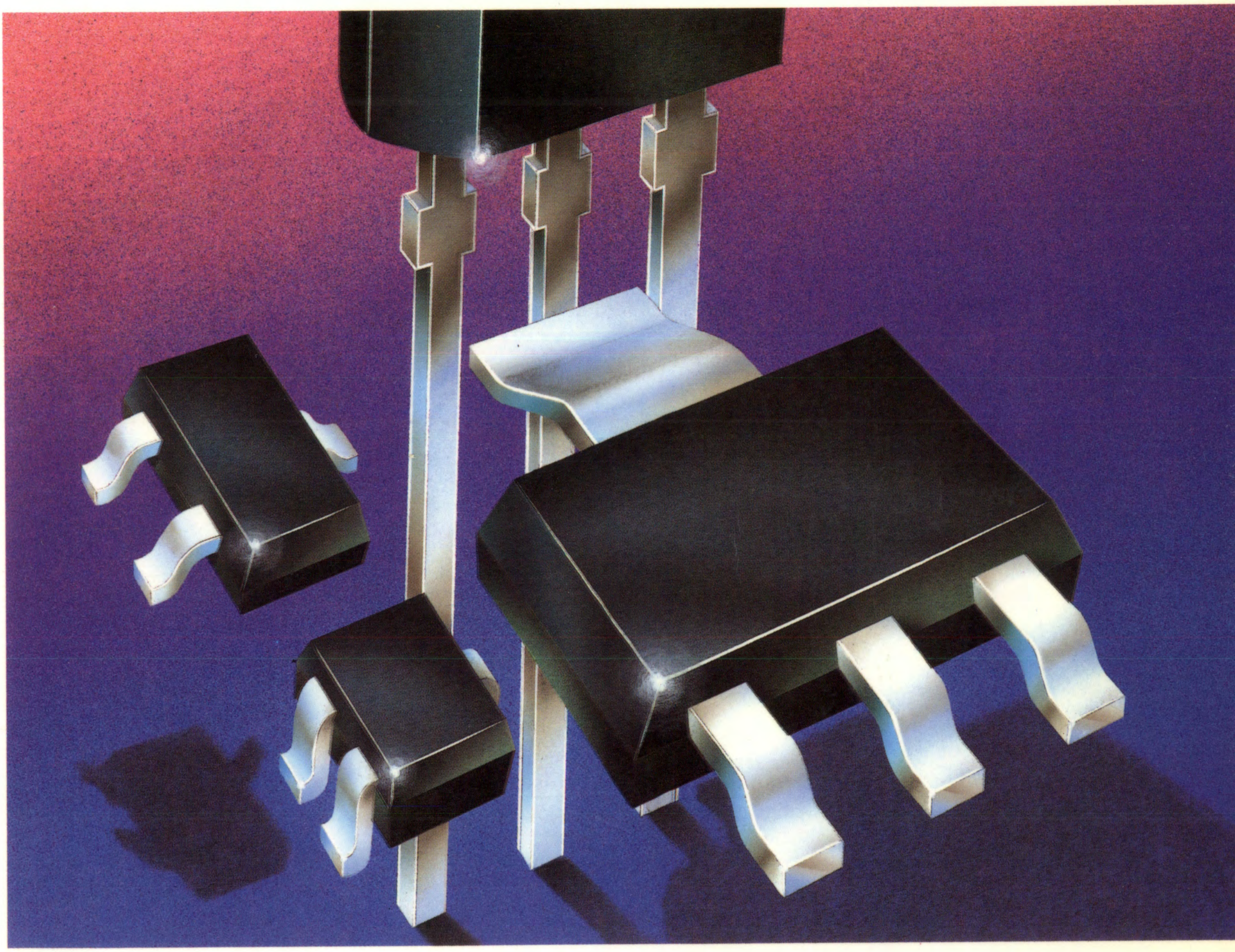
DISCRETE SEMICONDUCTORS

Small-signal Transistors



1995

DATA HANDBOOK SC04

Philips Semiconductors

PHILIPS

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.

Small-signal Transistors

CONTENTS

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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SELECTION GUIDE

GENERAL PURPOSE APPLICATIONS

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE} min.	h_{FE} max.	f_T typ. (MHz)	PAGE
NPN							
BC107	45	100	300	125	500	300	87
BC108	20	100	300	125	900	300	87
BC109	20	100	300	240	900	300	87
BC140	40	1000	3700	100	250	>50	91
BC141	60	1000	3700	100	250	>50	91
BC337	45	500	800	100	600	100	107
BC337A	60	500	800	100	600	100	107
BC338	25	500	800	100	600	100	107
BC368	20	1000	800	85	375	40	111
BC375	30	1000	800	60	340	150	119
BC517	30	400	625	>30000	–	220	125
BC546	65	100	500	110	450	300	127
BC547	45	100	500	110	800	300	127
BC548	30	100	500	110	800	300	127
BC549	30	100	500	200	800	300	131
BC550	45	100	500	200	800	300	131
BC617	40	1000	625	>4000	–	>155	143
BC618	55	1000	625	>2000	–	>155	143
BC635	45	1000	1000	40	250	130	145
BC637	60	1000	1000	40	160	130	149
BC639	80	1000	1000	40	160	130	149
BC875	45	1000	800	>1000	>1000	200	201
BC877	60	1000	800	>1000	>1000	200	201
BC879	80	1000	800	>1000	>1000	200	201
BCY56	45	100	300	100	450	85	321
BCY57	20	100	300	200	800	100	321
BCY58	32	200	330	125	700	>150	325
BCY59	45	200	330	125	700	>150	325
BCY87	40	30	150	100	450	>10	347
BCY88	40	30	150	100	450	>10	347
BCY89	40	30	150	100	450	>10	347
JC337	45	1000	800	100	600	100	789
JC337A	60	1000	800	100	600	100	789
JC338	25	1000	800	100	600	100	789
JC500	25	100	500	90	600	130	793
JC501	45	100	500	90	600	130	793

GENERAL PURPOSE APPLICATIONS *(continued)*

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE}		f_T typ. (MHz)	PAGE
				min.	max.		
NPN							
JC546	65	100	500	110	450	300	797
JC547	45	100	500	110	800	300	797
JC548	30	100	500	110	800	300	797
JC549	30	200	500	200	800	300	801
JC550	45	200	500	200	800	300	801
MPS3704	30	600	625	100	300	100	817
MPS3705	30	600	625	50	150	100	817
MPS3706	20	600	625	30	600	100	817
MPS6513	30	100	625	>60	>60	–	827
MPS6514	25	100	625	>90	>90	–	827
MPS6515	25	100	625	>150	>150	–	827
MPS6520	25	100	625	200	400	–	831
MPS6521	25	100	625	300	600	–	831
MPS6531	40	30	625	90	270	–	835
MPS6532	40	30	625	>30	>30	–	835
MPSA05	60	500	625	>50	>50	>100	839
MPSA06	80	500	625	>50	>50	>100	839
2N930	45	30	300	150	600	80	1083
2N2483	60	50	360	<500	<500	80	1123
2N2484	60	50	360	<800	<800	80	1123
2N4123	30	200	350	50	200	>250	1165
2N4124	25	200	350	120	480	>300	1165
2N4400	40	600	625	50	150	>200	1169
2N4401	40	600	625	100	300	>250	1169
2N5088	30	50	625	350	–	>50	1181
2PC945	50	100	500	90	600	>150	1211
2PC1815	50	150	500	120	700	>80	1213
2PC1815L	50	150	500	120	700	>80	1213
PNP							
BC160	40	1000	3700	100	250	>50	95
BC161	60	1000	3700	100	250	>50	95
BC177	45	100	300	75	260	150	99
BC178	25	100	300	125	500	150	99
BC179	20	100	300	125	500	150	99
BC327	45	500	800	100	600	100	103
BC327A	60	500	800	100	600	100	103

GENERAL PURPOSE APPLICATIONS *(continued)*

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE}		f_T typ. (MHz)	PAGE
				min.	max.		
PNP							
BC328	25	500	800	100	600	100	103
BC369	20	1000	800	85	375	40	115
BC376	30	1000	800	60	340	100	121
BC516	30	400	625	>30000	–	220	123
BC556	65	100	500	75	475	200	135
BC557	45	100	500	75	800	200	135
BC558	30	100	500	75	800	200	135
BC559	30	100	500	125	800	200	139
BC560	45	100	500	125	800	200	139
BC636	45	1000	1000	40	250	50	149
BC638	60	1000	1000	40	250	50	149
BC640	80	1000	1000	40	250	50	149
BC876	45	1000	800	>1000	>1000	200	205
BC878	60	1000	800	>1000	>1000	200	205
BC880	80	1000	800	>1000	>1000	200	205
BCY70	40	200	350	>100	>100	>250	335
BCY71	45	200	350	>100	>100	>250	335
BCY72	25	200	350	>100	>100	>250	335
BCY78	32	200	345	125	700	180	341
BCY79	45	200	345	125	700	180	341
JA100	25	100	500	90	600	130	781
JA101	45	100	500	90	600	130	781
JC327	45	1000	800	100	600	100	785
JC327A	60	1000	800	100	600	100	785
JC328	25	1000	800	100	600	100	785
JC556	65	100	500	75	475	200	805
JC557	45	100	500	75	800	200	805
JC558	30	100	500	75	800	200	805
JC559	30	200	500	125	800	200	809
JC560	45	200	500	125	800	200	809
MPS3702	25	600	625	60	300	>100	815
MPS3703	30	600	625	30	150	>100	815
MPS6517	40	100	625	>60	>60	–	829
MPS6518	40	100	625	>90	>90	–	829
MPS6519	25	100	625	>150	>150	–	829
MPS6522	25	100	625	200	400	–	833

GENERAL PURPOSE APPLICATIONS *(continued)*

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE}		f_T typ. (MHz)	PAGE
				min.	max.		
PNP							
MPS6523	25	100	625	400	600	–	833
MPS6534	40	30	625	90	270	–	837
MPS6535	30	30	625	>30	>30	–	837
MPSA55	60	500	625	>50	>50	>50	851
MPSA56	80	500	625	>50	>50	>50	851
2N4030	60	1000	800	40	120	>100	1159
2N4031	80	1000	800	40	120	>100	1159
2N4032	60	1000	800	100	300	>150	1159
2N4033	80	1000	800	100	300	>150	1159
2N4125	30	200	350	50	200	>200	1167
2N4126	25	200	350	120	480	>250	1167
2N4402	40	600	625	50	150	>150	1173
2N4403	40	600	625	100	300	>200	1173
2N5086	50	50	625	150	150	>40	1177
2N5087	50	50	625	250	250	>40	1177
2PA733	50	100	500	90	600	>100	1195
2PA1015	50	150	500	120	700	>80	1197
2PA1015L	50	150	500	120	700	>80	1197

MF APPLICATIONS

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE}		f_T typ. (MHz)	PAGE
				min.	max.		
NPN							
BF494	20	30	300	67	220	>120	499
BF494B	20	30	300	100	220	>120	499
BF495C	20	30	300	67	125	>120	499
BF494D	20	30	300	35	76	>120	499
BF495	20	30	300	35	125	>120	499

HF APPLICATIONS

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE} min.	h_{FE} max.	f_T typ. (MHz)	PAGE
NPN							
BF198	30	25	500	–	–	400	453
BF199	25	25	500	–	–	550	457
BF240	40	25	250	67	220	>150	459
BF241	40	25	250	35	125	>150	459
BF370	15	100	500	>40	>40	>500	465
BF494	20	30	300	67	220	260	499
BF495	30	30	300	35	125	120	499
BFR54	15	500	500	>40	>40	>500	547
JF494	20	30	300	67	220	260	813
PNP							
BF324	30	25	250	–	–	450	461
BF450	40	25	250	62	200	>350	479
BF451	40	25	250	30	90	>350	479

SWITCHING APPLICATIONS

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE} min.	h_{FE} max.	f_T typ. (MHz)	PAGE
NPN							
BCX58	32	200	450	80	1000	>125	305
BCX59	45	200	450	80	1000	>125	305
BCY58	32	200	330	80	1000	>150	325
BCY59	45	200	330	80	1000	>150	325
BCY65	60	200	330	200	330	125	331
BFX34	60	2000	5000	40	150	>70	573
BFX84	60	1000	800	>30	>30	>50	579
BFX85	60	1000	800	>70	>70	>50	579
BFY50	35	1000	800	112	112	>60	593
BFY51	30	1000	800	123	123	>50	593
BFY52	20	1000	800	142	142	>50	593
BFY55	35	1000	800	40	120	>60	603
BSR50	45	1000	800	>2000	>2000	–	691
BSR51	60	1000	800	>2000	>2000	–	691
BSR52	80	1000	800	>2000	>2000	–	691
BSS38	100	100	500	>20	>20	>60	699

SWITCHING APPLICATIONS *(continued)*

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE}		f_T typ. (MHz)	PAGE
				min.	max.		
NPN							
BSS50	45	1000	5000	>2000	>2000	–	703
BSS51	60	1000	5000	>2000	>2000	–	703
BSS52	80	1000	5000	>2000	>2000	–	703
BSV64	60	2000	5000	>40	>40	100	747
BSW66A	100	1000	5000	>30	>30	130	751
BSW67A	120	1000	5000	>30	>30	130	751
BSW68A	150	1000	5000	>30	>30	130	751
BSX20	15	500	360	40	120	>500	755
BSX32	40	1000	800	30	60	>300	761
BSX45	40	1000	6250	40	250	>50	765
BSX46	60	1000	6250	40	250	>50	765
BSX47	80	1000	6250	40	250	>50	765
BSX59	45	1000	800	30	90	>250	771
BSX60	30	1000	800	30	90	>250	771
BSX61	45	1000	800	30	90	>250	771
BSX62	40	3000	875	63	160	70	776
BSX63	60	3000	875	100	250	70	776
MPS3904	40	200	500	100	300	>180	819
MPSA13	30	500	625	>5000	>5000	>125	841
MPSA14	30	500	625	>10000	–	>125	841
MPSA25	40	500	500	>10000	–	220	843
MPSA26	50	500	500	>10000	–	220	843
MPSA27	60	500	500	>10000	–	220	843
MPSA42	300	500	625	>40	>40	>50	845
MPSA43	200	500	625	>40	>40	>50	845
PH2222	30	800	625	>75	>75	>250	879
PH2222A	40	800	625	>75	>75	>300	879
PH2369	15	(500)	500	40	120	>500	883
PN2222	30	600	625	100	300	>250	997
PN2222A	40	600	625	100	300	>250	997
PN2369	15	600	625	40	120	–	1001
PN2369A	15	600	625	40	40	–	1001
PN3439	350	1000	625	>30	>30	>70	1009
PN3440	250	1000	625	>40	>40	>70	1009
2N1613	50	500	800	40	120	>60	1087

SWITCHING APPLICATIONS *(continued)*

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE} min.	h_{FE} max.	f_T typ. (MHz)	PAGE
NPN							
2N1711	50	1000	800	100	300	>70	1091
2N1893	80	500	3000	40	120	>50	1095
2N2219	30	800	800	100	300	>250	1099
2N2219A	40	800	800	100	300	>300	1099
2N2222	30	800	500	100	300	250	1105
2N1613	50	500	800	40	120	>60	1087
2N2222A	40	800	500	100	300	200	1105
2N2297	35	1000	800	40	120	>60	1111
2N2369	15	500	360	40	120	>500	1115
2N2369A	15	200	360	>40	>40	>500	1119
2N3019	80	1000	800	100	300	>100	1143
2N3020	80	1000	800	40	120	>80	1143
2N3053	40	700	5000	50	250	150	1147
2N3439	400	1000	625	>30	>30	2	1149
2N3440	300	1000	625	>40	>40	20	1149
2N3904	40	200	350	100	300	10	1151
2N5550	140	60	625	>60	>60	10	1191
2N5551	160	60	625	>80	>80	10	1191
PNP							
BCX78	32	200	450	80	1000	>200	317
BCX79	45	200	450	80	1000	>200	317
BCY70	40	200	350	>100	>100	250	335
BCY71	45	200	350	>100	>100	250	335
BCY72	25	200	350	>100	>100	250	335
BCY78	32	200	345	80	1000	180	341
BCY79	45	200	345	80	1000	180	341
BFT44	300	500	500	50	150	70	553
BFT45	250	500	500	50	150	70	553
BFX29	60	600	600	>50	>50	>100	561
BFX30	65	600	600	50	200	–	567
BFX87	50	600	600	>40	>40	>100	587
BFX88	40	600	600	>40	>40	>100	587
BSR60	(45)	1000	800	>2000	>2000	–	695
BSR61	(60)	1000	800	>2000	>2000	–	695
BSR62	(80)	1000	800	>2000	>2000	–	695
BSS60	(45)	1000	5000	>2000	>2000	–	707

SWITCHING APPLICATIONS *(continued)*

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE}		f_T typ. (MHz)	PAGE
				min.	max.		
PNP							
BSS61	(60)	1000	5000	>2000	>2000	–	707
BSS62	(80)	1000	5000	>2000	>2000	–	707
BSS68	100	100	500	>30	>30	>50	719
BSV15	40	1000	5000	63	250	50	735
BSV16	60	1000	5000	63	250	>50	735
BSV17	80	1000	5000	63	250	>50	735
MPS3906	40	200	500	100	300	>150	823
MPSA63	30	500	625	>5000	>5000	>125	853
MPSA64	30	500	625	>10000	>10000	>125	853
MPSA75	40	500	500	>10000	–	220	855
MPSA76	50	500	500	>10000	–	220	855
MPSA77	60	500	500	>10000	–	220	855
MPSA92	300	500	625	>25	>25	>50	857
MPSA93	200	500	625	>25	>25	>50	857
PH2907	40	600	625	100	300	>200	887
PH2907A	60	600	625	100	300	>200	887
PH5415	200	1000	625	30	150	>15	891
PH5416	300	1000	625	30	120	>15	891
PN2907	40	600	625	100	300	>200	1005
PN2907A	60	600	625	100	300	>200	1005
PN5415	200	1000	625	30	150	>15	1011
PN5416	300	1000	625	30	120	>15	1011
2N2904	40	600	600	40	120	>200	1127
2N2904A	60	600	600	40	120	>200	1127
2N2905	40	600	600	100	300	>200	1131
2N2905A	60	600	600	100	300	>200	1131
2N2906	40	600	400	40	120	>200	1135
2N2906A	60	600	400	40	120	>200	1135
2N2907	40	600	400	100	300	>200	1139
2N2907A	60	600	400	100	300	>200	1139
2N3906	40	200	350	100	300	10	1155
2N4030	60	1000	800	>25	>25	500	1159
2N4031	80	1000	800	>25	>25	500	1159
2N4032	60	1000	800	>70	>70	500	1159
2N4033	80	1000	800	>70	>70	500	1159
2N4036	90	1000	7000	20	200	150	1163

SWITCHING APPLICATIONS *(continued)*

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE}		f_T typ. (MHz)	PAGE
				min.	max.		
PNP							
2N5400	120	600	625	>40	>40	10	1183
2N5401	150	600	625	>60	>60	10	1183
2N5415	200	1000	1000	30	150	50	1187
2N5416	300	1000	1000	30	120	50	1187

HIGH VOLTAGE APPLICATIONS

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE}		f_T typ. (MHz)	PAGE
				min.	max.		
NPN							
BF419	250	300	6000	typ. 45	–	90	467
BF420	(300)	50	830	>50	>50	>60	471
BF422	250	50	830	>50	>50	>60	471
BF457	160	300	6000	26		90	481
BF458	250	300	6000	26		90	481
BF459	300	300	6000	26		90	481
BF469	250	100	1800	50		>60	485
BF471	>250	100	1800	50		>60	485
BF483	250	100	830	>50	>50	>70	493
BF485	300	100	830	>50	>50	>70	493
BF487	350	100	830	>50	>50	>70	493
BF583	250	100	1600	50	–	>70	505
BF585	300	100	1600	50	–	>70	505
BF587	350	100	1600	50	–	>70	505
BF591	170	150	1300	30	–	–	511
BF593	210	150	1300	30	–	–	511
BF819	250	300	6000	typ. 45	–	90	521
BF857	160	300	6000	26	–	90	539
BF858	250	300	6000	26	–	90	539
BF859	300	300	6000	26	–	90	539
BF869	250	100	5000	50	–	>60	541
BF871	>250	1000	5000	50	–	>60	541
MPSA44	400	300	625	>40	–	>20	847
MPSA45	350	300	625	>40	–	>20	847

HIGH VOLTAGE APPLICATIONS *(continued)*

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE}		f_T typ. (MHz)	PAGE
				min.	max.		
NPN							
PN3439	350	1000	625	>30	>30	>70	1009
PN3440	250	1000	625	>40	>40	>70	1009
PN5415	200	1000	625	30	150	>15	1011
2N3439	400	1000	625	>30	>30	>70	1149
2N3440	400	1000	625	>40	>40	>70	1149
2N5550	140	60	625	>60	>60	>100	1191
2N5551	160	60	625	>80	>80	>100	1191
PNP							
BF421	(300)	50	830	>50	>50	>60	475
BF423	250	50	830	>50	>50	>60	475
BF470	250	100	1800	50	–	>60	489
BF472	>250	100	1800	50	–	>60	489
BF484	250	100	830	>50	>50	>70	495
BF486	300	100	830	>50	>50	>70	495
BF488	350	100	830	>50	>50	>70	495
BF584	250	100	1600	50	–	>70	507
BF586	300	100	1600	50	–	>70	507
BF588	350	100	1600	50	–	>70	507
BF870	250	100	5000	50		>60	545
BF872	>250	1000	5000	50		>60	545
MPSA42	300	500	625	>40	>40	>50	845
MPSA43	200	500	625	>40	>40	>50	845
MPSA92	300	500	625	>25	>25	>50	857
MPSA93	200	500	625	>25	>25	>50	857
PH5415	200	1000	625	30	150	>15	891
PH5416	300	1000	625	30	120	>15	891
2N5400	120	600	625	>40	>40	>100	1183
2N5401	150	600	625	>60	>60	>100	1183
2N5415	200	1000	1000	30	150	>15	1187
2N5416	300	1000	1000	30	120	>15	1187

POWER APPLICATIONS

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE}		f_T typ. (MHz)	PAGE
				min.	max.		
NPN							
BD131	45	3000	15000	40		60	355
BD135	45	1500	8000	40	250	250	367
BD137	60	1500	8000	40	250	250	367
BD139	80	1500	8000	40	250	250	367
BD226	45	1500	12500	40	250	125	383
BD228	60	1500	12500	40	250	125	383
BD230	80	1500	12500	40	250	125	383
BD329	20	3000	15000	85	375	130	399
BD825	45	1000	8000	40	250	250	411
BD827	60	1000	8000	40	250	250	411
BD829	80	1000	8000	40	250	250	411
BD839	45	1500	10000	25		125	423
BD841	60	1500	10000	25		125	423
BD843	80	1500	10000	25		125	423
BDX35	60	5000	15000	45		100	439
BDX36	60	5000	15000	45		100	439
BDX37	80	5000	15000	45		100	439
BDX42	45	1000	1250	2000	–	–	445
BDX43	60	1000	1250	2000	–	–	445
BDX44	80	1000	1250	2000	–	–	445
PNP							
BD132	45	3000	15000	40	–	60	361
BD136	45	1500	8000	40	250	75	375
BD138	60	1500	8000	40	250	75	375
BD140	80	1500	8000	40	250	75	375
BD227	45	1500	12500	40	250	50	391
BD229	60	1500	12500	40	250	50	391
BD231	80	1500	12500	40	250	50	391
BD330	20	3000	15000	85	375	100	405
BD826	45	1000	8000	40	250	75	417
BD828	60	1000	8000	40	250	75	417
BD830	80	1000	8000	40	250	75	417
BD840	45	1500	10000	25	–	50	429
BD842	60	1500	10000	25	–	50	429
BD844	80	1500	10000	25	–	50	429

POWER APPLICATIONS *(continued)*

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mW)	h_{FE} min.	h_{FE} max.	f_T typ. (MHz)	PAGE
PNP							
BDX45	45	1000	1250	2000	–	–	449
BDX46	60	1000	1250	2000	–	–	449
BDX47	80	1000	1250	2000	–	–	449

PROGRAMMABLE UNIJUNCTION TRANSISTORS

TYPE NUMBER	V_{GA} (V)	I_A (mA)	I_{ARM} (A)	dI_A/dt (A/µs)	I_P max. (A)	I_V min. (A)	t_r max. (ns)	PAGE
BRY39	70	175	2.5	20	5	25	80	611
BRY56	70	175	2.5	20	5	2	80	625

SILICON CONTROLLED SWITCHES

TYPE NUMBER	V_{CBO} (V)	I_E (mA)	I_{ERM} (A)	P_{tot} (mW)	V_{AK} max. (V)	I_h max. (mA)	t_{on} max. (µs)	t_q max. (µs)	PAGE
BR101	50	175	2.5	275	1.4	1	–	–	607
BRY39	70	175	2.5	275	1.4	1	1.5	8	616

GENERAL PURPOSE APPLICATIONS

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mw)	h_{FE} min.	h_{FE} max.	f_T typ. (MHz)	PAGE
NPN							
BC817	45	500	250	100	600	200	159
BC818	25	500	250	100	600	200	159
BC846	65	100	250	220	800	300	165
BC847	45	100	250	220	800	300	165
BC848	30	100	250	220	800	300	165
BC868	20	1000	1000	85	375	60	193
BCP54	45	1000	1500	40	250	130	227
BCP55	60	1000	1500	40	250	130	227
BCP56	80	1000	1500	40	250	130	227
BCP68	20	1000	1500	85	375	60	231
BCV27	30	300	250	20000	–	220	237
BCV29	30	500	1000	20000	–	220	241
BCV47	60	500	250	4000	–	220	237
BCV49	60	500	1000	10000	–	220	241
BCV71	60	100	250	110	220	300	261
BCV72	60	100	250	200	450	300	261
BCW31	32	100	250	110	220	300	267
BCW32	32	100	250	200	450	300	267
BCW33	32	100	250	420	800	300	267
BCW60A	32	200	250	120	220	250	271
BCW60B	32	200	250	180	310	250	271
BCW60C	32	200	250	250	460	250	271
BCW60D	32	200	250	380	630	250	271
BCW71	45	100	250	110	220	300	281
BCW72	45	100	250	220	450	300	281
BCW81	45	100	250	450	800	300	285
BCX19	45	500	250	100	600	200	293
BCX20	25	500	250	100	600	200	293
BCX54	45	1000	1000	45	250	130	301
BCX55	60	1000	1000	40	160	130	301
BCX56	80	1000	1000	40	160	130	301
BCX70G	45	200	250	120	220	250	309
BCX70H	45	200	250	180	310	250	309
BCX70J	45	200	250	250	460	250	309
BCX70K	45	200	250	380	630	250	309
BSP40	60	1000	1500	40	120	100	647

GENERAL PURPOSE APPLICATIONS *(continued)*

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mw)	h_{FE} min.	h_{FE} max.	f_T typ. (MHz)	PAGE
NPN							
BSP41	60	1000	1500	100	300	100	647
BSP42	80	1000	1500	40	120	100	647
BSP43	80	1000	1500	100	300	100	647
PMBT4401	40	600	250	100	300	250	921
PMBT5550	140	600	300	60	250	200	935
PMBT6428	50	200	350	250	650	300	939
PMBT6429	45	200	350	500	1250	300	939
PMBTA05	60	500	300	50	–	100	943
PMBTA06	80	500	300	50	–	100	943
PMBTA13	30	300	300	5000	–	125	945
PMBTA14	30	300	300	10000	–	125	945
PMSS3904	40	200	200	100	300	180	957
PMST3904	40	200	200	100	300	300	968
PMST5088	30	50	200	350	–	–	984
PMST5089	25	50	200	450	–	–	984
PXT4401	40	600	1000	100	300	250	1029
PXTA14	30	300	1000	20000	–	125	1037
PXTA27	60	500	1000	10000	–	125	1039
PZTA05	60	500	1500	50	–	100	1064
PZTA06	80	500	1500	50	–	100	1064
PZTA13	30	300	1500	5000	–	125	1067
PZTA14	30	300	1500	10000	–	125	1067
PZTA42	300	500	1500	40	–	50	1069
PZTA43	200	500	1500	40	–	50	1069
2PC4081	40	100	200	120	560	100	1215
2PD601	25	200	250	160	460	140	1217
2PD601A	50	200	250	160	460	140	1217
2PD602	25	1000	250	85	340	180	1220
2PD602A	50	1000	250	85	340	180	1220
PNP							
BC807	45	500	250	100	600	100	153
BC808	25	500	250	100	600	100	153
BC856	65	100	250	75	475	150	181
BC857	45	100	250	75	800	150	181
BC858	30	100	250	75	800	150	181
BC869	20	1000	1000	85	375	60	197

GENERAL PURPOSE APPLICATIONS *(continued)*

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mw)	h_{FE}		f_T typ. (MHz)	PAGE
				min.	max.		
PNP							
BCP51	45	1000	1500	40	250	50	223
BCP52	60	1000	1500	40	250	50	223
BCP53	80	1000	1500	40	250	50	223
BCP69	25	1000	1500	85	375	60	233
BCV26	30	250	350	20000	–	220	235
BCV28	30	500	1000	20000	–	220	239
BCV46	60	250	300	4000	–	220	235
BCV48	60	500	1000	10000	–	220	239
BCW29	32	100	250	120	260	150	263
BCW30	32	100	250	215	500	150	263
BCW61A	32	200	250	120	220	180	275
BCW61B	32	200	250	180	310	180	275
BCW61C	32	200	250	250	460	180	275
BCW61D	32	200	250	380	630	180	275
BCW69	45	100	250	120	260	150	279
BCW70	45	100	250	120	500	150	279
BCW89	60	100	250	120	260	150	287
BCX17	45	500	250	100	600	100	289
BCX18	25	500	250	100	600	100	289
BCX51	45	1000	1000	40	250	50	297
BCX52	60	1000	1000	40	160	50	297
BCX53	80	1000	1000	40	160	50	297
BCX71G	45	200	250	120	220	180	313
BCX71H	45	200	250	180	310	180	313
BCX71J	45	200	250	250	460	180	313
BCX71K	45	200	250	380	630	180	313
BSP30	60	1000	1500	40	120	100	643
BSP31	60	1000	1500	100	300	100	643
BSP32	80	1000	1500	40	120	100	643
BSP33	80	1000	1500	100	300	100	643
PMBT4403	40	600	250	100	300	200	925
PMBTA55	60	500	250	50	–	50	951
PMBTA56	80	500	250	50	–	50	951
PMBTA63	30	500	250	5000	–	125	953
PMBTA64	30	500	250	5000	–	125	953
PMSS3906	40	200	200	100	300	150	961

GENERAL PURPOSE APPLICATIONS *(continued)*

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mw)	h_{FE}		f_T typ. (MHz)	PAGE
				min.	max.		
PNP							
PMST3906	40	200	200	100	300	250	972
PXT4403	40	600	1000	100	300	200	1033
PXTA64	30	300	1000	20000	–	125	1045
PXTA92	300	500	1500	40	–	50	1047
PXTA93	200	500	1500	40	–	50	1047
PZTA55	60	500	1500	50	–	50	1075
PZTA56	80	500	1500	50	–	50	1075
PZTA63	30	500	1500	10000	–	125	1079
PZTA64	30	500	1500	10000	–	125	1079
PZTA92	300	500	1500	40	–	50	1081
PZTA93	200	500	1500	40	–	50	1081
2PA1576	40	100	200	120	560	100	1199
2PB709	25	200	250	160	460	80	1201
2PB709A	45	200	250	160	460	80	1201
2PB710	25	1000	250	85	340	140	1204
2PB710A	50	1000	250	85	340	140	1204
2PB1219	25	1000	200	85	340	140	1207
2PB1219A	50	1000	200	85	340	140	1207

HF APPLICATIONS

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mw)	h_{FE}		f_T typ. (MHz)	PAGE
				min.	max.		
NPN							
BF570	15	100	250	40	–	>490	503
BF840	40	25	250	–	–	380	537
BF841	40	25	250	–	–	380	537
BFS18	20	20	250	35	125	200	549
BFS19	20	30	250	65	225	260	549
BFS20	20	25	250	40	85	450	551
PNP							
BF550	40	25	250	50	–	325	501
BF824	30	25	250	–	–	450	533

SWITCHING APPLICATIONS

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mw)	h_{FE}		f_T typ. (MHz)	PAGE
				min.	max.		
NPN							
BSP50	45	500	1500	2000	–	–	651
BSP51	60	500	1500	2000	–	–	651
BSP52	80	500	1500	2000	–	–	651
BSR13	30	800	250	100	300	–	659
BSR14	40	800	250	100	300	–	659
BSR17A	40	200	250	100	300	–	667
BSR40	60	1000	1000	40	120	–	687
BSR41	60	1000	1000	100	300	–	687
BSR42	80	1000	1000	40	120	–	687
BSR43	80	1000	1000	100	300	–	687
BSS64	80	100	250	20	80	–	715
BST50	45	500	1000	1000	–	–	727
BST51	60	500	1000	1000	–	–	727
BST52	80	500	1000	1000	–	–	727
BSV52	12	100	250	40	120	–	743
PMBS3904	40	200	300	100	300	300	893
PMBT2222	30	600	250	100	300	–	901
PMBT2222A	40	600	250	100	300	–	901
PMBT2369	40	500	250	40	120	–	905
PMBT3904	40	200	300	100	300	–	913
PMST2369	15	500	200	40	120	–	965
PMST4401	40	600	200	100	300	250	976
PXT2222	30	600	1000	100	300	–	1013
PXT2222A	40	600	1000	100	300	–	1013
PXT3904	40	200	1000	100	300	–	1021
PZT2222	30	600	1500	100	300	–	1049
PZT2222A	40	600	1500	100	300	–	1049
PZT3904	40	200	1500	100	300	–	1059
PNP							
BSP60	45	500	1500	2000	–	–	655
BSP61	60	500	1500	2000	–	–	655
BSP62	80	500	1500	2000	–	–	655
BSR15	40	600	250	100	300	–	663
BSR16	60	600	250	100	300	–	663
BSR18A	40	200	250	100	300	–	671
BSR30	60	1000	1000	40	120	–	683

SWITCHING APPLICATIONS *(continued)*

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mw)	h_{FE} min.	h_{FE} max.	f_T typ. (MHz)	PAGE
PNP							
BSR31	60	1000	1000	100	300	–	683
BSR32	80	1000	1000	40	120	–	683
BSR33	80	1000	1000	100	300	–	683
BSS63	100	100	250	30	–	–	713
BST60	45	500	1000	1000	–	–	731
BST61	60	500	1000	1000	–	–	731
BST62	80	500	1000	1000	–	–	731
PMBS3906	40	200	300	100	300	250	897
PMBT2907	40	600	250	30	50	–	907
PMBT2907A	60	600	250	30	50	–	907
PMBT3906	40	200	250	100	300	–	917
PMST4403	40	600	200	100	300	200	980
PXT2907	40	600	1000	100	300	–	1017
PXT2907A	60	600	1000	100	300	–	1017
PXT3906	40	200	1000	100	300	–	1025
PZT2907	40	600	1500	100	300	–	1053
PZT2907A	60	600	1500	100	300	–	1053
PZT3906	40	200	1500	100	300	–	1061

LOW NOISE APPLICATIONS

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mw)	h_{FE} min.	h_{FE} max.	f_T typ. (MHz)	PAGE
NPN							
BC849	30	100	250	–	800	300	173
BC850	45	100	250	–	800	300	173
BCF32	32	100	250	200	450	300	213
BCF33	32	100	250	420	800	300	213
BCF81	45	100	250	420	800	300	221
PMBT5088	30	50	250	350	–	200	929

LOW NOISE APPLICATIONS *(continued)*

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mw)	h_{FE}		f_T typ. (MHz)	PAGE
				min.	max.		
PNP							
BC859	30	100	250	125	800	150	187
BC860	45	100	250	125	800	150	187
BCF29	32	100	250	120	260	150	209
BCF30	32	100	250	215	500	150	209
BCF70	45	100	250	215	500	150	217

HIGH VOLTAGE APPLICATIONS

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mw)	h_{FE}		f_T typ. (MHz)	PAGE
				min.	max.		
NPN							
BF620	–	50	1000	50	–	–	513
BF622	250	50	1000	50	–	–	513
BF720	–	50	1500	50	–	–	517
BF722	250	50	1500	50	–	–	517
BF820	–	50	310	50	–	–	525
BF822	250	50	310	50	–	–	525
BSP19	350	1000	1500	40	–	–	641
BSP20	250	1000	1500	40	–	–	641
BSR19	140	600	350	60	250	–	675
BSR19A	160	600	360	80	250	–	675
BST39	350	1000	1000	40	160	–	725
BST40	250	1000	1000	40	160	–	725
PMBT5551	160	600	250	80	250	–	937
PMBTA42	300	500	250	40	–	–	947
PMBTA43	200	500	250	40	–	–	947
PXTA42	300	500	1500	40	–	50	1041
PXTA43	200	500	1500	40	–	50	1041
PZTA44	400	300	1500	40	–	20	1072
PZTA45	350	300	1500	40	–	20	1072
PNP							
BF621	–	20	1000	50	–	–	515
BF623	250	20	1000	50	–	–	515
BF721	–	50	1500	50	–	–	519
BF723	250	50	1500	50	–	–	519

HIGH VOLTAGE APPLICATIONS *(continued)*

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mw)	h_{FE}		f_T typ. (MHz)	PAGE
				min.	max.		
PNP							
BF821	–	50	250	50	–	–	531
BF823	250	50	250	50	–	–	531
BSP15	200	1000	1500	30	150	–	639
BSP16	300	1000	1500	30	120	–	639
BSR20	120	600	250	40	180	–	679
BSR20A	150	600	250	60	240	–	679
BST15	200	1000	1000	30	150	–	723
BST16	300	1000	1000	30	120	–	723
PMBT5401	150	500	250	60	240	–	933
PMBTA92	300	500	250	40	–	–	955
PMBTA93	200	500	250	40	–	–	955

DIGITAL APPLICATIONS

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mw)	h_{FE}		f_T typ. (MHz)	PAGE
				min.	max.		
NPN							
PDTC114ET	50	100	250	30	–	100	869
PDTC124ET	50	100	250	56	–	100	871
PDTC143ET	50	100	250	20	–	–	873
PDTC144ET	50	100	250	68	–	100	875
PDTD114ET	50	500	250	56	–	100	877
PNP							
PDTA114ET	50	100	250	30	–	100	859
PDTA124ET	50	100	250	56	–	100	861
PDTA143ET	50	100	250	20	–	–	863
PDTA144ET	50	100	250	68	–	100	865
PDTB114ET	50	500	250	56	–	100	867

SPECIAL APPLICATIONS

TYPE NUMBER	V_{CEO} (V)	I_C (mA)	P_{tot} (mw)	h_{FE} min.	h_{FE} max.	f_T typ. (MHz)	PAGE
PNP							
BCV62	30	100	250	100	800	150	247
BCV64	30	100	250	100	900	200	255
NPN							
BCV61	30	100	250	110	800	300	243
BCV63	30	100	250	100	900	200	251
NPN/PNP							
BCV65	30	100	250	75	800	100	259

TRIGGER APPLICATIONS

TYPE	V_{GA}	I_A	I_P	I_V	PAGE
BRY61	70	175	5/1	30/50	629
BRY62	70	175	–	–	633

CONVERSION LIST

CONVERSION LIST FROM LEADED TO SMD TYPES

LEADED	SMD
BC107	BC847
BC107A	BC847A
BC107B	BC847B
BC108	BC848
BC108A	BC848A
BC108B	BC848B
BC108C	BC848C
BC109	BC849
BC109B	BC849B
BC109C	BC849C
BC177	BC857
BC177A	BC857A
BC177B	BC857B
BC178	BC858
BC178A	BC858A
BC178B	BC858B
BC179	BC859
BC179A	BC859A
BC179B	BC859B
BC327	BC807
BC327-16	BC807-16
BC327-25	BC807-25
BC327-40	BC807-40
BC328	BC808
BC328-16	BC808-16
BC328-25	BC808-25
BC328-40	BC808-40
BC337	BC817
BC337-16	BC817-16
BC337-25	BC817-25
BC337-40	BC817-40
BC338	BC818
BC338-16	BC818-16
BC338-25	BC818-25
BC338-40	BC818-40
BC368	BC868
BC369	BC869
BC516	BCV26
BC517	BCV27

LEADED	SMD
BC546	BC846
BC546A	BC846A
BC546B	BC846B
BC547	BC847
BC547A	BC847A
BC547B	BC847B
BC547C	BC847C
BC548	BC848
BC548A	BC848A
BC548B	BC848B
BC548C	BC848C
BC549	BC849
BC549B	BC849B
BC549C	BC849C
BC550	BC850
BC550B	BC850B
BC550C	BC850C
BC556	BC856
BC556A	BC856A
BC556B	BC856B
BC557	BC857
BC557A	BC857A
BC557B	BC857B
BC557C	BC857C
BC558	BC858
BC558A	BC858A
.	BCW29
BC558B	BC858B
BC558C	BC858C
BC559	BC859
BC559A	BC859A
BC559B	BC859B
BC559C	BC859C
BC560	BC860
BC560A	BC860A
BC560B	BC860B
BC560C	BC860C
BC635	BCX54
	BCP54

LEADED	SMD
BC635-10	BCX54-10
	BCP54-10
BC635-16	BCX54-16
	BCP54-16
BC636	BCX51
	BCP51
BC636-10	BCX51-10
	BCP51-10
BC636-16	BCX51-16
	BCP51-16
BC637	BCX55
	BCP55
BC637-10	BCX55-10
	BCP55-10
BC637-16	BCX55-16
	BCP55-16
BC638	BCX52
	BCP52
BC638-10	BCX52-10
	BCP52-10
BC638-16	BCX52-16
	BCP52-16
BC639	BCX56
	BCP56
BC639-10	BCX56-10
	BCP56-10
BC639-16	BCX56-16
	BCP56-16
BC640	BCX53
	BCP53
BC640-10	BCX53-10
	BCP53-10
BC640-16	BCX53-16
	BCP53-16
BCX58	BCW60
BCX59	BCX70
BCX78	BCW61
BCX79	BCX71
BCY56	BC850B

LEADED	SMD
BCY57	BC849
BCY58	BC849
	BCW60 family
BCY58-VII	BCW60A
BCY58-VIII	BCW60B
BCY58-IX	BCW60C
BCY58-X	BCW60D
BCY59	BCX70 fam.
BCY59-VII	BCX70G
BCY59-VIII	BCX70H
BCY59-IX	BCX70J
BCY59-X	BCX70K
BCY65	BCV71
	BCV72
BCY70	BCF70
BCY71	BCF70
BCY72	BCF29/30
BCY78	BCW61 fam.
BCY78-VII	BCW16A
BCY78-VIII	BCW61B
BCY78-IX	BCW61C
BCY78-X	BCW61D
BCY79	BCX71 fam.
BCY79-VII	BCX71G
BCY79-VIII	BCX71H
BCY79-IX	BCX71J
BD135	BCX54
	BCP54
BD135-10	BCX54-10
	BCP54-10
BD135-16	BCX54-16
	BCP54-16
BD136	BCX51
	BCP54
BD136-10	BCX51-10
	BCP51-10
BD136-16	BCX51-16
	BCP51-16
BD137	BCX55
	BCP55
BD137-10	BCX55-10

LEADED	SMD
	BCP55-10
BD137-16	BCX55-16
	BCP55-16
BD138	BCX52
	BCP52
BD138-10	BCX52-10
	BCP52-10
BD138-16	BCX52-16
	BCP52-16
BD139	BCX56
	BCP56
BD139-10	BCX56-10
	BCP56-10
BD139-16	BCX56-16
	BCP56-16
BD140	BCX53
	BCP53
BD140-10	BCX53-10
	BCP53-10
BD140-16	BCX53-16
	BCP53-16
BDX42	BST50
	BSP50
BDX43	BST51
	BSP51
BDX44	BST52
	BSP52
BDX45	BST60
	BSP60
BDX46	BST61
	BSP61
BDX47	BST61
	BSP61
BF199	BFS20
BF240	BF840
BF241	BF841
BF324	BF824
BF370	BF570
BF419	BST40
	BSP20
BF420	BF620

LEADED	SMD
	BF720
	BF820
BF421	BF621
	BF721
	BF821
BF422	BF622
	BF722
	BF822
BF423	BF623
	BF723
	BF823
BF450	BF550
BF451	BF550
BF457	BST40
BF458	BST40
BF459	BST39
BF469	BF622
	BF722
BF470	BF623
	BF723
BF471	BF620
	BF720
BF472	BF621
	BF721
BF483	BF722
BF484	BF723
BF485	BF720
BF486	BF721
BF494	BFS19
BF494B	BFS19
BF495	BFS18
BF459C	BFS18
BF459D	BFS18
BF819	BST40
	BSP20
BF857	BST40
	BSP20
BF858	BST40
	BSP20
BF859	BST39
BF869	BF622

LEADED	SMD
	BF722
BF870	BF623
	BF723
BF871	BF620
	BF720
BF872	BF621
	BF721
BFR54	BSV52
BFT44	BST16
	BSP16
BFT45	BST15/16
	BSP15/16
BFX29	BSR16
BFX30	BSR16
BFX84	BSR40
	BSP40
BFX85	BSR41
	BSP41
BFX87	BSR16
BFX88	BSR15
BFY50	BSR40
	BSP40
BFY51	BSR40
	BSP40
BFY52	BSR40
	BSP40
BFY55	BSR40
BR101	BRY62
BRY39	BRY62
BRY56	BRY61
BSR50	BST50
	BSP50
BSR51	BST51
	BSP51
BSR52	BST52
	BSP52
BSR60	BST60
	BSP60
BSR61	BST61
	BSP61
BSR62	BST62

LEADED	SMD
	BSP62
BSS38	BSS64
BSS50	BST50
	BSP50
BSS51	BST51
	BSP51
BSS52	BST52
	BSP52
BSS60	BST60
	BSP60
BSS61	BST61
	BSP61
BSS62	BST62
	BSP62
BSS68	BSS63
BSV15	BSR30/31
	BSP30/31
BSV15-10	BSR30/31
	BSP30/31
BSV15-16	BSR31
	BSP31
BSV16	BSR30/31
	BSP30/31
BSV16-10	BSR30/31
	BSP30/31
BSV16-16	BSR31
	BSP31
BSV17	BSR32/33
	BSP32/33
BSV17-10	BSR32/33
	BSP32/33
BSX20	BSV52
	PMBT2369
BSX45	BSR40/41
	BSP40/41
BSX45-10	BSR40/41
	BSP40/41
BSX45-16	BSR41
	BSP41
BSX46	BSR40/41
	BSP40/41

LEADED	SMD
BSX46-10	BSR40/41
BSX46-16	BSR41
BSX47	BSR42/43
BSX47-10	BSR42-43
MPS6513	BC848A
MPS6514	BC848A
MPS6515	BC848B
MPS6517	BC858A
MPS6518	BC858A
MPS6519	BC858B
MPS6520	BC859B
MPS6521	BC859C
MPS6522	BC859B
MPS6523	BC859C
MPSA05	PMBTA05
MPSA06	PMBTA06
MPSA13	PMBTA13
MPSA14	PMBTA14
MPSA42	PMBTA42
MPSA43	PMBTA43
MPSA55	PMBTA55
MPSA56	PMBTA56
MPSA63	PMBTA63
MPSA64	PMPTA64
MPSA92	PMBTA92
MPSA93	PMBTA93
PH2222	PMBT2222
PH2222A	PMBT2222A
PH2369	PMBT2369
PH2907	PMBT2907
PH2907A	PMBT2907A
PN2222	PMBT2222
PN2222A	PMBT2222A
PN2369	PMBT2369
PN2369A	PMBT2369A
PN2907	PMBT2907
PM2907A	PMBT2907A
PN3439	BST39
	BSP19
PN3440	BST40
	BSP20

LEADED	SMD
PN5415	BST15
	BSP15
PN5416	BST16
	BSP16
2N930	BC850
2N1613	BSR40
2N1711	BSR41
2N1893	BSR42
2N2219	PMBT2222
2N2219A	PMBT2222A
2N2222	PMBT2222
2N2222A	PMBT2222A
2N2297	BSR40
2N2369	PMBT2369
2N2369A	PMBT2369A
2N2483	BC850B

LEADED	SMD
2N2484	BC850B/C
2N2905	PMBT2907
2N2905A	PMBT2907A
2N2907	PMBT2907
2N2907A	PMBT2907A
2N3019	BSR43
	BSP43
2N3020	BSR42
	BSP42
2N3053	BSR40/41
	BSP40/41
2N3904	PMBT3904
2N3906	PMBT3906
2N4030	BSR30
2N4031	BSR32
2N4032	BSR31

LEADED	SMD
2N4033	BSR33
2N4124	PMBS3904
2N4126	PMBS3906
2N4400	PMBT4400
2N4401	PMBT4401
2N4402	PMBT4402
2N4403	PMBT4403
2N5086	PMBT5086
2N5087	PMBT5087
2N5088	PMBT5088
2N5415	BST15
	BSP15
2N5416	BST16
	BSP16

MARKING

MARKING LIST

Types in SC59, SC70, SOT23, SOT89, SOT143, SOT223 and SOT323 packages are marked with a code as listed in the following tables. The actual type number and data code are on the packing.

MARK	TYPE NO.
A27	PXTA27
AA	BCX51
AAp	BCW60A
ABp	BCW60B
AC	BCX51-10
ACp	BCW60C
AD	BCX51-16
ADp	BCW60D
AE	BCX52
AG	BCX52-10
AGp	BCX70G
AH	BCX53
AHp	BCX70H
AJp	BCX70J
AK	BCX53-10
AKp	BCX70K
AL	BCX53-16
AM	BCX52-16
AMp	BSS64
AR	2PB709R
AR1	BSR40
AR2	BSR41
AR3	BSR42
AR4	BSR43
AS	2PB709S
AS1	BST50
AS2	BST51
AS3	BST52
AQ	2PB709Q
AT1	BST39
AT2	BST40
B2p	BSV52
B26	BF570
BAp	BCW61A
BA	BCX54
BBp	BCW61B
BCp	BCW61C

MARK	TYPE NO.
BC	BCX54-10
BCP51	BCP51
BCP51-10	BCP51-10
BCP51-16	BCP51-16
BCP52	BCP52
BCP52-10	BCP52-10
BCP52-16	BCP52-16
BCP53	BCP53
BCP53-10	BCP53-10
BCP53-16	BCP53-16
BCP54	BCP54
BCP54-10	BCP54-10
BCP54-16	BCP54-16
BCP55	BCP55
BCP55-10	BCP55-10
BCP55-16	BCP55-16
BCP56	BCP56
BCP56-10	BCP56-10
BCP56-16	BCP56-16
BCP68	BCP68
BCP68-10	BCP68-10
BCP68-16	BCP68-16
BCP68-25	BCP68-25
BCP69	BCP69
BCP69-10	BCP69-10
BCP69-16	BCP69-16
BCP69-25	BCP69-25
BD	BCX54-16
BDp	BCW61D
BE	BCX55
BF720	BF720
BF721	BF721
BF722	BF722
BF723	BF723
BG	BCX55-10
BGp	BCX71G
BH	BCX56

MARK	TYPE NO.
BHp	BCX71H
BJp	BCX71J
BK	BCX56-10
BKp	BCX71K
BL	BCX56-16
BM	BCX55-16
BMp	BSS63
BQ	2PB709AQ
BR	2PB709AR
BR1	BSR30
BR2	BSR31
BR3	BSR32
BR4	BSR33
BRY61	A5p
BRY62	A51
BS	2PB709AS
BS1	BST60
BS2	BST61
BS3	BST62
BSP15	BSP15
BSP16	BSP16
BSP19	BSP19
BSP20	BSP20
BSP30	BSP30
BSP31	BSP31
BSP32	BSP32
BSP33	BSP33
BSP40	BSP40
BSP41	BSP41
BSP42	BSP42
BSP43	BSP43
BSP50	BSP50
BSP51	BSP51
BSP52	BSP52
BSP60	BSP60
BSP61	BSP61
BSP62	BSP62

MARK	TYPE NO.
BT1	BST15
BT2	BST16
C1p	BCW29
C2p	BCW30
C7p	BCF29
C8p	BCF30
C95	BCV64
C96	BCV64B
CAC	BC868
CBC	BC868-10
CCC	BC868-16
CDC	BC868-25
CEC	BC869
CGC	BC869-10
CQ	2PB710Q
CR	2PB710R
CS	2PB710S
D1p	BCW31
D2p	BCW32
D3p	BCW33
D7p	BCF32
D8p	BCF33
D95	BCV63
D96	BCV63B
DA	BF622
DB	BF623
DC	BF620
DF	BF621
DQ	2PB710AQ
DR	2PB710AR
DS	2PB710AS
ED	BCV28
EF	BCV29
EG	BCV49
F1p	BFS18
F2p	BFS19
F8p	BF824
FDp	BCV26
FEp	BCV46
FFp	BCV27
FGp	BCV47

MARK	TYPE NO.
FQ	2PA1576Q
FR	2PA1576R
FS	2PA1576S
G1p	BFS20
H1p	BCW69
H2p	BCW70
H3p	BCW89
H7p	BCF70
K1p	BCW71
K2p	BCW72
K3p	BCW81
K7p	BCV71
K8p	BCV72
K9p	BCF81
LAp	BF550
M86	BF556C
NCp	BF840
NDp	BF841
PZTA06	PZTA06
PZTA13	PZTA13
PZTA14	PZTA14
PZTA44	PZTA44
PZTA45	PZTA45
p01	PDTA143ET
	(SOT23)
p02	PDTC143ET
	(SOT23)
p03	PDTA114ET
	(SOT23)
p04	PMBS3904
	PDTC114ET
	(SOT23)
p05	PDTA124ET
	(SOT23)
p06	PMBS3906
	PDTC124ET
	(SOT23)
p07	PDTA144ET
	(SOT23)
p08	PDTC144ET
	(SOT23)

MARK	TYPE NO.
p09	PDTB114ET
	(SOT23)
p10	PDTD114ET
	(SOT23)
p1A	PMBT3904
	(SOT23)
	PXT3904
	(SOT89)
p1B	PMBT2222
	(SOT23)
	PXT2222
	(SOT89)
p1D	PMBTA42
	PXTA42
p1E	PMBTA43
	PTXA43
p1F	PMBT5550
p1G	PMBTA06
p1H	PMBTA05
p1J	PMBT2369
p1K	PMBT6428
p1L	PMBT6429
p1M	PMBTA13
p1N	PMBTA14
	(SOT23)
	PXTA14
	(SOT89)
p1P	PMBT2222A
	(SOT23)
	PXT2222A
	(SOT89)
p1Q	PMBT5088
p1R	PMBT5089
p2A	PMBT3906
	(SOT23)
	PXT3906
	(SOT89)
p2B	PMBT2907
	(SOT23)
	PXT2907
	(SOT89)

MARK	TYPE NO.
p2D	PMBTA92
	PXTA92
p2E	PMBTA93
	PXTA93
p2F	PMBT2907A
	(SOT23)
	PXT2907A
	(SOT89)
p2G	PMBTA56
p2H	PMBTA55
p2L	PMBT5401
p2T	PMBT4403
	(SOT23)
	PXT4403
	(SOT89)
p2U	PMBTA63
p2V	PMBTA63
p2V	PMBTA64
	(SOT23)
	PXTA64
	(SOT89)
p2X	PMBT4401
	(SOT23)
pG1	PMBT5551
T1p	BCX17
T2p	BCX18
T7p	BSR15
T8p	BSR16
T9p	BSR18
T35	BSR20
T36	BSR20A
T92	BSR18A
U1p	BCX19
U2p	BCX20
U7p	BSR13
U8p	BSR14
U9p	BSR17
U35	BSR19
U36	BSR19A
U92	BSR17A
V25	PMBT3640

MARK	TYPE NO.
WQ	2PD602Q
WR	2PD602R
WS	2PD602S
XQ	2PD602AQ
XR	2PD602AR
XS	2PD602AS
YQ	2PD601Q
YR	2PD601R
YS	2PD601S
ZQ	2PD601AQ
ZR	2PD601AR
ZS	2PD601AS
ZTA42	PZTA42
ZTA43	PZTA43
04	PMSS3904
06	PMSS3906
1A	BC846AW
1A	PMST3904
1Ap	BC846A
1B	BC846BW
1Bp	BC846B
1D	BC846W
1Dp	BC846
1E	BC847AW
1Ep	BC847A
1F	BC847BW
1Fp	BC847B
1G	BC847CW
1Gp	BC847C
1H	BC847W
1Hp	BC847
1J	BC848AW
1Jp	BC848A
	(SOT23)
1Jp	BCV61A
	(SOT143)
1K	BC848BW
1Kp	BC848B
	(SOT23)
1Kp	BCV61B
	(SOT143)

MARK	TYPE NO.
1L	BC848CW
1Lp	BC848C
	(SOT23)
1Lp	BCV61C
	(SOT143)
1M	BC848W
1Mp	BC848
	(SOT23)
1Mp	BCV61
	(SOT143)
1Q	PMST5088
1R	PMST5089
1Vp	BF820
1Wp	BF821
1Xp	BF822
1Yp	BF823
2B	BC849BW
2Bp	BC849B
2C	BC849CW
2Cp	BC849C
2D	BC849W
2Dp	BC849
2F	BC850BW
2Fp	BC850B
2G	BC850CW
2Gp	BC850C
2H	BC850W
2Hp	BC850
2T	PMST4403
3A	BC856AW
3Ap	BC856A
3B	BC856BW
3Bp	BC856B
3BR	BC856BR
3D	BC856W
3Dp	BC856
3E	BC857AW
3Ep	BC857A
3F	BC857BW
3Fp	BC857B
3G	BC857CW

MARK	TYPE NO.
3Gp	BC857C
3H	BC857W
3Hp	BC857
3J	BC858AW
3Jp	BC858A
3K	BC858BW
3Kp	BC858B
3L	BC858CW
3Lp	BC858C
3Ip	BCV62A
3Kp	BCV62B
3Lp	BCV62C
3M	BC858W
3Mp	BCV62
3Mp	BC858
4A	BC859AW
4Ap	BC859A
4B	BC859BW
4Bp	BC859B
4C	BC859CW
4Cp	BC859C
4D	BC859W
4Dp	BC859
4E	BC860AW
4Ep	BC860A

MARK	TYPE NO.
4F	BC860BW
4Fp	BC860B
4G	BC860CW
4Gp	BC860C
4H	BC860W
4Hp	BC860
5A	BC807-16W
5Ap	BC807-16
5B	BC807-25W
5Bp	BC807-25
5C	BC807-40W
5Cp	BC807-40
5D	BC807W
5Dp	BC807
5E	BC808-16W
5Ep	BC808-16
5F	BC808-25W
5Fp	BC808-25
5G	BC808-40W
5Gp	BC808-40
5H	BC808W
5Hp	BC808
6A	BC817-16W
6Ap	BC817-16
6B	BC817-25W

MARK	TYPE NO.
6Bp	BC817-25
6C	BC817-40W
6Cp	BC817-40
6D	BC817W
6Dp	BC817
6E	BC818-16W
6Ep	BC818-16
6F	BC818-25W
6Fp	BC818-25
6G	BC818-40W
6Gp	BC818-40
6H	BC818W
6Hp	BC818
97p	BCV65
98p	BCV65B
-1P	PMST2222A
-1L	PMST2369
-2A	PMST3906
-2X	PMST4401
-2L	PMST5401
-1F	PMST5550
-1K	PMST6428
-1L	PMST6429

GENERAL

QUALITY

Total Quality Management

Philips Semiconductors is a Quality Company, renowned for the high quality of our products and service. We keep alive this tradition by constantly aiming towards one ultimate standard, that of zero defects. This aim is guided by our Total Quality Management (TQM) system, the basis of which is described in the following paragraphs.

QUALITY ASSURANCE

Based on ISO 9000 standards, customer standards such as Ford TQE and IBM MDQ. Our factories are certified to ISO 9000 by external inspectorates.

PARTNERSHIPS WITH CUSTOMERS

PPM co-operations, design-in agreements, ship-to-stock, just-in-time and self-qualification programmes, and application support.

PARTNERSHIPS WITH SUPPLIERS

Ship-to-stock, statistical process control and ISO 9000 audits.

QUALITY IMPROVEMENT PROGRAMME

Continuous process and system improvement, design improvement, complete use of statistical process control, realization of our final objective of zero defects, and logistics improvement by ship-to-stock and just-in-time agreements.

Advanced quality planning

During the design and development of new products and processes, quality is built-in by advanced quality planning. Through failure-mode-and-effect analysis the critical parameters are detected and measures taken to ensure good performance on these parameters. The capability of process steps is also planned in this phase.

Product conformance

The assurance of product conformance is an integral part of our quality assurance (QA) practice. This is achieved by:

- Incoming material management through partnerships with suppliers.
- In-line quality assurance to monitor process reproducibility during manufacture and initiate any necessary corrective action. Critical process steps are 100% under statistical process control.
- Acceptance tests on finished products to verify conformance with the device specification. The test results are used for quality feedback and corrective actions. The inspection and test requirements are detailed in the general quality specifications.
- Periodic inspections to monitor and measure the conformance of products.

Product reliability

With the increasing complexity of Original Equipment Manufacturer (OEM) equipment, component reliability must be extremely high. Our research laboratories and development departments study the failure mechanisms of semiconductors. Their studies result in design rules and process optimization for the highest built-in product reliability. Highly accelerated tests are applied to the products reliability evaluation. Rejects from reliability tests and from customer complaints are submitted to failure analysis, to result in corrective action.

Customer responses

Our quality improvement depends on joint action with our customer. We need our customer's inputs and we invite constructive comments on all aspects of our performance. Please contact our local sales representative.

Recognition

The high quality of our products and services is demonstrated by many Quality Awards granted by major customers and international organizations.

PRO ELECTRON TYPE NUMBERING SYSTEM

Basic type number

This type designation code applies to discrete semiconductor devices (not integrated circuits), multiples of such devices, semiconductor chips and Darlington transistors.

FIRST LETTER

The first letter gives information about the material for the active part of the device.

- A germanium or other material with a band gap of 0.6 to 1 eV
- B silicon or other material with a band gap of 1 to 1.3 eV
- C gallium arsenide (GaAs) or other material with a band gap of 1.3 eV or more
- R compound materials, e.g. cadmium sulphide

SECOND LETTER

The second letter indicates the function for which the device is primarily designed. The same letter can be used for multi-chip devices with similar elements.

