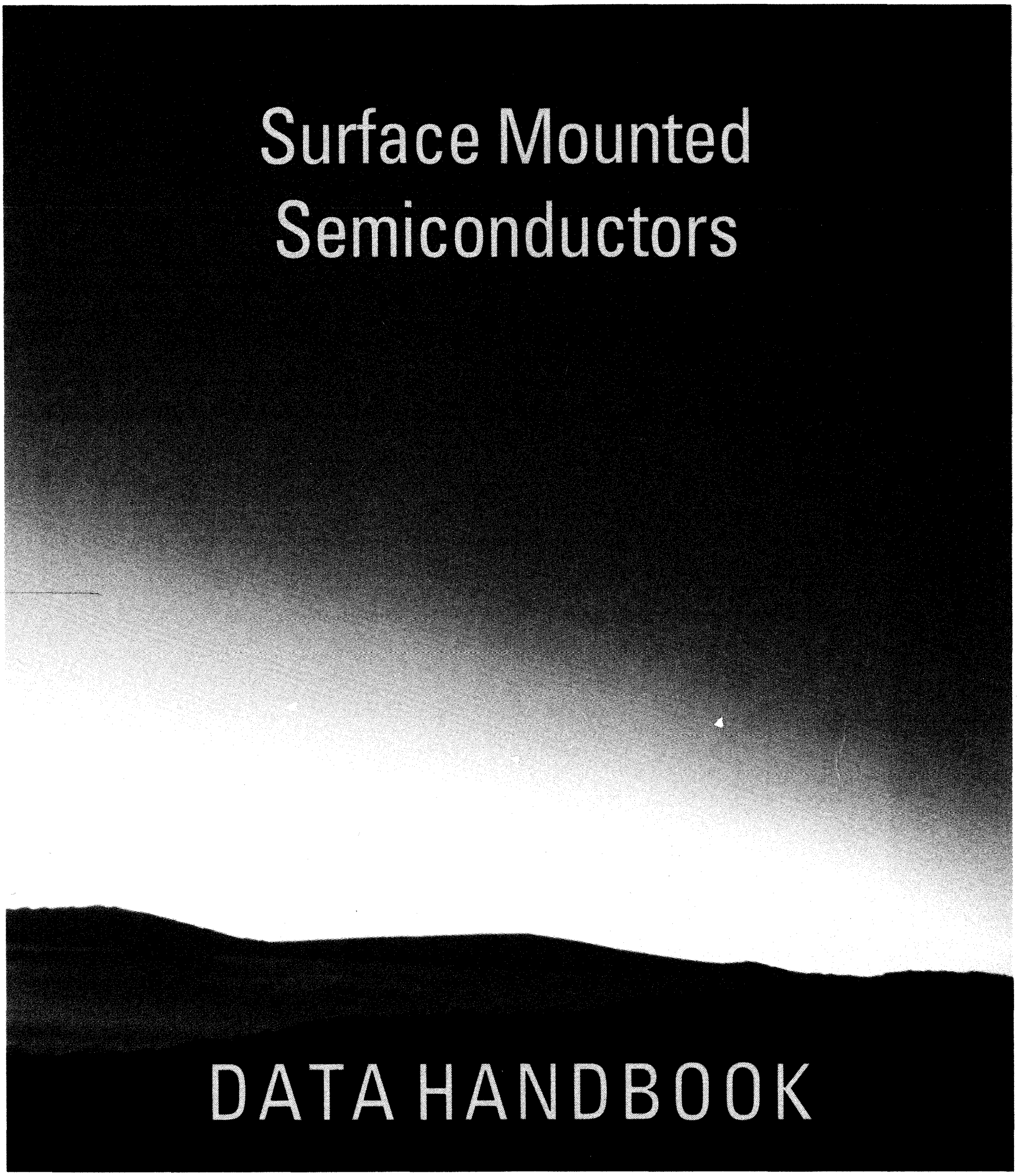

Surface Mounted Semiconductors

DATA HANDBOOK

BOOK SC10b 1994

Philips Semiconductors

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QUALITY ASSURED

Our quality system focuses on the continuing high quality of our components and the best possible service for our customers. We have a three-sided quality strategy: we apply a system of total quality control and assurance; we operate customer-oriented dynamic improvement programmes; and we promote a partnering relationship with our customers and suppliers.

PRODUCT SAFETY

In striving for state-of-the-art perfection, we continuously improve components and processes with respect to environmental demands. Our components offer no hazard to the environment in normal use when operated or stored within the limits specified in the data sheet.

Some components unavoidably contain substances that, if exposed by accident or misuse, are potentially hazardous to health. Users of these components are informed of the danger by warning notices in the data sheets supporting the components. Where necessary the warning notices also indicate safety precautions to be taken and disposal instructions to be followed. Obviously users of these components, in general the set-making industry, assume responsibility towards the consumer with respect to safety matters and environmental demands.

All used or obsolete components should be disposed of according to the regulations applying at the disposal location. Depending on the location, electronic components are considered to be 'chemical', 'special' or sometimes 'industrial' waste. Disposal as domestic waste is usually not permitted.

Surface Mounted Semiconductors

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PART B

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

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BF821	SOT23	pnp	BF421	BF820	591
BF822	SOT23	npn	BF422	BF823	587
BF823	SOT23	pnp	BF423	BF822	591
BF824	SOT23	pnp	BF324		595
BF840	SOT23	npn	BF240		601
BF841	SOT23	npn	BF241		601
BF901	SOT143	FET			603
BF901R	SOT143R	FET			603
BF904	SOT143	FET			607
BF904R	SOT143R	FET			607
BF908	SOT143	FET			613
BF908R	SOT143R	FET			613
BF989	SOT143	FET	BF960		619
BF990A	SOT143	FET	BF980A		623
BF990AR	SOT143R	FET	BF980A		627
BF991	SOT143	FET	BF981		629
BF992	SOT143	FET	BF982		633
BF994S	SOT143	FET	BF964S		639
BF996S	SOT143	FET	BF966S		643
BF997	SOT143	FET	BF965		647
BF998	SOT143	FET	BF988		651
BF998R	SOT143R	FET	BF988		661
BFG16A	SOT223	npn			671
BFG17A	SOT143	npn			679
BFG25AX	SOT143	npn			687
BFG31	SOT223	pnp			703
BFG33	SOT143	npn			709
BFG33X	SOT143	npn			709
BFG35	SOT223	npn	BFQ34T, BFG34	BFG55	723
BFG55	SOT223	pnp		BFG35	737
BFG67	SOT143	npn	BFG65		743
BFG67X	SOT143	npn			743
BFG92A	SOT143	npn			763
BFG92AX	SOT143	npn			763
BFG93A	SOT143	npn			783
BFG93AX	SOT143	npn			783
BFG94	SOT223	npn			801
BFG97	SOT223	npn	BFR96		815
BFG135	SOT223	npn	BFQ135		829

TYPE NUMBER	PACKAGE	DEVICE TYPE	NEAREST CONVENTIONAL TYPE(S)	COMPLEMENT	PAGE
BFG197	SOT143	npn			843
BFG197X	SOT143	npn			843
BFG198	SOT223	npn	BFG195		863
BFG505	SOT143	npn			875
BFG505/X	SOT143	npn			875
BFG505/XR	SOT143R	npn			875
BFG520	SOT143	npn			897
BFG520/X	SOT143	npn			897
BFG520/XR	SOT143R	npn			897
BFG540	SOT143	npn			919
BFG540/X	SOT143	npn			919
BFG540/XR	SOT143R	npn			919
BFG541	SOT223	npn			941
BFQ17	SOT89	npn	BFW16A		963
BFQ18A	SOT89	npn	BFQ34		967
BFQ19	SOT89	npn	BFR96		971
BFQ67	SOT23	npn	BFQ65		975
BFQ67W	SOT323	npn	BFQ65		993
BFQ149	SOT89	pnp			1013
BFQ166	SOT223	npn			1017
BFQ256	SOT223	pnp			1021
BFQ256A	SOT223	pnp			1021
BFR30	SOT23	FET	BFW11, BF245		1049
BFR31	SOT23	FET	BFW12, BF245		1049
BFR53	SOT23	npn	BFW30, BFW93		1059
BFR92	SOT23	npn	BFR90	BFT92	1065
BFR92A	SOT23	npn	BFR90		1073
BFR92AW	SOT323	npn	BFR90		1089
BFR93	SOT23	npn	BFR91	BFT93	1091
BFR93A	SOT23	npn	BFR91		1099
BFR93AW	SOT323	npn	BFR91		1115
BFR101A	SOT143	FET			1117
BFR101B	SOT143	FET			1117
BFR106	SOT23	npn			1119
BFR200	SOT143	FET			1127
BFR505	SOT23	npn			1131
BFR520	SOT23	npn			1153
BFR541	SOT103	npn			1175
BFS17	SOT23	npn	BFY90, BFW92		1177

TYPE NUMBER	PACKAGE	DEVICE TYPE	NEAREST CONVENTIONAL TYPE(S)	COMPLEMENT	PAGE
BFS17A	SOT23	npn			1181
BFS17W	SOT323	npn			1189
BFS18	SOT23	npn	BF495		1191
BFS19	SOT23	npn	BF494		1191
BFS20	SOT23	npn	BF199		1197
BFS25A	SOT323	npn			1203
BFS505	SOT323	npn			1223
BFS520	SOT323	npn			1245
BFS540	SOT323	npn			1267
BFT25	SOT23	npn	BFT24		1289
BFT25A	SOT23	npn			1295
BFT46	SOT23	FET	BFW13, BF245		1311
BFT92	SOT23	pnp	BFQ51; 52	BFR92	1319
BFT92W	SOT323	pnp	BFQ51; 52	BFR92	1325
BFT93	SOT23	pnp	BFQ23; 24	BFR93	1326
BFT93W	SOT323	pnp			1332
BLT50	SOT223	npn			1333
BLT80	SOT223	npn			1341
BLT81	SOT223	npn			1349
BLU56	SOT223	npn			1357
BLU86	SOT223	npn			1365
BRY61	SOT23	Pnpn	BRY56, BRY39		1373
BRY62	SOT143	Pnpn	BRY39		1379
BSD22	SOT143	FET			1385
BSN20	SOT23	FET			1389
BSP15	SOT223	pnp	2N5415	BSP20	1393
BSP16	SOT223	pnp	2N5416	BSP19	1393
BSP19	SOT223	npn	2N3439	BSP16	1395
BSP20	SOT223	npn	2N3440	BSP15	1395
BSP30	SOT223	pnp	2N4030	BSP40	1397
BSP31	SOT223	pnp	2N4032	BSP41	1397
BSP32	SOT223	pnp	2N4031	BSP42	1397
BSP33	SOT223	pnp	2N4033	BSP43	1397
BSP40	SOT223	npn	BSX46-10	BSP30	1401
BSP41	SOT223	npn	BSX46-16	BSP31	1401
BSP42	SOT223	npn		BSP32	1401
BSP43	SOT223	npn	2N3019	BSP33	1401
BSP50	SOT223	npn	BSR50	BSP60	1405
BSP51	SOT223	npn	BSR51	BSP61	1405

TYPE NUMBER	PACKAGE	DEVICE TYPE	NEAREST CONVENTIONAL TYPE(S)	COMPLEMENT	PAGE
BSP52	SOT223	npn	BSR52	BSP62	1405
BSP60	SOT223	pnp	BSR60	BSP50	1409
BSP61	SOT223	pnp	BSR61	BSP51	1409
BSP62	SOT223	pnp	BSR62	BSP52	1409
BSP89	SOT223	FET	BSS89	BSP92	1413
BSP92	SOT223	FET	BSS92	BSP89	1417
BSP103	SOT223	FET			1421
BSP105	SOT223	FET			1421
BSP106	SOT223	FET			1425
BSP107	SOT223	FET			1431
BSP108	SOT223	FET			1437
BSP109	SOT223	FET			1421
BSP110	SOT223	FET			1441
BSP120	SOT223	FET			1445
BSP121	SOT223	FET			1449
BSP122	SOT223	FET			1455
BSP124	SOT223	FET			1457
BSP126	SOT223	FET			1463
BSP127	SOT223	FET			1469
BSP128	SOT223	FET			1471
BSP130	SOT223	FET			1473
BSP152	SOT223	FET			1479
BSP205	SOT223	FET			1485
BSP206	SOT223	FET			1489
BSP220	SOT223	FET			1493
BSP225	SOT223	FET			1499
BSR12	SOT23	pnp	2N2894A	BSV52	1505
BSR13	SOT23	npn	2N2222, PH2222	BSR15	1511
BSR14	SOT23	npn	2N2222A,PH2222A	BSR16	1511
BSR15	SOT23	pnp	2N2907, PH2907	BSR13	1515
BSR16	SOT23	pnp	2N2907A,PH2907A	BSR14	1515
BSR17A	SOT23	npn	2N3904	BSR18A	1519
BSR18A	SOT23	pnp	2N3906	BSR17A	1523
BSR19	SOT23	npn	2N5550	BSR20	1527
BSR19A	SOT23	npn	2N5551	BSR20A	1527
BSR20	SOT23	pnp	2N5400	BSR19	1531
BSR20A	SOT23	pnp	2N5401	BSR19A	1531
BSR30	SOT89	pnp	2N4030	BSR40	1535
BSR31	SOT89	pnp	2N4032	BSR41	1535

TYPE NUMBER	PACKAGE	DEVICE TYPE	NEAREST CONVENTIONAL TYPE(S)	COMPLEMENT	PAGE
BSR32	SOT89	pnp	2N4031	BSR42	1535
BSR33	SOT89	pnp	2N4033	BSR43	1535
BSR40	SOT89	npn	BSX466	BSR30	1539
BSR41	SOT89	npn	BSX4616	BSR31	1539
BSR42	SOT89	pnp	2N3020	BSR32	1539
BSR43	SOT89	npn	2N3019	BSR33	1539
BSR56	SOT23	FET	2N4856		1543
BSR57	SOT23	FET	2N4857		1543
BSR58	SOT23	FET	2N4858		1543
BSS63	SOT23	pnp	BSS68	BSS64	1547
BSS64	SOT23	npn	BSS38	BSS33	1553
BSS83	SOT143	FET			1557
BSS84	SOT23	FET			1561
BSS87	SOT89	FET			1565
BSS131	SOT23	FET			1569
BSS192	SOT89	FET			1573
BST15	SOT89	pnp	2N5415	BST40	1579
BST16	SOT89	pnp	2N5416	BST39	1579
BST39	SOT89	npn	2N3439	BST16	1583
BST40	SOT89	npn	2N3440	BST15	1583
BST50	SOT89	npn	BSR50, BSS50, BDX42		1587
BST51	SOT89	npn	BSR51, BSS51, BDX43		1587
BST52	SOT89	npn	BSR52, BSS52, BDX44		1587
BST60	SOT89	pnp	BSR60, BSS60, BDX45		1591
BST61	SOT89	pnp	BSR61, BSS61, BDX46		1591
BST62	SOT89	pnp	BSR62, BSS62, BDX47		1591
BST80	SOT89	FET	BST70A		1595
BST82	SOT23	FET	BST72A		1599
BST84	SOT89	FET	BST74A		1603
BST86	SOT89	FET	BST76A		1607
BST120	SOT89	FET			1611
BST122	SOT89	FET			1615
BSV52	SOT23	npn	PH2369, BSX20	BSR12	1619
BT134W	SOT223	triac			1627
BT148W	SOT223	thyristor			1633
BYD17D	SOD87	diode	BYD13D		1639
BYD17G	SOD87	diode	BYD13G		1639
BYD17J	SOD87	diode	BYD13J		1639
BYD17K	SOD87	diode	BYD13K		1639

TYPE NUMBER	PACKAGE	DEVICE TYPE	NEAREST CONVENTIONAL TYPE(S)	COMPLEMENT	PAGE
BYD17M	SOD87	diode	BYD13M		1639
BYD37D	SOD87	diode	BYD33D		1647
BYD37G	SOD87	diode	BYD33G		1647
BYD37J	SOD87	diode	BYD33J		1647
BYD37K	SOD87	diode	BYD33K		1647
BYD37M	SOD87	diode	BYD33M		1647
BYD57	SOD87	diode			1653
BYD77A	SOD87	diode	BYD73A		1659
BYD77B	SOD87	diode	BYD73B		1659
BYD77C	SOD87	diode	BYD73C		1659
BYD77D	SOD87	diode	BYD73D		1659
BYD77E	SOD87	diode	BYD73E		1659
BYD77F	SOD87	diode	BYD73F		1659
BYD77G	SOD87	diode	BYD73G		1659
BYV40	SOT223	diode (2×)			1663
BZD27	SOD87	diode			1669
BZG03	SOD106A	zener diode			1675
BZV49	SOT89	diode	BZV85		1679
BZV55	SOD80C	diode	BZX79, BZX55		1689
BZV80	SOD80	diode			1703
BZV81	SOD80	diode			1703
BZV87	SOD80	diode			1705
BZV90	SOT223	diode	BZX79		1709
BZX84	SOT23	diode	BZX79, BZX55		1719
KTY82/1..	SOT23	temp sensor	KTY81/1		1731
KTY82/2..	SOT23	temp sensor	KTY81/2		1737
KTY85/1..	SOD80	temp sensor	KTY81/1		1743
PBYR2100CT	SOT223	diode (2×)			1747
PBYR280CT	SOT223	diode (2×)			1747
PBYR290CT	SOT223	diode (2×)			1747
PLVA600A	SOT23	diode			1751
PMBD914	SOT23	diode			1755
PMBD2835	SOT23	diode (2×)			1759
PMBD2836	SOT23	diode (2×)			1759
PMBD2837	SOT23	diode (2×)			1763
PMBD2838	SOT23	diode (2×)			1763

TYPE NUMBER	PACKAGE	DEVICE TYPE	NEAREST CONVENTIONAL TYPE(S)	COMPLEMENT	PAGE
PMBD6050	SOT23	diode			1767
PMBD6100	SOT23	diode (2×)			1771
PMBD7000	SOT23	diode			1775
PMBF170	SOT23	FET			1779
PMBF4391	SOT23	FET	2N4391		1783
PMBF4392	SOT23	FET	2N4392		1783
PMBF4393	SOT23	FET	2N4393		1783
PMBF4416	SOT23	FET			1787
PMBF4461A	SOT23	FET			1787
PMBF5484	SOT23	FET			1793
PMBF5485	SOT23	FET			1793
PMBF5486	SOT23	FET			1793
PMBFJ108	SOT23	FET			1801
PMBFJ109	SOT23	FET			1801
PMBFJ110	SOT23	FET			1801
PMBFJ111	SOT23	FET			1805
PMBFJ112	SOT23	FET			1805
PMBFJ113	SOT23	FET			1805
PMBFJ174	SOT23	FET			1809
PMBFJ175	SOT23	FET			1809
PMBFJ176	SOT23	FET			1809
PMBFJ177	SOT23	FET			1809
PMBFJ308	SOT23	FET			1813
PMBFJ309	SOT23	FET			1813
PMBFJ310	SOT23	FET			1813
PMBT2222	SOT23	npn	2N2222, PM2222	PMBT2907	1823
PMBT2222A	SOT23	npn	2N2222A,PM2222A	PMBT2907A	1823
PMBT2369	SOT23	npn	2N2369	BSR12	1827
PMBT2907	SOT23	pnp	2N2907, PM2907	PMBT2222	1829
PMBT2907A	SOT23	pnp	2N2907A,PM2907A	PMBT2222A	1829
PMBT3640	SOT23	pnp	2N2894A	BSV52	1833
PMBT3904	SOT23	npn	2N3904	PMBT3906	1835
PMBT3906	SOT23	pnp	2N3906	PMBT3904	1839
PMBT4401	SOT23	npn	2N4401	PMBT4403	1843
PMBT4403	SOT23	pnp	2N4403	PMBT4401	1847
PMBT5088	SOT23	npn	2N5088	–	1851
PMBT5401	SOT23	pnp	2N5401	PMBT5550	1855
PMBT5550	SOT23	npn	2N5550	PMBT5401	1857
PMBT5551	SOT23	npn	2N5551	–	1859

TYPE NUMBER	PACKAGE	DEVICE TYPE	NEAREST CONVENTIONAL TYPE(S)	COMPLEMENT	PAGE
PMBT6428	SOT23	npn	2N6428	–	1861
PMBT6429	SOT23	npn	2N6429	–	1861
PMBTA05	SOT23	npn	MPSA05	PMBTA55	1865
PMBTA06	SOT23	npn	MPSA06	PMBTA56	1865
PMBTA13	SOT23	npn	MPSA13	PMBTA63	1867
PMBTA14	SOT23	npn	MPSA14	PMBTA64	1867
PMBTA42	SOT23	npn	MPSA42	PMBTA94	1869
PMBTA43	SOT23	npn	MPSA43	PMBTA93	1869
PMBTA55	SOT23	npn	MPSA55	PMBTA05	1873
PMBTA56	SOT23	npn	MPSA56	PMBTA06	1873
PMBTA63	SOT23	pnp	MPSA63	PMBTA13	1875
PMBTA64	SOT23	pnp	MPSA63	PMBTA14	1875
PMBTA92	SOT23	pnp	MPSA92	PMBTA42	1877
PMBTA93	SOT23	pnp	MPSA93	PMBTA43	1877
PMBTH10	SOT23	npn	MPSH10	PMBTH81	1879
PMBTH81	SOT23	pnp	MPSH81	PMBTH10	1883
PMBZ5226B to PMBZ5257B	SOT23	diode	1N5226B, 1N5257B		1887
PMLL4148	SOD80C	diode	1N4148		1891
PMLL4150	SOD80C	diode	1N4150		1895
PMLL4151	SOD80C	diode	1N4151		1895
PMLL4153	SOD80C	diode	1N4153		1895
PMLL4446	SOD80C	diode	1N4446		1891
PMLL4448	SOD80C	diode	1N4448		1891
PMLL5225B to PMLL5267B	SOD80C	diode	1N5225B to 1N5267B		1899
PMSS3904	SOT323	npn	MPS3904	PMSS3906	1903
PMSS3906	SOT323	pnp	MPS3906	PMSS3904	1909
PMST3904	SOT323	npn	MPS3906	PMST3906	1915
PMST3906	SOT323	pnp	MPS3904	PMST3904	1921
PMST4401	SOT323	npn	2N4401	PMST4403	1927
PMST4403	SOT323	pnp	2N4403	PMST4401	1933
PMST5088	SOT323	npn	2N5088	–	1939
PMST5089	SOT323	npn	2N5089	–	1939
PRLL4001	SOD87	diode	1N4001ID		1943
PRLL4002	SOD87	diode	1N4002ID		1943
PRLL5817	SOD87	diode	1N5817		1947
PRLL5818	SOD87	diode	1N5818		1947

TYPE NUMBER	PACKAGE	DEVICE TYPE	NEAREST CONVENTIONAL TYPE(S)	COMPLEMENT	PAGE
PRLL5819	SOD87	diode	1N5819		1947
PXT2222	SOT89	npn	PH2222	PXT2907	1955
PXT2222A	SOT89	npn	PH2222A	PXT2907A	1955
PXT2907	SOT89	pnp	PH2907	PXT2222	1959
PXT2907A	SOT89	pnp	PH2907A	PXT2222A	1959
PXT3904	SOT89	npn	2N3904	PXT3906	1963
PXT3906	SOT89	pnp	2N3906	PXT3904	1967
PXT4401	SOT89	npn	2N4401	PXT4403	1971
PXT4403	SOT89	pnp	2N4403	PXT4401	1975
PXTA14	SOT89	npn	MPSA14	PXTA64	1979
PXTA27	SOT89	npn	MPSA27	PXTA77	1981
PXTA64	SOT89	pnp	MPSA64	PXTA14	1983
PXTA77	SOT89	pnp	MPSA77	PXTA27	1985
PXTA92	SOT89	pnp	MPSA92	PXTA42	1987
PXTA93	SOT89	pnp	MPSA93	PXTA43	1987
PZT2222	SOT223	npn	PH2222	PZT2907	1989
PZT2222A	SOT223	npn	PH2222A	PZT2907A	1989
PZT2907	SOT223	pnp	PH2907	PZT2222	1993
PZT2907A	SOT223	pnp	PH2907A	PZT222A	1993
PZT3904	SOT223	npn	2N3904	PZT3906	1997
PZT3906	SOT223	pnp	2N3906	PZT3904	2001
PZTA05	SOT223	npn	MPSA05	PZTA55	2005
PZTA06	SOT223	npn	MPSA06	PZTA56	2005
PZTA13	SOT223	npn	MPSA13	PZTA63	2009
PZTA14	SOT223	pnp	MPSA14	PZTA64	2009
PZTA42	SOT223	npn	MPSA42	PZTA92	2011
PZTA43	SOT223	npn	MPSA43	PZTA93	2011
PZTA44	SOT223	npn	MPSA44	–	2015
PZTA45	SOT223	npn	MPSA45	–	2015
PZTA55	SOT223	pnp	MPSA55	PZTA05	2019
PZTA56	SOT223	pnp	MPSA56	PZTA06	2019
PZTA63	SOT223	pnp	MPSA63	PZTA13	2023
PZTA64	SOT223	pnp	MPSA64	PZTA14	2023
PZTA92	SOT223	pnp	MPSA92	PZTA42	2025
PZTA93	SOT223	pnp	MPSA93	PZTA43	2025

TYPE NUMBER	PACKAGE	DEVICE TYPE	NEAREST CONVENTIONAL TYPE(S)	COMPLEMENT	PAGE
1PS181	SOT346	diode	1N4148 (double)		2027
1PS184	SC59	diode	1N4148 (double)		2031
1PS193	SC59	diode	1N4148		2035
1PS226	SC59	diode	1N4148 (double)		2039
2N7002	SOT23	FET	2N700		2043
2PB709/709A	SC59	pnp	BC557	2PD601/601A	2049
2PB710/710A	SC59	pnp	BC327	2PD602/602A	2053
2PD601/601A	SC59	npn	BC547	2PB709/709A	2057
2PD602/602A	SC59	npn	BC337	2PB710/710A	2061

DEVICE DATA
in alphanumeric sequence

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

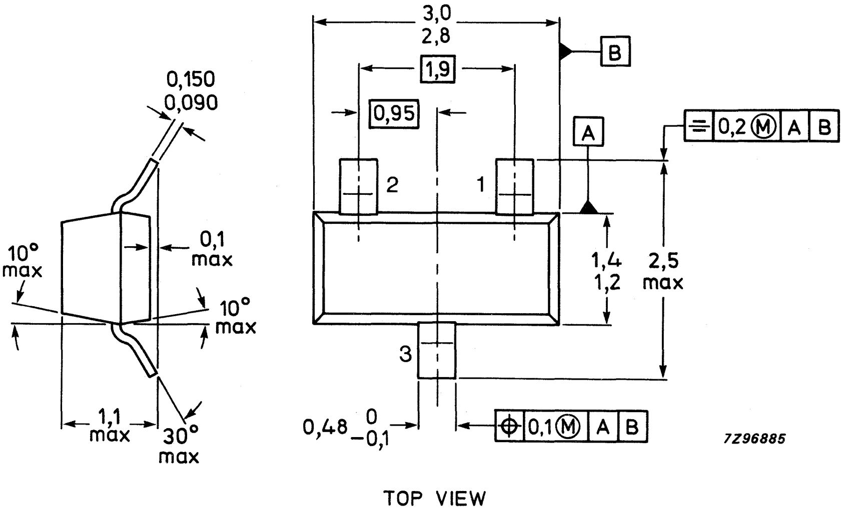
Drain-source voltage	$\pm V_{DS}$	max.	25	V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	25	V
Total power dissipation up to $T_{amb} = 40\ ^oC$	P_{tot}	max.	250	mW

			BFR30	BFR31	
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.

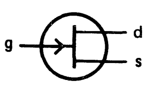


Marking code

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 $T_{amb} = 40\ ^{o}C$*	P_{tot}	max.	250	mW
Storage temperature range	T_{stg}		−65 to + 150	^{o}C
Junction temperature	T_j	max.	150	^{o}C

THERMAL RESISTANCE

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

CHARACTERISTICS

$T_j = 25\ ^{o}C$ 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.	4	1	mA
		max.	10	5	mA
Gate-source voltage $I_D = 1$ mA; $V_{DS} = 10$ V	$-V_{GS}$	min.	0.7	0	V
		max.	3.0	1.3	V
$I_D = 50\ \mu A$; $V_{DS} = 10$ 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; $T_{amb} = 25\ ^{o}C$ $I_D = 1$ mA; $V_{DS} = 10$ V	$\lvert y_{fs} \rvert$	min.	1.0	1.5	mS
		max.	4.0	4.5	mS
$I_D = 200\ \mu A$; $V_{DS} = 10$ V	$\lvert y_{fs} \rvert$	min.	0.5	0.75	mS
Output admittance at f = 1 kHz $I_D = 1$ mA; $V_{DS} = 10$ V	$\lvert y_{os} \rvert$	max.	40	25	μS
$I_D = 200\ \mu A$; $V_{DS} = 10$ V	$\lvert y_{os} \rvert$	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

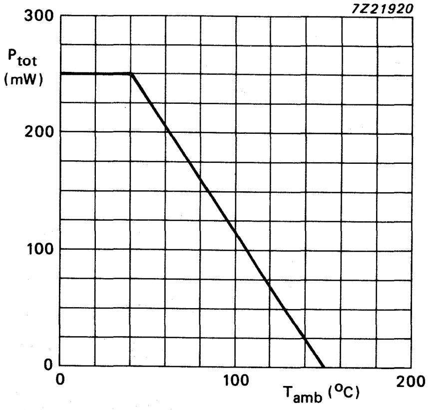


Fig.2 Power derating curve.

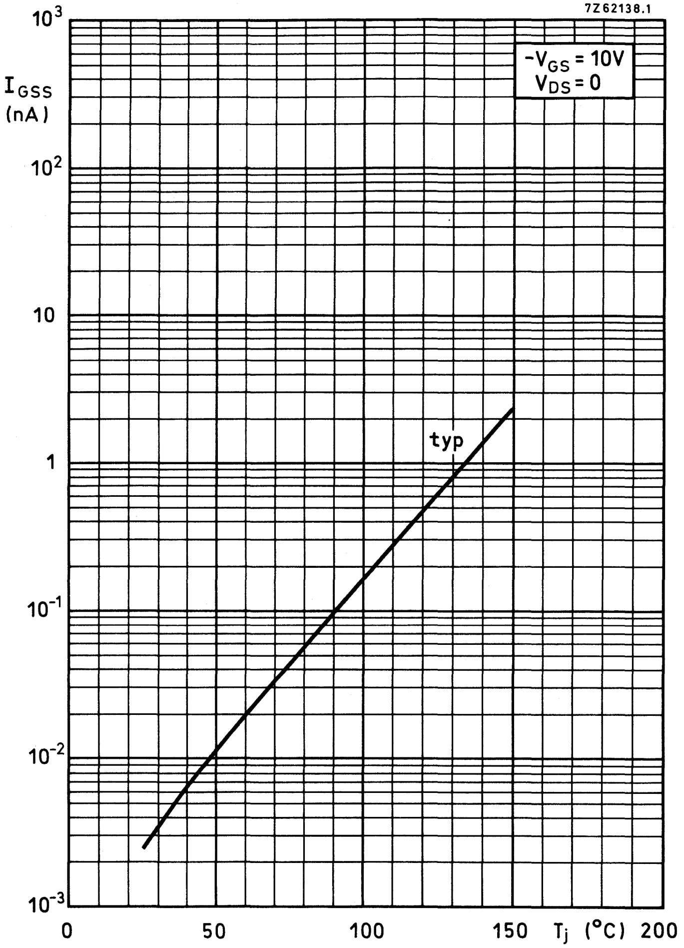

7Z62138.1
10^3
I_{GSS} (nA)
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
$-V_{GS} = 10V$
$V_{DS} = 0$
typ
0
50
100
150
T_j (°C)
200

Fig.3.

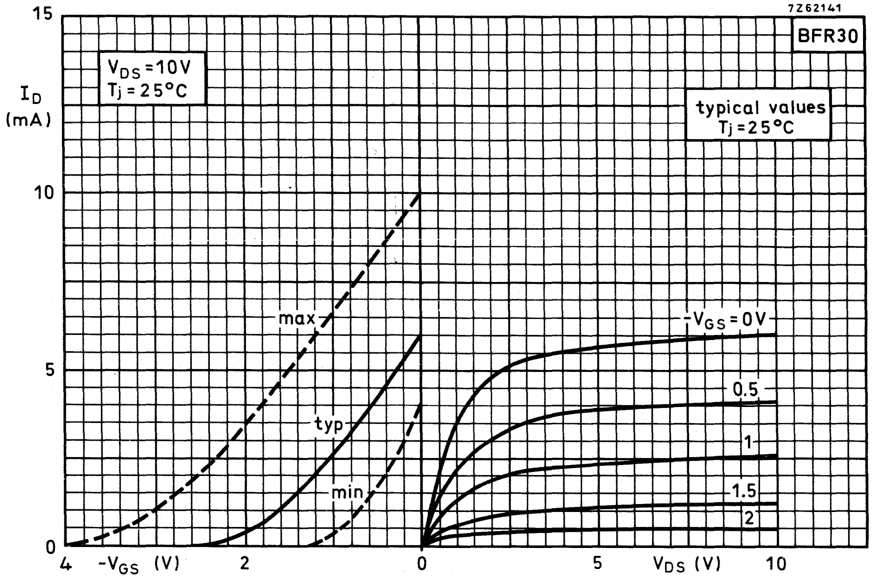

7Z62141
BFR30
V_{DS} = 10 V
T_j = 25 °C
I_D (mA)
15
10
5
0
max
typ
min
typical values
T_j = 25 °C
$-V_{GS}$ = 0 V
0.5
1
1.5
2
4
$-V_{GS}$ (V)
2
0
5
V_{DS} (V)
10

Fig.4.

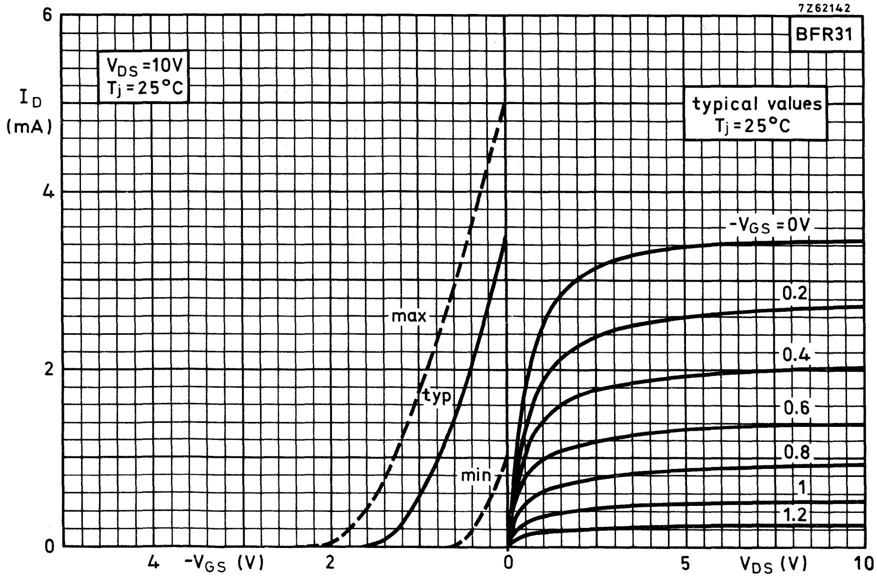

7Z62142
BFR31
V_{DS} = 10 V
T_j = 25 °C
I_D (mA)
6
4
2
0
max
typ
min
typical values
T_j = 25 °C
$-V_{GS}$ = 0 V
0.2
0.4
0.6
0.8
1
1.2
4
$-V_{GS}$ (V)
2
0
5
V_{DS} (V)
10

Fig.5.

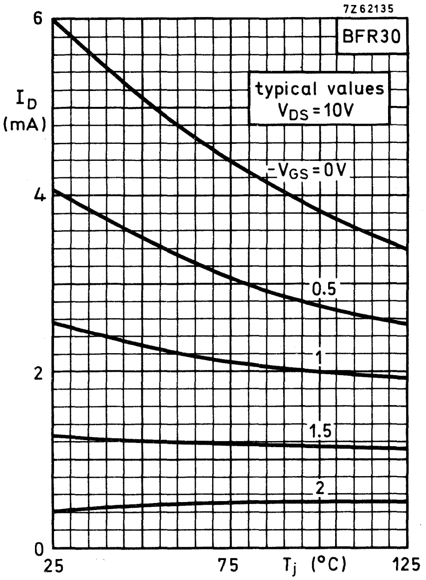


Fig.6.

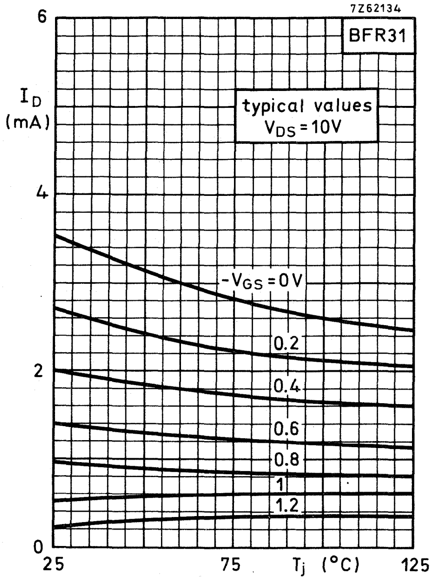


Fig.7.

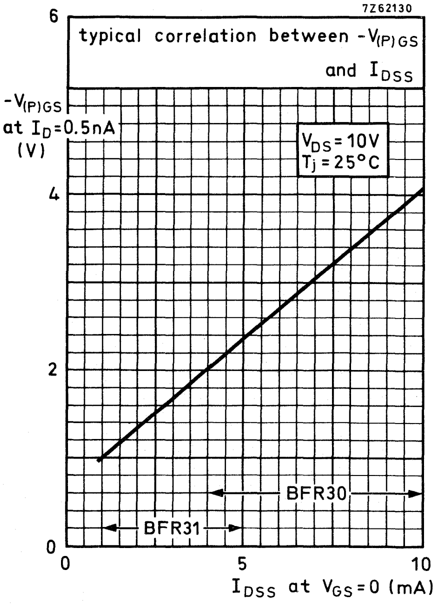


Fig.8.

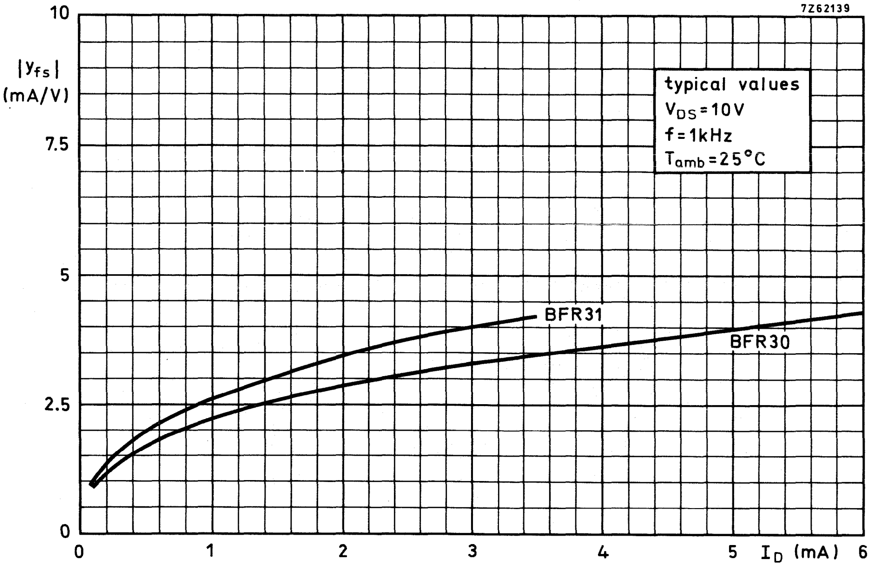

7Z62139
|y_fs| (mA/V)
10
7.5
5
2.5
0
0
1
2
3
4
5
I_D (mA)
6
typical values
V_DS = 10 V
f = 1 kHz
T_amb = 25 °C
BFR31
BFR30

Fig. 9.

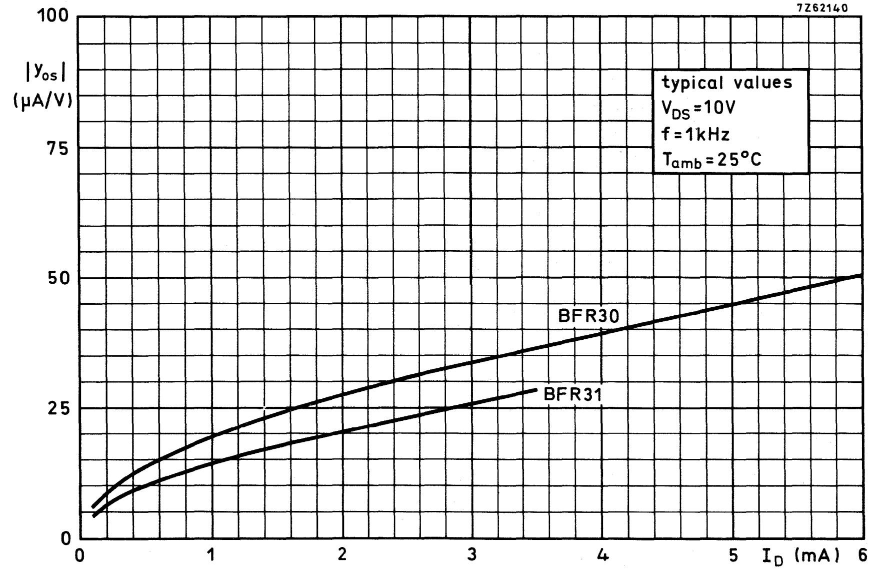

7Z62140
|y_os| (μA/V)
100
75
50
25
0
0
1
2
3
4
5
I_D (mA)
6
typical values
V_DS = 10 V
f = 1 kHz
T_amb = 25 °C
BFR30
BFR31

Fig. 10.

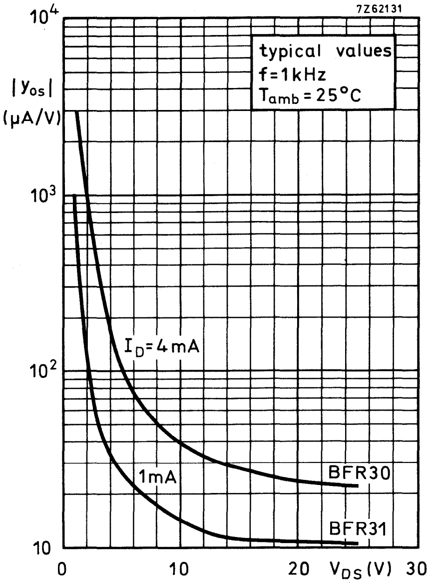


Fig.11.

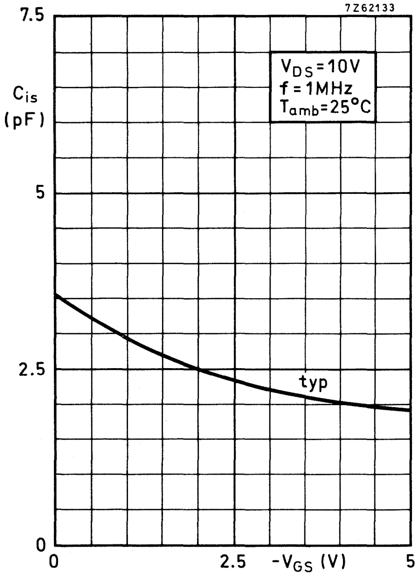


Fig.12.

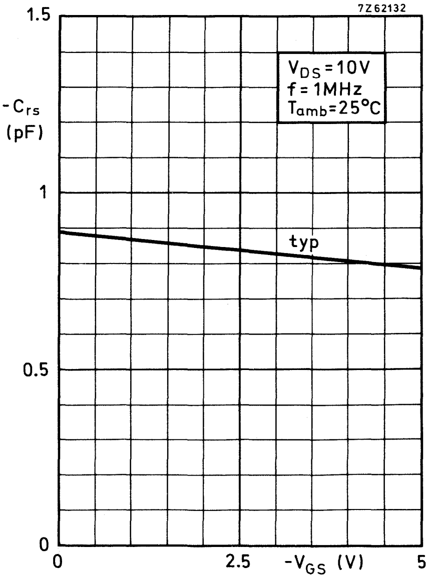


Fig.13.

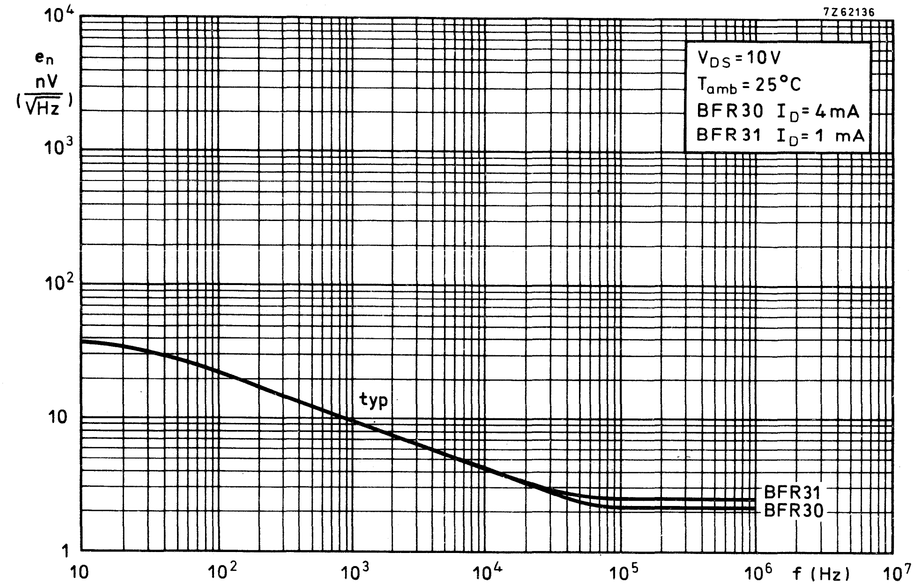

7Z62136
e_n
$(\frac{nV}{\sqrt{Hz}})$
10^4
10^3
10^2
10
1
$V_{DS} = 10 V$
$T_{amb} = 25°C$
BFR30 $I_D = 4 mA$
BFR31 $I_D = 1 mA$
typ
BFR31
BFR30
10
10^2
10^3
10^4
10^5
10^6
f (Hz)
10^7

Fig. 14.

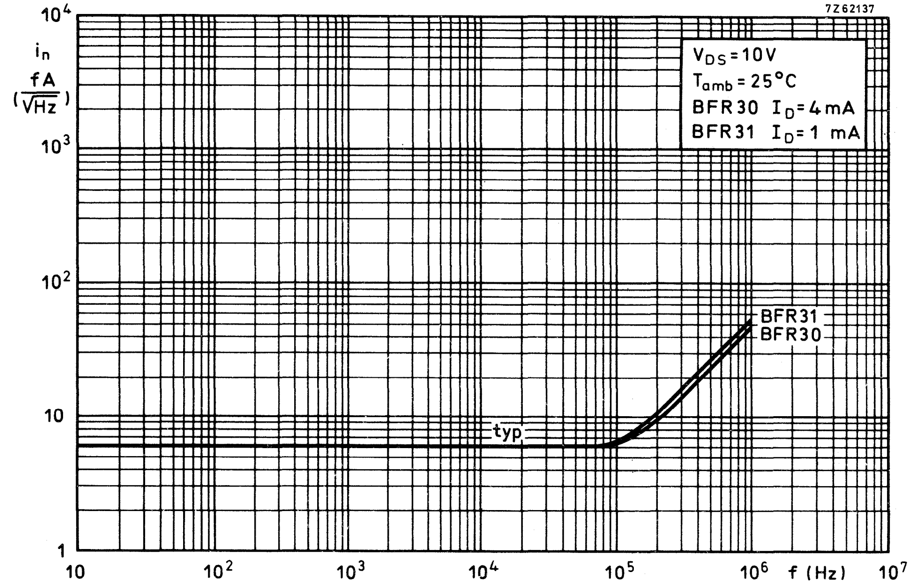

7Z62137
i_n
$(\frac{fA}{\sqrt{Hz}})$
10^4
10^3
10^2
10
1
$V_{DS} = 10 V$
$T_{amb} = 25°C$
BFR30 $I_D = 4 mA$
BFR31 $I_D = 1 mA$
BFR31
BFR30
typ
10
10^2
10^3
10^4
10^5
10^6
f (Hz)
10^7

Fig. 15.

NPN 2 GHz wideband transistor

BFR53

DESCRIPTION

NPN transistor in a plastic SOT23 envelope. It is intended for application in thick and thin-film circuits. The transistor has very low intermodulation distortion and very high power gain.

PINNING

PIN	DESCRIPTION
Code: N1	
1	base
2	emitter
3	collector

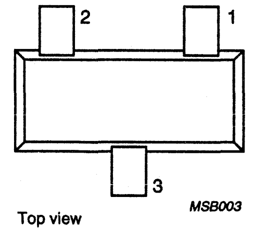


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	18	V
V_{CEO}	collector-emitter voltage	open base	–	10	V
I_{CM}	peak collector current	f > 1 MHz	–	100	mA
P_{tot}	total power dissipation	up to T_s = 45 °C (note 1)	–	400	mW
f_T	transition frequency	I_C = 25 mA; V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C	2	–	GHz
C_{re}	feedback capacitance	I_C = 2 mA; V_{CE} = 5 V; f = 1 MHz; T_{amb} = 25 °C	0.9	–	pF
G_{UM}	maximum unilateral power gain	I_C = 30 mA; V_{CE} = 5 V; f = 800 MHz; T_{amb} = 25 °C	10.5	–	dB

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	18	V
V_{CEO}	collector-emitter voltage	open base	–	10	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	50	mA
I_{CM}	peak collector current	f > 1 MHz	–	100	mA
P_{tot}	total power dissipation	up to T_s = 45 °C (note 1)	–	400	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C

Note

1. T_s is the temperature at the soldering point of the collector tab.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 45 °C (note 1)	260 K/W

Note

1. T_s is the temperature at the soldering point of the collector tab.

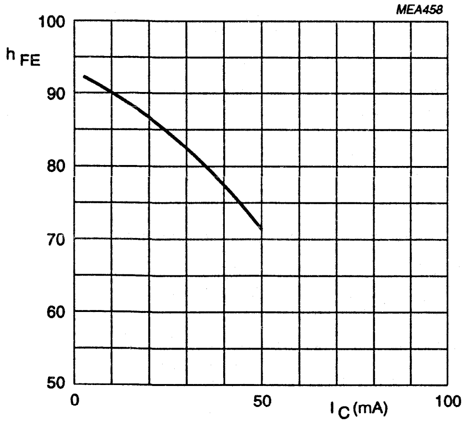
CHARACTERISTICS

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	–	–	50	nA
h_{FE}	DC current gain	I_C = 25 mA; V_{CE} = 5 V	25	–	–	
		I_C = 50 mA; V_{CE} = 5 V	25	–	–	
C_c	collector capacitance	$I_E = i_e = 0$; V_{CB} = 5 V; f = 1 MHz	–	0.9	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; V_{EB} = 0.5 V; f = 1 MHz	–	1.5	–	pF
C_{re}	feedback capacitance	I_C = 2 mA; V_{CE} = 5 V; f = 1 MHz; T_{amb} = 25 °C	–	0.9	–	pF
f_T	transition frequency	I_C = 25 mA; V_{CE} = 5 V; f = 500 MHz	–	2	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	I_C = 30 mA; V_{CE} = 5 V; f = 800 MHz; T_{amb} = 25 °C	–	10.5	–	dB
F	noise figure	I_C = 2 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C	–	–	5	dB

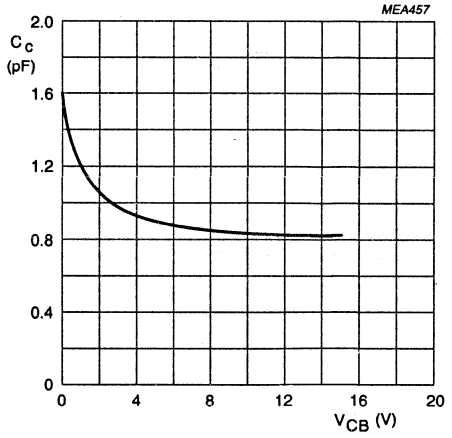
Note

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \dfrac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.



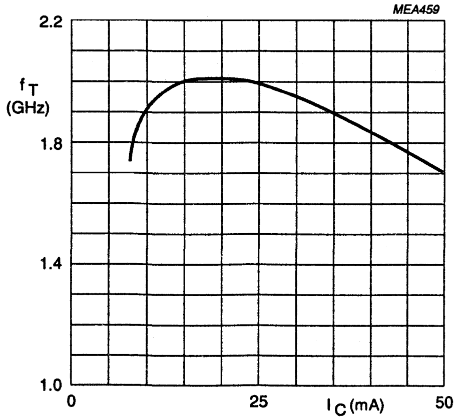
V_{CE} = 5 V; T_j = 25 °C.

Fig.2 DC current gain as a function of collector current.



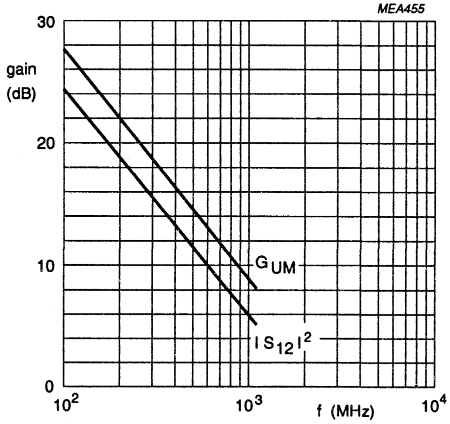
I_E = i_e = 0; f = 1 MHz; T_j = 25 °C

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



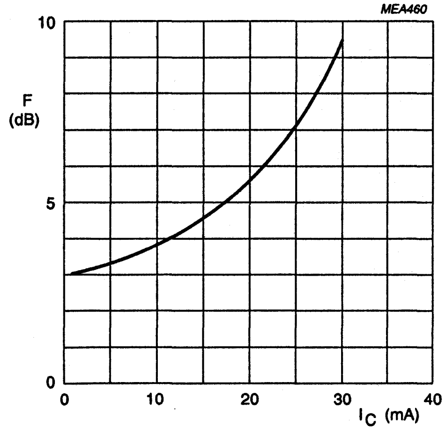
V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C.

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



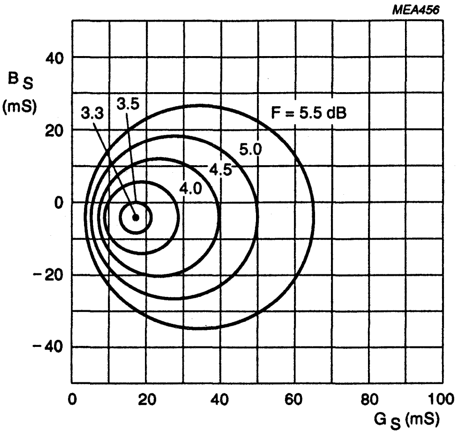
I_C = 30 mA; V_{CE} = 5 V; T_{amb} = 25 °C.

Fig.5 Gain as a function of frequency.



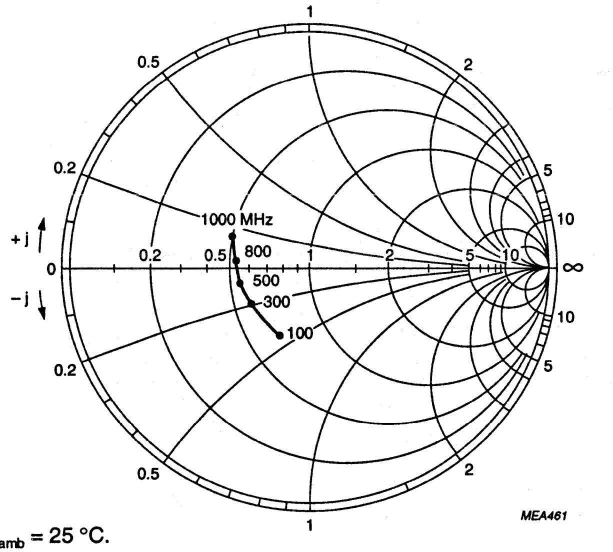
V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C; G_S = 20 mS; B_S is tuned.

Fig.6 Minimum noise figure as a function of collector current.



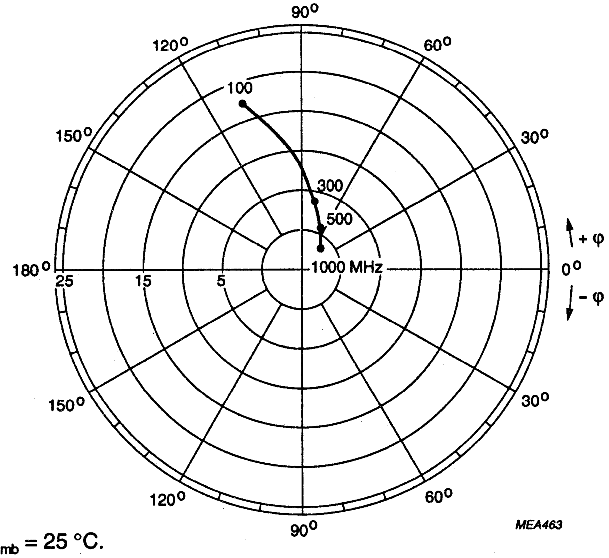
I_C = 2 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C.

Fig.7 Noise circle figure.



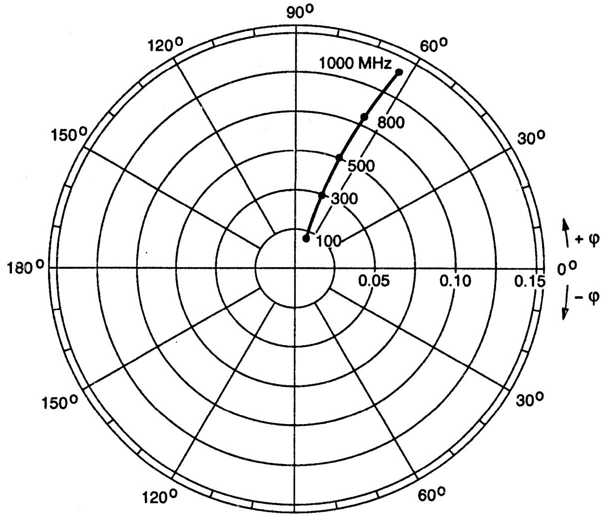
I_C = 30 mA; V_{CE} = 5 V; T_{amb} = 25 °C.

Fig.8 Common emitter input reflection coefficient (S_{11}).



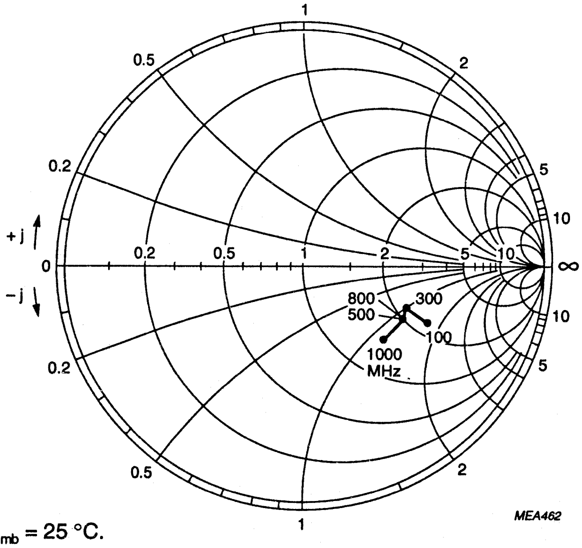
I_C = 30 mA; V_{CE} = 5 V; T_{amb} = 25 °C.

Fig.9 Common emitter forward transmission coefficient (S_{21}).



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

Fig.10 Common emitter reverse transmission coefficient (S_{12}).



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

Fig.11 Common emitter output reflection coefficient (S_{22}).

NPN 5 GHz wideband transistor

BFR92

DESCRIPTION

NPN transistor in a plastic SOT23 envelope primarily intended for use in RF wideband amplifiers and oscillators. The transistor features low intermodulation distortion and high power gain; due to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

PNP complement is BFT92.

PINNING

PIN	DESCRIPTION
	Code: P1p
1	base
2	emitter
3	collector

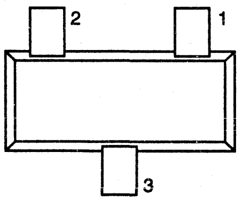


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	20	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
I_C	DC collector current		–	25	mA
P_{tot}	total power dissipation	up to T_s = 70 °C (note 1)	–	300	mW
f_T	transition frequency	I_C = 14 mA; V_{CE} = 10 V; f = 500 MHz; T_j = 25 °C	5	–	GHz
C_{re}	feedback capacitance	I_C = 2 mA; V_{CE} = 10 V; f = 1 MHz	0.4	–	pF
G_{UM}	maximum unilateral power gain	I_C = 14 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C	18	–	dB
F	noise figure	I_C = 2 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C; Z_S = opt.	2.4	–	dB
V_O	output voltage	d_{im} = –60 dB; I_C = 14 mA; V_{CE} = 10 V; R_L = 75 Ω; T_{amb} = 25 °C; $f_{(p+q-r)}$ = 493.25 MHz	150	–	mV

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	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	25	mA
P_{tot}	total power dissipation	up to T_s = 70 °C (note 1)	–	300	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C

Note

1. T_s is the temperature at the soldering point of the collector tab.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to $T_s = 70$ °C (note 1)	260 K/W

Note

1. T_s is the temperature at the soldering point of the collector tab.

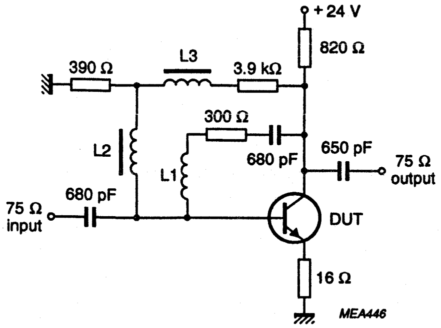
CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 10$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 14$ mA; $V_{CE} = 10$ V	40	90	–	
f_T	transition frequency	$I_C = 14$ mA; $V_{CE} = 10$ V; f = 500 MHz	–	5	–	GHz
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	0.75	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	0.8	–	pF
C_{re}	feedback capacitance	$I_C = 2$ mA; $V_{CE} = 10$ V; f = 1 MHz; $T_{amb} = 25$ °C	–	0.4	–	pF
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 14$ mA; $V_{CE} = 10$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	18	–	dB
F	noise figure (see Fig.2 and note 2)	$I_C = 2$ mA; $V_{CE} = 10$ V; f = 500 MHz; $T_{amb} = 25$ °C; Z_S = opt.	–	2.4	–	dB
V_O	output voltage	note 3	–	150	–	mV

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$ dB.
2. Crystal mounted in a SOT37 envelope (BFR90).
3. $d_{im} = -60$ dB (DIN 45004B); $I_C = 14$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$; $T_{amb} = 25$ °C;
   $V_p = V_O$ 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.



L2 = L3 = 5 µH Ferroxcube choke, catalogue number 3122 108 20150.

L1 = 4 turns 0.35 mm copper wire; winding pitch 1 mm; internal diameter 4 mm.

Fig.2 Intermodulation distortion test circuit.

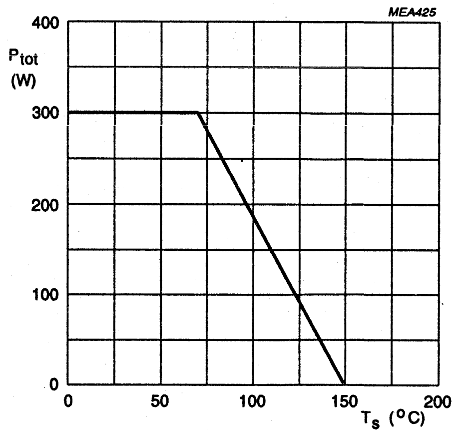
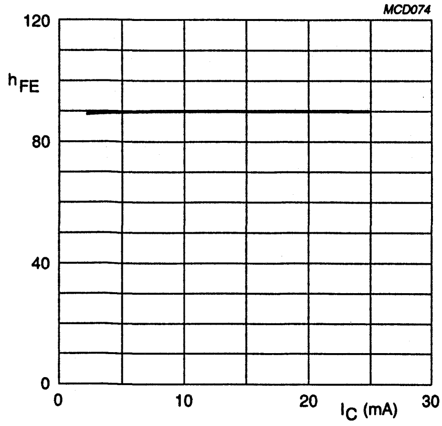
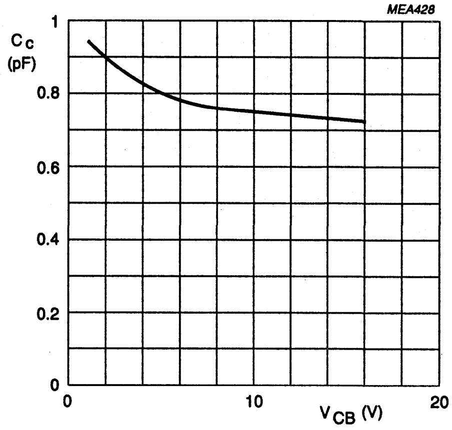


Fig.3 Power derating curve.



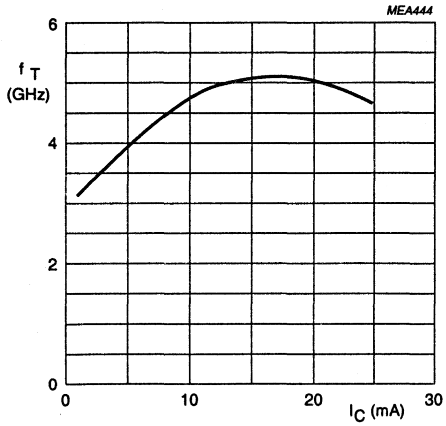
V_{CE} = 10 V; T_j = 25 °C.

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



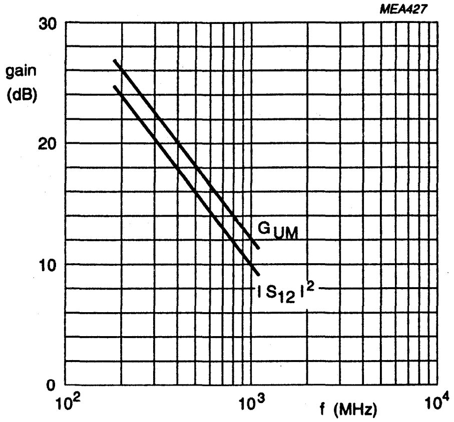
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C.

Fig.5 Collector capacitance as a function of collector-base voltage.



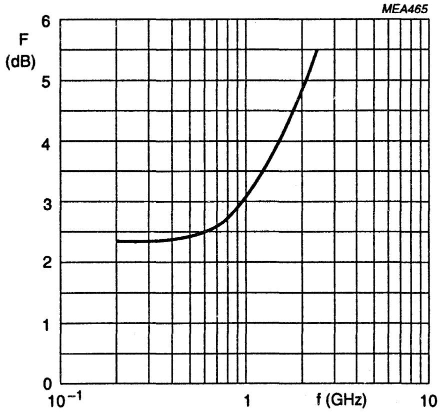
V_{CE} = 10 V; f = 500 MHz; T_j = 25 °C.

Fig.6 Transition frequency as a function of collector current.



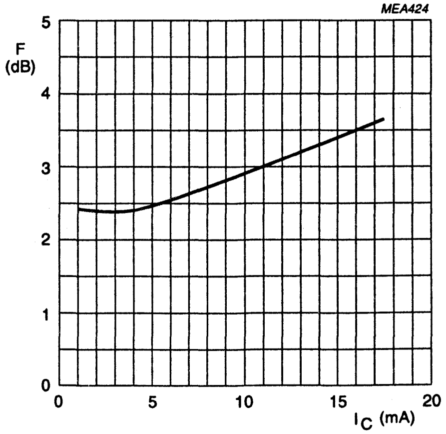
I_C = 14 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.7 Gain as a function of frequency.



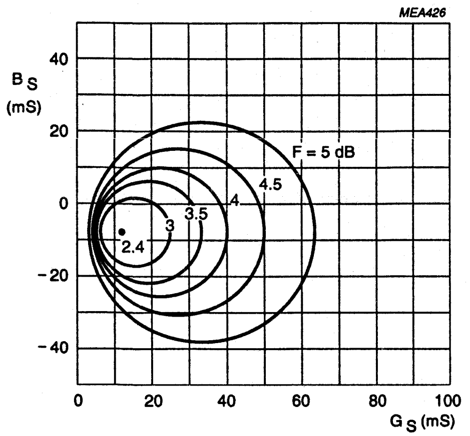
I_C = 2 mA; V_{CE} = 10 V; T_{amb} = 25 °C; Z_S = opt.

Fig.8 Minimum noise figure as a function of frequency.



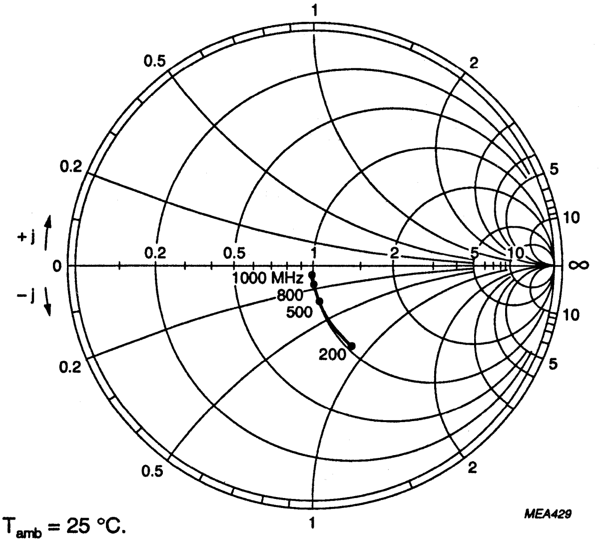
V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C; Z_S = opt.

Fig.9 Minimum noise figure as a function of collector current.



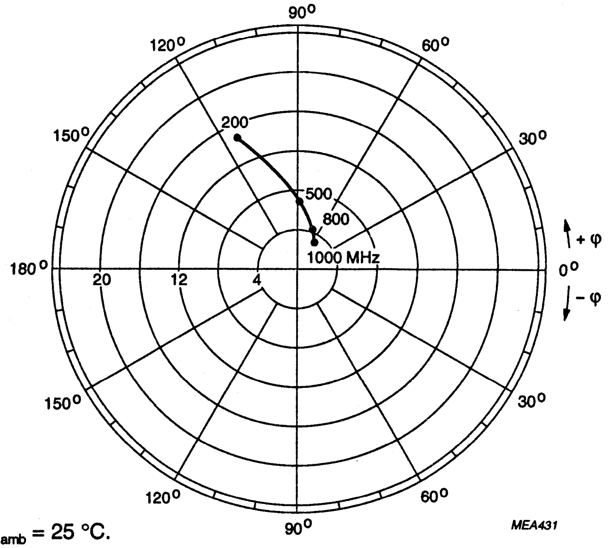
I_C = 2 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C.

Fig.10 Noise circle figure.



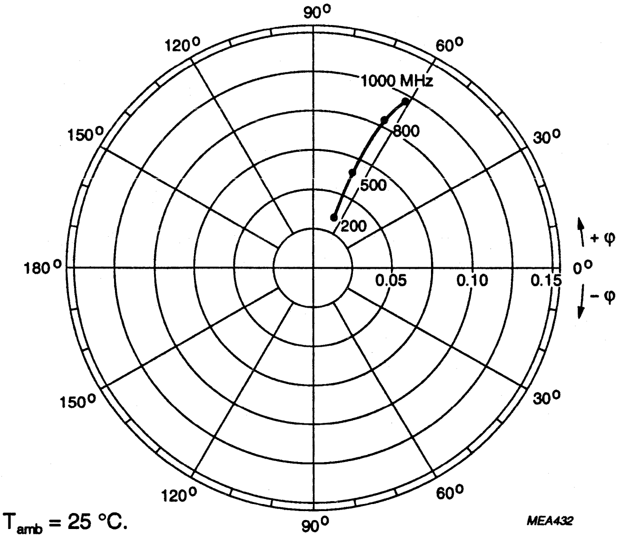
I_C = 14 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.11 Common emitter input reflection coefficient (S_{11}).



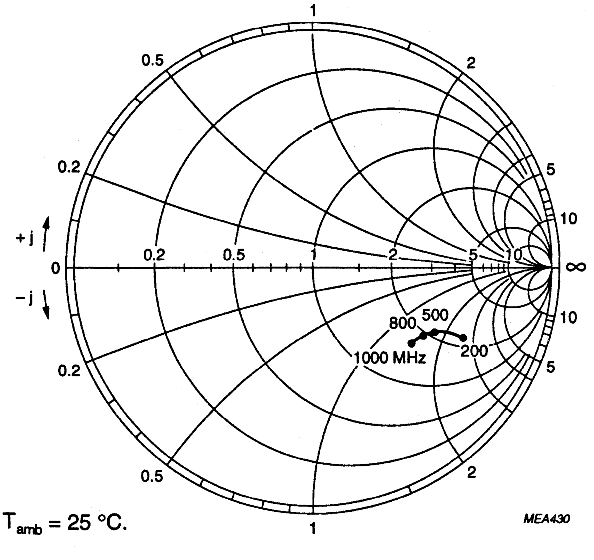
I_C = 14 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.12 Common emitter forward transmission coefficient (S_{21}).



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

Fig.13 Common emitter reverse transmission coefficient (S_{12}).



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

Fig.14 Common emitter output reflection coefficient (S_{22}).

NPN 5 GHz wideband transistor

BFR92A

FEATURES

- High power gain
- Low noise figure
- Low intermodulation distortion
- PNP complement is BFT92.

DESCRIPTION

NPN transistor in a plastic SOT23 envelope. It is primarily intended for use in RF wideband amplifiers and oscillators.

PINNING

PIN	DESCRIPTION
Code: P2p	
1	base
2	emitter
3	collector

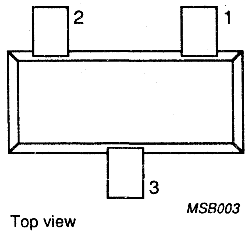


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage		–	20	V
V_{CEO}	collector-emitter voltage		–	15	V
I_C	DC collector current		–	25	mA
P_{tot}	total power dissipation	up to $T_s = 70$ °C (note 1)	–	300	mW
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 10$ V; f = 1 MHz	0.35	–	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 500 MHz	5	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 15$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C; f = 1 GHz	14	–	dB
		$I_C = 15$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C; f = 2 GHz	8	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C; f = 1 GHz	2.1	–	dB
V_O	output voltage	$d_{im} = -60$ dB; $I_C = 14$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$; $f_{(p+q-r)} = 793.25$ MHz	150	–	mV

Note

1. T_s is the temperature at the soldering point of the collector tab.

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	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	25	mA
P_{tot}	total power dissipation	$T_s = 70$ °C (note 1)	–	300	mW
T_{stg}	storage temperature range		–65	150	°C
T_j	junction temperature		–	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	from junction to soldering point (note 1)	260 K/W

Note

1. T_s is the temperature at the soldering point of the collector tab.

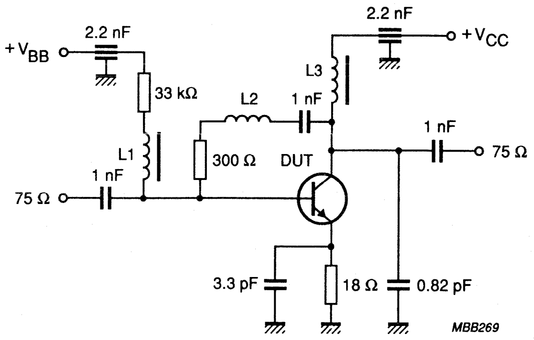
CHARACTERISTICS

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	–	–	50	nA
h_{FE}	DC current gain	$I_C = 15$ mA; $V_{CE} = 10$ V	40	90	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	0.6	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 10$ V; f = 1 MHz	–	1.2	–	pF
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 10$ V; f = 1 MHz	–	0.35	–	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 500 MHz	–	5	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 15$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	14	–	dB
		$I_C = 15$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	8	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	2.1	–	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	3	–	dB
V_O	output voltage	notes 2 and 3	–	150	–	mV
d_2	second order intermodulation distortion	notes 2 and 4	–	–50	–	dB

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.
2. Measured on the same crystal in a SOT37 envelope (BFR90A).
3. $d_{im} = -60$ dB (DIN 45004B); $T_{amb} = 25$ °C; $I_C = 14$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$; VSWR < 2;
   $V_p = V_O$ 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.
4. $T_{amb} = 25$ °C; $I_C = 14$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$; VSWR < 2;
   $V_p = 60$ mV at $f_p = 250$ MHz;
   $V_q = 60$ mV at $f_q = 560$ MHz;
   measured at $f_{(p+q)} = 810$ MHz.



L1 = L3 = 5 μH choke.

L2 = 3 turns 0.4 mm copper wire, internal diameter 3 mm, winding pitch 1 mm.

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

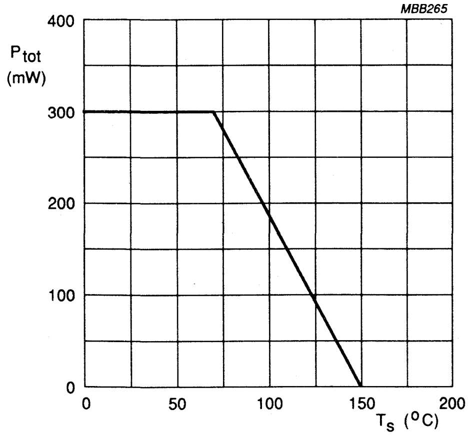
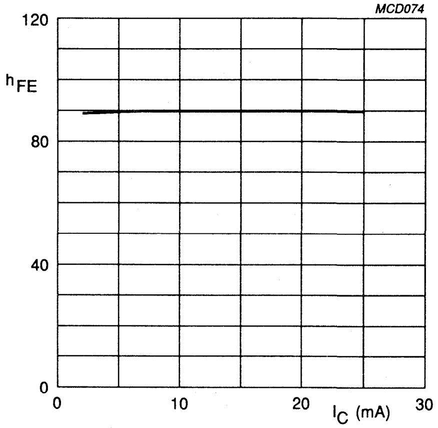
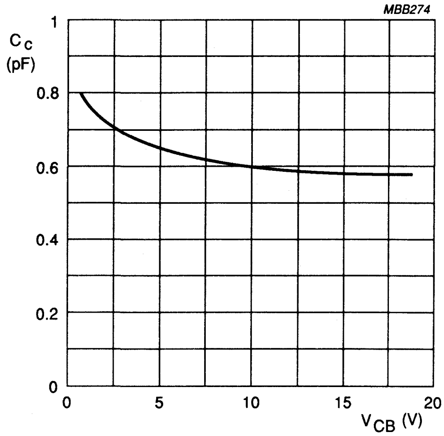


Fig.3 Power derating curve.



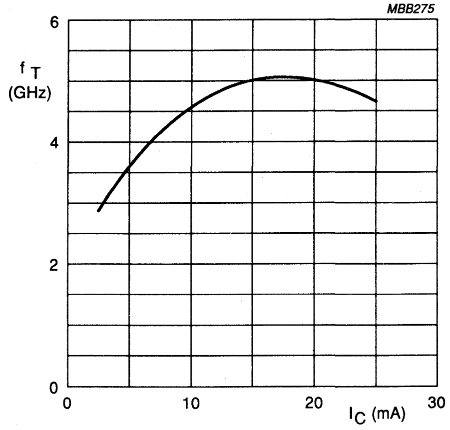
V_{CE} = 10 V; T_j = 25 °C.

Fig.4 DC current gain as a function of collector current, typical values.



$I_C = i_c = 0$; f = 1 MHz; T_j = 25 °C.

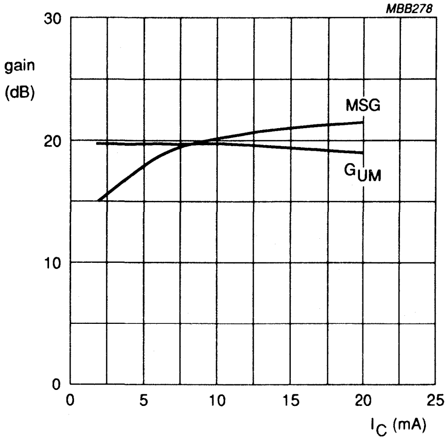
Fig.5 Collector capacitance as a function of collector-base voltage, typical values.



V_{CE} = 10 V; T_{amb} = 25 °C; f = 500 MHz.

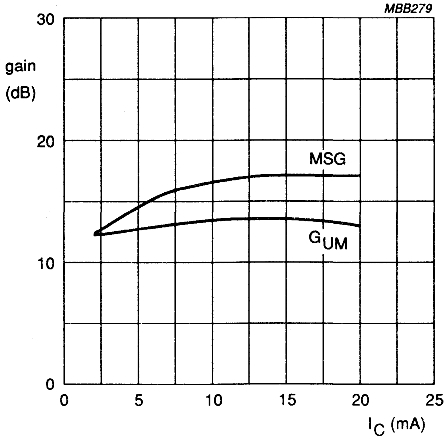
Fig.6 Transition frequency as a function of collector current, typical values.

In Figs 7 to 10, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



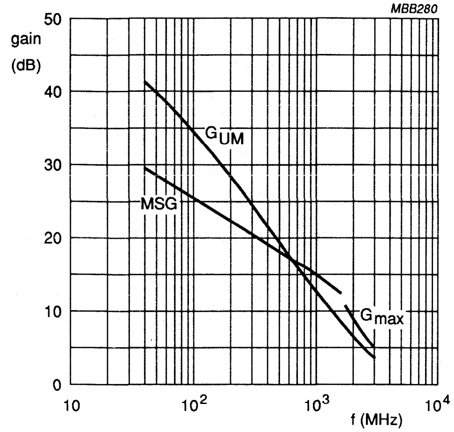
V_{CE} = 10 V; f = 500 MHz.

Fig.7 Gain as a function of collector current.



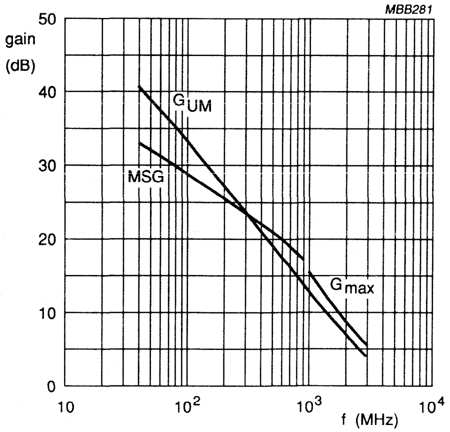
V_{CE} = 10 V; f = 1 GHz.

Fig.8 Gain as a function of collector current.



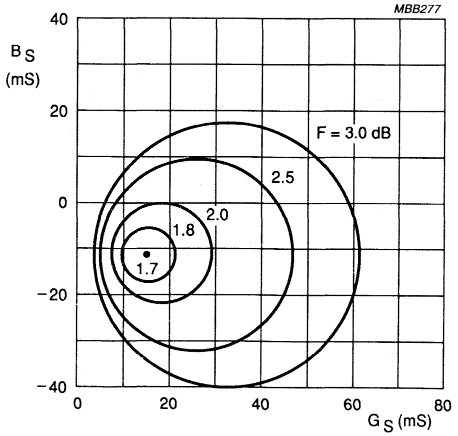
V_{CE} = 10 V; I_C = 5 mA.

Fig.9 Gain as a function of frequency.



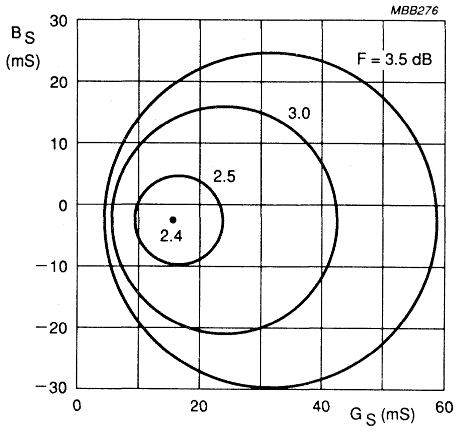
V_{CE} = 10 V; I_C = 15 mA.

Fig.10 Gain as a function of frequency.



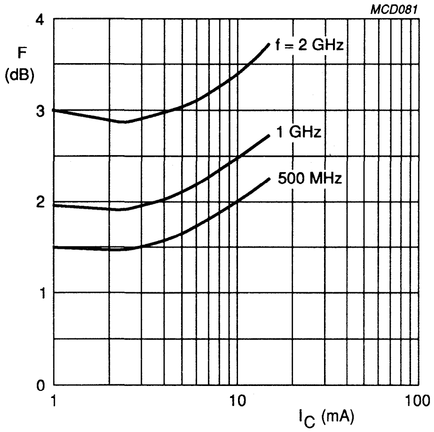
I_C = 4 mA; V_{CE} = 10 V; f = 800 MHz.

Fig.11 Circles of constant noise figure, typical values.



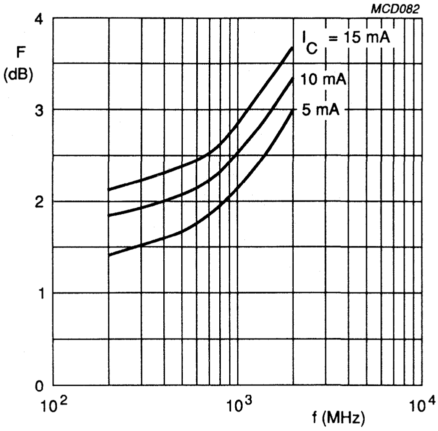
I_C = 4 mA; V_{CE} = 10 V; f = 800 MHz.

Fig.12 Circles of constant noise figure, typical values.



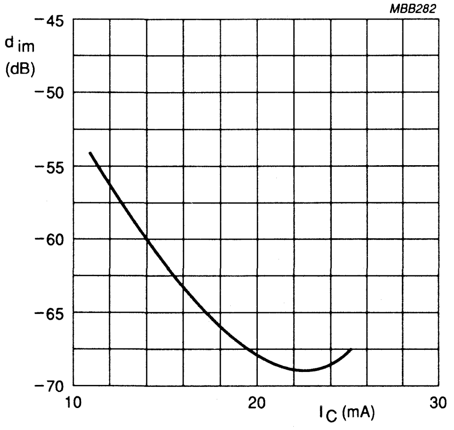
V_{CE} = 10 V.

Fig.13 Minimum noise figure as a function of collector current.



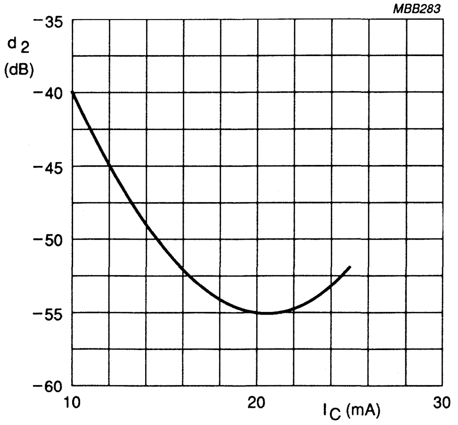
V_{CE} = 10 V.

Fig.14 Minimum noise figure as a function of frequency.



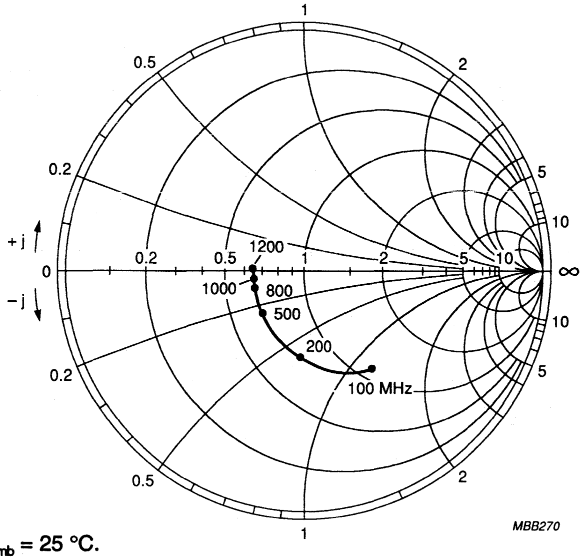
V_{CE} = 10 V; V_O = 150 mV (43.5 dBmV); $f_{(p+q-r)}$ = 793.25 MHz; T_{amb} = 25 °C.
Measured in MATV test circuit (see Fig.2).

Fig.15 Intermodulation distortion, typical values.



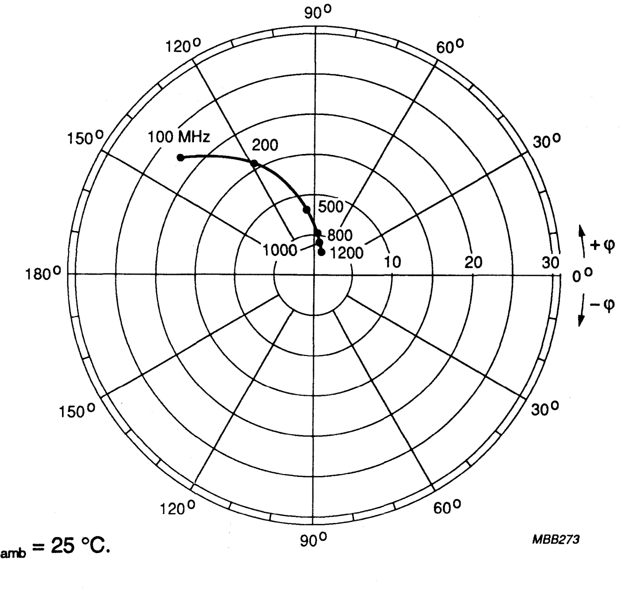
V_{CE} = 10 V; V_O = 60 mV; $f_{(p+q-r)}$ = 810 MHz; T_{amb} = 25 °C.
Measured in MATV test circuit (see Fig.2).

Fig.16 Second order intermodulation distortion, typical values.



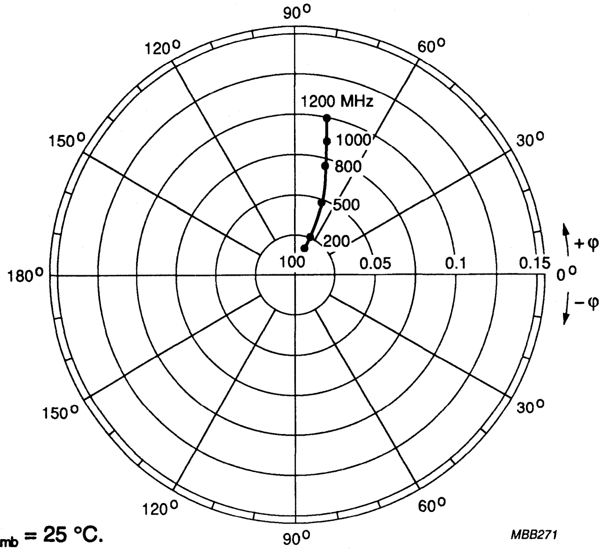
V_{CE} = 10 V; I_C = 14 mA; T_{amb} = 25 °C.

Fig.17 Common emitter input reflection coefficient (S_{11}).



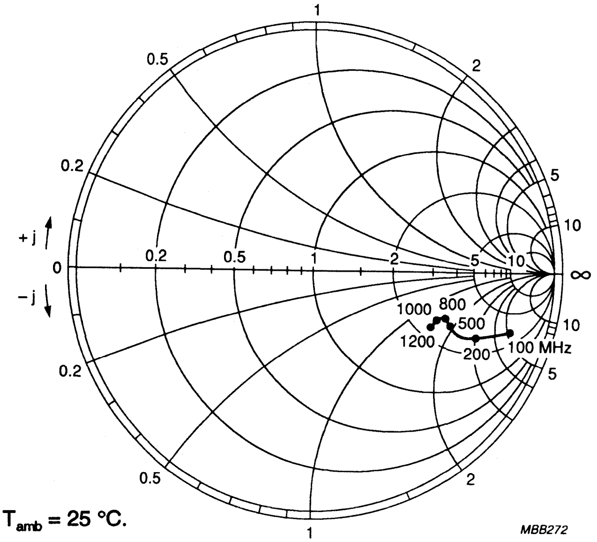
V_{CE} = 10 V; I_C = 14 mA; T_{amb} = 25 °C.

Fig.18 Common emitter forward transmission coefficient (S_{21}).



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

Fig.19 Common emitter reverse transmission coefficient (S_{12}).

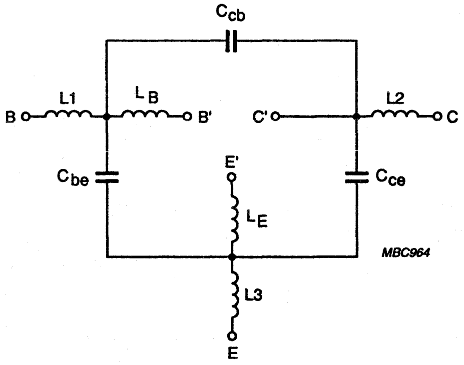


V_{CE} = 10 V; I_C = 14 mA; T_{amb} = 25 °C.

Fig.20 Common emitter output reflection coefficient (S_{22}).

SPICE parameters for BFR90A crystal

1	IS = 411.8	aA
2	BF = 102.6	–
3	NF = 997.2	m–
4	VAF = 62.67	V
5	IKF = 3.200	A
6	ISE = 4.010	fA
7	NE = 1.577	–
8	BR = 18.10	–
9	NR = 996.2	m
10	VAR = 3.369	V
11	IKR = 1.281	A
12	ISC = 279.9	aA
13	NC = 1.075	–
14	RB = 10.00	Ω
15	IRB = 1.000	μA
16	RBM = 10.00	Ω
17	RE = 1.164	Ω
18	RC = 2.320	Ω
19 (note 1)	XTB = 0.000	–
20 (note 1)	EG = 1.110	EV
21 (note 1)	XTI = 3.000	–
22	CJE = 890.5	fF
23	VJE = 600.0	mV
24	MJE = 258.5	m
25	TF = 15.49	ps
26	XTF = 39.14	–
27	VTF = 2.152	V
28	ITF = 213.7	mA
29	PTF = 0.000	deg
30	CJC = 546.5	fF
31	VJC = 380.8	mV
32	MJC = 202.9	m
33	XCJC = 150.0	m
34	TR = 5.618	ns
35 (note 1)	CJS = 0.000	F
36 (note 1)	VJS = 750.0	mV
37 (note 1)	MJS = 0.000	–
38	FC = 850.0	m



$QL_B = 50$; $QL_E = 50$.

$QL_{B,E}$ (f) = $QL_{B,E}$ √ (f/Fc).

Fc = scaling frequency = 1000 MHz.

Fig.21 Package equivalent circuit, SOT23.

List of components (see Fig.21)

DESIGNATION	VALUE
C_{be}	71 fF
C_{cb}	71 fF
C_{ce}	2 fF
L1	0.35 nH
L2	0.17 nH
L3	0.25 nH
L_B	0.40 nH
L_E	0.83 nH

Note

1. These parameters have not been extracted, the default values are shown.

Table 1 Common emitter scattering parameters, $V_{CE} = 5$ V, $I_C = 5$ mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.789	−12.2	14.151	169.0	0.009	85.7	0.987	−5.4	43.0
100	0.742	−28.7	12.938	154.2	0.023	74.9	0.936	−12.5	34.8
200	0.627	−53.5	10.952	136.7	0.040	66.9	0.824	−20.4	27.9
300	0.524	−72.0	8.943	123.7	0.050	62.6	0.736	−24.4	23.8
400	0.455	−86.4	7.427	114.4	0.059	60.9	0.670	−26.6	21.0
500	0.400	−100.5	6.449	107.0	0.067	60.8	0.625	−27.1	19.1
600	0.354	−109.4	5.509	101.8	0.075	62.4	0.596	−27.8	17.3
700	0.324	−113.7	4.835	97.3	0.081	63.9	0.576	−28.1	15.9
800	0.296	−124.7	4.293	93.0	0.089	64.8	0.563	−28.3	14.7
900	0.281	−129.5	3.890	89.5	0.097	66.0	0.555	−28.6	13.8
1000	0.251	−141.5	3.524	85.4	0.103	67.3	0.543	−28.8	12.7
1200	0.246	−153.8	3.007	79.6	0.119	68.9	0.532	−29.8	11.3
1400	0.243	−165.3	2.651	74.3	0.136	69.1	0.521	−31.5	10.1
1600	0.237	−174.0	2.363	70.5	0.152	71.0	0.520	−32.6	9.1
1800	0.211	174.9	2.091	65.9	0.170	71.2	0.518	−34.3	8.0
2000	0.226	163.6	1.969	61.9	0.186	71.6	0.513	−35.7	7.4
2200	0.240	149.9	1.783	57.6	0.206	72.3	0.495	−37.3	6.5
2400	0.243	149.5	1.690	54.2	0.227	71.5	0.482	−40.9	6.0
2600	0.253	146.9	1.593	51.7	0.245	71.1	0.478	−44.4	5.5
2800	0.244	136.4	1.506	49.0	0.265	71.1	0.481	−46.9	5.0
3000	0.275	129.0	1.427	44.9	0.286	70.2	0.469	−48.4	4.5

Table 2 Common emitter scattering parameters, $V_{CE} = 5$ V, $I_C = 10$ mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	
40	0.669	−16.6	23.024	164.2	0.008	79.9	0.970	−8.2	42.1
100	0.593	−39.2	19.631	145.4	0.020	72.1	0.873	−17.5	34.0
200	0.449	−67.6	14.753	125.9	0.033	68.7	0.716	−24.7	27.5
300	0.356	−86.7	11.181	113.9	0.043	66.2	0.620	−26.8	23.7
400	0.313	−99.2	8.899	106.3	0.052	68.0	0.562	−27.2	21.1
500	0.275	−113.9	7.512	99.9	0.060	67.4	0.531	−26.9	19.3
600	0.243	−120.1	6.336	95.7	0.070	69.7	0.512	−26.9	17.6
700	0.219	−127.0	5.513	92.2	0.078	71.3	0.499	−26.9	16.3
800	0.213	−139.5	4.868	88.8	0.089	72.4	0.494	−27.0	15.2
900	0.194	−144.7	4.391	85.8	0.098	72.5	0.488	−27.2	14.2
1000	0.182	−156.2	3.953	82.4	0.106	73.1	0.479	−27.4	13.2
1200	0.190	−163.4	3.339	77.5	0.125	73.5	0.472	−28.3	11.7
1400	0.193	−175.5	2.945	72.4	0.144	73.3	0.465	−30.1	10.6
1600	0.185	−179.0	2.626	69.3	0.163	73.6	0.466	−31.4	9.6
1800	0.163	163.1	2.316	65.0	0.181	73.3	0.465	−32.8	8.5
2000	0.179	156.0	2.174	61.7	0.200	72.6	0.462	−34.0	7.9
2200	0.210	142.6	1.977	57.6	0.219	72.5	0.443	−35.4	7.1
2400	0.216	144.8	1.857	54.6	0.240	71.1	0.429	−38.9	6.5
2600	0.230	143.8	1.762	52.1	0.258	70.5	0.424	−42.4	6.0
2800	0.213	136.1	1.657	49.3	0.279	70.0	0.427	−44.9	5.5
3000	0.240	127.1	1.571	45.5	0.299	68.6	0.419	−46.0	5.0

Table 3 Common emitter scattering parameters, V_{CE} = 5 V, I_C = 15 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	
40	0.611	−47.6	23.942	153.8	0.018	70.1	0.899	−21.1	36.8
100	0.585	−97.9	17.649	128.3	0.034	53.6	0.663	−39.5	29.3
200	0.580	−136.4	10.944	108.4	0.044	49.3	0.441	−48.3	23.5
300	0.586	−153.8	7.705	98.4	0.052	50.8	0.349	−49.8	20.1
400	0.591	−163.6	5.905	92.0	0.061	54.1	0.306	−50.6	17.7
500	0.596	−170.5	4.800	86.8	0.068	57.6	0.283	−51.4	15.9
600	0.596	−175.5	4.045	82.7	0.078	60.2	0.271	−52.7	14.4
700	0.591	−179.8	3.519	79.2	0.086	62.2	0.265	−54.4	13.1
800	0.590	176.4	3.119	75.7	0.096	64.2	0.263	−56.3	12.0
900	0.590	172.5	2.777	72.5	0.105	65.3	0.261	−58.4	11.0
1000	0.588	168.7	2.522	69.6	0.115	66.6	0.260	−60.9	10.2
1200	0.595	162.6	2.131	64.5	0.136	68.3	0.263	−66.0	8.8
1400	0.609	157.1	1.869	59.1	0.157	68.8	0.269	−72.4	7.8
1600	0.613	152.1	1.661	53.9	0.180	69.8	0.277	−78.0	6.8
1800	0.604	146.7	1.510	49.6	0.206	69.4	0.284	−83.8	5.9
2000	0.609	140.9	1.392	45.3	0.229	69.5	0.287	−90.0	5.3
2200	0.623	135.9	1.299	41.6	0.255	68.7	0.290	−98.3	4.8
2400	0.630	132.4	1.197	37.6	0.279	68.7	0.301	−107.1	4.2
2600	0.618	128.7	1.117	34.6	0.309	67.3	0.321	−114.3	3.5
2800	0.602	123.0	1.071	30.4	0.336	65.4	0.344	−120.4	3.1
3000	0.597	117.1	1.009	27.5	0.368	64.8	0.355	−126.1	2.6

Table 4 Common emitter scattering parameters, V_{CE} = 10 V, I_C = 5 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.813	−11.6	13.669	169.3	0.009	82.2	0.987	−4.9	43.3
100	0.769	−27.1	12.628	155.3	0.021	74.3	0.944	−11.4	35.5
200	0.650	−50.5	10.807	138.0	0.038	68.1	0.841	−19.1	28.4
300	0.547	−67.7	8.877	125.0	0.049	63.7	0.756	−22.8	24.2
400	0.471	−81.3	7.404	116.0	0.057	62.0	0.693	−24.8	21.3
500	0.419	−95.8	6.458	108.1	0.064	61.1	0.650	−25.5	19.4
600	0.358	−103.4	5.540	102.9	0.072	62.4	0.622	−26.2	17.6
700	0.325	−107.4	4.858	98.5	0.078	64.2	0.600	−26.5	16.2
800	0.302	−120.5	4.332	93.9	0.087	64.5	0.588	−26.7	15.0
900	0.277	−126.3	3.927	90.5	0.093	65.4	0.580	−26.9	14.0
1000	0.248	−136.6	3.550	86.3	0.100	67.0	0.569	−27.3	13.0
1200	0.231	−148.8	3.023	80.6	0.116	68.8	0.557	−28.2	11.5
1400	0.232	−160.5	2.670	75.2	0.131	69.6	0.547	−29.9	10.3
1600	0.218	−166.8	2.382	71.5	0.147	71.3	0.546	−31.1	9.3
1800	0.189	176.8	2.111	66.9	0.164	72.1	0.544	−32.6	8.2
2000	0.200	170.6	1.986	62.9	0.179	72.4	0.541	−34.0	7.6
2200	0.216	154.4	1.791	58.5	0.197	72.9	0.522	−35.6	6.7
2400	0.241	153.0	1.713	55.4	0.219	72.4	0.510	−39.1	6.2
2600	0.237	147.5	1.595	52.7	0.235	72.4	0.506	−42.4	5.6
2800	0.231	139.9	1.511	50.2	0.255	72.4	0.509	−44.9	5.1
3000	0.250	130.6	1.449	46.0	0.275	71.7	0.499	−46.0	4.7

Table 5 Common emitter scattering parameters, V_{CE} = 10 V, I_C = 10 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.720	−15.5	22.111	164.9	0.009	84.4	0.971	−7.4	42.5
100	0.640	−36.3	19.093	146.7	0.019	71.8	0.888	−16.0	34.6
200	0.491	−62.5	14.569	127.5	0.033	66.9	0.737	−22.9	27.9
300	0.399	−79.3	11.152	115.3	0.042	66.2	0.645	−25.0	24.0
400	0.332	−93.0	8.913	107.6	0.051	66.1	0.590	−25.5	21.4
500	0.293	−105.2	7.577	101.1	0.059	67.9	0.558	−25.3	19.6
600	0.254	−113.7	6.396	96.8	0.068	69.1	0.539	−25.5	17.9
700	0.231	−116.5	5.558	93.2	0.076	70.7	0.525	−25.5	16.5
800	0.205	−128.9	4.910	89.6	0.085	71.8	0.519	−25.5	15.4
900	0.189	−134.8	4.431	86.7	0.095	72.5	0.516	−25.8	14.4
1000	0.180	−146.7	3.989	83.1	0.103	72.7	0.508	−26.0	13.5
1200	0.169	−156.5	3.375	78.3	0.121	73.5	0.499	−26.8	11.9
1400	0.167	−169.7	2.967	73.4	0.139	73.3	0.492	−28.7	10.8
1600	0.160	−171.2	2.653	70.2	0.157	73.9	0.493	−29.7	9.8
1800	0.147	172.2	2.333	65.9	0.175	73.2	0.493	−31.2	8.7
2000	0.161	164.3	2.197	62.7	0.192	73.1	0.492	−32.4	8.2
2200	0.181	143.5	1.998	58.6	0.212	73.0	0.472	−33.8	7.3
2400	0.197	151.3	1.868	55.5	0.232	71.9	0.458	−37.1	6.6
2600	0.211	147.3	1.760	52.8	0.249	71.1	0.455	−40.6	6.1
2800	0.189	139.6	1.663	51.2	0.269	71.0	0.458	−42.8	5.6
3000	0.200	128.0	1.591	46.5	0.287	69.7	0.448	−44.1	5.2

Table 6 Common emitter scattering parameters, V_{CE} = 10 V, I_C = 15 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.672	−18.4	26.592	162.4	0.008	77.9	0.958	−8.7	42.0
100	0.578	−41.1	22.062	142.4	0.019	69.8	0.853	−17.8	34.3
200	0.415	−67.7	15.884	123.0	0.032	69.8	0.695	−23.9	27.7
300	0.326	−84.7	11.832	111.6	0.040	68.6	0.604	−25.0	23.9
400	0.283	−97.6	9.353	104.5	0.049	70.2	0.555	−25.1	21.4
500	0.247	−110.7	7.884	98.6	0.058	70.0	0.527	−24.5	19.6
600	0.211	−119.1	6.622	94.7	0.067	71.7	0.512	−24.5	17.9
700	0.197	−123.3	5.747	91.3	0.076	73.6	0.503	−24.7	16.6
800	0.172	−135.1	5.060	88.1	0.087	73.4	0.499	−24.6	15.5
900	0.159	−139.5	4.561	85.2	0.095	74.8	0.496	−25.0	14.5
1000	0.147	−152.9	4.106	82.0	0.105	74.6	0.489	−25.1	13.6
1200	0.149	−160.4	3.476	77.1	0.124	74.6	0.482	−26.1	12.1
1400	0.160	−172.5	3.055	72.7	0.143	74.2	0.477	−28.1	10.9
1600	0.151	−173.3	2.723	69.8	0.160	74.0	0.478	−29.1	9.9
1800	0.128	168.0	2.396	65.6	0.179	74.0	0.478	−30.8	8.8
2000	0.153	159.3	2.249	62.0	0.195	73.2	0.476	−32.0	8.3
2200	0.168	141.5	2.040	57.9	0.214	72.8	0.458	−33.1	7.3
2400	0.195	148.3	1.915	55.5	0.235	71.6	0.443	−36.5	6.8
2600	0.192	144.7	1.809	52.5	0.254	70.8	0.440	−39.8	6.2
2800	0.175	137.8	1.694	50.8	0.272	70.3	0.443	−42.3	5.7
3000	0.205	127.6	1.619	47.0	0.292	69.0	0.433	−43.2	5.3

NPN 5 GHz wideband transistor BFR92AW

FEATURES

- High power gain
- Gold metallization ensures excellent reliability
- SOT323 (S-mini) envelope.

DESCRIPTION

Silicon NPN transistor in a plastic SOT323 envelope. It is designed for use in RF amplifiers, mixers and oscillators with signal frequencies up to 1 GHz. The BFR92AW uses the same crystal as the SOT23 version, BFR92A.

PINNING

PIN	DESCRIPTION
Code: P2	
1	base
2	emitter
3	collector

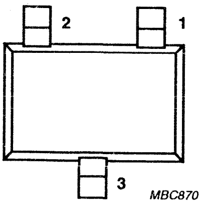


Fig.1 SOT323.

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	–	–	15	V
I_C	DC collector current		–	–	25	mA
P_{tot}	total power dissipation	up to T_s = 93 °C (note 1)	–	–	300	mW
h_{FE}	DC current gain	I_C = 15 mA; V_{CE} = 10 V	40	90	–	
f_T	transition frequency	I_C = 15 mA; V_{CE} = 10 V	–	5	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 15 mA; V_{CE} = 10 V; f = 1 GHz	–	14	–	dB
F	noise figure	I_C = 5 mA; V_{CE} = 10 V; f = 1 GHz	–	2.1	–	dB
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	note 1	–	–	190	K/W
T_j	junction temperature		–	–	150	°C

Note

1. T_s is the temperature at the soldering point of the collector tab.

NPN 5 GHz wideband transistor BFR93

DESCRIPTION

NPN transistor in a plastic SOT23 envelope primarily intended for use in RF amplifiers and oscillators. The transistor features very low intermodulation distortion and high power gain; due to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

A SOT54 (TO-92) version (ref: ON4186) is available on request.

PNP complement is BFT93.

PINNING

PIN	DESCRIPTION
Code: R1p	
1	base
2	emitter
3	collector

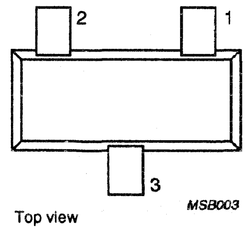


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	15	V
V_{CEO}	collector-emitter voltage	open base	–	12	V
I_C	DC collector current		–	35	mA
P_{tot}	total power dissipation	up to T_s = 70 °C (note 1)	–	300	mW
f_T	transition frequency	I_C = 30 mA; V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C	5	–	GHz
C_{re}	feedback capacitance	I_C = 2 mA; V_{CE} = 5 V; f = 1 MHz	0.8	–	pF
G_{UM}	maximum unilateral power gain	I_C = 30 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C	16.5	–	dB
F	noise figure	I_C = 2 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C	1.9	–	dB
d_{im}	intermodulation distortion	I_C = 30 mA; V_{CE} = 5 V; R_L = 75 Ω; V_O = 300 mV; T_{amb} = 25 °C; $f_{(p+q-r)}$ = 493.25 MHz	–60	–	dB

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	15	V
V_{CEO}	collector-emitter voltage	open base	–	12	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	35	mA
P_{tot}	total power dissipation	up to T_s = 70 °C (note 1)	–	300	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C

Note

1. T_s is the temperature at the soldering point of the collector tab.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 70 °C (note 1)	260 K/W

Note

1. T_s is the temperature at the soldering point of the collector tab.

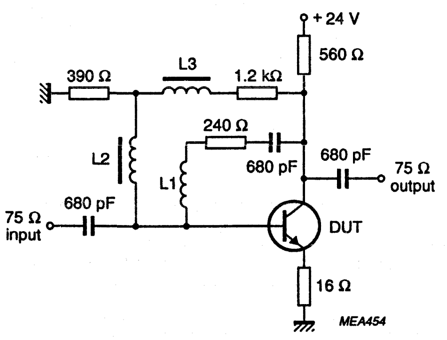
CHARACTERISTICS

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	–	–	50	nA
h_{FE}	DC current gain	I_C = 30 mA; V_{CE} = 5 V	40	90	–	
f_T	transition frequency	I_C = 30 mA; V_{CE} = 5 V; f = 500 MHz	–	5	–	GHz
C_c	collector capacitance	$I_E = i_e = 0$; V_{CB} = 10 V; f = 1 MHz	–	0.7	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; V_{EB} = 0.5 V; f = 1 MHz	–	1.8	–	pF
C_{re}	feedback capacitance	I_C = 2 mA; V_{CE} = 5 V; f = 1 MHz; T_{amb} = 25 °C	–	0.8	–	pF
G_{UM}	maximum unilateral power gain (note 1)	I_C = 30 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C	–	16.5	–	dB
F	noise figure (note 2)	I_C = 2 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C; Z_S = opt.	–	1.9	–	dB
d_{im}	intermodulation distortion	note 3	–	–60	–	dB

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10\log\frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.
2. Crystal mounted in a SOT37 envelope (BFR91).
3. I_C = 30 mA; V_{CE} = 5 V; R_L = 75 Ω; VSWR < 2; T_{amb} = 25 °C;
   $V_p = V_O$ = 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.



L2 = L3 = 5 µH Ferroxcube choke, catalogue number 3122 108 20150.

L1 = 4 turns 0.35 mm copper wire; winding pitch 1 mm; internal diameter 4 mm.

Fig.2 Intermodulation distortion test circuit.

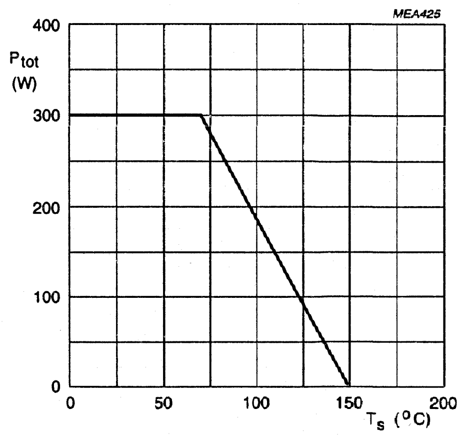
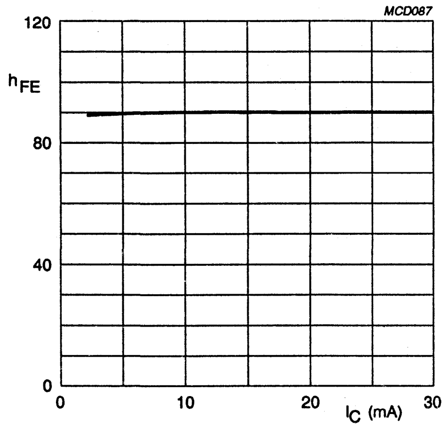
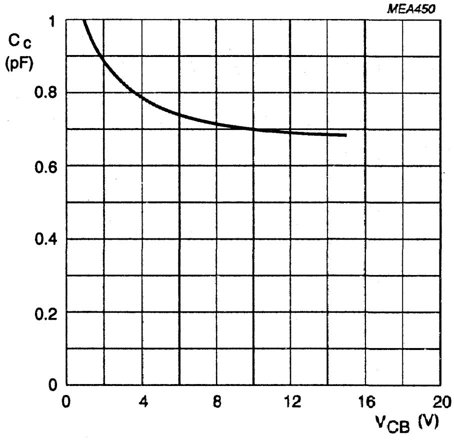


Fig.3 Power derating curve.



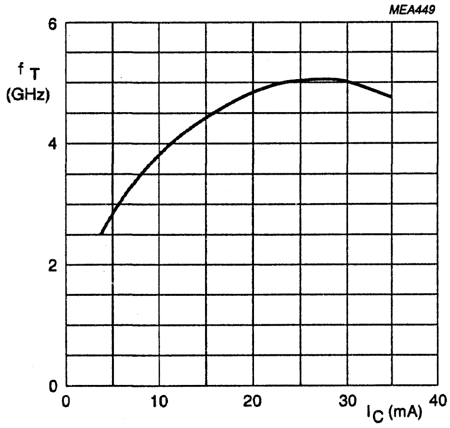
V_{CE} = 5 V; T_j = 25 °C.

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



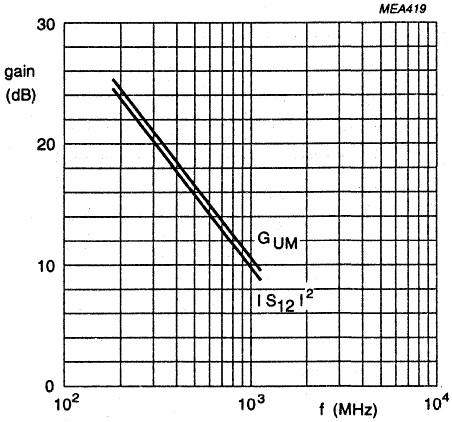
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C.

Fig.5 Collector capacitance as a function of collector-base voltage.



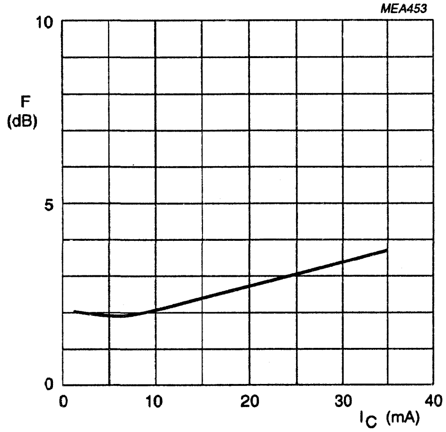
V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C.

Fig.6 Transition frequency as a function of collector current.



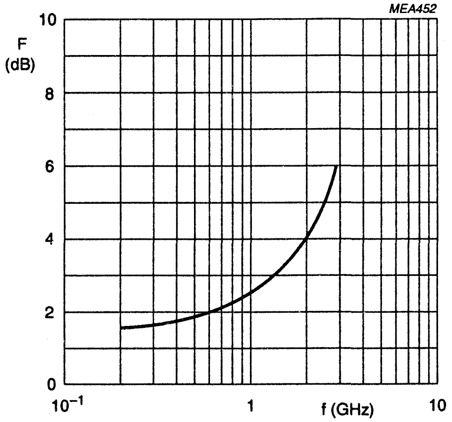
I_C = 30 mA; V_{CE} = 5 V; T_{amb} = 25 °C.

Fig.7 Gain as a function of frequency.



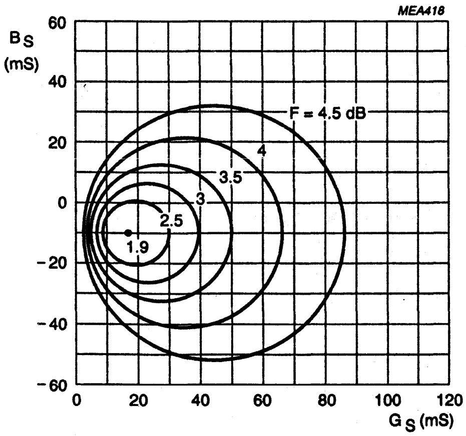
V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C; Z_S = opt.

Fig.8 Minimum noise figure as a function of collector current.



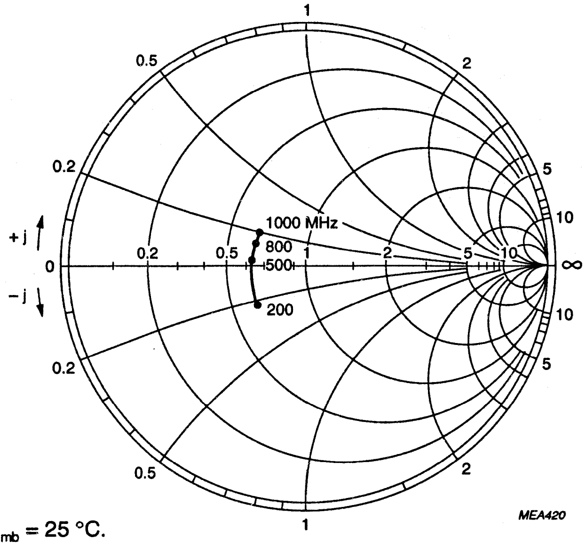
I_C = 2 mA; V_{CE} = 5 V; T_{amb} = 25 °C; Z_S = opt.

Fig.9 Minimum noise figure as a function of frequency.



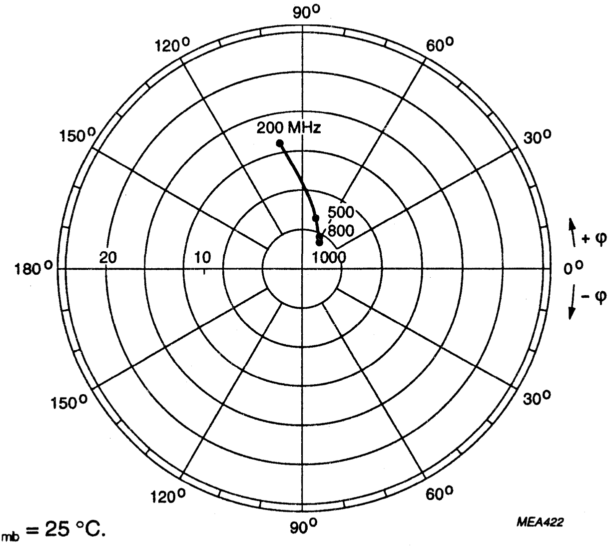
I_C = 2 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C.

Fig.10 Noise circle figure.



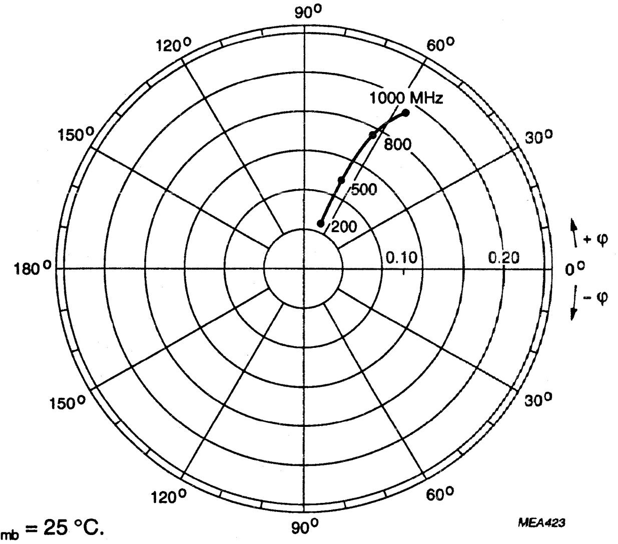
$I_C = 30$ mA; $V_{CE} = 5$ V; $T_{amb} = 25$ °C.

Fig.11 Common emitter input reflection coefficient (S_{11}).



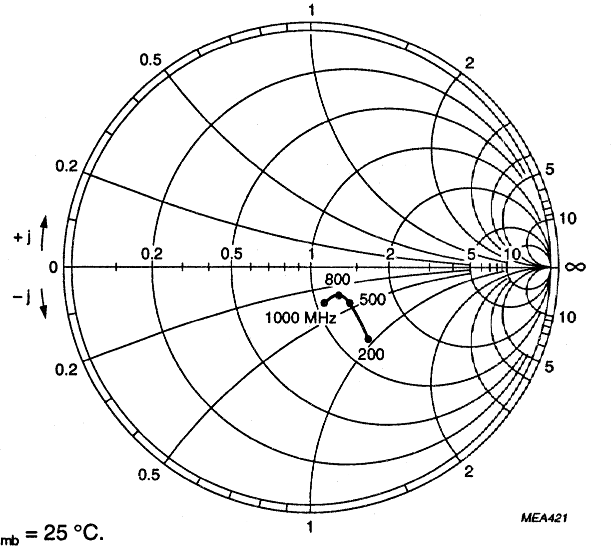
$I_C = 30$ mA; $V_{CE} = 5$ V; $T_{amb} = 25$ °C.

Fig.12 Common emitter forward transmission coefficient (S_{21}).



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

Fig.13 Common emitter reverse transmission coefficient (S_{12}).



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

Fig.14 Common emitter output reflection coefficient (S_{22}).

NPN 6 GHz wideband transistor BFR93A

FEATURES

- High power gain
- Low noise figure
- Very low intermodulation distortion
- PNP complement is the BFT93.

DESCRIPTION

NPN transistor in a plastic SOT23 envelope. It is primarily intended for use in RF wideband amplifiers and oscillators.

PINNING

PIN	DESCRIPTION
	Code: R2p
1	base
2	emitter
3	collector

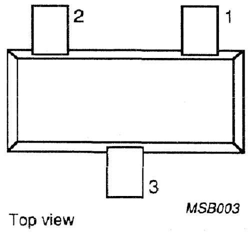


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	15	V
V_{CEO}	collector-emitter voltage	open base	–	12	V
I_C	DC collector current		–	35	mA
P_{tot}	total power dissipation	up to T_s = 70 °C (note 1)	–	300	mW
C_{re}	feedback capacitance	V_{CE} = 5 V; I_C = 0; f = 1 MHz	0.6	–	pF
f_T	transition frequency	I_C = 30 mA; V_{CE} = 5 V; f = 500 MHz	6	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 30 mA; V_{CE} = 8 V; T_{amb} = 25 °C; f = 1 GHz	13	–	dB
		I_C = 30 mA; V_{CE} = 8 V; T_{amb} = 25 °C; f = 2 GHz	7	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 8 V; T_{amb} = 25 °C; f = 1 GHz	1.9	–	dB
V_O	output voltage	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	425	–	mV

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	15	V
V_{CEO}	collector-emitter voltage	open base	–	12	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	35	mA
P_{tot}	total power dissipation	up to T_s = 70 °C (note 1)	–	300	mW
T_{stg}	storage temperature		−65	150	°C
T_j	junction temperature		–	150	°C

Note

1. T_s is the temperature at the soldering point of the collector tab.

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	from junction to soldering point (note 1)	260 K/W

Note

1. T_s is the temperature at the soldering point of the collector tab.

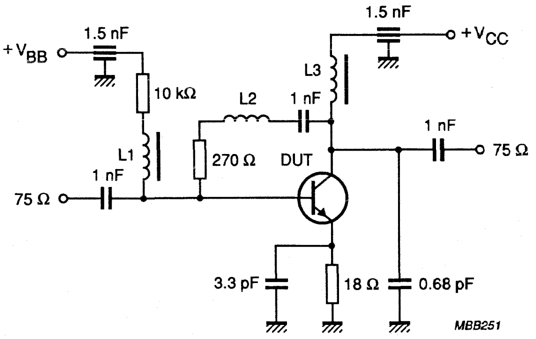
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector leakage current	$I_E = 0$; $V_{CB} = 5$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 30$ mA; $V_{CE} = 5$ V	40	90	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	0.7	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	1.9	–	pF
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 5$ V; $T_{amb} = 25$ °C; f = 1 MHz	–	0.6	–	pF
f_T	transition frequency	$I_C = 30$ mA; $V_{CE} = 5$ V; f = 500 MHz	4.5	6	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 30$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	13	–	dB
		$I_C = 30$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	7	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	1.9	–	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	3	–	dB
V_O	output voltage	notes 2 and 3	–	425	–	mV
d_2	second order intermodulation distortion	notes 2 and 4	–	–50	–	dB

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.
2. Measured on the same crystal in a SOT37 envelope (BFR91A).
3. $d_{im} = -60$ dB (DIN 45004B); $T_{amb} = 25$ °C; $I_C = 30$ mA; $V_{CE} = 8$ V; $R_L = 75\ \Omega$;
   $V_p = V_O$ 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.
4. $T_{amb} = 25$ °C; $I_C = 30$ mA; $V_{CE} = 8$ V; $R_L = 75\ \Omega$;
   $V_p = 200$ mV at $f_p = 250$ MHz;
   $V_q = 200$ mV at $f_q = 560$ MHz;
   measured at $f_{(p+q)} = 810$ MHz.



L1 = L3 = 5 μH choke.

L2 = 3 turns 0.4 mm copper wire, internal diameter 3 mm, winding pitch 1 mm.

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

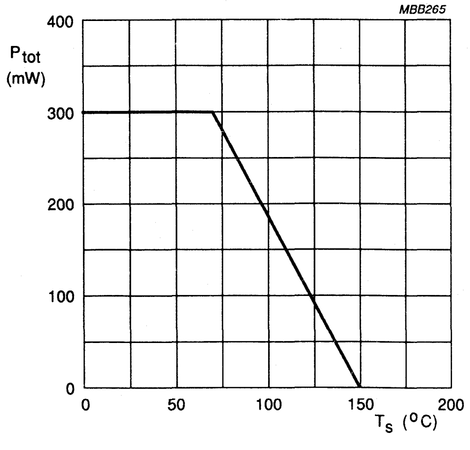
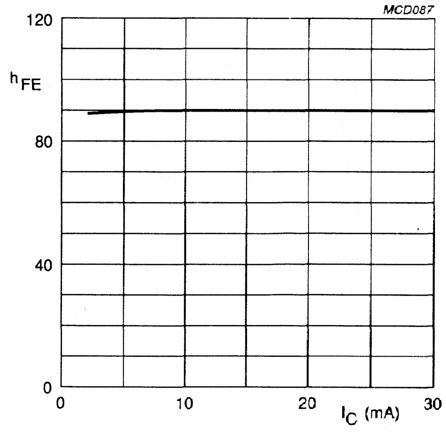
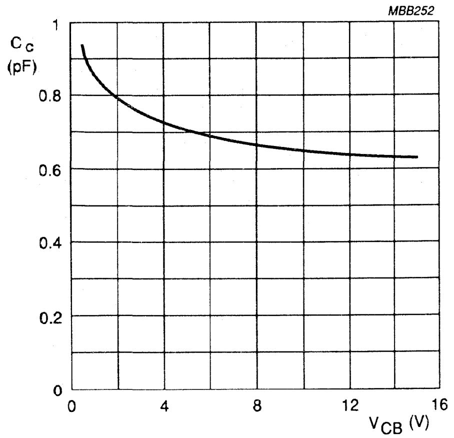


Fig.3 Power derating curve.



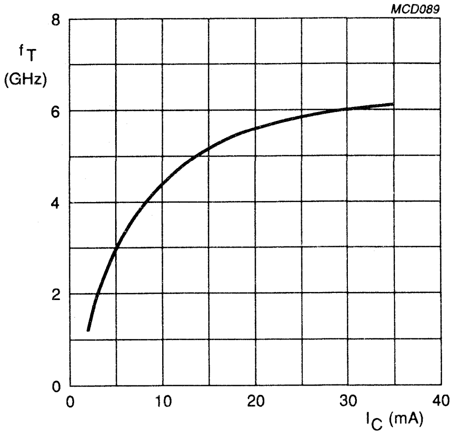
V_{CE} = 5 V; T_j = 25 °C.

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



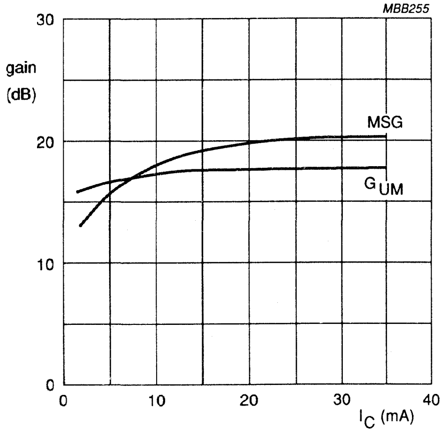
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C.

Fig.5 Collector capacitance as a function of collector-base voltage, typical values.



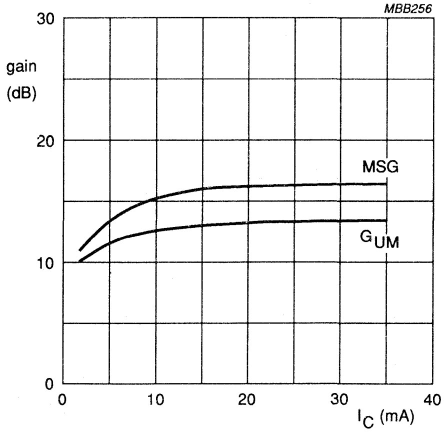
V_{CE} = 5 V; T_j = 25 °C; f = 500 MHz.

Fig.6 Transition frequency as a function of collector current, typical values.



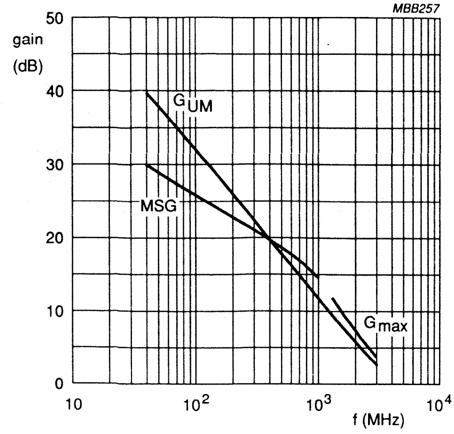
V_{CE} = 8 V; f = 500 MHz.

Fig.7 Gain as a function of collector current.



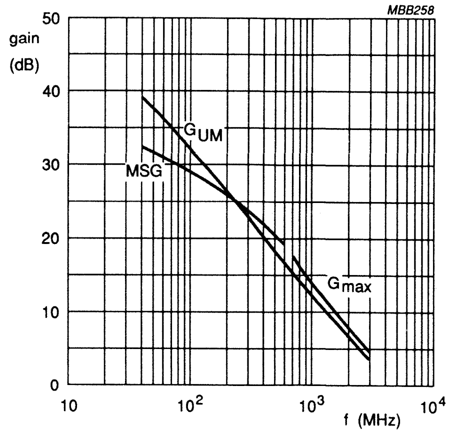
V_{CE} = 8 V; f = 1 GHz.

Fig.8 Gain as a function of collector current.



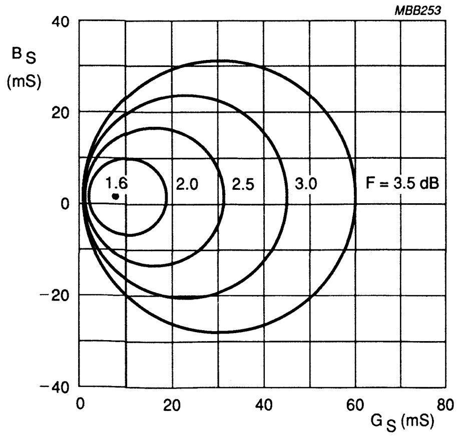
V_{CE} = 8 V; I_C = 10 mA.

Fig.9 Gain as a function of frequency.



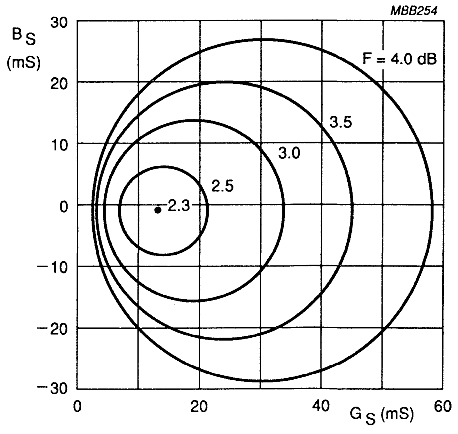
V_{CE} = 8 V; I_C = 30 mA.

Fig.10 Gain as a function of frequency.



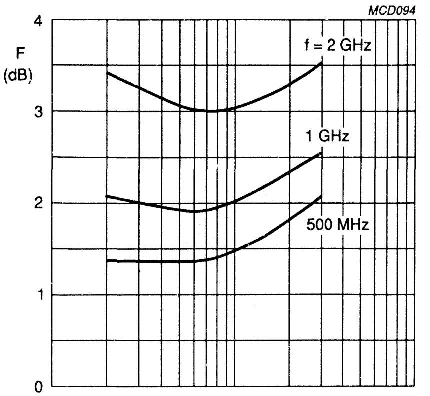
I_C = 4 mA; V_{CE} = 8 V; f = 800 MHz; T_{amb} = 25 °C.

Fig.11 Circles of constant noise figure, typical values.



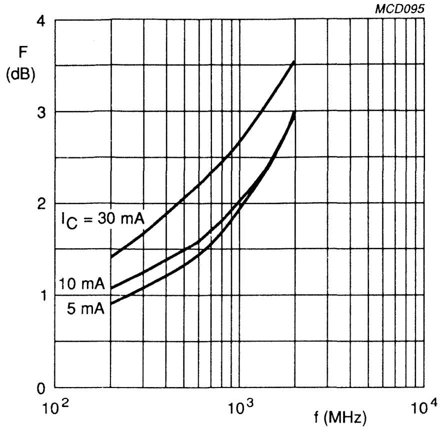
I_C = 4 mA; V_{CE} = 8 V; f = 800 MHz; T_{amb} = 25 °C.

Fig.12 Circles of constant noise figure, typical values.



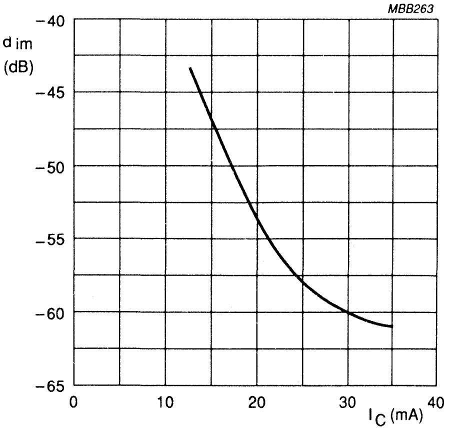
V_{CE} = 8 V.

Fig.13 Minimum noise figure as a function of collector current.



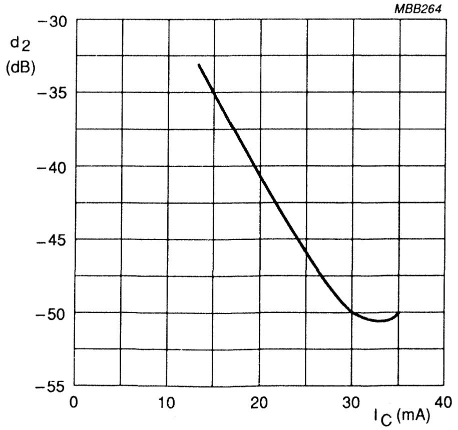
V_{CE} = 8 V.

Fig.14 Minimum noise figure as a function of frequency.



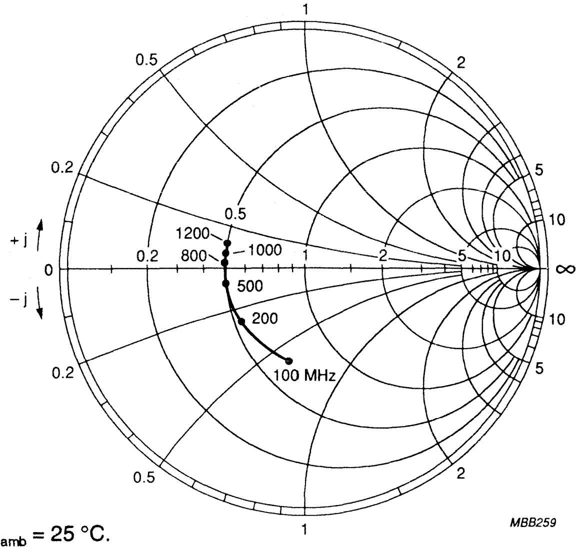
V_{CE} = 8 V; V_O = 425 mV (52.6 dBmV); $f_{(p+q-r)}$ = 793.25 MHz; T_{amb} = 25 °C.
Measured in MATV test circuit (see Fig.2).

Fig.15 Intermodulation distortion, typical values.



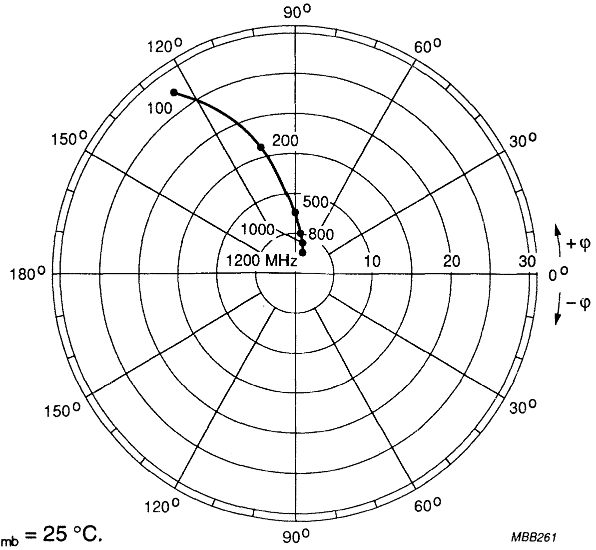
V_{CE} = 8 V; V_O = 200 mV (46 dBmV); $f_{(p+q-r)}$ = 810 MHz; T_{amb} = 25 °C.
Measured in MATV test circuit (see Fig.2).

Fig.16 Second order intermodulation distortion, typical values.



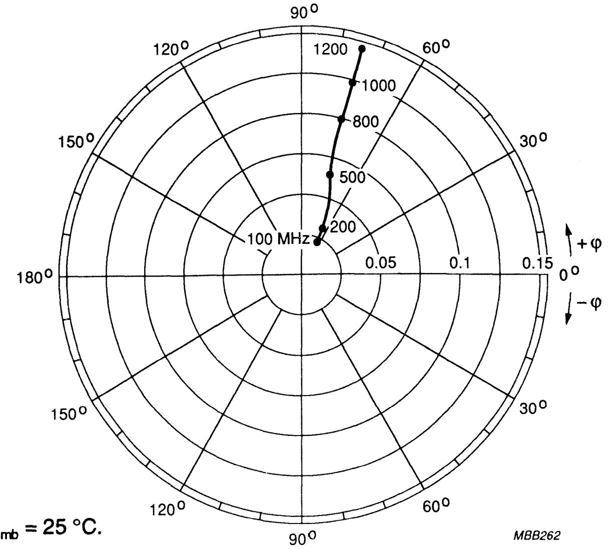
V_{CE} = 8 V; I_C = 30 mA; T_{amb} = 25 °C.

Fig.17 Common emitter input reflection coefficient (S_{11}).



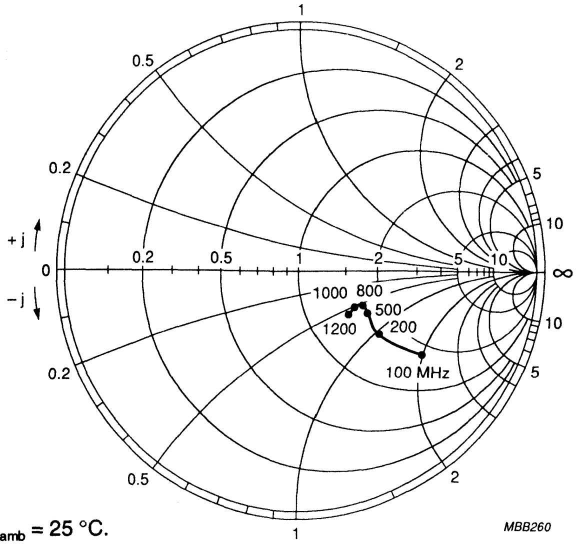
V_{CE} = 8 V; I_C = 30 mA; T_{amb} = 25 °C.

Fig.18 Common emitter forward transmission coefficient (S_{21}).



V_{CE} = 8 V; I_C = 30 mA; T_{amb} = 25 °C.

Fig.19 Common emitter reverse transmission coefficient (S_{12}).

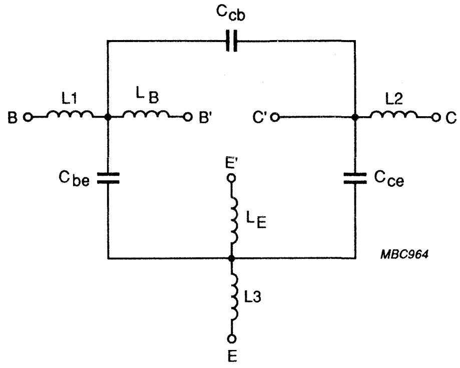


V_{CE} = 8 V; I_C = 30 mA; T_{amb} = 25 °C.

Fig.20 Common emitter output reflection coefficient (S_{22}).

SPICE parameters for BFR91A crystal

1	IS = 1.328	fA
2	BF = 102.0	–
3	NF = 1.000	–
4	VAF = 51.90	V
5	IKF = 8.155	A
6	ISE = 13.90	fA
7	NE = 1.512	–
8	BR = 17.69	–
9	NR = 994.0	m
10	VAR = 3.280	V
11	IKR = 10.00	A
12	ISC = 1.043	fA
13	NC = 1.189	–
14	RB = 10.00	Ω
15	IRB = 1.000	μA
16	RBM = 10.00	Ω
17	RE = 763.6	mΩ
18	RC = 9.000	Ω
19 (note 1)	XTB = 0.000	–
20 (note 1)	EG = 1.110	EV
21 (note 1)	XTI = 3.000	–
22	CJE = 2.032	pF
23	VJE = 600.0	mV
24	MJE = 290.0	m
25	TF = 6.557	ps
26	XTF = 38.97	–
27	VTF = 10.93	V
28	ITF = 521.0	mA
29	PTF = 0.000	deg
30	CJC = 1.003	pF
31	VJC = 340.8	mV
32	MJC = 194.2	m
33	XCJC = 120.0	m
34	TR = 3.073	ns
35 (note 1)	CJS = 0.000	F
36 (note 1)	VJS = 750.0	mV
37 (note 1)	MJS = 0.000	–
38	FC = 800.0	m



$QL_B = 50$; $QL_E = 50$.

$QL_{B,E}(f) = QL_{B,E}\sqrt{(f/Fc)}$.

Fc = scaling frequency = 1000 MHz.

Fig.21 Package equivalent circuit, SOT23.

List of components (see Fig.21)

DESIGNATION	VALUE
C_{be}	71 fF
C_{cb}	71 fF
C_{ce}	2 fF
L1	0.35 nH
L2	0.17 nH
L3	0.25 nH
L_B	0.40 nH
L_E	0.83 nH

Note

1. These parameters have not been extracted, the default values are shown.

Table 1 Common emitter scattering parameters, V_{CE} = 5 V, I_C = 10 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	
40	0.70	−26.0	24.58	161.0	0.01	77.0	0.95	−13.9	40.5
100	0.62	−58.0	19.89	139.4	0.03	64.2	0.80	−28.7	32.4
200	0.51	−98.1	13.90	119.3	0.04	57.3	0.58	−40.4	25.9
300	0.46	−119.1	10.22	107.7	0.05	56.0	0.46	−44.2	22.2
400	0.43	−133.1	7.99	100.7	0.06	57.6	0.40	−45.6	19.7
500	0.44	−144.4	6.67	94.6	0.07	58.9	0.36	−45.6	18.0
600	0.41	−152.5	5.61	90.6	0.08	61.1	0.33	−45.7	16.3
700	0.40	−156.2	4.88	87.2	0.09	62.8	0.32	−46.0	15.0
800	0.41	−163.5	4.29	83.8	0.10	64.0	0.31	−45.7	13.9
900	0.39	−168.2	3.89	80.8	0.11	65.1	0.30	−46.0	12.9
1000	0.39	−173.0	3.47	77.6	0.12	66.0	0.29	−46.2	11.9
1200	0.39	179.2	2.96	72.2	0.14	66.8	0.28	−47.2	10.5
1400	0.40	175.0	2.58	66.9	0.16	67.1	0.28	−50.0	9.3
1600	0.39	170.1	2.31	63.7	0.18	67.5	0.28	−51.7	8.3
1800	0.38	161.7	2.05	59.3	0.20	67.0	0.28	−53.5	7.3
2000	0.40	158.4	1.94	55.6	0.22	66.8	0.27	−54.8	6.8
2200	0.41	149.9	1.77	52.0	0.24	66.5	0.24	−57.7	6.0
2400	0.43	150.7	1.66	48.1	0.27	65.4	0.23	−64.9	5.5
2600	0.43	146.4	1.55	45.2	0.29	64.1	0.23	−71.0	4.9
2800	0.41	142.6	1.47	41.8	0.31	63.5	0.23	−74.8	4.4
3000	0.44	136.9	1.40	39.0	0.33	61.8	0.22	−77.7	4.1

Table 2 Common emitter scattering parameters, $V_{CE} = 5$ V, $I_C = 20$ mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.58	−36.9	36.29	154.1	0.01	74.7	0.89	−19.8	39.9
100	0.47	−77.2	26.07	129.7	0.02	61.3	0.68	−37.3	32.0
200	0.42	−117.9	16.36	111.4	0.03	61.4	0.45	−47.4	26.1
300	0.39	−136.5	11.55	101.9	0.04	63.3	0.35	−49.6	22.5
400	0.38	−147.9	8.94	96.1	0.05	65.4	0.30	−50.3	20.1
500	0.38	−156.0	7.34	91.1	0.07	67.4	0.27	−49.9	18.3
600	0.37	−162.7	6.16	87.8	0.08	68.3	0.25	−49.6	16.7
700	0.35	−163.6	5.35	84.7	0.09	70.0	0.24	−49.6	15.4
800	0.37	−172.2	4.68	82.1	0.10	69.8	0.24	−49.2	14.3
900	0.35	−175.4	4.22	79.4	0.12	70.2	0.23	−49.4	13.3
1000	0.36	−179.5	3.78	76.4	0.13	70.6	0.22	−49.1	12.4
1200	0.36	173.4	3.21	71.6	0.15	70.4	0.21	−50.0	10.9
1400	0.39	171.0	2.80	66.8	0.17	69.2	0.20	−52.8	9.9
1600	0.36	169.2	2.50	63.6	0.19	69.1	0.21	−54.2	8.8
1800	0.36	160.6	2.24	59.6	0.22	67.6	0.21	−55.6	7.8
2000	0.38	155.4	2.09	56.0	0.24	66.3	0.20	−55.8	7.3
2200	0.39	148.8	1.90	52.8	0.26	65.8	0.18	−58.4	6.4
2400	0.40	148.9	1.78	48.9	0.28	64.4	0.16	−66.7	5.9
2600	0.42	145.2	1.68	46.0	0.30	62.7	0.16	−73.5	5.5
2800	0.39	141.0	1.59	43.5	0.32	61.5	0.17	−77.0	4.9
3000	0.42	136.6	1.50	39.7	0.35	59.8	0.15	−79.5	4.4

NPN 6 GHz wideband transistor BFR93A

Table 3 Common emitter scattering parameters, V_{CE} = 5 V, I_C = 30 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.50	−44.2	42.81	149.9	0.01	74.3	0.85	−23.4	39.5
100	0.41	−88.8	28.62	124.9	0.02	62.9	0.61	−41.3	31.9
200	0.37	−127.6	17.10	107.9	0.04	64.2	0.39	−49.9	26.0
300	0.36	−144.5	11.93	99.3	0.05	66.9	0.30	−51.1	22.5
400	0.35	−153.5	9.17	94.3	0.06	68.3	0.26	−51.5	20.1
500	0.37	−160.2	7.51	89.4	0.07	70.5	0.23	−50.9	18.4
600	0.37	−167.0	6.30	86.7	0.08	70.8	0.22	−50.7	16.8
700	0.34	−168.3	5.46	83.7	0.09	72.8	0.21	−50.7	15.5
800	0.36	−175.7	4.78	81.3	0.11	72.0	0.21	−49.9	14.4
900	0.35	−177.4	4.32	78.8	0.12	72.3	0.20	−50.4	13.4
1000	0.35	176.8	3.86	76.0	0.13	72.3	0.20	−49.9	12.5
1200	0.35	173.4	3.29	71.2	0.15	71.5	0.19	−50.8	11.1
1400	0.37	168.3	2.85	66.7	0.17	70.2	0.18	−53.4	9.9
1600	0.36	166.1	2.55	63.4	0.20	69.2	0.18	−54.4	8.9
1800	0.35	158.4	2.27	59.3	0.22	68.0	0.19	−56.0	7.8
2000	0.35	154.7	2.13	56.0	0.24	66.5	0.18	−56.0	7.3
2200	0.37	147.1	1.93	52.6	0.26	66.2	0.15	−58.2	6.4
2400	0.39	148.6	1.81	49.5	0.29	64.1	0.14	−67.2	6.0
2600	0.39	146.3	1.69	46.1	0.31	62.5	0.14	−74.4	5.4
2800	0.39	142.6	1.63	43.3	0.33	61.4	0.14	−78.4	5.0
3000	0.41	136.2	1.54	40.6	0.35	59.2	0.13	−80.1	4.6

Table 4 Common emitter scattering parameters, V_{CE} = 8 V, I_C = 10 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.74	−24.7	24.13	161.4	0.01	77.8	0.95	−12.7	41.0
100	0.64	−55.3	19.70	140.2	0.03	65.6	0.80	−26.6	32.7
200	0.51	−92.7	13.93	120.1	0.04	58.4	0.60	−37.4	26.1
300	0.45	−113.9	10.26	108.5	0.05	57.0	0.49	−40.8	22.4
400	0.41	−129.2	8.06	101.5	0.06	58.5	0.42	−41.7	19.8
500	0.41	−140.5	6.73	95.2	0.07	60.1	0.38	−41.6	18.1
600	0.38	−149.0	5.66	91.2	0.08	61.7	0.36	−41.7	16.3
700	0.37	−152.9	4.93	87.6	0.09	64.4	0.35	−41.7	15.1
800	0.37	−161.9	4.33	84.3	0.10	65.1	0.34	−41.5	13.9
900	0.37	−165.5	3.91	81.3	0.11	66.5	0.33	−42.0	13.0
1000	0.37	−172.8	3.51	78.1	0.12	66.7	0.33	−42.0	12.0
1200	0.37	−179.3	2.98	72.8	0.14	67.7	0.31	−43.1	10.6
1400	0.38	173.9	2.60	67.7	0.16	67.7	0.31	−45.7	9.4
1600	0.38	169.3	2.34	64.2	0.18	68.5	0.31	−47.4	8.4
1800	0.36	161.2	2.08	59.8	0.20	67.7	0.31	−49.0	7.4
2000	0.37	157.9	1.96	55.8	0.22	67.5	0.30	−50.4	6.9
2200	0.39	148.4	1.78	52.5	0.24	67.9	0.28	−53.2	6.1
2400	0.40	149.8	1.65	48.5	0.27	66.3	0.27	−59.4	5.4
2600	0.40	144.1	1.55	46.1	0.29	65.5	0.27	−64.9	4.9
2800	0.40	138.9	1.49	42.8	0.31	64.4	0.27	−67.8	4.5
3000	0.41	134.4	1.42	40.1	0.33	63.2	0.25	−70.5	4.1

Table 5 Common emitter scattering parameters, $V_{CE} = 8$ V, $I_C = 20$ mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.62	–33.5	35.36	154.9	0.01	76.1	0.90	–18.2	40.3
100	0.50	–70.8	25.82	130.9	0.03	62.7	0.69	–34.4	32.3
200	0.41	–109.3	16.36	112.3	0.04	62.0	0.48	–43.3	26.2
300	0.37	–129.1	11.63	102.7	0.05	63.3	0.38	–44.7	22.6
400	0.35	–141.8	8.96	96.9	0.06	65.8	0.33	–44.9	20.1
500	0.35	–150.3	7.40	91.8	0.06	66.7	0.30	–44.2	18.4
600	0.34	–158.0	6.20	88.2	0.08	69.2	0.28	–43.8	16.7
700	0.32	–162.5	5.39	85.2	0.09	69.8	0.27	–44.1	15.4
800	0.34	–168.1	4.72	82.5	0.10	70.2	0.27	–43.5	14.3
900	0.33	–171.1	4.25	79.8	0.12	70.7	0.26	–43.9	13.4
1000	0.33	179.9	3.82	77.1	0.13	70.7	0.26	–43.7	12.4
1200	0.32	175.4	3.25	71.8	0.15	70.5	0.25	–44.7	11.0
1400	0.35	171.7	2.82	67.3	0.17	69.8	0.24	–47.1	9.8
1600	0.33	167.2	2.53	64.0	0.19	69.3	0.24	–48.5	8.8
1800	0.32	158.1	2.25	60.0	0.22	68.1	0.24	–50.2	7.8
2000	0.34	156.3	2.11	56.4	0.24	67.2	0.24	–50.7	7.3
2200	0.36	145.7	1.92	52.8	0.26	66.7	0.22	–52.8	6.5
2400	0.38	147.0	1.78	49.3	0.28	64.9	0.20	–59.2	5.9
2600	0.38	145.8	1.68	47.1	0.30	63.7	0.20	–66.0	5.3
2800	0.36	141.8	1.60	44.2	0.32	62.7	0.20	–68.6	4.9
3000	0.39	133.5	1.52	41.0	0.34	60.9	0.19	–70.5	4.5

Table 6 Common emitter scattering parameters, V_{CE} = 8 V, I_C = 30 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.57	−39.6	41.36	151.0	0.01	73.0	0.87	−21.3	40.1
100	0.45	−79.2	28.22	126.2	0.02	63.2	0.63	−37.7	32.2
200	0.37	−117.3	17.12	109.0	0.04	64.3	0.42	−45.0	26.2
300	0.34	−134.9	11.97	100.1	0.05	65.9	0.33	−45.6	22.6
400	0.32	−146.6	9.21	95.0	0.06	68.7	0.29	−45.2	20.1
500	0.34	−154.1	7.59	90.0	0.07	70.1	0.27	−44.3	18.4
600	0.33	−161.4	6.33	87.1	0.08	70.4	0.25	−44.0	16.8
700	0.31	−164.2	5.51	84.2	0.09	72.1	0.24	−43.8	15.5
800	0.31	−172.9	4.82	81.6	0.11	71.4	0.24	−43.5	14.3
900	0.31	−174.5	4.33	79.1	0.12	72.3	0.24	−43.9	13.4
1000	0.31	177.6	3.89	76.1	0.12	72.1	0.23	−43.6	12.5
1200	0.32	174.0	3.29	71.4	0.15	71.6	0.22	−44.7	11.0
1400	0.34	169.3	2.87	67.0	0.18	70.0	0.22	−47.4	9.9
1600	0.32	168.3	2.57	63.7	0.19	69.6	0.22	−49.2	8.9
1800	0.30	157.3	2.29	60.2	0.22	68.2	0.22	−50.2	7.8
2000	0.33	157.2	2.14	56.3	0.24	66.8	0.22	−50.6	7.3
2200	0.35	146.9	1.94	53.0	0.26	66.4	0.20	−52.9	6.5
2400	0.36	146.9	1.83	49.9	0.29	64.5	0.18	−59.9	6.0
2600	0.37	145.5	1.71	46.7	0.30	63.0	0.18	−66.2	5.4
2800	0.35	140.4	1.63	44.0	0.33	61.8	0.18	−69.4	4.9
3000	0.38	133.9	1.53	40.9	0.35	60.1	0.17	−70.8	4.5

NPN 6 GHz wideband transistor BFR93AW

FEATURES

- High power gain
- Low noise figure
- Gold metallization ensures excellent reliability
- SOT323 (S-mini) envelope.

DESCRIPTION

Silicon NPN transistor in a plastic SOT323 envelope. It is designed for use in RF amplifiers, mixers and oscillators with signal frequencies up to 1 GHz. The BFR93AW uses the same crystal as the SOT23 version, BFR93A.

PINNING

PIN	DESCRIPTION
	Code: R2
1	base
2	emitter
3	collector

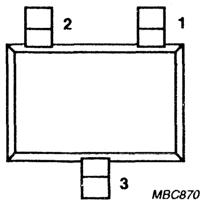


Fig.1 SOT323.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage		–	–	15	V
V_{CEO}	collector-emitter voltage		–	–	12	V
I_C	DC collector current		–	–	35	mA
P_{tot}	total power dissipation	up to T_s = 93 °C (note 1)	–	–	300	mW
h_{FE}	DC current gain	I_C = 30 mA; V_{CE} = 5 V	40	90	–	
f_T	transition frequency	I_C = 30 mA; V_{CE} = 5 V	4.5	6	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 30 mA; V_{CE} = 8 V; f = 1 GHz	–	16	–	dB
F	noise figure	I_C = 5 mA; V_{CE} = 8 V; f = 1 GHz	–	1.9	–	dB
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	note 1	–	–	190	K/W
T_j	junction temperature		–	–	150	°C

Note

1. T_s is the temperature at the soldering point of the collector tab.

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.

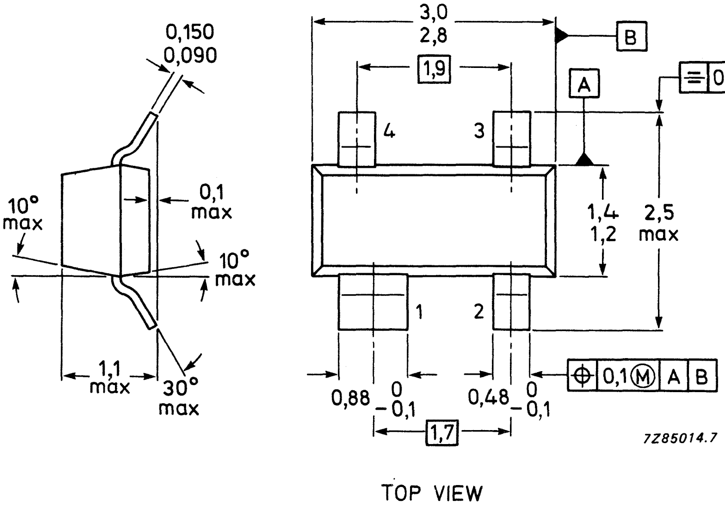
QUICK REFERENCE DATA

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

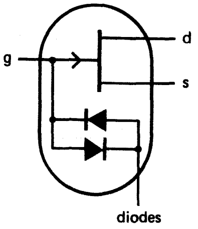
Dimensions in mm

Fig. 1 SOT-143.



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 5 GHz wideband transistor BFR106

DESCRIPTION

NPN silicon planar epitaxial transistor in a plastic SOT23 envelope. It is primarily intended for low noise, general RF applications.

PINNING

PIN	DESCRIPTION
Code: R7p	
1	base
2	emitter
3	collector

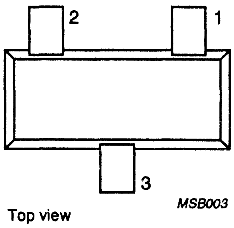


Fig.1 SOT23.

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	–	–	15	V
I_C	DC collector current		–	–	100	mA
P_{tot}	total power dissipation	up to T_s = 45 °C (note 1)	–	–	500	mW
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 9 V; T_{amb} = 25 °C	25	80	–	
f_T	transition frequency	I_C = 50 mA; V_{CE} = 9 V; f = 500 MHz; T_{amb} = 25 °C	–	5	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 30 mA; V_{CE} = 6 V; f = 800 MHz; T_{amb} = 25 °C	–	11.5	–	dB
V_O	output voltage	I_C = 50 mA; V_{CE} = 9 V; R_L = 75 Ω; T_{amb} = 25 °C; d_{im} = –60 dB; $f_{(p+q-r)}$ = 793.25 MHz	–	350	–	mV

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	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	DC collector current		–	100	mA
P_{tot}	total power dissipation	up to T_s = 45 °C (note 1)	–	500	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C

Note

1. T_s is the temperature at the soldering point of the collector tab.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 45 °C (note 1)	210 K/W

Note

1. T_s is the temperature at the soldering point of the collector tab.

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} = 9 V	25	80	–	
f_T	transition frequency	I_C = 50 mA; V_{CE} = 9 V; f = 500 MHz; T_{amb} = 25 °C	–	5	–	GHz
C_c	collector capacitance	$I_E = i_e = 0$; V_{CB} = 10 V; f = 1 MHz	–	1.5	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; V_{EB} = 0.5 V; f = 1 MHz	–	4.5	–	pF
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 10 V; f = 1 MHz	–	1.2	–	pF
G_{UM}	maximum unilateral power gain (note 1)	I_C = 30 mA; V_{CE} = 6 V; f = 800 MHz; T_{amb} = 25 °C	–	11.5	–	dB
F	noise figure	I_C = 30 mA; V_{CE} = 6 V; f = 800 MHz; T_{amb} = 25 °C	–	3.5	–	dB
d_2	second order intermodulation distortion	note 2	–	–50	–	dB
V_O	output voltage	note 3	–	350	–	mV

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10\log\frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.
2. I_C = 30 mA; V_{CE} = 6 V; R_L = 75 Ω; T_{amb} = 25 °C;
   $f_{(p+q)}$ = 810 MHz; V_O = 100 mV.
3. d_{im} = –60 dB (DIN 45004B); I_C = 50 mA; V_{CE} = 9 V; R_L = 75 Ω; T_{amb} = 25 °C; $f_{(p+q-r)}$ = 793.25 MHz.

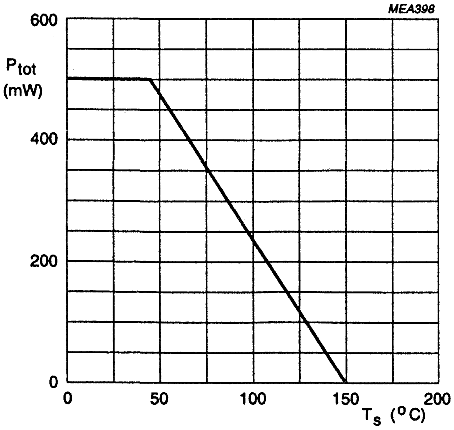
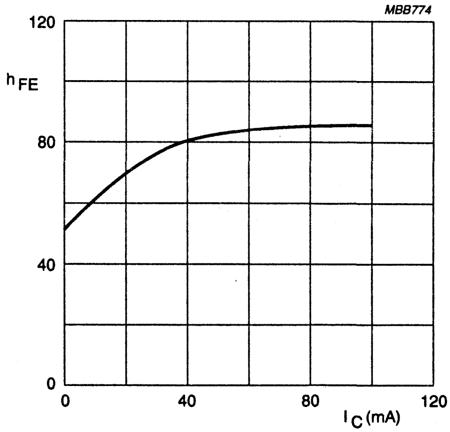
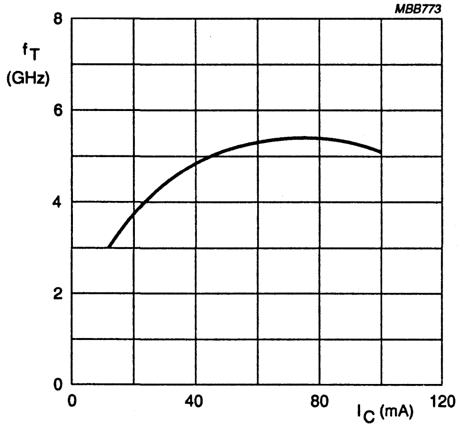


Fig.2 Power derating curve.



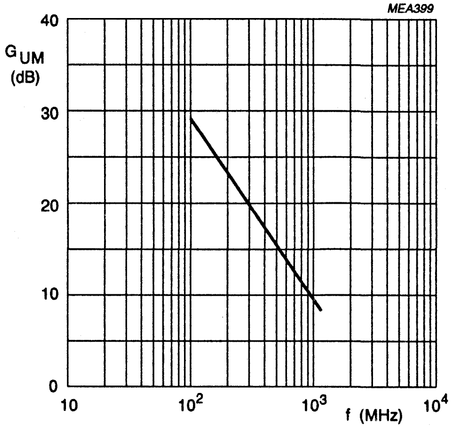
$V_{CE} = 9$ V; $T_{amb} = 25$ °C.

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



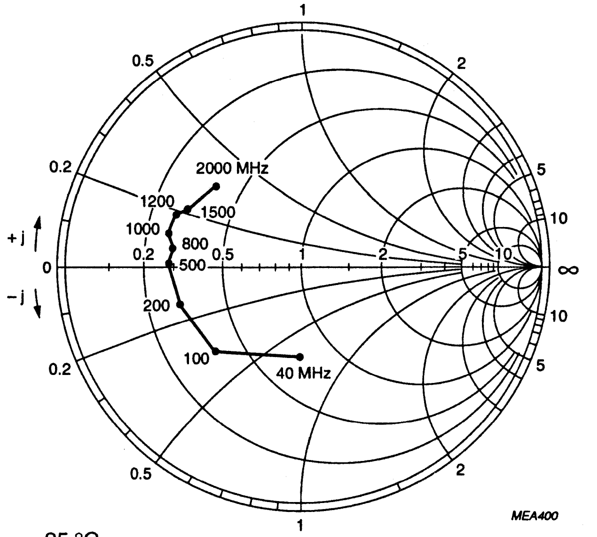
$V_{CE} = 9$ V; f = 500 MHz; $T_j = 25$ °C.

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



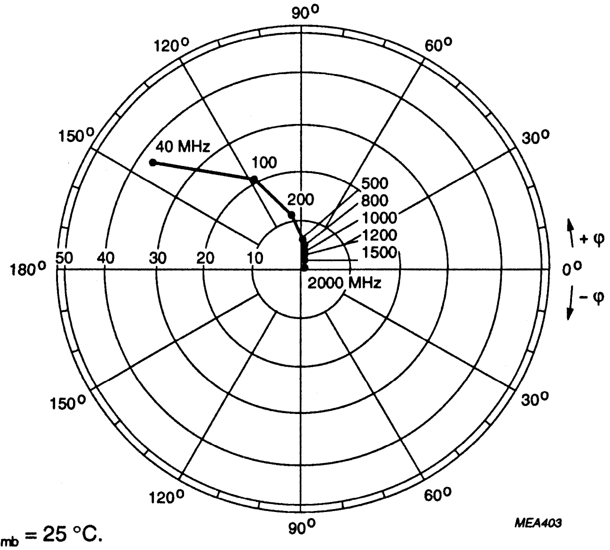
$I_C = 30$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C.

Fig.5 Maximum unilateral power gain as a function of frequency.



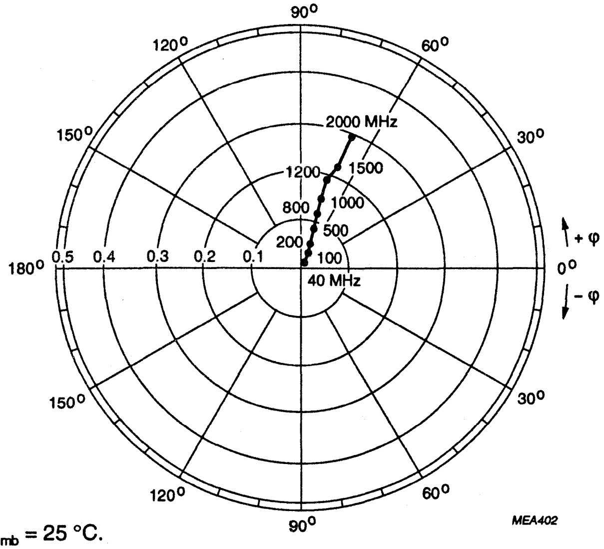
$I_C = 30$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C.

Fig.6 Common emitter input reflection coefficient (S_{11}).



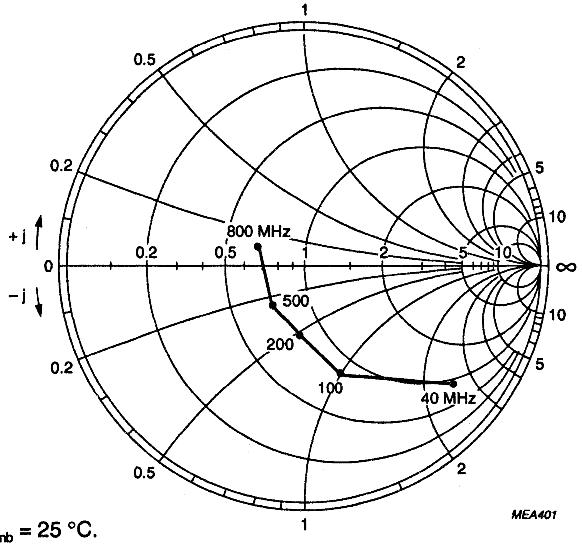
$I_C = 30$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C.

Fig.7 Common emitter forward transmission coefficient (S_{21}).



I_C = 30 mA; V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.8 Common emitter reverse transmission coefficient (S_{12}).



I_C = 30 mA; V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.9 Common emitter output reflection coefficient (S_{22}).

Table 1 Common emitter scattering parameters, $I_C = 30$ mA; $V_{CE} = 5$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.460	−86.7	39.780	136.7	0.017	63.4	0.717	−42.1	36.2
100	0.487	−136.5	21.728	110.9	0.027	56.5	0.403	−66.4	28.7
200	0.519	−159.7	11.675	97.7	0.042	63.0	0.230	−80.3	22.9
300	0.506	−169.8	8.005	90.7	0.055	66.6	0.171	−87.5	19.5
400	0.516	−175.0	6.068	86.8	0.070	69.2	0.146	−92.3	17.1
500	0.507	−177.4	4.899	82.2	0.085	70.6	0.132	−95.7	15.2
600	0.511	179.1	4.153	78.6	0.102	70.9	0.128	−97.9	13.8
700	0.510	175.4	3.568	76.1	0.116	71.1	0.127	−98.9	12.4
800	0.513	171.6	3.146	72.9	0.132	71.2	0.123	−100.1	11.3
900	0.510	169.3	2.834	70.0	0.148	71.2	0.125	−99.7	10.4
1000	0.518	168.1	2.561	67.0	0.163	70.2	0.123	−101.6	9.6
1200	0.534	162.9	2.180	62.5	0.193	69.3	0.123	−106.2	8.3
1400	0.534	158.3	1.902	57.5	0.223	67.6	0.130	−110.6	7.1
1600	0.538	155.0	1.716	52.5	0.251	66.5	0.132	−113.0	6.3
1800	0.524	151.1	1.565	49.3	0.282	64.7	0.140	−117.5	5.4
2000	0.542	144.0	1.456	45.0	0.308	63.2	0.137	−123.5	4.9

Table 2 Common emitter scattering parameters, $I_C = 50$ mA; $V_{CE} = 5$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.422	−103.7	44.957	130.4	0.015	61.2	0.629	−50.3	36.1
100	0.477	−147.4	22.741	106.7	0.024	60.8	0.332	−74.9	28.8
200	0.510	−165.6	11.956	95.3	0.040	69.2	0.188	−91.2	23.0
300	0.507	−173.6	8.115	89.3	0.055	70.5	0.145	−101.2	19.6
400	0.499	−177.5	6.179	85.8	0.071	72.5	0.126	−107.2	17.1
500	0.498	179.4	4.974	81.4	0.087	73.3	0.116	−111.2	15.2
600	0.500	177.1	4.207	78.0	0.103	73.2	0.117	−113.6	13.8
700	0.506	173.7	3.609	75.4	0.119	72.8	0.114	−114.3	12.5
800	0.511	170.6	3.188	72.8	0.136	72.3	0.112	−115.5	11.4
900	0.506	168.2	2.868	69.6	0.151	72.0	0.113	−114.6	10.5
1000	0.506	166.7	2.594	66.9	0.168	71.0	0.111	−116.5	9.6
1200	0.526	162.0	2.213	62.4	0.197	69.5	0.114	−120.9	8.4
1400	0.540	157.6	1.925	57.4	0.227	67.7	0.120	−124.1	7.3
1600	0.537	155.5	1.745	52.0	0.256	66.5	0.123	−126.7	6.4
1800	0.521	149.6	1.590	49.0	0.285	64.6	0.127	−129.8	5.5
2000	0.542	142.4	1.470	45.5	0.313	63.1	0.128	−136.2	4.9

Table 3 Common emitter scattering parameters, I_C = 70 mA; V_{CE} = 5 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.427	−115.1	46.126	126.4	0.015	63.2	0.567	−54.4	35.8
100	0.493	−153.2	22.301	104.3	0.023	62.6	0.288	−78.3	28.6
200	0.515	−168.0	11.587	94.1	0.040	70.2	0.166	−94.7	22.7
300	0.508	−174.8	7.868	88.4	0.054	72.6	0.130	−104.9	19.3
400	0.502	−179.5	5.988	84.9	0.071	74.0	0.116	−110.3	16.9
500	0.512	177.7	4.820	80.7	0.087	74.2	0.109	−114.6	15.0
600	0.509	176.7	4.064	77.5	0.104	74.2	0.110	−116.2	13.5
700	0.507	173.6	3.498	74.9	0.120	73.6	0.110	−117.3	12.2
800	0.513	169.6	3.094	72.1	0.136	72.8	0.109	−117.6	11.2
900	0.517	168.4	2.786	69.1	0.153	72.5	0.111	−117.6	10.3
1000	0.520	165.9	2.516	66.3	0.169	71.2	0.111	−119.4	9.4
1200	0.538	162.3	2.146	61.9	0.198	69.8	0.113	−123.7	8.2
1400	0.535	158.1	1.874	56.7	0.228	68.0	0.120	−127.2	7.0
1600	0.540	154.1	1.692	52.1	0.257	66.7	0.123	−129.6	6.1
1800	0.532	149.3	1.552	47.9	0.287	64.5	0.128	−133.4	5.3
2000	0.553	143.1	1.424	45.1	0.316	63.1	0.129	−139.1	4.7

Table 4 Common emitter scattering parameters, I_C = 30 mA; V_{CE} = 10 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.537	−72.6	39.272	139.0	0.018	64.2	0.745	−37.4	36.9
100	0.484	−125.7	22.247	112.7	0.027	57.1	0.433	−58.1	29.0
200	0.482	−152.1	12.075	98.7	0.041	61.6	0.251	−66.8	23.1
300	0.474	−165.3	8.282	91.6	0.054	64.6	0.189	−70.0	19.6
400	0.479	−171.3	6.288	87.5	0.069	67.4	0.161	−71.2	17.2
500	0.485	−175.7	5.076	82.7	0.083	69.2	0.146	−72.2	15.4
600	0.482	−178.5	4.281	79.2	0.098	70.0	0.142	−74.3	13.9
700	0.483	178.5	3.690	76.5	0.113	70.5	0.141	−74.7	12.6
800	0.474	174.0	3.257	73.5	0.127	70.4	0.138	−75.2	11.4
900	0.485	172.3	2.926	70.4	0.142	70.8	0.142	−75.6	10.6
1000	0.486	170.3	2.645	67.7	0.157	69.9	0.140	−77.2	9.7
1200	0.502	164.9	2.260	62.6	0.184	68.9	0.139	−81.1	8.4
1400	0.504	161.6	1.967	57.7	0.212	67.3	0.142	−85.9	7.2
1600	0.502	157.6	1.761	52.8	0.239	66.8	0.148	−89.2	6.3
1800	0.507	152.4	1.621	49.4	0.267	65.3	0.150	−93.7	5.6
2000	0.524	146.2	1.484	45.2	0.294	64.1	0.148	−98.9	4.9

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/√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

MECHANICAL DATA

Dimensions in mm

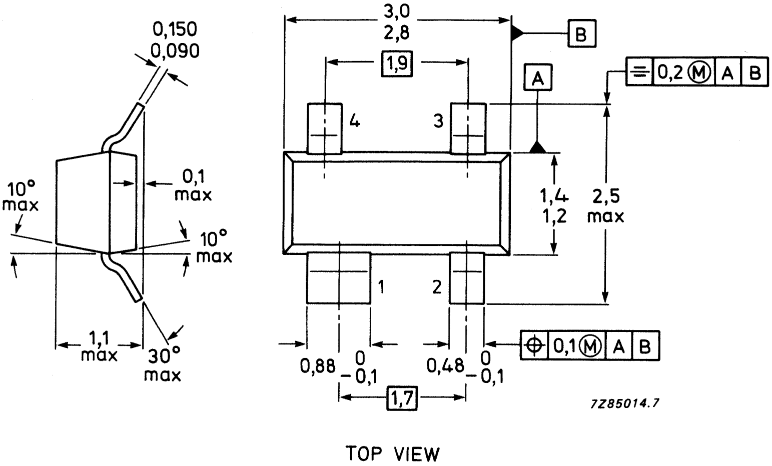


Fig.1 SOT143.

PIN CONFIGURATION

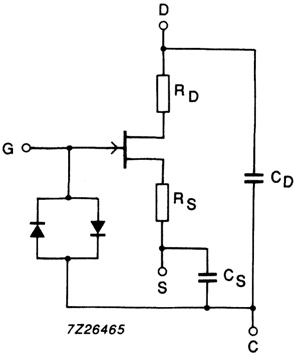


Fig.2 Pin configuration.

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.

STATIC CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$-V_{(BR)GSS}$	gate-source breakdown voltage	$V_{DS} = 0$ $-I_G = 1\ \mu A$	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	$I_D = 0.1\ \mu A$ $V_{DS} = 6$ 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.

NPN 9 GHz wideband transistor

BFR505

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability.

DESCRIPTION

The BFR505 is an npn silicon planar epitaxial transistor, intended for applications in the RF frontend in wideband applications in the GHz range, such as analog and digital cellular telephones, cordless telephones (CT1, CT2, DECT, etc.), radar detectors, pagers and satellite TV tuners (SATV).

The transistor is encapsulated in a plastic SOT23 envelope.

PINNING

PIN	DESCRIPTION
Code: N30	
1	base
2	emitter
3	collector

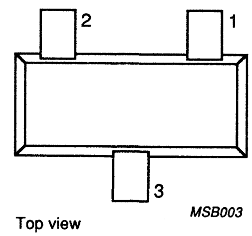


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	–	15	V
I_C	DC collector current		–	–	18	mA
P_{tot}	total power dissipation	up to T_s = 110 °C (note 1)	–	–	150	mW
h_{FE}	DC current gain	I_C = 5 mA; V_{CE} = 6 V	60	120	250	
C_{re}	feedback capacitance	$I_C = i_c = 0$; V_{CB} = 6 V; f = 1 MHz	–	0.3	–	pF
f_T	transition frequency	I_C = 5 mA; V_{CE} = 6 V; f = 1 GHz	–	9	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 900 MHz	–	17	–	dB
		I_C = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 2 GHz	–	10	–	dB
$\|S_{21}\|^2$	insertion power gain	I_C = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 900 MHz	13	14	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 1.25 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 900 MHz	–	1.2	1.7	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 900 MHz	–	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 1.25 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 2 GHz	–	1.9	–	dB

Note

1. T_s is the temperature at the soldering point of the collector tab.

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_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	15	V
V_{EBO}	emitter-base voltage		–	2.5	V
I_C	DC collector current	continuous	–	18	mA
P_{tot}	total power dissipation	up to T_s = 110 °C (note 1)	–	150	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	from junction to soldering point (note 1)	260 K/W

Note

1. T_s is the temperature at the soldering point of the collector tab.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 6$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 6$ V	60	120	250	
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	0.4	–	pF
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.4	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.3	–	pF
f_T	transition frequency	$I_C = 5$ mA; $V_{CE} = 6$ V; f = 1 GHz	–	9	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	17	–	dB
		$I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	10	–	dB
$\lvert S_{21}\rvert^2$	insertion power gain	$I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	13	14	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	1.2	1.7	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	1.9	–	dB
P_{L1}	output power at 1 dB gain compression	$I_C = 5$ mA; $V_{CE} = 6$ V; $R_L = 50\ \Omega$; $T_{amb} = 25$ °C; f = 900 MHz	–	4	–	dBm
ITO	third order intercept point	note 2	–	10	–	dBm

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{\lvert S_{21}\rvert^2}{(1 - \lvert S_{11}\rvert^2)(1 - \lvert S_{22}\rvert^2)}$ dB.
2. $I_C = 5$ mA; $V_{CE} = 6$ V; $R_L = 50\ \Omega$; $T_{amb} = 25$ °C;
   $f_p = 900$ MHz; $f_q = 902$ MHz;
   measured at $f_{(2p-q)} = 898$ MHz and $f_{(2q-p)} = 904$ MHz.

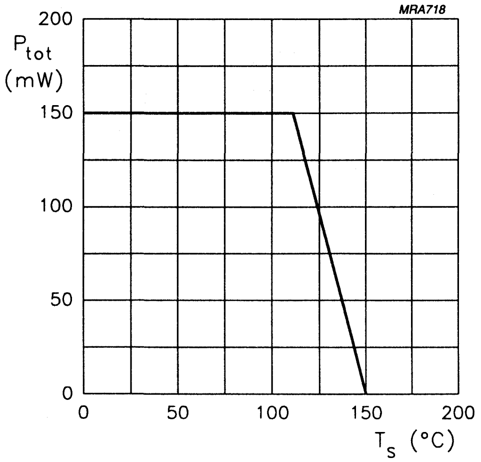
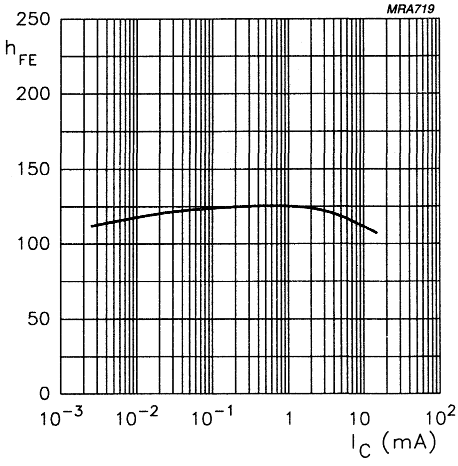
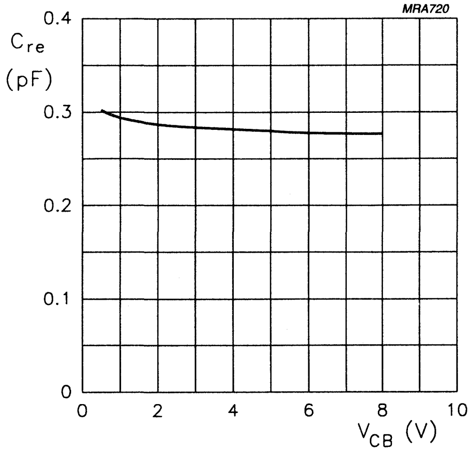


Fig.2 Power derating curve.



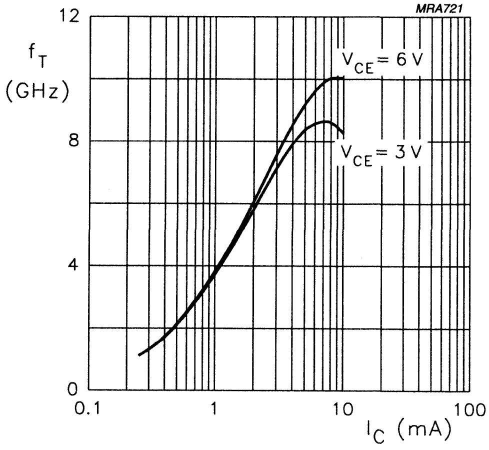
$V_{CE} = 6$ V.

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



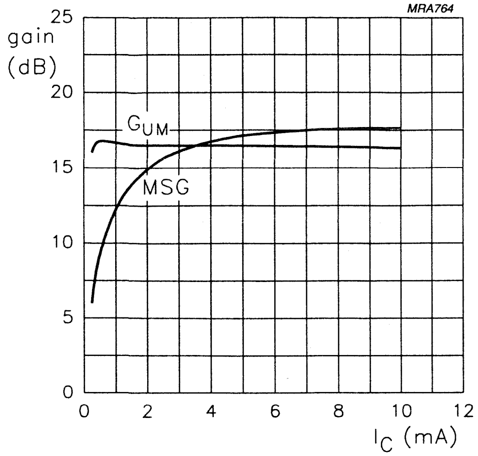
$I_C = 0$; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage.



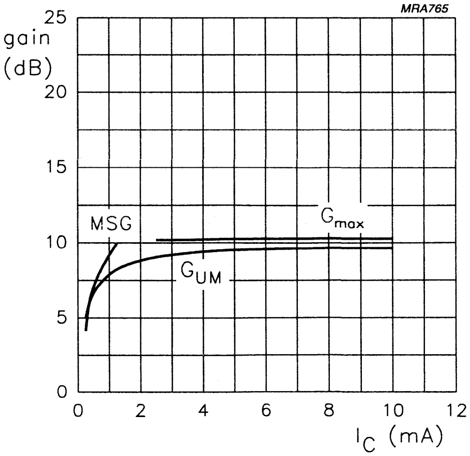
$T_{amb} = 25$ °C; f = 1 GHz.

Fig.5 Transition frequency as a function of collector current.



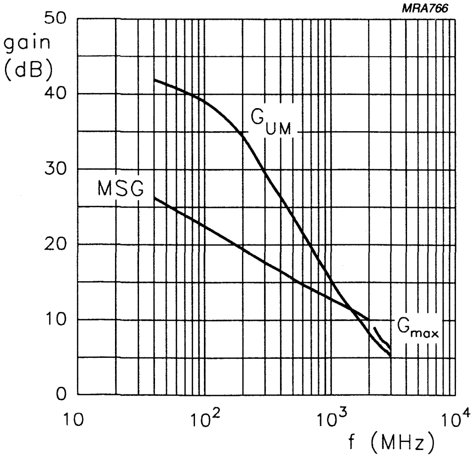
V_{CE} = 6 V; f = 900 MHz.

Fig.6 Gain as a function of collector current.



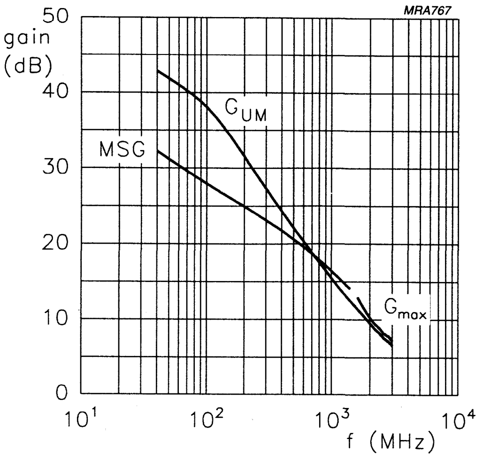
V_{CE} = 6 V; f = 2 GHz.

Fig.7 Gain as a function of collector current.



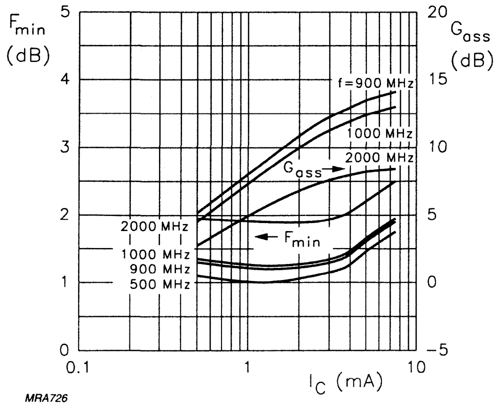
V_{CE} = 6 V; I_C = 1.25 mA.

Fig.8 Gain as a function of frequency.



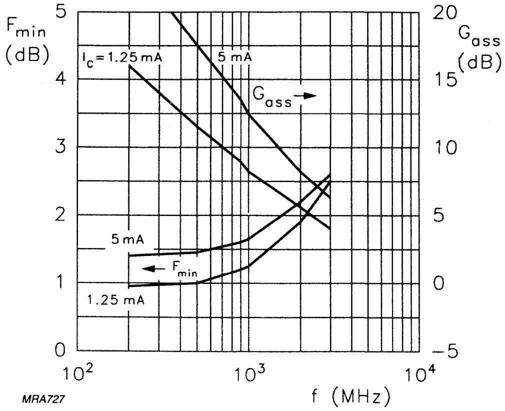
V_{CE} = 6 V; I_C = 5 mA.

Fig.9 Gain as a function of frequency.



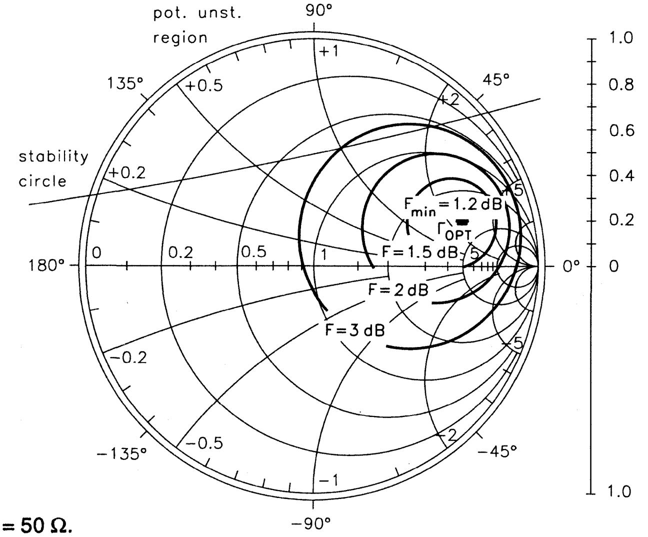
VCE = 6 V.

Fig.10 Minimum noise figure and associated available gain as functions of collector current.



VCE = 6 V.

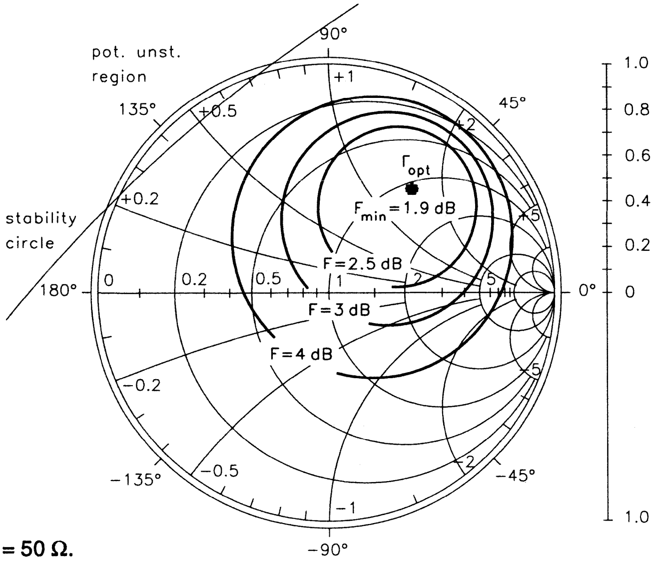
Fig.11 Minimum noise figure and associated available gain as functions of frequency.



Z0 = 50 Ω.

VCE = 6 V; IC = 5 mA; f = 900 MHz.

Fig.12 Noise circle figure.

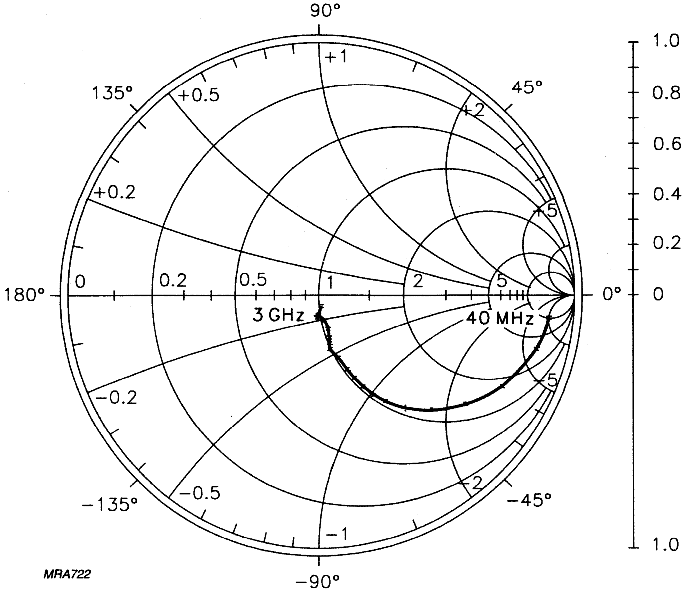


Z_O = 50 Ω.

