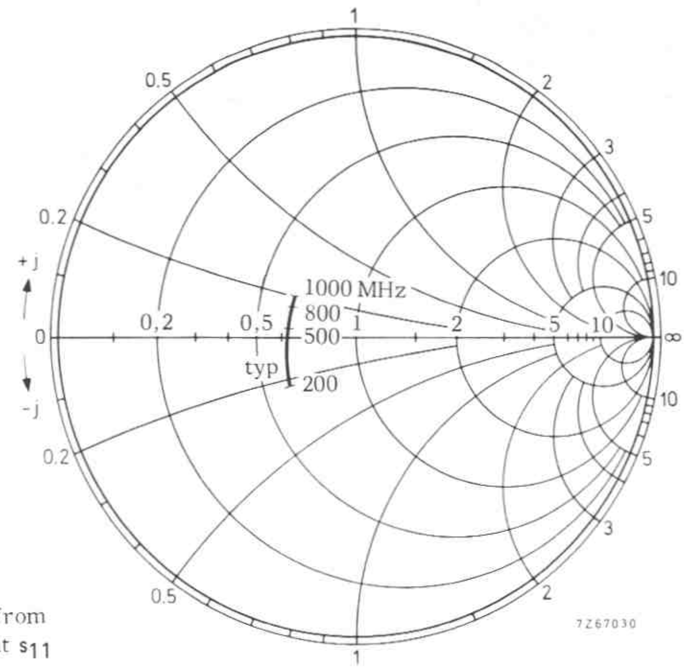


Fig. 11.

Input impedance derived from input reflection coefficient s_{11} coordinates in ohm x 50

V_{CE} = 5 V
I_C = 30 mA
T_{amb} = 25 °C

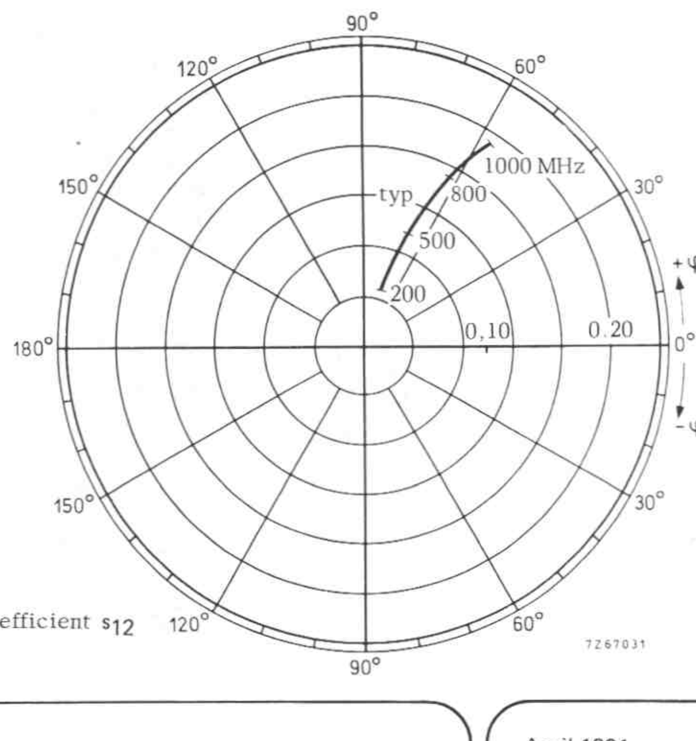


Fig. 12.

Reverse transmission coefficient s_{12}

V_{CE} = 5 V
I_C = 30 mA
T_{amb} = 25 °C

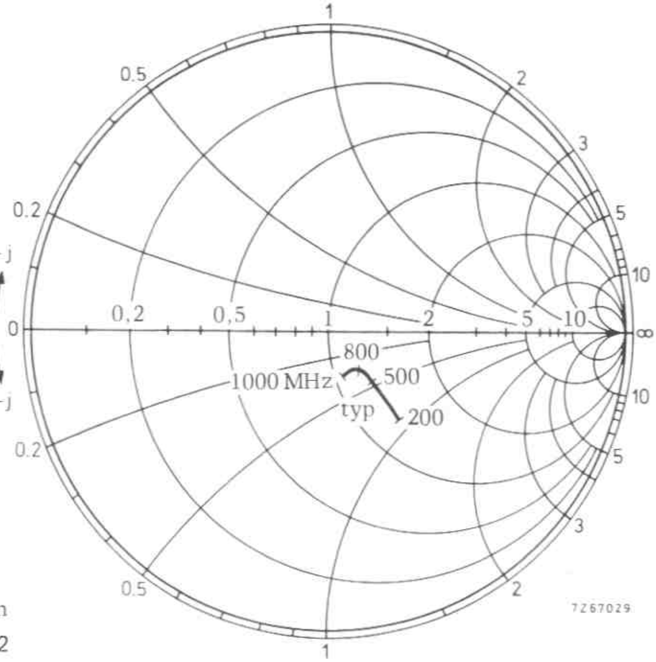


Fig. 13.

Output impedance derived from output reflection coefficient s_{22} coordinates in ohm x 50

V_{CE} = 5 V
I_C = 30 mA
T_{amb} = 25 °C

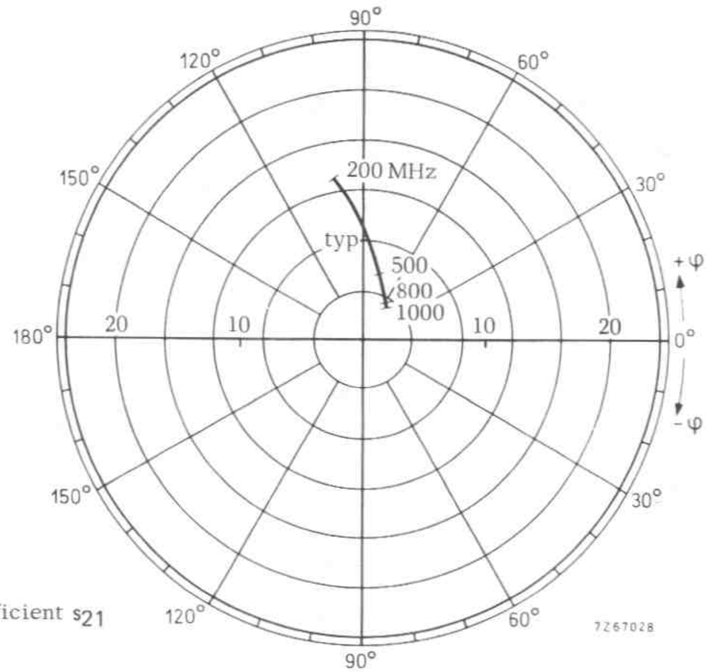


Fig. 14.

Forward transmission coefficient s_{21}

N-P-N 5 GHz WIDEBAND TRANSISTOR

N-P-N transistors in a SOT-23 plastic envelope.* They are primarily intended for use in v.h.f./u.h.f. broadband amplifiers. The transistors feature:

- low noise;
- very low intermodulation distortion;
- high power gain;
- P-N-P complement is the BFT93

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	15	V
Collector-emitter voltage (open base)	V_{CEO}	max.	12	V
Collector current (DC)	I_C	max.	35	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Junction temperature	T_j	max.	150	°C
Transition frequency at f = 500 MHz I_C = 30 mA; V_{CE} = 5 V	f_T	typ.	5	GHz
Feedback capacitance at f = 1 MHz I_C = 0; V_{CE} = 5 V; T_{amb} = 25 °C	C_{re}	typ.	0.6	pF
Noise figure at optimum source impedance I_C = 4 mA; V_{CE} = 8 V; f = 800 MHz	F	typ.	1.6	dB
Output voltage at d_{im} = −60 dB I_C = 30 mA; V_{CE} = 8 V; R_L = 75 Ω; T_{amb} = 25 °C $f_{(p+q-r)}$ = 793.25 MHz	V_o	typ.	425	mV

MECHANICAL DATA

Fig. 1 SOT-23.

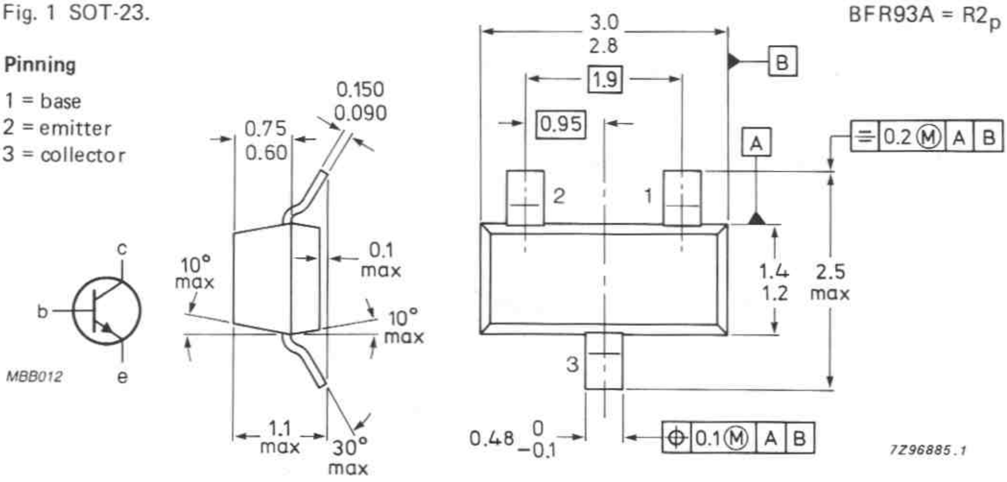
Dimensions in mm

Marking code

BFR93A = $R2_p$

Pinning

1 = base
2 = emitter
3 = collector



TOP VIEW

* If required, the R-version (reverse pinning) is available on request
TO92 version is also available on request: ref. ON 4186

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	15 V
Collector-emitter voltage (open base)	V_{CEO}	max.	12 V
Emitter-base voltage (open collector)	V_{EBO}	max.	2.0 V
Collector current (DC)	I_C	max.	35 mA
Total power dissipation up to T_{amb} = 25 °C *	P_{tot}	max.	300 mW
Storage temperature	T_{stg}	−65 to + 150 °C	
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	430 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current $I_E = 0$; $V_{CB} = 5$ V	I_{CBO}	max.	50 nA
DC current gain▲ $I_C = 30$ mA; $V_{CE} = 5$ V	h_{FE}	min. typ.	40 90
Transition frequency at f = 500 MHz▲ $I_C = 30$ mA; $V_{CE} = 5$ V	f_T	typ.	5 GHz
Collector capacitance at f = 1 MHz $I_E = I_e = 0$; $V_{CB} = 5$ V	C_c	typ.	0.7 pF
Emitter capacitance at f = 1 MHz $I_C = I_c = 0$; $V_{EB} = 0.5$ V	C_e	typ.	1.9 pF
Feedback capacitance at f = 1 MHz $I_C = 0$; $V_{CE} = 5$ V; $T_{amb} = 25$ °C	C_{re}	typ.	0.6 pF
Noise figure at optimum source impedance▲ $I_C = 4$ mA; $V_{CE} = 8$ V; f = 800 MHz $I_C = 30$ mA; $V_{CE} = 8$ V; f = 800 MHz	F F	typ. typ.	1.6 dB 2.3 dB

Maximum unilateral power gain (s_{12} assumed to be zero)
See Figs 10 to 15

$$G_{UM} \text{ (in dB)} = 10 \log \frac{|s_{21}|^2}{[1-|s_{11}|^2]\ [1-|s_{22}|^2]}$$

$I_C = 30$ mA; $V_{CE} = 8$ V; f = 800 MHz; $T_{amb} = 25$ °C	G_{UM}	typ.	14 dB

▲ Measured under pulse conditions.
* Mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.

Output voltage at d_{im} = −60 dB (see Figs 2 and 15)*
(DIN 45004B, par. 6.3: 3-tone)
I_C = 30 mA; V_{CE} = 8 V; R_L = 75 Ω; T_{amb} = 25 °C
$V_p = V_o$ at d_{im} = −60 dB; f_p = 795.25 MHz
$V_q = V_o$ −6 dB ; f_q = 803.25 MHz
$V_r = V_o$ −6 dB ; f_r = 805.25 MHz
Measured at $f_{(p+q-r)}$ = 793.25 MHz — V_o typ. 425 mV

Second harmonic distortion (see Figs 2 and 16)*
I_C = 30 mA; V_{CE} = 8 V; R_L = 75 Ω; T_{amb} = 25 °C
V_p = 200 mV at f_p = 250 MHz
V_q = 200 mV at f_q = 560 MHz
measured at $f_{(p+q)}$ = 810 MHz — d_2 typ. −50 dB

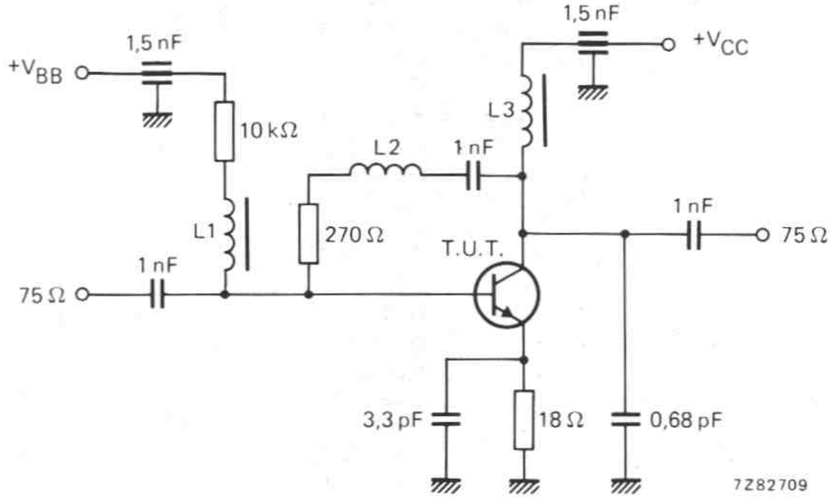


Fig. 2 Intermodulation distortion and second harmonic distortion MATV test circuit.

L1 = L3 = 5 μH micro choke
L2 = 3 turns Cu wire (0.4 mm); internal diameter 3 mm; winding pitch 1 mm.

* Measured on same crystal in a SOT-37 envelope (BFR91A).

s-parameters (common emitter)

V_{CE} V	I_C mA	f MHz	s_{11}	s_{12}	s_{21}	s_{22}
		40	0,89/ −12,4°	0,016/82,3°	7,0/171,8°	0,88/ −4,8°
		100	0,87/ −30,1°	0,038/74,2°	6,7/160,1°	0,96/−11,3°
		200	0,80/ −56,3°	0,067/61,8°	6,0/142,3°	0,88/−20,1°
5	2	500	0,64/−109,5°	0,106/44,3°	3,8/110,6°	0,69/−31,9°
		800	0,57/−140,3°	0,116/41,8°	2,7/ 91,5°	0,60/−35,5°
		1000	0,54/−154,5°	0,119/43,9°	2,2/ 82,8°	0,58/−38,0°
		1200	0,53/−166,6°	0,124/48,2°	1,9/ 75,1°	0,56/−40,2°
		40	0,77/ −19,9°	0,015/79,4°	15,1/166,8°	0,97/ −8,8°
		100	0,72/ −46,9°	0,033/68,6°	13,5/149,7°	0,89/−19,6°
		200	0,62/ −81,4°	0,053/57,0°	10,5/128,5°	0,73/−30,3°
5	5	500	0,48/−134,4°	0,079/52,6°	5,5/100,5°	0,51/−37,3°
		800	0,45/−159,8°	0,099/57,8°	3,6/ 85,6°	0,44/−37,9°
		1000	0,44/−170,8°	0,114/61,0°	3,0/ 78,8°	0,42/−39,3°
		1200	0,43/ 179,8°	0,131/64,2°	2,5/ 72,9°	0,41/−40,9°
		40	0,63/ −29,7°	0,013/76,5°	24,4/161,0°	0,95/−13,5°
		100	0,56/ −66,2°	0,028/64,8°	20,0/139,4°	0,80/−17,8°
		200	0,47/−105,4°	0,042/57,8°	13,6/118,0°	0,59/−37,3°
5	10	500	0,41/−152,0°	0,070/62,6°	6,4/ 94,8°	0,39/−39,0°
		800	0,39/−171,7°	0,099/67,6°	4,1/ 82,7°	0,35/−38,2°
		1000	0,39/ 179,6°	0,119/69,1°	3,4/ 76,7°	0,34/−39,1°
		1200	0,39/ 171,6°	0,140/70,5°	2,8/ 71,5°	0,33/−40,7°
		40	0,47/ −44,2°	0,012/73,8°	35,2/154,0°	0,90/−19,2°
		100	0,42/ −90,7°	0,023/63,9°	25,4/129,3°	0,68/−35,0°
		200	0,39/−129,4°	0,034/62,9°	15,6/109,7°	0,47/−41,0°
5	20	500	0,37/−165,1°	0,067/70,5°	6,8/ 90,9°	0,32/−38,4°
		800	0,37/ 179,5°	0,101/73,2°	4,4/ 80,3°	0,29/−37,4°
		1000	0,36/ 173,0°	0,124/73,4°	3,6/ 75,4°	0,29/−38,3°
		1200	0,37/ 166,2°	0,148/73,6°	3,0/ 70,3°	0,28/−40,0°
		40	0,39/ −56,3°	0,011/72,3°	40,8/149,5°	0,86/−22,5°
		100	0,38/−106,8°	0,021/64,5°	27,4/124,0°	0,61/−37,9°
		200	0,37/−141,6°	0,032/66,4°	16,0/105,8°	0,41/−41,1°
5	30	500	0,37/−171,0°	0,067/73,5°	6,9/ 88,9°	0,29/−36,6°
		800	0,37/ 175,9°	0,102/75,2°	4,4/ 79,1°	0,27/−36,0°
		1000	0,36/ 170,0°	0,126/74,8°	3,6/ 74,2°	0,27/−37,1°
		1200	0,37/ 163,9°	0,150/74,6°	3,0/ 69,5°	0,27/−39,0°

s-parameters (common emitter)

V_{CE} V	I_C mA	f MHz	s_{11}	s_{12}	s_{21}	s_{22}
8	2	40	0,90/ −12,2°	0,015/82,1°	6,9/171,7°	0,99/ −4,8°
		100	0,88/ −29,2°	0,036/74,5°	6,6/160,4°	0,96/−10,8°
		200	0,81/ −54,7°	0,064/62,4°	5,9/143,1°	0,89/−19,2°
		500	0,64/−107,0°	0,103/44,9°	3,8/111,5°	0,71/−30,6°
		800	0,56/−138,1°	0,112/42,1°	2,7/ 92,2°	0,62/−34,1°
		1000	0,54/−152,6°	0,116/44,1°	2,3/ 83,6°	0,60/−36,4°
		1200	0,52/−165,2°	0,120/48,5°	1,9/ 75,9°	0,58/−38,6°
8	5	40	0,78/ −19,2°	0,014/79,4°	14,8/166,9°	0,98/ −8,6°
		100	0,73/ −44,6°	0,032/69,0°	13,5/150,4°	0,90/−18,7°
		200	0,63/ −78,1°	0,051/57,5°	10,5/129,4°	0,75/−28,9°
		500	0,48/−131,2°	0,077/52,5°	5,6/101,3°	0,53/−35,7°
		800	0,44/−157,3°	0,096/57,7°	3,7/ 86,3°	0,46/−36,2°
		1000	0,42/−168,3°	0,110/61,0°	3,0/ 79,5°	0,44/−37,5°
		1200	0,42/−178,3°	0,126/64,3°	2,6/ 73,6°	0,43/−39,0°
8	10	40	0,66/ −27,7°	0,013/76,7°	24,0/161,5°	0,95/−12,9°
		100	0,58/ −62,0°	0,027/65,4°	19,9/140,4°	0,81/−26,3°
		200	0,48/−100,1°	0,041/58,0°	13,8/119,0°	0,61/−35,5°
		500	0,40/−148,2°	0,068/62,2°	6,5/ 95,4°	0,42/−37,0°
		800	0,38/−169,1°	0,096/67,4°	4,2/ 83,0°	0,37/−36,2°
		1000	0,37/−178,3°	0,116/69,0°	3,4/ 77,4°	0,36/−37,0°
		1200	0,37/ 173,6°	0,136/70,5°	2,9/ 72,5°	0,35/−38,5°
8	20	40	0,53/ −39,6°	0,012/73,8°	34,7/154,8°	0,91/−18,1°
		100	0,45/ −83,0°	0,023/63,9°	25,6/130,5°	0,70/−33,2°
		200	0,39/−122,0°	0,034/62,2°	15,9/110,6°	0,49/−39,0°
		500	0,35/−161,3°	0,066/69,7°	7,0/ 91,4°	0,34/−36,2°
		800	0,35/−177,9°	0,098/72,7°	4,5/ 80,7°	0,31/−35,1°
		1000	0,34/ 175,2°	0,121/73,1°	3,7/ 75,8°	0,31/−36,0°
		1200	0,34/ 168,3°	0,143/73,4°	3,1/ 71,2°	0,30/−37,5°
8	30	40	0,47/ −48,0°	0,011/72,2°	40,3/150,8°	0,87/−20,9°
		100	0,41/ −95,5°	0,021/63,8°	27,5/125,4°	0,63/−35,7°
		200	0,36/−132,8°	0,032/64,9°	16,4/106,8°	0,44/−38,9°
		500	0,35/−166,6°	0,065/72,3°	7,1/ 89,6°	0,32/−34,4°
		800	0,34/ 178,8°	0,100/74,4°	4,5/ 79,7°	0,30/−33,6°
		1000	0,34/ 172,7°	0,122/74,4°	3,7/ 74,7°	0,30/−34,7°
		1200	0,34/ 166,0°	0,145/74,3°	3,1/ 70,3°	0,29/−36,5°

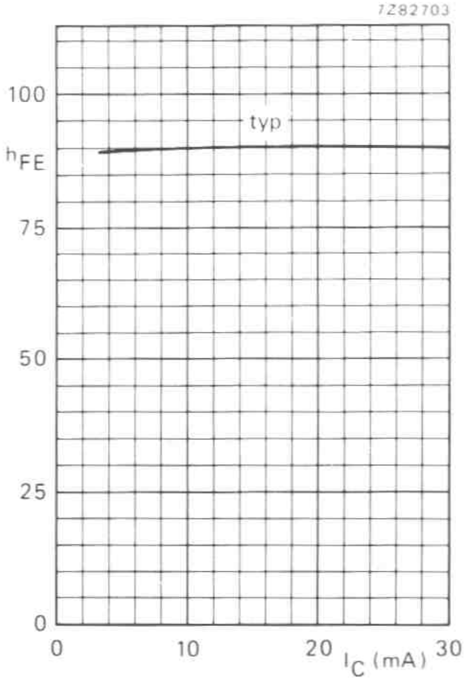


Fig. 3 V_{CE} = 5 V; T_j = 25 °C.

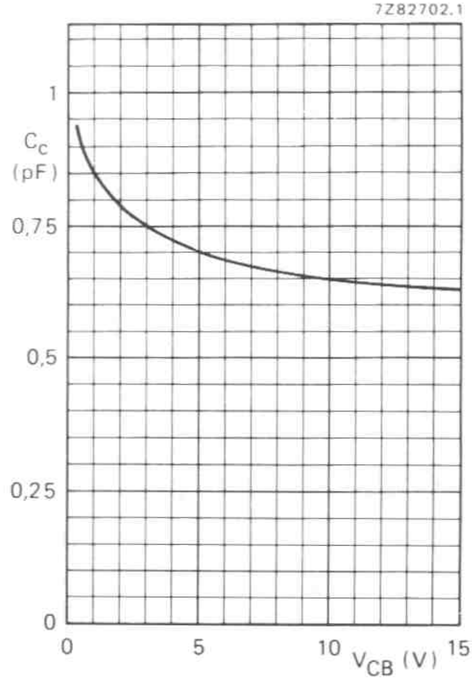


Fig. 4 Typical values collector capacitance
$I_E = I_e = 0$; f = 1 MHz; T_j = 25 °C.

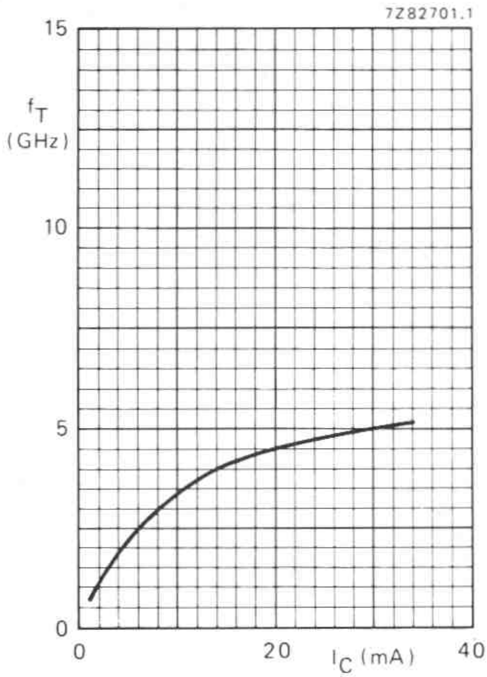


Fig. 5 Typical values transition frequency at V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C.

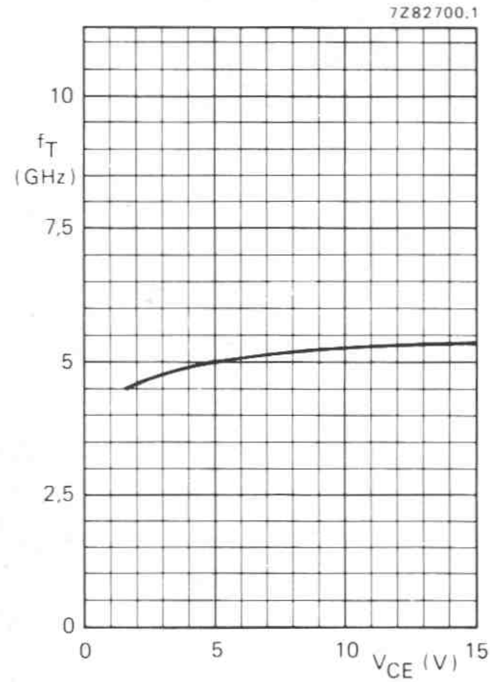


Fig. 6 Typical values transition frequency at I_C = 30 mA; f = 500 MHz; T_j = 25 °C.

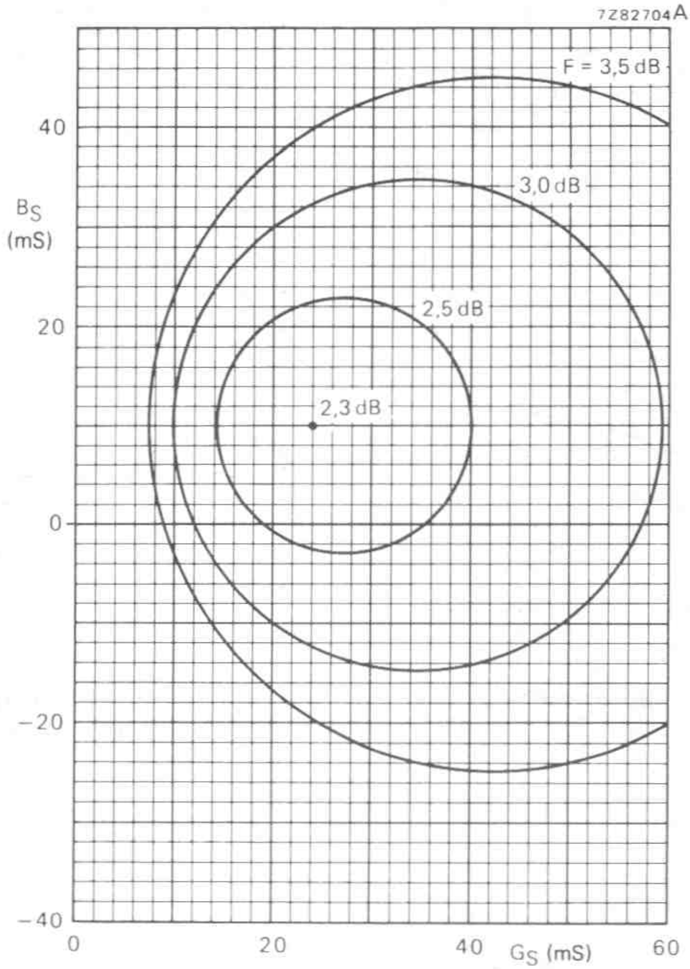


Fig. 7 Circles of constant noise figure.
V_{CE} = 8 V; I_C = 30 mA; f = 800 MHz;
T_{amb} = 25 °C; typical values.

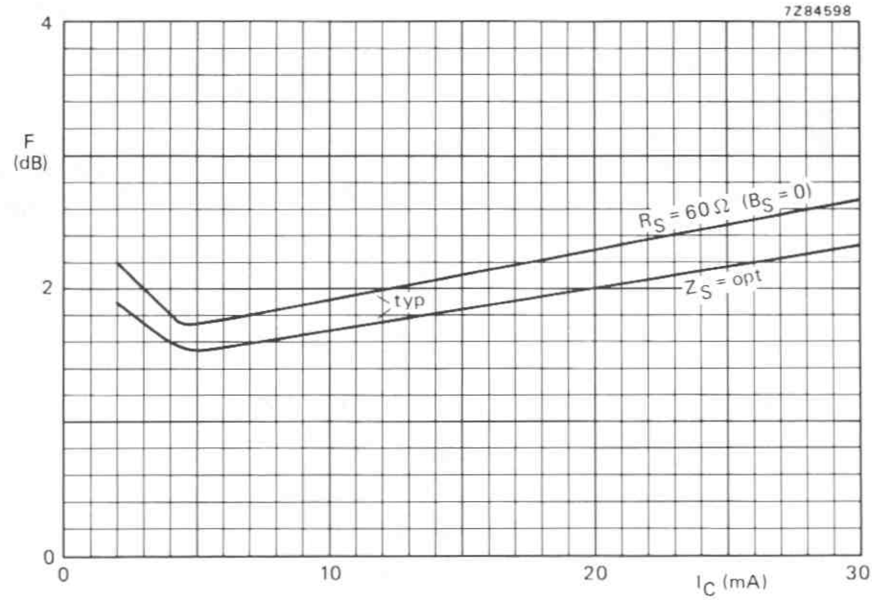


Fig. 8 V_{CE} = 8 V; f = 800 MHz; T_{amb} = 25 °C.

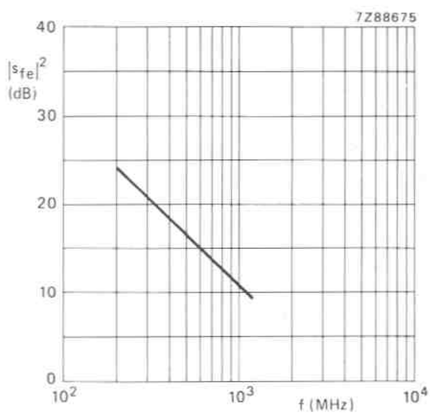


Fig. 9 Typical values forward transmission coefficient as a function of frequency. V_{CE} = 8 V; I_C = 30 mA; T_{amb} = 25 °C.

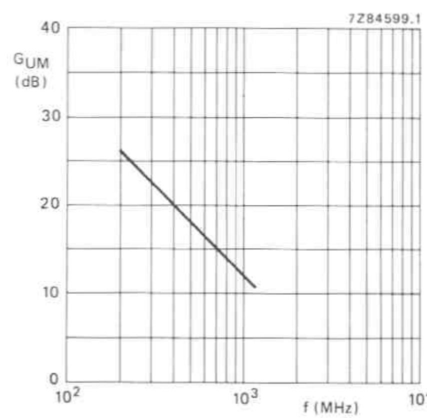


Fig. 10 Typical values unilateral power power gain as a function of frequency. V_{CE} = 8 V; I_C = 30 mA; T_{amb} = 25 °C.

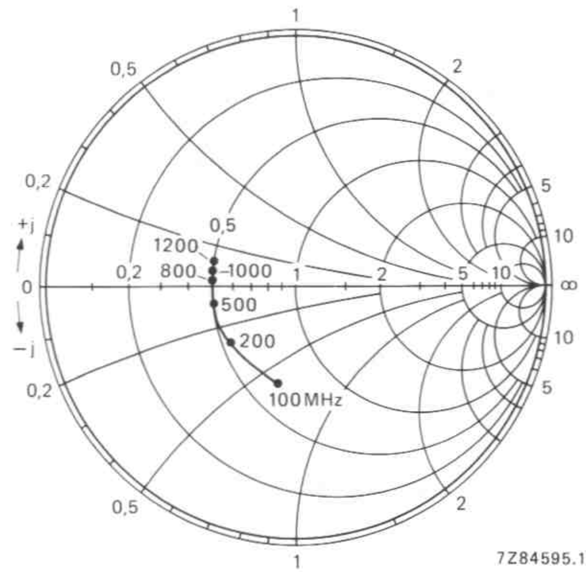


Fig. 11 Input impedance derived from input reflection coefficient s_{11} co-ordinates in ohm x 50.
V_{CE} = 8 V; I_C = 30 mA; T_{amb} = 25 °C.

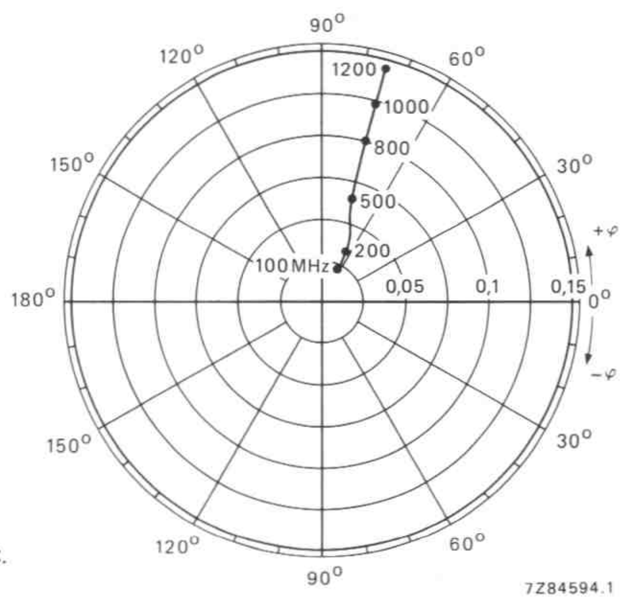


Fig. 12 Reverse transmission coefficient s_{12}
V_{CE} = 8 V; I_C = 30 mA; T_{amb} = 25 °C.

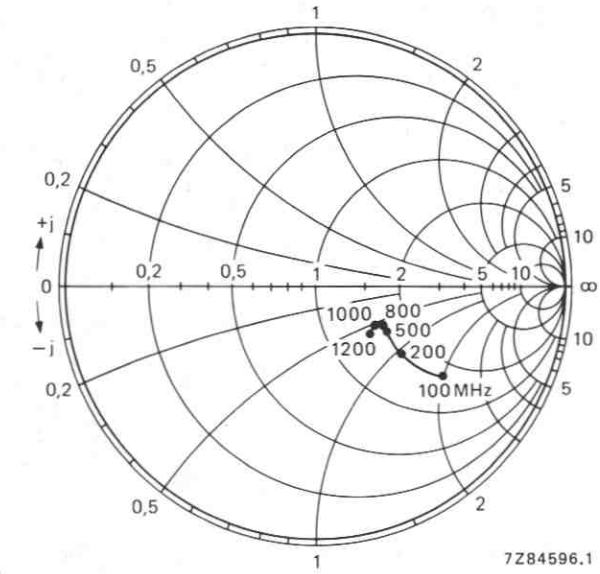


Fig. 13 Output impedance derived from output reflection coefficient s_{22} co-ordinates in ohm x 50.
V_{CE} = 8 V; I_C = 30 mA; T_{amb} = 25 °C.

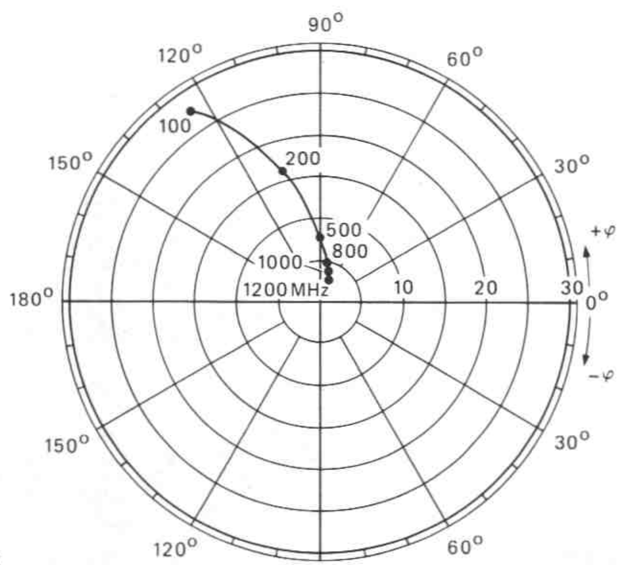


Fig. 14 Forward transmission coefficient s_{21}
V_{CE} = 8 V; I_C = 30 mA; T_{amb} = 25 °C.

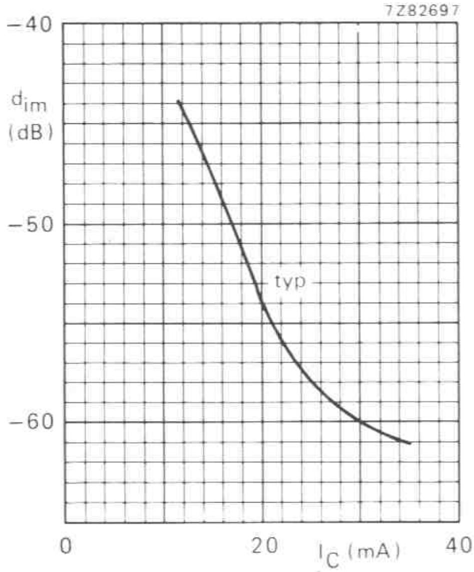


Fig. 15 V_{CE} = 8 V; V_o = 425 mV = 52,6 dBmV; $f_{(p+q-r)}$ = 793,25 MHz; T_{amb} = 25 °C; measured in MATV test circuit (see Fig. 2).

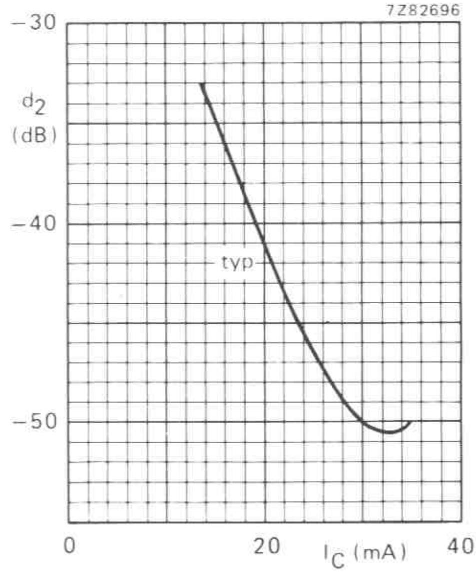


Fig. 16 V_{CE} = 8 V; V_o = 200 mV = 46 dBmV; $f_{(p+q)}$ = 810 MHz; T_{amb} = 25 °C; measured in MATV test circuit (see Fig. 2).

N-CHANNEL JUNCTION FIELD-EFFECT TRANSISTOR

Symmetrical n-channel silicon junction field-effect transistor, designed primarily for use as a source follower with the input protected against successive voltage surges by a forward and reverse integrated diode.

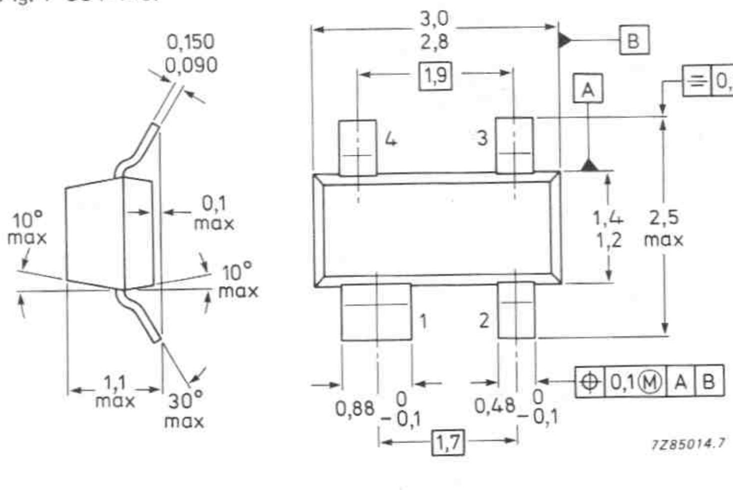
QUICK REFERENCE DATA

Drain-source voltage	$\pm V_{DS}$	max.	30 V
Gate-source voltage (open drain)	$-V_{GS}$	max.	30 V
Total power dissipation up to T_{amb} = 60 °C	P_{tot}	max.	200 mW
Drain current			
V_{DS} = 6 V; V_{GS} = 0: BFR101A	I_{DSS}		0,2 to 1,5 mA
V_{DS} = 6 V; V_{GS} = 0: BFR101B	I_{DSS}		1,0 to 5,0 mA
Transfer admittance (common source)			
V_{DS} = 6 V; V_{GS} = 0; f = 1 kHz: BFR101A	$\lvert y_{fs} \rvert$	>	1,2 mS
V_{DS} = 6 V; V_{GS} = 0; f = 1 kHz: BFR101B	$\lvert y_{fs} \rvert$	>	2,5 mS

MECHANICAL DATA

Dimensions in mm

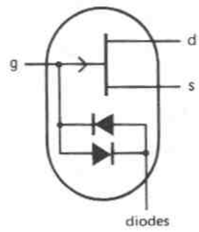
Fig. 1 SOT-143.



TOP VIEW

Marking code

BFR101A = M97
BFR101B = M98



Pinning

1 = gate
2 = diodes
3 = source
4 = drain

Note: Drain and source are interchangeable.

See also *Soldering recommendations.*

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	$\pm V_{DS}$	max.	30 V
Drain-gate voltage (open source)	V_{DGO}	max.	30 V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	30 V
Drain current (d.c.)	I_D	max.	20 mA
Gate current (d.c.)	I_G	max.	10 mA
Total power dissipation up to T_{amb} = 60 °C*	P_{tot}	max.	200 mW
Storage temperature	T_{stg}		−65 to + 150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient in free air*	$R_{th\ j\text{-}a}$	=	460 K/W

CHARACTERISTICS with source connected to case for all measurements

T_j = 25 °C unless otherwise specified

		BFR101A	BFR101B
Gate leakage current V_{DS} = 6 V; I_D = 10 μA	$-I_G$	< 5	5 nA
Drain current V_{DS} = 6 V; V_{GS} = 0	I_{DSS}	0,2 to 1,5	1 to 5 mA
Gate-source cut-off voltage V_{DS} = 6 V; I_D = 1 μA	$-V_{(P)GS}$	0,2 to 1	0,5 to 2,5 V
Small-signal common-source characteristics V_{DS} = 6 V; V_{GS} = 0, T_{amb} = 25 °C			
Transfer admittance f = 1 kHz	$\lvert y_{fs} \rvert$	> 1,2	2,5 mS
Output admittance at f = 1 kHz	$\lvert y_{os} \rvert$	typ. 10	50 mS
Input capacitance at f = 1 MHz diodes not connected	C_{is}	< 5	5 pF
Diode capacitance V_D = 0; source and drain not connected	C_d	typ. 0,7	0,7 pF
Diode forward voltage $\pm I_F$ = 10 mA	V_F	0,7 to 1,2	0,7 to 1,2 V

* Device mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

NPN 3 GHz WIDEBAND TRANSISTOR

The BFR106 is a npn silicon planar epitaxial transistor in a SOT23 microminiature plastic envelope. It is primarily intended for low noise, general RF applications using SMD-technology.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	20 V
Collector-emitter voltage (open base)	V_{CEO}	max.	15 V
Collector current (DC)	I_C	max.	100 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	350 mW
Junction temperature	T_j	max.	150 °C
DC current gain I_C = 30 mA; V_{CE} = 6 V	h_{FE}	min.	25
Transition frequency at f = 500 MHz I_C = 30 mA; V_{CE} = 6 V	f_T	typ.	3.7 GHz
Maximum unilateral power gain at f = 800 MHz I_C = 30 mA; V_{CE} = 6 V; T_{amb} = 25 °C	G_{UM}	typ.	11.5 dB
Output voltage at d_{im} = −60 dB I_C = 30 mA; V_{CE} = 6 V; R_L = 75 Ω; T_{amb} 25 °C $f_{(p+q-r)}$ = 793.25 MHz	V_O	typ.	250 mV

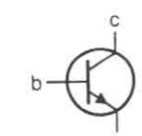
MECHANICAL DATA

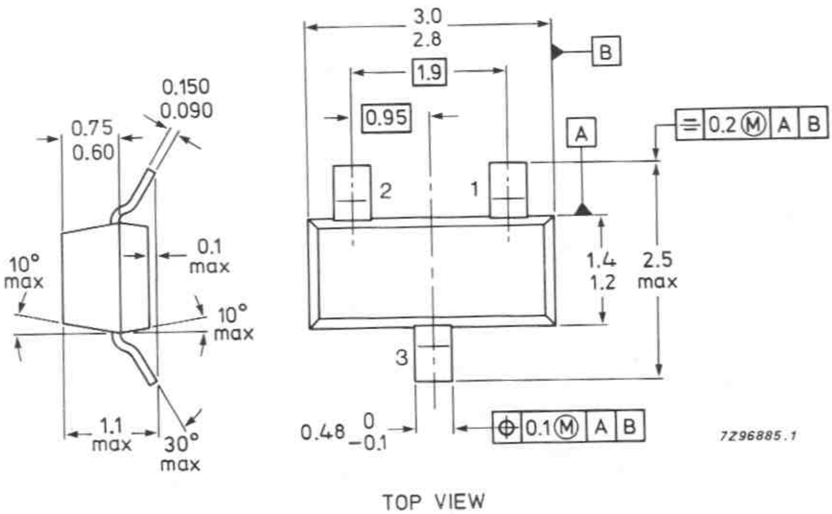
Fig.1 SOT23.

Marking code: R7

Pinning

1 = base
2 = emitter
3 = collector





RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134).

Collector-base voltage (open emitter)	V_{CBO}	max.	20 V
Collector-emitter voltage (open base)	V_{CEO}	max.	15 V
Emitter-base voltage (open collector)	V_{EBO}	max.	3 V
Collector current (DC)	I_C	max.	100 mA
Total power dissipation up to T_{amb} = 25 °C (note 1)	P_{tot}	max.	350 mW
Storage temperature range	T_{stg}		−65 to +150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient in free air mounted on a ceramic substrate of 8 x 10 x 0.7 mm	$R_{th\ j\text{-}a}$	=	430 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

Collector cut-off current $I_E = 0$; $V_{CB} = 10$ V	I_{CBO}	max.	100 nA
DC current gain $I_E = 30$ mA; $V_{CE} = 6$ V	h_{FE}	min.	25
Transition frequency at f = 500 MHz $I_E = 30$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C	f_T	typ.	3.7 GHz
Collector capacitance at f = 1 MHz $I_E = i_e = 0$; $V_{CB} = 10$ V	C_c	typ.	1.5 pF
Emitter capacitance at f = 1 MHz $I_C = i_c = 0$; $V_{EB} = 0.5$ V	C_e	typ.	4.5 pF
Feedback capacitance at f = 1 MHz $I_C = 0$; $V_{CE} = 10$ V	C_{re}	typ.	1.2 pF
Noise figure at optimum source impedance $I_C = 30$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 800 MHz	F	typ.	3.5 dB
Maximum unilateral power gain at f = 800 MHz; $I_E = 30$ mA; $V_{CE} = 6$V; $T_{amb} = 25$ °C $G_{UM} = 10 \log \frac{\|S_{21}\|^2}{(1-\|S_{11}\|^2)(1-\|S_{22}\|^2)}$	G_{UM}	typ.	11.5 dB
Output voltage at $d_{im} = -60$ dB $T_{amb} = 25$ °C; $I_C = 50$ mA; $V_{CE} = 7$ V; $R_L = 75\ \Omega$; $f_{(p+q-r)} = 793.25$ MHz	V_O	typ.	350 mV
Second harmonic distortion $T_{amb} = 25$ °C $I_C = 30$ mA; $V_{CE} = 6$ V; $R_L = 75\ \Omega$; $f_{(p+q)} = 810$ MHz; $V_O = 100$ mV	d_2	typ.	−50 dB

Note

1. Mounted on a ceramic substrate measuring 8 × 10 × 0.7 mm.

S-parameters (common emitter) at V_{CE} = 6 V; T_{amb} = 25 °C; typical values.

I_C mA	f MHz	S_{11} M Φ	S_{21} M Φ	S_{12} M Φ	S_{22} M Φ	G_{UM} dB
5	40	0.64/ −34.5	13.18/161.8	0.03/ 73.7	0.95/ −14.3	35.3
	100	0.64/ −82.0	10.59/136.0	0.05/ 55.7	0.80/ −33.1	27.3
	200	0.62/−123.3	6.88/114.5	0.07/ 43.8	0.56/ −45.8	20.5
	500	0.62/−165.0	3.20/ 86.8	0.09/ 42.0	0.40/ −58.3	13.0
	800	0.62/−177.7	2.11/ 74.0	0.11/ 51.8	0.40/ −66.7	9.4
	1000	0.63/ 173.8	1.69/ 66.5	0.12/ 57.3	0.41/ −70.5	7.6
	1200	0.64/ 166.0	1.40/ 61.9	0.13/ 63.9	0.40/ −76.7	6.0
	1500	0.62/ 159.5	1.21/ 54.1	0.17/ 68.7	0.41/ −84.0	4.6
	2000	0.60/ 142.6	.97/ 46.2	0.24/ 75.1	0.44/ −97.1	2.6
10	40	0.50/ −50.7	21.09/156.1	0.02/ 70.8	0.92/ −22.0	35.9
	100	0.55/−105.9	14.96/128.3	0.04/ 53.1	0.68/ −46.5	27.7
	200	0.57/−141.8	8.99/109.0	0.05/ 47.9	0.43/ −61.3	21.7
	500	0.59/−173.6	3.94/ 85.6	0.08/ 54.6	0.27/ −77.5	14.1
	800	0.59/ 176.7	2.59/ 74.7	0.11/ 62.5	0.28/ −82.4	10.4
	1000	0.59/ 169.0	2.07/ 68.1	0.13/ 65.5	0.28/ −84.8	8.6
	1200	0.60/ 161.6	1.73/ 64.4	0.15/ 69.1	0.26/ −88.8	7.0
	1500	0.58/ 156.9	1.49/ 56.3	0.19/ 69.6	0.29/ −93.9	5.6
	2000	0.55/ 140.8	1.19/ 48.0	0.26/ 71.4	0.31/−102.0	3.5
15	40	0.43/ −64.3	26.39/152.1	0.02/ 68.2	0.88/ −27.6	35.8
	100	0.52/−120.3	17.38/123.8	0.03/ 53.9	0.60/ −55.5	28.1
	200	0.56/−151.1	10.12/106.0	0.05/ 52.2	0.36/ −72.4	22.3
	500	0.58/−177.5	4.29/ 85.1	0.08/ 61.3	0.23/ −93.2	14.6
	800	0.57/ 174.0	2.82/ 75.0	0.12/ 66.9	0.23/ −95.8	10.9
	1000	0.58/ 166.8	2.25/ 69.0	0.14/ 68.3	0.23/ −97.8	9.0
	1200	0.59/ 159.5	1.89/ 65.4	0.16/ 71.0	0.21/−100.0	7.5
	1500	0.56/ 155.6	1.63/ 57.5	0.21/ 69.9	0.24/−103.1	6.1
	2000	0.52/ 139.7	1.30/ 49.1	0.28/ 70.1	0.26/−107.7	4.0
20	40	0.40/ −76.0	30.55/148.9	0.02/ 64.9	0.85/ −32.1	36.1
	100	0.51/−129.8	19.05/120.7	0.03/ 54.2	0.55/ −62.2	28.5
	200	0.55/−156.8	10.72/104.0	0.04/ 55.8	0.33/ −80.9	22.7
	500	0.57/−179.9	4.49/ 84.6	0.08/ 65.1	0.21/−105.3	15.0
	800	0.56/ 172.5	2.95/ 75.0	0.12/ 69.1	0.21/−106.4	11.2
	1000	0.57/ 165.5	2.36/ 69.3	0.14/ 69.9	0.20/−107.7	9.3
	1200	0.58/ 158.1	1.98/ 66.1	0.17/ 71.8	0.18/−110.9	7.8
	1500	0.54/ 154.7	1.71/ 58.0	0.21/ 69.9	0.21/−111.3	6.4
	2000	0.51/ 138.9	1.37/ 49.8	0.29/ 69.2	0.22/−113.1	4.3
30	40	0.37/ −92.2	36.02/144.4	0.02/ 63.6	0.80/ −38.5	36.3
	100	0.51/−140.5	20.70/116.7	0.03/ 55.5	0.49/ −71.4	28.8
	200	0.54/−161.9	11.40/101.8	0.04/ 60.71	0.29/ −92.7	23.0
	500	0.56/ 177.6	4.70/ 84.1	0.08/ 69.0	0.20/−120.5	15.3
	800	0.55/ 170.8	3.09/ 75.0	0.12/ 71.6	0.20/ 161.4	11.5
	1000	0.56/ 164.1	2.46/ 69.5	0.15/ 71.2	0.19/−122.1	9.6
	1200	0.57/ 156.8	2.07/ 66.6	0.17/ 73.0	0.16/−126.6	8.1
	1500	0.53/ 153.9	1.79/ 58.5	0.22/ 70.1	0.19/−122.2	6.7
	2000	0.49/ 138.0	1.44/ 50.5	0.29/ 68.6	0.19/−121.1	4.5

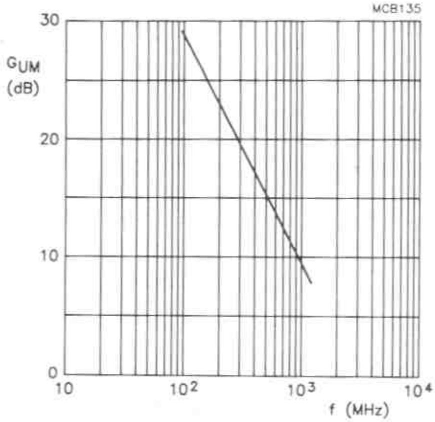


Fig. 2 Maximum power gain as a function of frequency; V_{CE} = 6 V; I_C = 30 mA; T_{amb} = 25 °C.

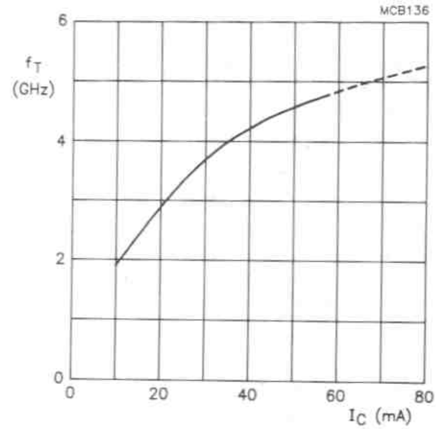


Fig. 3 Transition frequency as a function of collector current; V_{CE} = 6 V; f = 500 MHz; T_j = 25 °C.

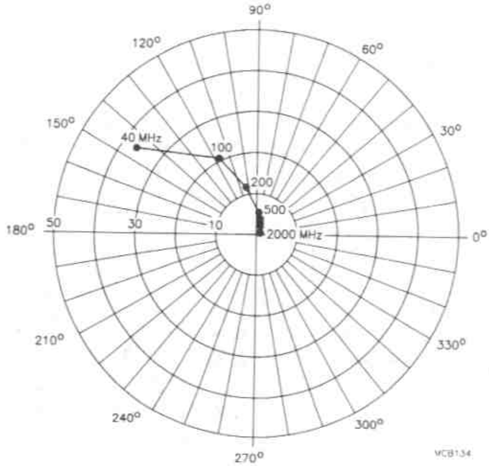


Fig.4 Forward transmission coefficient S_{21}; V_{CE} = 6 V; I_C = 30 mA; T_{amb} = 25 °C.

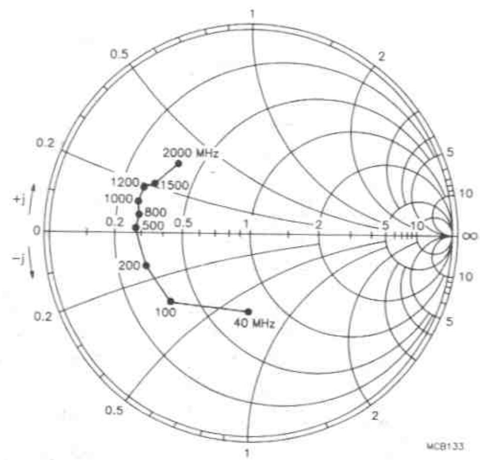


Fig.5 Input impedance derived from S_{11} (in Ohm x 50); V_{CE} = 6 V; I_C = 30 mA; T_{amb} = 25 °C.

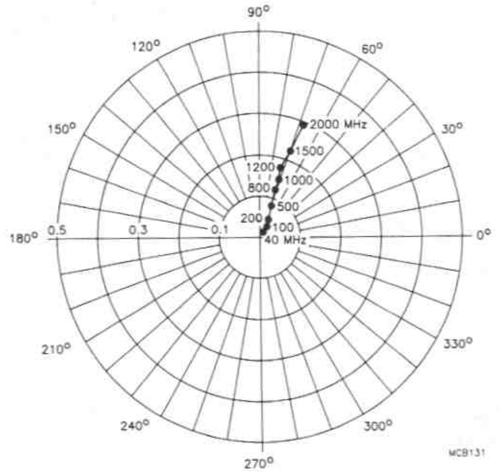


Fig. 6 Reverse transmission coefficient S_{12}; V_{CE} = 6 V; I_C = 30 mA; T_{amb} = 25 °C.

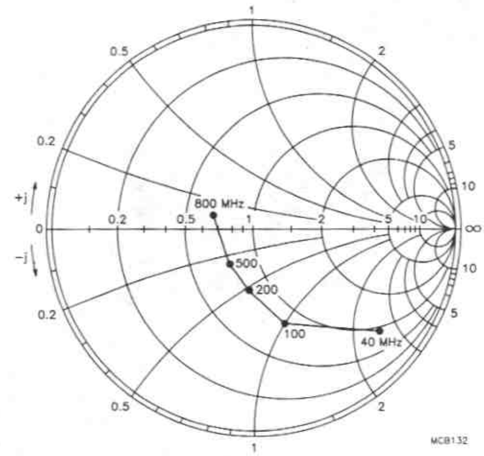


Fig. 7 Output impedance derived from S_{22} (in Ohm x 50); V_{CE} = 6 V; I_C = 30 mA; T_{amb} = 25 °C.

Philips Components

Data sheet	
status	Preliminary specification
date of issue	April 1991

BFR200

N-channel junction field-effect transistor

FEATURES

- Ultra-low leakage performance ($-I_{GSS}$ max. 3 pA); important for use in highly sensitive equipment, such as burglar alarms, infrared sensors, etc.
- Insensitive to radio frequency interference (RFI), owing to an integrated low pass filter.
- Input protected against successive voltage surges by a forward and reverse integrated diode.
- Low LF noise performance (20 nV/$\sqrt{Hz}$).

DESCRIPTION

Silicon asymmetrical n-channel junction FET in a surface mount SOT143 envelope, with an integrated RC low pass filter and two anti-parallel diodes connected to the gate. It is designed primarily for use as a source follower in infrared detectors, burglar alarms, electret microphones, smoke alarms and radiation detectors.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage	-	30	V
I_{DSS}	drain current	0.2	3.5	mA
$-V_{GS(off)}$	gate-source cut-off voltage	0.5	2	V

N-channel junction field-effect transistor

BFR200

MECHANICAL DATA

Dimensions in mm

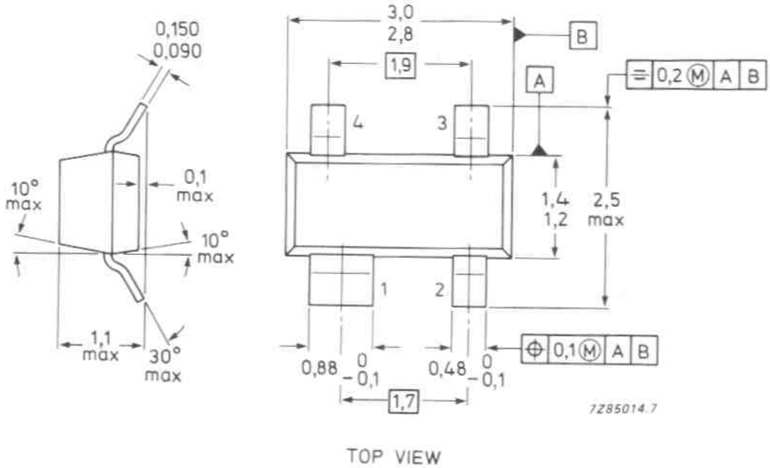


Fig.1 SOT143.

PIN CONFIGURATION

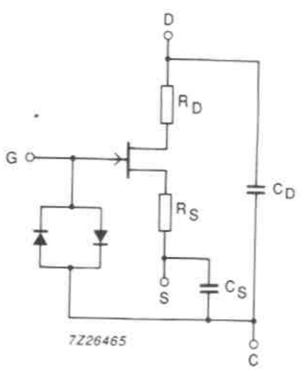


Fig.2 Pin configuration.

PINNING

PIN	DESCRIPTION
1	gate
2	common
3	source
4	drain

Marking: BFR200 = M20

N-channel junction field-effect transistor BFR200

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$\pm V_{DS}$	drain-source voltage		-	30	V
$-V_{GSO}$	gate-source voltage		-	30	V
$-V_{GDO}$	gate-drain voltage		-	30	V
I_D	drain current	DC	-	20	mA
I_G	forward gate current	DC	-	10	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	-	250	mW
T_{stg}	storage temperature range		−65	150	°C
T_j	operating junction temperature		-	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}a}$	from junction to ambient (note 1)	500	K/W

Notes

1. Mounted on FR4 printboard.

N-channel junction field-effect transistor | BFR200

STATIC CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$-V_{(BR)GSS}$	gate-source breakdown voltage	$V_{DS} = 0$ $-I_G = 1$ μA	30	-	-	V
I_{DSS}	drain current	$V_{DS} = 6$ V $V_{GS} = 0$	0.2	-	3.5	mA
$-I_{GSS}$	gate-source leakage current (note 1)	$-V_{GS} = 6$ V $V_{DS} = 0$ $V_{GC} = 0$	-	-	3	pA
$-V_{GS(off)}$	gate-source cut-off voltage	$I_D = 0.1$ μA $V_{DS} = 6$ V	0.5	-	2	V
V_F	diode forward voltage	$\pm I_F = 10$ mA	0.7	-	1.2	V
R_D	drain resistance		-	800	-	Ω
R_S	source resistance		-	180	-	Ω

Notes

1. Based on level I, AQL 1.5%.

DYNAMIC CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$\lvert Y_{fs} \rvert$	transfer admittance	$V_{DS} = 6$ V $V_{GS} = 0$	1.3	-	-	mS
$\lvert Y_{os} \rvert$	output admittance	$V_{DS} = 6$ V $V_{GS} = 0$	-	40	-	μS
C_{iss}	input capacitance (note 1)	$V_{DS} = 6$ V $V_{GS} = 0$ $V_{GC} = 0$ f = 1 MHz	-	-	6	pF
C_{GC}	diode capacitance	$V_{GC} = 0$ drain and source grounded	-	3	-	pF
C_D	drain decoupling capacitance	$V_{DC} = 0$ gate and source grounded	-	8	-	pF
C_S	source decoupling capacitance	$V_{SC} = 0$ gate and drain grounded	-	8	-	pF

Notes

1. Value is inclusive of the capacitance of the diodes.

N-P-N 4 GHz WIDEBAND TRANSISTOR

N-P-N transistor in a plastic SOT-23 envelope. It is intended for a wide range of v.h.f. and u.h.f. applications in thick and thin-film circuits.

QUICK REFERENCE DATA

Collector-base voltage (open emitter; peak value)	V_{CBOM}	max.	25	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	V
Collector current (peak value)	I_{CM}	max.	50	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Junction temperature	T_j	max.	150	°C
DC current gain I_C = 2 mA; V_{CE} = 1 V	h_{FE}		20 to 150	
Transition frequency I_C = 25 mA; V_{CE} = 5 V; f = 500 MHz	f_T	typ.	1.3	GHz
Noise figure I_C = 2 mA; V_{CE} = 5 V; R_S = 50 Ω; f = 500 MHz	F	typ.	4.5	dB

MECHANICAL DATA

Dimensions in mm

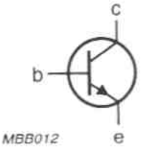
Marking code

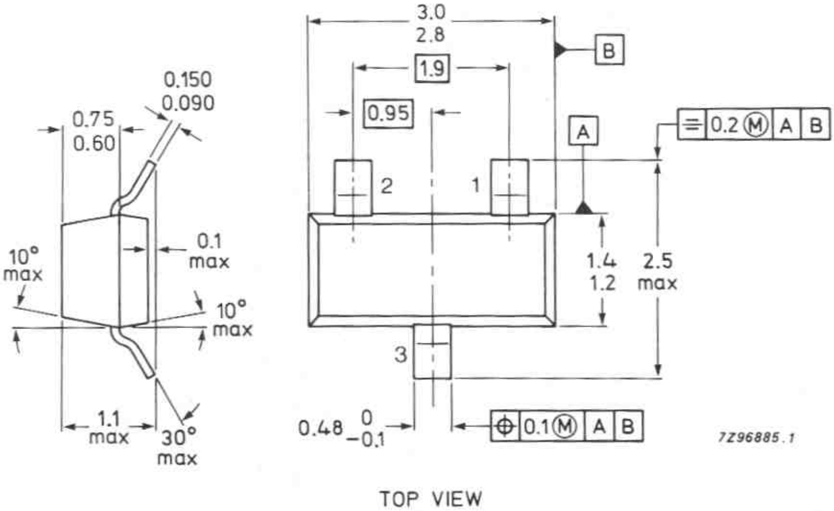
BFS17 = $E1_p$

Fig. 1 SOT-23.

Pinning

1 = base
2 = emitter
3 = collector





If required, the R-version (reverse pinning) is available on request.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter; peak value)	V_{CBOM}	max.	25	V
Collector-emitter voltage (open base) I_C = 10 mA	V_{CEO}	max.	15	V
Emitter-base voltage (open collector)	V_{EBO}	max.	2.5	V
Collector current (DC)	I_C	max.	25	mA
Collector current (peak value)	I_{CM}	max.	50	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Storage temperature	T_{stg}	−65 to + 150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient (note 1)	$R_{th\ j\text{-}a}$	=	430	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
I_E = 0; V_{CB} = 10 V	I_{CBO}	max.	10	nA
I_E = 0; V_{CB} = 10 V; T_j = 100 °C	I_{CBO}	max.	10	μA
DC current gain				
I_C = 2 mA; V_{CE} = 1 V	h_{FE}	20 to 150		
I_C = 25 mA; V_{CE} = 1 V	h_{FE}	min.	20	
Transition frequency				
I_C = 2 mA; V_{CE} = 5 V; f = 500 MHz	f_T	typ.	1.0	GHz
I_C = 25 mA; V_{CE} = 5 V; f = 500 MHz	f_T	typ.	1.3	GHz
Collector capacitance at f = 1 MHz				
I_E = I_e = 0; V_{CB} = 10 V	C_c	max.	1.5	pF

Notes

1. Mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.
2. Crystal mounted in a BFY90 envelope.

Emitter capacitance at f = 1 MHz			
$I_C = I_c = 0$; $V_{EB} = 0.5$ V	C_e	max.	2.0 pF
Feedback capacitance at f = 1 MHz			
$I_C = 1$ mA; $V_{CE} = 5$ V	C_{re}	typ.	0.65 pF
Noise figure (note 2)			
$I_C = 2$ mA; $V_{CE} = 5$ V; f = 500 MHz; $R_S = 50\ \Omega$	F	typ.	4.5 dB
Intermodulation distortion			
$I_C = 10$ mA; $V_{CE} = 6$ V; $R_L = 37{,}5\ \Omega$; $T_{amb} = 25\ ^oC$ $V_o = 100$ mV at $f_p = 183$ MHz $V_o = 100$ mV at $f_q = 200$ MHz measured at $f_{(2q-p)} = 217$ MHz	d_{im}	typ.	−45 dB

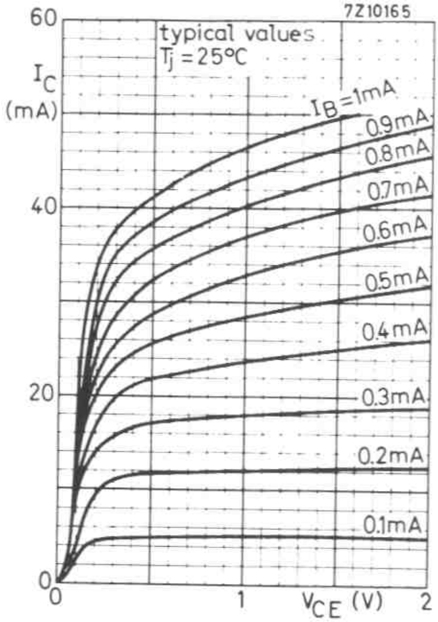


Fig. 2 T_j = 25 °C; typical values.

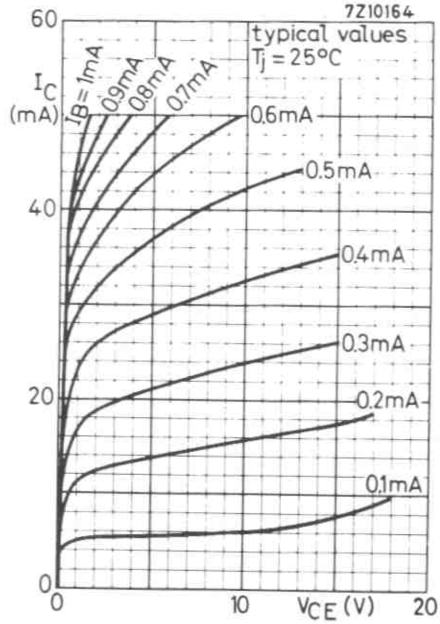


Fig. 3 T_j = 25 °C; typical values.

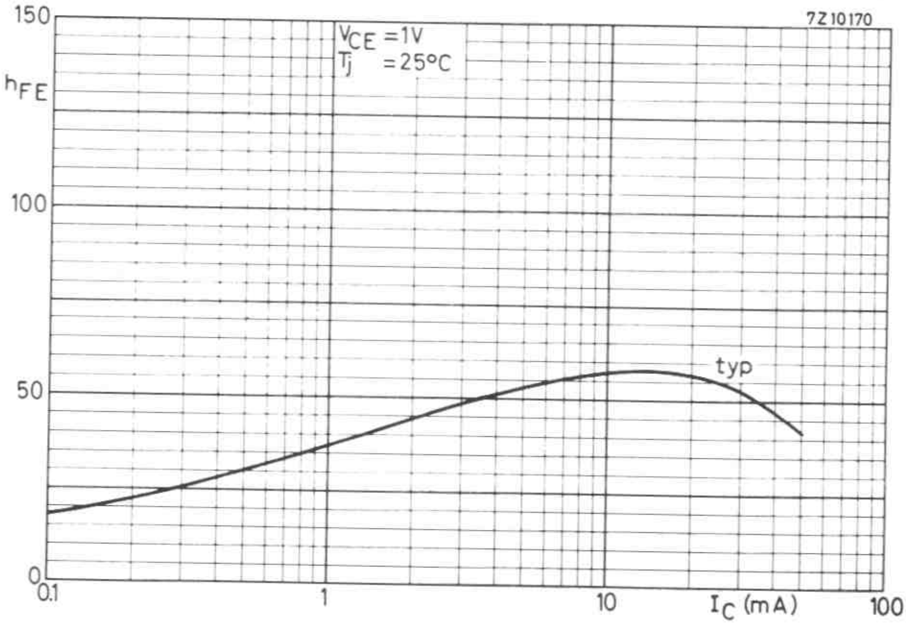


Fig. 4 V_{CE} = 1 V; T_j = 25 °C; typical values.

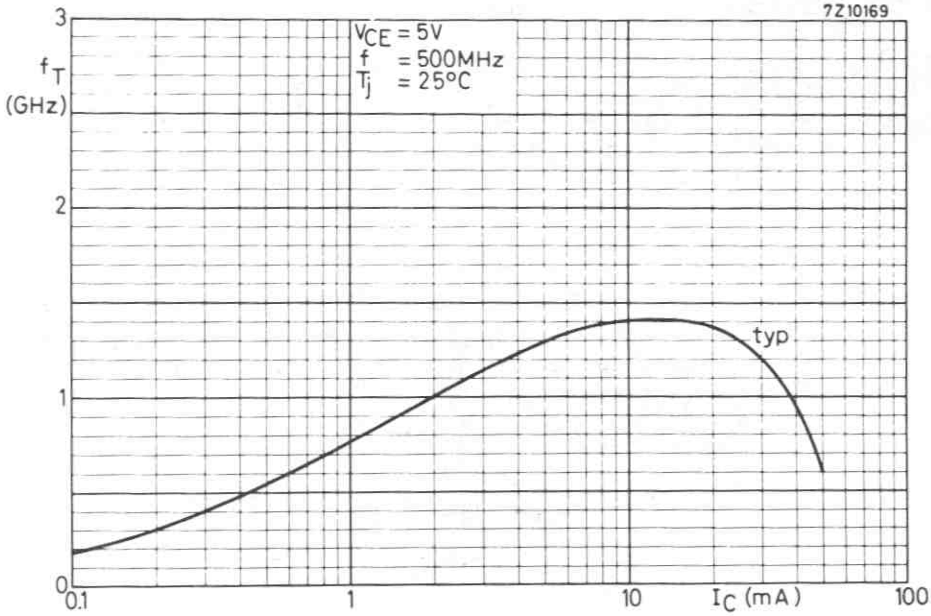


Fig. 5 V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C; typical values.

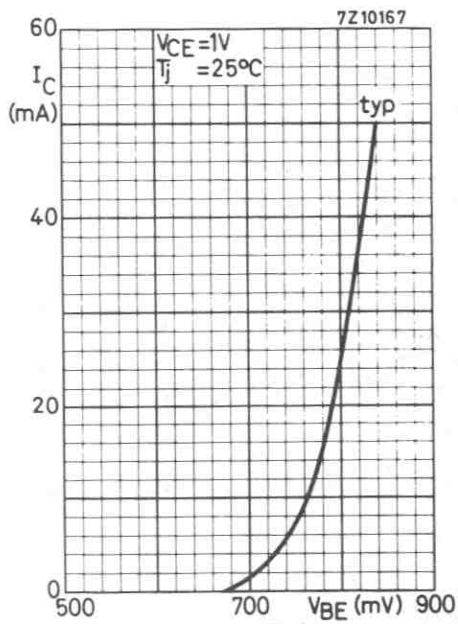


Fig. 6 V_{CE} = 1 V; T_j = 25 °C; typical values.

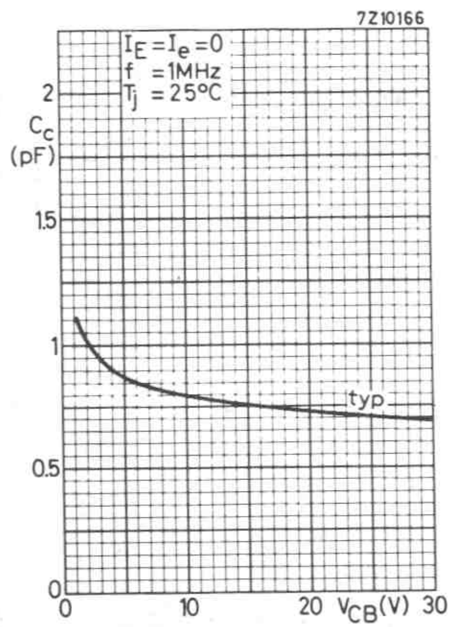


Fig. 7 $I_E = I_e = 0$; f = 1 MHz; T_j = 25 °C; typical values.

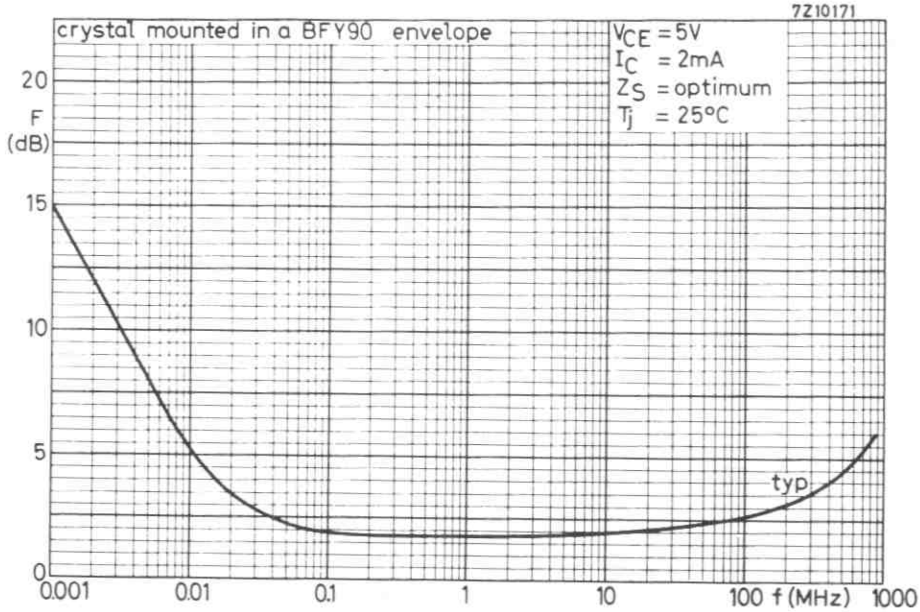


Fig. 8 V_{CE} = 5 V; I_C = 2 mA; Z_S = optimum; T_j = 25 °C; typical values.

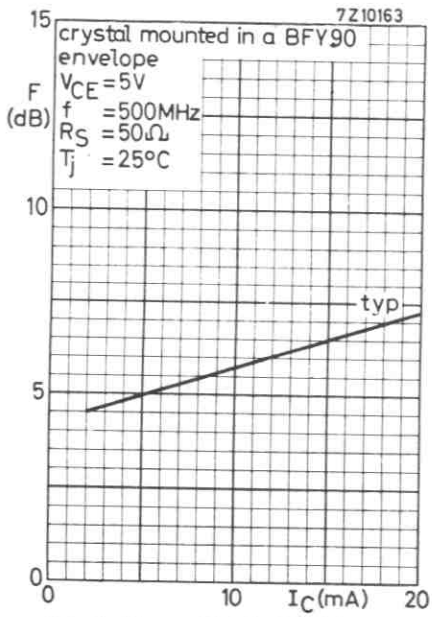


Fig. 9 V_{CE} = 5 V; f = 500 MHz; R_S = 50 Ω; T_j = 25 °C; typical values.

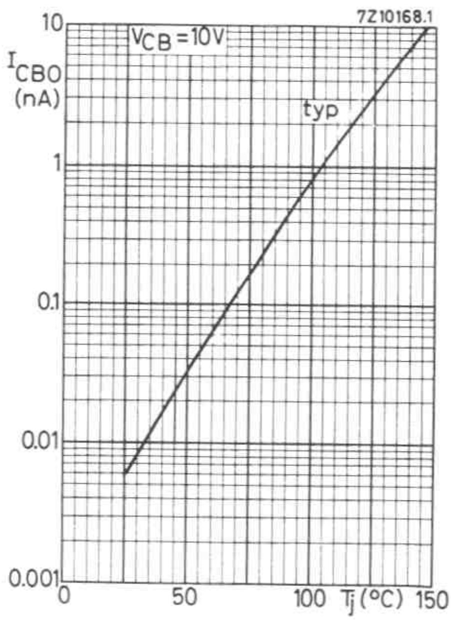


Fig. 10 V_{CB} = 10 V; typical values.

N-P-N 2 GHz WIDEBAND TRANSISTOR

N-P-N transistor in a plastic SOT-23 envelope. It is intended for a wide range of v.h.f. and u.h.f. applications in thick and thin-film circuits.

The BFS17A is the successor to the BFS17 and offers a higher power gain and an improved noise behaviour.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	25	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	V
Collector current (DC)	I_C	max.	25	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Junction temperature	T_j	max.	150	°C
D.C. current gain I_C = 2 mA; V_{CE} = 1 V	h_{FE}	min. max.	20 150	
Transition frequency at f = 500 MHz I_C = 25 mA; V_{CE} = 5 V	f_T	typ.	2.8	GHz
Noise figure I_C = 2 mA; V_{CE} = 5 V; f = 800 MHz	F	typ.	2.5	dB
Output voltage at d_{im} = –60 dB V_{CE} = 10 V; I_C = 14 mA; Z_L = 75 Ω $f_{(p+q-r)}$ = 793.25 MHz	V_o	typ.	150	mV
Maximum unilateral power gain at f = 800 MHz V_{CE} = 10 V; I_C = 14 mA	G_{UM}	typ.	13.5	dB

MECHANICAL DATA (see Fig. 1).

If required, the R-version (reverse pinning) is available on request.

MECHANICAL DATA

Dimensions in mm

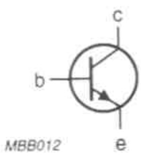
Marking code

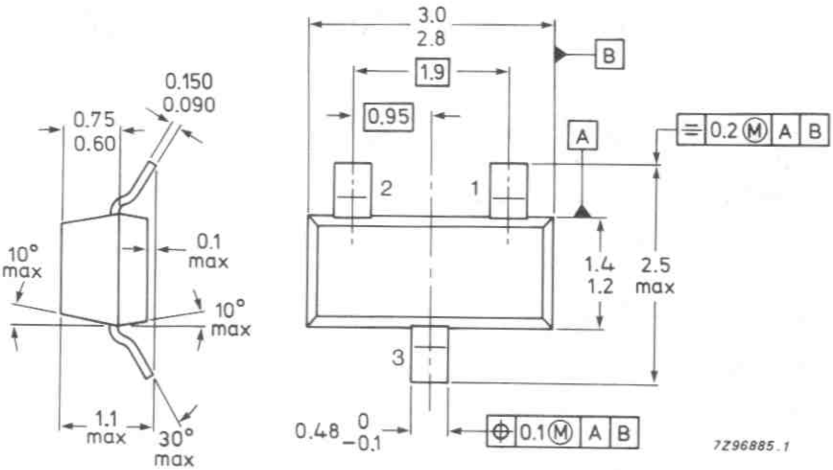
BFS17A = E2

Fig. 1 SOT-23.

Pinning

1 = base
2 = emitter
3 = collector





TOP VIEW

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	25 V
Collector-emitter voltage (open base)	V_{CEO}	max.	15 V
Emitter-base voltage (open collector)	V_{EBO}	max.	2.5 V
Collector current (DC)	I_C	max.	25 mA
Collector current (peak value)	I_{CM}	max.	50 mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	300 mW
Storage temperature	T_{stg}	−65 to + 150 °C	
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	430 K/W

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0$; $V_{CB} = 10$ V	I_{CBO}	max.	50 nA
DC current gain			
$I_C = 2$ mA; $V_{CE} = 1$ V	h_{FE}		20 to 150
$I_C = 25$ mA; $V_{CE} = 1$ V	h_{FE}	min.	20
Transition frequency at f = 500 MHz			
$I_C = 25$ mA; $V_{CE} = 5$ V	f_T	typ.	2.8 GHz
Collector capacitance at f = 1 MHz			
$I_E = 0$; $V_{CB} = 10$ V	C_c	typ.	0.7 pF
Emitter capacitance at f = 1 MHz			
$I_C = 0$; $V_{EB} = 0.5$ V	C_e	typ.	1.25 pF
Feedback capacitance at f = 1 MHz			
$I_C = 0$; $V_{CE} = 5$ V	C_{re}	typ.	0.6 pF

Maximum unilateral power gain
(s_{12} assumed to be zero)

$$G_{UM} = 10 \log \frac{|s_{21}|^2}{[1-|s_{11}|^2]\ [1-|s_{22}|^2]}$$

$I_C = 14$ mA; $V_{CE} = 10$ V; f = 800 MHz	G_{UM}	typ.	13.5 dB
Noise figure at f = 800 MHz			
$I_C = 2$ mA; $V_{CE} = 5$ V; $Z_S = 60\ \Omega$; $T_{amb} = 25$ °C	F	typ.	2.5 dB

Output voltage at $d_{im} = -60$ dB
(DIN 45004B, par. 6,3: 3-tone)

$I_C = 14$ mA; $V_{CE} = 10$ V; $Z_L = 75\ \Omega$

$V_p = V_o$; $f_p = 795.25$ MHz
$V_q = V_o - 6$ dB; $f_q = 803.25$ MHz
$V_r = V_o - 6$ dB; $f_r = 805.25$ MHz

Measured at $f_{(p+q-r)} = 793.25$ MHz	V_o	typ.	150 mV

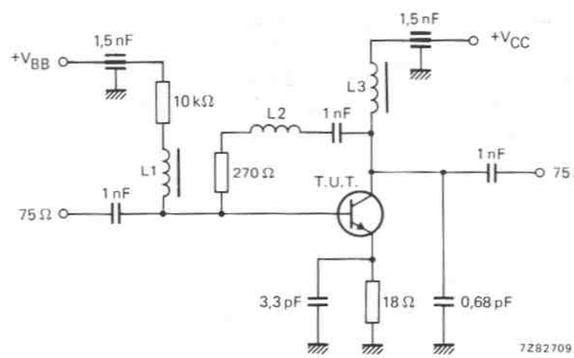


Fig. 2 Intermodulation distortion and second harmonic distortion MATV test circuit.

L1 = L3 = 5 μH Ferroxcube choke.
L2 = 3 turns Cu wire (0.4 mm), internal diameter 3 mm, winding pitch 1 mm.

s-parameters (common emitter) at V_{CE} = 5 V; typical values.

I_C mA	f MHz	s_{11}	s_{21}	s_{12}	s_{22}	G_{UM} dB
2	40	0,94/ −11,1°	6,50/173,0°	0,01/83,1°	1,00/ −4,1°	45,7
	100	0,89/ −27,6°	6,22/158,7°	0,03/74,1°	0,96/ −9,8°	34,0
	200	0,79/ −50,3°	5,38/143,2°	0,06/63,8°	0,89/−16,0°	25,7
	500	0,50/−103,1°	3,37/107,0°	0,09/47,1°	0,68/−24,3°	14,5
	800	0,43/−130,7°	2,43/ 93,1°	0,11/47,9°	0,64/−28,0°	10,9
	1000	0,43/−148,2°	2,08/ 84,5°	0,12/50,1°	0,62/−32,6°	9,3
	1200	0,41/−172,5°	1,73/ 75,8°	0,13/51,6°	0,54/−31,6°	7,1
5	40	0,84/ −19,0°	14,43/167,4°	0,01/80,2°	0,98/ −7,6°	42,5
	100	0,74/ −45,0°	12,92/147,3°	0,03/67,8°	0,89/−16,9°	32,5
	200	0,60/ −75,6°	9,60/128,6°	0,05/58,6°	0,75/−23,1°	25,3
	500	0,38/−133,5°	4,94/ 98,3°	0,07/54,6°	0,52/−23,7°	15,9
	800	0,35/−158,6°	3,25/ 86,5°	0,09/60,3°	0,52/−25,6°	12,2
	1000	0,37/−171,2°	2,71/ 79,9°	0,11/62,7°	0,50/−30,1°	10,5
	1200	0,41/+166,1°	2,31/ 73,4°	0,12/64,3°	0,43/−24,8°	8,9
10	40	0,73/ −28,7°	23,50/160,9°	0,01/76,3°	0,95/−11,7°	41,0
	100	0,59/ −64,1°	18,60/136,3°	0,02/63,7°	0,79/−22,4°	31,6
	200	0,46/ −99,8°	12,38/117,6°	0,04/58,6°	0,62/−26,1°	25,0
	500	0,35/−156,4°	5,64/ 92,5°	0,06/62,4°	0,44/−20,2°	16,5
	800	0,34/−175,1°	3,67/ 82,7°	0,09/67,9°	0,46/−22,2°	12,8
	1000	0,36/+175,8°	3,00/ 76,7°	0,11/69,3°	0,44/−26,6°	11,1
	1200	0,43/+158,2°	2,56/ 71,6°	0,13/70,6°	0,38/−19,1°	9,7
14	40	0,65/ −35,6°	28,67/156,8°	0,01/74,8°	0,93/−13,7°	40,5
	100	0,52/ −75,9°	20,73/131,2°	0,02/62,5°	0,74/−24,3°	31,2
	200	0,41/−113,1°	13,17/113,0°	0,03/60,3°	0,57/−25,8°	24,9
	500	0,35/−164,2°	5,85/ 90,3°	0,06/65,2°	0,42/−17,6°	16,8
	800	0,34/−179,4°	3,76/ 81,3°	0,09/70,6°	0,44/−20,1°	13,0
	1000	0,37/+173,9°	3,04/ 75,8°	0,11/71,7°	0,43/−24,8°	11,2
	1200	0,44/+154,6°	2,63/ 69,7°	0,13/72,4°	0,38/−17,0°	10,0
20	40	0,58/ −44,3°	33,42/152,4°	0,01/72,4°	0,90/−15,8°	39,6
	100	0,45/ −89,5°	22,57/125,6°	0,02/61,8°	0,69/−25,0°	30,9
	200	0,38/−125,9°	13,53/108,7°	0,03/62,5°	0,53/−24,2°	24,8
	500	0,35/−171,5°	5,80/ 87,8°	0,06/68,0°	0,42/−15,0°	16,7
	800	0,35/+176,2°	3,68/ 79,4°	0,09/72,5°	0,44/−18,4°	12,8
	1000	0,38/+170/1°	3,01/ 74,2°	0,11/73,5°	0,43/−23,1°	11,1
	1200	0,46/+153,2°	2,63/ 69,3°	0,12/74,1°	0,38/−15,8°	10,1

s-parameters (common emitter) at V_{CE} = 10 V; typical values.

I_C mA	f MHz	s_{11}	s_{21}	s_{12}	s_{22}	G_{UM} dB
2	40	0,94/ −10,5°	6,35/173,2°	0,01/83,2°	1,00/ −3,5°	45,5
	100	0,89/ −26,1°	6,15/159,7°	0,03/74,7°	0,97/ −8,7°	34,6
	200	0,80/ −47,7°	5,37/144,2°	0,05/64,9°	0,91/−13,8°	26,5
	500	0,51/ −98,2°	3,40/108,9°	0,08/48,8°	0,72/−21,3°	15,1
	800	0,42/−126,1°	2,45/ 94,6°	0,10/50,0°	0,69/−25,0°	11,4
	1000	0,41/−144,2°	2,09/ 85,6°	0,11/52,1°	0,66/−29,0°	9,7
	1200	0,39/−170,5°	1,76/ 77,1°	0,12/53,1°	0,59/−28,1°	7,5
5	40	0,85/ −18,0°	14,09/168,2°	0,01/81,0°	0,99/ −6,3°	44,0
	100	0,76/ −41,4°	12,61/149,1°	0,03/69,2°	0,91/−14,4°	33,3
	200	0,61/ −70,9°	9,69/130,0°	0,04/60,1°	0,79/−19,9°	26,0
	500	0,38/−126,8°	5,04/ 99,2°	0,07/54,9°	0,57/−20,6°	16,5
	800	0,33/−152,2°	3,35/ 87,9°	0,08/61,2°	0,57/−22,7°	12,7
	1000	0,35/−165,9°	2,75/ 81,0°	0,10/64,0°	0,55/−26,4°	10,9
	1200	0,39/+168,5°	2,35/ 74,1°	0,11/65,4°	0,49/−22,3°	9,3
10	40	0,76/−25,9 °	22,67/161,9°	0,01/76,6°	0,96/ −9,8°	42,1
	100	0,63/ −57,9°	18,55/138,5°	0,02/65,1°	0,83/−19,2°	32,5
	200	0,47/ −91,5°	12,47/119,0°	0,03/59,8°	0,67/−22,4°	25,6
	500	0,33/−151,1°	5,82/ 93,0°	0,06/62,2°	0,50/−17,7°	17,1
	800	0,31/−169,4°	3,78/ 83,6°	0,08/68,4°	0,51/−19,6°	13,3
	1000	0,33/−178,6°	3,10/ 77,9°	0,10/70,0°	0,50/−23,5°	11,6
	1200	0,39/+158,8°	2,65/ 71,9°	0,12/70,8°	0,45/−17,8°	10,1
14	40	0,70/ −30,8°	27,63/158,1°	0,01/74,7°	0,95/−11,6°	41,5
	100	0,55/ −67,6°	20,66/133,4°	0,02/63,8°	0,78/−20,9°	32,0
	200	0,42/−102,5°	13,42/115,4°	0,03/60,9°	0,62/−22,4°	25,5
	500	0,32/−158,3°	5,97/ 91,4°	0,06/65,1°	0,48/−15,7°	17,1
	800	0,31/−174,4°	3,88/ 81,8°	0,08/70,5°	0,50/−18,3°	13,5
	1000	0,34/+177,7°	3,14/ 76,7°	0,10/71,9°	0,49/−22,2°	11,6
	1200	0,40/+156,0°	2,71/ 70,2°	0,12/72,3°	0,44/−15,9°	10,3
20	40	0,65/ −37,4°	32,19/154,4°	0,01/73,2°	0,92/−13,4°	40,8
	100	0,49/ −76,7°	22,74/127,9°	0,02/62,7°	0,73/−21,8°	31,7
	200	0,38/−112,6°	13,78/110,5°	0,03/62,3°	0,59/−21,1°	25,3
	500	0,32/−164,7°	6,05/ 88,6°	0,06/67,4°	0,47/−13,6°	17,2
	800	0,31/−179,0°	3,84/ 80,1°	0,08/72,4°	0,50/−16,8°	13,4
	1000	0,34/+173,5°	3,14/ 75,1°	0,10/73,1°	0,49/−21,0°	11,6
	1200	0,40/+155,0°	2,69/ 69,8°	0,12/73,6°	0,44/−14,7°	10,3

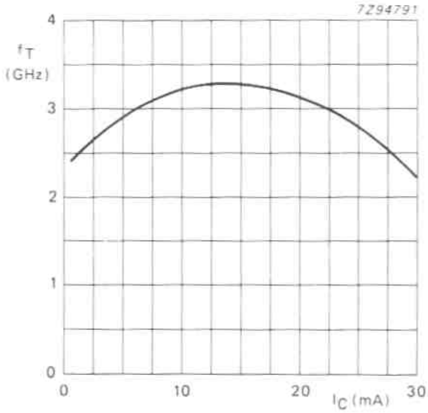


Fig. 3 V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C; typical values.

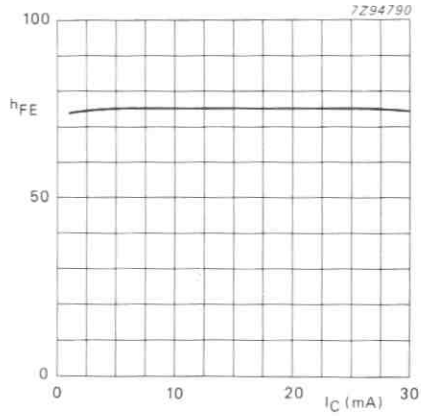


Fig. 4 V_{CE} = 1 V; T_{amb} = 25 °C; typical values.

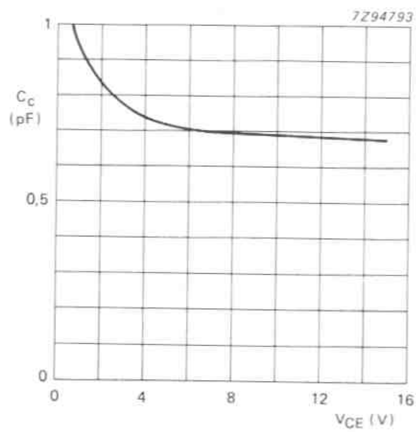


Fig. 5 I_E = 0; f = 1 MHz; T_{amb} = 25 °C; typical values.

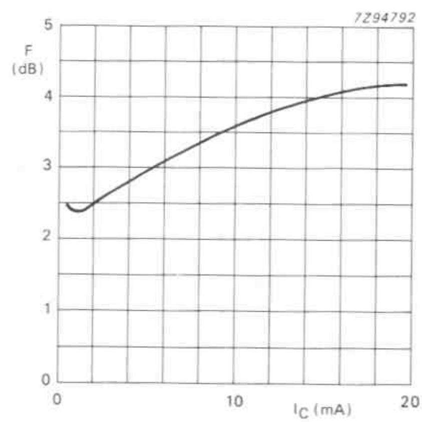


Fig. 6 V_{CE} = 5 V; T_{amb} = 25 °C; f = 800 MHz; Z_S = 60 Ω; typical values.

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in a microminiature plastic envelope. They are intended for general purpose and h.f. applications in thick and thin-film circuits.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	20	V
Collector current (d.c.)	I_C	max.	30	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	mW
Junction temperature	T_j	max.	150	°C

			BFS18	BFS19	
D.C. current gain I_C = 1 mA; V_{CE} = 10 V	h_{FE}		35 to 125	65 to 225	
Transition frequency at f = 100 MHz I_C = 1 mA; V_{CE} = 10 V	f_T	typ.	200	260	MHz
Noise figure at f = 100 MHz I_C = 1 mA; V_{CE} = 10 V; G_S = 10 mS	F	typ.	4		dB

MECHANICAL DATA

Dimensions in mm

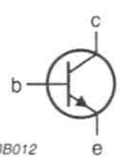
Fig. 1 SOT-23.

Marking code

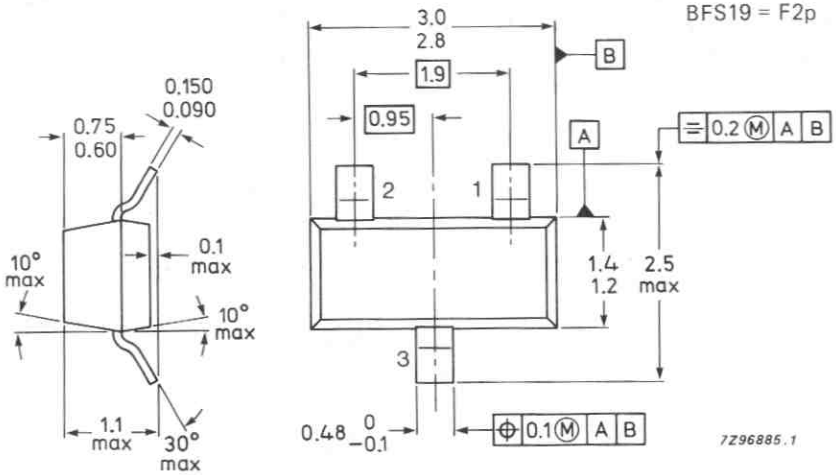
BFS18 = F1p
BFS19 = F2p

Pinning:

1 = base
2 = emitter
3 = collector



MBB012



TOP VIEW

Reverse pinning types are available on request.

See also *Soldering recommendations.*

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage (open base) I_C = 2 mA	V_{CEO}	max.	20	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V
Collector current (d.c.)	I_C	max.	30	mA
Collector current (peak value)	I_{CM}	max.	30	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	mW
Storage temperature	T_{stg}		−65 to + 150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	500	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current $I_E = 0$; V_{CB} = 20 V	I_{CBO}	<	100	nA
$I_E = 0$; V_{CB} = 20 V; T_j = 100 °C	I_{CBO}	<	10	μA
Base-emitter voltage I_C = 1 mA; V_{CE} = 10 V	V_{BE}		0,65 to 0,74	V

			BFS18	BFS19	
D.C. current gain I_C = 1 mA; V_{CE} = 10 V	h_{FE}		35 to 125	65 to 225	
Transition frequency at f = 100 MHz I_C = 1 mA; V_{CE} = 10 V	f_T	typ.	200	260	MHz
Collector capacitance at f = 1 MHz $I_E = I_e = 0$; V_{CB} = 10 V	C_c	typ.	1		pF
Feedback capacitance at f = 1 MHz I_C = 1 mA; V_{CE} = 10 V	$-C_{re}$	typ.	0,85		pF
Noise figure** I_C = 1 mA; V_{CE} = 10 V; G_S = 10 mS ; f = 100 MHz	F	typ.	4		dB

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.
** Crystal mounted in a BF115 envelope.

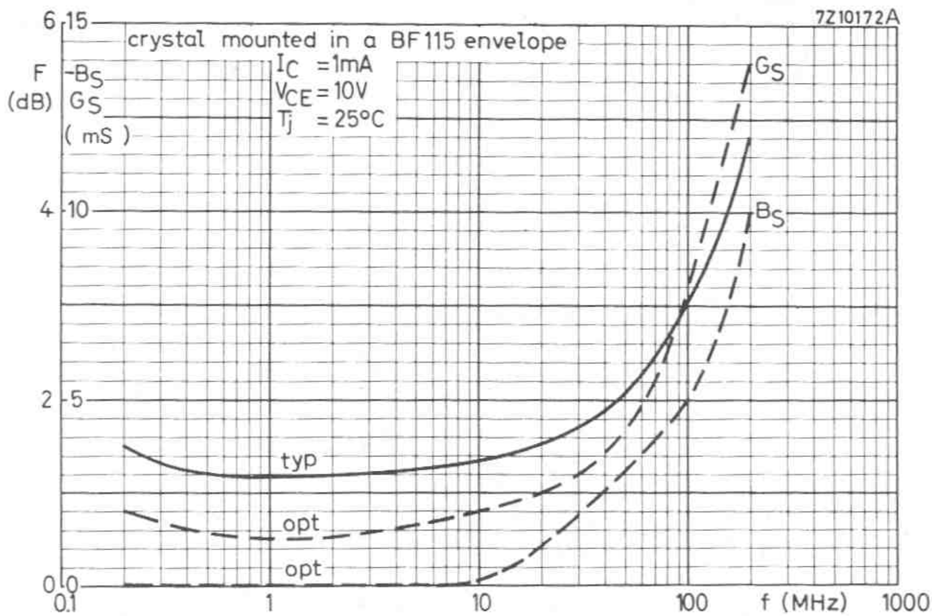


Fig. 2.

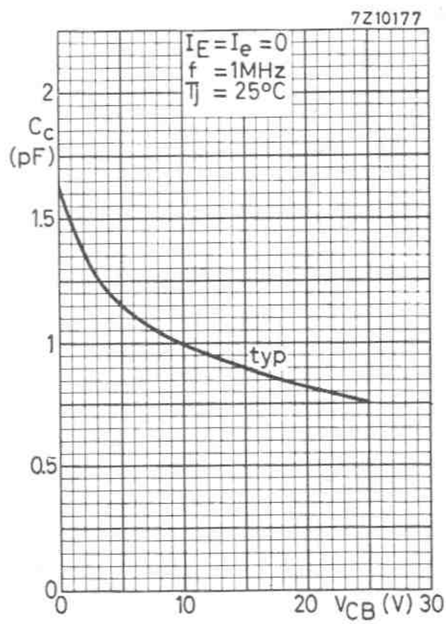


Fig. 3.

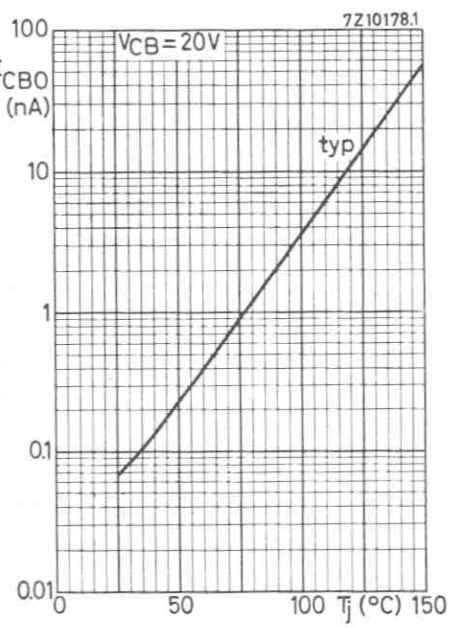


Fig. 4.

Typical behaviour of collector current versus collector-emitter voltage

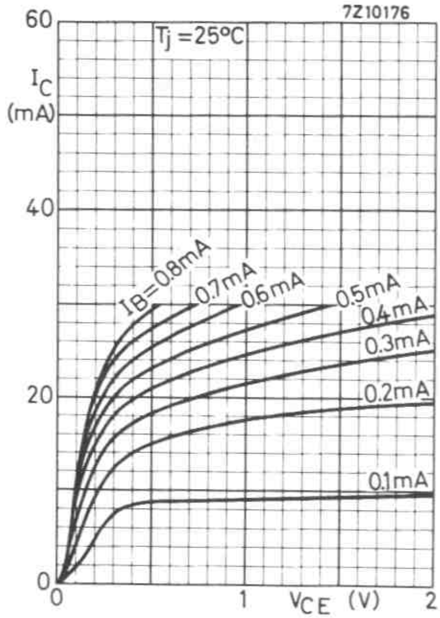


Fig. 5.

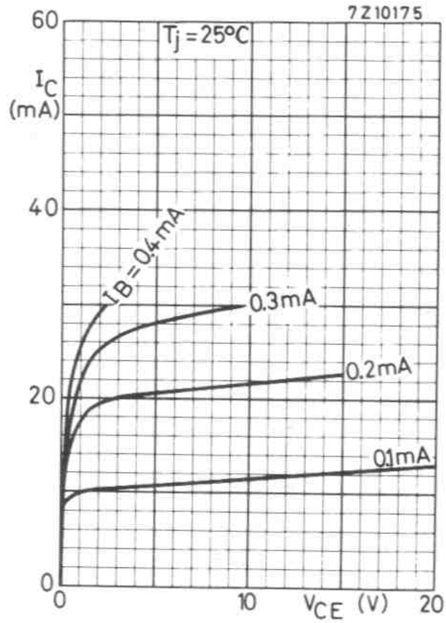


Fig. 6.

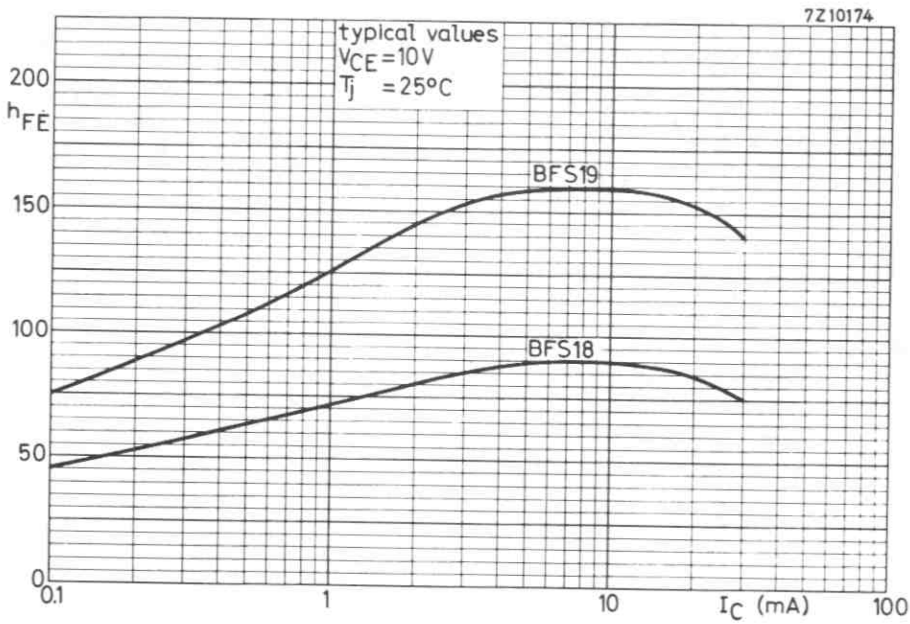


Fig. 7.

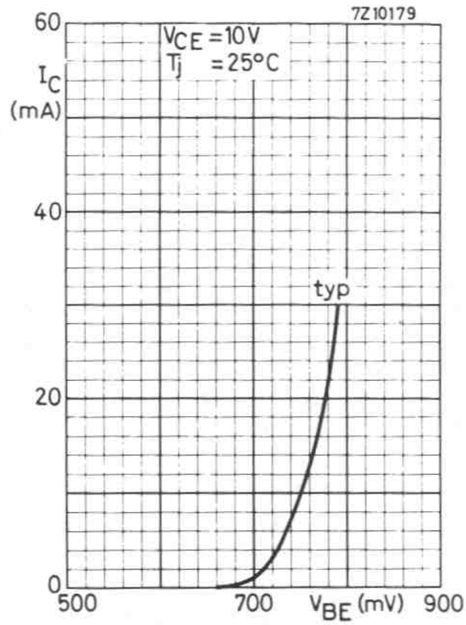

7Z10179
V_{CE} = 10 V
T_j = 25°C
I_C
(mA)
60
40
20
0
typ
500
700
V_{BE} (mV)
900

Fig. 8.

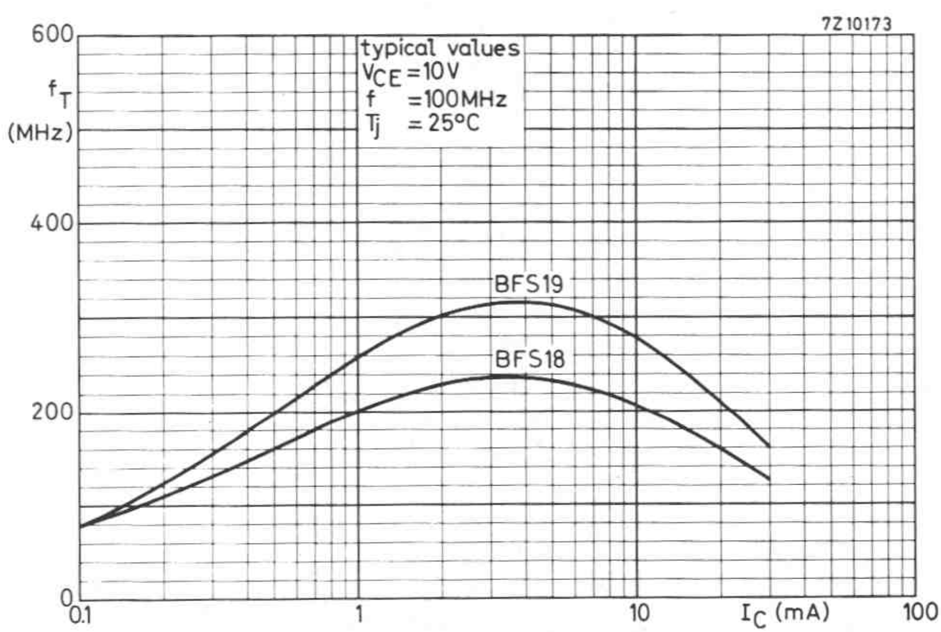

7Z10173
typical values
V_{CE} = 10 V
f = 100 MHz
T_j = 25°C
f_T
(MHz)
600
400
200
0
BFS19
BFS18
0.1
1
10
I_C (mA)
100

Fig. 9.

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistor in a microminiature plastic envelope. It has a very low feedback capacitance and is intended for i.f. and v.h.f. applications in thick and thin-film circuits.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	20	V
Collector current (d.c.)	I_C	max.	25	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	mW
Junction temperature	T_j	max.	150	°C
D.C. current gain I_C = 7 mA; V_{CE} = 10 V	h_{FE}	>	40	
Transition frequency at f = 100 MHz I_C = 5 mA; V_{CE} = 5 V	f_T	typ.	450	MHz
Feedback capacitance at f = 1 MHz I_C = 1 mA; V_{CE} = 10 V	C_{re}	typ.	350	fF

MECHANICAL DATA

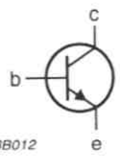
Dimensions in mm

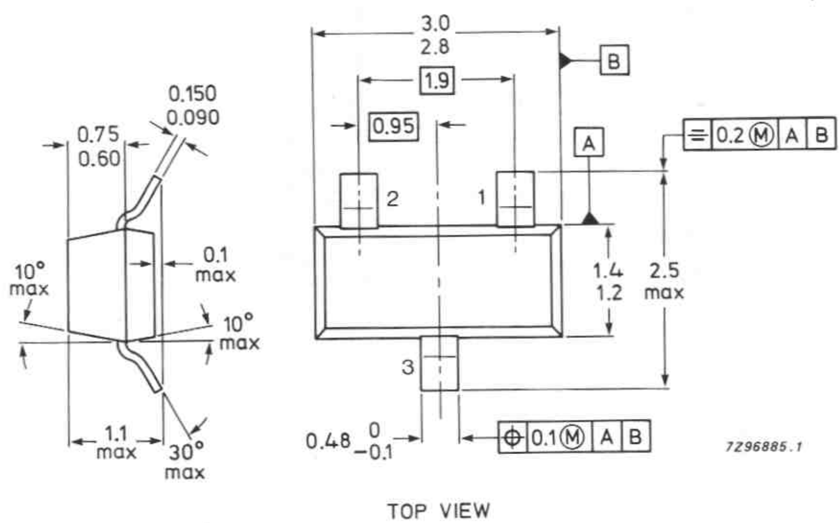
Marking code
BFS20 = G1p

Fig. 1 SOT-23.

Pinning:

1 = base
2 = emitter
3 = collector





Reverse pinning types are available on request.

See also *Soldering recommendations*.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter) see Fig. 2	V_{CBO}	max.	30	V
Collector-emitter voltage (open base) see Fig. 2 I_C = 2 mA	V_{CEO}	max.	20	V
Emitter-base voltage (open collector) see Fig. 2	V_{EBO}	max.	4	V
Collector current (d.c.)	I_C	max.	25	mA
Collector current (peak value)	I_{CM}	max.	25	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	mW
Storage temperature	T_{stg}	−65 to	+150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	500	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current I_E = 0; V_{CB} = 20 V	I_{CBO}	<	100	nA
I_E = 0; V_{CB} = 20 V; T_j = 100 °C	I_{CBO}	<	10	μA
Base-emitter voltage I_C = 7 mA; V_{CE} = 10 V	V_{BE}	typ. <	740 900	mV mV
D.C. current gain I_C = 7 mA; V_{CE} = 10 V	h_{FE}	> typ.	40 85	
Transition frequency at f = 100 MHz I_C = 5 mA; V_{CE} = 10 V	f_T	> typ.	275 450	MHz MHz
Collector capacitance at f = 1 MHz I_E = I_e = 0; V_{CB} = 10 V	C_c	typ.	0,8	pF
Feedback capacitance at f = 1 MHz I_C = 1 mA; V_{CE} = 10 V	$-C_{re}$	typ.	350	fF

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

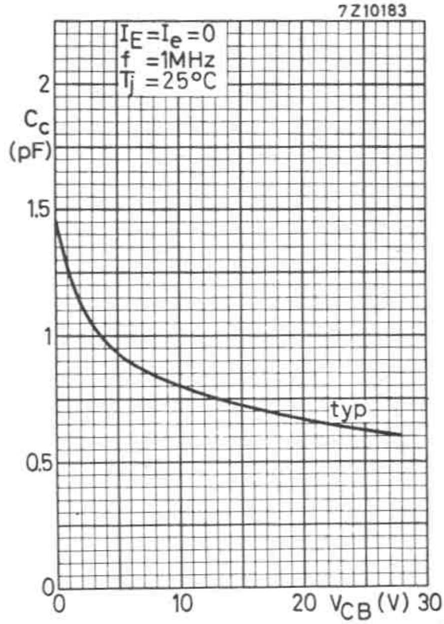

7Z10183
$I_E = I_e = 0$
f = 1MHz
T_j = 25°C
C_c
(pF)
2
1.5
1
0.5
0
typ
0
10
20
V_{CB} (V)
30

Fig. 2.

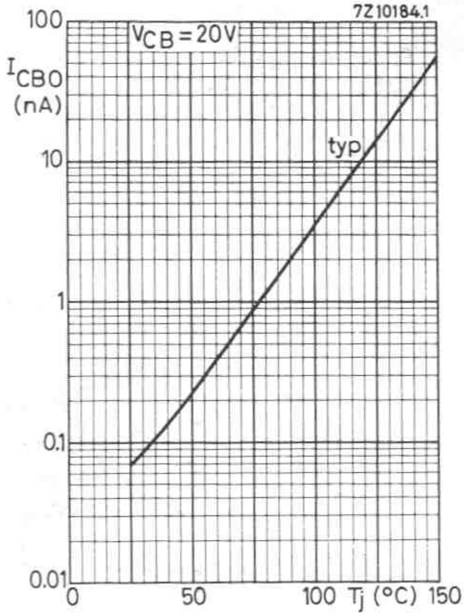

7Z10184.1
V_{CB} = 20V
I_{CBO}
(nA)
100
10
1
0.1
0.01
typ
0
50
100
T_j (°C)
150

Fig. 3.

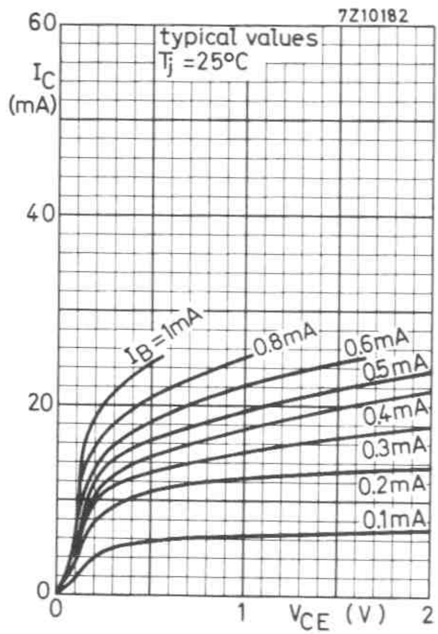


Fig. 4.

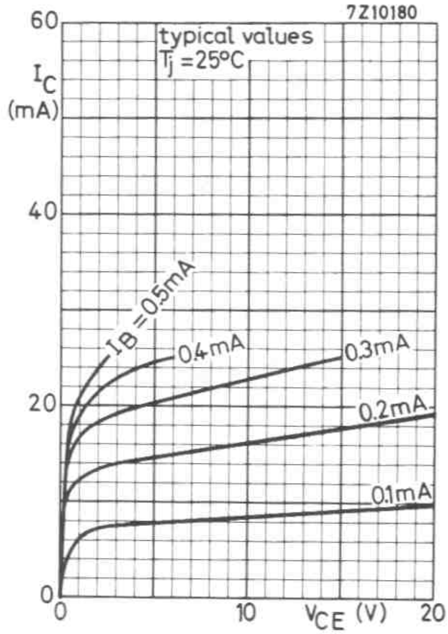


Fig. 5.

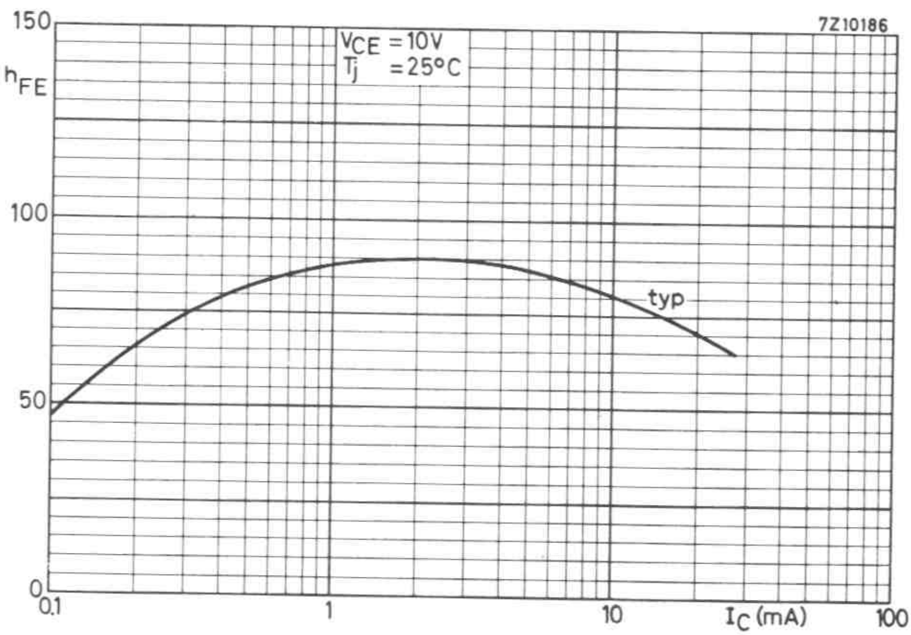


Fig. 6.

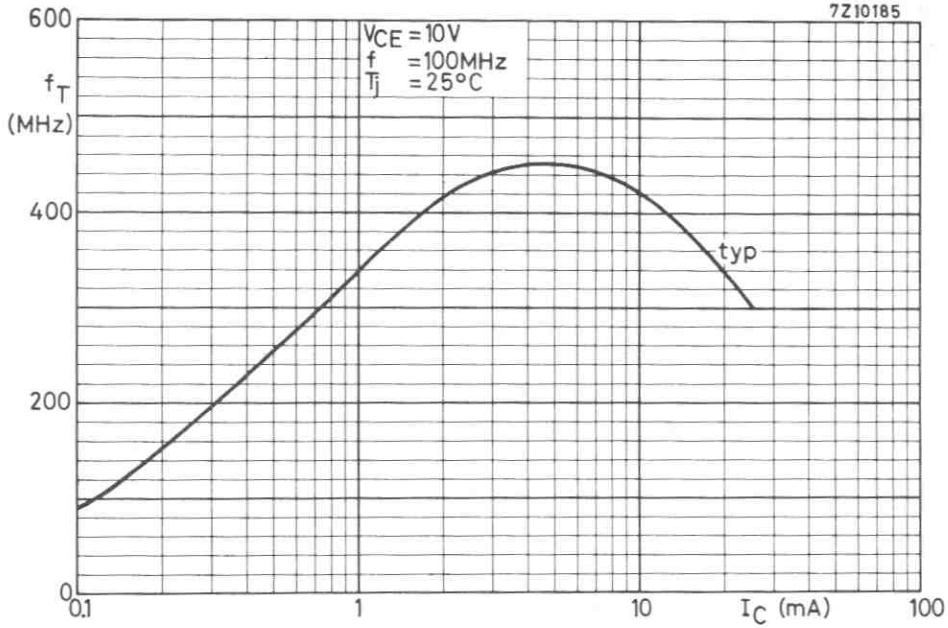

7Z10185
V_{CE} = 10 V
f = 100 MHz
T_j = 25 °C
f_T
(MHz)
600
400
200
0
typ
0.1
1
10
I_C (mA)
100

Fig. 7.

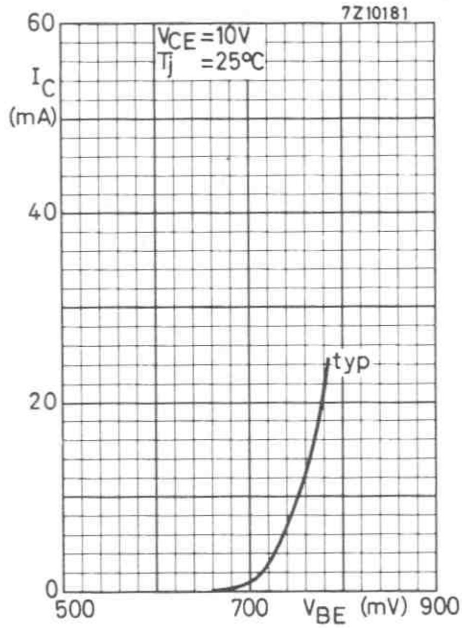

7Z10181
V_{CE} = 10 V
T_j = 25 °C
I_C
(mA)
60
40
20
0
typ
500
700
V_{BE} (mV)
900

Fig. 8.

N-P-N 2 GHz WIDEBAND TRANSISTOR

N-P-N transistor in a plastic SOT-23 envelope, primarily intended for use in u.h.f. low power amplifiers in thick and thin-film circuits, such as in pocket phones, paging systems, etc. The transistor features low current consumption (100 μA – 1 mA); thanks to its high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	8	V
Collector-emitter voltage (open base)	V_{CEO}	max.	5	V
Collector current (DC)	I_C	max.	6.5	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Junction temperature	T_j	max.	150	°C
Transition frequency at f = 500 MHz I_C = 1 mA; V_{CE} = 1 V	f_T	typ.	2.3	GHz
Feedback capacitance at f = 1 MHz I_C = 1 mA; V_{CE} = 1 V	C_{re}	max.	0.45	pF
Noise figure at optimum source impedance I_C = 1 mA; V_{CE} = 1 V; f = 500 MHz	F	typ.	3.8	dB
Max. unilateral power gain I_C = 1 mA; V_{CE} = 1 V; f = 500 MHz	G_{UM}	typ.	18	dB

MECHANICAL DATA

Dimensions in mm

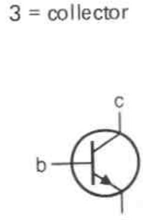
Marking code

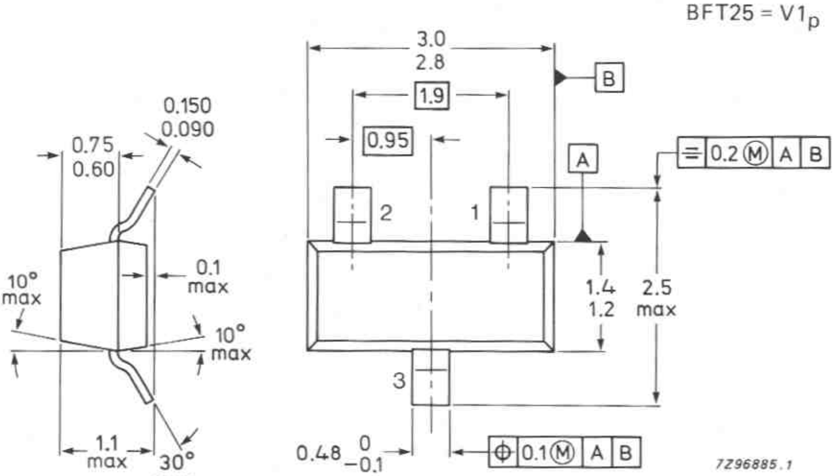
BFT25 = $V1_p$

Fig. 1 SOT-23.

Pinning

1 = base
2 = emitter
3 = collector





TOP VIEW

If required, the R-version (reverse pinning) is available on request.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	8	V
Collector-emitter voltage (open base)	V_{CEO}	max.	5	V
Emitter-base voltage (open collector)	V_{EBO}	max.	2	V
Collector current (DC)	I_C	max.	6.5	mA
Collector current (peak value; $f > 1$ MHz)	I_{CM}	max.	10	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	300	mW
Storage temperature	T_{stg}	−65 to + 150		^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	430	K/W

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

Collector cut-off current $I_E = 0$; $V_{CB} = 5$ V	I_{CBO}	max.	50	nA
D.C. current gain $I_C = 10\ \mu A$; $V_{CE} = 1$ V	h_{FE}	min. typ.	20 30	
$I_C = 1$ mA; $V_{CE} = 1$ V	h_{FE}	min. typ.	20 40	
Saturation voltages $I_C = 10\ \mu A$; $I_B = 1\ \mu A$	V_{CEsat} V_{BEsat}	max. max.	200 750	mV mV
$I_C = 1$ mA; $I_B = 0.1$ mA	V_{CEsat} V_{BEsat}	max. max.	175 900	mV mV
Transition frequency at $f = 500$ MHz $I_C = 1$ mA; $V_{CE} = 1$ V	f_T	min. typ.	1.2 2.3	GHz GHz

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.

Collector capacitance at f = 1 MHz			
$I_E = I_e = 0$; $V_{CB} = 0.5$ V	C_c	max.	0.6 pF
Emitter capacitance at f = 1 MHz			
$I_C = I_c = 0$; $V_{EB} = 0$	C_e	max.	0.5 pF
Feedback capacitance at f = 1 MHz			
$I_C = 1$ mA; $V_{CE} = 1$ V; $T_{amb} = 25$ °C	C_{re}	max.	0.45 pF
Noise figure at optimum source impedance			
$I_C = 0{,}1$ mA; $V_{CE} = 1$ V; f = 500 MHz; $T_{amb} = 25$ °C	F	typ.	5.5 dB
$I_C = 1$ mA; $V_{CE} = 1$ V; f = 500 MHz; $T_{amb} = 25$ °C	F	typ.	3.8 dB

Maximum unilateral power gain (s_{12} assumed to be zero)

$$G_{UM} \text{ (in dB)} = 10 \log \frac{|s_{21}|^2}{[1-|s_{11}|^2]\ [1-|s_{22}|^2]}$$

$I_C = 1$ mA; $V_{CE} = 1$ V; f = 200 MHz; $T_{amb} = 25$ °C	G_{UM}	typ.	25.0 dB
$I_C = 1$ mA; $V_{CE} = 1$ V; f = 500 MHz; $T_{amb} = 25$ °C	G_{UM}	typ.	18.0 dB
$I_C = 1$ mA; $V_{CE} = 1$ V; f = 800 MHz; $T_{amb} = 25$ °C	G_{UM}	typ.	12.0 dB

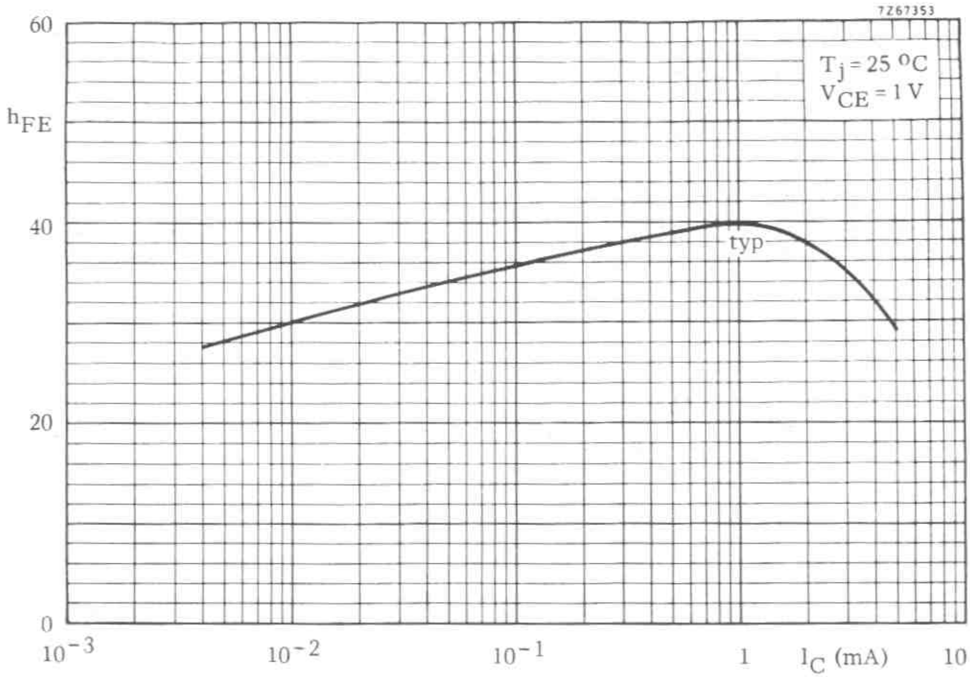


Fig. 2 V_{CE} = 1 V; T_j = 25 °C; typical values.

Fig. 3 V_{CE} = 1 V; f = 500 MHz; T_j = 25 °C; typical values.

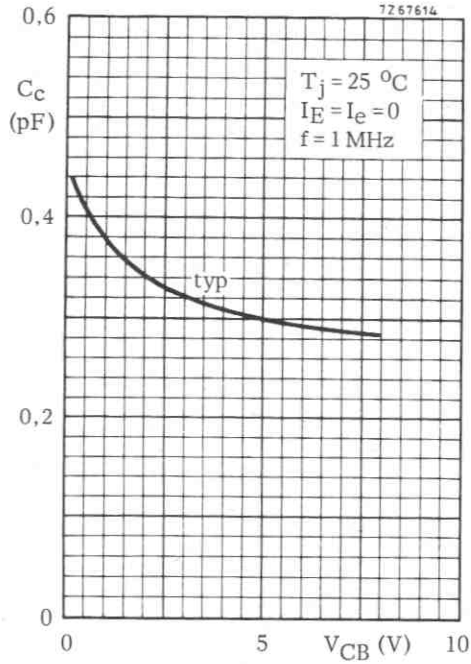


Fig. 4 $I_E = I_e = 0$; f = 1 MHz; T_j = 25 °C; typical values.

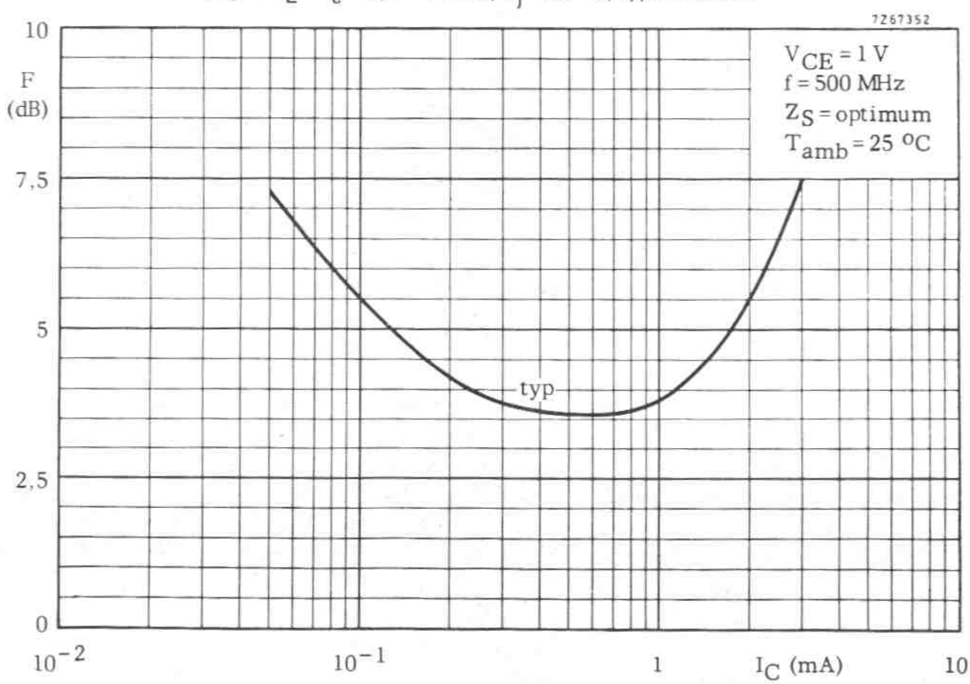


Fig. 5 V_{CE} = 1 V; f = 500 MHz; Z_S = opt.; T_{amb} = 25 °C; typical values.

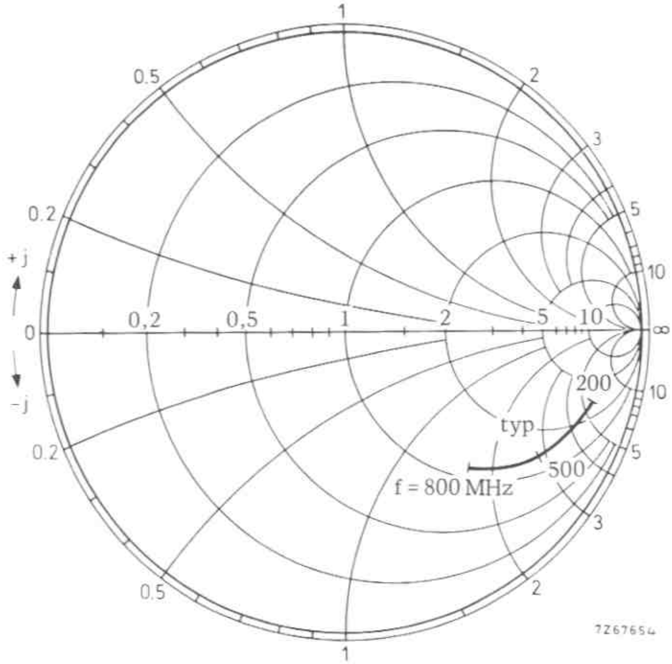


Fig. 6 V_{CE} = 1 V; I_C = 1 mA; T_{amb} = 25 °C; typical values.

Input impedance derived from input reflection coefficient s_{11} coordinates in ohm x 50

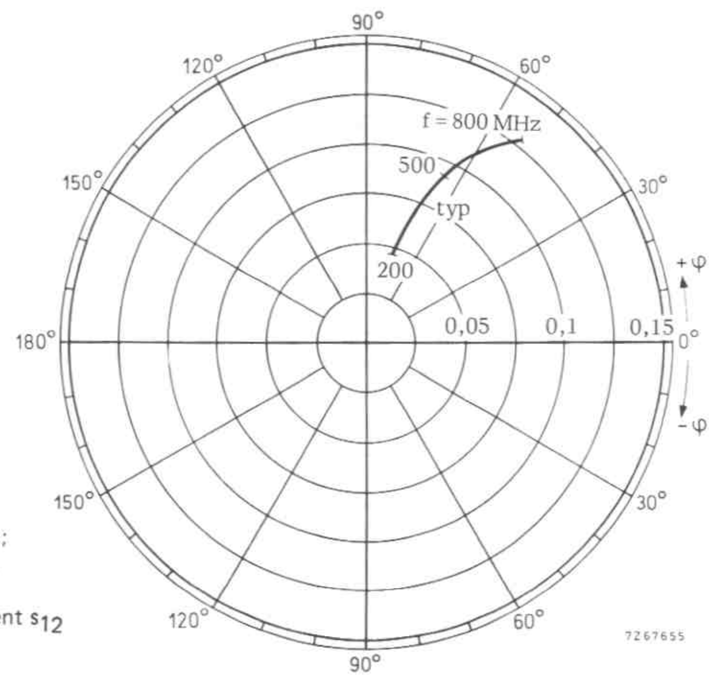


Fig. 7 V_{CE} = 1 V; I_C = 1 mA; T_{amb} = 25 °C; typical values.