In the following list low power types are defined by $R_{th\ j\text{-}mb} > 15$ K/W and power types by $R_{th\ j\text{-}mb} \leq 15$ K/W.

- A diode; signal, low power
- B diode; variable capacitance
- C transistor; low power, audio frequency
- D transistor; power, audio frequency
- E diode; tunnel
- F transistor; low power, high frequency
- G multiple of dissimilar devices/miscellaneous devices; e.g. oscillators. Also with special third letter; see under Section "Serial number"
- H diode; magnetic sensitive
- L transistor; power, high frequency
- N photocoupler
- P radiation detector; e.g. high sensitivity photo-transistor; with special third letter
- Q radiation generator; e.g. LED, laser; with special third letter
- R control or switching device; e.g. thyristor, low power; with special third letter
- S transistor; low power, switching
- T control or switching device; e.g. thyristor, low power; with special third letter
- U transistor; power, switching
- W surface acoustic wave device
- X diode; multiplier, e.g. varactor, step recovery
- Y diode; rectifying, booster
- Z diode; voltage reference or regulator, transient suppressor diode; with special third letter.

SERIAL NUMBER

The number comprises three figures running from 100 to 999 for devices primarily intended for consumer equipment, or one letter (Z, Y, X, etc.) and two figures running from 10 to 99 for devices primarily intended for industrial or professional equipment.(1)

(1) When the supply of these serial numbers is exhausted, the serial number may be expanded to three figures for industrial types and four figures for consumer types.

Version letter

A letter may be added to the basic type number to indicate minor electrical or mechanical variants of the basic type.

RATING SYSTEMS

The rating systems described are those recommended by the IEC in its publication number 134.

Definitions of terms used

ELECTRONIC DEVICE

An electronic tube or valve, transistor or other semiconductor device. This definition excludes inductors, capacitors, resistors and similar components.

CHARACTERISTIC

A characteristic is an inherent and measurable property of a device. Such a property may be electrical, mechanical, thermal, hydraulic, electro-magnetic or nuclear, and can be expressed as a value for stated or recognized conditions. A characteristic may also be a set of related values, usually shown in graphical form.

BOGEY ELECTRONIC DEVICE

An electronic device whose characteristics have the published nominal values for the type. A bogey electronic device for any particular application can be obtained by considering only those characteristics that are directly related to the application.

RATING

A value that establishes either a limiting capability or a limiting condition for an electronic device. It is determined for specified values of environment and operation, and may be stated in any suitable terms. Limiting conditions may be either maxima or minima.

RATING SYSTEM

The set of principles upon which ratings are established and which determine their interpretation. The rating system indicates the division of responsibility between the device manufacturer and the circuit designer, with the object of ensuring that the working conditions do not exceed the ratings.

Absolute maximum rating system

Absolute maximum ratings are limiting values of operating and environmental conditions applicable to any electronic device of a specified type, as defined by its published data, which should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environmental variations, and the effects of changes in operating conditions due to variations in the characteristics of the device under consideration and of all other electronic devices in the equipment.

The equipment manufacturer should design so that, initially and throughout the life of the device, no absolute maximum value for the intended service is exceeded with any device, under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, equipment control adjustment, load variations, signal variation, environmental conditions, and variations in characteristics of the device under consideration and of all other electronic devices in the equipment.

Design maximum rating system

Design maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in the characteristics of the electronic device under consideration.

The equipment manufacturer should design so that, initially and throughout the life of the device, no design maximum value for the intended service is exceeded with a bogey electronic device, under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, variation in characteristics of all other devices in the equipment, equipment control adjustment, load variation, signal variation and environmental conditions.

Design centre rating system

Design centre ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under normal conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device in average applications, taking responsibility for normal changes in operating conditions due to rated supply voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in the characteristics of all electronic devices.

The equipment manufacturer should design so that, initially, no design centre value for the intended service is exceeded with a bogey electronic device in equipment operating at the stated normal supply voltage.

LETTER SYMBOLS

The letter symbols for transistors detailed in this section are based on IEC publication number 148.

Basic letters

In the representation of currents, voltages and powers, lower-case letter symbols are used to indicate all instantaneous values that vary with time. All other values are represented by upper-case letters.

Electrical parameters[1] of external circuits and of circuits in which the device forms only a part are represented by upper-case letters. Lower-case letters are used for the representation of electrical parameters inherent in the device. Inductances and capacitances are always represented by upper-case letters.

The following is a list of basic letter symbols used with semiconductor devices:

B, b	susceptance (imaginary part of an admittance)
C	capacitance
G, g	conductance (real part of an admittance)
H, h	hybrid parameter
I, i	current
L	inductance
P, p	power
R, r	resistance (real part of an impedance)
V, v	voltage
X, x	reactance (imaginary part of an impedance)
Y, y	admittance
Z, z	impedance

(1) For the purpose of this publication, the term 'electrical parameters' applies to four-pole matrix parameters, elements of electrical equivalent circuits, electrical impedances and admittances, inductances and capacitances.

Subscripts

Upper-case subscripts are used for the indication of:

- continuous (DC) values (without signal), e.g. I_B
- instantaneous total values, e.g. i_B
- average total values, e.g. $I_{B(AV)}$
- peak total values, e.g. I_{BM}
- root-mean-square total values, e.g. $I_{B(RMS)}$.

Lower-case subscripts are used for the indication of values applying to the varying component alone:

- instantaneous values, e.g. i_b
- root-mean-square values, e.g. $I_{b(rms)}$
- peak values, e.g. I_{bm}
- average values, e.g. $I_{b(av)}$.

The following is a list of subscripts used with basic letter symbols for semiconductor devices:

A, a	anode
amb	ambient
(AV), (av)	average value
B, b	base
(BO)	breakover
(BR)	breakdown
case	case
C, c	collector
C	controllable
D, d	drain
E, e	emitter
F, f	fall, forward (or forward transfer)
G, g	gate
H	holding
h	heatsink
I, i	input
j-a	junction to ambient
j-mb	junction to mounting base
K, k	cathode
L	load
M, m	peak value
(min)	minimum
(max)	maximum
mb	mounting base
O, o	as third subscript: the terminal not mentioned is open-circuit
(OV)	overload
P, p	pulse
Q, q	turn-off
R, r	as first subscript: reverse (or reverse transfer), rise. As second subscript: repetitive, recovery. As third subscript: with a specified resistance between the terminal not mentioned and the reference terminal
(RMS), (rms)	root-mean-square value
S, s	as first subscript: series, source, storage, stray, switching. As second subscript: surge (non-repetitive). As third subscript: short circuit between the terminal not mentioned and the reference terminal
stg	storage
th	thermal
TO	threshold
tot	total
W	working
X, x	specified circuit
Z, z	reference or regulator (zener)
1	input (four-pole matrix)
2	output (four-pole matrix).

Applications and examples

TRANSISTOR CURRENTS

The first subscript indicates the terminal carrying the current (conventional current flow from the external circuit into the terminal is positive).

Examples: I_B, i_B, i_b, I_{bm}.

TRANSISTOR VOLTAGES

A voltage is indicated by the first two subscripts: the first identifies the terminal at which the voltage is measured and the second the reference terminal or the circuit node. The second subscript may be omitted when there is no possibility of confusion.

Examples: V_{BE}, v_{BE}, v_{be}, V_{bem}.

SUPPLY VOLTAGES OR CURRENTS

Supply voltages or supply currents are indicated by repeating the appropriate terminal subscript.

Examples: $V_D = C_C$, I_{EE}.

A reference terminal is indicated by a third subscript.

Example: V_{CCE}.

DEVICES WITH MORE THAN ONE TERMINAL OF THE SAME KIND

If a device has more than one terminal of the same kind, the subscript is formed by the appropriate letter for the terminal, followed by a number. Hyphens may be used to avoid confusion in multiple subscripts.

Examples:

I_{B2} continuous (DC) current flowing into the second gate terminal

$V_{B2\text{-}E}$ continuous (DC) voltage between the terminals of second gate and source.

MULTIPLE DEVICES

For multiple unit devices, the subscripts are modified by a number preceding the letter subscript. Hyphens may be used to avoid confusion in multiple subscripts.

Examples:

I_{2C} continuous (DC) current flowing into the drain terminal of the second unit

$V_{1C\text{-}2C}$ continuous (DC) voltage between the drain terminals of the first and second units.

ELECTRICAL PARAMETERS

The upper-case variant of a subscript is used for the designation of static (DC) values.

Examples:

h_{FE} static value of forward current transfer in common-emitter configuration (DC current gain)

R_E DC value of the external emitter resistance.

The static value is the slope of the line from the origin to the operating point on the appropriate characteristic curve, i.e. the quotient of the appropriate electrical quantities at the operating point.

The lower-case variant of a subscript is used for the designation of small-signal values.

Examples:

h_{fe} small-signal value of the short-circuit forward current transfer in common-emitter configuration

$Z_i = R_i + jX_i$ small-signal value of the input impedance.

If more than one subscript is used, subscripts for which a choice of style is allowed, the subscripts chosen are all upper-case or all lower-case.

Examples: h_{FE}, y_{RE}, h_{fe}, g_{FS}.

FOUR-POLE MATRIX PARAMETERS

The first letter subscript (or double numeric subscript) indicates input, output, forward transfer or reverse transfer.

Examples: h_i (or h_{11}), h_o (or h_{22}), h_f (or h_{21}), h_r (or h_{12}).

A further subscript is used for the identification of the circuit configuration. When no confusion is possible, this further subscript may be omitted.

Examples: h_{fe} (or h_{21e}), h_{FE} (or h_{21E}).

DISTINCTION BETWEEN REAL AND IMAGINARY PARTS

If it is necessary to distinguish between real and imaginary parts of electrical parameters, no additional subscripts are used. If basic symbols for the real and imaginary parts exist, these may be used.

Examples: $Z_i = R_i + jX_i$, $y_{fe} = g_{fe} + jb_{fe}$.

If such symbols do not exist or are not suitable, the notation shown in the following examples is used.

Examples:

Re (h_{ib}) etc. for the real part of h_{ib}

Im (h_{ib}) etc. for the imaginary part of h_{ib}.

S-PARAMETER DEFINITIONS

The S-parameter symbols in this section are based on IEC publication 747-7.

S-parameters (return losses or reflection coefficients) of a module can be defined as the S_{11} and the S_{22} of a two-port network (see Fig.1).

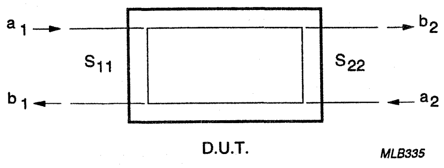


Fig.1 Two-port network with reflection coefficients S11 and S22.

$$b_1 = S_{11} \cdot a_1 + S_{12} \cdot a_2 \qquad (1)$$

$$b_2 = S_{21} \cdot a_1 + S_{22} \cdot a_2 \qquad (2)$$

where

$$a_1 = \frac{1}{2 \cdot \sqrt{Z_o}} \cdot (V_1 + Z_o \cdot i_1) = \text{signal into port 1} \qquad (3)$$

$$a_2 = \frac{1}{2 \cdot \sqrt{Z_o}} \cdot (V_2 + Z_o \cdot i_2) = \text{signal into port 2}$$

$$b_1 = \frac{1}{2 \cdot \sqrt{Z_o}} \cdot (V_1 + Z_o \cdot i_1) = \text{signal out port 1} \qquad (4)$$

$$b_2 = \frac{1}{2 \cdot \sqrt{Z_o}} \cdot (V_1 + Z_o \cdot i_2) = \text{signal out port 2}$$

From (1) and (2) formulae for the return losses can be derived:

$$S_{11} = \frac{b_1}{a_1}\bigg| a_2 = 0 \qquad (5)$$

$$S_{22} = \frac{b_2}{a_2}\bigg| a_1 = 0 \qquad (6)$$

In (5), $a_2 = 0$ means output port terminated with Z_o (derived from formula (4)).

In (6), $a_1 = 0$ means input port terminated with Z_o (derived from formula (3)).

Measurement

The return losses are measured with a network analyzer after calibration, where the influence of the test jig is eliminated. The necessary termination of the other port with Z_o is done automatically by the network analyzer.

The network analyser must have a directivity of at least 40 dB to obtain an accuracy of 0.5 dB when measuring return loss figures of 20 dB. A full two-port correction method can be used to improve the accuracy.

TRANSISTOR RATINGS

Voltage ratings

COLLECTOR TO BASE

V_{CBmax} The maximum permissible instantaneous voltage between collector and base terminals. The collector voltage is negative with respect to base in pnp transistors and positive with respect to base in npn types.

V_{CBmax} ($I_E = 0$) The maximum permissible instantaneous voltage between collector and base terminals when the emitter terminal is open-circuit.

EMITTER TO BASE

V_{EBmax} The maximum permissible instantaneous voltage between emitter and base terminals. The emitter voltage is negative with respect to base in pnp transistors and positive with respect to base in npn types.

V_{EBmax} ($I_C = 0$) The maximum permissible instantaneous voltage between emitter and base terminals when the collector terminal is open-circuit.

COLLECTOR TO EMITTER

V_{CEmax} The maximum permissible instantaneous voltage between collector and emitter terminals. The collector voltage is negative with respect to emitter in pnp transistors and positive with respect to emitter in npn types. This rating is very dependent on circuit conditions and collector current, and it is necessary to refer to the curve of V_{CE} versus I_C for the appropriate circuit condition in order to obtain the correct rating.

V_{CEmax}
(Cut-off) The maximum permissible instantaneous voltage between collector and emitter terminals when the emitter current is reduced to zero by means of a reverse emitter base voltage, i.e. the base voltage is normally positive with respect to emitter for pnp transistors and negative with respect to emitter for npn types. The term '(Cut-off)' is sometimes replaced by $V_{BE} > x$ V, or $R_B/R_E \leq y$, which are equivalent conditions under which the transistor may be cut off.

V_{CEmax}
($I_C = x$ mA) The maximum permissible instantaneous voltage between collector and emitter terminals when the collector current is at a high value, often the maximum rated value.

V_{CEmax}
($I_B = 0$) The maximum permissible instantaneous voltage between collector and emitter terminals when the base terminal is open-circuit or when a very high resistance is in series with the base terminal. Special care must be taken to ensure that thermal runaway due to excessive collector leakage current does not occur in this condition.

Due to the current dependency of V_{CE} it is usual to present this information as a voltage rating chart, a curve of collector current as a function of collector-to-emitter voltage (see Fig.2). The permissible area of operation under all conditions of base drive (provided the dissipation rating is not exceeded) is shown as area 1 and operation under certain specified conditions is shown as area 2.

To assist in determining the rating in area 2, further curves can relate the voltage rating to external circuit conditions, for example: R_B/R_E, R_B, Z_{Bg}, V_{BE}, I_B or V_{BB}/R_B. An example of this type of curve is given in Fig.3 with V_{CE} as a function of R_B/R_E for two values of collector current.

It should be noted that when R_E is shunted by a capacitor, during switching, the collector voltage V_{CE} must be restricted to a value that does not rely on the effect of R_E.

In the case of an inductive load, when an energy rating is given, it may be safe to operate outside the rated area provided the specified energy rating is not exceeded.

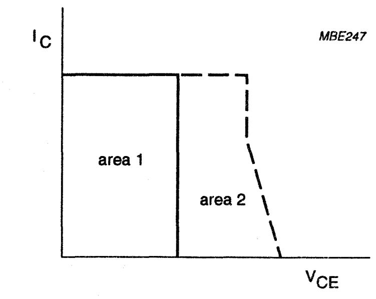


Fig.2 Graph of permissible operating areas.

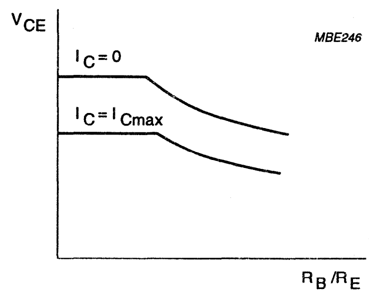


Fig.3 Graph showing effect of collector current on permissible operating areas.

Current ratings

COLLECTOR

I_{Cmax} The maximum permissible collector current. Without further qualification, the DC value is implied.

$I_{C(AV)max}$ The maximum permissible average value of the total collector current.

I_{CM} The maximum permissible instantaneous value of the total collector current.

Emitter

I_{Emax} The maximum permissible emitter current. Without further qualification, the DC value is implied.

$I_{E(AV)max}$ The maximum permissible average value of the total emitter current.

$I_{ER(AV)max}$ The maximum permissible average value of the total emitter current when operating in the reverse emitter-base breakdown region.

I_{EM} The maximum permissible instantaneous value of the total emitter current.

I_{ERM} The maximum permissible instantaneous value of the total emitter current when operating in the reverse breakdown region.

BASE

I_{Bmax} The maximum permissible base current. Without further qualification, the DC value is implied.

$I_{B(AV)max}$ The maximum permissible average value of the total base current.

$I_{BR(AV)max}$ The maximum permissible average value of the total base current when operating in the reverse breakdown region.

I_{BM} The maximum permissible instantaneous value of the total base current. The rating also includes the switch-off current.

I_{BRM} The maximum permissible instantaneous value of the total reverse current allowable in the reverse breakdown region.

Power ratings

The total maximum permissible continuous power dissipation in the transistor, $P_{tot\ max}$, includes collector-base dissipation and emitter-base dissipation. Under steady state conditions, the total power is given as:

$P_{tot} = V_{CE} \times I_C + V_{BE} \times I_B$.

In order to distinguish between 'steady state' and 'pulse' conditions, the terms 'steady state power (P_S)' and 'pulse power (P_P)' can be used. The permissible total power dissipation is dependent on temperature; this relationship is shown in Fig.4.

The temperature may be the ambient, the case or the mounting base temperature. Where a cooling clip or heatsink is attached to the device, the allowable power dissipation is also dependent on the efficiency of the heatsink.

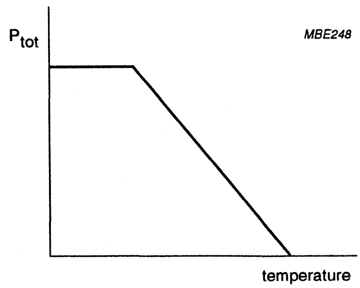


Fig.4 Permissible total power dissipation.

The efficiency of this clip or heatsink is measured in terms of its thermal resistance ($R_{th\ h}$) normally expressed in degrees kelvin per watt (K/W). For mounting-base rated devices, the added effect of the contact resistance ($R_{th\ i}$) must be taken into account.

The effect of heatsinks of various thermal and contact resistance is often included in the graph of permissible total power dissipation.

The relationship between maximum power dissipation, ambient temperature and thermal heatsink resistance is given by:

$$P_{tot} = \frac{T_j - T_{amb}}{R_{th\ j-a}}$$

where $R_{th\ j-a}$ is the thermal resistance from the transistor junction to the ambient. For case rated or mounting-base rated devices, the thermal resistance $R_{th\ j}$ is made up of the thermal resistance junction to case or mounting-base ($R_{th\ j-mb}$), the contact thermal resistance ($R_{th\ i}$) and the heatsink thermal resistance ($R_{th\ h}$).

For the calculation of pulse power operation, the maximum pulse power is obtained using a graph as shown in Fig.5

The general expression from which the maximum pulse power dissipation can be calculated is:

$$P_p = \frac{T_j - T_{amb} - P_S \times R_{th\ j-a}}{Z_{in\ t} + d\,(R_{th\ c-a})}$$

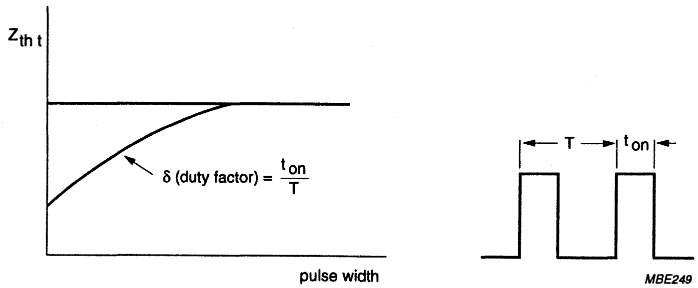


Fig.5 Pulse power operation.

where $Z_{th\ t}$ and δ are given in Fig.5 and $R_{th\ c-a}$ is the thermal resistance between case and ambient for a case rated device. For a mounting-base rated device, it is equal to $R_{th\ h} + R_{th\ i}$ and is zero for a free-air rated device because the effect of the temperature rise of the case over the ambient for a pulse train is already included in $Z_{th\ t}$.

Temperature ratings

$T_{j\ max}$ The maximum permissible junction temperature which is used as the basis for the calculation of power ratings. Unless otherwise stated, the continuous value is implied.

$T_{j\ max}$ (continuous operation): indicates the maximum permissible continuous value.

$T_{j\ max}$ (intermittent operation): indicates the maximum permissible instantaneous junction temperature usually allowed for a total duration of 200 hours.

T_{mb} The temperature of the surface in contact with the heatsink. This is confined to devices where a flange or stud for fixing onto a heatsink forms an integral part of the envelope.

T_{case} The temperature of the envelope. This is confined to devices that may have a clip-on cooling fin attachment.

TAPE AND REEL PACKING

Tape and reel packing meets the feed requirements of automatic pick and place equipment (packing conforms to IEC publication 286-2 and 286-3). Additionally, the tape is an ideal shipping container.

Packing (TO-92 leaded types)

The transistors are supplied on tape in boxes (ammopack) or on reels. The number per reel and per ammopack is 2000. The ammopack has 80 layers of 25 transistors each. Each layer contains 25 transistors, plus one empty position in order to fold the layer correctly.The ammopack is accessible from both sides, enabling the user to choose between “normal’ (see Fig.7) and “reverse” tape. “Normal” is indicated by a plus sign (+) on the ammopack and “reverse” by a minus sign (–). In the European version, the leading pin is the emitter.

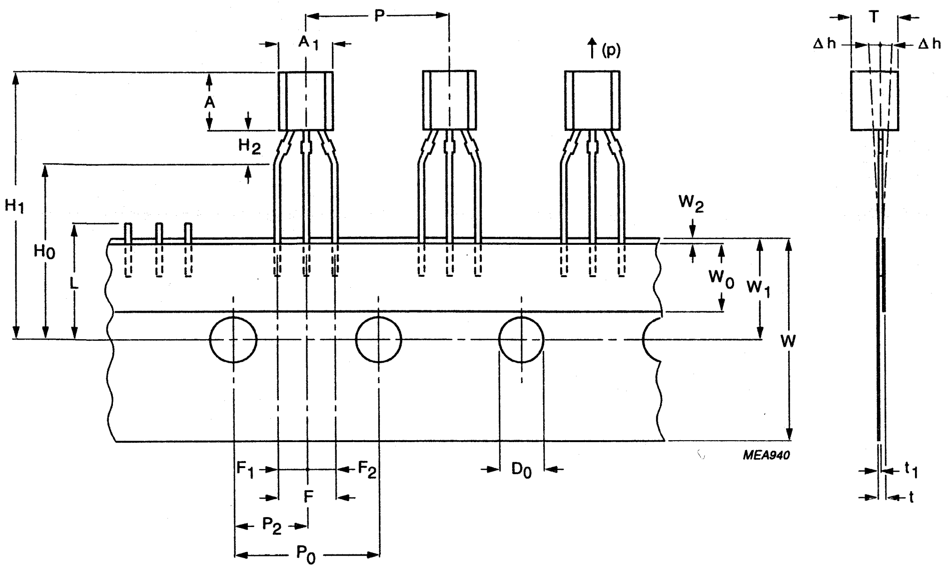


Fig.6 TO-92 transistors on tape.

Table 1 Tape specification (TO-92 leaded types)

SYMBOL	DIMENSION	SPECIFICATIONS					REMARKS
		MIN.	NOM.	MAX.	TOL.	UNIT	
A_1	body width	4	–	4.8	–	mm	
A	body height	4.8	–	5.2	–	mm	
T	body thickness	3.5	–	3.9	–	mm	
P	pitch of component	–	12.7	–	±1	mm	
P_0	feed hole pitch	–	12.7	–	±0.3	mm	
	cumulative pitch error	–	–	–	±0.1		note 1
P_2	feed hole centre to component centre	–	6.35	–	±0.4	mm	to be measured at bottom of clinch
F	distance between outer leads	–	5.08	–	+0.6/–0.2	mm	
Δh	component alignment	–	0	1	–	mm	at top of body
W	tape width	–	18	–	±0.5	mm	
W_0	hold-down tape width	–	6	–	±0.2	mm	
W_1	hole position	–	9	–	+0.7/–0.5	mm	
W_2	hold-down tape position	–	0.5	–	±0.2	mm	
H_0	lead wire clinch height	–	16.5	–	±0.5	mm	

SYMBOL	DIMENSION	SPECIFICATIONS					REMARKS
		MIN.	NOM.	MAX.	TOL.	UNIT	
H_1	component height	–	–	23.25	–	mm	
L	length of snipped leads	–	–	11	–	mm	
D_0	feed hole diameter	–	4	–	±0.2	mm	
t	total tape thickness	–	–	1.2	–	mm	t_1 0.3 to 0.6
F_1, F_2	lead-to-lead distance	–	–	–	+0.4/–0.2	mm	
H_2	clinch height	–	–	–	–	mm	
(p)	pull-out force	6	–	–	–	N	

Note

1. Measured over 20 devices.

Dropouts

A maximum of 0.5% of the specified number of transistors in each packing may be missing. Up to 3 consecutive components may be missing provided the gap is followed by 6 consecutive components.

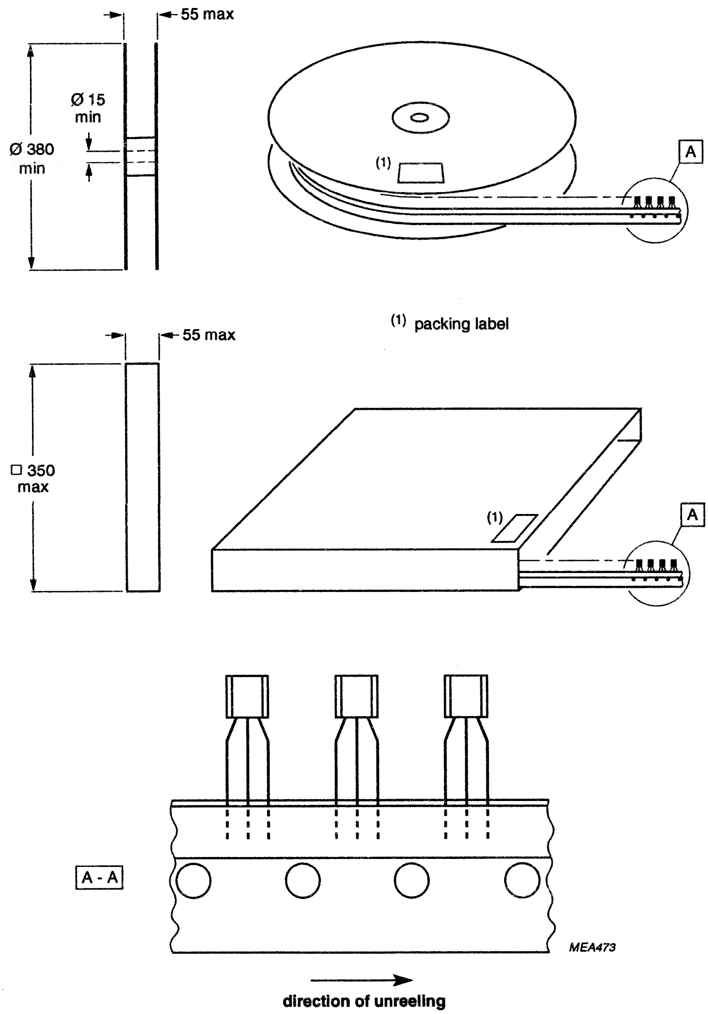
Tape splicing

Splice the carrier tape on the back and/or front so that the feed hole pitch (P_0) is maintained (see Figs 6 and 8).

Bulk packing

In addition to TO-92 on tape, TO-92 can also be delivered in bulk. Products are packed in boxes in foil and plastic bags with 1 000 pieces to a bag and 5 bags to a box.

As well as the standard TO-92 with straight leads, (see Fig.9) leads with delta pinning are available in bulk, on request (see Fig.10).



Dimensions in mm.

Fig.7 Dimensions of reel and box.

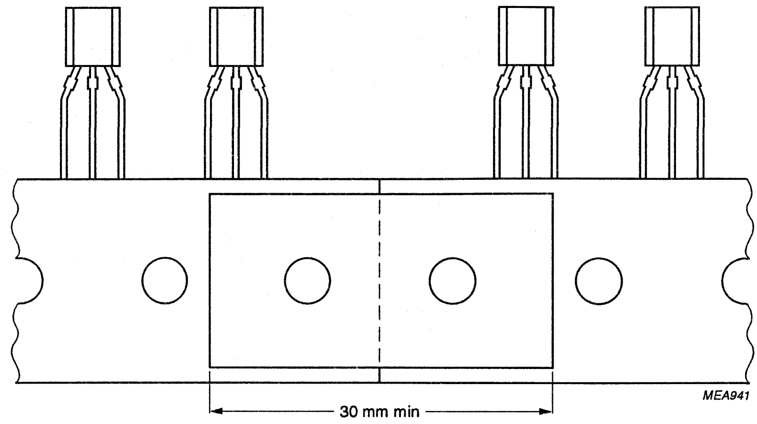
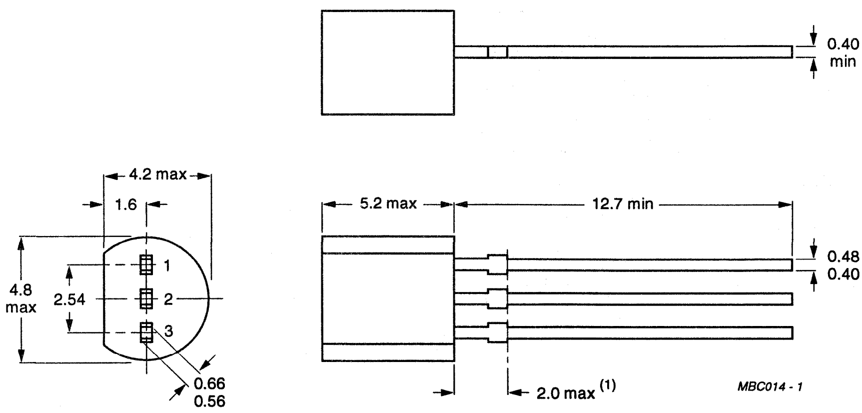


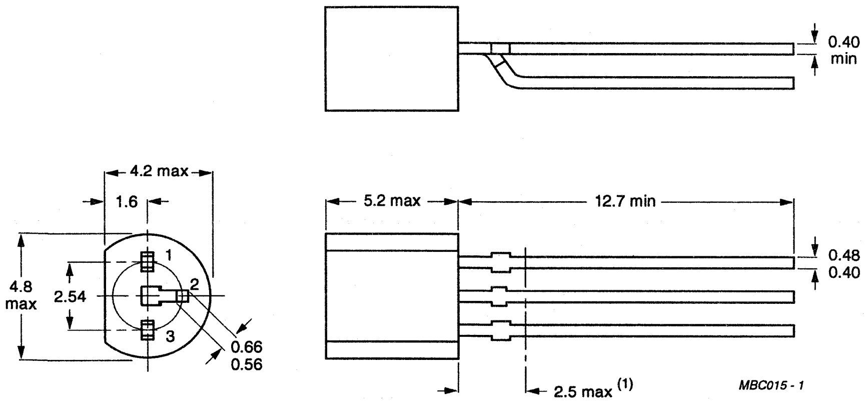
Fig.8 Joining tape with splicing patch.



Dimensions in mm.

(1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

Fig.9 TO-92 with straight leads.



Dimensions in mm.

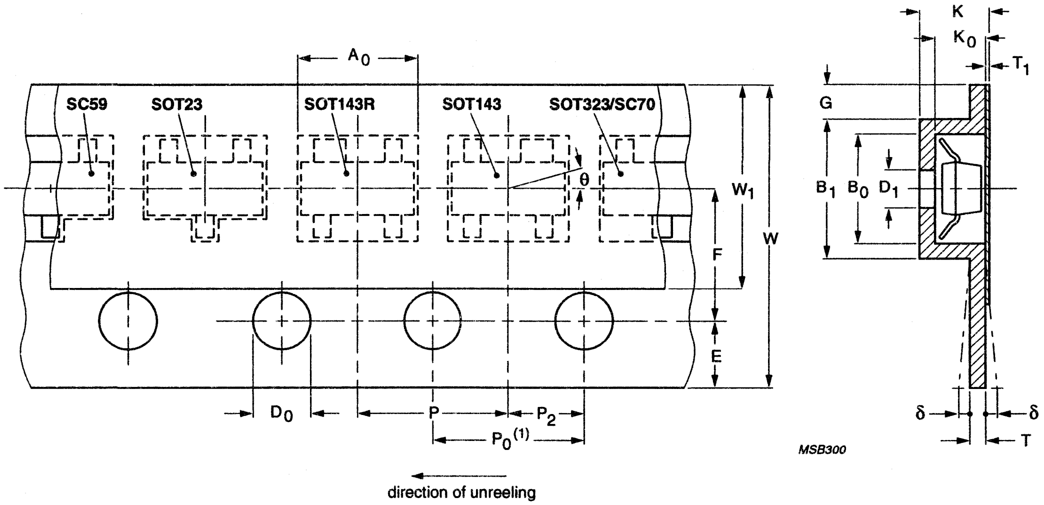
(1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

Fig.10 TO-92 with delta pinning.

Packing SMD types

Table 2 Packing quantities per reel (SMD types)

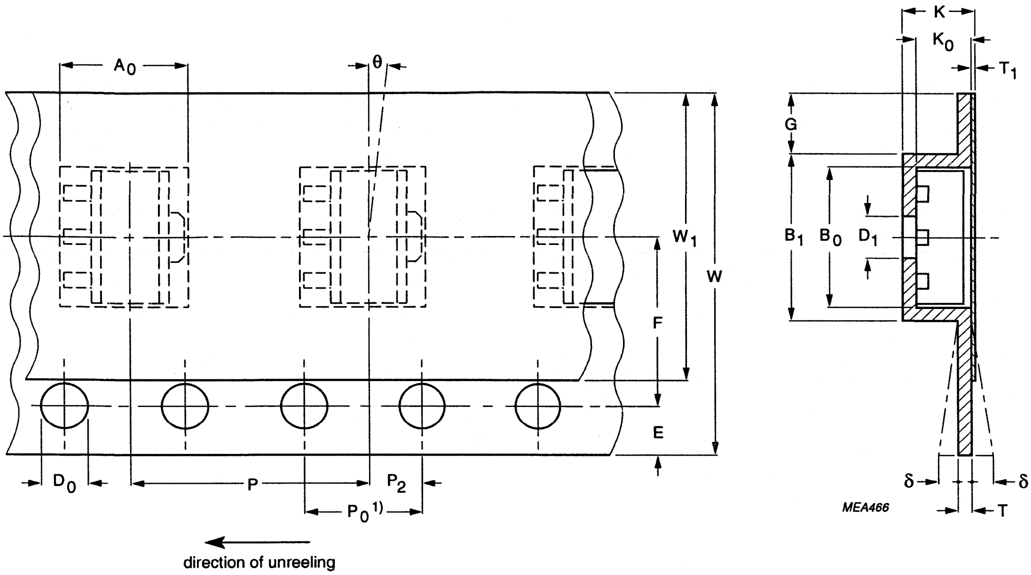
PACKAGE	7-INCH REEL	LARGE REEL
SOT23	3000	10000
SOT89	1000	4000
SOT143	3000	10000
SOT143R	3000	10000
SOT223	1000	4000
SOT323	3000	10000
SC59	3000	10000
SC70	3000	10000



For dimensions see Table 4.

(1) Tolerance over any 10 pitches: ±0.2 mm.

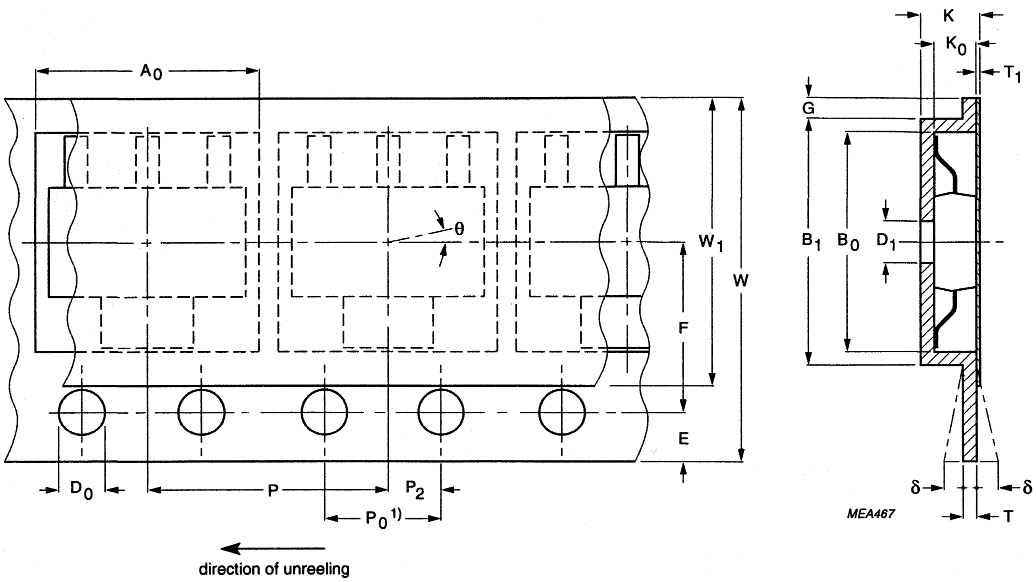
Fig.11 Specification for 8 mm tape (SC59, SC70, SOT23, SOT143, SOT143R and SOT323).



For dimensions see Table 4.

(1) Tolerance over any 10 pitches: ±0.2 mm.

Fig.12 Specification for 12 mm tape (SOT89).



For dimensions see Table 4.

(1) Tolerance ove any 10 pitches: ±0.2 mm.

Fig.13 Specification for 12 mm tape (SOT223).

Table 3 Carrier tape widths for packages

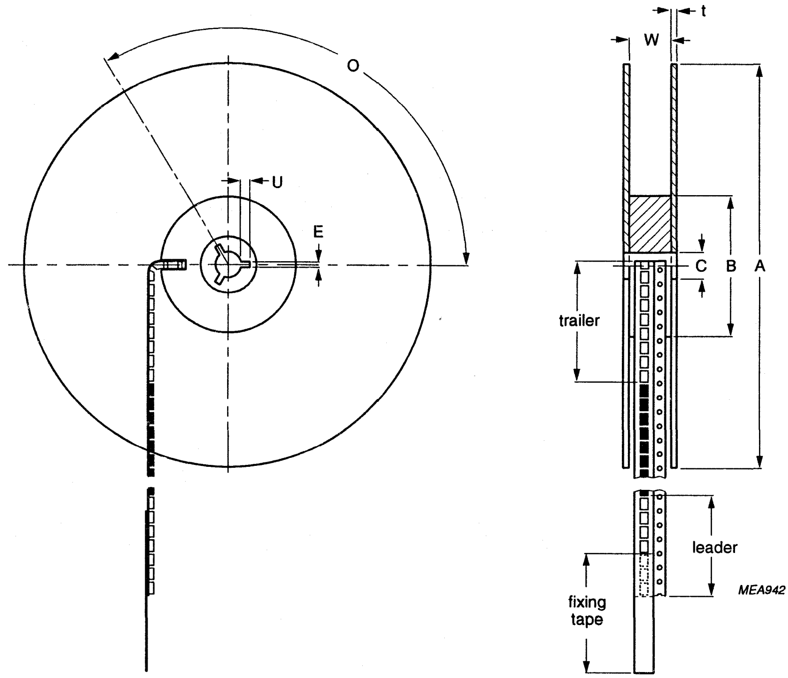
8 mm	12 mm
SC59	SOT89
SC70	SOT223
SOT23	–
SOT143(R)	–
SOT323	–

Table 4 SMD packages: tape dimensions (in mm)

DIMENSION (Figs to 13)	**CARRIER TAPE FOR:**		**TOLERANCE**
	8 mm	**12 mm**	
Overall dimensions			
W	8.0	12.0	±0.2
K	1.5	2.4	max.
G	0.75	0.75	min.
Sprocket holes[1]			
D_0	1.5	1.5	+0.1/–0
E	1.75	1.75	±0.1
P_0	4.0	4.0	±0.1
Relative placement compartment			
P_2	2.0	2.0	±0.1
F	3.5	5.5	±0.05
Compartment			
A_0 B_0 B_1 K_0	Compartment dimensions depend on package size. Maximum clearance between device and compartment is 0.3 mm; the minimum clearance ensures that the device is not totally restrained within the compartment.		
D_1	1.0	1.5	min.
P	4.0	8.0	±0.1
θ	15°	15°	max.
Cover tape [2]			
W_1	5.4	9.5	max.
T_1	0.1	0.1	max.
Carrier tape			
W	8.0	12.0	±0.2
T	0.2	0.2	max.
δ	0.3	0.3	max.

Notes

1. Tolerance over any 10 pitches ±0.2 mm.
2. The cover tape shall not overlap the tape or sprocket holes.



For dimensions see Table 5.

Fig.14 Reel specification.

Table 5 Reel dimensions (in mm)

DIMENSION (see Fig.14)	**8 mm TAPE**	**12 mm TAPE**	**TOLERANCE**
Flange			
A	180 (1)	180 or 286	±0.5
t	1.5	1.5	+0.5/–0.1
W	8.4	12.4	18.0+0.2
Hub			
B	62	62	±1.5
C	12.75	12.75	+0.15/–0.2
Key slot			
E	2	2	±0.2
U	4	4	±0.5
O	120°	120°	–

Note

1. Large reel diameter depends on individual package (286 or 350).

MOUNTING AND SOLDERING

Mounting methods

There are two basic forms of electronic component construction, those with leads for through-hole mounting and microminiature types for surface mounting (SMD). Through-hole mounting gives a very rugged construction and uses well established soldering methods. Surface mounting has the advantages of high packing density plus high-speed automated assembly. Surface mounting techniques are complex and this chapter gives only a simplified overview of the subject.

Although many electronic components are available as surface mounting types, some are not and this often leads to the use of through-hole as well as surface mounting components on one substrate (a mixed print). The mix of components affects the soldering methods that can be applied. A substrate having SMDs mounted on one or both sides but no through-hole components is likely to be suitable for reflow or wave soldering. A double sided mixed print that has through-hole components and some SMDs on one side and densely packed SMDs on the other normally undergoes a sequential combination of reflow and wave soldering. When the mixed print has only through-hole components on one side and all SMDs on the other, wave soldering is usually applied.

Reflow soldering

SOLDER PASTE

Most reflow soldering techniques utilize a paste that is a mixture of flux and solder. The solder paste is applied to the substrate before the components are placed. It is of sufficient viscosity to hold the components in place and, therefore, an application of adhesive is not required. Drying of the solder paste by preheating increases the viscosity and prevents any tendency for the components to become displaced during the soldering process. Preheating also minimizes thermal shock and drives off flux solvents.

Screen printing

This is the best high-volume production method of solder paste application. An emulsion-coated, fine mesh screen with apertures etched in the emulsion to coincide with the surfaces to be soldered is placed over the substrate. A squeegee is passed across the screen to force solder paste through the apertures and on to the substrate. The layer thickness of screened solder paste is usually between 150 and 200 μm.

Stencilling

In this method a stencil with etched holes to pass the paste is used. The thickness of the stencil determines the amount of amount of solder paste that is deposited on the substrate. This method is also suited to high-volume work.

Dispensing

A computer-controlled pressure syringe dispenses small doses of paste to where it is required. This method is mainly suitable for small production runs and laboratory use.

Pin transfer

A pin picks up a droplet of solder paste from a reservoir and transfers it to the surface of the substrate or component. A multi-pin arrangement with pins positioned to match the substrate is possible and this speeds up the process time.

REFLOW TECHNIQUES

Thermal conduction

The prepared substrates are carried on a conveyor belt, first through a preheating stage and then through a soldering stage. Heat is transferred to the substrate by conduction through the belt. Figure15 shows a theoretical time/temperature relationship for thermal conduction reflow soldering. This method is particularly suited to thick film substrates and is often combined with infrared heating.

Infrared

An infrared oven has several heating elements giving a broad spectrum of infrared radiation, normally above and below a closed loop belt system. There are separate zones for preheating, soldering and cooling. Dwell time in the soldering zone is kept as short as possible to prevent damage to components and substrate. A typical heating profile is shown in Fig.16. This reflow method is often applied in double-sided prints.

Vapour phase

A substrate is immersed in the vapours of a suitable boiling liquid. The vapours transfer latent heat of condensation to the substrate and solder reflow takes place. Temperature is controlled precisely by the boiling point of the liquid at a given pressure. Some systems employ two vapour zones, one above the other. An elevator tray, suspended from a hoist mechanism passes the substrate vertically through the first vapour zone into the secondary soldering zone and then hoists it out of the vapour to be cooled. A theoretical time/temperature relationship for this method is shown in Fig.17.

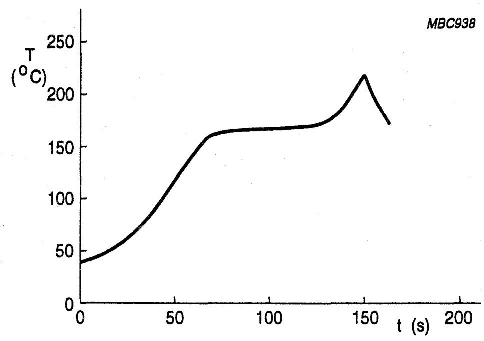


Fig.15 Theoretical time / temperature curve for a typical thermal conductive reflow cycle.

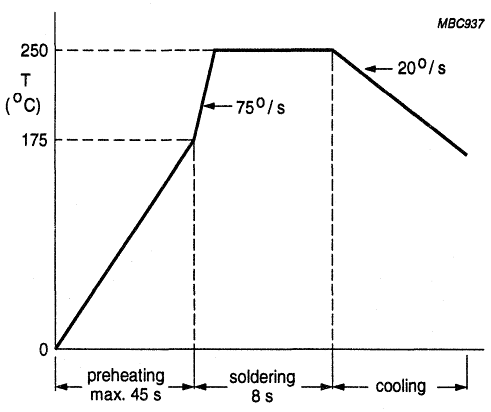


Fig.16 Typical temperature profile of an infrared oven operating at a belt speed of 0.41 mm / min.

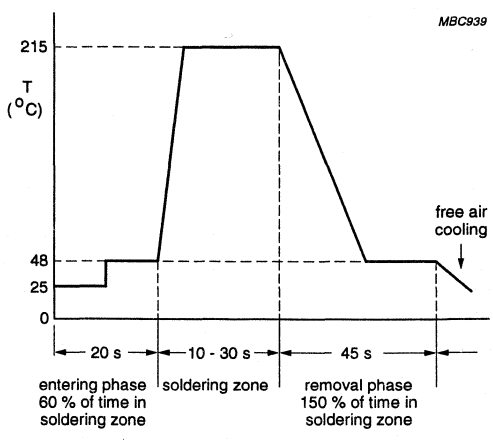


Fig.17 Theorectical time / temperature curve relationship for dual vapour reflow soldering.

Wave soldering

This soldering technique is not recommended for SOT89.

ADHESIVE APPLICATION

Since there are no connecting wires to retain them, leadless and short-leaded components are held in place with adhesive for wave soldering. A spot of adhesive is carefully placed between each SMD and the substrate. The adhesive is then heat-cured to withstand the forces of the soldering process, during which the components are fully immersed in solder. There are several methods of adhesive application.

Pin transfer method

A pin is used to transfer a droplet of adhesive from a reservoir to a precise position on the surface where it is required. The size of the droplet depends on pin diameter, depth to which the pin is dipped in the reservoir, rheology of the adhesive, and the temperature of adhesive and surrounds. The pin can be part of a pin array (bed of nails) that corresponds exactly with the required adhesive positions on the substrate. With this method, adhesive can be applied to the whole of one side of a substrate in one operation and is therefore suitable for high-volume production and can be used with pre-loaded mixed prints.

Alternatively, pins can be used to transfer adhesive to the components before they are placed on the substrate. This adds flexibility to production runs where variations in layout must be accommodated.

Screen printing method

A fine mesh screen is coated with emulsion except in the positions where the adhesive is required to pass. The screen is placed on the substrate and a squeegee passing across it forces adhesive through the uncoated parts of the screen. The amount of adhesive printed-through depends on the size of the uncoated screen areas, the thickness of the screen coating, the rheology of the adhesive and various machine parameters. With this method, the substrate must be flat and pre-loaded mixed prints cannot be accommodated.

Pressure syringe method

A computer-controlled syringe dispenses adhesive from an enclosed reservoir by means of pulses of compressed air. The adhesive dot size depends on the size of the syringe nozzle, the duration and pressure of the pulsed air and the viscosity of the adhesive. This method is most suited to low volume production. An advantage is the flexibility provided by computer programmability.

FLUXING

The quality of the soldered connections between components and substrate is critical for circuit performance and reliability. Flux promotes solderability of the connecting surfaces and is chosen for the following attributes:

- removal of surface oxides
- prevention of reoxidation
- transference of heat from source to joint area
- residue that is non-corrosive or, if residue is corrosive, should be easy to clean away after soldering
- ability to improve wettability (readiness of a metal surface to form an alloy at its interface with the solder) to ensure strong joints with low electrical resistance
- suitability for the desired method of flux application.

In wave soldering, liquified flux is usually applied as a foam, a spray or in a wave.

Foam

Flux foam is made by forcing low-pressure, water-free clean air through an aerator immersed in liquid flux. Fine bubbles of flux are directed onto the substrate/component surfaces where they burst and form a thin, even layer. The flux also penetrates any plated-through holes. The flux has to be chosen for its foaming capabilities.

Spray

Several methods of spray fluxing exist, the most common involves a mesh drum rotating in liquid flux. Air is blown into the drum which, when passing through the fine mesh, directs a spray of flux onto the underside of the substrate. The amount of flux deposited is controllable by the speed of the substrate passing through the spray, the speed of rotation of the drum and the density of the flux.

Wave

A wave fluxer creates a double flowing wave of liquid flux which adheres to the surface as the substrate passes through. Wave height control is essential and a soft wipe-off brush is usually incorporated to remove excess flux from the substrate.

PRE-HEATING

Pre-heating of the substrate and components is performed immediately before soldering. This reduces thermal shock as the substrate enters the soldering process, causes the flux to become more viscous and accelerates the chemical action of the flux and so speeds up the soldering action.

SOLDERING

Wave soldering is usually the best method to use when high throughput rates are required. The single-wave soldering principle (see Fig.18) is the most straight forward method and can be used on simple substrates with two-terminal SMD components. More complex substrates with increased circuit density and closer spacing of conductors can pose the problems of nonwetting (dry joints) and solder bridging. Bridging can occur across the closely spaced leads of multi-leaded devices as well as across adjacent leads on neighbouring components. Nonwetting is usually caused by components with plastic bodies. The plastic is not wetted by solder and creates a depression in the solder wave, which is augmented by surface tension. This can cause a shadow behind the component and prevent solder from reaching the joint surfaces. A smooth laminar solder wave is required to avoid bridging and a high pressure wave is needed to completely cover the areas that are difficult to wet. These conflicting demands are difficult to attain in a single wave but dual wave techniques go a long way in overcoming the problem.

In a dual wave machine (see Fig.19), the substrate first comes into contact with a turbulent wave which has a high vertical velocity. This ensures good solder contact with both edges of the components and prevents joints from being missed. The second smooth laminar wave completes the formation of the solder fillet, removes excess solder and prevents bridging. Figure 20 indicates the time/temperature relationship measured at the soldering site in dual wave soldering.

New methods of wave soldering are developing continually. For example, the Omega System is a single wave agitated by pulses, which combines the functions of smoothness and turbulence. In another, a lambda wave injects air bubbles in the final part of the wave. A further innovation is the hollow jet wave in which the solder wave flows in the opposite direction to the substrate.

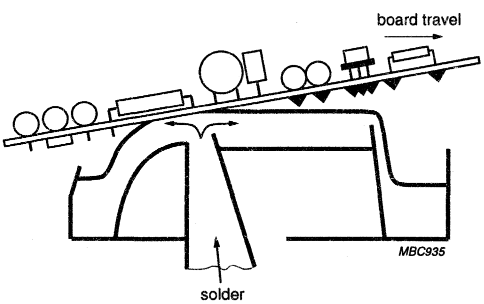


Fig.18 Single wave soldering principle.

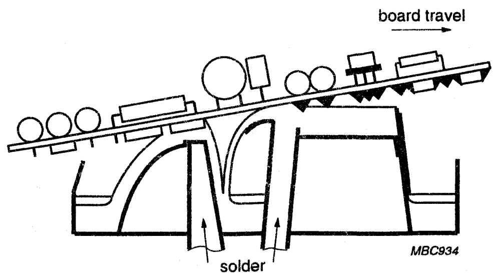


Fig.19 Dual wave soldering principle.

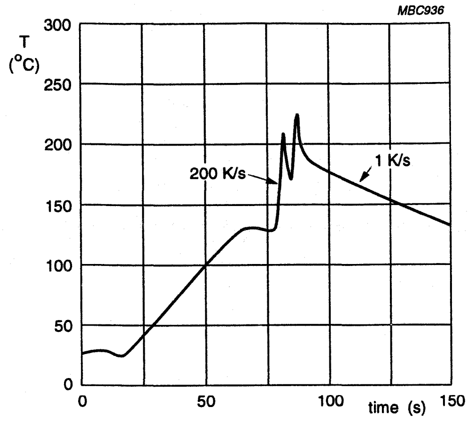


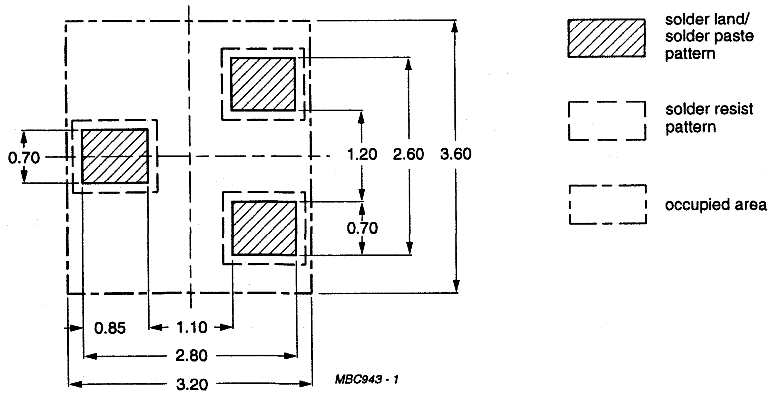
Fig.20 Typical time-temperature curve measured at the soldering site.

Footprint design

The footprint design of a component for surface mounting is influenced by many factors:

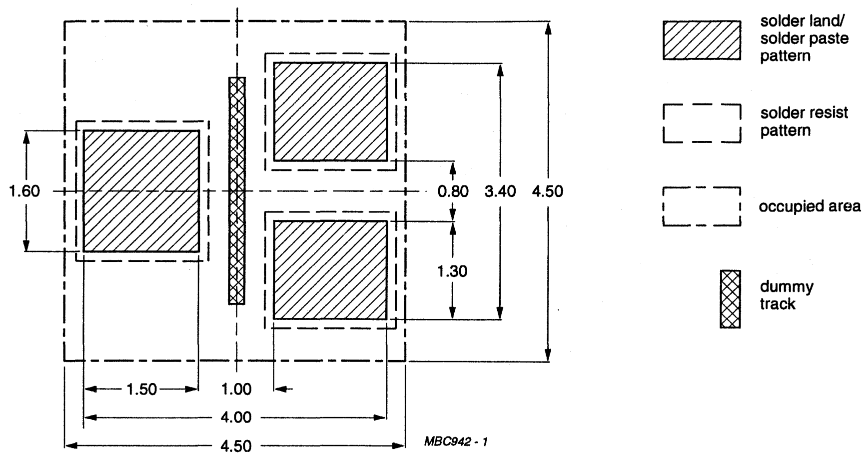
- features of the component, its dimensions and tolerances
- circuit board manufacturing processes
- desired component density
- minimum spacing between components
- circuit tracks under the component
- component orientation (if wave soldering)
- positional accuracy of solder resist to solder lands
- positional accuracy of solder paste to solder lands (if reflow soldering)
- component placement accuracy
- soldering process parameters
- solder joint reliability parameters.

SOT23 FOOTPRINTS



Dimensions in mm.
Placement accuracy: ±0.25 mm.

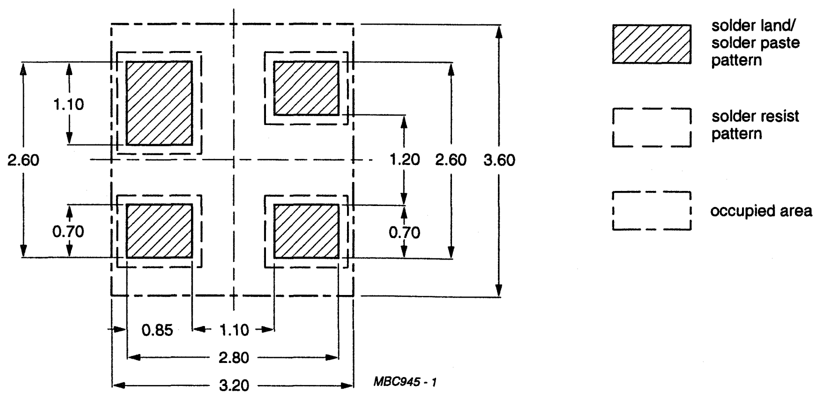
Fig.21 Reflow soldering footprint for SOT23; typical dimensions.



Dimensions in mm.
Dummy track dimensions: 0.40 × 3.00 mm.
Placement accuracy: ±0.25 mm.

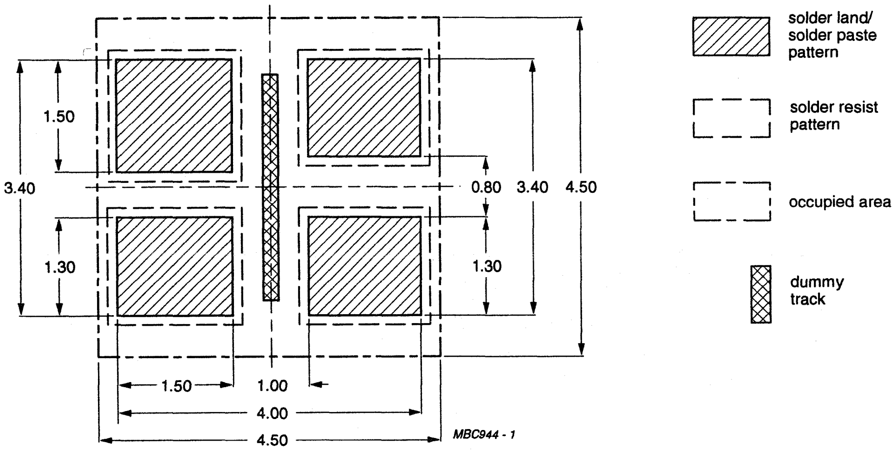
Fig.22 Wave soldering footprint for SOT23; typical dimensions.

SOT143 FOOTPRINTS



Dimensions in mm.
Placement accuracy: ±0.25 mm.

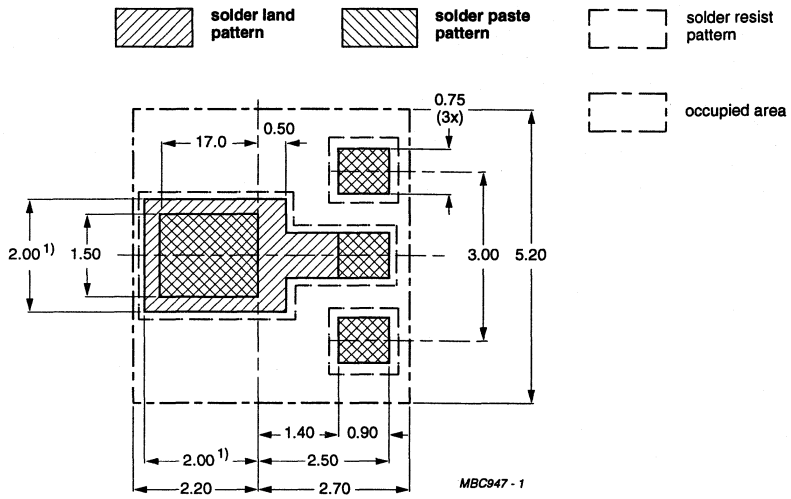
Fig.23 Reflow soldering footprint for SOT143; typical dimensions.



Dimensions in mm.
Dummy track dimensions: 0.40 × 3.00 mm.
Placement accuracy: ±0.25 mm.

Fig.24 Wave soldering footprint for SOT143; typical dimensions.

SOT89 FOOTPRINTS

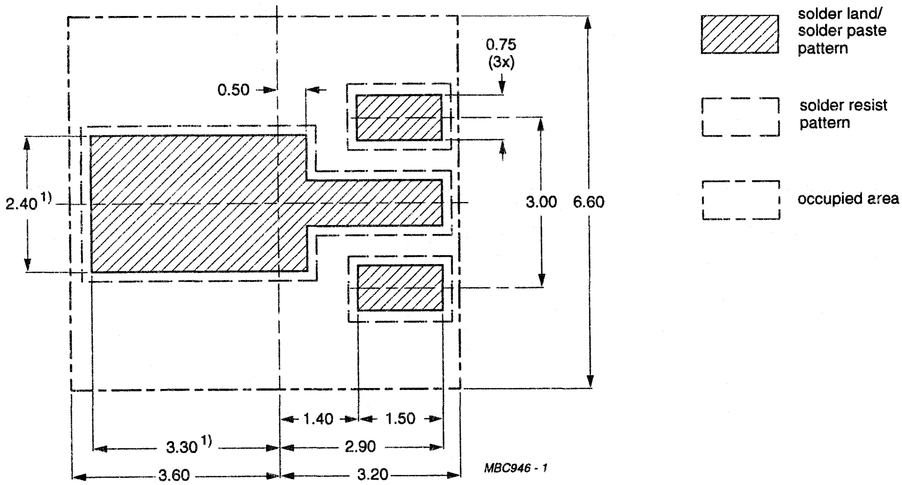


Dimensions in mm.