V_{CE} = 6 V; I_C = 5 mA; f = 2000 MHz.

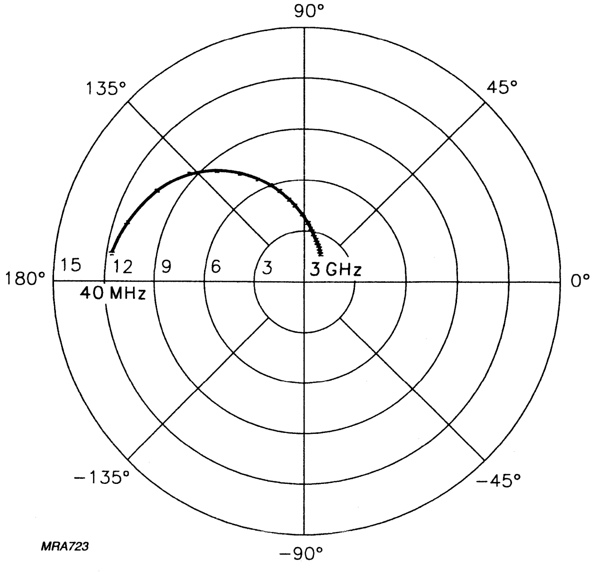
MRA729

Fig.13 Noise circle figure.



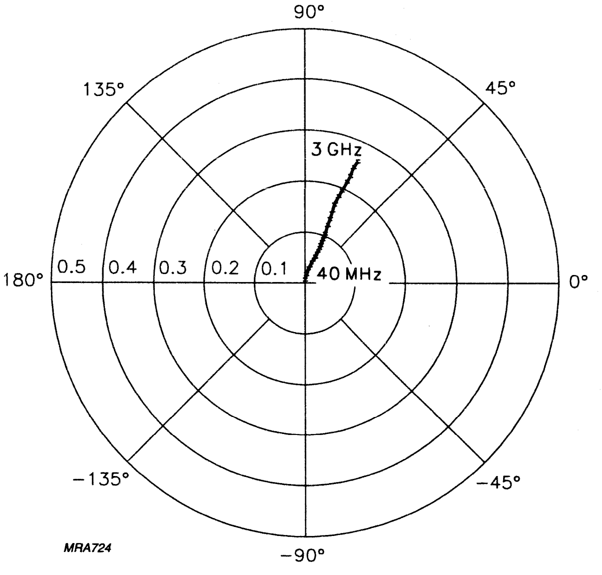
V_{CE} = 6 V; I_C = 5 mA.

Fig.14 Common emitter input reflection coefficient (S_{11}).



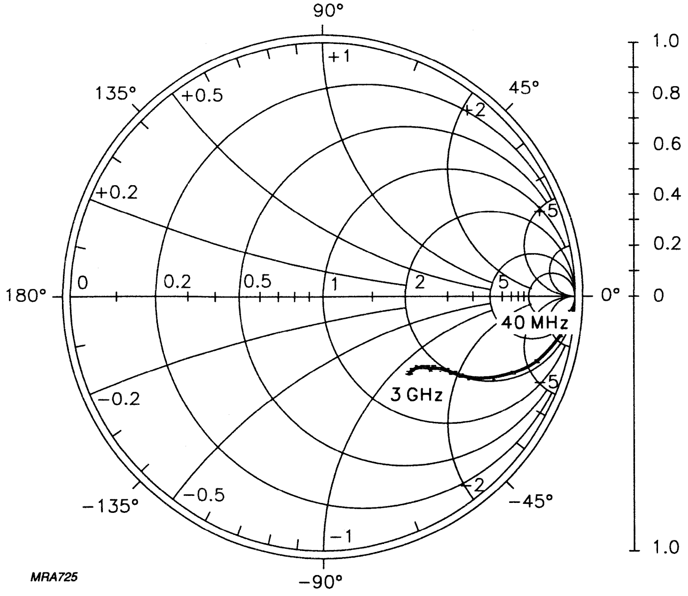
V_{CE} = 6 V; I_C = 5 mA.

Fig.15 Common emitter forward transmission coefficient (S_{21}).



V_{CE} = 6 V; I_C = 5 mA.

Fig.16 Common emitter reverse transmission coefficient (S_{12}).

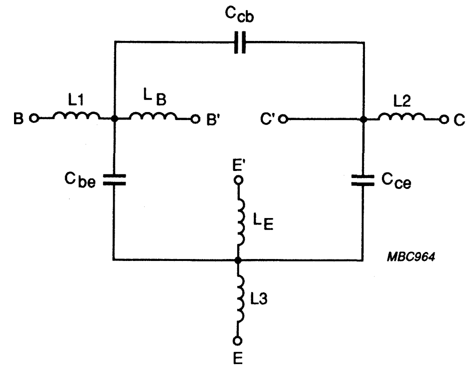


V_{CE} = 6 V; I_C = 5 mA.

Fig.17 Common emitter output reflection coefficient (S_{22}).

SPICE parameters for BFR505 crystal

1	IS = 134.1	aA
2	BF = 180.0	–
3	NF = 988.2	m
4	VAF = 38.34	V
5	IKF = 150.0	mA
6	ISE = 27.81	fA
7	NE = 2.051	–
8	BR = 55.19	–
9	NR = 982.2	m
10	VAR = 2.459	V
11	IKR = 2.920	mA
12	ISC = 17.45	aA
13	NC = 1.062	–
14	RB = 20.00	Ω
15	IRB = 1.000	µA
16	RBM = 20.00	Ω
17	RE = 1.171	Ω
18	RC = 4.350	Ω
19 (note 1)	XTB = 0.000	–
20 (note 1)	EG = 1.110	EV
21 (note 1)	XTI = 3.000	–
22	CJE = 284.7	fF
23	VJE = 600.0	mV
24	MJE = 303.6	m
25	TF = 7.037	ps
26	XTF = 12.34	–
27	VTF = 1.701	V
28	ITF = 30.64	mA
29 (note 1)	PTF = 0.000	deg
30	CJC = 242.4	fF
31	VJC = 188.6	mV
32	MJC = 41.49	m
33	XCJC = 130.0	m
34	TR = 1.332	ns
35 (note 1)	CJS = 0.000	F
36 (note 1)	VJS = 750.0	mV
37 (note 1)	MJS = 0.000	–
38	FC = 897.4	m



$QL_B = 50$; $QL_E = 50$.

$QL_{B,E}(f) = QL_{B,E}\sqrt{(f/Fc)}$.

Fc = scaling frequency = 1000 MHz.

Fig.18 Package equivalent circuit, SOT23.

List of components (see Fig.18)

DESIGNATION	VALUE
C_{be}	71 fF
C_{cb}	71 fF
C_{ce}	2 fF
L1	0.35 nH
L2	0.17 nH
L3	0.35 nH
L_B	0.40 nH
L_E	0.83 nH

Note

1. These parameters have not been extracted, the default values are shown.

Table 1 Common emitter scattering parameters, $V_{CE} = 3$ V, $I_C = 0.5$ mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.987	−1.8	1.368	177.3	0.008	87.7	0.995	−1.2	38.9
100	0.984	−4.5	1.362	173.8	0.019	86.4	0.994	−2.8	37.2
200	0.981	−9.1	1.353	167.9	0.039	82.7	0.991	−5.8	34.5
300	0.972	−13.8	1.354	161.9	0.057	79.5	0.983	−8.7	30.0
400	0.959	−18.3	1.351	156.8	0.075	76.8	0.975	−11.5	26.6
500	0.948	−22.5	1.333	151.7	0.092	74.2	0.967	−14.2	24.3
600	0.933	−26.7	1.314	146.8	0.108	71.5	0.957	−16.8	22.0
700	0.916	−30.8	1.298	142.2	0.123	68.9	0.946	−19.3	20.0
800	0.894	−34.7	1.291	137.4	0.137	66.5	0.933	−21.4	18.1
900	0.869	−38.7	1.284	132.4	0.149	64.0	0.921	−23.5	16.5
1000	0.844	−42.7	1.263	127.9	0.160	61.6	0.906	−25.5	14.9
1200	0.791	−50.7	1.232	119.2	0.180	57.0	0.873	−29.6	12.3
1400	0.740	−58.8	1.224	111.5	0.195	53.5	0.841	−33.1	10.5
1600	0.693	−65.3	1.199	105.0	0.204	50.3	0.814	−35.9	9.1
1800	0.648	−71.1	1.155	98.9	0.212	48.6	0.792	−38.5	7.9
2000	0.581	−77.5	1.127	92.1	0.217	46.1	0.761	−40.8	6.6
2200	0.518	−85.3	1.111	85.9	0.220	44.2	0.728	−43.5	5.6
2400	0.476	−94.2	1.106	79.5	0.223	43.0	0.699	−46.6	4.9
2600	0.450	−101.1	1.081	75.3	0.223	43.0	0.683	−49.6	4.4
2800	0.413	−106.2	1.072	71.7	0.225	44.3	0.677	−51.6	4.1
3000	0.356	−112.4	1.038	67.1	0.225	45.3	0.658	−53.1	3.4

Table 2 Common emitter scattering parameters, $V_{CE} = 3$ V, $I_C = 1.25$ mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.971	−2.7	3.415	176.1	0.008	87.8	0.993	−1.8	41.6
100	0.965	−6.6	3.375	171.2	0.019	85.2	0.990	−4.2	39.0
200	0.951	−13.3	3.305	163.3	0.038	80.3	0.977	−8.6	33.9
300	0.926	−19.7	3.244	156.0	0.055	76.4	0.955	−12.6	29.2
400	0.897	−25.8	3.173	149.9	0.071	73.0	0.932	−16.2	25.9
500	0.867	−31.5	3.059	143.8	0.086	69.8	0.909	−19.6	23.4
600	0.835	−36.7	2.947	138.6	0.098	67.0	0.882	−22.6	21.1
700	0.798	−41.9	2.868	133.3	0.110	64.8	0.857	−25.1	19.3
800	0.758	−46.7	2.780	128.1	0.119	62.8	0.832	−27.1	17.7
900	0.715	−51.4	2.688	123.0	0.128	61.0	0.810	−29.0	16.3
1000	0.674	−55.7	2.584	118.3	0.136	59.4	0.785	−30.6	15.0
1200	0.590	−64.5	2.413	109.5	0.149	56.9	0.739	−33.7	12.9
1400	0.520	−73.0	2.282	102.0	0.160	55.7	0.702	−36.1	11.5
1600	0.466	−78.4	2.121	95.7	0.167	55.0	0.674	−37.8	10.2
1800	0.413	−83.0	1.978	90.2	0.177	55.5	0.653	−39.3	9.2
2000	0.350	−87.9	1.856	84.3	0.185	55.2	0.627	−40.2	8.1
2200	0.294	−95.6	1.763	79.1	0.194	55.3	0.599	−41.9	7.2
2400	0.263	−104.5	1.692	73.7	0.204	55.4	0.574	−44.4	6.6
2600	0.247	−110.3	1.604	70.1	0.213	56.3	0.561	−46.8	6.0
2800	0.220	−113.6	1.551	67.0	0.224	57.7	0.559	−48.3	5.7
3000	0.174	−119.3	1.478	63.0	0.234	58.4	0.547	−48.9	5.1

Table 3 Noise data

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
900	1.20	0.670	17.0	0.86
2000	1.90	0.560	51.0	0.55

Table 4 Common emitter scattering parameters, $V_{CE} = 3$ V, $I_C = 2.5$ mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.944	−3.9	6.565	174.4	0.008	87.9	0.989	−2.7	42.6
100	0.931	−9.7	6.408	167.3	0.019	83.4	0.979	−6.4	38.7
200	0.895	−19.0	6.133	156.9	0.036	77.4	0.945	−12.3	32.5
300	0.844	−27.7	5.850	147.8	0.051	72.9	0.900	−17.3	28.0
400	0.789	−35.6	5.540	140.1	0.065	69.2	0.856	−21.3	24.8
500	0.734	−42.7	5.190	133.1	0.076	67.0	0.813	−24.6	22.4
600	0.679	−48.9	4.872	127.0	0.085	65.0	0.774	−27.1	20.4
700	0.622	−54.5	4.582	121.0	0.094	63.8	0.741	−28.9	18.8
800	0.569	−59.1	4.291	115.7	0.102	63.0	0.712	−30.1	17.4
900	0.518	−63.4	4.012	110.7	0.109	62.6	0.688	−31.2	16.2
1000	0.471	−67.3	3.750	106.3	0.116	62.0	0.665	−32.0	15.1
1200	0.389	−74.5	3.324	98.5	0.129	61.7	0.625	−33.6	13.3
1400	0.332	−81.4	2.997	92.2	0.141	62.0	0.597	−35.0	12.0
1600	0.291	−84.4	2.699	87.1	0.152	62.6	0.579	−35.8	10.8
1800	0.252	−86.7	2.461	82.6	0.166	63.5	0.567	−36.6	9.8
2000	0.204	−89.5	2.267	77.8	0.179	63.5	0.550	−37.0	8.9
2200	0.161	−97.2	2.121	73.6	0.193	63.5	0.528	−38.2	8.1
2400	0.141	−108.4	2.011	69.2	0.207	63.2	0.508	−40.4	7.5
2600	0.135	−113.1	1.885	66.1	0.221	63.4	0.499	−43.0	6.8
2800	0.118	−113.6	1.804	63.6	0.235	64.0	0.500	−44.3	6.4
3000	0.079	−118.6	1.711	60.0	0.249	63.7	0.493	−44.7	5.9

Table 5 Noise data

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
900	1.30	0.600	17.0	0.67
2000	1.90	0.438	48.0	0.52

Table 6 Common emitter scattering parameters, V_{CE} = 3 V, I_C = 3.75 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.918	−5.0	9.316	172.9	0.007	87.3	0.985	−3.4	42.6
100	0.897	−12.3	8.982	164.3	0.018	81.8	0.966	−8.0	38.0
200	0.840	−23.8	8.420	151.9	0.035	75.5	0.913	−15.0	31.6
300	0.766	−34.1	7.818	141.5	0.048	71.1	0.848	−20.1	27.2
400	0.692	−43.1	7.188	132.8	0.060	67.9	0.791	−23.8	24.2
500	0.622	−50.5	6.543	125.3	0.069	66.5	0.743	−26.6	21.9
600	0.558	−56.7	5.983	118.9	0.078	65.5	0.702	−28.4	20.1
700	0.499	−61.6	5.467	113.2	0.086	65.3	0.670	−29.5	18.6
800	0.447	−65.3	5.004	108.4	0.093	65.1	0.646	−30.1	17.3
900	0.402	−68.9	4.597	103.9	0.101	65.2	0.626	−30.6	16.2
1000	0.361	−72.0	4.237	100.0	0.108	65.2	0.606	−31.0	15.1
1200	0.291	−78.0	3.670	93.2	0.122	65.6	0.575	−32.0	13.4
1400	0.248	−84.1	3.261	87.8	0.137	66.0	0.554	−33.1	12.1
1600	0.217	−85.0	2.908	83.3	0.149	66.5	0.543	−33.7	11.0
1800	0.187	−86.2	2.634	79.3	0.164	67.2	0.536	−34.5	10.0
2000	0.145	−86.9	2.415	74.9	0.179	66.9	0.523	−34.8	9.1
2200	0.107	−95.3	2.252	71.2	0.195	66.6	0.503	−35.9	8.4
2400	0.092	−108.8	2.127	67.2	0.211	66.1	0.485	−38.2	7.8
2600	0.092	−114.0	1.986	64.4	0.225	66.0	0.476	−40.8	7.1
2800	0.079	−112.4	1.895	62.1	0.241	66.2	0.479	−42.3	6.7
3000	0.043	−116.2	1.797	58.7	0.256	65.5	0.474	−42.6	6.2

Table 7 Noise data

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
900	1.40	0.554	17.0	0.62
2000	2.00	0.402	47.0	0.49

Table 8 Common emitter scattering parameters, V_{CE} = 3 V, I_C = 5 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.893	−6.1	11.842	171.6	0.007	86.6	0.980	−4.0	42.5
100	0.863	−14.9	11.284	161.6	0.018	80.8	0.954	−9.5	37.4
200	0.785	−28.2	10.345	147.6	0.033	73.7	0.881	−17.0	31.0
300	0.693	−39.7	9.345	136.1	0.046	69.9	0.804	−21.9	26.8
400	0.607	−48.9	8.330	126.9	0.056	67.8	0.742	−25.0	23.9
500	0.531	−56.1	7.395	119.4	0.065	67.1	0.692	−27.1	21.6
600	0.469	−61.7	6.613	113.4	0.073	66.6	0.654	−28.3	19.9
700	0.415	−65.8	5.932	108.1	0.081	67.0	0.626	−29.0	18.4
800	0.370	−68.9	5.367	103.7	0.089	67.3	0.606	−29.3	17.2
900	0.328	−71.8	4.881	99.7	0.096	67.5	0.589	−29.5	16.1
1000	0.293	−74.4	4.472	96.1	0.104	67.7	0.573	−29.7	15.1
1200	0.234	−79.4	3.833	90.0	0.119	68.2	0.548	−30.4	13.5
1400	0.198	−85.4	3.385	85.1	0.135	68.6	0.532	−31.5	12.2
1600	0.174	−85.5	3.003	80.9	0.148	69.0	0.525	−32.1	11.1
1800	0.149	−85.0	2.714	77.3	0.164	69.5	0.521	−33.0	10.1
2000	0.112	−84.9	2.484	73.2	0.180	68.9	0.510	−33.2	9.3
2200	0.077	−93.8	2.311	69.7	0.196	68.4	0.492	−34.3	8.5
2400	0.065	−111.8	2.181	65.8	0.213	67.8	0.474	−36.7	7.9
2600	0.067	−116.3	2.032	63.3	0.228	67.3	0.466	−39.4	7.2
2800	0.058	−113.1	1.938	61.1	0.244	67.3	0.470	−41.0	6.8
3000	0.022	−120.6	1.835	57.8	0.260	66.5	0.465	−41.4	6.3

Table 9 Noise data

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
900	1.60	0.509	16.0	0.60
2000	2.20	0.353	46.0	0.49

Table 10 Common emitter scattering parameters, V_{CE} = 3 V, I_C = 7.5 mA

f (MHz)	S_{11} MAG. (RAT)	S_{11} ANG. (DEG)	S_{21} MAG. (RAT)	S_{21} ANG. (DEG)	S_{12} MAG. (RAT)	S_{12} ANG. (DEG)	S_{22} MAG. (RAT)	S_{22} ANG. (DEG)	G_{UM} (dB)
40	0.841	−8.1	16.013	169.4	0.007	84.5	0.971	−5.0	41.8
100	0.796	−19.6	14.950	157.0	0.017	79.3	0.929	−11.6	36.5
200	0.685	−35.8	13.083	140.5	0.031	72.1	0.828	−19.3	30.1
300	0.572	−48.1	11.182	128.0	0.042	69.7	0.739	−23.4	26.1
400	0.480	−57.1	9.517	118.9	0.051	68.6	0.675	−25.4	23.4
500	0.411	−63.5	8.163	112.0	0.060	68.9	0.631	−26.5	21.2
600	0.357	−68.1	7.124	106.7	0.067	69.1	0.601	−27.0	19.6
700	0.313	−71.2	6.289	102.1	0.076	69.9	0.580	−27.2	18.2
800	0.278	−73.5	5.626	98.3	0.084	70.3	0.566	−27.2	17.0
900	0.245	−75.9	5.082	94.8	0.092	70.9	0.555	−27.3	16.0
1000	0.215	−77.8	4.626	91.7	0.100	71.0	0.544	−27.3	15.0
1200	0.168	−82.7	3.939	86.4	0.116	71.4	0.526	−28.0	13.4
1400	0.143	−89.2	3.456	82.0	0.133	71.6	0.514	−29.2	12.2
1600	0.126	−86.9	3.058	78.2	0.148	71.7	0.511	−30.0	11.1
1800	0.104	−85.6	2.755	74.8	0.164	71.8	0.509	−31.0	10.2
2000	0.073	−83.5	2.519	71.0	0.181	71.1	0.501	−31.4	9.3
2200	0.041	−97.8	2.340	67.8	0.198	70.4	0.485	−32.6	8.6
2400	0.036	−130.1	2.205	64.2	0.215	69.6	0.468	−35.1	7.9
2600	0.042	−132.4	2.052	61.7	0.230	69.0	0.460	−37.9	7.3
2800	0.032	−129.6	1.954	59.7	0.247	68.8	0.464	−39.6	6.9
3000	0.011	144.2	1.852	56.5	0.263	67.8	0.460	−40.1	6.4

Table 11 Common emitter scattering parameters, V_{CE} = 6 V, I_C = 0.5 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.988	−1.7	1.312	177.4	0.008	89.6	0.995	−1.2	38.5
100	0.985	−4.4	1.313	174.0	0.019	86.8	0.994	−2.7	37.0
200	0.983	−8.8	1.303	168.1	0.038	83.0	0.992	−5.6	34.7
300	0.975	−13.3	1.296	162.3	0.057	80.0	0.984	−8.5	30.3
400	0.962	−17.7	1.295	157.3	0.074	77.0	0.977	−11.2	26.9
500	0.952	−21.8	1.279	152.2	0.091	74.6	0.969	−13.9	24.5
600	0.938	−25.7	1.256	147.5	0.107	72.1	0.960	−16.4	22.2
700	0.921	−29.6	1.243	142.9	0.122	69.6	0.949	−18.8	20.1
800	0.901	−33.5	1.237	138.2	0.135	67.1	0.938	−20.9	18.3
900	0.878	−37.4	1.237	133.2	0.148	64.7	0.927	−22.9	16.7
1000	0.854	−41.2	1.215	128.7	0.159	62.3	0.912	−24.9	15.1
1200	0.801	−49.0	1.194	120.0	0.179	57.8	0.880	−29.0	12.5
1400	0.752	−56.9	1.191	112.5	0.195	54.2	0.848	−32.5	10.6
1600	0.706	−63.2	1.171	105.9	0.204	51.0	0.822	−35.4	9.3
1800	0.660	−68.8	1.128	99.8	0.213	49.2	0.801	−38.1	8.0
2000	0.595	−74.8	1.100	93.0	0.218	46.7	0.771	−40.4	6.6
2200	0.533	−82.4	1.084	86.9	0.223	44.6	0.739	−43.2	5.6
2400	0.492	−90.8	1.081	80.5	0.226	43.2	0.709	−46.3	4.9
2600	0.465	−97.5	1.058	76.3	0.226	43.1	0.693	−49.2	4.4
2800	0.428	−102.4	1.051	72.7	0.227	44.1	0.685	−51.3	4.1
3000	0.370	−108.0	1.019	68.2	0.227	45.0	0.666	−52.8	3.4

Table 12 Common emitter scattering parameters, V_{CE} = 6 V, I_C = 1.25 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.974	−2.5	3.336	176.2	0.008	88.8	0.993	−1.8	42.1
100	0.968	−6.4	3.297	171.5	0.019	85.5	0.989	−4.2	38.9
200	0.955	−12.6	3.235	163.9	0.037	80.6	0.978	−8.4	34.4
300	0.931	−18.8	3.184	156.7	0.055	76.9	0.957	−12.3	29.6
400	0.904	−24.7	3.116	150.7	0.070	73.6	0.936	−15.8	26.3
500	0.876	−30.1	3.009	144.8	0.085	70.6	0.914	−19.2	23.7
600	0.845	−35.2	2.910	139.5	0.098	67.9	0.889	−22.1	21.5
700	0.810	−40.2	2.834	134.4	0.109	65.6	0.864	−24.7	19.6
800	0.770	−44.8	2.754	129.2	0.119	63.5	0.839	−26.7	18.0
900	0.730	−49.3	2.662	124.1	0.128	61.8	0.817	−28.6	16.6
1000	0.689	−53.6	2.565	119.5	0.136	60.1	0.794	−30.3	15.3
1200	0.608	−61.8	2.399	110.8	0.149	57.6	0.747	−33.5	13.2
1400	0.538	−69.9	2.273	103.3	0.161	56.1	0.710	−36.0	11.7
1600	0.484	−75.2	2.119	97.0	0.169	55.3	0.681	−37.7	10.4
1800	0.433	−79.6	1.978	91.5	0.178	55.6	0.660	−39.2	9.3
2000	0.368	−83.8	1.857	85.6	0.187	55.3	0.633	−40.2	8.2
2200	0.310	−90.8	1.768	80.2	0.196	55.2	0.604	−42.0	7.4
2400	0.277	−99.2	1.701	74.9	0.206	55.1	0.578	−44.3	6.7
2600	0.259	−104.6	1.615	71.2	0.214	55.9	0.565	−46.8	6.1
2800	0.233	−107.0	1.562	68.2	0.225	57.3	0.562	−48.2	5.8
3000	0.186	−111.2	1.488	64.1	0.235	57.6	0.550	−48.8	5.2

Table 13 Noise data

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
900	1.20	0.694	17.0	0.87
2000	1.90	0.580	51.0	0.58

Table 14 Common emitter scattering parameters, V_{CE} = 6 V, I_C = 2.5 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.949	−3.7	6.445	174.4	0.007	87.1	0.989	−2.6	42.7
100	0.937	−9.2	6.297	167.8	0.018	84.1	0.979	−6.1	39.0
200	0.905	−18.0	6.045	157.7	0.036	77.8	0.949	−12.0	33.0
300	0.856	−26.2	5.781	148.8	0.051	73.6	0.905	−16.9	28.4
400	0.804	−33.8	5.494	141.3	0.064	70.2	0.863	−20.9	25.3
500	0.751	−40.4	5.160	134.4	0.076	67.7	0.821	−24.3	22.7
600	0.698	−46.4	4.859	128.3	0.086	65.8	0.783	−26.9	20.8
700	0.643	−51.8	4.578	122.5	0.095	64.4	0.750	−28.8	19.1
800	0.591	−56.1	4.303	117.1	0.102	63.6	0.721	−30.1	17.7
900	0.540	−60.1	4.030	112.2	0.110	62.9	0.697	−31.2	16.5
1000	0.494	−63.9	3.775	107.8	0.117	62.4	0.673	−32.1	15.4
1200	0.410	−70.6	3.358	99.9	0.130	61.9	0.631	−33.8	13.5
1400	0.353	−77.1	3.036	93.6	0.143	62.1	0.602	−35.2	12.2
1600	0.312	−79.6	2.737	88.4	0.154	62.4	0.583	−36.0	11.0
1800	0.273	−81.5	2.498	83.9	0.167	63.3	0.570	−36.9	10.0
2000	0.224	−83.3	2.302	79.0	0.180	63.0	0.552	−37.2	9.0
2200	0.178	−89.2	2.154	74.8	0.194	63.0	0.530	−38.4	8.2
2400	0.155	−98.2	2.044	70.3	0.209	62.6	0.508	−40.6	7.6
2600	0.150	−102.6	1.915	67.3	0.221	62.8	0.498	−43.0	7.0
2800	0.134	−102.3	1.833	64.8	0.236	63.3	0.499	−44.4	6.6
3000	0.094	−102.7	1.739	61.2	0.249	63.0	0.492	−44.7	6.0

Table 15 Noise data

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
900	1.30	0.631	16.0	0.74
2000	1.90	0.483	46.0	0.55

Table 16 Common emitter scattering parameters, $V_{CE} = 6$ V, $I_C = 3.75$ mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.928	−4.7	9.181	173.0	0.007	87.4	0.985	−3.3	43.0
100	0.908	−11.5	8.876	164.9	0.018	82.5	0.969	−7.8	38.6
200	0.855	−22.4	8.351	152.9	0.034	75.7	0.918	−14.6	32.2
300	0.786	−32.1	7.782	142.7	0.048	71.8	0.856	−19.7	27.7
400	0.714	−40.5	7.184	134.2	0.060	68.7	0.802	−23.6	24.7
500	0.646	−47.5	6.568	126.8	0.070	67.2	0.752	−26.5	22.3
600	0.583	−53.4	6.031	120.5	0.078	66.0	0.712	−28.5	20.5
700	0.524	−58.1	5.530	114.7	0.087	65.7	0.679	−29.7	18.9
800	0.473	−61.5	5.072	109.9	0.094	65.5	0.653	−30.4	17.6
900	0.427	−64.9	4.671	105.3	0.102	65.5	0.632	−31.0	16.5
1000	0.385	−67.6	4.309	101.4	0.109	65.3	0.612	−31.4	15.4
1200	0.313	−72.8	3.747	94.5	0.123	65.5	0.578	−32.4	13.7
1400	0.269	−78.2	3.332	89.1	0.138	66.0	0.556	−33.5	12.4
1600	0.238	−78.7	2.968	84.5	0.151	66.3	0.543	−34.1	11.2
1800	0.208	−79.1	2.693	80.5	0.166	66.9	0.536	−34.8	10.3
2000	0.167	−78.9	2.470	76.2	0.181	66.4	0.522	−35.0	9.4
2200	0.128	−84.0	2.302	72.5	0.196	66.2	0.502	−36.1	8.6
2400	0.108	−94.7	2.175	68.4	0.212	65.5	0.483	−38.3	8.0
2600	0.107	−98.6	2.031	65.6	0.227	65.3	0.474	−40.9	7.3
2800	0.097	−96.2	1.938	63.4	0.241	65.5	0.476	−42.2	6.9
3000	0.062	−90.3	1.838	60.0	0.256	64.8	0.471	−42.5	6.4

Table 17 Noise data

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
900	1.40	0.600	15.0	0.68
2000	2.00	0.492	45.0	0.51

Table 18 Common emitter scattering parameters, $V_{CE} = 6$ V, $I_C = 5$ mA

f (MHz)	S_{11} MAG. (RAT)	S_{11} ANG. (DEG)	S_{21} MAG. (RAT)	S_{21} ANG. (DEG)	S_{12} MAG. (RAT)	S_{12} ANG. (DEG)	S_{22} MAG. (RAT)	S_{22} ANG. (DEG)	G_{UM} (dB)
40	0.906	−5.6	11.695	171.8	0.007	86.3	0.980	−3.9	42.9
100	0.879	−13.8	11.190	162.3	0.018	81.4	0.956	−9.1	38.1
200	0.806	−26.3	10.317	148.8	0.033	74.5	0.888	−16.6	31.6
300	0.719	−36.9	9.359	137.6	0.046	70.9	0.814	−21.6	27.3
400	0.635	−45.7	8.398	128.6	0.056	68.5	0.752	−25.0	24.3
500	0.561	−52.5	7.491	121.1	0.066	67.6	0.701	−27.3	22.1
600	0.497	−57.7	6.727	115.0	0.074	67.1	0.663	−28.6	20.3
700	0.443	−61.4	6.055	109.7	0.082	67.3	0.633	−29.4	18.8
800	0.397	−64.2	5.485	105.2	0.090	67.4	0.611	−29.8	17.6
900	0.355	−66.7	5.005	101.1	0.097	67.6	0.594	−30.1	16.5
1000	0.318	−68.9	4.587	97.5	0.105	67.7	0.577	−30.3	15.4
1200	0.257	−73.0	3.944	91.4	0.121	68.1	0.549	−31.0	13.8
1400	0.220	−78.0	3.482	86.4	0.136	68.4	0.531	−32.1	12.5
1600	0.197	−77.2	3.094	82.2	0.150	68.7	0.523	−32.6	11.4
1800	0.172	−76.0	2.792	78.6	0.166	69.0	0.518	−33.3	10.4
2000	0.137	−74.1	2.555	74.5	0.182	68.3	0.507	−33.5	9.5
2200	0.100	−78.1	2.377	71.0	0.198	67.8	0.488	−34.5	8.7
2400	0.083	−90.3	2.242	67.2	0.215	67.0	0.470	−36.8	8.1
2600	0.085	−94.8	2.090	64.6	0.229	66.6	0.461	−39.4	7.5
2800	0.077	−90.8	1.992	62.5	0.245	66.6	0.465	−40.9	7.1
3000	0.045	−77.8	1.886	59.2	0.260	65.8	0.459	−41.2	6.5

Table 19 Noise data

f (MHz)	F_{min} (dB)	Γ_{opt} (RAT)	Γ_{opt} (DEG)	R_n
900	1.60	0.552	16.0	0.67
2000	2.20	0.412	44.0	0.51

Table 20 Common emitter scattering parameters, V_{CE} = 6 V, I_C = 7.5 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.866	−7.3	15.867	169.8	0.007	84.5	0.972	−4.8	42.7
100	0.825	−17.5	14.896	158.3	0.017	80.1	0.934	−11.2	37.4
200	0.722	−32.4	13.178	142.4	0.031	73.4	0.839	−19.0	30.9
300	0.612	−43.8	11.373	130.1	0.042	70.2	0.752	−23.5	26.8
400	0.520	−52.2	9.759	121.0	0.052	69.1	0.687	−25.9	23.9
500	0.448	−57.9	8.422	114.0	0.061	69.3	0.640	−27.2	21.8
600	0.393	−62.0	7.377	108.6	0.069	69.3	0.607	−27.9	20.1
700	0.347	−64.8	6.527	103.9	0.077	69.8	0.584	−28.1	18.7
800	0.310	−66.5	5.850	100.1	0.085	70.1	0.567	−28.2	17.5
900	0.276	−68.0	5.289	96.5	0.093	70.6	0.555	−28.3	16.4
1000	0.246	−69.4	4.817	93.4	0.102	70.7	0.543	−28.3	15.4
1200	0.197	−72.5	4.104	87.9	0.118	71.0	0.522	−28.9	13.8
1400	0.168	−76.8	3.604	83.5	0.134	71.0	0.509	−30.0	12.6
1600	0.152	−74.3	3.184	79.8	0.149	71.1	0.505	−30.5	11.4
1800	0.134	−71.9	2.869	76.4	0.166	71.2	0.503	−31.5	10.5
2000	0.105	−67.3	2.626	72.6	0.183	70.2	0.493	−31.7	9.6
2200	0.071	−69.5	2.437	69.4	0.199	69.5	0.476	−32.7	8.9
2400	0.055	−84.2	2.298	65.8	0.217	68.5	0.459	−35.1	8.3
2600	0.060	−91.2	2.137	63.4	0.232	68.0	0.451	−37.8	7.6
2800	0.054	−84.5	2.034	61.4	0.248	67.8	0.455	−39.4	7.2
3000	0.029	−56.7	1.927	58.2	0.264	66.7	0.451	−39.7	6.7

NPN 9 GHz wideband transistor

BFR520

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability.

DESCRIPTION

The BFR520 is an npn silicon planar epitaxial transistor, intended for applications in the RF frontend in wideband applications in the GHz range, such as analog and digital cellular telephones, cordless telephones (CT1, CT2, DECT, etc.), radar detectors, pagers and satellite TV tuners (SATV) and repeater amplifiers in fibre-optic systems.

The transistor is encapsulated in a plastic SOT23 envelope.

PINNING

PIN	DESCRIPTION
Code: N28	
1	base
2	emitter
3	collector

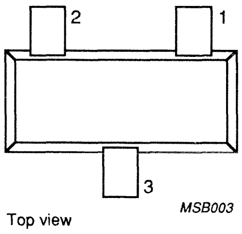


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage		–	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	–	15	V
I_C	DC collector current		–	–	70	mA
P_{tot}	total power dissipation	up to T_s = 72 °C (note 1)	–	–	300	mW
h_{FE}	DC current gain	I_C = 20 mA; V_{CE} = 6 V	60	120	250	
C_{re}	feedback capacitance	$I_C = i_c = 0$; V_{CB} = 6 V; f = 1 MHz	–	0.4	–	pF
f_T	transition frequency	I_C = 20 mA; V_{CE} = 6 V; f = 1 GHz	–	9	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 20 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 900 MHz	–	15	–	dB
		I_C = 20 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 2 GHz	–	9	–	dB
$\lvert S_{21}\rvert^2$	insertion power gain	I_C = 20 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 900 MHz	13	14	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 900 MHz	–	1.1	1.6	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 20 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 900 MHz	–	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 8 V; T_{amb} = 25 °C; f = 2 GHz	–	1.9	–	dB

Note

1. T_s is the temperature at the soldering point of the collector tab.

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_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	70	mA
P_{tot}	total power dissipation	up to T_s = 72 °C (note 1)	–	300	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	from junction to soldering point (note 1)	260 K/W

Note

1. T_s is the temperature at the soldering point of the collector tab.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 6$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 20$ mA; $V_{CE} = 6$ V	60	120	250	
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	1	–	pF
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.5	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.4	–	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 6$ V; f = 1 GHz	–	9	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 20$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	15	–	dB
		$I_C = 20$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	9	–	dB
$\lvert S_{21}\rvert^2$	insertion power gain	$I_C = 20$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	13	14	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	1.1	1.6	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 20$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	1.9	–	dB
P_{L1}	output power at 1 dB gain compression	$I_C = 20$ mA; $V_{CE} = 6$ V; $R_L = 50\ \Omega$; $T_{amb} = 25$ °C; f = 900 MHz	–	17	–	dBm
ITO	third order intercept point	note 2	–	26	–	dBm

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.
2. $I_C = 20$ mA; $V_{CE} = 6$ V; $R_L = 50\ \Omega$; $T_{amb} = 25$ °C;
   $f_p = 900$ MHz; $f_q = 902$ MHz;
   measured at $f_{(2p-q)} = 898$ MHz and $f_{(2q-p)} = 904$ MHz.

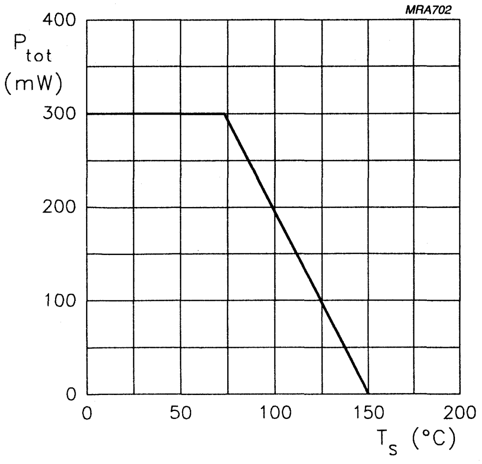
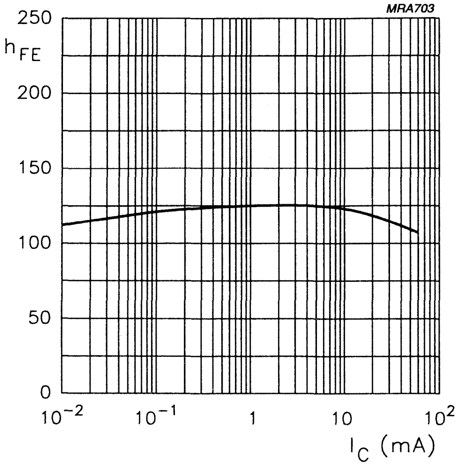
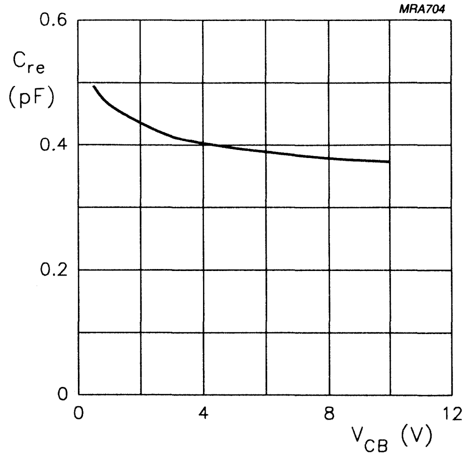


Fig.2 Power derating curve.



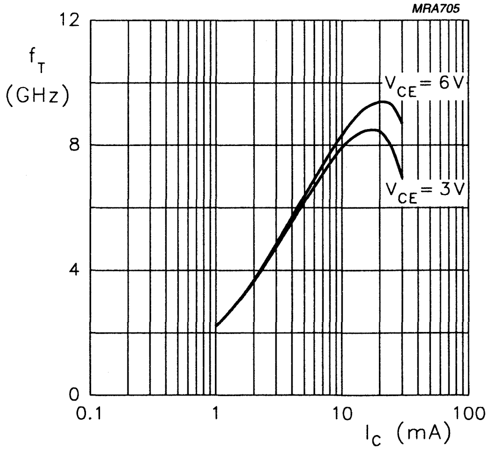
V_{CE} = 6 V.

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



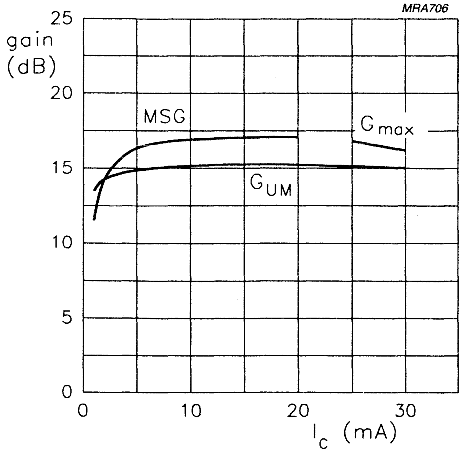
I_C = 0; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage.



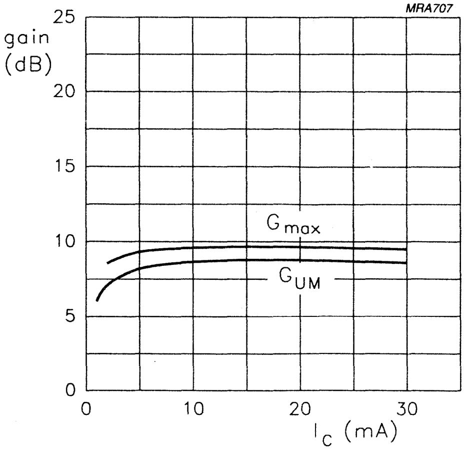
T_{amb} = 25 °C; f = 1 GHz.

Fig.5 Transition frequency as a function of collector current.



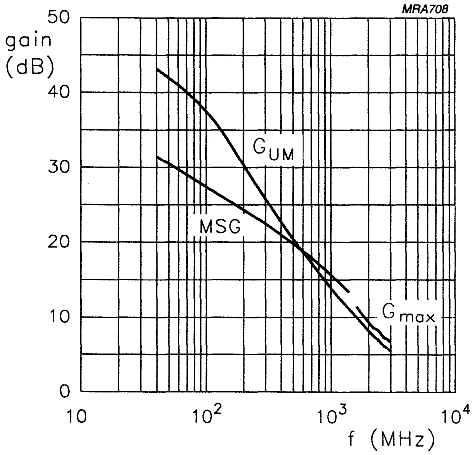
V_{CE} = 6 V; f = 900 MHz.

Fig.6 Gain as a function of collector current.



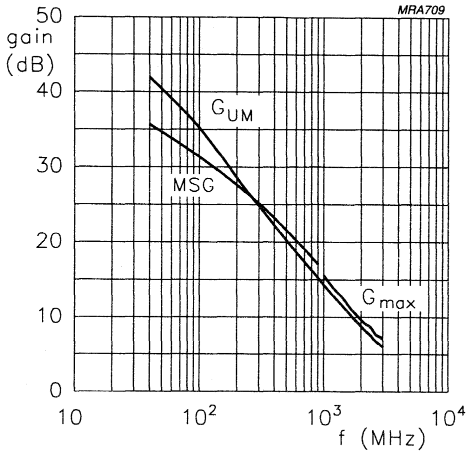
V_{CE} = 6 V; f = 2 GHz.

Fig.7 Gain as a function of collector current.



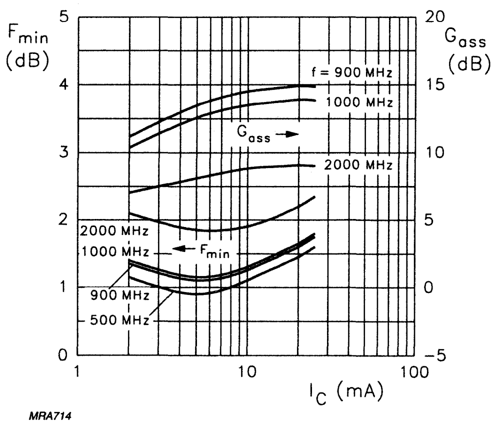
V_{CE} = 6 V; I_C = 5 mA.

Fig.8 Gain as a function of frequency.



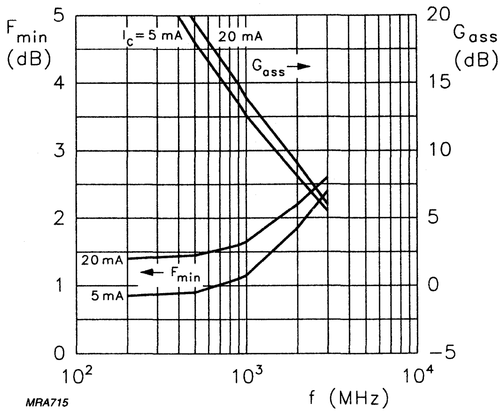
V_{CE} = 6 V; I_C = 20 mA.

Fig.9 Gain as a function of frequency.



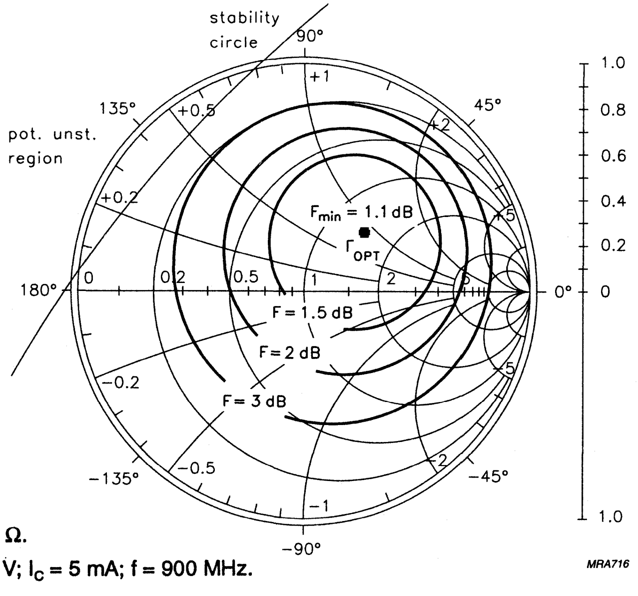
V_{CE} = 6 V.

Fig.10 Minimum noise figure and associated available gain as functions of collector current.



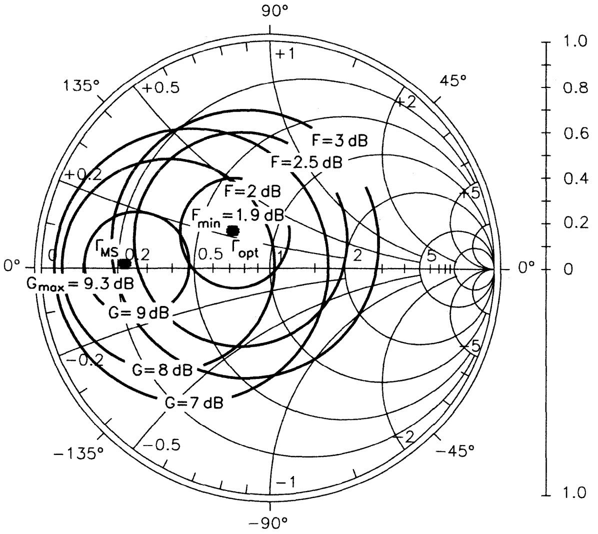
V_{CE} = 6 V.

Fig.11 Minimum noise figure and associated available gain as functions of frequency.



Z_O = 50 Ω.
V_{CE} = 6 V; I_C = 5 mA; f = 900 MHz.

Fig.12 Noise circle figure.

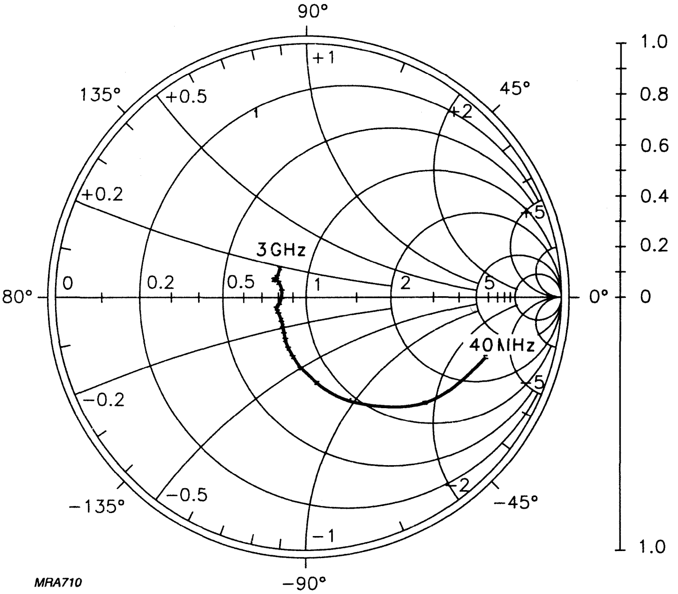


$Z_O = 50\ \Omega$.

$V_{CE} = 6\ V$; $I_C = 5\ mA$; f = 2000 MHz.

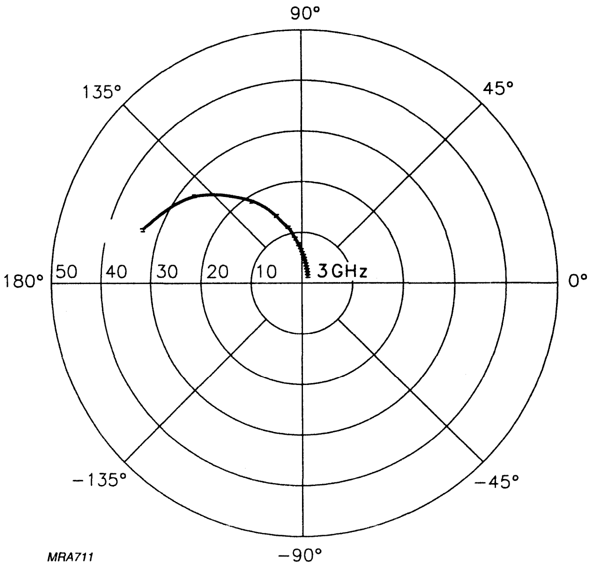
MRA717

Fig.13 Noise circle figure.



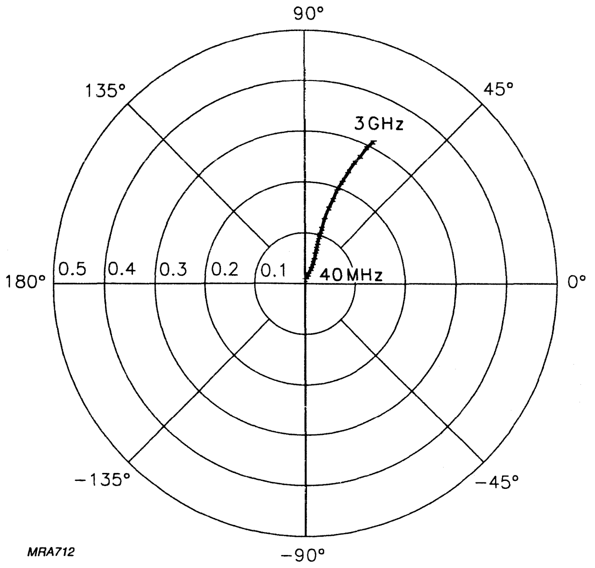
V_{CE} = 6 V; I_C = 20 mA.

Fig.14 Common emitter input reflection coefficient (S_{11}).



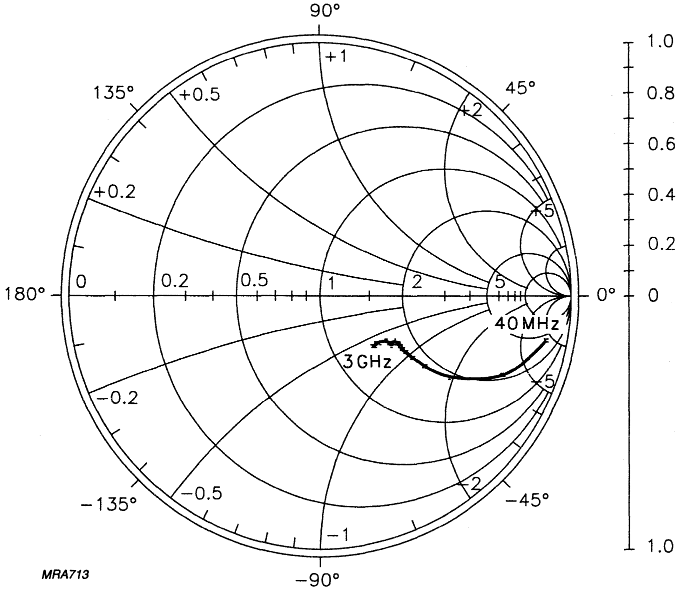
V_{CE} = 6 V; I_C = 20 mA.

Fig.15 Common emitter forward transmission coefficient (S_{21}).



V_{CE} = 6 V; I_C = 20 mA.

Fig.16 Common emitter reverse transmission coefficient (S_{12}).

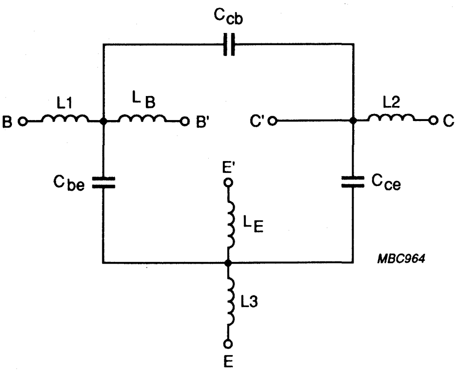


V_{CE} = 6 V; I_C = 20 mA.

Fig.17 Common emitter output reflection coefficient (S_{22}).

SPICE parameters for BFR520 crystal

1	IS = 1.016	fA
2	BF = 220.1	–
3	NF = 1.000	–
4	VAF = 48.06	V
5	IKF = 510.0	mA
6	ISE = 283.0	fA
7	NE = 2.035	–
8	BR = 100.7	–
9	NR = 988.1	m
10	VAR = 1.692	V
11	IKR = 2.352	mA
12	ISC = 24.48	aA
13	NC = 1.022	–
14	RB = 10.00	Ω
15	IRB = 1.000	µA
16	RBM = 10.00	Ω
17	RE = 775.3	mΩ
18	RC = 2.210	Ω
19 (note 1)	XTB = 0.000	–
20 (note 1)	EG = 1.110	EV
21 (note 1)	XTI = 3.000	–
22	CJE = 1.245	pF
23	VJE = 600.0	mV
24	MJE = 258.1	m
25	TF = 8.616	ps
26	XTF = 6.788	–
27	VTF = 1.414	V
28	ITF = 110.3	mA
29	PTF = 45.01	deg
30	CJC = 447.6	fF
31	VJC = 189.2	mV
32	MJC = 70.51	m
33	XCJC = 130.0	m
34	TR = 543.7	ps
35 (note 1)	CJS = 0.000	F
36 (note 1)	VJS = 750.0	mV
37 (note 1)	MJS = 0.000	–
38	FC = 780.2	m



$QL_B = 50$; $QL_E = 50$.
$QL_{B,E}(f) = QL_{B,E}\sqrt{(f/Fc)}$.
Fc = scaling frequency = 1000 MHz.

Fig.18 Package equivalent circuit, SOT23.

List of components (see Fig.18)

DESIGNATION	VALUE
C_{be}	71 fF
C_{cb}	71 fF
C_{ce}	2 fF
L1	0.35 nH
L2	0.17 nH
L3	0.35 nH
L_B	0.40 nH
L_E	0.83 nH

Note

1. These parameters have not been extracted, the default values are shown.

Table 1 Common emitter scattering parameters, V_{CE} = 3 V, I_C = 2 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	
40	0.951	–6.2	6.413	174.3	0.011	87.8	0.991	–3.0	43.8
100	0.937	–15.5	6.275	166.6	0.026	80.5	0.978	–7.4	38.8
200	0.891	–30.1	5.934	154.5	0.050	72.8	0.939	–14.2	31.6
300	0.832	–43.6	5.531	144.0	0.069	66.5	0.887	–19.8	26.7
400	0.769	–55.7	5.087	134.7	0.084	60.9	0.834	–24.3	23.2
500	0.709	–66.2	4.639	126.8	0.097	57.3	0.785	–27.9	20.5
600	0.653	–75.6	4.249	119.9	0.106	54.2	0.742	–30.5	18.5
700	0.600	–84.2	3.897	113.7	0.113	52.3	0.706	–32.4	16.7
800	0.552	–91.7	3.578	108.3	0.119	51.1	0.674	–33.7	15.3
900	0.510	–98.9	3.302	103.3	0.124	50.3	0.648	–34.7	14.0
1000	0.471	–106.4	3.054	98.6	0.128	50.0	0.624	–35.4	12.9
1200	0.419	–120.3	2.676	90.9	0.135	50.2	0.585	–36.9	11.2
1400	0.388	–132.3	2.399	84.4	0.144	51.5	0.559	–38.5	9.9
1600	0.355	–141.7	2.161	78.6	0.150	53.4	0.544	–39.4	8.8
1800	0.325	–152.0	1.965	73.8	0.158	56.4	0.533	–40.4	7.8
2000	0.306	–164.4	1.815	68.9	0.169	58.5	0.516	–41.1	6.9
2200	0.310	–176.7	1.690	64.5	0.181	60.7	0.495	–42.6	6.2
2400	0.322	175.1	1.604	59.9	0.196	62.6	0.479	–45.5	5.7
2600	0.323	169.6	1.504	56.3	0.211	64.0	0.472	–48.7	5.1
2800	0.317	161.7	1.441	53.4	0.228	65.6	0.472	–50.8	4.7
3000	0.324	151.3	1.375	49.9	0.247	66.5	0.461	–52.0	4.3

Table 2 Common emitter scattering parameters, V_{CE} = 3 V, I_C = 5 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.888	−10.0	14.292	170.5	0.010	84.7	0.977	−5.6	43.2
100	0.846	−24.3	13.459	158.3	0.024	76.9	0.936	−13.2	37.1
200	0.737	−44.9	11.641	141.4	0.043	68.1	0.833	−23.0	29.9
300	0.630	−61.3	9.877	128.8	0.057	63.2	0.732	−29.1	25.4
400	0.542	−74.5	8.377	119.2	0.067	60.5	0.653	−32.6	22.4
500	0.473	−84.8	7.179	112.0	0.076	59.6	0.595	−34.7	20.1
600	0.420	−93.5	6.263	106.3	0.084	59.6	0.554	−35.7	18.4
700	0.375	−101.2	5.539	101.4	0.092	60.3	0.524	−36.1	16.9
800	0.337	−107.9	4.952	97.2	0.100	61.0	0.501	−36.1	15.7
900	0.306	−114.9	4.479	93.3	0.107	61.7	0.484	−36.0	14.6
1000	0.280	−122.1	4.078	89.8	0.115	62.4	0.469	−35.9	13.6
1200	0.250	−135.7	3.484	84.1	0.130	63.7	0.444	−36.1	12.1
1400	0.235	−146.6	3.068	79.1	0.147	64.5	0.427	−37.2	10.9
1600	0.213	−154.4	2.727	74.5	0.162	65.1	0.421	−37.5	9.8
1800	0.193	−164.6	2.462	70.6	0.179	66.0	0.417	−38.2	8.8
2000	0.186	−178.6	2.256	66.6	0.196	66.0	0.405	−38.2	8.0
2200	0.202	168.9	2.093	63.1	0.214	66.0	0.386	−39.0	7.3
2400	0.220	163.0	1.977	59.2	0.233	65.6	0.369	−41.7	6.8
2600	0.221	160.7	1.842	56.1	0.250	65.1	0.361	−45.1	6.1
2800	0.216	153.7	1.759	53.6	0.268	65.0	0.362	−47.0	5.7
3000	0.225	142.6	1.673	50.3	0.287	64.3	0.354	−47.4	5.3

Table 3 Noise data

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	0.90	0.400	26.0	0.250
900	1.10	0.331	47.0	0.260
1000	1.15	0.336	49.0	0.250
2000	1.85	0.211	145.0	0.140

Table 4 Common emitter scattering parameters, $V_{CE} = 3$ V, $I_C = 10$ mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.800	−14.7	23.665	166.0	0.010	82.8	0.954	−8.6	42.3
100	0.721	−34.4	20.958	149.2	0.022	73.2	0.868	−19.2	35.7
200	0.562	−59.0	16.124	129.4	0.037	66.8	0.706	−29.4	28.8
300	0.449	−76.0	12.566	117.3	0.048	65.3	0.591	−33.6	24.8
400	0.371	−89.1	10.109	109.0	0.058	64.7	0.518	−35.0	22.1
500	0.317	−98.6	8.387	103.1	0.067	65.9	0.473	−35.4	20.0
600	0.281	−106.6	7.170	98.6	0.076	66.7	0.444	−35.3	18.4
700	0.250	−114.1	6.255	94.6	0.086	67.9	0.426	−34.9	17.1
800	0.224	−120.3	5.539	91.3	0.095	68.7	0.413	−34.4	15.9
900	0.205	−127.3	4.978	88.2	0.104	69.1	0.402	−34.0	14.9
1000	0.189	−135.3	4.509	85.3	0.114	69.6	0.394	−33.7	14.0
1200	0.175	−149.0	3.823	80.6	0.133	69.9	0.378	−33.7	12.5
1400	0.170	−159.0	3.348	76.4	0.153	69.8	0.366	−34.9	11.2
1600	0.153	−165.3	2.965	72.3	0.171	69.6	0.365	−35.3	10.2
1800	0.141	−175.6	2.665	68.9	0.191	69.4	0.364	−36.1	9.2
2000	0.141	168.5	2.441	65.3	0.210	68.5	0.355	−35.9	8.4
2200	0.164	157.0	2.261	62.2	0.230	67.8	0.337	−36.5	7.7
2400	0.183	154.0	2.131	58.6	0.251	66.7	0.320	−39.3	7.2
2600	0.183	153.6	1.981	55.8	0.268	65.5	0.311	−43.0	6.5
2800	0.179	146.7	1.888	53.4	0.287	64.9	0.312	−45.0	6.1
3000	0.191	135.1	1.797	50.4	0.306	63.7	0.305	−44.8	5.7

Table 5 Noise data

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.10	0.262	25.0	0.220
900	1.25	0.217	46.0	0.210
1000	1.30	0.212	48.0	0.230
2000	1.90	0.159	167.0	0.150

Table 6 Common emitter scattering parameters, V_{CE} = 3 V, I_C = 15 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.731	−18.2	29.853	162.7	0.010	82.7	0.932	−10.7	41.6
100	0.629	−41.4	25.095	143.3	0.021	72.2	0.814	−22.5	34.9
200	0.461	−67.9	17.933	123.1	0.034	67.4	0.631	−31.7	28.3
300	0.359	−85.3	13.444	111.9	0.044	67.2	0.522	−34.1	24.5
400	0.297	−98.3	10.603	104.5	0.054	68.2	0.460	−34.3	21.9
500	0.256	−107.8	8.712	99.4	0.064	69.4	0.424	−34.1	20.0
600	0.229	−115.7	7.394	95.3	0.074	70.1	0.402	−33.6	18.4
700	0.205	−123.1	6.425	91.9	0.084	71.4	0.390	−33.2	17.1
800	0.185	−129.6	5.673	88.9	0.094	71.9	0.381	−32.5	15.9
900	0.170	−136.9	5.090	86.0	0.104	72.1	0.374	−32.1	14.9
1000	0.161	−145.2	4.602	83.4	0.115	72.1	0.368	−31.9	14.0
1200	0.156	−158.8	3.896	79.0	0.135	72.2	0.356	−32.1	12.5
1400	0.154	−167.2	3.405	75.1	0.156	71.7	0.346	−33.5	11.3
1600	0.140	−173.6	3.012	71.2	0.175	71.0	0.347	−34.0	10.2
1800	0.130	175.4	2.708	67.9	0.195	70.4	0.347	−35.0	9.3
2000	0.134	160.5	2.479	64.4	0.215	69.3	0.338	−34.8	8.5
2200	0.161	151.0	2.296	61.5	0.235	68.3	0.321	−35.2	7.8
2400	0.179	149.2	2.161	58.0	0.257	67.2	0.304	−38.2	7.3
2600	0.179	149.2	2.008	55.3	0.274	65.8	0.294	−42.1	6.6
2800	0.177	143.1	1.914	53.0	0.293	65.0	0.295	−44.2	6.2
3000	0.189	131.9	1.821	50.0	0.313	63.5	0.290	−43.9	5.7

Table 7 Noise data

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.30	0.164	27.0	0.210
900	1.45	0.130	58.0	0.210
1000	1.50	0.134	62.0	0.240
2000	2.05	0.160	−169.0	0.160

Table 8 Common emitter scattering parameters, $V_{CE} = 3$ V, $I_C = 20$ mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.673	−21.4	33.855	160.2	0.009	79.8	0.911	−12.1	40.9
100	0.559	−47.4	27.286	139.2	0.020	71.7	0.771	−24.5	34.3
200	0.398	−75.6	18.570	119.2	0.032	68.0	0.582	−32.3	27.9
300	0.310	−93.7	13.629	108.7	0.043	68.9	0.482	−33.5	24.3
400	0.259	−107.3	10.647	101.8	0.053	70.4	0.428	−33.0	21.7
500	0.228	−116.8	8.690	97.1	0.063	71.2	0.399	−32.4	19.8
600	0.207	−125.0	7.358	93.4	0.073	72.2	0.382	−31.9	18.2
700	0.189	−132.4	6.382	90.1	0.083	73.1	0.373	−31.5	16.9
800	0.173	−139.8	5.631	87.3	0.094	73.5	0.366	−30.9	15.8
900	0.164	−146.8	5.048	84.5	0.104	73.5	0.362	−30.7	14.8
1000	0.157	−155.3	4.563	82.1	0.115	73.9	0.357	−30.5	13.9
1200	0.156	−167.5	3.859	77.8	0.135	73.4	0.347	−30.8	12.4
1400	0.158	−174.5	3.370	74.0	0.157	72.7	0.338	−32.4	11.2
1600	0.143	179.1	2.981	70.2	0.176	71.8	0.340	−33.1	10.1
1800	0.138	168.4	2.680	67.0	0.196	71.3	0.341	−34.2	9.2
2000	0.146	155.6	2.454	63.6	0.217	69.9	0.333	−34.1	8.4
2200	0.172	147.2	2.272	60.7	0.238	68.8	0.316	−34.7	7.7
2400	0.191	145.8	2.140	57.2	0.259	67.6	0.298	−37.7	7.2
2600	0.189	146.0	1.987	54.6	0.277	66.2	0.289	−41.7	6.5
2800	0.187	140.0	1.893	52.2	0.296	65.2	0.290	−44.0	6.1
3000	0.201	129.8	1.804	49.2	0.316	63.8	0.284	−43.9	5.7

Table 9 Noise data

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.45	0.090	32.0	0.210
900	1.60	0.080	76.0	0.210
1000	1.65	0.070	78.0	0.230
2000	2.20	0.210	−154.0	0.170

Table 10 Common emitter scattering parameters, V_{CE} = 3 V, I_C = 30 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.570	−29.5	36.792	156.0	0.009	77.3	0.849	−14.0	38.6
100	0.455	−63.1	27.504	132.7	0.019	69.4	0.684	−26.2	32.5
200	0.331	−97.4	17.456	113.4	0.030	68.7	0.508	−30.8	26.6
300	0.279	−118.1	12.470	104.0	0.040	70.8	0.430	−30.1	23.2
400	0.254	−132.3	9.628	97.9	0.051	71.8	0.392	−29.0	20.7
500	0.238	−142.0	7.818	93.5	0.061	73.1	0.373	−28.4	18.8
600	0.229	−149.5	6.596	90.1	0.072	73.9	0.362	−28.1	17.2
700	0.220	−156.5	5.712	87.0	0.082	74.9	0.358	−28.0	15.9
800	0.212	−162.8	5.035	84.3	0.093	75.1	0.355	−27.8	14.8
900	0.209	−168.7	4.512	81.6	0.103	75.2	0.353	−27.8	13.9
1000	0.209	−175.0	4.079	79.2	0.114	75.1	0.350	−28.0	13.0
1200	0.215	176.0	3.447	75.0	0.135	74.7	0.343	−28.9	11.5
1400	0.219	170.4	3.013	71.2	0.157	74.0	0.336	−30.9	10.3
1600	0.209	164.5	2.668	67.2	0.177	72.9	0.339	−32.3	9.2
1800	0.207	156.3	2.404	63.9	0.198	72.3	0.339	−33.7	8.3
2000	0.217	147.5	2.206	60.5	0.219	71.0	0.332	−34.0	7.6
2200	0.245	141.9	2.043	57.5	0.240	69.8	0.314	−35.1	6.9
2400	0.262	140.4	1.925	54.0	0.262	68.5	0.298	−38.5	6.4
2600	0.261	139.2	1.790	51.2	0.281	67.0	0.288	−42.8	5.7
2800	0.261	133.8	1.709	48.8	0.301	66.1	0.289	−45.4	5.3
3000	0.277	125.8	1.629	45.7	0.322	64.6	0.282	−45.7	4.9

Table 11 Common emitter scattering parameters, V_{CE} = 6 V, I_C = 2 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.957	−6.0	6.256	174.5	0.010	87.6	0.990	−2.8	43.6
100	0.945	−14.8	6.129	167.1	0.025	80.8	0.978	−7.0	39.1
200	0.900	−28.8	5.815	155.3	0.048	73.5	0.942	−13.5	32.0
300	0.845	−41.7	5.443	145.1	0.068	67.4	0.894	−18.9	27.1
400	0.783	−53.4	5.030	135.9	0.083	61.8	0.845	−23.3	23.6
500	0.723	−63.6	4.601	128.1	0.095	58.1	0.797	−26.8	20.8
600	0.668	−72.8	4.228	121.3	0.105	55.0	0.755	−29.5	18.8
700	0.614	−81.0	3.887	115.1	0.112	53.3	0.720	−31.4	17.0
800	0.565	−88.4	3.575	109.7	0.118	51.8	0.688	−32.7	15.5
900	0.522	−95.6	3.307	104.6	0.123	50.9	0.662	−33.8	14.3
1000	0.481	−102.6	3.063	99.9	0.126	50.5	0.638	−34.6	13.1
1200	0.424	−116.3	2.692	92.1	0.134	50.5	0.599	−36.0	11.4
1400	0.390	−128.2	2.419	85.6	0.142	51.6	0.572	−37.6	10.1
1600	0.354	−137.6	2.178	79.7	0.148	53.6	0.556	−38.5	9.0
1800	0.322	−147.8	1.982	74.8	0.157	56.4	0.545	−39.5	7.9
2000	0.300	−160.3	1.830	69.8	0.167	58.4	0.528	−40.1	7.1
2200	0.302	−173.0	1.706	65.5	0.178	60.6	0.507	−41.6	6.3
2400	0.312	178.4	1.620	60.8	0.192	62.6	0.491	−44.3	5.8
2600	0.312	172.7	1.520	57.3	0.206	64.1	0.484	−47.4	5.2
2800	0.305	164.7	1.455	54.2	0.223	65.9	0.484	−49.4	4.8
3000	0.311	153.5	1.387	50.8	0.241	66.8	0.474	−50.6	4.4

Table 12 Common emitter scattering parameters, V_{CE} = 6 V, I_C = 5 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.903	−9.4	14.064	170.8	0.010	85.3	0.974	−5.3	43.3
100	0.863	−22.9	13.287	159.1	0.024	77.4	0.937	−12.6	37.5
200	0.759	−42.5	11.590	142.6	0.043	69.2	0.841	−22.0	30.3
300	0.651	−58.1	9.914	130.1	0.056	64.1	0.745	−28.1	25.8
400	0.560	−70.8	8.450	120.5	0.067	61.2	0.667	−31.7	22.7
500	0.489	−80.6	7.274	113.3	0.076	60.0	0.609	−33.8	20.4
600	0.433	−88.9	6.360	107.5	0.084	60.0	0.567	−34.9	18.7
700	0.385	−96.3	5.636	102.5	0.091	60.6	0.537	−35.4	17.2
800	0.345	−102.7	5.045	98.3	0.099	61.2	0.514	−35.4	15.9
900	0.311	−109.0	4.566	94.4	0.106	61.9	0.496	−35.4	14.9
1000	0.283	−116.2	4.160	90.9	0.113	62.5	0.480	−35.3	13.9
1200	0.247	−129.2	3.558	85.1	0.129	63.7	0.454	−35.5	12.3
1400	0.229	−140.2	3.134	80.0	0.145	64.6	0.437	−36.5	11.1
1600	0.203	−147.3	2.786	75.4	0.160	65.2	0.431	−36.7	10.0
1800	0.182	−157.7	2.513	71.6	0.177	66.0	0.427	−37.4	9.0
2000	0.170	−171.9	2.304	67.5	0.194	66.0	0.415	−37.3	8.2
2200	0.182	173.7	2.136	64.0	0.211	66.0	0.396	−38.0	7.5
2400	0.202	167.1	2.019	60.1	0.230	65.7	0.379	−40.6	7.0
2600	0.202	164.7	1.880	57.1	0.246	65.2	0.371	−43.9	6.3
2800	0.196	157.1	1.795	54.5	0.264	65.1	0.372	−45.7	5.9
3000	0.203	144.7	1.706	51.2	0.283	64.4	0.365	−45.9	5.4

Table 13 Noise data

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	0.90	0.442	25.0	0.270
900	1.10	0.374	44.0	0.260
1000	1.15	0.378	48.0	0.270
2000	1.85	0.232	135.0	0.150

Table 14 Common emitter scattering parameters, V_{CE} = 6 V, I_C = 10 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.836	–13.3	22.877	166.6	0.010	82.7	0.953	–8.0	42.8
100	0.760	–31.4	20.460	150.7	0.022	74.6	0.877	–18.0	36.3
200	0.604	–54.5	16.069	131.4	0.037	67.0	0.726	–28.2	29.3
300	0.482	–70.5	12.675	119.1	0.048	65.1	0.612	–32.7	25.2
400	0.398	–82.5	10.263	110.7	0.058	64.7	0.538	–34.3	22.5
500	0.339	–91.5	8.558	104.7	0.067	65.8	0.491	–34.9	20.4
600	0.297	–98.7	7.322	99.9	0.076	66.7	0.460	–34.9	18.7
700	0.262	–105.2	6.399	96.0	0.085	67.7	0.441	–34.6	17.4
800	0.231	–111.2	5.675	92.5	0.095	68.4	0.426	–34.1	16.2
900	0.207	–117.4	5.099	89.3	0.104	68.8	0.416	–33.7	15.2
1000	0.188	–124.9	4.623	86.5	0.113	69.2	0.406	–33.4	14.2
1200	0.167	–138.3	3.920	81.7	0.131	69.6	0.389	–33.4	12.7
1400	0.157	–148.8	3.434	77.4	0.151	69.5	0.377	–34.4	11.5
1600	0.138	–154.8	3.041	73.4	0.170	69.3	0.376	–34.8	10.4
1800	0.123	–165.4	2.734	70.0	0.188	69.2	0.375	–35.5	9.5
2000	0.118	176.8	2.503	66.4	0.207	68.3	0.365	–35.2	8.7
2200	0.138	162.0	2.316	63.3	0.226	67.6	0.347	–35.6	7.9
2400	0.159	157.9	2.185	59.7	0.247	66.6	0.330	–38.3	7.4
2600	0.158	157.9	2.030	57.0	0.264	65.4	0.320	–41.8	6.7
2800	0.153	151.2	1.934	54.6	0.282	64.9	0.322	–43.7	6.3
3000	0.163	137.5	1.838	51.5	0.301	63.7	0.316	–43.5	5.9

Table 15 Noise data

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.10	0.333	25.0	0.240
900	1.25	0.291	41.0	0.240
1000	1.30	0.273	43.0	0.250
2000	1.90	0.170	148.0	0.160

Table 16 Common emitter scattering parameters, $V_{CE} = 6$ V, $I_C = 15$ mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.784	−16.2	28.912	163.7	0.009	83.1	0.934	−9.8	42.3
100	0.684	−37.3	24.730	145.3	0.021	73.3	0.829	−21.2	35.7
200	0.509	−61.5	18.106	125.3	0.034	67.4	0.654	−30.6	28.9
300	0.395	−77.3	13.734	113.8	0.045	67.2	0.544	−33.5	25.0
400	0.321	−88.9	10.898	106.2	0.054	67.8	0.479	−34.1	22.4
500	0.274	−97.6	8.977	100.9	0.064	68.9	0.441	−34.0	20.3
600	0.239	−104.6	7.637	96.7	0.074	69.6	0.417	−33.7	18.7
700	0.211	−111.0	6.644	93.2	0.084	70.8	0.403	−33.2	17.4
800	0.187	−116.7	5.871	90.1	0.094	71.4	0.393	−32.5	16.3
900	0.167	−122.9	5.269	87.2	0.104	71.7	0.386	−32.1	15.3
1000	0.151	−131.0	4.765	84.6	0.114	71.9	0.378	−31.8	14.3
1200	0.138	−145.4	4.034	80.2	0.133	71.8	0.365	−31.9	12.8
1400	0.134	−155.5	3.528	76.2	0.154	71.3	0.356	−33.2	11.6
1600	0.117	−160.6	3.118	72.4	0.173	70.7	0.355	−33.5	10.5
1800	0.104	−172.5	2.802	69.2	0.192	70.3	0.355	−34.4	9.6
2000	0.104	168.9	2.564	65.7	0.212	69.2	0.347	−34.1	8.8
2200	0.127	155.9	2.372	62.8	0.232	68.2	0.330	−34.4	8.1
2400	0.147	152.9	2.234	59.3	0.253	66.9	0.312	−37.2	7.5
2600	0.147	154.1	2.074	56.7	0.270	65.6	0.302	−40.9	6.8
2800	0.142	146.9	1.975	54.4	0.289	64.9	0.304	−42.9	6.4
3000	0.155	133.8	1.878	51.4	0.308	63.6	0.298	−42.4	6.0

Table 17 Noise data

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.30	0.250	25.0	0.240
900	1.45	0.218	45.0	0.250
1000	1.50	0.205	53.0	0.280
2000	2.05	0.135	167.0	0.170

Table 18 Common emitter scattering parameters, $V_{CE} = 6$ V, $I_C = 20$ mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.743	−18.7	33.272	161.4	0.009	81.0	0.918	−11.1	41.9
100	0.627	−41.8	27.392	141.4	0.020	72.1	0.792	−23.2	35.2
200	0.447	−66.7	19.114	121.4	0.033	68.1	0.607	−31.5	28.6
300	0.342	−82.4	14.179	110.6	0.043	68.6	0.503	−33.4	24.8
400	0.278	−94.3	11.131	103.5	0.053	69.6	0.446	−33.1	22.2
500	0.237	−102.7	9.118	98.7	0.063	71.1	0.414	−32.7	20.3
600	0.209	−109.7	7.724	94.8	0.073	71.7	0.395	−32.2	18.7
700	0.185	−116.5	6.708	91.5	0.083	72.7	0.384	−31.7	17.4
800	0.164	−122.5	5.920	88.7	0.094	73.0	0.377	−31.1	16.2
900	0.148	−129.1	5.307	85.9	0.104	73.2	0.371	−30.8	15.2
1000	0.135	−137.3	4.799	83.4	0.114	73.2	0.365	−30.5	14.3
1200	0.126	−152.3	4.058	79.2	0.134	73.0	0.354	−30.7	12.8
1400	0.125	−161.6	3.545	75.4	0.156	72.3	0.345	−32.1	11.6
1600	0.111	−166.7	3.132	71.7	0.175	71.4	0.347	−32.7	10.5
1800	0.099	−178.7	2.813	68.6	0.195	70.9	0.348	−33.6	9.6
2000	0.101	163.6	2.574	65.1	0.215	69.6	0.339	−33.4	8.8
2200	0.126	151.0	2.382	62.3	0.235	68.5	0.322	−33.7	8.1
2400	0.147	149.6	2.244	58.9	0.256	67.3	0.305	−36.4	7.5
2600	0.147	151.2	2.082	56.3	0.273	65.9	0.295	−40.3	6.9
2800	0.143	144.3	1.983	54.0	0.292	65.0	0.297	−42.4	6.4
3000	0.157	131.2	1.884	51.0	0.312	63.6	0.290	−42.0	6.0

Table 19 Noise data

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.45	0.194	27.0	0.250
900	1.60	0.164	49.0	0.260
1000	1.65	0.166	55.0	0.280
2000	2.20	0.165	−175.0	0.180

Table 20 Common emitter scattering parameters, $V_{CE} = 6$ V, $I_C = 30$ mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.691	−22.1	37.360	158.7	0.009	80.4	0.892	−12.5	41.2
100	0.559	−47.9	29.323	137.1	0.019	71.6	0.744	−24.8	34.5
200	0.387	−74.7	19.484	117.4	0.031	68.8	0.560	−31.3	28.1
300	0.294	−91.4	14.155	107.3	0.041	70.4	0.468	−31.8	24.5
400	0.242	−103.6	11.009	100.9	0.051	71.6	0.420	−30.9	21.9
500	0.209	−112.9	8.974	96.4	0.062	72.7	0.395	−30.3	20.0
600	0.187	−120.3	7.584	92.8	0.072	73.4	0.380	−29.8	18.4
700	0.169	−127.8	6.574	89.7	0.082	74.2	0.373	−29.5	17.1
800	0.153	−134.1	5.797	87.0	0.093	74.6	0.368	−29.0	16.0
900	0.141	−141.3	5.192	84.4	0.103	74.5	0.364	−28.8	15.0
1000	0.133	−150.1	4.694	82.0	0.114	74.5	0.361	−28.6	14.1
1200	0.131	−163.8	3.965	77.9	0.134	73.8	0.351	−29.1	12.6
1400	0.133	−171.6	3.463	74.2	0.156	73.2	0.344	−30.7	11.4
1600	0.120	−177.7	3.062	70.5	0.175	72.3	0.346	−31.6	10.3
1800	0.113	171.5	2.750	67.4	0.195	71.7	0.347	−32.7	9.4
2000	0.117	156.0	2.515	64.0	0.216	70.3	0.339	−32.6	8.6
2200	0.145	146.6	2.330	61.2	0.236	69.1	0.322	−33.1	7.9
2400	0.166	146.1	2.195	57.8	0.258	67.8	0.305	−35.9	7.4
2600	0.164	146.9	2.038	55.2	0.275	66.4	0.295	−39.9	6.7
2800	0.161	140.8	1.941	53.0	0.294	65.5	0.297	−42.1	6.3
3000	0.176	129.3	1.844	49.9	0.314	64.1	0.291	−41.9	5.8

NPN 9 GHz wideband transistor BFR541

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability.

DESCRIPTION

The BFR541 is an NPN silicon planar epitaxial transistor, intended for wideband applications up to 3 GHz, such as MATV/CATV amplifiers, repeater amplifiers in fibre-optic systems and RF communications subscriber equipment.

The transistor is mounted in a plastic SOT103 envelope.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	emitter
4	base

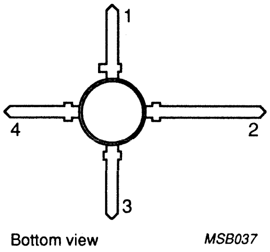


Fig.1 SOT103.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	–	15	V
I_C	DC collector current		–	–	120	mA
P_{tot}	total power dissipation	up to T_s = 140 °C (note 1)	–	–	650	mW
h_{FE}	DC current gain	V_{CE} = 8 V; I_C = 40 mA	60	120	250	
C_{re}	feedback capacitance	V_{CE} = 8 V; $I_C = i_c = 0$; f = 1 MHz	–	0.5	–	pF
f_T	transition frequency	V_{CE} = 8 V; I_C = 40 mA	–	9	–	GHz
G_{UM}	maximum unilateral power gain	V_{CE} = 8 V; I_C = 40 mA; f = 900 MHz	–	18	–	dB
$\|S_{21}\|^2$	insertion power gain	V_{CE} = 8 V; I_C = 40 mA; f = 900 MHz	15	16	–	dB
F	noise figure	V_{CE} = 8 V; I_C = 10 mA; f = 900 MHz	–	1.3	1.8	dB
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	note 1	–	–	55	K/W
T_j	junction temperature		–	–	175	°C

Note

1. T_s is the temperature at the soldering point of the collector tab.

NPN 1 GHz wideband transistor

BFS17

DESCRIPTION

NPN transistor in a plastic SOT23 envelope.

It is intended for a wide range of RF applications, such as mixers and oscillators in TV tuners and RF communications equipment.

PINNING

PIN	DESCRIPTION
Code: E1p	
1	base
2	emitter
3	collector

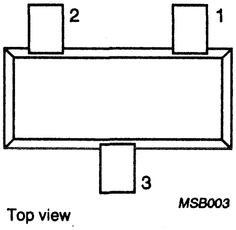


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
I_C	DC collector current		–	25	mA
P_{tot}	total power dissipation	up to T_s = 70 °C (note 1)	–	300	mW
f_T	transition frequency	I_C = 25 mA; V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C	1	–	GHz
F	noise figure	I_C = 2 mA; V_{CE} = 5 V; R_S = 50 Ω; f = 500 MHz; T_j = 25 °C	4.5	–	dB

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	25	mA
I_{CM}	peak collector current		–	50	mA
P_{tot}	total power dissipation	up to T_s = 70 °C (note 1)	–	300	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C

Note

1. T_s is the temperature at the soldering point of the collector tab.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to $T_s = 70$ °C (note 1)	260 K/W

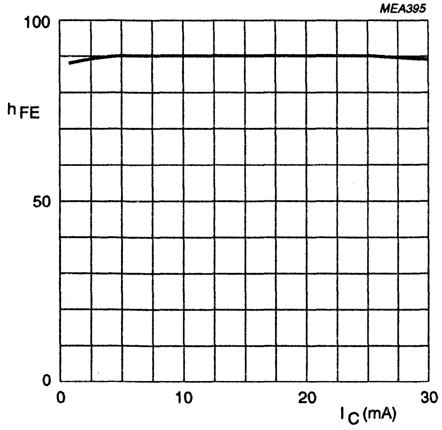
Note

1. T_s is the temperature at the soldering point of the collector tab.

CHARACTERISTICS

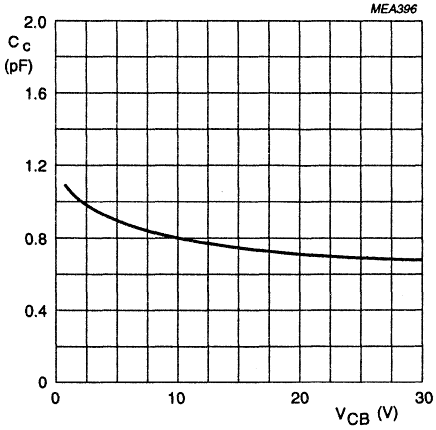
$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 10$ V	–	–	10	nA
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 1$ V	25	90	–	
		$I_C = 25$ mA; $V_{CE} = 1$ V	25	90	–	
f_T	transition frequency	$I_C = 2$ mA; $V_{CE} = 5$ V; f = 500 MHz	–	1	–	GHz
		$I_C = 25$ mA; $V_{CE} = 5$ V; f = 500 MHz	–	1.6	–	GHz
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	0.8	1.5	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	–	2	pF
C_{re}	feedback capacitance	$I_C = 1$ mA; $V_{CE} = 5$ V; f = 1 MHz	–	0.65	–	pF
F	noise figure	$I_C = 2$ mA; $V_{CE} = 5$ V; $R_S = 50\ \Omega$; f = 500 MHz	–	4.5	–	dB



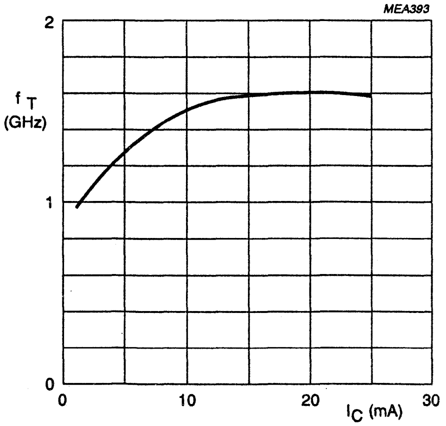
V_{CE} = 1 V; T_j = 25 °C.

Fig.2 DC current gain as a function of collector current.



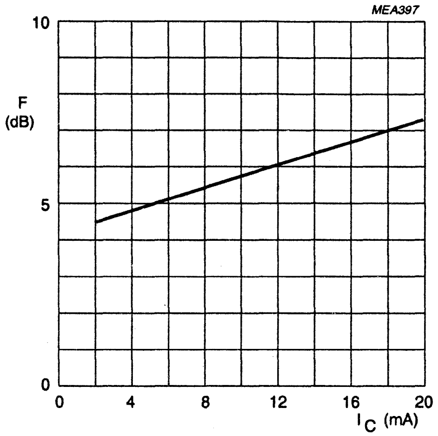
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C.

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



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

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



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

Fig.5 Minimum noise figure as a function of collector current.

NPN 3 GHz wideband transistor

BFS17A

DESCRIPTION

NPN transistor in a plastic SOT23 envelope.

It is intended for a wide range of RF applications such as TV tuners.

PINNING

PIN	DESCRIPTION
	Code: E2p
1	base
2	emitter
3	collector

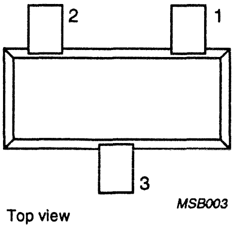


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
I_C	DC collector current		–	25	mA
P_{tot}	total power dissipation	up to T_s = 70 °C (note 1)	–	300	mW
f_T	transition frequency	I_C = 25 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C	2.8	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 14 mA; V_{CE} = 10 V; f = 800 MHz	13.5	–	dB
F	noise figure	I_C = 2 mA; V_{CE} = 5 V; f = 800 MHz; T_{amb} = 25 °C	2.5	–	dB
V_O	output voltage	d_{im} = –60 dB; I_C = 14 mA; V_{CE} = 10 V; R_L = 75 Ω; T_{amb} = 25 °C; $f_{(p+q-r)}$ = 793.25 MHz	150	–	mV

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	25	mA
I_{CM}	peak collector current		–	50	mA
P_{tot}	total power dissipation	up to T_s = 70 °C (note 1)	–	300	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C

Note

1. T_s is the temperature at the soldering point of the collector tab.

Capability approved CECC 50 000 (issue 4), 1986

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to $T_s = 70$ °C (note 1)	260 K/W

Note

1. T_s is the temperature at the soldering point of the collector tab.

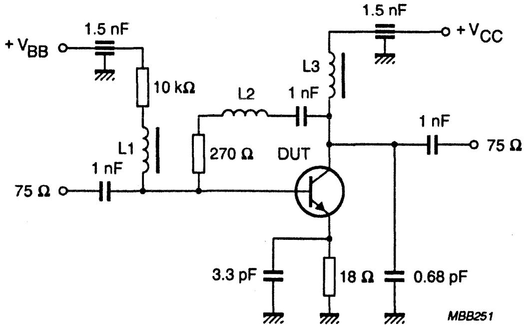
CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 10$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 1$ V; $T_{amb} = 25$ °C	25	90	–	
		$I_C = 25$ mA; $V_{CE} = 1$ V; $T_{amb} = 25$ °C	25	90	–	
f_T	transition frequency	$I_C = 25$ mA; $V_{CE} = 5$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	2.8	–	GHz
C_c	collector capacitance	$I_E = 0$; $V_{CB} = 10$ V; f = 1 MHz; $T_{amb} = 25$ °C	–	0.7	–	pF
C_e	emitter capacitance	$I_C = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	1.25	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = 5$ V; f = 1 MHz	–	0.6	–	pF
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 14$ mA; $V_{CE} = 10$ V; f = 800 MHz	–	13.5	–	dB
F	noise figure	$I_C = 2$ mA; $V_{CE} = 5$ V; $Z_S = 60\ \Omega$; f = 800 MHz; $T_{amb} = 25$ °C	–	2.5	–	dB
V_O	output voltage	note 2	–	150	–	mV

Notes

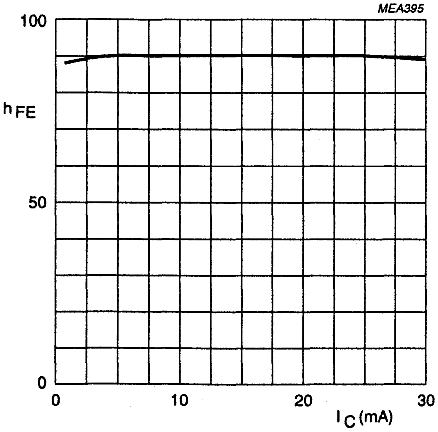
1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$ dB.
2. $d_{im} = -60$ dB (DIN 45004B); $I_C = 14$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$; $T_{amb} = 25$ °C;
   $V_p = V_O$; $f_p = 795.25$ MHz;
   $V_q = V_O - 6$ 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.



L1 = L3 = 5 μH Ferroxcube choke.

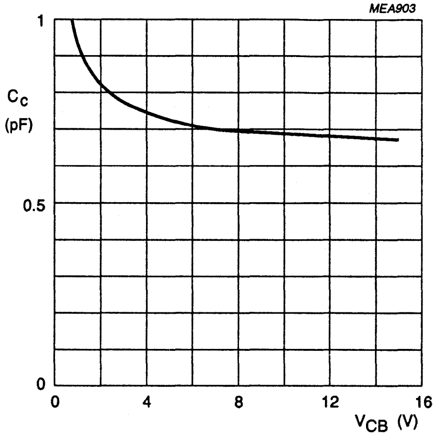
L2 = 3 turns 0.4 mm copper wire; winding pitch 1 mm; internal diameter 3 mm.

Fig.2 Intermodulation distortion and second order intermodulation distortion test circuit.



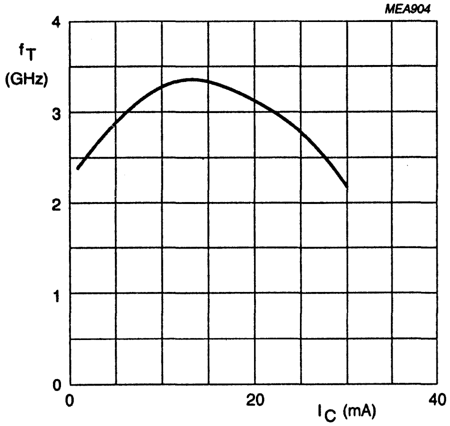
V_{CE} = 1 V; T_{amb} = 25 °C.

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



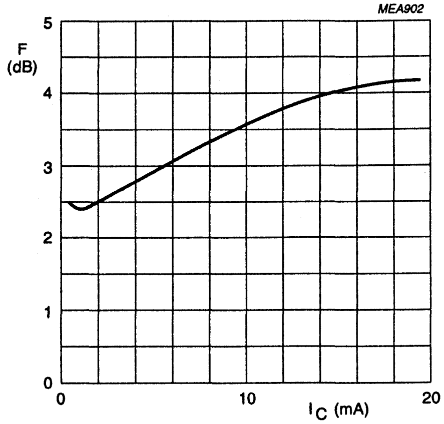
I_E = 0; f = 1 MHz; T_{amb} = 25 °C.

Fig.4 Collector capacitance as a function of collector-base voltage.



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

Fig.5 Transition frequency as a function of collector current.



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

Fig.6 Minimum noise figure as a function of collector current.

Table 1 Common emitter scattering parameters, I_C = 10 mA; V_{CE} = 5 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.590	−29.5	21.379	158.1	0.009	76.3	0.950	−9.1	38.6
100	0.491	−64.5	16.515	134.4	0.021	64.3	0.828	−16.7	30.6
200	0.386	−103.1	10.912	114.5	0.031	62.6	0.689	−19.0	24.3
300	0.349	−124.1	7.833	103.6	0.039	64.4	0.630	−18.8	20.6
400	0.331	−137.6	6.080	96.8	0.047	67.1	0.603	−18.9	18.1
500	0.322	−146.7	5.055	90.8	0.055	68.8	0.590	−19.0	16.4
600	0.319	−155.5	4.244	86.9	0.065	70.7	0.585	−19.8	14.8
700	0.306	−157.4	3.666	83.3	0.074	72.5	0.582	−20.8	13.5
800	0.317	−165.6	3.232	79.7	0.082	73.6	0.582	−21.7	12.4
900	0.301	−172.1	2.909	76.9	0.092	74.5	0.582	−23.0	11.5
1000	0.307	−177.7	2.610	73.1	0.100	75.1	0.579	−23.9	10.5
1200	0.311	177.2	2.234	67.5	0.119	75.8	0.578	−26.5	9.2
1400	0.330	170.6	1.966	62.3	0.138	76.4	0.579	−29.8	8.1
1600	0.310	164.5	1.746	58.5	0.157	77.4	0.582	−32.6	7.1
1800	0.326	153.7	1.552	53.6	0.175	77.6	0.580	−35.4	6.1
2000	0.351	149.2	1.458	50.1	0.196	77.2	0.580	−38.5	5.6

Table 2 Common emitter scattering parameters, I_C = 15 mA; V_{CE} = 5 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.496	−37.6	26.019	153.3	0.009	76.8	0.929	−10.9	38.1
100	0.404	−78.8	18.591	128.4	0.018	66.2	0.777	−17.7	30.2
200	0.335	−116.9	11.439	109.2	0.028	66.0	0.651	−18.0	24.1
300	0.314	−136.4	8.062	99.5	0.037	68.7	0.605	−17.1	20.6
400	0.307	−148.4	6.191	93.2	0.046	71.0	0.585	−16.8	18.1
500	0.304	−156.1	5.023	88.4	0.055	73.0	0.576	−17.3	16.2
600	0.303	−162.1	4.232	84.5	0.065	74.1	0.573	−18.0	14.7
700	0.301	−167.2	3.657	81.0	0.074	75.3	0.572	−19.0	13.4
800	0.299	−171.9	3.228	77.7	0.083	75.7	0.573	−20.1	12.3
900	0.298	−176.8	2.889	74.6	0.092	76.1	0.573	−21.3	11.3
1000	0.300	179.4	2.614	71.8	0.102	76.6	0.573	−22.5	10.5
1200	0.312	172.0	2.218	66.6	0.120	77.1	0.573	−25.1	9.1
1400	0.326	166.8	1.948	61.9	0.139	77.6	0.573	−28.1	8.0
1600	0.326	161.6	1.739	57.4	0.157	77.7	0.576	−31.0	7.0
1800	0.328	155.4	1.568	53.5	0.176	77.9	0.575	−33.9	6.1
2000	0.344	147.8	1.440	49.5	0.197	77.6	0.568	−36.8	5.4

Table 3 Common emitter scattering parameters, I_C = 20 mA; V_{CE} = 5 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.429	−45.4	28.889	149.3	0.008	68.0	0.906	−12.0	37.6
100	0.355	−91.8	19.198	123.2	0.017	62.0	0.742	−17.3	29.7
200	0.321	−131.3	11.342	105.9	0.026	67.9	0.632	−16.6	23.8
300	0.312	−145.1	7.873	96.9	0.035	71.2	0.596	−15.6	20.3
400	0.322	−154.3	6.023	91.4	0.044	73.4	0.583	−15.8	17.9
500	0.331	−162.4	4.965	86.3	0.053	74.5	0.577	−16.2	16.2
600	0.316	−168.2	4.149	82.9	0.062	74.9	0.576	−17.4	14.6
700	0.308	−171.4	3.568	79.6	0.071	77.3	0.576	−18.5	13.2
800	0.329	−177.2	3.147	76.4	0.081	77.6	0.579	−19.9	12.2
900	0.314	−178.4	2.840	73.2	0.089	78.1	0.581	−21.2	11.3
1000	0.330	175.6	2.544	69.8	0.099	78.9	0.579	−22.5	10.4
1200	0.332	170.0	2.166	64.8	0.117	79.2	0.579	−25.3	9.0
1400	0.357	163.8	1.896	59.9	0.136	79.2	0.581	−28.9	7.9
1600	0.345	159.3	1.682	56.3	0.156	80.1	0.585	−31.7	6.9
1800	0.343	153.1	1.490	51.4	0.175	80.1	0.585	−35.0	5.8
2000	0.384	146.7	1.408	47.8	0.195	79.6	0.583	−38.3	5.5

Table 4 Common emitter scattering parameters, I_C = 10 mA; V_{CE} = 10 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.654	−25.7	20.995	159.2	0.009	74.2	0.959	−8.1	39.8
100	0.533	−58.1	16.521	136.1	0.019	66.9	0.849	−14.8	31.4
200	0.410	−93.4	11.123	116.1	0.030	63.4	0.719	−17.3	24.9
300	0.353	−114.2	8.037	105.1	0.037	64.8	0.665	−17.1	21.2
400	0.321	−129.8	6.264	98.1	0.045	66.8	0.640	−17.2	18.7
500	0.308	−139.0	5.217	92.0	0.053	68.9	0.628	−17.3	17.0
600	0.290	−148.1	4.374	88.1	0.061	70.4	0.622	−18.2	15.3
700	0.276	−152.1	3.777	84.5	0.069	73.4	0.619	−19.1	14.0
800	0.286	−161.9	3.341	80.8	0.078	73.8	0.618	−20.0	12.9
900	0.271	−165.8	3.004	77.6	0.086	75.2	0.621	−21.0	12.0
1000	0.281	−172.9	2.708	74.1	0.094	75.2	0.615	−22.0	11.1
1200	0.279	177.3	2.309	68.6	0.111	76.9	0.616	−24.5	9.7
1400	0.301	174.1	2.036	63.6	0.129	77.2	0.616	−27.5	8.7
1600	0.296	169.4	1.813	59.7	0.146	78.1	0.620	−30.0	7.7
1800	0.290	159.4	1.593	54.9	0.163	78.6	0.619	−32.7	6.5
2000	0.307	153.8	1.504	51.1	0.182	78.3	0.620	−35.6	6.1

Table 5 Common emitter scattering parameters, $I_C = 15$ mA; $V_{CE} = 10$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.573	−32.7	25.747	154.5	0.009	76.8	0.938	−9.6	39.2
100	0.453	−69.6	18.801	130.1	0.017	67.3	0.802	−15.9	31.0
200	0.345	−105.9	11.759	110.6	0.027	65.9	0.682	−16.5	24.7
300	0.306	−126.5	8.332	100.7	0.036	68.0	0.637	−15.8	21.1
400	0.291	−139.6	6.408	94.3	0.044	70.4	0.618	−15.6	18.6
500	0.282	−148.4	5.206	89.5	0.053	72.3	0.609	−16.0	16.7
600	0.278	−155.3	4.386	85.5	0.061	73.7	0.605	−16.7	15.2
700	0.273	−160.8	3.792	82.1	0.070	75.2	0.604	−17.6	13.9
800	0.272	−166.2	3.347	78.8	0.079	75.4	0.606	−18.6	12.8
900	0.268	−171.4	2.992	75.7	0.088	76.1	0.606	−19.7	11.8
1000	0.270	−176.0	2.707	72.9	0.096	76.6	0.606	−20.8	11.0
1200	0.282	175.9	2.295	67.7	0.113	77.3	0.606	−23.3	9.6
1400	0.295	170.2	2.016	63.1	0.131	78.0	0.606	−26.1	8.5
1600	0.294	164.6	1.797	58.6	0.148	78.3	0.609	−28.7	7.5
1800	0.296	158.3	1.619	54.7	0.166	78.6	0.609	−31.4	6.6
2000	0.312	149.9	1.484	50.8	0.185	78.4	0.602	−34.1	5.8

Table 6 Common emitter scattering parameters, $I_C = 20$ mA; $V_{CE} = 10$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.526	−38.1	28.982	151.1	0.008	75.1	0.919	−10.7	38.8
100	0.409	−77.7	19.795	125.2	0.016	64.3	0.775	−16.0	30.7
200	0.320	−115.1	11.907	107.4	0.026	66.7	0.667	−15.2	24.5
300	0.297	−134.0	8.293	98.2	0.033	69.8	0.630	−14.5	21.0
400	0.276	−146.2	6.358	92.7	0.042	71.7	0.615	−14.7	18.5
500	0.293	−152.8	5.256	87.6	0.051	73.3	0.609	−15.1	16.8
600	0.286	−160.3	4.387	84.1	0.060	75.4	0.608	−16.1	15.2
700	0.271	−163.7	3.775	80.8	0.068	76.9	0.608	−17.2	13.9
800	0.289	−171.1	3.323	77.6	0.078	76.9	0.611	−18.4	12.8
900	0.287	−174.0	2.993	74.7	0.085	77.7	0.613	−19.5	11.9
1000	0.280	179.2	2.684	71.2	0.094	78.6	0.610	−20.6	11.0
1200	0.300	173.3	2.282	65.9	0.112	79.0	0.612	−23.3	9.6
1400	0.310	168.8	2.000	61.2	0.128	79.2	0.613	−26.5	8.5
1600	0.308	163.6	1.778	57.7	0.146	80.4	0.618	−29.3	7.5
1800	0.312	154.0	1.577	53.1	0.165	80.7	0.619	−32.1	6.5
2000	0.335	149.6	1.480	49.6	0.182	80.3	0.619	−35.1	6.0

NPN 1 GHz wideband transistor BFS17W

DESCRIPTION

Silicon NPN transistor in a plastic SOT323 (S-mini) envelope. It is primarily intended as a mixer, oscillator and IF amplifier in UHF and VHF tuners. The BFS17W uses the same crystal as the SOT23 version, BFS17.

PINNING

PIN	DESCRIPTION
Code: E1	
1	base
2	emitter
3	collector

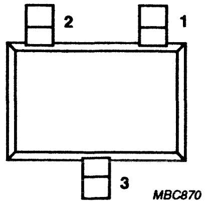


Fig.1 SOT323.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	–	15	V
I_C	DC collector current		–	–	50	mA
P_{tot}	total power dissipation	up to T_s = 87 °C (note 1)	–	–	300	mW
h_{FE}	DC current gain	I_C = 2 mA; V_{CE} = 1 V	25	90	–	
f_T	transition frequency	I_C = 25 mA; V_{CE} = 5 V	–	1.6	–	GHz
C_c	collector capacitance	I_E = 0; V_{CB} = 10 V; f = 1 MHz	–	0.8	1.5	pF
C_{re}	feedback capacitance	I_C = 1 mA; V_{CE} = 5 V; f = 1 MHz	–	0.65	–	pF
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	note 1	–	–	290	K/W
T_j	junction temperature		–	–	150	°C

Note

1. T_s is the temperature at the soldering point of the collector tab.

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

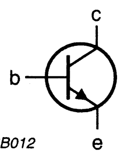
Fig. 1 SOT-23.

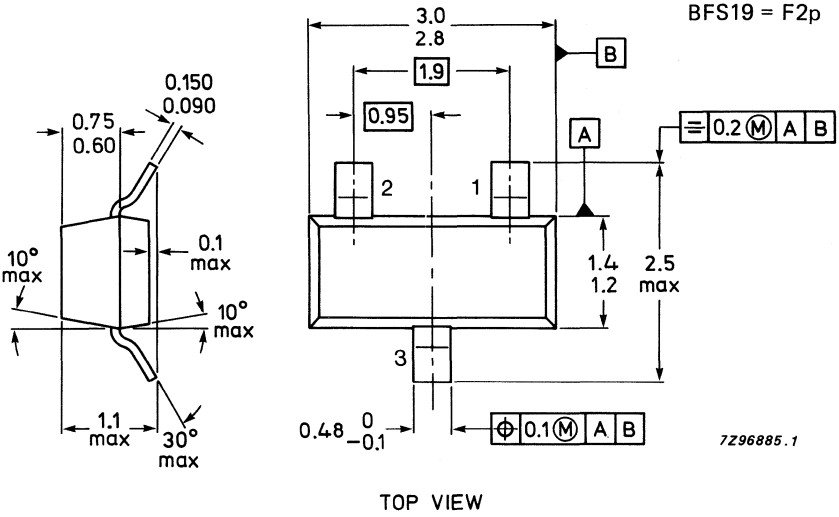
Marking code

BFS18 = F1p
BFS19 = F2p

Pinning:

1 = base
2 = emitter
3 = collector





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.

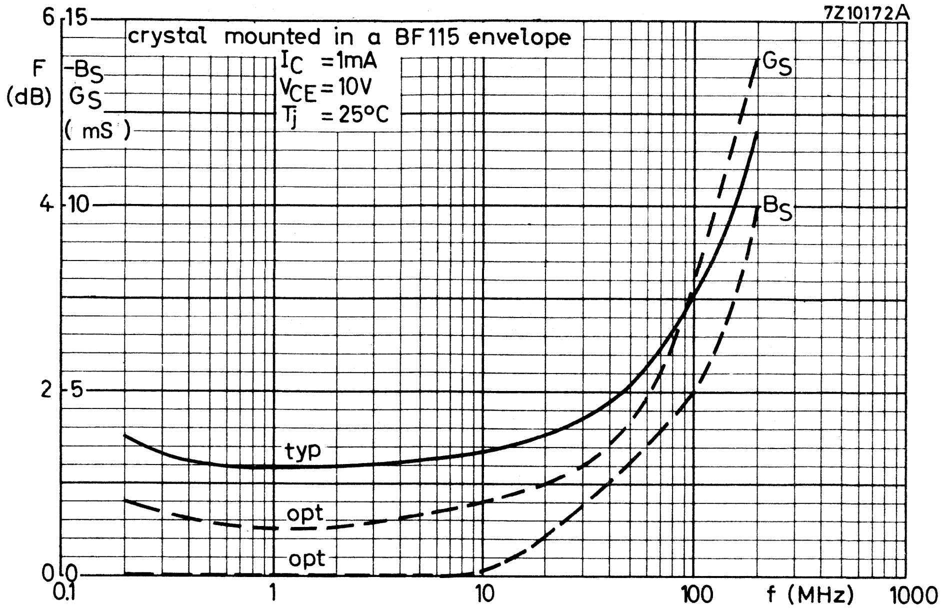


Fig. 2.

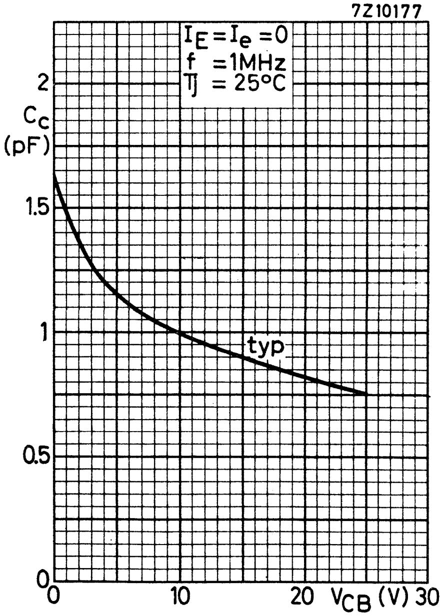


Fig. 3.

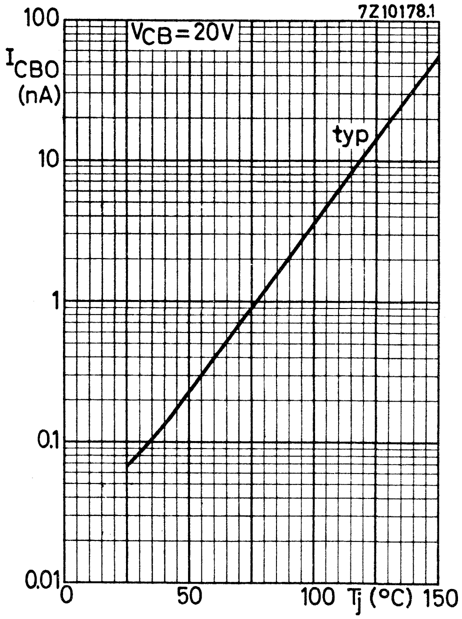


Fig. 4.

Typical behaviour of collector current versus collector-emitter voltage

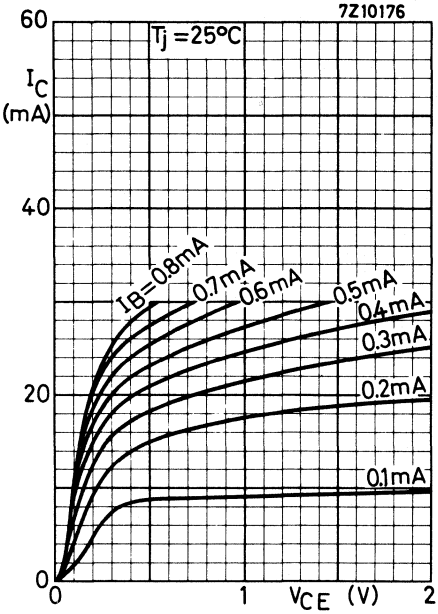


Fig. 5.

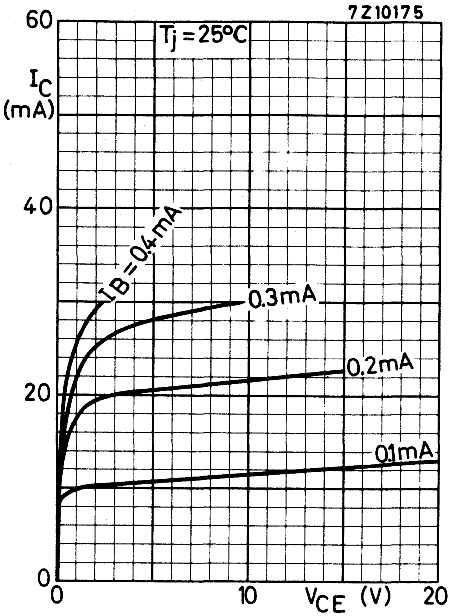


Fig. 6.

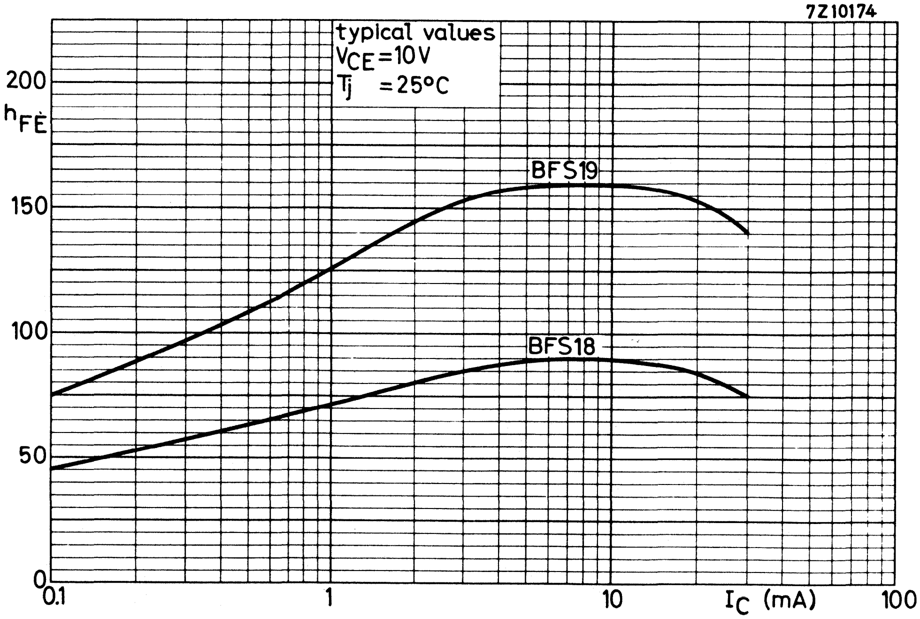


Fig. 7.

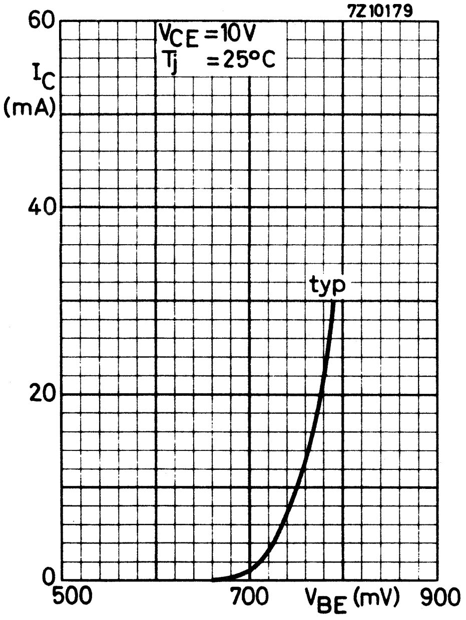

7Z10179
60
I_C
(mA)
40
20
0
500
700
V_{BE} (mV)
900
V_{CE} = 10 V
T_j = 25°C
typ

Fig. 8.

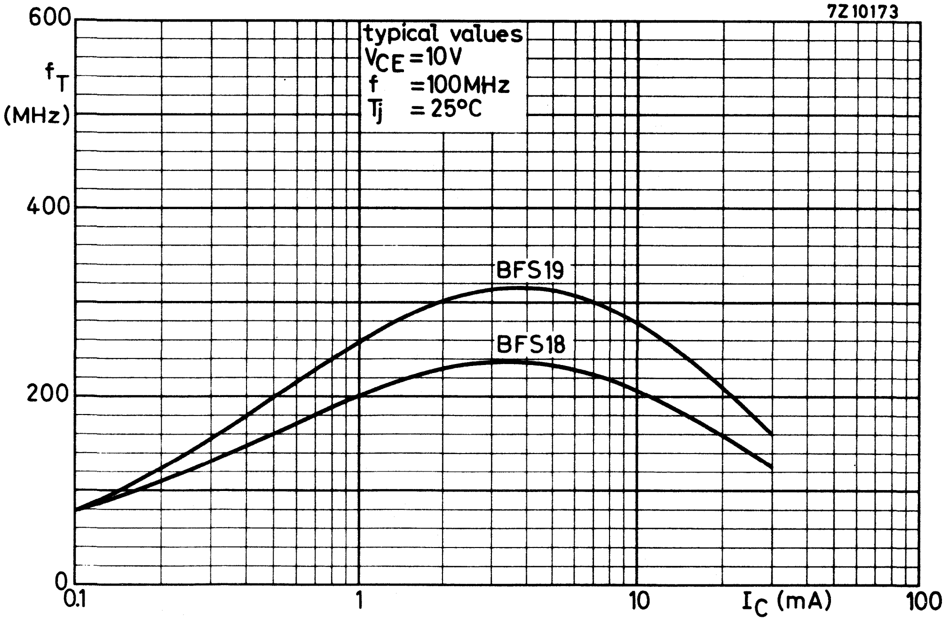

7Z10173
600
f_T
(MHz)
400
200
0
0.1
1
10
I_C (mA)
100
typical values
V_{CE} = 10 V
f = 100 MHz
T_j = 25°C
BFS19
BFS18

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

Fig. 1 SOT-23.

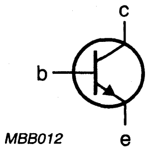
Dimensions in mm

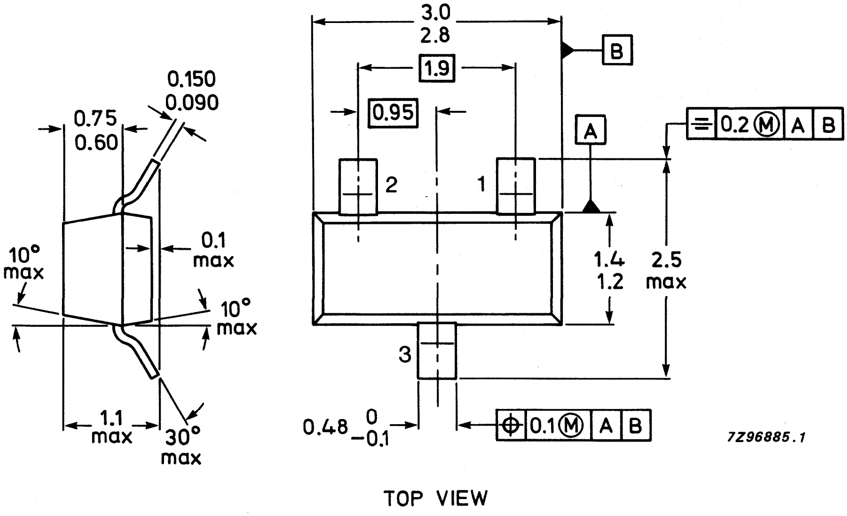
Marking code

BFS20 = G1p

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

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

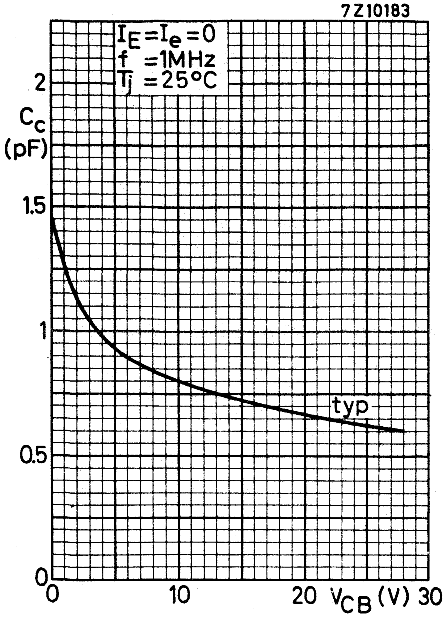

7Z10183
$I_E = I_e = 0$
f = 1MHz
T_j = 25°C
C_c
(pF)
2
1.5
1
0.5
0
0
10
20
30
V_{CB} (V)
typ

Fig. 2.

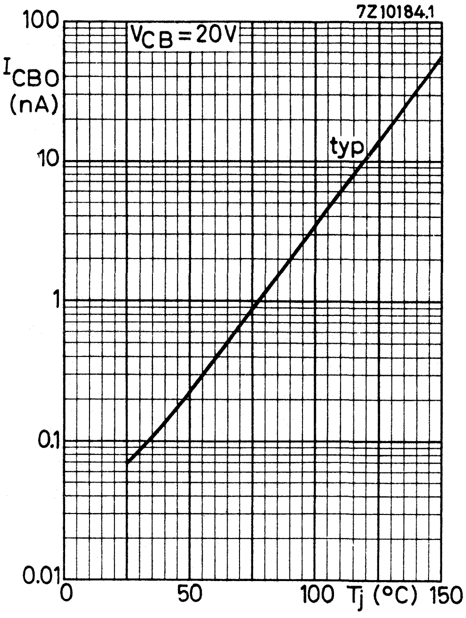

7Z10184.1
V_{CB} = 20V
I_{CBO}
(nA)
100
10
1
0.1
0.01
0
50
100
150
T_j (°C)
typ

Fig. 3.

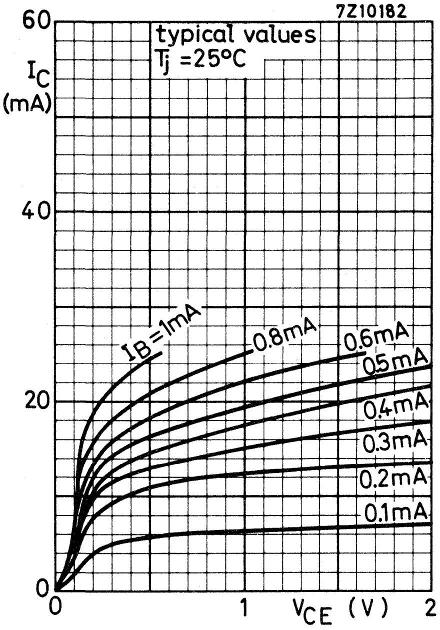


Fig. 4.

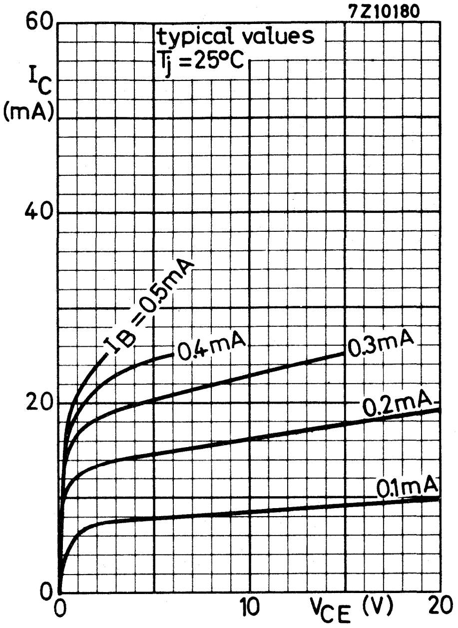


Fig. 5.

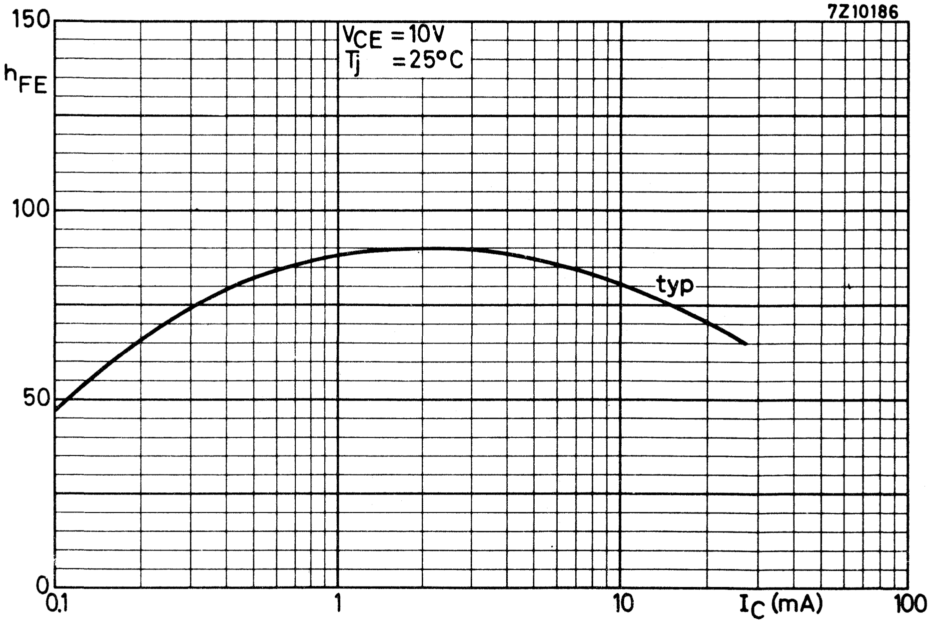


Fig. 6.

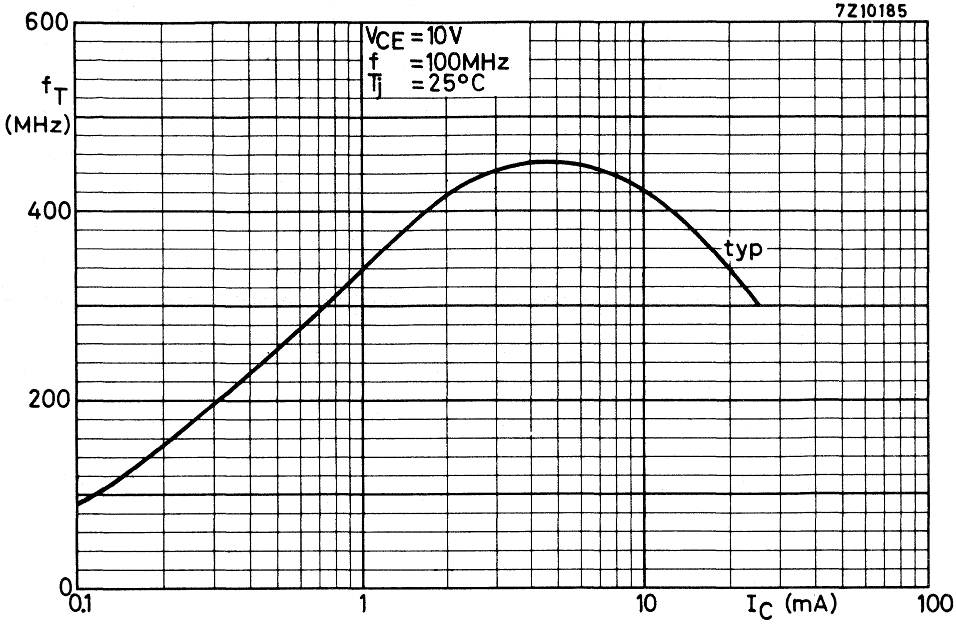

7Z10185
600
400
200
0
f_T
(MHz)
V_{CE} = 10 V
f = 100 MHz
T_j = 25 °C
typ
0.1
1
10
I_C (mA)
100

Fig. 7.

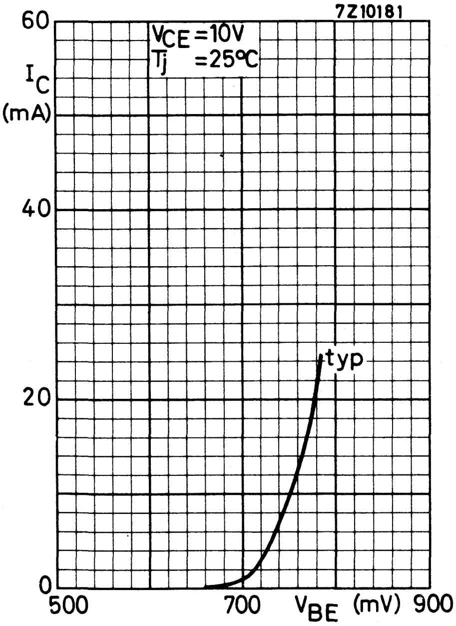

7Z10181
60
40
20
0
I_C
(mA)
V_{CE} = 10 V
T_j = 25 °C
typ
500
700
V_{BE} (mV)
900

Fig. 8.

NPN 5 GHz wideband transistor

BFS25A

FEATURES

- Low current consumption
- Low noise figure
- Gold metallization ensures excellent reliability
- SOT323 envelope.

DESCRIPTION

NPN transistor in a plastic SOT323 envelope.

It is designed for use in RF amplifiers and oscillators in pagers and pocket phones with signal frequencies up to 2 GHz.

PINNING

PIN	DESCRIPTION
Code: N6	
1	base
2	emitter
3	collector

PIN CONFIGURATION

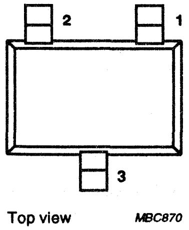


Fig.1 SOT323.

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	DC collector current		–	–	6.5	mA
P_{tot}	total power dissipation	up to T_s = 142 °C (note 1)	–	–	32	mW
h_{FE}	DC current gain	I_C = 0.5 mA; V_{CE} = 1 V; T_j = 25 °C	50	80	200	
f_T	transition frequency	I_C = 1 mA; V_{CE} = 1 V; f = 1 GHz; T_{amb} = 25 °C	3.5	5	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 0.5 mA; V_{CE} = 1 V; f = 1 GHz; T_{amb} = 25 °C	–	13	–	dB
F	noise figure	I_C = 0.5 mA; V_{CE} = 1 V; f = 1 GHz; T_{amb} = 25 °C	–	1.8	–	dB

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	8	V
V_{CEO}	collector-emitter voltage	open base	–	5	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	6.5	mA
P_{tot}	total power dissipation	up to T_s = 142 °C (note 1)	–	32	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C

Note

1. T_s is the temperature at the soldering point of the collector tab.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 142 °C (note 1)	190 K/W

Note

1. T_s is the temperature at the soldering point of the collector tab.

CHARACTERISTICS

T_j = 25 °C, unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 5$ V	–	–	50	μA
h_{FE}	DC current gain	$I_C = 0.5$ mA; $V_{CE} = 1$ V	50	80	200	
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 1$ V; f = 1 MHz	–	0.3	0.45	pF
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 1$ V; f = 1 GHz; T_{amb} = 25 °C	3.5	5	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 0.5$ mA; $V_{CE} = 1$ V; f = 1 GHz; T_{amb} = 25 °C	–	13	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 0.5$ mA; $V_{CE} = 1$ V; f = 1 GHz; T_{amb} = 25 °C	–	1.8	–	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 1$ mA; $V_{CE} = 1$ V; f = 1 GHz; T_{amb} = 25 °C	–	2	–	dB

Note

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$ dB.

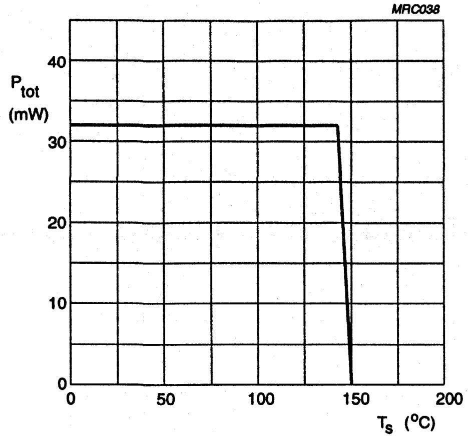
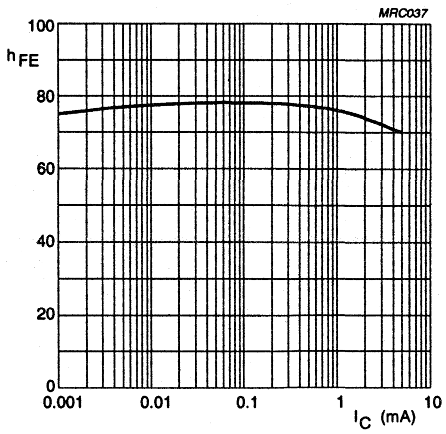
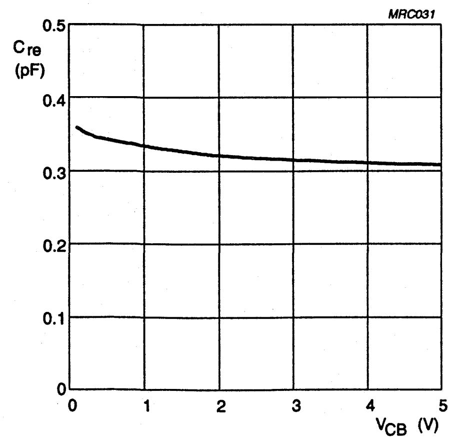


Fig.2 Power derating curve.



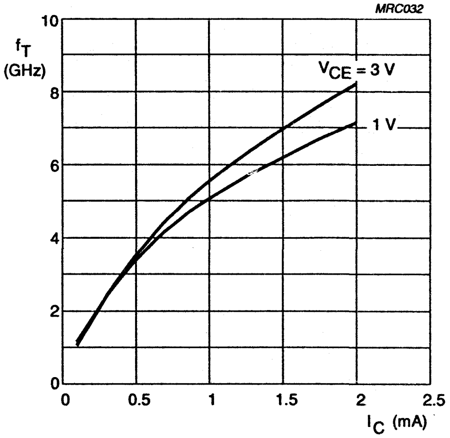
$V_{CE} = 1$ V; $T_j = 25$ °C.

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



$I_C = 0$; f = 1 MHz.

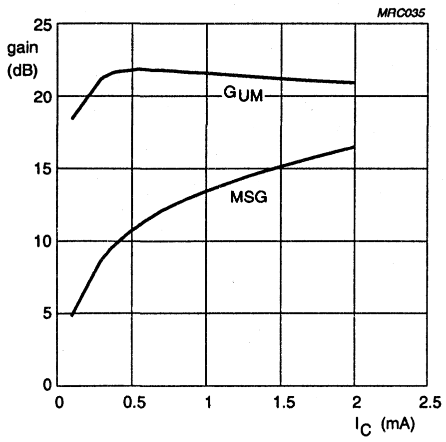
Fig.4 Feedback capacitance as a function of collector-base voltage.



f = 1 GHz; $T_{amb} = 25$ °C.

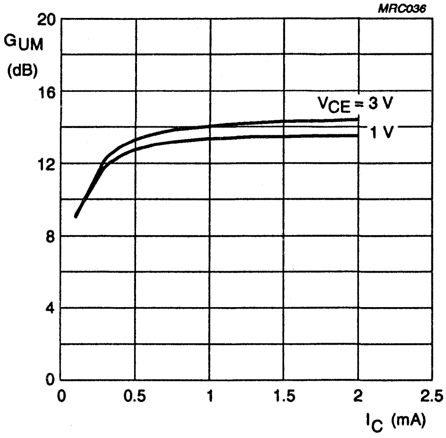
Fig.5 Transition frequency as a function of collector current.

In Figs 6 to 9, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



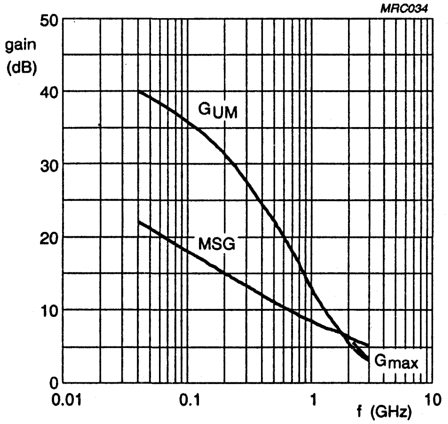
V_{CE} = 1 V; f = 500 MHz; T_{amb} = 25 °C.

Fig.6 Gain as a function of collector current.



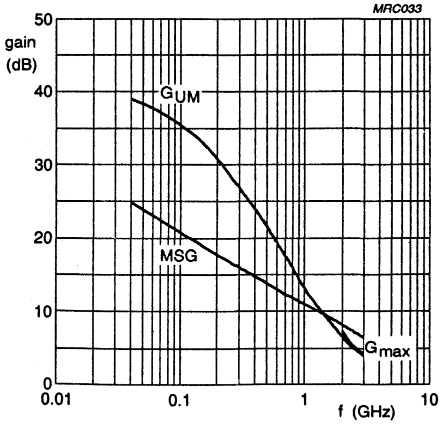
f = 1 GHz; T_{amb} = 25 °C.

Fig.7 Maximum unilateral power gain as a function of collector current.



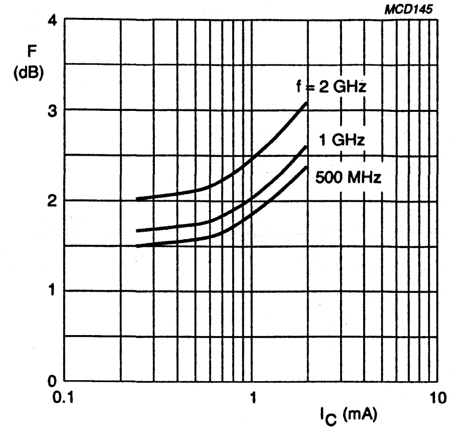
I_C = 0.5 mA; V_{CE} = 1 V; T_{amb} = 25 °C.

Fig.8 Gain as a function of frequency.



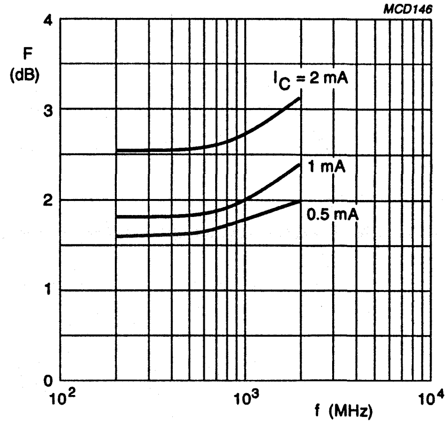
I_C = 1 mA; V_{CE} = 1 V; T_{amb} = 25 °C.

Fig.9 Gain as a function of frequency.



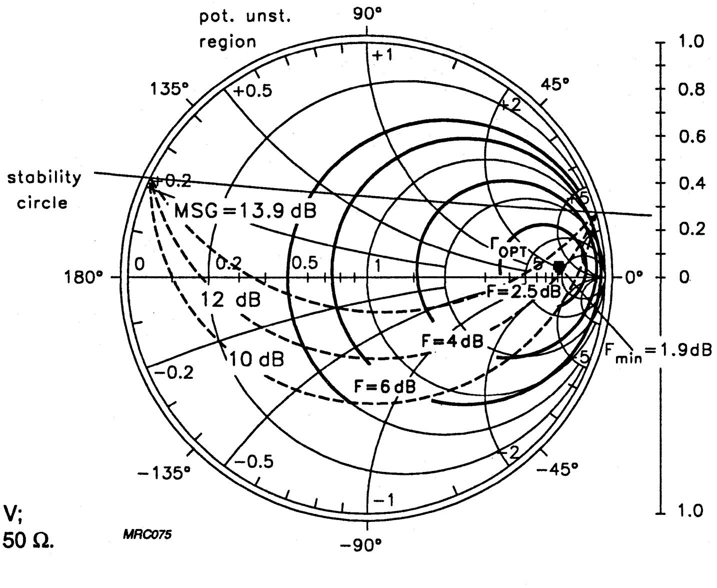
V_{CE} = 1 V; T_{amb} = 25 °C.

Fig.10 Minimum noise figure as a function of collector current.



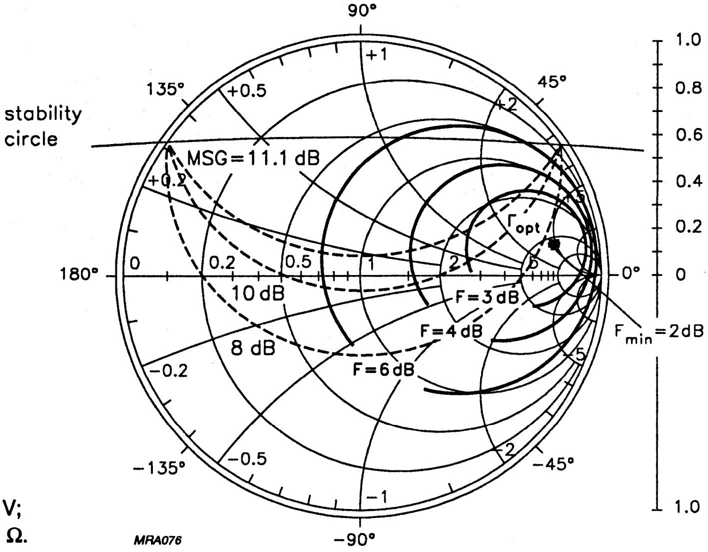
V_{CE} = 1 V; T_{amb} = 25 °C.

Fig.11 Minimum noise figure as a function of frequency.



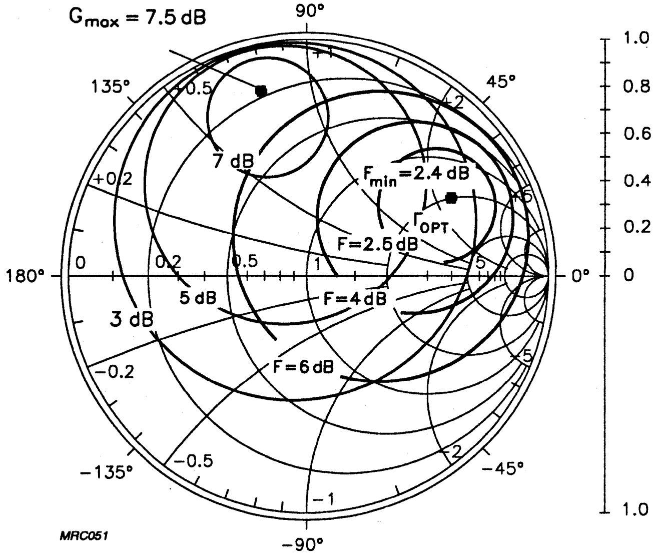
I_C = 1 mA; V_{CE} = 1 V;
f = 500 MHz; Z_O = 50 Ω.

Fig.12 Noise circle.



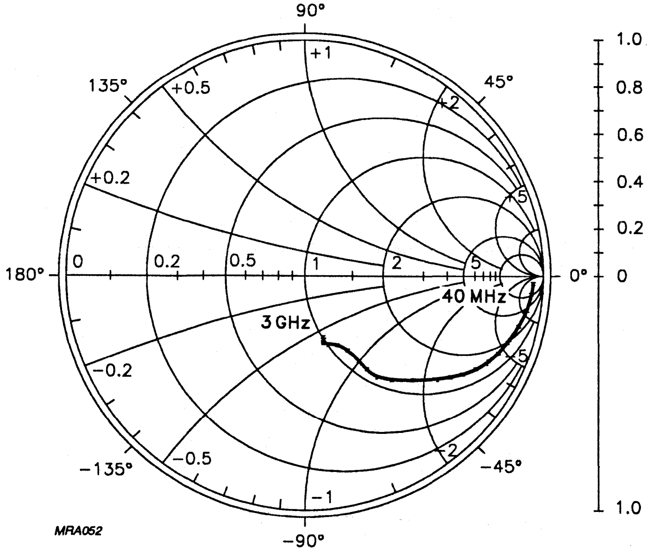
I_C = 1 mA; V_{CE} = 1 V;
f = 1 GHz; Z_O = 50 Ω.

Fig.13 Noise circle.



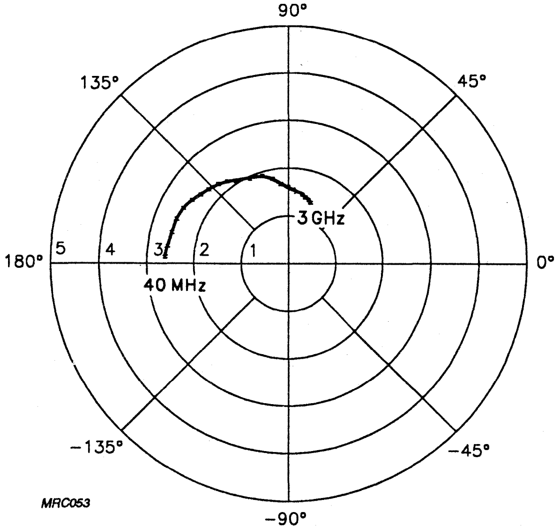
I_C = 1 mA; V_{CE} = 1 V;
f = 2 GHz; Z_O = 50 Ω.

Fig.14 Noise circle.



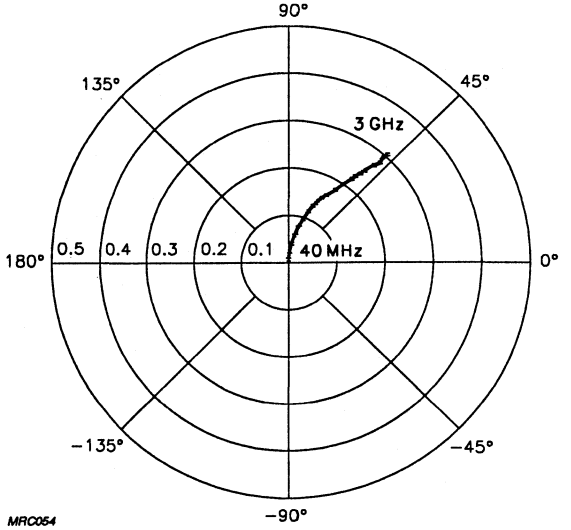
I_C = 1 mA; V_{CE} = 1 V;
Z_O = 50 Ω.

Fig.15 Common emitter input reflection coefficient (S_{11}).



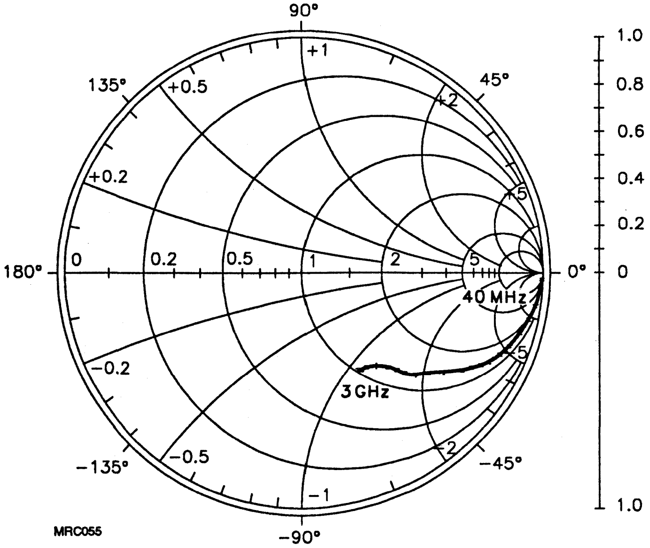
I_C = 1 mA; V_{CE} = 1 V.

Fig.16 Common emitter forward transmission coefficient (S_{21}).



I_C = 1 mA; V_{CE} = 1 V.

Fig.17 Common emitter reverse transmission coefficient (S_{12}).



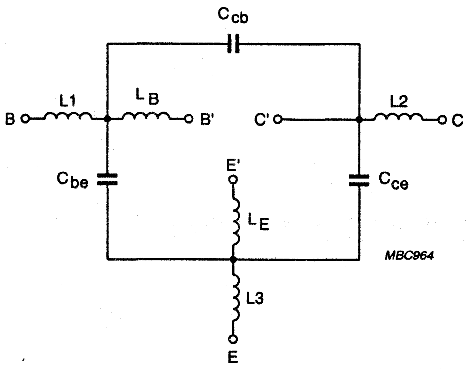
I_C = 1 mA; V_{CE} = 1 V;
Z_o = 50 Ω.

Fig.18 Common emitter output reflection coefficient (S_{22}).

NPN 5 GHz wideband transistor BFS25A

SPICE parameters for BFT25A crystal

1	IS = 13.77	aA
2	BF = 85.65	–
3	NF = 979.9	m
4	VAF = 50.80	V
5	IKF = 10.00	A
6	ISE = 2.199	fA
7	NE = 1.857	–
8	BR = 16.97	–
9	NR = 985.5	m
10	VAR = 2.491	V
11	IKR = 188.0	mA
12	ISC = 205.1	aA
13	NC = 1.107	–
14	RB = 80.00	Ω
15	IRB = 1.000	µA
16	RBM = 80.00	Ω
17	RE = 7.911	Ω
18	RC = 5.300	Ω
19 (note 1)	XTB = 0.000	–
20 (note 1)	EG = 1.110	EV
21 (note 1)	XTI = 3.000	–
22	CJE = 223.0	fF
23	VJE = 669.7	mV
24	MJE = 59.66	m
25	TF = 5.112	ps
26	XTF = 7.909	–
27	VTF = 1.338	V
28	ITF = 5.662	mA
29	PTF = 15.37	deg
30	CJC = 229.0	fF
31	VJC = 394.7	mV
32	MJC = 43.32	m
33	XCJC = 50.00	m
34	TR = 13.26	ns
35 (note 1)	CJS = 0.000	F
36 (note 1)	VJS = 750.0	mV
37 (note 1)	MJS = 0.000	–
38	FC = 987.8	m



$QL_B = 50$; $QL_E = 50$.

$QL_{B,E}(f) = QL_{B,E} \sqrt{(f/Fc)}$.

Fc = scaling frequency = 100 MHz.

Fig.19 Package equivalent circuit, SOT323.

List of components (see Fig.19)

DESIGNATION	VALUE
C_{be}	2 fF
C_{cb}	100 fF
C_{ce}	100 fF
L1	0.34 nH
L2	0.10 nH
L3	0.34 nH
L_B	0.60 nH
L_E	0.60 nH

Note

1. These parameters have not been extracted, the default values are shown.

Table 1 Common emitter scattering parameters, $I_C = 0.1$ mA; $V_{CE} = 1$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.994	−0.8	0.295	176.8	0.008	87.3	0.999	−0.9	37.5
100	0.994	−2.0	0.299	172.6	0.021	86.4	0.998	−2.3	32.7
200	0.992	−4.1	0.301	165.3	0.043	84.1	0.995	−4.6	27.7
300	0.989	−6.3	0.302	158.4	0.064	81.6	0.991	−6.9	23.5
400	0.984	−8.5	0.308	151.5	0.086	79.9	0.986	−9.3	20.3
500	0.980	−10.7	0.320	145.6	0.106	78.0	0.981	−11.7	18.3
600	0.975	−12.8	0.329	139.7	0.127	76.2	0.977	−13.9	16.8
700	0.968	−14.8	0.337	133.6	0.146	74.4	0.970	−16.1	14.9
800	0.957	−16.7	0.344	128.1	0.163	72.4	0.962	−18.1	12.7
900	0.945	−18.6	0.359	123.0	0.180	70.1	0.950	−20.0	10.9
1000	0.930	−20.6	0.369	117.9	0.196	67.8	0.936	−22.0	9.1
1200	0.901	−24.9	0.396	108.9	0.228	63.1	0.907	−26.2	6.7
1400	0.879	−29.3	0.428	100.9	0.263	59.2	0.879	−30.4	5.5
1600	0.857	−32.9	0.448	94.6	0.292	55.5	0.859	−34.1	4.6
1800	0.829	−35.7	0.465	89.7	0.311	53.2	0.834	−37.5	3.6
2000	0.792	−38.7	0.478	82.9	0.331	49.7	0.799	−40.5	2.3
2200	0.751	−42.1	0.502	77.4	0.349	46.5	0.763	−43.9	1.4
2400	0.721	−46.3	0.532	71.1	0.378	42.7	0.733	−48.1	1.0
2600	0.705	−51.1	0.554	68.4	0.394	39.8	0.714	−52.2	0.9
2800	0.686	−54.3	0.583	65.7	0.408	38.9	0.705	−55.3	1.1
3000	0.664	−56.0	0.582	62.3	0.419	36.8	0.688	−57.2	0.6

Table 2 Common emitter scattering parameters, $I_C = 0.25$ mA; $V_{CE} = 1$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.989	−1.0	0.699	177.5	0.008	89.3	0.998	−1.1	37.5
100	0.988	−2.5	0.696	174.1	0.021	86.6	0.997	−2.6	35.3
200	0.985	−5.0	0.693	168.4	0.042	83.5	0.993	−5.2	30.6
300	0.979	−7.7	0.709	163.0	0.064	80.8	0.987	−7.9	26.7
400	0.971	−10.3	0.717	157.6	0.085	78.7	0.980	−10.6	23.6
500	0.965	−12.9	0.717	152.9	0.105	76.6	0.972	−13.3	21.3
600	0.956	−15.4	0.714	147.8	0.125	74.6	0.965	−15.9	19.4
700	0.945	−17.7	0.713	142.9	0.143	72.6	0.955	−18.2	17.3
800	0.930	−20.0	0.713	138.2	0.160	70.5	0.944	−20.3	15.4
900	0.913	−22.2	0.714	133.3	0.175	68.1	0.928	−22.4	13.4
1000	0.893	−24.4	0.711	128.6	0.189	65.7	0.911	−24.5	11.7
1200	0.855	−29.3	0.716	120.1	0.219	60.9	0.874	−28.9	9.1
1400	0.823	−34.2	0.736	112.5	0.250	57.2	0.840	−33.1	7.6
1600	0.791	−38.4	0.749	106.1	0.275	53.6	0.813	−37.1	6.5
1800	0.757	−41.3	0.742	100.8	0.290	51.4	0.785	−40.5	5.3
2000	0.710	−44.5	0.743	94.2	0.306	48.3	0.746	−43.3	4.0
2200	0.660	−48.1	0.757	88.4	0.321	45.6	0.708	−46.5	3.1
2400	0.618	−52.9	0.780	81.9	0.343	42.3	0.673	−50.7	2.6
2600	0.596	−58.4	0.791	78.5	0.356	39.7	0.652	−54.9	2.3
2800	0.577	−61.7	0.811	75.2	0.368	39.2	0.645	−57.8	2.3
3000	0.551	−63.1	0.798	71.4	0.377	37.5	0.628	−59.7	1.8

Table 3 Noise data, $I_C = 0.25$ mA; $V_{CE} = 1$ V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.60	0.935	2.00	3.00
1000	1.80	0.920	9.00	3.00
2000	2.10	0.796	28.00	1.60

Table 4 Common emitter scattering parameters, $I_C = 0.5$ mA; $V_{CE} = 1$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.979	−1.3	1.367	177.4	0.008	89.5	0.998	−1.3	40.5
100	0.977	−3.2	1.376	173.8	0.021	86.2	0.995	−3.1	36.2
200	0.971	−6.4	1.362	167.8	0.042	82.6	0.989	−6.3	31.7
300	0.961	−9.7	1.356	162.3	0.063	79.6	0.978	−9.5	27.4
400	0.948	−13.1	1.355	156.9	0.083	77.1	0.967	−12.6	24.5
500	0.936	−16.1	1.336	152.2	0.103	74.6	0.955	−15.8	22.1
600	0.921	−19.1	1.320	147.3	0.121	72.4	0.942	−18.6	20.1
700	0.903	−22.0	1.303	142.6	0.138	70.2	0.927	−21.2	18.2
800	0.882	−24.6	1.282	138.0	0.153	68.0	0.909	−23.5	16.3
900	0.855	−27.3	1.281	133.1	0.167	65.8	0.888	−25.6	14.6
1000	0.828	−29.8	1.254	128.7	0.179	63.4	0.866	−27.7	13.0
1200	0.774	−35.5	1.236	120.6	0.204	58.8	0.817	−32.2	10.6
1400	0.728	−41.1	1.235	113.2	0.229	55.5	0.772	−36.4	9.0
1600	0.684	−45.5	1.215	106.8	0.250	52.3	0.742	−40.2	7.9
1800	0.644	−48.5	1.166	101.7	0.262	50.7	0.711	−43.3	6.7
2000	0.590	−51.2	1.128	95.2	0.275	48.3	0.670	−45.6	5.5
2200	0.532	−54.8	1.117	89.8	0.287	46.5	0.630	−48.4	4.6
2400	0.485	−59.7	1.117	83.3	0.305	44.1	0.592	−52.5	4.0
2600	0.461	−65.6	1.103	79.8	0.314	42.2	0.571	−56.7	3.6
2800	0.439	−68.9	1.111	76.5	0.325	42.2	0.564	−59.5	3.5
3000	0.414	−69.4	1.077	72.7	0.334	41.4	0.549	−61.1	3.0

Table 5 Noise data, $I_C = 0.5$ mA; $V_{CE} = 1$ V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.60	0.902	3.00	2.40
1000	1.80	0.800	10.00	2.40
2000	2.00	0.846	26.00	1.40

Table 6 Common emitter scattering parameters, $I_C = 1$ mA; $V_{CE} = 1$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	
40	0.958	−1.8	2.617	176.6	0.008	89.4	0.995	−1.7	39.2
100	0.954	−4.4	2.587	172.3	0.021	84.6	0.992	−4.1	36.7
200	0.942	−8.9	2.545	165.1	0.041	80.9	0.978	−8.1	31.2
300	0.922	−13.4	2.535	158.7	0.061	77.5	0.959	−12.1	27.3
400	0.899	−17.8	2.497	152.5	0.081	74.6	0.937	−15.9	24.3
500	0.875	−21.8	2.425	147.0	0.098	71.8	0.915	−19.6	21.9
600	0.849	−25.5	2.344	141.9	0.114	69.2	0.890	−22.8	19.8
700	0.818	−29.0	2.288	136.9	0.128	67.2	0.865	−25.6	18.0
800	0.783	−32.2	2.223	131.9	0.141	65.3	0.839	−27.8	16.3
900	0.747	−35.0	2.148	127.0	0.152	63.2	0.811	−29.8	14.8
1000	0.708	−37.9	2.073	122.5	0.162	61.3	0.783	−31.7	13.5
1200	0.635	−43.9	1.972	114.3	0.181	57.7	0.723	−35.4	11.4
1400	0.572	−49.8	1.905	106.8	0.201	55.5	0.674	−38.9	9.9
1600	0.523	−54.0	1.802	100.6	0.218	53.3	0.640	−42.3	8.8
1800	0.479	−56.1	1.690	95.7	0.228	52.7	0.609	−44.7	7.7
2000	0.423	−57.6	1.594	89.9	0.241	51.5	0.573	−46.1	6.6
2200	0.366	−60.3	1.534	85.1	0.253	50.6	0.536	−48.2	5.8
2400	0.323	−65.1	1.491	79.3	0.271	49.1	0.503	−51.9	5.2
2600	0.303	−71.5	1.434	76.1	0.281	47.9	0.483	−56.2	4.7
2800	0.290	−74.4	1.412	73.2	0.293	48.4	0.480	−58.9	4.5
3000	0.273	−73.2	1.349	69.8	0.306	47.9	0.472	−60.1	4.0

Table 7 Noise data, $I_C = 1$ mA; $V_{CE} = 1$ V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	**(DEG)**	
500	1.90	0.807	3.00	2.10
1000	2.00	0.814	10.00	2.00
2000	2.40	0.681	29.00	1.50

Table 8 Common emitter scattering parameters, $I_C = 2$ mA; $V_{CE} = 1$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.917	−2.8	4.710	175.4	0.008	87.9	0.990	−2.2	38.6
100	0.908	−6.7	4.641	169.5	0.020	83.8	0.983	−5.6	35.5
200	0.882	−13.3	4.493	160.3	0.040	78.7	0.955	−10.9	30.2
300	0.843	−19.6	4.361	152.1	0.058	74.6	0.918	−15.8	26.2
400	0.799	−25.5	4.185	144.5	0.075	71.5	0.878	−20.2	23.3
500	0.757	−30.5	3.967	138.1	0.089	68.7	0.838	−24.2	20.9
600	0.713	−35.0	3.753	132.1	0.102	66.7	0.801	−27.2	19.0
700	0.664	−39.0	3.567	126.4	0.113	65.1	0.767	−29.5	17.4
800	0.616	−42.0	3.364	121.1	0.123	63.9	0.735	−31.2	16.0
900	0.570	−44.6	3.167	116.1	0.133	62.6	0.705	−32.4	14.7
1000	0.525	−46.9	2.981	111.6	0.141	61.6	0.675	−33.6	13.5
1200	0.445	−52.1	2.697	103.8	0.158	59.6	0.617	−35.9	11.7
1400	0.388	−56.9	2.485	97.3	0.176	58.8	0.574	−38.4	10.3
1600	0.349	−59.6	2.267	91.9	0.193	57.6	0.546	−41.0	9.2
1800	0.315	−59.9	2.074	87.7	0.204	57.5	0.523	−42.7	8.2
2000	0.273	−58.9	1.914	82.9	0.219	56.9	0.497	−43.5	7.2
2200	0.227	−60.1	1.811	79.1	0.233	56.4	0.468	−45.1	6.5
2400	0.191	−65.5	1.733	74.2	0.252	55.3	0.438	−48.7	5.9
2600	0.179	−73.6	1.640	71.6	0.265	54.2	0.422	−53.1	5.3
2800	0.175	−76.5	1.598	69.2	0.278	54.7	0.423	−56.1	5.1
3000	0.165	−72.6	1.516	66.1	0.293	54.1	0.419	−57.4	4.6

Table 9 Noise data, $I_C = 2$ mA; $V_{CE} = 1$ V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	2.50	0.746	4.00	1.90
1000	2.60	0.716	10.00	1.90
2000	3.10	0.647	27.00	1.30

Table 10 Common emitter scattering parameters, $I_C = 0.1$ mA; $V_{CE} = 3$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.995	−0.8	0.239	176.6	0.008	89.0	0.999	−0.9	34.1
100	0.994	−1.8	0.243	172.2	0.020	86.6	0.999	−2.1	32.9
200	0.994	−3.9	0.245	164.4	0.040	84.5	0.995	−4.3	27.5
300	0.991	−5.9	0.250	157.1	0.061	82.0	0.992	−6.5	23.3
400	0.986	−7.9	0.256	150.0	0.081	80.3	0.988	−8.8	20.1
500	0.984	−9.9	0.268	143.9	0.101	78.6	0.984	−11.1	18.4
600	0.979	−11.9	0.280	138.2	0.120	76.9	0.979	−13.2	16.6
700	0.973	−13.8	0.289	132.0	0.138	75.3	0.974	−15.3	14.8
800	0.964	−15.6	0.296	126.2	0.156	73.3	0.966	−17.1	12.6
900	0.952	−17.3	0.310	121.1	0.172	71.1	0.955	−19.1	10.7
1000	0.939	−19.3	0.321	116.1	0.187	68.9	0.943	−20.9	9.0
1200	0.913	−23.3	0.347	107.2	0.218	64.3	0.915	−25.0	6.5
1400	0.893	−27.4	0.380	99.2	0.253	60.6	0.890	−29.2	5.4
1600	0.874	−30.7	0.399	93.0	0.282	57.0	0.872	−32.8	4.5
1800	0.848	−33.5	0.419	88.5	0.301	54.8	0.848	−36.1	3.5
2000	0.813	−36.3	0.435	82.0	0.321	51.2	0.815	−39.1	2.2
2200	0.775	−39.7	0.461	76.7	0.340	48.0	0.780	−42.5	1.3
2400	0.748	−43.5	0.491	70.6	0.368	44.3	0.751	−46.6	1.0
2600	0.733	−48.1	0.514	68.1	0.385	41.4	0.733	−50.7	0.9
2800	0.715	−51.2	0.543	65.6	0.400	40.5	0.725	−53.6	1.0
3000	0.694	−52.8	0.545	62.3	0.412	38.3	0.708	−55.7	0.6

Table 11 Common emitter scattering parameters, $I_C = 0.25$ mA; $V_{CE} = 3$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.990	−1.0	0.661	177.6	0.008	88.3	0.999	−1.0	39.5
100	0.989	−2.3	0.655	174.3	0.020	85.9	0.998	−2.5	36.1
200	0.987	−4.7	0.653	168.8	0.040	83.7	0.993	−4.9	30.9
300	0.982	−7.2	0.670	163.6	0.061	81.3	0.988	−7.5	27.1
400	0.975	−9.7	0.676	158.5	0.081	79.2	0.982	−10.1	24.1
500	0.969	−12.0	0.679	153.9	0.100	77.3	0.976	−12.6	22.1
600	0.961	−14.3	0.676	149.0	0.119	75.4	0.969	−15.1	19.9
700	0.952	−16.6	0.676	144.3	0.136	73.5	0.960	−17.4	17.9
800	0.938	−18.7	0.677	139.6	0.152	71.5	0.949	−19.4	15.9
900	0.922	−20.8	0.677	134.7	0.167	69.2	0.934	−21.5	13.8
1000	0.904	−22.9	0.677	130.3	0.181	66.9	0.919	−23.5	12.1
1200	0.870	−27.5	0.680	121.9	0.210	62.2	0.884	−27.9	9.4
1400	0.841	−32.1	0.700	114.2	0.240	58.5	0.851	−32.0	7.8
1600	0.812	−36.1	0.715	108.2	0.265	55.0	0.827	−35.8	6.7
1800	0.779	−39.0	0.710	102.9	0.281	52.9	0.800	−39.2	5.5
2000	0.734	−42.0	0.712	96.4	0.297	49.7	0.762	−42.0	4.2
2200	0.686	−45.5	0.728	90.6	0.313	47.0	0.724	−45.2	3.2
2400	0.649	−50.0	0.754	84.0	0.336	43.7	0.690	−49.4	2.7
2600	0.627	−55.0	0.767	80.8	0.348	41.1	0.670	−53.6	2.5
2800	0.607	−58.3	0.788	77.7	0.361	40.5	0.663	−56.5	2.4
3000	0.582	−59.7	0.775	73.8	0.370	38.9	0.646	−58.3	1.9

Table 12 Noise data, $I_C = 0.25$ mA; $V_{CE} = 3$ V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.60	0.927	2.00	3.70
1000	1.80	0.903	7.00	3.40
2000	2.00	0.694	29.00	2.00

Table 13 Common emitter scattering parameters, $I_C = 0.5$ mA; $V_{CE} = 3$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.980	−1.2	1.356	177.4	0.008	88.4	0.997	−1.2	39.1
100	0.979	−2.9	1.346	174.1	0.020	86.0	0.996	−3.0	37.2
200	0.974	−6.0	1.335	168.5	0.040	82.9	0.989	−6.0	32.1
300	0.965	−9.1	1.345	163.2	0.060	80.2	0.980	−9.0	28.2
400	0.953	−12.2	1.345	158.1	0.079	77.6	0.970	−12.1	25.2
500	0.943	−15.0	1.329	153.5	0.098	75.4	0.960	−15.1	23.0
600	0.930	−17.8	1.288	148.9	0.115	73.2	0.948	−17.8	20.8
700	0.914	−20.4	1.275	144.4	0.132	71.2	0.933	−20.4	18.9
800	0.894	−22.9	1.266	139.9	0.146	69.2	0.916	−22.6	16.9
900	0.871	−25.4	1.247	135.2	0.160	66.9	0.897	−24.7	15.2
1000	0.846	−27.8	1.225	130.9	0.172	64.6	0.877	−26.8	13.6
1200	0.795	−33.1	1.213	123.0	0.196	60.2	0.831	−31.1	11.1
1400	0.752	−38.4	1.219	115.8	0.222	56.8	0.787	−35.3	9.5
1600	0.710	−42.8	1.209	109.5	0.242	53.7	0.756	−39.2	8.4
1800	0.671	−45.7	1.165	104.5	0.254	52.0	0.725	−42.3	7.2
2000	0.615	−48.4	1.135	98.0	0.268	49.7	0.685	−44.6	5.9
2200	0.561	−51.7	1.123	92.6	0.281	47.7	0.646	−47.4	5.0
2400	0.515	−56.4	1.124	86.2	0.300	45.2	0.609	−51.4	4.4
2600	0.493	−61.8	1.109	82.8	0.310	43.2	0.588	−55.7	3.9
2800	0.474	−65.0	1.114	79.5	0.321	43.2	0.581	−58.5	3.8
3000	0.449	−65.6	1.079	75.7	0.330	42.3	0.565	−60.0	3.3

Table 14 Noise data, $I_C = 0.5$ mA; $V_{CE} = 3$ V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.60	0.886	2.00	2.60
1000	1.80	0.839	9.00	2.60
2000	2.00	0.718	29.00	1.80

Table 15 Common emitter scattering parameters, I_C = 1 mA; V_{CE} = 3 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.961	−1.7	2.608	176.7	0.008	89.6	0.996	−1.6	40.3
100	0.958	−4.1	2.582	172.7	0.020	85.5	0.993	−3.9	37.5
200	0.948	−8.2	2.544	166.0	0.039	81.5	0.980	−7.7	32.1
300	0.930	−12.4	2.541	159.9	0.058	78.3	0.963	−11.5	28.1
400	0.909	−16.5	2.509	154.0	0.076	75.5	0.944	−15.2	25.2
500	0.888	−20.2	2.441	148.9	0.093	72.8	0.923	−18.8	22.8
600	0.864	−23.6	2.369	143.8	0.109	70.5	0.900	−22.0	20.7
700	0.837	−26.9	2.314	139.0	0.123	68.5	0.876	−24.7	18.9
800	0.804	−29.8	2.255	134.2	0.136	66.6	0.851	−26.9	17.2
900	0.770	−32.6	2.183	129.4	0.147	64.5	0.824	−28.9	15.6
1000	0.734	−35.3	2.111	125.1	0.156	62.6	0.797	−30.8	14.2
1200	0.665	−41.0	2.013	117.1	0.176	59.0	0.738	−34.6	12.0
1400	0.604	−46.6	1.952	109.8	0.196	56.6	0.689	−38.2	10.6
1600	0.556	−50.7	1.853	103.6	0.213	54.5	0.655	−41.6	9.4
1800	0.513	−52.7	1.740	98.8	0.224	53.7	0.623	−44.1	8.3
2000	0.457	−54.1	1.644	92.9	0.236	52.4	0.586	−45.6	7.2
2200	0.401	−56.6	1.587	88.0	0.249	51.5	0.548	−47.6	6.3
2400	0.356	−60.9	1.546	82.3	0.266	49.9	0.513	−51.4	5.7
2600	0.334	−67.0	1.489	79.2	0.277	48.6	0.493	−55.6	5.2
2800	0.322	−69.6	1.465	76.3	0.289	49.1	0.489	−58.3	5.0
3000	0.305	−68.5	1.399	72.9	0.301	48.6	0.481	−59.4	4.5

Table 16 Noise data, I_C = 1 mA; V_{CE} = 3 V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.90	0.839	3.00	2.40
1000	2.00	0.775	9.00	2.40
2000	2.30	0.804	26.00	1.60

Table 17 Common emitter scattering parameters, I_C = 2 mA; V_{CE} = 3 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.926	−2.5	4.735	175.5	0.008	88.2	0.992	−2.1	40.0
100	0.919	−5.9	4.667	170.3	0.020	83.9	0.985	−5.2	36.8
200	0.897	−11.9	4.541	161.8	0.038	79.7	0.961	−10.3	31.4
300	0.863	−17.6	4.434	154.1	0.055	75.8	0.927	−15.1	27.4
400	0.824	−23.1	4.274	147.0	0.072	72.8	0.892	−19.4	24.5
500	0.786	−27.8	4.077	140.9	0.086	70.1	0.856	−23.4	22.1
600	0.745	−31.9	3.881	135.1	0.099	67.9	0.819	−26.5	20.1
700	0.702	−35.6	3.708	129.6	0.110	66.5	0.785	−29.0	18.5
800	0.655	−38.6	3.514	124.3	0.121	65.3	0.754	−30.7	17.0
900	0.611	−41.1	3.322	119.5	0.130	63.8	0.723	−32.2	15.7
1000	0.566	−43.5	3.136	115.0	0.138	62.6	0.692	−33.4	14.4
1200	0.487	−48.4	2.861	107.2	0.154	60.6	0.631	−35.9	12.5
1400	0.429	−53.1	2.647	100.6	0.173	59.3	0.585	−38.5	11.2
1600	0.389	−55.6	2.421	95.2	0.190	58.2	0.556	−41.2	10.0
1800	0.355	−56.2	2.217	91.1	0.201	58.1	0.531	−43.0	8.9
2000	0.312	−55.2	2.047	86.3	0.215	57.4	0.502	−43.7	7.9
2200	0.264	−56.3	1.935	82.3	0.229	56.9	0.471	−45.0	7.1
2400	0.226	−60.4	1.856	77.4	0.248	55.7	0.440	−48.6	6.5
2600	0.212	−67.6	1.755	74.9	0.261	54.6	0.423	−53.0	5.9
2800	0.208	−70.3	1.708	72.5	0.274	55.1	0.423	−55.8	5.7
3000	0.199	−67.0	1.618	69.4	0.289	54.5	0.420	−57.0	5.2

Table 18 Noise data, I_C = 2 mA; V_{CE} = 3 V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	2.50	0.775	4.00	2.20
1000	2.50	0.731	10.00	2.20
2000	3.00	0.662	27.00	1.60

NPN 9 GHz wideband transistor BFS505

FEATURES

- Low current consumption
- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability
- SOT323 envelope.

DESCRIPTION

NPN transistor in a plastic SOT323 envelope.

It is intended for low power amplifiers, oscillators and mixers particularly in RF portable communication equipment (cellular phones, cordless phones, pagers) up to 2 GHz.

PINNING

PIN	DESCRIPTION
Code: N0	
1	base
2	emitter
3	collector

PIN CONFIGURATION

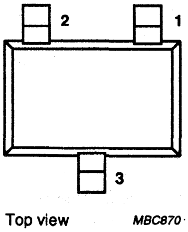


Fig.1 SOT323.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	–	15	V
I_C	DC collector current		–	–	18	mA
P_{tot}	total power dissipation	up to $T_s = 122$ °C (note 1)	–	–	150	mW
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 6$ V; $T_j = 25$ °C	60	120	250	
f_T	transition frequency	$I_C = 5$ mA; $V_{CE} = 6$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	9	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 5$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	17	–	dB
F	noise figure	$I_C = 1.25$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	1.2	1.7	dB

Note

1. T_s is the temperature at the soldering point of the collector tab.

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_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	18	mA
P_{tot}	total power dissipation	up to T_s = 122 °C (note 1)	–	150	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 122 °C (note 1)	190 K/W

Note

1. T_s is the temperature at the soldering point of the collector tab.

CHARACTERISTICS

T_j = 25 °C, unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 6$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 6$ V	60	120	250	
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	0.4	–	pF
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.4	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 0.5$ V; f = 1 MHz	–	0.3	–	pF
f_T	transition frequency	$I_C = 5$ mA; $V_{CE} = 6$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	9	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 5$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	17	–	dB
		$I_C = 5$ mA; $V_{CE} = 6$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	10	–	dB
$\lvert S_{21}\rvert^2$	insertion power gain	$I_C = 5$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	13	14	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 1.25$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	1.2	1.7	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 1.25$ mA; $V_{CE} = 6$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	1.9	–	dB
P_{L1}	output power at 1 dB gain compression	$I_C = 5$ mA; $V_{CE} = 6$ V; $R_L = 50\ \Omega$; f = 900 MHz; $T_{amb} = 25$ °C	–	4	–	dBm
ITO	third order intercept point	note 2	–	10	–	dBm

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10\log\dfrac{\lvert S_{21}\rvert^2}{(1-\lvert S_{11}\rvert^2)(1-\lvert S_{22}\rvert^2)}$ dB.
2. $I_C = 5$ mA; $V_{CE} = 6$ V; $R_L = 50\ \Omega$; f = 900 MHz; $T_{amb} = 25$ °C;
   $f_p = 900$ MHz; $f_q = 902$ MHz; measured at $f_{(2p-q)} = 898$ MHz and at $f_{(2q-p)} = 904$ MHz.

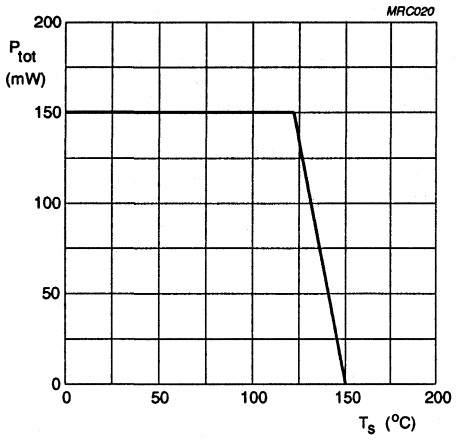
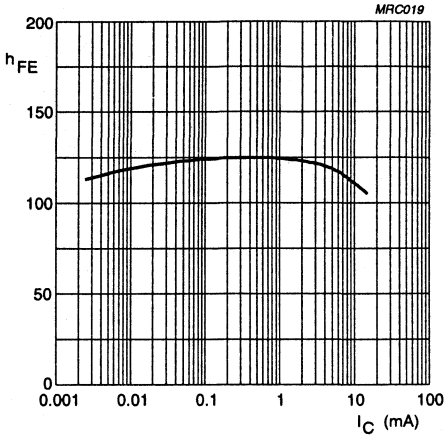
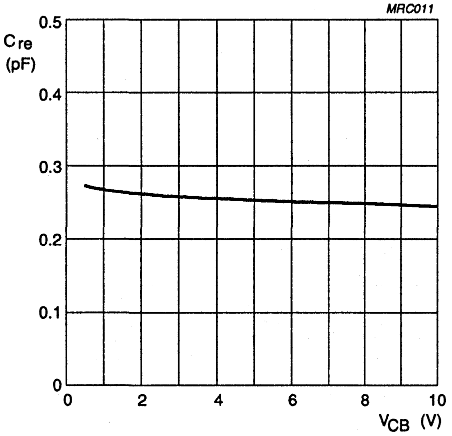


Fig.2 Power derating curve.

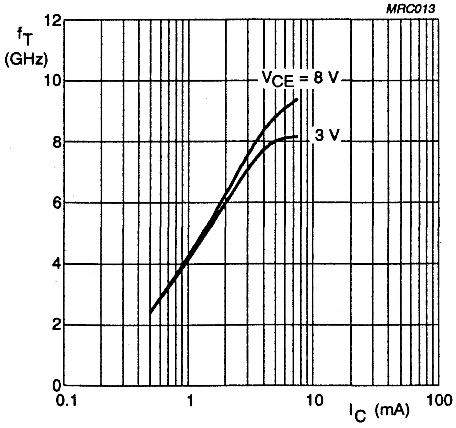


$V_{CE} = 6$ V; $T_j = 25$ °C.

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



$I_C = 0$; f = 1 MHz.

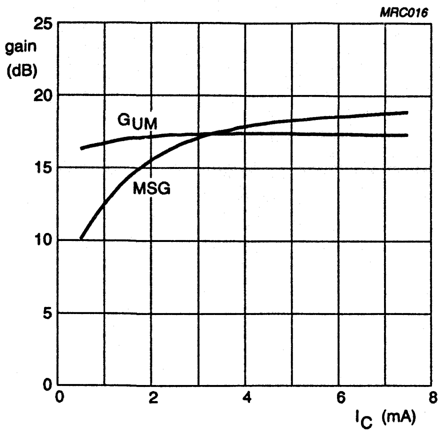


f = 1 GHz; $T_{amb} = 25$ °C.

Fig.5 Transition frequency as a function of collector current.

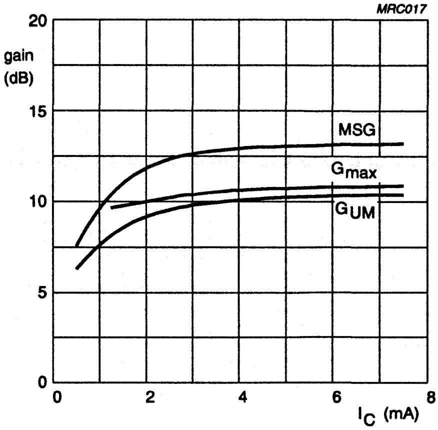
Fig.4 Feedback capacitance as a function of collector-base voltage.

In Figs 6 to 9, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



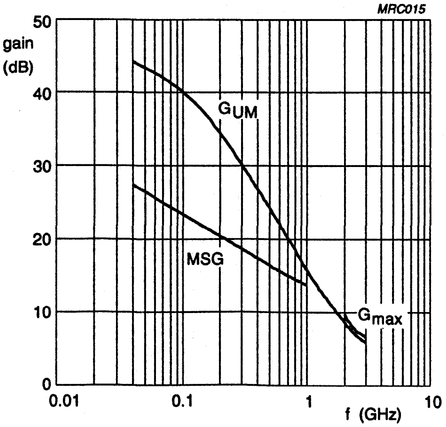
V_{CE} = 6 V; f = 900 MHz; T_{amb} = 25 °C.

Fig.6 Gain as a function of collector current.



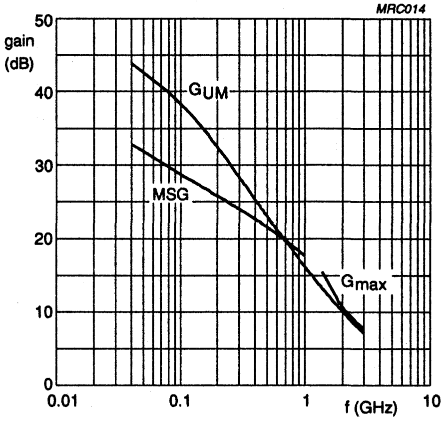
V_{CE} = 6 V; f = 2 GHz; T_{amb} = 25 °C.

Fig.7 Gain as a function of collector current.



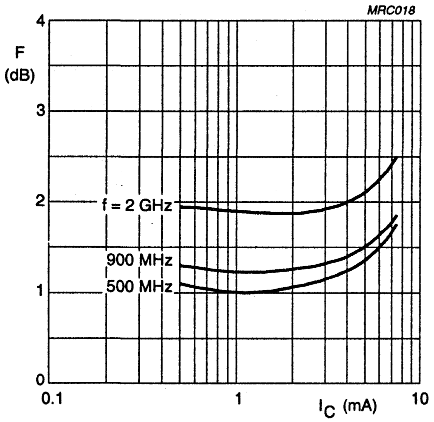
I_C = 1.25 mA; V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.8 Gain as a function of frequency.



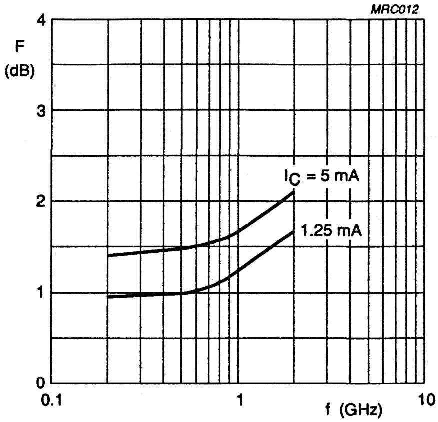
I_C = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.9 Gain as a function of frequency.



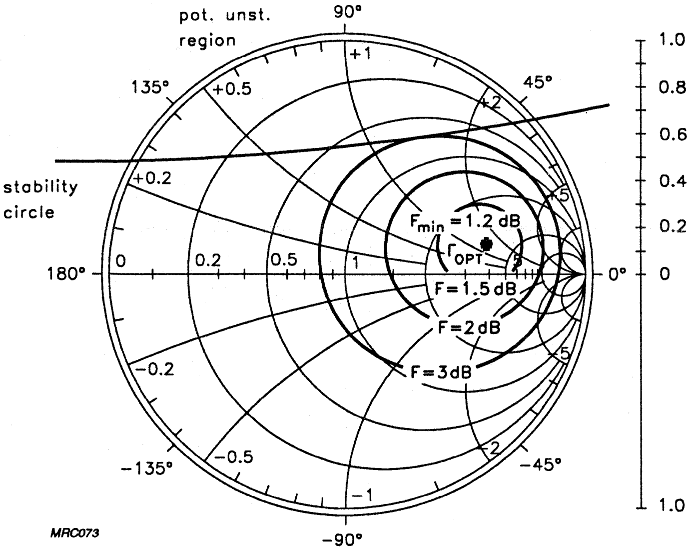
V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.10 Minimum noise figure as a function of collector current.



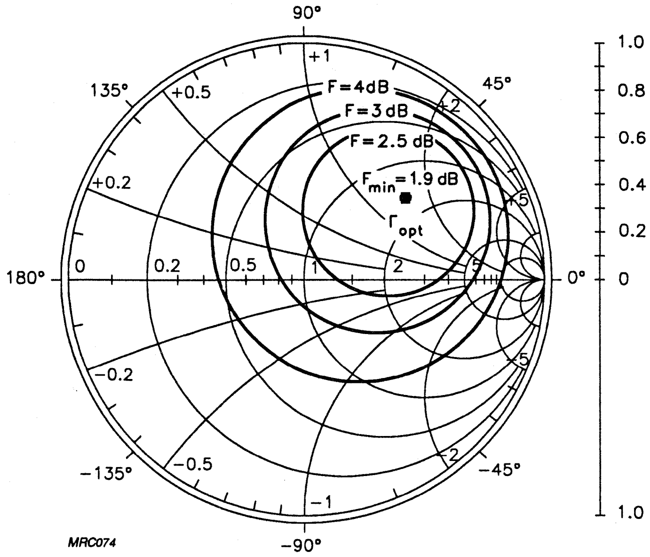
V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.11 Minimum noise figure as a function of frequency.



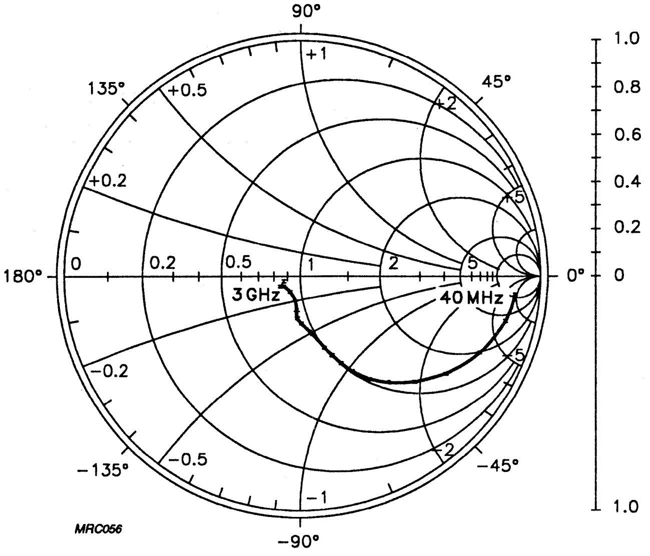
I_C = 1.25 mA; V_{CE} = 6 V;
f = 900 MHz; Z_O = 50 Ω.

Fig.12 Noise circle.



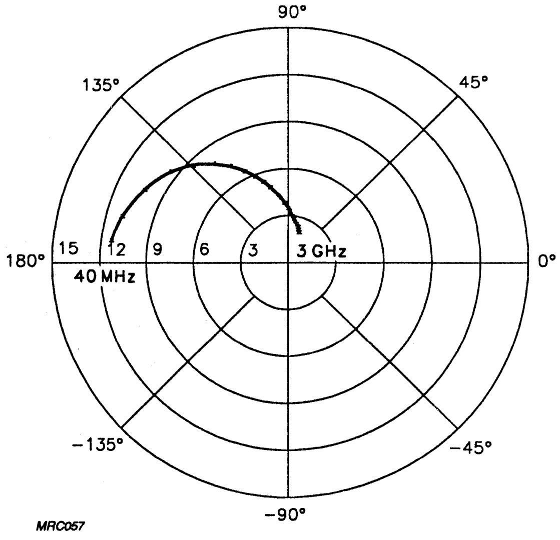
I_C = 1.25 mA; V_{CE} = 6 V;
f = 2 GHz; Z_O = 50 Ω.

Fig.13 Noise circle.



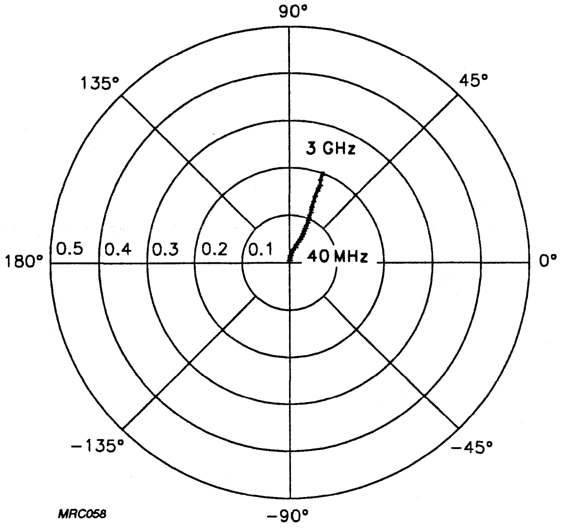
I_C = 5 mA; V_{CE} = 6 V;
Z_O = 50 Ω.

Fig.14 Common emitter input reflection coefficient (S_{11}).



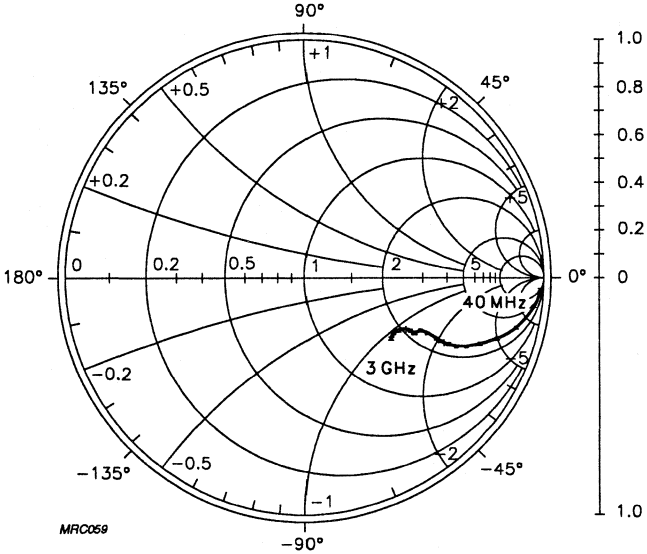
I_C = 5 mA; V_{CE} = 6 V.

Fig.15 Common emitter forward transmission coefficient (S_{21}).



$I_C = 5$ mA; $V_{CE} = 6$ V.

Fig.16 Common emitter reverse transmission coefficient (S_{12}).

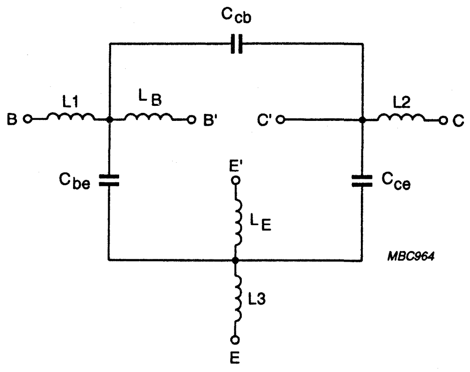


$I_C = 5$ mA; $V_{CE} = 6$ V;
$Z_O = 50\ \Omega$.

Fig.17 Common emitter output reflection coefficient (S_{22}).

SPICE parameters for BFR505 crystal

1	IS = 134.1	aA
2	BF = 180.0	–
3	NF = 988.2	m
4	VAF = 38.34	V
5	IKF = 150.0	A
6	ISE = 27.81	fA
7	NE = 2.051	–
8	BR = 55.19	–
9	NR = 982.2	m
10	VAR = 2.459	V
11	IKR = 2.920	mA
12	ISC = 17.45	aA
13	NC = 1.062	–
14	RB = 20.00	Ω
15	IRB = 1.000	µA
16	RBM = 20.00	Ω
17	RE = 1.171	Ω
18	RC = 4.350	Ω
19 (note 1)	XTB = 0.000	–
20 (note 1)	EG = 1.110	EV
21 (note 1)	XTI = 3.000	–
22	CJE = 284.7	fF
23	VJE = 600.0	mV
24	MJE = 303.6	m
25	TF = 7.037	ps
26	XTF = 12.34	–
27	VTF = 1.701	V
28	ITF = 30.64	mA
29	PTF = 0.000	deg
30	CJC = 242.4	fF
31	VJC = 188.6	mV
32	MJC = 41.49	m
33	XCJC = 130.0	m
34	TR = 1.332	ns
35 (note 1)	CJS = 0.000	F
36 (note 1)	VJS = 750.0	mV
37 (note 1)	MJS = 0.000	–
38	FC = 897.4	m



$QL_B = 50$; $QL_E = 50$.

$QL_{B,E}$ (f) = $QL_{B,E}$ $\sqrt{}$ (f/Fc).

Fc = scaling frequency = 100 MHz.

Fig.18 Package equivalent circuit, SOT323.