Reverse transmission coefficient s_{12}

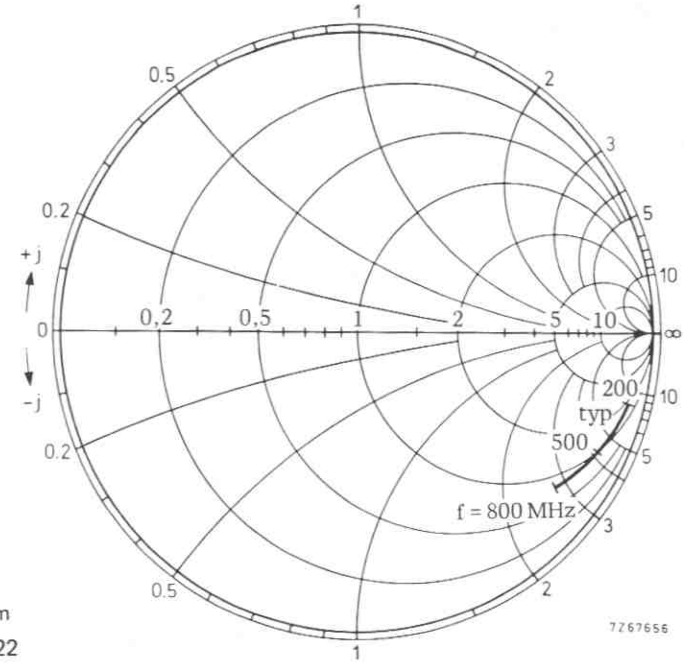


Fig. 8 V_{CE} = 1 V; I_C = 1 mA; T_{amb} = 25 °C; typical values.

Output impedance derived from output reflection coefficient s_{22} coordinates in ohm x 50

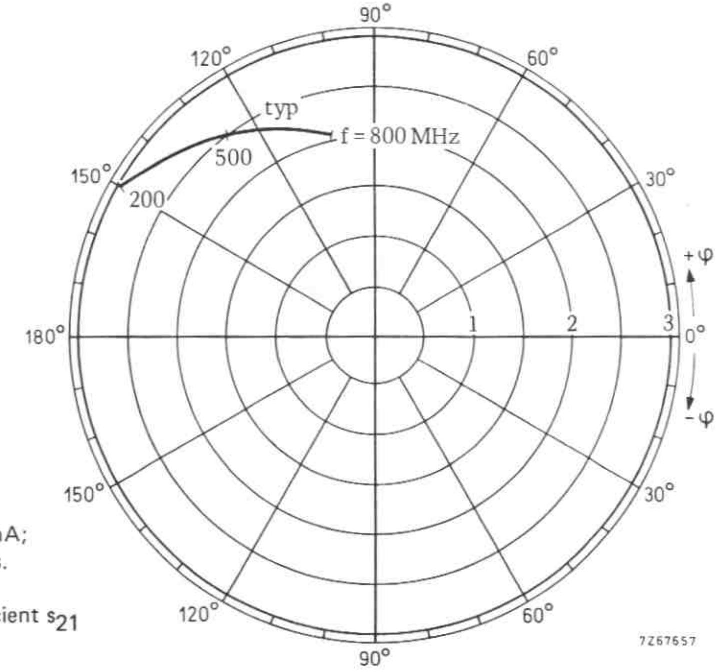


Fig. 9 V_{CE} = 1 V; I_C = 1 mA; T_{amb} = 25 °C; typical values.

Forward transmission coefficient s_{21}

Philips Components

Data sheet	
status	Preliminary specification
date of issue	April 1991

BFT25A
NPN HF wideband transistor

DESCRIPTION

NPN transistor in a plastic SOT23 envelope, primarily for use on low power amplifiers. Ideal for pagers and other battery operated systems where low power consumption is critical.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

MECHANICAL DATA

SOT23.

Marking code: V10

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	-	-	8	V
V_{CEO}	collector-emitter voltage	open base	-	-	5	V
I_C	collector current		-	-	6.5	mA
P_{tot}	total power dissipation (DC)		-	-	50	mW
T_j	junction temperature		-	-	150	°C
h_{FE}	DC current gain	I_C = 0. mA; V_{CE} = V	-	80	-	
f_T	transition frequency	f = 500 MHz; I_C = 1 mA; V_{CE} = V	3.5	5	-	GHz

LIMITING VALUES

Limiting values in accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	-	8	V
V_{CEO}	collector-emitter voltage	-	5	V
V_{EBO}	emitter-base voltage	-	2	V
I_C	collector current	-	6.5	mA
P_{tot}	total power dissipation (DC)	-	50	mW
T_{stg}	storage temperature range	−65	+150	°C
T_j	junction temperature	-	150	°C

NPN HF wideband transistor BFT25A

THERMAL RESISTANCE

SYMBOL	PARAMETER	MAX.	UNIT
$R_{th\ j-c}$	from junction to case	320	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)\ CBO}$	collector-base breakdown voltage	open emitter I_C = 10 µA	8	-	-	V
$V_{(BR)\ CEO}$	collector-emitter breakdown voltage	open base I_C = 100 µA	5	-	-	V
$V_{(BR)\ EBO}$	emitter-base breakdown voltage	open collector I_E = 10 µA	2	-	-	V
h_{FE}	DC current gain	I_C = 0.5 mA; V_{CE} = 1 V	-	80	-	
C_{re}	feedback capacitance	f = 1 MHz; I_C = 0; V_{CE} = 1 V	-	0.22	-	pF
G_{UM}	maximum unilateral gain	f = 500 MHz; I_C = 0.5 mA; V_{CE} = 1 V	-	24	-	dB
G_{UM}	maximum unilateral gain	f = 1 GHz; I_C = 0.5 mA; V_{CE} = 1 V	-	15	-	dB
F	noise figure	f = 500 MHz; I_C = 0.5 mA; V_{CE} = 1 V	-	1.7	2	dB
F	noise figure	f = 1 GHz; I_C = 0.5 mA; V_{CE} = 1 V	-	2	2.5	dB
f_T	transition frequency	f = 500 MHz; I_C = 1 mA; V_{CE} = 1 V	3.5	5	-	GHz

N-CHANNEL SILICON FET

Symmetrical n-channel silicon epitaxial planar junction field-effect transistor in a microminiature plastic envelope. The transistor is intended for low level general purpose amplifiers in thick and thin-film circuits.

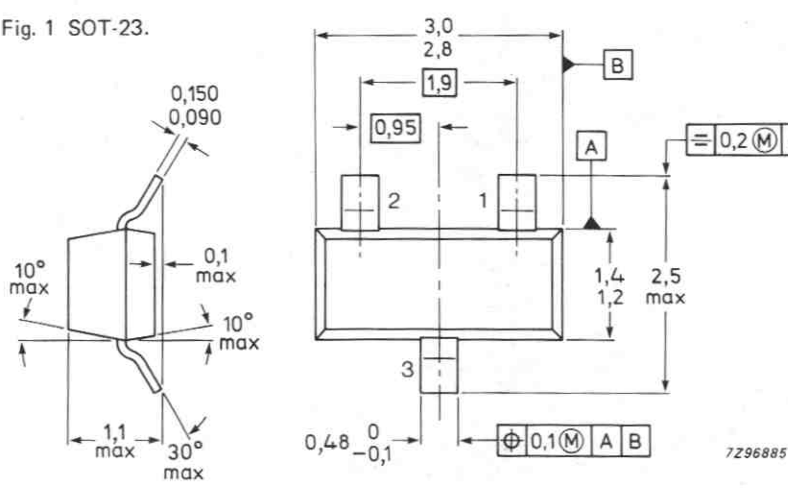
QUICK REFERENCE DATA

Drain-source voltage	$\pm V_{DS}$	max.	25 V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	25 V
Total power dissipation up to T_{amb} = 40 °C	P_{tot}	max.	250 mW
Drain current V_{DS} = 10 V; V_{GS} = 0	I_{DSS}	> <	0,2 mA 1,5 mA
Transfer admittance (common source) I_D = 0,2 mA; V_{DS} = 10 V; f = 1 kHz	$\lvert y_{fs} \rvert$	>	0,5 mS
Equivalent noise voltage V_{DS} = 10 V; I_D = 200 μA; B = 0,6 to 100 Hz	V_n	<	0,5 μV

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-23.



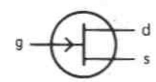
TOP VIEW

Marking code

BFT46 = M3

Pinning

1 = drain
2 = source
3 = gate



Note : Drain and source are interchangeable.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	$\pm V_{DS}$	max.	25 V
Drain-gate voltage (open source)	V_{DGO}	max.	25 V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	25 V
Drain current	I_D	max.	10 mA
Gate current	I_G	max.	5 mA
Total power dissipation up to T_{amb} = 40 °C *	P_{tot}	max.	250 mW
Storage temperature range	T_{stg}		−65 to +150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	430 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Gate cut-off current $-V_{GS}$ = 10 V; V_{DS} = 0	$-I_{GSS}$	<	0,2 nA
Drain current V_{DS} = 10 V; V_{GS} = 0	I_{DSS}	> <	0,2 mA 1,5 mA
Gate-source voltage I_D = 50 μA; V_{DS} = 10 V	$-V_{GS}$	> <	0,1 V 1,0 V
Gate-source cut-off voltage I_D = 0,5 nA; V_{DS} = 10 V	$-V_{(P)GS}$	<	1,2 V
y-parameters at f = 1 kHz; V_{DS} = 10 V; V_{GS} = 0; T_{amb} = 25 °C			
Transfer admittance	$\|y_{fs}\|$	>	1,0 mS
Output admittance	$\|y_{os}\|$	<	10 μS
V_{DS} = 10 V; I_D = 200 μA; T_{amb} = 25 °C			
Transfer admittance	$\|y_{fs}\|$	>	0,5 mS
Output admittance	$\|y_{os}\|$	<	5 μS

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

Input capacitance at f = 1 MHz; V_{DS} = 10 V; V_{GS} = 0; T_{amb} = 25 °C	C_{is}	<	5 pF
Feedback capacitance at f = 1 MHz; V_{DS} = 10 V; V_{GS} = 0; T_{amb} = 25 °C	C_{rs}	<	1,5 pF
Equivalent noise voltage V_{DS} = 10 V; I_D = 200 μA; T_{amb} = 25 °C B = 0,6 to 100 Hz	V_n	<	0,5 μV

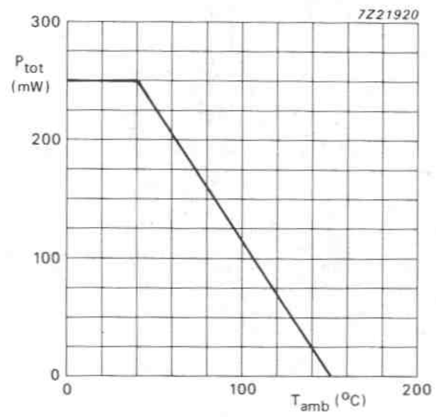


Fig.2 Power derating curve.

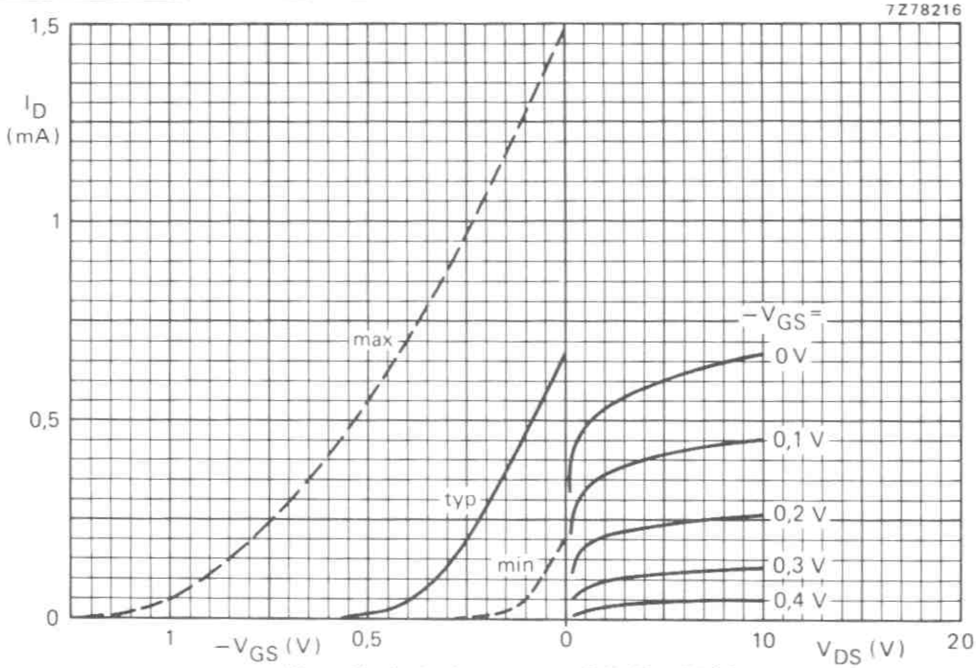


Fig. 3 Typical values. V_{DS} = 10 V; T_j = 25 °C.

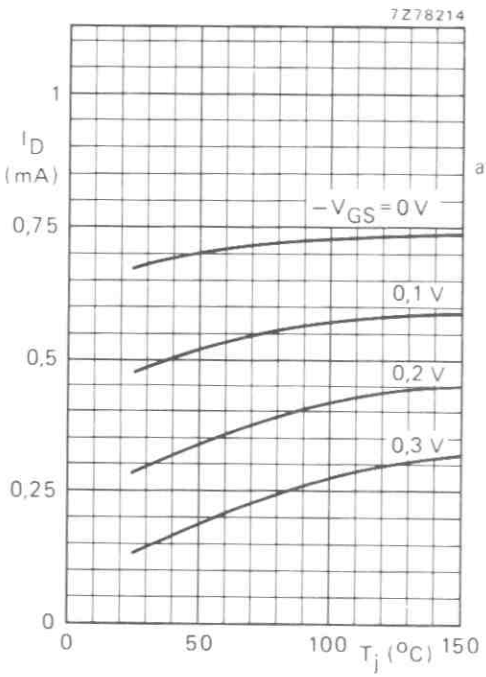


Fig. 4 Typical values. V_{DS} = 10 V.

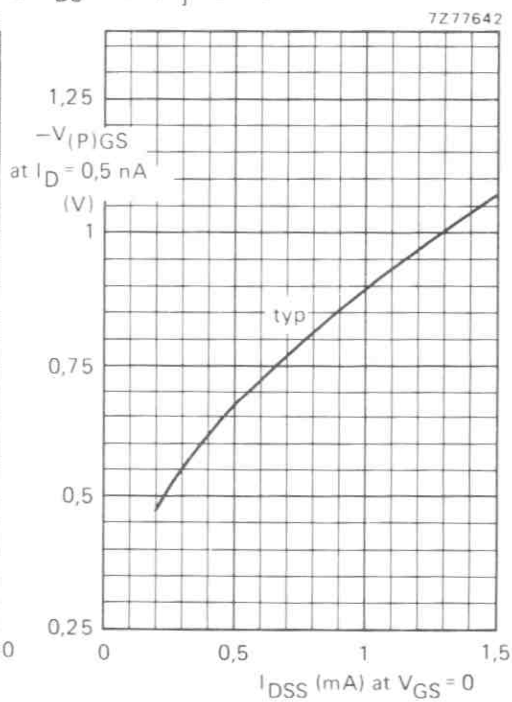


Fig. 5 Correlation between $-V_{(P)GS}$ and I_{DSS}. V_{DS} = 10 V; T_j = 25 °C.

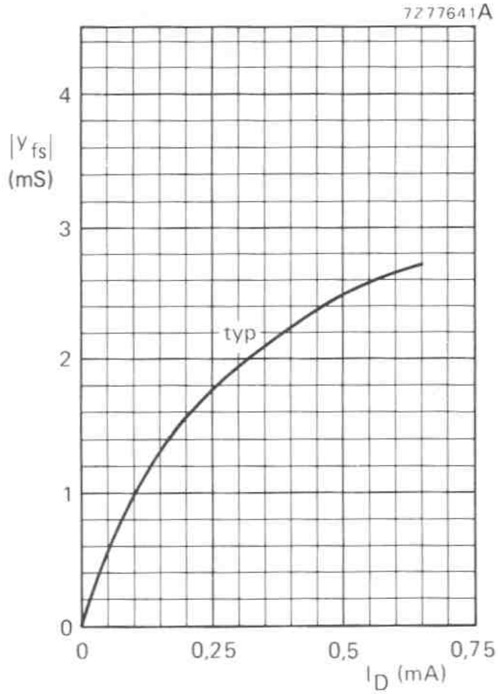


Fig. 6

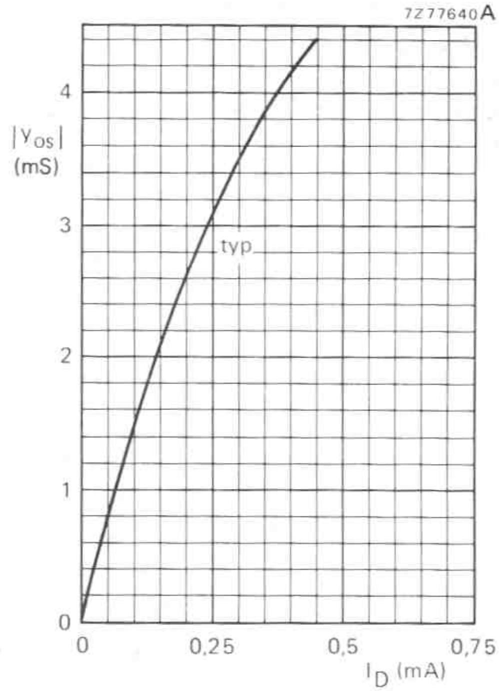


Fig. 7

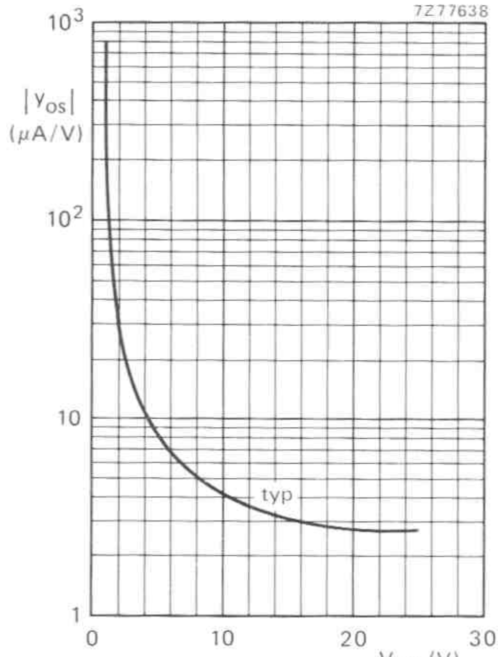


Fig. 8

Fig. 6 $|y_{fs}|$ versus I_D.
V_{DS} = 10 V; f = 1 kHz; T_{amb} = 25 °C.

Fig. 7 $|y_{os}|$ versus I_D.
V_{DS} = 10 V; f = 1 kHz; T_{amb} = 25 °C.

Fig. 8 $|y_{os}|$ versus V_{DS}.
I_D = 0,4 mA; f = 1 kHz; T_{amb} = 25 °C.

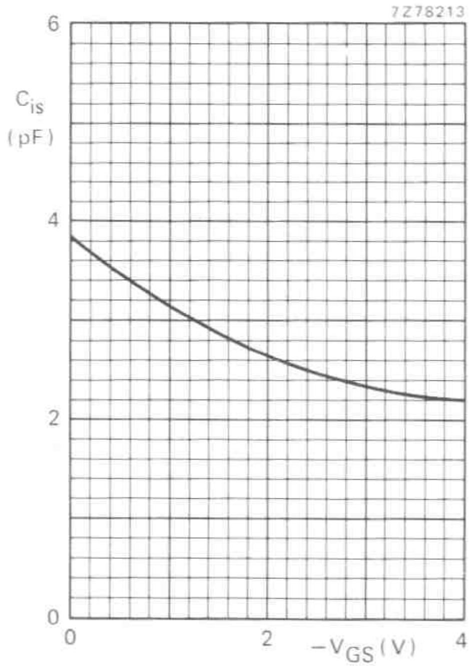


Fig. 9

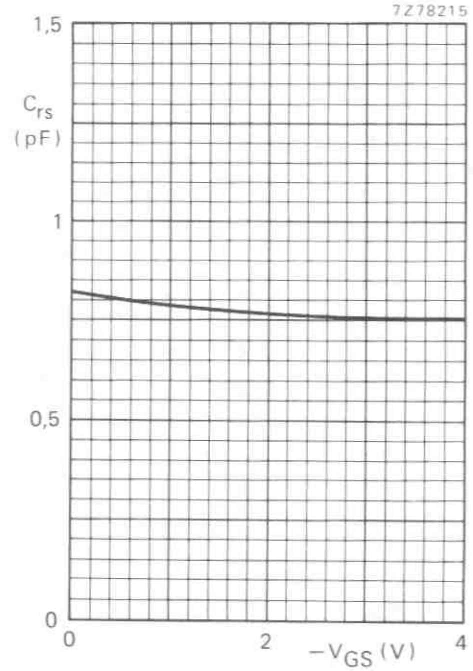


Fig. 10

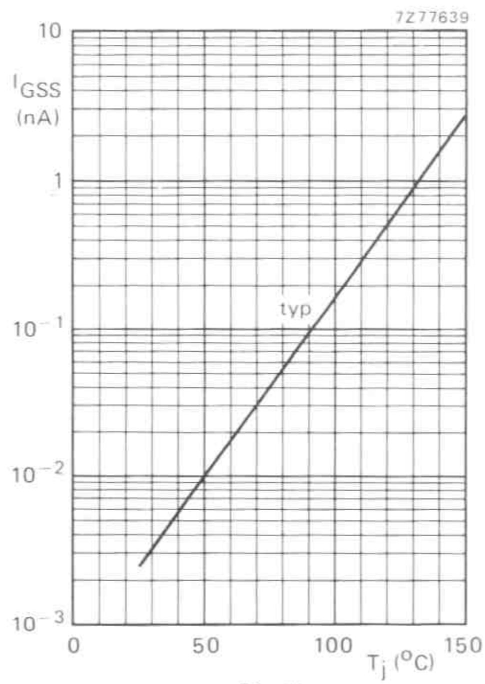


Fig. 11

Fig. 9 Typical values.
V_{DS} = 10 V, T_{amb} = 25 °C.

Fig. 10 Typical values.
V_{DS} = 10 V, T_{amb} = 25 °C.

Fig. 11 I_{GSS} versus T_j.
$-V_{GSS}$ = 10V; V_{DS} = 0.

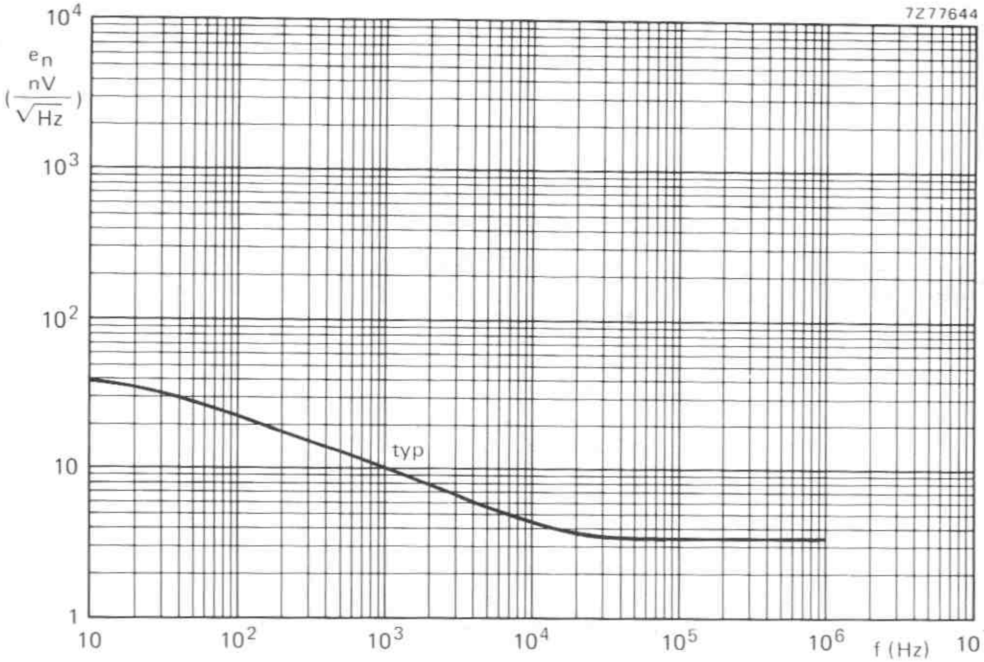


Fig. 12 V_{DS} = 10 V; I_D = 0,2 mA; T_{amb} = 25 °C.

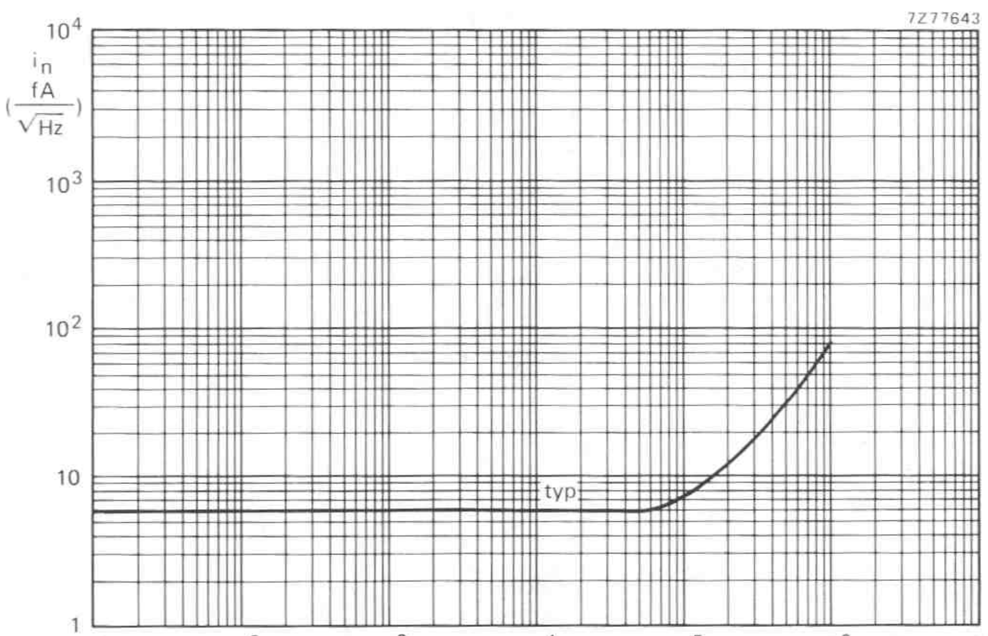


Fig. 13 V_{DS} = 10 V; I_D = 0,2 mA; T_{amb} = 25 °C.

PNP 5 GHz WIDEBAND TRANSISTOR

P-N-P transistor in a microminiature plastic envelope. It is primarily intended for use in u.h.f. and microwave amplifiers in thick and thin-film circuits, such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analysers, etc.

The transistor features low intermodulation distortion and high power gain; thanks to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

N-P-N complements are BFR92 and BFR92A.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	20	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	15	V
Collector current (DC)	$-I_C$	max.	25	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Junction temperature	T_j	max.	150	°C
Transition frequency at f = 500 MHz $-I_C$ = 14 mA; $-V_{CE}$ = 10 V	f_T	typ.	5	GHz
Feedback capacitance at f = 1 MHz $-I_C$ = 2 mA; $-V_{CE}$ = 10 V; T_{amb} = 25 °C	C_{re}	typ.	0.7	pF
Noise figure at optimum source impedance $-I_C$ = 2 mA; $-V_{CE}$ = 10 V; f = 500 MHz; T_{amb} = 25 °C	F	typ.	2.7	dB
Max. unilateral power gain $-I_C$ = 14 mA; $-V_{CE}$ = 10 V; f = 500 MHz; T_{amb} = 25 °C	G_{UM}	typ.	18	dB
Intermodulation distortion at T_{amb} = 25 °C $-I_C$ = 14 mA; $-V_{CE}$ = 10 V; R_L = 75 Ω; V_o = 150 mV $f_{(p+q-r)}$ = 493.25 MHz	d_{im}	typ.	−60	dB

MECHANICAL DATA

(See next page).

See also *Soldering recommendations.*

MECHANICAL DATA

Dimensions in mm

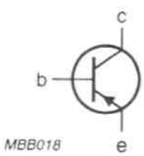
Marking code

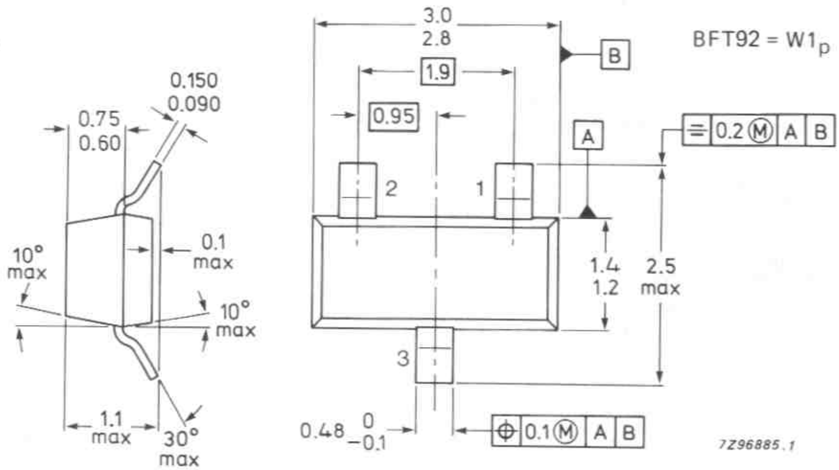
BFT92 = $W1_p$

Fig. 1 SOT-23.

Pinning

1 = base
2 = emitter
3 = collector





TOP VIEW

If required, the R-version (reverse pinning) is available on request.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	20 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	15 V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	2 V
Collector current (DC)	$-I_C$	max.	25 mA
Collector current (peak value; f > 1 MHz)	$-I_{CM}$	max.	35 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300 mW
Storage temperature	T_{stg}	−65 to + 150	°C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	430 K/W

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current $I_E = 0$; $-V_{CB} = 10$ V	$-I_{CBO}$	max.	50	nA
DC current gain $-I_C = 14$ mA; $-V_{CE} = 10$ V	h_{FE}	min.	20	
		typ.	50	
Transition frequency at f = 500 MHz $-I_C = 14$ mA; $-V_{CE} = 10$ V	f_T	typ.	5.0	GHz
Collector capacitance at f = 1 MHz $I_E = I_e = 0$; $-V_{CB} = 10$ V	C_c	typ.	0.75	pF
Emitter capacitance at f = 1 MHz $I_C = I_c = 0$; $-V_{EB} = 0.5$ V	C_e	typ.	0.8	pF

T_{amb} = 25 °C

Feedback capacitance at f = 1 MHz $-I_C = 2$ mA; $-V_{CE} = 10$ V	C_{re}	typ.	0.7	pF
Noise figure at optimum source impedance * $-I_C = 2$ mA; $-V_{CE} = 10$ V; f = 500 MHz	F	typ.	2.7	dB
Max. unilateral power gain (s_{re} assumed to be zero) $G_{UM} = 10 \log \frac{\lvert s_{21}\rvert^2}{[1-\lvert s_{11}\rvert^2]\,[1-\lvert s_{22}\rvert^2]}$ $-I_C = 14$ mA; $-V_{CE} = 10$ V; f = 500 MHz	G_{UM}	typ.	18.0	dB
Output voltage at $d_{im} = -60$ dB (see Fig. 2) (DIN 45004B, par. 6.3.: 3-tone) $-I_C = 14$ mA; $-V_{CE} = 10$ V; $R_L = 75\ \Omega$ $V_p = V_o$ at $d_{im} = -60$ dB; f_p = 495.25 MHz $V_q = V_o - 6$ dB ; f_q = 503.25 MHz $R_r = V_o - 6$ dB ; f_r = 505.25 MHz measured at $f_{(p+q-r)}$ = 493.25 MHz	V_o	typ.	150	mV

* Crystal mounted in SOT-37 envelope.

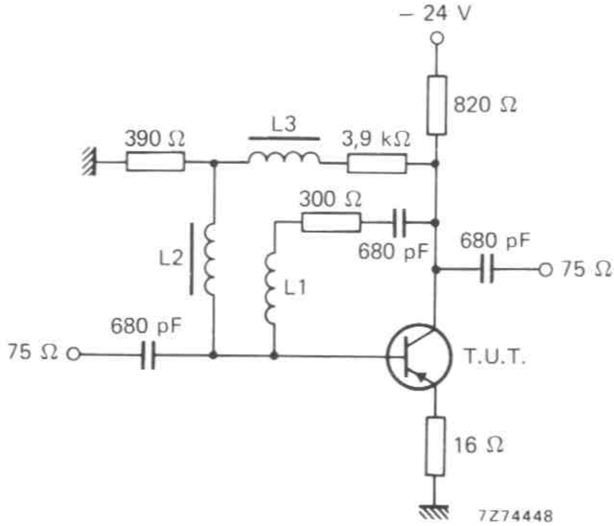


Fig. 2 Intermodulation test circuit.

L1 = 4 turns Cu wire (0,35 mm); winding pitch 1 mm; int. dia. 4 mm.
L2 = L3 = 5 μH (catalogue number: 3122 108 20150).

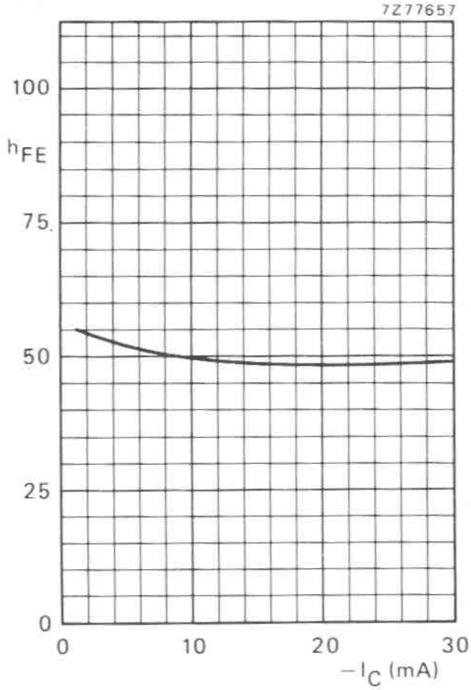


Fig. 3 $-V_{CE}$ = 10 V; T_j = 25 °C; typical values.

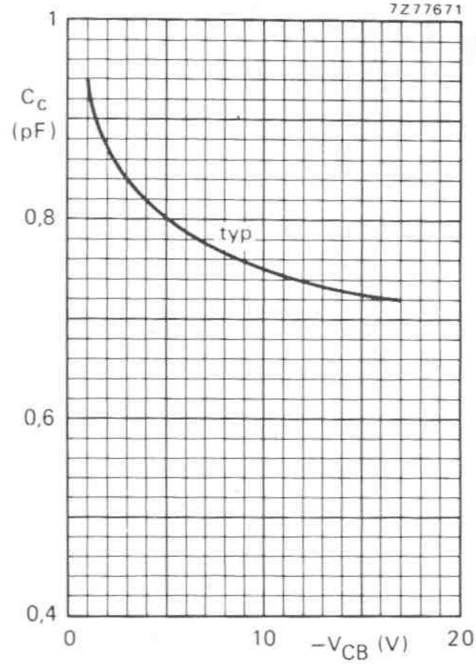


Fig. 4 $I_E = I_e = 0$; T_j = 25 °C; f = 1 MHz; typical values.

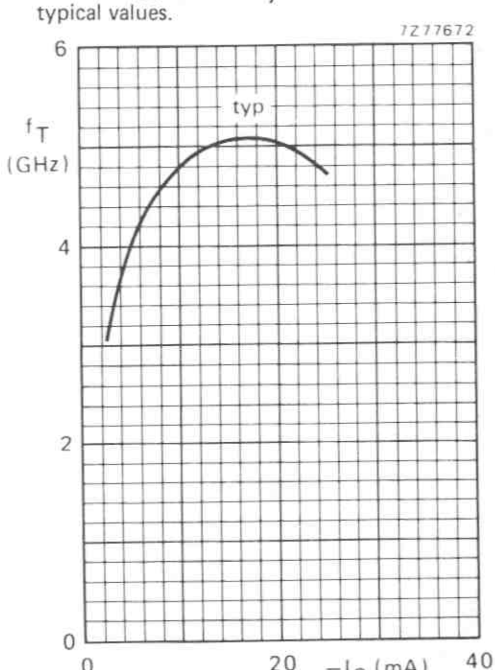


Fig. 5 $-V_{CE}$ = 10 V; f = 500 MHz; T_j = 25 °C; typical values.

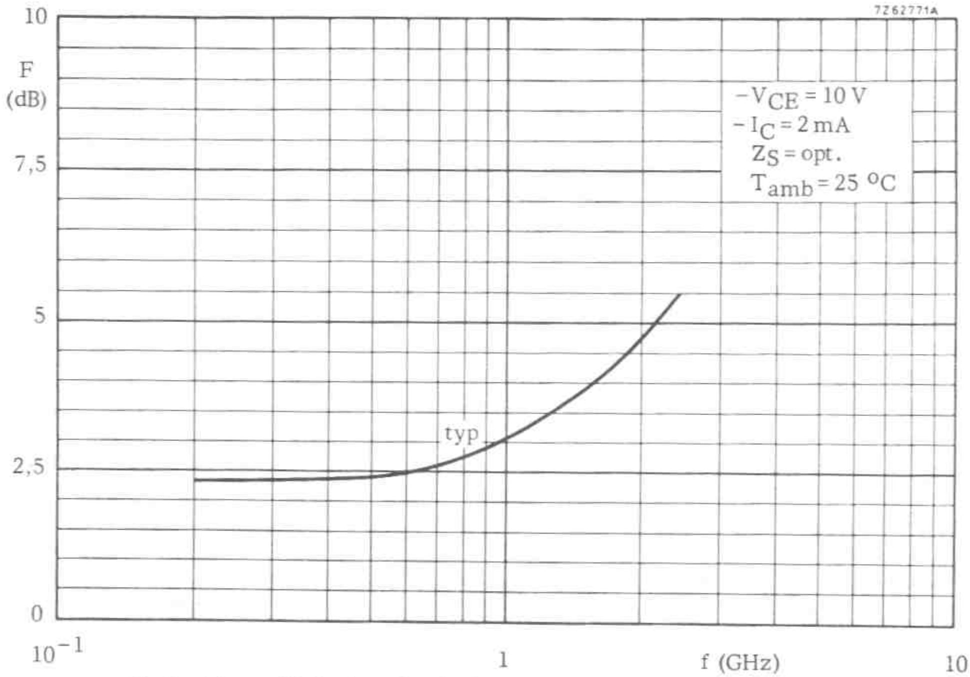


Fig. 6 $-V_{CE} = 10$ V; $-I_C = 2$ mA; Z_S = opt.; $T_{amb} = 25$ °C; typical values.

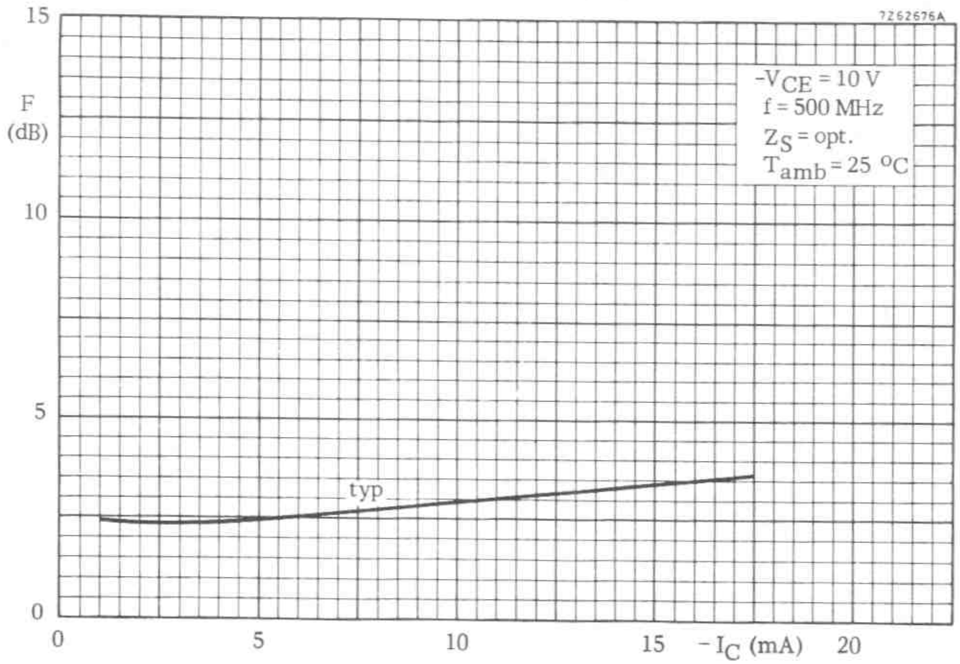


Fig. 7 $-V_{CE} = 10$ V; f = 500 MHz; Z_S = opt.; $T_{amb} = 25$ °C; typical values.

P-N-P 5 GHz WIDEBAND TRANSISTOR

P-N-P transistor in a plastic SOT-23 envelope. It is primarily intended for use in u.h.f. and microwave amplifiers in thick and thin-film circuits, such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analyses, etc.

The transistor features low intermodulation distortion and high power gain; thanks to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

N-P-N complements are BFR93 and BFR93A.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	15 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	12 V
Collector current (DC)	$-I_C$	max.	35 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300 mW
Junction temperature	T_j	max.	150 °C
Transition frequency at f = 500 MHz $-I_C$ = 30 mA; $-V_{CE}$ = 5 V	f_T	typ.	5.0 GHz
Feedback capacitance at f = 1 MHz $-I_C$ = 2 mA; $-V_{CE}$ = 5 V	C_{re}	typ.	1.0 pF
Noise figure at optimum source impedance $-I_C$ = 2 mA; $-V_{CE}$ = 5 V; f = 500 MHz	F	typ.	2.4 dB
Max. unilateral power gain $-I_C$ = 30 mA; $-V_{CE}$ = 5 V; f = 500 MHz	G_{UM}	typ.	16.5 dB
Output voltage at d_{im} = −60 dB $-I_C$ = 30 mA; $-V_{CE}$ = 5 V; R_L = 75 Ω $f_{(p+q-r)}$ = 493.25 MHz	V_o	typ.	300 mV

MECHANICAL DATA

Dimensions in mm

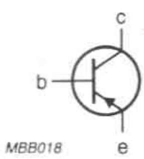
Marking code

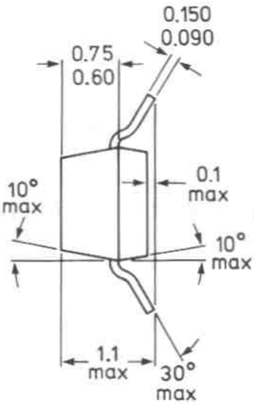
BFT93 = $X1_p$

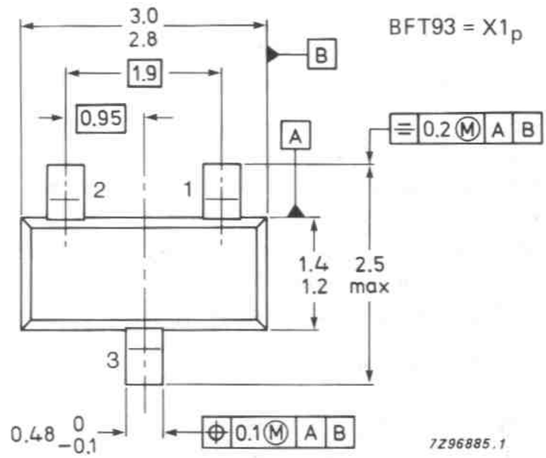
Fig. 1 SOT-23.

Pinning

1 = base
2 = emitter
3 = collector







TOP VIEW

If required, the R-version (reverse pinning) is available on request.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	15 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	12 V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	2 V
Collector current (DC)	$-I_C$	max.	35 mA
Collector current (peak value; f > 1 MHz)	$-I_{CM}$	max.	50 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300 mW
Storage temperature	T_{stg}	−65 to + 150 °C	
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	430 K/W

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current $I_E = 0; -V_{CB} = 5$ V	$-I_{CBO}$	max.	50 nA
DC current gain $-I_C = 30$ mA; $-V_{CE} = 5$ V	h_{FE}	min. typ.	20 50
Transition frequency at f = 500 MHz $-I_C = 30$ mA; $-V_{CE} = 5$ V	f_T	typ.	5.0 GHz
Collector capacitance at f = 1 MHz $I_E = I_e = 0; -V_{CB} = 10$ V	C_c	typ.	0.95 pF
Emitter capacitance at f = 1 MHz $I_C = I_c = 0; -V_{EB} = 0.5$ V	C_e	typ.	1.8 pF
T_{amb} = 25 °C			
Feedback capacitance at f = 1 MHz $-I_C = 2$ mA; $-V_{CE} = 5$ V	C_{re}	typ.	1.0 pF
Noise figure at optimum source impedance * $-I_C = 2$ mA; $-V_{CE} = 5$ V; f = 500 MHz	F	typ.	2.4 dB
Max. unilateral power gain (s_{12} assumed to be zero) $G_{UM} = 10 \log \frac{\|s_{21}\|^2}{[1-\|s_{11}\|^2]\ [1-\|s_{22}\|^2]}$ $-I_C = 30$ mA; $-V_{CE} = 5$ V; f = 500 MHz	G_{UM}	typ.	16.5 dB
Output voltage at $d_{im} = -60$ dB (see Fig. 2) $-I_C = 30$ mA; $-V_{CE} = 5$ V; $R_L = 75\ \Omega$ $V_p = V_o$ at $d_{im} = -60$ dB; f_p = 495.25 MHz $V_q = V_o$ −6 dB ; f_q = 503.25 MHz $V_r = V_o$ −6 dB ; f_r = 505.25 MHz measured at $f_{(p+q-r)}$ = 443.25 MHz	V_o	typ.	300 mV

* Crystal mounted in SOT-37 envelope.

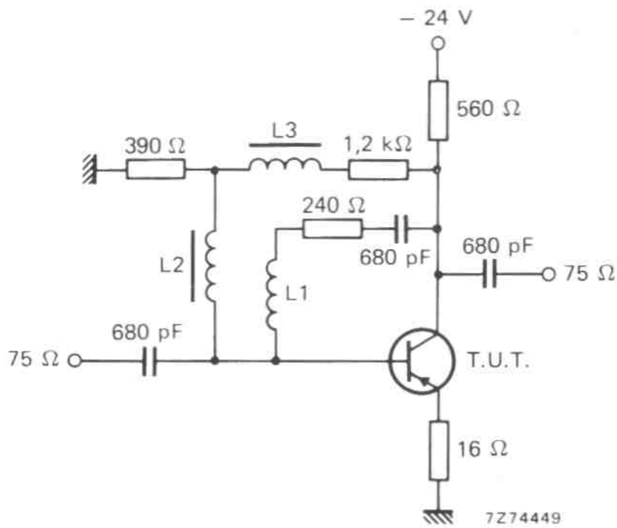


Fig. 2 Intermodulation test circuit.

L1 = 4 turns Cu wire (0.35); winding pitch 1 mm; int. dia. 4 mm.
L2 and L3 = 5 μH (catalogue number: 3122 108 20150).

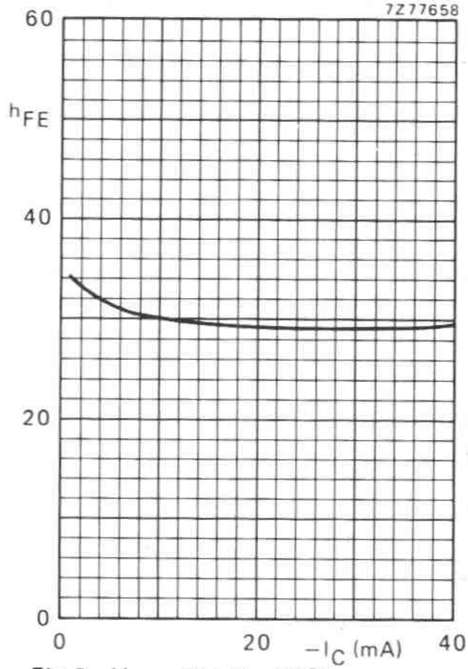


Fig. 3 $-V_{CE}$ = 5 V; T_j = 25 °C; typical values.

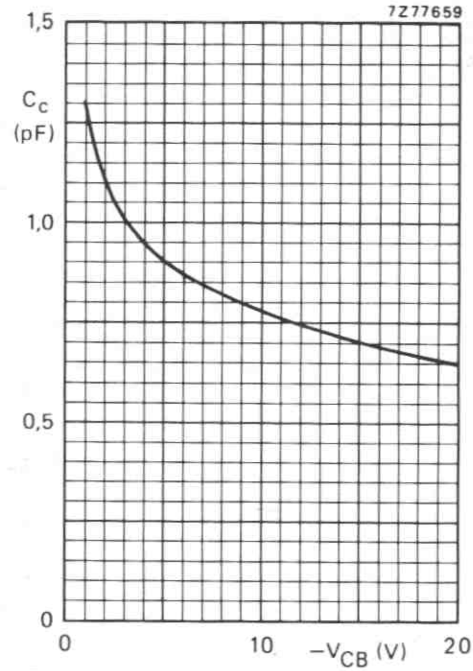


Fig. 4 $I_E = I_e = 0$; T_j = 25 °C; f = 1 MHz; typical values.

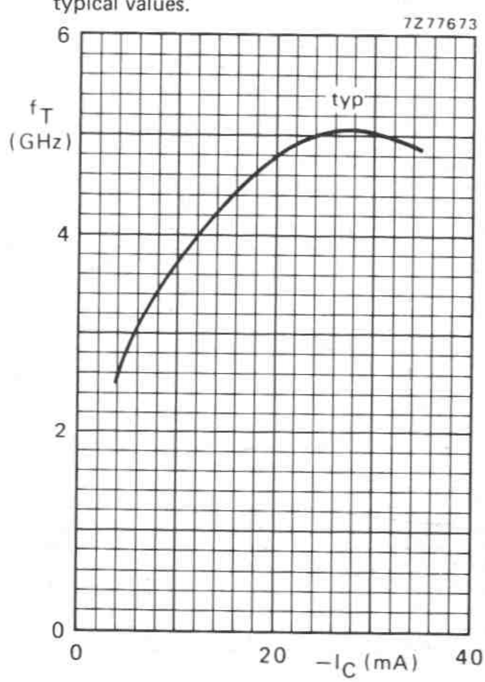


Fig. 5 $-V_{CE}$ = 5 V; T_j = 25 °C; f = 500 MHz; typical values.

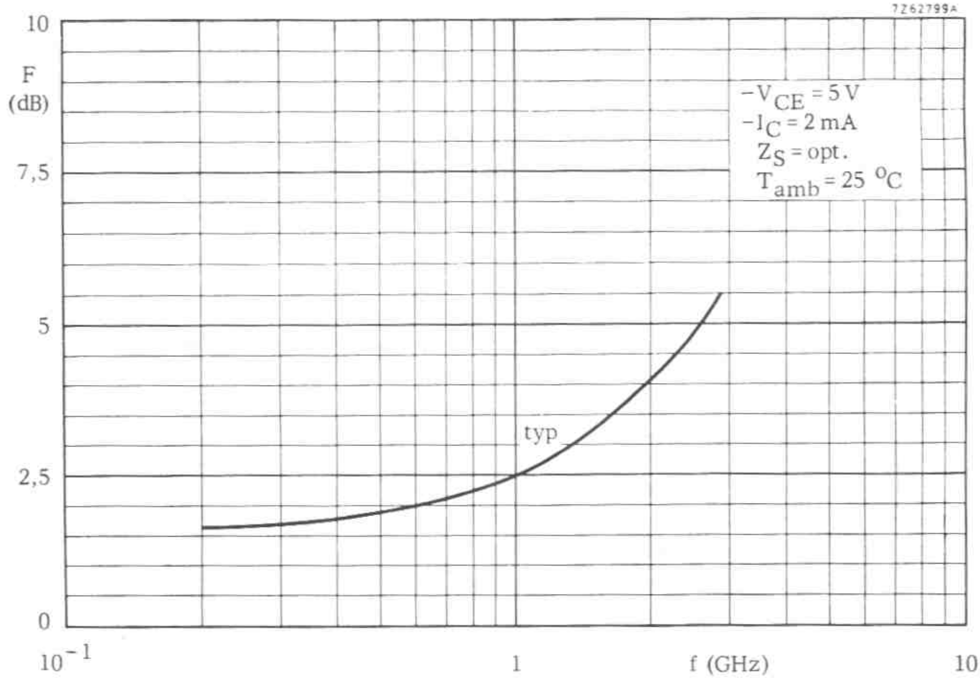


Fig. 6 $-V_{CE} = 5$ V; $-I_C = 2$ mA; Z_S = opt.; $T_{amb} = 25$ °C; typical values.

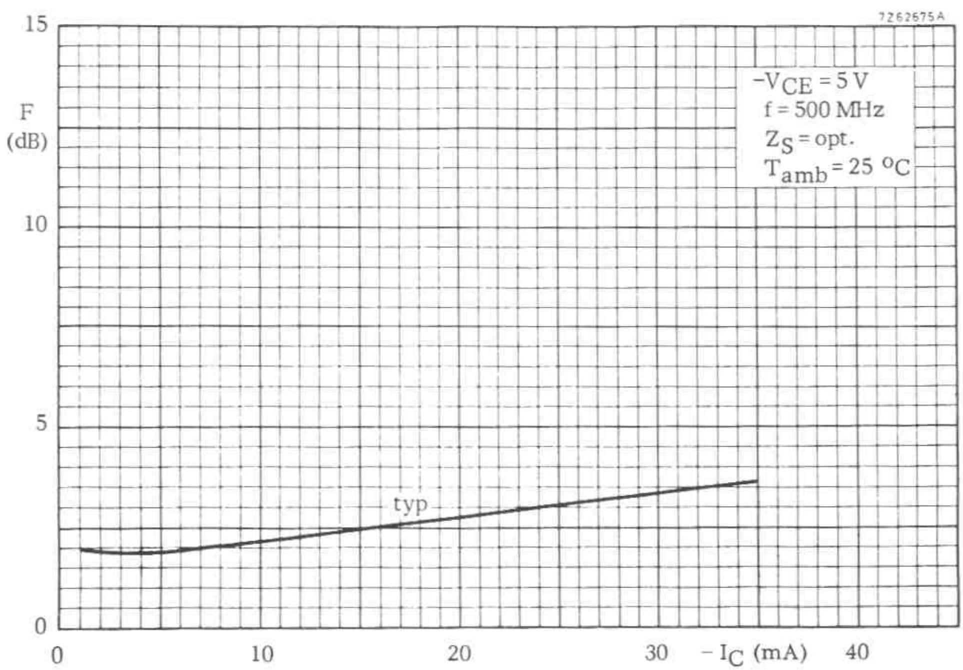


Fig. 7 $-V_{CE} = 5$ V; f = 500 MHz; Z_S = opt.; $T_{amb} = 25$ °C; typical values.

PROGRAMMABLE UNIJUNCTION TRANSISTOR

Planar p-n-p-n trigger device in a microminiature plastic envelope intended for applications in thick and thin-film circuits. It is intended for use in switching applications such as motor control, oscillators, relay replacement, timers, pulse shaper, trigger device etc.

QUICK REFERENCE DATA

Gate-anode voltage	V_{GA}	max.	70 V
Anode current (d.c.) up to T_{amb} = 25 °C	I_A	max.	175 mA
Junction temperature	T_j	max.	150 °C
Peak point current V_S = 10 V; R_G = 10 kΩ	I_P	$<$	5 µA
Valley point current V_S = 10 V; R_G = 10 kΩ	I_V	$>$	30 µA

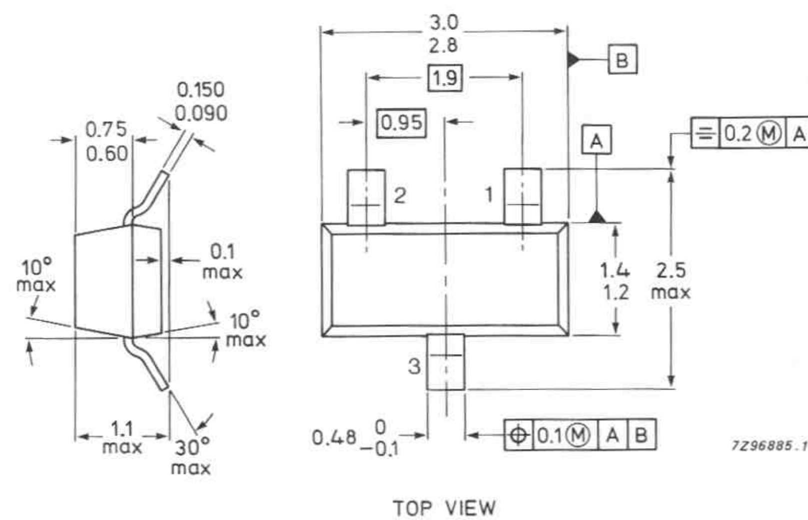
MECHANICAL DATA

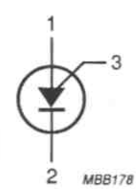
Dimensions in mm

Marking code

Fig. 1 SOT-23.

BRY61 = A5p





See also *Soldering Recommendations*.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Gate-anode voltage	V_{GA}	max.	70 V
Anode current (d.c.) up to T_{amb} = 25 °C	I_A	max.	175 mA
Repetitive peak anode current t = 10 μs; δ = 0,01	I_{ARM}	max.	2,5 A
Non-repetitive peak anode current t = 10 μs; T_j = 150 °C	I_{ASM}	max.	3 A
Rate of rise of anode current up to I_A = 2,5 A	$\frac{dI_A}{dt}$	max.	20 A/μs
Storage temperature	T_{stg}	−65 to + 150	°C
Junction temperature	T_j	max.	150 °C
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250 mW

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	500 K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Peak point current (see Figs 2, 3 and 4)			
V_S = 10 V; R_G = 10 kΩ	I_P	<	5 μA
V_S = 10 V; R_G = 1 MΩ	I_P	<	1 μA
Valley point current (see also Figs 2, 3 and 4)			
V_S = 10 V; R_G = 10 kΩ	I_V	>	30 μA
V_S = 10 V; R_G = 1 MΩ	I_V	<	50 μA
Offset voltage (see Fig. 12) I_A = 0 (for V_P see Fig. 2; for V_S see Fig. 4)	V_{offset}	=	$V_P - V_S$ V

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

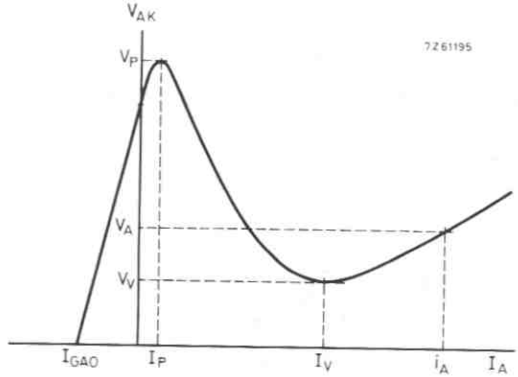


Fig. 2 See also Fig. 11.

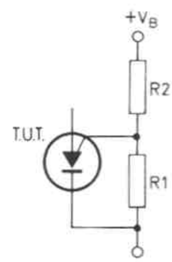


Fig. 3 BRY61 with "program" resistors R1 and R2.

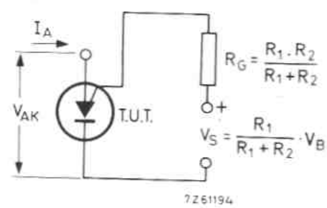


Fig. 4 Equivalent test circuit for characteristics testing.

Gate-anode leakage current (Fig. 5a) $I_K = 0$; $V_{GA} = 70$ V	I_{GAO}	$<$	10 nA
Gate-cathode leakage current (Fig. 5b) $V_{AK} = 0$; $V_{GK} = 70$ V	I_{GKS}	$<$	100 nA

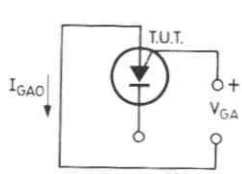


Fig. 5a.

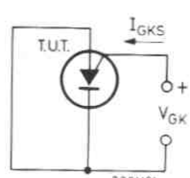


Fig. 5b.

Anode voltage			
I_A = 100 mA	V_A	<	1,4 V
I_A = 180 mA	V_A	<	1,6 V
Peak output voltage			
V_{AA} = 20 V; C = 200 nF (see Fig. 12)	V_{OM}	>	6 V
Rise time			
V_{AA} = 20 V; C = 10 nF (see Fig. 12)	t_r	<	80 ns

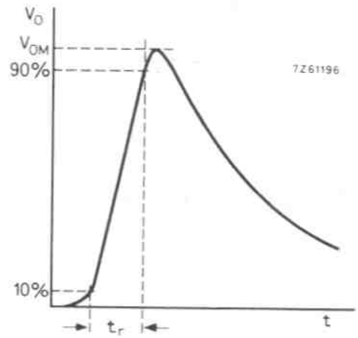


Fig. 6 Output voltage waveform.

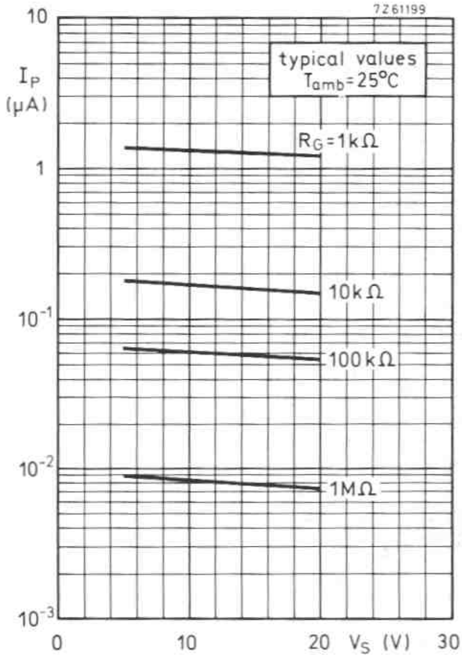


Fig. 7.

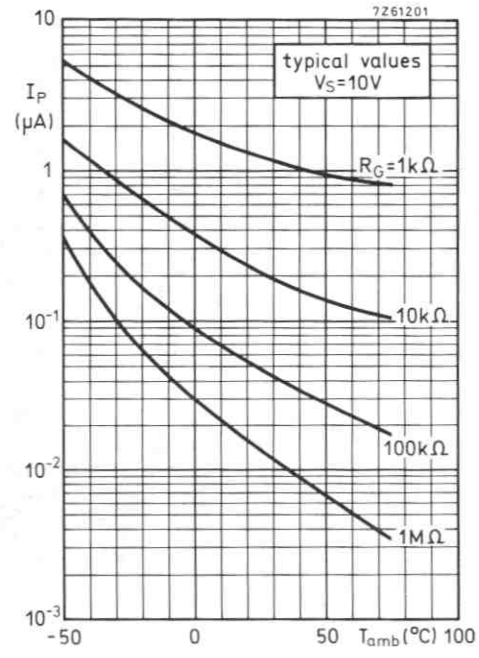


Fig. 8.

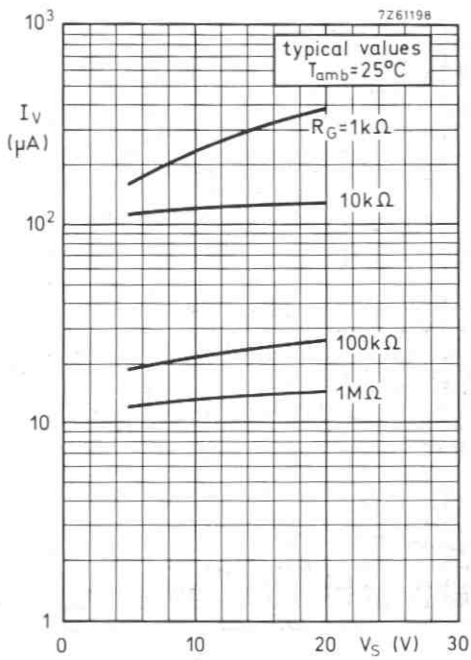


Fig. 9.

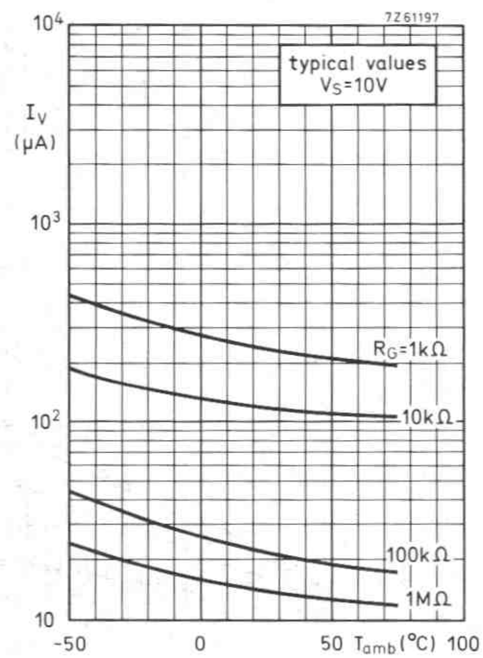


Fig. 10.

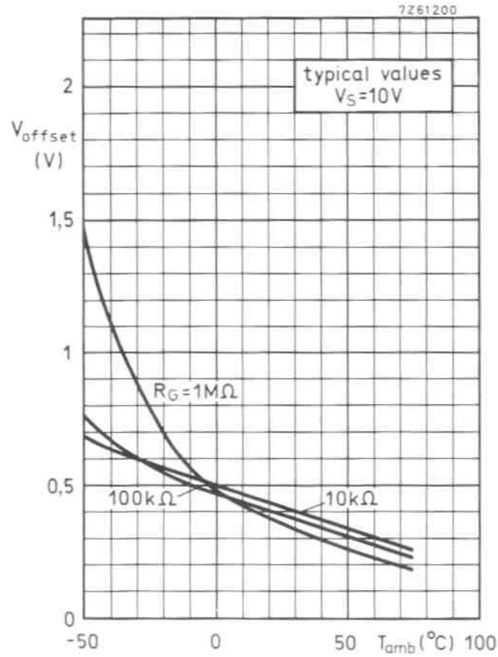

7Z61200
typical values
V_S=10V
V_{offset} (V)
2
1,5
1
0,5
0
R_G=1MΩ
100kΩ
10kΩ
-50
0
50
T_{amb} (°C)
100

Fig. 11.

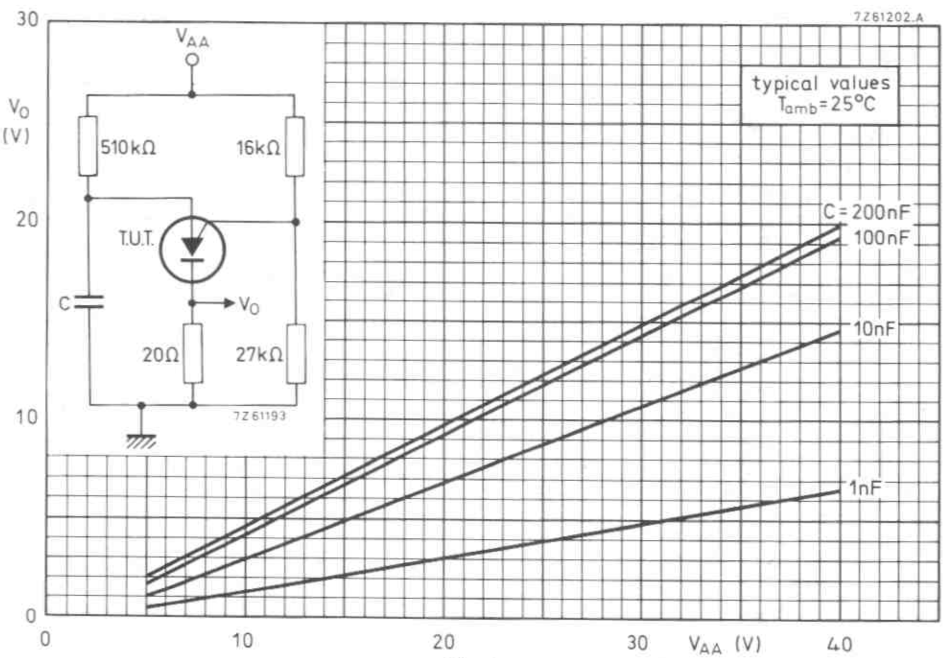

7Z61202.A
typical values
T_{amb}=25°C
V_O (V)
30
20
10
0
V_{AA}
510kΩ
16kΩ
T.U.T.
C
V_O
20Ω
27kΩ
7Z61193
C = 200nF
100nF
10nF
1nF
0
10
20
30
V_{AA} (V)
40

Fig. 12.

SILICON P-N-P-N PLANAR TETRODE THYRISTOR

Planar p-n-p-n trigger device in a microminiature plastic envelope. It is intended for use as a programmable trigger device (SCS = silicon controlled switch).

QUICK REFERENCE DATA

Anode gate — cathode voltage	$V_{ga\text{-}kR}$	max.	70 V
Anode gate — anode voltage (open cathode)	$V_{ga\text{-}aO}$	max.	70 V
Average anode current	$I_{A(AV)}$	max.	175 mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	250 mW
Junction temperature	T_j	max.	150 °C
Gate-controlled turn-on time $R_{gk\text{-}k}$ = 1 kΩ	t_{gt}	<	0,25 μs
Circuit-commutated turn-off time $R_{gk\text{-}k}$ = 1 kΩ	t_q	<	5 μs

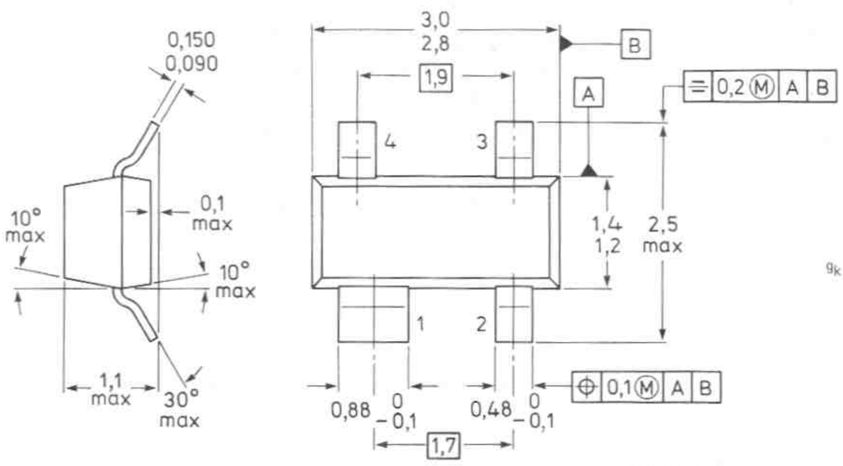
MECHANICAL DATA

Dimensions in mm

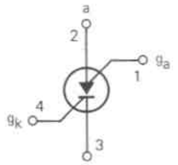
Fig. 1 SOT-143.

Marking code

BRY62 = A51



TOP VIEW



See also *Soldering recommendations.*

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Transistor 1 (T1)

Collector-base voltage (open emitter)	V_{CBO}	max.	70	V
Collector-emitter voltage (R_{BE} = 10 kΩ)	V_{CEO}	max.	70	V
Emitter-collector voltage (I_{C1} = 0)	V_{EBO}	max.	5	V
Average collector current	$I_{C(AV)}$	max.	175	mA ▲
Collector current (peak value)	I_{CM}	max.	175	mA**
Average emitter current	$I_{E(AV)}$	max.	175	mA
Emitter current (peak value) t_p = 10 μs; δ = 1%	I_{EM}	max.	2,5	A

Transistor 2 (T2)

Collector-base voltage (I_{E2} = 0)	$-V_{CBO}$	max.	70	V
Collector-emitter voltage (I_{B2} = 0)	$-V_{CEO}$	max.	70	V
Emitter-base voltage (I_{C2} = 0)	$-V_{EBO}$	max.	70	V
Emitter current (average)	$I_{E(AV)}$	max.	175	mA
Emitter current (peak value) t_p = 10 μs; δ = 1%	I_{EM}	max.	2,5	A
Reverse gate to cathode voltage	$V_{ga\text{-}kR}$	max.	70	V
Gate to anode voltage (open cathode)	$V_{ga\text{-}aO}$	max.	70	V
Gate to cathode voltage (open anode)	$V_{gk\text{-}kO}$	max.	5	V
Average anode current	$I_{A(AV)}$	max.	175	mA
Anode current (peak value) t_p = 10 μs; δ = 1%	I_{AM}	max.	2,5	A
Anode gate current (average)	$I_{GA(AV)}$	max.	175	mA
Anode gate current (peak value)	I_{GAM}	max.	**	
Total power dissipation at T_{amb} = 25 °C*	P_{tot}	max.	250	mW
Junction temperature	T_j	max.	150	°C
Storage temperature	T_{stg}		−65 to + 150	°C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	500	K/W

* Device mounted on a ceramic substrate of 15 mm x 15 mm x 0,5 mm.

** During switching on, the device can withstand the discharge of a capacitor of maximum value of 500 pF. This capacitor is charged when the transistor is in cut-off condition, with a collector supply voltage of 160 V and a series resistance of 100 kΩ.

▲ Provided the I_E rating is not exceeded.

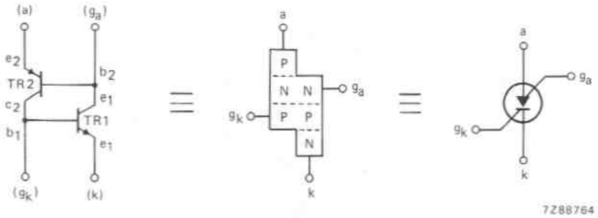


Fig. 2 Circuit diagram.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

Transistor 1 (TR1)

Collector-emitter cut-off current			
V_{CE} = 60 V; R_{BE} = 10 kΩ	I_{CER}	<	100 nA
V_{CE} = 70 V; R_{BE} = 10 kΩ; T_j = 150 °C	I_{CER}	<	10 μA
Emitter cut-off current			
V_{EB} = 5 V; I_C = 0; T_j = 150 °C	I_{EBO}	<	10 μA
Saturation voltages			
I_C = 10 mA; I_B = 1 mA	V_{CEsat}	<	0,5 V
	V_{BEsat}	<	0,9 V
D.C. current gain			
V_{CE} = 2 V; I_C = 10 mA	h_{FE}	>	50
Collector capacitance			
V_{CB} = 20 V; $I_E = I_e$ = 0	C_c	<	5 pF
Emitter capacitance			
V_{EB} = 1 V; $I_C = I_c$ = 0	C_e	<	25 pF
Transition frequency at f = 100 MHz			
V_{CE} = 2 V; I_C = 10 mA	f_T	=	300 MHz

Transistor 2 (TR2)

Collector-emitter cut-off current			
$-V_{CE}$ = 70 V; I_B = 0; T_j = 150 °C	$-I_{CEO}$	<	10 μA
Emitter cut-off current			
$-V_{EB}$ = 70 V; $I_C = i_c$ = 0; T_j = 150 °C	$-I_{EBO}$	<	10 μA
D.C. current gain			
V_{CB} = 0 V; I_E = 1 mA	h_{FE}		0,25 to 2,5

THYRISTOR

Anode to cathode

On-state voltage

I_A = 50 mA; I_{ga} = 0; $R_{gk\text{-}k}$ = 10 kΩ	V_T	<	1,4 V
I_A = 1 mA; I_{ga} = 10 mA; $R_{gk\text{-}k}$ = 10 kΩ	V_T	<	1,2 V

Holding current

I_{ga} = 10 mA; $-V_{gk}$ = 2 V; $R_{gk\text{-}k}$ = 10 Ω	I_H	<	1 mA

Switching characteristics

Gate-controlled turn-on time ($t_{gt} = t_d + t_r$)
when switched from V_{gk} = −0,5 V to 4,5 V

at $R_{gk\text{-}k}$ = 1 kΩ	t_{gt}	<	0,25 μs
at $R_{gk\text{-}k}$ = 10 kΩ	t_{gt}	<	1,5 μs

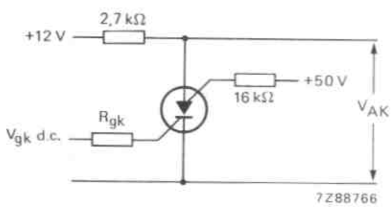


Fig. 3 Switching times test circuit.
The pulse time of V_{gk} can be adjusted in such a way that the broken line in Fig. 4 disappears, which means that the thyristor starts triggering.

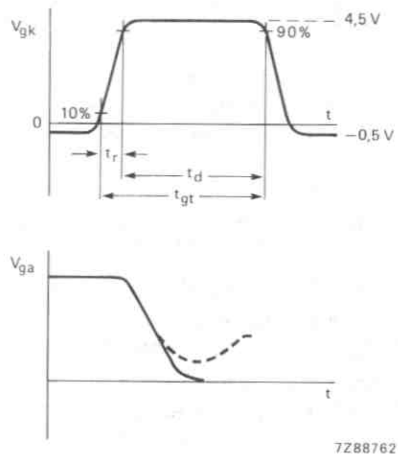


Fig. 4 Switching times waveforms.

Turn-off time (Figs 5 and 6)

R_{gk} = 1 kΩ	t_q	<	5 μs
R_{gk} = 10 kΩ	t_q	<	8 μs
R_{gk} = 10 kΩ; T_j = 125 °C	t_q	<	15 μs

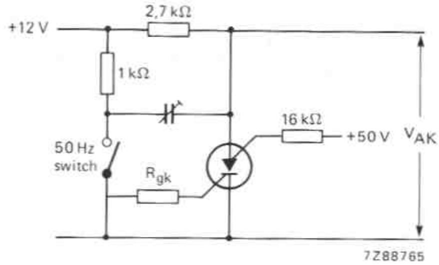


Fig. 5 Switching times test circuit.

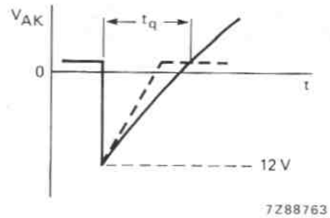


Fig. 6 Switching times waveforms.

The capacitor can be adjusted in such a way that the broken line disappears, which means that the thyristor will not trigger any more.

MOSFET N-CHANNEL DEPLETION SWITCHING TRANSISTOR

Symmetrical insulated-gate silicon MOS field-effect transistor of the n-channel depletion mode type.

The transistor is sealed in a SOT-143 envelope and features a low ON-resistance and low capacitances.

The transistor is protected against excessive input voltages by integrated back-to-back diodes between gate and substrate.

Applications:
- analog and/or digital switch
- switch driver
- convertor
- chopper

QUICK REFERENCE DATA

Drain-source voltage	V_{DS}	max.	20	V
Gate-source voltage	V_{GS}	max.	+ 15 − 40	V V
Drain current (DC)	I_D	max.	50	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	230	mW
Junction temperature	T_j	max.	125	°C
Drain-source ON-resistance V_{GS} = 10 V; V_{SB} = 0; I_D = 1 mA	R_{DSon}	max.	30	Ω
Feed-back capacitance V_{GS} = V_{BS} = −5 V; V_{DS} = 10 V; f = 1 MHz	C_{rss}	typ.	0.6	pF

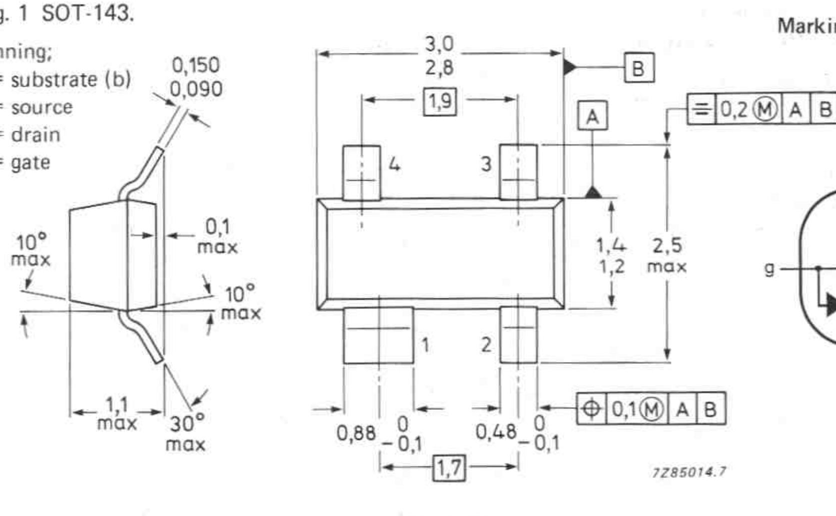
MECHANICAL DATA

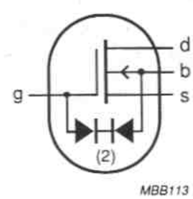
Dimensions in mm

Fig. 1 SOT-143.

Marking code: M32

Pinning;
1 = substrate (b)
2 = source
3 = drain
4 = gate





TOP VIEW

Note: Drain and source are interchangeable

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	V_{DS}	max.	20	V
Source-drain voltage	V_{SD}	max.	20	V
Drain-substrate voltage	V_{DB}	max.	25	V
Source-substrate voltage	V_{SB}	max.	25	V
Gate-substrate voltage	V_{GB}	max.	± 25	V
Gate-source voltage	V_{GS}	max.	+ 15 −40	V V
Drain current (DC)	I_D	max.	50	mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	230	mW
Storage temperature range	T_{stg}		−65 to + 150	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to ambient in free air*	$R_{th\ j\text{-}a}$	=	430	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Drain-source breakdown voltage $V_{GS} = V_{BS} = -5$ V; I_S = 10 nA	$V_{(BR)DSX}$	min.	20	V
Source-drain breakdown voltage $V_{GD} = V_{BD} = -5$ V; I_D = 10 nA	$V_{(BR)SDX}$	min.	20	V
Drain-substrate breakdown voltage V_{GB} = 0; I_D = 10 nA; open source	$V_{(BR)DBO}$	min.	25	V
Source-substrate breakdown voltage V_{GB} = 0; I_S = 10 nA; open drain	$V_{(BR)SBO}$	min.	25	V
Drain-source leakage current $V_{GS} = V_{BS} = -5$ V; V_{DS} = 10V	I_{DSoff}	typ.	1.0	nA
Source-drain leakage current $V_{GD} = V_{BD}$ = 5 V; V_{SD} = 10V	I_{SDoff}	typ.	1.0	nA
Gate-substrate leakage current $V_{DB} = V_{SB}$ = 0; V_{GB} = ± 15 V	I_{GBS}	max.	10	nA

* Device mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.

Forward transconductance at f = 1 kHz V_{DS} = 10 V; V_{SB} = 0; I_D = 20 mA	g_{fs}	min. typ.	10 mS 15 mS
Gate-source cut-off voltage V_{DS} = 10 V; V_{SB} = 0; I I_D = 10 μA	$-V_{(P)GS}$	max.	2.0 V
Drain-source ON-resistance I_D = 1 mA; V_{SB} = 0; V_{GS} = 5 V	R_{DSon}	typ. max.	25 Ω 50 Ω
V_{GS} = 10 V	R_{DSon}	typ. max.	15 Ω 30 Ω
Capacitances at f = 1 MHz V_{GS} = V_{BS} = −5V; V_{DS} = 10 V Feed-back capacitance	C_{rss}	typ.	0.6 pF
Input capacitance	C_{iss}	typ.	1.5 pF
Output capacitance	C_{oss}	typ.	1.0 pF
Switching times (see Fig. 3) V_{DD} = 10 V; V_i = −5 V to +5 V	t_{on} t_{off}	typ. typ.	1.0 ns 5.0 ns

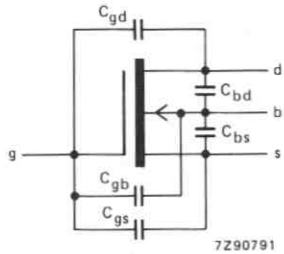
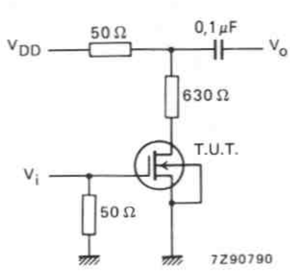


Fig. 2 Capacitances model.

$C_{iss} = C_{gs} + C_{gd} + C_{gb}$

$C_{oss} = C_{gd} + C_{bd}$

$C_{rss} = C_{gd}$



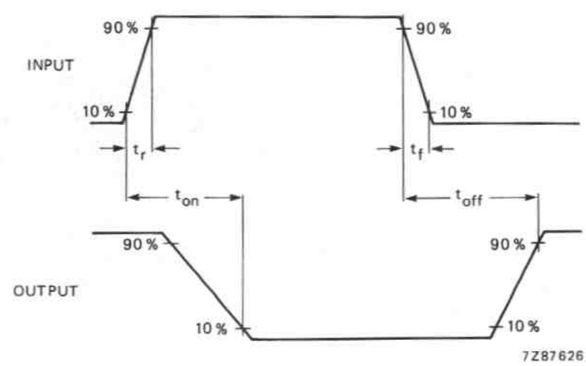


Fig. 3 Switching times and input and output waveforms;
R_i = 50 Ω; t_r < 0.5 ns; t_f < 1.0 ns; t_p = 20 ns; δ < 0.01.

SILICON PLANAR EPITAXIAL TRANSISTORS

PNP transistors in miniature plastic envelopes intended for use in amplifier and switching applications. Complementary types are BSP19/20.

QUICK REFERENCE DATA

			BSP15	BSP16	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	200	350	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	200	300	V
Collector current (DC)	$-I_C$	max.	1		A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1,5		W
Junction temperature	T_j	max.	150		°C
DC current gain $-V_{CE}$ = 10 V; $-I_C$ = 50 mA	h_{FE}		30 to 150	30 to 120	
Transition frequency $-V_{CE}$ = 10 V; $-I_C$ = 10 mA	f_T	>	15		MHz

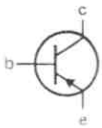
MECHANICAL DATA

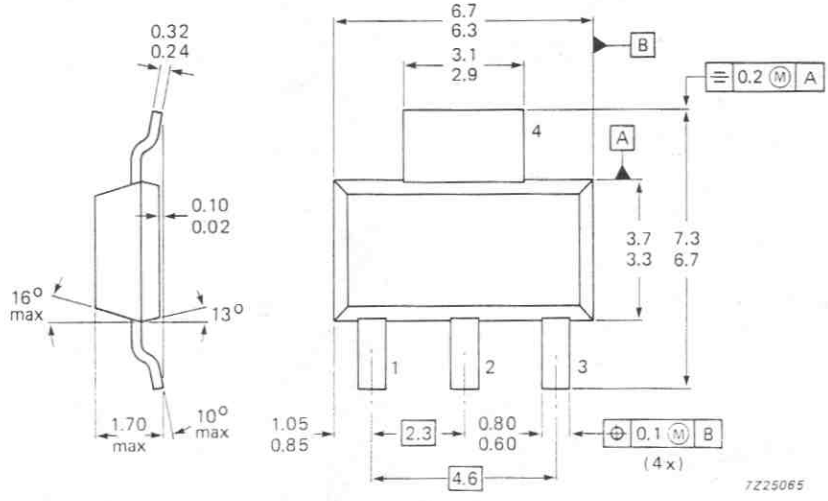
Dimensions in mm

Fig. 1 SOT-223

Pinning

1 = Base
2 = Collector
3 = Emitter
4 = Collector





RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BSP15	BSP16	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	200	350	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	200	300	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	4	6	V
Collector current (DC)	$-I_C$	max.	1		A
Base current	$-I_B$	max.	0,5		A
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	1,5		W
Junction temperature	T_j	max.	150		°C
Storage temperature range	T_{stg}		–65 to 150		°C

THERMAL RESISTANCE

from junction to ambient*	$R_{th\ j\text{-}mb}$	=	83,3	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BSP15	BSP16	
Collector cut-off current					
$I_E = 0; -V_{CB} = 175$ V	$-I_{CBO}$	<	1	–	μA
$I_E = 0; -V_{CB} = 280$ V	$-I_{CBO}$	<	–	1	μA
$I_B = 0; -V_{CE} = 150$ V	$-I_{CEO}$	<	50	–	μA
$I_B = 0; -V_{CE} = 250$ V	$-I_{CEO}$	<	–	50	μA
Emitter cut-off current					
$I_C = 0; -V_{EB} = 4$ V	$-I_{EBO}$	<	20	–	μA
$I_C = 0; -V_{EB} = 6$ V	$-I_{EBO}$	<	–	20	μA
Collector-emitter breakdown voltage					
$I_B = 0; -I_C = 50$ mA; L = 25 mH	$-V_{(BR)CEO}$	>	200	300	V
Collector-emitter saturation voltage					
$-I_C = 50$ mA; $-I_B = 5$ mA	$-V_{CEsat}$	<	2,5	2,0	V
DC current gain					
$-V_{CE} = 10$ V; $-I_C = 50$ mA	h_{FE}		30 to 150	30 to 120	
Transition frequency at f = 30 MHz					
$-I_C = 10$ mA; $-V_{CE} = 10$ V	f_T	>	15		MHz
Collector capacitance at f = 1 MHz					
$I_E = I_e = 0; -V_{CB} = 10$ V	C_c	<	15		pF

* Device mounted on an epoxy printed circuit board 40 mm x 40 mm x 1,5 mm; mounting pad for the collector lead min. 6 cm².

SILICON PLANAR EPITAXIAL TRANSISTORS

NPN transistors in miniature plastic envelopes intended for use in amplifier and switching applications. Complementary pnp types are BSP15/16.

QUICK REFERENCE DATA

			BSP19	BSP20	
Collector-base voltage (open emitter)	V_{CBO}	max.	400	300	V
Collector-emitter voltage (open base)	V_{CEO}	max.	350	250	V
Collector current (DC)	I_C	max.	1		A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1,5		W
Junction temperature	T_j	max.	150		°C
DC current gain V_{CE} = 10 V; I_C = 20 mA	h_{FE}	min.	40		
Transition frequency at f = 5 MHz V_{CE} = 10 V; I_C = 10 mA	f_T	min.	70		MHz

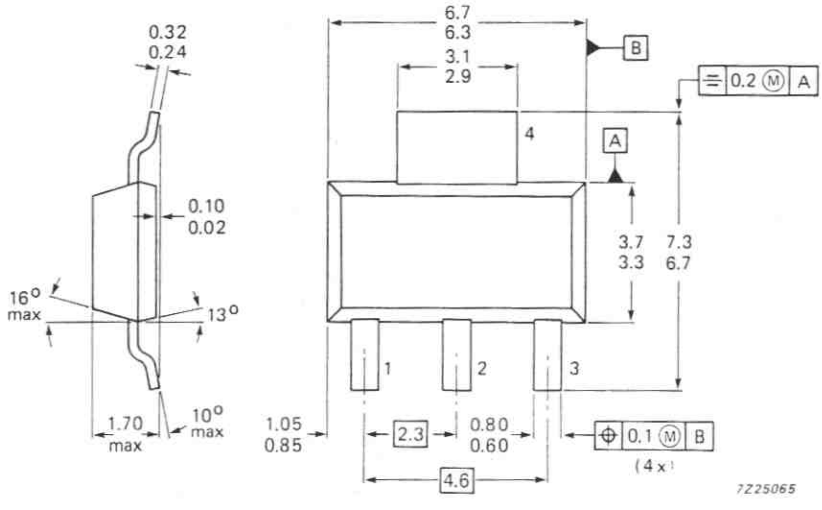
MECHANICAL DATA

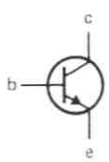
Dimensions in mm

Fig. 1 SOT-223

Pinning

1 = Base
2 = Collector
3 = Emitter
4 = Collector





RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BSP19	BSP20	
Collector-base voltage (open emitter)	V_{CBO}	max.	400	300	V
Collector-emitter voltage (open base)	V_{CEO}	max.	350	250	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5		V
Collector current (DC)	I_C	max.	1		A
Base current	I_B	max.	0,5		A
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	1,5		W
Junction temperature	T_j	max.	150		°C
Storage temperature range	T_{stg}		−65 to 150		°C

THERMAL RESISTANCE

from junction to ambient*	$R_{th\,j\text{-}a}$	=	83,3	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current $I_B = 0$; $V_{CE} = 300$ V	I_{CBO}	≤	20	nA
Emitter cut-off current $I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	≤	10	μA
Collector-emitter saturation voltage $I_C = 50$ mA; $I_B = 4$ mA	V_{CEsat}	≤	0,5	V
Base-emitter saturation voltage $I_C = 50$ mA; $I_B = 4$ mA	V_{BEsat}	≤	1,3	V
DC current gain $V_{CE} = 10$ V; $I_C = 20$ mA	h_{FE}	≤	40	
Collector capacitance at f = 1 MHz $I_E = i_e = 0$; $V_{CB} = 10$ V	C_c	≤	2	pF
Emitter capacitance at f = 1 MHz $I_C = I_c = 0$; $V_{EB} = 5$ V	C_e	≤	20	pF
Transition frequency at f = 5 MHz $V_{CE} = 10$ V; $I_C = 10$ mA	f_T	≥	70	MHz

* Device mounted on an epoxy printed circuit board 40 mm x 40 mm x 1,5 mm; mounting pad for the collector lead min. 6 cm^2.

SILICON PLANAR EPITAXIAL TRANSISTORS

PNP transistors in miniature plastic envelopes intended for application in thick and thin-film circuits. They are intended for use in telephony and general industrial applications.

QUICK REFERENCE DATA

			BSP30	BSP31	BSP32	BSP33	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	70	70	90	90	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	60	60	80	80	V
Collector current (DC)	$-I_C$	max.	1	1	1	1	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1,5	1,5	1,5	1,5	W
Junction temperature	T_j	max.	150	150	150	150	°C
DC current gain $-I_C$ = 100 mA; $-V_{CE}$ = 5 V	h_{FE}	> <	40 120	100 300	40 120	100 300	
Transition frequency at f = 35 MHz $-I_C$ = 50 mA; $-V_{CE}$ = 10 V	f_T	>	100	100	100	100	MHz

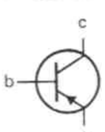
MECHANICAL DATA

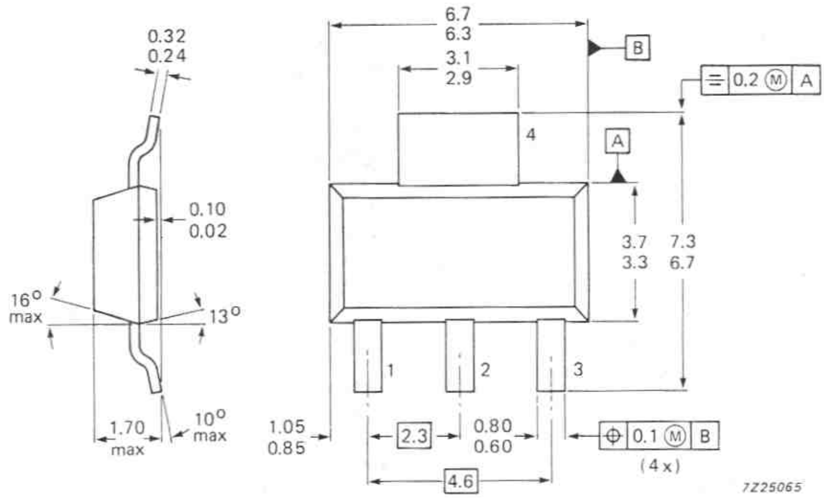
Dimensions in mm

Fig. 1 SOT-223

Pinning

1 = Base
2 = Collector
3 = Emitter
4 = Collector





RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BSP30	BSP31	BSP32	BSP33	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	70	70	90	90	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	60	60	80	80	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	5	V

Collector current (DC)	$-I_C$	max.	1	A
Base current (DC)	$-I_B$	max.	0,1	A
Total power dissipation up to $T_{amb} = 25\,^oC$ *	P_{tot}	max.	1,5	W
Storage temperature range	T_{stg}		−65 to +150	^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

From junction to collector tab	$R_{th\ j\text{-}tab}$	=	10	K/W
From junction to ambient*	$R_{th\ j\text{-}a}$	=	83,3	K/W

* Device mounted on an epoxy printed circuit board 40 mm x 40 mm x 1,5 mm; mounting pad for the collector lead min. 6 cm^2.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			BSP30	BSP31	BSP32	BSP33	
Collector cut-off current							
$I_E = 0; -V_{CB} = 60$ V	$-I_{CBO}$	<		100			nA
$I_E = 0; -V_{CB} = 60$ V; $T_j = 150$ °C	$-I_{CBO}$	<		50			μA
Breakdown voltages							
$I_B = 0; -I_C = 10$ mA	$-V_{(BR)CEO}$	>	60	60	80	80	V
$V_{BE} = 0; -I_C = 10$ μA	$-V_{(BR)CES}$	>	70	70	90	90	V
$I_C = 0; -I_E = 10$ μA	$-V_{(BR)EBO}$	>	5	5	5	5	V
Saturation voltages *							
$-I_C = 150$ mA; $-I_B = 15$ mA	$-V_{CEsat}$	<	0,25	0,25	0,25	0,25	V
	$-V_{BEsat}$	<	1,0	1,0	1,0	1,0	V
$-I_C = 500$ mA; $-I_B = 50$ mA	$-V_{CEsat}$	<	0,5	0,5	0,5	0,5	V
	$-V_{BEsat}$	<	1,2	1,2	1,2	1,2	V
DC current gain*							
$-I_C = 100$ μA; $V_{CE} = 5$ V	h_{FE}	>	10	30	10	30	
$-I_C = 100$ mA; $V_{CE} = 5$ V	h_{FE}	>	40	100	40	100	
		<	120	300	120	300	
$-I_C = 500$ mA; $V_{CE} = 5$ V	h_{FE}	>	30	50	30	50	
Transition frequency at f = 35 MHz							
$-I_C = 50$ mA; $-V_{CE} = 10$ V	f_T	>		100			MHz
Collector capacitance at f = 1 MHz							
$I_E = I_e = 0; -V_{CB} = 10$ V	C_c	<		20			pF
Emitter capacitance at f = 1 MHz							
$I_C = I_c = 0; -V_{EB} = 0,5$ V	C_e	<		120			pF

Switching times see next page.

* Measured under pulse conditions: $t_p = 300$ μs; $\delta < 0,01$.

CHARACTERISTICS (continued)

T_{amb} = 25 °C

Switching times

$-I_{Con}$ = 100 mA; $-I_{Bon}$ = $+I_{Boff}$ = 5 mA

Turn-on time	t_{on}	<	500	ns
Turn-off time	t_{off}	<	650	ns

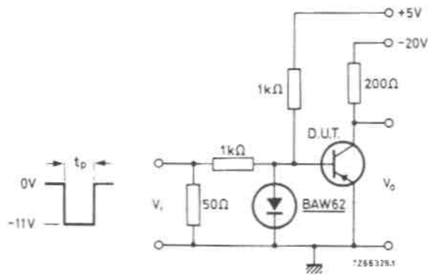


Fig. 2 Switching times test circuit.

Pulse generator:

Pulse duration	t_p = 10 μs
Rise time	$t_r \leqslant$ 15 ns
Fall time	$t_f \leqslant$ 15 ns
Source impedance	Z_S = 50 Ω

Oscilloscope:

Rise time	$t_r \leqslant$ 15 ns
Input impedance	$Z_I \geqslant$ 100 kΩ

SILICON PLANAR EPITAXIAL TRANSISTORS

NPN transistors in miniature plastic envelopes intended for application in thick and thin-film circuits. They are intended for use in telephony and general industrial applications.

QUICK REFERENCE DATA

			BSP40	BSP41	BSP42	BSP43	
Collector-base voltage (open emitter)	V_{CBO}	max.	70	70	90	90	V
Collector-emitter voltage (open base)	V_{CEO}	max.	60	60	80	80	V
Collector current (DC)	I_C	max.	1	1	1	1	A
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	1,5	1,5	1,5	1,5	W
Junction temperature	T_j	max.	150	150	150	150	^oC
DC current gain $I_C = 100$ mA; $V_{CE} = 5$ V	h_{FE}	>	40	100	40	100	
		<	120	300	120	300	
Transition frequency at f = 35 MHz $I_C = 50$ mA; $V_{CE} = 10$ V	f_T	>	100	100	100	100	MHz

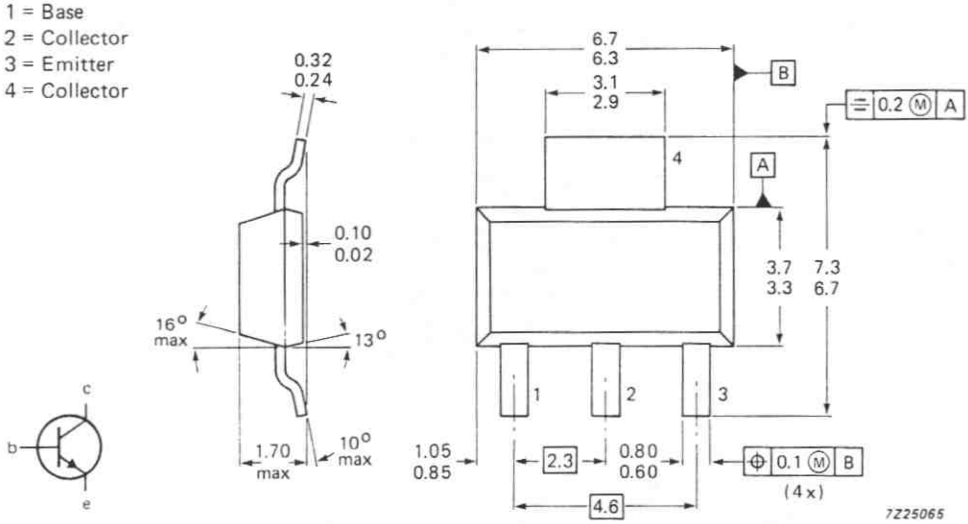
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-223

Pinning

1 = Base
2 = Collector
3 = Emitter
4 = Collector



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BSP40	BSP41	BSP42	BSP43	
Collector-base voltage (open emitter)	V_{CBO}	max.	70	70	90	90	V
Collector-emitter voltage (open base)	V_{CEO}	max.	60	60	80	80	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	5	5	V
Collector current (DC)	I_C	max.			1		A
Base current (DC)	I_B	max.			0,1		A
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.			1,5		W
Storage temperature range	T_{stg}				−65 to +150		°C
Junction temperature	T_j	max.			150		°C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	83,3	K/W

* Device mounted on an epoxy printed circuit board 40 mm x 40 mm x 1,5 mm; mounting pad for the collector lead min. 6 cm².

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			BSP40	BSP41	BSP42	BSP43	
Collector cut-off current							
$I_E = 0$; $V_{CB} = 60$ V	I_{CBO}	<	100				nA
$I_E = 0$; $V_{CB} = 60$ V; $T_j = 150$ °C	I_{CBO}	<	50				μA
Breakdown voltages			BSP40	BSP41	BSP42	BSP43	
$I_B = 0$; $I_C = 10$ mA	$V_{(BR)CEO}$	>	60	60	80	80	V
$V_{BE} = 0$; $I_C = 10$ μA	$V_{(BR)CES}$	>	70	70	90	90	V
$I_C = 0$; $I_E = 10$ μA	$V_{(BR)EBO}$	>	5	5	5	5	V
Saturation voltages *							
$I_C = 150$ mA; $I_B = 15$ mA	V_{CEsat}	<	0,25	0,25	0,25	0,25	V
	V_{BEsat}	<	1,0	1,0	1,0	1,0	V
$I_C = 500$ mA; $I_B = 50$ mA	V_{CEsat}	<	0,5	0,5	0,5	0,5	V
	V_{BEsat}	<	1,2	1,2	1,2	1,2	V
DC current gain*							
$I_C = 100$ μA; $V_{CE} = 5$ V	h_{FE}	>	10	30	10	30	
$I_C = 100$ mA; $V_{CE} = 5$ V	h_{FE}	>	40	100	40	100	
		<	120	300	120	300	
$I_C = 500$ mA; $V_{CE} = 5$ V	h_{FE}	>	30	50	30	50	
Transition frequency at f = 35 MHz							
$I_C = 50$ mA; $V_{CE} = 10$ V	f_T	>	100				MHz
Collector capacitance at f = 1 MHz							
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	<	12				pF
Emitter capacitance at f = 1 MHz							
$I_C = I_c = 0$; $V_{EB} = 0{,}5$ V	C_e	<	90				pF

Switching times see next page.

* Measured under pulse conditions: $t_p = 300$ μs; $\delta < 0{,}01$.

CHARACTERISTICS (continued)

T_{amb} = 25 °C

Switching times

I_{Con} = 100 mA; I_{Bon} = $-I_{Boff}$ = 5 mA

Turn-on time	t_{on}	<	250 ns
Turn-off time	t_{off}	<	1000 ns

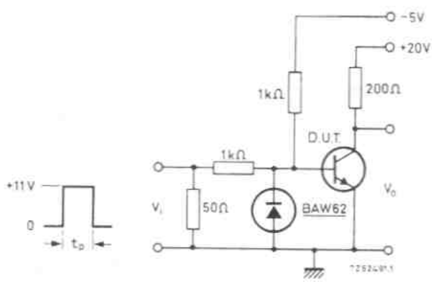


Fig. 2 Switching times test circuit.

Pulse generator:

Pulse duration	t_p = 10 μs
Rise time	t_r ≤ 15 ns
Fall time	t_f ≤ 15 ns
Source impedance	Z_S = 50 Ω

Oscilloscope:

Rise time	t_r ≤ 15 ns
Input impedance	Z_I ≥ 100 kΩ

NPN SILICON PLANAR DARLINGTON TRANSISTORS

Silicon npn planar Darlington transistors for industrial switching applications, e.g. print hammer, solenoid, relay and lamp driving. Encapsulated in a microminiature SOT-223 envelope.

PNP complements are BSP60, 61, 62 respectively.

QUICK REFERENCE DATA

			BSP50	BSP51	BSP52	
Collector-base voltage (open emitter)	V_{CBO}	max.	60	80	90	V
Collector-emitter voltage	V_{CER}	max.	45	60	80	V
Collector current	I_C	max.	0,5	0,5	0,5	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		1,5		W
DC current gain I_C = 500 mA; V_{CE} = 10 V	h_{FE}	>		2000		
Collector-emitter saturation voltage I_C = 500 mA; I_B = 0,5 mA	V_{CEsat}	<		1,3		V
Turn-off time I_C = 500 mA; I_{Bon} = $-I_{Boff}$ = 0,5 mA	t_{off}	typ.		1500		ns

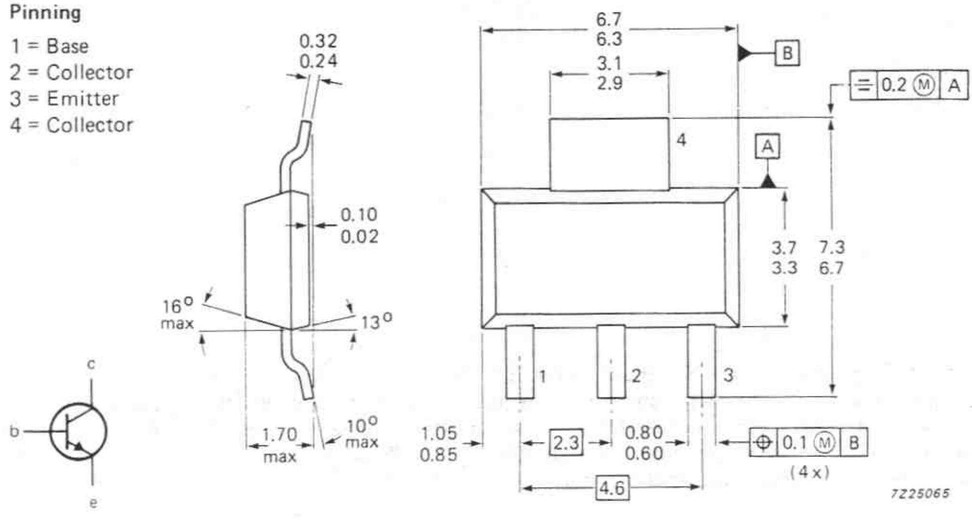
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-223

Pinning

1 = Base
2 = Collector
3 = Emitter
4 = Collector



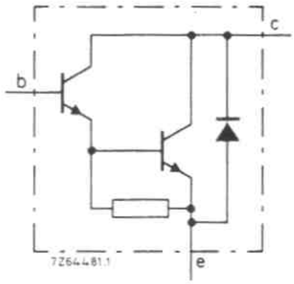


Fig. 2 Circuit diagram.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BSP50	BSP51	BSP52	
Collector-base voltage (open emitter)	V_{CBO}	max.	60	80	90	V
Collector-emitter voltage*	V_{CER}	max.	45	60	80	V
Emitter-base voltage (open collector)	V_{EBO}	max.		5		V
Collector current (DC)	I_C	max.		0,5		A
Collector current (peak)	I_{CM}	max.		1,5		A
Base current (DC)	I_B	max.		0,1		A
Total power dissipation▲ up to T_{amb} = 25 °C	P_{tot}	max.		1,5		W
Storage temperature range	T_{stg}			−65 to + 150		°C
Junction temperature**	T_j	max.		150		°C

THERMAL RESISTANCE**

From junction to ambient▲	$R_{th\ j\text{-}a}$	=	83,3	K/W

* External R_{BE} not to exceed value shown in Fig. 5.

** Based on maximum average junction temperature in line with common industrial practice. The resulting higher junction temperature of the output transistor part is taken into account.

▲ Device mounted on an epoxy printed circuit board 40 mm x 40 mm x 1,5 mm; mounting pad for the collector lead min. 6 cm^2.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
V_{BE} = 0; V_{CE} = V_{CERmax}	I_{CES}	<	10 μA
Emitter cut-off current			
I_C = 0; V_{EB} = 4 V	I_{EBO}	<	10 μA
DC current gain*			
I_C = 150 mA; V_{CE} = 10 V	h_{FE}	>	1000
I_C = 500 mA; V_{CE} = 10 V	h_{FE}	>	2000
Collector-emitter saturation voltage			
I_C = 500 mA; I_B = 0,5 mA	V_{CEsat}	<	1,3 V
I_C = 500 mA; I_B = 0,5 mA; T_j = 150 °C	V_{CEsat}	<	1,3 V
Base-emitter saturation voltage			
I_C = 500 mA; I_B = 0,5 mA	V_{BEsat}	<	1,9 V
Switching times (see also Fig. 3 and Fig. 4)			
I_C = 500 mA; I_{Bon} = $-I_{Boff}$ = 0,5 mA			
Turn-on time	t_{on}	typ.	400 ns
Turn-off time	t_{off}	typ.	1500 ns

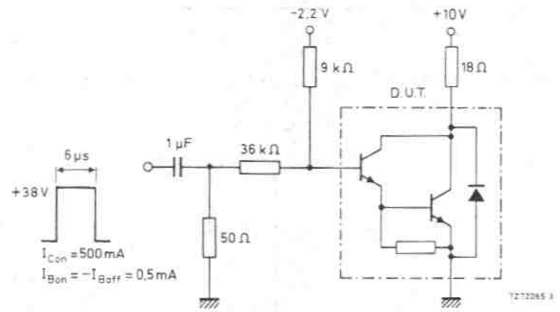


Fig. 3 Switching times test circuit.

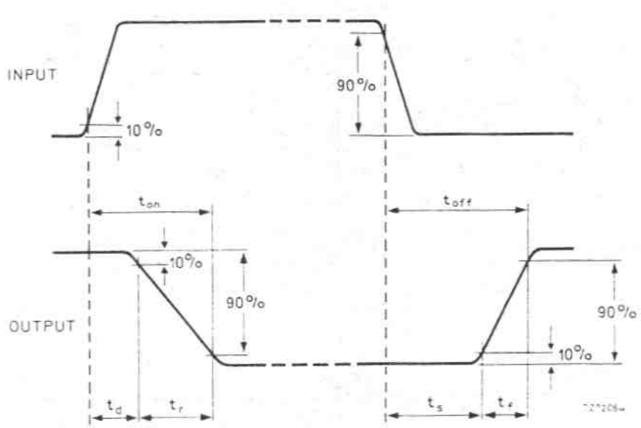


Fig. 4 Switching times waveform.

* Measured under pulsed conditions.

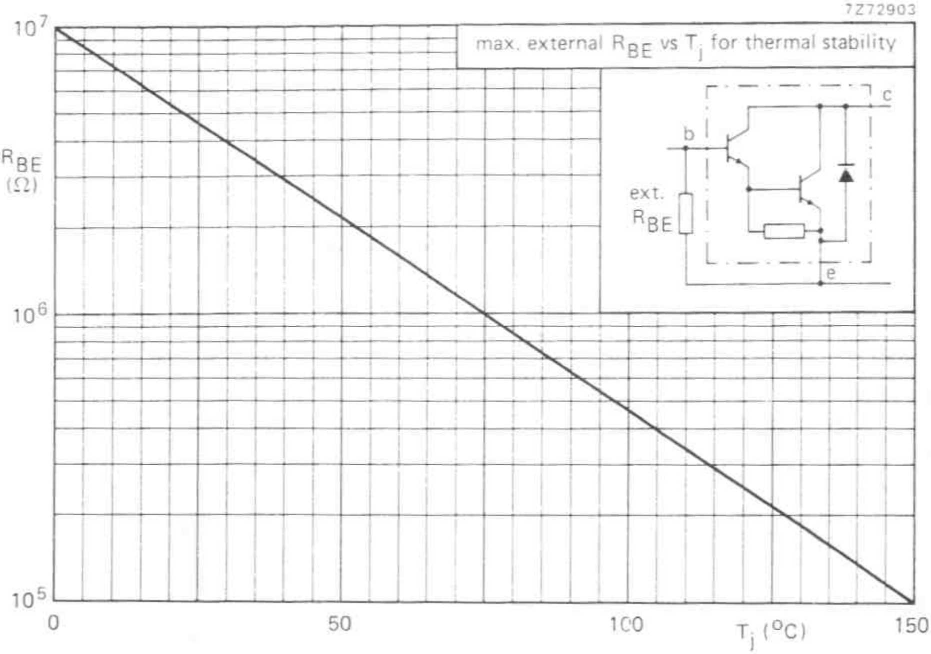


Fig. 5 Maximum values external R_{BE} as a function of junction temperature.

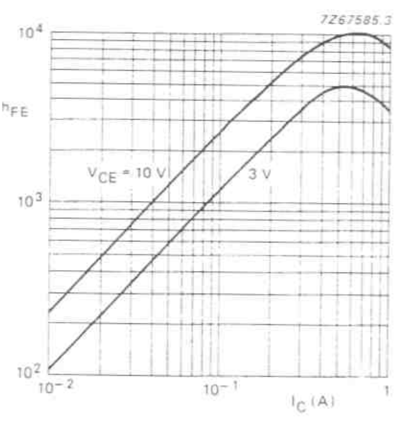


Fig. 6 T_j = 25 °C.

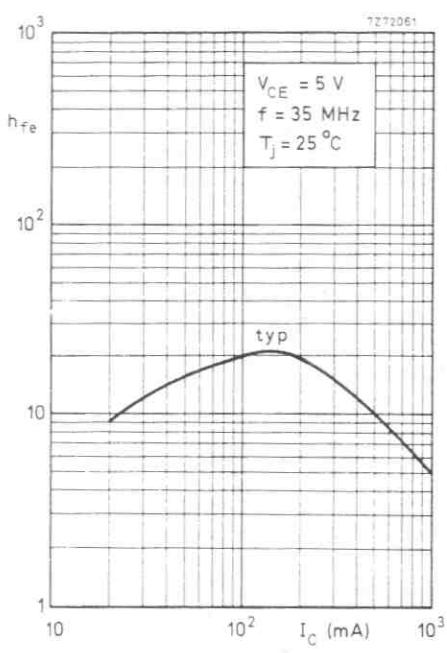


Fig. 7.

SILICON PLANAR DARLINGTON TRANSISTORS

Silicon pnp planar Darlington transistors for industrial switching applications such as print hammer, solenoid, relay and lamp driving. They are encapsulated in a microminiature plastic SOT-223 envelope.

NPN complements are BSP50, BSP51 and BSP52 respectively.

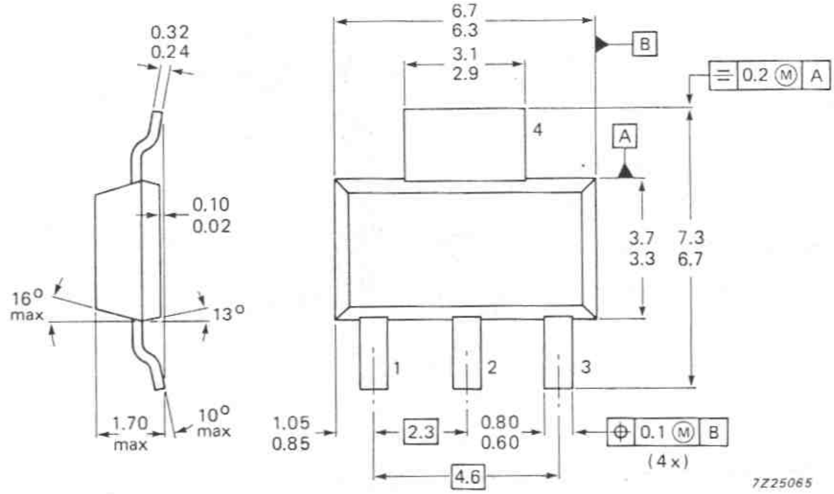
QUICK REFERENCE DATA

			BSP60	BSP61	BSP62	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60	80	90	V
Collector-emitter voltage	$-V_{CER}$	max.	45	60	80	V
Collector current	$-I_C$	max.	0,5	0,5	0,5	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		1,5		W
DC current gain $-I_C$ = 500 mA; $-V_{CE}$ = 10 V	h_{FE}	>		2000		
Collector-emitter saturation voltage $-I_C$ = 0,5 A; $-I_B$ = 0,5 mA	$-V_{CEsat}$	<		1,3		V
Turn-off time $-I_C$ = 500 mA; $-I_{Bon}$ = I_{Boff} = 0,5 mA	t_{off}	typ.		1500		ns

MECHANICAL DATA

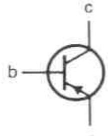
Dimensions in mm

Fig. 1 SOT-223



Pinning

1 = Base
2 = Collector
3 = Emitter
4 = Collector



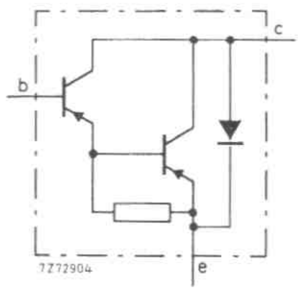


Fig. 2 Circuit diagram.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BSP60	BSP61	BSP62	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60	80	90	V
Collector-emitter voltage*	$-V_{CER}$	max.	45	60	80	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.		5		V
Collector current (DC)	$-I_C$	max.		0,5		A
Collector current (peak)	$-I_{CM}$	max.		1,5		A
Base current (DC)	$-I_B$	max.		0,1		A
Total power dissipation▲ up to T_{amb} = 25 °C	P_{tot}	max.		1,5		W
Storage temperature range	T_{stg}			−65 to + 150		°C
Junction temperature**	T_j	max.		150		°C

THERMAL RESISTANCE**

From junction to ambient▲	$R_{th\,j\text{-}a}$	=	83,3	K/W

* External R_{BE} not to exceed value shown in Fig. 5.

** Based on maximum average junction temperature in line with common industrial practice. The resulting higher junction temperature of the output transistor part is taken into account.

▲ Device mounted on an epoxy printed circuit board 40 mm x 40 mm x 1,5 mm; mounting pad for the collector lead min. 6 cm^2.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
$V_{BE} = 0$; $-V_{CE} = -V_{CER}max$	$-I_{CES}$	<	10 μA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 4$ V	$-I_{EBO}$	<	10 μA
DC current gain*			
$-I_C = 150$ mA; $-V_{CE} = 10$ V	h_{FE}	>	1000
$-I_C = 500$ mA; $-V_{CE} = 10$ V	h_{FE}	>	2000
Collector-emitter saturation voltage			
$-I_C = 500$ mA; $-I_B = 0,5$ mA	$-V_{CEsat}$	<	1,3 V
$-I_C = 500$ mA; $-I_B = 0,5$ mA; $T_j = 150$ °C	$-V_{CEsat}$	<	1,3 V
Base-emitter saturation voltage			
$-I_C = 500$ mA; $-I_B = 0,5$ mA	$-V_{BEsat}$	<	1,9 V
Switching times (see also Fig. 3 and Fig. 4)			
$-I_C = 500$ mA; $-I_{Bon} = -I_{Boff} = 0,5$ mA			
Turn-on time	t_{on}	typ.	400 ns
Turn-off time	t_{off}	typ.	1500 ns

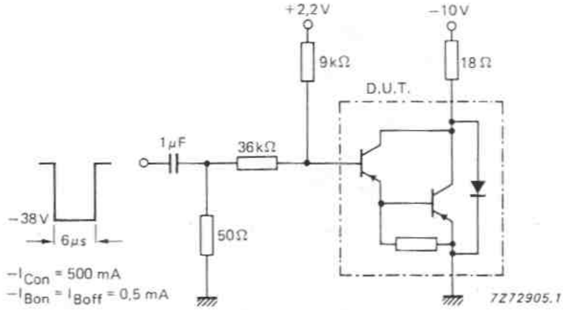


Fig. 3 Switching times test circuit.

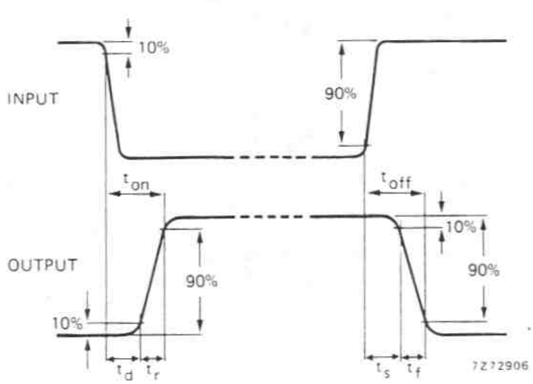


Fig. 4 Switching times waveform.

* Measured under pulsed conditions.

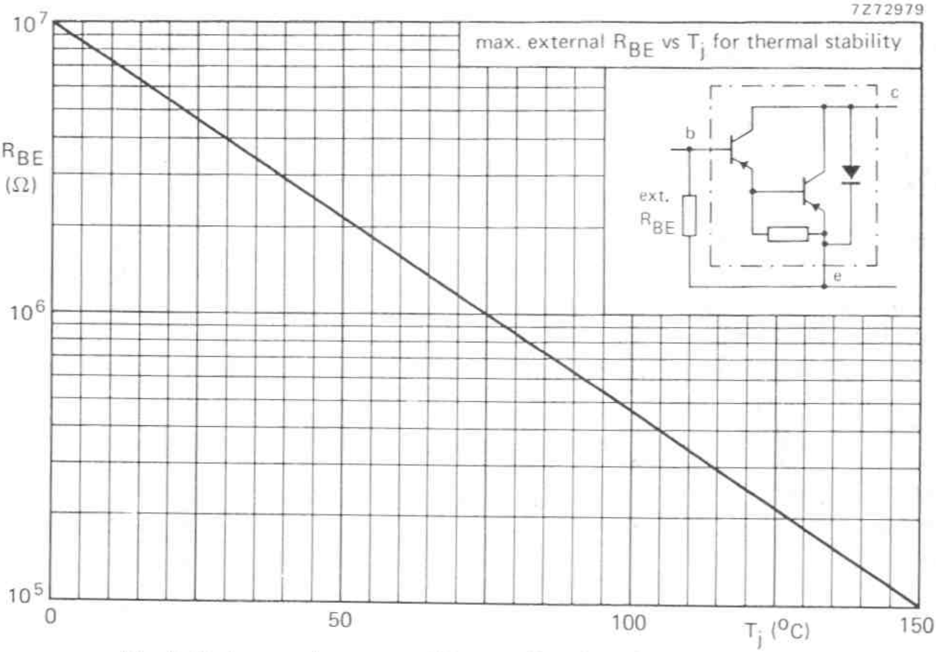


Fig. 5 Maximum values external R_{BE} as a function of junction temperature.

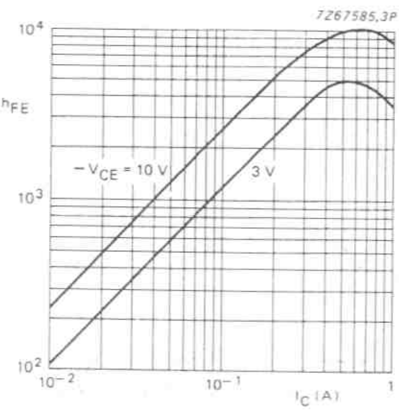


Fig. 6 T_j = 25 °C.

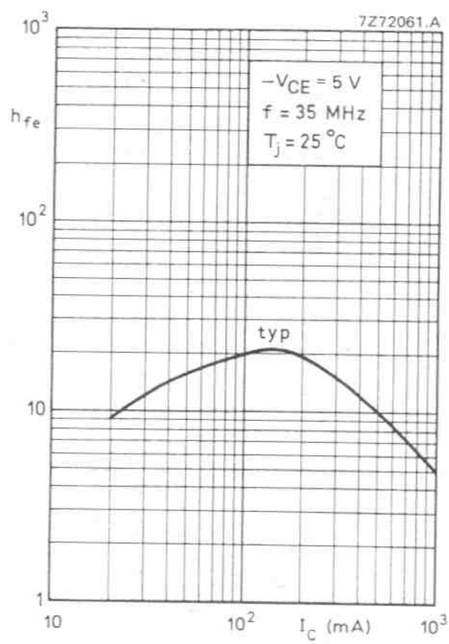


Fig. 7.

Philips Components

Data sheet	
status	Product specification
date of issue	April 1991

BSP103/BSP105/BSP109
N-channel enhancement mode vertical D-MOS transistors

FEATURES

- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No secondary breakdown
- Low $R_{DS(on)}$.

DESCRIPTION

N-channel enhancement mode vertical D-MOS transistor in a miniature SOT223 envelope, designed for application as low power, high frequency inverters and line drivers.

PINNING - SOT223

PIN	DESCRIPTION
1	gate
2	drain
3	source
4	drain

MARKING CODES

BSP103: BSP103
BSP105: BSP105
BSP109: BSP109

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
V_{DS}	drain-source voltage			
	BSP103		35	V
	BSP105		60	V
	BSP109		90	V
I_D	drain current	DC value		
	BSP103		700	mA
	BSP105		500	mA
	BSP109		450	mA
$R_{DS(on)}$	drain-source on-resistance	$I_D = 1$ A $V_{GS} = 10$ V		
	BSP103		1.8	Ω
	BSP105		3	Ω
	BSP109		4	Ω
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1$ mA $V_{GS} = V_{DS}$	2	V

PIN CONFIGURATION

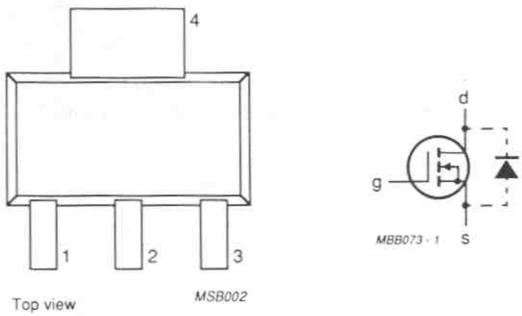


Fig.1 Simplified outline and symbol.

N-channel enhancement mode vertical D-MOS transistors

BSP103/BSP105/BSP109

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage				
	BSP103		–	35	V
	BSP105		–	60	V
	BSP109		–	90	V
$\pm V_{GSO}$	gate-source voltage	open drain	–	30	V
I_D	drain current	DC value			
	BSP103		–	700	mA
	BSP105		–	500	mA
	BSP109		–	450	mA
I_{DM}	drain current	peak value	–	1	A
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	1.5	W
T_{stg}	storage temperature range		–65	150	°C
T_j	junction temperature		–	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}a}$	from junction to ambient (note 1)	83.3	K/W

Note

1. Device mounted on an epoxy printed-circuit board, 40 mm x 40 mm x 1.5 mm; mounting pad for the drain lead minimum 6 mm^2.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 10 μA V_{GS} = 0				
	BSP103		35	–	–	V
	BSP105		60	–	–	V
	BSP109		90	–	–	V
I_{DSS}	drain-source leakage current	$V_{DS} = V_{DS\,max}$ V_{GS} = 0	–	–	10	μA
$\pm I_{GSS}$	gate-source leakage current	$\pm V_{GS}$ = 15 V V_{DS} = 0	–	–	100	nA
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA $V_{GS} = V_{DS}$	0.8	–	2	V
$I_{D(on)}$	on-state drain current	V_{DS} = 25 V V_{GS} = 10 V	1	2	–	A
$R_{DS(on)}$	drain-source on-resistance	I_D = 300 mA V_{GS} = 5 V				
	BSP103		–	1.5	5	Ω
	BSP105		–	1.8	5	Ω
	BSP109		–	2.4	5.3	Ω
		I_D = 1 A V_{GS} = 10 V				
	BSP103		–	0.9	1.8	Ω
	BSP105		–	1.4	3	Ω
	BSP109		–	1.9	4	Ω
$\lvert y_{fs} \rvert$	transfer admittance	I_D = 500 mA V_{DS} = 25 V	170	–	–	mS
C_{iss}	input capacitance	V_{DS} = 25 V V_{GS} = 0 f = 1 MHz	–	–	60	pF
C_{oss}	output capacitance	V_{DS} = 25 V V_{GS} = 0 f = 1 MHz				
	BSP103		–	–	50	pF
	BSP105		–	–	40	pF
	BSP109		–	–	40	pF
C_{rss}	feedback capacitance	V_{DS} = 25 V V_{GS} = 0 f = 1 MHz	–	–	15	pF
Switching times (see Figs 2 and 3)						
t_{on}	turn-on time	I_D = 500 mA V_{DD} = 25 V V_{GS} = 0 to 10 V	–	–	10	ns

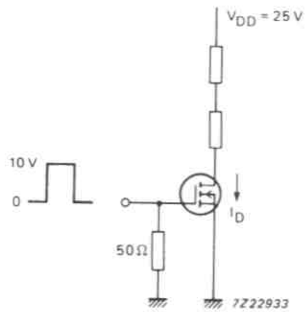


Fig.2 Switching time test circuit.

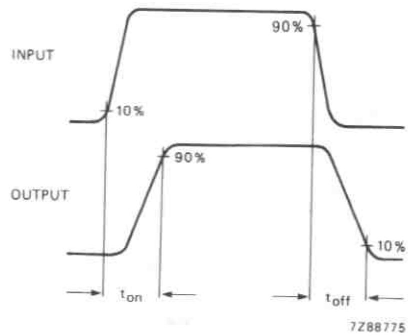


Fig.3 Input and output waveforms.

Philips Components

Data sheet	
status	Product specification
date of issue	April 1991

BSP106

N-channel enhancement mode vertical D-MOS transistor

FEATURES

- Very low $R_{DS(on)}$
- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No secondary breakdown.

DESCRIPTION

N-channel enhancement mode vertical D-MOS transistor in a miniature SOT223 envelope and intended for use in relay, high-speed and line transformer drivers.

PINNING - SOT223

PIN	DESCRIPTION
1	gate
2	drain
3	source
4	drain

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
V_{DS}	drain-source voltage	–	60	V
I_D	drain current	DC value	425	mA
$R_{DS(on)}$	drain-source on-resistance	I_D = 200 mA V_{GS} = 10 V	4	Ω
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA V_{GS} = V_{DS}	3	V

PIN CONFIGURATION

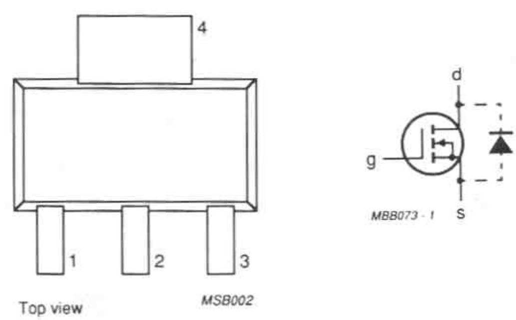


Fig.1 Simplified outline and symbol.

N-channel enhancement mode vertical D-MOS transistor

BSP106

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage		–	60	V
V_{DG}	drain-gate voltage		–	60	V
$\pm V_{GSO}$	gate-source voltage		–	20	V
I_D	drain current	DC value	–	425	mA
I_{DM}	drain current	peak value	–	850	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C (note 1)	–	1.5	W
T_{stg}	storage temperature range		−55	150	°C
T_j	junction temperature		–	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}a}$	from junction to ambient (note 1)	83.3	K/W

Note

1. Device mounted on an epoxy printed-circuit board 40 x 40 x 1.5 mm; mounting pad for the drain lead minimum 6 cm^2.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 10 μA V_{GS} = 0	60	90	–	V
I_{DSS}	drain-source leakage current	V_{DS} = 48 V V_{GS} = 0	–	–	1	μA
		V_{DS} = 25 V V_{GS} = 0	–	–	0.5	μA
$\pm I_{GSS}$	gate-source leakage current	V_{DS} = 0 $\pm V_{GS}$ = 15 V	–	–	10	nA
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA V_{GS} = V_{DS}	0.8	–	3	V
$R_{DS(on)}$	drain-source on-resistance	I_D = 200 mA V_{GS} = 10 V	–	2.5	4	Ω
$\lvert Y_{fs} \rvert$	transfer admittance	I_D = 200 mA V_{DS} = 10 V	100	200	–	mS
C_{iss}	input capacitance	V_{DS} = 10 V V_{GS} = 0 f = 1 MHz	–	25	40	pF
C_{oss}	output capacitance	V_{DS} = 10 V V_{GS} = 0 f = 1 MHz	–	22	30	pF
C_{rss}	feedback capacitance	V_{DS} = 10 V V_{GS} = 0 f = 1 MHz	–	6	10	pF
Switching times (see Figs 2 and 3)						
t_{on}	turn-on time	I_D = 200 mA V_{DD} = 50 V V_{GS} = 0 to 10 V	–	2	5	ns
t_{off}	turn-off time	I_D = 200 mA V_{DD} = 50 V V_{GS} = 0 to 10	–	10	15	ns

N-channel enhancement mode vertical D-MOS transistor

BSP106

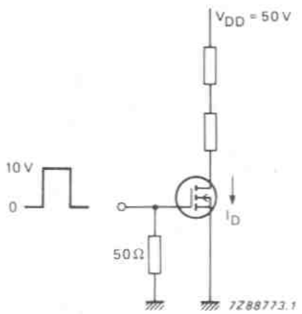


Fig.2 Switching time test circuit.

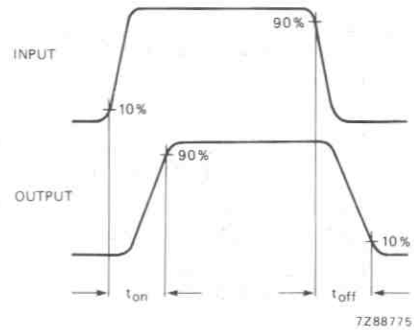


Fig.3 Input and output waveforms.

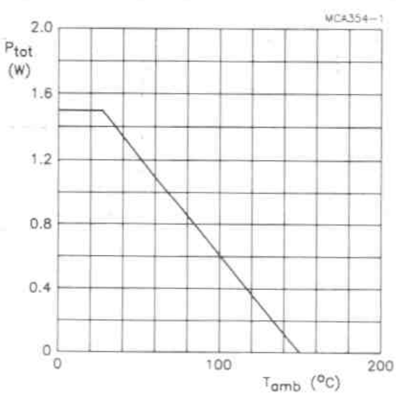


Fig.4 Power derating curve.

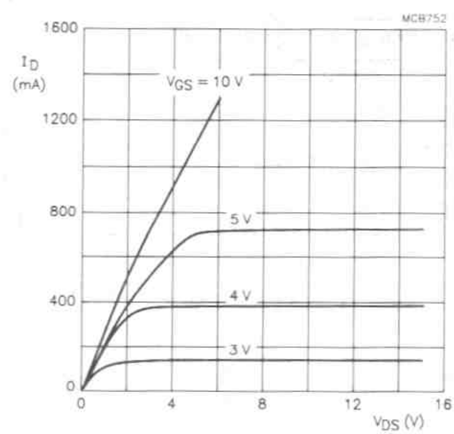


Fig.5 Typical output characteristics; $T_j = 25$ °C.

N-channel enhancement mode vertical D-MOS transistor

BSP106

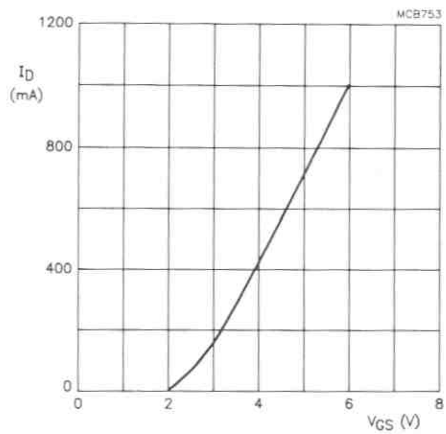


Fig.6 Typical transfer characteristic; V_{DS} = 10 V; T_j = 25 °C.

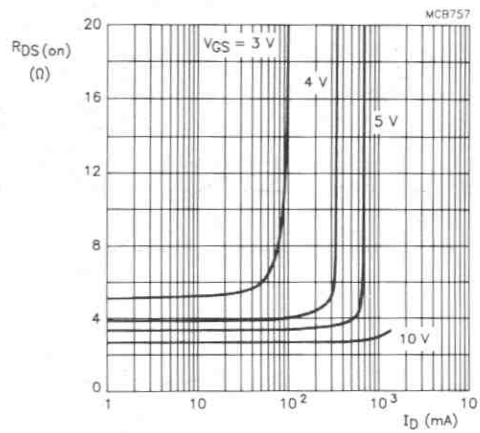


Fig.7 Typical on-resistance as a function of drain current; T_j = 25 °C.