Placement accuracy: ±0.25 mm.

(1) To improve the power dissipation the marked dimensions may be enlarged without changing the solder resist cut out of the footprint.

Fig.25 Reflow soldering footprint for SOT89; typical dimensions.



We do not recommend SOT89 for wave soldering, SOT223 is preferred.

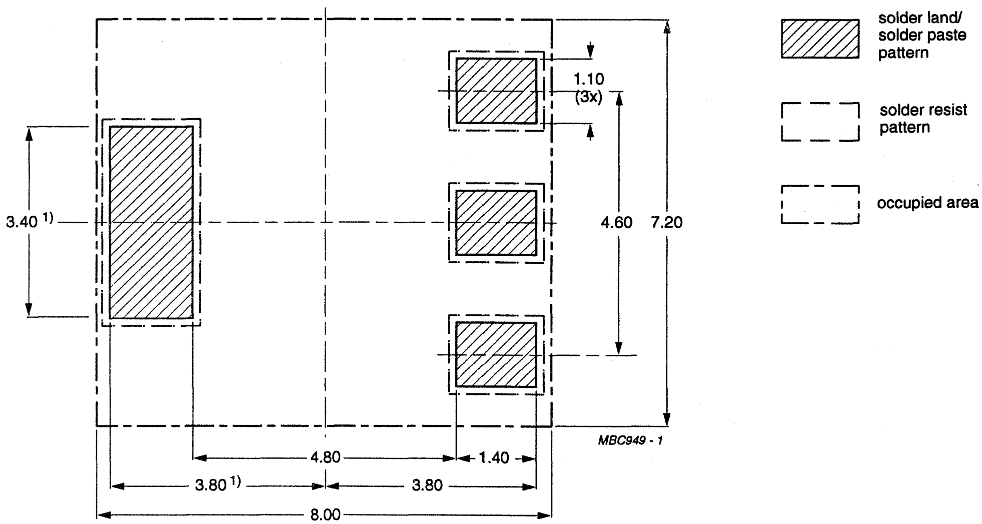
Dimensions in mm.

Placement accuracy: ±0.25 mm.

(1) To improve the power dissipation the marked dimensions may be enlarged without changing the solder resist cut out of the footprint.

Fig.26 Wave soldering footprint for SOT89: typical dimensions.

SOT233 FOOTPRINTS

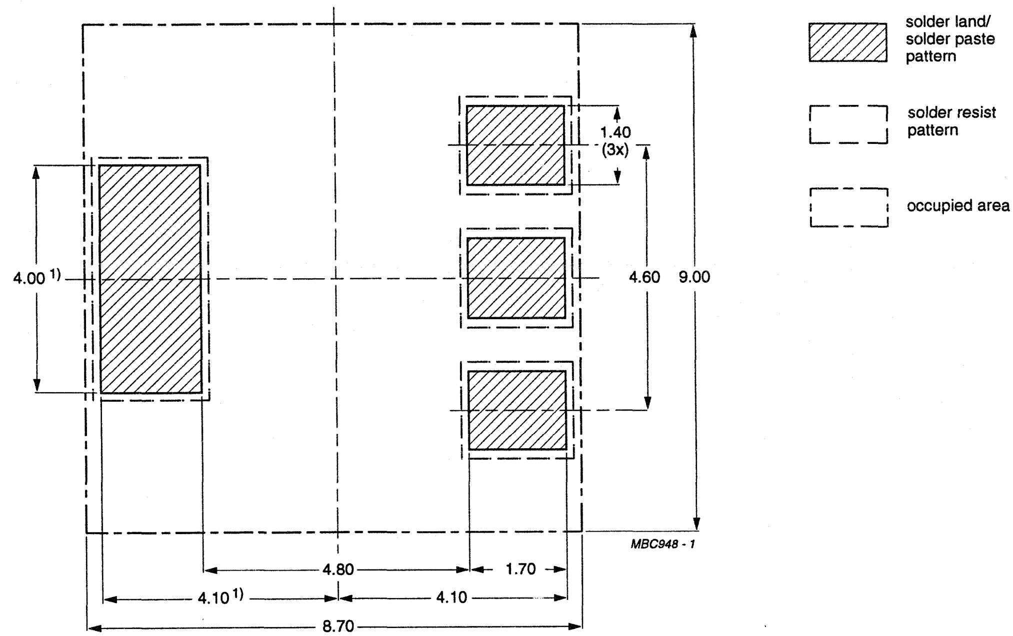


Dimensions in mm.

Placement accuracy: ±0.25 mm.

(1) To improve the power dissipation the marked dimensions may be enlarged without changing the solder resist cut out of the footprint.

Fig.27 Reflow soldering footprint for SOT223; typical dimensions.



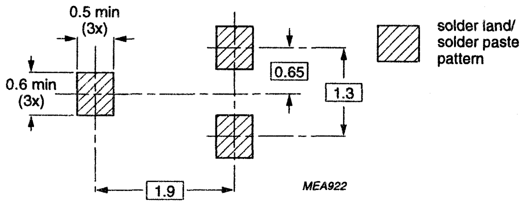
Dimensions in mm.

Placement accuracy: ±0.25 mm.

(1) To improve the power dissipation the marked dimensions may be enlarged without changing the solder resist cut out of the footprint.

Fig.28 Wave soldering footprint for SOT223; typical dimensions.

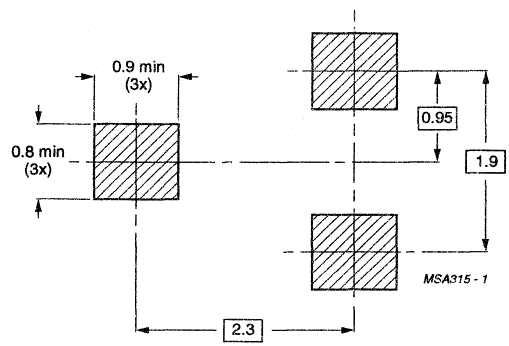
SOT323 FOOTPRINT



Dimensions in mm.

Fig.29 Reflow soldering footprint for SOT323; typical dimensions

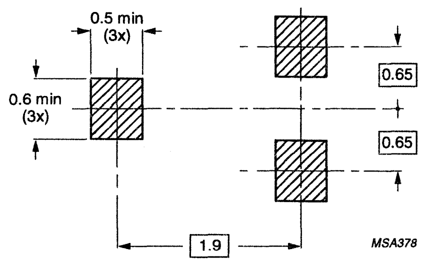
SOT59 FOOTPRINT



Dimensions in mm.

Fig.30 Reflow soldering footprint for SC59; typical dimensions.

SC70 FOOTPRINT



Dimensions in mm.

Fig.31 Reflow soldering footprint for SC70; typical dimensions.

Hand soldering microminiature components

It is possible to solder microminiature components with a light-weight hand-held soldering iron, but this method has obvious drawbacks and should be restricted to laboratory use and/or incidental repairs on production circuits:

- hand-soldering is time-consuming and therefore expensive
- the component cannot be positioned accurately and the connecting tags may come into contact with the substrate and damage it
- there is a risk of breaking the substrate and internal connections in the component could be damaged
- the component package could be damaged by the iron.

THERMAL CONSIDERATIONS

Thermal resistance

Circuit performance and long-term reliability are affected by the temperature of the transistor die. Normally, both are improved by keeping the die temperature (junction temperature) low.

Electrical power dissipated in any semiconductor device is a source of heat. This increases the temperature of the die about some reference point, normally an ambient temperature of 25 °C in still air. The size of the increase in temperature depends on the amount of power dissipated in the circuit and the net thermal resistance between the heat source and the reference point.

Devices lose most of their heat by conduction when mounted on a a printed board, a substrate or heatsink. Referring to Fig.32 (for surface mounted devices mounted on a substrate), heat conducts from its source (the junction) via the package leads and soldered connections to the substrate. Some heat radiates from the package into the surrounding air where it is dispersed by convection or by forced cooling air. Heat that radiates from the substrate is dispersed in the same way.

The elements of thermal resistance shown in Fig.33 are defined as follows:

$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base
$R_{th\ j\text{-}c}$	thermal resistance from junction to case
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point
$R_{th\ s\text{-}a}$	thermal resistance from soldering point to ambient
$R_{th\ c\text{-}a}$	thermal resistance from case to ambient ($R_{th\ s\text{-}a}$ and $R_{th\ c\text{-}a}$ are the same for most packages)
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient.

The temperature at the junction depends on the ability of the package and its mounting to transfer heat from the junction region to the ambient environment. The basic relationship between junction temperature and power dissipation is:

$$T_{j\ max} = T_{amb} + P_{tot\ max}(R_{th\ j\text{-}s} + R_{th\ s\text{-}a}) = T_{amb} + P_{tot\ max}(R_{th\ j\text{-}a})$$

where

$T_{j\ max}$	is the maximum junction temperature
T_{amb}	is the ambient temperature
$P_{tot\ max}$	is the maximum power handling capability of the device, including the effects of external loads when applicable.

In the expression for $T_{j\ max}$, only T_{amb} and $R_{th\ s\text{-}a}$ can be varied by the user. The package mounting technique and the flow of cooling air are factors that affect $R_{th\ s\text{-}a}$. The device power dissipation can be controlled to a limited extent but under recommended usage, the supply voltage and circuit loading dictate a fixed power maximum. The $R_{th\ j\text{-}s}$ value is essentially independent of external mounting method and cooling air; but is sensitive to the materials used in the package construction, the die bonding method and the die area, all of which are fixed.

Values of $T_{j\ max}$ and $R_{th\ j\text{-}s}$, or $R_{th\ j\text{-}c}$ or $R_{th\ j\text{-}a}$ are given in the device data sheets. For applications where the temperature of the case is stabilized by a large or temperature-controlled heatsink, the junction temperature can be calculated from

$T_j = T_{case} + P_{tot} \times R_{th\ j\text{-}c}$ or, using the soldering point definition, from $T_j = T_{solder} + P_{tot} \times R_{th\ j\text{-}s}$.

Thermal resistance ($R_{th\ s\text{-}a}$ and $R_{th\ c\text{-}a}$)

The thermal resistance from soldering point to ambient (SMDs), and that from case to ambient depends on the mounting technique, the shape and material of the tracks and substrate. Standard mounting conditions to set the maximum power ratings of the various packages are shown in Figs 34 to 40. Each figure shows single-sided 35 µm copper-clad epoxy fibre-glass print, 1.5 mm thick, the tracks are fully solder-tinned and the shaded areas shown are copper or ceramic (Al_2O_3) 0.7 mm thick.

$R_{th\ s\text{-}a}$ for SMDs mounted on ceramic substrate

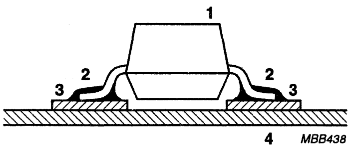
The thermal resistance $R_{th\ s\text{-}a}$ for devices in SOT23, 89, 143, 223, 323, SC59 and SC70 packages mounted on ceramic substrate is a function of the substrate area as shown in Fig.42.

The thermal resistance $R_{th\ j\text{-}a}$ can then be calculated by:

$R_{th\ j\text{-}a}$ (Substrate) = $R_{th\ j\text{-}a}$ (PCB) – $R_{th\ s\text{-}a}$ (PCB) + $R_{th\ s\text{-}a}$ (Substrate)

The $R_{th\ s\text{-}a}$ (PCB) is:

SOT23, 143 and SC59	150 K/W
SOT89	140 K/W
SOT323 /SC70	200 K/W
SOT223	a function of pad area as shown in Fig.41



Heat radiates from the package (1) to ambient.
Heat conducts via leads (2), solder joints (3) to the substrate (4).

Fig.32 Heat losses.

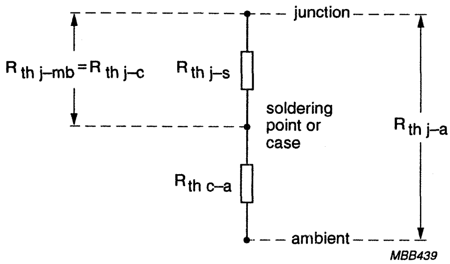
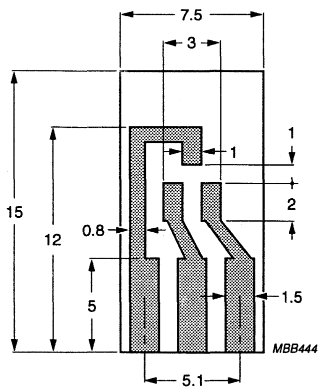
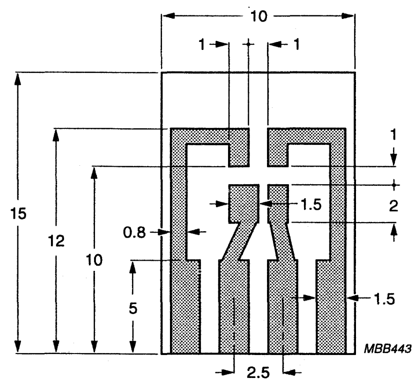


Fig.33 Representation of thermal resistance paths of a device mounted on a substrate or printed board.



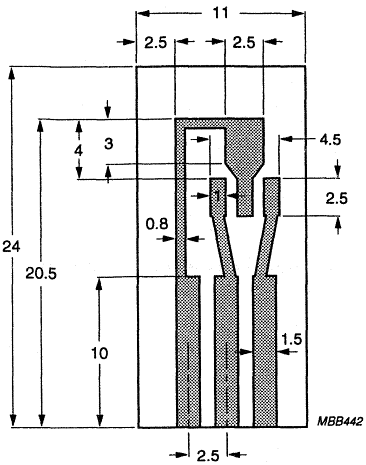
Dimensions in mm.

Fig.34 Standard mounting conditions for SOT23 and SC59.



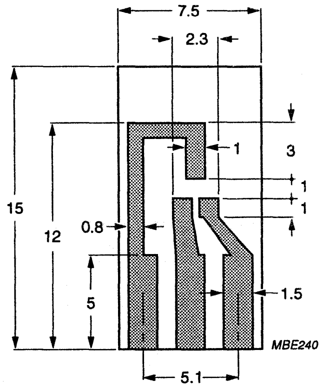
Dimensions in mm.

Fig.35 Standard mounting conditions for SOT143.



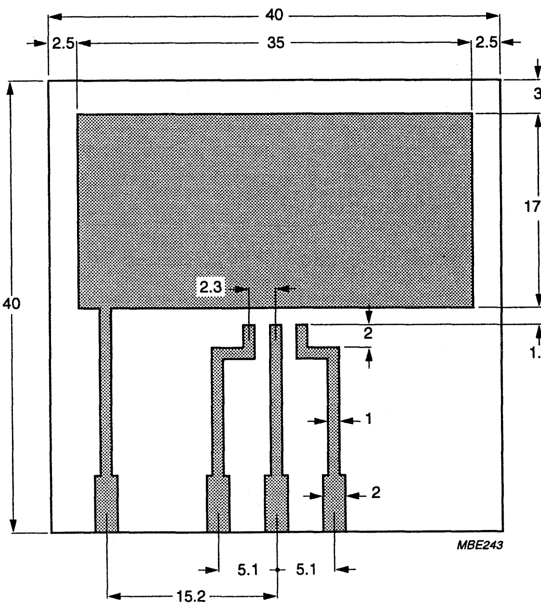
Dimensions in mm.

Fig.36 Standard mounting conditions for SOT89



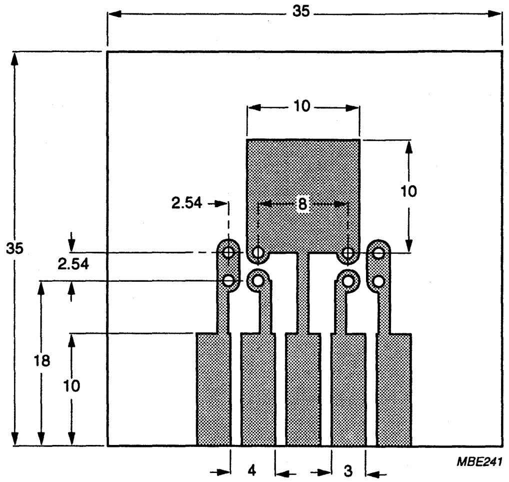
Dimensions in mm.

Fig.37 Standard mounting conditions for SOT323.



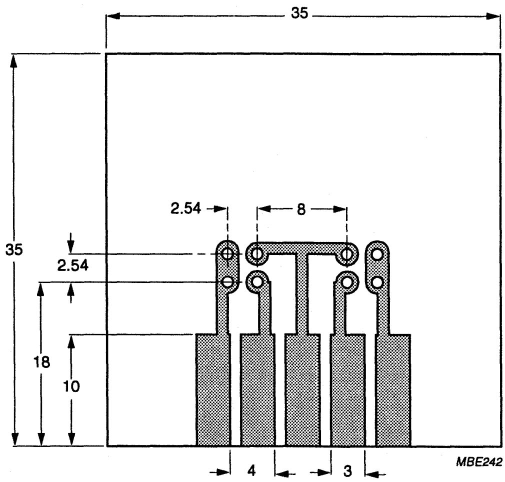
Dimensions in mm.

Fig.38 Standard mounting conditions for SOT223.



Dimensions in mm.

Fig.39 Standard mounting conditions for 1.1 SOT54.



Dimensions in mm.

Fig.40 Standard mounting conditions for 1.2 SOT54.

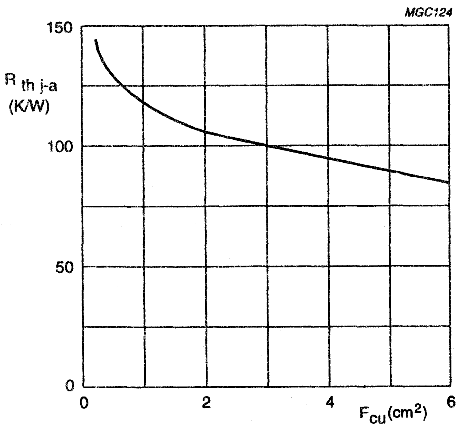


Fig.41 Thermal resistance ($R_{th\ j\text{-}a}$) as a function of FR4 epoxy fibre-glass circuit board.

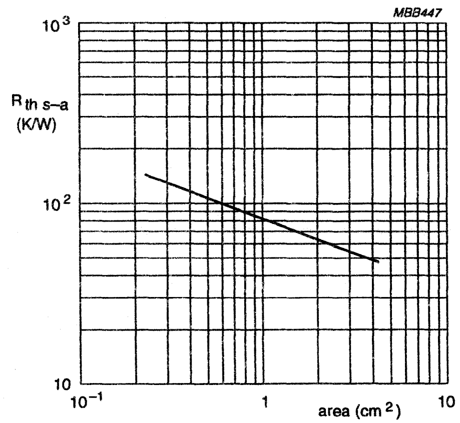


Fig.42 Thermal resistance ($R_{th\ s\text{-}a}$) as a function of area of ceramic substrate.

DEVICE DATA

in alphanumeric sequence

A.F. SILICON PLANAR EPITAXIAL TRANSISTORS

General purpose NPN transistors in TO-18 metal packages with the collector connected to the case.
PNP complements are BC177, BC178 and BC179.

QUICK REFERENCE DATA

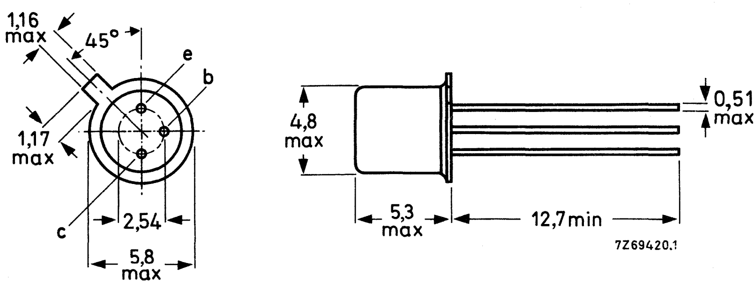
			BC107	BC108	BC109	
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	50	30	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	20	20	V
Collector current (peak value)	I_{CM}	max.	200	200	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	300	300	mW
Junction temperature	T_j	max.	175	175	175	°C
DC current gain at T_j = 25 °C; I_C = 2 mA; V_{CE} = 5 V	h_{FE}	>	110	110	200	
		<	450	800	800	
Transition frequency at f = 35 MHz; I_C = 10 mA; V_{CE} = 5 V	f_T	>	100	100	100	MHz
Noise figure at R_S = 2 kΩ; I_C = 200 μA; V_{CE} = 5 V; f = 30 Hz to 15 kHz	F	typ.	–	–	1,4	dB
		<	–	–	4,0	dB
f = 1 kHz; B = 200 Hz	F	typ.	2	2	1,2	dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-18.

Collector connected to case



RATINGS

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

			BC107	BC108	BC109	
Collector-base voltage (open emitter)	V_{CBO}	max.	50	30	30	V
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	50	30	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	20	20	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6	5	5	V
Collector current (d.c.)	I_C	max.		100		mA
Collector current (peak value)	I_{CM}	max.		200		mA
Emitter current (peak value)	$-I_{EM}$	max.		200		mA
Base current (peak value)	I_{BM}	max.		200		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.		175		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\,j\text{-}a}$	=	0,5	K/mW
From junction to case	$R_{th\,j\text{-}c}$	=	0,2	K/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; V_{CB} = 20 V; T_j = 150 °C	I_{CBO}	<	15	μA
Base-emitter voltage*				
I_C = 2 mA; V_{CE} = 5 V	V_{BE}	typ.	620	mV
			550 to 700	mV
I_C = 10 mA; V_{CE} = 5 V	V_{BE}	<	770	mV
Saturation voltages**				
I_C = 10 mA; I_B = 0,5 mA	V_{CEsat}	typ.	90	mV
		<	250	mV
	V_{BEsat}	typ.	700	mV
I_C = 100 mA; I_B = 5 mA	V_{CEsat}	typ.	200	mV
		<	600	mV
	V_{BEsat}	typ.	900	mV

* V_{BE} decreases by about 2 mV/K with increasing temperature.

** V_{BEsat} decreases by about 1,7 mV/K with increasing temperature.

Collector capacitance at f = 1 MHz						
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.		2,5		pF
		<		6		pF
Emitter capacitance at f = 1 MHz						
$I_C = I_c = 0$; $V_{EB} = 0{,}5$ V	C_e	typ.		9		pF
Transition frequency at f = 35 MHz						
$I_C = 10$ mA; $V_{CE} = 5$ V	f_T	>		100		MHz

			BC107	BC108	BC109
Small signal current gain at f = 1 kHz					
$I_C = 2$ mA; $V_{CE} = 5$ V	h_{fe}	>	110	110	200
		<	450	800	800
Noise figure at $R_S = 2\ k\Omega$					
$I_C = 200\ \mu A$; $V_{CE} = 5$ V					
f = 30 Hz to 15 kHz	F	typ.			1,4 dB
		<			4 dB
f = 1 kHz; B = 200 Hz	F	typ.	2	2	1,2 dB
		<	10	10	4 dB

			BC107A BC108A	BC107B BC108B BC109B	BC108C BC109C
D.C. current gain					
$I_C = 10\ \mu A$; $V_{CE} = 5$ V	h_{FE}	>		40	100
		typ.	90	150	270
$I_C = 2$ mA; $V_{CE} = 5$ V	h_{FE}	>	110	200	420
		typ.	180	290	520
		<	220	450	800
h parameters at f = 1 kHz (common emitter)					
$I_C = 2$ mA; $V_{CE} = 5$ V					
Input impedance	h_{ie}	>	1,6	3,2	6 kΩ
		typ.	2,7	4,5	8,7 kΩ
		<	4,5	8,5	15 kΩ
Reverse voltage transfer ratio	h_{re}	typ.	1,5	2	3 10^{-4}
Small signal current gain	h_{fe}	>	110	200	420
		<	220	450	800
Output admittance	h_{oe}	typ.	18	30	60 $\mu\Omega^{-1}$
		<	30	60	110 $\mu\Omega^{-1}$

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in TO-39 metal package for general purpose applications. P-N-P complements are BC160 and BC161.

QUICK REFERENCE DATA

			BC140	BC141	
Collector-emitter voltage (open base)	V_{CEO}	max.	40	60	V
Collector current (d.c.)	I_C	max.	1		A
Total power dissipation up to T_{case} = 45 °C	P_{tot}	max.	3,7		W
Junction temperature	T_j	max.	175		°C
Transition frequency at f = 20 MHz I_C = 50 mA; V_{CE} = 10 V	f_T	>	50		MHz

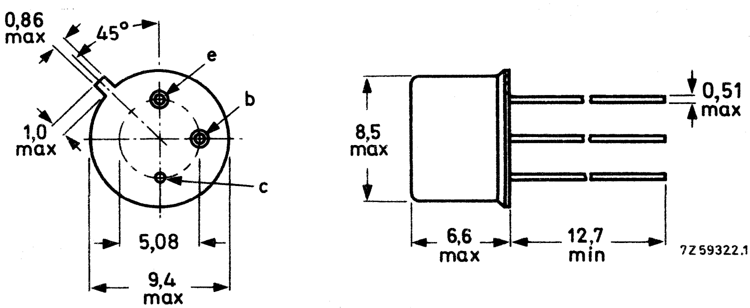
			BC140-10 BC141-10	BC140-16 BC141-16
D.C. current gain I_C = 100 mA; V_{CE} = 1 V	h_{FE}	>	63	100
		<	160	250

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case.



maximum lead diameter is guaranteed only for 12,7 mm.

RATINGS

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

			BC140	BC141	
Collector-base voltage (open emitter)	V_{CBO}	max.	80	100	V
Collector-emitter voltage (open base)	V_{CEO}	max.	40	60	V
Emitter-base voltage (open collector)	V_{EBO}	max.	7	7	V
Collector current (d.c.)	I_C	max.	1		A
Base current (d.c.)	I_B	max.	100		mA
Total power dissipation up to T_{case} = 45 °C	P_{tot}	max.	3,7		W
Storage temperature range	T_{stg}		−65 to + 150		°C
Junction temperature	T_j	max.	175		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\,j\text{-}a}$	=	200	K/W
From junction to case	$R_{th\,j\text{-}c}$	=	35	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector cut-off current				
$V_{BE} = 0$; $V_{CE} = 60$ V	I_{CES}	typ.	10	nA
		<	100	nA
$V_{BE} = 0$; $V_{CE} = 60$ V; $T_{amb} = 150$ °C	I_{CES}	typ.	10	μA
		<	100	μA
Base-emitter voltage				
$I_C = 1$ A; $V_{CE} = 1$ V	V_{BE}	typ.	1,2	V
		<	1,8	V
Saturation voltage				
$I_C = 1$ A; $I_B = 100$ mA	V_{CEsat}	typ.	0,6	V
		<	1,0	V
Transition frequency at f = 20 MHz				
$I_C = 50$ mA; $V_{CE} = 10$ V	f_T	>	50	MHz
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	<	25	pF
Emitter capacitance at f = 1 MHz				
$I_C = I_c = 0$; $V_{EB} = 0{,}5$ V	C_e	<	80	pF

			BC140-10 BC141-10	BC140-16 BC141-16
D.C. current gain				
$I_C = 100\ \mu$A; $V_{CE} = 1$ V	h_{FE}	typ.	40	90
		>	63	100
$I_C = 100$ mA; $V_{CE} = 1$ V	h_{FE}	typ.	100	160
		<	160	250
$I_C = 1$ A; $V_{CE} = 1$ V	h_{FE}	typ.	20	30

CHARACTERISTICS (continued)

T_{amb} = 25 °C

Switching times

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

Turn-on time	t_{on}	<	250 ns
Turn-off time	t_{off}	<	850 ns

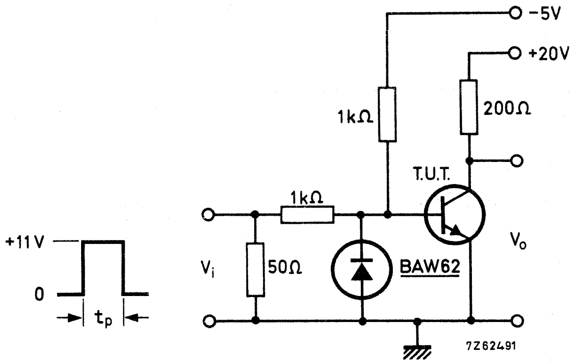


Fig. 2 Test circuit.

Pulse generator:

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

Oscilloscope:

Rise time	t_r	⩽ 15 ns
Input impedance	Z_i	⩾ 100 kΩ

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors in TO-39 metal package for general purpose applications. N-P-N complements are BC140 and BC141.

QUICK REFERENCE DATA

			BC160	BC161	
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40	60	V
Collector current (d.c.)	$-I_C$	max.	1		A
Total power dissipation up to T_{case} = 45 °C	P_{tot}	max.	3,7		W
Junction temperature	T_j	max.	175		°C
Transition frequency at f = 20 MHz $-I_C$ = 50 mA; $-V_{CE}$ = 10 V	f_T	>	50		MHz

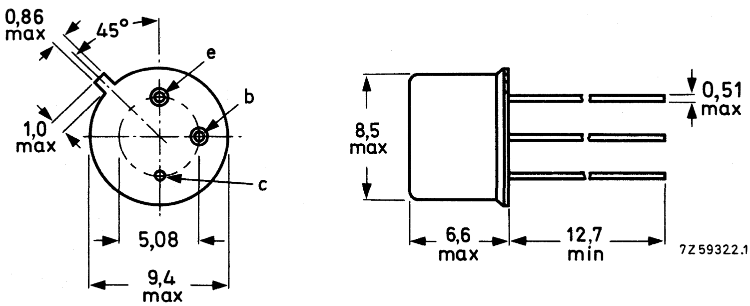
			BC160-10 BC161-10	BC160-16 BC161-16
D.C. current gain $-I_C$ = 100 mA; $-V_{CE}$ = 1 V	h_{FE}	>	63	100
		<	160	250

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case.



maximum lead diameter is guaranteed only for 12,7 mm.

RATINGS

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

			BC160	BC161	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40	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.	1		A
Base current (d.c.)	$-I_B$	max.	100		mA
Total power dissipation up to T_{case} = 45 °C	P_{tot}	max.	3,7		W
Storage temperature range	T_{stg}		−65 to + 150		°C
Junction temperature	T_j	max.	175		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\,j\text{-}a}$	=	200	K/W
From junction to case	$R_{th\,j\text{-}c}$	=	35	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specfied

Collector cut-off current $V_{BE} = 0; -V_{CE} = -V_{CEOmax}$	$-I_{CES}$	typ. <	10 100	nA nA
$V_{BE} = 0; -V_{CE} = -V_{CEOmax}$; T_{amb} = 150 °C	$-I_{CES}$	typ. <	10 100	μA μA
Base-emitter voltage $-I_C$ = 1 A; $-V_{CE}$ = 1 V	$-V_{BE}$	typ. <	1,0 1,7	V V
Saturation voltage $-I_C$ = 1 A; $-I_B$ = 100 mA	$-V_{CEsat}$	typ. <	0,6 1,0	V V
Transition frequency at f = 20 MHz $-I_C$ = 50 mA; $-V_{CE}$ = 10 V	f_T	>	50	MHz
Collector capacitance at f = 1 MHz $I_E = I_e = 0; -V_{CB}$ = 10 V	C_c	<	30	pF
Emitter capacitance at f = 1 MHz $I_C = I_c = 0; -V_{EB}$ = 0,5 V	C_e	<	180	pF

D.C. current gain			BC160-10 BC161-10	BC160-16 BC161-16
$-I_C$ = 100 μA; $-V_{CE}$ = 1 V	h_{FE}	typ.	80	120
		>	63	100
$-I_C$ = 100 mA; $-V_{CE}$ = 1 V	h_{FE}	typ.	100	160
		<	160	250
$-I_C$ = 1 A; $-V_{CE}$ = 1 V	h_{FE}	typ.	20	30

CHARACTERISTICS (continued)

T_{amb} = 25 °C

Switching times

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

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

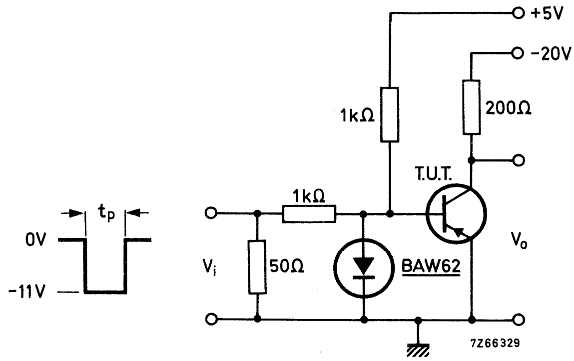


Fig. 2 Test circuit.

Pulse generator:

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

Oscilloscope:

Rise time	t_r	⩽	15 ns
Input impedance	Z_i	⩾	100 kΩ

A.F. SILICON PLANAR EPITAXIAL TRANSISTORS

General purpose P-N-P transistors in TO-18 metal package with the collector connected to the case.
Complementary types for the BC107, BC108 and BC109.

QUICK REFERENCE DATA

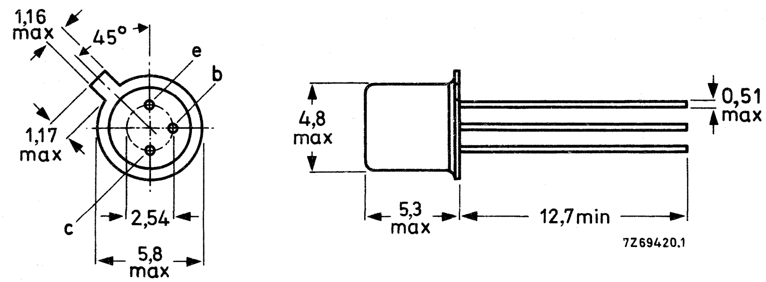
			BC177	BC178	BC179	
Collector-emitter voltage (V_{BE} = OV)	$-V_{CES}$	max.	50	30	25	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	25	20	V
Collector current (peak value)	$-I_{CM}$	max.	200	200	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	300	300	mW
Junction temperature	T_j	max.	175	175	175	°C
DC current gain at T_j = 25 °C $-I_C$ = 2 mA; $-V_{CE}$ = 5 V; f = 1 kHz	h_{FE}	> <	125 500	125 500	125 500	
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	>	100	100	100	MHz
Noise figure at R_S = 2 kΩ $-I_C$ = 200 μA; $-V_{CE}$ = 5 V f = 30 Hz to 15 kHz	F	typ. <	– –	– –	1,2 4,0	dB dB
f = 1 kHz; B = 200 Hz	F	<	10	10	4,0	dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-18.

Collector connected to case



Accessories: 56246 (distance disc).

RATINGS

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

			BC177	BC178	BC179	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	50	30	25	V
Collector-emitter voltage (V_{BE} = 0V)	$-V_{CES}$	max.	50	30	25	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	25	20	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	V
Collector current (d.c.)	$-I_C$	max.		100		mA
Collector current (peak value)	$-I_{CM}$	max.		200		mA
Emitter current (peak value)	I_{EM}	max.		200		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.		175		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\,j\text{-}a}$	=	0,5	K/mW
From junction to case	$R_{th\,j\text{-}c}$	=	0,2	K/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $-V_{CB} = 20$ V	$-I_{CBO}$	typ.	1	nA
		<	100	nA
T_j = 150 °C	$-I_{CBO}$	<	10	μA
Base-emitter voltage*				
$-I_C = 2$ mA; $-V_{CE} = 5$ V	$-V_{BE}$	typ.	650	mV
			600 to 750	mV
Saturation voltages				
$-I_C = 10$ mA; $-I_B = 0{,}5$ mA	$-V_{CEsat}$	typ.	75	mV
		<	300	mV
	$-V_{BEsat}$	typ.	700	mV
$-I_C = 100$ mA; $-I_B = 5$ mA	$-V_{CEsat}$	typ.	250	mV
	$-V_{BEsat}$	typ.	850	mV
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $-V_{CB} = 10$ V	C_c	typ.	4,0	pF
		<	6,0	pF
Transition frequency at f = 35 MHz				
$-I_C = 10$ mA; $-V_{CE} = 5$ V	f_T	>	100	MHz

* $-V_{BE}$ decreases by about 2 mV/K with increasing temperature.

			BC177	BC178	BC179
Noise figure at $R_S = 2\ k\Omega$					
$-I_C = 200\ \mu A$; $-V_{CE} = 5\ V$					
f = 30 Hz to 15 kHz	F	typ.			1,2 dB
		<			4 dB
f = 1 kHz; B = 200 Hz	F	typ.	2	2	1 dB
		<	10	10	4 dB

			BC177 BC178	BC177A BC178A BC179A	BC177B BC178B BC179B
D.C. current gain					
$-I_C = 2\ mA$; $-V_{CE} = 5\ V$	h_{FE}	typ.	140	180	290
		>	125	125	240
		<	500	260	500

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors in plastic TO-92 package, primarily intended for use in driver and output stages of audio amplifiers.

The BC327, BC327A, BC328 are complementary to the BC337, BC337A and BC338 respectively.

QUICK REFERENCE DATA

			BC327	BC327A	BC328	
Collector-emitter voltage ($V_{BE} = 0$)	$-V_{CES}$	max.	50	60	30	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	60	25	V
Collector current (peak value)	$-I_{CM}$	max.		1000		mA
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.		800		mW
Junction temperature	T_j	max.		150		^oC
Transition frequency at f = 100 MHz $-I_C = 10$ mA; $-V_{CE} = 5$ V	f_T	>		80		MHz
D.C. current gain $-I_C = 100$ mA; $-V_{CE} = 1$ V	h_{FE}			100 to 600		

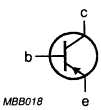
MECHANICAL DATA

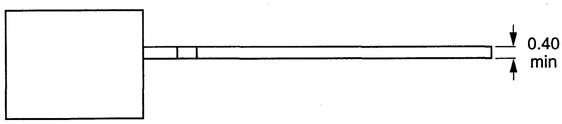
Dimensions in mm

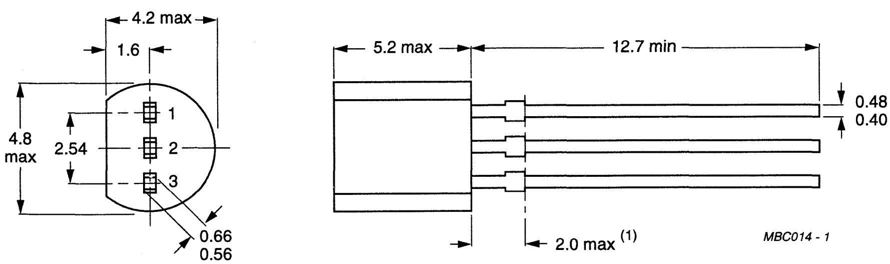
Fig. 1 TO-92.

Pinning

1 = emitter
2 = base
3 = collector







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			BC327	BC327A	BC328	
Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	50	60	30	V
Collector-emitter voltage (open base) $-I_C$ = 10 mA	$-V_{CEO}$	max.	45	60	25	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	V
Collector current (d.c.)	$-I_C$	max.		500		mA
Collector current (peak value)	$-I_{CM}$	max.		1000		mA
Emitter current (peak value)	I_{EM}	max.		1000		mA
Base current (d.c.)	$-I_B$	max.		100		mA
Base current (peak value)	$-I_{BM}$	max.		200		mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.		625		mW
up to T_{amb} = 25 °C	P_{tot}	max.		800		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	$R_{th\ j\text{-}a}$	=	0,2	K/mW
From junction to ambient	$R_{th\ j\text{-}a}$	=	0,156	K/mW*

* Transistor mounted on printed circuit board, max. lead length 4 mm, mounting pad for collector lead min. 10 mm x 10 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0; -V_{CB} = 20$ V; $T_j = 25$ °C	$-I_{CBO}$	<	100 nA
$I_E = 0; -V_{CB} = 20$ V; $T_j = 150$ °C	$-I_{CBO}$	<	5 μA
Emitter cut-off current			
$I_C = 0; -V_{EB} = 5$ V	$-I_{EBO}$	<	10 μA
Base-emitter voltage*			
$-I_C = 500$ mA; $-V_{CE} = 1$ V	$-V_{BE}$	<	1,2 V
Saturation voltage			
$-I_C = 500$ mA; $-I_B = 50$ mA	$-V_{CEsat}$	<	700 mV
D.C. current gain			
$-I_C = 500$ mA; $-V_{CE} = 1$ V	h_{FE}	>	40
$-I_C = 100$ mA; $-V_{CE} = 1$ V; BC327; BC328	h_{FE}		100 to 600
BC327A	h_{FE}		100 to 400
BC327-16, BC328-16	h_{FE}		100 to 250
BC327-25, BC328-25	h_{FE}		160 to 400
BC327-40, BC328-40	h_{FE}		250 to 600
Transition frequency at f = 100 MHz			
$-I_C = 10$ mA; $-V_{CE} = 5$ V	f_T	>	80 MHz
Collector capacitance at f = 1 MHz			
$I_E = I_e = 0; -V_{CB} = 10$ V	C_c	typ.	8 pF

* $-V_{BE}$ decreases by about 2 mV/K with increasing temperature.

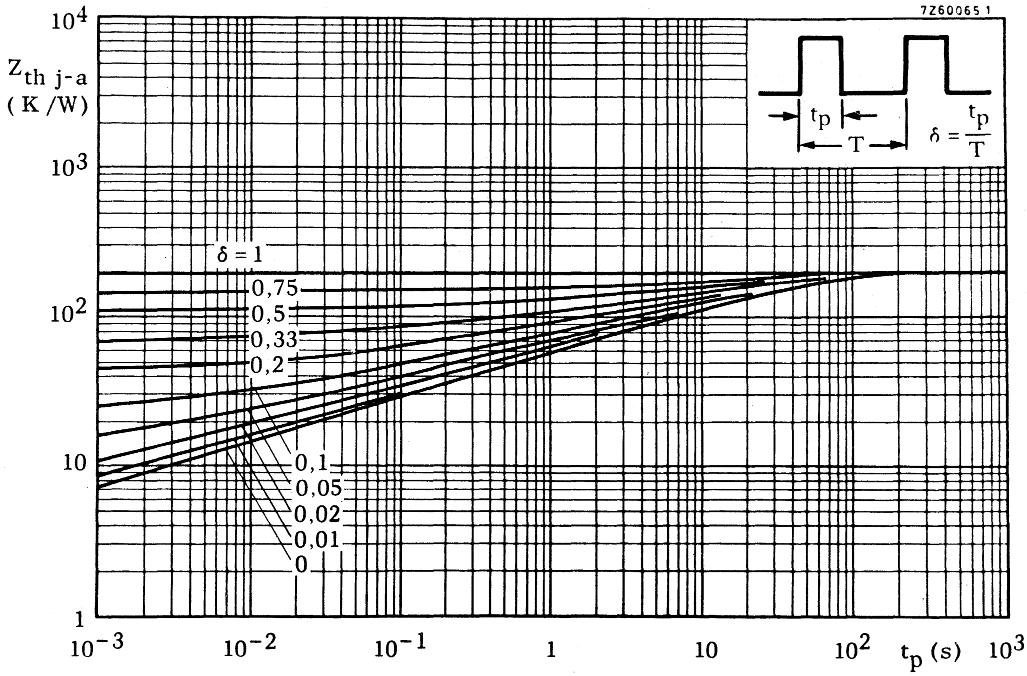

7Z60065.1
$Z_{th\ j\text{-}a}$ (K/W)
10^4
10^3
10^2
10
1
$\delta = 1$
0,75
0,5
0,33
0,2
0,1
0,05
0,02
0,01
0
t_p
T
$\delta = \frac{t_p}{T}$
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
t_p (s)
10^3

Fig. 2.

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in plastic TO-92 package, primarily intended for use in driver and output stages of audio amplifiers.

The BC337, BC337A, BC338 are complementary to the BC327, BC327A and BC328 respectively.

QUICK REFERENCE DATA

			BC337	BC337A	BC338	
Collector-emitter voltage ($V_{BE} = 0$)	V_{CES}	max.	50	60	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	60	25	V
Collector current (peak value)	I_{CM}	max.		1000		mA
Total power dissipation up to $T_{amb} = 25\ ^{o}C$	P_{tot}	max.		800		mW
Junction temperature	T_j	max.		150		^{o}C
Transition frequency at f = 100 MHz $I_C = 10$ mA; $V_{CE} = 5$ V	f_T	>		100		MHz
D.C. current gain $I_C = 100$ mA; $V_{CE} = 1$ V	h_{FE}			100 to 600		

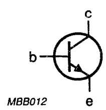
MECHANICAL DATA

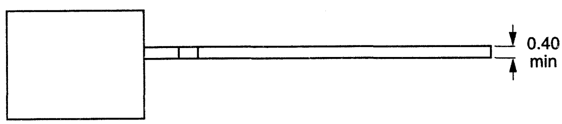
Dimensions in mm

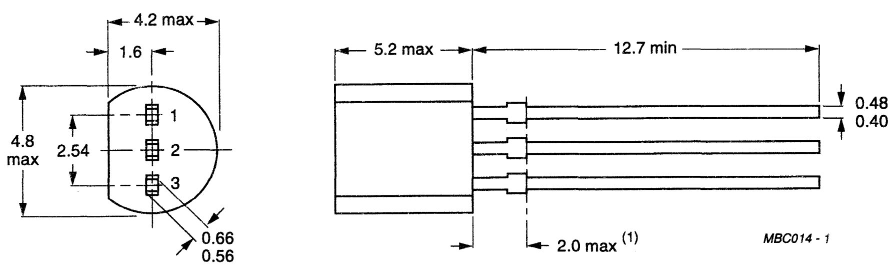
Fig. 1 TO-92.

Pinning

1 = emitter
2 = base
3 = collector







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			BC337	BC337A	BC338	
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	50	60	30	V
Collector-emitter voltage (open base) I_C = 10 mA	V_{CEO}	max.	45	60	25	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	5	V
Collector current (d.c.)	I_C	max.		500		mA
Collector current (peak value)	I_{CM}	max.		1000		mA
Emitter current (peak value)	$-I_{EM}$	max.		1000		mA
Base current (d.c.)	I_B	max.		100		mA
Base current (peak value)	I_{BM}	max.		200		mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.		625		mW
up to T_{amb} = 25 °C	P_{tot}	max.		800		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	$R_{th\ j\text{-}a}$	=	0,2	K/mW
From junction to ambient	$R_{th\ j\text{-}a}$	=	0,156	K/mW*

* Transistor mounted on printed circuit board, max. lead length 4 mm, mounting pad for collector lead min. 10 mm x 10 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
I_E = 0; V_{CB} = 20 V; T_j = 25 °C	I_{CBO}	<	100 nA
I_E = 0; V_{CB} = 20 V; T_j = 150 °C	I_{CBO}	<	5 μA
Emitter cut-off current			
I_C = 0; V_{EB} = 5 V	I_{EBO}	<	10 μA
Base-emitter voltage*			
I_C = 500 mA; V_{CE} = 1 V	V_{BE}	<	1,2 V
Saturation voltage			
I_C = 500 mA; I_B = 50 mA	V_{CEsat}	<	700 mV
D.C. current gain			
I_C = 500 mA; V_{CE} = 1 V	h_{FE}	>	40
I_C = 100 mA; V_{CE} = 1 V; BC337; BC338	h_{FE}	100 to 600	
BC337A	h_{FE}	100 to 400	
BC337-16, BC338-16	h_{FE}	100 to 250	
BC337-25, BC338-25	h_{FE}	160 to 400	
BC337-40, BC338-40	h_{FE}	250 to 600	
Transition frequency at f = 100 MHz			
I_C = 10 mA; V_{CE} = 5 V	f_T	>	100 MHz
Collector capacitance at f = 1 MHz			
$I_E = I_e$ = 0; V_{CB} = 10 V	C_c	typ.	5 pF

* V_{BE} decreases by about 2 mV/K with increasing temperature.

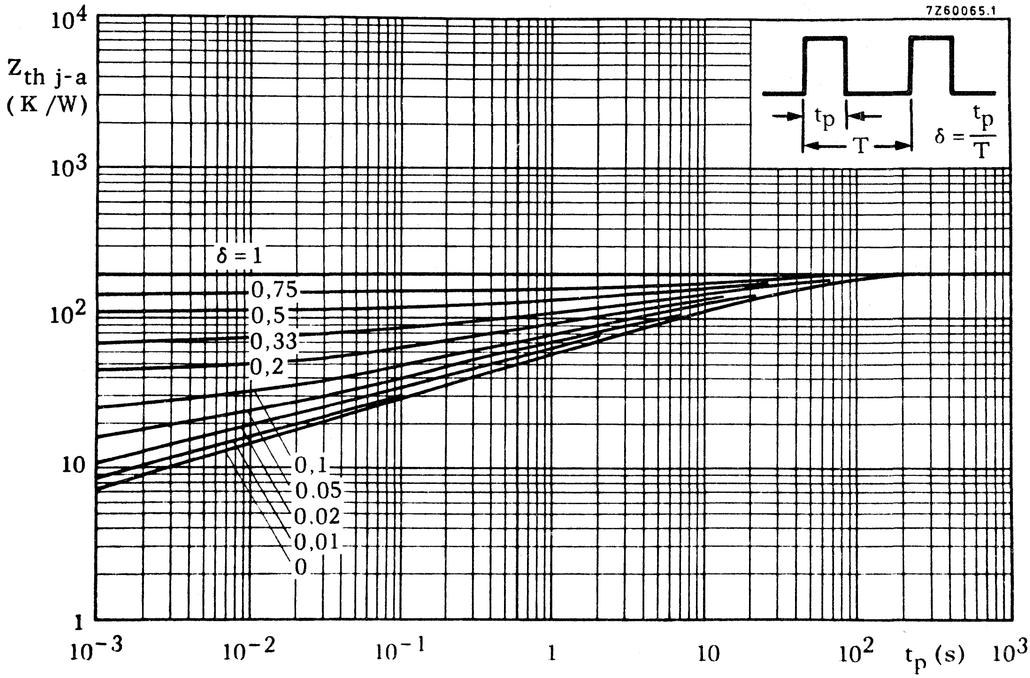

7Z60065.1
$Z_{th\ j-a}$
(K/W)
10^4
10^3
10^2
10
1
$\delta = 1$
0,75
0,5
0,33
0,2
0,1
0.05
0.02
0,01
0
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
t_p (s)
10^3
t_p
T
$\delta = \frac{t_p}{T}$

Fig. 2.

SILICON PLANAR EPITAXIAL TRANSISTOR

NPN transistor in a plastic TO-92 package, intended for low-voltage, high current LF applications. BC368/BC369 is the matched complementary pair suitable for class-B audio output stages up to 3 W.

QUICK REFERENCE DATA

Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	25	V
Collector-emitter voltage (open base)	V_{CEO}	max.	20	V
Collector current (peak value)	I_{CM}	max.	2	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1	W
Junction temperature	T_j	max.	150	°C
DC current gain I_C = 500 mA; V_{CE} = 1 V	h_{FE}		85 to 375	
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 5 V	f_T	min.	40	MHz

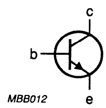
MECHANICAL DATA

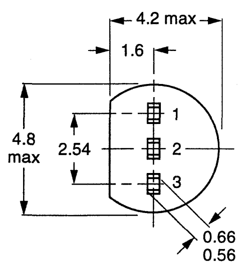
Dimensions in mm

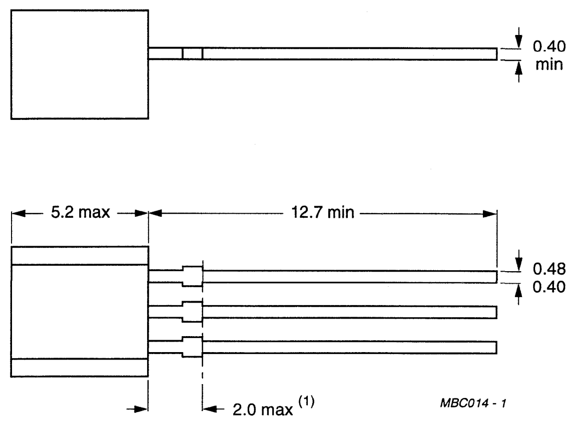
Fig. 1 TO-92.

Pinning

1 = base
2 = collector
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	25	V
Collector-emitter voltage (open base)	V_{CEO}	max.	20	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V
Collector current (DC)	I_C	max.	1	A
Collector current (peak value)	I_{CM}	max.	2	A
Base current (DC)	I_B	max.	100	mA
Base current (peak value)	I_{BM}	max.	200	mA
Total power dissipation				
at T_{amb} = 25 °C (in free air)	P_{tot}	max.	0,8	W
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 in free air	$R_{th\ j\text{-}a}$	=	156	K/W
From junction to ambient*	$R_{th\ j\text{-}a}$	=	125	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	60	K/W

* Transistor mounted on printed-circuit board, maximum lead length 4 mm, mounting pad for collector lead min. 10 mm x 10 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $V_{CB} = 25$ V		I_{CBO}	max.	10 μA
$I_E = 0$; $V_{CB} = 25$ V; $T_j = 150$ °C		I_{CBO}	max.	1 mA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 5$ V		I_{EBO}	max.	10 μA
Base-emitter voltage				
$I_C = 5$ mA; $V_{CE} = 10$ V		V_{BE}	max.	0.7 V
$I_C = 1$ A; $V_{CE} = 1$ V		V_{BE}	max.	1 V
Collector-emitter saturation voltage				
$I_C = 1$ A; $I_B = 100$ mA		V_{CEsat}	max.	0.5 V
DC current gain				
$I_C = 5$ mA; $V_{CE} = 10$ V		h_{FE}	min.	50
$I_C = 500$ mA; $V_{CE} = 1$ V	BC368	h_{FE}		85 to 375
	BC368-25	h_{FE}	>	160
$I_C = 1$ A; $V_{CE} = 1$ V		h_{FE}	min.	60
Collector capacitance at f = 450 kHz				
$I_E = I_e = 0$; $V_{CB} = 5$ V		C_c	max.	40 pF
Transition frequency at f = 100 MHz				
$I_C = 10$ mA; $V_{CE} = 5$ V		f_T	min.	40 MHz

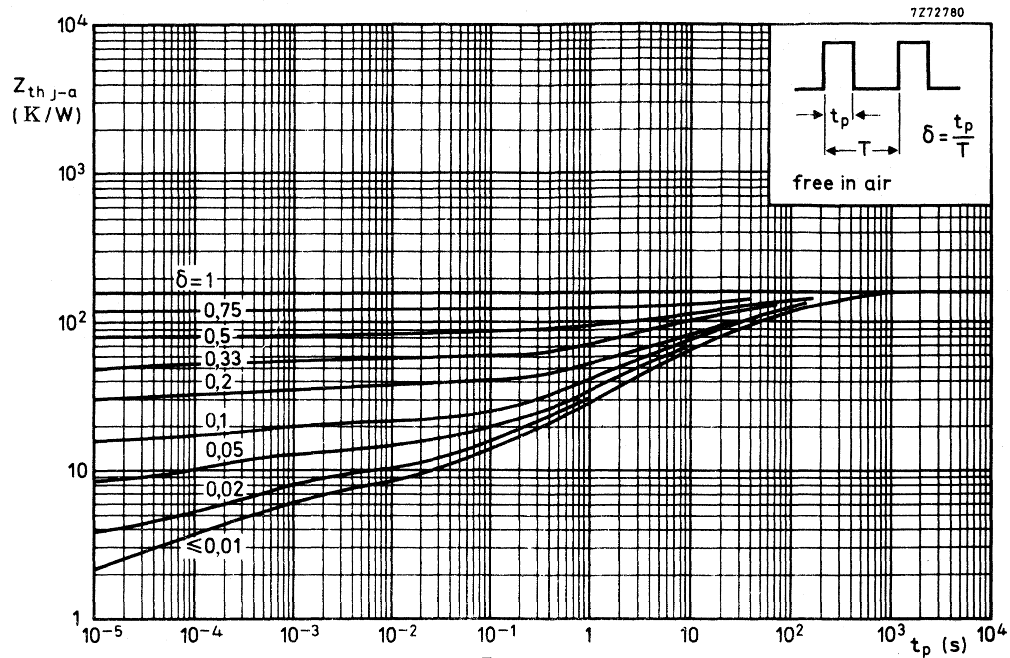

7Z72780
$Z_{th\ j-a}$ (K/W)
10^4
10^3
10^2
10
1
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3
10^4
t_p (s)
t_p
T
$\delta = \frac{t_p}{T}$
free in air
δ = 1
0,75
0,5
0,33
0,2
0,1
0,05
0,02
≤0,01

Fig. 2.

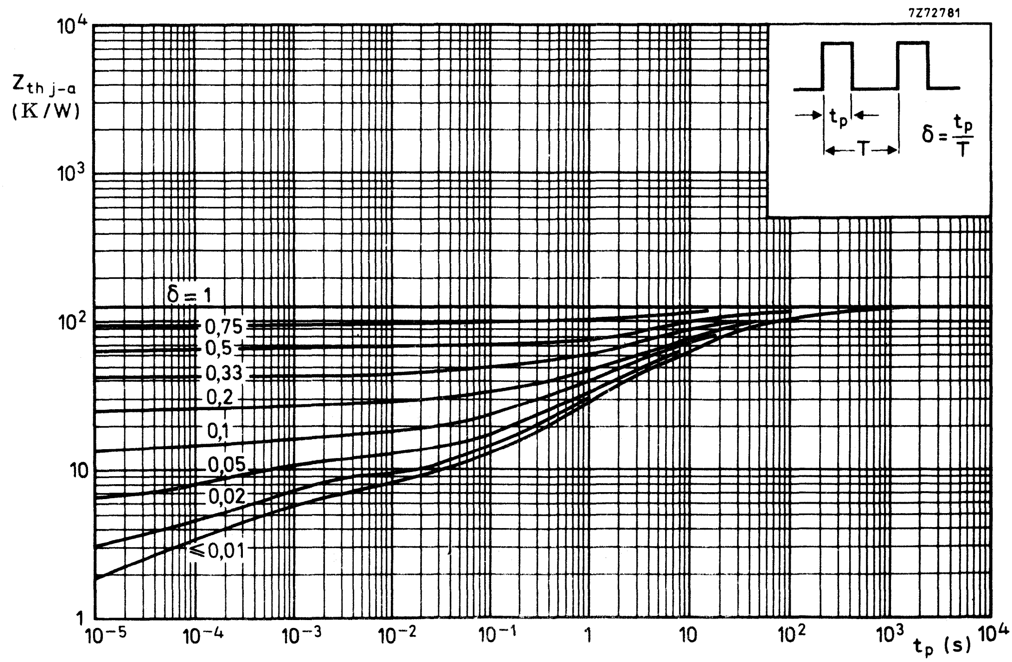

7Z72781
$Z_{th\ j-a}$ (K/W)
10^4
10^3
10^2
10
1
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3
10^4
t_p (s)
t_p
T
$\delta = \frac{t_p}{T}$
δ = 1
0,75
0,5
0,33
0,2
0,1
0,05
0,02
≤0,01

Fig. 3.

SILICON PLANAR EPITAXIAL TRANSISTOR

PNP transistor in a plastic TO-92 package, intended for low-voltage, high-current LF applications. BC368/BC369 is the matched complementary pair suitable for class-B output stages up to 3 W.

QUICK REFERENCE DATA

Collector-emitter voltage ($V_{BE} = 0$)	$-V_{CES}$	max.	25 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	20 V
Collector current (peak value)	$-I_{CM}$	max.	2 A
Total power dissipation up to $T_{amb} = 25\ ^{o}C$	P_{tot}	max.	1 W
Junction temperature	T_j	max.	150 ^{o}C
DC current gain $-I_C = 500$ mA; $-V_{CE} = 1$ V	h_{FE}		85 to 375
Transition frequency at f = 100 MHz $-I_C = 10$ mA; $-V_{CE} = 5$ V	f_T	min.	40 MHz

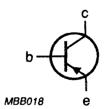
MECHANICAL DATA

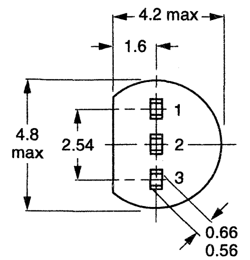
Dimensions in mm

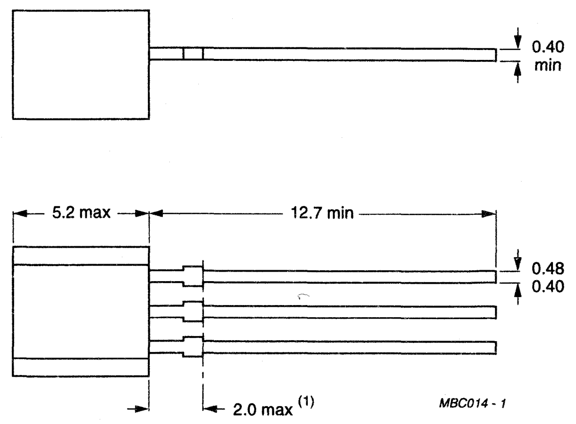
Fig. 1 TO-92.