List of components (see Fig.18)

DESIGNATION	VALUE
C_{be}	2 fF
C_{cb}	100 fF
C_{ce}	100 fF
L1	0.34 nH
L2	0.10 nH
L3	0.34 nH
L_B	0.60 nH
L_E	0.60 nH

Note

1. These parameters have not been extracted, the default values are shown.

Table 1 Common emitter scattering parameters, $I_C = 0.5$ mA; $V_{CE} = 3$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.987	−1.7	1.389	177.6	0.006	88.4	0.999	−0.9	44.2
100	0.985	−4.0	1.385	174.3	0.016	85.8	0.998	−2.3	41.3
200	0.979	−8.2	1.371	168.8	0.031	82.1	0.992	−4.6	34.5
300	0.969	−12.2	1.372	163.8	0.046	79.0	0.983	−7.0	29.6
400	0.956	−16.5	1.368	158.8	0.061	76.5	0.975	−9.3	26.4
500	0.944	−20.3	1.349	154.5	0.076	73.0	0.966	−11.7	24.0
600	0.929	−24.0	1.307	150.1	0.089	71.4	0.957	−13.7	21.7
700	0.912	−27.6	1.290	146.0	0.101	69.1	0.944	−15.7	19.6
800	0.891	−31.1	1.279	141.8	0.112	66.8	0.931	−17.5	17.8
900	0.867	−34.6	1.267	137.2	0.122	64.2	0.917	−19.0	16.1
1000	0.839	−38.2	1.239	133.1	0.131	61.6	0.900	−20.6	14.3
1200	0.782	−45.8	1.218	125.4	0.147	56.4	0.859	−23.8	11.6
1400	0.732	−53.4	1.220	118.9	0.161	52.9	0.822	−26.7	10.0
1600	0.694	−60.4	1.212	113.0	0.175	49.7	0.798	−29.6	8.9
1800	0.654	−65.9	1.158	108.0	0.180	47.3	0.772	−31.9	7.6
2000	0.592	−71.9	1.123	101.9	0.185	45.0	0.742	−33.4	6.4
2200	0.533	−79.9	1.106	96.7	0.189	43.0	0.708	−35.4	5.3
2400	0.491	−89.3	1.104	90.2	0.195	41.0	0.679	−38.1	4.7
2600	0.480	−97.2	1.073	86.8	0.196	39.7	0.662	−41.2	4.3
2800	0.459	−102.6	1.080	84.0	0.196	40.6	0.656	−43.2	4.1
3000	0.421	−107.2	1.048	80.2	0.196	41.2	0.644	−44.3	3.6

Table 2 Common emitter scattering parameters, $I_C = 1.25$ mA; $V_{CE} = 3$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.968	−2.4	3.435	176.5	0.006	89.0	0.997	−1.4	44.4
100	0.963	−6.0	3.400	171.9	0.015	84.7	0.993	−3.4	40.3
200	0.947	−11.9	3.325	164.8	0.030	79.5	0.980	−6.9	34.3
300	0.924	−17.8	3.288	158.3	0.044	76.0	0.959	−10.1	29.6
400	0.895	−23.6	3.226	152.3	0.058	72.6	0.937	−13.2	26.4
500	0.867	−28.9	3.115	147.1	0.070	69.3	0.915	−16.2	23.8
600	0.836	−33.7	2.986	142.3	0.081	66.7	0.892	−18.7	21.6
700	0.802	−38.6	2.911	137.7	0.090	64.6	0.868	−20.7	19.8
800	0.763	−43.0	2.827	132.9	0.098	62.6	0.843	−22.3	18.2
900	0.722	−47.3	2.725	128.2	0.105	60.5	0.819	−23.6	16.7
1000	0.679	−51.5	2.619	123.9	0.111	58.5	0.794	−24.9	15.4
1200	0.593	−60.7	2.472	116.1	0.121	55.3	0.740	−27.0	13.2
1400	0.524	−69.9	2.373	109.4	0.131	53.9	0.696	−29.0	11.8
1600	0.474	−77.1	2.237	103.6	0.140	52.8	0.668	−31.1	10.7
1800	0.425	−82.6	2.080	98.9	0.144	52.8	0.643	−32.4	9.5
2000	0.362	−88.4	1.949	93.5	0.150	52.8	0.619	−32.9	8.5
2200	0.307	−97.9	1.858	89.0	0.156	53.1	0.588	−33.9	7.7
2400	0.278	−109.5	1.788	83.6	0.164	53.1	0.561	−36.0	7.0
2600	0.273	−117.6	1.691	80.7	0.170	53.6	0.546	−38.9	6.4
2800	0.260	−122.5	1.655	78.3	0.176	55.6	0.544	−40.8	6.2
3000	0.277	−127.2	1.573	74.9	0.183	56.9	0.540	−41.5	5.7

Table 3 Noise data, $I_C = 1.25$ mA; $V_{CE} = 3$ V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.00	0.716	9.00	0.770
900	1.20	0.659	12.00	0.740
2000	1.90	0.505	37.00	0.580

Table 4 Common emitter scattering parameters, $I_C = 2.5$ mA; $V_{CE} = 3$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.938	−3.6	6.470	175.0	0.006	87.8	0.993	−2.1	43.9
100	0.927	−8.8	6.361	168.6	0.015	83.1	0.984	−5.0	39.7
200	0.893	−17.2	6.103	159.2	0.029	77.0	0.954	−9.8	33.1
300	0.848	−25.3	5.871	151.0	0.042	72.1	0.914	−13.9	28.7
400	0.796	−33.0	5.600	143.7	0.053	69.0	0.873	−17.4	25.6
500	0.747	−39.8	5.282	137.5	0.062	66.0	0.834	−20.4	23.2
600	0.696	−45.9	4.983	131.8	0.070	64.2	0.798	−22.6	21.2
700	0.641	−51.7	4.731	126.4	0.078	62.7	0.766	−24.1	19.6
800	0.586	−56.6	4.453	121.2	0.084	61.6	0.738	−24.9	18.2
900	0.533	−61.0	4.189	116.5	0.089	60.9	0.712	−25.5	17.0
1000	0.482	−65.3	3.922	112.3	0.093	60.1	0.686	−25.9	15.8
1200	0.391	−74.5	3.521	104.9	0.102	59.3	0.636	−26.6	13.9
1400	0.331	−83.8	3.217	99.2	0.112	59.9	0.600	−27.5	12.6
1600	0.292	−90.9	2.923	94.2	0.123	60.2	0.579	−29.1	11.5
1800	0.252	−95.0	2.658	90.4	0.130	61.3	0.562	−29.7	10.4
2000	0.203	−101.0	2.442	86.1	0.139	61.9	0.546	−29.7	9.5
2200	0.164	−114.3	2.287	82.6	0.148	62.7	0.521	−30.2	8.7
2400	0.154	−130.8	2.172	78.2	0.160	63.1	0.498	−32.2	8.1
2600	0.162	−138.6	2.025	75.9	0.169	63.2	0.484	−35.3	7.4
2800	0.155	−142.0	1.959	74.0	0.178	64.9	0.485	−37.3	7.1
3000	0.130	−148.7	1.852	70.9	0.190	65.5	0.485	−38.2	6.6

Table 5 Noise data, $I_C = 2.5$ mA; $V_{CE} = 3$ V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.10	0.640	9.00	0.610
900	1.25	0.581	10.00	0.650
2000	1.90	0.410	37.00	0.530

Table 6 Common emitter scattering parameters, $I_C = 3.75$ mA; $V_{CE} = 3$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.909	−4.6	9.162	173.7	0.006	86.4	0.989	−2.6	43.6
100	0.891	−11.3	8.921	165.9	0.015	82.2	0.975	−6.3	38.9
200	0.840	−21.9	8.412	154.7	0.028	74.9	0.928	−11.9	32.4
300	0.744	−31.7	7.908	145.3	0.039	70.4	0.871	−16.2	28.1
400	0.704	−40.7	7.358	137.0	0.049	67.2	0.818	−19.7	25.1
500	0.640	−48.3	6.782	130.1	0.057	64.9	0.771	−22.2	22.8
600	0.578	−54.9	6.255	124.1	0.064	63.8	0.732	−23.8	21.0
700	0.517	−60.7	5.781	118.5	0.070	63.3	0.701	−24.7	19.5
800	0.462	−65.1	5.313	113.7	0.075	63.2	0.676	−25.0	18.2
900	0.410	−69.1	4.903	109.3	0.080	62.9	0.653	−25.0	17.0
1000	0.362	−73.0	4.523	105.4	0.085	63.0	0.631	−25.0	15.9
1200	0.285	−82.2	3.953	99.0	0.095	63.2	0.589	−24.8	14.2
1400	0.238	−92.1	3.544	94.1	0.106	64.4	0.559	−25.5	12.9
1600	0.208	−98.9	3.182	89.9	0.118	64.8	0.542	−26.9	11.8
1800	0.176	−102.7	2.874	86.4	0.126	66.0	0.530	−27.5	10.7
2000	0.134	−110.3	2.624	82.6	0.137	66.5	0.518	−27.4	9.8
2200	0.108	−129.8	2.447	79.6	0.148	67.1	0.497	−27.8	9.1
2400	0.112	−150.3	2.314	75.6	0.161	67.3	0.474	−29.7	8.4
2600	0.125	−155.4	2.149	73.6	0.171	67.2	0.461	−33.0	7.7
2800	0.120	−158.1	2.071	71.9	0.182	68.4	0.463	−35.4	7.4
3000	0.100	−167.8	1.954	69.0	0.194	68.7	0.465	−36.3	6.9

Table 7 Noise data, $I_C = 3.75$ mA; $V_{CE} = 3$ V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.20	0.591	8.00	0.570
900	1.35	0.503	9.00	0.630
2000	2.00	0.352	41.00	0.490

Table 8 Common emitter scattering parameters, $I_C = 5$ mA; $V_{CE} = 3$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.881	−5.6	11.534	172.6	0.006	87.2	0.986	−3.1	43.4
100	0.856	−13.6	11.129	163.5	0.015	80.4	0.965	−7.4	38.4
200	0.788	−26.1	10.306	150.8	0.027	73.9	0.904	−13.5	31.8
300	0.707	−37.3	9.476	140.4	0.037	69.1	0.835	−17.7	27.7
400	0.624	−47.1	8.592	131.5	0.046	66.7	0.774	−20.8	24.8
500	0.552	−55.0	7.742	124.4	0.053	64.9	0.726	−22.7	22.6
600	0.487	−61.6	6.993	118.4	0.059	64.6	0.687	−23.8	20.8
700	0.429	−66.8	6.339	113.1	0.065	64.6	0.660	−24.2	19.4
800	0.379	−70.9	5.748	108.7	0.071	64.9	0.638	−24.2	18.1
900	0.332	−74.6	5.247	104.7	0.076	65.3	0.619	−24.0	17.0
1000	0.289	−78.3	4.805	101.2	0.081	65.5	0.600	−23.7	16.0
1200	0.221	−88.0	4.147	95.5	0.092	66.1	0.565	−23.2	14.2
1400	0.184	−99.0	3.685	91.1	0.103	67.4	0.539	−23.7	13.0
1600	0.162	−106.2	3.293	87.2	0.116	67.9	0.525	−25.2	11.9
1800	0.134	−109.9	2.962	84.1	0.125	68.8	0.516	−25.8	10.9
2000	0.097	−120.7	2.701	80.5	0.137	69.1	0.506	−25.8	10.0
2200	0.083	−147.1	2.513	77.8	0.148	69.6	0.486	−26.2	9.2
2400	0.099	−168.2	2.374	74.0	0.162	69.6	0.464	−28.2	8.6
2600	0.111	−169.6	2.199	72.1	0.173	69.4	0.451	−31.5	7.9
2800	0.108	−171.6	2.115	70.6	0.184	70.4	0.454	−34.0	7.6
3000	0.091	177.0	1.994	67.7	0.197	70.4	0.457	−35.1	7.0

Table 9 Noise data, $I_C = 5$ mA; $V_{CE} = 3$ V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.45	0.536	7.00	0.550
900	1.60	0.487	8.00	0.570
2000	2.10	0.297	41.00	0.470

Table 10 Common emitter scattering parameters, $I_C = 7.5$ mA; $V_{CE} = 3$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	
40	0.828	−7.5	15.309	170.7	0.006	84.7	0.979	−3.8	42.5
100	0.790	−18.2	14.502	159.5	0.014	78.8	0.946	−9.0	37.3
200	0.693	−33.9	12.929	144.4	0.025	71.9	0.861	−15.4	30.9
300	0.592	−46.9	11.369	132.7	0.034	67.8	0.778	−19.0	27.0
400	0.500	−57.3	9.871	123.5	0.042	66.5	0.715	−21.1	24.2
500	0.428	−65.2	8.598	116.7	0.048	65.9	0.669	−22.1	22.1
600	0.370	−71.3	7.566	111.2	0.054	66.5	0.637	−22.5	20.5
700	0.320	−76.1	6.726	106.7	0.060	67.4	0.616	−22.5	19.1
800	0.279	−79.9	6.020	102.8	0.066	68.2	0.601	−22.2	17.9
900	0.240	−83.7	5.446	99.4	0.071	68.5	0.587	−21.8	16.8
1000	0.205	−87.8	4.954	96.3	0.077	69.1	0.574	−21.3	15.8
1200	0.153	−100.2	4.229	91.3	0.088	69.8	0.545	−20.7	14.2
1400	0.129	−114.7	3.733	87.5	0.101	71.0	0.525	−21.3	12.9
1600	0.117	−123.3	3.318	84.0	0.114	71.3	0.514	−23.0	11.8
1800	0.095	−129.6	2.982	81.2	0.124	72.0	0.508	−23.8	10.8
2000	0.070	−150.3	2.713	77.9	0.137	72.1	0.500	−23.9	9.9
2200	0.078	179.9	2.521	75.4	0.148	72.3	0.482	−24.4	9.2
2400	0.104	167.8	2.379	71.9	0.163	72.2	0.461	−26.4	8.6
2600	0.116	170.6	2.201	70.1	0.174	71.8	0.448	−30.0	7.9
2800	0.112	169.7	2.114	68.7	0.185	72.7	0.451	−32.6	7.5
3000	0.102	156.4	1.991	65.9	0.199	72.5	0.454	−33.9	7.0

Table 11 Common emitter scattering parameters, $I_C = 0.5$ mA; $V_{CE} = 6$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.988	−1.5	1.295	177.7	0.006	88.8	0.998	−0.9	43.7
100	0.987	−3.9	1.298	174.4	0.015	85.7	0.997	−2.2	40.9
200	0.982	−7.8	1.284	169.2	0.030	82.3	0.992	−4.5	34.7
300	0.972	−11.7	1.292	164.3	0.045	79.3	0.984	−6.7	30.0
400	0.960	−15.7	1.296	159.5	0.060	76.9	0.976	−9.0	26.6
500	0.949	−19.4	1.277	155.2	0.074	74.3	0.969	−11.2	24.2
600	0.934	−23.1	1.265	150.8	0.087	72.0	0.959	−13.3	22.0
700	0.918	−26.6	1.250	146.8	0.100	69.9	0.949	−15.2	20.0
800	0.898	−29.9	1.229	142.6	0.110	67.6	0.938	−16.9	18.1
900	0.875	−33.4	1.225	138.1	0.120	64.9	0.922	−18.6	16.3
1000	0.849	−36.8	1.201	134.0	0.129	62.3	0.907	−20.1	14.6
1200	0.794	−44.0	1.169	126.5	0.145	57.2	0.866	−23.4	11.7
1400	0.748	−51.3	1.166	120.1	0.161	53.7	0.831	−26.3	10.0
1600	0.712	−58.0	1.158	114.3	0.175	50.4	0.809	−29.1	9.0
1800	0.674	−63.3	1.104	109.3	0.181	48.1	0.783	−31.4	7.6
2000	0.612	−69.0	1.075	103.1	0.186	45.6	0.751	−33.1	6.3
2200	0.552	−76.6	1.067	97.9	0.190	43.5	0.717	−35.1	5.3
2400	0.508	−85.8	1.074	91.4	0.196	41.4	0.687	−37.8	4.7
2600	0.494	−93.7	1.050	88.2	0.197	40.0	0.670	−40.9	4.2
2800	0.472	−99.0	1.063	85.3	0.198	40.6	0.665	−43.0	4.2
3000	0.434	−103.4	1.034	81.5	0.198	41.0	0.653	−44.0	3.6

Table 12 Common emitter scattering parameters, $I_C = 1.25$ mA; $V_{CE} = 6$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	
40	0.971	−2.3	3.306	176.6	0.006	87.8	0.996	−1.4	44.2
100	0.967	−5.6	3.287	172.2	0.015	84.6	0.993	−3.3	41.1
200	0.953	−11.3	3.219	165.4	0.030	80.4	0.980	−6.6	34.6
300	0.931	−16.9	3.184	159.1	0.044	76.5	0.962	−9.8	30.1
400	0.904	−22.4	3.133	153.3	0.058	73.2	0.942	−12.8	26.8
500	0.878	−27.4	3.029	148.3	0.069	70.3	0.921	−15.7	24.2
600	0.848	−32.2	2.937	143.4	0.080	67.5	0.899	−18.2	22.0
700	0.815	−36.7	2.863	138.9	0.090	65.3	0.877	−20.3	20.2
800	0.779	−41.0	2.779	134.2	0.098	63.4	0.854	−21.8	18.6
900	0.738	−45.1	2.696	129.5	0.105	61.2	0.828	−23.3	17.1
1000	0.696	−49.2	2.595	125.2	0.111	59.4	0.803	−24.5	15.7
1200	0.613	−57.8	2.447	117.6	0.121	56.0	0.748	−26.9	13.4
1400	0.544	−66.5	2.354	111.0	0.132	54.5	0.705	−28.9	12.0
1600	0.496	−73.5	2.222	105.2	0.142	53.1	0.678	−31.1	10.8
1800	0.449	−78.6	2.068	100.5	0.146	52.9	0.652	−32.5	9.7
2000	0.383	−83.8	1.940	95.1	0.152	52.7	0.625	−33.0	8.6
2200	0.325	−92.6	1.857	90.5	0.157	52.9	0.594	−34.0	7.7
2400	0.290	−103.7	1.793	85.1	0.166	52.9	0.566	−36.1	7.1
2600	0.284	−111.9	1.701	82.1	0.171	53.1	0.550	−39.0	6.5
2800	0.269	−116.2	1.668	79.7	0.177	55.0	0.547	−40.9	6.3
3000	0.235	−120.1	1.588	76.2	0.184	56.3	0.543	−41.6	5.8

Table 13 Noise data, $I_C = 1.25$ mA; $V_{CE} = 6$ V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	**(DEG)**	
500	1.00	0.739	8.00	0.820
900	1.20	0.602	12.00	0.810
2000	1.90	0.544	39.00	0.600

Table 14 Common emitter scattering parameters, $I_C = 2.5$ mA; $V_{CE} = 6$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.945	−3.3	6.332	175.1	0.006	85.0	0.993	−1.9	44.4
100	0.935	−8.2	6.233	169.0	0.015	83.1	0.985	−4.9	40.2
200	0.904	−16.2	6.000	160.0	0.029	77.5	0.957	−9.4	33.7
300	0.862	−23.8	5.801	152.1	0.041	73.3	0.919	−13.5	29.2
400	0.813	−31.1	5.557	145.0	0.053	69.8	0.881	−17.0	26.1
500	0.764	−37.5	5.254	138.9	0.062	66.8	0.843	−20.1	23.6
600	0.714	−43.4	4.982	133.3	0.071	64.7	0.808	−22.3	21.6
700	0.662	−48.9	4.744	127.9	0.078	63.5	0.776	−24.0	20.0
800	0.609	−53.4	4.471	122.9	0.084	62.5	0.748	−25.0	18.6
900	0.557	−57.6	4.216	118.1	0.089	61.4	0.721	−25.6	17.3
1000	0.506	−61.6	3.961	113.8	0.094	60.5	0.694	−26.1	16.1
1200	0.415	−70.1	3.559	106.5	0.103	59.6	0.642	−26.9	14.2
1400	0.352	−78.6	3.264	100.7	0.114	59.9	0.605	−27.9	12.8
1600	0.311	−84.8	2.969	95.7	0.124	60.0	0.583	−29.4	11.7
1800	0.271	−88.4	2.705	91.9	0.131	61.0	0.564	−30.1	10.6
2000	0.218	−93.1	2.487	87.5	0.140	61.5	0.547	−30.0	9.7
2200	0.175	−104.0	2.332	84.0	0.150	62.2	0.521	−30.5	8.9
2400	0.157	−120.1	2.217	79.5	0.162	62.5	0.497	−32.4	8.3
2600	0.162	−128.1	2.070	77.2	0.170	62.6	0.482	−35.4	7.6
2800	0.155	−131.0	2.003	75.3	0.179	64.2	0.483	−37.5	7.3
3000	0.126	−135.6	1.893	72.2	0.191	64.8	0.483	−38.2	6.8

Table 15 Noise data, $I_C = 2.5$ mA; $V_{CE} = 6$ V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.10	0.692	8.00	0.660
900	1.25	0.612	9.00	0.700
2000	1.90	0.439	36.00	0.580

Table 16 Common emitter scattering parameters, $I_C = 3.75$ mA; $V_{CE} = 6$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.920	−4.2	8.980	173.9	0.006	87.6	0.990	−2.5	44.1
100	0.905	−10.4	8.768	166.6	0.015	81.9	0.976	−6.1	39.5
200	0.858	−20.3	8.301	155.8	0.028	75.7	0.933	−11.5	33.0
300	0.797	−29.5	7.844	146.7	0.039	71.2	0.880	−15.9	28.7
400	0.730	−37.8	7.335	138.6	0.049	68.1	0.829	−19.4	25.6
500	0.668	−45.0	6.790	131.9	0.057	65.8	0.782	−22.1	23.3
600	0.606	−51.2	6.296	125.9	0.065	64.5	0.743	−23.8	21.5
700	0.545	−56.6	5.846	120.3	0.071	63.7	0.712	−24.9	19.9
800	0.491	−60.7	5.389	115.5	0.077	63.7	0.685	−25.3	18.6
900	0.439	−64.4	4.987	111.1	0.082	63.3	0.660	−25.5	17.4
1000	0.390	−67.9	4.613	107.1	0.087	63.1	0.637	−25.4	16.3
1200	0.308	−75.8	4.044	100.6	0.096	63.2	0.592	−25.4	14.4
1400	0.258	−84.4	3.632	95.6	0.108	64.1	0.560	−26.0	13.1
1600	0.226	−90.2	3.264	91.3	0.119	64.5	0.543	−27.5	12.0
1800	0.192	−92.4	2.949	87.9	0.128	65.5	0.530	−28.0	11.0
2000	0.146	−96.6	2.695	84.0	0.139	65.9	0.516	−27.8	10.1
2200	0.112	−112.1	2.515	81.0	0.149	66.5	0.494	−28.1	9.3
2400	0.105	−133.5	2.379	77.0	0.163	66.5	0.470	−30.0	8.7
2600	0.116	−140.7	2.212	74.9	0.173	66.5	0.456	−33.2	8.0
2800	0.111	−142.3	2.131	73.2	0.183	67.7	0.459	−35.5	7.6
3000	0.087	−149.4	2.012	70.4	0.196	67.9	0.460	−36.3	7.1

Table 17 Noise data, $I_C = 3.75$ mA; $V_{CE} = 6$ V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.20	0.628	8.00	0.640
900	1.35	0.544	9.00	0.670
2000	2.00	0.388	37.00	0.540

Table 18 Common emitter scattering parameters, I_C = 5 mA; V_{CE} = 6 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.898	–5.0	11.309	172.9	0.006	85.6	0.986	–2.9	43.9
100	0.876	–12.4	10.944	164.5	0.014	80.8	0.968	–7.1	39.2
200	0.815	–23.8	10.199	152.4	0.027	74.7	0.911	–13.1	32.6
300	0.738	–34.2	9.448	142.3	0.037	70.1	0.846	–17.5	28.4
400	0.658	–43.3	8.631	133.5	0.047	67.4	0.786	–20.7	25.4
500	0.588	–50.7	7.824	126.5	0.054	65.8	0.737	–22.9	23.1
600	0.522	–56.8	7.109	120.5	0.060	65.0	0.698	–24.2	21.3
700	0.463	–61.6	6.473	115.2	0.067	65.0	0.669	–24.8	19.8
800	0.411	–65.1	5.887	110.7	0.072	65.1	0.646	–24.8	18.5
900	0.362	–68.3	5.388	106.6	0.078	65.4	0.624	–24.7	17.4
1000	0.319	–71.4	4.945	103.0	0.083	65.5	0.604	–24.4	16.3
1200	0.246	–79.1	4.279	97.2	0.093	65.9	0.565	–23.9	14.6
1400	0.204	–88.1	3.811	92.7	0.105	66.9	0.538	–24.4	13.3
1600	0.178	–93.6	3.406	88.8	0.118	67.3	0.523	–25.9	12.2
1800	0.149	–95.5	3.062	85.6	0.127	68.1	0.512	–26.4	11.1
2000	0.107	–100.3	2.796	82.0	0.138	68.4	0.501	–26.3	10.2
2200	0.079	–121.0	2.602	79.2	0.150	68.8	0.481	–26.5	9.5
2400	0.081	–147.7	2.458	75.5	0.164	68.8	0.458	–28.4	8.9
2600	0.094	–152.6	2.280	73.6	0.174	68.4	0.444	–31.7	8.2
2800	0.092	–153.1	2.191	72.0	0.185	69.5	0.447	–34.2	7.8
3000	0.070	–163.4	2.066	69.2	0.198	69.5	0.450	–35.1	7.3

Table 19 Noise data, I_C = 5 mA; V_{CE} = 6 V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.45	0.584	8.00	0.630
900	1.60	0.506	9.00	0.680
2000	2.20	0.365	35.00	0.550

Table 20 Common emitter scattering parameters, I_C = 7.5 mA; V_{CE} = 6 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.858	−6.5	15.093	171.3	0.006	85.9	0.980	−3.6	43.5
100	0.827	−15.8	14.388	161.1	0.014	80.3	0.952	−8.6	38.4
200	0.740	−29.8	12.990	146.8	0.026	72.8	0.874	−15.0	32.0
300	0.640	−41.6	11.565	135.4	0.035	69.2	0.794	−19.0	27.9
400	0.548	−51.1	10.151	126.2	0.043	67.2	0.729	−21.5	25.0
500	0.475	−58.2	8.909	119.3	0.049	66.5	0.680	−22.9	22.8
600	0.414	−63.6	7.884	113.8	0.056	66.6	0.646	−23.5	21.1
700	0.361	−67.7	7.037	109.0	0.062	67.3	0.621	−23.7	19.7
800	0.316	−70.6	6.315	105.1	0.068	68.0	0.604	−23.4	18.4
900	0.275	−73.0	5.720	101.5	0.073	68.3	0.587	−22.9	17.3
1000	0.237	−75.8	5.211	98.4	0.079	68.5	0.572	−22.4	16.3
1200	0.178	−84.2	4.459	93.2	0.090	69.2	0.541	−21.7	14.6
1400	0.145	−93.9	3.943	89.4	0.103	70.2	0.518	−22.2	13.4
1600	0.126	−100.6	3.507	85.8	0.116	70.5	0.506	−23.7	12.3
1800	0.102	−101.2	3.143	83.0	0.126	71.1	0.498	−24.4	11.2
2000	0.065	−110.2	2.867	79.6	0.139	71.0	0.490	−24.3	10.4
2200	0.049	−145.1	2.661	77.1	0.151	71.2	0.471	−24.6	9.6
2400	0.068	−174.5	2.511	73.6	0.166	71.1	0.449	−26.5	9.0
2600	0.081	−172.9	2.323	71.9	0.176	70.5	0.435	−30.0	8.3
2800	0.080	−171.8	2.231	70.5	0.188	71.5	0.438	−32.7	7.9
3000	0.063	173.4	2.101	67.8	0.201	71.2	0.442	−33.7	7.4

NPN 9 GHz wideband transistor BFS520

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability
- SOT323 envelope.

DESCRIPTION

NPN transistor in a plastic SOT323 envelope.

It is intended for wideband applications such as satellite TV tuners, cellular phones, cordless phones, pagers etc., with signal frequencies up to 2 GHz.

PINNING

PIN	DESCRIPTION
Code: N2	
1	base
2	emitter
3	collector

PIN CONFIGURATION

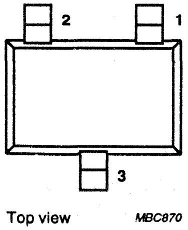


Fig.1 SOT323.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	–	15	V
I_C	DC collector current		–	–	70	mA
P_{tot}	total power dissipation	up to T_s = 93 °C (note 1)	–	–	300	mW
h_{FE}	DC current gain	I_C = 20 mA; V_{CE} = 6 V; T_j = 25 °C	60	120	250	
f_T	transition frequency	I_C = 20 mA; V_{CE} = 6 V; f = 1 GHz; T_{amb} = 25 °C	–	9	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 20 mA; V_{CE} = 6 V; f = 900 MHz; T_{amb} = 25 °C	–	15	–	dB
F	noise figure	I_C = 5 mA; V_{CE} = 6 V; f = 900 MHz; T_{amb} = 25 °C	–	1.1	1.6	dB

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_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	70	mA
P_{tot}	total power dissipation	up to T_s = 93 °C (note 1)	–	300	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C

Note

1. T_s is the temperature at the soldering point of the collector tab.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 93 °C (note 1)	190 K/W

Note

1. T_s is the temperature at the soldering point of the collector tab.

CHARACTERISTICS

T_j = 25 °C, unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CE} = 6$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 20$ mA; $V_{CE} = 6$ V	60	120	250	
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	1	–	pF
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.5	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.4	–	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 6$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	9	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 20$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	15	–	dB
		$I_C = 20$ mA; $V_{CE} = 6$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	9	–	dB
$\|S_{21}\|^2$	insertion power gain	$I_C = 20$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	13	14	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	1.1	1.6	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 20$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	1.9	–	dB
P_{L1}	output power at 1 dB gain compression	$I_C = 20$ mA; $V_{CE} = 6$ V; $R_L = 50\ \Omega$; f = 900 MHz; $T_{amb} = 25$ °C	–	17	–	dBm
ITO	third order intercept point	note 2	–	26	–	dBm

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.
2. $I_C = 20$ mA; $V_{CE} = 6$ V; $R_L = 50\ \Omega$; f = 900 MHz; $T_{amb} = 25$ °C; $f_p = 900$ MHz; $f_q = 902$ MHz; measured at $f_{(2p-q)} = 898$ MHz and at $f_{(2q-p)} = 904$ MHz.

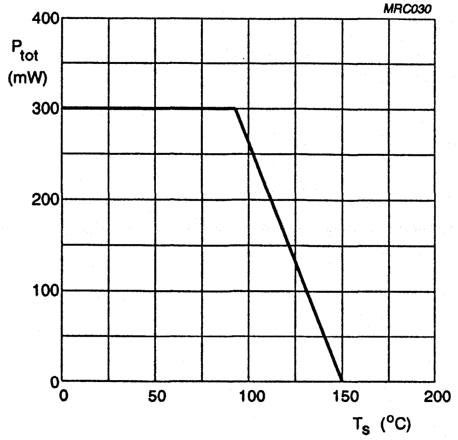
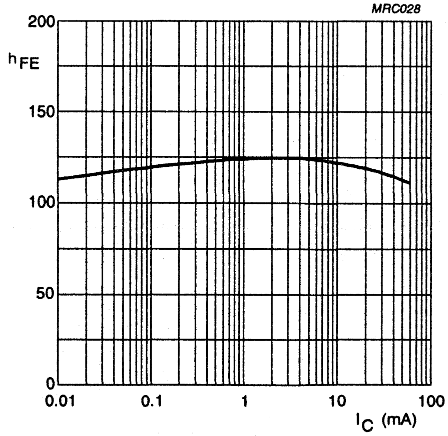
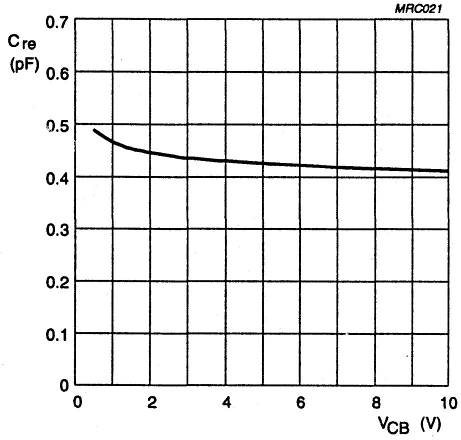


Fig.2 Power derating curve.



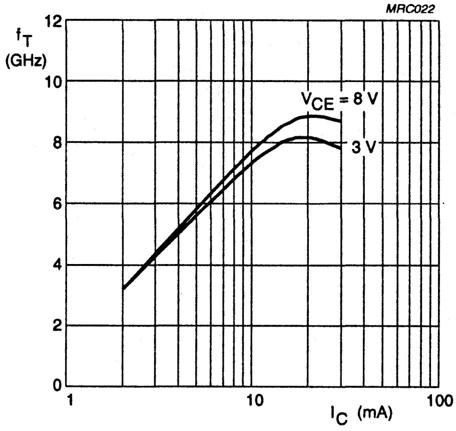
V_{CE} = 6 V; T_j = 25 °C.

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



I_C = 0; f = 1 MHz.

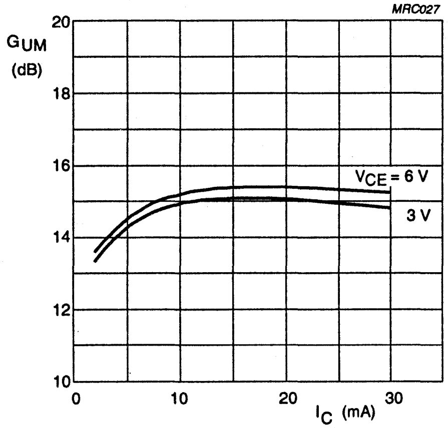
Fig.4 Feedback capacitance as a function of collector-base voltage.



f = 1 GHz; T_{amb} = 25 °C.

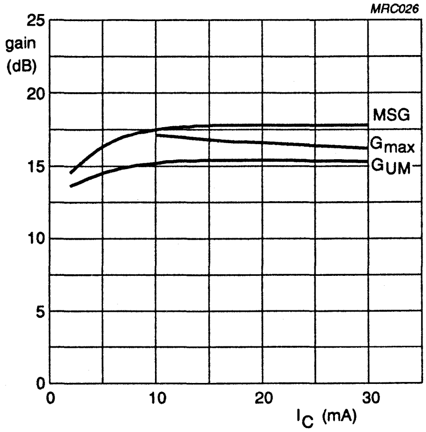
Fig.5 Transition frequency as a function of collector current.

In Figs 6 to 9, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



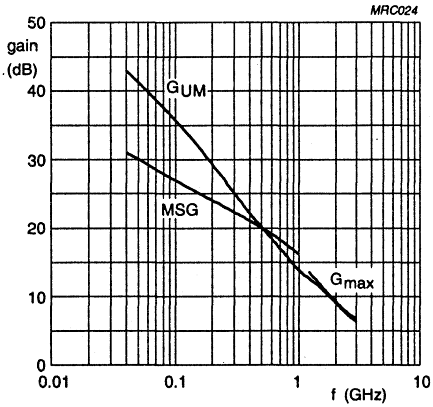
V_{CE} = 6 V; f = 900 MHz; T_{amb} = 25 °C.

Fig.6 Maximum unilateral power gain as a function of collector current.



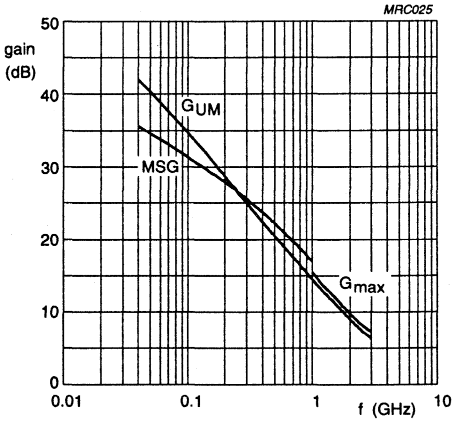
V_{CE} = 6 V; f = 2 GHz; T_{amb} = 25 °C.

Fig.7 Gain as a function of collector current.



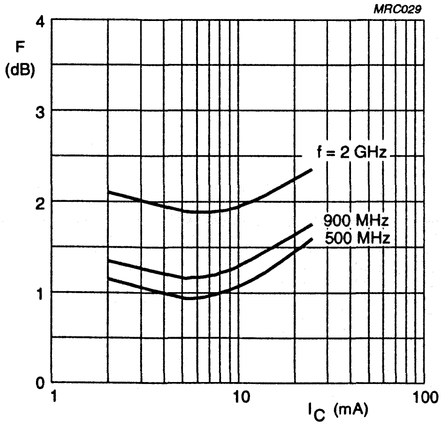
I_C = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.8 Gain as a function of frequency.



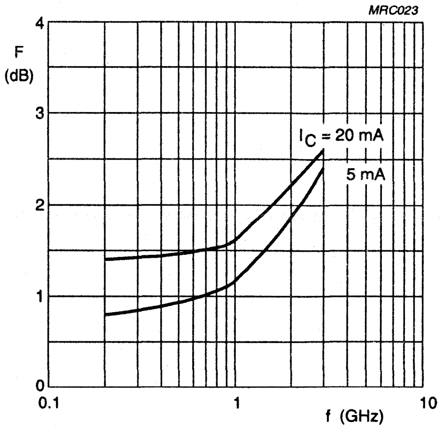
I_C = 20 mA; V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.9 Gain as a function of frequency.



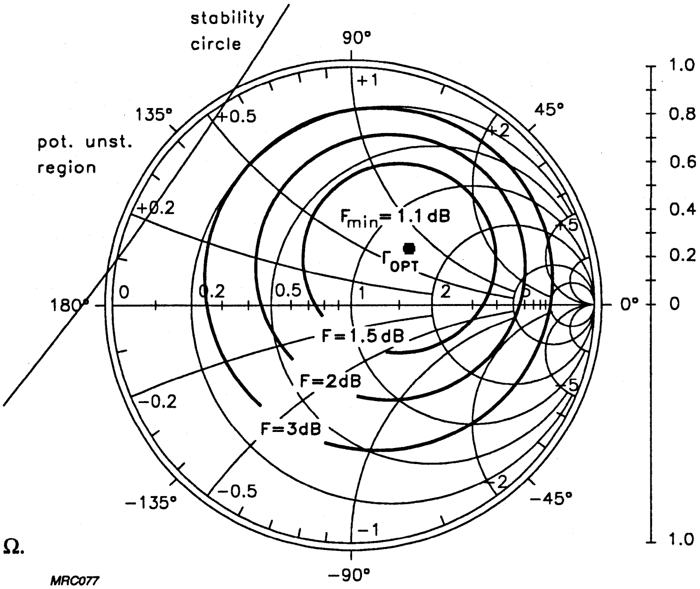
V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.10 Minimum noise figure as a function of collector current.



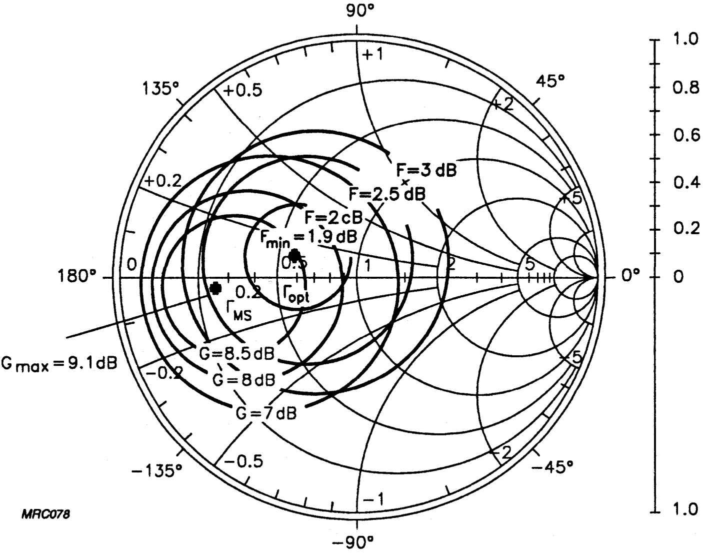
V_{CE} = 6 V; T_{amb} = 25 °C.

Fig.11 Minimum noise figure as a function of frequency.



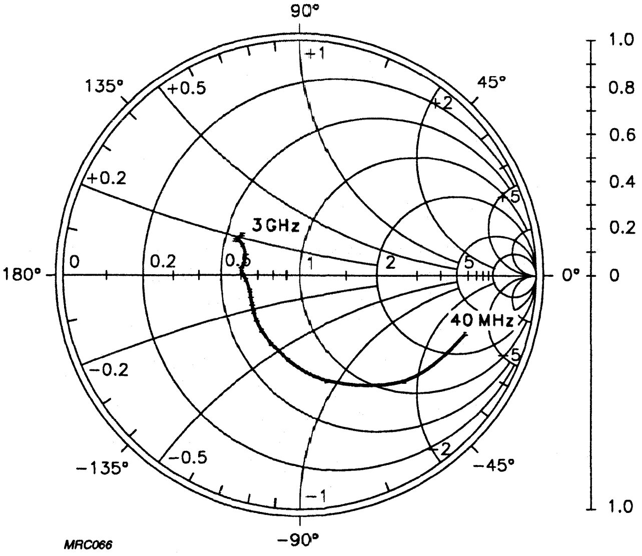
I_C = 5 mA; V_{CE} = 6 V;
f = 900 MHz; Z_O = 50 Ω.

Fig.12 Noise circle.



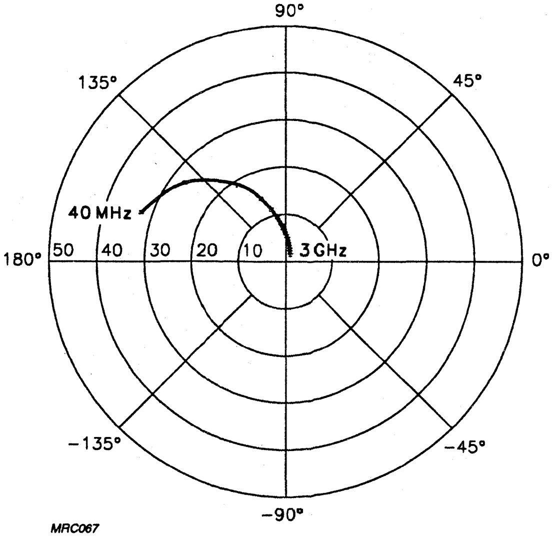
I_C = 5 mA; V_{CE} = 6 V;
f = 2 GHz; Z_O = 50 Ω.

Fig.13 Noise circle.



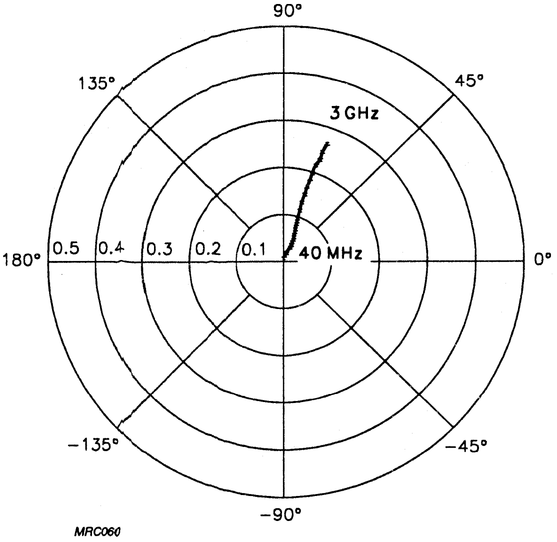
I_C = 20 mA; V_{CE} = 6 V;
Z_O = 50 Ω.

Fig.14 Common emitter input reflection coefficient (S_{11}).



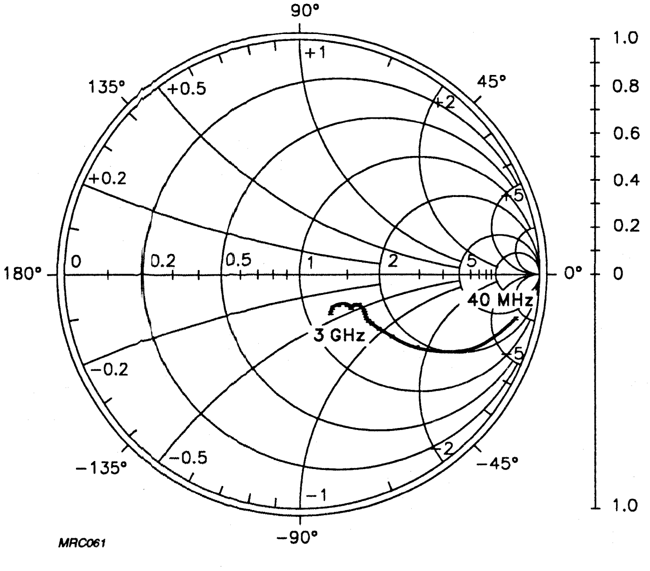
I_C = 20 mA; V_{CE} = 6 V.

Fig.15 Common emitter forward transmission coefficient (S_{21}).



$I_C = 20$ mA; $V_{CE} = 6$ V.

Fig.16 Common emitter reverse transmission coefficient (S_{12}).

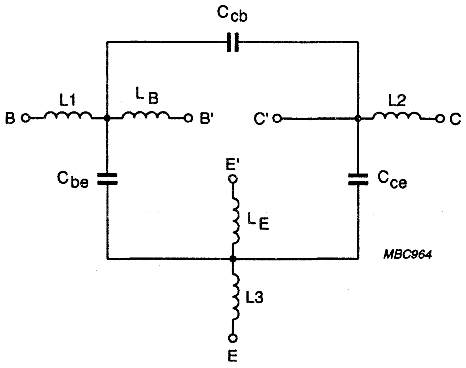


$I_C = 20$ mA; $V_{CE} = 6$ V;
$Z_O = 50\ \Omega$.

Fig.17 Common emitter output reflection coefficient (S_{22}).

SPICE parameters for BFR520 crystal

1	IS = 1.016	fA
2	BF = 220.1	–
3	NF = 1.000	–
4	VAF = 48.06	V
5	IKF = 510.0	mA
6	ISE = 283.0	fA
7	NE = 2.035	–
8	BR = 100.7	–
9	NR = 988.1	m
10	VAR = 1.692	V
11	IKR = 2.352	mA
12	ISC = 24.48	aA
13	NC = 1.022	–
14	RB = 10.00	Ω
15	IRB = 1.000	µA
16	RBM = 10.00	Ω
17	RE = 775.3	mΩ
18	RC = 2.210	Ω
19 (note 1)	XTB = 0.000	–
20 (note 1)	EG = 1.110	EV
21 (note 1)	XTI = 3.000	–
22	CJE = 1.245	pF
23	VJE = 600.0	mV
24	MJE = 258.1	m
25	TF = 8.616	ps
26	XTF = 6.788	–
27	VTF = 1.414	V
28	ITF = 110.3	mA
29	PTF = 45.01	deg
30	CJC = 447.6	fF
31	VJC = 189.2	mV
32	MJC = 70.51	m
33	XCJC = 130.0	m
34	TR = 543.7	ps
35 (note 1)	CJS = 0.000	F
36 (note 1)	VJS = 750.0	mV
37 (note 1)	MJS = 0.000	–
38	FC = 780.2	m



$QL_B = 50$; $QL_E = 50$.

$QL_{B,E}(f) = QL_{B,E} \sqrt{(f/Fc)}$.

Fc = scaling frequency = 100 MHz.

Fig.18 Package equivalent circuit, SOT323.

List of components (see Fig.18)

DESIGNATION	VALUE
C_{be}	2 fF
C_{cb}	100 fF
C_{ce}	100 fF
L1	0.34 nH
L2	0.10 nH
L3	0.34 nH
L_B	0.60 nH
L_E	0.60 nH

Note

1. These parameters have not been extracted, the default values are shown.

NPN 9 GHz wideband transistor BFS520

Table 1 Common emitter scattering parameters, $I_C = 2$ mA; $V_{CE} = 3$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.951	−6.5	5.567	173.5	0.011	85.2	0.992	−3.1	43.1
100	0.933	−16.0	5.416	165.0	0.026	79.0	0.976	−7.6	36.8
200	0.885	−31.3	5.128	153.8	0.049	69.6	0.925	−14.3	29.2
300	0.827	−46.0	4.862	142.8	0.067	62.0	0.862	−19.7	24.6
400	0.767	−59.4	4.532	133.8	0.081	56.2	0.803	−24.1	21.5
500	0.713	−71.5	4.186	126.4	0.091	51.9	0.751	−27.5	19.1
600	0.663	−82.3	3.885	119.8	0.099	48.9	0.708	−29.8	17.3
700	0.614	−92.3	3.615	113.7	0.105	47.1	0.673	−31.3	15.8
800	0.570	−101.0	3.342	108.5	0.109	45.9	0.644	−32.1	14.5
900	0.532	−109.2	3.088	103.7	0.112	44.9	0.619	−32.6	13.3
1000	0.499	−117.3	2.857	99.5	0.114	44.7	0.595	−33.0	12.3
1200	0.458	−132.8	2.514	92.2	0.117	45.2	0.550	−33.8	10.6
1400	0.447	−145.5	2.270	86.2	0.121	47.0	0.520	−35.6	9.5
1600	0.442	−154.8	2.050	81.0	0.126	49.3	0.502	−37.9	8.4
1800	0.429	−163.2	1.871	77.0	0.130	52.8	0.491	−39.4	7.5
2000	0.421	−172.9	1.725	72.8	0.137	56.2	0.478	−40.5	6.7
2200	0.435	178.0	1.610	69.3	0.144	59.9	0.458	−42.4	6.1
2400	0.459	171.6	1.514	64.9	0.154	62.9	0.438	−46.1	5.5
2600	0.470	167.8	1.416	62.1	0.164	65.4	0.431	−50.9	5.0
2800	0.469	163.3	1.373	59.5	0.177	68.6	0.438	−54.3	4.8
3000	0.467	156.9	1.311	56.5	0.192	70.8	0.440	−56.2	4.4

Table 2 Common emitter scattering parameters, I_C = 5 mA; V_{CE} = 3 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.885	−10.1	12.638	169.8	0.010	83.8	0.979	−5.7	42.4
100	0.841	−24.6	11.872	157.6	0.024	74.5	0.932	−13.5	35.7
200	0.741	−46.8	10.599	141.8	0.042	64.1	0.812	−23.1	28.6
300	0.639	−66.4	9.319	129.5	0.054	58.5	0.703	−28.8	24.6
400	0.555	−82.8	8.055	119.9	0.063	55.7	0.620	−32.3	21.8
500	0.496	−95.9	7.005	112.8	0.070	54.6	0.560	−34.3	19.8
600	0.449	−107.0	6.617	107.0	0.076	54.7	0.520	−35.2	18.1
700	0.411	−116.4	5.475	102.2	0.082	55.4	0.491	−35.5	16.8
800	0.382	−124.5	4.898	98.2	0.088	56.4	0.470	−35.1	15.6
900	0.358	−132.4	4.426	94.7	0.093	57.5	0.452	−34.5	14.5
1000	0.340	−140.3	4.022	91.5	0.098	58.5	0.434	−33.8	13.5
1200	0.327	−154.7	3.431	86.3	0.109	60.6	0.400	−33.1	12.0
1400	0.333	−164.8	3.025	81.7	0.121	63.0	0.376	−34.2	10.8
1600	0.334	−171.7	2.694	77.7	0.135	64.2	0.364	−36.6	9.7
1800	0.326	−178.5	2.438	74.5	0.146	66.1	0.357	−37.6	8.8
2000	0.327	172.3	2.235	71.0	0.160	67.2	0.348	−37.8	8.0
2200	0.348	164.5	2.076	68.3	0.174	68.6	0.329	−38.9	7.4
2400	0.375	160.2	1.946	64.6	0.190	69.1	0.308	−42.8	6.9
2600	0.385	158.6	1.808	62.1	0.202	69.3	0.299	−48.5	6.2
2800	0.382	155.8	1.743	59.9	0.216	70.3	0.308	−52.6	5.9
3000	0.379	149.9	1.660	56.9	0.234	70.5	0.313	−54.2	5.5

Table 3 Noise data, I_C = 5 mA; V_{CE} = 3 V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	0.90	0.325	31.0	0.200
900	1.10	0.266	54.0	0.210
2000	1.94	0.245	174.0	0.170

Table 4 Common emitter scattering parameters, $I_C = 10$ mA; $V_{CE} = 3$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.793	−15.0	21.963	165.5	0.010	82.3	0.956	−8.9	41.8
100	0.718	−35.8	19.615	149.5	0.022	71.5	0.860	−19.7	34.9
200	0.568	−65.1	15.811	130.3	0.035	62.8	0.684	−29.8	28.4
300	0.462	−87.1	12.578	117.9	0.045	60.1	0.560	−33.8	24.7
400	0.396	−103.8	10.183	109.7	0.053	60.5	0.482	−35.5	22.0
500	0.358	−116.3	8.508	103.9	0.060	61.5	0.433	−36.1	20.1
600	0.330	−126.2	7.279	99.5	0.067	62.8	0.404	−36.0	18.5
700	0.309	−134.8	6.354	95.8	0.074	64.3	0.385	−35.5	17.2
800	0.292	−142.3	5.624	92.7	0.082	65.7	0.372	−34.5	16.0
900	0.279	−149.9	5.046	89.8	0.090	66.5	0.361	−33.4	15.0
1000	0.270	−157.1	4.562	87.4	0.097	67.4	0.348	−32.2	14.1
1200	0.273	−169.9	3.860	83.1	0.111	68.8	0.322	−30.8	12.5
1400	0.287	−177.7	3.383	79.4	0.128	70.1	0.302	−31.8	11.4
1600	0.291	177.4	2.999	75.8	0.144	70.2	0.292	−34.8	10.3
1800	0.284	171.2	2.706	73.0	0.158	71.0	0.288	−35.8	9.4
2000	0.288	162.7	2.476	70.0	0.175	71.0	0.282	−35.5	8.6
2200	0.314	155.8	2.297	67.6	0.191	71.4	0.263	−36.1	8.0
2400	0.342	153.1	2.150	64.2	0.208	71.2	0.241	−40.3	7.4
2600	0.351	153.3	1.991	62.0	0.221	70.6	0.231	−47.4	6.8
2800	0.346	151.1	1.914	59.9	0.237	70.8	0.240	−52.2	6.5
3000	0.341	145.4	1.821	57.0	0.255	70.4	0.246	−53.9	6.0

Table 5 Noise data, $I_C = 10$ mA; $V_{CE} = 3$ V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.10	0.716	32.0	0.190
900	1.25	0.318	59.0	0.160
2000	1.90	0.257	−171.0	0.150

Table 6 Common emitter scattering parameters, I_C = 15 mA; V_{CE} = 3 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.722	−19.1	28.824	162.3	0.009	80.4	0.934	−11.2	41.4
100	0.624	−44.7	24.593	143.7	0.020	70.1	0.804	−23.5	34.5
200	0.468	−77.2	18.171	123.7	0.032	63.0	0.607	−32.4	28.3
300	0.380	−99.5	13.751	112.4	0.041	62.8	0.488	−35.0	24.6
400	0.333	−116.1	10.875	105.2	0.049	64.1	0.419	−35.6	22.1
500	0.308	−127.7	8.966	100.2	0.057	65.5	0.379	−35.5	20.2
600	0.291	−137.0	7.618	96.4	0.065	67.1	0.356	−35.1	18.6
700	0.276	−145.0	6.619	93.2	0.073	68.5	0.342	−34.5	17.3
800	0.265	−151.8	5.841	90.4	0.081	69.6	0.333	−33.3	16.2
900	0.255	−159.0	5.231	87.8	0.089	70.4	0.324	−32.0	15.1
1000	0.251	−165.8	4.723	85.6	0.097	70.9	0.315	−30.7	14.2
1200	0.261	−177.4	3.986	81.7	0.114	71.8	0.291	−29.1	12.7
1400	0.277	176.3	3.485	78.3	0.131	72.5	0.273	−30.3	11.5
1600	0.281	172.1	3.087	74.9	0.148	72.2	0.264	−33.7	10.5
1800	0.274	166.7	2.782	72.2	0.163	72.5	0.261	−34.7	9.5
2000	0.281	158.3	2.548	69.3	0.181	72.3	0.255	−34.4	8.8
2200	0.308	152.4	2.362	67.1	0.197	72.4	0.237	−34.8	8.1
2400	0.335	150.2	2.210	63.9	0.215	72.0	0.214	−39.3	7.6
2600	0.343	150.8	2.043	61.8	0.229	71.0	0.204	−47.0	6.9
2800	0.337	149.0	1.965	59.7	0.244	71.1	0.213	−52.4	6.6
3000	0.332	143.5	1.869	56.9	0.263	70.4	0.220	−54.2	6.2

Table 7 Noise data, I_C = 15 mA; V_{CE} = 3 V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.30	0.0980	37.0	0.200
900	1.45	0.0750	99.0	0.180
2000	2.05	0.265	−158.0	0.180

Table 8 Common emitter scattering parameters, $I_C = 20$ mA; $V_{CE} = 3$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.665	−22.9	33.838	159.8	0.009	80.4	0.914	−12.9	40.9
100	0.556	−52.1	27.652	139.3	0.019	69.1	0.759	−25.7	34.2
200	0.409	−86.3	19.226	119.5	0.030	63.7	0.556	−33.6	28.1
300	0.340	−108.7	14.178	109.2	0.039	64.7	0.445	−35.0	24.5
400	0.306	−124.8	11.088	102.6	0.047	66.4	0.383	−35.0	22.0
500	0.288	−135.9	9.094	98.1	0.055	68.1	0.348	−34.6	20.1
600	0.275	−144.5	7.701	94.6	0.064	69.6	0.330	−34.0	18.6
700	0.265	−151.9	6.681	91.6	0.072	70.9	0.319	−33.3	17.3
800	0.257	−158.9	5.888	89.0	0.081	71.7	0.312	−32.1	16.1
900	0.250	−165.1	5.266	86.6	0.090	72.2	0.305	−30.8	15.1
1000	0.249	−171.4	4.754	84.5	0.098	72.7	0.297	−29.6	14.2
1200	0.261	178.3	4.007	80.8	0.115	73.3	0.276	−27.9	12.7
1400	0.278	172.7	3.501	77.6	0.133	73.8	0.258	−29.2	11.5
1600	0.282	169.1	3.100	74.2	0.151	73.2	0.250	−32.9	10.5
1800	0.276	164.0	2.794	71.7	0.166	73.4	0.247	−34.0	9.5
2000	0.283	155.9	2.557	68.8	0.184	72.9	0.242	−33.6	8.8
2200	0.311	150.5	2.370	66.6	0.201	72.9	0.224	−34.1	8.2
2400	0.339	148.5	2.215	63.4	0.219	72.4	0.201	−38.7	7.6
2600	0.345	149.4	2.050	61.4	0.233	71.3	0.191	−47.0	6.9
2800	0.340	147.7	1.970	59.3	0.248	71.3	0.200	−52.8	6.6
3000	0.335	142.2	1.873	56.5	0.268	70.6	0.207	−54.5	6.2

Table 9 Noise data, $I_C = 20$ mA; $V_{CE} = 3$ V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.45	0.0480	61.0	0.200
900	1.60	0.0780	136.0	0.180
2000	2.20	0.311	−153.0	0.170

Table 10 Common emitter scattering parameters, $I_C = 30$ mA; $V_{CE} = 3$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	
40	0.579	−30.5	39.467	155.6	0.009	77.8	0.872	−15.2	39.9
100	0.467	−65.7	29.988	133.1	0.018	67.5	0.688	−28.3	33.4
200	0.354	−102.1	19.424	114.5	0.028	64.7	0.490	−33.8	27.5
300	0.313	−123.9	13.983	105.3	0.037	66.9	0.394	−33.6	24.1
400	0.295	−138.6	10.823	99.5	0.046	69.1	0.344	−32.8	21.6
500	0.288	−148.1	8.827	95.4	0.054	70.9	0.316	−32.2	19.7
600	0.281	−155.4	7.452	92.2	0.063	72.1	0.303	−31.7	18.2
700	0.276	−161.7	6.453	89.5	0.072	73.1	0.296	−31.1	16.9
800	0.270	−167.5	5.684	87.0	0.081	73.8	0.292	−30.1	15.8
900	0.267	−173.2	5.079	84.8	0.090	74.1	0.288	−28.9	14.8
1000	0.268	−178.7	4.585	82.8	0.099	74.5	0.281	−27.7	13.9
1200	0.283	172.9	3.861	79.3	0.116	74.7	0.263	−26.2	12.4
1400	0.300	168.3	3.375	76.1	0.134	75.2	0.246	−27.9	11.2
1600	0.304	165.0	2.987	72.8	0.153	74.4	0.238	−32.0	10.2
1800	0.298	160.5	2.691	70.3	0.168	74.3	0.237	−33.4	9.3
2000	0.306	153.1	2.466	67.4	0.187	73.7	0.232	−33.3	8.5
2200	0.335	148.3	2.287	65.3	0.204	73.7	0.214	−33.8	7.9
2400	0.363	146.5	2.138	62.2	0.223	73.0	0.192	−38.9	7.4
2600	0.368	147.3	1.976	60.0	0.237	71.9	0.182	−47.8	6.7
2800	0.362	145.3	1.900	58.0	0.253	71.8	0.192	−53.9	6.3
3000	0.359	140.3	1.808	55.2	0.272	71.0	0.198	−55.8	5.9

Table 11 Common emitter scattering parameters, I_C = 2 mA; V_{CE} = 6 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.956	−6.2	5.495	173.7	0.010	86.1	0.992	−2.9	43.4
100	0.939	−15.4	5.368	165.4	0.025	79.2	0.977	−7.2	37.3
200	0.893	−30.1	5.096	153.8	0.047	70.1	0.929	−13.7	29.7
300	0.836	−44.1	4.834	143.8	0.065	62.8	0.869	−19.0	25.0
400	0.777	−57.3	4.527	135.0	0.079	57.3	0.813	−23.3	21.8
500	0.724	−68.8	4.196	127.6	0.090	52.8	0.762	−26.7	19.5
600	0.672	−79.5	3.915	121.0	0.097	49.9	0.720	−29.0	17.6
700	0.622	−89.3	3.650	115.0	0.103	47.9	0.685	−30.5	16.1
800	0.577	−97.8	3.375	109.7	0.107	46.6	0.657	−31.4	14.8
900	0.536	−105.9	3.130	104.9	0.110	45.7	0.630	−31.9	13.6
1000	0.501	−113.8	2.899	100.6	0.113	45.2	0.606	−32.3	12.5
1200	0.456	−129.4	2.555	93.4	0.116	45.5	0.561	−33.2	10.8
1400	0.442	−142.4	2.309	87.4	0.121	47.2	0.530	−34.9	9.6
1600	0.435	−151.9	2.085	82.1	0.126	49.4	0.512	−37.2	8.6
1800	0.419	−160.3	1.903	78.1	0.129	52.7	0.501	−38.5	7.7
2000	0.410	−170.2	1.753	73.9	0.135	56.0	0.487	−39.5	6.9
2200	0.422	−179.8	1.638	70.4	0.142	59.7	0.465	−41.4	6.2
2400	0.445	173.5	1.543	65.9	0.153	62.7	0.446	−44.9	5.7
2600	0.457	169.6	1.442	63.1	0.162	65.2	0.439	−49.5	5.1
2800	0.455	165.0	1.400	60.6	0.174	68.3	0.445	−52.9	4.9
3000	0.451	158.5	1.336	57.5	0.189	70.6	0.446	−54.7	4.5

Table 12 Common emitter scattering parameters, $I_C = 5$ mA; $V_{CE} = 6$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.900	−9.4	12.307	170.3	0.010	84.3	0.980	−5.3	42.9
100	0.860	−23.0	11.606	158.7	0.024	75.8	0.938	−12.6	36.3
200	0.764	−43.8	10.436	143.4	0.041	65.3	0.828	−21.9	29.2
300	0.663	−62.3	9.258	131.3	0.054	59.4	0.723	−27.7	25.1
400	0.577	−77.8	8.062	121.7	0.063	56.4	0.641	−31.4	22.2
500	0.513	−90.6	7.058	114.5	0.070	54.9	0.580	−33.6	20.1
600	0.462	−101.3	6.235	108.7	0.077	54.9	0.538	−34.6	18.4
700	0.420	−110.6	5.554	103.7	0.082	55.5	0.508	−35.0	17.0
800	0.385	−118.6	4.976	99.7	0.088	56.3	0.486	−34.6	15.8
900	0.358	−126.5	4.503	96.0	0.093	57.2	0.467	−34.1	14.7
1000	0.335	−134.3	4.098	92.8	0.098	58.2	0.448	−33.5	13.7
1200	0.317	−149.3	3.504	87.4	0.109	60.3	0.413	−32.8	12.2
1400	0.321	−160.2	3.093	82.9	0.121	62.3	0.388	−33.8	11.0
1600	0.320	−167.6	2.753	78.7	0.134	63.6	0.375	−36.0	9.9
1800	0.310	−174.7	2.492	75.5	0.145	65.5	0.367	−36.9	9.0
2000	0.307	175.4	2.284	72.0	0.158	66.7	0.358	−37.1	8.2
2200	0.329	167.0	2.122	69.3	0.171	67.9	0.339	−38.0	7.6
2400	0.355	162.2	1.990	65.6	0.187	68.6	0.318	−41.6	7.0
2600	0.366	160.9	1.847	63.1	0.199	68.8	0.308	−47.1	6.4
2800	0.363	158.1	1.781	60.8	0.213	69.8	0.316	−50.9	6.1
3000	0.358	152.0	1.694	57.9	0.230	70.1	0.320	−52.5	5.6

Table 13 Noise data, $I_C = 5$ mA; $V_{CE} = 6$ V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	0.900	0.359	27.0	0.240
900	1.10	0.338	45.0	0.230
2000	1.85	0.277	161.0	0.130

Table 14 Common emitter scattering parameters, I_C = 10 mA; V_{CE} = 6 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.830	−13.7	21.306	166.3	0.009	82.2	0.957	−8.2	42.4
100	0.758	−32.7	19.195	151.0	0.022	72.8	0.873	−18.5	35.6
200	0.608	−59.5	15.715	132.4	0.036	63.4	0.707	−28.5	28.9
300	0.492	−80.1	12.682	119.9	0.045	60.5	0.584	−33.0	25.1
400	0.415	−95.9	10.348	111.5	0.053	60.1	0.503	−35.0	22.4
500	0.368	−108.2	8.684	105.6	0.060	60.9	0.452	−35.8	20.4
600	0.333	−118.1	7.455	101.0	0.068	62.3	0.420	−35.8	18.8
700	0.306	−126.8	6.519	97.2	0.075	63.8	0.400	−35.4	17.5
800	0.285	−134.4	5.778	93.9	0.082	64.9	0.386	−34.4	16.3
900	0.267	−142.1	5.184	91.0	0.089	66.0	0.372	−33.3	15.3
1000	0.255	−149.9	4.689	88.5	0.096	66.8	0.360	−32.2	14.3
1200	0.253	−164.0	3.971	84.1	0.111	68.2	0.332	−30.6	12.8
1400	0.265	−172.8	3.479	80.4	0.127	69.4	0.311	−31.5	11.6
1600	0.267	−178.4	3.090	76.8	0.143	69.5	0.300	−34.3	10.5
1800	0.260	175.5	2.782	74.1	0.157	70.3	0.296	−35.1	9.6
2000	0.262	165.7	2.547	71.0	0.173	70.4	0.289	−34.7	8.8
2200	0.287	158.3	2.362	68.6	0.189	70.8	0.270	−35.2	8.2
2400	0.315	155.1	2.211	65.2	0.206	70.6	0.247	−39.0	7.6
2600	0.324	155.3	2.047	63.1	0.219	70.0	0.237	−45.8	7.0
2800	0.320	153.4	1.970	61.0	0.234	70.3	0.245	−50.5	6.6
3000	0.315	147.5	1.871	58.1	0.252	69.9	0.251	−52.0	6.2

Table 15 Noise data, I_C = 10 mA; V_{CE} = 6 V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.10	0.250	48.0	0.230
900	1.25	0.210	49.0	0.230
2000	1.90	0.230	162.0	0.150

Table 16 Common emitter scattering parameters, I_C = 15 mA; V_{CE} = 6 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.781	−17.0	27.776	163.5	0.009	81.3	0.939	−10.3	42.2
100	0.685	−39.7	24.046	145.8	0.021	70.7	0.823	−21.9	35.3
200	0.516	−69.2	18.202	126.1	0.033	63.5	0.634	−31.3	28.8
300	0.410	−89.9	13.964	114.5	0.042	62.3	0.513	−34.4	25.0
400	0.349	−105.7	11.119	107.0	0.050	63.3	0.441	−35.4	22.4
500	0.312	−117.4	9.205	101.9	0.057	64.9	0.397	−35.6	20.5
600	0.287	−127.0	7.841	97.8	0.065	66.2	0.372	−35.3	18.9
700	0.267	−135.2	6.821	94.5	0.074	67.5	0.356	−34.6	17.6
800	0.251	−142.7	6.025	91.6	0.082	68.7	0.346	−33.4	16.4
900	0.238	−150.3	5.396	89.0	0.090	69.4	0.336	−32.1	15.4
1000	0.230	−157.9	4.874	86.7	0.097	70.1	0.325	−30.8	14.5
1200	0.234	−171.1	4.115	82.8	0.113	70.9	0.301	−29.1	12.9
1400	0.249	−178.6	3.601	79.3	0.130	71.7	0.281	−30.1	11.8
1600	0.252	176.6	3.191	76.0	0.148	71.3	0.272	−33.1	10.7
1800	0.245	170.7	2.874	73.4	0.162	71.8	0.268	−34.0	9.8
2000	0.249	161.2	2.629	70.3	0.179	71.6	0.263	−33.5	9.0
2200	0.275	154.4	2.436	68.1	0.195	71.6	0.244	−33.8	8.3
2400	0.305	152.1	2.279	64.9	0.213	71.2	0.221	−37.8	7.8
2600	0.313	153.0	2.108	62.8	0.226	70.3	0.210	−45.2	7.1
2800	0.307	151.3	2.027	60.8	0.242	70.5	0.218	−50.4	6.8
3000	0.303	145.6	1.926	58.0	0.260	69.8	0.224	−52.0	6.3

Table 17 Noise data, I_C = 15 mA; V_{CE} = 6 V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.30	0.192	26.0	0.230
900	1.45	0.158	56.0	0.230
2000	2.05	0.202	175.0	0.180

Table 18 Common emitter scattering parameters, I_C = 20 mA; V_{CE} = 6 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.746	−19.7	32.383	161.4	0.009	80.3	0.922	−11.6	42.0
100	0.633	−45.1	27.053	142.0	0.020	69.5	0.785	−23.9	35.0
200	0.462	−75.6	19.369	122.2	0.031	64.2	0.588	−32.5	28.6
300	0.368	−96.6	14.485	111.4	0.040	63.8	0.473	−34.6	24.9
400	0.315	−112.4	11.399	104.5	0.048	65.4	0.407	−35.0	22.4
500	0.287	−123.8	9.381	99.8	0.056	66.8	0.368	−34.8	20.5
600	0.266	−133.1	7.959	96.1	0.065	68.5	0.347	−34.3	18.9
700	0.250	−140.8	6.912	93.0	0.073	69.7	0.334	−33.6	17.6
800	0.237	−148.0	6.096	90.3	0.082	70.6	0.327	−32.3	16.4
900	0.227	−155.6	5.456	87.8	0.090	71.2	0.318	−31.0	15.4
1000	0.221	−162.9	4.924	85.7	0.098	71.6	0.309	−29.6	14.5
1200	0.229	−175.5	4.154	81.9	0.114	72.2	0.287	−27.8	13.0
1400	0.244	177.8	3.629	78.6	0.132	72.8	0.268	−28.9	11.8
1600	0.249	173.6	3.215	75.3	0.150	72.3	0.259	−32.3	10.7
1800	0.241	168.2	2.897	72.7	0.164	72.4	0.256	−33.3	9.8
2000	0.247	158.9	2.647	69.9	0.182	72.1	0.251	−32.7	9.0
2200	0.274	152.5	2.453	67.7	0.199	72.1	0.232	−32.8	8.4
2400	0.303	150.4	2.295	64.5	0.217	71.6	0.209	−37.0	7.8
2600	0.311	151.6	2.124	62.5	0.230	70.6	0.198	−44.8	7.2
2800	0.305	150.1	2.040	60.5	0.246	70.7	0.206	−50.3	6.8
3000	0.299	144.4	1.937	57.7	0.264	69.9	0.212	−51.9	6.3

Table 19 Noise data, I_C = 20 mA; V_{CE} = 6 V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.45	0.154	28.0	0.250
900	1.60	0.130	63.0	0.250
2000	2.20	0.228	−175.0	0.180

Table 20 Common emitter scattering parameters, $I_C = 30$ mA; $V_{CE} = 6$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.697	−24.1	37.925	158.2	0.009	78.9	0.892	−13.3	41.4
100	0.566	−53.3	29.886	136.8	0.019	68.6	0.731	−26.0	34.5
200	0.403	−85.6	20.003	117.6	0.029	64.4	0.532	−32.7	28.2
300	0.327	−106.7	14.570	107.8	0.038	65.6	0.429	−33.4	24.6
400	0.289	−122.4	11.346	101.6	0.047	67.7	0.373	−32.9	22.1
500	0.270	−133.3	9.276	97.3	0.055	69.4	0.341	−32.4	20.2
600	0.255	−141.9	7.845	93.9	0.064	70.4	0.325	−31.9	18.7
700	0.244	−149.4	6.799	91.1	0.072	71.6	0.316	−31.2	17.4
800	0.234	−156.2	5.989	88.6	0.081	72.4	0.312	−30.1	16.2
900	0.227	−162.7	5.357	86.2	0.090	72.8	0.305	−28.9	15.2
1000	0.225	−169.8	4.834	84.1	0.098	73.3	0.298	−27.6	14.3
1200	0.237	179.3	4.075	80.6	0.115	73.5	0.278	−25.9	12.8
1400	0.253	173.8	3.557	77.4	0.133	74.0	0.261	−27.2	11.6
1600	0.257	170.2	3.151	74.2	0.151	73.3	0.253	−30.9	10.6
1800	0.250	164.5	2.838	71.6	0.166	73.3	0.250	−32.1	9.6
2000	0.259	156.0	2.596	68.8	0.184	72.9	0.245	−31.7	8.9
2200	0.286	150.5	2.406	66.6	0.201	72.7	0.227	−31.9	8.2
2400	0.313	148.9	2.249	63.5	0.220	72.1	0.204	−36.2	7.7
2600	0.321	149.8	2.080	61.4	0.233	71.1	0.193	−44.3	7.0
2800	0.316	148.3	1.998	59.4	0.249	71.0	0.202	−50.1	6.6
3000	0.311	143.0	1.899	56.7	0.267	70.2	0.208	−51.9	6.2

NPN 9 GHz wideband transistor BFS540

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability
- SOT323 envelope.

DESCRIPTION

NPN transistor in a plastic SOT323 envelope.

It is intended for RF wideband amplifier applications such as satellite TV systems and RF portable communication equipment with signal frequencies up to 2 GHz.

PINNING

PIN	DESCRIPTION
Code: N4	
1	base
2	emitter
3	collector

PIN CONFIGURATION

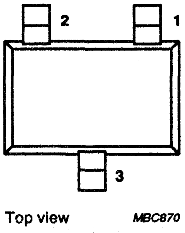


Fig.1 SOT323.

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	–	–	15	V
I_C	DC collector current		–	–	120	mA
P_{tot}	total power dissipation	up to T_s = 55 °C (note 1)	–	–	500	mW
h_{FE}	DC current gain	I_C = 40 mA; V_{CE} = 8 V; T_j = 25 °C	60	120	250	
f_T	transition frequency	I_C = 40 mA; V_{CE} = 8 V; f = 1 GHz; T_{amb} = 25 °C	–	9	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 40 mA; V_{CE} = 8 V; f = 900 MHz; T_{amb} = 25 °C	–	14	–	dB
F	noise figure	I_C = 10 mA; V_{CE} = 8 V; f = 900 MHz; T_{amb} = 25 °C	–	1.3	1.7	dB

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_{CES}	collector-emitter voltage	R_{BE} = 0	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	120	mA
P_{tot}	total power dissipation	up to T_s = 55 °C (note 1)	–	500	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C

Note

1. T_s is the temperature at the soldering point of the collector tab.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 55 °C (note 1)	190 K/W

Note

1. T_s is the temperature at the soldering point of the collector tab.

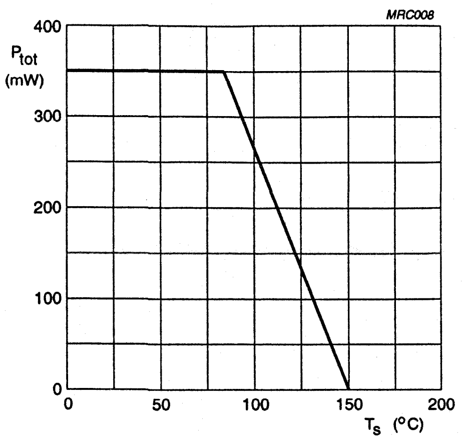
CHARACTERISTICS

T_j = 25 °C, unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CE} = 8$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 40$ mA; $V_{CE} = 8$ V	60	120	250	
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	2	–	pF
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 8$ V; f = 1 MHz	–	0.9	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 8$ V; f = 1 MHz	–	0.6	–	pF
f_T	transition frequency	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	9	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	14	–	dB
		$I_C = 40$ mA; $V_{CE} = 8$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	8	–	dB
$\|S_{21}\|^2$	insertion power gain	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 900 MHz; $T_{amb} = 25$ °C	12	13	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 10$ mA; $V_{CE} = 8$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	1.3	1.8	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 40$ mA; $V_{CE} = 8$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	1.9	2.4	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 10$ mA; $V_{CE} = 8$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	2.1	–	dB
P_{L1}	output power at 1 dB gain compression	$I_C = 40$ mA; $V_{CE} = 8$ V; $R_L = 50\ \Omega$; f = 900 MHz; $T_{amb} = 25$ °C	–	21	–	dBm
ITO	third order intercept point	note 2	–	34	–	dBm

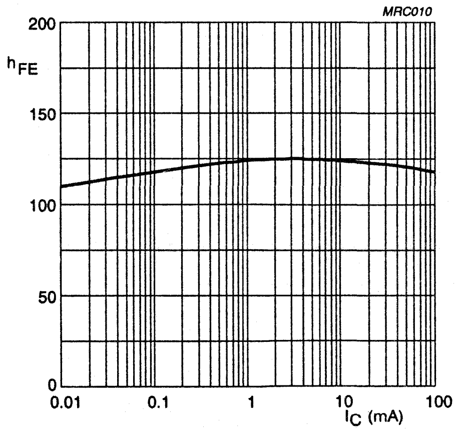
Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$ dB.
2. $I_C = 40$ mA; $V_{CE} = 8$ V; $R_L = 50\ \Omega$; f = 900 MHz; $T_{amb} = 25$ °C; $f_p = 900$ MHz; $f_q = 902$ MHz; measured at $f_{(2p-q)} = 898$ MHz and at $f_{(2p-q)} = 904$ MHz.



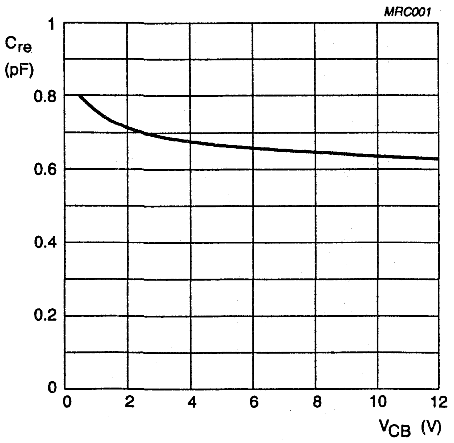
$V_{CE} \leq 10$ V.

Fig.2 Power derating curve.



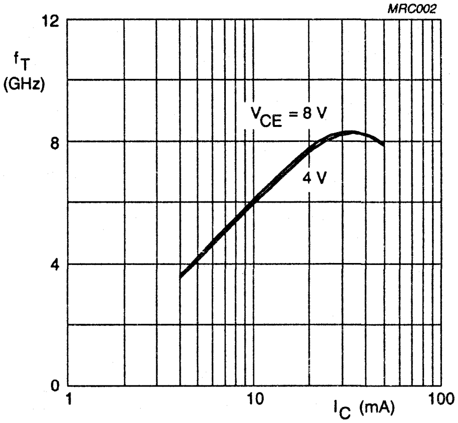
$V_{CE} = 8$ V; $T_j = 25$ °C.

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



$I_C = 0$; f = 1 MHz.

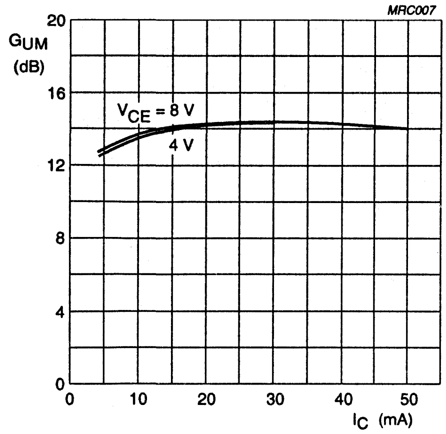
Fig.4 Feedback capacitance as a function of collector-base voltage.



f = 1 GHz; $T_{amb} = 25$ °C.

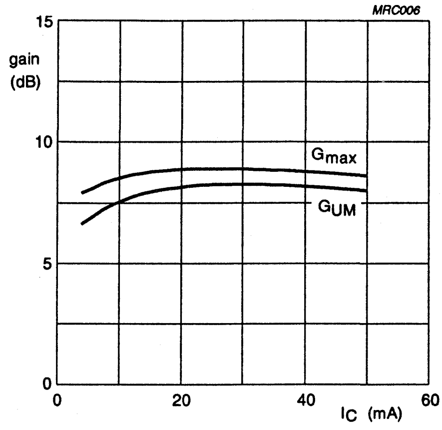
Fig.5 Transition frequency as a function of collector current.

In Figs 6 to 9, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



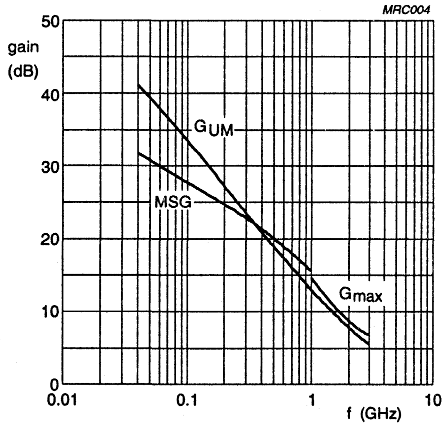
f = 900 MHz; T_{amb} = 25 °C.

Fig.6 Maximum unilateral power gain as a function of collector current.



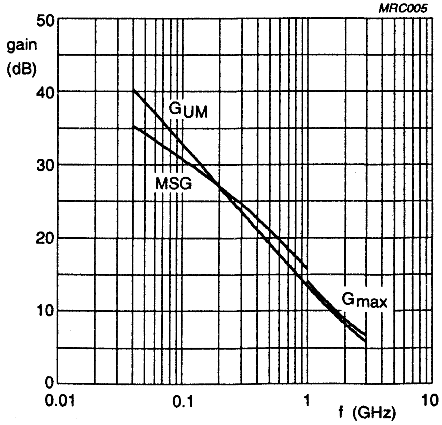
V_{CE} = 8 V; f = 2 GHz; T_{amb} = 25 °C.

Fig.7 Gain as a function of collector current.



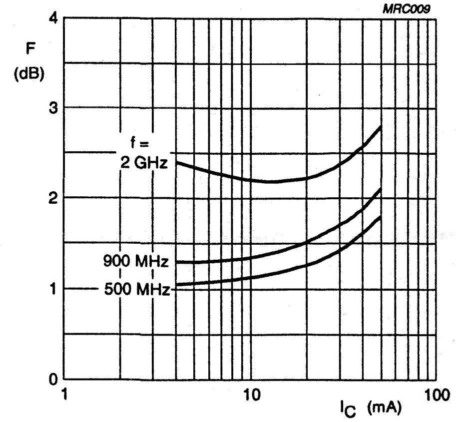
I_C = 10 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.8 Gain as a function of frequency.



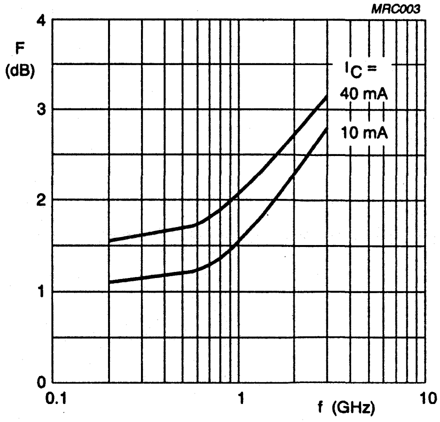
I_C = 40 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.9 Gain as a function of frequency.



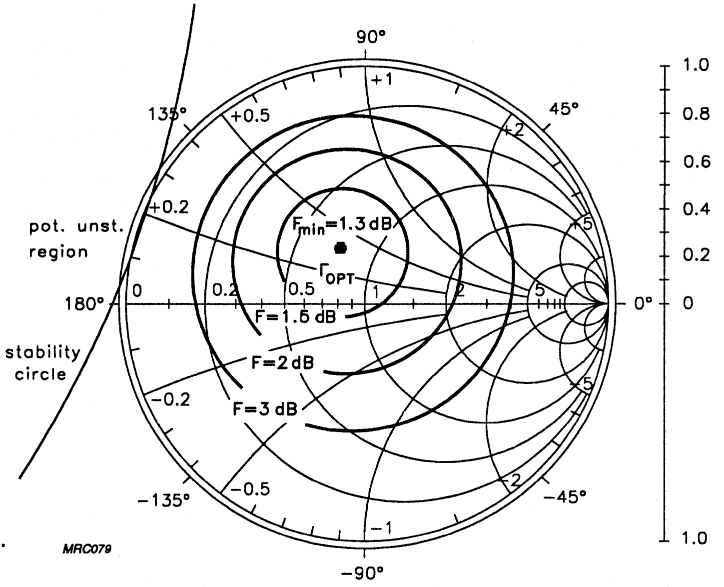
V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.10 Minimum noise figure as a function of collector current.



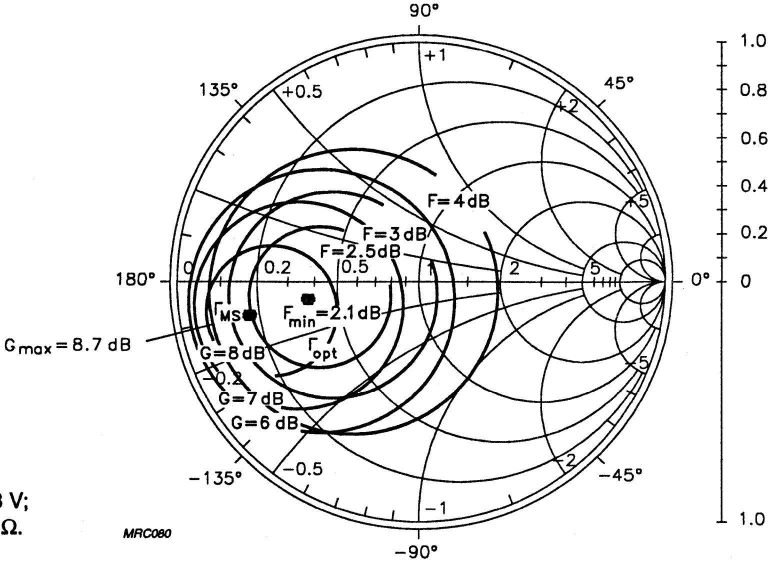
V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.11 Minimum noise figure as a function of frequency.



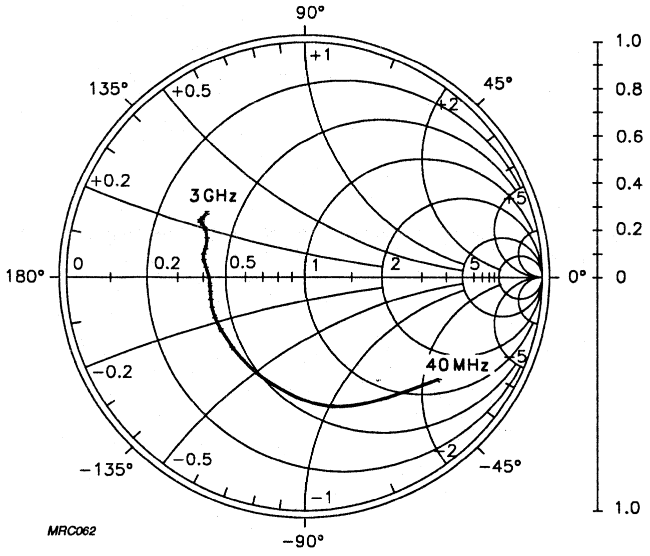
I_C = 10 mA; V_{CE} = 8 V;
f = 900 MHz; Z_O = 50 Ω.

Fig.12 Noise circle.



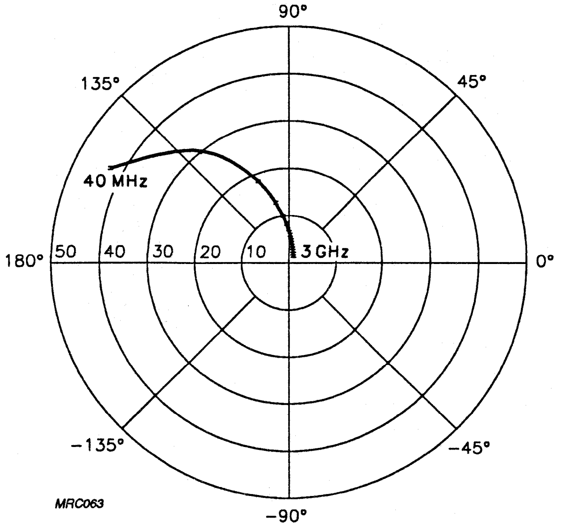
I_C = 10 mA; V_{CE} = 8 V;
f = 2 GHz; Z_O = 50 Ω.

Fig.13 Noise circle.



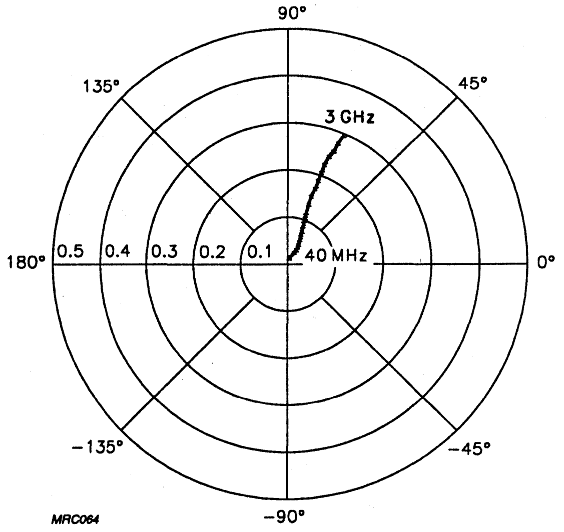
I_C = 40 mA; V_{CE} = 8 V;
Z_O = 50 Ω.

Fig.14 Common emitter input reflection coefficient (S_{11}).



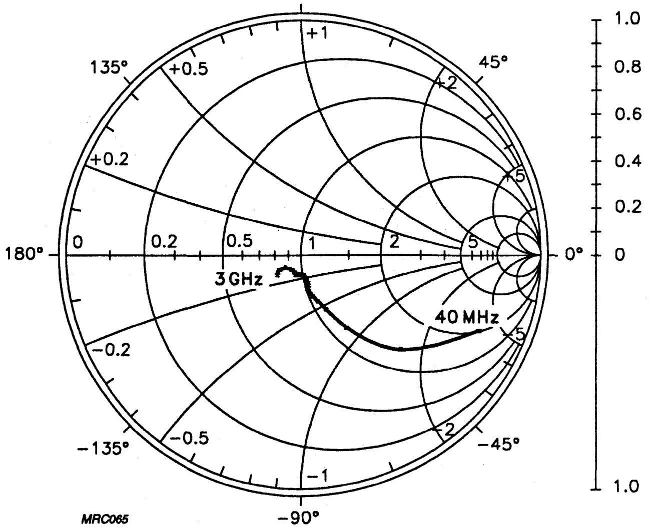
I_C = 40 mA; V_{CE} = 8 V.

Fig.15 Common emitter forward transmission coefficient (S_{21}).



I_C = 40 mA; V_{CE} = 8 V.

Fig.16 Common emitter reverse transmission coefficient (S_{12}).

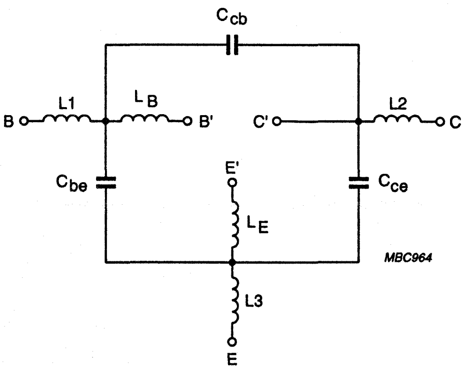


I_C = 40 mA; V_{CE} = 8 V;
Z_O = 50 Ω.

Fig.17 Common emitter output reflection coefficient (S_{22}).

SPICE parameters for BFR540 crystal

1	IS = 1.045	fA
2	BF = 184.3	–
3	NF = 981.7	m
4	VAF = 41.69	V
5	IKF = 10.00	A
6	ISE = 232.4	fA
7	NE = 2.028	–
8	BR = 43.99	–
9	NR = 992.5	m
10	VAR = 2.097	V
11	IKR = 166.2	mA
12	ISC = 129.8	aA
13	NC = 1.064	–
14	RB = 5.000	Ω
15	IRB = 1.000	µA
16	RBM = 5.000	Ω
17	RE = 353.5	mΩ
18	RC = 1.340	Ω
19 (note 1)	XTB = 0.000	–
20 (note 1)	EG = 1.110	EV
21 (note 1)	XTI = 3.000	–
22	CJE = 1.978	pF
23	VJE = 600.0	mV
24	MJE = 332.6	m
25	TF = 7.457	ps
26	XTF = 11.4	–
27	VTF = 3.158	V
28	ITF = 156.9	mA
29	PTF = 0.000	deg
30	CJC = 793.7	fF
31	VJC = 185.5	mV
32	MJC = 84.16	m
33	XCJC = 150.0	m
34	TR = 1.598	ns
35 (note 1)	CJS = 0.000	F
36 (note 1)	VJS = 750.0	mV
37 (note 1)	MJS = 0.000	–
38	FC = 814.7	m



$QL_B = 50$; $QL_E = 50$.

$QL_{B,E}(f) = QL_{B,E}\sqrt{(f/Fc)}$.

Fc = scaling frequency = 100 MHz.

Fig.18 Package equivalent circuit, SOT323.

List of components (see Fig.18)

DESIGNATION	VALUE
C_{be}	2 fF
C_{cb}	100 fF
C_{ce}	100 fF
L1	0.34 nH
L2	0.10 nH
L3	0.34 nH
L_B	0.60 nH
L_E	0.60 nH

Note

1. These parameters have not been extracted, the default values are shown.

Table 1 Common emitter scattering parameters, $I_C = 4$ mA; $V_{CE} = 4$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.909	−13.6	10.406	168.4	0.016	81.7	0.975	−7.6	41.0
100	0.863	−32.9	9.687	154.8	0.037	70.2	0.913	−17.8	33.5
200	0.768	−62.4	8.519	137.2	0.062	56.4	0.764	−30.1	26.3
300	0.688	−86.5	7.296	124.1	0.077	48.5	0.637	−37.4	22.3
400	0.637	−104.9	6.175	114.4	0.086	44.4	0.549	−42.1	19.6
500	0.606	−118.6	5.313	107.3	0.091	42.3	0.487	−45.1	17.7
600	0.582	−129.4	4.640	101.6	0.096	41.8	0.447	−46.8	16.1
700	0.563	−137.9	4.102	96.8	0.100	42.1	0.420	−47.7	14.8
800	0.547	−145.0	3.660	92.8	0.104	43.1	0.399	−47.9	13.6
900	0.536	−151.5	3.300	89.3	0.107	44.2	0.380	−47.9	12.5
1000	0.530	−157.5	2.999	86.1	0.110	45.7	0.363	−47.9	11.6
1200	0.533	−167.5	2.555	80.6	0.116	49.2	0.329	−49.1	10.1
1400	0.545	−174.6	2.251	75.7	0.124	53.0	0.308	−52.4	9.0
1600	0.549	179.9	2.012	71.2	0.135	55.9	0.301	−56.9	8.0
1800	0.550	174.6	1.830	67.7	0.144	59.3	0.298	−59.8	7.2
2000	0.559	168.9	1.684	64.3	0.156	62.4	0.291	−62.2	6.5
2200	0.578	163.6	1.561	61.4	0.169	65.3	0.275	−66.5	6.0
2400	0.601	159.9	1.455	57.7	0.184	67.4	0.266	−74.0	5.5
2600	0.614	157.6	1.355	54.8	0.197	68.4	0.273	−82.1	5.0
2800	0.614	154.7	1.309	52.1	0.213	70.0	0.291	−86.6	4.8
3000	0.614	150.3	1.256	49.3	0.233	70.9	0.298	−89.3	4.4

Table 2 Common emitter scattering parameters, I_C = 10 mA; V_{CE} = 4 V

f (MHz)	S_{11} MAG. (RAT)	S_{11} ANG. (DEG)	S_{21} MAG. (RAT)	S_{21} ANG. (DEG)	S_{12} MAG. (RAT)	S_{12} ANG. (DEG)	S_{22} MAG. (RAT)	S_{22} ANG. (DEG)	G_{UM} (dB)
40	0.806	−22.1	22.248	162.2	0.015	77.7	0.935	−14.3	40.5
100	0.719	−51.7	19.148	143.7	0.032	64.2	0.790	−30.8	33.0
200	0.586	−90.5	14.458	123.2	0.048	53.9	0.564	−45.8	26.7
300	0.525	−115.2	10.993	111.5	0.057	51.5	0.427	−53.2	23.1
400	0.500	−131.3	8.703	104.0	0.064	51.9	0.346	−57.9	20.6
500	0.488	−141.9	7.190	98.8	0.071	53.2	0.298	−61.0	18.7
600	0.479	−149.8	6.117	94.6	0.078	54.9	0.268	−62.6	17.2
700	0.470	−156.2	5.321	91.2	0.086	56.9	0.248	−63.2	15.9
800	0.463	−161.7	4.704	88.2	0.093	58.6	0.233	−62.7	14.7
900	0.459	−166.8	4.214	85.6	0.101	59.9	0.218	−62.0	13.7
1000	0.458	−171.6	3.809	83.3	0.108	61.4	0.202	−61.4	12.8
1200	0.470	−179.2	3.211	79.1	0.123	63.7	0.173	−62.4	11.3
1400	0.484	175.8	2.807	75.2	0.139	65.5	0.157	−67.6	10.2
1600	0.488	171.8	2.499	71.4	0.156	66.0	0.154	−74.4	9.2
1800	0.488	167.4	2.266	68.3	0.171	67.0	0.153	−77.0	8.4
2000	0.496	162.1	2.085	65.4	0.189	67.8	0.145	−78.7	7.7
2200	0.517	157.7	1.930	63.1	0.205	68.7	0.132	−84.9	7.1
2400	0.541	154.9	1.797	59.7	0.222	68.8	0.130	−98.0	6.7
2600	0.553	153.8	1.667	57.1	0.235	68.2	0.145	−108.8	6.1
2800	0.551	151.8	1.607	54.5	0.252	68.4	0.166	−110.9	5.8
3000	0.546	147.8	1.541	51.6	0.272	68.1	0.173	−111.6	5.4

Table 3 Noise data, I_C = 10 mA; V_{CE} = 4 V

f (MHz)	F_{min} (dB)	Γ_{opt} (RAT)	Γ_{opt} (DEG)	R_n
500	1.10	0.159	78.0	0.140
900	1.30	0.234	133.0	0.140
2000	2.10	0.520	−165.0	0.070

Table 4 Common emitter scattering parameters, $I_C = 20$ mA; $V_{CE} = 4$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.693	−32.8	35.366	155.7	0.014	74.2	0.875	−21.1	40.1
100	0.578	−72.6	27.190	133.1	0.027	61.3	0.659	−41.6	32.9
200	0.478	−113.0	17.616	113.9	0.039	56.2	0.421	−57.1	26.9
300	0.453	−134.1	12.631	104.6	0.048	57.5	0.303	−64.9	23.4
400	0.447	−147.0	9.759	98.7	0.057	60.1	0.241	−70.8	21.0
500	0.444	−154.9	7.960	94.6	0.065	62.0	0.206	−75.0	19.2
600	0.440	−161.0	6.724	91.3	0.074	63.7	0.185	−77.6	17.6
700	0.437	−166.1	5.824	88.5	0.083	65.3	0.171	−78.6	16.4
800	0.432	−170.6	5.137	86.0	0.093	66.6	0.159	−78.2	15.2
900	0.431	−175.0	4.595	83.8	0.103	67.4	0.146	−77.6	14.2
1000	0.432	−179.1	4.147	81.8	0.112	68.2	0.133	−77.7	13.3
1200	0.447	174.5	3.489	78.2	0.130	69.4	0.106	−81.8	11.9
1400	0.461	170.7	3.043	74.7	0.149	70.2	0.097	−91.8	10.7
1600	0.465	167.5	2.702	71.2	0.168	69.5	0.102	−100.8	9.7
1800	0.465	163.5	2.450	68.4	0.184	69.9	0.102	−103.7	8.9
2000	0.472	158.6	2.252	65.8	0.204	69.7	0.095	−106.5	8.2
2200	0.495	154.5	2.084	63.7	0.222	70.0	0.087	−118.3	7.6
2400	0.519	152.1	1.939	60.5	0.240	69.5	0.099	−134.3	7.2
2600	0.531	151.5	1.795	58.0	0.253	68.5	0.124	−140.6	6.6
2800	0.526	149.8	1.729	55.5	0.270	68.2	0.142	−138.3	6.3
3000	0.520	146.2	1.657	52.7	0.291	67.3	0.146	−137.2	5.9

Table 5 Noise data, $I_C = 20$ mA; $V_{CE} = 4$ V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.25	0.104	123.0	0.140
900	1.50	0.225	153.0	0.140
2000	2.20	0.487	−160.0	0.090

Table 6 Common emitter scattering parameters, $I_C = 30$ mA; $V_{CE} = 4$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.630	−40.6	42.829	151.5	0.013	72.5	0.830	−25.1	39.9
100	0.516	−84.8	30.299	127.6	0.025	60.8	0.584	−46.9	32.8
200	0.446	−123.5	18.450	110.0	0.036	58.4	0.357	−62.3	26.9
300	0.434	−142.4	13.000	101.8	0.045	61.0	0.253	−70.6	23.5
400	0.434	−153.5	9.980	96.6	0.055	63.5	0.201	−77.3	21.1
500	0.435	−160.3	8.111	92.9	0.064	65.6	0.172	−82.4	19.2
600	0.433	−165.6	6.837	89.9	0.074	67.1	0.157	−85.5	17.7
700	0.430	−170.1	5.916	87.3	0.084	68.5	0.146	−86.8	16.4
800	0.426	−174.1	5.213	84.9	0.094	69.3	0.135	−86.4	15.3
900	0.426	−178.2	4.664	82.9	0.104	69.9	0.123	−86.3	14.3
1000	0.429	178.1	4.208	81.0	0.113	70.4	0.111	−87.0	13.4
1200	0.445	172.3	3.540	77.6	0.133	71.1	0.087	−94.2	12.0
1400	0.459	168.7	3.085	74.4	0.152	71.6	0.083	−107.0	10.8
1600	0.462	165.8	2.735	70.8	0.172	70.7	0.092	−115.8	9.8
1800	0.462	162.0	2.480	68.2	0.189	70.7	0.093	−118.4	9.0
2000	0.470	157.2	2.281	65.6	0.210	70.4	0.086	−122.0	8.3
2200	0.492	153.1	2.111	63.5	0.228	70.4	0.084	−135.5	7.7
2400	0.517	151.0	1.964	60.4	0.246	69.8	0.102	−149.1	7.3
2600	0.527	150.6	1.816	58.0	0.260	68.6	0.128	−152.2	6.7
2800	0.523	149.0	1.748	55.4	0.277	68.2	0.143	−148.5	6.3
3000	0.516	145.3	1.677	52.6	0.298	67.2	0.146	−147.4	5.9

Table 7 Noise data, $I_C = 30$ mA; $V_{CE} = 4$ V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.45	0.129	150.0	0.140
900	1.70	0.235	163.0	0.150
2000	2.40	0.488	−154.0	0.120

Table 8 Common emitter scattering parameters, $I_C = 40$ mA; $V_{CE} = 4$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.587	−47.0	47.166	148.3	0.013	71.2	0.789	−27.8	39.5
100	0.484	−93.5	31.466	124.0	0.024	60.7	0.532	−50.0	32.6
200	0.435	−130.5	18.561	107.7	0.034	59.9	0.317	−65.0	26.7
300	0.432	−147.6	12.969	100.1	0.044	62.8	0.223	−73.4	23.4
400	0.434	−157.5	9.921	95.3	0.054	65.7	0.177	−80.7	21.0
500	0.436	−163.6	8.049	91.8	0.063	67.5	0.154	−86.2	19.1
600	0.435	−168.4	6.777	88.9	0.073	68.8	0.141	−89.5	17.6
700	0.432	−172.5	5.864	86.4	0.084	69.9	0.132	−90.8	16.3
800	0.430	−176.4	5.166	84.2	0.094	70.7	0.123	−90.4	15.2
900	0.430	179.8	4.618	82.1	0.104	71.1	0.112	−90.5	14.2
1000	0.433	176.3	4.170	80.3	0.114	71.5	0.100	−91.7	13.3
1200	0.450	170.9	3.505	77.1	0.134	72.1	0.079	−100.5	11.9
1400	0.464	167.6	3.052	73.8	0.154	72.4	0.078	−114.4	10.8
1600	0.467	164.7	2.709	70.4	0.174	71.4	0.088	−122.5	9.8
1800	0.466	161.0	2.456	67.7	0.191	71.2	0.090	−124.6	8.9
2000	0.474	156.4	2.259	65.1	0.212	70.7	0.084	−128.8	8.2
2200	0.498	152.4	2.092	63.1	0.230	70.7	0.084	−142.4	7.7
2400	0.522	150.4	1.945	60.1	0.250	70.1	0.104	−154.4	7.2
2600	0.532	150.1	1.799	57.6	0.262	68.7	0.130	−156.4	6.6
2800	0.528	148.4	1.732	55.0	0.280	68.3	0.145	−152.2	6.3
3000	0.521	144.7	1.661	52.2	0.301	67.3	0.148	−151.0	5.9

Table 9 Noise data, $I_C = 40$ mA; $V_{CE} = 4$ V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.60	0.153	164.0	0.150
900	1.90	0.253	170.0	0.160
2000	2.60	0.496	−152.0	0.140

Table 10 Common emitter scattering parameters, $I_C = 50$ mA; $V_{CE} = 4$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.556	−52.7	48.898	146.0	0.012	70.2	0.756	−29.7	39.1
100	0.470	−100.6	31.374	121.7	0.023	60.0	0.493	−51.9	32.2
200	0.437	−135.7	18.167	106.1	0.034	60.5	0.289	−66.3	26.5
300	0.438	−151.4	12.630	99.0	0.043	64.1	0.203	−74.7	23.1
400	0.443	−160.5	9.644	94.3	0.053	66.7	0.162	−82.0	20.7
500	0.446	−166.2	7.812	90.9	0.063	68.5	0.141	−87.7	18.9
600	0.446	−170.6	6.579	88.1	0.073	69.8	0.131	−91.0	17.4
700	0.443	−174.5	5.688	85.7	0.084	70.7	0.123	−92.1	16.1
800	0.440	−178.1	5.013	83.5	0.094	71.5	0.115	−91.7	15.0
900	0.442	178.4	4.480	81.5	0.104	71.8	0.105	−91.7	14.0
1000	0.445	175.0	4.045	79.7	0.114	72.1	0.094	−93.0	13.1
1200	0.461	169.9	3.402	76.4	0.134	72.6	0.075	−102.6	11.7
1400	0.475	166.7	2.964	73.1	0.155	72.7	0.075	−116.9	10.6
1600	0.479	163.8	2.631	69.7	0.175	71.7	0.087	−124.6	9.6
1800	0.479	160.1	2.385	67.0	0.192	71.5	0.089	−126.5	8.7
2000	0.488	155.7	2.196	64.3	0.213	71.0	0.084	−130.7	8.0
2200	0.510	151.9	2.032	62.3	0.232	71.0	0.085	−143.9	7.5
2400	0.534	149.8	1.890	59.3	0.251	70.3	0.106	−155.5	7.0
2600	0.544	149.3	1.749	56.8	0.264	69.0	0.132	−157.0	6.5
2800	0.539	147.7	1.683	54.3	0.281	68.4	0.147	−152.8	6.1
3000	0.533	144.1	1.617	51.4	0.303	67.5	0.150	−151.7	5.7

Table 11 Common emitter scattering parameters, I_C = 4 mA; V_{CE} = 8 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.925	−12.8	10.157	169.0	0.015	82.3	0.974	−7.0	41.5
100	0.882	−30.9	9.500	155.9	0.036	71.0	0.919	−16.6	34.2
200	0.787	−58.9	8.419	138.7	0.061	57.6	0.780	−28.4	26.8
300	0.703	−82.2	7.281	125.7	0.076	49.7	0.659	−35.6	22.7
400	0.646	−100.3	6.211	116.0	0.086	45.3	0.571	−40.3	19.9
500	0.611	−114.0	5.371	108.7	0.092	42.8	0.509	−43.4	17.9
600	0.583	−125.0	4.704	102.9	0.097	42.1	0.467	−45.1	16.3
700	0.561	−133.9	4.169	98.1	0.100	42.3	0.438	−46.0	15.0
800	0.543	−141.3	3.723	94.0	0.104	43.1	0.416	−46.2	13.8
900	0.529	−148.0	3.365	90.4	0.107	44.1	0.397	−46.3	12.7
1000	0.521	−154.3	3.057	87.2	0.110	45.4	0.379	−46.2	11.8
1200	0.521	−164.8	2.605	81.6	0.116	48.6	0.344	−47.2	10.2
1400	0.532	−172.2	2.296	76.6	0.124	52.2	0.323	−50.2	9.1
1600	0.537	−177.9	2.053	72.1	0.134	55.1	0.314	−54.4	8.2
1800	0.537	176.5	1.867	68.5	0.142	58.6	0.310	−57.1	7.3
2000	0.544	170.6	1.717	65.1	0.154	61.6	0.302	−59.3	6.6
2200	0.563	165.1	1.593	62.2	0.166	64.7	0.286	−63.2	6.1
2400	0.586	161.2	1.486	58.4	0.180	66.7	0.275	−70.3	5.6
2600	0.599	158.9	1.384	55.5	0.193	67.9	0.280	−78.2	5.1
2800	0.601	155.9	1.337	52.8	0.208	69.7	0.297	−82.7	4.9
3000	0.599	151.5	1.281	50.0	0.228	70.6	0.303	−85.4	4.5

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Table 12 Common emitter scattering parameters, I_C = 10 mA; V_{CE} = 8 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.849	−20.0	21.314	163.4	0.014	78.4	0.936	−12.9	41.2
100	0.762	−46.9	18.589	145.8	0.032	65.6	0.809	−28.3	33.8
200	0.619	−83.1	14.351	125.5	0.049	54.5	0.593	−43.0	27.1
300	0.541	−107.5	11.062	113.6	0.058	51.4	0.456	−50.5	23.4
400	0.504	−124.1	8.822	105.8	0.066	51.3	0.372	−55.2	20.8
500	0.485	−135.6	7.317	100.3	0.073	52.2	0.320	−58.2	18.9
600	0.471	−144.1	6.243	96.0	0.080	53.7	0.288	−59.8	17.4
700	0.459	−151.1	5.435	92.4	0.087	55.6	0.267	−60.3	16.1
800	0.450	−157.0	4.808	89.4	0.094	57.4	0.250	−59.7	14.9
900	0.443	−162.6	4.310	86.7	0.101	58.7	0.234	−59.0	13.9
1000	0.441	−167.8	3.895	84.2	0.108	60.0	0.218	−58.3	13.0
1200	0.451	−176.1	3.291	80.0	0.123	62.4	0.187	−58.7	11.5
1400	0.465	178.3	2.879	76.0	0.138	64.3	0.169	−63.0	10.4
1600	0.469	174.2	2.560	72.2	0.154	64.8	0.165	−69.2	9.4
1800	0.469	169.6	2.322	69.1	0.168	66.1	0.162	−71.6	8.5
2000	0.475	164.0	2.134	66.1	0.186	66.9	0.154	−72.8	7.8
2200	0.496	159.3	1.974	63.7	0.201	67.8	0.139	−78.1	7.2
2400	0.521	156.3	1.839	60.4	0.218	68.0	0.133	−90.4	6.7
2600	0.534	155.2	1.707	57.7	0.231	67.5	0.145	−101.6	6.2
2800	0.532	153.3	1.644	55.1	0.247	67.8	0.164	−104.5	5.9
3000	0.527	149.3	1.577	52.3	0.266	67.6	0.171	−105.4	5.5

Table 13 Noise data, I_C = 10 mA; V_{CE} = 8 V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.10	0.225	59.0	0.170
900	1.30	0.255	113.0	0.160
2000	2.10	0.459	−171.0	0.100

Table 14 Common emitter scattering parameters, I_C = 20 mA; V_{CE} = 8 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.778	−28.1	32.958	157.8	0.014	75.8	0.882	−18.5	40.9
100	0.651	−63.0	26.163	136.4	0.028	62.1	0.692	−37.7	33.6
200	0.510	−101.6	17.548	116.6	0.041	55.6	0.458	−53.1	27.2
300	0.460	−124.0	12.748	106.7	0.050	56.0	0.334	−60.7	23.7
400	0.442	−138.4	9.905	100.5	0.059	57.8	0.266	−66.1	21.2
500	0.433	−147.6	8.105	96.0	0.067	59.9	0.227	−69.9	19.3
600	0.426	−154.6	6.857	92.5	0.076	61.7	0.204	−72.2	17.8
700	0.419	−160.5	5.945	89.6	0.084	63.4	0.188	−72.9	16.5
800	0.412	−165.5	5.243	87.0	0.094	64.7	0.175	−72.3	15.3
900	0.410	−170.4	4.693	84.7	0.103	65.6	0.161	−71.5	14.3
1000	0.410	−175.0	4.238	82.6	0.111	66.3	0.147	−71.0	13.4
1200	0.424	177.8	3.569	78.9	0.129	67.8	0.118	−73.3	12.0
1400	0.437	173.4	3.110	75.4	0.147	68.7	0.105	−81.6	10.8
1600	0.442	170.0	2.763	71.8	0.166	68.2	0.106	−90.4	9.8
1800	0.441	165.8	2.505	69.1	0.182	68.7	0.105	−93.1	9.0
2000	0.448	160.6	2.301	66.3	0.201	68.7	0.097	−95.1	8.3
2200	0.469	156.1	2.129	64.1	0.218	69.0	0.086	−105.4	7.7
2400	0.495	153.6	1.981	61.0	0.237	68.6	0.092	−123.3	7.2
2600	0.507	153.1	1.835	58.4	0.249	67.6	0.114	−132.2	6.6
2800	0.503	151.5	1.765	55.9	0.266	67.5	0.132	−130.8	6.3
3000	0.498	147.7	1.691	53.1	0.286	66.7	0.137	−130.0	5.9

Table 15 Noise data, I_C = 20 mA; V_{CE} = 8 V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.25	0.156	64.0	0.180
900	1.50	0.206	121.0	0.170
2000	2.20	0.413	−167.0	0.120

Table 16 Common emitter scattering parameters, I_C = 30 mA; V_{CE} = 8 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.739	−33.5	39.365	154.4	0.013	73.4	0.841	−21.6	40.7
100	0.596	−72.0	29.173	131.4	0.026	61.2	0.625	−42.1	33.4
200	0.472	−110.3	18.416	112.8	0.038	56.9	0.396	−57.2	27.1
300	0.436	−131.4	13.127	103.9	0.047	58.5	0.284	−64.8	23.6
400	0.423	−144.6	10.122	98.3	0.056	60.8	0.226	−70.6	21.2
500	0.419	−152.8	8.246	94.3	0.065	62.9	0.193	−74.8	19.3
600	0.414	−159.0	6.963	91.1	0.075	64.6	0.174	−77.4	17.8
700	0.408	−164.3	6.028	88.3	0.084	66.1	0.151	−78.3	16.5
800	0.403	−169.0	5.315	85.9	0.094	67.2	0.149	−77.6	15.4
900	0.401	−173.5	4.753	83.7	0.104	67.8	0.137	−77.0	14.4
1000	0.403	−177.9	4.293	81.8	0.113	68.6	0.123	−76.6	13.5
1200	0.418	175.5	3.610	78.3	0.131	69.4	0.097	−80.7	12.0
1400	0.432	171.5	3.149	74.8	0.151	70.2	0.087	−91.5	10.9
1600	0.436	168.2	2.792	71.4	0.170	69.4	0.092	−101.3	9.9
1800	0.435	164.3	2.531	68.6	0.186	69.6	0.092	−104.1	9.0
2000	0.442	159.1	2.326	65.9	0.206	69.3	0.084	−106.8	8.3
2200	0.465	154.7	2.153	63.8	0.224	69.4	0.076	−120.0	7.7
2400	0.489	152.6	2.002	60.7	0.242	68.9	0.088	−137.5	7.3
2600	0.502	152.2	1.854	58.3	0.255	67.7	0.113	−143.5	6.7
2800	0.498	150.7	1.783	55.7	0.272	67.4	0.129	−140.3	6.3
3000	0.492	147.0	1.708	52.9	0.292	66.6	0.133	−139.2	5.9

Table 17 Noise data, I_C = 30 mA; V_{CE} = 8 V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.45	0.133	68.0	0.200
900	1.70	0.191	122.0	0.190
2000	2.40	0.405	−166.0	0.140

Table 18 Common emitter scattering parameters, $I_C = 40$ mA; $V_{CE} = 8$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.716	−37.3	42.648	152.1	0.013	71.9	0.809	−23.4	40.3
100	0.567	−77.7	30.194	128.4	0.025	60.6	0.581	−44.1	33.1
200	0.456	−115.7	18.486	110.8	0.037	57.8	0.360	−58.5	27.0
300	0.427	−135.8	13.056	102.4	0.046	59.9	0.257	−65.6	23.5
400	0.419	−148.1	10.036	97.0	0.055	62.6	0.204	−71.2	21.1
500	0.416	−155.8	8.162	93.2	0.064	64.6	0.175	−75.5	19.2
600	0.412	−161.7	6.882	90.1	0.074	66.1	0.159	−78.0	17.7
700	0.407	−166.6	5.957	87.5	0.084	67.4	0.147	−78.6	16.4
800	0.403	−171.0	5.251	85.1	0.094	68.4	0.137	−77.8	15.3
900	0.402	−175.4	4.693	83.0	0.104	68.9	0.126	−76.9	14.3
1000	0.404	−179.5	4.236	81.1	0.113	69.6	0.114	−76.6	13.4
1200	0.419	174.2	3.556	77.6	0.132	70.3	0.089	−80.8	11.9
1400	0.433	170.3	3.105	74.2	0.152	70.8	0.080	−92.6	10.8
1600	0.438	167.3	2.758	70.7	0.171	69.9	0.086	−103.0	9.8
1800	0.437	163.5	2.499	68.0	0.188	70.0	0.086	−105.4	8.9
2000	0.444	158.3	2.296	65.3	0.208	69.7	0.079	−108.1	8.2
2200	0.467	154.2	2.125	63.2	0.226	69.6	0.072	−122.1	7.6
2400	0.492	152.1	1.977	60.1	0.244	69.0	0.086	−139.9	7.2
2600	0.504	151.6	1.830	57.6	0.257	67.9	0.111	−145.4	6.6
2800	0.500	150.1	1.761	55.1	0.274	67.5	0.127	−141.8	6.2
3000	0.494	146.5	1.688	52.3	0.294	66.6	0.130	−140.4	5.8

Table 19 Noise data, $I_C = 40$ mA; $V_{CE} = 8$ V

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.60	0.123	72.0	0.240
900	1.90	0.184	127.0	0.230
2000	2.60	0.400	−164.0	0.170

Table 20 Common emitter scattering parameters, I_C = 50 mA; V_{CE} = 8 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.700	−40.1	43.866	150.6	0.013	71.1	0.780	−24.3	39.8
100	0.551	−81.9	30.164	126.6	0.025	60.3	0.550	−44.7	32.7
200	0.451	−119.5	18.142	109.4	0.036	58.0	0.337	−57.9	26.7
300	0.426	−138.8	12.750	101.3	0.045	60.8	0.241	−64.1	23.2
400	0.422	−150.6	9.777	96.1	0.055	63.6	0.191	−69.1	20.8
500	0.420	−157.8	7.942	92.4	0.064	65.3	0.165	−72.9	19.0
600	0.416	−163.4	6.693	89.4	0.074	66.8	0.151	−75.0	17.4
700	0.412	−168.1	5.789	86.8	0.083	68.1	0.141	−75.5	16.1
800	0.408	−172.5	5.103	84.4	0.093	69.0	0.133	−74.3	15.0
900	0.408	−176.6	4.563	82.3	0.104	69.5	0.123	−73.1	14.0
1000	0.410	179.4	4.118	80.4	0.113	70.0	0.111	−72.4	13.1
1200	0.426	173.4	3.468	76.9	0.132	70.8	0.088	−75.7	11.7
1400	0.440	169.7	3.024	73.5	0.152	71.1	0.078	−87.2	10.6
1600	0.444	166.6	2.682	70.0	0.171	70.3	0.084	−97.8	9.6
1800	0.444	162.8	2.430	67.2	0.188	70.3	0.085	−100.3	8.7
2000	0.452	157.7	2.235	64.5	0.208	69.9	0.078	−102.8	8.0
2200	0.474	153.7	2.070	62.4	0.226	69.9	0.070	−116.6	7.4
2400	0.500	151.6	1.927	59.3	0.244	69.3	0.082	−135.5	7.0
2600	0.513	151.1	1.781	56.8	0.257	68.1	0.107	−141.7	6.4
2800	0.508	149.7	1.714	54.2	0.274	67.8	0.124	−138.6	6.0
3000	0.502	146.0	1.644	51.3	0.295	66.8	0.128	−137.2	5.7

NPN 2 GHz wideband transistor BFT25

DESCRIPTION

NPN transistor in a plastic SOT23 envelope.

It is primarily intended for use in RF low power amplifiers, such as in pocket phones, paging systems, etc. The transistor features low current consumption (100 µA to 1 mA); due to its high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

PINNING

PIN	DESCRIPTION
Code: V1p	
1	base
2	emitter
3	collector

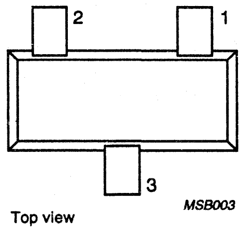


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	8	V
V_{CEO}	collector-emitter voltage	open base	–	5	V
I_C	DC collector current		–	6.5	mA
P_{tot}	total power dissipation	up to T_s = 142 °C (note 1)	–	30	mW
f_T	transition frequency	I_C = 1 mA; V_{CE} = 1 V; f = 500 MHz; T_j = 25 °C	2.3	–	GHz
C_{re}	feedback capacitance	I_C = 1 mA; V_{CE} = 1 V; f = 1 MHz; T_{amb} = 25 °C	–	0.45	pF
G_{UM}	maximum unilateral power gain	I_C = 1 mA; V_{CE} = 1 V; f = 500 MHz; T_{amb} = 25 °C	18	–	dB
F	noise figure	I_C = 1 mA; V_{CE} = 1 V; f = 500 MHz; T_{amb} = 25 °C	3.8	–	dB

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	8	V
V_{CEO}	collector-emitter voltage	open base	–	5	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	6.5	mA
I_{CM}	peak collector current	f > 1 MHz	–	10	mA
P_{tot}	total power dissipation	up to T_s = 142 °C (note 1)	–	30	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C

Note

1. T_s is the temperature at the soldering point of the collector tab.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 142 °C (note 1)	260 K/W

Note

1. T_s is the temperature at the soldering point of the collector tab.

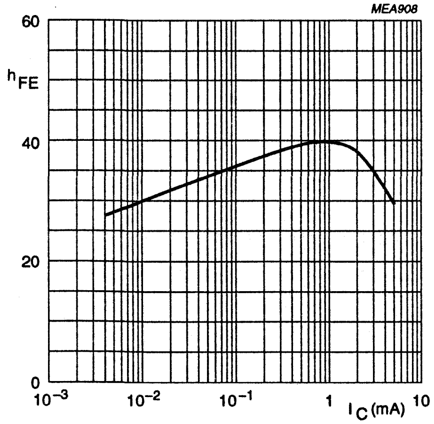
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 5$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 10$ µA; $V_{CE} = 1$ V	20	30	–	
		$I_C = 1$ mA; $V_{CE} = 1$ V	20	40	–	
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 1$ V; f = 500 MHz	1.2	2.3	–	GHz
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 0.5$ V; f = 1 MHz	–	–	0.6	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0$; f = 1 MHz	–	–	0.5	pF
C_{re}	feedback capacitance	$I_C = 1$ mA; $V_{CE} = 1$ V; f = 1 MHz; $T_{amb} = 25$ °C	–	–	0.45	pF
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 1$ mA; $V_{CE} = 1$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	18	–	dB
		$I_C = 1$ mA; $V_{CE} = 1$ V; f = 800 MHz; $T_{amb} = 25$ °C	–	12	–	dB
F	noise figure	$I_C = 0.1$ mA; $V_{CE} = 1$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	5.5	–	dB
		$I_C = 1$ mA; $V_{CE} = 1$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	3.8	–	dB

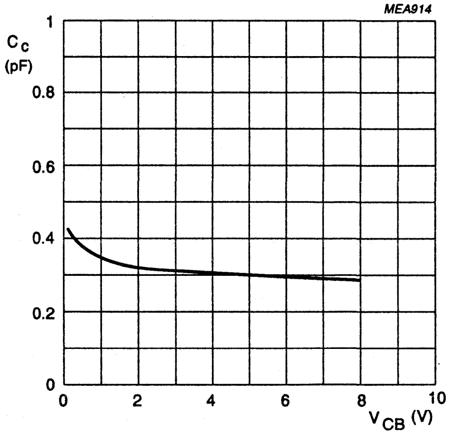
Note

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$ dB.



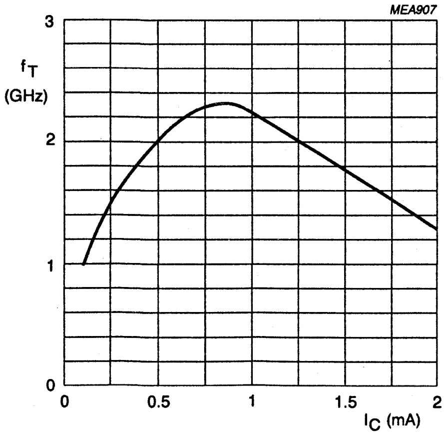
V_{CE} = 1 V; T_j = 25 °C.

Fig.2 DC current gain as a function of collector current.



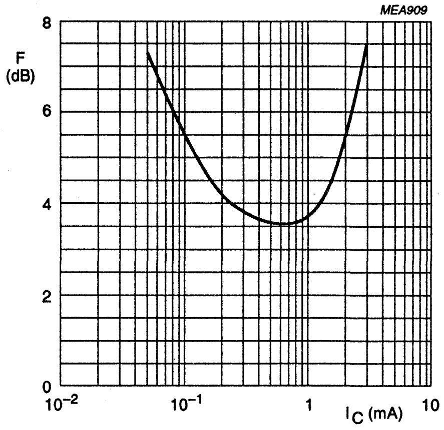
$I_E = i_e = 0$; f = 1 MHz; T_j = 25 °C.

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



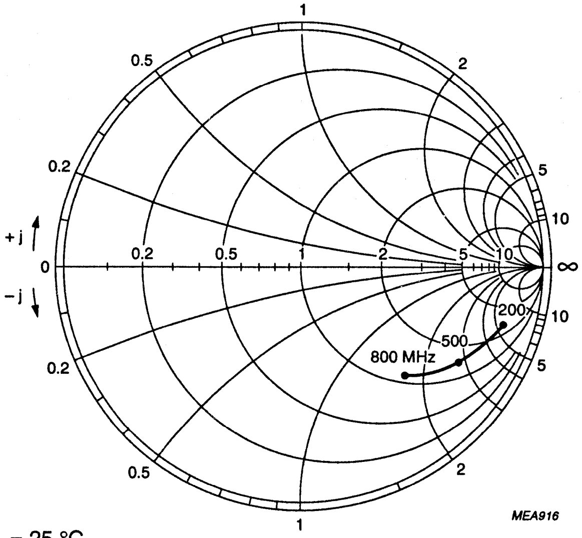
V_{CE} = 1 V; f = 500 MHz; T_j = 25 °C.

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



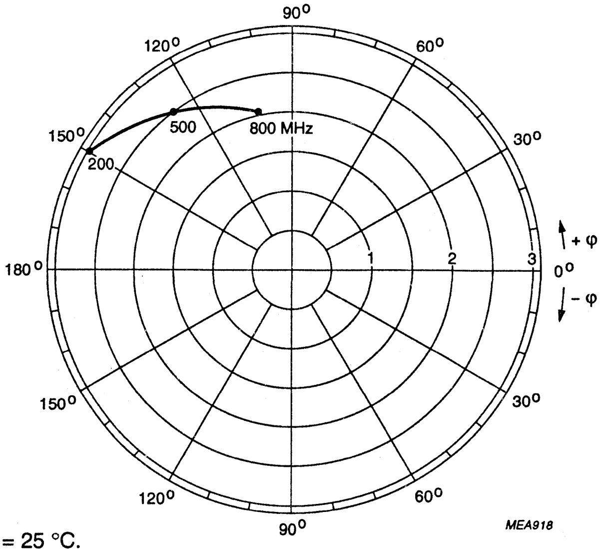
V_{CE} = 1 V; Z_S = opt.; f = 500 MHz; T_{amb} = 25 °C.

Fig.5 Minimum noise figure as a function of collector current.



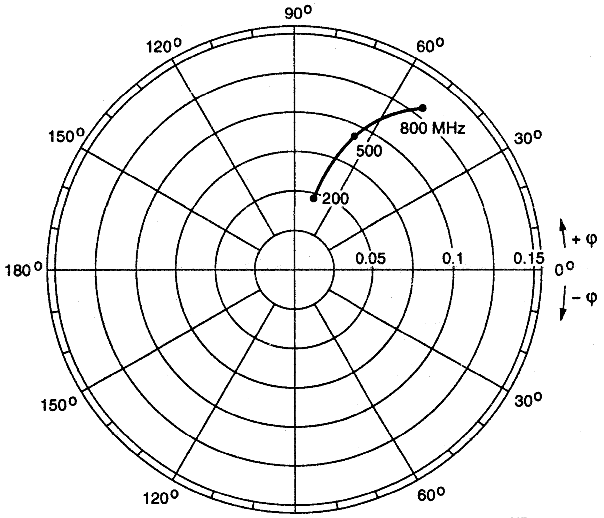
$I_C = 1$ mA; $V_{CE} = 1$ V; $T_{amb} = 25$ °C.

Fig.6 Common emitter input reflection coefficient (S_{11}).



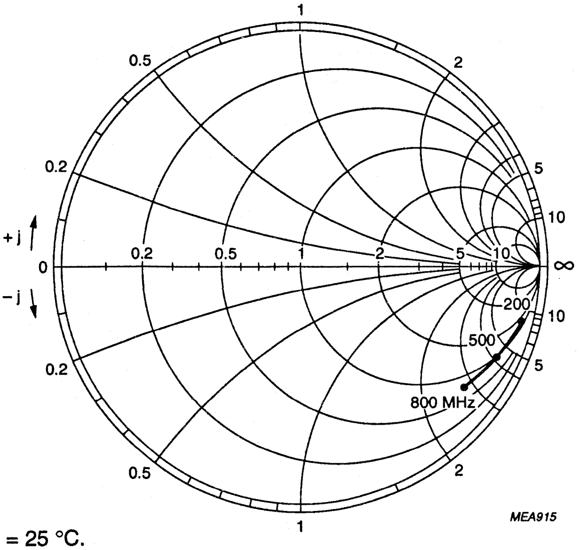
$I_C = 1$ mA; $V_{CE} = 1$ V; $T_{amb} = 25$ °C.

Fig.7 Common emitter forward transmission coefficient (S_{21}).



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

Fig.8 Common emitter reverse transmission coefficient (S_{12}).



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

Fig.9 Common emitter output reflection coefficient (S_{22}).

Table 1 Common emitter scattering parameters, $I_C = 1$ mA; $V_{CE} = 1$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.948	−2.8	3.158	176.0	0.008	83.6	0.998	−1.7	43.9
100	0.935	−7.2	3.098	168.9	0.023	84.2	0.993	−4.4	37.4
200	0.913	−13.0	3.061	160.5	0.045	80.5	0.972	−8.6	30.1
300	0.881	−19.7	2.917	151.2	0.066	76.6	0.952	−12.6	26.1
400	0.849	−24.9	2.753	143.5	0.085	74.1	0.930	−16.1	23.0
500	0.797	−30.4	2.722	135.8	0.102	71.9	0.899	−19.0	20.2
600	0.747	−34.0	2.526	129.3	0.118	69.3	0.878	−21.7	18.0
700	0.717	−36.3	2.364	123.6	0.132	68.0	0.848	−23.8	16.1
800	0.663	−40.7	2.237	116.7	0.145	65.7	0.829	−25.7	14.6
900	0.638	−43.0	2.112	112.1	0.156	64.7	0.814	−27.2	13.5
1000	0.584	−44.7	1.993	106.1	0.168	63.4	0.791	−28.8	12.1
1200	0.523	−49.3	1.797	97.1	0.189	61.3	0.756	−31.4	10.2
1400	0.463	−54.4	1.677	90.0	0.211	59.6	0.726	−34.1	8.8
1600	0.438	−53.3	1.548	84.9	0.230	58.4	0.707	−36.0	7.7
1800	0.396	−52.8	1.383	78.0	0.244	57.0	0.690	−37.8	6.4
2000	0.364	−56.7	1.351	72.8	0.262	55.7	0.671	−39.7	5.8
2200	0.295	−54.3	1.245	66.6	0.279	54.2	0.639	−41.7	4.6
2400	0.286	−57.4	1.222	62.5	0.301	52.5	0.615	−44.9	4.2
2600	0.263	−61.3	1.175	59.5	0.315	51.3	0.604	−47.8	3.7
2800	0.268	−60.1	1.120	56.6	0.332	50.6	0.597	−49.9	3.2
3000	0.238	−58.1	1.079	52.2	0.346	48.8	0.577	−51.3	2.7

NPN 5 GHz wideband transistor

BFT25A

FEATURES

- Low current consumption (100 μA - 1 mA)
- Low noise figure
- Gold metallization ensures excellent reliability.

DESCRIPTION

The BFT25A is a silicon npn transistor, primarily intended for use in RF low power amplifiers, such as pocket telephones and paging systems with signal frequencies up to 2 GHz.

The transistor is encapsulated in a 3-pin plastic SOT23 envelope.

PINNING

PIN	DESCRIPTION
Code: V10	
1	base
2	emitter
3	collector

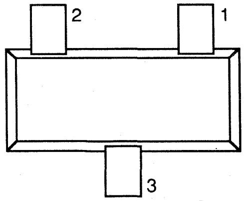


Fig.1 SOT23.

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	DC collector current		–	–	6.5	mA
P_{tot}	total power dissipation	up to T_s = 140 °C note 1	–	–	32	mW
h_{FE}	DC current gain	I_C = 0.5 mA; V_{CE} = 1 V	50	80	200	
f_T	transition frequency	I_C = 1 mA; V_{CE} = 1 V; T_{amb} = 25 °C; f = 500 MHz	3.5	5	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 0.5 mA; V_{CE} = 1 V; T_{amb} = 25 °C; f = 1 GHz	–	15	–	dB
F	noise figure	$\Gamma = \Gamma_{opt}$; I_C = 0.5 mA; V_{CE} = 1 V; T_{amb} = 25 °C; f = 1 GHz	–	1.8	–	dB
		$\Gamma = \Gamma_{opt}$; I_C = 1 mA; V_{CE} = 1 V; T_{amb} = 25 °C; f = 1 GHz	–	2	–	dB

Note

1. T_s is the temperature at the soldering point of the collector tab.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	8	V
V_{CEO}	collector-emitter voltage	open base	–	5	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	6.5	mA
P_{tot}	total power dissipation	up to T_s = 140 °C; note 1	–	32	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	from junction to soldering point (note 1)	260 K/W

Note

1. T_s is the temperature at the soldering point of the collector tab.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 5$ V	–	–	50	μA
h_{FE}	DC current gain	$I_C = 0.5$ mA; $V_{CE} = 1$ V	50	80	200	
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 1$ V; $T_{amb} = 25$ °C; f = 500 MHz	3.5	5	–	GHz
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 1$ V; f = 1 MHz	–	0.3	0.45	pF
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 0.5$ mA; $V_{CE} = 1$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	15	–	dB
F	noise figure	$\Gamma = \Gamma_{opt}$; $I_C = 0.5$ mA; $V_{CE} = 1$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	1.8	–	dB
		$\Gamma = \Gamma_{opt}$; $I_C = 1$ mA; $V_{CE} = 1$ V; $T_{amb} = 25$ °C; f = 1 GHz	–	2	–	dB

Note

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$ dB.

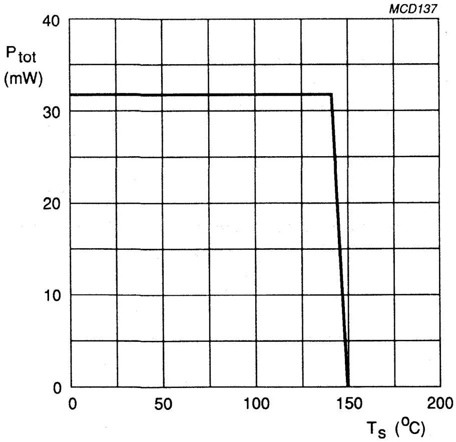
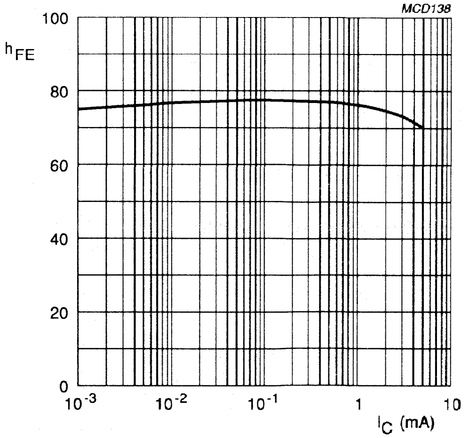
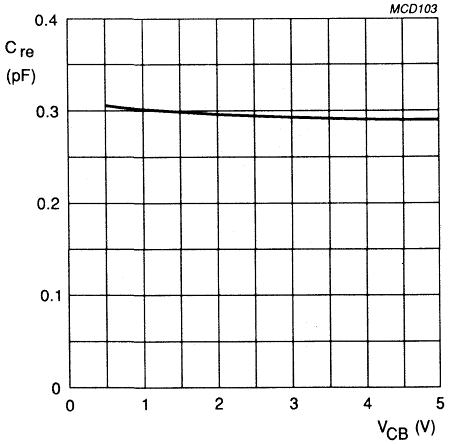


Fig.2 Power derating curve.



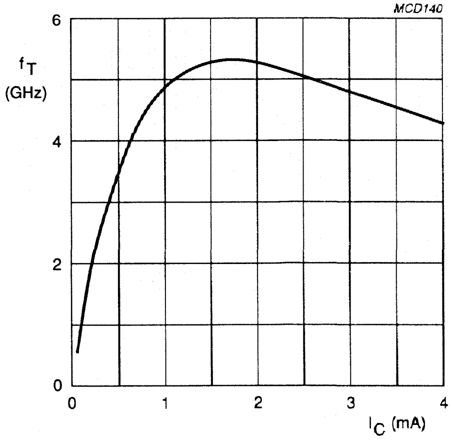
V_{CE} = 1 V.

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



$I_C = i_c = 0$; f = 1 MHz.

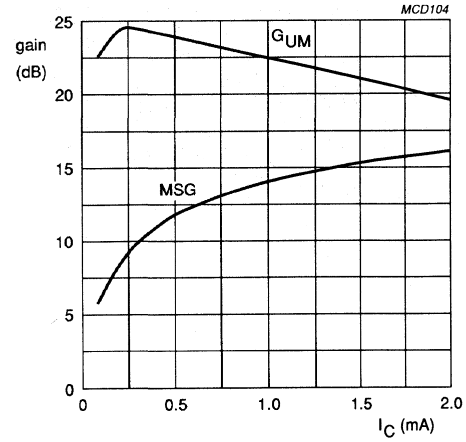
Fig.4 Feedback capacitance as a function of collector-base voltage.



V_{CE} = 1 V; T_{amb} =25 °C; f = 500 MHz.

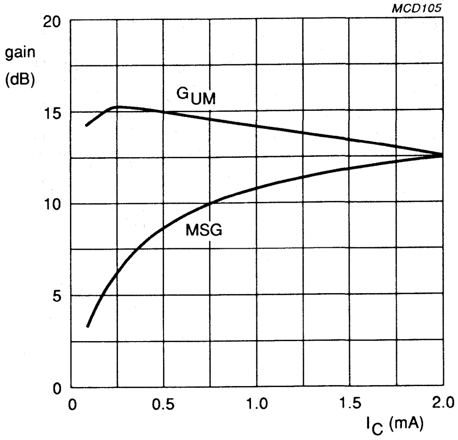
Fig.5 Transition frequency as a function of collector current.

In Figs 6 to 9, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



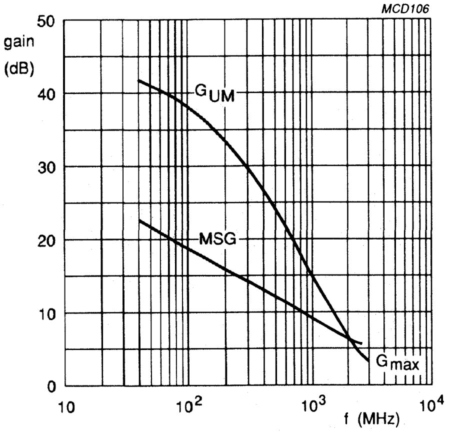
V_{CE} = 1 V; f = 500 MHz.

Fig.6 Gain as a function of collector current.



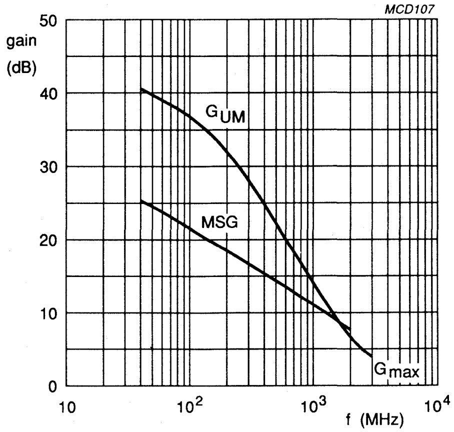
V_{CE} = 1 V; f = 1 GHz.

Fig.7 Gain as a function of collector current.



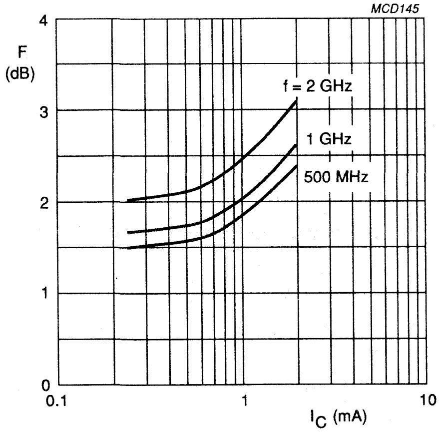
V_{CE} = 1 V; I_C = 0.5 mA.

Fig.8 Gain as a function of frequency.



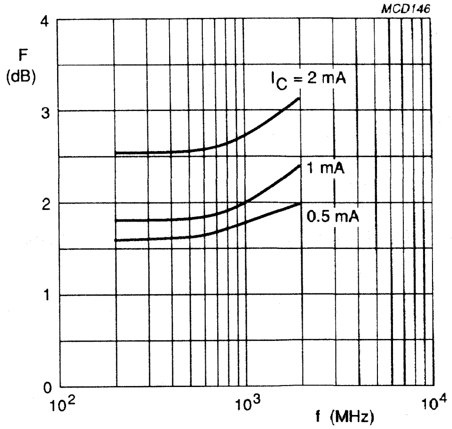
V_{CE} = 1 V; I_C = 1 mA.

Fig.9 Gain as a function of frequency.



V_{CE} = 1 V.

Fig.10 Minimum noise figure as a function of collector current.



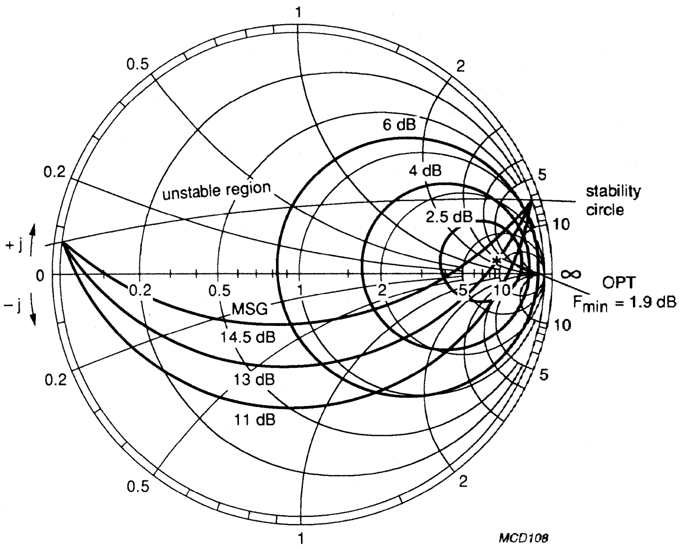
V_{CE} = 1 V.

Fig.11 Minimum noise figure as a function of frequency.

f (MHz)	V_{CE} (V)	I_C (mA)
500	1	1

Noise Parameters

F_{min} (dB)	Gamma (opt)		$R_n/50$
	(mag)	(ang)	
1.9	0.79	4	2.5



Z_o = 50 Ω.

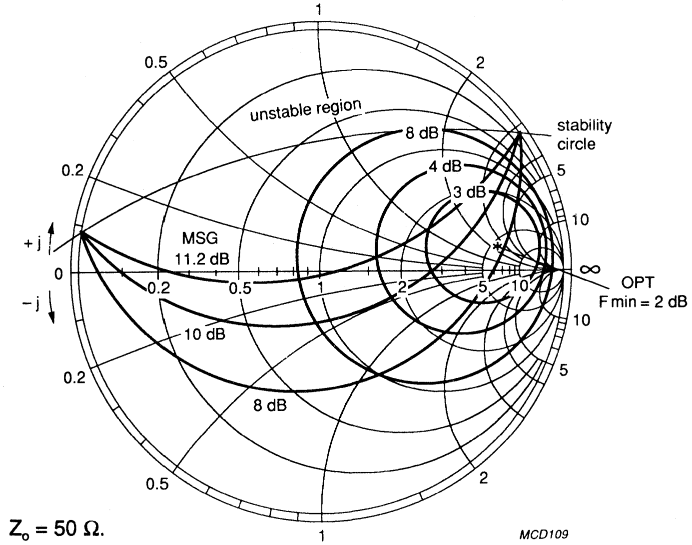
Average gain parameter: MSG = 14.5 dB.

Fig.12 Noise circle figure.

f (MHz)	V_{CE} (V)	I_C (mA)
1000	1	1

Noise Parameters

F_{min} (dB)	Gamma (opt)		$R_n/50$
	(mag)	(ang)	
2	0.74	8	2.6



$Z_o = 50\ \Omega$.

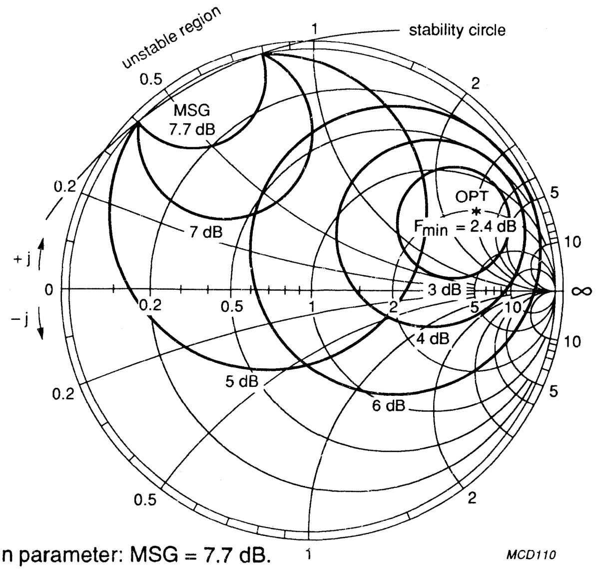
Average gain parameter: MSG = 11.2 dB.

Fig.13 Noise circle figure.

f (MHz)	V_{CE} (V)	I_C (mA)
2000	1	1

Noise Parameters

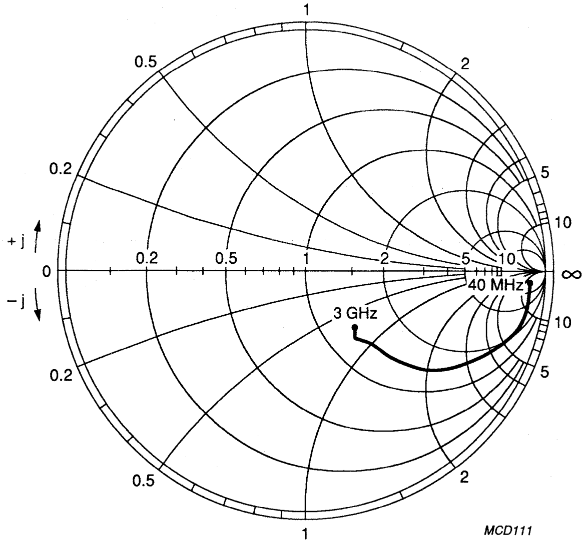
F_{min} (dB)	Gamma (opt)		$R_n/50$
	(mag)	(ang)	
2.4	0.72	26	1.7



$Z_o = 50\ \Omega$.

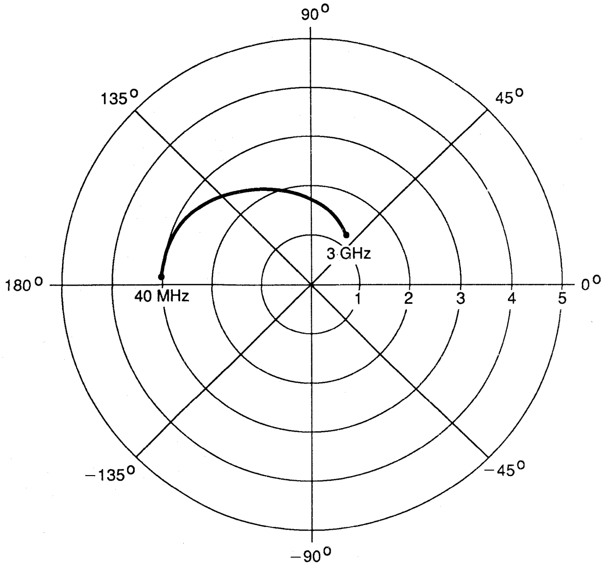
Average gain parameter: MSG = 7.7 dB.

Fig.14 Noise circle figure.



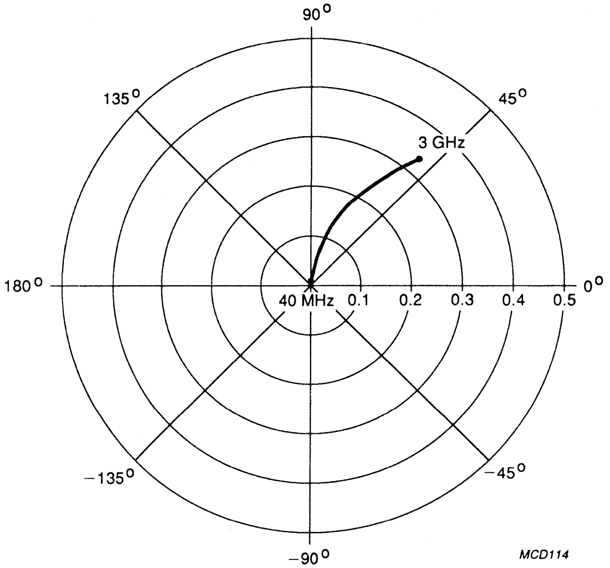
V_{CE} = 1 V; I_C = 1 mA.

Fig.15 Common emitter input reflection coefficient (S_{11}).



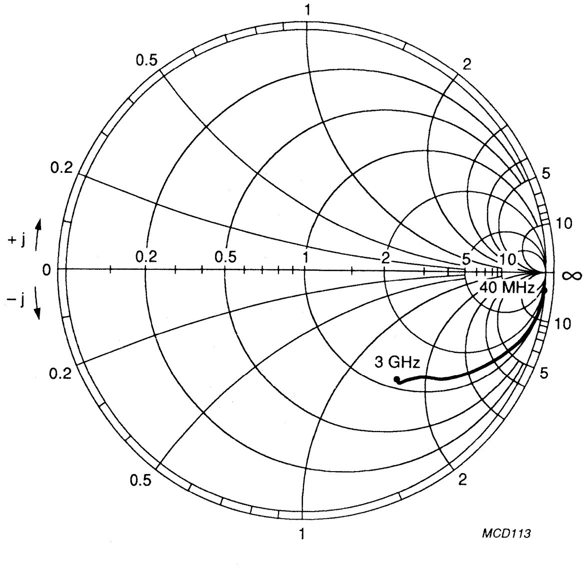
V_{CE} = 1 V; I_C = 1 mA.

Fig.16 Common emitter forward transmission coefficient (S_{21}).



V_{CE} = 1 V; I_C = 1 mA.

Fig.17 Common emitter reverse transmission coefficient (S_{12}).

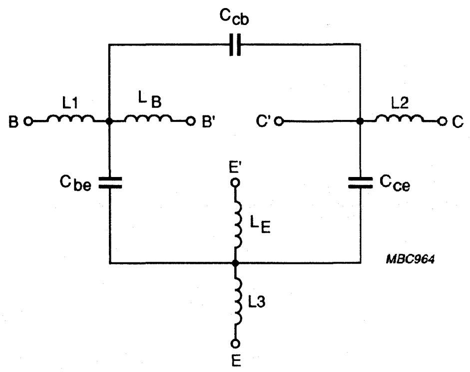


V_{CE} = 1 V; I_C = 1 mA.

Fig.18 Common emitter output reflection coefficient (S_{22}).

SPICE parameters for BFT25A crystal

1	IS = 13.77	aA
2	BF = 85.65	–
3	NF = 979.9	m
4	VAF = 50.80	V
5	IKF = 10.00	A
6	ISE = 2.199	fA
7	NE = 1.857	–
8	BR = 16.97	–
9	NR = 985.5	m
10	VAR = 2.491	V
11	IKR = 188.0	mA
12	ISC = 205.1	aA
13	NC = 1.107	–
14	RB = 80.00	Ω
15	IRB = 1.000	µA
16	RBM = 80.00	Ω
17	RE = 7.911	Ω
18	RC = 5.300	Ω
19 (note 1)	XTB = 0.000	–
20 (note 1)	EG = 1.110	EV
21 (note 1)	XTI = 3.000	–
22	CJE = 223.0	fF
23	VJE = 669.7	mV
24	MJE = 59.66	m
25	TF = 5.112	ps
26	XTF = 7.909	–
27	VTF = 1.338	V
28	ITF = 5.662	mA
29	PTF = 15.37	deg
30	CJC = 229.0	fF
31	VJC = 394.7	mV
32	MJC = 43.32	m
33	XCJC = 50.00	m
34	TR = 13.26	ns
35 (note 1)	CJS = 0.000	F
36 (note 1)	VJS = 750.0	mV
37 (note 1)	MJS = 0.000	–
38	FC = 987.8	m



$QL_B = 50$; $QL_E = 50$.

$QL_{B,E}$ (f) = $QL_{B,E}$ $\sqrt{}$ (f/Fc).

Fc = scaling frequency = 1000 MHz.

Fig.19 Package equivalent circuit SOT23.

List of components (see Fig.19)

DESIGNATION	VALUE
C_{be}	71 fF
C_{cb}	71 fF
C_{ce}	2 fF
L1	0.35 nH
L2	0.17 nH
L3	0.35 nH
L_B	0.40 nH
L_E	0.83 nH

Note

1. These parameters have not been extracted, the default values are shown.

Table 1 Common emitter scattering parameters, V_{CE} = 1 V, I_C = 0.25 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.986	−1.2	0.89	177.8	0.009	88.5	0.999	−1	40.8
100	0.983	−2.8	0.893	174.1	0.022	85.7	0.998	−2.5	37.1
200	0.98	−5.4	0.89	169.3	0.043	85.5	0.996	−5.1	33.6
300	0.976	−8.1	0.888	164.3	0.063	83	0.992	−7.6	30.1
400	0.967	−10.6	0.883	159.1	0.084	81.2	0.987	−10.2	26.8
500	0.96	−13.1	0.884	154.2	0.104	79	0.983	−12.6	24.7
600	0.953	−15.8	0.885	149.6	0.122	77.3	0.977	−14.9	22.7
700	0.941	−18.2	0.879	144.6	0.141	75.6	0.971	−17.2	20.8
800	0.929	−20.4	0.874	140.1	0.158	73.4	0.963	−19.3	18.8
900	0.911	−22.6	0.873	135.1	0.174	71.5	0.955	−21.4	17.1
1000	0.896	−24.7	0.875	130.5	0.19	69.5	0.943	−23.5	15.4
1200	0.859	−29.3	0.874	121.2	0.221	65.5	0.916	−27.6	12.6
1400	0.825	−33.2	0.882	113.7	0.25	62.1	0.894	−31.6	10.8
1600	0.795	−36.6	0.87	106.6	0.272	59.2	0.871	−34.9	9.3
1800	0.755	−39.7	0.867	99.4	0.292	56.3	0.846	−38	7.9
2000	0.707	−42.2	0.858	92.1	0.305	52.9	0.808	−40.7	6.3
2200	0.66	−45.7	0.864	85.6	0.322	49.8	0.769	−44.3	5.1
2400	0.623	−49.1	0.871	80.3	0.343	47.2	0.74	−48.2	4.4
2600	0.602	−52.5	0.881	75.3	0.359	45	0.723	−51.5	4.1
2800	0.577	−52.8	0.861	71.2	0.364	43.7	0.707	−53.3	3.5
3000	0.532	−54	0.849	67	0.369	42.3	0.674	−55	2.7

Table 2 Noise data, V_{CE} = 1 V, I_C = 0.25 mA

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.6	0.91	4	3.6
1000	1.8	0.78	9	3.5
2000	2.1	0.8	28	2

Table 3 Common emitter scattering parameters, V_{CE} = 1 V, I_C = 0.5 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.971	−1.5	1.706	177.5	0.009	85.6	0.998	−1.2	42
100	0.97	−3.7	1.706	173.5	0.022	85.9	0.997	−3.1	38.5
200	0.961	−7.3	1.691	167.9	0.042	84.5	0.992	−6.1	33.6
300	0.953	−10.8	1.676	162.1	0.063	81.8	0.984	−9.1	29.9
400	0.939	−14.2	1.65	156.5	0.082	79.4	0.975	−12.1	26.7
500	0.921	−17.4	1.628	151.1	0.101	77.3	0.965	−14.9	24.1
600	0.905	−20.6	1.604	146	0.119	75	0.954	−17.5	22
700	0.882	−23.7	1.569	140.6	0.135	73.1	0.942	−19.9	20
800	0.863	−26.2	1.531	135.7	0.151	70.8	0.928	−22.2	18.2
900	0.836	−28.8	1.499	130.6	0.165	69.1	0.914	−24.4	16.5
1000	0.81	−31.2	1.475	126	0.179	67	0.896	−26.4	15.1
1200	0.756	−35.8	1.416	116.6	0.205	63.3	0.859	−30.4	12.5
1400	0.709	−40	1.372	108.9	0.229	60.6	0.828	−34.1	10.8
1600	0.67	−42.7	1.306	102.2	0.247	58.4	0.801	−37	9.4
1800	0.624	−45.2	1.257	95.1	0.265	56.4	0.775	−39.4	8.1
2000	0.573	−46.9	1.21	88.4	0.276	53.7	0.736	−41.5	6.8
2200	0.523	−49.7	1.179	82.4	0.292	51.4	0.697	−44.4	5.7
2400	0.486	−53	1.156	77.1	0.309	49.5	0.669	−48	5
2600	0.465	−55.5	1.143	72.4	0.326	48.3	0.654	−51	4.6
2800	0.444	−55	1.099	68.4	0.334	47.4	0.641	−52.5	4.1
3000	0.404	−54.2	1.065	64.6	0.341	46.8	0.612	−53.6	3.4

Table 4 Noise data, V_{CE} = 1 V, I_C = 0.5 mA

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.6	0.84	4	2.8
1000	1.8	0.77	8	2.9
2000	2	0.75	27	1.8

Table 5 Common emitter scattering parameters, V_{CE} = 1 V, I_C = 1 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.946	−2.2	3.078	176.5	0.009	86.5	0.996	−1.6	40.6
100	0.94	−5.4	3.067	171.3	0.021	85.3	0.993	−4	37.5
200	0.923	−10.6	3.003	163.8	0.041	82.7	0.981	−7.8	32.1
300	0.903	−15.6	2.923	156.3	0.061	79.5	0.964	−11.5	28.2
400	0.873	−19.9	2.815	149.2	0.08	76.7	0.945	−14.9	25
500	0.84	−24.1	2.708	142.6	0.096	74.5	0.924	−18	22.3
600	0.807	−27.9	2.597	136.5	0.111	72.2	0.902	−20.7	20.2
700	0.772	−31.1	2.472	130.4	0.125	70	0.881	−23.1	18.3
800	0.736	−33.6	2.35	125.3	0.138	68.5	0.859	−25.1	16.6
900	0.699	−35.9	2.24	119.9	0.15	67	0.839	−27	15.2
1000	0.665	−38	2.147	115.3	0.161	65.6	0.817	−28.6	14
1200	0.599	−41.8	1.966	106.2	0.183	63	0.775	−31.7	11.8
1400	0.551	−44.8	1.83	99	0.204	61.2	0.745	−34.6	10.3
1600	0.513	−46.3	1.688	92.9	0.221	60.2	0.721	−36.7	9.1
1800	0.472	−47.6	1.58	86.8	0.239	59	0.702	−38.4	8
2000	0.427	−47.6	1.485	80.8	0.252	57.1	0.671	−40	6.9
2200	0.384	−49.2	1.417	75.7	0.268	55.4	0.637	−42.3	6
2400	0.354	−51.8	1.36	71.2	0.288	54.2	0.613	−45.5	5.3
2600	0.34	−53.7	1.326	67.1	0.306	52.9	0.601	−48.5	4.9
2800	0.33	−52	1.262	63.4	0.317	52.2	0.595	−49.7	4.4
3000	0.299	−50	1.208	60.2	0.326	51.6	0.573	−50.7	3.8

Table 6 Noise data, V_{CE} = 1 V, I_C = 1 mA

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.9	0.79	4	2.5
1000	2	0.74	8	2.6
2000	2.4	0.72	26	1.7

Table 7 Common emitter scattering parameters, V_{CE} = 3 V, I_C = 0.5 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.972	−1.3	1.703	177.5	0.008	86.7	0.999	−1.2	42.7
100	0.971	−3.5	1.702	173.8	0.021	86.1	0.997	−3	39.1
200	0.966	−6.8	1.689	168.5	0.04	84.7	0.992	−5.9	34.5
300	0.957	−10.2	1.674	163	0.06	82	0.986	−8.9	30.8
400	0.945	−13.3	1.65	157.8	0.08	80.2	0.978	−11.7	27.7
500	0.93	−16.4	1.632	152.6	0.098	77.7	0.969	−14.4	25.1
600	0.915	−19.4	1.609	147.7	0.115	75.7	0.959	−17	22.9
700	0.894	−22.3	1.578	142.5	0.131	74	0.947	−19.4	20.8
800	0.874	−24.7	1.543	137.8	0.147	71.8	0.934	−21.7	19
900	0.852	−27.1	1.514	132.9	0.161	69.8	0.92	−23.9	17.3
1000	0.828	−29.2	1.489	128.4	0.174	68.1	0.903	−25.9	15.8
1200	0.777	−33.9	1.435	119.3	0.2	64.4	0.868	−29.9	13.2
1400	0.733	−38	1.396	111.7	0.224	61.7	0.838	−33.7	11.5
1600	0.695	−40.7	1.331	105	0.243	59.3	0.811	−36.5	10
1800	0.65	−43	1.282	98.2	0.26	57.4	0.784	−39	8.7
2000	0.599	−45.1	1.233	91.3	0.273	54.6	0.745	−41.2	7.3
2200	0.55	−48	1.202	85.3	0.288	52.3	0.706	−44.1	6.2
2400	0.515	−50.9	1.182	80.1	0.306	50.3	0.676	−47.7	5.4
2600	0.496	−53.3	1.167	75.5	0.322	48.9	0.66	−50.7	5.1
2800	0.473	−53.1	1.126	71.5	0.33	48	0.646	−52.1	4.5
3000	0.435	−52.9	1.086	67.7	0.336	47.4	0.618	−53.2	3.7

Table 8 Noise data, V_{CE} = 3 V, I_C = 0.5 mA

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.6	0.85	3	3
1000	1.8	0.78	8	3.1
2000	2	0.8	25	2.2

Table 9 Common emitter scattering parameters, V_{CE} = 3 V, I_C = 1 mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	**MAG. (RAT)**	**ANG. (DEG)**	
40	0.95	–2.1	3.086	176.6	0.008	83.9	0.997	–1.5	41.4
100	0.945	–4.9	3.073	171.9	0.02	85.2	0.994	–3.8	38.3
200	0.931	–9.6	3.021	165.1	0.04	83.4	0.984	–7.6	33.3
300	0.914	–14	2.953	158.2	0.058	80.5	0.97	–11.1	29.5
400	0.889	–18.2	2.858	151.6	0.077	77.5	0.952	–14.5	26.2
500	0.859	–21.9	2.766	145.4	0.093	75.4	0.933	–17.6	23.5
600	0.83	–25.6	2.669	139.6	0.109	73.4	0.913	–20.4	21.4
700	0.798	–28.9	2.554	133.8	0.123	71.5	0.892	–22.8	19.5
800	0.767	–31.3	2.438	128.8	0.136	69.5	0.872	–24.9	17.8
900	0.733	–33.7	2.336	123.6	0.148	68.1	0.851	–26.9	16.3
1000	0.701	–35.6	2.247	119	0.159	66.8	0.828	–28.6	15
1200	0.636	–39.6	2.072	110.1	0.181	63.9	0.786	–31.9	12.8
1400	0.587	–42.9	1.939	102.9	0.202	62.4	0.753	–35	11.2
1600	0.551	–44.4	1.789	96.8	0.219	60.8	0.727	–37	9.9
1800	0.51	–45.7	1.679	90.8	0.237	59.5	0.706	–38.8	8.8
2000	0.465	–45.9	1.577	84.7	0.249	57.4	0.672	–40.2	7.6
2200	0.42	–48.1	1.505	79.4	0.265	56	0.637	–42.5	6.7
2400	0.39	–50.1	1.447	74.9	0.284	54.5	0.611	–45.7	6
2600	0.375	–52.6	1.408	70.9	0.302	53.2	0.599	–48.6	5.6
2800	0.361	–51.4	1.337	67.1	0.313	52.6	0.591	–49.7	5
3000	0.331	–49.3	1.282	63.9	0.321	52	0.568	–50.4	4.4

Table 10 Noise data, V_{CE} = 3 V, I_C = 1 mA

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	1.9	0.8	3	2.6
1000	2	0.75	8	2.8
2000	2.3	0.75	25	1.9

Table 11 Common emitter scattering parameters, $V_{CE} = 3$ V, $I_C = 2$ mA

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.905	−2.9	5.215	175.2	0.008	86.7	0.994	−2	40.8
100	0.896	−7.1	5.152	168.8	0.02	84.5	0.987	−5.1	37.2
200	0.868	−13.7	4.955	159.3	0.038	81.9	0.965	−9.9	31.6
300	0.829	−19.6	4.7	150.2	0.055	78.2	0.935	−14.1	27.5
400	0.784	−24.7	4.396	142	0.072	75.9	0.901	−17.8	24.3
500	0.736	−28.7	4.105	134.7	0.086	73	0.869	−20.8	21.8
600	0.695	−32.5	3.824	128.3	0.098	71.6	0.838	−23.2	19.8
700	0.65	−35	3.544	122.3	0.111	70.2	0.812	−25.2	18
800	0.615	−37.1	3.287	117.3	0.122	69	0.787	−26.7	16.6
900	0.579	−38.9	3.066	112.4	0.132	68.3	0.766	−28.1	15.3
1000	0.545	−40	2.884	108.2	0.143	67.6	0.744	−29.1	14.2
1200	0.484	−42.4	2.561	100.2	0.163	65.8	0.706	−31.4	12.3
1400	0.442	−44.1	2.323	93.9	0.184	64.8	0.679	−33.7	11
1600	0.417	−44.5	2.099	88.7	0.201	63.9	0.662	−35.1	9.8
1800	0.386	−44.4	1.937	83.5	0.22	63.1	0.649	−36.6	8.8
2000	0.351	−43	1.796	78.2	0.234	61.4	0.624	−37.6	7.8
2200	0.317	−44.2	1.692	73.8	0.252	59.8	0.594	−39.6	6.9
2400	0.295	−45.8	1.608	70	0.273	58.7	0.573	−42.6	6.3
2600	0.285	−48.6	1.551	66.4	0.291	57.4	0.564	−45.6	5.8
2800	0.279	−46	1.466	63.1	0.304	56.7	0.56	−46.7	5.3
3000	0.255	−42.9	1.398	60.4	0.315	56	0.542	−47.3	4.7

Table 12 Noise data, $V_{CE} = 3$ V, $I_C = 2$ mA

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n
		(RAT)	(DEG)	
500	2.5	0.81	3	2.4
1000	2.5	0.71	8	2.6
2000	3	0.69	25	1.7

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.

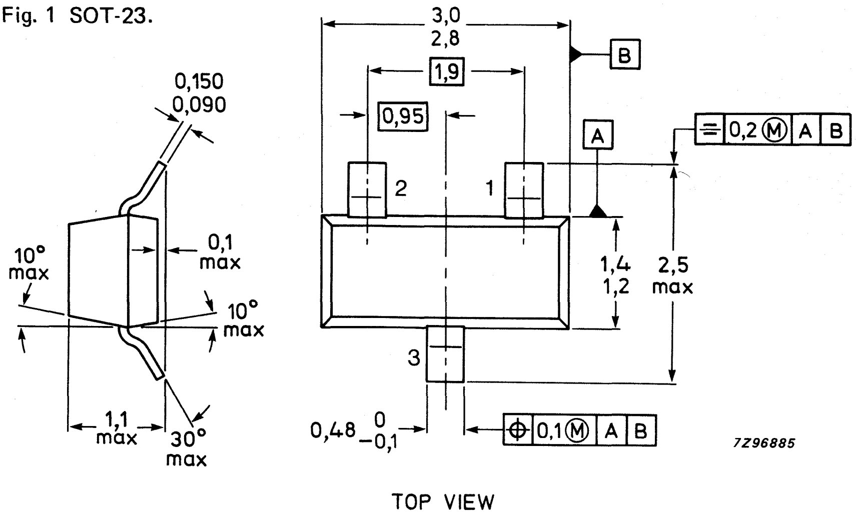
QUICK REFERENCE DATA

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 1,5	mA 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.

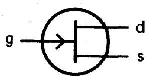


Marking code

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	$\lvert y_{fs}\rvert$	>	1,0 mS
Output admittance	$\lvert y_{os}\rvert$	<	10 µS
V_{DS} = 10 V; I_D = 200 µA; T_{amb} = 25 °C			
Transfer admittance	$\lvert y_{fs}\rvert$	>	0,5 mS
Output admittance	$\lvert y_{os}\rvert$	<	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

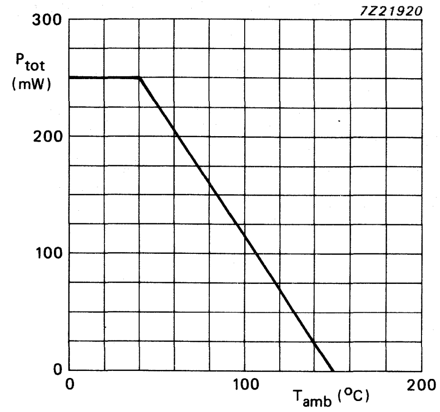


Fig.2 Power derating curve.

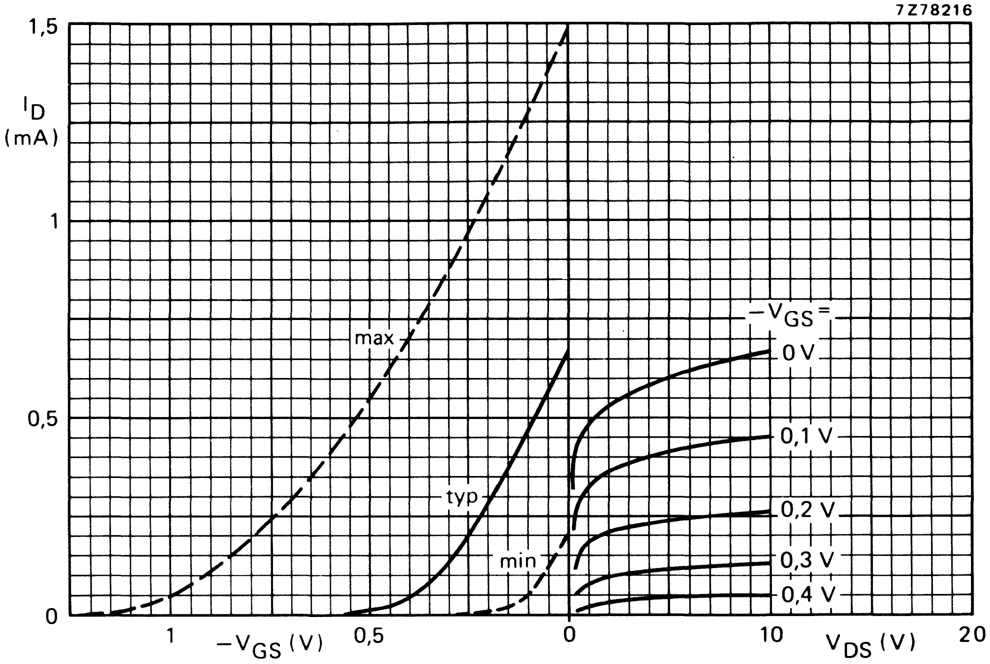


Fig. 3 Typical values. V_{DS} = 10 V; T_j = 25 °C.

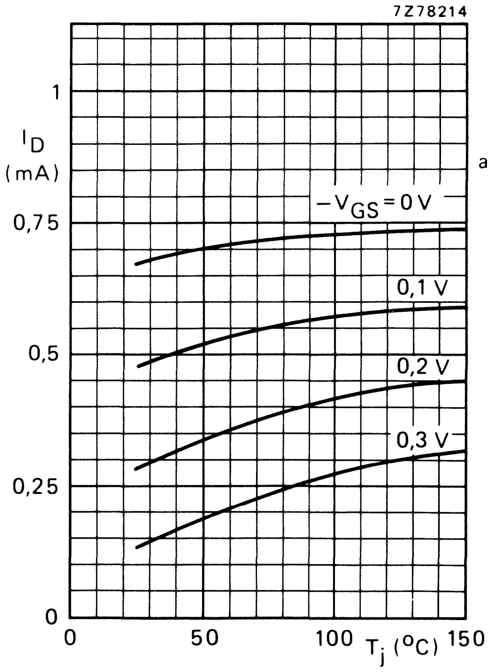


Fig. 4 Typical values. V_{DS} = 10 V.

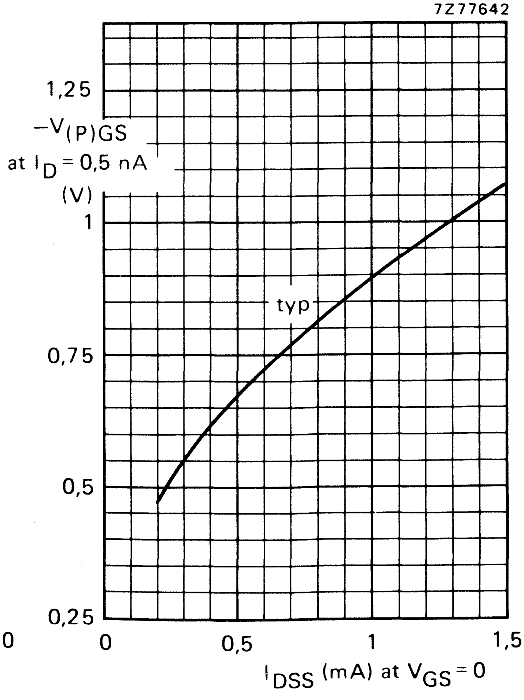


Fig. 5 Correlation between $-V_{(P)GS}$ and I_{DSS}. V_{DS} = 10 V; T_j = 25 °C.

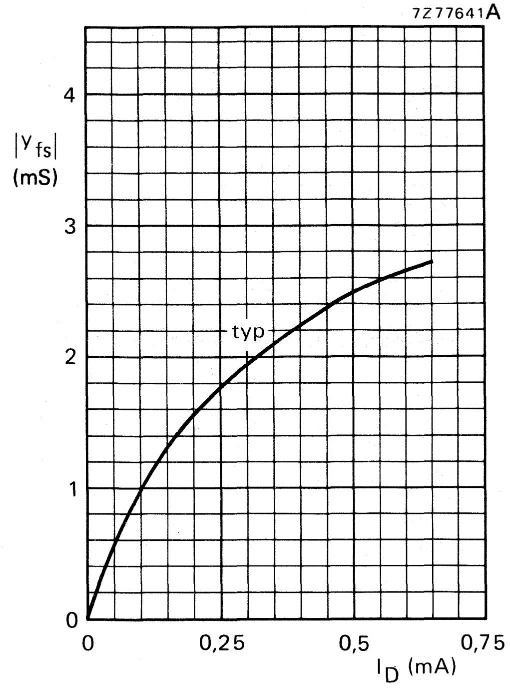


Fig. 6

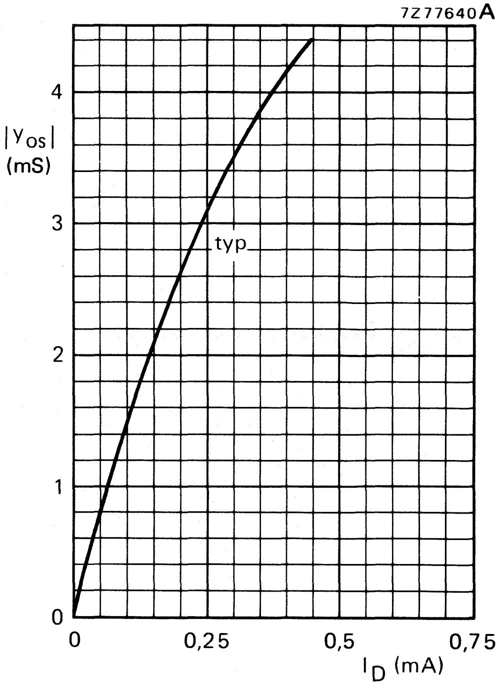


Fig. 7

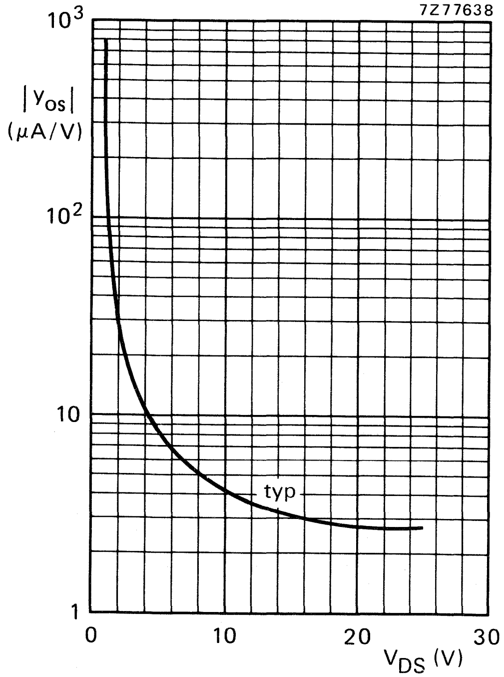


Fig. 8

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.

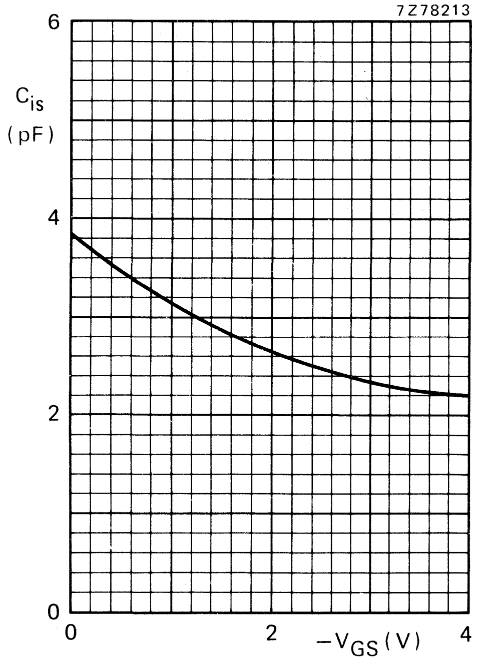


Fig. 9

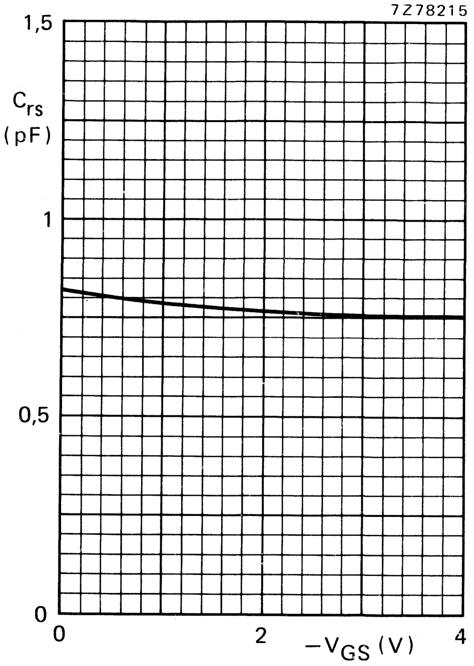


Fig. 10

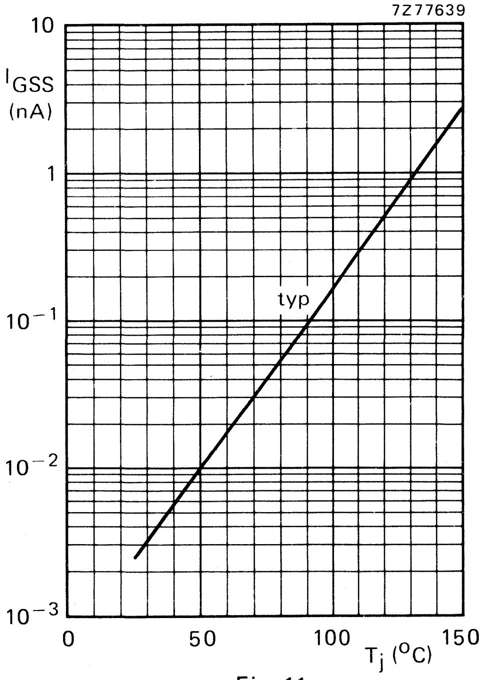


Fig. 11

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.

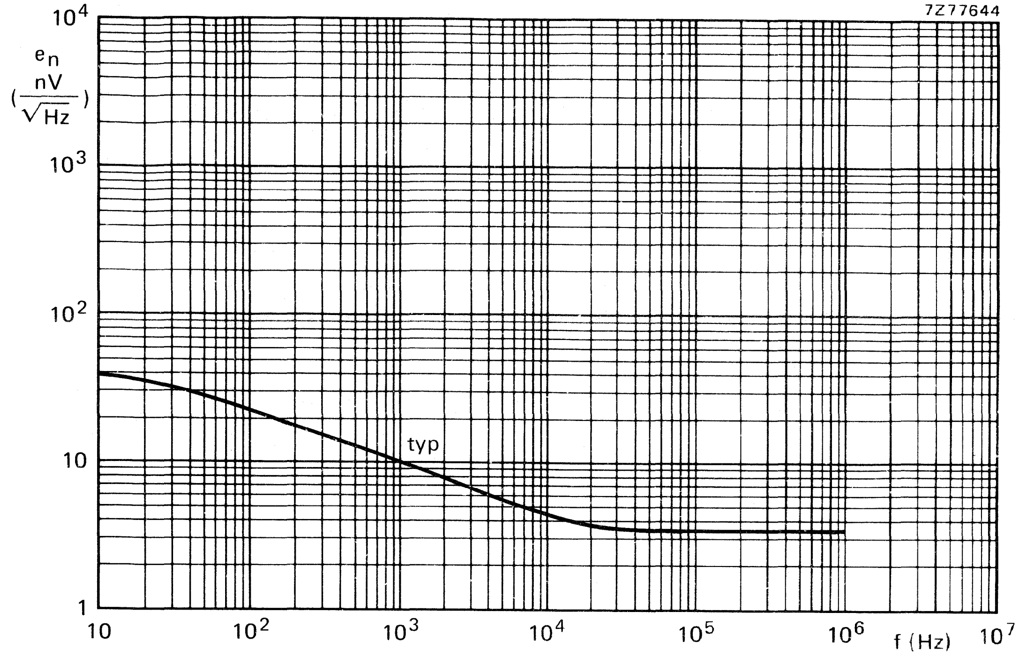


Fig. 12 V_{DS} = 10 V; I_D = 0,2 mA; T_{amb} = 25 °C.

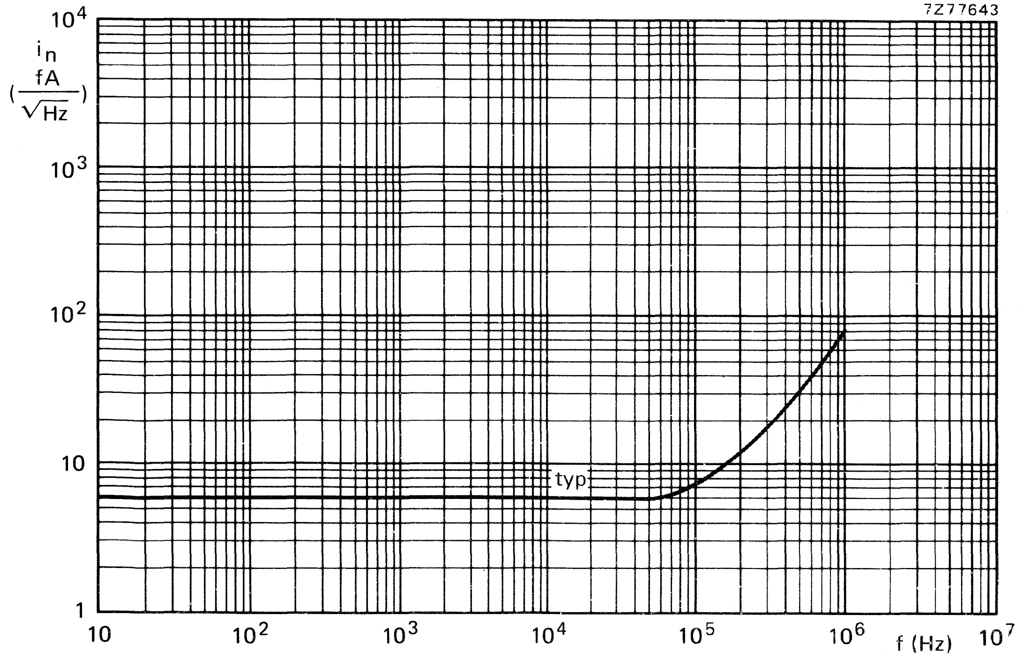


Fig. 13 V_{DS} = 10 V; I_D = 0,2 mA; T_{amb} = 25 °C.

PNP 5 GHz wideband transistor

BFT92

DESCRIPTION

PNP transistor in a plastic SOT23 envelope.

It is primarily intended for use in RF wideband amplifiers, such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analyzers, etc. The transistor features low intermodulation distortion and high power gain; due to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

NPN complements are BFR92 and BFR92A.

PINNING

PIN	DESCRIPTION
Code: W1p	
1	base
2	emitter
3	collector

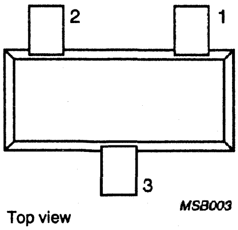


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–20	V
V_{CEO}	collector-emitter voltage	open base	–	–15	V
I_C	DC collector current		–	–25	mA
P_{tot}	total power dissipation	up to T_s = 70 °C (note 1)	–	300	mW
f_T	transition frequency	I_C = –14 mA; V_{CE} = –10 V; f = 500 MHz	5	–	GHz
C_{re}	feedback capacitance	I_C = –2 mA; V_{CE} = –10 V; f = 1 MHz	0.7	–	pF
G_{UM}	maximum unilateral power gain	I_C = –14 mA; V_{CE} = –10 V; f = 500 MHz; T_{amb} = 25 °C	18	–	dB
F	noise figure	I_C = –5 mA; V_{CE} = –10 V; f = 500 MHz; T_{amb} = 25 °C	2.5	–	dB
d_{im}	intermodulation distortion	I_C = –14 mA; V_{CE} = –10 V; R_L = 75 Ω; V_O = 150 mV; T_{amb} = 25 °C; $f_{(p+q-r)}$ = 493.25 MHz	–60	–	dB

Note

1. T_s is the temperature at the soldering point of the collector tab.

PNP 5 GHz wideband transistor BFT92

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	–	–15	V
V_{EBO}	emitter-base voltage	open collector	–	–2	V
I_C	DC collector current		–	–25	mA
I_{CM}	peak collector current	f > 1 MHz	–	–35	mA
P_{tot}	total power dissipation	up to T_s = 70 °C (note 1)	–	300	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 70 °C (note 1)	260 K/W

Note

1. T_s is the temperature at the soldering point of the collector tab.

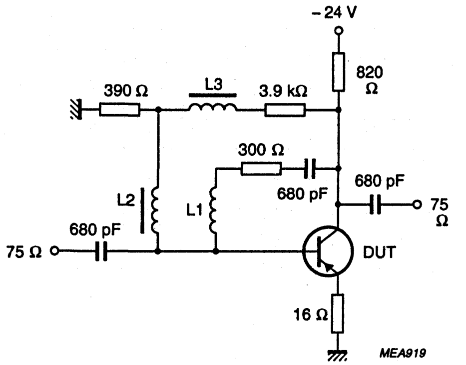
CHARACTERISTICS

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	–	–	–50	nA
h_{FE}	DC current gain	$I_C = -14$ mA; $V_{CE} = -10$ V	20	50	–	
f_T	transition frequency	$I_C = -14$ mA; $V_{CE} = -10$ V; f = 500 MHz	–	5	–	GHz
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	0.75	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -0.5$ V; f = 1 MHz	–	0.8	–	pF
C_{re}	feedback capacitance	$I_C = -2$ mA; $V_{CE} = -10$ V; f = 1 MHz	–	0.7	–	pF
G_{UM}	maximum unilateral power gain (note 1)	$I_C = -14$ mA; $V_{CE} = -10$ V; f = 500 MHz; T_{amb} = 25 °C	–	18	–	dB
F	noise figure	$I_C = -5$ mA; $V_{CE} = -10$ V; f = 500 MHz; T_{amb} = 25 °C	–	2.5	–	dB
V_O	output voltage	note 2	–	150	–	mV

Notes

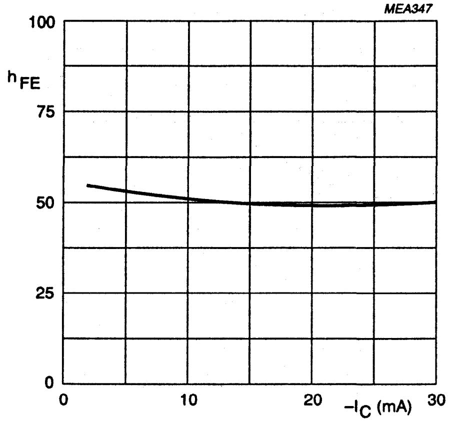
1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.
2. $d_{im} = -60$ dB (DIN 45004B); $I_C = -14$ mA; $V_{CE} = -10$ V; $R_L = 75\ \Omega$;
   $V_p = V_O$ at $d_{im} = -60$ dB; f_p = 495.25 MHz;
   $V_q = V_O$ –6 dB; f_q = 503.25 MHz;
   $V_r = V_O$ –6 dB; f_r = 505.25 MHz;
   measured at $f_{(p+q-r)}$ = 493.25 MHz.



L2 = L3 = 5 μH Ferroxcube choke, catalogue number 3122 108 20150.

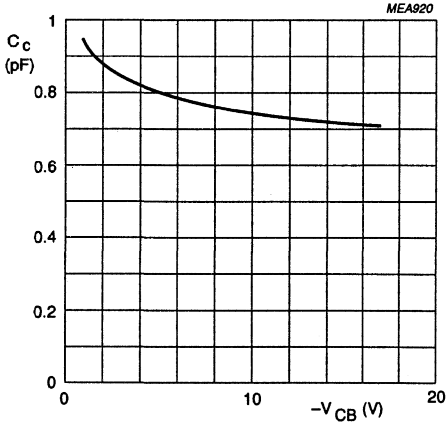
L1 = 4 turns 0.35 mm copper wire; winding pitch 1 mm; internal diameter 4 mm.

Fig.2 Intermodulation distortion test circuit.



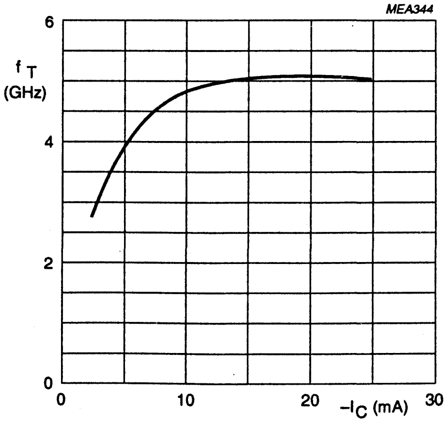
$V_{CE} = -10$ V; $T_j = 25$ °C.

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



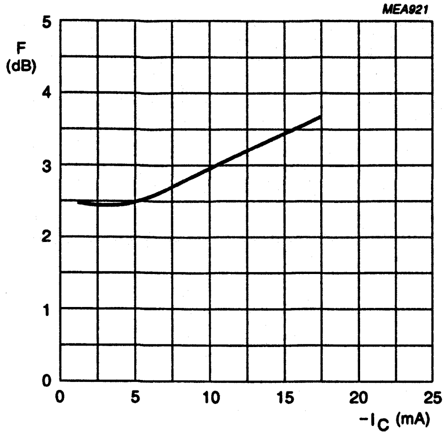
$I_E = i_e = 0$; f = 1 MHz; $T_j = 25$ °C.