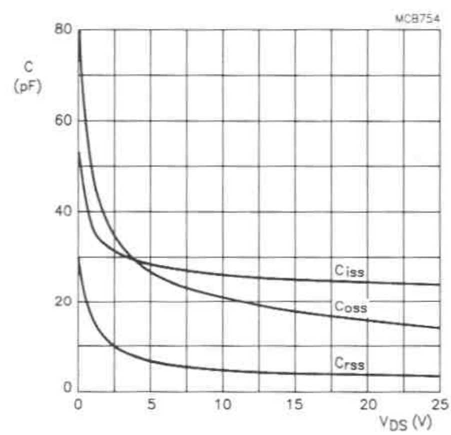


Fig.8 Typical capacitances as a function of drain-source voltage; V_{GS} = 0; f = 1 MHz; T_j = 25 °C.

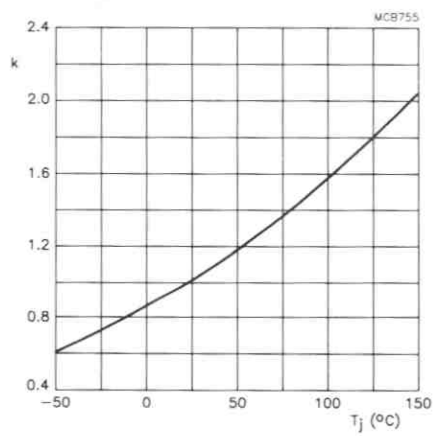


Fig.9 Temperature coefficient of drain-source on-resistance; $k = \frac{R_{DS(on)} \text{ at } T_j}{R_{DS(on)} \text{ at } 25\ °C}$; typical $R_{DS(on)}$ at 200 mA/10 V.

N-channel enhancement mode vertical D-MOS transistor

BSP106

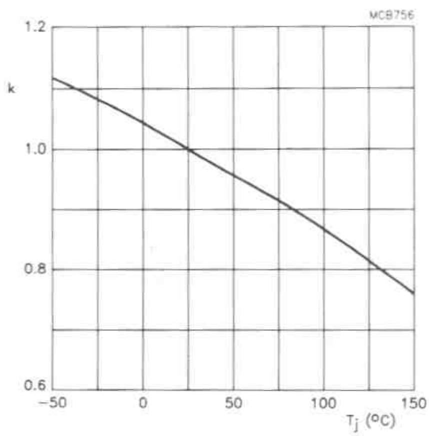
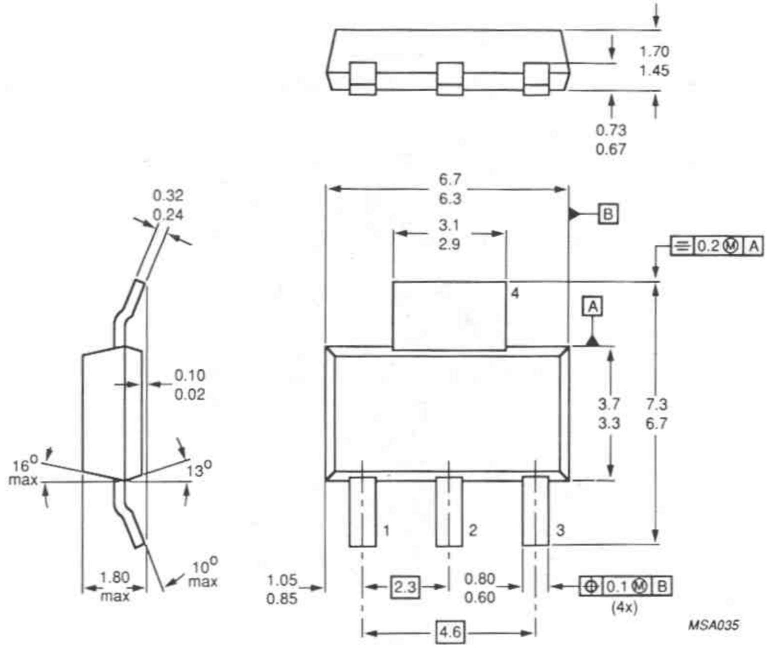


Fig.10 Temperature coefficient of gate-source threshold voltage; $k = \frac{V_{GS(th)} \text{ at } T_j}{V_{GS(th)} \text{ at } 25\ °C}$; typical $V_{GS(th)}$ at 1 mA.

PACKAGE OUTLINE



Dimensions in mm.

Marking code: BSP106.

Fig.11 SOT223.

Philips Components

Data sheet	
status	Preliminary specification
date of issue	April 1991

BSP107

N-channel enhancement mode vertical D-MOS transistor

FEATURES

- Direct interface to C-MOS, TTL, etc., due to low threshold voltage
- High speed switching
- No secondary breakdown

DESCRIPTION

N-channel enhancement mode vertical D-MOS transistor in a miniature SOT223 envelope and intended for use as a line current interruptor in telephone sets and for applications in relay, high speed and line transformer driver switching.

PIN CONFIGURATION

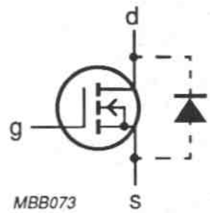


Fig.1 Symbol.

PINNING

PIN	DESCRIPTION
1	gate
2	drain
3	source
4	drain

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MAX.	UNIT
V_{DS}	drain-source voltage	200	V
I_D	drain current	200	mA
$R_{DS(on)}$	drain-source on-resistance	28	Ω
$V_{GS(th)}$	gate threshold voltage	2.4	V

N-channel enhancement mode vertical D-MOS transistor

BSP107

LIMITING VALUES

Limiting values in accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage		-	200	V
$\pm V_{GSO}$	gate-source voltage	open drain	-	20	V
I_D	drain current	DC	-	200	mA
I_{DM}	drain current	peak	-	350	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	-	1.5	W
T_{stg}	storage temperature range		−65	150	°C
T_j	operating junction temperature		-	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}a}$	from junction to ambient (note 1)	83.3	K/W

Notes

1. Device mounted on an epoxy printed circuit board, 40 mm x 40 mm x 1.5 mm. Mounting pad for the drain lead minimum 6 cm^2.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)DSS}$	drain-source breakdown voltage	V_{GS} = 0 I_D = 10 μA	200	-	-	V
I_{DSS}	drain-source leakage current	V_{DS} = 130 V V_{GS} = 0	-	-	30	nA
I_{DSX}	drain-source leakage current	V_{DS} = 70 V V_{GS} = 0.2 V	-	-	1	μA
$\pm I_{GSS}$	gate-source leakage current	$\pm V_{GS}$ = 15 V V_{DS} = 0	-	-	10	nA
$V_{GS(th)}$	gate threshold voltage	I_D = 1 mA V_{DS} = V_{GS}	0.8	-	2.4	V
$R_{DS(on)}$	drain-source on-resistance	I_D = 20 mA V_{GS} = 2.6 V	-	20	28	Ω
$R_{DS(on)}$	drain-source on-resistance	I_D = 150 mA V_{GS} = 10 V	-	14	-	Ω
$\|Y_{fs}\|$	transfer admittance	I_D = 250 mA V_{DS} = 15 V	90	180	-	mS
C_{iss}	input capacitance	V_{DS} = 10 V V_{GS} = 0 f = 1 MHz	-	50	65	pF
C_{oss}	output capacitance	V_{DS} = 10 V V_{GS} = 0 f = 1 MHz	-	16	25	pF
C_{rss}	feedback capacitance	V_{DS} = 10 V V_{GS} = 0 f = 1 MHz	-	4	10	pF
Switching times (see Figs 2 and 3)						
t_{on}	switching-on time	I_D = 250 mA V_{DD} = 50 V V_{GS} = 0 - 10 V	-	2	10	ns
t_{off}	switching-off time	I_D = 250 mA V_{DD} = 50 V V_{GS} = 0 - 10 V	-	5	20	ns

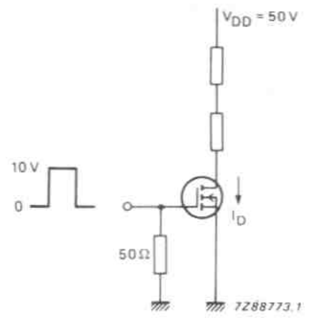


Fig.2 Switching time test circuit.

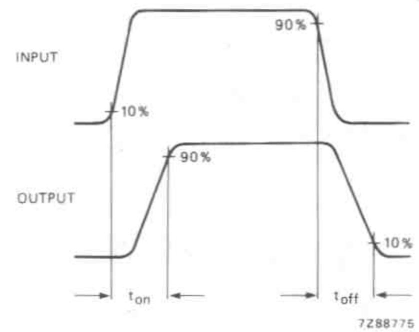


Fig.3 Input and output waveforms.

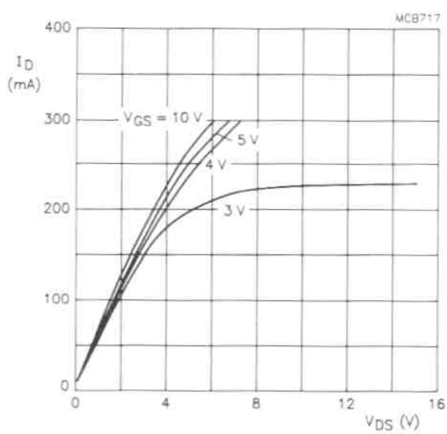


Fig.4 Typical output characteristics; $T_j = 25°$ C.

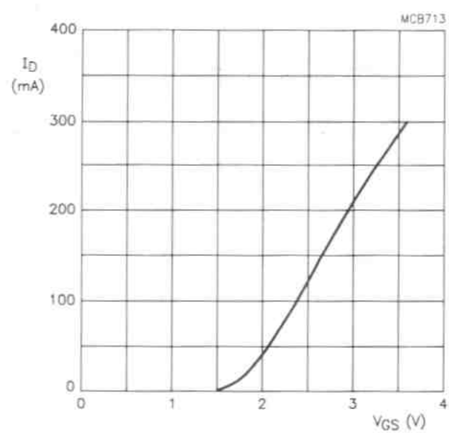


Fig.5 Typical transfer characteristics; $V_{DS} = 10$ V; $T_j = 25°$ C.

N-channel enhancement mode vertical D-MOS transistor

BSP107

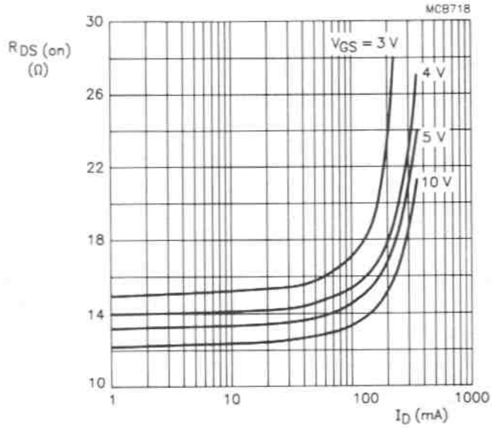


Fig.6 Typical on-resistance as a function of drain current; $T_j = 25°$ C.

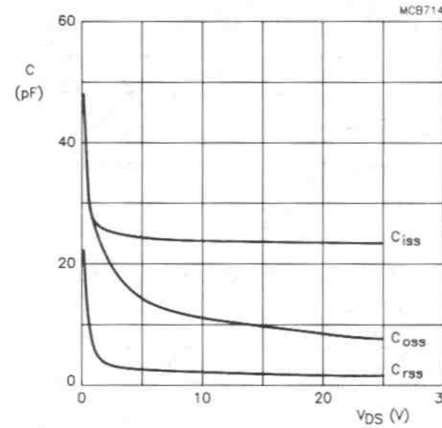


Fig.7 Typical capacitances as a function of drain-source voltage; $V_{GS} = 0$; f = 1 MHz; $T_j = 25°$ C

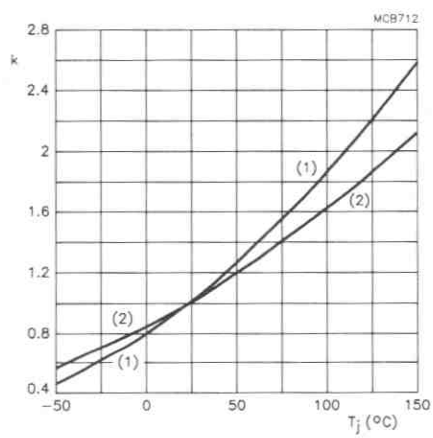


Fig.8 Temperature coefficient of drain-source on-resistance; $k = \frac{R_{DS(on)} \text{ at } T_j}{R_{DS(on)} \text{ at } 25° C}$;

typical $R_{DS(on)}$ at 150 mA/10 V;

(1) I_D = 150 mA; V_{GS} = 10 V;

(2) I_D = 20 mA; V_{GS} = 2.6 V;

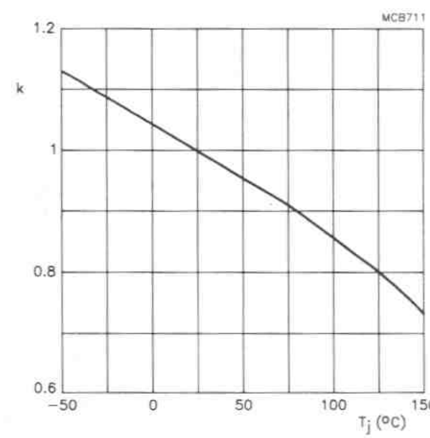


Fig.9 Temperature coefficient of gate-source threshold voltage;

$k = \frac{V_{GS(th)} \text{ at } T_j}{V_{GS(th)} \text{ at } 25° C}$; typical $V_{GS(th)}$ at 1 mA.

N-channel enhancement mode vertical D-MOS transistor

BSP107

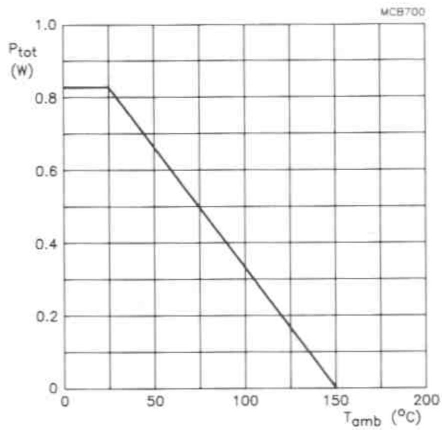


Fig.10 Power derating curve.

PACKAGE OUTLINE

Dimensions in mm

Marking code:

BSP107 = BSP107

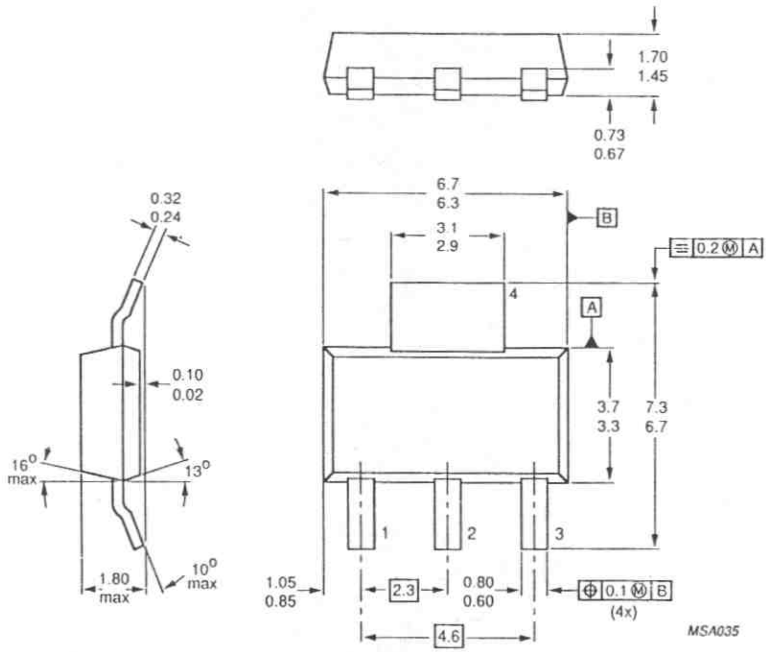


Fig.11 SOT223

N-CHANNEL ENHANCEMENT MODE VERTICAL D-MOS TRANSISTOR

N-channel enhancement mode vertical D-MOS transistor in a miniature SOT223 envelope and intended for use in relay, high-speed and line-transformer drivers.

Features

- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No secondary breakdown

QUICK REFERENCE DATA

Drain-source voltage	V_{DS}	max.	80	V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20	V
Drain current (DC)	I_D	max.	500	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1.5	W
Drain-source ON-resistance I_D = 500 mA; V_{GS} = 10 V	$R_{DS\,on}$	typ. max.	2.0 3.0	Ω Ω
Transfer admittance I_D = 500 mA; V_{DS} = 15 V	$\lvert y_{fs} \rvert$	min. typ.	150 300	mS mS

MECHANICAL DATA

Dimensions in mm

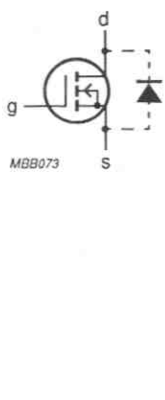
Fig.1 SOT223.

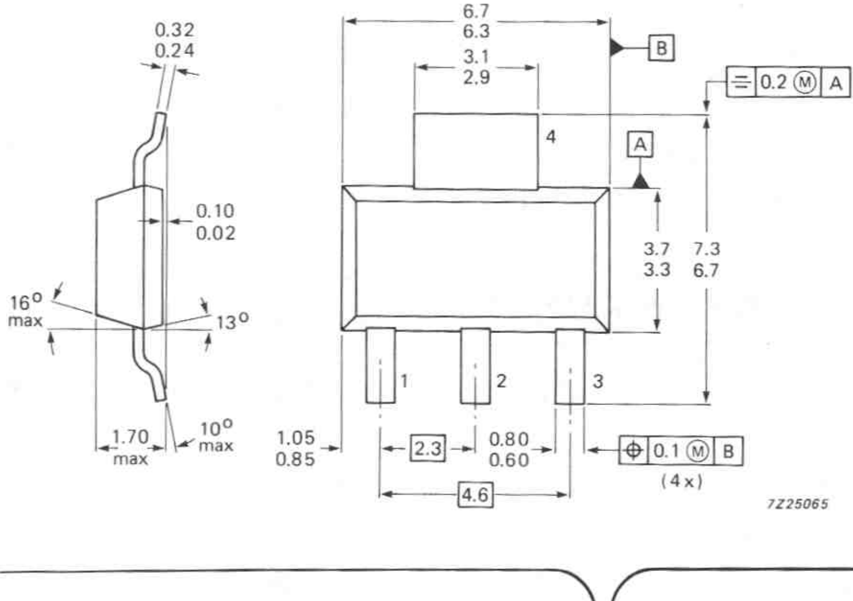
Marking code

BSP108

Pinning

1 = gate
2 = drain
3 = source
4 = drain





RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	V_{DS}	max.	80 V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20 V
Drain current (DC)	I_D	max.	500 mA
Drain current (peak)	I_{DM}	max.	1.0 A
Total power dissipation up to T_{amb} = 25 °C (note 1)	P_{tot}	max.	1.5 W
Storage temperature range	T_{stg}		−65 to + 150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient (note 1)	$R_{th\ j\text{-}a}$	=	83.3 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Drain-source breakdown voltage I_D = 10 μA; V_{GS} = 0	$V_{(BR)DSS}$	min.	80 V
Gate threshold voltage I_D = 1 mA; V_{GS} = V_{DS}	$V_{GS(th)}$	min. max.	1.5 V 3.5 V
Gate-source leakage current $\pm V_{GS}$ = 20 V; V_{DS} = 0	I_{GSS}	max.	100 nA
Drain-source leakage current V_{DS} = 60 V; V_{GS} = 0	I_{DSS}	max.	1.0 μA
Drain-source ON-resistance I_D = 500 mA; V_{GS} = 10 V	$R_{DS\ on}$	typ. max.	2.0 Ω 3.0 Ω
Transfer admittance I_D = 500 mA; V_{DS} = 15 V	$\lvert y_{fs} \rvert$	min. typ.	150 mS 300 mS
Input capacitance at f = 1 MHz; V_{DS} = 10 V; V_{GS} = 0	C_{iss}	typ. max.	45 pF 60 pF
Output capacitance at f = 1 MHz; V_{DS} = 10 V; V_{GS} = 0	C_{oss}	typ. max.	30 pF 45 pF
Feedback capacitance at f = 1 MHz; V_{DS} = 10 V; V_{GS} = 0	C_{rss}	typ. max.	8 pF 12 pF
Switching times (see Figs 2 and 3) I_D = 500 mA; V_{DD} = 50 V V_{GS} = 0 to 10 V	t_{on}	typ. max.	4 ns 8 ns
	t_{off}	typ. max.	10 ns 15 ns

Note

1. Device mounted on an epoxy printed-circuit board 40 mm x 40 mm x 1.5 mm; mounting pad for the collector lead min. 6 cm^2.

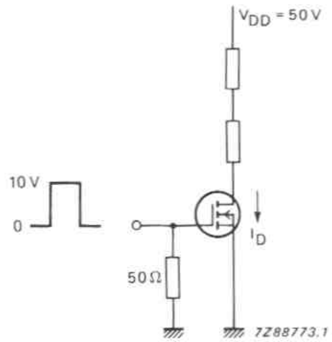


Fig.2 Switching times test circuit.

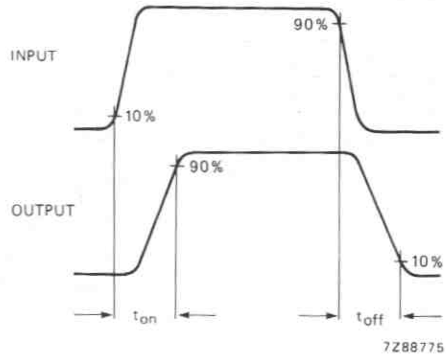


Fig.3 Input and output waveforms.

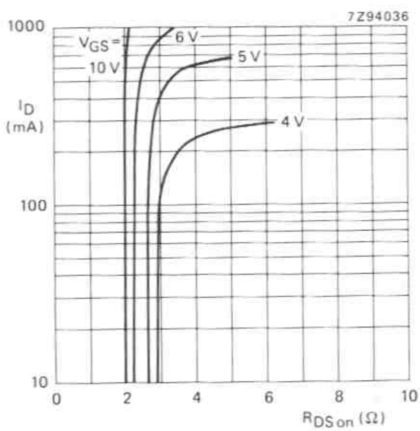


Fig.4 T_j = 25 °C; typical values.

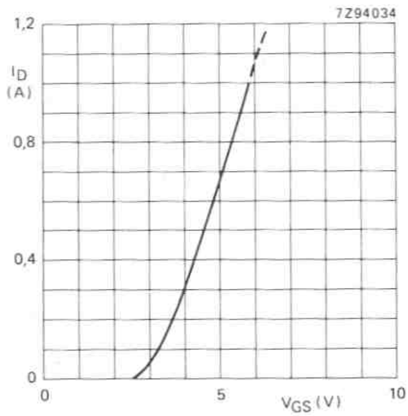


Fig.5 T_j = 25 °C; typical values at V_{DS} = 10 V.

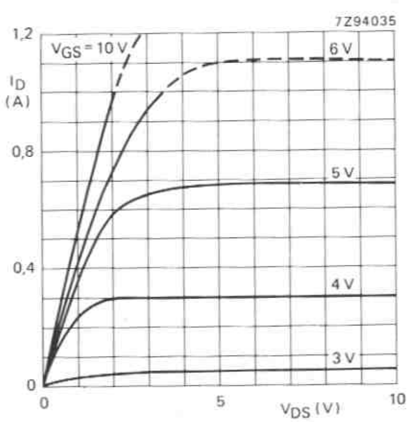


Fig.6 T_j = 25 °C; typical values.

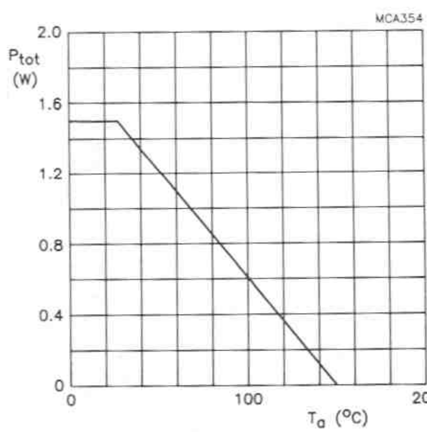


Fig.7 Power derating curve.

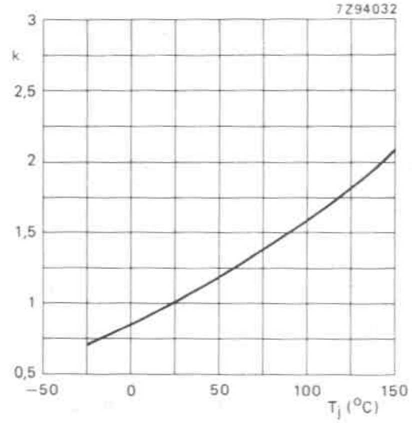


Fig.8 $k = \frac{R_{DS\,on} \text{ at } T_j}{R_{DS\,on} \text{ at } 25\,^{\circ}C}$; typ. values at 500 mA/10 V.

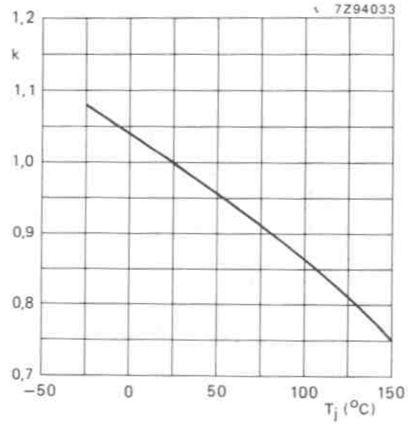


Fig.9 $k = \frac{V_{GS(th)} \text{ at } T_j}{V_{GS(th)} \text{ at } 25\,^{\circ}C}$; $V_{GS(th)}$ at 1 mA; typical values.

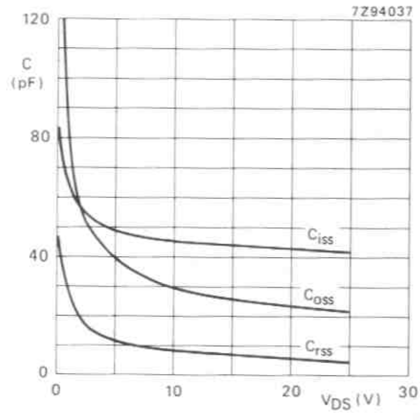


Fig.10 $T_j = 25\,^{\circ}C$; $V_{GS} = 0$; f = 1 MHz; typical values.

N-CHANNEL ENHANCEMENT MODE VERTICAL D-MOS TRANSISTOR

N-channel enhancement mode vertical D-MOS transistor in a miniature SOT223 envelope and designed for use in telephone ringer circuits and for application with relay, high-speed and line transformer drivers.

Features

- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No secondary breakdown

QUICK REFERENCE DATA

Drain-source voltage	V_{DS}	max.	80 V
Drain-source voltage (non-repetitive peak; $t_p \leq 2$ ms)	$V_{DS(SM)}$	max.	100 V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20 V
Drain current (DC)	I_D	max.	325 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1.5 W
Drain-source ON-resistance I_D = 200 mA; V_{GS} = 10 V	R_{DSon}	typ.	4.5 Ω
		max.	7 Ω
Transfer admittance I_D = 200 mA; V_{DS} = 15 V	$\lvert Y_{fs}\rvert$	min.	75 mS
		typ.	150 mS

MECHANICAL DATA

Dimensions in mm

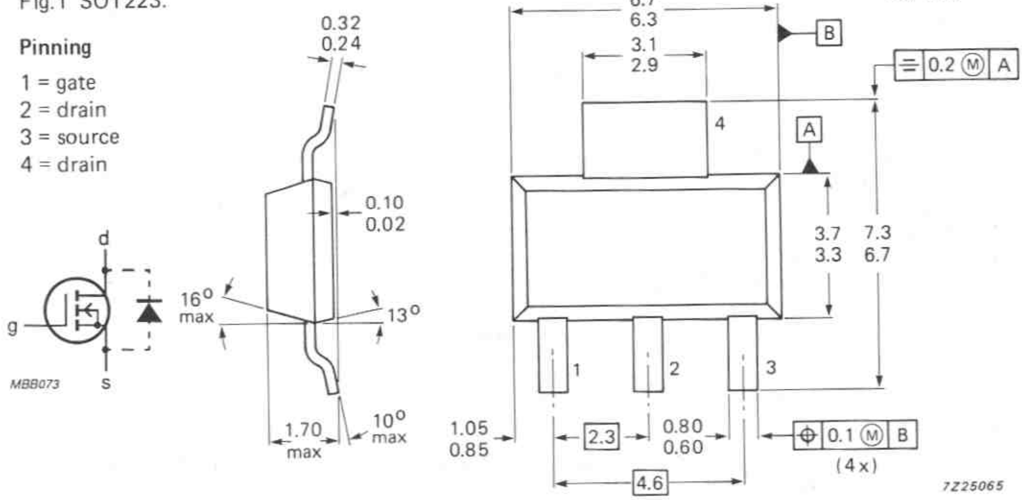
Fig.1 SOT223.

Pinning

1 = gate
2 = drain
3 = source
4 = drain

Marking code

BSP110



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	V_{DS}	max.	80 V
Drain-source voltage (non-repetitive peak; $t_p \leq 2$ ms)	$V_{DS(SM)}$	max.	100 V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20 V
Drain current (DC)	I_D	max.	325 mA
Drain current (peak)	I_{DM}	max.	650 mA
Total power dissipation up to T_{amb} = 25 °C (note 1)	P_{tot}	max.	1.5 W
Storage temperature range	T_{stg}		−65 to + 150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient (note 1)	$R_{th\ j\text{-}a}$	=	83.3 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Drain-source breakdown voltage I_D = 10 μA; V_{GS} = 0	$V_{(BR)DSS}$	min.	80 V
Drain-source leakage current V_{DS} = 60 V; V_{GS} = 0	I_{DSS}	max.	1.0 μA
Gate-source leakage current V_{GS} = 20 V; V_{DS} = 0	I_{GSS}	max.	100 nA
Gate threshold voltage I_D = 1 mA; V_{DS} = V_{GS}	$I_{GS(th)}$	min.	0.8 V
		max.	2.8 V
Drain-source ON-resistance (see Fig.4) I_D = 150 mA; V_{GS} = 5 V	R_{DSon}	typ.	7 Ω
		max.	10 Ω
I_D = 200 mA; V_{GS} = 10 V	R_{DSon}	typ.	4.5 Ω
		max.	7 Ω
Transfer admittance I_D = 200 mA; V_{DS} = 5 V	$\|Y_{fs}\|$	min.	75 mS
		typ.	150 mS
Input capacitance at f = 1 MHz; V_{DS} = 10 V; V_{GS} = 0	C_{iss}	typ.	15 pF
		max.	30 pF
Output capacitance at f = 1 MHz; V_{DS} = 10 V; V_{GS} = 0	C_{oss}	typ.	13 pF
		max.	20 pF

Note

1. Device mounted on an epoxy printed-circuit board 40 mm x 40 mm x 1.5 mm; mounting pad for the drain lead min. 6 cm^2.

Feedback capacitance at f = 1 MHz; V_{DS} = 10 V; V_{GS} = 0	C_{rss}	typ.	3 pF
		max.	6 pF
Switching times (see Figs 2 and 3) I_D = 200 mA; V_{DD} = 50 V; V_{GS} = 0 to 10 V	t_{on}	typ.	2 ns
		max.	5 ns
	t_{off}	typ.	5 ns
		max.	10 ns

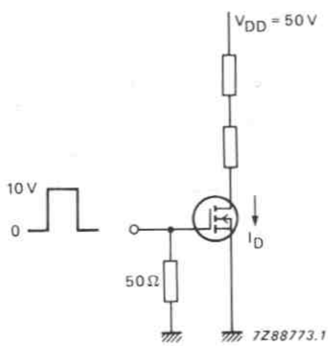


Fig.2 Switching time test circuit.

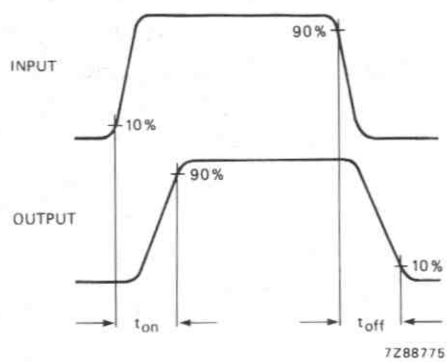


Fig.3 Input and output waveforms.

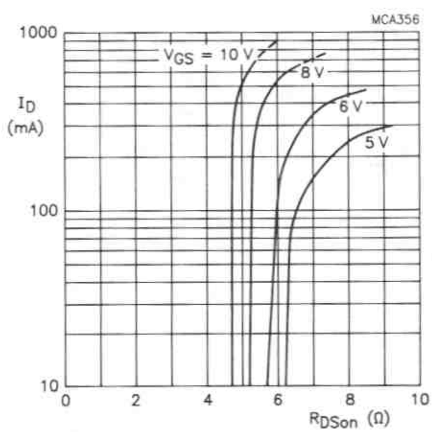


Fig.4 T_j = 25 °C; typical values.

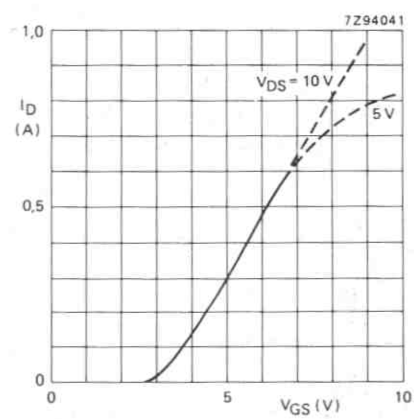


Fig.5 T_j = 25 °C; typical values.

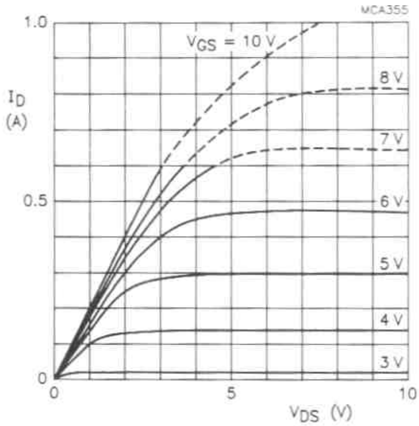


Fig.6 T_j = 25 °C; typical values.

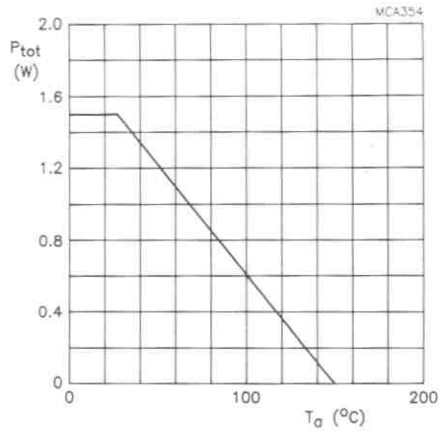


Fig.7 Power derating curve.

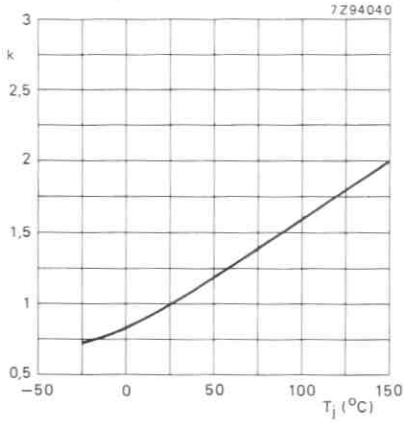


Fig.8 $k = \frac{R_{DSon} \text{ at } T_j}{R_{DSon} \text{ at } 25\,°C}$;

typical values at 150 mA/5 V.

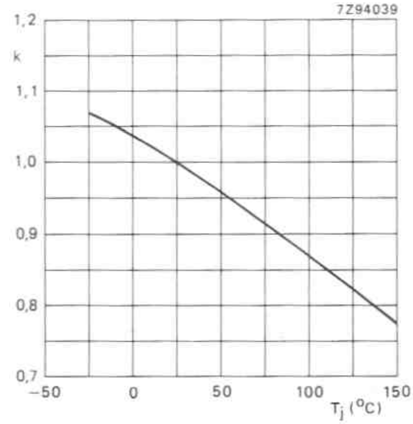


Fig.9 $k = \frac{V_{GS(th)} \text{ at } T_j}{V_{GS(th)} \text{ at } 25\,°C}$;

$V_{GS(th)}$ at 1 mA; typical values.

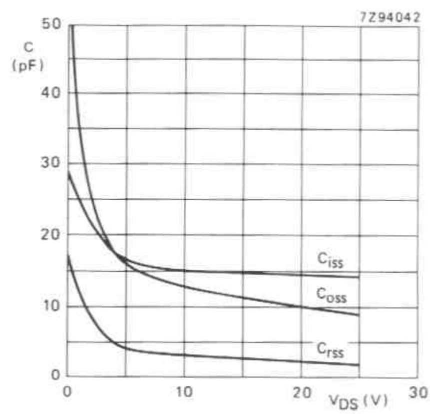


Fig.10 T_j = 25 °C; V_{GS} = 0;
f = 1 MHz; typical values.

N-CHANNEL ENHANCEMENT MODE VERTICAL D-MOS TRANSISTOR

N-channel enhancement mode vertical D-MOS transistor in a miniature SOT223 envelope and designed for use as a line current interrupter in telephone sets and for application in relay, high-speed and line-transformer drivers.

Features

- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No secondary breakdown

QUICK REFERENCE DATA

Drain-source voltage	V_{DS}	max.	200 V
Drain-current (DC)	I_D	max.	250 mA
Drain-source ON-resistance I_D = 250 mA; V_{GS} = 10 V	$R_{DS(on)}$	typ. max.	7 Ω 12 Ω
Gate threshold voltage	$V_{GS(th)}$	max.	2.8 V

MECHANICAL DATA

Dimensions in mm

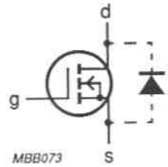
Marking code

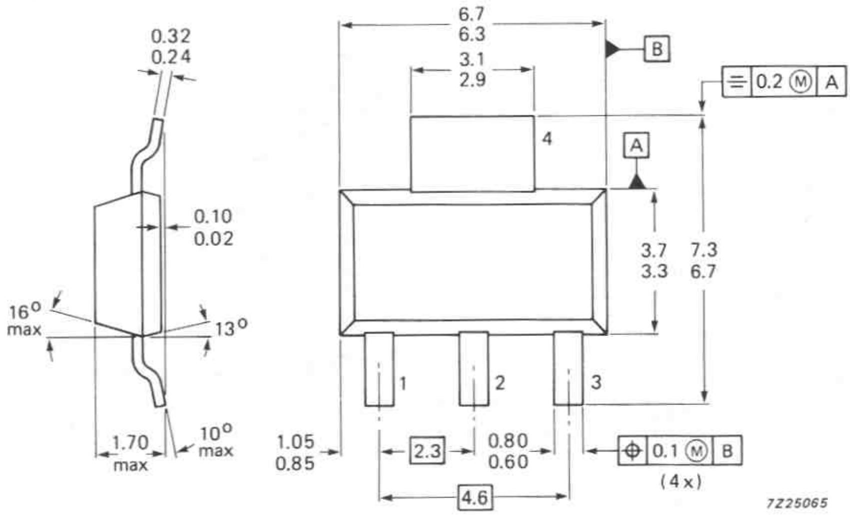
BSP120

Fig.1 SOT223.

Pinning

1 = gate
2 = drain
3 = source
4 = drain





RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	V_{DS}	max.	200 V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20 V
Drain current (DC)	I_D	max.	250 mA
Drain current (peak)	I_{DM}	max.	800 mA
Total power dissipation up to T_{amb} = 25 °C (note 1)	P_{tot}	max.	1.5 W
Storage temperature range	T_{stg}		−65 to + 150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient (note 1)	$R_{th\ j\text{-}a}$	=	83.3 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Drain-source breakdown voltage I_D = 10 μA; V_{GS} = 0	$V_{(BR)DSS}$	min.	200 V
Drain-source leakage current V_{DS} = 160 V; V_{GS} = 0	I_{DSS}	max.	1.0 μA
Gate-source leakage current V_{GS} = 20 V; V_{DS} = 0	I_{GSS}	max.	100 nA
Drain-source ON-resistance (see Fig.4) I_D = 250 mA; V_{GS} = 10 V	R_{DSon}	typ. max.	7 Ω 12 Ω
Gate threshold voltage I_D = 1 mA; V_{GS} = V_{DS}	$V_{GS(th)}$	min. max.	0.8 V 2.8 V
Transfer admittance I_D = 250 mA; V_{DS} = 15 V	$\lvert Y_{fs} \rvert$	min. typ.	125 mS 250 mS
Input capacitance at f = 1 MHz; V_{DS} = 10 V; V_{GS} = 0	C_{iss}	typ. max.	45 pF 65 pF
Output capacitance at f = 1 MHz; V_{DS} = 10 V; V_{GS} = 0	C_{oss}	typ. max.	20 pF 30 pF
Feedback capacitance at f = 1 MHz; V_{DS} = 10 V; V_{GS} = 0	C_{rss}	typ. max.	5 pF 10 pF

Note

1. Device mounted on an epoxy printed-circuit board 40 mm x 40 mm x 1.5 mm; mounting pad for the drain lead min. 6 cm^2.

Switching times (see Figs 2 and 3)
I_D = 250 mA; V_{DD} = 50 V;
V_{GS} = 0 to 10 V

t_{on}	typ.	3	ns
	max.	6	ns
t_{off}	typ.	15	ns
	max.	20	ns

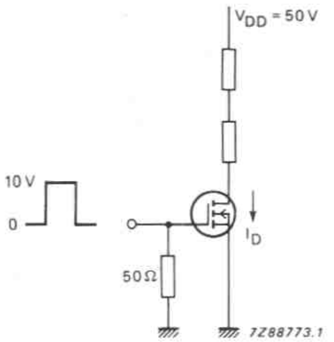


Fig.2 Switching time test circuit.

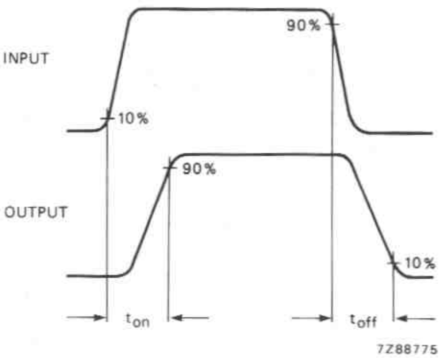


Fig.3 Input and output waveforms.

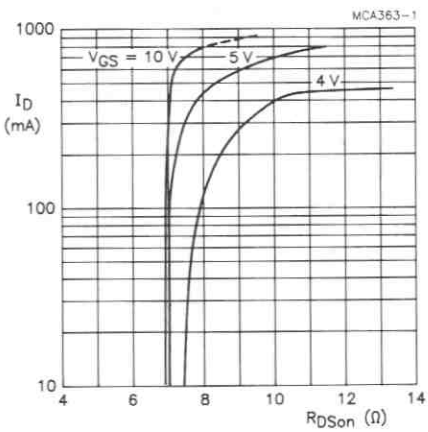


Fig.4 T_j = 25 °C; typical values.

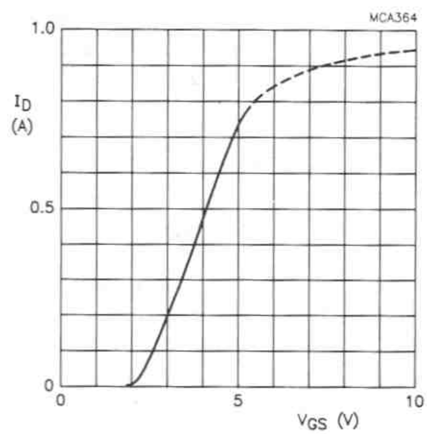


Fig.5 T_j = 25 °C; V_{DS} = 10 V; typical values.

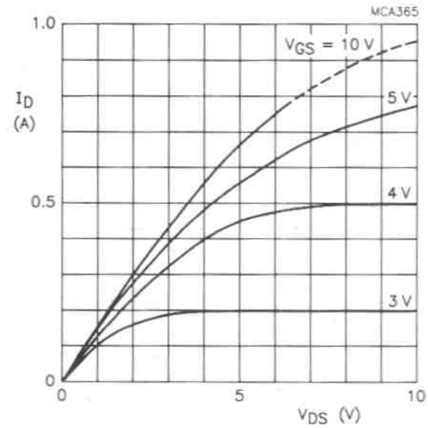


Fig.6 $T_j = 25\ ^oC$; typical values.

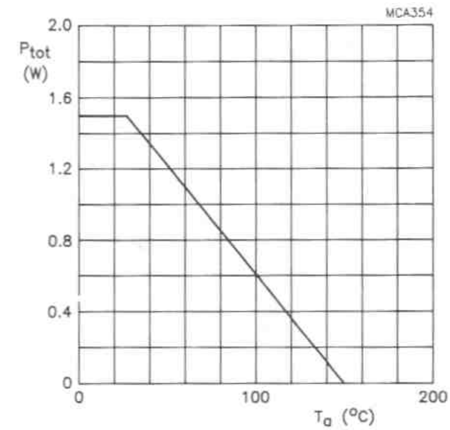


Fig.7 Power derating curve.

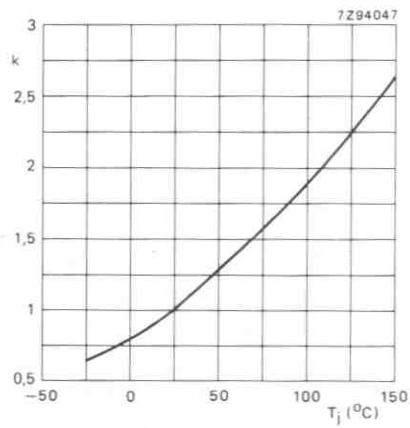


Fig.8 $k = \frac{R_{DSon}\ at\ T_j}{R_{DSon}\ at\ 25\ ^oC}$; at 250 mA/10 V; typical values.

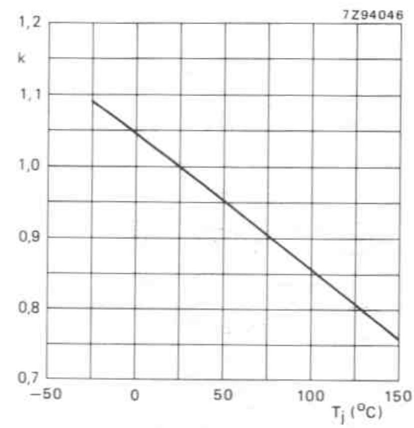


Fig.9 $k = \frac{V_{GS(th)}\ at\ T_j}{V_{GS(th)}\ at\ 25\ ^oC}$; $V_{GS(th)}$ at 1 mA; typical values.

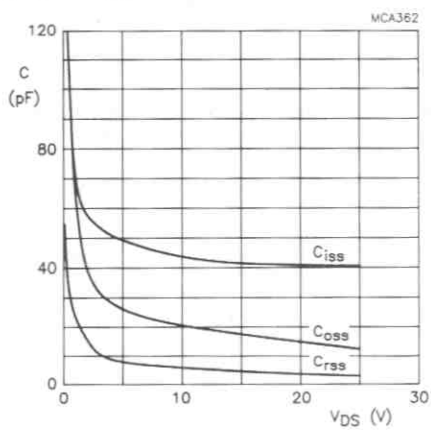


Fig.10 $T_j = 25\ ^oC$; $V_{GS} = 0$; f = 1 MHz; typical values.

N-CHANNEL ENHANCEMENT MODE VERTICAL D-MOS TRANSISTOR

N-channel enhancement mode vertical D-MOS transistor in a miniature SOT223 envelope and designed for use as a line current interrupter in telephone sets and for application in relay, high-speed and line-transformer drivers.

Features

- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No secondary breakdown

QUICK REFERENCE DATA

Drain source voltage	V_{DS}	max.	200 V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20 V
Drain current (DC)	I_D	max.	350 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1.5 W
Drain-source on-resistance I_D = 400 mA; V_{GS} = 10 V	$R_{DS(on)}$	typ. max.	4.5 Ω 6.0 Ω
Transfer admittance I_D = 400 mA; V_{DS} = 25 V	$\lvert Y_{fs} \rvert$	min. typ.	200 mS 350 mS

MECHANICAL DATA

Dimensions in mm

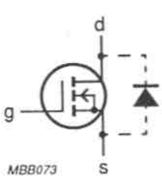
Fig.1 SOT223.

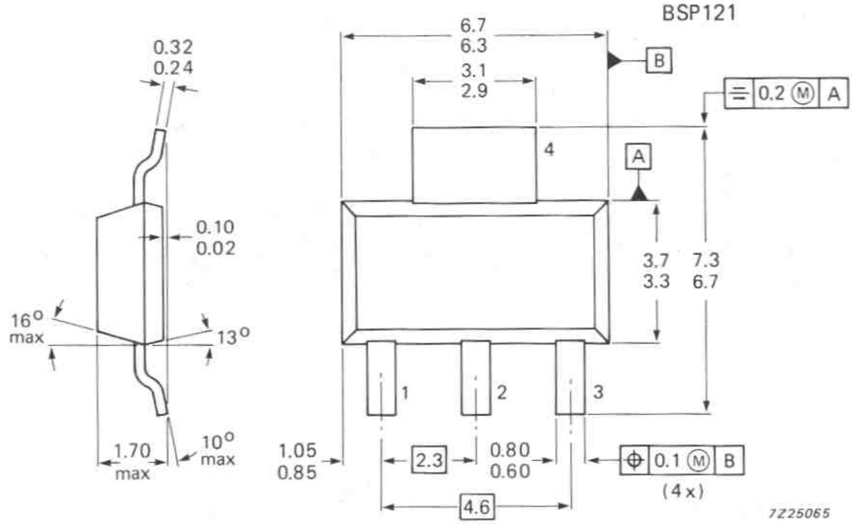
Marking code

BSP121

Pinning:

1 = gate
2 = drain
3 = source
4 = drain





RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	V_{DS}	max.	200 V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20 V
Drain current (DC)	I_D	max.	350 mA
Drain current (peak)	I_{DM}	max.	1.2 A
Total power dissipation up to T_{amb} = 25 °C (note 1)	P_{tot}	max.	1.5 W
Storage temperature range	T_{stg}		−65 to +150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient (note 1)	$R_{thj\text{-}a}$	=	83.3 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Drain-source breakdown voltage I_D = 10 μA; V_{GS} = 0	$V_{(BR)DSS}$	min.	200 V
Drain-source leakage current V_{DS} = 160 V; V_{GS} = 0	I_{DSS}	max.	1.0 μA
V_{DS} = 60 V; V_{GS} = 0	I_{DSS}	max.	200 nA
Gate-source leakage current $\pm V_{GS}$ = 20 V; V_{DS} = 0	$\pm I_{GSS}$	max.	100 nA
Gate threshold voltage I_D = 1 mA; V_{DS} = V_{GS}	$V_{GS(th)}$	min. max.	0.8 V 2.8 V
Drain-source on-resistance I_D = 400 mA; V_{GS} = 10 V	$R_{DS(on)}$	typ. max.	4.5 Ω 6.0 Ω
Transfer admittance I_D = 400 mA; V_{DS} = 25 V	$\|Y_{fs}\|$	min. typ.	200 mS 350 mS
Input capacitance at f = 1 MHz V_{DS} = 25 V; V_{GS} = 0	C_{iss}	typ. max.	45 pF 60 pF
Output capacitance at f = 1 MHz V_{DS} = 25 V; V_{GS} = 0	C_{oss}	typ. max.	15 pF 25 pF
Feedback capacitance at f = 1 MHz V_{DS} = 25 V; V_{GS} = 0	C_{rss}	typ. max.	3.5 pF 10 pF

Note

1. Device mounted on an epoxy printed-circuit board 40 mm x 40 mm x 1.5 mm; mounting pad for the drain lead min. 6 cm^2.

Switching times (see Figs 2 and 3)
I_D = 250 mA; V_{DD} = 50 V; V_{GS} = 0 to 10 V

t_{on}	typ.	5	ns
	max.	10	ns
t_{off}	typ.	15	ns
	max.	20	ns

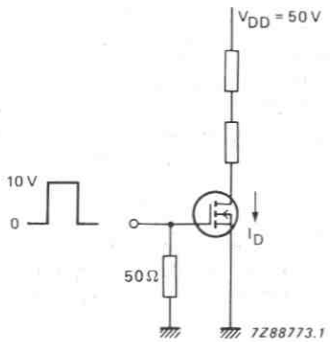


Fig.2 Switching time test circuit

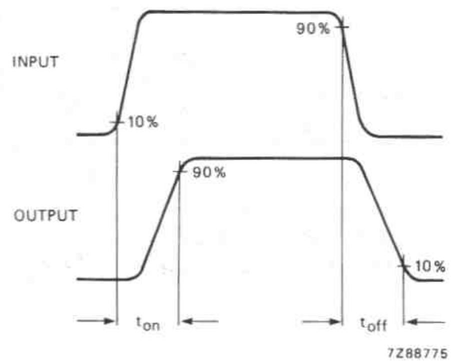


Fig.3 Input and output waveforms.

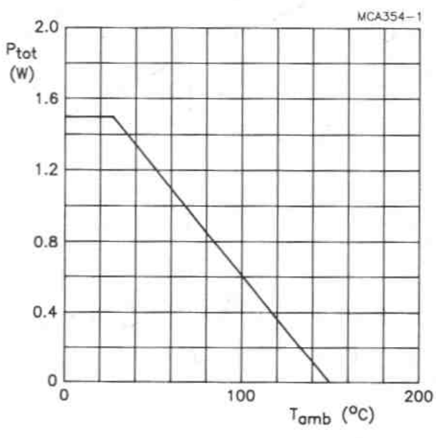


Fig.4 Power derating curve.

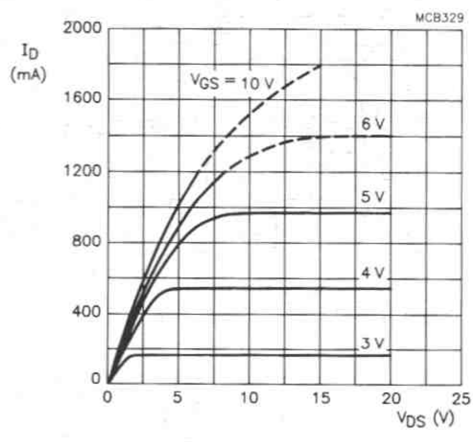


Fig.5 Output characteristic;
T_j = 25 °C; typical value.

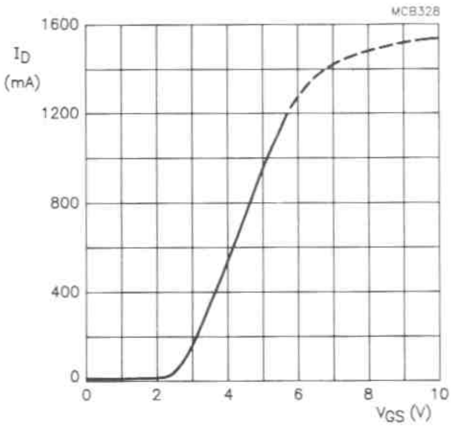


Fig.6 Transfer characteristic;
V_{DS} = 10 V; T_j = 25 °C; typical values.

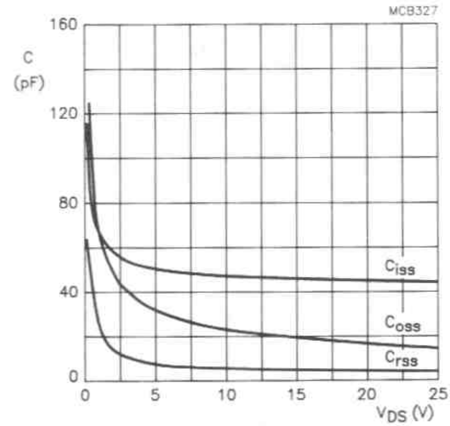


Fig.7 Capacitance as a function of drain-source voltage; V_{GS} = 0; f = 1 MHz; T_j = 25 °C; typical values.

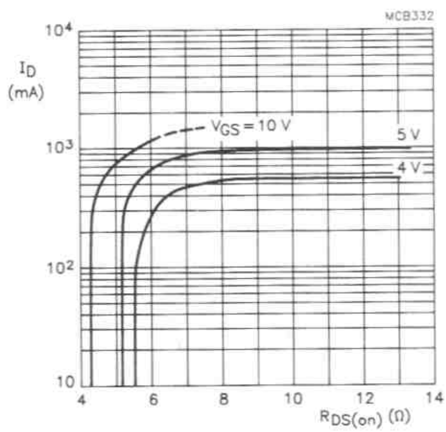


Fig.8 T_j = 25 °C; typical values.

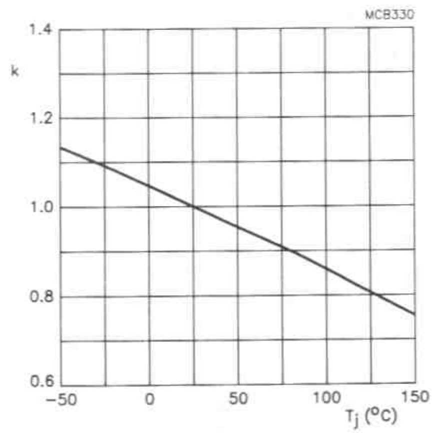


Fig.9 $k = \frac{V_{GS(th)} \text{ at } T_j}{V_{GS(th)} \text{ at } 25\ ^{o}C}$; $V_{GS(th)}$ at 1 mA; typical values.

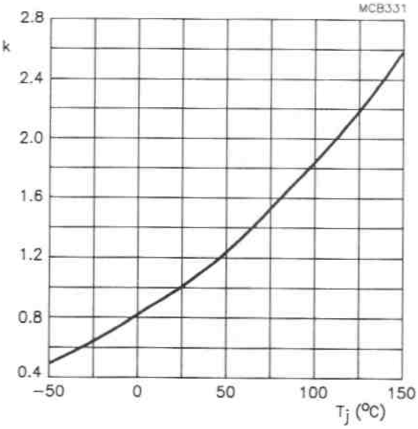


Fig.10 $k = \frac{R_{DS(on)} \text{ at } T_j}{R_{DS(on)} \text{ at } 25\ ^\circ C}$; at 400 mA/10V; typical values.

N-CHANNEL ENHANCEMENT MODE VERTICAL D-MOS TRANSISTOR

N-channel enhancement mode vertical D-MOS transistor in a miniature SOT223 envelope and designed for use as a line interrupter in telephone sets and for application in relay, high-speed and line-transformer drivers.

Features

- Direct interface to C-MOS, TTL, etc.
- High-speed switching.
- No secondary breakdown.

QUICK REFERENCE DATA

Drain-source voltage	V_{DS}	max.	250	V
Drain current (DC)	I_D	max.	350	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1.5	W
Drain-source on-resistance I_D = 300 mA; V_{GS} = 10 V	$R_{DS(on)}$	typ.	5.0	Ω
		max.	7.0	Ω
Gate-source threshold voltage	$V_{GS(th)}$	max.	2	V

MECHANICAL DATA

Dimensions in mm

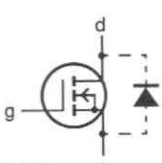
Marking code

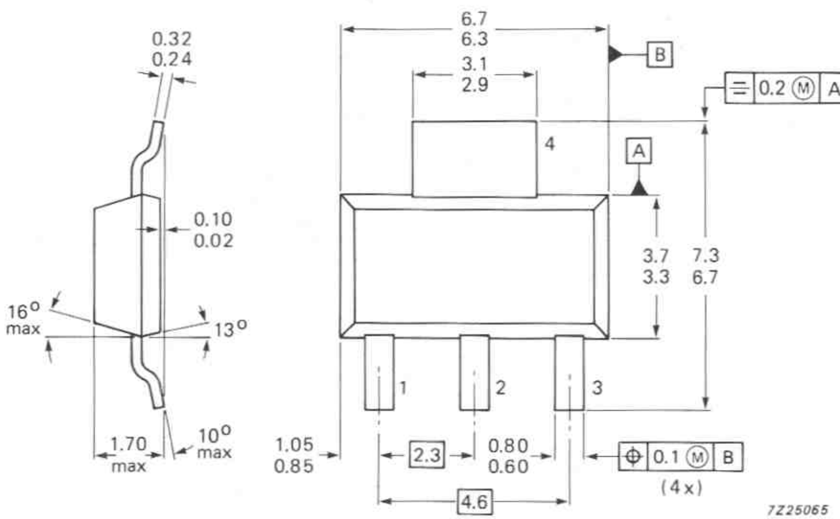
BSP126

Fig.1 SOT223.

Pinning

1 = gate
2 = drain
3 = source
4 = drain





RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	V_{DS}	max.	250 V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20 V
Drain current (DC)	I_D	max.	350 mA
Drain current (peak)	I_{DM}	max.	1.2 A
Total power dissipation up to T_{amb} = 25 °C (note 1)	P_{tot}	max.	1.5 W
Storage temperature range	T_{stg}		−65 to + 150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient (note 1)	$R_{th\ j\text{-}a}$	=	83.3 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Drain-source breakdown voltage I_D = 10 μA; V_{GS} = 0	$V_{(BR)DSS}$	min.	250 V
Drain-source leakage current V_{DS} = 200 V; V_{GS} = 0	I_{DSS}	max.	1.0 μA
Gate-source leakage current $\pm V_{GS}$ = 20 V; V_{DS} = 0	$\pm I_{GSS}$	max.	100 nA
Gate threshold voltage I_D = 1 mA; V_{DS} = V_{GS}	$V_{GS(th)}$	min. max.	0.8 V 2.0 V
Drain-source on-resistance I_D = 300 mA; V_{GS} = 10 V	$R_{DS(on)}$	typ. max.	5.0 Ω 7.0 Ω
I_D = 20 mA; V_{GS} = 2.4 V	$R_{DS(on)}$	max.	10 Ω
Transfer admittance I_D = 300 mA; V_{DS} = 25 V	$\|Y_{fs}\|$	min. typ.	200 mS 400 mS
Input capacitance at f = 1 MHz; V_{DS} = 25 V; V_{GS} = 0	C_{iss}	typ. max.	65 pF 90 pF
Output capacitance at f = 1 MHz; V_{DS} = 25 V; V_{GS} = 0	C_{oss}	typ. max.	20 pF 30 pF
Feedback capacitance at f = 1 MHz; V_{DS} = 25 V; V_{GS} = 0	C_{rss}	typ. max.	5 pF 15 pF

Note

1. Device mounted on an epoxy printed-circuit board 40 mm x 40 mm x 1.5 mm; mounting pad for the drain lead min. 6 cm^2.

Switching times (see Figs 2 and 3)
I_D = 250 mA; V_{DD} = 50 V;
V_{GS} = 0 to 10 V

t_{on}	typ.	5	ns
	max.	10	ns
t_{off}	typ.	20	ns
	max.	30	ns

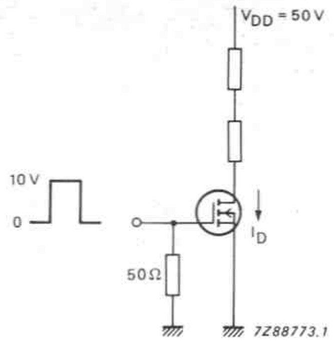


Fig.2 Switching time test circuit.

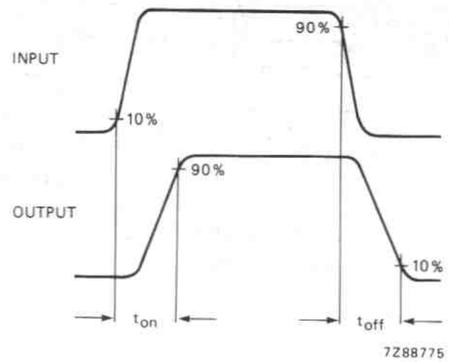


Fig.3 Input and output waveforms.

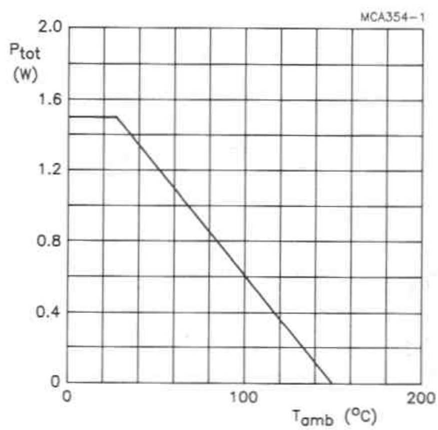


Fig.4 Power derating curve.

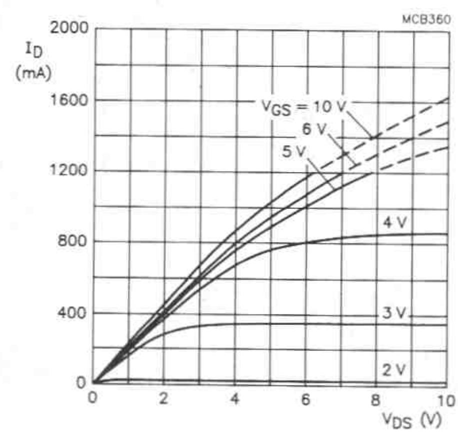


Fig.5 Output characteristics; T_j = 25 °C; typical values.

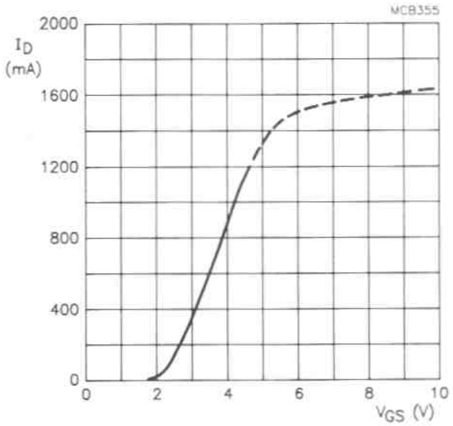


Fig.6 Transfer characteristic; V_{DS} = 10 V; T_j = 25 °C; typical value.

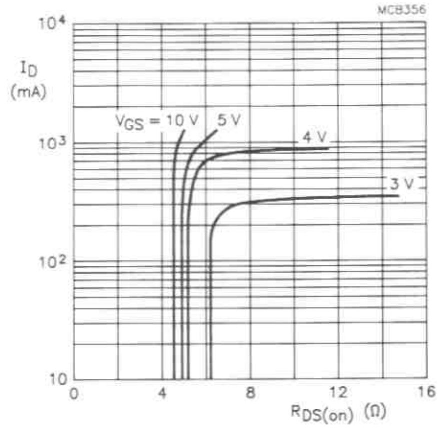


Fig.7 On-resistance as a function of drain current; T_j = 25 °C; typical values.

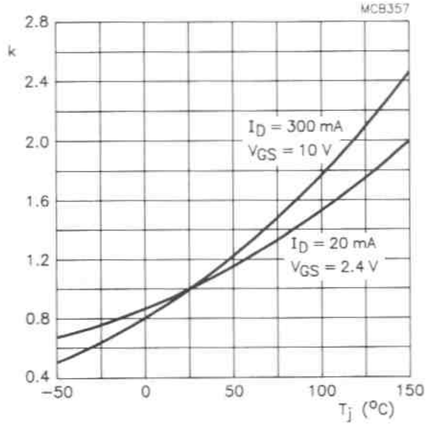


Fig.8 $k = \frac{R_{DS(on)} \text{ at } T_j}{R_{DS(on)} \text{ at } 25\ ^{o}C}$;

typical values.

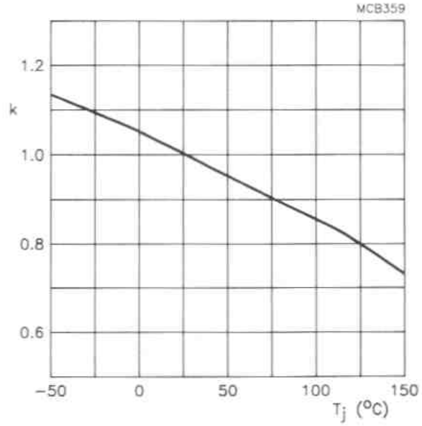


Fig.9 $k = \frac{V_{GS(th)} \text{ at } T_j}{V_{GS(th)} \text{ at } 25\ ^{o}C}$;

$V_{GS(th)}$ at 1 mA; typical values.

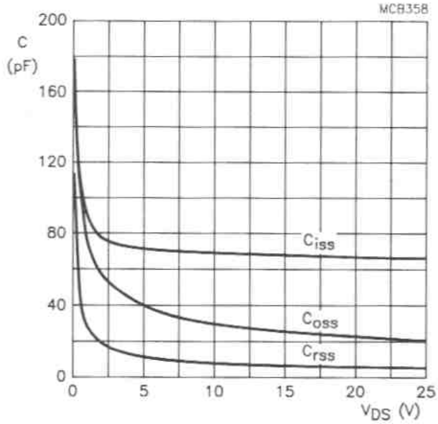


Fig.10 Capacitances as a function of drain-source voltage; V_{GS} = 0; f = 1 MHz; T_j = 25 °C; typical values.

P-CHANNEL ENHANCEMENT MODE VERTICAL D-MOS TRANSISTOR

P-channel enhancement mode vertical D-MOS transistor in a miniature SOT223 envelope and intended for use in relay, high-speed and line-transformer drivers.

Features

- Very low $r_{DS(on)}$
- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No secondary breakdown

QUICK REFERENCE DATA

Drain-source voltage	$-V_{DS}$	max.	60 V
Drain current (DC)	$-I_D$	max.	275 mA
Drain-source ON-resistance $-I_D$ = 200 mA; $-V_{GS}$ = 10 V	$r_{DS(on)}$	max.	10 Ω
Gate threshold voltage	$-V_{GS(th)}$	max.	3.5 V

MECHANICAL DATA

Dimensions in mm

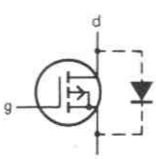
Marking code

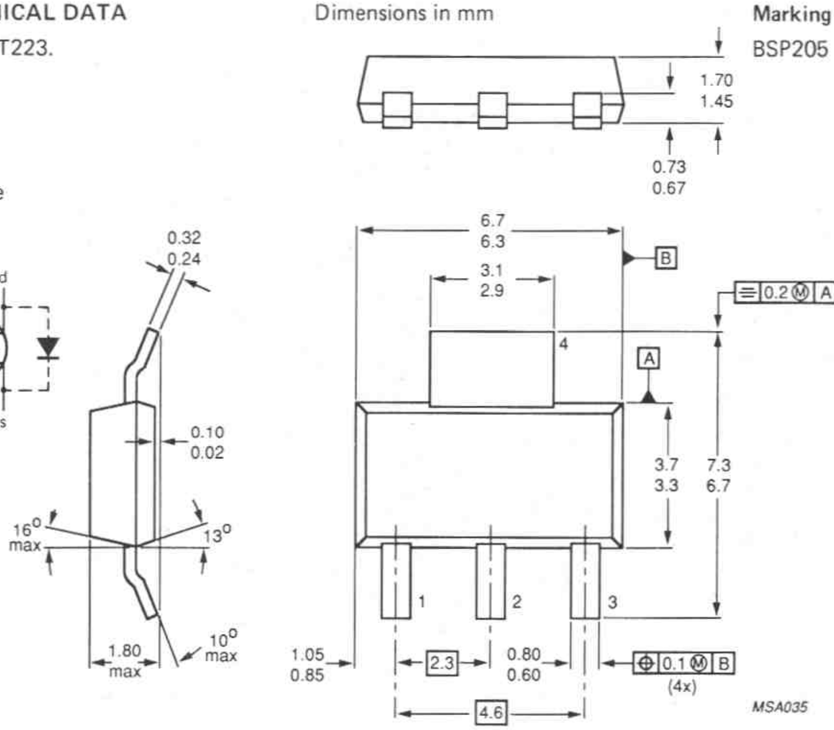
BSP205

Fig.1 SOT223.

Pinning:

1 = gate
2 = drain
3 = source
4 = drain





RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	$-V_{DS}$	max.	60 V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20 V
Drain current (DC)	$-I_D$	max.	275 mA
Drain current (peak)	$-I_{DM}$	max.	550 mA
Total power dissipation up to T_{amb} = 25 °C (note 1)	P_{tot}	max.	1.5 W
Storage temperature range	T_{stg}		−65 to + 150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient (note 1)	$R_{th\ j\text{-}a}$	=	83.3 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Drain-source breakdown voltage $-I_D$ = 10 μA; V_{GS} = 0	$-V_{(BR)DSS}$	min.	60 V
Drain-source leakage current $-V_{DS}$ = 48 V; V_{GS} = 0	$-I_{DSS}$	max.	1.0 μA
Gate-source leakage current $\pm V_{GS}$ = 20 V; V_{DS} = 0	$\pm I_{GSS}$	max.	100 nA
Gate threshold voltage $-I_D$ = 1 mA; V_{DS} = V_{GS}	$-V_{GS(th)}$	min. max.	1.5 V 3.5 V
Drain-source ON-resistance $-I_D$ = 200 mA; $-V_{GS}$ = 10 V	$r_{DS(on)}$	typ. max.	7.5 Ω 10 Ω
Transfer admittance $-I_D$ = 200 mA; $-V_{DS}$ = 15 V	$\|Y_{fs}\|$	min. typ.	60 mS 125 mS
Input capacitance at f = 1 MHz; $-V_{DS}$ = 10 V; V_{GS} = 0	C_{iss}	typ. max.	30 pF 45 pF
Output capacitance at f = 1 MHz; $-V_{DS}$ = 10 V; V_{GS} = 0	C_{oss}	typ. max.	20 pF 30 pF
Feedback capacitance at f = 1 MHz; $-V_{DS}$ = 10 V; V_{GS} = 0	C_{rss}	typ. max.	5 pF 10 pF
Switching times (see Figs 2 and 3) $-I_D$ = 200 mA; $-V_{DD}$ = 50 V; $-V_{GS}$ = 0 to 10 V	t_{on}	typ. max.	3 ns 6 ns
	t_{off}	typ. max.	10 ns 15 ns

Note

1. Device mounted on an epoxy printed-circuit board 40 mm x 40 mm x 1.5 mm; mounting pad for the drain lead min. 6 cm^2.

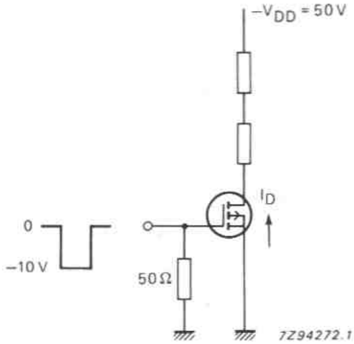


Fig.2 Switching time test circuit.

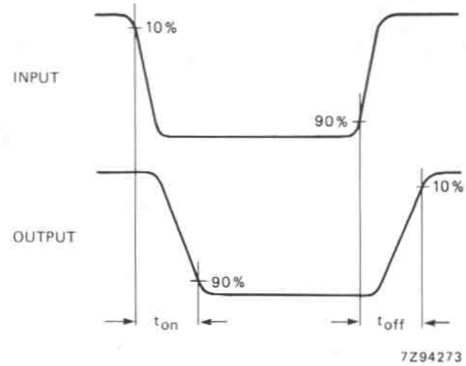


Fig.3 Input and output waveforms.

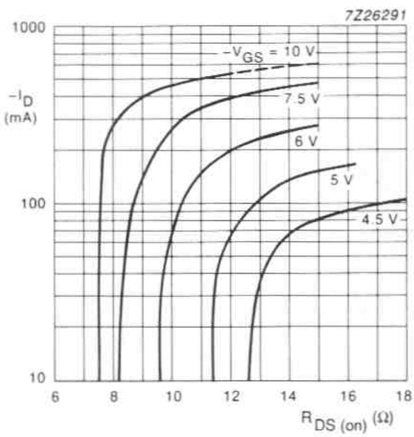


Fig.4 ON-resistance as a function of drain current; T_j = 25 °C; typical values.

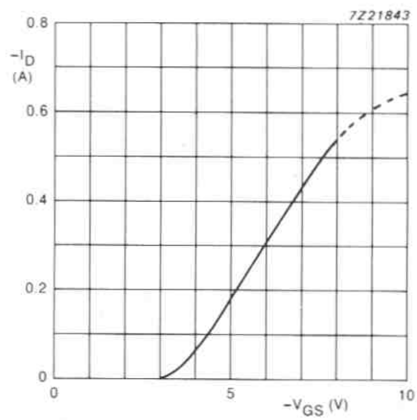


Fig.5 Transfer characteristics; $-V_{DS}$ = 10 V; T_j = 25 °C; typical values.

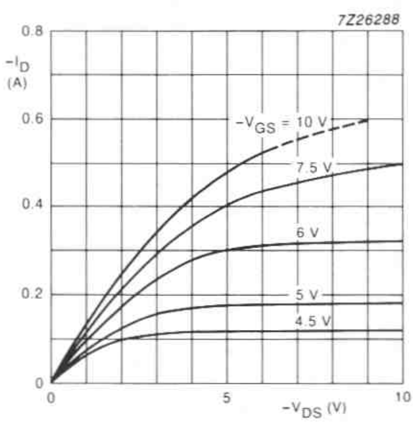


Fig.6 Output characteristics; T_j = 25 °C; typical values.

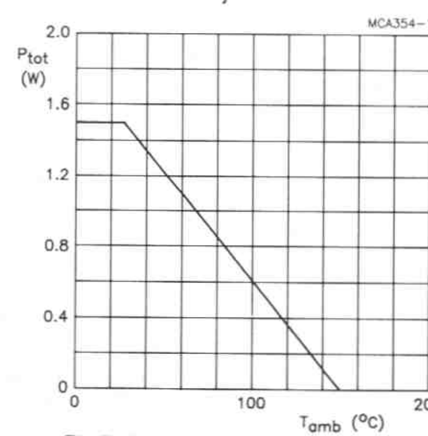


Fig.7 Power derating curve.

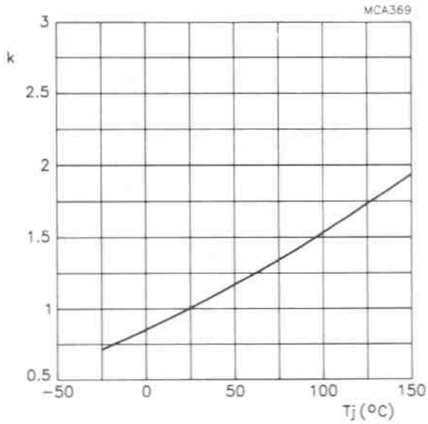


Fig.8 $k = \frac{r_{DS(on)} \text{ at } T_j}{r_{DS(on)} \text{ at } 25\ ^{o}C}$; at −200 mA/−10 V; typical values.

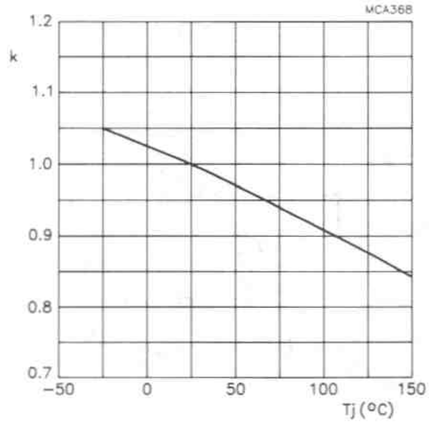


Fig.9 $k = \frac{-V_{GS(th)} \text{ at } T_j}{-V_{GS(th)} \text{ at } 25\ ^{o}C}$; $-V_{GS(th)}$ at −1 mA; typical values.

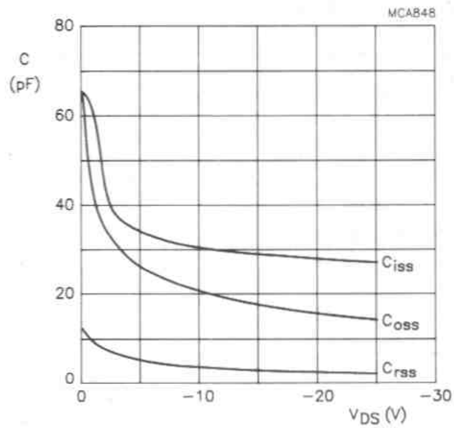


Fig.10 $T_j = 25\ ^{o}C$; $V_{GS} = 0$; f = 1 MHz; typical values.

P-CHANNEL ENHANCEMENT MODE VERTICAL D-MOS TRANSISTOR

P-channel enhancement mode vertical D-MOS transistor in a miniature SOT223 envelope and intended for use in relay, high-speed and line-transformer drivers.

Features

- Very low $r_{DS(on)}$
- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No secondary breakdown

QUICK REFERENCE DATA

Drain-source voltage	$-V_{DS}$	max.	60 V
Drain current (DC)	$-I_D$	max.	350 mA
Drain-source ON-resistance $-I_D$ = 200 mA; $-V_{GS}$ = 10 V	$r_{DS(on)}$	max.	6 Ω
Gate threshold voltage	$-V_{GS(th)}$	max.	3.5 V

MECHANICAL DATA

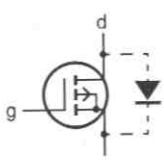
Dimensions in mm

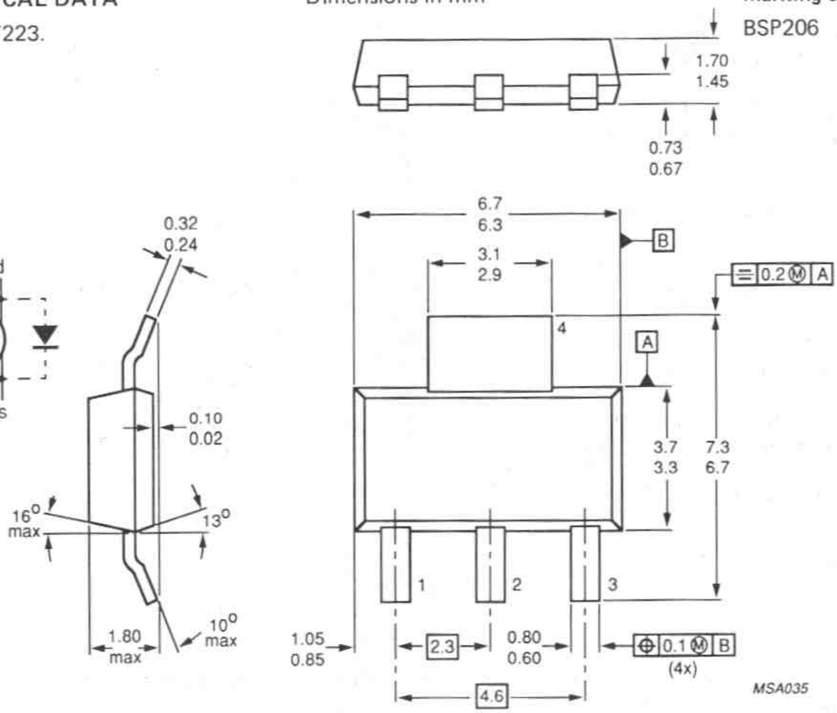
Marking code
BSP206

Fig.1 SOT223.

Pinning:

1 = gate
2 = drain
3 = source
4 = drain





RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	$-V_{DS}$	max.	60 V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20 V
Drain current (DC)	$-I_D$	max.	350 mA
Drain current (peak)	$-I_{DM}$	max.	700 mA
Total power dissipation up to T_{amb} = 25 °C (note 1)	P_{tot}	max.	1.5 W
Storage temperature range	T_{stg}		−65 to + 150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient (note 1)	$R_{th\ j\text{-}a}$	=	83.3 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Drain-source breakdown voltage $-I_D$ = 10 μA; V_{GS} = 0	$-V_{(BR)DSS}$	min.	60 V
Drain-source leakage current $-V_{DS}$ = 48 V; V_{GS} = 0	$-I_{DSS}$	max.	1.0 μA
Gate-source leakage current $\pm V_{GS}$ = 20 V; V_{DS} = 0	$\pm I_{GSS}$	max.	100 nA
Gate threshold voltage $-I_D$ = 1 mA; V_{DS} = V_{GS}	$-V_{GS(th)}$	min. max.	1.5 V 3.5 V
Drain-source ON-resistance $-I_D$ = 200 mA; $-V_{GS}$ = 10 V	$r_{DS(on)}$	typ. max.	4.5 Ω 6 Ω
Transfer admittance $-I_D$ = 200 mA; $-V_{DS}$ = 15 V	$\|Y_{fs}\|$	min. typ.	100 mS 200 mS
Input capacitance at f = 1 MHz; $-V_{DS}$ = 10 V; V_{GS} = 0	C_{iss}	typ. max.	55 pF 70 pF
Output capacitance at f = 1 MHz; $-V_{DS}$ = 10 V; V_{GS} = 0	C_{oss}	typ. max.	30 pF 45 pF
Feedback capacitance at f = 1 MHz; $-V_{DS}$ = 10 V; V_{GS} = 0	C_{rss}	typ. max.	8 pF 12 pF
Switching times (see Figs 2 and 3) $-I_D$ = 200 mA; $-V_{DD}$ = 50 V; $-V_{GS}$ = 0 to 10 V	t_{on}	typ. max.	4 ns 8 ns
	t_{off}	typ. max.	15 ns 25 ns

Note

1. Device mounted on an epoxy printed-circuit board 40 mm x 40 mm x 1.5 mm; mounting pad for the drain lead min. 6 cm^2.

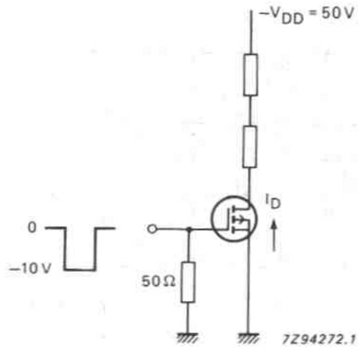


Fig.2 Switching time test circuit.

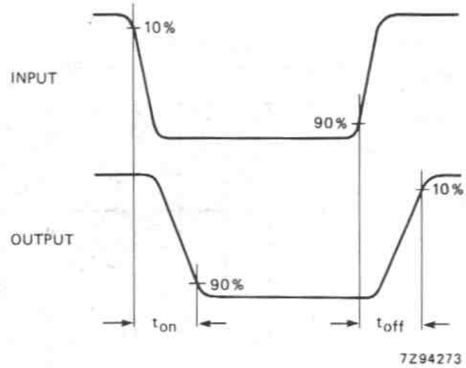


Fig.3 Input and output waveforms.

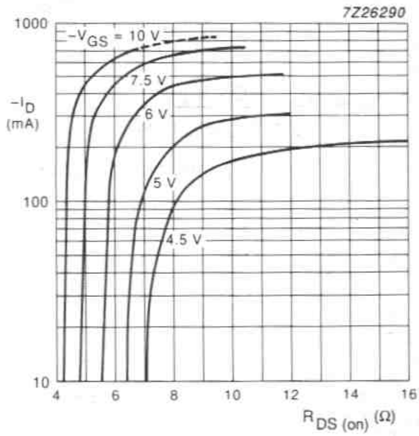


Fig.4 ON-resistance as a function of drain current; T_j = 25 °C; typical values.

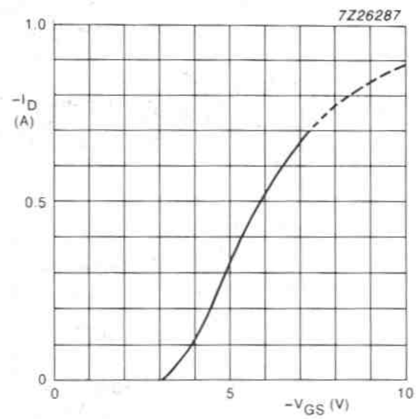


Fig.5 Transfer characteristics; $-V_{DS}$ = 10 V; T_j = 25 °C; typical values.

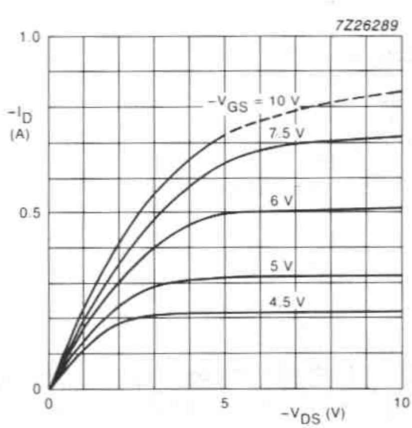


Fig.6 Output characteristics; T_j = 25 °C; typical values.

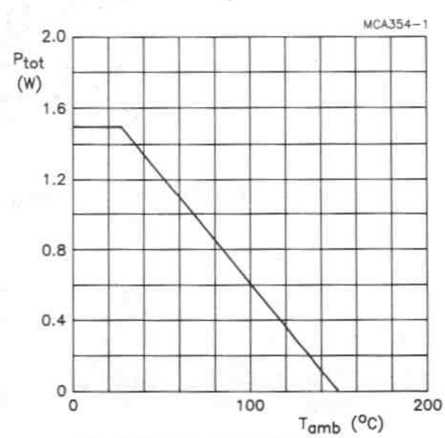


Fig.7 Power derating curve.

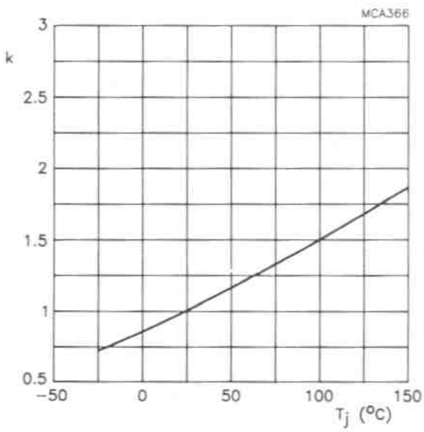


Fig.8 $k = \frac{r_{DS(on)} \text{ at } T_j}{r_{DS(on)} \text{ at } 25\ ^oC}$; at −200 mA/−10V;

typical values.

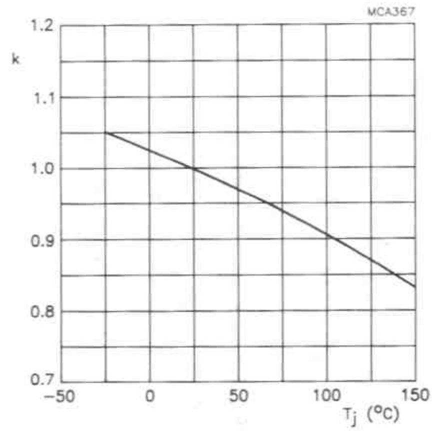


Fig.9 $k = \frac{-V_{GS(th)} \text{ at } T_j}{-V_{GS(th)} \text{ at } 25\ ^oC}$;

$-V_{GS(th)}$ at −1 mA; typical values.

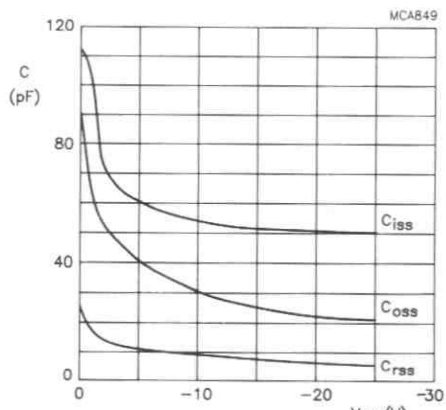


Fig.10 T_j = 25 °C; V_{GS} = 0; f = 1 MHz; typical values.

Philips Components

Data sheet	
status	Product specification
date of issue	April 1991

BSP220

P-channel enhancement mode vertical D-MOS transistor

FEATURES

- Low $R_{DS(on)}$
- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No secondary breakdown.

DESCRIPTION

P-channel enhancement mode vertical D-MOS transistor in a miniature SOT223 envelope and intended for use in relay, high-speed and line transformer drivers.

PINNING - SOT223

PIN	DESCRIPTION
1	gate
2	drain
3	source
4	drain

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$-V_{DS}$	drain-source voltage		200	V
$-I_D$	drain current	DC value	225	mA
$R_{DS(on)}$	drain-source on-resistance	$-I_D$ = 200 mA $-V_{GS}$ = 10 V	12	Ω
$-V_{GS(th)}$	gate-source threshold voltage		2.8	V

PIN CONFIGURATION

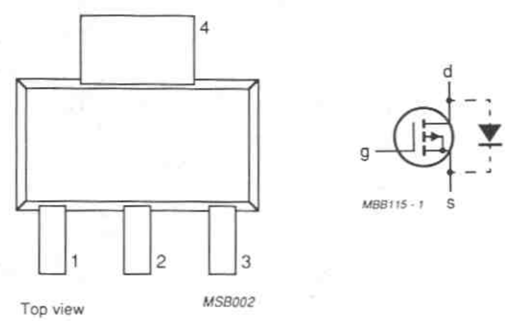


Fig.1 Simplified outline and symbol.

P-channel enhancement mode vertical D-MOS transistor

BSP220

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$-V_{DS}$	drain-source voltage		–	200	V
$\pm V_{GSO}$	gate-source voltage	open drain	–	20	V
$-I_D$	drain current	DC value	–	225	mA
$-I_{DM}$	drain current	peak value	–	600	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C (note 1)	–	1.5	W
T_{stg}	storage temperature range		–65	150	°C
T_j	junction temperature		–	150	°C

Note

1. Device mounted on an epoxy printed-circuit board 40 x 40 x 1.5 mm; mounting pad for the drain lead minimum 6 cm^2.

THERMAL RESISTANCE

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}a}$	from junction to ambient (note 1)	83.3	K/W

Note

1. Device mounted on an epoxy printed-circuit board 40 x 40 x 1.5 mm; mounting pad for the drain lead minimum 6 cm^2.

P-channel enhancement mode vertical D-MOS transistor

BSP220

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$-V_{(BR)DSS}$	drain-source breakdown voltage	$-I_D$ = 10 µA V_{GS} = 0	200	–	–	V
$-I_{DSS}$	drain-source leakage current	$-V_{DS}$ = 160 V V_{GS} = 0	–	–	1	µA
$\pm I_{GSS}$	gate-source leakage current	$\pm V_{GS}$ = 20 V V_{DS} = 0	–	–	100	nA
$-V_{GS(th)}$	gate-source threshold voltage	$-I_D$ = 1 mA V_{GS} = V_{DS}	0.8	–	2.8	V
$R_{DS(on)}$	drain-source on-resistance	$-I_D$ = 200 mA $-V_{GS}$ = 10 V	–	10	12	Ω
$\lvert Y_{fs} \rvert$	transfer admittance	$-I_D$ = 200 mA $-V_{DS}$ = 25 V	100	200	–	mS
C_{iss}	input capacitance	$-V_{DS}$ = 25 V V_{GS} = 0 f = 1 MHz	–	65	90	pF
C_{oss}	output capacitance	$-V_{DS}$ = 25 V V_{GS} = 0 f = 1 MHz	–	20	30	pF
C_{rss}	feedback capacitance	$-V_{DS}$ = 25 V V_{GS} = 0 f = 1 MHz	–	6	15	pF
Switching times (see Figs 2 and 3)						
t_{on}	turn-on time	$-I_D$ = 250 mA $-V_{DD}$ = 50 V $-V_{GS}$ = 0 to 10 V	–	5	20	ns
t_{off}	turn-off time	$-I_D$ = 250 mA $-V_{DD}$ = 50 V $-V_{GS}$ = 0 to 10 V	–	20	30	ns

P-channel enhancement mode vertical D-MOS transistor

BSP220

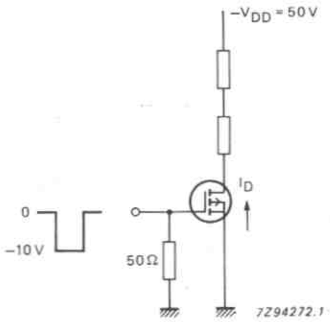


Fig.2 Switching time test circuit.

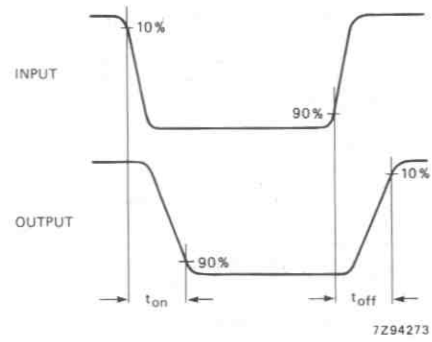


Fig.3 Input and output waveforms.

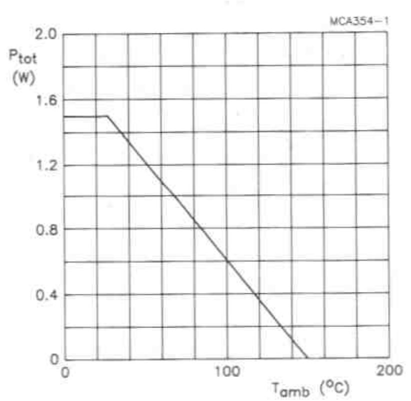


Fig.4 Power derating curve.

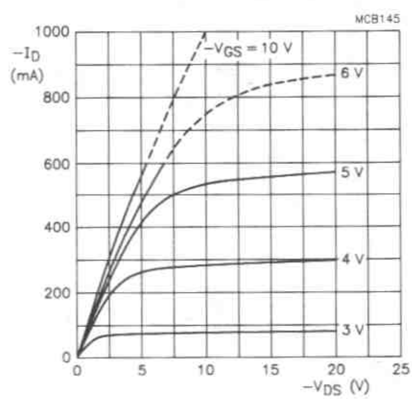


Fig.5 Typical output characteristics; T_j = 25 °C.

P-channel enhancement mode vertical D-MOS transistor

BSP220

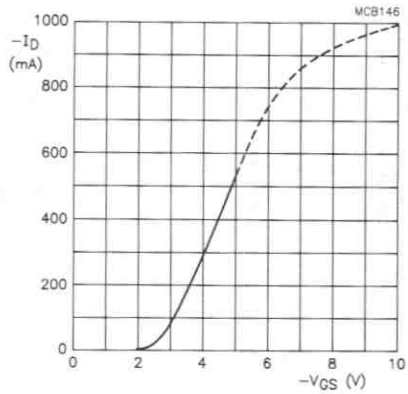


Fig.6 Typical transfer characteristic; $-V_{DS} = 10$ V; $T_j = 25$ °C.

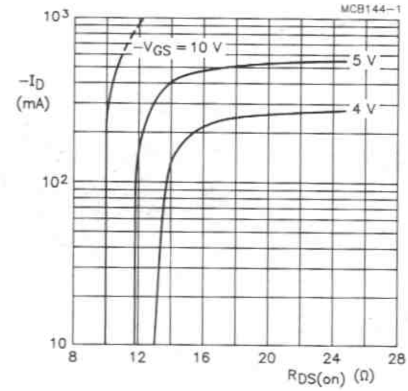


Fig.7 Typical on-resistance as a function of drain current; $T_j = 25$ °C.

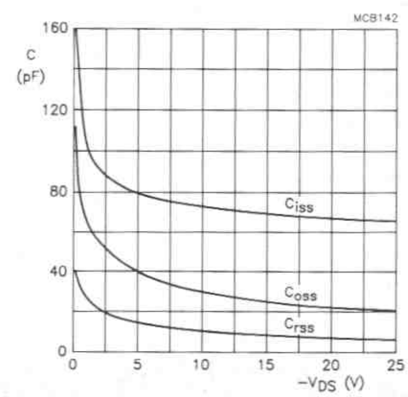


Fig.8 Typical capacitances as a function of drain-source voltage; $V_{GS} = 0$; f = 1 MHz; $T_j = 25$ °C.

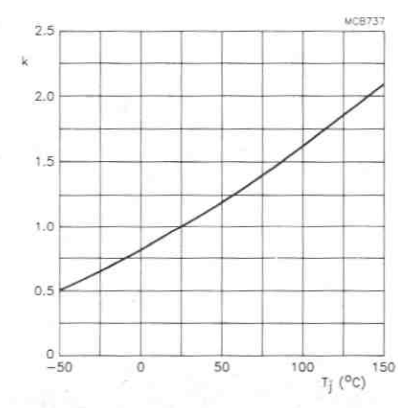


Fig.9 Temperature coefficent of drain-source on-resistance; $k = \frac{R_{DS(on)} \text{ at } T_j}{R_{DS(on)} \text{ at } 25\ °C}$; typical $R_{DS(on)}$ at −200 mA/−10 V.

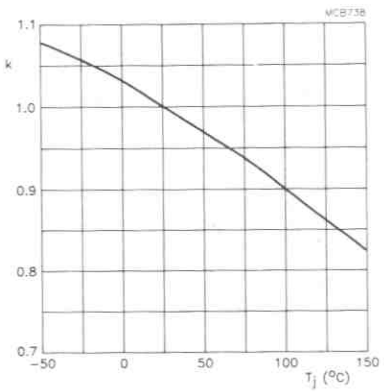
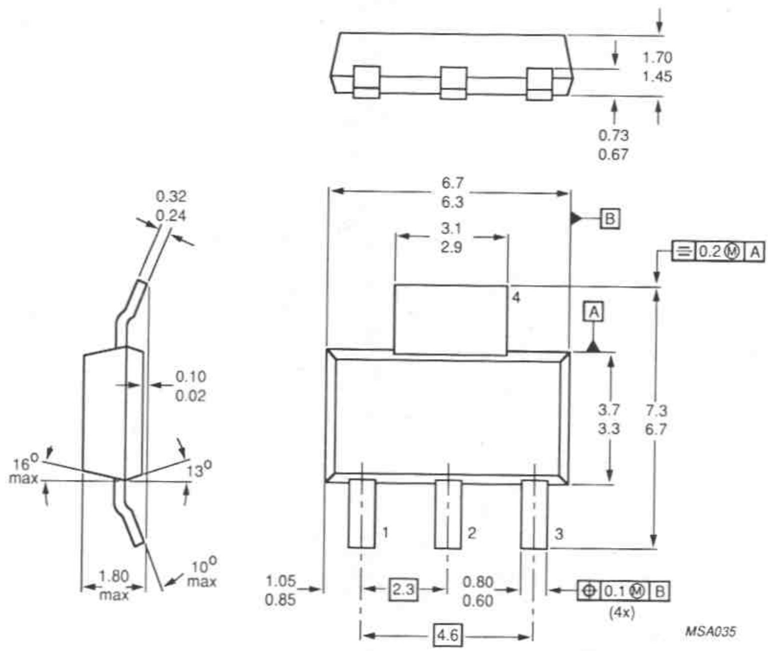


Fig.10 Temperature coefficient of gate-source threshold voltage; $k = \frac{V_{GS(th)} \text{ at } T_j}{V_{GS(th)} \text{ at } 25\ ^\circ C}$; typical $-V_{GS(th)}$ at −1 mA.

PACKAGE OUTLINE



Dimensions in mm.

Marking code: BSP220.

Fig.11 SOT223.

Philips Components

Data sheet	
status	Product specification
date of issue	November 1990

BSP225

P-channel enhancement mode vertical D-MOS transistor

FEATURES

- Low $R_{DS(on)}$
- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No secondary breakdown.

DESCRIPTION

P-channel enhancement mode vertical D-MOS transistor in a miniature SOT223 envelope, intended for use in relay, high-speed and line transformer drivers.

PINNING - SOT223

PIN	DESCRIPTION
1	gate
2	drain
3	source
4	drain

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$-V_{DS}$	drain-source voltage		250	V
$-I_D$	drain current	DC value	225	mA
$R_{DS(on)}$	drain-source on-resistance	$-I_D$ = 200 mA $-V_{GS}$ = 10 V	15	Ω
$-V_{GS(th)}$	gate-source threshold voltage	$-I_D$ = 1 mA $V_{GS} = V_{DS}$	2.8	V

PIN CONFIGURATION

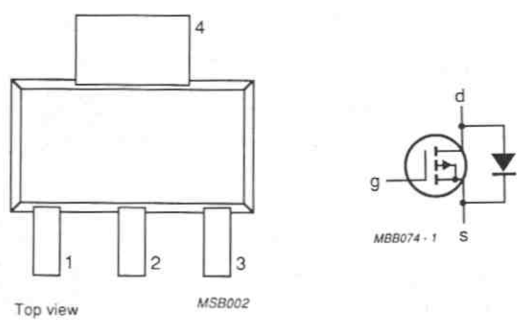


Fig.1 Simplified outline and symbol.

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$-V_{DS}$	drain-source voltage		–	250	V
$\pm V_{GSO}$	gate-source voltage	open drain	–	20	V
$-I_D$	drain current	DC value	–	225	mA
$-I_{DM}$	drain current	peak value	–	600	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C (note 1)	–	1.5	W
T_{stg}	storage temperature range		–65	150	°C
T_j	junction temperature		–	150	°C

Note

1. Device mounted on an epoxy printed-circuit board, 40 x 40 x 1.5 mm, mounting pad for the drain lead minimum 6 cm^2.

THERMAL RESISTANCE

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}a}$	from junction to ambient (note 1)	83.3	K/W

Note

1. Device mounted on an epoxy printed-circuit board, 40 x 40 x 1.5 mm, mounting pad for the drain lead minimum 6 cm^2.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$-V_{(BR)DSS}$	drain-source breakdown voltage	$-I_D$ = 10 μA V_{GS} = 0	250	–	–	V
$-I_{DSS}$	drain-source leakage current	$-V_{DS}$ = 200 V V_{GS} = 0	–	–	1	μA
$\pm I_{GSS}$	gate-source leakage current	V_{DS} = 0 $\pm V_{GS}$ = 20 V	–	–	100	nA
$-V_{GS(th)}$	gate-source threshold voltage	$-I_D$ = 1 mA $V_{GS} = V_{DS}$	0.8	–	2.8	V
$R_{DS(on)}$	drain-source on-resistance	$-I_D$ = 200 mA $-V_{GS}$ = 10 V	–	10	15	Ω
$\lvert y_{fs} \rvert$	transfer admittance	$-I_D$ = 200 mA $-V_{DS}$ = 25 V	100	200	–	mS
C_{iss}	input capacitance	$-V_{DS}$ = 25 V $-V_{GS}$ = 0 f = 1 MHz	–	65	90	pF
C_{oss}	output capacitance	$-V_{DS}$ = 25 V $-V_{GS}$ = 0 f = 1 MHz	–	20	30	pF
C_{rss}	feedback capacitance	$-V_{DS}$ = 25 V $-V_{GS}$ = 0 f = 1 MHz	–	6	15	pF
Switching times (see Figs 2 and 3)						
t_{on}	turn-on time	$-I_D$ = 250 mA $-V_{DD}$ = 50 V $-V_{GS}$ = 0 to 10 V	–	5	10	ns
t_{off}	turn-off time	$-I_D$ = 250 mA $-V_{DD}$ = 50 V $-V_{GS}$ = 0 to 10 V	–	20	30	ns

P-channel enhancement mode vertical D-MOS transistor

BSP225

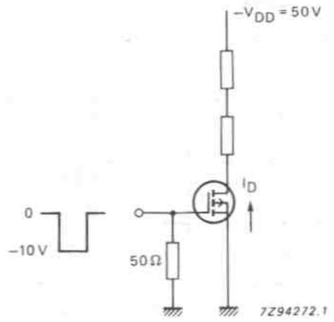


Fig.2 Switching time test circuit.

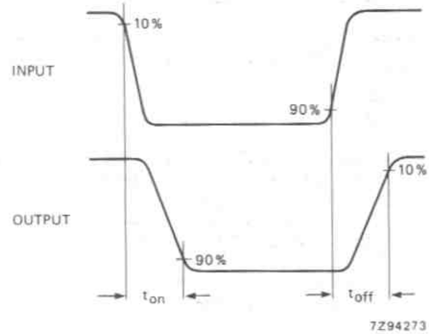


Fig.3 Input and output waveforms.

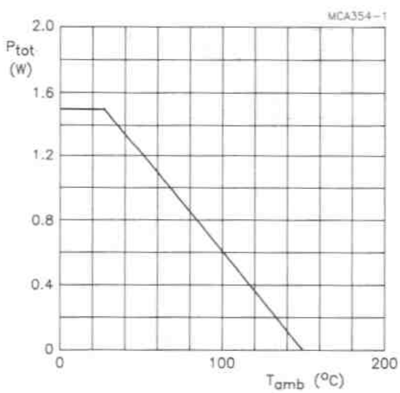


Fig.4 Power derating curve.

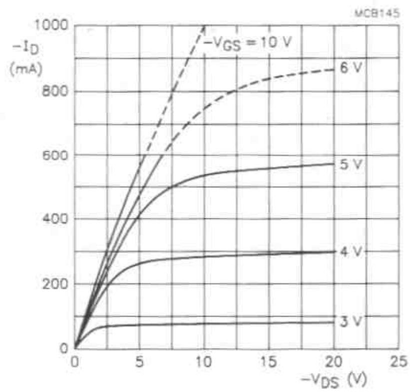


Fig.5 Typical output characteristics; T_j = 25 °C.

P-channel enhancement mode vertical D-MOS transistor

BSP225

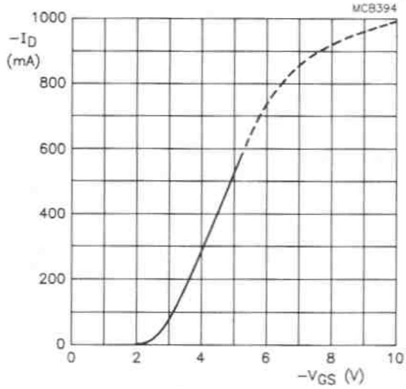


Fig.6 Typical transfer characteristic; $-V_{DS}$ = 10 V; T_j = 25 °C.

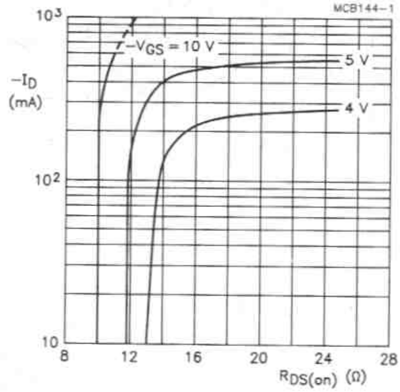


Fig.7 Typical on-resistance as a function of drain current; T_j = 25 °C; $R_{DS(on)} = f(I_D)$.

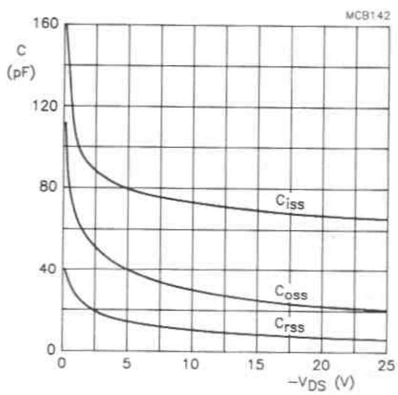


Fig.8 Typical capacitances as a function of drain-source voltage; V_{GS} = 0; f = 1 MHz; T_j = 25 °C.

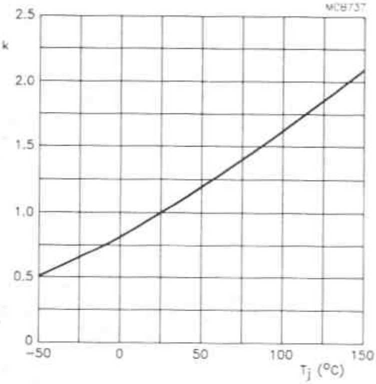


Fig.9 Temperature coefficient of drain-source on-resistance; $k = \frac{R_{DS(on)} \text{ at } T_j}{R_{DS(on)} \text{ at } 25\ °C}$; typical $R_{DS(on)}$ at −200 mA/−10 V.

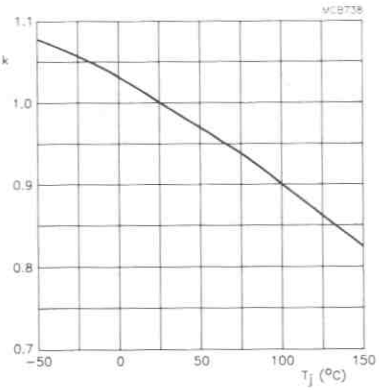
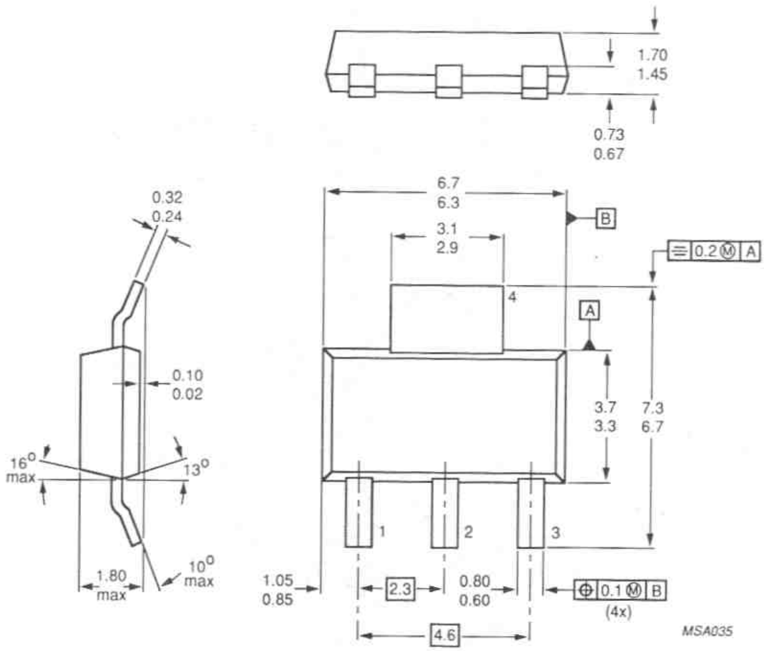


Fig.10 Temperature coefficient of gate-source threshold voltage; $k = \frac{-V_{GS(th)} \ at \ T_j}{-V_{GS(th)} \ at \ 25 \ °C}$; typical $V_{GS(th)}$ at −1 mA.

PACKAGE OUTLINE



Dimensions in mm.

Marking code: BSP225.

Fig.11 SOT223.

SILICON LOW-POWER SWITCHING TRANSISTORS

P-N-P silicon transistor in a microminiature plastic envelope. It is intended for high-speed, saturated switching applications for industrial service in thick and thin-film circuits.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	15	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	15	V
Collector current (peak value)	$-I_{CM}$	max.	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	mW
Junction temperature	T_j	max.	150	°C
D.C. current gain				
$-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}	>	30	
$-I_C$ = 50 mA; $-V_{CE}$ = 1 V	h_{FE}		30 to 120	
Transition frequency at f = 500 MHz				
$-I_C$ = 50 mA; $-V_{CE}$ = 10 V	f_T	>	1,5	GHz
Turn-off time				
$-I_{Con}$ = 30 mA; $-I_{Bon}$ = $+I_{Boff}$ = 3,0 mA	t_{off}	<	30	ns

MECHANICAL DATA

Dimensions in mm

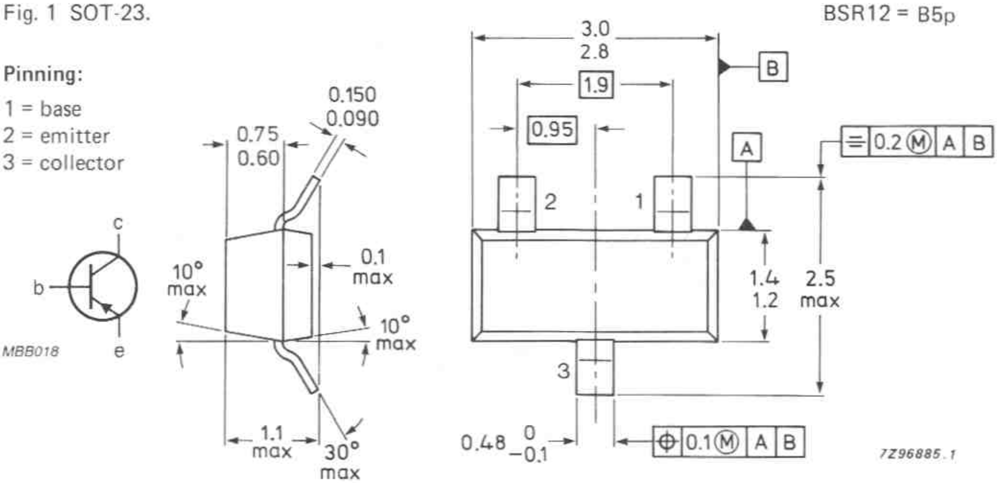
Marking code

Fig. 1 SOT-23.

BSR12 = B5p

Pinning:

1 = base
2 = emitter
3 = collector



TOP VIEW

Reverse pinning types are available on request.

See also *Soldering recommendations.*

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	15 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	15 V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	3 V
Collector current (d.c.)	$-I_C$	max.	100 mA
Collector current (peak value)	$-I_{CM}$	max.	200 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250 mW
Storage temperature	T_{stg}	−65 to + 150 °C	
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	500 K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0$; $-V_{CB} = 10$ V	$-I_{CBO}$	<	50 nA
$I_E = 0$; $-V_{CB} = 10$ V; $T_{amb} = 125$ °C	$-I_{CBO}$	<	5 μA
$V_{BE} = 0$; $-V_{CE} = 10$ V	$-I_{CES}$	<	50 nA
Breakdown voltages			
$I_E = 0$; $-I_C = 10$ μA	$-V_{(BR)CBO}$	>	15 V
$V_{BE} = 0$; $-I_C = 10$ μA	$-V_{(BR)CES}$	>	15 V
$I_C = 0$; $-I_E = 100$ μA	$-V_{(BR)EBO}$	>	3 V
Collector-emitter sustaining voltage			
$I_B = 0$; $-I_C = 10$ mA	$-V_{CEOsust}$	>	15 V
Saturation voltages**			
$-I_C = 10$ mA; $-I_B = 1$ mA	$-V_{CEsat}$	<	130 mV
	$-V_{BEsat}$		725 to 920 mV
$-I_C = 50$ mA; $-I_B = 5$ mA	$-V_{CEsat}$	typ.	180 mV
		<	270 mV
	$-V_{BEsat}$		800 to 1150 mV
$-I_C = 100$ mA; $-I_B = 10$ mA	$-V_{CEsat}$	<	450 mV
	$-V_{BEsat}$		900 to 1500 mV

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

** Measured under pulse conditions; t_p = 300 μs; δ = 0,01.

D.C. current gain *

$-I_C$ = 1 mA; $-V_{CE}$ = 1 V	h_{FE}	>	30
$-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}	>	30
$-I_C$ = 50 mA; $-V_{CE}$ = 1 V	h_{FE}		30 to 120
$-I_C$ = 50 mA; $-V_{CE}$ = 1 V; T_{amb} = 55 °C	h_{FE}	>	30
$-I_C$ = 100 mA; $-V_{CE}$ = 1 V	h_{FE}	>	20
Transition frequency at f = 500 MHz			
$-I_C$ = 50 mA; $-V_{CE}$ = 10 V	f_T	>	1,5 GHz
Collector capacitance			
$I_E = I_e = 0$; $-V_{CB}$ = 5 V	C_c	<	4,5 pF
Emitter capacitance			
$I_C = I_c = 0$; $-V_{EB}$ = 0,5 V	C_e	<	6,0 pF
Switching times			
Turn-on time	t_{on}	<	20 ns
Turn-off time	t_{off}	<	30 ns

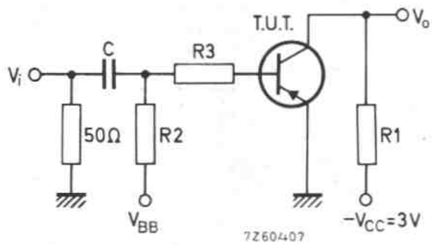


Fig. 2 Test circuit switching times.

Pulse generator

Pulse duration	t_p	= 400 ns
Rise time	t_r	< 1 ns
Output impedance	Z_o	= 50 Ω

Sampling scope

Rise time	t_r	< 1 ns
Input impedance	Z_i	= 100 kΩ

	V_i V	V_{BB} V	R1 Ω	R2 kΩ	R3 kΩ	$-I_{Con}$ mA	$-I_{Bon}$ mA	I_{Boff} mA	C μF
t_{on}	−6,85	0	94	1,0	2,0	30	3,0	–	0,1
t_{off}	11,7	−9,85	94	1,0	2,0	30	3,0	3,0	0,1

* Measured under pulse conditions; t_p = 300 μs; δ = 0,01.

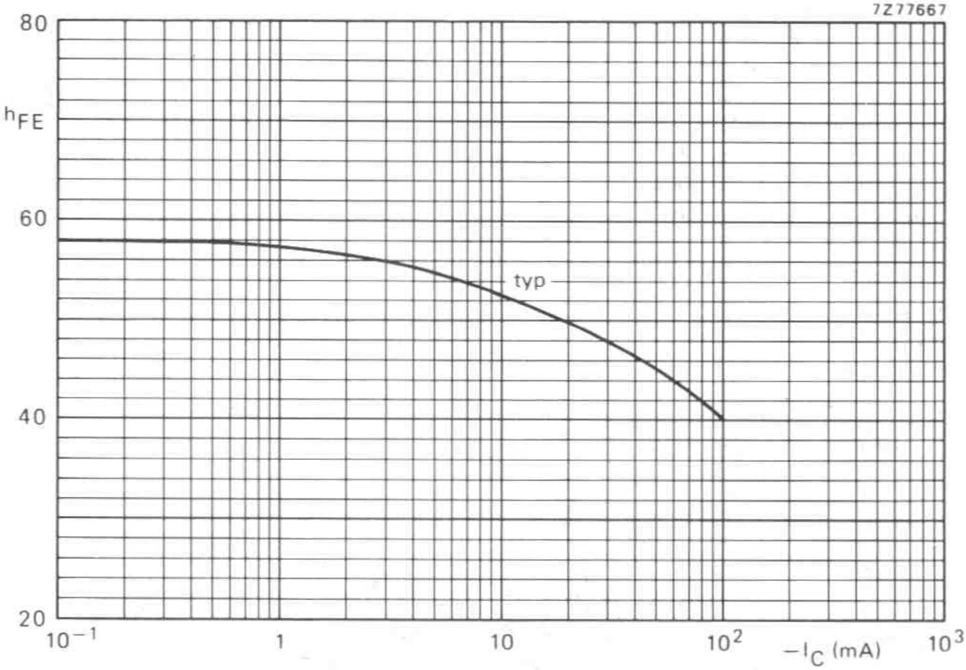


Fig. 3 $-V_{CE}$ = 1 V; T_{amb} = 25 °C.

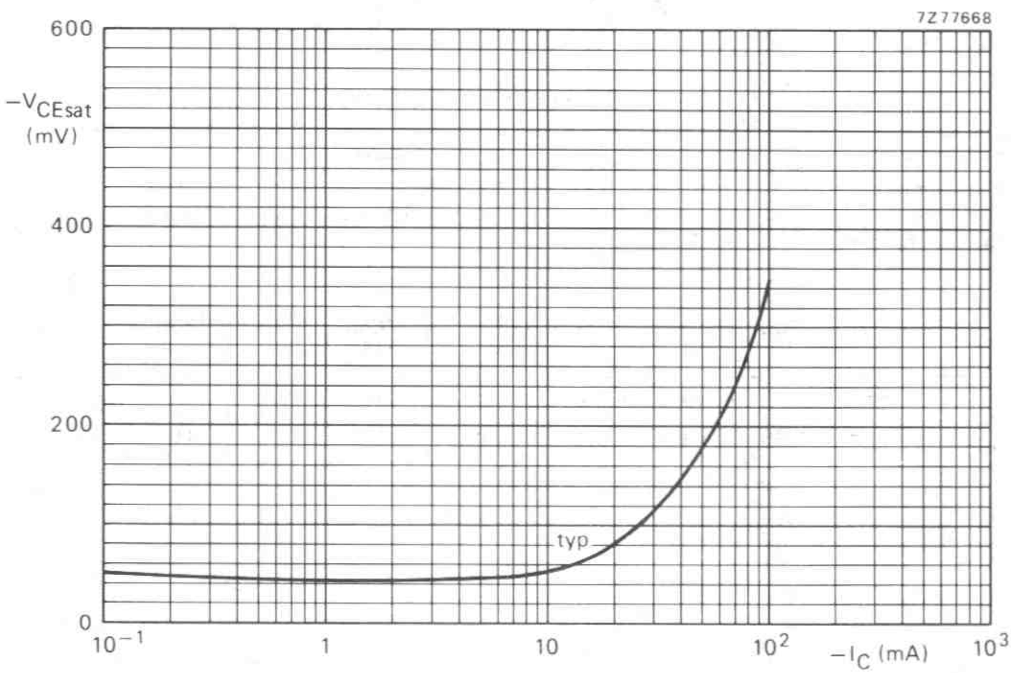


Fig. 4 V_{CEsat} as a function of I_C at I_C/I_B = 10.

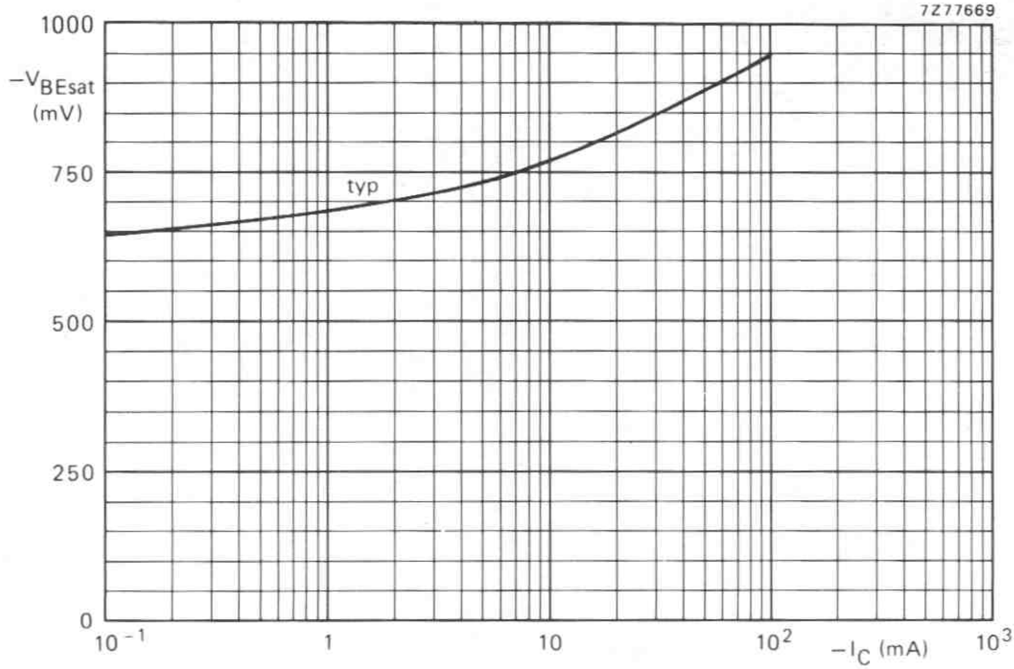


Fig. 5 V_{BEsat} as a function of I_C at $I_C/I_B = 10$.

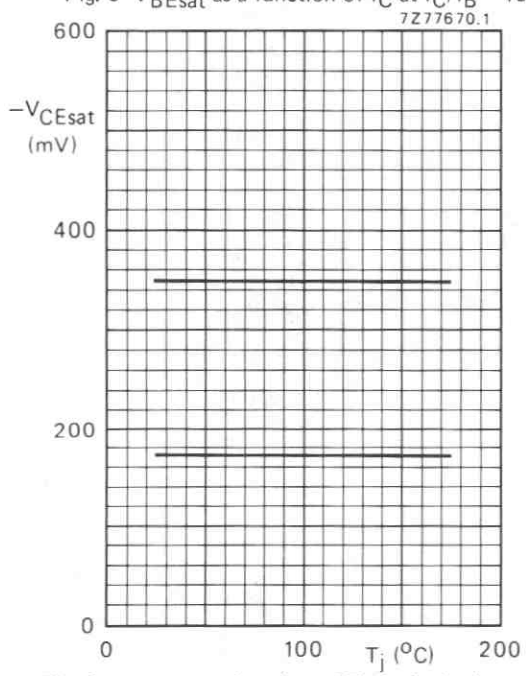


Fig. 6 V_{CEsat} as a function of T_j; typical values.

Upper graph at I_C = 100 mA; I_B = 10 mA. Lower graph at I_C = 50 mA and I_B = 5 mA.

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N silicon transistors, in a microminiature plastic envelope intended for switching and linear applications in thick and thin-film circuits.

QUICK REFERENCE DATA

			BSR13	BSR14	
Collector-base voltage (open emitter)	V_{CBO}	max.	60	75	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	40	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	6	V
Collector current (d.c.)	I_C	max.	800		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Junction temperature	T_j	max.	150		°C
D.C. current gain					
I_C = 150 mA; V_{CE} = 10 V	h_{FE}		100 to 300		
I_C = 500 mA; V_{CE} = 10 V	h_{FE}	>	30	40	
Transition frequency at f = 100 MHz					
I_C = 20 mA; V_{CE} = 20 V	f_T	>	250	300	MHz

MECHANICAL DATA

Dimensions in mm

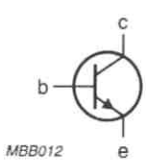
Fig. 1 SOT-23.

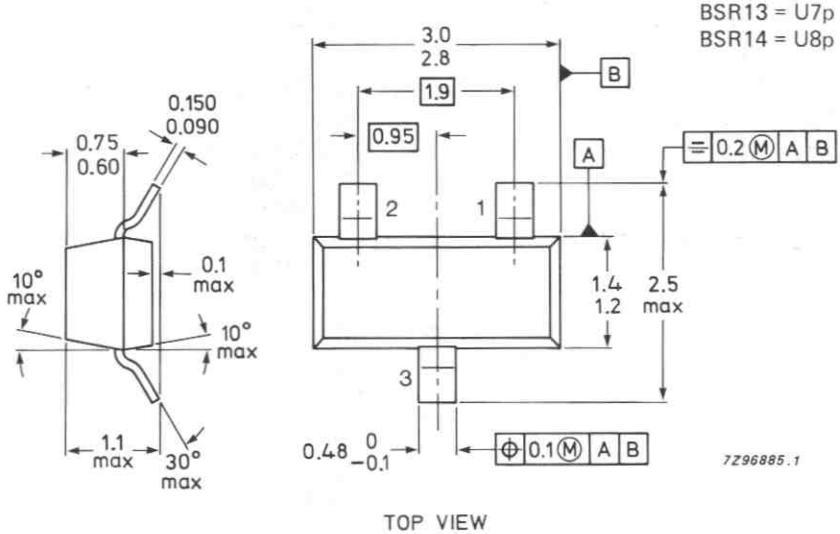
Marking code

BSR13 = U7p
BSR14 = U8p

Pinning:

1 = base
2 = emitter
3 = collector





Reverse pinning types are available on request.

See also Soldering recommendations.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BSR13	BSR14	
Collector-base voltage (open emitter)	V_{CBO}	max.	60	75	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	40	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	6	V
Collector current (d.c.)	I_C	max.	800		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Storage temperature	T_{stg}		−65 to + 150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	500	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BSR13	BSR14	
Collector cut-off current					
I_E = 0; V_{CB} = 50 V	I_{CBO}	<	30	−	nA
I_E = 0; V_{CB} = 60 V	I_{CBO}	<	−	10	nA
I_E = 0; V_{CB} = 50 V; T_j = 150 °C	I_{CBO}	<	10	−	μA
I_E = 0; V_{CB} = 60 V; T_j = 150 °C	I_{CBO}	<	−	10	μA
V_{EB} = 3 V; V_{CE} = 60 V	I_{CEX}	<	−	10	nA
Base current with reverse biased emitter junction V_{EB} = 3 V; V_{CE} = 60 V	I_{BEX}	<	−	20	nA
Emitter cut-off current I_C = 0; V_{EB} = 3 V	I_{EBO}	<	30	15	nA
Saturation voltages					
I_C = 150 mA; I_B = 15 mA	V_{CEsat}	<	400	300	mV
	V_{BEsat}	<	1300	−	mV
	V_{BEsat}		−	0,6 to 1,2	V
I_C = 500 mA; I_B = 50 mA	V_{CEsat}	<	1600	1000	mV
	V_{BEsat}	<	2600	2000	mV

* Device mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

D.C. current gain *				
$I_C = 0{,}1$ mA; $V_{CE} = 10$ V		h_{FE}	> 35	
$I_C = 1$ mA; $V_{CE} = 10$ V		h_{FE}	> 50	
$I_C = 10$ mA; $V_{CE} = 10$ V		h_{FE}	> 75	
$I_C = 150$ mA; $V_{CE} = 10$ V		h_{FE}	100 to 300	
$I_C = 150$ mA; $V_{CE} = 1$ V		h_{FE}	> 50	
$I_C = 500$ mA; $V_{CE} = 10$ V	BSR13; R	h_{FE}	> 30	
$I_C = 500$ mA; $V_{CE} = 10$ V	BSR14; R	h_{FE}	> 40	
Transition frequency at f = 100 MHz				
$I_C = 20$ mA; $V_{CE} = 20$ V	BSR13; R	f_T	> 250	MHz
$I_C = 20$ mA; $V_{CE} = 20$ V	BSR14; R	f_T	> 300	MHz
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 10$ V		C_c	< 8	pF
h parameters (common emitter) at f = 1 kHz				
$I_C = 1$ mA; $V_{CE} = 10$ V			BSR14	
input impedance		h_{ie}	2 to 8	kΩ
reverse voltage transfer ratio		h_{re}	< 8.10^{-4}	
small signal current gain		h_{fe}	50 to 300	
output admittance		h_{oe}	5 to 35	μS
$I_C = 10$ mA; $V_{CE} = 10$ V			BSR13	
input impedance		h_{ie}	0,25 to 1,25	kΩ
reverse voltage transfer ratio		h_{re}	< 4.10^{-4}	
small signal current gain		h_{fe}	75 to 375	
output admittance		h_{oe}	25 to 200	μS

* Measured under pulsed conditions to avoid excessive dissipation; pulse duration $t_p \leq 300$ μs; duty factor $\delta \leq 0{,}02$.

Switching times (between 10% and 90% levels)

		BSR14		
Turn-on time switched to I_C = 150 mA (see Fig. 2)				
delay time	t_d	<	10	ns
rise time	t_r	<	25	ns
Turn-off time switched from I_C = 150 mA (see Fig. 3)				
storage time	t_s	<	225	ns
fall time	t_f	<	60	ns

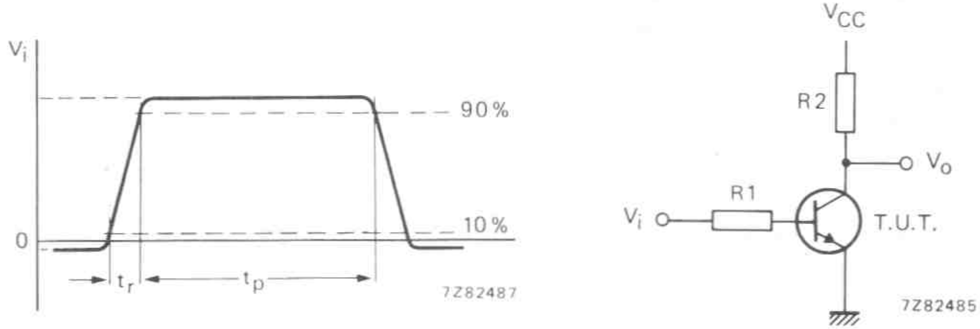


Fig. 2 Waveform and test circuit delay and rise time.

V_i = −0,5 to + 9,9 V; V_{CC} = 30 V; R1 = 619 Ω; R2 = 200 Ω.

Pulse generator:				Oscilloscope:			
pulse duration	t_p	⩽	200 ns	input impedance	Z_i	>	100 kΩ
rise time	t_r	⩽	2 ns	input capacitance	C_i	<	12 pF
duty factor	δ	=	2 %	rise time	t_r	<	5 ns

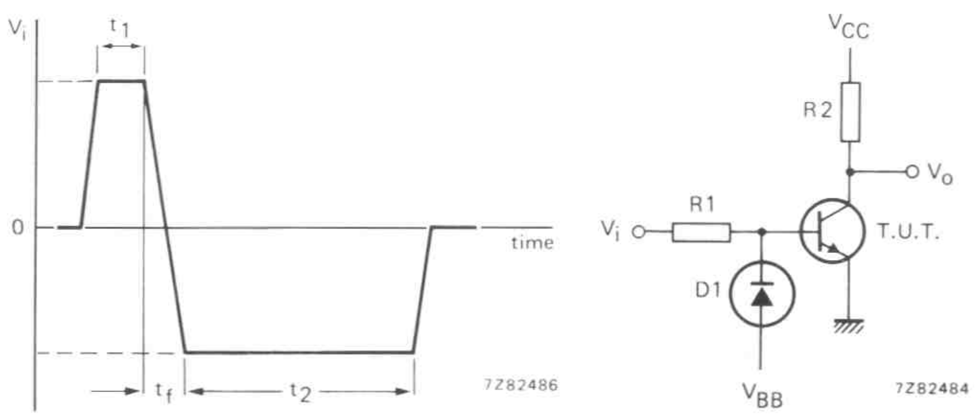


Fig. 3 Waveform and test circuit storage and fall time.

V_i = −13,8 to + 16,2 V; V_{CC} = 30 V; $-V_{BB}$ = 3 V; R1 = 1 kΩ; R2 = 200 Ω.

Pulse generator:				Oscilloscope:			
fall time	t_f	<	5 ns	input impedance	Z_i	>	100 kΩ
pulse time	t_1	=	100 μs	input capacitance	C_i	<	12 pF
	t_2	=	500 μs	rise time	t_r	<	5 ns

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P silicon transistors, in a microminiature plastic envelope, intended for medium power switching and general purpose amplifier applications in thick and thin-film circuits.