Pinning

1 = base
2 = collector
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	25	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	20	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	V
Collector current (DC)	$-I_C$	max.	1	A
Collector current (peak value)	$-I_{CM}$	max.	2	A
Base current (DC)	$-I_B$	max.	100	mA
Base current (peak value)	$-I_{BM}$	max.	200	mA
Total power dissipation				
at T_{amb} = 25 °C (in free air)	P_{tot}	max.	0,8	W
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 in free air	$R_{th\ j\text{-}a}$	=	156	K/W
From junction to ambient*	$R_{th\ j\text{-}a}$	=	125	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	60	K/W

* Transistor mounted on printed-circuit board, maximum lead length 4 mm, mounting pad for collector lead min. 10 mm x 10 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current					
I_E = 0; $-V_{CB}$ = 25 V		$-I_{CBO}$	max.	10	μA
I_E = 0; $-V_{CB}$ = 25 V; T_j = 150 °C		$-I_{CBO}$	max.	1	mA
Emitter cut-off current					
I_C = 0; $-V_{EB}$ = 5 V		$-I_{EBO}$	max.	10	μA
Base-emitter voltage					
$-I_C$ = 5 mA; $-V_{CE}$ = 10 V		$-V_{BE}$	max.	0.7	V
$-I_C$ = 1 A; $-V_{CE}$ = 1 V		$-V_{BE}$	max.	1	V
Collector-emitter saturation voltage					
$-I_C$ = 1 A; $-I_B$ = 100 mA		$-V_{CEsat}$	max.	0.5	V
DC current gain					
$-I_C$ = 5 mA; $-V_{CE}$ = 10 V		h_{FE}	min.	50	
$-I_C$ = 500 mA; $-V_{CE}$ = 1 V	BC369	h_{FE}		85 to 375	
	BC369-10	h_{FE}	$<$	160	
	BC369-25	h_{FE}	$>$	160	
$-I_C$ = 1 A; $-V_{CE}$ = 1 V		h_{FE}	min.	60	
Collector capacitance at f = 450 kHz					
$I_E = I_e$ = 0; $-V_{CB}$ = 5 V		C_c	max.	60	pF
Transition frequency at f = 100 MHz					
$-I_C$ = 10 mA; $-V_{CE}$ = 5 V		f_T	min.	40	MHz

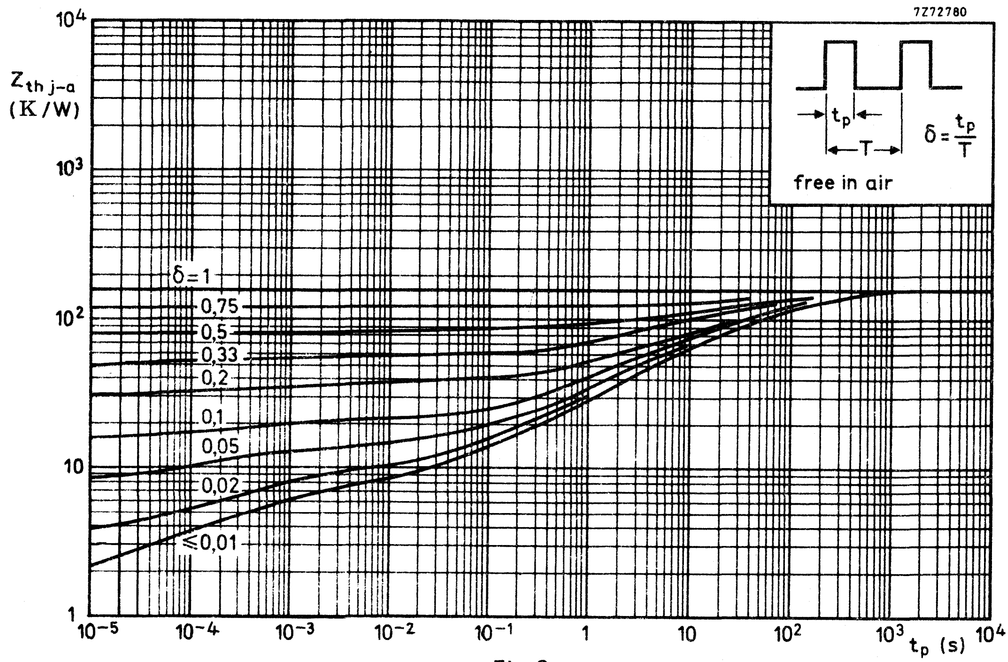

7Z72780
$Z_{th\ j-a}$ (K/W)
10^4
10^3
10^2
10
1
t_p
T
$\delta = \frac{t_p}{T}$
free in air
δ = 1
0,75
0,5
0,33
0,2
0,1
0,05
0,02
≤0,01
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3
t_p (s)
10^4

Fig. 2.

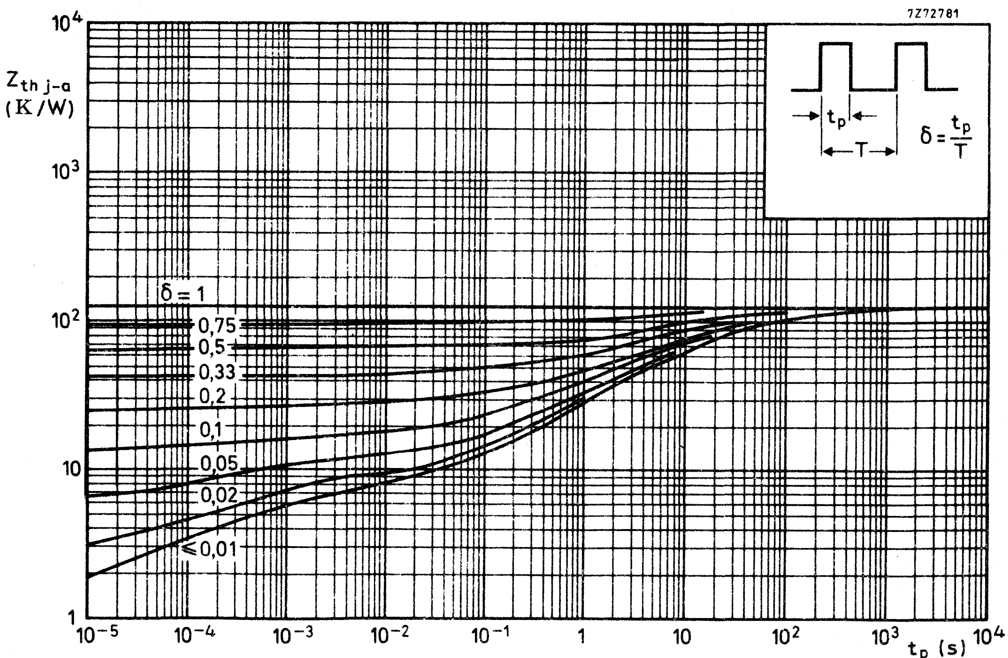

7Z72781
$Z_{th\ j-a}$ (K/W)
10^4
10^3
10^2
10
1
t_p
T
$\delta = \frac{t_p}{T}$
δ = 1
0,75
0,5
0,33
0,2
0,1
0,05
0,02
≤0,01
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3
t_p (s)
10^4

Fig. 3.

SILICON PLANAR EPITAXIAL TRANSISTOR

NPN transistor in a plastic TO-92 package, intended for low-voltage, high current LF applications. BC375/BC376 is the matched complementary pair suitable for output stages up to 2 W.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Collector current (peak value)	I_{CM}	max.	1.5	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	800	mW
Junction temperature	T_j	max.	150	°C
DC current gain I_C = 150 mA; V_{CE} = 1 V	h_{FE}		100 to 400	
Transition frequency at f = 100 MHz I_C = 150 mA; V_{CE} = 1 V	f_T	typ.	150	MHz

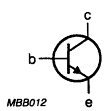
MECHANICAL DATA

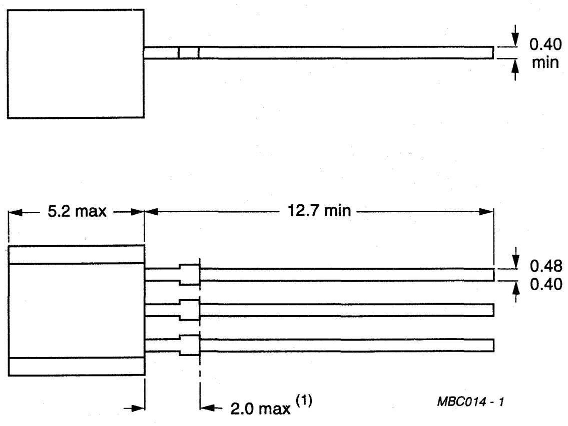
Dimensions in mm

Fig. 1 TO-92.

Pinning

1 = emitter
2 = base
3 = collector





Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

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)	V_{CEO}	max.	30	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6	V
Collector current (DC)	I_C	max.	1	A
Collector current (peak value)	I_{CM}	max.	1,5	A
Base current (DC)	I_B	max.	100	mA
Base current (peak value)	I_{BM}	max.	200	mA
Total power dissipation				
at T_{amb} = 25 °C (in free air)	P_{tot}	max.	625	mW
up to T_{amb} = 25 °C*	P_{tot}	max.	800	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	$R_{th\ j\text{-}a}$	=	200	K/W
From junction to ambient *	$R_{th\ j\text{-}a}$	=	156	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	95	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $V_{CB} = 25$ V	I_{CBO}	max.	100	nA
$I_E = 0$; $V_{CB} = 25$ V; $T_j = 150$ °C	I_{CBO}	max.	5	μA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	max.	10	μA
Base-emitter voltage**				
I_C = 5 mA; V_{CE} = 10 V	V_{BE}	typ.	650	mV
I_C = 700 mA; V_{CE} = 1 V	V_{BE}	max.	1.1	V
Collector-emitter saturation voltage				
I_C = 700 mA; I_B = 70 mA	V_{CEsat}	typ.	250	mV
		max.	400	mV
D.C. current gain				
I_C = 5 mA; V_{CE} = 10 V	h_{FE}	min.	100	
I_C = 150 mA; V_{CE} = 1 V	h_{FE}		100 to 400	
I_C = 700 mA; V_{CE} = 1 V	h_{FE}	min.	50	
Transition frequency at f = 100 MHz				
I_C = 150 mA; V_{CE} = 1 V	f_T	typ.	150	MHz

* Transistor mounted on printed-circuit board, maximum lead length 4 mm, mounting pad for collector lead minimum 10 mm x 10 mm.

** V_{BE} decreases by about 2 mV/K with increasing temperature.

SILICON PLANAR EPITAXIAL TRANSISTOR

PNP transistor in a plastic TO-92, package, intended for low-voltage, high current LF applications. BC375/BC376 is the matched complementary pair suitable for output stages up to 2 W.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	25	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	20	V
Collector current (peak value)	$-I_{CM}$	max.	1.5	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	800	mW
Junction temperature	T_j	max.	150	°C
DC current gain $-I_C$ = 150 mA; $-V_{CE}$ = 1 V	h_{FE}		100 to 400	
Transition frequency at f = 100 MHz $-I_C$ = 150 mA; $-V_{CE}$ = 1 V	f_T	typ.	100	MHz

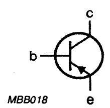
MECHANICAL DATA

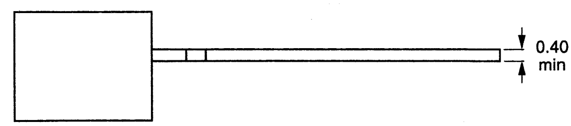
Dimensions in mm

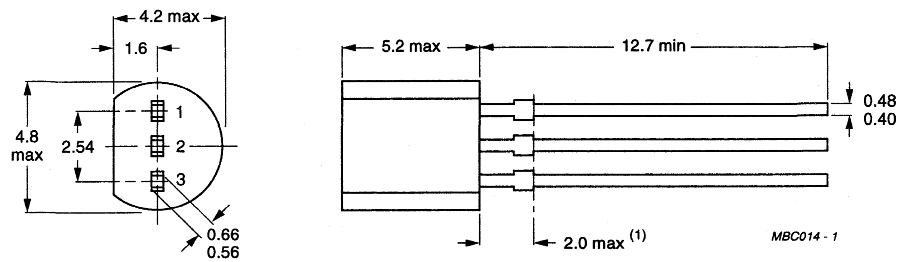
Fig. 1 TO-92.

Pinning

1 = emitter
2 = base
3 = collector







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	25	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	20	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	6	V
Collector current (DC)	$-I_C$	max.	1	A
Collector current (peak value)	$-I_{CM}$	max.	1.5	A
Base current (DC)	$-I_B$	max.	100	mA
Base current (peak value)	$-I_{BM}$	max.	200	mA
Total power dissipation				
at T_{amb} = 25 °C (in free air)	P_{tot}	max.	625	mW
up to T_{amb} = 25 °C*	P_{tot}	max.	800	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	$R_{th\ j\text{-}a}$	=	200	K/W
From junction to ambient*	$R_{th\ j\text{-}a}$	=	156	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	95	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $-V_{CB}$ = 25 V	$-I_{CBO}$	max.	100	nA
$I_E = 0$; $-V_{CB}$ = 25 V; T_j = 150 °C	$-I_{CBO}$	max.	5	μA
Emitter cut-off current				
$I_C = 0$; $-V_{EB}$ = 5 V	$-I_{EBO}$	max.	10	μA
Base-emitter voltage**				
$-I_C$ = 5 mA; $-V_{CE}$ = 10 V	$-V_{BE}$	typ.	650	mV
$-I_C$ = 700 mA; $-V_{CE}$ = 1 V	$-V_{BE}$	max.	1.1	V
Collector-emitter saturation voltage				
$-I_C$ = 700 mA; $-I_B$ = 70 mA	$-V_{CEsat}$	typ.	280	mV
		max.	400	mV
DC current gain				
$-I_C$ = 5 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	100	
$-I_C$ = 150 mA; $-V_{CE}$ = 1 V	h_{FE}	100 to 400		
$-I_C$ = 700 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	50	
Transition frequency at f = 100 MHz				
$-I_C$ = 150 mA; $-V_{CE}$ = 1 V	f_T	typ.	100	MHz

* Transistor mounted on printed-circuit board, maximum lead length 4 mm, mounting pad for collector lead minimum 10 mm x 10 mm.

** $-V_{BE}$ decreases by about 2 mV/K with increasing temperature.

SILICON PLANAR DARLINGTON TRANSISTOR

P-N-P silicon planar darlington transistor in a plastic TO-92 package.

N-P-N complement is BC517.

QUICK REFERENCE DATA

Collector-emitter voltage (open base)	$-V_{CEO}$	max.	30	V
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40	V
Collector current	$-I_C$	max.	400	mA
Junction temperature	T_j	max.	150	^oC
Total power dissipation up to T_{amb} = 25 ^oC	P_{tot}	max.	625	mW
D.C. current gain $-I_C$ = 20 mA; $-V_{CE}$ = 2 V	h_{FE}	>	30 000	
Collector-emitter saturation voltage $-I_C$ = 100 mA; $-I_B$ = 0,1 mA	$-V_{CEsat}$	max.	1	V
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	typ.	220	MHz

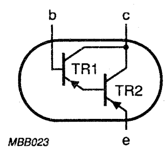
MECHANICAL DATA

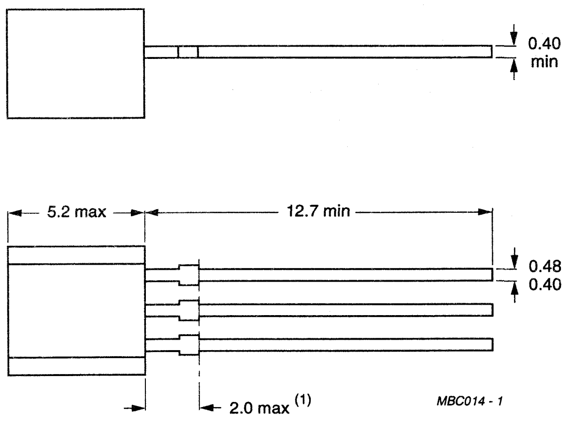
Dimensions in mm

Fig. 1 TO-92.

Pinning

1 = emitter
2 = base
3 = collector





Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

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.	40	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	10	V
Collector current	$-I_C$	max.	400	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	625	mW
Junction temperature	T_j	max.	150	°C
Storage temperature	T_{stg}	−65 to + 150		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	max.	200	K/W
From junction to case	$R_{th\ j\text{-}c}$	max.	90	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise stated

Collector cut-off current $-V_{CB}$ = 30 V	$-I_{CBO}$	max.	100	nA
Collector-emitter breakdown voltage $-I_C$ = 2 mA	$-V_{(BR)CEO}$	min.	30	V
Collector-base breakdown voltage	$-V_{(BR)CBO}$	min.	40	V
Emitter-base breakdown voltage	$-V_{(BR)EBO}$	min.	10	V
D.C. current gain $-I_C$ = 20 mA; $-V_{CE}$ = 2 V	h_{FE}	>	30 000	
Collector-emitter saturation voltage $-I_C$ = 100 mA; $-I_B$ = 0,1 mA	$-V_{CEsat}$	max.	1	V
Base-emitter voltage $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	$-V_{BE}$	max.	1,4	V
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	typ.	220	MHz

SILICON PLANAR DARLINGTON TRANSISTOR

N-P-N silicon planar darlington transistor in a plastic TO-92 package.
P-N-P complement is BC516.

QUICK REFERENCE DATA

Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Collector-base voltage (open emitter)	V_{CBO}	max.	40	V
Collector current	I_C	max.	400	mA
Junction temperature	T_j	max.	150	^oC
Total power dissipation up to T_{amb} = 25 ^oC	P_{tot}	max.	625	mW
D.C. current gain I_C = 20 mA; V_{CE} = 2 V	h_{FE}	>	30 000	
Collector-emitter saturation voltage I_C = 100 mA; I_B = 0,1 mA	V_{CEsat}	max.	1	V
Transition frequency at f = 100 MHz I_C = 30 mA; V_{CE} = 5 V	f_T	typ.	220	MHz

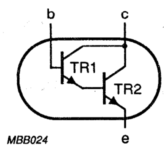
MECHANICAL DATA

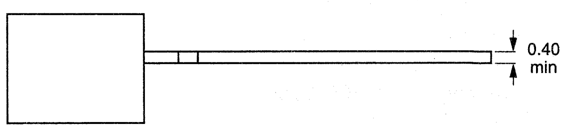
Dimensions in mm

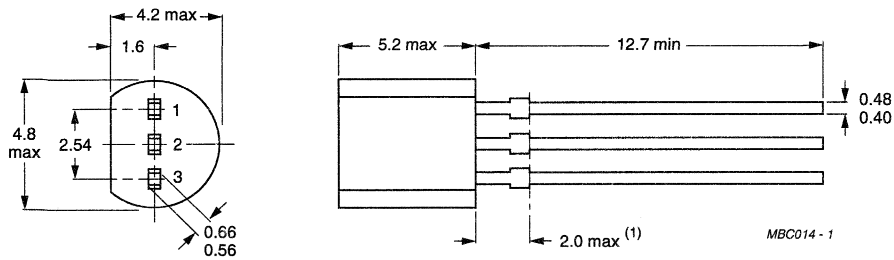
Fig. 1 TO-92.

Pinning

1 = emitter
2 = base
3 = collector







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

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.	40	V
Emitter-base voltage (open collector)	V_{EBO}	max.	10	V
Collector current	I_C	max.	400	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	625	mW
Junction temperature	T_j	max.	150	°C
Storage temperature	T_{stg}		−65 to + 150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	max.	200	K/W
From junction to case	$R_{th\ j\text{-}c}$	max.	90	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise stated

Collector cut-off current V_{CB} = 30 V	I_{CBO}	max.	100	nA
Collector-emitter breakdown voltage I_C = 2 mA	$V_{(BR)CEO}$	min.	30	V
Collector-base breakdown voltage	$V_{(BR)CBO}$	min.	40	V
Emitter-base breakdown voltage	$V_{(BR)EBO}$	min.	10	V
D.C. current gain I_C = 20 mA; V_{CE} = 2 V	h_{FE}	>	30 000	
Collector-emitter saturation voltage I_C = 100 mA; I_B = 0,1 mA	V_{CEsat}	max.	1	V
Base-emitter voltage I_C = 10 mA; V_{CE} = 5 V	V_{BE}	max.	1,4	V
Transition frequency at f = 100 MHz I_C = 30 mA; V_{CE} = 5 V	f_T	typ.	220	MHz

SILICON PLANAR EPITAXIAL TRANSISTORS

General purpose n-p-n transistors in a plastic TO-92 package.

QUICK REFERENCE DATA

			BC546	BC547	BC548	
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	80	50	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	65	45	30	V
Collector current (peak value)	I_{CM}	max.	200	200	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	500	500	mW
Junction temperature	T_j	max.	150	150	150	°C
D.C. current gain I_C = 2 mA; V_{CE} = 5 V	h_{FE}	>	110	110	110	
		<	450	800	800	
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 5 V	f_T	>	100	100	100	MHz
Noise figure at R_S = 2 kΩ I_C = 200 μA; V_{CE} = 5 V f = 1 kHz; B = 200 Hz	F	typ.	2	2	2	dB

MECHANICAL DATA

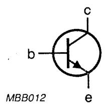
Dimensions in mm

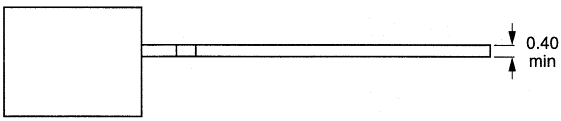
Fig. 1 TO-92.

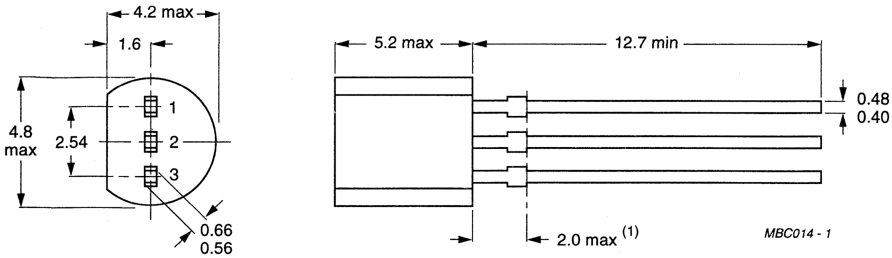
Pinning

1 = emitter

2 = base







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			BC546	BC547	BC548	
Collector-base voltage (open emitter)	V_{CBO}	max.	80	50	30	V
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	80	50	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	65	45	30	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6	6	5	V

Collector current (d.c.)	I_C	max.	100	mA
Collector current (peak value)	I_{CM}	max.	200	mA
Emitter current (peak value)	$-I_{EM}$	max.	200	mA
Base current (peak value)	I_{BM}	max.	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	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	$R_{th\,j\text{-}a}$	=	0,25	K/mW
From junction to case	$R_{th\,j\text{-}c}$	=	0,15	K/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; V_{CB} = 30 V	I_{CBO}	<	15	nA
$I_E = 0$; V_{CB} = 30 V; T_j = 150 °C	I_{CBO}	<	5	μA
Base-emitter voltage*				
I_C = 2 mA; V_{CE} = 5 V	V_{BE}	typ.	660	mV
			580 to 700	mV
I_C = 10 mA; V_{CE} = 5 V	V_{BE}	<	770	mV

* V_{BE} decreases by about 2 mV/K with increasing temperature.

Saturation voltage*				
$I_C = 10$ mA; $I_B = 0,5$ mA	V_{CEsat}	typ.	90	mV
		<	250	mV
	V_{BEsat}	typ.	700	mV
$I_C = 100$ mA; $I_B = 5$ mA	V_{CEsat}	typ.	200	mV
		<	600	mV
	V_{BEsat}	typ.	900	mV
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	2,5	pF
Emitter capacitance at f = 1 MHz				
$I_C = I_c = 0$; $V_{EB} = 0,5$ V	C_e	typ.	9	pF
Transition frequency at f = 100 MHz				
$I_C = 10$ mA; $V_{CE} = 5$ V	f_T	>	100	MHz
Small signal current gain at f = 1 kHz				
$I_C = 2$ mA; $V_{CE} = 5$ V	h_{fe}		110 to 800	

			BC546	BC547	BC548	
Noise figure at $R_S = 2$ kΩ $I_C = 200$ μA; $V_{CE} = 5$ V f = 1 kHz; B = 200 Hz	F	typ.	2	2	2	dB
		<	10	10	10	dB

			BC546A BC547A BC548A	BC546B BC547B BC548B	BC547C BC548C	BC547 BC548	BC546
D.C. current gain							
$I_C = 10$ μA; $V_{CE} = 5$ V	h_{FE}	typ.	90	150	270		
		>	110	200	420	110	110
$I_C = 2$ mA; $V_{CE} = 5$ V	h_{FE}	typ.	180	290	520		
		<	220	450	800	800	450

* V_{BEsat} decreases by about 1,7 mV/K with increasing temperature.

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in plastic TO-92 package.

QUICK REFERENCE DATA

			BC549	BC550	
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max	30	50	V
Collector-emitter voltage (open base)	V_{CEO}	max	30	45	V
Collector current (peak value)	I_{CM}	max	200	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max	500	500	mW
Junction temperature	T_j	max	150	150	°C
D.C. current gain I_C = 2 mA; V_{CE} = 5 V	h_{FE}	> <	200 800	200 800	
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 5 V	f_T		100	100	MHz
Noise figure at R_S = 2 kΩ I_C = 200 μA; V_{CE} = 5 V f = 30 Hz to 15 kHz	F	typ <	1,4 4	1,4 3	dB dB
f = 1 kHz; B = 200 Hz	F	typ	1,2	1	dB
f = 10 Hz to 50 Hz (equivalent noise voltage)	V_n	<	–	0,135	μV

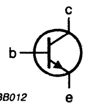
MECHANICAL DATA

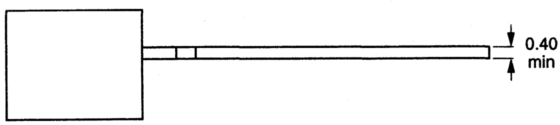
Dimensions in mm

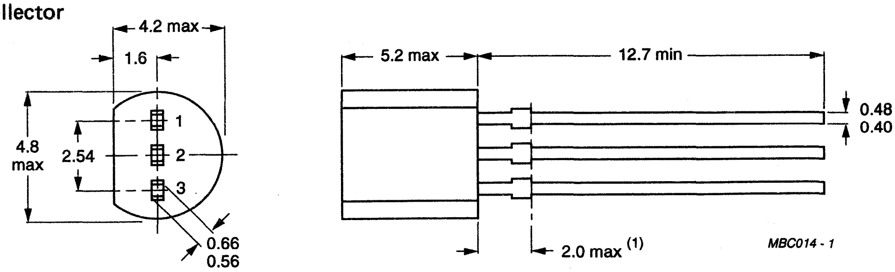
Fig. 1 TO-92.

Pinning

1 = emitter
2 = base
3 = collector







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			BC549	BC550	
Collector-base voltage (open emitter)	V_{CBO}	max.	30	50	V
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	30	50	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	45	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	V
Collector current (d.c.)	I_C	max.		100	mA
Collector current (peak value)	I_{CM}	max.		200	mA
Emitter current (peak value)	$-I_{EM}$	max.		200	mA
Base current (peak value)	I_{BM}	max.		200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		500	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	$R_{th\ j\text{-}a}$	=	0,25	K/mW
From junction to case	$R_{th\ j\text{-}c}$	=	0,15	K/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
I_E = 0; V_{CB} = 30 V	I_{CBO}	<	15	nA
I_E = 0; V_{CB} = 30 V; T_j = 150 °C	I_{CBO}	<	5	μA
Base emitter voltage*				
I_C = 2 mA; V_{CE} = 5 V	V_{BE}	typ.	660	mV
			580 to 700	mV
I_C = 10 mA; V_{CE} = 5 V	V_{BE}	<	770	mV
Saturation voltages **				
I_C = 10 mA; I_B = 0,5 mA	V_{CEsat}	typ.	90	mV
		<	250	mV
	V_{BEsat}	typ.	700	mV
I_C = 100 mA; I_B = 5 mA	V_{CEsat}	typ.	200	mV
		<	600	mV
	V_{BEsat}	typ.	900	mV

* V_{BE} decreases by about 2 mV/K with increasing temperature.

** V_{BEsat} decreases by about 1,7 mV/K with increasing temperature.

Collector capacitance at f = 1 MHz			
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	2,5 pF
Emitter capacitance at f = 1 MHz			
$I_C = I_c = 0$; $V_{EB} = 0,5$ V	C_e	typ.	9 pF
Transition frequency at f = 100 MHz			
$I_C = 10$ mA; $V_{CE} = 5$ V	f_T	>	100 MHz
Small signal current gain at f = 1 kHz			
$I_C = 2$ mA; $V_{CE} = 5$ V	h_{fe}		700 – 800

			BC549	BC550
Noise figure at $R_S = 2$ kΩ				
$I_C = 200$ μA; $V_{CE} = 5$ V				
f = 30 Hz to 15 kHz	F	typ.	1,4	1,4 dB
		<	4	3 dB
f = 1 kHz; B = 200 Hz	F	typ.	1,2	1 dB
		<	4	4 dB
Equivalent noise voltage at $R_S = 2$ kΩ				
$I_C = 200$ μA; $V_{CE} = 5$ V				
f = 10 Hz to 50 Hz; $T_{amb} = 25$ °C	V_n	max.	–	0,135 μV

			BC549B BC550B	BC549C BC550C	BC549 BC550
D.C. current gain					
$I_C = 10$ μA; $V_{CE} = 5$ V	h_{FE}	typ.	150	270	
		>	200	420	200
$I_C = 2$ mA; $V_{CE} = 5$ V	h_{FE}	typ.	290	520	
		<	450	800	800

SILICON PLANAR EPITAXIAL TRANSISTORS

General purpose p-n-p transistors in plastic TO-92 package.

QUICK REFERENCE DATA

			BC556	BC557	BC558	
Collector-emitter voltage (+ V_{BE} = 0 V)	$-V_{CES}$	max.	80	50	30	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	65	45	30	V
D.C. current gain $-I_C$ = 2 mA; $-V_{CE}$ = 5 V	h_{FE}	> <	75 475	75 800	75 800	
Collector current (peak value)	$-I_{CM}$	max.		200		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		500		mW
Junction temperature	T_j	max.		150		°C
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	>		100		MHz
Noise figure at R_S = 2 kΩ $-I_C$ = 200 μA; $-V_{CE}$ = 5 V f = 1 kHz; B = 200 Hz	F	typ.		2		dB

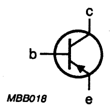
MECHANICAL DATA

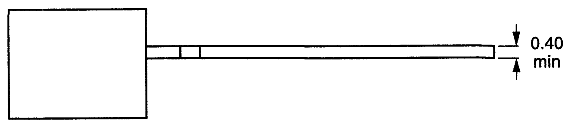
Dimensions in mm

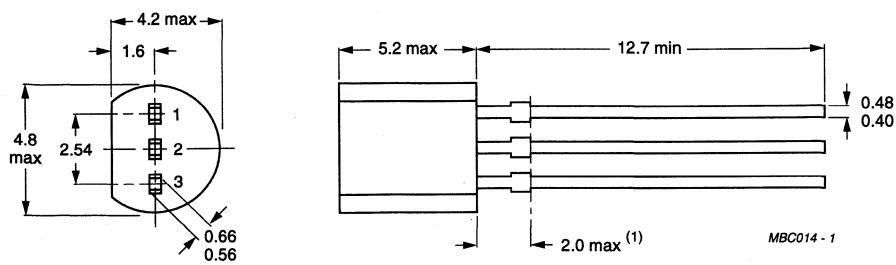
Fig. 1 TO-92

Pinning

1 = emitter
2 = base
3 = collector







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			BC556	BC557	BC558	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	80	50	30	V
Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	80	50	30	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	65	45	30	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	V

Collector current (d.c.)	$-I_C$	max.	100	mA
Collector current (peak value)	$-I_{CM}$	max.	200	mA
Emitter current (peak value)	I_{EM}	max.	200	mA
Base current (peak value)	$-I_{BM}$	max.	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	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	$R_{th\ j\text{-}a}$	=	250	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	150	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

Collector cut-off current				
$I_E = 0$; $-V_{CB}$ = 30 V; T_j = 25 °C	$-I_{CBO}$	typ.	1	nA
		<	15	nA
T_j = 150 °C	$-I_{CBO}$	<	4	μA
Base-emitter voltage*				
$-I_C$ = 2 mA; $-V_{CE}$ = 5 V	$-V_{BE}$	typ.	650	mV
			600 to 750	mV
$-I_C$ = 10 mA; $-V_{CE}$ = 5 V	$-V_{BE}$	<	820	mV
Saturation voltages**				
$-I_C$ = 10 mA; $-I_B$ = 0,5 mA	$-V_{CEsat}$	typ.	60	mV
		<	300	mV
	$-V_{BEsat}$	typ.	750	mV
$-I_C$ = 100 mA; $-I_B$ = 5 mA	$-V_{CEsat}$	typ.	180	mV
		<	650	mV
	$-V_{BEsat}$	typ.	930	mV

* $-V_{BE}$ decreases by about 2 mV/K with increasing temperature.

** $-V_{BEsat}$ decreases by about 1,7 mV/K with increasing temperature.

Collector capacitance at f = 1 MHz $I_E = I_e = 0$; $-V_{CB} = 10$ V	C_c	typ.	4	pF
Transition frequency at f = 100 MHz $-I_C = 10$ mA; $-V_{CE} = 5$ V	f_T	>	100	MHz
Small-signal current gain at f = 1 kHz $-I_C = 2$ mA; $-V_{CE} = 5$ V	h_{fe}		125 to 800	
Noise figure at $R_S = 2$ kΩ $-I_C = 200$ μA; $-V_{CE} = 5$ V f = 1 kHz; B = 200 Hz	F	typ. <</br>	2 10	dB dB

			BC556 BC557 BC558	BC556A BC557A BC558A	BC556B BC557B BC558B	BC556C BC557C BC558C
D.C. current gain $-I_C = 2$ mA; $-V_{CE} = 5$ V	h_{FE}	>	125	125	220	420
		<	800	250	475	800

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors in a plastic TO-92 package.

QUICK REFERENCE DATA

			BC559	BC560	
Collector-emitter voltage ($+V_{BE} = 0$ V)	$-V_{CES}$	max.	30	50	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	30	45	V
Collector current (peak value)	$-I_{CM}$	max.	200	200	mA
Total power dissipation up to $T_{amb} = 25$ °C	P_{tot}	max.	500	500	mW
Junction temperature	T_j	max.	150	150	°C
D.C. current gain $-I_C = 2$ mA; $-V_{CE} = 5$ V	h_{FE}	>	125	125	
		<	800	800	
Transition frequency at f = 100 MHz $-I_C = 10$ mA; $-V_{CE} = 5$ V	f_T	>	100	100	MHz
Noise figure at $R_s = 2$ kΩ $-I_C = 200$ μA; $-V_{CE} = 5$ V f = 30 Hz to 15 kHz	F	typ.	1,2	1	dB
		<	4	3	dB
f = 1 kHz; B = 200 Hz	F	<	4	4	dB
f = 10 kHz to 50 Hz (equivalent noise voltage)	V_n	<	–	0,11	μV

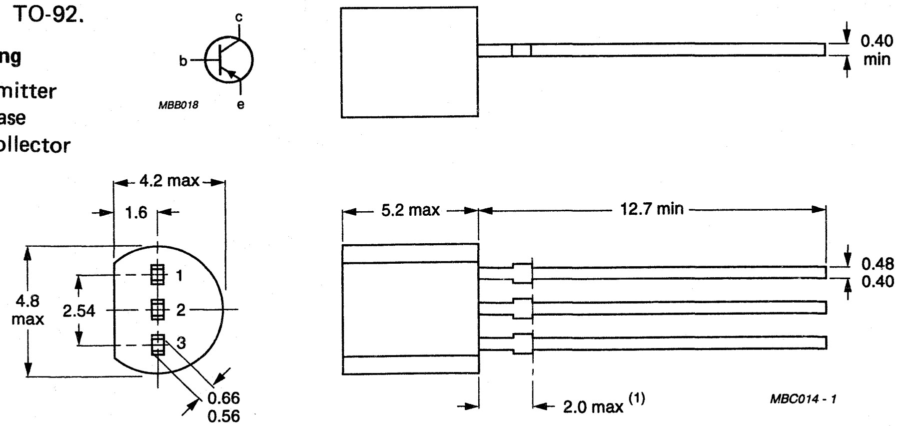
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92.

Pinning

1 = emitter
2 = base
3 = collector



Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			BC559	BC560	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	30	50	V
Collector-emitter voltage ($+V_{BE}$ = 0 V)	$-V_{CES}$	max.	30	50	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	30	45	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	V

Collector current (d.c.)	$-I_C$	max.	100	mA
Collector current (peak value)	$-I_{CM}$	max.	200	mA
Emitter current (peak value)	I_{EM}	max.	200	mA
Base current (peak value)	$-I_{BM}$	max.	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	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	$R_{th\ j\text{-}a}$	=	250	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	150	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
I_E = 0; $-V_{CB}$ = 30 V; T_j = 25 °C	$-I_{CBO}$	typ.	1	nA
		<	15	nA
T_j = 150 °C	$-I_{CBO}$	<	4	μA
Base-emitter voltage*				
$-I_C$ = 2 mA; $-V_{CE}$ = 5 V	$-V_{BE}$	typ.	650	mV
			600 to 750	mV
$-I_C$ = 10 mA; $-V_{CE}$ = 5 V	$-V_{BE}$	<	820	mV
Saturation voltages**				
$-I_C$ = 10 mA; $-I_B$ = 0,5 mA	$-V_{CEsat}$	typ.	60	mV
		<	300	mV
	$-V_{BEsat}$	typ.	750	mV
$-I_C$ = 100 mA; $-I_B$ = 5 mA	$-V_{CEsat}$	typ.	180	mV
		<	650	mV
	$-V_{BEsat}$	typ.	930	mV

* $-V_{BE}$ decreases by about 2 mV/K with increasing temperature.
** $-V_{BEsat}$ decreases by about 1,7 mV/K with increasing temperature.

Collector capacitance at f = 1 MHz

$I_E = I_e = 0$; $-V_{CB} = 10$ V	C_c	typ.	4 pF

Transition frequency at f = 100 MHz

$-I_C = 10$ mA; $-V_{CE} = 5$ V	f_T	typ.	100 MHz

Small-signal current gain at f = 1 kHz

$-I_C = 2$ mA; $-V_{CE} = 5$ V	h_{fe}	125 to 800

Noise figure at $R_S = 2\ k\Omega$

$-I_C = 200\ \mu A$; $-V_{CE} = 5$ V

			BC559	BC560	
f = 30 Hz to 15 kHz	F	typ.	1,2	1	dB
		<	4	3	dB
f = 1 kHz; B = 200 Hz	F	typ.	1	1	dB
		<	4	4	dB

Equivalent noise voltage at $R_S = 2\ k\Omega$

			BC559	BC560	
$-I_C = 200\ \mu A$; $-V_{CE} = 5$ V f = 10 Hz to 50 Hz; $T_{amb} = 25\ ^oC$	V_n	<	–	0,11	μV

D.C. current gain

			BC559 BC560	BC559A BC560A	BC559B BC560B	BC559C BC560C
$-I_C = 2$ mA; $-V_{CE} = 5$ V	h_{FE}	>	125	125	220	420
		<	800	250	475	800

NPN DARLINGTON TRANSISTOR

NPN small-signal Darlington transistors, each in a plastic TO-92 package.

They can be used for general purpose low frequency applications and as relay drivers etc.

QUICK REFERENCE DATA

			BC617	BC618	
Collector-base voltage	V_{CBO}	max.	50	80	V
Collector-emitter voltage	V_{CEO}	max.	40	55	V
DC collector current	I_C	max.	1		A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	625		mW
DC current gain I_C = 1 mA; V_{CE} = 5 V	h_{FE}	min.	4000	2000	

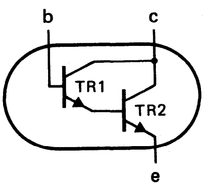
MECHANICAL DATA

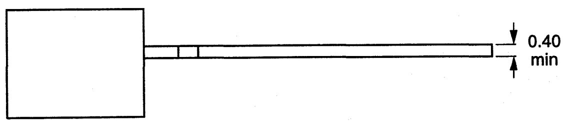
Dimensions in mm

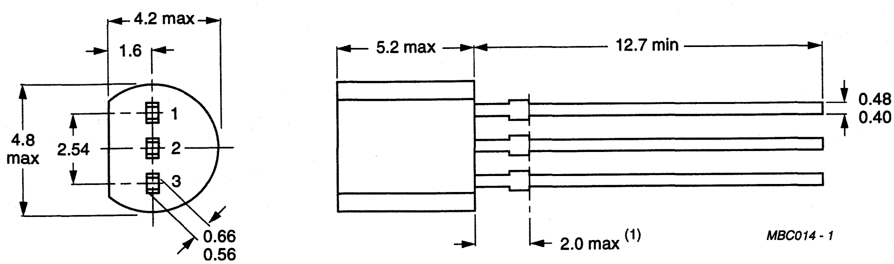
Fig.1 TO-92.

Pinning

1 = emitter
2 = base
3 = collector







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			BC617	BC618	
Collector-base voltage	V_{CBO}	max.	50	80	V
Collector-emitter voltage	V_{CEO}	max.	40	55	V
Emitter-base voltage	V_{EBO}	max.	12		V
DC collector current	I_C	max.	1		A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	625		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	$R_{th\ j\text{-}a}$	=	200	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BC617	BC618	
Collector-emitter breakdown voltage I_C = 10 mA	$V_{(BR)CES}$	min.	40	55	V
Collector-base breakdown voltage I_C = 10 μA	$V_{(BR)CBO}$	min.	50	80	V
Emitter-base breakdown voltage I_E = 100 nA	$V_{(BR)EBO}$	min.	12	12	V
Collector cut-off current V_{CB} = 40 V; I_E = 0	I_{CBO}	max.	50	–	nA
V_{CB} = 60 V; I_E = 0	I_{CBO}	max.	—	50	nA
Emitter cut-off current V_{EB} = 10 V; I_C = 0	I_{EBO}	max.	50	50	nA
DC current gain I_C = 1 mA; V_{CE} = 5 V	h_{FE}	min.	4000	2000	
I_C = 10 mA; V_{CE} = 5 V	h_{FE}	min.	10000	4000	
I_C = 200 mA; V_{CE} = 5 V	h_{FE}	min.	10000	10000	
		max.	70000	70000	
Collector-emitter saturation voltage I_C = 200 mA; I_B = 0.2 mA	V_{CEsat}	max.	1.1		V
Base-emitter saturation voltage I_C = 200 mA; I_B = 0.2 mA	V_{BEsat}	max.	1.6		V
Transition frequency at T_{amb} = 25 °C I_C = 500 mA; V_{CE} = 5 V; f = 100 MHz	f_T	min.	155		MHz
Output capacitance V_{CB} = 30 V; I_E = 0	C_c	typ.	3.5		pF

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in a plastic TO-92 package.
PNP complements are BC636, BC638 and BC640.

QUICK REFERENCE DATA

			BC635	BC637	BC639	
Collector-base voltage (open emitter)	V_{CBO}	max.	45	60	100	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	V_{CER}	max.	45	60	100	V
Collector-current (peak value)	I_{CM}	max.	1,5	1,5	1,5	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1	1	1	W
Junction temperature	T_j	max.	150	150	150	°C
D.C. current gain I_C = 150 mA; V_{CE} = 2 V	h_{FE}	>	40	40	40	
		<	250	250	250	
Transition frequency at f = 100 MHz I_C = 50 mA; V_{CE} = 5 V	f_T	>	100	100	100	MHz

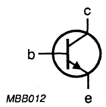
MECHANICAL DATA

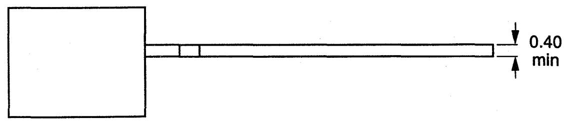
Dimensions in mm

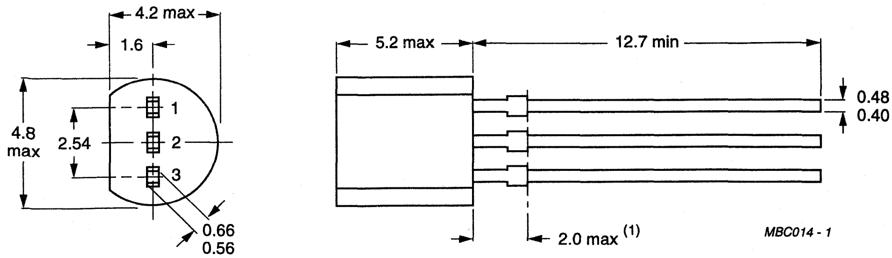
Fig. 1 TO-92.

Pinning

1 = base
2 = collector
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			BC635	BC637	BC639	
Collector-base voltage (open emitter)	V_{CBO}	max.	45	60	100	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	V_{CER}	max.	45	60	100	V
Collector-emitter voltage (R_{BE} = 0)	V_{CES}	max.	45	60	100	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	5	V

Collector current (d.c.)	I_C	max.	1	A
Collector current (peak value)	I_{CM}	max.	1,5	A
Emitter current (peak value)	$-I_{EM}$	max.	1,5	A
Base current (d.c.)	I_B	max.	100	mA
Base current (peak value)	I_{BM}	max.	200	mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	0,8	W
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 in free air	$R_{th\ j\text{-}a}$	=	156	K/W
From junction to ambient	$R_{th\ j\text{-}a}$	=	125	K/W*
From junction to case	$R_{th\ j\text{-}c}$	=	60	K/W

* Transistor mounted on printed circuit board, max. lead length 4 mm, mounting pad for collector lead min. 10 mm x 10 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0$; $V_{CB} = 30$ V	I_{CBO}	<	100 nA
$I_E = 0$; $V_{CB} = 30$ V; $T_j = 150$ °C	I_{CBO}	<	10 μA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	<	10 μA
Base-emitter voltage			
$I_C = 500$ mA; $V_{CE} = 2$ V	V_{BE}	<	1 V
Saturation voltage			
$I_C = 500$ mA; $I_B = 50$ mA	V_{CEsat}	<	0,5 V
D.C. current gain			
$I_C = 5$ mA; $V_{CE} = 2$ V	h_{FE}	>	25
$I_C = 150$ mA; $V_{CE} = 2$ V*	h_{FE}	> <	40 250
$I_C = 500$ mA; $V_{CE} = 2$ V	h_{FE}	>	25
Transition frequency at f = 100 MHz			
$I_C = 50$ mA; $V_{CE} = 5$ V	f_T	>	100 MHz

* BC635-10 BC637-10 BC639-10	h_{FE}	> <	63 160
BC635-16 BC637-16 BC639-16	h_{FE}	> <	100 250

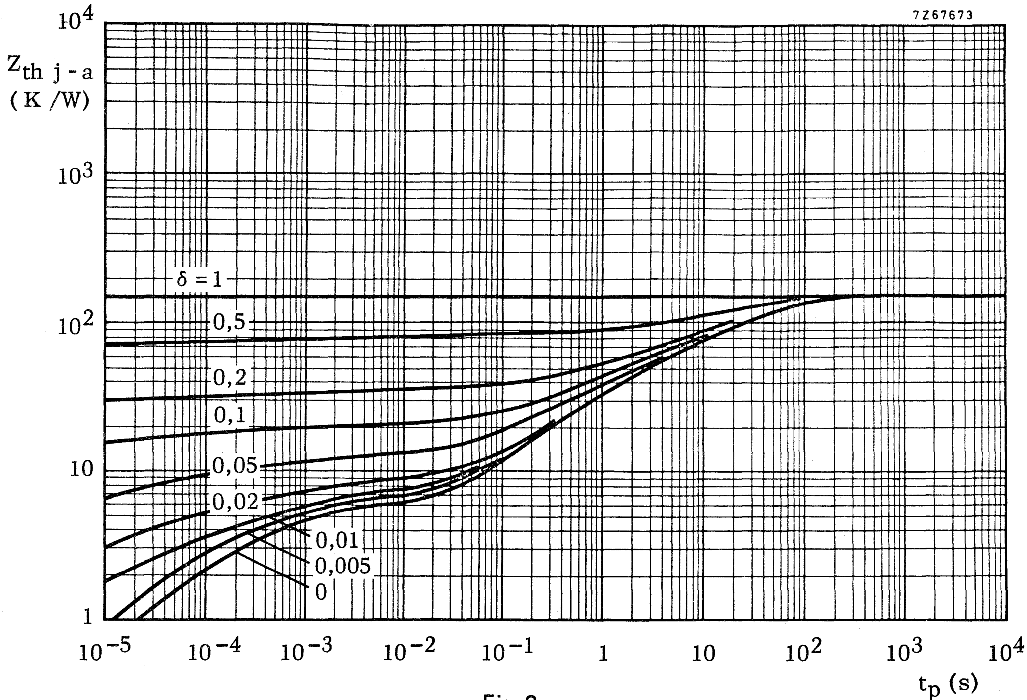


Fig. 2.

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors in a plastic TO-92 package.
amplifiers. N-P-N complements are BC635, BC637 and BC639.

QUICK REFERENCE DATA

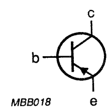
			BC636	BC638	BC640	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	45	60	100	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	$-V_{CER}$	max.	45	60	100	V
Collector-current (peak value)	$-I_{CM}$	max.	1,5	1,5	1,5	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1	1	1	W
Junction temperature	T_j	max.	150	150	150	°C
D.C. current gain $-I_C$ = 150 mA; $-V_{CE}$ = 2 V	h_{FE}	>	40	40	40	
		<	250	250	250	
Transition frequency $-I_C$ = 50 mA; $-V_{CE}$ = 5 V	f_T	>	100	100	100	MHz

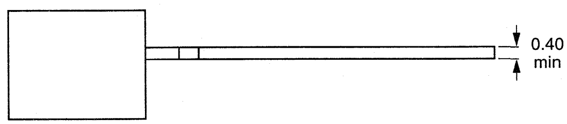
MECHANICAL DATA

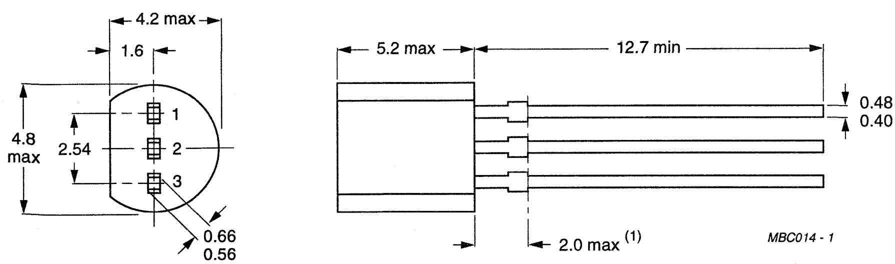
Dimensions in mm

Fig. 1 TO-92.

Pinning
1 = base
2 = collector
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			BC636	BC638	BC640	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	45	60	100	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	$-V_{CER}$	max.	45	60	100	V
Collector-emitter voltage ($-V_{BE}$ = 0)	$-V_{CES}$	max.	45	60	100	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	V
Collector current (d.c.)	$-I_C$	max.		1		A
Collector current (peak value)	$-I_{CM}$	max.		1,5		A
Emitter current (peak value)	I_{EM}	max.		1,5		A
Base current (d.c.)	$-I_B$	max.		100		mA
Base current (peak value)	$-I_{BM}$	max.		200		mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.		0,8		W
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 in free air	$R_{th\,j\text{-}a}$	=	156	K/W
From junction to ambient	$R_{th\,j\text{-}a}$	=	125	K/W*
From junction to case	$R_{th\,j\text{-}c}$	=	60	K/W

* Transistor mounted on printed circuit board, max. lead length 4 mm, mounting pad for collector lead min. 10 mm x 10 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0$; $-V_{CB} = 30$ V	$-I_{CBO}$	<	100 nA
$I_E = 0$; $-V_{CB} = 30$ V; $T_j = 150$ °C	$-I_{CBO}$	<	10 μA
Emitter cut-off current			
$I_C = 0$; $-V_{EB} = 5$ V	$-I_{EBO}$	<	10 μA
Base-emitter voltage			
$-I_C = 500$ mA; $-V_{CE} = 2$ V	$-V_{BE}$	<	1 V
Saturation voltage			
$-I_C = 500$ mA; $-I_B = 50$ mA	$-V_{CEsat}$	<	0,5 V
D.C. current gain			
$-I_C = 5$ mA; $-V_{CE} = 2$ V	h_{FE}	>	25
$-I_C = 150$ mA; $-V_{CE} = 2$ V*	h_{FE}	> <	40 250
$-I_C = 500$ mA; $-V_{CE} = 2$ V	h_{FE}	>	25
Transition frequency at f = 100 MHz			
$-I_C = 50$ mA; $-V_{CE} = 5$ V	f_T	>	100 MHz

* BC636-10 BC638-10 BC640-10	h_{FE}	> <	63 160
BC636-16 BC638-16 BC640-16	h_{FE}	> <	100 250

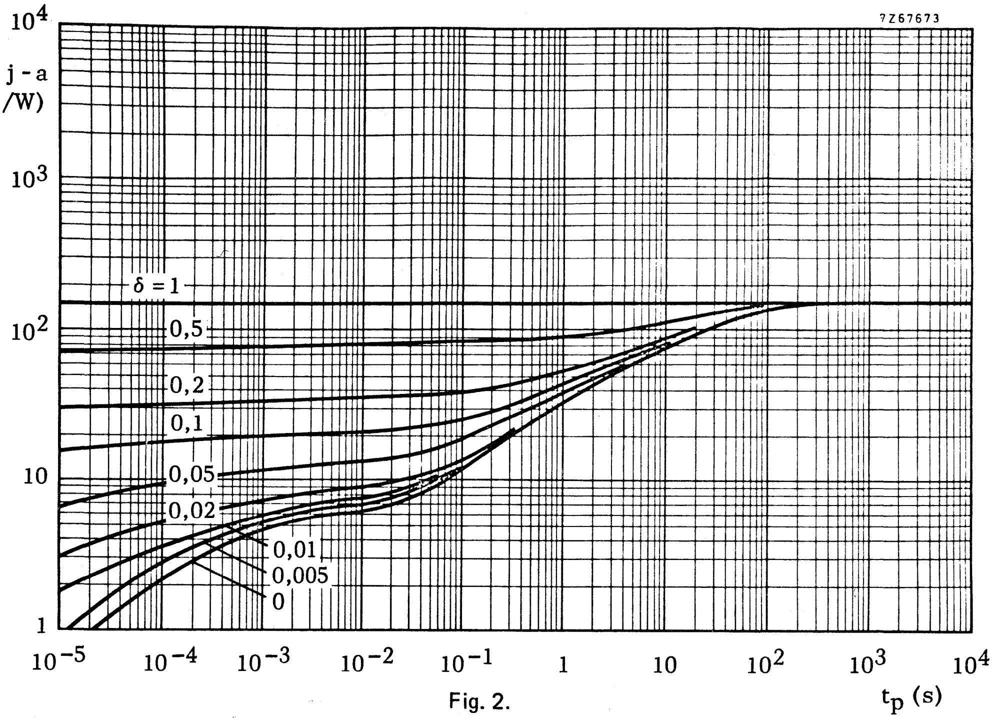

7Z67673
$Z_{th\ j-a}$ (K/W)
10^4
10^3
10^2
10
1
δ = 1
0,5
0,2
0,1
0,05
0,02
0,01
0,005
0
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3
10^4
t_p (s)

Fig. 2.

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors, in a SOT-23 plastic package for use in driver and output stages of audio amplifiers in thick and thin-film hybrid circuits.

N-P-N complements are BC817; R and BC818; R respectively.

QUICK REFERENCE DATA

			BC807	BC808	
Collector-emitter voltage ($V_{BE} = 0$)	$-V_{CES}$	max.	50	30	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	25	V
Collector current (peak value)	$-I_{CM}$	max.	1000		mA
Total power dissipation up to $T_{amb} = 25\ °C$	P_{tot}	max.	250		mW
Junction temperature	T_j	max.	150		°C
Transition frequency at f = 100 MHz $-I_C = 10$ mA; $-V_{CE} = 5$ V	f_T	>	80		MHz

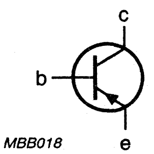
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-23.

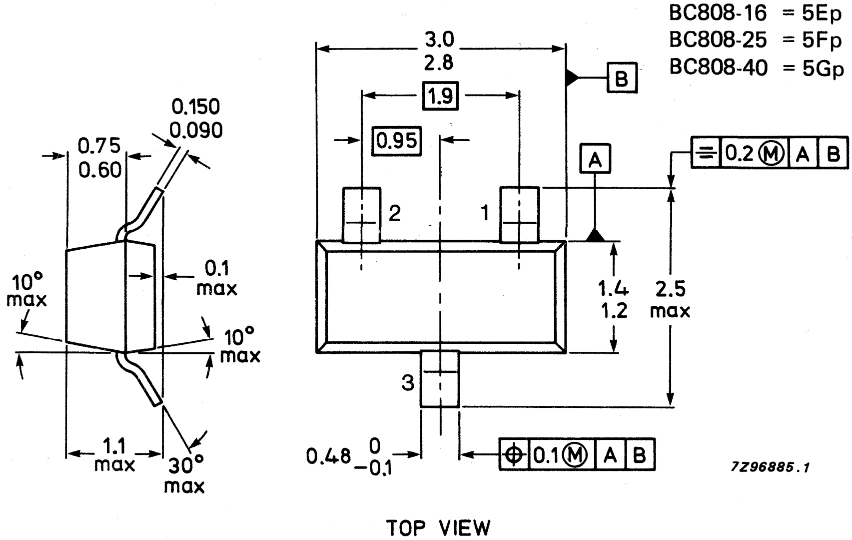
Pinning:

1 = base
2 = emitter
3 = collector



Marking code:

BC807 = 5Dp
BC807-16 = 5Ap
BC807-25 = 5Bp
BC807-40 = 5Cp
BC808 = 5Hp
BC808-16 = 5Ep
BC808-25 = 5Fp
BC808-40 = 5Gp



Reverse pinning types are available on request.

RATINGS

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

			BC807	BC808	
Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	50	30	V
Collector-emitter voltage (open base) $-I_C$ = 10 mA	$-V_{CEO}$	max.	45	25	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	V
Collector current (DC)	$-I_C$	max.	500		mA
Collector current (peak value)	$-I_{CM}$	max.	1000		mA
Emitter current (peak value)	I_{EM}	max.	1000		mA
Base current (DC)	$-I_B$	max.	100		mA
Base current (peak value)	$-I_{BM}$	max.	200		mA
Total power dissipation at T_{amb} = 25 °C *	P_{tot}	max.	250		mW
Storage temperature	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE*

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

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0$; $-V_{CB} = 20$ V; $T_j = 25$ °C	$-I_{CBO}$	max.	100 nA
$I_E = 0$; $-V_{CB} = 20$ V; $T_j = 150$ °C	$-I_{CBO}$	max.	5 μA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 5$ V	$-I_{EBO}$	max.	10 μA
Base emitter voltage *			
$-I_C = 500$ mA; $-V_{CE} = 1$ V	$-V_{BE}$	max.	1,2 V
Saturation voltage			
$-I_C = 500$ mA; $-I_B = 50$ mA	$-V_{CEsat}$	max.	700 mV
D.C. current gain			
$-I_C = 500$ mA; $-V_{CE} = 1$ V	h_{FE}	min.	40
$-I_C = 100$ mA; $-V_{CE} = 1$ V; BC807; BC808	h_{FE}	100 to 600	
BC807-16, BC808-16	h_{FE}	100 to 250	
BC807-25, BC808-25	h_{FE}	160 to 400	
BC807-40, BC808-40	h_{FE}	250 to 600	
Transition frequency at f = 100 MHz			
$-I_C = 10$ mA; $-V_{CE} = 5$ V	f_T	>	80 MHz
Collector capacitance at f = 1 MHz			
$I_E = I_e = 0$; $-V_{CB} = 10$ V	C_c	typ.	8 pF

* $-V_{BE}$ decreases by about 2 mV/K with increasing temperature.

PNP general purpose transistor BC807W; BC808W

FEATURES

- High current
- S- mini package.

DESCRIPTION

PNP transistor in a plastic SOT323 package, for general switching and amplification.

PINNING - SOT323

PIN	DESCRIPTION
1	base
2	emitter
3	collector

MARKING CODES

BC807W:	5D
BC807-16W:	5A
BC807-25W:	5B
BC807-40W:	5C
BC808W:	5H
BC808-16W:	5E
BC808-25W:	5F
BC808-40W:	5G

PIN CONFIGURATION

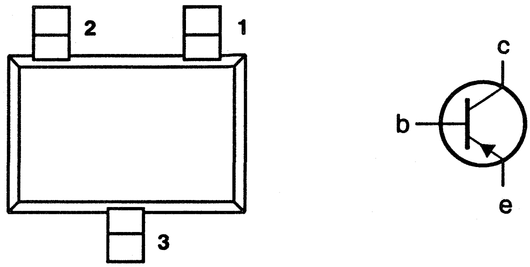


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BC807W		–	–50	V
	BC808W		–	–30	V
V_{CEO}	collector-emitter voltage	open base			
	BC807W		–	–45	V
	BC808W		–	–25	V
I_{CM}	peak collector current		–	–1	A
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	200	mW
h_{FE}	DC current gain	I_C = –100 mA; V_{CE} = –1 V; T_{amb} = 25 °C	100	600	
f_T	transition frequency	I_C = –10 mA; V_{CE} = –5 V; T_{amb} = 25 °C	80	–	MHz

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BC807W		–	−50	V
	BC808W		–	−30	V
V_{CEO}	collector-emitter voltage	open base; $I_C = -10$ mA			
	BC807W		–	−45	V
	BC808W		–	−25	V
V_{EBO}	emitter-base voltage	open collector	–	−5	V
I_C	DC collector current		–	−500	mA
I_{CM}	peak collector current		–	−1	A
I_{EM}	peak emitter current		–	1	A
I_B	DC base current		–	−100	mA
I_{BM}	peak base 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		−65	150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature	see Fig.2	−65	150	°C

Note

1. Refer to SOT323 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 SOT323 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

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 cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	−100	nA
V_{BE}	base-emitter voltage	$I_C = -500$ mA; $V_{CE} = -1$ V (note 1)	–	−1.2	V
$V_{CE(sat)}$	collector-emitter saturation voltage	$I_C = -500$ mA; $I_B = -50$ mA (note 1)	–	−700	mV
C_c	collector capacitance	$I_E = I_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	10	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	80	–	MHz
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -1$ V (note 1)	40	–	
		$I_C = -100$ mA; $V_{CE} = -1$ V (note 1)			
	BC807W; BC808W		100	600	
	BC807-16W; BC808-16W		100	250	
	BC807-25W; BC808-25W		160	400	
	BC807-40W; BC808-40W		250	600	

Note

1. Pulse test : $t_p \leq 300$ μs; $\delta \leq 0.02$

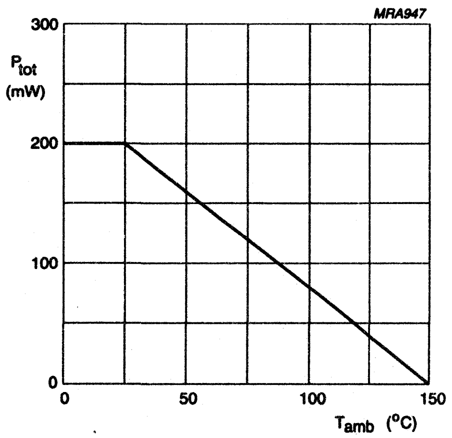


Fig.2 Power derating curve.