Fig.4 Collector capacitance as a function of collector-base voltage.



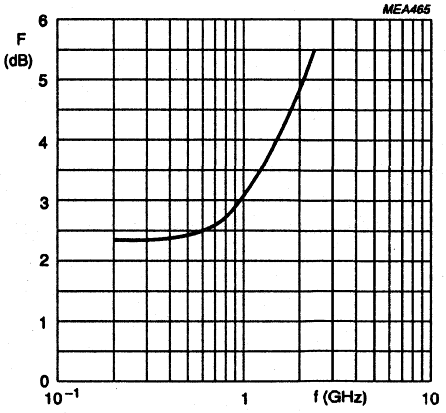
$V_{CE} = -10$ V; f = 500 MHz; $T_j = 25$ °C.

Fig.5 Transition frequency as a function of collector current.



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

Fig.6 Minimum noise figure as a function of collector current.



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

Fig.7 Minimum noise figure as a function of frequency.

PNP 5 GHz wideband transistor BFT92

Table 1 Common emitter scattering parameters, $I_C = -15$ mA; $V_{CE} = -10$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.475	−21.7	19.699	163.2	0.010	81.5	0.937	−9.0	36.2
100	0.428	−51.1	16.745	143.8	0.022	72.4	0.836	−19.1	30.6
200	0.355	−86.3	12.160	123.0	0.036	67.0	0.675	−26.6	24.9
300	0.316	−109.2	9.143	110.8	0.048	66.7	0.579	−28.4	21.5
400	0.297	−124.4	7.231	102.7	0.057	67.3	0.525	−28.5	19.0
500	0.287	−135.0	5.962	96.8	0.068	68.2	0.494	−28.5	17.1
600	0.281	−143.0	5.069	92.1	0.078	69.1	0.476	−28.6	15.6
700	0.275	−149.2	4.409	88.1	0.088	69.7	0.465	−28.8	14.3
800	0.269	−155.1	3.904	84.5	0.098	70.2	0.459	−29.1	13.2
900	0.264	−160.7	3.504	81.1	0.109	70.3	0.453	−29.4	12.2
1000	0.265	−165.8	3.177	78.1	0.119	70.4	0.449	−30.1	11.3
1200	0.273	−174.7	2.700	72.7	0.138	70.3	0.442	−31.6	9.9
1400	0.286	179.0	2.375	67.8	0.158	70.2	0.437	−33.6	8.8
1600	0.285	174.0	2.123	63.1	0.177	69.7	0.437	−35.5	7.8
1800	0.284	168.0	1.918	59.1	0.195	69.4	0.434	−37.6	6.9
2000	0.296	159.9	1.762	55.1	0.215	68.8	0.425	−39.6	6.2
2200	0.325	153.8	1.642	51.7	0.235	68.2	0.411	−42.3	5.6
2400	0.351	150.6	1.554	47.6	0.256	67.4	0.400	−46.5	5.2
2600	0.359	148.9	1.451	44.4	0.273	66.7	0.394	−50.8	4.6
2800	0.365	144.1	1.396	41.8	0.294	66.5	0.393	−53.9	4.2
3000	0.381	137.2	1.334	38.4	0.316	65.6	0.382	−56.7	3.9

PNP 5 GHz wideband transistor BFT92W

FEATURES

- High power gain
- Gold metallization ensures excellent reliability
- SOT323 (S-mini) envelope.

DESCRIPTION

Silicon PNP transistor in a plastic SOT323 envelope. It is intended as a general purpose transistor for wideband applications up to 2 GHz. The BFT92W uses the same crystal as the SOT23 version, BFT92.

PINNING

PIN	DESCRIPTION
Code: W1	
1	base
2	emitter
3	collector

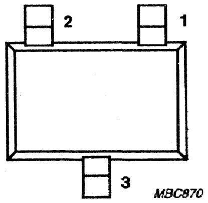


Fig.1 SOT323.

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	–	–	15	V
$-I_C$	DC collector current		–	–	35	mA
P_{tot}	total power dissipation	up to T_s = 87 °C (note 1)	–	–	300	mW
h_{FE}	DC current gain	$-I_C$ = 15 mA; $-V_{CE}$ = 10 V	20	50	–	
f_T	transition frequency	$-I_C$ = 15 mA; $-V_{CE}$ = 10 V	–	5	–	GHz
G_{UM}	maximum unilateral power gain	$-I_C$ = 15 mA; $-V_{CE}$ = 10 V; f = 500 MHz	–	18	–	dB
F	noise figure	$-I_C$ = 5 mA; $-V_{CE}$ = 10 V; f = 500 MHz	–	2.5	–	dB
C_{re}	feedback capacitance	$-I_C$ = 2 mA; $-V_{CE}$ = 5 V; f = 1 MHz	–	0.7	–	pF
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	note 1	–	–	290	K/W
T_j	junction temperature		–	–	150	°C

Note

1. T_s is the temperature at the soldering point of the collector tab.

PNP 5 GHz wideband transistor BFT93

DESCRIPTION

PNP transistor in a plastic SOT23 envelope.

It is primarily intended for use in RF wideband amplifiers, such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analyzers, etc. The transistor features low intermodulation distortion and high power gain; due to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

NPN complements are BFR93 and BFR93A.

PINNING

PIN	DESCRIPTION
Code: X1p	
1	base
2	emitter
3	collector

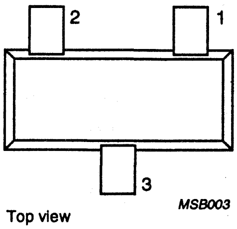


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–15	V
V_{CEO}	collector-emitter voltage	open base	–	–12	V
I_C	DC collector current		–	–35	mA
P_{tot}	total power dissipation	up to T_s = 70 °C (note 1)	–	300	mW
f_T	transition frequency	I_C = –30 mA; V_{CE} = –5 V; f = 500 MHz; T_j = 25 °C	5	–	GHz
C_{re}	feedback capacitance	I_C = –2 mA; V_{CE} = –5 V; f = 1 MHz	1	–	pF
G_{UM}	maximum unilateral power gain	I_C = –30 mA; V_{CE} = –5 V; f = 500 MHz; T_{amb} = 25 °C	16.5	–	dB
F	noise figure	I_C = –10 mA; V_{CE} = –5 V; f = 500 MHz; T_{amb} = 25 °C	2.4	–	dB
V_O	output voltage	d_{im} = –60 dB; I_C = –30 mA; V_{CE} = –5 V; R_L = 75 Ω; $f_{(p+q-r)}$ = 493.25 MHz	300	–	mV

Note

1. T_s is the temperature at the soldering point of the collector tab.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–15	V
V_{CEO}	collector-emitter voltage	open base	–	–12	V
V_{EBO}	emitter-base voltage	open collector	–	–2	V
I_C	DC collector current		–	–35	mA
I_{CM}	peak collector current	f > 1 MHz	–	–50	mA
P_{tot}	total power dissipation	up to T_s = 70 °C (note 1)	–	300	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 70 °C (note 1)	260 K/W

Note

1. T_s is the temperature at the soldering point of the collector tab.

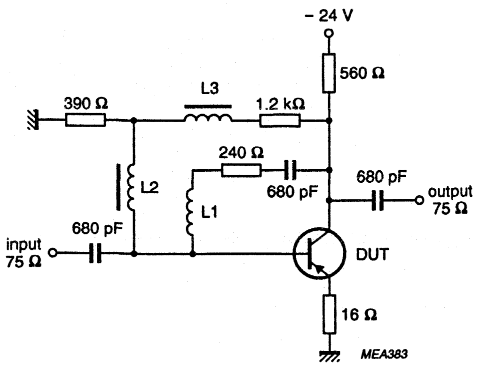
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -5$ V	–	–	–50	nA
h_{FE}	DC current gain	$I_C = -30$ mA; $V_{CE} = -5$ V	20	50	–	
f_T	transition frequency	$I_C = -30$ mA; $V_{CE} = -5$ V; f = 500 MHz	–	5	–	GHz
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	0.95	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -0.5$ V; f = 1 MHz	–	1.8	–	pF
C_{re}	feedback capacitance	$I_C = -2$ mA; $V_{CE} = -5$ V; f = 1 MHz	–	1	–	pF
G_{UM}	maximum unilateral power gain (note 1)	$I_C = -30$ mA; $V_{CE} = -5$ V; f = 500 MHz; T_{amb} = 25 °C	–	16.5	–	dB
F	noise figure	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 500 MHz; T_{amb} = 25 °C	–	2.4	–	dB
V_O	output voltage	see Fig.2 and note 2	–	300	–	mV

Notes

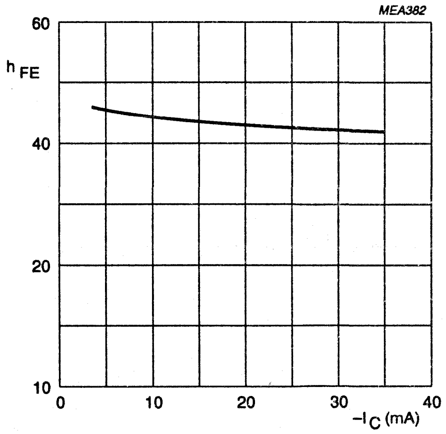
1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$ dB.
2. $d_{im} = -60$ dB (DIN 45004B); $I_C = -30$ mA; $V_{CE} = -5$ V; $R_L = 75\ \Omega$;
   $V_p = V_O$ at $d_{im} = -60$ dB; f_p = 495.25 MHz;
   $V_q = V_O$ –6 dB; f_q = 503.25 MHz;
   $V_r = V_O$ –6 dB; f_r = 505.25 MHz;
   measured at $f_{(p+q-r)}$ = 493.25 MHz.



L2 = L3 = 5 μH Ferroxcube choke, catalogue number 3122 108 20150.

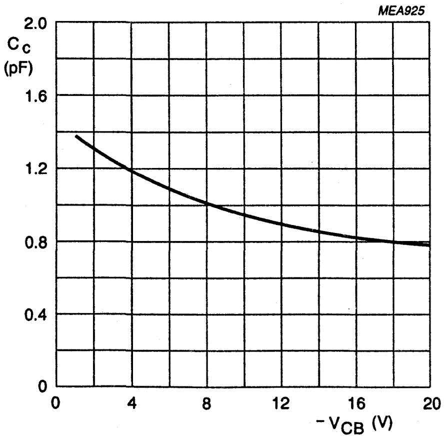
L1 = 4 turns 0.35 mm copper wire; winding pitch 1 mm; internal diameter 4 mm.

Fig.2 Intermodulation distortion test circuit.



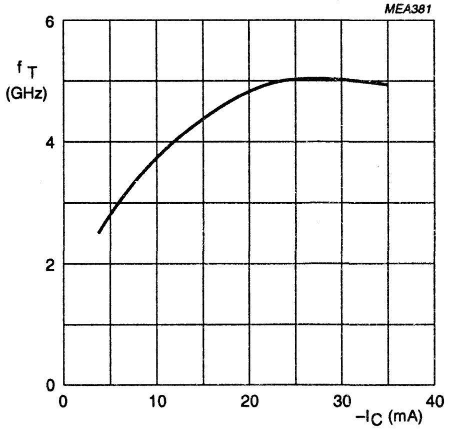
$V_{CE} = -5$ V; $T_j = 25$ °C.

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



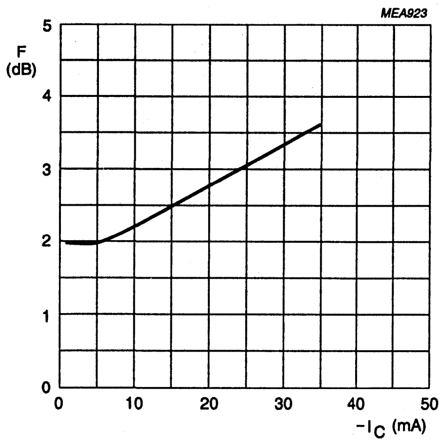
$I_E = i_e = 0$; f = 1 MHz; $T_j = 25$ °C.

Fig.4 Collector capacitance as a function of collector-base voltage.



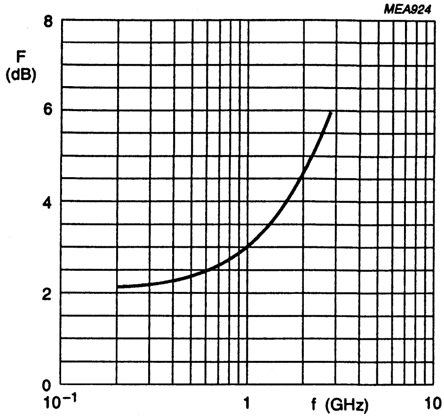
$V_{CE} = -5$ V; f = 500 MHz; $T_j = 25$ °C.

Fig.5 Transition frequency as a function of collector current.



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

Fig.6 Minimum noise figure as a function of collector current.



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

Fig.7 Minimum noise figure as a function of frequency.

Table 1 Common emitter scattering parameters, $I_C = -30$ mA; $V_{CE} = -10$ V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.464	−44.5	30.411	151.4	0.017	73.5	0.777	−26.2	34.7
100	0.406	−91.1	21.158	126.3	0.032	64.6	0.553	−50.5	28.9
200	0.370	−128.2	12.731	107.6	0.050	63.9	0.346	−68.4	23.3
300	0.363	−145.9	8.907	98.4	0.066	65.8	0.252	−77.2	19.9
400	0.363	−155.9	6.831	92.1	0.082	67.4	0.204	−82.9	17.5
500	0.361	−162.5	5.533	87.5	0.098	68.2	0.177	−86.9	15.6
600	0.360	−167.5	4.671	83.6	0.115	68.3	0.160	−89.4	14.1
700	0.360	−171.9	4.045	80.2	0.132	68.2	0.149	−91.1	12.8
800	0.355	−175.8	3.579	77.0	0.148	68.0	0.140	−91.9	11.7
900	0.354	−179.9	3.215	74.0	0.164	67.3	0.133	−93.1	10.8
1000	0.357	176.5	2.913	71.3	0.180	66.7	0.127	−94.5	10.0
1200	0.367	170.3	2.471	66.2	0.211	65.1	0.117	−98.2	8.5
1400	0.380	165.7	2.176	61.4	0.241	63.3	0.113	−101.9	7.5
1600	0.376	161.5	1.944	56.7	0.269	61.7	0.111	−102.3	6.5
1800	0.376	156.9	1.774	52.8	0.296	59.9	0.107	−106.9	5.7
2000	0.387	150.6	1.646	49.3	0.324	58.4	0.095	−110.9	5.1
2200	0.412	144.9	1.538	45.9	0.350	56.6	0.089	−121.3	4.6
2400	0.434	141.5	1.446	42.1	0.373	54.8	0.095	−135.6	4.1
2600	0.440	139.1	1.358	38.6	0.395	52.9	0.105	−143.9	3.6
2800	0.443	134.8	1.308	35.5	0.417	51.1	0.109	−147.1	3.3
3000	0.458	129.0	1.261	32.7	0.440	49.5	0.106	−154.6	3.1

PNP 5 GHz wideband transistor BFT93W

FEATURES

- High power gain
- Gold metallization ensures excellent reliability
- SOT323 (S-mini) envelope.

DESCRIPTION

Silicon PNP transistor in a plastic SOT323 envelope. It is intended as a general purpose transistor for wideband applications up to 2 GHz. The BFT93W uses the same crystal as the SOT23 version, BFT93.

PINNING

PIN	DESCRIPTION
Code: X1	
1	base
2	emitter
3	collector

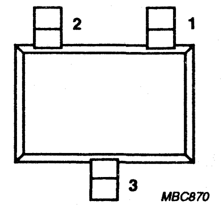


Fig.1 SOT323.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$-V_{CBO}$	collector-base voltage	open emitter	–	–	15	V
$-V_{CEO}$	collector-emitter voltage	open base	–	–	12	V
$-I_C$	DC collector current		–	–	50	mA
P_{tot}	total power dissipation	up to T_s = 87 °C (note 1)	–	–	300	mW
h_{FE}	DC current gain	$-I_C$ = 30 mA; $-V_{CE}$ = 5 V	20	50	–	
f_T	transition frequency	$-I_C$ = 30 mA; $-V_{CE}$ = 5 V	–	5	–	GHz
G_{UM}	maximum unilateral power gain	$-I_C$ = 30 mA; $-V_{CE}$ = 5 V; f = 500 MHz	–	16.5	–	dB
F	noise figure	$-I_C$ = 10 mA; $-V_{CE}$ = 5 V; f = 500 MHz	–	2.4	–	dB
C_{re}	feedback capacitance	$-I_C$ = 2 mA; $-V_{CE}$ = 5 V; f = 1 MHz	–	1	–	pF
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	note 1	–	–	290	K/W
T_j	junction temperature		–	–	150	°C

Note

1. T_s is the temperature at the soldering point of the collector tab.

UHF power transistor BLT50

FEATURES

- SMD encapsulation
- Gold metallization ensures excellent reliability.

DESCRIPTION

NPN silicon planar epitaxial transistor encapsulated in a SOT223 surface mounted envelope and designed primarily for use in hand-held radio equipment in the 470 MHz communications band.

PINNING - SOT223

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector

QUICK REFERENCE DATA

RF performance at $T_S \leq 60$ °C in a common emitter class-B test circuit (see note 1).

MODE OF OPERATION	f (MHz)	V_{CE} (V)	P_L (W)	G_p (dB)	η_c (%)
c.w. narrow band	470	7.5	1.2	> 10	> 55

Note

1. T_S = temperature at soldering point of collector tab.

PIN CONFIGURATION

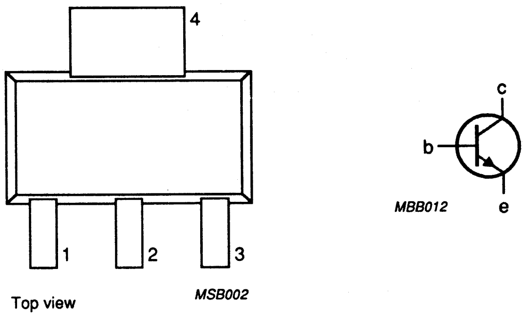


Fig.1 Simplified outline and symbol.

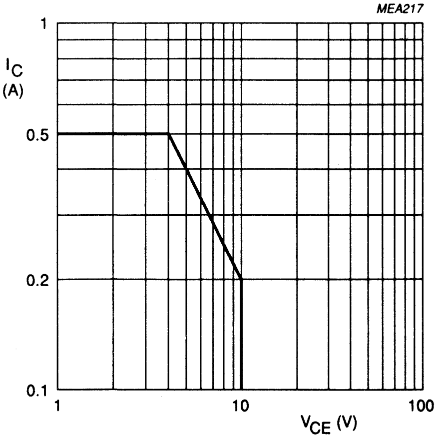
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	20	V
V_{CEO}	collector-emitter voltage	open base	–	10	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C, $I_{C(AV)}$	collector current	DC or average value	–	500	mA
I_{CM}	collector current	peak value f > 1 MHz	–	1.5	A
P_{tot}	total power dissipation	f > 1 MHz; T_S = 103 °C (note 1)	–	2	W
T_{stg}	storage temperature range		–65	150	°C
T_j	operating junction temperature		–	175	°C

Note

1. T_S = temperature at soldering point of collector tab.



T_S = 103 °C.

Fig.2 DC SOAR.

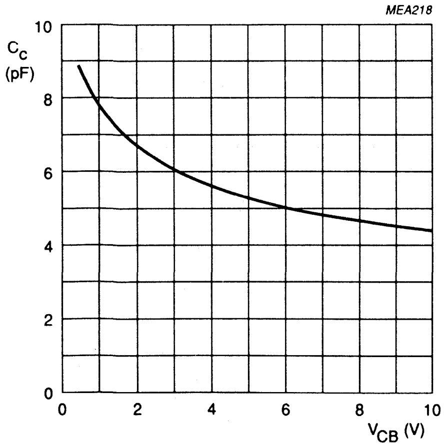
THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}s(DC)}$	from junction to soldering point	P_{tot} = 2 W; T_s = 103 °C	36	K/W

CHARACTERISTICS

T_j = 25 °C.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 5 mA	20	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 10 mA	10	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 1 mA	3	–	–	V
I_{CES}	collector-emitter leakage current	V_{BE} = 0; V_{CE} = 10 V	–	–	250	µA
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 300 mA	25	–	–	
E_{SBR}	second breakdown energy	L = 25 mH; R_{BE} = 10 Ω; f = 50 Hz	0.55	–	–	mJ
C_c	collector capacitance	V_{CB} = 7.5 V; $I_E = I_e$ = 0; f = 1 MHz	–	4.7	6	pF
C_{re}	feedback capacitance	V_{CE} = 7.5 V; I_C = 0; f = 1 MHz	–	2.9	4.5	pF



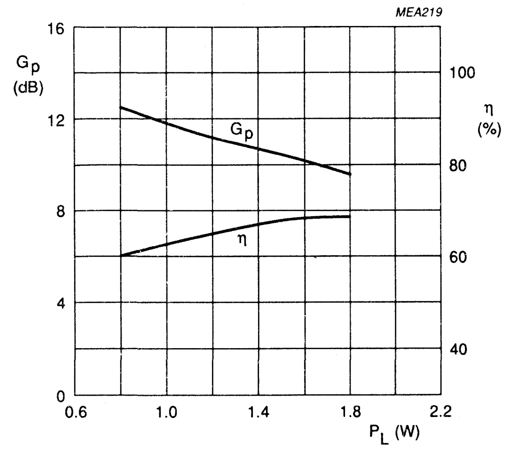
$I_E = i_e = 0$; f = 1 MHz.

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

APPLICATION INFORMATION

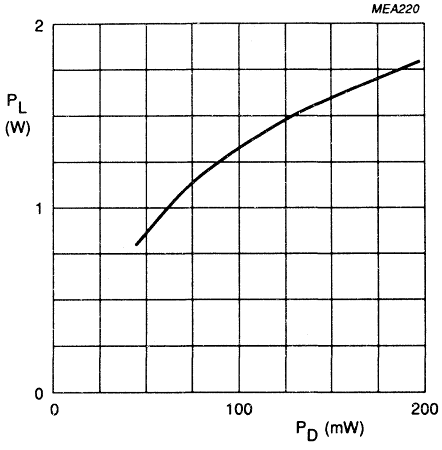
RF performance at $T_s \le 60$ °C in a common emitter class-B test circuit.

MODE OF OPERATION	f (MHz)	V_{CE} (V)	P_L (W)	G_p (dB)	η_c (%)
c.w. narrow band	470	7.5	1.2	> 10 typ. 11.2	> 55 typ. 65



V_{CE} = 7.5 V; f = 470 MHz.

Fig.4 Gain and efficiency as functions of load power, typical values.



V_{CE} = 7.5 V; f = 470 MHz.

Fig.5 Load power as a function of drive power, typical values.

Ruggedness in class-B operation

The BLT50 is capable of withstanding a load mismatch corresponding to VSWR = 50:1 through all phases at rated output power, up to a supply voltage of 9 V, f = 470 MHz and $T_S \le 60$ °C, where T_s is the temperature at the soldering point of the collector tab.

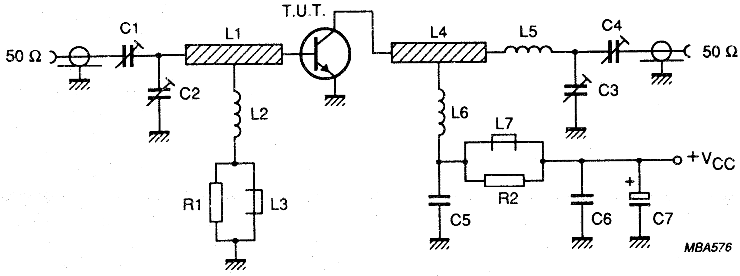


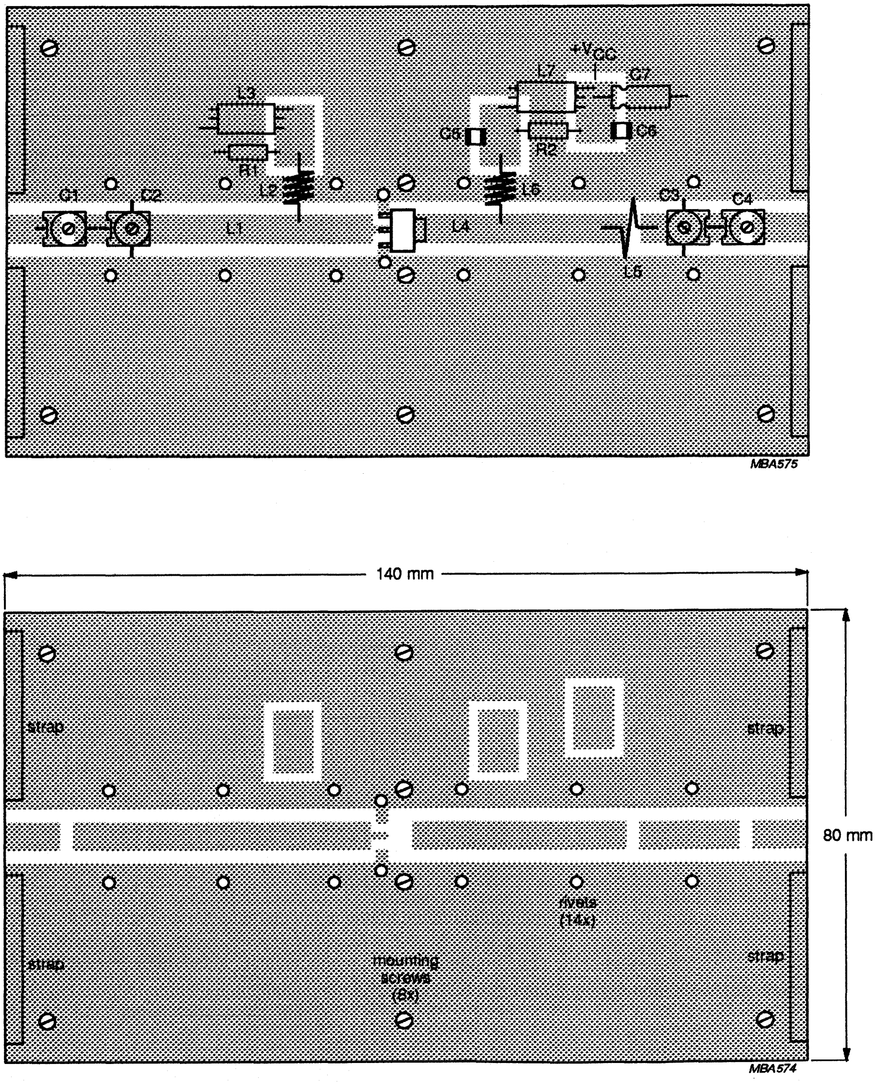
Fig.6 Class-B test circuit at f = 470 MHz.

List of components (see test circuit)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
C1	film dielectric trimmer	1.4 to 5.5 pF		2222 809 09004
C2	film dielectric trimmer	1.4 to 5.5 pF		2222 809 09001
C3	film dielectric trimmer	2 to 9 pF		2222 809 09002
C4	film dielectric trimmer	2 to 9 pF		2222 809 09005
C5	multilayer ceramic chip capacitor (note 1)	100 pF		
C6	multilayer ceramic chip capacitor (note 1)	1 nF		
C7	63 V electrolytic capacitor	2.2 μF		
L1	stripline (note 2)	50 Ω	54 mm x 4.7 mm	
L2	5 turns enamelled 0.4 mm copper wire		int. dia. 3 mm	
L3, L7	grade 3B1 Ferroxcube wideband RF choke			4312 020 36640
L4	stripline (note 2)	50 Ω	36 mm x 4.7 mm	
L5	1 turn enamelled 1.4 mm copper wire	5 nH	int. dia. 4 mm	
L6	3 turns enamelled 0.4 mm copper wire		int. dia. 3 mm	
R1, R2	0.25 W metal film resistor	10 Ω, 5%		

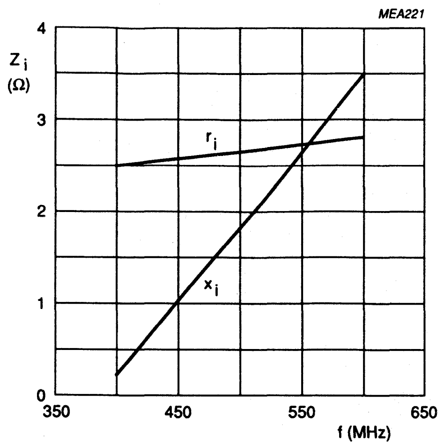
Notes

1. American Technical Ceramics (ATC) capacitor, type 100B or other capacitor of the same quality.
2. The striplines are mounted on a double copper-clad printed circuit board, with PTFE fibre-glass dielectric (ϵ_r = 2.2); thickness 1⁄16 inch.



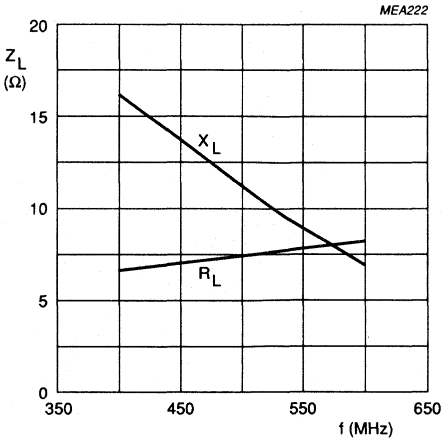
The circuit and components are situated on one side of a copper-clad PTFE fibre-glass board; the other side is unetched and serves as a ground plane. Earth connections from the component side to the ground plane are made by means of fixing screws, hollow rivets and copper foil straps, as shown.

Fig.7 Component layout for 470 MHz class-B test circuit.



Class-B operation; V_{CE} = 7.5 V; P_L = 1.2 W.

Fig.8 Input impedance (series components) as a function of frequency, typical values.



Class-B operation; V_{CE} = 7.5 V; P_L = 1.2 W.

Fig.9 Load impedance (series components) as a function of frequency, typical values.

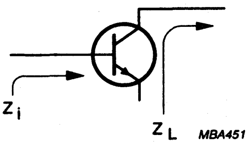
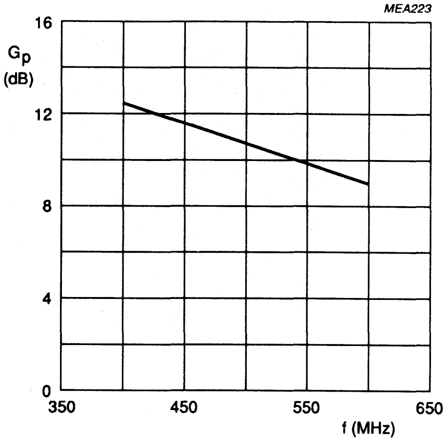


Fig.10 Definition of transistor impedance.



Class-B operation; V_{CE} = 7.5 V; P_L = 1.2 W.

Fig.11 Power gain as a function of frequency, typical values.

UHF power transistor BLT80

FEATURES

- SMD encapsulation
- Gold metallization ensures excellent reliability.

DESCRIPTION

NPN silicon planar epitaxial transistor designed primarily for use in hand-held radio equipment in the 900 MHz communications band.

The transistor is encapsulated in a surface-mountable SOT223 envelope.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector

QUICK REFERENCE DATA

RF performance at $T_s \leq 60$ °C in a common emitter test circuit (see note 1).

MODE OF OPERATION	f (MHz)	V_{CE} (V)	P_L (W)	G_p (dB)	η_c (%)
c.w. class-B narrow band	900	7.5	0.8	≥ 6	≥ 60

Note

1. T_s is the temperature at the soldering point of the collector tab.

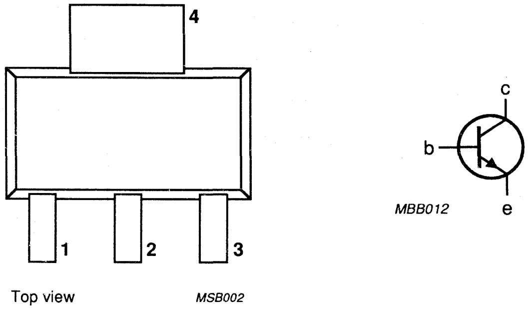


Fig.1 Simplified outline (SOT223) and symbol.

LIMITING VALUES

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

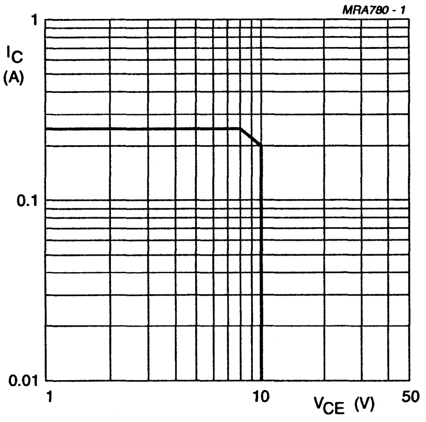
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	20	V
V_{CEO}	collector-emitter voltage	open base	–	10	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	DC or average collector current		–	250	mA
I_{CM}	peak collector current	f > 1 MHz	–	750	mA
P_{tot}	total power dissipation	T_s = 131 °C (note 1)	–	2	W
T_{stg}	storage temperature range		–65	150	°C
T_j	junction temperature		–	175	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s(DC)}$	from junction to soldering point	P_{dis} = 2 W; T_s = 131 °C (note 1)	22 K/W
$R_{th\ j\text{-}amb}$	from junction to ambient	P_{dis} = 2 W; T_{amb} = 25 °C (note 2)	85 K/W

Notes

1. T_s is the temperature at the soldering point of the collector tab.
2. Mounted on a PCB measuring 40 x 40 x 1 mm, collector pad 35 x 17 mm.



T_s = 131 °C.

Fig.2 DC SOAR.

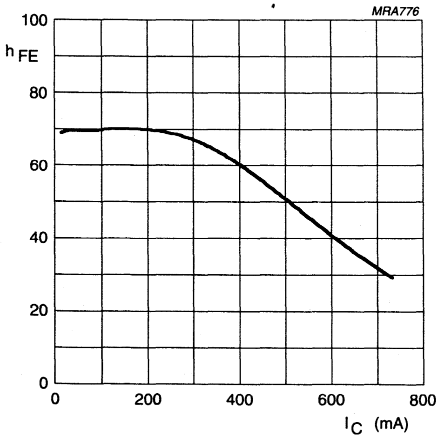
CHARACTERISTICS

T_j = 25 °C.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 2.5 mA	20	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 5 mA	10	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 0.5 mA	3	–	V
I_{CES}	collector-emitter leakage current	V_{BE} = 0; V_{CE} = 10 V	–	0.1	mA
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 150 mA (note 1)	25	–	
C_c	collector capacitance	V_{CB} = 7.5 V; I_E = I_e = 0; f = 1 MHz	–	3.5	pF
C_{re}	feedback capacitance	V_{CE} = 7.5 V; I_C = 0; f = 1 MHz	–	2.5	pF

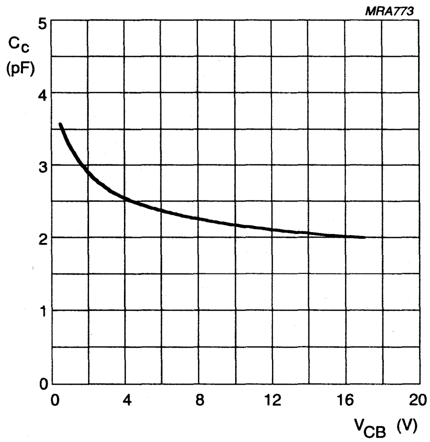
Note

1. Measured under pulse conditions: $t_p \leq 200$ µs; $\delta \leq 0.02$.



V_{CE} = 7.5 V; $t_p \leq 200$ µs; $\delta \leq 0.02$.

Fig.3 DC current gain as a function of collector current, typical values.



I_E = i_e = 0; f = 1 MHz.

Fig.4 Collector capacitance as a function of collector-base voltage, typical values.

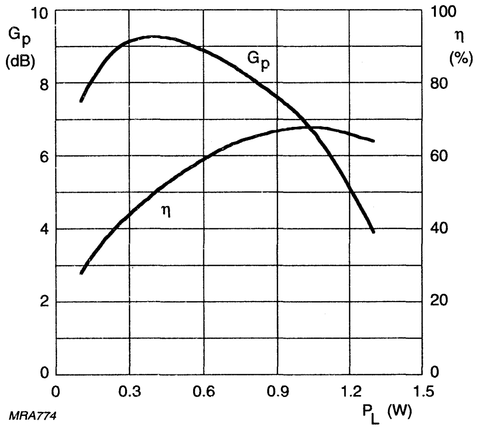
APPLICATION INFORMATION

RF performance at $T_s \leq 60$ °C in a common emitter test circuit (see note 1.)

MODE OF OPERATION	f (MHz)	V_{CE} (V)	P_L (W)	G_p (dB)	η_c (%)
c.w. class-B narrow band	900	7.5	0.8	≤ 6 typ. 8	> 60 typ. 67

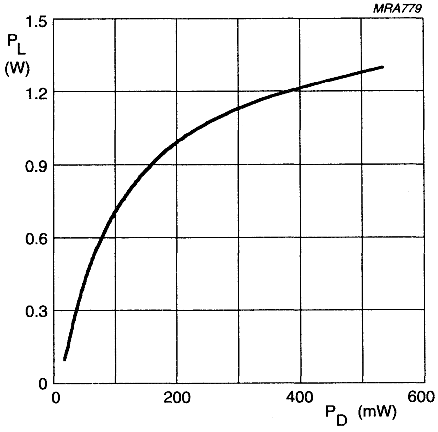
Note

1. T_s is the temperature at the soldering point of the collector tab.



Class-B operation; V_{CE} = 7.5 V; f = 900 MHz.

Fig.5 Power gain and efficiency as functions of load power, typical values.



Class-B operation; V_{CE} = 7.5 V; f = 900 MHz.

Fig.6 Load power as a function of drive power, typical values.

Ruggedness in class-B operation

The BLT80 is capable of withstanding a full load mismatch corresponding to VSWR = 50:1 through all phases at rated output power, up to a supply voltage of 9 V, f = 900 MHz and $T_s \leq 60$ °C, where T_s is the temperature at the soldering point of the collector tab.

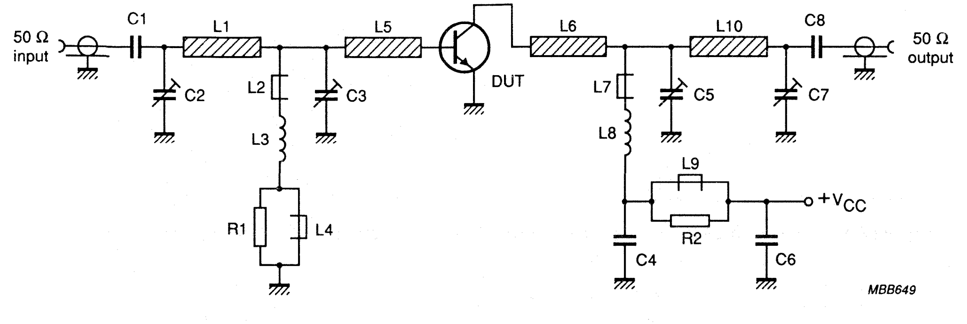


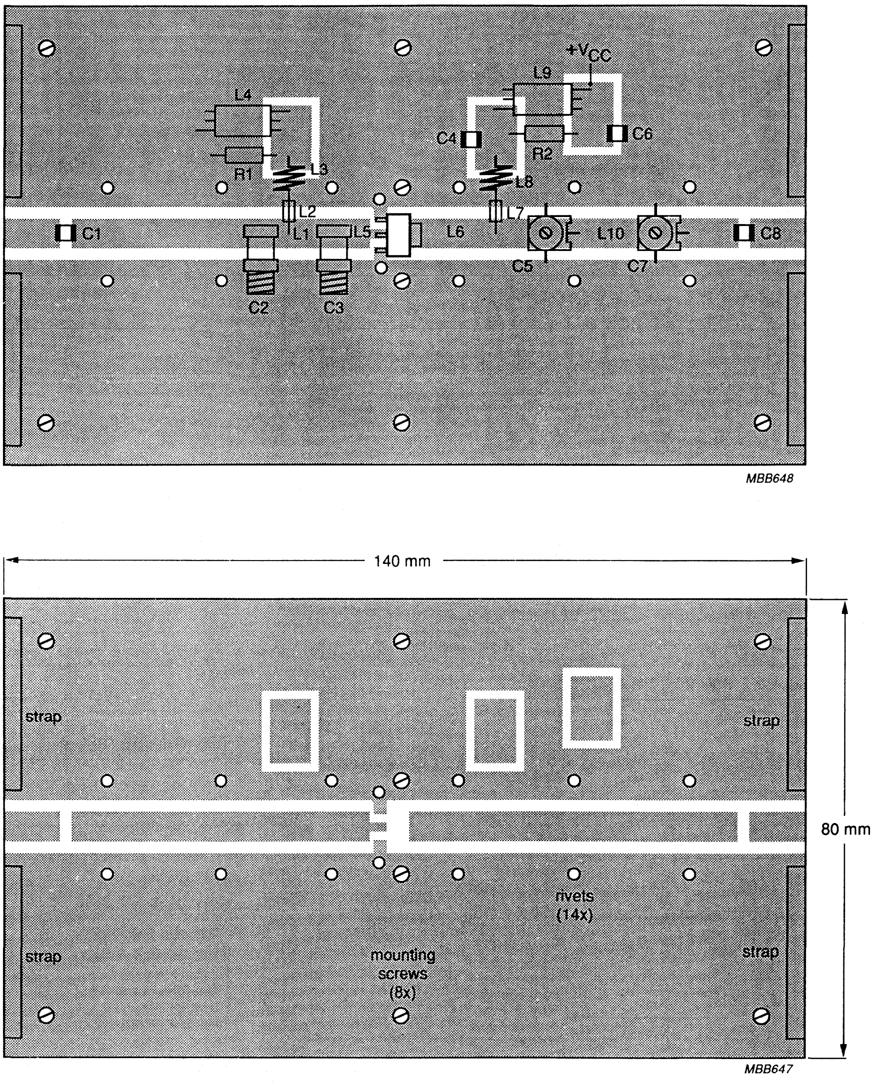
Fig.7 Class-B test circuit at f = 900 MHz.

List of components (see test circuit)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
C1, C8	multilayer ceramic chip capacitor (note 1)	100 pF		
C2, C3	type 9105 Voltronix KM10 trimmer	0.6 to 10 pF		
C4	multilayer ceramic chip capacitor (note 1)	220 pF		
C5, C7	film dielectric trimmer	1.4 to 5.5 pF		2222 809 09001
C6	multilayer ceramic chip capacitor (note 1)	1 nF		
L1	stripline (note 2)	50 Ω	length 13 mm width 4.85 mm	
L2, L7	1 turn 0.4 mm copper wire on grade 3B core			4330 030 32221
L3, L8	6 turns enamelled 0.8 mm copper wire		int. dia. 3 mm	
L4, L9	grade 3B Ferroxcube wideband HF choke			4312 020 36640
L5	stripline (note 2)	50 Ω	length 8.4 mm width 4.85 mm	
L6	stripline (note 2)	50 Ω	length 20 mm width 4.85 mm	
L10	stripline (note 2)	50 Ω	length 21 mm width 4.85 mm	
R1, R2	metal film resistor	10 Ω, 0.25 W		

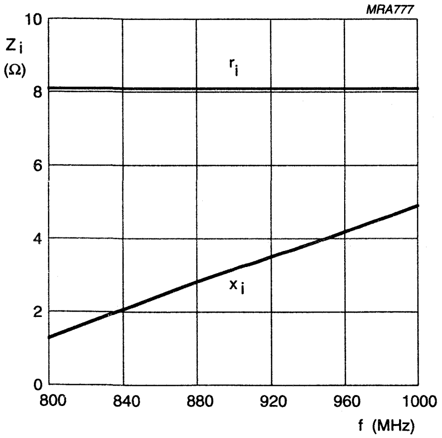
Notes

1. American Technical Ceramics (ATC) capacitor, type 100A or other capacitor of the same quality.
2. The striplines are on a double copper-clad printed circuit board, with PTFE fibre-glass dielectric ($\epsilon_r = 2.2$); thickness 1⁄16 inch.



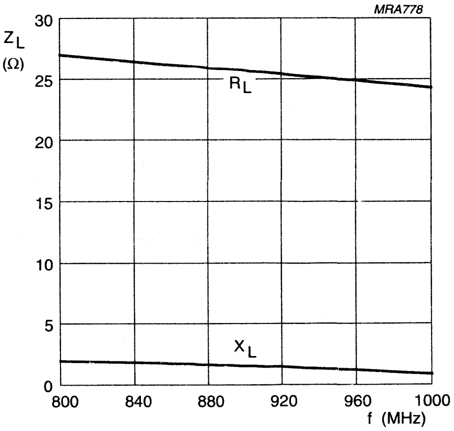
The components are situated on one side of a copper-clad PTFE fibre-glass board; the other side is unetched and serves as a ground plane. Earth connections from the component side to the ground plane are made by means of fixing screws and copper straps under the emitter leads.

Fig.8 Printed circuit board and component layout for 900 MHz test circuit.



Class-B operation; $V_{CE} = 7.5$ V; $P_L = 0.8$ W; $T_s \leq 60$ °C.

Fig.9 Input impedance (series components) as a function of frequency, typical values.



Class-B operation; $V_{CE} = 7.5$ V; $P_L = 0.8$ W; $T_s \leq 60$ °C.

Fig.10 Load impedance (series components) as a function of frequency, typical values.

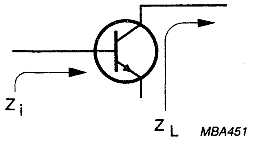
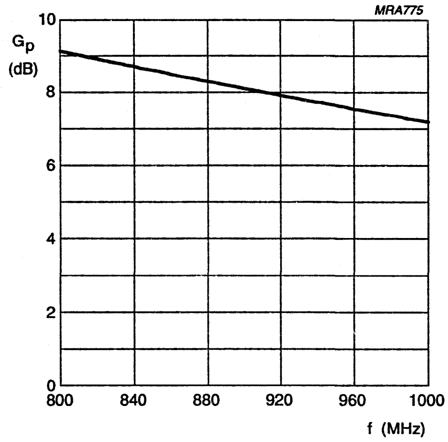


Fig.11 Definition of transistor impedance.



Class-B operation; $V_{CE} = 7.5$ V; $P_L = 0.8$ W; $T_s \leq 60$ °C.

Fig.12 Power gain as a function of frequency, typical values.

UHF power transistor BLT81

FEATURES

- SMD encapsulation
- Gold metallization ensures excellent reliability.

DESCRIPTION

NPN silicon planar epitaxial transistor in a 4-lead SOT223 surface mounting package.

It is primarily designed for use in hand-held radio equipment in the 900 MHz communications band.

PINNING - SOT223

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector

QUICK REFERENCE DATA

RF performance at $T_s \leq 60$ °C in a common emitter test circuit (note 1).

MODE OF OPERATION	f (MHz)	V_{CE} (V)	P_L (W)	G_p (dB)	η_C (%)
CW class-B, narrow band	900	7.5	1.2	≥ 6	≥ 60
	900	6	1.2	typ. 6.5	typ. 70

Note

1. T_s is the temperature at the soldering point of the collector tab.

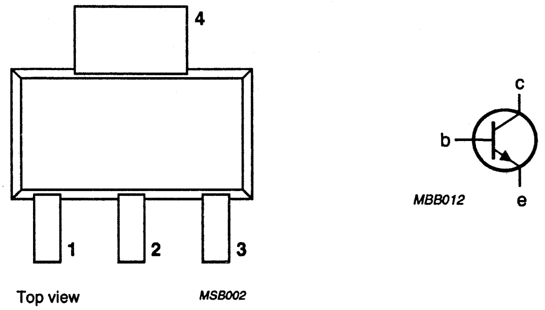


Fig.1 Simplified outline and symbol.

LIMITING VALUES

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

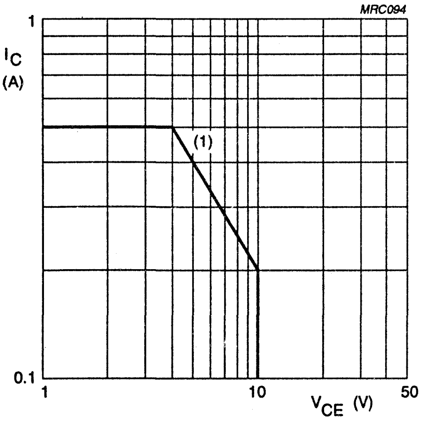
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	20	V
V_{CEO}	collector-emitter voltage	open base	–	9.5	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	500	mA
P_{tot}	total power dissipation	T_s = 110 °C (note 1)	–	2	W
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	175	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	P_{tot} = 2 W; T_s = 110 °C (note 1)	max. 32 K/W

Note

1. T_s is the temperature at the soldering point of the collector tab.



(1) T_s = 110 °C.

Fig.2 DC SOAR.

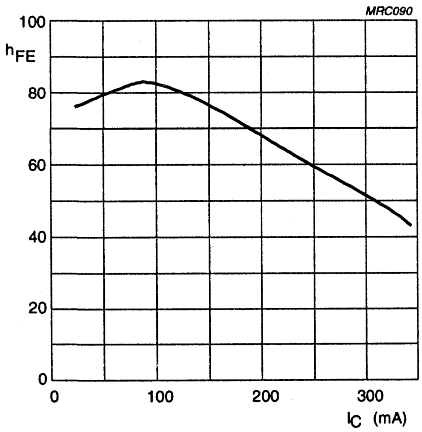
CHARACTERISTICS

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 = 1 mA	20	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 10 mA	9.5	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 0.1 mA	2.5	–	–	V
I_{CES}	collector-emitter cut-off current	V_{BE} = 0; V_{CE} = 10 V	–	–	0.1	mA
h_{FE}	DC current gain	I_C = 300 mA; V_{CE} = 5 V (note 1)	25	–	–	
C_c	collector capacitance	$I_E = i_e = 0$; V_{CB} = 7.5 V; f = 1 MHz	–	2.7	4	pF
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 7.5 V; f = 1 MHz	–	1.7	3	pF

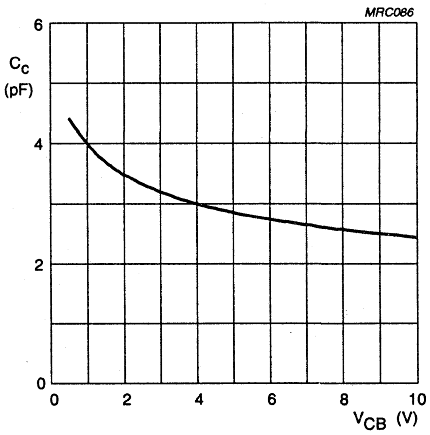
Note

1. Measured under pulse conditions: $t_p \leq 200$ µs; $\delta \leq 0.02$.



V_{CE} = 7.5 V; $t_p \leq 200$ µs; $\delta \leq 0.02$.

Fig.3 DC current gain as a function of collector current, typical values.



$I_E = i_e = 0$; f = 1 MHz.

Fig.4 Collector capacitance as a function of collector-base voltage, typical values.

APPLICATION INFORMATION

RF performance at $T_s \leq 60$ °C in a common emitter test circuit (note 1).

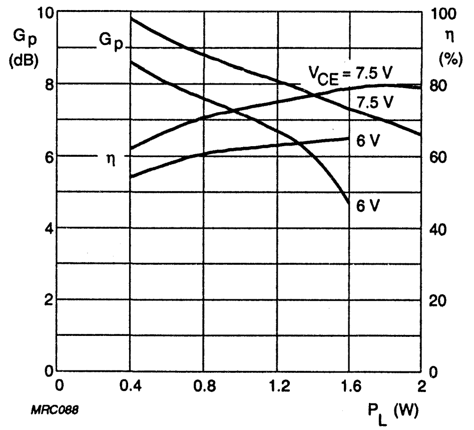
MODE OF OPERATION	f (MHz)	V_{CE} (V)	P_L (W)	G_p (dB)	η_C (%)
CW class-B, narrow band	900	7.5	1.2	≥ 6 typ. 8	≥ 60 typ. 70
	900	6	1.2	typ. 6.5	typ. 70

Note

1. T_s is the temperature at the soldering point of the collector tab.

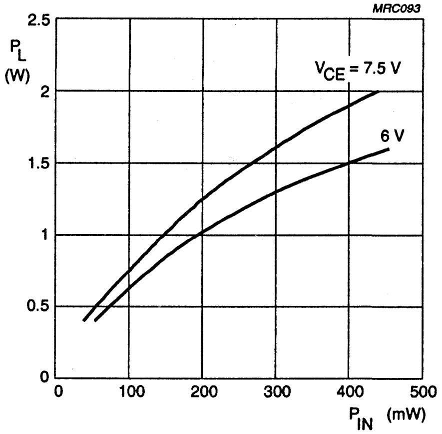
Ruggedness in class-B operation

The BLT81 is capable of withstanding a full load mismatch corresponding to VSWR = 50:1 through all phases at rated output power, up to a supply voltage of 9 V, f = 900 MHz and $T_s \leq 60$ °C, where T_s is the temperature at the soldering point of the collector tab.



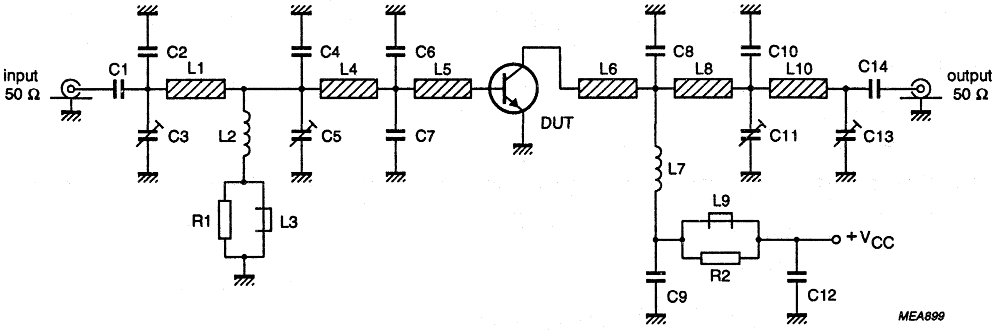
Class-B operation;
f = 900 MHz.

Fig.5 Power gain and efficiency as functions of load power, typical values.



Class-B operation;
f = 900 MHz.

Fig.6 Load power as a function of input power, typical values.



f = 900 MHz.

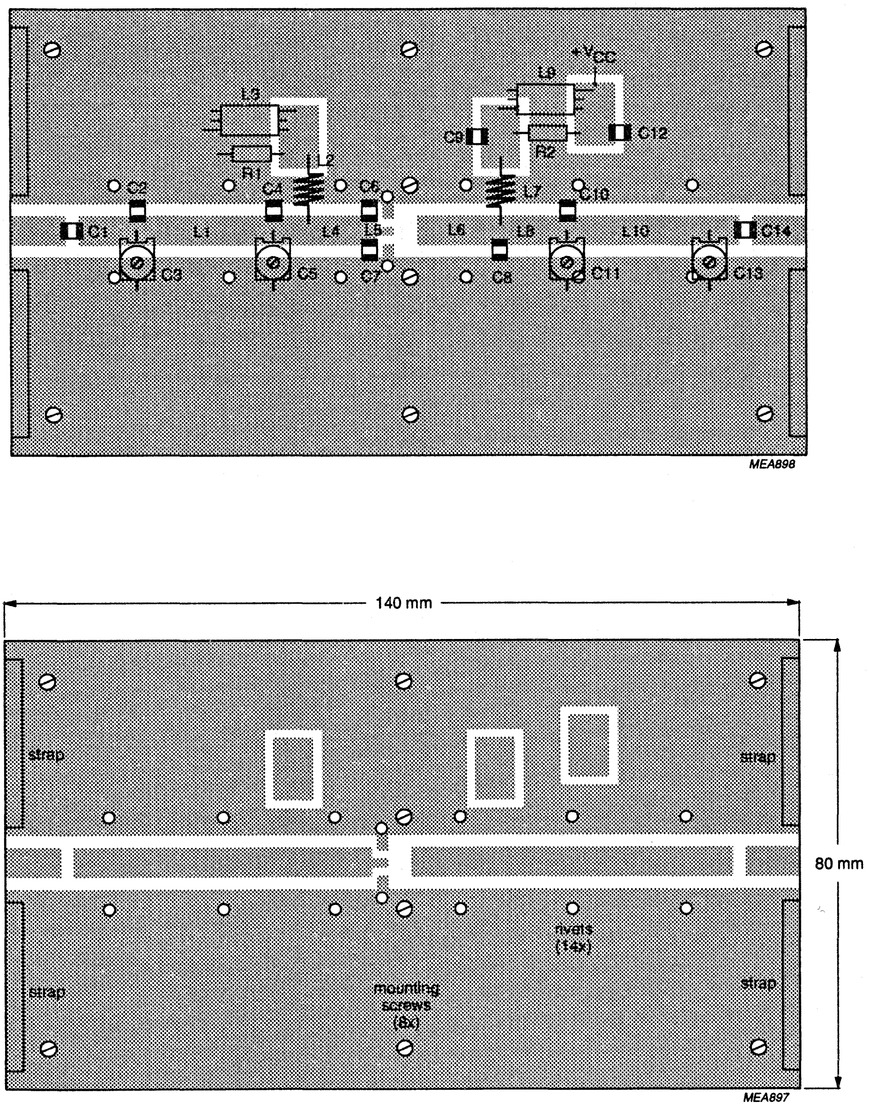
Fig.7 Class-B test circuit.

List of components (see Figs 7 and 8)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
C1, C14	multilayer ceramic chip capacitor (note 1)	110 pF		
C2	multilayer ceramic chip capacitor (note 1)	3 pF		
C3, C5, C11, C13	film dielectric trimmer	1.4 to 5.5 pF		2222 809 09004
C4	multilayer ceramic chip capacitor (note 1)	5.6 pF		
C6, C7, C10	multilayer ceramic chip capacitor (note 1)	5.1 pF		
C8	multilayer ceramic chip capacitor (note 1)	3.6 pF		
C9	multilayer ceramic chip capacitor (note 1)	220 pF		
C12	multilayer ceramic chip capacitor	1 nF		
L1	stripline (note 2)	50 Ω	length 26.6 mm width 4.85 mm	
L2	10 turns 0.6 mm enamelled copper wire	250 nH	int. dia. 4.5 mm leads 2 x 5 mm	
L3, L9	grade 3B Ferroxcube wideband HF choke			4312 020 36640
L4	stripline (note 2)	50 Ω	length 18 mm width 4.85 mm	
L5	stripline (note 2)	75 Ω	length 3.5 mm width 2.5 mm	
L6	stripline (note 2)	50 Ω	length 10 mm width 4.85 mm	
L7	4 turns 0.6 mm enamelled copper wire	65 nH	int. dia. 4.5 mm leads 2 x 5 mm	
L8	stripline (note 2)	50 Ω	length 15 mm width 4.85 mm	
L10	stripline (note 2)	50 Ω	length 24.6 mm width 4.85 mm	
R1, R2	metal film resistor	10 Ω, 0.25 W		

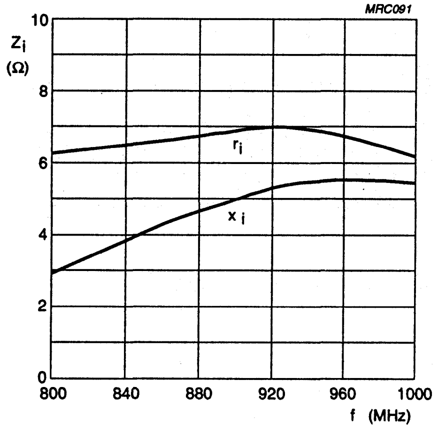
Notes

1. American Technical Ceramics (ATC) capacitor, type 100B or other capacitor of the same quality.
2. The striplines are on a double copper-clad printed circuit board, with PTFE fibre-glass dielectric ($\epsilon_r = 2.2$); thickness 1⁄16 inch.



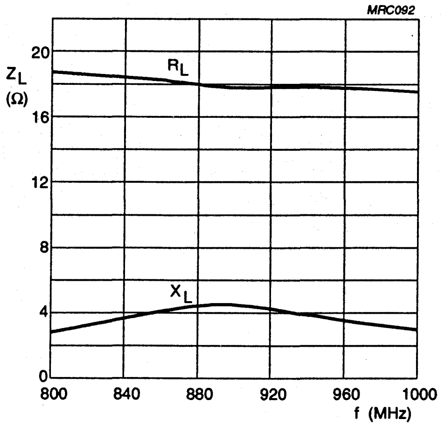
The components are situated on one side of a copper-clad PTFE fibre-glass board; the other side is unetched and serves as a ground plane. Earth connections from the component side to the ground plane are made by means of fixing screws and copper foil straps under the emitter leads.

Fig.8 Printed circuit board and component layout for 900 MHz test circuit.



Class-B operation;
V_{CE} = 7.5 V; P_L = 1.2 W; $T_s \leq 60$ °C.

Fig.9 Input impedance as a function of frequency (series components), typical values.



Class-B operation;
V_{CE} = 7.5 V; P_L = 1.2 W; $T_s \leq 60$ °C.

Fig.10 Load impedance as a function of frequency (series components), typical values.

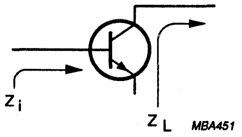
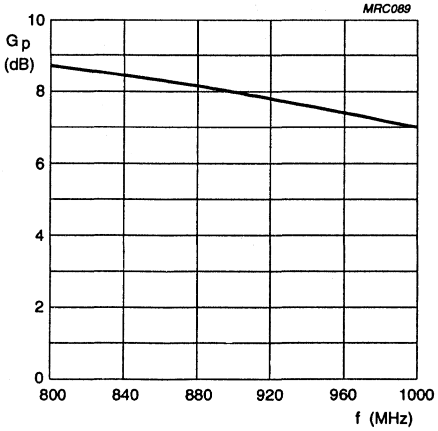


Fig.11 Definition of transistor impedance.



Class-B operation;
V_{CE} = 7.5 V; P_L = 1.2 W; $T_s \leq 60$ °C.

Fig.12 Power gain as a function of frequency, typical values.

Philips Semiconductors

Data sheet	
status	Product specification
date of issue	January 1991

BLU56
UHF power transistor

FEATURES

- SMD encapsulation
- Emitter-ballasting resistors for optimum temperature profile
- Gold metallization ensures excellent reliability.

DESCRIPTION

NPN silicon planar epitaxial transistor encapsulated in a SOT223 surface mounted envelope and designed primarily for use in mobile radio equipment in the 470 MHz communications band.

PINNING - SOT223

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector

QUICK REFERENCE DATA

RF performance at $T_S \leq 60$ °C in a common emitter class-B test circuit (see note 1.)

MODE OF OPERATION	f (MHz)	V_{CE} (V)	P_L (W)	G_p (dB)	η_c (%)
c.w. narrow band	470	12.5	1	> 12	> 50

Note

1. T_S = temperature at soldering point of collector tab.

PIN CONFIGURATION

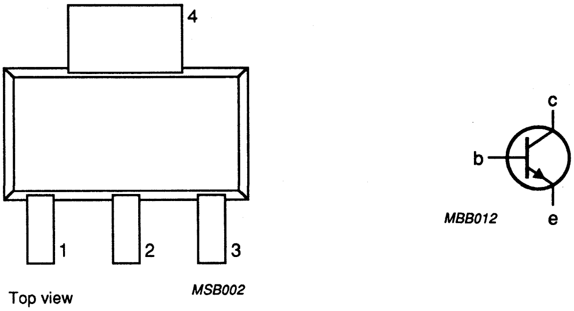


Fig.1 Simplified outline and symbol.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	36	V
V_{CEO}	collector-emitter voltage	open base	–	16	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C, $I_{C(AV)}$	collector current	DC or average value	–	200	mA
I_{CM}	collector current	peak value f > 1 MHz	–	600	mA
P_{tot}	total power dissipation	f > 1 MHz T_S = 105 °C (note 1)	–	2	W
T_{stg}	storage temperature range		–65	150	°C
T_j	operating junction temperature		–	175	°C

Note

1. T_S = temperature at soldering point of collector tab.

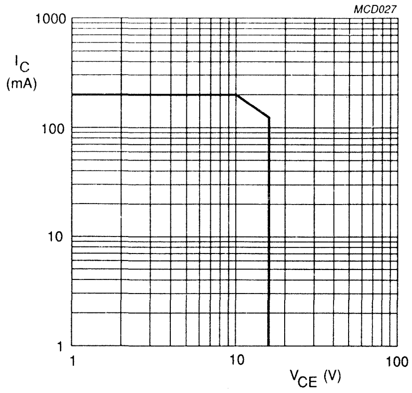


Fig.2 DC SOAR; T_S = 105 °C.

THERMAL RESISTANCE

SYMBOL	PARAMETER	MAX.	UNIT
$R_{th\ j\text{-}s(DC)}$	from junction to soldering point	35	K/W

CHARACTERISTICS

T_j = 25 °C.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter I_C = 2.5 mA	36	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base I_C = 10 mA	16	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector I_E = 0.5 mA	3	–	–	V
I_{CES}	collector-emitter leakage current	V_{BE} = 0 V_{CE} = 16 V	–	–	1	mA
h_{FE}	DC current gain	V_{CE} = 10 V I_C = 150 mA	25	–	–	
E_{SBR}	second breakdown energy	L = 25 mH R_{BE} = 10 Ω f = 50 Hz	0.3	–	–	mJ
C_c	collector capacitance	V_{CB} = 12.5 V $I_E = I_e$ = 0 f = 1 MHz	–	2.2	3	pF
C_{re}	feedback capacitance	V_{CE} = 12.5 V I_C = 0 f = 1 MHz	–	1.2	2	pF

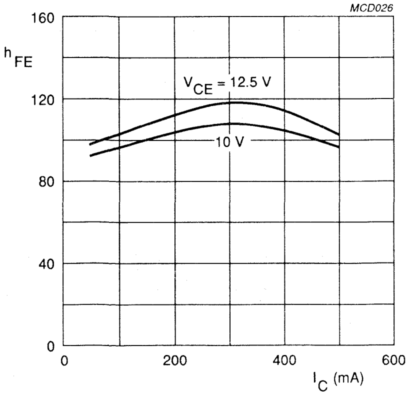


Fig.3 DC current gain as a function of drain current; typical values.

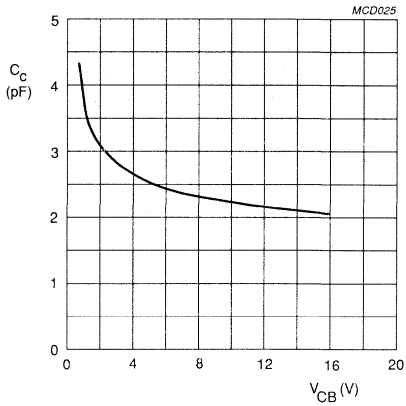


Fig.4 Collector capacitance as a function of collector-base voltage; $I_E = I_e = 0$; f = 1 MHz; typical values.

APPLICATION INFORMATION

RF performance at $T_s \leq 60$ °C; in a common emitter class-B test circuit.

MODE OF OPERATION	f (MHz)	V_{CE} (V)	P_L (W)	G_p (dB)	η_c (%)
c.w. narrow band	470	12.5	1	> 12 typ. 14	> 50 typ. 58

Ruggedness in class-B operation

The BLU56 is capable of withstanding a load mismatch corresponding to VSWR = 50:1 through all phases at rated output power, up to a supply voltage of 15.5 V, f = 470 MHz and $T_S \leq 60$ °C.

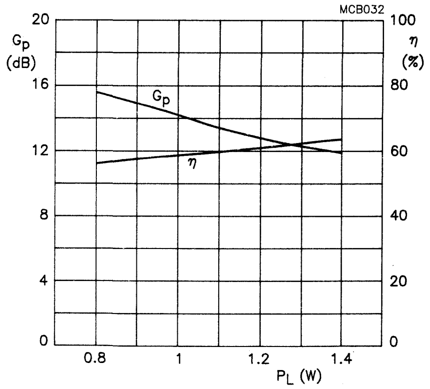


Fig.5 Gain and efficiency as functions of load power; typical values.

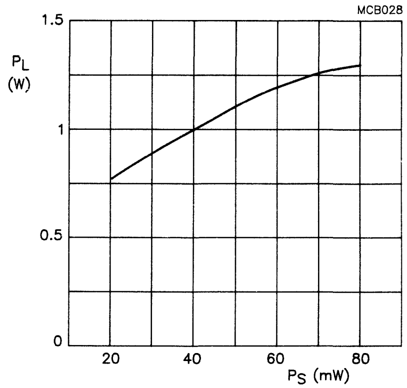


Fig.6 Load power as a function of drive power; typical values.

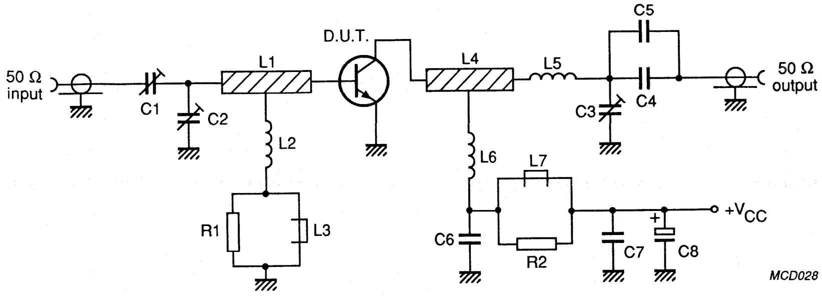


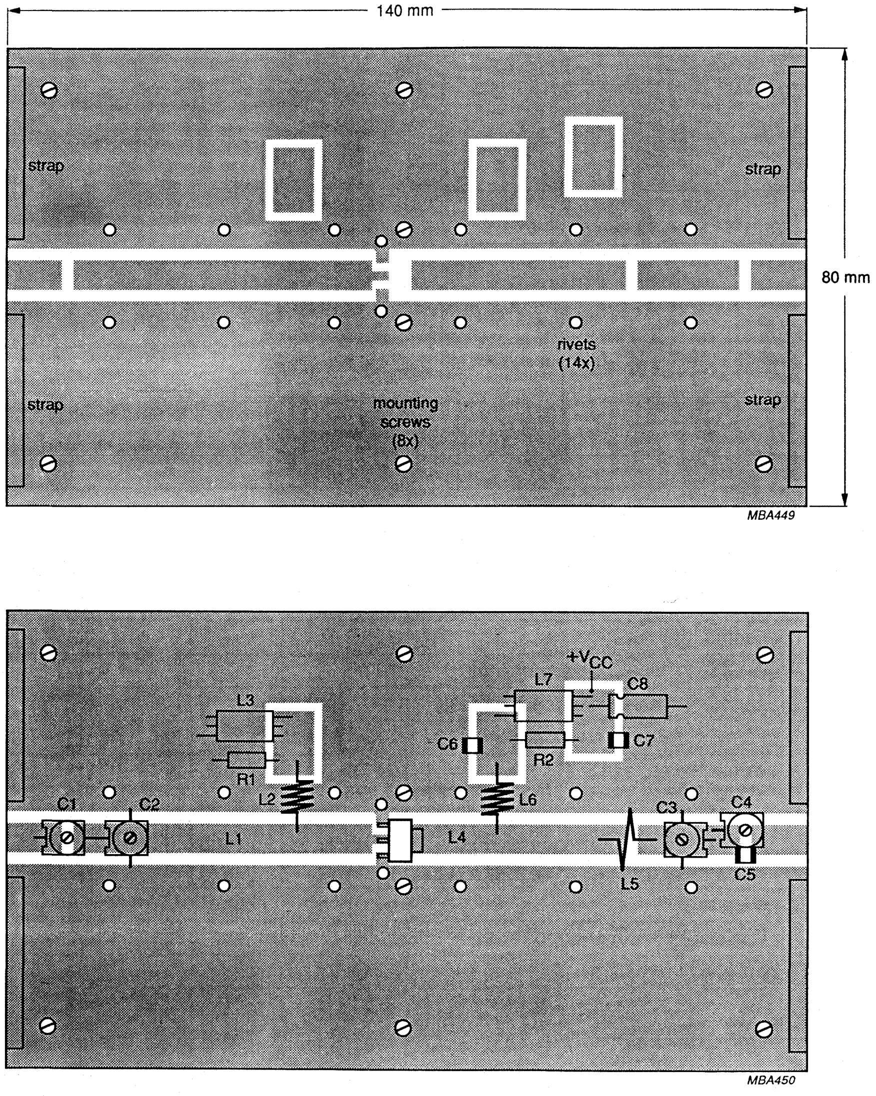
Fig.7 Class-B test circuit at f = 470 MHz.

List of components (see test circuit)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
C1, C4	film dielectric trimmer	2 to 18 pF		2222 809 05217
C2, C3	film dielectric trimmer	2 to 9 pF		2222 809 09002
C5	multilayer ceramic chip capacitor (note 1)	10 pF		
C6	multilayer ceramic chip capacitor (note 1)	100 pF		
C7	multilayer ceramic chip capacitor (note 1)	1 nF		
C8	63 V electrolytic capacitor	2.2 μF		
L1	stripline (note 2)	50 Ω	54 mm x 4.7 mm	
L2, L6	4 turns enamelled 0.4 mm copper wire	50 nH	int. dia. 3 mm	
L3, L7	grade 3B1 Ferroxcube wideband RF choke			4312 020 36640
L4	stripline (note 2)	50 Ω	36 mm x 4.7 mm	
L5	1 turn enamelled 2.2 mm copper wire	20 nH	int. dia. 8 mm	
R1, R2	0.25 W metal film resistor	10 Ω, 5%		

Notes

1. American Technical Ceramics (ATC) capacitor, type 100B or other capacitor of the same quality.
2. The striplines are mounted on a double copper-clad printed circuit board, with PTFE fibre-glass dielectric (ε_r = 2.2); thickness 1⁄16 inch.



The circuit and components are situated on one side of a copper-clad PTFE fibre-glass board; the other side is unetched and serves as a ground plane. Earth connections from the component side to the ground plane are made by means of fixing screws, hollow rivets and copper foil straps, as shown.

Fig.8 Component layout for 470 MHz class-B test circuit.

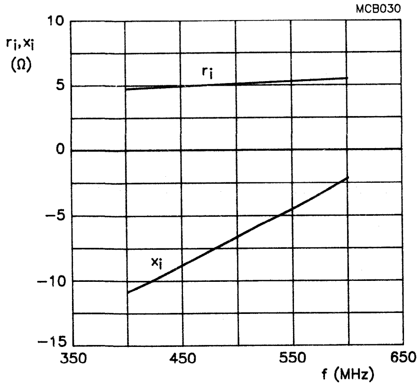


Fig.9 Input impedance (series components) as a function of frequency; class-B operation; V_{CE} = 12.5 V; P_L = 1 W; typical values.

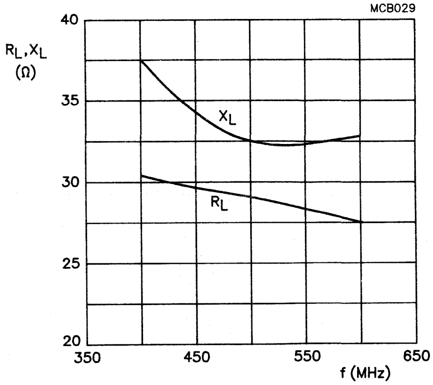


Fig.10 Load impedance (series components) as a function of frequency; class-B operation; V_{DS} = 12.5 V; P_L = 1 W; typical values.

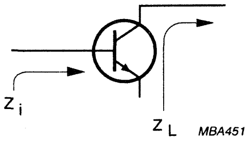


Fig.11 Definition of transistor impedance.

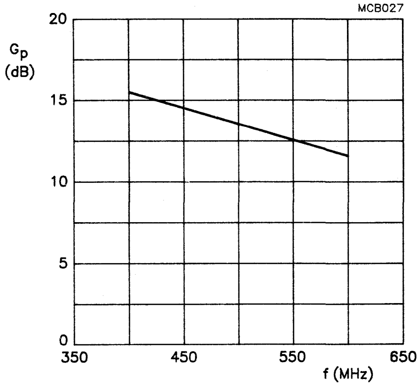


Fig.12 Power gain as a function of frequency; class-B operation; V_{DS} = 12.5 V; P_L = 1 W; typical values.

UHF power transistor BLU86

FEATURES

- SMD encapsulation
- Emitter-ballasting resistors for optimum temperature profile
- Gold metallization ensures excellent reliability.

DESCRIPTION

NPN silicon planar epitaxial transistor encapsulated in a SOT223 surface mounted envelope and designed primarily for use in mobile radio equipment in the 900 MHz communications band.

PINNING - SOT223

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector

QUICK REFERENCE DATA

RF performance at $T_S \leq 60$ °C in a common emitter class-B test circuit (see note 1).

MODE OF OPERATION	f (MHz)	V_{CE} (V)	P_L (W)	G_p (dB)	η_c (%)
c.w. narrow band	900	12.5	1	> 7	> 55

Note

1. T_S = temperature at soldering point of collector tab.

PIN CONFIGURATION

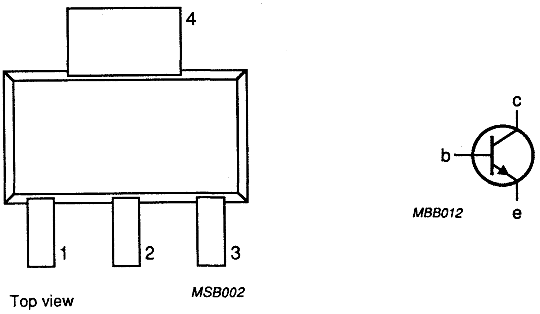


Fig.1 Simplified outline and symbol.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	32	V
V_{CEO}	collector-emitter voltage	open base	–	16	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C, $I_{C(AV)}$	collector current	DC or average value	–	200	mA
I_{CM}	collector current	peak value; f > 1 MHz	–	600	mA
P_{tot}	total power dissipation	f > 1 MHz; T_S = 129 °C (note 1)	–	2	W
T_{stg}	storage temperature range		–65	150	°C
T_j	operating junction temperature		–	175	°C

Note

1. T_S = temperature at soldering point of collector tab.

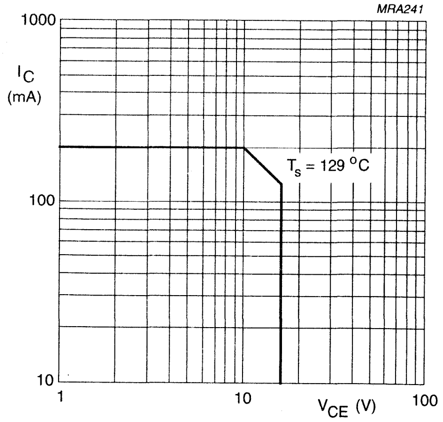


Fig.2 DC SOAR.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}s(DC)}$	from junction to soldering point	P_{tot} = 2 W; T_S = 129 °C	23	K/W

CHARACTERISTICS

T_j = 25 °C.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 2.5 mA	32	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 10 mA	16	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 0.5 mA	3	–	–	V
I_{CES}	collector-emitter leakage current	V_{BE} = 0; V_{CE} = 16 V	–	–	1	mA
h_{FE}	DC current gain	V_{CE} = 10 V; I_C = 150 mA	25	–	–	
E_{SBR}	second breakdown energy	L = 25 mH; R_{BE} = 10 Ω; f = 50 Hz	0.3	–	–	mJ
C_c	collector capacitance	V_{CB} = 12.5 V; $I_E = I_e$ = 0; f = 1 MHz	–	2.2	2.6	pF
C_{re}	feedback capacitance	V_{CE} = 12.5 V; I_C = 0; f = 1 MHz	–	1.2	1.8	pF

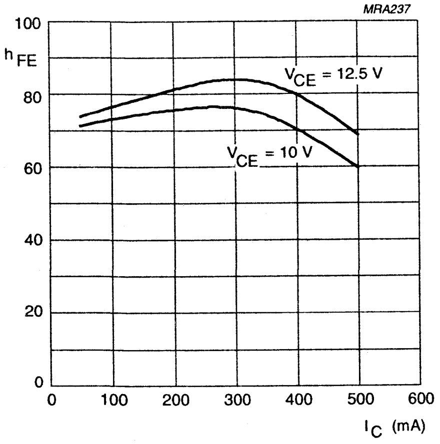


Fig.3 DC current gain as a function of collector current; typical values.

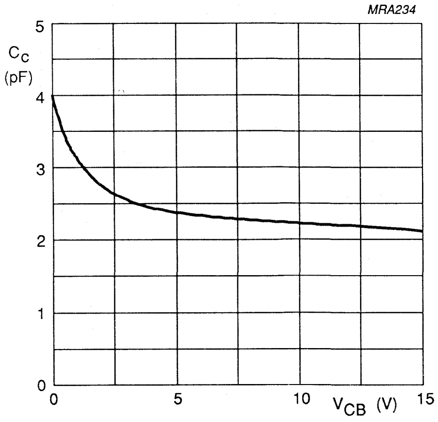


Fig.4 Collector capacitance as a function of collector-base voltage, typical values.

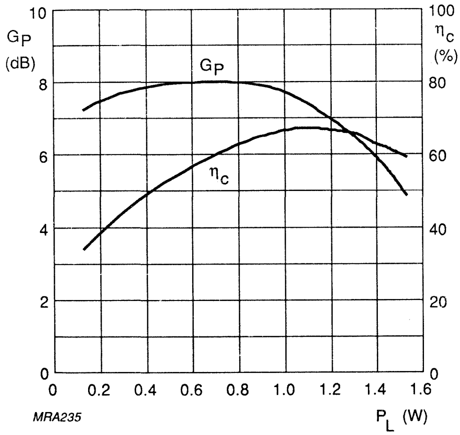
APPLICATION INFORMATION

RF performance at $T_s \leq 60$ °C; in a common emitter class-B test circuit (see note 1).

MODE OF OPERATION	f (MHz)	V_{CE} (V)	P_L (W)	G_p (dB)	η_c (%)
c.w. narrow band	900	12.5	1	> 7 typ. 7.7	> 55 typ. 66

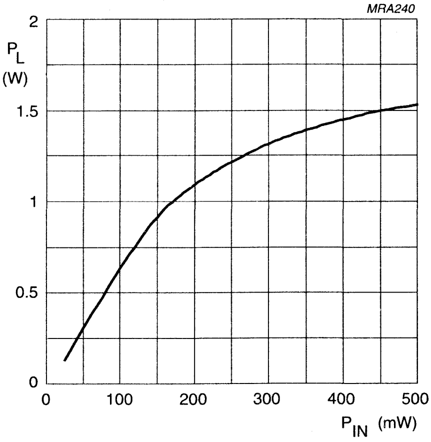
Note

1. T_S = temperature at soldering point of collector tab.



Class-B operation; V_{CE} = 12.5 V; f = 900 MHz.

Fig.5 Gain and efficiency as functions of load power, typical values.



Class-B operation; V_{CE} = 12.5 V; f = 900 MHz.

Fig.6 Load power as a function of drive power, typical values.

Ruggedness in class-B operation

The BLU86 is capable of withstanding a full load mismatch corresponding to VSWR = 50:1 through all phases at rated output power, up to a supply voltage of 15.5 V, f = 900 MHz and $T_S \leq 60$ °C, where T_S is the temperature at the soldering point of the collector tab.

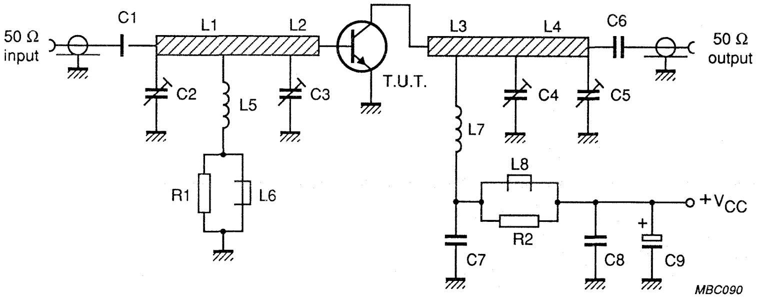


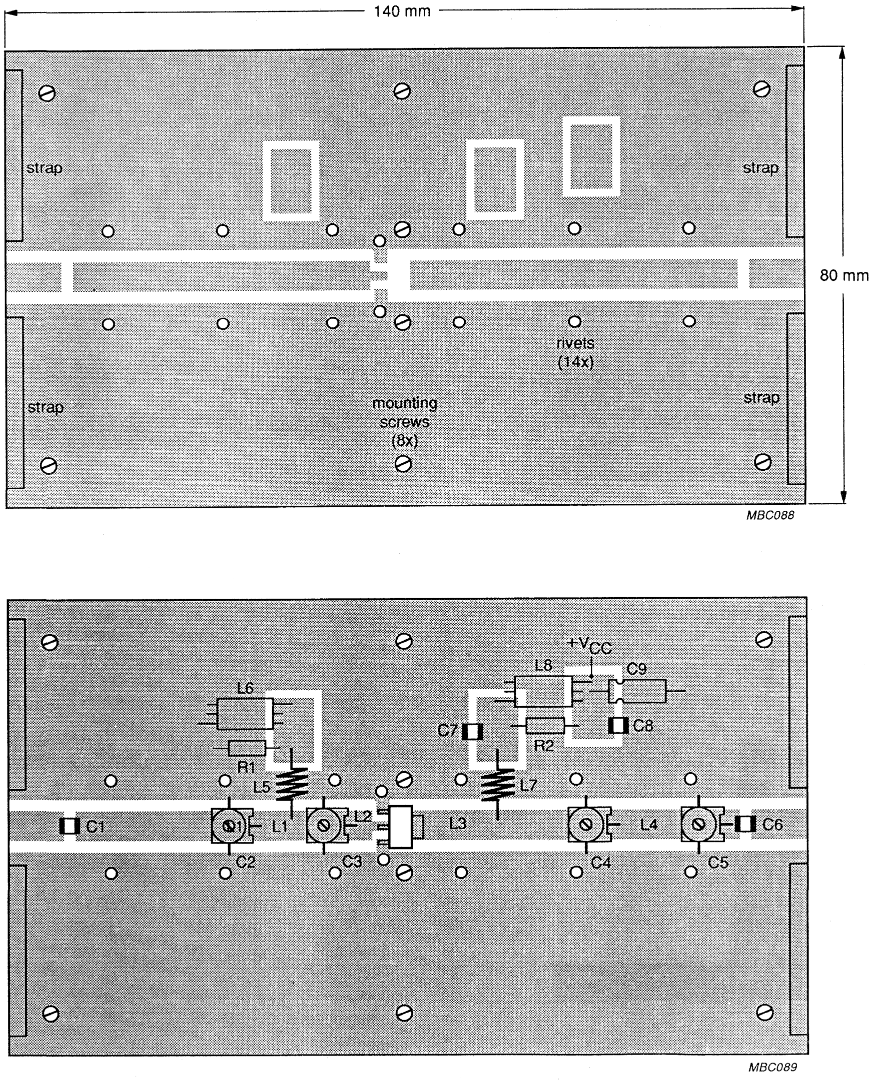
Fig.7 Class-B test circuit at f = 900 MHz.

List of components (see test circuit)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
C1, C6	multilayer ceramic chip capacitor (note 1)	100 pF		
C2, C3, C4, C5	film dielectric trimmer	1.4 to 5.5 pF		2222 809 09001
C7	multilayer ceramic chip capacitor (note 1)	220 pF		
C8	multilayer ceramic chip capacitor (note 1)	1 nF		
C9	63 V electrolytic capacitor	2.2 µF		
L1	stripline (note 2)	50 Ω	17 mm x 4.7 mm	
L2	stripline (note 2)	50 Ω	5 mm x 4.7 mm	
L3	stripline (note 2)	50 Ω	32 mm x 4.7 mm	
L4	stripline (note 2)	50 Ω	20 mm x 4.7 mm	
L5, L7	6 turns enamelled 0.8 mm copper wire		int. dia. 3 mm	
L6, L8	grade 3B1 Ferroxcube wideband HF choke			4312 020 36640
R1, R2	0.25 W metal film resistor	10 Ω, 5%		

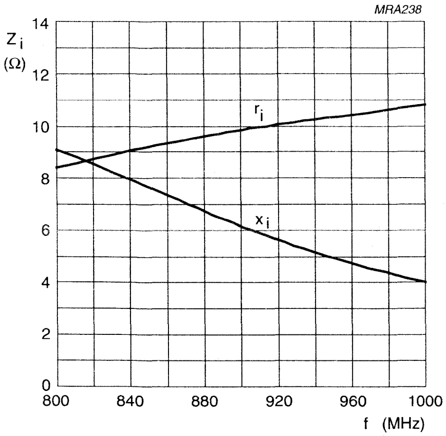
Notes

1. American Technical Ceramics (ATC) capacitor, type 100B or other capacitor of the same quality.
2. The striplines are mounted on a double copper-clad printed circuit board, with PTFE fibre-glass dielectric ($\varepsilon_r = 2.2$); thickness 1⁄16 inch.



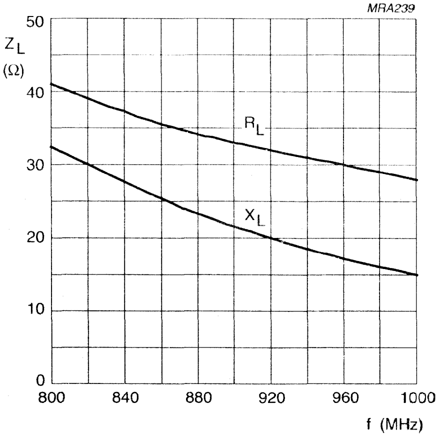
The circuit and components are situated on one side of a copper-clad PTFE fibre-glass board; the other side is unetched and serves as a ground plane. Earth connections from the component side to the ground plane are made by means of fixing screws, hollow rivets and copper foil straps, as shown.

Fig.8 Component layout for 900 MHz class-B test circuit.



Class-B operation; V_{CE} = 12.5 V; P_L = 1 W.

Fig.9 Input impedance (series components) as a function of frequency, typical values.



Class-B operation; V_{CE} = 12.5 V; P_L = 1 W.

Fig.10 Load impedance (series components) as a function of frequency, typical values.

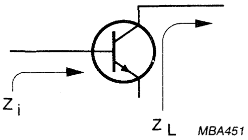
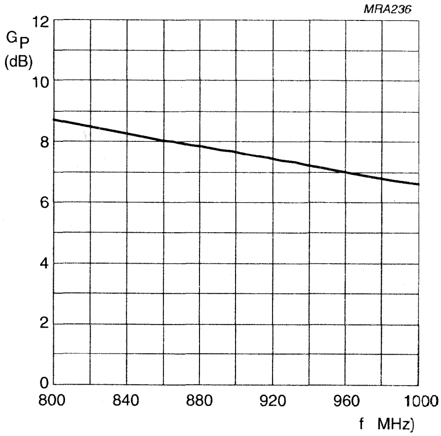


Fig.11 Definition of transistor impedance.



Class-B operation; V_{CE} = 12.5 V; P_L = 1 W.

Fig.12 Power gain as a function of frequency, 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

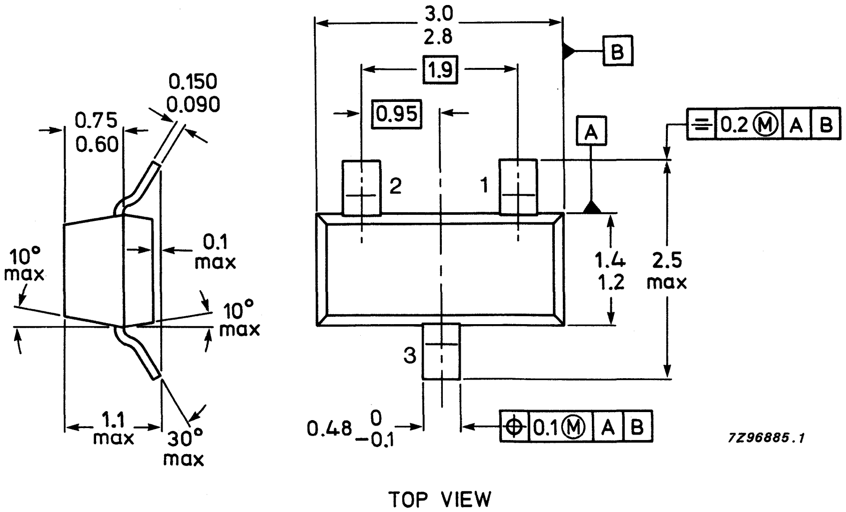
MECHANICAL DATA

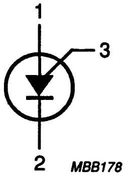
Dimensions in mm

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

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

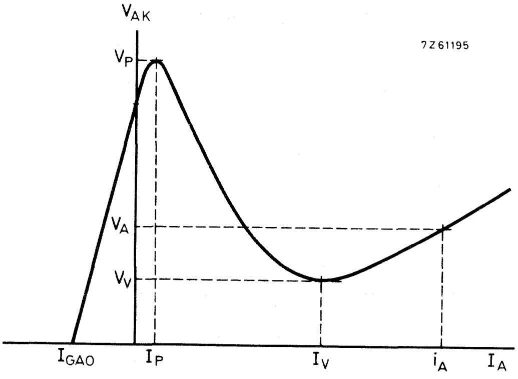


Fig. 2 See also Fig. 11.

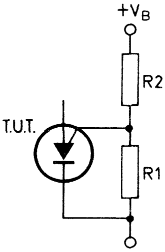


Fig. 3 BRY61 with "program" resistors R1 and R2.

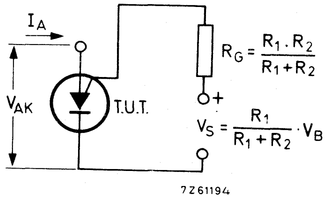


Fig. 4 Equivalent test circuit for characteristics testing.

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

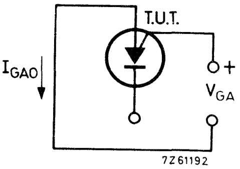


Fig. 5a.

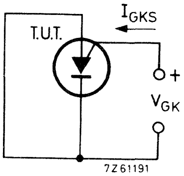


Fig. 5b.

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

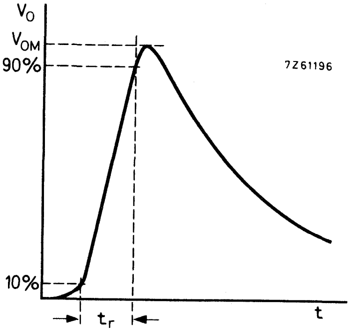


Fig. 6 Output voltage waveform.

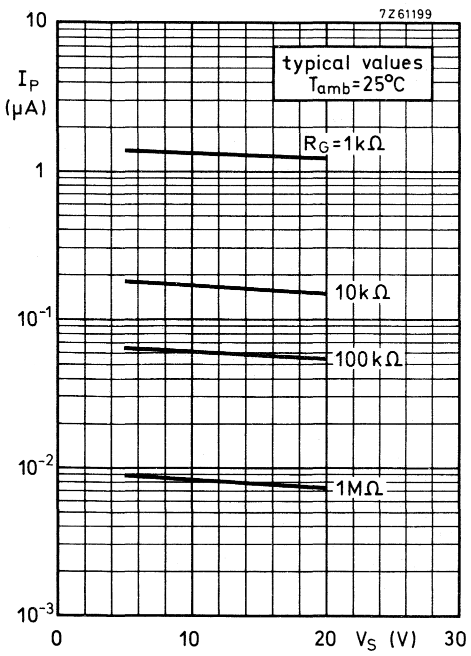


Fig. 7.

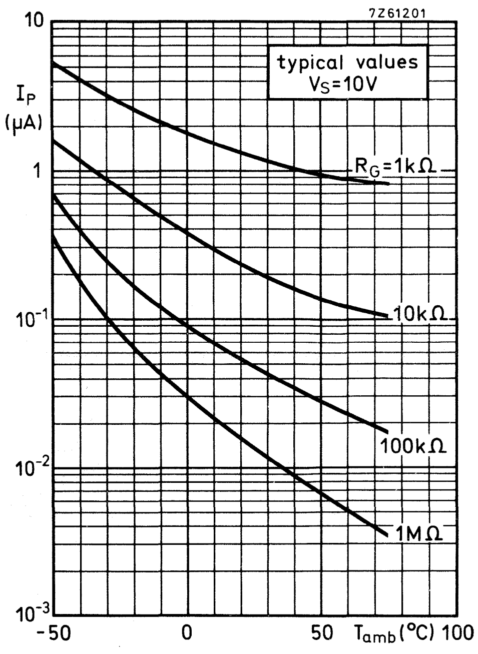


Fig. 8.

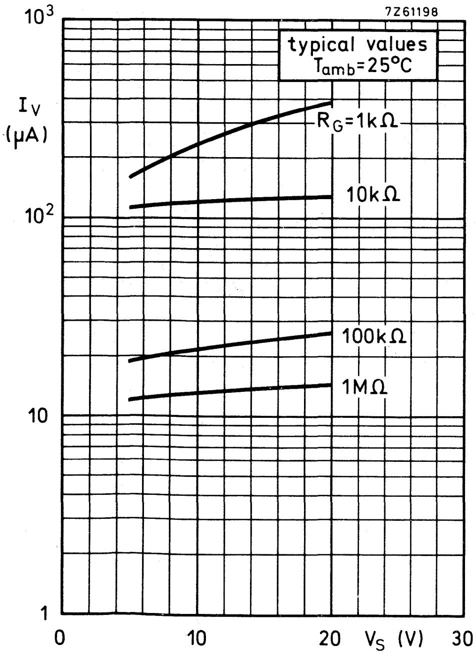


Fig. 9.

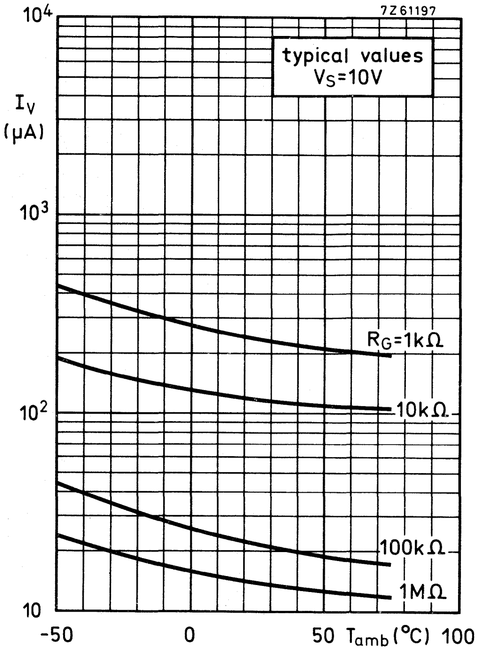


Fig. 10.

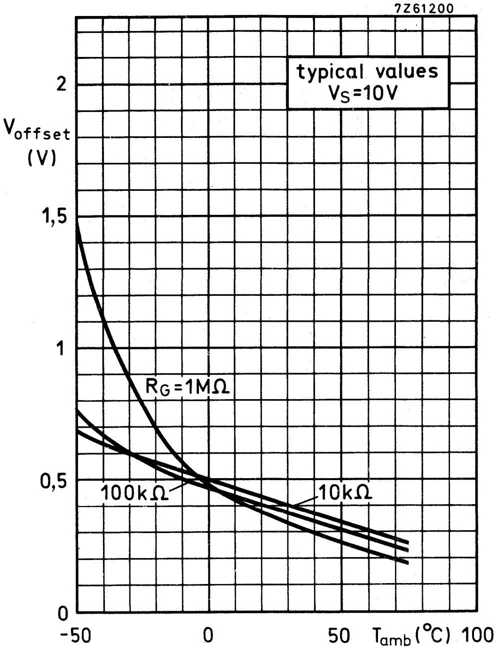

7Z61200
typical values
V_S=10V
V_{offset} (V)
2
1,5
1
0,5
0
R_G=1MΩ
100kΩ
10kΩ
−50
0
50
T_{amb} (°C)
100

Fig. 11.

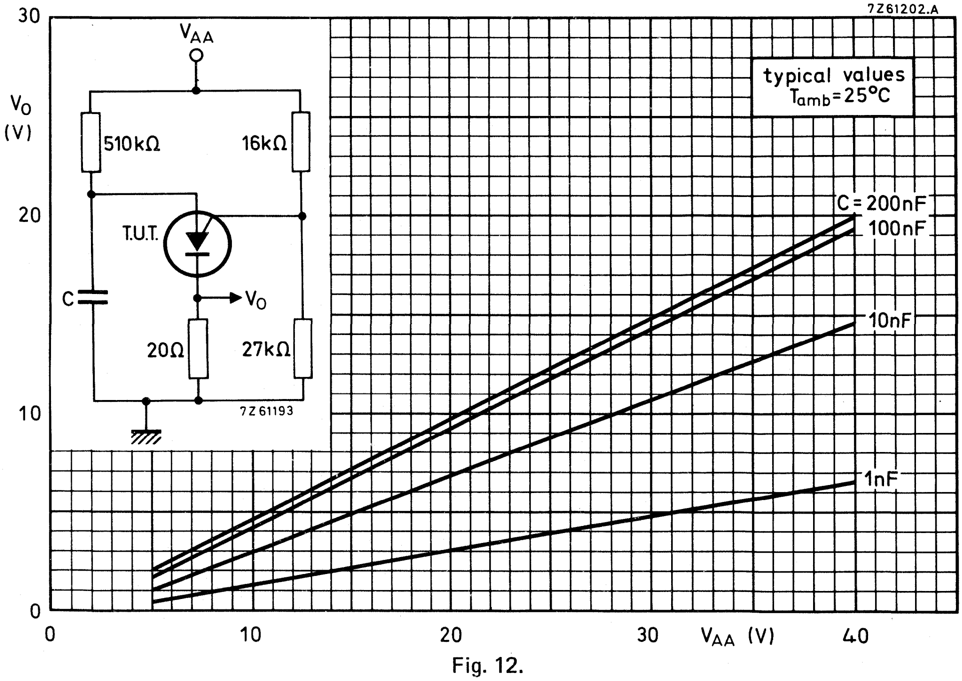

7Z61202.A
typical values
T_{amb}=25°C
V_O (V)
30
20
10
0
V_{AA}
510kΩ
16kΩ
T.U.T.
C
V_O
20Ω
27kΩ
7Z61193
C = 200nF
100nF
10nF
1nF
0
10
20
30
V_{AA} (V)
40

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

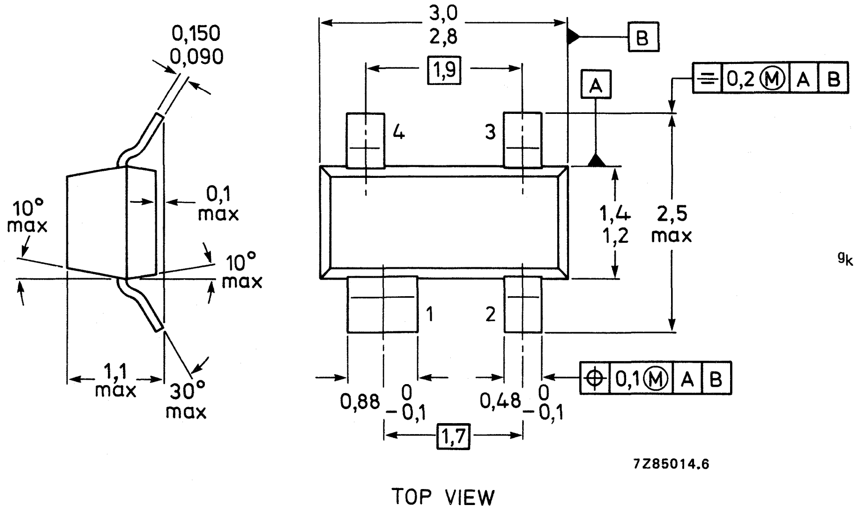
MECHANICAL DATA

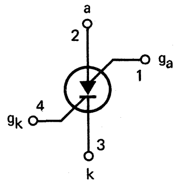
Dimensions in mm

Fig. 1 SOT-143.

Marking code

BRY62 = A51





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.

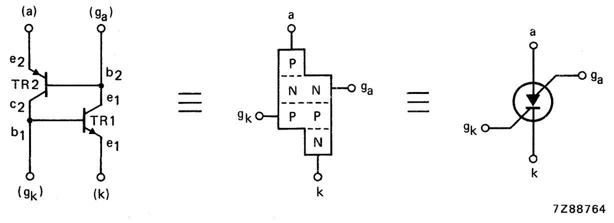


Fig. 2 Circuit diagram.

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

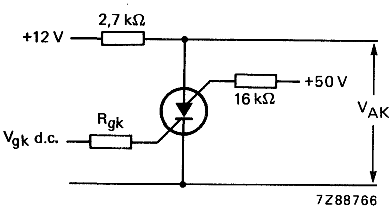


Fig. 3 Switching times test circuit.
The pulse time of V_{gk} can be adjusted in such a way that the broken line in Fig. 4 disappears, which means that the thyristor starts triggering.

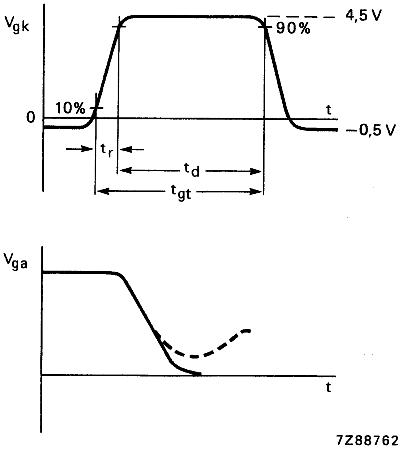


Fig. 4 Switching times waveforms.

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

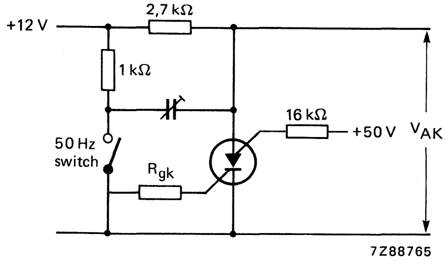


Fig. 5 Switching times test circuit.

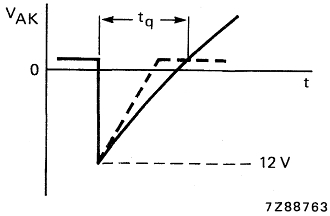


Fig. 6 Switching times waveforms.

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

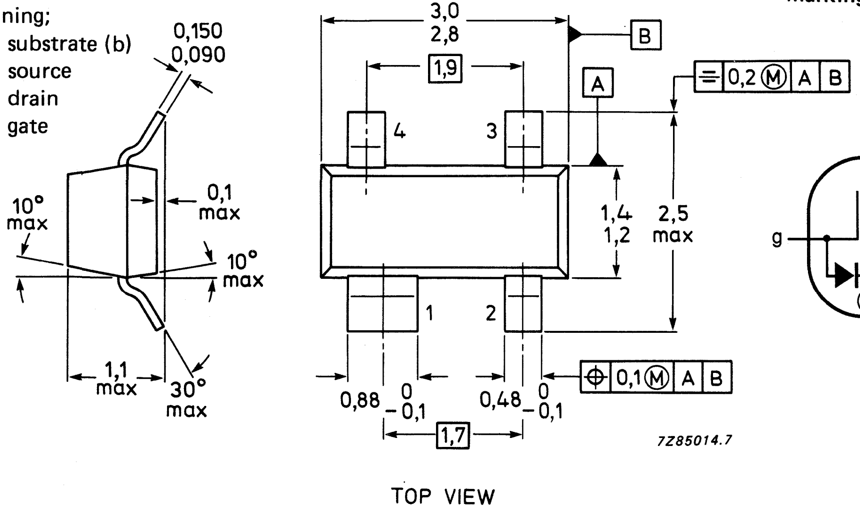
MECHANICAL DATA

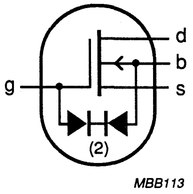
Dimensions in mm

Fig. 1 SOT-143.

Marking code: M32

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





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; $V_{DS} = 10$V	I_{DSoff}	typ.	1.0	nA
Source-drain leakage current $V_{GD} = V_{BD} = 5$ V; $V_{SD} = 10$V	I_{SDoff}	typ.	1.0	nA
Gate-substrate leakage current $V_{DB} = V_{SB} = 0$; $V_{GB} = \pm 15$ 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 $V_{GS} = V_{BS} = -5$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. 3) V_{DD} = 10 V; V_i = –5 V to +5 V	t_{on} t_{off}	typ. typ.	1.0 ns 5.0 ns

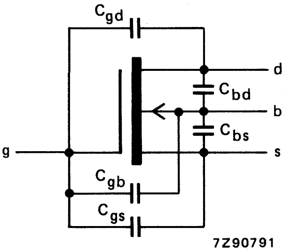


Fig. 2 Capacitances model.

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

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

$C_{rss} = C_{gd}$

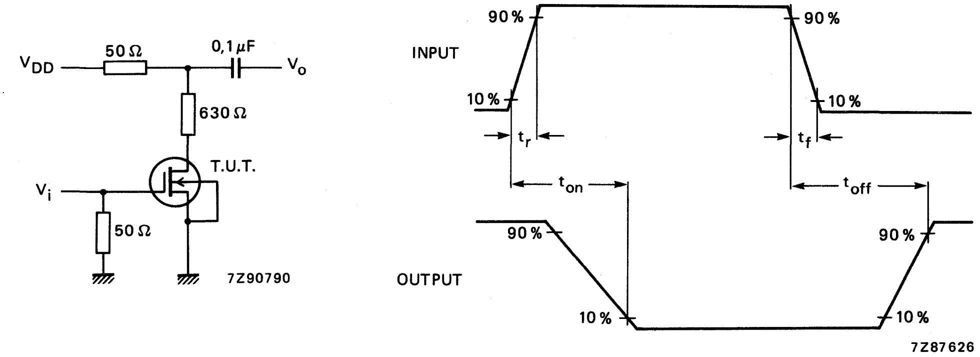


Fig. 3 Switching times and input and output waveforms;
R_i = 50 Ω; t_r < 0.5 ns; t_f < 1.0 ns; t_p = 20 ns; δ < 0.01.

N-channel enhancement mode vertical D-MOS transistor

BSN20

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, intended for use as a surface-mounted device in thin and thick film circuits and in general purpose fast switching applications.

PINNING

PIN	DESCRIPTION
1	gate
2	source
3	drain

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MAX.	UNIT
V_{DS}	drain-source voltage	50	V
I_D	DC drain current	100	mA
$R_{DS(on)}$	drain-source on-resistance	15	Ω
$V_{GS(th)}$	gate-source threshold voltage	1.8	V

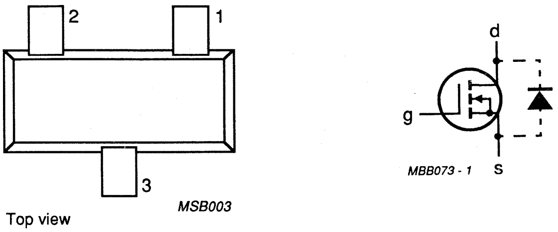


Fig.1 Simplified outline (SOT23) and symbol.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage		–	50	V
$\pm V_{GSO}$	gate-source voltage	open drain	–	20	V
I_D	DC drain current		–	100	mA
I_{DM}	peak drain current		–	300	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C (note 1)	–	300	mW
		up to T_{amb} = 25 °C (note 2)	–	250	mW
T_{stg}	storage temperature range		–65	150	°C
T_j	junction temperature		–	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	from junction to ambient (note 1)	430 K/W
$R_{th\ j\text{-}a}$	from junction to ambient (note 2)	500 K/W

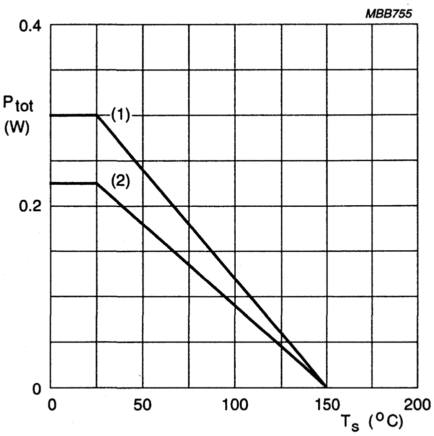
Notes

1. Transistor mounted on a ceramic substrate, 10 x 8 x 0.7 mm.
2. Transistor mounted on a printed circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

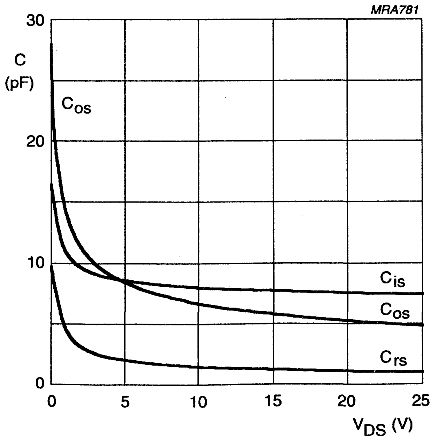
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 10 µA; V_{GS} = 0	50	–	–	V
I_{DSS}	drain-source leakage current	V_{DS} = 40 V; V_{GS} = 0	–	–	1	µA
$\pm I_{GSS}$	gate-source leakage current	$\pm V_{GS}$ = 20 V; V_{DS} = 0	–	–	100	nA
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{GS} = V_{DS}	0.4	–	1.8	V
$R_{DS(on)}$	drain-source on-resistance	I_D = 100 mA; V_{GS} = 10 V	–	8	15	Ω
		I_D = 100 mA; V_{GS} = 5 V	–	14	20	Ω
		I_D = 10 mA; V_{GS} = 2.5 V	–	18	30	Ω
$\lvert Y_{fs}\rvert$	transfer admittance	I_D = 100 mA; V_{DS} = 10 V	40	80	–	mS
C_{iss}	input capacitance	V_{DS} = 10 V; V_{GS} = 0; f = 1 MHz	–	8	15	pF
C_{oss}	output capacitance	V_{DS} = 10 V; V_{GS} = 0; f = 1 MHz	–	7	15	pF
C_{rss}	feedback capacitance	V_{DS} = 10 V; V_{GS} = 0; f = 1 MHz	–	2	5	pF
Switching times						
t_{on}	turn-on time	I_D = 100 mA; V_{DD} = 20 V; V_{GS} = 0 to 10 V	–	2	5	ns
t_{off}	turn-off time	I_D = 100 mA; V_{DD} = 20 V; V_{GS} = 0 to 10 V	–	5	10	ns



(1) Mounted on a ceramic substrate.

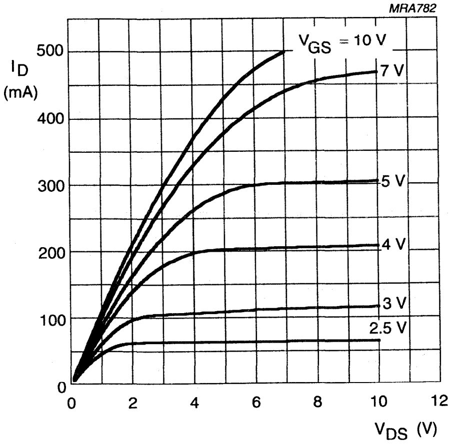
(2) Mounted on a printed circuit board.

Fig.2 Power derating curve.



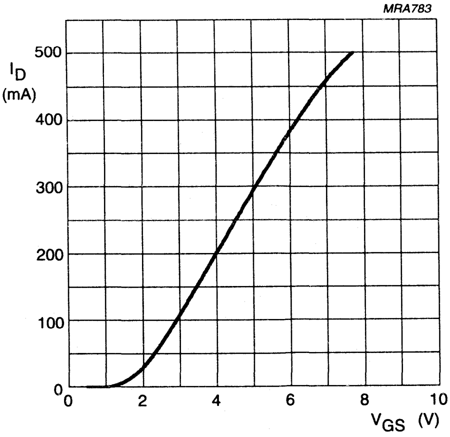
V_{GS} = 0; f = 1 MHz; T_j = 25 °C.

Fig.3 Capacitance as a function of drain-source voltage, typical values.



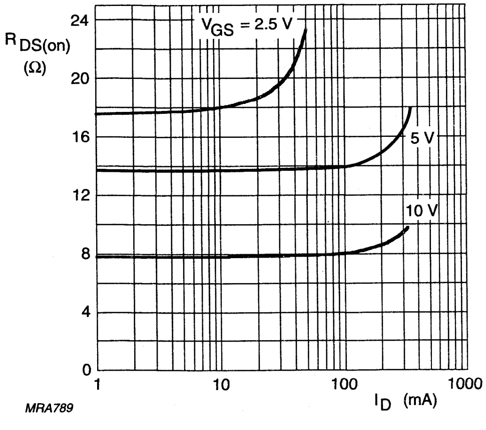
T_j = 25 °C.

Fig.4 Typical output characteristics.



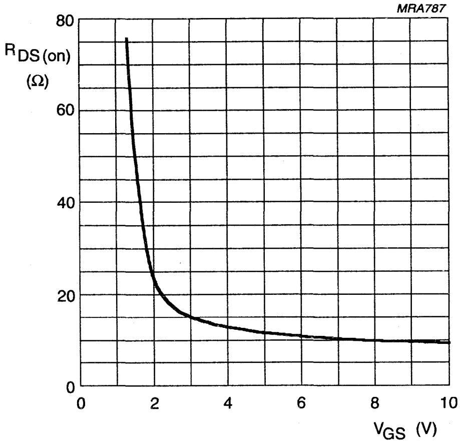
V_{DS} = 10 V; T_j = 25 °C.

Fig.5 Typical transfer characteristics.



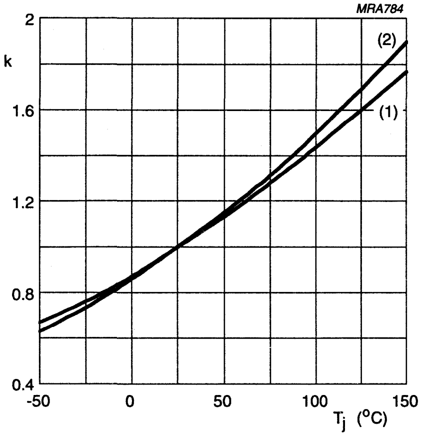
T_j = 25 °C.

Fig.6 Drain-source on-resistance as a function of drain current, typical values.



V_{DS} = 0.1 V; T_j = 25 °C.

Fig.7 Drain-source on-resistance as a function of gate-source voltage, typical values.



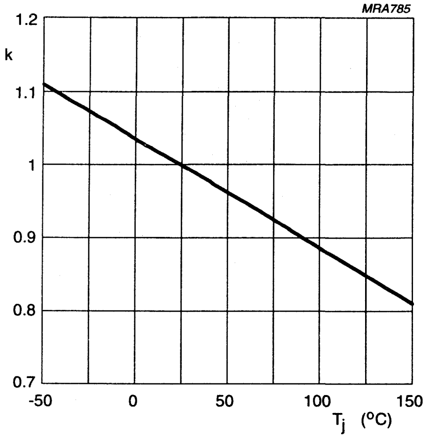
$$k = \frac{R_{DS(on)} \text{ at } T_j}{R_{DS(on)} \text{ at } 25\ °C}.$$

Typical $R_{DS(on)}$ at 100 mA/10 V.

(1) I_D = 10 mA; V_{GS} = 2.5 V.

(2) I_D = 100 mA; V_{GS} = 10 V.

Fig.8 Temperature coefficient of drain-source on-resistance.



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

Typical $V_{GS(th)}$ at 1 mA.

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

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

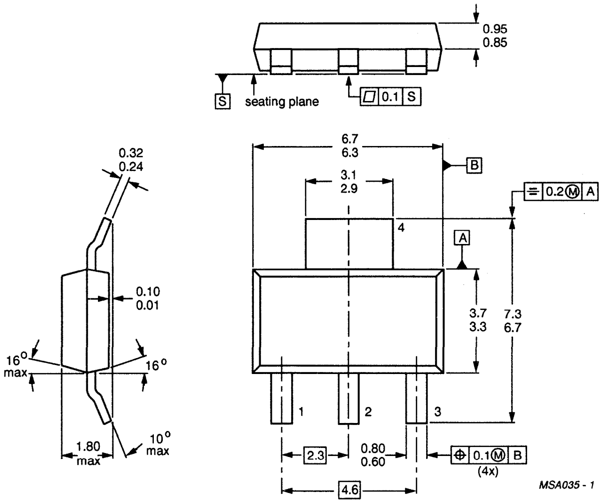
MECHANICAL DATA

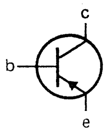
Dimensions in mm

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

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* 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

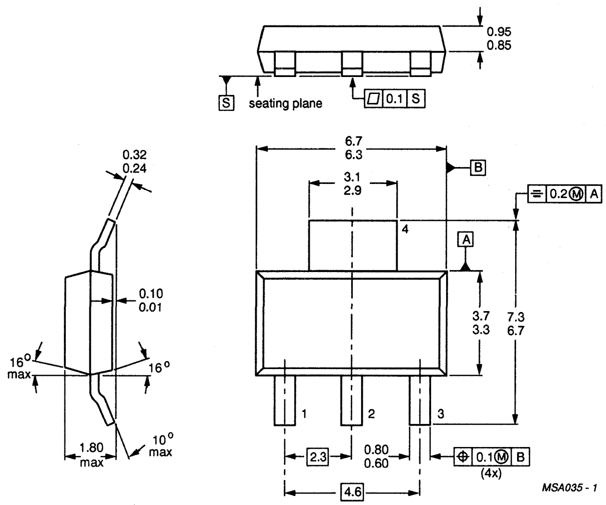
MECHANICAL DATA

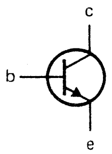
Dimensions in mm

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

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

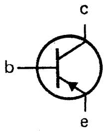
MECHANICAL DATA

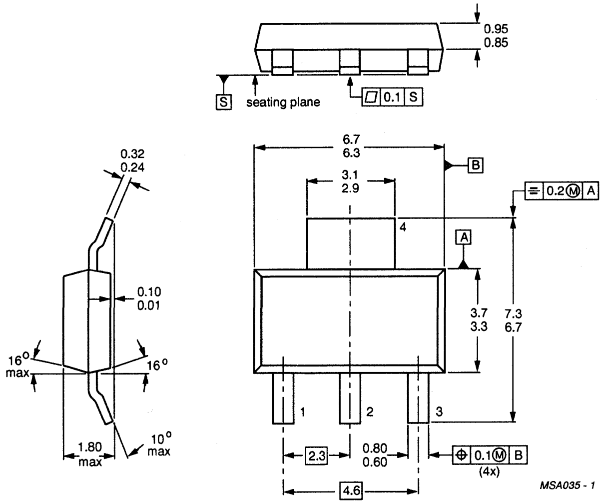
Dimensions in mm

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 $T_{amb} = 25\,^{\circ}C$*	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 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

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			BSP30	BSP31	BSP32	BSP33	
$I_B = 0; -I_C = 10$ 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.

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

CHARACTERISTICS (continued)

$T_{amb} = 25\,^{\circ}C$

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

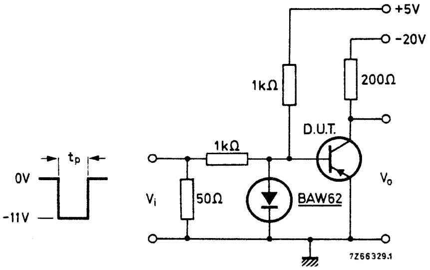


Fig. 2 Switching times test circuit.

Pulse generator:		Oscilloscope:	
Pulse duration	$t_p = 10\ \mu s$	Rise time	$t_r \leqslant 15$ ns
Rise time	$t_r \leqslant 15$ ns	Input impedance	$Z_I \geqslant 100$ kΩ
Fall time	$t_f \leqslant 15$ ns		
Source impedance	$Z_S = 50\ \Omega$		

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

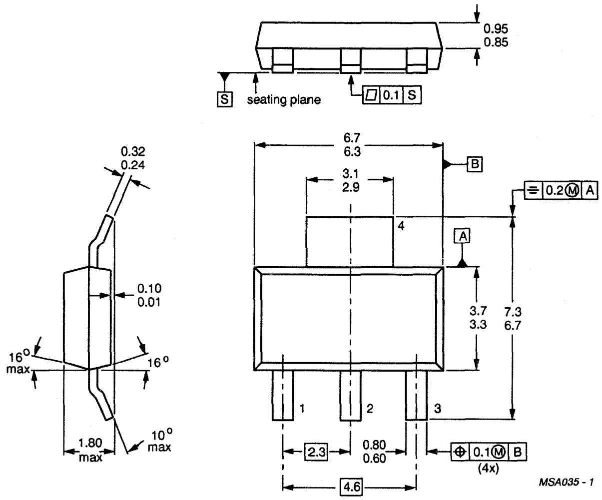
			BSP40	BSP41	BSP42	BSP43	
Collector-base voltage (open emitter)	V_{CBO}	max.	70	70	90	90	V
Collector-emitter voltage (open base)	V_{CEO}	max.	60	60	80	80	V
Collector current (DC)	I_C	max.	1	1	1	1	A
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	1,5	1,5	1,5	1,5	W
Junction temperature	T_j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

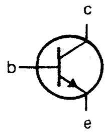
MECHANICAL DATA Dimensions in mm

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)

			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 cm^2.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

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

			BSP40	BSP41	BSP42	BSP43	
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	$<$	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)

$T_{amb} = 25\ ^{o}C$

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

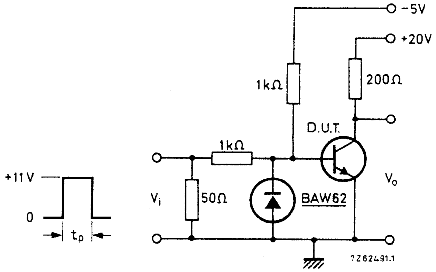


Fig. 2 Switching times test circuit.

Pulse generator:	
Pulse duration	$t_p = 10\ \mu s$
Rise time	$t_r \leqslant 15$ ns
Fall time	$t_f \leqslant 15$ ns
Source impedance	$Z_S = 50\ \Omega$

Oscilloscope:	
Rise time	$t_r \leqslant 15$ ns
Input impedance	$Z_I \geqslant 100\ k\Omega$

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

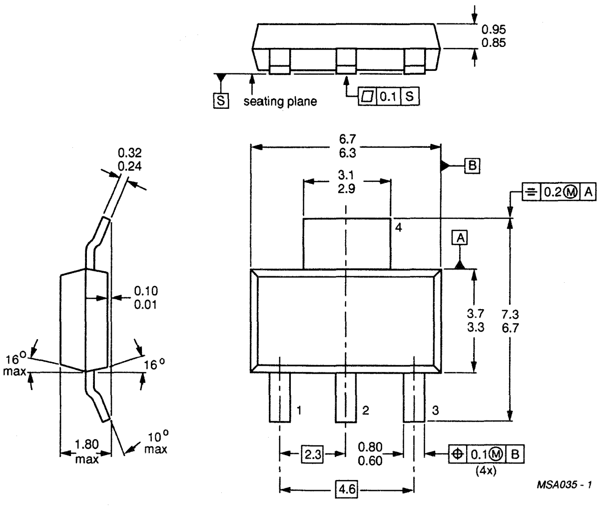
MECHANICAL DATA

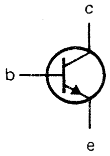
Dimensions in mm

Fig. 1 SOT-223

Pinning

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





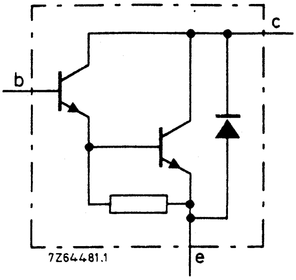


Fig. 2 Circuit diagram.

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

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* 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 cm².

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

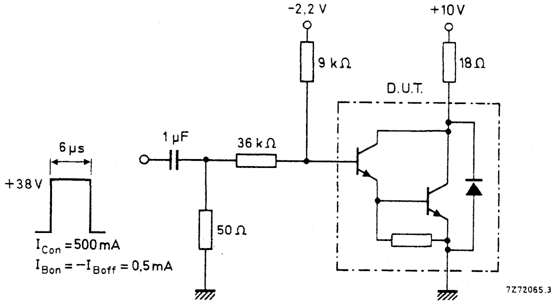

Fig. 3 Switching times test circuit.

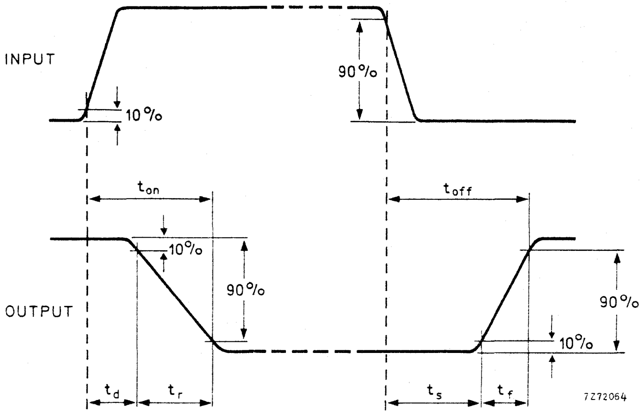

Fig. 4 Switching times waveform.

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* Measured under pulsed conditions.

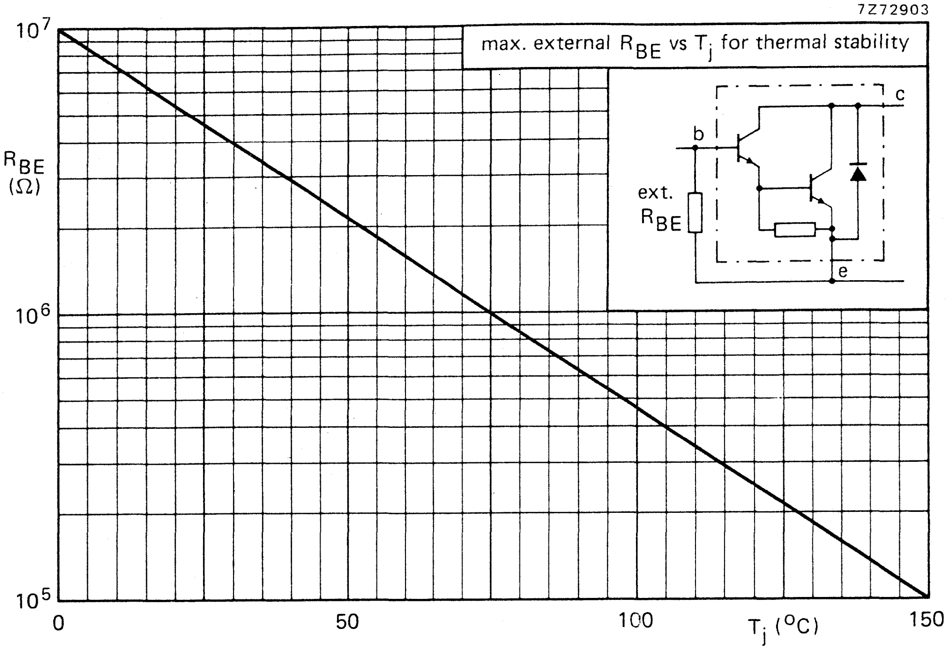


Fig. 5 Maximum values external R_{BE} as a function of junction temperature.

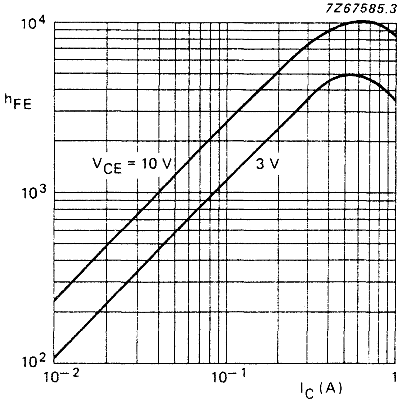


Fig. 6 T_j = 25 °C.

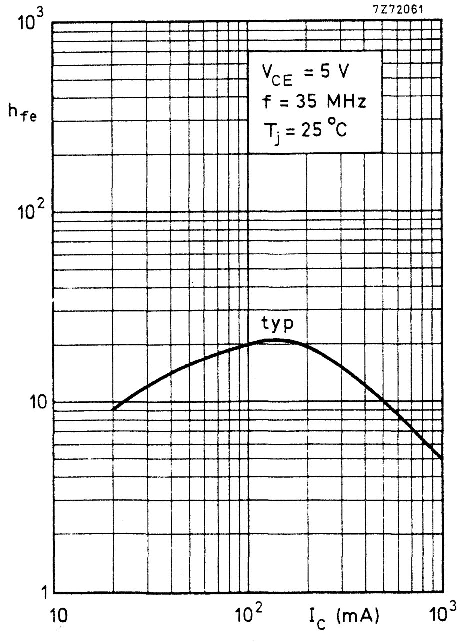


Fig. 7.

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.

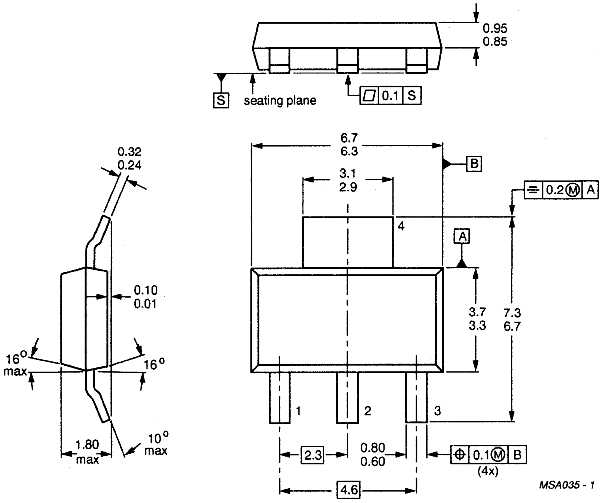
QUICK REFERENCE DATA

			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

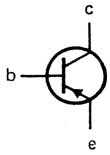
Dimensions in mm

Fig. 1 SOT-223



Pinning

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



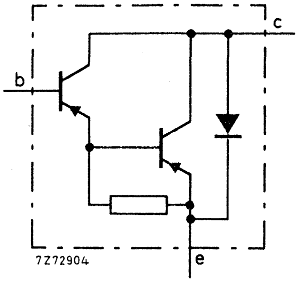


Fig. 2 Circuit diagram.

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

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* 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

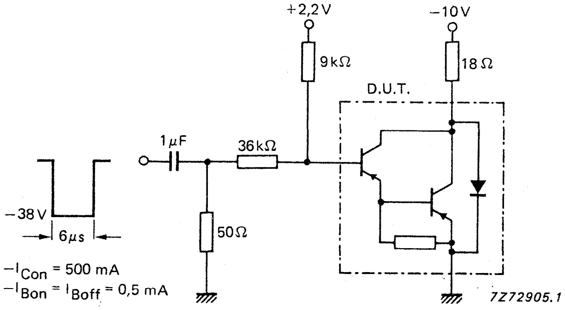

Fig. 3 Switching times test circuit.

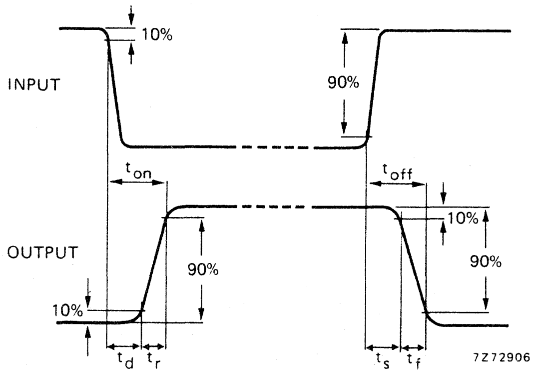

Fig. 4 Switching times waveform.

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* Measured under pulsed conditions.

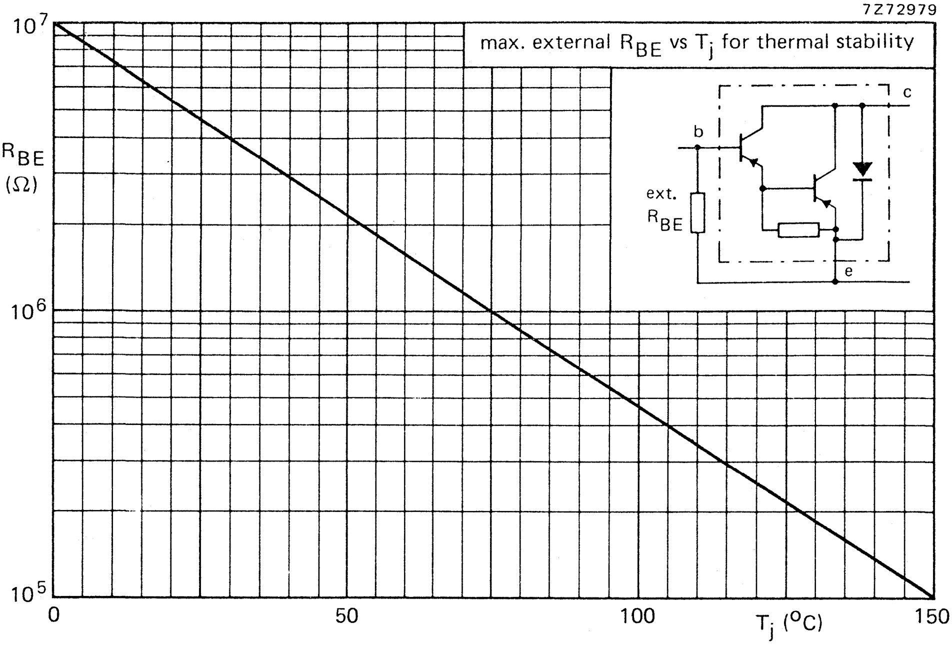


Fig. 5 Maximum values external R_{BE} as a function of junction temperature.

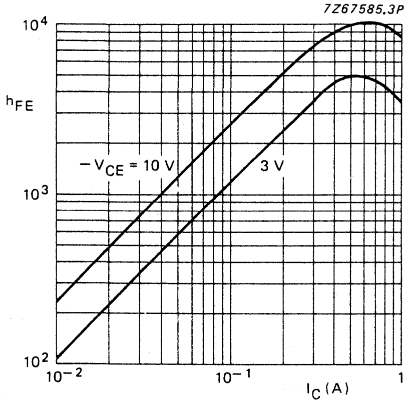


Fig. 6 T_j = 25 °C.

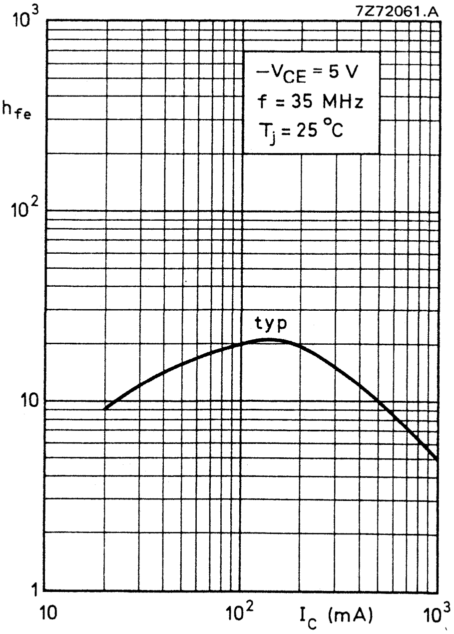


Fig. 7.

N-channel enhancement mode vertical D-MOS transistor

BSP89

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 SOT223 envelope, intended for use as a surface-mounted device in line current interrupters in telephone sets and for application in relay, high speed and line transformer drivers.

PINNING

PIN	DESCRIPTION
Code: BSP89	
1	gate
2	drain
3	source
4	drain

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MAX.	UNIT
V_{DS}	drain-source voltage	240	V
I_D	DC drain current	350	mA
$R_{DS(on)}$	drain-source on-resistance	6	Ω
$V_{GS(th)}$	gate-source threshold voltage	2	V

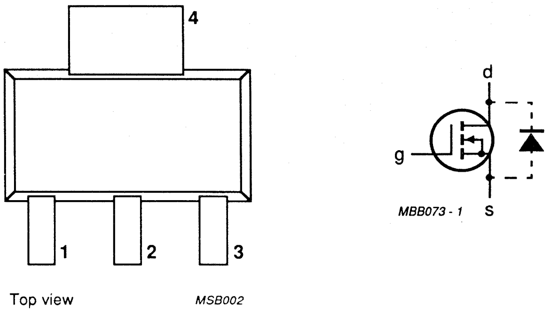


Fig.1 Simplified outline (SOT223) and symbol.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage		–	240	V
$\pm V_{GSO}$	gate-source voltage	open drain	–	20	V
I_D	DC drain current		–	350	mA
I_{DM}	peak drain current		–	1.4	A
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

THERMAL RESISTANCE

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

Note

1. Transistor mounted on an epoxy printed circuit board, 40 x 40 x 1.5 mm, mounting pad for the drain tab minimum 6 cm².

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	240	–	–	V
I_{DSS}	drain-source leakage current	V_{DS} = 60 V; V_{GS} = 0	–	–	200	nA
$\pm I_{GSS}$	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	V
$R_{DS(on)}$	drain-source on-resistance	I_D = 340 mA; V_{GS} = 10 V	–	4	6	Ω
		I_D = 340 mA; V_{GS} = 4.5 V	–	–	10	Ω
$\lvert Y_{fs} \rvert$	transfer admittance	I_D = 340 mA; V_{DS} = 25 V	140	350	–	mS
C_{iss}	input capacitance	V_{DS} = 25 V; V_{GS} = 0; f = 1 MHz	–	65	140	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	9	pF
Switching times (see Figs 3 and 4)						
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

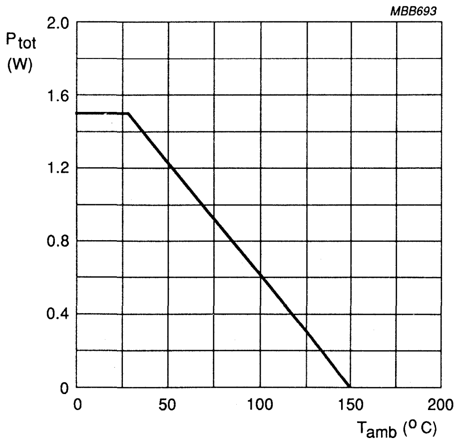
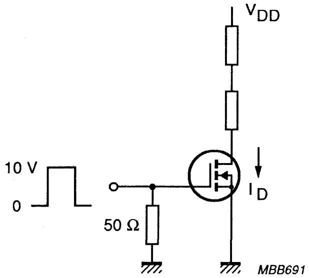


Fig.2 Power derating curve.



V_{DD} = 50 V.

Fig.3 Switching times test circuit.

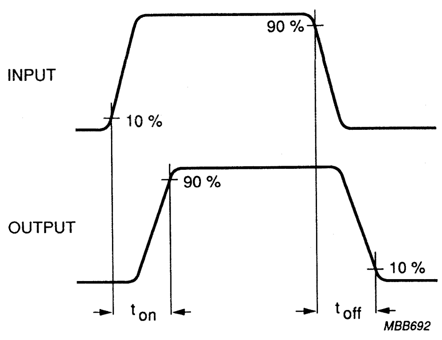


Fig.4 Input and output waveforms.

P-channel enhancement mode vertical D-MOS transistor

BSP92

FEATURES

- Low threshold voltage $V_{GS(th)}$
- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No secondary breakdown.

DESCRIPTION

P-channel enhancement mode vertical D-MOS transistor in a SOT223 envelope, intended for use as a surface-mounted device in line current interruptor in telephone sets and for application in relay, high speed and line transformer drivers.

PINNING

PIN	DESCRIPTION
1	gate
2	drain
3	source
4	drain

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MAX.	UNIT
$-V_{DS}$	drain-source voltage	240	V
$-I_D$	DC drain current	180	mA
$R_{DS(on)}$	drain-source on-resistance	20	Ω
$-V_{GS(th)}$	gate-source threshold voltage	1.8	V

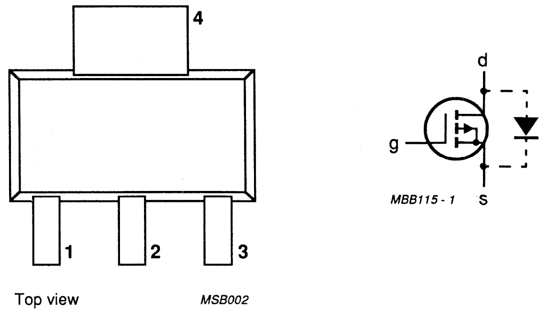


Fig.1 Simplified outline (SOT223) and symbol.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$-V_{DS}$	drain-source voltage		–	240	V
$\pm V_{GSO}$	gate-source voltage	open drain	–	20	V
$-I_D$	DC drain current		–	180	mA
$-I_{DM}$	peak drain current		–	720	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

THERMAL RESISTANCE

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

Note

1. Transistor mounted on an epoxy printed circuit board, 40 x 40 x 1.5 mm, mounting pad for the drain tab 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	240	–	–	V
$-I_{DSS}$	drain-source leakage current	$-V_{DS}$ = 200 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	V
$-V_{GS}$	gate-source voltage	$-I_D$ = 50 mA; $-V_{DS}$ = 5 V	0.8	–	2.8	V
$R_{DS(on)}$	drain-source on-resistance	$-I_D$ = 180 mA; $-V_{GS}$ = 10 V	–	10	20	Ω
		$-I_D$ = 100 mA; $-V_{GS}$ = 5 V	–	–	18	Ω
		$-I_D$ = 25 mA; $-V_{GS}$ = 2.8 V	–	–	20	Ω
$\lvert Y_{fs}\rvert$	transfer admittance	$-I_D$ = 180 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 3 and 4)						
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

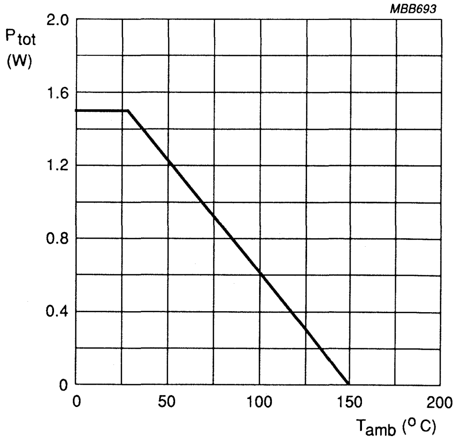
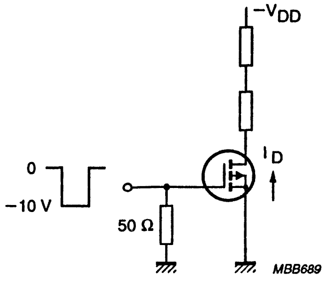


Fig.2 Power derating curve.



$-V_{DD}$ = 50 V.

Fig.3 Switching times test circuit.

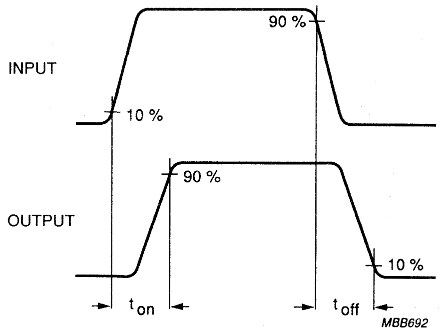


Fig.4 Input and output waveforms.

Philips Semiconductors

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

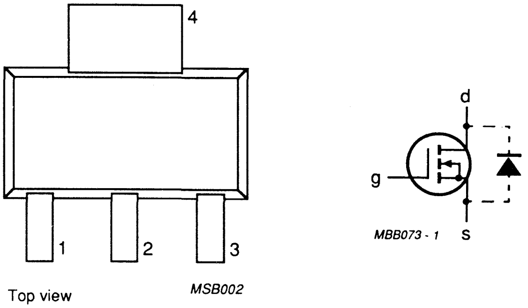


Fig.1 Simplified outline and symbol.

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

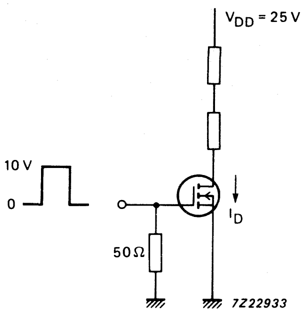


Fig.2 Switching time test circuit.

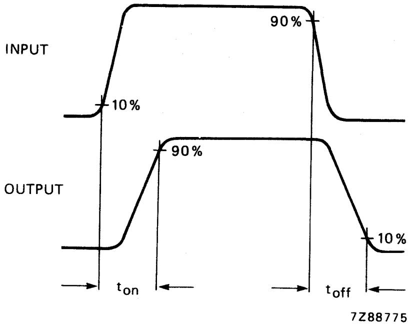


Fig.3 Input and output waveforms.

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

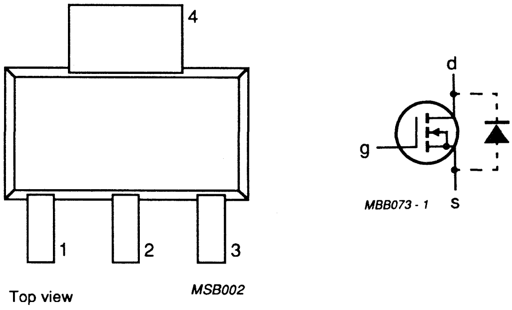


Fig.1 Simplified outline and symbol.

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

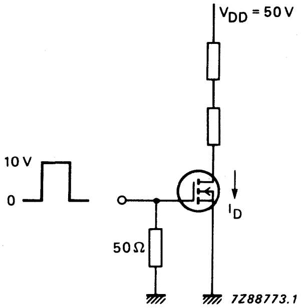


Fig.2 Switching time test circuit.

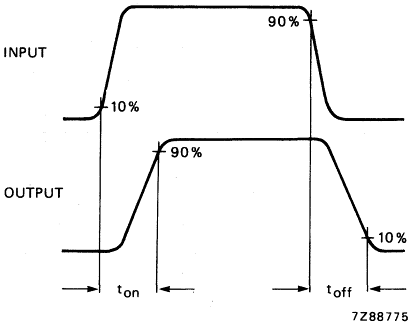


Fig.3 Input and output waveforms.

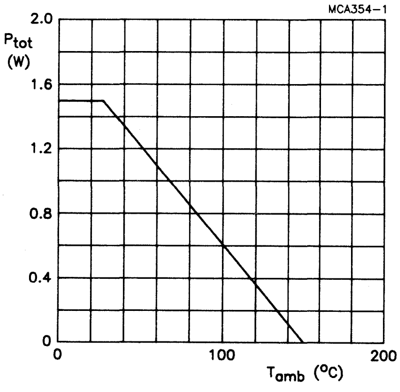


Fig.4 Power derating curve.

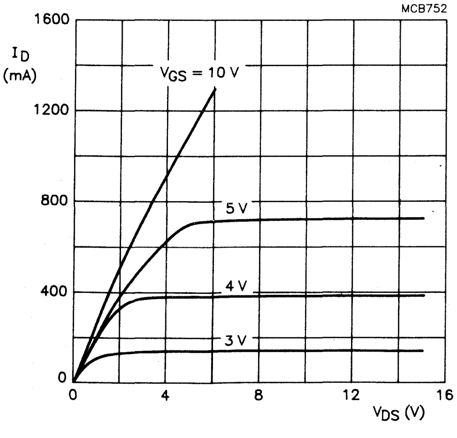


Fig.5 Typical output characteristics; T_j = 25 °C.

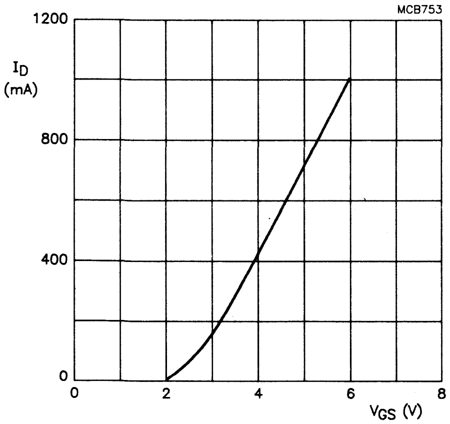


Fig.6 Typical transfer characteristic; V_{DS} = 10 V; T_j = 25 °C.

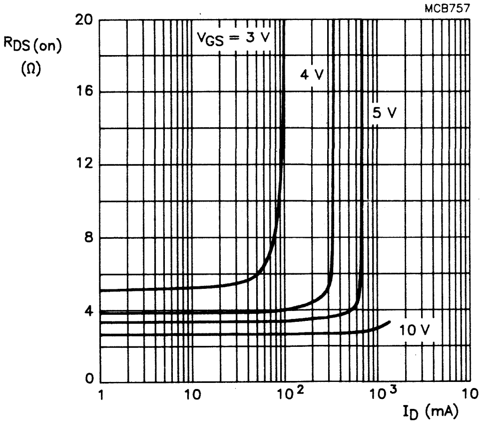


Fig.7 Typical on-resistance as a function of drain current; T_j = 25 °C.

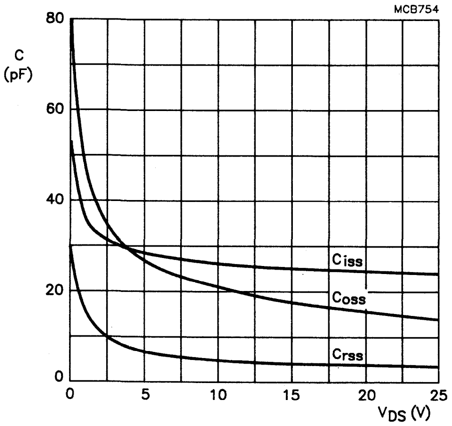


Fig.8 Typical capacitances as a function of drain-source voltage; V_{GS} = 0; f = 1 MHz; T_j = 25 °C.

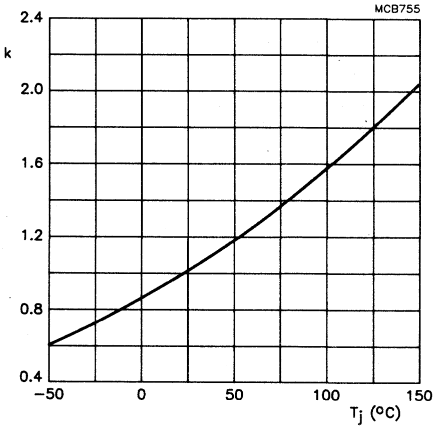


Fig.9 Temperature coefficient of drain-source on-resistance; $k = \frac{R_{DS(on)}\ at\ T_j}{R_{DS(on)}\ at\ 25\ °C}$; typical $R_{DS(on)}$ at 200 mA/10 V.

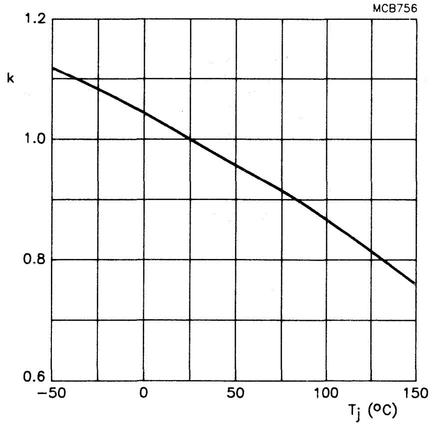


Fig.10 Temperature coefficient of gate-source threshold voltage; $k = \frac{V_{GS(th)}\ at\ T_j}{V_{GS(th)}\ at\ 25\ °C}$; typical $V_{GS(th)}$ at 1 mA.

Philips Semiconductors

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

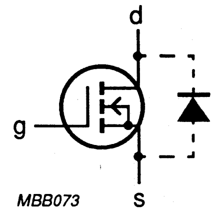


Fig.1 Symbol.

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

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	$V_{GS} = 0$ $I_D = 10\ \mu A$	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
$\lvert Y_{fs} \rvert$	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

N-channel enhancement mode vertical D-MOS transistor

BSP107

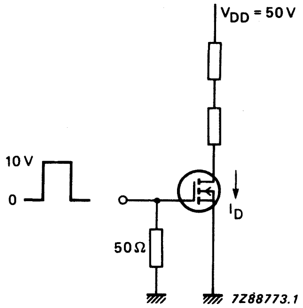


Fig.2 Switching time test circuit.

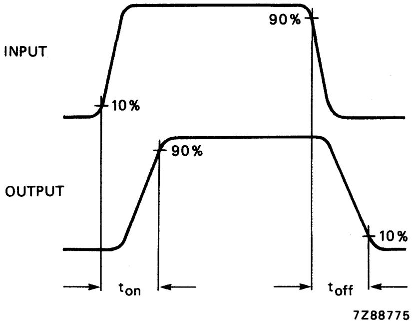


Fig.3 Input and output waveforms.

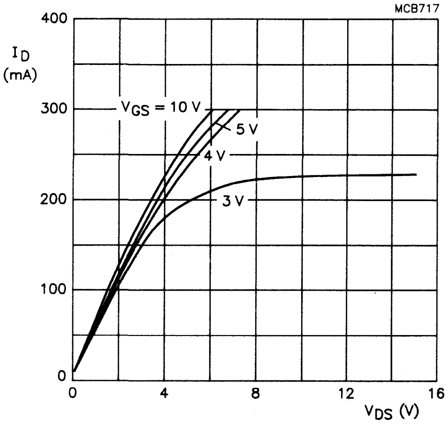


Fig.4 Typical output characteristics; $T_j = 25°$ C.

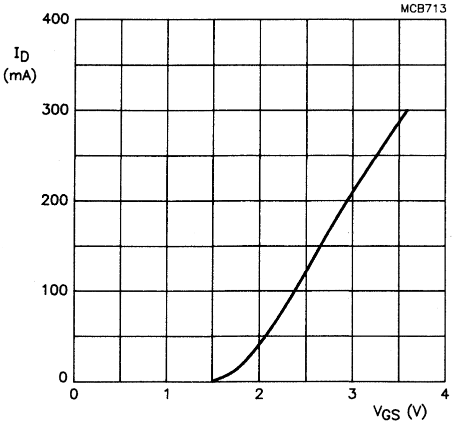


Fig.5 Typical transfer characteristics; $V_{DS} = 10$ V; $T_j = 25°$ C.

N-channel enhancement mode vertical D-MOS transistor

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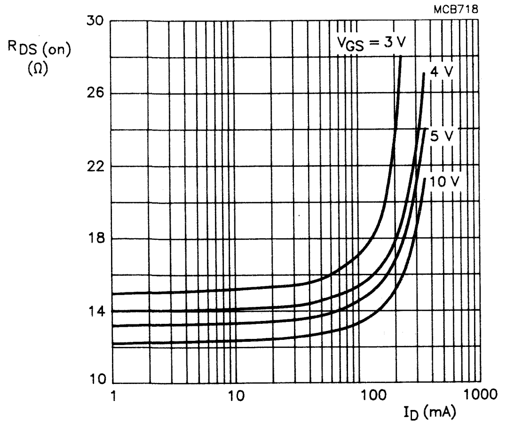


Fig.6 Typical on-resistance as a function of drain current; $T_j = 25°$ C.

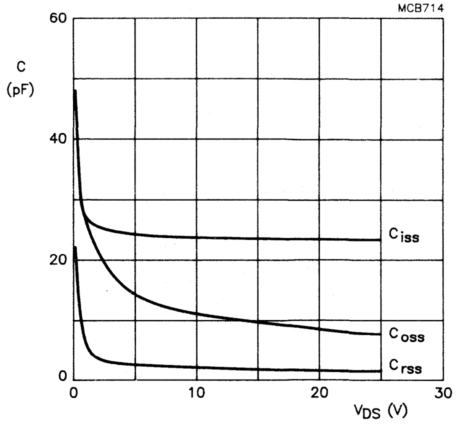


Fig.7 Typical capacitances as a function of drain-source voltage; $V_{GS} = 0$; f = 1 MHz; $T_j = 25°$ C

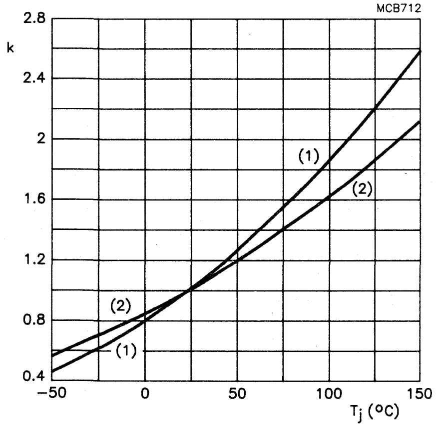


Fig.8 Temperature coefficient of drain-source on-resistance; $k = \frac{R_{DS(on)} \text{ at } T_j}{R_{DS(on)} \text{ at } 25° C}$; typical $R_{DS(on)}$ at 150 mA/10 V;

(1) $I_D = 150$ mA; $V_{GS} = 10$ V;
(2) $I_D = 20$ mA; $V_{GS} = 2.6$ V;

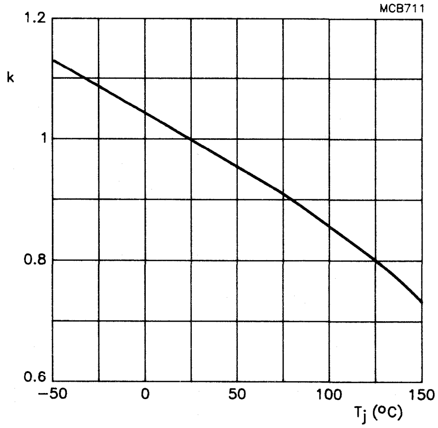


Fig.9 Temperature coefficient of gate-source threshold voltage; $k = \frac{V_{GS(th)} \text{ at } T_j}{V_{GS(th)} \text{ at } 25° C}$; typical $V_{GS(th)}$ at 1 mA.

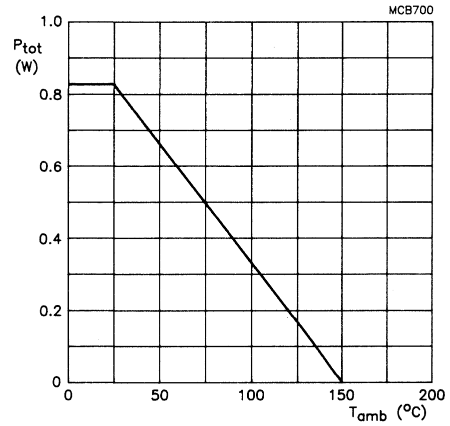


Fig.10 Power derating curve.

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	$\|y_{fs}\|$	min. typ.	150 300	mS mS

MECHANICAL DATA

Dimensions in mm

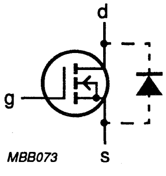
Marking code

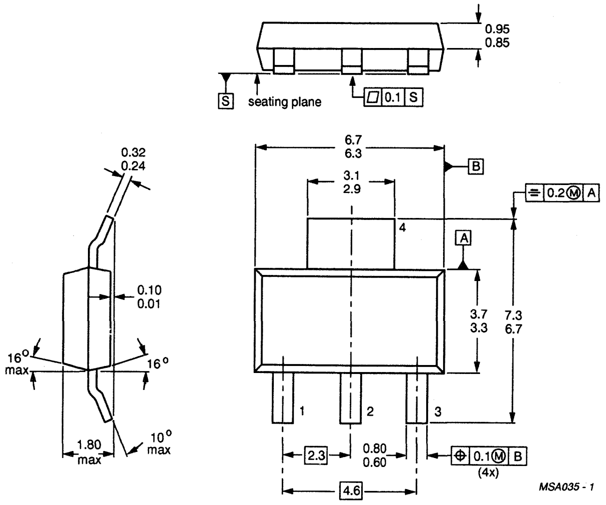
BSP108

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.	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 $I_D = 10\ \mu A$; $V_{GS} = 0$	$V_{(BR)DSS}$	min.	80	V
Gate threshold voltage I_D = 1 mA; $V_{GS} = V_{DS}$	$V_{GS(th)}$	min.	1.5	V
		max.	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.	2.0	Ω
		max.	3.0	Ω
Transfer admittance I_D = 500 mA; V_{DS} = 15 V	$\lvert y_{fs} \rvert$	min.	150	mS
		typ.	300	mS
Input capacitance at f = 1 MHz; V_{DS} = 10 V; $V_{GS} = 0$	C_{iss}	typ.	45	pF
		max.	60	pF
Output capacitance at f = 1 MHz; V_{DS} = 10 V; $V_{GS} = 0$	C_{oss}	typ.	30	pF
		max.	45	pF
Feedback capacitance at f = 1 MHz; V_{DS} = 10 V; $V_{GS} = 0$	C_{rss}	typ.	8	pF
		max.	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.	4	ns
		max.	8	ns
	t_{off}	typ.	10	ns
		max.	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.

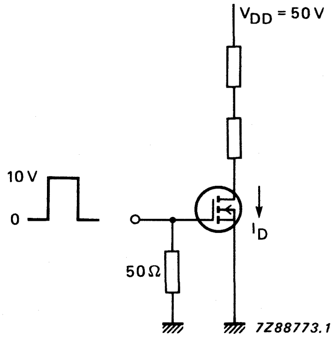


Fig.2 Switching times test circuit.

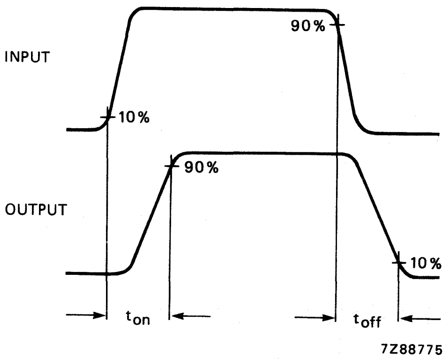


Fig.3 Input and output waveforms.

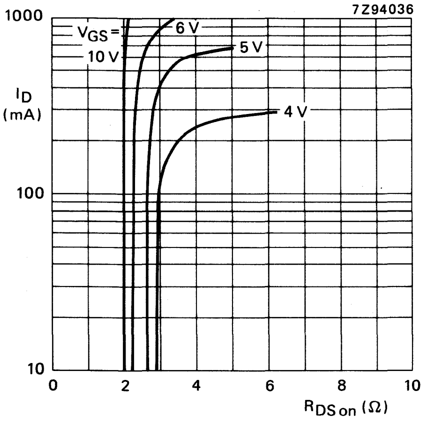


Fig.4 T_j = 25 °C; typical values.

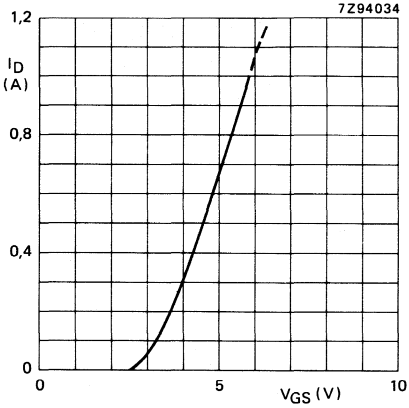


Fig.5 T_j = 25 °C; typical values at V_{DS} = 10 V.

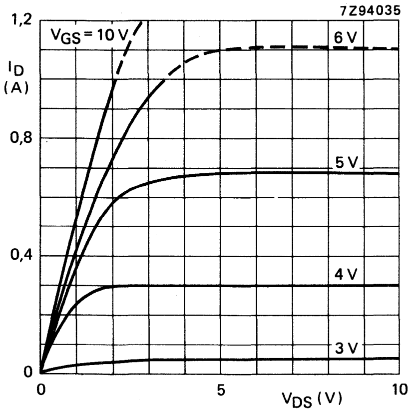


Fig.6 T_j = 25 °C; typical values.

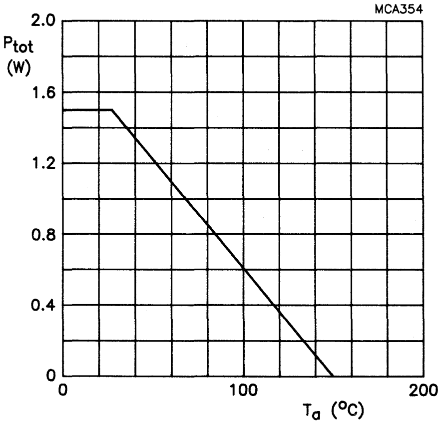


Fig.7 Power derating curve.

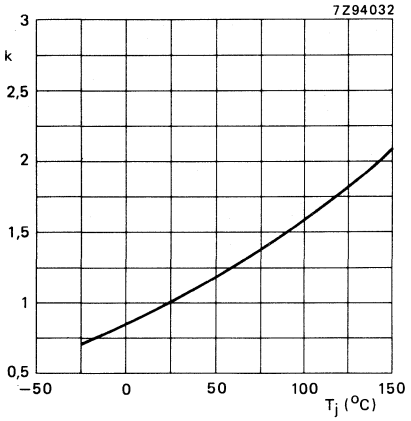


Fig.8 $k = \frac{R_{DS\,on} \text{ at } T_j}{R_{DS\,on} \text{ at } 25\ ^oC}$; typ. values at 500 mA/10 V.

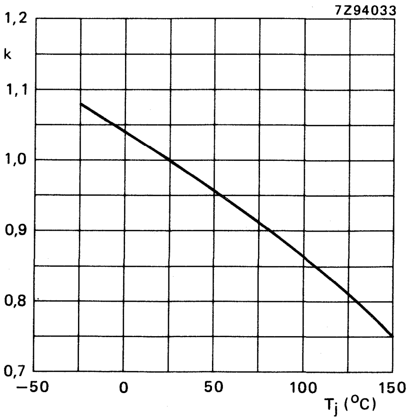


Fig.9 $k = \frac{V_{GS(th)} \text{ at } T_j}{V_{GS(th)} \text{ at } 25\ ^oC}$; $V_{GS(th)}$ at 1 mA; typical values.

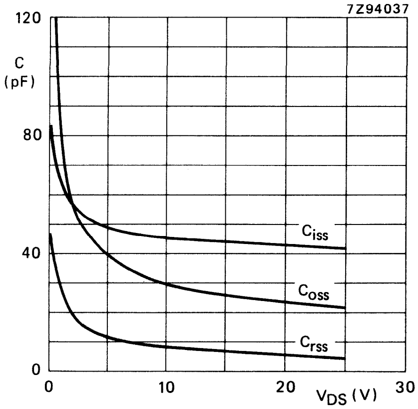


Fig.10 $T_j = 25\ ^oC$; $V_{GS} = 0$; f = 1 MHz; typical values.

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

MECHANICAL DATA

Dimensions in mm

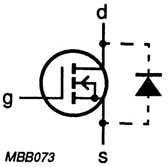
Marking code

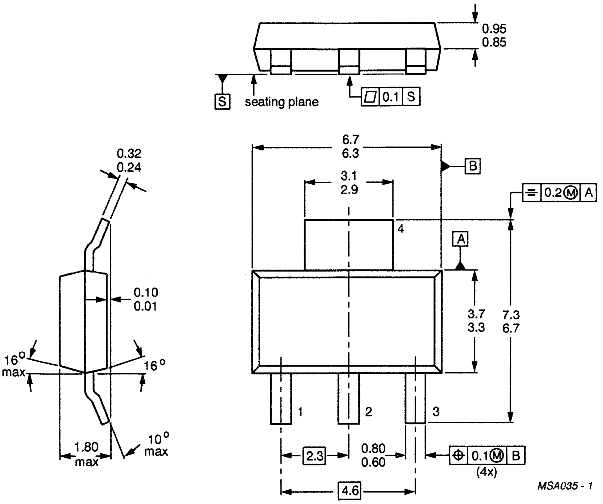
BSP110

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.	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.	325	mA
Drain current (peak)	I_{DM}	max.	650	mA
Total power dissipation up to $T_{amb} = 25\ ^{\circ}C$ (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

$T_j = 25\ ^{\circ}C$ unless otherwise specified

Drain-source breakdown voltage $I_D = 10\ \mu A$; $V_{GS} = 0$	$V_{(BR)DSS}$	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	$\lvert Y_{fs} \rvert$	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. max.	3 pF 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. max.	2 ns 5 ns
	t_{off}	typ. max.	5 ns 10 ns

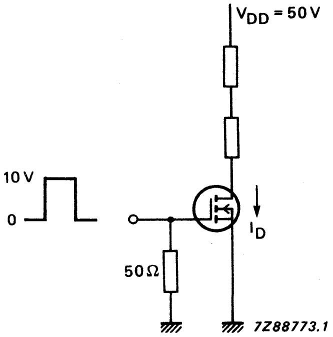


Fig.2 Switching time test circuit.

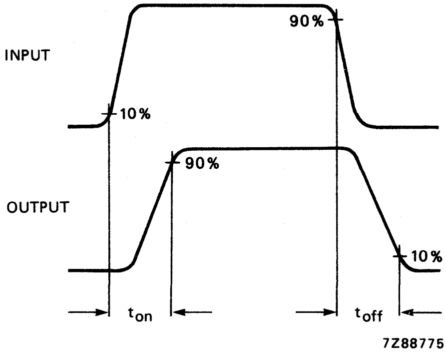


Fig.3 Input and output waveforms.

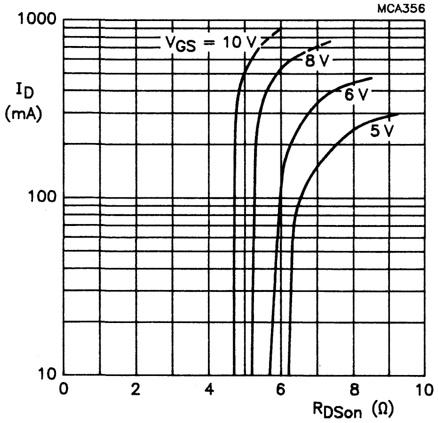


Fig.4 T_j = 25 °C; typical values.

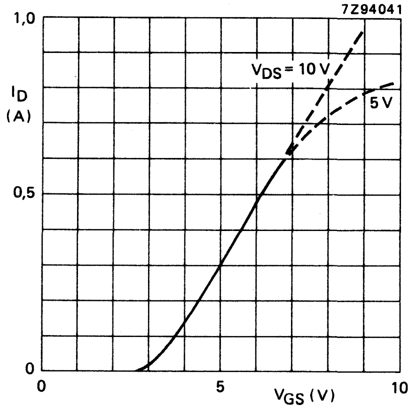


Fig.5 T_j = 25 °C; typical values.

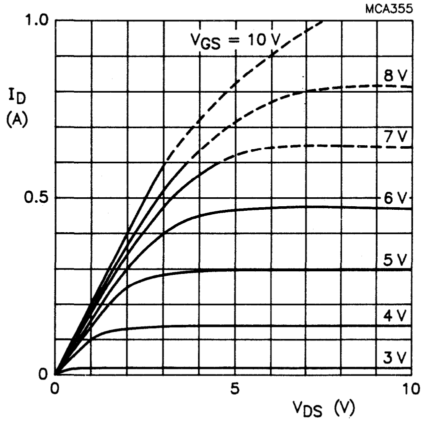


Fig.6 T_j = 25 °C; typical values.

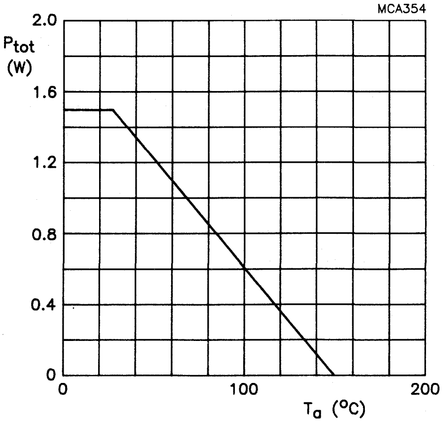


Fig.7 Power derating curve.

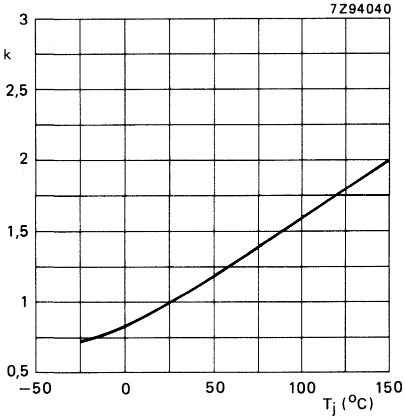


Fig.8 $k = \frac{R_{DSon} \text{ at } T_j}{R_{DSon} \text{ at } 25\ ^{\circ}C}$;
typical values at 150 mA/5 V.

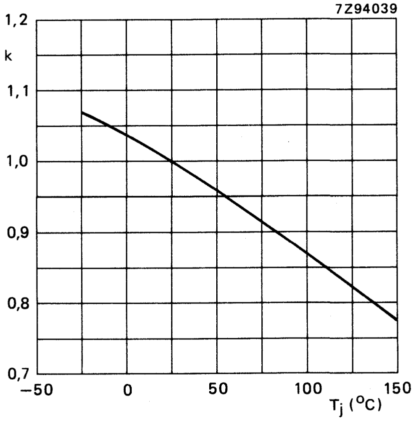


Fig.9 $k = \frac{V_{GS(th)} \text{ at } T_j}{V_{GS(th)} \text{ at } 25\ ^{\circ}C}$;
$V_{GS(th)}$ at 1 mA; typical values.

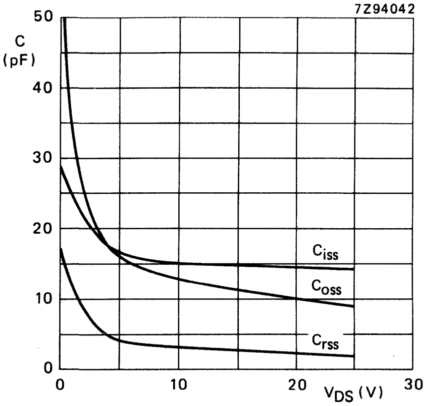


Fig.10 T_j = 25 °C; V_{GS} = 0;
f = 1 MHz; typical values.

N-CHANNEL ENHANCEMENT MODE VERTICAL D-MOS TRANSISTOR

N-channel 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

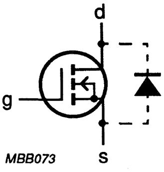
Marking code

Fig.1 SOT223.

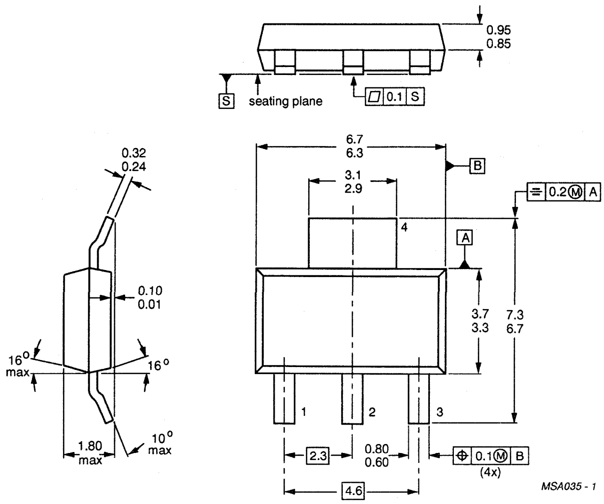
BSP120

Pinning

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



MBB073



MSA035 - 1

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 $I_D = 10\ \mu A$; $V_{GS} = 0$	$V_{(BR)DSS}$	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 12	Ω Ω
Gate threshold voltage $I_D = 1$ mA; $V_{GS} = V_{DS}$	$V_{GS(th)}$	min. max.	0.8 2.8	V V
Transfer admittance $I_D = 250$ mA; $V_{DS} = 15$ V	$\lvert Y_{fs} \rvert$	min. typ.	125 250	mS mS
Input capacitance at f = 1 MHz; $V_{DS} = 10$ V; $V_{GS} = 0$	C_{iss}	typ. max.	45 65	pF pF
Output capacitance at f = 1 MHz; $V_{DS} = 10$ V; $V_{GS} = 0$	C_{oss}	typ. max.	20 30	pF pF
Feedback capacitance at f = 1 MHz; $V_{DS} = 10$ V; $V_{GS} = 0$	C_{rss}	typ. max.	5 10	pF 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

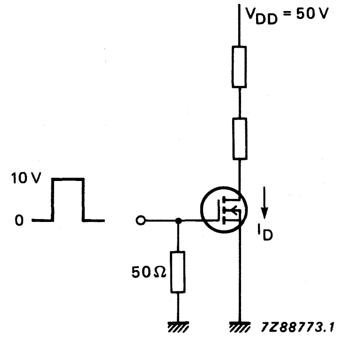


Fig.2 Switching time test circuit.

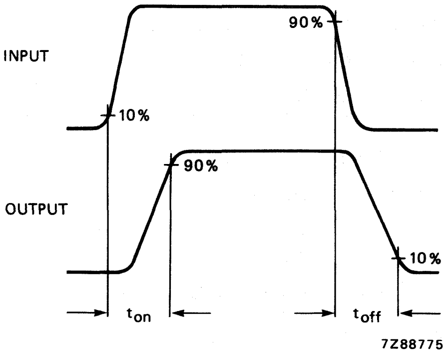


Fig.3 Input and output waveforms.

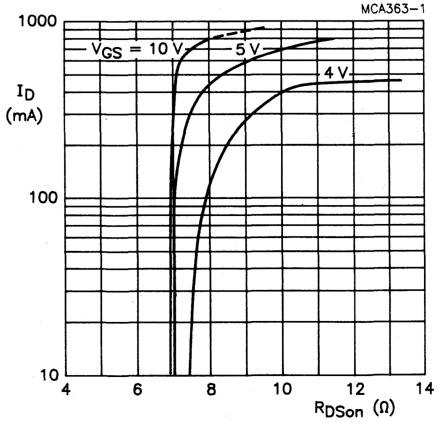


Fig.4 T_j = 25 °C; typical values.

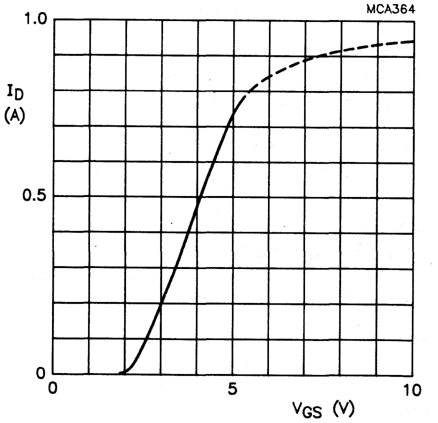


Fig.5 T_j = 25 °C; V_{DS} = 10 V; typical values.

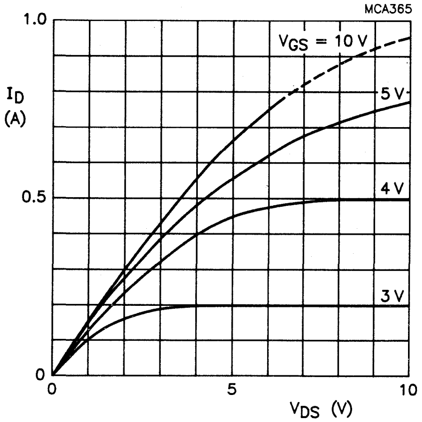


Fig.6 T_j = 25 °C; typical values.

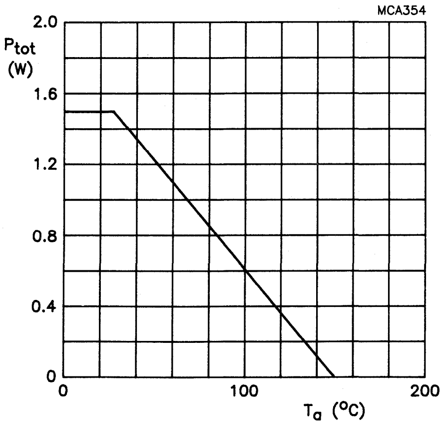


Fig.7 Power derating curve.

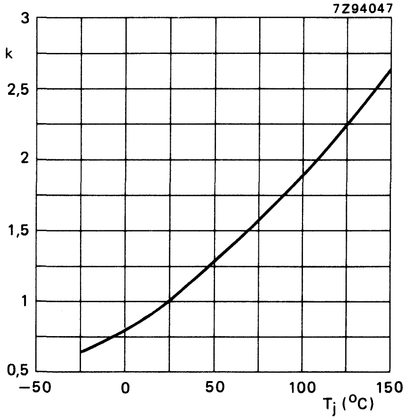


Fig.8 $k = \frac{R_{DSon} \text{ at } T_j}{R_{DSon} \text{ at } 25\ ^\circ C}$; at 250 mA/10 V; typical values.

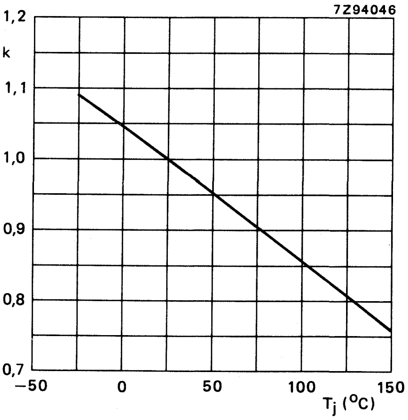


Fig.9 $k = \frac{V_{GS(th)} \text{ at } T_j}{V_{GS(th)} \text{ at } 25\ ^\circ C}$; $V_{GS(th)}$ at 1 mA; typical values.

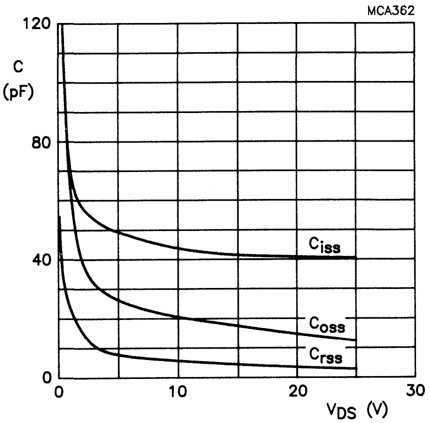


Fig.10 T_j = 25 °C; V_{GS} = 0; f = 1 MHz; typical values.

N-CHANNEL ENHANCEMENT MODE VERTICAL D-MOS TRANSISTOR

N-channel 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 $T_{amb} = 25\ ^oC$	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 6.0	Ω Ω
Transfer admittance $I_D = 400$ mA; $V_{DS} = 25$ V	$\lvert Y_{fs}\rvert$	min. typ.	200 350	mS mS

MECHANICAL DATA

Dimensions in mm

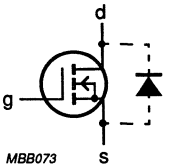
Fig.1 SOT223.

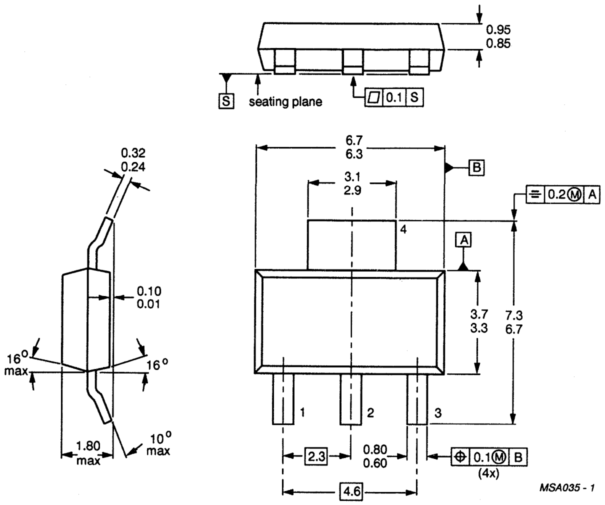
Marking code

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-a}	=	83.3	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Drain-source breakdown voltage $I_D = 10\ \mu A$; $V_{GS} = 0$	$V_{(BR)DSS}$	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 2.8	V V
Drain-source on-resistance $I_D = 400$ mA; $V_{GS} = 10$ V	$R_{DS(on)}$	typ. max.	4.5 6.0	Ω Ω
Transfer admittance $I_D = 400$ mA; $V_{DS} = 25$ V	$\lvert Y_{fs} \rvert$	min. typ.	200 350	mS mS
Input capacitance at f = 1 MHz $V_{DS} = 25$ V; $V_{GS} = 0$	C_{iss}	typ. max.	45 60	pF pF
Output capacitance at f = 1 MHz $V_{DS} = 25$ V; $V_{GS} = 0$	C_{oss}	typ. max.	15 25	pF pF
Feedback capacitance at f = 1 MHz $V_{DS} = 25$ V; $V_{GS} = 0$	C_{rss}	typ. max.	3.5 10	pF 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

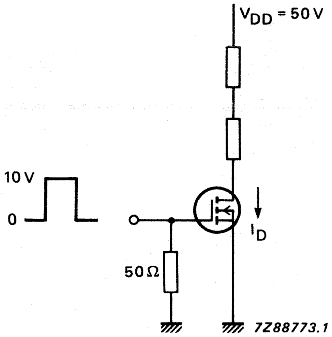


Fig.2 Switching time test circuit

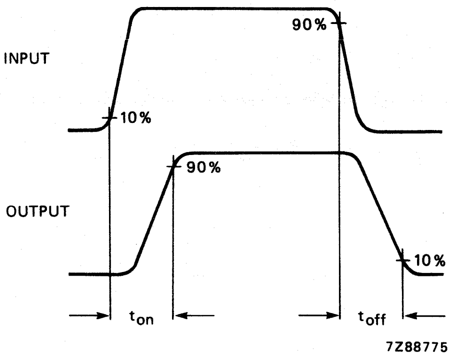


Fig.3 Input and output waveforms.

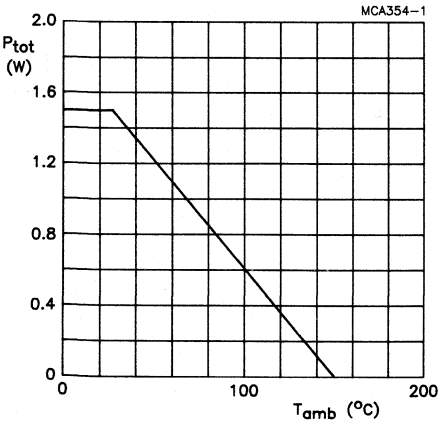


Fig.4 Power derating curve.

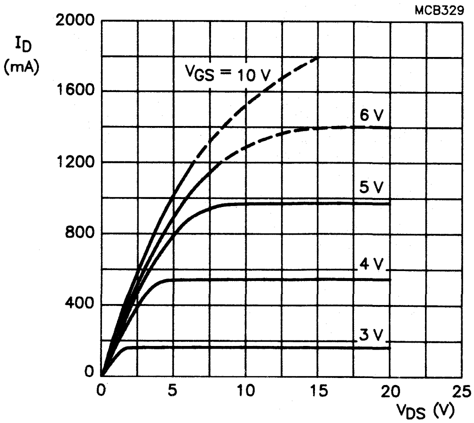


Fig.5 Output characteristic;
$T_j = 25$ °C; typical value.

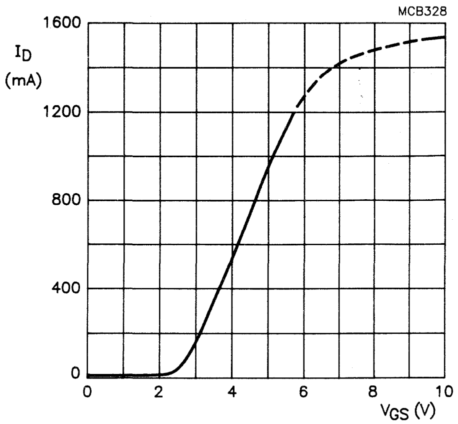


Fig.6 Transfer characteristic;
V_{DS} = 10 V; T_j = 25 °C; typical values.

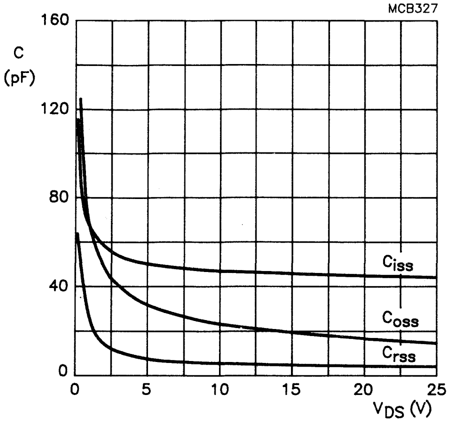


Fig.7 Capacitance as a function of drain-source voltage; V_{GS} = 0;
f = 1 MHz; T_j = 25 °C; typical values.

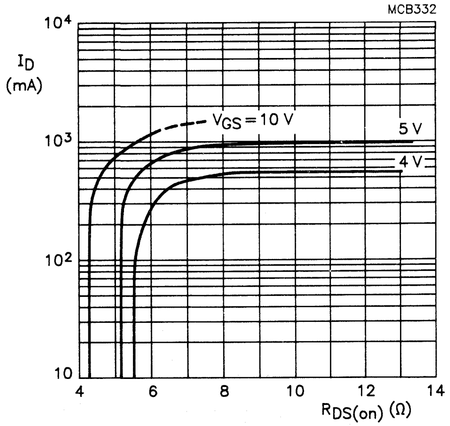


Fig.8 T_j = 25 °C; typical values.

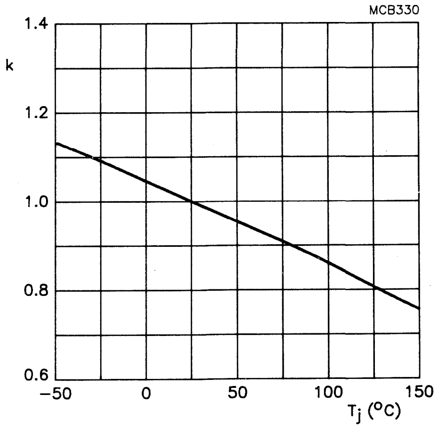


Fig.9 $k = \frac{V_{GS(th)} \text{ at } T_j}{V_{GS(th)} \text{ at } 25\,^{o}C}$; $V_{GS(th)}$ at 1 mA; typical values.

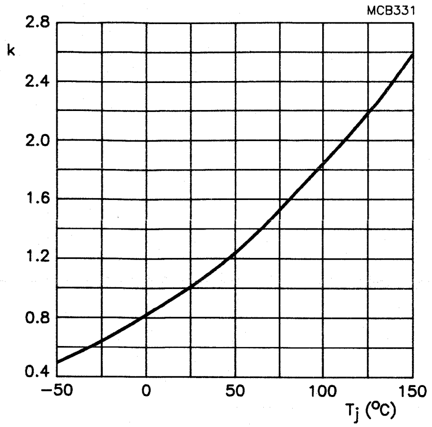


Fig.10 $k = \frac{R_{DS(on)} \text{ at } T_j}{R_{DS(on)} \text{ at } 25\ ^{o}C}$; at 400 mA/10V; typical values.