QUICK REFERENCE DATA

			BSR15	BSR16	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60	60	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40	60	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5		V
Collector current (d.c.)	$-I_C$	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Junction temperature	T_j	max.	150		°C
D.C. current gain $-I_C$ = 500 mA; $-V_{CE}$ = 10 V	h_{FE}	>	30	50	
Turn-off switching time $-I_{Con}$ = 150 mA; $-I_{Bon}$ = I_{Boff} = 15 mA	t_{off}	>	100		ns
Transition frequency at f = 100 MHz $-I_C$ = 50 mA; $-V_{CE}$ = 20 V	f_T	>	200		MHz

MECHANICAL DATA

Fig. 1 SOT-23.

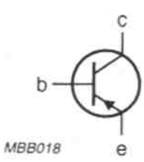
Dimensions in mm

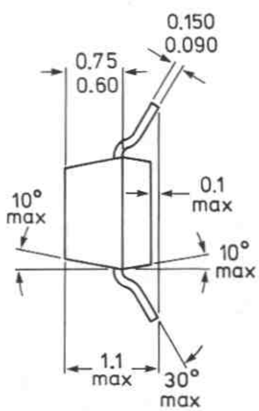
Marking code

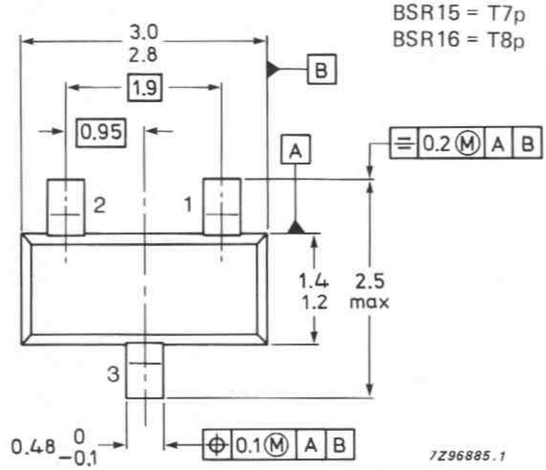
BSR15 = T7p
BSR16 = T8p

Pinning:

1 = base
2 = emitter
3 = collector







TOP VIEW

Reverse pinning types are available on request.

See also Soldering recommendations.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BSR15	BSR16	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60	60	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40	60	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	V
Collector current (d.c.)	$-I_C$	max.	600		mA
Power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Storage temperature	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	500	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BSR15	BSR16	
Collector cut-off current					
$I_E = 0$; $-V_{CB} = 50$ V	$-I_{CBO}$	<	20	10	nA
$I_E = 0$; $-V_{CB} = 50$ V; $T_j = 150$ °C	$-I_{CBO}$	<	20	10	μA
$-V_{EB} = 0,5$ V; $-V_{CE} = 30$ V	$-I_{CEX}$	<	50		nA
Base current with reverse biased emitter junction					
$-V_{EB} = 3$ V; $-V_{CE} = 30$ V	$-I_{BEX}$	<	50		nA
Saturation voltages					
$-I_C = 150$ mA; $-I_B = 15$ mA	$-V_{CEsat}$	<	0,4		V
	$-V_{BEsat}$	<	1,3		V
$-I_C = 500$ mA; $-I_B = 50$ mA	$-V_{CEsat}$	<	1,6		V
	$-V_{BEsat}$	<	2,6		V

* Device mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.

			BSR15	BSR16	
D.C. current gain *					
$-I_C$ = 0,1 mA; $-V_{CE}$ = 10 V	h_{FE}	>	35	75	
$-I_C$ = 1 mA; $-V_{CE}$ = 10 V	h_{FE}	>	50	100	
$-I_C$ = 10 mA; $-V_{CE}$ = 10 V	h_{FE}	>	75	100	
$-I_C$ = 150 mA; $-V_{CE}$ = 10 V	h_{FE}		100 to 300		
$-I_C$ = 500 mA; $-V_{CE}$ = 10 V	h_{FE}	>	30	50	
Transition frequency at f = 100 MHz					
$-I_C$ = 50 mA; $-V_{CE}$ = 20 V; T_{amb} = 25 °C	f_T	>	200		MHz
Collector capacitance at f = 1 MHz					
$I_E = I_e = 0$; $-V_{CB}$ = 10 V	C_c	<	8		pF
Emitter capacitance at f = 1 MHz					
$I_C = I_c = 0$; $-V_{EB}$ = 2 V	C_e	<	30		pF
Switching times (between 10% and 90% levels)					
Turn-on time when switched to					
$-I_C$ = 150 mA; $-I_B$ = 15 mA; (see Fig. 3)					
delay time	t_d	<	10		ns
rise time	t_r	<	40		ns
turn-on time ($t_d + t_r$)	t_{on}	<	45		ns
Turn-off time when switched from					
$-I_C$ = 150 mA; $-I_B$ = 15 mA					
to cut-off with + I_{BM} = 15 mA (see Fig. 4)					
storage time	t_s	<	80		ns
fall time	t_f	<	30		ns
turn-off time ($t_s + t_f$)	t_{off}	<	100		ns

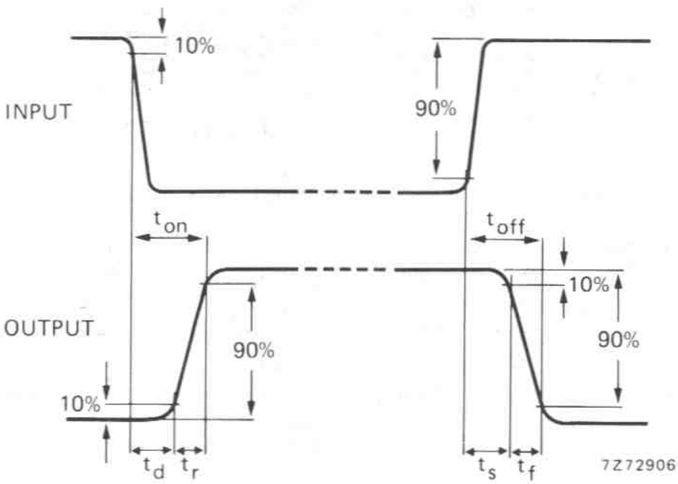


Fig. 2 Switching time waveforms.

* Measured under pulsed conditions to avoid excessive dissipation; pulse duration $t_p \leqslant 300\ \mu s$; duty factor $\delta \leqslant 0{,}02$.

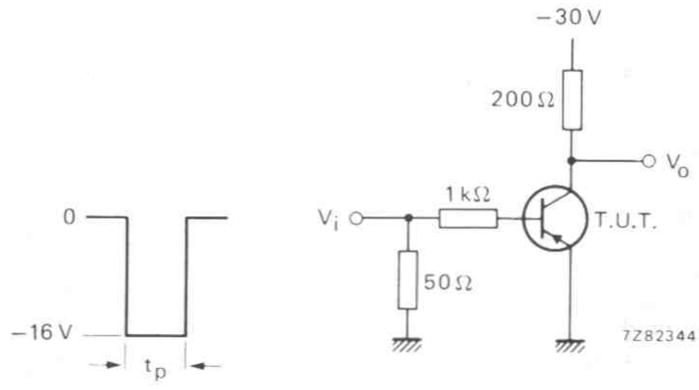


Fig. 3 Turn-on switching time test circuit.

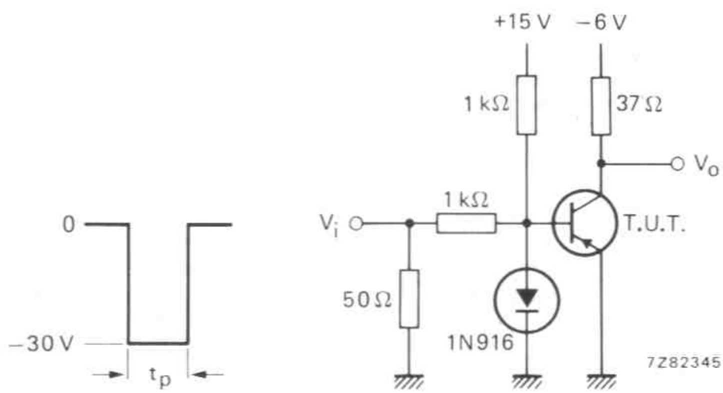


Fig. 4 Turn-off switching time test circuit.

Input pulse generator: Fig. 3 and Fig. 4	frequency	f	=	150	Hz
	pulse duration	t_p	=	200	ns
	rise time	t_r	$\leq$	2	ns
	output impedance	Z_o	=	50	Ω
Output oscilloscope: Fig. 3 and Fig. 4	rise time	t_r	$\leq$	5	ns
	input impedance	Z_i	=	10	MΩ

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N silicon transistor in a microminiature plastic envelope intended for switching and linear applications in thick and thin-film circuits.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	60	V
Collector-emitter voltage (open base)	V_{CEO}	max.	40	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6	V
Collector current (DC)	I_C	max.	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	mW
Junction temperature	T_j	max.	150	°C
DC current gain I_C = 10 mA; V_{CE} = 1 V	h_{FE}	100 to 300		
Transition frequency at f = 500 MHz I_C = 10 mA; V_{CE} = 20 V	f_T	>	300	MHz

MECHANICAL DATA

Dimensions in mm

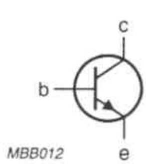
Fig.1 SOT-23.

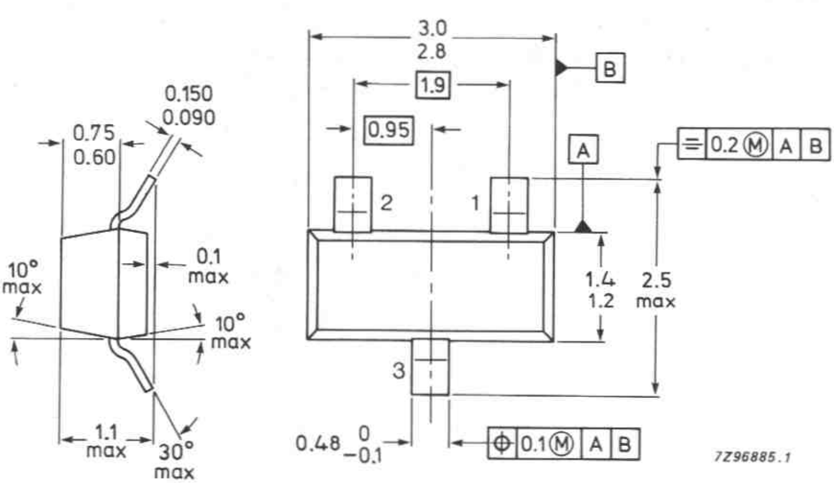
Marking code

BSR17A = U92

Pinning:

1 = base
2 = emitter
3 = collector





TOP VIEW

Reverse pinning types are available on request.

See also *Soldering recommendations.*

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	60 V
Collector-emitter voltage (open base)	V_{CEO}	max.	40 V
Emitter base voltage (open collector)	V_{EBO}	max.	6 V
Collector current (d.c.)	I_C	max.	200 mA
Power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250 mW
Storage temperature	T_{stg}		−65 to +150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	500 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

Collector cut-off current			
$I_E = 0$; V_{CB} = 30 V; T_j = 150 °C	I_{CBO}	<	5 μA
V_{EB} = 3 V; V_{CE} = 30 V	I_{CEX}	<	50 nA
Base current with reverse biased emitter junction			
V_{EB} = 3 V; V_{CE} = 30 V	I_{BEX}	<	50 nA
Saturation voltages *			
I_C = 10 mA; I_B = 1 mA	V_{CEsat}	<	200 mV
	V_{BEsat}		650 to 850 mV
I_C = 50 mA; I_B = 5 mA	V_{CEsat}	<	300 mV
	V_{BEsat}	<	950 mV
Collector capacitance at f = 1 MHz			
$I_E = I_e = 0$; V_{CB} = 5 V	C_c	<	4 pF
Emitter capacitance at f = 1 MHz			
$I_C = I_c = 0$; V_{EB} = 0,5 V	C_e	<	8 pF

* Measured under pulsed conditions; pulse duration $t_p \leqslant 300\ \mu s$; duty factor $\delta \leqslant 0{,}02$.

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

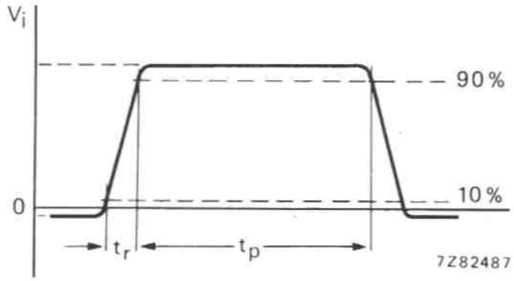
D.C. current gain*			
I_C = 0,1 mA; V_{CE} = 1 V	h_{FE}	>	40
I_C = 1 mA; V_{CE} = 1 V	h_{FE}	>	70
I_C = 10 mA; V_{CE} = 1 V	h_{FE}	> <300	100 300
I_C = 50 mA; V_{CE} = 1 V	h_{FE}	>	60
I_C = 100 mA; V_{CE} = 1 V	h_{FE}	>	30
Transition frequency at f = 100 MHz			
I_C = 10 mA; V_{CE} = 20 V	f_T	>	300 MHz

h-parameters (common emitter)
I_C = 1 mA; V_{CE} = 10 V; f = 1 kHz

Input impedance	h_{ie}	1 to 10 kΩ
Reverse voltage transfer ratio	h_{re}	0,5 to 8 10^{-4}
Small-signal current gain	h_{fe}	100 to 400
Output admittance	h_{oe}	1 to 40 μS

Switching times (between 10% and 90% levels)
Turn on time switched to
I_C = 10 mA; I_B = 1 mA; V_{EB} = 0,5 V

delay time	t_d	<	35 ns
rise time	t_r	<	35 ns



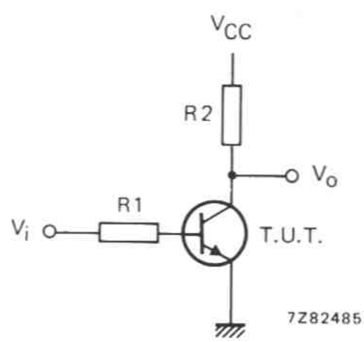
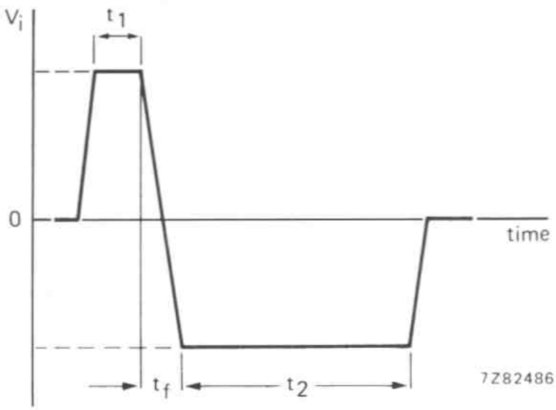


Fig. 2 Delay and rise time equivalent circuit.

V_i = −0,5 to +10,6 V; V_{CC} = 3 V; R1 = 10 kΩ; R2 = 275 Ω;
total shunt capacitance of test jig and connectors = $C_s \leq 4$ pF.
Pulse generator: pulse duration 300 ns; fall time < 1 ns; duty factor 2%.

Turn off time switched from
I_C = 10 mA; $I_{Bon} = -I_{Boff}$ = 1 mA

storage time	t_s	<	200 ns
fall time	t_f	<	50 ns



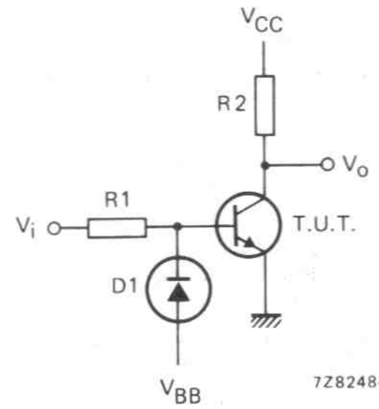


Fig. 3 Storage and fall time equivalent test circuit.

V_i = −9,1 to + 10,9 V; V_{CC} = 3 V; V_{BB} = 0 V (ground); R1 = 10 kΩ; R2 = 275 Ω;
total shunt capacitance of test jig and connectors = $C_s \leqslant$ 4 pF.
Pulse generator: pulse duration t_1 = 10 to 500 μs; fall time t_f < 1 ns; duty factor δ = 2%.

SILICON LOW-POWER SWITCHING TRANSISTORS

P-N-P silicon transistor in a microminiature plastic envelope, intended for switching and linear applications in thick and thin-film circuits.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40	V
Collector current (DC)	$-I_C$	max.	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	mW
Junction temperature	T_j	max.	150	°C
DC current gain $-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}	100 to 300		
Transition frequency at f = 500 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 20 V	f_T	>	250	MHz

MECHANICAL DATA

Dimensions in mm

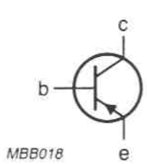
Fig.1 SOT-23.

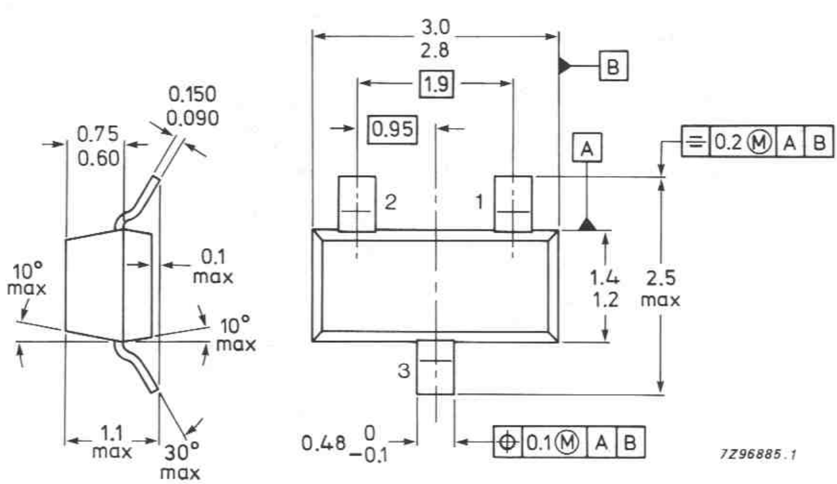
Marking code

BSR18A = T92

Pinning:

1 = base
2 = emitter
3 = collector





TOP VIEW

Reverse pinning types are available on request.
See also *Soldering recommendations.*

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40 V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5 V
Collector current (d.c.)	$-I_C$	max.	200 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250 mW
Storage temperature	T_{stg}	−65 to +150 °C	
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	500 K/W

CHARACTERISTICS

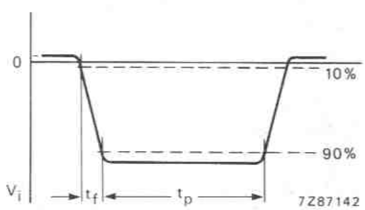
T_{amb} = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0$; $-V_{CB} = 30$ V	$-I_{CBO}$	<	50 nA
Emitter cut-off current			
$I_C = 0$; $-V_{EB} = 3$ V	$-I_{EBO}$	<	50 nA
Saturation voltages *			
$-I_C = 10$ mA; $-I_B = 1$ mA	$-V_{CEsat}$	<	250 mV
	$-V_{BEsat}$		650 to 850 mV
$-I_C = 50$ mA; $-I_B = 5$ mA	$-V_{CEsat}$	<	400 mV
	$-V_{BEsat}$	<	950 mV
Collector capacitance at f = 100 kHz			
$I_E = I_e = 0$; $-V_{CB} = 5$ V	C_c	<	4,5 pF
Emitter capacitance at f = 100 kHz			
$I_C = I_c = 0$; $-V_{EB} = 0,5$ V	C_e	<	10 pF

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

* Measured under pulse conditions; $t_p = 300\ \mu s$; $\delta = 0,01$.

D.C. current gain*			
$-I_C$ = 0,1 mA; $-V_{CE}$ = 1 V	h_{FE}	>	60
$-I_C$ = 1,0 mA; $-V_{CE}$ = 1 V	h_{FE}	>	80
$-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}		100 to 300
$-I_C$ = 50 mA; $-V_{CE}$ = 1 V	h_{FE}	>	60
$-I_C$ =100 mA; $-V_{CE}$ = 1 V	h_{FE}	>	30
Transition frequency at f = 100 MHz			
$-I_C$ = 10 mA; $-V_{CE}$ = 20 V	f_T	>	250 MHz
Noise figure at R_S = 1 kΩ			
$-I_C$ = 100 μA; $-V_{CE}$ = 5 V			
f = 10 to 15 700 Hz	F	<	4 dB
h parameters (common emitter) at f = 1 kHz			
$-I_C$ = 1 mA; $-V_{CE}$ = 10 V			
input impedance	h_{ie}		2 to 12 kΩ
reverse voltage transfer ratio	h_{re}		1 to 10.10^{-4}
small signal current gain	h_{fe}		100 to 400
output admittance	h_{oe}		3 to 60 μS
Switching times (between 10% and 90% levels)			
$-I_C$ = 10 mA; $-I_{Bon}$ = $+I_{Boff}$ = 1 mA			
delay time	t_d	<	35 ns
rise time	t_r	<	35 ns



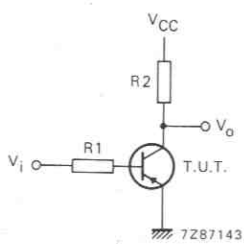


Fig. 2 Waveform and test circuit delay and rise time.
V_i = +0,5 to −10,6 V; $-V_{CC}$ = 3 V; R1 = 10 kΩ; R2 = 275 Ω.
Total shunt capacitance of test jig and connectors = $C_s \leq 4$ pF.
Pulse generator: pulse duration 300 ns; fall time < 1 ns; duty factor 2%.

Switching times (between 10% and 90% levels)

$-I_C = 10$ mA, $-I_{Bon} = I_{Boff} = 1$ mA			
storage time	t_s	<	225 ns
fall time	t_r	<	75 ns

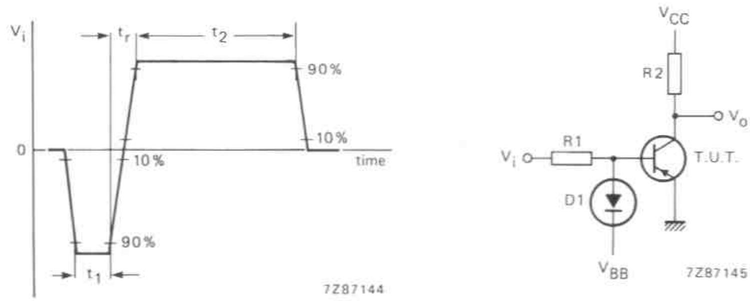


Fig. 3 Waveform and test circuit fall and storage time.
$V_i = -9,1$ to $+10,9$ V; $V_{CC} = 3$ V; $V_{BB} = 0$ V (ground); R1 = 10 kΩ; R2 = 275 Ω; D1 = 1N916.

Total shunt capacitance of test jig and connectors = $C_s \leq 4$ pF.
Pulse generator: pulse duration $t_1 = 10$ to 500 μs; rise time $t_r < 1$ ns; duty factor $\delta = 2\%$.

SILICON N-P-N HIGH-VOLTAGE TRANSISTORS

N-P-N high-voltage small-signal transistors for general purposes and especially telephony applications and encapsulated in a SOT-23 envelope.

P-N-P complements are BSR20 and BSR20A.

QUICK REFERENCE DATA

			BSR19	BSR19A	
Collector-base voltage (open emitter)	V_{CBO}	max.	160	180	V
Collector-emitter voltage (open base)	V_{CEO}	max.	140	160	V
Collector current	I_C	max.	600	600	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	250	mW
Junction temperature	T_j	max.	150	150	°C
Collector-emitter saturation voltage I_C = 50 mA; I_B = 5 mA	V_{CEsat}	max.	0,25	0,20	V
D.C. current gain I_C = 10 mA; V_{CE} = 5 V	h_{FE}	min.	60	80	

MECHANICAL DATA

Dimensions in mm

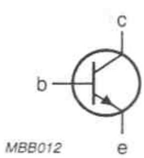
Fig. 1 SOT-23.

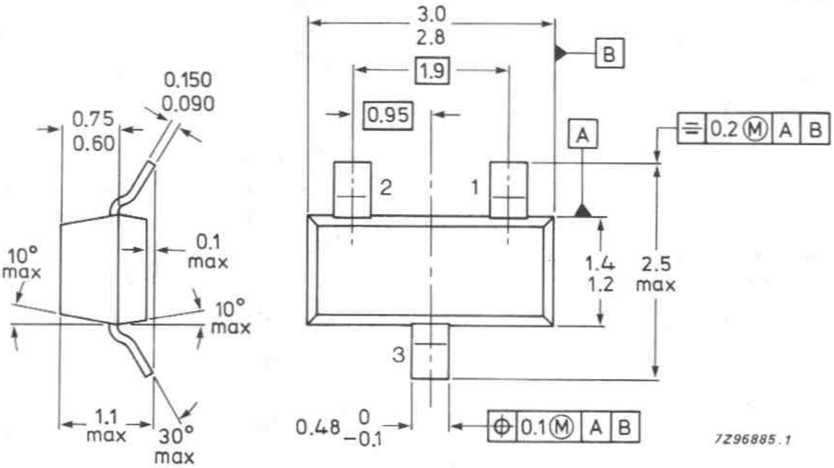
Pinning:

1 = base
2 = emitter
3 = collector

Marking code

BSR19 = U35
BSR19A = U36





TOP VIEW

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BSR19	BSR19A	
Collector-base voltage (open emitter)	V_{CBO}	max.	160	180	V
Collector-emitter voltage (open base)	V_{CEO}	max.	140	160	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6		V
Collector current	I_C	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Junction temperature	T_j	max.	150		°C
Storage temperature	T_{stg}		−65 to + 150		°C

THERMAL RESISTANCE

From junction to ambient* $R_{th\ j\text{-}a}$ = 500 K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			BSR19	BSR19A	
Collector cut-off current					
$I_E = 0$; V_{CB} = 100 V	I_{CBO}	max.	100		nA
$I_E = 0$; V_{CB} = 120 V	I_{CBO}	max.		50	nA
$I_E = 0$; V_{CB} = 100 V; T_{amb} = 100 °C	I_{CBO}	max.	100		μA
$I_E = 0$; V_{CB} = 120 V; T_{amb} = 100 °C	I_{CBO}	max.		50	μA
Emitter cut-off current					
$I_C = 0$; V_{EB} = 4,0 V	I_{EBO}	max.	50	50	nA
Breakdown voltages					
I_C = 1,0 mA; $I_B = 0$	$V_{(BR)CEO}$	min.	140	160	V
I_C = 100 μA; $I_E = 0$	$V_{(BR)CBO}$	min.	160	180	V
$I_C = 0$; I_E = 10 μA	$V_{(BR)EBO}$	min.	6,0	6,0	V
Saturation voltages					
I_C = 10 mA; I_B = 1,0 mA	V_{CEsat}	max.	0,15	0,15	V
	V_{BEsat}	max.	1,0	1,0	V
I_C = 50 mA; I_B = 5,0 mA	V_{CEsat}	max.	0,25	0,20	V
	V_{BEsat}	max.	1,2	1,0	V
D.C. current gain					
I_C = 1,0 mA; V_{CE} = 5 V	h_{FE}	min.	60	80	
I_C = 10 mA; V_{CE} = 5 V	h_{FE}	min.	60	80	
		max.	250	250	
I_C = 50 mA; V_{CE} = 5 V	h_{FE}	min.	20	30	
Small-signal current gain					
I_C = 1,0 mA; V_{CE} = 10 V; f = 1 kHz	h_{fe}	min.	50	50	
		max.	200	200	
Output capacitance at f = 1 MHz					
$I_E = 0$; V_{CB} = 10 V	C_o	max.	6	6	pF

* Substrate size 8 mm x 10 mm x 0.7 mm.

			BSR19	BSR19A
Input capacitance at f = 1 MHz $I_C = 0$; $V_{EB} = 0{,}5$ V	C_i	max.	30	30 pF
Transition frequency at f = 100 MHz $I_C = 10$ mA; $V_{CE} = 10$ V	f_T	min. max.	100 300	100 MHz 300 MHz
Noise figure at $R_S = 1\ k\Omega$ $I_C = 250\ \mu A$; $V_{CE} = 5$ V; f = 10 Hz to 15,7 kHz	F	max.	10	8 dB

SILICON P-N-P HIGH-VOLTAGE TRANSISTORS

P-N-P high-voltage small-signal transistors for general purposes and especially in telephony applications and encapsulated in a SOT-23 envelope.

N-P-N complements are BSR19 and BSR19A.

QUICK REFERENCE DATA

			BSR20	BSR20A	
Collector-base boltage (open emitter)	$-V_{CBO}$	max.	130	160	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	120	150	V
Collector current	$-I_C$	max.	600	600	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	250	mW
Junction temperature	T_j	max.	150	150	°C
Collector-emitter saturation voltage I_C = 50 mA; I_B = 5 mA	V_{CEsat}	max.	0,5	0,5	V
D.C. current gain I_C = 10 mA; V_{CE} = −5 V	h_{FE}	min.	40	60	

MECHANICAL DATA

Dimensions in mm

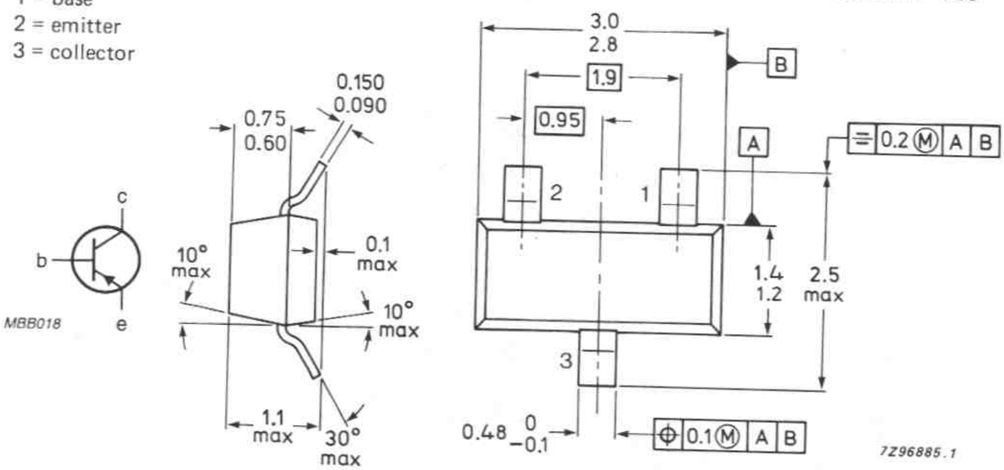
Fig. 1 SOT-23.

Pinning:

1 = base
2 = emitter
3 = collector

Marking code

BSR20 = T35
BSR20A = T36



TOP VIEW

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BSR20	BSR20A	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	130	160	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	120	150	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5		V
Collector current	$-I_C$	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Junction temperature	T_j	max.	150		°C
Storage temperature	T_{stg}		−65 to + 150		°C

THERMAL RESISTANCE

From junction to ambient* $R_{th\ j\text{-}a}$ = 500 K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			BSR20	BSR20A	
Collector cut-off current					
$I_E = 0$; $-V_{CB}$ = 100 V	$-I_{CBO}$	max.	100		nA
$I_E = 0$; $-V_{CB}$ = 120 V	$-I_{CBO}$	max.		50	nA
$I_E = 0$; $-V_{CB}$ = 100 V; T_{amb} = 100 °C	$-I_{CBO}$	max.	100		μA
$I_E = 0$; $-V_{CB}$ = 120 V; T_{amb} = 100 °C	$-I_{CBO}$	max.		50	μA
Emitter cut-off current					
$I_C = 0$; $-V_{EB}$ = 4,0 V	$-I_{EBO}$	max.	50	50	nA
Breakdown voltages					
I_C = 1,0 mA; $I_B = 0$	$-V_{(BR)CEO}$	min.	120	150	V
I_C = 100 μA; $I_E = 0$	$-V_{(BR)CBO}$	min.	130	160	V
$I_C = 0$; I_E = 10 μA	$-V_{(BR)EBO}$	min.	5,0	5,0	V
Saturation voltages					
$-I_C$ = 10 mA; $-I_B$ = 1,0 mA	$-V_{CEsat}$	max.	0,2	0,2	V
	$-V_{BEsat}$	max.	1,0	1,0	V
$-I_C$ = 50 mA; $-I_B$ = 5,0 mA	$-V_{CEsat}$	max.	0,5	0,5	V
	$-V_{BEsat}$	max.	1,0	1,0	V
D.C. current gain					
I_C = 1,0 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	30	50	
I_C = 10 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	40	60	
		max.	180	240	
I_C = 50 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	40	50	
Small-signal current gain					
I_C = 1,0 mA; $-V_{CE}$ = 10 V; f = 1 kHz	h_{fe}	min.	30	40	
		max.	200	200	
Output capacitance at f = 1 MHz					
$I_E = 0$; $-V_{CB}$ = 10 V	C_o	max.	6	6	pF

* Substrate size 8 mm x 10 mm x 0.7 mm.

			BSR20	BSR20A	
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 10 V	f_T	min. max.	100 400	100 300	MHz MHz
Noise figure at R_S = 1 kΩ I_C = 250 μA; $-V_{CE}$ = 5 V; f = 10 Hz to 15,7 kHz	F	max.	8	8	dB

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors in miniature plastic envelopes intended for application in thick and thin-film circuits. They are intended for use in telephony and general industrial applications.

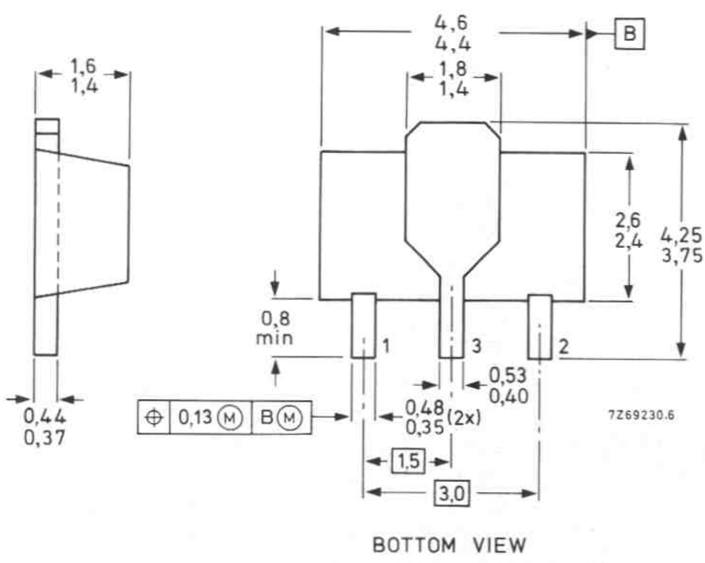
QUICK REFERENCE DATA

			BSR30	BSR31	BSR32	BSR33	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	70	70	90	90	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	60	60	80	80	V
Collector current (d.c.)	$-I_C$	max.	1	1	1	1	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1	1	1	1	W
Junction temperature	T_j	max.	150	150	150	150	°C
D.C. current gain $-I_C$ = 100 mA; $-V_{CE}$ = 5 V	h_{FE}	> <	40 120	100 300	40 120	100 300	
Transition frequency at f = 35 MHz $-I_C$ = 50 mA; $-V_{CE}$ = 10 V	f_T	>	100	100	100	100	MHz

MECHANICAL DATA

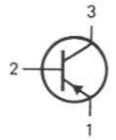
Dimensions in mm

Fig. 1 SOT-89.



Marking code

BSR30 = BR1
BSR31 = BR2
BSR32 = BR3
BSR33 = BR4



See also *Soldering recommendations.*

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BSR30	BSR31	BSR32	BSR33	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	70	70	90	90	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	60	60	80	80	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	5	V

Collector current (d.c.)	$-I_C$	max.	1	A
Base current (d.c.)	$-I_B$	max.	0,1	A
Total power dissipation up to T_{amb} = 25 °C mounted on a ceramic substrate area = 2,5 cm²; thickness = 0,7 mm	P_{tot}	max.	1	W
Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to collector tab	$R_{th\ j\text{-}tab}$	=	10	K/W
From junction to ambient in free air mounted on a ceramic substrate area = 2,5 cm²; thickness = 0,7 mm	$R_{th\ j\text{-}a}$	=	125	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			BSR30	BSR31	BSR32	BSR33	
Collector cut-off current							
$I_E = 0; -V_{CB} = 60$ V	$-I_{CBO}$	<	100				nA
$I_E = 0; -V_{CB} = 60$ V; $T_j = 150$ °C	$-I_{CBO}$	<	50				μA
Breakdown voltages							
$I_B = 0; -I_C = 10$ mA	$-V_{(BR)CEO}$	>	60	60	80	80	V
$V_{BE} = 0; -I_C = 10$ μA	$-V_{(BR)CES}$	>	70	70	90	90	V
$I_C = 0; -I_E = 10$ μA	$-V_{(BR)EBO}$	>	5	5	5	5	V
Saturation voltages *							
$-I_C = 150$ mA; $-I_B = 15$ mA	$-V_{CEsat}$	<	0,25	0,25	0,25	0,25	V
	$-V_{BEsat}$	<	1,0	1,0	1,0	1,0	V
$-I_C = 500$ mA; $-I_B = 50$ mA	$-V_{CEsat}$	<	0,5	0,5	0,5	0,5	V
	$-V_{BEsat}$	<	1,2	1,2	1,2	1,2	V
D.C. current gain *							
$-I_C = 100$ μA; $V_{CE} = 5$ V	h_{FE}	>	10	30	10	30	
$-I_C = 100$ mA; $V_{CE} = 5$ V	h_{FE}	>	40	100	40	100	
		<	120	300	120	300	
$-I_C = 500$ mA; $V_{CE} = 5$ V	h_{FE}	>	30	50	30	50	
Transition frequency at f = 35 MHz							
$-I_C = 50$ mA; $-V_{CE} = 10$ V	f_T	>	100				MHz
Collector capacitance at f = 1 MHz							
$I_E = I_e = 0; -V_{CB} = 10$ V	C_c	<	20				pF
Emitter capacitance at f = 1 MHz							
$I_C = I_c = 0; -V_{EB} = 0,5$ V	C_e	<	120				pF

Switching times see next page.

* Measured under pulse conditions: $t_p = 300$ μs; $\delta < 0,01$.

CHARACTERISTICS (continued)

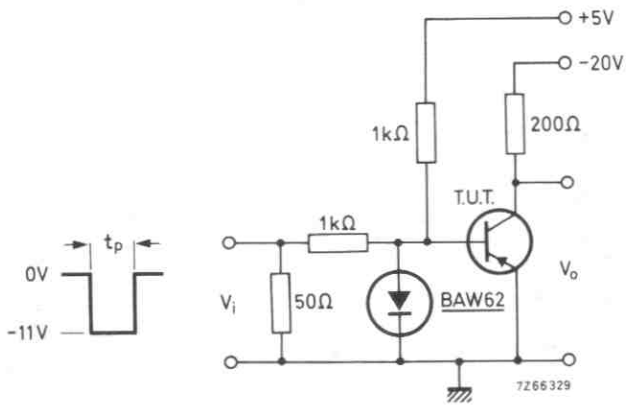
T_{amb} = 25 °C

Switching times

$-I_{Con}$ = 100 mA; $-I_{Bon}$ = $+I_{Boff}$ = 5 mA

Turn-on time	t_{on}	<	500 ns
Turn-off time	t_{off}	<	650 ns

Test circuit



Pulse generator:

Pulse duration	t_p = 10 μs
Rise time	t_r ≤ 15 ns
Fall time	t_f ≤ 15 ns
Source impedance	Z_S = 50 Ω

Oscilloscope:

Rise time	t_r ≤ 15 ns
Input impedance	Z_I ≥ 100 kΩ

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in miniature plastic envelopes intended for application in thick and thin-film circuits. They are intended for use in telephony and general industrial applications.

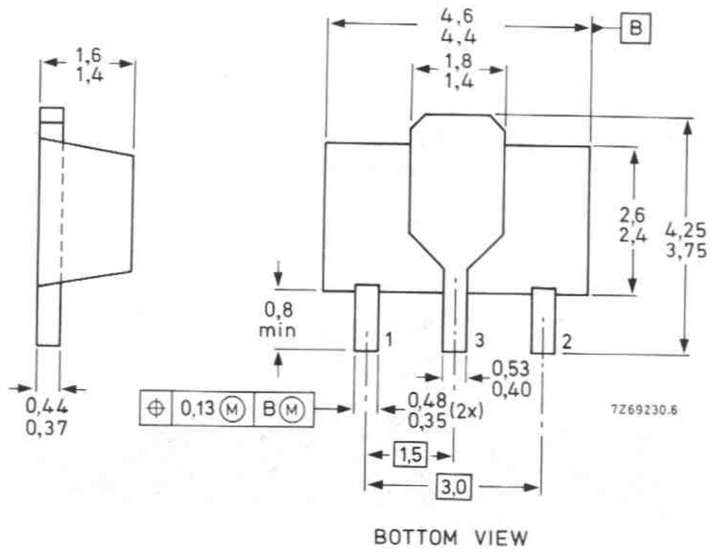
QUICK REFERENCE DATA

			BSR40	BSR41	BSR42	BSR43	
Collector-base voltage (open emitter)	V_{CBO}	max.	70	70	90	90	V
Collector-emitter voltage (open base)	V_{CEO}	max.	60	60	80	80	V
Collector current (d.c.)	I_C	max.	1	1	1	1	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1	1	1	1	W
Junction temperature	T_j	max.	150	150	150	150	°C
D.C. current gain I_C = 100 mA; V_{CE} = 5 V	h_{FE}	> <	40 120	100 300	40 120	100 300	
Transition frequency at f = 35 MHz I_C = 50 mA; V_{CE} = 10 V	f_T	>	100	100	100	100	MHz

MECHANICAL DATA

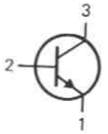
Dimensions in mm

Fig. 1 SOT-89.



Marking code

BSR40 = AR1
BSR41 = AR2
BSR42 = AR3
BSR43 = AR4



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BSR40	BSR41	BSR42	BSR43	
Collector-base voltage (open emitter)	V_{CBO}	max.	70	70	90	90	V
Collector-emitter voltage (open base)	V_{CEO}	max.	60	60	80	80	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	5	5	V

Collector current (d.c.)	I_C	max.	1	A
Base current (d.c.)	I_B	max.	0,1	A
Total power dissipation up to T_{amb} = 25 °C mounted on a ceramic substrate area = 2,5 cm^2; thickness = 0,7 mm	P_{tot}	max.	1	W
Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to collector tab	$R_{th\ j\text{-}tab}$	=	10	K/W
From junction to ambient in free air mounted on a ceramic substrate area = 2,5 cm^2; thickness = 0,7 m	$R_{th\ j\text{-}a}$	=	125	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			BSR40	BSR41	BSR42	BSR43	
Collector cut-off current							
$I_E = 0$; $V_{CB} = 60$ V	I_{CBO}	<	100				nA
$I_E = 0$; $V_{CB} = 60$ V; $T_j = 150$ °C	I_{CBO}	<	50				μA
Breakdown voltages							
$I_B = 0$; $I_C = 10$ mA	$V_{(BR)CEO}$	>	60	60	80	80	V
$V_{BE} = 0$; $I_C = 10$ μA	$V_{(BR)CES}$	>	70	70	90	90	V
$I_C = 0$; $I_E = 10$ μA	$V_{(BR)EBO}$	>	5	5	5	5	V
Saturation voltages *							
$I_C = 150$ mA; $I_B = 15$ mA	V_{CEsat}	<	0,25	0,25	0,25	0,25	V
	V_{BEsat}	<	1,0	1,0	1,0	1,0	V
$I_C = 500$ mA; $I_B = 50$ mA	V_{CEsat}	<	0,5	0,5	0,5	0,5	V
	V_{BEsat}	<	1,2	1,2	1,2	1,2	V
D.C. current gain *							
$I_C = 100$ μA; $V_{CE} = 5$ V	h_{FE}	>	10	30	10	30	
$I_C = 100$ mA; $V_{CE} = 5$ V	h_{FE}	>	40	100	40	100	
		<	120	300	120	300	
$I_C = 500$ mA; $V_{CE} = 5$ V	h_{FE}	>	30	50	30	50	
Transition frequency at f = 35 MHz							
$I_C = 50$ mA; $V_{CE} = 10$ V	f_T	>	100				MHz
Collector capacitance at f = 1 MHz							
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	<	12				pF
Emitter capacitance at f = 1 MHz							
$I_C = I_c = 0$; $V_{EB} = 0{,}5$ V	C_e	<	90				pF

Switching times see next page.

* Measured under pulse conditions: $t_p = 300$ μs; $\delta < 0{,}01$.

CHARACTERISTICS (continued)

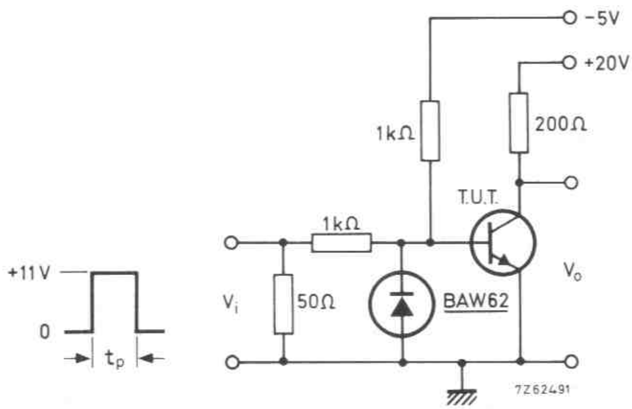
$T_{amb} = 25\ ^oC$

Switching times

$I_{Con} = 100$ mA; $I_{Bon} = -I_{Boff} = 5$ mA

Turn-on time	t_{on}	<	250	ns
Turn-off time	t_{off}	<	1000	ns

Test circuit



Pulse generator:

Pulse duration	$t_p = 10\ \mu s$
Rise time	$t_r \leq 15$ ns
Fall time	$t_f \leq 15$ ns
Source impedance	$Z_S = 50\ \Omega$

Oscilloscope:

Rise time	$t_r \leq 15$ ns
Input impedance	$Z_I \geq 100\ k\Omega$

N-CHANNEL FETS

Symmetrical silicon n-channel depletion type junction field-effect transistors in a plastic microminiature envelope intended for application in thick and thin-film circuits. The transistors are intended for low-power, chopper or switching applications in industrial service.

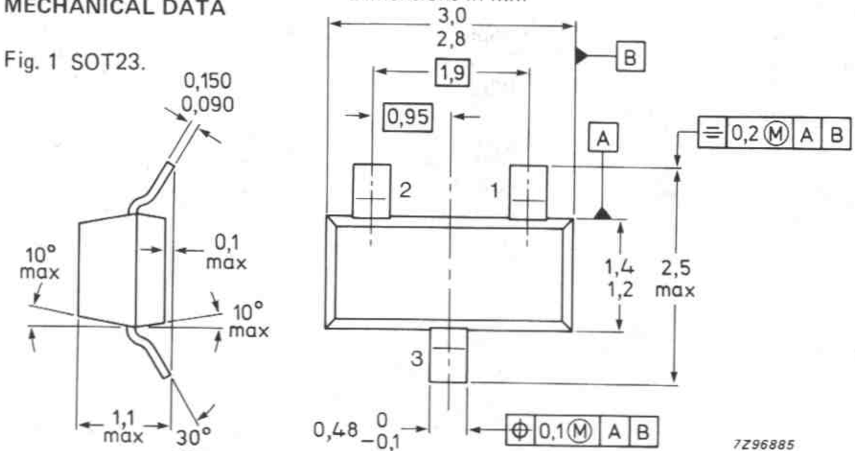
QUICK REFERENCE DATA

			BSR56	BSR57	BSR58	
Drain-source voltage	$\pm V_{DS}$	max.	40	40	40	V
Total power dissipation up to T_{amb} = 40 °C	P_{tot}	max.	250	250	250	mW
Drain current						
V_{DS} = 15 V; V_{GS} = 0	I_{DSS}	>	50	20	8	mA
		<	–	100	80	mA
Gate-source cut-off voltage						
V_{DS} = 15 V; I_D = 0.5 nA	$-V_{(P)GS}$	>	4	2	0.8	V
		<	10	6	4	V
Drain-source resistance (on) at f = 1 kHz						
I_D = 0; V_{GS} = 0	$r_{ds\,on}$	<	25	40	60	Ω
Feedback capacitance at f = 1 MHz						
$-V_{GS}$ = 10 V; V_{DS} = 0	C_{rs}	<	5	5	5	pF
Turn-off time						
V_{DD} = 10 V; V_{GS} = 0						
I_D = 20 mA; $-V_{GSM}$ = 10 V	t_{off}	<	25	–	–	ns
I_D = 10 mA; $-V_{GSM}$ = 6 V	t_{off}	<	–	50	–	ns
I_D = 5 mA; $-V_{GSM}$ = 4 V	t_{off}	<	–	–	100	ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT23.



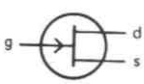
TOP VIEW

Marking code

BSR56 = M4p
BSR57 = M5p
BSR58 = M6p

Pinning

1 = drain
2 = source
3 = gate



Note: Drain and source are interchangeable.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	$\pm V_{DS}$	max.	40 V
Drain-gate voltage	V_{DGO}	max.	40 V
Gate-source voltage	$-V_{GSO}$	max.	40 V
Forward gate current	I_{GF}	max.	50 mA
Total power dissipation up to T_{amb} = 40 °C (note 1)	P_{tot}	max.	250 mW
Storage temperature range	T_{stg}	−65 to + 150 °C	
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient (note 1)	$R_{th\ j\text{-}a}$	=	430 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Gate-source cut-off current V_{DS} = 0 V; $-V_{GS}$ = 20 V	$-I_{GSS}$	max.	1.0 nA
Drain cut-off current V_{DS} = 15 V; $-V_{GS}$ = 10 V	I_{DSX}	max.	1.0 nA

			BSR56	BSR57	BSR58	
Drain current V_{DS} = 15 V; V_{GS} = 0	I_{DSS}	>	50	20	8	mA
		<	–	100	80	mA
Gate-source breakdown voltage $-I_G$ = 1 μA; V_{DS} = 0	$-V_{(BR)GSS}$	>	40	40	40	V
Gate-source cut-off voltage I_D = 0,5 nA; V_{DS} = 15 V	$-V_{(P)GS}$	>	4	2	0.8	V
		<	10	6	4	V
Drain-source voltage (on) I_D = 20 mA; V_{GS} = 0	V_{DSon}	<	750	–	–	mV
I_D = 10 mA; V_{GS} = 0	V_{DSon}	<	–	500	–	mV
I_D = 5 mA; V_{GS} = 0	V_{DSon}	<	–	–	400	mV
Drain-source resistance (on) at f = 1 kHz I_D = 0; V_{GS} = 0; T_a = 25 °C	$r_{ds\ on}$	<	25	40	60	Ω
Feedback capacitance at f = 1 MHz $-V_{GS}$ = 10 V; V_{DS} = 0	C_{rss}	<	5	5	5	pF

Notes

1. Mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.

Switching times			BSR56	BSR57	BSR58	
V_{DD} = 10 V; V_{GS} = 0						
Conditions I_D and $-V_{GSM}$	I_D	=	20	10	5	mA
	$-V_{GSM}$	=	10	6	4	V
Delay time	t_d	<	6	6	10	ns
Rise time	t_r	<	3	4	10	ns
Turn-off time	t_{off}	<	25	50	100	ns

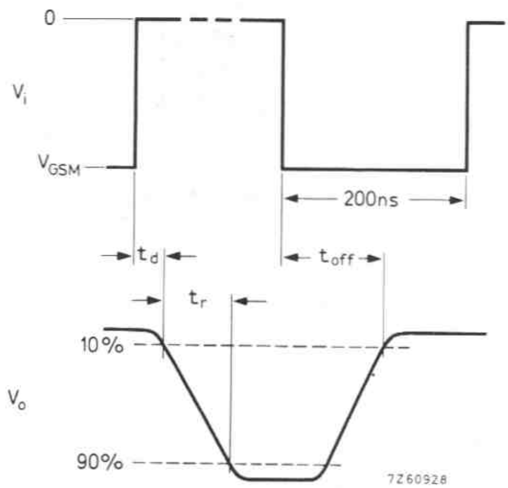


Fig. 2 Switching times waveforms.

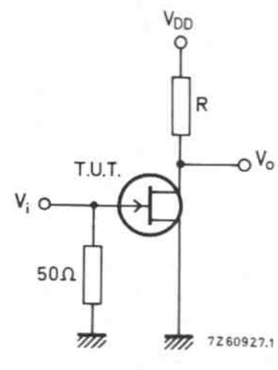


Fig. 3 Test circuit.

BSR56; R = 464 Ω
BSR57; R = 953 Ω
BSR58; R = 1910 Ω

Pulse generator

$t_r = t_f \leqslant 1$ ns
δ = 0.02
Z_o = 50 Ω

Oscilloscope

$t_r \leqslant 0.75$ ns
$R_i \geqslant$ 1 MΩ
$C_i \leqslant$ 2.5 pF

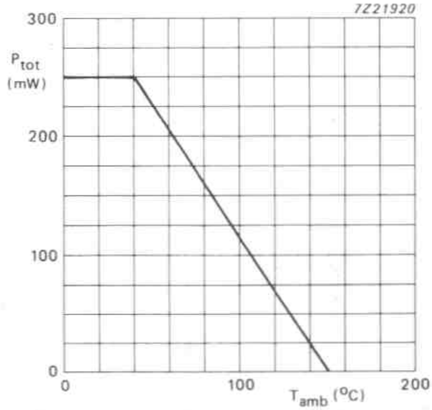


Fig.4 Power derating curve.

HIGH VOLTAGE P-N-P TRANSISTORS

Silicon planar epitaxial transistor in a microminiature plastic envelope intended for application in thick and thin-film circuits. This transistor is intended for high voltage general purpose and switching applications.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	110 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	100 V
Collector current (peak value)	$-I_{CM}$	max.	100 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250 mW
Junction temperature	T_j	max.	150 °C
D.C. current gain at T_j = 25 °C $-I_C$ = 25 mA; $-V_{CE}$ = 5 V	h_{FE}	>	30
Transition frequency at f = 35 MHz $-I_C$ = 25 mA; $-V_{CE}$ = 5 V	f_T	> typ.	50 MHz 85 MHz

MECHANICAL DATA

Dimensions in mm

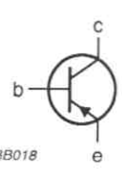
Marking code

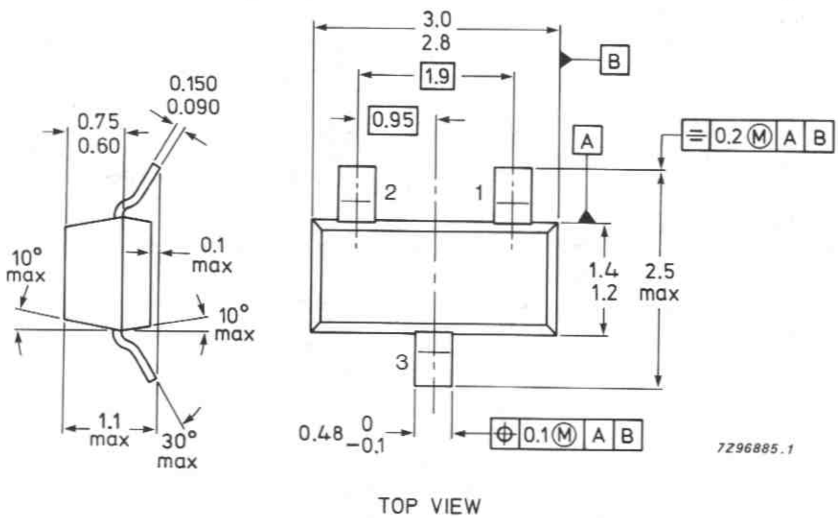
BSS63 = BMp

Fig. 1 SOT-23.

Pinning:

1 = base
2 = emitter
3 = collector





Reverse pinning types are available on request.

See also *Soldering recommendations.*

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter) $-I_C = 10\ \mu A$	$-V_{CBO}$	max.	110 V
Collector-emitter voltage (open base) $-I_C = 100\ \mu A$	$-V_{CEO}$	max.	100 V
Emitter-base voltage (open collector) $-I_E = 10\ \mu A$	$-V_{EBO}$	max.	6 V
Collector current (d.c.)	$-I_C$	max.	100 mA
Collector current (peak value)	$-I_{CM}$	max.	100 mA
Base current (peak value)	$-I_{BM}$	max.	100 mA
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	250 mW
Storage temperature	T_{stg}	−65 to + 150	^oC
Junction temperature	T_j	max.	150 ^oC

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	500 K/W

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

Collector cut-off current $I_E = 0$; $-V_{CB} = 90$ V	$-I_{CBO}$	<	100 nA
$I_E = 0$; $-V_{CB} = 90$ V; $T_j = 150\ ^oC$	$-I_{CBO}$	<	50 μA
Emitter cut-off current $I_C = 0$; $-V_{EB} = 6$ V	$-I_{EBO}$	<	200 nA
Saturation voltage $-I_C = 25$ mA; $-I_B = 2,5$ mA	$-V_{CEsat}$	<	250 mV
	$-V_{BEsat}$	<	900 mV
D.C. current gain $-I_C = 10$ mA; $-V_{CE} = 1$ V	h_{FE}	>	30
$-I_C = 25$ mA; $-V_{CE} = 1$ V	h_{FE}	>	30
Collector capacitance at f = 1 MHz $I_E = I_e = 0$; $-V_{CB} = 10$ V	C_c	typ.	3 pF
Transition frequency at f = 35 MHz $-I_C = 25$ mA; $-V_{CE} = 5$ V	f_T	>	50 MHz
		typ.	85 MHz

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

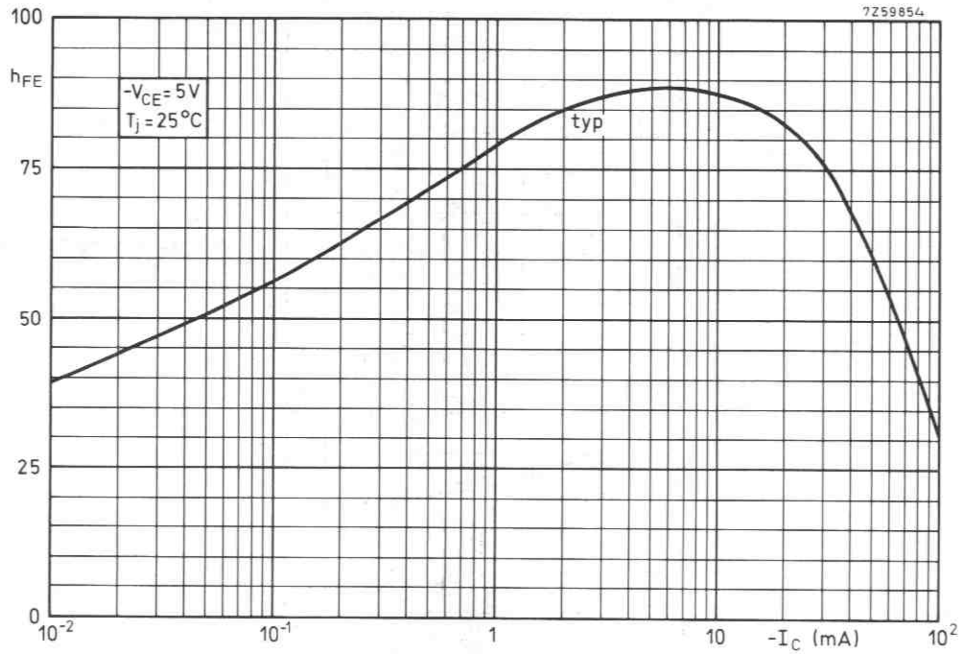

7Z59854
100
h_{FE}
$-V_{CE} = 5V$
$T_j = 25°C$
typ
75
50
25
0
10^{-2}
10^{-1}
1
10
$-I_C$ (mA)
10^2

Fig. 2.

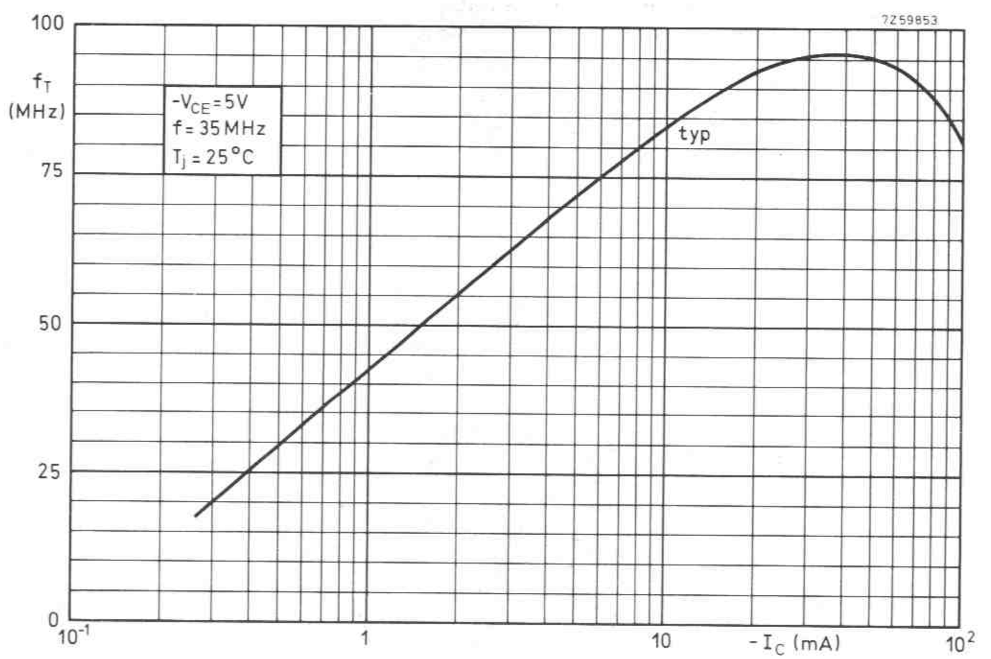

7Z59853
100
f_T
(MHz)
$-V_{CE} = 5V$
f = 35 MHz
$T_j = 25°C$
typ
75
50
25
0
10^{-1}
1
10
$-I_C$ (mA)
10^2

Fig. 3.

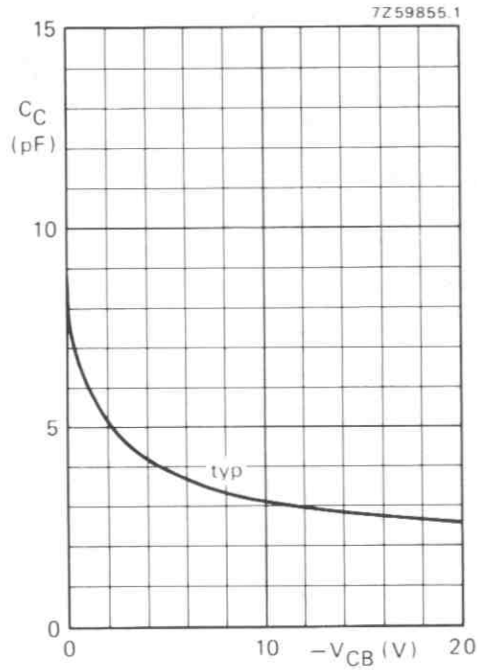


Fig. 4 Typical values collector capacitance as a function of collector-base voltage.
$I_E = I_e = 0$; $T_j = 25\ ^oC$; f = 1 MHz.

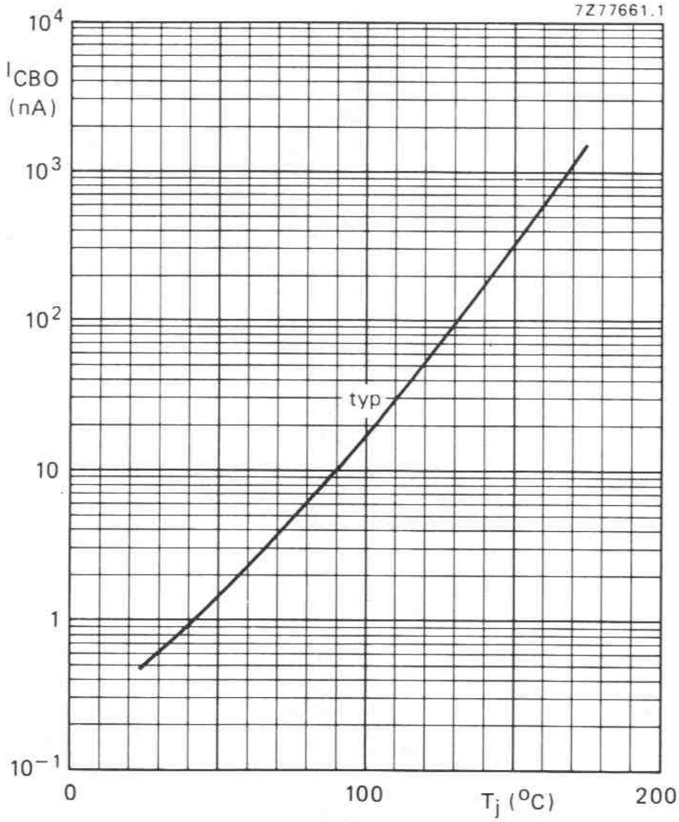


Fig. 5 Typical values collector-base currents as a function of the junction temperature at a collector-base voltage of 90 V.

HIGH VOLTAGE N-P-N TRANSISTORS

Silicon planar epitaxial transistor in a microminiature plastic envelope intended for application in thick and thin-film circuits. This transistor is intended for high-voltage general purpose and switching applications.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	120	V
Collector-emitter voltage (open base)	V_{CEO}	max.	80	V
Collector current (peak value)	I_{CM}	max.	250	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	mW
Junction temperature	T_j	max.	150	°C
D.C. current gain I_C = 10 mA; V_{CE} = 1 V; T_j = 25 °C	h_{FE}	> typ.	20 80	
Transition frequency at f = 35 MHz I_C = 4 mA; V_{CE} = 10 V	f_T	>	60	MHz
Turn-off time I_C = 15 mA; I_{Bon} = $-I_{Boff}$ = 1 mA	t_{off}	<	1	μs

MECHANICAL DATA

Dimensions in mm

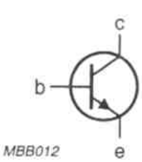
Marking code

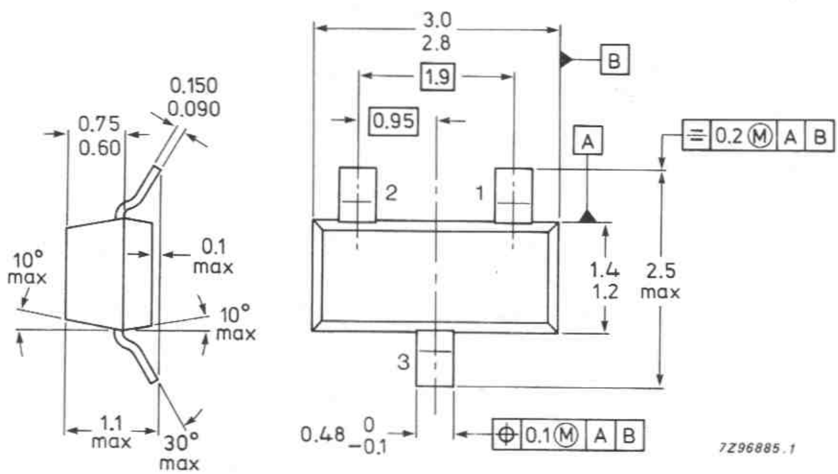
BSS64 = AMp

Fig. 1 SOT-23.

Pinning:

1 = base
2 = emitter
3 = collector





Reverse pinning types are available on request.

TOP VIEW

See also *Soldering recommendations.*

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter) I_C = 100 μA	V_{CBO}	max.	120 V
Collector-emitter voltage (open base) I_C = 4 mA	V_{CEO}	max.	80 V
Emitter-base voltage (open collector) I_E = 100 μA	V_{EBO}	max.	5 V
Collector current (d.c. or averaged over any 20 ms period)	I_C	max.	100 mA
Collector current (peak value)	I_{CM}	max.	250 mA
Base current (peak value)	I_{BM}	max.	100 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250 mW
Storage temperature	T_{stg}	−65 to	+ 150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	500 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current I_E = 0; V_{CB} = 90 V	I_{CBO}	<	100 nA
I_E = 0; V_{CB} = 90 V; T_j = 150 °C	I_{CBO}	<	50 μA
Emitter cut-off current I_C = 0; V_{EB} = 5 V	I_{EBO}	typ.	0,5 nA
		<	200 nA
Saturation voltages I_C = 4 mA; I_B = 400 μA	V_{CEsat}	<	150 mV
	V_{BEsat}	<	1200 mV
I_C = 50 mA; I_B = 15 mA	V_{CEsat}	<	200 mV
D.C. current gain I_C = 1 mA; V_{CE} = 1 V	h_{FE}	typ.	60
I_C = 10 mA; V_{CE} = 1 V	h_{FE}	>	20
		typ.	80
I_C = 20 mA; V_{CE} = 1 V	h_{FE}	typ.	55

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

Transition frequency at f = 35 MHz			
I_C = 4 mA; V_{CE} = 10 V	f_T	>	60 MHz
		typ.	100 MHz
Collector capacitance at f = 1 MHz			
$I_E = I_e = 0$; V_{CB} = 10 V	C_c	typ.	3 pF
Turn-off switching time			
I_{Con} = 15 mA; $I_{Bon} = -I_{Boff}$ = 1 mA	t_{off}	<	1 μs

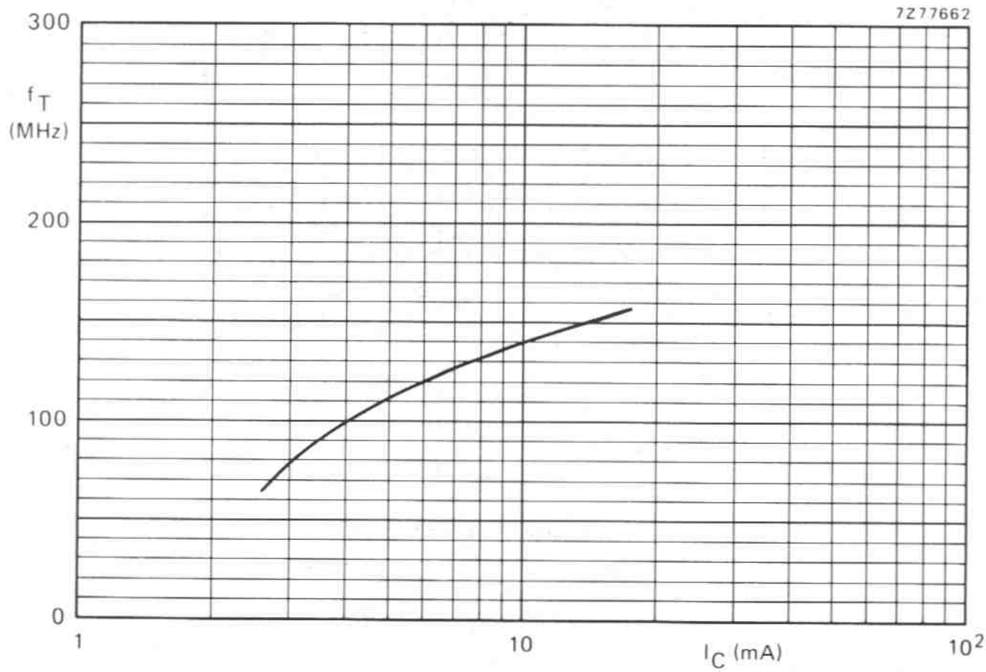


Fig. 2 Typical values transition frequency. V_{CE} = 10 V; f = 35 MHz; T_j = 25 °C.

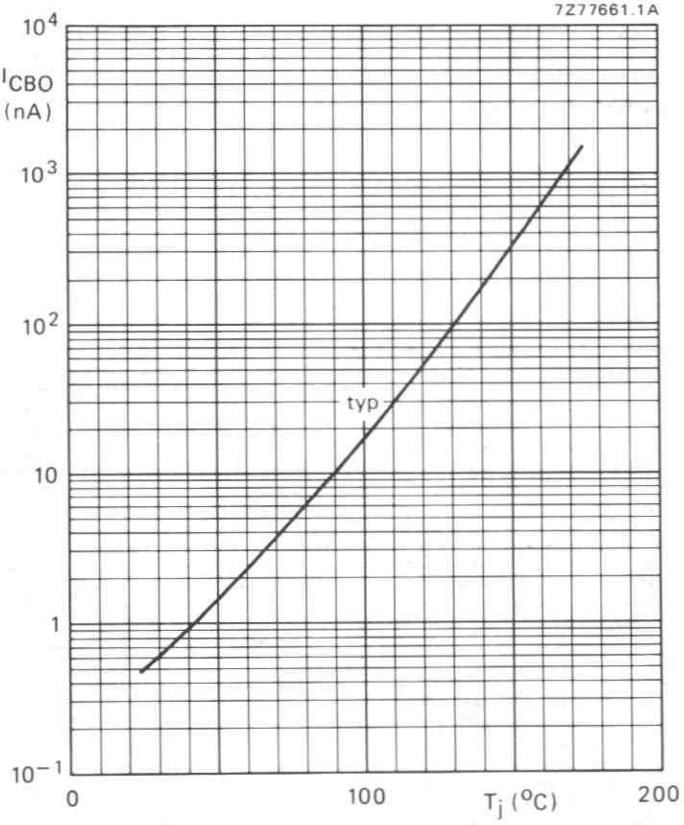


Fig. 3 Typical values collector-base current as a function of the junction temperature at a collector-base voltage of −90 V.

MOSFET N-CHANNEL ENHANCEMENT SWITCHING TRANSISTOR

Symmetrical insulated-gate silicon MOS field-effect transistor of the N-channel enhancement mode type.

The transistor is sealed in a SOT143 envelope and features a low ON resistance and low capacitances.

The transistor is protected against excessive input voltages by integrated back-to-back diodes between gate and substrate.

Applications:

- analog and/or digital switch
- switch driver

QUICK REFERENCE DATA

Drain-source voltage	V_{DS}	max.	10 V
Source-drain voltage	V_{SD}	max.	10 V
Drain-substrate voltage	V_{DB}	max.	15 V
Source-substrate voltage	V_{SB}	max.	15 V
Drain current (DC)	I_D	max.	50 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	230 mW
Gate-source threshold voltage $V_{DS} = V_{GS}$; $V_{SB} = 0$; $I_D = 1\ \mu A$	$V_{GS(th)}$	> <	0.1 V 2.0 V
Drain-source ON-resistance V_{GS} = 10 V; V_{SB} = 0; I_D = 0.1 mA	R_{DSon}	<	45 Ω
Feed-back capacitance $V_{GS} = V_{BS} = -15$ V; V_{DS} = 10 V; f = 1 MHz	C_{rss}	typ.	0.6 pF

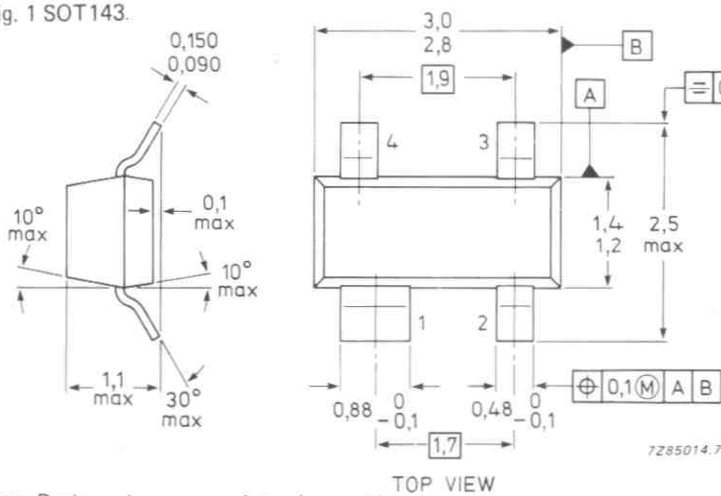
MECHANICAL DATA

SOT143 (see Fig. 1).

See also *Soldering recommendations*.

Fig. 1 SOT143.

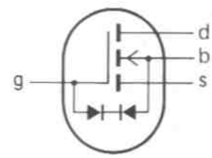
Dimensions in mm



Marking code:

BSS83 = M74

Pinning;
1 = substrate (b)
2 = source
3 = drain
4 = gate



Note: Drain and source are interchangeable.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	V_{DS}	max.	10 V
Source-drain voltage	V_{SD}	max.	10 V
Drain-substrate voltage	V_{DB}	max.	15 V
Source-substrate voltage	V_{SB}	max.	15 V
Drain current (DC)	I_D	max.	50 mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	230 mW
Storage temperature range	T_{stg}		−65 to + 150 °C
Junction temperature	T_j	max.	125 °C

THERMAL RESISTANCE

From junction to ambient in free air*	$R_{th\ j\text{-}a}$	=	430 K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

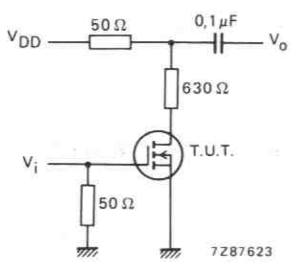
Drain-source breakdown voltage $V_{GS} = V_{BS} = -5$ V; I_D = 10 nA	$V_{(BR)DSX}$	>	10 V
Source-drain breakdown voltage $V_{GD} = V_{BD} = -5$ V; I_D = 10 nA	$V_{(BR)SDX}$	>	10 V
Drain-substrate breakdown voltage $V_{GB} = 0$; I_D = 10 nA; open source	$V_{(BR)DBO}$	>	15 V
Source-substrate breakdown voltage $V_{GB} = 0$; I_D = 10 nA; open drain	$V_{(BR)SBO}$	>	15 V
Drain-source leakage current $V_{GS} = V_{BS} = -2$ V; V_{DS} = 6,6 V	I_{DSoff}	<	10 nA

* Device mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

Source-drain leakage current $V_{GD} = V_{BD} = -2$ V; $V_{SD} = 6{,}6$ V	I_{SDoff}	<	10 nA
Forward transconductance at f = 1 kHz $V_{DS} = 10$ V; $V_{SB} = 0$; $I_D = 20$ mA	g_{fs}	> typ.	10 mS 15 mS
Gate-source threshold voltage $V_{DS} = V_{GS}$; $V_{SB} = 0$; $I_D = 1\ \mu$A	$V_{GS(th)}$	> <	0,1 V 2,0 V
Drain-source ON-resistance $I_D = 0{,}1$ mA;			
$V_{GS} = 5$ V; $V_{SB} = 0$	R_{DSon}	<	70 Ω
$V_{GS} = 10$ V; $V_{SB} = 0$	R_{DSon}	<	45 Ω
$V_{GS} = 3{,}2$ V; $V_{SB} = 6{,}8$ V (see Fig. 4)	R_{DSon}	typ. <	80 Ω 120 Ω
Gate-substrate zener voltages $V_{DB} = V_{SB} = 0$; $-I_G = 10\ \mu$A	$V_{Z(1)}$	>	12,5 V
$V_{DB} = V_{SB} = 0$; $+I_G = 10\ \mu$A	$V_{Z(2)}$	>	12,5 V
Capacitances at f = 1 MHz $V_{GS} = V_{BS} = -15$ V; $V_{DS} = 10$ V			
Feed-back capacitance	C_{rss}	typ.	0,6 pF
Input capacitance	C_{iss}	typ.	1,5 pF
Output capacitance	C_{oss}	typ.	1,0 pF
Switching times (see Fig. 2) $V_{DD} = 10$ V; $V_i = 5$ V	t_{on}	typ.	1,0 ns
	t_{off}	typ.	5,0 ns

Pulse generator:

R_i = 50 Ω
t_r < 0,5 ns
t_f < 1,0 ns
t_p = 20 ns
δ < 0,01



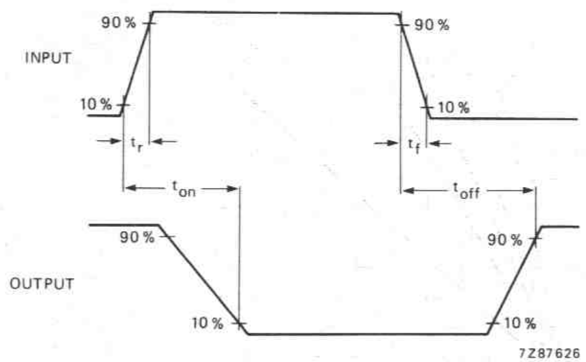


Fig. 2 Switching times test circuit and input and output waveforms.

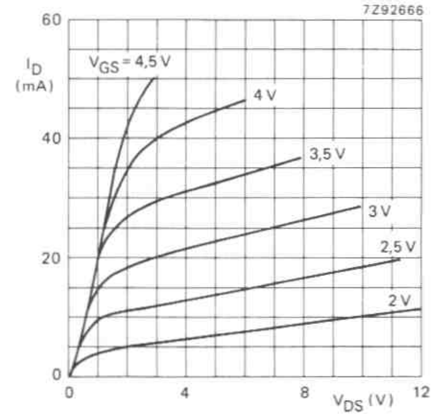


Fig. 3 V_{SB} = 0; typical values.

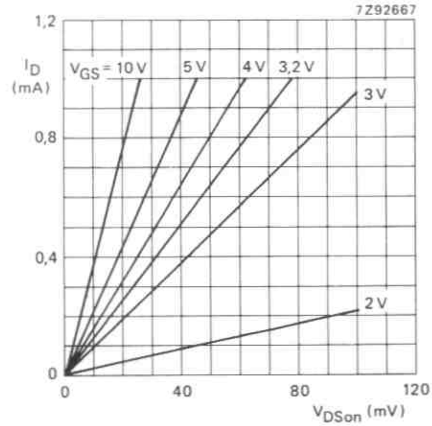


Fig. 4 V_{SB} = 6,8 V; typical values.

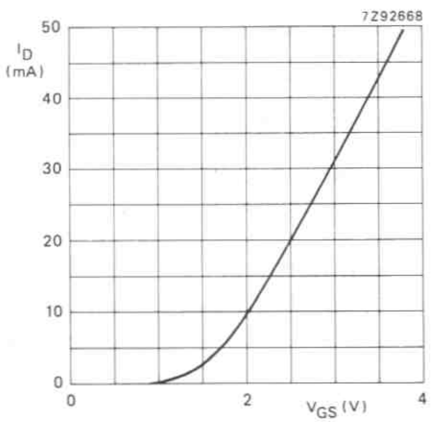


Fig. 5 V_{DS} = 10 V; V_{BS} = 0; typical values.

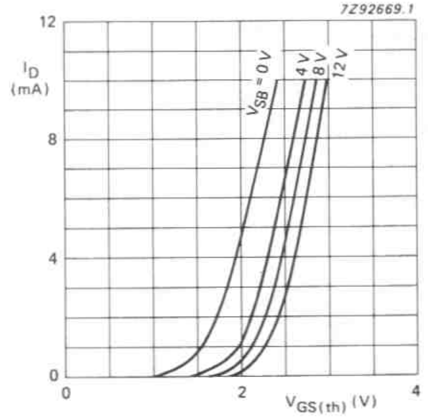


Fig. 6 V_{DS} = V_{GS} = $V_{GS(th)}$.

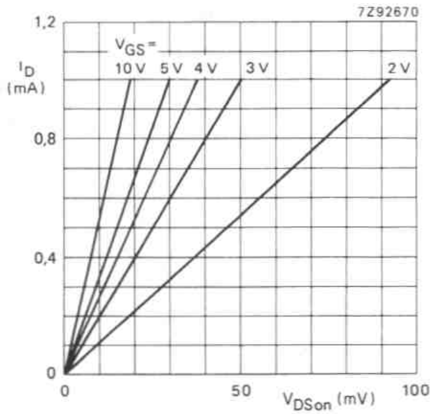


Fig. 7 V_{SB} = 0; typical values.

Conditions for Figs 3, 4, 5, 6 and 7:
T_j = 25 °C.

Philips Components

Data sheet	
status	Preliminary specification
date of issue	April 1991

BSS84

P-channel enhancement mode vertical D-MOS FET

DESCRIPTION

Silicon p-channel enhancement mode vertical D-MOS transistor in a SOT23 envelope. It is intended for use in general purpose and high-speed switching applications, such as relays, multiplexers, choppers and line transformer drivers.

PINNING - SOT23

PIN	DESCRIPTION
1	gate
2	source
3	drain

PIN CONFIGURATION

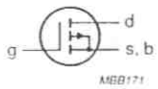


Fig.1 Symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MAX.	UNIT
$-V_{DS}$	drain-source voltage	50	V
$-I_D$	drain current	130	mA
$R_{DS(on)}$	drain-source on resistance	10	Ω
$-V_{GS(th)}$	gate-source threshold voltage	2	V

P-channel enhancement mode vertical D-MOS FET

BSS84

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$-V_{DS}$	drain-source voltage		-	50	V
$-V_{GSO}$	gate-source voltage	open drain $I_D = 0$	-	20	V
$-I_D$	drain current	average value	-	130	mA
$-I_{DM}$	drain current	peak value	-	520	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	-	360	mW
T_{stg}	storage temperature range		−55	150	°C
T_j	junction temperature		-	150	°C

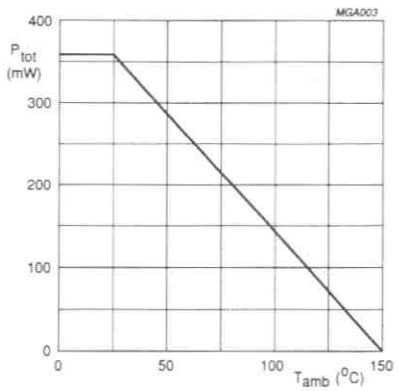


Fig.2 Total power dissipation as a function of ambient temperature.

THERMAL RESISTANCE

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}a}$	from junction to ambient	500	K/W

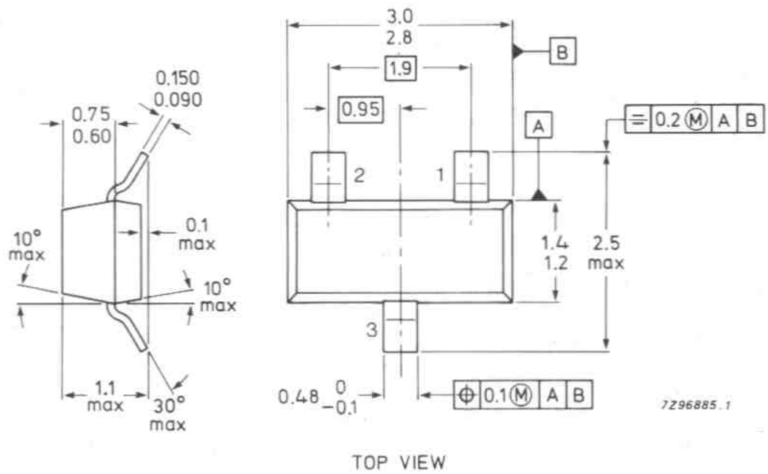
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$-V_{(BR)DSS}$	drain-source breakdown voltage	$V_{GS} = 0$ $-I_D = 250\ \mu A$	50	-	-	V
$-I_{DSS}$	drain-source leakage current	$V_{GS} = 0$ $-V_{DS} = 25$ V	-	-	0.1	μA
		$V_{GS} = 0$ $-V_{DS} = 50$ V	-	-	15	μA
		$V_{GS} = 0$ $-V_{DS} = 50$ V $T_j = 125$ °C	-	-	60	μA
$-I_{GSS}$	gate-source leakage current	$V_{DS} = 0$ $-V_{GS} = 20$ V	-	-	60	μA
$-V_{GS(th)}$	gate-source threshold voltage	$-I_D = 1$ mA $V_{DS} = V_{GS}$	0.8	-	2	V
$R_{DS(on)}$	drain-source on resistance	$-V_{GS} = 5$ V $-I_D = 100$ mA	-	6	10	Ω
$\lvert y_{fs} \rvert$	transfer admittance	$-V_{DS} = 25$ V $-I_D = 100$ mA f = 1 kHz	50	70	-	mS
C_{iss}	input capacitance	$-V_{DS} = 25$ V $V_{GS} = 0$ f = 1 MHz	-	40	-	pF
C_{oss}	output capacitance	$-V_{DS} = 25$ V $V_{GS} = 0$ f = 1 MHz	-	15	-	pF
C_{rss}	feedback capacitance	$-V_{DS} = 25$ V $V_{GS} = 0$ f = 1 MHz	-	6	-	pF
t_{on}	turn-on time	$-V_{CC} = 30$ V $-I_D = 0.27$ A $-V_{GS} = 0/5$ V	-	20	-	ns
t_{off}	turn-off time	$-V_{CC} = 30$ V $-I_D = 0.27$ A $-V_{GS} = 0/5$ V	-	43	-	ns

PACKAGE OUTLINE

Dimensions in mm



Marking: SP

Fig.3 SOT23.

N-CHANNEL ENHANCEMENT MODE VERTICAL D-MOS TRANSISTOR

N-channel vertical D-MOS transistor in a SOT89 envelope.
Designed primarily as a line current interrupter in telephone sets, it can also be applied in other applications such as in relays, line and high-speed transformer drivers etc.

Features

- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No secondary breakdown.
- Low R_{DS} on

QUICK REFERENCE DATA

Drain-source voltage	V_{DS}	max.	200 V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20 V
Drain current (DC)	I_D	max.	280 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1 W
Drain-source on-resistance I_D = 400 mA; V_{GS} = 10 V	$R_{DS\,(on)}$	max. typ.	6 Ω 4.5 Ω
Transfer admittance I_D = 400 mA; V_{DS} = 25 V	$\|y_{fs}\|$	typ. min.	350 mS 140 mS

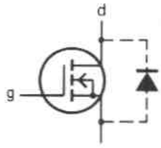
MECHANICAL DATA

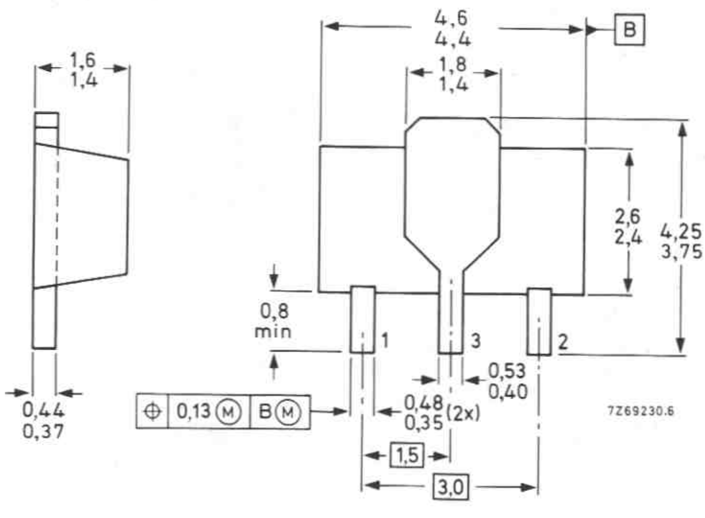
Dimensions in mm

Fig. 1 SOT89.

Pinning

1 = source
2 = gate
3 = drain





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BOTTOM VIEW

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	V_{DS}	max.	200	V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20	V
Drain current (DC)	I_D	max.	280	mA
Drain current (peak)	I_{DM}	max.	1.1	A
Total power dissipation up to T_{amb} = 25 °C *	P_{tot}	max.	1	W
Storage temperature range	T_{stg}	−65 to + 150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient *	$R_{th\ j\text{-}a}$	=	125	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Drain-source breakdown voltage I_D = 250 μA; V_{GS} = 0	$V_{(BR)DSS}$	min.	200	V
Drain-source leakage current V_{DS} = 60 V; V_{GS} = 0	I_{DSS}	max.	200	nA
V_{DS} = 200 V; V_{GS} = 0	I_{DSS}	max.	60	μA
		typ.	100	nA
Gate-source leakage current V_{GS} = 20 V; V_{DS} = 0	I_{GSS}	max.	100	nA
Gate threshold voltage I_D = 1 mA; V_{DS} = V_{GS}	$V_{GS(th)}$	min.	0.8	V
		max.	2.8	V
Drain-source on-resistance I_D = 400 mA; V_{GS} = 10 V	$R_{DS(on)}$	max.	6	Ω
		typ.	4.5	Ω
Transfer admittance I_D = 400 mA; V_{DS} = 25 V	$\|y_{fs}\|$	typ.	350	mS
		min.	140	mS
Input capacitance f = 1 MHz; V_{DS} = 25 V; V_{GS} = 0	C_{iss}	max.	60	pF
		typ.	45	pF
Output capacitance f = 1 MHz; V_{DS} = 25 V; V_{GS} = 0	C_{oss}	max.	25	pF
		typ.	15	pF
Feedback capacitance f = 1 MHz; V_{DS} = 25 V; V_{GS} = 0	C_{rss}	max.	10	pF
		typ.	3.5	pF
Switching times (see Figs 2 and 3) I_D = 250 mA; V_{DD} = 50 V;	t_{on}	typ.	5	ns
		max.	10	ns
V_{GS} = 0 to 10	t_{off}	typ.	15	ns
		max.	25	ns

* Transistor mounted on ceramic substrate area 2.5 cm^2, thickness 0.7 mm.

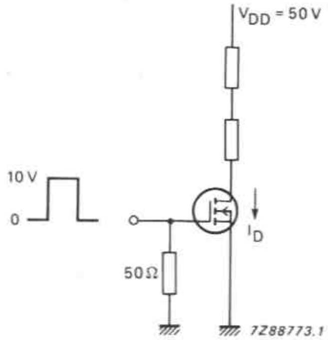


Fig. 2 Switching times test circuit.

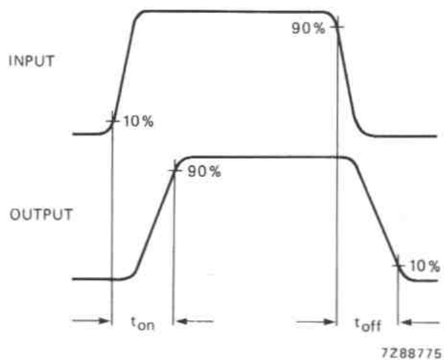


Fig. 3 Input and output waveforms.

Philips Components

Data sheet	
status	Preliminary specification
date of issue	April 1991

BSS131

N-channel enhancement mode vertical D-MOS FET

DESCRIPTION

Silicon n-channel enhancement mode vertical D-MOS transistor in a SOT23 envelope. It is intended for use in general purpose and high-speed switching applications, such as relays, multiplexers, choppers and line transformer drivers.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MAX.	UNIT
V_{DS}	drain-source voltage	240	V
I_D	drain current	100	mA
$R_{DS(on)}$	drain-source on resistance	16	Ω
$-V_{GS(th)}$	gate-source threshold voltage	2.8	V

PINNING - SOT23

PIN	DESCRIPTION
1	gate
2	source
3	drain

PIN CONFIGURATION

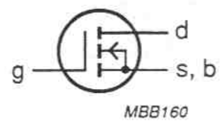


Fig.1 Symbol.

N-channel enhancement mode vertical D-MOS FET

BSS131

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage		-	240	V
V_{GSO}	gate-source voltage	open drain $I_D = 0$	-	20	V
I_D	drain current	average value	-	100	mA
I_{DM}	drain current	peak value	-	400	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	-	360	mW
T_{stg}	storage temperature range		−55	150	°C
T_j	junction temperature		-	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}a}$	from junction to ambient	350	K/W

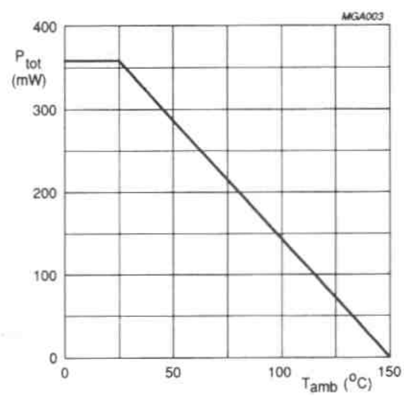


Fig.2 Total power dissipation as a function of ambient temperature.

N-channel enhancement mode vertical D-MOS FET

BSS131

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

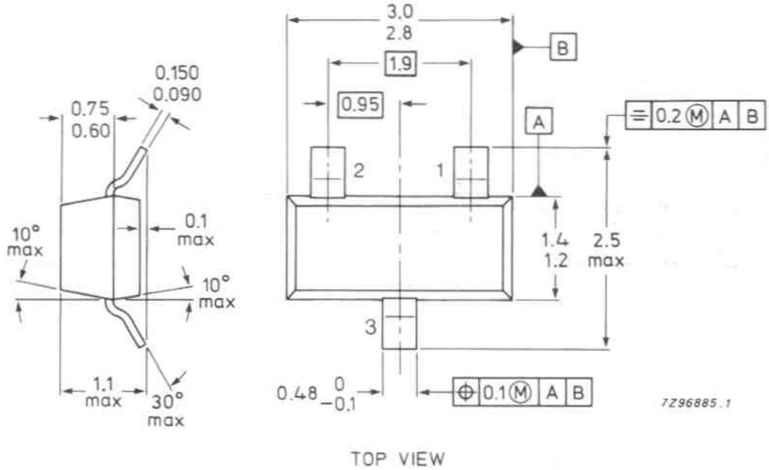
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)DSS}$	drain-source breakdown voltage	V_{GS} = 0 I_D = 250 μA	240	-	-	V
I_{DSS}	drain-source leakage current	V_{GS} = 0 V_{DS} = 130 V	-	-	30	nA
		V_{GS} = 0 V_{DS} = 240 V	-	-	15	μA
		V_{GS} = 0 V_{DS} = 240 V T_j = 125 °C	-	-	60	μA
I_{GSS}	gate-source leakage current	V_{DS} = 0 V_{GS} = 20 V	-	-	10	nA
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA V_{DS} = V_{GS}	0.8	-	2.8	V
$R_{DS(on)}$	drain-source on resistance	V_{GS} = 10 V I_D = 100 mA	-	-	16	Ω
$\|Y_{fs}\|$	transfer admittance	V_{DS} = 25 V I_D = 100 mA f = 1 kHz	60	100	-	mS
C_{iss}	input capacitance	V_{DS} = 25 V V_{GS} = 0 f = 1 MHz	-	20	-	pF
C_{oss}	output capacitance	V_{DS} = 25 V V_{GS} = 0 f = 1 MHz	-	6	-	pF
C_{rss}	feedback capacitance	V_{DS} = 25 V V_{GS} = 0 f = 1 MHz	-	2.5	-	pF
t_{on}	turn-on time	V_{CC} = 30 V I_D = 0.28 A V_{GS} = 0-5 V	-	20	-	ns
t_{off}	turn-off time	V_{CC} = 30 V I_D = 0.28 A V_{GS} = 0-5 V	-	40	-	ns

N-channel enhancement mode vertical D-MOS FET

BSS131

PACKAGE OUTLINE

Dimensions in mm



Marking: SR

Fig.3 SOT23.

Philips Components

Data sheet	
status	Product specification
date of issue	April 1991

BSS192

P-channel enhancement mode vertical D-MOS transistor

FEATURES

- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No secondary breakdown.

DESCRIPTION

P-channel enhancement mode vertical D-MOS transistor in a SOT89 envelope, intended for use in relay, high-speed and line transformer drivers, and as a line current interruptor in telephony applications.

PINNING - SOT89

PIN	DESCRIPTION
1	source
2	gate
3	drain

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$-V_{DS}$	drain-source voltage		200	V
$-I_D$	drain current	DC value	150	mA
$R_{DS(on)}$	drain-source on-resistance	$-I_D$ = 100 mA $-V_{GS}$ = 10 V	20	Ω
$V_{GS(th)}$	gate-source threshold voltage	$-I_D$ = 1 mA $V_{GS} = V_{DS}$	2.8	V

PIN CONFIGURATION

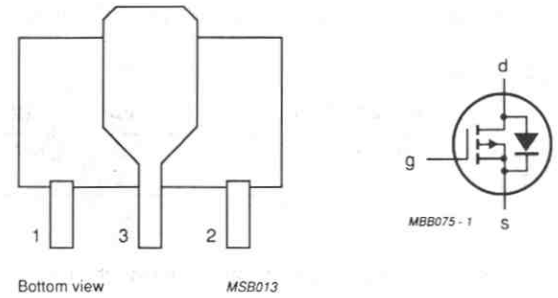


Fig.1 Simplified outline and symbol.

P-channel enhancement mode vertical D-MOS transistor

BSS192

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$-V_{DS}$	drain-source voltage		–	200	V
$\pm V_{GSO}$	gate-source voltage	open drain	–	20	V
$-I_D$	drain current	DC value	–	150	mA
$-I_{DM}$	drain current	peak value	–	600	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C (note 1)	–	1	W
T_{stg}	storage temperature range		−65	150	°C
T_j	junction temperature		–	150	°C

Note

1. Transistor mounted on a ceramic substrate, area 2.5 cm^2, thickness 0.7 mm.

THERMAL RESISTANCE

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j-a}$	from junction to ambient (note 1)	125	K/W

Note

1. Transistor mounted on a ceramic substrate, area 2.5 cm^2, thickness 0.7 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$-V_{(BR)DSS}$	drain-source breakdown voltage	$-I_D$ = 10 μA V_{GS} = 0	200	–	–	V
$-I_{DSS}$	drain-source leakage current	$-V_{DS}$ = 60 V V_{GS} = 0	–	–	0.2	μA
		$-V_{DS}$ = 200 V $-V_{GS}$ = 0.2 V	–	0.1	60	μA
$\pm I_{GSS}$	gate-source leakage current	$\pm V_{GS}$ = 20 V V_{DS} = 0	–	–	100	nA
$-V_{GS(th)}$	gate-source threshold voltage	$-I_D$ = 1 mA $V_{GS} = V_{DS}$	0.8	–	2.8	V
$R_{DS(on)}$	drain-source on-resistance	$-I_D$ = 100 mA $-V_{GS}$ = 10 V	–	10	20	Ω
$\|Y_{fs}\|$	transfer admittance	$-I_D$ = 200 mA $-V_{DS}$ = 25 V	60	200	–	mS
C_{iss}	input capacitance	$-V_{DS}$ = 25 V V_{GS} = 0 f = 1 MHz	–	55	90	pF
C_{oss}	output capacitance	$-V_{DS}$ = 25 V V_{GS} = 0 f = 1 MHz	–	20	30	pF
C_{rss}	feedback capacitance	$-V_{DS}$ = 25 V V_{GS} = 0 f = 1 MHz	–	5	15	pF
Switching times (see Figs 2 and 3)						
t_{on}	turn-on time	$-I_D$ = 250 mA $-V_{DD}$ = 50 V $-V_{GS}$ = 0 to 10 V	–	5	10	ns
t_{off}	turn-off time	$-I_D$ = 250 mA $-V_{DD}$ = 50 V $-V_{GS}$ = 0 to 10 V	–	20	30	ns

P-channel enhancement mode vertical D-MOS transistor

BSS192

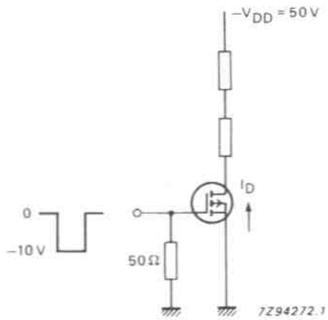


Fig.2 Switching time test circuit.

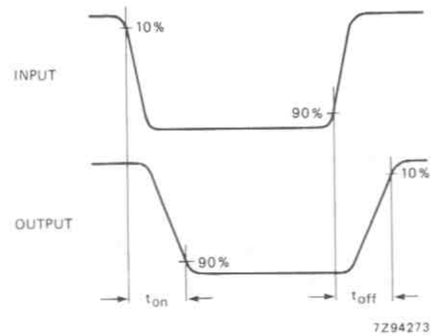


Fig.3 Input and output waveforms.

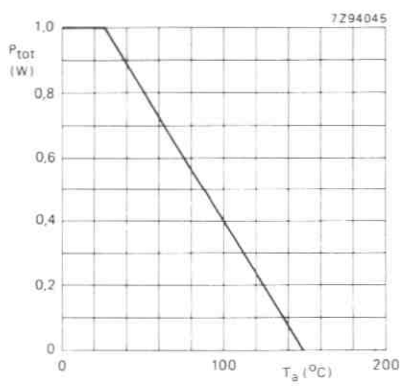


Fig.4 Power derating curve.

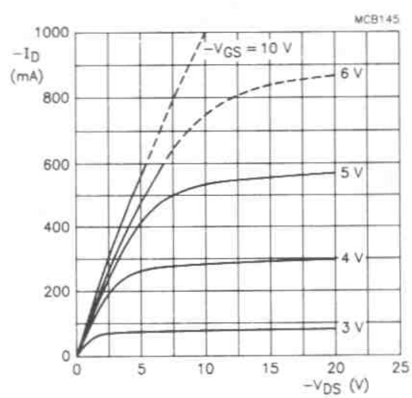


Fig.5 Typical output characteristics; T_j = 25 °C.

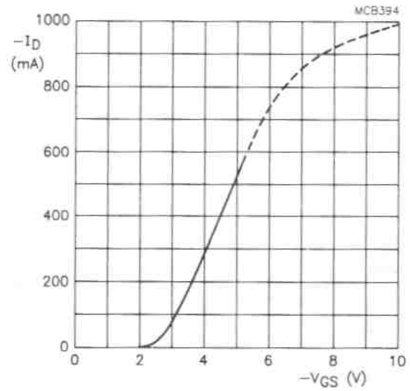


Fig.6 Typical transfer characteristic;
$-V_{DS}$ = 10 V; T_j = 25 °C.

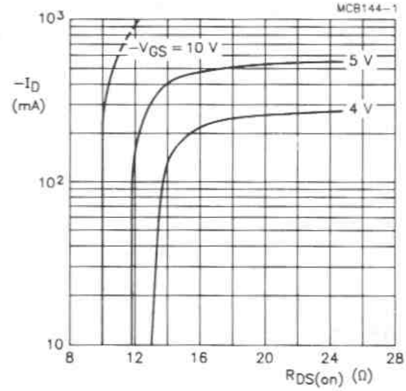


Fig.7 Typical on-resistance as a function of
drain current; T_j = 25 °C.

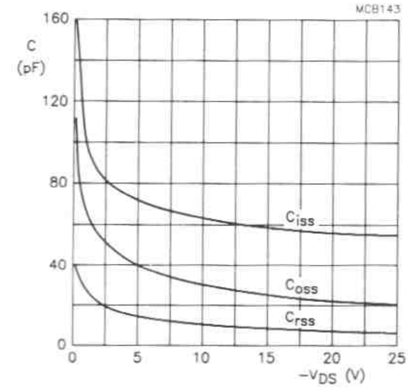


Fig.8 Typical capacitances as a function of
drain-source voltage; V_{GS} = 0; f = 1 MHz;
T_j = 25 °C.

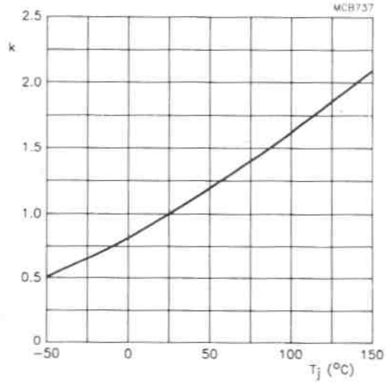


Fig.9 Temperature coefficient of drain-source
on-resistance; $k = \frac{R_{DS(on)}\ at\ T_j}{R_{DS(on)}\ at\ 25\ °C}$; typical $R_{DS(on)}$
at −200 mA/−10 V.

P-channel enhancement mode vertical D-MOS transistor

BSS192

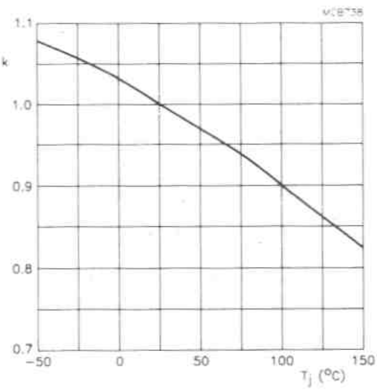


Fig.10 Temperature coefficient of gate-source threshold voltage; $k = \frac{-V_{GS(th)} \ at \ T_j}{-V_{GS(th)} \ at \ 25\ °C}$; typical $V_{GS(th)}$ at −1 mA.

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors in miniature plastic envelopes intended for use in amplifier and switching applications. Complementary types are BST39/40.

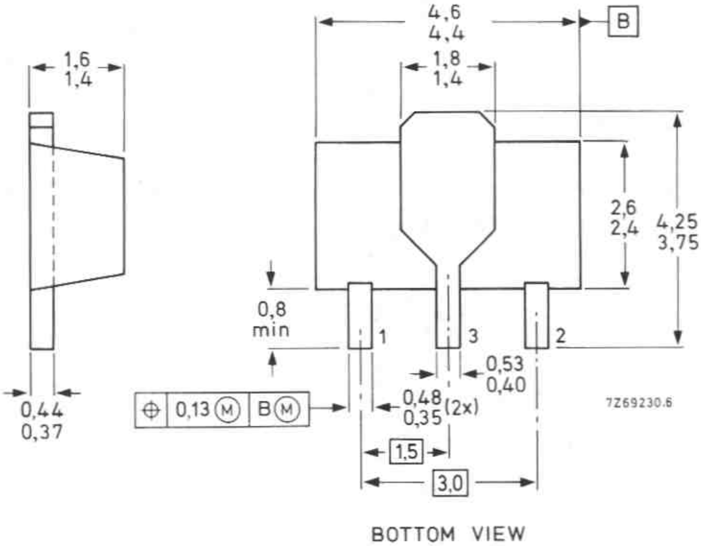
QUICK REFERENCE DATA

			BST15	BST16	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	200	350	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	200	300	V
Collector current (d.c.)	$-I_C$	max.	1		A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1		W
Junction temperature	T_j	max.	150		°C
D.C. current gain $-V_{CE}$ = 10 V; $-I_C$ = 50 mA	h_{FE}		30 to 150	30 to 120	
Transition frequency $-V_{CE}$ = 10 V; $-I_C$ = 10 mA	f_T	>	15		MHz

MECHANICAL DATA

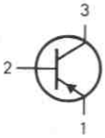
Dimensions in mm

Fig. 1 SOT-89.



Marking code

BST15 = BT1
BST16 = BT2



See also *Soldering Recommendations*

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BST15	BST16	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	200	350	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	200	300	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	4	6	V
Collector current (d.c.)	$-I_C$	max.	1		A
Base current	$-I_B$	max.	0,5		A
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	1		W
Junction temperature	T_j	max.	150		°C
Storage temperature	T_{stg}		−65 to 150		°C

THERMAL RESISTANCE

from junction to ambient*	$R_{th\ j\text{-}mb}$	=	125	K/W
from junction to collector tab	$R_{th\ j\text{-}tab}$	=	10	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BST15	BST16	
Collector cut-off current					
$I_E = 0$; $-V_{CB}$ = 175 V	$-I_{CBO}$	<	1	–	μA
$I_E = 0$; $-V_{CB}$ = 280 V	$-I_{CBO}$	<	–	1	μA
$I_B = 0$; $-V_{CE}$ = 150 V	$-I_{CEO}$	<	50	–	μA
$I_B = 0$; $-V_{CE}$ = 250 V	$-I_{CEO}$	<	–	50	μA
Emitter cut-off current					
$I_C = 0$; $-V_{EB}$ = 4 V	$-I_{EBO}$	<	20	–	μA
$I_C = 0$; $-V_{EB}$ = 6 V	$-I_{EBO}$	<	–	20	μA
Collector-emitter breakdown voltage					
$I_B = 0$; $-I_C$ = 50 mA; L = 25 mH	$-V_{(BR)CEO}$	>	200	300	V
Collector-emitter saturation voltage					
$-I_C$ = 50 mA; $-I_B$ = 5 mA	$-V_{CEsat}$	<	2,5	2,0	V
D.C. current gain					
$-V_{CE}$ = 10 V; $-I_C$ = 50 mA	h_{FE}		30 to 150	30 to 120	
Transition frequency at f = 30 MHz					
$-I_C$ = 10 mA; $-V_{CE}$ = 10 V	f_T	>	15		MHz
Collector capacitance at f = 1 MHz					
$I_E = I_e = 0$; $-V_{CB}$ = 10 V	C_c	<	15		pF

* Mounted on an area of 2,5 cm² of a ceramic substrate; thickness 0,7 mm.

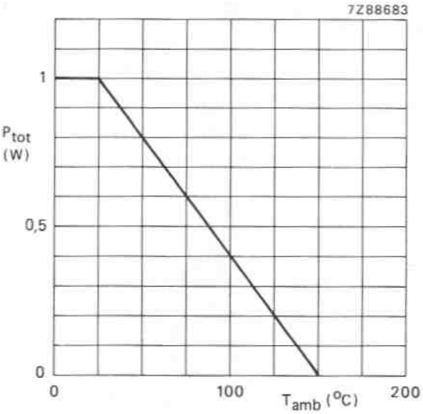


Fig. 2 Power derating curve.

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in miniature plastic envelopes intended for use in amplifier and switching applications. Complementary p-n-p types are BST15/16.

QUICK REFERENCE DATA

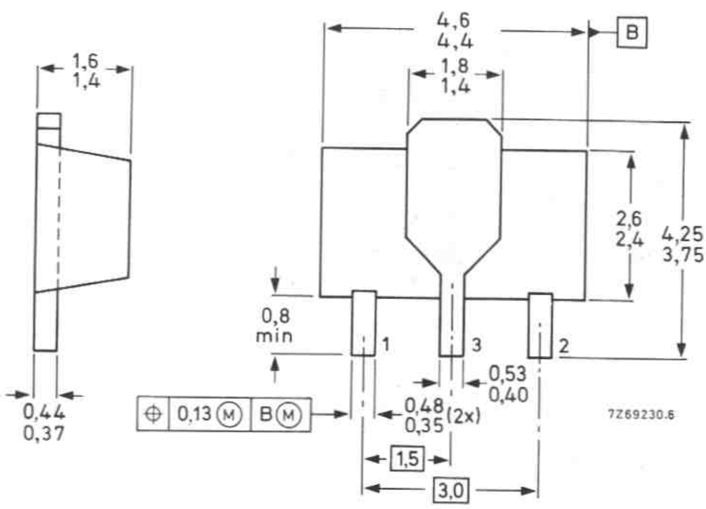
			BST39	BST40	
Collector-base voltage (open emitter)	V_{CBO}	max.	400	300	V
Collector-emitter voltage (open base)	V_{CEO}	max.	350	250	V
Collector current (d.c.)	I_C	max.	1		A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1		W
Junction temperature	T_j	max.	150		°C
D.C. current gain V_{CE} = 10 V; I_C = 20 mA	h_{FE}	min.	40		
Transition frequency at f = 5 MHz V_{CE} = 10 V; I_C = 10 mA	f_T	min.	70		MHz

MECHANICAL DATA

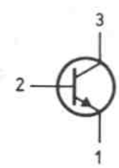
Dimensions in mm

Fig. 1 SOT-89.

Marking code
BST39 = AT1
BST40 = AT2



BOTTOM VIEW



See also *Soldering Recommendations.*

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BST39	BST40	
Collector-base voltage (open emitter)	V_{CBO}	max.	400	300	V
Collector-emitter voltage (open base)	V_{CEO}	max.	350	250	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5		V
Collector current (d.c.)	I_C	max.	1		A
Base current	I_B	max.	0,5		A
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	1		W
Junction temperature	T_j	max.	150		°C
Storage temperature	T_{stg}		−65 to 150		°C

THERMAL RESISTANCE

from junction to ambient*	$R_{th\,j\text{-}a}$	=	125	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current $I_B = 0$; $V_{CE} = 300$ V	I_{CBO}	⩽	20	nA
Emitter cut-off current $I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	⩽	10	µA
Collector-emitter saturation voltage $I_C = 50$ mA; $I_B = 4$ mA	V_{CEsat}	⩽	0,5	V
Base-emitter saturation voltage $I_C = 50$ mA; $I_B = 4$ mA	V_{BEsat}	⩽	1,3	V
D.C. current gain $V_{CE} = 10$ V; $I_C = 20$ mA	h_{FE}	⩽	40	
Collector capacitance at f = 1 MHz $I_E = i_e = 0$; $V_{CB} = 10$ V	C_c	⩽	2	pF
Emitter capacitance at f = 1 MHz $I_C = I_c = 0$; $V_{EB} = 5$ V	C_e	⩽	20	pF
Transition frequency at f = 5 MHz $V_{CE} = 10$ V; $I_C = 10$ mA	f_T	⩾	70	MHz

* Mounted on an area of 2,5 cm^2 of a ceramic substrate; thickness 0,7 mm.

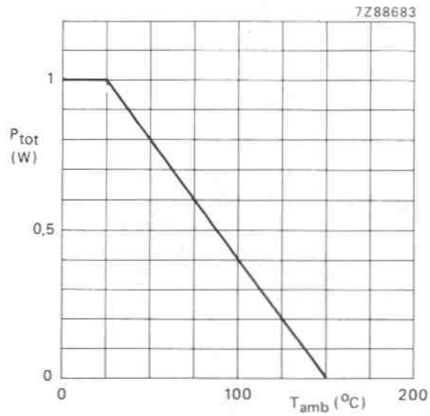


Fig. 2 Power derating curve.

N-P-N SILICON PLANAR DARLINGTON TRANSISTORS

Silicon n-p-n planar Darlington transistors for industrial switching applications, e.g. print hammer, solenoid, relay and lamp driving. Encapsulated in a microminiature SOT-89 envelope.

P-N-P complements are BST60, 61, 62 respectively.

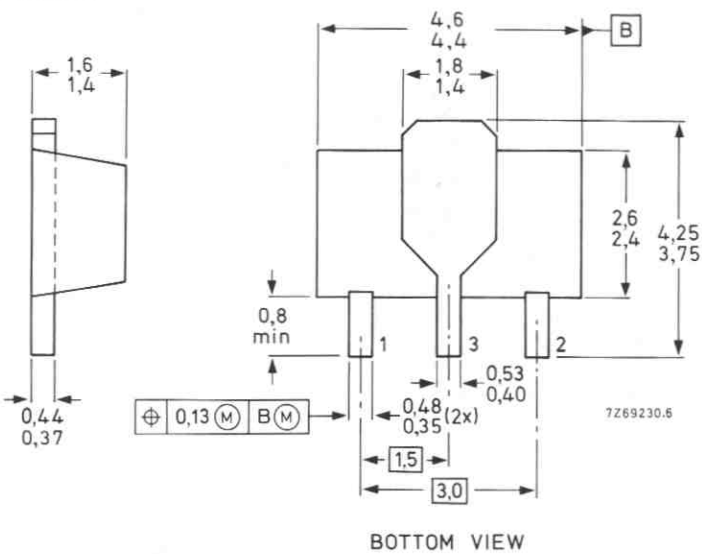
QUICK REFERENCE DATA

			BST50	BST51	BST52	
Collector-base voltage (open emitter)	V_{CBO}	max.	60	80	90	V
Collector-emitter voltage	V_{CER}	max.	45	60	80	V
Collector current	I_C	max.	0,5	0,5	0,5	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		1		W
D.C. current gain I_C = 500 mA; V_{CE} = 10 V	h_{FE}	>		2000		
Collector-emitter saturation voltage I_C = 500 mA; I_B = 0,5 mA	V_{CEsat}	<		1,3		V
Turn-off time I_C = 500 mA; $I_{Bon} = -I_{Boff}$ = 0,5 mA	t_{off}	typ.		1500		ns

MECHANICAL DATA

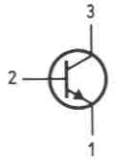
Dimensions in mm

Fig. 1 SOT-89.



Marking code

BST50 = AS1
BST51 = AS2
BST52 = AS3



See also *Soldering recommendations.*

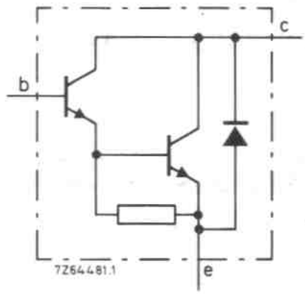


Fig. 2 Circuit diagram.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BST50	BST51	BST52	
Collector-base voltage (open emitter)	V_{CBO}	max.	60	80	90	V
Collector-emitter voltage *	V_{CER}	max.	45	60	80	V
Emitter-base voltage (open collector)	V_{EBO}	max.		5		V
Collector current (d.c.)	I_C	max.		0,5		A
Collector current (peak)	I_{CM}	max.		1,5		A
Base current (d.c.)	I_B	max.		0,1		A
Total power dissipation ▲ up to T_{amb} = 25 °C	P_{tot}	max.		1		W
Storage temperature	T_{stg}			−65 to + 150		°C
Junction temperature **	T_j	max.		150		°C

THERMAL RESISTANCE **

From junction to ambient▲	$R_{th\ j\text{-}a}$	=	125	K/W
From junction to tab	$R_{th\ j\text{-}tab}$	=	10	K/W

* External R_{BE} not to exceed value shown in Fig. 5.

** Based on maximum average junction temperature in line with common industrial practice. The resulting higher junction temperature of the output transistor part is taken into account.

▲ Device mounted on a ceramic substrate; area = 2,5 cm², thickness = 0,7 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
V_{BE} = 0; V_{CE} = V_{CER}max	I_{CES}	<	10 μA
Emitter cut-off current			
I_C = 0; V_{EB} = 4 V	I_{EBO}	<	10 μA
D.C. current gain*			
I_C = 150 mA; V_{CE} = 10 V	h_{FE}	>	1000
I_C = 500 mA; V_{CE} = 10 V	h_{FE}	>	2000
Collector-emitter saturation voltage			
I_C = 500 mA; I_B = 0,5 mA	V_{CEsat}	<	1,3 V
I_C = 500 mA; I_B = 0,5 mA; T_j = 150 °C	V_{CEsat}	<	1,3 V
Base-emitter saturation voltage			
I_C = 500 mA; I_B = 0,5 mA	V_{BEsat}	<	1,9 V
Switching times (see also Fig. 3 and Fig. 4)			
I_C = 500 mA; I_{Bon} = $-I_{Boff}$ = 0,5 mA			
Turn-on time	t_{on}	typ.	400 ns
Turn-off time	t_{off}	typ.	1500 ns

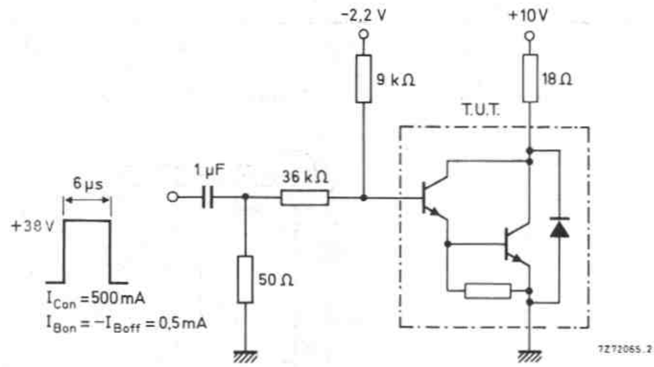


Fig. 3 Switching times test circuit.

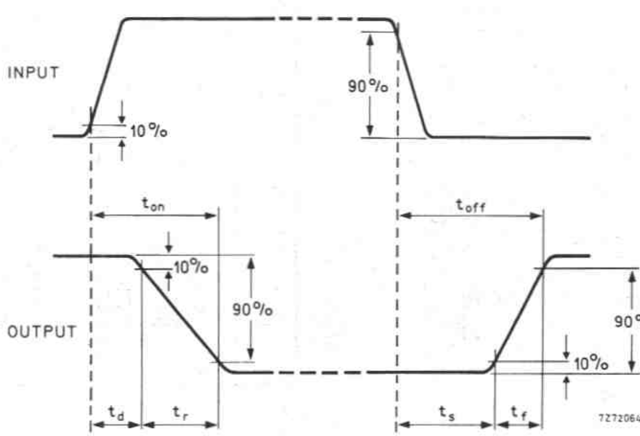


Fig. 4 Switching times waveform.

* Measured under pulsed conditions.

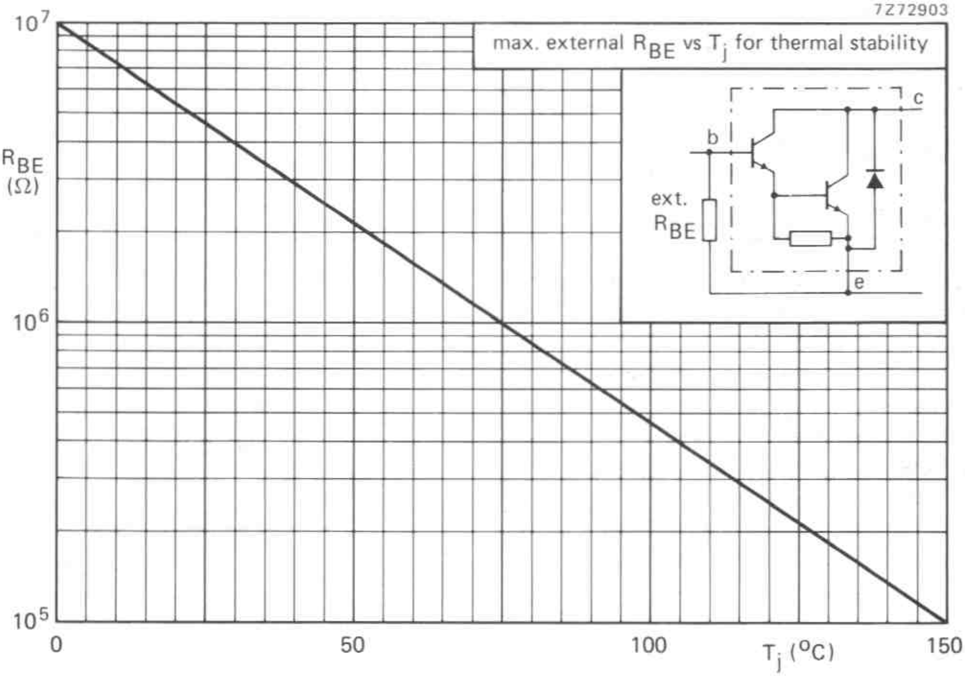


Fig. 5 Maximum values external R_{BE} as a function of junction temperature.

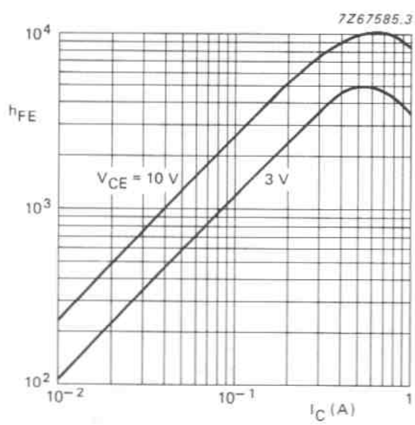


Fig. 6 T_j = 25 °C.

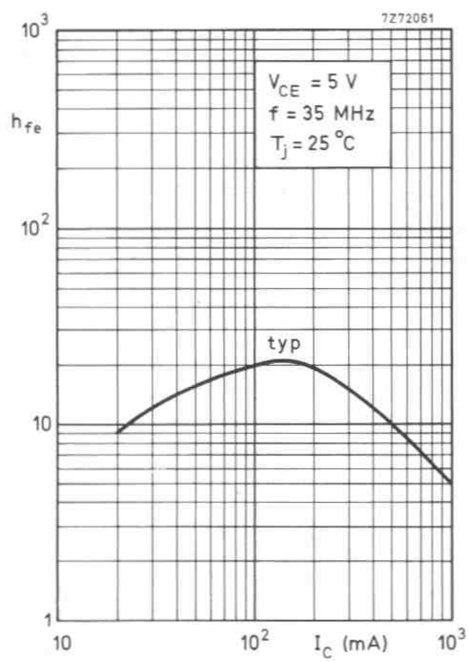


Fig. 7.

P-N-P SILICON PLANAR DARLINGTON TRANSISTORS

Silicon p-n-p planar Darlington transistors for industrial switching applications, e.g. print hammer, solenoid, relay and lamp driving. Encapsulated in a microminiature plastic SOT-89 envelope.

N-P-N complements are BST50, BST51 and BST52 respectively.

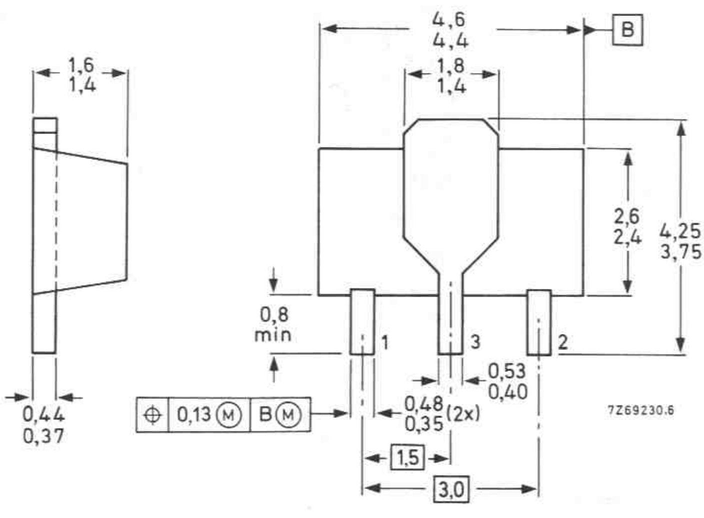
QUICK REFERENCE DATA

			BST60	BST61	BST62	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60	80	90	V
Collector-emitter voltage	$-V_{CER}$	max.	45	60	80	V
Collector current	$-I_C$	max.	0,5	0,5	0,5	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		1		W
D.C. current gain $-I_C$ = 500 mA; $-V_{CE}$ = 10 V	h_{FE}	>		2000		
Collector-emitter saturation voltage $-I_C$ = 0,5 A; $-I_B$ = 0,5 mA	$-V_{CEsat}$	<		1,3		V
Turn-off time $-I_C$ = 500 mA; $-I_{Bon}$ = I_{Boff} = 0,5 mA	t_{off}	typ.		1500		ns

MECHANICAL DATA

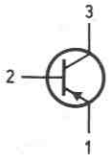
Dimensions in mm

Fig. 1 SOT-89.



Marking code

BST60 = BS1
BST61 = BS2
BST62 = BS3



See also *Soldering recommendations.*

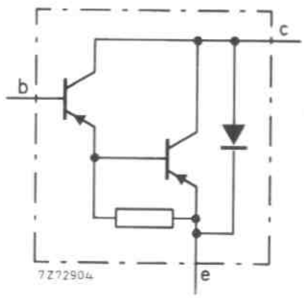


Fig. 2 Circuit diagram.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BST60	BST61	BST62	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60	80	90	V
Collector-emitter voltage*	$-V_{CER}$	max.	45	60	80	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.		5		V
Collector current (d.c.)	$-I_C$	max.		0,5		A
Collector current (peak)	$-I_{CM}$	max.		1,5		A
Base current (d.c.)	$-I_B$	max.		0,1		A
Total power dissipation ▲ up to T_{amb} = 25 °C	P_{tot}	max.		1		W
Storage temperature	T_{stg}			−65 to + 150		°C
Junction temperature **	T_j	max.		150		°C

THERMAL RESISTANCE **

From junction to ambient ▲	$R_{th\,j\text{-}a}$	=	125	K/W
From junction to tab	$R_{th\,j\text{-}tab}$	=	10	K/W

* External R_{BE} not to exceed value shown in Fig. 5.

** Based on maximum average junction temperature in line with common industrial practice. The resulting higher junction temperature of the output transistor part is taken into account.

▲ Device mounted on a ceramic substrate area 2,5 cm^2, thickness = 0,7 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
$V_{BE} = 0$; $-V_{CE} = -V_{CERmax}$	$-I_{CES}$	<	10 μA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 4$ V	$-I_{EBO}$	<	10 μA
D.C. current gain*			
$-I_C$ = 150 mA; $-V_{CE}$ = 10 V	h_{FE}	>	1000
$-I_C$ = 500 mA; $-V_{CE}$ = 10 V	h_{FE}	>	2000
Collector-emitter saturation voltage			
$-I_C$ = 500 mA; $-I_B$ = 0,5 mA	$-V_{CEsat}$	<	1,3 V
$-I_C$ = 500 mA; $-I_B$ = 0,5 mA; T_j = 150 °C	$-V_{CEsat}$	<	1,3 V
Base-emitter saturation voltage			
$-I_C$ = 500 mA; $-I_B$ = 0,5 mA	$-V_{BEsat}$	<	1,9 V
Switching times (see also Fig. 3 and Fig. 4)			
$-I_C$ = 500 mA; $-I_{Bon} = -I_{Boff}$ = 0,5 mA			
Turn-on time	t_{on}	typ.	400 ns
Turn-off time	t_{off}	typ.	1500 ns

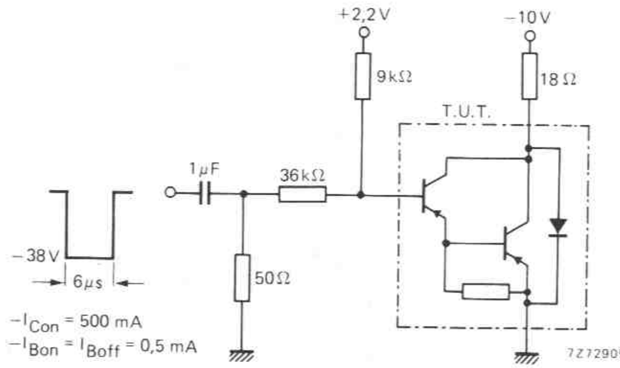


Fig. 3 Switching times test circuit.

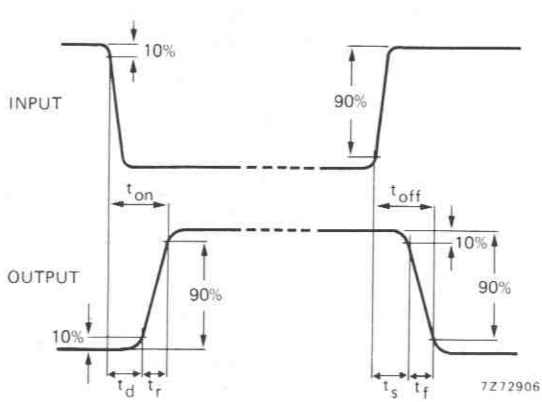


Fig. 4 Switching times waveform.

* Measured under pulsed conditions.

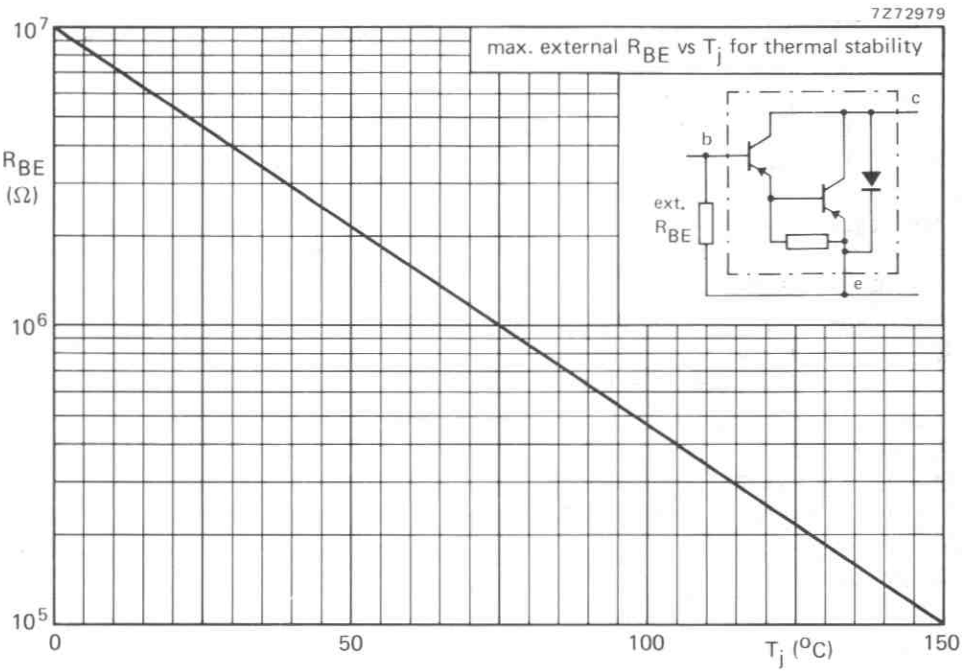


Fig. 5 Maximum values external R_{BE} as a function of junction temperature.

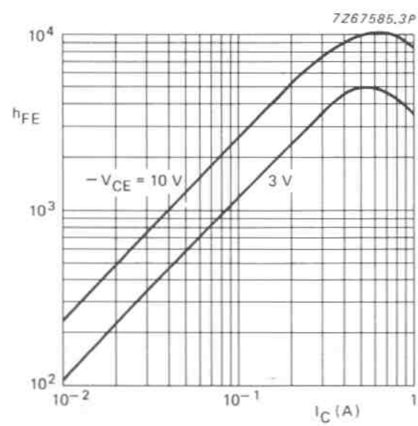


Fig. 6 T_j = 25 °C.

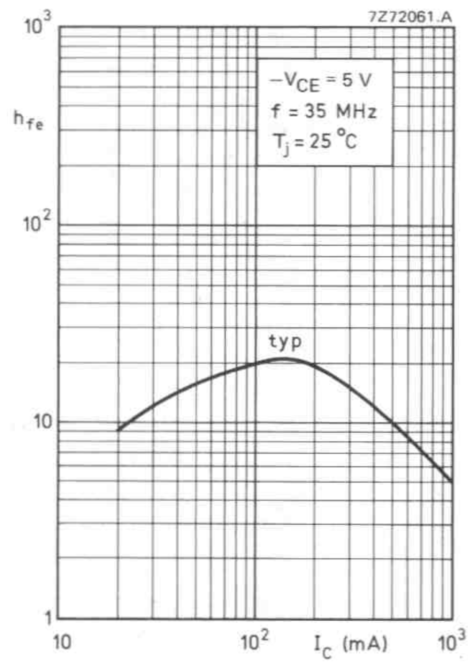


Fig. 7.