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors, in a SOT-23 plastic package for use in driver and output stages of audio amplifiers in thick and thin-film hybrid circuits.

P-N-P complements are BC807; R and BC808; R respectively.

QUICK REFERENCE DATA

			BC817	BC818	
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	50	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	25	V
Collector current (peak value)	I_{CM}	max.	1000		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Junction temperature	T_j	max.	150		°C
Transition frequency at f = 100 MHz; I_C = 10 mA; V_{CE} = 5 V	f_T	>	100		MHz

MECHANICAL DATA

Dimensions in mm

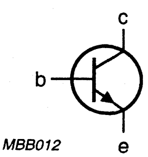
Fig. 1 SOT-23.

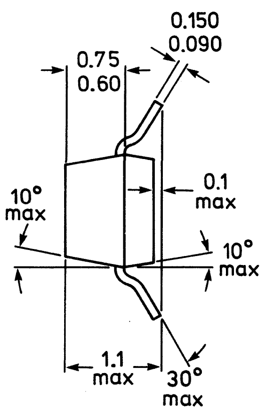
Pinning:

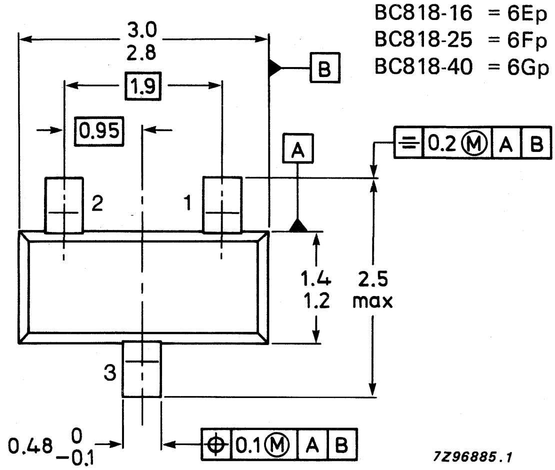
1 = base
2 = emitter
3 = collector

Marking code:

BC817 = 6Dp
BC817-16 = 6Ap
BC817-25 = 6Bp
BC817-40 = 6Cp
BC818 = 6Hp
BC818-16 = 6Ep
BC818-25 = 6Fp
BC818-40 = 6Gp







Reverse pinning types are available on request.

TOP VIEW

RATINGS

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

			BC817	BC818	
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	50	30	V
Collector-emitter voltage (open base) I_C = 10 mA	V_{CEO}	max.	45	25	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	V
Collector current (d.c.)	I_C	max.	500		mA
Collector current (peak value)	I_{CM}	max.	1000		mA
Emitter current (peak value)	$-I_{EM}$	max.	1000		mA
Base current (d.c.)	I_B	max.	100		mA
Base current (peak value)	I_{BM}	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

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0$; $V_{CB} = 20$ V; $T_j = 25$ °C	I_{CBO}	<	100 nA
$I_E = 0$; $V_{CB} = 20$ V; $T_j = 150$ °C	I_{CBO}	<	5 μA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	<	10 μA
Base emitter voltage *			
$I_C = 500$ mA; $V_{CE} = 1$ V	V_{BE}	<	1,2 V
Saturation voltage			
$I_C = 500$ mA; $I_B = 50$ mA	V_{CEsat}	<	700 mV
D.C. current gain			
$I_C = 500$ mA; $V_{CE} = 1$ V	h_{FE}	>	40
$I_C = 100$ mA; $V_{CE} = 1$ V; BC817; BC818	h_{FE}	100 to 600	
BC817-16, BC818-16	h_{FE}	100 to 250	
BC817-25, BC818-25	h_{FE}	160 to 400	
BC817-40, BC818-40	h_{FE}	250 to 600	
Transition frequency at f = 100 MHz			
$I_C = 10$ mA; $V_{CE} = 5$ V	f_T	>	100 MHz
Collector capacitance at f = 1 MHz			
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	5 pF

* V_{BE} decreases by about 2 mV/K with increasing temperature.

NPN general purpose transistor — BC817W; BC818W

FEATURES

- High current
- S- mini package.

DESCRIPTION

NPN transistor in a plastic SOT323 package.

PINNING - SOT323

PIN	DESCRIPTION
1	base
2	emitter
3	collector

PIN CONFIGURATION

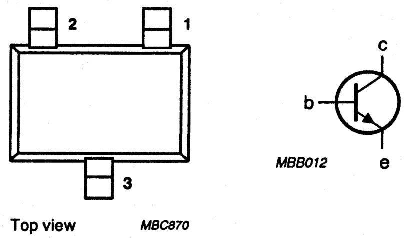


Fig.1 Simplified outline and symbol.

MARKING CODES

BC817W:	6D
BC817-16W:	6A
BC817-25W:	6B
BC817-40W:	6C
BC818W:	6H
BC818-16W:	6E
BC818-25W:	6F
BC818-40W:	6G

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BC817W		–	50	V
	BC818W		–	30	V
V_{CEO}	collector-emitter voltage	open base			
	BC817W		–	45	V
	BC818W		–	25	V
I_{CM}	peak collector current		–	1	A
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	200	mW
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 1 V; T_{amb} = 25 °C	100	600	
f_T	transition frequency	I_C = 10 mA; V_{CE} = 5 V; T_{amb} = 25 °C	100	–	MHz

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BC817W		–	50	V
	BC818W		–	30	V
V_{CEO}	collector-emitter voltage	open base; $I_C = 10$ mA			
	BC817W		–	45	V
	BC818W		–	25	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	DC collector current		–	500	mA
I_{CM}	peak collector current		–	1	A
I_{EM}	peak emitter current		–	–1	A
I_B	DC base current		–	100	mA
I_{BM}	peak base 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		–65	150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature	see Fig.2	–65	150	°C

Note

1. Refer to SOT323 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 SOT323 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

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 cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	100	nA
V_{BE}	base-emitter voltage	$I_C = 500$ mA; $V_{CE} = 1$ V (note 1)	–	1.2	V
$V_{CE(sat)}$	collector-emitter saturation voltage	$I_C = 500$ mA; $I_B = 50$ mA (note 1)	–	700	mV
C_c	collector capacitance	$I_E = I_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	5	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	100	–	MHz
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 1$ V (note 1)	40	–	
		$I_C = 100$ mA; $V_{CE} = 1$ V (note 1)			
	BC817W; BC818W		100	600	
	BC817-16W; BC818-16W		100	250	
	BC817-25W; BC818-25W		160	400	
	BC817-40W; BC818-40W		250	600	

Note

1. Pulse test : $t_p \leq 300$ μs; $\delta \leq 0.02$

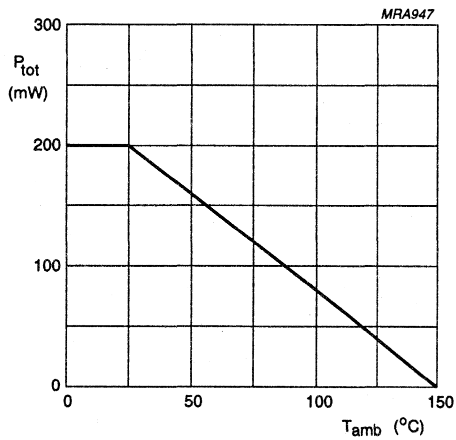


Fig.2 Power derating curve.

SILICON PLANAR EPITAXIAL TRANSISTORS

General purpose n-p-n transistors in a plastic SOT-23 package.

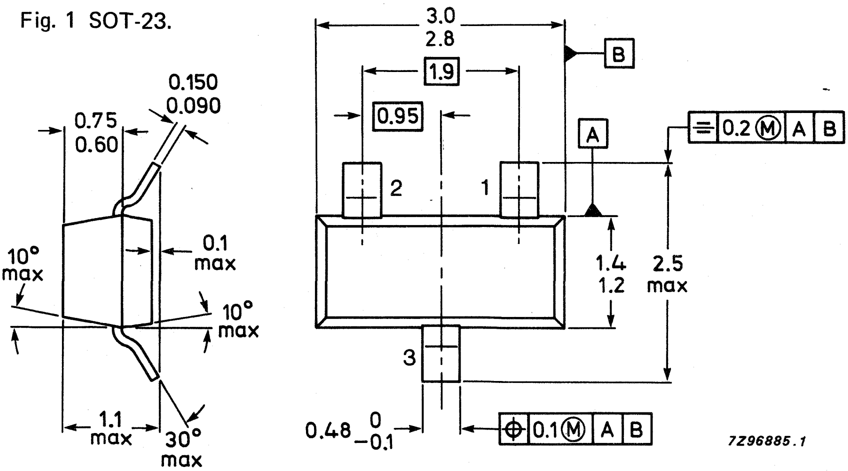
QUICK REFERENCE DATA

			BC846	BC847	BC848	
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	80	50	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	65	45	30	V
Collector current (peak value)	I_{CM}	max.	200	200	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	250	250	mW
Junction temperature	T_j	max.	150	150	150	°C
DC current gain I_C = 2 mA; V_{CE} = 5 V	h_{fe}	>	110	110	110	
		<	450	800	800	
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 5 V	f_T	>	100	> 100	> 100	MHz
Noise figure at R_S = 2 kΩ I_C = 200 μA; V_{CE} = 5 V f = 1 kHz; B = 200 Hz	F	typ.	2	2	2	dB

MECHANICAL DATA

Fig. 1 SOT-23.

Dimensions in mm



TOP VIEW

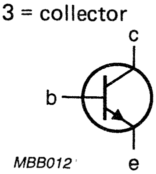
Reverse pinning types are available on request.

Marking code:

BC846 = 1Dp
BC846A = 1Ap
BC846B = 1Bp
BC847 = 1Hp
BC847A = 1Ep
BC847B = 1Fp
BC847C = 1Gp
BC848 = 1Mp
BC848A = 1Jp
BC848B = 1Kp
BC848C = 1Lp

Pinning:

1 = base
2 = emitter
3 = collector



RATINGS

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

			BC846	BC847	BC848	
Collector-base voltage (open emitter)	V_{CBO}	max.	80	50	30	V
Collector-emitter voltage ($V_{BE} = 0$)	V_{CES}	max.	80	50	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	65	45	30	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6	6	5	V
Collector current (d.c.)	I_C	max.		100		mA
Collector current (peak value)	I_{CM}	max.		200		mA
Emitter current (peak value)	$-I_{EM}$	max.		200		mA
Base current (peak value)	I_{BM}	max.		200		mA
Total power dissipation* up to $T_{amb} = 25\ ^oC$	P_{tot}	max.		250		mW
Storage temperature	T_{stg}			−65 to + 150		^oC
Junction temperature	T_j	max.		150		^oC

THERMAL RESISTANCE

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

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
I_E = 0; V_{CB} = 30 V	I_{CBO}	<	15	nA
I_E = 0; V_{CB} = 30 V; T_j = 150 °C	I_{CBO}	<	5	μA
Base-emitter voltage*				
I_C = 2 mA; V_{CE} = 5 V	V_{BE}	typ.	660	mV
		580 to	700	mV
I_C = 10 mA; V_{CE} = 5 V	V_{BE}	<	770	mV
Saturation voltage**				
I_C = 10 mA; I_B = 0,5 mA	V_{CEsat}	typ.	90	mV
		<	250	mV
	V_{BEsat}	typ.	700	mV
I_C = 100 mA; I_B = 5 mA	V_{CEsat}	typ.	200	mV
		<	600	mV
	V_{BEsat}	typ.	900	mV
Collector capacitance at f = 1 MHz				
$I_E = I_e$ = 0; V_{CB} = 10 V	C_c	typ.	2,5	pF
Transition frequency at f = 100 MHz				
I_C = 10 mA; V_{CE} = 5 V	f_T	>	100	MHz

* V_{BE} decreases by about 2 mV/K with increasing temperature.
** V_{BEsat} decreases by about 1,7 mV/K with increasing temperature.

Small signal current gain at f = 1 kHz

I_C = 2 mA; V_{CE} = 5 V	h_{fe}		110 – 800

Noise figure at R_S = 2 kΩ

I_C = 200 μA; V_{CE} = 5 V; f = 1 kHz; B = 200 Hz	F	typ.	2 dB
		<	10 dB

DC current gain

			BC846	BC847 BC848	BC846A BC847A BC848A	BC846B BC847B BC848B	BC847C BC848C
I_C = 10 μA; V_{CE} = 5 V	h_{FE}	typ.			90	150	270
		>	110	110	110	200	420
I_C = 2 mA; V_{CE} = 5 V	h_{FE}	typ.			180	290	520
		<	450	800	220	450	800

NPN general purpose transistor BC846W; BC847W; BC848W

FEATURES

- S- mini package.

DESCRIPTION

NPN transistor in a plastic SOT323 package.

PINNING - SOT323

PIN	DESCRIPTION
1	base
2	emitter
3	collector

PIN CONFIGURATION

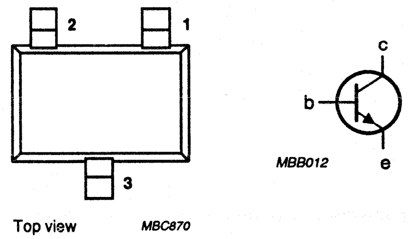


Fig.1 Simplified outline and symbol.

MARKING CODES

BC846W:	1D
BC846AW:	1A
BC846BW:	1B
BC847W:	1H
BC847AW:	1E
BC847BW:	1F
BC847CW:	1G
BC848W:	1M
BC848AW:	1J
BC848BW:	1K
BC848CW:	1L

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BC846W		–	80	V
	BC847W		–	50	V
	BC848W		–	30	V
V_{CEO}	collector-emitter voltage	open base			
	BC846W		–	65	V
	BC847W		–	45	V
	BC848W		–	30	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	up to $T_{amb} = 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V; $T_{amb} = 25$ °C			
	BC846W		110	450	
	BC847W		110	800	
	BC848W		110	800	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; $T_{amb} = 25$ °C	100	–	MHz

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC846W		–	80	V
	BC847W		–	50	V
	BC848W		–	30	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BC846W		–	80	V
	BC847W		–	50	V
	BC848W		–	30	V
V_{CEO}	collector-emitter voltage	open base			
	BC846W		–	65	V
	BC847W		–	45	V
	BC848W		–	30	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	DC collector current		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{EM}	peak emitter current		–	–200	mA
I_{BM}	peak base 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		–65	150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature	see Fig.2	–65	150	°C

Note

1. Refer to SOT323 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 SOT323 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector-base cut-off current	I_E = 0; V_{CB} = 30 V	–	15	nA
		I_E = 0; V_{CB} = 30 V; T_j = 150 °C	–	5	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 5 V	–	100	nA
V_{BE}	base-emitter voltage	I_C = 2 mA; V_{CE} = 5 V	580	700	mV
		I_C = 10 mA; V_{CE} = 5 V	–	770	mV
$V_{CE(sat)}$	collector-emitter saturation voltage	I_C = 10 mA; I_B = 0.5 mA	–	250	mV
		I_C = 100 mA; I_B = 5 mA (note 1)	–	600	mV
C_c	collector capacitance	I_E = I_e = 0; V_{CB} = 10 V; f = 1 MHz	–	3	pF
f_T	transition frequency	I_C = 10 mA; V_{CE} = 5 V; f = 100 MHz	100	–	MHz
F	noise figure	I_C = 200 μA; V_{CE} = 5 V; R_S = 2 kΩ f = 1 kHz; B = 200 Hz	–	10	dB
h_{FE}	DC current gain	I_C = 2 mA; V_{CE} = 5 V;			
	BC846W		110	450	
	BC847W; BC848W		110	800	
	BC846AW; BC847AW; BC848AW		110	220	
	BC846BW; BC847BW; BC848BW		200	450	
	BC847CW; BC848CW		420	800	

Note

1. Pulse test : $t_p \leq 300$ μs; $\delta \leq 0.02$

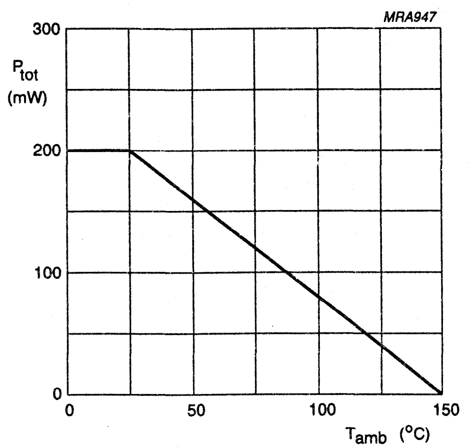


Fig.2 Power derating curve.

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in a plastic SOT-23 package.

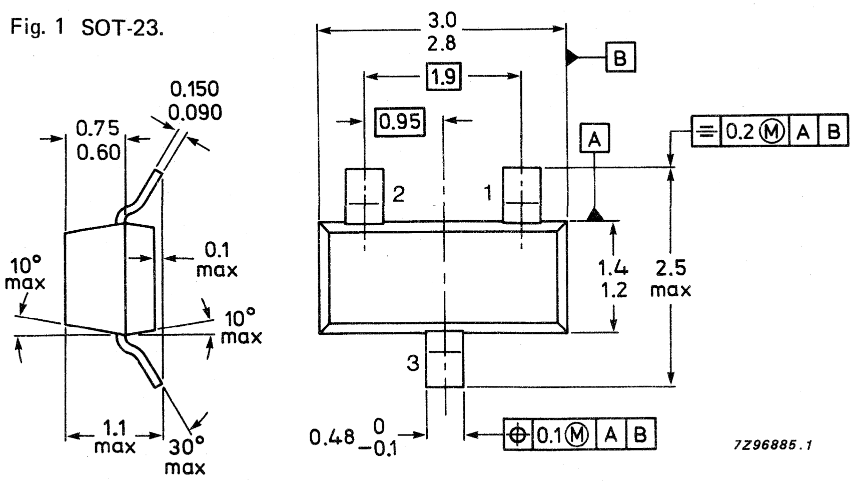
QUICK REFERENCE DATA

			BC849	BC850	
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	30	50	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	45	V
Collector current (peak value)	I_{CM}	max.	200	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	250	mW
Junction temperature	T_j	max.	150	150	°C
DC current gain I_C = 2 mA; V_{CE} = 5 V	h_{fe}	> <	200 800	200 800	
Transition frequency I_C = 10 mA; V_{CE} = 5 V, f = 100 MHz	f_T	>	100	> 100	MHz
Noise figure at R_S = 2 kΩ, I_C = 200 μA; V_{CE} = 5 V, f = 30 Hz to 15 kHz	F	typ. <	1,4 4	1,4 3	dB dB
f = 1 kHz; B = 200 Hz	F	typ.	1,2	1	dB
f = 10 Hz to 50 Hz (equivalent noise voltage)	V_n	<	–	0,135	μV

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-23.



Reverse pinning types are available on request.

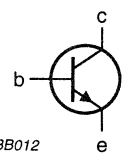
TOP VIEW

Marking code:

BC849 = 2Dp
BC849B = 2Bp
BC849C = 2Cp
BC850 = 2Hp
BC850B = 2Fp
BC850C = 2Gp

Pinning:

1 = base
2 = emitter
3 = collector



RATINGS

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

			BC849	BC850	
Collector-base voltage (open emitter)	V_{CBO}	max.	30	50	V
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	30	50	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	45	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	V
Collector current (d.c.)	I_C	max.	100		mA
Collector current (peak value)	I_{CM}	max.	200		mA
Emitter current (peak value)	$-I_{EM}$	max.	200		mA
Base current (peak value)	I_{BM}	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

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $V_{CB} = 30$ V	I_{CBO}	<	15	nA
$I_E = 0$; $V_{CB} = 30$ V; $T_j = 150$ °C	I_{CBO}	<	5	μA
Base emitter voltage*				
$I_C = 2$ mA; $V_{CE} = 5$ V	V_{BE}	typ.	660	mV
		580 to	700	mV
$I_C = 10$ mA; $V_{CE} = 5$ V	V_{BE}	<	770	mV
Saturation voltages**				
$I_C = 10$ mA; $I_B = 0,5$ mA	V_{CEsat}	typ.	90	mV
		<	250	mV
	V_{BEsat}	typ.	700	mV
$I_C = 100$ mA; $I_B = 5$ mA	V_{CEsat}	typ.	200	mV
		<	600	mV
	V_{BEsat}	typ.	900	mV
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	2,5	pF
Transition frequency at f = 100 MHz				
$I_C = 10$ mA; $V_{CE} = 5$ V	f_T	>	100	MHz

* V_{BE} decreases by about 2 mV/K with increasing temperature.

** V_{BEsat} decreases by about 1,7 mV/K with increasing temperature.

			BC849	BC850	
Small signal current gain at f = 1 kHz I_C = 2 mA; V_{CE} = 5 V	h_{fe}	200 – 800			
Noise figure at R_S = 2 kΩ I_C = 200 μA; V_{CE} = 5 V f = 30 Hz to 15 kHz	F	typ.	1,4	1,4	dB
		<	4	3	dB
f = 1 kHz; B = 200 Hz	F	typ.	1,2	1	dB
		<	4	4	dB
Equivalent noise voltage at R_S = 2 kΩ I_C = 200 μA; V_{CE} = 5 V f = 10 Hz to 50 Hz; T_{amb} = 25 °C	V_n	max.	–	0,135	μV

			BC849B BC850B	BC849C BC850C	BC849 BC850
D.C. current gain I_C = 10 μA; V_{CE} = 5 V	h_{FE}	typ.	150	270	
		>	200	420	200
I_C = 2 mA; V_{CE} = 5 V	h_{FE}	typ.	290	520	
		<	450	800	800

NPN general purpose transistor BC849W; BC850W

FEATURES

- S- mini package.
- Low noise

DESCRIPTION

NPN transistor in a plastic SOT323 package, primarily intended for low noise stages in tape recorders, hi-fi amplifiers and other audio-frequency equipment.

PINNING - SOT323

PIN	DESCRIPTION
1	base
2	emitter
3	collector

MARKING CODES

BC849W:	2D
BC849BW:	2B
BC849CW:	2C
BC850W:	2H
BC850BW:	2F
BC850CW:	2G

PIN CONFIGURATION

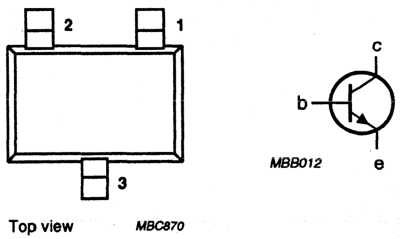


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BC849W		–	30	V
	BC850W		–	50	V
V_{CEO}	collector-emitter voltage	open base			
	BC849W		–	30	V
	BC850W		–	45	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	up to $T_{amb} = 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V; $T_{amb} = 25$ °C	200	800	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; $T_{amb} = 25$ °C	100	–	MHz
F	noise figure	$I_C = 200$ µA; $V_{CE} = 5$ V; $R_S = 2$ kΩ; f = 1 kHz; B = 200 Hz	–	4	dB

NPN general purpose transistor BC849W; BC850W

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			
	BC849W		–	30	V
	BC850W		–	50	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BC849W		–	30	V
	BC850W		–	50	V
V_{CEO}	collector-emitter voltage	open base			
	BC849W		–	30	V
	BC850W		–	45	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	DC collector current		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{EM}	peak emitter current		–	–200	mA
I_{BM}	peak base 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		–65	150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature	see Fig.2	–65	150	°C

Note

1. Refer to SOT323 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 SOT323 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector-base cut-off current	$I_E = 0$; $V_{CB} = 30$ V	–	15	nA
		$I_E = 0$; $V_{CB} = 30$ V; $T_j = 150$ °C	–	5	µA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	100	nA
V_{BE}	base-emitter voltage	$I_C = 2$ mA; $V_{CE} = 5$ V	580	700	mV
		$I_C = 10$ mA; $V_{CE} = 5$ V	–	770	mV
$V_{CE(sat)}$	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	250	mV
		$I_C = 100$ mA; $I_B = 5$ mA (note 1)	–	600	mV
C_c	collector capacitance	$I_E = I_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	3	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	100	–	MHz
F	noise figure	$I_C = 200$ µA; $V_{CE} = 5$ V; $R_S = 2$ kΩ			
	BC849W	f = 30 Hz to 15 kHz	–	4	dB
	BC850W		–	3	dB
	BC849W	f = 1 kHz; B = 200 Hz	–	4	dB
	BC850W		–	4	dB
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V			
	BC849W; BC850W		200	800	
	BC849BW; BC850BW		200	450	
	BC849CW; BC850CW		420	800	

Note

1. Pulse test : $t_p \leq 300$ µs; $\delta \leq 0.02$.

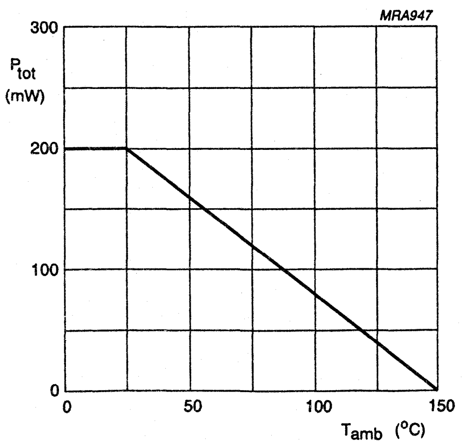


Fig.2 Power derating curve.

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors, in a SOT-23 plastic package.

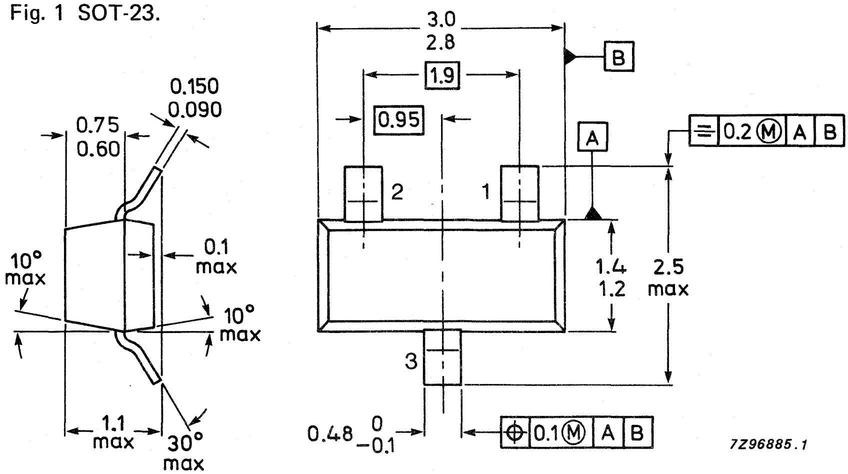
QUICK REFERENCE DATA

			BC856	BC857	BC858	
Collector-emitter voltage ($+V_{BE}$ = 1 V)	$-V_{CEX}$	max.	80	50	30	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	65	45	30	V
Collector current (peak value)	$-I_{CM}$	max.		200		mA
Total power dissipation up to T_{amb} = 60 °C	P_{tot}	max.		250		mW
Junction temperature	T_j	max.		150		°C
DC current gain $-I_C$ = 2 mA; $-V_{CE}$ = 5 V	h_{fe}			75 to 800		
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	>		100		MHz
Noise figure at R_S = 2 kΩ $-I_C$ = 200 μA; $-V_{CE}$ = 5 V f = 1 kHz; B = 200 Hz	F	<		10		dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-23.



TOP VIEW

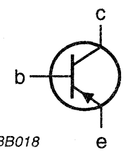
Reverse pinning types are available on request.

Marking code:

BC856	= 3Dp
BC856A	= 3Ap
BC856B	= 3Bp
BC857	= 3Hp
BC857A	= 3Ep
BC857B	= 3Fp
BC857C	= 3Gp
BC858	= 3Mp
BC858A	= 3Jp
BC858B	= 3Kp
BC858C	= 3Lp

Pinning:

1 = base
2 = emitter
3 = collector



RATINGS

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

			BC856	BC857	BC858	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	80	50	30	V
Collector-emitter voltage ($+V_{BE} = 1$ V)	$-V_{CEX}$	max.	80	50	30	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	65	45	30	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	V

Collector current (d.c.)	$-I_C$	max.	100	mA
Collector current (peak value)	$-I_{CM}$	max.	200	mA
Emitter current (peak value)	I_{EM}	max.	200	mA
Base current (peak value)	$-I_{BM}$	max.	200	mA
Total power dissipation * up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	250	mW
Storage temperature	T_{stg}		-65 to $+150$	^oC
Junction temperature	T_j	max.	150	^oC

THERMAL CHARACTERISTICS

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				
$I_E = 0$; $-V_{CB} = 30$ V; T_j 25 ^oC	$-I_{CBO}$	typ.	1	nA
		$<$	15	nA
$T_j = 150\ ^oC$	$-I_{CBO}$	$<$	4	μA
Base-emitter voltage ▲				
$-I_C = 2$ mA; $-V_{CE} = 5$ V	$-V_{BE}$	typ.	650	mV
			600 to 750	mV
$-I_C = 10$ mA; $-V_{CE} = 5$ V	$-V_{BE}$	$<$	820	mV

▲ $-V_{BE}$ decreases by about 2 mV/K with increasing temperature.

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

Saturation voltages *

$-I_C$ = 10 mA; $-I_B$ = 0,5 mA	$-V_{CEsat}$	typ.	75 mV
		<	300 mV
	$-V_{BEsat}$	typ.	700 mV
$-I_C$ = 100 mA; $-I_B$ = 5 mA	$-V_{CEsat}$	typ.	250 mV
		<	650 mV
	$-V_{BEsat}$	typ.	850 mV

Knee voltage

Collector capacitance at f = 1 MHz $I_E = I_e = 0$; $-V_{CB}$ = 10 V		C_c	typ.	4,5 pF
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V		f_T	>	100 MHz
Small-signal current gain at f = 1 kHz $-I_C$ = 2 mA; $-V_{CE}$ = 5 V		h_{fe}		125 to 800
Noise figure at R_S = 2 kΩ $-I_C$ = 200 μA; $-V_{CE}$ = 5 V f = 1 kHz; B = 200 Hz		F	typ. <	2 dB 10 dB
D.C. current gain $-I_C$ = 2 mA; $-V_{CE}$ = 5 V	BC856/857 BC858	h_{FE}		125 to 800
	BC856A/857A/858A	h_{FE}		125 to 250
	BC856B/857B/858B	h_{FE}		220 to 475
	BC857C/858C	h_{FE}		420 to 800

* $-V_{BEsat}$ decreases by about 1,7 mV/K with increasing temperature.

PNP general purpose transistor — BC856W; BC857W; BC858W

FEATURES

- S- mini package.

DESCRIPTION

NPN transistor in a plastic SOT323 package.

PINNING - SOT323

PIN	DESCRIPTION
1	base
2	emitter
3	collector

PIN CONFIGURATION

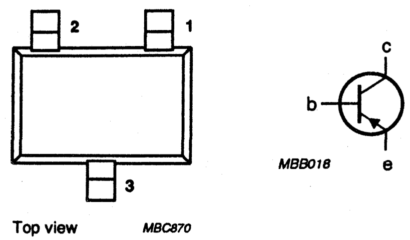


Fig.1 Simplified outline and symbol.

MARKING CODES

BC856W:	3D
BC856AW:	3A
BC856BW:	3B
BC857W:	3H
BC857AW:	3E
BC857BW:	3F
BC857CW:	3G
BC858W:	3M
BC858AW:	3J
BC858BW:	3K
BC858CW:	3L

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CEX}	collector-emitter voltage	V_{BE} = 1 V			
	BC856W		–	–80	V
	BC857W		–	–50	V
	BC858W		–	–30	V
V_{CEO}	collector-emitter voltage	open base			
	BC856W		–	–65	V
	BC857W		–	–45	V
	BC858W		–	–30	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	200	mW
h_{FE}	DC current gain	I_C = –2 mA; V_{CE} = –5 V; T_{amb} = 25 °C	125	800	
f_T	transition frequency	I_C = –10 mA; V_{CE} = –5 V; T_{amb} = 25 °C	100	–	MHz

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC856W		–	–80	V
	BC857W		–	–50	V
	BC858W		–	–30	V
V_{CEX}	collector-emitter voltage	V_{BE} = 1 V			
	BC856W		–	–80	V
	BC857W		–	–50	V
	BC858W		–	–30	V
V_{CEO}	collector-emitter voltage	open base			
	BC856W		–	–65	V
	BC857W		–	–45	V
	BC858W		–	–30	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	DC collector current		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{EM}	peak emitter current		–	200	mA
I_{BM}	peak base 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		–65	150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature	see Fig.2	–65	150	°C

Note

1. Refer to SOT323 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 SOT323 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector-base cut-off current	I_E = 0; V_{CB} = −30 V	−	−15	nA
		I_E = 0; V_{CB} = −30 V; T_j = 150 °C	−	−4	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −5 V	−	−500	nA
V_{BE}	base-emitter voltage	I_C = −2 mA; V_{CE} = −5 V	−600	−750	mV
		I_C = −10 mA; V_{CE} = −5 V	−	−820	mV
$V_{CE(sat)}$	collector-emitter saturation voltage	I_C = −10 mA; I_B = −0.5 mA	−	−300	mV
		I_C = −100 mA; I_B = −5 mA (note 1)	−	−650	mV
C_c	collector capacitance	I_E = I_e = 0; V_{CB} = −10 V f = 1 MHz	−	5	pF
f_T	transition frequency	I_C = −10 mA; V_{CE} = −5 V; f = 100 MHz	100	−	MHz
F	noise figure	I_C = −200 μA; V_{CE} = −5 V; R_S = 2 kΩ; f = 1 kHz; B = 200 Hz	−	10	dB
h_{FE}	DC current gain	I_C = −2 mA; V_{CE} = −5 V;			
	BC856W; BC857W; BC858W		125	800	
	BC856AW; BC857AW; BC858AW		125	250	
	BC856BW; BC857BW; BC858BW		220	475	
	BC856CW; BC857CW; BC858CW		420	800	

Note

1. Pulse test : $t_p \leq 300$ μs; $\delta \leq 0.02$

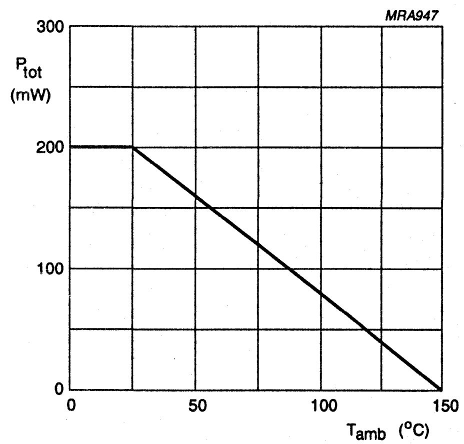


Fig.2 Power derating curve.

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors in a plastic SOT-23 package primarily intended for low-noise input stages in tape recorders, hi-fi amplifiers and other audio frequency equipment in thick and thin-film hybrid circuits.

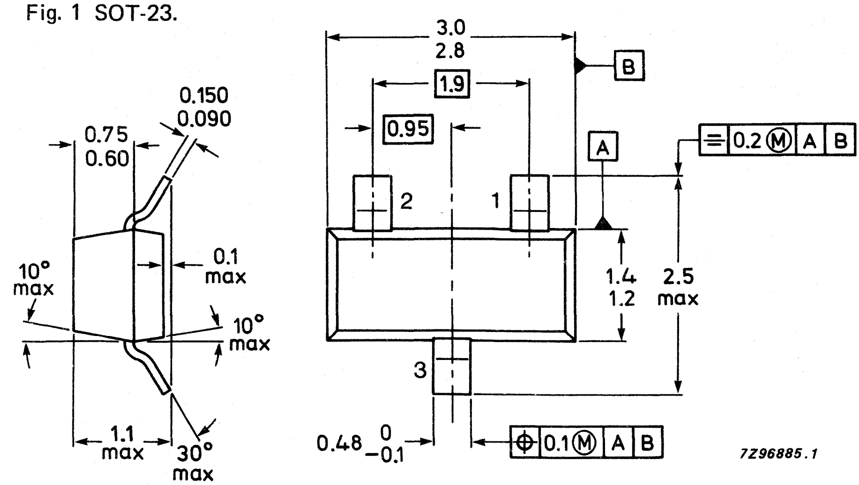
QUICK REFERENCE DATA

			BC859	BC860	
Collector-emitter voltage (+ V_{BE} = 1 V)	$-V_{CEX}$	max.	30	50	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	30	45	V
Collector current (peak value)	$-I_{CM}$	max.	200	200	mA
Total power dissipation up to T_{amb} = 60 °C	P_{tot}	max.	250	250	mW
Junction temperature	T_j	max.	150	150	°C
DC current gain $-I_C$ = 2 mA; $-V_{CE}$ = 5 V	h_{fe}	>	125	125	
		<	800	800	
Transition frequency $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	>	100	100	MHz
Noise figure at R_s = 2 kΩ $-I_C$ = 200 μA; $-V_{CE}$ = 5 V f = 30 Hz to 15 kHz	F	typ.	1,2	1	dB
		<	4	3	dB
f = 1 kHz; B = 200 Hz	F	<	4	4	dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-23.



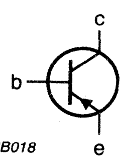
TOP VIEW

Marking code:

BC859 = 4Dp
BC859A = 4Ap
BC859B = 4Bp
BC859C = 4Cp
BC860 = 4Hp
BC860A = 4Ep
BC860B = 4Fp
BC860C = 4Gp

Pinning:

1 = base
2 = emitter
3 = collector



Reverse pinning types are available on request.

RATINGS

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

			BC859	BC860	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	30	50	V
Collector-emitter voltage (+ V_{BE} = 1 V)	$-V_{CEX}$	max.	30	50	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	30	45	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	V

Collector current (d.c.)	$-I_C$	max.	100	mA
Collector current (peak value)	$-I_{CM}$	max.	200	mA
Emitter current (peak value)	I_{EM}	max.	200	mA
Base current (peak value)	$-I_{BM}$	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 CHARACTERISTICS

Thermal resistance

From junction to amb	$R_{th\ j\text{-}t}$	=	500	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current

$I_E = 0$; $-V_{CB}$ = 30 V; T_j = 25 °C	$-I_{CBO}$	typ.	1	nA
		<	15	nA
T_j = 150 °C	$-I_{CBO}$	<	4	μA

Base-emitter voltage ▲

$-I_C$ = 2 mA; $-V_{CE}$ = 5 V	$-V_{BE}$	typ.	650	mV
			600 to 750	mV
$-I_C$ = 10 mA; $-V_{CE}$ = 5 V	$-V_{BE}$	<	820	mV

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

▲ $-V_{BE}$ decreases by about 2 mV/K with increasing temperature.

Saturation voltages*					
$-I_C$ = 10 mA; $-I_B$ = 0,5 mA	$-V_{CEsat}$	typ.	75		mV
		<	300		mV
	$-V_{BEsat}$	typ.	700		mV
$-I_C$ = 100 mA; $-I_B$ = 5 mA	$-V_{CEsat}$	typ.	250		mV
		<	650		mV
	$-V_{BEsat}$	typ.	850		mV
Collector capacitance at f = 1 MHz					
$I_E = I_e = 0$; $-V_{CB}$ = 10 V	C_c	typ.	4,5		pF
Transition frequency at f = 100 MHz					
$-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	>	100		MHz
Small-signal current gain at f = 1 kHz					
$-I_C$ = 2 mA; $-V_{CE}$ = 5 V	h_{fe}		125 to 800		
Noise figure at R_S = 2 kΩ					
$-I_C$ = 200 μA; $-V_{CE}$ = 5 V			BC859	BC860	
f = 30 Hz to 15 kHz	F	typ.	1,2	1	dB
		<	4	3	dB
f = 1 kHz; B = 200 Hz	F	typ.	1	1	dB
		<	4	4	dB
Equivalent noise voltage at R_S = 2 kΩ					
$-I_C$ = 200 μA; $-V_{CE}$ = 5 V f = 10 Hz to 50 Hz; T_{amb} = 25 °C	V_n	<	–	0,11	μV
D.C. current gain					
$-I_C$ = 2 mA; $-V_{CE}$ = 5 V; total range	h_{FE}		125 to 800		
A selections	h_{FE}		125 to 250		
B selections	h_{FE}		220 to 475		
C selections	h_{FE}		420 to 800		

* $-V_{BEsat}$ decreases by about 1,7 mV/K with increasing temperature.

PNP general purpose transistor | BC859W; BC860W

FEATURES

- S- mini package.
- Low noise

DESCRIPTION

PNP transistor in a plastic SOT323 package, primarily intended for low noise stages in tape recorders, hi-fi amplifiers and other audio-frequency equipment.

PINNING - SOT323

PIN	DESCRIPTION
1	base
2	emitter
3	collector

MARKING CODES

BC859W:	4D
BC859AW:	4A
BC859BW:	4B
BC859CW:	4C
BC860W:	4H
BC860AW:	4E
BC860BW:	4F
BC860CW:	4G

PIN CONFIGURATION

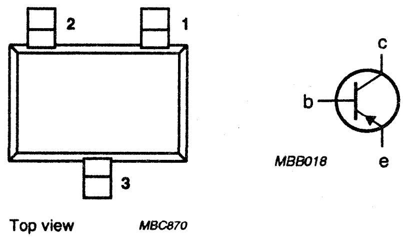


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CEX}	collector-emitter voltage	V_{BE} = 1 V			
	BC859W		–	–30	V
	BC860W		–	–50	V
V_{CEO}	collector-emitter voltage	open base			
	BC859W		–	–30	V
	BC860W		–	–45	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	200	mW
h_{FE}	DC current gain	I_C = –2 mA; V_{CE} = –5 V; T_{amb} = 25 °C	125	800	
f_T	transition frequency	I_C = –10 mA; V_{CE} = –5 V; T_{amb} = 25 °C	100	–	MHz
F	noise figure	I_C = –200 µA; V_{CE} = –5 V; R_S = 2 kΩ; f = 1 kHz; B = 200 Hz	–	4	dB

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			
	BC859W		–	–30	V
	BC860W		–	–50	V
V_{CEX}	collector-emitter voltage	V_{BE} = 1 V			
	BC859W		–	–30	V
	BC860W		–	–50	V
V_{CEO}	collector-emitter voltage	open base			
	BC859W		–	–30	V
	BC860W		–	–45	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	DC collector current		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{EM}	peak emitter current		–	200	mA
I_{BM}	peak base 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		–65	150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature	see Fig.2	–65	150	°C

Note

1. Refer to SOT323 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 SOT323 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector-base cut-off current	I_E = 0; V_{CB} = −30 V	–	−15	nA
		I_E = 0; V_{CB} = −30 V; T_j = 150 °C	–	−4	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −5 V	–	−100	nA
V_{BE}	base-emitter voltage	I_C = −2 mA; V_{CE} = −5 V	600	750	mV
		I_C = −10 mA; V_{CE} = −5 V	–	820	mV
$V_{CE(sat)}$	collector-emitter saturation voltage	I_C = −10 mA; I_B = −0.5 mA	–	−300	mV
		I_C = −100 mA; I_B = −5 mA (note 1)	–	−650	mV
C_c	collector capacitance	I_E = I_e = 0; V_{CB} = −10 V; f = 1 MHz	–	5	pF
f_T	transition frequency	I_C = −10 mA; V_{CE} = −5 V; f = 100 MHz	100	–	MHz
F	noise figure	I_C = −200 μA; V_{CE} = −5 V; R_S = 2 kΩ			
	BC859W	f = 30 Hz to 15 kHz	–	4	dB
	BC860W		–	3	dB
	BC859W	f = 1 kHz; B = 200 Hz	–	4	dB
	BC860W		–	4	dB
h_{FE}	DC current gain	I_C = −2 mA; V_{CE} = −5 V			
	BC859W; BC860W		125	800	
	BC859AW; BC860AW		125	250	
	BC859BW; BC860BW		220	475	
	BC859CW; BC860CW		420	800	

Note

1. Pulse test : t_p ≤ 300 μs; δ ≤ 0.02.

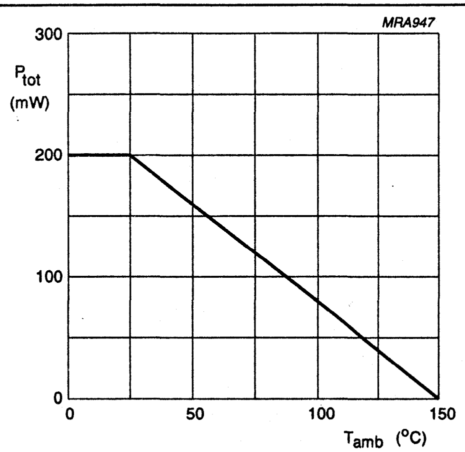


Fig.2 Power derating curve.

SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a microminiature plastic package intended for low-voltage, high-current l.f. applications. BC868/BC869 is the matched complementary pair suitable for class-B audio output stages up to 3 W.

QUICK REFERENCE DATA

Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	25	V
Collector-emitter voltage (open base)	V_{CEO}	max.	20	V
Collector current (peak value)	I_{CM}	max.	2	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 I_C = 500 mA; V_{CE} = 1 V	h_{FE}		85 to 375	
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 5 V	f_T	>	40	MHz

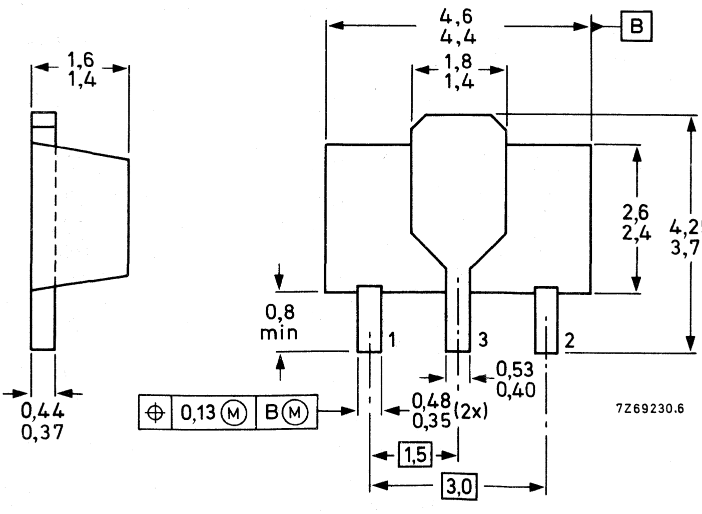
MECHANICAL DATA

Dimensions in mm

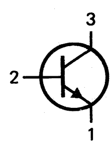
Fig. 1 SOT-89.

Marking code

BC868 = CAC
BC868-10 = CBC
BC868-16 = CCC
BC868-25 = CDC



BOTTOM VIEW



RATINGS

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

Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	25 V
Collector-emitter voltage (open base)	V_{CEO}	max.	20 V
Emitter-base voltage (open collector)	V_{EBO}	max.	5 V
Collector current (d.c.)	I_C	max.	1 A
Collector current (peak value)	I_{CM}	max.	2 A
Base current (d.c.)	I_B	max.	100 mA
Base current (peak value)	I_{BM}	max.	200 mA
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 in free air*	$R_{th\ j\text{-}a}$	=	125 K/W
From junction to tab	$R_{th\ j\text{-}t}$	=	10 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
I_E = 0; V_{CB} = 25 V		I_{CBO}	<	10 μA
I_E = 0; V_{CB} = 25 V; T_j = 150 °C		I_{CBO}	<	1 mA
Emitter cut-off current				
I_C = 0; V_{EB} = 5 V		I_{EBO}	<	10 μA
Base-emitter voltage				
I_C = 5 mA; V_{CE} = 10 V		V_{BE}	typ.	0,62 V
I_C = 1 A; V_{CE} = 1 V		V_{BE}	<	1 V
Collector-emitter saturation voltage				
I_C = 1 A; I_B = 100 mA		V_{CEsat}	<	0,5 V
DC current gain				
I_C = 5 mA; V_{CE} = 10 V	BC868	h_{FE}	>	50
I_C = 500 mA; V_{CE} = 1 V	BC868	h_{FE}		85 to 375
	BC868-10	h_{FE}	⩽	160
	BC868-16	h_{FE}		100 to 250
	BC868-25	h_{FE}	⩾	160
I_C = 1 A; V_{CE} = 1 V	BC868	h_{FE}	>	60
Collector capacitance at f = 450 kHz				
I_E = I_e = 0; V_{CB} = 5 V		C_c	typ.	27 pF
Transition frequency at f = 100 MHz				
I_C = 10 mA; V_{CE} = 5 V		f_T	>	40 MHz

* Mounted on a ceramic substrate, area = 2,5 cm²; thickness = 0,7 mm.

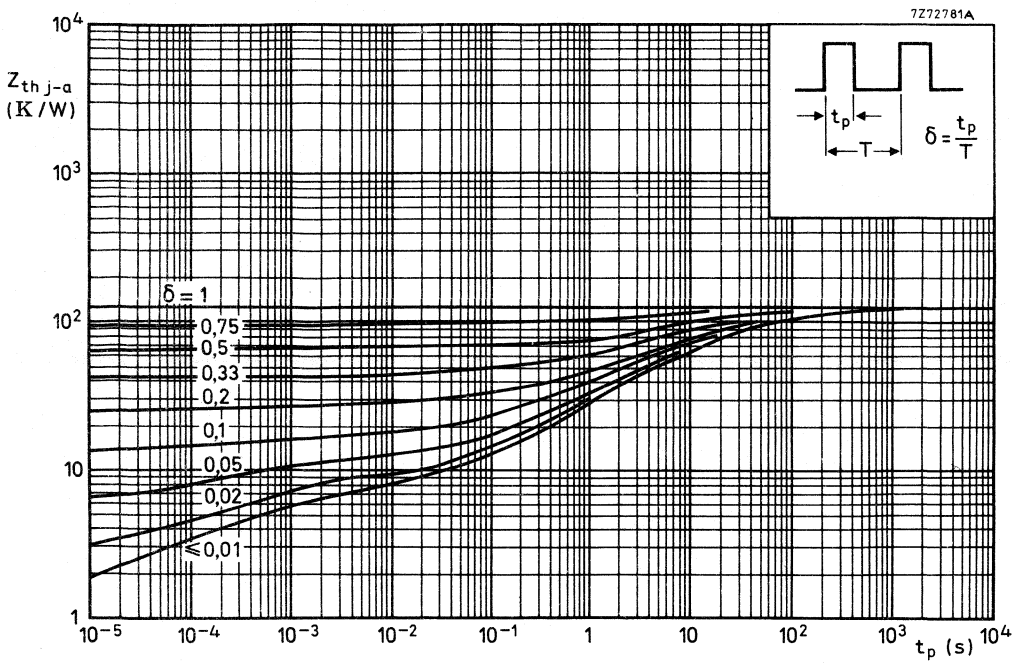


Fig. 2 Pulse power rating chart.

SILICON PLANAR EPITAXIAL TRANSISTOR

P-N-P transistor in a plastic microminiature package, intended for low-voltage, high-current l.f. applications. BC868/BC869 is the matched complementary pair suitable for class-B audio output stages up to 3 W.

QUICK REFERENCE DATA

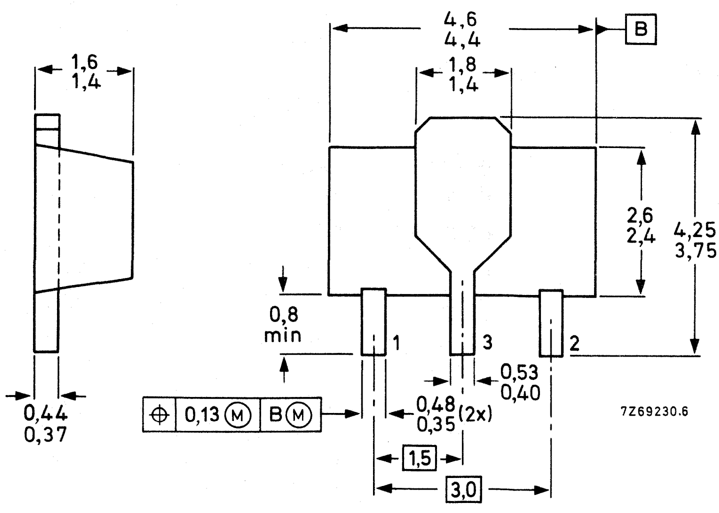
Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	25	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	20	V
Collector current (peak value)	$-I_{CM}$	max.	2	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1	W
Junction temperature	T_j	max.	150	°C
D.C. current gain $-I_C$ = 500 mA; $-V_{CE}$ = 1 V	h_{FE}		85 to 375	
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	>	40	MHz

MECHANICAL DATA

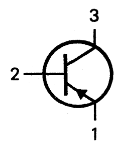
Dimensions in mm

Fig. 1 SOT-89.

Marking code
BC869 = CEC
BC869-10 = CFC



BOTTOM VIEW



RATINGS

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

Collector-emitter voltage ($V_{BE} = 0$)	$-V_{CES}$	max.	25	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	20	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	V
Collector current (d.c.)	$-I_C$	max.	1	A
Collector current (peak value)	$-I_{CM}$	max.	2	A
Base current (d.c.)	$-I_B$	max.	100	mA
Base current (peak value)	$-I_{BM}$	max.	200	mA
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 in free air*	$R_{th\ j\text{-}a}$	=	125	K/W
From junction to tab	$R_{th\ j\text{-}t}$	=	10	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current					
$I_E = 0$; $-V_{CB} = 25$ V		$-I_{CBO}$	<	10	μA
$I_E = 0$; $-V_{CB} = 25$ V; $T_j = 150$ °C		$-I_{CBO}$	<	1	mA
Emitter cut-off current					
$I_C = 0$; $-V_{EB} = 5$ V		$-I_{EBO}$	<	10	μA
Base-emitter voltage					
$-I_C = 5$ mA; $-V_{CE} = 10$ V		$-V_{BE}$	typ.	0,62	V
$-I_C = 1$ A; $-V_{CE} = 1$ V		$-V_{BE}$	<	1	V
Collector-emitter saturation voltage					
$-I_C = 1$ A; $-I_B = 100$ mA		$-V_{CEsat}$	<	0,5	V
D.C. current gain					
$-I_C = 5$ mA; $-V_{CE} = 10$ V	BC869	h_{FE}	>	50	
$-I_C = 500$ mA; $-V_{CE} = 1$ V	BC869	h_{FE}		85 to 375	
	BC869-10	h_{FE}	⩽	160	
	BC869-16	h_{FE}		100 to 250	
	BC869-25	h_{FE}	⩾	160	
$-I_C = 1$ A; $-V_{CE} = 1$ V	BC869	h_{FE}	>	60	
Collector capacitance at f = 450 kHz					
$I_E = I_e = 0$; $-V_{CB} = 5$ V		C_c	typ.	45	pF
Transition frequency at f = 100 MHz					
$-I_C = 10$ mA; $-V_{CE} = 5$ V		f_T	>	40	MHz

* Mounted on a ceramic substrate, area = 2,5 cm²; thickness = 0,7 mm.

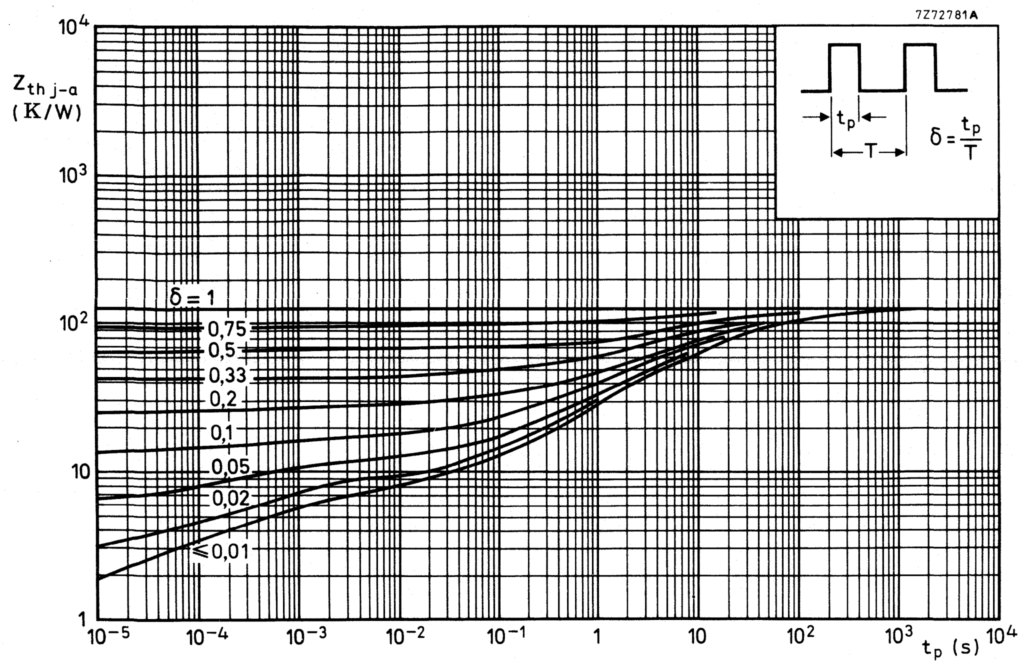


Fig. 2 Pulse power rating chart.

SMALL-SIGNAL DARLINGTON TRANSISTORS

NPN epitaxial small-signal Darlington transistors, each in a plastic TO-92 package with an integrated diode and resistor.

They can be used for general purpose low frequency applications and as relay drivers etc.

PNP complementary types are the BC876, BC878, and BC880.

QUICK REFERENCE DATA

			BC875	877	879	
Collector-base voltage	V_{CBO}	max.	60	80	100	V
Collector-emitter voltage	V_{CEO}	max.	45	60	80	V
DC collector current	I_C	max.		1		A
Total power dissiaption up to T_{amb} = 25 °C	P_{tot}	max.		0.8		W
DC current gain I_C = 150 mA; V_{CE} = 10 V	h_{FE}	min.		1000		

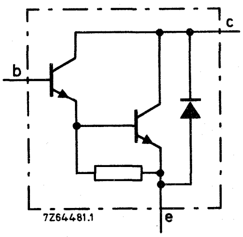
MECHANICAL DATA

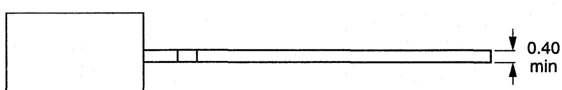
Dimensions in mm

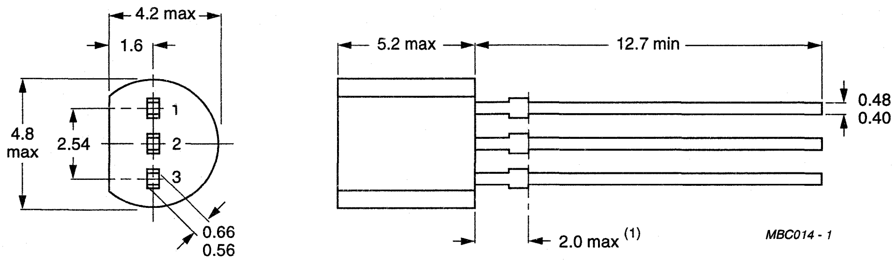
Fig. 1 TO-92.

Pinning

1 = base
2 = collector
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			BC875	877	879	
Collector-base voltage	V_{CBO}	max.	60	80	100	V
Collector-emitter voltage	V_{CEO}	max.	45	60	80	V
Emitter-base voltage	V_{EBO}	max.		5		V
DC collector current	I_C	max.		1		A
Total power dissipation up to						
T_{amb} = 25 °C	P_{tot}	max.		0.8		W
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 in free air	$R_{th\ j\text{-}a}$	=	156	K/W
From junction to ambient (note 1)	$R_{th\ j\text{-}a}$	=	125	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BC875	877	879	
Collector-emitter breakdown voltage						
I_C = 50 mA; I_B = 0	$V_{(BR)CEO}$	min.	45	60	80	V
Collector-base breakdown voltage						
I_C = 100 μA; I_B = 0	$V_{(BR)CBO}$	min.	60	80	100	V
Emitter-base breakdown voltage						
I_E = 100 μA; I_C = 0	$V_{(BR)EBO}$	min.	5	5	5	V
Collector cut-off current						
V_{CB} = 60 V; I_E = 0	I_{CBO}	max.	100	—	—	nA
V_{CB} = 80 V; I_E = 0	I_{CBO}	max.	—	100	—	nA
V_{CB} = 100 V; I_E = 0	I_{CBO}	max.	—	—	100	nA
V_{CE} = 22.2 V; I_B = 0	I_{CEO}	max.	500	—	—	nA
V_{CE} = 30 V; I_B = 0	I_{CEO}	max.	—	500	—	nA
V_{CE} = 40 V; I_B = 0	I_{CEO}	max.	—	—	500	nA
Emitter cut-off current						
V_{EB} = 4 V; I_C = 0	I_{EBO}	max.		100		nA
DC current gain						
I_C = 150 mA; V_{CE} = 10 V	h_{FE}	min.		1000		
I_C = 0.5 A; V_{CE} = 10 V	h_{FE}	min.		2000		

Note

1. Mounted on a printed circuit board, max. lead length 4 mm, mounting pad for collector lead min. 10 mm x 10 mm.

			BC875 | 877 | 879	
Collector-emitter saturation voltage				
I_C = 0.5 A; I_B = 0.5 mA	V_{CEsat}	max.	1.3	V
I_C = 1.0 A; I_B = 1.0 mA	V_{CEsat}	max.	1.8	V
Base-emitter saturation voltage				
I_C = 1.0 A; I_B = 1.0 mA	V_{BEsat}	max.	2.2	V
Transition frequency at T_{amb} = 25 °C				
I_C = 0.5 A; V_{CE} = 5 V; f = 100 MHz	f_T	typ.	200	MHz

SMALL-SIGNAL DARLINGTON TRANSISTORS

PNP epitaxial small-signal Darlington transistors, each in a plastic TO-92 package with an integrated diode and resistor.

They can be used for general purpose low frequency applications and as relay drivers etc.

NPN complementary types are the BC875, BC877, and BC879.