N-channel enhancement mode vertical D-MOS transistor

BSP122

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 SOT223 envelope and intended for use as a line current interruptor in telephone sets and for applications in relay, high-speed and line transformer drivers.

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	DC drain current	550	mA
$R_{DS(on)}$	drain-source on-resistance	2.5	Ω
$V_{GS(th)}$	gate-source threshold voltage	2	V

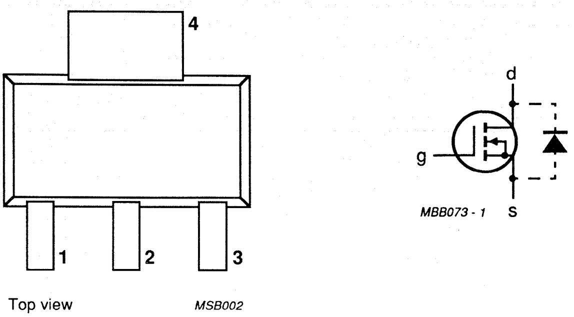


Fig.1 Simplified outline (SOT223) and symbol.

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	DC drain current		–	550	mA
I_{DM}	peak drain current		–	3	A
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

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	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 tab minimum 6 cm^2.

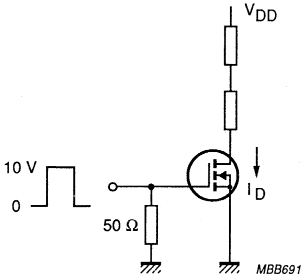
N-channel enhancement mode vertical D-MOS transistor

BSP122

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}	0.4	–	2	V
$R_{DS(on)}$	drain-source on-resistance	I_D = 750 mA; V_{GS} = 10 V	–	1.6	2.5	Ω
		I_D = 20 mA; V_{GS} = 2.4 V	–	2.5	–	Ω
$\lvert Y_{fs}\rvert$	transfer admittance	I_D = 750 mA; V_{DS} = 25 V	400	800	–	mS
C_{iss}	input capacitance	V_{DS} = 25 V; V_{GS} = 0; f = 1 MHz	–	165	–	pF
C_{oss}	output capacitance	V_{DS} = 25 V; V_{GS} = 0; f = 1 MHz	–	40	–	pF
C_{rss}	feedback capacitance	V_{DS} = 25 V; V_{GS} = 0; f = 1 MHz	–	9	–	pF
Switching times (see Figs 2 and 3)						
t_{on}	turn-on time	I_D = 750 mA; V_{DD} = 50 V; V_{GS} = 0 to 10 V	–	–	35	ns
t_{off}	turn-off time	I_D = 750 mA; V_{DD} = 50 V; V_{GS} = 0 to 10 V	–	–	50	ns



V_{DD} = 50 V.

Fig.2 Switching times test circuit.

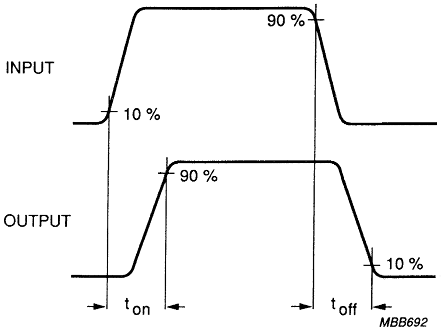


Fig.3 Input and output waveforms.

N-channel depletion mode vertical D-MOS transistor

BSP124

FEATURES

- High-speed switching
- No secondary breakdown.

DESCRIPTION

N-channel depletion mode vertical D-MOS transistor in a SOT223 envelope, intended for use as a line current interruptor in telephone sets and for applications 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	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage		–	250	V
I_D	DC drain current		–	250	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	1.5	W
$\pm V_{GSO}$	gate-source voltage	open drain	–	20	V
$R_{DS(on)}$	drain-source on-resistance	I_D = 20 mA; V_{GS} = 0	–	20	Ω
$V_{GS(off)}$	gate-source cut-off voltage	I_D = 100 µA; V_{DS} = 60 V	−1.65	−0.75	V

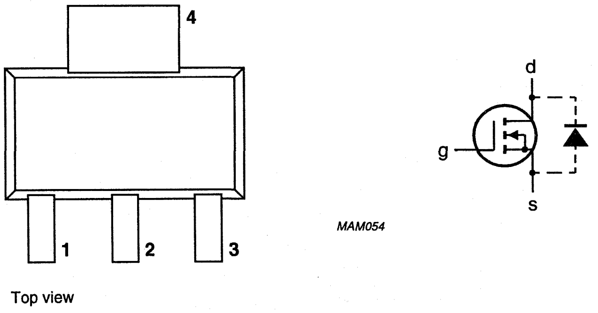


Fig.1 Simplified outline and symbol.

LIMITING VALUES

In accordance with the Absolute Maximum Rating 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	DC drain current		–	250	mA
I_{DM}	peak drain current		–	1.2	A
P_{tot}	total power dissipation	up to T_{amb} = 25 °C; note 1	–	1.5	W
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	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 tab minimum 6 mm^2.

STATIC CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 10 μA; V_{GS} = –3 V	250	–	V
I_{DSX}	drain-source cut-off leakage current	V_{DS} = 200 V; V_{GS} = –3 V	–	100	nA
$\pm I_{GSS}$	gate-source leakage current	$\pm V_{GS}$ = 20 V; V_{DS} = 0	–	100	nA
$V_{GS(off)}$	gate-source cut-off voltage	I_D = 100 μA; V_{DS} = 60 V	–1.65	–0.75	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS} = 3 V	–1.4	–0.6	V
$R_{DS(on)}$	drain-source on-resistance	I_D = 20 mA; V_{GS} = 0	–	20	Ω
		I_D = 250 mA; V_{GS} = 5 V	–	12	Ω
I_{DSS}	drain current	V_{DS} = 25 V; V_{GS} = 0	70	–	mA
$\lvert Y_{fs}\rvert$	transfer admittance	I_D = 250 mA; V_{DS} = 25 V	200	–	mS
C_{iss}	input capacitance	V_{DS} = 25 V; V_{GS} = –3 V; f = 1 MHz	–	90	pF
C_{oss}	output capacitance	V_{DS} = 25 V; V_{GS} = –3 V; f = 1 MHz	–	30	pF
C_{rss}	feedback capacitance	V_{DS} = 25 V; V_{GS} = –3 V; f = 1 MHz	–	15	pF
Switching times (see Figs 2 and 3)					
t_{on}	turn-on time	I_D = 250 mA; V_{DD} = 50 V; V_{GS} = –3 to +5 V	–	10	ns
t_{off}	turn-off time	I_D = 250 mA; V_{DD} = 50 V; V_{GS} = +5 to –3 V	–	30	ns

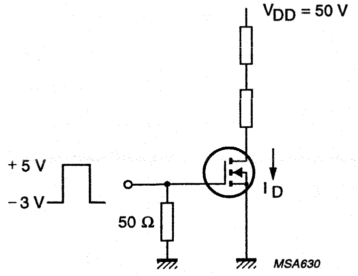


Fig.2 Switching times test circuit.

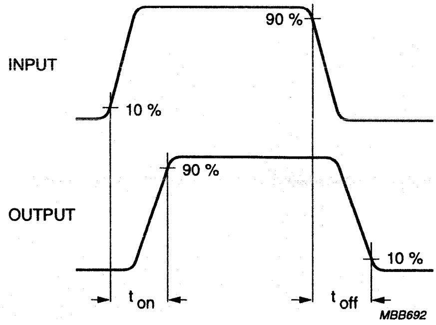


Fig.3 Input and output waveforms.

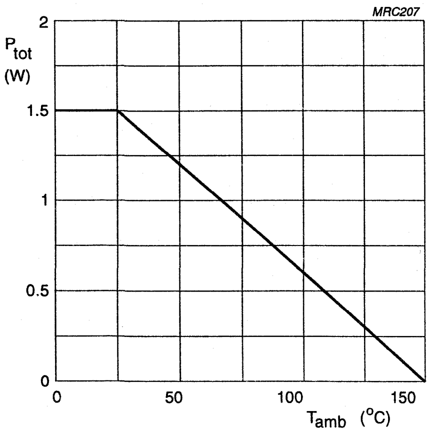
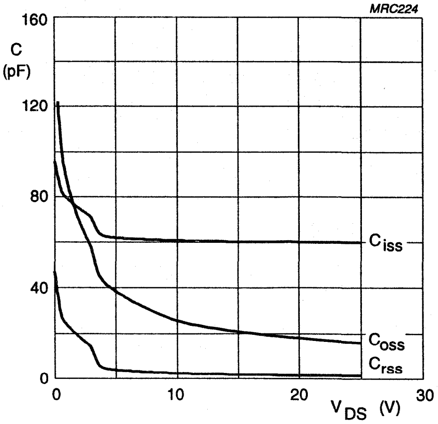
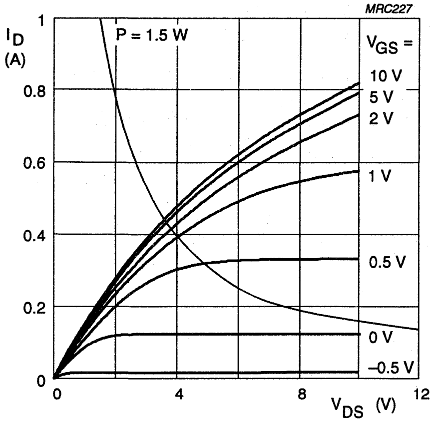


Fig.4 Power derating curve.



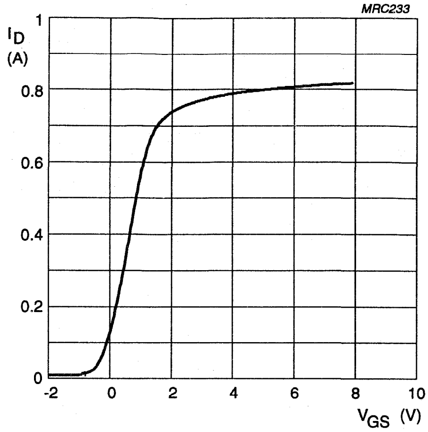
V_{GS} = −3 V; f = 1 MHz; T_j = 25 °C.

Fig.5 Capacitance as a function of drain-source voltage, typical values.



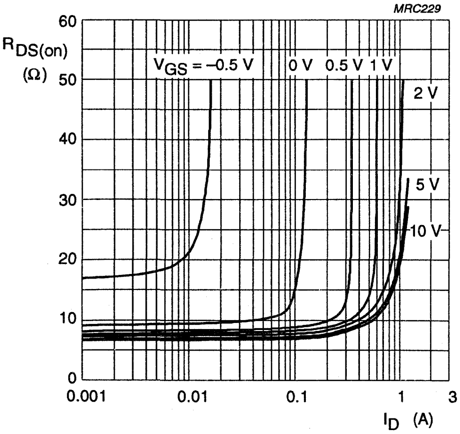
T_j = 25 °C.

Fig.6 Typical output characteristics.



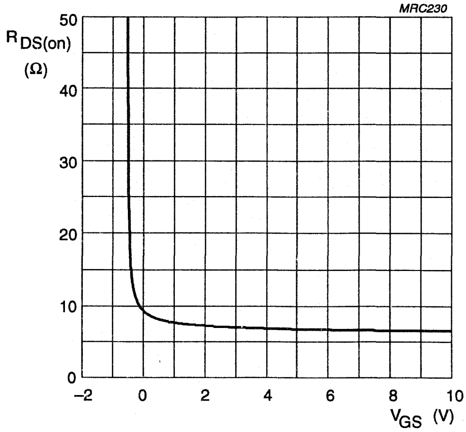
V_{DS} = 10 V; T_j = 25 °C.

Fig.7 Typical transfer characteristics.



T_j = 25 °C.

Fig.8 Drain-source on-resistance as a function of drain current, typical values.



I_D = 10 mA; T_j = 25 °C.

Fig.9 Drain-source on-resistance as a function of gate-source voltage, typical values.

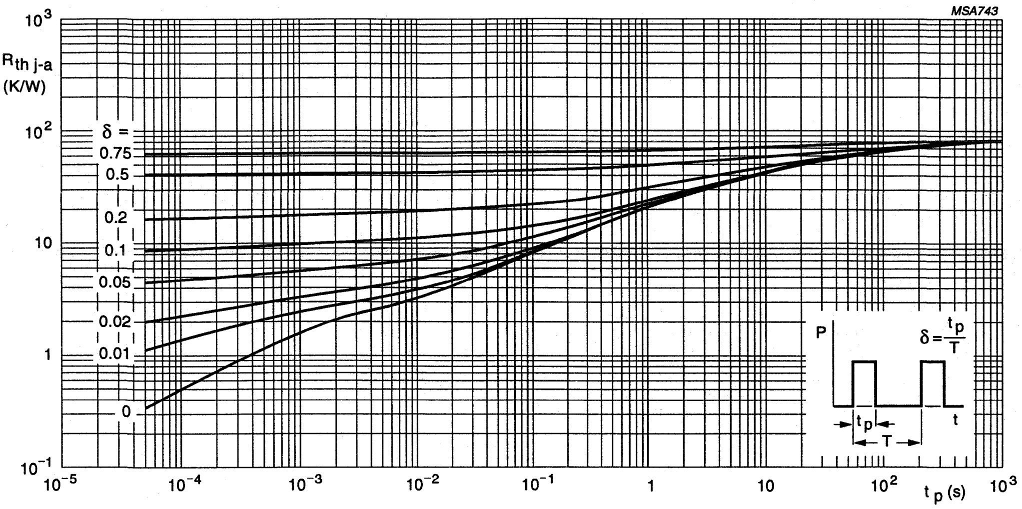
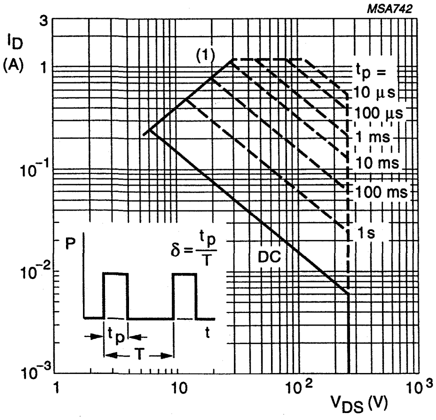


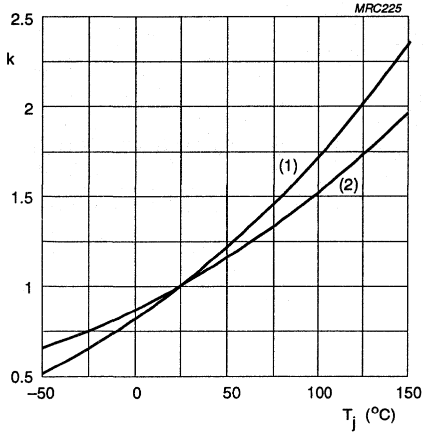
Fig.10 Transient thermal resistance from junction to ambient as a function of pulse time.



δ = 0.01; T_{amb} = 25 °C.

(1) $R_{DS(on)}$ limitation.

Fig.11 SOAR curve.



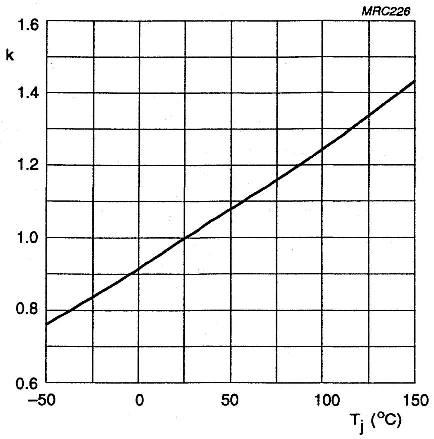
$$k = \frac{R_{DS(on)}\ at\ T_j}{R_{DS(on)}\ at\ 25\ °C}.$$

Typical $R_{DS(on)}$;

(1) I_D = 250 mA; V_{GS} = 5 V.

(2) I_D = 20 mA; V_{GS} = 0.

Fig.12 Temperature coefficient of drain-source on-resistance.



$$k = \frac{V_{GS(th)}\ at\ T_j}{V_{GS(th)}\ at\ 25\ °C}.$$

Typical $V_{GS(th)}$ at I_D = 1 mA; V_{DS} = 3 V.

Fig.13 Temperature coefficient of gate-source threshold voltage.

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. max.	5.0 Ω 7.0 Ω
Gate-source threshold voltage	$V_{GS(th)}$	max.	2 V

MECHANICAL DATA

Dimensions in mm

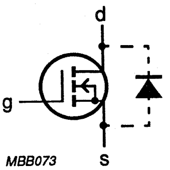
Marking code

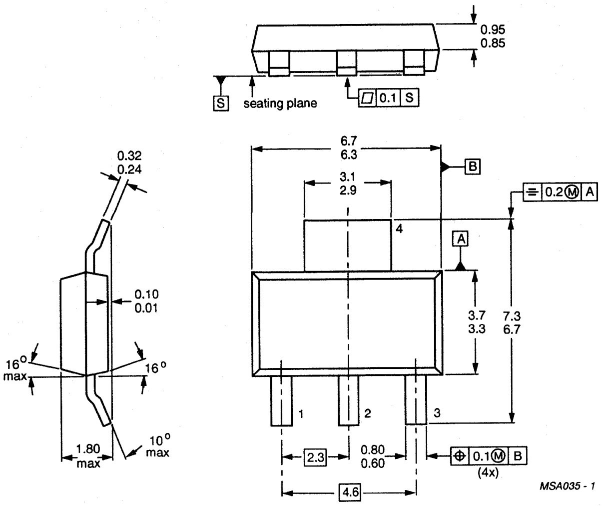
BSP126

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 $T_{amb} = 25\ ^oC$ (note 1)	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 (note 1)	$R_{th\ j\text{-}a}$	=	83.3	K/W

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

Drain-source breakdown voltage $I_D = 10\ \mu A$; $V_{GS} = 0$	$V_{(BR)DSS}$	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 2.0	V V
Drain-source on-resistance $I_D = 300$ mA; $V_{GS} = 10$ V	$R_{DS(on)}$	typ. max.	5.0 7.0	Ω 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	$\lvert Y_{fs} \rvert$	min. typ.	200 400	mS mS
Input capacitance at f = 1 MHz; $V_{DS} = 25$ V; $V_{GS} = 0$	C_{iss}	typ. max.	65 90	pF pF
Output capacitance at f = 1 MHz; $V_{DS} = 25$ V; $V_{GS} = 0$	C_{oss}	typ. max.	20 30	pF pF
Feedback capacitance at f = 1 MHz; $V_{DS} = 25$ V; $V_{GS} = 0$	C_{rss}	typ. max.	5 15	pF 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

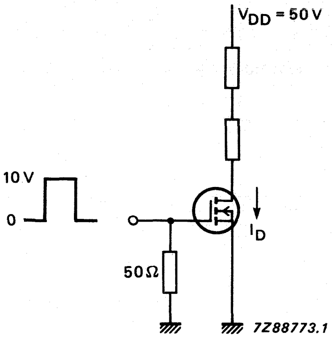


Fig.2 Switching time test circuit.

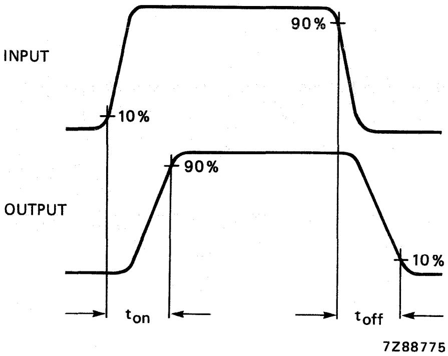


Fig.3 Input and output waveforms.

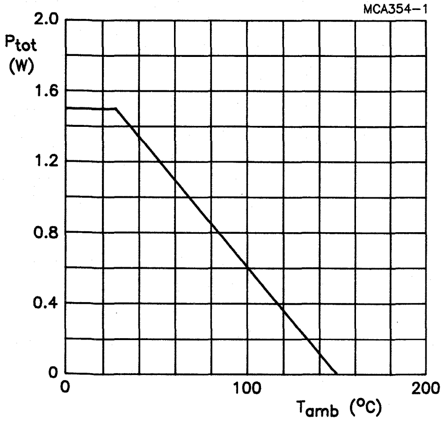


Fig.4 Power derating curve.

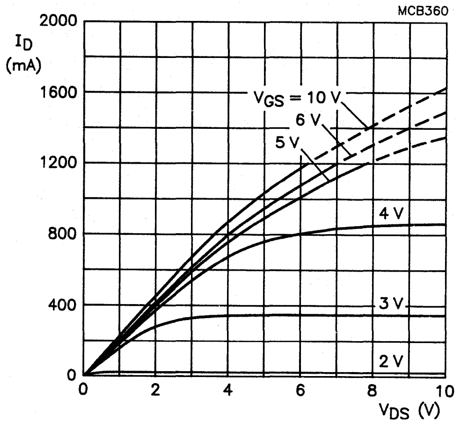


Fig.5 Output characteristics; T_j = 25 °C; typical values.

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

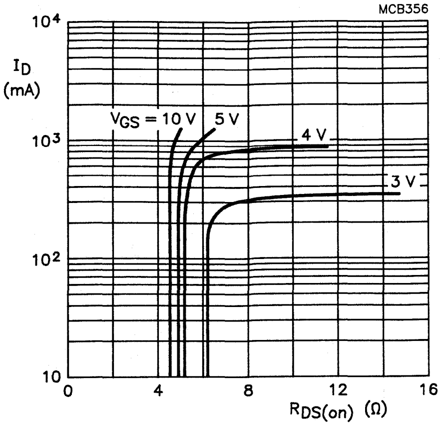


Fig.7 On-resistance as a function of drain current; T_j = 25 °C; typical values.

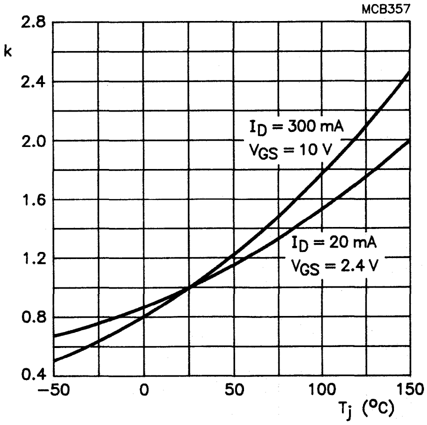


Fig.8 $k = \frac{R_{DS(on)} \text{ at } T_j}{R_{DS(on)} \text{ at } 25\ ^{o}C}$;

typical values.

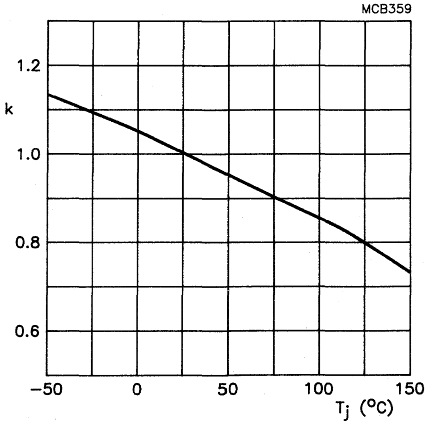


Fig.9 $k = \frac{V_{GS(th)} \text{ at } T_j}{V_{GS(th)} \text{ at } 25\ ^{o}C}$;

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

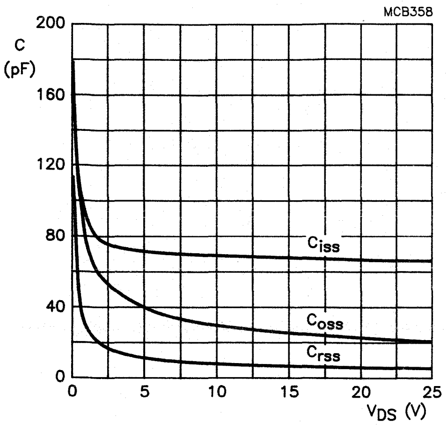


Fig.10 Capacitances as a function of drain-source voltage; V_{GS} = 0; f = 1 MHz; T_j = 25 °C; typical values.

N-channel enhancement mode vertical D-MOS transistor

BSP127

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 SOT223 envelope and intended for use as a line current interruptor in telephone sets and for applications in relay, high-speed and line transformer drivers.

PINNING

PIN	DESCRIPTION
Code: BSP127	
1	gate
2	drain
3	source
4	drain

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MAX.	UNIT
V_{DS}	drain-source voltage	270	V
I_D	DC drain current	350	mA
$R_{DS(on)}$	drain-source on-resistance	8	Ω
$V_{GS(th)}$	gate-source threshold voltage	2	V

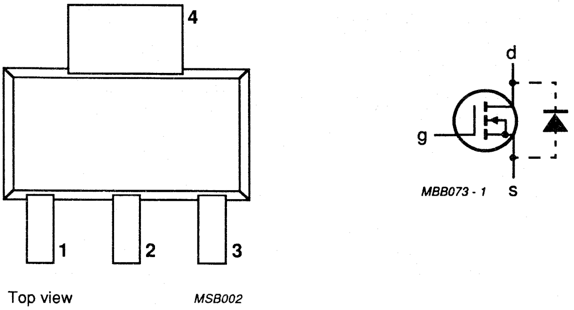


Fig.1 Simplified outline (SOT223) and symbol.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage		–	270	V
$\pm V_{GSO}$	gate-source voltage	open drain	–	20	V
I_D	DC drain current		–	350	mA
I_{DM}	peak drain current		–	1.4	A
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

THERMAL RESISTANCE

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

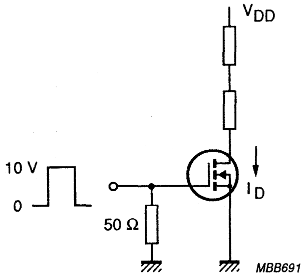
Note

1. Device mounted on an epoxy printed circuit board, 40 x 40 x 1.5 mm, mounting pad for the drain tab minimum 6 cm².

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	270	–	–	V
I_{DSS}	drain-source leakage current	V_{DS} = 220 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	V
$R_{DS(on)}$	drain-source on-resistance	I_D = 250 mA; V_{GS} = 10 V	–	6.5	8	Ω
		I_D = 20 mA; V_{GS} = 2.4 V	–	9	14	Ω
$\lvert Y_{fs} \rvert$	transfer admittance	I_D = 250 mA; V_{DS} = 25 V	200	400	–	mS
C_{iss}	input capacitance	V_{DS} = 25 V; V_{GS} = 0; f = 1 MHz	–	55	80	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	10	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



V_{DD} = 50 V.

Fig.2 Switching times test circuit.

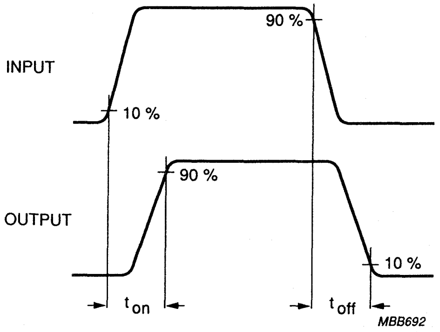


Fig.3 Input and output waveforms.

N-channel enhancement mode vertical D-MOS transistor

BSP128

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 SOT223 envelope and intended for use as a line current interruptor in telephone sets and for applications in relay, high-speed and line transformer drivers.

PINNING

PIN	DESCRIPTION
Code: BSP128	
1	gate
2	drain
3	source
4	drain

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MAX.	UNIT
V_{DS}	drain-source voltage	200	V
I_D	DC drain current	350	mA
$R_{DS(on)}$	drain-source on-resistance	8	Ω
$V_{GS(th)}$	gate-source threshold voltage	1.8	V

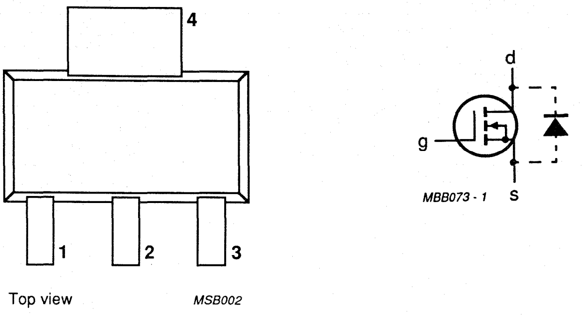


Fig.1 Simplified outline (SOT223) and symbol.

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	DC drain current		–	350	mA
I_{DM}	peak drain current		–	1.4	A
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

THERMAL RESISTANCE

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

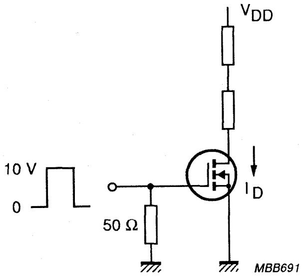
Note

1. Device mounted on an epoxy printed circuit board, 40 x 40 x 1.5 mm, mounting pad for the drain tab 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	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; $V_{GS} = V_{DS}$	0.4	–	1.8	V
$R_{DS(on)}$	drain-source on-resistance	I_D = 100 mA; V_{GS} = 2.8 V	–	5	8	Ω
$\lvert Y_{fs}\rvert$	transfer admittance	I_D = 300 mA; V_{DS} = 25 V	200	400	–	mS
C_{iss}	input capacitance	V_{DS} = 25 V; V_{GS} = 0; f = 1 MHz	–	50	80	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	10	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



V_{DD} = 50 V.

Fig.2 Switching times test circuit.

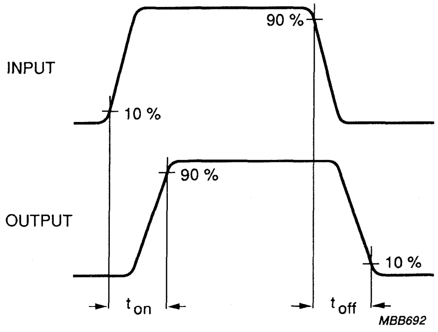


Fig.3 Input and output waveforms.

N-channel enhancement mode vertical D-MOS transistor

BSP130

FEATURES

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

DESCRIPTION

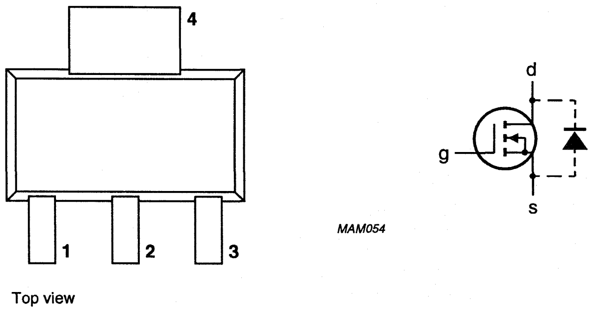
N-channel enhancement mode vertical D-MOS transistor in a SOT223 envelope, intended for use as a line current interruptor in telephone sets and for applications in relay, high-speed and line transformer drivers.

PINNING - SOT223

PIN	DESCRIPTION
1	gate
2	drain
3	source
4	drain

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage		–	300	V
I_D	DC drain current		–	300	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	1.5	W
$\pm V_{GSO}$	gate-source voltage	open drain	–	20	V
$R_{DS(on)}$	drain-source on-resistance	I_D = 250 mA; V_{GS} = 10 V	–	8	Ω
$V_{GS(off)}$	gate-source cut-off voltage	I_D = 1 mA; $V_{DS} = V_{GS}$	0.8	2	V



Marking code
BSP130.

Fig.1 Simplified outline and symbol.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage		–	300	V
$\pm V_{GSO}$	gate-source voltage	open drain	–	20	V
I_D	DC drain current		–	300	mA
I_{DM}	peak drain current		–	1.4	A
P_{tot}	total power dissipation	up to T_{amb} = 25 °C; note 1	–	1.5	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	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 tab minimum 6 mm^2.

STATIC 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	300	–	–	V
$\pm I_{GSS}$	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; $V_{DS} = V_{GS}$	0.8	–	2	V
$R_{DS(on)}$	drain-source on-resistance	I_D = 20 mA; V_{GS} = 2.4 V	–	7.9	14	Ω
		I_D = 250 mA; V_{GS} = 10 V	–	6.7	8	Ω
I_{DSS}	drain-source leakage current	V_{DS} = 240 V; V_{GS} = 0	–	–	100	nA
$\lvert Y_{fs}\rvert$	transfer admittance	I_D = 250 mA; V_{DS} = 25 V	200	380	–	mS
C_{iss}	input capacitance	V_{DS} = 25 V; V_{GS} = 0; f = 1 MHz	–	57	90	pF
C_{oss}	output capacitance	V_{DS} = 25 V; V_{GS} = 0; f = 1 MHz	–	15	30	pF
C_{rss}	feedback capacitance	V_{DS} = 25 V; V_{GS} = 0; f = 1 MHz	–	2.6	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	–	2.5	10	ns
t_{off}	turn-off time	I_D = 250 mA; V_{DD} = 50 V; V_{GS} = 10 to 0 V	–	17	30	ns

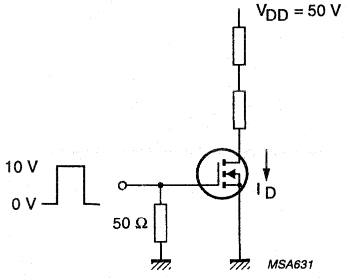


Fig.2 Switching times test circuit.

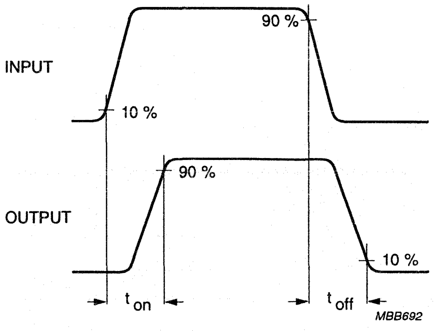


Fig.3 Input and output waveforms.

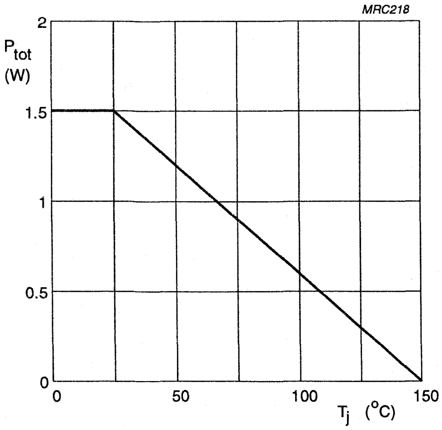
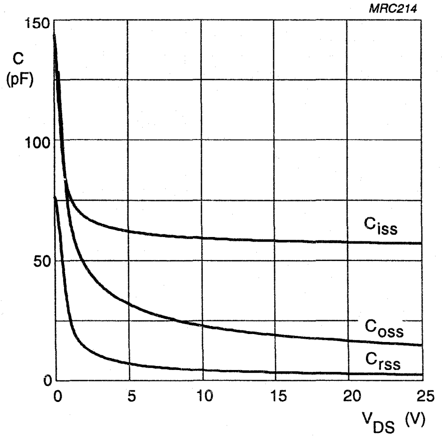
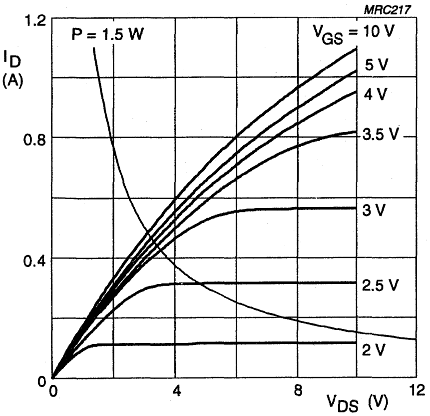


Fig.4 Power derating curve.



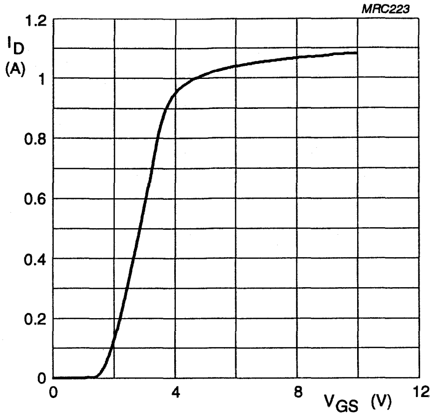
V_{GS} = 0; f = 1 MHz; T_j = 25 °C.

Fig.5 Capacitance as a function of drain-source voltage, typical values.



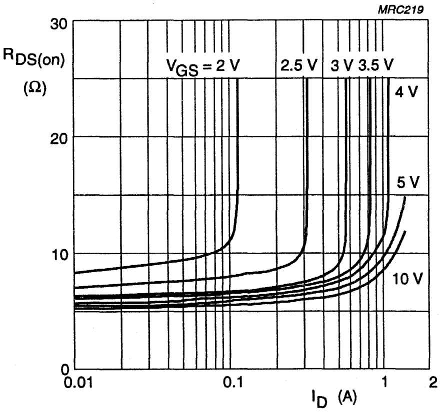
$T_j = 25$ °C.

Fig.6 Typical output characteristics.



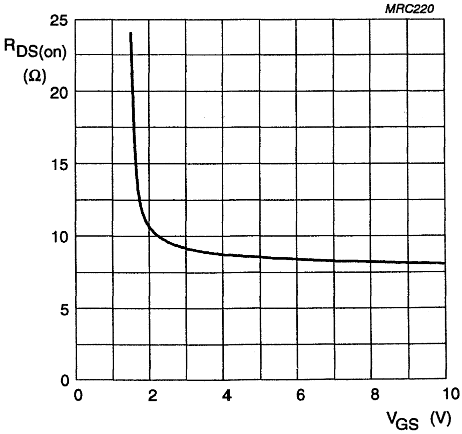
$V_{DS} = 10$ V; $T_j = 25$ °C.

Fig.7 Typical transfer characteristics.



$T_j = 25$ °C.

Fig.8 Drain-source on-resistance as a function of drain current, typical values.



$V_{DS} = 100$ mV; $T_j = 25$ °C.

Fig.9 Drain-source on-resistance as a function of gate-source voltage, typical values.

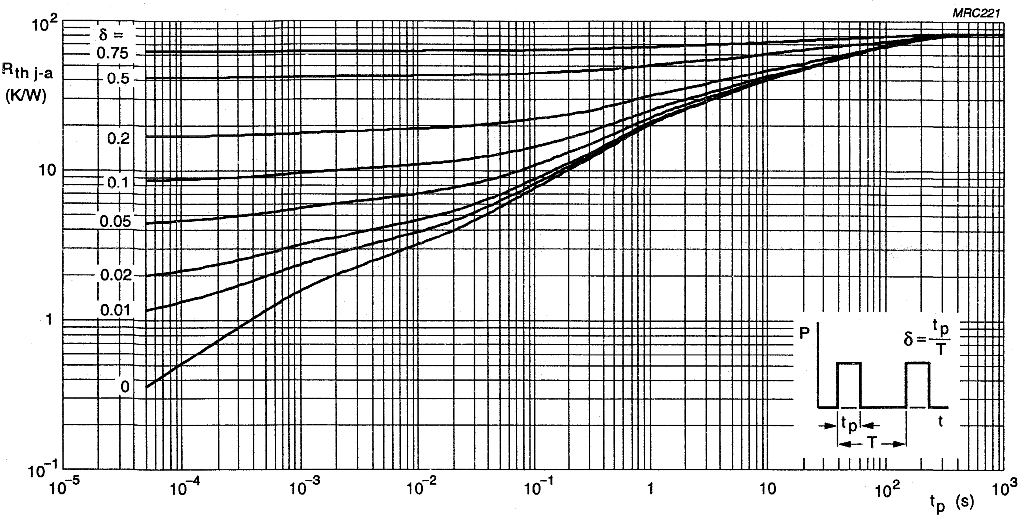
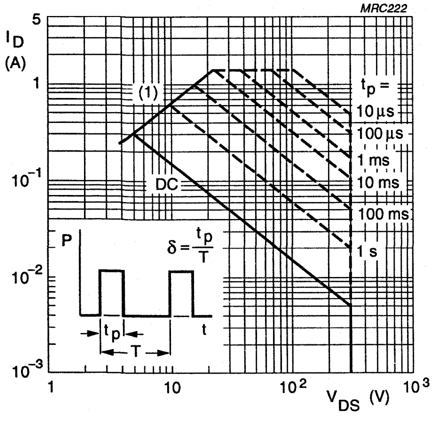


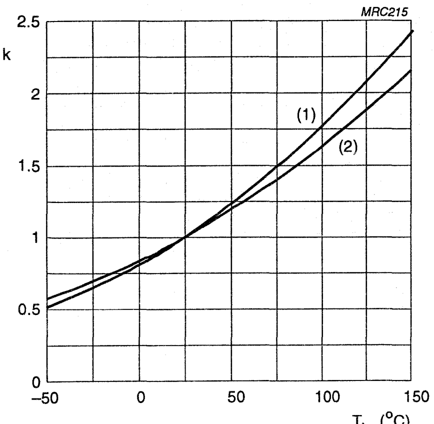
Fig.10 Transient thermal resistance from junction to ambient as a function of pulse time.



$δ = 0.01$; $T_{amb} = 25$ °C.

(1) $R_{DS(on)}$ limitation.

Fig.11 SOAR curve.



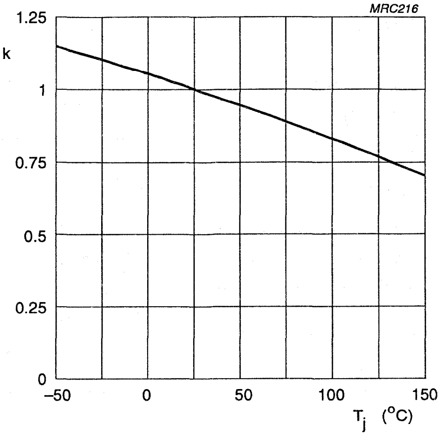
$$k = \frac{R_{DS(on)}\ at\ T_j}{R_{DS(on)}\ at\ 25\ °C}.$$

Typical $R_{DS(on)}$;

(1) I_D = 250 mA; V_{GS} = 10 V.

(2) I_D = 20 mA; V_{GS} = 2.4 V.

Fig.12 Temperature coefficient of drain-source on-resistance.



$$k = \frac{V_{GS(th)}\ at\ T_j}{V_{GS(th)}\ at\ 25\ °C}.$$

Typical $V_{GS(th)}$ at 1 mA.

Fig.13 Temperature coefficient of gate-source threshold voltage.

N-channel enhancement mode vertical D-MOS transistor

BSP152

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 SOT223 envelope, intended for use as a line current interruptor in telephone sets and for applications 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	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage		–	200	V
I_D	DC drain current		–	550	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	1.5	W
$\pm V_{GSO}$	gate-source voltage	open drain	–	40	V
$R_{DS(on)}$	drain-source on-resistance	I_D = 750 mA; V_{GS} = 10 V	–	2.5	Ω
$V_{GS(off)}$	gate-source cut-off voltage	I_D = 1 mA; $V_{DS} = V_{GS}$	1.5	3.5	V

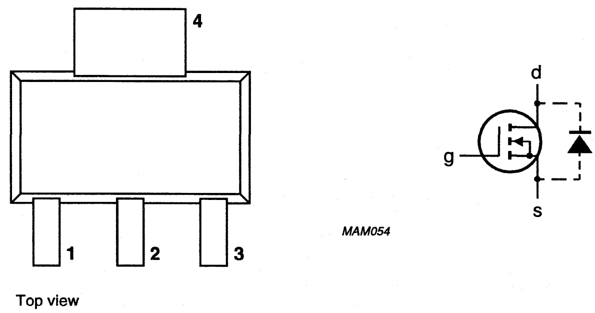


Fig.1 Simplified outline and symbol.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage		–	200	V
$\pm V_{GSO}$	gate-source voltage	open drain	–	40	V
I_D	DC drain current		–	550	mA
I_{DM}	peak drain current		–	3	A
P_{tot}	total power dissipation	up to T_{amb} = 25 °C; note 1	–	1.5	W
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	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 tab minimum 6 mm^2.

STATIC 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
$\pm I_{GSS}$	gate-source leakage current	$\pm V_{GS}$ = 40 V; V_{DS} = 0	–	–	100	nA
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; $V_{DS} = V_{GS}$	1.5	–	3.5	V
$R_{DS(on)}$	drain-source on-resistance	I_D = 750 mA; V_{GS} = 10 V	–	–	2.5	Ω
I_{DSS}	drain-source leakage current	V_{DS} = 160 V; V_{GS} = 0	–	–	100	nA
$\lvert Y_{fs}\rvert$	transfer admittance	I_D = 750 mA; V_{DS} = 25 V	400	–	–	mS
C_{iss}	input capacitance	V_{DS} = 25 V; V_{GS} = 0; f = 1 MHz	–	100	–	pF
C_{oss}	output capacitance	V_{DS} = 25 V; V_{GS} = 0; f = 1 MHz	–	42	–	pF
C_{rss}	feedback capacitance	V_{DS} = 25 V; V_{GS} = 0; f = 1 MHz	–	8	–	pF
Switching times (see Figs 2 and 3)						
t_{on}	turn-on time	I_D = 750 mA; V_{DD} = 50 V; V_{GS} = 0 to 10 V	–	–	15	ns
t_{off}	turn-off time	I_D = 750 mA; V_{DD} = 50 V; V_{GS} = 10 to 0 V	–	–	30	ns

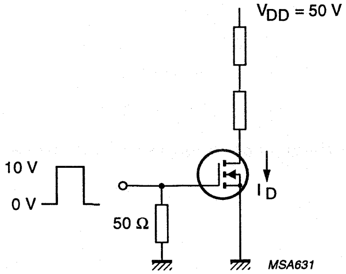


Fig.2 Switching times test circuit.

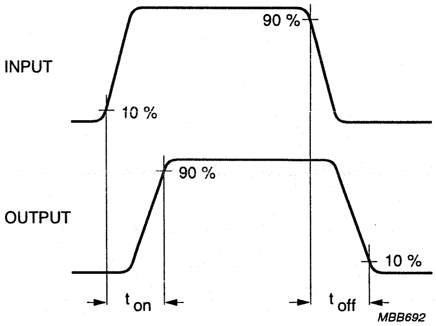


Fig.3 Input and output waveforms.

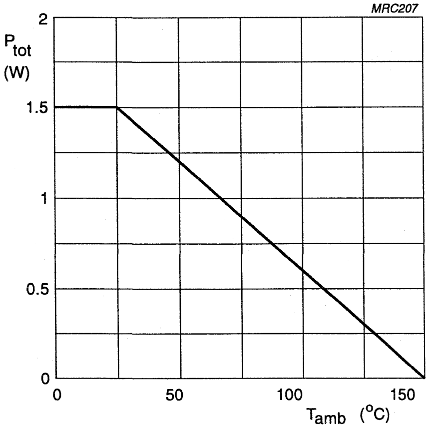
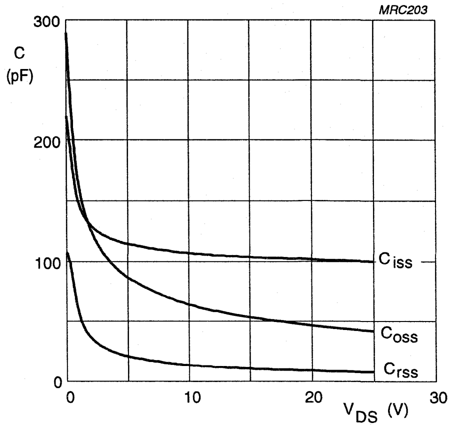
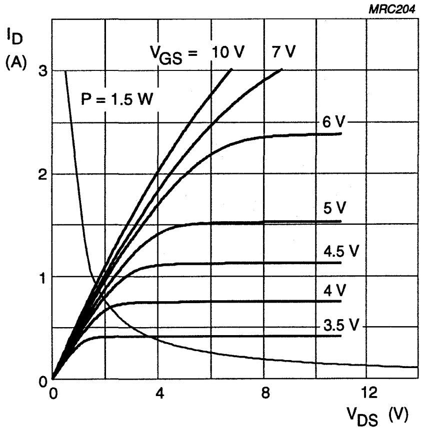


Fig.4 Power derating curve.



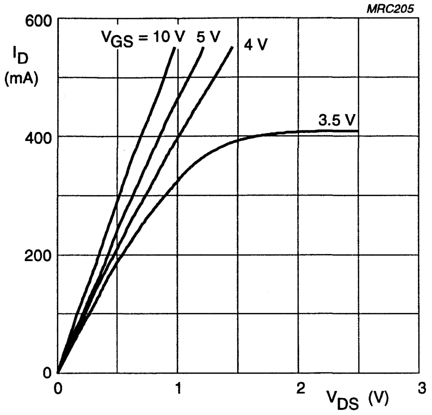
$V_{GS} = 0$; f = 1 MHz; T_j = 25 °C.

Fig.5 Capacitance as a function of drain-source voltage, typical values.



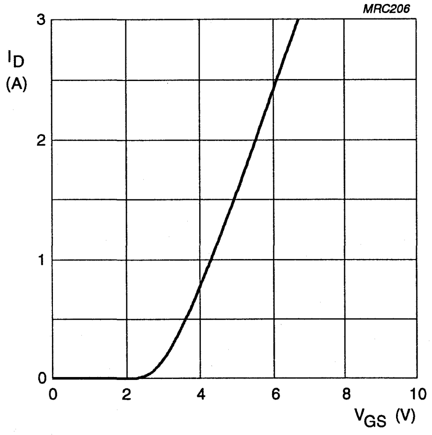
T_j = 25 °C.

Fig.6 Typical output characteristics.



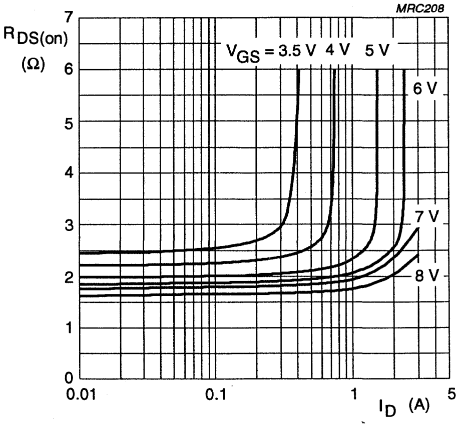
T_j = 25 °C.

Fig.7 Typical output characteristics.



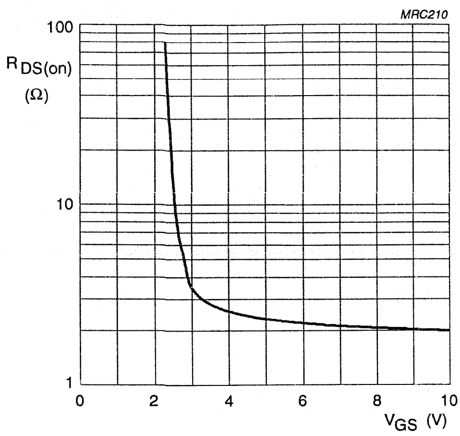
V_{DS} = 10 V; T_j = 25 °C.

Fig.8 Typical transfer characteristics.



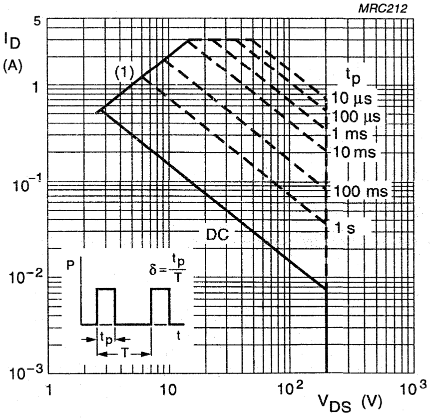
T_j = 25 °C.

Fig.9 Drain-source on-resistance as a function of drain current, typical values.



V_{DS} = 100 mV; T_j = 25 °C.

Fig.10 Drain-source on-resistance as a function of gate-source voltage, typical values.



δ = 0.01; T_{amb} = 25 °C.

(1) R_{DSon} limitation.

Fig.11 SOAR curve.

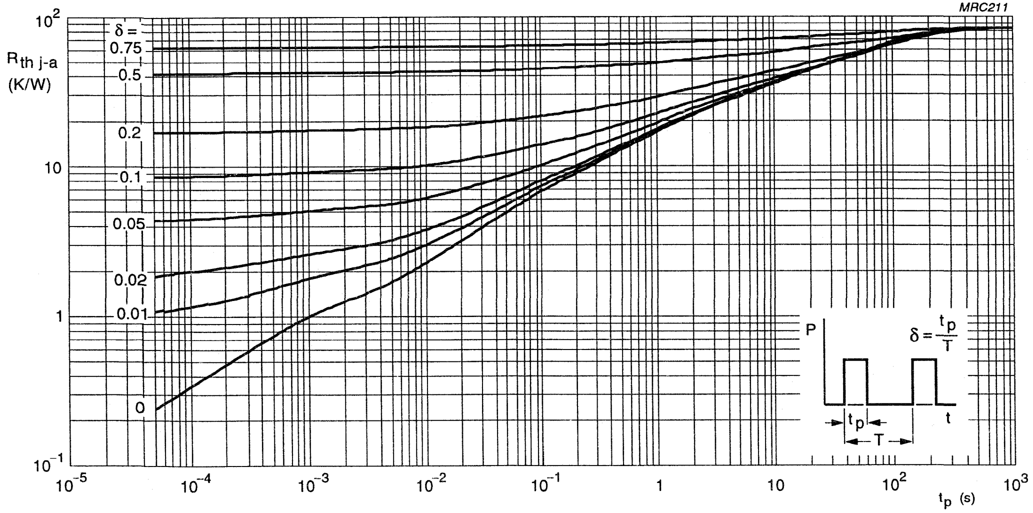
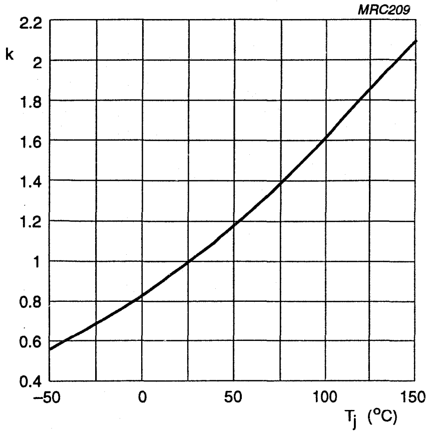


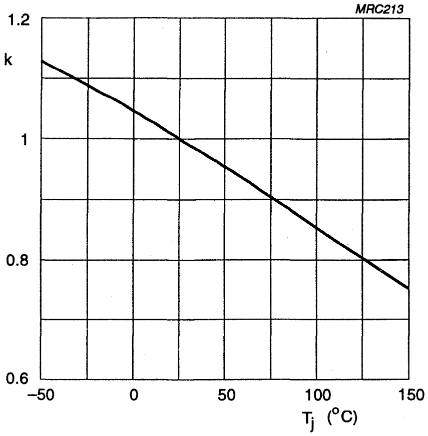
Fig.12 Transient thermal resistance from junction to ambient as a function of pulse time.



$$k = \frac{R_{DS(on)} \text{ at } T_j}{R_{DS(on)} \text{ at } 25\ °C}.$$

Typical R_{DSon} at $I_D = 750$ mA; $V_{GS} = 10$ V.

Fig.13 Temperature coefficient of drain-source on-resistance.



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

Typical $V_{GS(th)}$ at $I_D = 1$ mA.

Fig.14 Temperature coefficient of gate-source threshold voltage.

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

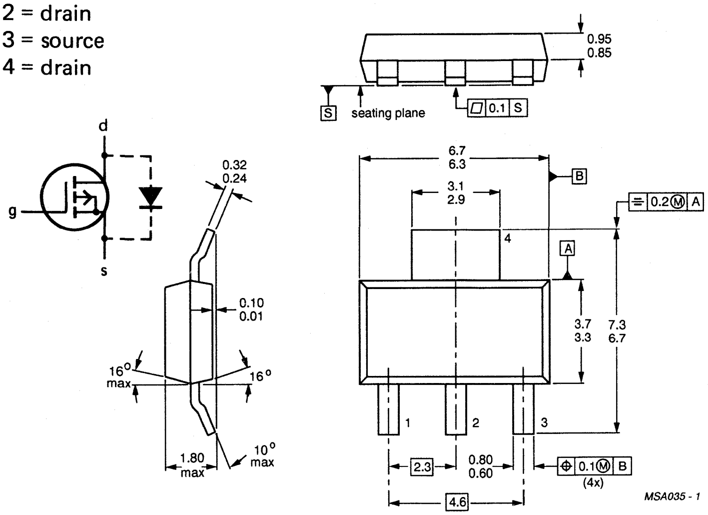
Fig.1 SOT223.

Marking code

BSP205

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 3.5	V V
Drain-source ON-resistance $-I_D$ = 200 mA; $-V_{GS}$ = 10 V	$r_{DS(on)}$	typ. max.	7.5 10	Ω Ω
Transfer admittance $-I_D$ = 200 mA; $-V_{DS}$ = 15 V	$\lvert Y_{fs} \rvert$	min. typ.	60 125	mS mS
Input capacitance at f = 1 MHz; $-V_{DS}$ = 10 V; V_{GS} = 0	C_{iss}	typ. max.	30 45	pF pF
Output capacitance at f = 1 MHz; $-V_{DS}$ = 10 V; V_{GS} = 0	C_{oss}	typ. max.	20 30	pF pF
Feedback capacitance at f = 1 MHz; $-V_{DS}$ = 10 V; V_{GS} = 0	C_{rss}	typ. max.	5 10	pF 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 6	ns ns
	t_{off}	typ. max.	10 15	ns 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 cm².

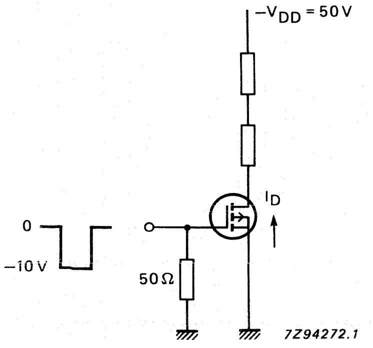


Fig.2 Switching time test circuit.

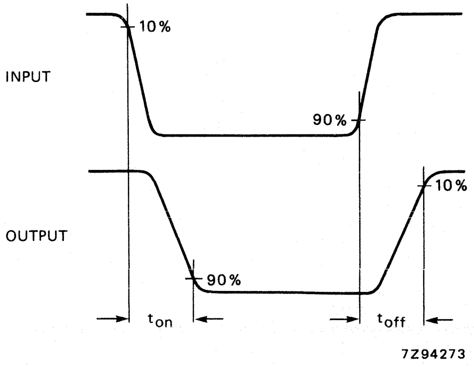


Fig.3 Input and output waveforms.

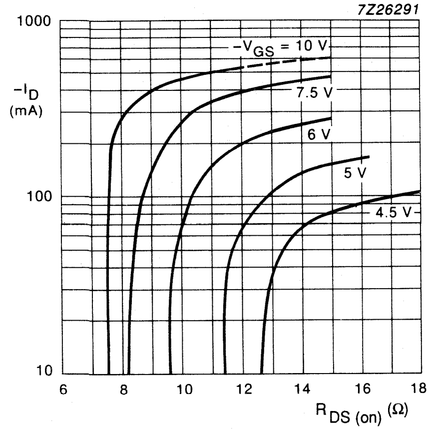


Fig.4 ON-resistance as a function of drain current; T_j = 25 °C; typical values.

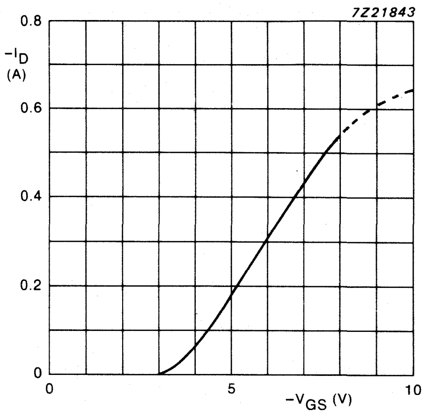


Fig.5 Transfer characteristics; $-V_{DS}$ = 10 V; T_j = 25 °C; typical values.

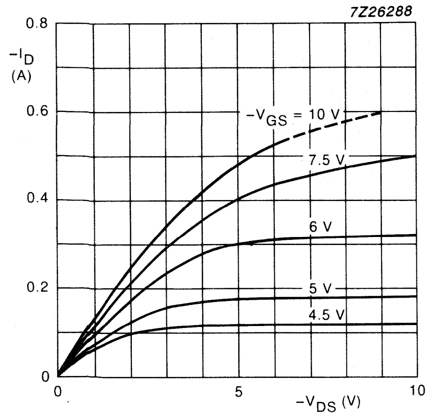


Fig.6 Output characteristics; T_j = 25 °C; typical values.

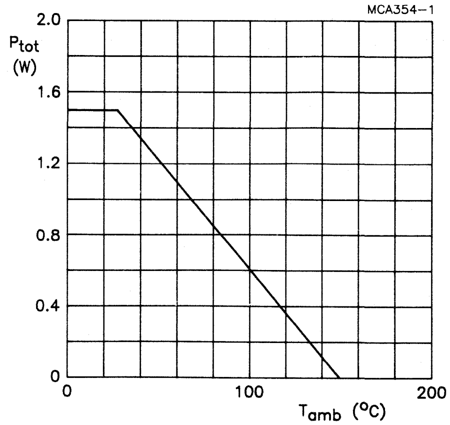


Fig.7 Power derating curve.

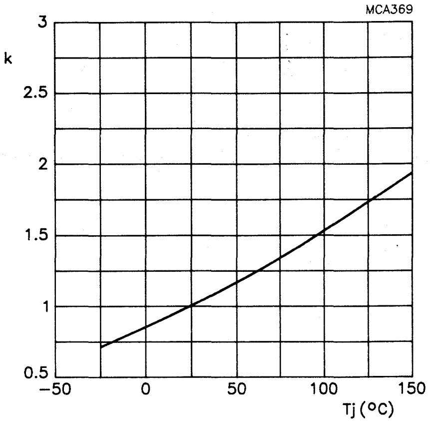


Fig.8 $k = \frac{r_{DS(on)} \text{ at } T_j}{r_{DS(on)} \text{ at } 25\ ^oC}$; at −200 mA/−10 V; typical values.

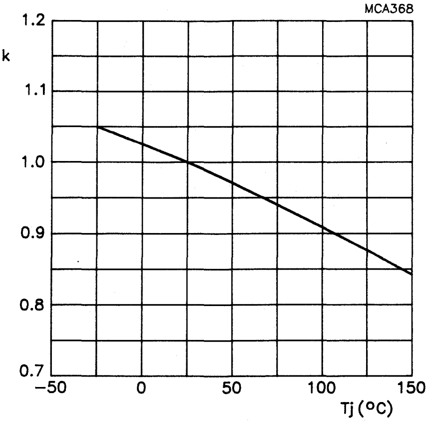


Fig.9 $k = \frac{-V_{GS(th)} \text{ at } T_j}{-V_{GS(th)} \text{ at } 25\ ^oC}$; $-V_{GS(th)}$ at −1 mA; typical values.

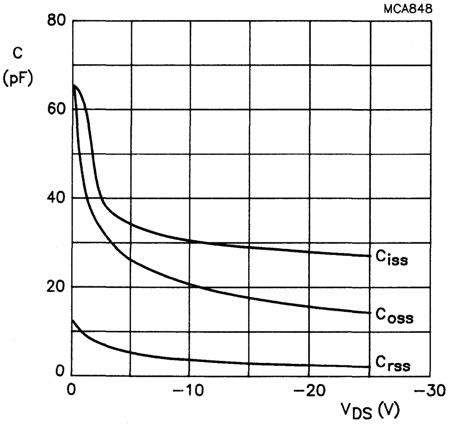


Fig.10 T_j = 25 °C; V_{GS} = 0; f = 1 MHz; typical values.

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

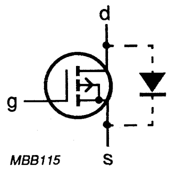
Dimensions in mm

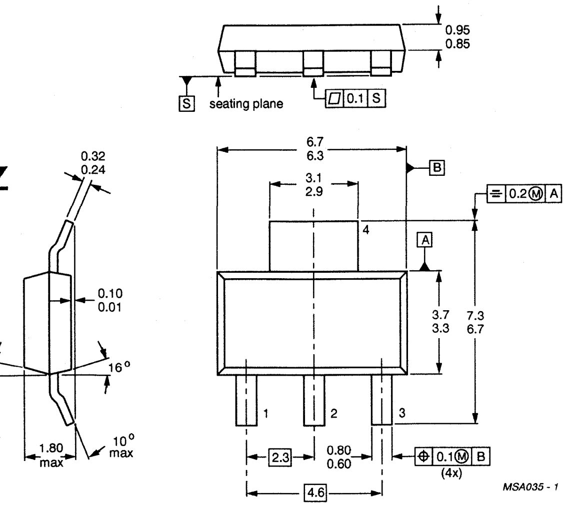
Marking code
BSP206

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 $-I_D = 10\ \mu A$; $V_{GS} = 0$	$-V_{(BR)DSS}$	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 3.5	V V
Drain-source ON-resistance $-I_D = 200$ mA; $-V_{GS} = 10$ V	$r_{DS(on)}$	typ. max.	4.5 6	Ω Ω
Transfer admittance $-I_D = 200$ mA; $-V_{DS} = 15$ V	$\lvert Y_{fs} \rvert$	min. typ.	100 200	mS mS
Input capacitance at f = 1 MHz; $-V_{DS} = 10$ V; $V_{GS} = 0$	C_{iss}	typ. max.	55 70	pF pF
Output capacitance at f = 1 MHz; $-V_{DS} = 10$ V; $V_{GS} = 0$	C_{oss}	typ. max.	30 45	pF pF
Feedback capacitance at f = 1 MHz; $-V_{DS} = 10$ V; $V_{GS} = 0$	C_{rss}	typ. max.	8 12	pF 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 8	ns ns
	t_{off}	typ. max.	15 25	ns 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.

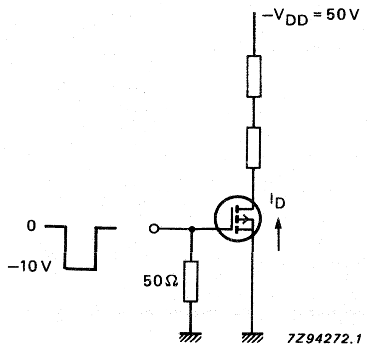


Fig.2 Switching time test circuit.

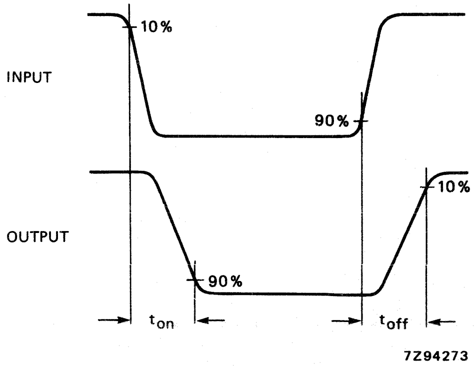


Fig.3 Input and output waveforms.

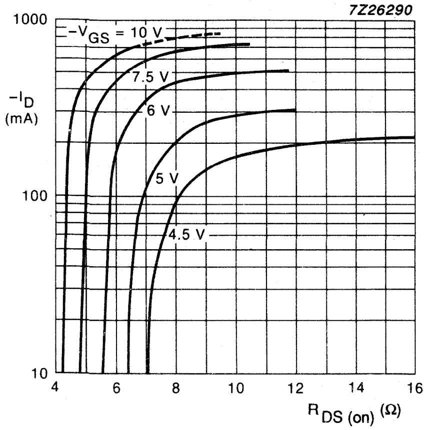


Fig.4 ON-resistance as a function of drain current; $T_j = 25\,^{o}C$; typical values.

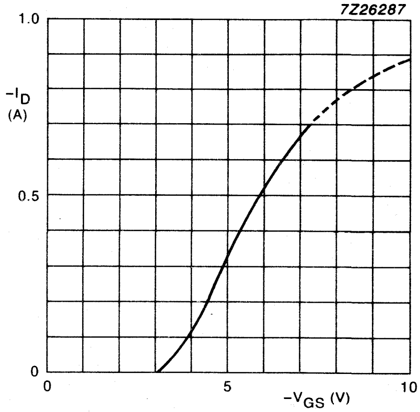


Fig.5 Transfer characteristics; $-V_{DS} = 10\,V$; $T_j = 25\,^{o}C$; typical values.

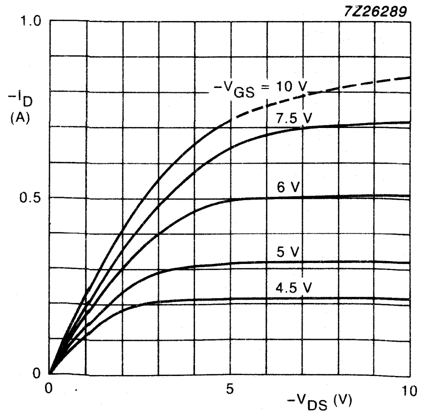


Fig.6 Output characteristics; $T_j = 25\,^{o}C$; typical values.

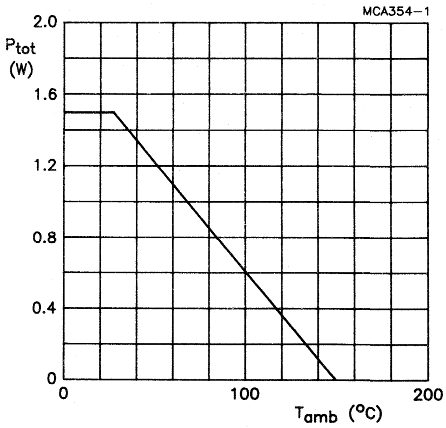


Fig.7 Power derating curve.

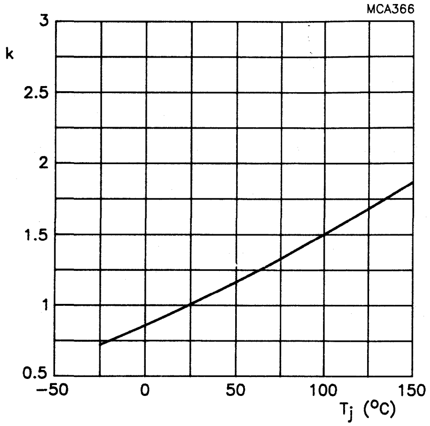


Fig.8 $k = \frac{r_{DS(on)} \text{ at } T_j}{r_{DS(on)} \text{ at } 25\ ^oC}$; at −200 mA/−10V; typical values.

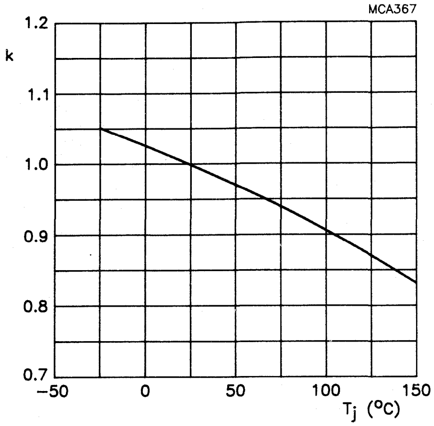


Fig.9 $k = \frac{-V_{GS(th)} \text{ at } T_j}{-V_{GS(th)} \text{ at } 25\ ^oC}$; $-V_{GS(th)}$ at −1 mA; typical values.

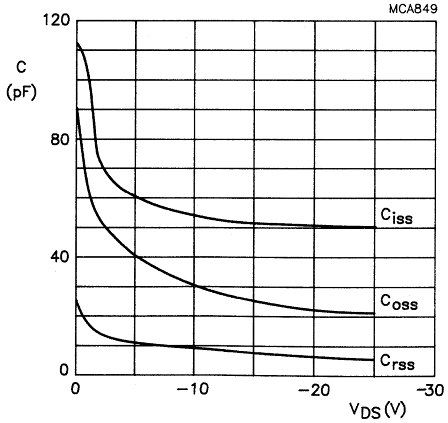


Fig.10 $T_j = 25\ ^oC$; $V_{GS} = 0$; f = 1 MHz; typical values.

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

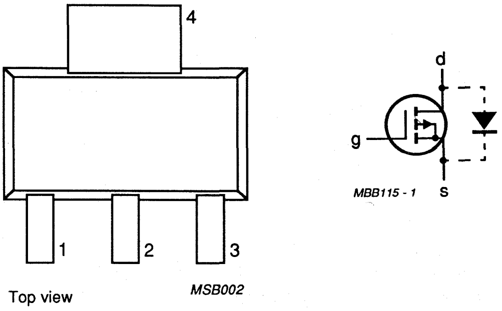


Fig.1 Simplified outline and symbol.

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

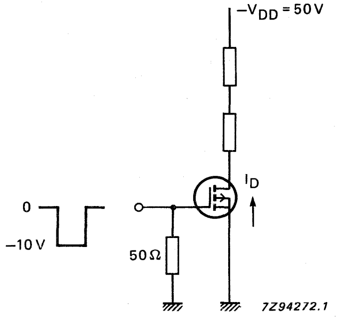


Fig.2 Switching time test circuit.

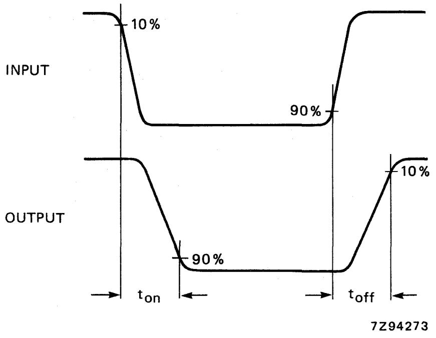


Fig.3 Input and output waveforms.

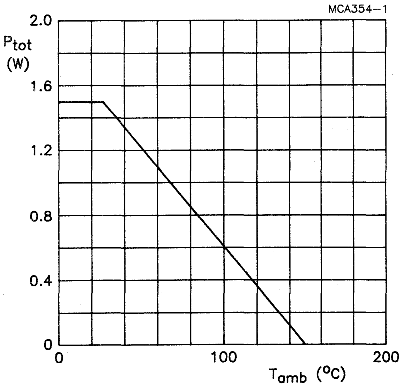


Fig.4 Power derating curve.

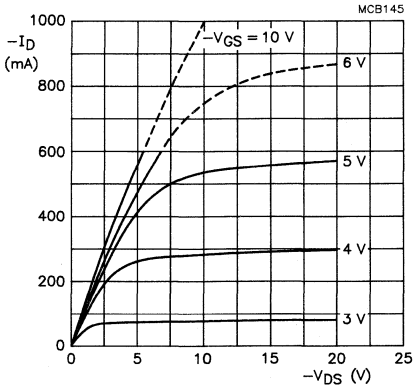


Fig.5 Typical output characteristics; T_j = 25 °C.

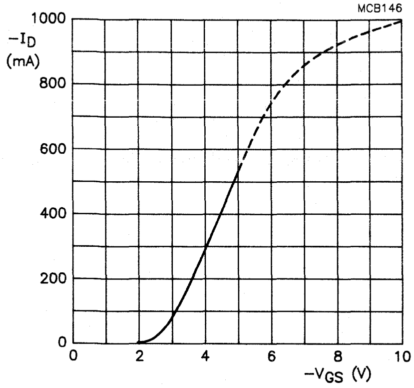


Fig.6 Typical transfer characteristic; $-V_{DS}$ = 10 V; T_j = 25 °C.

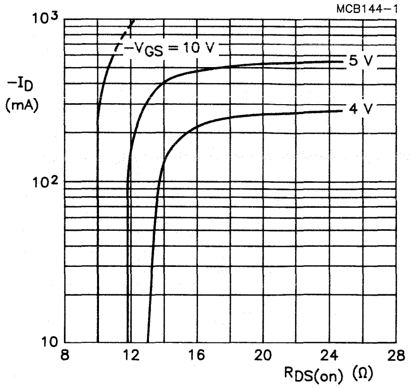


Fig.7 Typical on-resistance as a function of drain current; T_j = 25 °C.

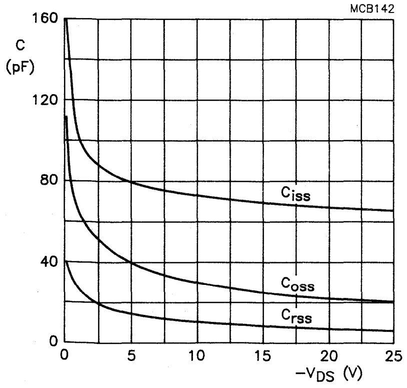


Fig.8 Typical capacitances as a function of drain-source voltage; V_{GS} = 0; f = 1 MHz; T_j = 25 °C.

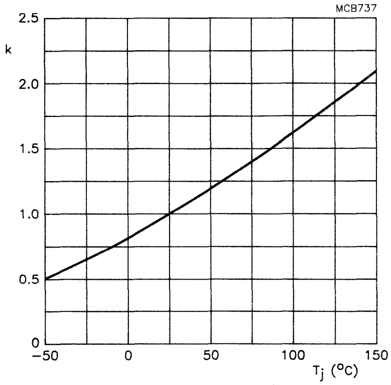


Fig.9 Temperature coefficent of drain-source on-resistance; $k = \frac{R_{DS(on)}\ at\ T_j}{R_{DS(on)}\ at\ 25\ °C}$; typical $R_{DS(on)}$ at −200 mA/−10 V.

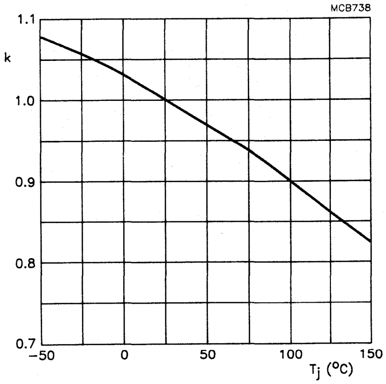


Fig.10 Temperature coefficient of gate-source threshold voltage; $k = \frac{V_{GS(th)} \text{ at } T_j}{V_{GS(th)} \text{ at } 25\ °C}$; typical $-V_{GS(th)}$ at −1 mA.

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

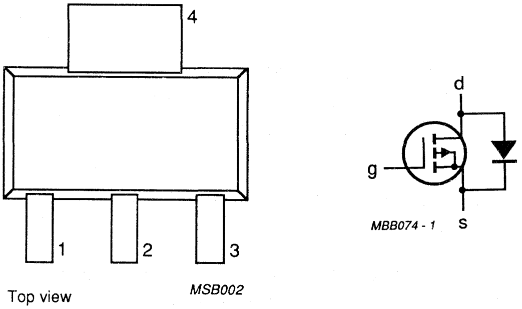


Fig.1 Simplified outline and symbol.

P-channel enhancement mode vertical D-MOS transistor

BSP225

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	$-I_D = 10\ \mu A$ $V_{GS} = 0$	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

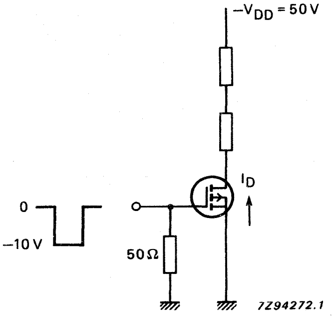


Fig.2 Switching time test circuit.

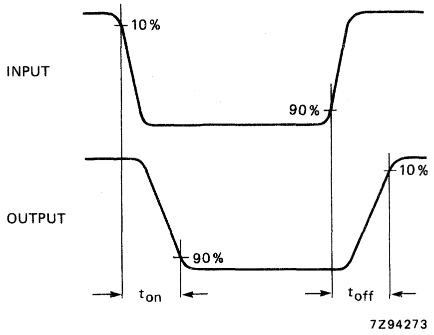


Fig.3 Input and output waveforms.

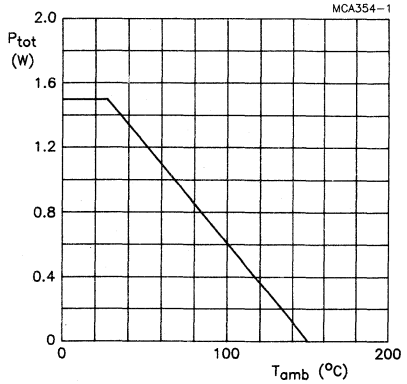


Fig.4 Power derating curve.

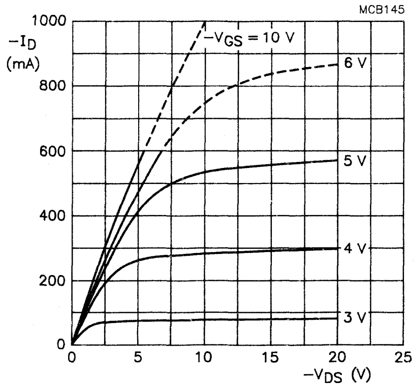


Fig.5 Typical output characteristics; T_j = 25 °C.

P-channel enhancement mode vertical D-MOS transistor

BSP225

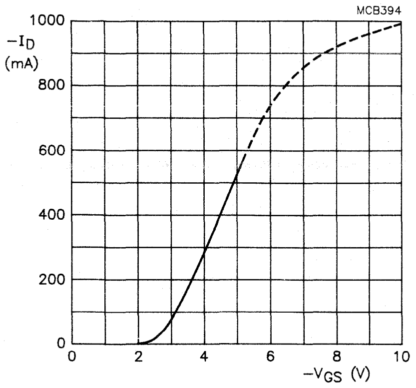


Fig.6 Typical transfer characteristic; $-V_{DS}$ = 10 V; T_j = 25 °C.

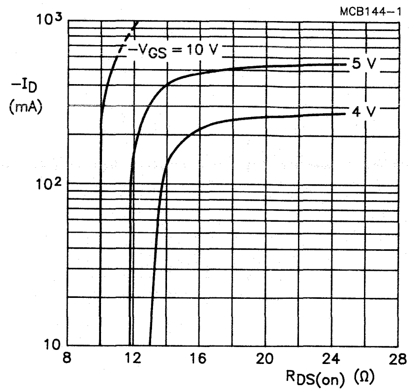


Fig.7 Typical on-resistance as a function of drain current; T_j = 25 °C; $R_{DS(on)} = f(I_D)$.

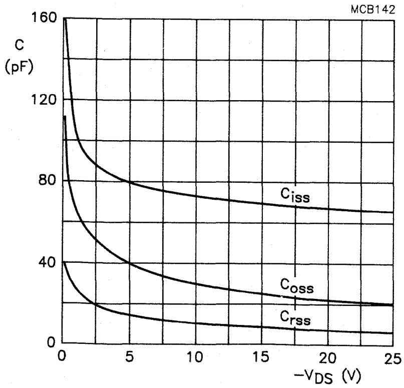


Fig.8 Typical capacitances as a function of drain-source voltage; V_{GS} = 0; f = 1 MHz; T_j = 25 °C.

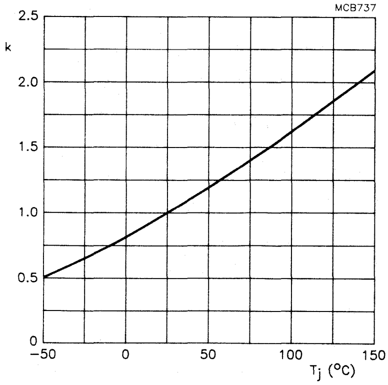


Fig.9 Temperature coefficient of drain-source on-resistance; $k = \frac{R_{DS(on)}\ at\ T_j}{R_{DS(on)}\ at\ 25\ °C}$; typical $R_{DS(on)}$ at −200 mA/−10 V.

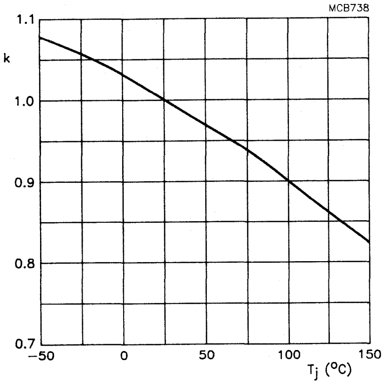


Fig.10 Temperature coefficient of gate-source threshold voltage; $k = \frac{-V_{GS(th)}\ at\ T_j}{-V_{GS(th)}\ at\ 25\ °C}$; typical $V_{GS(th)}$ at −1 mA.

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

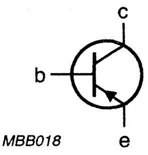
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	15	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	15	V
Collector current (peak value)	$-I_{CM}$	max.	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	mW
Junction temperature	T_j	max.	150	°C
D.C. current gain				
$-I_C$ = 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

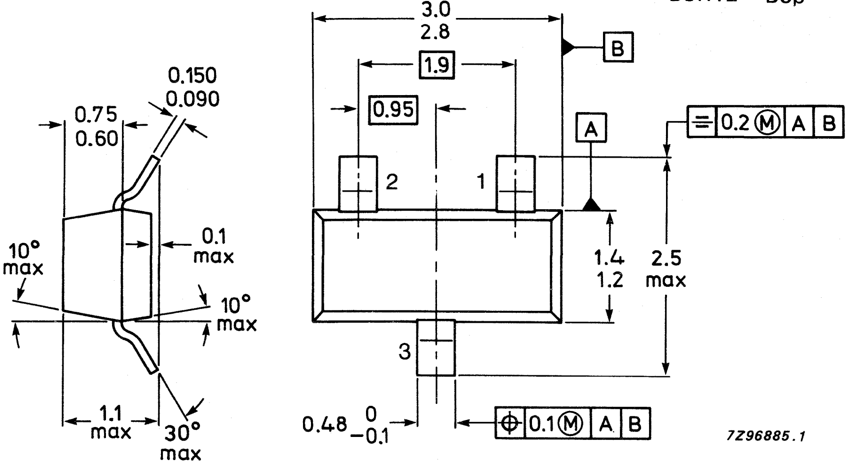
MECHANICAL DATA Dimensions in mm **Marking code**

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

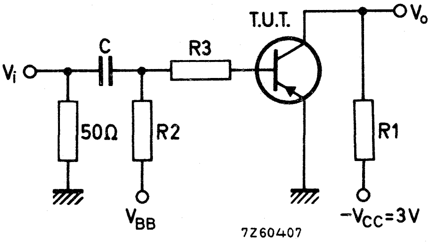


Fig. 2 Test circuit switching times.

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

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

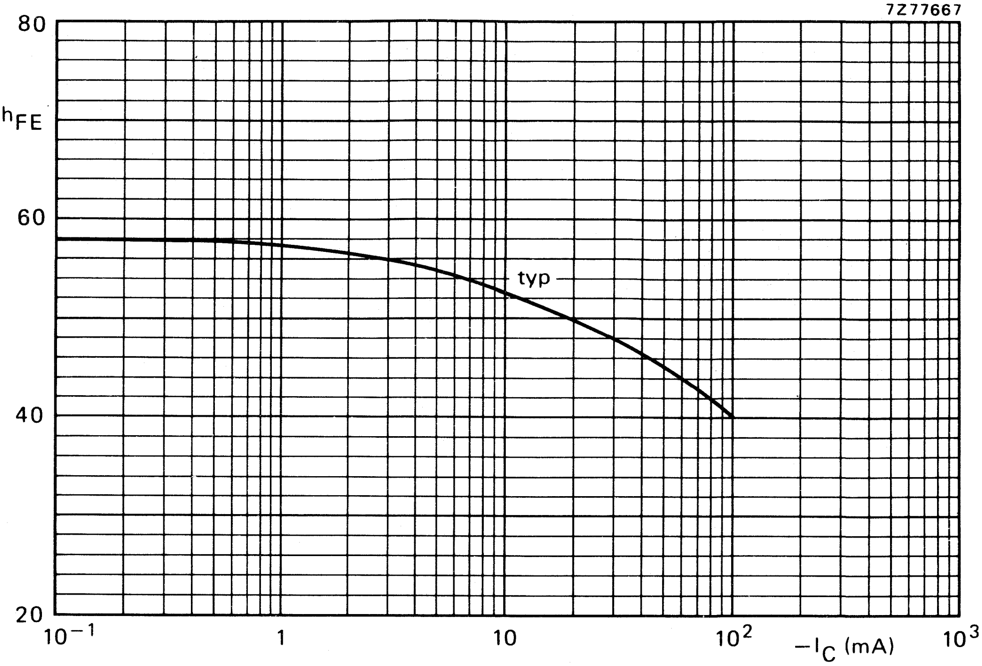


Fig. 3 $-V_{CE}$ = 1 V; T_{amb} = 25 °C.

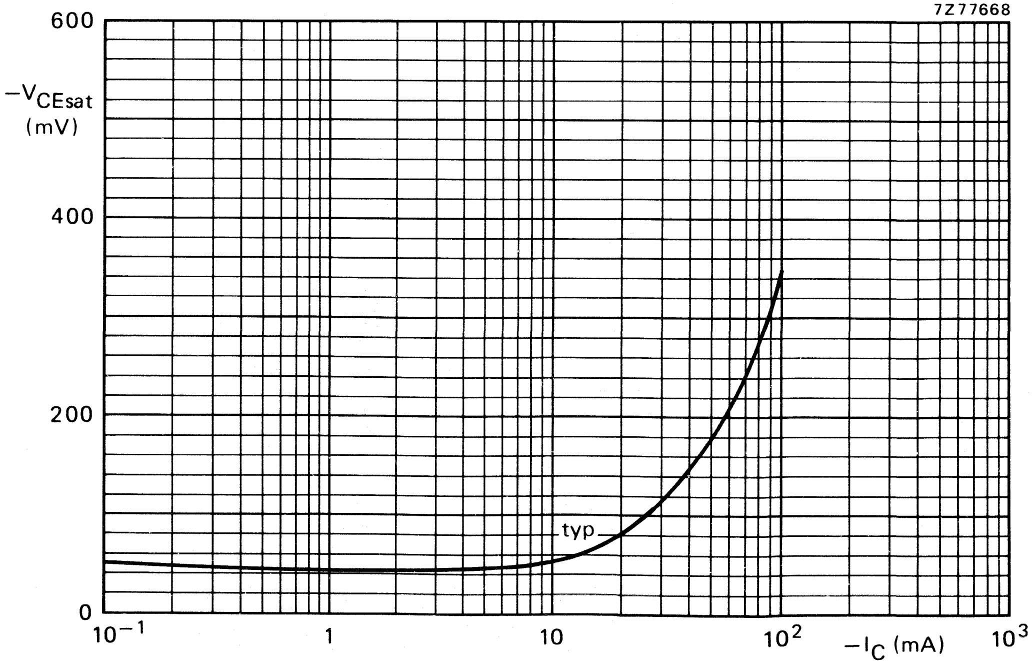


Fig. 4 V_{CEsat} as a function of I_C at I_C/I_B = 10.

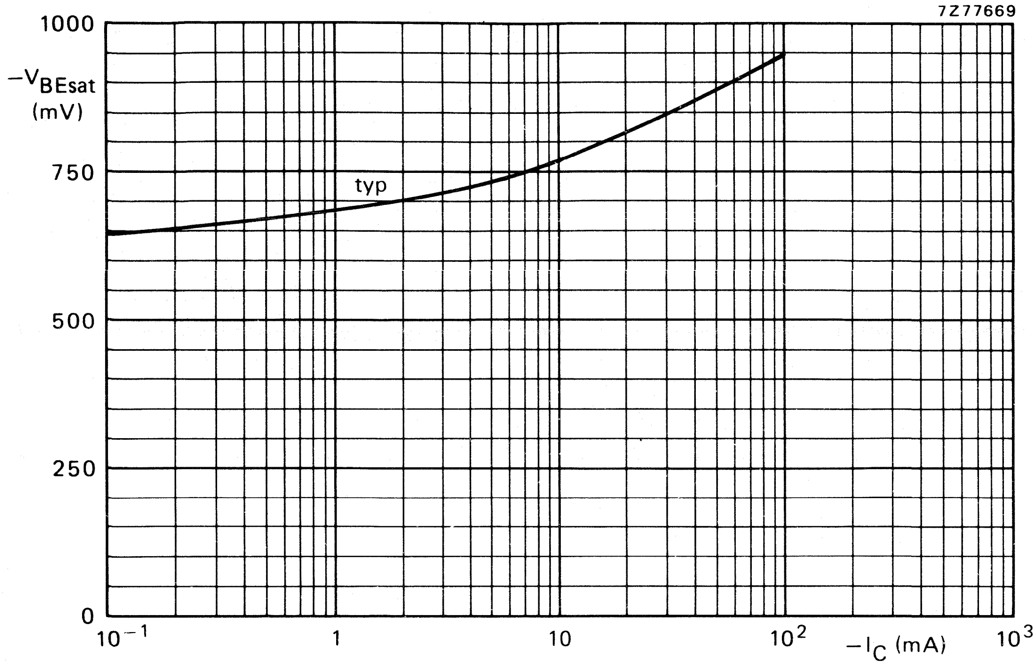


Fig. 5 V_{BEsat} as a function of I_C at $I_C/I_B = 10$.

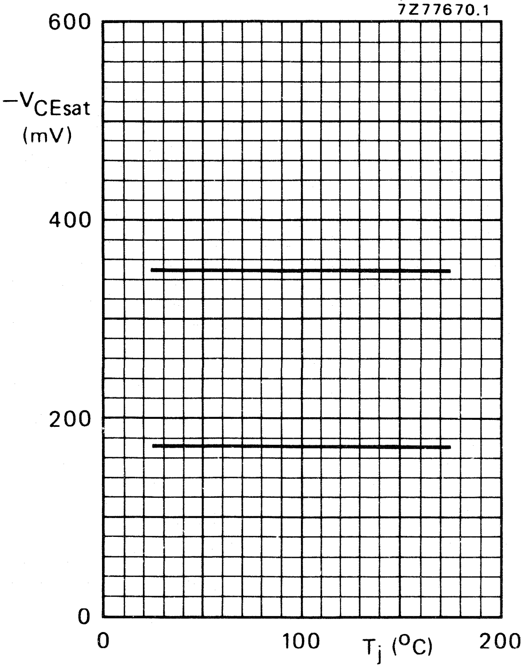


Fig. 6 V_{CEsat} as a function of T_j; typical values.
Upper graph at I_C = 100 mA; I_B = 10 mA. Lower graph at I_C = 50 mA and I_B = 5 mA.

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

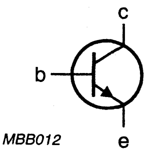
Marking code

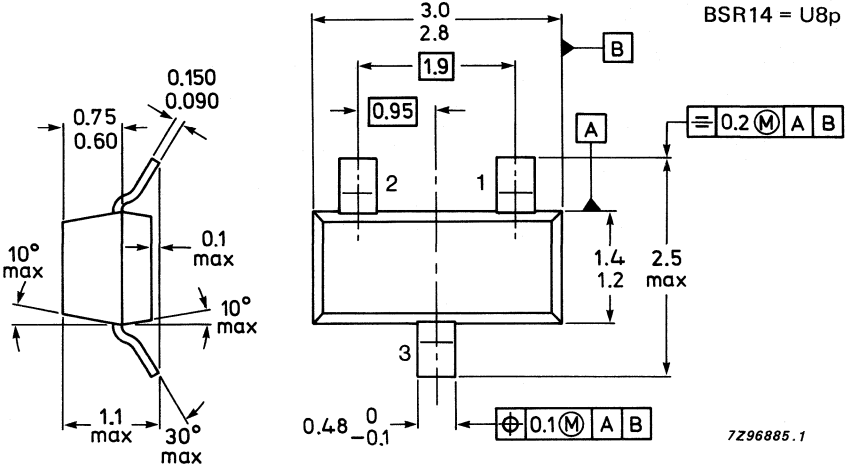
BSR13 = U7p
BSR14 = U8p

Fig. 1 SOT-23.

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)

			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

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

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

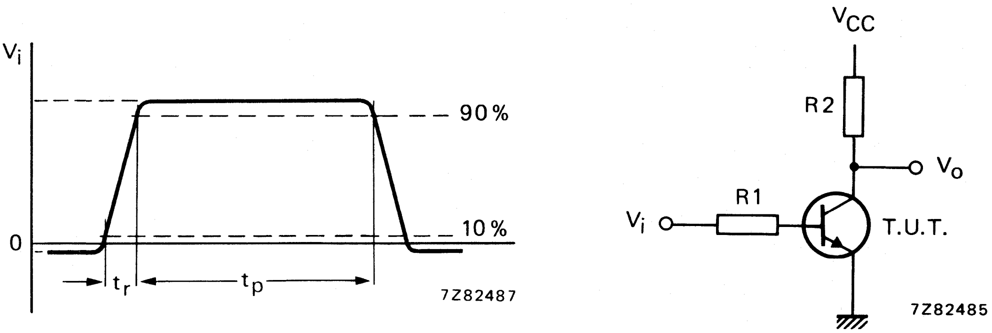


Fig. 2 Waveform and test circuit delay and rise time.
$V_i = -0{,}5$ to $+9{,}9$ V; $V_{CC} = 30$ V; R1 = 619 Ω; R2 = 200 Ω.

Pulse generator:			
pulse duration	t_p	$\leqslant$	200 ns
rise time	t_r	$\leqslant$	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

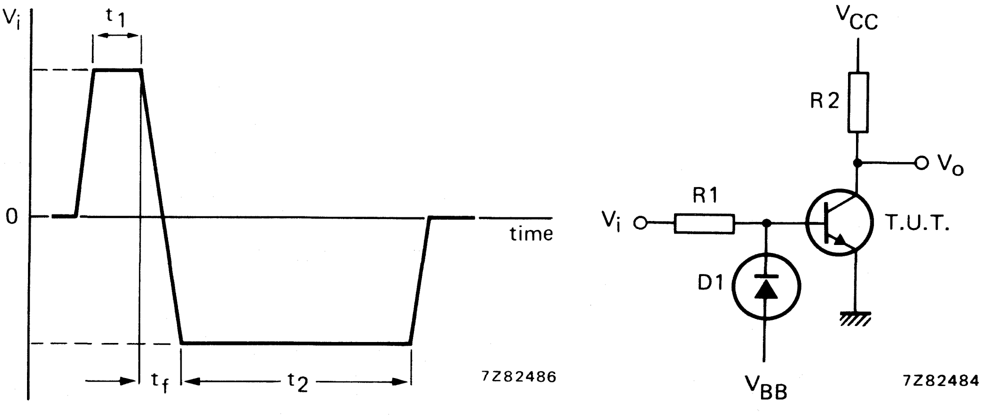


Fig. 3 Waveform and test circuit storage and fall time.
$V_i = -13{,}8$ to $+16{,}2$ V; $V_{CC} = 30$ V; $-V_{BB} = 3$ V; R1 = 1 kΩ; R2 = 200 Ω.

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 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

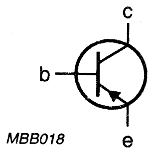
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-23.

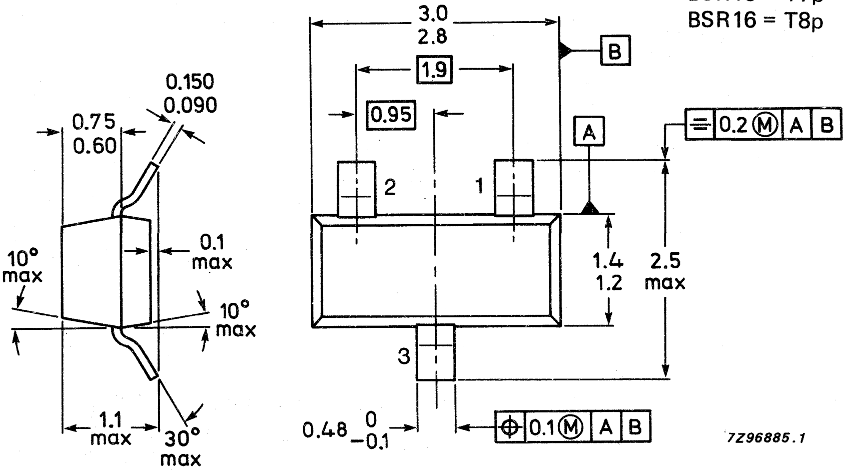
Pinning:

1 = base
2 = emitter
3 = collector



Marking code

BSR15 = T7p
BSR16 = T8p



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

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* 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

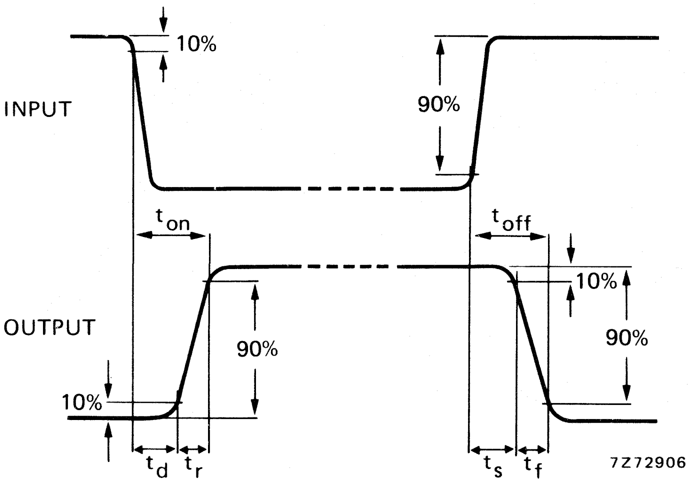

Fig. 2 Switching time waveforms.

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

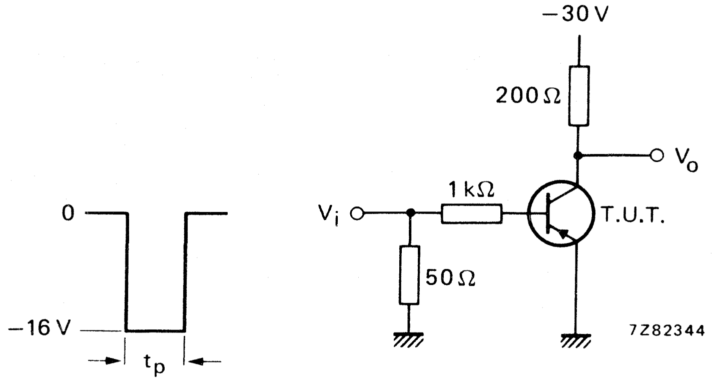


Fig. 3 Turn-on switching time test circuit.

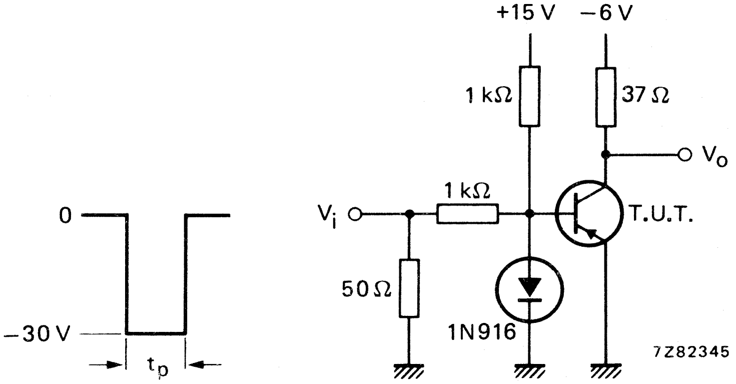


Fig. 4 Turn-off switching time test circuit.

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

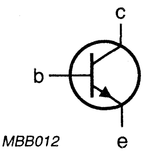
Marking code

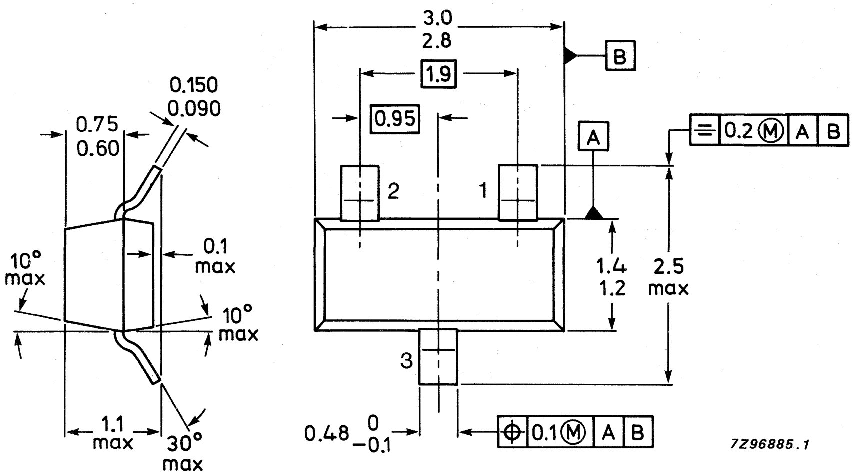
BSR17A = U92

Fig.1 SOT-23.

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

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* 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}	> <	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

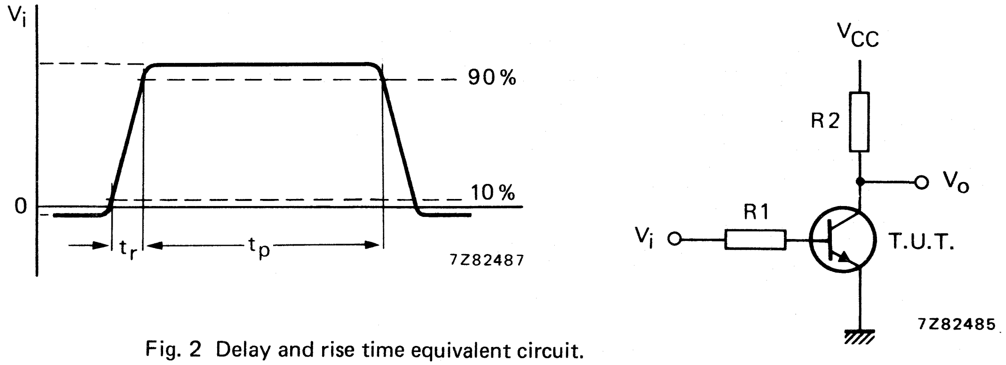


Fig. 2 Delay and rise time equivalent circuit.

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 = $C_s \leqslant 4$ pF.
Pulse generator: pulse duration 300 ns; fall time < 1 ns; duty factor 2%.

Turn off time switched from
$I_C = 10\ \mathrm{mA}$; $I_{Bon} = -I_{Boff} = 1\ \mathrm{mA}$

storage time	t_s	$<$	200	ns
fall time	t_f	$<$	50	ns

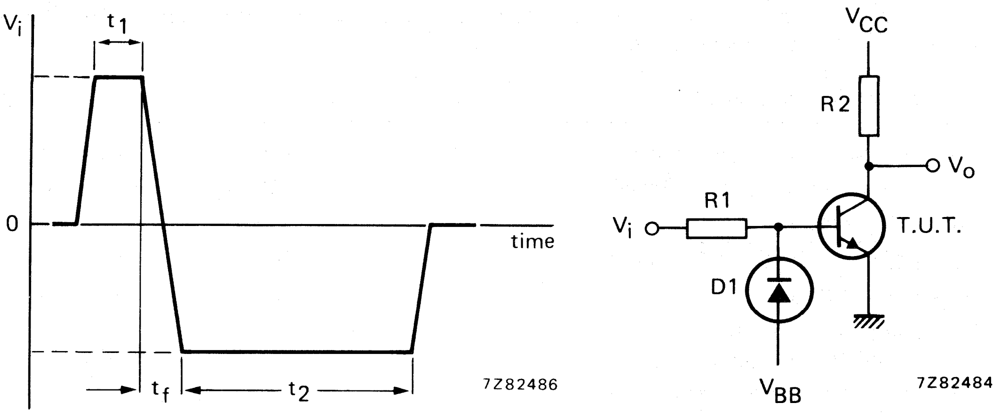


Fig. 3 Storage and fall time equivalent test circuit.

$V_i = -9{,}1$ to $+10{,}9\ \mathrm{V}$; $V_{CC} = 3\ \mathrm{V}$; $V_{BB} = 0\ \mathrm{V}$ (ground); $R1 = 10\ \mathrm{k\Omega}$; $R2 = 275\ \Omega$;
total shunt capacitance of test jig and connectors = $C_s \leqslant 4\ \mathrm{pF}$.
Pulse generator: pulse duration $t_1 = 10$ to $500\ \mu\mathrm{s}$; fall time $t_f < 1\ \mathrm{ns}$; duty factor $\delta = 2\%$.

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

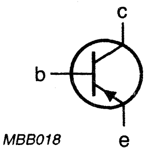
Fig.1 SOT-23.

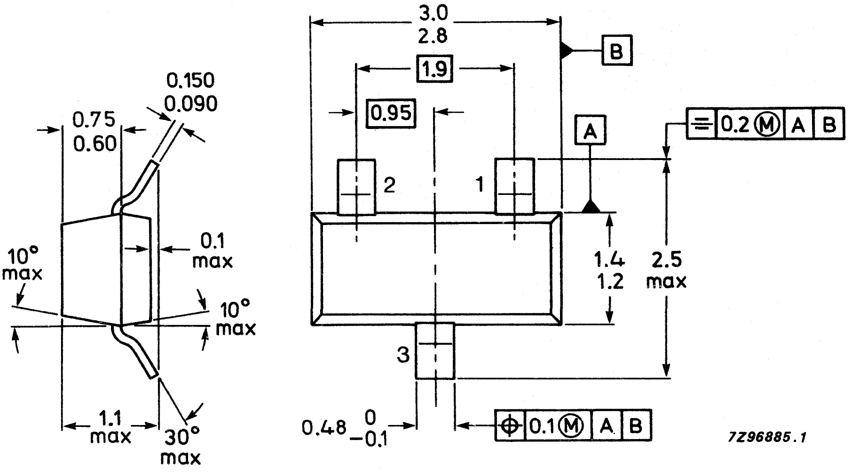
Marking code

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

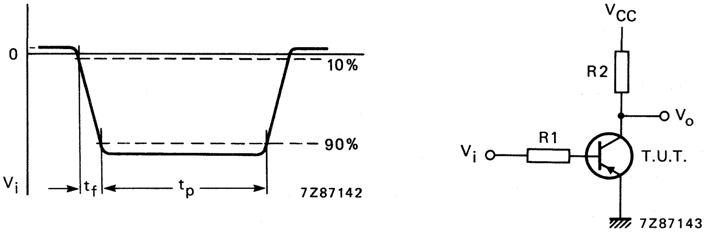


Fig. 2 Waveform and test circuit delay and rise time.
$V_i = +0{,}5$ to $-10{,}6$ V; $-V_{CC} = 3$ V; R1 = 10 kΩ; R2 = 275 Ω.
Total shunt capacitance of test jig and connectors = $C_s \leqslant 4$ pF.
Pulse generator: pulse duration 300 ns; fall time < 1 ns; duty factor 2%.

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

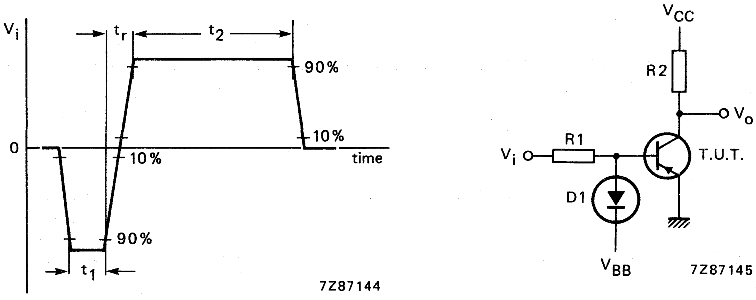


Fig. 3 Waveform and test circuit fall and storage time.
$V_i = -9{,}1$ to $+10{,}9$ V; $V_{CC} = 3$ V; $V_{BB} = 0$ V (ground); R1 = 10 kΩ; R2 = 275 Ω; D1 = 1N916.

Total shunt capacitance of test jig and connectors = $C_s \leqslant 4$ 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	

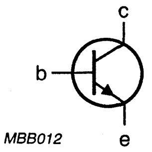
MECHANICAL DATA

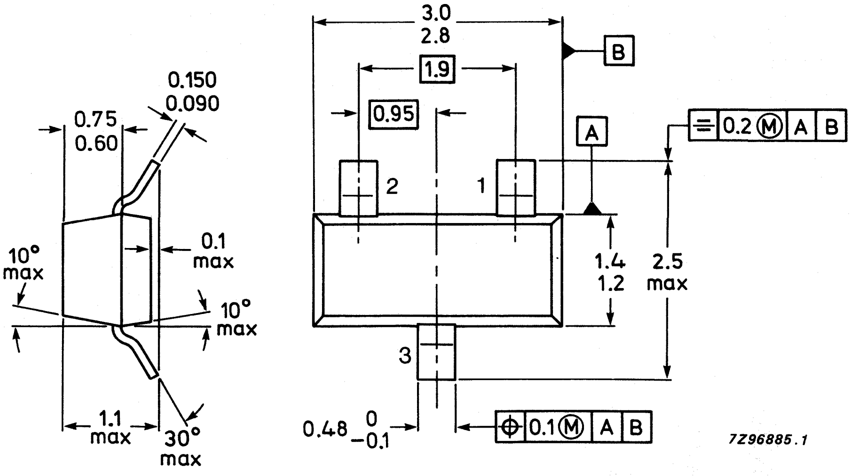
Dimensions in mm

Fig. 1 SOT-23.

Marking code
BSR19 = U35
BSR19A = U36

Pinning:
1 = base
2 = emitter
3 = collector





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

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* 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 kΩ I_C = 250 μA; 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

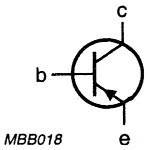
Fig. 1 SOT-23.

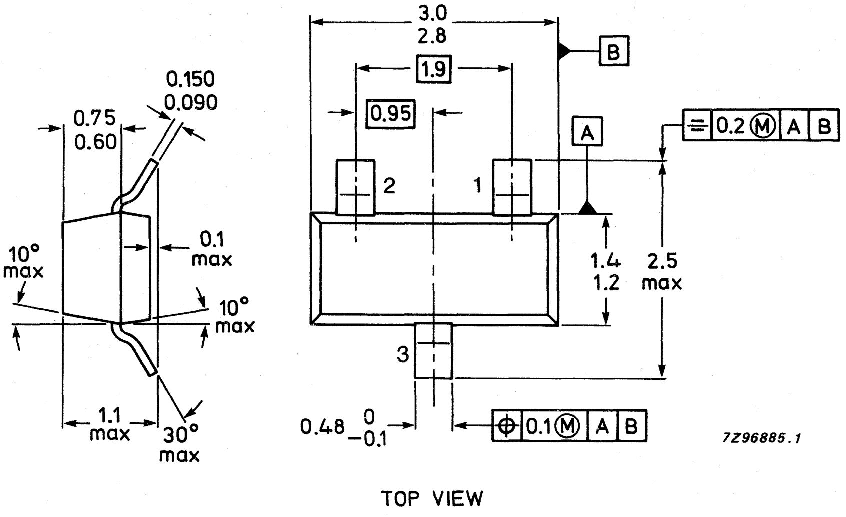
Marking code

BSR20 = T35
BSR20A = T36

Pinning:

1 = base
2 = emitter
3 = collector





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

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* 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	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

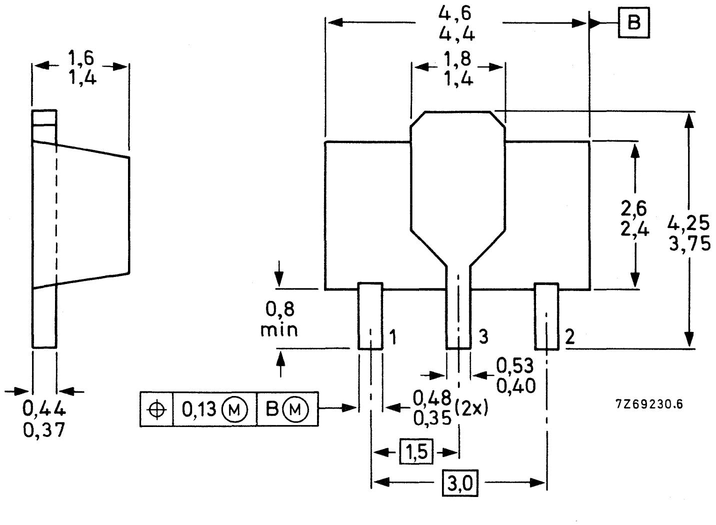
MECHANICAL DATA

Dimensions in mm

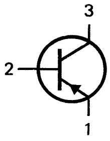
Fig. 1 SOT-89.

Marking code

BSR30 = BR1
BSR31 = BR2
BSR32 = BR3
BSR33 = BR4



BOTTOM VIEW



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 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 mm	$R_{th\ j\text{-}a}$	=	125	K/W

CHARACTERISTICS

$T_{amb} = 25\ ^{\circ}C$ unless otherwise specified

Collector cut-off current

$I_E = 0$; $-V_{CB} = 60$ V	$-I_{CBO}$	$<$	100	nA
$I_E = 0$; $-V_{CB} = 60$ V; $T_j = 150\ ^{\circ}C$	$-I_{CBO}$	$<$	50	μA

Breakdown voltages			BSR30	BSR31	BSR32	BSR33	
$I_B = 0$; $-I_C = 10$ 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.

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

CHARACTERISTICS (continued)

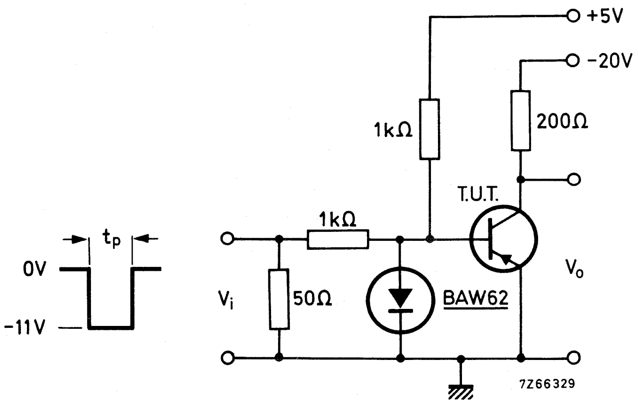
$T_{amb} = 25\ ^{o}C$

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	$t_p = 10\ \mu s$
Rise time	$t_r \leqslant 15$ ns
Fall time	$t_f \leqslant 15$ ns
Source impedance	$Z_S = 50\ \Omega$

Oscilloscope:

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

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.

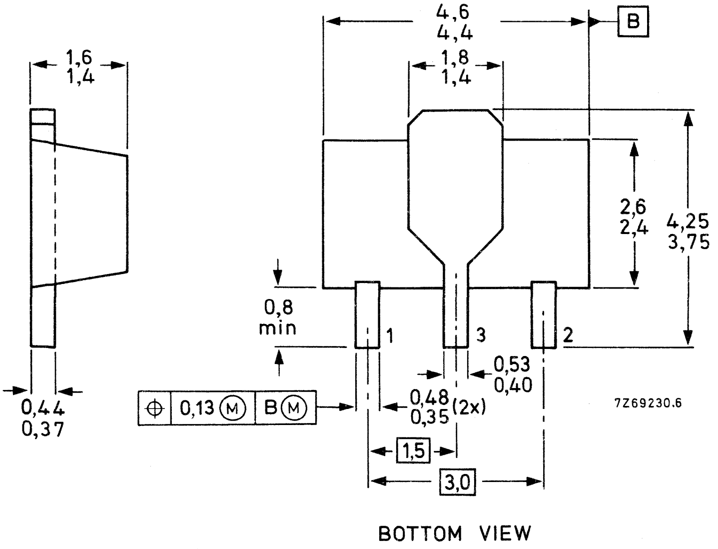
QUICK REFERENCE DATA

			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	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

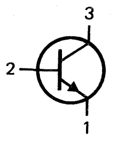
Dimensions in mm

Fig. 1 SOT-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

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

			BSR40	BSR41	BSR42	BSR43	
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.

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

CHARACTERISTICS (continued)

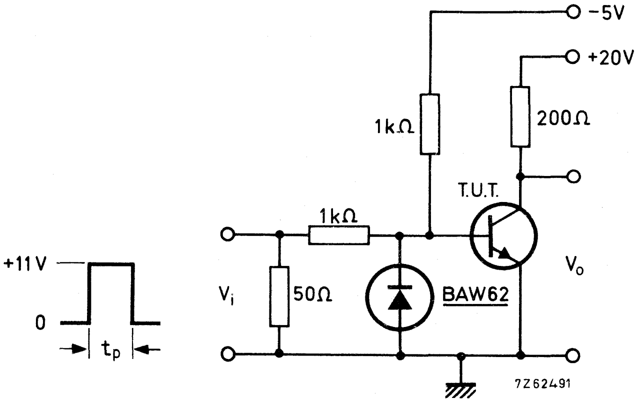
$T_{amb} = 25\ ^{o}C$

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

Test circuit



Pulse generator:

Pulse duration	$t_p = 10\ \mu s$
Rise time	$t_r \leqslant 15$ ns
Fall time	$t_f \leqslant 15$ ns
Source impedance	$Z_S = 50\ \Omega$

Oscilloscope:

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

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.

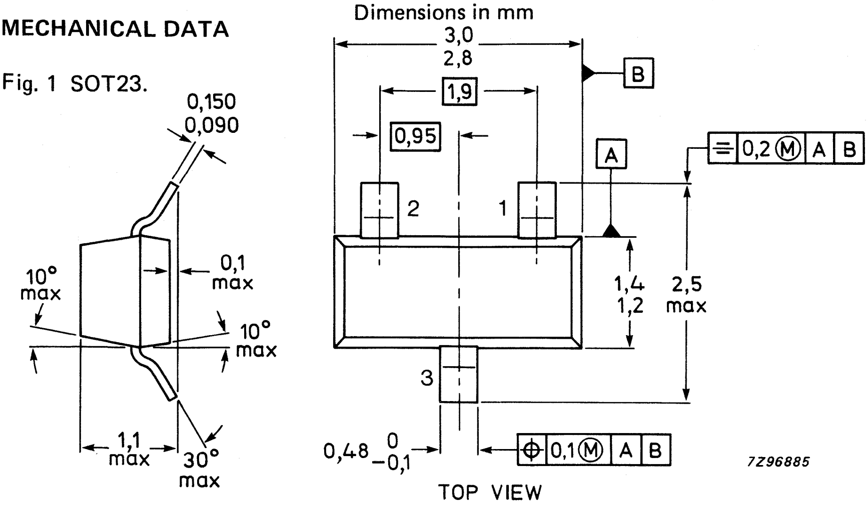
QUICK REFERENCE DATA

			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

Fig. 1 SOT23.

Dimensions in mm



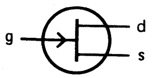
TOP VIEW

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 $T_{amb} = 40\ ^{o}C$ (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

$T_j = 25\ ^{o}C$ 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 $-I_G = 1\ \mu A$; $V_{DS} = 0$	$-V_{(BR)GSS}$	$>$	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 $I_D = 0$; $V_{GS} = 0$; $T_a = 25\ ^{o}C$	$r_{ds\ on}$	$<$	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
$V_{DD} = 10$ V; $V_{GS} = 0$

			BSR56	BSR57	BSR58	
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

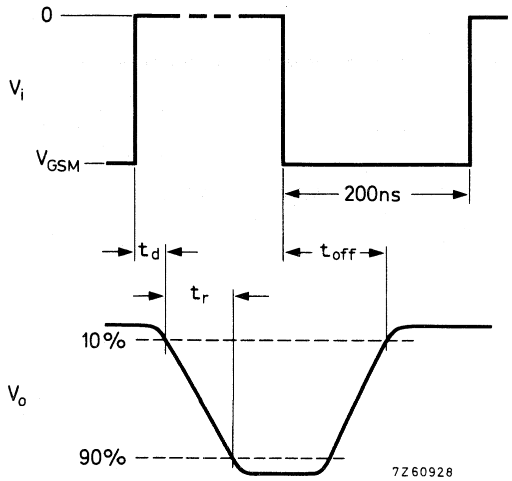


Fig. 2 Switching times waveforms.

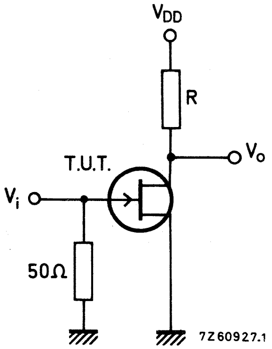


Fig. 3 Test circuit.

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

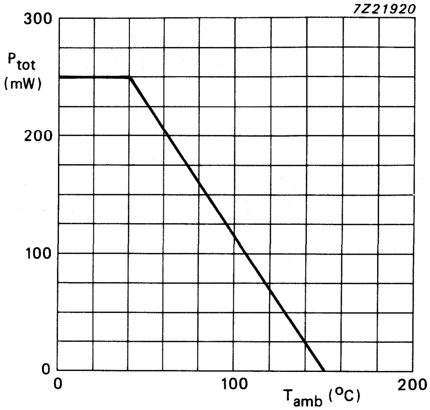


Fig.4 Power derating curve.

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 85	MHz MHz

MECHANICAL DATA

Dimensions in mm

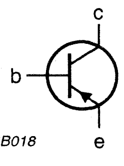
Marking code

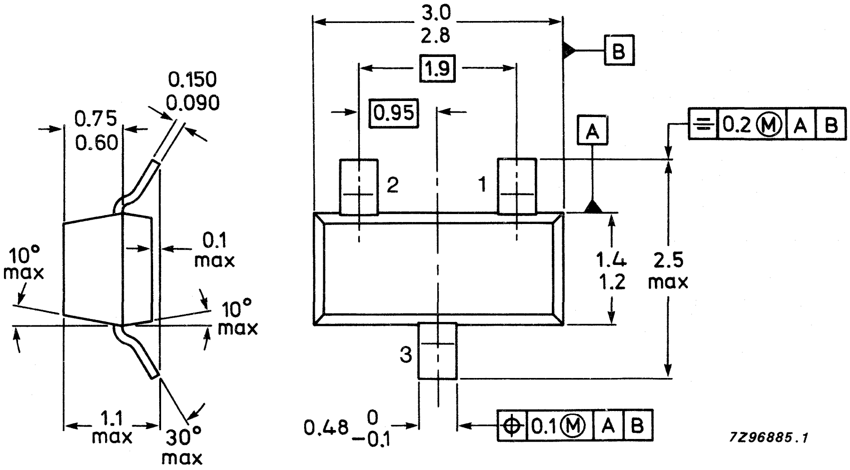
BSS63 = BMp

Fig. 1 SOT-23.

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) $-I_C = 10\ \mu A$	$-V_{CBO}$	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	°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 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

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

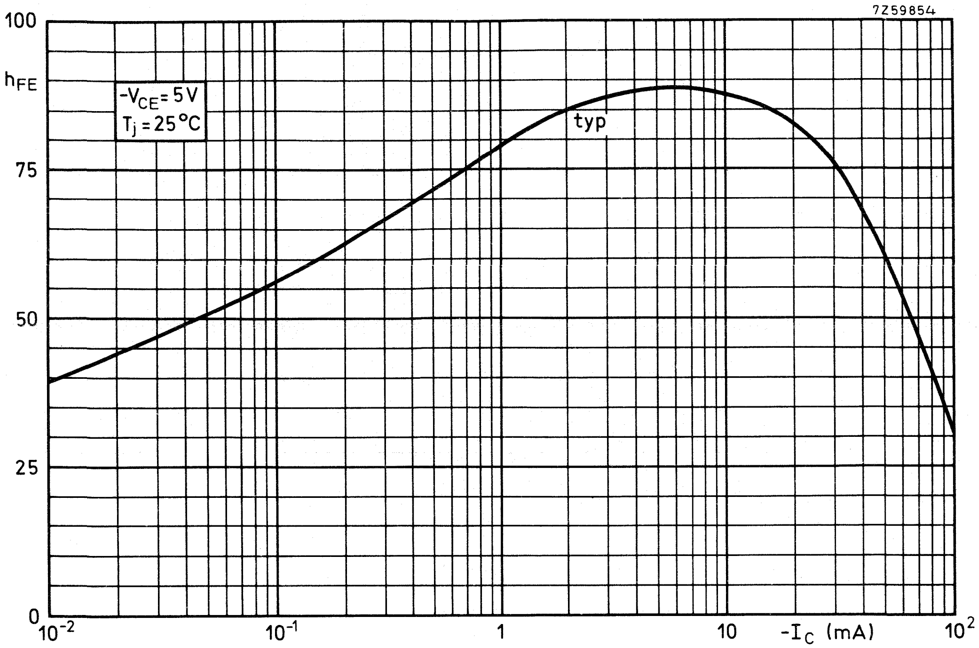

7Z59854
100
h_{FE}
75
50
25
0
$-V_{CE} = 5$ V
$T_j = 25$ °C
typ
10^{-2}
10^{-1}
1
10
$-I_C$ (mA)
10^2

Fig. 2.

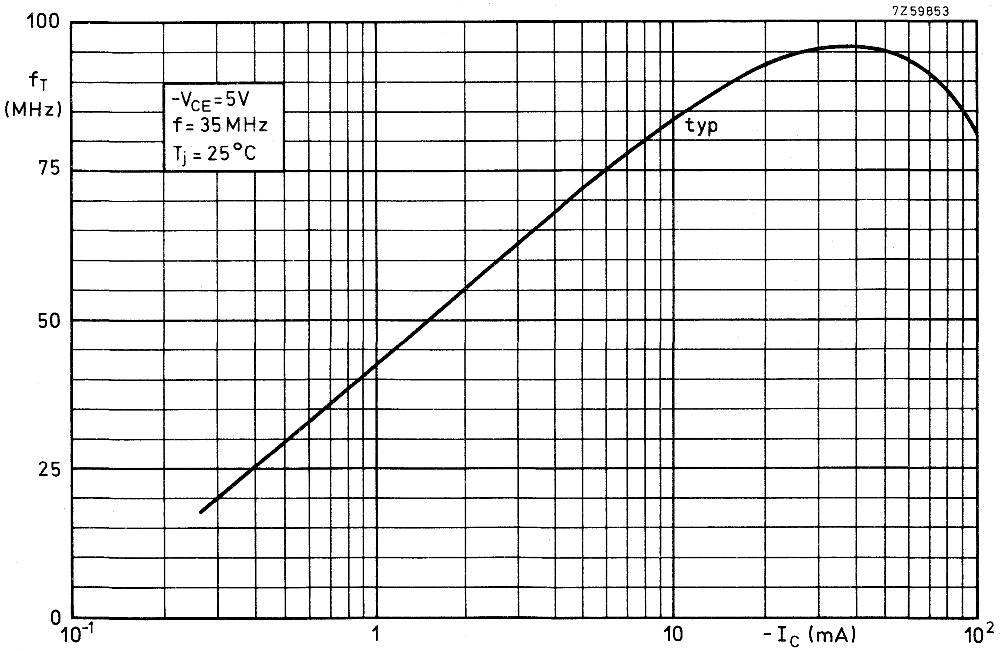

7Z59853
100
f_T
(MHz)
75
50
25
0
$-V_{CE} = 5$ V
f = 35 MHz
$T_j = 25$ °C
typ
10^{-1}
1
10
$-I_C$ (mA)
10^2

Fig. 3.

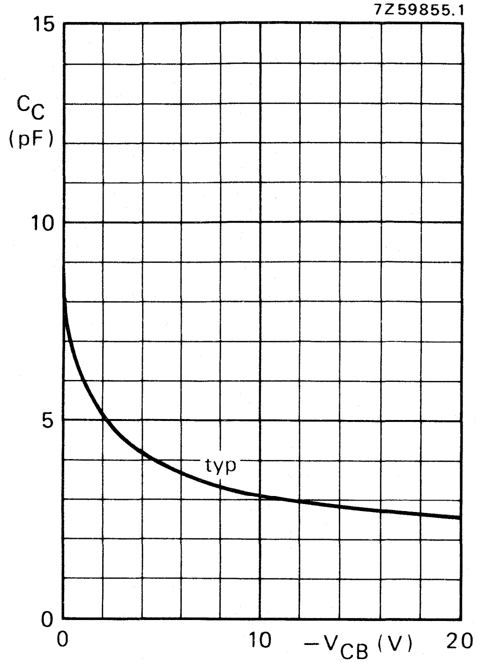


Fig. 4 Typical values collector capacitance as a function of collector-base voltage.
$I_E = I_e = 0$; $T_j = 25\ ^{\circ}C$; f = 1 MHz.

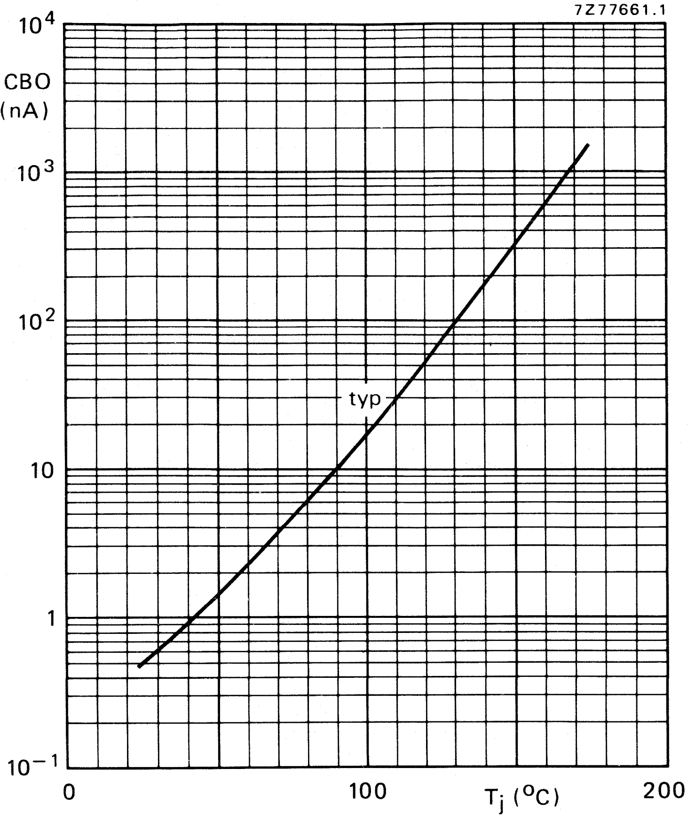


Fig. 5 Typical values collector-base currents as a function of the junction temperature at a collector-base voltage of 90 V.

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

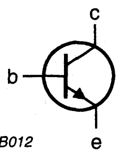
Marking code

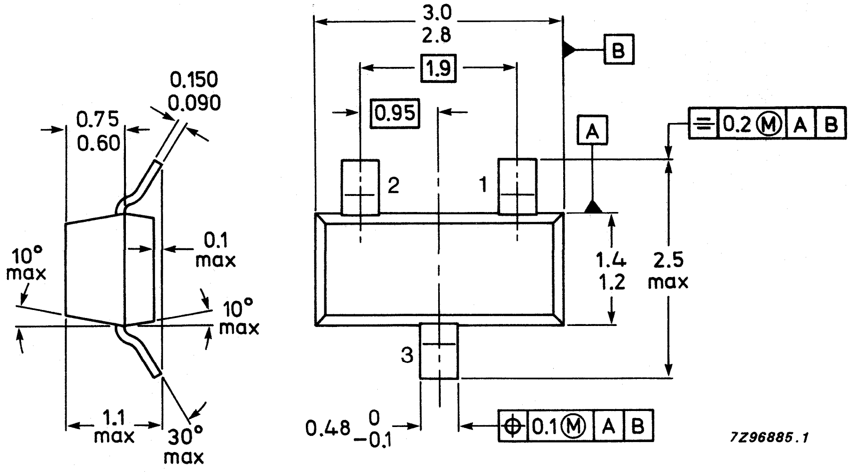
BSS64 = AMp

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) $I_C = 100\ \mu A$	V_{CBO}	max.	120	V
Collector-emitter voltage (open base) $I_C = 4$ mA	V_{CEO}	max.	80	V
Emitter-base voltage (open collector) $I_E = 100\ \mu A$	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 $T_{amb} = 25\ ^oC$	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 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 $I_C = 0;\ V_{EB} = 5$ V	I_{EBO}	typ. <	0,5 200	nA nA
Saturation voltages $I_C = 4$ mA; $I_B = 400\ \mu A$	V_{CEsat} V_{BEsat}	< <	150 1200	mV 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}	> typ.	20 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	> typ.	60 MHz 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

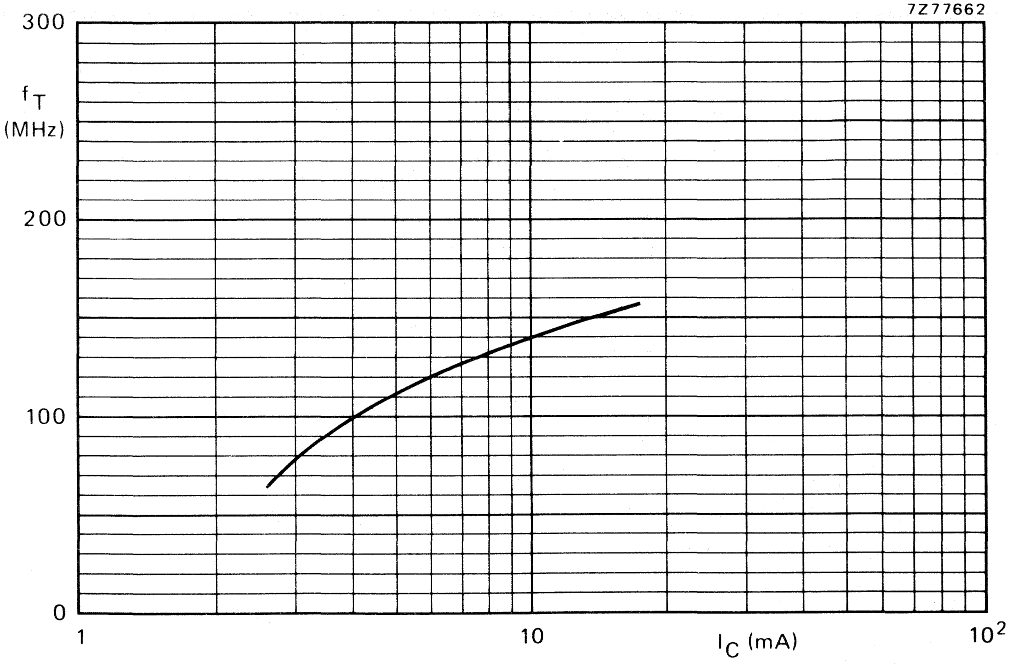


Fig. 2 Typical values transition frequency. V_{CE} = 10 V; f = 35 MHz; T_j = 25 °C.

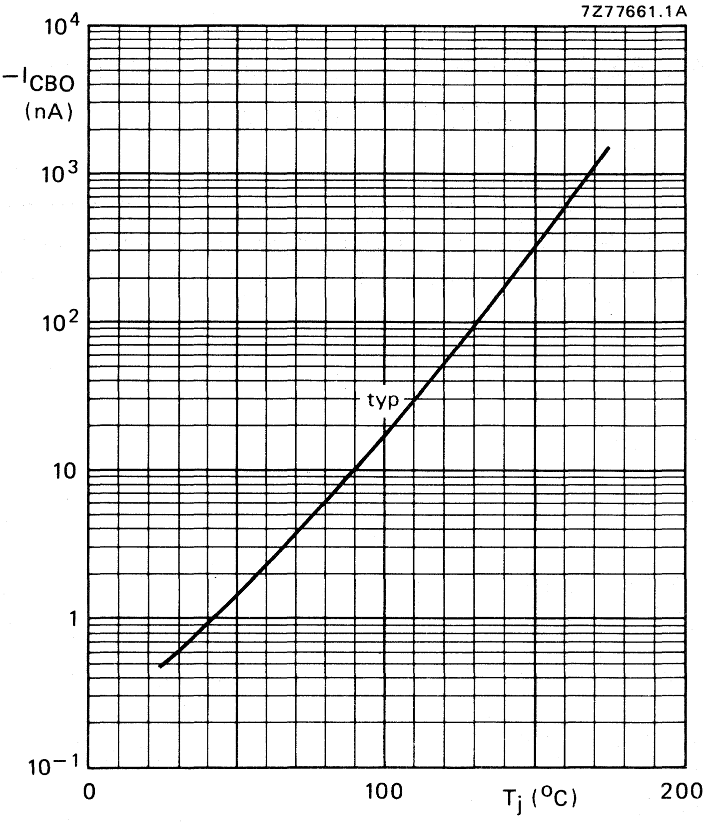


Fig. 3 Typical values collector-base current as a function of the junction temperature at a collector-base voltage of −90 V.

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 $T_{amb} = 25\ ^oC$	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

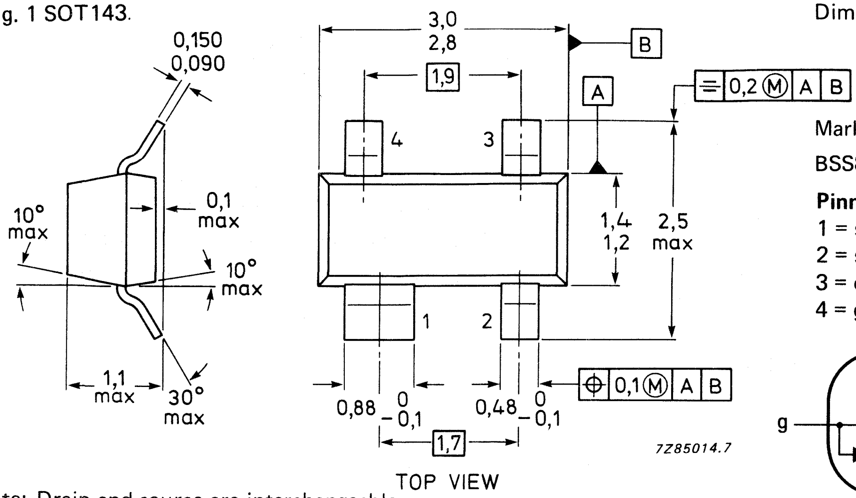
MECHANICAL DATA

SOT143 (see Fig. 1).

See also *Soldering recommendations*.

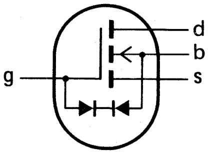
Fig. 1 SOT143.

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

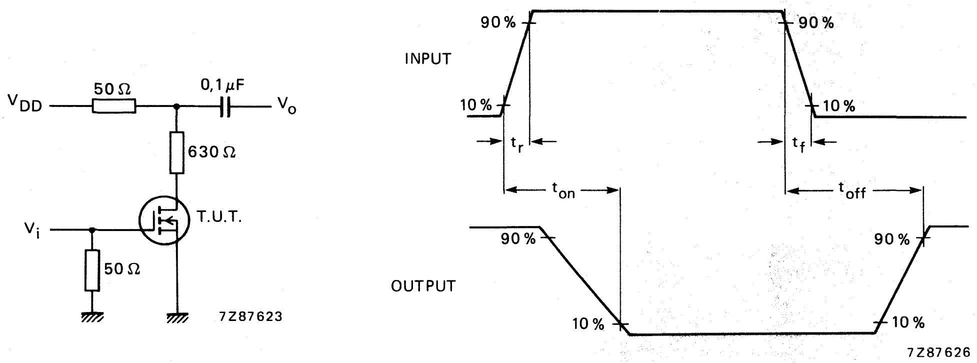


Fig. 2 Switching times test circuit and input and output waveforms.

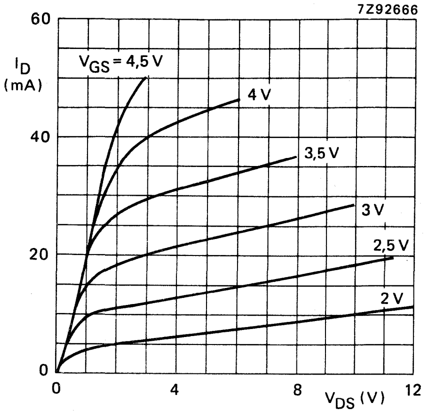


Fig. 3 V_{SB} = 0; typical values.

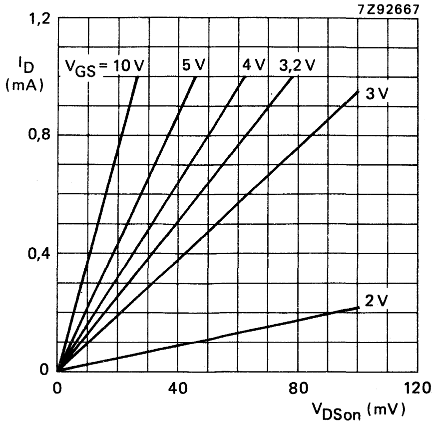


Fig. 4 V_{SB} = 6,8 V; typical values.

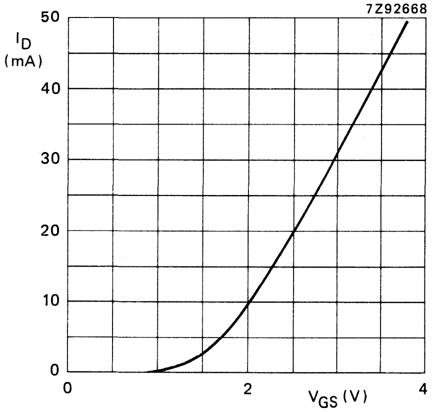


Fig. 5 V_{DS} = 10 V; V_{BS} = 0; typical values.

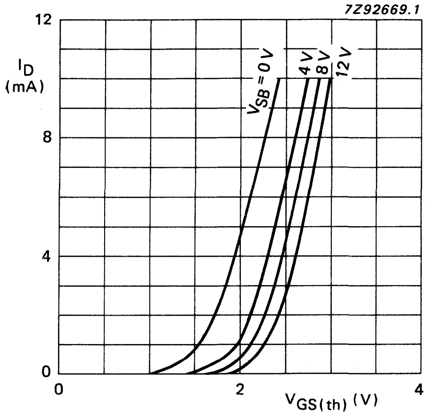


Fig. 6 $V_{DS} = V_{GS} = V_{GS(th)}$.

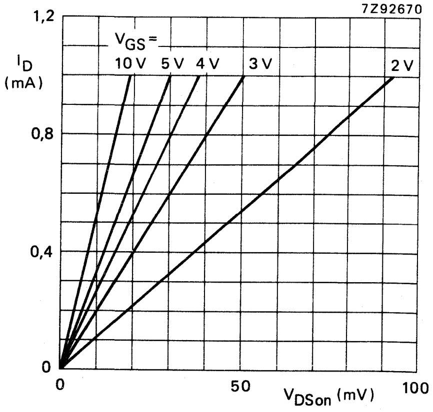


Fig. 7 V_{SB} = 0; typical values.

Conditions for Figs 3, 4, 5, 6 and 7:
T_j = 25 °C.

Philips Semiconductors

Data sheet	
status	Product specification
date of issue	July 1993

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

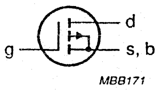


Fig.1 Symbol.

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

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

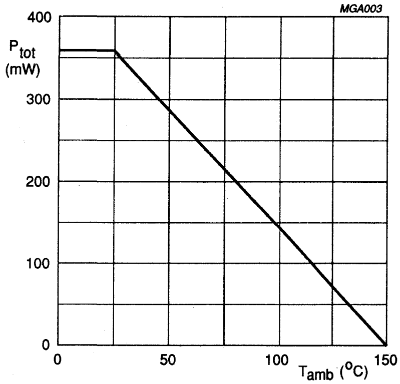


Fig.2 Total power dissipation as a function of ambient temperature.

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

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 4.5	Ω Ω
Transfer admittance I_D = 400 mA; V_{DS} = 25 V	$\lvert y_{fs}\rvert$	typ. min.	350 140	mS mS

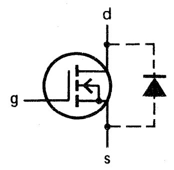
MECHANICAL DATA

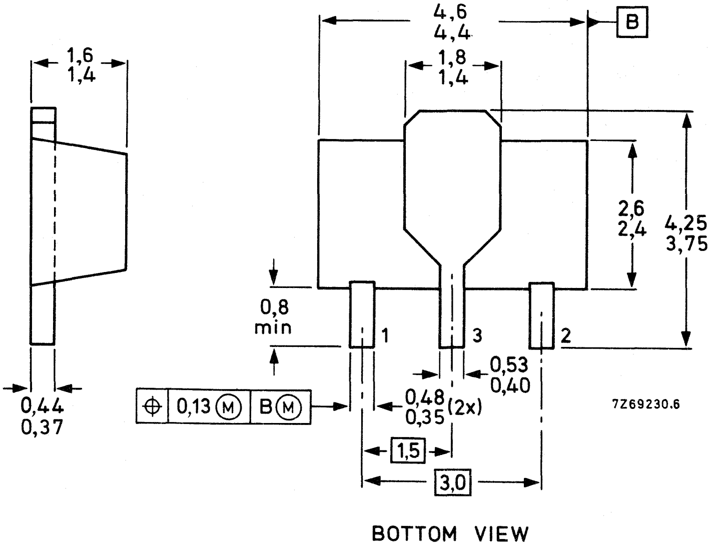
Dimensions in mm

Fig. 1 SOT89.

Pinning

1 = source
2 = gate
3 = drain





marking: KA

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

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* Transistor mounted on ceramic substrate area 2.5 cm^2, thickness 0.7 mm.

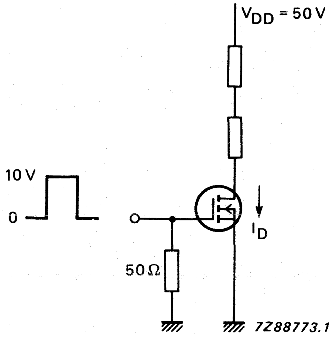


Fig. 2 Switching times test circuit.

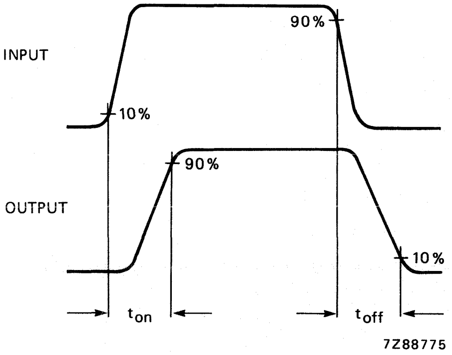


Fig. 3 Input and output waveforms.

Philips Semiconductors

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

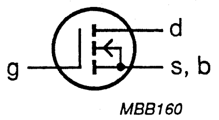


Fig.1 Symbol.

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

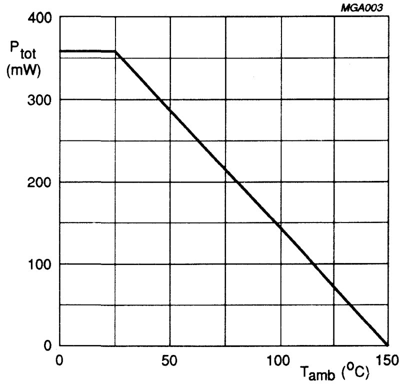


Fig.2 Total power dissipation as a function of ambient temperature.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)DSS}$	drain-source breakdown voltage	$V_{GS} = 0$ $I_D = 250\ \mu A$	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

Philips Semiconductors

Data sheet	
status	Product specification
date of issue	July 1993

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

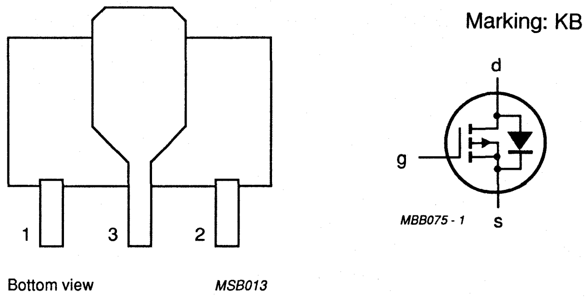


Fig.1 Simplified outline and symbol.

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
$R_{th\ j\text{-}a}$	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	$-I_D = 10\ \mu A$ $V_{GS} = 0$	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

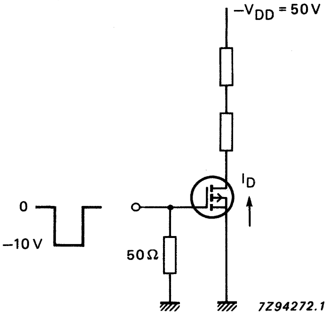


Fig.2 Switching time test circuit.

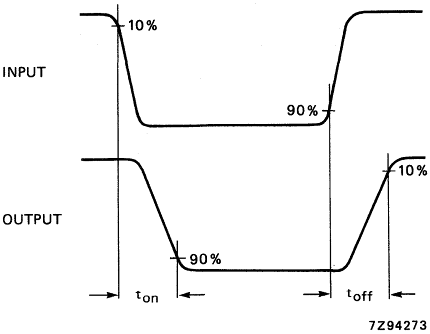


Fig.3 Input and output waveforms.

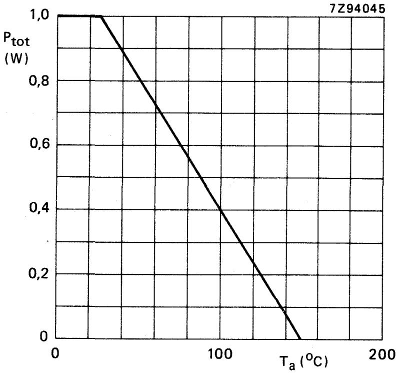


Fig.4 Power derating curve.

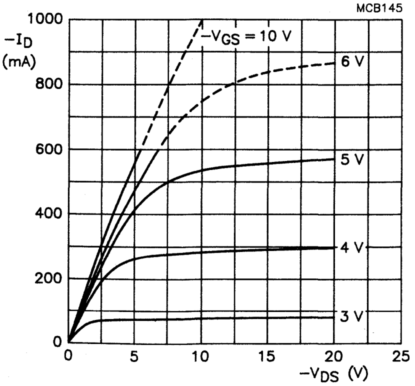


Fig.5 Typical output characteristics; $T_j = 25\ °C$.

P-channel enhancement mode vertical D-MOS transistor

BSS192

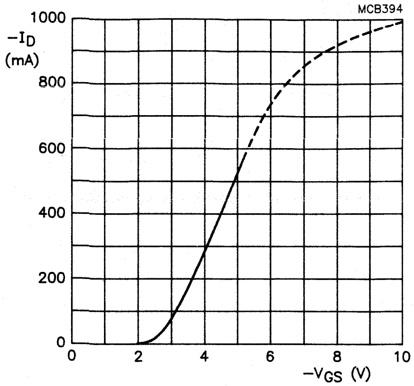


Fig.6 Typical transfer characteristic; $-V_{DS}$ = 10 V; T_j = 25 °C.

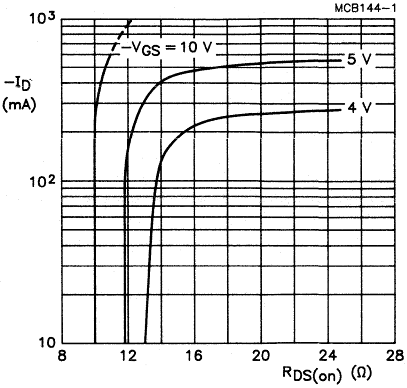


Fig.7 Typical on-resistance as a function of drain current; T_j = 25 °C.

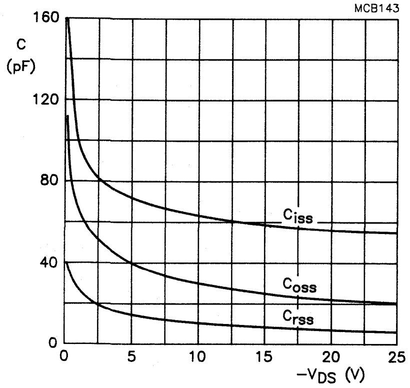


Fig.8 Typical capacitances as a function of drain-source voltage; V_{GS} = 0; f = 1 MHz; T_j = 25 °C.

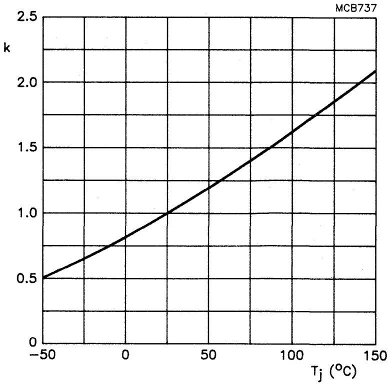


Fig.9 Temperature coefficient of drain-source on-resistance; $k = \frac{R_{DS(on)} \text{ at } T_j}{R_{DS(on)} \text{ at } 25\ °C}$; typical $R_{DS(on)}$ at −200 mA/−10 V.

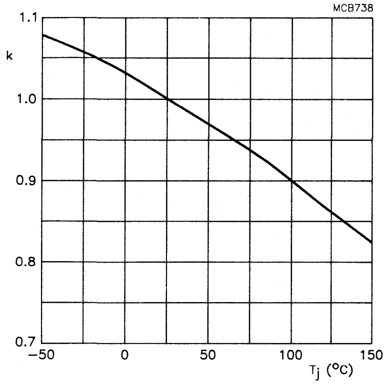


Fig.10 Temperature coefficient of gate-source threshold voltage; $k = \frac{-V_{GS(th)}\ at\ T_j}{-V_{GS(th)}\ at\ 25\ °C}$; typical $V_{GS(th)}$ at −1 mA.

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

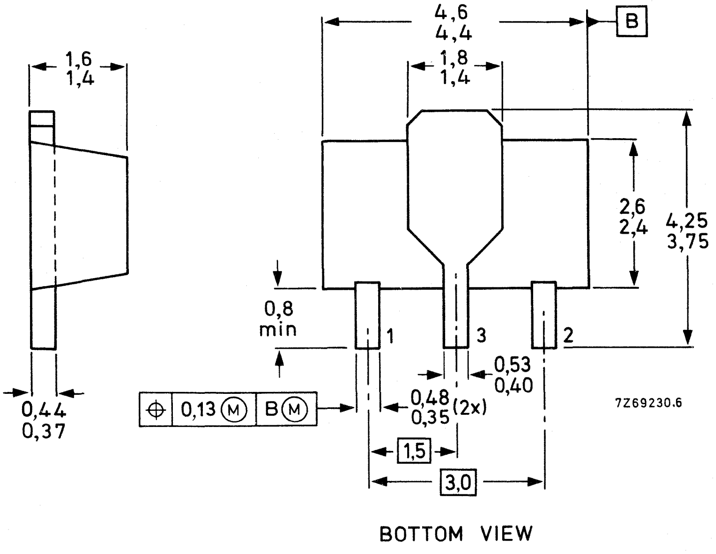
MECHANICAL DATA

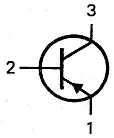
Dimensions in mm

Marking code

BST15 = BT1
BST16 = BT2

Fig. 1 SOT-89.





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

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* Mounted on an area of 2,5 cm^2 of a ceramic substrate; thickness 0,7 mm.

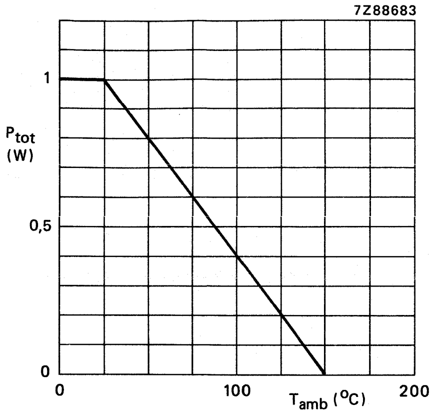


Fig. 2 Power derating curve.

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

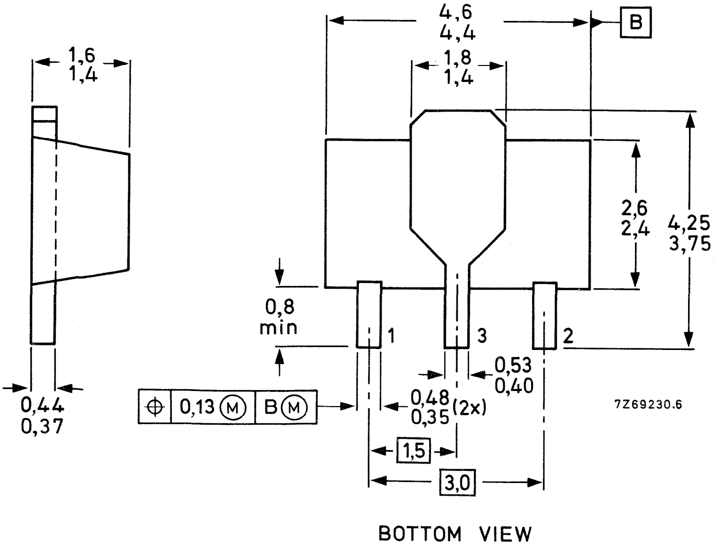
			BST39	BST40	
Collector-base voltage (open emitter)	V_{CBO}	max.	400	300	V
Collector-emitter voltage (open base)	V_{CEO}	max.	350	250	V
Collector current (d.c.)	I_C	max.	1		A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1		W
Junction temperature	T_j	max.	150		°C
D.C. current gain V_{CE} = 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

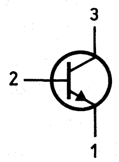
MECHANICAL DATA

Dimensions in mm

Marking code
BST39 = AT1
BST40 = AT2

Fig. 1 SOT-89.





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

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* Mounted on an area of 2,5 cm^2 of a ceramic substrate; thickness 0,7 mm.

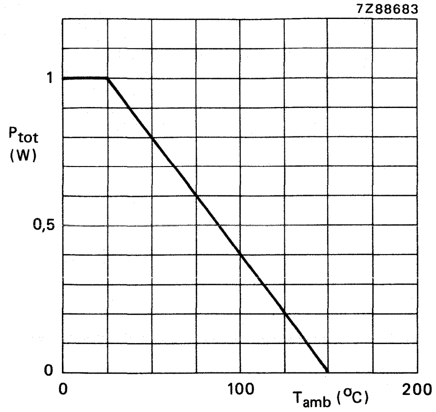


Fig. 2 Power derating curve.

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.

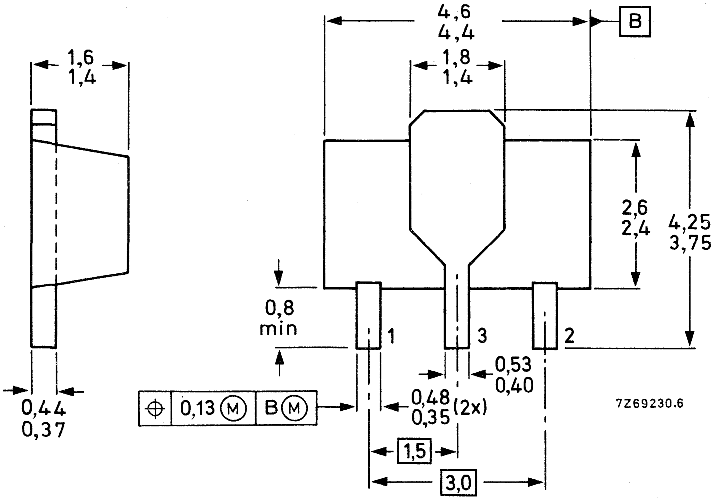
QUICK REFERENCE DATA

			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

Fig. 1 SOT-89.

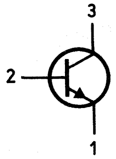
Dimensions in mm



BOTTOM VIEW

Marking code

BST50 = AS1
BST51 = AS2
BST52 = AS3



See also *Soldering recommendations.*

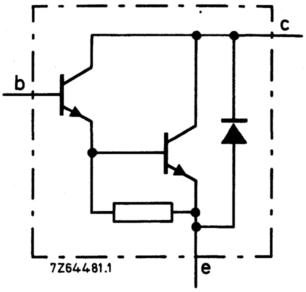


Fig. 2 Circuit diagram.

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

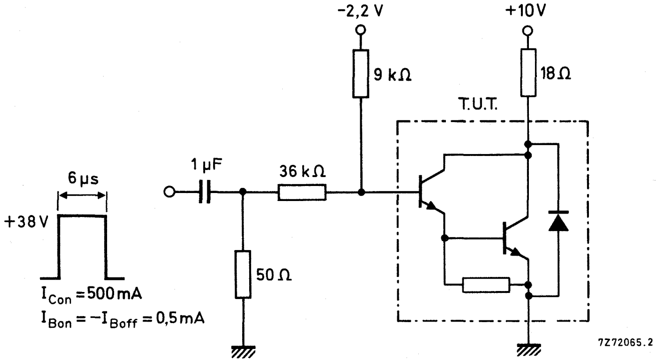


Fig. 3 Switching times test circuit.

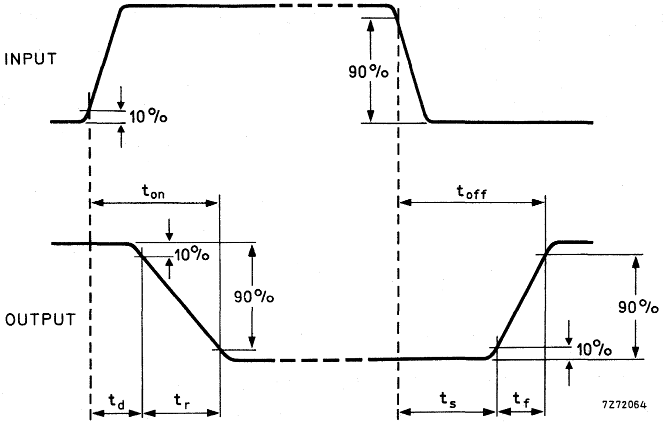


Fig. 4 Switching times waveform.

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* Measured under pulsed conditions.

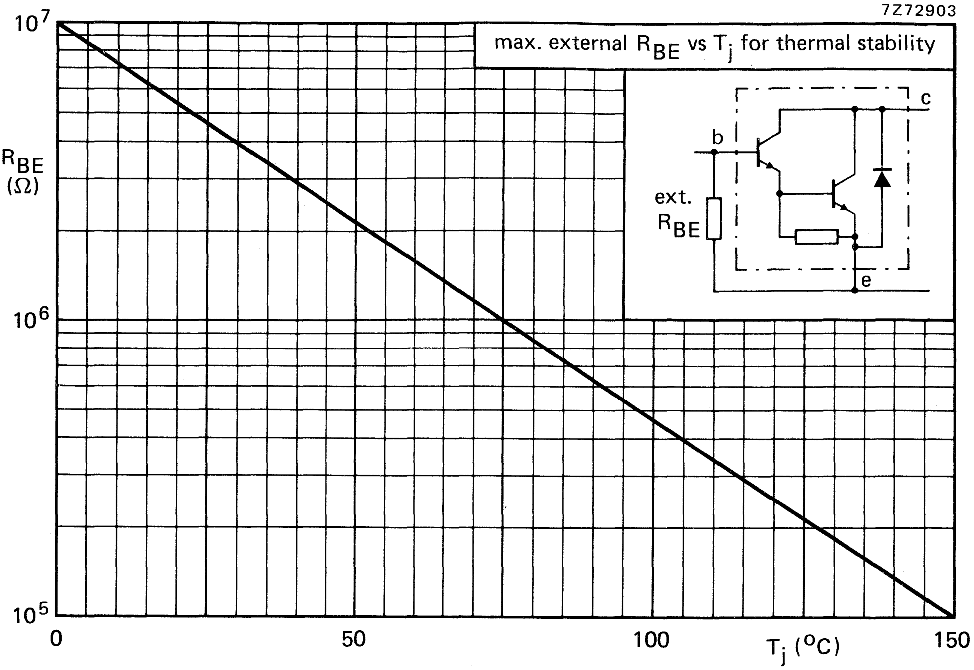


Fig. 5 Maximum values external R_{BE} as a function of junction temperature.

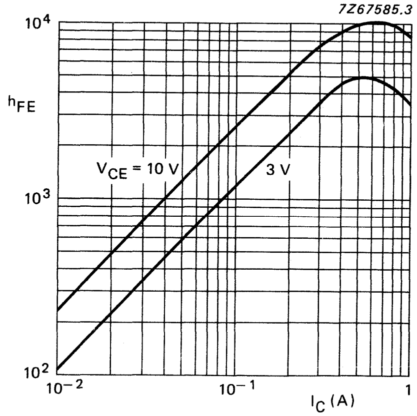


Fig. 6 T_j = 25 °C.

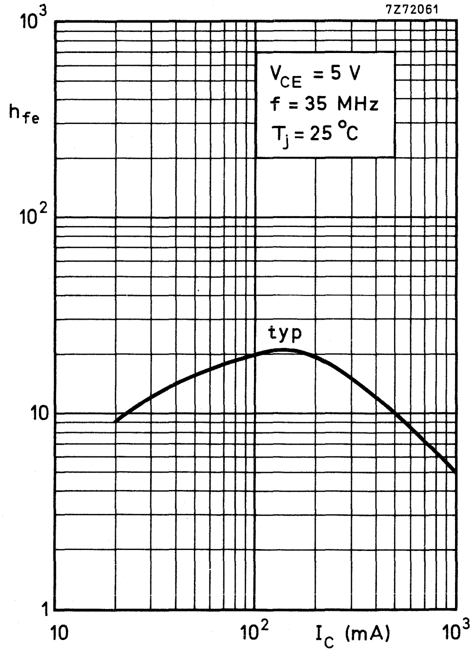


Fig. 7.

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.

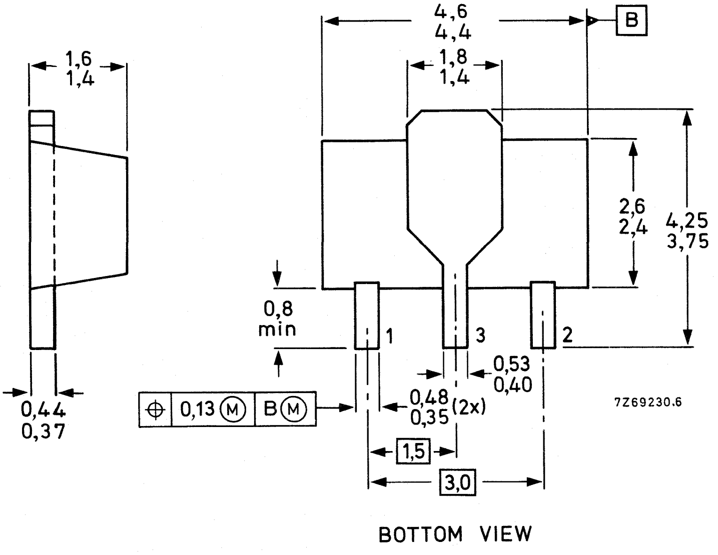
QUICK REFERENCE DATA

			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

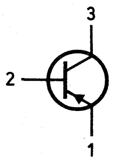
Dimensions in mm

Fig. 1 SOT-89.



Marking code

BST60 = BS1
BST61 = BS2
BST62 = BS3



See also *Soldering recommendations.*

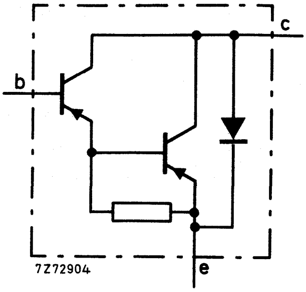


Fig. 2 Circuit diagram.

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 cm², 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

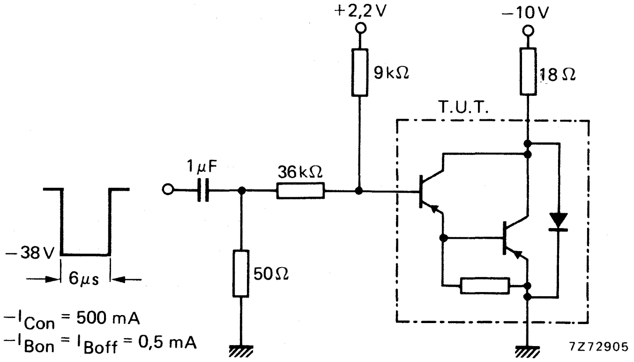


Fig. 3 Switching times test circuit.

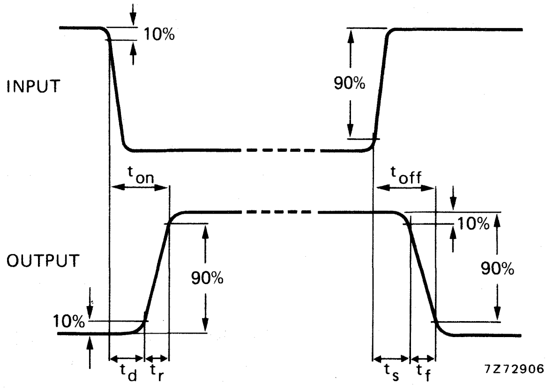


Fig. 4 Switching times waveform.

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* Measured under pulsed conditions.

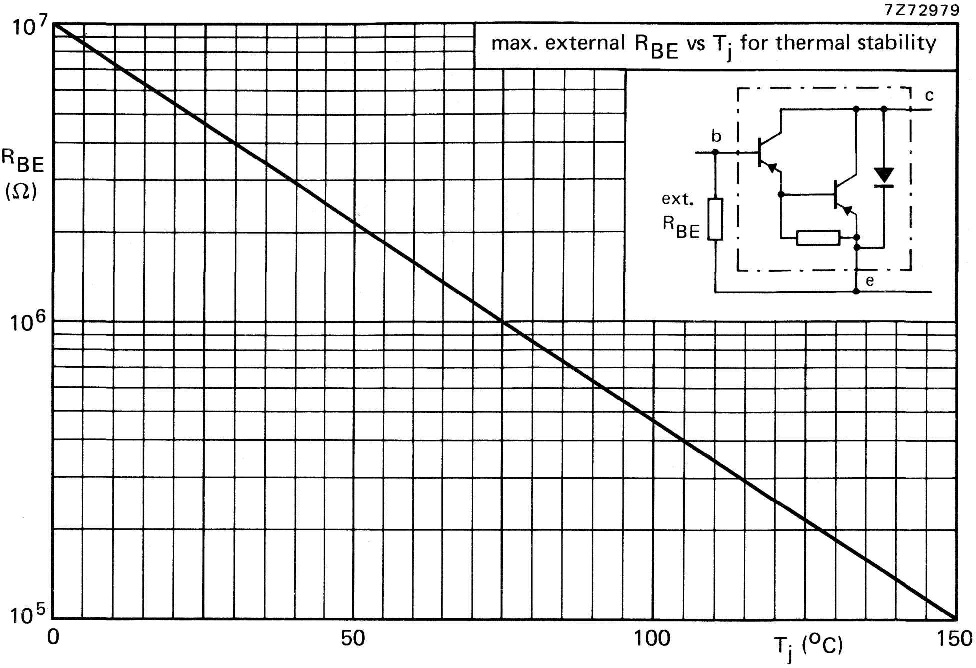


Fig. 5 Maximum values external R_{BE} as a function of junction temperature.

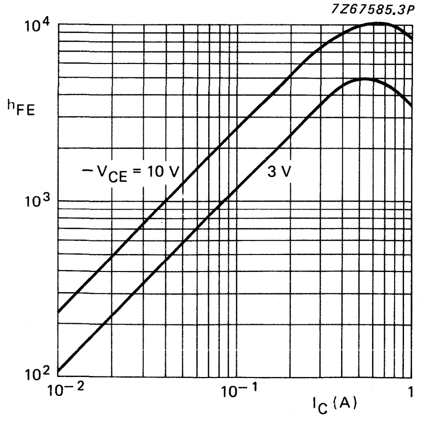


Fig. 6 T_j = 25 °C.

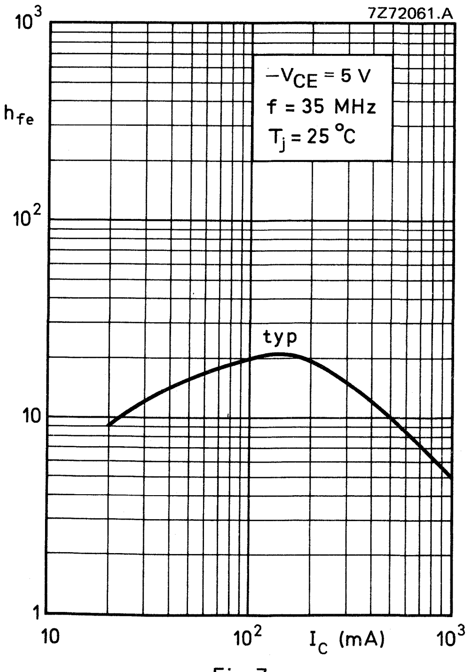


Fig. 7.

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. max.	2.0 4.0	Ω Ω
Transfer admittance I_D = 500 mA; V_{DS} = 15 V	$\lvert y_{fs} \rvert$	typ.	300	mS

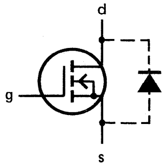
MECHANICAL DATA

Dimensions in mm

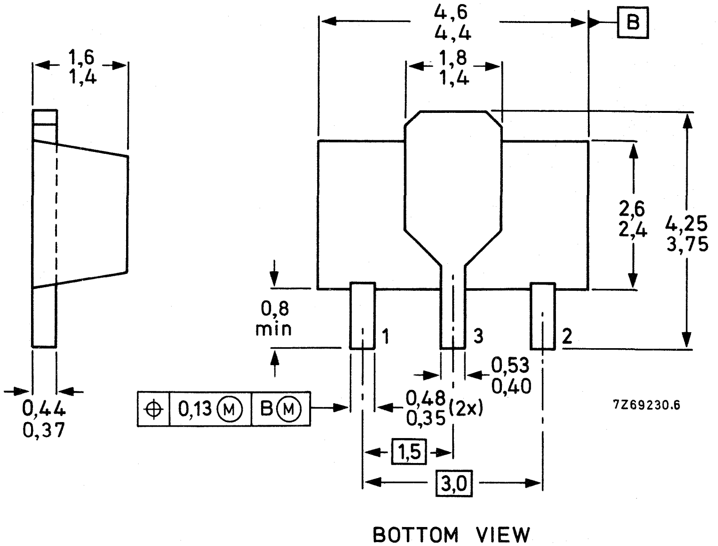
Fig.1 SOT89.

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 $I_D = 10\ \mu A$; $V_{GS} = 0$	$V_{(BR)DSS}$	min.	80	V
Drain-source leakage current $V_{DS} = 60$ V; $V_{GS} = 0$	I_{DSS}	max.	1	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 3.5	V V
Drain-source ON-resistance $I_D = 500$ mA; $V_{GS} = 10$ V	R_{DSon}	typ. max.	2.0 3.0	Ω 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 60	pF pF
Output capacitance at f = 1 MHz $V_{DS} = 10$ V; $V_{GS} = 0$	C_{oss}	typ. max.	30 45	pF pF
Feedback capacitance at f = 1 MHz $V_{DS} = 10$ V; $V_{GS} = 0$	C_{rss}	typ. max.	8 12	pF 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 15	ns ns

Note

1. Transistors mounted on a substrate with surface area of 2.5 cm^2 and thickness of 0.7 mm.

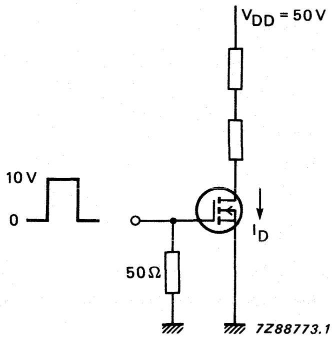


Fig.2 Switching times test circuit.

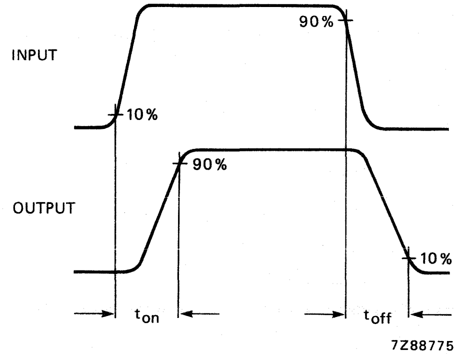


Fig.3 Input and output waveforms.

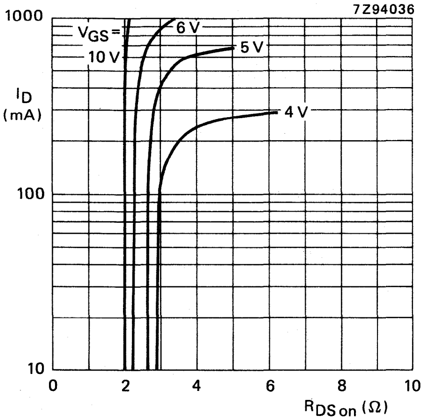


Fig.4 T_j = 25 °C; typical values.

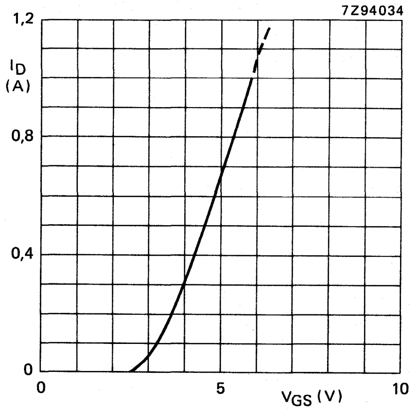


Fig.5 T_j = 25 °C; typical values at V_{DS} = 10 V.

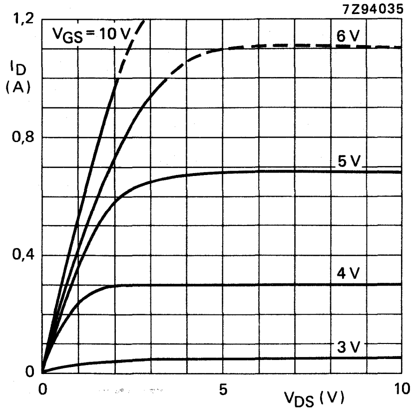


Fig.6 T_j = 25 °C; typical values.

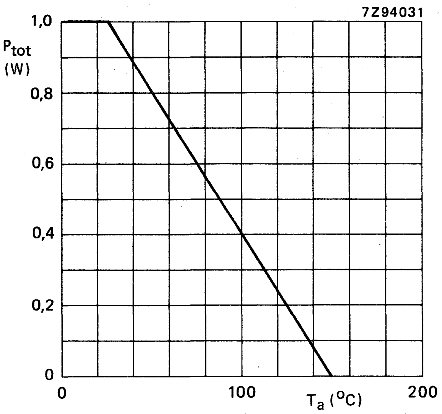


Fig.7 Power derating curve.

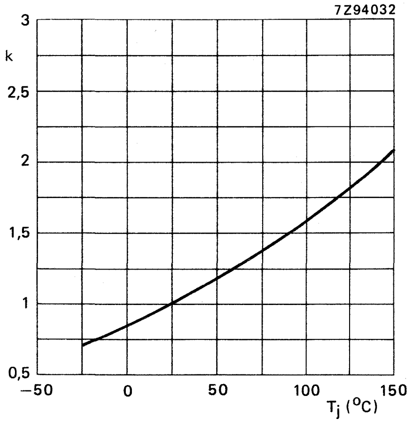


Fig.8 $k = \frac{R_{DS\,on}\text{ at }T_j}{R_{DS\,on}\text{ at }25\ ^{o}C}$; typ. values. at 500 mA/10 V.

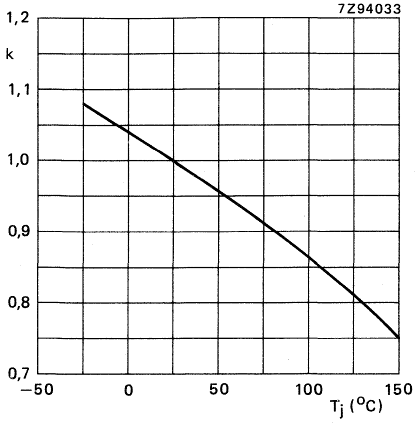


Fig.9 $k = \frac{V_{GS(th)}\text{ at }T_j}{V_{GS(th)}\text{ at }25\ ^{o}C}$; $V_{GS(th)}$ at 1 mA; typical values.

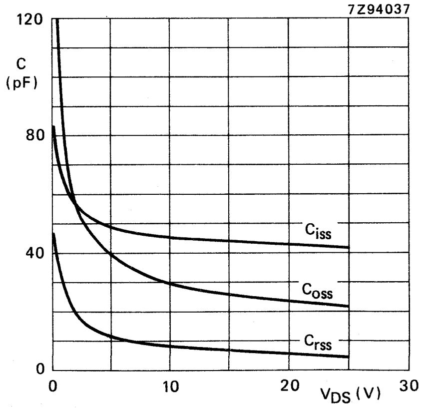


Fig.10 T_j = 25 °C; V_{GS} = 0; f = 1 MHz; typical values.

N-CHANNEL ENHANCEMENT MODE VERTICAL D-MOS TRANSISTOR

N-channel enhancement mode vertical D-MOS transistor in 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 $T_{amb} = 25\ ^oC$	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

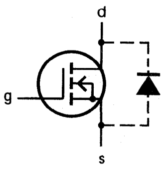
Dimensions in mm

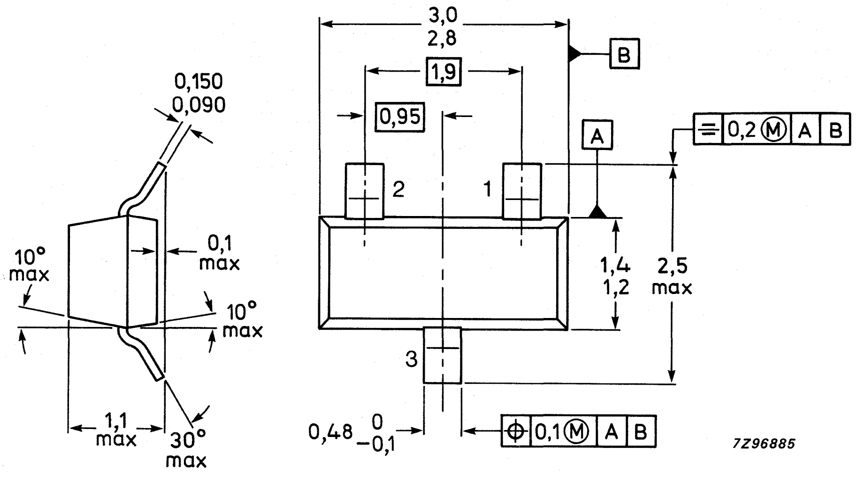
Fig.1 SOT23.

Marking: 02p

Pinning

1 = gate
2 = source
3 = drain





TOP VIEW

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; $t_p \leqslant 2$ 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
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 $I_D = 10\ \mu A$; $V_{GS} = 0$	$V_{(BR)DSS}$	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.	1.5	V
		max.	3.5	V
Drain-source ON-resistance $I_D = 150$ mA; $V_{GS} = 5$ V	R_{DSon}	typ.	7	Ω
		max.	10	Ω
Transfer admittance $I_D = 175$ mA; $V_{DS} = 5$ V	$\lvert y_{fs} \rvert$	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
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) $I_D = 175$ mA; $V_{DD} = 50$ V; $V_{GS} = 0$ to 10 V	t_{on}	typ.	4	ns
		max.	10	ns
	t_{off}	typ.	4	ns
		max.	10	ns

Note

1. Transistors mounted on a ceramic substrate of 7 mm x 5 mm x 0.7 mm.

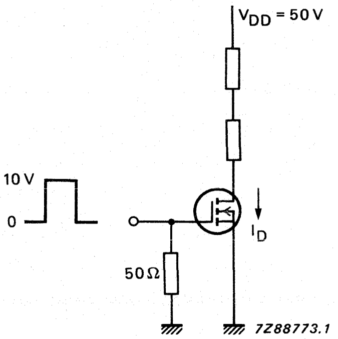


Fig.2 Switching times test circuit.

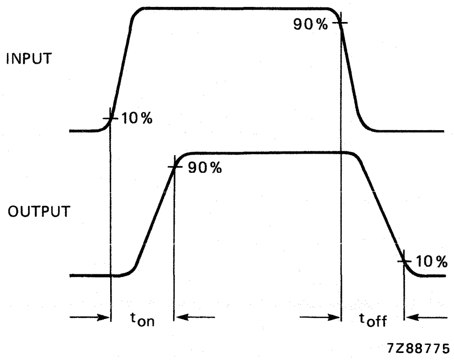


Fig.3 Input and output waveforms.

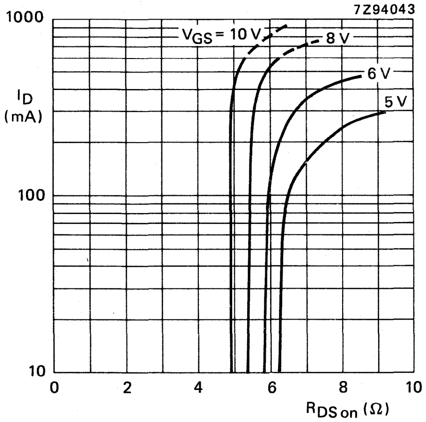


Fig.4 T_j = 25 °C; typical values.

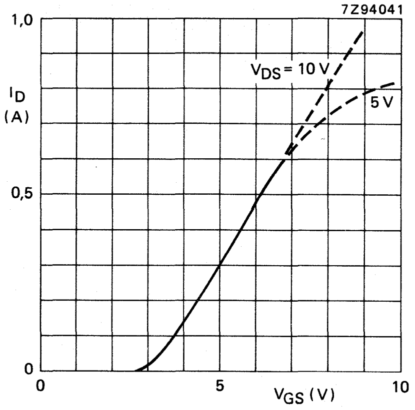


Fig.5 T_j = 25 °C; typical values.

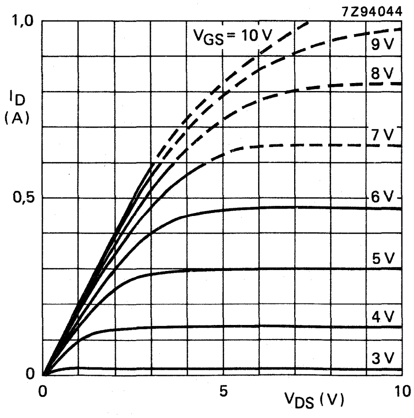


Fig.6 T_j = 25 °C; typical values.

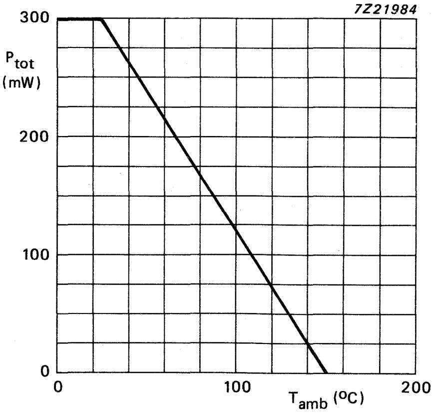


Fig.7 Power derating curve.

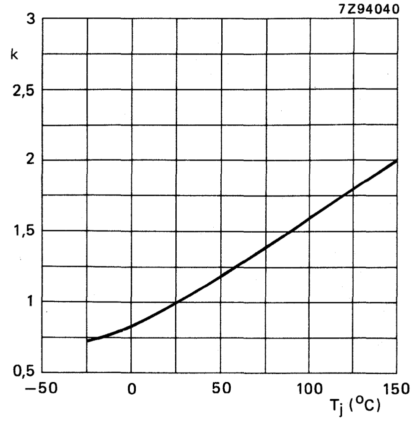


Fig.8 $k = \frac{R_{DS\,on} \text{ at } T_j}{R_{DS\,on} \text{ at } 25\,^{\circ}C}$; typ. values at 150 mA/5 V.

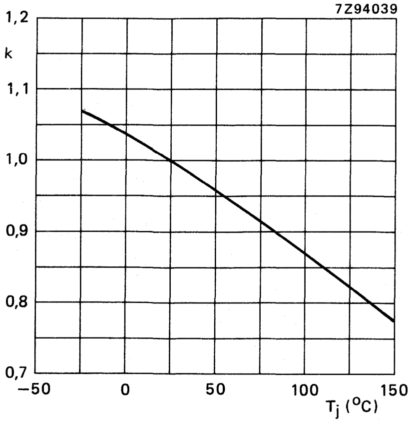


Fig.9 $k = \frac{V_{GS(th)} \text{ at } T_j}{V_{GS(th)} \text{ at } 25\,^{\circ}C}$; $V_{GS(th)}$ at 1 mA; typical values.

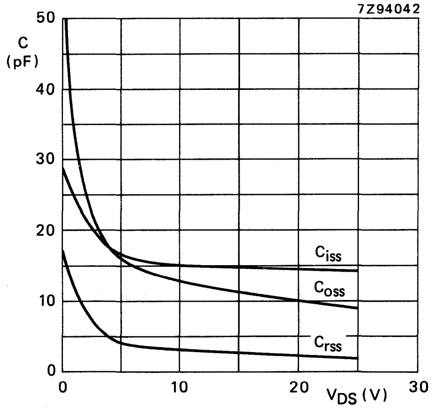


Fig.10 $T_j = 25\,^{\circ}C$; $V_{GS} = 0$; f = 1 MHz; typical values.

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

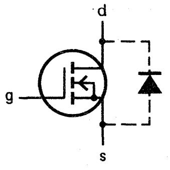
Drain-source voltage	V_{DS}	max.	200	V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20	V
Drain current (DC)	I_D	max.	250	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	1	W
Drain-source ON-resistance $I_D = 250$ mA; $V_{GS} = 10$ V	R_{DSon}	typ. max.	6 12	Ω Ω
Transfer admittance $I_D = 250$ mA; $V_{DS} = 15$ V	$\lvert y_{fs} \rvert$	typ.	250	mS

MECHANICAL DATA

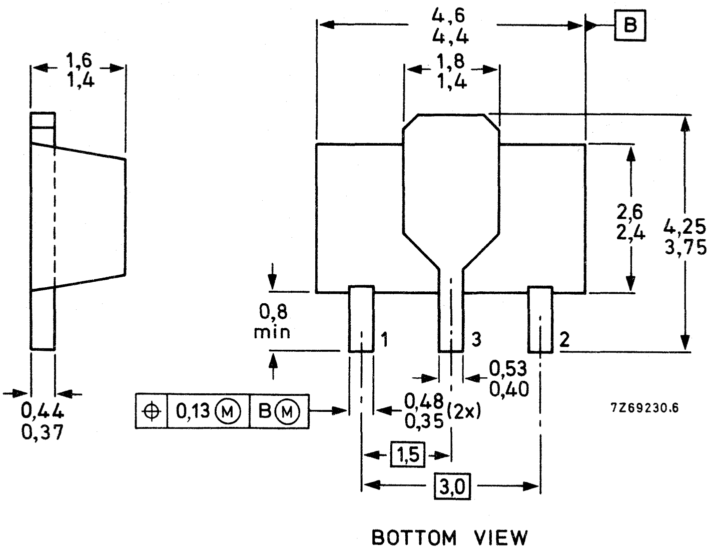
Dimensions in mm

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 2.8	V V
Drain-source ON-resistance I_D = 250 mA; V_{GS} = 10 V	R_{DSon}	typ. max.	6 12	Ω Ω
Transfer admittance I_D = 250 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.	70 90	pF pF
Output capacitance at f = 1 MHz V_{DS} = 10 V; V_{GS} = 0	C_{oss}	typ. max.	20 30	pF pF
Feedback capacitance at f = 1 MHz V_{DS} = 10 V; V_{GS} = 0	C_{rss}	typ. max.	5 10	pF 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 10	ns ns
	t_{off}	typ. max.	15 25	ns ns

Note

1. Transistor mounted on a ceramic substrate with area of 2.5 cm^2 and thickness of 0.7 mm.

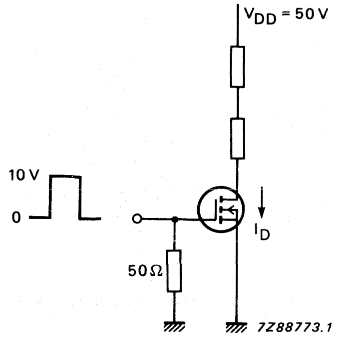


Fig. 2 Switching times test circuit.