N-CHANNEL ENHANCEMENT MODE VERTICAL D-MOS TRANSISTOR

N-channel enhancement mode vertical D-MOS transistor in SOT89 envelope and designed for use as Surface Mounted Device (SMD) in thin and thick-film circuits for application with relay, high-speed and line-transformer drivers.

Features

- Low $R_{DS\,on}$
- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No second breakdown

QUICK REFERENCE DATA

Drain-source voltage	V_{DS}	max.	80 V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20 V
Drain current (DC)	I_D	max.	0.5 A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1 W
Drain-source ON-resistance I_D = 500 mA; V_{GS} = 10 V	R_{DSon}	typ.	2.0 Ω
		max.	4.0 Ω
Transfer admittance I_D = 500 mA; V_{DS} = 15 V	$\lvert y_{fs} \rvert$	typ.	300 mS

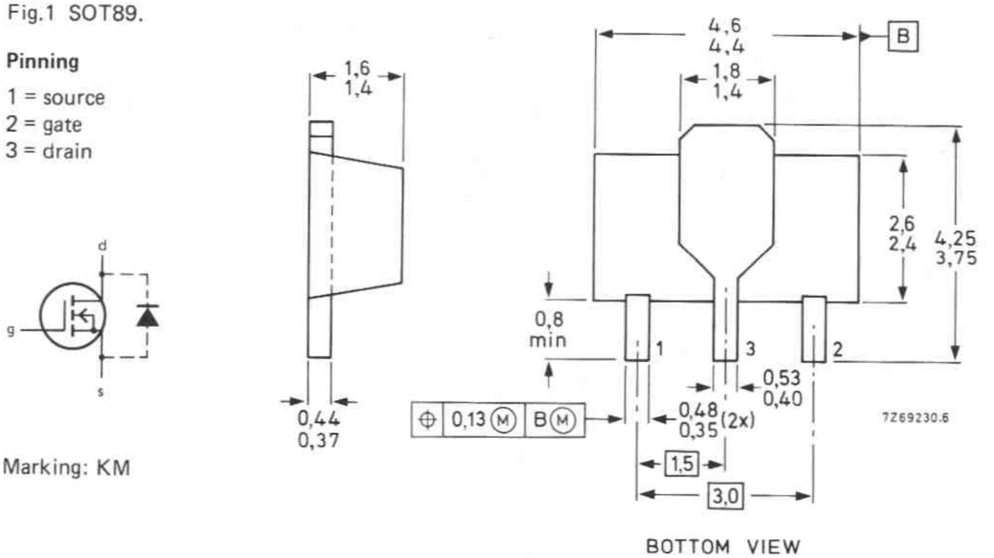
MECHANICAL DATA

Dimensions in mm

Fig.1 SOT89.

Pinning

1 = source
2 = gate
3 = drain



Marking: KM

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	V_{DS}	max.	80 V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20 V
Drain current (DC)	I_D	max.	0.5 A
Drain current (peak)	I_{DM}	max.	1.0 A
Total power dissipation up to T_{amb} = 25 °C (note 1)	P_{tot}	max.	1 W
Storage temperature range	T_{stg}	−65 to + 150 °C	
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient (note 1)	$R_{th\ j\text{-}a}$	=	125 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Drain-source breakdown voltage I_D = 100 μA; V_{GS} = 0	$V_{(BR)DSS}$	min.	80 V
Drain-source leakage current V_{DS} = 60 V; V_{GS} = 0	I_{DSS}	max.	10 μA
Gate-source leakage current V_{GS} = 20 V; V_{DS} = 0	I_{GSS}	max.	100 nA
Gate threshold voltage I_D = 1 mA; V_{DS} = V_{GS}	$V_{GS(th)}$	min. max.	1.5 V 3.5 V
Drain-source ON-resistance I_D = 500 mA; V_{GS} = 10 V	R_{DSon}	typ. max.	2.0 Ω 4.0 Ω
Transfer admittance I_D = 500 mA; V_{DS} = 15 V	$\lvert y_{fs} \rvert$	typ.	300 mS
Input capacitance at f = 1 MHz V_{DS} = 10 V; V_{GS} = 0	C_{iss}	typ. max.	45 pF 60 pF
Output capacitance at f = 1 MHz V_{DS} = 10 V; V_{GS} = 0	C_{oss}	typ. max.	30 pF 45 pF
Feedback capacitance at f = 1 MHz V_{DS} = 10 V; V_{GS} = 0	C_{rss}	typ. max.	8 pF 12 pF
Switching times (see Figs 2 and 3) I_D = 500 mA; V_{DD}= 50 V; V_{GS} = 0 to 10 V	t_{on} t_{off}	max. max.	10 ns 15 ns

Note

1. Transistors mounted on a substrate with surface area of 2.5 cm^2 and thickness of 0.7 mm.

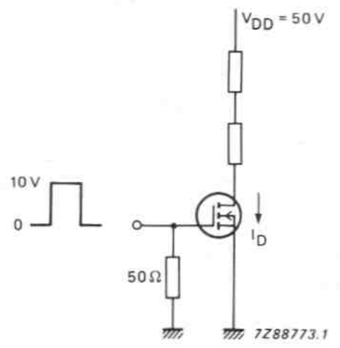


Fig.2 Switching times test circuit.

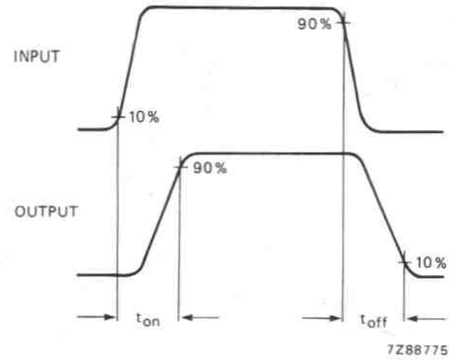


Fig.3 Input and output waveforms.

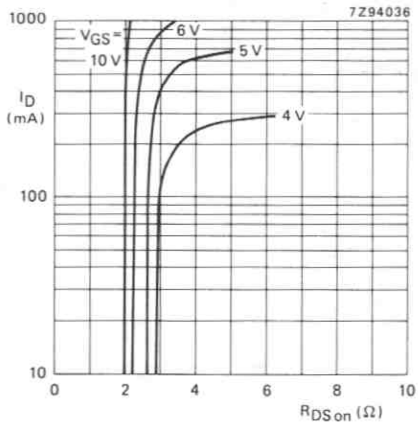


Fig.4 T_j = 25 °C; typical values.

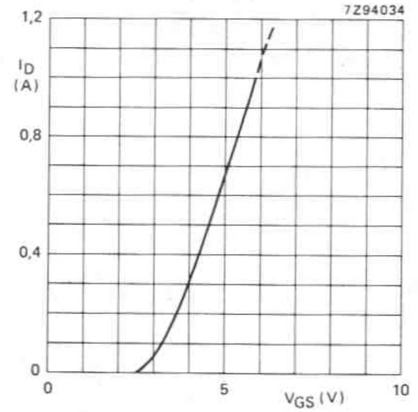


Fig.5 T_j = 25 °C; typical values at V_{DS} = 10 V.

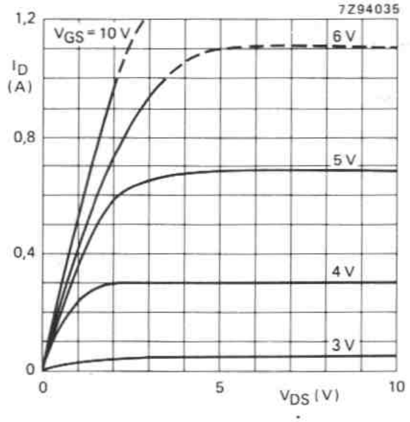


Fig.6 T_j = 25 °C; typical values.

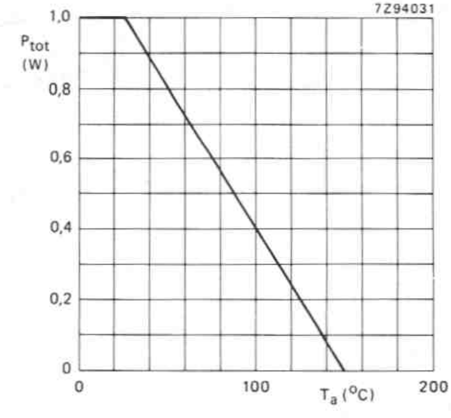


Fig.7 Power derating curve.

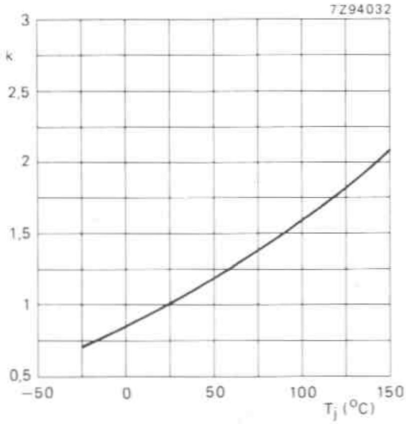


Fig.8 $k = \frac{R_{DS\,on} \text{ at } T_j}{R_{DS\,on} \text{ at } 25\ ^oC}$; typ. values. at 500 mA/10 V.

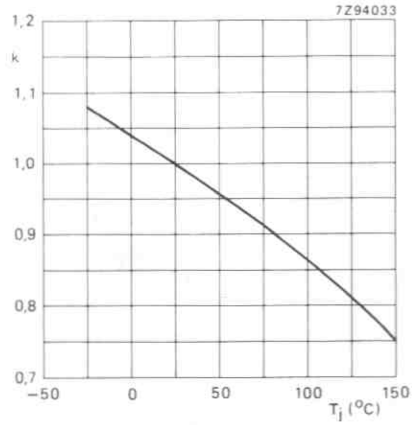


Fig.9 $k = \frac{V_{GS(th)} \text{ at } T_j}{V_{GS(th)} \text{ at } 25\ ^oC}$; $V_{GS(th)}$ at 1 mA; typical values.

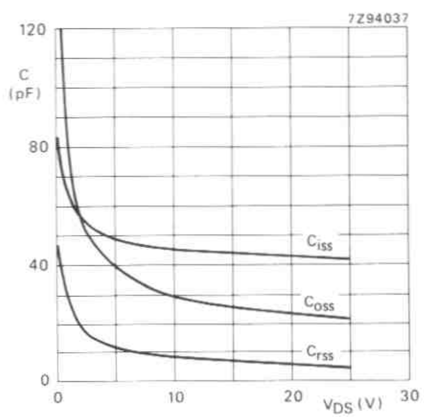


Fig.10 T_j = 25 °C; V_{GS} = 0; f = 1 MHz; typical values.

N-CHANNEL ENHANCEMENT MODE VERTICAL D-MOS TRANSISTOR

N-channel enhancement mode vertical D-MOS transistor in SOT23 envelope and designed for use as Surface Mounted Device (SMD) in thin and thick-film circuits for telephone ringer and for application with relay, high-speed and line transformer drivers.

Features

- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No second breakdown
- Low $R_{DS\ on}$

QUICK REFERENCE DATA

Drain-source voltage	V_{DS}	max.	80	V
Drain-source voltage (non-repetitive peak; $t_p \leqslant 2$ ms)	$V_{DS(SM)}$	max.	100	V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20	V
Drain current (DC)	I_D	max.	175	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Drain-source ON-resistance I_D = 150 mA; V_{GS} = 5 V	R_{DSon}	typ. max.	7 10	Ω Ω
Transfer admittance I_D = 175 mA; V_{DS} = 5 V	$\lvert y_{fs} \rvert$	typ.	150	mS

MECHANICAL DATA

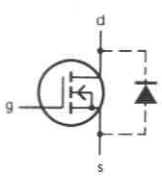
Dimensions in mm

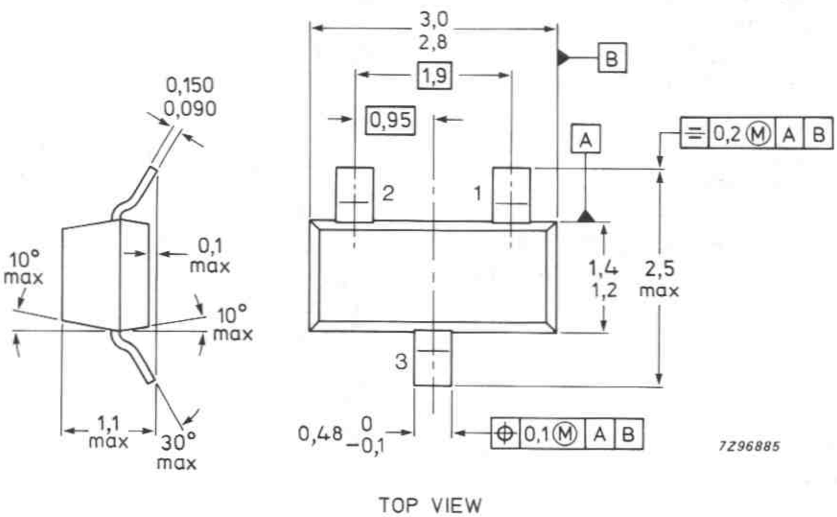
Fig.1 SOT23.

Marking: 02p

Pinning

1 = gate
2 = source
3 = drain





RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	V_{DS}	max.	80 V
Drain-source voltage (non-repetitive peak; $t_p \leq 2$ ms)	$V_{DS(SM)}$	max.	100 V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20 V
Drain current (DC)	I_D	max.	175 mA
Drain current (peak)	I_{DM}	max.	600 mA
Total power dissipation up to T_{amb} = 25 °C (note 1)	P_{tot}	max.	300 mW
Storage temperature range	T_{stg}	−65 to + 150 °C	
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient (note 1)	$R_{th\ j\text{-}a}$	=	430 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Drain-source breakdown voltage I_D = 100 μA; V_{GS} = 0	$V_{(BR)DSS}$	min.	80 V
Drain-source leakage current V_{DS} = 60 V; V_{GS} = 0	I_{DSS}	max.	1.0 μA
Gate-source leakage current V_{GS} = 20 V; V_{DS} = 0	I_{GSS}	max.	100 nA
Gate-source cut-off voltage I_D = 1 mA; V_{DS} = V_{GS}	$V_{(P)GS}$	min. max.	1.5 V 3.5 V
Drain-source ON-resistance I_D = 150 mA; V_{GS} = 5 V	R_{DSon}	typ. max.	7 Ω 10 Ω
Transfer admittance I_D = 175 mA; V_{DS} = 5 V	$\|y_{fs}\|$	typ.	150 mS
Input capacitance at f = 1 MHz V_{DS} = 10 V; V_{GS} = 0	C_{iss}	typ. max.	15 pF 30 pF
Output capacitance at f = 1 MHz V_{DS} = 10 V; V_{GS} = 0	C_{oss}	typ. max.	13 pF 20 pF
Feedback capacitance at f = 1 MHz V_{DS} = 10 V; V_{GS} = 0	C_{rss}	typ. max.	3 pF 6 pF
Switching times (see Figs 2 and 3) I_D = 175 mA; V_{DD} = 50 V; V_{GS} = 0 to 10 V	t_{on}	typ. max.	4 ns 10 ns
	t_{off}	typ. max.	4 ns 10 ns

Note

1. Transistors mounted on a ceramic substrate of 7 mm x 5 mm x 0.7 mm.

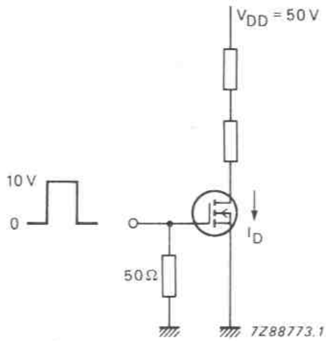


Fig.2 Switching times test circuit.

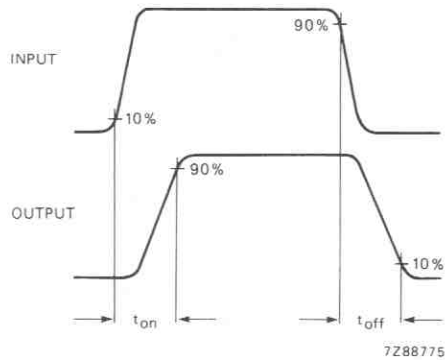


Fig.3 Input and output waveforms.

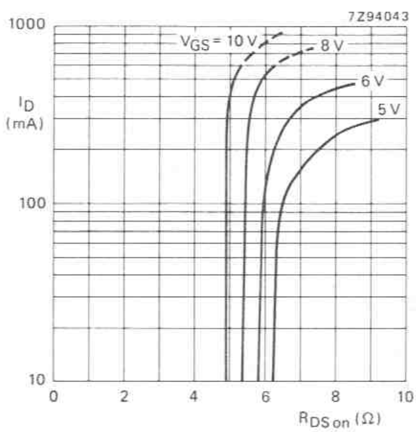


Fig.4 T_j = 25 °C; typical values.

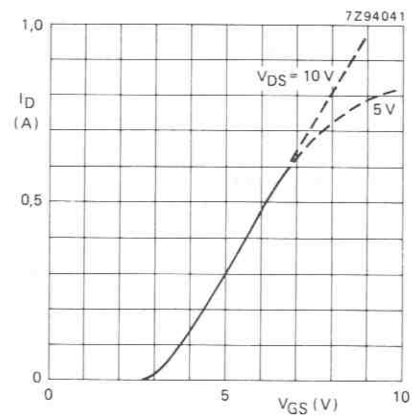


Fig.5 T_j = 25 °C; typical values.

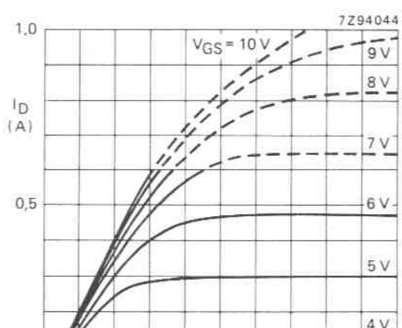


Fig.6 T_j = 25 °C; typical values.

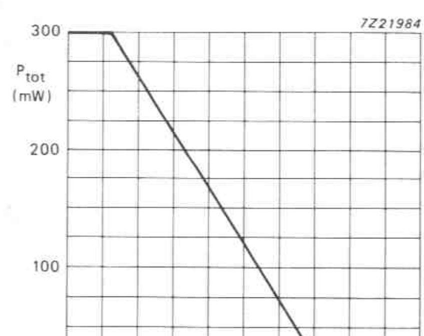


Fig.7 Power derating curve.

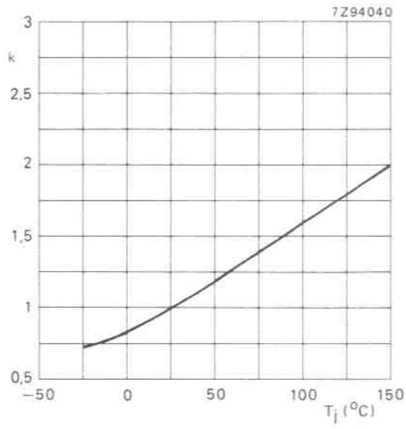


Fig.8 $k = \frac{R_{DS\,on} \text{ at } T_j}{R_{DS\,on} \text{ at } 25\,^{\circ}C}$; typ. values at 150 mA/5 V.

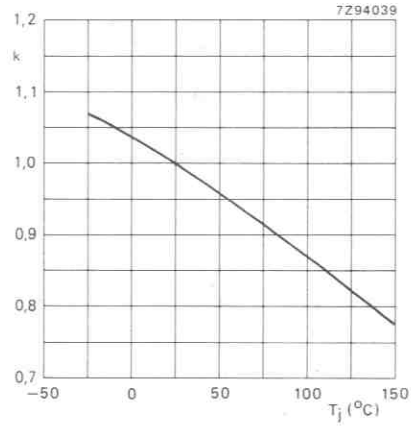


Fig.9 $k = \frac{V_{GS(th)} \text{ at } T_j}{V_{GS(th)} \text{ at } 25\,^{\circ}C}$; $V_{GS(th)}$ at 1 mA; typical values.

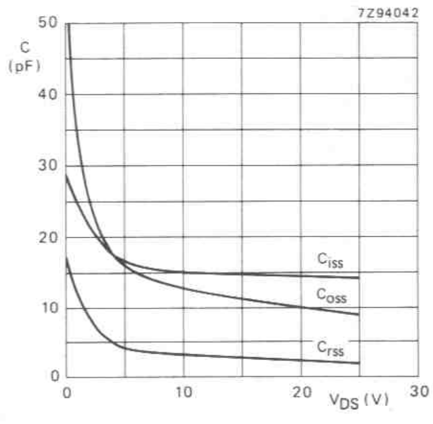


Fig.10 T_j = 25 °C; V_{GS} = 0; f = 1 MHz; typical values.

N-CHANNEL ENHANCEMENT MODE VERTICAL D-MOS TRANSISTOR

N-channel vertical D-MOS transistor in SOT89 envelope and designed for use as line current interrupter in telephone sets and for application in relay, high-speed and line-transformer drivers.

Features

- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No second breakdown

QUICK REFERENCE DATA

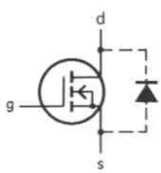
Drain-source voltage	V_{DS}	max.	200 V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20 V
Drain current (DC)	I_D	max.	250 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1 W
Drain-source ON-resistance I_D = 250 mA; V_{GS} = 10 V	R_{DSon}	typ. max.	6 Ω 12 Ω
Transfer admittance I_D = 250 mA; V_{DS} = 15 V	$\lvert y_{fs} \rvert$	typ.	250 mS

MECHANICAL DATA

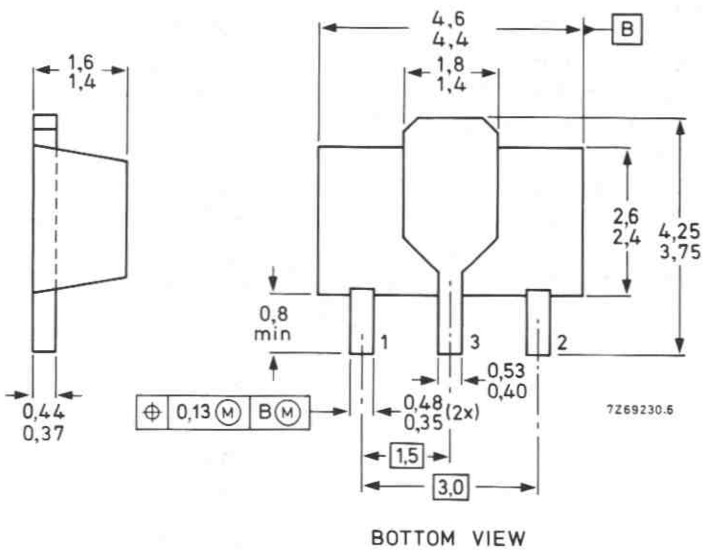
Dimensions in mm

Fig. 1 SOT89.

Pinning:
1 = source
2 = gate
3 = drain



Marking: KN



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	V_{DS}	max.	200 V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20 V
Drain current (DC)	I_D	max.	250 mA
Drain current (peak)	I_{DM}	max.	800 mA
Total power dissipation up to T_{amb} = 25 °C (note 1)	P_{tot}	max.	1 W
Storage temperature range	T_{stg}	−65 to + 150 °C	
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient (note 1)	$R_{th\ j\text{-}a}$	=	125 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Drain-source breakdown voltage I_D = 100 μA; V_{GS} = 0	$V_{(BR)DSS}$	min.	200 V
Drain-source leakage current V_{DS} = 160 V; V_{GS} = 0	I_{DSS}	max.	10 μA
Gate-source leakage current V_{GS} = 20 V; V_{DS} = 0	I_{GSS}	max.	100 nA
Gate threshold voltage I_D = 1 mA; V_{DS} = V_{GS}	$V_{GS(th)}$	min. max.	0.8 V 2.8 V
Drain-source ON-resistance I_D = 250 mA; V_{GS} = 10 V	R_{DSon}	typ. max.	6 Ω 12 Ω
Transfer admittance I_D = 250 mA; V_{DS} = 15 V	$\|y_{fs}\|$	typ.	250 mS
Input capacitance at f = 1 MHz V_{DS} = 10 V; V_{GS} = 0	C_{iss}	typ. max.	70 pF 90 pF
Output capacitance at f = 1 MHz V_{DS} = 10 V; V_{GS} = 0	C_{oss}	typ. max.	20 pF 30 pF
Feedback capacitance at f = 1 MHz V_{DS} = 10 V; V_{GS} = 0	C_{rss}	typ. max.	5 pF 10 pF
Switching times (see Figs 2 and 3) I_D = 250 mA; V_{DD} = 50 V; V_{GS} = 0 to 10 V	t_{on}	typ. max.	4 ns 10 ns
	t_{off}	typ. max.	15 ns 25 ns

Note

1. Transistor mounted on a ceramic substrate with area of 2.5 cm^2 and thickness of 0.7 mm.

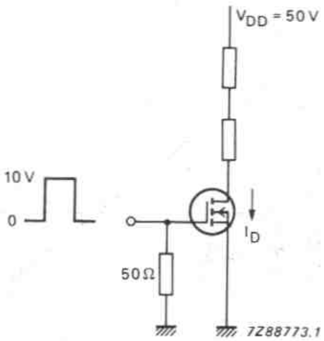


Fig. 2 Switching times test circuit.

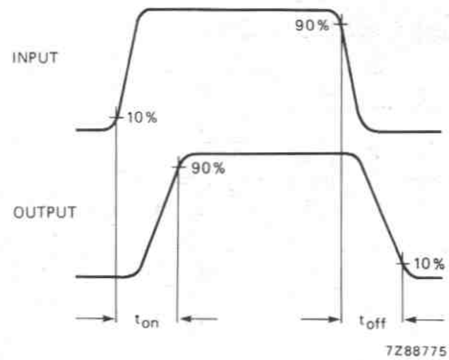


Fig. 3 Input and output waveforms.

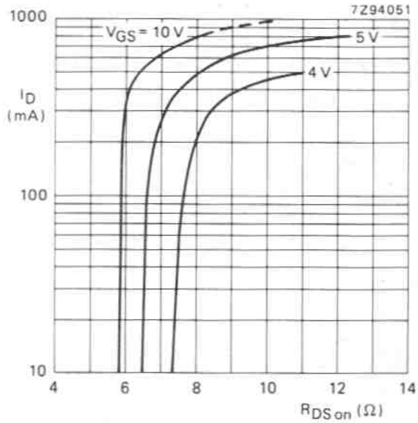


Fig. 4 T_j = 25 °C; typical values.

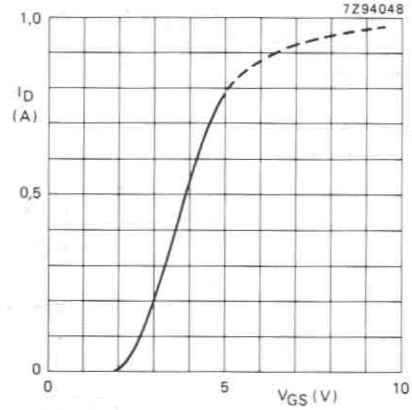


Fig. 5 T_j = 25 °C; V_{DS} = 10 V; typical values.

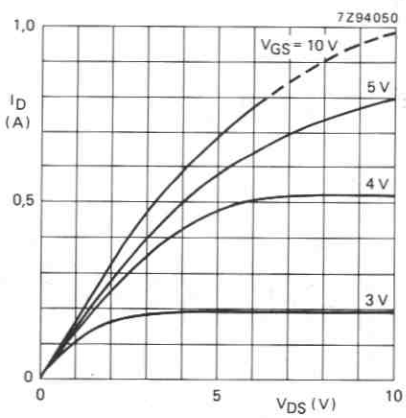


Fig. 6 T_j = 25 °C; typical values.

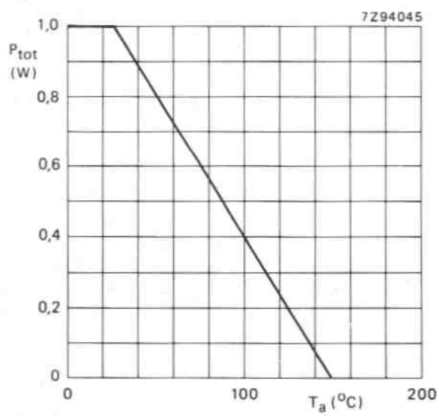


Fig. 7 Power derating curve.

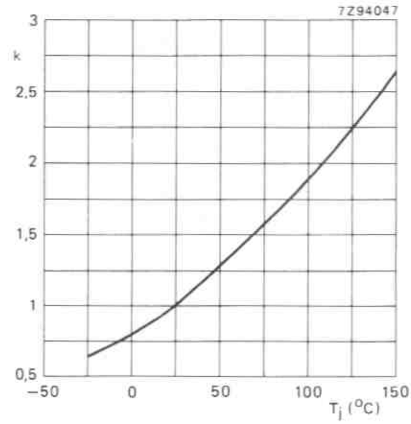


Fig. 8 $k = \frac{R_{DS\ on}\ \text{at}\ T_j}{R_{DS\ on}\ \text{at}\ 25\ ^oC}$; at 400 mA/10 V; typical values.

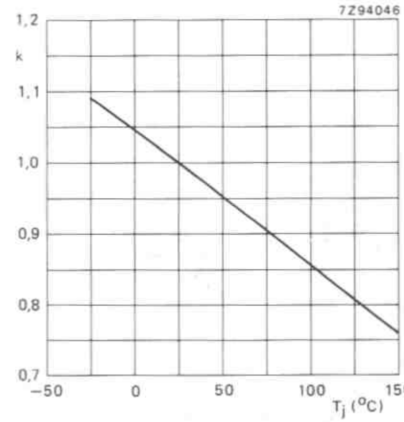


Fig. 9 $k = \frac{V_{GS(th)}\ \text{at}\ T_j}{V_{GS(th)}\ \text{at}\ 25\ ^oC}$; $V_{GS(th)}$ at 1 mA; typical values.

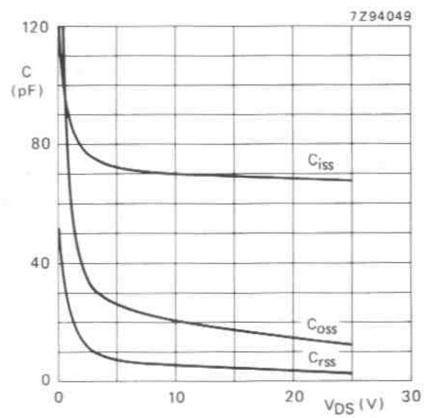


Fig. 10 T_j = 25 °C; V_{GS} = 0; f = 1 MHz; typical values.

N-CHANNEL ENHANCEMENT MODE VERTICAL D-MOS TRANSISTOR

N-channel enhancement mode vertical D-MOS transistor in SOT89 envelope and designed for use as Surface Mounted Device (SMD) in thin and thick-film circuits for application with relay, high-speed and line-transformer drivers.

Features

- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No second breakdown

QUICK REFERENCE DATA

Drain-source voltage	V_{DS}	max.	180	V
Drain-source voltage (non-repetitive peak; $t_p \leq 2$ ms)	$V_{DS(SM)}$	max.	200	V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20	V
Drain current (DC)	I_D	max.	300	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1	W
Drain-source ON-resistance I_D = 15 mA; V_{GS} = 3 V	R_{DSon}	typ. max.	7 10	Ω Ω
Transfer admittance I_D = 300 mA; V_{DS} = 15 V	$\lvert y_{fs} \rvert$	typ.	250	mS

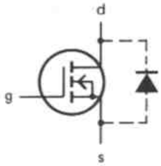
MECHANICAL DATA

Dimensions in mm

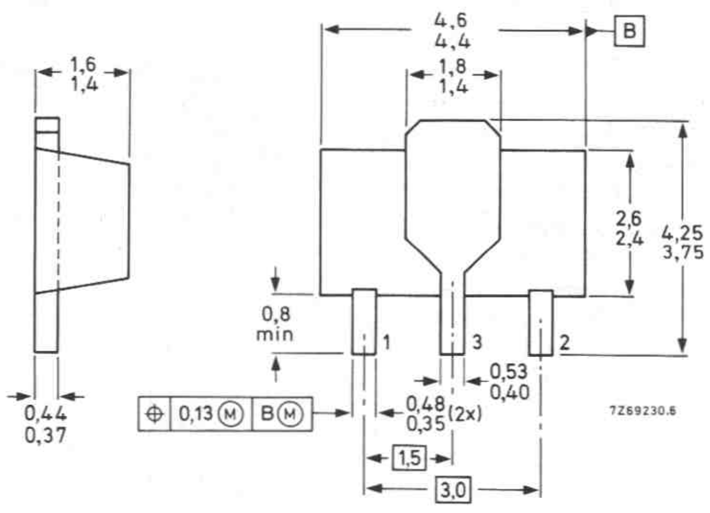
Fig.1 SOT89.

Pinning

1 = source
2 = gate
3 = drain



Marking: K0



BOTTOM VIEW

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	V_{DS}	max.	180 V
Drain-source voltage (non-repetitive peak; $t_p \leq 2$ ms)	$V_{DS(SM)}$	max.	200 V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20 V
Drain current (DC)	I_D	max.	300 mA
Drain current (peak)	I_{DM}	max.	800 mA
Total power dissipation up to T_{amb} = 25 °C (note 1)	P_{tot}	max.	1 W
Storage temperature range	T_{stg}	−65 to + 150 °C	
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient (note 1)	$R_{th\ j\text{-}a}$	=	125 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Drain-source breakdown voltage I_D = 100 μA; V_{GS} = 0	$V_{(BR)DSS}$	min.	180 V
Drain-source leakage current V_{DS} = 120 V; V_{GS} = 0	I_{DSS}	max.	10 μA
Gate-source leakage current V_{GS} = 20 V; V_{DS} = 0	I_{GSS}	max.	100 nA
Gate threshold voltage I_D = 100 μA; V_{DS} = V_{GS}	$V_{GS(th)}$	min. max.	0.7 V 2.7 V
Drain-source ON-resistance I_D = 15 mA; V_{GS} = 3 V	R_{DSon}	typ. max.	7 Ω 10 Ω
I_D = 300 mA; V_{GS} = 10 V	R_{DSon}	typ.	6 Ω
Transfer admittance I_D = 300 mA; V_{DS} = 15 V	$\lvert y_{fs} \rvert$	typ.	250 mS
Input capacitance at f = 1 MHz V_{DS} = 10 V; V_{GS} = 0	C_{iss}	typ. max.	50 pF 65 pF
Output capacitance at f = 1 MHz V_{DS} = 10 V; V_{GS} = 0	C_{oss}	typ. max.	20 pF 30 pF
Feedback capacitance at f = 1 MHz V_{DS} = 10 V; V_{GS} = 0	C_{rss}	typ. max.	6 pF 10 pF
Switching times (see Figs 2 and 3) I_D = 300 mA; V_{DD} = 50 V; V_{GS} = 0 to 10 V	t_{on} t_{off}	max. max.	10 ns 15 ns

1. Transistors mounted on a ceramic substrate with area of 2.5 cm^2 and thickness of 0.7 mm.

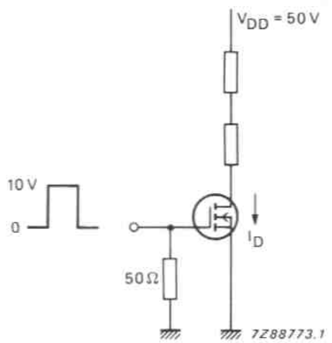


Fig.2 Switching times test circuit.

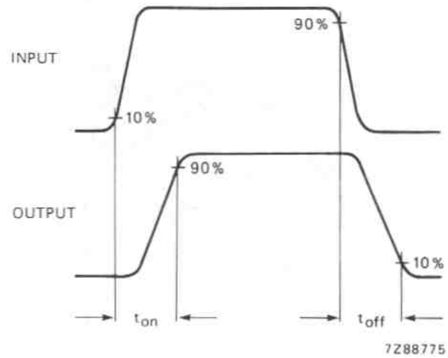


Fig.3 Input and output waveforms.

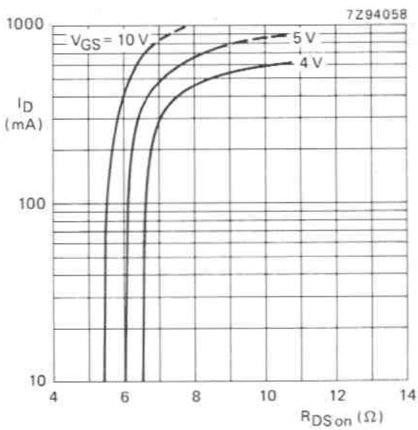


Fig.4 T_j = 25 °C; typical values.

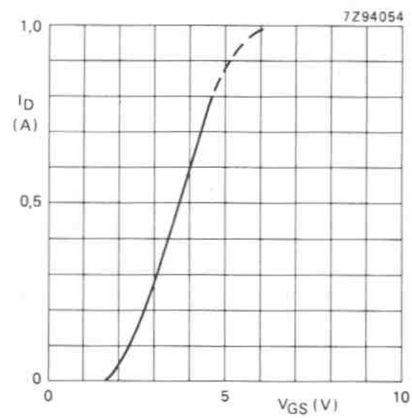


Fig.5 T_j = 25 °C; V_{DS} = 10 V; typ. values.

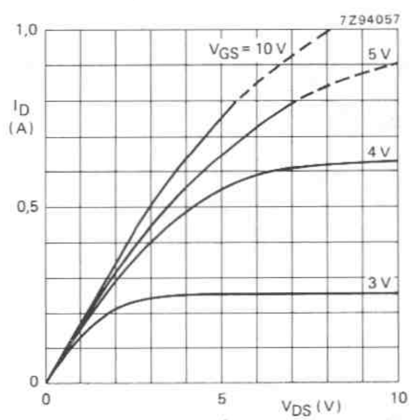


Fig.6 T_j = 25 °C; typical values.

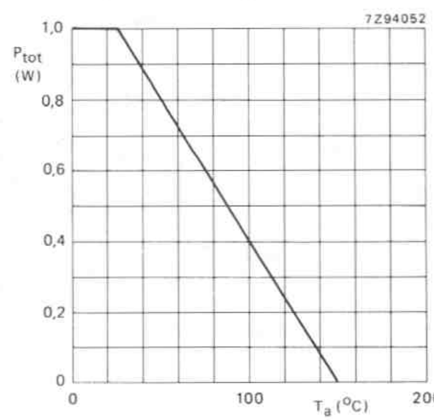


Fig.7 Power derating curve.

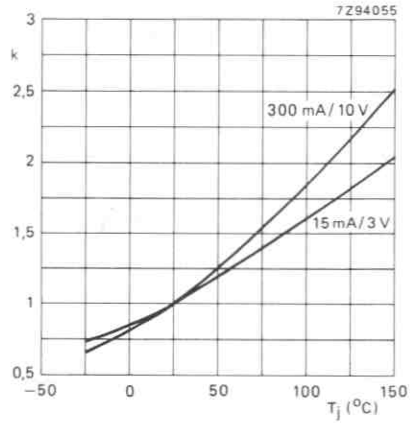


Fig.8 $k = \frac{R_{DS\,on}\ \text{at}\ T_j}{R_{DS\,on}\ \text{at}\ 25\ ^oC}$; typical values.

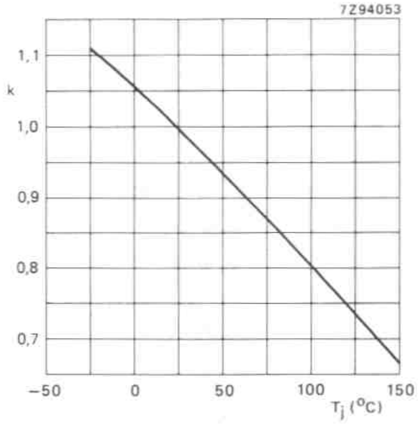


Fig.9 $k = \frac{V_{GS(th)}\ \text{at}\ T_j}{V_{GS(th)}\ \text{at}\ 25\ ^oC}$; $V_{GS(th)}$ at 0.1 mA; typical values.

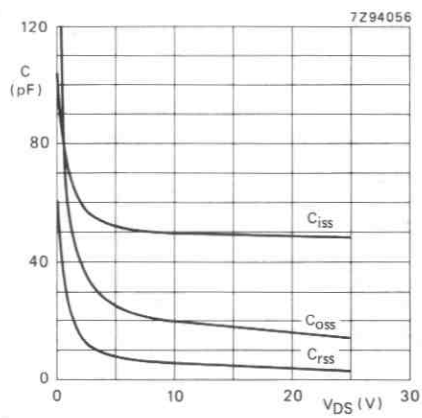


Fig.10 $T_j = 25\ ^oC$; $V_{GS} = 0$; f = 1 MHz; typical values.

P-CHANNEL ENHANCEMENT MODE VERTICAL D-MOS TRANSISTOR

P-channel vertical D-MOS transistor in SOT89 envelope and intended for use in relay, high-speed and line-transformer drivers, using SMD technology.

Features

- Very low R_{DSon}
- Direct interface to C-MOS
- High-speed switching
- No second breakdown

QUICK REFERENCE DATA

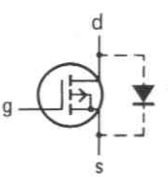
Drain-source voltage	$-V_{DS}$	max.	60 V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20 V
Drain current (DC)	$-I_D$	max.	0,3 A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1 W
Drain-source ON-resistance $-I_D$ = 200 mA; $-V_{GS}$ = 10 V	R_{DSon}	typ. max.	4,5 Ω 6 Ω
Transfer admittance $-I_D$ = 200 mA; $-V_{DS}$ = 15 V	$\lvert y_{fs} \rvert$	typ.	200 mS

MECHANICAL DATA

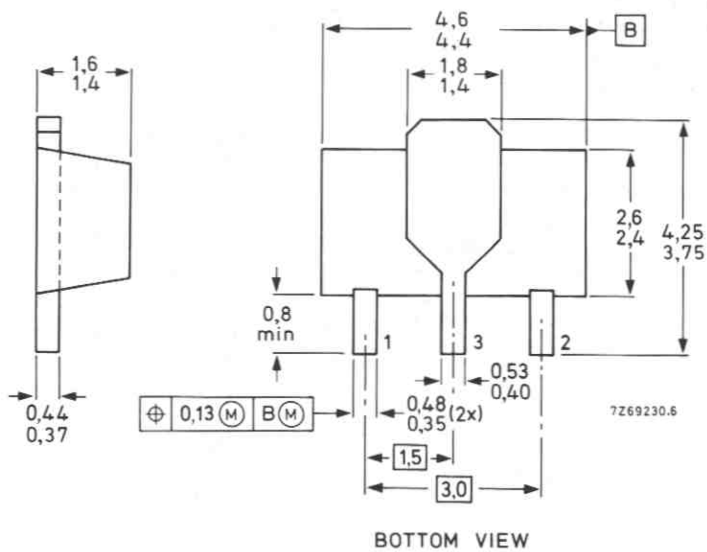
Dimensions in mm

Fig. 1 SOT89.

Pinning:
1 = source
2 = gate
3 = drain



marking: LM



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	$-V_{DS}$	max.	60 V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20 V
Drain current (DC)	$-I_D$	max.	0.3 A
Drain current (peak)	$-I_{DM}$	max.	0.8 A
Total power dissipation up to T_{amb} = 25 °C (note 1)	P_{tot}	max.	1 W
Storage temperature range	T_{stg}	−65 to + 150	°C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient (note 1)	$R_{th\ j\text{-}a}$	=	125 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Drain-source breakdown voltage $-I_D$ = 100 μA; $-V_{GS}$ = 0	$-V_{(BR)DSS}$	min.	60 V
Drain-source leakage current $-V_{DS}$ = 45 V; V_{GS} = 0	$-I_{DSS}$	max.	10 μA
Gate-source leakage current $-V_{GS}$ = 20 V; V_{DS} = 0	$-I_{GSS}$	max.	100 nA
Gate threshold voltage $-I_D$ = 1 mA; V_{DS} = V_{GS}	$-V_{GS(th)}$	min. max.	1.5 V 3.5 V
Drain-source ON-resistance $-I_D$ = 200 mA; $-V_{GS}$ = 10 V	R_{DSon}	typ. max.	4.5 Ω 6 Ω
Transfer admittance $-I_D$ = 200 mA; $-V_{DS}$ = 15 V	$\|y_{fs}\|$	typ.	200 mS
Input capacitance at f = 1 MHz $-V_{DS}$ = 10 V; V_{GS} = 0	C_{iss}	typ. max.	55 pF 70 pF
Output capacitance at f = 1 MHz $-V_{DS}$ = 10 V; V_{GS} = 0	C_{oss}	typ. max.	30 pF 45 pF
Feedback capacitance at f = 1 MHz $-V_{DS}$ = 10 V; V_{GS} = 0	C_{rss}	typ. max.	8 pF 12 pF
Switching times (see Figs 2 and 3) $-I_D$ = 200 mA; $-V_{DD}$ = 50 V; $-V_{GS}$ = 0 to 10 V	t_{on} t_{off}	typ. typ.	4 ns 20 ns

Note:

1. Transistor mounted on a ceramic substrate: area = 2,5 cm^2 and thickness = 0,7 mm.

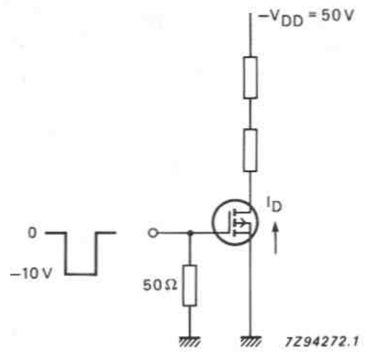


Fig.2 Switching times test circuit.

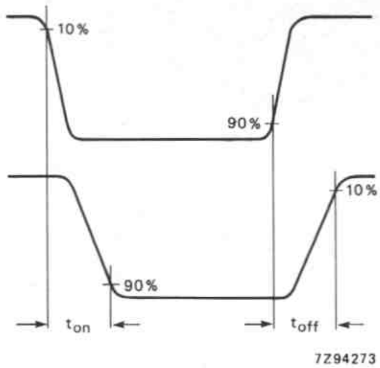


Fig.3 Input and output waveforms.

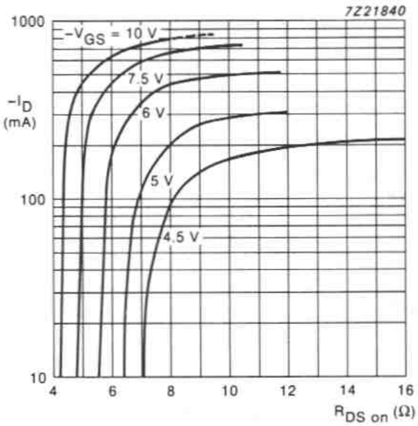


Fig.4 Drain current vs ON-resistance; $T_j = 25$ °C; typical values.

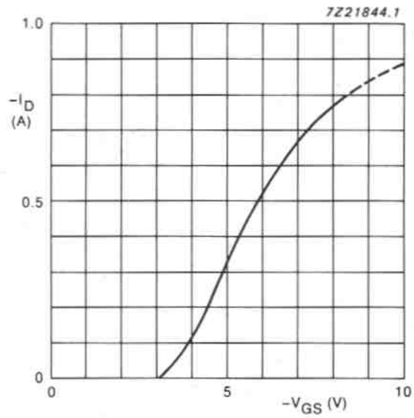


Fig.5 Transfer characteristics; $T_j = 25$ °C; $-V_{DS} = 10$ V; typical values.

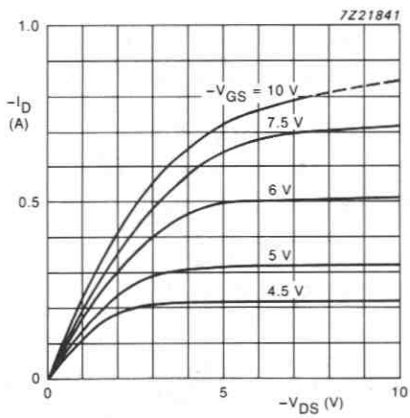


Fig.6 Output characteristics; $T_j = 25$ °C; typical values.

P-CHANNEL ENHANCEMENT MODE VERTICAL D-MOS TRANSISTOR

P-channel vertical D-MOS transistor in SOT89 envelope and intended for use in relay, high-speed and line-transformer drivers, using SMD-technology.

Features

- Very low R_{DSon}
- Direct interface to C-MOS, TTL
- High-speed switching
- No second breakdown

QUICK REFERENCE DATA

Drain-source voltage	$-V_{DS}$	max.	50	V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20	V
Drain current (DC)	$-I_D$	max.	0,25	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1	W
Drain-source ON-resistance $-I_D$ = 200 mA; $-V_{GS}$ = 10 V	R_{DSon}	max. typ.	10 7.5	Ω Ω
Transfer admittance $-I_D$ = 200 mA; $-V_{DS}$ = 15 V	$\lvert y_{fs} \rvert$	typ.	125	mS

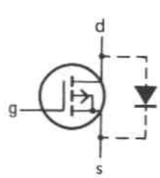
MECHANICAL DATA

Dimensions in mm

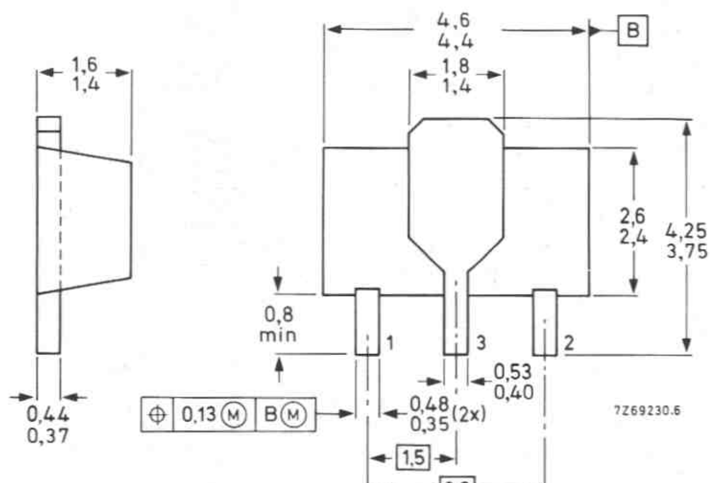
Fig. 1 SOT89.

Pinning:

1 = source
2 = gate
3 = drain



Marking: LN



BOTTOM VIEW

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	$-V_{DS}$	max.	50 V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20 V
Drain current (DC)	$-I_D$	max.	0.25 A
Drain current (peak)	$-I_{DM}$	max.	0.5 A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1 W
Storage temperature range	T_{stg}		−65 to + 150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient (note 1)	$R_{th\ j\text{-}a}$	=	125 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Drain-source breakdown voltage $-I_D$ = 100 μA; $-V_{GS}$ = 0	$-V_{(BR)DSS}$	min.	50 V
Drain-source leakage current $-V_{DS}$ = 1 V; V_{GS} = 0	$-I_{DSS}$	max.	10 μA
Gate-source leakage current $-V_{GS}$ = 20 V; V_{DS} = 0	$-I_{GSS}$	max.	100 nA
Gate threshold voltage $-I_D$ = 1 mA; V_{DS} = V_{GS}	$-V_{GS(th)}$	min. max.	1.5 V 3.5 V
Drain-source ON-resistance $-I_D$ = 200 mA; $-V_{GS}$ = 10 V	R_{DSon}	max. typ..	10 Ω 7.5 Ω
Transfer admittance $-I_D$ = 200 mA; $-V_{DS}$ = 15 V	$\lvert y_{fs} \rvert$	typ.	125 mS
Input capacitance at f = 1 MHz $-V_{DS}$ = 10 V; V_{GS} = 0	C_{iss}	typ. max.	30 pF 45 pF
Output capacitance at f = 1 MHz $-V_{DS}$ = 10 V; V_{GS} = 0	C_{oss}	typ. max.	20 pF 30 pF
Feedback capacitance at f = 1 MHz $-V_{DS}$ = 10 V; V_{GS} = 0	C_{rss}	typ. max.	5 pF 10 pF
Switching times (see Figs 2 and 3) $-I_D$ = 200 mA; $-V_{DD}$ = 50 V; $-V_{GS}$ = 0 to 10 V	t_{on} t_{off}	typ. typ.	4 ns 10 ns

Note:

1. Transistor mounted on a ceramic substrate: area = 2,5 cm^2; thickness = 0,7 mm.

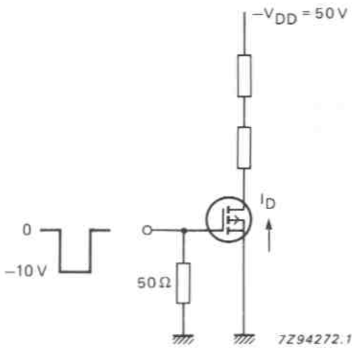


Fig. 2 Switching times test circuit.

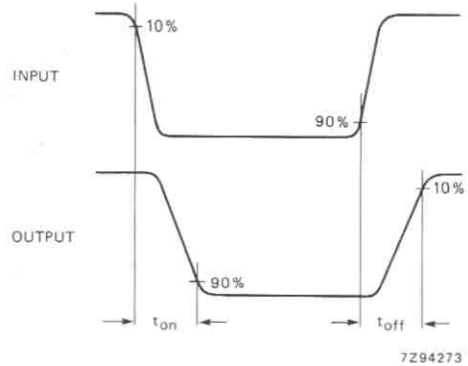


Fig. 3 Input and output waveforms.

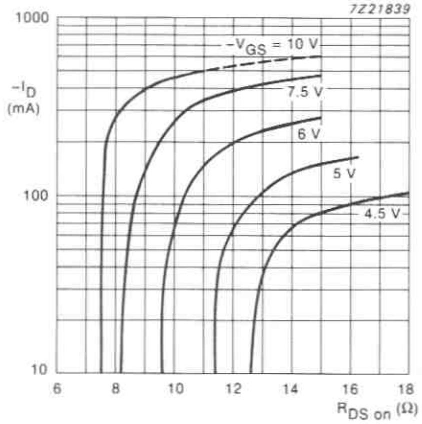


Fig.4 Drain current vs ON-resistance; T_j = 25 °C; typical values.

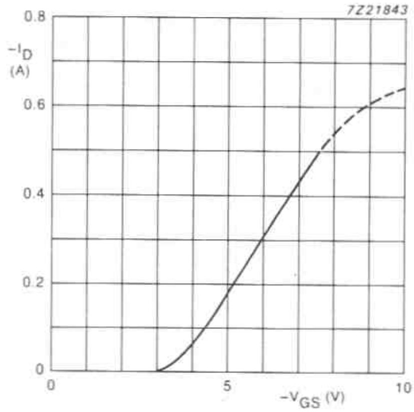


Fig.5 Transfer characteristics; T_j = 25 °C; $-V_{DS}$ = 10 V; typical values.

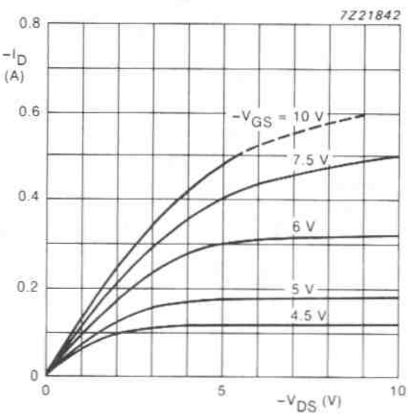


Fig.6 Output characteristics; T_j = 25 °C; typical values.

SILICON PLANAR EPITAXIAL TRANSISTORS

- **High-speed switching**

N-P-N transistor in a microminiature plastic envelope. It is intended for very high-speed saturated switching in thick and thin-film circuits.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	20	V
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	20	V
Collector-emitter voltage (open base)	V_{CEO}	max.	12	V
Collector current (peak value)	I_{CM}	max.	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	mW
Junction temperature	T_j	max.	150	°C
D.C. current gain				
I_C = 10 mA; V_{CE} = 1 V	h_{FE}		40 to 120	
I_C = 50 mA; V_{CE} = 1 V	h_{FE}	>	25	
Transition frequency at f = 100 MHz				
I_C = 10 mA; V_{CE} = 10 V	f_T	>	400	MHz
		typ.	500	MHz
Storage time				
$I_C = I_B = -I_{BM}$ = 10 mA	t_s	<	13	ns

MECHANICAL DATA

Fig. 1 SOT-23.

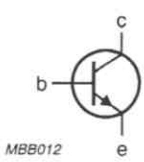
Dimensions in mm

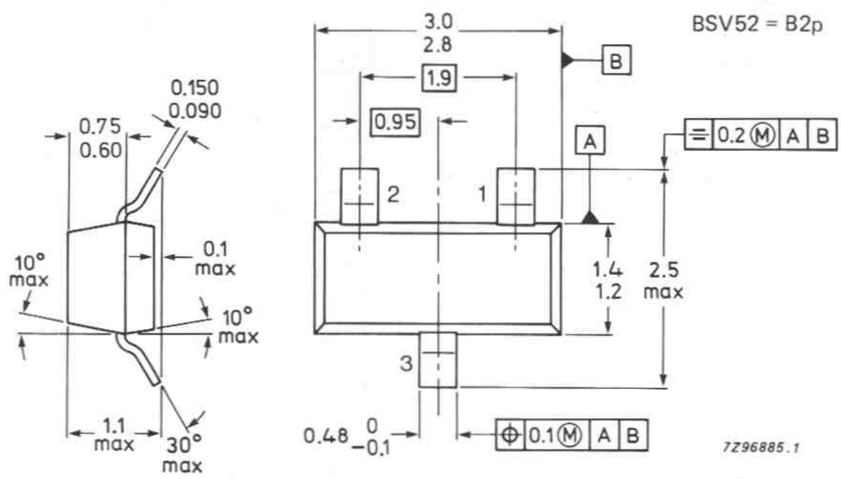
Marking code

BSV52 = B2p

Pinning:

1 = base
2 = emitter
3 = collector





Reverse pinning types are available on request.

TOP VIEW

See also *Soldering recommendations*.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	20 V
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	20 V
Collector-emitter voltage (open base) I_C = 10 mA (see Fig. 4)	V_{CEO}	max.	12 V
Emitter-base voltage (open collector)	V_{EBO}	max.	5 V
Collector current (d.c.)	I_C	max.	100 mA
Collector current (peak value)	I_{CM}	max.	200 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250 mW
Storage temperature	T_{stg}	−65 to + 150 °C	
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	500 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
I_E = 0; V_{CB} = 10 V	I_{CBO}	<	100 nA
I_E = 0; V_{CB} = 10 V; T_j = 125 °C	I_{CBO}	<	5 μA
Saturation voltages			
I_C = 10 mA; I_B = 300 μA	V_{CEsat}	<	300 mV
I_C = 10 mA; I_B = 1 mA	V_{CEsat}	<	250 mV
	V_{BEsat}		700 to 850 mV
I_C = 50 mA; I_B = 5 mA	V_{CEsat}	<	400 mV
	V_{BEsat}	<	1200 mV
D.C. current gain			
I_C = 1 mA; V_{CE} = 1 V	h_{FE}	>	25
I_C = 10 mA; V_{CE} = 1 V	h_{FE}		40 to 120
I_C = 50 mA; V_{CE} = 1 V	h_{FE}	>	25
Transition frequency at f = 100 MHz			
I_C = 10 mA; V_{CE} = 10 V	f_T	>	400 MHz
		typ.	500 MHz

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

Collector capacitance at f = 1 MHz $I_E = I_e = 0$; $V_{CB} = 5$ V	C_c	<	4 pF
Emitter capacitance at f = 1 MHz $I_C = I_c = 0$; $V_{EB} = 1$ V	C_e	<	4,5 pF
Switching times Storage time $I_C = I_B = -I_{BM} = 10$ mA	t_s	<	13 ns
Turn on time when switched from $-V_{BE} = 1{,}5$ V to $I_C = 10$ mA; $I_B = 3$ mA	t_{on}	<	12 ns
Turn off time when switched from $I_C = 10$ mA; $I_B = 3$ mA to cut-off with $-I_{BM} = 1{,}5$ mA	t_{off}	<	18 ns

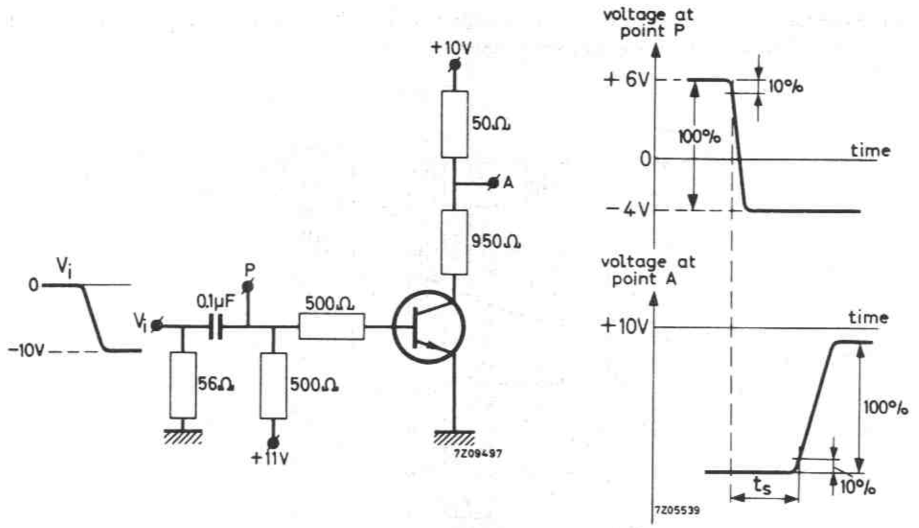


Fig. 2 Test circuit and waveform storage time.

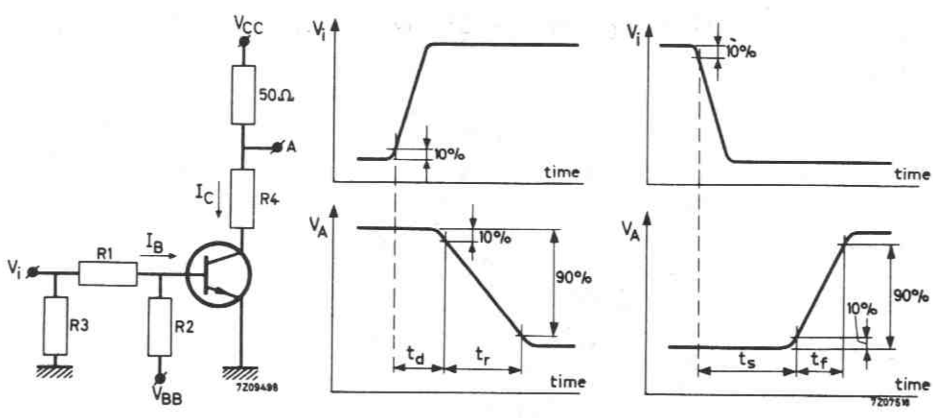


Fig. 3 Test circuit and waveforms turn on and turn off time.

Pulse generator:

Rise time	t_r	<	1 ns
Pulse duration	t	>	300 ns
Duty cycle	δ	<	0,02
Source impedance	R_S	=	50 Ω

Oscilloscope:

Input impedance	R_i	=	50 Ω
Rise time	t_r	<	1 ns

							turn on time			turn off time	
I_C mA	I_B mA	$-I_{BM}$ mA	V_{CC} V	R_1; R_2 kΩ	R_3 Ω	R_4 Ω	$-V_{BB}$ V	$-V_{BE}$ V	V_i V	V_{BB} V	$-V_i$ V
10	3	1,5	3	3,3	50	220	3,0	1,5	15	12,0	15

$-I_{BM}$ is the reverse current that can flow during switching off. The indicated $-I_{BM}$ is determined and limited by the applied cut-off voltage and series resistance.

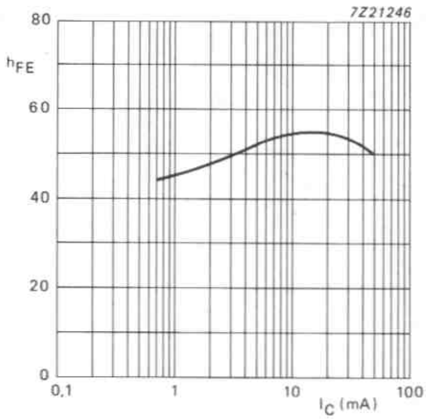


Fig. 4 V_{CE} = 1 V; T_j = 25 °C; typical values.

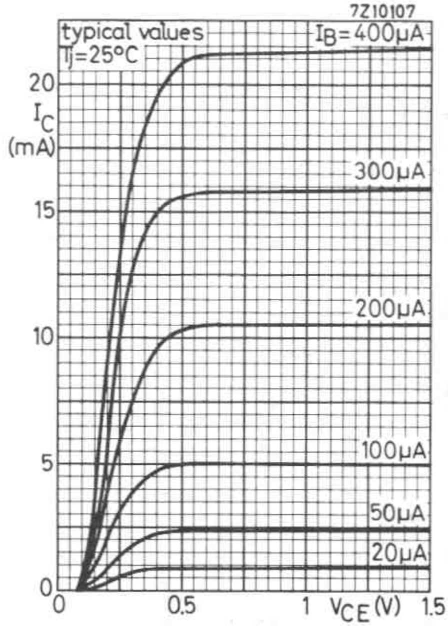

7Z10107
typical values
Tj=25°C
I_B=400µA
300µA
200µA
100µA
50µA
20µA
I_C
(mA)
20
15
10
5
0
0
0.5
1
V_{CE} (V)
1.5

Fig. 5

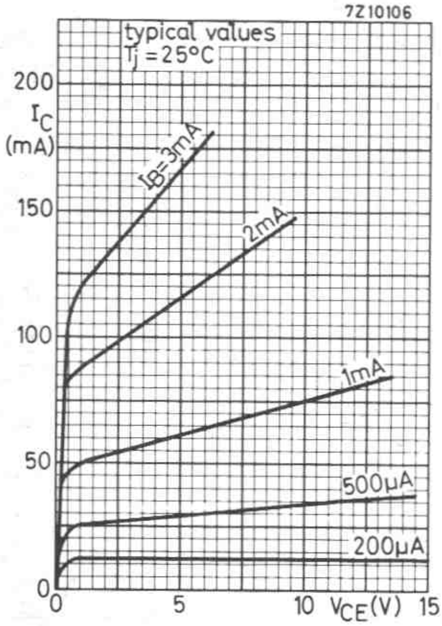

7Z10106
typical values
Tj =25°C
I_B=3mA
2mA
1mA
500µA
200µA
I_C
(mA)
200
150
100
50
0
0
5
10
V_{CE} (V)
15

Fig. 6

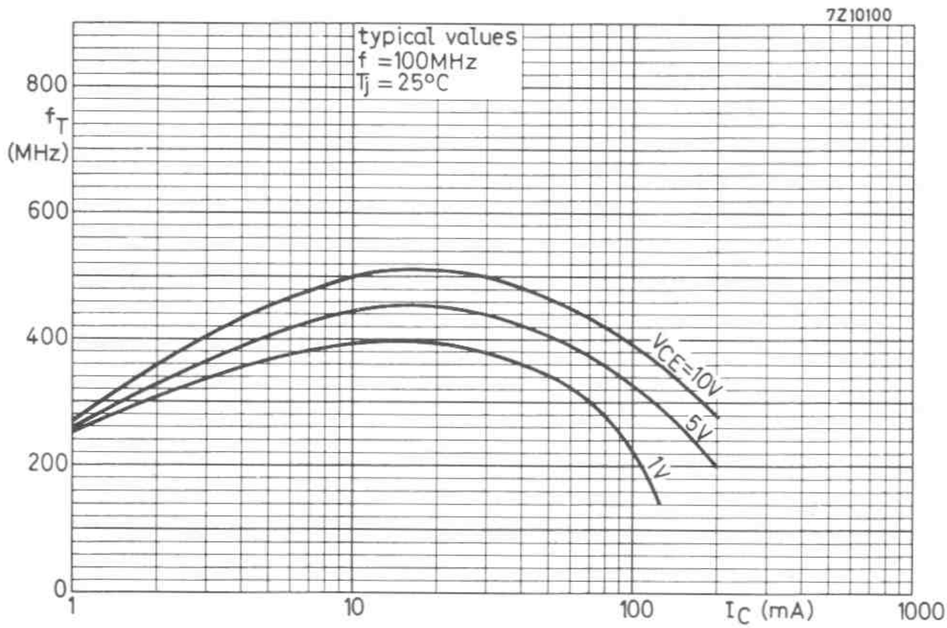

7Z10100
typical values
f = 100MHz
T_j = 25°C
800
f_T
(MHz)
600
400
200
0
1
10
100
1000
I_C (mA)
V_{CE}=10V
5V
1V

Fig. 7

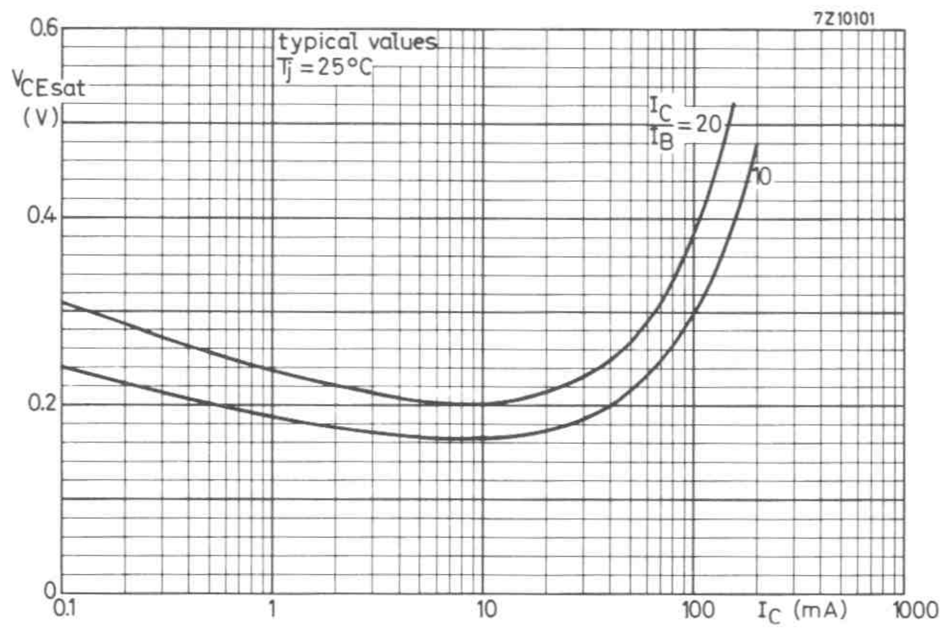

7Z10101
typical values
T_j = 25°C
0.6
V_{CEsat}
(V)
0.4
0.2
0
0.1
1
10
100
1000
I_C (mA)
$\frac{I_C}{I_B}$ = 20
10

Fig. 8

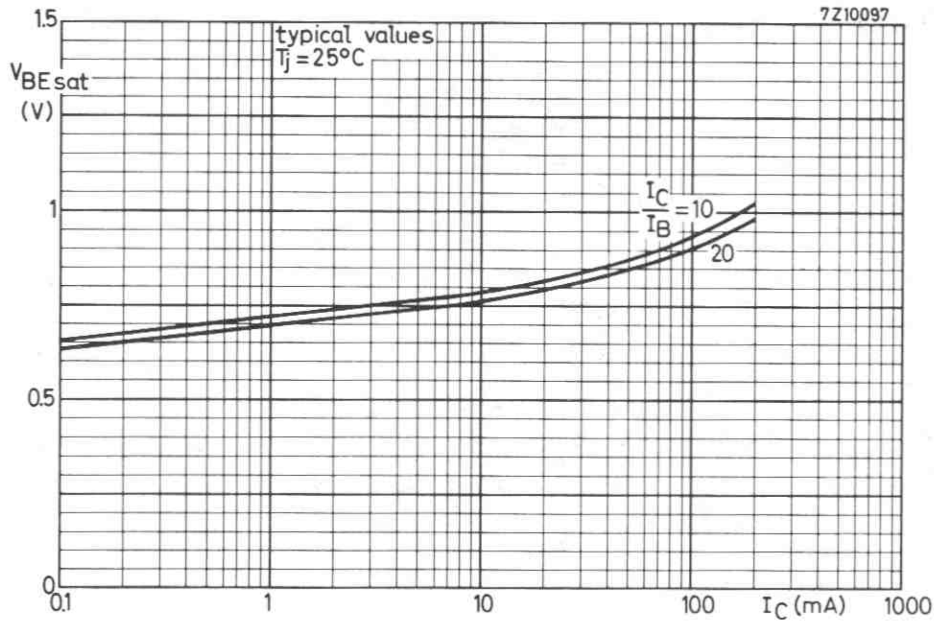


Fig. 9

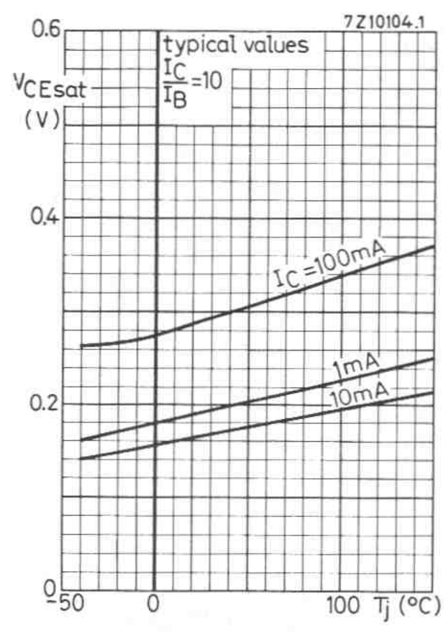


Fig. 10

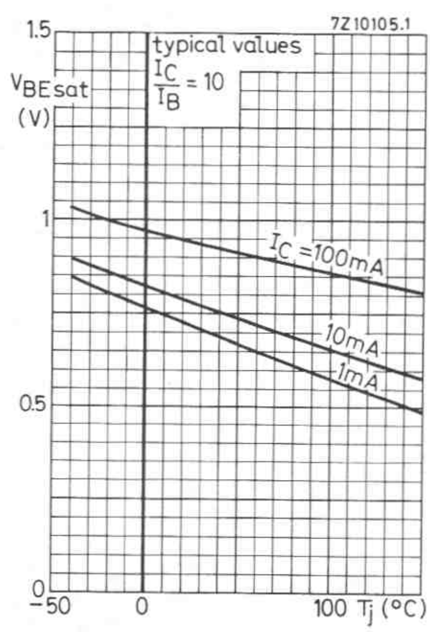


Fig. 11

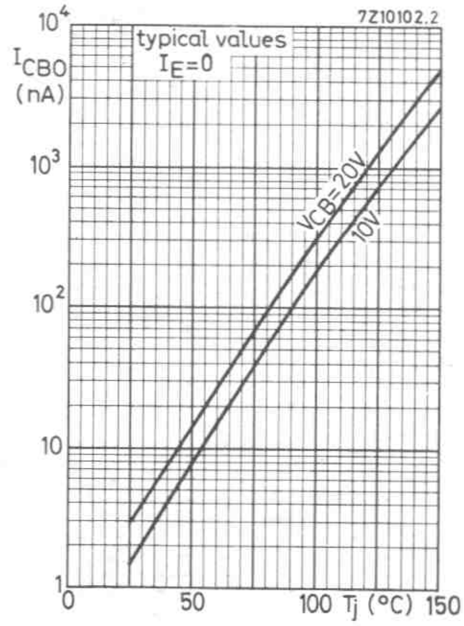

7Z10102.2
typical values
$I_E = 0$
I_{CBO} (nA)
10^4
10^3
10^2
10
1
$V_{CB} = 20V$
10V
0
50
100
T_j (°C)
150

Fig. 12

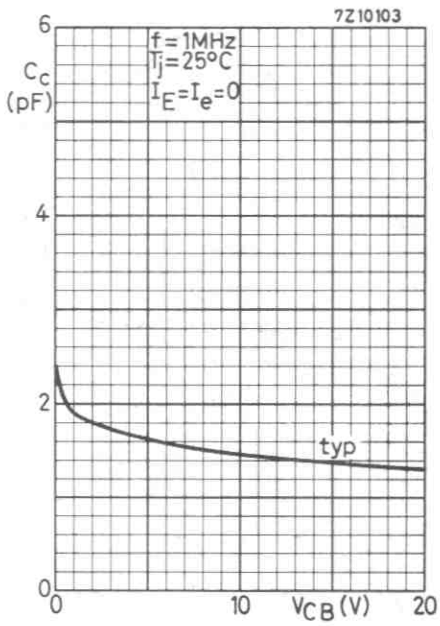

7Z10103
f = 1MHz
$T_j = 25°C$
$I_E = I_e = 0$
C_c (pF)
6
4
2
0
typ
0
10
V_{CB} (V)
20

Fig. 13

CONTROLLED AVALANCHE RECTIFIER DIODES

Glass passivated rectifier diodes in hermetically sealed leadless SMID* envelopes and intended for general purpose rectifier applications.

The device is capable of absorbing reverse transient energy.

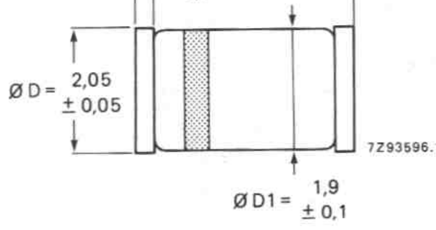
QUICK REFERENCE DATA

			BYD17D	G	J	K	M	
Crest working voltage	V_{RWM}	max.	200	400	600	800	1000	V
Reverse avalanche breakdown voltage	$V_{(BR)R}$	>	225	450	650	900	1100	V
		<	1600	1600	1600	1600	1600	V
Average forward current	$I_{F(AV)}$	max.			1,5			A
Non-repetitive peak forward current	I_{FSM}	max.			20			A
Non-repetitive peak reverse power dissipation	P_{RSM}	max.			0,4			kW
Junction temperature	T_j	max.			175			°C

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-87.



* Surface-mounted implosion diode.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BYD17D	G	J	K	M	
Crest working reverse voltage	V_{RWM}	max.	200	400	600	800	1000	V
Continuous reverse voltage	V_R	max.	200	400	600	800	1000	V
Average forward current (averaged over any 20 ms period)								
T_{tp} = 105 °C;	$I_{F(AV)}$	max.			1,5			A
T_{amb} = 65 °C; p.c. board mounting	$I_{F(AV)}$	max.			0,6			A
Repetitive peak forward current T_{tp} = 55 °C; f = 50 Hz; a = 3; (inclusive derating for $T_{j\,max}$ at V_{RRM} = 1000 V)	I_{FRM}	max.			5,5			A
Non-repetitive peak forward current t = 10 ms, half-sinewave, T_j = $T_{j\,max}$ prior to surge; $V_R = V_{RWMmax}$	I_{FSM}	max.			20			A
Non-repetitive peak reverse power dissipation; t = 20 μs (half-sinewave); $T_j = T_{j\,max}$ prior to surge	P_{RSM}	max.			0,4			kW
Non-repetitive peak reverse avalanche energy; I_R = 0,34 A; $T_j = T_{j\,max}$ prior to surge; with inductive load switched off	E_{RSM}	max.			7			mJ
Storage temperature	T_{stg}				−65 to + 175			°C
Junction temperature	T_j	max.			175			°C

THERMAL RESISTANCE

Influence of mounting method

1. Thermal resistance from junction to tie-point	$R_{th\,j\text{-}tp}$	=	30	K/W
2. Thermal resistance from junction to ambient; device mounted on an 1,5 mm thick epoxy-glass p.c. board; Cu-thickness ⩾ 40 μm (see Fig. 2)	$R_{th\,j\text{-}a}$	=	150	K/W

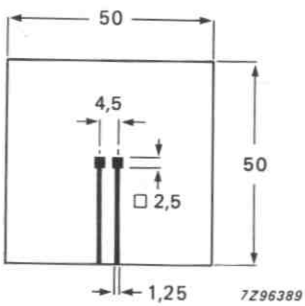


Fig. 2 Mounted on a p.c. board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BYD17D	G	J	K	M	
Forward voltage*								
I_F = 1 A; $T_j = T_{j\,max}$	V_F	<	0,93	0,93	0,93	0,93	0,93	V
I_F = 1 A	V_F	<	1,05	1,05	1,05	1,05	1,05	V
Reverse avalanche breakdown voltage		>	225	450	650	900	1100	V
I_R = 0,1 mA	$V_{(BR)R}$	<	1600	1600	1600	1600	1600	V
Reverse current								
$V_R = V_{RWMmax}$	I_R	<			1			μA
$V_R = V_{RWMmax}$; T_j = 165 °C	I_R	<			100			μA
Diode capacitance								
V_R = 0; f = 1 MHz	C_d	typ.			21			pF

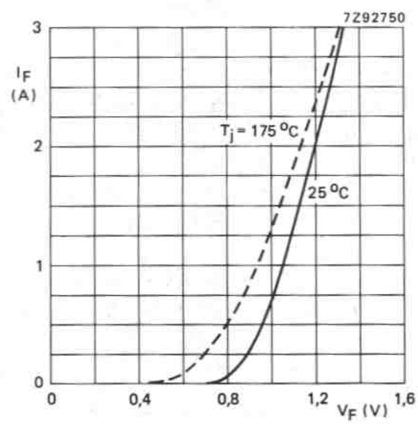


Fig. 3 Maximum forward voltage.

* Measured under pulse conditions to avoid excessive dissipation.

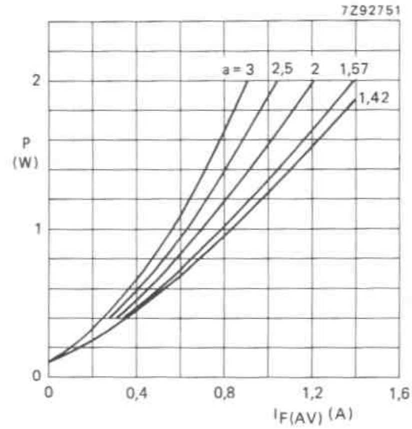


Fig. 4 Maximum values steady power dissipation (forward plus leakage current) as a function of the average (a) forward current. $a = I_{F(RMS)}/I_{F(AV)}$; $V_R = V_{RWMmax}$.

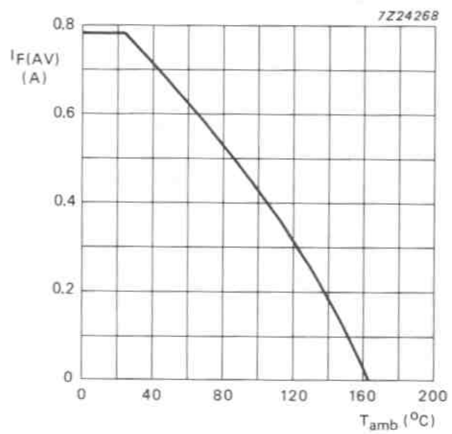


Fig. 5 Maximum average forward current as a function of temperature; the curves include losses due to reverse leakage.

$V_R = V_{RWMmax}$, $\delta = 0.5$; a = 1.57.

——— = ambient temperature and device mounted as shown in Fig. 2.

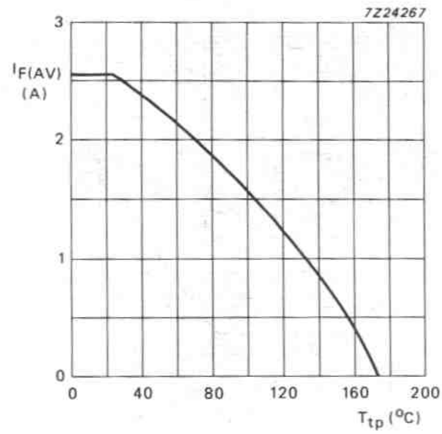


Fig. 6 Maximum average forward current as a function of temperature; the curves include losses due to reverse leakage.
$V_R = V_{RWMmax}$, $\delta = 0.5$; a = 1.57.
——— = tie-point temperature and device mounted as shown in Fig. 2.

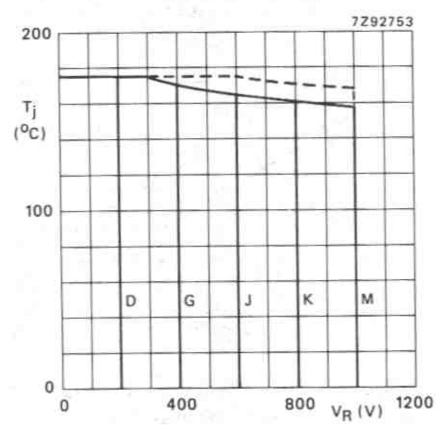


Fig. 7 Maximum permissible junction temperature as a function of reverse voltage;
——— = V_R; – – – – = V_{RWM}, $\delta = 0.5$.

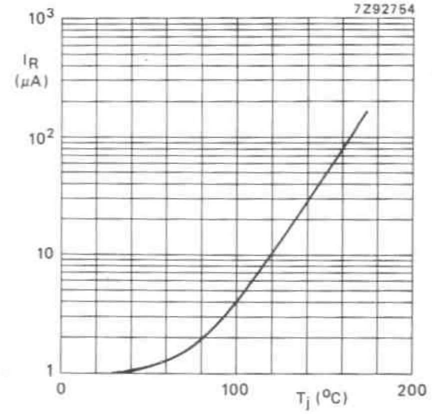


Fig. 8 Maximum values reverse current as a function of junction temperature; $V_R = V_{RWMmax}$.

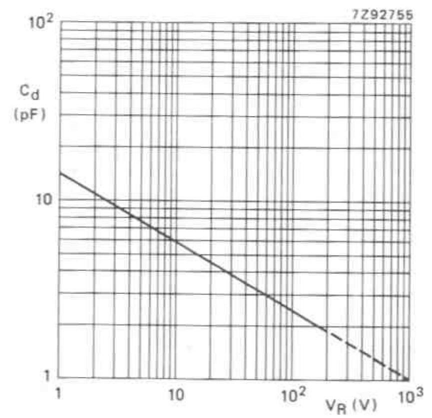
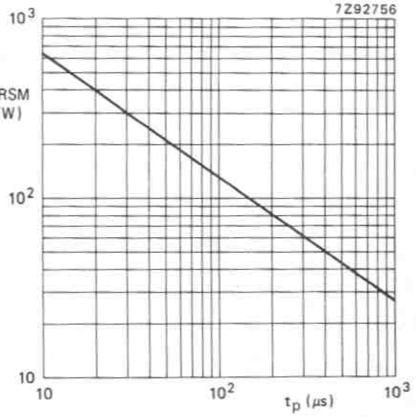


Fig. 9 Capacitance as a function of reverse voltage; f = 1 MHz; T_j = 25 °C; typical values.



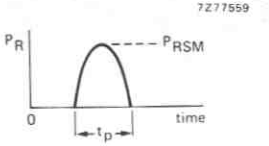


Fig. 10 Maximum permissible non-repetitive peak reverse power dissipation in the avalanche region; $T_j = T_{jmax}$.

AVALANCHE FAST SOFT-RECOVERY RECTIFIER DIODES

Glass passivated rectifier diodes in hermetically sealed leadless SMID* envelopes. They are intended for television and industrial applications, such as switched-mode power supplies, scan rectifiers in TV receivers and also for use in inverter and converter applications. The devices feature non-snap-off (soft-recovery) switching characteristics and are capable of absorbing reverse transient energy (e.g. during flashover in a picture tube).

QUICK REFERENCE DATA

			BYD37D	G	J	K	M	
Repetitive peak reverse voltage	V_{RRM}	max.	200	400	600	800	1000	V
Continuous reverse voltage	V_R	max.	200	400	600	800	1000	V
Average forward current	$I_{F(AV)}$	max.		1.5		1.5		A
Non-repetitive peak forward current	I_{FSM}	max.		20		20		A
Non-repetitive peak reverse energy	E_{RSM}	max.		10		7		mJ
Reverse recovery time	t_{rr}	<		250		300		ns

MECHANICAL DATA

Dimensions in mm

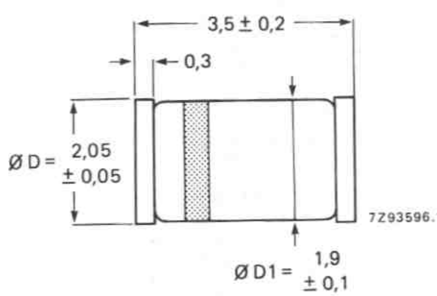


Fig. 1 SOD-87.

* Implosion Diode

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BYD37D	G	J	K	M	
Repetitive peak reverse voltage	V_{RRM}	max.	200	400	600	800	1000	V
Continuous reverse voltage	V_R	max.	200	400	600	800	1000	V
Average forward current square wave; $\delta = 0.5$								
$T_{tp} = 105\ ^oC$	$I_{F(AV)}$	max.		1.5		1.5		A
$T_{amb} = 65\ ^oC$; PCB mounting	$I_{F(AV)}$	max.		0.6		0.6		A
Repetitive peak forward current				12		12		A
Non-repetitive peak forward current t = 10 ms, half-sinewave; $T_j = T_j$max prior to surge; $V_R = V_{RRMmax}$	I_{FSM}	max.		20		20		A
Non-repetitive peak reverse avalanche energy; I_R = 400 mA; $T_j = T_{jmax}$, prior to surge; with inductive load switched off	E_{RSM}	max.		10		7		mJ
Storage temperature range	T_{stg}			−65 to + 175				^oC
Junction temperature	T_j	max.		175				^oC

THERMAL RESISTANCE

Influence of mounting method

1. Thermal resistance from junction to tie-point — $R_{th\ j\text{-}tp}$ = 30 K/W
2. Thermal resistance from junction to ambient; device mounted on an 1.5 mm thick epoxy-glass printed circuit board; Cu-thickness ≥ 40 μm; Fig. 2 — $R_{th\ j\text{-}a}$ = 150 K/W

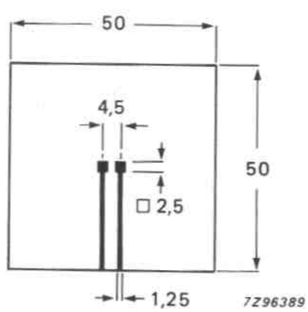


Fig. 2 Mounted on a PCB.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BYD37D	G	J	K	M	
Forward voltage *								
I_F = 1 A	V_F	<	1.3	1.3	1.3	1.3	1.3	V
I_F = 1 A; $T_j = T_{jmax}$	V_F	<	1.1	1.1	1.1	1.1	1.1	V
Reverse avalanche breakdown voltage								
I_R = 0.1 mA	$V_{(BR)R}$	>	300	500	700	900	1100	V
Reverse current								
$V_R = V_{RRMmax}$	I_R	<		1			1	μA
$V_R = V_{RRMmax}$; T_j = 165 °C	I_R	<		100			100	μA
Reverse recovery when switched from I_F = 1 A to $V_R \leqslant$ 30 V with $-dI_F/dt$ = 20 A/μs								
recovery charge	Q_s	<		250			400	nC
recovery time	t_{rr}	<		250			300	ns
Maximum slope of reverse recovery current when switched from I_F = 1 A to $V_R \geqslant$ 30 V with $-dI_F/dt$ = 1 A/μs	$\|dI_R/dt\|$	<		6			5	A/μs

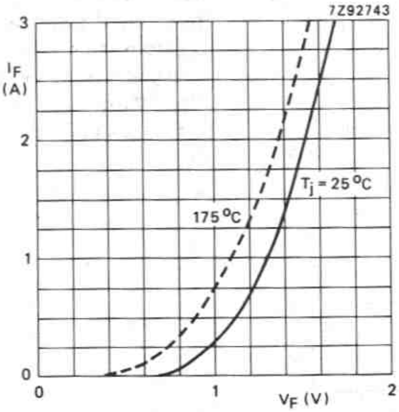


Fig. 3 Maximum forward voltage.

* Measured under pulse conditions to avoid excessive dissipation.

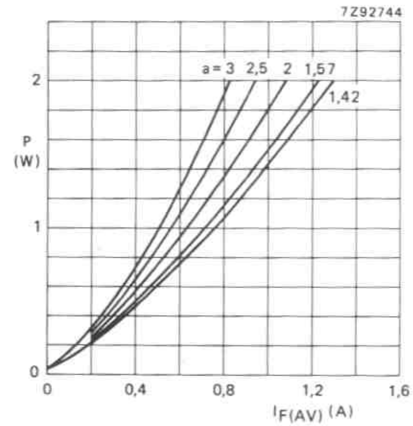


Fig. 4 Maximum values steady state power dissipation (forward plus leakage current) excluding switching losses as a function of the forward current.
The graph is for switched-mode application.
$a = I_{F(RMS)}/I_{F(AV)}$; $V_R = V_{RRMmax}$.

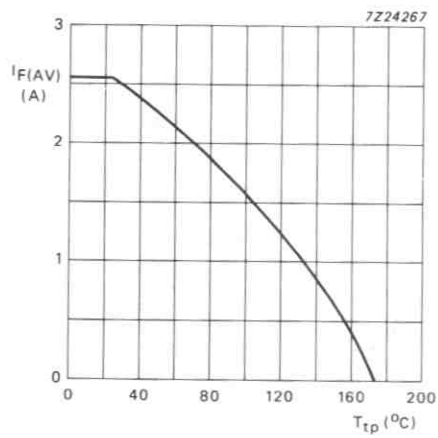


Fig. 5 Maximum average forward current as a function of temperature; the curve includes losses due to reverse leakage.
The graph is for switched-mode application.
$V_R = V_{RRMmax}$, $\delta = 0.5$; a = 1.42.
—— = tie-point temperature.

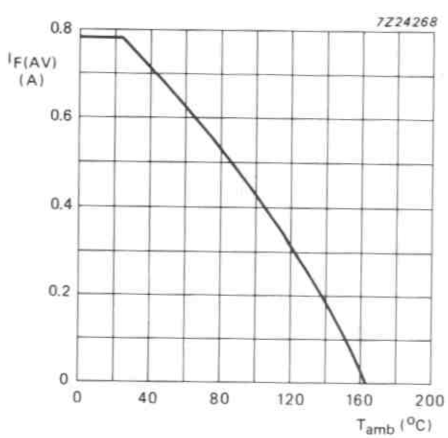


Fig. 6 Maximum average forward current as a function of temperature; the curve includes losses due to reverse leakage.
The graph is for switched-mode application.
$V_R = V_{RRMmax}$, $\delta = 0.5$; a = 1.42.
—— = ambient temperature and device mounted as shown in Fig. 2.

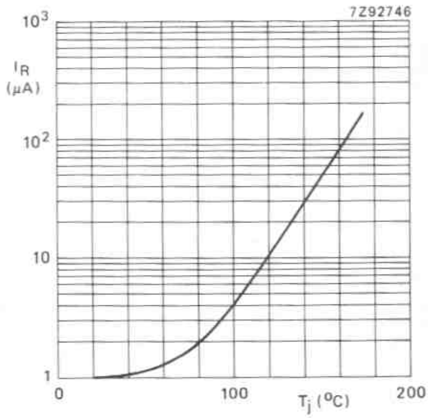


Fig. 7 Maximum values reverse current as a function of junction temperature.
$V_R = V_{RRMmax}$.

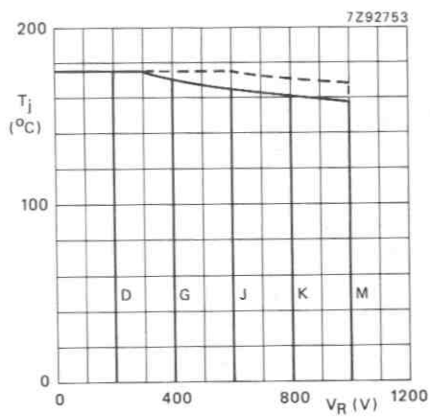


Fig. 8 Maximum permissible junction temperature as a function of reverse voltage.
—— = V_R; – – – = V_{RRM}; $\delta = 0.5$.

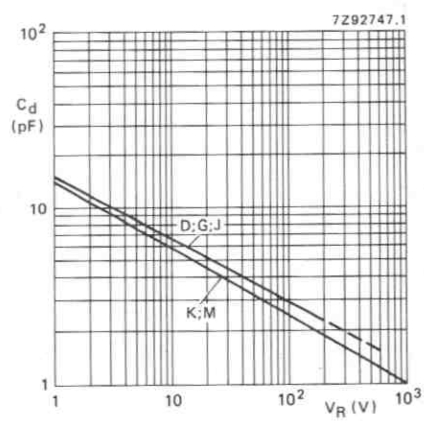


Fig. 9 Capacitance as a function of reverse voltage.
f = 1 MHz; T_j = 25 °C; typical values.

EPITAXIAL AVALANCHE DIODES

Rectifier diodes in hermetically sealed leadless SMID*-envelopes. They feature low forward voltage drop, very fast recovery, very low stored charge, non-snap-off switching characteristics and are capable of absorbing reverse transient energy (e.g. during flashover in a picture tube). These properties make the diodes very suitable for use in switched-mode power supplies and in general high-frequency circuits, where low conduction and switching losses are essential.

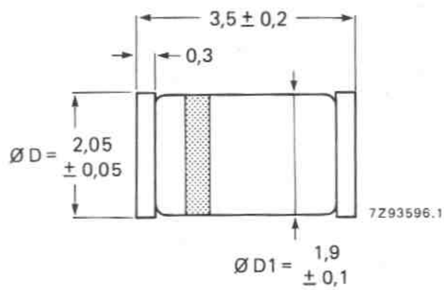
QUICK REFERENCE DATA

			BYD77A	B	C	D	E	F	G	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	250	300	400	V
Continuous reverse voltage	V_R	max.	50	100	150	200	250	300	400	V
Average forward current	$I_{F(AV)}$	max.	2	2	2	2	1,85	1,85	1,85	A
Non-repetitive peak forward current	I_{FSM}	max.	25	25	25	25	25	25	25	A
Non-repetitive peak reverse energy	E_{RSM}	max.	20	20	20	20	20	20	20	mJ
Reverse recovery time	t_{rr}	<	25	25	25	25	50	50	50	ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-87.



* Surface-mounted implosion diode.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BYD77A	B	C	D	E	F	G	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	250	300	400	V
Continuous reverse voltage	V_R	max.	50	100	150	200	250	300	400	V
Average forward current square wave; δ = 0,5										
T_{tp} = 105 °C	$I_{F(AV)}$	max.	2	2	2	2	1,85	1,85	1,85	A
T_{amb} = 60 °C; p.c.b. mounting	$I_{F(AV)}$	max.	0,85	0,85	0,85	0,85	0,8	0,8	0,8	A
Repetitive peak forward current	I_{FRM}	max.	15	15	15	15	13	13	13	A
Non-repetitive peak forward current (t = 10 ms; half sine-wave) $T_j = T_{j\,max}$ prior to surge; with reapplied V_{RRM}	I_{FSM}	max.				25				A
Non-repetitive peak reverse avalanche energy; with inductive load switched off: I_R = 600 mA at T_j = 25 °C prior to surge	E_{RSM}	max.				20				mJ
I_R = 400 mA at $T_j = T_{j\,max}$ prior to surge	E_{RSM}	max.				10				mJ
Storage temperature	T_{stg}					−65 to + 175				°C
Junction temperature	T_j	max.				175				°C

THERMAL RESISTANCE

Influence of mounting method

1. Thermal resistance from junction to tie-point	$R_{th\,j\text{-}tp}$	=	30	K/W
2. Thermal resistance from junction to ambient when mounted on a 1,5 mm thick epoxy-glass printed-circuit board; Cu-thickness ⩾ 40 μm; Fig 2.	$R_{th\,j\text{-}a}$	=	150	K/W

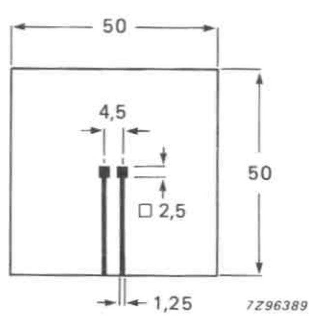


Fig 2. Mounted on a printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BYD77A	B	C	D	E	F	G	
Reverse avalanche breakdown voltage I_R = 0,1 mA	$V_{(BR)R}$	>	55	110	165	220	275	330	440	V
Forward voltage* I_F = 1 A; $T_j = T_{j\,max}$	V_F	<	0,74	0,74	0,74	0,74	0,83	0,83	0,83	V
I_F = 1 A	V_F	<	0,95	0,95	0,95	0,95	1,05	1,05	1,05	V
Reverse current $V_R = V_{RRMmax}$	I_R	<	1	1	1	1	1	1	1	µA
$V_R = V_{RRMmax}$; T_j = 165 °C	I_R	<	100	100	100	100	100	100	100	µA
Reverse recovery time when switched from I_F = 0,5 A to I_R = 1 A; measured at I_R = 0,25 A	t_{rr}	<	25	25	25	25	50	50	50	ns

DEVELOPMENT DATA

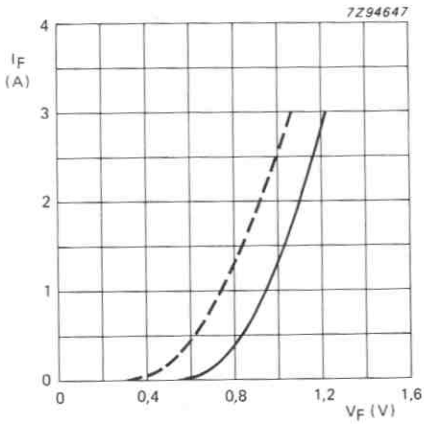


Fig. 3 **BYD77A; B; C; D.**
Maximum forward voltage.
—— T_j = 25 °C; – – – T_j = 175 °C.

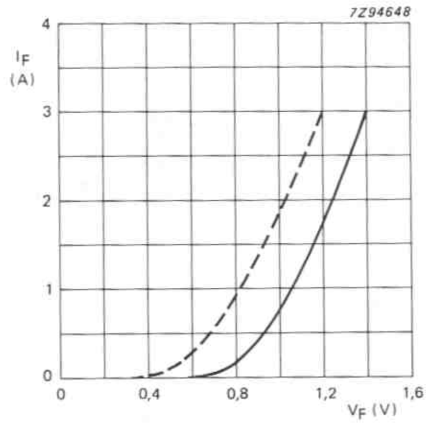


Fig. 4 **BYD77E; F; G.**
Maximum forward voltage.
—— T_j = 25 °C; – – – T_j = 175 °C.

* Measured under pulse conditions to avoid excessive dissipation.

REGULATOR DIODES

Diodes in hermetically sealed leadless SMID* glass envelopes.
They are intended for use as voltage regulator and transient suppressor diodes in medium power regulation and transient suppression circuits.
The series consists of BZD27-C7V5 to BZD27-C510 in the normalized E24 range.

QUICK REFERENCE DATA

			voltage regulator	transient suppressor	
Working voltage range	V_Z	nom.	7.5 to 270		V
Stand-off voltage	V_R			6.2 to 430	V
Total power dissipation	P_{tot}	max.	2.3		W
Non-repetitive peak reverse power dissipation $T_j = 25\ ^oC$; $t_p = 100\ \mu s$	P_{RSM}	max.	300		W

MECHANICAL DATA

Dimensions in mm

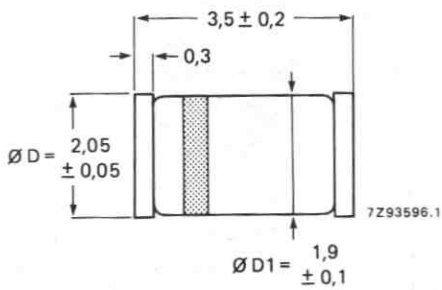


Fig. 1 SOD-87.

* Surface mounted implosion diode.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Total power dissipation			
T_{tp} = 105 °C	P_{tot}	max.	2.3 W
T_{amb} = 55 °C; PCB mounting (Fig. 2)	P_{tot}	max.	0.8 W
Non-repetitive peak reverse power dissipation			
t_p = 100 μs, square pulse; T_j = 25 °C (prior to surge) waveforms	P_{RSM}	max.	300 W
waveform 10/1000 exponential pulse (Fig. 3); T_j = 25 °C (prior to surge)	P_{RSM}	max.	150 W
Storage temperature	T_{stg}		−65 to + 175 °C
Junction temperature	T_j	max.	175 °C

THERMAL RESISTANCE

Influence of mounting method

1. Thermal resistance from junction to tie-point	$R_{thj\text{-}tp}$	=	30 K/W

2. Thermal resistance from junction to ambient when mounted on a 1.5 mm thick epoxy glass PCB;
Cu-thickness ⩾ 40 μm; Fig. 2.

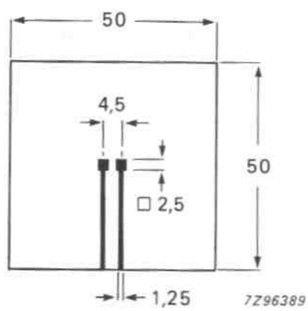


Fig. 2 Mounted on a printed-circuit board.

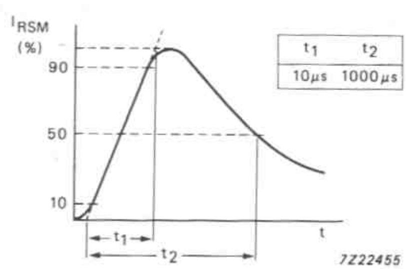


Fig. 3 Current pulse in accordance with IEC 60-2, Section 6.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Forward voltage I_F = 0.2 A	V_F	<	1.2 V

	temperature coefficient S_Z %/K		test current I_Z mA	reverse current µA	at reverse voltage V	working voltage V_Z V			differential resistance r_{diff} Ω	
	min.	max.		max		min.	nom.	max.	typ.	max.
C7V5	0	0.07	100	50	3	7.0	7.5	7.9	1	2
C8V2	0.03	0.08	100	10	3	7.7	8.2	8.7	1	2
C9V1	0.03	0.08	50	10	5	8.5	9.1	9.6	2	4
C10	0.05	0.09	50	7	7.5	9.4	10.0	10.6	2	4
C11	0.05	0.10	50	3	8.2	10.4	11.0	11.6	4	7
C12	0.05	0.10	50	2	9.1	11.4	12.0	12.7	4	7
C13	0.05	0.10	50	2	10	12.4	13.0	14.1	5	10
C15	0.05	0.10	50	1	11	13.8	15.0	15.6	5	10
C16	0.06	0.11	25	1	12	15.3	16.0	17.1	6	15
C18	0.06	0.11	25	1	13	16.8	18.0	19.1	6	15
C20	0.06	0.11	25	1	15	18.8	20.0	21.2	6	15
C22	0.06	0.11	25	1	16	20.8	22.0	23.3	6	15
C24	0.06	0.11	25	1	18	22.8	24.0	25.6	7	15
C27	0.06	0.11	25	1	20	25.1	27.0	28.9	7	15
C30	0.06	0.11	25	1	22	28	30	32	8	15
C33	0.06	0.11	25	1	24	31	33	35	8	15
C36	0.06	0.11	10	1	27	34	36	38	21	40
C39	0.06	0.11	10	1	30	37	39	41	21	40
C43	0.07	0.12	10	1	33	40	43	46	24	45
C47	0.07	0.12	10	1	36	44	47	50	24	45
C51	0.07	0.12	10	1	39	48	51	54	25	60
C56	0.07	0.12	10	1	43	52	56	60	25	60
C62	0.08	0.13	10	1	47	58	62	66	25	80
C68	0.08	0.13	10	1	51	64	68	72	25	80
C75	0.08	0.13	10	1	56	70	75	79	30	100
C82	0.08	0.13	10	1	62	77	82	87	30	100
C91	0.09	0.13	5	1	68	85	91	96	60	200
C100	0.09	0.13	5	1	75	94	100	106	60	200
C110	0.09	0.13	5	1	82	104	110	116	80	250
C120	0.09	0.13	5	1	91	114	120	127	80	250
C130	0.09	0.13	5	1	100	124	130	141	110	300
C150	0.09	0.13	5	1	110	138	150	156	130	300
C160	0.09	0.13	5	1	120	153	160	171	150	350
C180	0.09	0.13	5	1	130	168	180	191	180	400
C200	0.09	0.13	5	1	150	188	200	212	200	500
C220	0.09	0.13	2	1	160	208	220	233	350	750
C240	0.09	0.13	2	1	180	228	240	256	400	850
C270	0.09	0.13	2	1	200	251	270	289	450	1000

CHARACTERISTICS when used as transient suppressor diodes; $T_j = 25\ ^oC$

BZD27	clamping voltage (10/1000 pulse) $V_{(CL)R}$ V	non-repetitive at peak reverse I_{RSM} A	reverse current at recommended stand-off voltage I_R μA	V_R V
	max.		max.	
C7V5	11.3	13.3	1500	6.2
C8V2	12.3	12.2	1200	6.8
C9V1	13.3	11.3	100	7.5
C10	14.8	10.1	20	8.2
C11	15.7	9.6	5	9.1
C12	17.0	8.8	5	10
C13	18.9	7.9	5	11
C15	20.9	7.2	5	12
C16	22.9	6.6	5	13
C18	25.6	5.9	5	15
C20	28.4	5.3	5	16
C22	31.0	4.8	5	18
C24	33.8	4.4	5	20
C27	38.1	3.9	5	22
C30	42.2	3.6	5	24
C33	46.2	3.2	5	27
C36	50.1	3.0	5	30
C39	54.1	2.8	5	33
C43	60.7	2.5	5	36
C47	65.5	2.3	5	39
C51	70.8	2.1	5	43
C56	78.6	1.9	5	47
C62	86.5	1.7	5	51
C68	94.4	1.6	5	56
C75	103.5	1.5	5	62
C82	114.0	1.3	5	68
C91	126	1.2	5	75
C100	139	1.1	5	82
C110	152	1.0	5	91
C120	167	0.90	5	100
C130	185	0.81	5	110
C150	204	0.73	5	120
C160	224	0.67	5	130
C180	249	0.60	5	150
C200	276	0.54	5	160
C220	305	0.50	5	180
C240	336	0.45	5	200
C270	380	0.40	5	220
C300	419	0.36	5	240
C330	459	0.33	5	270
C360	498	0.30	5	300
C390	537	0.28	5	330
C430	603	0.25	5	360
C470	655	0.23	5	390
C510	707	0.21	5	430

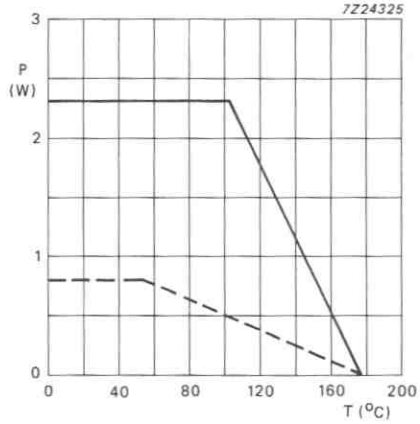


Fig. 4 Maximum total power dissipation as a function of temperature.

——— = tie-point temperature
– – – = ambient temperature and device mounted ans shown in Fig. 2.

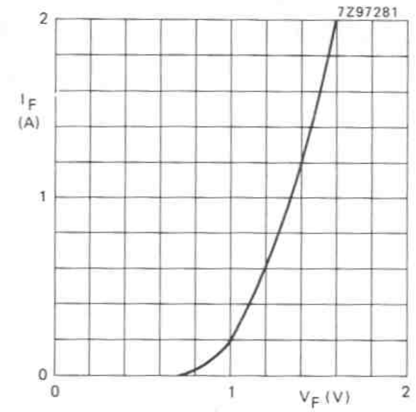


Fig. 5 Forward voltage; T_j = 25 °C; typical values.

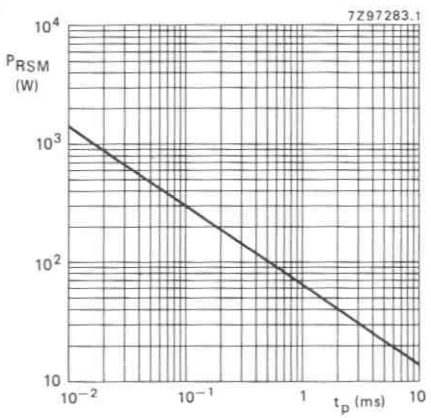


Fig. 6 Maximum non-repetitive peak reverse power dissipation (square pulse); T_j = 25 °C prior to surge.

SILICON PLANAR VOLTAGE REGULATOR DIODES

Silicon planar voltage regulator diodes, in a SOT-89 plastic envelope, intended for stabilization applications in thick and thin-film circuits.

The series covers the normalized range of nominal working voltages from 2,4 V to 75 V with a tolerance of ± 5% (international standard E24 range).

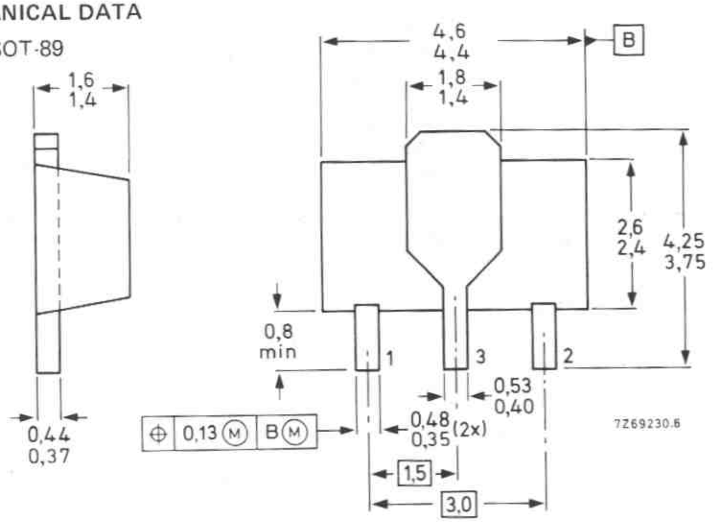
QUICK REFERENCE DATA

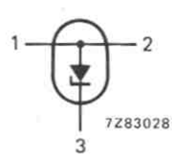
Working voltage range	V_Z	nom.	2,4 to 75 V
Working voltage tolerance (E24 range)			±5 %
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1 W
Junction temperature	T_j	max.	150 °C

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-89





BOTTOM VIEW

Marking code

BZV49-	C2V4 = 2Y4	C5V1 = 5Y1	C12 = 12Y	C33 = 33Y
	C2V7 = 2Y7	C5V6 = 5Y6	C13 = 13Y	C36 = 36Y
	C3V0 = 3Y0	C6V2 = 6Y2	C15 = 15Y	C39 = 39Y
	C3V3 = 3Y3	C6V8 = 6Y8	C16 = 16Y	C43 = 43Y
	C3V6 = 3Y6	C7V5 = 7Y5	C18 = 18Y	C47 = 47Y
	C3V9 = 3Y9	C8V2 = 8Y2	C20 = 20Y	C51 = 51Y
	C4V3 = 4Y3	C9V1 = 9Y1	C22 = 22Y	C56 = 56Y
	C4V7 = 4Y7	C10 = 10Y	C24 = 24Y	C62 = 62Y
		C11 = 11Y	C27 = 27Y	C68 = 68Y
			C30 = 30Y	C75 = 75Y

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Repetitive peak forward current	I_{FRM}	max.	250 mA
Average forward current (averaged over any 20 ms period)	$I_{F(AV)}$	max.	250 mA
Working current (d.c.)	I_Z	limited by $P_{tot\,max}$	
Total power dissipation * up to T_{amb} = 25 °C	P_{tot}	max.	1 W
Non-repetitive peak reverse power dissipation * T_j = 25 °C; t_p = 100 µs	P_{ZSM}	max.	40 W
Storage temperature	T_{stg}		−65 to +150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to collector tab	$R_{th\ j\text{-}tab}$	=	15 K/W
From junction to ambient in free air *	$R_{th\ j\text{-}a}$	=	125 K/W

CHARACTERISTICS

T_j = 25 °C

Forward voltage

I_F = 50 mA		V_F	<	1,0 V

Reverse current

BZV49- C2V4	V_R = 1 V	I_R	<	50 µA
C2V7	V_R = 1 V	I_R	<	20 µA
C3V0	V_R = 1 V	I_R	<	10 µA
C3V3	V_R = 1 V	I_R	<	5 µA
C3V6	V_R = 1 V	I_R	<	5 µA
C3V9	V_R = 1 V	I_R	<	3 µA
C4V3	V_R = 1 V	I_R	<	3 µA
C4V7	V_R = 2 V	I_R	<	3 µA
C5V1	V_R = 2 V	I_R	<	2 µA
C5V6	V_R = 2 V	I_R	<	1 µA
C6V2	V_R = 4 V	I_R	<	3 µA
C6V8	V_R = 4 V	I_R	<	2 µA
C7V5	V_R = 5 V	I_R	<	1 µA
C8V2	V_R = 5 V	I_R	<	700 nA
C9V1	V_R = 6 V	I_R	<	500 nA
C10	V_R = 7 V	I_R	<	200 nA
C11 to C13	V_R = 8 V	I_R	<	100 nA
C15 to C75	V_R = 0,7 V_{Znom}	I_R	<	50 nA

* Device mounted on a ceramic substrate: area = 2,5 cm^2; thickness = 0,7 mm.

T_j = 25 °C

E24 logarithmic range (tolerance ± 5%)

BZV49-...	working voltage V_Z (V) at I_{Ztest} = 5 mA		differential resistance r_{diff} (Ω) at I_{Ztest} = 5 mA		temperature coefficient S_Z (mV/K) at I_{Ztest} = 5 mA			diode capacitance C_d(pF); f = 1 MHz V_R = 0	
	min.	max.	typ.	max.	min.	typ.	max.	typ.	max.
C2V4	2,2	2,6	70	100	−3,5	−1,6	0	375	450
C2V7	2,5	2,9	75	100	−3,5	−2,0	0	350	450
C3V0	2,8	3,2	80	95	−3,5	−2,1	0	350	450
C3V3	3,1	3,5	85	95	−3,5	−2,4	0	325	450
C3V6	3,4	3,8	85	90	−3,5	−2,4	0	300	450
C3V9	3,7	4,1	85	90	−3,5	−2,5	0	300	450
C4V3	4,0	4,6	80	90	−3,5	−2,5	0	275	450
C4V7	4,4	5,0	50	80	−3,5	−1,4	0,2	130	180
C5V1	4,8	5,4	40	60	−2,7	−0,8	1,2	110	160
C5V6	5,2	6,0	15	40	−2,0	1,2	2,5	95	140
C6V2	5,8	6,6	6	10	0,4	2,3	3,7	90	130
C6V8	6,4	7,2	6	15	1,2	3,0	4,5	85	110
C7V5	7,0	7,9	6	15	2,5	4,0	5,3	80	100
C8V2	7,7	8,7	6	15	3,2	4,6	6,2	75	95
C9V1	8,5	9,6	6	15	3,8	5,5	7,0	70	90
C10	9,4	10,6	8	20	4,5	6,4	8,0	70	90
C11	10,4	11,6	10	20	5,4	7,4	9,0	65	85
C12	11,4	12,7	10	25	6,0	8,4	10,0	65	85
C13	12,4	14,1	10	30	7,0	9,4	11,0	60	80
C15	13,8	15,6	10	30	9,2	11,4	13,0	55	75
C16	15,3	17,1	10	40	10,4	12,4	14,0	52	75
C18	16,8	19,1	10	45	12,4	14,4	16,0	47	70
C20	18,8	21,2	15	55	14,4	16,4	18,0	36	60
C22	20,8	23,3	20	55	16,4	18,4	20,0	34	60
C24	22,8	25,6	25	70	18,4	20,4	22,0	33	55
	at I_{Ztest} = 2 mA		at I_{Ztest} = 2 mA		at I_{Ztest} = 2 mA				
C27	25,1	28,9	25	80	21,4	23,4	25,3	30	50
C30	28,0	32,0	30	80	24,4	26,6	29,4	27	50
C33	31,0	35,0	35	80	27,4	29,7	33,4	25	45
C36	34,0	38,0	35	90	30,4	33,0	37,4	23	45
C39	37,0	41,0	40	130	33,4	36,4	41,2	21	45
C43	40,0	46,0	45	150	37,6	41,2	46,6	21	40
C47	44,0	50,0	50	170	42,0	46,1	51,8	19	40
C51	48,0	54,0	60	180	46,6	51,0	57,2	19	40
C56	52,0	60,0	70	200	52,2	57,0	63,8	18	40
C62	58,0	66,0	80	215	58,8	64,4	71,6	17	35
C68	64,0	72,0	90	240	65,6	71,7	79,8	17	35
C75	70,0	79,0	95	255	73,4	80,2	88,6	16,5	35

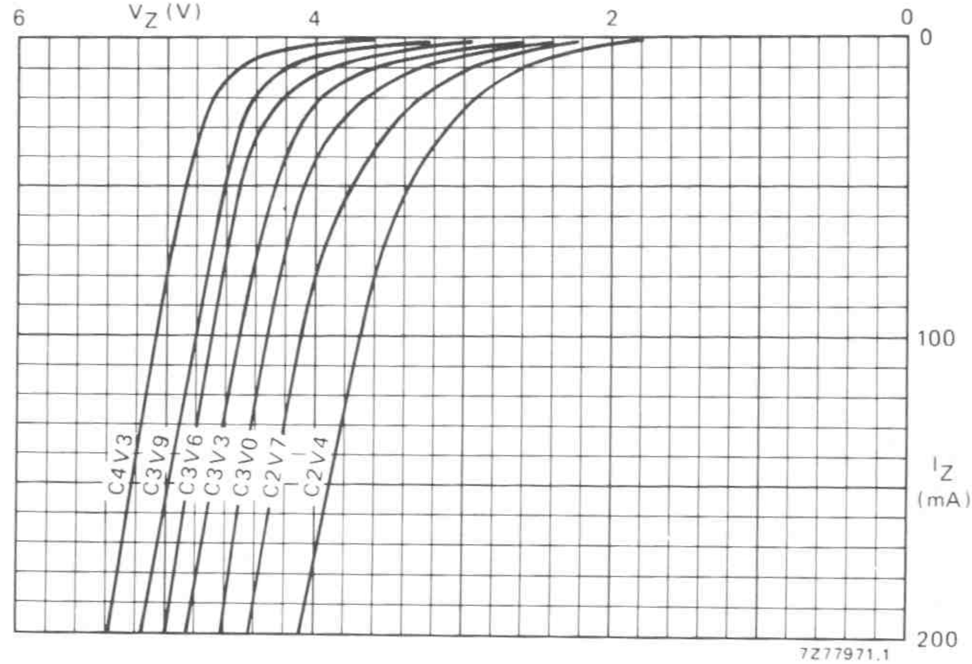


Fig. 2 Dynamic characteristics; typical values; T_j = 25 °C.

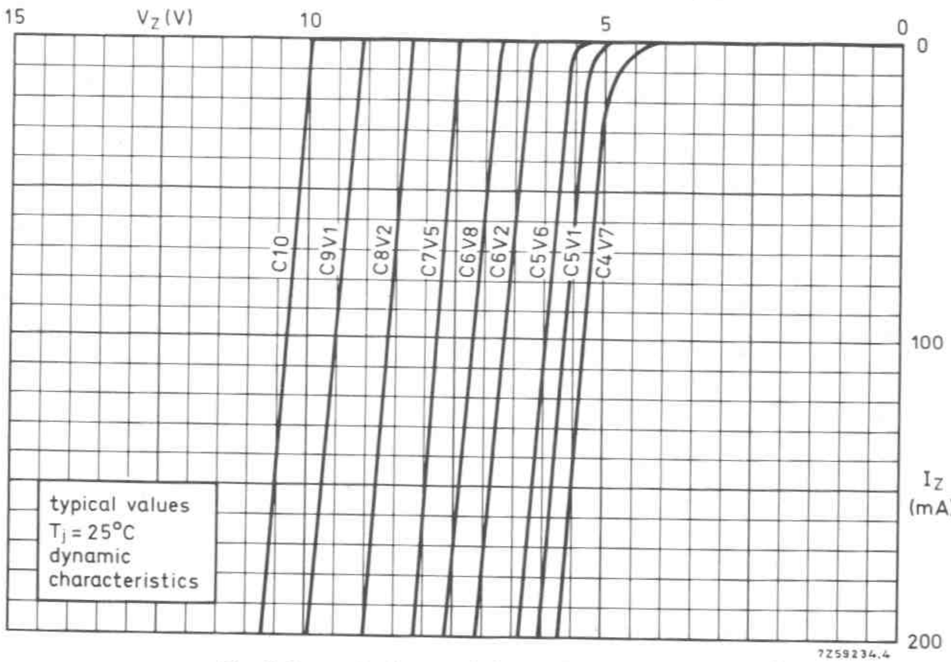


Fig. 3 Dynamic characteristics; typical values at T_j = 25 °C.

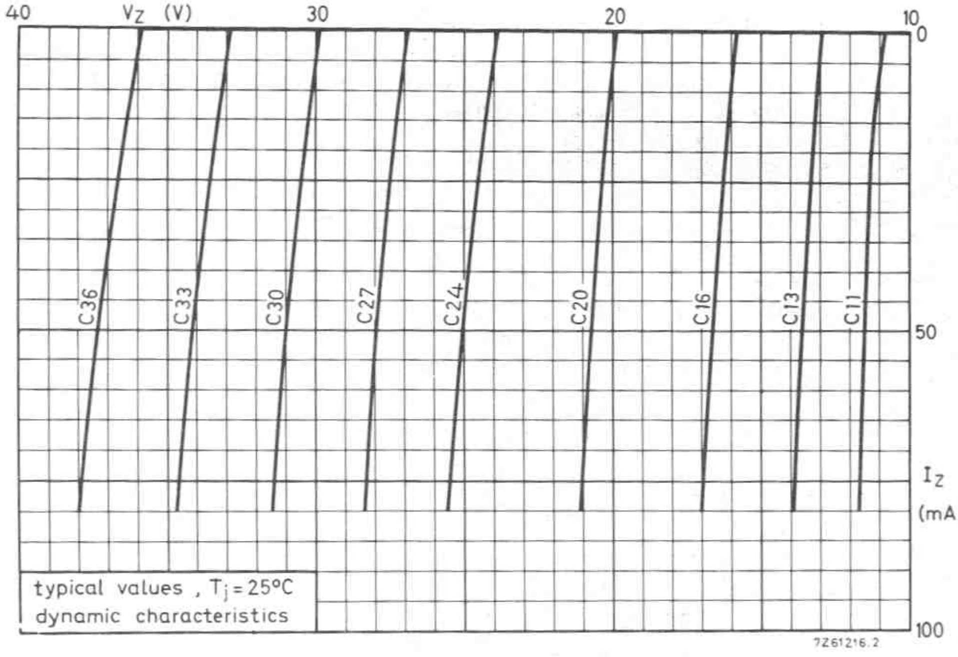


Fig. 4 Dynamic characteristics; typical values; T_j = 25 °C.

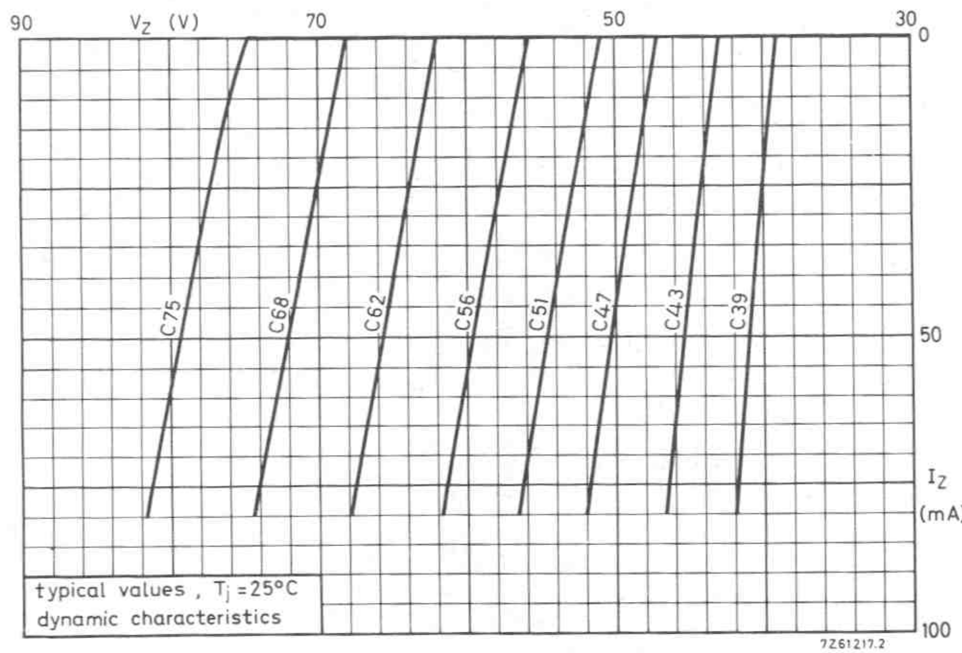


Fig. 5 Dynamic characteristics; typical values at T_j = 25 °C.

Model for calculating the static working voltage ($V_{Z\ stat}$).

This model can be derived from $V_{Z\ stat} = V_{Z\ dyn} + \Delta V_Z$ of which $V_{Z\ dyn}$ is given in the preceding tables and can be derived from the typical dynamic characteristic curves (Figs 2, 3, 4 and 5)

$\Delta V_Z = \Delta T \times S_Z$. For S_Z see tables and graphs S_Z versus T_j.

$\Delta T = P_{tot} \times R_{th\ j\text{-}a} = I_Z \times V_{Z\ dyn} \times R_{th\ j\text{-}a}$.

Following $\Delta V_Z = I_Z \times V_{Z\ dyn} \times R_{th\ j\text{-}a} \times S_Z$ and the model will be:

$$V_{Z\ stat} = V_{Z\ dyn} + I_Z \times V_{Z\ dyn} \times R_{th\ j\text{-}a} \times S_Z$$

Calculating example

BZV49-C24 mounted on a ceramic substrate of 7 x 5 x 0,6 mm; at I_Z = 7 mA.

$$V_{Z\ stat} = 24 + \left(\frac{7}{1000} \times 24 \times \frac{125}{1000} \times 20{,}3\right)$$

$$= 24 + 0{,}4 = 24{,}4\ \text{V}.$$

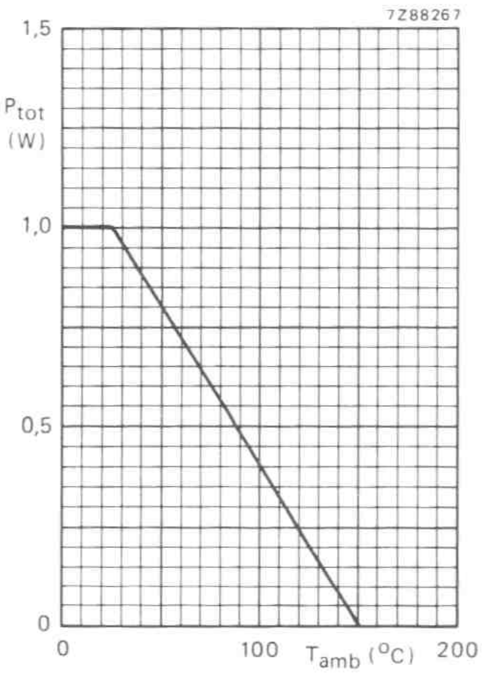


Fig. 6 Power derating curve.

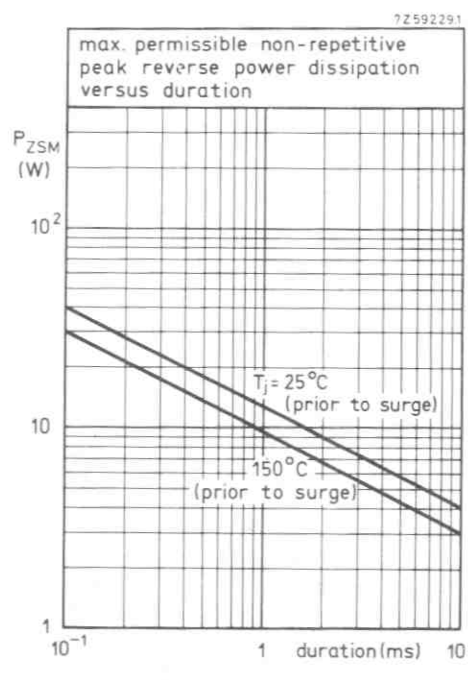


Fig. 7.

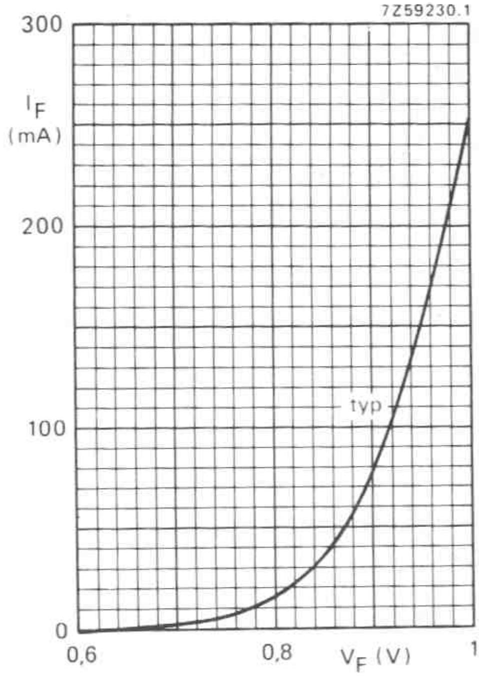


Fig. 8 $T_j = 25\ ^oC$.

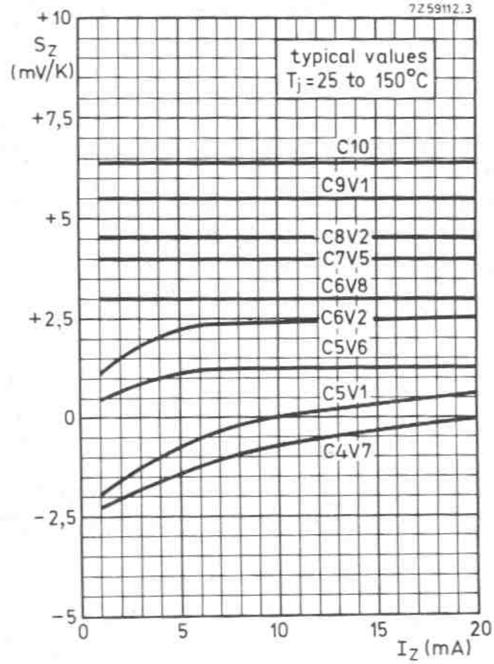


Fig. 9.

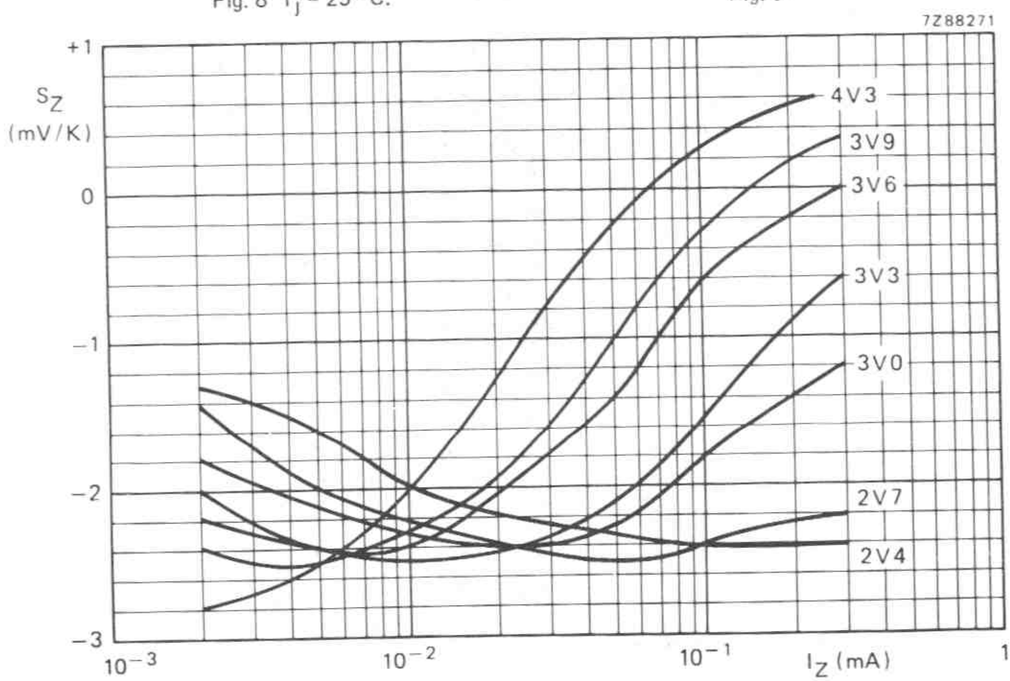


Fig. 10 Typical values temperature coefficient.

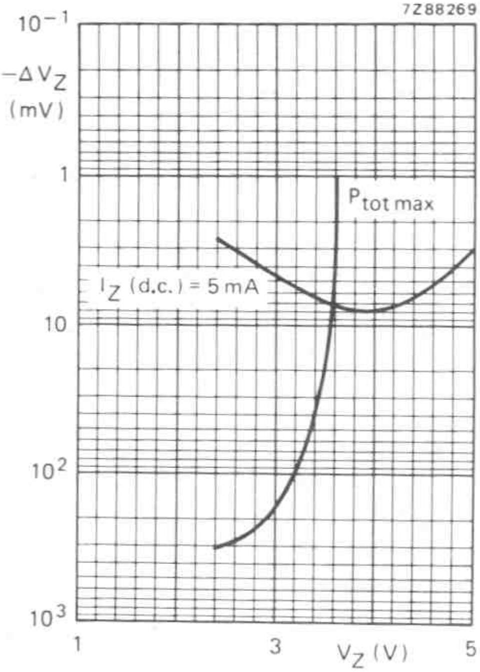


Fig. 11 Typical change of working voltage; T_j = 25 °C.