QUICK REFERENCE DATA

			BC876	878	880	
Collector-base voltage	$-V_{CBO}$	max.	60	80	100	V
Collector-emitter voltage	$-V_{CEO}$	max.	45	60	80	V
DC collector current	$-I_C$	max.		1		A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		0.8		W
DC current gain $-I_C$ = 150 mA; $-V_{CE}$ = 10 V	h_{FE}	min.		1000		

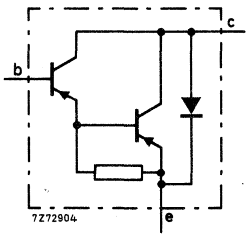
MECHANICAL DATA

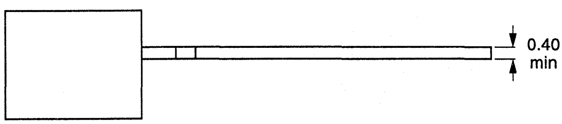
Dimensions in mm

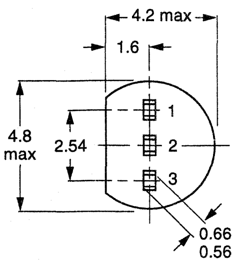
Fig.1 TO-92.

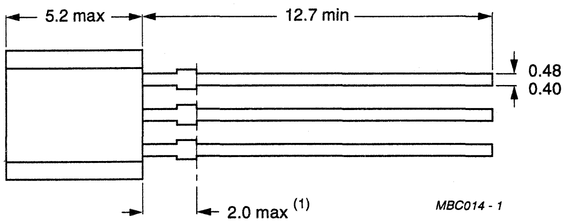
Pinning

1 = base
2 = collector
3 = emitter









Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			BC876	878	880	
Collector-base voltage	$-V_{CBO}$	max.	60	80	100	V
Collector-emitter voltage	$-V_{CEO}$	max.	45	60	80	V
Emitter-base voltage	$-V_{EBO}$	max.		5		V
DC collector current	$-I_C$	max.		1		A
Total power dissipation up to						
T_{amb} = 25 °C	P_{tot}	max.		0.8		W
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 in free air	$R_{th\ j\text{-}a}$	=	156	K/W
From junction to ambient (note 1)	$R_{th\ j\text{-}a}$	=	125	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BC876	878	880	
Collector-emitter breakdown voltage						
$-I_C$ = 50 mA; $-I_B$ = 0	$-V_{(BR)CEO}$	min.	45	60	80	V
Collector-base breakdown voltage						
$-I_C$ = 100 μA; $-I_B$ = 0	$-V_{(BR)CBO}$	min.	60	80	100	V
Emitter-base breakdown voltage						
$-I_E$ = 100 μA; $-I_C$ = 0	$-V_{(BR)EBO}$	min.	5	5	5	V
Collector cut-off current						
$-V_{CB}$ = 60 V; $-I_E$ = 0	$-I_{CBO}$	max.	100	–	–	nA
$-V_{CB}$ = 80 V; $-I_E$ = 0	$-I_{CBO}$	max.	–	100	–	nA
$-V_{CB}$ = 100 V; $-I_E$ = 0	$-I_{CBO}$	max.	–	–	100	nA
$-V_{CE}$ = 22.2 V; $-I_B$ = 0	$-I_{CEO}$	max.	500	–	–	nA
$-V_{CE}$ = 30 V; $-I_B$ = 0	$-I_{CEO}$	max.	–	500	–	nA
$-V_{CE}$ = 40 V; $-I_B$ = 0	$-I_{CEO}$	max.	–	–	500	nA
Emitter cut-off current						
$-V_{EB}$ = 4 V; $-I_C$ = 0	$-I_{EBO}$	max.		100		nA
DC current gain						
$-I_C$ = 150 mA; $-V_{CE}$ = 10 V	h_{FE}	min.		1000		
$-I_C$ = 0.5 A; $-V_{CE}$ = 10 V	h_{FE}	min.		2000		

Note

1. Mounted on a printed circuit board, max. lead length 4 mm, mounting pad for collector lead min. 10 mm x 10 mm.

			BC876	878	880	
Collector-emitter saturation voltage						
$-I_C = 0.5$ A; $-I_B = 0.5$ mA	$-V_{CEsat}$	max.		1.3		V
$-I_C = 1.0$ A; $-I_B = 1.0$ mA	$-V_{CEsat}$	max.		1.8		V
Base-emitter saturation voltage						
$-I_C = 1.0$ A; $-I_B = 1.0$ mA	$-V_{BEsat}$	max.		2.2		V
Transition frequency at $T_{amb} = 25\ ^{o}C$						
$-I_C = 0.5$ A; $-V_{CE} = 5$ V; f = 100 MHz	f_T	typ.		200		MHz

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors, in a microminiature plastic package, intended for low level, low noise general purpose applications in thick and thin-film circuits.

QUICK REFERENCE DATA

			BCF29	BCF30	
D.C. current gain at T_j = 25 °C $-I_C$ = 2 mA; $-V_{CE}$ = 5 V	h_{FE}	> <	120 260	215 500	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	32		V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	32		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
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	>	100		MHz
Noise figure at R_S = 2 kΩ $-I_C$ = 200 μA; $-V_{CE}$ = 5 V; f = 1 kHz; B = 200 Hz	F	<	4		dB

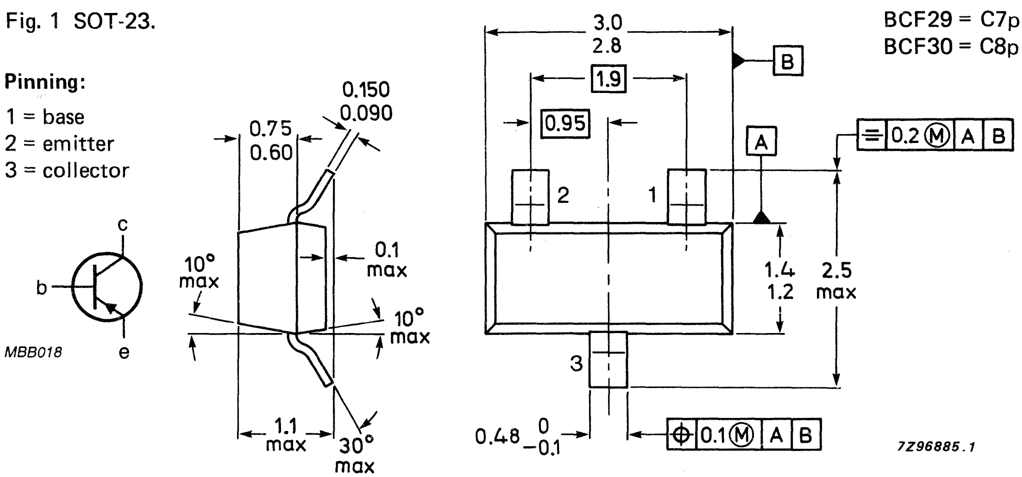
MECHANICAL DATA

Dimensions in mm

Marking code
BCF29 = C7p
BCF30 = C8p

Fig. 1 SOT-23.

Pinning:
1 = base
2 = emitter
3 = collector



Reverse pinning types are available on request.

TOP VIEW

RATINGS

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

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	32 V
Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	32 V
Collector-emitter voltage (open base) $-I_C$ = 2 mA	$-V_{CEO}$	max.	32 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; $-V_{CB}$ = 32 V	$-I_{CBO}$	<	100 nA
I_E = 0; $-V_{CB}$ = 32 V; T_j = 100 °C	$-I_{CBO}$	<	10 μA
Base-emitter voltage			
$-I_C$ = 2 mA; $-V_{CE}$ = 5 V	$-V_{BE}$		600 to 750 mV
Saturation voltages			
$-I_C$ = 10 mA; $-I_B$ = 0,5 mA	$-V_{CEsat}$	typ.	80 mV
		<	300 mV
	$-V_{BEsat}$	typ.	720 mV
$-I_C$ = 50 mV; $-I_B$ = 2,5 mA	$-V_{CEsat}$	typ.	150 mV
	$-V_{BEsat}$	typ.	810 mV

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

D.C. current gain

			BCF29	BCF30	
$-I_C = 10\ \mu A$; $-V_{CE} = 5$ V	h_{FE}	typ.	90	150	
$-I_C = 2$ mA; $-V_{CE} = 5$ V	h_{FE}	>	120	215	
		<	260	500	
Collector capacitance at f = 1 MHz $I_E = I_e = 0$; $-V_{CB} = 10$ V	C_c	typ.	4,5		pF
Transition frequency at f = 100 MHz $-I_C = 10$ mA; $-V_{CE} = 5$ V	f_T	>	100		MHz
Noise figure at $R_S = 2\ k\Omega$ $-I_C = 200\ \mu A$; $-V_{CE} = 5$ V f = 1 kHz; B = 200 Hz	F	<	4		dB
		typ.	1		dB

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in a microminiature plastic package. They are intended for low level, low noise general purpose applications in thick and thin-film circuits.

QUICK REFERENCE DATA

			BCF32	BCF33	
D.C. current gain at T_j = 25 °C; I_C = 2 mA; V_{CE} = 5 V	h_{FE}	>	200	420	
		<	450	800	
Collector-base voltage (open emitter)	V_{CBO}	max.	32		V
Collector-emitter voltage (open base)	V_{CEO}	max.	32		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
Transition frequency at f = 100 MHz; I_C = 2 mA; V_{CE} = 5 V	f_T	>	100		MHz
Noise figure at R_S = 2 kΩ; I_C = 200 μA; V_{CE} = 5 V; f = 1 kHz; B = 200 Hz	F	<	4		dB

MECHANICAL DATA

Dimensions in mm

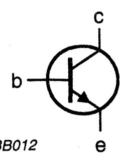
Fig. 1 SOT-23.

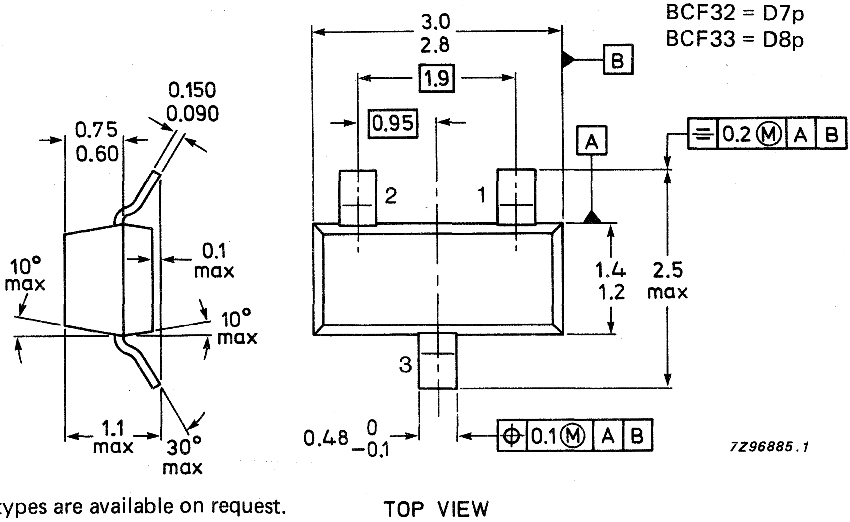
Marking code

BCF32 = D7p
BCF33 = D8p

Pinning:

1 = base
2 = emitter
3 = collector





Reverse pinning types are available on request.

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	32 V
Collector-emitter voltage (open base) $I_C = 2$ mA	V_{CEO}	max.	32 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 dissipatation 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			
$I_E = 0$; $V_{CB} = 32$ V	I_{CBO}	<	100 nA
$I_E = 0$; $V_{CB} = 32$ V; $T_j = 100\ ^oC$	I_{CBO}	<	10 µA
Base-emitter voltage			
$I_C = 2$ mA; $V_{CE} = 5$ V	V_{BE}	550 to 700 mV	
Saturation voltages			
$I_C = 10$ mA; $I_B = 0{,}5$ mA	V_{CEsat}	typ.	120 mV
		<	250 mV
	V_{BEsat}	typ.	750 mV
$I_C = 50$ mA; $I_B = 2{,}5$ mA	V_{CEsat}	typ.	210 mV
	V_{BEsat}	typ.	850 mV

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

			BCF32	BCF33
D.C. current gain				
$I_C = 10\ \mu A$; $V_{CE} = 5\ V$	h_{FE}	typ.	150	270
		>	200	420
$I_C = 2\ mA$; $V_{CE} = 5\ V$	h_{FE}	<	450	800
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 10\ V$	C_c	typ.	2,5 pF	
Transition frequency at f = 100 MHz				
$I_C = 10\ mA$; $V_{CE} = 5\ V$	f_T	>	100 MHz	
Noise figure at $R_S = 2\ k\Omega$				
$I_C = 200\ \mu A$; $V_{CE} = 5\ V$		<	4 dB	
f = 1 kHz; B = 200 Hz	F	typ.	1,2 dB	

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors, in a microminiature plastic package, intended for low level, low noise applications in thick and thin-film circuits.

QUICK REFERENCE DATA

D.C. current gain at T_j = 25 °C $-I_C$ = 2 mA; $-V_{CE}$ = 5 V	h_{FE}	> <	215 500
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	50 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45 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
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	>	100 MHz
Noise figure at R_S = 2 kΩ $-I_C$ = 200 μA; $-V_{CE}$ = 5 V; f = 1 kHz; B = 200 Hz	F	<	4 dB

MECHANICAL DATA

Dimensions in mm

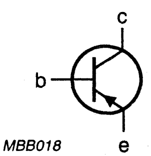
Marking code

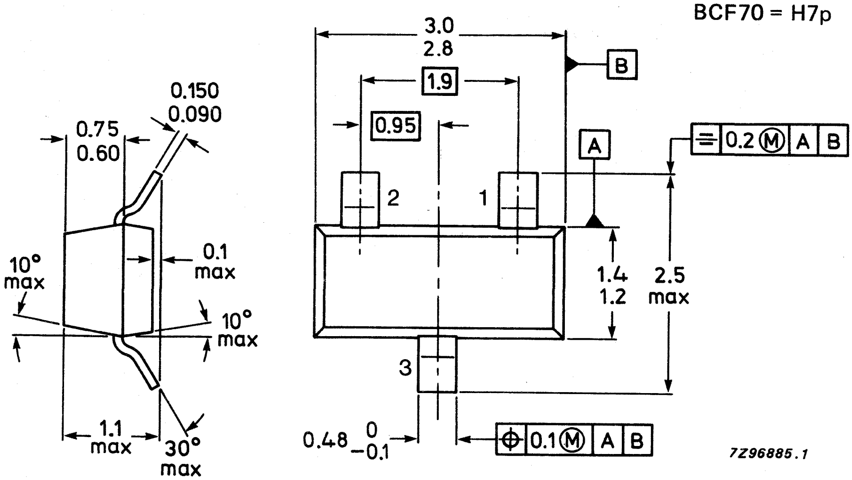
BCF70 = H7p

Fig. 1 SOT-23.

Pinning:

1 = base
2 = emitter
3 = collector





TOP VIEW

Reverse pinning types are available on request.

RATINGS

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

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	50	V
Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	50	V
Collector-emitter voltage (open base) $-I_C$ = 2 mA	$-V_{CEO}$	max.	45	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

I_E = 0; $-V_{CB}$ = 20 V; T_j = 25 °C	$-I_{CBO}$	<	100	nA
T_j = 100 °C	$-I_{CBO}$	<	10	μA
Base-emitter voltage $-I_C$ = 2 mA; $-V_{CE}$ = 5 V; T_j = 25 °C	$-V_{BE}$		600 to 750	mV
Saturation voltages $-I_C$ = 10 mA; $-I_B$ = 0,5 mA	$-V_{CEsat}$	typ.	80	mV
		<	300	mV
	$-V_{BEsat}$	typ.	720	mV
$-I_C$ = 50 mA; $-I_B$ = 2,5 mA	$-V_{CEsat}$	typ.	150	mV
	$-V_{BEsat}$	typ.	810	mV

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

D.C. current gain				
$-I_C = 10\ \mu A$; $-V_{CE} = 5$ V	h_{FE}	typ.	150	
$-I_C = 2$ mA; $-V_{CE} = 5$ V	h_{FE}	$>$ $<$	215 500	
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $-V_{CB} = 10$ V	C_c	typ.	4,5	pF
Transition frequency at f = 100 MHz				
$-I_C = 10$ mA; $-V_{CE} = 5$ V	f_T	$>$	100	MHz
Noise figure at $R_S = 2\ k\Omega$				
$-I_C = 200\ \mu A$; $-V_{CE} = 5$ V f = 1 kHz; B = 200 Hz	F	$<$ typ.	4 1	dB dB

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors, in a microminiature plastic package, intended for low level, low noise general purpose applications in thick and thin-film circuits.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	50 V
Collector-emitter voltage (open base)	V_{CEO}	max.	45 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 at T_j = 25 °C I_C = 2 mA; V_{CE} = 5 V	h_{FE}	$>$ $<$	420 800
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 5 V	f_T	$>$	100 MHz
Noise figure at R_S = 2 kΩ I_C = 200 μA; V_{CE} = 5 V; f = 1 kHz; B = 200 Hz	F	$<$	4 dB

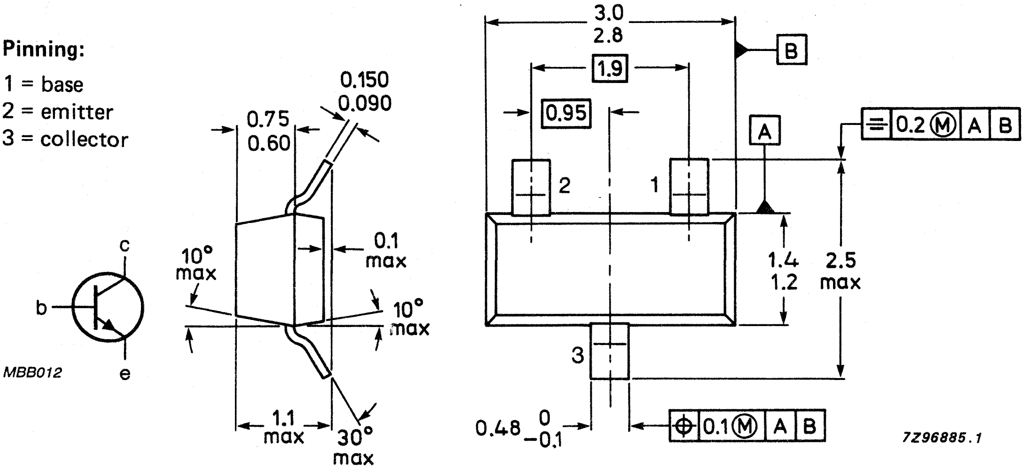
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-23.

Marking code
BCF81 = K9p

Pinning:
1 = base
2 = emitter
3 = collector



TOP VIEW

Reverse pinning types are available on request.

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	50	V
Collector-emitter voltage (open base) $I_C = 2$ mA	V_{CEO}	max.	45	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				
$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	<	100	nA
$I_E = 0$; $V_{CB} = 20$ V; $T_j = 100$ °C	I_{CBO}	<	10	μA
Base emitter voltage				
$I_C = 2$ mA; $V_{CE} = 5$ V	V_{BE}	550 to 700		mV
Saturation voltages				
$I_C = 10$ mA; $I_B = 0{,}5$ mA	V_{CEsat}	typ.	120	mV
		<	250	mV
	V_{BEsat}	typ.	750	mV
$I_C = 50$ mA; $I_B = 2{,}5$ mA	V_{CEsat}	typ.	210	mV
	V_{BEsat}	typ.	850	mV
D.C. current gain				
$I_C = 2$ mA; $V_{CE} = 5$ V	h_{FE}	>	420	
		<	800	
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	2,5	pF
Transition frequency at f = 100 MHz				
$I_C = 10$ mA; $V_{CE} = 5$ V	f_T	>	100	MHz
Noise figure at $R_S = 2$ kΩ				
$I_C = 200$ μA; $V_{CE} = 5$ V; f = 1 kHz; B = 200 Hz	F	<	4	dB
		typ.	1,2	dB

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

SILICON PLANAR EPITAXIAL TRANSISTORS

Medium power pnp transistors in a miniature plastic package intended for applications in thick and thin-film circuits. They are general purpose transistors, primarily designed for audio amplifier output stages.

NPN complements are BCP54, BCP55 and BCP56 respectively.

QUICK REFERENCE DATA

			BCP51	BCP52	BCP53	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	45	60	100	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	$-V_{CER}$	max.	45	60	100	V
Collector current (peak value)	$-I_{CM}$	max.		1,5		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 $-I_C$ = 150 mA; $-V_{CE}$ = 2 V	h_{FE}			40 to 250		
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	typ.		50		MHz

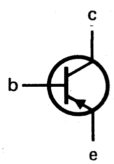
MECHANICAL DATA

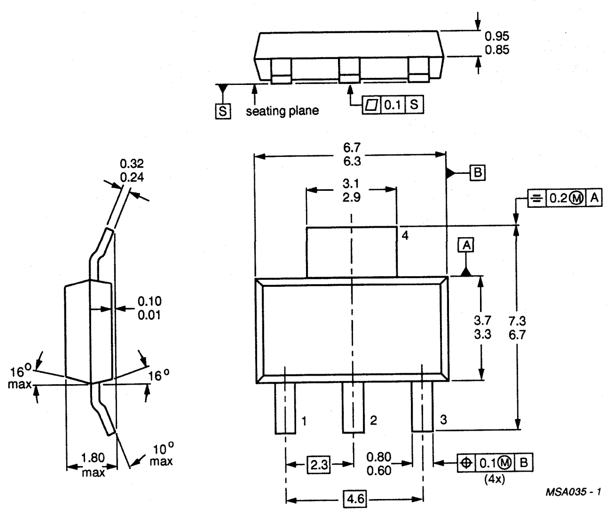
Dimensions in mm

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)

			BCP51	BCP52	BCP53	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	45	60	100	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	$-V_{CER}$	max.	45	60	100	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	V
Collector current (DC)	$-I_C$	max.		1,0		A
Collector current (peak value)	$-I_{CM}$	max.		1,5		A
Base current (DC)	$-I_B$	max.		0,1		A
Base current (peak value)	$-I_{BM}$	max.		0,2		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 collector tab	$R_{th\ j\text{-}tab}$	=	10	K/W
From junction to ambient*	$R_{th\ j\text{-}a}$	=	83,3	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0; -V_{CB} = 30$ V	$-I_{CBO}$	<	100	nA
$I_E = 0; -V_{CB} = 30$ V; $T_j = 125$ °C	$-I_{CBO}$	<	10	μA
Emitter cut-off current				
$I_C = 0; -V_{EB} = 5$ V	$-I_{EBO}$	<	10	μA
Base-emitter voltage				
$-I_C = 500$ mA; $-V_{CE} = 2$ V	$-V_{BE}$	<	1	V
Saturation voltage				
$-I_C = 500$ mA; $-I_B = 50$ mA	$-V_{CEsat}$	<	0,5	V
DC current gain				
$-I_C = 5$ mA; $-V_{CE} = 2$ V	h_{FE}	>	25	
$-I_C = 150$ mA; $-V_{CE} = 2$ V	h_{FE}		40 to 250	
$-I_C = 500$ mA; $-V_{CE} = 2$ V	h_{FE}	>	25	
Transition frequency at f = 100 MHz				
$-I_C = 10$ mA; $-V_{CE} = 5$ V	f_T	typ.	50	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 cm².

CHARACTERISTICS (continued)

			BCP51-10 52-10 53-10	BCP51-16 52-16 53-16
DC current gain		>	63	100
I_C = 150 mA; $-V_{CE}$ = 2 V	h_{FE}	<	160	250

SILICON PLANAR EPITAXIAL TRANSISTORS

Medium power npn transistors in a miniature plastic package intended for applications in thick and thin-film circuits. They are general purpose transistors, primarily designed for audio amplifier output stages.

PNP complements are BCP51, BCP52 and BCP53 respectively.

QUICK REFERENCE DATA

			BCP54	BCP55	BCP56	
Collector-base voltage (open emitter)	V_{CBO}	max.	45	60	100	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	V_{CER}	max.	45	60	100	V
Collector current (peak value)	I_{CM}	max.		1,5		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 I_C = 150 mA; V_{CE} = 2 V	h_{FE}			40 to 250		
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 5 V	f_T	typ.		130		MHz

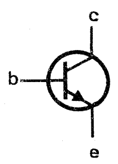
MECHANICAL DATA

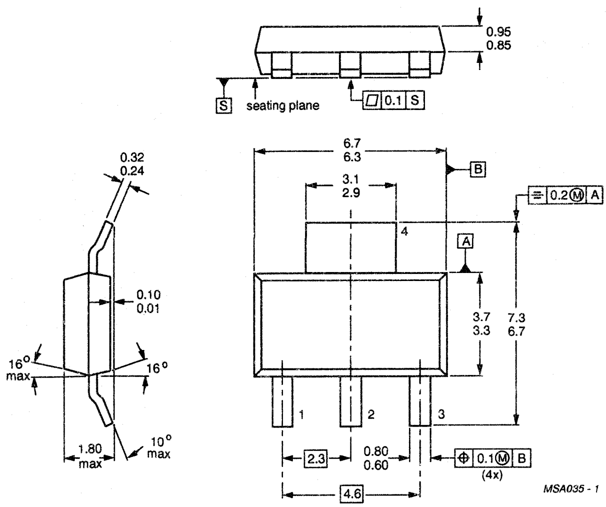
Dimensions in mm

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)

			BCP54	BCP55	BCP56	
Collector-base voltage (open emitter)	V_{CBO}	max.	45	60	100	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	V_{CER}	max.	45	60	100	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	5	V
Collector current (DC)	I_C	max.		1,0		A
Collector current (peak value)	I_{CM}	max.		1,5		A
Base current (DC)	I_B	max.		0,1		A
Base current (peak value)	I_{BM}	max.		0,2		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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector cut-off current				
I_E = 0; V_{CB} = 30 V	I_{CBO}	<	100	nA
I_E = 0; V_{CB} = 30 V; T_j = 125 °C	I_{CBO}	<	10	μA
Emitter cut-off current				
I_C = 0; V_{EB} = 5 V	I_{EBO}	<	10	μA
Base-emitter voltage				
I_C = 500 mA; V_{CE} = 2 V	V_{BE}	<	1	V
Saturation voltage				
I_C = 500 mA; I_B = 50 mA	V_{CEsat}	<	0,5	V
DC current gain				
I_C = 5 mA; V_{CE} = 2 V	h_{FE}	>	25	
I_C = 150 mA; V_{CE} = 2 V	h_{FE}		40 to 250	
I_C = 500 mA; V_{CE} = 2 V	h_{FE}	>	25	
Transition frequency at f = 100 MHz				
I_C = 10 mA; V_{CE} = 5 V	f_T	typ.	130	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 cm².

CHARACTERISTICS (continued)

			BCP54-10 55-10 56-10	BCP54-16 55-16 56-16
DC current gain		>	63	100
$I_C = 150$ mA; $V_{CE} = 2$ V	h_{FE}	<	160	250

SILICON PLANAR EPITAXIAL TRANSISTOR

NPN transistor in a microminiature plastic package, intended for low-voltage, high-current LF applications.

QUICK REFERENCE DATA

Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	25	V
Collector-emitter voltage (open base)	V_{CEO}	max.	20	V
Collector current (peak value)	I_{CM}	max.	2	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 I_C = 500 mA; V_{CE} = 1 V	h_{FE}		85 to 375	
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 5 V	f_T	>	40	MHz

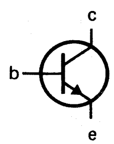
MECHANICAL DATA

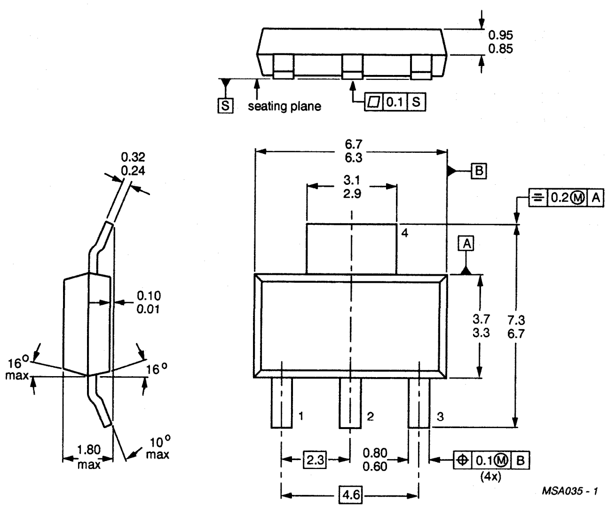
Dimensions in mm

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-emitter voltage (V_{BE} = 0)	V_{CES}	max.	25	V
Collector-emitter voltage (open base)	V_{CEO}	max.	20	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V
Collector current (DC)	I_C	max.	1	A
Collector current (peak value)	I_{CM}	max.	2	A
Base current (DC)	I_B	max.	100	mA
Base current (peak value)	I_{BM}	max.	200	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 in free air*	$R_{th\ j\text{-}a}$	=	83,3	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current					
I_E = 0; V_{CB} = 25 V		I_{CBO}	<	10	μA
I_E = 0; V_{CB} = 25 V; T_j = 150 °C		I_{CBO}	<	1	mA
Emitter cut-off current					
I_C = 0; V_{EB} = 5 V		I_{EBO}	<	10	μA
Base-emitter voltage					
I_C = 5 mA; V_{CE} = 10 V		V_{BE}	typ.	0,62	V
I_C = 1 A; V_{CE} = 1 V		V_{BE}	<	1	V
Collector-emitter saturation voltage					
I_C = 1 A; I_B = 100 mA		V_{CEsat}	<	0,5	V
DC current gain					
I_C = 5 mA; V_{CE} = 10 V	BCP68	h_{FE}	>	50	
I_C = 500 mA; V_{CE} = 1 V	BCP68	h_{FE}		85 to 375	
	BCP68-10	h_{FE}	⩽	160	
	BCP68-16	h_{FE}		100 to 250	
	BCP68-25	h_{FE}	⩾	250	
I_C = 1 A; V_{CE} = 1 V	BCP68	h_{FE}	>	60	
Collector capacitance at f = 450 kHz					
I_E = I_e = 0; V_{CB} = 5 V		C_c	typ.	27	pF
Transition frequency at f = 100 MHz					
I_C = 10 mA; V_{CE} = 5 V		f_T	>	40	MHz

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

SILICON PLANAR EPITAXIAL TRANSISTOR

PNP transistor in a plastic microminiature package, intended for low-voltage, high-current LF applications.

QUICK REFERENCE DATA

Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	25	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	20	V
Collector current (peak value)	$-I_{CM}$	max.	2	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 $-I_C$ = 500 mA; $-V_{CE}$ = 1 V	h_{FE}		85 to 375	
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	>	40	MHz

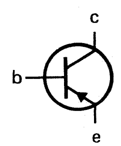
MECHANICAL DATA

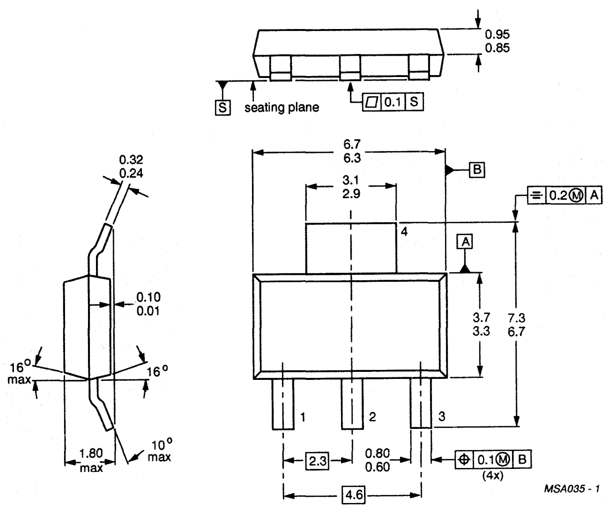
Dimensions in mm

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-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	25	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	20	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	V
Collector current (DC)	$-I_C$	max.	1	A
Collector current (peak value)	$-I_{CM}$	max.	2	A
Base current (DC)	$-I_B$	max.	100	mA
Base current (peak value)	$-I_{BM}$	max.	200	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 cut-off current					
$I_E = 0; -V_{CB} = 25$ V		$-I_{CBO}$	<	10	μA
$I_E = 0; -V_{CB} = 25$ V; $T_j = 150$ °C		$-I_{CBO}$	<	1	mA
Emitter cut-off current					
$I_C = 0; -V_{EB} = 5$ V		$-I_{EBO}$	<	10	μA
Base-emitter voltage					
$-I_C = 5$ mA; $-V_{CE} = 10$ V		$-V_{BE}$	typ.	0,62	V
$-I_C = 1$ A; $-V_{CE} = 1$ V		$-V_{BE}$	<	1	V
Collector-emitter saturation voltage					
$-I_C = 1$ A; $-I_B = 100$ mA		$-V_{CEsat}$	<	0,5	V
DC current gain					
$-I_C = 5$ mA; $-V_{CE} = 10$ V	BCP69	h_{FE}	>	50	
$-I_C = 500$ mA; $-V_{CE} = 1$ V	BCP69	h_{FE}		85 to 375	
	BCP69-10	h_{FE}	⩽	160	
	BCP69-16	h_{FE}		100 to 250	
	BCP69-25	h_{FE}	⩾	250	
$-I_C = 1$ A; $-V_{CE} = 1$ V	BCP69	h_{FE}	>	60	
Collector capacitance at f = 450 kHz					
$I_E = I_e = 0; -V_{CB} = 5$ V		C_c	typ.	45	pF
Transition frequency at f = 100 MHz					
$-I_C = 10$ mA; $-V_{CE} = 5$ V		f_T	>	40	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 cm².

SILICON PLANAR DARLINGTON TRANSISTOR

P-N-P silicon planar darlington transistor in a plastic SOT23 package.
N-P-N complement is BCV27/47.

QUICK REFERENCE DATA

			BCV26	BCV46	
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	30	60	V
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40	80	V
Collector current	$-I_C$	max.	300	500	mA
DC current gain					
$-I_C$ = 1 mA; $-V_{CE}$ = 5 V	h_{FE}	>	4 000	2 000	
$-I_C$ = 10 mA; $-V_{CE}$ = 5 V	h_{FE}	>	10 000	4 000	
$-I_C$ = 100 mA; $-V_{CE}$ = 5 V	h_{FE}	>	20 000	10 000	
Junction temperature	T_j	max.	150		°C
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Collector-emitter saturation voltage					
$-I_C$ = 100 mA; $-I_B$ = 0.1 mA	$-V_{CEsat}$	max.	1.0		V
Transition frequency at f = 100 MHz					
$-I_C$ = 30 mA; $-V_{CE}$ = 5 V	f_T	typ.	220		MHz

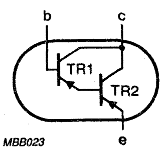
MECHANICAL DATA

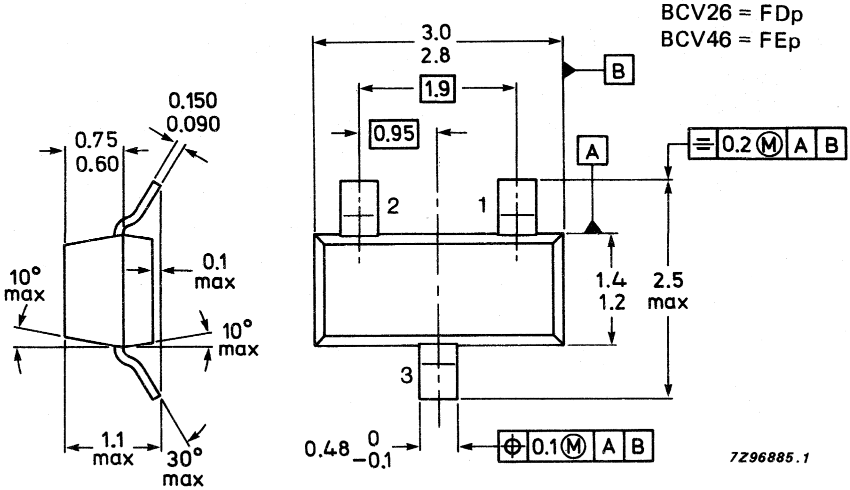
Dimensions in mm

Fig. 1 SOT23

Marking code:
BCV26 = FDp
BCV46 = FEp

Pinning:
1 = base
2 = emitter
3 = collector





TOP VIEW

RATINGS

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

			BCV26	BCV46	
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	30	60	V
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40	80	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	10	10	V
Collector current	$-I_C$	max.	300	500	mA
Collector current (peak value)	$-I_{CM}$	max.	800		mA
Base current	$-I_B$	max.	100		mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	250		mW
Storage temperature	T_s		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise stated

			BCV26	BCV46	
Collector-base current $-V_{CBO}$ = 30 V	$-I_{CBO}$	max.	0.1	0.1	μA
Emitter-base current $-V_{EB}$ = 10 V	$-I_{EBO}$	max.	0.1	0.1	μA
Collector-emitter break-down voltage $-I_C$ = 10 mA	$-V_{(BR)CEO}$	min.	30	60	V
Collector-base breakdown voltage I_C = 10 μA	$-V_{(BR)CBO}$	min.	40	80	V
Emitter-base breakdown voltage $-I_E$ = 100 nA	$-V_{(BR)EBO}$	min.	10	10	V
DC current gain $-I_C$ = 1 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	4 000	2 000	
$-I_C$ = 10 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	10 000	4 000	
$-I_C$ = 100 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	20 000	10 000	
Collector-emitter saturation voltage $-I_C$ = 100 mA; $-I_B$ = 0.1 mA	$-V_{CEsat}$	max.	1.0		V
Base-emitter saturation voltage $-I_C$ = 100 mA; $-I_B$ = 0.1 mA	$-V_{BEsat}$	max.	1.5		V
Transition frequency at f = 100 MHz $-I_C$ = 30 mA; $-V_{CE}$ = 5 V	f_T	typ.	220		MHz
Collector capacitance at f = 1 MHz I_E = 0; $-V_{CB}$ = 30 V	C_c	typ.	3.5		pF

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

SILICON PLANAR DARLINGTON TRANSISTOR

N-P-N silicon planar darlington transistor in a plastic SOT23 package.
P-N-P complement is BCV26/46.

QUICK REFERENCE DATA

			BCV27	BCV47	
Collector-emitter voltage (open base)	V_{CEO}	max.	30	60	V
Collector-base voltage (open emitter)	V_{CBO}	max.	40	80	V
Collector current	I_C	max.	300	500	mA
DC current gain					
I_C = 1 mA; V_{CE} = 5 V	h_{FE}	>	4 000	2 000	
I_C = 10 mA; V_{CE} = 5 V	h_{FE}	>	10 000	4 000	
I_C = 100 mA; V_{CE} = 5 V	h_{FE}	>	20 000	10 000	
Junction temperature	T_j	max.	150		°C
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Collector-emitter saturation voltage					
I_C = 100 mA; I_B = 0.1 mA	V_{CEsat}	max.	1.0		V
Transition frequency at f = 100 MHz					
I_C = 30 mA; V_{CE} = 5 V	f_T	typ.	220		MHz

MECHANICAL DATA

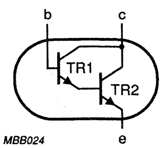
Dimensions in mm

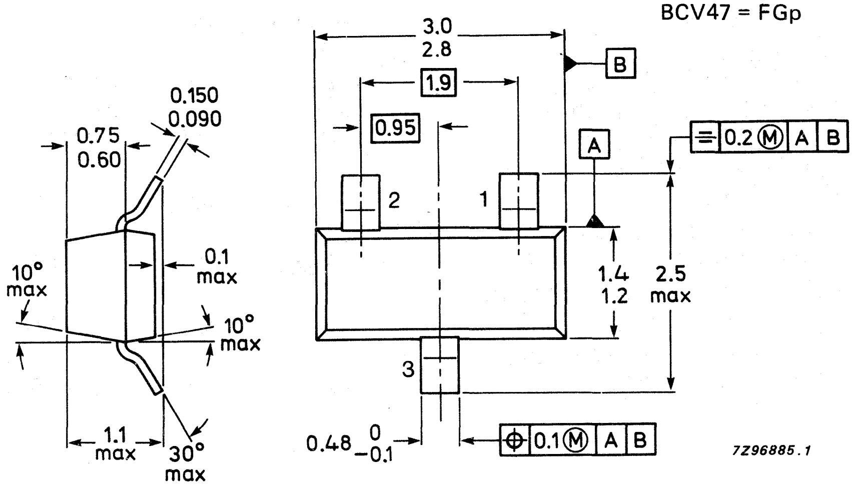
Fig. 1 SOT23

Marking code:
BCV27 = FFp
BCV47 = FGp

Pinning:

1 = base
2 = emitter
3 = collector





TOP VIEW

RATINGS

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

			BCV27	BCV47	
Collector-emitter voltage (open base)	V_{CEO}	max.	30	60	V
Collector-base voltage (open emitter)	V_{CBO}	max.	40	80	V
Emitter-base voltage (open collector)	V_{EBO}	max.	10	10	V
Collector current	I_C	max.	300	500	mA
Collector current (peak value)	I_{CM}	max.	800		mA
Base current	I_B	max.	100		mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	250		mW
Storage temperature	T_s		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise stated			BCV27	BCV47	
Collector-base current V_{CBO} = 30 V	I_{CBO}	max.	0.1	0.1	μA
Emitter-base current V_{EB} = 10 V	I_{EBO}	max.	0.1	0.1	μA
Collector-emitter break-down voltage I_C = 10 mA	$V_{(BR)CEO}$	min.	30	60	V
Collector-base breakdown voltage I_C = 10 μA	$V_{(BR)CBO}$	min.	40	80	V
Emitter-base breakdown voltage I_E = 100 nA	$V_{(BR)EBO}$	min.	10	10	V
DC current gain I_C = 1 mA; V_{CE} = 5 V	h_{FE}	min.	4 000	2 000	
I_C = 10 mA; V_{CE} = 5 V	h_{FE}	min.	10 000	4 000	
I_C = 100 mA; V_{CE} = 5 V	h_{FE}	min.	20 000	10 000	
Collector-emitter saturation voltage I_C = 100 mA; I_B = 0.1 mA	V_{CEsat}	max.	1.0		V
Base-emitter saturation voltage I_C = 100 mA; I_B = 0.1 mA	V_{BEsat}	max.	1.5		V
Transition frequency at f = 100 MHz I_C = 30 mA; V_{CE} = 5 V	f_T	typ.	220		MHz
Collector capacitance at f = 1 MHz I_E = 0; V_{CB} = 30 V	C_c	typ.	3.5		pF

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

SMALL-SIGNAL DARLINGTON TRANSISTOR

PNP small-signal darlington transistors, housed in a microminiature package (SOT89).
NPN complementary types are BCV29/49.

QUICK REFERENCE DATA

			BCV28	BCV48	
Collector-base voltage	$-V_{CBO}$	max.	40	80	V
Collector-emitter voltage	$-V_{CEO}$	max.	30	60	V
Emitter-base voltage	$-V_{EBO}$	max.	10	10	V
Collector current (DC)	$-I_C$	max.	500	500	mA
DC current gain					
$-I_C$ = 1 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	4000	2000	
$-I_C$ = 10 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	10000	4000	
$-I_C$ = 100 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	20000	10000	
$-I_C$ = 500 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	4000	2000	
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	typ.	220		MHz

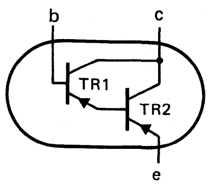
MECHANICAL DATA

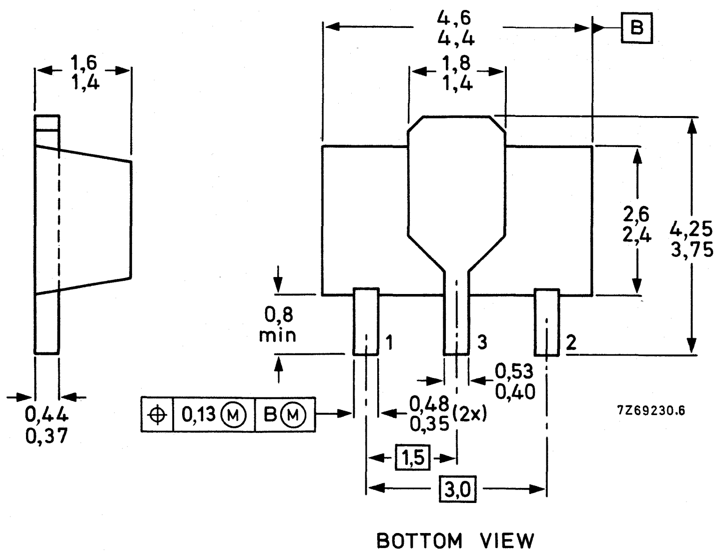
Dimensions in mm

Fig.1 SOT89

Pinning

1 = emitter
2 = base
3 = collector





* Mounted on a ceramic substrate; area = 2.5 cm^2; thickness = 0.7 mm.

RATINGS

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

			BCV28	BCV48	
Collector-base voltage	$-V_{CBO}$	max.	40	80	V
Collector-emitter voltage	$-V_{CEO}$	max.	30	60	V
Emitter-base voltage	$-V_{EBO}$	max.	10	10	V
Collector current (DC)	$-I_C$	max.	500	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 RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	125	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			BCV28	BCV48	
Collector-emitter breakdown voltage $-I_C$ = 10 mA	$-V_{(BR)CES}$	min.	30	60	V
Collector-base breakdown voltage $-I_C$ = 10 µA	$-V_{(BR)CBO}$	min.	40	80	V
Emitter-base breakdown voltage $-I_E$ = 0.1 µA	$-V_{(BR)EBO}$	min.	10	10	V
Emitter-base cut-off current $-V_{BE}$ = 4 V; I_C = 0	$-I_{EBO}$	max.	0.1	0.1	µA
Collector-base cut-off current $-V_{CB}$ = 30/60 V; I_E = 0	$-I_{CBO}$	max.	0.1	0.1	µA
DC current gain					
$-I_C$ = 1 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	4000	2000	
$-I_C$ = 10 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	10000	4000	
$-I_C$ = 100 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	20000	10000	
$-I_C$ = 500 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	4000	2000	
Collector-emitter saturation voltage $-I_C$ = 100 mA; $-I_B$ = 0.1 mA	$-V_{CEsat}$	max.	1.0		V
Base-emitter saturation voltage $-I_C$ = 100 mA; $-I_B$ = 0.1 mA	$-V_{BEsat}$	max.	1.5		V
Transition frequency at f = 100 MHz $-I_C$ = 30 mA; $-V_{CE}$ = 5 V	f_T	typ.	220		MHz
Output capacitance $-V_{CB}$ = 30 V; I_E = 0	C_c	typ.	3.5		pF

* 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 package (SOT89)
PNP complementary types are BCV28/48.

QUICK REFERENCE DATA

			BCV29	BCV49	
Collector-base voltage	V_{CBO}	max.	40	80	V
Collector-emitter voltage	V_{CEO}	max.	30	60	V
Emitter-base voltage	V_{EBO}	max.	10	10	V
Collector current (DC)	I_C	max.	500	500	mA
DC current gain					
I_C = 1 mA; V_{CE} = 5 V	h_{FE}	min.	4000	2000	
I_C = 10 mA; V_{CE} = 5 V	h_{FE}	min.	10000	4000	
I_C = 100 mA; V_{CE} = 5 V	h_{FE}	min.	20000	10000	
I_C = 500 mA; V_{CE} = 5 V	h_{FE}	min.	4000	2000	
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	typ.	220		MHz

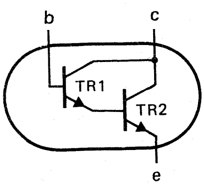
MECHANICAL DATA

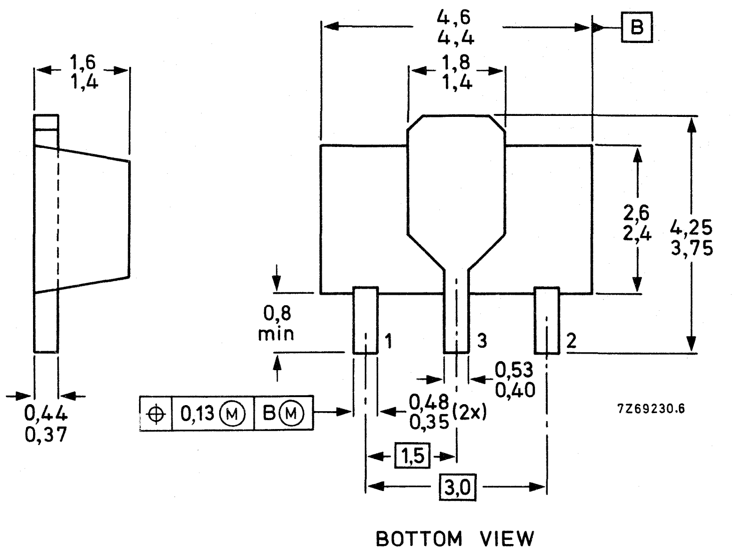
Dimensions in mm

Fig.1 SOT89.

Pinning

1 = emitter
2 = base
3 = collector





* Mounted on a ceramic substrate; area = 2.5 cm²; thickness = 0.7 mm.

RATINGS

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

			BCV29	BCV49	
Collector-base voltage	V_{CBO}	max.	40	80	V
Collector-emitter voltage	V_{CEO}	max.	30	60	V
Emitter-base voltage	V_{EBO}	max.	10	10	V
Collector current (DC)	I_C	max.	500	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 RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	125	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			BCV29	BCV49	
Collector-emitter breakdown voltage I_C = 10 mA	$V_{(BR)CES}$	min.	30	60	V
Collector-base breakdown voltage I_C = 10 μA	$V_{(BR)CBO}$	min.	40	80	V
Emitter-base breakdown voltage I_E = 0.1 μA	$V_{(BR)EBO}$	min.	10	10	V
Emitter-base cut-off current V_{BE} = 4 V; I_C = 0	I_{EBO}	max.	0.1	0.1	μA
Collector-base cut-off current V_{CB} = 30/60 V; I_E = 0	I_{CBO}	max.	0.1	0.1	μA
DC current gain I_C = 1 mA; V_{CE} = 5 V	h_{FE}	min.	4000	2000	
I_C = 10 mA; V_{CE} = 5 V	h_{FE}	min.	10000	4000	
I_C = 100 mA; V_{CE} = 5 V	h_{FE}	min.	20000	10000	
I_C = 500 mA; V_{CE} = 5 V	h_{FE}	min.	4000	2000	
Collector-emitter saturation voltage I_C = 100 mA; I_B = 0.1 mA	V_{CEsat}	max.	1.0	1.0	V
Base-emitter saturation voltage I_C = 100 mA; I_B = 0.1 mA	V_{BEsat}	max.	1.5	1.5	V
Transition frequency at f = 100 MHz I_C = 30 mA; V_{CE} = 5 V	f_T	typ.	220		MHz
Output capacitance V_{CB} = 30 V; I_E = 0	C_c	typ.	3.5		pF

* Mounted on a ceramic substrate; area = 2.5 cm^2; thickness = 0.7 mm.

SILICON PLANAR EPITAXIAL TRANSISTOR

Double n-p-n transistor, in SOT-143 plastic package, designed for use in applications where the working point must be independent of temperature.

Owing to application of two similar crystals of one slice this device has a good thermal coupling and V_{BE} matching. Special interconnection of the two transistor crystals allows the device to be used as a current mirror and the separated emitter leads allow connection to different sources.

A similar device in p-n-p configuration is the BCV62.

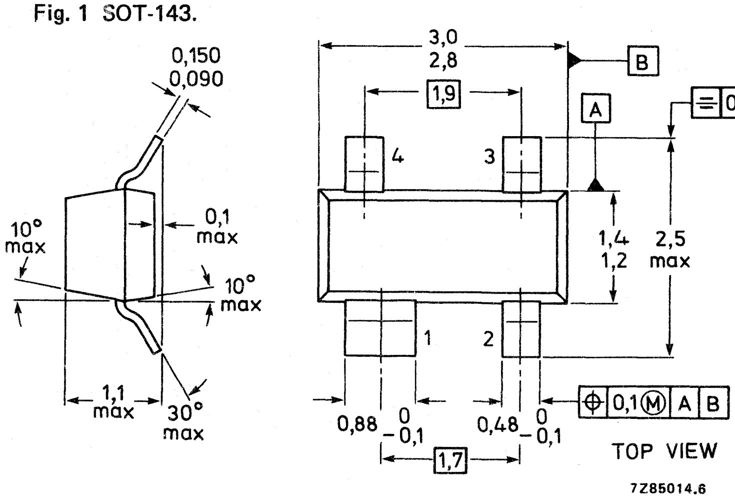
QUICK REFERENCE DATA

Collector-emitter voltage (open base) regarding transistor T1	V_{CEO}	max.	30 V
Collector-base voltage (open emitter) regarding transistor T1	V_{CBO}	max.	30 V
Collector current d.c.	I_C	max.	100 mA
peak	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

MECHANICAL DATA

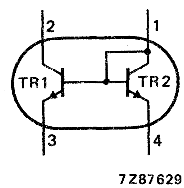
Fig. 1 SOT-143.

Dimensions in mm



Marking code:

BCV61 = 1Mp
BCV61A = 1Jp
BCV61B = 1Kp
BCV61C = 1Lp



See also *Soldering recommendations.*

RATINGS

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

Collector-emitter voltage (open base) regarding transistor T1	V_{CEO}	max.	30	V
Collector-base voltage (open emitter) regarding transistor T1	V_{CBO}	max.	30	V
Base current (transistor T1) peak value	I_{BM1}	max.	200	mA
Emitter-base voltage	V_{EBS}	max.	6	V
Collector current d.c.	I_C	max.	100	mA
peak	I_{CM}	max.	200	mA
Total power dissipation up to T_{amb} = 25 °C when mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm	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

Transistor T1

Collector cut-off current				
$I_E = 0$; $V_{CB} = 30$ V	I_{CBO}	<	15	nA
$I_E = 0$; $V_{CB} = 30$ V; $T_j = 150$ °C	I_{CBO}	<	5	μA
Base-emitter voltage				
$I_C = 2$ mA; $V_{CE} = 5$ V	V_{BE}	typ.	660	mV*
			580 to 700	mV*
$I_C = 10$ mA; $V_{CE} = 5$ V	V_{BE}	<	770	mV*
Saturation voltages				
$I_C = 10$ mA; $I_B = 0,5$ mA	V_{CEsat}	typ.	90	mV
		<	250	mV
	V_{BEsat}	typ.	700	mV**
$I_C = 100$ mA; $I_B = 5$ mA	V_{CEsat}	typ.	200	mV
		<	600	mV
	V_{BEsat}	typ.	900	mV**

* Decreasing 2 mV/°C with increasing temperature.
** Decreasing 1,7 mV/°C with increasing temperature.

Transition frequency at f = 100 MHz				
I_C = 10 mA; V_{CE} = 5 V		f_T	>	100 MHz
Collector capacitance at f = 1 MHz				
$I_E = i_e = 0$; V_{CB} = 10 V		C_c	typ.	2,5 pF
Noise figure at R_S = 2 kΩ				
I_C = 200 μA; V_{CE} = 5 V		F	typ.	2 dB
f = 1 kHz; B = 200 Hz			<	10 dB
D.C. current gain				
I_C = 100 μA; V_{CE} = 5 V		h_{FE}	>	100
I_C = 2 mA; V_{CE} = 5 V		h_{FE}		110 to 800

Transistor T2

Base-emitter forward voltage				
I_E = 250 mA		V_{BES}	<	1,8 V
I_E = 10 μA		V_{BES}	>	400 mV
Matching of transistor T1 and transistor T2				
at I_{E2} = 0,5 mA and V_{CE1} = 5 V				
T_{amb} = 25 °C		I_{C1}/I_{C2}		0,7 to 1,3
T_{amb} = 150 °C		I_{C1}/I_{C2}		0,7 to 1,3
Thermal coupling of transistor T1 and Transistor T2*				
T1 : V_{CE} = 5 V				
Maximum current for thermal stability of I_{C1}		I_{E2}	max.	5 mA
D.C. current gain			min.	110
I_C = 2 mA; V_{CE} = 5 V	BCV61A	h_{FE}	max.	220
			min.	200
	BCV61B	h_{FE}	max.	450
			min.	420
	BCV61C	h_{FE}	max.	800

* Without emitter resistor and device mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm. (See Fig. 2)

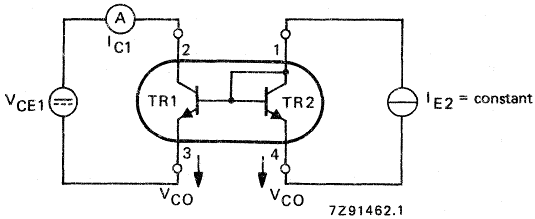


Fig. 2 Test circuit current matching.

Note: Voltage drop at contacts: $V_{CO} < \frac{2}{3} U_T \triangleq 16$ mV.

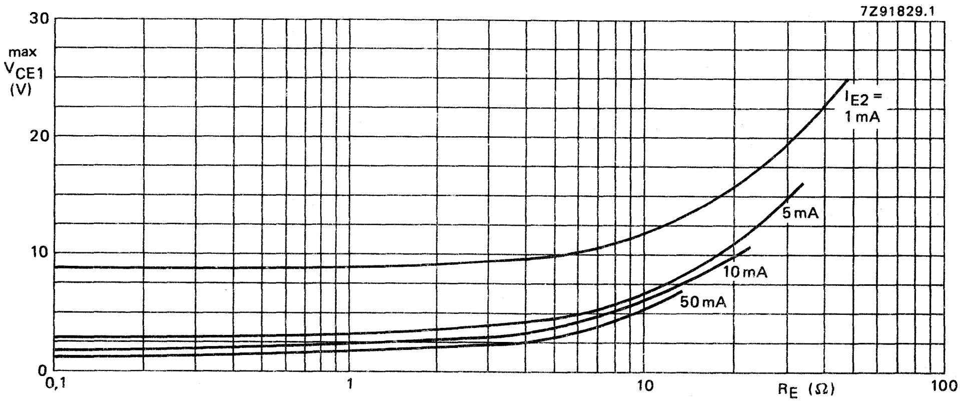


Fig. 3 Characteristic for determination of max. V_{CE1} at specified R_E range with I_{E2} as parameter under condition of $\frac{I_{C1}}{I_{E2}} = 1{,}3$ (see Fig. 4).

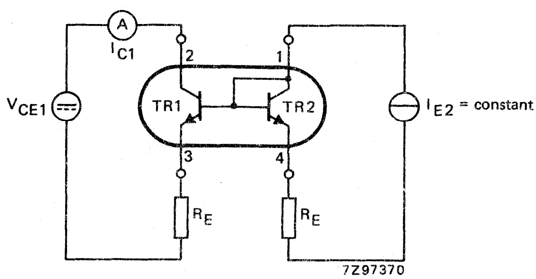


Fig. 4 BCV61 with emitter resistors.

SILICON PLANAR EPITAXIAL TRANSISTOR

Double p-n-p transistor, in SOT-143 plastic package, designed for use in applications where the working point must be independent of temperature.

Owing to application of two similar crystals of one slice this device has a good thermal coupling and V_{BE} matching. Special interconnection of the two transistor crystals allows the device to be used as a current mirror and the separated emitter leads allow connection to different sources.

A similar device in n-p-n configuration is the BCV61.

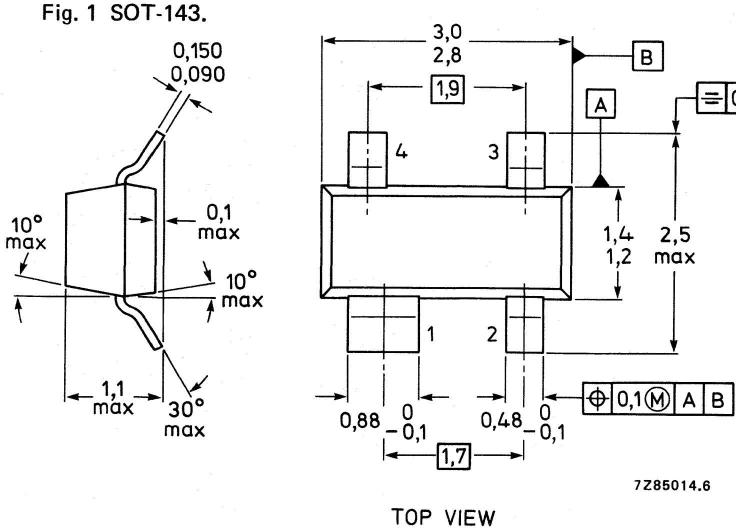
QUICK REFERENCE DATA

Collector-emitter voltage (open base) regarding transistor T1	$-V_{CEO}$	max	30 V
Collector-base voltage (open emitter) regarding transistor T1	$-V_{CBO}$	max.	30 V
Collector current d.c.	$-I_C$	max.	100 mA
peak	$-I_{CM}$	max.	200 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250 mW
Junction temperature	T_j	max.	150 °C

MECHANICAL DATA

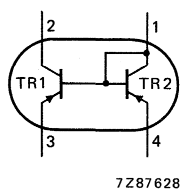
Fig. 1 SOT-143.

Dimensions in mm



Marking code:

BCV62 : 3Mp
BCV62A: 3Jp
BCV62B: 3Kp
BCV62C: 3Lp



RATINGS

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

Collector-emitter voltage (open base) regarding transistor T1	$-V_{CEO}$	max.	30 V
Collector-base voltage (open emitter) regarding transistor T1	$-V_{CBO}$	max.	30 V
Base current (transistor T1) peak value	$-I_{BM1}$	max.	200 mA
Emitter-base voltage	$-V_{EBS}$	max.	6 V
Collector current d.c.	$-I_C$	max.	100 mA
peak	$-I_{CM}$	max.	200 mA
Total power dissipation up to T_{amb} = 25 °C when mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm	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

Transistor T1

Collector cut-off current			
$-I_E = 0$; $-V_{CB} = 30$ V	$-I_{CBO}$	<	15 nA
$-I_E = 0$; $-V_{CB} = 30$ V; $T_j = 150$ °C	$-I_{CBO}$	<	5 μA
Base-emitter voltage			
$-I_C = 2$ mA; $-V_{CE} = 5$ V	$-V_{BE}$	typ.	650 mV*
			600 to 750 mV*
$-I_C = 10$ mA; $-V_{CE} = 5$ V	$-V_{BE}$	<	820 mV*
Saturation voltages			
$-I_C = 10$ mA; $-I_B = 0{,}5$ mA	$-V_{CEsat}$	typ.	75 mV
		<	300 mV
	$-V_{BEsat}$	typ.	700 mV**
$-I_C = 100$ mA; $-I_B = 5$ mA	$-V_{CEsat}$	typ.	250 mV
		<	650 mV
	$-V_{BEsat}$	typ.	850 mV**

* Decreasing 2 mV/°C with increasing temperature.
** Decreasing 1,7 mV/°C with increasing temperature.