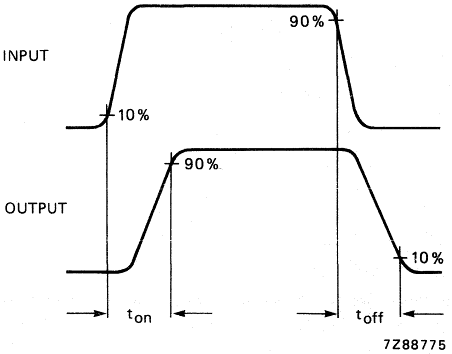


Fig. 3 Input and output waveforms.

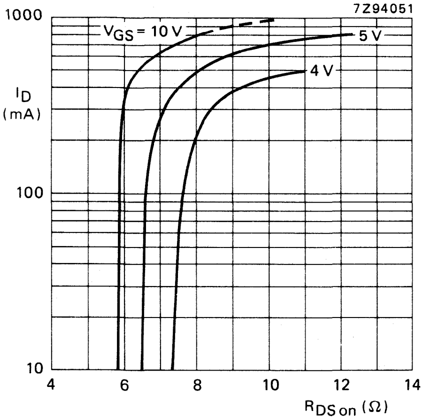


Fig. 4 T_j = 25 °C; typical values.

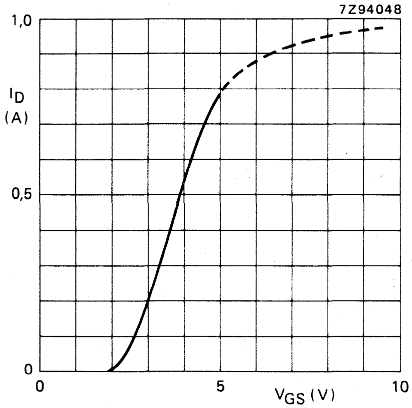


Fig. 5 T_j = 25 °C; V_{DS} = 10 V; typical values.

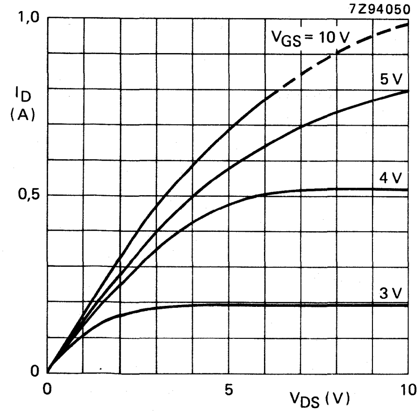


Fig. 6 T_j = 25 °C; typical values.

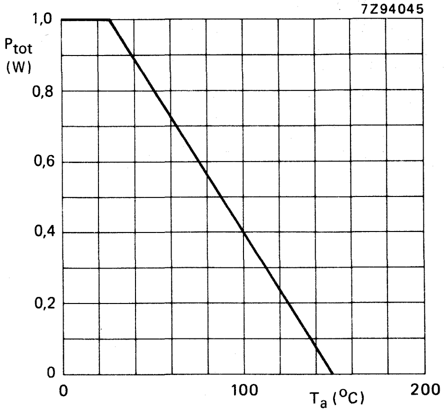


Fig. 7 Power derating curve.

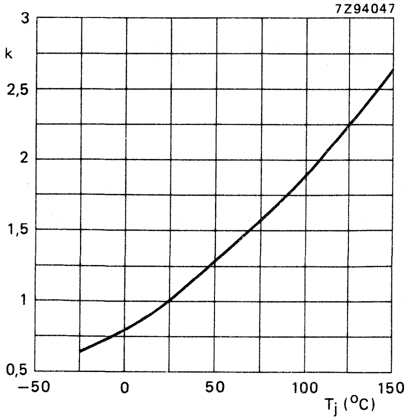


Fig. 8 $k = \frac{R_{DS\ on}\ \text{at}\ T_j}{R_{DS\ on}\ \text{at}\ 25\ ^oC}$; at 400 mA/10 V; typical values.

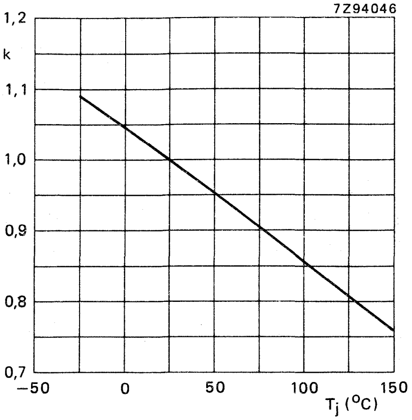


Fig. 9 $k = \frac{V_{GS(th)}\ \text{at}\ T_j}{V_{GS(th)}\ \text{at}\ 25\ ^oC}$; $V_{GS(th)}$ at 1 mA; typical values.

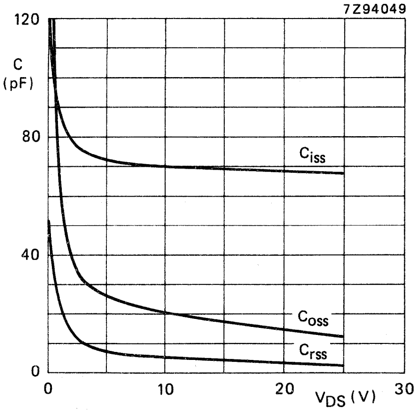


Fig. 10 $T_j = 25\ ^oC$; $V_{GS} = 0$; f = 1 MHz; typical values.

N-CHANNEL ENHANCEMENT MODE VERTICAL D-MOS TRANSISTOR

N-channel enhancement mode vertical D-MOS transistor in 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 $T_{amb} = 25\ ^oC$	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

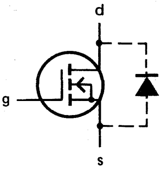
MECHANICAL DATA

Dimensions in mm

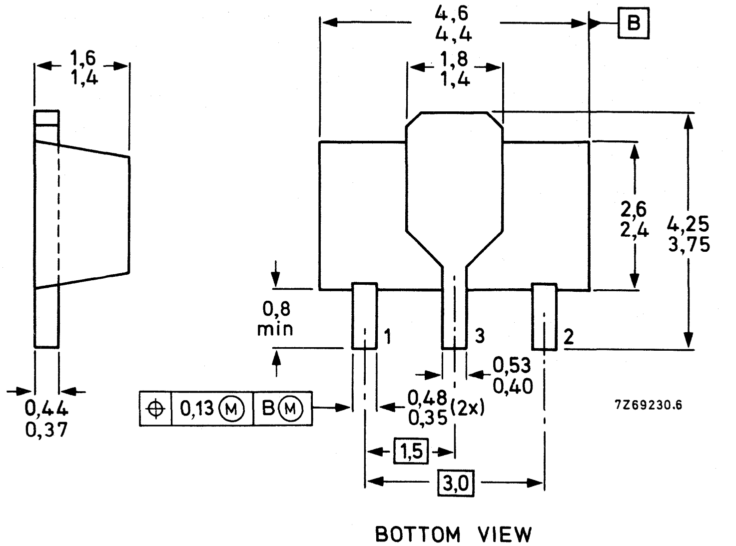
Fig.1 SOT89.

Pinning

1 = source
2 = gate
3 = drain



Marking: K0



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; $t_p \leqslant 2$ 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 $I_D = 100\ \mu A$; $V_{GS} = 0$	$V_{(BR)DSS}$	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 $I_D = 100\ \mu A$; $V_{DS} = V_{GS}$	$V_{GS(th)}$	min. max.	0.7 2.7	V V
Drain-source ON-resistance $I_D = 15$ mA; $V_{GS} = 3$ V	R_{DSon}	typ. max.	7 10	Ω 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 65	pF pF
Output capacitance at f = 1 MHz $V_{DS} = 10$ V; $V_{GS} = 0$	C_{oss}	typ. max.	20 30	pF pF
Feedback capacitance at f = 1 MHz $V_{DS} = 10$ V; $V_{GS} = 0$	C_{rss}	typ. max.	6 10	pF 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 15	ns ns

---

1. Transistors mounted on a ceramic substrate with area of 2.5 cm^2 and thickness of 0.7 mm.

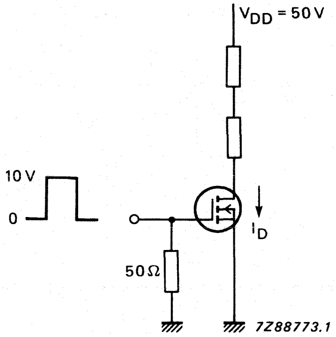


Fig.2 Switching times test circuit.

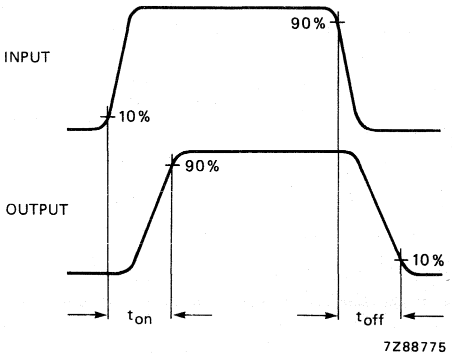


Fig.3 Input and output waveforms.

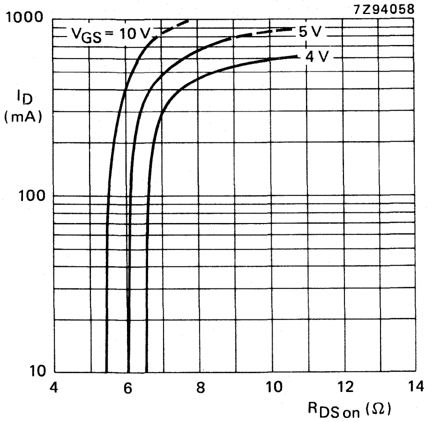


Fig.4 T_j = 25 °C; typical values.

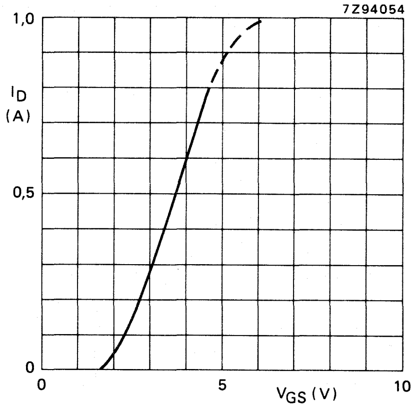


Fig.5 T_j = 25 °C; V_{DS} = 10 V; typ. values.

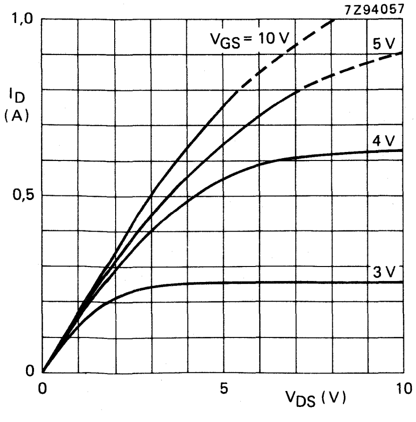


Fig.6 T_j = 25 °C; typical values.

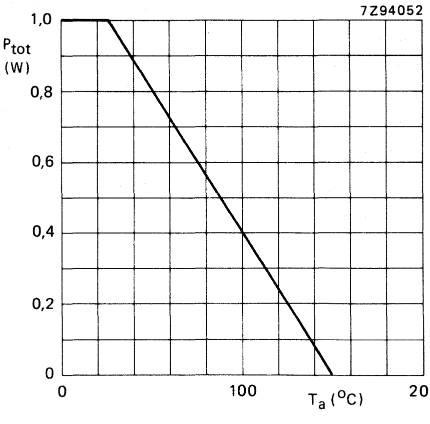


Fig.7 Power derating curve.

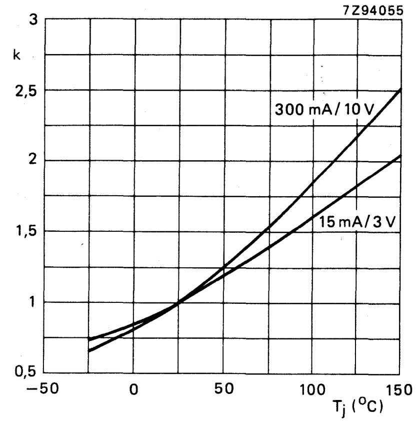


Fig.8 $k = \frac{R_{DS\,on}\text{ at }T_j}{R_{DS\,on}\text{ at }25\ ^{o}C}$; typical values.

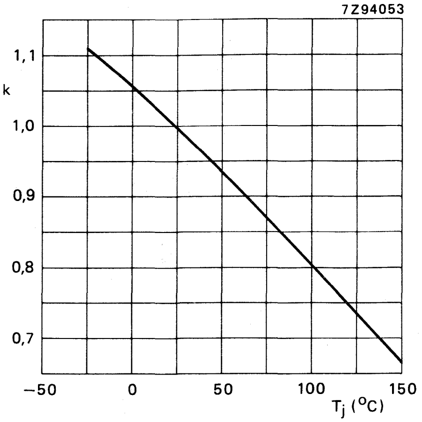


Fig.9 $k = \frac{V_{GS(th)}\text{ at }T_j}{V_{GS(th)}\text{ at }25\ ^{o}C}$; $V_{GS(th)}$ at 0.1 mA; typical values.

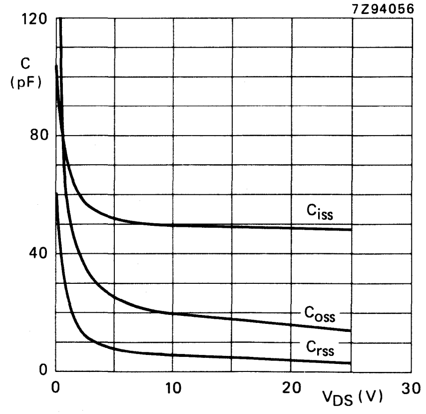


Fig.10 $T_j = 25\ ^{o}C$; $V_{GS} = 0$; f = 1 MHz; typical values.

P-CHANNEL ENHANCEMENT MODE VERTICAL D-MOS TRANSISTOR

P-channel 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

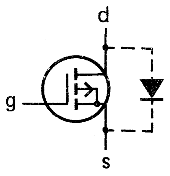
Drain-source voltage	$-V_{DS}$	max.	60	V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20	V
Drain current (DC)	$-I_D$	max.	0,3	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1	W
Drain-source ON-resistance $-I_D$ = 200 mA; $-V_{GS}$ = 10 V	R_{DSon}	typ. max.	4,5 6	Ω Ω
Transfer admittance $-I_D$ = 200 mA; $-V_{DS}$ = 15 V	$\lvert y_{fs} \rvert$	typ.	200	mS

MECHANICAL DATA

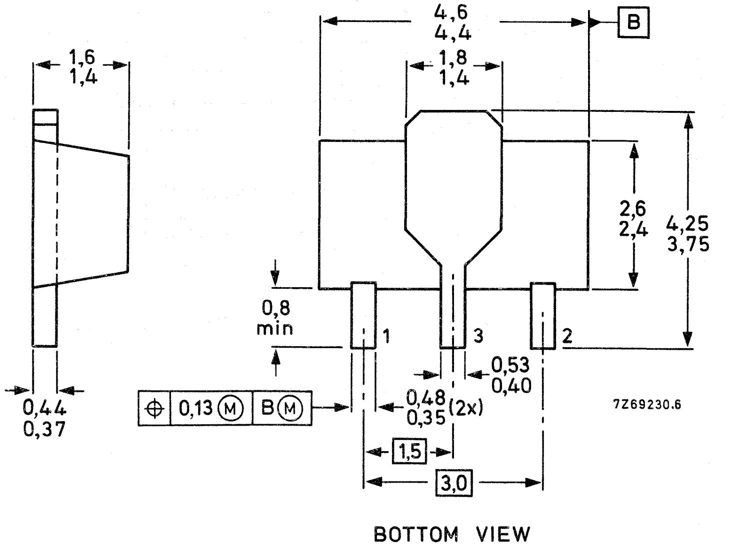
Dimensions in mm

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 $-I_D$ = 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 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	$\lvert y_{fs} \rvert$	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.

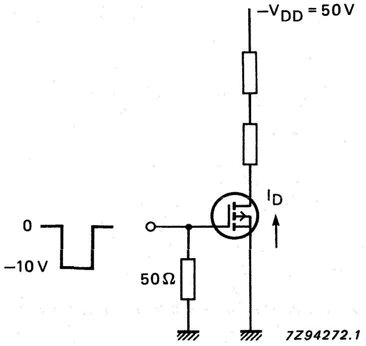


Fig.2 Switching times test circuit.

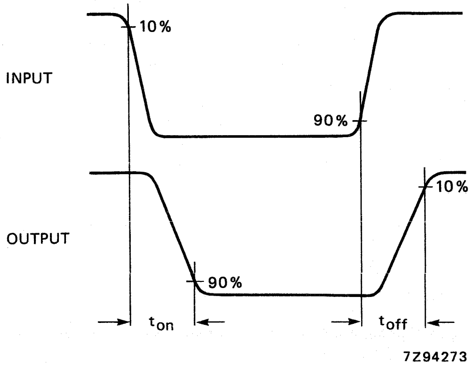


Fig.3 Input and output waveforms.

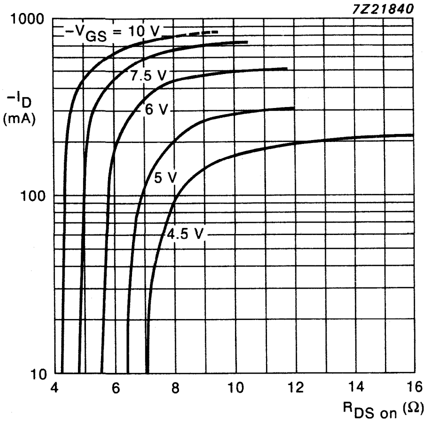


Fig.4 Drain current vs ON-resistance; T_j = 25 °C; typical values.

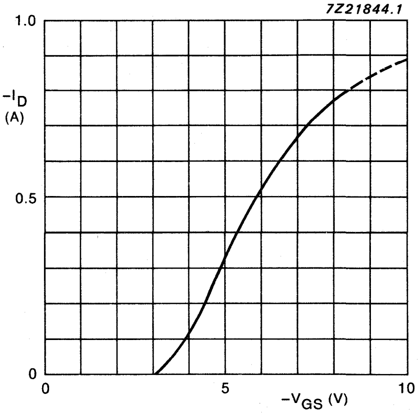


Fig.5 Transfer characteristics; T_j = 25 °C; $-V_{DS}$ = 10 V; typical values.

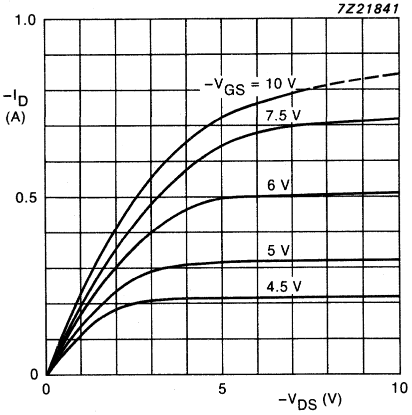


Fig.6 Output characteristics; T_j = 25 °C; typical values.

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.	60	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

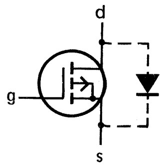
MECHANICAL DATA

Dimensions in mm

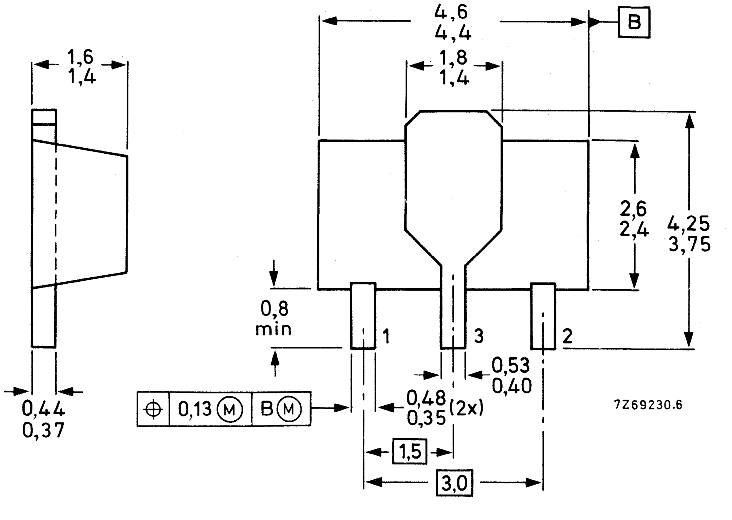
Fig. 1 SOT89.

Pinning:

1 = source
2 = gate
3 = drain



Marking: LN



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.	0.25	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 $-I_D = 10\ \mu A$; $V_{GS} = 0$	$-V_{(BR)DSS}$	min.	60	V
Drain-source leakage current $-V_{DS} = 48\ V$; $V_{GS} = 0$	$-I_{DSS}$	max.	1	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 3.5	V V
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
Input capacitance at f = 1 MHz $-V_{DS} = 10\ V$; $V_{GS} = 0$	C_{iss}	typ. max.	30 45	pF pF
Output capacitance at f = 1 MHz $-V_{DS} = 10\ V$; $V_{GS} = 0$	C_{oss}	typ. max.	20 30	pF pF
Feedback capacitance at f = 1 MHz $-V_{DS} = 10\ V$; $V_{GS} = 0$	C_{rss}	typ. max.	5 10	pF 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 10	ns ns

Note:

1. Transistor mounted on a ceramic substrate: area = 2,5 cm^2; thickness = 0,7 mm.

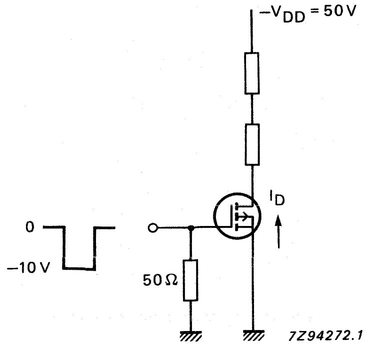


Fig. 2 Switching times test circuit.

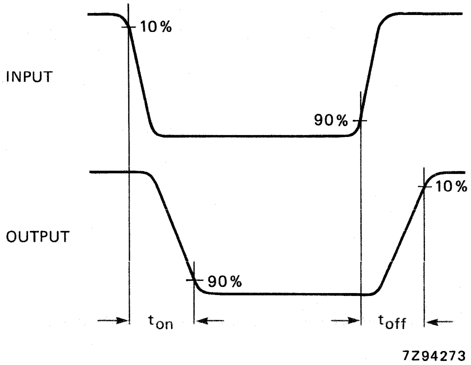


Fig. 3 Input and output waveforms.

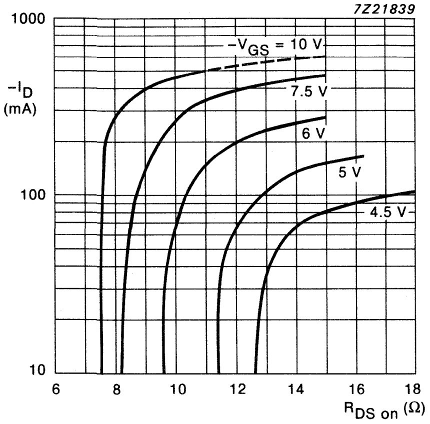


Fig.4 Drain current vs ON-resistance;
$T_j = 25\ ^{\circ}C$; typical values.

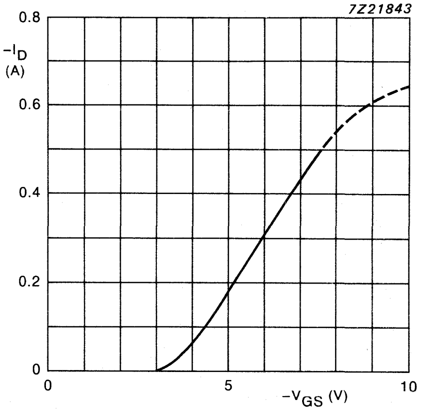


Fig.5 Transfer characteristics;
$T_j = 25\ ^{\circ}C$; $-V_{DS} = 10$ V; typical values.

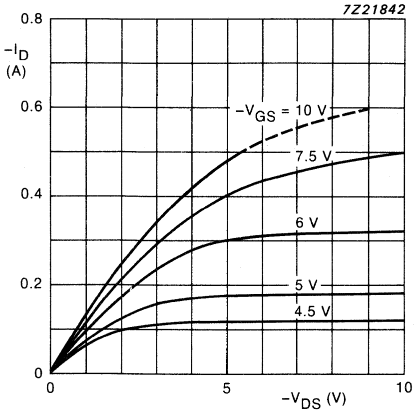


Fig.6 Output characteristics; $T_j = 25\ ^{\circ}C$; typical values.

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 $T_{amb} = 25\ ^oC$	P_{tot}	max.	250	mW
Junction temperature	T_j	max.	150	^oC
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

Dimensions in mm

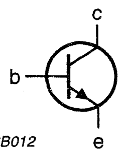
Fig. 1 SOT-23.

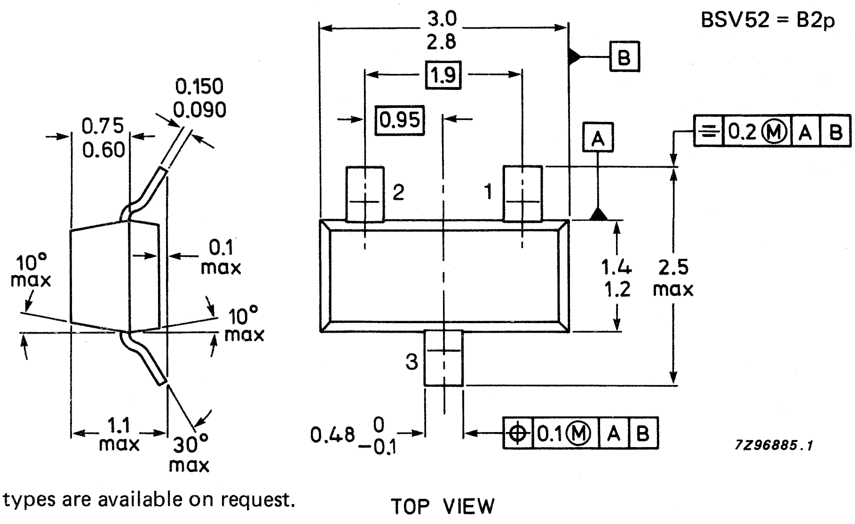
Marking code

BSV52 = B2p

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)	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

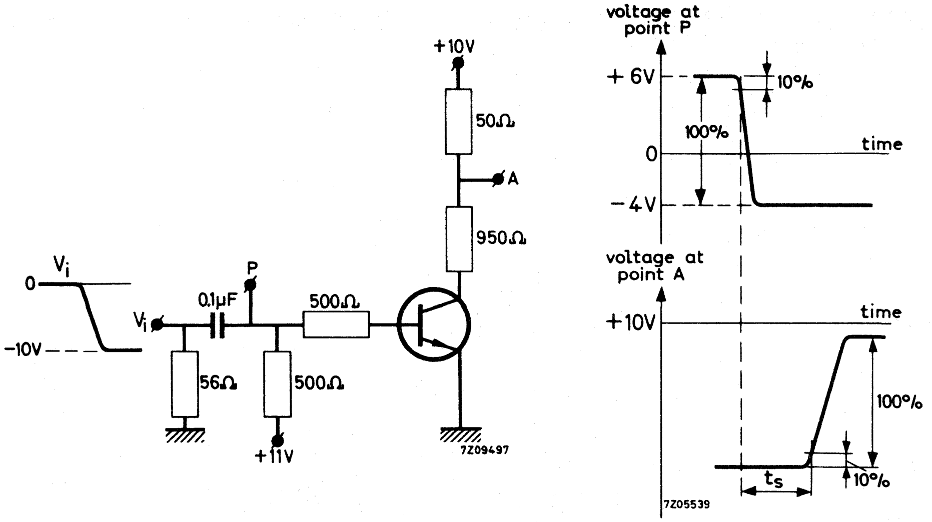


Fig. 2 Test circuit and waveform storage time.

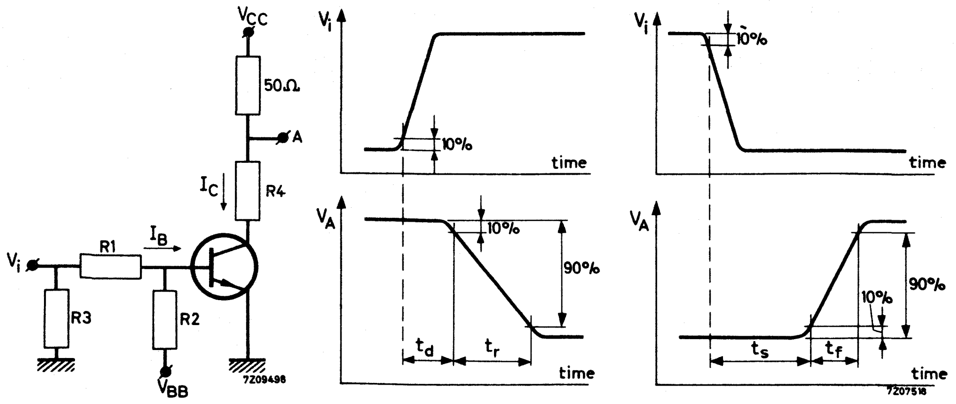


Fig. 3 Test circuit and waveforms turn on and turn off time.

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.

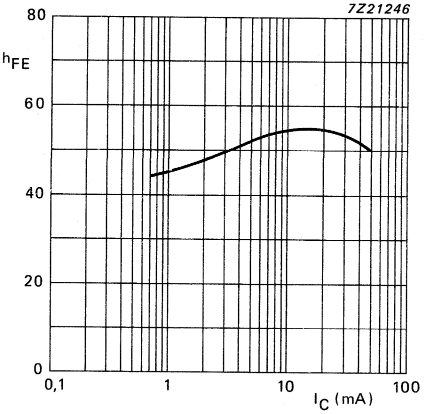


Fig. 4 V_{CE} = 1 V; T_j = 25 °C; typical values.

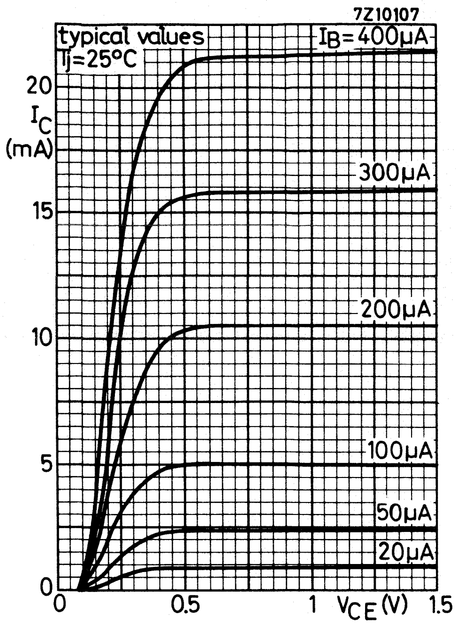

7Z10107
typical values
Tj=25°C
IB=400μA
300μA
200μA
100μA
50μA
20μA
IC (mA)
0
5
10
15
20
0
0.5
1
VCE (V)
1.5

Fig. 5

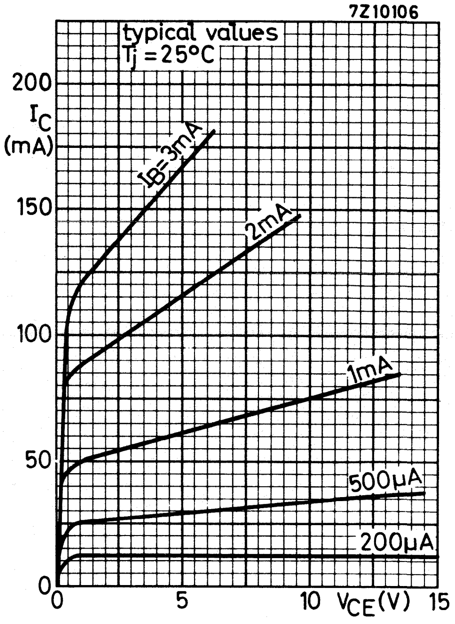

7Z10106
typical values
Tj=25°C
IB=3mA
2mA
1mA
500μA
200μA
IC (mA)
0
50
100
150
200
0
5
10
VCE (V)
15

Fig. 6

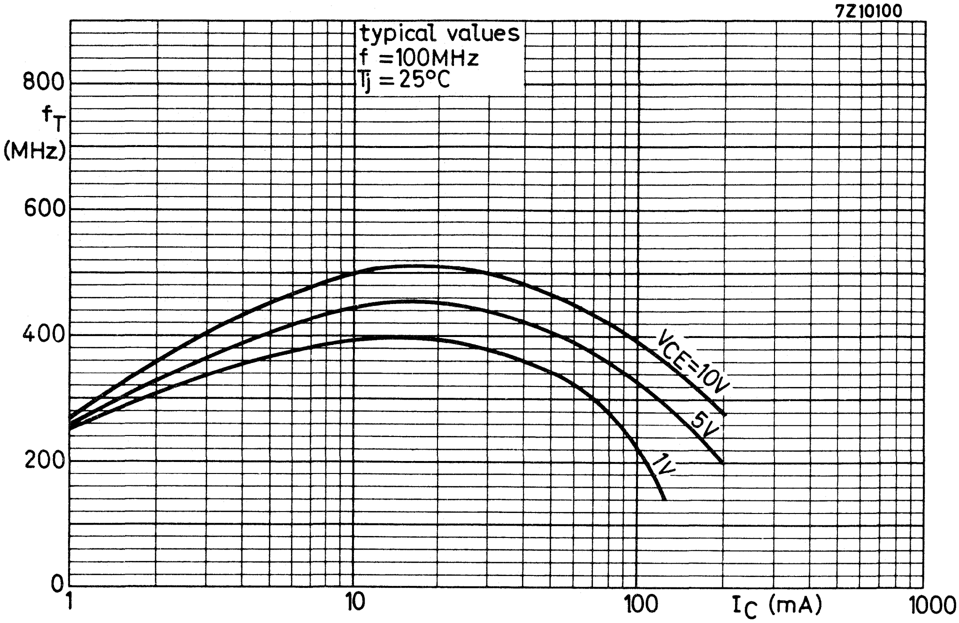

7Z10100
typical values
f = 100MHz
Tj = 25°C
800
f_T
(MHz)
600
400
200
0
1
10
100
I_C (mA)
1000
V_{CE}=10V
5V
1V

Fig. 7

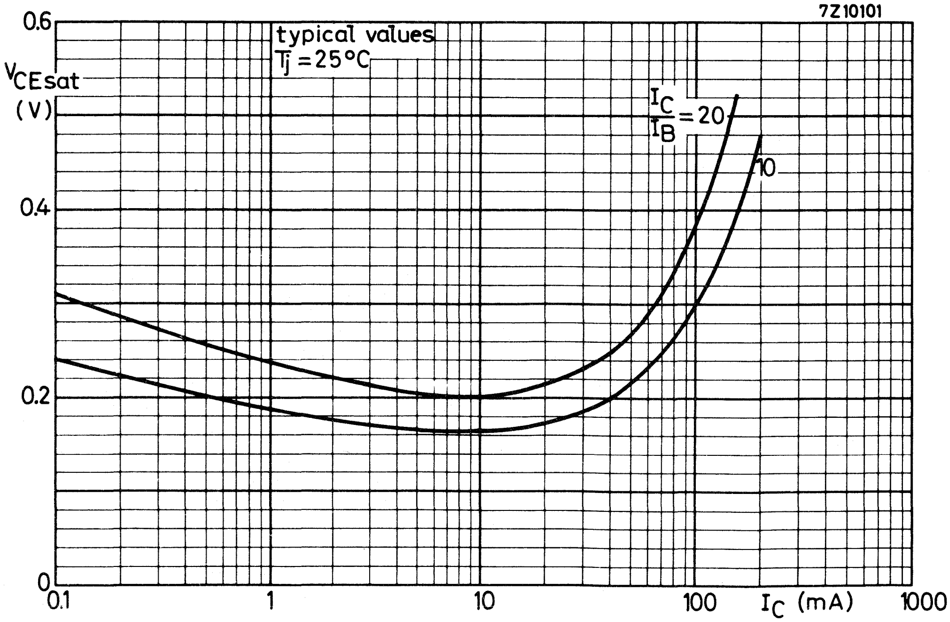

7Z10101
typical values
Tj = 25°C
0.6
V_{CEsat}
(V)
0.4
0.2
0
0.1
1
10
100
I_C (mA)
1000
$\frac{I_C}{I_B}$ = 20
10

Fig. 8

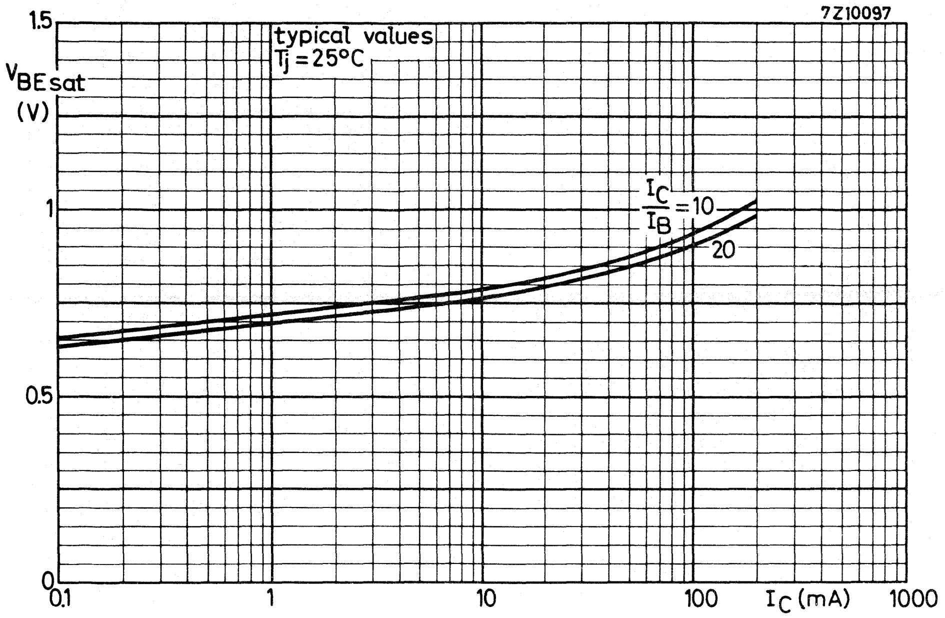


Fig. 9

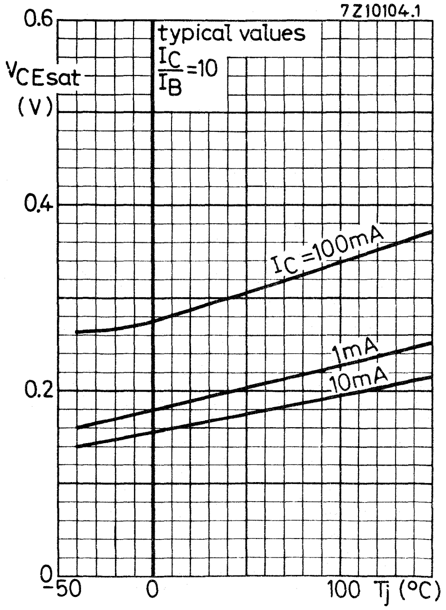


Fig. 10

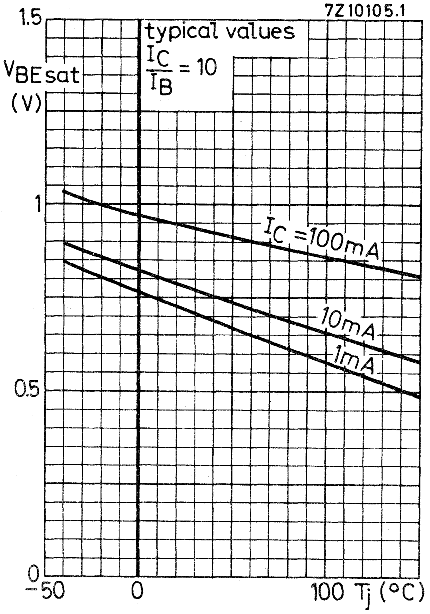


Fig. 11

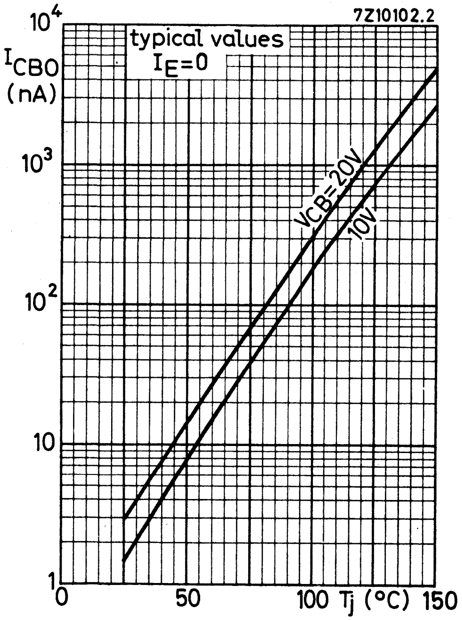

7Z10102.2
typical values
$I_E=0$
I_{CBO} (nA)
10^4
10^3
10^2
10
1
$V_{CB}=20V$
10V
0
50
100
150
T_j (°C)

Fig. 12

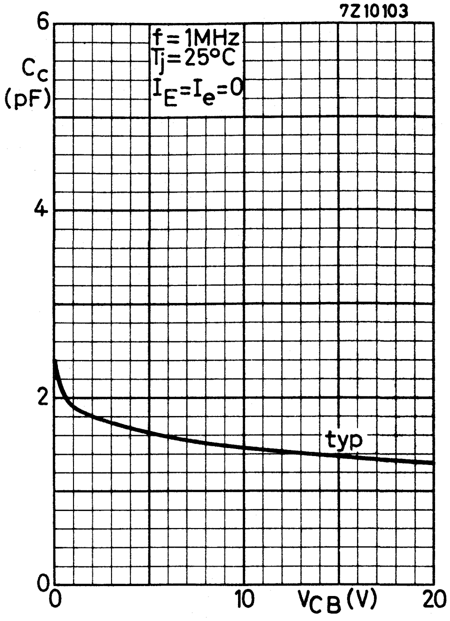

7Z10103
f = 1MHz
$T_j=25°C$
$I_E=I_e=0$
C_c (pF)
6
4
2
0
typ
0
10
20
V_{CB} (V)

Fig. 13

GENERAL DESCRIPTION

Glass passivated triacs in SOT223 envelopes suitable for surface mounting. They are intended for general purpose switching and phase control applications.

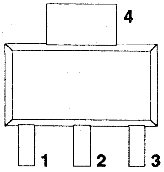
QUICK REFERENCE DATA

SYMBOL	PARAMETER	MAX.	MAX.	MAX.	MAX.	UNIT
	BT134W-	**500**	**600**	**700**[1]	**800**[1]	
V_{DRM}	Repetitive peak voltages	500	600	700	800	V
$I_{T(RMS)}$	R.M.S. on-state current	1	1	1	1	A
I_{TSM}	Non-repetitive on-state current	10	10	10	10	A

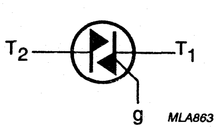
PINNING - SOT223

PIN	DESCRIPTION
1	main terminal 1
2	main terminal 2
3	gate
4	main terminal 2 (tab)

PIN CONFIGURATION



SYMBOL



LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.				UNIT
	Voltages (in either direction)			**-500**	**-600**	**-700**[1]	**-800**[1]	
V_{DSM}	Non-repetitive peak off-state voltage.	t ≤ 10 ms	-	500	600	700	800	V
V_{DRM}	Repetitive peak off-state voltage	$\delta \leq 0.01$	-	500	600	700	800	V
V_{DWM}	Crest working off-state voltage		-	400	400	400	400	V
	Currents (in either direction)							
$I_{T(RMS)}$	R.M.S. on-state current	Conduction angle = 360°; T_b = 77 °C	-	1				A
I_{TRM}	Repetitive peak on-state current		-	10				A
I_{TSM}	Non-repetitive peak on-state current	t = 20 ms; full sine-wave; T_j = *120 °C* prior to surge.	-	10				A
I^2t	I^2t for fusing	t = 10 ms	-	0.5				A^2s
dI_T/dt	Rate of rise of on-state current after triggering	I_G = 200 mA to I_T = 1.5 A; dI_G/dt = 0.2 A/μs	-	10				A/μs
	Power dissipation							
$P_{G(AV)}$	Average power dissipation	over any 20 ms period	-	0.13				W
P_{GM}	Peak power dissipation		-	1.3				W
	Temperatures							
T_{stg}	Storage temperature		- 40	125				°C
T_j	Junction temperature	Full-cycle operation	-	120				°C
T_j	Junction temperature	Half-cycle operation	-	110				°C

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[1] These voltage grades not available for D and E type gate selections. (See next page for details of gate selections)

THERMAL RESISTANCES

From junction to board	P.c.b. mounted (see fig 2), temperature measured 1 - 3 mm from tab.	$R_{th\ j\text{-}b}$ = 30 K/W
From junction to ambient	P.c.b. mounted (see fig 2)	$R_{th\ j\text{-}a}$ = 70 K/W

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
	Voltages and Currents (in either direction)					
V_T	On-state voltage	I_T = 1.5 A	-	1.2	1.7	V
dV_D/dt	Rate of rise of off-state voltage (exponential method)	T_j = 120 °C; $V_D = V_{DWM}$max; gate open circuit				
		BT134W-500 to 800	100	-	-	V/µs
		BT134W-500E/600E	-	30	-	V/µs
		BT134W-500D/600D[2]	-	5	-	V/µs
dV_{com}/dt	Rate of change of commutating voltage	$-dI_{com}/dt$ = 1.8 A/ms; $I_{T(RMS)}$ = 1 A; T_b = 50 °C; gate open circuit; $V_D = V_{DWM}$max				
		BT134W-500 to 800	10	-	-	V/µs
		BT134W-500E/600E		Not applicable		
		BT134W-500D/600D		Not applicable		
I_D	Off-state current	$V_D = V_{DWM}$max; T_j = 120 °C	-	-	0.5	mA
V_{GT}	Gate trigger voltage	V_D = 12 V	-	-	1.5	V
		V_D = 12 V; T_j = -40 °C	-	-	2.3	V
		$V_D = V_{DWM}$max, T_j = 120 °C	0.25	-	-	
I_{GT}	Gate trigger current	G to T1; V_D = 12 V	-	-	Table 1	mA
I_H	Holding current		-	-	Table 1	mA
I_L	Latching current		-	-	Table 1	mA

Table 1: Gate Characteristics - Maximum Values		T2+ G+	T2+ G-	T2- G-	T2- G+	UNIT
BT134W - 500/600/700/800	I_{GT}	35	35	35	70	mA
	I_H	15	15	15	15	mA
	I_L	20	30	20	30	mA
BT134W - 500E/600E	I_{GT}	10	10	10	25	mA
	I_H	15	15	15	15	mA
	I_L	15	20	15	20	mA
BT134W - 500D/600D	I_{GT}	5	5	5	10	mA
	I_H	10	10	10	10	mA
	I_L	10	15	10	15	mA

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[2] With $R_{G\text{-}MT1}$ = 1 kΩ

MOUNTING INSTRUCTIONS

Dimensions in mm.

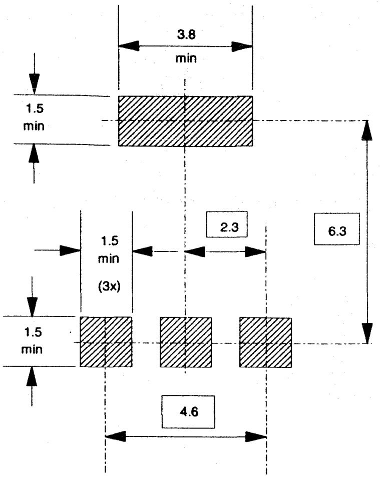


Fig.1. Soldering pattern for surface mounting SOT223.

PRINTED CIRCUIT BOARD

Dimensions in mm.

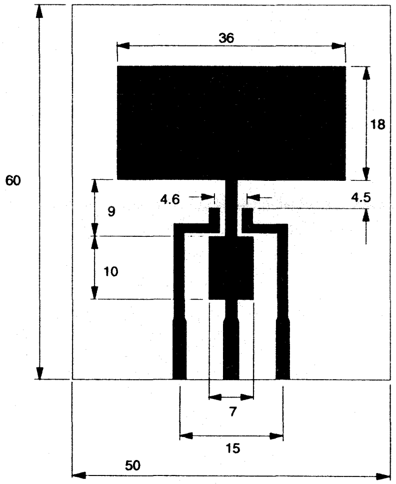


Fig.2. PCB for thermal resistance and power rating for SOT223.
PCB: FR4 epoxy glass (1.6 mm thick), copper laminate (35 µm thick).

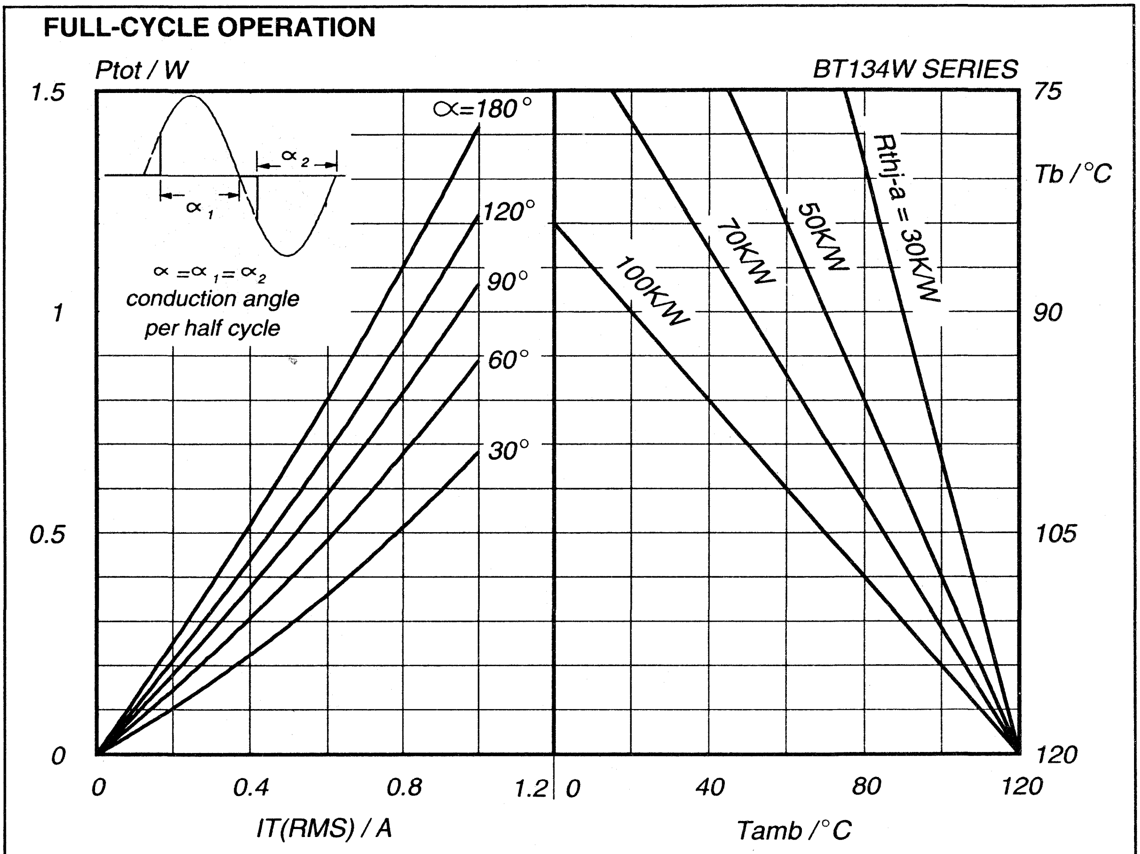


Fig.3. The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures for various P.C.B. mountings.

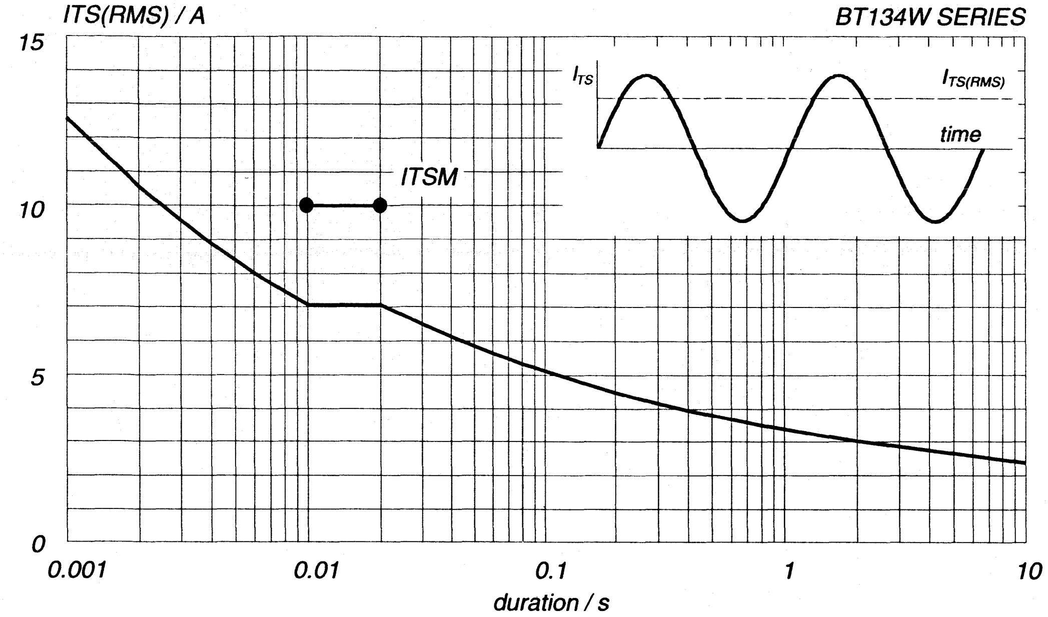


Fig.4. Maximum permissible non-repetitive r.m.s. on-state current based on sinusoidal currents (f = 50 Hz); T_j = 120 °C prior to surge. The triac may temporarily lose control following the surge.

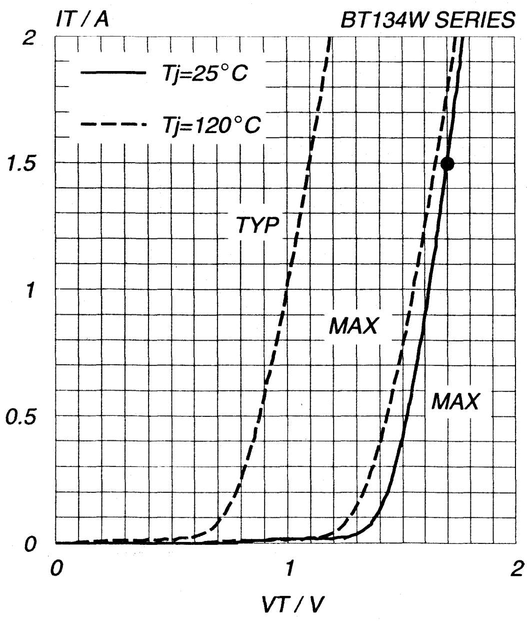


Fig. 5. Forward voltage drop versus temperature.

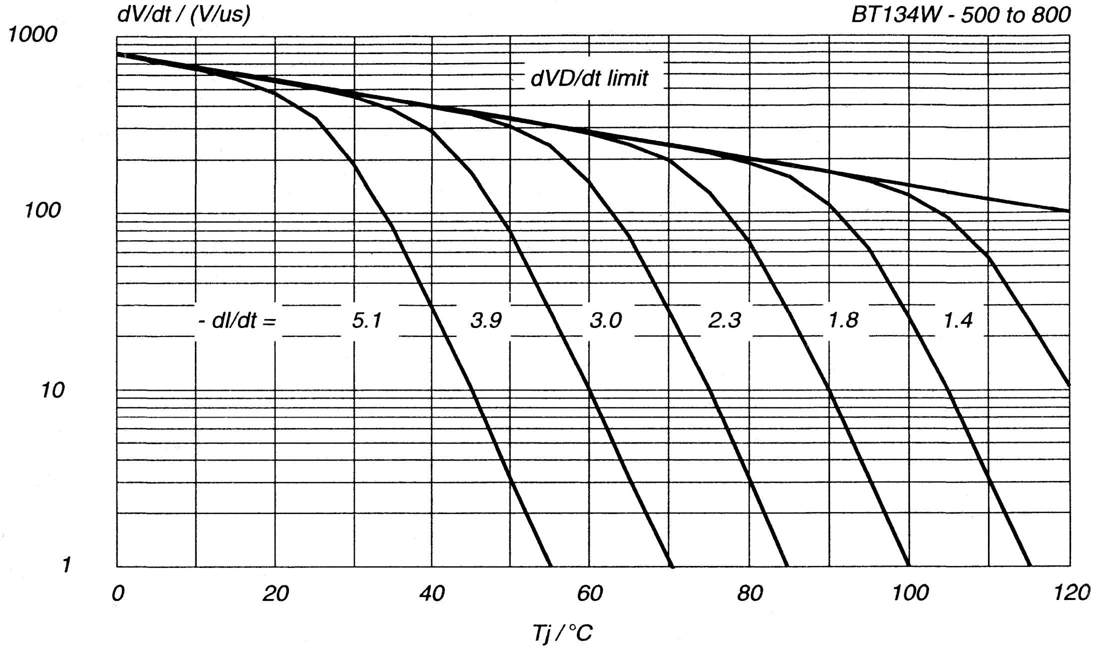


Fig.6. Typical commutation dV/dt for BT134W - 500/600/700/800 versus T_j. The triac should commutate when the dV/dt is below the value on the appropriate curve for pre-commutation dI_T/dt.

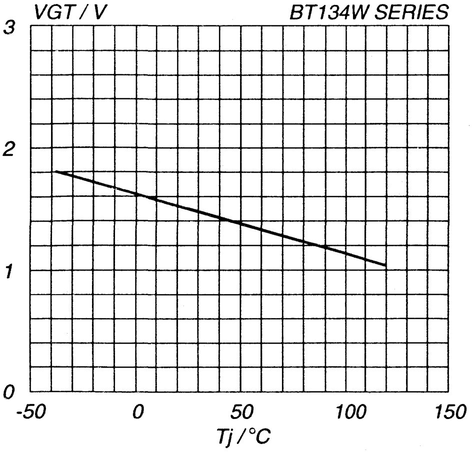


Fig.7. Minimum gate voltage that will trigger all devices, all conditions.

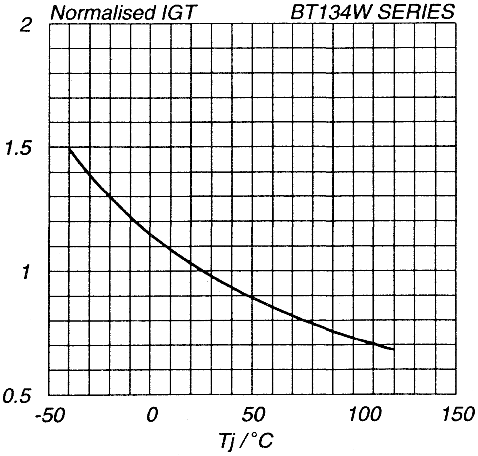


Fig.8. Normalised gate current (i.e. I_{GT} / I_{GT} @ 25˚C) that will trigger all devices, all conditions.

THYRISTORS

Glass-passivated, sensitive-gate thyristors in SOT-223 plastic envelopes suitable for surface mounting. They are intended for general purpose switching and phase-control applications.

QUICK REFERENCE DATA

			BT148W-400R	500R	600R	
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	400	500	600	V
Average on-state current	$I_{T(AV)}$	max.		0.6		A
RMS on-state current	$I_{T(RMS)}$	max.		1		A
Non-repetitive peak on-state current	I_{TSM}	max.		10		A
Gate trigger current	I_{GT}	>		200		μA

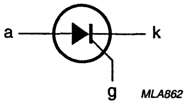
MECHANICAL DATA

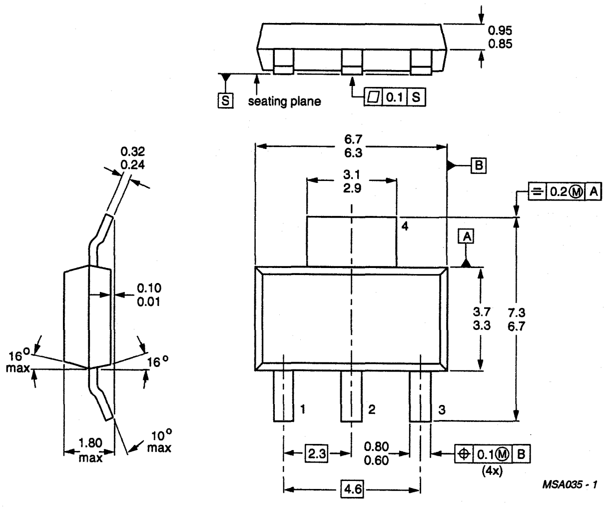
Dimensions in mm

Fig. 1 SOT-223

Pinning:

1 = Cathode
2 = Anode
3 = Gate
4 = Anode (tab)





Net mass: 0.11 g.
Notes:
1. Refer to surface mounting instructions for SOT-223 envelope.

RATINGS

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

Anode to cathode			BT148W-400R	500R	600R	
Non-repetitive peak voltages†	V_{DSM}/V_{RSM}	max.	400	500	600	V
Repetitive peak voltages†	V_{DRM}/V_{RRM}	max.	400	500	600	V
Crest working voltages	V_{DWM}/V_{RWM}	max.	400	400	400	V
Continuous voltages	V_D/V_R	max.	400	400	400	V

Average on-state current (averaged over any 20 ms period) up to $T_b = 84.5\ °C$	$I_{T(AV)}$	max.	0.6	A
RMS on-state current	$I_{T(RMS)}$	max.	1	A
Repetitive peak on-state current	I_{TRM}	max.	10	A
Non-repetitive peak on-state current t = 10 ms; half sinewave; $T_j = 110\ °C$ prior to surge; with reapplied V_{RWMmax}	I_{TSM}	max.	10	A
I^2t for fusing (t = 10 ms)	I^2t	max.	0.5	A^2s
Rate of rise of on-state current after triggering when $I_G = 200$ mA to $I_T = 4A$; $dI_G/dt = 200\ mA/\mu s$	dI_T/dt	max.	50	A/μs
Gate to cathode				
Reverse gate voltage	V_{GR}	max.	5	V
Peak gate current; $t_{max} = 10\ \mu s$	I_{GM}	max.	10	A
Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	0.12	W
Peak power dissipation	P_{GM}	max.	1.2	W
Temperatures				
Storage temperature	T_{stg}		−40 to + 125	°C
Junction temperature	T_j	max.	110	°C

THERMAL RESISTANCE

From junction to board p.c.b. mounted (see Fig. 3); temperature measured 1—3 mm from tab (see Fig. 1 for tab).	$R_{th\ j-b}$	=	30	K/W
Junction to ambient p.c.b. mounted (see Fig. 3).	$R_{th\ j-a}$	=	70	K/W

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† $R_{GK} = 1\ k\Omega$.

CHARACTERISTICS (T_j = 25 °C unless otherwise stated)

Anode to cathode

On-state voltage	V_T	typ.	1.1	V
I_T = 1.5 A	V_T	$<$	1.8	V
Rate of rise of off-state voltage that will not trigger any device R_{GK} = 1 kΩ; T_j = 110 °C	dV_D/dt	typ.	5	V/μs
Reverse current $V_R = V_{RWMmax}$; T_j = 110 °C	I_R	$<$	0.5	mA
Off-state current $V_D = V_{DWMmax}$; T_j = 110 °C	I_D	$<$	0.5	mA
Latching current	I_L	$<$	10	mA
Holding current	I_H	$<$	6	mA

Gate to cathode

Voltage that will trigger all devices				
V_D = 12 V	V_{GT}	$>$	1.5	V
V_D = 12 V; T_j = −40 °C	V_{GT}	$>$	2.3	V
Voltage that will not trigger any device V_D = 12 V; T_j = 110 °C	V_{GD}	$<$	250	mV
Current that will trigger all devices V_D = 12 V	I_{GT}	$>$	200	μA

MOUNTING INSTRUCTIONS

All dimensions in mm

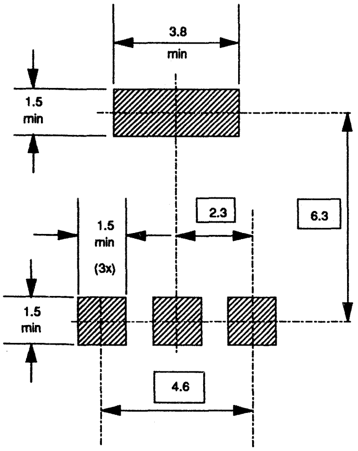


Fig. 2 soldering pattern for surface mounting SOT-223.

PRINTED CIRCUIT BOARD

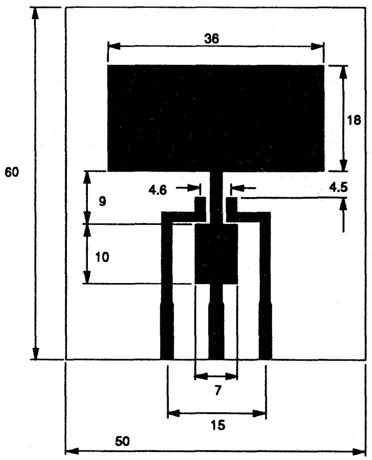


Fig. 3 PCB for thermal resistance and power rating for SOT-223.

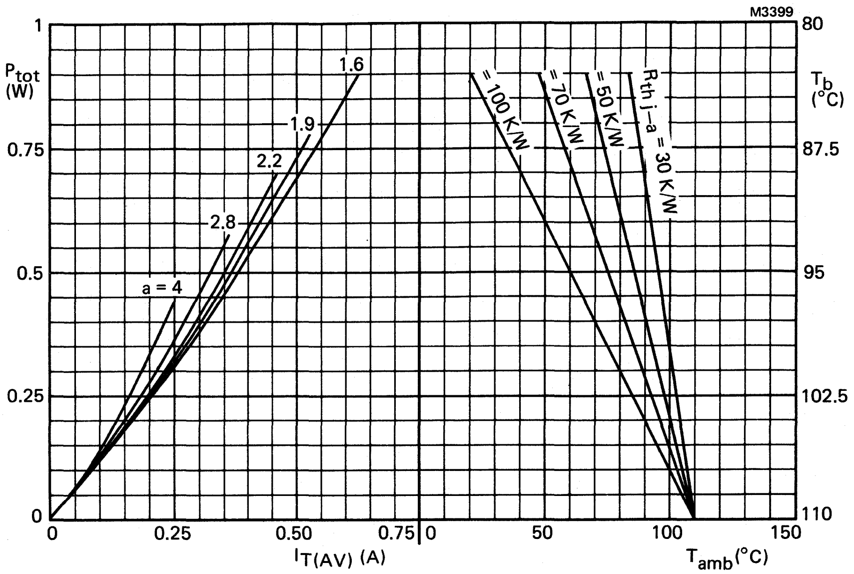
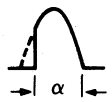


Fig. 4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures for various p.c.b. mountings.



α = conduction angle per half cycle

a = form factor = $\frac{I_{T(RMS)}}{I_{T(AV)}}$

α	a
30°	4
60°	2.8
90°	2.2
120°	1.9
180°	1.57

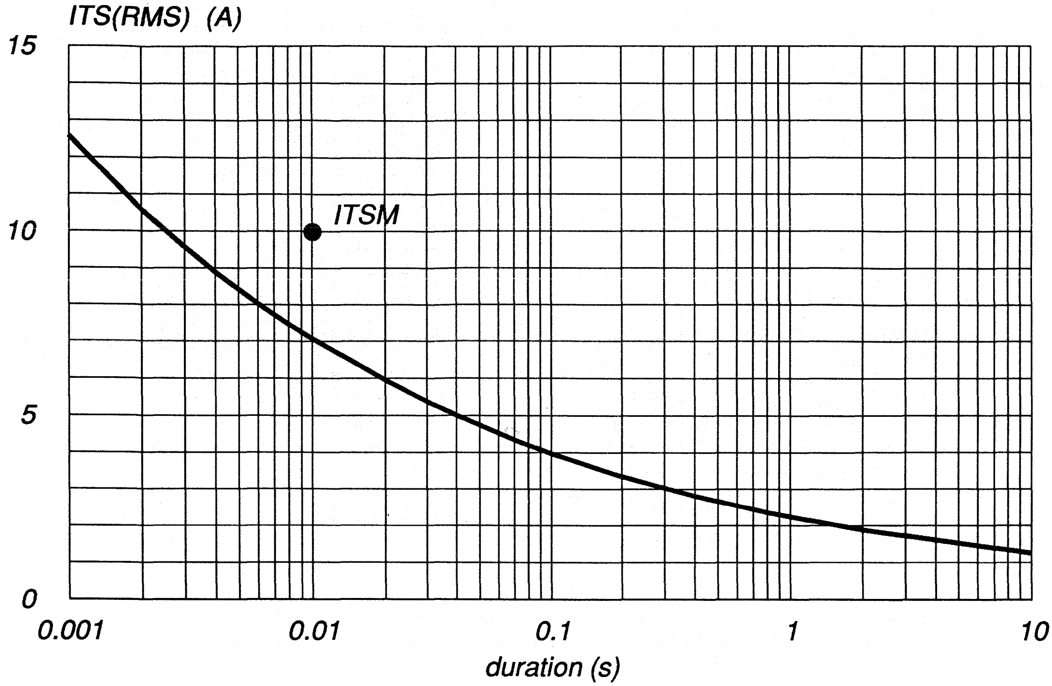
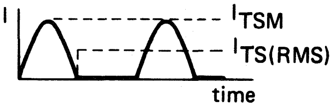


Fig. 5 Maximum permissible non-repetitive R.M.S. on-state current based on sinusoidal currents (f = 50 Hz) with reapplied V_{RWMmax}. T_j = 110 °C prior to surge.



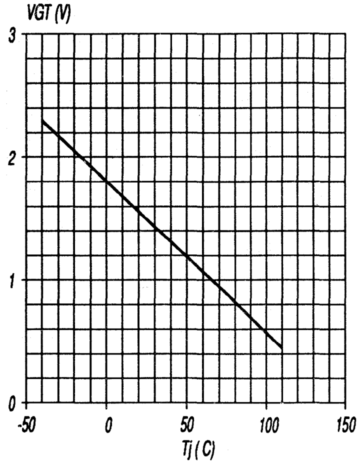


Fig. 6 Minimum gate voltage that will trigger all devices as a function of junction temperature.

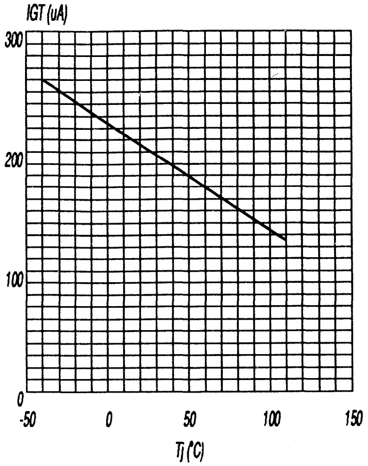


Fig. 7 Minimum gate current that will trigger all devices as a function of junction temperature.

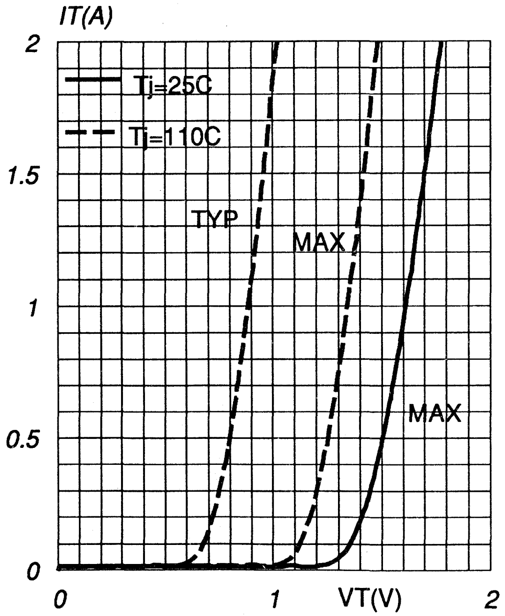


Fig. 8 On-state voltage drop.

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.

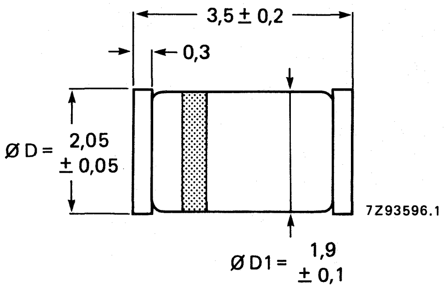
QUICK REFERENCE DATA

			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.



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* 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

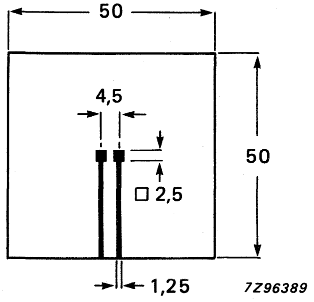

Fig. 2 Mounted on a p.c. board.

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

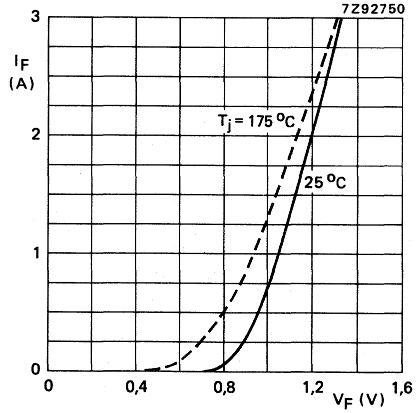

Fig. 3 Maximum forward voltage.

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* Measured under pulse conditions to avoid excessive dissipation.

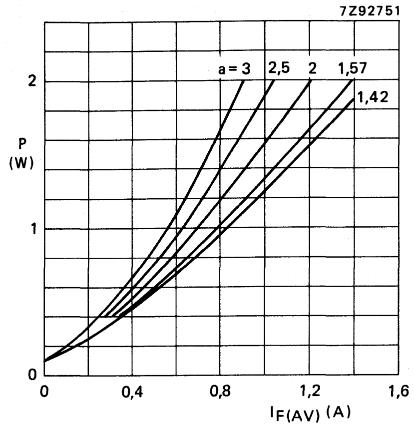

Fig. 4 Maximum values steady power dissipation (forward plus leakage current) as a function of the average (a) forward current. $a = I_{F(RMS)}/I_{F(AV)}$; $V_R = V_{RWMmax}$.

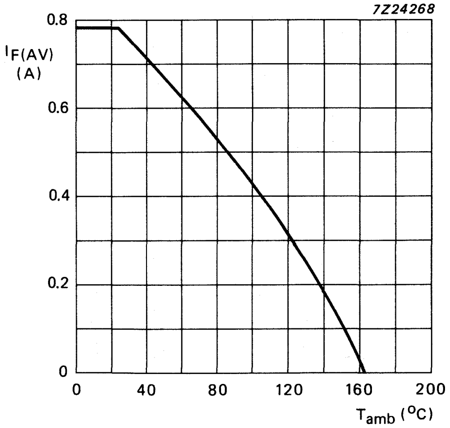

Fig. 5 Maximum average forward current as a function of temperature; the curves include losses due to reverse leakage.
$V_R = V_{RWMmax}$, $\delta = 0.5$; a = 1.57.
——— = ambient temperature and device mounted as shown in Fig. 2.

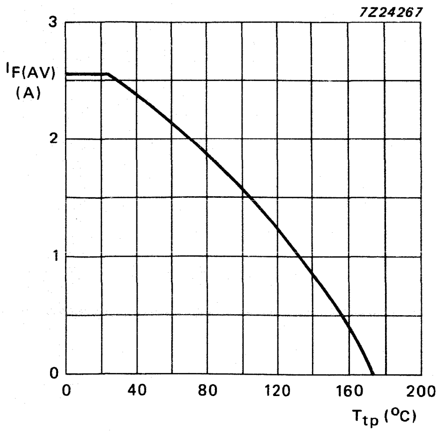

Fig. 6 Maximum average forward current as a function of temperature; the curves include losses due to reverse leakage.
$V_R = V_{RWMmax}$, $\delta = 0.5$; a = 1.57.
——— = tie-point temperature and device mounted as shown in Fig. 2.

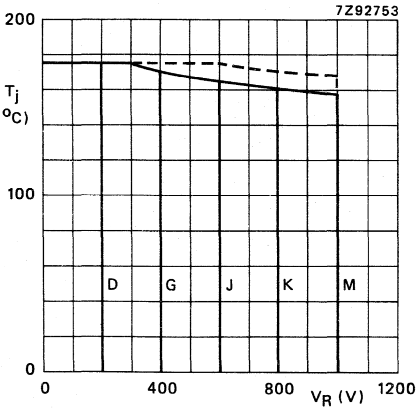

Fig. 7 Maximum permissible junction temperature as a function of reverse voltage;
——— = V_R; – – – – = V_{RWM}, $\delta = 0.5$.

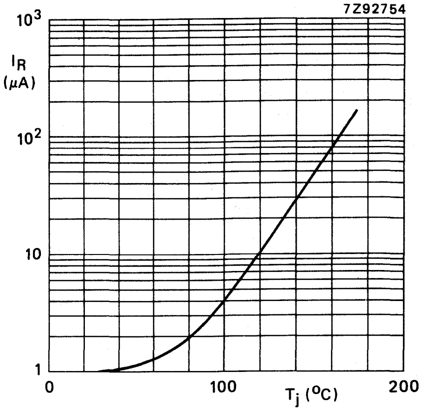

Fig. 8 Maximum values reverse current as a function of junction temperature; $V_R = V_{RWMmax}$.

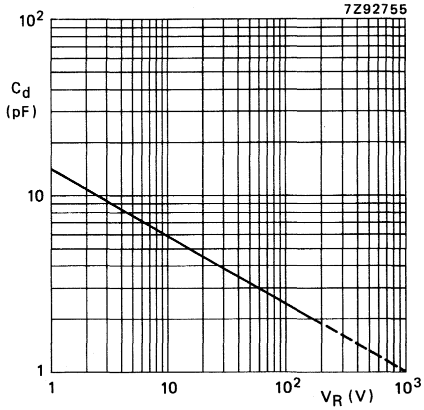

Fig. 9 Capacitance as a function of reverse voltage; f = 1 MHz; T_j = 25 °C; typical values.

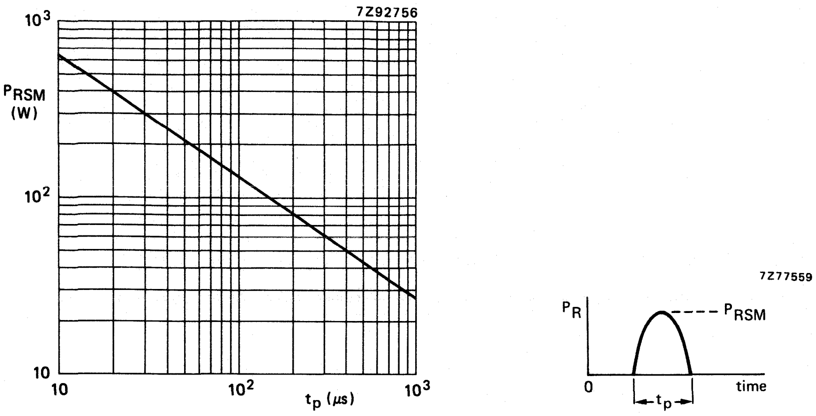

Fig. 10 Maximum permissible non-repetitive peak reverse power dissipation in the avalanche region; $T_j = T_{jmax}$.

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

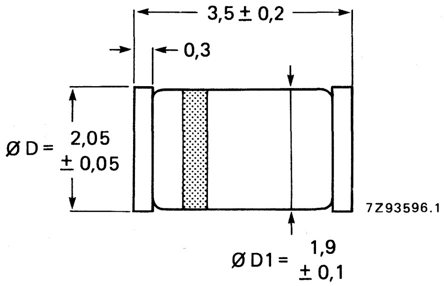

Fig. 1 SOD-87.

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* 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

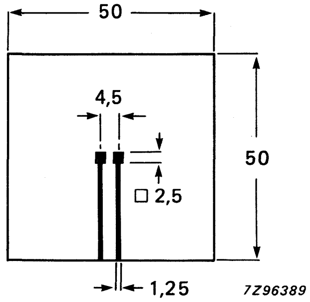

Fig. 2 Mounted on a PCB.

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	$\lvert dI_R/dt \rvert$	$<$	6			5		A/μs

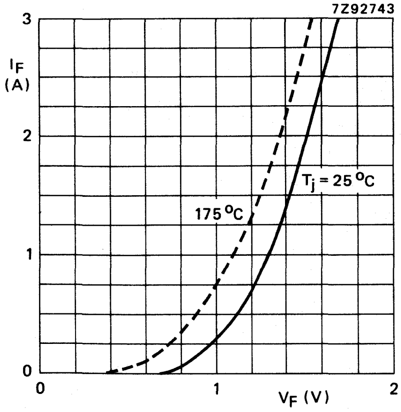

Fig. 3 Maximum forward voltage.

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* Measured under pulse conditions to avoid excessive dissipation.

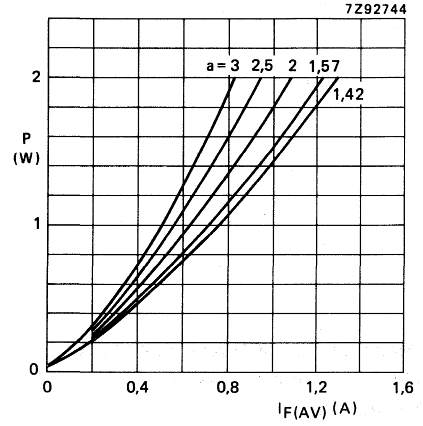


Fig. 4 Maximum values steady state power dissipation (forward plus leakage current) excluding switching losses as a function of the forward current.
The graph is for switched-mode application.
$a = I_{F(RMS)}/I_{F(AV)}$; $V_R = V_{RRMmax}$.

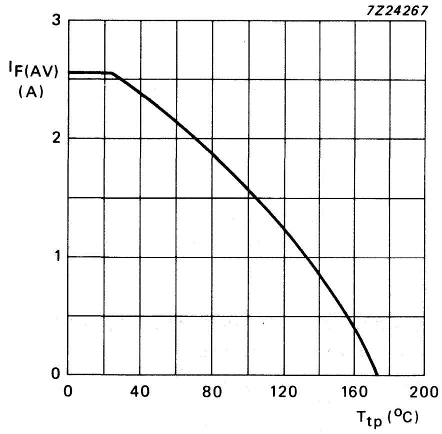


Fig. 5 Maximum average forward current as a function of temperature; the curve includes losses due to reverse leakage.
The graph is for switched-mode application.
$V_R = V_{RRMmax}$, $\delta = 0.5$; a = 1.42.
—— = tie-point temperature.

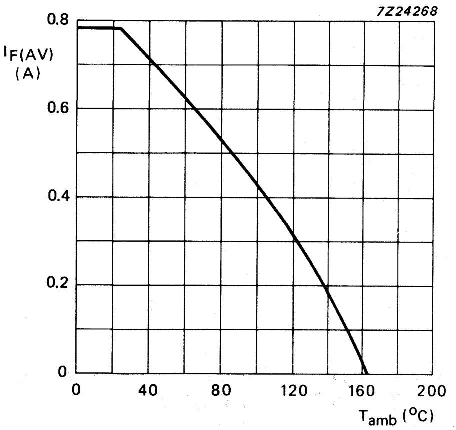


Fig. 6 Maximum average forward current as a function of temperature; the curve includes losses due to reverse leakage.
The graph is for switched-mode application.
$V_R = V_{RRMmax}$, $\delta = 0.5$; a = 1.42.
—— = ambient temperature and device mounted as shown in Fig. 2.

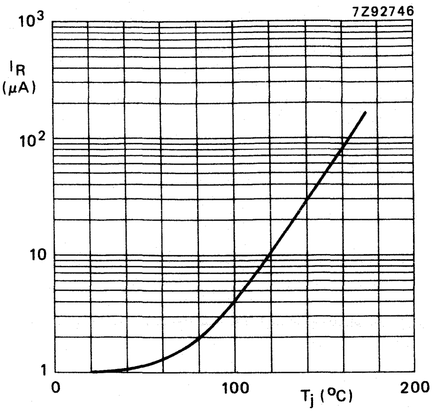


Fig. 7 Maximum values reverse current as a function of junction temperature.
$V_R = V_{RRMmax}$.

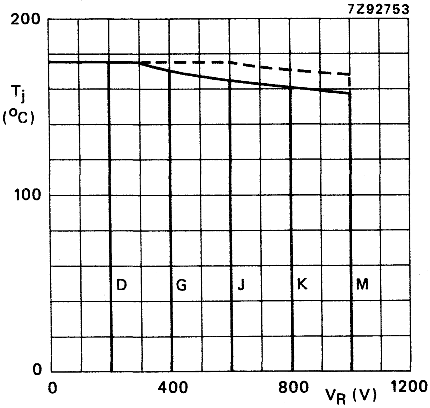


Fig. 8 Maximum permissible junction temperature as a function of reverse voltage.
——— = V_R; – – – = V_{RRM}; $\delta = 0.5$.

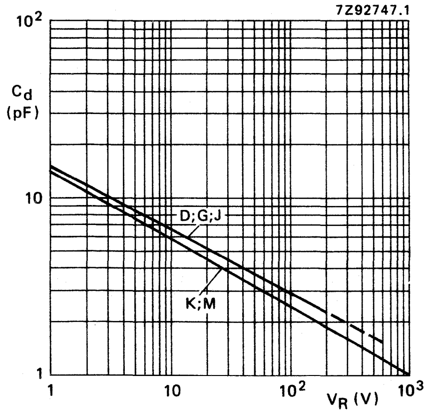


Fig. 9 Capacitance as a function of reverse voltage.
f = 1 MHz; T_j = 25 °C; typical values.

Very fast soft-recovery avalanche rectifier diodes

BYD57 series

DESCRIPTION

Glass passivated epitaxial rectifier diodes in hermetically sealed leadless surface mounted implosion diode (SMID) envelopes. Intended for use in switched-mode power supplies and high frequency inverter circuits. In general they are used where high output voltages and low switching losses are essential. The devices feature non-snap-off (soft-recovery) switching characteristics and are capable of absorbing reverse transient energy.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MAX.	UNIT
V_{RRM}	repetitive peak reverse voltage		
	BYD57D	200	V
	BYD57G	400	V
	BYD57J	600	V
	BYD57K	800	V
	BYD57M	1000	V
V_R	continuous reverse voltage		
	BYD57D	200	V
	BYD57G	400	V
	BYD57J	600	V
	BYD57K	800	V
	BYD57M	1000	V
$I_{F(AV)}$	average forward current	1	A
I_{FSM}	non-repetitive peak forward current	15	A
E_{RSM}	non-repetitive peak reverse energy	10	mJ
t_{rr}	reverse recovery time		
	BYD57D; BYD57G; BYD57J	30	ns
	BYD57K; BYD57M;	75	ns

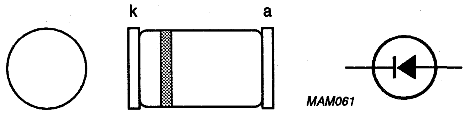


Fig.1 Simplified outline (SOD87) and symbol.

LIMITING VALUES

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

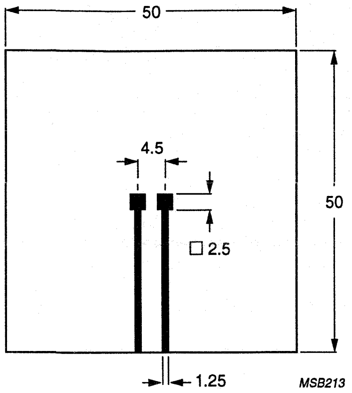
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{RRM}	repetitive peak reverse voltage				
	BYD57D		–	200	V
	BYD57G		–	400	V
	BYD57J		–	600	V
	BYD57K		–	800	V
	BYD57M		–	1000	V
V_R	continuous reverse voltage				
	BYD57D		–	200	V
	BYD57G		–	400	V
	BYD57J		–	600	V
	BYD57K		–	800	V
	BYD57M		–	1000	V
$I_{F(AV)}$	average forward current	T_{tp} = 85 °C; averaged over any 20 ms period	–	1	A
		T_{amb} = 60 °C; PCB mounted; see Fig.2	–	0.4	A
I_{FRM}	repetitive peak forward current		–	8.5	A
I_{FSM}	non-repetitive peak forward current	t = 10 ms half sinewave; T_j = 25 °C prior to surge; $V_{RRM} = V_{RRMmax}$	–	15	A
E_{RSM}	non-repetitive peak reverse energy	I_R = 400 mA; $T_j = T_{j\,max}$ prior to surge; inductive load switched off	–	10	mJ
T_{stg}	storage temperature		–65	+175	°C
T_j	junction temperature		–	175	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}tp}$	thermal resistance from junction to tie-point		30 K/W
$R_{th\ j\text{-}amb}$	thermal resistance from junction to ambient	note (1)	150 K/W

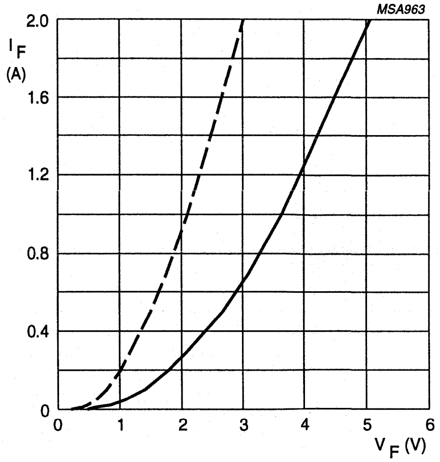
Note

1. Device mounted on a 1.5 mm thick epoxy-glass printed-circuit board; thickness of copper ≥ 40 μm; see Fig.2.



Dimensions in mm.

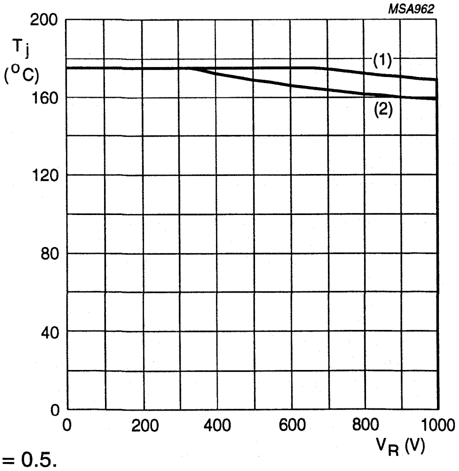
Fig.2 Printed-circuit board for surface mounting.



Solid line: $T_j = 25$ °C.

Dotted line: $T_j = 175$ °C.

Fig.3 Maximum forward current as a function of forward voltage.



$\delta = 0.5$.

(1) V_{RRM}

(2) V_R

Fig.4 Maximum permissible junction temperature as a function of applied reverse voltage.

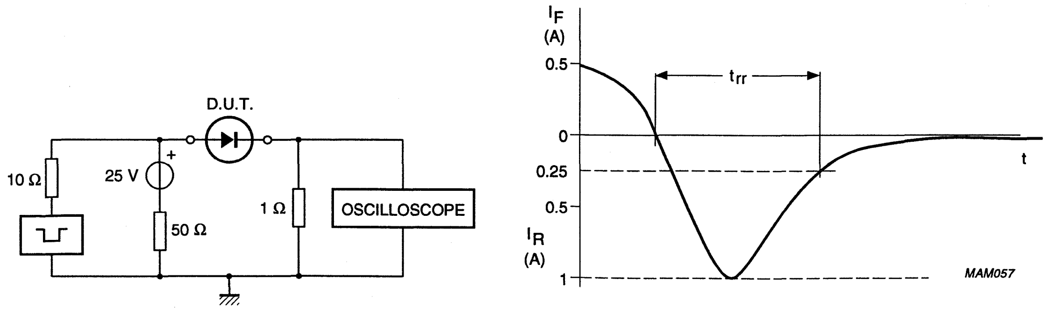
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_F	forward voltage	I_F = 1 A; $T_j = T_{j\,max}$; note (1)	–	2.1	V
		I_F = 1 A; note (1)	–	3.6	V
$V_{(BR)R}$	reverse avalanche breakdown voltage	I_R = 0.1 mA			
	BYD57D		300	–	V
	BYD57G		500	–	V
	BYD57J		700	–	V
	BYD57K		900	–	V
	BYD57M		1100	–	V
I_R	reverse current	$V_R = V_{RRMmax}$	–	5	µA
		$V_R = V_{RRMmax}$; T_j = 165 °C	–	100	µA
t_{rr}	reverse recovery time	switched from I_F = 0.5 A to I_R = 1 A; measured at I_R = 0.25 A			
	BYD57D; BYD57G; BYD57J		–	30	ns
	BYD57K; BYD57M		–	75	ns

Note

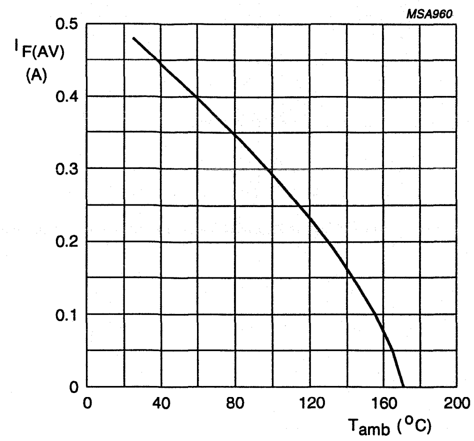
1. Measured under pulsed conditions to avoid excessive dissipation.



Input impedance oscilloscope: 1 MΩ , 22 pF; rise time < 7 ns.

Source impedance: 50 Ω ; rise time < 15 ns.

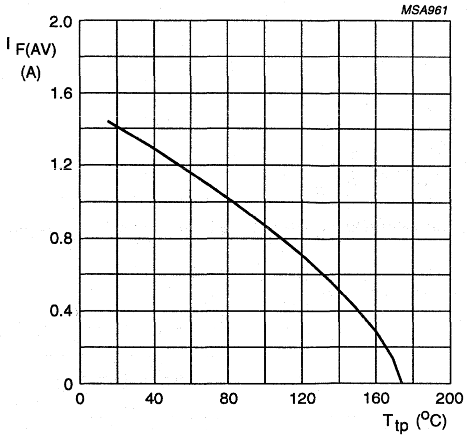
Fig.4 Test circuit and reverse recovery time definitions.



$V_R = V_{RRMmax}$; $\delta = 0.5$; a = 1.42.

Switched mode application.
Includes losses due to reverse leakage.

Fig.5 Maximum average forward current as a function of ambient temperature, device mounted on printed-circuit board (Fig.2).



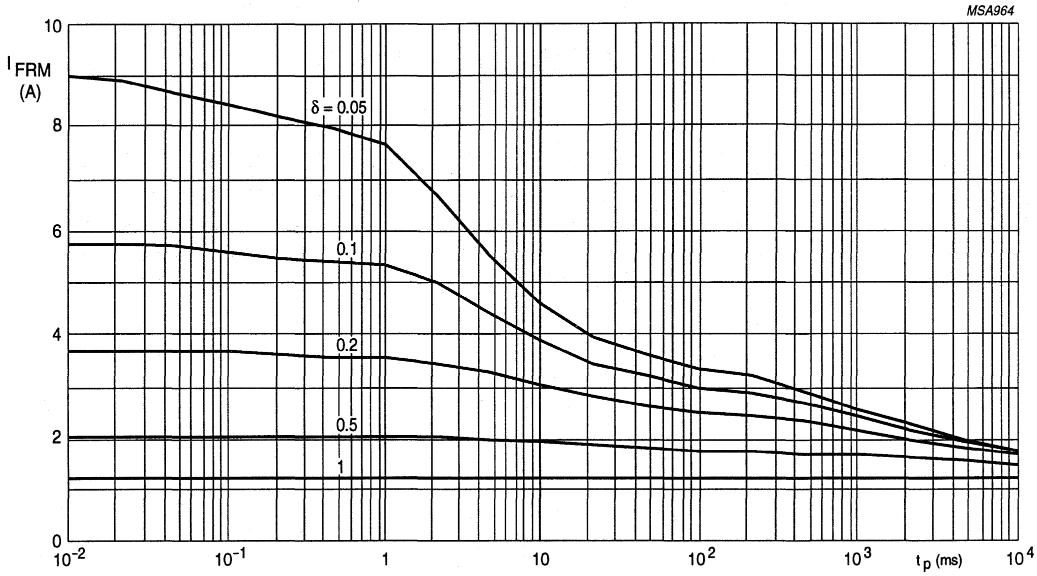
$V_R = V_{RRMmax}$; $\delta = 0.5$; a = 1.42.

Switched mode application.
Includes losses due to reverse leakage.

Fig.6 Maximum average forward current as a function of tie-point temperature.

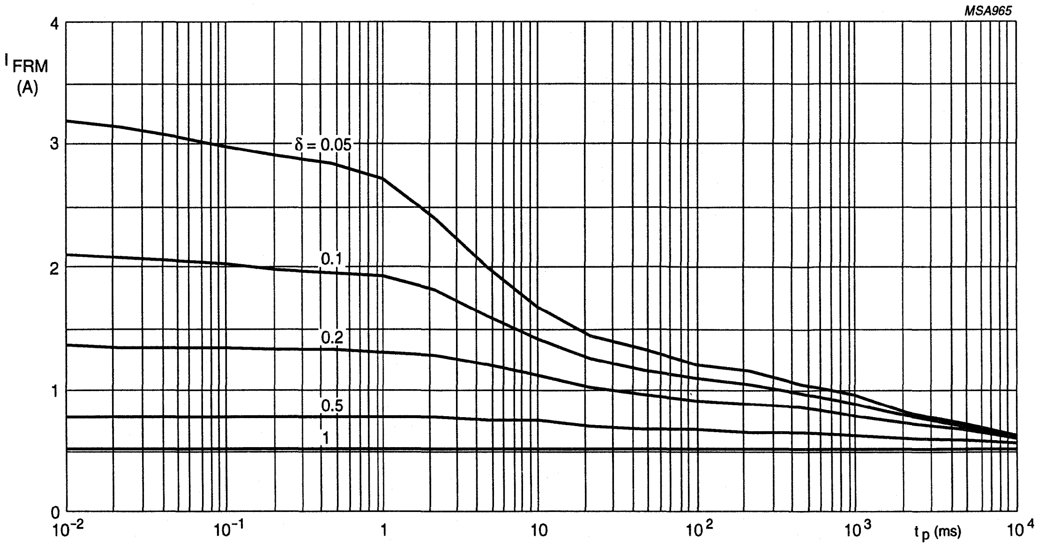
Very fast soft-recovery avalanche rectifier diodes

BYD57 series



T_{tp} = 85 °C; $R_{th\ j\text{-}tp}$ = 30 K/W; V_{RRM} during 1 – δ; the curves include derating for $T_{j\ max}$ at V_{RRM} = 600 V.

Fig.7 Maximum repetitive peak forward current as a function of pulse time (square pulse) and duty factor (δ).



T_{amb} = 60 °C; $R_{th\ j\text{-}a}$ = 150 K/W; V_{RRM} during 1 – δ; the curves include derating for $T_{j\ max}$ at V_{RRM} = 600 V.

Fig.8 Maximum repetitive peak forward current as a function of pulse time (square pulse) and duty factor (δ).

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.

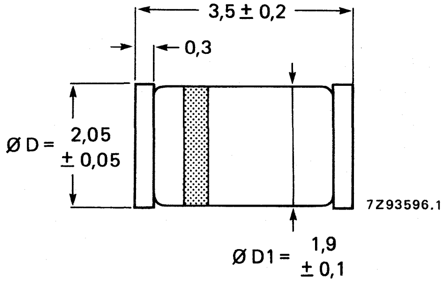
QUICK REFERENCE DATA

			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.



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* 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; $\delta = 0,5$ $T_{tp} = 105\ ^oC$	$I_{F(AV)}$	max.	2	2	2	2	1,85	1,85	1,85	A
$T_{amb} = 60\ ^oC$; 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 $T_j = 25\ ^oC$ 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							^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 when mounted on a 1,5 mm thick epoxy-glass printed-circuit board; Cu-thickness $\geqslant 40\ \mu m$; Fig 2.	$R_{th\,j\text{-}a}$	=	150	K/W

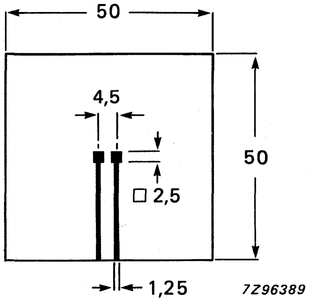

Fig 2. Mounted on a printed-circuit board.

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

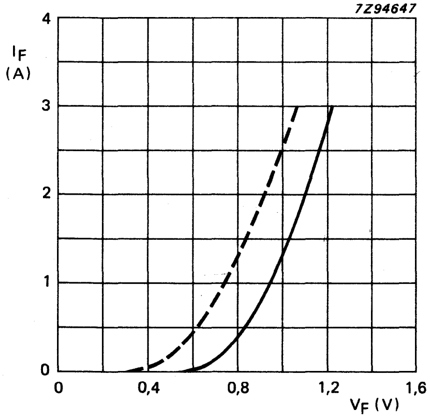

Fig. 3 **BYD77A; B; C; D.**
Maximum forward voltage.
—— T_j = 25 °C; – – – T_j = 175 °C.

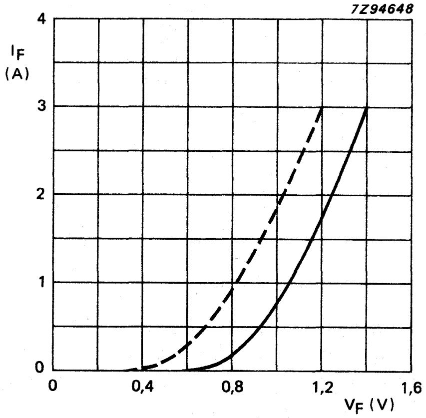

Fig. 4 **BYD77E; F; G.**
Maximum forward voltage.
—— T_j = 25 °C; – – – T_j = 175 °C.

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* Measured under pulse conditions to avoid excessive dissipation.

Dual rectifiers - SMD version
Ultra fast recovery

BYV40 series

GENERAL DESCRIPTION

Glass passivated high efficiency monolithic dual rectifiers in SOT223 plastic envelope suitable for surface mounting, featuring low forward voltage drop, ultra-fast recovery times and soft recovery characteristic.

QUICK REFERENCE DATA

(per diode, unless otherwise stated)

SYMBOL	PARAMETER	MAX.			UNIT
	BYV40	**-100**	**-150**	**-200**	
V_{RRM}	Repetitive peak voltage	100	150	200	V
I_O	Output current (both diodes conducting)		1.5		A
V_F	Forward voltage		1		V
t_{rr}	Reverse recovery time		25		ns

MECHANICAL DATA

Dimensions in mm

Net Mass: 0.11 g

Pinning:

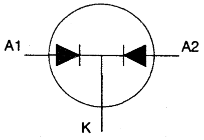
1 = Anode(A1)

2 = Cathode(K)

3 = Anode(A2)

4 = Cathode(K)

(tab)



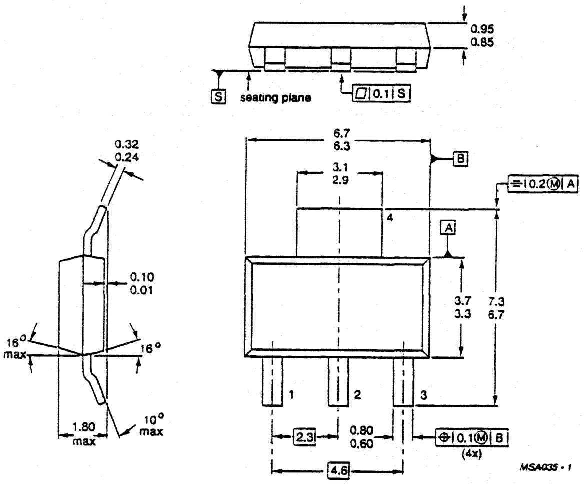


Fig. 1. SOT223 surface mounting package.

Notes

1. Refer to surface mounting instructions for SOT223 envelope.

Dual rectifiers - SMD version
Ultra fast recovery

BYV40 series

RATINGS

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

SYMBOL	PARAMETER	CONDITIONS	MAX.			UNIT
	Voltages (per diode)	**BYV40**	**-100**	**-150**	**-200**	
V_{RRM}	Repetitive peak reverse voltage		100	150	200	V
V_{RWM}	Crest working reverse voltage		100	150	200	V
V_R	Continuous reverse voltage		100	150	200	V
	Currents (both diodes conducting; see note 2)					
I_O	Output current	switching losses negligible up to 500 kHz; $T_b \leq 115$ ˚C				
		square wave; δ = 0.5		1.5		A
		sine wave		1.3		A
$I_{F(RMS)}$	R.M.S. forward current			2.1		A
I_{FRM}	Repetitive peak forward current (per diode)	$t_p = 20$ µs; δ = 0.02		35		A
I_{FSM}	Non-repetitive peak forward current (per diode)	t = 10 ms; half sine-wave; $T_j = 150$ ˚C prior to surge; with re-applied V_{RWM}max		6		A
I^2t	I^2t for fusing	t = 10 ms		0.18		A^2s
P_{tot}	Total Power dissipation mounted on a P.C.B.			1.5		W
	Temperatures		**MIN.**		**MAX.**	
T_{stg}	Storage temperature		-40		150	˚C
T_{sold}	Lead solder temperature		-		300	˚C
T_j	Operating junction temperature		-		150	˚C

Notes

2. The limits for both diodes apply whether both diodes conduct simultaneously or on alternate half cycles.

CHARACTERISTICS

Per diode; T_j at 25 ˚C unless otherwise stated

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_F	Forward voltage	$I_F = 1.5$ A	-	-	1	V
		$I_F = 0.5$ A; $T_j = 100$ ˚C	-	-	0.7	V
I_R	Reverse current	$V_R = V_{RWM}$ max	-	-	10	µA
		$V_R = V_{RWM}$ max; $T_j = 100$ ˚C	-	-	300	µA
Q_s	Recovered charge	$I_F = 2$ A to $V_R \geq 30$ V; $dI_F/dt = 20$ A/µs.	-	-	11	nC
t_{rr}	Reverse recovery time	$I_F = 1$ A to $V_R \geq 30$ V; $dI_F/dt = 100$ A/µs.	-	-	25	ns
V_{fr}	Forward recovery voltage	$I_F = 2$ A; $dI_F/dt = 20$ A/µs.	-	3.0	-	V

THERMAL RESISTANCES

Junction to board (per diode)	PCB mounted (see fig.3) Board temperature measured 1-3mm from tab. See fig. 1 for tab.	$R_{th\,j\text{-}b} = 30$ K/W
Junction to ambient	PCB mounted (see fig.3)	$R_{th\,j\text{-}a} = 70$ K/W

MOUNTING INSTRUCTIONS

Dimensions in mm.

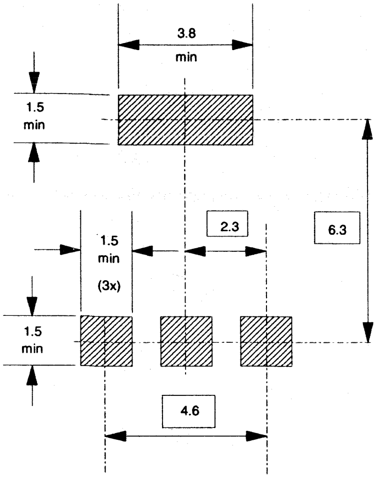


Fig.2. soldering pattern for surface mounting SOT223.

PRINTED CIRCUIT BOARD

Dimensions in mm.

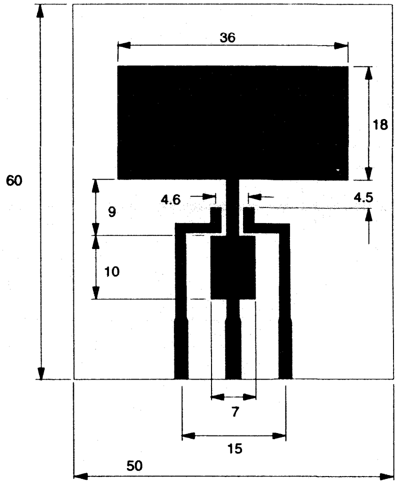
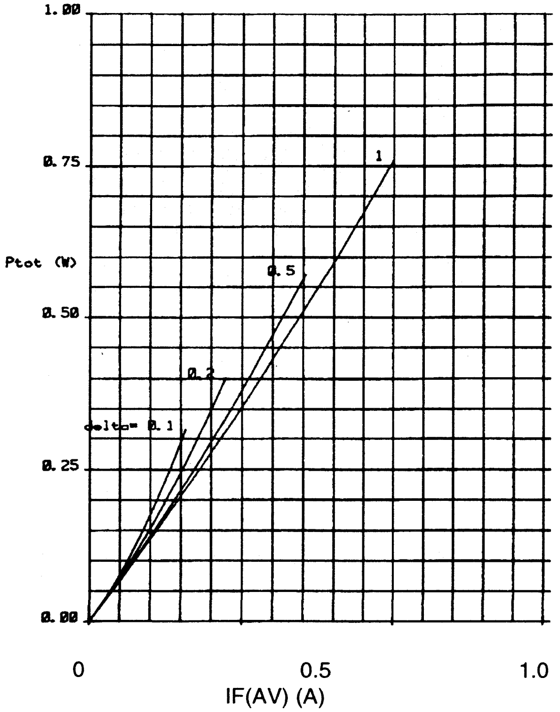
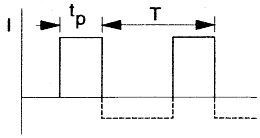


*Fig.3. PCB for thermal resistance and power rating for SOT223.
PCB: FR4 epoxy glass (1.6 mm thick), copper laminate (35 μm thick).*

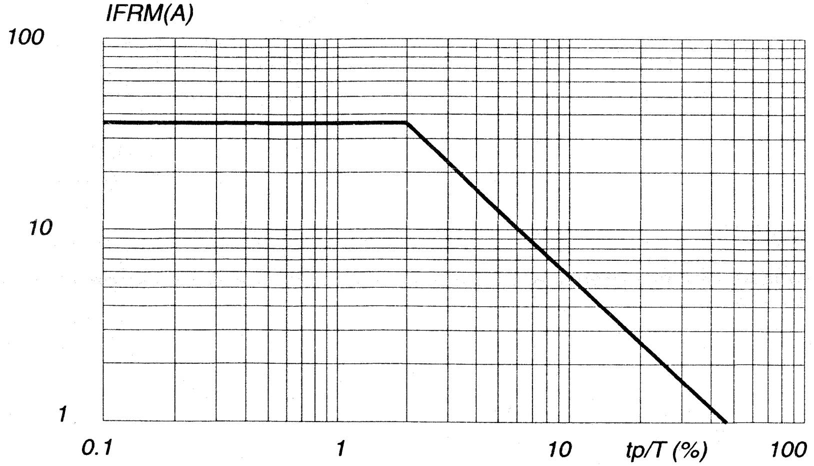




$$I_{F(AV)} = I_{F(RMS)} x \sqrt{\delta}$$

$$\delta = t_p/T$$

Fig.4. Power rating curves per diode.
The individual power loss in each diode should at first be determined then both added together. The resulting total power loss is then used



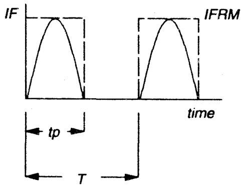


Fig.5. Maximum permissisble repetitive peak forward current for either square or sinusoidal currents for 1 µs < t_p < 1 ms; per diode.

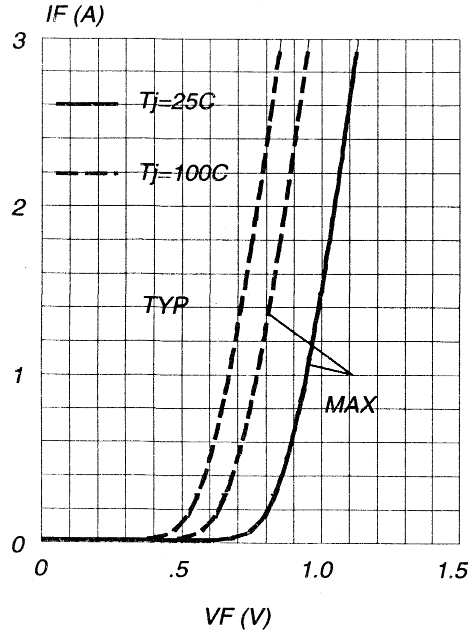


Fig.6. Forward voltage drop across each diode.

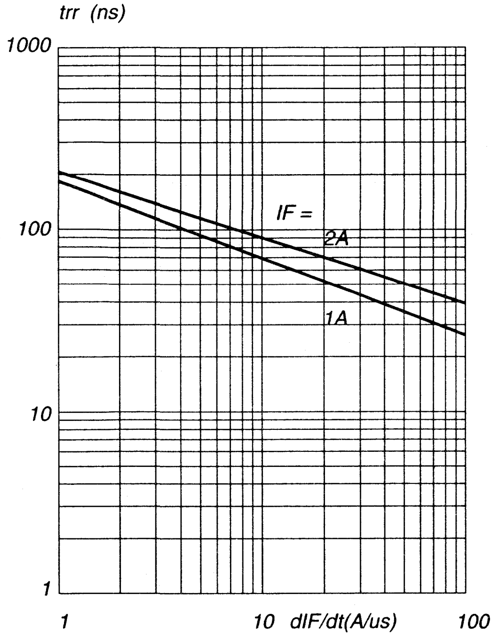


Fig.7. Maximum t_{rr} at T_j = 25 ˚C; per diode

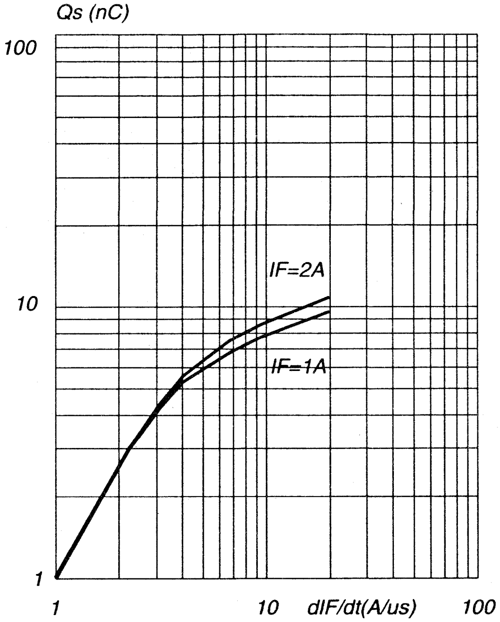


Fig.8. Maximum Q_s at T_j = 25 ˚C; per diode

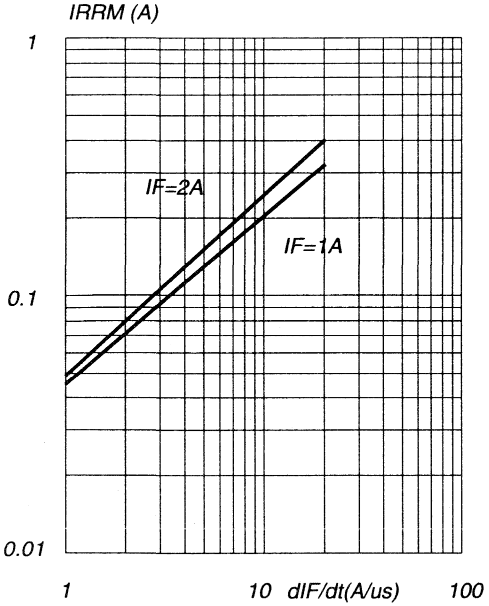


Fig.9. Maximum I_{RRM} at T_j = 25 ˚C; per diode

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 °C; t_p = 100 μs	P_{RSM}	max.	300		W

MECHANICAL DATA

Dimensions in mm

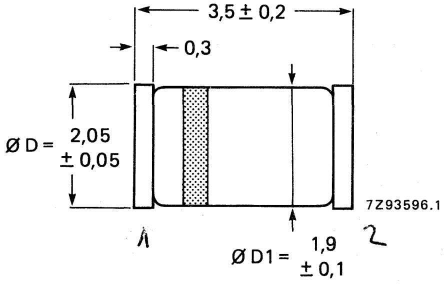


Fig. 1 SOD-87.

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* 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-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.			

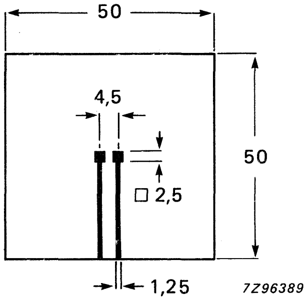


Fig. 2 Mounted on a printed-circuit board.

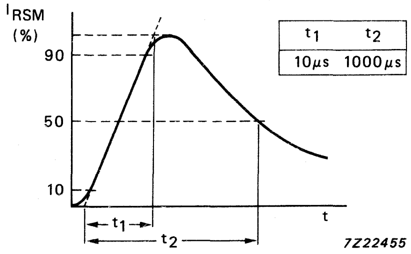


Fig. 3 Current pulse in accordance with IEC 60-2, Section 6.

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; $T_j = 25\ ^{o}C$

BZD27	clamping voltage (10/1000 pulse)	non-repetitive at peak reverse	reverse current at recommended stand-off voltage	
	$V_{(CL)R}$ V	I_{RSM} A	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

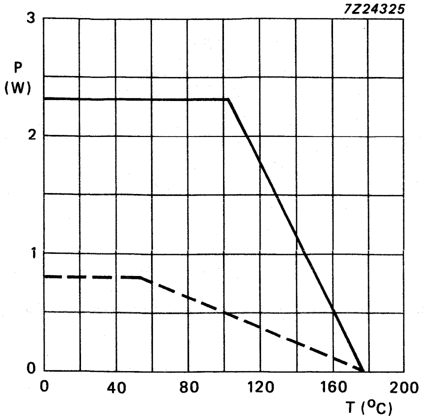


Fig. 4 Maximum total power dissipation as a function of temperature.

——— = tie-point temperature
– – – = ambient temperature and device mounted ans shown in Fig. 2.

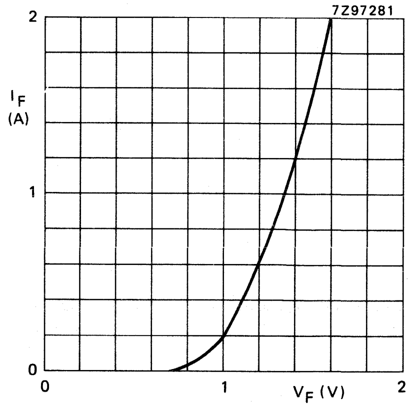


Fig. 5 Forward voltage; T_j = 25 °C; typical values.

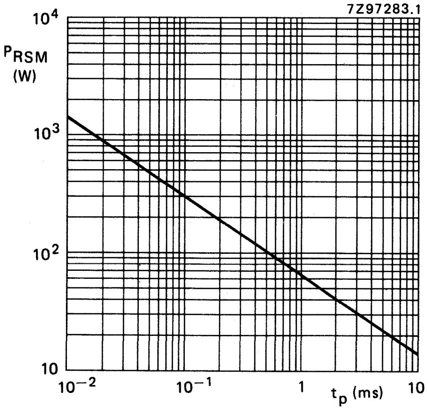


Fig. 6 Maximum non-repetitive peak reverse power dissipation (square pulse); T_j = 25 °C prior to surge.

Voltage regulator diodes BZG03 series

DESCRIPTION

High reliability glass-passivated diodes in a small rectangular SMD SOD106A envelope. The envelope dimensions meet JEDEC DO-214AC envelope specification. They are intended for use as medium power voltage regulator diodes, especially in automotive applications.

The series consists of BZG03-C10 to BZG03-C270 in the normalized E24 range.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	NOM.	MAX.	UNIT
V_Z	working voltage range	10 to 270	–	V
P_{tot}	total power dissipation	–	3	W
P_{ZSM}	non-repetitive peak reverse power dissipation	–	600	W

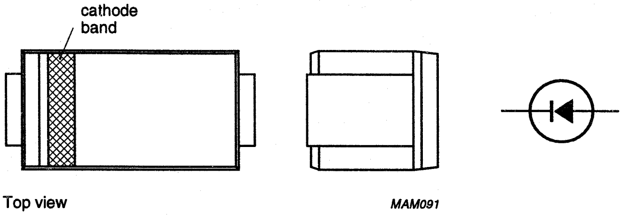


Fig.1 Simplified outline (SOD106A) and symbol.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
P_{tot}	total power dissipation	T_{tp} = 100 °C	–	3	W
		T_{amb} = 50 °C; PCB mounted; see Fig 2	–	1.25	W
P_{ZSM}	non-repetitive peak reverse power dissipation	t_p = 100 µs, square pulse; T_j = 25 °C prior to surge	–	600	W
T_{stg}	storage temperature		–65	+175	°C
T_j	junction temperature		–65	+175	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}tp}$	thermal resistance from junction to tie-point		25 K/W
$R_{th\ j\text{-}amb}$	thermal resistance from junction to ambient	note (1)	100 K/W
		note (2)	150 K/W

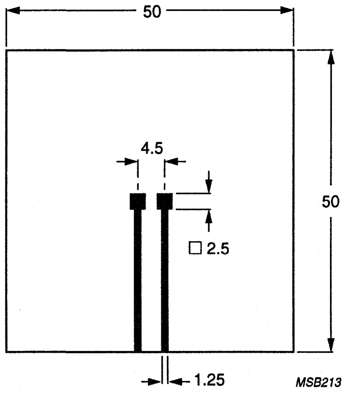
Note

1. Device mounted on a 0.7 mm thick Al_2O_3 printed-circuit board; thickness of copper ≥ 35 µm; see Fig 2.
2. Device mounted on a 1.5 mm thick epoxy glass printed-circuit board; thickness of copper ≥ 40 µm ; see Fig 2

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

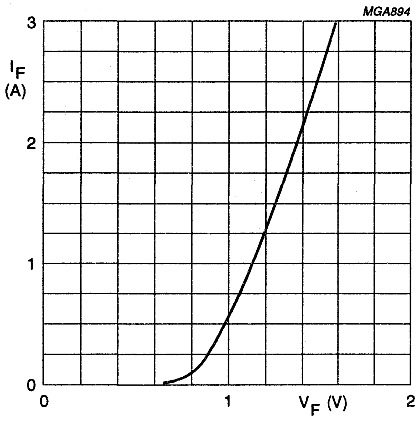
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_F	forward voltage	I_F = 0.5 A	–	1.2	V



Dimensions in mm.

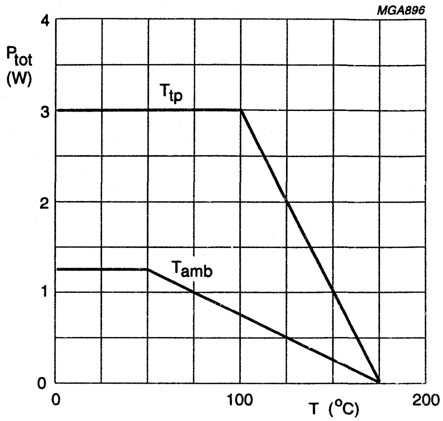
Fig.2 Printed-circuit board for surface mounting.

BZG03 -XXXX	WORKING VOLTAGE			DIFFERENTIAL RESISTANCE		TEMPERATURE COEFFICIENT		TEST CURRENT	REVERSE CURRENT at REVERSE VOLTAGE	
	V_Z (V) at I_Z			r_{dif} (Ω) at I_Z		S_Z (%/K) at I_Z		I_Z (mA)	I_R (μA)	V_R (V)
	MIN.	NOM.	MAX.	TYP.	MAX.	MIN.	MAX.		MAX.	
C10	9.4	10	10.6	2	4	0.05	0.09	50	10	7.5
C11	10.4	11	11.6	4	7	0.05	0.10	50	4	8.2
C12	11.4	12	12.7	4	7	0.05	0.10	50	3	9.1
C13	12.4	13	14.1	5	10	0.05	0.10	50	2	10
C15	13.8	15	15.6	5	10	0.05	0.10	50	1	11
C16	15.3	16	17.1	6	15	0.06	0.11	25	1	12
C18	16.8	18	19.1	6	15	0.06	0.11	25	1	13
C20	18.8	20	21.2	6	15	0.06	0.11	25	1	15
C22	20.8	22	23.3	6	15	0.06	0.11	25	1	16
C24	22.8	24	25.6	7	15	0.06	0.11	25	1	18
C27	25.1	27	28.9	7	15	0.06	0.11	25	1	20
C30	28	30	32	8	15	0.06	0.11	25	1	22
C33	31	33	35	8	15	0.06	0.11	25	1	24
C36	34	36	38	21	40	0.06	0.11	10	1	27
C39	37	39	41	21	40	0.06	0.11	10	1	30
C43	40	43	46	24	45	0.07	0.12	10	1	33
C47	44	47	50	24	45	0.07	0.12	10	1	36
C51	48	51	54	25	60	0.07	0.12	10	1	39
C56	52	56	60	25	60	0.07	0.12	10	1	43
C62	58	62	66	25	80	0.08	0.13	10	1	47
C68	64	68	72	25	80	0.08	0.13	10	1	51
C75	70	75	79	30	100	0.08	0.13	10	1	56
C82	77	82	87	30	100	0.08	0.13	10	1	62
C91	85	91	96	60	200	0.09	0.13	5	1	68
C100	94	100	106	60	200	0.09	0.13	5	1	75
C110	104	110	116	80	250	0.09	0.13	5	1	82
C120	114	120	127	80	250	0.09	0.13	5	1	91
C130	124	130	141	110	300	0.09	0.13	5	1	100
C150	138	150	156	130	300	0.09	0.13	5	1	110
C160	153	160	171	150	350	0.09	0.13	5	1	120
C180	168	180	191	180	400	0.09	0.13	5	1	130
C200	188	200	212	200	500	0.09	0.13	5	1	150
C220	208	220	233	350	750	0.09	0.13	2	1	160
C240	228	240	256	400	850	0.09	0.13	2	1	180
C270	251	270	289	450	1000	0.09	0.13	2	1	200



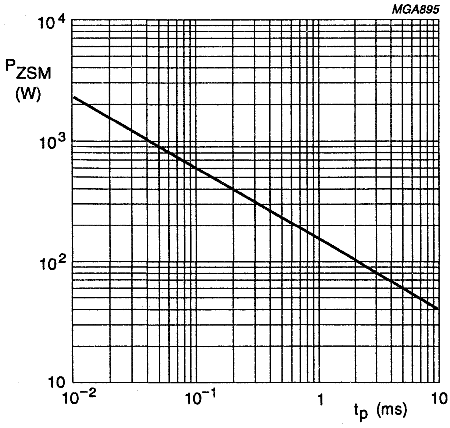
T_j = 25 °C.

Fig.3 Forward current as a function of forward voltage; typical values.



Device mounted as shown in Fig.2.

Fig.4 Maximum total power dissipation as a function of temperature.



T_j = 25 °C prior to surge.

Fig.5 Maximum non-repetitive peak reverse power dissipation (square pulse).

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).

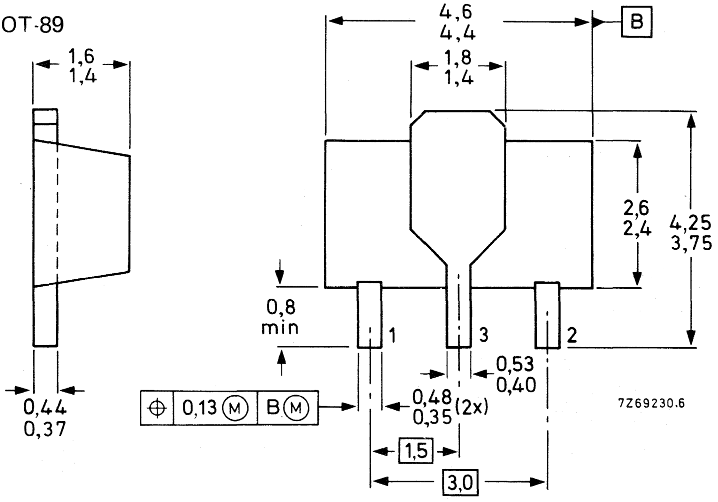
QUICK REFERENCE DATA

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

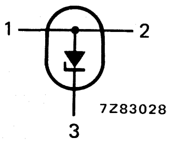
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-89



BOTTOM VIEW



Marking code

BZV49- C2V4 = 2Y4
C2V7 = 2Y7
C3V0 = 3Y0
C3V3 = 3Y3
C3V6 = 3Y6
C3V9 = 3Y9
C4V3 = 4Y3
C4V7 = 4Y7

C5V1 = 5Y1
C5V6 = 5Y6
C6V2 = 6Y2
C6V8 = 6Y8
C7V5 = 7Y5
C8V2 = 8Y2
C9V1 = 9Y1
C10 = 10Y
C11 = 11Y

C12 = 12Y
C13 = 13Y
C15 = 15Y
C16 = 16Y
C18 = 18Y
C20 = 20Y
C22 = 22Y
C24 = 24Y
C27 = 27Y
C30 = 30Y

C33 = 33Y
C36 = 36Y
C39 = 39Y
C43 = 43Y
C47 = 47Y
C51 = 51Y
C56 = 56Y
C62 = 62Y
C68 = 68Y
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		differential resistance		temperature coefficient			diode capacitance	
	V_Z (V) **at I_{Ztest} = 5 mA**		r_{diff} (Ω) **at I_{Ztest} = 5 mA**		S_Z (mV/K) **at I_{Ztest} = 5 mA**			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

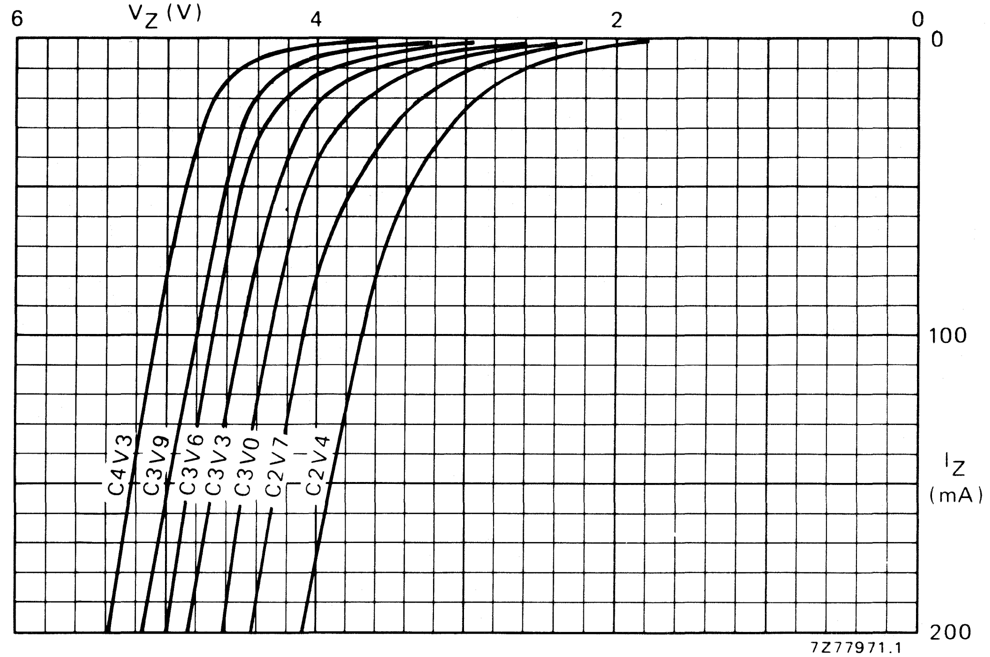


Fig. 2 Dynamic characteristics; typical values; T_j = 25 °C.

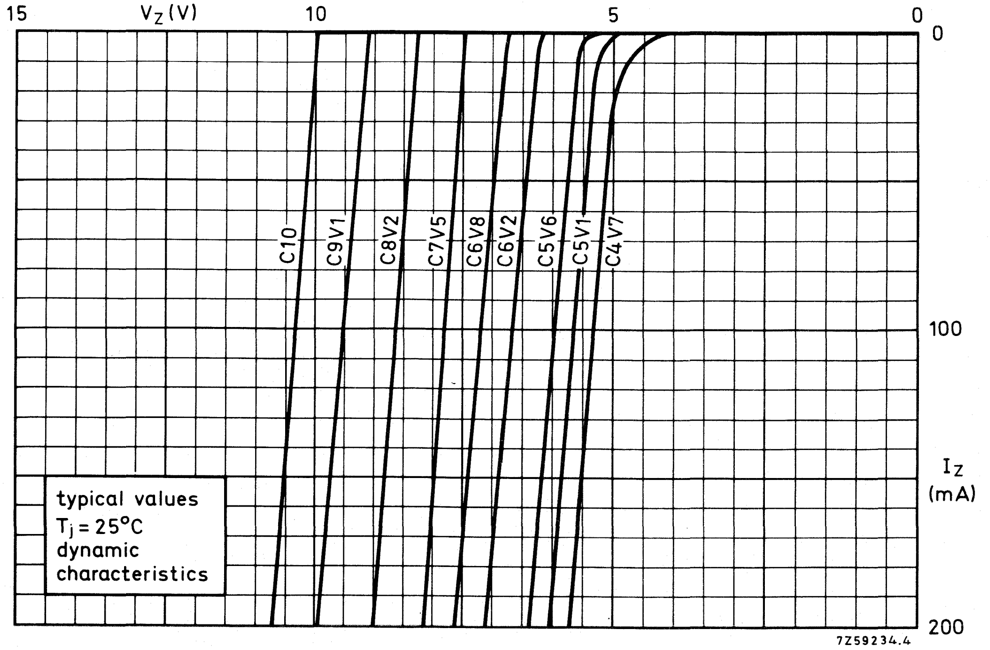


Fig. 3 Dynamic characteristics; typical values at T_j = 25 °C.

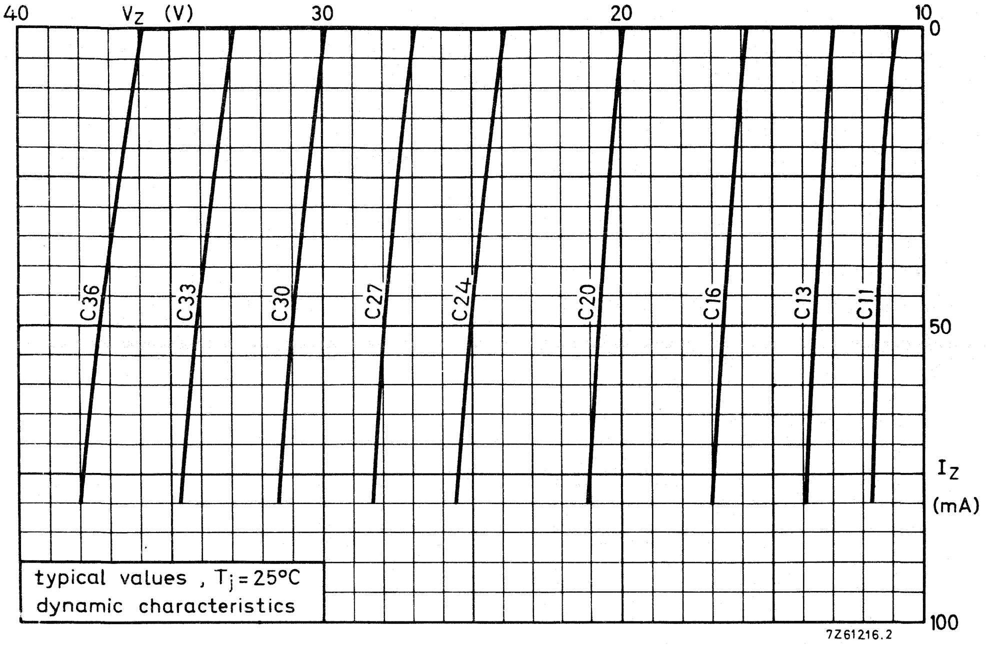


Fig. 4 Dynamic characteristics; typical values; T_j = 25 °C.

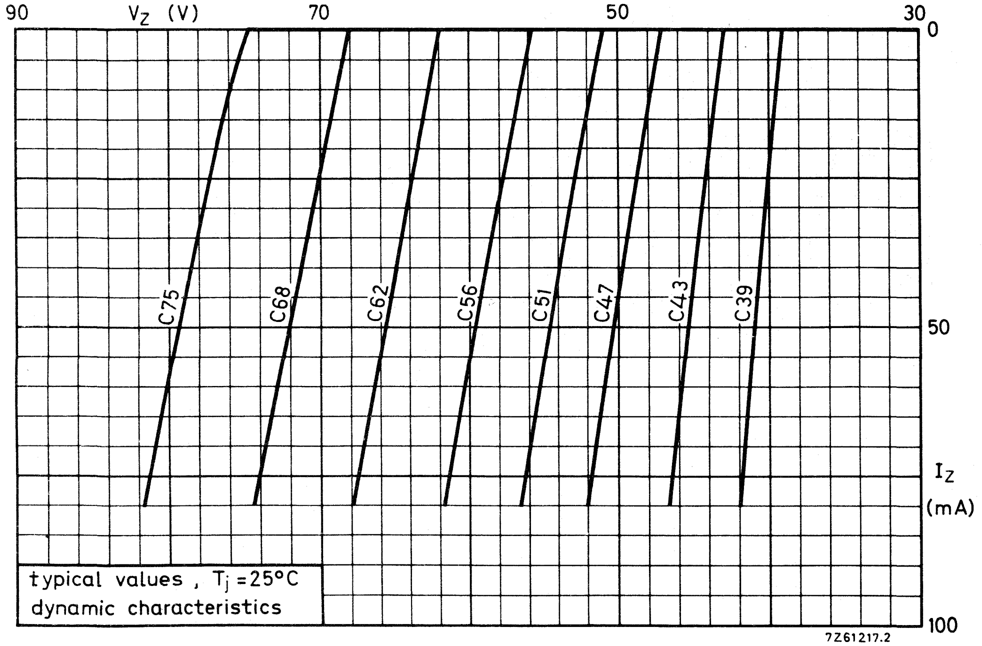


Fig. 5 Dynamic characteristics; typical values at T_j = 25 °C.

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.

$$V_{Z\,stat} = 24 + \left(\frac{7}{1000} \times 24 \times \frac{125}{1000} \times 20{,}3\right)$$
$$= 24 + 0{,}4 = 24{,}4\ \text{V}.$$

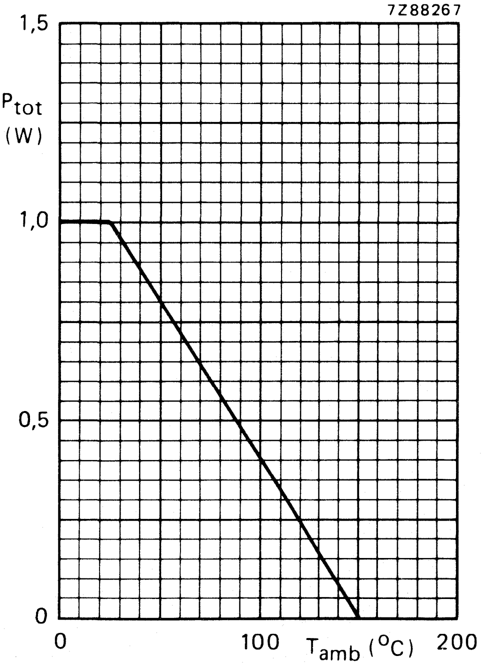


Fig. 6 Power derating curve.

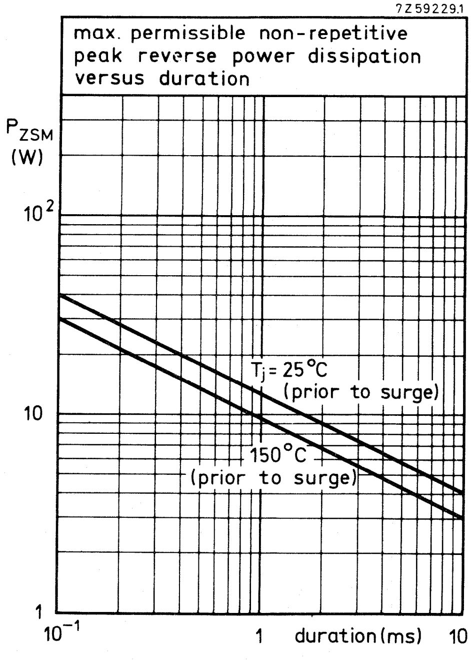


Fig. 7.

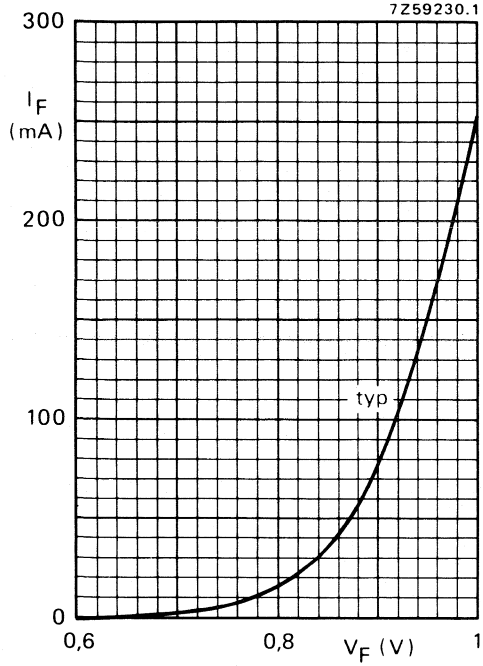


Fig. 8 T_j = 25 °C.

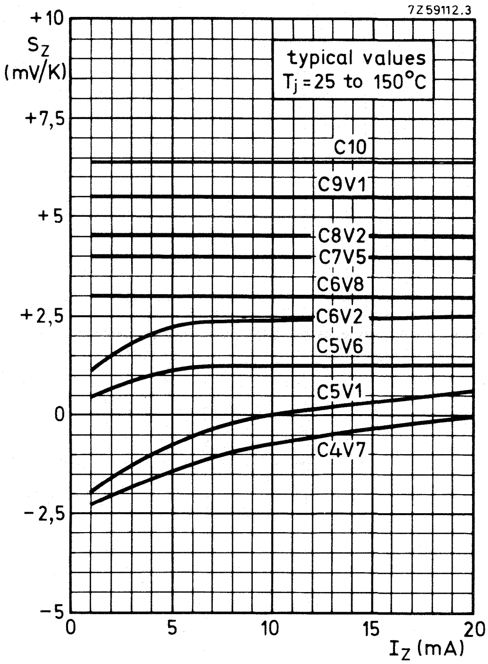


Fig. 9.

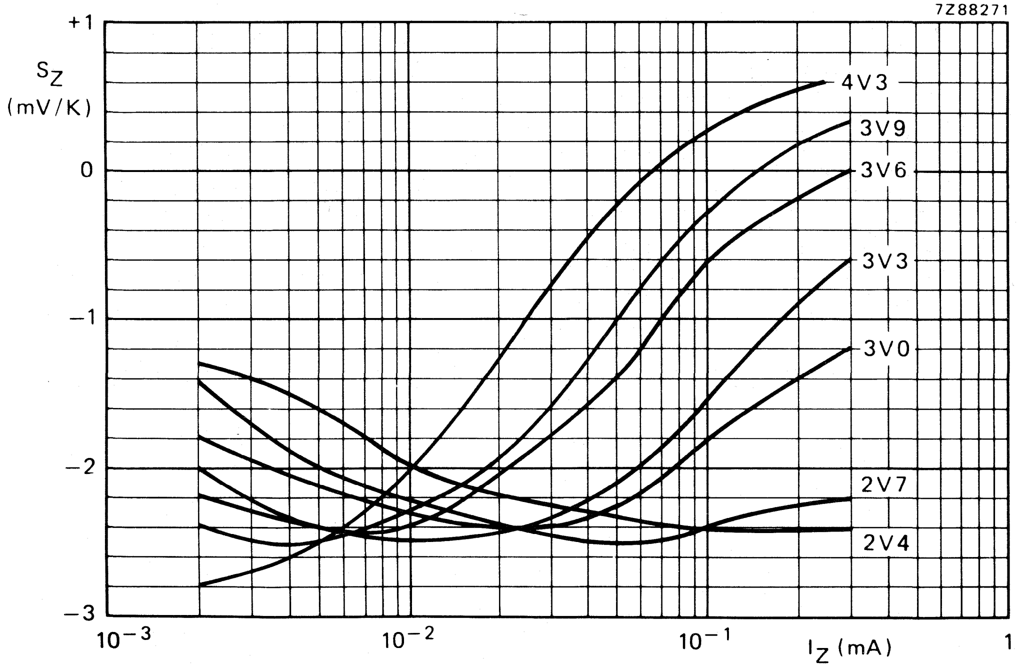


Fig. 10 Typical values temperature coefficient.

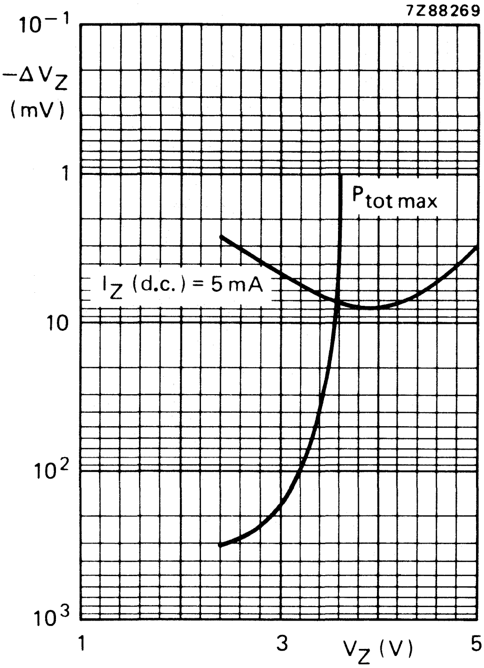


Fig. 11 Typical change of working voltage; T_j = 25 °C.

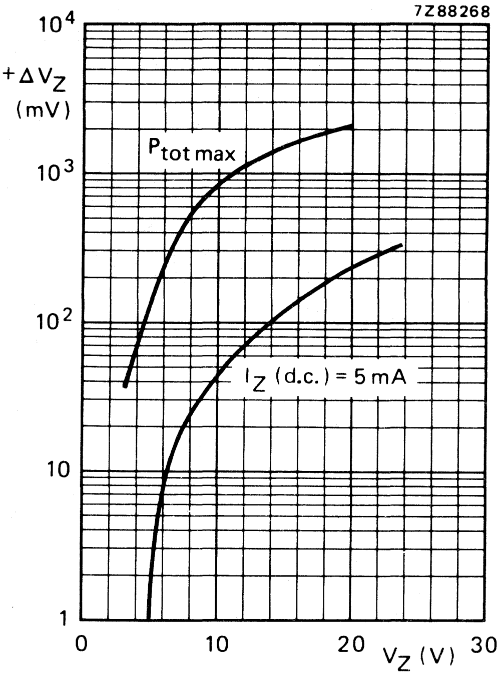


Fig. 12 Typical change of working voltage; T_{amb} = 25 °C.

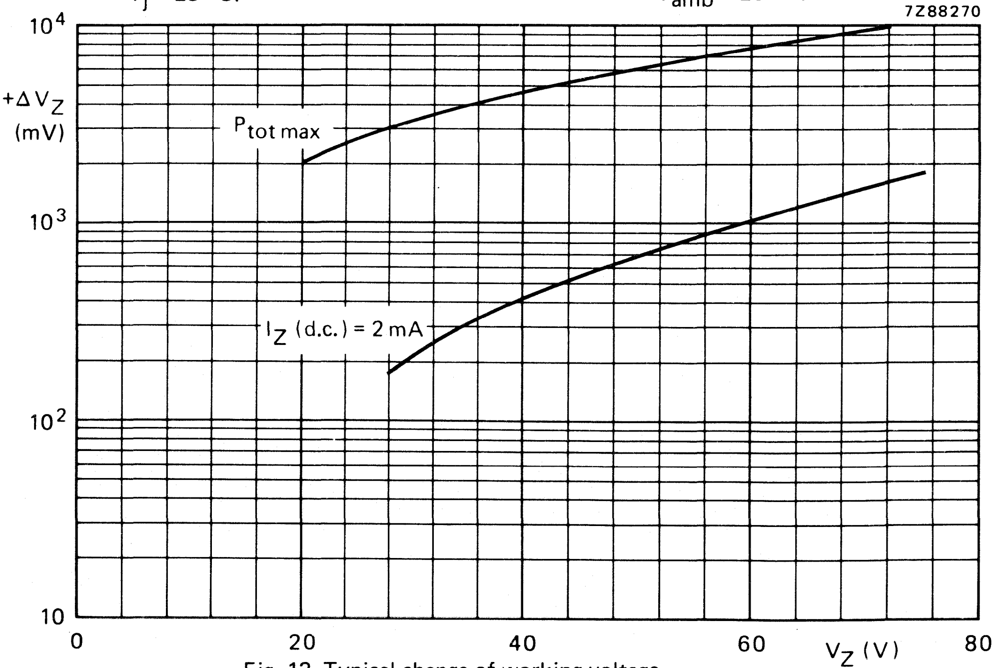


Fig. 13 Typical change of working voltage.

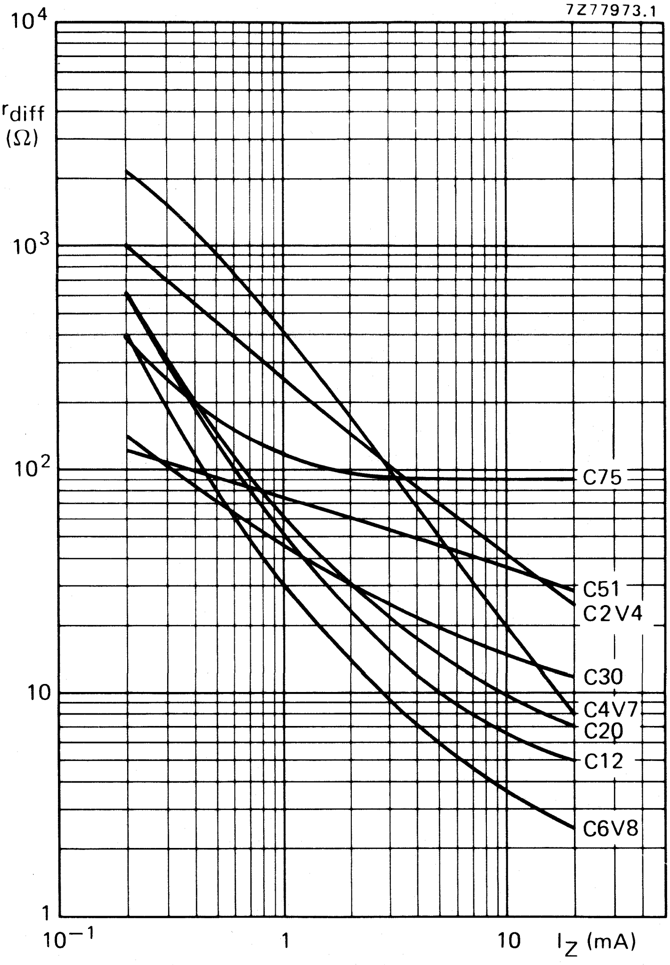


Fig. 14 Typical values; T_j = 25 °C; f = 1 kHz.

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 SOD80C 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.

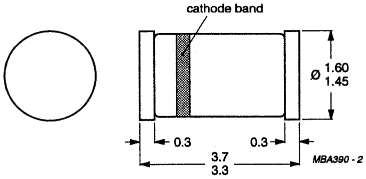
QUICK REFERENCE DATA

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 SOD80C.



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%.

T_j = 25 °C
± 2% tolerance range

BZV55B	working voltage V_Z (V)		differential resistance r_{diff} (Ω)		temperature coefficient S_Z (mV/K)			differential resistance r_{diff} (Ω)	
	at I_{Ztest} = 5 mA		**at I_{Ztest} = 5 mA**		**at I_{Ztest} = 5 mA**			**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	80,2	88,6	170	500

T_j = 25 °C
± 3% tolerance range

BZV55F	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		
	min.	max.	typ.	max.	min.	typ.	max.
F2V4	2,33	2,47	70	100	−3,5	−1,6	0
F2V7	2,62	2,78	75	100	−3,5	−2,0	0
F3V0	2,91	3,09	80	100	−3,5	−2,1	0
F3V3	3,20	3,40	85	100	−3,5	−2,4	0
F3V6	3,49	3,71	85	100	−3,5	−2,4	0
F3V9	3,78	4,02	85	100	−3,5	−2,5	0
F4V3	4,17	4,43	80	100	−3,5	−2,5	0
F4V7	4,56	4,84	50	100	−3,5	−1,4	0,2
F5V1	4,95	5,25	40	80	−2,7	−0,8	1,2
F5V6	5,43	5,77	15	40	−2,0	1,2	2,5
F6V2	6,01	6,39	6	30	0,4	2,3	3,7
F6V8	6,60	7,00	6	20	1,2	3,0	4,5
F7V5	7,28	7,72	6	20	2,5	4,0	5,3
F8V2	7,95	8,45	6	20	3,2	4,6	6,2
F9V1	8,83	9,37	6	20	3,8	5,5	7,0
F10	9,70	10,30	8	25	4,5	6,4	8,0
F11	10,67	11,33	10	25	5,4	7,4	9,0
F12	11,64	12,36	10	25	6,0	8,4	10,0
F13	12,61	13,39	10	35	7,0	9,4	11,0
F15	14,55	15,45	10	40	9,2	11,4	13,0
F16	15,50	16,50	10	45	10,4	12,4	14,0
F18	17,50	18,50	10	50	12,4	14,4	16,0
F20	19,40	20,60	15	60	14,4	16,4	18,0
F22	21,30	22,70	20	70	16,4	18,4	20,0
F24	23,30	24,70	25	80	18,4	20,4	22,0
	at I_{Ztest} = 2 mA		at I_{Ztest} = 2 mA		at I_{Ztest} = 2 mA		
F27	26,20	27,80	25	80	21,4	23,4	25,3
F30	29,10	30,90	30	100	24,4	26,6	29,4
F33	32,00	34,00	35	120	27,4	29,7	33,4
F36	34,90	37,10	35	140	30,4	33,0	37,4
F39	37,80	40,20	40	150	33,4	36,4	41,2
F43	41,70	44,30	45	160	37,6	41,2	46,6
F47	45,60	48,40	50	170	42,0	46,1	51,8
F51	49,50	52,50	60	180	46,6	51,0	57,2
F56	54,30	57,70	70	200	52,2	57,0	63,8
F62	60,10	63,90	80	220	58,8	64,4	71,6
F68	66,00	70,00	90	240	65,6	71,7	79,8
F75	72,80	77,20	95	255	73,4	80,2	88,6

T_j = 25 °C
± 5% tolerance range

BZV55C	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	8,70	6	15	3,2	4,6	6,2	40	80
C9V1	8,50	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	80,2	88,6	170	500

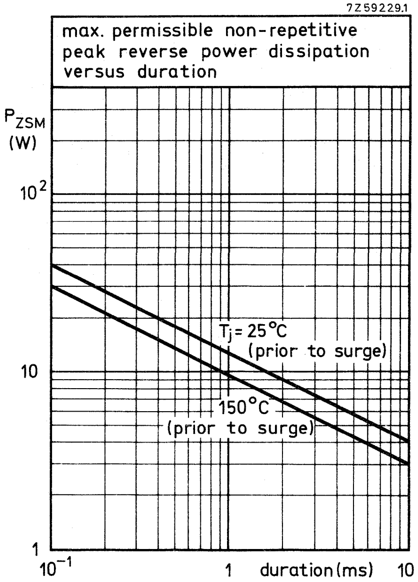

7Z59229.1
max. permissible non-repetitive peak reverse power dissipation versus duration
P_{ZSM} (W)
10^2
10
1
10^{-1}
1
duration (ms)
10
T_j = 25 °C (prior to surge)
150 °C (prior to surge)

Fig. 2.

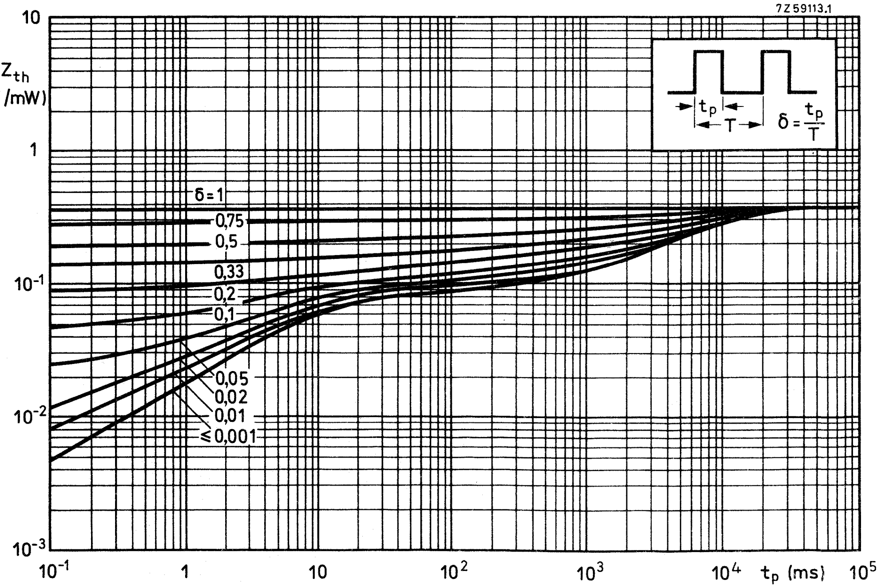

7Z59113.1
Z_{th} (K/mW)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-1}
1
10
10^2
10^3
10^4
t_p (ms)
10^5
t_p
T
$\delta = \frac{t_p}{T}$
δ = 1
0,75
0,5
0,33
0,2
0,1
0,05
0,02
0,01
≤ 0,001

Fig. 3.

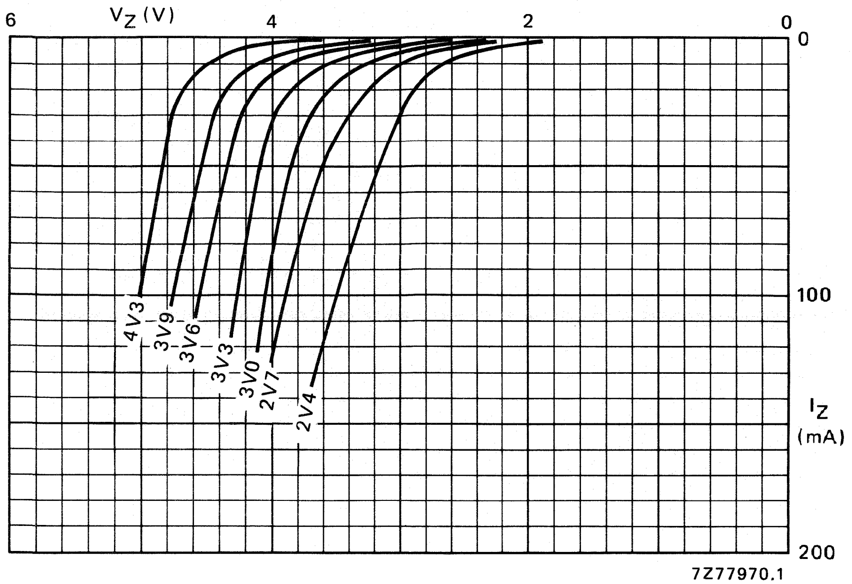


Fig. 4 Static characteristics; typical values; T_{amb} = 25 °C.

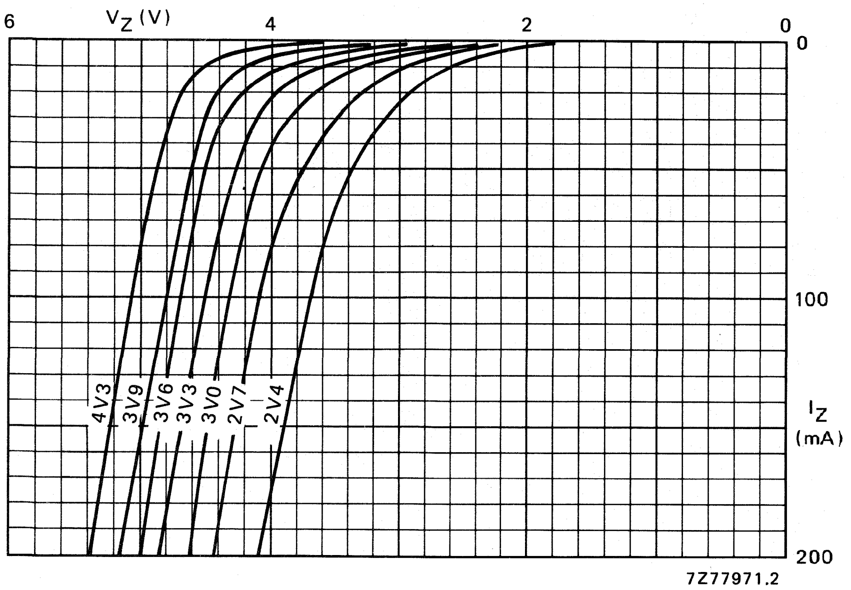


Fig. 5 Dynamic characteristics; typical values; T_j = 25 °C.

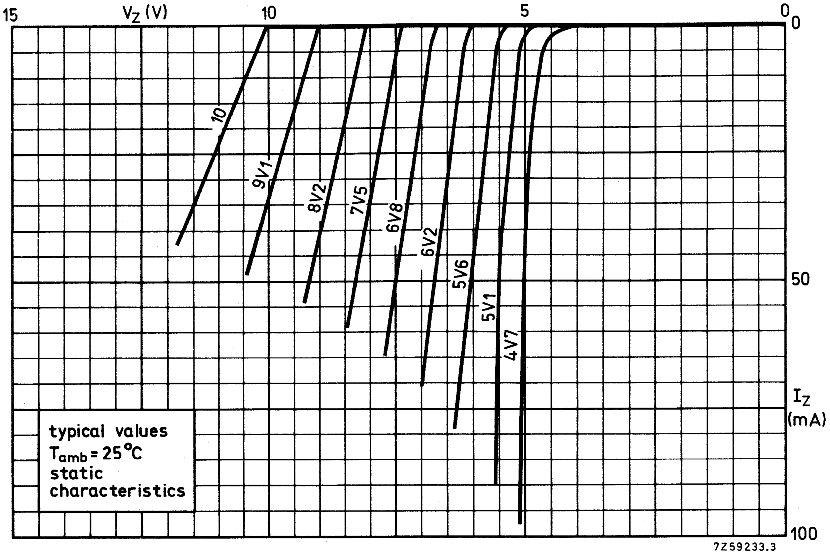

15
V_Z (V)
10
5
0
0
50
100
I_Z (mA)
10
9V1
8V2
7V5
6V8
6V2
5V6
5V1
4V7
typical values
T_{amb} = 25°C
static
characteristics
7Z59233.3

Fig. 6.

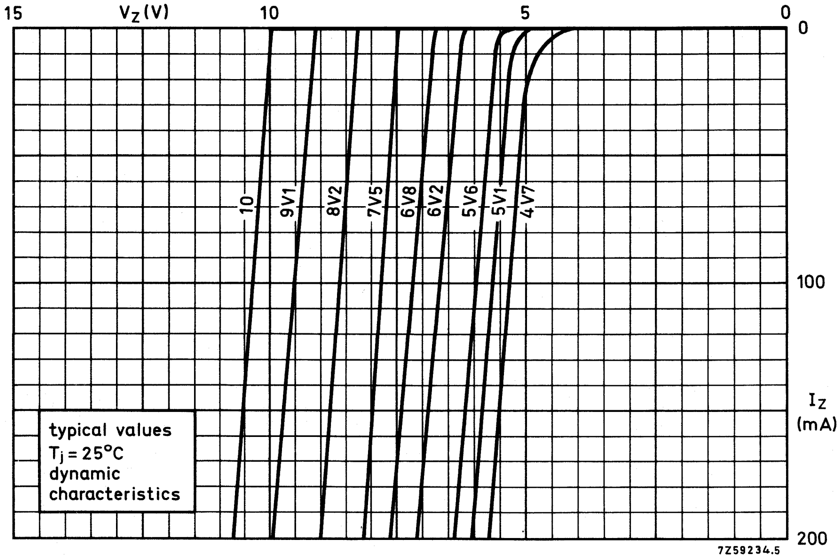

15
V_Z (V)
10
5
0
0
100
200
I_Z (mA)
10
9V1
8V2
7V5
6V8
6V2
5V6
5V1
4V7
typical values
T_j = 25°C
dynamic
characteristics
7Z59234.5

Fig. 7.

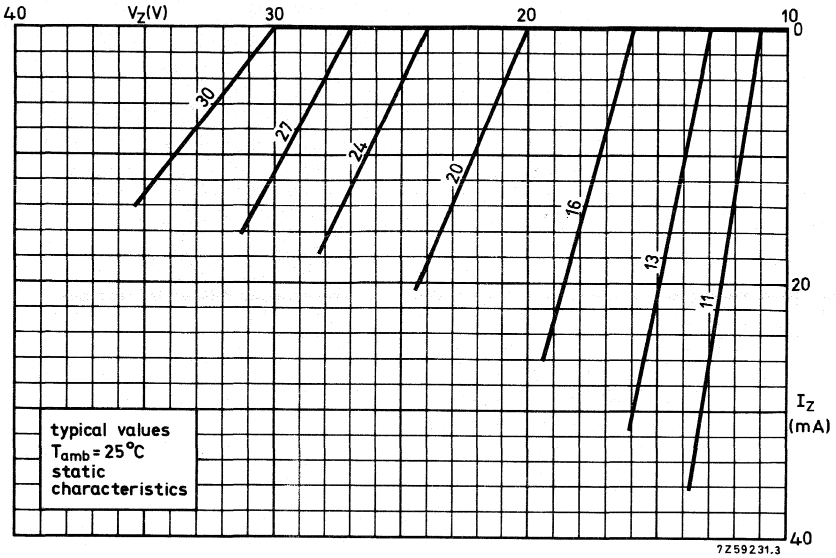

40
V_Z(V)
30
20
10
0
20
I_Z
(mA)
40
30
27
24
20
16
13
11
typical values
T_{amb} = 25 °C
static
characteristics
7Z59231.3

Fig. 8.

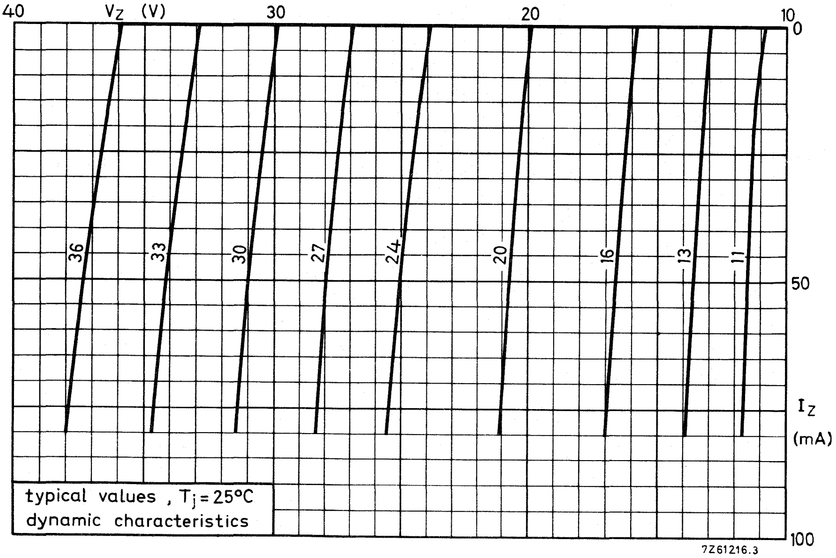

40
V_Z (V)
30
20
10
0
50
I_Z
(mA)
100
36
33
30
27
24
20
16
13
11
typical values , T_j = 25 °C
dynamic characteristics
7Z61216.3

Fig. 9.

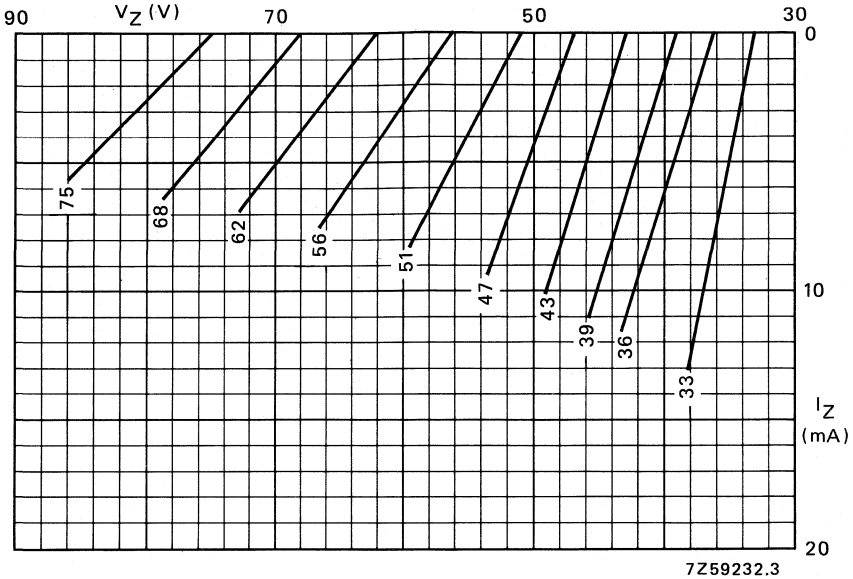


Fig. 10 Static characteristics; typical values; T_{amb} = 25 °C.

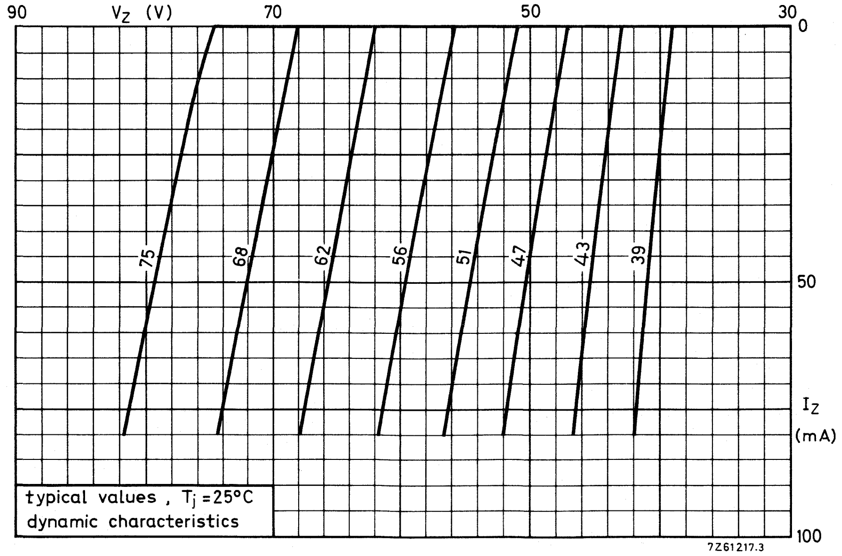


Fig. 11.

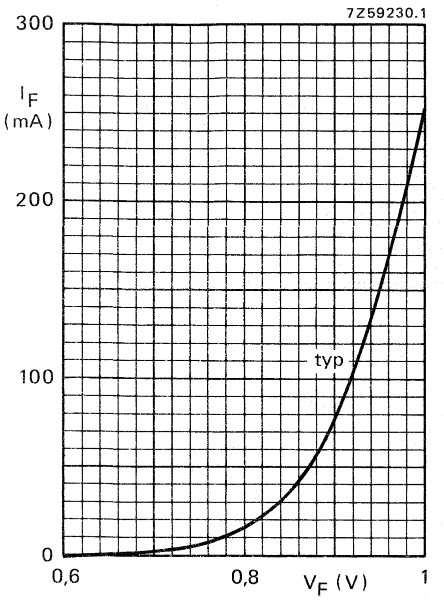


Fig. 12 T_j = 25 °C.

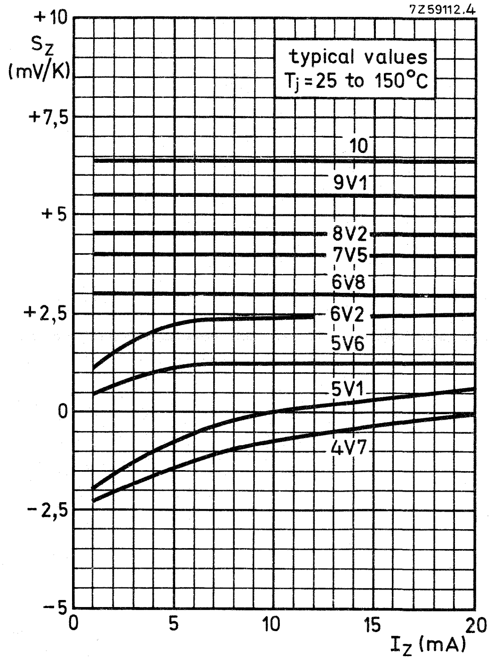


Fig. 13.

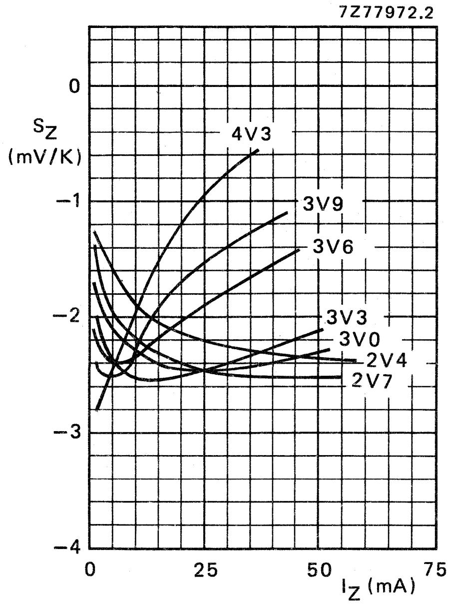


Fig. 14 Typical values; T_j = 25 to 150 °C.

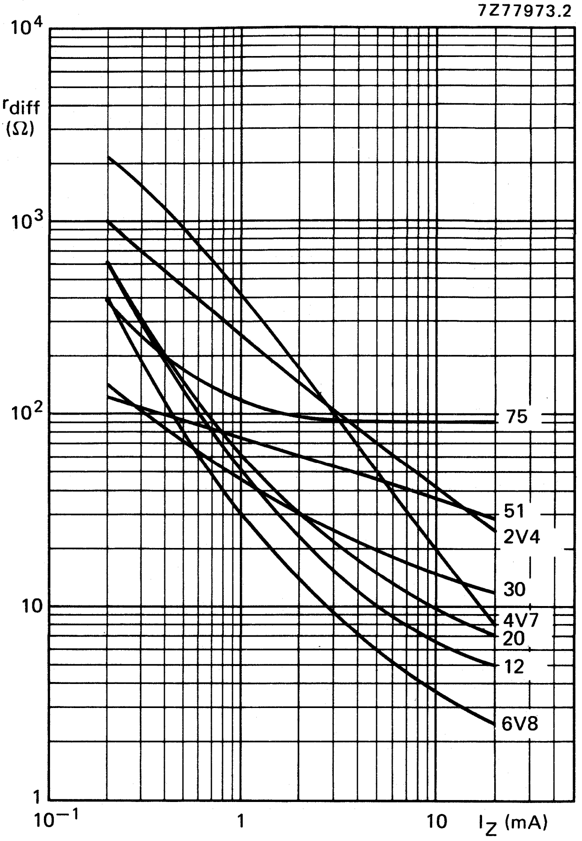


Fig. 15 Typical values; T_j = 25 °C; f = 1 kHz.

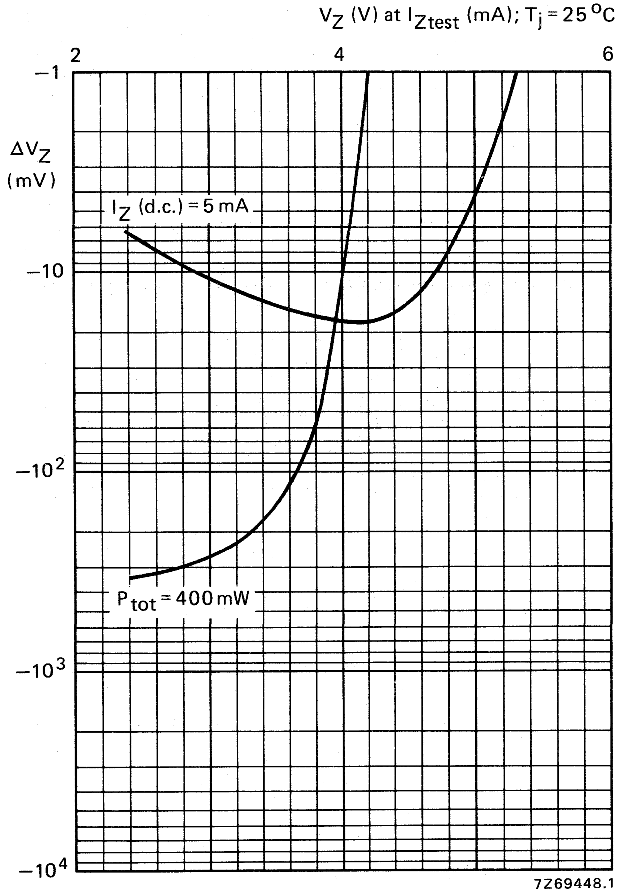


Fig. 16 Typical change of working voltage under operating conditions at $T_{amb} = 25\,^oC$.

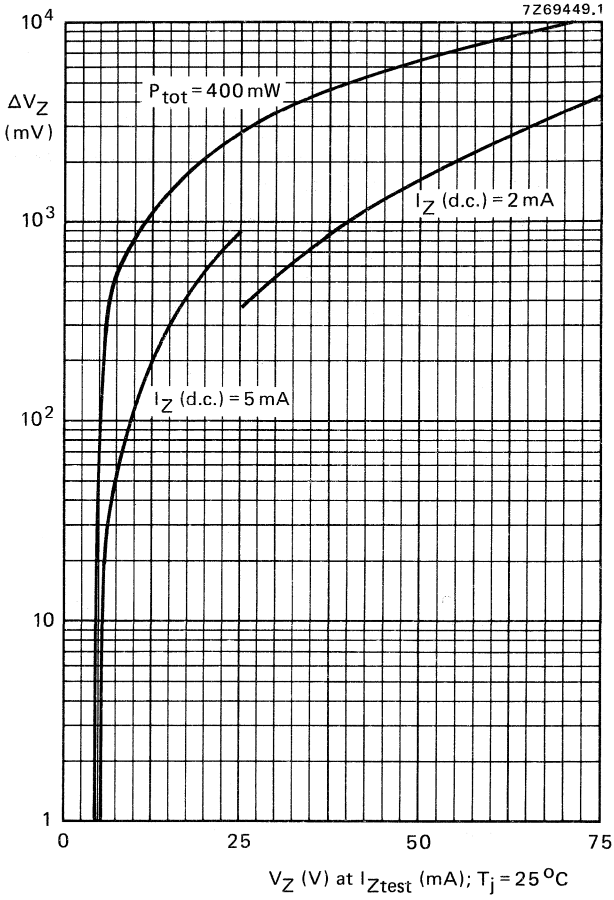


Fig. 17 Typical change of working voltage under operating conditions at T_{amb} = 25 °C.

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.

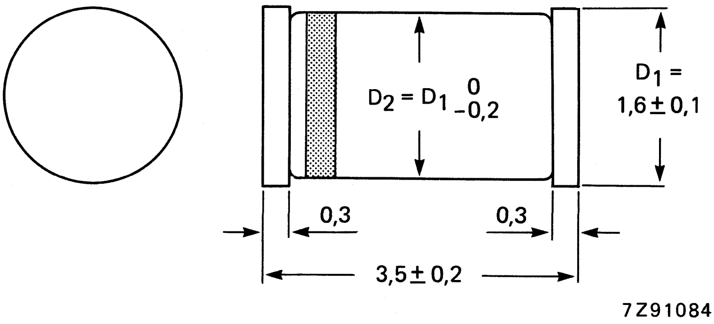
QUICK REFERENCE DATA

			>	5,89	V
Reference voltage at $I_Z = 7,5$ mA		V_{ref}	typ.	6,20	V
			<	6,51	V
Temperature coefficient at $I_Z = 7,5$ mA	BZV80	$\lvert S_Z \rvert$	<	0,01	%/K
	BZV81	$\lvert S_Z \rvert$	<	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	$\lvert\Delta V_{ref}\rvert$	<	62	mV
	BZV81	$\lvert\Delta V_{ref}\rvert$	<	31	mV
Effective temperature coefficient at I_Z = 7,5 mA	BZV80	$\lvert S_Z\rvert$	<	0,01	%/K
	BZV81	$\lvert S_Z\rvert$	<	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.
$$S_Z = \frac{(V_{ref\,1} - V_{ref\,2})}{(T_{amb\,2} - T_{mab\,1})} \times \frac{100}{V_{ref\,nom}}\ \%/\text{K}$$

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 "super 8" tape.

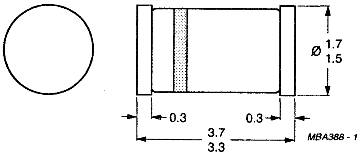
QUICK REFERENCE DATA

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.	330				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.



Cathode indicated by yellow 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		150		mA
Continuous reverse voltage	V_R	max.	10				V
Repetitive peak reverse voltage	V_{RRM}	max.	10				V
Total power dissipation (note 1) up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	330				mW
Storage temperature range	T_{stg}		−65 to 150				^oC
Junction temperature	T_j	max.	150				^oC

THERMAL RESISTANCE

From junction to ambient in free air (note 1)	$R_{th\ j\text{-}a}$	=	380	K/W

CHARACTERISTICS

$T_j = 25\ ^oC$ 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.

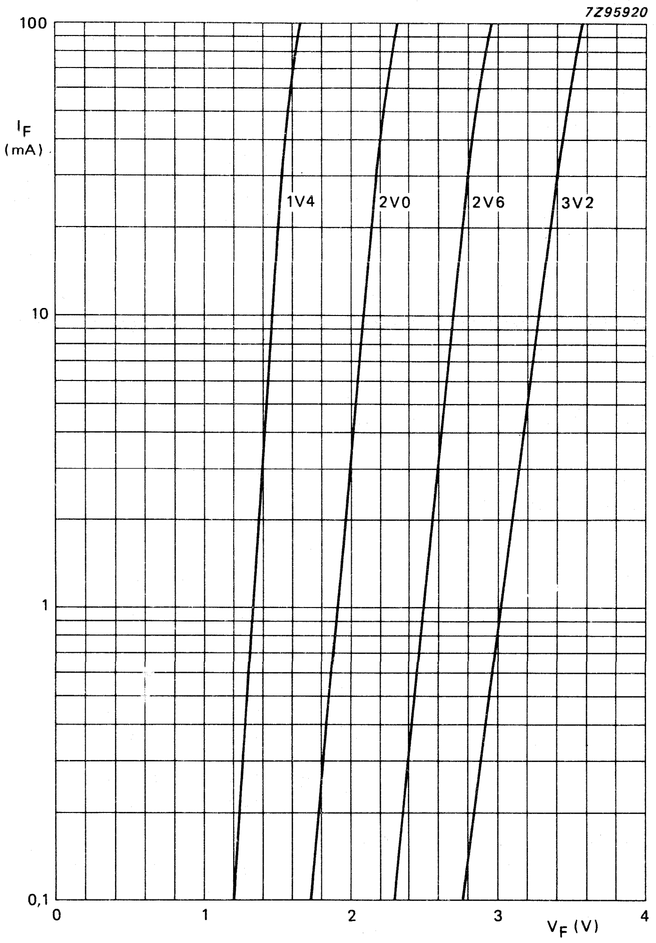


Fig. 2 Forward current as a function of forward voltage; T_j = 25 °C; typical values.

SILICON PLANAR VOLTAGE REGULATOR DIODES

Silicon planar voltage regulator diodes, in a SOT223 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.	1.3	W
Junction temperature	T_j	max.	150	°C

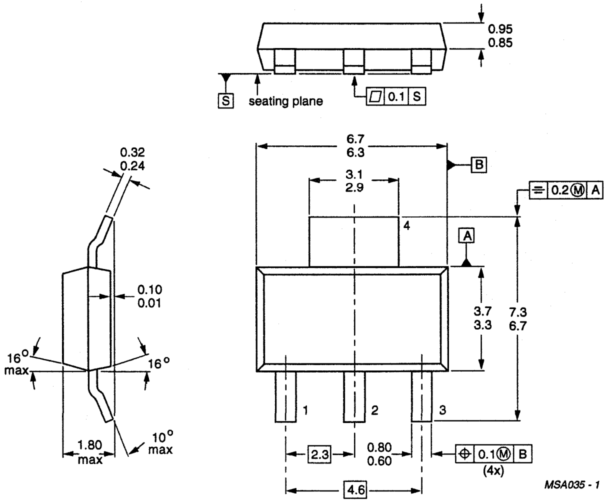
MECHANICAL DATA

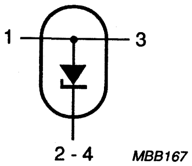
Dimensions in mm

Fig.1 SOT223.

Pinning

1 = anode
2 = cathode
3 = anode
4 = cathode





RATINGS

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

Repetitive peak forward current	I_{FRM}	max.	400	mA
Average forward current (averaged over any 20 ms period)	$I_{F(AV)}$	max.	400	mA
Working current (DC)	I_Z	limited by $P_{tot\ max}$		
Total power dissipation up to T_{amb} = 25 °C (note 1)	P_{tot}	max.	1.3	W
Non-repetitive peak reverse power dissipation T_j = 25 °C; t_p = 100 μs	P_{ZSM}	max.	40	W
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 (note 1)	$R_{th\ j\text{-}a}$	=	95	K/W

CHARACTERISTICS

T_j = 25 °C

Forward voltage I_F = 50 mA		V_F	max.	1.0	V
Reverse current					
BZV90- C2V4	V_R = 1 V	I_R	max.	50	μA
C2V7	V_R = 1 V	I_R	max.	20	μA
C3V0	V_R = 1 V	I_R	max.	10	μA
C3V3	V_R = 1 V	I_R	max.	5	μA
C3V6	V_R = 1 V	I_R	max.	5	μA
C3V9	V_R = 1 V	I_R	max.	3	μA
C4V3	V_R = 1 V	I_R	max.	3	μA
C4V7	V_R = 2 V	I_R	max.	3	μA
C5V1	V_R = 2 V	I_R	max.	2	μA
C5V6	V_R = 2 V	I_R	max.	1	μA
C6V2	V_R = 4 V	I_R	max.	3	μA
C6V8	V_R = 4 V	I_R	max.	2	μA
C7V5	V_R = 5 V	I_R	max.	1	μA
C8V2	V_R = 5 V	I_R	max.	700	nA
C9V1	V_R = 6 V	I_R	max.	500	nA
C10	V_R = 7 V	I_R	max.	200	nA
C11 to C13	V_R = 8 V	I_R	max.	100	nA
C15 to C75	V_R = 0,7 V_{Znom}	I_R	max.	50	nA

Note

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

T_j = 25 °C

E24 logarithmic range (tolerance ± 5%)

BZV90-...	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

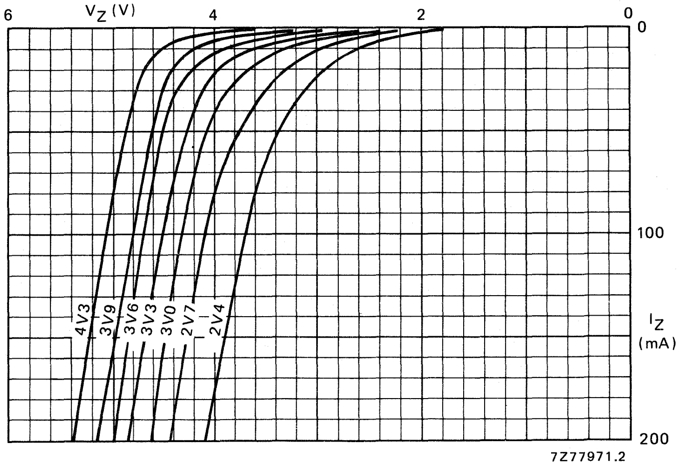


Fig. 2 Dynamic characteristics; typical values; T_j = 25 °C.

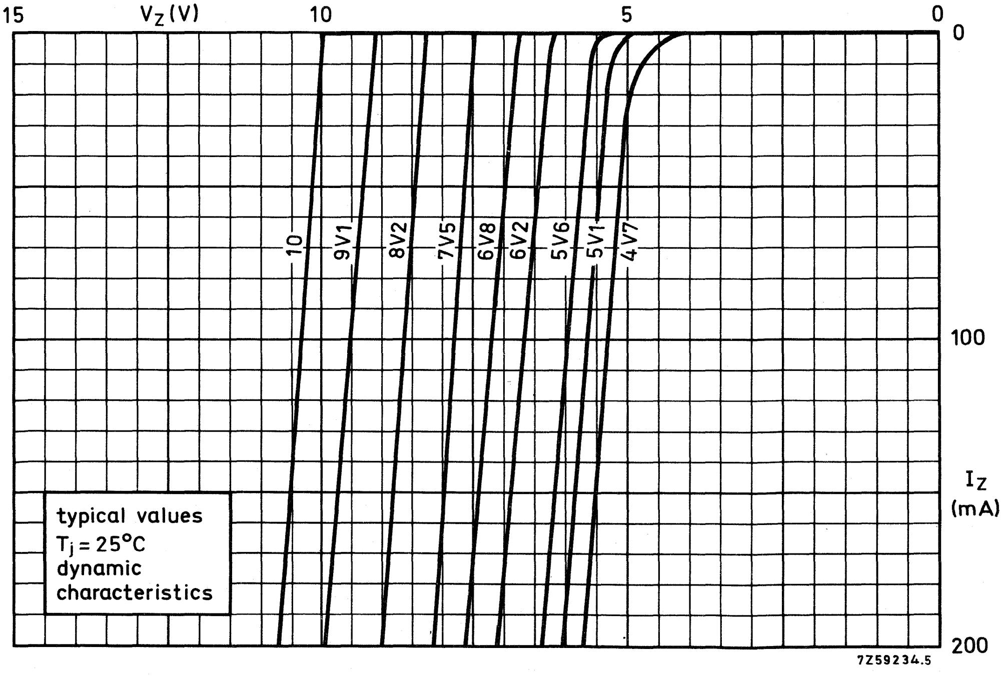


Fig. 3 Dynamic characteristics; typical values at T_j = 25 °C.

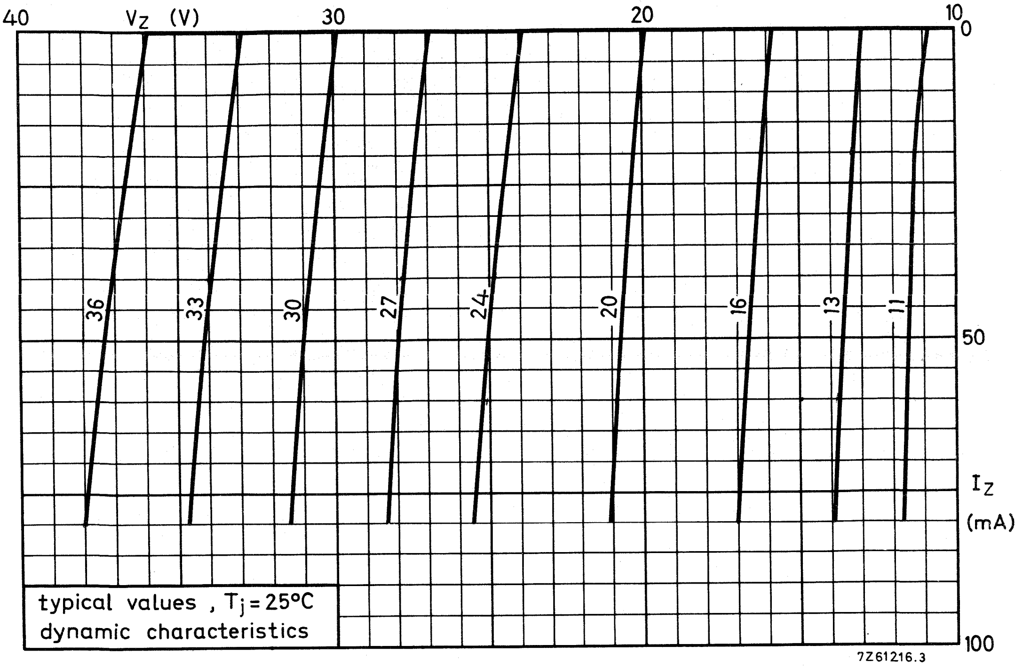


Fig. 4 Dynamic characteristics; typical values; T_j = 25 °C.