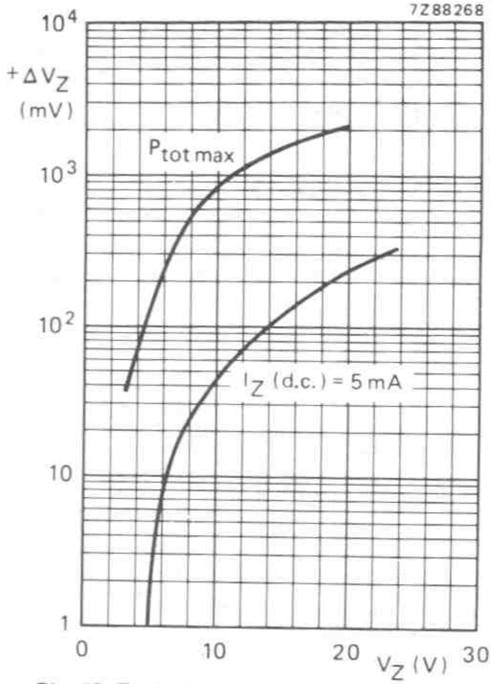


Fig. 12 Typical change of working voltage; T_{amb} = 25 °C.

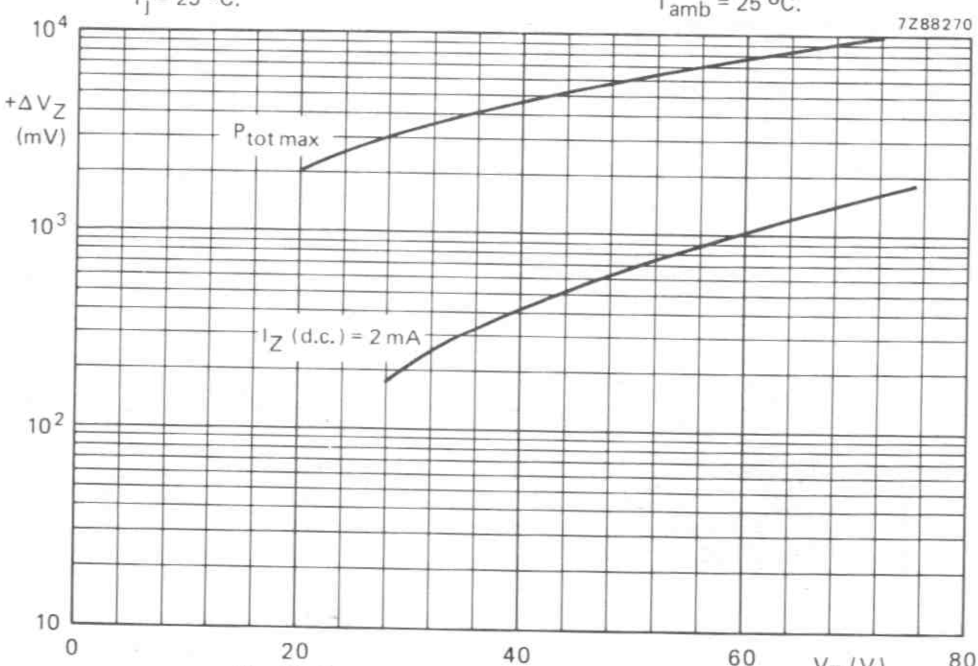


Fig. 13 Typical change of working voltage.

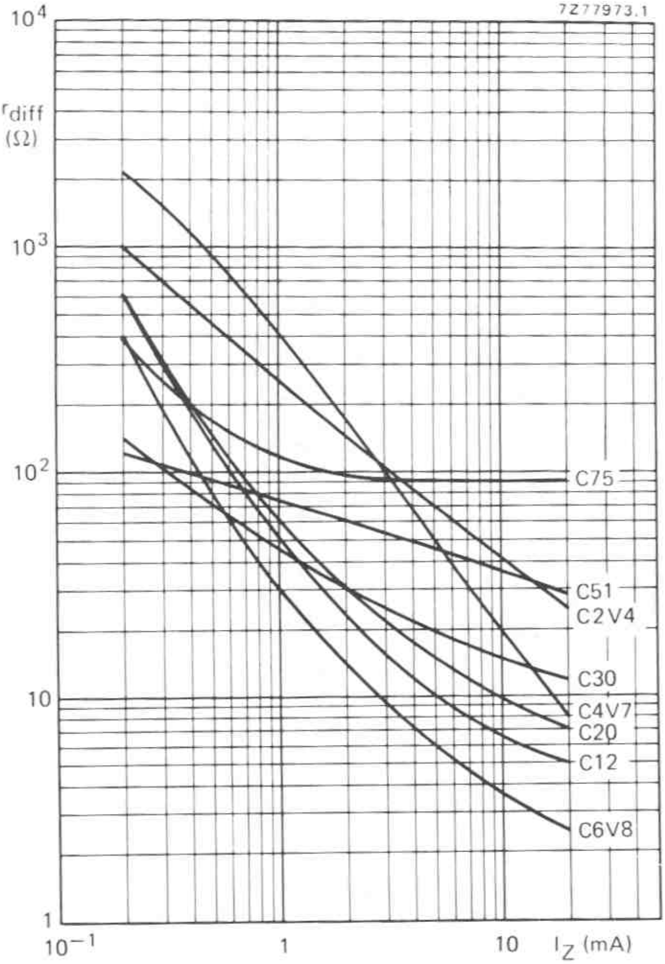


Fig. 14 Typical values; T_j = 25 °C; f = 1 kHz.

VOLTAGE REGULATOR DIODES FOR SURFACE MOUNTING

Silicon planar diodes designed for use as low-voltage stabilizers or voltage references. They are available in the international standardized E24 (± 5%) range, and also in tolerance ranges of 2% and 3%. The series consists of 37 types with nominal working voltages ranging from 2,4 V to 75 V.

The SM diode is a leadless diode in a hermetically sealed glass SOD-80 envelope with tin plated metal discs at each end. It is suitable for "automatic placement" and as such it can withstand immersion soldering.

The diodes are delivered in "super 8" tape.

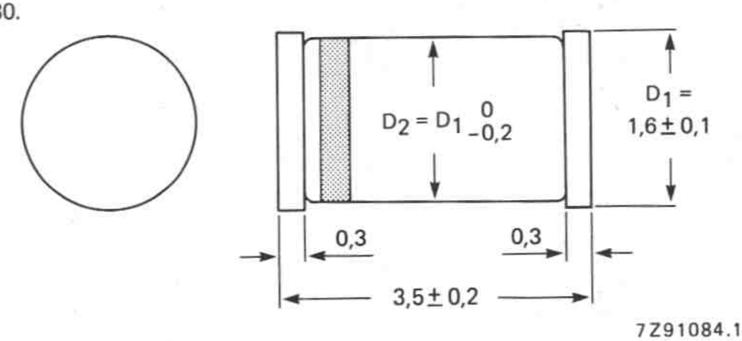
QUICK REFERENCE DATA

Working voltage range	V_Z	nom.	2,4 to 75	V
Total power dissipation up to flange temperature of 50 °C	P_{tot}	max.	500	mW
Non-repetitive peak reverse power dissipation	P_{ZSM}	max.	30	W
Junction temperature	T_j	max.	200	°C
Thermal resistance from junction to tie-point	$R_{th\ j\text{-}tp}$	=	0,30	K/mW

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-80.



The BZV55 cathode is indicated by a yellow band.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134).

Average forward current (averaged over any 20 ms period)	$I_{F(AV)}$	max.	250 mA
Repetitive peak forward current	I_{FRM}	max.	250 mA
Total power dissipation up to T_{flange} = 50 °C	P_{tot}	max.	500 mW
up to T_{amb} = 50 °C and mounted on a ceramic substrate of 10 mm x 10 mm x 0,6 mm	P_{tot}	max.	400 mW
Non-repetitive peak reverse power dissipation t = 100 μs; T_j = 150 °C	P_{ZSM}	max.	30 W
Storage temperature	T_{stg}	−65 to	+200 °C
Junction temperature	T_j	max.	200 °C

THERMAL RESISTANCE

From junction to tie-point (flanges)	$R_{th\ j\text{-}tp}$	=	0,30 K/mW
From junction to ambient when mounted on a ceramic substrate of 10 mm x 10 mm x 0,6 mm	$R_{th\ j\text{-}a}$	=	0,38 K/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Forward voltage I_F = 10 mA		V_F	<	0,9 V
Reverse current				
BZV55-.2V4	V_R = 1 V	I_R	<	50 μA
.2V7	V_R = 1 V	I_R	<	20 μA
.3V0	V_R = 1 V	I_R	<	10 μA
.3V3	V_R = 1 V	I_R	<	5 μA
.3V6	V_R = 1 V	I_R	<	5 μA
.3V9	V_R = 1 V	I_R	<	3 μA
.4V3	V_R = 1 V	I_R	<	3 μA
.4V7	V_R = 2 V	I_R	<	3 μA
.5V1	V_R = 2 V	I_R	<	2 μA
.5V6	V_R = 2 V	I_R	<	1 μA
.6V2	V_R = 4 V	I_R	<	3 μA
.6V8	V_R = 4 V	I_R	<	2 μA
.7V5	V_R = 5 V	I_R	<	1 μA
.8V2	V_R = 5 V	I_R	<	700 nA
.9V1	V_R = 6 V	I_R	<	500 nA
.10	V_R = 7 V	I_R	<	200 nA
.11 to .13	V_R = 8 V	I_R	<	100 nA
.15 to .75	V_R = 0,7 V_{Znom}	I_R	<	50 nA

. = C for E24 (± 5%) tolerance
. = B for ± 2%
. = F for ± 3%.

± 2% tolerance range

BZV55B	working voltage V_Z (V) at I_{Ztest} = 5 mA		differential resistance r_{diff} (Ω) at I_{Ztest} = 5 mA		temperature coefficient S_Z (mV/K) at I_{Ztest} = 5 mA			differential resistance r_{diff} (Ω) at I_Z = 1 mA	
	min.	max.	typ.	max.	min.	typ.	max.	typ.	max.
B2V4	2,35	2,45	70	100	−3,5	−1,6	0	275	600
B2V7	2,65	2,75	75	100	−3,5	−2,0	0	300	600
B3V0	2,94	3,06	80	95	−3,5	−2,1	0	325	600
B3V3	3,23	3,37	85	95	−3,5	−2,4	0	350	600
B3V6	3,53	3,67	85	90	−3,5	−2,4	0	375	600
B3V9	3,82	3,98	85	90	−3,5	−2,5	0	400	600
B4V3	4,21	4,39	80	90	−3,5	−2,5	0	410	600
B4V7	4,61	4,79	50	80	−3,5	−1,4	0,2	425	500
B5V1	5,00	5,20	40	60	−2,7	−0,8	1,2	400	480
B5V6	5,49	5,71	15	40	−2,0	1,2	2,5	80	400
B6V2	6,08	6,32	6	10	0,4	2,3	3,7	40	150
B6V8	6,66	6,94	6	15	1,2	3,0	4,5	30	80
B7V5	7,35	7,65	6	15	2,5	4,0	5,3	30	80
B8V2	8,04	8,36	6	15	3,2	4,6	6,2	40	80
B9V1	8,92	9,28	6	15	3,8	5,5	7,0	40	100
B10	9,80	10,20	8	20	4,5	6,4	8,0	50	150
B11	10,80	11,20	10	20	5,4	7,4	9,0	50	150
B12	11,80	12,20	10	25	6,0	8,4	10,0	50	150
B13	12,70	13,30	10	30	7,0	9,4	11,0	50	170
B15	14,70	15,30	10	30	9,2	11,4	13,0	50	200
B16	15,70	16,30	10	40	10,4	12,4	14,0	50	200
B18	17,60	18,40	10	45	12,4	14,4	16,0	50	225
B20	19,60	20,40	15	55	14,4	16,4	18,0	60	225
B22	21,60	22,40	20	55	16,4	18,4	20,0	60	250
B24	23,50	24,50	25	70	18,4	20,4	22,0	60	250
	at I_{Ztest} = 2 mA		at I_{Ztest} = 2 mA		at I_{Ztest} = 2 mA			at I_Z = 0,5 mA	
B27	26,50	27,50	25	80	21,4	23,4	25,3	65	300
B30	29,40	30,60	30	80	24,4	26,6	29,4	70	300
B33	32,30	33,70	35	80	27,4	29,7	33,4	75	325
B36	35,30	36,70	35	90	30,4	33,0	37,4	80	350
B39	38,20	39,80	40	130	33,4	36,4	41,2	80	350
B43	42,10	43,90	45	150	37,6	41,2	46,6	85	375
B47	46,10	47,90	50	170	42,0	46,1	51,8	85	375
B51	50,00	51,00	60	180	46,6	51,0	57,2	90	400
B56	54,90	57,10	70	200	52,2	57,0	63,8	100	425
B62	60,80	63,20	80	215	58,8	64,4	71,6	120	450
B68	66,60	69,40	90	240	65,6	71,7	79,8	150	475
B75	73,50	76,50	95	255	73,4	80,02	88,6	170	500

T_j = 25 °C
± 3% tolerance range

BZV55F	working voltage V_Z (V) at I_{Ztest} = 5 mA min.	max.	differential resistance r_{diff} (Ω) at I_{Ztest} = 5 mA typ.	max.	temperature coefficient S_Z (mV/K) at I_{Ztest} = 5 mA typ.	leakage current I_R at V_R μA	V
F2V	2,33	2,47	70	100	−1,6	50	1
F2V7	2,62	2,78	75	100	−2,0	20	1
F3V0	2,91	3,09	80	100	−2,1	10	1
F3V3	3,20	3,40	85	100	−2,4	5	1
F3V6	3,49	3,71	85	100	−2,4	5	1
F3V9	3,78	4,02	85	100	−2,5	3	1
F4V3	4,17	4,43	80	100	−2,5	3	1
F4V7	4,56	4,84	50	100	−1,4	3	2
F5V1	4,95	5,25	40	80	−0,8	2	2
F5V6	5,43	5,77	15	40	1,2	1	2
F6V2	6,01	6,39	6	30	2,3	3	4
F6V8	6,60	7,00	6	20	3,0	2	4
F7V5	7,28	7,72	6	20	4,0	1	5
F8V2	7,95	8,45	6	20	4,6	0,7	5
F9V1	8,83	9,37	6	20	5,5	0,5	6
F10	9,7	10,30	8	25	6,4	0,2	7
F11	10,67	11,33	10	25	7,4	0,1	8
F12	11,64	12,36	10	25	8,4	0,1	8
F13	12,61	13,39	10	35	9,4	0,1	8
F15	14,55	15,45	10	40	11,4	0,05	10
F16	15,50	16,50	10	45	12,4	0,05	
F18	17,50	18,50	10	50	14,4	0,05	
F20	19,40	20,60	15	60	16,4	0,05	
F22	21,30	22,70	20	70	18,4	0,05	
F24	23,30	24,70	25	80	20,4	0,05	
	at I_{Ztest} = 2 mA		at I_{Ztest} = 2 mA		at I_{Ztest} = 2 mA	at I_Z = 0,5 mA	
F27	26,20	27,80	25	80	23,4	0,05	0,7
F30	29,10	30,90	30	100	26,6	0,05	0,7
F33	32,00	34,00	35	120	29,7	0,05	0,7
F36	34,90	37,10	35	140	33,0	0,05	0,7
F39	37,80	40,20	40	150	36,4	0,05	0,7
F43	41,70	44,30	45	160	41,2	0,05	0,7
F47	45,60	48,40	50	170	46,1	0,05	0,7
F51	49,50	52,50	60	180	51,0	0,05	0,7
F56	54,30	57,70	70	200	57,0	0,05	0,7
F62	60,10	63,90	80	220	64,4	0,05	0,7
F68	66,00	70,00	90	240	71,7	0,05	0,7
F75	72,80	77,20	95	255	80,02	0,05	0,7

T_j = 25 °C

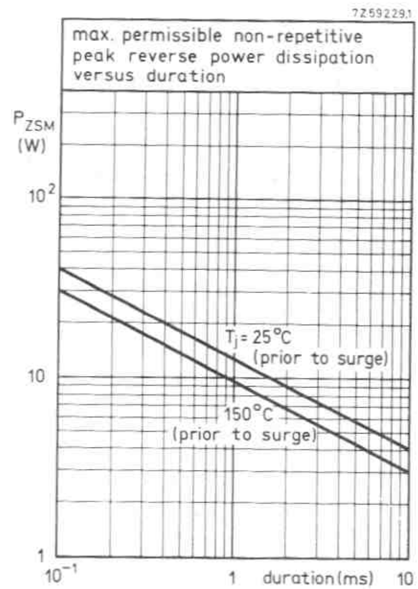

7Z59229.1
max. permissible non-repetitive peak reverse power dissipation versus duration
P_{ZSM} (W)
10^2
10
1
T_j = 25 °C (prior to surge)
150 °C (prior to surge)
10^{-1}
1
duration (ms)
10

Fig. 2.

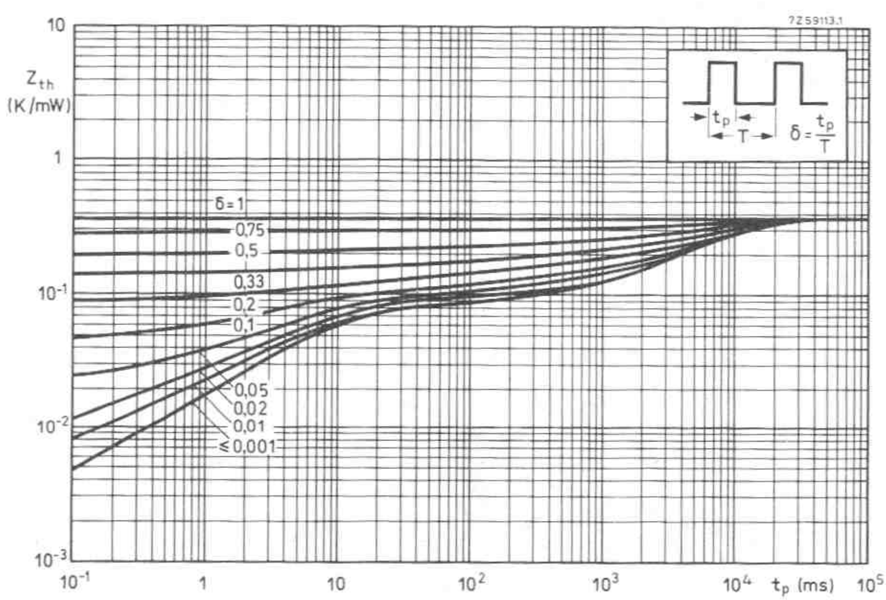

7Z59113.1
Z_{th} (K/mW)
10
1
10^{-1}
10^{-2}
10^{-3}
δ = 1
0,75
0,5
0,33
0,2
0,1
0,05
0,02
0,01
≤ 0,001
t_p
T
$\delta = \frac{t_p}{T}$
10^{-1}
1
10
10^2
10^3
10^4
t_p (ms)
10^5

Fig. 3.

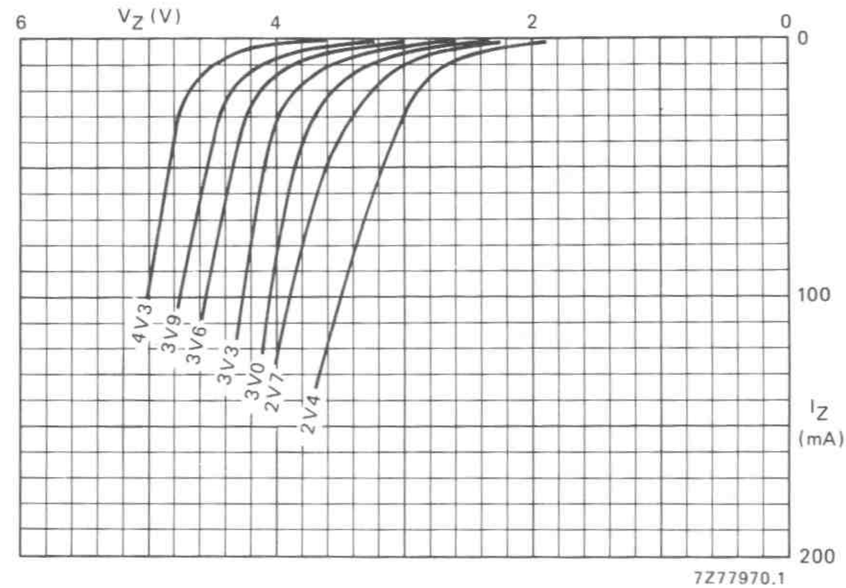


Fig. 4 Static characteristics; typical values; T_{amb} = 25 °C.

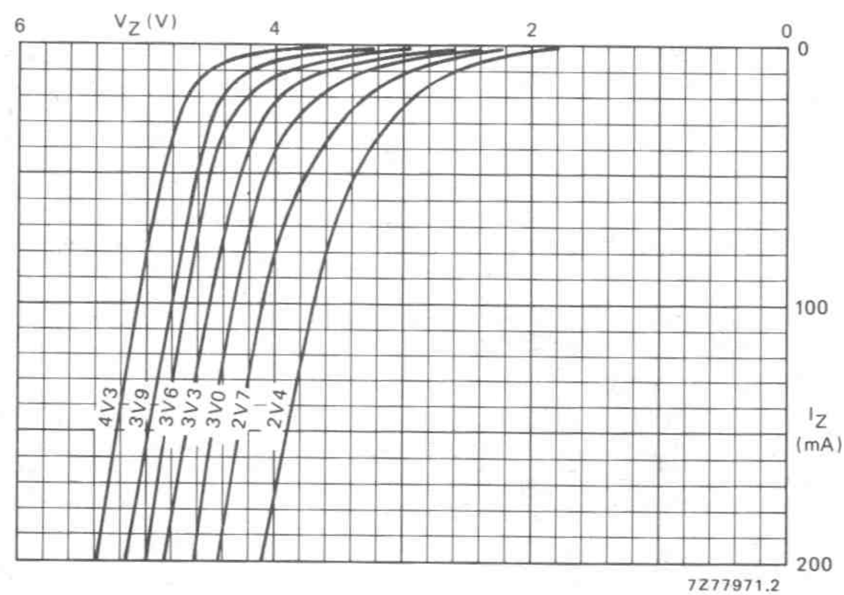


Fig. 5 Dynamic characteristics; typical values; T_j = 25 °C.

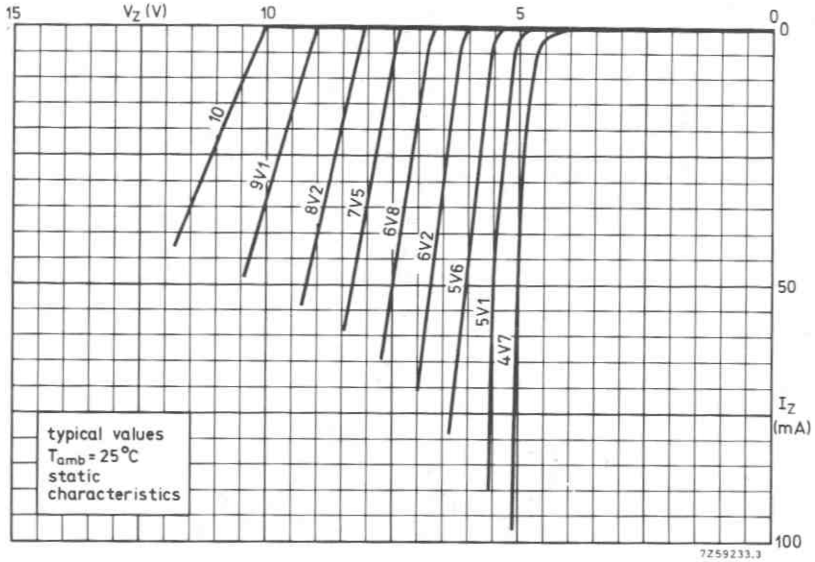

15
V_Z (V)
10
5
0
0
10
9V1
8V2
7V5
6V8
6V2
5V6
5V1
4V7
50
I_Z (mA)
100
typical values
T_{amb} = 25 °C
static
characteristics
7Z59233.3

Fig. 6.

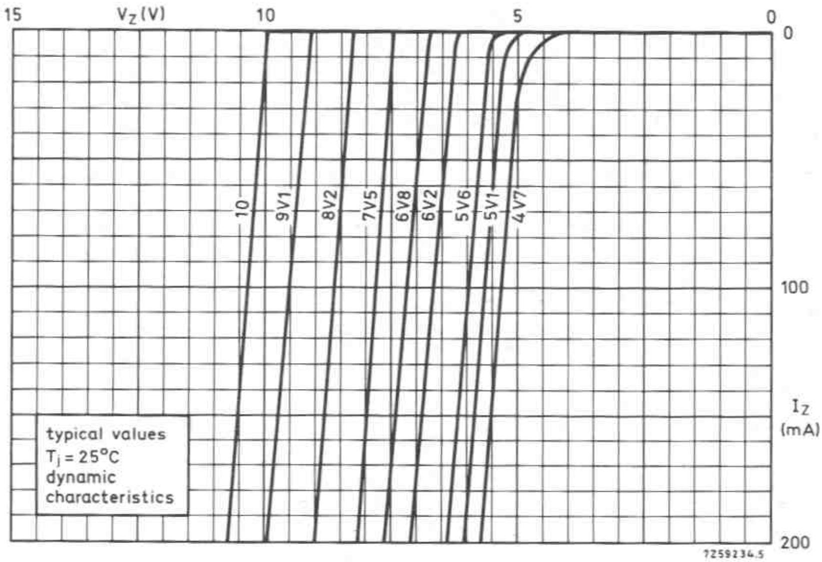

15
V_Z (V)
10
5
0
0
10
9V1
8V2
7V5
6V8
6V2
5V6
5V1
4V7
100
I_Z (mA)
200
typical values
T_j = 25°C
dynamic
characteristics
7Z59234.5

Fig. 7.

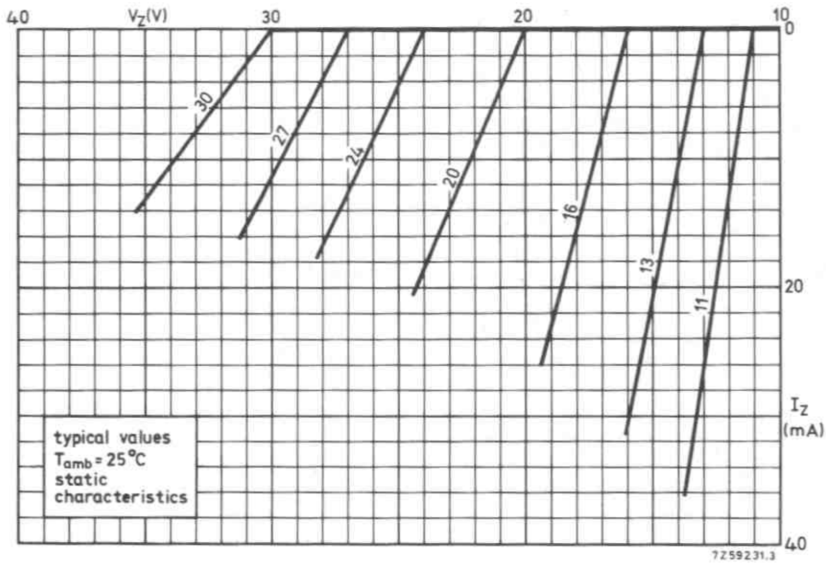

40
V_Z(V)
30
20
10
0
30
27
24
20
16
13
11
20
I_Z
(mA)
40
typical values
T_{amb} = 25 °C
static
characteristics
7Z59231.3

Fig. 8.

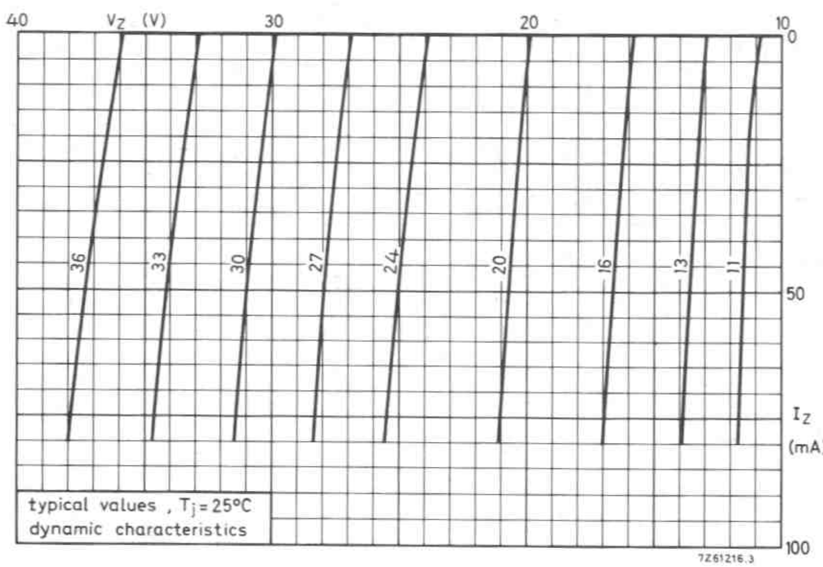

40
V_Z (V)
30
20
10
0
36
33
30
27
24
20
16
13
11
50
I_Z
(mA)
100
typical values , T_j = 25°C
dynamic characteristics
7Z61216.3

Fig. 9.

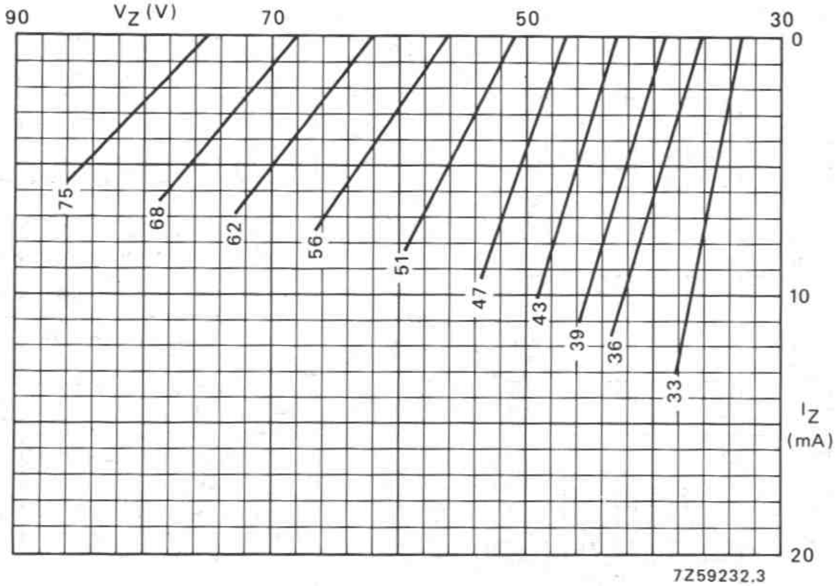


Fig. 10 Static characteristics; typical values; T_{amb} = 25 °C.

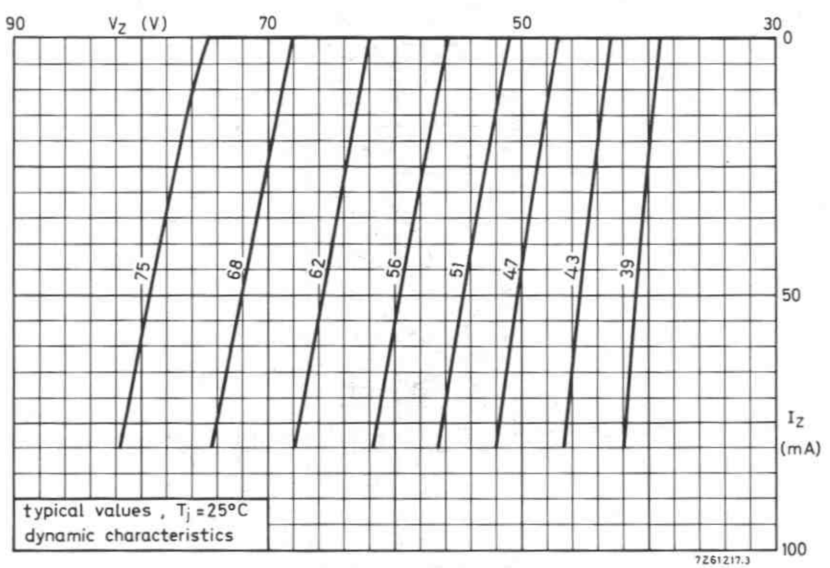


Fig. 11.

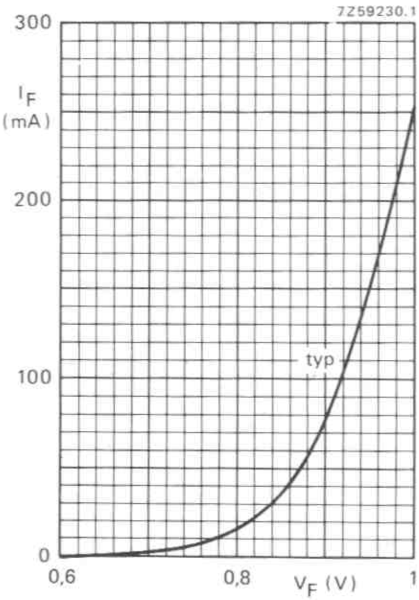


Fig. 12 T_j = 25 °C.

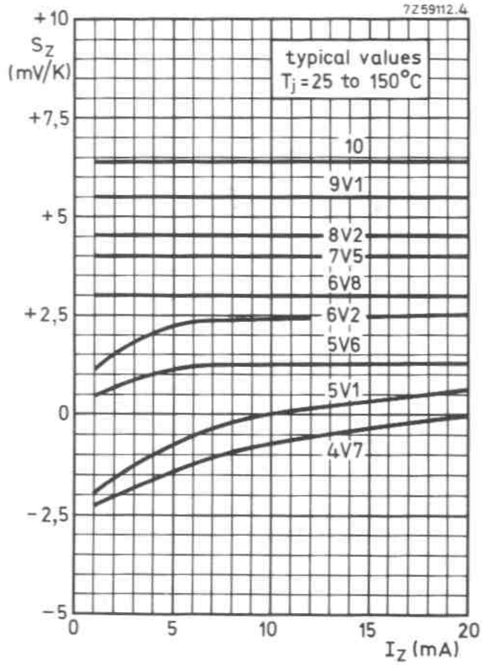


Fig. 13.

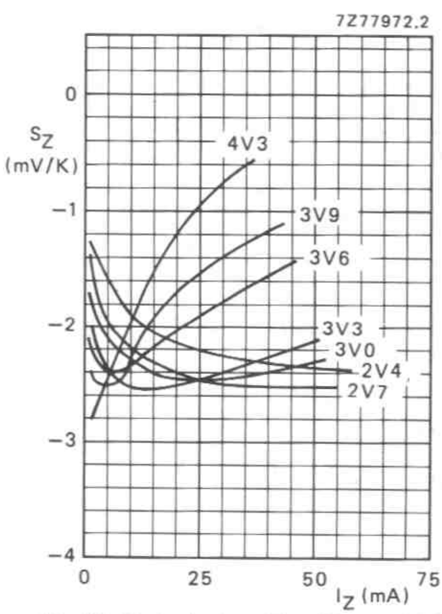


Fig. 14 Typical values; T_j = 25 to 150 °C.

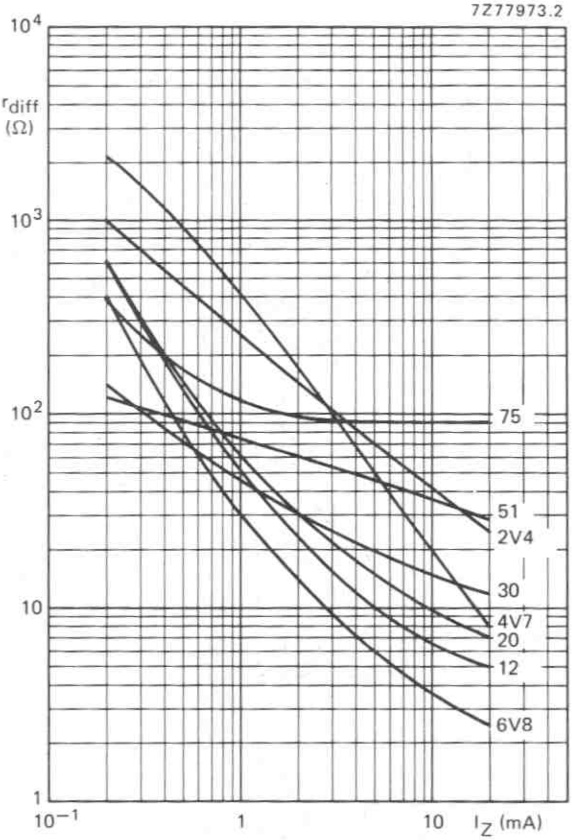


Fig. 15 Typical values; T_j = 25 °C; f = 1 kHz.

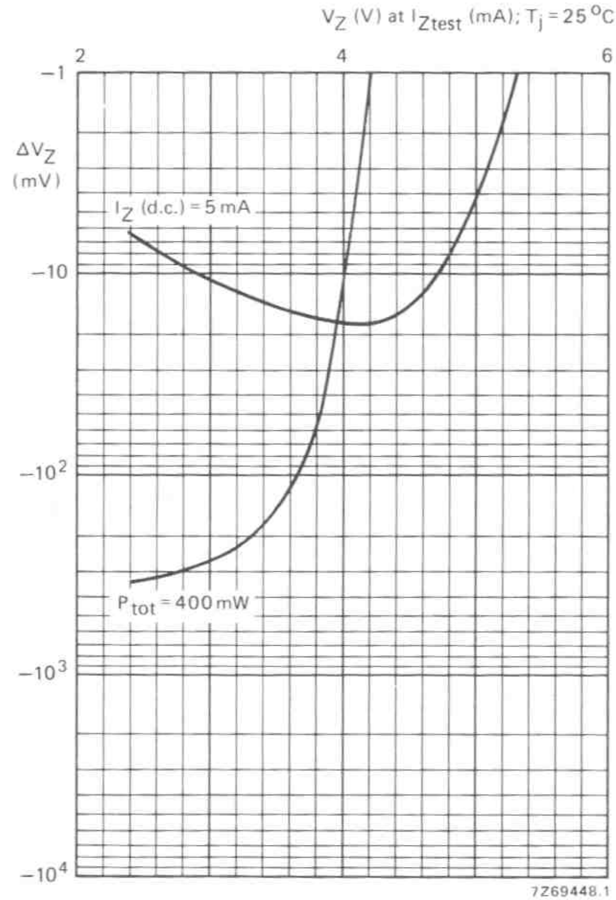


Fig. 16 Typical change of working voltage under operating conditions at T_{amb} = 25 °C.

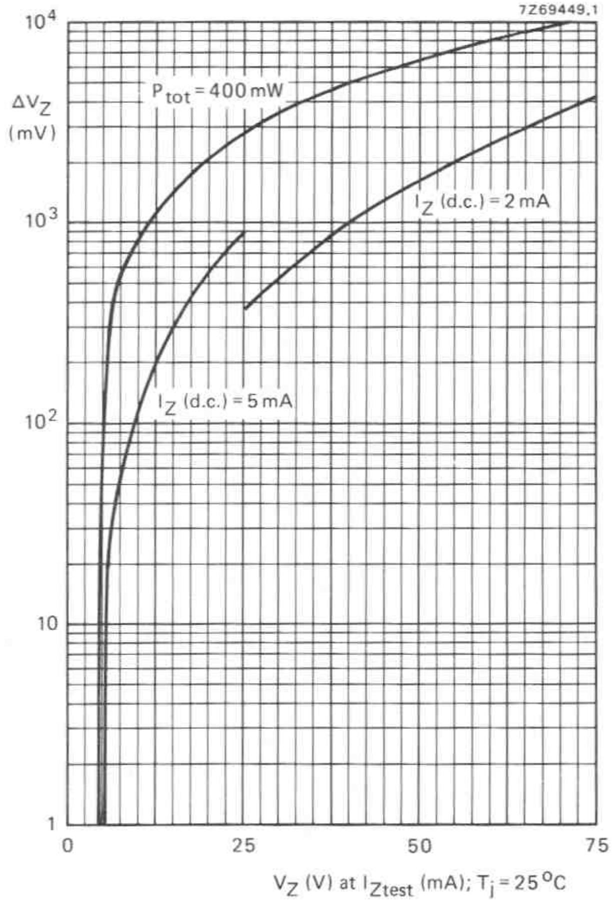


Fig. 17 Typical change of working voltage under operating conditions at T_{amb} = 25 °C.

VOLTAGE REFERENCE DIODES FOR SURFACE MOUNTING

Voltage reference diodes in a SOD-80 envelope. They have a low temperature coefficient and are primarily intended for use as voltage reference sources.

The SM diode is a leadless diode in a hermetically sealed glass SOD-80 envelope with tinplated metal discs at each end. It is suitable for "automatic placement" and as such it can withstand immersion soldering.

The diodes are delivered in bulk or in "super 8" tape.

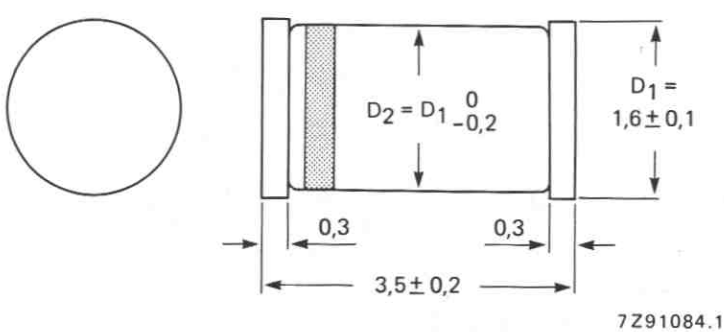
QUICK REFERENCE DATA

Reference voltage at I_Z = 7,5 mA		V_{ref}	>	5,89 V
			typ.	6,20 V
			<	6,51 V
Temperature coefficient at I_Z = 7,5 mA	BZV80	$\|S_Z\|$	<	0,01 %/K
	BZV81	$\|S_Z\|$	<	0,005 %/K
Operating temperature		T_{amb}		−20 to + 80 °C

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-80



Cathode indicated by yellow band

BZV80 second band: black

BZV81 second band: brown

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Working current (d.c.)	I_Z	max.	50 mA
Working current (peak value)	I_{ZM}	max.	50 mA
Total power dissipation up to T_{amb} = 50 °C	P_{tot}	max.	400 mW
Storage temperature	T_{stg}		−65 to + 200 °C
Operating ambient temperature	T_{amb}		−20 to + 80 °C

THERMAL RESISTANCE

From junction to ambient mounted on a ceramic substrate of 10 x 10 x 0,6 mm	$R_{th\ j\text{-}a}$	=	380 K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Reference voltage at I_Z = 7,5 mA		V_{ref}	>	5,89 V
			typ.	6,20 V
			<	6,51 V
Reference voltage excursion at I_Z = 7,5 mA ambient temperature test points −20; + 25; + 55; + 80 °C	BZV80	$\|\Delta V_{ref}\|$	<	62 mV
	BZV81	$\|\Delta V_{ref}\|$	<	31 mV
Effective temperature coefficient at I_Z = 7,5 mA	BZV80	$\|S_Z\|$	<	0,01 %/K
	BZV81	$\|S_Z\|$	<	0,005 %/K
Differential resistance at I_Z = 7,5 mA		r_{diff}	<	15 Ω

Notes

1. Tolerance and stability of I_Z.
   The quoted values of ΔV_{ref} are based on a constant current I_Z. Two factors can cause V_{ref} to change with I_Z, namely the differential resistance r_{diff} and the temperature coefficient S_Z.
   a. Each change of I_Z can result in a maximum change of V_{ref} as follows:

      $$\Delta V_{ref}\ (\text{mV}) = \Delta I_Z\ (\text{mA}) \times 15\ \Omega$$

      taking into account r_{diff} is max. 15 Ω.
   b. The temperature coefficient of the reference voltage is also a function of I_Z. However, for these reference diodes S_Z varies max. ± 0,05 mV/K or ± 0,001 %/K when I_Z is between 6 and 10 mA, so this effect can be neglected in practice for these types.

2. The temperature coefficient of the reference voltage is obtained from the following equation.

$$S_Z = \frac{(V_{ref\ 1} - V_{ref\ 2})}{(T_{amb\ 2} - T_{mab\ 1})} \times \frac{100}{V_{ref\ nom}}\ \%/K$$

LOW VOLTAGE STABISTORS FOR SURFACE MOUNTING

Silicon planar integrated voltage regulator diodes in hermetically sealed SOD80 glass envelopes, intended for low power clipping, level shifting, voltage regulation, temperature stabilization of transistor base-emitter biasing network and in many other applications where tight tolerances and low voltage levels are required.
The series consists of four types with nominal voltages ranging from 1.4 to 3.2 V.

The SM diode is a leadless diode in a hermetically sealed glass SOD80 envelope with tin plated metal discs at each end. It is suitable for "automatic placement" and as such it can withstand immersion soldering.

The diodes are delivered in bulk or in "super 8" tape.

QUICK REFERENCE DATA

Regulation voltage range	V_F	nom.	1.4	2.0	2.6	3.2	V
Continuous reverse voltage	V_R	max.	10				V
Repetitive peak reverse voltage	V_{RRM}	max.	10				V
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	350				mW
Junction temperature	T_j	max.	150				°C
Differential resistance at I_F = 5 mA; f = 1 kHz	r_{diff}	typ.	10	15	18	20	Ω
		max.	20	30	32.5	35	Ω

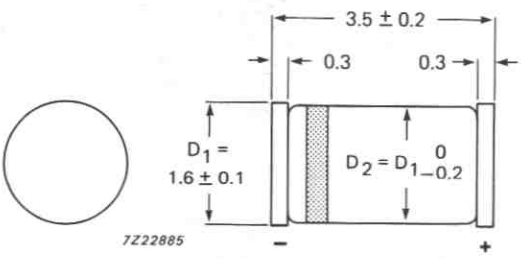
MECHANICAL DATA

Dimensions in mm

Fig.1 SOD80.

Marking code:

BZV87–1V4 = 1V4 Ph
BZV87–2V0 = 2V0 Ph
BZV87–2V6 = 2V6 Ph
BZV87–3V2 = 3V2 Ph



Cathode indicated by black band.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			1.4	2.0	2.6	3.2	V
Repetitive peak forward current	I_{FRM}	max.	250		175		mA
Continuous reverse voltage	V_R	max.		10			V
Repetitive peak reverse voltage	V_{RRM}	max.		10			V
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		350			mW
Storage temperature range	T_{stg}			−65 to 150			°C
Junction temperature	T_j	max.		150			°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	350	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			1.4	2.0	2.6	3.2	V
Regulation voltage range at I_F = 5 mA	V_F	min.	1.3	1.85	2.35	2.85	V
		max.	1.5	2.15	2.8	3.45	V
Differential resistance at I_F = 1 mA; f = 1 kHz	r_{diff}	typ.	55	80	90	100	Ω
at I_F = 5 mA; f = 1 kHz	r_{diff}	typ.	10	15	18	20	Ω
		max.	20	30	32.5	35	Ω
at I_F = 10 mA; f = 1 kHz	r_{diff}	typ.	6.0	8.0	9.0	10	Ω
		max.	10	15	17.5	20	Ω
Negative temperature coefficient at I_F = 5 mA	S_F	typ.	3.8	6.0	8.5	11.5	mV/K
Reverse current at V_R = 5 V	I_R	max.		200			nA
Diode capacitance at V_R = 0; f = 1 MHz	C_d	typ.		15			pF
		max.		25			pF

Note

1. Mounted on an epoxy-glass printed-circuit board measuring 15 mm x 10 mm x 0.8 mm.

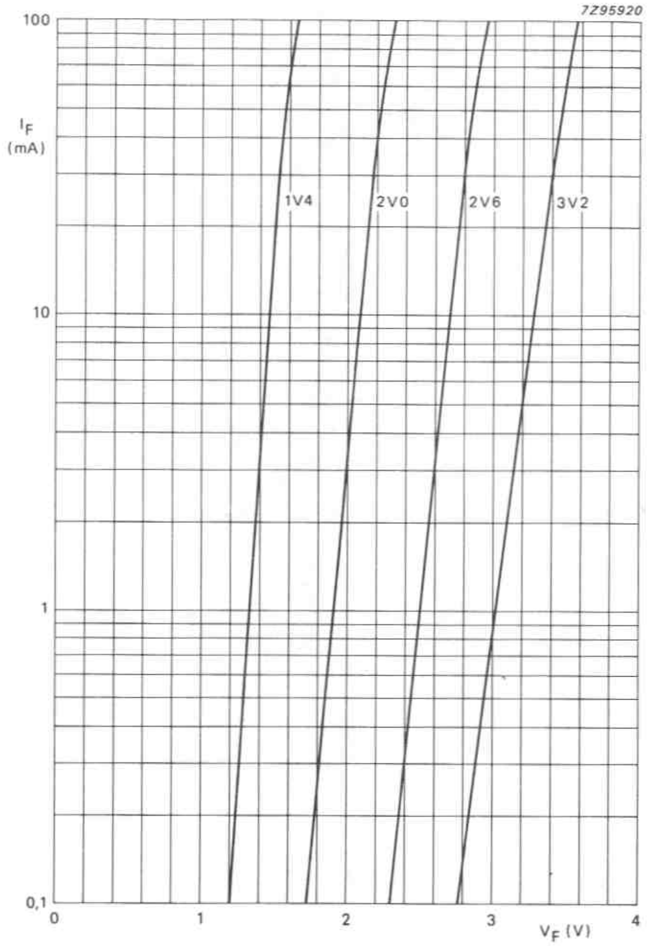


Fig. 2 Forward current as a function of forward voltage; T_j = 25 °C; typical values.

SILICON PLANAR VOLTAGE REGULATOR DIODES

Low power general purpose voltage regulator diodes in a micro miniature plastic envelope. They are available in three series; one to the international standardized E24 (± 5%) range, one in a tolerance of ± 2% and the other in a tolerance of ± 1%.
Each series consists of 37 types with nominal working voltages from 2.4 V to 75 V.

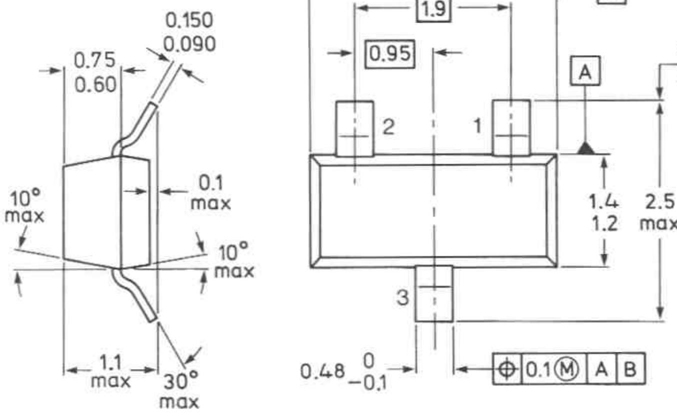
QUICK REFERENCE DATA

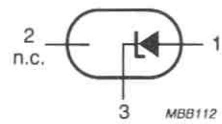
Working voltage range	V_Z	nom.	2.4 to 75	V
Working voltage tolerance			± 5	%
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Junction temperature	T_j	max.	175	°C

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-23.





See also *Soldering recommendations.*

Marking code

BZX84-C2V4 = Z11	BZX84-C5V6 = Z3	BZX84-C13 = Y3	BZX84-C33 = Y12
C2V7 = Z12	C6V2 = Z4	C15 = Y4	C36 = Y13
C3V0 = Z13	C6V8 = Z5	C16 = Y5	C39 = Y14
C3V3 = Z14	C7V5 = Z6	C18 = Y6	C43 = Y15
C3V6 = Z15	C8V2 = Z7	C20 = Y7	C47 = Y16
C3V9 = Z16	C9V1 = Z8	C22 = Y8	C51 = Y17
C4V3 = Z17	C10 = Z9	C24 = Y9	C56 = Y18
C4V7 = Z1	C11 = Y1	C27 = Y10	C62 = Y19
C5V1 = Z2	C12 = Y2	C30 = Y11	C68 = Y20
			C75 = Y21

Marking for B and A types available on request.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Repetitive peak forward current	I_{FRM}	max.	250 mA
Repetitive peak working current	I_{ZRM}	max.	250 mA
Total power dissipation up to T_{amb} = 25 °C**	P_{tot}	max.	300 mW
Storage temperature	T_{stg}		−65 to + 150 °C
Junction temperature	T_j	max.	150 °C

THERMAL CHARACTERISTICS*

Thermal resistance**

From junction to ambient	$R_{th\ j\text{-}t}$	=	420 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Forward voltage				
I_F = 10 mA		V_F	<	0.9 V
Reverse current				
BZX84–.2V4	V_R = 1 V	I_R	<	50 μA
2V7	V_R = 1 V	I_R	<	20 μA
3V0	V_R = 1 V	I_R	<	10 μA
3V3	V_R = 1 V	I_R	<	5 μA
3V6	V_R = 1 V	I_R	<	5 μA
3V9	V_R = 1 V	I_R	<	3 μA
4V3	V_R = 1 V	I_R	<	3 μA
4V7	V_R = 2 V	I_R	<	3 μA
5V1	V_R = 2 V	I_R	<	2 μA
5V6	V_R = 2 V	I_R	<	1 μA
6V2	V_R = 4 V	I_R	<	3 μA
6V8	V_R = 4 V	I_R	<	2 μA
7V5	V_R = 5 V	I_R	<	1 μA
8V2	V_R = 5 V	I_R	<	700 nA
9V1	V_R = 6 V	I_R	<	500 nA
10	V_R = 7 V	I_R	<	200 nA
11	V_R = 8 V	I_R	<	100 nA
12	V_R = 8 V	I_R	<	100 nA
13	V_R = 8 V	I_R	<	100 nA
15 to 75	V_R = 0.7 V_{Znom}	I_R	<	50 nA

. = A for 1%
. = B for 2%
.. = C for (E24), 5%

* See *Thermal characteristics* in chapter GENERAL.
** Device mounted on a ceramic substrate of 7 mm x 5 mm x 0.6 mm.

T_j = 25 °C
± 5% tolerance range

BZX84	working voltage V_Z (V) at I_{Ztest} = 5 mA		differential resistance r_{diff} (Ω) at I_{Ztest} = 5 mA		temperature coefficient S_Z (mV/K) at I_{Ztest} = 5 mA			differential resistance r_{diff} (Ω) at I_Z = 1 mA	
	min.	max.	typ.	max.	min.	typ.	max.	typ.	max.
C2V4	2.20	2.60	70	100	−3.5	−1.6	0	275	600
C2V7	2.50	2.90	75	100	−3.5	−2.0	0	300	600
C3V0	2.80	3.20	80	95	−3.5	−2.1	0	325	600
C3V3	3.10	3.50	85	95	−3.5	−2.4	0	350	600
C3V6	3.40	3.80	85	90	−3.5	−2.4	0	375	600
C3V9	3.70	4.10	85	90	−3.5	−2.5	0	400	600
C4V3	4.00	4.60	80	90	−3.5	−2.5	0	410	600
C4V7	4.40	5.00	50	80	−3.5	−1.4	0.2	425	500
C5V1	4.80	5.40	40	60	−2.7	−0.8	1.2	400	480
C5V6	5.20	6.00	15	40	−2.0	1.2	2.5	80	400
C6V2	5.80	6.60	6	10	0.4	2.3	3.7	40	150
C6V8	6.40	7.20	6	15	1.2	3.0	4.5	30	80
C7V5	7.00	7.90	6	15	2.5	4.0	5.3	30	80
C8V2	7.70	8.90	6	15	3.2	4.6	6.2	40	80
C9V1	9.50	9.60	6	15	3.8	5.5	7.0	40	100
C10	9.40	10.60	8	20	4.5	6.4	8.0	50	150
C11	10.40	11.60	10	20	5.4	7.4	9.0	50	150
C12	11.40	12.70	10	25	6.0	8.4	10.0	50	150
C13	12.40	14.10	10	30	7.0	9.4	11.0	50	170
C15	13.80	15.60	10	30	9.2	11.4	13.0	50	200
C16	15.30	17.10	10	40	10.4	12.4	14.0	50	200
C18	16.80	19.10	10	45	12.4	14.4	16.0	50	225
C20	18.80	21.20	15	55	14.4	16.4	18.0	60	225
C22	20.80	23.30	20	55	16.4	18.4	20.0	60	250
C24	22.80	25.60	25	70	18.4	20.4	22.0	60	250
	at I_{Ztest} = 2 mA		at I_{Ztest} = 2 mA		at I_{Ztest} = 2 mA			at I_Z = 0.5 mA	
C27	25.10	28.90	25	80	21.4	23.4	25.3	65	300
C30	28.00	32.00	30	80	24.4	26.6	29.4	70	300
C33	31.00	35.00	35	80	27.4	29.7	33.4	75	325
C36	34.00	38.00	35	90	30.4	33.0	37.4	80	350
C39	37.00	41.00	40	130	33.4	36.4	41.2	80	350
C43	40.00	46.00	45	150	37.6	41.2	46.6	85	375
C47	44.00	50.00	50	170	42.0	46.1	51.8	85	375
C51	48.00	54.00	60	180	46.6	51.0	57.2	90	400
C56	52.00	60.00	70	200	52.2	57.0	63.8	100	425
C62	58.00	66.00	80	215	58.8	64.4	71.6	120	450
C68	64.00	72.00	90	240	65.6	71.7	79.8	150	475
C75	70.00	79.00	95	255	73.4	80.02	88.6	170	500

± 2% tolerance range

BZX84	working voltage V_Z (V) at I_{Ztest} = 5 mA		differential resistance r_{diff} (Ω) at I_{Ztest} = 5 mA		temperature coefficient S_Z (mV/K) at I_{Ztest} = 5 mA			differential resistance r_{diff} (Ω) at I_Z = 1 mA	
	min.	max.	typ.	max.	min.	typ.	max.	typ.	max.
B2V4	2.35	2.45	70	100	−3.5	−1.6	0	275	600
B2V7	2.65	2.75	75	100	−3.5	−2.0	0	300	600
B3V0	2.94	3.06	80	95	−3.5	−2.1	0	325	600
B3V3	3.23	3.37	85	95	−3.5	−2.4	0	350	600
B3V6	3.53	3.67	85	90	−3.5	−2.4	0	375	600
B3V9	3.82	3.98	85	90	−3.5	−2.5	0	400	600
B4V3	4.21	4.39	80	90	−3.5	−2.5	0	410	600
B4V7	4.61	4.79	50	80	−3.5	−1.4	0.2	425	500
B5V1	5.00	5.20	40	60	−2.7	−0.8	1.2	400	480
B5V6	5.49	5.71	15	40	−2.0	1.2	2.5	80	400
B6V2	6.08	6.32	6	10	0.4	2.3	3.7	40	150
B6V8	6.66	6.94	6	15	1.2	3.0	4.5	30	80
B7V5	7.35	7.65	6	15	2.5	4.0	5.3	30	80
B8V2	8.04	8.36	6	15	3.2	4.6	6.2	40	80
B9V1	8.92	9.28	6	15	3.8	5.5	7.0	40	100
B10	9.80	10.20	8	20	4.5	6.4	8.0	50	150
B11	10.80	11.20	10	20	5.4	7.4	9.0	50	150
B12	11.80	12.20	10	25	6.0	8.4	10.0	50	150
B13	12.70	13.30	10	30	7.0	9.4	11.0	50	170
B15	14.70	15.30	10	30	9.2	11.4	13.0	50	200
B16	15.70	16.30	10	40	10.4	12.4	14.0	50	200
B18	17.60	18.40	10	45	12.4	14.4	16.0	50	225
B20	19.60	20.40	15	55	14.4	16.4	18.0	60	225
B22	21.60	22.40	20	55	16.4	18.4	20.0	60	250
B24	23.50	24.50	25	70	18.4	20.4	22.0	60	250
	at I_{Ztest} = 2 mA		at I_{Ztest} = 2 mA		at I_{Ztest} = 2 mA			at I_Z = 0.5 mA	
B27	26.50	27.50	25	80	21.4	23.4	25.3	65	300
B30	29.40	30.60	30	80	24.4	26.6	29.4	70	300
B33	32.30	33.70	35	80	27.4	29.7	33.4	75	325
B36	35.30	36.70	35	90	30.4	33.0	37.4	80	350
B39	38.20	39.80	40	130	33.4	36.4	41.2	80	350
B43	42.10	43.90	45	150	37.6	41.2	46.6	85	375
B47	46.10	47.90	50	170	42.0	46.1	51.8	85	375
B51	50.00	51.00	60	180	46.6	51.0	57.2	90	400
B56	54.90	57.10	70	200	52.2	57.0	63.8	100	425
B62	60.80	63.20	80	215	58.8	64.4	71.6	120	450
B68	66.60	69.40	90	240	65.6	71.7	79.8	150	475
B75	73.50	76.50	95	255	73.4	80.02	88.6	170	500

T_j = 25 °C
± 1% tolerance range

BZX84	working voltage V_Z (V) at I_{Ztest} = 5 mA		differential resistance r_{diff} (Ω) at I_{Ztest} = 5 mA		temperature coefficient S_Z (mV/K) at I_{Ztest} = 5 mA			differential resistance r_{diff} (Ω) at I_Z = 1 mA	
	min.	max.	typ.	max.	min.	typ.	max.	typ.	max.
A2V4	2.37	2.43	70	100	−3.5	−1.6	0	275	600
A2V7	2.67	2.73	75	100	−3.5	−2.0	0	300	600
A3V0	2.97	3.03	80	95	−3.5	−2.1	0	325	600
A3V3	3.26	3.34	85	95	−3.5	−2.4	0	350	600
A3V6	3.56	3.64	85	90	−3.5	−2.4	0	375	600
A3V9	3.86	3.94	85	90	−3.5	−2.5	0	400	600
A4V3	4.25	4.35	80	90	−3.5	−2.5	0	410	600
A4V7	4.65	4.75	50	80	−3.5	−1.4	0.2	425	500
A5V1	5.04	5.16	40	60	−2.7	−0.8	1.2	400	480
A5V6	5.54	5.66	15	40	−2.0	1.2	2.5	80	400
A6V2	6.13	6.27	6	10	0.4	2.3	3.7	40	150
A6V8	6.73	6.87	6	15	1.2	3.0	4.5	30	80
A7V5	7.42	7.58	6	15	2.5	4.0	5.3	30	80
A8V2	8.11	8.29	6	15	3.2	4.6	6.2	40	80
A9V1	9.0	9.2	6	15	3.8	5.5	7.0	40	100
A10	9.9	10.10	8	20	4.5	6.4	8.0	50	150
A11	10.8	11.11	10	20	5.4	7.4	9.0	50	150
A12	11.88	12.12	10	25	6.0	8.4	10.0	50	150
A13	12.87	13.13	10	30	7.0	9.4	11.0	50	170
A15	14.85	15.15	10	30	9.2	11.4	13.0	50	200
A16	15.84	16.16	10	40	10.4	12.4	14.0	50	200
A18	17.82	18.18	10	45	12.4	14.4	16.0	50	225
A20	19.80	20.20	15	55	14.4	16.4	18.0	60	225
A22	21.78	22.22	20	55	16.4	18.4	20.0	60	250
A24	23.76	24.24	25	70	18.4	20.4	22.0	60	250
	at I_{Ztest} = 2 mA		at I_{Ztest} = 2 mA		at I_{Ztest} = .2 mA			at I_Z = 0.5 mA	
A27	26.73	27.27	25	80	21.4	23.4	25.3	65	300
A30	29.70	30.30	30	80	24.4	26.6	29.4	70	300
A33	32.67	33.33	35	80	27.4	29.7	33.4	75	325
A36	35.64	36.36	35	90	30.4	33.0	37.4	80	350
A39	38.61	39.39	40	130	33.4	36.4	41.2	80	350
A43	42.57	43.43	45	150	37.6	41.2	46.6	85	375
A47	46.53	47.47	50	170	42.0	46.1	51.8	85	375
A51	50.49	51.51	60	180	46.6	51.0	57.2	90	400
A56	55.44	56.56	70	200	52.2	57.0	63.8	100	425
A62	61.38	62.62	80	215	58.8	64.4	71.6	120	450
A68	74.25	75.75	90	240	65.6	71.7	79.8	150	475
A75	90.09	91.91	95	255	73.4	80.02	88.6	170	500

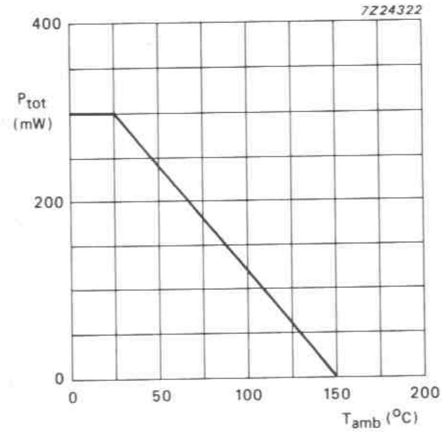


Fig. 2 Power derating curve.

Model for calculating the static working voltage ($V_{Z\ stat}$).

This model can be derived from $V_{Z\ stat} = V_{Z\ dyn} + \Delta V_Z$ of which $V_{Z\ dyn}$ is given in the preceding tables and can be derived from the typical dynamic characteristic curves in Figs 3 to 6.
$\Delta V_Z = \Delta T \times S_Z$. For S_Z see tables and graphs S_Z versus T_j.
$\Delta T = P_{tot} \times R_{th\ j\text{-}a} = I_Z \times V_{Z\ dyn} \times R_{th\ j\text{-}a}$.
Following $\Delta V_Z = I_Z \times V_{Z\ dyn} \times R_{th\ j\text{-}a} \times S_Z$ and the model will be:

$$V_{Z\ stat} = V_{Z\ dyn} + I_Z \times V_{Z\ dyn} \times R_{th\ j\text{-}a} \times S_Z$$

Calculating example

BZX84-C24 mounted on a ceramic substrate of 7 x 5 x 0.6 mm; at I_Z = 7 mA.

$$V_{Z\ stat} = 24 + (\frac{7}{1000} \times 24 \times \frac{430}{1000} \times 20.3)$$
$$= 24 + 1.47 = 25.47\ \text{V}.$$

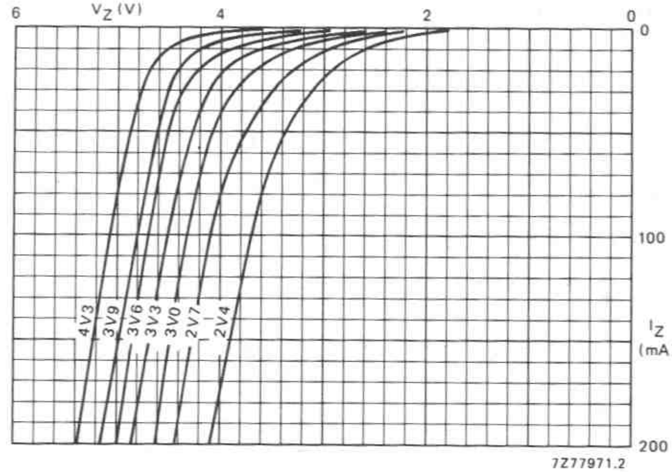


Fig. 3 Dynamic characteristics; typical values; T_j = 25 °C.

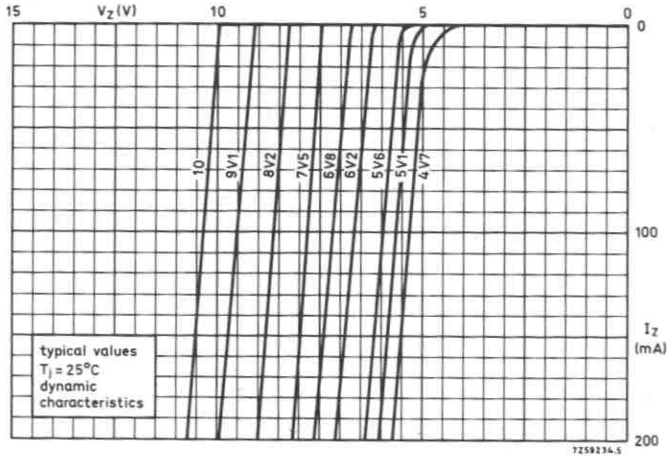


Fig. 4 Dynamic characteristics; typical values; T_j = 25 °C.

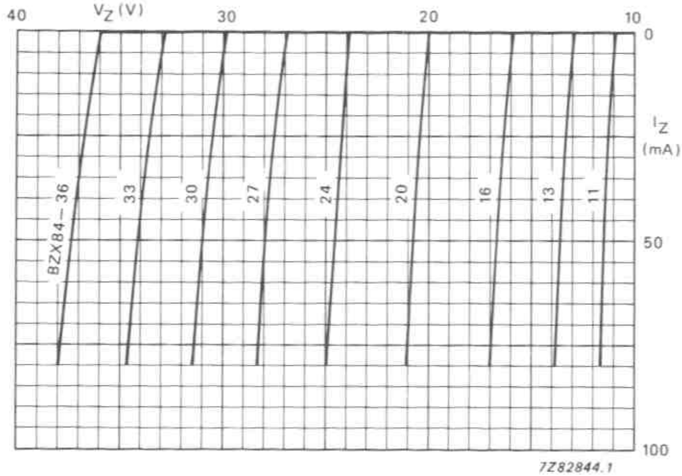


Fig. 5 Dynamic characteristics; typical values; T_j = 25 °C.

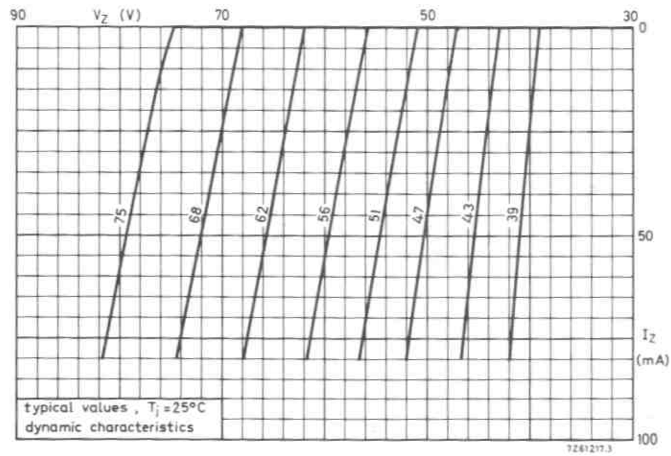


Fig. 6 Dynamic characteristics; typical values; T_j = 25 °C.

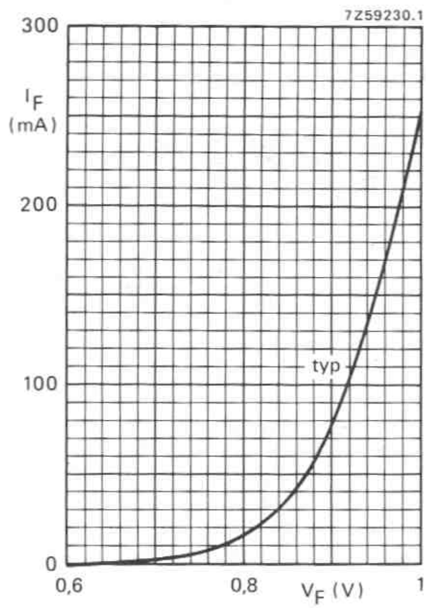


Fig. 7 Typical values at T_j = 25 °C.

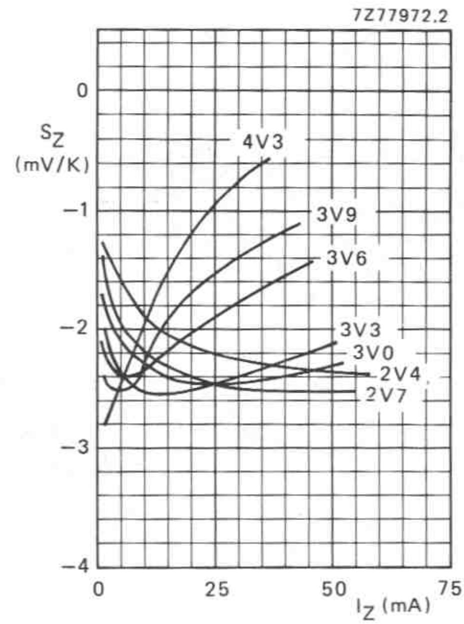


Fig. 8 Typical values; T_j = 25 to 175 °C.

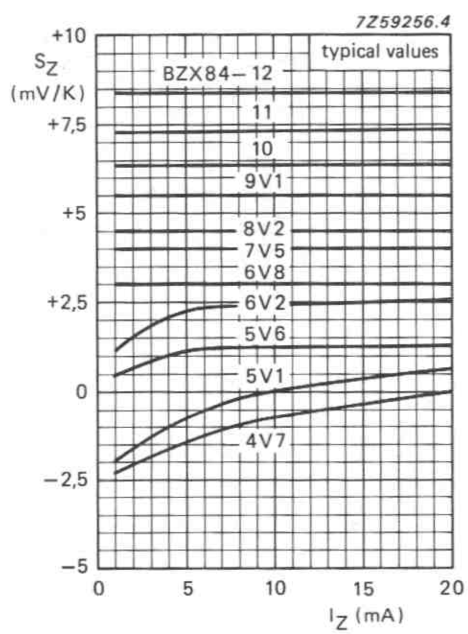


Fig. 9 Typical values; T_j = 25 to 175 °C.

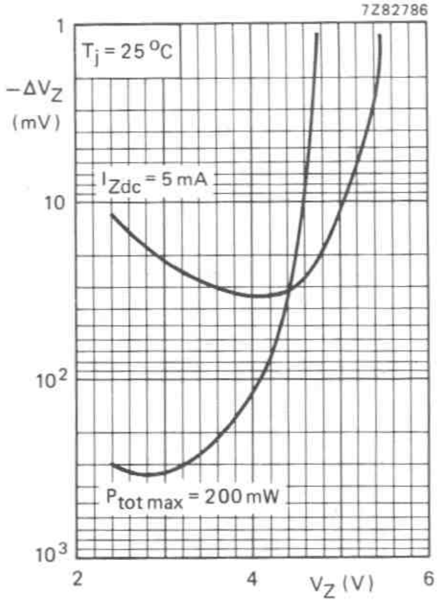


Fig. 10 Typical values; $T_j = 25\ ^oC$.

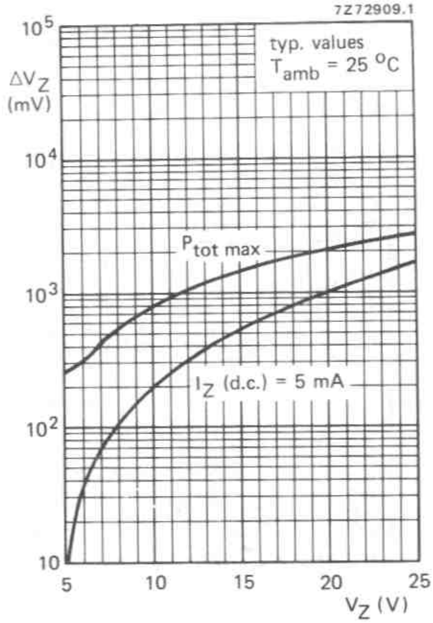


Fig. 11 Typical values; $T_{amb} = 25\ ^oC$.

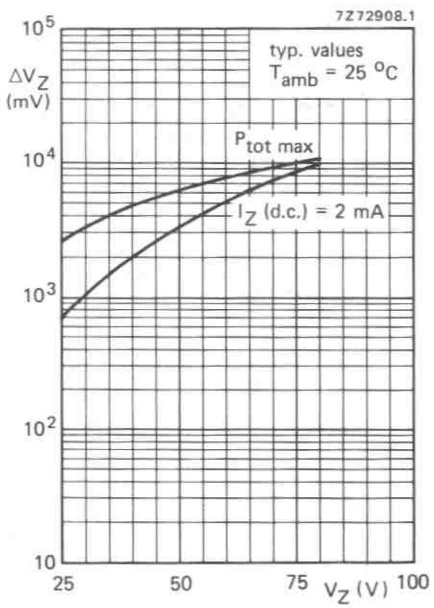


Fig. 12 Typical values; $T_{amb} = 25\ ^oC$.

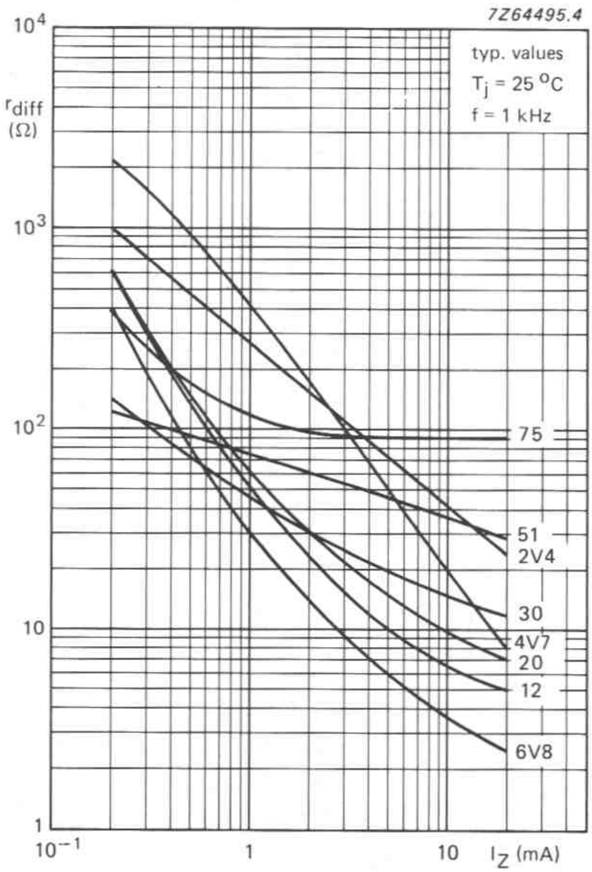

7Z64495.4
10^4
r_{diff}
(Ω)
10^3
10^2
10
1
10^{-1}
1
10
I_Z (mA)
typ. values
T_j = 25 °C
f = 1 kHz
75
51
2V4
30
4V7
20
12
6V8

Fig. 13.

SILICON TEMPERATURE SENSORS

These sensors have a positive temperature coefficient of resistance and are for use in measurement and control.

QUICK REFERENCE DATA

Resistance at T_{amb} = 25 °C — Type tape (identification colour)

I_C = 1 mA

KTY85-110	R_{25} = 990 - 1010 Ω;	yellow
KTY85-120	R_{25} = 980 - 1020 Ω;	white or green
KTY85-121	R_{25} = 980 - 1000 Ω;	white
KTY85-122	R_{25} = 1000 - 1020 Ω;	green
KTY85-150	R_{25} = 950 - 1050 Ω;	black or blue
KTY85-151	R_{25} = 950 - 1000 Ω;	black
KTY85-152	R_{25} = 1000 - 1050 Ω;	blue

KTY85-120 is composed of groups −121 and −122, and is correspondingly designated.

KTY85-150 is composed of groups −151 and −152, and is correspondingly designated.

Operating ambient temperature range T_{amb} −40 to +125 °C

MECHANICAL DATA

Dimensions in mm

Indication of polarity and type tape

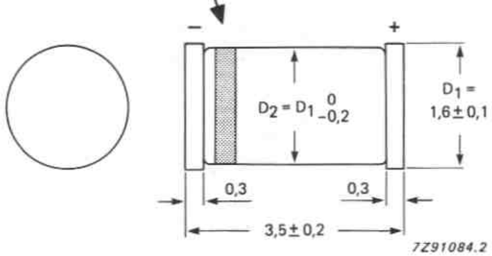


Fig. 1 SOD-80.

Note

The sensor has to be operated with the lower potential at the marked connection.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Continuous sensor current in free air

T_{amb} = 25 °C	I_C	max.	10 mA
T_{amb} = 125 °C	I_C	max.	2.0 mA

CHARACTERISTICS

(Based on the measurements in liquid at T_{amb} = 25 °C unless otherwise specified)

Resistance				
I_C = 1 mA	KTY85-110	R_{25} =	990 - 1010 Ω	
	KTY85-120	R_{25} =	980 - 1020 Ω	
	KTY85-121	R_{25} =	980 - 1000 Ω	
	KTY85-122	R_{25} =	1000 - 1020 Ω	
	KTY85-150	R_{25} =	950 - 1050 Ω	
	KTY85-151	R_{25} =	950 - 1000 Ω	
	KTY85-152	R_{25} =	1000 - 1050 Ω	
Temperature coefficient		typ.		0.76 %/K
Resistance ratio		R100/R25	1.670 ± 0.020	
		R−40/R25	0.577 ± 0.008	
Thermal time constant*				
in still air		typ.		20 s
in still liquid**		typ.		1.0 s
in flowing liquid**		typ.		0.5 s
Measuring temperature range				−40 to +125 °C

* The thermal time constant is the time the sensor needs to reach 63.2% of the total temperature difference. For instance, the time needed to reach a temperature of 72.4 °C, when a sensor with an initial temperature of 25 °C is put into an ambient with a temperature of 100 °C.

** Inert liquid FC43 of 3M company.

T_{amb} °C	Resistance Ω
−40	577
−30	632
−20	691
−10	754
0	820
10	889
20	962
25	1000
30	1039
40	1118
50	1202
60	1288
70	1379
80	1472
90	1569
100	1670
110	1774
120	1882
125	1937

Ambient temperatures and corresponding resistance values of sensor (I_C = 1mA).

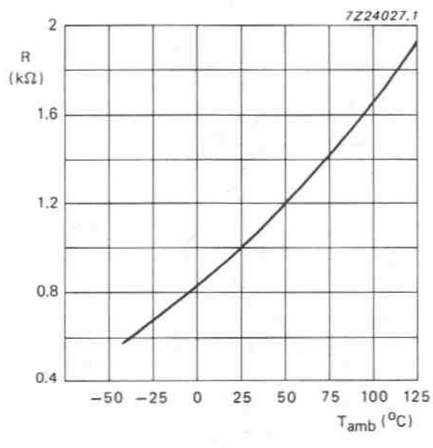


Fig. 2 Average resistance value of sensor at I_C = 1 mA as a function of ambient temperature.

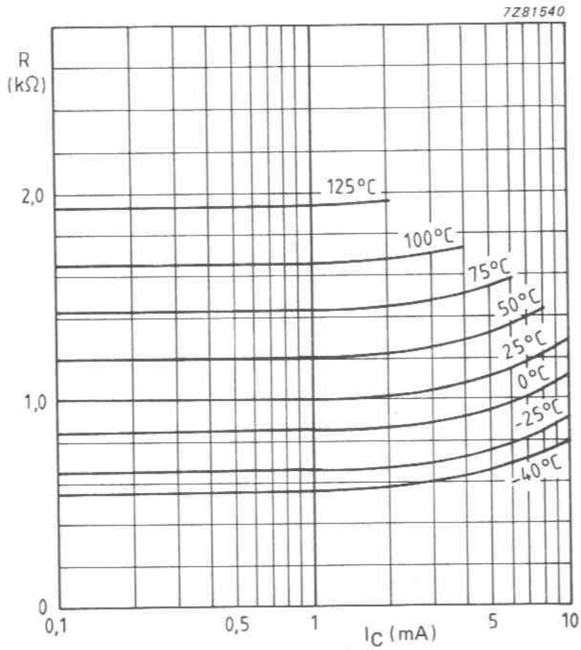


Fig. 3 Sensor resistance as a function of operating current.

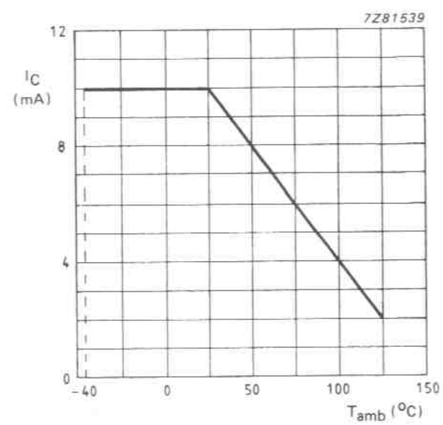


Fig. 4 Maximum operating current for safe operation.

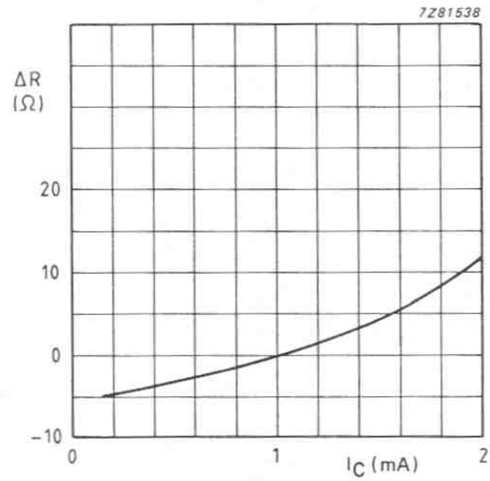


Fig. 5 Deviation of sensor resistance R as a function of operating current I_C in still liquid; T_{amb} = 25 °C.

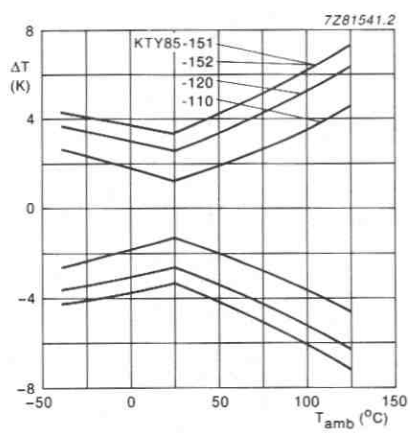


Fig. 6 Maximum expected temperature error ΔT.

SUPESEDES DATA OF NOVEMBER 1988

SILICON PLANAR EPITAXIAL HIGH SPEED DIODES

Silicon epitaxial high speed diodes in a microminiature plastic envelope. It is intended for high-speed switching in thick and thin-film circuits.

QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	70 V
Forward current (DC)	I_F	max.	200 mA
Non-repetitive peak forward current	I_{FSM}	max.	500 mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	300 mW
Junction temperature	T_j	max.	150 °C
Forward voltage at I_F = 10 mA	V_F	max.	1 V
Reverse recovery time I_F = 10 mA to I_R = 10 mA measured at I_R = 1 mA	t_{rr}	max.	15 ns

MECHANICAL DATA

Dimensions in mm

Marking code:
PMBD914: 5D

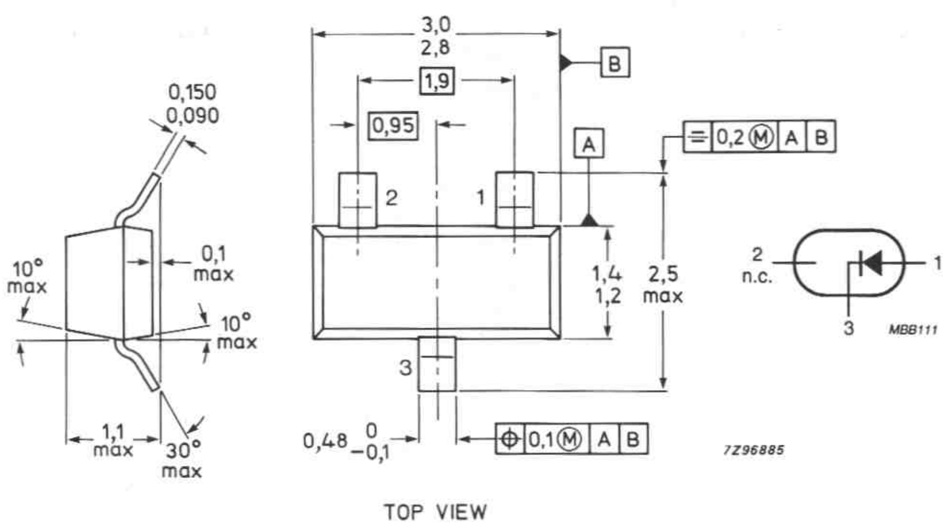


Fig. 1 SOT-23.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Continuous reverse voltage	V_R	max.	70 V
Forward current (DC)	I_F	max.	200 mA
Non-repetitive peak forward current	I_{FSM}	max.	500 mA
Total power dissipated up to T_{amb} = 25 °C	P_{tot}	max.	300 mW
Storage temperature	T_{stg}		−65 to + 150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$		430 K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Forward voltage			
I_F = 10 mA	V_F	max.	1.0 V
Reverse breakdown voltage			
I_R = 100 μA	$V_{(br)r}$	min.	100 V
Reverse current			
V_R = 25 V	I_R	max.	25 nA
V_R = 75 V	I_R	max.	5 μA
Diode capacitance			
V_R = 0 V; f = 1 MHz	C_d	max.	4.0 pF
Reverse recovery time switched from I_F = 10 mA to I_R = 10 mA; measured at I_R = 1 mA (see Fig. 2)	t_{rr}	max.	15 ns

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.

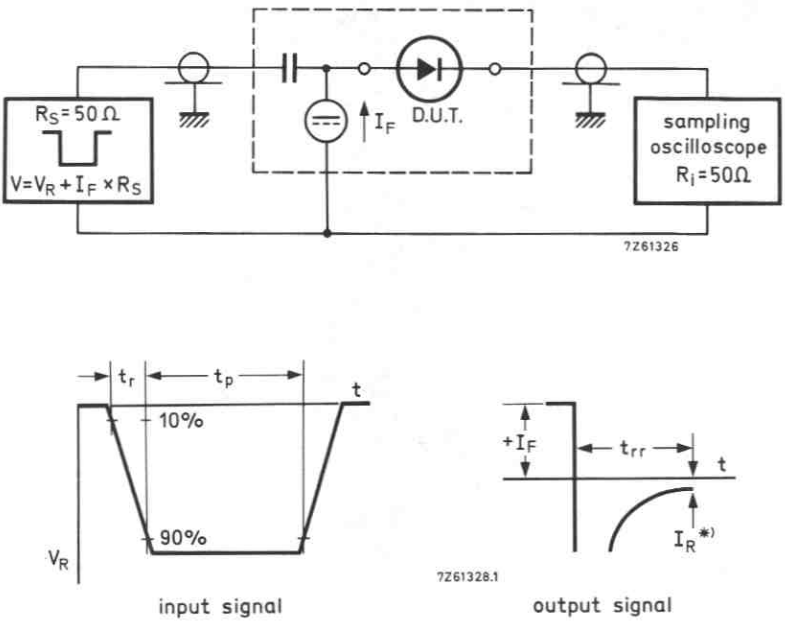


Fig. 2 Test circuit and waveforms; reverse recovery time.

DEVELOPMENT DATA

SUPERSEDES DATA OF NOVEMBER 1988

SILICON PLANAR EPITAXIAL HIGH SPEED DIODES

Silicon epitaxial high speed diodes in a microminiature plastic envelope. It is intended for high-speed switching in thick and thin-film circuits.

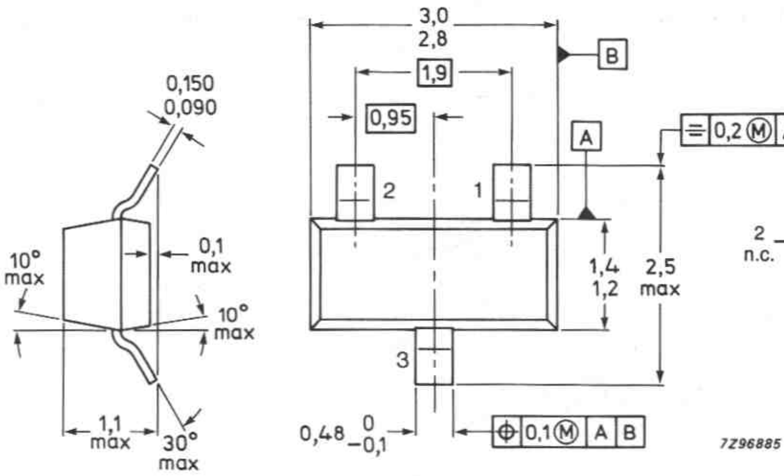
QUICK REFERENCE DATA

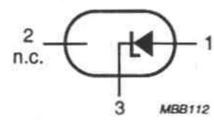
Continuous reverse voltage	V_R	max.	70	V
Forward current (DC)	I_F	max.	200	mA
Non-repetitive peak forward current	I_{FSM}	max.	500	mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	300	mW
Junction temperature	T_j	max.	150	°C
Forward voltage at I_F = 100 mA	V_F	min.	0.85	V
		max.	1.1	V
Reverse recovery time I_F = 10 mA to I_R = 10 mA measured at I_R = 1 mA	t_{rr}	max.	15	ns

MECHANICAL DATA

Dimensions in mm

Marking code:
PMBD6050: 5A





TOP VIEW

Fig. 1 SOT-23.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Continuous reverse voltage	V_R	max.	70 V
Forward current (DC)	I_F	max.	200 mA
Non-repetitive peak forward current	I_{FSM}	max.	500 mA
Total power dissipated up to T_{amb} = 25 °C	P_{tot}	max.	300 mW
Storage temperature	T_{stg}		−65 to +150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$		430 K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Forward voltage I_F = 1 mA	V_F	min. max.	0.55 V 0.70 V
I_F = 100 mA	V_F	min. max.	0.85 V 1.10 V
Reverse breakdown voltage I_R = 100 μA	$V_{(br)r}$	min.	70 V
Reverse current V_R = 50 V	I_R	max.	100 nA
Diode capacitance V_R = 0 V; f = 1 MHz	C_d	max.	2.5 pF
Reverse recovery time switched from I_F = 10 mA to I_R = 10 mA; measured at I_R = 1 mA (see Fig. 2)	t_{rr}	max.	15 ns

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.

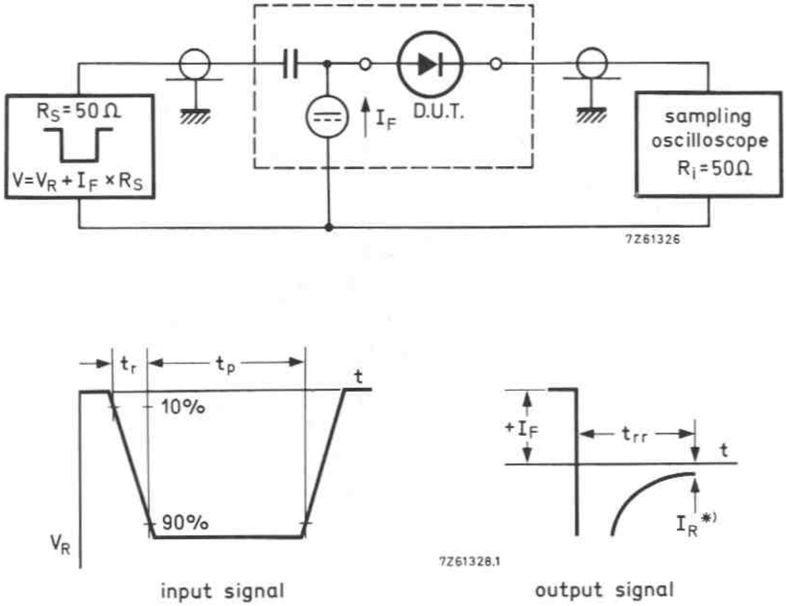


Fig. 2 Test circuit and waveforms; reverse recovery time.

DEVELOPMENT DATA

SUPERSEDES DATA OF MAY 1988

SILICON PLANAR EPITAXIAL HIGH SPEED DIODES

The PMBD7000 consists of two diodes in a microminiature plastic envelope. The diodes are connected in series and the unit is intended for high speed switching.

QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	100 V
Forward current (DC)	I_F	max.	200 mA
Non-repetitive peak forward current	I_{FSM}	max.	500 mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	300 mW
Junction temperature	T_j	max.	150 °C
Forward voltage at I_F = 100 mA	V_F	max.	1.10 V
Reverse recovery time I_F = 10 mA to I_R = 10 mA measured at I_R = 1 mA	t_{rr}	max.	15 ns

MECHANICAL DATA

Dimensions in mm

Marking code:
PMBD7000: 5C

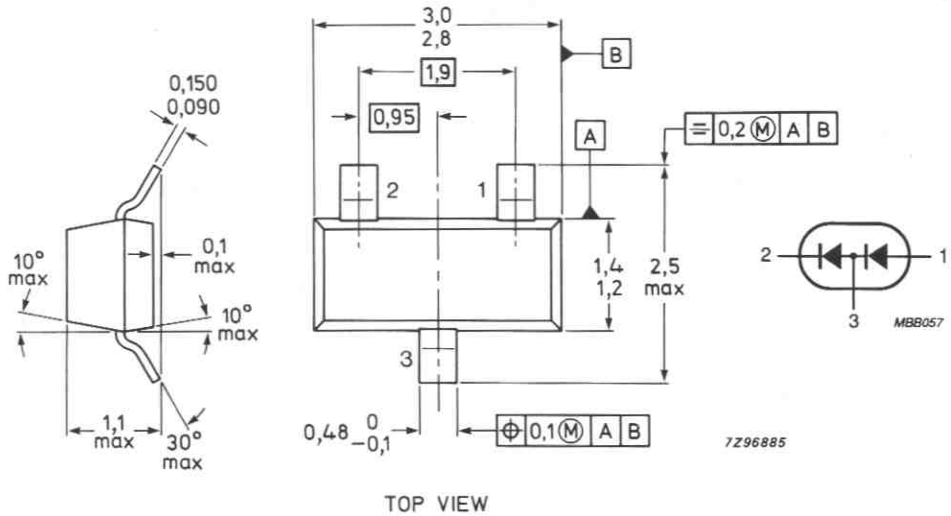


Fig. 1 SOT-23.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Continuous reverse voltage	V_R	max.	100	V
Forward current (DC)	I_F	max.	200	mA
Non-repetitive peak forward current	I_{FSM}	max.	500	mA
Total power dissipated up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Storage temperature	T_{stg}		−65 to + 150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$		430	K/W

CHARACTERISTICS (per diode)

T_{amb} = 25 °C unless otherwise specified

Forward voltage				
I_F = 1 mA	V_F	min.	0.55	V
		max.	0.70	V
I_F = 10 mA	V_F	min.	0.67	V
		max.	0.82	V
I_F = 100 mA	V_F	min.	0.75	V
		max.	1.10	V
Reverse breakdown voltage				
I_R = 100 μA	$V_{(br)r}$	min.	100	V
Reverse current				
V_R = 50 V	I_R	max.	300	nA
V_R = 100 V	I_R	max.	500	nA
V_R = 50 V; T_{amb} = 125 °C	I_R	max.	100	μA
Diode capacitance				
V_R = 0 V; f = 1 MHz	C_d	max.	1.5	pF
Reverse recovery time switched from I_F = 10 mA to I_R = 10 mA; measured at I_R = 1 mA (see Fig. 2)	t_{rr}	max.	15	ns

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.

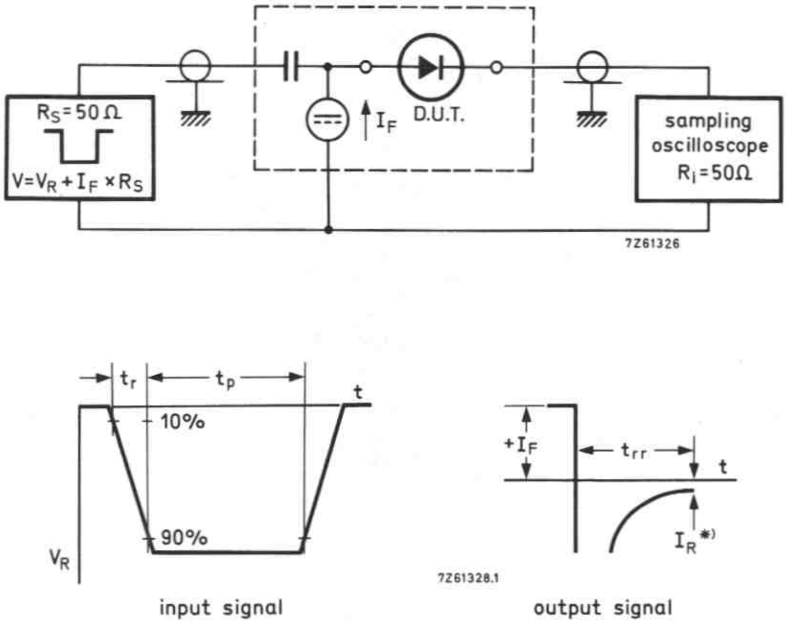


Fig. 2 Test circuit and waveforms; reverse recovery time.

DEVELOPMENT DATA

N-CHANNEL ENHANCEMENT MODE VERTICAL D-MOS TRANSISTOR

N-channel enhancement mode vertical D-MOS transistor in a SOT23 envelope. Designed for use as a Surface Mounted Device (SMD) in thin and thick-film circuits with applications in relay, high-speed and line transformer drivers.

Features

- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No secondary breakdown

QUICK REFERENCE DATA

Drain-source voltage	V_{DS}	max.	60	V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20	V
Drain current (DC)	I_D	max.	250	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	300	mW
Drain-source on-resistance $I_D = 200$ mA; $V_{GS} = 10$ V	$R_{DS\,on}$	typ.	2.5	Ω
		max.	5.0	Ω
Transfer admittance $I_D = 200$ mA; $V_{DS} = 10$ V	$\lvert y_{fs}\rvert$	min.	100	mS
		typ.	200	mS

MECHANICAL DATA

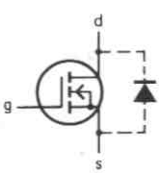
Dimensions in mm

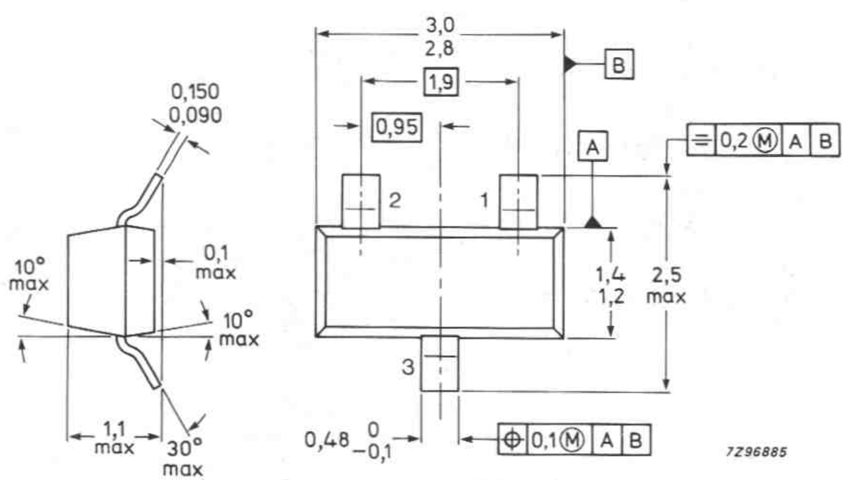
Fig.1 SOT23.

Marking code: PMBF170 = pKX

Pinning

1 = gate
2 = source
3 = drain





TOP VIEW

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	V_{DS}	max.	60 V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20 V
Drain current (DC)	I_D	max.	250 mA
Drain current (peak)	I_{DM}	max.	500 mA
Total power dissipation up to T_{amb} = 25 °C (note 1)	P_{tot}	max. max.	300 mW (note 1) 250 mW (note 2)
Storage temperature range	T_{stg}		−65 to + 150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient (note 1)	$R_{th\ j\text{-}a}$	=	430 K/W
From junction to ambient (note 2)	$R_{th\ j\text{-}a}$	=	500 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Drain-source breakdown voltage I_D = 10 μA; V_{GS} = 0	$V_{(BR)DSS}$	min. typ.	60 V 90 V
Drain-source leakage current V_{DS} = 25 V; V_{GS} = 0	I_{DSS}	max.	500 nA
V_{DS} = 48V; V_{GS} = 0	I_{DSS}	max.	1 μA
Gate-source leakage current V_{GS} = 15 V; V_{DS} = 0	I_{GSS}	max.	10 nA
Gate-source cut-off voltage I_D = 1 mA; V_{DS} = V_{GS}	$V_{GS(th)}$	min. max.	0.8 V 3.0 V
Drain-source on-resistance I_D = 200 mA; V_{GS} = 10 V	$R_{DS\,on}$	typ. max.	2.5 Ω 5.0 Ω
Transfer admittance I_D = 200 mA; V_{DS} = 10 V	$\|y_{fs}\|$	min. typ.	100 mS 200 mS
Input capacitance V_{DS} = 10 V; V_{GS} = 0 V; f = 1 MHz	C_{iss}	typ. max.	25 pF 40 pF
Output capacitance V_{DS} = 10 V; V_{GS} = 0 V; f = 1 MHz	C_{oss}	typ. max.	22 pF 30 pF
Feedback capacitance V_{DS} = 10 V; V_{GS} = 0 V; f = 1 MHz	C_{rss}	typ. max.	6 pF 10 pF

Notes

1. Mounted on ceramic substrate measuring 10 mm x 8 mm x 0.7 mm.
2. Mounted on printed-circuit board.

Switching times
V_{GS} = 0 to 10 V; I_D = 200 mA ; V_{DD} = 50 V

t_{on}	max.	10 ns
t_{off}	max.	15 ns

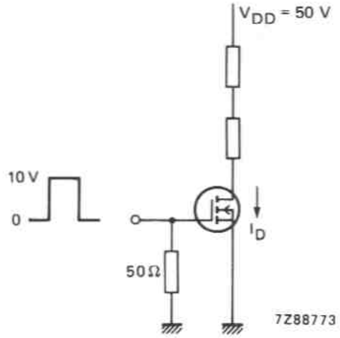


Fig.2 Switching times test circuit.

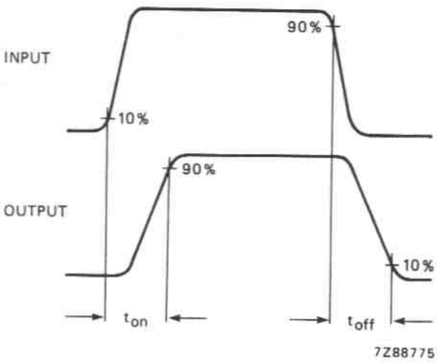


Fig.3 Input and output waveforms.

N-CHANNEL FETS

Symmetrical silicon n-channel depletion type junction field-effect transistors on a plastic microminiature envelope intended for application in thick and thin-film circuits. The transistors are intended for low-power chopper or switching applications in industry.

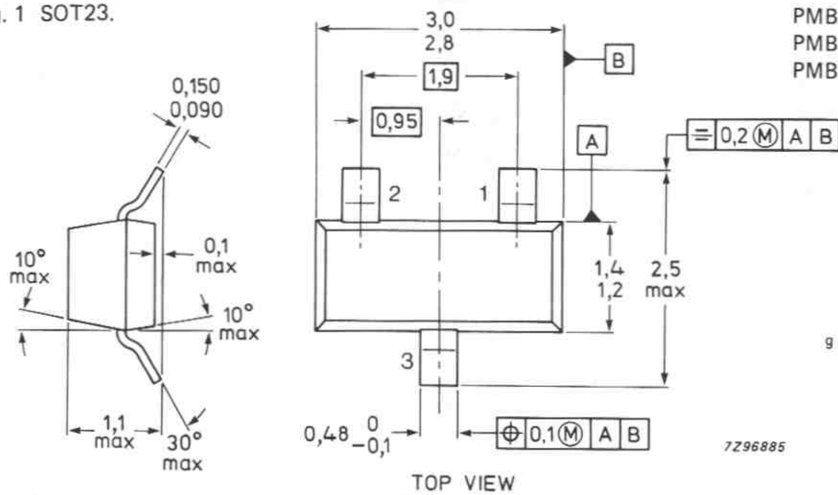
QUICK REFERENCE DATA

			PMBF4391	PMBF4392	PMBF4393	
Drain-source voltage	$\pm V_{DS}$	max.	40	40	40	V
Drain current $V_{DS} = 20$ V; $V_{GS} = 0$	I_{DSS}	>	50	25	5	mA
Gate-source cut-off voltage $V_{DS} = 20$ V; $I_D = 1$ nA	$-V_{(P)GS}$	>	4	2	0.5	V
		<	10	5	3	V
Drain-source resistance (on) at f = 1 kHz $I_D = 0$; $V_{GS} = 0$	$R_{ds\ on}$	<	30	60	100	Ω
Feedback capacitance at f = 1 MHz $-V_{GS} = 12$ V; $V_{DS} = 0$	C_{rs}	<	3.5	3.5	3.5	pF
Turn-off time $V_{DD} = 10$ V; $V_{GS} = 0$						
$I_D = 12$ mA; $-V_{GSM} = 12$ V	t_{off}	<	20	–	–	ns
$I_D = 6$ mA; $-V_{GSM} = 7$ V	t_{off}	<	–	35	–	ns
$I_D = 3$ mA; $-V_{GSM} = 5$ V	t_{off}	<	–	–	50	ns

MECHANICAL DATA

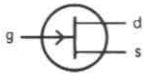
Dimensions in mm

Fig. 1 SOT23.



Marking code
PMBF4391 = p6J
PMBF4392 = p6K
PMBF4393 = p6G

Pinning
1 = drain
2 = source
3 = gate



Note: Drain and source are interchangeable.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	$\pm V_{DS}$	max.	40 V
Drain-gate voltage	V_{DGO}	max.	40 V
Gate-source voltage	$-V_{GSO}$	max.	40 V
Gate current (DC)	I_G	max.	50 mA
Total power dissipation up to T_{amb} = 40 °C *	P_{tot}	max.	250 mW
Storage temperature range	T_{stg}	−65 to + 150 °C	
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	430 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Gate-source voltage I_G = 1 mA; V_{DS} = 0	V_{GSon}	<	1 V
Gate-source cut-off current V_{DS} = 0 V; $-V_{GS}$ = 20 V	$-I_{GSS}$	<	0.1 nA
V_{DS} = 0 V; $-V_{GS}$ = 20 V; T_{amb} = 150 °C	$-I_{GSS}$	<	0.2 μA

			PMBF4391	PMBF4392	PMBF4393
Drain current V_{DS} = 20 V; V_{GS} = 0	I_{DSS}	>	50	25	5 mA
		<	150	75	30 mA
Gate-source breakdown voltage $-I_G$ = 1 μA; V_{DS} = 0	$-V_{(BR)GSS}$	>	40	40	40 V
Gate-source cut-off voltage I_D = 1 nA; V_{DS} = 20 V	$-V_{(P)GS}$	>	4	2	0.5 V
		<	10	5	3 V
Drain-source voltage (on) I_D = 12 mA; V_{GS} = 0	V_{DSon}	<	0.4	–	– V
I_D = 6 mA; V_{GS} = 0	V_{DSon}	<		0.4	– V
I_D = 3 mA; V_{GS} = 0	V_{DSon}	<	–	–	0.4 V
Drain-source resistance (on) I_D = 0; V_{GS} = 0; f = 1 kHz; T_{amb} = 25 °C	$r_{ds\ on}$	<	30	60	100 Ω

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

			PMBF4391	PMBF4392	PMBF4393	
Drain cut-off current						
$-V_{GS} = 12$ V; $V_{DS} = 20$ V	I_{DSX}	<	0.1	–	–	nA
$-V_{GS} = 7$ V; $V_{DS} = 20$ V	I_{DSX}	<	–	0.1	–	nA
$-V_{GS} = 5$ V; $V_{DS} = 20$ V	I_{DSX}	<	–	–	0.1	nA
$-V_{GS} = 12$ V; $V_{DS} = 20$ V; $T_{amb} = 150\,^{o}C$	I_{DSX}	<	0.2	–	–	μA
$-V_{GS} = 7$ V; $V_{DS} = 20$ V; $T_{amb} = 150\,^{o}C$	I_{DSX}	<	–	0.2	–	μA
$-V_{GS} = 5$ V; $V_{DS} = 20$ V; $T_{amb} = 150\,^{o}C$	I_{DSX}	<	–	–	0.2	μA
y-parameters (common source) $V_{DS} = 20$ V; $V_{GS} = 0$; f = 1 MHz; $T_{amb} = 25\,^{o}C$						
Input capacitance	C_{is}	<	14	14	14	pF
Feedback capacitance						
$-V_{GS} = 12$ V	C_{rs}	<	3.5	–	–	pF
$-V_{GS} = 7$ V	C_{rs}	<	–	3.5	–	pF
$-V_{GS} = 5$ V	C_{rs}	<	–	–	3.5	pF
Switching times $V_{DD} = 10$ V; $V_{GS} = 0$						
Conditions I_D and $-V_{GSoff}$	I_D	=	12	6	3	mA
	$-V_{GS\,off}$	=	12	7	5	V
	R_L	=	750	1550	3150	Ω
Rise time	t_r	<	5	5	5	ns
Turn on time	t_{on}	<	15	15	15	ns
Fall time	t_f	<	15	20	30	ns
Turn off time	t_{off}	<	20	35	50	ns

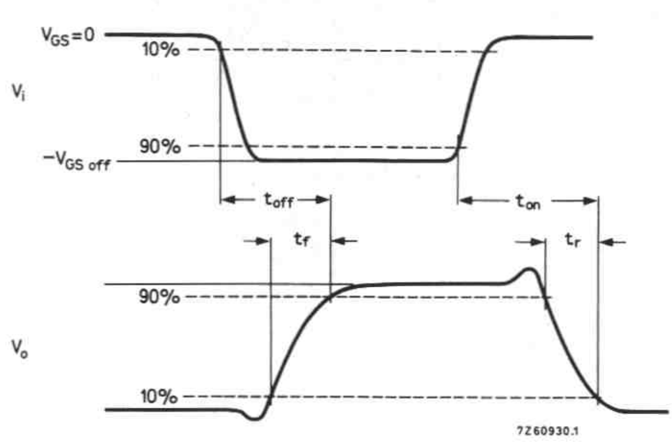
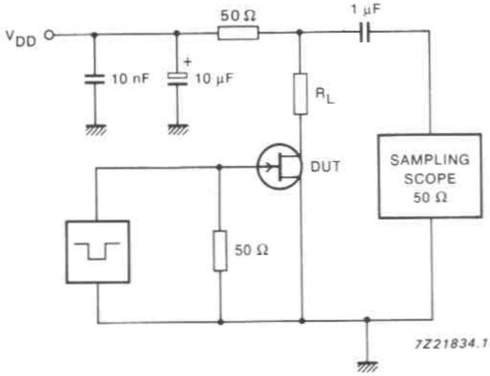


Fig.2 Switching times waveforms.



Pulse generator:

t_r < 0.5 ns

t_f < 0.5 ns

t_p = 100 μs

δ = 0.01

Oscilloscope:

R_i = 50 Ω

Fig. 3 Test circuit.

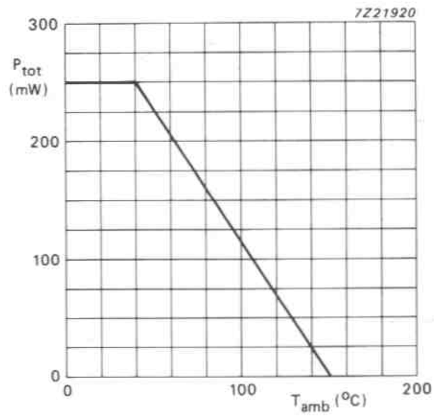


Fig.4 Power derating curve.

Philips Components

Data sheet	
status	Preliminary specification
date of issue	April 1991

PMBFJ108/PMBFJ109/ PMBFJ110
N-channel junction FETs

FEATURES

- High speed switching
- Interchangeability of drain and source connections
- Low $R_{DS(on)}$ at zero gate voltage (< 8 Ω for PMBFJ108)

DESCRIPTION

Silicon symmetrical n-channel junction FETs in a SOT23 envelope. They are intended for use in applications such as analog switches, choppers and commutators, and in audio amplifiers.

PIN CONFIGURATION

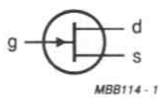


Fig.1 Symbol.

PINNING - SOT23

PIN	DESCRIPTION
1	drain
2	source
3	gate

Note

1. Drain and source are interchangeable.

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$\pm V_{DS}$	drain-source voltage		-	25	V
$-V_{GSO}$	gate-source voltage		-	25	V
$-V_{GDO}$	gate-drain voltage		-	25	V
I_G	forward gate current	DC	-	50	mA
P_{tot}	total power dissipation	T_{amb} = 25 °C (note 1)	-	250	mW
T_{stg}	storage temperature range		−65	150	°C
T_j	operating junction temperature		-	150	°C

N-channel junction FETs PMBFJ108/PMBFJ109/PMBFJ110

THERMAL RESISTANCE

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}a}$	from junction to ambient (note 1)	500	K/W

Notes

1. Mounted on an FR-4 printboard.

STATIC CHARACTERISTICS

T_j = 25 °C.

SYMBOL	PARAMETER	CONDITIONS		MIN.	MAX.	UNIT
$-I_{GSS}$	reverse gate current	$-V_{GS}$ = 15 V V_{DS} = 0		-	3	nA
I_{DSX}	drain-source cut-off current	V_{GS} = −10 V V_{DS} = 5 V		-	3	nA
I_{DSS}	drain current	V_{GS} = 0 V_{DS} = 15 V	PMBFJ108 PMBFJ109 PMBFJ110	80 40 10	- - -	mA
$-V_{(BR)GSS}$	gate-source breakdown voltage	$-I_G$ = 1 μA V_{DS} = 0		-	25	V
$-V_{GS(off)}$	gate-source cut-off voltage	I_D = 1 μA V_{DS} = 5 V	PMBFJ108 PMBFJ109 PMBFJ110	3 2 0.5	10 6 4	V
$R_{DS(on)}$	drain-source on-resistance	V_{GS} = 0 V V_{DS} = 0.1 V	PMBFJ108 PMBFJ109 PMBFJ110	- - -	8 12 18	Ω

DYNAMIC CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_{is}	input capacitance	V_{DS} = 0 $-V_{GS}$ = 10 V f = 1 MHz	15	30	pF
C_{is}	input capacitance	V_{DS} = 0 $-V_{GS}$ = 0 f = 1 MHz T_{amb} = 25 °C	50	85	pF
C_{rs}	feedback capacitance	V_{DS} = 0 $-V_{GS}$ = 10 V f = 1 MHz	8	15	pF
Switching times (see Fig.2)					
t_d	delay time	note 1	2	-	ns
t_{on}	turn-on time	note 1	4	-	ns
t_s	storage time	note 1	4	-	ns
t_{off}	turn-off time	note 1	6	-	ns

Notes

1. Test conditions for switching times are as follows:
   V_{DD} = 1.5 V, V_{GS} = 0 to $-V_{GS(off)}$ (all types);
   $-V_{GS(off)}$ = 12 V, R_L = 100 Ω (PMBFJ108);
   $-V_{GS(off)}$ = 7 V, R_L = 100 Ω (PMBFJ109);
   $-V_{GS(off)}$ = 5 V, R_L = 100 Ω (PMBFJ110).

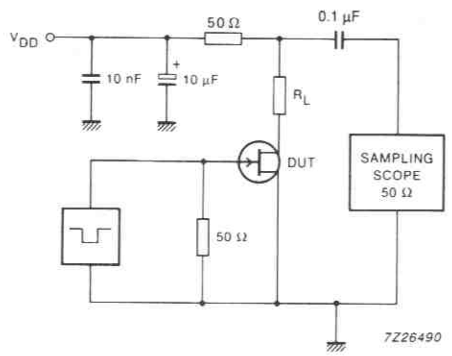


Fig.2 Switching circuit.

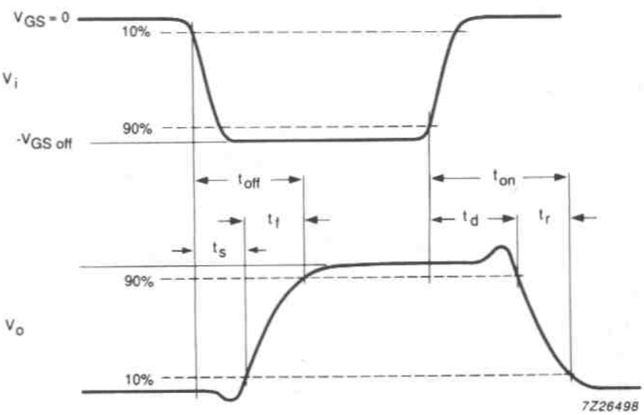
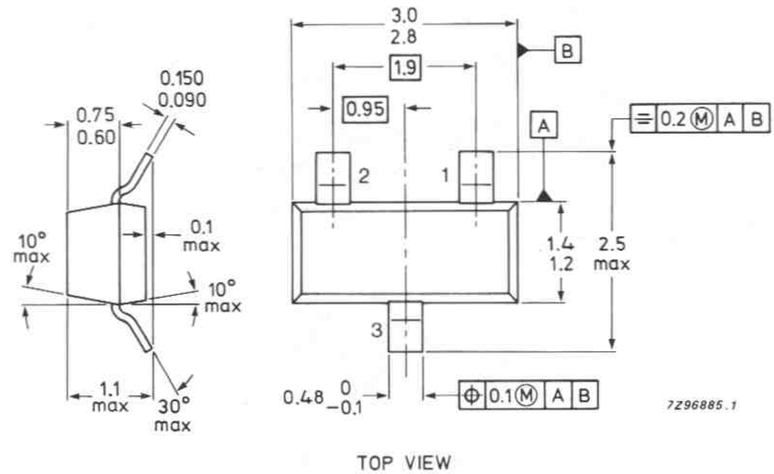


Fig.3 Input and output waveforms.

PACKAGE OUTLINE

Dimensions in mm



Marking code:

PMBFJ108 = p08
PMBFJ109 = p09
PMBFJ110 = p10

Fig.4 SOT23.

Philips Components

Data sheet	
status	Preliminary specification
date of issue	April 1991

PMBFJ111/PMBFJ112/ PMBFJ113

N-channel junction FETs

FEATURES

- High-speed switching
- Low $R_{DS(on)}$ at zero gate voltage (< 30 Ω for PMBFJ111)
- Interchangeability of drain and source connections.

DESCRIPTION

Silicon n-channel junction field-effect transistors in a surface-mount SOT23 envelope. They are intended for use in applications such as analog switches, choppers, commutators, multiplexers and thin and thick film hybrids.

PIN CONFIGURATION

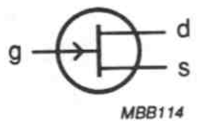


Fig.1 Symbol.

PINNING - SOT23

PIN	DESCRIPTION
1	drain
2	source
3	gate

Note

1. Drain and source are interchangeable.

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$\pm V_{DS}$	drain-source voltage		-	40	V
$-V_{GSO}$	gate-source voltage		-	40	V
$-V_{GDO}$	gate-drain voltage		-	40	V
I_G	forward gate current	DC	-	50	mA
P_{tot}	total power dissipation	T_{amb} = 25 °C note 1	-	300	mW
T_{stg}	storage temperature range		−65	150	°C
T_j	operating junction temperature		-	150	°C

THERMAL CHARACTERISTICS

$T_j = P(R_{th\ j\text{-}t} + R_{th\ t\text{-}s} + R_{th\ s\text{-}a}) + T_{amb}$

SYMBOL	PARAMETER	MAX.	UNIT
$R_{th\ j\text{-}a}$	from junction to ambient (note 1)	430	K/W
$R_{th\ j\text{-}a}$	from junction to ambient (note 2)	500	K/W

Notes

1. Mounted on a ceramic substrate, 8 mm x 10 mm x 0.7 mm.
2. Mounted on printed circuit board.

STATIC CHARACTERISTICS

T_j = 25 °C.

SYMBOL	PARAMETER	CONDITIONS		MIN.	MAX.	UNIT
$-I_{GSS}$	reverse gate current	$-V_{GS}$ = 15 V V_{DS} = 0		-	1	nA
I_{DSS}	drain current	V_{GS} = 0 V_{DS} = 15 V	PMBFJ111 PMBFJ112 PMBFJ113	20 5 2	- - -	mA
$-V_{(BR)GSS}$	gate-source breakdown voltage	$-I_G$ = 1 μA V_{DS} = 0		40	-	V
$-V_{GS(off)}$	gate-source cut-off voltage	I_D = 1 μA V_{DS} = 5 V	PMBFJ111 PMBFJ112 PMBFJ113	3 1 0.5	10 5 3	V
$R_{DS(on)}$	drain-source on-resistance	V_{GS} = 0 V V_{DS} = 0.1 V	PMBFJ111 PMBFJ112 PMBFJ113	- - -	30 50 100	Ω

DYNAMIC CHARACTERISTICS

T_j = 25 °C.

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_{iss}	input capacitance	V_{DS} = 0 $-V_{GS}$ = 10 V f = 1 MHz	6	-	pF
		V_{DS} = 0 $-V_{GS}$ = 0 f = 1 MHz T_{amb} = 25 °C	22	28	pF
C_{rss}	feedback capacitance	V_{DS} = 0 $-V_{GS}$ = 10 V f = 1 MHz	3	-	pF
Switching times (see Fig.2)					
t_r	rise time	note 1	6	-	ns
t_{on}	turn-on time	note 1	13	-	ns
t_f	fall time	note 1	15	-	ns
t_{off}	turn-off time	note 1	35	-	ns

Notes

1. Test conditions for switching times are as follows:
   V_{DD} = 10 V, V_{GS} = 0 to $-V_{GS(off)}$ (all types);
   $-V_{GS(off)}$ = 12 V, R_L = 750 Ω (PMBFJ111);
   $-V_{GS(off)}$ = 7 V, R_L = 1550 Ω (PMBFJ112);
   $-V_{GS(off)}$ = 5 V, R_L = 3150 Ω (PMBFJ113).

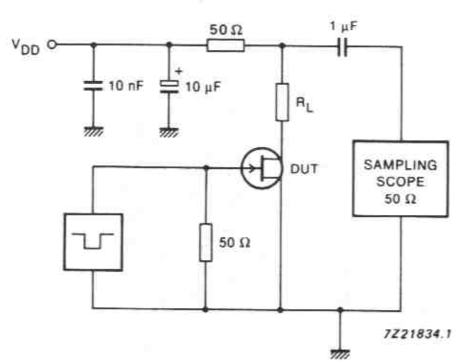


Fig.2 Switching circuit.

N-channel junction FETs

PMBFJ111/PMBFJ112/PMBFJ113

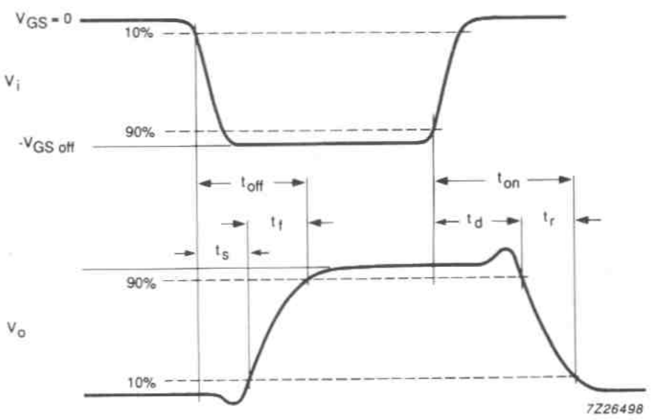


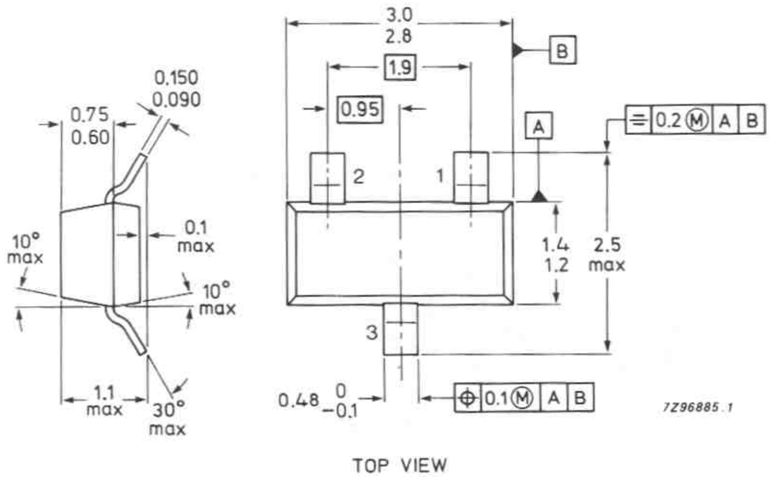
Fig.3 Input and output waveforms.

PACKAGE OUTLINE

Dimensions in mm

Marking code:

PMBFJ111 = p11
PMBFJ112 = p12
PMBFJ113 = p13



See also soldering recommendations

Fig.4 SOT23.

P-CHANNEL SILICON FIELD-EFFECT TRANSISTORS

Silicon symmetrical p-channel junction FETs in plastic microminiature SOT-23 envelopes.

They are intended for application with analogue switches, choppers, commutators etc. using SMD technology.

A special feature is the interchangeability of the drain and source connections.

QUICK REFERENCE DATA

Drain-source voltage	$\pm V_{DS}$	max.	30				V
Gate-source voltage	V_{GSO}	max.	30				V
Gate current	$-I_G$	max.	50				mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300				mW
			PMBFJ174	**175**	**176**	**177**	
Drain current $-V_{DS}$ = 15 V; V_{GS} = 0	$-I_{DSS}$	>	20	7	2	1,5	mA
		<	135	70	35	20	mA
Drain-source ON-resistance $-V_{DS}$ = 0,1 V; V_{GS} = 0	$R_{DS\,on}$	<	85	125	250	300	Ω

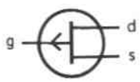
MECHANICAL DATA

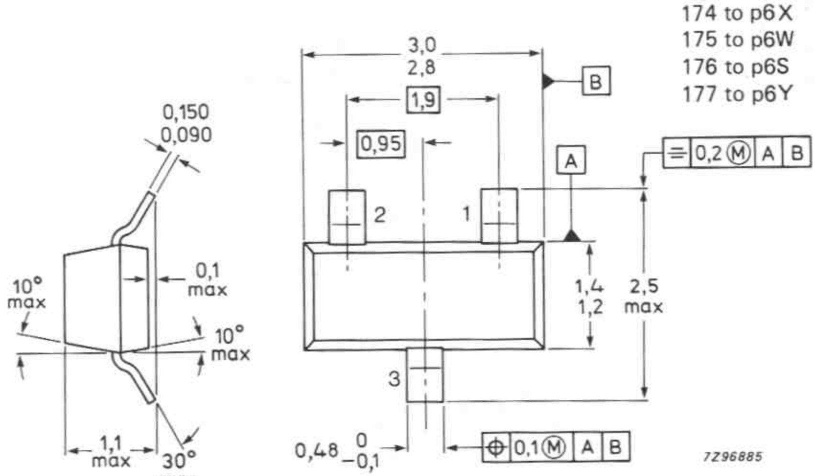
Dimensions in mm

Fig. 1 SOT-23.

Marking codes:
174 to p6X
175 to p6W
176 to p6S
177 to p6Y

Pinning:
1 = Drain
2 = Source
3 = Gate





TOP VIEW

Note: Drain and source are interchangeable.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	$\pm V_{DS}$	max.	30	V
Gate-source voltage	V_{GSO}	max.	30	V
Gate-drain voltage	V_{GDO}	max.	30	V
Gate current (DC)	$-I_G$	max.	50	mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	300	mW
Storage temperature range	T_{stg}		−65 to + 150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air *	$R_{th\ j\text{-}a}$	=	430	K/W

STATIC CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			PMBFJ174	175	176	177	
Gate cut-off current $-V_{GS}$ = 20 V; V_{DS} = 0	I_{GSS}	<	1	1	1	1	nA
Drain cut-off current $-V_{DS}$ = 15 V; $-V_{GS}$ = 10 V	$-I_{DSX}$	<	1	1	1	1	nA
Drain current $-V_{DS}$ = 15 V; V_{GS} = 0	$-I_{DSS}$	>	20	7	2	1,5	mA
		<	135	70	35	20	mA
Gate-source breakdown voltage I_G = 1 µA; V_{DS} = 0	$V_{(BR)GSS}$	>	30	30	30	30	V
Gate-source cut-off voltage $-I_D$ = 10 nA; V_{DS} = 15 V	$V_{GS\ off}$	>	5	3	1	0,8	V
		<	10	6	4	2,25	V
Drain-source ON-resistance $-V_{DS}$ = 0,1 V; V_{GS} = 0	$R_{DS\ on}$	<	85	125	250	300	Ω

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

DYNAMIC CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Input capacitance, f = 1 MHz							
$-V_{GS}$ = 10 V; V_{DS} = 0 V	C_{is}	typ.	8				pF
$-V_{GS}$ = V_{DS} = 0	C_{is}	typ.	30				pF
Feedback capacitance, f = 1 MHz							
$-V_{GS}$ = 10 V; V_{DS} = 0 V	C_{rs}	typ.	4				pF
Switching times (see Fig. 2 + 3)		PMBFJ174		175	176	177	
Delay time	t_d	typ.	2	5	15	20	ns
Rise time	t_r	typ.	5	10	20	25	ns
Turn-on time	t_{on}	typ.	7	15	35	45	ns
Storage temperature	t_s	typ.	5	10	15	20	ns
Fall time	t_f	typ.	10	20	20	25	ns
Turn-off time	t_{off}	typ.	15	30	35	45	ns
Test conditions:	$-V_{DD}$		10	6	6	6	V
	$V_{GS\,off}$		12	8	6	3	V
	R_L		560	1200	2000	2900	Ω
	$V_{GS\,on}$		0	0	0	0	V

Rise time input voltage < 1 ns

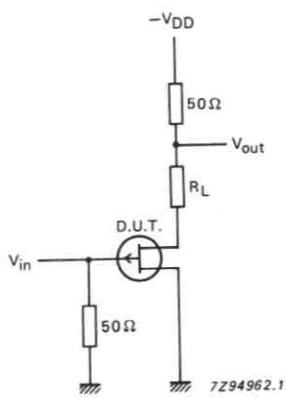


Fig. 2 Switching times test circuit.

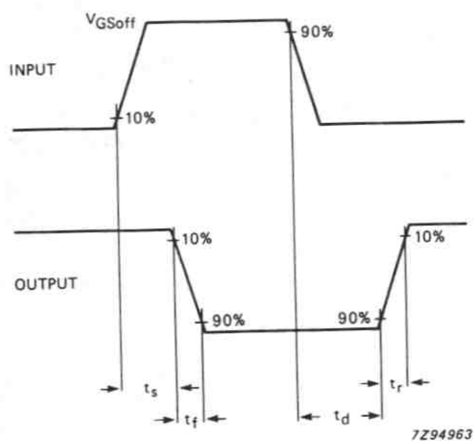


Fig. 3 Input and output waveforms;

$t_d + t_r = t_{on}$

$t_s + t_f = t_{off}$.

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N silicon transistors, in a microminiature plastic envelope intended for switching and linear applications in thick and thin-film circuits.

QUICK REFERENCE DATA

			PMBT2222	PMBT2222A	
Collector-base voltage (open emitter)	V_{CBO}	max.	60	75	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	40	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5,0	6,0	V
Collector current (d.c.)	I_C	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
D.C. current gain					
I_C = 150 mA; V_{CE} = 10 V	h_{FE}		100 to 300		
I_C = 500 mA; V_{CE} = 10 V	h_{FE}	>	30	40	
Transition frequency at f = 100 MHz					
I_C = 20 mA; V_{CE} = 20 V	f_T	>	250	300	MHz

MECHANICAL DATA

Dimensions in mm

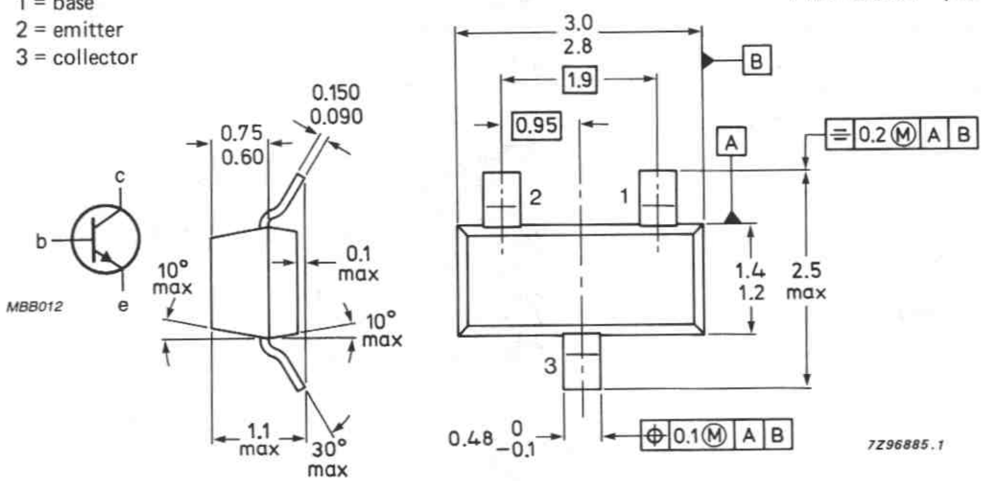
Fig. 1 SOT-23.

Marking code

PMBT2222 = p1B
PMBT2222A = p1P

Pinning:

1 = base
2 = emitter
3 = collector



TOP VIEW

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			PMBT2222	PMBT2222A	
Collector-base voltage (open emitter)	V_{CBO}	max.	60	75	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	40	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5,0	6,0	V
Collector current (d.c.)	I_C	max.	600		mA
Total power dissipation* up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Storage temperature range	T_{stg}		−65 to 150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE *

From junction to ambient	$R_{th\ j\text{-}a}$	=	500	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			PMBT2222	PMBT2222A	
Collector cut-off current					
I_E = 0; V_{CB} = 50 V	I_{CBO}	<	0,01	–	μA
I_E = 0; V_{CB} = 60 V	I_{CBO}	<	–	0,01	μA
I_E = 0; V_{CB} = 50 V; T_j = 125 °C	I_{CBO}	<	10	–	μA
I_E = 0; V_{CB} = 60 V; T_j = 125 °C	I_{CBO}	<	–	10	μA
V_{EB} = 3 V; V_{CE} = 60 V	I_{CEX}	<	–	10	nA
Base current with reverse biased emitter junction					
V_{EB} = 3 V; V_{CE} = 60 V	I_{BEX}	<	–	20	nA
Emitter cut-off current					
I_C = 0; V_{EB} = 3 V	I_{EBO}	<		10	nA
Saturation voltages**					
I_C = 150 mA; I_B = 15 mA	V_{CEsat}	<	400	300	mV
	V_{BEsat}	<	1300	–	mV
	V_{BEsat}		–	0,6 to 1,2	V
I_C = 500 mA; I_B = 50 mA	V_{CEsat}	<	1600	1000	mV
	V_{BEsat}	<	2600	2000	mV
Breakdown voltages					
I_C = 1,0 mA; I_B = 0	$V_{(BR)CEO}$	>	30	40	V
I_C = 100 μA; I_E = 0	$V_{(BR)CBO}$	>	60	75	V
I_C = 0; I_E = 10 μA	$V_{(BR)EBO}$	>	5,0	6,0	V

* Device mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.