Transition frequency at f = 100 MHz				
$-I_C$ = 10 mA; $-V_{CE}$ = 5 V		f_T	>	100 MHz
Collector capacitance at f = 1 MHz				
$I_E = i_e = 0$; $-V_{CB}$ = 10 V		C_c	typ.	4,5 pF
Noise figure at R_S = 2 kΩ				
$-I_C$ = 200 μA; $-V_{CE}$ = 5 V		F	typ.	2 dB
f = 1 kHz; B = 200 Hz		F	<	10 dB
D.C. current gain				
$-I_C$ = 100 μA; $-V_{CE}$ = 5 V		h_{FE}	>	100
$-I_C$ = 2 mA; $-V_{CE}$ = 5 V		h_{FE}		100 to 800

Transistor T2

Base-emitter forward voltage				
$-I_E$ = 250 mA		$-V_{BES}$	<	1,5 V
$-I_E$ = 10 μA		$-V_{BES}$	>	400 mV
Matching of transistor T1 and transistor T2				
at I_{E2} = 0,5 mA and V_{CE1} = 5 V				
T_{amb} = 25 °C		I_{C1}/I_{C2}		0,7 to 1,3
T_{amb} = 150 °C		I_{C1}/I_{C2}		0,7 to 1,3
Thermal coupling of transistor T1 and transistor T2*				
T1 : $-V_{CE}$ = 5 V				
Maximum current for thermal stability of $-I_{C1}$		I_{E2}	max.	5 mA
D.C. current gain				
$-I_C$ = 2 mA; $-V_{CE}$ = 5 V	BCV62A	h_{FE}	min.	125
			max.	250
	BCV62B	h_{FE}	min.	220
			max.	475
	BCV62C	h_{FE}	min.	420
			max.	800

* Without emitter resistor and device mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm. (see Fig. 2)

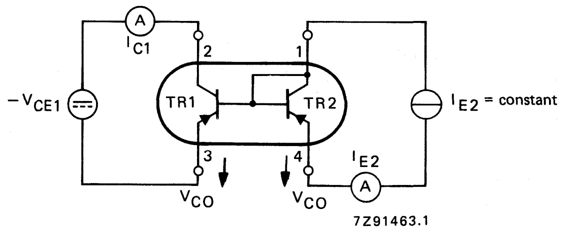


Fig. 2 Test circuit current matching.

Note: Voltage drop at contacts: $V_{CO} < \frac{2}{3} U_T \triangleq 16$ mV.

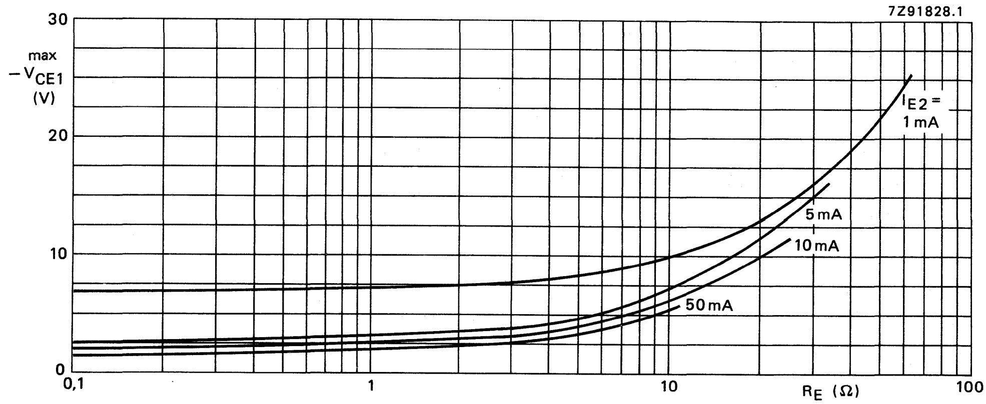


Fig. 3 Characteristic for determination of max. V_{CE1} at specified R_E range with I_{E2} as parameter under condition of $\frac{I_{C1}}{I_{E2}} = 1{,}3$ (see Fig. 4).

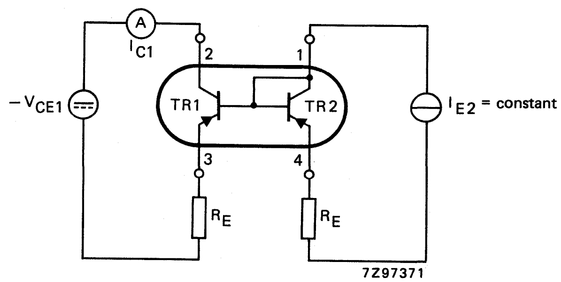


Fig. 4 BCV62 with emitter resistors.

SILICON PLANAR TRANSISTOR

Double N-P-N transistor in a plastic SOT-143 package. Intended for Schmitt-trigger applications. P-N-P complement is the BCV64.

QUICK REFERENCE DATA

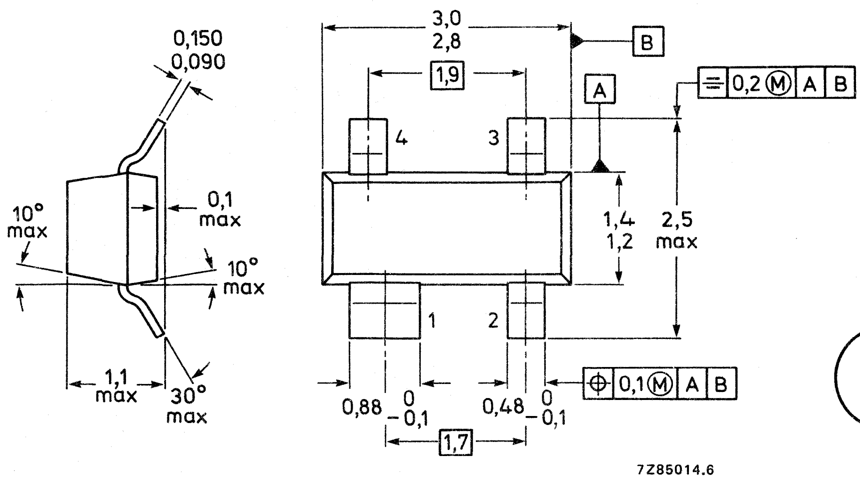
	transistor		T1	T2	
Collector-emitter voltage (open base)	V_{CEO}	max.	30	6	V
Collector-base voltage (open emitter)	V_{CBO}	max.	30	6	V
Collector current	I_C	max.	100		mA
Junction temperature	T_j	max.	150		^oC
Total power dissipation up to T_{amb} = 25 ^oC	P_{tot}	max.	250		mW
Collector-emitter saturation voltage I_C = 10 mA; I_B = 0,5 mA	V_{CEsat}	max.	300		mV
Small signal current gain	h_{fe}		100 to 900		
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 5 V	f_T	>	100	–	MHz

MECHANICAL DATA

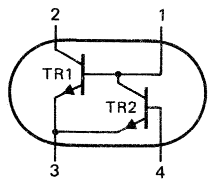
Dimensions in mm

Fig. 1 SOT-143.

Marking code
BCV63 : D95
BCV63B : D96



TOP VIEW



RATINGS

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

	transistor		T1	T2	
Collector-emitter voltage (open base)	V_{CEO}	max.	30	6	V
Collector-base voltage (open emitter)	V_{CBO}	max.	30	6	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6		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_s		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise stated

	transistor		T1	T2	
Collector cut-off current					
I_E = 0; V_{CBO} = 30 V	I_{CBO}	max.	15	15	nA
I_E = 0; V_{CBO} = 30 V; T_j = 150 °C	I_{CBO}	max.	5	5	μA
Saturation voltage**					
I_C = 10 mA; I_B = 0,5 mA	V_{CEsat}	typ.	75	75	mV
	V_{CEsat}	max.	300	300	mV
	V_{BEsat}	typ.	700	700	mV
I_C = 100 mA; I_B = 5 mA	V_{CEsat}	typ.	250	250	mV
	V_{CEsat}	max.	650	–	mV
	V_{BEsat}	typ.	850	–	mV
Base-emitter voltage ▲					
I_C = 2 mA; V_{CE} = 5 V	V_{BE}	min.	600	–	mV
	V_{BE}	typ.	650	–	mV
	V_{BE}	max.	750	–	mV
I_C = 10 mA; V_{CE} = 5 V	V_{BE}	max.	820	–	mV
I_C = 2 mA; V_{CE} = 700 mV	V_{BE}	typ.		700	mV
Collector capacitance at f = 1 MHz					
I_E = i_e = 0; V_{CE} = 10 V	C_c	typ.	4	–	pF
Transition frequency at f = 100 MHz					
I_C = 10 mA; V_{CE} = 5 V	f_T	>	100	–	MHz

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.
** V_{BEsat} decreases by approx 1,7 mV/K with increasing temperature.
▲ $-V_{BE}$ decreases by about 2 mV/K with increasing temperature.

Small signal current gain at f = 1 kHz
I_C = 2 mA; T1 : V_{CE} = 5 V
T2 : V_{CE} = 700 mV — h_{fe} 100 to 900

Transistor 1

D.C. current gain
I_C = 2 mA; V_{CE} = 5 V

		BCV63	BCV63B
h_{FE}	min.	110	200
	max.	800	450

Transistor 2

D.C. current gain
I_C = 2 mA; V_{CE} = 700 mV

Group selection will be done on T1. Due to matched crystals h_{FE} values for T2 are the same as T1.

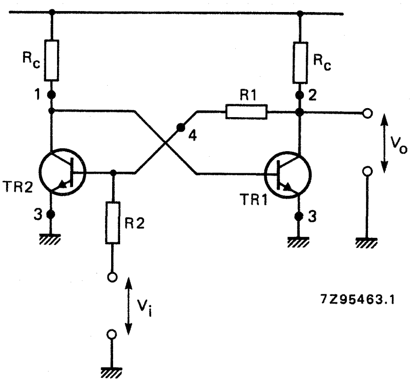


Fig. 2 Schmitt-trigger application.

SILICON PLANAR TRANSISTOR

Double P-N-P transistor in a plastic SOT-143 package. Intended for Schmitt-trigger applications.
N-P-N complement is the BCV63.

QUICK REFERENCE DATA

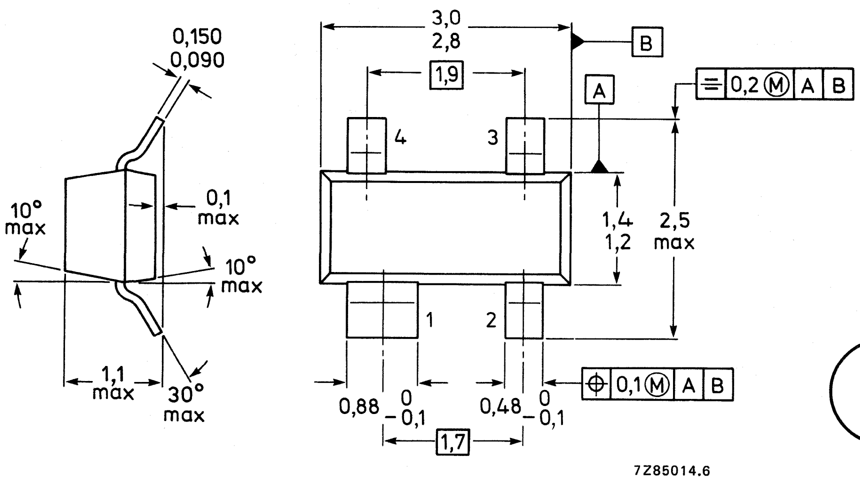
	transistor		T1	T2	
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	30	6	V
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	30	6	V
Collector current	$-I_C$	max.	100		mA
Junction temperature	T_j	max.	150		°C
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Collector-emitter saturation voltage $-I_C$ = 10 mA; $-I_B$ = 0,5 mA	$-V_{CEsat}$	max.	300		mV
Small signal current gain	h_{fe}		100 to 900		
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	>	100	–	MHz

MECHANICAL DATA

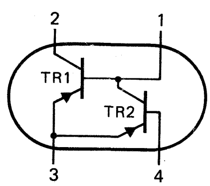
Dimensions in mm

Fig. 1 SOT-143.

Marking code
BCV64 : C95
BCV64B : C96



TOP VIEW



RATINGS

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

	transistor		T1	T2	
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	30	6	V
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	30	6	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	6	6	V
Collector current (d.c.)	$-I_C$	max.	6		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_s		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise stated

	transistor		T1	T2	
Collector cut-off current					
$-I_E = 0$; $-V_{CBO} = 30$ V	$-I_{CBO}$	max.	15	15	nA
$-I_E = 0$; $-V_{CBO} = 30$ V; $T_j = 150$ °C	$-I_{CBO}$	max.	5	5	μA
Saturation voltage**					
$-I_C = 10$ mA; $-I_B = 0{,}5$ mA	$-V_{CEsat}$	typ.	75	75	mV
	$-V_{CEsat}$	max.	300	300	mV
	$-V_{BEsat}$	typ.	700	700	mV
$-I_C = 100$ mA; $-I_B = 5$ mA	$-V_{CEsat}$	typ.	250	250	mV
	$-V_{CEsat}$	max.	650	–	mV
	$-V_{BEsat}$	typ.	850	–	mV
Base-emitter voltage ▲					
$-I_C = 2$ mA; $-V_{CE} = 5$ V	$-V_{BE}$	typ.	650	–	mV
			600/750	–	mV
$-I_C = 10$ mA; $-V_{CE} = 5$ V	$-V_{BE}$	max.	820	–	mV
$-I_C = 2$ mA; $-V_{CE} = 700$ mV	$-V_{BE}$	typ.		700	mV
Collector capacitance at f = 1 MHz					
$-I_E = i_e = 0$; $-V_{CE} = 10$ V	C_c	typ.	4	–	pF
Transition frequency at f = 100 MHz					
$-I_C = 10$ mA; $-V_{CE} = 5$ V	f_T	>	100	–	MHz

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

** V_{BEsat} decreases by approx 1,7 mV/K with increasing temperature.

▲ $-V_{BE}$ decreases by about 2 mV/K with increasing temperature.

Small signal current gain at f = 1 kHz $-I_C$ = 2 mA; T1 : $-V_{CE}$ = 5 V T2 : $-V_{CE}$ = 700 mV	h_{fe}		100 to 900
		BCV64	BCV64B
Transistor 1 D.C. current gain $-I_C$ = 2 mA; $-V_{CE}$ = 5 V	h_{FE} min.	110	220
	h_{FE} max.	800	475
Transistor 2 D.C. current gain $-I_C$ = 2 mA; $-V_{CE}$ = 700 mV			

Group selection will be done on T1. Due to matched crystals h_{FE} values for T2 are the same as T1.

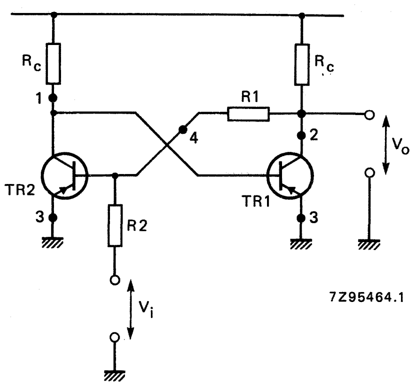


Fig. 2 Schmitt-trigger application.

SILICON PLANAR TRANSISTORS

A matched pair of P-N-P and N-P-N crystal, based on the BC557 and BC547, in a microminiature SOT-143 package.

Complementary crystals give advantages in P.C.B. layout using S.M.D. technology.

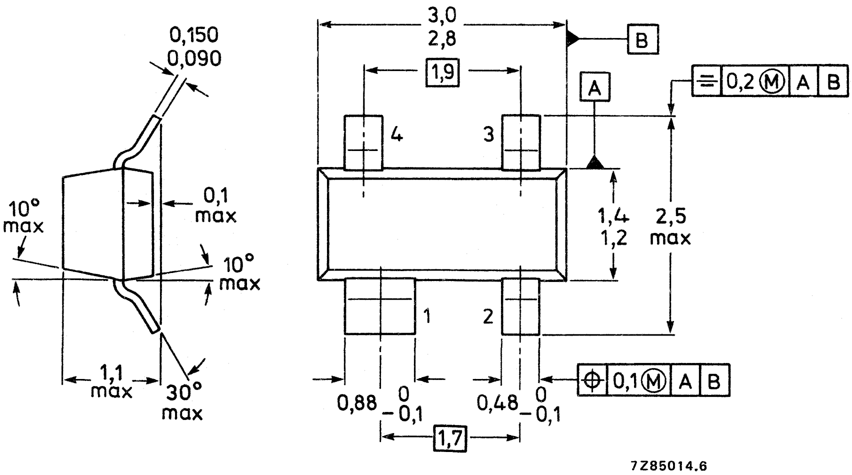
QUICK REFERENCE DATA

Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector current (DC)	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
Junction temperature	T_j	max.	150	°C

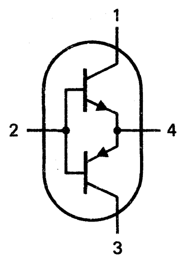
MECHANICAL DATA

Fig. 1 SOT-143.

Dimensions in mm
Marking code
BCV65: 97p
BCV65B: 98p



TOP VIEW



RATINGS

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

Per transistor:

Collector-emitter voltage (open base)	V_{CEO}	max.	30 V
Collector-base voltage (open emitter)	V_{CBO}	max.	30 V
Collector current (DC)	I_C	max.	100 mA
Collector current (peak value)	I_{CM}	max.	200 mA
Total power dissipation (per device) up to T_{amb} = 25 °C	P_{tot}	max.	250 mW
Storage temperature	T_s		−65 to + 150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

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

CHARACTERISTICS

Per transistor:

T_j = 25 °C unless otherwise stated

Collector cut-off current			
$I_E = 0$; V_{CB} = 30 V	I_{CBO}	max.	15 nA
$I_E = 0$; V_{CB} = 30 V; T_j = 150 °C	I_{CBO}	max.	5 μA
Base-emitter voltage**			
I_C = 2 mA; V_{CE} = 5 V	V_{BE}	typ.	650 mV
			580 to 750 mV
I_C = 10 mA; V_{CE} = 5 V	V_{BE}	max.	820 mV
Saturation voltage▲			
I_C = 10 mA; I_B = 0,5 mA	V_{CEsat}	typ.	90 mV
		max.	300 mV
	V_{BEsat}	typ.	700 mV
I_C = 100 mA; I_B = 5 mA	V_{CEsat}	typ.	250 mV
		max.	650 mV
	V_{BEsat}	typ.	900 mV

D.C. current gain
I_C = 2 mA; V_{CE} = 5 V

		BCV65	BCV65B
h_{FE}	min.	75	200
h_{FE}	max.	800	475

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.
** $-V_{BE}$ decreases by about 2 mV/K with increasing temperature.
▲ V_{BEsat} decreases by approx. 1,7 mV/K with increasing temperature.

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors, in a microminiature plastic package, intended for low level general purpose applications in thick and thin-film circuits.

QUICK REFERENCE DATA

			BCV71	BCV72	
D.C. current gain at T_j = 25 °C; I_C = 2 mA; V_{CE} = 5 V	h_{FE}	>	110	200	
		<	220	450	
Collector-base voltage (open emitter)	V_{CBO}	max.	80		V
Collector-emitter voltage (open base)	V_{CEO}	max.	60		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
Transition frequency at f = 100 MHz; I_C = 10 mA; V_{CE} = 5 V	f_T	>	100		MHz
Noise figure at R_S = 2 kΩ; I_C = 200 µA; V_{CE} = 5 V; f = 1 kHz; B = 200 Hz	F	<	10		dB

MECHANICAL DATA

Dimensions in mm

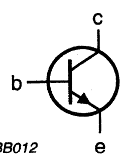
Fig. 1 SOT-23.

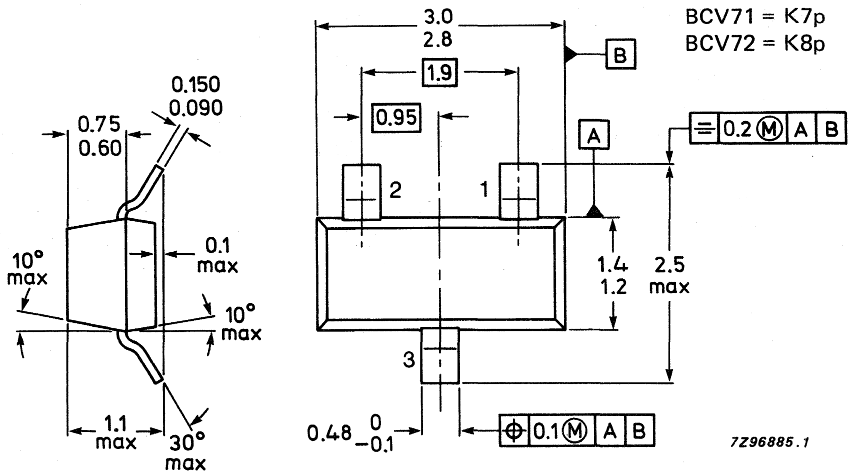
Marking code

BCV71 = K7p
BCV72 = K8p

Pinning:

1 = base
2 = emitter
3 = collector





TOP VIEW

Reverse pinning types are available on request.

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	80	V
Collector-emitter voltage (open base) I_C = 2 mA	V_{CEO}	max.	60	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} = 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 = 2 mA; V_{CE} = 5 V	V_{BE}		550 to 700	mV
Saturation voltages				
I_C = 10 mA; I_B = 0,5 mA	V_{CEsat}	typ.	120	mV
		<	250	mV
	V_{BEsat}	typ.	750	mV
I_C = 50 mA; I_B = 2,5 mA	V_{CEsat}	typ.	210	mV
	V_{BEsat}	typ.	850	mV

			BCV71	BCV72	
D.C. current gain					
I_C = 10 μA; V_{CE} = 5 V	h_{FE}	typ.	90	150	
I_C = 2 mA; V_{CE} = 5 V	h_{FE}	>	110	200	
		<	220	450	
Collector capacitance at f = 1 MHz $I_E = I_e = 0$; V_{CB} = 10 V	C_c	typ.	2,5		pF
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 5 V	f_T	>	100		MHz
Noise figure at R_S = 2 kΩ I_C = 200 μA; V_{CE} = 5 V f = 1 kHz; B = 200 Hz	F	<	10		dB

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors, in a microminiature plastic package, intended for low level general purpose applications in thick and thin-film circuits.

QUICK REFERENCE DATA

			BCW29	BCW30	
D.C. current gain at T_j = 25 °C $-I_C$ = 2 mA; $-V_{CE}$ = 5 V	h_{FE}	> <	120 260	215 500	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	32		V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	32		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
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	>	100		MHz
Noise figure at R_S = 2 kΩ $-I_C$ = 200 μA; $-V_{CE}$ = 5 V; f = 1 kHz; B = 200 Hz	F	<	10		dB

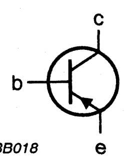
MECHANICAL DATA

Fig. 1 SOT-23.

Dimensions in mm

Marking code
BCW29 = C1p
BCW30 = C2p

Pinning:
1 = base
2 = emitter
3 = collector



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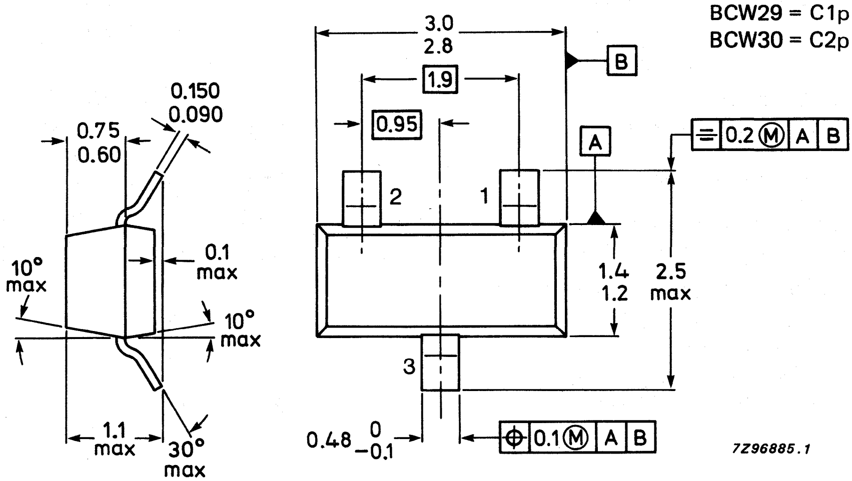


TOP VIEW

Reverse pinning types are available on request.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	32 V
Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	32 V
Collector-emitter voltage (open base) $-I_C$ = 2 mA	$-V_{CEO}$	max.	32 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; $-V_{CB}$ = 32 V	$-I_{CBO}$	<	100 nA
I_E = 0; $-V_{CB}$ = 32 V; T_j = 100 °C	$-I_{CBO}$	<	10 μA
Base-emitter voltage			
$-I_C$ = 2 mA; $-V_{CE}$ = 5 V	$-V_{BE}$		600 to 750 mV
Saturation voltages			
$-I_C$ = 10 mA; $-I_B$ = 0,5 mA	$-V_{CEsat}$	typ.	80 mV
		<	300 mV
	$-V_{BEsat}$	typ.	720 mV
$-I_C$ = 50 mA; $-I_B$ = 2,5 mA	$-V_{CEsat}$	typ.	150 mV
	$-V_{BEsat}$	typ.	810 mV

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

			BCW29	BCW30	
D.C. current gain					
$-I_C = 10\ \mu A$; $-V_{CE} = 5\ V$	h_{FE}	typ.	90	150	
$-I_C = 2\ mA$; $-V_{CE} = 5\ V$	h_{FE}	>	120	215	
		<	260	500	
Collector-capacitance at f = 1 MHz $I_E = I_e = 0$; $-V_{CB} = 10\ V$	C_c	typ.	4,5		pF
Transition frequency at f = 100 MHz $-I_C = 10\ mA$; $-V_{CE} = 5\ V$	f_T	>	100		MHz
Noise figure at $R_S = 2\ k\Omega$ $-I_C = 200\ \mu A$; $-V_{CE} = 5\ V$ f = 1 kHz; B = 200 Hz	F	<	10		dB

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in a microminiature plastic package. They are intended for low level general purpose applications in thick and thin-film circuits.

QUICK REFERENCE DATA

			BCW31	BCW32	BCW33	
D.C. current gain at $T_j = 25\ ^oC$ $I_C = 2$ mA; $V_{CE} = 5$ V	h_{FE}	> <	110 220	200 450	420 800	
Collector-base voltage (open emitter)	V_{CBO}	max.		32		V
Collector-emitter voltage (open base)	V_{CEO}	max.		32		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
Transition frequency at f = 100 MHz $I_C = 2$ mA; $V_{CE} = 5$ V	f_T	>		100		MHz
Noise figure at $R_S = 2$ kΩ $I_C = 200\ \mu A$; $V_{CE} = 5$ V; f = 1 kHz; B = 200 Hz	F	<		10		dB

MECHANICAL DATA

Dimensions in mm

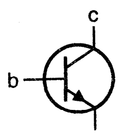
Fig. 1 SOT-23.

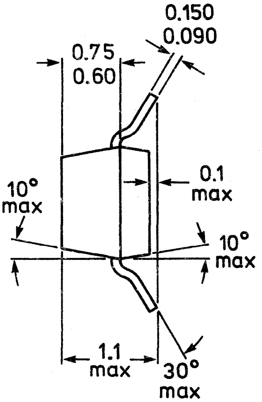
Pinning:

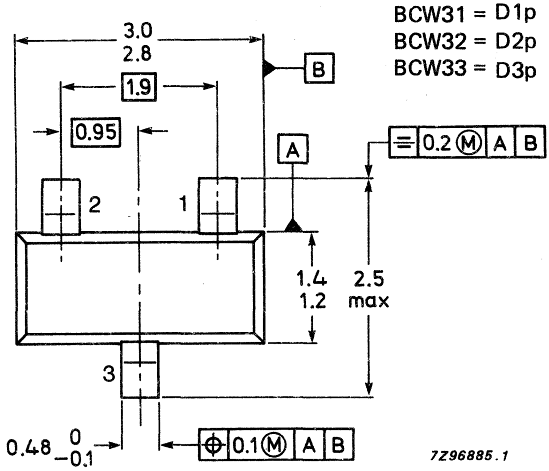
1 = base
2 = emitter
3 = collector

Marking code

BCW31 = D1p
BCW32 = D2p
BCW33 = D3p







Reverse pinning types are available on request.

TOP VIEW

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Collector-base voltage (open emitter)	V_{CBO}	max.	32 V
Collector-emitter voltage (open base) $I_C = 2$ mA	V_{CEO}	max.	32 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			
$I_E = 0$; $V_{CB} = 32$ V	I_{CBO}	<	100 nA
$I_E = 0$; $V_{CB} = 32$ V; $T_j = 100$ °C	I_{CBO}	<	10 μA
Base-emitter voltage			
$I_C = 2$ mA; $V_{CE} = 5$ V	V_{BE}		550 to 700 mV
Saturation voltages			
I_C 10 mA; $I_B = 0{,}5$ mA	V_{CEsat}	typ.	120 mV
		<	250 mV
	V_{BEsat}	typ.	750 mV
$I_C = 50$ mA; $I_B = 2{,}5$ mA	V_{CEsat}	typ.	210 mV
	V_{BEsat}	typ.	850 mV

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

			BCW31	BCW32	BCW33	
D.C. current gain						
$I_C = 10\ \mu A$, $V_{CE} = 5\ V$	h_{FE}	typ.	90	150	270	
$I_C = 2\ mA$; $V_{CE} = 5\ V$	h_{FE}	>	110	200	420	
		<	220	450	800	
Collector capacitance at f = 1 MHz $I_E = I_e = 0$; $V_{CB} = 10\ V$	C_c	typ.		2,5		pF
Transition frequency at f = 100 MHz $I_C = 10\ mA$; $V_{CE} = 5\ V$	f_T	>		100		MHz
Noise figure at $R_S = 2\ k\Omega$ $I_C = 200\ \mu A$; $V_{CE} = 5\ V$ f = 1 kHz; B = 200 Hz	F	<		10		dB

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N silicon transistors, in a microminiature plastic package, intended for low level, low noise, low frequency purpose applications in hybrid circuits.

QUICK REFERENCE DATA

Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	32	V
Collector-emitter voltage (open base)	V_{CEO}	max.	32	V
Collector current (d.c.)	I_C	max.	200	mA
Total power dissipation	P_{tot}	max.	250	mW
Junction temperature	T_j	max.	150	°C
Transition frequency at f = 100 MHz V_{CE} = 5 V; I_C = 10 mA	f_T	>	100	MHz
Noise figure at f = 1 kHz V_{CE} = 5 V; I_C = 200 μA; B = 200 Hz	F	typ.	2	dB

MECHANICAL DATA

Dimensions in mm

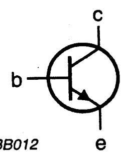
Fig. 1 SOT-23.

Marking code

BCW60A = AAp
BCW60B = ABp
BCW60C = ACp
BCW60D = ADp

Pinning:

1 = base
2 = emitter
3 = collector



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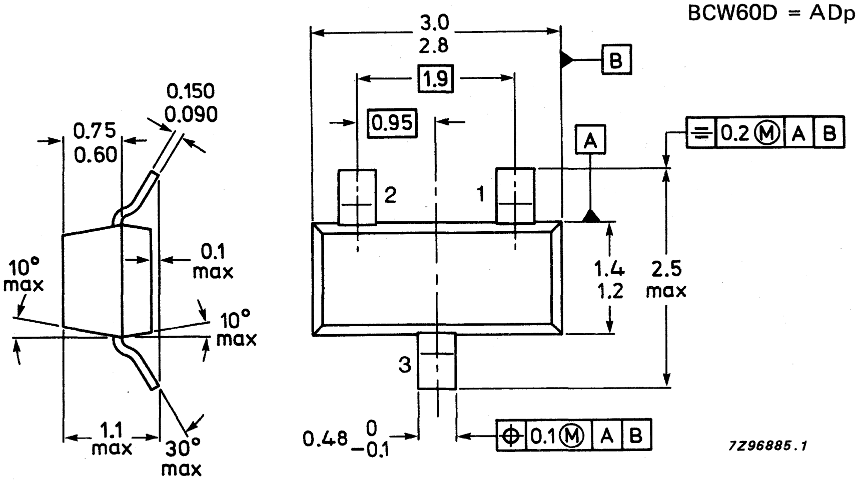

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TOP VIEW

RATINGS

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

Collector-emitter voltage ($V_{BE} = 0$)	V_{CES}	max.	32	V
Collector-emitter voltage (open base)	V_{CEO}	max.	32	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V
Collector current (d.c.)	I_C	max.	200	mA
Base current	I_B	max.	50	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	250	mW
Storage temperature	T_{stg}	− 65 to + 150		^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

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

CHARACTERISTICS

$T_{amb} = 25\ ^oC$ unless otherwise specified

Collector-emitter cut-off current				
$V_{BE} = 0$; $V_{CE} = 32$ V	I_{CES}	<	20	nA
$V_{BE} = 0$; $V_{CE} = 32$ V; $T_{amb} = 150\ ^oC$	I_{CES}	<	20	µA
Emitter-base cut-off current				
$I_C = 0$; $V_{EB} = 4$ V	I_{EBO}	<	20	nA
Saturation voltages				
at $I_C = 10$ mA; $I_B = 0{,}25$ mA	V_{CEsat}	0,05 to 0,35		V
	V_{BEsat}	0,6 to 0,85		V
at $I_C = 50$ mA; $I_B = 1{,}25$ mA	V_{CEsat}	0,1 to 0,55		V
	V_{BEsat}	0,7 to 1,05		V
Transition frequency at f = 100 MHz ▲		>	100	MHz
$I_C = 10$ mA; $V_{CE} = 5$ V	f_T	typ.	250	MHz
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	2,5	pF
Emitter capacitance at f = 1 MHz				
$I_C = I_c = 0$; $V_{EB} = 0{,}5$ V	C_e	typ.	8	pF
Noise figure at $R_S = 2\ k\Omega$		typ.	2	dB
$I_C = 200\ \mu A$; $V_{CE} = 5$ V; f = 1 kHz; B = 200 Hz	F	<	6	dB

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

▲ Measured under pulse conditions.

			BCW60A	60B	60C	60D	
D.C. current gain							
$V_{CE} = 5$ V; $I_C = 10\ \mu A$	h_{FE}	>	–	20	40	100	
$V_{CE} = 5$ V; $I_C = 2$ mA	h_{FE}	>	120	180	250	380	
		<	220	310	460	630	
$V_{CE} = 1$ V; $I_C = 50$ mA	h_{FE}	>	50	70	90	100	
Small-signal current gain							
$V_{CE} = 5$ V; $I_C = 2$ mA; f = 1 kHz	h_{fe}	typ.	200	260	330	520	
Base-emitter voltage							
$V_{CE} = 5$ V; $I_C = 2$ mA	V_{BE}		0,55 to 0,75				V
		typ.	0,65				V
$V_{CE} = 5$ V; $I_C = 10\ \mu A$	V_{BE}	typ.	0,52				V
$V_{CE} = 1$ V; $I_C = 50$ mA	V_{BE}	typ.	0,78				V

Switching times

$I_{Con} = 10$ mA; $I_{Bon} = -I_{Boff} = 1$ mA
$V_{CC} = 10$ V; $R_L = 990\ \Omega$

turn-on time ($t_d + t_r$)	t_{on}	typ.	85	ns
		<	150	ns
turn-off time ($t_s + t_f$)	t_{off}	typ.	480	ns
		<	800	ns

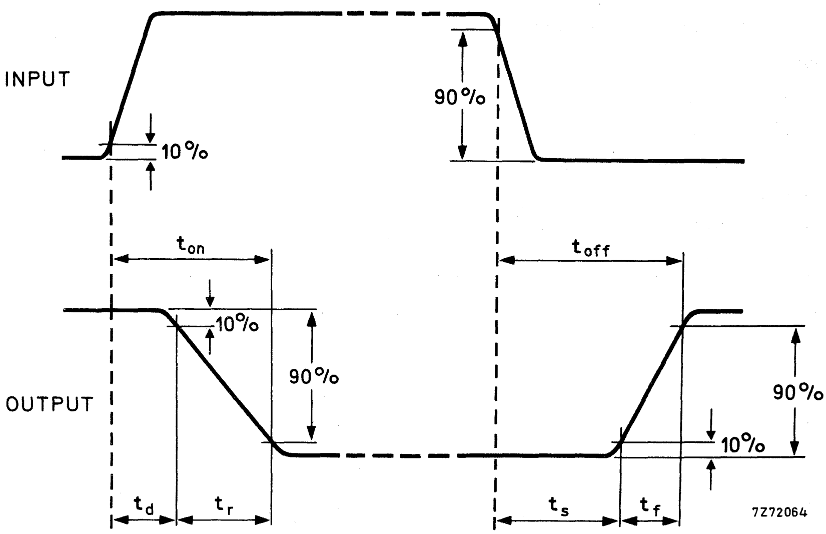


Fig. 2 Switching waveforms.

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P silicon transistors, in a microminiature plastic package, intended for low level, low noise, low frequency purpose applications in hybrid circuits.

QUICK REFERENCE DATA

Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	32	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	32	V
Collector current (d.c.)	$-I_C$	max.	200	mA
Total power dissipation	P_{tot}	max.	250	mW
Junction temperature	T_j	max.	150	°C
Transition frequency at f = 100 MHz $-V_{CE}$ = 5 V; $-I_C$ = 10 mA	f_T	>	100	MHz
Noise figure at f = 1 kHz $-V_{CE}$ = 5 V; $-I_C$ = 200 μA	F	typ.	2	dB

MECHANICAL DATA

Dimensions in mm

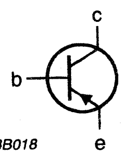
Fig. 1 SOT-23.

Marking code

BCW61A = BAp
BCW61B = BBp
BCW61C = BCp
BCW61D = BDp

Pinning:

1 = base
2 = emitter
3 = collector



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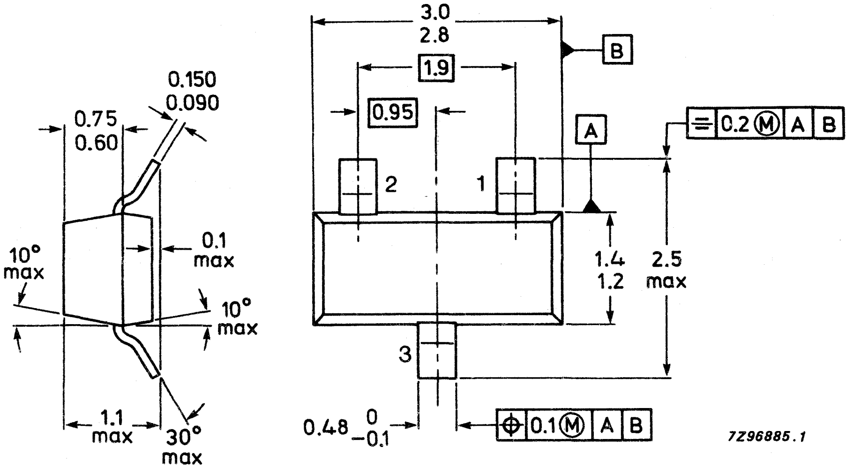


TOP VIEW

RATINGS

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

Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	32 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	32 V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5 V
Collector current (d.c.)	$-I_C$	max.	200 mA
Base current	$-I_B$	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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector-emitter cut-off current			
$V_{EB} = 0$; $-V_{CE} = 32$ V	$-I_{CES}$	<	20 nA
$V_{EB} = 0$; $-V_{CE} = 32$ V; $T_{amb} = 150$ °C	$-I_{CES}$	<	20 μA
Emitter-base cut-off current			
$I_C = 0$; $-V_{EB} = 4$ V	$-I_{EBO}$	<	20 nA
Saturation voltages			
$-I_C = 10$ mA; $-I_B = 0,25$ mA	$-V_{CEsat}$	0,06 to 0,25 V	
	$-V_{BEsat}$	0,6 to 0,85 V	
$-I_C = 50$ mA; $-I_B = 1,25$ mA	$-V_{CEsat}$	0,12 to 0,55 V	
	$-V_{BEsat}$	0,68 to 1,05 V	
Transition frequency at f = 100 MHz ▲			
$-V_{CE} = 5$ V; $-I_C = 10$ mA	f_T	>	100 MHz
Collector capacitance at f = 1 MHz			
$-V_{CB} = 10$ V; $I_E = I_e = 0$	C_c	typ.	4,5 pF
Emitter capacitance at f = 1 MHz			
$-V_{EB} = 0,5$ V; $I_C = I_c = 0$	C_e	typ.	11 pF
Noise figure at $R_S = 2$ kΩ			
$-V_{CE} = 5$ V; $-I_C = 200$ μA; B = 200 Hz	F	typ.	2 dB
		<	6 dB

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

▲ Measured under pulse conditions.

			BCW61A	61B	61C	61D	
D.C. current gain							
$-V_{CE} = 5$ V; $-I_C = 10\ \mu A$	h_{FE}	>	–	30	40	100	
$-V_{CE} = 5$ V; $-I_C = 2$ mA	h_{FE}	>	120	180	250	380	
		<	220	310	460	630	
$-V_{CE} = 1$ V; $-I_C = 50$ mA	h_{FE}	>	60	80	100	110	
Small-signal current gain							
$-V_{CE} = 5$ V; $-I_C = 2$ mA; f = 1 kHz	h_{fe}	typ.	200	260	330	520	
Base-emitter voltage							
$-V_{CE} = 5$ V; $-I_C = 2$ mA	V_{BE}		0,6 to 0,75				V
		typ.	0,65				V
$-V_{CE} = 5$ V; $-I_C = 10\ \mu A$	V_{BE}	typ.	0,55				V
$-V_{CE} = 1$ V; $-I_C = 50$ mA	V_{BE}	typ.	0,72				V

Switching times

$-I_{Con} = 10$ mA; $-I_{Bon} = I_{Boff} = 1$ mA
$-V_{CC} = 10$ V; $R_L = 990\ \Omega$

turn-on time ($t_d + t_r$)	t_{on}	typ.	85	ns
		<	150	ns
turn-off time ($t_s + t_f$)	t_{off}	typ.	480	ns
		<	800	ns

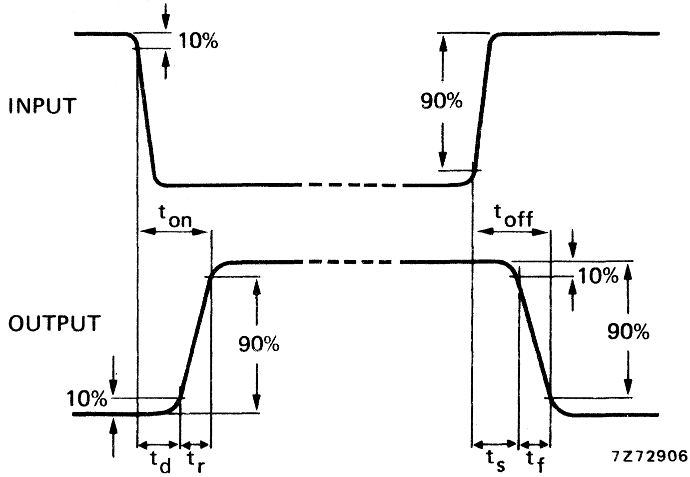


Fig. 2 Switching waveforms.

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors, in a microminiature plastic package, intended for low level general purpose applications in thick and thin-film circuits.

QUICK REFERENCE DATA

			BCW69	BCW70	
D.C. current gain at T_j = 25 °C $-I_C$ = 2 mA; $-V_{CE}$ = 5 V	h_{FE}	> <	120 260	215 500	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	50		V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45		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
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	>	100		MHz
Noise figure at R_S = 2 kΩ $-I_C$ = 200 μA; $-V_{CE}$ = 5 V; f = 1 kHz; B = 200 Hz	F	<	10		dB

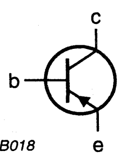
MECHANICAL DATA

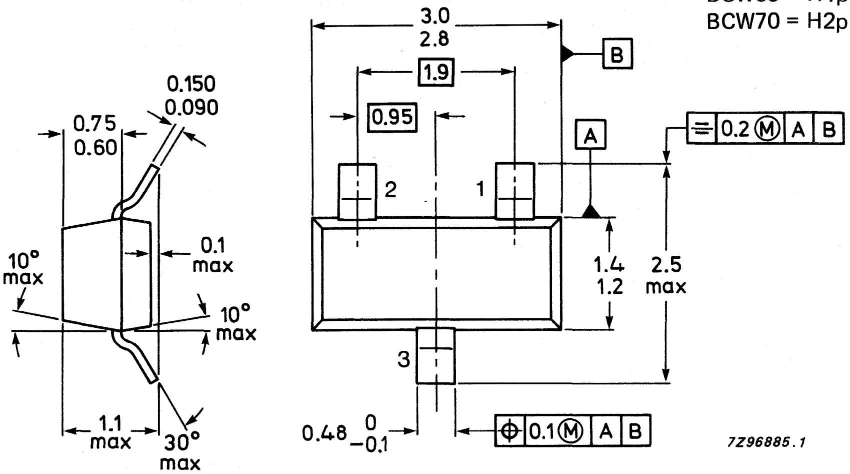
Dimensions in mm

Marking code
BCW69 = H1p
BCW70 = H2p

Fig. 1 SOT-23.

Pinning:
1 = base
2 = emitter
3 = collector





Reverse pinning types are available on request.

TOP VIEW

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	50 V
Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	50 V
Collector-emitter voltage (open base) $-I_C$ = 2 mA	$-V_{CEO}$	max.	45 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; $-V_{CB}$ = 20 V	$-I_{CBO}$	<	100 nA
I_E = 0; $-V_{CB}$ = 20 V; T_j = 100 °C	$-I_{CBO}$	<	10 μA
Base-emitter voltage $-I_C$ = 2 mA; $-V_{CE}$ = 5 V	$-V_{BE}$		600 to 750 mV
Saturation voltages	$-V_{CEsat}$	typ.	80 mV
		<	300 mV
$-I_C$ = 10 mA; $-I_B$ = 0,5 mA	$-V_{BEsat}$	typ.	720 mV
$-I_C$ = 50 mA; $-I_B$ = 2,5 mA	$-V_{CEsat}$	typ.	150 mV
	$-V_{BEsat}$	typ.	810 mV

			BCW69	BCW70
D.C. current gain $-I_C$ = 10 μA; $-V_{CE}$ = 5 V	h_{FE}	typ.	90	150
$-I_C$ = 2 mA; $-V_{CE}$ = 5 V	h_{FE}	>	120	215
		<	260	500

Collector capacitance at f = 1 MHz $I_E = I_e$ = 0; $-V_{CB}$ = 10 V	C_c	typ.	4,5	pF
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	>	100	MHz
Noise figure at R_S = 2 kΩ $-I_C$ = 200 μA; $-V_{CE}$ = 5 V f = 1 kHz; B = 200 Hz	F	<	10	dB

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors, in a microminiature plastic package, intended for low level general purpose applications in thick and thin-film circuits.

QUICK REFERENCE DATA

			BCW71	BCW72	
D.C. current gain at T_j = 25 °C I_C = 2 mA; V_{CE} = 5 V	h_{FE}	> <	110 220	200 450	
Collector-base voltage (open emitter)	V_{CBO}	max.	50		V
Collector-emitter voltage (open base)	V_{CEO}	max.	45		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
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 5 V	f_T	>	100		MHz
Noise figure at R_S = 2 kΩ I_C = 200 μA; V_{CE} = 5 V; f = 1 kHz; B = 200 Hz	F	<	10		dB

MECHANICAL DATA

Dimensions in mm

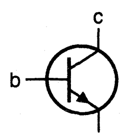
Marking code

BCW71 = K1p
BCW72 = K2p

Fig. 1 SOT-23.

Pinning:

1 = base
2 = emitter
3 = collector



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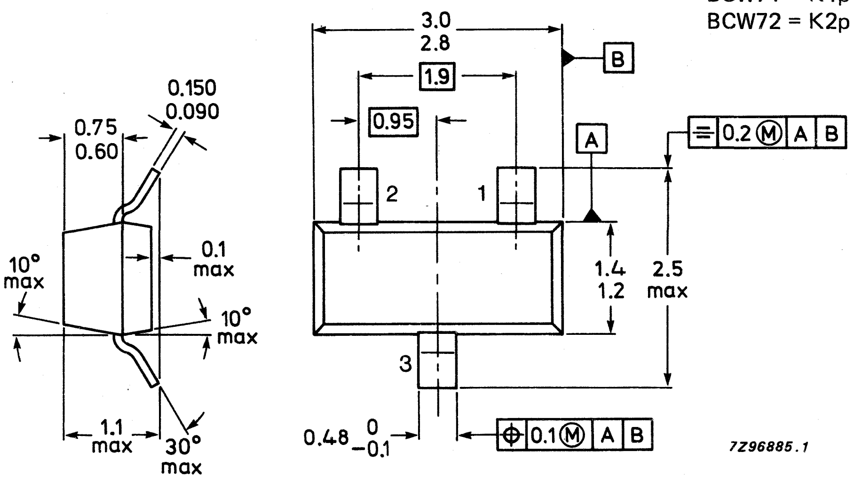

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Reverse pinning types are available on request.

TOP VIEW

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	50	V
Collector-emitter voltage (open base) $I_C = 2$ mA	V_{CEO}	max.	45	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 $T_{amb} = 25\ ^oC$	P_{tot}	max.	250	mW
Storage temperature	T_{stg}		−65 to +150	^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

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

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

Collector cut-off current				
$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	<	100	nA
$I_E = 0$; $V_{CB} = 20$ V; $T_j = 100\ ^oC$	I_{CBO}	<	10	μA
Base emitter voltage				
$I_C = 2$ mA; $V_{CE} = 5$ V	V_{BE}		550 to 700	mV
Saturation voltages				
$I_C = 10$ mA; $I_B = 0{,}5$ mA	V_{CEsat}	typ.	120	mV
		<	250	mV
	V_{BEsat}	typ.	750	mV
$I_C = 50$ mA; $I_B = 2{,}5$ mA	V_{CEsat}	typ.	210	mV
	V_{BEsat}	typ.	850	mV

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

			BCW71	BCW72	
D.C. current gain					
I_C = 10 μA; V_{CE} = 5 V	h_{FE}	typ.	90	150	
I_C = 2 mA; V_{CE} = 5 V	h_{FE}	>	110	200	
		<	220	450	
Collector capacitance at f = 1 MHz $I_E = I_e = 0$; V_{CB} = 10 V	C_c	typ.	2,5		pF
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 5 V	f_T	>	100		MHz
Noise figure at R_S = 2 kΩ I_C = 200 μA; V_{CE} = 5 V f = 1 kHz; B = 200 Hz	F	<	10		dB

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors, in a microminiature plastic package, intended for low level general purpose applications in thick and thin-film circuits.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	50 V
Collector-emitter voltage (open base)	V_{CEO}	max.	45 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 at T_j = 25 °C I_C = 2 mA; V_{CE} = 5 V	h_{FE}	> <	420 800
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 5 V	f_T	>	100 MHz
Noise figure at R_S = 2 kΩ I_C = 200 μA; V_{CE} = 5 V; f = 1 kHz; B = 200 Hz	F	<	10 dB

MECHANICAL DATA

Dimensions in mm

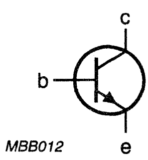
Fig. 1 SOT-23.

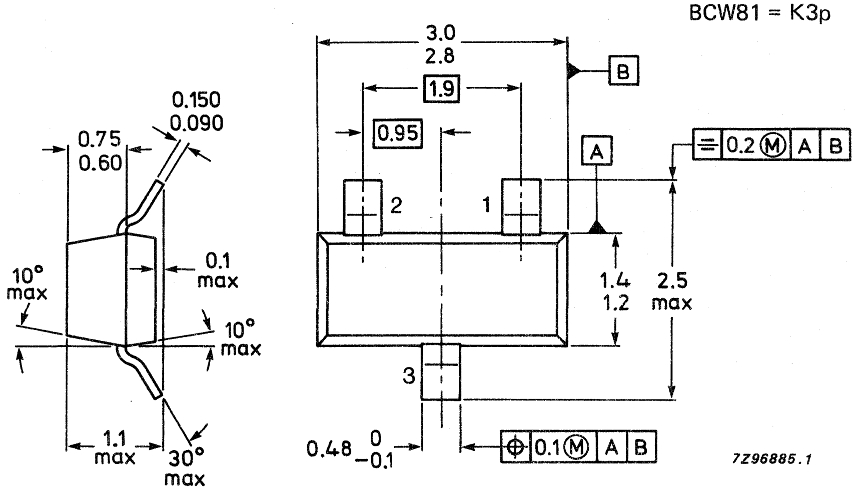
Marking code

BCW81 = K3p

Pinning:

1 = base
2 = emitter
3 = collector





TOP VIEW

Reverse pinning types are available on request.

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	50 V
Collector-emitter voltage (open base) $I_C = 2$ mA	V_{CEO}	max.	45 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 $T_{amb} = 25\ ^oC$	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 $I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	<	100 nA
$I_E = 0$; $V_{CB} = 20$ V; $T_j = 100\ ^oC$	I_{CBO}	<	10 μA
Base emitter voltage $I_C = 2$ mA; $V_{CE} = 5$ V	V_{BE}		550 to 700 mV
Saturation voltages $I_C = 10$ mA; $I_B = 0{,}5$ mA	V_{CEsat}	typ.	120 mV
		<	250 mV
	V_{BEsat}	typ.	750 mV
$I_C = 50$ mA; $I_B = 2{,}5$ mA	V_{CEsat}	typ.	210 mV
	V_{BEsat}	typ.	850 mV
D.C. current gain $I_C = 2$ mA; $V_{CE} = 5$ V	h_{FE}	>	420
		<	800
Collector capacitance at f = 1 MHz $I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	2,5 pF
Transition frequency at f = 100 MHz $I_C = 10$ mA; $V_{CE} = 5$ V	f_T	>	100 MHz
Noise figure at $R_S = 2\ k\Omega$ $I_C = 200\ \mu A$; $V_{CE} = 5$ V f = 1 kHz; B = 200 Hz	F	<	10 dB

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors, in a microminiature plastic package, intended for low level general purpose applications in thick and thin-film circuits.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	80	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	60	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 at T_j = 25 °C; $-I_C$ = 2 mA; $-V_{CE}$ = 5 V	h_{FE}	> / <	120 / 260	
Transition frequency at f = 100 MHz; $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	>	100	MHz
Noise figure at R_S = 2 kΩ; $-I_C$ = 200 μA; $-V_{CE}$ = 5 V; f = 1 kHz; B = 200 Hz	F	<	10	dB

MECHANICAL DATA

Dimensions in mm

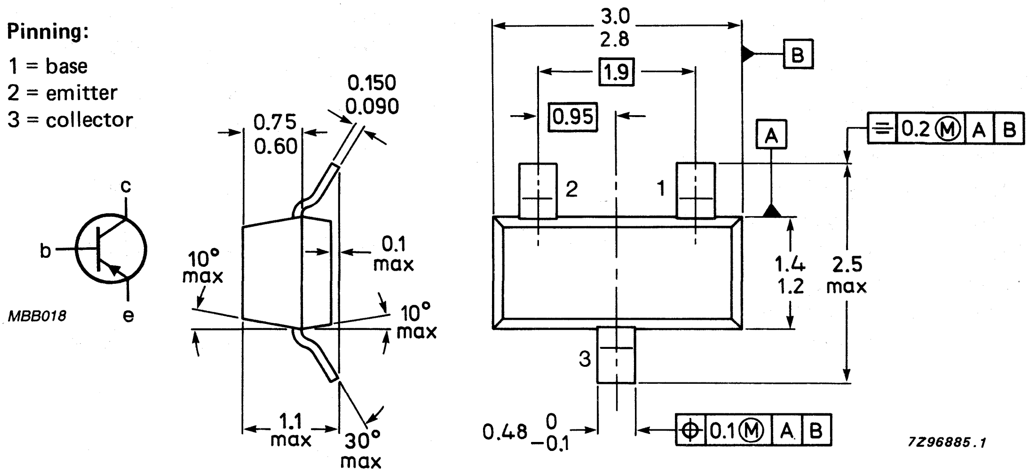
Marking code

BCW89 = H3p

Fig. 1 SOT-23.

Pinning:

1 = base
2 = emitter
3 = collector



TOP VIEW

Reverse pinning types are available on request.

RATINGS

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

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	80	V
Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	60	V
Collector-emitter voltage (open base) $-I_C$ = 2 mA	$-V_{CEO}$	max.	60	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				
$I_E = 0$; $-V_{CB}$ = 20 V	$-I_{CBO}$	<	100	nA
$I_E = 0$; $-V_{CB}$ = 20 V; T_j = 100 °C	$-I_{CBO}$	<	10	μA
Base-emitter voltage				
$-I_C$ = 2 mA; $-V_{CE}$ = 5 V; T_j = 25 °C	$-V_{BE}$	600 to 750		mV
Saturation voltages				
$-I_C$ = 10 mA; $-I_B$ = 0,5 mA	$-V_{CEsat}$	typ.	80	mV
		<	300	mV
	$-V_{BEsat}$	typ.	720	mV
$-I_C$ = 50 mA; $-I_B$ = 2,5 mA	$-V_{CEsat}$	typ.	150	mV
	$-V_{BEsat}$	typ.	810	mV
D.C. current gain				
$-I_C$ = 10 μA; $-V_{CE}$ = 5 V	h_{FE}	typ.	90	
$-I_C$ = 2 mA; $-V_{CE}$ = 5 V	h_{FE}	>	120	
		<	260	
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $-V_{CB}$ = 10 V	C_c	typ.	4,5	pF
Transition frequency at f = 35 MHz				
$-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	typ.	150	MHz
Noise figure at R_S = 2 kΩ				
$-I_C$ = 200 μA; $-V_{CE}$ = 5 V; f = 1 kHz; B = 200 Hz	F	<	10	dB

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors, in a SOT-23 plastic package, intended for application in thick and thin-film circuits. These transistors are intended for general purposes as well as saturated switching and driver applications for industrial service.
N-P-N complements are BCX19 and BCX20 respectively.

QUICK REFERENCE DATA

			BCX17	BCX18	
Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	50	30	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	25	V
Collector current (peak value)	$-I_{CM}$	max.	1000		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 $-I_C$ = 100 mA; $-V_{CE}$ = 1 V	h_{FE}		100 to 600		
Transition frequency $-I_C$ = 10 mA; $-V_{CE}$ = 5 V; f = 100 MHz	f_T	>	80		MHz

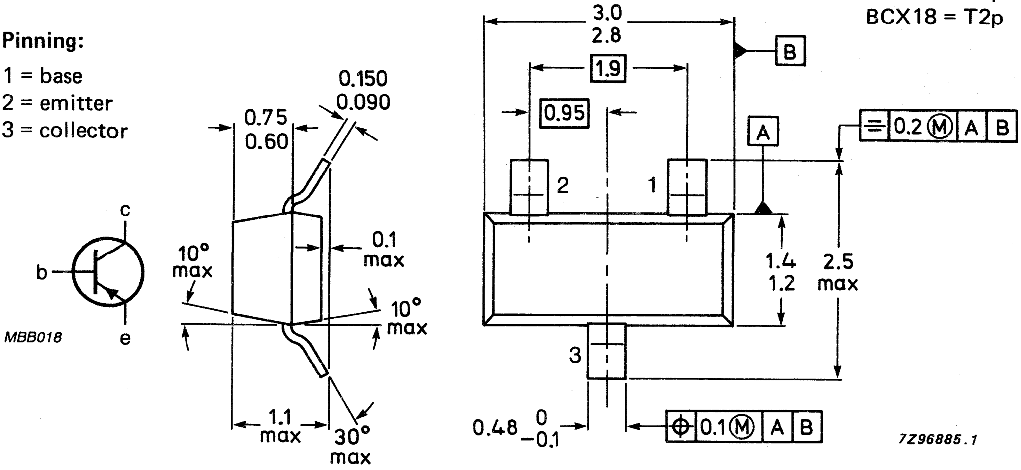
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-23.

Pinning:
1 = base
2 = emitter
3 = collector

Marking code
BCX17 = T1p
BCX18 = T2p



TOP VIEW

Reverse pinning types are available on request.

RATINGS

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

			BCX17	BCX18	
Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	50	30	V
Collector-emitter voltage $-I_C$ = 10 mA (see Fig. 2)	$-V_{CEO}$	max.	45	25	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	V
Collector current (d.c.)	$-I_C$	max.	500		mA
Collector current (peak value)	$-I_{CM}$	max.	1000		mA
Emitter current (peak value)	I_{EM}	max.	1000		mA
Base current (d.c.)	$-I_B$	max.	100		mA
Base current (peak value)	$-I_{BM}$	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				
$I_E = 0; -V_{CB} = 20$ V	$-I_{CBO}$	<	100	nA
$I_E = 0; -V_{CB} = 20$ V; T_j = 150 °C	$-I_{CBO}$	<	5	μA
Emitter cut-off current				
$I_C = 0; -V_{EB} = 5$ V	$-I_{EBO}$	<	10	μA
Base-emitter voltage ▲				
$-I_C = 500$ mA; $-V_{CE} = 1$ V	$-V_{BE}$	<	1,2	V
Saturation voltage				
$-I_C = 500$ mA; $-I_B = 50$ mA	$-V_{CEsat}$	<	620	mV

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.
▲ $-V_{BE}$ decreases by about 2 mV/°C with increasing temperature.