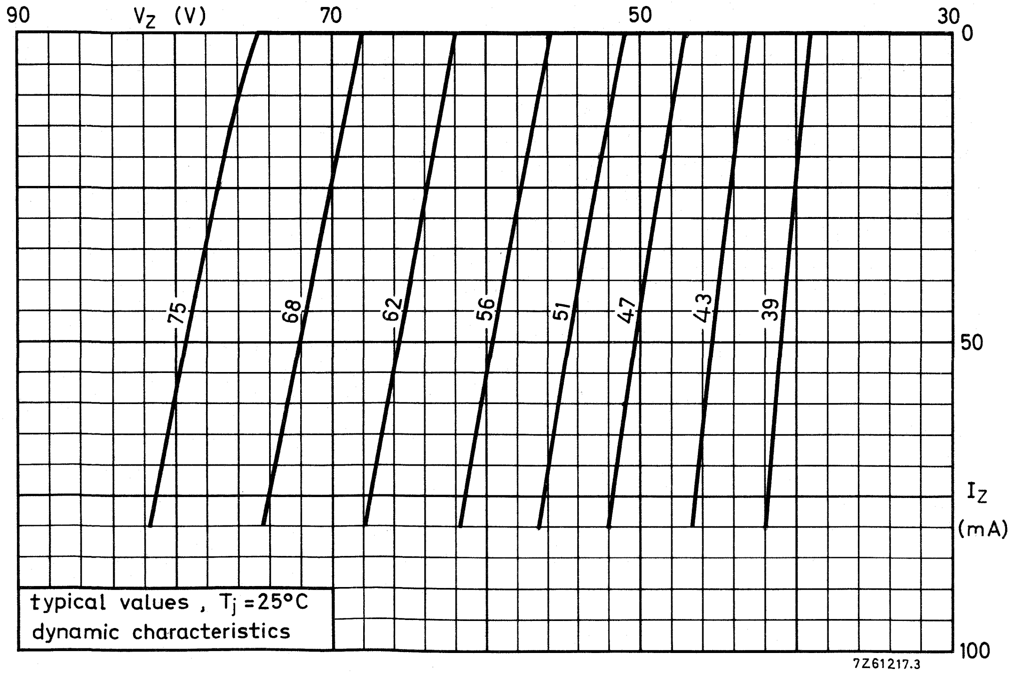


Fig. 5 Dynamic characteristics; typical values at T_j = 25 °C.

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

BZV90-C24 mounted on an epoxy printed circuit board of 40 mm x 40 mm x 1.5 mm; at $I_Z = 7$ mA.

$$V_{Z\ stat} = 24 + (0.007 \times 24 \times 0.095 \times 20.4)$$
$$= 24 + 0.32 = 24.32\ \text{V}$$

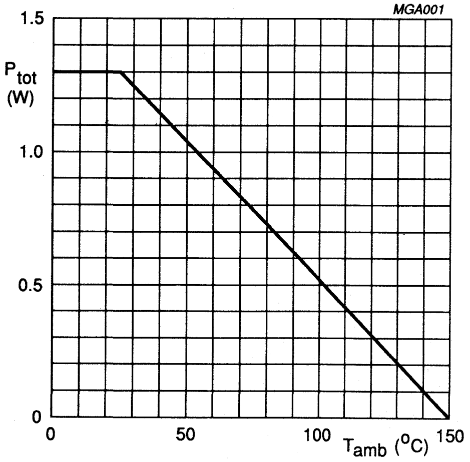


Fig. 6 Power derating curve.

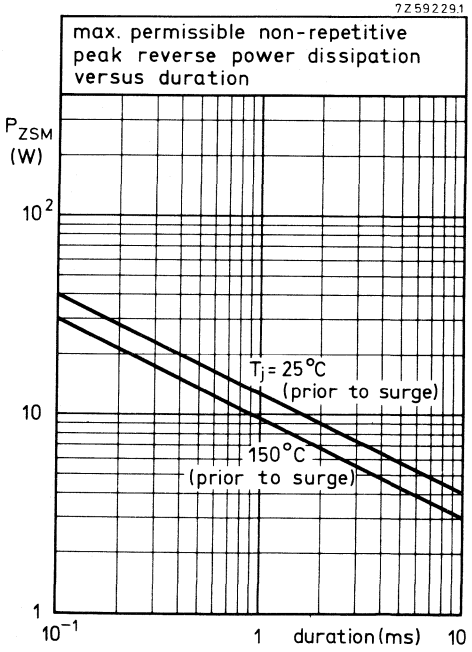


Fig. 7.

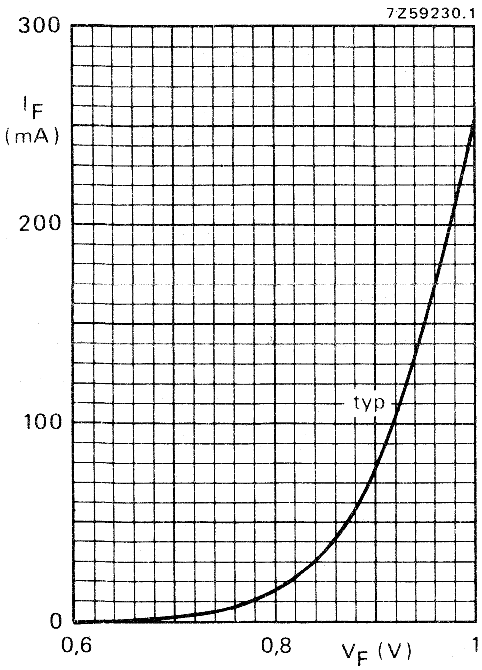


Fig. 8 T_j = 25 °C.

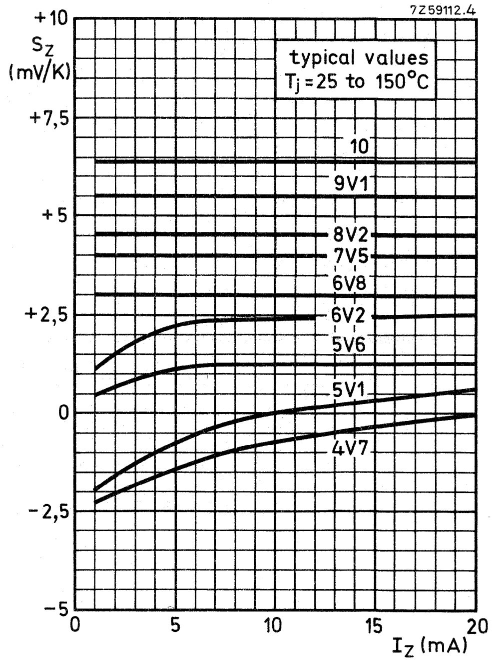


Fig. 9.

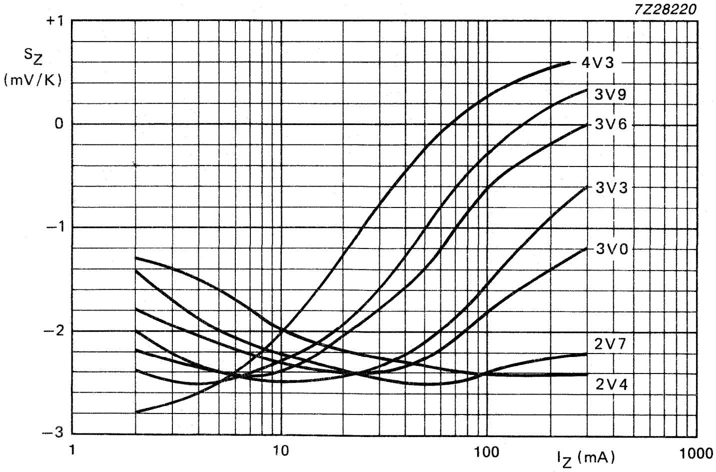


Fig. 10 Typical values temperature coefficient.

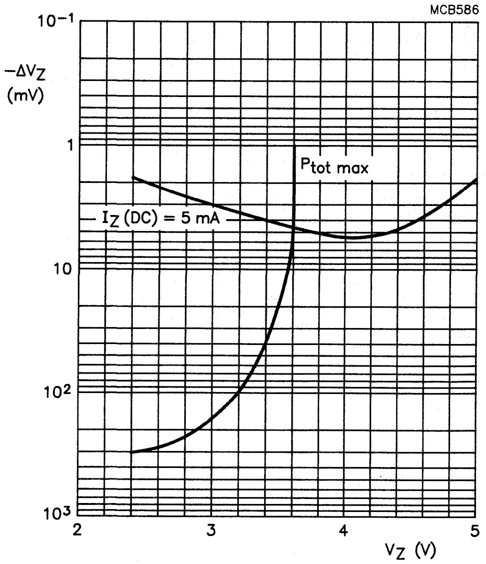


Fig. 11 Typical change of working voltage; $T_j = 25\ ^{o}C$.

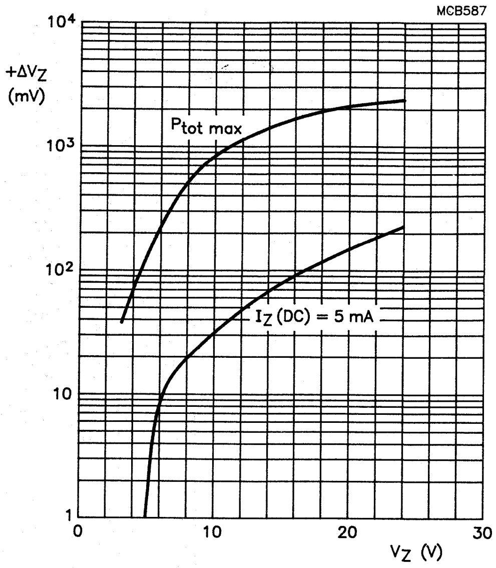


Fig. 12 Typical change of working voltage; $T_j = 25\ ^{o}C$.

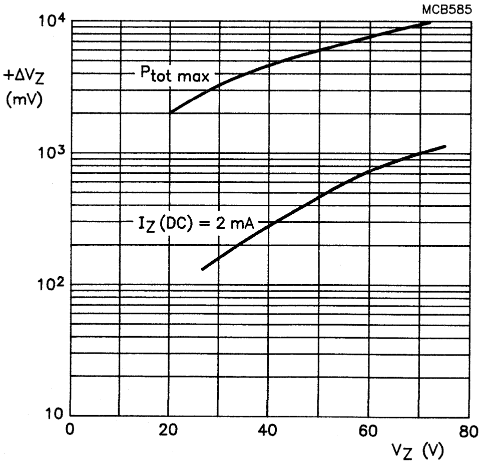


Fig. 13 Typical change of working voltage; $T_j = 25\ ^{o}C$.

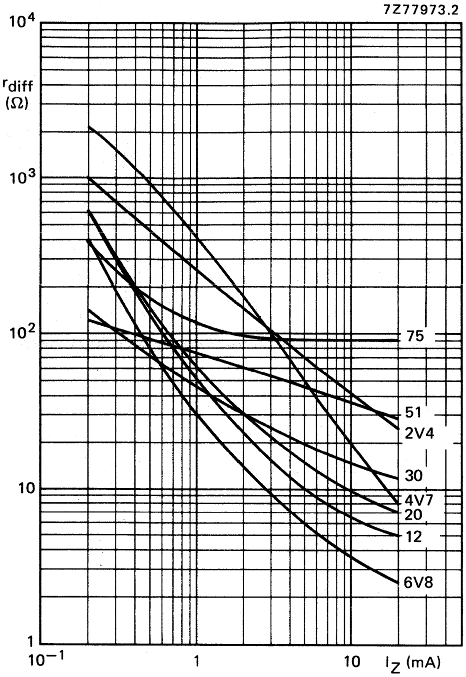


Fig. 14 Typical values; T_j = 25 °C; f = 1 kHz.

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%. The C5V1 is CECC approved to 50 005-21.
Each series consists of 37 types with nominal working voltages from 2.4 V to 75 V.

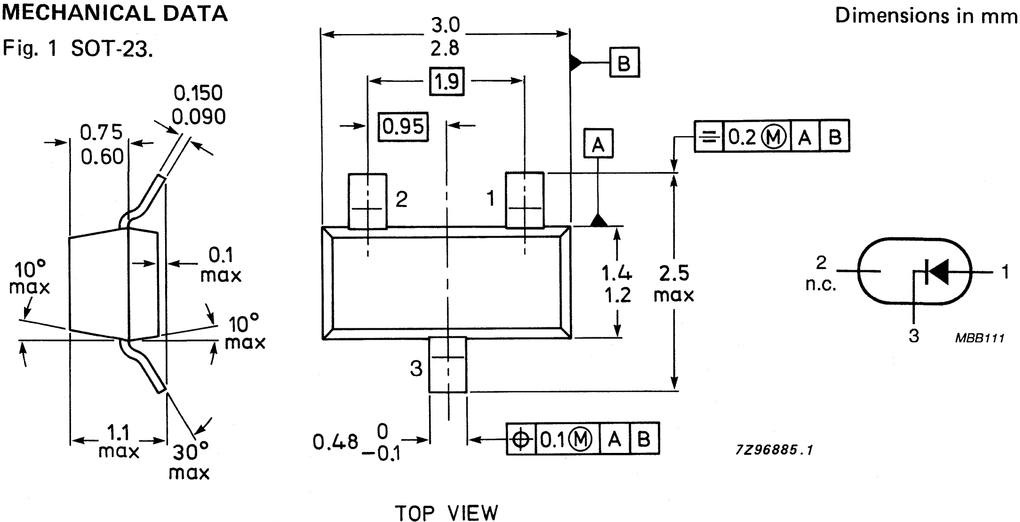
QUICK REFERENCE DATA

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.	150	°C

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-23.



See also *Soldering recommendations.*

Marking code

BZX84-C2V4 = Z11
C2V7 = Z12
C3V0 = Z13
C3V3 = Z14
C3V6 = Z15
C3V9 = Z16
C4V3 = Z17
C4V7 = Z1p
C5V1 = Z2p

BZX84-C5V6 = Z3p
C6V2 = Z4p
C6V8 = Z5p
C7V5 = Z6p
C8V2 = Z7p
C9V1 = Z8p
C10 = Z9p
C11 = Y1p
C12 = Y2p

BZX84-C13 = Y3p
C15 = Y4p
C16 = Y5p
C18 = Y6p
C20 = Y7p
C22 = Y8p
C24 = Y9p
C27 = Y10
C30 = Y11

BZX84-C33 = Y12
C36 = Y13
C39 = Y14
C43 = Y15
C47 = Y16
C51 = Y17
C56 = Y18
C62 = Y19
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
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*	$R_{th\ j\text{-}a}$	=	430 K/W
From junction to ambient**	$R_{th\ j\text{-}a}$	=	500 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%

---

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

** Device mounted on an FR4 printed-circuit board.

T_j = 25 °C
± 5% tolerance range

BZX84	working voltage V_Z (V)		differential resistance r_{diff} (Ω)		temperature coefficient S_Z (mV/K)			differential resistance r_{diff} (Ω)	
	at I_{Ztest} = 5 mA		**at I_{Ztest} = 5 mA**		**at I_{Ztest} = 5 mA**			**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	8.70	6	15	3.2	4.6	6.2	40	80
C9V1	8.50	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	52.00	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	67.32	68.68	90	240	65.6	71.7	79.8	150	475
A75	74.25	75.75	95	255	73.4	80.02	88.6	170	500

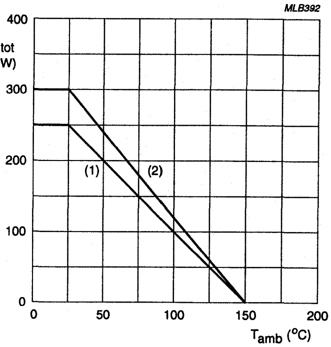


Fig. 2 Power derating curve.

(1) Mounted on an FR4 printed-circuit board.
(2) Mounted on a ceramic substrate 8 x 10 x 0.7 mm.

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 8 x 10 x 0.7 mm; at $I_Z = 7$ mA.

$$V_{Z\ stat} = 24 + \left(\frac{7}{1000} \times 24 \times \frac{430}{1000} \times 20.4\right)$$
$$= 24 + 1.47 = 25.47\ \text{V}.$$

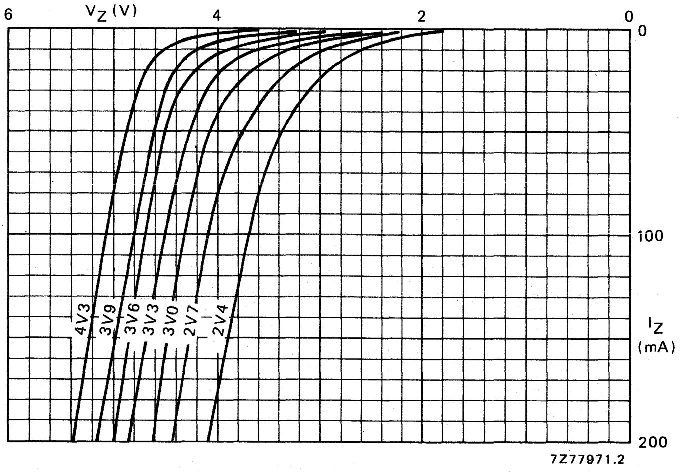


Fig. 3 Dynamic characteristics; typical values; T_j = 25 °C.

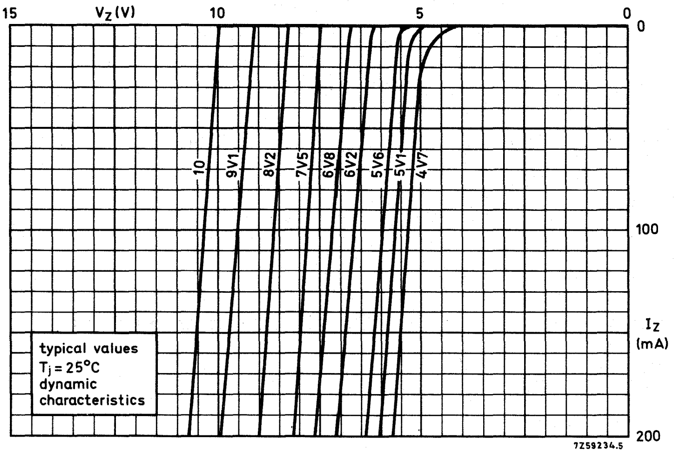


Fig. 4 Dynamic characteristics; typical values; T_j = 25 °C.

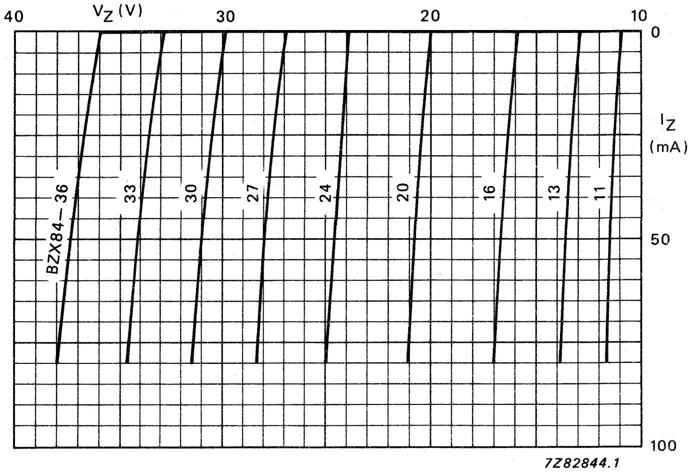


Fig. 5 Dynamic characteristics; typical values; T_j = 25 °C.

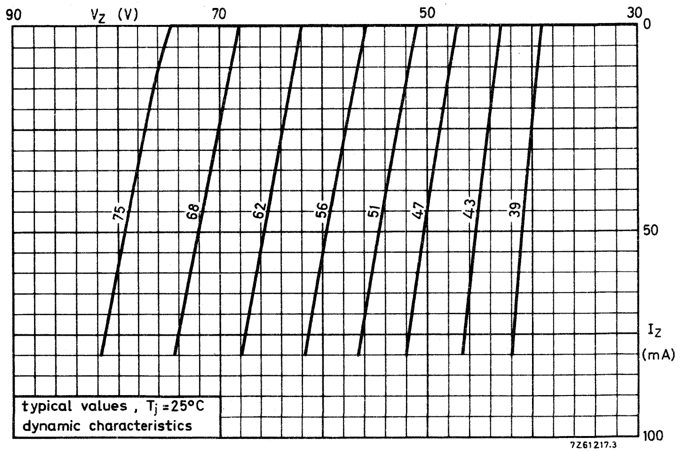


Fig. 6 Dynamic characteristics; typical values; T_j = 25 °C.

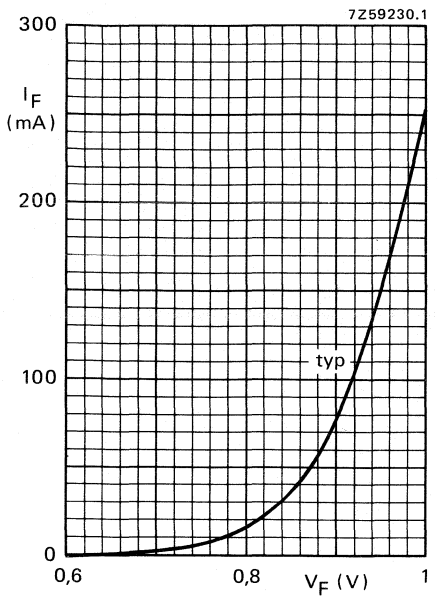


Fig. 7 Typical values at T_j = 25 °C.

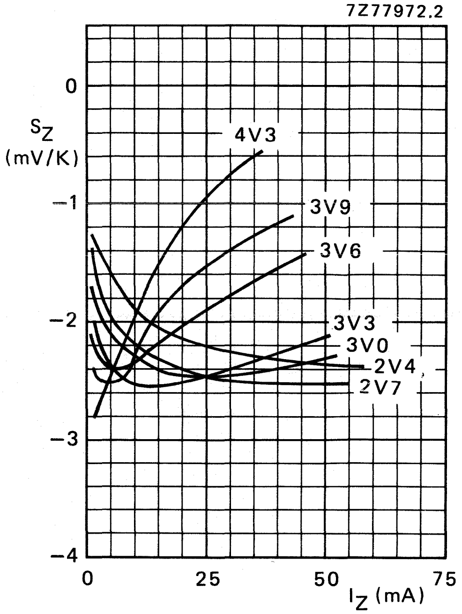


Fig. 8 Typical values; T_j = 25 to 175 °C.

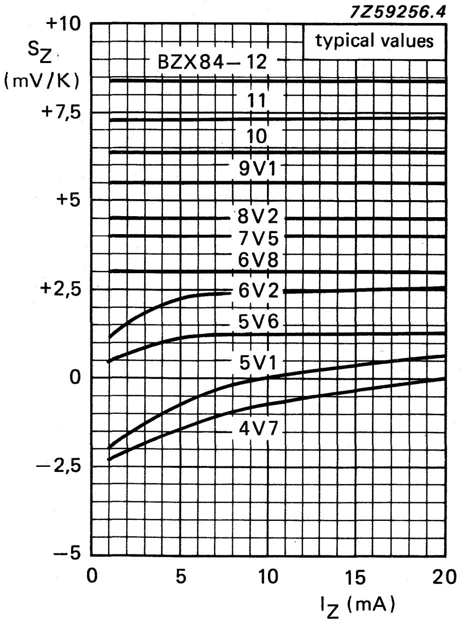


Fig. 9 Typical values; T_j = 25 to 175 °C.

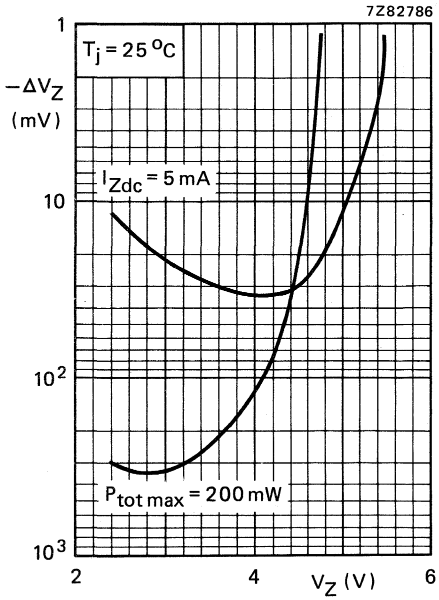


Fig. 10 Typical values; $T_j = 25$ °C.

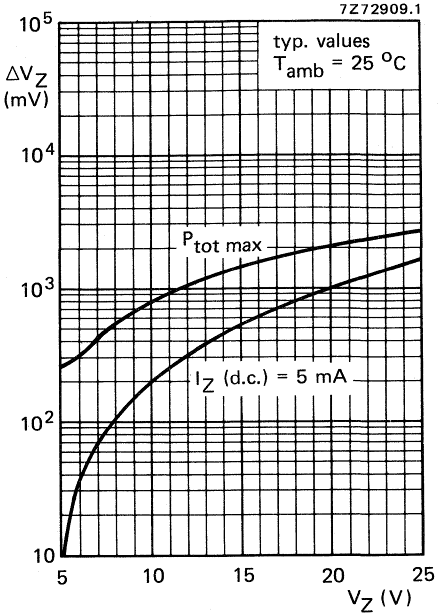


Fig. 11 Typical values; $T_{amb} = 25$ °C.

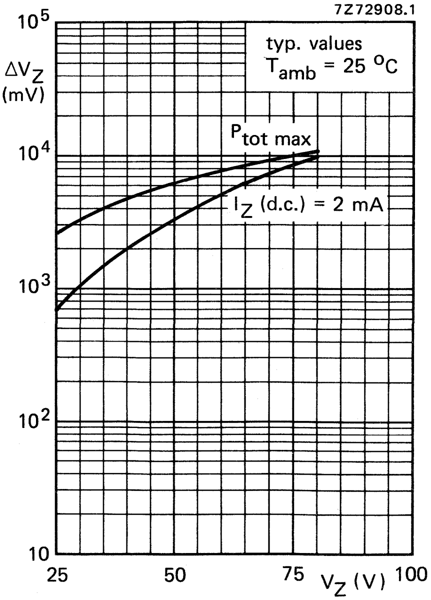


Fig. 12 Typical values; $T_{amb} = 25$ °C.

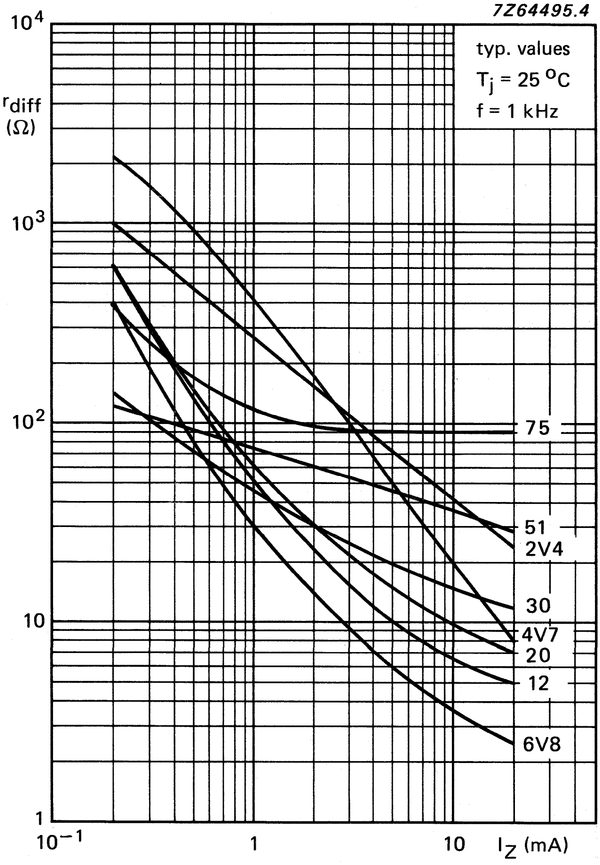

7Z64495.4
10^4
r_{diff}
(Ω)
10^3
10^2
10
1
10^{-1}
1
10
I_Z (mA)
typ. values
T_j = 25 °C
f = 1 kHz
75
51
2V4
30
4V7
20
12
6V8

Fig. 13.

Silicon temperature sensors KTY82-1 series

DESCRIPTION

These temperature sensors have a positive temperature coefficient of resistance and are for use in measurement and control systems.

PINNING

PIN	DESCRIPTION
1	electrical contact
2	electrical contact
3	substrate (must remain potential free)

Marking codes:

KTY82-110: 110.
KTY82-120: 120.
KTY82-121: 121.
KTY82-122: 122.
KTY82-150: 150.
KTY82-151: 151.
KTY82-152: 152.

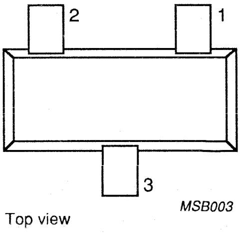


Fig.1 Simplified outline.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
R_{25}	sensor resistance	T_{amb} = 25 °C; I_{cont} = 1 mA			
	KTY82-110		990	1010	Ω
	KTY82-120		980	1020	Ω
	KTY82-121		980	1000	Ω
	KTY82-122		1000	1020	Ω
	KTY82-150		950	1050	Ω
	KTY82-151		950	1000	Ω
	KTY82-152		1000	1050	Ω
T_{amb}	ambient operating temperature range		–55	150	°C

Note

Tolerances of 0.5% or other special selections available on request.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{cont}	continuous sensor current	in free air; T_{amb} = 25 °C	–	10	mA
		in free air; T_{amb} = 150 °C	–	2	mA
T_{amb}	ambient operating temperature range		–55	150	°C

CHARACTERISTICS

T_{amb} = 25 °C, in liquid, unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
R_{25}	sensor resistance	T_{amb} = 25 °C; I_{cont} = 1 mA				
	KTY82-110		990	–	1010	Ω
	KTY82-120		980	–	1020	Ω
	KTY82-121		980	–	1000	Ω
	KTY82-122		1000	–	1020	Ω
	KTY82-150		950	–	1050	Ω
	KTY82-151		950	–	1000	Ω
	KTY82-152		1000	–	1050	Ω
TC	temperature coefficient		–	0.79	–	%/K
R_{100}/R_{25}	resistance ratio	at T_{amb} = 100 °C and 25 °C	1.676	1.696	1.716	
R_{-55}/R_{25}	resistance ratio	at T_{amb} = –55 °C and 25 °C	0.480	0.490	0.500	
τ	thermal time constant (note 1)	in still air	–	7	–	s
		in still liquid (note 2)	–	1	–	s
		in flowing liquid	–	0.5	–	s
	rated temperature range		–55	–	150	°C

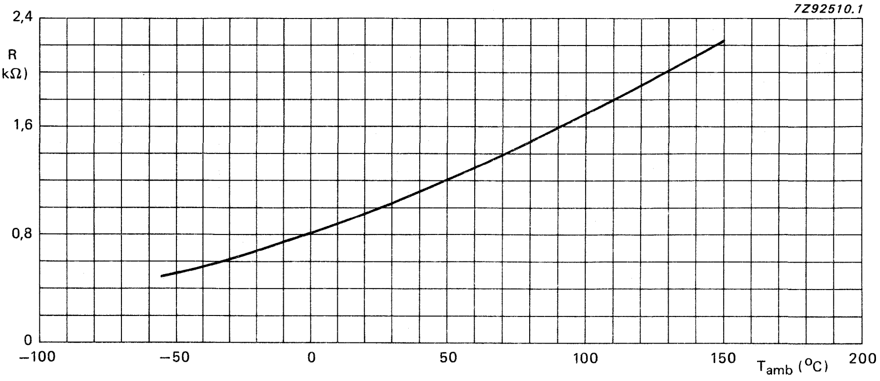
Notes

1. The thermal time constant is the time the sensor needs to reach 63.2% of the total temperature difference. For example, 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.
2. Inert liquid FC43 by 3M.

AMBIENT TEMPERATURES AND CORRESPONDING RESISTANCE OF SENSOR

I_{cont} = 1 mA.

AMBIENT TEMPERATURE (°C)	RESISTANCE (Ω)
−55	490
−50	515
−40	567
−30	624
−20	684
−10	747
0	815
10	886
20	961
25	1000
30	1040
40	1122
50	1209
60	1299
70	1392
80	1490
90	1591
100	1696
110	1805
120	1915
125	1969
130	2023
140	2124
150	2211



I_{cont} = 1 mA.

Fig.2 Average resistance value of sensor as a function of ambient temperature.

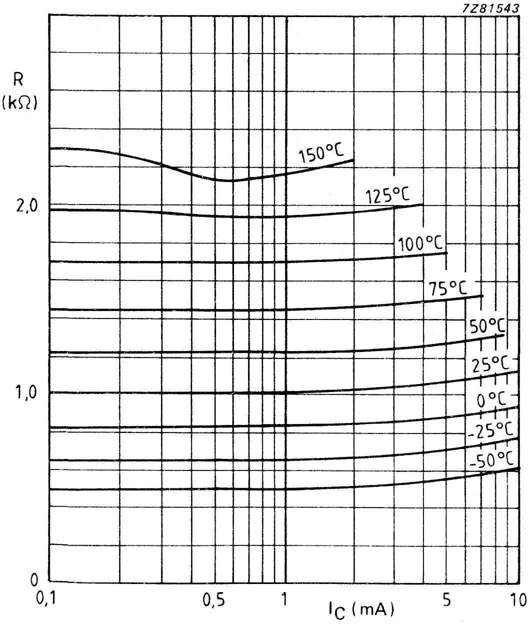


Fig.3 Sensor resistance as a function of operating current.

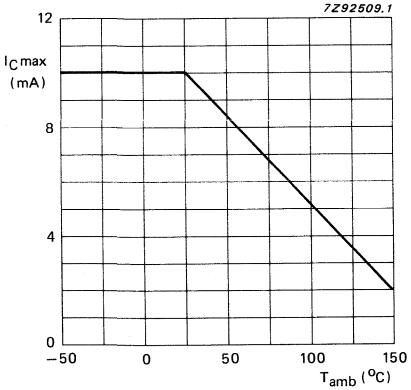
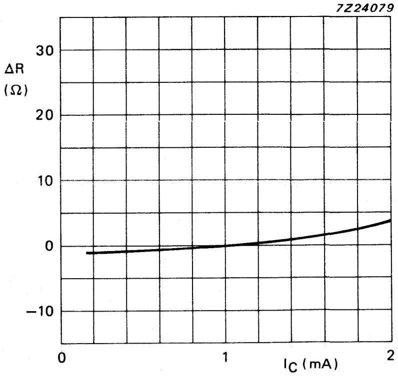


Fig.4 Maximum operating current for safe operation.



T_{amb} = 25 °C.

Fig.5 Deviation of sensor resistance as a function of operating current in still liquid.

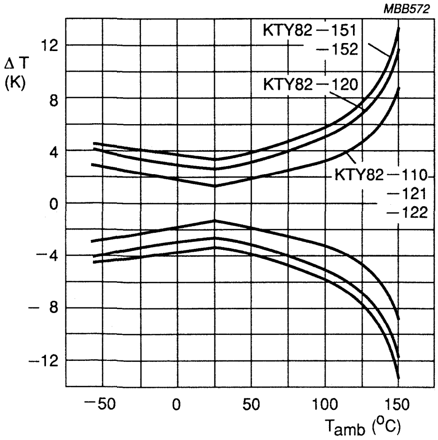


Fig.6 Maximum expected temperature error (ΔT).

Note

To keep the temperature error low, an operating current of I_{cont} = 1 mA is recommended for temperatures above 100 °C.

Silicon temperature sensors | KTY82-2 series

DESCRIPTION

These temperature sensors have a positive temperature coefficient of resistance and are for use in measurement and control systems.

PINNING

PIN	DESCRIPTION
1	electrical contact
2	electrical contact
3	substrate (must remain potential free)

Marking codes:

KTY82-210: 210.
KTY82-220: 220.
KTY82-221: 221.
KTY82-222: 222.
KTY82-250: 250.
KTY82-251: 251.
KTY82-252: 252.

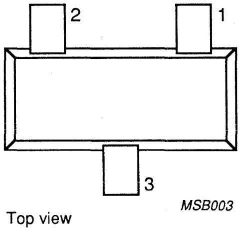


Fig.1 Simplified outline.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
R_{25}	sensor resistance	T_{amb} = 25 °C; I_{cont} = 1 mA			
	KTY82-210		1980	2020	Ω
	KTY82-220		1960	2040	Ω
	KTY82-221		1960	2000	Ω
	KTY82-222		2000	2040	Ω
	KTY82-250		1900	2100	Ω
	KTY82-251		1900	2000	Ω
	KTY82-252		2000	2100	Ω
T_{amb}	ambient operating temperature range		–55	150	°C

Note

Tolerances of 0.5% or other special selections available on request.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{cont}	continuous sensor current	in free air; T_{amb} = 25 °C	–	10	mA
		in free air; T_{amb} = 150 °C	–	2	mA
T_{amb}	ambient operating temperature range		–55	150	°C

CHARACTERISTICS

T_{amb} = 25 °C, in liquid, unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
R_{25}	sensor resistance	T_{amb} = 25 °C; I_{cont} = 1 mA				
	KTY82-210		1980	–	2020	Ω
	KTY82-220		1960	–	2040	Ω
	KTY82-221		1960	–	2000	Ω
	KTY82-222		2000	–	2040	Ω
	KTY82-250		1900	–	2100	Ω
	KTY82-251		1900	–	2000	Ω
	KTY82-252		2000	–	2100	Ω
TC	temperature coefficient		–	0.79	–	%/K
R_{100}/R_{25}	resistance ratio	at T_{amb} = 100 °C and 25 °C	1.676	1.696	1.716	
R_{-55}/R_{25}	resistance ratio	at T_{amb} = –55 °C and 25 °C	0.480	0.490	0.500	
τ	thermal time constant (note 1)	in still air	–	7	–	s
		in still liquid (note 2)	–	1	–	s
		in flowing liquid	–	0.5	–	s
	rated temperature range (note 3)		–55	–	150	°C

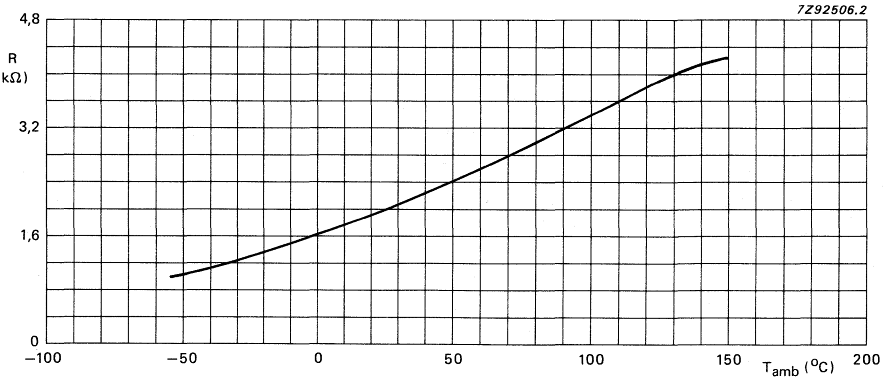
Notes

1. The thermal time constant is the time the sensor needs to reach 63.2% of the total temperature difference. For example, 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.
2. Inert liquid FC43 by 3M.
3. Restricted accuracy in the temperature range 125 to 150 °C.

AMBIENT TEMPERATURES AND CORRESPONDING RESISTANCE OF SENSOR

I_{cont} = 1 mA.

AMBIENT TEMPERATURE (°C)	RESISTANCE (Ω)
−55	980
−50	1030
−40	1135
−30	1247
−20	1367
−10	1495
0	1630
10	1772
20	1922
25	2000
30	2080
40	2245
50	2417
60	2597
70	2785
80	2980
90	3182
100	3392
110	3607
120	3817
125	3915
130	4008
140	4166
150	4280



I_{cont} = 1 mA.

Fig.2 Average resistance value of sensor as a function of ambient temperature.

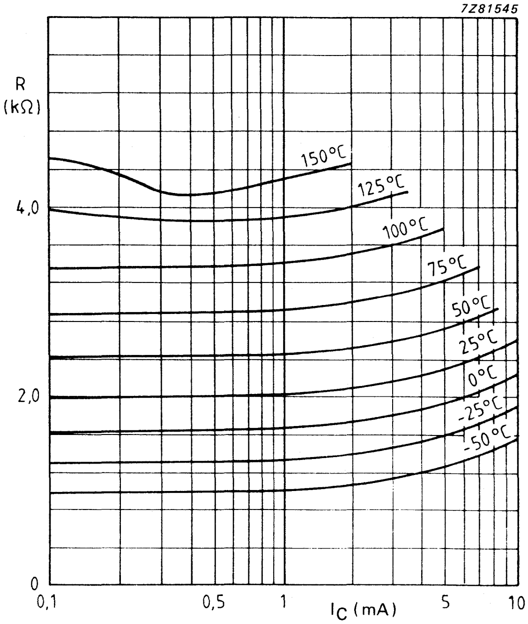


Fig.3 Sensor resistance as a function of operating current (ΔT).

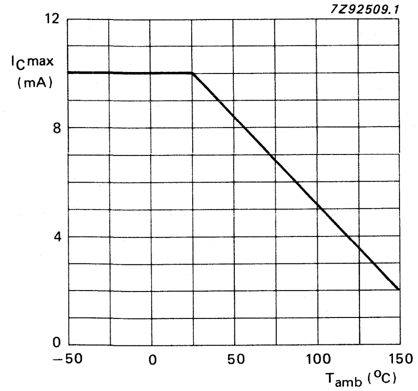
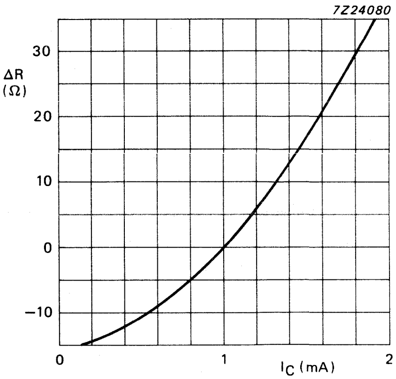


Fig.4 Maximum operating current for safe operation.



T_{amb} = 25 °C.

Fig.5 Deviation of sensor resistance as a function of operating current in still liquid.

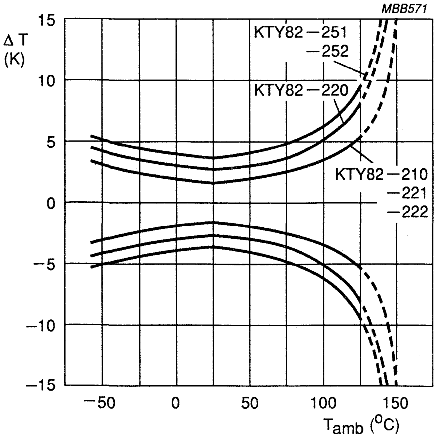


Fig.6 Maximum expected temperature error (ΔT).

Note

To keep the temperature error low, an operating current of I_{cont} = 1 mA is recommended for temperatures above 100 °C.

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

I_C = 1 mA

		Type tape (identification colour)
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.

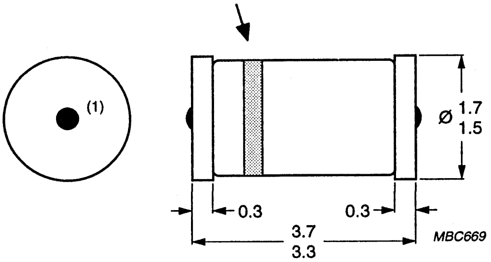
KTY85-150 is composed of groups −151 and −152, and is correspondingly designated.

Operating ambient temperature range T_{amb} −40 to +125 °C

MECHANICAL DATA

Dimensions in mm

Indication of polarity and type tape



(1) Area not tinned; small elevations are possible.

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).

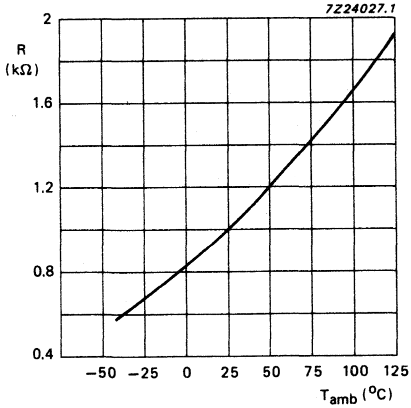


Fig. 2 Average resistance value of sensor at I_C = 1 mA as a function of ambient temperature.

Schottky barrier diodes

PBYR2100CT series

FEATURES

- Double diode in SMD power package
- Low turn-on and high breakdown voltage
- Ultra-fast switching speed.

DESCRIPTION

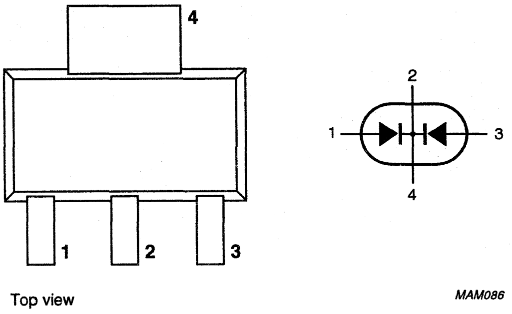
The PBYR2100CT series are Schottky barrier rectifier double diodes in a SOT223 plastic package. They are intended for low power, high frequency switching-mode power supplies and high frequency circuits in general, where low conduction and switching losses are important.

PINNING-SOT223

PIN	DESCRIPTION
1	anode (a1)
2	cathode
3	anode (a2)
4	cathode

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MAX.	UNIT
V_R	continuous reverse voltage		
	PBYR280CT	80	V
	PBYR290CT	90	V
	PBYR2100CT	100	V
V_{RRM}	continuous peak reverse voltage		
	PBYR280CT	80	V
	PBYR290CT	90	V
	PBYR2100CT	100	V
V_{RWM}	crest working reverse voltage		
	PBYR280CT	80	V
	PBYR290CT	90	V
	PBYR2100CT	100	V
$I_{F(AV)}$	average forward current	1	A
I_{FSM}	non-repetitive peak forward current	10	A
T_j	junction temperature	150	°C



Marking codes:
PBYR280CT: BYR28
PBYR290CT: BYR29
PBYR2100CT: BYR210

Fig.1 Simplified outline (SOT223) and symbol.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per diode					
V_{RRM}	repetitive peak reverse voltage				
	PBYR280CT		–	80	V
	PBYR290CT		–	90	V
	PBYR2100CT		–	100	V
V_{RWM}	crest working reverse voltage				
	PBYR280CT		–	80	V
	PBYR290CT		–	90	V
	PBYR2100CT		–	100	V
V_R	continuous reverse voltage				
	PBYR280CT		–	80	V
	PBYR290CT		–	90	V
	PBYR2100CT		–	100	V
$I_{F(AV)}$	average forward current	T_{amb} = 85 °C; PCB mounted; $R_{th\ j\text{-}a}$ = 70 K/W; $V_{R(equiv)}$ = 0.2 V; note (1)	–	1	A
I_{FSM}	non-repetitive peak forward current	t = 8.3 ms; half sinewave; JEDEC method	–	10	A
T_j	operating junction temperature		–65	+150	°C
T_{stg}	storage temperature		–65	+150	°C
T_{amb}	ambient temperature	rated V_R; $P_F = 0$; $R_{th\ j\text{-}a}$ = 70 K/W	–	85	°C
dV_R/dt	rate of change of reverse voltage	$V_R = V_{Rmax}$	–	10	V/ns

Note

1. For Schottky barrier diodes thermal runaway has to be considered as, in some applications, the reverse power losses P_R are a significant part of the total power losses. Nomograms for determination of the reverse power losses P_R and $I_{F(AV)}$-rating will be available later.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	from junction to ambient	PCB standard mounting conditions	70 K/W

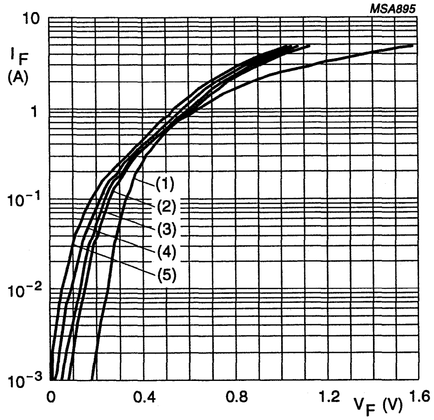
CHARACTERISTICS

T_{amb} = 25°C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
Per diode					
V_F	forward voltage	I_F = 1 A; note (1)	–	790	mV
		I_F = 1 A; T_{amb} = 100 °C; note (1)	–	690	mV
I_R	reverse current	$V_R = V_{RRMmax}$; note (1)	–	0.5	mA
		$V_R = V_{RRMmax}$; T_{amb} = 100 °C; note (1)	–	5	mA
C_d	diode capacitance	V_R = 4 V; f = 1 MHz	–	100	pF

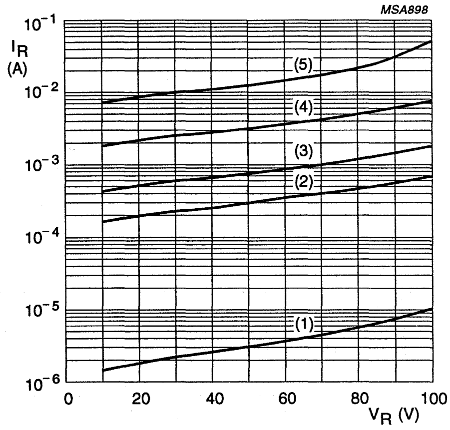
Note

1. Pulsed test: pulse width = 300 µs; δ = 0.02.



(1) T_{amb} = 25°C
(2) T_{amb} = 85°C
(3) T_{amb} = 100°C
(4) T_{amb} = 125°C
(5) T_{amb} = 150°C

Fig.2 Forward current as a function of forward voltage.



(1) T_{amb} = 25°C
(2) T_{amb} = 85°C
(3) T_{amb} = 100°C
(4) T_{amb} = 125°C
(5) T_{amb} = 150°C

Fig.3 Reverse current as a function of reverse voltage.

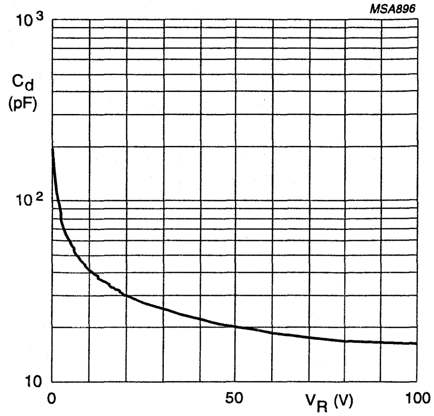


Fig.4 Diode capacitance as a function of reverse voltage.

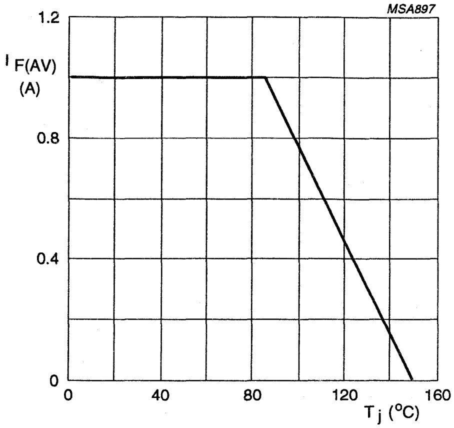


Fig.5 Average forward current derating curve.

Low voltage avalanche diode PLVA600A

FEATURES

- Very low dynamic impedance at low currents
- Hard breakdown knee
- Low noise level.

DESCRIPTION

The PLVA600A series are silicon planar high performance voltage regulators, with a hard breakdown knee, low noise and very low dynamic impedance.

They are intended for low current, low power and low noise applications, such as CMOS RAM back-up circuits, voltage stabilizers, voltage limiters and smoke detector relays.

The devices are encapsulated in a SOT23 microminiature plastic envelope.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_Z	nominal working voltage range		5	6.8	V
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	250	mW
P_{ZSM}	non-repetitive peak reverse power dissipation	t_p = 100 µs; T_j = 150 °C	–	30	W
T_j	junction temperature		–	150	°C

Marking code:
PLVA650A: p9A
PLVA653A: p9B
PLVA656A: p9C
PLVA659A: p9D
PLVA662A: p9E
PLVA665A: p9F
PLVA668A: p9G.

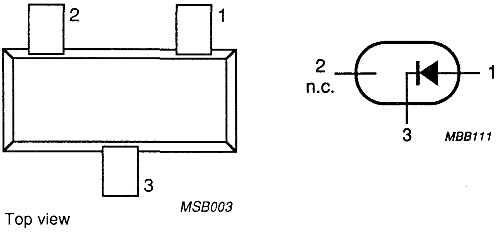


Fig.1 Simplified outline (SOT23) and symbol.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_Z	working current	DC	–	note 1	mA
I_{FRM}	repetitive peak forward current	t_p = 100 µs; δ = 10%	–	250	mA
I_{ZRM}	repetitive peak working current	t_p = 100 µs; δ = 10%	–	250	mA
P_{ZSM}	non-repetitive peak reverse power dissipation	t_p = 100 µs; T_j = 150 °C	–	30	W
P_{tot}	total power dissipation	up to T_{amb} = 25 °C; note 2	–	250	mW
T_{stg}	storage temperature range		−65	150	°C
T_j	junction temperature		–	150	°C

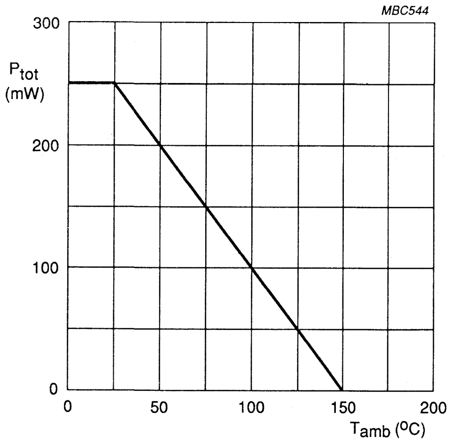


Fig.2 Power derating curve.

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	from junction to ambient (note 2)	500 K/W

Notes

1. The DC working current (I_Z) is limited by $P_{tot\ max}$.
2. Device mounted on FR4 printboard.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_F	forward voltage	I_F = 10 mA	–	–	900	mV
V_Z	working voltage	I_Z = 250 μA				
	PLVA650A		4.8	5.0	5.2	V
	PLVA653A		5.1	5.3	5.5	V
	PLVA656A		5.4	5.6	5.8	V
	PLVA659A		5.7	5.9	6.1	V
	PLVA662A		6	6.2	6.4	V
	PLVA665A		6.3	6.5	6.7	V
	PLVA668A		6.6	6.8	7.0	V
		I_Z = 10 μA				
	PLVA650A		–	4.30	–	V
	PLVA653A		–	5.20	–	V
	PLVA656A		–	5.51	–	V
	PLVA659A		–	5.85	–	V
	PLVA662A		–	6.19	–	V
	PLVA665A		–	6.49	–	V
	PLVA668A		–	6.80	–	V
R_z	dynamic resistance	1 kHz superimposed; I_{ZAC} is 10% of I_{ZDC}; I_Z = 250 μA				
	PLVA650A		–	–	700	Ω
	PLVA653A		–	–	250	Ω
	PLVA656A to 668A		–	–	100	Ω
S_z	temperature coefficient	I_Z = 250 μA				
	PLVA650A		–	0.2	–	mV/K
	PLVA653A		–	1.6	–	mV/K
	PLVA656A		–	1.9	–	mV/K
	PLVA659A		–	2.4	–	mV/K
	PLVA662A		–	2.65	–	mV/K
	PLVA665A		–	2.9	–	mV/K
	PLVA668A		–	3.4	–	mV/K

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_R	reverse current	$V_R = 80\%\ V_Z$ nominal				
	PLVA650A		–	–	10 000	nA
	PLVA653A		–	–	5000	nA
	PLVA656A		–	–	1000	nA
	PLVA659A		–	–	500	nA
	PLVA662A		–	–	100	nA
	PLVA665A		–	–	50	nA
	PLVA668A		–	–	10	nA
		$V_R = 50\%\ V_Z$ nominal				
	PLVA650A		–	34	–	nA
	PLVA653A		–	22	–	nA
	PLVA656A		–	1.1	–	nA
	PLVA659A		–	0.9	–	nA
	PLVA662A		–	0.9	–	nA
	PLVA665A		–	0.8	–	nA
	PLVA668A		–	0.8	–	nA
		$V_R = 90\%\ V_Z$ nominal				
	PLVA650A		–	21	–	μA
	PLVA653A		–	3.5	–	μA
	PLVA656A		–	1.3	–	μA
	PLVA659A		–	1.0	–	μA
	PLVA662A		–	0.05	–	μA
	PLVA665A		–	0.04	–	μA
	PLVA668A		–	0.006	–	μA
ΔV_Z	line regulation PLVA659A to 668A	$I_{LO} = 10\ \mu A$; $I_{HI} = 1\ mA$	–	–	0.1	V
	PLVA656A	$I_{LO} = 50\ \mu A$; $I_{HI} = 1\ mA$	–	–	0.1	V
	PLVA650A	$I_{LO} = 100\ \mu A$; $I_{HI} = 1\ mA$	–	–	0.4	V
	PLVA653A		–	–	0.2	V
V_n	noise voltage density	f = 1 kHz; B = 1 kHz; $I_Z = 250\ \mu A$	–	–	1.0	μV/√Hz

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

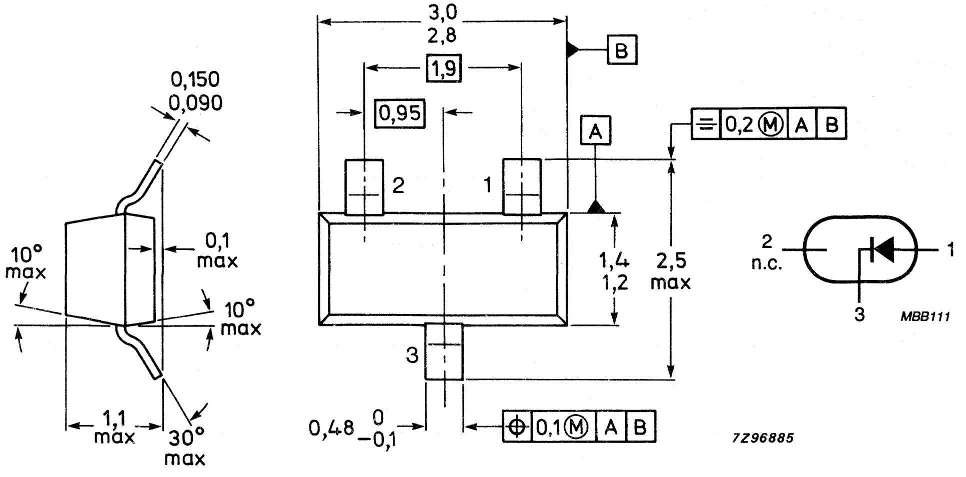
Continuous reverse voltage	V_R	max.	70	V
Forward current (DC)	I_F	max.	215	mA
Non-repetitive peak forward current	I_{FSM}	max.	500	mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	250	mW
Junction temperature	T_j	max.	150	°C
Forward voltage at I_F = 10 mA	V_F	max.	1	V
Reverse recovery time I_F = 10 mA to I_R = 10 mA measured at I_R = 1 mA	t_{rr}	max.	4	ns

MECHANICAL DATA

Dimensions in mm

Marking code:

PMBD914: p5D



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.	215	mA
Non-repetitive peak forward current	I_{FSM}	max.	500	mA
Total power dissipated 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

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.	4	ns

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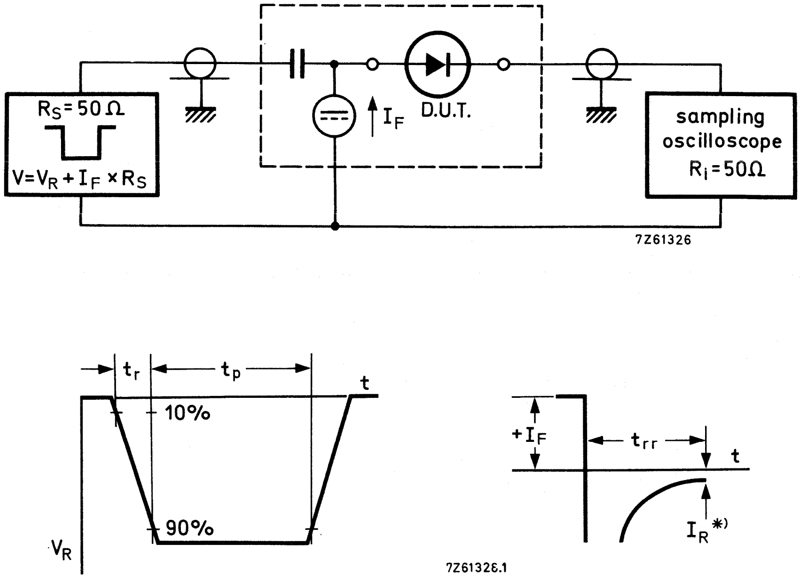
* Mounted on an FR4 printed-circuit board.



input signal

output signal

Fig. 2 Test circuit and waveforms; reverse recovery time.

SILICON PLANAR EPITAXIAL HIGH SPEED DIODES

The PMBD2835 and 2836 consist of two diodes in a microminiature plastic envelope. The anodes are commoned and the unit is intended for high speed switching.

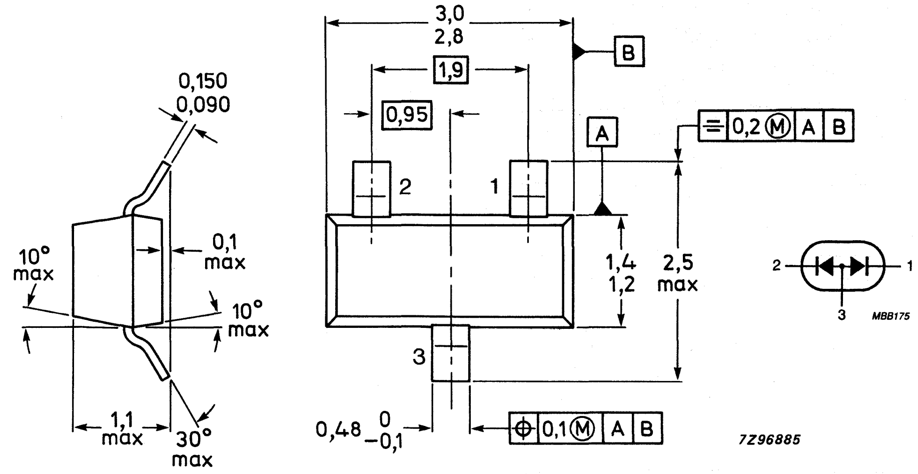
QUICK REFERENCE DATA (per diode)

			PMBD2835	PMBD2836	
Continuous reverse voltage	V_R	max.	35	75	V
Forward current (DC)	I_F	max.	215		mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	250		mW
Junction temperature	T_j	max.	150		°C
Forward voltage at I_F = 50 mA	V_F	<	1.0		V
Reverse recovery time I_F = 10 mA to I_R = 10 mA measured at I_R = 1 mA	t_{rr}	<	4		ns

MECHANICAL DATA

Dimensions in mm

Marking code:
PMBD2835: pA3
PMBD2836: pA2



TOP VIEW

Fig. 1 SOT-23.

See also soldering recommendations.

RATINGS (per diode)

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

			PMBD2835	PMBD2836	
Continuous reverse voltage	V_R	max.	35	75	V
Forward current (DC)	I_F	max.	215		mA
Total power dissipated 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 (per diode)

T_{amb} = 25 °C unless otherwise specified

Forward voltage					
I_F = 50 mA		V_F	$<$	1.0	V
I_F = 100 mA		V_F	$<$	1.2	V
Reverse breakdown voltage					
I_R = 100 μA	PMBD2835	$V_{(BR)R}$	$>$	35	V
	PMBD2836	$V_{(BR)R}$	$>$	75	V
Reverse current					
V_R = 30 V	PMBD2835	I_R	$<$	100	nA
V_R = 50 V	PMBD2836	I_R	$<$	100	nA
Diode capacitance					
V_R = 0 V; f = 1 MHz		C_d	$<$	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}	$<$	4	ns

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* Mounted on an FR4 printed-circuit board.

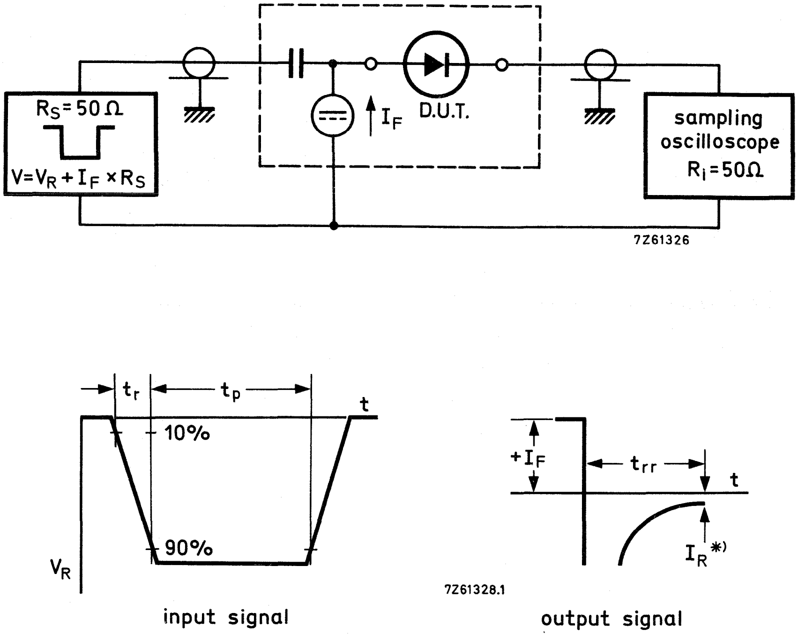


Fig. 2 Test circuit and waveforms; reverse recovery time.

SILICON PLANAR EPITAXIAL HIGH SPEED DIODES

The PMBD2837 and 2838 consist of two diodes in a microminiature plastic envelope. The cathodes are commoned and the unit is intended for high speed switching.

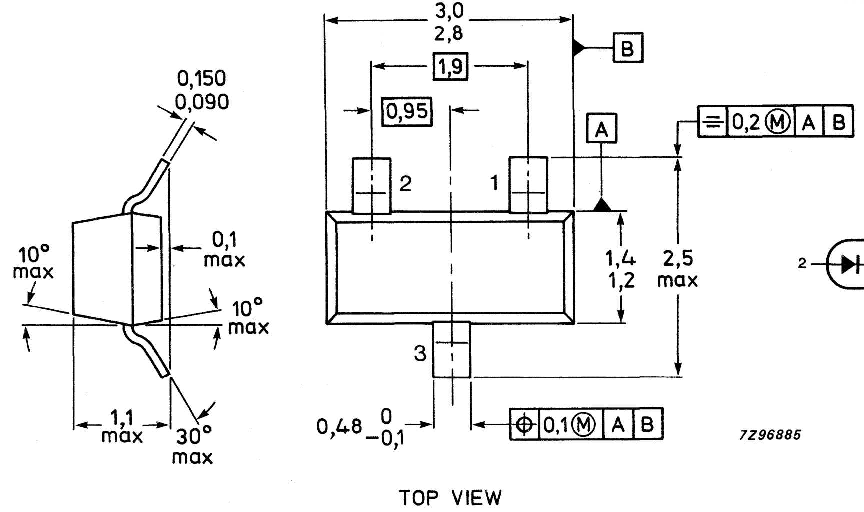
QUICK REFERENCE DATA (per diode)

			PMBD2837	PMBD2838	
Continuous reverse voltage	V_R	max.	30	50	V
Repetitive peak reverse voltage	V_{RRM}	max.	35	75	V
Repetitive peak forward current	I_{FRM}	max.	450		mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	250		mW
Junction temperature	T_j	max.	150		°C
Forward voltage at I_F = 50 mA	V_F	$<$	1.0		V
Reverse recovery time I_F = 10 mA to I_R = 10 mA measured at I_R = 1 mA	t_{rr}	$<$	4		ns

MECHANICAL DATA

Dimensions in mm

Marking code:
PMBD2837: pA5
PMBD2838: pA6



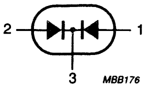


Fig. 1 SOT-23.

See also soldering recommendations.

RATINGS (per diode)

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

			PMBD2837	PMBD2838	
Continuous reverse voltage	V_R	max.	30	50	V
Repetitive peak reverse voltage	V_{RRM}	max.	35	75	V
Forward current (DC)	I_F	max.	215		mA
Repetitive peak forward current	I_{FRM}	max.	450		mA
Total power dissipated 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 (per diode)

T_{amb} = 25 °C unless otherwise specified

Forward voltage					
I_F = 50 mA		V_F	$<$	1.0	V
I_F = 100 mA		V_F	$<$	1.2	V
Reverse breakdown voltage					
I_R = 100 μA	PMBD2837	$V_{(BR)R}$	$>$	35	V
	PMBD2838	$V_{(BR)R}$	$>$	75	V
Reverse current					
V_R = 30 V	PMBD2837	I_R	$<$	100	nA
V_R = 50 V	PMBD2838	I_R	$<$	100	nA
Diode capacitance					
V_R = 0 V; f = 1 MHz		C_d	$<$	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}	$<$	4	ns

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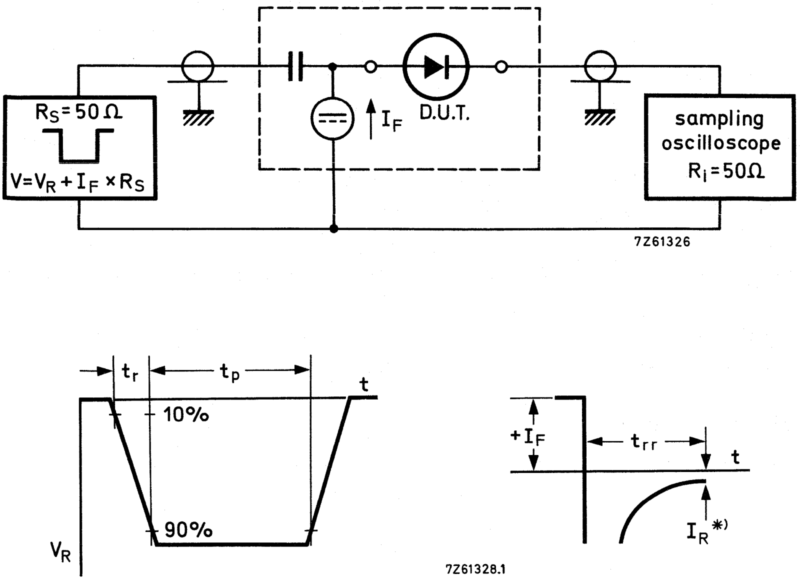
* Mounted on an FR4 printed-circuit board.



input signal

output signal

Fig. 2 Test circuit and waveforms; reverse recovery time.

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.	250	mW
Junction temperature	T_j	max.	150	°C
Forward voltage at I_F = 100 mA	V_F	min. max.	0.85 1.1	V V
Reverse recovery time I_F = 10 mA to I_R = 10 mA measured at I_R = 1 mA	t_{rr}	max.	4	ns

MECHANICAL DATA

Dimensions in mm

Marking code:
PMBD6050: p5A

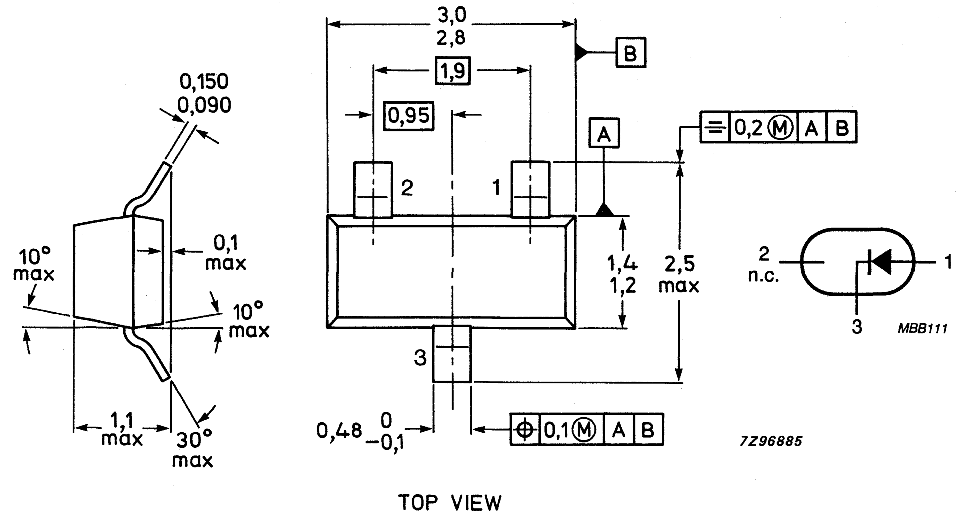


Fig. 1 SOT-23.

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.	215	mA
Non-repetitive peak forward current (t = 1 s)	I_{FSM}	max.	500	mA
Total power dissipated 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

Forward voltage				
I_F = 1 mA	V_F	min. max.	0.55 0.70	V V
I_F = 100 mA	V_F	min. max.	0.85 1.10	V 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.	4	ns

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* Mounted on an FR4 printed-circuit board.

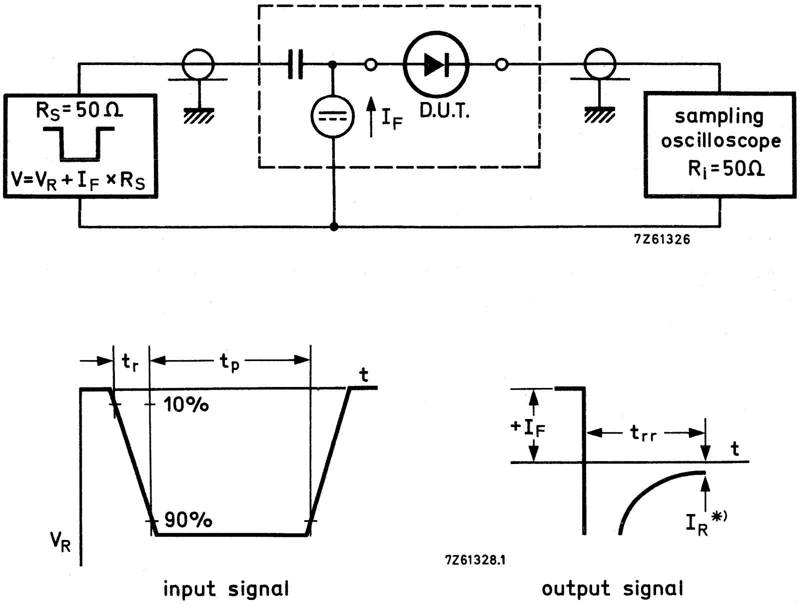


Fig. 2 Test circuit and waveforms; reverse recovery time.

SILICON PLANAR EPITAXIAL HIGH SPEED DIODES

The PMBD6100 consists of two diodes in a microminiature plastic envelope. The cathodes are commoned and the unit is intended for high speed switching.

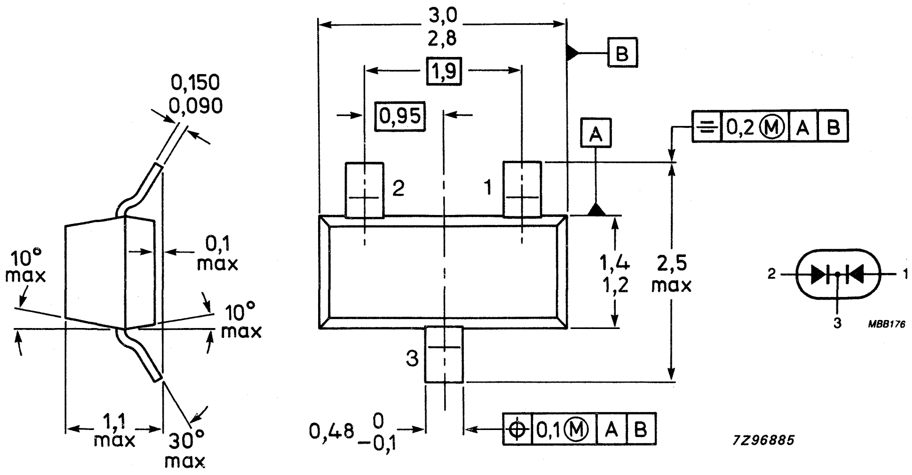
QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	70	V
Forward current (DC)	I_F	max.	215	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	$>$ $<$	0.85 1.1	V V
Reverse recovery time I_F = 10 mA to I_R = 10 mA measured at I_R = 1 mA	t_{rr}	$<$	4	ns

MECHANICAL DATA

Dimenions in mm

Marking code:
PMBD6100: p5B



TOP VIEW

Fig. 1 SOT-23.

See also soldering recommendations.

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.	215 mA
Non-repetitive peak forward current (t = 1 s)	I_{FSM}	max.	500 mA
Total power dissipated 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 (per diode)

T_{amb} = 25 °C unless otherwise specified

Forward voltage			
I_F = 1 mA	V_F	$>$ $<$	0.55 V 0.70 V
I_F = 100 mA	V_F	$>$ $<$	0.85 V 1.10 V
Reverse breakdown voltage			
I_R = 100 μA	$V_{(BR)R}$	$>$	70 V
Reverse current V_R = 50 V	I_R	$<$	100 nA
Diode capacitance			
V_R = 0 V; f = 1 MHz	C_d	$<$	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}	$<$	4 ns

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** Mounted on an FR4 printed-circuit board.

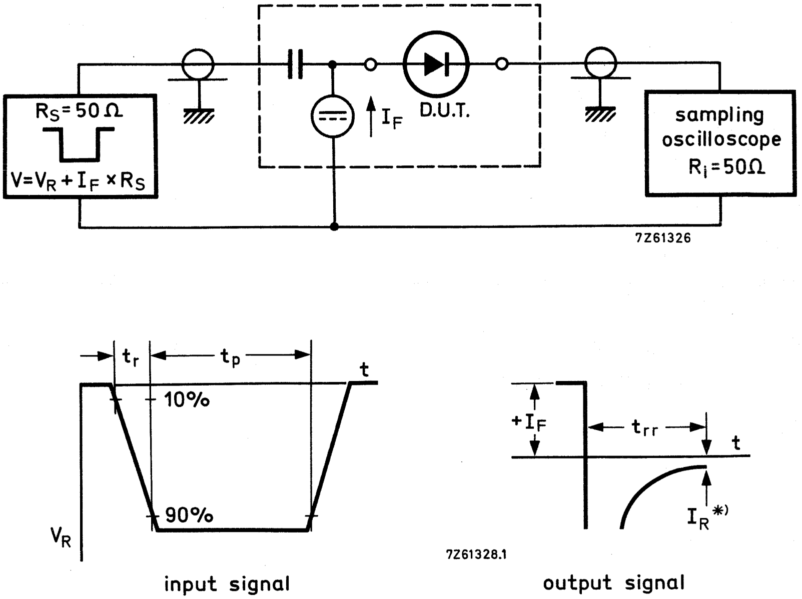

Fig. 2 Test circuit and waveforms; reverse recovery time.

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.	215	mA
Non-repetitive peak forward current	I_{FSM}	max.	500	mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	250	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.	4	ns

MECHANICAL DATA

Dimensions in mm

Marking code:
PMBD7000: p5C

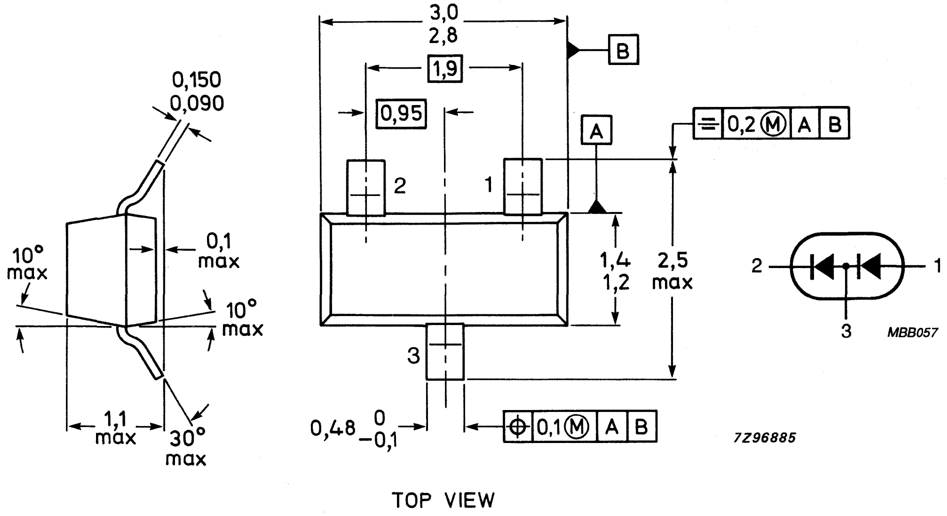

Fig. 1 SOT-23.

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.	215	mA
Non-repetitive peak forward current (t = 1 s)	I_{FSM}	max.	500	mA
Total power dissipated 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 (per diode)

T_{amb} = 25 °C unless otherwise specified

Forward voltage				
I_F = 1 mA	V_F	min. max.	0.55 0.70	V V
I_F = 10 mA	V_F	min. max.	0.67 0.82	V V
I_F = 100 mA	V_F	min. max.	0.75 1.10	V 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.	4	ns

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* Mounted on an FR4 printed-circuit board.

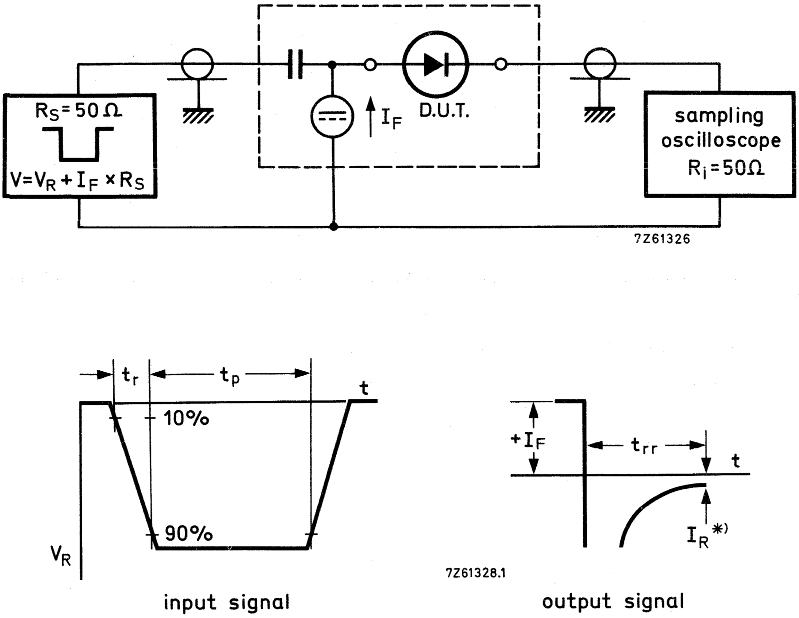


Fig. 2 Test circuit and waveforms; reverse recovery time.

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 °C	P_{tot}	max.	300	mW
Drain-source on-resistance I_D = 200 mA; V_{GS} = 10 V	$R_{DS\,on}$	typ. max.	2.5 5.0	Ω Ω
Transfer admittance I_D = 200 mA; V_{DS} = 10 V	$\lvert y_{fs} \rvert$	min. typ.	100 200	mS mS

MECHANICAL DATA

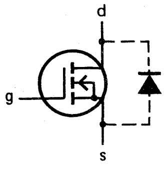
Dimensions in mm

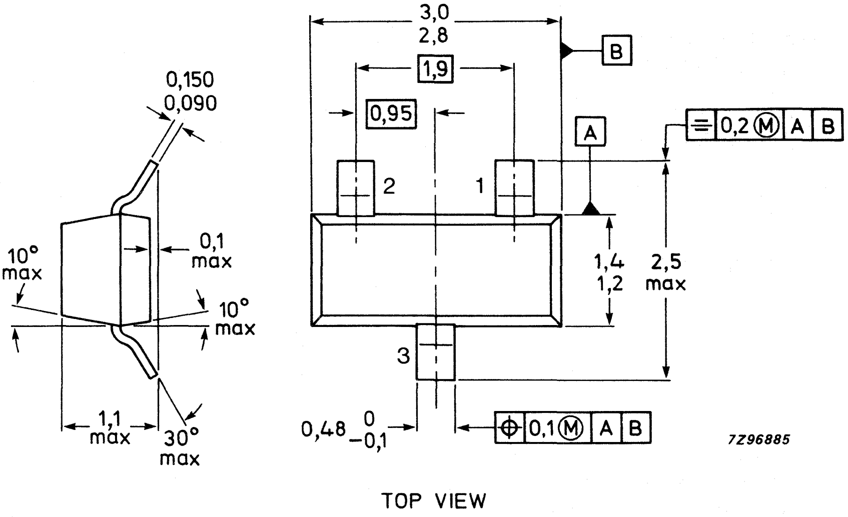
Fig.1 SOT23.

Marking code:
PMBF170 = pKX

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.	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.	300	mW (note 1)
		max.	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.	60	V
		typ.	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.	0.8	V
		max.	3.0	V
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
Input capacitance				
V_{DS} = 10 V; V_{GS} = 0 V; f = 1 MHz	C_{iss}	typ.	25	pF
		max.	40	pF
Output capacitance				
V_{DS} = 10 V; V_{GS} = 0 V; f = 1 MHz	C_{oss}	typ.	22	pF
		max.	30	pF
Feedback capacitance				
V_{DS} = 10 V; V_{GS} = 0 V; f = 1 MHz	C_{rss}	typ.	6	pF
		max.	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} t_{off}	max. max.	10 ns 15 ns

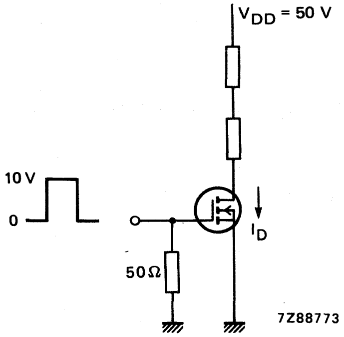


Fig.2 Switching times test circuit.

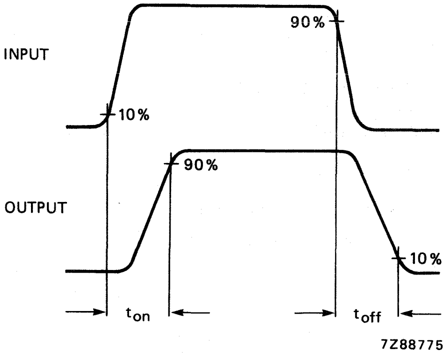


Fig.3 Input and output waveforms.

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.

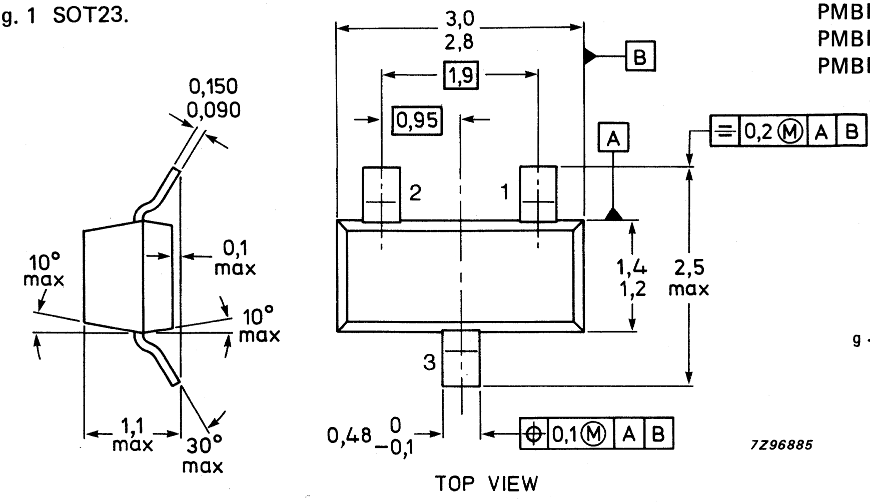
QUICK REFERENCE DATA

			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.

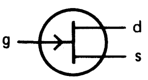


Marking code

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 $T_{amb} = 40\ ^oC$ *	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

$T_j = 25\ ^oC$ 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; $T_{amb} = 150\ ^oC$	$-I_{GSS}$	<	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; $T_{amb} = 25\ ^oC$	$r_{ds\ on}$	<	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 °C	I_{DSX}	<	0.2	–	–	μA
$-V_{GS}$ = 7 V; V_{DS} = 20 V; T_{amb} = 150 °C	I_{DSX}	<	–	0.2	–	μA
$-V_{GS}$ = 5 V; V_{DS} = 20 V; T_{amb} = 150 °C	I_{DSX}	<	–	–	0.2	μA
y-parameters (common source) V_{DS} = 20 V; V_{GS} = 0; f = 1 MHz; T_{amb} = 25 °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

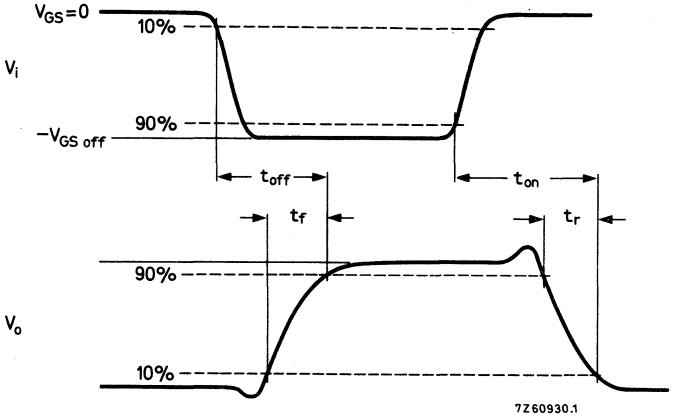
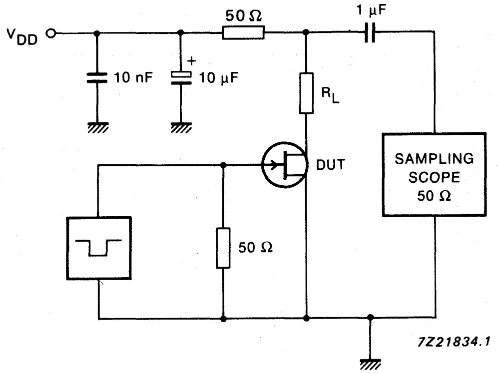


Fig.2 Switching times waveforms.



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.

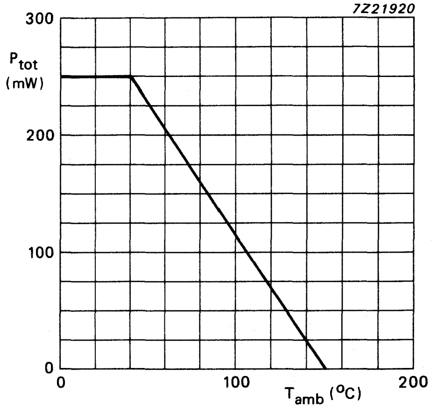


Fig.4 Power derating curve.

N-channel field-effect transistor PMBF4416; PMBF4416A

FEATURES

- Low noise
- Interchangeability of drain and source connections
- High gain.

DESCRIPTION

N-channel symmetrical silicon junction FETs in a surface-mountable SOT23 envelope. These devices are intended for use in VHF/UHF amplifiers, oscillators and mixers.

PINNING - SOT23

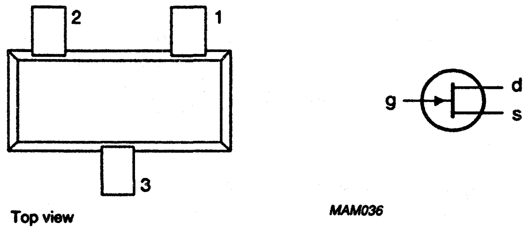
PIN	DESCRIPTION
1	source
2	drain
3	gate

CAUTION

The device is supplied in an antistatic package. The gate-source input must be protected against static charge during transport and handling.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage				
	PMBF4416		–	30	V
	PMBF4416A		–	35	V
I_{DSS}	drain-source current	$V_{DS} = 15$ V; $V_{GS} = 0$	5	15	mA
P_{tot}	total power dissipation	up to $T_{amb} = 25$ °C	–	250	mW
$V_{GS(off)}$	gate-source cut-off voltage	$V_{DS} = 15$ V; $I_D = 1$ nA			
	PMBF4416		–	−6	V
	PMBF4416A		−2.5	−6	V
$\|Y_{fs}\|$	common-source transfer admittance	$V_{DS} = 15$ V; $V_{GS} = 0$; f = 1 kHz	4.5	7.5	mS



Marking codes:
PMBF4416: P6A.
PMBF4416A: M16.

Fig.1 Simplified outline and symbol.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage				
	PMBF4416		–	30	V
	PMBF4416A		–	35	V
V_{GSO}	gate-source voltage				
	PMBF4416		–	–30	V
	PMBF4416A		–	–35	V
V_{GDO}	gate-drain voltage				
	PMBF4416		–	–30	V
	PMBF4416A		–	–35	V
I_G	DC forward gate current		–	10	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C (note 1)	–	250	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

THERMAL RESISTANCE

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

Note

1. Mounted on an FR4 printed-circuit board.

STATIC CHARACTERISTICS

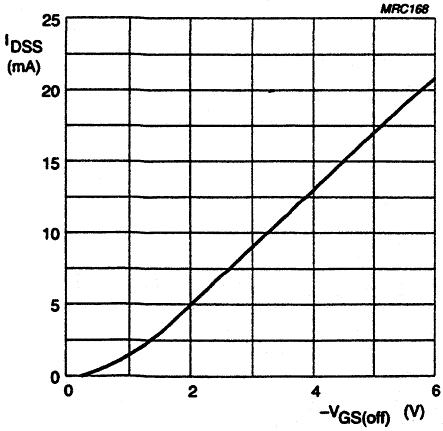
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)GSS}$	gate-source breakdown voltage	$V_{DS} = 0$; $I_G = -1\ \mu A$			
	PMBF4416		–30	–	V
	PMBF4416A		–35	–	V
I_{GSS}	reverse gate leakage current	$V_{DS} = 0$; $V_{GS} = -15$ V	–	1	nA
I_{DSS}	drain current	V_{DS} = 15 V; $V_{GS} = 0$	5	15	mA
V_{GSS}	gate-source forward voltage	$V_{DS} = 0$; I_G = 1 mA	–	1	V
$V_{GS(off)}$	gate-source cut-off voltage	V_{DS} = 15 V; I_D = 1 nA			
	PMBF4416		–	–6	V
	PMBF4416A		–2.5	–6	V
$\lvert Y_{fs}\rvert$	common source transfer admittance	V_{DS} = 15 V; $V_{GS} = 0$	4.5	7.5	mS
$\lvert Y_{os}\rvert$	common source output admittance	V_{DS} = 15 V; $V_{GS} = 0$			
	PMBF4416		–	50	µS
	PMBF4416A		–	50	µS

DYNAMIC CHARACTERISTICS

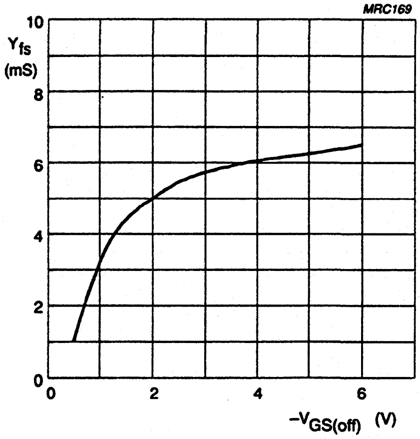
$T_j = 25\ °C$; $V_{DS} = 15\ V$; $V_{GS} = 0$.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
C_{is}	input capacitance	f = 1 MHz	–	–	4	pF
C_{os}	output capacitance	f = 1 MHz	–	–	2	pF
C_{rs}	feedback capacitance	f = 1 MHz	–	–	0.8	pF
g_{is}	common source input conductance	f = 100 MHz	–	–	100	µS
		f = 400 MHz	–	–	1	mS
g_{fs}	common source transfer conductance	f = 100 MHz	–	5.2	–	mS
		f = 400 MHz	4	5	–	mS
g_{rs}	common source feedback conductance	f = 100 MHz	–	−8	–	µS
		f = 400 MHz	–	−100	–	µS
g_{os}	common source output conductance	f = 100 MHz	–	–	75	µS
		f = 400 MHz	–	–	100	µS
V_n	equivalent input noise voltage	f = 100 Hz	–	5	–	nV/√Hz



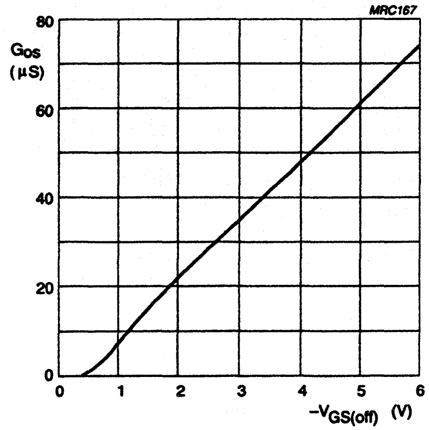
$V_{DS} = 15\ V$; $T_j = 25\ °C$.

Fig.2 Drain current as a function of gate-source cut-off voltage; typical values.



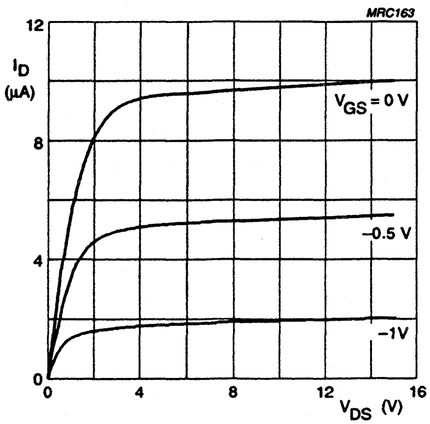
$V_{DS} = 15\ V$; $T_j = 25\ °C$.

Fig.3 Common source transfer admittance as a function of gate-source cut-off voltage; typical values.



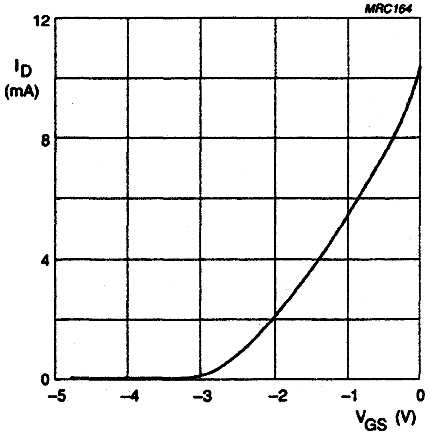
V_{DS} = 15 V; T_j = 25 °C.

Fig.4 Common source output conductance as a function of gate-source cut-off voltage; typical values.



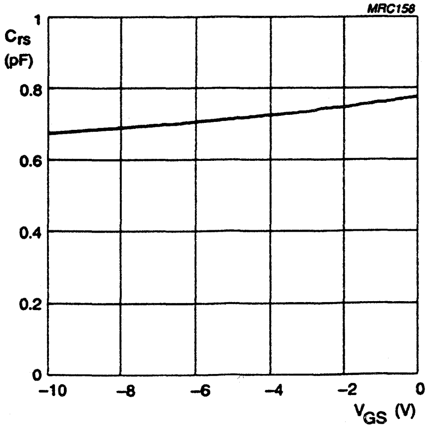
T_j = 25 °C.

Fig.5 Typical output characteristics.



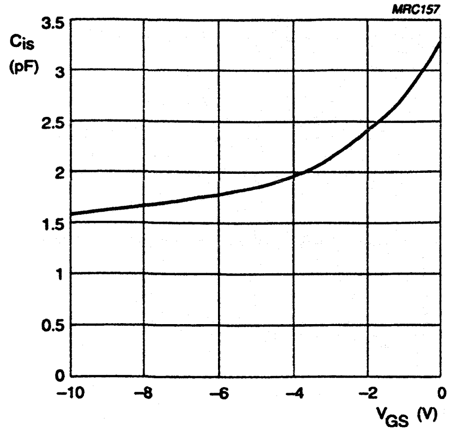
V_{DS} = 15 V; T_j = 25 °C.

Fig.6 Typical input characteristics.



V_{DS} = 15 V; T_j = 25 °C.

Fig.7 Typical feedback capacitance.



V_{DS} = 15 V; T_j = 25 °C.

Fig.8 Typical input capacitance.

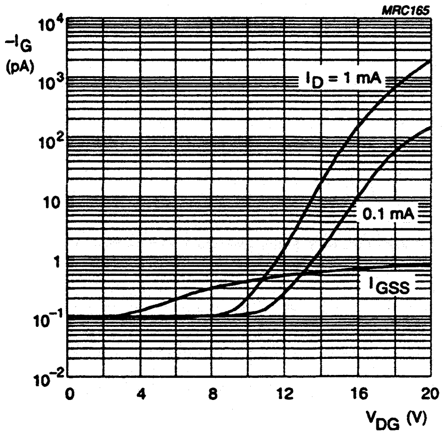


Fig.9 Gate current as a function of drain-gate voltage, typical values.

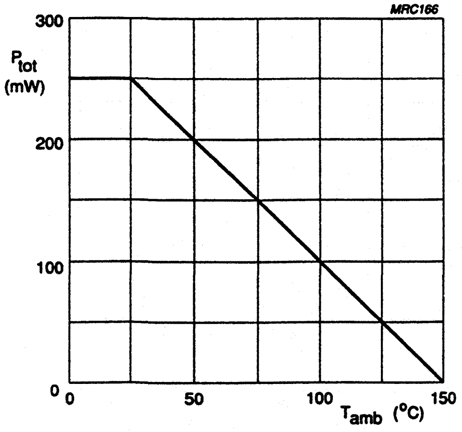
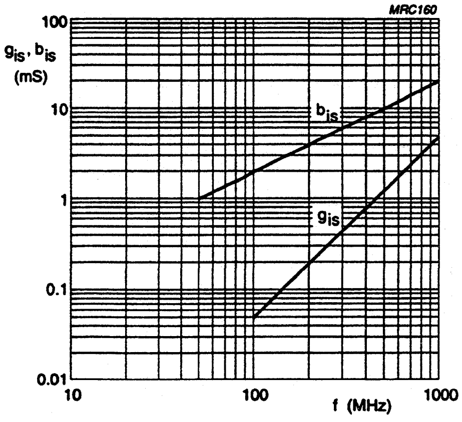
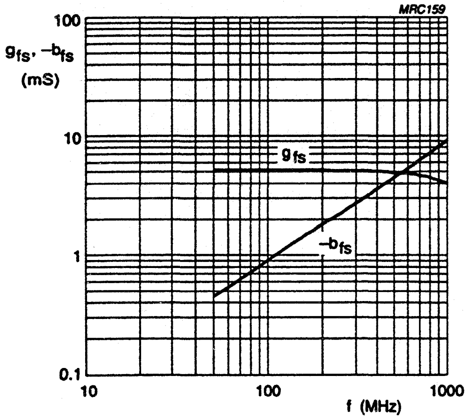


Fig.10 Power derating curve.



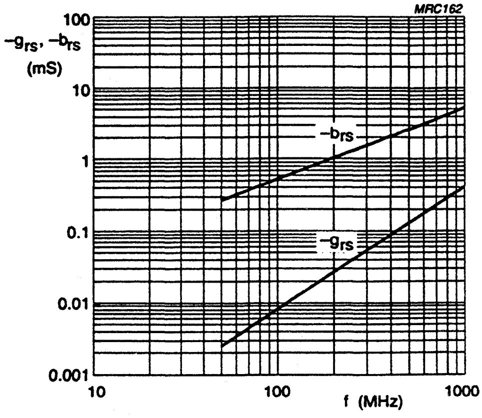
V_{DS} = 15 V; V_{GS} = 0; T_{amb} = 25 °C.

Fig.11 Common source input conductance; typical values.



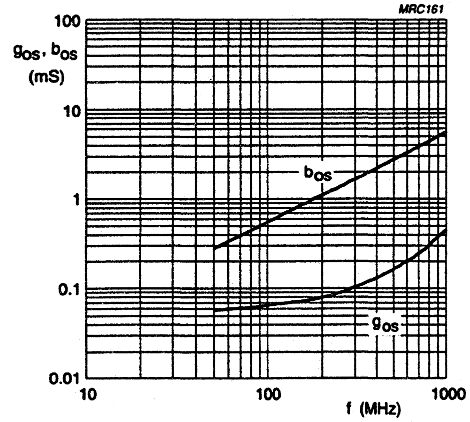
V_{DS} = 15 V; V_{GS} = 0; T_{amb} = 25 °C.

Fig.12 Common source transfer conductance; typical values.



V_{DS} = 15 V; V_{GS} = 0; T_{amb} = 25 °C.

Fig.13 Common source feedback conductance; typical values.



V_{DS} = 15 V; V_{GS} = 0; T_{amb} = 25 °C.

Fig.14 Common source output conductance; typical values.

SPICE parameters for PMBF4416

September 1992; version 1.0.

1	VTO = −3.553	V
2	BETA = 792.6	µA/V²
3	LAMBDA = 18.46	m/V
4	RD = 7.671	Ω
5	RS = 7.671	Ω
6	IS = 333.4	aA
7	CGSO = 2.920	pF
8	CGDO = 2.261	pF
9	PB = 1.090	V
10 (note 1)	FC = 500.0	m

Note

1. Parameter not extracted; default value.

N-channel field-effect transistors PMBF5484; PMBF5485; PMBF5486

FEATURES

- Low noise
- Interchangeability of drain and source connections
- High gain.

DESCRIPTION

N-channel, symmetrical, silicon junction FETs in a surface-mountable SOT23 envelope. Intended for use in VHF/UHF amplifiers, oscillators and mixers.

PINNING - SOT23

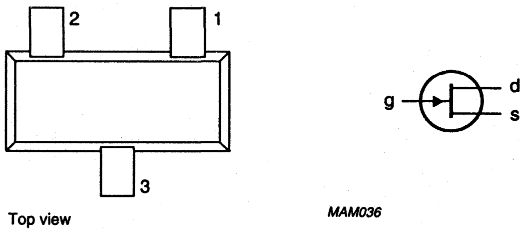
PIN	DESCRIPTION
1	source
2	drain
3	gate

CAUTION

The device is supplied in an antistatic package. The gate-source input must be protected against static charge during transport and handling.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage		–	25	V
I_{DSS}	drain current	V_{DS} = 15 V; V_{GS} = 0			
	PMBF5484		1	5	mA
	PMBF5485		4	10	mA
	PMBF5486		8	20	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	250	mW
$V_{GS(off)}$	gate-source cut-off voltage	V_{DS} = 15 V; I_D = 1 nA			
	PMBF5484		−0.3	−3	V
	PMBF5485		−0.5	−4	V
	PMBF5486		−2	−6	V
$\|Y_{fs}\|$	common source transfer admittance	V_{DS} = 15 V; V_{GS} = 0; f = 1 kHz			
	PMBF5484		3	6	mS
	PMBF5485		3.5	7	mS
	PMBF5486		4	8	mS



Marking codes:
PMBF5484: p6B
PMBF5485: p6M
PMBF5486: p6H

Fig.1 Simplified outline and symbol.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage		–	25	V
V_{GSO}	gate-source voltage		–	–25	V
V_{GDO}	gate-drain voltage		–	–25	V
I_G	DC forward gate current		–	10	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C (note 1)	–	250	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

THERMAL RESISTANCE

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

Note

1. Device mounted on an FR4 printed-circuit board.

STATIC CHARACTERISTICS

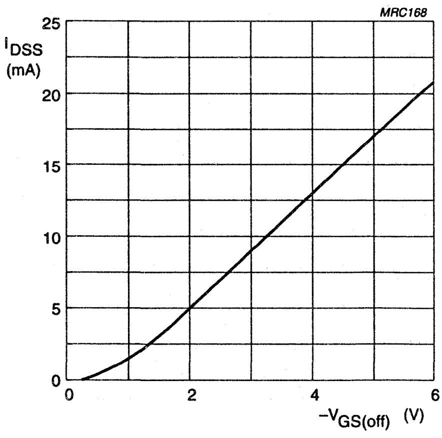
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)GSS}$	gate-source breakdown voltage	$V_{DS} = 0$; $I_G = -1$ µA	–25	–	V
I_{DSS}	drain current	V_{DS} = 15 V; $V_{GS} = 0$			
	PMBF5484		1	5	mA
	PMBF5485		4	10	mA
	PMBF5486		8	20	mA
I_{GSS}	reverse gate leakage current	$V_{DS} = 0$; $V_{GS} = -15$ V	–	–1	nA
V_{GSS}	gate-source forward voltage	$V_{DS} = 0$; I_G = 1 mA	–	1	V
$V_{GS(off)}$	gate-source cut-off voltage	V_{DS} = 15 V; I_D = 1 nA			
	PMBF5484		–0.3	–3	V
	PMBF5485		–0.5	–4	V
	PMBF5486		–2	–6	V
$\|Y_{fs}\|$	common source transfer admittance	V_{DS} = 15 V; $V_{GS} = 0$			
	PMBF5484		3	6	mS
	PMBF5485		3.5	7	mS
	PMBF5486		4	8	mS
$\|Y_{os}\|$	common source output admittance	V_{DS} = 15 V; $V_{GS} = 0$			
	PMBF5484		–	50	µS
	PMBF5485		–	60	µS
	PMBF5486		–	75	µS

DYNAMIC CHARACTERISTICS

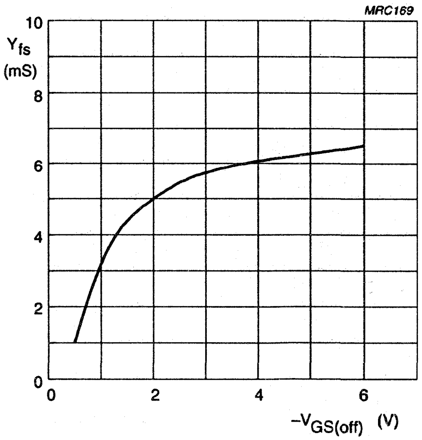
$T_j = 25\ °C$; $V_{DS} = 15\ V$; $V_{GS} = 0$

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
C_{is}	input capacitance	f = 1 MHz	–	–	5	pF
C_{os}	output capacitance	f = 1 MHz	–	–	2	pF
C_{rs}	feedback capacitance	f = 1 MHz	–	–	1	pF
g_{is}	common source input conductance					
	PMBF5484	f = 100 MHz	100	–	–	µS
	PMBF5485; PMBF5486	f = 400 MHz	–	–	1	mS
g_{fs}	common source transfer conductance					
	PMBF5484	f = 100 MHz	2.5	–	–	mS
	PMBF5485	f = 400 MHz	3	–	1	mS
	PMBF5486	f = 400 MHz	3.5	–	1	mS
g_{os}	common source output conductance					
	PMBF5484	f = 100 MHz	–	–	75	µS
	PMBF5485; PMBF5486	f = 400 MHz	–	–	100	µS
V_n	equivalent input noise voltage	f = 100 Hz	–	5	–	nV/√Hz



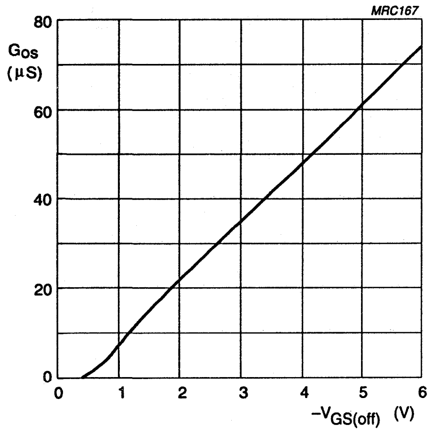
$V_{DS} = 15\ V$; $T_j = 25\ °C$; typical values.

Fig.2 Drain current as a function of gate-source cut-off voltage.



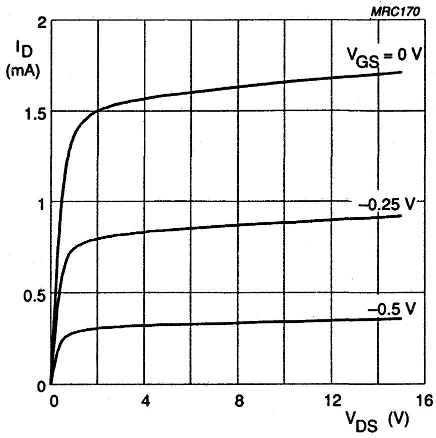
$V_{DS} = 15\ V$; $T_j = 25\ °C$; typical values.

Fig.3 Common source transfer admittance as a function of gate-source cut-off voltage.



V_{DS} = 15 V; T_j = 25 °C; typical values.

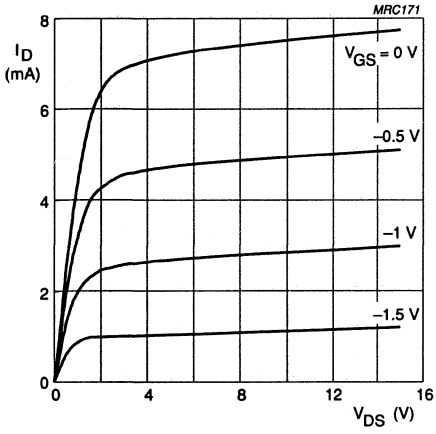
Fig.4 Common source output conductance as a function of gate-source cut-off voltage.



PMBF5484

T_j = 25 °C.

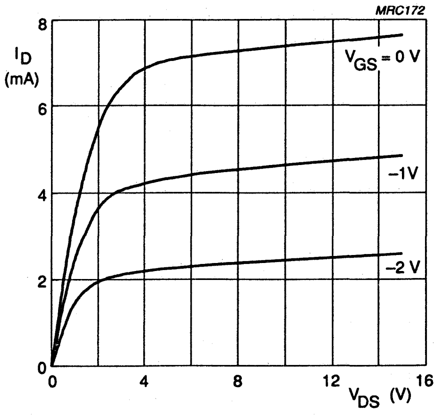
Fig.5 Typical output characteristics.



PMBF5485

T_j = 25 °C.

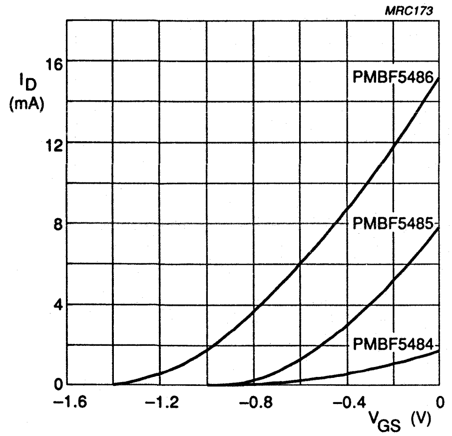
Fig.6 Typical output characteristics.



PMBF5486

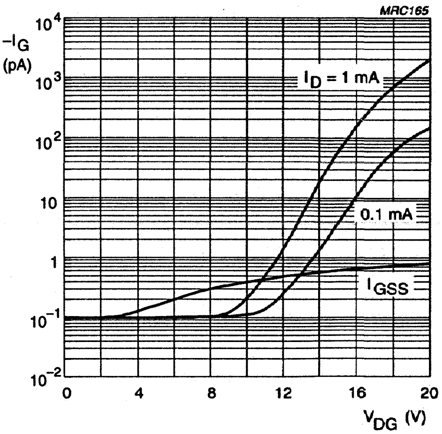
T_j = 25 °C.

Fig.7 Typical output characteristics.



V_{DS} = 15 V; T_j = 25 °C.

Fig.8 Typical input characteristics.



T_j = 25 °C.

Fig.9 Gate current as a function of drain-gate voltage, typical values.

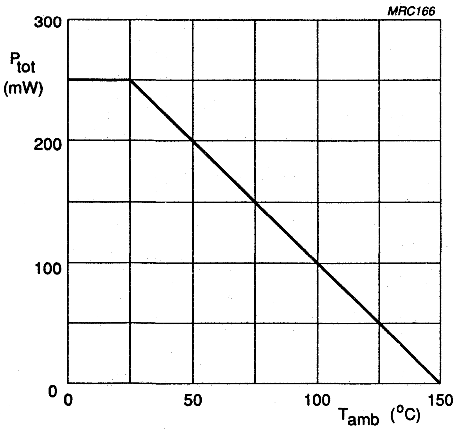
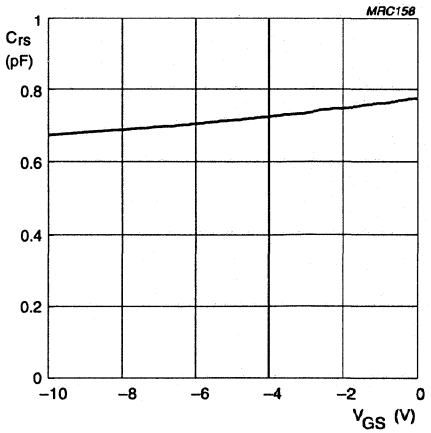
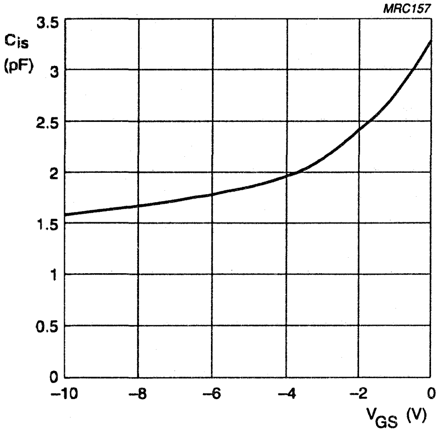


Fig.10 Power derating curve.



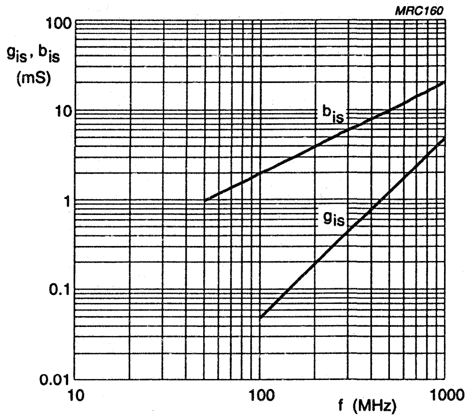
V_{DS} = 15 V; T_j = 25 °C.

Fig.11 Typical feedback capacitance.



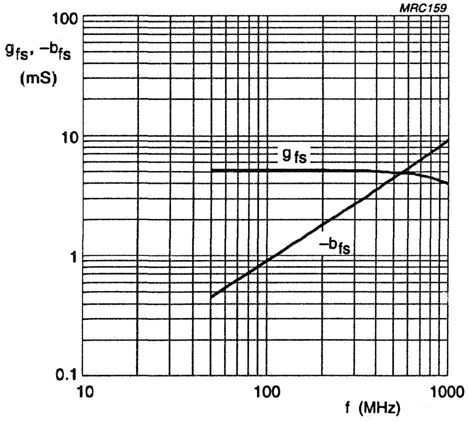
V_{DS} = 15 V; T_j = 25 °C.

Fig.12 Typical input capacitance.



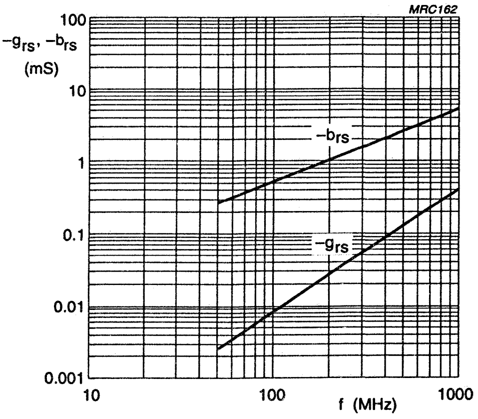
V_{DS} = 15 V; V_{GS} = 0; T_{amb} = 25 °C; typical values.

Fig.13 Common source input conductance.



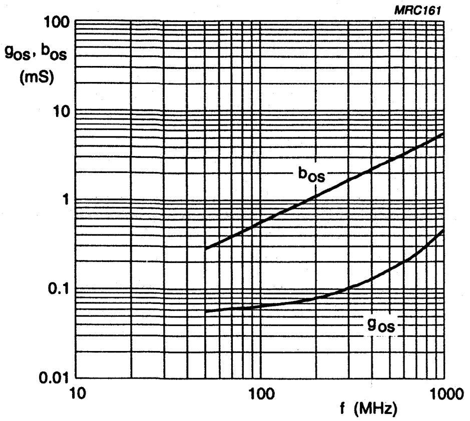
V_{DS} = 15 V; V_{GS} = 0; T_{amb} = 25 °C; typical values.

Fig.14 Common source transfer conductance.



V_{DS} = 15 V; V_{GS} = 0; T_{amb} = 25 °C; typical values.

Fig.15 Common source feedback conductance.



V_{DS} = 15 V; V_{GS} = 0; T_{amb} = 25 °C; typical values.

Fig.16 Common source output conductance.

Philips Semiconductors

Data sheet	
status	Product specification
date of issue	July 1993

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

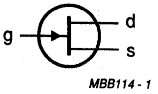


Fig.1 Symbol.

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

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	$V_{GS} = 0$	PMBFJ108	80	-	mA
		$V_{DS} = 15$ V	PMBFJ109	40	-	
			PMBFJ110	10	-	
$-V_{(BR)GSS}$	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	PMBFJ108	3	10	V
		$V_{DS} = 5$ V	PMBFJ109	2	6	
			PMBFJ110	0.5	4	
$R_{DS(on)}$	drain-source on-resistance	$V_{GS} = 0$ V	PMBFJ108	-	8	Ω
		$V_{DS} = 0.1$ V	PMBFJ109	-	12	
			PMBFJ110	-	18	

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).

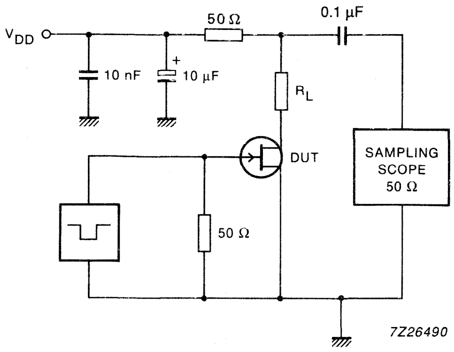


Fig.2 Switching circuit.

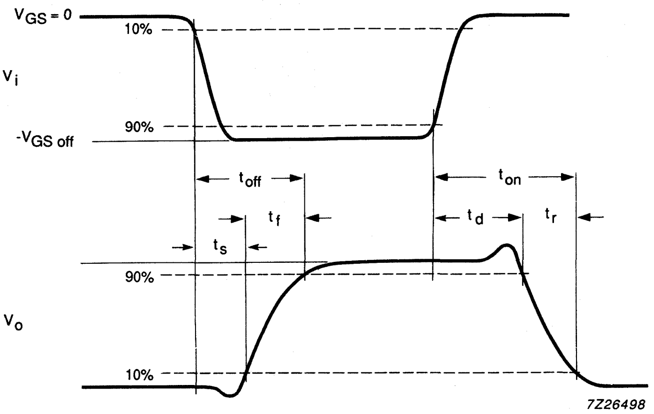


Fig.3 Input and output waveforms.

Philips Semiconductors

Data sheet	
status	Product specification
date of issue	July 1993

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

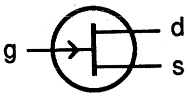


Fig.1 Symbol.

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).

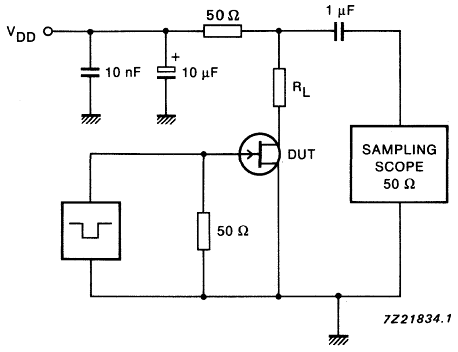


Fig.2 Switching circuit.

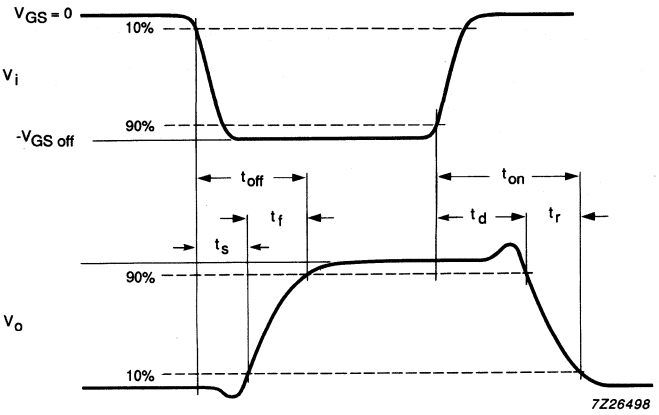


Fig.3 Input and output waveforms.

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

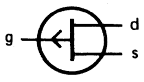
Dimensions in mm

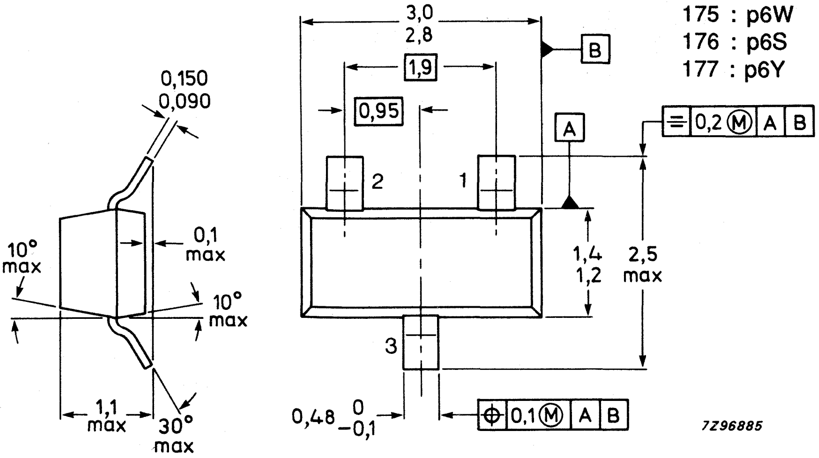
Fig. 1 SOT-23.

Marking codes:

174 : p6X
175 : p6W
176 : p6S
177 : 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 (d.c.)	$-I_G$	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

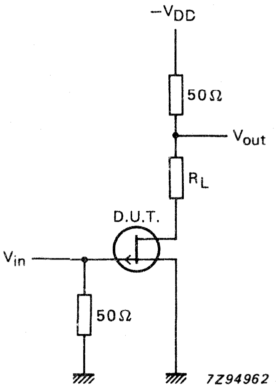


Fig. 2 Switching times test circuit

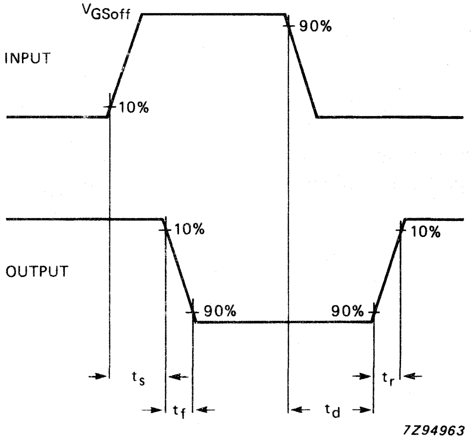


Fig. 3 Input and output waveforms

$t_d + t_r = t_{on}$

$t_s + t_f = t_{off}$

N-channel silicon field-effect transistors

PMBFJ308/309/310

FEATURES

- Low noise
- Interchangeability of drain and source connections
- High gain.

DESCRIPTION

Silicon symmetrical n-channel junction FETs in a SOT23 envelope. They are intended for use in VHF amplifiers, the AM input stage of car radios, oscillators and mixers.

PINNING - SOT23

PIN	DESCRIPTION
1	source
2	drain
3	gate

PIN CONFIGURATION

Marking codes:
PMBFJ308: M08.
PMBFJ309: M09.
PMBFJ310: M10.

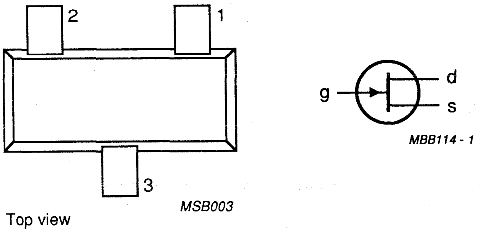


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$\pm V_{DS}$	drain-source voltage		–	25	V
I_{DSS}	drain current	$V_{DS} = 10$ V; $V_{GS} = 0$			
	PMBFJ308		12	60	mA
	PMBFJ309		12	30	mA
	PMBFJ310		24	60	mA
P_{tot}	total power dissipation	up to $T_{amb} = 25$ °C	–	250	mW
$-V_{GS(off)}$	gate-source cut-off voltage	$V_{DS} = 10$ V; $I_D = 1$ µA			
	PMBFJ308		1	6.5	V
	PMBFJ309		1	4	V
	PMBFJ310		2	6.5	V
$\lvert Y_{fs} \rvert$	common-source transfer admittance	$V_{DS} = 10$ V; $I_D = 10$ mA	10	–	mS

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 value	–	50	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	250	mW
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)	500	K/W

Note

1. Device mounted on an FR4 printed-circuit board.

STATIC CHARACTERISTICS

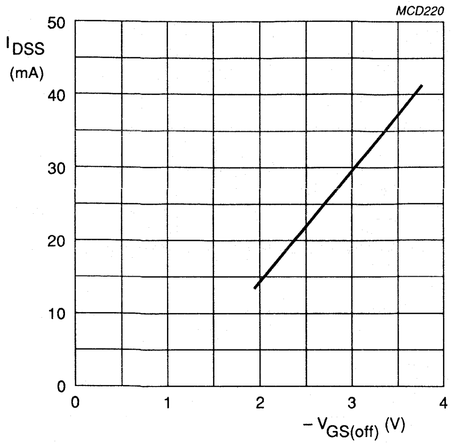
T_j = 25 °C.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$-V_{(BR)GSS}$	gate-source breakdown voltage	$-I_G = 1\ \mu A$ $V_{DS} = 0$	–	–	25	V
I_{DSS}	drain current	$V_{DS} = 10$ V; $V_{GS} = 0$				
	PMBFJ308		12	–	60	mA
	PMBFJ309		12	–	30	mA
	PMBFJ310		24	–	60	mA
$-I_{GSS}$	reverse gate leakage current	$-V_{GS} = 15$ V; $V_{DS} = 0$	–	–	1	nA
V_{GSS}	gate-source forward voltage	$V_{DS} = 0$; $I_G = 1$ mA	–	–	1	V
$-V_{GS(off)}$	gate-source cut-off voltage	$V_{DS} = 10$ V; $I_D = 1\ \mu A$				
	PMBFJ308		1	–	6.5	V
	PMBFJ309		1	–	4	V
	PMBFJ310		2	–	6.5	V
$R_{DS(on)}$	drain-source on-resistance	$V_{DS} = 100$ mV; $V_{GS} = 0$	–	50	–	Ω
$\lvert Y_{fs} \rvert$	common-source transfer admittance	$V_{DS} = 10$ V; $I_D = 10$ mA	10	–	–	mS
$\lvert Y_{os} \rvert$	common-source output admittance	$V_{DS} = 10$ V; $I_D = 10$ mA	–	–	250	µS

DYNAMIC CHARACTERISTICS

T_j = 25 °C.

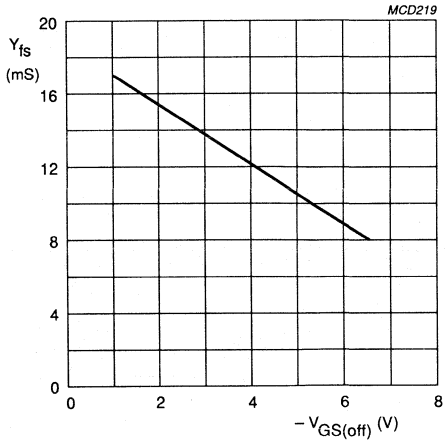
SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_{is}	input capacitance	V_{DS} = 10 V; $-V_{GS}$ = 10 V; f = 1 MHz	3	5	pF
		V_{DS} = 10 V; $-V_{GS}$ = 0; T_{amb} = 25 °C	6	–	pF
C_{rs}	feedback capacitance	V_{DS} = 0; $-V_{GS}$ = 10 V; f = 1 MHz	1.3	2.5	pF
g_{is}	common-source input conductance	V_{DS} = 10 V; I_D = 10 mA; f = 100 MHz	200	–	µS
		V_{DS} = 10 V; I_D = 10 mA; f = 450 MHz	3	–	mS
g_{fs}	common-source transfer conductance	V_{DS} = 10 V; I_D = 10 mA; f = 100 MHz	13	–	mS
		V_{DS} = 10 V; I_D = 10 mA; f = 450 MHz	12	–	mS
$-g_{rs}$	common-source feedback conductance	V_{DS} = 10 V; I_D = 10 mA; f = 100 MHz	30	–	µS
		V_{DS} = 10 V; I_D = 10 mA; f = 450 MHz	450	–	µS
g_{os}	common-source output conductance	V_{DS} = 10 V; I_D = 10 mA; f = 100 MHz	150	–	µS
		V_{DS} = 10 V; I_D = 10 mA; f = 450 MHz	400	–	µS
$\overline{e}_n$	equivalent input noise voltage	V_{DS} = 10 V; I_D = 10 mA; f = 100 Hz	6	–	$\frac{nV}{\sqrt{Hz}}$



PMBFJ308, 309 & 310.

V_{DS} = 10 V; T_j = 25 °C.

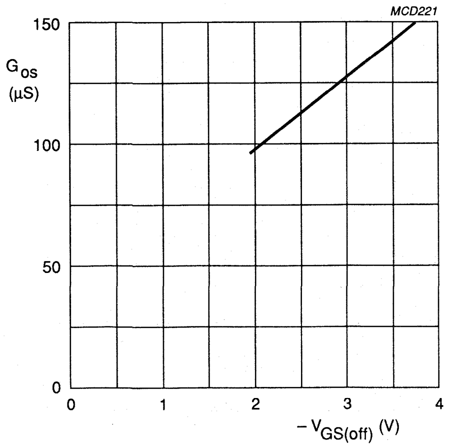
Fig.2 Drain current as a function of gate-source cut-off voltage.



PMBFJ308, 309 & 310.

V_{DS} = 10 V; I_D = 10 mA; T_j = 25 °C.

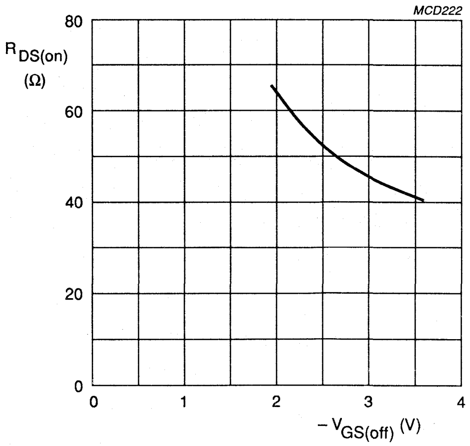
Fig.3 Common-source transfer admittance as a function of gate-source cut-off voltage.



PMBFJ308, 309 & 310.

V_{DS} = 10 V; I_D = 10 mA; T_j = 25 °C.

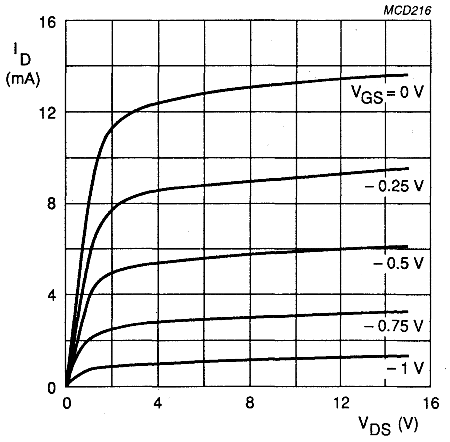
Fig.4 Common-source output conductance as a function of gate-source cut-off voltage.



PMBFJ308, 309 & 310.

V_{DS} = 0.1 V; V_{GS} = 0; T_j = 25 °C.

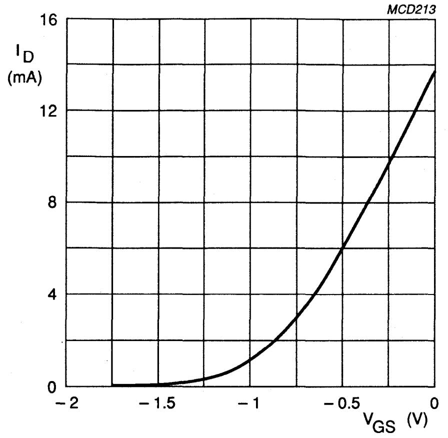
Fig.5 Drain-source on resistance as a function of gate-source cut-off voltage.



PMBFJ308.

T_j = 25 °C.

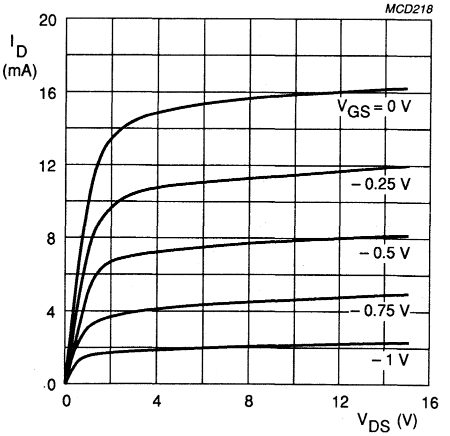
Fig.6 Output characteristics, typical values.



PMBFJ308.

V_{DS} = 10 V; T_j = 25 °C.

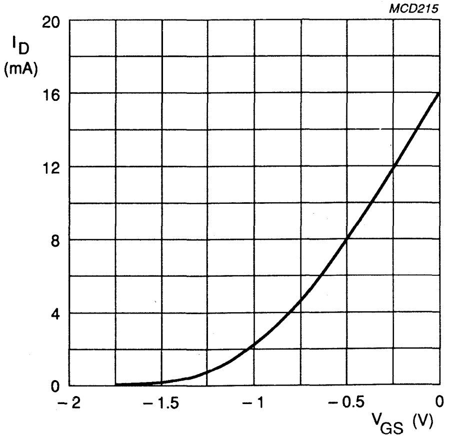
Fig.7 Input characteristics, typical values.



PMBFJ309.

T_j = 25 °C.

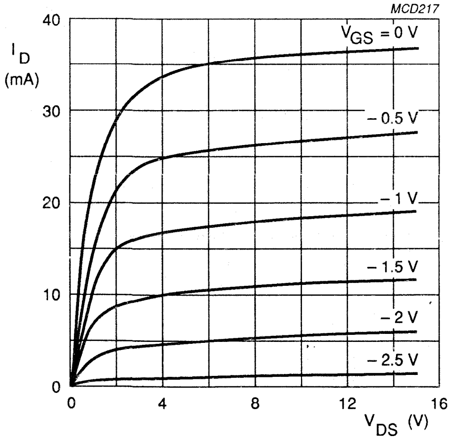
Fig.8 Output characteristics, typical values.



PMBFJ309.

V_{DS} = 10 V; T_j = 25 °C.

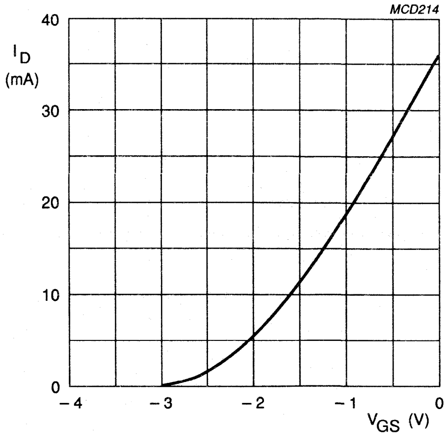
Fig.9 Input characteristics, typical values.



PMBFJ310.

T_j = 25 °C.

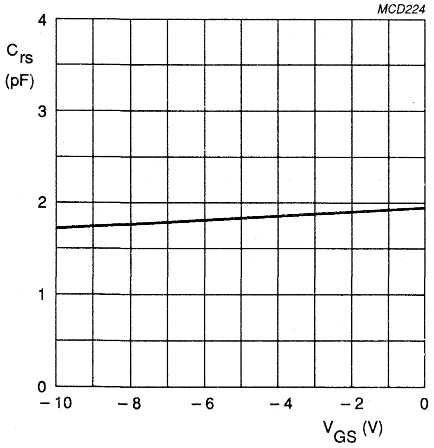
Fig.10 Output characteristics, typical values.



PMBFJ310.

V_{DS} = 10 V; T_j = 25 °C.

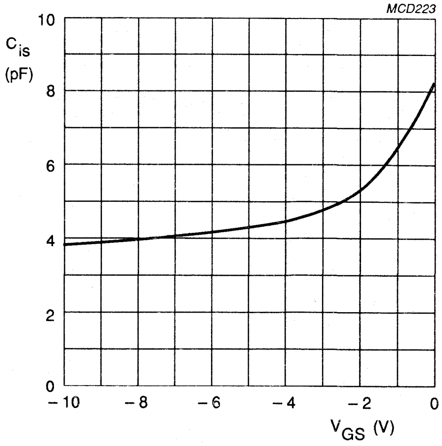
Fig.11 Input characteristics, typical values.



PMBFJ308, 309 & 310.

V_{DS} = 10 V; T_j = 25 °C.

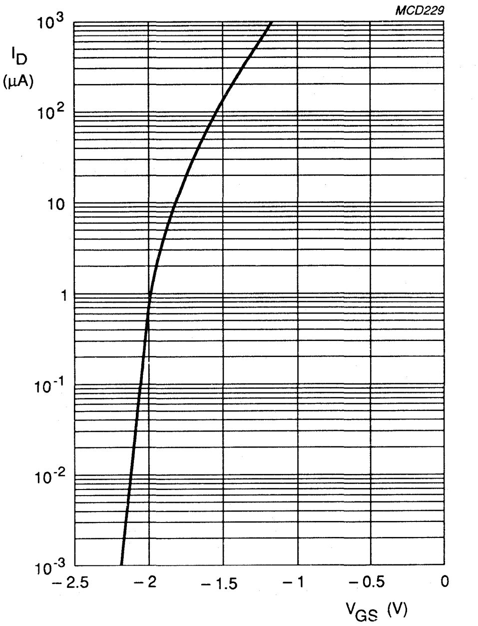
Fig.12 Feedback capacitance, typical values.



PMBFJ308, 309 & 310.

V_{DS} = 10 V; T_j = 25 °C.

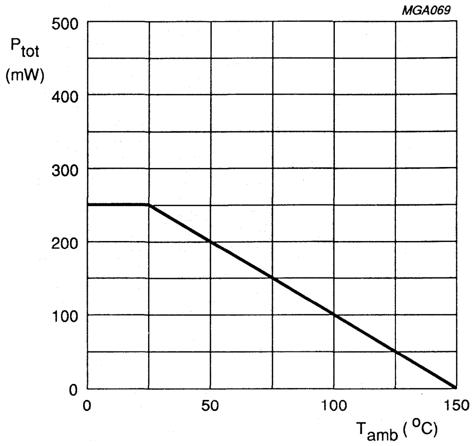
Fig.13 Input capacitance, typical values.



PMBFJ308, 309 & 310.

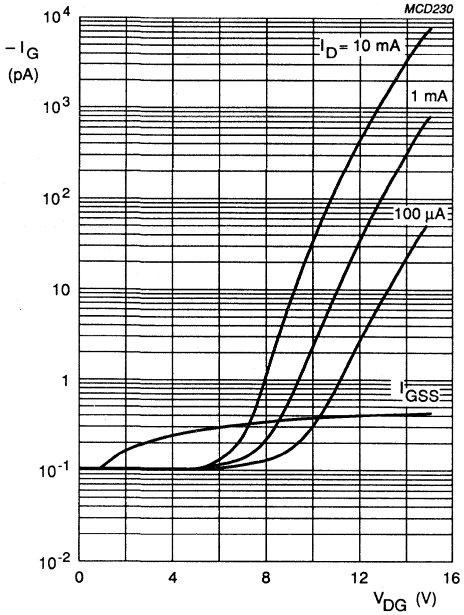
$V_{DS} = 10$ V; $T_j = 25$ °C.

Fig.14 Drain current as a function of gate-source voltage, typical values.



PMBFJ308, 309 & 310.

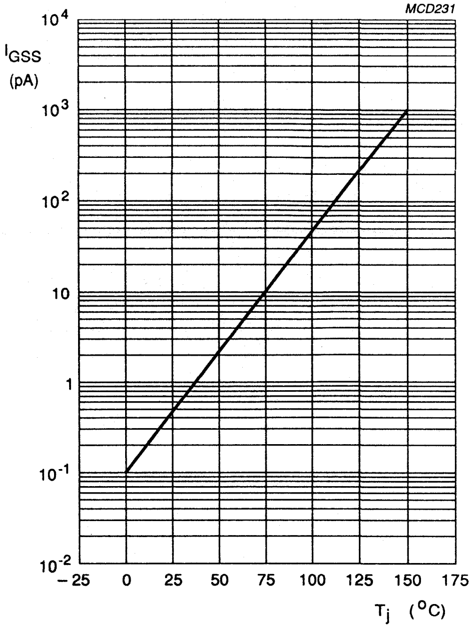
Fig.15 Power derating curve.



PMBFJ308, 309 & 310.

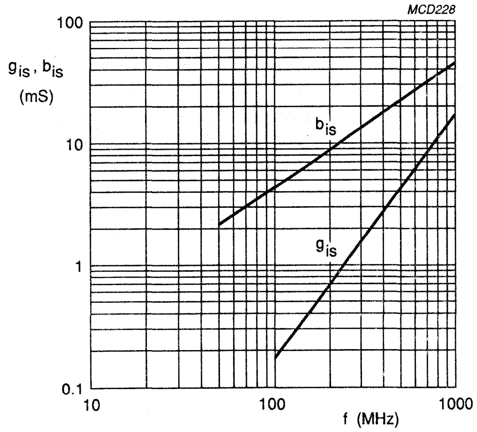
$T_j = 25$ °C.

Fig.16 Gate current as a function of drain-gate voltage, typical values.



PMBFJ308, 309 & 310.

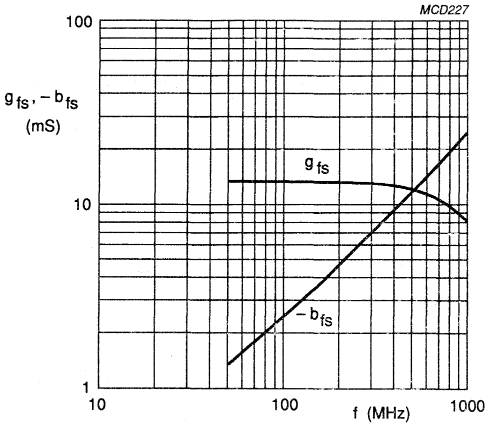
Fig.17 Gate current as a function of junction temperature, typical values.



PMBFJ308, 309 & 310.

V_{DS} = 10 V; I_D = 10 mA; T_{amb} = 25 °C.

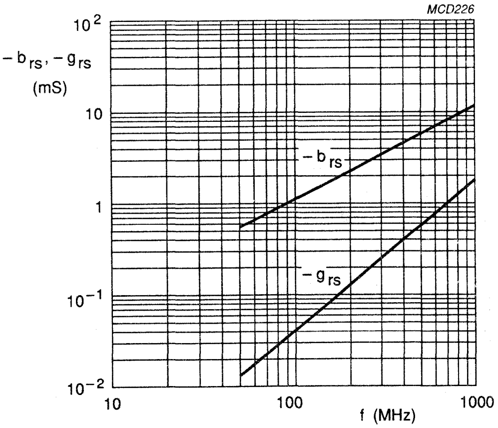
Fig.18 Input admittance, typical values.



PMBFJ308, 309 & 310.

V_{DS} = 10 V; I_D = 10 mA; T_{amb} = 25 °C.

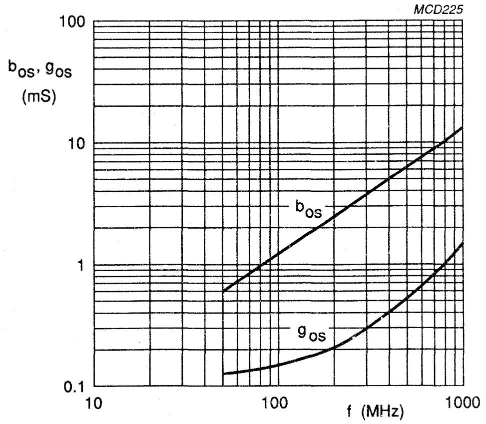
Fig.19 Forward admittance, typical values.



PMBFJ308, 309 & 310.

V_{DS} = 10 V; I_D = 10 mA; T_{amb} = 25 °C.

Fig.20 Reverse admittance, typical values.



PMBFJ308, 309 & 310.

V_{DS} = 10 V; I_D = 10 mA; T_{amb} = 25 °C.

Fig.21 Output admittance, typical values.

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

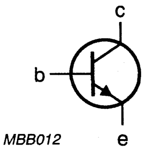
Fig. 1 SOT-23.

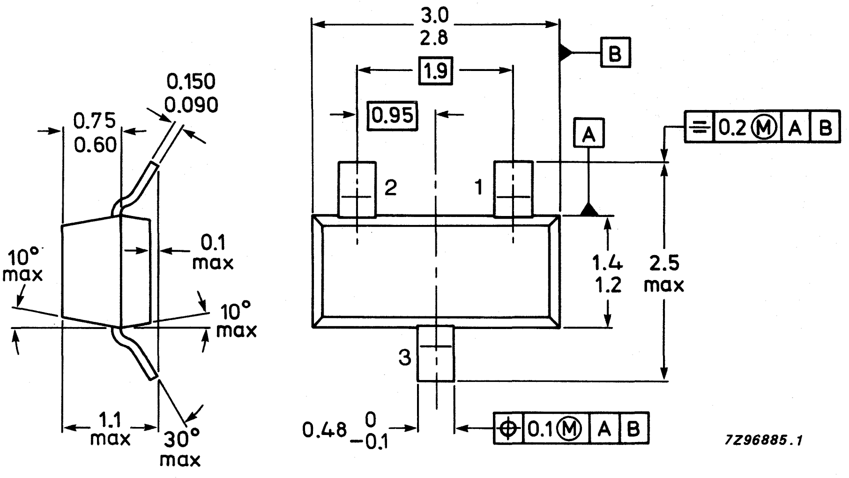
Marking code

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; $t_p \leqslant 300\ \mu s$; $\delta \leqslant 0{,}02$.

<table>
<tr><th></th><th></th><th></th><th>PMBT2222</th><th>PMBT2222A</th><th></th></tr>
<tr><td>D.C. current gain</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>I_C = 0,1 mA; V_{CE} = 10 V</td><td>h_{FE}</td><td>></td><td colspan="2">35</td><td></td></tr>
<tr><td>I_C = 1 mA; V_{CE} = 10 V</td><td>h_{FE}</td><td>></td><td colspan="2">50</td><td></td></tr>
<tr><td>I_C = 10 mA; V_{CE} = 10 V</td><td>h_{FE}</td><td>></td><td colspan="2">75</td><td></td></tr>
<tr><td>I_C = 10 mA; V_{CE} = 10 V; T_{amb} = −55 °C</td><td>h_{FE}</td><td>></td><td colspan="2">35</td><td></td></tr>
<tr><td>I_C = 150 mA; V_{CE} = 10 V</td><td>h_{FE}</td><td></td><td colspan="2">100 to 300</td><td></td></tr>
<tr><td>I_C = 150 mA; V_{CE} = 1 V</td><td>h_{FE}</td><td>></td><td colspan="2">50</td><td></td></tr>
<tr><td>I_C = 500 mA; V_{CE} = 10 V</td><td>h_{FE}</td><td>></td><td>30</td><td>40</td><td></td></tr>
<tr><td>Transition frequency at f = 100 MHz*</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>I_C = 20 mA; V_{CE} = 20 V</td><td>f_T</td><td>></td><td>250</td><td>300</td><td>MHz</td></tr>
<tr><td>Output capacitance at f = 1 MHz</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>I_E = 0; V_{CB} = 10 V</td><td>C_o</td><td><</td><td colspan="2">8,0</td><td>pF</td></tr>
<tr><td>Input capacitance at f = 1 MHz</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>I_C = 0; V_{EB} = 0,5 V</td><td>C_i</td><td><</td><td>30</td><td>25</td><td></td></tr>
<tr><td>h-parameters (common emitter) at f = 1 kHz</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>I_C = 1 mA; V_{CE} = 10 V</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>input impedance</td><td>h_{ie}</td><td></td><td colspan="2">2,0 to 8,0</td><td>kΩ</td></tr>
<tr><td>reverse voltage transfer ratio</td><td>h_{re}</td><td></td><td colspan="2">$< 8{,}0 \times 10^{-4}$</td><td></td></tr>
<tr><td>small signal current gain</td><td>h_{fe}</td><td></td><td colspan="2">50 to 300</td><td></td></tr>
<tr><td>output admittance</td><td>h_{oe}</td><td></td><td colspan="2">5,0 to 35</td><td>µS</td></tr>
<tr><td>I_C = 10 mA; V_{CE} = 10 V</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>input impedance</td><td>h_{ie}</td><td></td><td colspan="2">0,25 to 1,25</td><td>kΩ</td></tr>
<tr><td>reverse voltage transfer ratio</td><td>h_{re}</td><td></td><td colspan="2">$< 4{,}0 \times 10^{-4}$</td><td></td></tr>
<tr><td>small signal current gain</td><td>h_{fe}</td><td></td><td colspan="2">75 to 375</td><td></td></tr>
<tr><td>output admittance</td><td>h_{oe}</td><td></td><td colspan="2">25 to 200</td><td>µS</td></tr>
<tr><td>Noise figure at R_S = 1 kΩ</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>I_C = 100 µA; V_{CE} = 10 V; f = 1 kHz</td><td>F</td><td><</td><td colspan="2">4,0</td><td>dB</td></tr>
<tr><td>Switching times (between 10% and 90% levels)</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Turn-on time switched to I_C = 150 mA</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>delay time</td><td>t_d</td><td><</td><td colspan="2">10</td><td>ns</td></tr>
<tr><td>rise time</td><td>t_r</td><td><</td><td colspan="2">25</td><td>ns</td></tr>
<tr><td>Turn-off time switched from I_C = 150 mA</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>storage time</td><td>t_s</td><td><</td><td colspan="2">225</td><td>ns</td></tr>
<tr><td>fall time</td><td>t_f</td><td><</td><td colspan="2">60</td><td>ns</td></tr>
</table>

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* f_T is defined as the frequency at which h_{fe} extrapolates to unity.

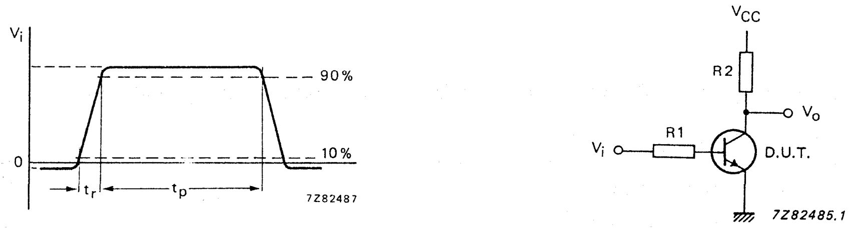


Fig. 2 Waveform and test circuit delay and rise time.
$V_i = -0{,}5$ to $+ 9{,}9$ V; $V_{CC} = 30$ V; R1 = 619 Ω; R2 = 200 Ω.

Pulse generator:			
pulse duration	t_p	$\leqslant$	200 ns
rise time	t_r	$\leqslant$	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

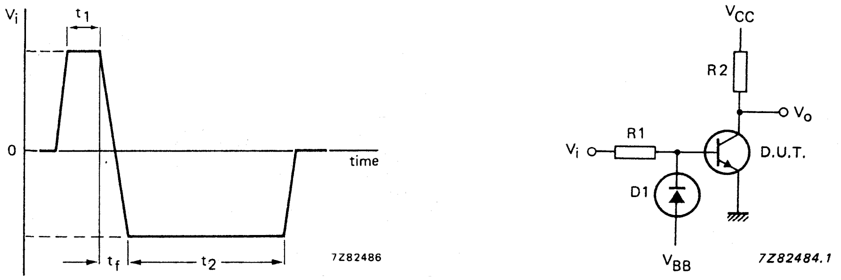


Fig. 3 Waveform and test circuit storage and fall time.
$V_i = -13{,}8$ to $+ 16{,}2$ V; $V_{CC} = 30$ V; $-V_{BB} = 3$ V; R1 = 1 kΩ; R2 = 200 Ω.

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

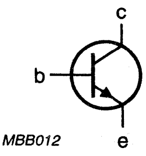
Fig. 1 SOT-23.

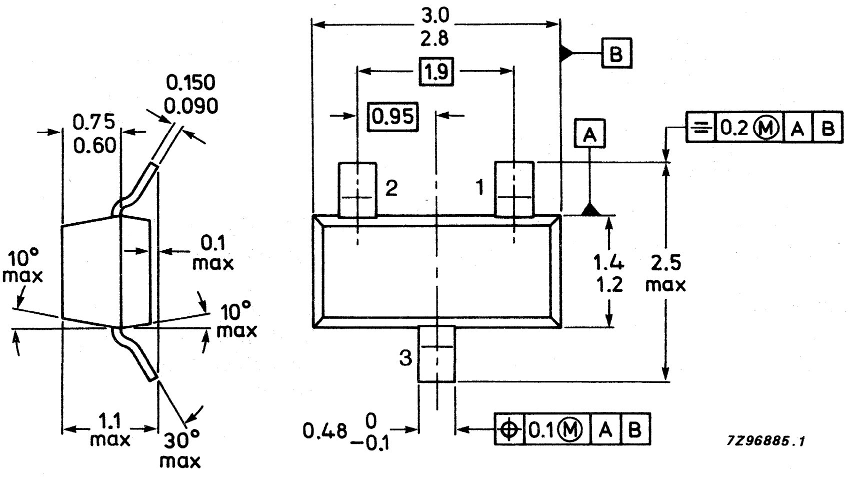
Marking code

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

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* 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

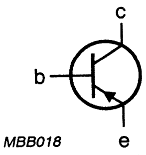
MECHANICAL DATA

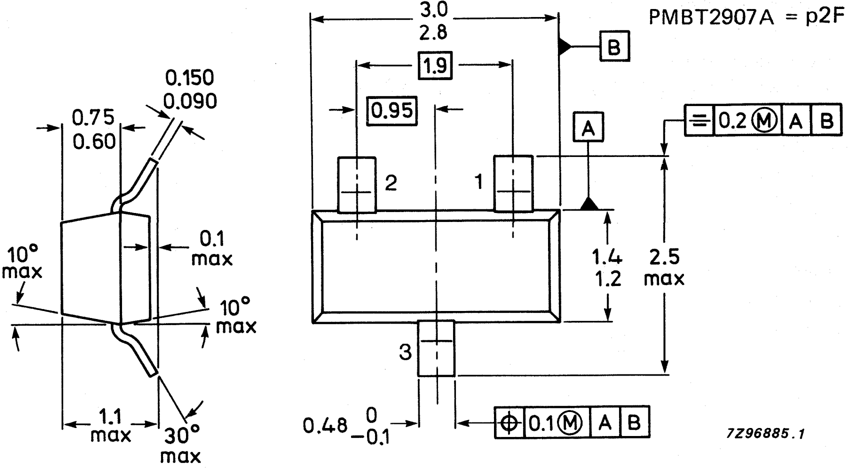
Dimensions in mm

Fig. 1 SOT-23.

Marking code
PMBT2907 = p2B
PMBT2907A = p2F

Pinning:
1 = base
2 = emitter
3 = collector





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

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* 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

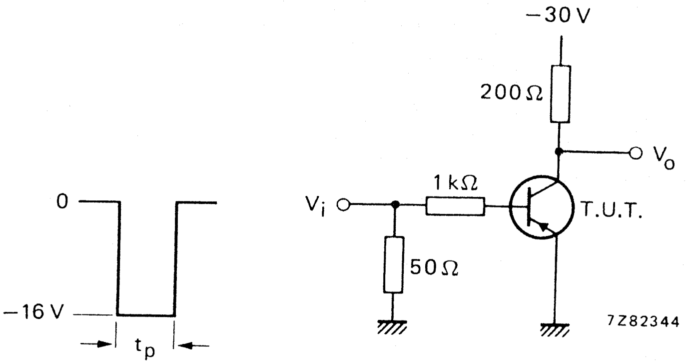


Fig. 2 Turn-on switching time test circuit.

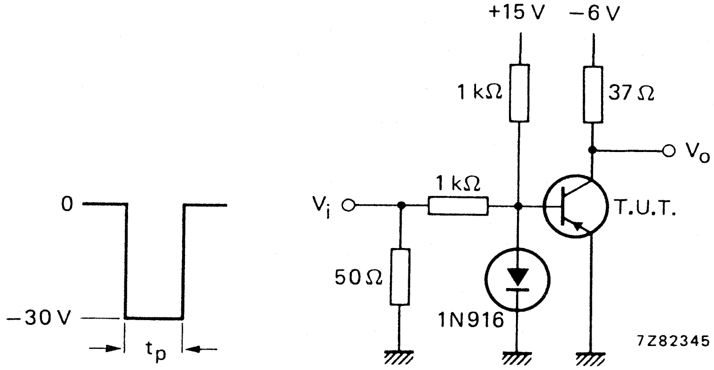


Fig. 3 Turn-off switching time test circuit.

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

PNP 1 GHz switching transistor

PMBT3640

DESCRIPTION

PNP general purpose switching transistor in a SOT23 package.

PINNING

PIN	DESCRIPTION
Code: V25	
1	base
2	emitter
3	collector

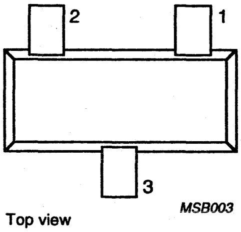


Fig.1 SOT23.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$-V_{CBO}$	collector-base voltage	open emitter	–	12	V
$-V_{CEO}$	collector-emitter voltage	open base	–	12	V
$-V_{EBO}$	emitter-base voltage	open collector	–	4	V
$-I_C$	DC collector current		–	80	mA
P_{tot}	total power dissipation	up to T_s = 60 °C (note 1)	–	350	mW
T_{stg}	storage temperature		–55	150	°C
T_j	junction temperature		–	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	from junction to soldering point (note 1)	260 K/W

Note

1. T_s is the temperature at the soldering point of the collector tab.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Off characteristics					
$-V_{(BR)CBO}$	collector-base breakdown voltage	$-I_C$ = 100 μA; I_E = 0	12	–	V
$-V_{(BR)CES}$	collector-emitter breakdown voltage	$-I_C$ = 100 μA; V_{BE} = 0	12	–	V
$-V_{(BR)EBO}$	emitter-base breakdown voltage	$-I_E$ = 100 μA; I_C = 0	4	–	V
$-I_{CES}$	collector cut-off current	$-V_{CE}$ = 6 V; V_{BE} = 0	–	0.01	μA
		$-V_{CE}$ = 6 V; V_{BE} = 0; T_{amb} = 65 °C	–	1	μA
$-I_B$	base current	$-V_{CE}$ = 6 V; V_{EB} = 0	–	10	nA
On characteristics; pulse test: pulse width ≤ 300 μs, duty cycle ≤ 2%.					
h_{FE}	DC current gain	$-I_C$ = 10 mA; $-V_{CE}$ = 0.3 V	30	120	
		$-I_C$ = 50 mA; $-V_{CE}$ = 1 V	20	–	
$-V_{CEsat}$	collector-emitter saturation voltage	$-I_C$ = 10 mA; $-I_B$ = 1 mA	–	0.2	V
		$-I_C$ = 50 mA; $-I_B$ = 5 mA	–	0.6	V
		$-I_C$ = 10 mA; $-I_B$ = 1 mA; T_{amb} = 65 °C	–	0.25	V
$-V_{BEsat}$	base-emitter saturation voltage	$-I_C$ = 10 mA; $-I_B$ = 0.5 mA	0.75	0.95	V
		$-I_C$ = 10 mA; $-I_B$ = 1 mA	0.8	1	V
		$-I_C$ = 50 mA; $-I_B$ = 5 mA	–	1.5	V
Small-signal characteristics					
f_T	transition frequency	$-I_C$ = 10 mA; $-V_{CE}$ = 5 V; f = 100 MHz	500	–	MHz
C_o	output capacitance	I_E = 0; $-V_{CB}$ = 5 V; f = 1 MHz	–	3.5	pF
C_i	input capacitance	I_C = 0; $-V_{EB}$ = 0.5 V; f = 1 MHz	–	3.5	pF
Switching times					
t_d	delay time	$-V_{CC}$ = 6 V; $-I_C$ = 50 mA; $-V_{BE(off)}$ = 1.9 V; $-I_{B1}$ = 5 mA	–	10	ns
t_s	storage time	$-V_{CC}$ = 6 V; $-I_C$ = 50 mA; $-I_{B1}$ = $-I_{B2}$ = 5 mA	–	20	ns
t_r	rise time	$-V_{CC}$ = 6 V; $-I_C$ = 50 mA; $-V_{BE(off)}$ = 1.9 V; $-I_{B1}$ = 5 mA	–	30	ns
t_f	fall time	$-V_{CC}$ = 6 V; $-I_C$ = 50 mA; $-I_{B1}$ = $-I_{B2}$ = 5 mA	–	12	ns
t_{on}	turn-on time	$-V_{CC}$ = 6 V; $-I_C$ = 50 mA; $-V_{BE(off)}$ = 1.9 V; $-I_{B1}$ = 5 mA	–	25	ns
		$-V_{CC}$ = 1.5 V; $-I_C$ = 10 mA; $-I_{B1}$ = 0.5 mA	–	60	ns
t_{off}	turn-off time	$-V_{CC}$ = 6 V; $-I_C$ = 50 mA; $-V_{BE(off)}$ = 1.9 V; $-I_{B1}$ = I_{B2} = 5 mA	–	35	ns
		$-V_{CC}$ = 1.5 V; $-I_C$ = 10 mA; $-I_{B1}$ = I_{B2} = 0.5 mA	–	75	ns

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

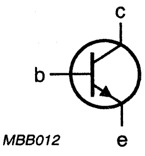
MECHANICAL DATA

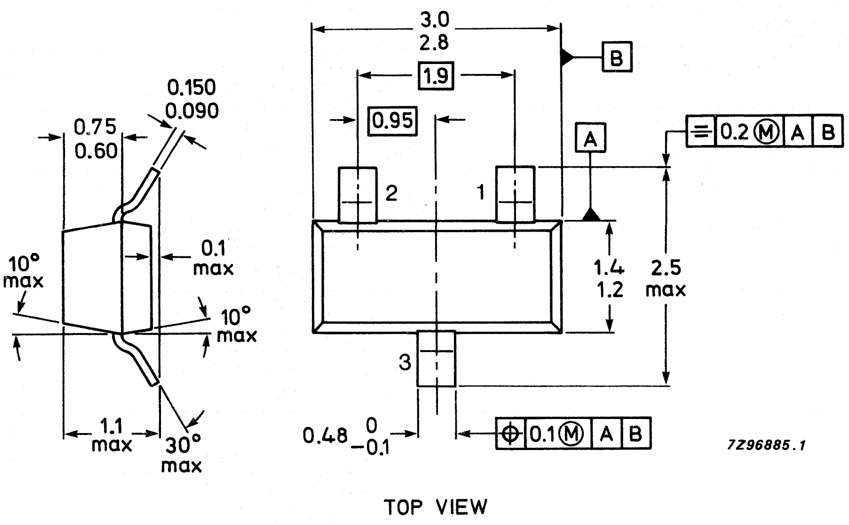
Fig.1 SOT-23.

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

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* 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 $\leqslant 2\%$.

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

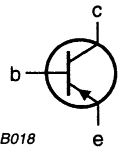
Dimensions in mm

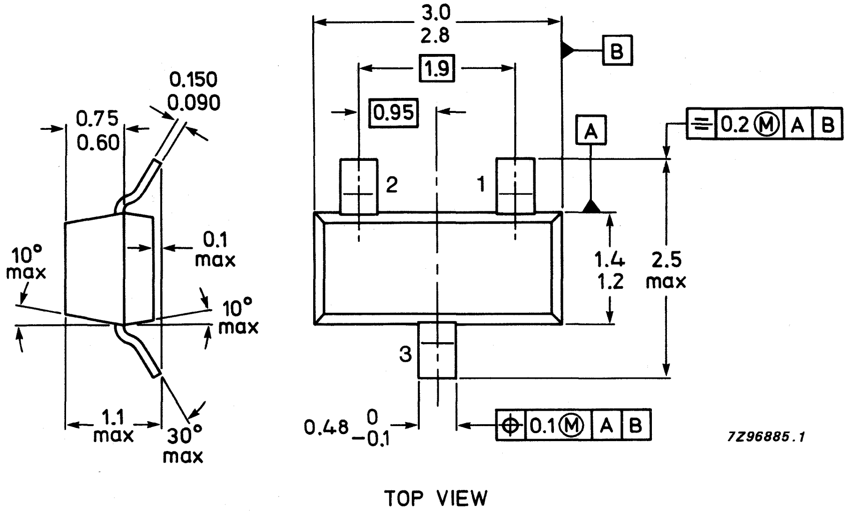
Fig. 1 SOT-23.

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

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* Mounted on a ceramic substrate: area = 10 a 8 mm; 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.	0,25	V
$-I_C = 50$ mA; $-I_B = 5$ mA	$-V_{CEsat}$	max. min.	0,4 0,65	V 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 12	kΩ kΩ
Reverse voltage transfer ratio	h_{re}	min. max.	1,0 10	10^{-4} 10^{-4}
Small signal current gain	h_{fe}	min. max.	100 400	
Output admittance	h_{oe}	min. max.	30 60	μS 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

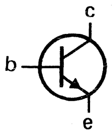
Marking code = p2X

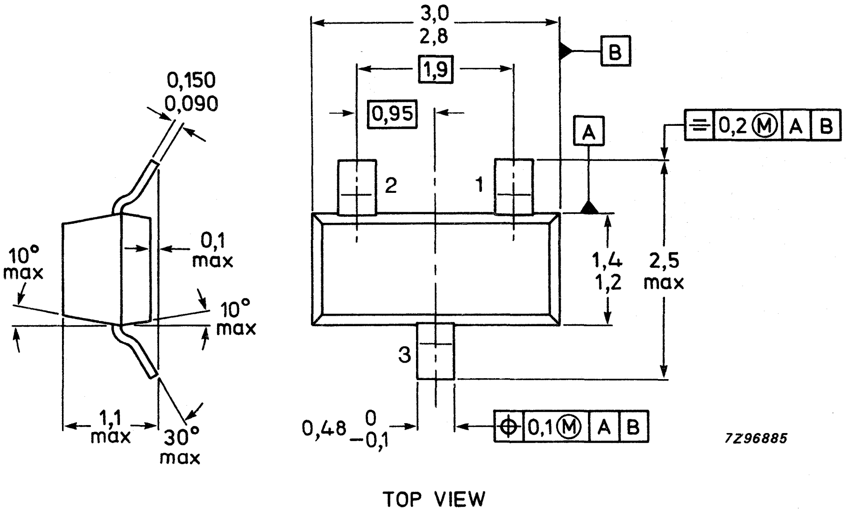
Pinning:

1 = base

2 = emitter

3 = collector





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* 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

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* 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.	1.0	kΩ
		max.	8.0	kΩ
Voltage feed-back ratio I_C = 1 mA; V_{CE} = 10 V; f = 1 kHz	h_{re}	min.	0.1×10^{-4}	
		max.	30×10^{-4}	
Small-signal current gain; f = 1 kHz; I_C = 1 mA; V_{CE} = 10 V	h_{fe}	min.	40	
		max.	500	
Output admittance; f = 1 kHz; I_C = 1 mA; V_{CE} = 10 V	h_{oe}	min.	1.0	μS
		max.	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

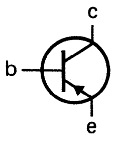
MECHANICAL DATA

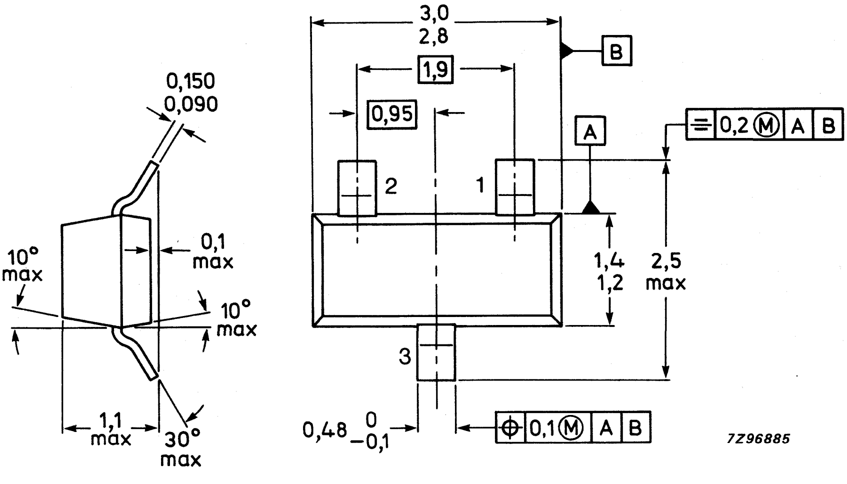
Dimensions in mm

Fig. 1 SOT-23

Marking code = p2T

Pinning:
1 = base
2 = emitter
3 = collector





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.	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				
$-I_C = 100\ \mu$A; $I_E = 0$	$-V_{(BR)CBO}$	>	40	V
Emitter-base breakdown voltage				
$-I_E = 100\ \mu$A; $I_C = 0$	$-V_{(BR)EBO}$	>	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

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* 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. max.	1.5 kΩ 15 kΩ
Voltage feed-back ratio at 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 at f = 1 kHz; $-I_C$ = 1 mA; $-V_{CE}$ = 10 V	h_{fe}	min. max.	60 500
Output admittance at f = 1 kHz; $-I_C$ = 1 mA; $-V_{CE}$ = 10 V	h_{oe}	min. max.	1.0 μS 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

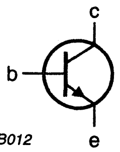
Dimensions in mm

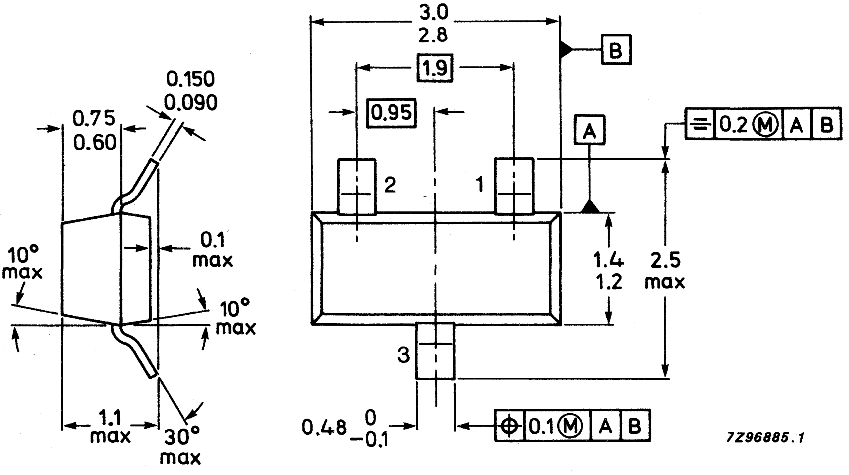
Fig. 1 SOT-23.

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

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* 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} V_{BEsat}	max. max.	0,5 0,8	V V
D.C. current gain $I_C = 100\ \mu A$; $V_{CE} = 5$ V	h_{FE}	min. max.	300 900	
$I_C = 1$ mA; $V_{CE} = 5$ V $I_C = 10$ mA; $V_{CE} = 5$ V	h_{FE}	min. min.	350 300	
Small-signal current gain $I_C = 1$ mA; $V_{CE} = 5$ V; f = 1 kHz	h_{fe}	min. max.	350 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

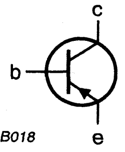
Dimensions in mm

Fig. 1 SOT-23.

Marking code: p2L

Pinning:

1 = base
2 = emitter
3 = collector



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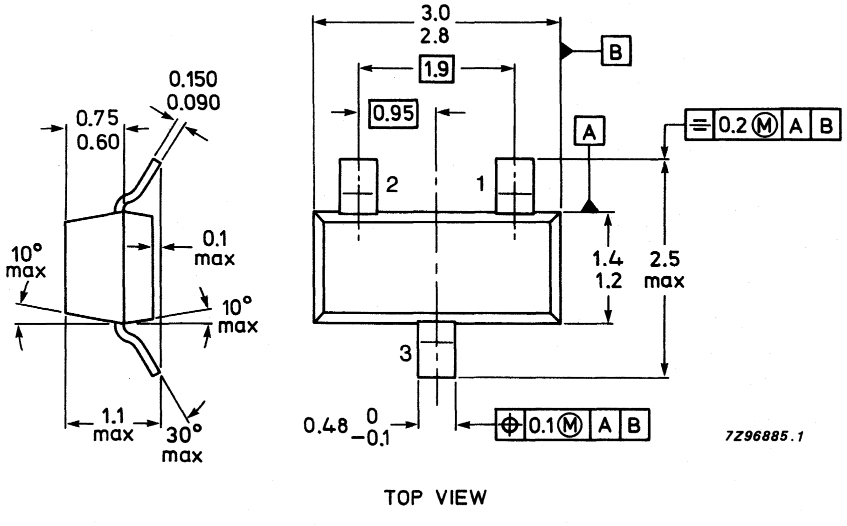


RATINGS

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. max.	60 240	
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. max.	40 200	
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. max.	100 300	MHz 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

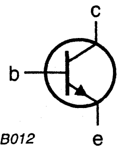
Dimensions in mm

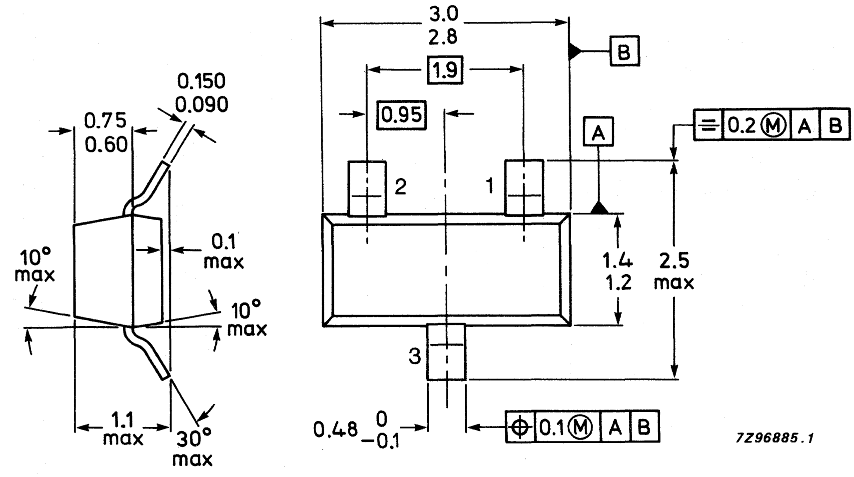
Fig. 1 SOT-23.

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

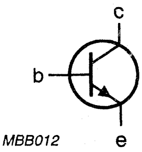
Fig. 1 SOT23.

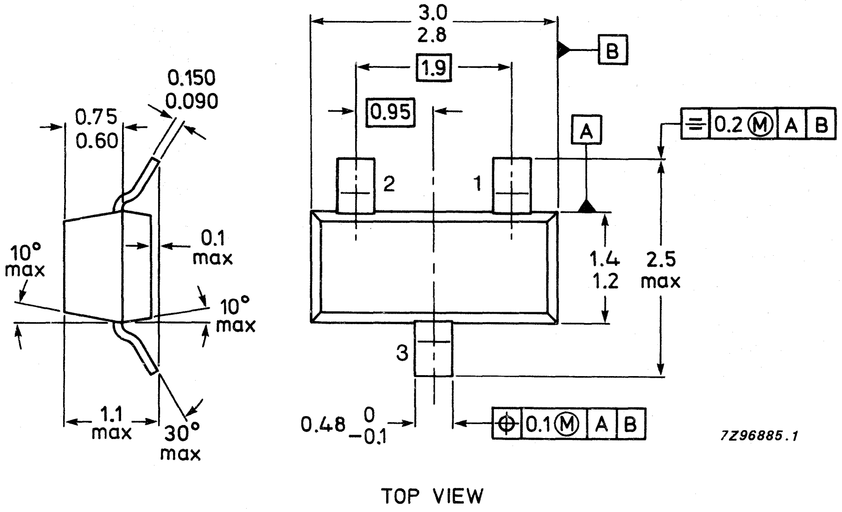
Marking code

PMBT5551 = pGl

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.	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 $T_{amb} = 25\ ^oC$	P_{tot}	max.	250	mW
Junction temperature	T_j	max.	150	^oC
Storage temperature range	T_{stg}		–65 to + 150	^oC

THERMAL RESISTANCE

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

CHARACTERISTICS

$T_{amb} = 25\ ^oC$ 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; $T_{amb} = 100\ ^oC$	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
$I_C = 100\ \mu$A; $I_E = 0$	$V_{(BR)CBO}$	min.	180	V
$I_C = 0$; $I_E = 10\ \mu$A	$V_{(BR)EBO}$	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 $R_S = 1\ k\Omega$				
$I_C = 250\ \mu$A; $V_{CE} = 5$ 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

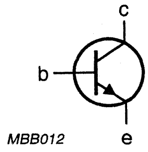
Fig. 1 SOT-23.

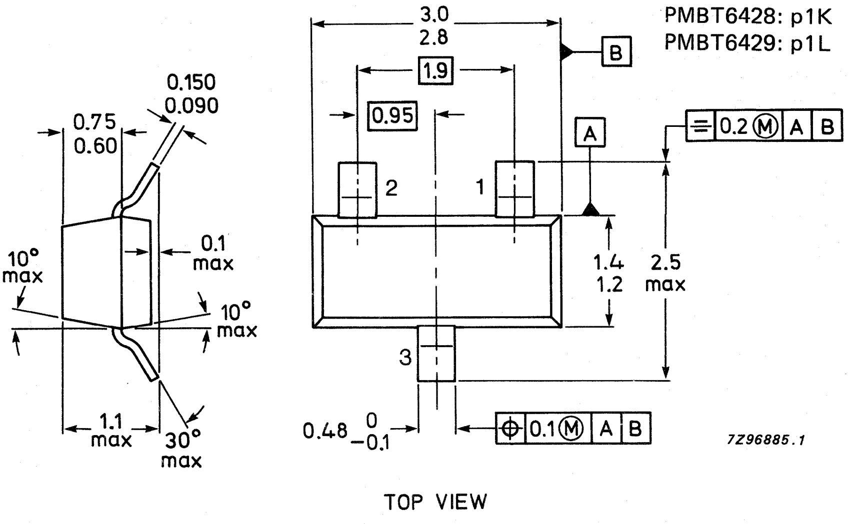
Marking code

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. max.	560 660		mV mV

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* 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. max.	250 650	500 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. max.	100 700		MHz 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

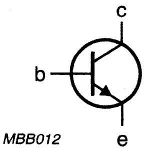
Fig. 1 SOT-23.

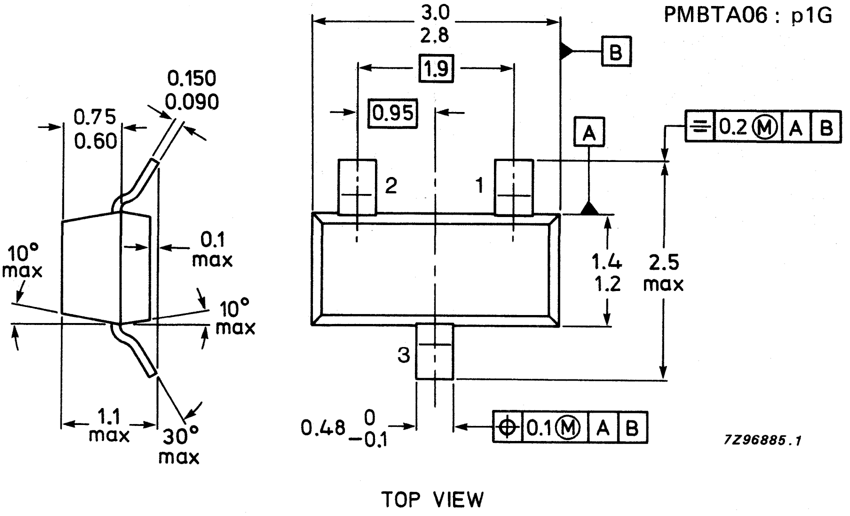
Marking code

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		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

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* 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 $T_{amb} = 25$ °C		P_{tot}	max.	250	mW
Junction temperature		T_j	max.	150	°C
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

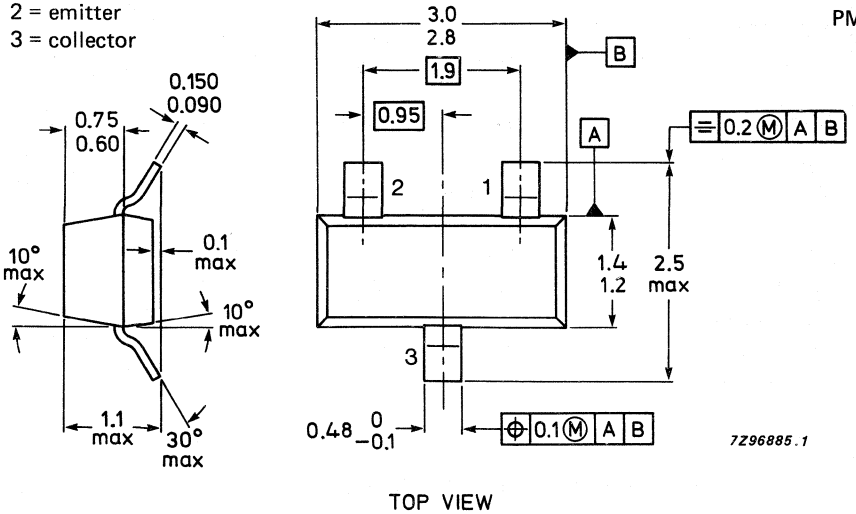
Fig. 1 SOT-23.

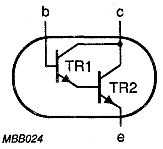
Pinning:

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 $T_{amb} = 25\ ^{o}C$*	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

$T_j = 25\ ^{o}C$ 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

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* 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

			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		V
Collector current (DC)	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
D.C. current gain I_C = 10 mA; V_{CE} = 10 V	h_{FE}	min.	40		
Transition frequency at f = 35 MHz I_C = 10 mA; V_{CE} = 20 V	f_T	min.	50		MHz
Feedback capacitance at f = 1 MHz I_C = 0; V_{CE} = 20 V	C_{re}	max.	3	4	pF

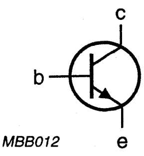
MECHANICAL DATA

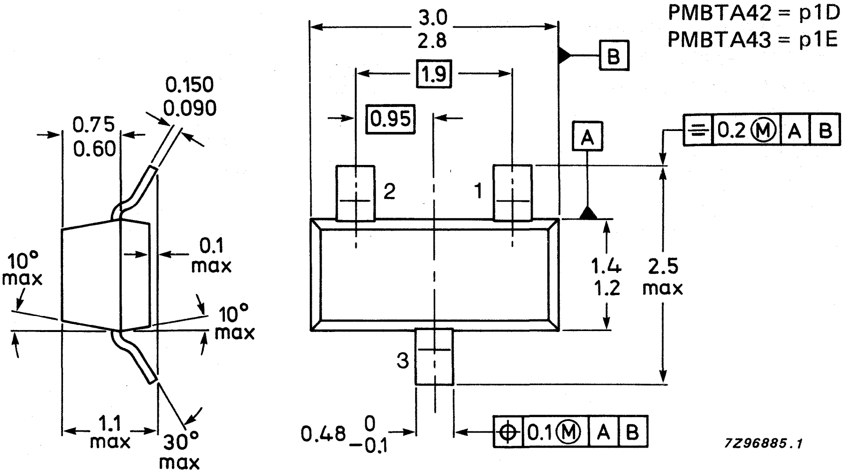
Dimensions in mm

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		V
Collector current (DC)	I_C	max.	500		mA
Total power dissipation (note 1) 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

			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		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		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

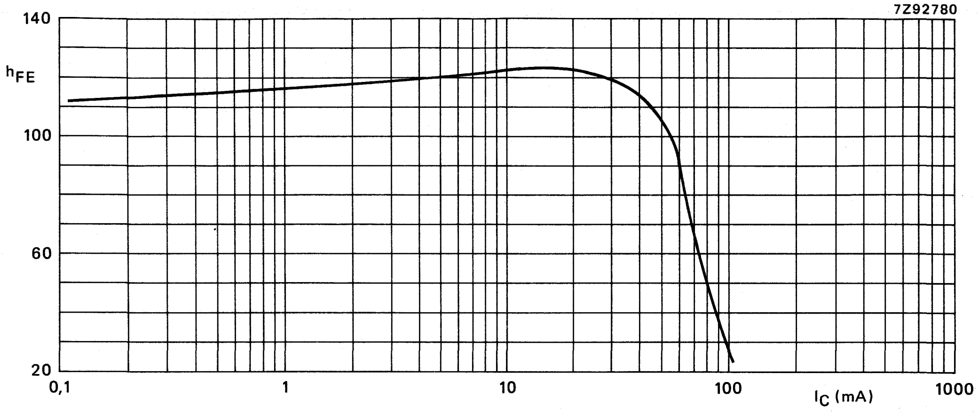


Fig. 2 T_j = 25 °C; V_{CE} = 20 V; typical values.

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

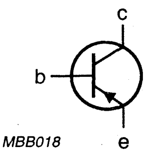
Dimensions in mm

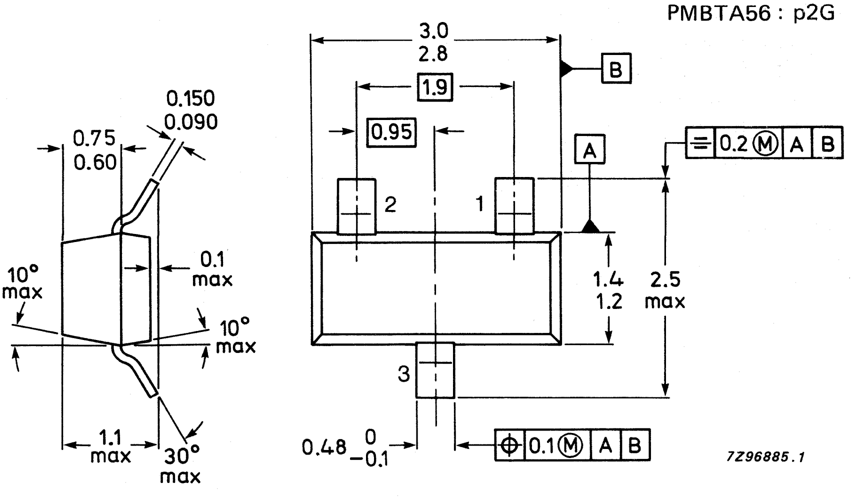
Fig. 1 SOT-23.

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		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

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* 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

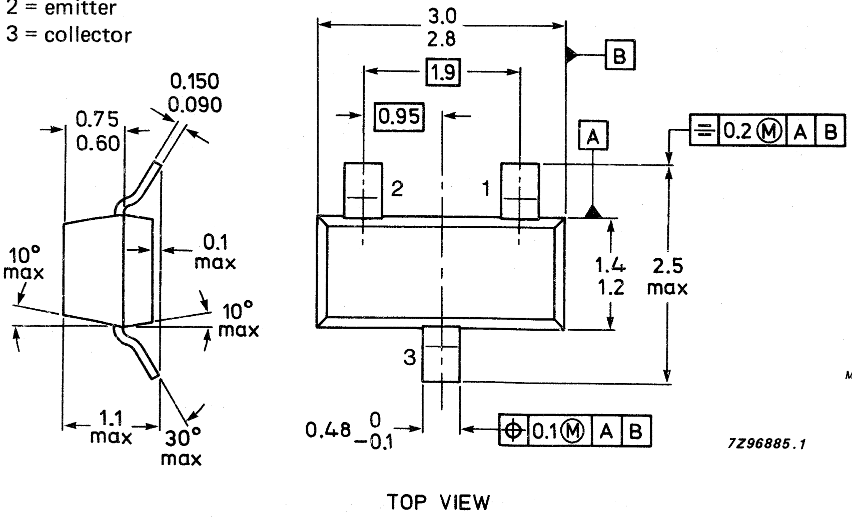
Fig. 1 SOT-23.

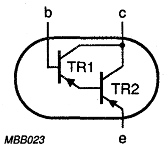
Pinning:

1 = base
2 = emitter
3 = collector

Marking code

PMBTA63: p2U
PMBTA64: p2V





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 $T_{amb} = 25$ °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-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; $T_{amb} = 25$ °C		f_T	min.	125	MHz

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* 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

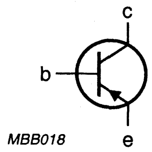
Fig. 1 SOT-23.

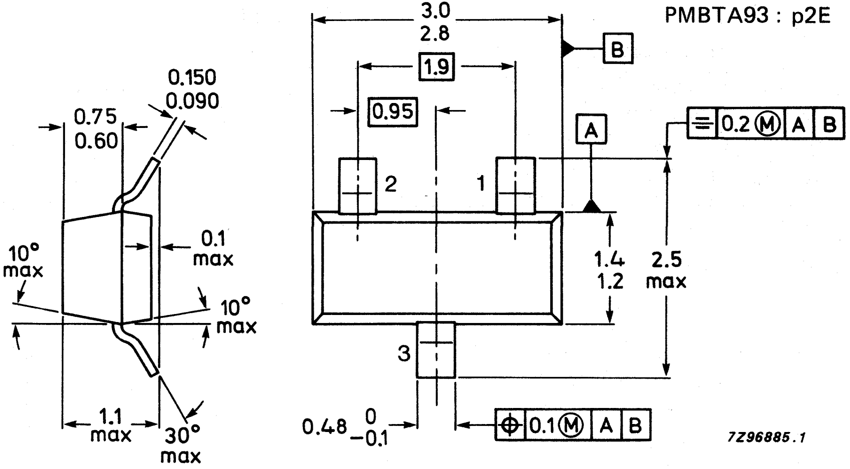
Marking code

PMBTA92 : p2D
PMBTA93 : p2E

Pinning:

1 = base
2 = emitter
3 = collector





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		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		

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* 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%.

NPN 1 GHz general purpose switching transistor

PMBTH10

FEATURES

- Low cost
- High power gain.

DESCRIPTION

The PMBTH10 is a general purpose silicon npn transistor, encapsulated in a SOT23 plastic envelope. Its pnp complement is the PMBTH81.