** Measured under pulsed conditions to avoid excessive dissipation; $t_p \leq 300\ \mu s$; $\delta \leq 0{,}02$.

			PMBT2222	PMBT2222A	
D.C. current gain					
$I_C = 0{,}1$ mA; $V_{CE} = 10$ V	h_{FE}	>	35		
$I_C = 1$ mA; $V_{CE} = 10$ V	h_{FE}	>	50		
$I_C = 10$ mA; $V_{CE} = 10$ V	h_{FE}	>	75		
$I_C = 10$ mA; $V_{CE} = 10$ V; $T_{amb} = -55$ °C	h_{FE}	>	35		
$I_C = 150$ mA; $V_{CE} = 10$ V	h_{FE}		100 to 300		
$I_C = 150$ mA; $V_{CE} = 1$ V	h_{FE}	>	50		
$I_C = 500$ mA; $V_{CE} = 10$ V	h_{FE}	>	30	40	
Transition frequency at f = 100 MHz*					
$I_C = 20$ mA; $V_{CE} = 20$ V	f_T	>	250	300	MHz
Output capacitance at f = 1 MHz					
$I_E = 0$; $V_{CB} = 10$ V	C_o	<	8,0		pF
Input capacitance at f = 1 MHz					
$I_C = 0$; $V_{EB} = 0{,}5$ V	C_i	<	30	25	
h-parameters (common emitter) at f = 1 kHz					
$I_C = 1$ mA; $V_{CE} = 10$ V					
input impedance	h_{ie}		2,0 to 8,0		kΩ
reverse voltage transfer ratio	h_{re}		$< 8{,}0 \times 10^{-4}$		
small signal current gain	h_{fe}		50 to 300		
output admittance	h_{oe}		5,0 to 35		μS
$I_C = 10$ mA; $V_{CE} = 10$ V					
input impedance	h_{ie}		0,25 to 1,25		kΩ
reverse voltage transfer ratio	h_{re}		$< 4{,}0 \times 10^{-4}$		
small signal current gain	h_{fe}		75 to 375		
output admittance	h_{oe}		25 to 200		μS
Noise figure at $R_S = 1$ kΩ					
$I_C = 100$ μA; $V_{CE} = 10$ V; f = 1 kHz	F	<	4,0		dB
Switching times (between 10% and 90% levels)					
Turn-on time switched to $I_C = 150$ mA					
delay time	t_d	<	10		ns
rise time	t_r	<	25		ns
Turn-off time switched from $I_C = 150$ mA					
storage time	t_s	<	225		ns
fall time	t_f	<	60		ns

* f_T is defined as the frequency at which h_{fe} extrapolates to unity.

Fig. 2 Waveform and test circuit delay and rise time.

V_i = −0,5 to + 9,9 V; V_{CC} = 30 V; R1 = 619 Ω; R2 = 200 Ω.

Pulse generator:			
pulse duration	t_p	⩽	200 ns
rise time	t_r	⩽	2 ns
duty factor	δ	=	2 %

Oscilloscope:			
input impedance	Z_i	>	100 kΩ
input capacitance	C_i	<	12 pF
rise time	t_r	<	5 ns

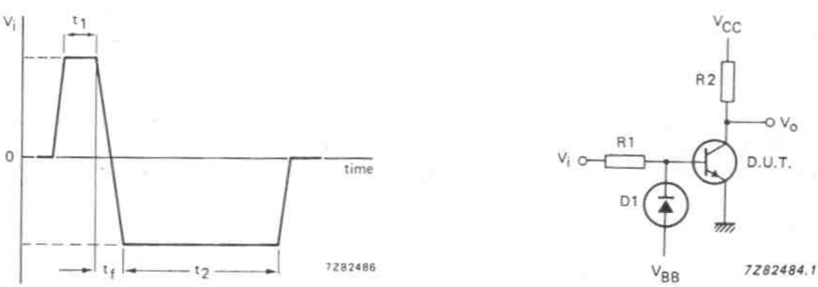


Fig. 3 Waveform and test circuit storage and fall time.

V_i = −13,8 to + 16,2 V; V_{CC} = 30 V; $-V_{BB}$ = 3 V; R1 = 1 kΩ; R2 = 200 Ω.

Pulse generator:			
fall time	t_f	<	5 ns
pulse time	t_1	=	100 μs
	t_2	=	500 μs

Oscilloscope:			
input impedance	Z_i	>	100 kΩ
input capacitance	C_i	<	12 pF
rise time	t_r	<	5 ns

SILICON PLANAR EPITAXIAL SWITCHING TRANSISTOR

N-P-N transistor in a plastic SOT-23 envelope intended for high-speed switching applications.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	40	V
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	40	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	V
Collector current (d.c. value)	I_C	max.	500	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	mW
D.C. current gain				
I_C = 10 mA; V_{CE} = 1 V	h_{FE}		40 to 120	
I_C = 100 mA; V_{CE} = 2 V	h_{FE}	>	20	
Storage time				
$I_{Con} = I_{Bon} = I_{Boff}$ = 10 mA	t_s	<	13	ns

MECHANICAL DATA

Dimensions in mm

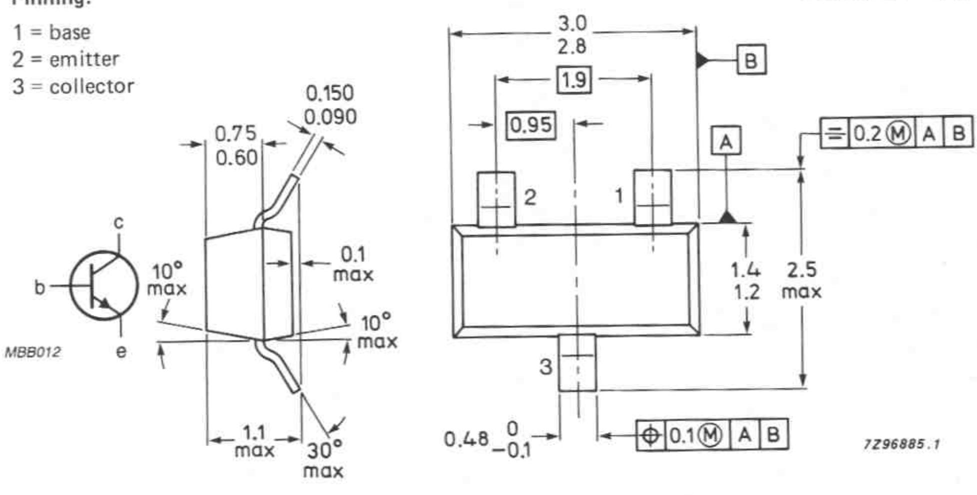
Fig. 1 SOT-23.

Marking code

PMBT2369 = p1J

Pinning:

1 = base
2 = emitter
3 = collector



TOP VIEW

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	40	V
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	40	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	V
Emitter-base voltage (open collector)	V_{EBO}	max.	4,5	V
Collector current (d.c. value)	I_C	max.	500	mA
Total power dissipation up to T_{amb} = 25 °C *	P_{tot}	max.	250	mW
Storage temperature	T_{stg}		−65 to 150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air*	$R_{th\ j\text{-}a}$	=	500	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; V_{CB} = 20 V	I_{CBO}	<	400	nA
$I_E = 0$; V_{CB} = 20 V; T_j = 125 °C	I_{CBO}	<	30	μA
Saturation voltages				
I_C = 10 mA; I_B = 1 mA	V_{CEsat}	<	0,25	V
	V_{BEsat}		0,70 to 0,85	V
D.C. current gain				
I_C = 10 mA; V_{CE} = 1 V	h_{FE}		40 to 120	
I_C = 10 mA; V_{CE} = 1 V; T_{amb} = −55 °C	h_{FE}	>	20	
I_C = 100 mA; V_{CE} = 2 V	h_{FE}	>	20	
Output capacitance at f = 1 MHz				
$I_E = 0$; V_{CB} = 5 V	C_o	<	4,0	pF
Small-signal current gain				
I_C = 1,0 mA; V_{CE} = 10 V; f = 100 MHz; T_{amb} = 25 °C	h_{fe}	>	5,0	pF
Breakdown voltages				
I_C = 10 mA; I_B = 0	$V_{(BR)CEO}$	min.	15	V
I_C = 10 μA; I_E = 0	$V_{(BR)CBO}$	min.	40	V
I_C = 0; I_E = 10 μA	$V_{(BR)EBO}$	min.	4,5	V
I_C = 10 μA; V_{BE} = 0	$V_{(BR)CES}$	min.	40	V

Switching times at T_{amb} = 25 °C

Storage time (see Fig. 2)				
$I_{Con} = I_{Bon} = -I_{Boff}$ = 10 mA	t_s	typ.	5,0	ns
		<	13	ns
Turn-on time (see Fig. 3)				
I_C = 10 mA; I_{Bon} = 3 mA; V_{CC} = 3 V	t_{on}	typ.	8,0	ns
	t_{on}	<	12	ns
Turn-off time (see Fig. 3)				
I_C = 10 mA; I_{Bon} = 3 mA; I_{Boff} = 1,5 mA; V_{CC} = 3 V	t_{off}	typ.	10	ns
	t_{off}	<	18	ns

* Device mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm .

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P silicon transistors, in a microminiature plastic envelope, intended for medium power switching and general purpose amplifier applications in thick and thin-film circuits.

QUICK REFERENCE DATA

			PMBT2907	PMBT2907A	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60	60	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40	60	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5,0		V
Collector current (d.c.)	$-I_C$	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Junction temperature	T_j	max.	150		°C
D.C. current gain $-I_C$ = 500 mA; $-V_{CE}$ = 10 V	h_{FE}	>	30	50	
Turn-off switching time $-I_{Con}$ = 150 mA; $-I_{Bon}$ = I_{Boff} = 15 mA	t_{off}	<	100		ns
Transition frequency at f = 100 MHz $-I_C$ = 50 mA; $-V_{CE}$ = 20 V	f_T	>	200		MHz

MECHANICAL DATA

Dimensions in mm

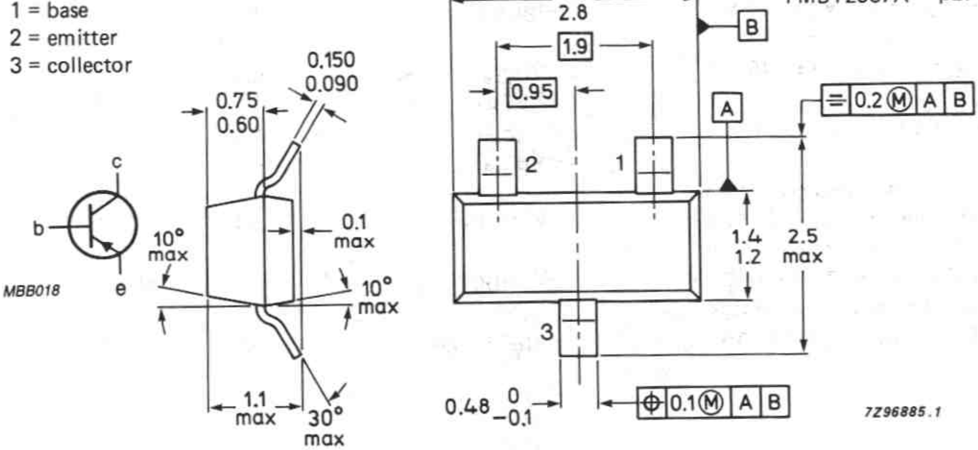
Fig. 1 SOT-23.

Pinning:

1 = base
2 = emitter
3 = collector

Marking code

PMBT2907 = p2B
PMBT2907A = p2F



TOP VIEW

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			PMBT2907	PMBT2907A	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60	60	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40	60	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5,0		V
Collector current (d.c.)	$-I_C$	max.	600		mA
Power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Storage temperature range	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE *

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	500	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			PMBT2907	PMBT2907A	
Collector cut-off current					
$I_E = 0$; $-V_{CB} = 50$ V	$-I_{CBO}$	<	20	10	nA
$I_E = 0$; $-V_{CB} = 50$ V; $T_j = 125$ °C	$-I_{CBO}$	<	20	10	μA
$-V_{EB} = 0,5$ V; $-V_{CE} = 30$ V	$-I_{CEX}$	<	50		nA
Base current with reverse biased emitter junction					
$-V_{EB} = 3$ V; $-V_{CE} = 30$ V	$-I_{BEX}$	<	50		nA
Saturation voltages**					
$-I_C = 150$ mA; $-I_B = 15$ mA	$-V_{CEsat}$	<	0,4		V
	$-V_{BEsat}$	<	1,3		V
$-I_C = 500$ mA; $-I_B = 50$ mA	$-V_{CEsat}$	<	1,6		V
	$-V_{BEsat}$	<	2,6		V
Collector-base breakdown voltage open emitter; $-I_C = 10$ μA; $I_E = 0$	$-V_{(BR)CBO}$		60		V
Collector-emitter breakdown voltage open base; $-I_C = 10$ mA; $I_B = 0$	$-V_{(BR)CEO}$	>	40	60	V
Emitter-base breakdown voltage open collector; $-I_E = 10$ μA; $I_C = 0$	$-V_{(BR)EBO}$		5,0		V

* Device mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.

			PMBT2907	PMBT2907A	
D.C. current gain					
$-I_C$ = 0,1 mA; $-V_{CE}$ = 10 V	h_{FE}	>	35	75	
$-I_C$ = 1 mA; $-V_{CE}$ = 10 V	h_{FE}	>	50	100	
$-I_C$ = 10 mA; $-V_{CE}$ = 10 V	h_{FE}	>	75	100	
$-I_C$ = 150 mA; $-V_{CE}$ = 10 V	h_{FE}		100 to 300		
$-I_C$ = 500 mA; $-V_{CE}$ = 10 V	h_{FE}	>	30	50	
Transition frequency at f = 100 MHz					
$-I_C$ = 50 mA; $-V_{CE}$ = 20 V; T_{amb} = 25 °C	f_T	>	200		MHz
Output capacitance at f = 1 MHz					
$I_E = I_e$ = 0; $-V_{CB}$ = 10 V	C_o	<	8,0		pF
Input capacitance at f = 1 MHz					
$I_C = I_c$ = 0; $-V_{EB}$ = 2 V	C_i	<	30		pF
Switching times (between 10% and 90% levels)					
Turn-on time when switched to					
$-I_C$ = 150 mA; $-I_B$ = 15 mA; V_{CC} = 30 V					
delay time	t_d	<	10		ns
rise time	t_r	<	40		ns
turn-on time ($t_d + t_r$)	t_{on}	<	45		ns
Turn-off time when switched from					
$-I_C$ = 150 mA; $-I_B$ = 15 mA; V_{CC} = 6 V					
to cut-off with + I_{BM} = 15 mA (see Fig. 3)					
storage time	t_s	<	80		ns
fall time	t_f	<	30		ns
turn-off time ($t_s + t_f$)	t_{off}	<	100		ns

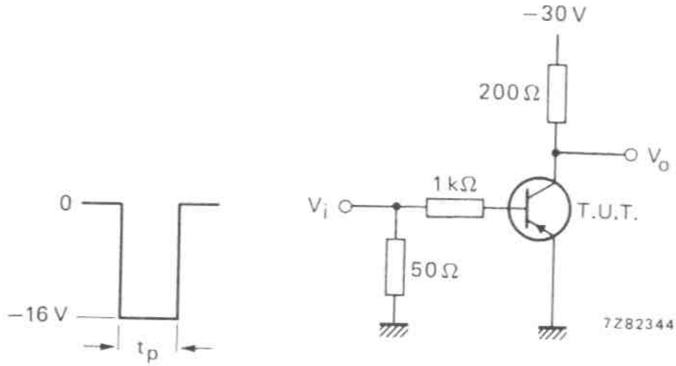


Fig. 2 Turn-on switching time test circuit.

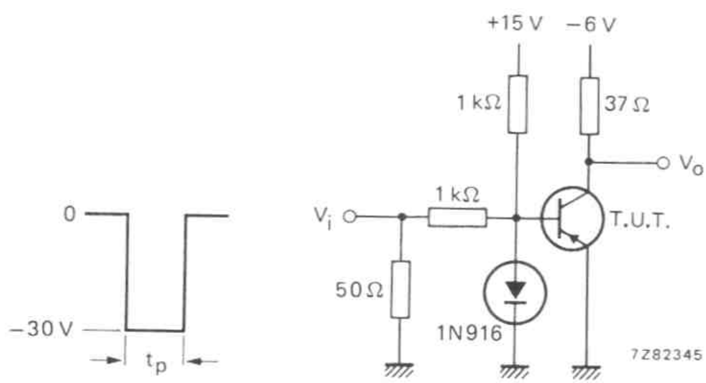


Fig. 3 Turn-off switching time test circuit.

Input pulse generator: Fig. 2 and Fig. 3	frequency	f	=	150	Hz
	pulse duration	t_p	=	200	ns
	rise time	t_r	⩽	2	ns
	output impedance	Z_o	=	50	Ω
Output oscilloscope: Fig. 2 and Fig. 3	rise time	t_r	⩽	5	ns
	input impedance	Z_i	=	10	MΩ

SILICON EPITAXIAL TRANSISTORS

N-P-N transistors in a microminiature (SMD) plastic envelope intended for surface mounted applications. They are primarily intended for use in telephony and professional communication equipment.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	60	V
Collector-emitter voltage (open base)	V_{CEO}	max.	40	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6	V
Collector current (DC)	I_C	max.	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	mW
DC current gain I_C = 10 mA; V_{CE} = 1 V	h_{FE}	> <	100 300	
Transition frequency at f = 35 MHz I_C = 10 mA; V_{CE} = 20 V	f_T	>	300	MHz

MECHANICAL DATA

Fig.1 SOT-23.

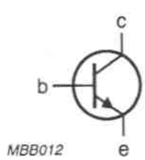
Dimensions in mm

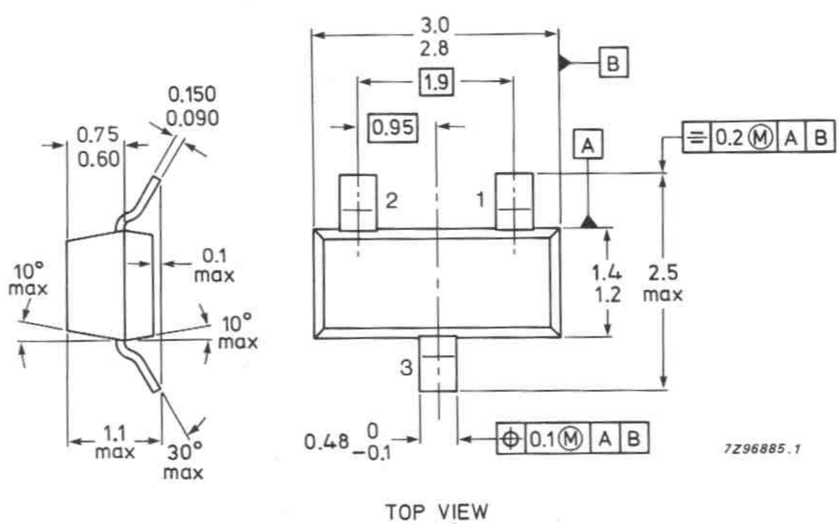
Marking code

PMBT3904: p1A

Pinning:

1 = base
2 = emitter
3 = collector





See also Soldering recommendations.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	60	V
Collector-emitter voltage (open base)	V_{CEO}	max.	40	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6	V
Collector current (d.c.)	I_C	max.	200	mA
Total power dissipation* up to T_{amb} = 25 °C	P_{tot}	max.	250	mW
Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

$T_j = P\ (R_{th\ j\text{-}t} + R_{th\ t\text{-}s} + R_{th\ s\text{-}a}) + T_{amb}$

Thermal resistance from junction to ambient*	$R_{th\ j\text{-}a}$	=	500	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector-emitter breakdown voltage▲ I_C = 1 mA; I_B = 0	$V_{(BR)CEO}$	min.	40	V
Collector-base breakdown voltage I_C = 10 μA; I_E = 0	$V_{(BR)CBO}$	min.	60	V
Emitter-base breakdown voltage I_E = 10 μA; I_C = 0	$V_{(BR)EBO}$	min.	6	V
Collector cut-off current V_{CE} = 30 V; V_{EB} = 3 V	I_{CEX}	max.	50	nA
Output capacitance at f = 1 MHz I_E = 0; V_{CB} = 5 V	C_c	max.	4	pF
Input capacitance at f = 1 MHz I_C = 0; V_{BE} = 0,5 V	C_e	max.	8	pF
Base current with reverse biased emitter junction V_{EB} = 3 V; V_{CE} = 30 V	I_{BEX}	max.	50	nA

* Mounted on a ceramic substrate: area = 10 x 8 mm^2; thickness = 0,7 mm.

▲ Pulse test conditions: t_p = 300 μs; duty cycle ⩽ 2%.

Saturation voltages			
I_C = 10 mA; I_B = 1 mA	V_{CEsat}	max.	0.2 V
I_C = 50 mA; I_B = 5 mA		max.	0.3 V
I_C = 10 mA; I_B = 1 mA	V_{BEsat}	min.	0.65 V
		max.	0.85 V
I_C = 50 mA; I_B = 5 mA	V_{BEsat}	max.	0.95 V
D.C. current gain *			
I_C = 0,1 mA; V_{CE} = 1 V	h_{FE}	>	40
I_C = 1 mA; V_{CE} = 1 V	h_{FE}	>	70
I_C = 10 mA; V_{CE} = 1 V	h_{FE}	>	100
		<	300
I_C = 50 mA; V_{CE} = 1 V	h_{FE}	>	60
I_C = 100 mA; V_{CE} = 1 V	h_{FE}	>	30
Transition frequency at f = 100 MHz			
I_C = 10 mA; V_{CE} = 20 V	f_T	min.	300 MHz
Noise figure at R_S = 1 kΩ			
I_C = 100 μA; V_{CE} = 5 V			
f = 10 Hz to 15,7 kHz	F	max.	5 dB
h-parameters (common emitter)			
I_C = 1 mA; V_{CE} = 10 V; f = 1 kHz			
Input impedance	h_{ie}		1 to 10 kΩ
Reverse voltage transfer ratio	h_{re}		0.5 to 8 10^{-4}
Small-signal current gain	h_{fe}		100 to 400
Output admittance	h_{oe}		1 to 40 μS
Switching times			
Turn-on time when V_{CC} = 3 V; V_{BE} = 0,5 V			
I_C = 10 mA; I_{Bon} = 1 mA			
Delay time	t_d	<	35 ns
Rise time	t_r	<	35 ns
Turn-off time when V_{CC} = 3 V; I_C = 10 mA			
I_{Bon} = I_{Boff} = 1 mA			
Storage time	t_s	<	200 ns
Fall time	t_f	<	50 ns

* Pulse test conditions: t_p = 300 μs; duty cycle ≤ 2%.

SILICON EPITAXIAL TRANSISTOR

P-N-P transistor in a microminiature (SMD) plastic envelope intended for surface mounted applications. The PMBT3906 is primarily intended for use in telephony and professional communication equipment.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40 V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5 V
Collector current (d.c.)	$-I_C$	max.	200 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250 mW
D.C. current gain $-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}		100 to 300
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 20 V	f_T	min.	250 MHz

MECHANICAL DATA

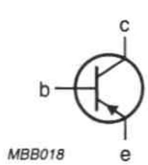
Dimensions in mm

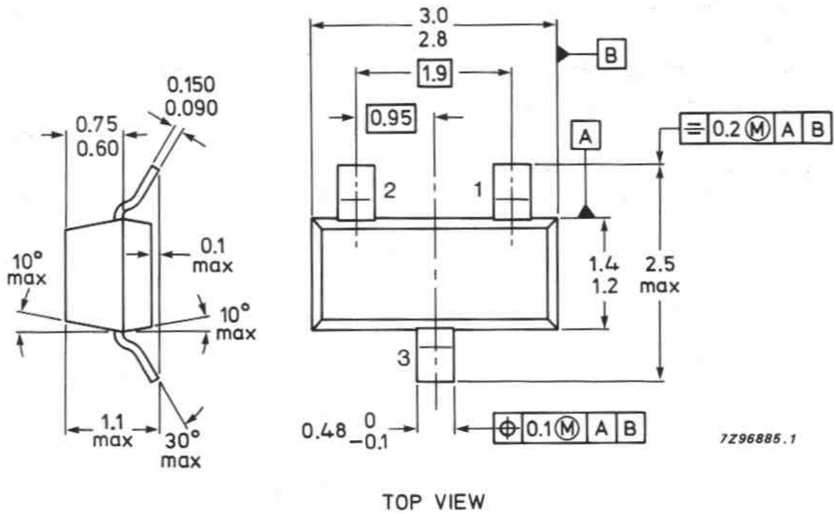
Fig. 1 SOT-23.

Marking code
PMBT3906 : p2A

Pinning:

1 = base
2 = emitter
3 = collector





See also Soldering recommendations.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40 V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5 V
Collector current (d.c.)	$-I_C$	max.	200 mA
Total power dissipation* up to T_{amb} = 25 °C	P_{tot}	max.	250 mW
Storage temperature	T_{stg}		−65 to +150 °C

THERMAL CHARACTERISTICS**

$T_j = P(R_{th\ j\text{-}t} + R_{th\ t\text{-}s} + R_{th\ s\text{-}a}) + T_{amb}$

Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	500 K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector-emitter breakdown voltage▲ $-I_C$ = 1 mA; I_B = 0	$-V_{(BR)CEO}$	min.	40 V
Collector-base breakdown voltage $-I_C$ = 10 μA; I_E = 0	$-V_{(BR)CBO}$	min.	40 V
Emitter-base breakdown voltage $-I_E$ = 10 μA; I_C = 0	$-V_{(BR)EBO}$	min.	5 V
Collector cut-off current $-V_{CE}$ = 30 V; $-V_{EB}$ = 3 V	$-I_{CE}$	max.	50 nA
Base current with reverse biased emitter junction	$-I_{BEX}$	max.	50 nA
Output capacitance at f = 100 kHz I_E = 0; $-V_{CB}$ = 5 V	C_c	max.	4,5 pF
Input capacitance at f = 100 kHz I_C = 0; $-V_{BE}$ = 0,5 V	C_e	max.	10 pF

* Mounted on a ceramic substrate: area = 10 x 8 mm; thickness = 0,7 mm.

** See Thermal characteristics.

▲ Pulse test conditions: t_p = 300 μs; duty cycle ≤ 2%.

Saturation voltages			
$-I_C = 10$ mA; $-I_B = 1$ mA	$-V_{CEsat}$	max.	0,25 V
$-I_C = 50$ mA; $-I_B = 5$ mA	$-V_{CEsat}$	max. min.	0,4 V 0,65 V
$-I_C = 10$ mA; $-I_B = 1$ mA	$-V_{BEsat}$	max.	0,85 V
$-I_C = 50$ mA; $-I_B = 5$ mA	$-V_{BBsat}$	max.	0,95 V
D.C. current gain			
$-I_C = 0,1$ mA; $-V_{CE} = 1$ V	h_{FE}	min.	60
$-I_C = 1$ mA; $-V_{CE} = 1$ V	h_{FE}	min.	80
$-I_C = 10$ mA; $-V_{CE} = 1$ V	h_{FE}	min. max.	100 300
$-I_C = 50$ mA; $-V_{CE} = 1$ V	h_{FE}	min.	60
$-I_C = 100$ mA; $-V_{CE} = 1$ V	h_{FE}	min.	30
Transition frequency at f = 100 MHz			
$-I_C = 10$ mA; $-V_{CE} = 20$ V	f_T	min.	250 MHz
Noise figure at $R_S = 1$ kΩ			
$-I_C = 100$ μA; $-V_{CE} = 5$ V f = 10 Hz to 15,7 kHz	F	max.	4 dB
h-parameters (common emitter)			
$-I_C = 1$ mA; $-V_{CE} = 10$ V; f = 1 kHz			
Input impedance	h_{ie}	min. max.	2,0 kΩ 12 kΩ
Reverse voltage transfer ratio	h_{re}	min. max.	1,0 10^{-4} 10 10^{-4}
Small signal current gain	h_{fe}	min. max.	100 400
Output admittance	h_{oe}	min. max.	30 μS 60 μS
Switching times			
Turn-on time when $-V_{CC} = 3$ V; $-V_{BE} = 0,5$ V $-I_C = 10$ mA; $-I_{Bon} = 1$ mA			
Delay time	t_d	max.	35 ns
Rise time	t_r	max.	35 ns
Turn-off time when $-V_{CC} = 3$ V; $-I_C = 10$ mA $-I_{Bon} = -I_{Boff} = 1$ mA			
Storage time	t_s	max.	225 ns
Fall time	t_f	max.	75 ns

SILICON PLANAR EPITAXIAL TRANSISTOR

NPN silicon planar epitaxial transistor, housed in a SOT-23 envelope.

It is intended for use in linear, switching, and general purpose applications.

The complementary type is the PMBT4403.

QUICK REFERENCE DATA

Collector-emitter voltage	V_{CEO}	max.	40 V
Collector current (DC)	I_C	max.	600 mA
DC current gain I_C = 150 mA; V_{CE} = 1 V	h_{FE}	min. max.	100 300
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	250 mW

MECHANICAL DATA

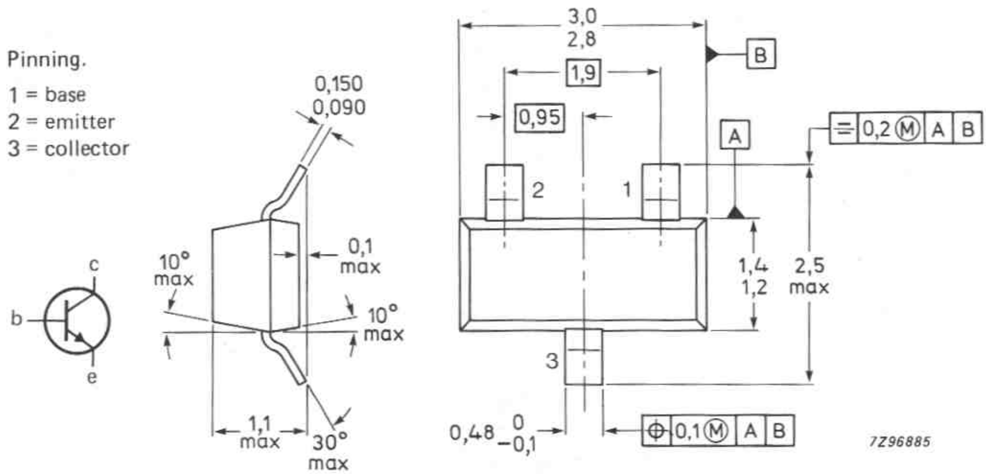
Dimensions in mm

Fig. 1 SOT-23

Marking code = p2X

Pinning.

1 = base
2 = emitter
3 = collector



TOP VIEW

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage	V_{CEO}	max.	40	V
Collector-base voltage	V_{CBO}	max.	60	V
Emitter-base voltage	V_{EBO}	max.	6.0	V
Collector current (DC)	I_C	max.	600	mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	250	mW
Storage temperature range	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	500	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector-emitter breakdown voltage I_C = 1.0 mA; I_B = 0	$V_{(BR)CEO}$	>	40	V
Collector-base breakdown voltage I_C = 100 μA; I_E = 0	$V_{(BR)CBO}$	>	60	V
Emitter-base breakdown voltage I_E = 100 μA; I_C = 0	$V_{(BR)EBO}$	>	6.0	V
Base cut-off current V_{CE} = 35 V; V_{EB} = 0.4 V	I_{BEX}	<	0.1	μA
Collector cut-off current V_{CE} = 35 V; V_{EB} = 0.4 V	I_{CEX}	<	0.1	μA
DC current gain				
I_C = 0.1 mA; V_{CE} = 1 V	h_{FE}	>	20	
I_C = 1.0 mA; V_{CE} = 1 V	h_{FE}	>	40	
I_C = 10 mA; V_{CE} = 1 V	h_{FE}	>	80	
I_C = 150 mA; V_{CE} = 1 V	h_{FE}		100 to 300	
I_C = 500 mA; V_{CE} = 2 V	h_{FE}	>	40	
Saturation voltage				
I_C = 150 mA; I_B = 15 mA	$V_{CE\ sat}$	<	0.4	V
	$V_{BE\ sat}$		0.75 to 0.95	V
I_C = 500 mA; I_B = 50 mA	$V_{CE\ sat}$	<	0.75	V
	$V_{BE\ sat}$	<	1.2	V

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.

Transition frequency; f = 100 MHz; I_C = 20 mA; V_{CE} = 10 V	f_T	>	250 MHz
Collector-base capacitance I_E = 0; V_{CB} = 5 V; f = 100 kHz	C_{cb}	<	8.0 pF
Emitter-base capacitance I_C = 0; V_{BE} = 0.5 V; f = 100 kHz	C_{eb}	<	30 pF
Input impedance; f = 1 kHz; I_C = 1 mA; V_{CE} = 10 V	h_{ie}	min. max.	1.0 kΩ 8.0 kΩ
Voltage feed-back ratio I_C = 1 mA; V_{CE} = 10 V; f = 1 kHz	h_{re}	min. max.	0.1×10^{-4} 30×10^{-4}
Small-signal current gain; f = 1 kHz; I_C = 1 mA; V_{CE} = 10 V	h_{fe}	min. max.	40 500
Output admittance; f = 1 kHz; I_C = 1 mA; V_{CE} = 10 V	h_{oe}	min. max.	1.0 μS 30 μS
Switching times (resistive load)			
Turn-on time I_C = 150 mA; I_{B1} = 15 mA; V_{CC} = 30 V; V_{EB} = 2 V			
delay time	t_d	max.	15 ns
rise time	t_r	max.	20 ns
Turn-off time I_C = 150 mA; V_{CC} = 30 V; I_{B1} = I_{B2} = 15 mA			
storage time	t_s	max.	225 ns
fall time	t_f	max.	30 ns

SILICON PLANAR EPITAXIAL TRANSISTOR

PNP silicon planar epitaxial transistor, housed in a SOT-23 envelope.

It is intended for use in linear, switching and general purpose applications.

The complementary type is the PMBT4401.

QUICK REFERENCE DATA

Collector-emitter voltage	$-V_{CEO}$	max.	40 V
Collector current (DC)	$-I_C$	max.	600 mA
DC current gain I_C = 150 mA; V_{CE} = 2 V	h_{FE}	min. max.	100 300
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250 mW

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-23

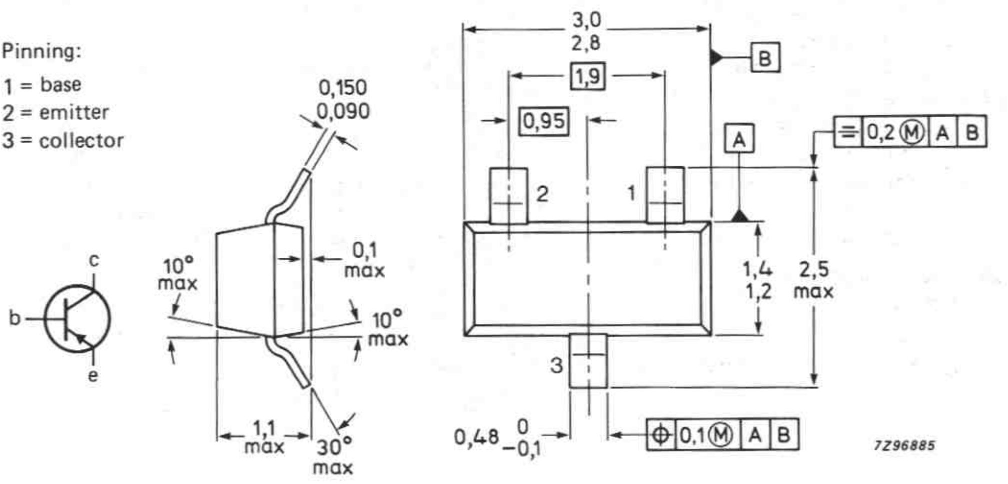
Marking code = p2T

Pinning:

1 = base

2 = emitter

3 = collector



* Mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage	$-V_{CEO}$	max.	40 V
Collector-base voltage	$-V_{CBO}$	max.	40 V
Emitter-base voltage	$-V_{EBO}$	max.	5.0 V
Collector current (DC)	$-I_C$	max.	600 mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	250 mW
Storage temperature range	T_{stg}		−65 to +150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	500 K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector-emitter breakdown voltage $-I_C$ = 1.0 mA; I_B = 0	$-V_{(BR)CEO}$	>	40 V
Collector-base breakdown voltage $-I_C$ = 100 μA; I_E = 0	$-V_{(BR)CBO}$	>	40 V
Emitter-base breakdown voltage $-I_E$ = 100 μA; I_C = 0	$-V_{(BR)EBO}$	>	5.0 V
Base cut-off current $-V_{CE}$ = 35 V; $-V_{EB}$ = 0.4 V	$-I_{BEX}$	<	0.1 μA
Collector cut-off current $-V_{CE}$ = 35 V; $-V_{EB}$ = 0.4 V	$-I_{CEX}$	<	0.1 μA
DC current gain $-I_C$ = 0.1 mA; $-V_{CE}$ = 1 V	h_{FE}	>	30
$-I_C$ = 1.0 mA; $-V_{CE}$ = 1 V	h_{FE}	>	60
$-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}	>	100
$-I_C$ = 150 mA; $-V_{CE}$ = 2 V	h_{FE}		100 to 300
$-I_C$ = 500 mA; $-V_{CE}$ = 2 V	h_{FE}	>	20
Saturation voltage $-I_C$ = 150 mA; $-I_B$ = 15 mA	$-V_{CE\ sat}$	<	0.4 V
	$-V_{BE\ sat}$		0.75 to 0.95 V
$-I_C$ = 500 mA; $-I_B$ = 50 mA	$-V_{CE\ sat}$	<	0.75 V
	$-V_{BE\ sat}$	<	1.3 V

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.

Transition frequency at f = 100 MHz; $-I_C$ = 20 mA; $-V_{CE}$ = 10 V	f_T	>	200 MHz
Collector-base capacitance I_E = 0; $-V_{CB}$ = 10 V; f = 100 kHz	C_{cb}	<	8.5 pF
Emitter-base capacitance at f = 100 kHz; I_C = 0; $-V_{BE}$ = 0.5 V	C_{eb}	<	35 pF
Input impedance at f = 1 kHz; $-I_C$ = 1 mA; $-V_{CE}$ = 10 V	h_{ie}	min.	1.5 kΩ
		max.	15 kΩ
Voltage feed-back ratio at f = 1 kHz; $-I_C$ = 1 mA; $-V_{CE}$ = 10 V	h_{re}	min.	0.1×10^{-4}
		max.	8.0×10^{-4}
Small-signal current gain at f = 1 kHz; $-I_C$ = 1 mA; $-V_{CE}$ = 10 V	h_{fe}	min.	60
		max.	500
Output admittance at f = 1 kHz; $-I_C$ = 1 mA; $-V_{CE}$ = 10 V	h_{oe}	min.	1.0 μS
		max.	100 μS
Switching times (resistive load)			
Turn-on time $-I_C$ = 150 mA; $-I_{B1}$ = 15 mA; $-V_{CC}$ = 30 V; $-V_{EB}$ = 2 V			
delay time	t_d	max.	15 ns
rise time	t_r	max.	20 ns
Turn-off time $-I_C$ = 150 mA; $-V_{CC}$ = 30 V; $-I_{B1}$ = $+I_{B2}$ = 15 mA			
storage time	t_s	max.	225 ns
fall time	t_f	max.	30 ns

SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N small-signal transistor in plastic SOT-23 envelope intended for low-noise input stages in audio equipment, when using SMD technology.

QUICK REFERENCE DATA

Collector-emitter voltage (open base)	V_{CEO}	max.	30 V
Collector-base voltage (open emitter)	V_{CBO}	max.	35 V
Collector current (d.c.)	I_C	max.	50 mA
Total device dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250 mW
Collector-emitter saturation voltage I_C = 10 mA; I_B = 1 mA	V_{CEsat}	max.	0,5 V
D.C. current gain I_C = 1 mA; V_{CE} = 5 V	h_{FE}	min.	350

MECHANICAL DATA

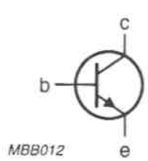
Dimensions in mm

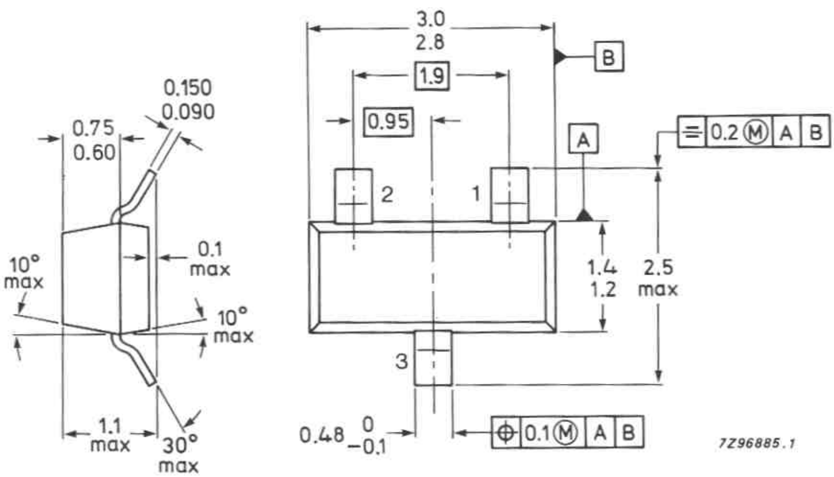
Fig. 1 SOT-23.

Marking code: p1Q

Pinning:

1 = base
2 = emitter
3 = collector





TOP VIEW

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage (open base)	V_{CEO}	max.	30 V
Collector-base voltage (open emitter)	V_{CBO}	max.	35 V
Emitter-base voltage (open collector)	V_{EBO}	max.	4,5 V
Collector current (d.c.)	I_C	max.	50 mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	250 mW
Storage temperature	T_{stg}		−65 to +150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	500 K/W

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

Collector-emitter breakdown voltage $I_B = 0; I_C = 1$ mA	$V_{(BR)CEO}$	min.	30 V
Collector-base breakdown voltage $I_E = 0; I_C = 100\ \mu A$	$V_{(BR)CBO}$	min.	35 V
Collector cut-off current $V_{CB} = 20$ V; $I_E = 0$	I_{CBO}	max.	50 nA
Emitter cut-off current $V_{EBoff} = 3$ V; $I_C = 0$	I_{EBO}	max.	50 nA
Saturation voltages $I_C = 10$ mA; $I_B = 1$ mA	V_{CEsat}	max.	0,5 V
	V_{BEsat}	max.	0,8 V
D.C. current gain $I_C = 100\ \mu A$; $V_{CE} = 5$ V	h_{FE}	min.	300
		max.	900
$I_C = 1$ mA; $V_{CE} = 5$ V	h_{FE}	min.	350
$I_C = 10$ mA; $V_{CE} = 5$ V		min.	300
Small-signal current gain $I_C = 1$ mA; $V_{CE} = 5$ V; f = 1 kHz	h_{fe}	min.	350
		max.	1400
Noise figure at $R_S = 10\ k\Omega$; $T_{amb} = 25\ ^oC$ $I_C = 100\ \mu A$; $V_{CE} = 5$ V; f = 10 Hz to 15,7 kHz	F	max.	3,0 dB
Collector capacitance at f = 100 kHz $V_{CB} = 5$ V; $I_E = 0$	C_c	max.	4,0 pF
Emitter capacitance at f = 100 kHz $V_{BE} = 0,5$ V; $I_C = 0$	C_e	max.	10 pF

SILICON P-N-P HIGH-VOLTAGE TRANSISTOR

P-N-P high-voltage small-signal transistor for general purposes and especially in telephony applications and encapsulated in a SOT-23 envelope.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	160 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	150 V
Collector current	$-I_C$	max.	500 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250 mW
Collector-emitter saturation voltage I_C = 50 mA; I_B = 5 mA	V_{CEsat}	max.	0,5 V
D.C. current gain I_C = 10 mA; V_{CE} = −5 V	h_{FE}		60 to 240

MECHANICAL DATA

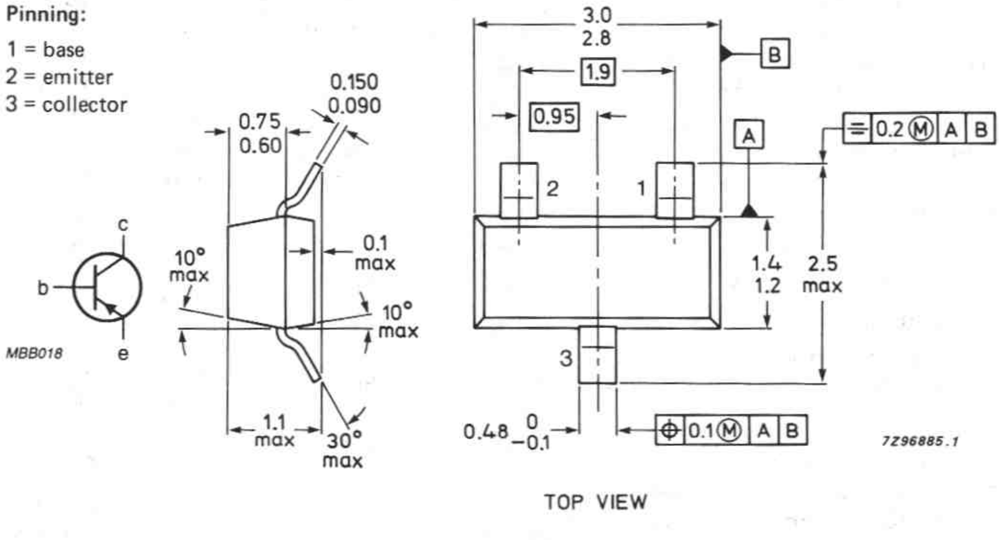
Dimensions in mm

Fig. 1 SOT-23.

Marking code: p2L

Pinning:

1 = base
2 = emitter
3 = collector



TOP VIEW

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	160 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	150 V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5,0 V
Collector current	$-I_C$	max.	500 mA
Total power dissipation * up to T_{amb} = 25 °C	P_{tot}	max.	250 mW
Junction temperature	T_j	max.	150 °C
Storage temperature	T_{stg}		−65 to +150 °C

THERMAL RESISTANCE

From junction to ambient *	$R_{th\ j\text{-}a}$	500 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0$; $-V_{CB}$ = 120 V	$-I_{CBO}$	max.	50 nA
$I_E = 0$; $-V_{CB}$ = 120 V; T_{amb} = 150 °C	$-I_{CBO}$	max.	50 μA
Breakdown voltages			
I_C = 1,0 mA; I_B = 0	$-V_{(BR)CEO}$	min.	150 V
I_C = 100 μA; I_E = 0	$-V_{(BR)CBO}$	min.	160 V
I_C = 0; I_E = 10 μA	$-V_{(BR)EBO}$	min.	5,0 V
Saturation voltages			
$-I_C$ = 10 mA; $-I_B$ = 1,0 mA	$-V_{CEsat}$	max.	0,2 V
	$-V_{BEsat}$	max.	1,0 V
$-I_C$ = 50 mA; $-I_B$ = 5,0 mA	$-V_{CEsat}$	max.	0,5 V
	$-V_{BEsat}$	max.	1,0 V
D.C. current gain			
I_C = 1,0 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	50
I_C = 10 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	60
		max.	240
I_C = 50 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	50
Small-signal current gain			
I_C = 1,0 mA; $-V_{CE}$ = 10 V; f = 1 kHz	h_{fe}	min.	40
		max.	200
Output capacitance at f = 1 MHz			
I_E = 0; $-V_{CB}$ = 10 V	C_o	max.	6,0 pF
Transition frequency at f = 100 MHz			
$-I_C$ = 10 mA; $-V_{CE}$ = 10 V; T_{amb} = 25 °C	f_T	min.	100 MHz
		max.	300 MHz
Noise figure at R_S = 10 Ω			
I_C = 200 μA; $-V_{CE}$ = 5 V; f = 10 Hz to 15,7 kHz; T_{amb} = 25 °C	F	max.	8,0 dB

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.

SILICON N-P-N HIGH-VOLTAGE TRANSISTOR

N-P-N high-voltage small-signal transistor for general purposes and especially telephony applications and encapsulated in a SOT-23 envelope.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	160 V
Collector-emitter voltage (open base)	V_{CEO}	max.	140 V
Collector current	I_C	max.	600 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250 mW
Collector-emitter saturation voltage I_C = 50 mA; I_B = 5 mA	V_{CEsat}	max.	0,25 V
D.C. current gain I_C = 10 mA; V_{CE} = 5 V	h_{FE}		60 to 250

MECHANICAL DATA

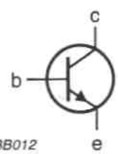
Dimensions in mm

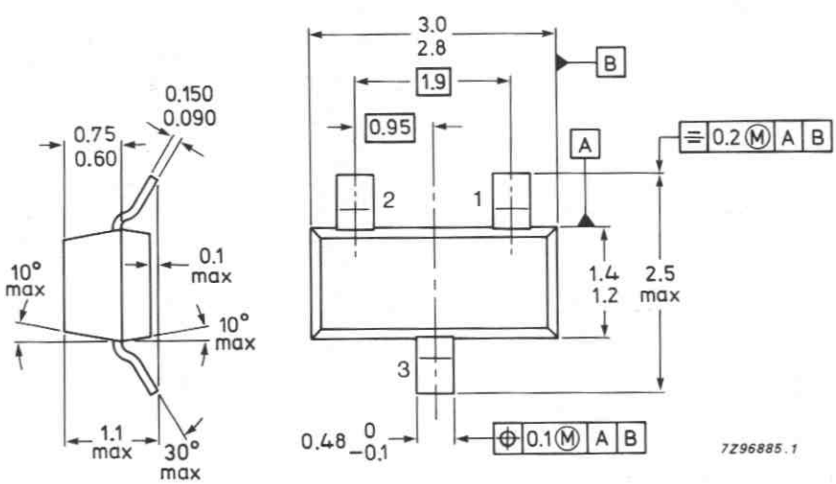
Fig. 1 SOT-23.

Marking code: p1F

Pinning:

1 = base
2 = emitter
3 = collector





TOP VIEW

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	160	
Collector-emitter voltage (open base)	V_{CEO}	max.	140	
Emitter-base voltage (open collector)	V_{EBO}	max.	6	V
Collector current	I_C	max.	600	mA
Total power dissipation * up to T_{amb} = 25 °C	P_{tot}	max.	250	mW
Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE *

From junction to ambient	$R_{th\ t\text{-}a}$	500	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
I_E = 0; V_{CB} = 100 V	I_{CBO}	max.	100	nA
I_E = 0; V_{CB} = 100 V; T_{amb} = 100 °C	I_{CBO}	max.	100	μA
Emitter cut-off current				
I_C = 0; V_{EB} = 4,0 V	I_{EBO}	max.	50	nA
Breakdown voltages				
I_C = 1,0 mA; I_B = 0	$V_{(BR)CEO}$	min.	140	V
I_C = 10 μA; I_E = 0	$V_{(BR)CBO}$	min.	160	V
I_C = 0; I_E = 10 μA	$V_{(BR)EBO}$	min.	6	V
Saturation voltages				
I_C = 10 mA; I_B = 1,0 mA	V_{CEsat}	max.	0,15	V
	V_{BEsat}	max.	1,0	V
I_C = 50 mA; I_B = 5,0 mA	V_{CEsat}	max.	0,25	V
	V_{BEsat}	max.	1,2	V
D.C. current gain				
I_C = 1,0 mA; V_{CE} = 5 V	h_{FE}	min.	60	
I_C = 10 mA; V_{CE} = 5 V	h_{FE}	min.	60	
		max.	250	
I_C = 50 mA; V_{CE} = 5 V	h_{FE}	min.	20	
Output capacitance at f = 1 MHz				
I_E = 0; V_{CB} = 10 V	C_o	max.	6	pF
Input capacitance at f = 1 MHz				
I_C = 0; V_{EB} = 0,5 V	C_i	max.	30	pF
Transition frequency at f = 100 MHz				
I_C = 10 mA; V_{CE} = 10 V; T_{amb} = 25 °C	f_T	min.	100	MHz
		max.	300	MHz

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.

SILICON NPN HIGH-VOLTAGE TRANSISTOR

NPN high-voltage small-signal transistor for general purposes and especially telephony applications and encapsulated in a SOT23 envelope.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	180 V
Collector-emitter voltage (open base)	V_{CEO}	max.	160 V
Collector current	I_C	max.	600 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250 mW
Junction temperature	T_j	max.	150 °C
Collector-emitter saturation voltage I_C = 50 mA; I_B = 5 mA	V_{CEsat}	max.	0.20 V
DC current gain I_C = 10 mA; V_{CE} = 5 V	h_{FE}	min.	80

MECHANICAL DATA

Dimensions in mm

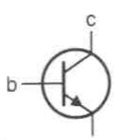
Fig.1 SOT23.

Marking code

PMBT5551 = pGI

Pinning:

1 = base
2 = emitter
3 = collector



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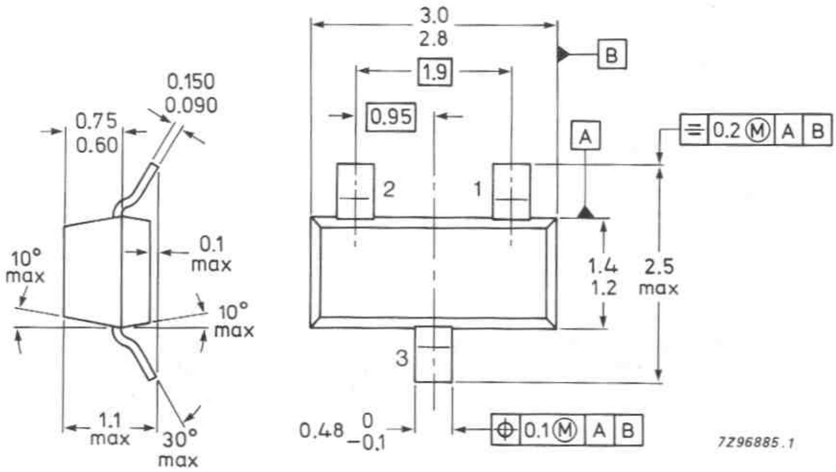


TOP VIEW

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	180 V
Collector-emitter voltage (open base)	V_{CEO}	max.	160 V
Emitter-base voltage (open collector)	V_{EBO}	max.	6 V
Collector current	I_C	max.	600 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250 mW
Junction temperature	T_j	max.	150 °C
Storage temperature range	T_{stg}		−65 to + 150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	500 K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector cut-off current			
I_E = 0; V_{CB} = 120 V	I_{CBO}	max.	50 nA
I_E = 0; V_{CB} = 120 V; T_{amb} = 100 °C	I_{CBO}	max.	50 μA
Emitter cut-off current			
I_C = 0; V_{EB} = 4.0 V	I_{EBO}	max.	50 nA
Breakdown voltages			
I_C = 1.0 mA; I_B = 0	$V_{(BR)CEO}$	min.	160 V
I_C = 100 μA; I_E = 0	$V_{(BR)CBO}$	min.	180 V
I_C = 0; I_E = 10 μA	$V_{(BR)EBO}$	min.	6.0 V
Saturation voltages			
I_C = 10 mA; I_B = 1.0 mA	V_{CEsat}	max.	0.15 V
	V_{BEsat}	max.	1.0 V
I_C = 50 mA; I_B = 5.0 mA	V_{CEsat}	max.	0.20 V
	V_{BEsat}	max.	1.0 V
DC current gain			
I_C = 1.0 mA; V_{CE} = 5 V	h_{FE}	min.	80
I_C = 10 mA; V_{CE} = 5 V	h_{FE}	min.	80
		max.	250
I_C = 50 mA; V_{CE} = 5 V	h_{FE}	min.	30
Small-signal current gain			
I_C = 1.0 mA; V_{CE} = 10 V; f = 1 kHz	h_{fe}	min.	50
		max.	200
Output capacitance at f = 1 MHz			
I_E = 0; V_{CB} = 10 V	C_o	max.	6 pF
Input capacitance at f = 1 MHz			
I_C = 0; V_{EB} = 0.5 V	C_i	max.	30 pF
Transition frequency at f = 100 MHz			
I_C = 10 mA; V_{CE} = 10 V	f_T	min.	100 MHz
		max.	300 MHz
Noise figure at R_S = 1 kΩ			
I_C = 250 μA; V_{CE} = 5 V; f = 10 Hz to 15.7 kHz	F	max.	8 dB

* Substrate size 8 mm x 10 mm x 0.7 mm.

SILICON EPITAXIAL TRANSISTORS

N-P-N transistors in a microminiature (SMD) plastic envelope intended for application in thick and thin-film circuits (Surface Mounted Device).

They are primarily intended for use in telephony and professional communication equipment.

QUICK REFERENCE DATA

			PMBT6428	PMBT6429	
Collector-base voltage (open emitter)	V_{CBO}	max.	60	55	V
Collector-emitter voltage (open base)	V_{CEO}	max.	50	45	V
Collector current (d.c.)	I_C	max.	200		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
D.C. current gain I_C = 0,1 mA; V_{CE} = 5 V	h_{FE}	min. max.	250 650	500 1250	
I_C = 1 mA; V_{CE} = 5 V	h_{FE}	min.	250	500	
Transition frequency at f = 100 MHz I_C = 1 mA; V_{CE} = 5 V	f_T	min. max.	100 700		MHz MHz
Input capacitance at f = 1 MHz I_C = 0; V_{EB} = 0,5 V	C_e	max.	8,0		pF

MECHANICAL DATA

Dimensions in mm

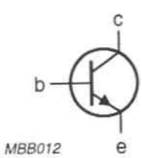
Fig. 1 SOT-23.

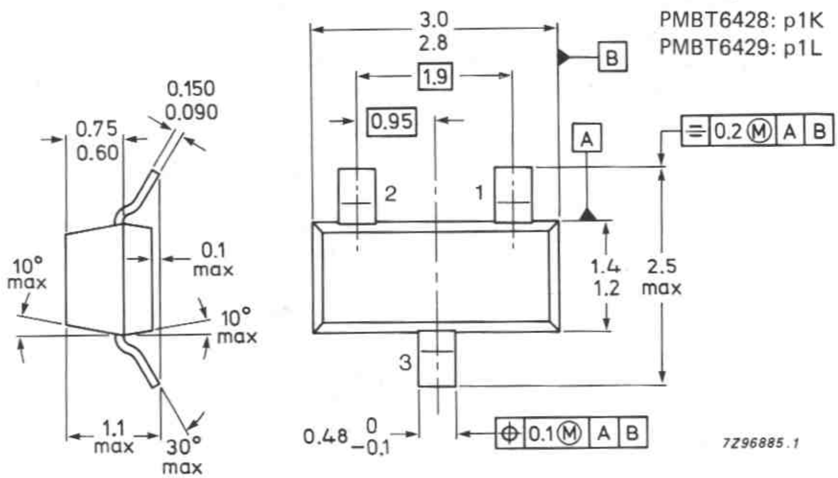
Marking code

PMBT6428: p1K
PMBT6429: p1L

Pinning:

1 = base
2 = emitter
3 = collector





See also Soldering recommendations.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			PMBT6428	PMBT6429	
Collector-base voltage (open emitter)	V_{CBO}	max.	60	55	V
Collector-emitter voltage (open base)	V_{CEO}	max.	50	45	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6,0		V
Collector current (d.c.)	I_C	max.	200		mA
Total power dissipation* up to T_{amb} = 25 °C	P_{tot}		250		mW
Storage temperature	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL CHARACTERISTICS

Thermal resistance from junction to ambient*	$R_{th\ j\text{-}a}$	=	500	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			PMBT6428	PMBT6429	
Collector-emitter breakdown voltage I_C = 1 mA; I_B = 0	$V_{(BR)CEO}$	min.	50	45	V
Collector-base breakdown voltage I_C = 0,1 mA; I_E = 0	$V_{(BR)CBO}$	min.	60	55	V
Collector cut-off current V_{CE} = 30 V	I_{CEO}	max.	100		nA
I_E = 0; V_{CB} = 30 V	I_{CBO}	max.	10		nA
Emitter cut-off current I_C = 0; V_{EB} = 5 V	I_{EBO}	max.	10		nA
Base-emitter On-voltage I_C = 1 mA; V_{CE} = 5 V	$V_{BE(on)}$	min.	560		mV
		max.	660		mV

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.

			PMBT6428	PMBT6429	
Collector-emitter saturation voltage					
I_C = 10 mA; I_B = 0,5 mA	V_{CEsat}	max.	0,2		V
I_C = 100 mA; I_B = 5 mA	V_{CEsat}	max.	0,6		V
D.C. current gain					
I_C = 0,1 mA; V_{CE} = 5 V	h_{FE}	min.	250	500	
I_C = 0,1 mA; V_{CE} = 5 V	h_{FE}	min.	250	500	
		max.	650	1250	
I_C = 1 mA; V_{CE} = 5 V	h_{FE}	min.	250	500	
I_C = 10 mA; V_{CE} = 5 V	h_{FE}	min.	250	500	
Transition frequency at f = 100 MHz					
I_C = 1 mA; V_{CE} = 5 V	f_T	min.	100		MHz
		max.	700		MHz
Output capacitance at f = 1 MHz					
I_E = 0; V_{CB} = 10 V	C_c	max.	3,0		pF
Input capacitance at f = 1 MHz					
I_C = 0; V_{EB} = 0,5 V	C_e	max.	8,0		pF

SILICON EPITAXIAL TRANSISTORS

N-P-N transistors in a microminiature (SMD) plastic envelope intended for surface mounted applications. They are primarily intended for use in telephony and professional communication equipment.

QUICK REFERENCE DATA

			PMBTA05	PMBTA06	
Collector-base voltage (open emitter)	V_{CBO}	max.	60	80	V
Collector-emitter voltage (open base)	V_{CEO}	max.	60	80	V
Emitter-base voltage (open collector)	V_{EBO}	max.	4		V
Collector current (d.c.)	I_C	max.	500		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
D.C. current gain I_C = 100 mA; V_{CE} = 1 V	h_{FE}	min.	50		
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 2 V	f_T	min.	100		MHz
Collector-emitter saturation voltage I_C = 100 mA; I_B = 10 mA	V_{CEsat}	max.	0,25		V

MECHANICAL DATA

Dimensions in mm

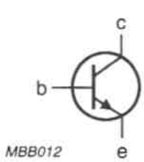
Fig. 1 SOT-23.

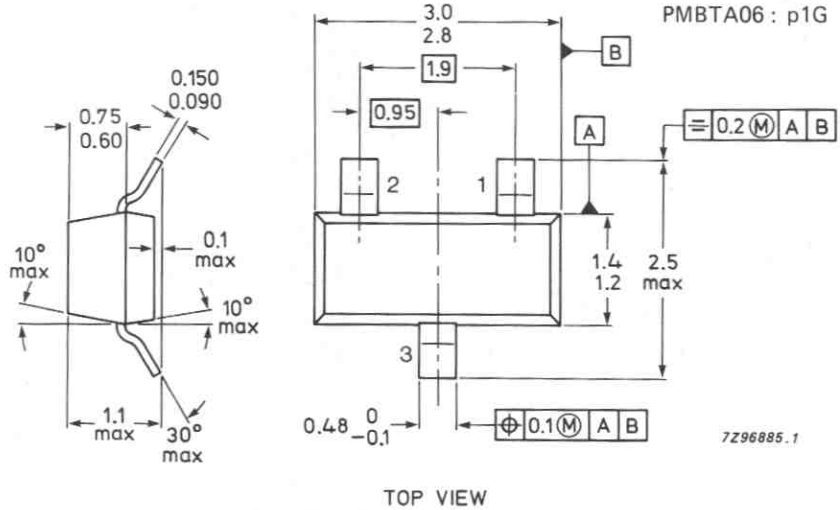
Marking code

PMBTA05 : p1H
PMBTA06 : p1G

Pinning:

1 = base
2 = emitter
3 = collector





See also Soldering recommendations.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			PMBTA05	PMBTA06	
Collector-base voltage	V_{CBO}	max.	60	80	V
Collector-emitter voltage (open base)	V_{CEO}	max.	60	80	V
Emitter-base voltage (open collector)	V_{EBO}	max.	4		V
Collector current (d.c.)	I_C	max.	500		mA
Total power dissipation * up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Storage temperature	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL CHARACTERISTICS **

$T_j = P\ (R_{th\ j\text{-}t} + R_{th\ t\text{-}s} + R_{th\ s\text{-}a}) + T_{amb}$

Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	500	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			PMBTA05	PMBTA06	
Collector-emitter breakdown voltage ▲ I_C = 1 mA; I_B = 0	$V_{(BR)CEO}$	min.	60	80	V
Emitter-base breakdown voltage I_C = 0; I_E = 100 μA	$V_{(BR)EBO}$	min.	4		V
Collector cut-off current V_{CE} = 60 V; I_B = 0	I_{CEO}	max.	0,1		μA
Collector cut-off current V_{CB} = 60 V; I_E = 0	I_{CBO}	max.	0,1		μA
V_{CB} = 80 V; I_E = 0	I_{CBO}	max.	0,1		μA
Saturation voltages I_C = 100 mA; I_B = 10 mA	V_{CEsat}	max.	0,25		V
Base-emitter on voltage I_C = 100 mA; V_{CE} = 1 V	$V_{BE(on)}$	max.	1,2		V
D.C. current gain I_C = 10 mA; V_{CE} = 1 V	h_{FE}	min.	50		
I_C = 100 mA; V_{CE} = 1 V	h_{FE}	min.	50		
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 2 V	f_T	min.	100		MHz

* Mounted on a ceramic substrate: area = 10 x 8 mm; thickness = 0,7 mm.
** See Thermal characteristics.
▲ Pulse test conditions: t_p = 300 μs; duty cycle ≤ 2%.

N-P-N SMALL-SIGNAL DARLINGTON TRANSISTORS

N-P-N small-signal darlington transistors in a microminiature SMD envelope (SOT-23).

Designed primarily for preamplifier input applications requiring high input impedance.

P-N-P complement is the PMBTA63/64.

QUICK REFERENCE DATA

Collector-emitter voltage $V_{BE} = 0$		V_{CES}	max.	30 V
Collector current (d.c.)		I_C	max.	300 mA
Total power dissipation up to $T_{amb} = 25\ ^oC$		P_{tot}	max.	250 mW
Junction temperature		T_j	max.	150 ^oC
D.C. current gain $I_C = 10$ mA; $V_{CE} = 5$ V	PMBTA13	h_{FE}	min.	5000
	PMBTA14	h_{FE}	min.	10 000
Transition frequency at f = 100 MHz $I_C = 10$ mA; $V_{CE} = 5$ V		f_T	min.	125 MHz

MECHANICAL DATA

Dimensions in mm

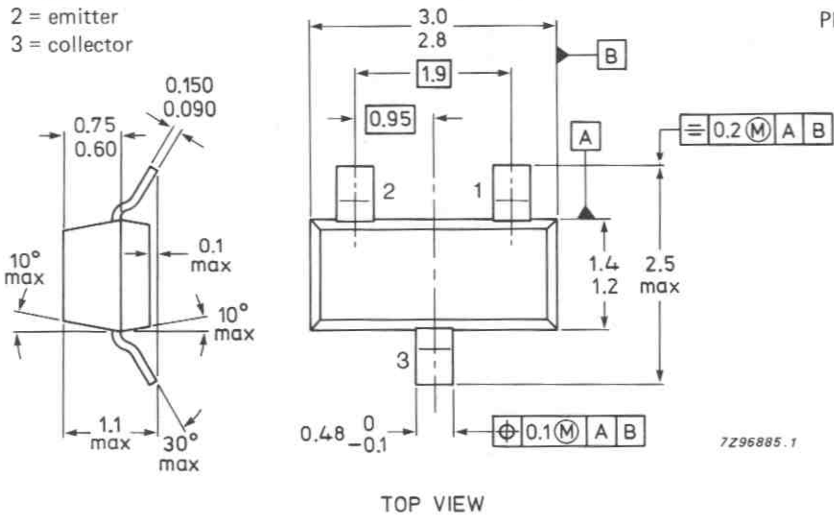
Fig. 1 SOT-23.

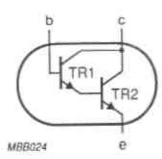
Pinning:

1 = base
2 = emitter
3 = collector

Marking code

PMBTA13: p1M
PMBTA14: p1N





See also Soldering recommendations.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage $V_{BE} = 0$	V_{CES}	max.	30	V
Emitter-base voltage (open collector)	V_{EBO}	max.	10	V
Collector current (d.c.)	I_C	max.	300	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$*	P_{tot}	max.	250	mW
Storage temperature	T_{stg}		−65 to +150	^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$		500	K/W

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

Collector-emitter breakdown voltage $I_C = 100\ \mu A$		$V_{(BR)CES}$	min.	30	V
Emitter-base cut-off current $V_{BE} = 10$ V		I_{EBO}	max.	0,1	μA
Collector-base cut-off current $V_{CB} = 30$ V		I_{CBO}	max.	0,1	μA
D.C. current gain $I_C = 10$ mA; $V_{CE} = 5$ V	PMBTA13	h_{FE}	min.	5000	
	PMBTA14	h_{FE}	min.	10 000	
$I_C = 100$ mA; $V_{CE} = 5$ V	PMBTA13	h_{FE}	min.	10 000	
	PMBTA14	h_{FE}	min.	20 000	
Collector-emitter saturation voltage $I_C = 100$ mA; $I_B = 0,1$ mA		V_{CEsat}	max.	1,5	V
Base-emitter ON-voltage $I_C = 100$ mA; $V_{CE} = 5$ V		$V_{BE(on)}$	max.	2,0	V
Transition frequency at f = 100 MHz $I_C = 10$ mA; $V_{CE} = 5$ V		f_T	min.	125	MHz

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

SILICON EPITAXIAL TRANSISTORS

N-P-N transistors in a microminiature (SMD) plastic envelope intended for surface mounted applications. They are primarily intended for use in telephony and professional communication equipment.

QUICK REFERENCE DATA

<table>
<tr><th></th><th></th><th></th><th>PMBTA42</th><th>PMBTA43</th><th></th></tr>
<tr><td>Collector-base voltage (open emitter)</td><td>V_{CBO}</td><td>max.</td><td>300</td><td>200</td><td>V</td></tr>
<tr><td>Collector-emitter voltage (open base)</td><td>V_{CEO}</td><td>max.</td><td>300</td><td>200</td><td>V</td></tr>
<tr><td>Emitter-base voltage (open collector)</td><td>V_{EBO}</td><td>max.</td><td colspan="2">6</td><td>V</td></tr>
<tr><td>Collector current (DC)</td><td>I_C</td><td>max.</td><td colspan="2">500</td><td>mA</td></tr>
<tr><td>Total power dissipation up to T_{amb} = 25 °C</td><td>P_{tot}</td><td>max.</td><td colspan="2">250</td><td>mW</td></tr>
<tr><td>Junction temperature</td><td>T_j</td><td>max.</td><td colspan="2">150</td><td>°C</td></tr>
<tr><td>D.C. current gain
I_C = 10 mA; V_{CE} = 10 V</td><td>h_{FE}</td><td>min.</td><td colspan="2">40</td><td></td></tr>
<tr><td>Transition frequency at f = 35 MHz
I_C = 10 mA; V_{CE} = 20 V</td><td>f_T</td><td>min.</td><td colspan="2">50</td><td>MHz</td></tr>
<tr><td>Feedback capacitance at f = 1 MHz
I_C = 0; V_{CE} = 20 V</td><td>C_{re}</td><td>max.</td><td>3</td><td>4</td><td>pF</td></tr>
</table>

MECHANICAL DATA

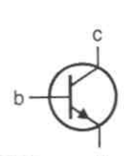
Dimensions in mm

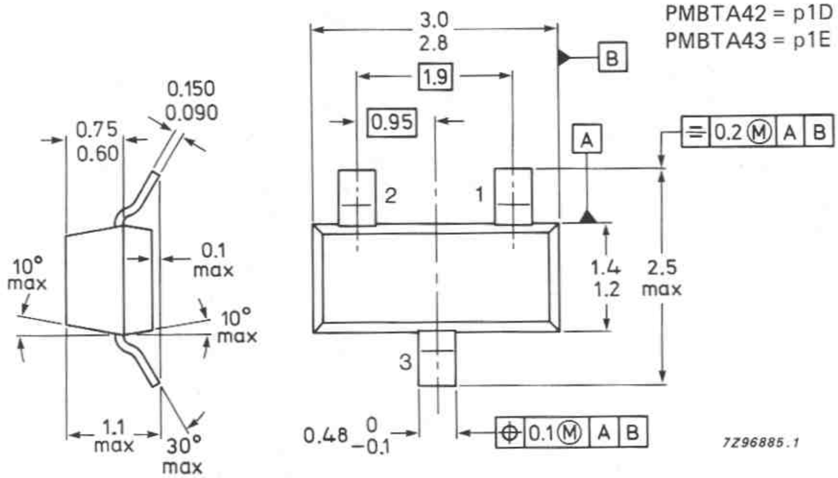
Fig. 1 SOT-23.

Marking code
PMBTA42 = p1D
PMBTA43 = p1E

Pinning:

1 = base
2 = emitter
3 = collector





TOP VIEW

See also Soldering recommendations.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			PMBTA42	PMBTA43	
Collector-base voltage (open emitter)	V_{CBO}	max.	300	200	V
Collector-emitter voltage (open base)	V_{CEO}	max.	300	200	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6	6	V
Collector current (DC)	I_C	max.	500	500	mA
Total power dissipation (note 1) up to T_{amb} = 25 °C	P_{tot}	max.	250	250	mW
Storage temperature	T_{stg}		−65 to +150	−65 to +150	°C
Junction temperature	T_j	max.	150	150	°C

THERMAL CHARACTERISTICS

$T_j = P\,(R_{th\ j\text{-}t} + R_{th\ t\text{-}s} + R_{th\ s\text{-}a}) + T_{amb}$

Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	500	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			PMBTA42	PMBTA43	
Collector-emitter breakdown voltage (note 2) I_C = 1 mA; I_B = 0	$V_{(BR)CEO}$	min.	300	200	V
Collector-base breakdown voltage I_C = 100 μA; I_E = 0	$V_{(BR)CBO}$	min.	300	200	V
Emitter-base breakdown voltage I_E = 100 μA; I_C = 0	$V_{(BR)EBO}$	min.	6	6	V
Collector cut-off current I_E = 0; V_{CB} = 200 V	I_{CBO}	max.	0,1	–	μA
I_E = 0; V_{CB} = 160 V	I_{CBO}	max.	–	0,1	μA
Emitter cut-off current I_C = 0; V_{BE} = 6 V	I_{EBO}	max.	0,1	–	μA
I_C = 0; V_{BE} = 4 V	I_{EBO}	max.	–	0,1	μA
Feedback capacitance at f = 1 MHz I_E = 0; V_{CB} = 20 V	C_{re}	max.	3	4	pF

Notes

1. Mounted on a ceramic substrate: area = 2,5 cm^2; thickness 0,7 mm.
2. Pulse test conditions: t_p = 300 μs; δ = 0,02.

Saturation voltages				
I_C = 20 mA; I_B = 2 mA	V_{CEsat}	max.	0,5	V
	V_{BEsat}	max.	0,9	V
D.C. current gain				
I_C = 1 mA; V_{CE} = 10 V		min.	25	
I_C = 10 mA; V_{CE} = 10 V	h_{FE}	min.	40	
I_C = 30 mA; V_{CE} = 10 V		min.	40	
Transition frequency at f = 100 MHz				
I_C = 10 mA; V_{CE} = 20 V	f_T	min.	50	MHz

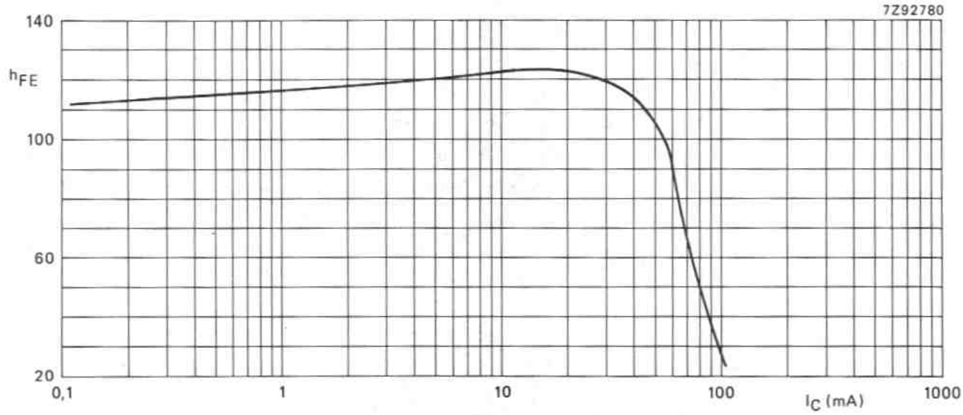


Fig. 2 T_j = 25 °C; V_{CE} = 20 V; typical values.

SILICON EPITAXIAL TRANSISTORS

P-N-P transistors in a microminiature (SMD) plastic envelope intended for surface mounted applications. They are primarily intended for use in telephony and professional communication equipment.

QUICK REFERENCE DATA

			PMBTA55	PMBTA56	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60	80	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	60	80	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	4		V
Collector current (d.c.)	$-I_C$	max.	500		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
D.C. current gain $-I_C$ = 100 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	50		
Transition frequency at f = 100 MHz $-I_C$ = 100 mA; $-V_{CE}$ = 1 V	f_T	min.	50		MHz
Collector-emitter saturation voltage $-I_C$ = 100 mA; I_B = 10 mA	V_{CEsat}	max.	0,25		V

MECHANICAL DATA

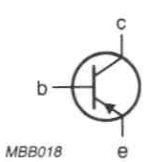
Dimensions in mm

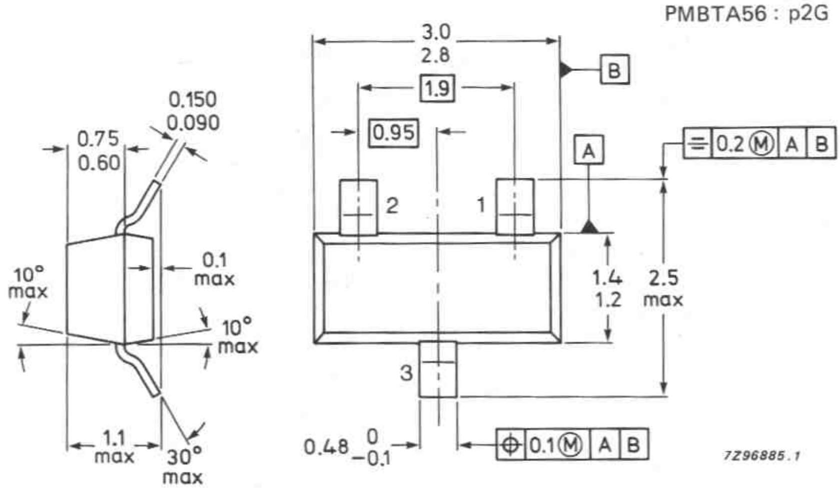
Fig. 1 SOT-23.

Marking code
PMBTA55 : p2H
PMBTA56 : p2G

Pinning:

1 = base
2 = emitter
3 = collector





TOP VIEW

See also Soldering recommendations.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			PMBTA55	PMBTA56	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60	80	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	60	80	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	4		V
Collector current (d.c.)	$-I_C$	max.	500		mA
Total power dissipation * up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Storage temperature	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL CHARACTERISTICS**

$T_j = P\,(R_{th\ j\text{-}t} + R_{th\ t\text{-}s} + R_{th\ s\text{-}a}) + T_{amb}$

Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	500	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			PMBTA55	PMBTA56	
Collector-emitter breakdown voltage▲ $-I_C$ = 1 mA; I_B = 0	$-V_{(BR)CEO}$	min.	60	80	V
Emitter-base breakdown voltage $-I_C$ = 0; I_E = 100 μA	$-V_{(BR)EBO}$	min.	4		V
Collector cut-off current $-V_{CE}$ = 60 V; I_B = 0	$-I_{CEO}$	max.	0,1		μA
Collector cut-off current $-V_{CB}$ = 60 V; I_E = 0	$-I_{CBO}$	max.	0,1		μA
$-V_{CB}$ = 80 V; I_E = 0	$-I_{CBO}$	max.	0,1		μA
Saturation voltages $-I_C$ = 100 mA; $-I_B$ = 10 mA	$-V_{CEsat}$	max.	0,25		V
Base-emitter on voltage $-I_C$ = 100 mA; $-V_{CE}$ = 1 V	$-V_{BE(on)}$	max.	1,2		V
D.C. current gain $-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	50		
$-I_C$ = 100 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	50		
Transition frequency at f = 100 MHz $-I_C$ = 100 mA; $-V_{CE}$ = 1 V	f_T	min.	50		MHz

* Mounted on a ceramic substrate: area = 10 x 8 mm; thickness = 0,7 mm.
** See Thermal characteristics.
▲ Pulse test conditions: t_p = 300 μs; duty cycle ≤ 2%.

P-N-P SMALL-SIGNAL DARLINGTON TRANSISTORS

P-N-P small-signal darlington transistors in a microminiature SMD envelope (SOT-23).

Designed primarily for preamplifier input applications requiring high input impedance.

N-P-N complement is the PMBTA13/14.

QUICK REFERENCE DATA

Collector-emitter voltage				
$V_{BE} = 0$		$-V_{CES}$	max.	30 V
Collector current (d.c.)		$-I_C$	max.	500 mA
Total power dissipation				
up to $T_{amb} = 25\ ^oC$		P_{tot}	max.	250 mW
Junction temperature		T_j	max.	150 ^oC
D.C. current gain				
$-I_C = 10$ mA; $-V_{CE} = 5$ V	PMBTA63	h_{FE}	min.	5000
	PMBTA64	h_{FE}	min.	10 000
Transition frequency at f = 100 MHz				
$-I_C = 10$ mA; $-V_{CE} = 50$ V		f_T	min.	125 MHz

MECHANICAL DATA

Dimensions in mm

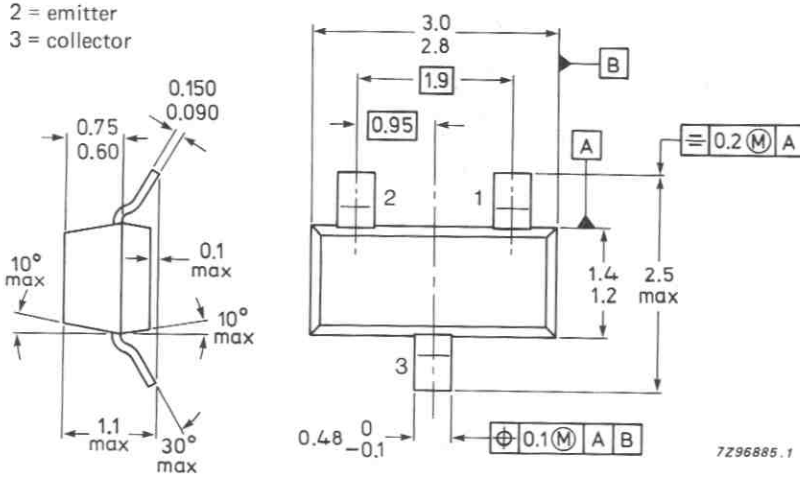
Fig. 1 SOT-23.

Pinning:

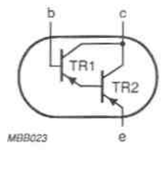
1 = base
2 = emitter
3 = collector

Marking code

PMBTA63: p2U
PMBTA64: p2V



TOP VIEW



See also Soldering recommendations.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)		$-V_{CBO}$	max.	30 V
Collector-emitter voltage $V_{BE} = 0$		$-V_{CES}$	max.	30 V
Emitter-base voltage (open collector)		$-V_{EBO}$	max.	10 V
Collector current (d.c.)		$-I_C$	max.	500 mA
Total power dissipation up to $T_{amb} = 25\ ^oC$*		P_{tot}	max.	250 mW
Storage temperature		T_{stg}		−65 to +150 °C
Junction temperature		T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*		$R_{th\ j\text{-}a}$		500 K/W

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

Collector-emitter breakdown voltage $-I_C = 100\ \mu A$		$-V_{(BR)CES}$	min.	30 V
Emitter-base cut-off current $-V_{BE} = 10$ V		$-I_{EBO}$	max.	0,1 μA
Collector-base cut-off current $-V_{CB} = 30$ V		$-I_{CBO}$	max.	0,1 μA
D.C. current gain $-I_C = 10$ mA; $-V_{CE} = 5$ V	PMBTA63	h_{FE}	min.	5000
	PMBTA64	h_{FE}	min.	10 000
$-I_C = 100$ mA; $-V_{CE} = 5$ V	PMBTA63	h_{FE}	min.	10 000
	PMBTA64	h_{FE}	min.	20 000
Collector-emitter saturation voltage $-I_C = 100$ mA; $-I_B = 0,1$ mA		$-V_{CEsat}$	max.	1,5 V
Base-emitter ON-voltage $-I_C = 100$ mA; $-V_{CE} = 5$ V		$-V_{BE(on)}$	max.	2,0 V
Transition frequency at f = 100 MHz $-I_C = 10$ mA; $-V_{CE} = 50$ V; $T_{amb} = 25\ ^oC$		f_T	min.	125 MHz

* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

SILICON EPITAXIAL TRANSISTORS

P-N-P transistors in a microminiature (SMD) plastic envelope intended for surface mounted applications. They are primarily intended for use in telephony and professional communication equipment.

QUICK REFERENCE DATA

			PMBTA92	PMBTA93	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	300	200	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	300	200	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5		V
Collector current (d.c.)	$-I_C$	max.	500		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
D.C. current gain $-I_C$ = 10 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	40		
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 20 V	f_T	min.	50		MHz
Collector-base capacitance at f = 1 MHz I_E = 0; $-V_{CB}$ = 20 V	C_{cb}	max.	6	8	pF

MECHANICAL DATA

Dimensions in mm

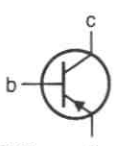
Fig. 1 SOT-23.

Marking code

PMBTA92 : p2D
PMBTA93 : p2E

Pinning:

1 = base
2 = emitter
3 = collector



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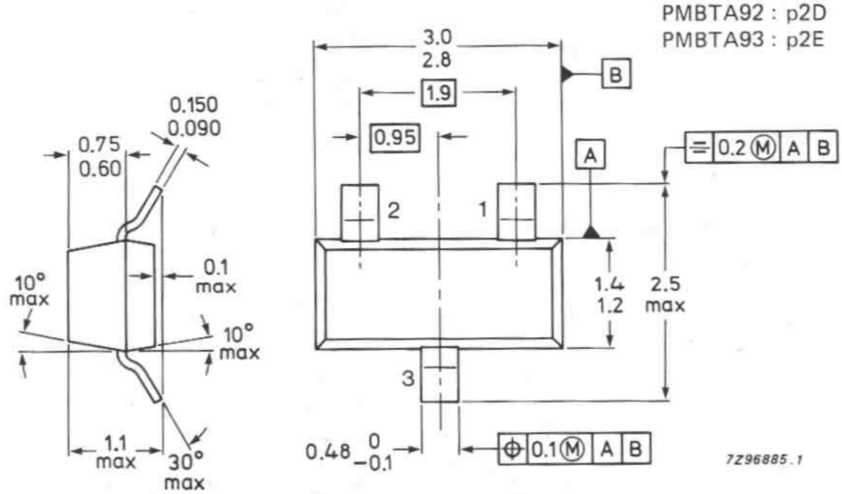

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TOP VIEW

See also Soldering recommendations.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			PMBTA92	PMBTA93	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	300	200	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	300	200	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5		V
Collector current (d.c.)	$-I_C$	max.	500		mA
Total power dissipation * up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Storage temperature	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL CHARACTERISTICS **

$T_j = P (R_{th\ j\text{-}t} + R_{th\ t\text{-}s} + R_{th\ s\text{-}a}) + T_{amb}$

Thermal resistance from junction to ambient*	$R_{th\ j\text{-}a}$	=	500	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			PMBTA92	PMBTA93	
Collector-emitter breakdown voltage $-I_C$ = 1 mA; I_B = 0	$-V_{(BR)CEO}$	min.	300	200	V
Collector-base breakdown voltage $-I_C$ = 100 μA; I_E = 0	$-V_{(BR)CBO}$	min.	300	200	V
Collector cut-off current $-V_{CB}$ = 200 V; I_E = 0	$-I_{CBO}$	max.	0,25	–	μA
$-V_{CB}$ = 160 V; I_E = 0	$-I_{CBO}$	max.	–	0,25	μA
Emitter-base breakdown voltage $-I_E$ = 100 μA; I_C = 0	$-V_{(BR)EBO}$	min.	5		V
Emitter cut-off current I_C = 0; $-V_{BE}$ = 3 V	$-I_{EBO}$	max.	0,1		μA
Collector-base capacitance at f = 1 MHz; I_E = 0; $-V_{CB}$ = 20 V	C_{cb}	max.	6	8	pF
Saturation voltages $-I_C$ = 20 mA; $-I_B$ = 2 mA	$-V_{CEsat}$	max.	0,5		V
$-I_C$ = 20 mA; $-I_B$ = 2 mA	$-V_{BEsat}$	max.	0,9		V
D.C. current gain ▲ $-I_C$ = 1 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	25		
$-I_C$ = 10 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	40		
$-I_C$ = 30 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	25		

* Mounted on a ceramic substrate: area = 10 x 8 mm; thickness = 0,7 mm.
** See Thermal characteristics.
▲ Pulse test conditions: t_p = 300 μs; duty cycle ≤ 2%.

SUPERSEDES DATA OF NOVEMBER 1988

SILICON PLANAR VOLTAGE REGULATOR DIODES

Low power general purpose voltage regulator diodes in a microminiature plastic envelope intended for application in thick and thin film circuits. The series covers the range of nominal working voltages from 3.3 to 33 V with a working voltage tolerance of ± 5%.

QUICK REFERENCE DATA

Working voltage range	V_Z	nom.	3.3 to 33	V
Working voltage tolerance			± 5	%
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Junction temperature	T_j	max.	150	°C

MECHANICAL DATA

Dimensions in mm

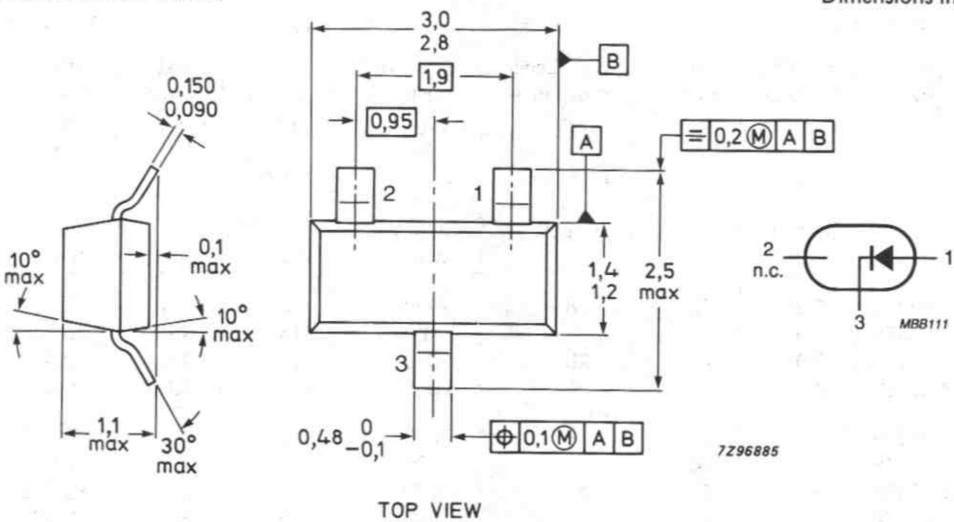


Fig.1 SOT23.

Marking code

PMBZ 5226B = 8A
PMBZ 5227B = 8B
PMBZ 5228B = 8C
PMBZ 5229B = 8D
PMBZ 5230B = 8E
PMBZ 5231B = 8F
PMBZ 5232B = 8G
PMBZ 5233B = 8H
PMBZ 5234B = 8J
PMBZ 5235B = 8K
PMBZ 5236B = 8L
PMBZ 5237B = 8M
PMBZ 5238B = 8N
PMBZ 5239B = 8P
PMBZ 5240B = 8Q
PMBZ 5241B = 8R
PMBZ 5242B = 8S
PMBZ 5243B = 8T
PMBZ 5244B = 8U
PMBZ 5245B = 8V
PMBZ 5246B = 8W
PMBZ 5247B = 8X
PMBZ 5248B = 8Y
PMBZ 5249B = 8Z
PMBZ 5250B = 81A
PMBZ 5251B = 81B
PMBZ 5252B = 81C
PMBZ 5253B = 81D
PMBZ 5254B = 81E
PMBZ 5255B = 81F
PMBZ 5256B = 81G
PMBZ 5257B = 81H

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Repetitive peak forward current	I_{FRM}	max.	250 mA
Repetitive peak working current	I_{ZRM}	max.	250 mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	300 mW
Storage temperature	T_{stg}		−65 to + 150 °C
Junction temperature	T_j	max.	150 °C

THERMAL CHARACTERISTICS

Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	420 K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise stated

Forward voltage I_F = 200 mA	V_F	max.	1.1 V

type number	working voltage V_Z (V) at I_{ztest} (note 1) nom.	test current I_{Ztest} (mA)	max. Zener impedance Z_{ZT} (Ω) at I_{Ztest} (note 2)	differential resistance r_{diff} (Ω) at I_{ZK} = 0.25 mA (note 2) max.	reverse current I_R (μA) at V_R max.	test voltage V_R (V)	temp. coeff. S_Z (%/K) (note 3) typ.
PMBZ 5226B	3.3	20	28	1600	25	1.0	−0.064
PMBZ 5227B	3.6	20	26	1700	15	1.0	−0.065
PMBZ 5228B	3.9	20	25	1900	10	1.0	−0.063
PMBZ 5229B	4.3	20	22	2000	5	1.0	−0.058
PMBZ 5230B	4.7	20	19	2000	5	1.0	−0.047
PMBZ 5231B	5.1	20	17	2000	5	2.0	−0.013
PMBZ 5232B	5.6	20	11	1600	5	3.0	+0.023
PMBZ 5233B	6.0	20	7	1600	5	3.5	+0.023
PMBZ 5234B	6.2	20	7	1000	5	4.0	+0.039
PMBZ 5235B	6.8	20	5	750	3	5.0	+0.040
PMBZ 5236B	7.5	20	6	500	3	6.0	+0.047
PMBZ 5237B	8.2	20	8	500	3	6.5	+0.052
PMBZ 5238B	8.7	20	8	600	3	6.5	+0.053
PMBZ 5239B	9.1	20	10	600	3	7.0	+0.055
PMBZ 5240B	10	20	17	600	3	8.0	+0.055
PMBZ 5241B	11	20	22	600	2	8.4	+0.058
PMBZ 5242B	12	20	30	600	1	9.1	+0.062
PMBZ 5243B	13	9.5	13	600	0.5	9.9	+0.065
PMBZ 5244B	14	9.0	15	600	0.1	10	+0.067

* Device mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.

type number	working voltage V_Z (V) at I_{ztest} (note 1) nom.	test current I_{Ztest} (mA)	max. Zener impedance Z_{ZT} (Ω) at I_{Ztest} (note 2)	differential resistance r_{diff} (Ω) at I_{ZK} = 0.25 mA (note 2) max.	reverse current I_R (μA) at V_R max.	test voltage V_R (V)	temp. coeff. S_Z (%/K) (note 3) (typ.
PMBZ 5245B	15	8.5	16	600	0.1	11	+0.073
PMBZ 5246B	16	7.8	17	600	0.1	12	+0.073
PMBZ 5247B	17	7.4	19	600	0.1	13	+0.073
PMBZ 5248B	18	7.0	21	600	0.1	14	+0.078
PMBZ 5249B	19	6.6	23	600	0.1	14	+0.078
PMBZ 5250B	20	6.2	25	600	0.1	15	+0.080
PMBZ 5251B	22	5.6	29	600	0.1	17	+0.080
PMBZ 5252B	24	5.2	33	600	0.1	18	+0.081
PMBZ 5253B	25	5.0	35	600	0.1	19	+0.082
PMBZ 5254B	27	4.6	41	600	0.1	21	+0.085
PMBZ 5255B	28	4.5	44	600	0.1	21	+0.085
PMBZ 5256B	30	4.2	49	600	0.1	23	+0.085
PMBZ 5257B	33	3.8	58	700	0.1	25	+0.085

DEVELOPMENT DATA

Notes

1. V_Z is measured with device at thermal equilibrium while mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.
2. $I_{(ac\ rms)}$ = 10% of I_{Ztest} resp. I_{ZK}; 1 kHz superimposed; thermal equilibrium see note 1.
3. For types PMBZ 5226B to PMBZ 5242B the current I_Z = 7.5 mA; for PMBZ 5243B and higher $I_Z = I_{Ztest}$. Testpoints at T_1 = 25 °C, T_2 = 125 °C.

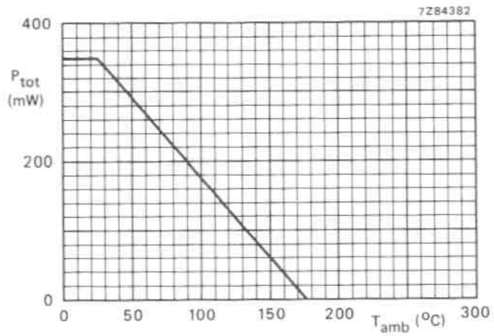


Fig. 2 Power derating curve.

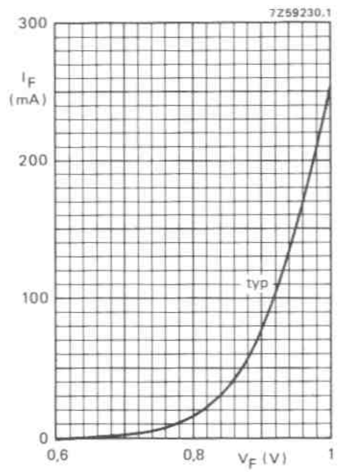


Fig. 3 Typical values at T_j = 25 °C.
Forward current as a function of forward voltage.

HIGH-SPEED SILICON DIODES FOR SURFACE MOUNTING

These diodes are primarily designed for fast logic applications.

These SM diodes are leadless diodes in a hermetically sealed SOD-80 envelope with tin-plated metal discs at each end. They are suitable for "automatic placement" and as such it can withstand immersion soldering.

The diodes can be delivered in "super 8" tape.

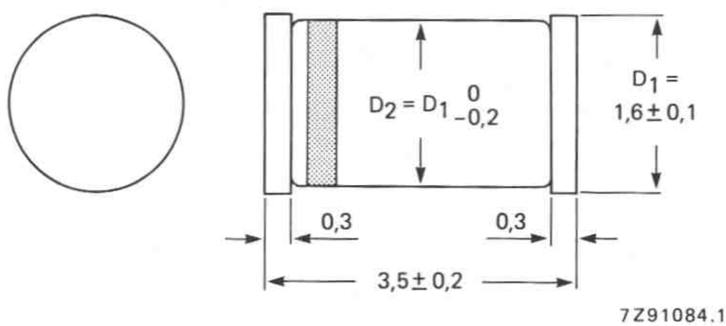
QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	75 V
Repetitive peak reverse voltage	V_{RRM}	max.	75 V
Repetitive peak forward current	I_{FRM}	max.	450 mA
Forward voltage PMLL4148: I_F = 10 mA PMLL4446: I_F = 20 mA PMLL4448: I_F = 100 mA	V_F	<	1 V
Reverse recovery time when switched from I_F = 10 mA to I_R = 60 mA; R_L = 100 Ω; measured at I_R = 1 mA	t_{rr}	<	4 ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-80.



Cathode indicated by black band.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Continuous reverse voltage	V_R	max.	75 V
Repetitive peak reverse voltage	V_{RRM}	max.	75 V
Average rectified forward current	$I_{F(AV)}$	max.	150 mA
Forward current (d.c.)	I_F	max.	200 mA
Repetitive peak forward current	I_{FRM}	max.	450 mA
Non-repetitive peak forward current			
t = 1 μs	I_{FSM}	max.	2000 mA
t = 1 s	I_{FSM}	max.	500 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500 mW
Derating factor			2,85 mW/K
Storage temperature	T_{stg}		−65 to + 200 °C
Junction temperature	T_j	max.	200 °C

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Forward voltages				
PMLL4148: I_F = 10 mA; PMLL4446: I_F = 20 mA; PMLL4448: I_F = 100 mA		V_F	<	1 V
PMLL4448: I_F = 5 mA		V_F		0,62 to 0,72 V
Reverse avalanche breakdown voltage				
I_R = 100 μA		$V_{(BR)R}$	>	100 V
I_R = 5 μA		$V_{(BR)R}$	>	75 V
Reverse currents				
V_R = 20 V		I_R	<	25 nA
V_R = 20 V; T_j = 100 °C	PMLL4448	I_R	<	3 μA
V_R = 20 V; T_j = 150 °C		I_R	<	50 μA
Diode capacitance				
V_R = 0; f = 1 MHz		C_d	<	4 pF
Forward recovery voltage when switched to I_F = 50 mA; t_r = 20 ns		V_{fr}	<	2,5 V

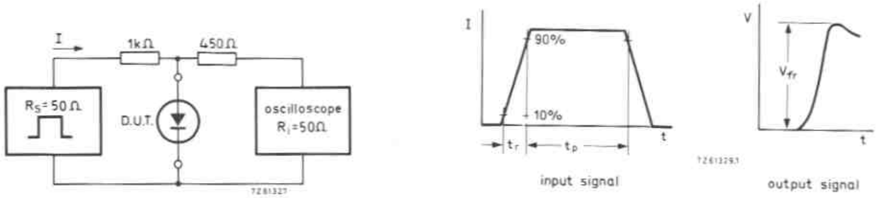


Fig. 2 Forward recovery voltage test circuit and waveforms.

Input signal: Rise time of the forward pulse t_r = 20 ns
Forward current pulse duration t_p = 120 ns
Duty factor δ = 0,01

Oscilloscope: Rise time t_r = 0,35 ns

Circuit capacitance C ⩽ 1 pF (C = oscilloscope input capacitance + parasitic capacitance)

Reverse recovery time when switched from
I_F = 10 mA to I_R = 10 mA; R_L = 100 Ω;
measured at I_R = 1 mA t_{rr} < 4 ns

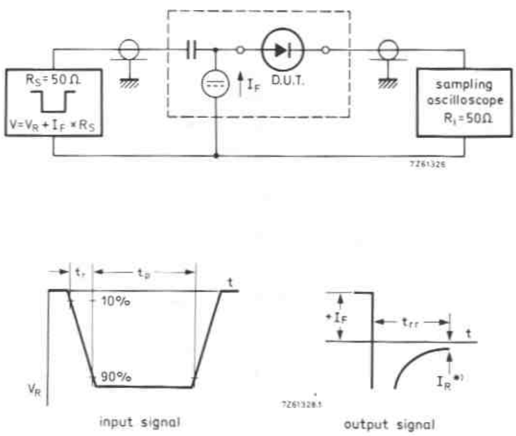


Fig. 3 Reverse recovery time test circuit and waveforms.

Input signal: Rise time of the reverse pulse t_r = 0,6 ns
Reverse pulse duration t_p = 100 ns
Duty factor δ = 0,05

* I_R = 1 mA

Oscilloscope: Rise time t_r = 0,35 ns

Circuit capacitance C ⩽ 1 pF (C = oscilloscope input capacitance + parasitic capacitance)

ULTRA-HIGH-SPEED SILICON DIODES FOR SURFACE MOUNTING

Whiskerless diodes in SOD-80 envelopes.
The PMLL4150 is primarily intended for general purpose use in computer and industrial applications.
The PMLL4151 and PMLL4153 are intended for military and industrial applications.

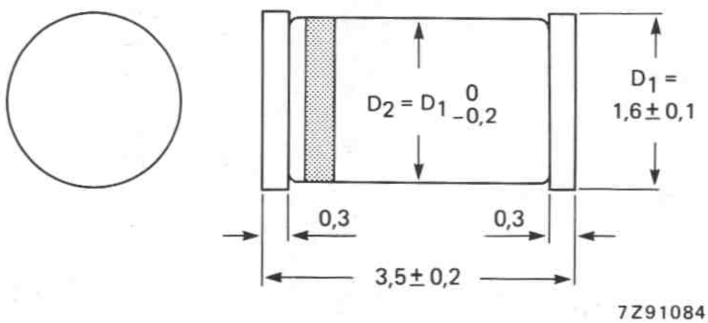
QUICK REFERENCE DATA

			PMLL4150	4151	4153	
Continuous reverse voltage	V_R	max.	50	50	50	V
Repetitive peak reverse voltage	V_{RRM}	max.	–	75	75	V
Repetitive peak forward current	I_{FRM}	max.	0,60	0,45	0,45	A
Non-repetitive peak forward current						
t = 1 μs	I_{FSM}	max.	4,0	–	–	A
t = 1 s	I_{FSM}	max.	0,5	–	–	A
Forward voltage						
I_F = 20 mA	V_F	<	–	–	0,88	V
I_F = 50 mA	V_F	<	–	1	–	V
I_F = 200 mA	V_F	<	1	–	–	V
Reverse recovery time when switched from						
I_F = 400 mA to I_R = 400 mA; R_L = 100 Ω; measured at I_R = 40 mA	t_{rr}	<	6	–	–	ns
I_F = 10 mA to I_R = 10 mA; R_L = 100 Ω; measured at I_R = 1 mA	t_{rr}	<	–	4	4	ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-80.



Cathode indicated by black band.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

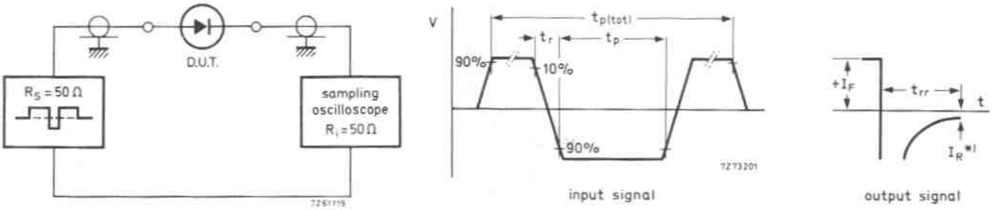
			PMLL4150	4151	4153	
Continuous reverse voltage	V_R	max.	50	50	50	V
Repetitive peak reverse voltage	V_{RRM}	max.	–	75	75	V
Forward current (d.c.)	I_F	max.	0,30	0,20	0,20	A
Repetitive peak forward current	I_{FRM}	max.	0,60	0,45	0,45	A
Non-repetitive peak forward current						
t = 1 μs	I_{FSM}	max.	4,0	–	–	A
t = 1 s	I_{FSM}	max.	0,5	–	–	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		500		mW
Derating factor				2,85		mW/K
Storage temperature	T_{stg}			–65 to + 200		°C
Junction temperature	T_j	max.		200		°C

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			PMLL4150	4151	4153	
Forward voltage						
I_F = 0,1 mA	V_F	>	–	–	0,49	V
		<	–	–	0,55	V
I_F = 0,25 mA	V_F	>	–	–	0,53	V
		<	–	–	0,59	V
I_F = 1 mA	V_F	>	0,54	–	0,59	V
		<	0,62	–	0,67	V
I_F = 2 mA	V_F	>	–	–	0,62	V
		<	–	–	0,70	V
I_F = 10 mA	V_F	>	0,66	–	0,70	V
		<	0,74	–	0,81	V
I_F = 20 mA	V_F	>	–	–	0,74	V
		<	–	–	0,88	V
I_F = 50 mA	V_F	>	0,76	–	–	V
		<	0,86	1	–	V
I_F = 100 mA	V_F	>	0,82	–	–	V
		<	0,92	–	–	V
I_F = 200 mA	V_F	>	0,87	–	–	V
		<	1,00	–	–	V
Reverse avalanche breakdown voltage						
I_R = 5 μA	$V_{(BR)R}$	>	–	75	75	V
Reverse current						
V_R = 50 V	I_R	<	0,1	0,05	0,05	μA
V_R = 50 V; T_{amb} = 150 °C	I_R	<	100	50	50	μA

			PMLL4150	4151	4153	
Diode capacitance						
$V_R = 0$; f = 1 MHz	C_d	<	2,5	2	2	pF
Reverse recovery time when switched from						
I_F = 10 to 200 mA to I_R = 10 to 200 mA; $R_L = 100\ \Omega$; measured at $I_R = 0,1 \times I_F$	t_{rr}	<	4	–	–	ns
I_F = 200 to 400 mA to I_R = 200 to 400 mA; $R_L = 100\ \Omega$; measured at $I_R = 0,1 \times I_F$	t_{rr}	<	6	–	–	ns
I_F = 10 mA to I_R = 1 mA; $R_L = 100\ \Omega$; measured at I_R = 0,1 mA	t_{rr}	<	6	–	–	ns
I_F = 10 mA to I_R = 10 mA; $R_L = 100\ \Omega$; measured at I_R = 1 mA	t_{rr}	<	–	4	4	ns
I_F = 10 mA to I_R = 60 mA; $R_L = 100\ \Omega$; measured at I_R = 1 mA	t_{rr}	<	–	2	2	ns



*) value at which t_{rr} is measured

Fig. 2 Test circuit and waveforms.

Input signal:	Total pulse duration	$t_{p(tot)}$	=	0,2 μs
	Duty factor	δ	=	0,0025
	Rise time of the reverse pulse	t_r	=	0,6 ns
	Reverse pulse duration	t_p	=	30 ns
Oscilloscope:	Rise time	t_r	=	0,35 ns

Circuit capacitance $C \leqslant 1$ pF (C = oscilloscope input capacitance + parasitic capacitance)

Forward recovery time when switched from
I = 0 to I_F = 200 mA; t_r = 0,4 ns; t_p = 100 ns; $\delta < 0{,}01$;
measured at V_f = 1 V $\quad t_{fr}$ < 10 ns

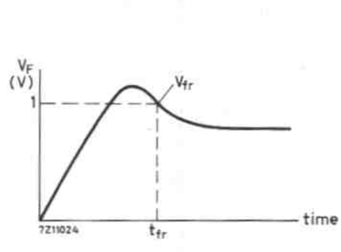


Fig. 3 PMLL4150.

VOLTAGE REGULATOR DIODES FOR SURFACE MOUNTING

Silicon planar diodes in a SOD-80 envelope intended for use as low-power voltage stabilizers or voltage references.

The series consists of 43 types with nominal working voltages in the range 3,0 V to 75 V with a tolerance of ± 5%. The SM diode is a leadless diode in a hermetically sealed glass SOD-80 envelope with tin plated metal discs at each end. It is suitable for "automatic placement" and as such can withstand immersion soldering.

The diodes are delivered on "super 8" tape.

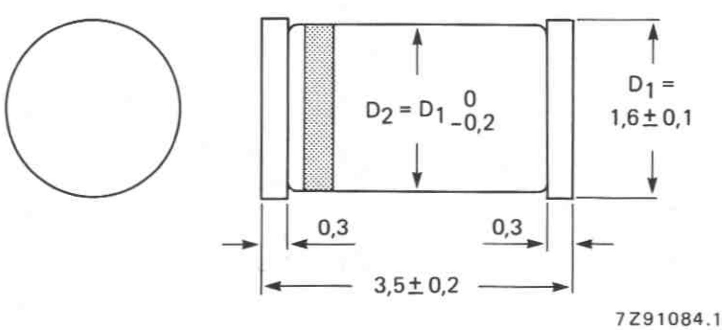
QUICK REFERENCE DATA

Working voltage range	V_Z	nom.	3,0 to 75	V
Working voltage tolerance			± 5	%
Total power dissipation	P_{tot}	max.	500	mW
Non-repetitive peak reverse power dissipation T_j = 55 °C; t_p = 8,3 ms, square wave	P_{ZSM}	max.	10	W
Junction temperature	T_j		−65 to + 200	°C

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-80.



Cathode indicated by yellow band.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Average forward current (averaged over any 20 ms period)	$I_{F(AV)}$	max.	250 mA
Repetitive peak forward current	I_{FRM}	max.	250 mA
Total power dissipation if flanges are kept at T_{flange} = 75 °C	P_{tot}	max.	500 mW
Derating factor			4 mW/K
Non-repetitive peak reverse power dissipation T_j = 55 °C; t_p = 8,3 ms, square wave	P_{ZSM}	max.	10 W
Storage temperature	T_{stg}		−65 to + 200 °C
Junction temperature	T_j		−65 to + 200 °C

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise stated

Forward voltage I_F = 200 mA	V_F	max.	1,1 V

type number	working voltage V_Z (V) at I_{ztest} (note 1) nom.	test current I_{Ztest} (mA)	max. Zener impedance Z_{ZT} (Ω) at I_{Ztest} (note 2)	differential resistance r_{diff} (Ω) at I_{ZK} = 0,25 mA (note 2) max.	reverse current I_R (μA) at V_R max.	test voltage V_R (V)	temp. coeff. S_Z (%/K) (note 3) max.
PMLL5225B	3,0	20	29	1600	50	1,0	−0,075
PMLL5226B	3,3	20	28	1600	25	1,0	−0,070
PMLL5227B	3,6	20	24	1700	15	1,0	−0,065
PMLL5228B	3,9	20	23	1900	10	1,0	−0,060
PMLL5229B	4,3	20	22	2000	5	1,0	± 0,055
PMLL5230B	4,7	20	19	1900	5	2,0	± 0,030
PMLL5231B	5,1	20	17	1600	5	2,0	± 0,030
PMLL5232B	5,6	20	11	1600	5	3,0	+ 0,038
PMLL5233B	6,0	20	7	1600	5	3,5	+ 0,038
PMLL5234B	6,2	20	7	1000	5	4,0	+ 0,045
PMLL5235B	6,8	20	5	750	3	5,0	+ 0,050
PMLL5236B	7,5	20	6	500	3	6,0	+ 0,058
PMLL5237B	8,2	20	8	500	3	6,5	+ 0,062
PMLL5238B	8,7	20	8	600	3	6,5	+ 0,065
PMLL5239B	9,1	20	10	600	3	7,0	+ 0,068

type number	working voltage V_Z (V) at I_{Ztest} (note 1) nom.	test current I_{Ztest} (mA)	max. Zener impedance Z_{ZT} (Ω) at I_{Ztest} (note 2)	differential resistance r_{diff} (Ω) at I_{ZK} = 0,25 mA (note 2) max.	reverse current I_R (μA) at V_R max.	test voltage V_R (V)	temp. coeff. S_Z (%/K) (note 3) max.
PMLL5240B	10	20	17	600	3	8,0	+ 0,075
PMLL5241B	11	20	22	600	2	8,4	+ 0,076
PMLL5242B	12	20	30	600	1	9,1	+ 0,077
PMLL5243B	13	9,5	13	600	0,5	9,9	+ 0,079
PMLL5244B	14	9,0	15	600	0,1	10	+ 0,082
PMLL5245B	15	8,5	16	600	0,1	11	+ 0,082
PMLL5246B	16	7,8	17	600	0,1	12	+ 0,083
PMLL5247B	17	7,4	19	600	0,1	13	+ 0,084
PMLL5248B	18	7,0	21	600	0,1	14	+ 0,085
PMLL5249B	19	6,6	23	600	0,1	14	+ 0,086
PMLL5250B	20	6,2	25	600	0,1	15	+ 0,086
PMLL5251B	22	5,6	29	600	0,1	17	+ 0,087
PMLL5252B	24	5,2	33	600	0,1	18	+ 0,088
PMLL5253B	25	5,0	35	600	0,1	19	+ 0,089
PMLL5254B	27	4,6	41	600	0,1	21	+ 0,090
PMLL5255B	28	4,5	44	600	0,1	21	+ 0,091
PMLL5256B	30	4,2	49	600	0,1	23	+ 0,091
PMLL5257B	33	3,8	58	700	0,1	25	+ 0,092
PMLL5258B	36	3,4	70	700	0,1	27	+ 0,093
PMLL5259B	39	3,2	80	800	0,1	30	+ 0,094
PMLL5260B	43	3,0	93	900	0,1	33	+ 0,095
PMLL5261B	47	2,7	105	1000	0,1	36	+ 0,095
PMLL5262B	51	2,5	125	1100	0,1	39	+ 0,096
PMLL5263B	56	2,2	150	1300	0,1	43	+ 0,096
PMLL5264B	60	2,1	170	1400	0,1	46	+ 0,097
PMLL5265B	62	2,0	185	1400	0,1	47	+ 0,097
PMLL5266B	68	1,8	230	1600	0,1	52	+ 0,097
PMLL5267B	75	1,7	270	1700	0,1	56	+ 0,098

Notes to the characteristics

1. V_Z is measured with device at thermal equilibrium while held in clips in still air at 25 °C.
2. $I_{(ac\,rms)}$ = 10% of I_{Ztest} resp. I_{ZK}, 60 Hz superimposed.
3. For types PMLL5225B to PMLL5242B the current I_Z = 7,5 mA; for PMLL5243B and higher $I_Z = I_{Ztest}$. Testpoints at T_1 = 25 °C, T_2 = 125 °C.

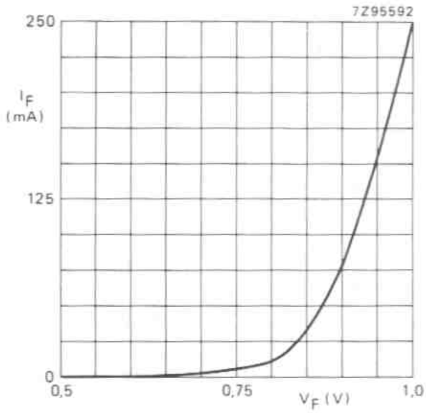


Fig. 2 T_{amb} = 25 °C; typical values.

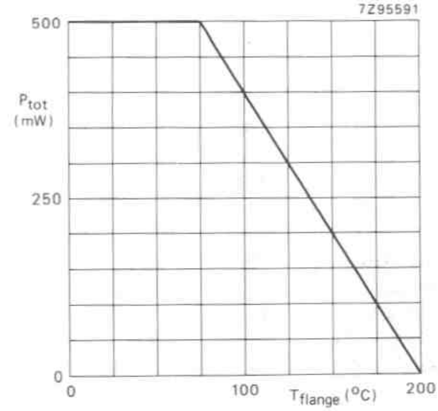


Fig. 3 Total power dissipation versus flange temperature.

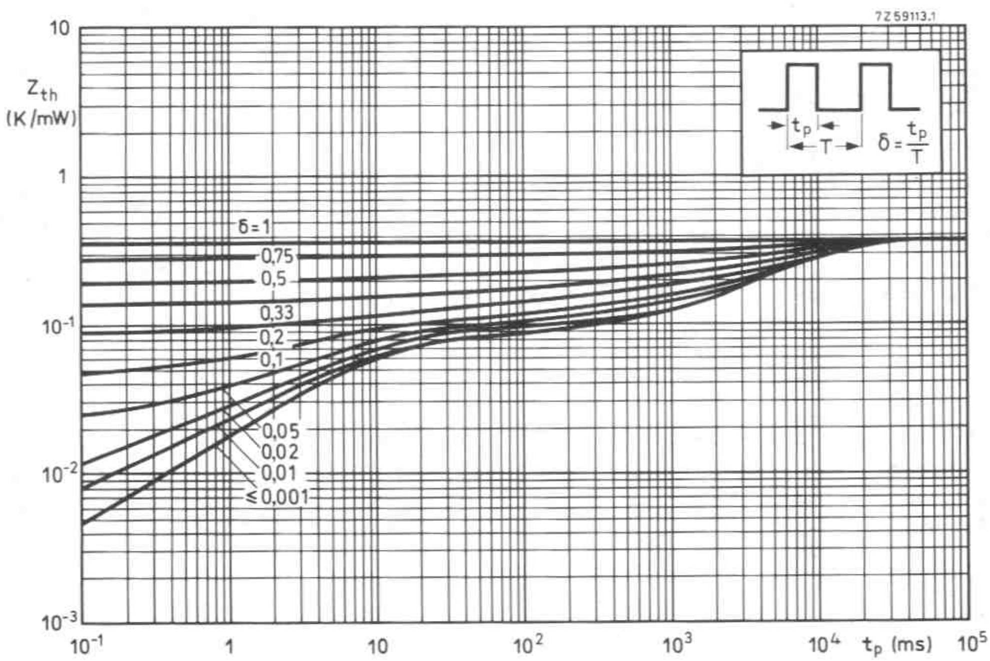


Fig. 4 Thermal impedance versus pulse duration.

SILICON DIFFUSED RECTIFIER DIODES

A range of silicon rectifier diodes for general use in leadless **SMID*** envelopes.

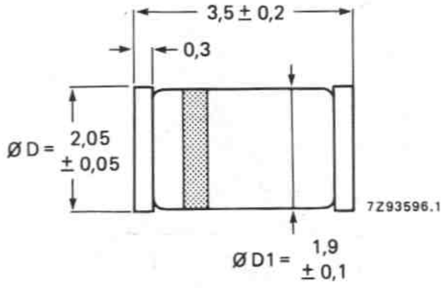
QUICK REFERENCE DATA

			PRLL4001	PRLL4002	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	V
Continuous reverse voltage	V_R	max.	50	100	V
Average forward current	$I_{F(AV)}$	max.	1.6		A
Repetitive peak forward current	I_{FRM}	max.	10		A
Non-repetitive peak forward current	I_{FSM}	max.	20		A

MECHANICAL DATA

Dimensions in mm

Fig.1 SOD87.



* Surface-mounted implosion diode.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			PRLL4001	PRLL4002	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	V
Continuous reverse voltage	V_R	max.	50	100	V
Average forward current (averaged over any 20 ms period) up to T_{tp} = 105 °C	$I_{F(AV)}$	max.	1.6		A
at T_{amb} = 65 °C mounted on a printed-circuit board	$I_{F(AV)}$	max.	0.68		A
Repetitive peak forward current	I_{FRM}	max.	10		A
Non-repetitive peak forward current (half-cycle sinewave, 60 Hz)	I_{FSM}	max.	20		A
Storage temperature range	T_{stg}		−65 to +175		°C
Junction temperature	T_j	max.	175		°C

THERMAL RESISTANCE

Influence of mounting method

1. Thermal resistance from junction to tie-point	$R_{th\ j\text{-}tp}$	=	30	K/W
2. Thermal resistance from junction to ambient; device mounted on an 1.5 mm thick epoxy-glass printed-circuit board; Cu-thickness ⩾ 40 μm (see Fig.2)	$R_{th\ j\text{-}a}$	=	150	K/W

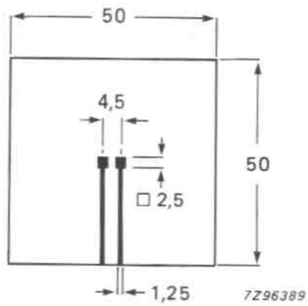


Fig.2 Mounted on a printed-circuit board.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise stated

Forward voltage				
I_F = 1 A	V_F	max.	1.1	V
Full-cycle average forward voltage				
$I_{F(AV)}$ = 1 A	$V_{F(AV)}$	max.	0.8	V
Reverse current				
$V_R = V_{Rmax}$	I_R	max.	10	μA
$V_R = V_{Rmax}$; T_{amb} = 100 °C	I_R	max.	50	μA
Full-cycle average reverse current				
$V_R = V_{RRMmax}$; T_{amb} = 75 °C	$I_{R(AV)}$	max.	30	μA

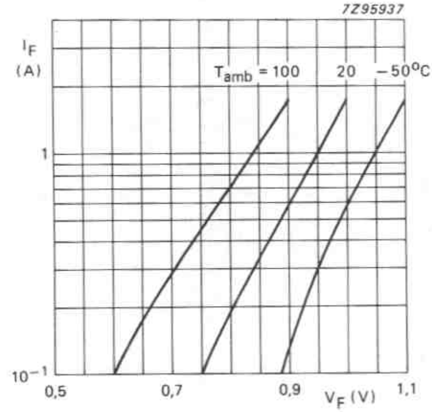


Fig.3 Typical forward current as a function of forward voltage.

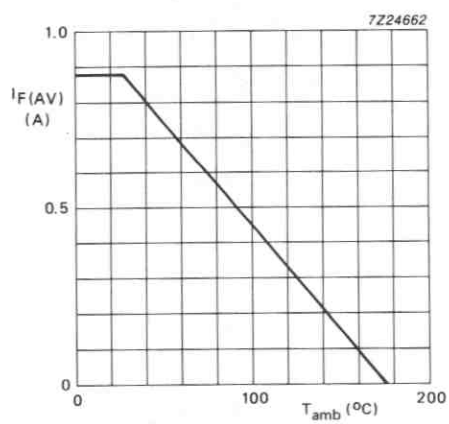


Fig.4 Maximum forward current as a function of temperature.

SCHOTTKY BARRIER DIODES

Schottky barrier diodes in hermetically sealed leadless SOD87 SMID* envelope. They are intended for use in low output voltage, low power switched-mode power supplies and high-frequency circuits where low conduction and switching losses are important.

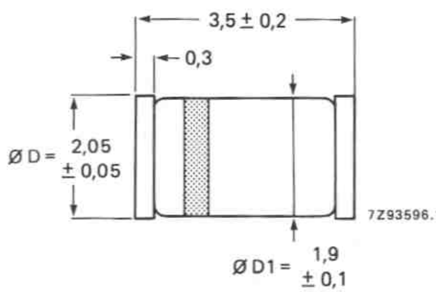
QUICK REFERENCE DATA

			PRLL5817	18	19	
Repetitive peak reverse voltage	V_{RRM}	max.	20	30	40	V
Crest working reverse voltage	V_{RWM}	max.	20	30	40	V
Continuous reverse voltage	V_R	max.	20	30	40	V
Non-repetitive peak reverse voltage	V_{RSM}	max.	24	36	48	V
Average forward current	$I_{F(AV)}$	max.		1		A
Non-repetitive peak forward current	I_{FSM}	max.		25		A
Junction temperature	T_j	max.		125		°C

MECHANICAL DATA

Dimensions in mm

Fig.1 SOD87.



* Surface Mounted Implosion Diode.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			PRLL5817	18	19	
Repetitive peak reverse voltage	V_{RRM}	max.	20	30	40	V
Crest working reverse voltage	V_{RWM}	max.	20	30	40	V
Continuous reverse voltage	V_R	max.	20	30	40	V
Non-repetitive peak reverse voltage	V_{RSM}	max.	24	36	48	V
Average forward current (a = 1); T_{amb} = 60 °C; see Fig.2	$I_{F(AV)}$	max.		1		A
Non-repetitive peak forward current t = 10 ms; half sine wave; $T_j = T_{j\,max}$ prior to surge; $V_R = 0$	I_{FSM}	max.		25		A
Storage temperature range	T_{stg}			−65 to + 175		°C
Junction temperature	T_j	max.		125		°C

THERMAL RESISTANCE

Influence of mounting method

1. Thermal resistance from junction to tie-point	$R_{th\,j\text{-}tp}$	=	30	K/W
2. Thermal resistance from junction to ambient; device mounted on a 1.5 mm thick epoxy-glass printed-circuit board; Cu thickness ⩾ 40 μm; see Fig.2	$R_{th\,j\text{-}a}$	=	150	K/W

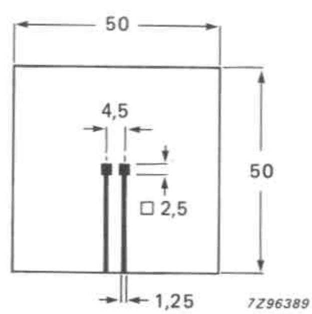


Fig.2 Mounted on a printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			PRLL5817	18	19	
Forward voltage						
I_F = 0.1 A	V_F	max.	320	330	340	mV
I_F = 1 A	V_F	max.	450	550	600	mV
I_F = 3 A	V_F	max.	750	875	900	mV
Reverse current						
$V_R = V_{RRM\,max}$	I_R	max.	1.0	0.5	0.5	mA
$V_R = V_{RRM\,max}$; T_j = 100 °C	I_R	max.	10	5	5	mA
Diode capacitance						
V_R = 4 V; f = 1 MHz	C_d	typ.	70	50	50	pF

OPERATING NOTE

Calculation of $I_{F(AV)}$-rating

For Schottky barrier diodes thermal runaway has to be considered, as in some applications the reverse power losses are a significant part of the total power losses. For that reason the starting point for the calculation of the $I_{F(AV)}$-rating should be the maximum permissible junction temperature $T_{j\,max}$.

Method of calculation

1. Input:
   type
   V_{RWM} and its duty cycle δ
   T_{amb}
   $a = I_{F(RMS)}/I_{F(AV)}$
2. Determine the maximum permissible junction temperature $T_{j\,max}$ (125 °C or the temperature at which thermal runaway occurs, whichever is lowest) from Figs 7, 9 or 11.
3. Determine the reverse power losses P_R from Figs 8, 10 or 12 and multiply P_R by 150 K/W, giving a certain number of degrees centigrade (this being the increase of junction temperature caused by reverse power dissipation).
4. Calculate T_R by subtracting the calculated number of degrees centigrade (15 °C or less) from the maximum permissible junction temperature.
5. Substract T_{amb} from T_R (giving the admissible increase of junction temperature caused by forward dissipation) and calculate the admissible forward power dissipation by means of the formula;
   $P_F = (T_R - T_{amb})/R_{th\,j\text{-}a}$.
6. Determine the $I_{F(AV)}$-rating from Figs 4, 5 or 6.

   Example: PRLL5818; V_{RWM} = 22 V; δ = 0.5; T_{amb} = 60 °C; a = 1.42.

   Find $T_{j\,max}$ from Fig.9: 112 °C.

   Find P_R from Fig.10: 0.1 W.
   $P_R \times R_{th\,j\text{-}a}$ = 0.1 x 150 = 15 °C.

   Calculate T_R: 112 − 15 = 97 °C.
   Calculate P_F : (97 − 60)/150 = 0.25 W.
   Find $I_{F(AV)max}$ from Fig.5, for a = 1.42: $I_{F(AV)max}$ = 0.5 A.

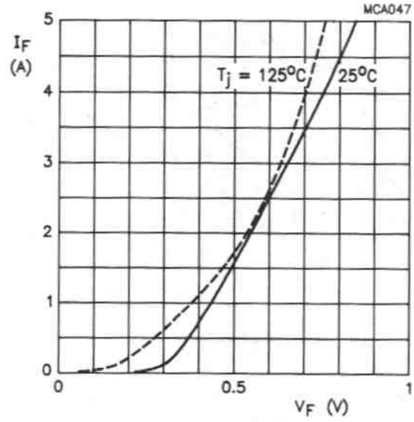


Fig.3 **PRLL5817; 18; 19.** Typical forward voltage.

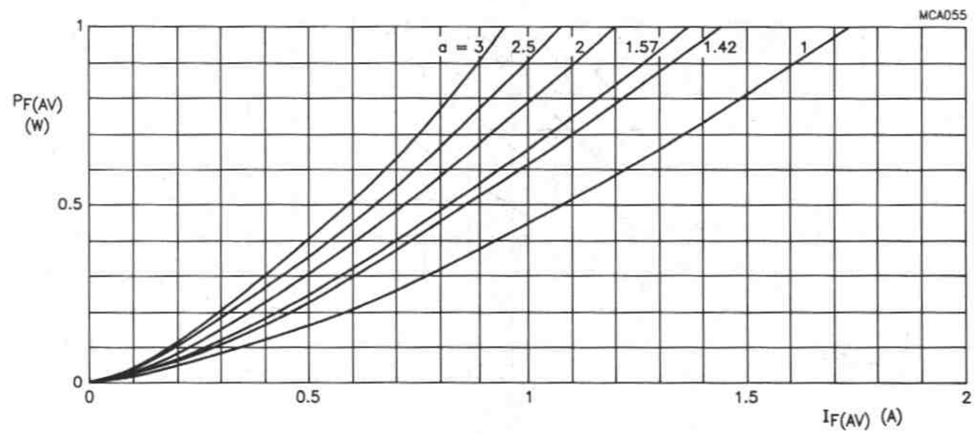


Fig.4 **PRLL5817.** Maximum values steady state forward power dissipation as a function of the average forward current; a = $I_{F(RMS)}/I_{F(AV)}$.

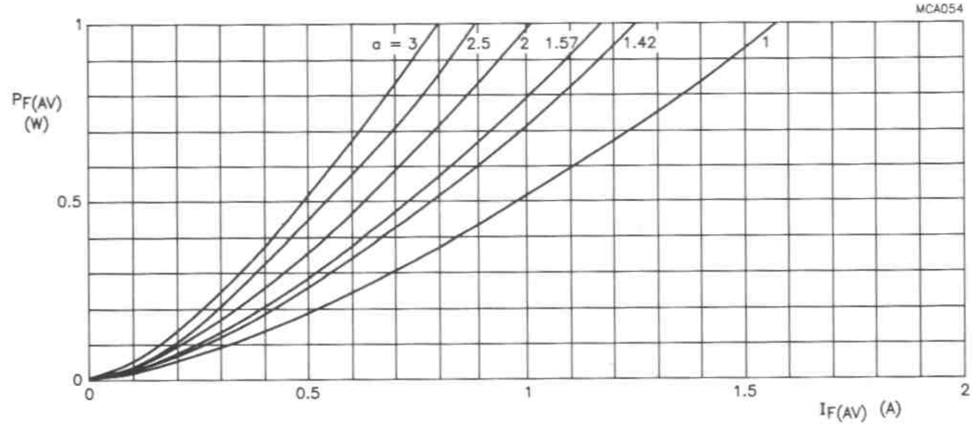


Fig.5 **PRLL5818**. Maximum values steady state forward power dissipation as a function of the average forward current; $a = I_{F(RMS)}/I_{F(AV)}$.

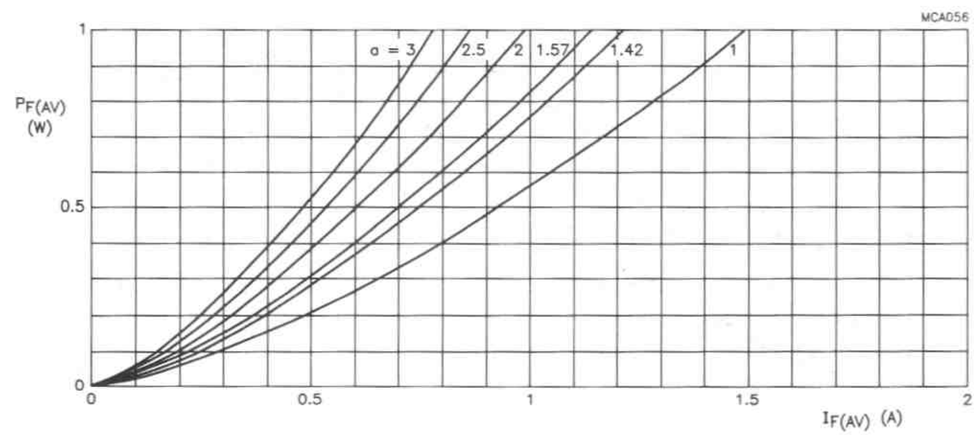


Fig.6 **PRLL5819.** Maximum values steady state forward power dissipation as a function of the average forward current; $a = I_{F(RMS)}/I_{F(AV)}$.

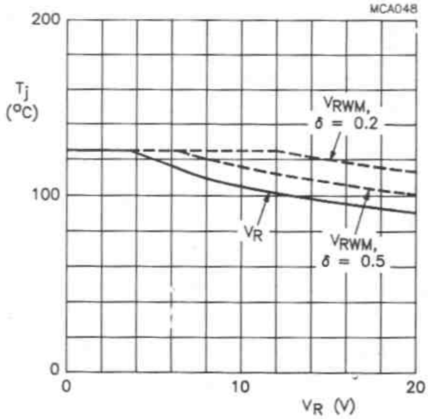


Fig.7 **PRLL5817**. Maximum permissible junction temperature as a function of reverse voltage; device mounted as shown in Fig.2.

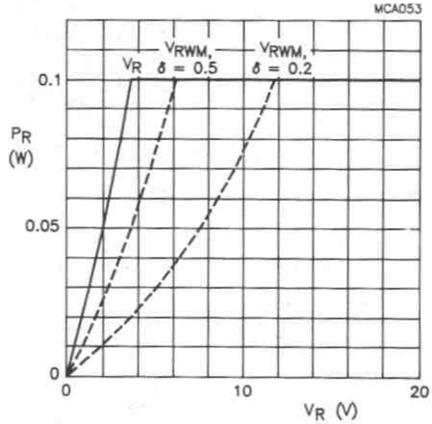


Fig.8 **PRLL5817**. Reverse power dissipation as a function of reverse voltage (max. values); device mounted as shown in Fig.2.

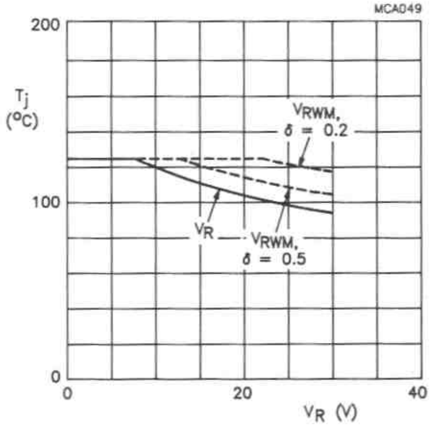


Fig.9 **PRLL5818**. Maximum permissible junction temperature as a function of reverse voltage; device mounted as shown in Fig.2.

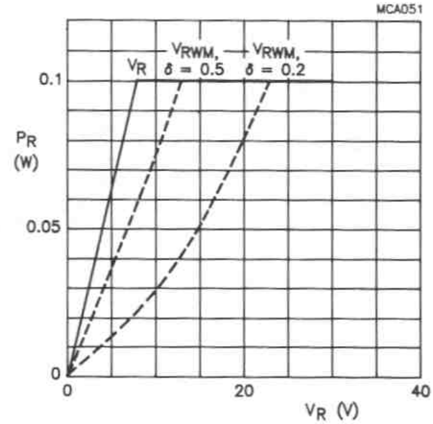


Fig.10 **PRLL5818**. Reverse power dissipation as a function of reverse voltage (max. values); device mounted as shown in Fig.2.