PINNING

PIN	DESCRIPTION
Code: V30	
1	base
2	emitter
3	collector

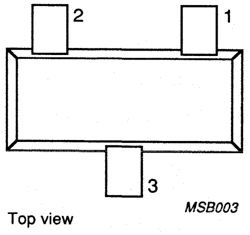


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
P_{tot}	total power dissipation	$T_s = 45$ °C (note 1)	–	400	mW
h_{FE}	DC current gain	$V_{CE} = 10$ V; $I_C = 4$ mA	60	–	
C_{re}	collector-emitter feedback capacitance	$V_{CB} = 10$ V; $I_E = 0$; f = 1 MHz	–	0.7	pF
C_{rb}	collector-base feedback capacitance	$V_{CB} = 10$ V; $I_E = 0$; f = 1 MHz	0.35	0.65	pF
f_T	transition frequency	$V_{CE} = 10$ V; $I_C = 4$ mA; f = 100 MHz; $T_{amb} = 25$ °C	650	–	MHz
r_bC_c	collector-base time constant	$V_{CE} = 10$ V; $I_C = 4$ mA; f = 100 MHz; $T_{amb} = 25$ °C	–	9	ps

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	DC collector current		–	40	mA
P_{tot}	total power dissipation	$T_s = 45$ °C (note 1)	–	400	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C

Note

1. T_s is the temperature at the soldering point of the collector tab.

Capability approved CECC 50 000 (issue 4), 1986

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	from junction to soldering point (note 1)	260 K/W

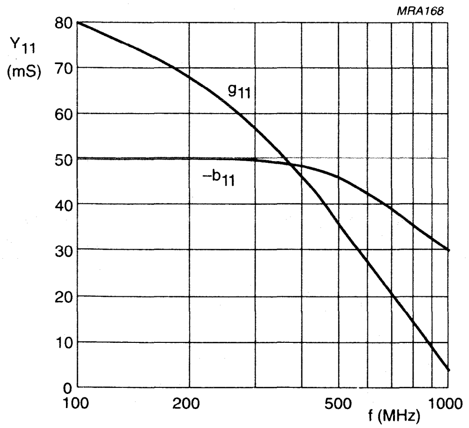
Note

1. T_s is the temperature at the soldering point of the collector tab.

CHARACTERISTICS

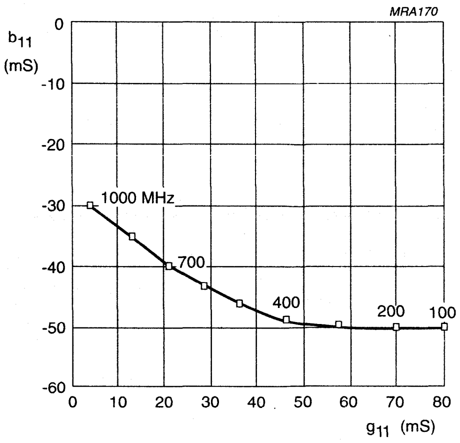
T_j = 25 °C.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 100 µA; I_E = 0	30	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 1 mA; I_B = 0	25	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 10 µA; I_C = 0	3	–	V
$V_{CE\ sat}$	collector-emitter saturation voltage	I_C = 4 mA; I_B = 0.4 mA	–	0.5	V
$V_{BE\ on}$	base-emitter ON voltage	V_{CE} = 10 V; I_C = 4 mA	–	0.95	V
I_{CBO}	collector-base cut-off current	V_{CB} = 25 V; I_E = 0	–	100	nA
I_{EBO}	emitter-base cut-off current	V_{CB} = 25 V; I_C = 0	–	100	nA
h_{FE}	DC current gain	V_{CE} = 10 V; I_C = 4 mA	60	–	
C_{re}	collector-emitter feedback capacitance	V_{CB} = 10 V; I_E = i_e = 0; f = 1 MHz	–	0.7	pF
C_{rb}	collector-base feedback capacitance	V_{CB} = 10 V; I_C = i_c = 0; f = 1 MHz	0.35	0.65	pF
f_T	transition frequency	V_{CE} = 10 V; I_C = 4 mA; f = 100 MHz; T_{amb} = 25 °C	650	–	MHz
r_bC_c	collector-base time constant	V_{CB} = 10 V; I_C = 4 mA; f = 100 MHz; T_{amb} = 25 °C	–	9	ps



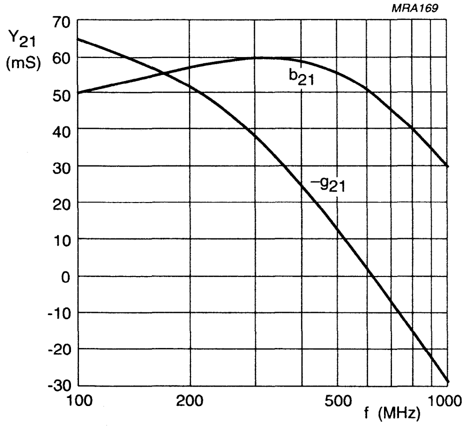
$V_{CB} = 10$ V; $I_C = 4$ mA.

Fig.2 Common base input admittance (Y_{11}) as a function of frequency.



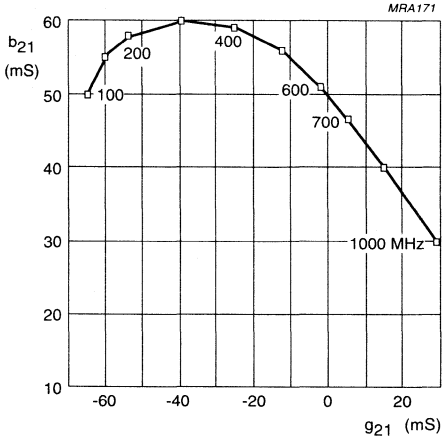
$V_{CB} = 10$ V; $I_C = 4$ mA.

Fig.3 Common base input admittance (Y_{11}).



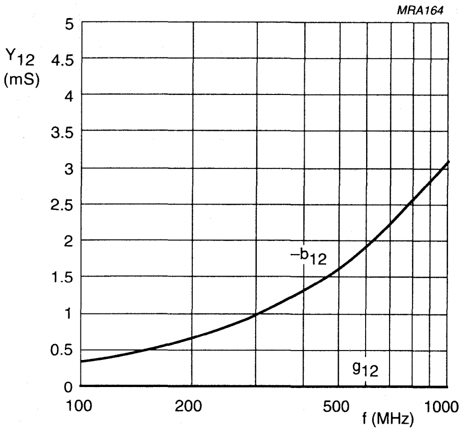
$V_{CB} = 10$ V; $I_C = 4$ mA.

Fig.4 Common base forward transfer admittance (Y_{21}) as a function of frequency.



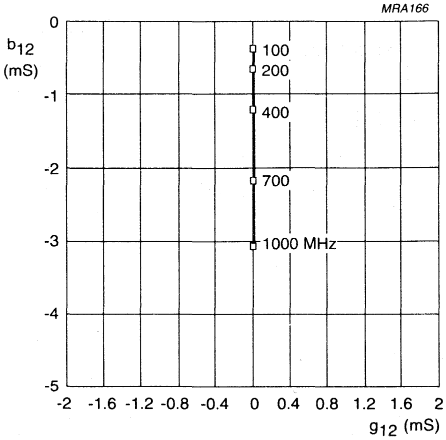
$V_{CB} = 10$ V; $I_C = 4$ mA.

Fig.5 Common base forward transfer admittance (Y_{21}).



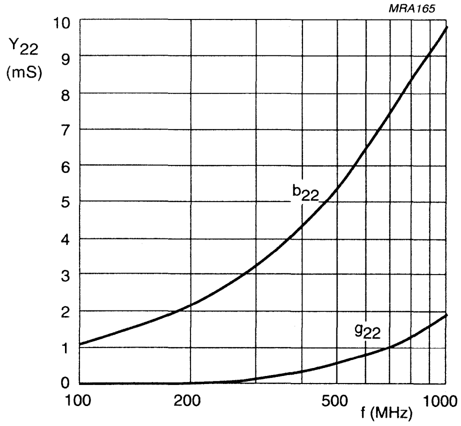
V_{CB} = 10 V; I_C = 4 mA.

Fig.6 Common base reverse transfer admittance (Y_{12}) as a function of frequency.



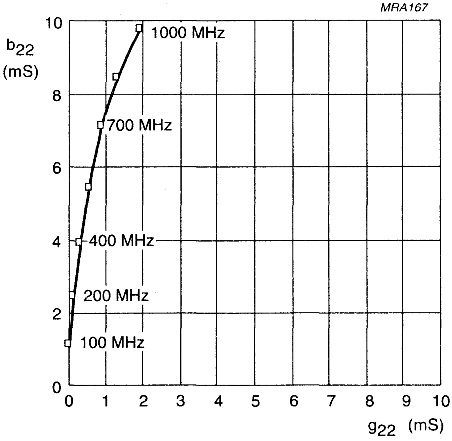
V_{CB} = 10 V; I_C = 4 mA.

Fig.7 Common base reverse transfer admittance (Y_{12}).



V_{CB} = 10 V; I_C = 4 mA.

Fig.8 Common base reverse admittance (Y_{22}) as a function of frequency.



V_{CB} = 10 V; I_C = 4 mA.

Fig.9 Common base reverse admittance (Y_{22}).

PNP 1 GHz switching transistor

PMBTH81

FEATURES

- Low cost
- High transition frequency.

DESCRIPTION

The PMBTH81 is a general purpose silicon pnp transistor, encapsulated in a SOT23 plastic envelope. Its complement is the PMBTH10.

PINNING

PIN	DESCRIPTION
	Code: V31
1	base
2	emitter
3	collector

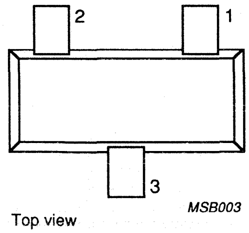


Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	20	V
V_{CEO}	collector-emitter voltage	open base	–	20	V
P_{tot}	total power dissipation	T_s = 45 °C (note 1)	–	400	mW
C_{ce}	collector-emitter capacitance	V_{CB} = 10 V; I_B = 0; f = 1 MHz	–	0.65	pF
C_{cb}	collector-base capacitance	V_{CB} = 10 V; I_E = 0; f = 1 MHz	–	0.85	pF
f_T	transition frequency	V_{CE} = 10 V; I_C = 5 mA; f = 100 MHz; T_{amb} = 25 °C	600	–	MHz

Note

1. T_s is the temperature at the soldering point of the collector tab.

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	–	20	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current		–	40	mA
P_{tot}	total power dissipation	T_s = 45 °C (note 1)	–	400	mW
T_{stg}	storage temperature		−65	150	°C
T_j	junction temperature		–	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	from junction to soldering point (note 1)	260 K/W

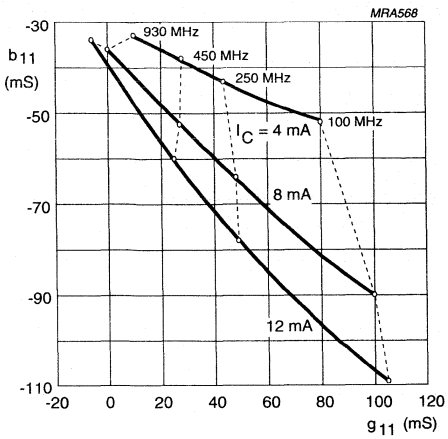
Note

1. T_s is the temperature at the soldering point of the collector tab.

CHARACTERISTICS

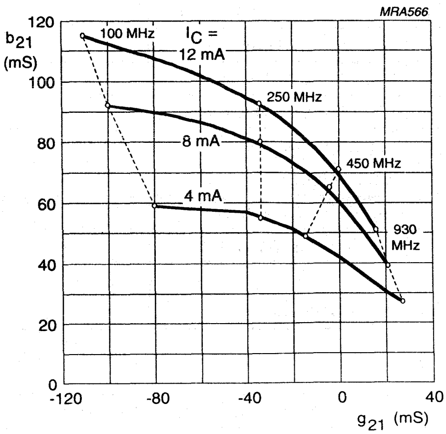
T_j = 25 °C.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 10 μA; I_E = 0	20	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 1 mA; I_B = 0	20	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 10 μA; I_C = 0	3	–	V
$V_{CE\ sat}$	collector-emitter saturation voltage	I_C = 5 mA; I_B = 0.5 mA	–	0.5	V
$V_{BE\ on}$	base-emitter ON voltage	V_{CE} = 10 V; I_C = 5 mA	–	0.9	V
I_{CBO}	collector-base cut-off current	V_{CB} = 10 V; I_E = 0	–	100	nA
I_{EBO}	emitter-base cut-off current	V_{EB} = 2 V; I_C = 0	–	100	nA
h_{FE}	DC current gain	V_{CE} = 10 V; I_C = 5 mA	60	–	
C_{ce}	collector-emitter capacitance	V_{CB} = 10 V; I_B = 0; f = 1 MHz	–	0.65	pF
C_{cb}	collector-base capacitance	V_{CB} = 10 V; I_E = 0; f = 1 MHz	–	0.85	pF
f_T	transition frequency	V_{CE} = 10 V; I_C = 5 mA; f = 100 MHz; T_{amb} = 25 °C	600	–	MHz



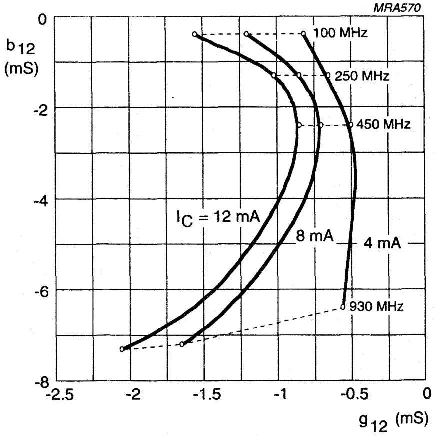
V_{CB} = 10 V; T_{amb} = 25 °C.

Fig.2 Common base input admittance (Y_{11}).



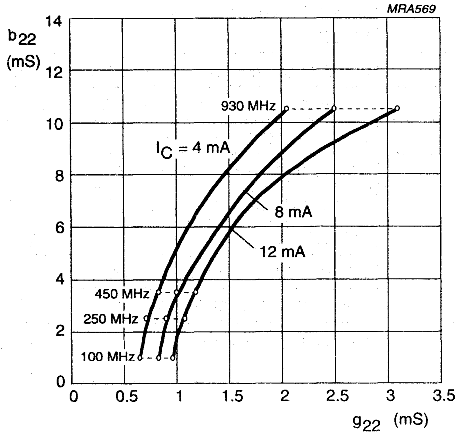
V_{CB} = 10 V; T_{amb} = 25 °C.

Fig.3 Forward transfer admittance (Y_{21}).



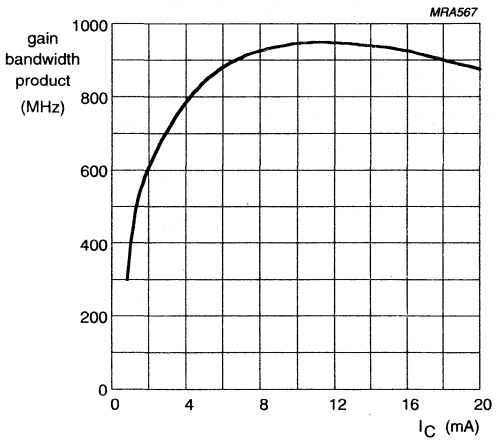
V_{CB} = 10 V; T_{amb} = 25 °C.

Fig.4 Reverse transfer admittance (Y_{12}).



V_{CB} = 10 V; T_{amb} = 25 °C.

Fig.5 Common base output admittance (Y_{22}).



V_{CE} = 10 V; f = 100 MHz.

Fig.6 Current gain-bandwidth product as a function of collector current.

SILICON PLANAR VOLTAGE REGULATOR DIODES

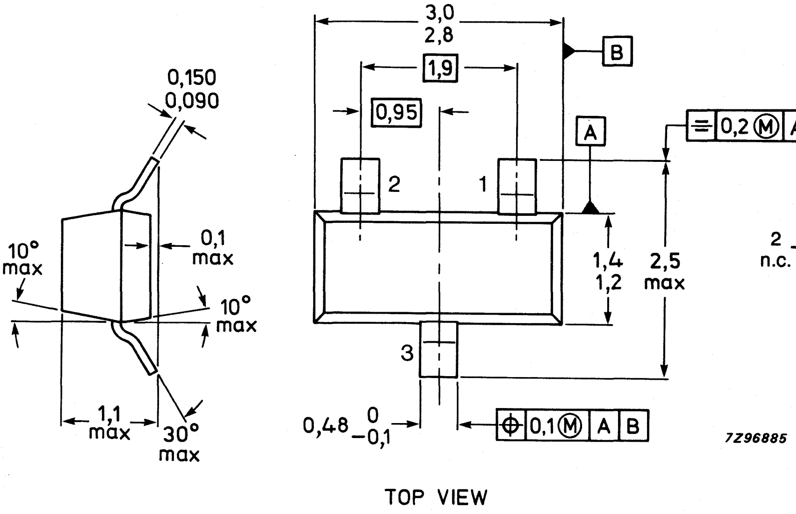
Low power general purpose voltage regulator diodes in a microminiature plastic envelope intended for application in thick and thin film circuits. The series covers the range of nominal working voltages from 3.3 to 33 V with a working voltage tolerance of ± 5%.

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



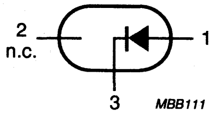


Fig.1 SOT23.

Marking code

PMBZ 5226B = p8A
PMBZ 5227B = p8B
PMBZ 5228B = p8C
PMBZ 5229B = p8D
PMBZ 5230B = p8E
PMBZ 5231B = p8F
PMBZ 5232B = p8G
PMBZ 5233B = p8H
PMBZ 5234B = p8J
PMBZ 5235B = p8K
PMBZ 5236B = p8L
PMBZ 5237B = p8M
PMBZ 5238B = p8N
PMBZ 5239B = p8P
PMBZ 5240B = p8Q
PMBZ 5241B = p8R
PMBZ 5242B = p8S
PMBZ 5243B = p8T
PMBZ 5244B = p8U
PMBZ 5245B = p8V
PMBZ 5246B = p8W
PMBZ 5247B = p8X
PMBZ 5248B = p8Y
PMBZ 5249B = p8Z
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

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.

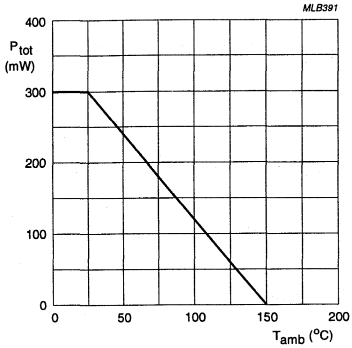


Fig. 2 Power derating curve.

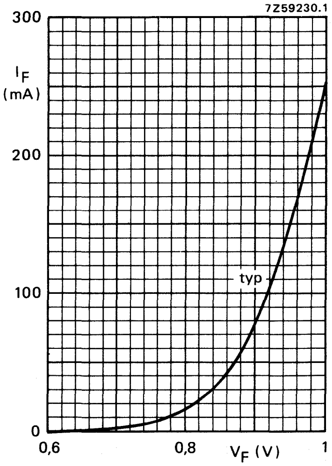


Fig. 3 Typical values at T_j = 25 °C.
Forward current as a function of forward voltage.

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 SOD80C 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 are delivered in "super 8" tape.

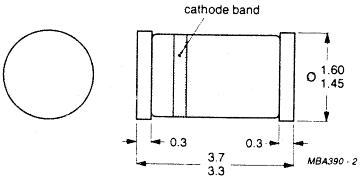
QUICK REFERENCE DATA

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 SOD80C.



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

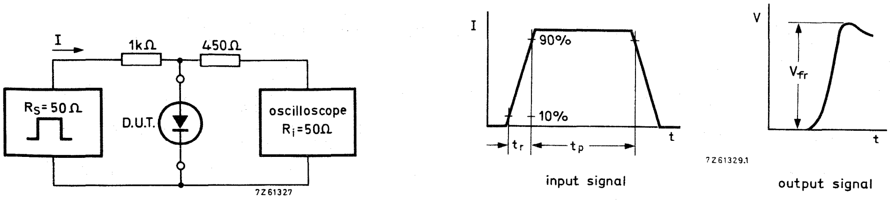


Fig. 2 Forward recovery voltage test circuit and waveforms.

Input signal:	Rise time of the forward pulse	$t_r = 20$ ns
	Forward current pulse duration	$t_p = 120$ ns
	Duty factor	$\delta = 0{,}01$
Oscilloscope:	Rise time	$t_r = 0{,}35$ ns

Circuit capacitance $C \leqslant 1$ pF (C = oscilloscope input capacitance + parasitic capacitance)

Reverse recovery time when switched from
$I_F = 10$ mA to $I_R = 60$ mA; $R_L = 100\ \Omega$;
measured at $I_R = 1$ mA $\qquad t_{rr} < 4$ ns

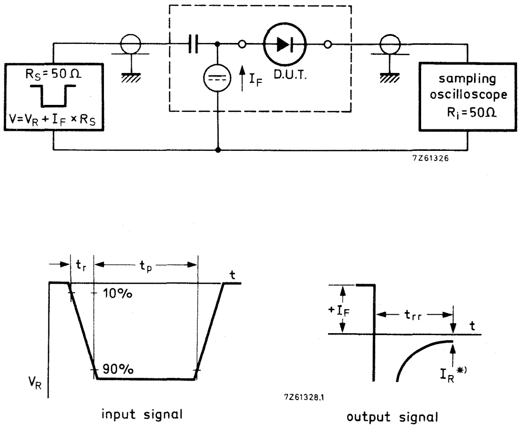


Fig. 3 Reverse recovery time test circuit and waveforms.

Input signal:	Rise time of the reverse pulse	$t_r = 0{,}6$ ns
	Reverse pulse duration	$t_p = 100$ ns
	Duty factor	$\delta = 0{,}05$
Oscilloscope:	Rise time	$t_r = 0{,}35$ ns

Circuit capacitance $C \leqslant 1$ pF (C = oscilloscope input capacitance + parasitic capacitance)

* $I_R = 1$ mA

ULTRA-HIGH-SPEED SILICON DIODES FOR SURFACE MOUNTING

Whiskerless diodes in SOD80C 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.

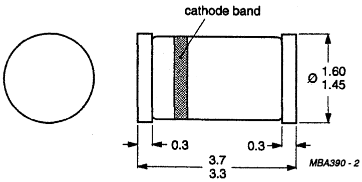
QUICK REFERENCE DATA

			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 SOD80C.



Cathode indicated by black band.

RATINGS

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

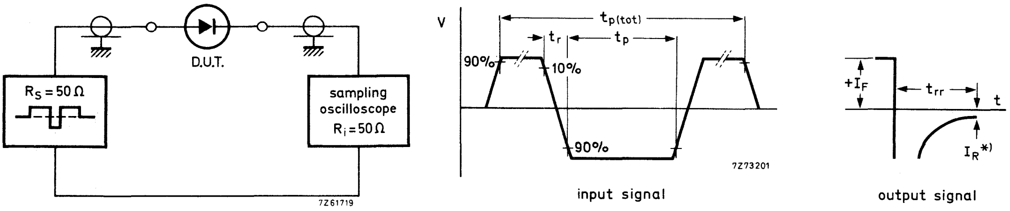
			PMLL4150	4151	4153	
Continuous reverse voltage	V_R	max.	50	50	50	V
Repetitive peak reverse voltage	V_{RRM}	max.	–	75	75	V
Forward current (d.c.)	I_F	max.	0,30	0,20	0,20	A
Repetitive peak forward current	I_{FRM}	max.	0,60	0,45	0,45	A
Non-repetitive peak forward current						
t = 1 μs	I_{FSM}	max.	4,0	–	–	A
t = 1 s	I_{FSM}	max.	0,5	–	–	A
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.		500		mW
Derating factor				2,85		mW/K
Storage temperature	T_{stg}			–65 to + 200		^oC
Junction temperature	T_j	max.		200		^oC

CHARACTERISTICS

$T_j = 25\ ^oC$ 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						
$I_R = 5\ \mu A$	$V_{(BR)R}$	>	–	75	75	V
Reverse current						
$V_R = 50$ V	I_R	<	0,1	0,05	0,05	μA
$V_R = 50$ V; $T_{amb} = 150\ ^oC$	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 Ω; 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 Ω; 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 Ω; measured at I_R = 0,1 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
I_F = 10 mA to I_R = 60 mA; R_L = 100 Ω; 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 t_{fr} < 10 ns

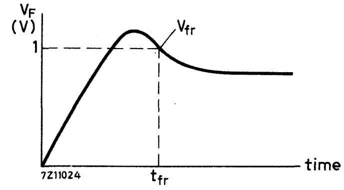


Fig. 3 PMLL4150.

VOLTAGE REGULATOR DIODES FOR SURFACE MOUNTING

Silicon planar diodes in a SOD80C 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 SOD80C 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.

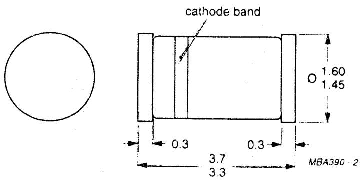
QUICK REFERENCE DATA

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 $T_j = 55\ ^{o}C$; $t_p = 8,3$ ms, square wave	P_{ZSM}	max.	10	W
Junction temperature	T_j		−65 to + 200	^{o}C

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD80C.



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.

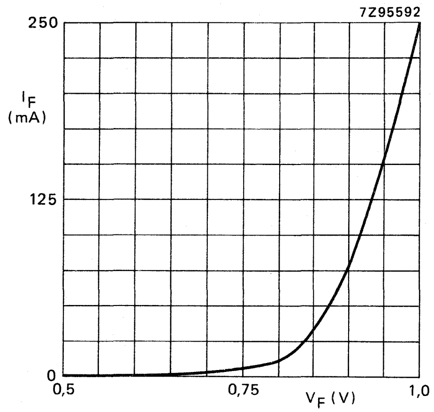


Fig. 2 T_{amb} = 25 °C; typical values.

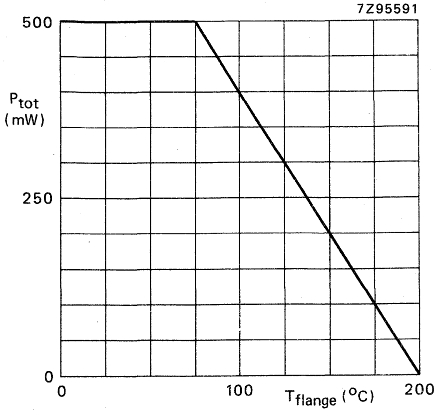


Fig. 3 Total power dissipation versus flange temperature.

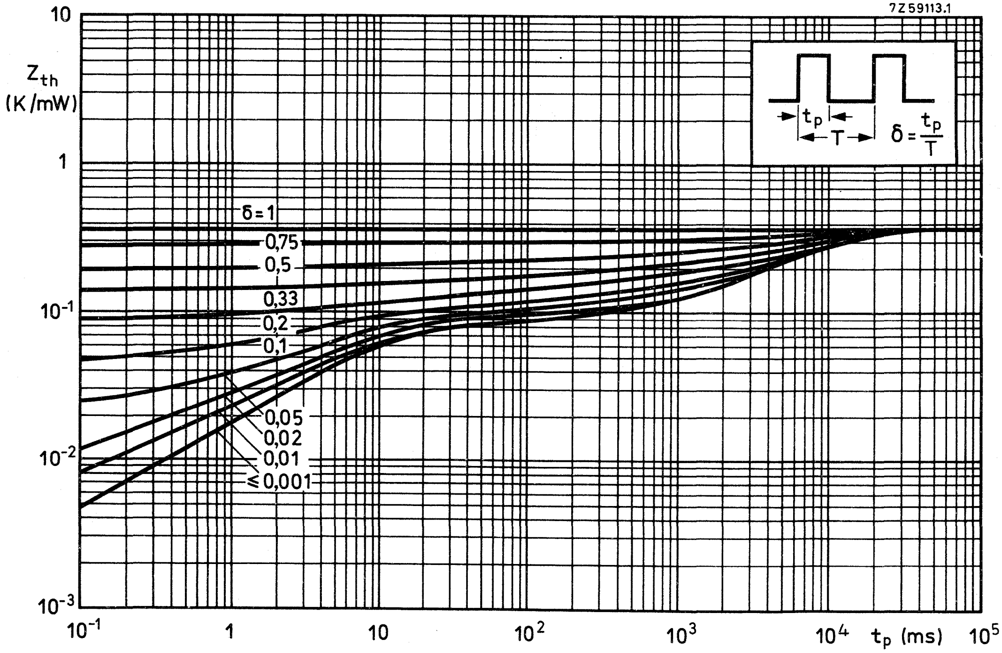


Fig. 4 Thermal impedance versus pulse duration.

NPN general purpose transistor PMSS3904

FEATURES

- S-mini package.

DESCRIPTION

NPN transistor in a plastic SOT323 package, primarily intended for use in telephony and professional communication equipment.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

MARKING CODE

PMSS3904	PO4

PIN CONFIGURATION

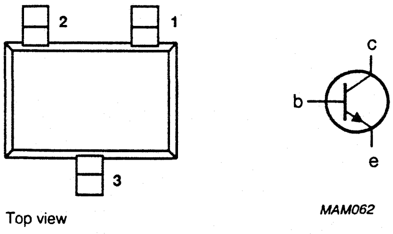


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	60	V
V_{CEO}	collector-emitter voltage	open base	–	40	V
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	200	mW
h_{FE}	DC current gain	I_C = 10 mA; V_{CE} = 1 V	100	300	
f_T	transition frequency	I_C = 10 mA; V_{CE} = 20 V; f = 100 MHz	180	–	MHz

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	60	V
V_{CEO}	collector-emitter voltage	open base	–	40	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	DC collector current		–	200	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C; note 1	–	200	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Refer to SOT323 standard mounting conditions.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	from junction to ambient in free air	note 1	625 K/W

Note

1. Refer to SOT323 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

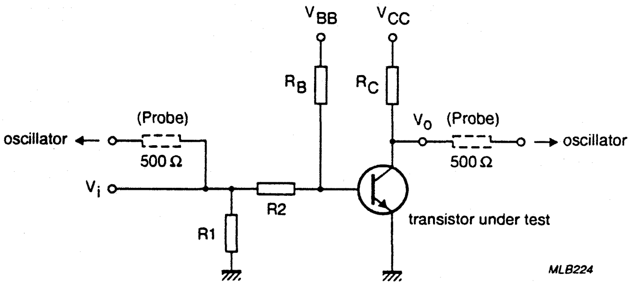
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter $I_C = 10\ \mu A$; $I_E = I_e = 0$	60	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base $I_C = 1$ mA; $I_B = I_b = 0$; note 1	40	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector $I_E = 10\ \mu A$; $I_C = I_c = 0$	6	–	V
I_{CEX}	current at reverse biased emitter junction	$V_{CE} = 30$ V; $V_{EB} = 3$ V	–	50	nA
I_{CEX}	collector cut-off current emitter junction	$V_{CE} = 30$ V; $V_{EB} = 3$ V; $T_j = 150$ °C	–	10	µA
I_{EBX}	emitter cut-off current emitter junction	$V_{CE} = 30$ V; $V_{EB} = 3$ V	–	–50	nA
V_{CEsat}	saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	–	200	mV
		$I_C = 50$ mA; $I_B = 5$ mA; note 1	–	300	mV
V_{BEsat}	saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	650	850	mV
		$I_C = 50$ mA; $I_B = 5$ mA; note 1	–	950	mV
C_c	collector capacitance	$V_{CB} = 5$ V; $I_E = I_e = 0$; f = 1 MHz	–	4	pF
C_e	emitter capacitance	$V_{EB} = 0.5$ V; $I_E = I_e = 0$; f = 1 MHz	–	12	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 20$ V; f = 100 MHz	180	–	MHz
h_{FE}	DC current gain				
		$I_C = 0.1$ mA; $V_{CE} = 1$ V	40	–	
		$I_C = 1$ mA; $V_{CE} = 1$ V	70	–	
		$I_C = 10$ mA; $V_{CE} = 1$ V	100	300	
		$I_C = 50$ mA; $V_{CE} = 1$ V; note 1	60	–	
		$I_C = 100$ mA; $V_{CE} = 1$ V; note 1	30	–	
F	noise figure	$I_C = 100\ \mu A$; $V_{CE} = 5$ V; $R_S = 1\ k\Omega$; f = 10 Hz to 15.7 kHz	–	5	dB

Note

1. Pulse test: $t_p \leq 300\ \mu s$; $\delta \leq 0.02$.

Table 1 Switching times (resistive load); see Fig.2.

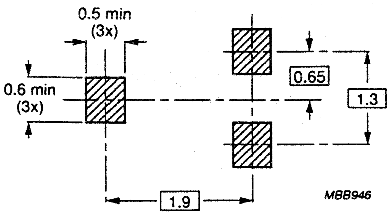
SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
t_{on}	turn-on time	I_{Con} = 10 mA; I_{Bon} = 1 mA; V_{CC} = 3 V; V_{BB} = −1.9 V		
t_d	delay time		45	ns
t_r	rise time		55	ns
t_{off}	turn-off time	I_{Con} = 10 mA; I_{Bon} = I_{Boff} = 1 mA; V_{CC} = 3 V; V_{BB} = −1.9 V		
t_s	storage time		900	ns
t_f	fall time		90	ns



V_i = 5 V; $t_p \geq$ 4 µs; t_r = $t_f \leq$ 3 ns
R1 = 56 Ω; R2 = 2.5 kΩ; R_B = 3.9 kΩ; R_C = 270 Ω

Fig.2 Test circuit for switching times (see Table 1).

MOUNTING



Dimensions in mm.

Fig.3 SOT323 typical soldering pattern.

PNP general purpose transistor PMSS3906

FEATURES

- S-mini package.

DESCRIPTION

PNP transistor in a plastic SOT323 package, primarily intended for use in telephony and professional communication equipment.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

MARKING CODE

PMSS3906	PO6

PIN CONFIGURATION

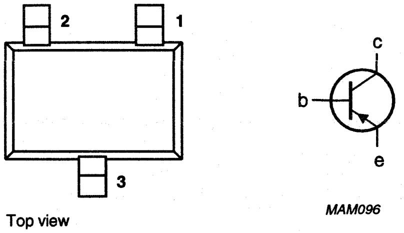


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–40	V
V_{CEO}	collector-emitter voltage	open base	–	–40	V
I_c	DC collector current		–	–200	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	200	mW
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -1$ V	100	300	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -20$ V; f = 100 MHz	150	–	MHz

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–40	V
V_{CEO}	collector-emitter voltage	open base	–	–40	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	DC collector current		–	–200	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C; note 1	–	200	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Refer to SOT323 standard mounting conditions.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	from junction to ambient in free air	note 1	625 K/W

Note

1. Refer to SOT323 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

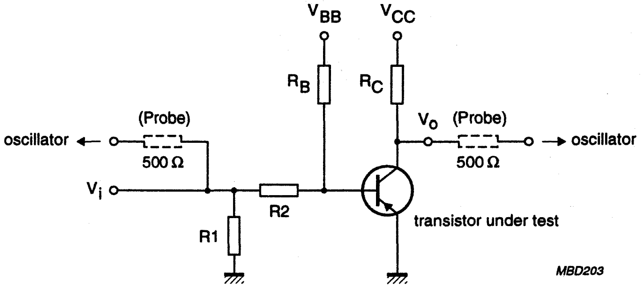
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter $I_C = -10$ μA; $I_E = I_e = 0$	−40	−	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base $I_C = -1$ mA; $I_B = I_b = 0$; note 1	−40	−	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector $I_E = -10$ μA; $I_C = I_c = 0$	−5	−	V
I_{CEX}	collector cut-off current emitter junction	$V_{CE} = -30$ V; $V_{EB} = -3$ V	−	−50	nA
		$V_{CE} = -30$ V; $V_{EB} = -3$ V; T_j = 150 °C	−	−10	μA
I_{EBX}	emitter cut-off current emitter junction	$V_{CE} = -30$ V; $V_{EB} = -3$ V	−	−50	nA
V_{CEsat}	saturation voltage	$I_C = -10$ mA; $I_B = -1$ mA	−	−250	mV
		$I_C = -50$ mA; $I_B = -5$ mA; note 1	−	−400	mV
V_{BEsat}	saturation voltage	$I_C = -10$ mA; $I_B = -1$ mA	−	−850	mV
		$I_C = -50$ mA; $I_B = -5$ mA; note 1	−	−950	mV
C_c	collector capacitance	$V_{CB} = -5$ V; $I_E = I_e = 0$; f = 1 MHz	−	4.5	pF
C_e	emitter capacitance	$V_{EB} = -0.5$ V; $I_E = I_e = 0$; f = 1 MHz	−	14	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -20$ V; f = 100 MHz	150	−	MHz
h_{FE}	DC current gain				
		$I_C = -0.1$ mA; $V_{CE} = -1$ V	60	−	
		$I_C = -1$ mA; $V_{CE} = -1$ V	80	−	
		$I_C = -10$ mA; $V_{CE} = -1$ V	100	300	
		$I_C = -50$ mA; $V_{CE} = -1$ V; note 1	60	−	
		$I_C = -100$ mA; $V_{CE} = -1$ V; note 1	30	−	
F	noise figure	$I_C = -100$ μA; $V_{CE} = -5$ V; R_S = 1 kΩ; f = 10 Hz to 15.7 kHz	−	4	dB

Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.02$.

Table 1 Switching times (resistive load); see Fig.2.

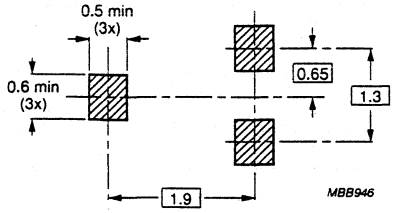
SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
t_{on}	turn-on time	$I_{Con} = -10$ mA; $I_{Bon} = -1$ mA; $V_{CC} = -3$ V; $V_{BB} = -1.9$ V		
t_d	delay time		45	ns
t_r	rise time		55	ns
t_{off}	turn-off time	$I_{Con} = -10$ mA; $I_{Bon} = I_{Boff} = -1$ mA; $V_{CC} = -3$ V; $V_{BB} = -1.9$ V		
t_s	storage time		600	ns
t_f	fall time		90	ns



$V_i = -5$ V; $t_p \geq 4$ µs; $t_r = t_f \leq 3$ ns
R1 = 56 Ω; R2 = 2.5 kΩ; $R_B = 3.9$ kΩ; $R_C = 270$ Ω

Fig.2 Test circuit for switching times (see Table 1).

MOUNTING



Dimensions in mm.

Fig.3 SOT323 typical soldering pattern.

NPN switching transistor PMST3904

FEATURES

- S-mini package
- Short switching time.

DESCRIPTION

NPN transistor in a plastic SOT323 package, primarily intended for use in telephony and professional communication equipment.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

MARKING CODE

PMST3904	P1A

PIN CONFIGURATION

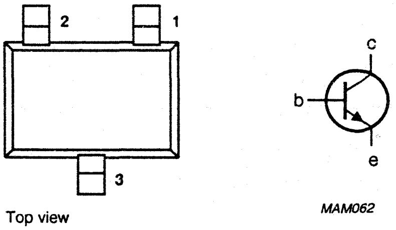


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	60	V
V_{CEO}	collector-emitter voltage	open base	–	40	V
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	200	mW
h_{FE}	DC current gain	I_C = 10 mA; V_{CE} = 1 V	100	300	
f_T	transition frequency	I_C = 10 mA; V_{CE} = 20 V; f = 100 MHz	300	–	MHz
t_s	storage time	I_{Con} = 10 mA; I_{Bon} = I_{Boff} = 1 mA	–	200	ns

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	60	V
V_{CEO}	collector-emitter voltage	open base	–	40	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	DC collector current		–	200	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C; note 1	–	200	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Refer to SOT323 standard mounting conditions.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	from junction to ambient in free air	note 1	625 K/W

Note

1. Refer to SOT323 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

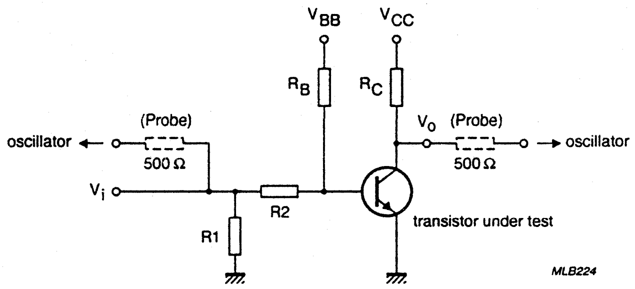
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter $I_C = 10\ \mu A$; $I_E = I_e = 0$	60	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base $I_C = 1\ mA$; $I_B = I_b = 0$; note 1	40	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector $I_E = 10\ \mu A$; $I_C = I_c = 0$	6	–	V
I_{CEX}	collector cut-off current emitter junction	$V_{CE} = 30\ V$; $V_{EB} = 3\ V$	–	50	nA
		$V_{CE} = 30\ V$; $V_{EB} = 3\ V$; $T_j = 150\ °C$	–	10	µA
I_{EBX}	emitter cut-off current emitter junction	$V_{CE} = 30\ V$; $V_{EB} = 3\ V$	–	50	nA
V_{CEsat}	saturation voltage	$I_C = 10\ mA$; $I_B = 1\ mA$; note 1	–	200	mV
		$I_C = 50\ mA$; $I_B = 5\ mA$; note 1	–	300	mV
V_{BEsat}	saturation voltage	$I_C = 10\ mA$; $I_B = 1\ mA$; note 1	650	850	mV
		$I_C = 50\ mA$; $I_B = 5\ mA$; note 1	–	950	mV
C_c	collector capacitance	$V_{CB} = 5\ V$; $I_E = I_e = 0$; f = 1 MHz	–	4	pF
C_e	emitter capacitance	$V_{EB} = 0.5\ V$; $I_C = I_c = 0$; f = 1 MHz	–	8	pF
f_T	transition frequency	$I_C = 10\ mA$; $V_{CE} = 20\ V$; f = 100 MHz	300	–	MHz
h_{FE}	DC current gain				
		$I_C = 0.1\ mA$; $V_{CE} = 1\ V$	40	–	
		$I_C = 1\ mA$; $V_{CE} = 1\ V$	70	–	
		$I_C = 10\ mA$; $V_{CE} = 1\ V$	100	300	
		$I_C = 50\ mA$; $V_{CE} = 1\ V$; note 1	60	–	
		$I_C = 100\ mA$; $V_{CE} = 1\ V$; note 1	30	–	
F	noise figure	$I_C = 100\ \mu A$; $V_{CE} = 5\ V$; $R_S = 1\ k\Omega$; f = 10 Hz to 15.7 kHz	–	5	dB

Note

1. Pulse test: $t_p \leq 300\ \mu s$; $\delta \leq 0.02$.

Table 1 Switching times (resistive load); see Fig.2.

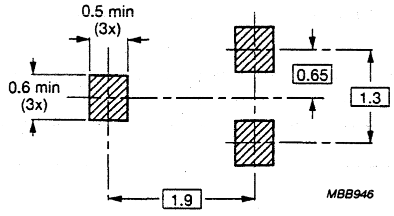
SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
t_{on}	turn-on time	I_{Con} = 10 mA; I_{Bon} = 1 mA; V_{CC} = 3 V; V_{BB} = −1.9 V		
t_d	delay time		35	ns
t_r	rise time		35	ns
t_{off}	turn-off time	I_{Con} = 10 mA; I_{Bon} = I_{Boff} = 1 mA; V_{CC} = 3 V; V_{BB} = −1.9 V		
t_s	storage time		200	ns
t_f	fall time		50	ns



V_i = 5 V; $t_p \geq 4$ µs; $t_r = t_f \leq 3$ ns
R1 = 56 Ω; R2 = 2.5 kΩ; R_B = 3.9 kΩ; R_C = 270 Ω

Fig.2 Test circuit for switching times (see Table 1).

MOUNTING



Dimensions in mm.

Fig.3 SOT323 typical soldering pattern.

PNP switching transistor PMST3906

FEATURES

- S-mini package
- Short switching time.

DESCRIPTION

PNP transistor in a plastic SOT323 package, primarily intended for use in telephony and professional communication equipment.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

MARKING CODE

PMST3906	P2A

PIN CONFIGURATION

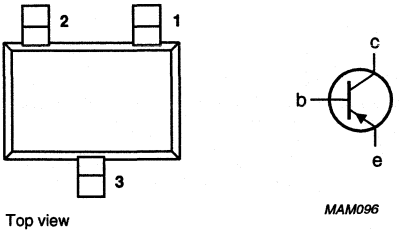


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–40	V
V_{CEO}	collector-emitter voltage	open base	–	–40	V
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	200	mW
h_{FE}	DC current gain	I_C = –10 mA; V_{CE} = –1 V	100	300	
f_T	transition frequency	I_C = –10 mA; V_{CE} = –20 V; f = 100 MHz	250	–	MHz
t_s	storage time	I_{Con} = –10 mA; I_{Bon} = I_{Boff} = –1 mA	–	225	ns

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–40	V
V_{CEO}	collector-emitter voltage	open base	–	–40	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	DC collector current		–	–200	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C; note 1	–	200	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Refer to SOT323 standard mounting conditions.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	from junction to ambient in free air	note 1	625 K/W

Note

1. Refer to SOT323 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

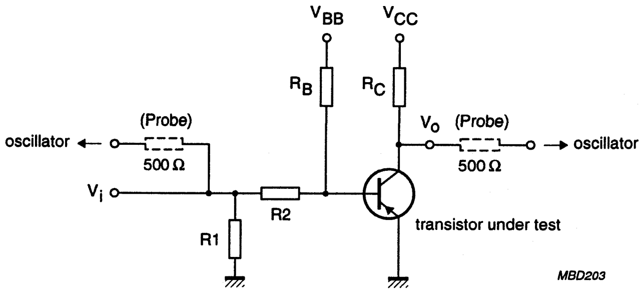
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter $I_C = -10\ \mu A$; $I_E = I_e = 0$	−40	−	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base $I_C = -1$ mA; $I_B = I_b = 0$; note 1	−40	−	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector $I_E = -10\ \mu A$; $I_C = I_c = 0$	−5	−	V
I_{CEX}	collector cut-off current emitter junction	$V_{CE} = -30$ V; $V_{EB} = -3$ V	−	−50	nA
		$V_{CE} = -30$ V; $V_{EB} = -3$ V; T_j = 150 °C	−	−10	µA
I_{EBX}	emitter cut-off current emitter junction	$V_{CE} = -30$ V; $V_{EB} = -3$ V	−	−50	nA
V_{CEsat}	saturation voltage	$I_C = -10$ mA; $I_B = -1$ mA; note 1	−	−250	mV
		$I_C = -50$ mA; $I_B = -5$ mA; note 1	−	−400	mV
V_{BEsat}	saturation voltage	$I_C = -10$ mA; $I_B = -1$ mA; note 1	−	−850	mV
		$I_C = -50$ mA; $I_B = -5$ mA; note 1	−	−950	mV
C_c	collector capacitance	$V_{CB} = -5$ V; $I_E = I_e = 0$; f = 1 MHz	−	4.5	pF
C_e	emitter capacitance	$V_{EB} = -0.5$ V; $I_C = I_c = 0$; f = 1 MHz	−	10	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -20$ V; f = 100 MHz	250	−	MHz
h_{FE}	DC current gain				
		$I_C = -0.1$ mA; $V_{CE} = -1$ V	60	−	
		$I_C = -1$ mA; $V_{CE} = -1$ V	80	−	
		$I_C = -10$ mA; $V_{CE} = -1$ V	100	300	
		$I_C = -50$ mA; $V_{CE} = -1$ V; note 1	60	−	
		$I_C = -100$ mA; $V_{CE} = -1$ V; note 1	30	−	
F	noise figure	$I_C = -100\ \mu A$; $V_{CE} = -5$ V; $R_S = 1\ k\Omega$; f = 10 Hz to 15.7 kHz	−	4	dB

Note

1. Pulse test: $t_p \leq 300\ \mu s$; $\delta \leq 0.02$.

Table 1 Switching times (resistive load); see Fig.2.

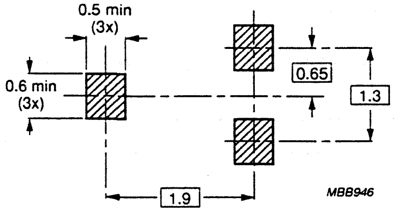
SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
t_{on}	turn-on time	$I_{Con} = -10$ mA; $I_{Bon} = -1$ mA; $V_{CC} = -3$ V; $V_{BB} = -1.9$ V		
t_d	delay time		35	ns
t_r	rise time		35	ns
t_{off}	turn-off time	$I_{Con} = -10$ mA; $I_{Bon} = I_{Boff} = -1$ mA; $V_{CC} = -3$ V; $V_{BB} = -1.9$ V		
t_s	storage time		225	ns
t_f	fall time		75	ns



$V_i = -5$ V; $t_p \geq 4$ µs; $t_r = t_f \leq 3$ ns
R1 = 56 Ω; R2 = 2.5 kΩ; $R_B = 3.9$ kΩ; $R_C = 270$ Ω

Fig.2 Test circuit for switching times (see Table 1).

MOUNTING



Dimensions in mm.

Fig.3 SOT323 typical soldering pattern.

NPN switching transistor PMST4401

FEATURES

- S-mini package
- High current.

DESCRIPTION

NPN silicon planar epitaxial transistor in a plastic SOT323 package. It is intended for use in linear, switching and general purpose applications.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

MARKING CODE

PMST4401	P2X

PIN CONFIGURATION

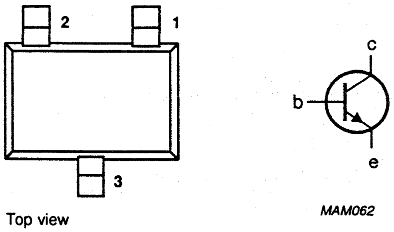


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	60	V
V_{CEO}	collector-emitter voltage	open base	–	40	V
I_c	DC collector current		–	600	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	200	mW
h_{FE}	DC current gain	I_C = 150 mA; V_{CE} = 1 V	100	300	

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	60	V
V_{CEO}	collector-emitter voltage	open base	–	40	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	DC collector current		–	600	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C; note 1	–	200	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Refer to SOT323 standard mounting conditions.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	from junction to ambient in free air	note 1	625 K/W

Note

1. Refer to SOT323 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter $I_C = 100\ \mu A$; $I_E = I_e = 0$	60	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base $I_C = 1$ mA; $I_B = I_b = 0$; note 1	40	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector $I_E = 100\ \mu A$; $I_C = I_c = 0$	6	–	V
I_{CEX}	collector cut-off current emitter junction	$V_{CE} = 35$ V; $V_{EB} = 0.4$ V	–	0.1	µA
		$V_{CE} = 35$ V; $V_{EB} = 0.4$ V; $T_j = 150$ °C	–	10	µA
I_{EBX}	emitter cut-off current emitter junction	$V_{CE} = 35$ V; $V_{EB} = 0.4$ V	–	0.1	µA
V_{CEsat}	saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA; note 1	–	400	mV
		$I_C = 500$ mA; $I_B = 50$ mA; note 1	–	750	mV
V_{BEsat}	saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA; note 1	750	950	mV
		$I_C = 500$ mA; $I_B = 50$ mA; note 1	–	1200	mV
C_c	collector capacitance	$V_{CB} = 5$ V; $I_E = I_e = 0$; f = 1 MHz	–	8	pF
C_e	emitter capacitance	$V_{EB} = 0.5$ V; $I_E = I_e = 0$; f = 1 MHz	–	30	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 10$ V; f = 100 MHz	250	–	MHz
h_{FE}	DC current gain				
		$I_C = 0.1$ mA; $V_{CE} = 1$ V	20	–	
		$I_C = 1$ mA; $V_{CE} = 1$ V	40	–	
		$I_C = 10$ mA; $V_{CE} = 1$ V	80	–	
		$I_C = 150$ mA; $V_{CE} = 1$ V; note 1	100	300	
		$I_C = 500$ mA; $V_{CE} = 2$ V; note 1	40	–	

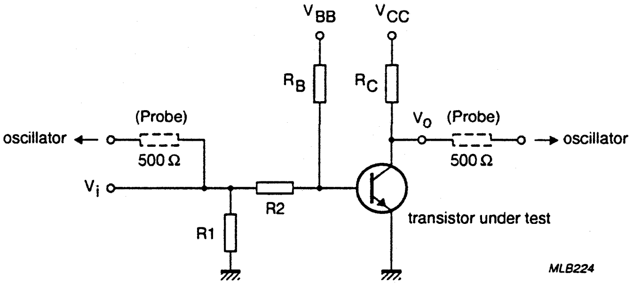
Note

1. Pulse test: $t_p \leq 300\ \mu s$; $\delta \leq 0.02$.

NPN switching transistor PMST4401

Table 1 Switching times (resistive load); see Fig.2.

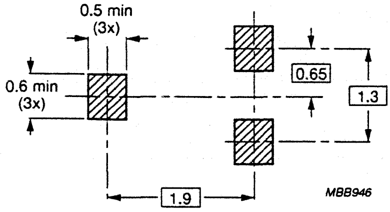
SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
t_{on}	turn-on time	I_{Con} = 150 mA; I_{Bon} = 15 mA; V_{CC} = 30 V; V_{BB} = −3.4 V		
t_d	delay time		15	ns
t_r	rise time		20	ns
t_{off}	turn-off time	I_{Con} = 150 mA; I_{Bon} = I_{Boff} = 15 mA; V_{CC} = 30 V; V_{BB} = −3.4 V		
t_s	storage time		225	ns
t_f	fall time		30	ns



V_i = 10 V; $t_p \geq 1$ µs; $t_r = t_f \leq 3$ ns
R1 = 68 Ω; R2 = 330 Ω; R_B = 330 Ω; R_C = 180 Ω

Fig.2 Test circuit for switching times (see Table 1).

MOUNTING



Dimensions in mm.

Fig.3 SOT323 typical soldering pattern.

PNP switching transistor PMST4403

FEATURES

- S-mini package
- High collector current.

DESCRIPTION

PNP silicon planar epitaxial transistor in a plastic SOT323 package. It is intended for use in linear, switching and general purpose applications.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

MARKING CODE

PMST4403	P2T

PIN CONFIGURATION

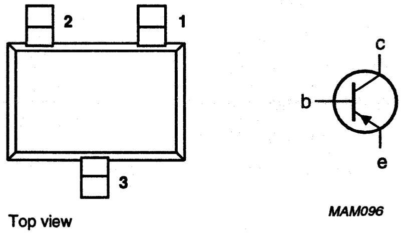


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–40	V
V_{CEO}	collector-emitter voltage	open base	–	–40	V
I_c	DC collector current		–	–600	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	200	mW
h_{FE}	DC current gain	I_C = –150 mA; V_{CE} = –2 V	100	300	

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–40	V
V_{CEO}	collector-emitter voltage	open base	–	–40	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	DC collector current		–	–600	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C; note 1	–	200	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Refer to SOT323 standard mounting conditions.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	from junction to ambient in free air	note 1	625 K/W

Note

1. Refer to SOT323 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

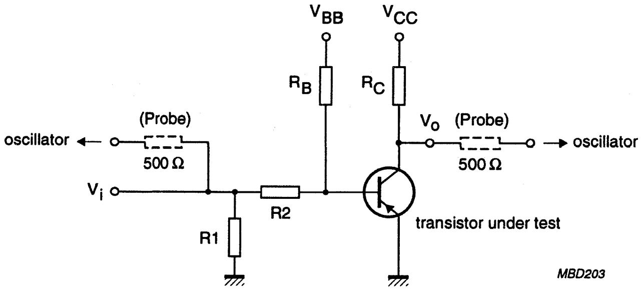
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter $I_C = -100$ µA; $I_E = I_e = 0$	–	–40	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base $I_C = -1$ mA; $I_B = I_b = 0$; note 1	–	–40	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector $I_E = -100$ µA; $I_C = I_c = 0$	–	–5	V
I_{CEX}	collector cut-off current emitter junction	$V_{CE} = -35$ V; $V_{EB} = -0.4$ V	–	–0.1	µA
		$V_{CE} = -35$ V; $V_{EB} = -0.4$ V; T_j = 150 °C	–	–10	µA
I_{EBX}	emitter cut-off current emitter junction	$V_{CE} = -35$ V; $V_{EB} = -0.4$ V	–	–0.1	µA
V_{CEsat}	saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA; note 1	–	–400	mV
		$I_C = -500$ mA; $I_B = -50$ mA; note 1	–	–750	mV
V_{BEsat}	saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA; note 1	–750	–950	mV
		$I_C = -500$ mA; $I_B = -50$ mA; note 1	–	–1300	mV
C_c	collector capacitance	$V_{CB} = -10$ V; $I_E = I_e = 0$; f = 1 MHz	–	8.5	pF
C_e	emitter capacitance	$V_{EB} = -0.5$ V; $I_E = I_e = 0$; f = 1 MHz	–	35	pF
f_T	transition frequency	$I_C = -20$ mA; $V_{CE} = -10$ V; f = 100 MHz	200	–	MHz
h_{FE}	DC current gain				
		$I_C = -0.1$ mA; $V_{CE} = -1$ V	30	–	
		$I_C = -1$ mA; $V_{CE} = -1$ V	60	–	
		$I_C = -10$ mA; $V_{CE} = -1$ V	100	–	
		$I_C = -150$ mA; $V_{CE} = -2$ V; note 1	100	300	
		$I_C = -500$ mA; $V_{CE} = -2$ V; note 1	20	–	

Note

1. Pulse test: $t_p \leq 300$ µs; $\delta \leq 0.02$.

Table 1 Switching times (resistive load); see Fig.2.

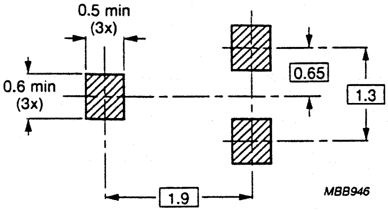
SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
t_{on}	turn-on time	I_{Con} = −150 mA; I_{Bon} = −15 mA; V_{CC} = −30 V; V_{BB} = −3.4 V		
t_d	delay time		15	ns
t_r	rise time		20	ns
t_{off}	turn-off time	I_{Con} = −150 mA; I_{Bon} = I_{Boff} = −15 mA; V_{CC} = −30 V; V_{BB} = −3.4 V		
t_s	storage time		225	ns
t_f	fall time		30	ns



V_i = −10 V; $t_p \geq 1$ µs; $t_r = t_f \leq 3$ ns
R1 = 68 Ω; R2 = 330 Ω; R_B = 330 Ω; R_C = 180 Ω

Fig.2 Test circuit for switching times (see Table 1).

MOUNTING



Dimensions in mm.

Fig.3 SOT323 typical soldering pattern.

NPN general purpose transistors | PMST5088; PMST5089

FEATURES

- S-mini package
- Low noise.

DESCRIPTION

NPN small signal transistor in a plastic SOT323 package, intended for low-noise input stages in audio equipment.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

MARKING CODES

PMST5088	P1Q
PMST5089	P1R

PIN CONFIGURATION

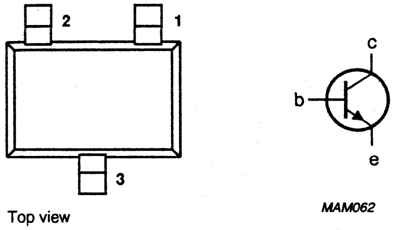


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PMST5088		–	35	V
	PMST5089		–	30	V
V_{CEO}	collector-emitter voltage	open base			
	PMST5088		–	30	V
	PMST5089		–	25	V
I_C	DC collector current		–	50	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	200	mW
h_{FE}	DC current gain	I_C = 1 mA; V_{CE} = 5 V			
	PMST5088		350	–	
	PMST5089		450	–	
V_{CEsat}	saturation voltage	I_C = 10 mA; I_B = 1 mA	–	500	mV

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PMST5088		–	35	V
	PMST5089		–	30	V
V_{CEO}	collector-emitter voltage	open base			
	PMST5088		–	30	V
	PMST5089		–	25	V
V_{EBO}	emitter-base voltage	open collector	–	4.5	V
I_C	DC collector current		–	50	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C; note 1	–	200	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Refer to SOT323 standard mounting conditions.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	from junction to ambient in free air	note 1	625 K/W

Note

1. Refer to SOT323 standard mounting conditions.

CHARACTERISTICS

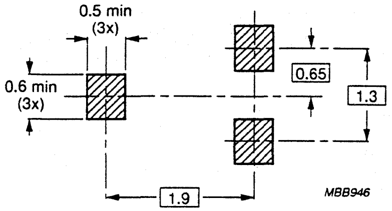
T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter I_C = 100 μA; I_B = 0			
	PMST5088		–	35	V
	PMST5089		–	30	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base I_C = 1 mA; I_E = 0; note 1			
	PMST5088		–	30	V
	PMST5089		–	25	V
I_{CBO}	collector cut-off current	V_{CB} = 20 V; I_E = 0	–	50	nA
		V_{CB} = 20 V; I_E = 0; T_j = 150 °C	–	10	μA
I_{EBO}	emitter cut-off current	V_{EB} = 3 V; I_C = 0	–	50	nA
		V_{EB} = 4.5 V; I_C = 0	–	100	nA
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA; I_B = 1 mA	–	500	mV
V_{BEon}	base-emitter on-voltage	I_C = 10 mA; V_{CE} = 5 V	–	800	mV
C_c	collector capacitance	V_{CB} = 5 V; I_E = I_e = 0; f = 1 MHz	–	4	pF
C_e	emitter capacitance	V_{EB} = 0.5 V; I_E = I_e = 0; f = 1 MHz	–	10	pF
h_{FE}	DC current gain				
	PMST5088	I_C = 0.1 mA; V_{CE} = 5 V	300	900	
		I_C = 1 mA; V_{CE} = 5 V	350	–	
		I_C = 10 mA; V_{CE} = 5 V	300	–	
	PMST5089	I_C = 0.1 mA; V_{CE} = 5 V	400	1200	
		I_C = 1 mA; V_{CE} = 5 V	450	–	
		I_C = 10 mA; V_{CE} = 5 V	400	–	
F	noise figure	I_C = 100 μA; V_{CE} = 5 V; R_S = 10 kΩ; f = 10 Hz to 15.7 kHz			
	PMST5088		–	3	dB
	PMST5089		–	2	dB

Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.02$.

MOUNTING



Dimensions in mm.

Fig.2 SOT323 typical soldering pattern.

SILICON DIFFUSED RECTIFIER DIODES

A range of silicon rectifier diodes for general use in leadless **SMID*** envelopes.

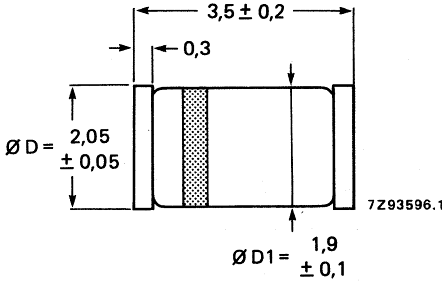
QUICK REFERENCE DATA

			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.



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* 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

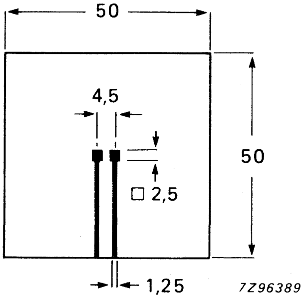


Fig.2 Mounted on a printed-circuit board.

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

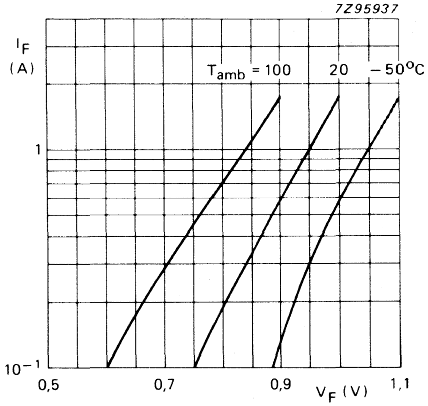


Fig.3 Typical forward current as a function of forward voltage.

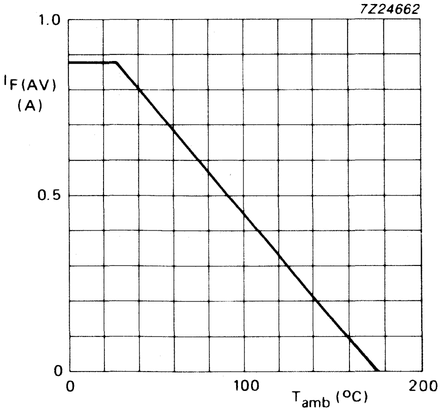


Fig.4 Maximum forward current as a function of temperature.

PRLL5817
PRLL5818
PRLL5819

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.

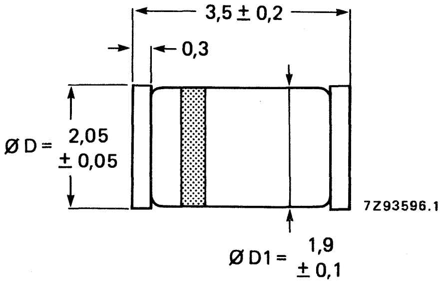
QUICK REFERENCE DATA

			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.



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* 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

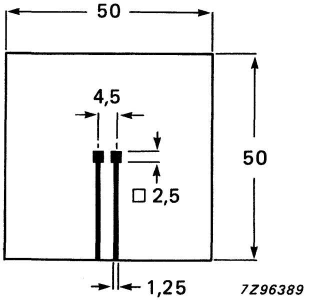


Fig.2 Mounted on a printed-circuit board.

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; $\delta = 0.5$; $T_{amb} = 60$ °C; $a = 1.42$.

   Find $T_{j\,max}$ from Fig.9: 112 °C.

   Find P_R from Fig.10: 0.1 W.
   $P_R \times R_{th\,j\text{-}a} = 0.1 \times 150 = 15$ °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.

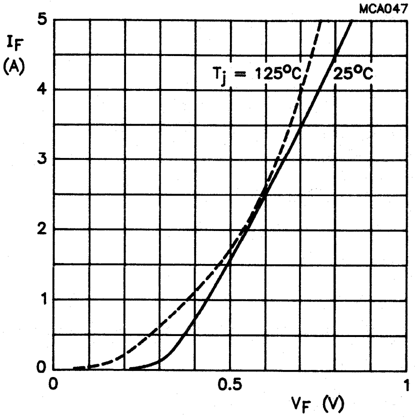


Fig.3 **PRLL5817; 18; 19**. Typical forward voltage.

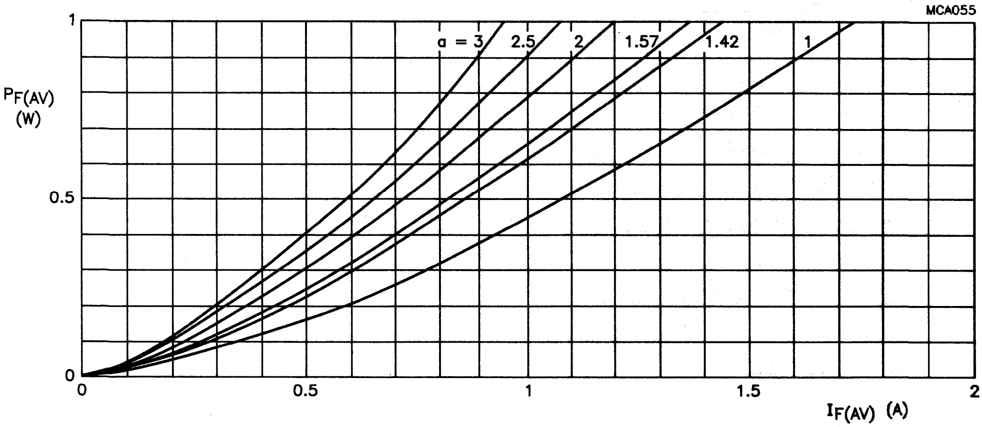


Fig.4 **PRLL5817**. Maximum values steady state forward power dissipation as a function of the average forward current; a = $I_{F(RMS)}/I_{F(AV)}$.

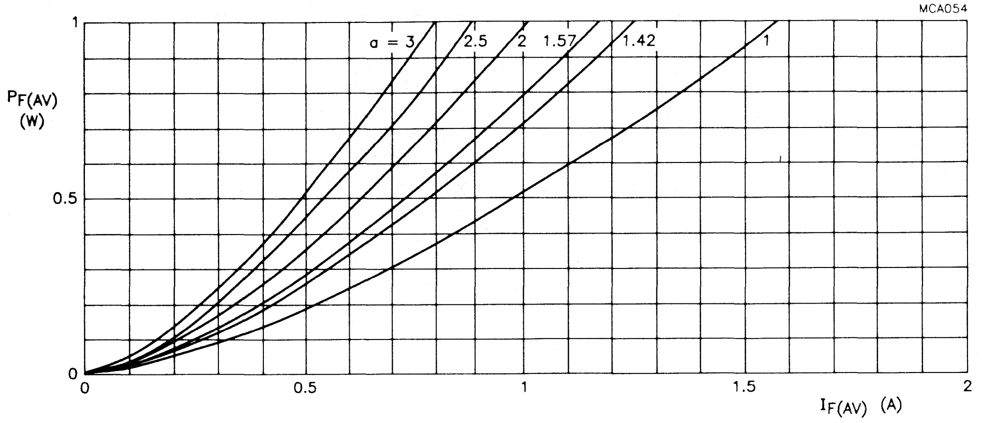


Fig.5 **PRLL5818**. Maximum values steady state forward power dissipation as a function of the average forward current; a = $I_{F(RMS)}/I_{F(AV)}$.

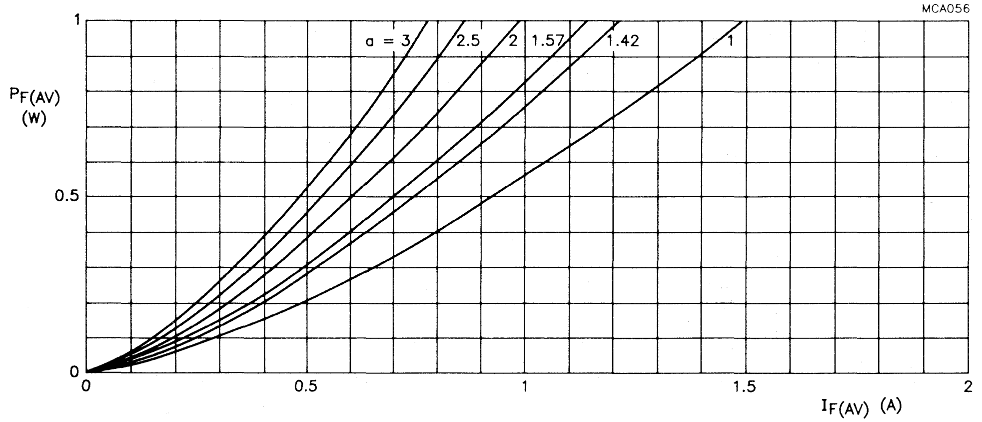


Fig.6 **PRLL5819.** Maximum values steady state forward power dissipation as a function of the average forward current; a = $I_{F(RMS)}/I_{F(AV)}$.

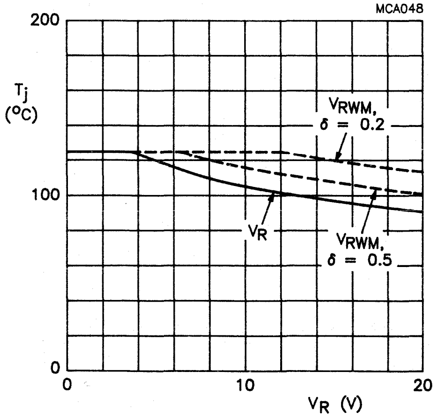


Fig.7 **PRLL5817.** Maximum permissible junction temperature as a function of reverse voltage; device mounted as shown in Fig.2.

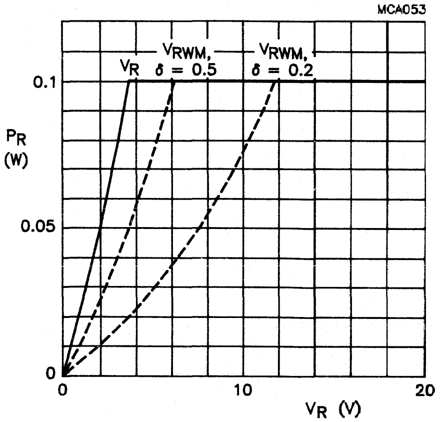


Fig.8 **PRLL5817.** Reverse power dissipation as a function of reverse voltage (max. values); device mounted as shown in Fig.2.

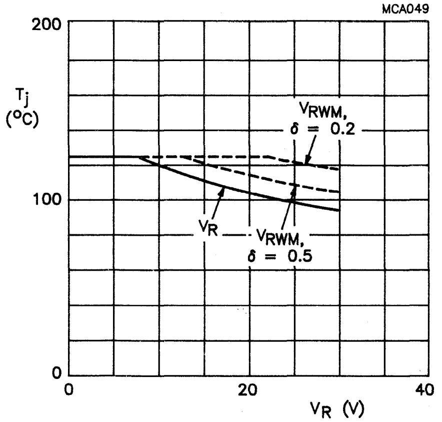


Fig.9 **PRLL5818.** Maximum permissible junction temperature as a function of reverse voltage; device mounted as shown in Fig.2.

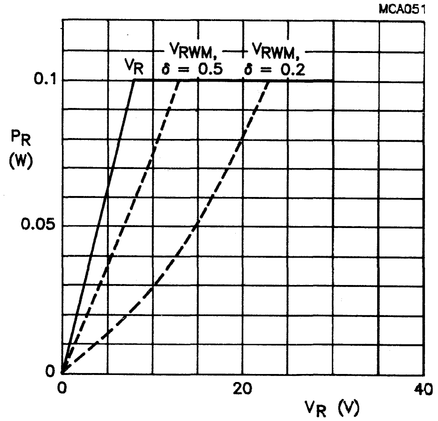


Fig.10 **PRLL5818.** Reverse power dissipation as a function of reverse voltage (max. values); device mounted as shown in Fig.2.

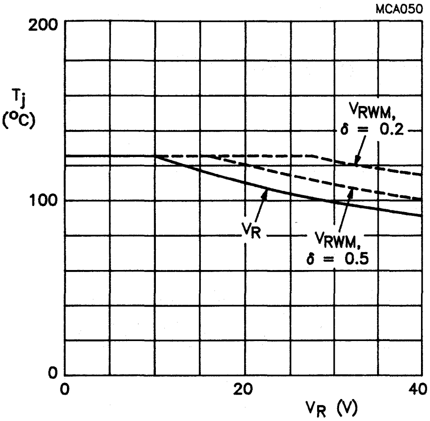


Fig.11 **PRLL5819.** Maximum permissible junction temperature as a function of reverse voltage; device mounted as shown in Fig.2.

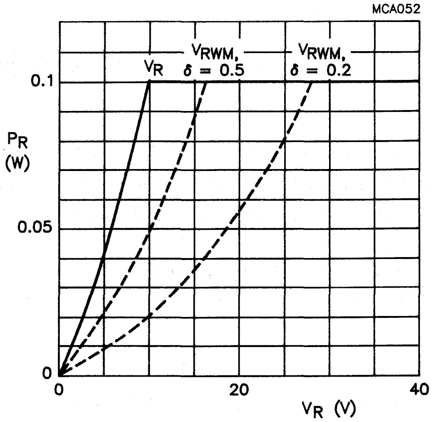


Fig.12 **PRLL5819.** Reverse power dissipation as a function of reverse voltage (max. values); device mounted as shown in Fig.2.

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

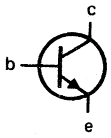
Fig.1 SOT89.

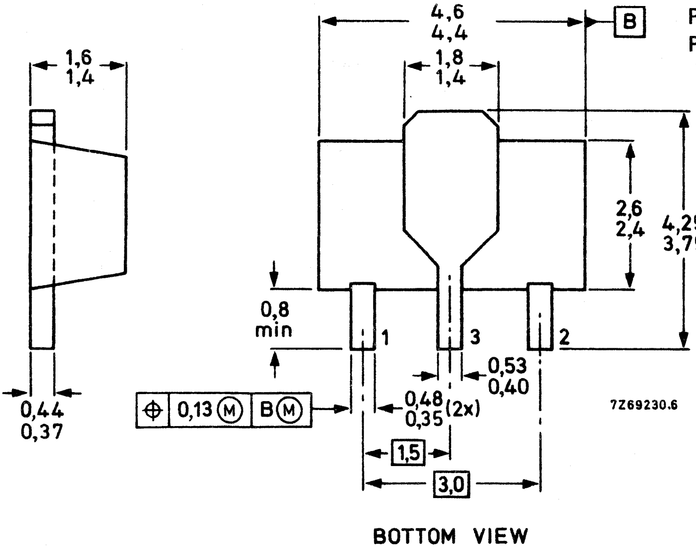
Dimensions in mm

Marking codes:
PXT2222 : p1B
PXT2222A: p1P

Pinning

1 = emitter
2 = base
3 = collector





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* 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)

			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

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* 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	$r_{b'}C_c$	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

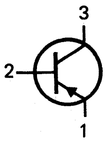
Fig.1 SOT89.

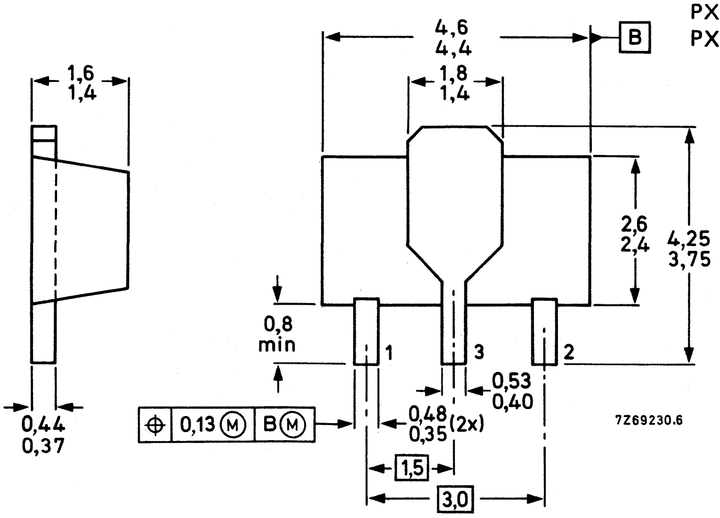
Dimensions in mm

Marking code:
PXT2907 : p2B
PXT2907A: p2F

Pinning

1 = emitter
2 = base
3 = collector





BOTTOM VIEW

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* 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

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* 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

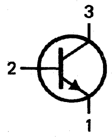
MECHANICAL DATA

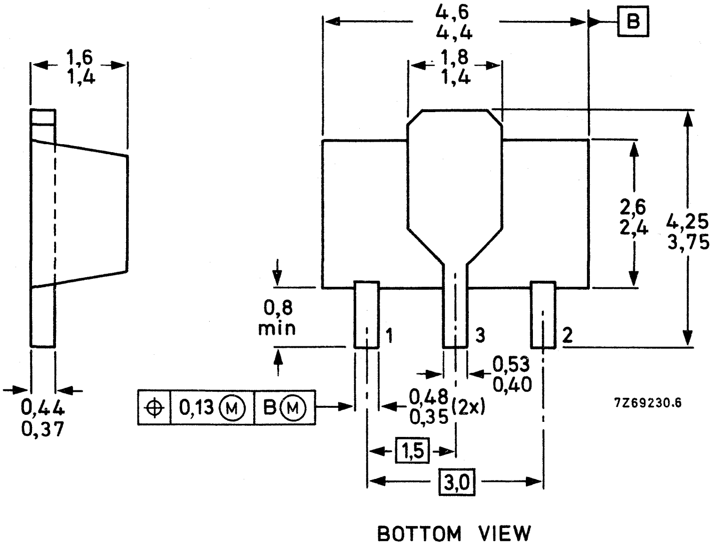
Dimensions in mm

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 $\leqslant f \leqslant$ 1 MHz $I_E = I_e$ = 0; V_{CB} = 5 V	C_c	$<$	4,0	pF
Emitter capacitance at 100 kHz $\leqslant f \leqslant$ 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

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* 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 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

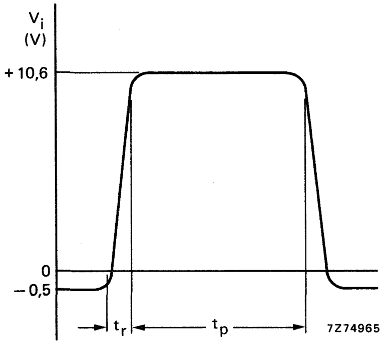


Fig. 2 Input waveform; $t_r < 1$ ns; $t_p = 300$ ns; $\delta = 0{,}02$.

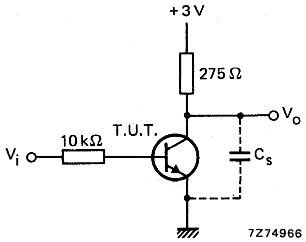


Fig. 3 Delay and rise time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

Turn-off time (see Figs 4 and 5)
$I_{Con} = 10$ mA; $I_{Bon} = -I_{Boff} = 1$ mA

Storage time	t_s	<	200	ns
Fall time	t_f	<	50	ns

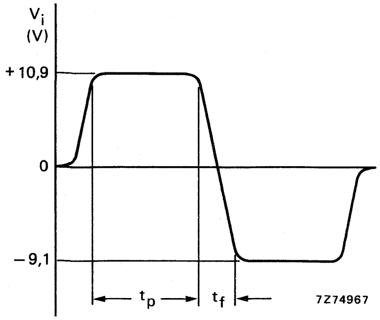


Fig. 4 Input waveform; $t_f < 1$ ns; 10 μs $< t_p <$ 500 μs; $\delta = 0{,}02$.

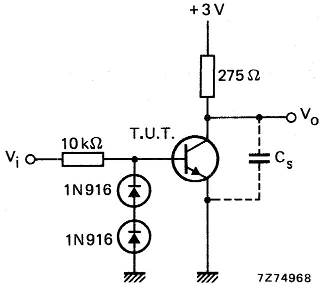


Fig. 5 Storage and fall time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

SILICON PLANAR EPITAXIAL TRANSISTOR

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

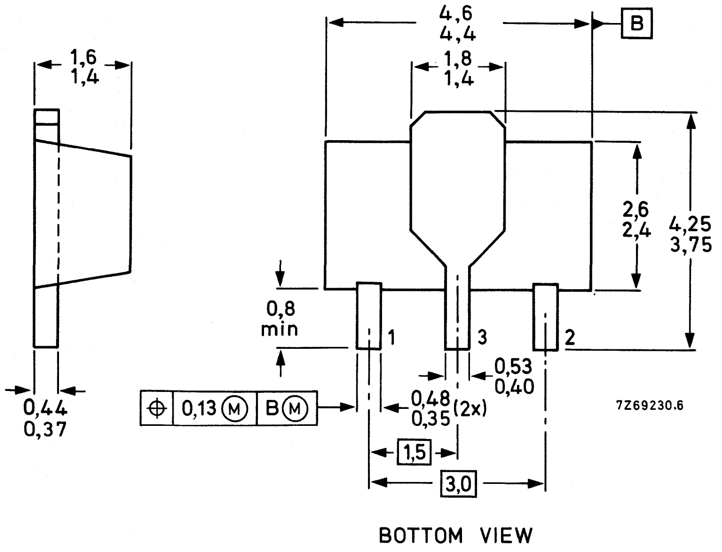
MECHANICAL DATA

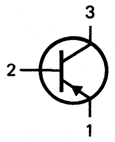
Dimensions in mm

Fig. 1 SOT-89.

Marking code

p2A





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 $\leqslant f \leqslant$ 1 MHz $I_E = I_e = 0$; $-V_{CB} = 5$ V	C_c	<	4,5	pF
Emitter capacitance at 100 kHz $\leqslant f \leqslant$ 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

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* 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}	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

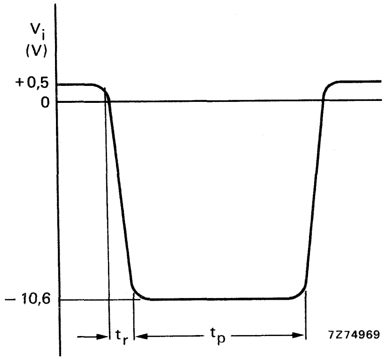


Fig. 2 Input waveform; $t_r < 1$ ns; $t_p = 300$ ns; $\delta = 0,02$.

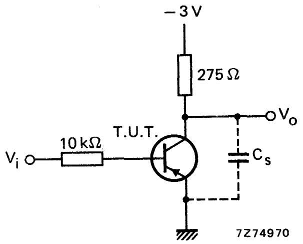


Fig. 3 Delay and rise time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

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

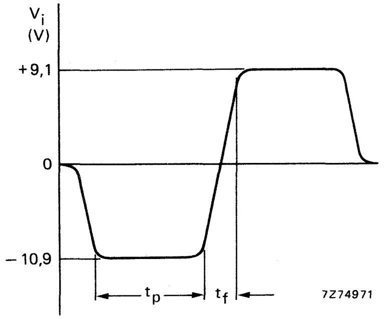


Fig. 4 Input waveform; $t_f < 1$ ns; 10 μs $< t_p <$ 500 μs; $\delta = 0,02$.

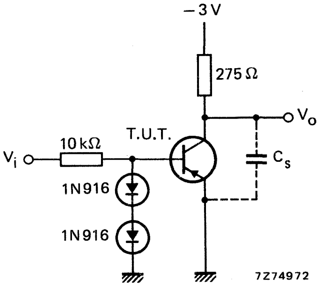


Fig. 5 Storage and fall time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

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

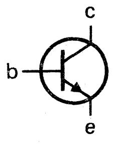
Dimensions in mm

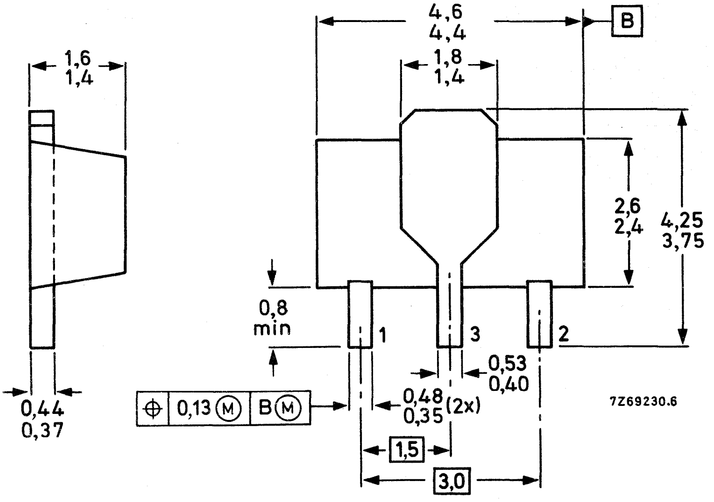
Fig. 1 SOT-89

Marking code = p2X

Pinning:

1 = emitter
2 = base
3 = collector





BOTTOM VIEW

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* 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

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* 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

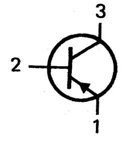
Dimensions in mm

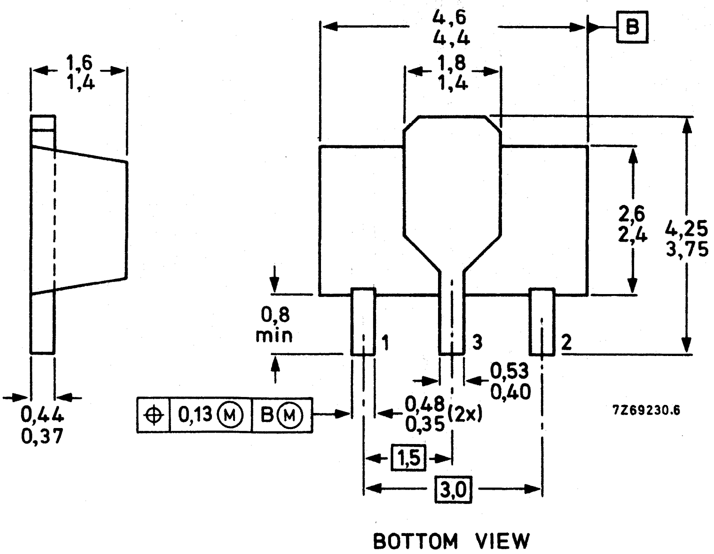
Fig.1 SOT89.

Marking code = p2T

Pinning

1 = emitter
2 = base
3 = collector





* Mounted on a ceramic substrate; area = 2.5 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
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

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* Mounted on a ceramic substrate; area = 2.5 cm^2; 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 x 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

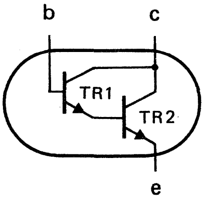
MECHANICAL DATA

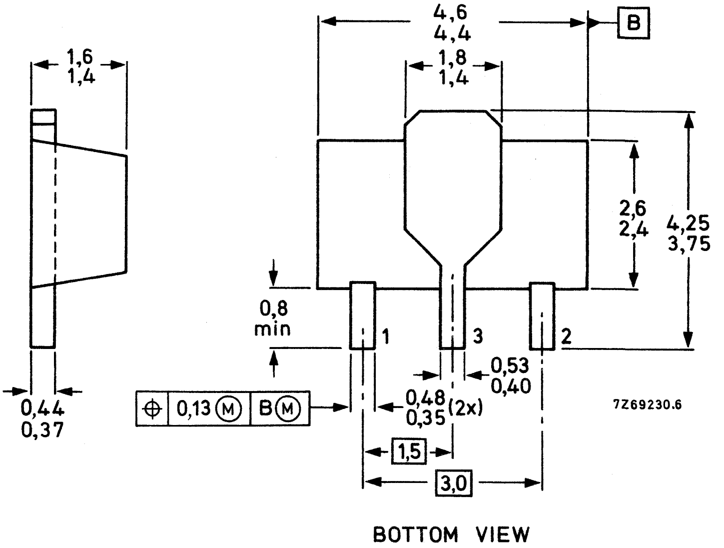
Dimensions in mm

Fig. 1 SOT-89.

Marking code = p1N

Pinning:
1 = emitter
2 = collector
3 = base





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 $T_{amb} = 25\ ^{o}C$*	P_{tot}	max.	1.0	W
Storage temperature range	T_{stg}		−65 to + 150	^{o}C
Junction temperature	T_j	max.	150	^{o}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 $I_C = 100\ \mu A$	$V_{(BR)CES}$	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 $T_{amb} = 25\ ^{o}C$*	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

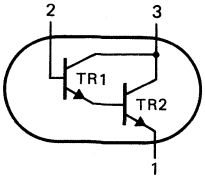
MECHANICAL DATA

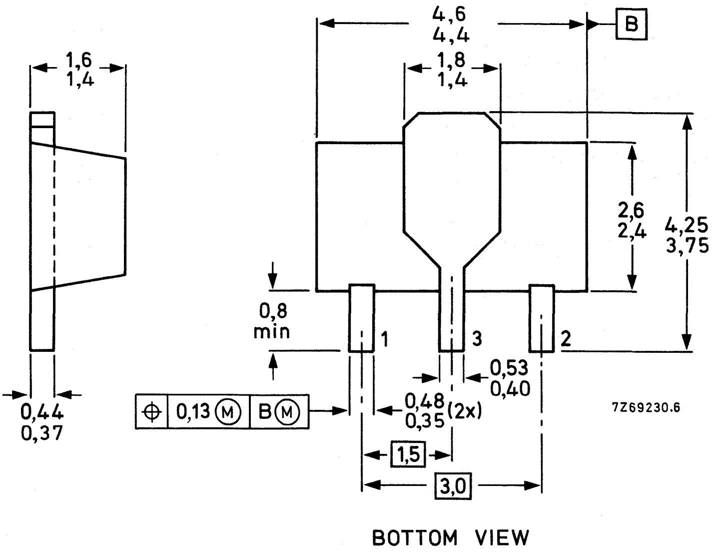
Dimensions in mm

Fig.1 SOT89.

Pinning

1 = emitter
2 = collector
3 = base





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* 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	^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 $I_C = 100\ \mu A; -V_{BE} = 0$	$V_{(BR)CES}$	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

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* 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 $T_{amb} = 25\ ^{o}C$*	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

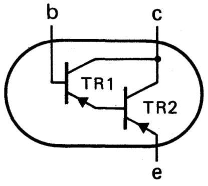
Dimensions in mm

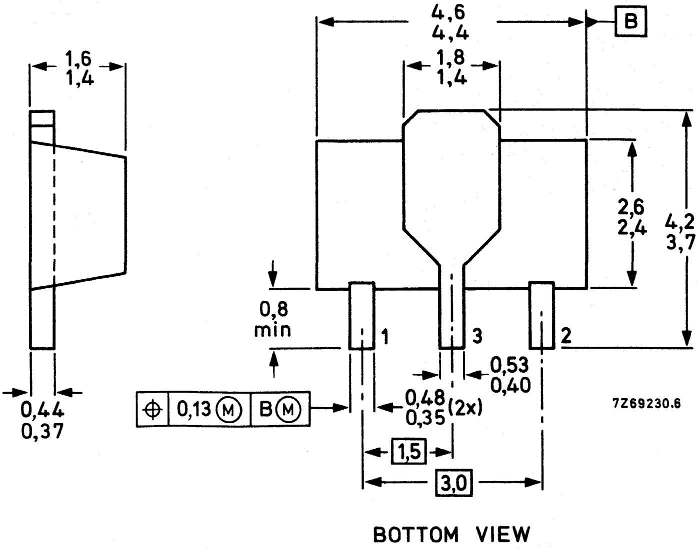
Fig. 1 SOT-89

Marking code = p2V

Pinning:

1 = emitter
2 = base
3 = collector





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* 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 $T_{amb} = 25\ ^{o}C$	P_{tot}	max.	1.0	W
Storage temperature range	T_{stg}		–65 to +150	^{o}C
Junction temperature	T_j	max.	150	^{o}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 $-I_C = 100\ \mu A$	$-V_{(BR)CES}$	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

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* 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

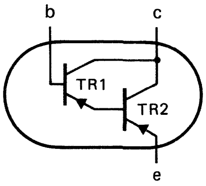
MECHANICAL DATA

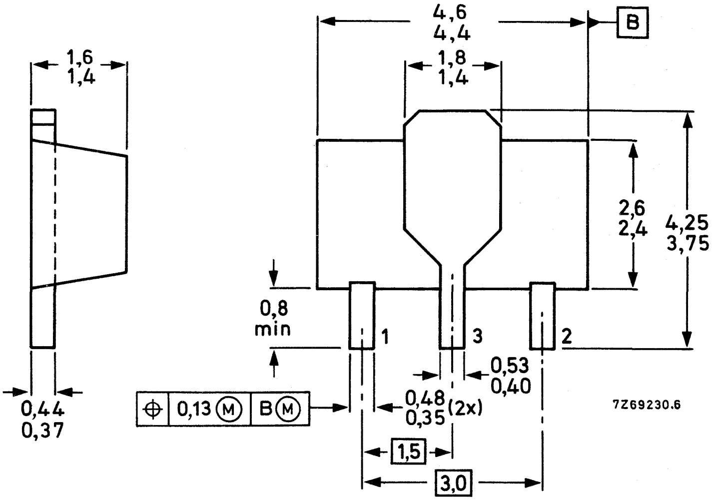
Dimensions in mm

Fig.1 SOT89.

Pinning

1 = emitter
2 = base
3 = collector





BOTTOM VIEW

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* 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		^{o}C
Junction temperature	T_j	max.	150	^{o}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.	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

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* 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

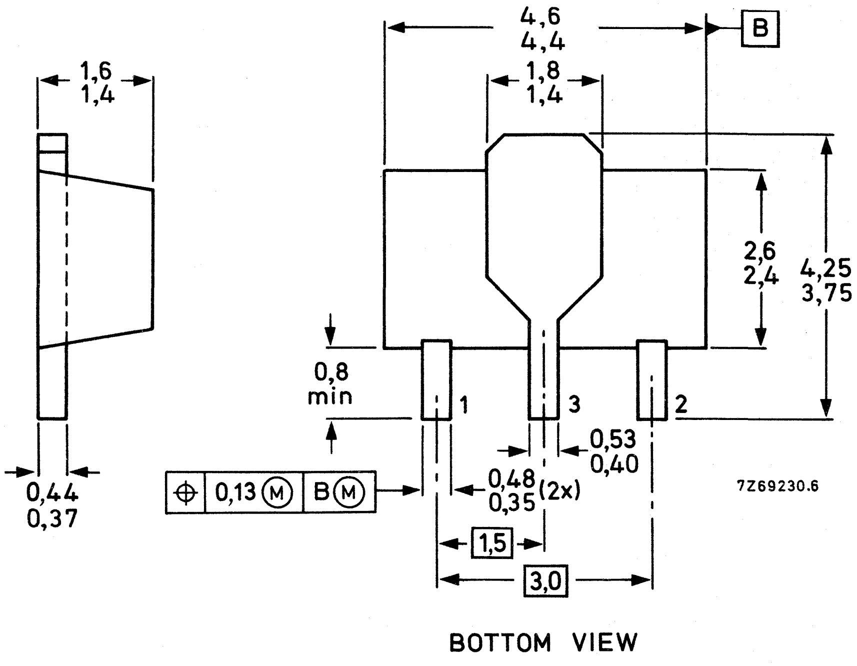
Fig.1 SOT89.

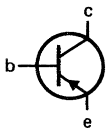
Marking code

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 $-I_C = 100\ \mu$A; $I_E = 0$	$-V_{(BR)CBO}$	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 $-I_E = 100\ \mu$A; $I_C = 0$	$-V_{(BR)EBO}$	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

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* Device mounted on a ceramic substrate; area 2.5 cm^2; thickness 0.7 mm.

** Pulse test conditions: $t_p = 300\ \mu s$; duty factor $\leqslant$ 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.

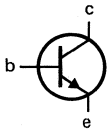
QUICK REFERENCE DATA

			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. max.	100 300		

MECHANICAL DATA

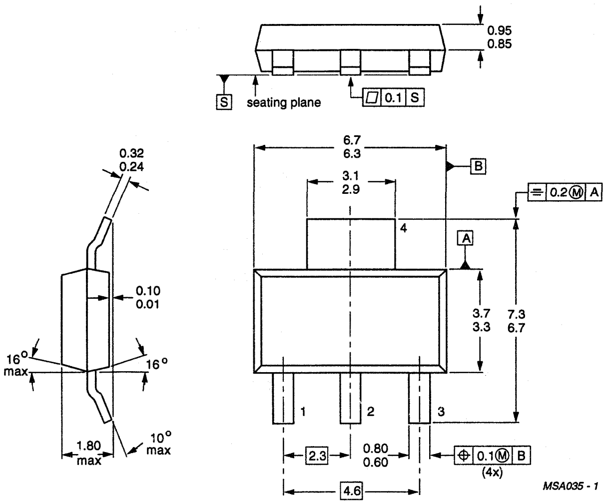
Dimensions in mm

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

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* 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		
I_C = 1 mA; V_{CE} = 10 V	h_{FE}	min.	50		
I_C = 10 mA; V_{CE} = 10 V	h_{FE}	min.	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.	100		
		max.	300		
I_C = 150 mA; V_{CE} = 1 V	h_{FE}	min.	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.		0,6	V
		max.		1,2	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		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.	–	2,0	kΩ
		max.	–	8,0	kΩ
I_C = 10 mA; V_{CE} = 10 V ; T_{amb} = 25 °C	h_{ie}	min.	–	0,25	kΩ
		max.	–	1,25	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.	–	50	
		max.	–	300	
I_C = 10 mA; V_{CE} = 10 V; T_{amb} = 25 °C	h_{fe}	min.	–	75	
		max.	–	375	
Output admittance at f = 1 kHz					
I_C = 1 mA; V_{CE} = 10 V; T_{amb} = 25 °C	h_{oe}	min.	–	5,0	μmhos
		max.	–	35	μmhos
I_C = 10 mA; V_{CE} = 10 V; T_{amb} = 25 °C	h_{oe}	min.	–	25	μmhos
		max.	–	200	μmhos

PZT2222A

Noise figure at $R_S = 1\ k\Omega$ $I_C = 100\ \mu A$; $V_{CE} = 10\ V$; $f = 1\ kHz$; $T_{amb} = 25\ ^oC$	F	max.	4,0 dB
Switching times at $T_{amb} = 25\ ^oC$			
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

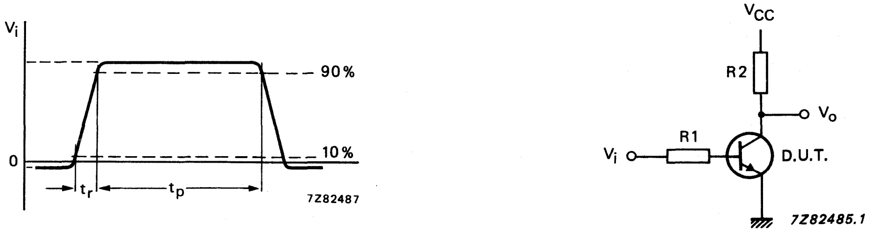


Fig. 2 Input waveform and test circuit for determining delay time and rise time.

$V_i = -0,5\ V$ to $+9,9\ V$; $V_{CC} = +30\ V$; $R1 = 619\ \Omega$; $R2 = 200\ \Omega$.

Pulse generator:				Oscilloscope:			
pulse duration	t_p	$\leqslant$	200 ns	input impedance	Z_i	>	100 kΩ
rise time	t_r	$\leqslant$	2 ns	input capacitance	C_i	<	12 pF
duty factor	δ	=	0,02	rise time	t_r	<	5 ns

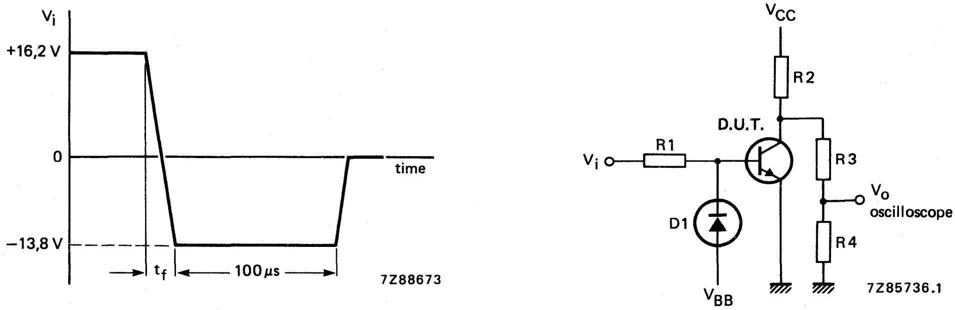


Fig. 3 Input waveform and test circuit for determining storage time and fall time.

SILICON PLANAR EPITAXIAL TRANSISTORS

PNP medium power transistors in a microminiature SMD envelope (SOT-223). Designed primarily for high-speed switching and driver applications.

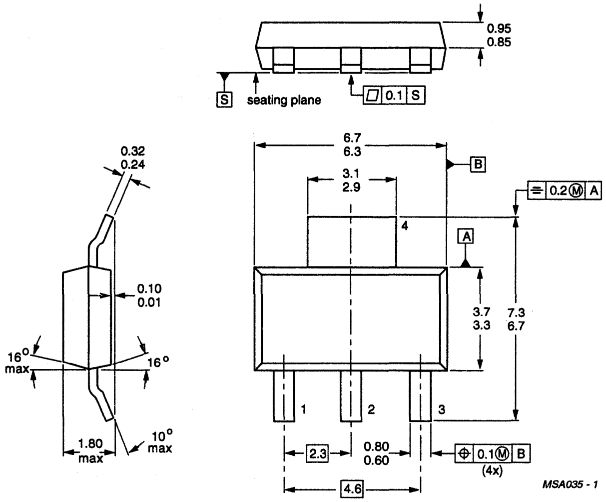
QUICK REFERENCE DATA

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

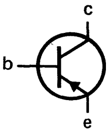
Dimensions in mm

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 $T_{amb} = 25\ ^{o}C$		P_{tot}	max.	1,5	W
Storage temperature range		T_{stg}	−65 to	+150	^{o}C
Junction temperature		T_j	max.	150	^{o}C

THERMAL RESISTANCE

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

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* 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

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* 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

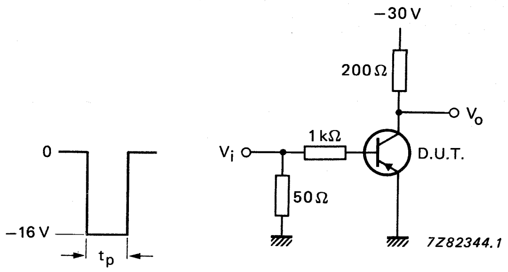


Fig. 2 Input waveform and test circuit for determining delay, rise and turn-on time.

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

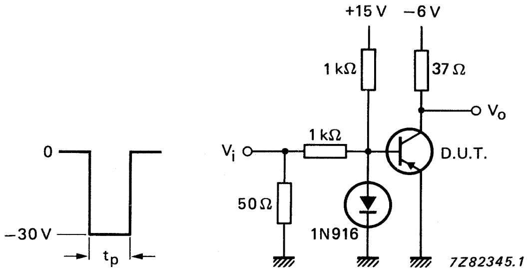


Fig. 3 Input waveform and test circuit for determining storage, fall and turn-off time.

Pulse generator (see Figs 2 and 3)

frequency	f	=	150	Hz
pulse duration	t_p	=	200	ns
rise time	t_r	$\leqslant$	2	ns
output impedance	Z_o	=	50	Ω

Oscilloscope (see Figs 2 and 3)

rise time	t_r	$\leqslant$	5	ns
input impedance	Z_i	$\leqslant$	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.

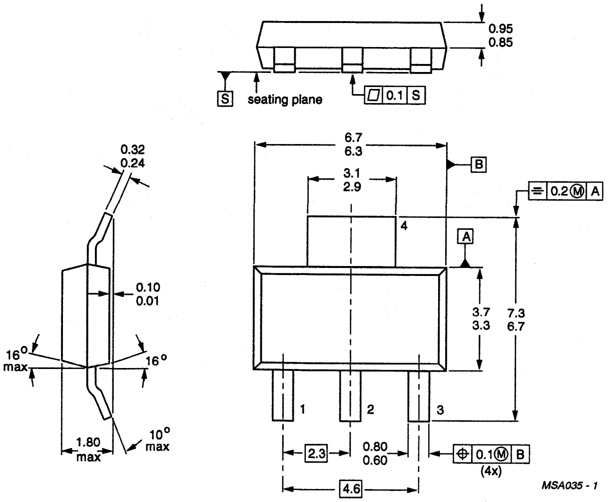
QUICK REFERENCE DATA

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

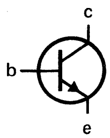
Dimensions in mm

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} $-I_{BEX}$	$<$ $<$	50 50	nA nA
Saturation voltages $I_C = 10$ mA; $I_B = 1$ mA	V_{CEsat} V_{BEsat}	$<$	200 650 to 850	mV mV
$I_C = 50$ mA; $I_B = 5$ mA	V_{CEsat} V_{BEsat}	$<$ $<$	300 950	mV 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 $\leqslant f \leqslant$ 1 MHz $I_E = I_e = 0$; $V_{CB} = 5$ V	C_c	$<$	4,0	pF
Emitter capacitance at 100 kHz $\leqslant f \leqslant$ 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

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* 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 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

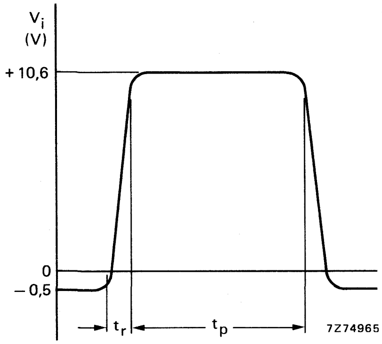


Fig. 2 Input waveform; $t_r < 1$ ns; t_p = 300 ns; δ = 0,02.

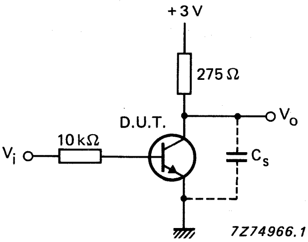


Fig. 3 Delay and rise time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

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

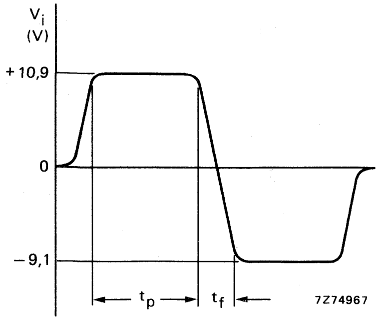


Fig. 4 Input waveform; $t_f < 1$ ns; 10 μs $< t_p <$ 500 μs; δ = 0,02.

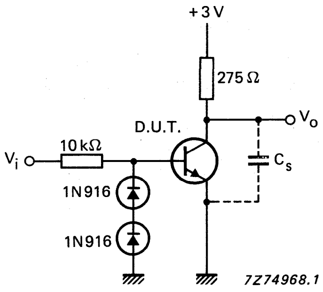


Fig. 5 Storage and fall time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

SILICON PLANAR EPITAXIAL TRANSISTOR

PNP transistor in a microminiature SMD envelope (SOT-223). Designed primarily for high-speed, saturated switching applications in industrial service.

QUICK REFERENCE DATA

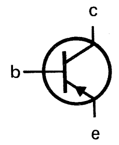
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40	V
Collector current (DC)	$-I_C$	max.	200	mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	1,5	W
Junction temperature	T_j	max.	150	°C
DC current gain $-I_C$ = 10 mA; $-V_{CE}$ = 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

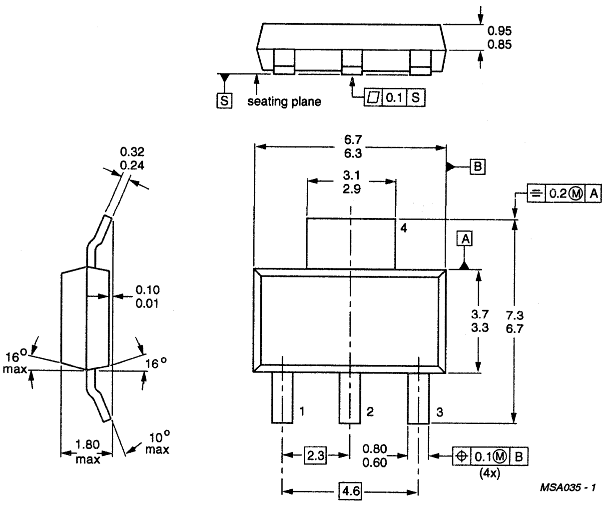
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-223

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.	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	$-I_{CEX}$ $+I_{BEX}$	$<$ $<$	50 50	nA nA
Saturation voltages $-I_C$ = 10 mA; $-I_B$ = 1 mA	$-V_{CEsat}$ $-V_{BEsat}$	$<$	250 650 to 850	mV mV
$-I_C$ = 50 mA; $-I_B$ = 5 mA	$-V_{CEsat}$ $-V_{BEsat}$	$<$ $<$	400 950	mV 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 $\leqslant f \leqslant$ 1 MHz $I_E = I_e = 0$; $-V_{CB}$ = 5 V	C_c	$<$	4,5	pF
Emitter capacitance at 100 kHz $\leqslant f \leqslant$ 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

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* 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

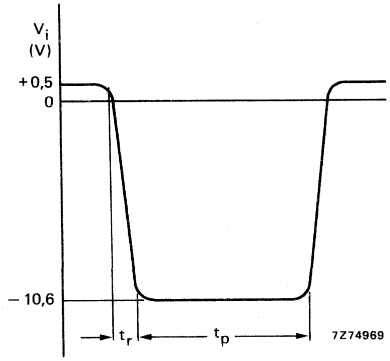


Fig. 2 Input waveform; $t_r < 1$ ns; $t_p = 300$ ns; $\delta = 0,02$.

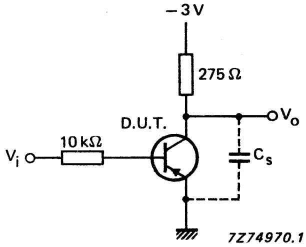


Fig. 3 Delay and rise time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

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

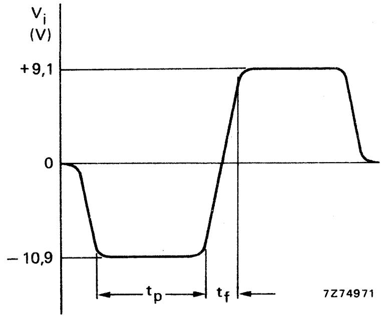


Fig. 4 Input waveform; $t_f < 1$ ns; 10 μs < t_p < 500 μs; $\delta = 0,02$.

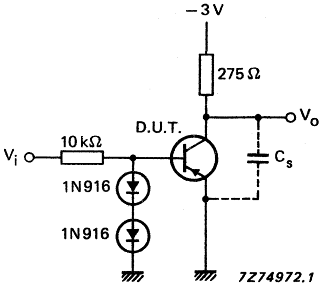


Fig. 5 Storage and fall time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

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

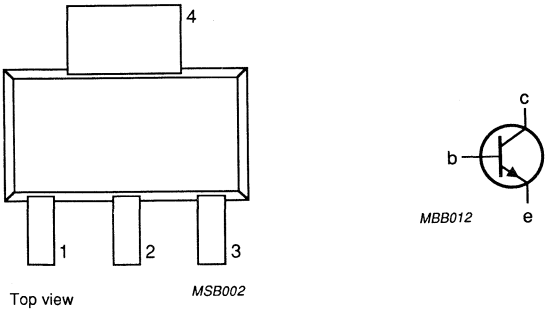


Fig.1 Simplified outline and symbol.

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
$R_{th\ j\text{-}a}$	from junction to ambient	on PCB	83.3	K/W

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

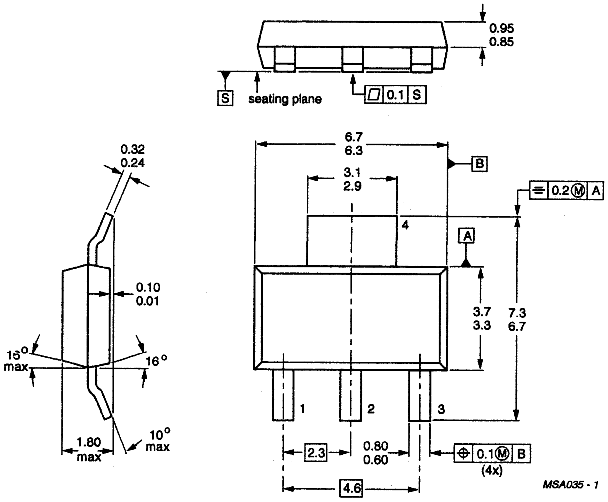
MECHANICAL DATA

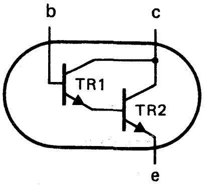
Dimensions in mm

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

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* 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

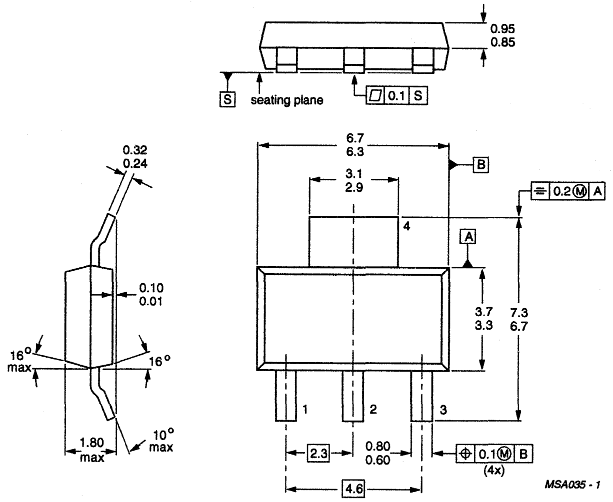
MECHANICAL DATA

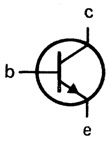
Dimensions in mm

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		<	–	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		<	–	0,1	μA
Feedback capacitance at f = 1 MHz I_E = 0; V_{CB} = 20 V	C_{re}	<	3	4	pF

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* 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

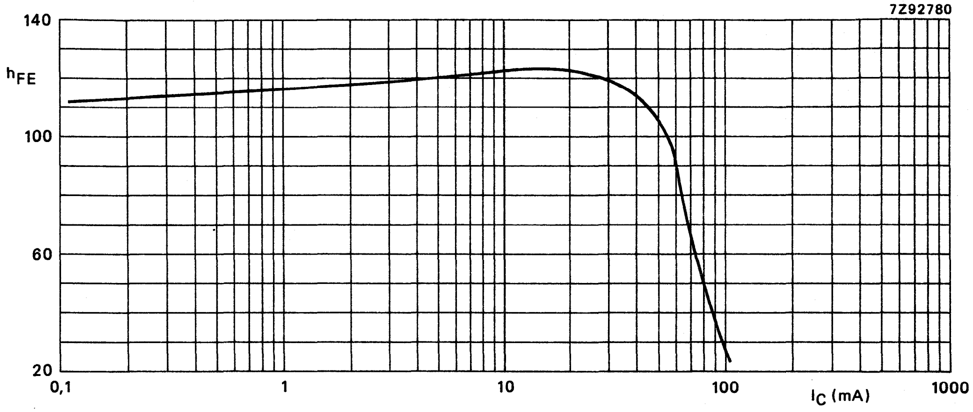


Fig. 2 T_j = 25 °C; V_{CE} = 20 V; typical values.

NPN high voltage transistor PZTA44; PZTA45

FEATURES

- High voltage
- High current.

DESCRIPTION

High voltage NPN transistor in a 4-lead SOT223 surface mounting package, especially suitable for use in telecommunications applications.

PINNING - SOT223

PIN	DESCRIPTION
1	base
2	collector
3	emitter
4	collector

PIN CONFIGURATION

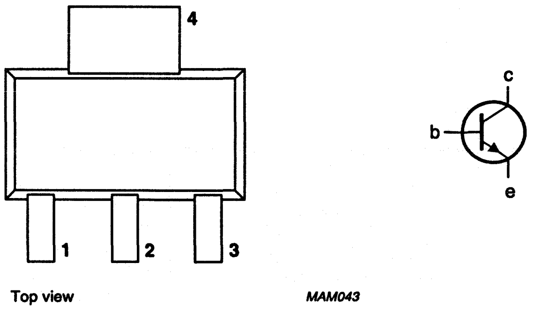


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PZTA44		–	500	V
	PZTA45		–	400	V
V_{CEO}	collector-emitter voltage	open base			
	PZTA44		–	400	V
	PZTA45		–	350	V
$V_{CE(sat)}$	collector-emitter saturation voltage	$I_C = 50$ mA; $I_B = 5$ mA	–	750	mV
h_{FE}	DC current gain	$I_C = 100$ mA; $V_{CE} = 10$ V;	40	–	
I_C	DC collector current		–	300	mA
P_{tot}	total power dissipation	up to $T_{amb} = 25$ °C	–	1.5	W

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PZTA44		–	500	V
	PZTA45		–	400	V
V_{CEO}	collector-emitter voltage	open base			
	PZTA44		–	400	V
	PZTA45		–	350	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	DC collector current		–	300	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C (note 1) see Fig.2	–	1.5	W
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature	see Fig.2	–65	150	°C

Note

1. Refer to SOT223 standard mounting conditions.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air (note 1)	max. 83.3 K/W

Note

1. Refer to SOT223 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 100 μA; I_E = 0			
	PZTA44		500	–	V
	PZTA45		400	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 1 mA; I_B = 0 (note 1)			
	PZTA44		400	–	V
	PZTA45		350	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	R_{BE} = 0; I_C = 100 μA; V_{BE} = 0			
	PZTA44		500	–	V
	PZTA45		400	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 10 μA; I_C = 0	6	–	V

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{CE(sat)}$	collector-emitter saturation voltage	I_C = 1 mA; I_B = 0.1 mA	–	0.4	V
		I_C = 10 mA; I_B = 1 mA	–	0.5	V
		I_C = 50 mA; I_B = 5 mA (note 1)	–	750	mV
$V_{BE(sat)}$	base-emitter saturation voltage	I_C = 10 mA; I_B = 1 mA	–	750	mV
I_{CBO}	collector-base cut-off current				
	PZTA44	I_E = 0; V_{CB} = 400 V	–	100	nA
		I_E = 0; V_{CB} = 400 V; T_j = 150 °C	–	10	μA
	PZTA45	I_E = 0; V_{CB} = 320 V	–	100	nA
		I_E = 0; V_{CB} = 320 V; T_j = 150 °C	–	10	μA
I_{EBO}	emitter-base cut-off current	I_C = 0; V_{EB} = 4 V	–	100	nA
I_{CES}	collector-emitter cut-off current				
	PZTA44	V_{BE} = 0; V_{CE} = 400 V	–	500	nA
	PZTA45	V_{BE} = 0; V_{CE} = 320 V	–	500	nA
h_{FE}	DC current gain	I_C = 1 mA; V_{CE} = 10 V	40	–	
		I_C = 10 mA; V_{CE} = 10 V	50	200	
		I_C = 50 mA; V_{CE} = 10 V (note 1)	45	–	
		I_C = 100 mA; V_{CE} = 10 V (note 1)	40	–	
f_T	transition frequency	I_C = 10 mA; V_{CB} = 10 V; f = 100 MHz	20	–	MHz
C_{ob}	output capacitance	I_E = 0; V_{CB} = 20 V; f = 1 MHz	–	7	pF
C_{ib}	input capacitance	I_C = 0; V_{EB} = 0.5 V; f = 1 MHz	–	180	pF

Note

1. Pulse test : $t_p \leq 300$ μs; $\delta \leq 0.02$.

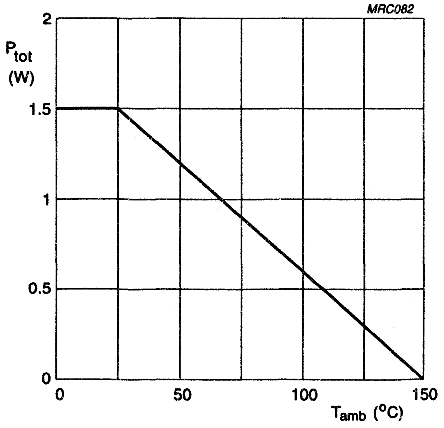


Fig.2 Power derating curve.

Philips Semiconductors

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

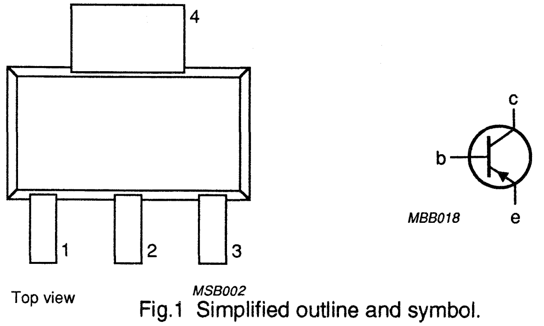


Fig.1 Simplified outline and symbol.

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.

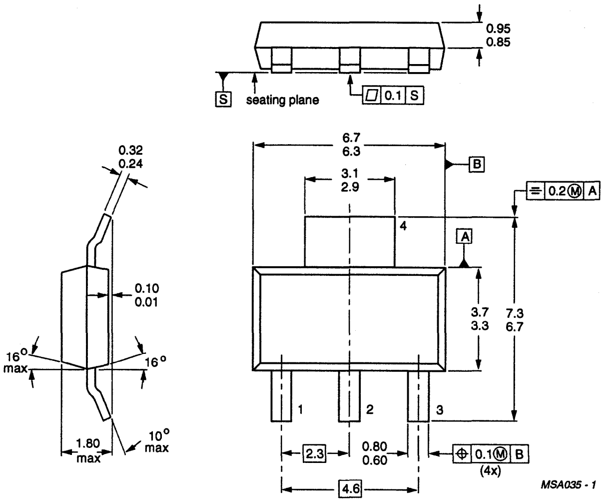
QUICK REFERENCE DATA

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

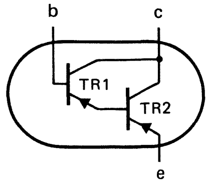
Dimensions in mm

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 $T_{amb} = 25$ °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

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; $T_{amb} = 25$ °C		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.

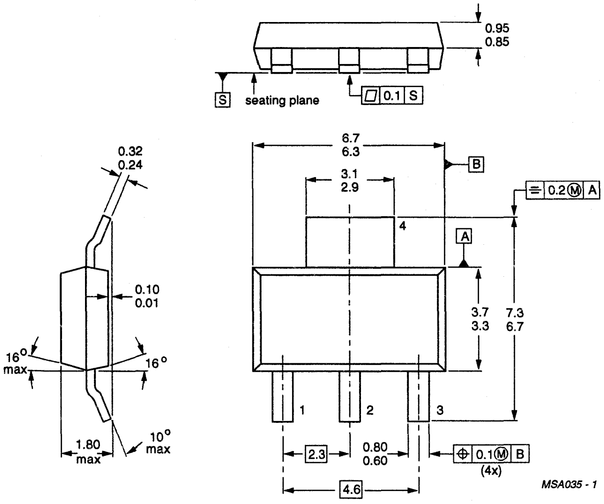
QUICK REFERENCE DATA

			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

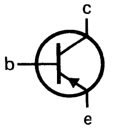
Dimensions in mm

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		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 mm^2.

** Pulse test conditions: t_p = 300 μs; duty cycle $\leqslant$2%.

High speed double diode 1PS181

FEATURES

- Plastic SMD envelope
- High speed
- General application.

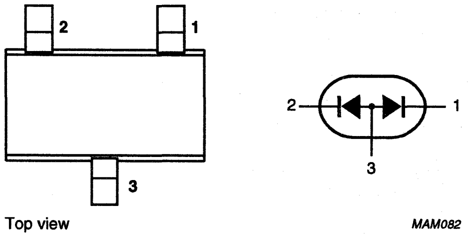
DESCRIPTION

Two epitaxial high-speed switching diodes in a small rectangular SMD, SC59 package. The anodes are common. This unit is intended for high-speed switching in surface mounted circuits.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
Per diode				
V_R	continuous reverse voltage		80	V
V_{RRM}	repetitive peak reverse voltage		85	V
I_{FRM}	repetitive peak forward current		500	mA
T_j	operating junction temperature		150	°C
V_F	forward voltage	$I_F = 100$ mA	1.2	V
t_{rr}	reverse recovery time	when switched from $I_F = 10$ mA to $I_R = 10$ mA; $R_L = 100\ \Omega$; measured at $I_R = 1$ mA	4	ns

PIN CONFIGURATION



Marking code: A3T

Fig.1 Simplified outline (SC59) and symbol.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per diode					
V_R	continuous reverse voltage		–	80	V
V_{RRM}	repetitive peak reverse voltage		–	85	V
I_F	DC forward current	single diode loaded	–	215	mA
		double diode loaded	–	125	mA
I_{FRM}	repetitive peak forward current		–	500	mA
I_{FSM}	non-repetitive peak forward current	t_p = 1 µs	–	4	A
		t_p = 1 s	–	0.5	A
P_{tot}	total power dissipation	up to T_{amb} = 25 °C; note 1	–	250	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	+150	°C

Note

1. Device mounted on FR4 printed-circuit board.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	500 K/W

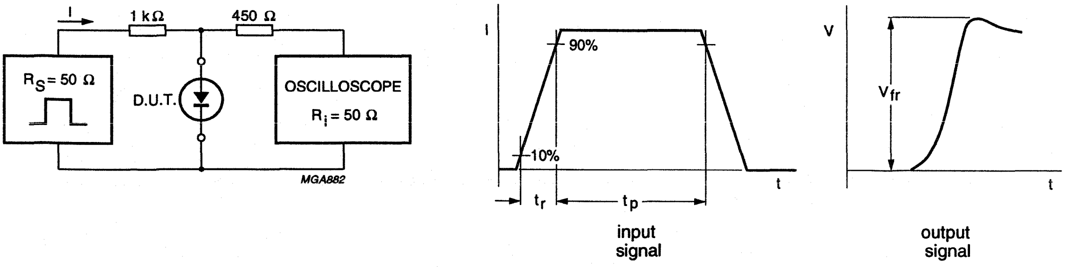
Note

1. Device mounted on FR4 printed-circuit board.

CHARACTERISTICS

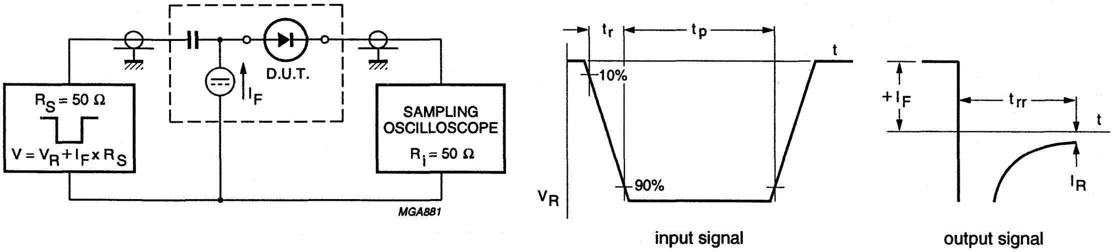
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
Per diode					
V_F	forward voltage	I_F = 1 mA	610	–	mV
		I_F = 10 mA	740	–	mV
		I_F = 100 mA	–	1.2	V
I_R	reverse current	V_R = 80 V	–	0.5	µA
C_d	diode capacitance	V_R = 0; f = 1 MHz	–	1.5	pF
V_{fr}	forward recovery voltage	switched to I_F = 10 mA; t_p = 20 ns; see Fig.2	–	1.75	V
t_{rr}	reverse recovery time	switching from I_F = 10 mA to I_R = 10 mA; R_L = 100 Ω; measured at I_R = 1 mA; see Fig.3	–	4	ns



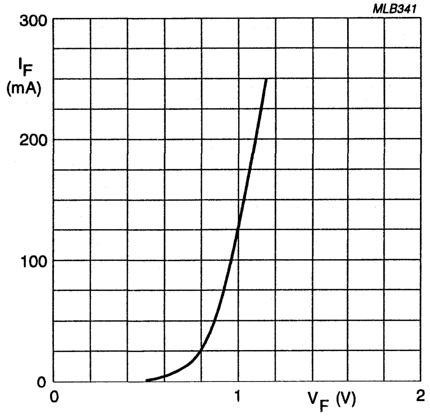
Input signal: forward pulse rise time $t_r = 20$ ns; forward pulse duration $t_p = 120$ ns; duty factor $\delta = 0.01$.
Oscilloscope: rise time $t_r = 0.35$ ns.
Circuit capacitance: $C \leq 1$ pF (oscilloscope input capacitance + parasitic capacitance).

Fig.2 Forward recovery time test circuit and waveforms.



Input signal: reverse pulse rise time $t_r = 0.6$ ns; reverse pulse duration $t_p = 100$ ns; duty factor $\delta = 0.05$.
Oscilloscope: rise time $t_r = 0.35$ ns.
Circuit capacitance: $C \leq 1$ pF (oscilloscope input capacitance + parasitic capacitance).

Fig.3 Reverse recovery time test circuit and waveforms.



T_j = 25 °C.

Fig.4 Forward current as a function of the forward voltage; typical values.

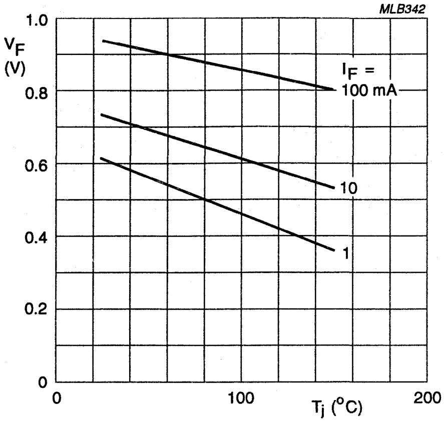


Fig.5 Forward voltage as a function of the junction temperature; typical values.

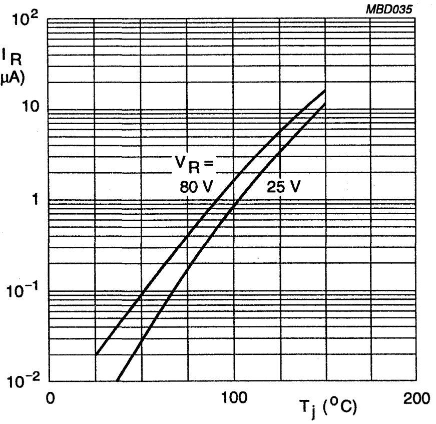
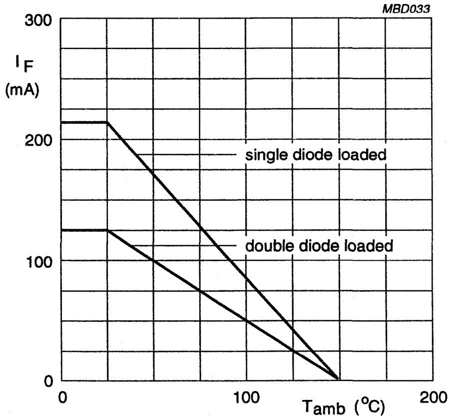


Fig.6 Reverse current as a function of the junction temperature; typical values.



Device mounted on a FR4 printed-circuit board.

Fig.7 Forward current derating curves.

High speed double diode 1PS184

FEATURES

- Plastic SMD envelope
- High speed
- General application.

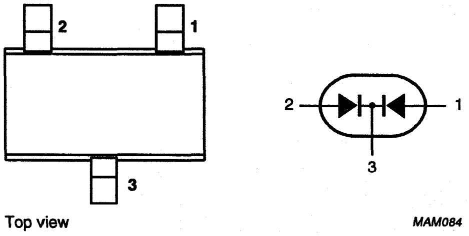
DESCRIPTION

Two epitaxial high-speed switching diodes in a small rectangular SMD SC59 package. The cathodes are common. This unit is intended for high-speed switching in surface mounted circuits.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
Per diode				
V_R	continuous reverse voltage		80	V
V_{RRM}	repetitive peak reverse voltage		85	V
I_{FRM}	repetitive peak forward current		500	mA
T_j	operating junction temperature		150	°C
V_F	forward voltage	I_F = 100 mA	1.2	V
t_{rr}	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	4	ns

PIN CONFIGURATION



Marking code: B3T

Fig.1 Simplified outline (SC59) and symbol.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per diode					
V_R	continuous reverse voltage		–	80	V
V_{RRM}	repetitive peak reverse voltage		–	85	V
I_F	DC forward current	single diode loaded	–	215	mA
		double diode loaded	–	125	mA
I_{FRM}	repetitive peak forward current		–	500	mA
I_{FSM}	non-repetitive peak forward current	t_p = 1 µs	–	4	A
		t_p = 1 s	–	0.5	A
P_{tot}	total power dissipation	up to T_{amb} = 25 °C; note 1	–	250	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	+150	°C

Note

1. Device mounted on FR4 printed-circuit board.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	500 K/W

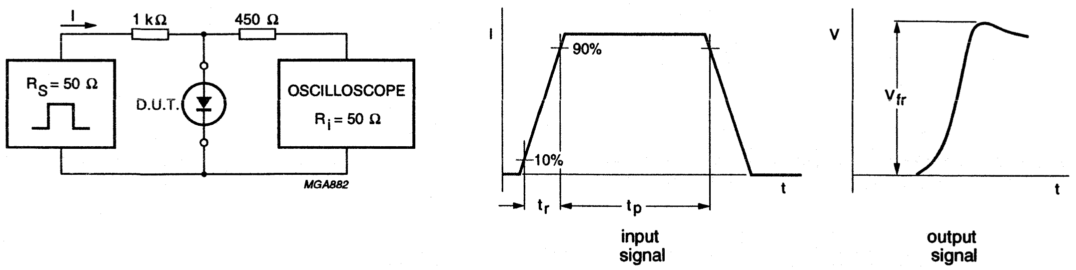
Note

1. Device mounted on FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
Per diode					
V_F	forward voltage	I_F = 1 mA	610	–	mV
		I_F = 10 mA	740	–	mV
		I_F = 100 mA	–	1.2	V
I_R	reverse current	V_R = 80 V	–	0.5	µA
C_d	diode capacitance	V_R = 0; f = 1 MHz	–	1.5	pF
V_{fr}	forward recovery voltage	switched to I_F = 10 mA; t_p = 20 ns; see Fig.2	–	1.75	V
t_{rr}	reverse recovery time	switching from I_F = 10 mA to I_R = 10 mA; R_L = 100 Ω; measured at I_R = 1 mA; see Fig.3	–	4	ns

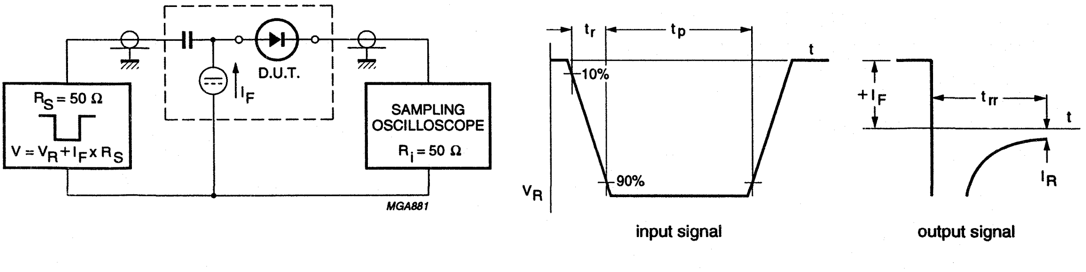


Input signal: forward pulse rise time t_r = 20 ns; forward pulse duration t_p = 120 ns; duty factor δ = 0.01.

Oscilloscope: rise time t_r = 0.35 ns.

Circuit capacitance: C ≤ 1 pF (oscilloscope input + parasitic capacitance).

Fig.2 Forward recovery voltage test circuit and waveforms.

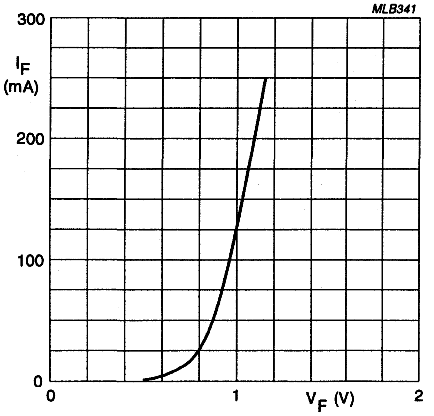


Input signal: reverse pulse rise time t_r = 0.6 ns, reverse pulse duration t_p = 100 ns; duty factor δ = 0.05.

Oscilloscope: rise time t_r = 0.35 ns.

Circuit capacitance: C ≤ 1 pF (oscilloscope input + parasitic capacitance).

Fig.3 Reverse recovery time test circuit and waveforms.



T_j = 25 °C.

Fig.4 Forward current as a function of the forward voltage; typical values.

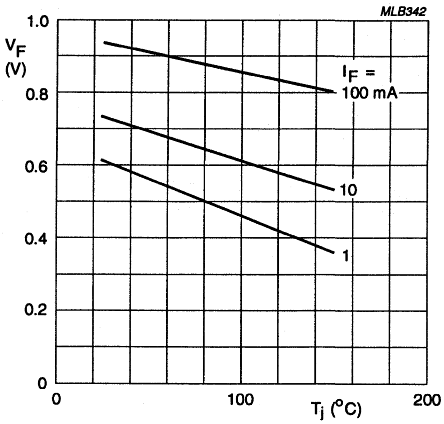


Fig.5 Forward voltage as a function of the junction temperature; typical values.

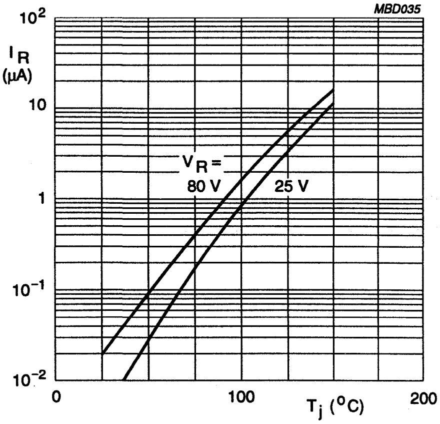
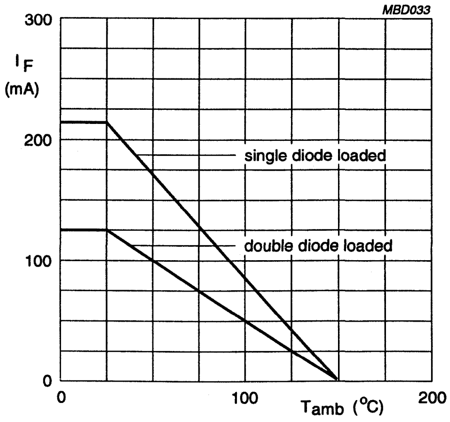


Fig.6 Reverse current as a function of the junction temperature; typical values.



Device mounted on a FR4 printed-circuit board.

Fig.7 Forward current derating curve.

High speed diode 1PS193

FEATURES

- Plastic SMD envelope
- High speed
- General application.

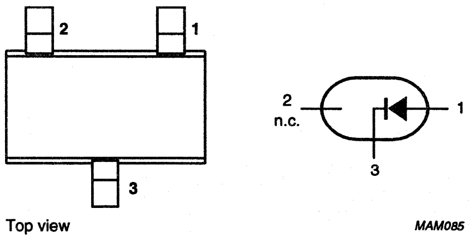
DESCRIPTION

Silicon epitaxial high-speed switching diode in a small rectangular SMD SC59 package. It is intended for high-speed switching in surface mounted circuits.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
Per diode				
V_R	continuous reverse voltage		80	V
V_{RRM}	repetitive peak reverse voltage		85	V
I_{FRM}	repetitive peak forward current		500	mA
T_j	operating junction temperature		150	°C
V_F	forward voltage	I_F = 100 mA	1.2	V
t_{rr}	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	4	ns

PIN CONFIGURATION



Marking code: F3T

Fig.1 Simplified outline (SC59) and symbol.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per diode					
V_R	continuous reverse voltage		–	80	V
V_{RRM}	repetitive peak reverse voltage		–	85	V
I_F	DC forward current		–	215	mA
I_{FRM}	repetitive peak forward current		–	500	mA
I_{FSM}	non-repetitive peak forward current	$t_p = 1\ \mu s$	–	4	A
		$t_p = 1$ s	–	0.5	A
P_{tot}	total power dissipation	up to $T_{amb} = 25$ °C; note 1	–	250	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	+150	°C

Note

1. Device mounted on FR4 printed-circuit board.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	500 K/W

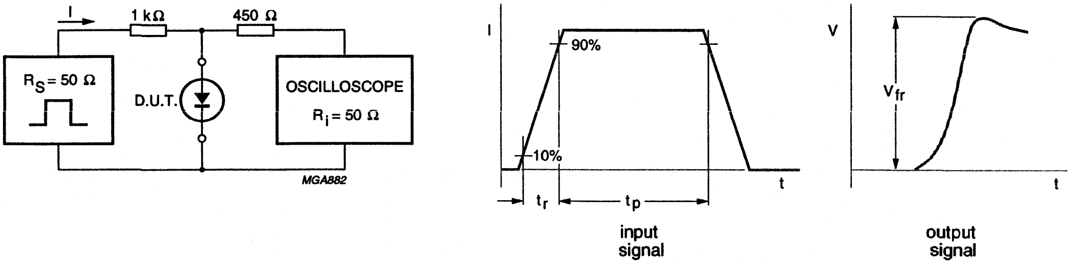
Note

1. Device mounted on FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
Per diode					
V_F	forward voltage	$I_F = 1$ mA	610	–	mV
		$I_F = 10$ mA	740	–	mV
		$I_F = 100$ mA	–	1.2	V
I_R	reverse current	$V_R = 80$ V	–	0.5	µA
C_d	diode capacitance	$V_R = 0$; f = 1 MHz	–	1.5	pF
V_{fr}	forward recovery voltage	switched to $I_F = 10$ mA; $t_p = 20$ ns; see Fig.2	–	1.75	V
t_{rr}	reverse recovery time	switching from $I_F = 10$ mA to $I_R = 10$ mA; $R_L = 100\ \Omega$; measured at $I_R = 1$ mA; see Fig.3	–	4	ns

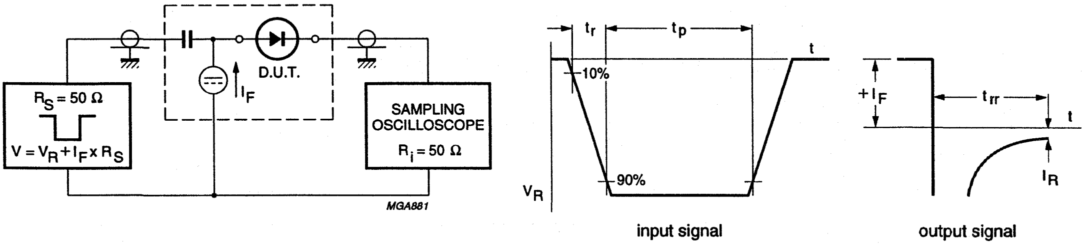


Input signal: forward pulse rise time t_r = 20 ns; forward pulse duration t_p = 120 ns; duty factor $\delta = 0.01$.

Oscilloscope: rise time t_r = 0.35 ns.

Circuit capacitance: $C \leq 1$ pF (oscilloscope input + parasitic capacitance).

Fig.2 Forward recovery voltage test circuit and waveforms.

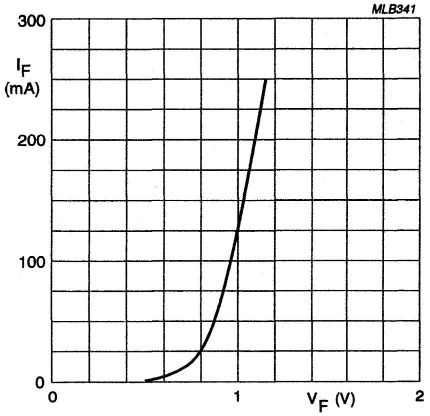


Input signal: reverse pulse rise time t_r = 0.6 ns; reverse pulse duration t_p = 100 ns; duty factor $\delta = 0.05$.

Oscilloscope: rise time t_r = 0.35 ns.

Circuit capacitance: $C \leq 1$ pF (oscilloscope input + parasitic capacitance).

Fig.3 Reverse recovery time test circuit and waveforms.



T_j = 25 °C.

Fig.4 Forward current as a function of the forward voltage; typical values.

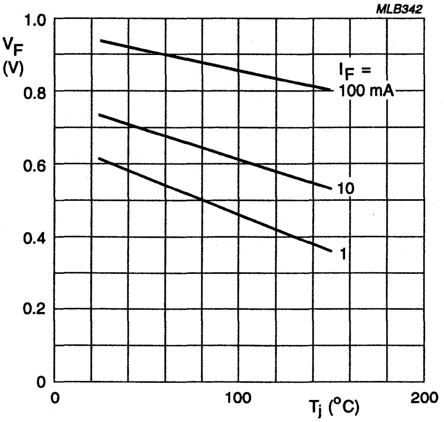


Fig.5 Forward voltage as a function of the junction temperature; typical values.

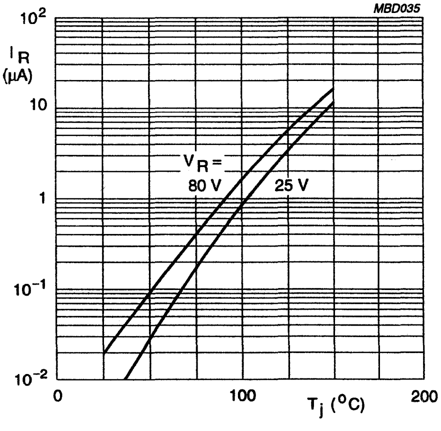
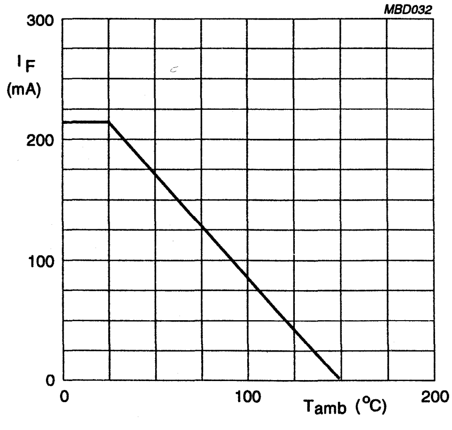


Fig.6 Reverse current as a function of the junction temperature; typical values.



Device mounted on a FR4 printed-circuit board.

Fig.7 Forward current derating curve.

High speed double diode 1PS226

FEATURES

- Plastic SMD envelope
- High speed
- General application.

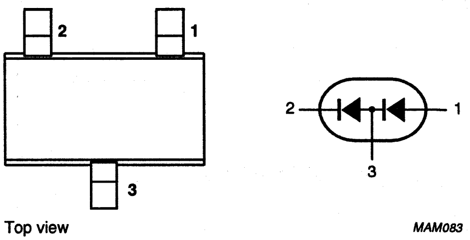
DESCRIPTION

Two epitaxial high-speed switching diodes in a small rectangular SMD SC59 package. The diodes are connected in series. This unit is intended for high-speed switching in surface mounted circuits.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
Per diode				
V_R	continuous reverse voltage		80	V
V_{RRM}	repetitive peak reverse voltage		85	V
I_{FRM}	repetitive peak forward current		500	mA
T_j	operating junction temperature		150	°C
V_F	forward voltage	$I_F = 100$ mA	1.2	V
t_{rr}	reverse recovery time	when switched from $I_F = 10$ mA to $I_R = 10$ mA; $R_L = 100\ \Omega$; measured at $I_R = 1$ mA	4	ns

PIN CONFIGURATION



Marking code: C3T

Fig.1 Simplified outline (SC59) and symbol.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per diode					
V_R	continuous reverse voltage		–	80	V
V_{RRM}	repetitive peak reverse voltage		–	85	V
I_F	DC forward current	single diode loaded	–	215	mA
		double diode loaded	–	125	mA
I_{FRM}	repetitive peak forward current		–	500	mA
I_{FSM}	non-repetitive peak forward current	t_p = 1 µs	–	4	A
		t_p = 1 s	–	0.5	A
P_{tot}	total power dissipation	up to T_{amb} = 25 °C; note 1	–	250	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	+150	°C

Note

1. Device mounted on FR4 printed-circuit board.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	500 K/W

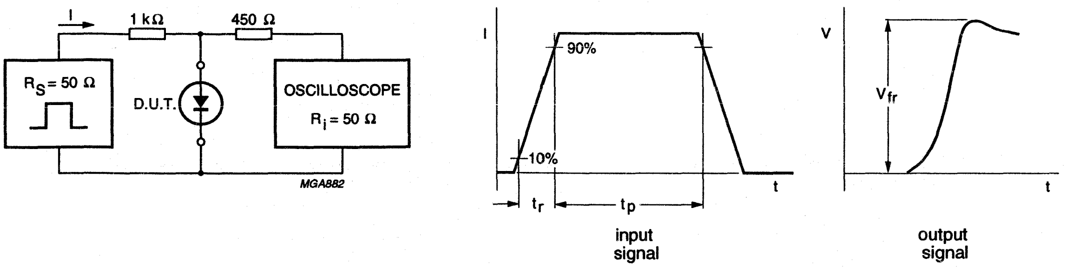
Note

1. Device mounted on FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
Per diode					
V_F	forward voltage	I_F = 1 mA	610	–	mV
		I_F = 10 mA	740	--	mV
		I_F = 100 mA	–	1.2	V
I_R	reverse current	V_R = 80 V	–	0.5	µA
C_d	diode capacitance	V_R = 0; f = 1 MHz	–	1.5	pF
V_{fr}	forward recovery voltage	switched to I_F = 10 mA; t_p = 20 ns; see Fig.2	–	1.75	V
t_{rr}	reverse recovery time	switching from I_F = 10 mA to I_R = 10 mA; R_L = 100 Ω; measured at I_R = 1 mA; see Fig.3	–	4	ns

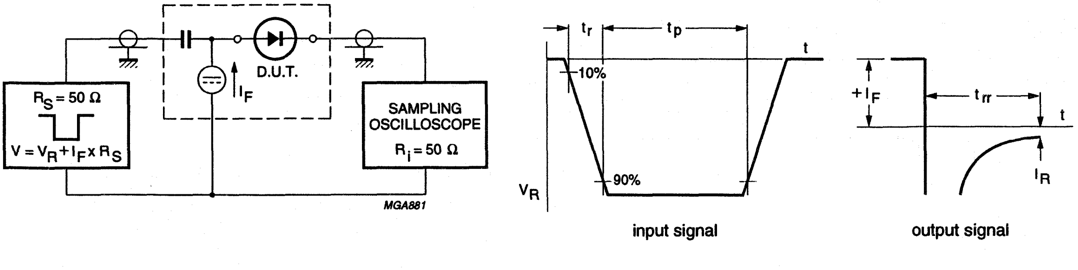


Input signal: forward pulse rise time t_r = 20 ns; forward pulse duration t_p = 120 ns; duty factor δ = 0.01.

Oscilloscope: rise time t_r = 0.35 ns.

Circuit capacitance: C ≤ 1 pF (oscilloscope input + parasitic capacitance).

Fig.2 Forward recovery voltage test circuit and waveforms.

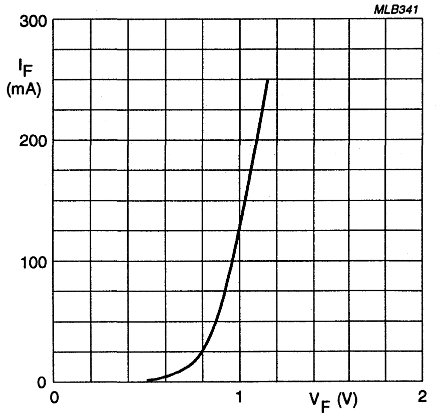


Input signal: reverse pulse rise time t_r = 0.6 ns; reverse pulse duration t_p = 100 ns; duty factor δ = 0.05.

Oscilloscope: rise time t_r = 0.35 ns.

Circuit capacitance: C ≤ 1 pF (oscilloscope input + parasitic capacitance).

Fig.3 Reverse recovery time test circuit and waveforms.



T_j = 25 °C.

Fig.4 Forward current as a function of the forward voltage; typical values.

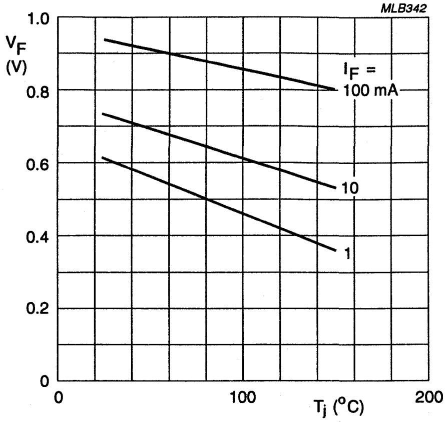


Fig.5 Forward voltage as a function of the junction temperature; typical values.

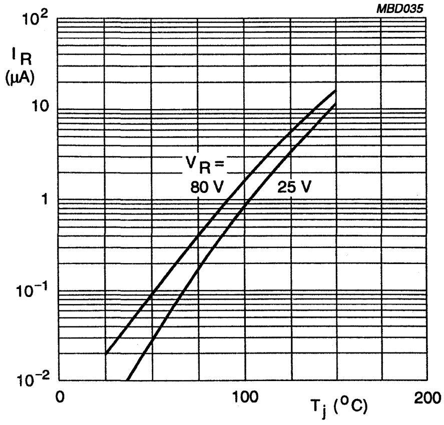
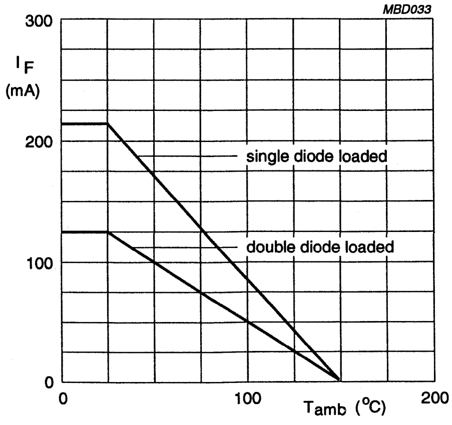


Fig.6 Reverse current as a function of the junction temperature; typical values.



Device mounted on a FR4 printed-circuit board.

Fig.7 Forward current derating curves.

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

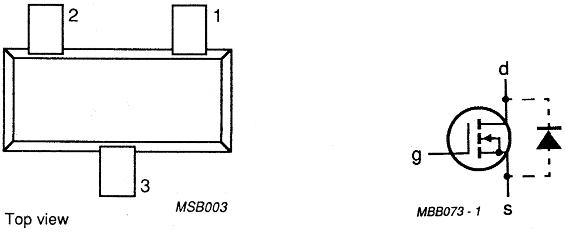


Fig.1 Simplified outline and symbol.

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) (note 2)	 – –	 300 250	 mW 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 note 2	430 500	K/W 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

2N7002

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
$\lvert Y_{fs} \rvert$	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	–	–	10	ns
t_{off}	turn-off time	I_D = 200 mA V_{DD} = 50 V V_{GS} = 0 to 10 V	–	–	15	ns

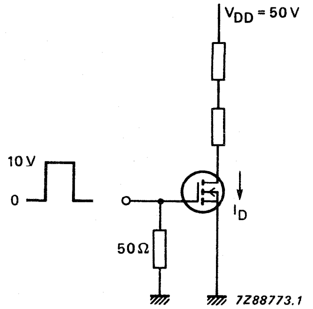


Fig.2 Switching time test circuit.

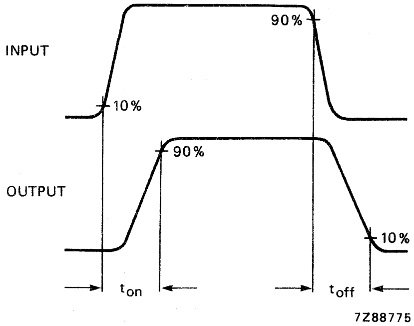
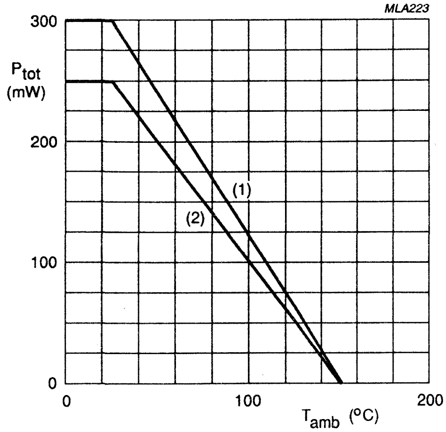


Fig.3 Input and output waveforms.



(1) On ceramic substrate.

(2) On printed circuit board.

Fig.4 Power derating curve.

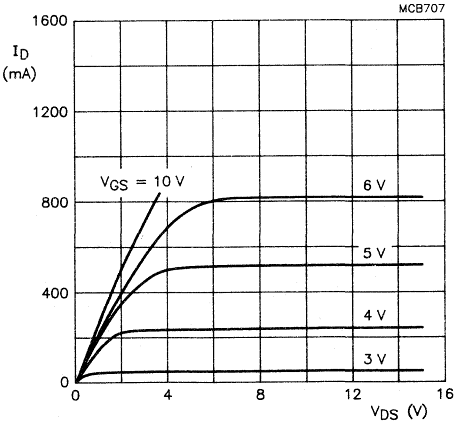


Fig.5 Typical output characteristics; T_j = 25 °C.

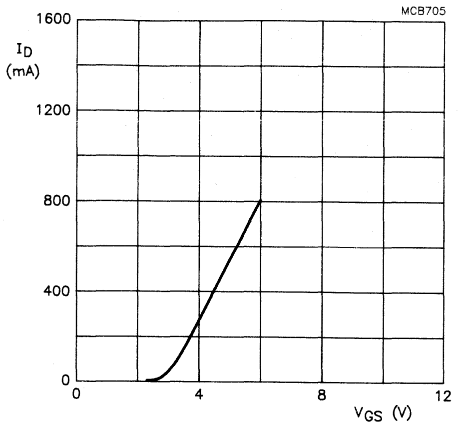


Fig.6 Typical transfer characteristic; V_{DS} = 10 V; T_j = 25 °C.

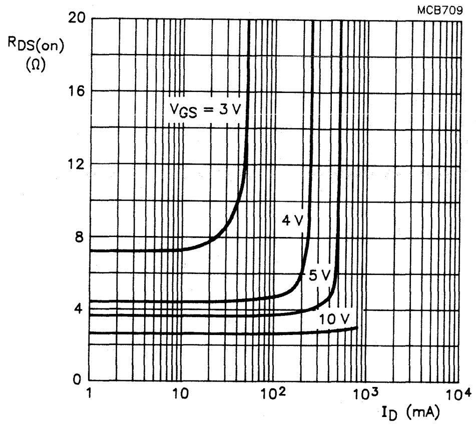


Fig.7 Typical on-resistance as a function of drain current; T_j = 25 °C.

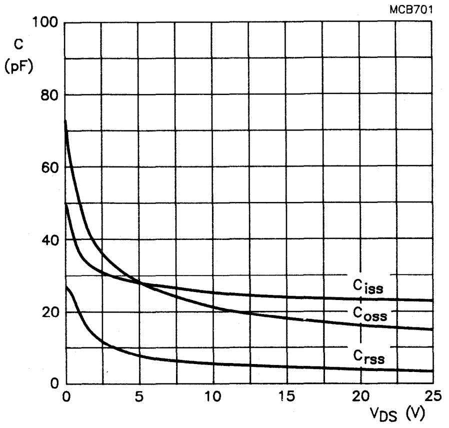
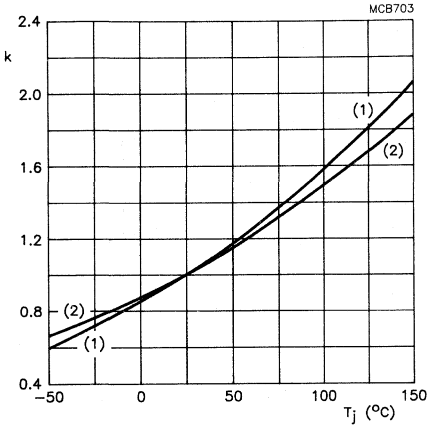


Fig.8 Typical capacitances as a function of drain-source voltage; V_{GS} = 0; f = 1 MHz; T_j = 25 °C.

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; $k = \frac{R_{DS(on)}\ at\ T_j}{R_{DS(on)}\ at\ 25\ °C}$; typical $R_{DS(on)}$.

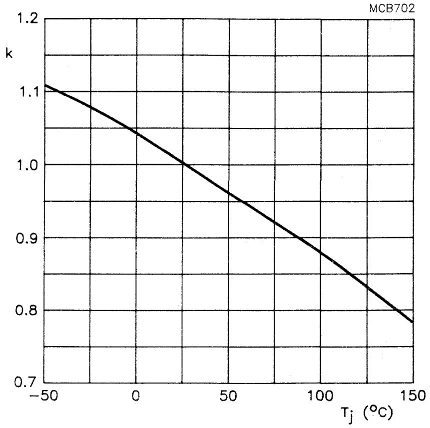


Fig.10 Temperature coefficient of gate-source threshold voltage; $k = \frac{V_{GS(th)}\ at\ T_j}{V_{GS(th)}\ at\ 25\ °C}$; typical $V_{GS(th)}$ at 1 mA.

PNP general purpose transistor 2PB709; 2PB709A

FEATURES

- High DC current gain
- Low collector-emitter saturation voltage.

DESCRIPTION

PNP transistor in a plastic SC59 package for general switching and amplification. Complementary pairs are 2PD601 and 2PD601A respectively.

PINNING - SC59

PIN	DESCRIPTION
1	base
2	emitter
3	collector

MARKING CODES

2PB709Q:	AQ
2PB709R:	AR
2PB709S:	AS
2PB709AQ:	BQ
2PB709AR:	BR
2PB709AS:	BS

PIN CONFIGURATION

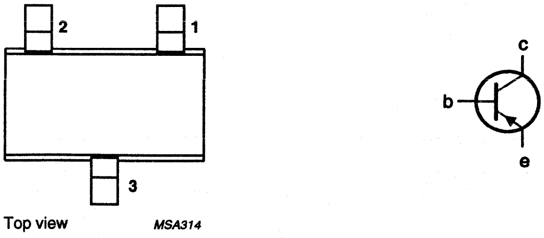


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	2PB709		–	–25	V
	2PB709A		–	–45	V
V_{CEO}	collector-emitter voltage	open base			
	2PB709		–	–25	V
	2PB709A		–	–45	V
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -10$ V; $T_{amb} = 25$ °C	160	460	
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	up to $T_{amb} = 25$ °C	–	200	mW
f_T	transition frequency	$I_E = 1$ mA; $V_{CB} = -10$ V; f = 100 MHz; $T_{amb} = 25$ °C	80	–	MHz

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	2PB709		–	–25	V
	2PB709A		–	–45	V
V_{CEO}	collector-emitter voltage	open base			
	2PB709		–	–25	V
	2PB709A		–	–45	V
V_{EBO}	emitter-base voltage	open collector	–	–6	V
I_C	DC collector current		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C (note 1) see Fig.2	–	200	mW
T_{stg}	storage temperature		–55	150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature	see Fig.2	–55	150	°C

Note

1. Refer to SC59 standard mounting conditions.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air (note 1)	max. 625 K/W

Note

1. Refer to SC59 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; $I_C = -10$ µA; $I_E = 0$			
	2PB709		−25	−	V
	2PB709A		−45	−	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; $I_C = -2$ mA; $I_B = 0$ (note 1)			
	2PB709		−25	−	V
	2PB709A		−45	−	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; $I_E = 10$ µA; $I_C = 0$	−6	−	V
$V_{CE(sat)}$	collector-emitter saturation voltage	$I_C = -100$ mA; $I_B = -10$ mA (note 1)	−	−500	mV
I_{CBO}	collector-base cut-off current	$I_E = 0$; $V_{CB} = -20$ V	−	−100	nA
		$I_E = 0$; $V_{CB} = -20$ V; $T_j = 150$ °C	−	−5	µA
I_{EBO}	emitter-base cut-off current	$I_C = 0$; $V_{EB} = -5$ V	−	−100	nA
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -10$ V (note 1)			
	2PB709; 2PB709A		160	460	
	2PB709Q; 2PB709AQ		160	260	
	2PB709R; 2PB709AR		210	340	
	2PB709S; 2PB709AS		290	460	
f_T	transition frequency	$I_E = 1$ mA; $V_{CB} = -10$ V; f = 100 MHz	80	−	MHz
C_{ob}	collector output capacitance	$I_E = 0$; $V_{CB} = -10$ V; f = 1 MHz	−	5	pF

Note

1. Pulse test : $t_p \leq 300$ µs; $\delta \leq 0.02$.

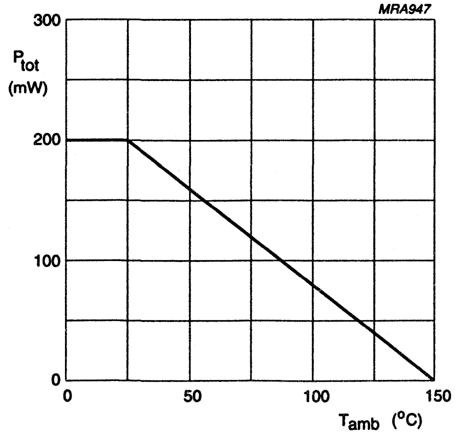


Fig.2 Power derating curve.

PNP general purpose transistor 2PB710; 2PB710A

FEATURES

- Large collector current
- Low collector-emitter saturation voltage.

DESCRIPTION

PNP transistor in a plastic SC59 package for general switching or amplification. Complementary pairs are 2PD602 and 2PD602A respectively.

PINNING - SC59

PIN	DESCRIPTION
1	base
2	emitter
3	collector

MARKING CODES

2PB710Q:	CQ
2PB710R:	CR
2PB710S:	CS
2PB710AQ:	DQ
2PB710AR:	DR
2PB710AS:	DS

PIN CONFIGURATION

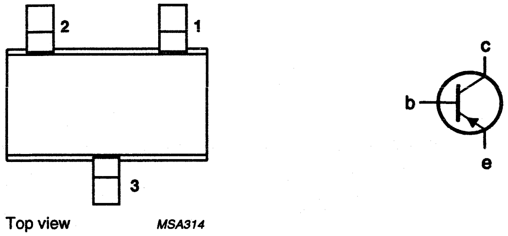


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	2PB710		–	–30	V
	2PB710A		–	–60	V
V_{CEO}	collector-emitter voltage	open base			
	2PB710		–	–25	V
	2PB710A		–	–50	V
h_{FE}	DC current gain	I_C = –150 mA; V_{CE} = –10 V; T_{amb} = 25 °C	85	340	
I_{CM}	peak collector current		–	–1	A
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	200	mW
f_T	transition frequency	I_E = 50 mA; V_{CB} = –10 V; f = 100 MHz; T_{amb} = 25 °C	150	–	MHz

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	2PB710		–	–30	V
	2PB710A		–	–60	V
V_{CEO}	collector-emitter voltage	open base			
	2PB710		–	–25	V
	2PB710A		–	–50	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	DC collector current		–	–500	mA
I_{CM}	peak collector current		–	–1	A
P_{tot}	total power dissipation	up to T_{amb} = 25 °C (note 1) see Fig.2	–	200	mW
T_{stg}	storage temperature		–55	150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature	see Fig.2	–55	150	°C

Note

1. Refer to SC59 standard mounting conditions.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air (note 1)	max. 625 K/W

Note

1. Refer to SC59 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = –10 μA; I_E = 0			
	2PB710		–30	–	V
	2PB710A		–60	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = –2 mA; I_B = 0 (note 1)			
	2PB710		–25	–	V
	2PB710A		–50	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = –10 μA; I_C = 0	–5	–	V
$V_{CE(sat)}$	collector-emitter saturation voltage	I_C = –300 mA; I_B = –30 mA (note 1)	–	–600	mV
$V_{BE(sat)}$	base-emitter saturation voltage	I_C = –300 mA; I_B = –30 mA (note 1)	–	–1.5	V

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector-base cut-off current	$I_E = 0$; $V_{CB} = -20$ V	–	–100	nA
		$I_E = 0$; $V_{CB} = -20$ V; $T_j = 150$ °C	–	–5	µA
I_{EBO}	emitter-base cut-off current	$I_C = 0$; $V_{EB} = -4$ V	–	–100	nA
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -10$ V (note 1)	40	–	
		$I_C = -150$ mA; $V_{CE} = -10$ V (note 1)			
	2PB710; 2PB710A		85	340	
	2PB710Q; 2PB710AQ		85	170	
	2PB710R; 2PB710AR		120	240	
	2PB710S; 2PB710AS		170	340	
f_T	transition frequency	$I_E = 50$ mA; $V_{CB} = -10$ V; f = 100 MHz	150	–	MHz
C_{ob}	collector output capacitance	$I_E = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	15	pF

Note

1. Pulse test : $t_p \leq 300$ µs; $\delta \leq 0.02$.

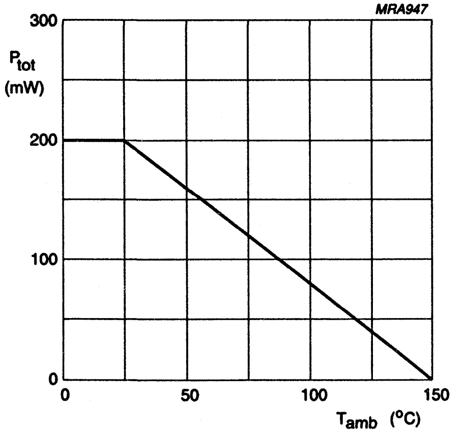


Fig.2 Power derating curve.

NPN general purpose transistor 2PD601; 2PD601A

FEATURES

- High DC current gain
- Low collector-emitter saturation voltage.

DESCRIPTION

NPN transistor in a plastic SC59 package for general switching and amplification. Complementary pairs are 2PB709 and 2PB709A respectively.

PINNING - SC59

PIN	DESCRIPTION
1	base
2	emitter
3	collector

MARKING CODES

2PD601Q:	YQ
2PD601R:	YR
2PD601S:	YS
2PD601AQ:	ZQ
2PD601AR:	ZR
2PD601AS:	ZS

PIN CONFIGURATION

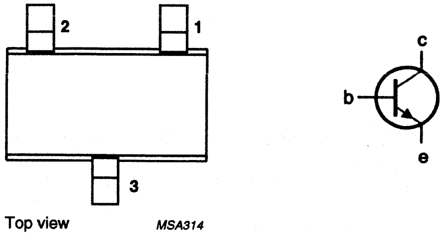


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	2PD601		–	30	V
	2PD601A		–	60	V
V_{CEO}	collector-emitter voltage	open base			
	2PD601		–	25	V
	2PD601A		–	50	V
h_{FE}	DC current gain	I_C = 2 mA; V_{CE} = 10 V; T_{amb} = 25 °C	160	460	
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	200	mW
f_T	transition frequency	I_E = −2 mA; V_{CB} = 10 V; f = 100 MHz; T_{amb} = 25 °C	100	–	MHz

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	2PD601		–	30	V
	2PD601A		–	60	V
V_{CEO}	collector-emitter voltage	open base			
	2PD601		–	25	V
	2PD601A		–	50	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	DC collector current		–	100	mA
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C (note 1) see Fig.2	–	200	mW
T_{stg}	storage temperature		–55	150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature	see Fig.2	–55	150	°C

Note

1. Refer to SC59 standard mounting conditions.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air (note 1)	max. 625 K/W

Note

1. Refer to SC59 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 10 μA; I_E = 0			
	2PD601		30	–	V
	2PD601A		60	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 2 mA; I_B = 0			
	2PD601		25	–	V
	2PD601A		50	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = −10 μA; I_C = 0	6	–	V
$V_{CE(sat)}$	collector-emitter saturation voltage	I_C = 100 mA; I_B = 10 mA (note 1)	–	500	mV

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector-base cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	100	nA
		$I_E = 0$; $V_{CB} = 20$ V; $T_j = 150$ °C	–	5	μA
I_{EBO}	emitter-base cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	100	nA
h_{FE}	DC current gain	$I_C = 100$ mA; $V_{CE} = 2$ V (note 1)	90	–	
		$I_C = 2$ mA; $V_{CE} = 10$ V (note 1)			
	2PD601; 2PD601A		160	460	
	2PD601Q; 2PD601AQ		160	260	
	2PD601R; 2PD601AR		210	340	
	2PD601S; 2PD601AS		290	460	
f_T	transition frequency	$I_E = -2$ mA; $V_{CB} = 10$ V; f = 100 MHz	100	–	MHz
C_{ob}	collector output capacitance	$I_E = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	3.5	pF

Note

1. Pulse test : $t_p \leq 300$ μs; $\delta \leq 0.02$.

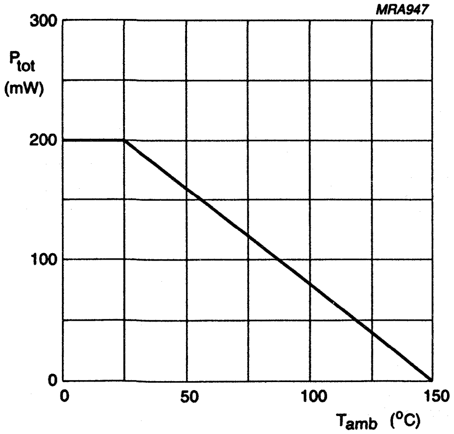


Fig.2 Power derating curve.

NPN general purpose transistor 2PD602; 2PD602A

FEATURES

- Large collector current
- Low collector-emitter saturation voltage.

DESCRIPTION

NPN transistor in a plastic SC59 package for general switching or amplification. Complementary pairs are 2PB710 and 2PB710A respectively.

PINNING - SC59

PIN	DESCRIPTION
1	base
2	emitter
3	collector

MARKING CODES

2PD602Q:	WQ
2PD602R:	WR
2PD602S:	WS
2PD602AQ:	XQ
2PD602AR:	XR
2PD602AS:	XS

PIN CONFIGURATION

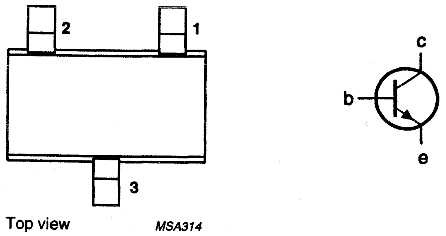


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	2PD602		–	30	V
	2PD602A		–	60	V
V_{CEO}	collector-emitter voltage	open base			
	2PD602		–	25	V
	2PD602A		–	50	V
h_{FE}	DC current gain	I_C = 150 mA; V_{CE} = 10 V; T_{amb} = 25 °C	85	340	
I_{CM}	peak collector current		–	1	A
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	200	mW
f_T	transition frequency	I_E = –50 mA; V_{CB} = 10 V; f = 100 MHz; T_{amb} = 25 °C	150	–	MHz

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	2PD602		–	30	V
	2PD602A		–	60	V
V_{CEO}	collector-emitter voltage	open base			
	2PD602		–	25	V
	2PD602A		–	50	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	DC collector current		–	500	mA
I_{CM}	peak collector current		–	1	A
P_{tot}	total power dissipation	up to T_{amb} = 25 °C (note 1) see Fig.2	–	200	mW
T_{stg}	storage temperature		–55	150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature	see Fig.2	–55	150	°C

Note

1. Refer to SC59 standard mounting conditions.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air (note 1)	max. 625 K/W

Note

1. Refer to SC59 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 10 µA; I_E = 0			
	2PD602		30	–	V
	2PD602A		60	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 2 mA; I_B = 0 (note 1)			
	2PD602		25	–	V
	2PD602A		50	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = –10 µA; I_C = 0	5	–	V
$V_{CE(sat)}$	collector-emitter saturation voltage	I_C = 300 mA; I_B = 30 mA (note 1)	–	600	mV

CHARACTERISTICS *(Continued)*

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector-base cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	100	nA
		$I_E = 0$; $V_{CB} = 20$ V; $T_j = 150$ °C	–	5	μA
I_{EBO}	emitter-base cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	100	nA
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 10$ V (note 1)	40	–	
		$I_C = 150$ mA; $V_{CE} = 10$ V (note 1)			
	2PD602; 2PD602A		85	340	
	2PD602Q; 2PD602AQ		85	170	
	2PD602R; 2PD602AR		120	240	
	2PD602S; 2PD602AS		170	340	
f_T	transition frequency	$I_E = -50$ mA; $V_{CB} = 10$ V f = 100 MHz (note 1)	150	–	MHz
C_{ob}	collector output capacitance	$I_E = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	15	pF

Note

1. Pulse test : $t_p \leq 300$ μs; $\delta \leq 0.02$.

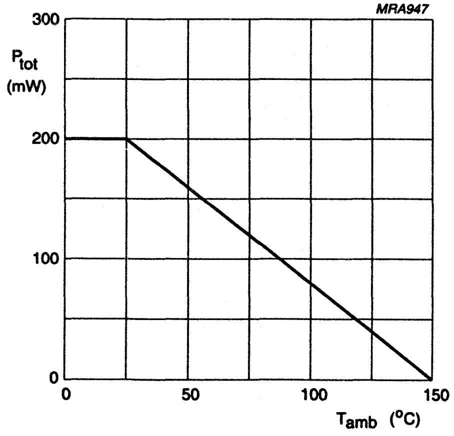
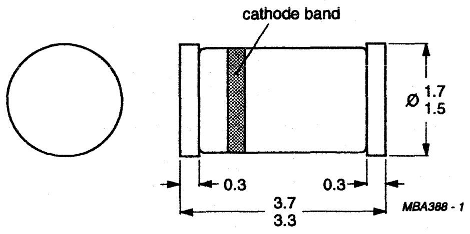


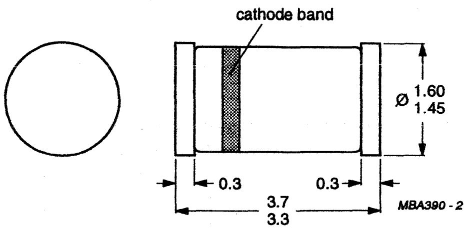
Fig.2 Power derating curve.

PACKAGE OUTLINES



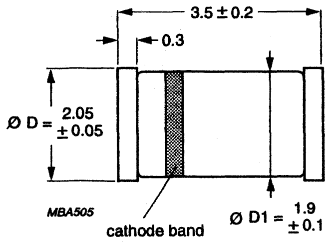
Dimensions in mm.

Fig.1 SOD80.



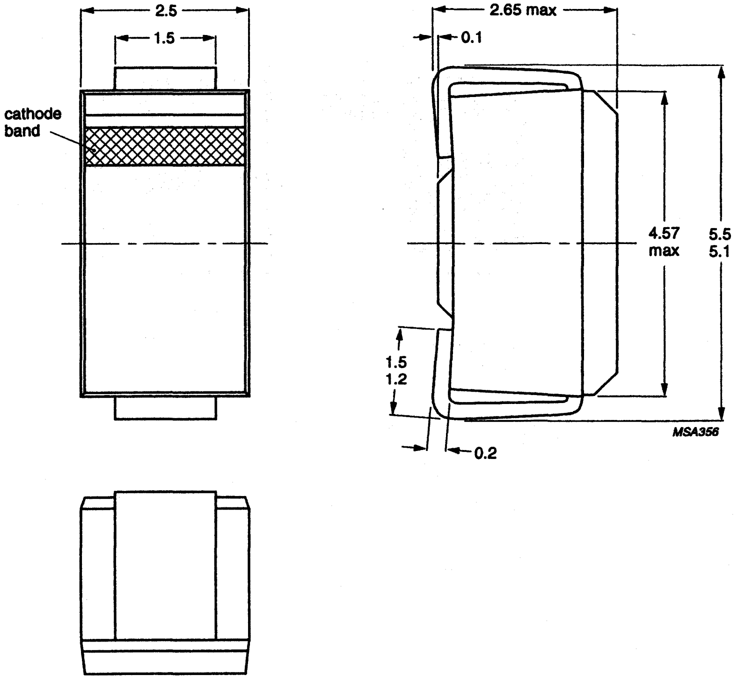
Dimensions in mm.

Fig.2 SOD80C.



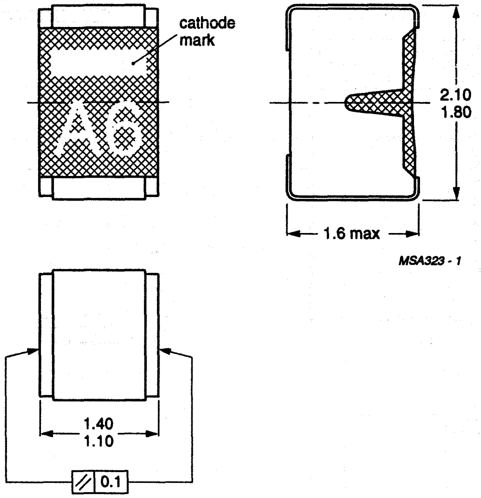
Dimensions in mm.

Fig.3 SOD87.



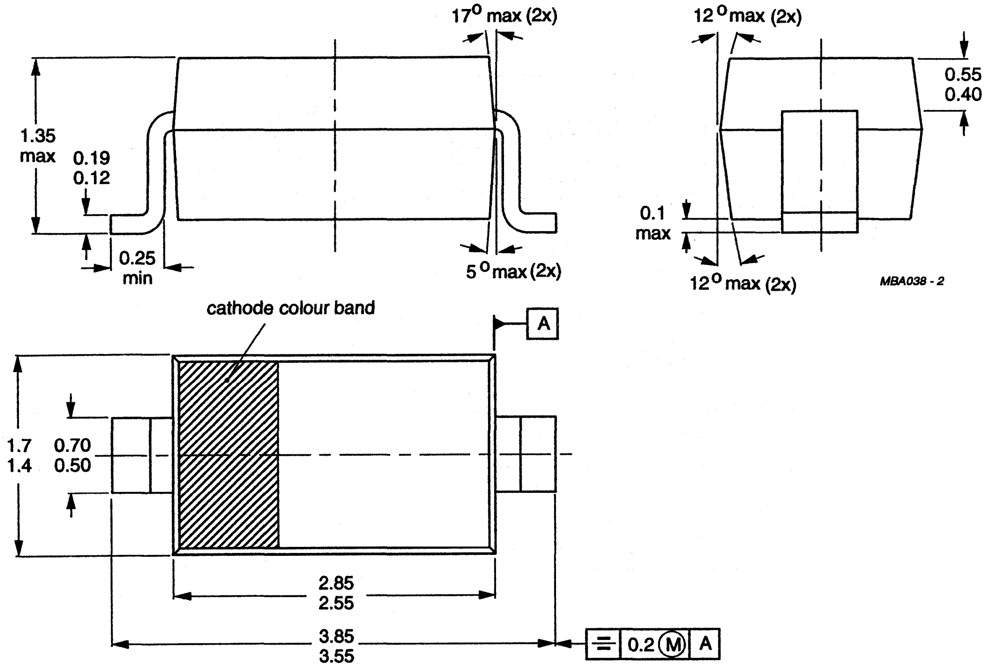
Dimensions in mm.

Fig.4 SOD106A.



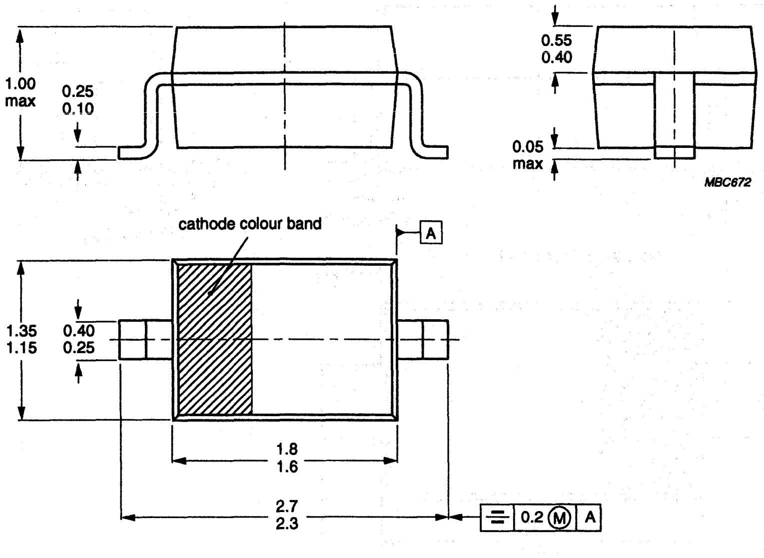
Dimensions in mm.

Fig.5 SOD110.



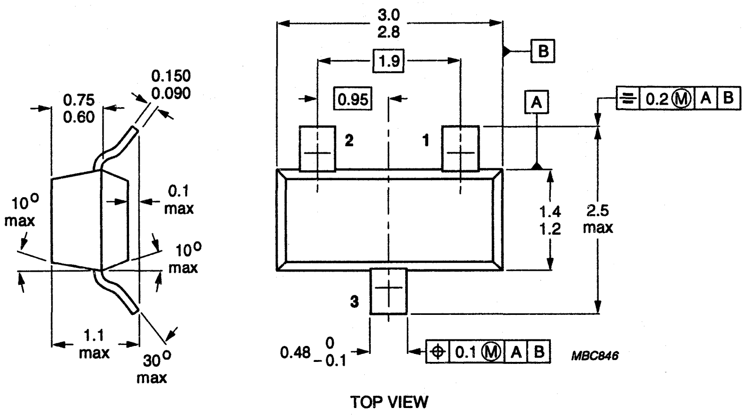
Dimensions in mm.

Fig.6 SOD123.



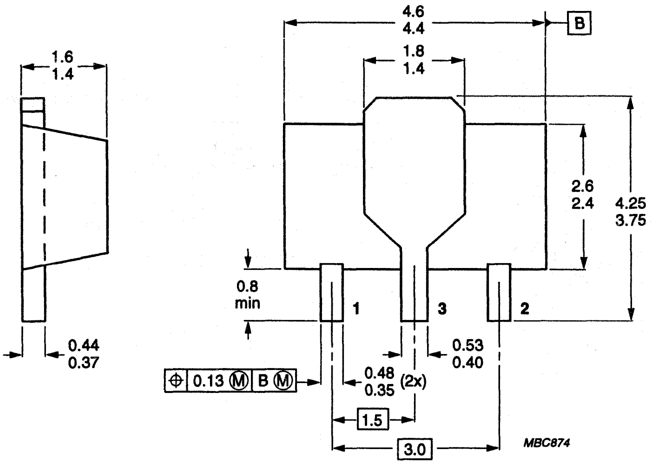
Dimensions in mm.

Fig.7 SOD323.



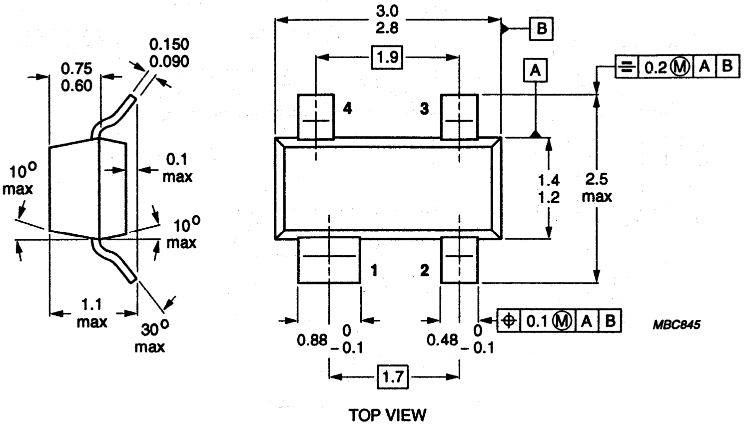
Dimensions in mm.

Fig.8 SOT23.



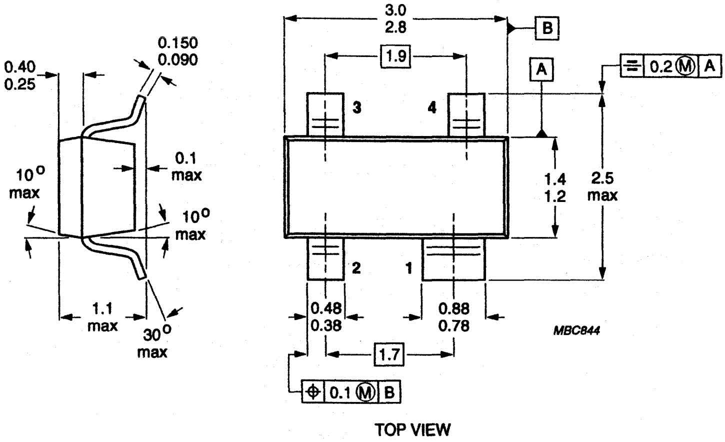
Dimensions in mm.

Fig.9 SOT89.



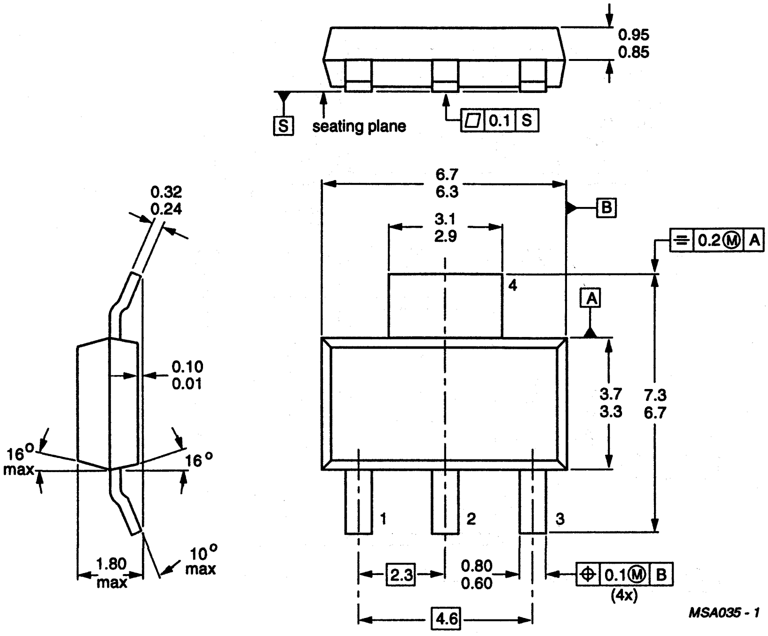
Dimensions in mm.

Fig.10 SOT143.



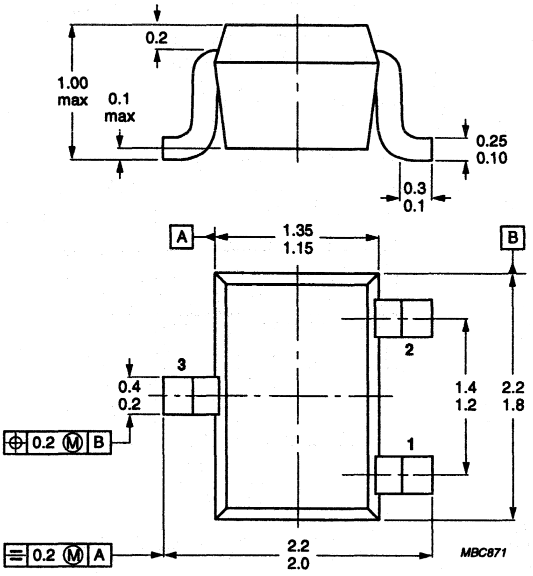
Dimensions in mm.

Fig.11 SOT143R.



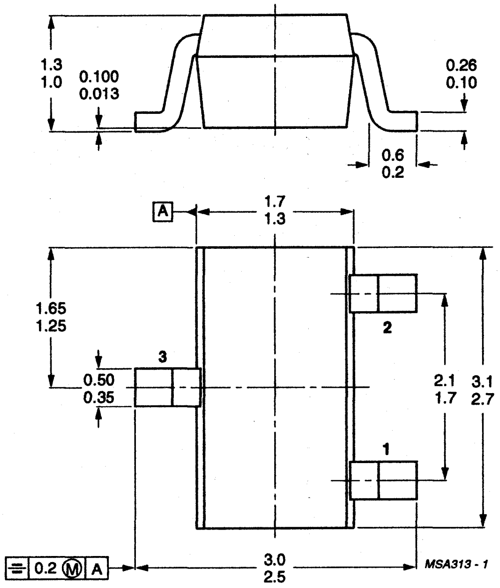
Dimensions in mm.

Fig.12 SOT223.



Dimensions in mm.

Fig.13 SOT323.



Dimensions in mm.

Fig.14 SC59.

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Data handbook system

DATA HANDBOOK SYSTEM

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SC08a	RF Power Bipolar Transistors
SC08b	RF Power MOS Transistors
SC09	RF Power Modules
SC10	Surface Mounted Semiconductors
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SC14	RF Wideband Transistors, Video Transistors and Modules
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Data handbook system

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DC03	Television Tuners, Coaxial Aerial Input Assemblies
DC05	Flyback Transformers, Mains Transformers and General-purpose FXC Assemblies

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