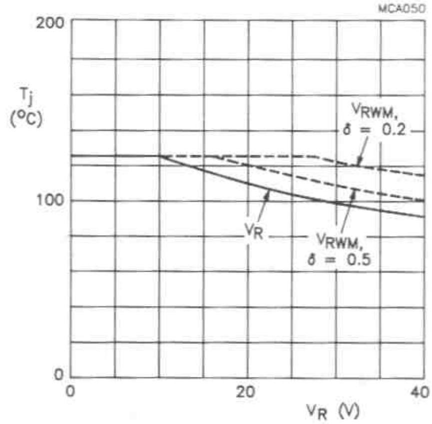


Fig.11 **PRLL5819**. Maximum permissible junction temperature as a function of reverse voltage; device mounted as shown in Fig.2.

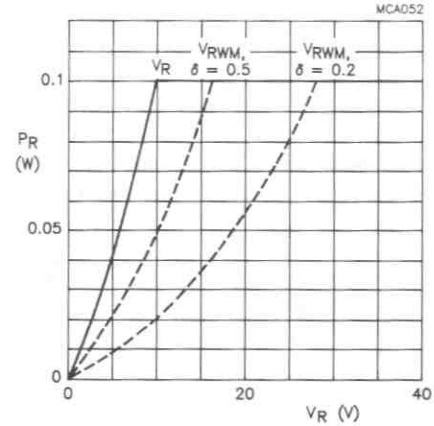


Fig.12 **PRLL5819**. Reverse power dissipation as a function of reverse voltage (max. values); device mounted as shown in Fig.2.

SILICON PLANAR EPITAXIAL TRANSISTOR

NPN silicon planar epitaxial transistor, housed in a SOT89 envelope.

It is intended for switching and linear applications.

The complementary type is PXT2907/A.

QUICK REFERENCE DATA

			PXT2222	PXT2222A	
Collector-emitter voltage (open base)	V_{CEO}	max.	30	40	V
Collector-base voltage (open emitter)	V_{CBO}	max.	60	75	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5.0	6.0	V
Collector current (DC)	I_C	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	1.0		W
DC current gain I_C = 150 mA; V_{CE} = 10 V	h_{FE}		100 to 300	100 to 300	
Transition frequency at f = 100 MHz I_C = 20 mA; V_{CE} = 20 V	f_T	min.	250	300	MHz
Saturation voltage I_C = 150 mA; I_B = 15 mA	$V_{CE\,sat}$	max.	400	300	mV

MECHANICAL DATA

Dimensions in mm

Fig.1 SOT89.

Marking codes:

PXT2222 : p1B

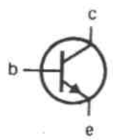
PXT2222A: p1P

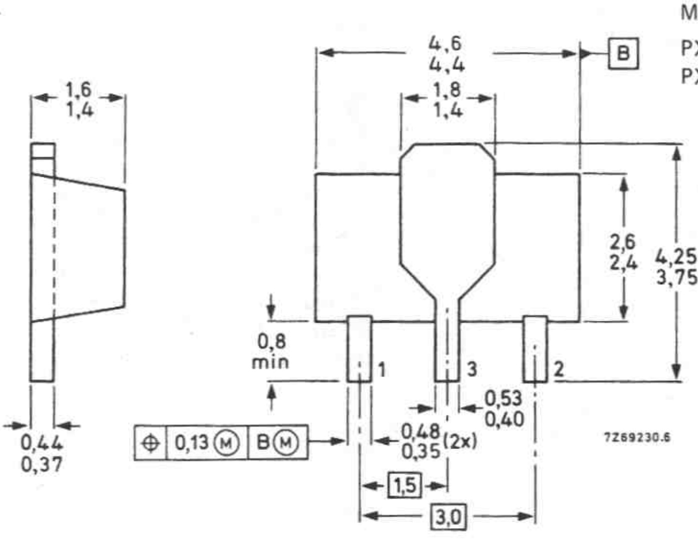
Pinning

1 = emitter

2 = base

3 = collector





BOTTOM VIEW

* Mounted on a ceramic substrate: area = 2.5 cm²; thickness = 0.7 mm.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			PXT2222	PXT2222A	
Collector-emitter voltage	V_{CEO}	max.	30	40	V
Collector-base voltage	V_{CBO}	max.	60	75	V
Emitter-base voltage	V_{EBO}	max.	5.0	6.0	V
Collector current (DC)	I_C	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	1.0		W
Storage temperature range	T_{stg}		−65 to + 150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	125	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			PXT2222	PXT2222A	
Collector cut-off current					
V_{CB} = 50 V; I_E = 0	I_{CBO}	max.	10	–	nA
V_{CB} = 50 V; I_E = 0; T_{amb} = 125 °C	I_{CBO}	max.	10	–	μA
V_{CB} = 60 V; I_E = 0	I_{CBO}	max.	–	10	nA
V_{CB} = 60 V; I_E = 0; T_{amb} = 125 °C	I_{CBO}	max.	–	10	μA
V_{CE} = 60 V; V_{EB} = 3 V	I_{CEX}	min.	–	10	nA
Base current with reverse biased emitter junction					
V_{CE} = 60 V; V_{BE} = 3 V	I_{BEX}	max.	–	20	nA
Emitter cut-off current					
V_{BE} = 3 V; I_C = 0	I_{EBO}	max.	–	10	nA
Saturation voltage					
I_C = 150 mA; I_B = 15 mA	$V_{CE\ sat}$	max.	0.4	0.3	V
	$V_{BE\ sat}$	max.	1.3	0.6 to 1.2	V
I_C = 500 mA; I_B = 50 mA	$V_{CE\ sat}$	max.	1.6	1.0	V
	$V_{BE\ sat}$	max.	2.6	2.0	V
Breakdown voltages					
I_C = 10 mA; I_B = 0	$V_{(BR)CEO}$	min.	30	40	V
I_C = 10 μA; I_E = 0	$V_{(BR)CBO}$	min.	60	75	V
I_E = 10 μA; I_C = 0	$V_{(BR)EBO}$	min.	5.0	6.0	V

* Mounted on a ceramic substrate; area = 2.5 cm^2; thickness = 0.7 mm.

			PXT2222	PXT2222A
DC current gain				
I_C = 0.1 mA; V_{CE} = 10 V	h_{FE}	min.	35	35
I_C = 1.0 mA; V_{CE} = 10 V	h_{FE}	min.	50	50
I_C = 10 mA; V_{CE} = 10 V	h_{FE}	min.	75	75
I_C = 10 mA; V_C = 10 V; T_{amb} = −55 °C	h_{FE}	min.	–	35
I_C = 150 mA; V_{CE} = 10 V	h_{FE}	min. max.	100 300	100 300
I_C = 150 mA; V_{CE} = 1 V	h_{FE}	min.	50	50
I_C = 500 mA; V_{CE} = 10 V	h_{FE}	min.	30	40
Transition frequency at f = 100 MHz				
I_C = 20 mA; V_{CE} = 10 V	f_T	min.	250	300 MHz
Output capacitance at f = 1 MHz				
V_{CB} = 10 V; I_E = 0	C_o	max.	8.0	8.0 pF
Input capacitance at f = 1 MHz				
V_{EB} = 0.5 V; I_C = 0	C_i	max.	30	25 pF
Collector-base time constant				
I_E = 20 mA; V_{CB} = 20 V	$rb'C_c$	max.	–	150 ps
Noise figure at R_s = 1 KΩ				
I_C = 100 μA; V_{CE} = 10 V; f = 1 kHz	F	max.	–	4.0 dB
h-parameters (common emitter) at f = 1 kHz				
I_C = 1 mA; V_{CE} = 10 V				
input impedance	h_{ie}		–	4.0 to 8.0 kΩ
voltage feedback ratio	h_{re}		–	8.0×10^{-4}
small-signal current gain	h_{fe}		–	50 to 300
output admittance	h_{oe}		–	5.0 to 35 μS
I_C = 10 mA; V_{CE} = 10 V				
input impedance	h_{ie}		–	0.25 to 1.25 kΩ
voltage feedback ratio	h_{re}		–	4.0×10^{-4}
small-signal current gain	h_{fe}		–	75 to 375
output admittance	h_{oe}		–	25 to 200 μS

Switching times

Turn-on time (V_{cc} = 30 V; $V_{EB\,off}$ = 0.5 V; I_C = 150 mA; I_{B1} = 15 mA)				
Delay time	t_d	max.	10	ns
Rise time	t_r	max.	25	ns
Turn-off time (V_{cc} = 30 V; I_C = 150 mA; I_{B1} = I_{B2} = 15 mA)				
Storage time	t_s	max.	225	ns
Fall time	t_f	max.	60	ns

SILICON PLANAR EPITAXIAL TRANSISTOR

PNP silicon planar epitaxial transistor, housed in a SOT89 envelope.

It is intended for switching and linear applications.

The complementary type is PXT2222/A.

QUICK REFERENCE DATA

			PXT2907	PXT2907A	
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40	60	V
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60		V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5.0		V
Collector current (DC)	$-I_C$	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	1.0		W
DC current gain $-I_C$ = 150 mA; $-V_{CE}$ = 10 V	h_{FE}		100 to 300	100 to 300	
Transition frequency at f = 100 MHz $-I_C$ = 20 mA; $-V_{CE}$ = 20 V	f_T	min.	200		MHz
Saturation voltage $-I_C$ = 150 mA; $-I_B$ = 15 mA	$-V_{CE\,sat}$	max.	0.4		V

MECHANICAL DATA

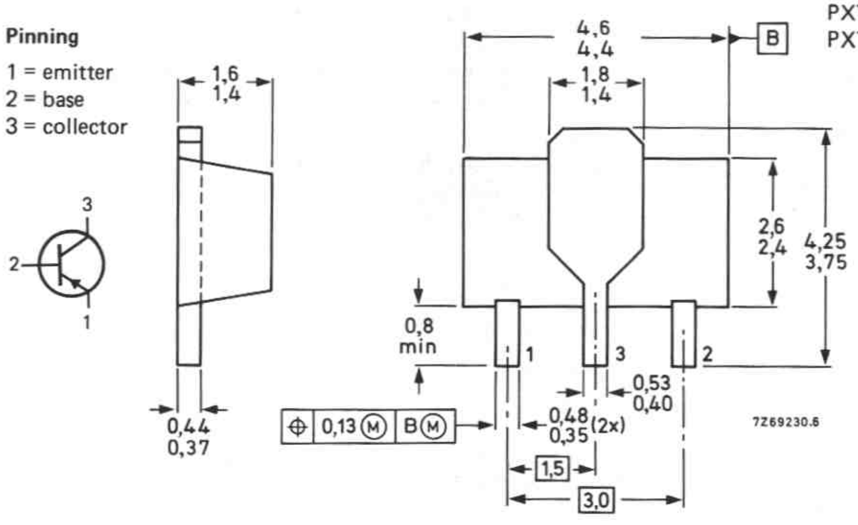
Dimensions in mm

Fig.1 SOT89.

Marking code:
PXT2907 : p2B
PXT2907A: p2F

Pinning

1 = emitter
2 = base
3 = collector



BOTTOM VIEW

* Mounted on a ceramic substrate; area = 2.5 cm^2; thickness = 0.7 mm.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			PXT2907	PXT2907A	
Collector-emitter voltage	$-V_{CEO}$	max.	40	60	V
Collector-base voltage	$-V_{CBO}$	max.	60		V
Emitter-base voltage	$-V_{EBO}$	max.	5.0		V
Collector current (DC)	$-I_C$	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	1.0		W
Storage temperature range	T_{stg}		−65 to + 150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	125	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			PXT2907	PXT2907A	
Collector-cut-off current					
$-V_{CB}$ = 50 V; I_E = 0	$-I_{CBO}$	max.	20	10	nA
$-V_{CB}$ = 50 V; I_E = 0; T_{amb} = 125 °C	$-I_{CBO}$	max.	20	10	μA
$-V_{CE}$ = 30 V; $-V_{EB}$ = 0.5 V	$-I_{CEX}$	max.	50		nA
Base current with reverse biased emitter junction					
$-V_{CE}$ = 60 V; $-V_{BE}$ = 0.5 V	$-I_{BEX}$	max.	50		nA
Saturation voltage					
$-I_C$ = 150 mA; $-I_B$ = 15 mA	$-V_{CE\,sat}$	max.	0.4		V
	$-V_{BE\,sat}$	max.	1.3		V
$-I_C$ = 500 mA; $-I_B$ = 50 mA	$-V_{CE\,sat}$	max.	1.6		V
	$-V_{BE\,sat}$	max.	2.6		V
Breakdown voltages					
$-I_C$ = 10 mA; I_B = 0	$-V_{(BR)CEO}$	min.	40	60	V
$-I_C$ = 10 μA; I_E = 0	$-V_{(BR)CBO}$	min.	60		V
$-I_E$ = 10 μA; I_C = 0	$-V_{(BR)EBO}$	min.	5.0		V

* Mounted on a ceramic substrate; area = 2.5 cm^2; thickness = 0.7 mm.

			PXT2907	PXT2907A	
DC current gain					
$-I_C = 0.1$ mA; $-V_{CE} = 1$ V	h_{FE}	min.	35	75	
$-I_C = 1.0$ mA; $-V_{CE} = 1$ V	h_{FE}	min.	50	100	
$-I_C = 10$ mA; $-V_{CE} = 1$ V	h_{FE}	min.	75	100	
$-I_C = 150$ mA; $-V_{CE} = 2$ V	h_{FE}		100 to 300	100 to 300	
$-I_C = 500$ mA; $-V_{CE} = 2$ V	h_{FE}	min.	30	50	
Transition frequency at f = 100 MHz					
$-I_C = 20$ mA; $-V_{CE} = 10$ V	f_T	min.	200		MHz
Output capacitance at f = 1 MHz					
$-V_{CB} = 10$ V; $I_E = 0$	C_o	max.	8.0		pF
Input capacitance at f = 1 MHz					
$-V_{EB} = 0.5$ V; $I_C = 0$	C_i	max.	35		pF
h-parameters (common emitter) at f = 1 kHz					
$-I_C = 1$ mA; $-V_{CE} = 10$ V					
input impedance	h_{ie}		1.5	to 15	kΩ
voltage feedback ratio	h_{re}		0.1	to 8.0×10^{-4}	
small-signal current gain	h_{fe}		60	to 500	
output admittance	h_{oe}		1.0	to 100	µmhos
Switching times					
Turn-on time					
($-V_{cc} = 30$ V; $-I_C = 150$ mA					
$-I_{B1} = 15$ mA)	t_{on}	max.	45		ns
Delay time	t_d	max.	10		ns
Rise time	t_r	max.	40		ns
Turn-off time					
($-V_{cc} = 6.0$ V; $-I_C = 150$ mA;					
$-I_{B1} = I_{B2} = 15$ mA)	t_{off}	max.	100		ns
Storage time	t_s	max.	80		ns
Fall time	t_f	max.	30		ns

SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a SOT-89 envelope primarily intended for high-speed, saturated switching applications for industrial service.

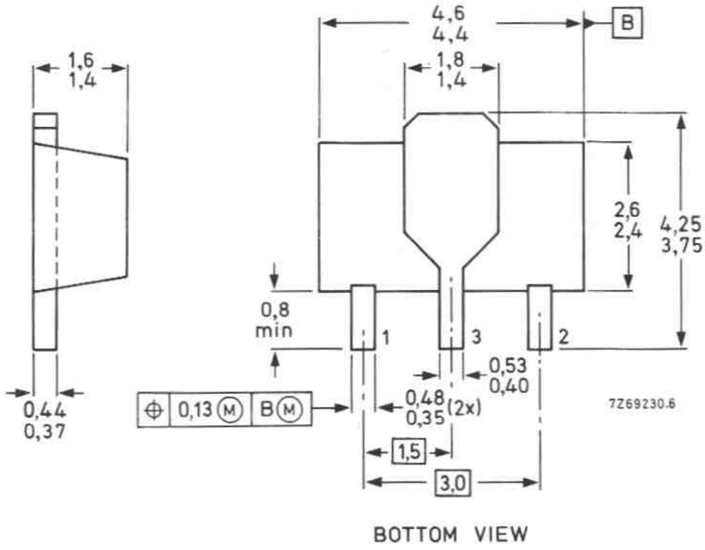
QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	60 V
Collector-emitter voltage (open base)	V_{CEO}	max.	40 V
Collector current (d.c.)	I_C	max.	200 mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	1,0 W
Junction temperature	T_j	max.	150 °C
D.C. current gain I_C = 10 mA; V_{CE} = 1 V	h_{FE}	> <	100 300
Transistion frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 20 V	f_T	>	300 MHz
Storage time I_{Con} = 10 mA; I_{Bon} = $-I_{Boff}$ = 1 mA	t_s	<	200 ns

MECHANICAL DATA

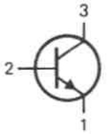
Dimensions in mm

Fig. 1 SOT-89.



Marking code

p1A



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	60	V
Collector-emitter voltage (open base)	V_{CEO}	max.	40	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6	V
Collector current (d.c.)	I_C	max.	200	mA
Total power dissipation at T_{amb} = 25 °C*	P_{tot}	max.	1,0	W
Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	125	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Currents at reverse biased emitter junction				
V_{CE} = 30 V; $-V_{BE}$ = 3 V	I_{CEX}	<	50	nA
	$-I_{BEX}$	<	50	nA
Saturation voltages				
I_C = 10 mA; I_B = 1 mA	V_{CEsat}	<	200	mV
	V_{BEsat}		650 to 850	mV
I_C = 50 mA; I_B = 5 mA	V_{CEsat}	<	300	mV
	V_{BEsat}	<	950	mV
D.C. current gain				
I_C = 0,1 mA; V_{CE} = 1 V	h_{FE}	>	40	
I_C = 1 mA; V_{CE} = 1 V	h_{FE}	>	70	
I_C = 10 mA; V_{CE} = 1 V	h_{FE}	>	100	
		<	300	
I_C = 50 mA; V_{CE} = 1 V	h_{FE}	>	60	
I_C = 100 mA; V_{CE} = 1 V	h_{FE}	>	30	
Collector capacitance at 100 kHz ≤ f ≤ 1 MHz				
$I_E = I_e$ = 0; V_{CB} = 5 V	C_c	<	4,0	pF
Emitter capacitance at 100 kHz ≤ f ≤ 1 MHz				
$I_C = I_c$ = 0; V_{EB} = 0,5 V	C_e	<	8,0	pF
Transition frequency at f = 100 MHz				
I_C = 10 mA; V_{CE} = 20 V; T_{amb} = 25 °C	f_T	>	300	MHz
Noise figure at R_S = 1 kΩ				
I_C = 100 μA; V_{CE} = 5 V				
f = 10 Hz to 15,7 kHz; T_{amb} = 25 °C	F	<	5,0	dB

* Mounted on a ceramic substrate area = 2,5 cm^2; thickness = 0,7 mm.

h-parameters (common emitter)

I_C = 1 mA; V_{CE} = 10 V; f = 1 kHz; T_{amb} = 25 °C

Input impedance	h_{ie}	1 to 10 kΩ
Reverse voltage transfer ratio	h_{re}	0,5 to 8×10^{-4}
Small-signal current gain	h_{fe}	100 to 400
Output admittance	h_{oe}	1 to 40 μS

Switching times

Turn-on time (see Figs 2 and 3) when switched from

$-V_{BEoff}$ = 0,5 V to I_{Con} = 10 mA; I_{Bon} = 1 mA

Delay time	t_d	<	35 ns
Rise time	t_r	<	35 ns

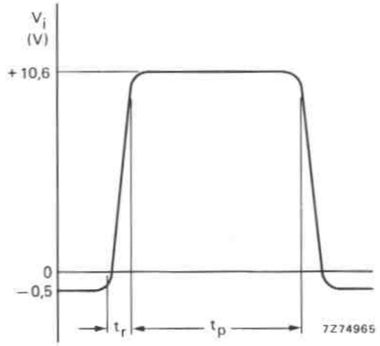


Fig. 2 Input waveform; $t_r < 1$ ns; t_p = 300 ns; δ = 0,02.

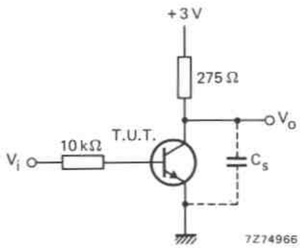


Fig. 3 Delay and rise time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

Turn-off time (see Figs 4 and 5)

I_{Con} = 10 mA; $I_{Bon} = -I_{Boff}$ = 1 mA

Storage time	t_s	<	200 ns
Fall time	t_f	<	50 ns

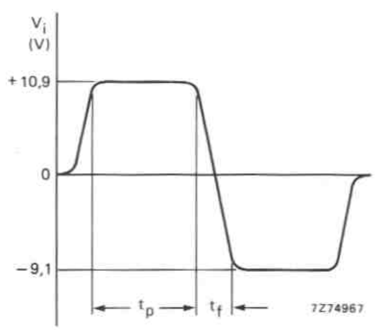


Fig. 4 Input waveform; $t_f < 1$ ns; 10 μs < t_p < 500 μs; δ = 0,02.

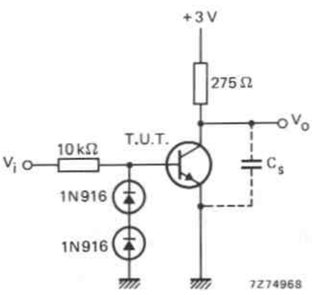


Fig. 5 Storage and fall time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

SILICON PLANAR EPITAXIAL TRANSISTOR

P-N-P transistor in a SOT-89 envelope primarily intended for high-speed, saturated switching applications for industrial service.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40	V
Collector current (d.c.)	$-I_C$	max.	200	mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	1,0	W
Junction temperature	T_j	max.	150	°C
D.C. current gain $-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}	> <	100 300	
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 20 V	f_T	>	250	MHz
Storage time $-I_{Con}$ = 10 mA; $-I_{Bon}$ = I_{Boff} = 1 mA	t_s	<	225	ns

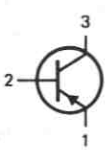
MECHANICAL DATA

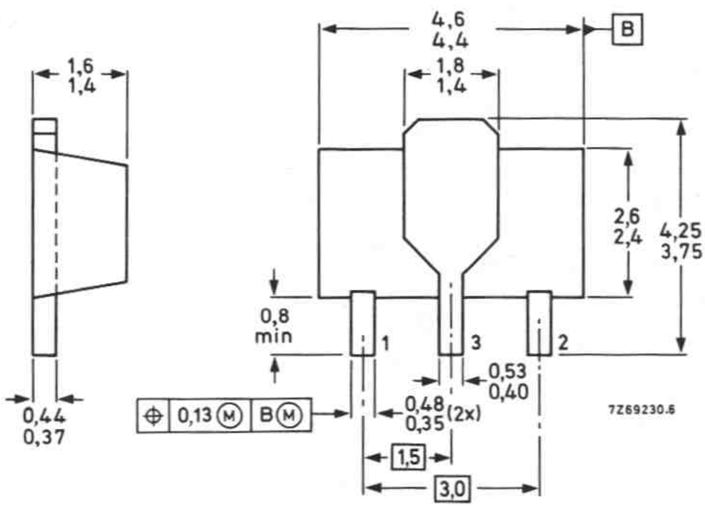
Dimensions in mm

Fig. 1 SOT-89.

Marking code

p2A





BOTTOM VIEW

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	V
Collector current (d.c.)	$-I_C$	max.	200	mA
Total power dissipation at T_{amb} = 25 °C*	P_{tot}	max.	1,0	W
Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air*	$R_{th\ j\text{-}a}$	=	125	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Currents at reverse biased emitter junction				
$-V_{CE}$ = 30 V; + V_{BE} = 3 V	$-I_{CEX}$	<	50	nA
	$+I_{BEX}$	<	50	nA
Saturation voltages				
$-I_C$ = 10 mA; $-I_B$ = 1 mA	$-V_{CEsat}$	<	250	mV
	$-V_{BEsat}$		650 to 850	mV
$-I_C$ = 50 mA; $-I_B$ = 5 mA	$-V_{CEsat}$	<	400	mV
	$-V_{BEsat}$	<	950	mV
D.C. current gain				
$-I_C$ = 0,1 mA; $-V_{CE}$ = 1 V	h_{FE}	>	60	
$-I_C$ = 1 mA; $-V_{CE}$ = 1 V	h_{FE}	>	80	
$-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}	>	100	
		<	300	
$-I_C$ = 50 mA; $-V_{CE}$ = 1 V	h_{FE}	>	60	
$-I_C$ = 100 mA; $-V_{CE}$ = 1 V	h_{FE}	>	30	
Collector capacitance at 100 kHz ⩽ f ⩽ 1 MHz				
$I_E = I_e = 0$; $-V_{CB}$ = 5 V	C_c	<	4,5	pF
Emitter capacitance at 100 kHz ⩽ f ⩽ 1 MHz				
$I_C = I_c = 0$; $-V_{EB}$ = 0,5 V	C_e	<	10	pF
Transition frequency at f = 100 MHz				
$-I_C$ = 10 mA; $-V_{CE}$ = 20 V; T_{amb} = 25 °C	f_T	>	250	MHz
Noise figure at R_S = 1 kΩ				
$-I_C$ = 100 μA; $-V_{CE}$ = 5 V				
f = 10 Hz to 15,7 kHz; T_{amb} = 25 °C	F	<	4,0	dB

* Mounted on a ceramic substrate area = 2,5 cm²; thickness = 0,7 mm.

h-parameters (common emitter)

$-I_C = 1$ mA; $-V_{CE} = 10$ V; f = 1 kHz; $T_{amb} = 25$ °C

Input impedance	h_{ie}	2 to 12 kΩ
Reverse voltage transfer ratio	h_{re}	0,1 to 10×10^{-4}
Small-signal current gain	h_{fe}	100 to 400
Output admittance	h_{oe}	3 to 60 μS

Switching times

Turn-on time (see Figs 2 and 3) when switched from $+V_{BEoff} = 0{,}5$ V to $-I_{Con} = 10$ mA; $-I_{Bon} = 1$ mA

Delay time	t_d	<	35 ns
Rise time	t_r	<	35 ns

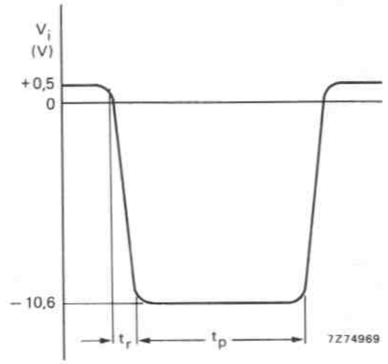


Fig. 2 Input waveform; $t_r < 1$ ns; $t_p = 300$ ns; $\delta = 0{,}02$.

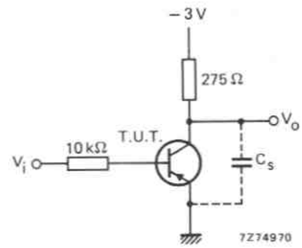


Fig. 3 Delay and rise time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

Turn-off time (see Figs 4 and 5) $-I_{Con} = 10$ mA; $-I_{Bon} = I_{Boff} = 1$ mA

Storage time	t_s	<	225 ns
Fall time	t_f	<	75 ns

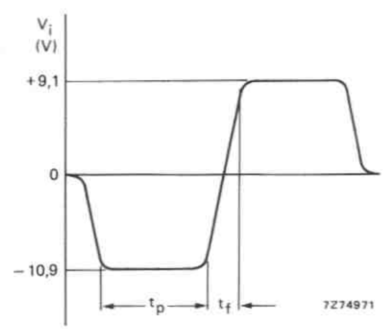


Fig. 4 Input waveform; $t_f < 1$ ns; 10 μs $< t_p <$ 500 μs; $\delta = 0{,}02$.

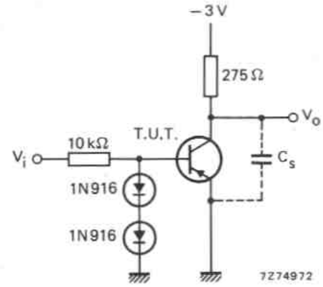


Fig. 5 Storage and fall time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

SILICON PLANAR EPITAXIAL TRANSISTOR

NPN silicon planar epitaxial transistor, housed in a SOT-89 envelope.

It is intended for use in linear, switching, and general purpose applications.

QUICK REFERENCE DATA

Collector-emitter voltage	V_{CEO}	max.	40 V
Collector current (DC)	I_C	max.	600 mA
DC current gain I_C = 150 mA; V_{CE} = 1 V	h_{FE}	min. max.	100 300
Collector-emitter saturation voltage I_C = 500 mA; I_B = 50 mA	$V_{CE\,sat}$	max.	0.75 V
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	1000 mW

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-89

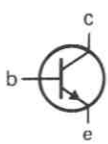
Marking code = p2X

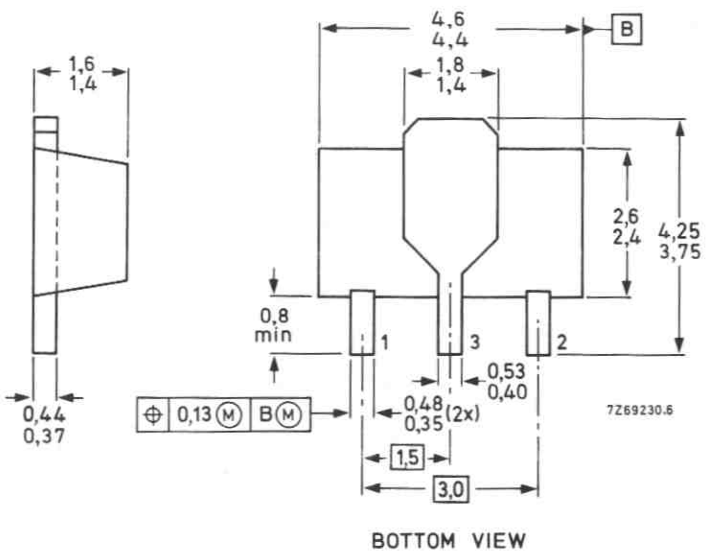
Pinning:

1 = emitter

2 = base

3 = collector





* Mounted on a ceramic substrate; area = 2.5 cm^2; thickness = 0.7 mm.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage	V_{CEO}	max.	40	V
Collector-base voltage	V_{CBO}	max.	60	V
Emitter-base voltage	V_{EBO}	max.	6.0	V
Collector current (DC)	I_C	max.	600	mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	1000	mW
Storage temperature range	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	125	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector-emitter breakdown voltage I_C = 1.0 mA; I_B = 0	$V_{(BR)CEO}$	min.	40	V
Collector-base breakdown voltage I_C = 0.1 mA; I_E = 0	$V_{(BR)CBO}$	min.	60	V
Emitter-base breakdown voltage I_E = 0.1 mA; I_C = 0	$V_{(BR)EBO}$	min.	6.0	V
Base cut-off current V_{CE} = 35 V; $-V_{EB}$ = 0.4 V	I_{BEX}	max.	0.1	μA
Collector cut-off current V_{CE} = 35 V; $-V_{EB}$ = 0.4 V	I_{CEX}	max.	0.1	μA
DC current gain				
I_C = 0.1 mA; V_{CE} = 1 V	h_{FE}	min.	20	
I_C = 1.0 mA; V_{CE} = 1 V	h_{FE}	min.	40	
I_C = 10 mA; V_{CE} = 1 V	h_{FE}	min.	80	
I_C = 150 mA; V_{CE} = 1 V	h_{FE}		100 to 300	
I_C = 500 mA; V_{CE} = 2 V	h_{FE}	min.	40	
Saturation voltage				
I_C = 150 mA; I_B = 15 mA	$V_{CE\ sat}$	max.	0.4	V
	$V_{BE\ sat}$		0.75 to 0.95	V
I_C = 500 mA; I_B = 50 mA	$V_{CE\ sat}$	max.	0.75	V
	$V_{BE\ sat}$	max.	1.2	V

* Mounted on a ceramic substrate; area = 2.5 cm^2; thickness = 0.7 mm.

Transition frequency; f = 100 MHz; I_C = 20 mA; V_{CE} = 10 V	f_T	min.	250 MHz
Collector-base capacitance I_E = 0; V_{CB} = 5 V; f = 100 kHz	C_{cb}	max.	8.0 pF
Emitter-base capacitance I_C = 0; V_{BE} = 0.5 V; f = 100 kHz	C_{eb}	max.	30 pF
Input impedance; f = 1 kHz; I_C = 1 mA; V_{CE} = 10 V	h_{ie}	min. max.	1.0 kΩ 15 kΩ
Voltage feed-back ratio; f = 1 kHz; I_C = 1 mA; V_{CE} = 10 V	h_{re}	min. max.	0.1×10^{-4} 8.0×10^{-4}
Small-signal current gain; f = 1 kHz; I_C = 1 mA; V_{CE} = 10 V	h_{fe}	min. max.	40 500
Output admittance; f = 1 kHz; I_C = 1 mA; V_{CE} = 10 V	h_{oe}	min. max.	1.0 µS 30 µS
Switching times (resistive load)			
Turn-on time I_C = 150 mA; I_{B1} = 15 mA; V_{CC} = 30 V; V_{EB} = 2 V			
delay time	t_d	max.	15 ns
rise time	t_r	max.	20 ns
Turn-off time I_C = 150 mA; V_{CC} = 30 V; $I_{B1} = I_{B2}$ = 15 mA			
storage time	t_s	max.	225 ns
fall time	t_f	max.	30 ns

SILICON PLANAR EPITAXIAL TRANSISTOR

PNP silicon planar epitaxial transistor, housed in a SOT89 envelope.

It is intended for linear switching applications.

The complementary type is PXT4401.

QUICK REFERENCE DATA

Collector-emitter voltage	$-V_{CEO}$	max.	40 V
Collector current (DC)	$-I_C$	max.	600 mA
DC current gain			
$-I_C$ = 0.1 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	30
$-I_C$ = 1.0 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	60
$-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	100
$-I_C$ = 150 mA; $-V_{CE}$ = 2 V	h_{FE}	min.	100 to 300
$-I_C$ = 500 mA; $-V_{CE}$ = 2 V	h_{FE}	min.	20
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	1.0 W
Transition frequency at f = 100 MHz $-I_C$ = 20 mA; $-V_{CE}$ = 10 V	f_T	min.	200 MHz

MECHANICAL DATA

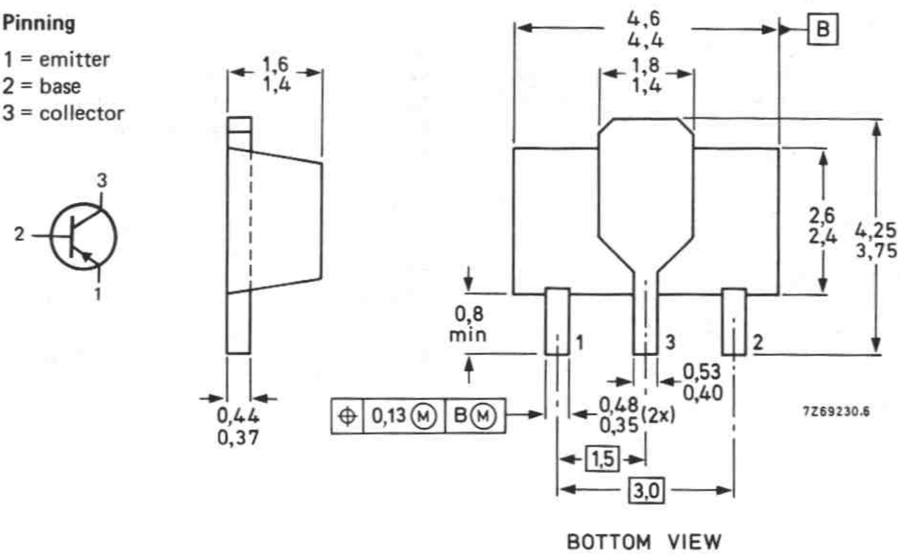
Dimensions in mm

Fig.1 SOT89.

Marking code = p2T

Pinning

1 = emitter
2 = base
3 = collector



* Mounted on a ceramic substrate; area = 2.5 cm²; thickness = 0.7 mm.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage	$-V_{CEO}$	max.	40 V
Emitter-base voltage	$-V_{EBO}$	max.	5.0 V
Collector-base voltage	$-V_{CBO}$	max.	40 V
Collector current (DC)	$-I_C$	max.	600 mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	1.0 W
Storage temperature range	T_{stg}		−55 to + 150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	125 K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector-emitter breakdown voltage			
$-I_C$ = 1.0 mA; I_B = 0	$-V_{(BR)CEO}$	min.	40 V
Collector-base breakdown voltage			
$-I_C$ = 100 μA; I_E = 0	$-V_{(BR)CBO}$	min.	40 V
Emitter-base breakdown voltage			
$-I_E$ = 100 μA; I_C = 0	$-V_{(BR)EBO}$	min.	5.0 V
Base cut-off current			
$-V_{CE}$ = 35 V; $-V_{BE}$ = 0.4 V	$-I_{BEV}$	max.	0.1 μA
Collector cut-off current			
$-V_{CE}$ = 35 V; V_{BE} = 0.4 V	$-I_{CEX}$	max.	0.1 μA
DC current gain			
$-I_C$ = 0.1 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	30
$-I_C$ = 1.0 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	60
$-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	100
$-I_C$ = 150 mA; $-V_{CE}$ = 2 V	h_{FE}	min.	100 to 300
$-I_C$ = 500 mA; $-V_{CE}$ = 2 V	h_{FE}	min.	20
Saturation voltage			
$-I_C$ = 150 mA; $-I_B$ = 15 mA	$-V_{CE\ sat}$	max.	0.4 V
	$-V_{BE\ sat}$		0.70 to 0.95 V
$-I_C$ = 500 mA; $-I_B$ = 50 mA	$-V_{CE\ sat}$	max.	0.75 V
	$-V_{BE\ sat}$	max.	1.3 V
Transition frequency at f = 100 MHz			
$-I_C$ = 20 mA; $-V_{CE}$ = 10 V	f_T	min.	200 MHz

* Mounted on a ceramic substrate; area = 2.5 cm²; thickness = 0.7 mm.

Collector-base capacitance			
$-V_{CB} = 10$ V; $I_E = 0$; f = 0.14 MHz	C_{cb}	max.	8.5 pF
Emitter-base capacitance			
$-V_{EB} = 0.5$ V; $I_C = 0$; f = 0.14 MHz	C_{eb}	max.	35 pF
Input impedance			
$-I_C = 1$ mA; $-V_{CE} = 10$ V; f = 1 kHz	h_{ie}		1.5 to 15 kΩ
Voltage feedback ratio			
$-I_C = 1$ mA; $-V_{CE} = 10$ V; f = 1 kHz	h_{re}		0.1 to 8.0×10^{-4}
Small-signal current gain			
$-I_C = 1$ mA; $-V_{CE} = 10$ V; f = 1 kHz	h_{fe}		60 to 500
Output admittance			
$-I_C = 1$ mA; $-V_{CE} = 10$ V; f = 1 kHz	h_{oe}		1.0 to 100 μS

SWITCHING CHARACTERISTICS

Turn-on time $-I_C = 150$ mA; $-I_{B1} = 15$ mA $-V_{CC} = 30$ V; $-V_{BE} = 2$ V			
Delay time	t_d	max.	15 ns
Rise time	t_r	max.	20 ns
Turn-off time $-I_C = 150$ mA; $-I_{B1} = I_{B2} = 15$ mA $-V_{CC} = 30$ V			
Storage time	t_s	max.	225 ns
Fall time	t_f	max.	30 ns

NPN SMALL-SIGNAL DARLINGTON TRANSISTOR

NPN small-signal darlington transistor, housed in a microminiature envelope (SOT-89).

It is intended primarily for use in preamplifier input applications requiring a high input impedance.

The complementary type is the PXTA64.

QUICK REFERENCE DATA

Collector-emitter voltage $V_{BE} = 0$	V_{CES}	max.	30 V
Collector current (DC)	I_C	max.	300 mA
DC current gain $I_C = 100$ mA; $V_{CE} = 5$ V	h_{FE}	min.	20 000
Total power dissipation up to $T_{amb} = 25$ °C*	P_{tot}	max.	1.0 W
Transition frequency at f = 100 MHz; $I_C = 30$ mA; $V_{CE} = 5$ V	f_T	min.	125 MHz

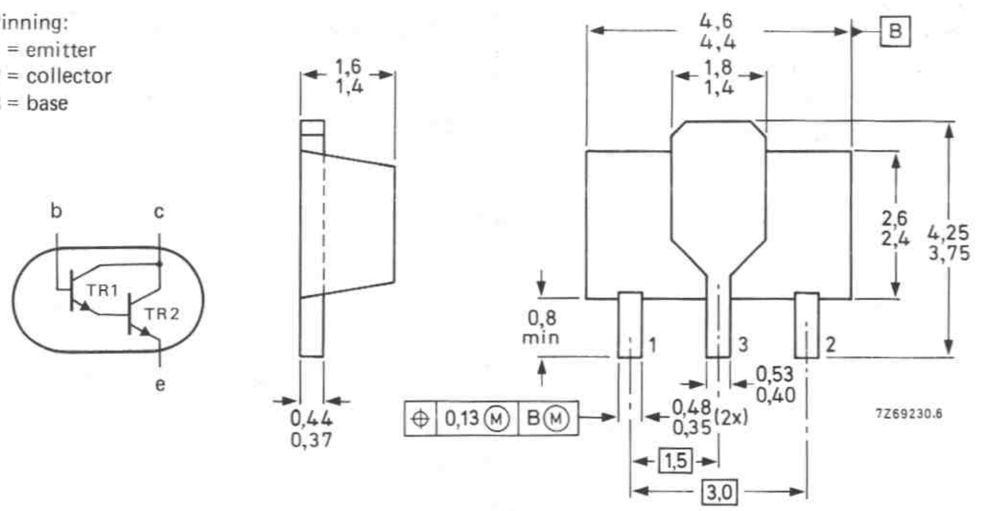
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-89.

Marking code = p1N

Pinning:
1 = emitter
2 = collector
3 = base



BOTTOM VIEW

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage			
$V_{BE} = 0$	V_{CES}	max.	30 V
Collector-base voltage (open emitter)	V_{CBO}	max.	30 V
Emitter-base voltage (open collector)	V_{EBO}	max.	10 V
Collector current (DC)	I_C	max.	300 mA
Total power dissipation			
up to $T_{amb} = 25\ ^oC$*	P_{tot}	max.	1.0 W
Storage temperature range	T_{stg}	−65 to + 150	^oC
Junction temperature	T_j	max.	150 ^oC

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	125 K/W

CHARACTERISTICS

$T_{amb} = 25\ ^oC$ unless otherwise specified

Collector-emitter breakdown voltage			
$I_C = 100\ \mu A$	$V_{(BR)CES}$	min.	30 V
Emitter-base cut-off current			
$V_{BE} = 10\ V$	I_{EBO}	max.	0.1 μA
Collector-base cut-off current			
$V_{CB} = 30\ V$	I_{CBO}	max.	0.1 μA
DC current gain			
$I_C = 10\ mA$; $V_{CE} = 5\ V$	h_{FE}	min.	10 000
$I_C = 100\ mA$; $V_{CE} = 5\ V$	h_{FE}	min.	20 000
Collector-emitter saturation voltage			
$I_C = 100\ mA$; $I_B = 0.1\ mA$	$V_{CE\ sat}$	max.	1.5 V
Base-emitter on-state voltage			
$I_C = 100\ mA$; $V_{CE} = 5\ V$	$V_{BE(on)}$	max.	2.0 V
Transition frequency at f = 100 MHz;			
$I_C = 30\ mA$; $V_{CE} = 5\ V$	f_T	min.	125 MHz

* Mounted on a ceramic substrate; area = 2.5 cm^2 ; thickness = 0.7 mm.

SMALL-SIGNAL DARLINGTON TRANSISTOR

NPN small-signal darlington transistors, housed in a microminiature envelope (SOT89).

The complementary type is the PXTA77.

QUICK REFERENCE DATA

Collector-emitter voltage $V_{BE} = 0$	V_{CES}	max.	60 V
Collector current (DC)	I_C	max.	500 mA
DC current gain			
$I_C = 10$ mA; $V_{CE} = 5$ V	h_{FE}	min.	10000
$I_C = 100$ mA; $V_{CE} = 5$ V	h_{FE}	min.	10000
Total power dissipation up to $T_{amb} = 25\,^oC$*	P_{tot}	max.	1.0 W
Transition frequency at f = 100 MHz $I_C = 30$ mA; $V_{CE} = 5$ V	f_T	min.	125 MHz

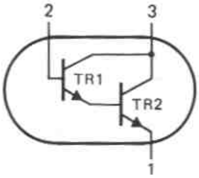
MECHANICAL DATA

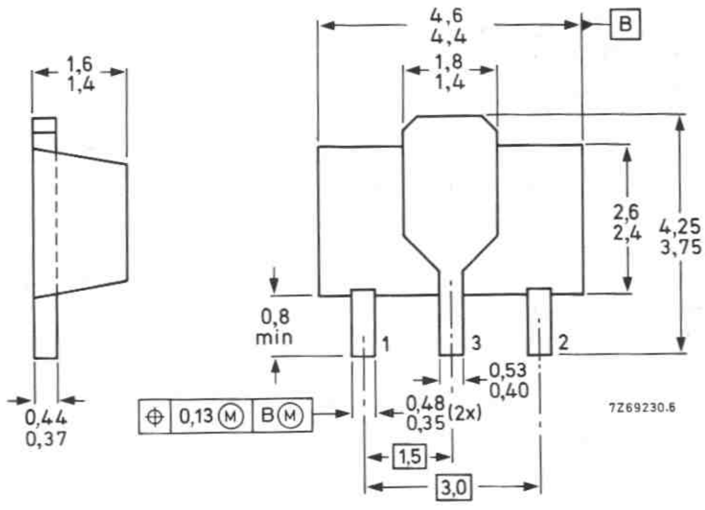
Dimensions in mm

Fig.1 SOT89.

Pinning

1 = emitter
2 = collector
3 = base





* Mounted on a ceramic substrate; area = 2.5 cm^2 ; thickness = 0.7 mm.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage $V_{BE} = 0$	V_{CES}	max.	60 V
Emitter-base voltage (open collector)	V_{EBO}	max.	10 V
Collector current (DC)	I_C	max.	500 mA
Total power dissipation up to $T_{amb} = 25\ ^{o}C$*	P_{tot}	max.	1.0 W
Storage temperature range	T_{stg}		−55 to + 150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	125 K/W

CHARACTERISTICS

$T_{amb} = 25\ ^{o}C$ unless otherwise specified

Collector-emitter breakdown voltage $I_C = 100\ \mu A; -V_{BE} = 0$	$V_{(BR)CES}$	min.	60 V
Collector-base breakdown voltage $I_C = 100\ \mu A; I_E = 0$	$V_{(BR)CBO}$	min.	60 V
Emitter-base cut-off current $V_{BE} = 10\ V; I_C = 0$	I_{EBO}	max.	0.1 μA
Collector-base cut-off current $V_{CB} = 50\ V; I_E = 0$	I_{CBO}	max.	0.1 μA
Collector-emitter cut-off current $V_{CB} = 50\ V; V_{BE} = 0$	I_{CES}	max.	0.5 μA
DC current gain $I_C = 10\ mA; V_{CE} = 5\ V$	h_{FE}	min.	10000
$I_C = 100\ mA; V_{CE} = 5\ V$	h_{FE}	min.	10000
Collector-emitter saturation voltage $I_C = 100\ mA; I_B = 0.1\ mA$	$V_{CE\ sat}$	max.	1.5 V
Base-emitter on-state voltage $I_C = 100\ mA; V_{CE} = 5\ V$	$V_{BE(on)}$	max.	2.0 V
Transition frequency at f = 100 MHz $I_C = 30\ mA; V_{CE} = 5\ V$ /	f_T	min.	125 MHz

* Mounted on a ceramic substrate; area = 2.5 cm^2; thickness = 0.7 mm.

PNP SMALL-SIGNAL DARLINGTON TRANSISTOR

PNP small-signal darlington transistor, housed in a microminiature envelope (SOT-89).
It is intended primarily for use in preamplifier input applications requiring high input impedance.
The complementary type is the PXTA14.

QUICK REFERENCE DATA

Collector-emitter voltage $V_{BE} = 0$	$-V_{CES}$	max.	30	V
Collector current (DC)	$-I_C$	max.	300	mA
DC current gain $-I_C = 10$ mA; $-V_{CE} = 5$ V	h_{FE}	min.	10.000	
Total power dissipation up to $T_{amb} = 25\ ^oC$*	P_{tot}	max.	1.0	W
Transition frequency at f = 100 MHz; $-I_C = 100$ mA; $-V_{CE} = 5$ V	f_T	min.	125	MHz

MECHANICAL DATA

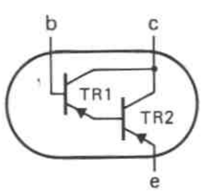
Dimensions in mm

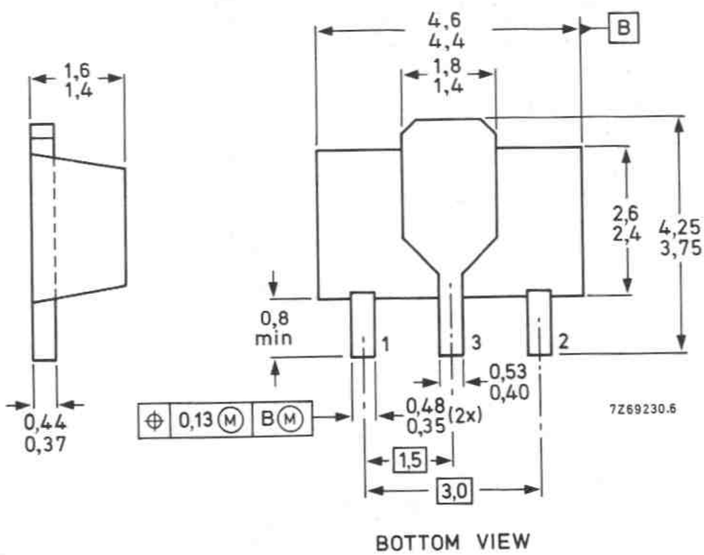
Fig. 1 SOT-89

Marking code = p2V

Pinning:

1 = emitter
2 = base
3 = collector





* Mounted on a ceramic substrate; area = 2.5 cm^2; thickness = 0.7 mm.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage $V_{BE} = 0$	$-V_{CES}$	max.	30	V
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	30	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	10	V
Collector current (DC)	$-I_C$	max.	300	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	1.0	W
Storage temperature range	T_{stg}		−65 to +150	^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	125	K/W

CHARACTERISTICS

$T_{amb} = 25\ ^oC$ unless otherwise specified

Collector-emitter breakdown voltage $-I_C = 100\ \mu A$	$-V_{(BR)CES}$	min.	30	V
Emitter-base cut-off current $-V_{BE} = 10\ V$	$-I_{EBO}$	max.	0.1	μA
Collector-base cut-off current $-V_{CB} = 30\ V$	$-I_{CBO}$	max.	0.1	μA
DC current gain $-I_C = 10\ mA$; $-V_{CE} = 5\ V$	h_{FE}	min.	10.000	
$-I_C = 100\ mA$; $-V_{CE} = 5\ V$	h_{FE}	min.	20.000	
Collector-emitter saturation voltage $-I_C = 100\ mA$; $-I_B = 0.1\ mA$	$-V_{CEsat}$	max.	1.5	V
Base-emitter on-state voltage $-I_C = 100\ mA$; $-V_{CE} = 5\ V$	$-V_{BE(on)}$	max.	2.0	V
Transition frequency at f = 100 MHz; $-I_C = 100\ mA$; $-V_{CE} = 5\ V$	f_T	min.	125	MHz

* Mounted on a ceramic substrate; area = 2.5 cm^2; thickness = 0.7 mm.

SMALL-SIGNAL DARLINGTON TRANSISTOR

PNP small-signal darlington transistors, housed in a microminiature envelope (SOT89).

The complementary type is the PXTA27.

QUICK REFERENCE DATA

Collector-emitter voltage $V_{BE} = 0$	$-V_{CES}$	max.	60 V
Collector current (DC)	$-I_C$	max.	500 mA
DC current gain $-I_C = 10$ mA; $-V_{CE} = 5$ V	h_{FE}	min.	10 000
$-I_C = 100$ mA; $-V_{CE} = 5$ V	h_{FE}	min.	10 000
Total power dissipation up to $T_{amb} = 25$ °C*	P_{tot}	max.	1.0 W
Transition frequency at f = 100 MHz $-I_C = 30$ mA; $-V_{CE} = 5$ V	f_T	min.	125 MHz

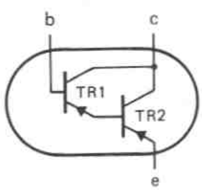
MECHANICAL DATA

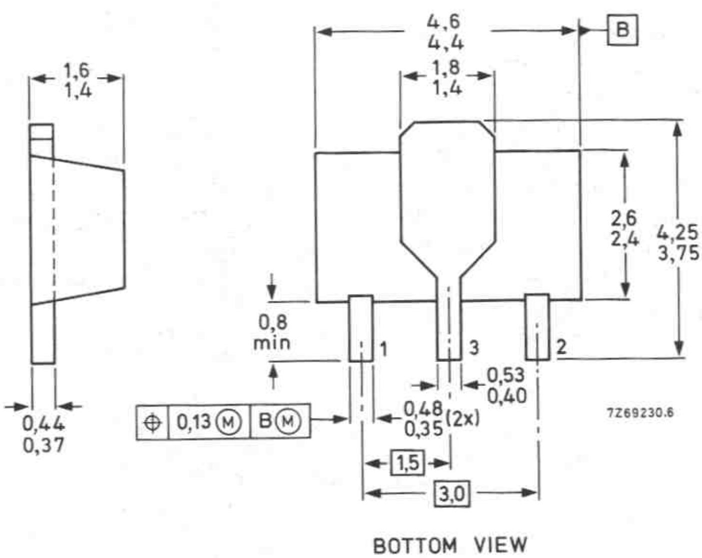
Dimensions in mm

Fig.1 SOT89.

Pinning

1 = emitter
2 = base
3 = collector





* Mounted on a ceramic substrate; area = 2.5 cm^2; thickness = 0.7 mm.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage $V_{BE} = 0$	$-V_{CES}$	max.	60 V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	10 V
Collector current (DC)	$-I_C$	max.	500 mA
Total power dissipation up to $T_{amb} = 25\ ^oC$*	P_{tot}	max.	1.0 W
Storage temperature range	T_{stg}	−55 to + 150	°C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	125 K/W

CHARACTERISTICS

$T_{amb} = 25\ ^oC$ unless otherwise specified

Collector-emitter breakdown voltage $-I_C = 100\ \mu A$; $V_{BE} = 0$	$-V_{(BR)CES}$	min.	60 V
Collector-base breakdown voltage $-I_C = 100\ \mu A$; $I_E = 0$	$-V_{(BR)CBO}$	min.	60 V
Emitter-base cut-off current $-V_{BE} = 10$ V; $I_C = 0$	$-I_{EBO}$	max.	0.1 µA
Collector-base cut-off current $-V_{CB} = 50$ V; $I_E = 0$	$-I_{CBO}$	max.	0.1 µA
Collector-emitter cut-off current $-V_{CB} = 50$ V; $V_{BE} = 0$	$-I_{CES}$	max.	0.5 µA
DC current gain $-I_C = 10$ mA; $-V_{CE} = 5$ V	h_{FE}	min.	10 000
$-I_C = 100$ mA; $-V_{CE} = 5$ V	h_{FE}	min.	10 000
Collector-emitter saturation voltage $-I_C = 100$ mA; $-I_B = 0.1$ mA	$-V_{CE\ sat}$	max.	1.5 V
Base-emitter on-state voltage $-I_C = 100$ mA; $-V_{CE} = 5$ V	$-V_{BE\ (on)}$	max.	2.0 V
Transition frequency at f = 100 MHz $-I_C = 30$ mA; $-V_{CE} = 5$ V	f_T	min.	125 MHz

* Mounted on a ceramic substrate; area = 2.5 cm^2; thickness = 0.7 mm.

SILICON EPITAXIAL TRANSISTORS

PNP high voltage transistors in a SOT89 envelope, intended for surface-mounted applications. They are primarily intended for use in telephony and professional communications equipment.

QUICK REFERENCE DATA

			PXTA92	PXTA93	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	300	200	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	300	200	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5		V
Collector current (DC)	$-I_C$	max.	500		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1.0		W
DC current gain $-I_C$ = 10 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	40		
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 20 V	f_T	min.	50		MHz
Collector-base capacitance at f = 1 MHz I_E = 0; $-V_{CB}$ = 20 V	C_{cb}	max.	6	8	pF

MECHANICAL DATA

Dimensions in mm

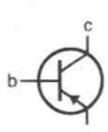
Fig.1 SOT89.

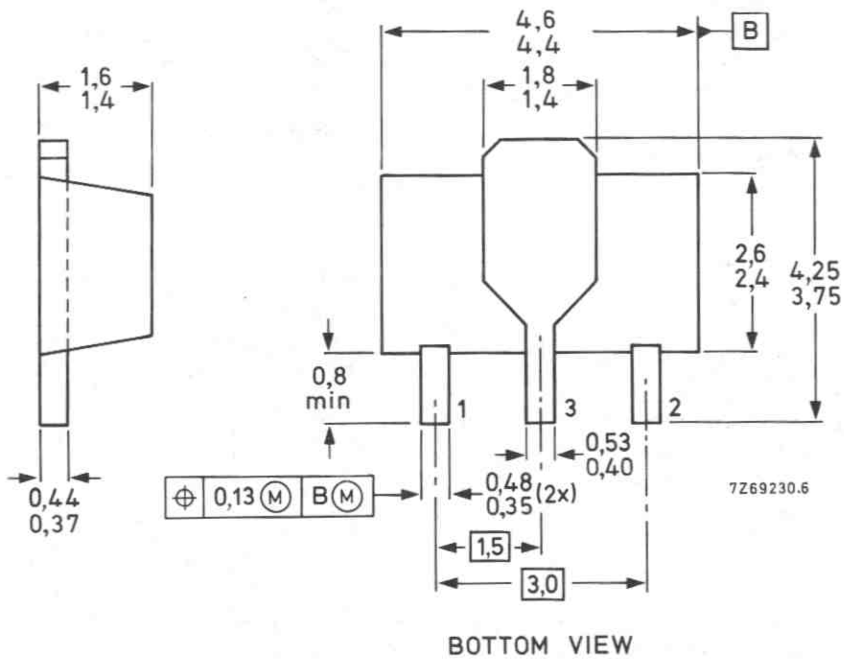
Marking code

PXTA92: p2D
PXTA93: p2E

Pinning:

1 = emitter
2 = base
3 = collector





RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			PXTA92	PXTA93	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	300	200	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	300	200	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5		V
Collector current (DC)	$-I_C$	max.	500		mA
Total power dissipation * up to T_{amb} = 25 °C	P_{tot}	max.	1.0		W
Storage temperature range	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL CHARACTERISTICS

Thermal resistance from junction to ambient*	$R_{th\ j\text{-}a}$	=	125	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			PXTA92	PXTA93	
Collector-emitter breakdown voltage $-I_C$ = 1 mA; I_B = 0	$-V_{(BR)CEO}$	min.	300	200	V
Collector-base breakdown voltage $-I_C$ = 100 μA; I_E = 0	$-V_{(BR)CBO}$	min.	300	200	V
Collector cut-off current $-V_{CB}$ = 200 V; I_E = 0	$-I_{CBO}$	max.	0.25	–	μA
$-V_{CB}$ = 160 V; I_E = 0	$-I_{CBO}$	max.	–	0.25	μA
Emitter-base breakdown voltage $-I_E$ = 100 μA; I_C = 0	$-V_{(BR)EBO}$	min.	5		V
Emitter cut-off current I_C = 0; $-V_{BE}$ = 3 V	$-I_{EBO}$	max.	0.1		μA
Collector-base capacitance at f = 1 MHz; I_E = 0; $-V_{CB}$ = 20 V	C_{cb}	max.	6	8	pF
Saturation voltages $-I_C$ = 20 mA; $-I_B$ = 2 mA	$-V_{CEsat}$	max.	0.5		V
$-I_C$ = 20 mA; $-I_B$ = 2 mA	$-V_{BEsat}$	max.	0.9		V
DC current gain** $-I_C$ = 1 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	25		
$-I_C$ = 10 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	40		
$-I_C$ = 30 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	25		
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 20 V	f_T	min.	50		MHz

* Device mounted on a ceramic substrate; area 2.5 cm^2; thickness 0.7 mm.
** Pulse test conditions: t_p = 300 μs; duty factor ≤ 2%.

SILICON PLANAR EPITAXIAL TRANSISTORS

NPN silicon planar epitaxial transistors in a microminiature SMD envelope (SOT-223), primarily intended for linear and switching applications.

PNP complements are PZT2907/2907A.

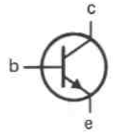
QUICK REFERENCE DATA

			PZT2222	PZT2222A	
Collector-emitter voltage (open base)	V_{CEO}	max.	30	40	V
Collector-base voltage (open emitter)	V_{CBO}	max.	60	75	V
Collector current (DC)	I_C	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C *	P_{tot}	max.	1,5		W
Collector-emitter saturation voltage I_C = 150 mA; I_B = 15 mA	V_{CEsat}	max.	0,4	0,3	V
DC current gain I_C = 150 mA; V_{CE} = 10 V	h_{FE}	min.	100		
		max.	300		

MECHANICAL DATA

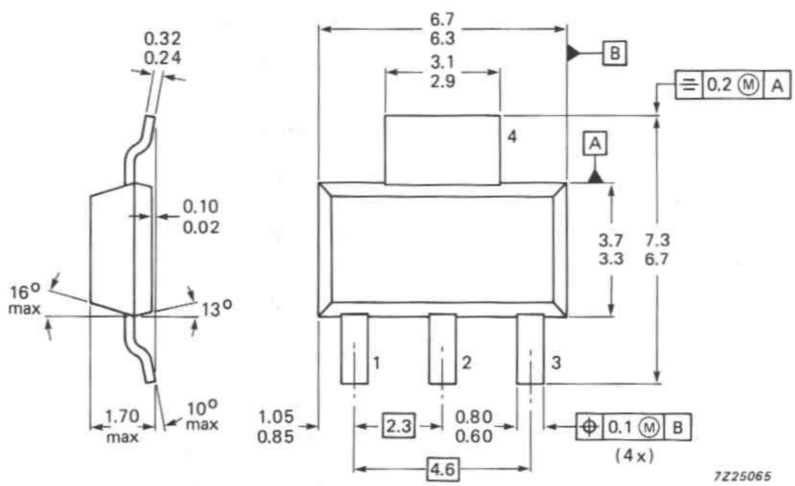
Dimensions in mm

Fig. 1 SOT-223



Pinning:

1 = base
2 = collector
3 = emitter
4 = collector



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			PZT2222	PZT2222A	
Collector-emitter voltage (open base)	V_{CEO}	max.	30	40	V
Collector-base voltage (open emitter)	V_{CBO}	max.	60	75	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5,0	6,0	V
Collector current (DC)	I_C	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C *	P_{tot}	max.	1,5		W
Storage temperature range	T_{stg}		−55 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to ambient in free air *	$R_{th\ j\text{-}a}$	=	83,3	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			PZT2222	PZT2222A	
Collector-emitter breakdown voltage $I_B = 0$; I_C = 10 mA	$V_{(BR)CEO}$	min.	30	40	V
Collector-base breakdown voltage $I_E = 0$; I_C = 10 μA	$V_{(BR)CBO}$	min.	60	75	V
Emitter-base breakdown voltage I_E = 10 μA; $I_C = 0$	$V_{(BR)EBO}$	min.	5,0	6,0	V
Base cut-off current V_{CE} = 60 V; $-V_{BE}$ = 3 V	I_{BEX}	max.	–	20	nA
Collector cut-off current V_{CE} = 60 V; $-V_{BE}$ = 3 V	I_{CEX}	r ax.	–	10	nA
Emitter cut-off current $I_C = 0$; V_{EB} = 3 V	I_{EBO}	max.	–	10	nA
Collector cut-off current $I_E = 0$; V_{CB} = 50 V	I_{CBO}	max.	10	–	nA
$I_E = 0$; V_{CB} = 60 V	I_{CBO}	max.	–	10	nA
$I_E = 0$; V_{CB} = 50 V; T_{amb} = 125 °C	I_{CBO}	max.	10	–	μA
$I_E = 0$; V_{CB} = 60 V; T_{amb} = 125 °C	I_{CBO}	max.	–	10	μA

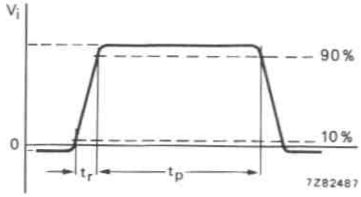
* Device mounted on an epoxy printed circuit board 40 mm x 40 mm x 1,5 mm; mounting pad for the collector lead min. 6 cm^2.

			PZT2222	PZT2222A	
DC current gain					
I_C = 0,1 mA; V_{CE} = 10 V	h_{FE}	min.	35	35	
I_C = 1 mA; V_{CE} = 10 V	h_{FE}	min.	50	50	
I_C = 10 mA; V_{CE} = 10 V	h_{FE}	min.	75	75	
I_C = 10 mA; V_{CE} = 10 V; T_{amb} = −55 °C	h_{FE}	min.	–	35	
I_C = 150 mA; V_{CE} = 10 V	h_{FE}	min. max.	100 300	100 300	
I_C = 150 mA; V_{CE} = 1 V	h_{FE}	min.	50	50	
I_C = 500 mA; V_{CE} = 10 V	h_{FE}	min.	30	40	
Saturation voltages					
I_C = 150 mA; I_B = 15 mA	V_{CEsat}	max.	0,4	0,3	V
I_C = 500 mA; I_B = 50 mA	V_{CEsat}	min.	1,6	1,0	V
I_C = 150 mA; I_B = 15 mA	V_{BEsat}	max.	1,3	–	V
I_C = 150 mA; I_B = 15 mA	V_{BEsat}	min. max.		0,6 1,2	V V
I_C = 500 mA; I_B = 50 mA	V_{BEsat}	max.	2,6	2,0	V
Transition frequency at f = 100 MHz					
I_C = 20 mA; V_{CE} = 20 V; T_{amb} = 25 °C	f_T	min.	250	300	MHz
Output capacitance at f = 1 MHz					
I_E = 0; V_{CB} = 10 V	C_c	max.	8,0	8,0	pF
Input capacitance at f = 1 MHz					
I_C = 0; V_{EB} = 0,5 V	C_e	max.	30	25	pF
Input impedance at f = 1 kHz					
I_C = 1 mA; V_{CE} = 10 V; T_{amb} = 25 °C	h_{ie}	min. max.	– –	2,0 8,0	kΩ kΩ
I_C = 10 mA; V_{CE} = 10 V; T_{amb} = 25 °C	h_{ie}	min. max.	– –	0,25 1,25	kΩ kΩ
Voltage feedback ratio at f = 1 kHz					
I_C = 1 mA; V_{CE} = 10 V; T_{amb} = 25 °C	h_{re}	max.	–	$8,0 \times 10^{-4}$	
I_C = 10 mA; V_{CE} = 10 V; T_{amb} = 25 °C	h_{re}	max.	–	$4,0 \times 10^{-4}$	
Small-signal current gain at f = 1 kHz					
I_C = 1 mA; V_{CE} = 10 V; T_{amb} = 25 °C	h_{fe}	min. max.	– –	50 300	
I_C = 10 mA; V_{CE} = 10 V; T_{amb} = 25 °C	h_{fe}	min. max.	– –	75 375	
Output admittance at f = 1 kHz					
I_C = 1 mA; V_{CE} = 10 V; T_{amb} = 25 °C	h_{oe}	min. max.	– –	5,0 35	μmhos μmhos
I_C = 10 mA; V_{CE} = 10 V; T_{amb} = 25 °C	h_{oe}	min. max.	– –	25 200	μmhos μmhos

			PZT2222A
Noise figure at R_S = 1 kΩ I_C = 100 μA; V_{CE} = 10 V; f = 1 kHz; T_{amb} = 25 °C	F	max.	4,0 dB

Switching times at T_{amb} = 25 °C

Turn-on time (see Fig. 2) I_C = 150 mA; I_{Bon} = 15 mA V_{CC} = 30 V; $V_{EB(off)}$ = 0,5 V			
delay time	t_d	max.	10 ns
rise time	t_r	max.	25 ns
Turn-off time (see Fig. 3) I_C = 150 mA; I_{Bon} = I_{Boff} = 15 mA V_{CC} = 30 V			
storage time	t_s	max.	225 ns
fall time	t_f	max.	60 ns



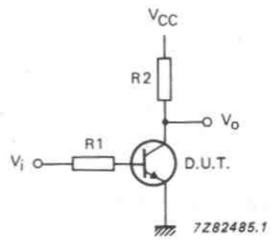
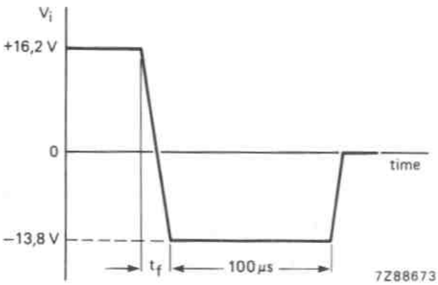


Fig. 2 Input waveform and test circuit for determining delay time and rise time.

V_i = −0,5 V to + 9,9 V; V_{CC} = + 30 V; R1 = 619 Ω; R2 = 200 Ω.

Pulse generator:				Oscilloscope:			
pulse duration	t_p	⩽	200 ns	input impedance	Z_i	>	100 kΩ
rise time	t_r	⩽	2 ns	input capacitance	C_i	<	12 pF
duty factor	δ	=	0,02	rise time	t_r	<	5 ns



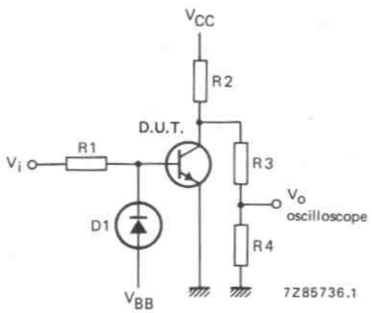


Fig. 3 Input waveform and test circuit for determining storage time and fall time.

SILICON PLANAR EPITAXIAL TRANSISTORS

PNP medium power transistors in a microminiature SMD envelope (SOT-223). Designed primarily for high-speed switching and driver applications.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)		$-V_{CBO}$	max.	60	V
Collector-emitter voltage (open base)	**PZT2907**	$-V_{CEO}$	max.	40	V
	PZT2907A	$-V_{CEO}$	max.	60	V
Collector current (DC)		$-I_C$	max.	600	mA
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	1,5	W
Junction temperature		T_j	max.	150	°C
DC current gain at T_j = 25 °C $-I_C$ = 150 mA; $-V_{CE}$ = 10 V		h_{FE}	100 to 300		
Transition frequency at f = 100 MHz $-I_C$ = 50 mA; $-V_{CE}$ = 20 V; T_j = 25 °C		f_T	min.	200	MHz
Storage time $-I_{Con}$ = 150 mA; $-I_{Bon}$ = I_{Boff} = 15 mA		t_s	max.	80	ns

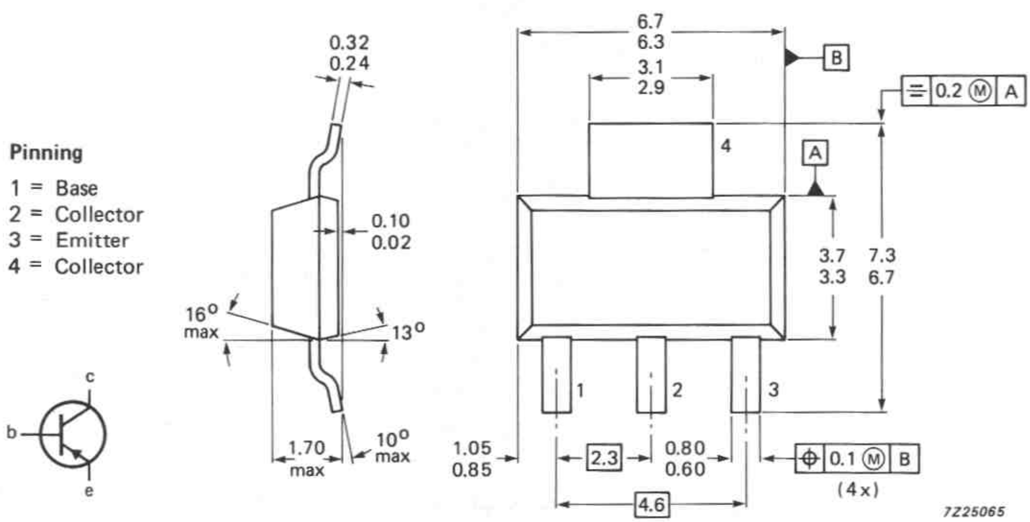
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-223

Pinning

1 = Base
2 = Collector
3 = Emitter
4 = Collector



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)		$-V_{CBO}$	max.	60	V
Collector-emitter voltage (open base)	PZT2907	$-V_{CEO}$	max.	40	V
	PZT2907A	$-V_{CEO}$	max.	60	V
Emitter-base voltage (open collector)		$-V_{EBO}$	max.	5	V
Collector current (DC)		$-I_C$	max.	600	mA
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	1,5	W
Storage temperature range		T_{stg}	−65 to	+150	°C
Junction temperature		T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	83,3	K/W

* Device mounted on an epoxy printed-circuit board 40 mm x 40 mm x 1,5 mm; mounting pad for the collector lead min. 6 cm^2.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			PZT2907	PZT2907A	
Collector cut-off current					
$I_E = 0$; $-V_{CB} = 50$ V	$-I_{CBO}$	<	20	10	nA
$I_E = 0$; $-V_{CB} = 50$ V; $T_{amb} = 150$ °C	$-I_{CBO}$	<	20	10	μA
$+V_{BE} = 0{,}5$ V; $-V_{CE} = 30$ V	$-I_{CEX}$	<	50	50	nA
Base current					
$+V_{BE} = 0{,}5$ V; $-V_{CE} = 30$ V	I_{BEX}	<	50	50	nA
Collector-base breakdown voltage					
open emitter; $-I_C = 10$ μA	$-V_{(BR)CBO}$	>	60	60	V
Collector-emitter breakdown voltage*					
open base; $-I_C = 10$ mA	$-V_{(BR)CEO}$	>	40	60	V
Emitter-base breakdown voltage					
open collector; $-I_E = 10$ μA	$-V_{(BR)EBO}$	>	5	5	V
Saturation voltages*					
$-I_C = 150$ mA; $-I_B = 15$ mA	$-V_{CEsat}$	<	0,4	0,4	V
	$-V_{BEsat}$	<	1,3	1,3	V
$-I_C = 500$ mA; $-I_B = 50$ mA	$-V_{CEsat}$	<	1,6	1,6	V
	$-V_{BEsat}$	<	2,6	2,6	V
DC current gain					
$-I_C = 0{,}1$ mA; $-V_{CE} = 10$ V	h_{FE}	>	35	75	
$-I_C = 1$ mA; $-V_{CE} = 10$ V	h_{FE}	>	50	100	
$-I_C = 10$ mA; $-V_{CE} = 10$ V	h_{FE}	>	75	100	
$-I_C = 150$ mA; $-V_{CE} = 10$ V*	h_{FE}	>	100	100	
		<	300	300	
$-I_C = 500$ mA; $-V_{CE} = 10$ V*	h_{FE}	>	30	50	
Collector capacitance at f = 100 kHz					
$I_E = I_e = 0$; $-V_{CB} = 10$ V	C_c	<	8		pF
Emitter capacitance at f = 100 kHz					
$I_C = I_c = 0$; $-V_{EB} = 2$ V	C_e	<	30		pF
Transition frequency at f = 100 MHz					
$-I_C = 50$ mA; $-V_{CE} = 20$ V*	f_T	>	200		MHz

* Measured under pulse conditions to avoid excessive dissipation: $t_p \leqslant 300$ μs; $\delta \leqslant 0{,}02$.

Turn-on time (see Fig. 2)
when switched to $-I_{Con}$ = 150 mA; $-I_{Bon}$ = 15 mA

delay time	t_d	<	10 ns
rise time	t_r	<	40 ns
turn-on time	t_{on}	<	45 ns

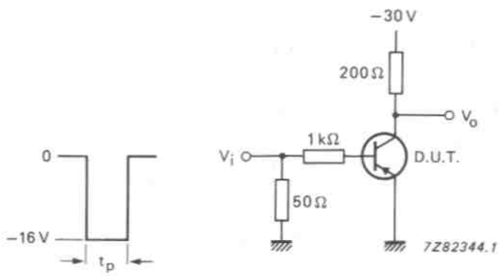


Fig. 2 Input waveform and test circuit for determining delay, rise and turn-on time.

Turn-off time (see Fig. 3)
when switched from $-I_{Con}$ = 150 mA; $-I_{Bon}$ = 15 mA
to cut-off with + I_{Boff} = 15 mA

storage time	t_s	<	80 ns
fall time	t_f	<	30 ns
turn-off time	t_{off}	<	100 ns

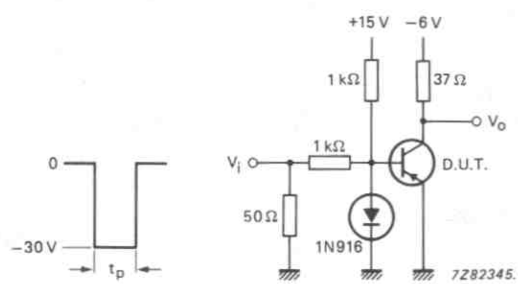


Fig. 3 Input waveform and test circuit for determining storage, fall and turn-off time.

Pulse generator (see Figs 2 and 3)

frequency	f	=	150 Hz
pulse duration	t_p	=	200 ns
rise time	t_r	⩽	2 ns
output impedance	Z_o	=	50 Ω

Oscilloscope (see Figs 2 and 3)

rise time	t_r	⩽	5 ns
input impedance	Z_i	⩽	10 MΩ

SILICON PLANAR EPITAXIAL TRANSISTOR

NPN transistor in a microminiature SMD envelope (SOT-223). Designed primarily for high-speed, saturated switching applications in industrial service.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	60	V
Collector-emitter voltage (open base)	V_{CEO}	max.	40	V
Collector current (DC)	I_C	max.	200	mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	1,5	W
Junction temperature	T_j	max.	150	°C
DC current gain I_C = 10 mA; V_{CE} = 1 V	h_{FE}	> <	100 300	
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 20 V	f_T	>	300	MHz
Storage time I_{Con} = 10 mA; I_{Bon} = $-I_{Boff}$ = 1 mA	t_s	<	200	ns

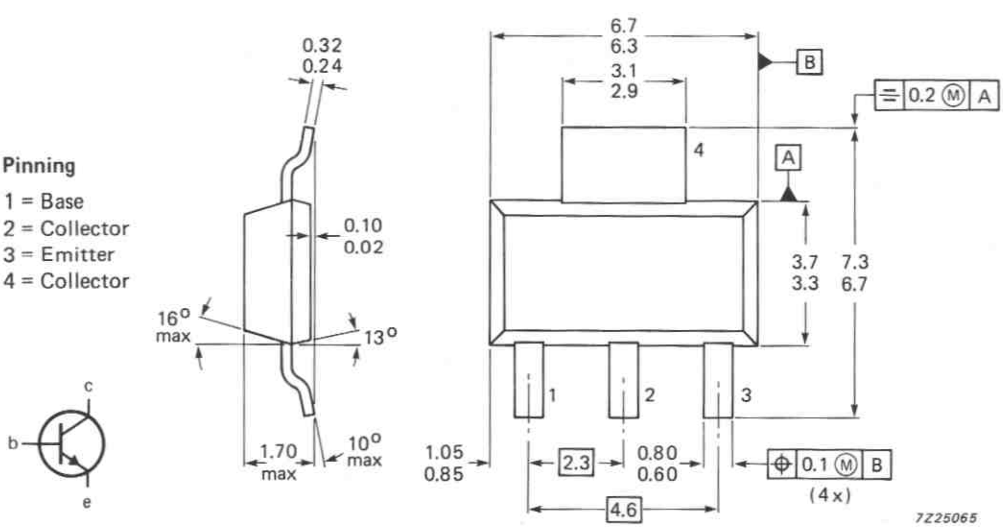
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-223

Pinning

1 = Base
2 = Collector
3 = Emitter
4 = Collector



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	60 V
Collector-emitter voltage (open base)	V_{CEO}	max.	40 V
Emitter-base voltage (open collector)	V_{EBO}	max.	6 V
Collector current (DC)	I_C	max.	200 mA
Total power dissipation at T_{amb} = 25 °C*	P_{tot}	max.	1,5 W
Storage temperature range	T_{stg}		−65 to +150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	83,3 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Currents at reverse biased emitter junction			
V_{CE} = 30 V; $-V_{BE}$ = 3 V	I_{CEX}	<	50 nA
	$-I_{BEX}$	<	50 nA
Saturation voltages			
I_C = 10 mA; I_B = 1 mA	V_{CEsat}	<	200 mV
	V_{BEsat}		650 to 850 mV
I_C = 50 mA; I_B = 5 mA	V_{CEsat}	<	300 mV
	V_{BEsat}	<	950 mV
DC current gain			
I_C = 0,1 mA; V_{CE} = 1 V	h_{FE}	>	40
I_C = 1 mA; V_{CE} = 1 V	h_{FE}	>	70
I_C = 10 mA; V_{CE} = 1 V	h_{FE}	>	100
		<	300
I_C = 50 mA; V_{CE} = 1 V	h_{FE}	>	60
I_C = 100 mA; V_{CE} = 1 V	h_{FE}	>	30
Collector capacitance at 100 kHz ≤ f ≤ 1 MHz			
$I_E = I_e = 0$; V_{CB} = 5 V	C_c	<	4,0 pF
Emitter capacitance at 100 kHz ≤ f ≤ 1 MHz			
$I_C = I_c = 0$; V_{EB} = 0,5 V	C_e	<	8,0 pF
Transition frequency at f = 100 MHz			
I_C = 10 mA; V_{CE} = 20 V; T_{amb} = 25 °C	f_T	>	300 MHz
Noise figure at R_S = 1 kΩ			
I_C = 100 μA; V_{CE} = 5 V; f = 10 Hz to 15,7 kHz; T_{amb} = 25 °C	F	<	5,0 dB

* Device mounted on an epoxy printed circuit board 40 mm x 40 mm x 1,5 mm; mounting pad for the collector lead min. 6 cm^2.

h-parameters (common emitter)

I_C = 1 mA; V_{CE} = 10 V; f = 1 kHz; T_{amb} = 25 °C

Input impedance	h_{ie}	1 to 10 kΩ
Reverse voltage transfer ratio	h_{re}	0,5 to 8x10^{-4}
Small-signal current gain	h_{fe}	100 to 400
Output admittance	h_{oe}	1 to 40 μS

Switching times

Turn-on time (see Figs 2 and 3) when switched from

$-V_{BEoff}$ = 0,5 V to I_{Con} = 10 mA; I_{Bon} = 1 mA

Delay time	t_d	<	35 ns
Rise time	t_r	<	35 ns

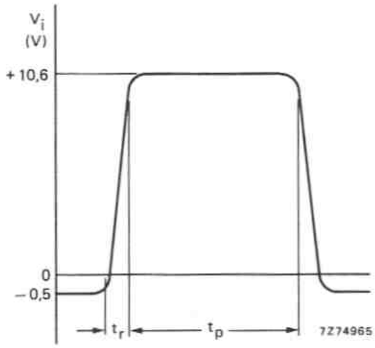


Fig. 2 Input waveform; t_r < 1 ns; t_p = 300 ns; δ = 0,02.

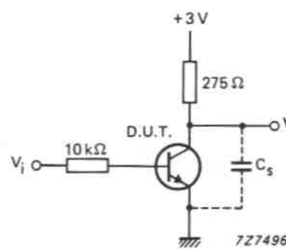


Fig. 3 Delay and rise time test circuit; total shunt capacitance of test jig and connectors C_s < 4 pF; scope impedance = 10 MΩ.

Turn-off time (see Figs 4 and 5)

I_{Con} = 10 mA; I_{Bon} = $-I_{Boff}$ = 1 mA

Storage time	t_s	<	200 ns
Fall time	t_f	<	50 ns

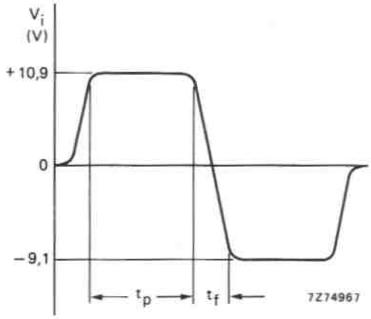


Fig. 4 Input waveform; t_f < 1 ns; 10 μs < t_p < 500 μs; δ = 0,02.

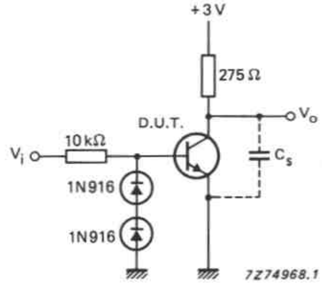


Fig. 5 Storage and fall time test circuit; total shunt capacitance of test jig and connectors C_s < 4 pF; scope impedance = 10 MΩ.

SILICON PLANAR EPITAXIAL TRANSISTOR

PNP transistor in a microminiature SMD envelope (SOT-223). Designed primarily for high-speed, saturated switching applications in industrial service.

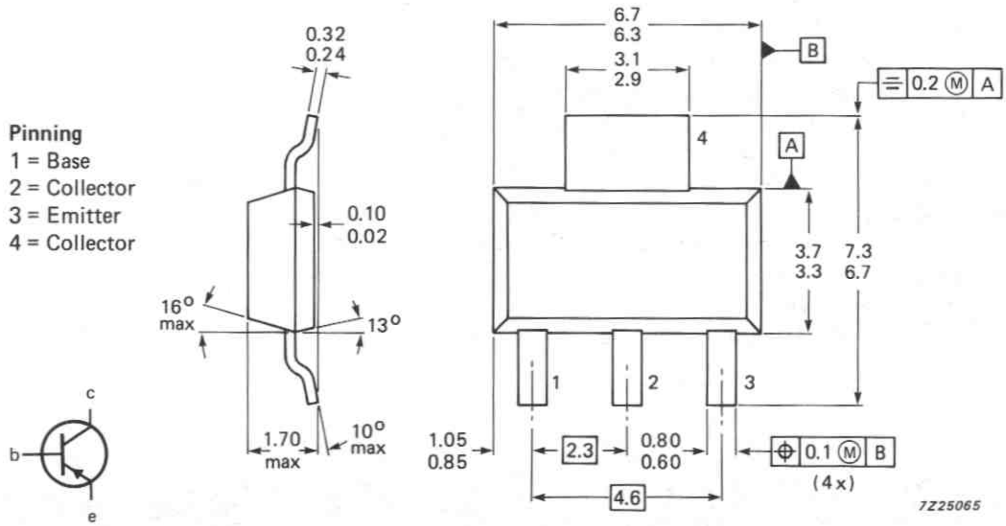
QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40	V
Collector current (DC)	$-I_C$	max.	200	mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	1,5	W
Junction temperature	T_j	max.	150	°C
DC current gain $-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}	> <	100 300	
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 20 V	f_T	>	250	MHz
Storage time $-I_{Con}$ = 10 mA; $-I_{Bon}$ = I_{Boff} = 1 mA	t_s	<	225	ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-223



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40 V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5 V
Collector current (DC)	$-I_C$	max.	200 mA
Total power dissipation at T_{amb} = 25 °C*	P_{tot}	max.	1,5 W
Storage temperature range	T_{stg}		−65 to +150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	83,3 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Currents at reverse biased emitter junction			
$-V_{CE}$ = 30 V; + V_{BE} = 3 V	$-I_{CEX}$	<	50 nA
	$+I_{BEX}$	<	50 nA
Saturation voltages			
$-I_C$ = 10 mA; $-I_B$ = 1 mA	$-V_{CEsat}$	<	250 mV
	$-V_{BEsat}$		650 to 850 mV
$-I_C$ = 50 mA; $-I_B$ = 5 mA	$-V_{CEsat}$	<	400 mV
	$-V_{BEsat}$	<	950 mV
DC current gain			
$-I_C$ = 0,1 mA; $-V_{CE}$ = 1 V	h_{FE}	>	60
$-I_C$ = 1 mA; $-V_{CE}$ = 1 V	h_{FE}	>	80
$-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}	>	100
		<	300
$-I_C$ = 50 mA; $-V_{CE}$ = 1 V	h_{FE}	>	60
$-I_C$ = 100 mA; $-V_{CE}$ = 1 V	h_{FE}	>	30
Collector capacitance at 100 kHz ⩽ f ⩽ 1 MHz			
$I_E = I_e = 0$; $-V_{CB}$ = 5 V	C_c	<	4,5 pF
Emitter capacitance at 100 kHz ⩽ f ⩽ 1 MHz			
$I_C = I_c = 0$; $-V_{EB}$ = 0,5 V	C_e	<	10 pF
Transition frequency at f = 100 MHz			
$-I_C$ = 10 mA; $-V_{CE}$ = 20 V; T_{amb} = 25 °C	f_T	>	250 MHz
Noise figure at R_S = 1 kΩ			
$-I_C$ = 100 μA; $-V_{CE}$ = 5 V			
f = 10 Hz to 15,7 kHz; T_{amb} = 25 °C	F	<	4,0 dB

* Device mounted on an epoxy printed circuit board 40 mm x 40 mm x 1,5 mm; mounting pad for the collector lead min. 6 cm².

h-parameters (common emitter)

$-I_C = 1$ mA; $-V_{CE} = 10$ V; f = 1 kHz; $T_{amb} = 25$ °C

Input impedance	h_{ie}		2 to 12 kΩ
Reverse voltage transfer ratio	h_{re}		0,1 to 10×10^{-4}
Small-signal current gain	h_{fe}		100 to 400
Output admittance	h_{oe}		3 to 60 μS

Switching times

Turn-on time (see Figs 2 and 3) when switched from
$+V_{BEoff} = 0{,}5$ V to $-I_{Con} = 10$ mA; $-I_{Bon} = 1$ mA

Delay time	t_d	<	35 ns
Rise time	t_r	<	35 ns

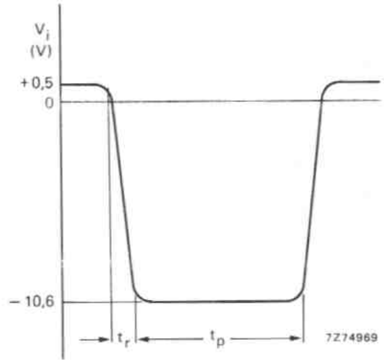


Fig. 2 Input waveform; $t_r < 1$ ns; $t_p = 300$ ns; $\delta = 0{,}02$.

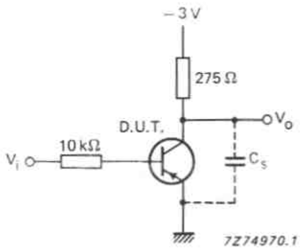


Fig. 3 Delay and rise time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

Turn-off time (see Figs 4 and 5)
$-I_{Con} = 10$ mA; $-I_{Bon} = I_{Boff} = 1$ mA

Storage time	t_s	<	225 ns
Fall time	t_f	<	75 ns

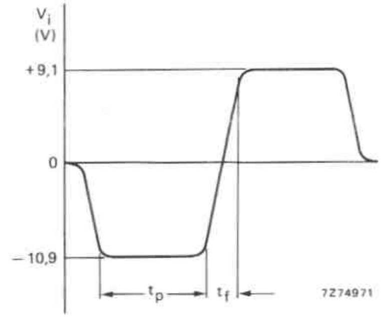


Fig. 4 Input waveform; $t_f < 1$ ns; $10\ \mu s < t_p < 500\ \mu s$; $\delta = 0{,}02$.

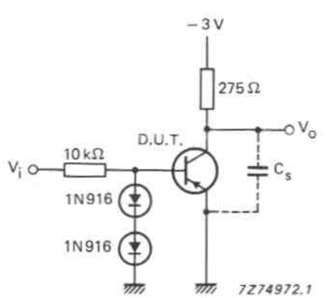


Fig. 5 Storage and fall time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

Philips Components

Data sheet	
status	Preliminary specification
date of issue	April 1991

PZTA05/PZTA06

Silicon epitaxial transistors

DESCRIPTION

NPN transistors in a microminiature plastic envelope intended for surface mounted (SMD) applications.They are primarily intended for use in telephony and professional communication equipment.

PINNING - SOT223

PIN	DESCRIPTION
1	base
2	collector
3	emitter
4	collector

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PZTA05		–	60	V
	PZTA06		–	80	V
V_{CEO}	collector-emitter voltage	open base			
	PZTA05		–	60	V
	PZTA06		–	80	V
V_{EBO}	emitter-base voltage	open collector	–	4	V
I_C	collector current	DC value	–	500	mA
P_{tot}	total power dissipation	T_{amb} = 25 °C	–	1.5	W
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 1 V	50	–	
f_T	transition frequency	I_C = 10 mA; V_{CE} = 2 V; f = 100 MHz	100	–	MHz
$V_{CE\ sat}$	collector-emitter saturation voltage	I_C = 100 mA; I_B = 10 mA	–	0.25	V

PIN CONFIGURATION

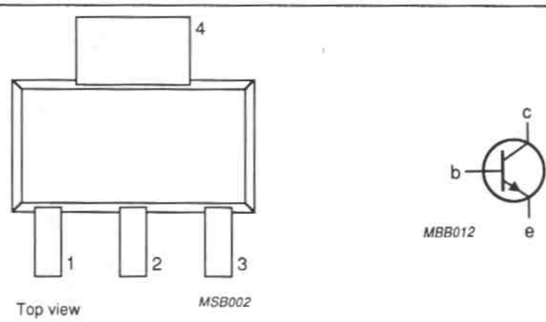


Fig.1 Simplified outline and symbol.

Silicon epitaxial transistors — PZTA05/PZTA06

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PZTA05		–	60	V
	PZTA06		–	80	V
V_{CEO}	collector-emitter voltage	open base			
	PZTA05		–	60	V
	PZTA06		–	80	V
V_{EBO}	emitter-base voltage	open collector	–	4	V
I_C	collector current	DC value	–	500	mA
P_{tot}	total power dissipation	T_{amb} = 25 °C note 1	–	1.5	W
T_{stg}	storage temperature range		−65	150	°C
T_j	junction storage		–	150	°C

Note

1. Mounted on a ceramic substrate: area = 10 x 8 mm; thickness = 0.7 mm.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	NOM.	UNIT
$R_{th\ j-a}$	from junction to ambient	on PCB	83.3	K/W

Silicon epitaxial transistors PZTA05/PZTA06

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = 1 mA; I_B = 0; t_p = 300 μs; δ = 0.02			
	PZTA05		60	–	V
	PZTA06		80	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_C = 0; I_E = 100 μA	4	–	V
I_{CEO}	collector cut-off current	V_{CE} = 60 V; I_B = 0	–	0.1	μA
I_{CBO}	collector cut-off current	I_E = 0			
		V_{CB} = 60 V	–	0.1	μA
		V_{CB} = 80 V	–	0.1	μA
$V_{CE\ sat}$	collector-emitter saturation voltage	I_C = 100 mA; I_B=10 mA	–	0.25	V
$V_{BE(on)}$	base-emitter on voltage	I_C = 100 mA V_{CE} = 1 V	–	1.2	V
h_{FE}	DC current gain	V_{CE} = 1 V;			
		I_C = 10 mA;	50	–	
		I_C = 100 mA	50	–	
f_T	transition frequency	V_{CE} = 2 V; I_C = 10 mA; f = 100 MHz	100	–	MHz

SMALL-SIGNAL DARLINGTON TRANSISTORS

NPN small-signal Darlington transistors in a microminiature SMD envelope (SOT-223).

Designed primarily for preamplifier input applications requiring high input impedance.

PNP complement is the PZTA63/64.

QUICK REFERENCE DATA

Collector-emitter voltage $V_{BE} = 0$		V_{CES}	max.	30 V
Collector current (DC)		I_C	max.	300 mA
Total power dissipation up to $T_{amb} = 25\ ^oC$		P_{tot}	max.	1,5 W
Junction temperature		T_j	max.	150 ^oC
DC current gain $I_C = 10$ mA; $V_{CE} = 5$ V	**PZTA13**	h_{FE}	min.	5000
	PZTA14	h_{FE}	min.	10 000
Transition frequency at f = 100 MHz $I_C = 10$ mA; $V_{CE} = 5$ V		f_T	min.	125 MHz

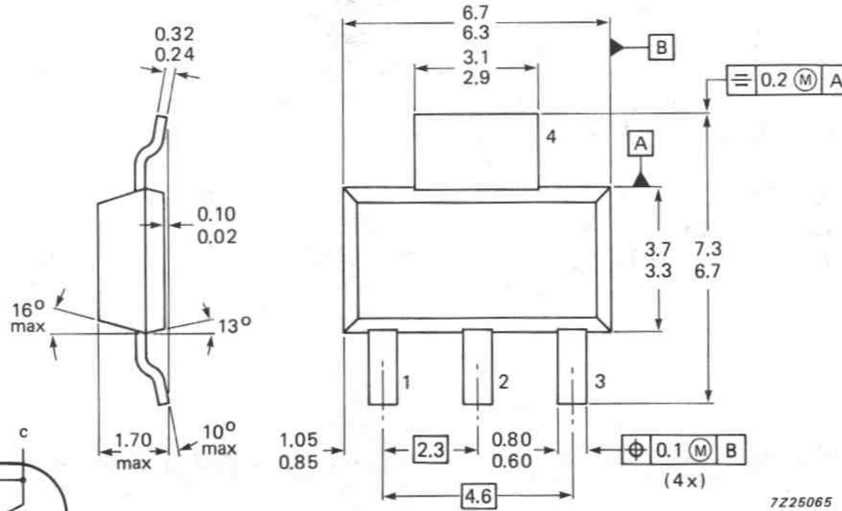
MECHANICAL DATA

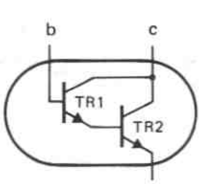
Dimensions in mm

Fig. 1 SOT-223

Pinning

1 = Base
2 = Collector
3 = Emitter
4 = Collector





RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage $V_{BE} = 0$	V_{CES}	max.	30	V
Emitter-base voltage (open collector)	V_{EBO}	max.	10	V
Collector current (DC)	I_C	max.	300	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$*	P_{tot}	max.	1,5	W
Storage temperature range	T_{stg}		−65 to +150	^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	83,3	K/W

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

Collector-emitter breakdown voltage $I_C = 100\ \mu A$		$V_{(BR)CES}$	min.	30	V
Emitter-base cut-off current $V_{BE} = 10\ V$		I_{EBO}	max.	0,1	μA
Collector-base cut-off current $V_{CB} = 30\ V$		I_{CBO}	max.	0,1	μA
DC current gain $I_C = 10\ mA$; $V_{CE} = 5\ V$	**PZTA13**	h_{FE}	min.	5000	
	PZTA14	h_{FE}	min.	10 000	
$I_C = 100\ mA$; $V_{CE} = 5\ V$	**PZTA13**	h_{FE}	min.	10 000	
	PZTA14	h_{FE}	min.	20 000	
Collector-emitter saturation voltage $I_C = 100\ mA$; $I_B = 0,1\ mA$		V_{CEsat}	max.	1,5	V
Base-emitter ON-voltage $I_C = 100\ mA$; $V_{CE} = 5\ V$		$V_{BE(on)}$	max.	2,0	V
Transition frequency at f = 100 MHz $I_C = 10\ mA$; $V_{CE} = 5\ V$		f_T	min.	125	MHz

* Device mounted on an epoxy printed circuit board 40 mm x 40 mm x 1,5 mm; mounting pad for the collector lead min. 6 cm^2.

SILICON EPITAXIAL TRANSISTORS

NPN transistors in a microminiature SMD envelope (SOT-223).
They are primarily intended for use in telephony and professional communication equipment.

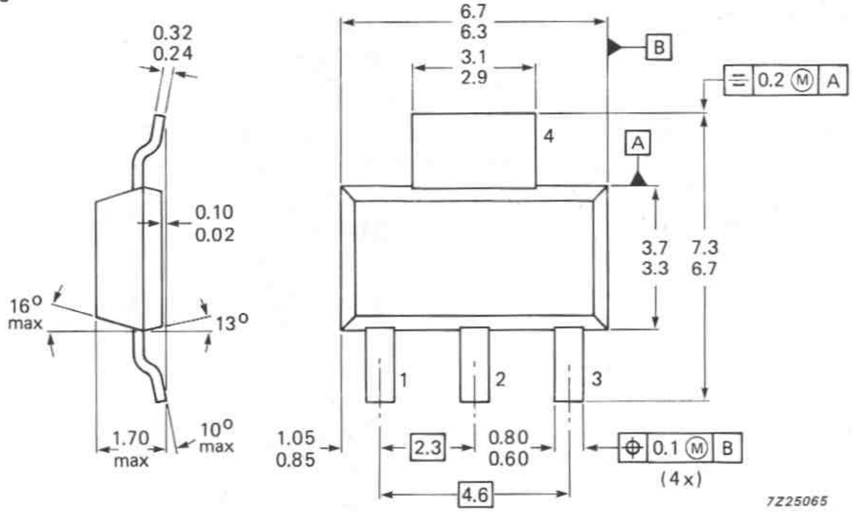
QUICK REFERENCE DATA

			PZTA42	PZTA43	
Collector-base voltage (open emitter)	V_{CBO}	max.	300	200	V
Collector-emitter voltage (open base)	V_{CEO}	max.	300	200	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6		V
Collector current (DC)	I_C	max.	500		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1,5		W
Junction temperature	T_j	max.	150		°C
DC current gain I_C = 10 mA; V_{CE} = 10 V	h_{FE}	>	40		
Transition frequency at f = 35 MHz I_C = 10 mA; V_{CE} = 20 V	f_T	>	50		MHz
Feedback capacitance at f = 1 MHz I_C = 0; V_{CE} = 20 V	C_{re}	<	3	4	pF

MECHANICAL DATA

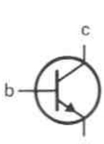
Dimensions in mm

Fig. 1 SOT-223



Pinning

1 = Base
2 = Collector
3 = Emitter
4 = Collector



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			PZTA42	PZTA43	
Collector-base voltage (open emitter)	V_{CBO}	max.	300	200	V
Collector-emitter voltage (open base)	V_{CEO}	max.	300	200	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6		V
Collector current (DC)	I_C	max.	500		mA
Total power dissipation* up to T_{amb} = 25 °C	P_{tot}	max.	1,5		W
Storage temperature range	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL CHARACTERISTICS

Thermal resistance from junction to ambient*	$R_{th\ j\text{-}a}$	=	83,3	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			PZTA42	PZTA43	
Collector-emitter breakdown voltage** I_C = 1 mA; I_B = 0	$V_{(BR)CEO}$	>	300	200	V
Collector-base breakdown voltage I_C = 100 μA; I_E = 0	$V_{(BR)CBO}$	>	300	200	V
Emitter-base breakdown voltage I_E = 100 μA; I_C = 0	$V_{(BR)EBO}$	>	6	6	V
Collector cut-off current I_E = 0; V_{CB} = 200 V	I_{CBO}	<	0,1	–	μA
I_E = 0; V_{CB} = 160 V	I_{CBO}	<	–	0,1	μA
Emitter cut-off current I_C = 0; V_{BE} = 6 V	I_{EBO}	<	0,1	–	μA
I_C = 0; V_{BE} = 4 V	I_{EBO}	<	–	0,1	μA
Feedback capacitance at f = 1 MHz I_E = 0; V_{CB} = 20 V	C_{re}	<	3	4	pF

* Device mounted on an epoxy printed circuit board 40 mm x 40 mm x 1,5 mm; mounting pad for the collector lead min. 6 cm^2.

** Pulse test conditions t_p = 300 μs; δ = 0,02.

Saturation voltages				
I_C = 20 mA; I_B = 2 mA	V_{CEsat}	<	0,5	V
	V_{BEsat}	<	0,9	V
DC current gain				
I_C = 1 mA; V_{CE} = 10 V		>	25	
I_C = 10 mA; V_{CE} = 10 V	h_{FE}	>	40	
I_C = 30 mA; V_{CE} = 10 V		>	40	
Transition frequency at f = 100 MHz				
I_C = 10 mA; V_{CE} = 20 V	f_T	>	50	MHz

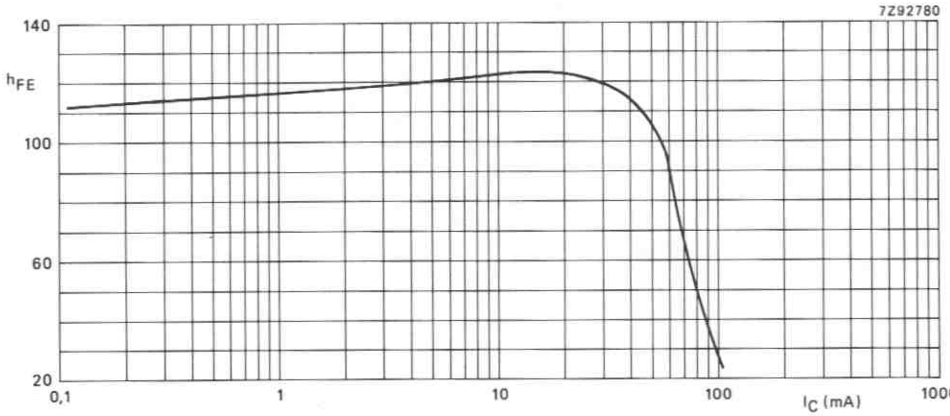


Fig. 2 T_j = 25 °C; V_{CE} = 20 V; typical values.

Philips Components

Data sheet	
status	Preliminary specification
date of issue	April 1991

PZTA55/PZTA56
Silicon epitaxial transistors

DESCRIPTION

PNP transistors in a microminiature plastic envelope intended for surface mounted (SMD) applications.They are primarily intended for use in telephony and professional communication equipment.

PINNING - SOT223

PIN	DESCRIPTION
1	base
2	collector
3	emitter
4	collector

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$-V_{CBO}$	collector-base voltage	open emitter			
	PZTA55		–	60	V
	PZTA56		–	80	V
$-V_{CEO}$	collector-emitter voltage	open base			
	PZTA55		–	60	V
	PZTA56		–	80	V
$-V_{EBO}$	emitter-base voltage	open collector	–	4	V
$-I_C$	collector current	DC value	–	500	mA
P_{tot}	total power dissipation	T_{amb} = 25 °C	–	1.5	W
h_{FE}	DC current gain	$-I_C$ = 100 mA; $-V_{CE}$ = 1 V	50	–	
f_T	transition frequency	$-I_C$ = 100 mA; $-V_{CE}$ = 1 V; f = 100 MHz	50	–	MHz
$V_{CE\ sat}$	collector-emitter saturation voltage	$-I_C$ = 100 mA; I_B = 10 mA	–	0.25	V

PIN CONFIGURATION

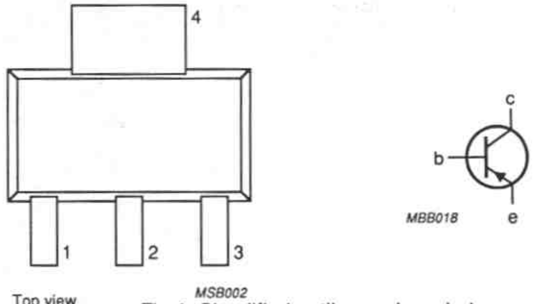


Fig.1 Simplified outline and symbol.

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$-V_{CBO}$	collector-base voltage	open emitter			
	PZTA55		–	60	V
	PZTA56		–	80	V
$-V_{CEO}$	collector-emitter voltage	open base			
	PZTA55		–	60	V
	PZTA56		–	80	V
$-V_{EBO}$	emitter-base voltage	open collector	–	4	V
$-I_C$	collector current	DC value	–	500	mA
P_{tot}	total power dissipation	T_{amb} = 25 °C note 1	–	1.5	W
T_{stg}	storage temperature range		–65	150	°C
T_j	junction storage		–	150	°C

Note

1. Mounted on a ceramic substrate: area = 10 x 8 mm; thickness = 0.7 mm.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	NOM.	UNIT
$R_{th\ j\text{-}a}$	from junction to ambient	on PCB	83.3	K/W

Silicon epitaxial transistors PZTA55/PZTA56

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$-V_{(BR)CEO}$	collector-emitter breakdown voltage	$-I_C$ = 1 mA; I_B = 0; t_p = 300 μs; δ = 0.02			
	PZTA55		60	–	V
	PZTA56		80	–	V
$-V_{(BR)EBO}$	emitter-base breakdown voltage	$-I_C$ = 0; I_E = 100 μA	4	–	V
$-I_{CEO}$	collector cut-off current	$-V_{CE}$ = 60 V; I_B = 0	–	0.1	μA
$-I_{CBO}$	collector cut-off current	I_E = 0			
		$-V_{CB}$ = 60 V;	–	0.1	μA
		$-V_{CB}$ = 80 V	–	0.1	μA
$-V_{CE\ sat}$	collector-emitter saturation voltage	$-I_C$ = 100 mA; $-I_B$ = 10 mA	–	0.25	V
$-V_{BE(on)}$	base-emitter on voltage	$-I_C$ = 100 mA; $-V_{CE}$ = 1 V	–	1.2	V
h_{FE}	DC current gain	$-V_{CE}$ = 1 V;			
		$-I_C$ = 10 mA;	50	–	
		$-I_C$ = 100 mA	50	–	
f_T	transition frequency	$-V_{CE}$ = 1 V; $-I_C$ = 100 mA; f = 100 MHz	50	–	MHz

SMALL-SIGNAL DARLINGTON TRANSISTORS

PNP small-signal Darlington transistors in a microminiature SMD envelope (SOT-223).
Designed primarily for preamplifier input applications requiring high input impedance.
NPN complement is the PZTA13/14.

QUICK REFERENCE DATA

Collector-emitter voltage $V_{BE} = 0$		$-V_{CES}$	max.	30 V
Collector current (DC)		$-I_C$	max.	500 mA
Total power dissipation up to $T_{amb} = 25\ ^oC$		P_{tot}	max.	1,5 W
Junction temperature		T_j	max.	150 ^oC
DC current gain $-I_C = 10$ mA; $-V_{CE} = 5$ V	**PZTA63**	h_{FE}	min.	5000
	PZTA64	h_{FE}	min.	10 000
Transition frequency at f = 100 MHz $-I_C = 10$ mA; $-V_{CE} = 50$ V		f_T	min.	125 MHz

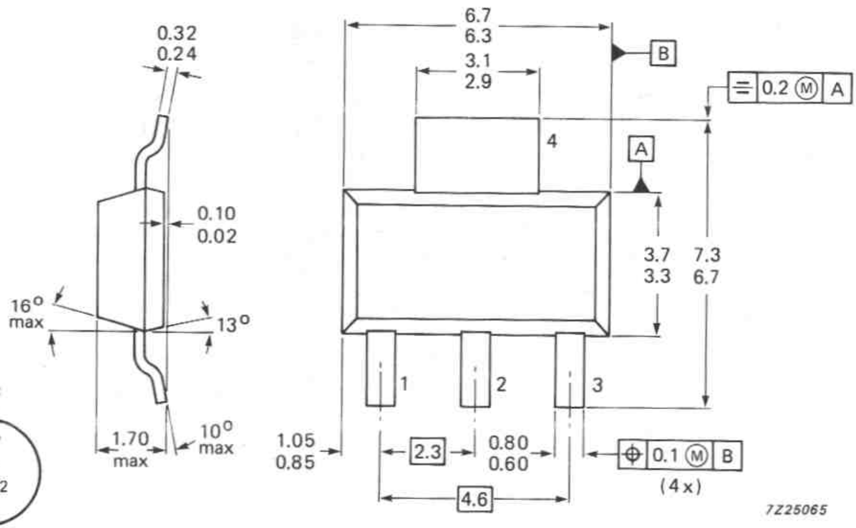
MECHANICAL DATA

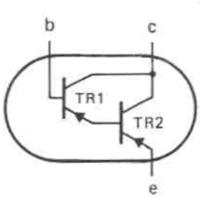
Dimensions in mm

Fig. 1 SOT-223

Pinning

1 = Base
2 = Collector
3 = Emitter
4 = Collector





RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	30	V
Collector-emitter voltage $V_{BE} = 0$	$-V_{CES}$	max.	30	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	10	V
Collector current (DC)	$-I_C$	max.	500	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$*	P_{tot}	max.	1,5	W
Storage temperature range	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	83,3	K/W

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

Collector-emitter breakdown voltage $-I_C = 100\ \mu A$		$-V_{(BR)CES}$	min.	30	V
Emitter-base cut-off current $-V_{BE} = 10\ V$		$-I_{EBO}$	max.	0,1	μA
Collector-base cut-off current $-V_{CB} = 30\ V$		$-I_{CBO}$	max.	0,1	μA
DC current gain $-I_C = 10\ mA; -V_{CE} = 5\ V$	**PZTA63**	h_{FE}	min.	5000	
	PZTA64	h_{FE}	min.	10 000	
$-I_C = 100\ mA; -V_{CE} = 5\ V$	**PZTA63**	h_{FE}	min.	10 000	
	PZTA64	h_{FE}	min.	20 000	
Collector-emitter saturation voltage $-I_C = 100\ mA; -I_B = 0,1\ mA$		$-V_{CEsat}$	max.	1,5	V
Base-emitter ON-voltage $-I_C = 100\ mA; -V_{CE} = 5\ V$		$-V_{BE(on)}$	max.	2,0	V
Transition frequency at f = 100 MHz $-I_C = 10\ mA; -V_{CE} = 50\ V; T_{amb} = 25\ ^oC$		f_T	min.	125	MHz

* Device mounted on an epoxy printed circuit board 40 mm x 40 mm x 1,5 mm; mounting pad for the collector lead min. 6 cm^2.

SILICON EPITAXIAL TRANSISTORS

PNP transistors in a microminiature SMD envelope (SOT-223).
They are primarily intended for use in telephony and professional communication equipment.

QUICK REFERENCE DATA

			PZTA92	PZTA93	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	300	200	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	300	200	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5		V
Collector current (DC)	$-I_C$	max.	500		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1,5		W
DC current gain $-I_C$ = 10 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	40		
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 20 V	f_T	min.	50		MHz
Collector-base capacitance at f = 1 MHz I_E = 0; $-V_{CB}$ = 20 V	C_{cb}	max.	6	8	pF

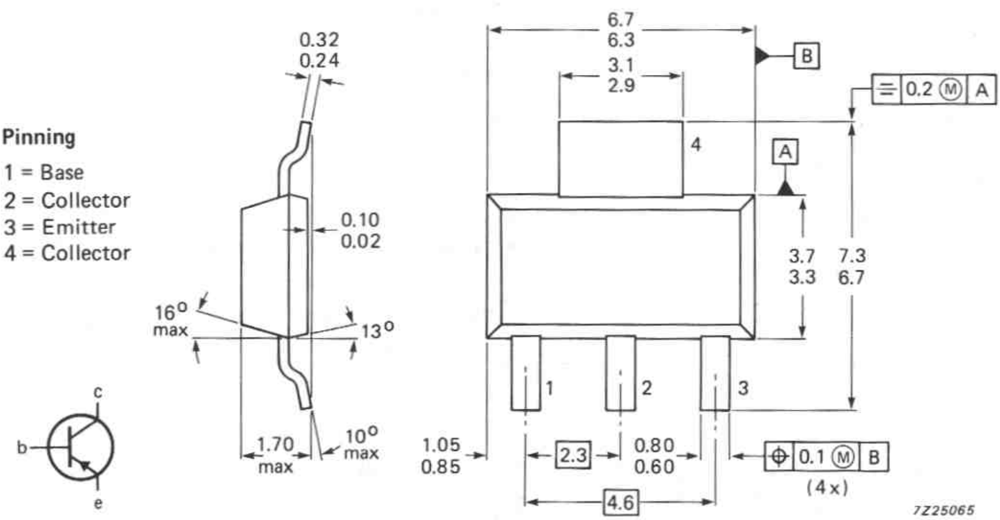
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-223

Pinning

1 = Base
2 = Collector
3 = Emitter
4 = Collector



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			PZTA92	PZTA93	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	300	200	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	300	200	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5		V
Collector current (DC)	$-I_C$	max.	500		mA
Total power dissipation * up to T_{amb} = 25 °C	P_{tot}	max.	1,5		W
Storage temperature range	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL CHARACTERISTICS

Thermal resistance from junction to ambient*	$R_{th\ j\text{-}a}$	=	83,3	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			PZTA92	PZTA93	
Collector-emitter breakdown voltage $-I_C$ = 1 mA; I_B = 0	$-V_{(BR)CEO}$	min.	300	200	V
Collector-base breakdown voltage $-I_C$ = 100 μA; I_E = 0	$-V_{(BR)CBO}$	min.	300	200	V
Collector cut-off current $-V_{CB}$ = 200 V; I_E = 0	$-I_{CBO}$	max.	0,25	–	μA
$-V_{CB}$ = 160 V; I_E = 0	$-I_{CBO}$	max.	–	0,25	μA
Emitter-base breakdown voltage $-I_E$ = 100 μA; I_C = 0	$-V_{(BR)EBO}$	min.	5		V
Emitter cut-off current I_C = 0; $-V_{BE}$ = 3 V	$-I_{EBO}$	max.	0,1		μA
Collector-base capacitance at f = 1 MHz; I_E = 0; $-V_{CB}$ = 20 V	C_{cb}	max.	6	8	pF
Saturation voltages $-I_C$ = 20 mA; $-I_B$ = 2 mA	$-V_{CEsat}$	max.	0,5		V
$-I_C$ = 20 mA; $-I_B$ = 2 mA	$-V_{BEsat}$	max.	0,9		V
DC current gain** $-I_C$ = 1 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	25		
$-I_C$ = 10 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	40		
$-I_C$ = 30 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	25		

* Device mounted on an epoxy printed circuit board 40 mm x 40 mm x 1,5 mm; mounting pad for the collector lead min. 6 mm².

** Pulse test conditions: t_p = 300 μs; duty cycle ≤2%.

Philips Components

Data sheet	
status	Product specification
date of issue	April 1991

2N7002
N-channel vertical D-MOS transistor

FEATURES

- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No secondary breakdown.

DESCRIPTION

N-channel enhancement mode vertical D-MOS transistor in a SOT23 envelope. It is designed for use as a Surface Mounted Device (SMD) in thin and thick-film circuits, with applications in relay, high-speed and line transformer drivers.

PINNING - SOT23

PIN	DESCRIPTION
1	gate
2	source
3	drain

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
V_{DS}	drain-source voltage		60	V
I_D	drain current	DC value	180	mA
$R_{DS(on)}$	drain-source on-resistance	I_D = 500 mA V_{GS} = 10 V	5	Ω
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA V_{GS} = V_{DS}	3	V

PIN CONFIGURATION

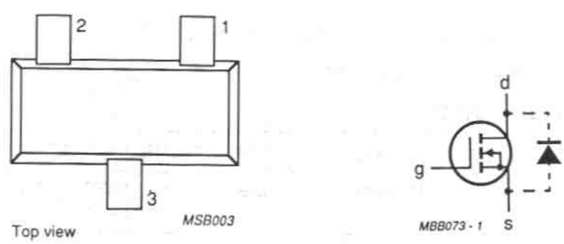


Fig.1 Simplified outline and symbol.

N-channel vertical D-MOS transistor

2N7002

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage		–	60	V
$\pm V_{GSO}$	gate-source voltage	open drain	–	40	V
I_D	drain current	DC value	–	180	mA
I_{DM}	drain current	peak value	–	800	mA
P_{tot}	total power dissipation	T_{amb} = 25 °C			
		(note 1)	–	300	mW
		(note 2)	–	250	mW
T_{stg}	storage temperature range		–65	150	°C
T_j	junction temperature		–	150	°C

Notes

1. Mounted on a ceramic substrate measuring 10 x 8 x 0.7 mm.
2. Mounted on a printed circuit board.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	from junction to ambient	note 1	430	K/W
		note 2	500	K/W

Notes

1. Mounted on a ceramic substrate measuring 10 x 8 x 0.7 mm.
2. Mounted on a printed circuit board.

N-channel vertical D-MOS transistor

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 10 μA V_{GS} = 0	60	90	–	V
I_{DSS}	drain-source leakage current	V_{DS} = 48 V V_{GS} = 0	–	–	1	μA
$\pm I_{GSS}$	gate-source leakage current	V_{DS} = 0 $\pm V_{GS}$ = 15 V	–	–	10	nA
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA $V_{GS} = V_{DS}$	0.8	–	3	V
$R_{DS(on)}$	drain-source on-resistance	I_D = 500 mA V_{GS} = 10 V	–	2.5	5	Ω
		I_D = 75 mA V_{GS} = 4.5 V	–	–	5.3	Ω
$\|Y_{fs}\|$	transfer admittance	I_D = 200 mA V_{DS} = 10 V	100	200	–	mS
C_{iss}	input capacitance	V_{DS} = 10 V V_{GS} = 0 f = 1 MHz	–	25	40	pF
C_{oss}	output capacitance	V_{DS} = 10 V V_{GS} = 0 f = 1 MHz	–	22	30	pF
C_{rss}	feedback capacitance	V_{DS} = 10 V V_{GS} = 0 f = 1 MHz	–	6	10	pF
Switching times (see Figs 2 and 3)						
t_{on}	turn-on time	I_D = 200 mA V_{DD} = 50 V V_{GS} = 0 to 10 V	–	–	10	ns
t_{off}	turn-off time	I_D = 200 mA V_{DD} = 50 V V_{GS} = 0 to 10 V	–	–	15	ns

N-channel vertical D-MOS transistor

2N7002

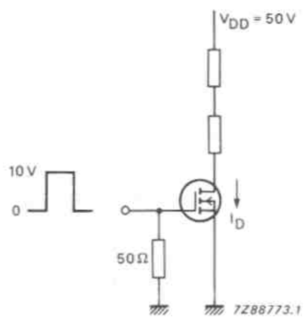


Fig.2 Switching time test circuit.

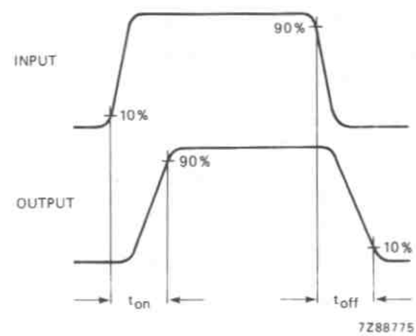
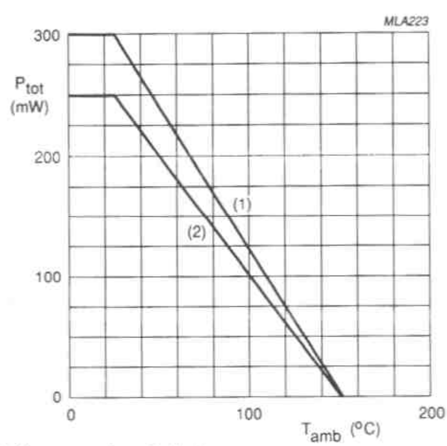


Fig.3 Input and output waveforms.



(1) On ceramic substrate.

(2) On printed circuit board.

Fig.4 Power derating curve.

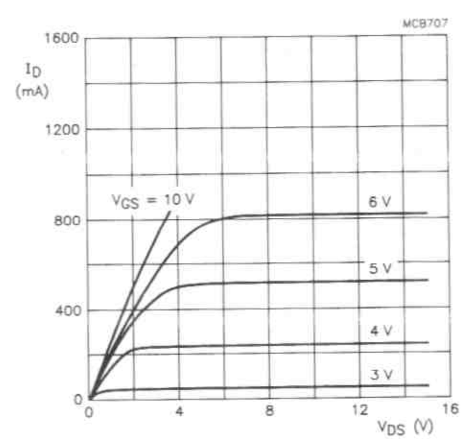


Fig.5 Typical output characteristics; $T_j = 25$ °C.

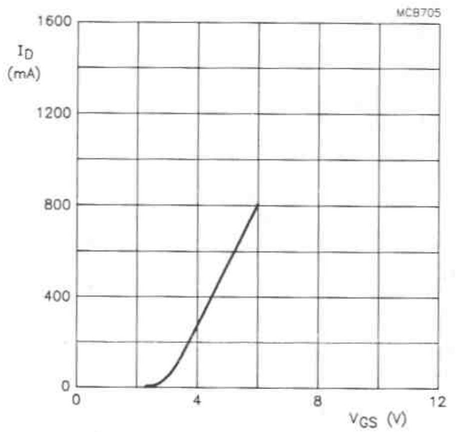


Fig.6 Typical transfer characteristic; V_{DS} = 10 V; T_j = 25 °C.

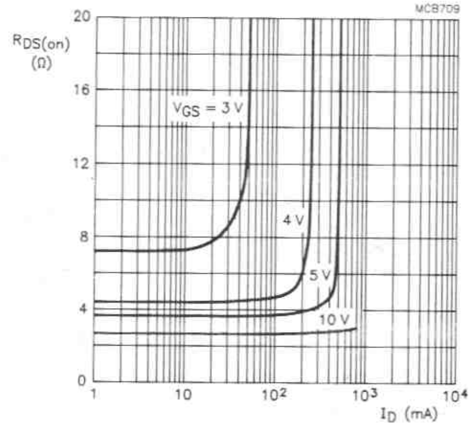


Fig.7 Typical on-resistance as a function of drain current; T_j = 25 °C.

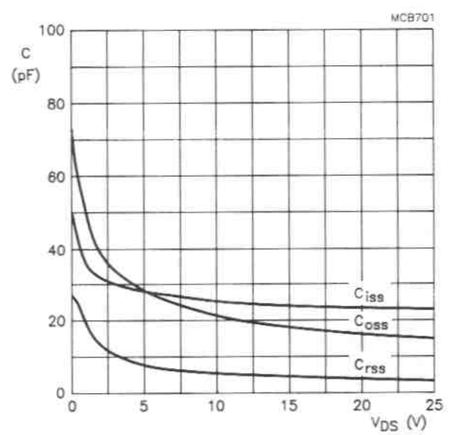
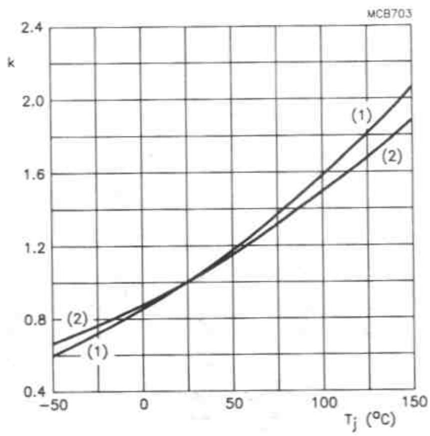


Fig.8 Typical capacitances as a function of drain-source voltage; V_{GS} = 0; f = 1 MHz; T_j = 25 °C.

N-channel vertical D-MOS transistor

2N7002



(1) I_D = 500 mA; V_{GS} = 10 V.

(2) I_D = 75 mA; V_{GS} = 4.5 V.

Fig.9 Temperature coefficient of drain-source on-resistance; $k = \frac{R_{DS(on)} \text{ at } T_j}{R_{DS(on)} \text{ at } 25\ °C}$; typical $R_{DS(on)}$.

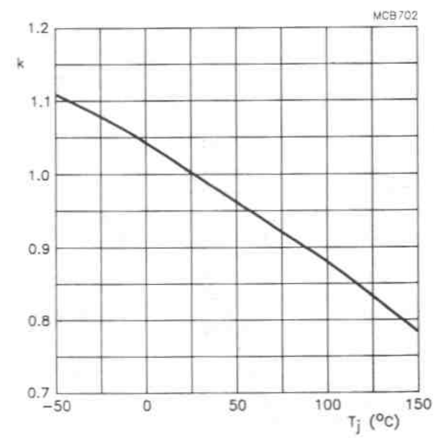
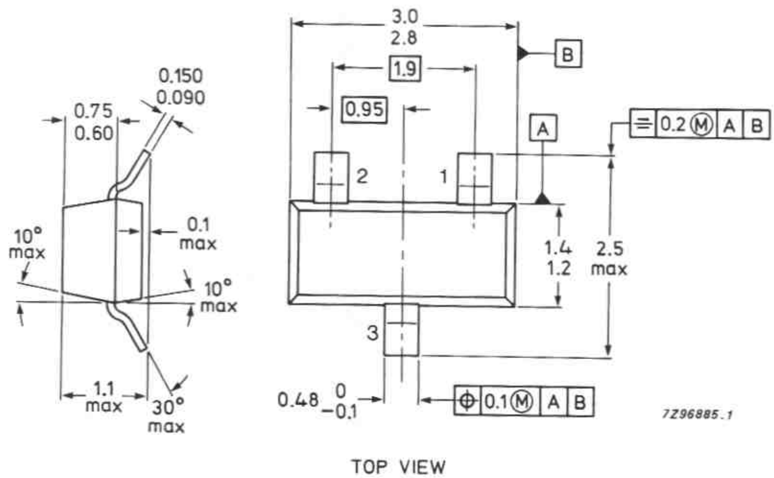


Fig.10 Temperature coefficient of gate-source threshold voltage; $k = \frac{V_{GS(th)} \text{ at } T_j}{V_{GS(th)} \text{ at } 25\ °C}$; typical $V_{GS(th)}$ at 1 mA.

PACKAGE OUTLINE



Dimensions in mm.

Marking code: 2N7002 = 702.

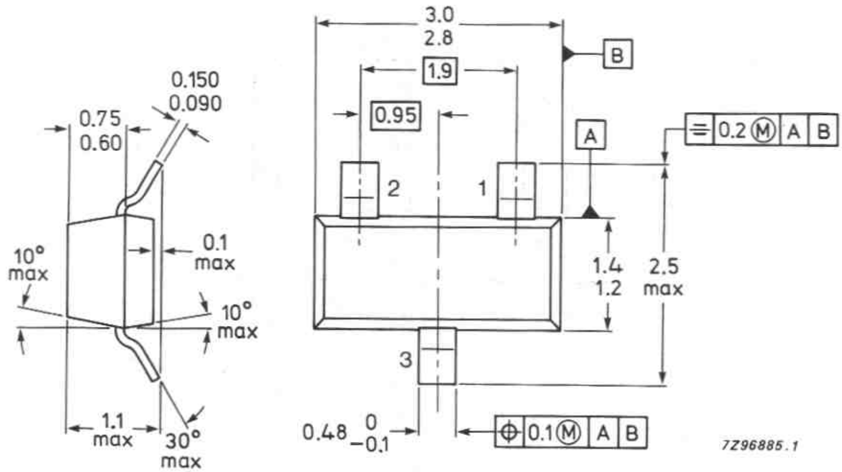
Fig.11 SOT23.

Envelopes

MECHANICAL DATA
(European projection)

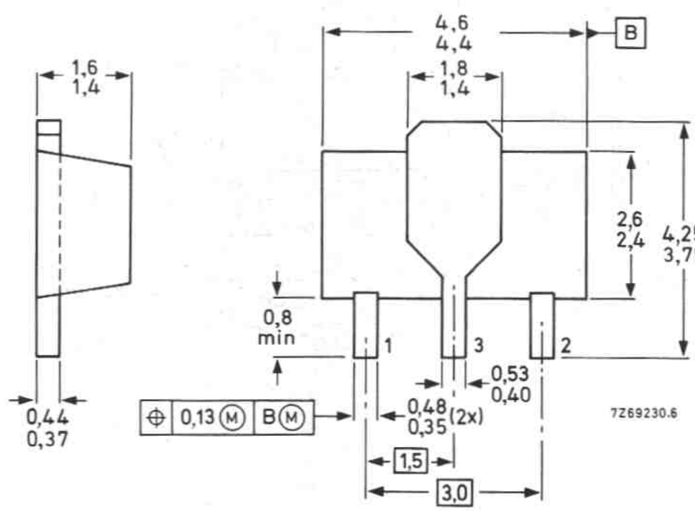
Dimensions in mm

SOT-23



TOP VIEW

SOT-89



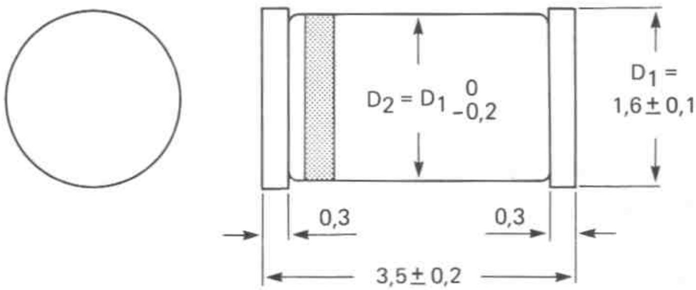
BOTTOM VIEW

MECHANICAL DATA

(European projection)

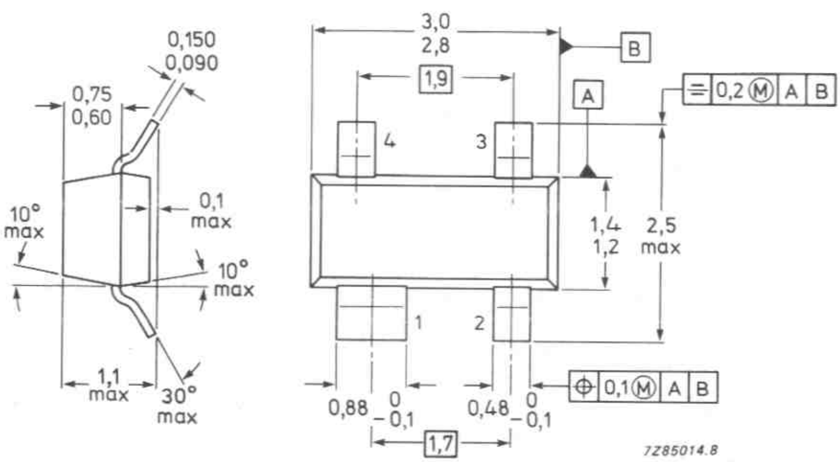
Dimensions in mm

SOD-80



7Z91084.1

SOT-143

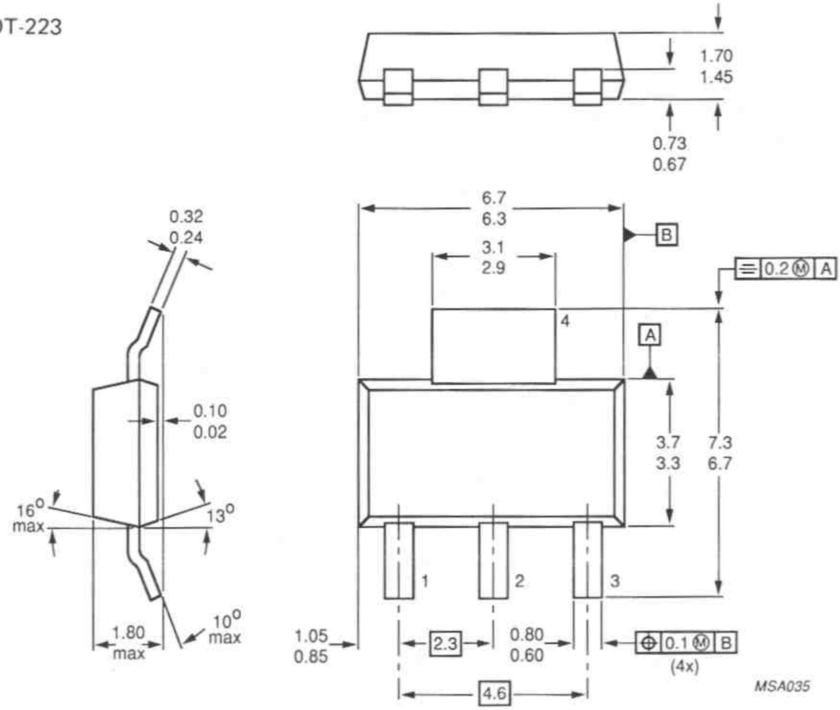


TOP VIEW

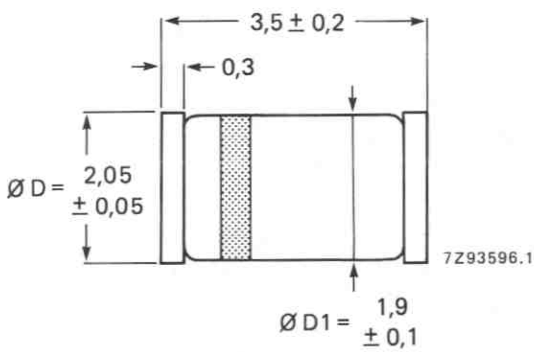
MECHANICAL DATA
(European projection)

Dimensions in mm

SOT-223



SOD-87



NOTES

NOTES

DATA HANDBOOK SYSTEM

DATA HANDBOOK SYSTEM

Our Data Handbook System comprises more than 60 books with specifications on electronic components, subassemblies and materials. It is made up of seven series of handbooks:

INTEGRATED CIRCUITS

DISCRETE SEMICONDUCTORS

DISPLAY COMPONENTS

PASSIVE COMPONENTS*

PROFESSIONAL COMPONENTS**

MAGNETIC PRODUCTS*

LIQUID CRYSTAL DISPLAYS

The contents of each series are listed on pages iii to ix.

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Product specialists are at your service and enquiries will be answered promptly.

* Will replace the Components and materials (green) series of handbooks.

** Will replace the Electron tubes (blue) series of handbooks.

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code	handbook title
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IC05	**Advanced Low-power Schottky (ALS) Logic Series**
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IC07	**Advanced CMOS logic (ACL)**
Supplement to IC07	**Advanced CMOS logic (ACL)**
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IC09	**TTL logic series**
IC10	**Memories** MOS, TTL, ECL
IC11	**Linear Products**
IC12	**I^2C-bus compatible ICs**
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T13	**PC08**	**Image intensifiers**
T15	**PC09**	**Dry-reed switches**
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