D.C. current gain					
$-I_C$ = 100 mA; $-V_{CE}$ = 1 V	BCX17-25	h_{FE}	>	160	
	BCX17/18	h_{FE}	100 to 600		
$-I_C$ = 300 mA; $-V_{CE}$ = 1 V		h_{FE}	>	70	
$-I_C$ = 500 mA; $-V_{CE}$ = 1 V		h_{FE}	>	40	
Transition frequency at f = 100 MHz					
$-I_C$ = 10 mA; $-V_{CE}$ = 5 V		f_T	typ.	80	MHz
Collector capacitance at f = 1 MHz					
$I_E = I_e = 0$; $-V_{CB}$ = 10 V		C_c	typ.	8	pF

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors, in a SOT-23 plastic package, intended for application in thick and thin-film circuits. These transistors are intended for general purposes as well as saturated switching and driver applications for industrial service.
P-N-P complements are BCX17 and BCX18 respectively.

QUICK REFERENCE DATA

			BCX19	BCX20	
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	50	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	25	V
Collector current (peak value)	I_{CM}	max.	1000		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 = 100 mA; V_{CE} = 1 V	h_{FE}		100 to 600		
Transition frequency I_C = 10 mA; V_{CE} = 5 V; f = 100 MHz	f_T	>	100		MHz

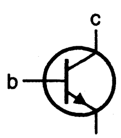
MECHANICAL DATA

Dimensions in mm

Marking code
BCX19 = U1p
BCX20 = U2p

Fig. 1 SOT-23.

Pinning:
1 = base
2 = emitter
3 = collector



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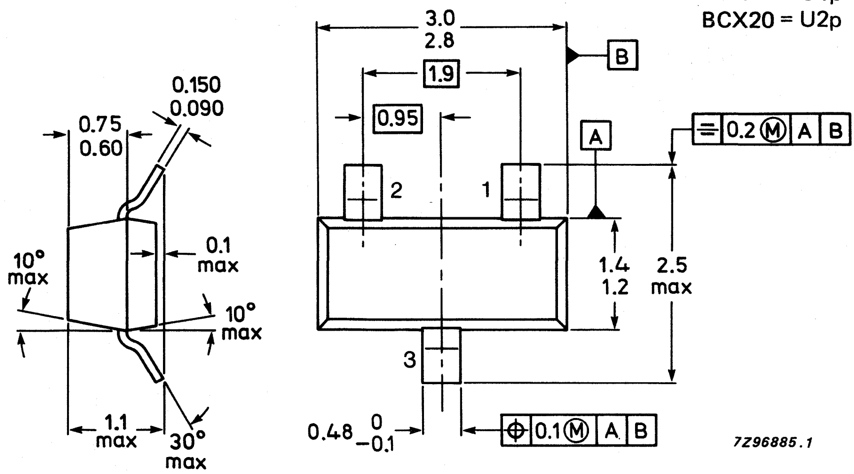

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TOP VIEW

Reverse pinning types are available on request.

RATINGS

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

			BCX19	BCX20	
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	50	30	V
Collector-emitter voltage (open base) I_C = 10 mA	V_{CEO}	max.	45	25	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	V

Collector current (d.c.)	I_C	max.	500	mA
Collector current (peak value)	I_{CM}	max.	1000	mA
Emitter current (peak value)	$-I_{EM}$	max.	1000	mA
Base current (d.c.)	I_B	max.	100	mA
Base current (peak value)	I_{BM}	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} = 20 V	I_{CBO}	<	100	nA
I_E = 0; V_{CB} = 20 V; T_j = 150 °C	I_{CBO}	<	5	μA
Emitter cut-off current				
I_C = 0; V_{EB} = 5 V	I_{EBO}	<	10	μA
Base emitter voltage ▲				
I_C = 500 mA; V_{CE} = 1 V	V_{BE}	<	1,2	V
Saturation voltage				
I_C = 500 mA; I_B = 50 mA	V_{CEsat}	<	620	mV

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

▲ V_{BE} decreases by about 2 mV/°C with increasing temperature.

D.C. current gain					
I_C = 100 mA; V_{CE} = 1 V	BCX19/20	h_{FE}	100 to 600		
	BCX19-25	h_{FE}	160 − 400		
	BCX19-40	h_{FE}	>	250	
I_C = 300 mA; V_{CE} = 1 V		h_{FE}	>	70	
I_C = 500 mA; V_{CE} = 1 V		h_{FE}	>	40	
Transition frequency at f = 100 MHz					
I_C = 10 mA; V_{CE} = 5 V		f_T	typ.	100	MHz
Collector capacitance at f = 1 MHz					
$I_E = I_e = 0$; V_{CB} = 10 V		C_c	typ.	5	pF

SILICON PLANAR EPITAXIAL TRANSISTORS

Medium power p-n-p transistors in a miniature plastic package intended for applications in thick and thin-film circuits. These transistors are intended for general purposes as well as for use in driver stages of audio amplifiers.

N-P-N complements are BCX54, BCX55 and BCX56 respectively.

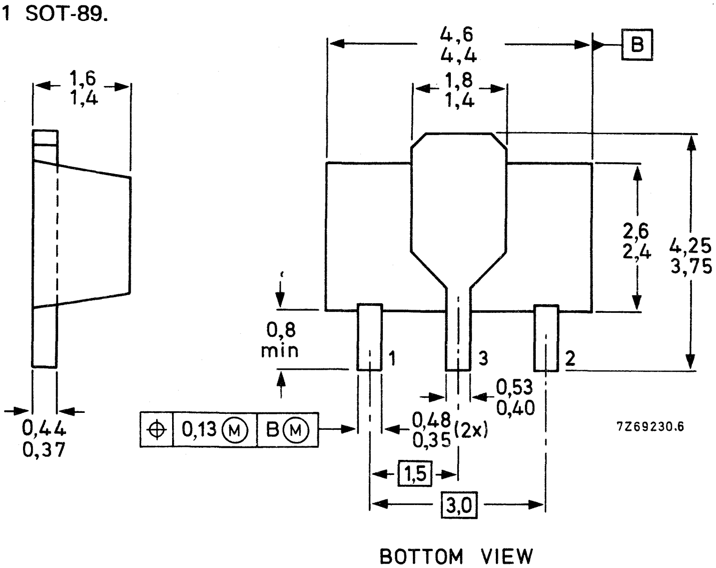
QUICK REFERENCE DATA

			BCX51	BCX52	BCX53	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	45	60	100	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	$-V_{CER}$	max.	45	60	100	V
Collector current (peak value)	$-I_{CM}$	max.		1,5		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 $-I_C$ = 150 mA; $-V_{CE}$ = 2 V	h_{FE}			40 to 250		
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	typ.		50		MHz

MECHANICAL DATA

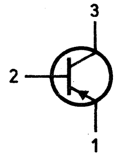
Dimensions in mm

Fig. 1 SOT-89.



Marking code

BCX51	=AA
BCX51-10	=AC
BCX51-16	=AD
BCX52	=AE
BCX52-10	=AG
BCX52-16	=AM
BCX53	=AH
BCX53-10	=AK
BCX53-16	=AL



RATINGS

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

			BCX51	BCX52	BCX53	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	45	60	100	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	$-V_{CER}$	max.	45	60	100	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	V
Collector current (d.c.)	$-I_C$	max.		1,0		A
Collector current (peak value)	$-I_{CM}$	max.		1,5		A
Base current (d.c.)	$-I_B$	max.		0,1		A
Base current (peak value)	$-I_{BM}$	max.		0,2		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.		1,0		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 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $-V_{CB}$ = 30 V	$-I_{CBO}$	<	100	nA
$I_E = 0$; $-V_{CB}$ = 30 V; T_j = 125 °C	$-I_{CBO}$	<	10	µA
Emitter cut-off current				
$I_C = 0$; $-V_{EB}$ = 5 V	$-I_{EBO}$	<	10	µA
Base-emitter voltage				
$-I_C$ = 500 mA; $-V_{CE}$ = 2 V	$-V_{BE}$	<	1	V
Saturation voltage				
$-I_C$ = 500 mA; $-I_B$ = 50 mA	$-V_{CEsat}$	<	0,5	V
D.C. current gain				
$-I_C$ = 5 mA; $-V_{CE}$ = 2 V	h_{FE}	>	25	
$-I_C$ = 150 mA; $-V_{CE}$ = 2 V	h_{FE}		40 to 250	
$-I_C$ = 500 mA; $-V_{CE}$ = 2 V	h_{FE}	>	25	
Transition frequency at f = 100 MHz				
$-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	typ.	50	MHz

CHARACTERISTICS (continued)

			BCX51-10 52-10 53-10	BCX51-16 52-16 53-16
D.C. current gain $-I_C = 150$ mA; $-V_{CE} = 2$ V	h_{FE}	$>$ $<$	63 160	100 250

SILICON PLANAR EPITAXIAL TRANSISTORS

Medium power n-p-n transistors in a miniature plastic package intended for applications in thick and thin-film circuits. These transistors are intended for general purposes as well as for use in driver stages of audio amplifiers.

P-N-P complements are BCX51, BCX52 and BCX53 respectively.

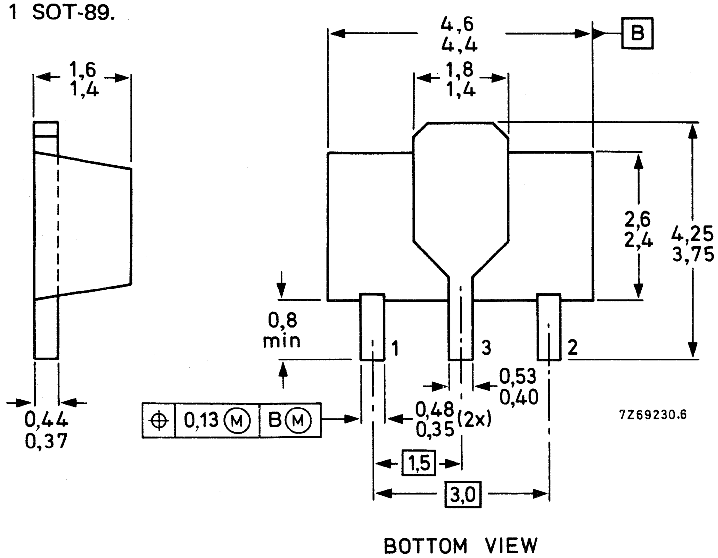
QUICK REFERENCE DATA

			BCX54	BCX55	BCX56	
Collector-base voltage (open emitter)	V_{CBO}	max.	45	60	100	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	V_{CER}	max.	45	60	100	V
Collector current (peak value)	I_{CM}	max.		1,5		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 I_C = 150 mA; V_{CE} = 2 V	h_{FE}			40 to 250		
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 5 V	f_T	typ.		130		MHz

MECHANICAL DATA

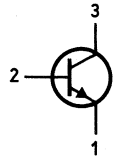
Dimensions in mm

Fig. 1 SOT-89.



Marking code

BCX54	= BA
BCX54-10	= BC
BCX54-16	= BD
BCX55	= BE
BCX55-10	= BG
BCX55-16	= BM
BCX56	= BH
BCX56-10	= BK
BCX56-16	= BL



RATINGS

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

			BCX54	BCX55	BCX56	
Collector-base voltage (open emitter)	V_{CBO}	max.	45	60	100	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	V_{CER}	max.	45	60	100	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	5	V
Collector current (d.c.)	I_C	max.		1,0		A
Collector current (peak value)	I_{CM}	max.		1,5		A
Base current (d.c.)	I_B	max.		0,1		A
Base current (peak value)	I_{BM}	max.		0,2		A
Total power dissipation up to T_{amb} = 25 °C mounted on a ceramic substrate area = 2,5 cm²; thickness = 0,7 mm	P_{tot}	max.		1,0		W
Storage temperature	T_{stg}			−65 to +150		°C
Junction temperature	T_j	max.		150		°C

THERMAL RESISTANCE

From junction to collector tab	$R_{th\ j\text{-}tab}$	=	10	K/W
From junction to ambient in free air mounted on a ceramic substrate area = 2,5 cm²; thickness = 0,7 mm	$R_{th\ j\text{-}a}$	=	125	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; V_{CB} = 30 V	I_{CBO}	<	100	nA
$I_E = 0$; V_{CB} = 30 V; T_j = 125 °C	I_{CBO}	<	10	μA
Emitter cut-off current				
$I_C = 0$; V_{EB} = 5 V	I_{EBO}	<	10	μA
Base-emitter voltage				
I_C = 500 mA; V_{CE} = 2 V	V_{BE}	<	1	V
Saturation voltage				
I_C = 500 mA; I_B = 50 mA	V_{CEsat}	<	0,5	V
D.C. current gain				
I_C = 5 mA; V_{CE} = 2 V	h_{FE}	>	25	
I_C = 150 mA; V_{CE} = 2 V	h_{FE}		40 to 250	
I_C = 500 mA; V_{CE} = 2 V	h_{FE}	>	25	
Transition frequency at f = 100 MHz				
I_C = 10 mA; V_{CE} = 5 V	f_T	typ.	130	MHz

CHARACTERISTICS (continued)

			BCX54-10 55-10 56-10	BCX54-16 55-16 56-16
D.C. current gain I_C = 150 mA; V_{CE} = 2 V	h_{FE}	>	63	100
		<	160	250

N-P-N SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N silicon planar epitaxial transistors in a plastic TO-92 package.

P-N-P complementary types are BCX78 and BCX79.

QUICK REFERENCE DATA

			BCX58	BCX59	
Collector-emitter voltage (open base)	V_{CEO}	max.	32	45	V
Collector-emitter voltage (emitter to base)	V_{CES}	max.	32	45	V
Emitter-base voltage (open collector)	V_{EBO}	max.	7		V
Collector current (peak)	I_{CM}	max.	200		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	450		mW
Junction temperature	T_j	max.	150		°C
Transition frequency at f = 100 MHz I_C = 10 mA, V_{CE} = 5 V	f_T	>	100		MHz

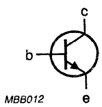
MECHANICAL DATA

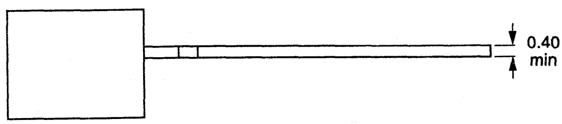
Dimensions in mm

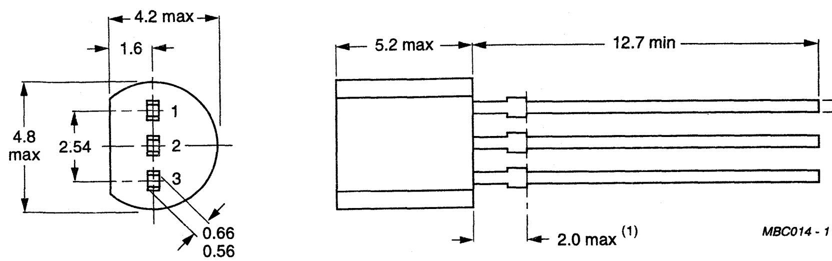
Fig. 1 TO-92.

Pinning

1 = emitter
2 = base
3 = collector







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			BCX58	BCX59	
Collector-emitter voltage (open base)	V_{CEO}	max.	32	45	V
Collector-emitter voltage (emitter to base)	V_{CES}	max.	32	45	V
Emitter-base voltage	V_{EBO}	max.	7		V
Collector current (d.c.)	I_C	max.	100		mA
Collector current (peak value)	I_{CM}	max.	200		mA
Base current (d.c.)	I_B	max.	50		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	450		mW
Junction temperature	T_j	max.	150		°C
Storage temperature	T_{stg}		−55 to +150		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	280	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BCX58	BCX59	
Collector-emitter current					
V_{CE} = 32 V	I_{CES}	<	10		nA
V_{CE} = 32 V; T_j = 125 °C	I_{CES}	<	2,5		μA
V_{CE} = 32 V; V_{BE} = 0,2 V; T_j = 100 °C	I_{CEX}	<	20		μA
Collector-emitter current					
V_{CE} = 45 V	I_{CES}	<		10	nA
V_{CE} = T_j = 125 °C	I_{CES}	<		2,5	μA
V_{CE} = 45 °C; V_{BE} = 0,2 V; T_j = 100 °C	I_{CEX}	<		20	μA
Emitter-base current					
V_{EBO} = 5 V	I_{EBO}	<	20	20	nA
Collector-emitter breakdown voltage					
I_C = 10 mA	$V_{(BR)CEO}$	>	32	45	V
Emitter-base breakdown voltage					
I_{EBO} = 1 μA	$V_{(BR)EBO}$	>	7		V
Collector-emitter saturation voltage					
I_C = 100 mA; I_B = 2,5 mA	V_{CEsat}	<	0,5		V
I_C = 100 mA; I_B = 2,5 mA	V_{BEsat}	<	1,0		V
Collector-base capacitance at 1 MHz					
V_{CBO} = 10 V	C_c	<	4,5		pF

			BCX58	BCX59	
Emitter-base capacitance at 1 MHz					
V_{EBO} = 0,5 V	C_e	<	15		pF
Transition frequency at f = 100 MHz					
I_C = 10 mA; V_{CE} = 5 V	f_T	<	100		MHz
Noise figure at f = 1 kHz					
I_C = 0,2 mA; V_{CE} = 5 V; R_S = 2 kΩ	F	<	6		dB
		typ.	2		dB

type		BCX58, BCX59				BCX58
h_{FE}	group	7	8	9	10	BCX59
V_{CE} (V)	I_C (mA)	h_{FE}	h_{FE}	h_{FE}	h_{FE}	V_{BE} (V)
5	0,01	78	145 (>20)	220 (>40)	300 (>100)	0,5
5	2	170	250	350	500	0,62
		(120 – 220)	(180 – 310)	(250 – 460)	(380 – 630)	(0,55 – 0,7)
1	10	190	260	380	550	0,7
		(>80)	(120 – 400)	(160 – 630)	(240 – 1000)	
1	100	>40	>45	>60	>60	0,83

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N silicon transistors, in a microminiature plastic package, intended for low level, low noise, low frequency purpose applications in hybrid circuits.

QUICK REFERENCE DATA

Collector-emitter voltage ($V_{BE} = 0$)	V_{CES}	max.	45	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	V
Collector current (d.c.)	I_C	max.	200	mA
Total power dissipation at $T_{amb} = 25\ ^oC$	P_{tot}	max.	250	mW
Junction temperature	T_j	max.	150	^oC
Transition frequency at f = 100 MHz $V_{CE} = 5$ V; $I_C = 10$ mA	f_T	>	100	MHz
Noise figure at f = 1 kHz $V_{CE} = 5$ V; $I_C = 200\ \mu A$; B = 200 Hz	F	typ.	2	dB

MECHANICAL DATA

Dimensions in mm

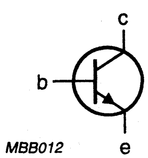
Fig. 1 SOT-23.

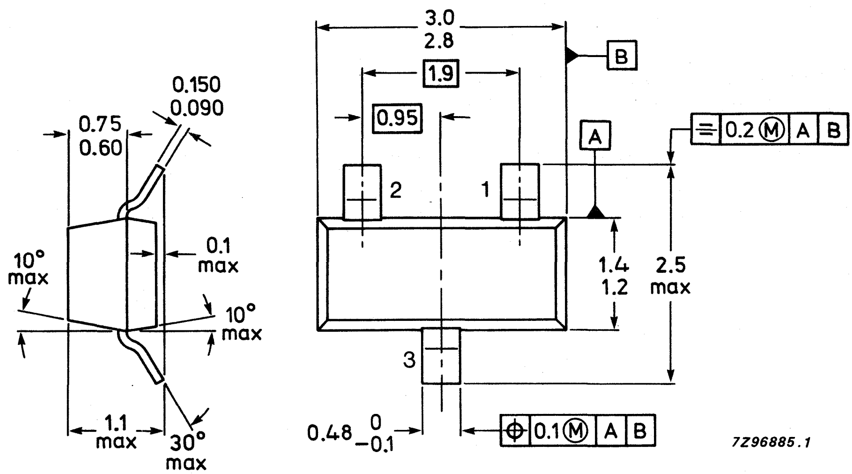
Marking code

BCX70G = AGp
BCX70H = AHp
BCX70J = AJp
BCX70K = AKp

Pinning:

1 = base
2 = emitter
3 = collector





TOP VIEW

RATINGS

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

Collector-emitter voltage ($V_{BE} = 0$)	V_{CES}	max.	45	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V
Collector current (d.c.)	I_C	max.	200	mA
Base current	I_B	max.	50	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	250	mW
Storage temperature	T_{stg}	−65 to + 150		^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

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

CHARACTERISTICS

$T_{amb} = 25\ ^oC$ unless otherwise specified

Collector-emitter cut-off current				
$V_{BE} = 0$; $V_{CE} = 45$ V	I_{CES}	<	20	nA
$V_{BE} = 0$; $V_{CE} = 45$ V; $T_{amb} = 150\ ^oC$	I_{CES}	<	20	μA
Emitter-base cut-off current				
$I_C = 0$; $V_{EB} = 4$ V	I_{EBO}	<	20	nA
Saturation voltages				
at $I_C = 10$ mA; $I_B = 0{,}25$ mA	V_{CEsat}	0,05 to 0,35		V
	V_{BEsat}	0,6 to 0,85		V
at $I_C = 50$ mA; $I_B = 1{,}25$ mA	V_{CEsat}	0,1 to 0,55		V
	V_{BEsat}	0,7 to 1,05		V
Transition frequency at f = 100 MHz▲				
$I_C = 10$ mA; $V_{CE} = 5$ V	f_T	>	100	MHz
		typ.	250	MHz
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	2,5	pF
Emitter capacitance at f = 1 MHz				
$I_C = I_c = 0$; $V_{EB} = 0{,}5$ V	C_e	typ.	8	pF
Noise figure at $R_S = 2$ kΩ				
$I_C = 200\ \mu$A; $V_{CE} = 5$ V; f = 1 kHz; B = 200 Hz	F	typ.	2	dB
		<	6	dB

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

▲ Measured under pulse conditions.

			BCX70G	70H	70J	70K	
D.C. current gain							
$V_{CE} = 5$ V; $I_C = 10$ μA	h_{FE}	>	–	40	30	100	
$V_{CE} = 5$ V; $I_C = 2$ mA	h_{FE}	>	120	250	180	380	
		<	220	460	310	630	
$V_{CE} = 1$ V; $I_C = 50$ mA	h_{FE}	>	50	70	90	100	
Small-signal current gain							
$V_{CE} = 5$ V; $I_C = 2$ mA; f = 1 kHz	h_{fe}	typ.	200	260	330	520	
Base-emitter voltage							
$V_{CE} = 5$ V; $I_C = 2$ mA	V_{BE}		0,55 to 0,75				V
		typ.	0,65				V
$V_{CE} = 5$ V; $I_C = 10$ μA	V_{BE}	typ.	0,52				V
$V_{CE} = 1$ V; $I_C = 50$ mA	V_{BE}	typ.	0,78				V

Switching times

I_{Con} = 10 mA; $I_{Bon} = -I_{Boff}$ = 1 mA
V_{CC} = 10 V; R_L = 990 Ω

turn-on time ($t_d + t_r$)	t_{on}	typ.	85	ns
		<	150	ns
turn-off time ($t_s + t_f$)	t_{off}	typ.	480	ns
		<	800	ns

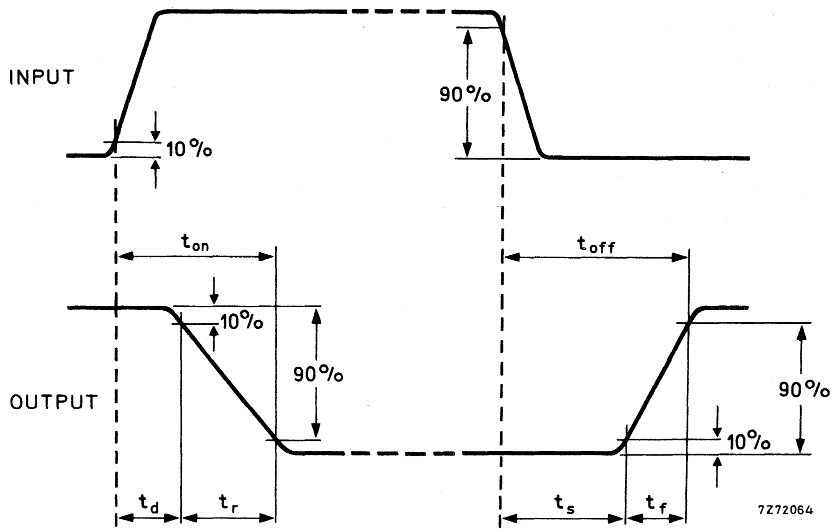


Fig. 2 Switching waveforms.

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P silicon transistors, in a microminiature plastic package, intended for low level, low noise, low frequency purpose applications in hybrid circuits.

QUICK REFERENCE DATA

Collector-emitter voltage ($V_{BE} = 0$)	$-V_{CES}$	max.	45	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	V
Collector current (d.c.)	$-I_C$	max.	200	mA
Total power dissipation	P_{tot}	max.	250	mW
Junction temperature	T_j	max.	150	°C
Transition frequency at f = 100 MHz $-V_{CE} = 5$ V; $-I_C = 10$ mA	f_T	>	100	MHz
Noise figure at f = 1 kHz $-V_{CE} = 5$ V; $-I_C = 200$ μA	F	typ.	2	dB

MECHANICAL DATA

Dimensions in mm

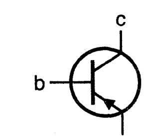
Fig. 1 SOT-23.

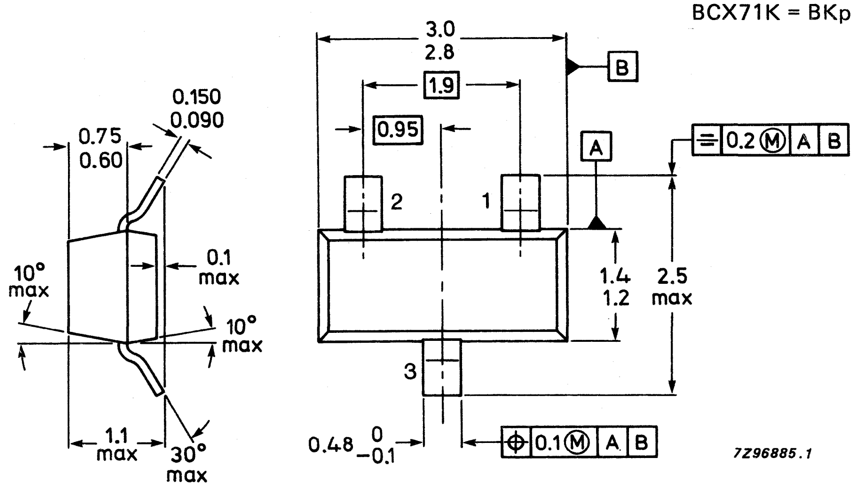
Marking code

BCX71G = BGp
BCX71H = BHp
BCX71J = BJp
BCX71K = BKp

Pinning:

1 = base
2 = emitter
3 = collector





TOP VIEW

RATINGS

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

Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	45	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	V
Collector current (d.c.)	$-I_C$	max.	200	mA
Base current	$-I_B$	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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector-emitter cut-off current				
$V_{EB} = 0; -V_{CE} = 45$ V	$-I_{CES}$	<	20	nA
$V_{EB} = 0; -V_{CE} = 45$ V; T_{amb} = 150 °C	$-I_{CES}$	<	20	μA
Emitter-base cut-off current				
$I_C = 0; -V_{EB} = 4$ V	$-I_{EBO}$	<	20	nA
Saturation voltages				
$-I_C = 10$ mA; $-I_B = 0,25$ mA	$-V_{CEsat}$	0,06 to 0,25		V
	$-V_{BEsat}$	0,6 to 0,85		V
$-I_C = 50$ mA; $-I_B = 1,25$ mA	$-V_{CEsat}$	0,12 to 0,55		V
	$-V_{BEsat}$	0,68 to 1,05		V
Transition frequency at f = 100 MHz▲				
$-V_{CE} = 5$ V; $-I_C = 10$ mA	f_T	>	100	MHz
Collector capacitance at f = 1 MHz				
$-V_{CB} = 10$ V; $I_E = I_e = 0$	C_c	typ.	4,5	pF
Emitter capacitance at f = 1 MHz				
$-V_{EB} = 0,5$ V; $I_C = I_c = 0$	C_e	typ.	11	pF
Noise figure at $R_S = 2$ kΩ				
$-V_{CE} = 5$ V; $-I_C = 200$ μA; B = 200 Hz	F	typ.	2	dB
		<	6	dB

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

▲ Measured under pulse conditions.

			BCX71G	71H	71J	71K	
D.C. current gain							
$-V_{CE} = 5$ V; $-I_C = 10\ \mu A$	h_{FE}	>	–	30	40	100	
$-V_{CE} = 5$ V; $-I_C = 2$ mA	h_{FE}	>	120	180	250	380	
		<	220	310	460	630	
$-V_{CE} = 1$ V; $-I_C = 50$ mA	h_{FE}	>	60	80	100	110	
Small-signal current gain							
$-V_{CE} = 5$ V; $-I_C = 2$ mA; f = 1 kHz	h_{fe}	typ.	200	260	330	520	
Base-emitter voltage							
$-V_{CE} = 5$ V; $-I_C = 2$ mA	V_{BE}		0,6 to 0,75				V
		typ.	0,65				V
$-V_{CE} = 5$ V; $-I_C = 10\ \mu A$	V_{BE}	typ.	0,55				V
$-V_{CE} = 1$ V; $-I_C = 50$ mA	V_{BE}	typ.	0,72				V

Switching times

$-I_{Con}$ = 10 mA; $-I_{Bon}$ = I_{Boff} = 1 mA
$-V_{CC}$ = 10 V; R_L = 990 Ω

turn-on time ($t_d + t_r$)	t_{on}	typ.	85	ns
		<	150	ns
turn-off time ($t_s + t_f$)	t_{off}	typ.	480	ns
		<	800	ns

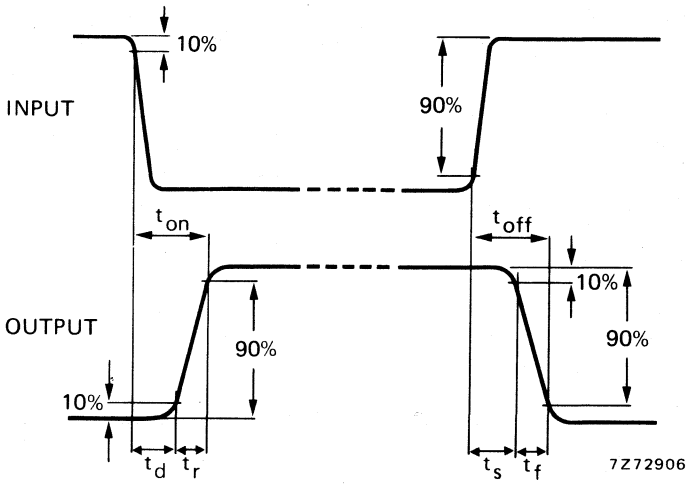


Fig. 2 Switching waveforms.

P-N-P SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P silicon planar epitaxial transistors in a plastic TO-92 package.
N-P-N complementary types are BCX58 and BCX59.

QUICK REFERENCE DATA

			BCX78	BCX79	
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	32	45	V
Collector-emitter voltage (emitter to base)	$-V_{CES}$	max.	32	45	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5		V
Collector current (peak)	$-I_{CM}$	max.	200		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	450		mW
Junction temperature	T_j	max.	150		°C
Transition frequency at f = 100 MHz I_C = 10 mA, V_{CE} = 5 V	f_T	>	200		MHz

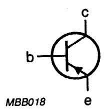
MECHANICAL DATA

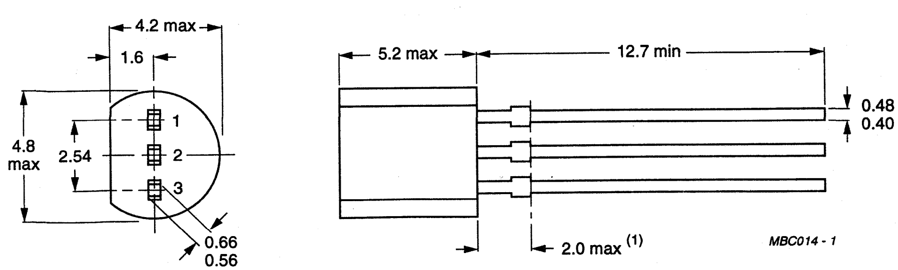
Dimensions in mm

Fig. 1 TO-92.

Pinning

1 = emitter
2 = base
3 = collector





Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			BCX78	BCX79	
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	32	45	V
Collector-emitter voltage (emitter to base)	$-V_{CES}$	max.	32	45	V
Emitter-base voltage	$-V_{EBO}$	max.	5		V
Collector current (d.c.)	$-I_C$	max.	100		mA
Collector current (peak value)	$-I_{CM}$	max.	200		mA
Base current (d.c.)	$-I_B$	max.	50		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	450		mW
Junction temperature	T_j	max.	150		°C
Storage temperature	T_{stg}		−55 to +150		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	max.	280	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BCX78	BCX79	
Collector-emitter current					
$-V_{CE}$ = 32 V	$-I_{CES}$	<	10		nA
$-V_{CE}$ = 32 V; T_j = 125 °C	$-I_{CES}$	<	2,5		μA
$-V_{CE}$ = 32 V; $-V_{BE}$ = 0,2 V; T_j = 100 °C	$-I_{CEX}$	<	20		μA
Collector-emitter current					
$-V_{CE}$ = 45 V	$-I_{CES}$	<		10	nA
$-V_{CE}$ = T_j = 125 °C	$-I_{CES}$	<		2,5	μA
$-V_{CE}$ = 45 °C; $-V_{BE}$ = 0,2 V; T_j = 100 °C	$-I_{CEX}$	<		20	μA
Emitter-base current					
$-V_{EBO}$ = 4 V	$-I_{EBO}$	<	20	20	nA
Collector-emitter breakdown voltage					
$-I_C$ = 10 mA	$-V_{(BR)CEO}$	>	32	45	V
Emitter-base breakdown voltage					
$-I_{EBO}$ = 1 μA	$-V_{(BR)EBO}$	>	5		V
Collector-emitter saturation voltage					
$-I_C$ = 100 mA; $-I_B$ = 2,5 mA	$-V_{CEsat}$	<	0,6		V
$-I_C$ = 100 mA; $-I_B$ = 2,5 mA	$-V_{BEsat}$	<	1,0		V
Collector-base capacitance at 1 MHz					
$-V_{CBO}$ = 10 V	C_c	<	4,5		pF
Emitter-base capacitance at 1 MHz					
$-V_{EBO}$ = 0,5 V	C_e	<	15		pF

			BCX78	BCX79	
Transition frequency at f = 100 MHz					
$-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	>	200		MHz
Noise figure at f = 1 kHz					
$-I_C$ = 0,2 mA; $-V_{CE}$ = 5 V; R_S = 2 kΩ	F	<	6		dB
		typ.	2		dB

type		BCX78, BCX79				BCX78
h_{FE} group		7	8	9	10	BCX79
$-V_{CE}$ (V)	$-I_C$ (mA)	h_{FE}	h_{FE}	h_{FE}	h_{FE}	$-V_{BE}$ (V)
5	0,01	140	200 (>30)	270 (>40)	340 (>100)	0,55
5	2	170	250	350	500	0,65
		(120 – 220)	(180 – 310)	(250 – 460)	(380 – 630)	(0,6 – 0,7)
1	10	180	260	360	500	0,68
		(>80)	(120 – 400)	(160 – 630)	(240 – 1000)	
1	100	>40	>45	>60	>60	0,76 (<0,9)

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in TO-18 metal package with the collector connected to the case.

They are intended for general purpose very high-gain low level and low-noise applications. Moreover, they are also suitable for low-speed switching applications.

QUICK REFERENCE DATA

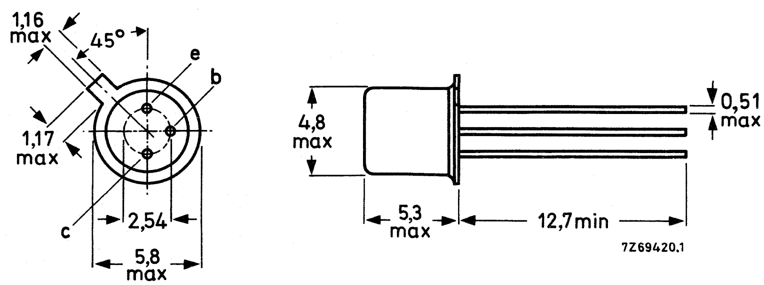
			BCY56	BCY57	
Collector-base voltage (open emitter)	V_{CBO}	max.	45	25	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	20	V
Collector current (d.c.)	I_C	max.	100	100	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	300	mW
Junction temperature	T_j	max.	175	175	°C
D.C. current gain at T_j = 25 °C					
I_C = 10 µA; V_{CE} = 5 V	h_{FE}	>	40	100	
I_C = 2 mA; V_{CE} = 5 V	h_{FE}	>	100	200	
		<	450	800	
Transition frequency at f = 100 MHz					
I_C = 0,5 mA; V_{CE} = 5 V	f_T	typ.	85	100	MHz
Noise figure at R_S = 2 kΩ					
I_C = 200 µA; V_{CE} = 5 V		typ.	1,5	1,5	dB
f = 30 Hz to 15,7 kHz	F	<	5,0	5,0	dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-18.

Collector connected to case



Accessories 56246 (distance disc).

RATINGS (Limiting values)*

			BCY56	BCY57	
Collector-base voltage (open emitter)	V_{CBO}	max.	45	25	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	20	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	V

Collector current (d.c.)	I_C	max.	100	mA
Collector current (peak value)	I_{CM}	max.	100	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.	175	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\,j\text{-}a}$	=	0,5	K/mW
From junction to case	$R_{th\,j\text{-}c}$	=	0,2	K/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current $I_E = 0$; V_{CB} = 20 V	I_{CBO}	<	100	nA
Emitter cut-off current $I_C = 0$; V_{EB} = 5 V	I_{EBO}	<	100	nA
Base-emitter voltage** I_C = 2 mA; V_{CE} = 5 V	V_{BE}	typ.	650 600 to 700	mV mV
Collector-emitter saturation voltage I_C = 10 mA; I_B = 1 mA	V_{CEsat}	typ.	80	mV
I_C = 100 mA; I_B = 10 mA	V_{CEsat}	typ.	200	mV

* Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

** V_{BE} decreases with about 2 mV/K at increasing temperature.

		BCY56	BCY57	
D.C. current gain				
$I_C = 10\ \mu A$; $V_{CE} = 5$ V	h_{FE}	> 40	100	
$I_C = 2$ mA; $V_{CE} = 5$ V	h_{FE}	typ. 200 100 to 450	400 200 to 800	
$I_C = 10$ mA; $V_{CE} = 5$ V	h_{FE}	> 100	200	
Transition frequency at f = 100 MHz				
$I_C = 0{,}5$ mA; $V_{CE} = 5$ V	f_T	typ. 85	100	MHz
$I_C = 10$ mA; $V_{CE} = 5$ V	f_T	> 100	100	MHz
h parameters at f = 1 kHz				
$I_C = 2$ mA; $V_{CE} = 5$ V				
Small signal current gain	h_{fe}	typ. 250 100 to 500	500 200 to 900	
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 5$ V	C_c	typ. 4,5	4,5	pF
Noise figure				
$I_C = 200\ \mu A$; $V_{CE} = 5$ V; $R_S = 2$ kΩ				
f = 30 Hz to 15,7 kHz	F	typ. 1,5 < 5	1,5 5	dB dB

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in TO-18 metal package with the collector connected to the case, for use in amplifier and switching applications.

QUICK REFERENCE DATA

			BCY58	BCY59	
Collector-emitter voltage (open base)	V_{CEO}	max.	32	45	V
Collector current (d.c.)	I_C	max.	200	200	mA
Total power dissipation					
up to T_{amb} = 45 °C	P_{tot}	max.	330	330	mW
up to T_{case} = 45 °C	P_{tot}	max.	1000	1000	mW
Junction temperature	T_j	max.	200	200	°C

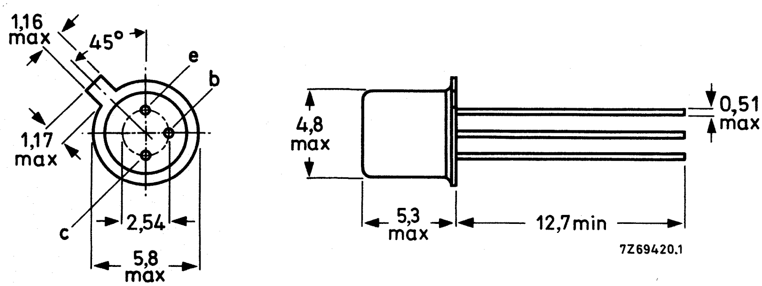
			BCY58–VII BCY59–VII	VIII VIII	IX IX	X X	
Small-signal current gain at T_j = 25 °C I_C = 2 mA; V_{CE} = 5 V; f = 1 kHz	h_{fe}	> <	120 250	175 350	250 500	350 700	
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 5 V	f_T	>	150				MHz
Noise figure at R_S = 2 kΩ I_C = 200 μA; V_{CE} = 5 V f = 1 kHz; B = 200 Hz	F	typ.	2				dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-18.

Collector connected to case



Accessories 56246 (distance disc).

RATINGS

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

			BCY58	BCY59	
Collector emitter voltage (V_{BE} = 0)	V_{CES}	max.	32	45	V
Collector-emitter voltage (open base)	V_{CEO}	max.	32	45	V
Emitter-base voltage (open collector)	V_{EBO}	max.	7	7	V

Collector current	I_C	max.	200	mA
Base current	I_B	max.	50	mA
Total power dissipation up to T_{case} = 45 °C	P_{tot}	max.	1000	mW
Storage temperature range	T_{stg}		−65 to + 150	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,45	K/mW
From junction to case	$R_{th\ j\text{-}c}$	=	0,15	K/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BCY58	BCY59	
Collector cut-off currents					
V_{CE} = 32 V; V_{BE} = 0	I_{CES}	<	10		nA
V_{CE} = 45 V; V_{BE} = 0	I_{CES}	<		10	nA
V_{CE} = 32 V; V_{BE} = 0; T_j = 150 °C	I_{CES}	<	10		μA
V_{CE} = 45 V; V_{BE} = 0; T_j = 150 °C	I_{CES}	<		10	μA
Emitter cut-off current					
I_C = 0; V_{EB} = 5 V	I_{EBO}	<	10	10	nA
Collector-emitter breakdown voltage					
I_B = 0; I_C = 2 mA	$V_{(BR)CEO}$	>	32	45	V
Emitter-base breakdown voltage					
I_C = 0; I_E = 1 μA	$V_{(BR)EBO}$	>	7	7	V

Base emitter voltage				
I_C = 10 μA; V_{CE} = 5 V	V_{BE}	typ.	0,5	V
I_C = 20 μA; V_{CE} = $V_{CEO\,max}$; T_j = 100 °C	V_{BE}	>	0,2	V
I_C = 2 mA; V_{CE} = 5 V	V_{BE}	typ.	0,62	V
			0,55 to 0,70	V
I_C = 10 mA; V_{CE} = 1 V	V_{BE}	typ.	0,70	V
I_C = 100 mA; V_{CE} = 1 V	V_{BE}	typ.	0,76	V
Saturation voltages				
I_C = 10 mA; I_B = 0,25 mA	V_{CEsat}	typ.	100	mV
			50 to 350	mV
	V_{BEsat}	typ.	700	mV
			600 to 850	mV
I_C = 100 mA; I_B = 2,5 mA	V_{CEsat}	typ.	250	mV
			150 to 700	mV
		typ.	875	mV
			750 to 1200	mV
Collector capacitance at f = 1 MHz				
I_E = I_e = 0; V_{CB} = 10 V	C_c	<	5,0	pF
Emitter capacitance at f = 1 MHz				
I_C = I_c = 0; V_{EB} = 0,5 V	C_e	<	15	pF
Transition frequency at f = 100 MHz				
I_C = 10 mA; V_{CE} = 5 V	f_T	>	150	MHz
Noise figure at R_S = 2 kΩ				
I_C = 200 μA; V_{CE} = 5 V				
f = 1 kHz; B = 200 Hz	F	typ.	2	dB
		<	6	dB

CHARACTERISTICS (continued)

			BCY58VII BCY59VII	BCY58VIII BCY59VIII	BCY58IX BCY59IX	BCY58X BCY59X
D.C. current gain						
$I_C = 10\ \mu A$; $V_{CE} = 5\ V$	h_{FE}	>	–	20	40	100
		typ.	20	95	190	300
$I_C = 2\ mA$; $V_{CE} = 5\ V$	h_{FE}	>	120	180	250	380
		typ.	170	250	350	500
		<	220	310	460	630
$I_C = 10\ mA$; $V_{CE} = 1\ V$	h_{FE}	>	80	120	160	240
		typ.	250	300	390	550
		<	–	400	630	1000
$I_C = 100\ mA$; $V_{CE} = 1\ V$	h_{FE}	>	40	45	60	60
h parameters at f = 1 kHz						
$I_C = 2\ mA$; $V_{CE} = 5\ V$						
Small signal current gain	h_{fe}	typ.	200	260	330	520

Switching times

I_C = 10 mA; I_B = 1 mA; $-I_{BM}$ = 1 mA
R1 = 5 kΩ; R_L = 990 Ω
V_{BB} = 3,6 V

delay time	t_d	typ.	35	ns
rise time	t_r	typ.	50	ns
turn on time	t_{on}	typ.	85	ns
		<	150	ns
storage time	t_s	typ.	400	ns
fall time	t_f	typ.	80	ns
turn off time	t_{off}	typ.	480	ns
		<	800	ns

I_C = 100 mA; I_B = 10 mA; $-I_{BM}$ = 10 mA
R1 = 500 Ω; R2 = 700 Ω; R_L = 98 Ω
V_{BB} = 5 V

delay time	t_d	typ.	5	ns
rise time	t_r	typ.	50	ns
turn on time	t_{on}	typ.	55	ns
		<	150	ns
storage time	t_s	typ.	250	ns
fall time	t_f	typ.	200	ns
turn off time	t_{off}	typ.	450	ns
		<	800	ns

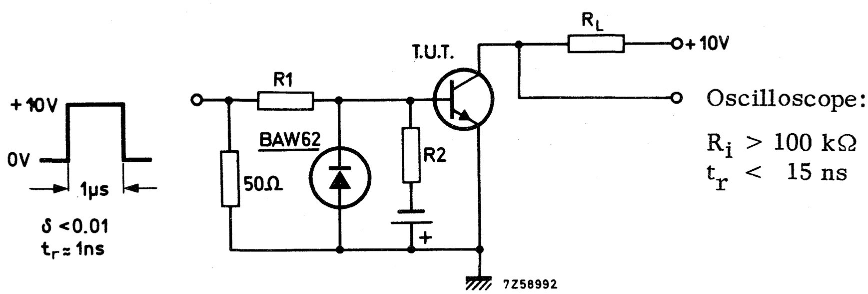


Fig. 2 Test circuit for switching times.

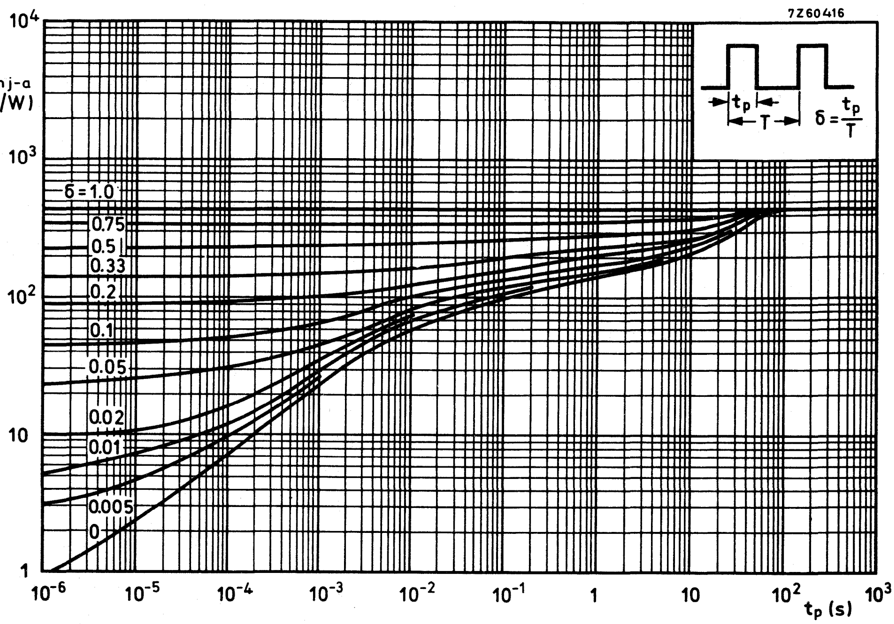

7Z60416
$Z_{th\,j-a}$ (K/W)
10^4
10^3
10^2
10
1
δ = 1.0
0.75
0.5
0.33
0.2
0.1
0.05
0.02
0.01
0.005
0
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3
t_p (s)
t_p
T
$\delta = \frac{t_p}{T}$

Fig. 3.

SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in TO-18 metal package with the collector connected to the case and designed for use in amplifier and switching applications.

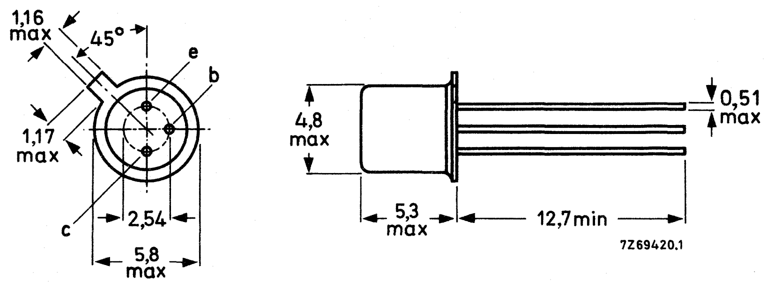
QUICK REFERENCE DATA

Collector-emitter voltage (open base)	V_{CEO}	max.	60			V
Collector current (d.c.)	I_C	max.	200			mA
Total power dissipation						
up to T_{case} = 45 °C	P_{tot}	max.	1000			mW
up to T_{amb} = 45 °C	P_{tot}	max.	330			mW
Junction temperature	T_j	max.	200			°C
			BCY65-VII	VIII	IX	
Small-signal current gain at f = 1 kHz		⩾	120	175	250	
I_C = 2 mA; V_{CE} = 5 V	h_{fe}	typ.	200	260	330	
		⩾	250	350	500	
Transition frequency at f = 100 MHz						
I_C = 10 mA; V_{CE} = 5 V	f_T	⩾	125			MHz
Noise figure at R_S = 2 kΩ						
I_C = 200 μA; V_{CE} = 5 V;						
f = 1 kHz; B = 200 Hz	F	⩽	6			dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-18.



Collector connected to case.

RATINGS (up to $T_{j\,max}$)

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

Collector-emitter voltage				
$V_{BE} = 0$	V_{CES}	max.	60	V
open base	V_{CEO}	max.	60	V
Emitter-base voltage (open collector)	V_{EBO}	max.	7	V
Collector current (d.c.)	I_C	max.	200	mA
Base current (d.c.)	I_B	max.	50	mA
Total power dissipation				
up to $T_{case} = 45\ ^oC$	P_{tot}	max.	1000	mW
up to $T_{amb} = 45\ ^oC$	P_{tot}	max.	330	mW
Junction temperature	T_j	max.	200	^oC
Storage temperature range	T_{stg}		−65 to + 150	^oC

THERMAL RESISTANCE

From junction to ambient	$R_{th\,j\text{-}a}$	max.	0,45	K/W
From junction to case	$R_{th\,j\text{-}c}$	max.	0,15	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless indicated otherwise

Collector cut-off currents			
V_{CE} = 60 V; V_{BE} = 0	I_{CES}	⩽	10 nA
V_{CE} = 60 V; V_{BE} = 0; T_{amb} = 150 °C	I_{CES}	⩽	10 μA
V_{CE} = 60 V; V_{BE} = 0,2 V; T_{amb} = 100 °C	I_{CEX}	⩽	20 μA
Emitter cut-off current			
V_{EB} = 5 V; I_C = 0	I_{BEO}	⩽	10 nA
Collector-emitter breakdown voltage			
I_B = 0; I_C = 2 mA	$V_{(BR)CEO}$	⩾	60 V
Emitter-base breakdown voltage			
I_C = 0; I_E = 1 μA	$V_{(BR)EBO}$	⩾	7 V
Base-emitter voltage			
V_{CE} = 5 V; I_C = 10 μA	V_{BE}	typ.	500 mV
V_{CE} = 5 V; I_C = 2 mA			550 to 700 mV
V_{CE} = 1 V; I_C = 10 mA	V_{BE}	typ.	700 mV
V_{CE} = 1 V; I_C = 50 mA		typ.	760 mV
Saturation voltages			
I_C = 10 mA; I_B = 0,25 mA	V_{CEsat}	⩽	350 mV
	V_{BEsat}		600 to 850 mV
I_C = 50 mA; I_B = 1,25 mA	V_{CEsat}	⩽	700 mV
	V_{BEsat}	⩽	1200 mV
Transition frequency at f = 100 MHz			
I_C = 10 mA; V_{CE} = 5 V	f_T	⩾	125 MHz
Noise figure at R_S = 2 kΩ			
I_C = 200 μA; V_{CE} = 5 V; f = 1 kHz; B = 200 Hz	F	⩽	6 dB
Collector capacitance at f = 1 MHz			
V_{CB} = 10 V; I_E = 0	C_c	⩽	6 pF
Emitter capacitance at f = 1 MHz			
V_{EB} = 0,5 V; I_C = 0	C_e	⩽	15 pF

			BCY65-VII	BCY65-VIII	BCY65-IX
D.C. current gain					
V_{CE} = 5 V; I_C = 10 μA	h_{FE}	⩾	–	20	40
		typ.	20	95	190
V_{CE} = 5 V; I_C = 2 mA	h_{FE}	⩾	120	180	250
		typ.	170	250	350
		⩽	220	310	460
V_{CE} = 1 V; I_C = 10 mA	h_{FE}	⩾	80	120	160
		typ.	250	300	390
		⩽	–	400	630
V_{CE} = 1 V; I_C = 50 mA	h_{FE}	⩾	40	45	60

			BCY65-VII	BCY65-VIII	BCY65-IX
h-parameters $f = 1$ kHz; $T_{amb} = 25\ ^{o}C$; $V_{CE} = 5$ V; $I_C = 2$ mA					
		⩾	120	175	250
small-signal current gain	h_{fe}	typ.	200	260	330
		⩽	250	350	500

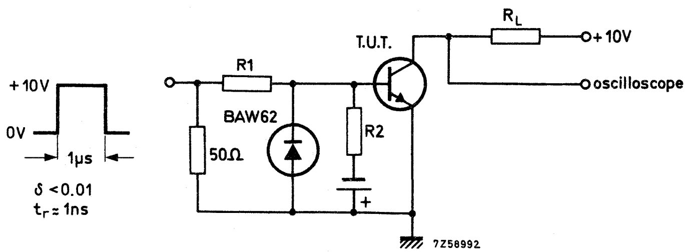
Switching times (see Fig. 2)

$I_C = 10$ mA; $I_B = -I_{BM} = 1$ mA
$R_1 = R_2 = 5\ k\Omega$; $R_L = 990\ \Omega$; $V_{BB} = 5$ V

delay time	t_d	typ.	35 ns
rise time	t_r	typ.	50 ns
turn-on time	t_{on}	typ.	85 ns
		⩽	150 ns
storage time	t_s	typ.	400 ns
fall time	t_f	typ.	80 ns
turn-off time	t_{off}	typ.	480 ns
		⩽	800 ns

$I_C = 50$ mA; $I_B = -I_{BM} = 5$ mA
$R_1 = 1\ k\Omega$; $R_2 = 1{,}3\ k\Omega$; $R_L = 195\ \Omega$; $V_{BB} = 4{,}7$ V

delay time	t_d	typ.	15 ns
rise time	t_r	typ.	50 ns
turn-on time	t_{on}	typ.	65 ns
		⩽	150 ns
storage time	t_s	typ.	300 ns
fall time	t_f	typ.	150 ns
turn-off time	t_{off}	typ.	450 ns
		⩽	800 ns



Oscilloscope:
$R_i > 100\ k\Omega$
$t_r < 15$ ns

Fig. 2 Test circuit.

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors in TO-18 metal packages intended for general purpose industrial applications. The BCY71 is a low noise version.

QUICK REFERENCE DATA

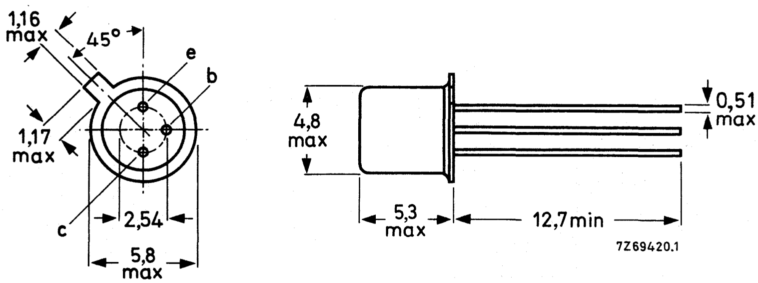
			BCY70	BCY71	BCY72	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	50	45	30	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40	45	25	V
Collector current (peak value)	$-I_{CM}$	max.		200		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		350		mW
Junction temperature	T_j	max.		200		°C
D.C. current gain $-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}	>		100		
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 20 V	f_T	>		250		MHz

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-18.

Collector connected to case.



Accessories: 56246 (distance disc).

RATINGS

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

			BCY70	BCY71	BCY72	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	50	45	30	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40	45	25	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5,0	5,0	5,0	V
Collector current (d.c.)	$-I_C$	max.		200		mA
Collector current (peak value)	$-I_{CM}$	max.		200		mA
Emitter current (peak value)	I_{EM}	max.		200		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		350		mW
Storage temperature range	T_{stg}			−65 to +150		°C
Junction temperature	T_j	max.		200		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	500	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	150	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BCY70	BCY71	BCY72	
Collector cut-off current						
$I_E = 0; -V_{CB} = -V_{CBOmax}$	$-I_{CBO}$	<	500	500	500	nA
$I_E = 0; -V_{CB} = 40$ V	$-I_{CBO}$	<	10	50	–	nA
$I_E = 0; -V_{CB} = 40$ V; $T_j = 100$ °C	$-I_{CBO}$	<	0,5	2,0	–	μA
$I_E = 0; -V_{CB} = 25$ V	$-I_{CBO}$	<	–	–	50	nA
$I_E = 0; -V_{CB} = 25$ V; $T_j = 100$ °C	$-I_{CBO}$	<	–	–	2,0	μA
$-V_{CE} = 50$ V; $-V_{EB} = 3,0$ V	$-I_{CEX}$	<	20	–	–	nA
Emitter cut-off current						
$I_C = 0; -V_{EB} = 4,0$ V	$-I_{EBO}$	<		10		nA
$I_C = 0; -V_{EB} = 4,0$ V; $T_j = 100$ °C	$-I_{EBO}$	<		2,0		μA
$I_C = 0; -V_{EB} = 5,0$ V	$-I_{EBO}$	<		500		nA
Saturation voltages						
$-I_C = 10$ mA; $-I_B = 10$ mA	$-V_{CEsat}$	<		250		mV
	$-V_{BEsat}$	<		600 to 900		mV
$-I_C = 50$ mA; $-I_B = 5,0$ mA	$-V_{CEsat}$	<		500		mV
	$-V_{BEsat}$	<		1200		mV
D.C. current gain						
$-I_C = 10$ μA; $-V_{CE} = 1,0$ V	h_{FE}	>		60		
$-I_C = 0,1$ mA; $-V_{CE} = 1,0$ V	h_{FE}	>		80		
$-I_C = 1,0$ mA; $-V_{CE} = 1,0$ V	h_{FE}	>		100		
$-I_C = 10$ mA; $-V_{CE} = 1,0$ V	h_{FE}	>		100		
$-I_C = 10$ mA; $-V_{CE} = 1,0$ V **BCY71**	h_{FE}	<		500		
$-I_C = 50$ mA; $-V_{CE} = 1,0$ V	h_{FE}	>		45		
Collector capacitance at f = 1 MHz						
$I_E = I_e = 0; -V_{CB} = 10$ V	C_c	<		6,0		pF
Emitter capacitance at f = 1 MHz						
$I_C = I_c = 0; -V_{EB} = 1,0$ V	C_e	<		8,0		pF
Transition frequency at T_{amb} = 25 °C						
$-I_C = 10$ mA; $-V_{CE} = 20$ V; f = 100 MHz	f_T	>	250	250	250	MHz
$-I_C = 100$ μA; $-V_{CE} = 20$ V; f = 10,7 MHz	f_T	>	–	15	–	MHz
Noise figure						
$-I_C = 100$ μA; $-V_{CE} = 5,0$ V; f = 10 Hz to 10 kHz; $R_S = 2,0$ kΩ	F	<	6,0	2,0	6,0	dB
h-parameters (common emitter)						
$-I_C = 10$ mA; $-V_{CE} = 10$ V; f = 1 kHz; T_{amb} = 25 °C						
Small-signal current gain	h_{fe}	typ.	–	325	–	

Switching times of the **BCY70** and **BCY72**

$-I_C = 10$ mA; $-I_{Bon} = +I_{Boff} = 1$ mA

delay time	t_d	<	35 ns
rise time	t_r	<	35 ns
turn-on time	t_{on}	<	65 ns
storage time	t_s	<	420 ns
fall time	t_f	<	80 ns
turn-off time	t_{off}	<	500 ns

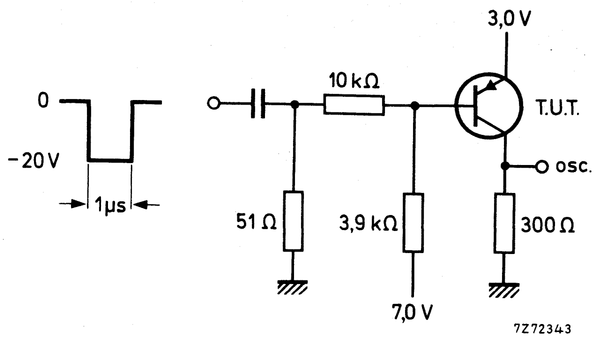


Fig. 2 Test circuit.

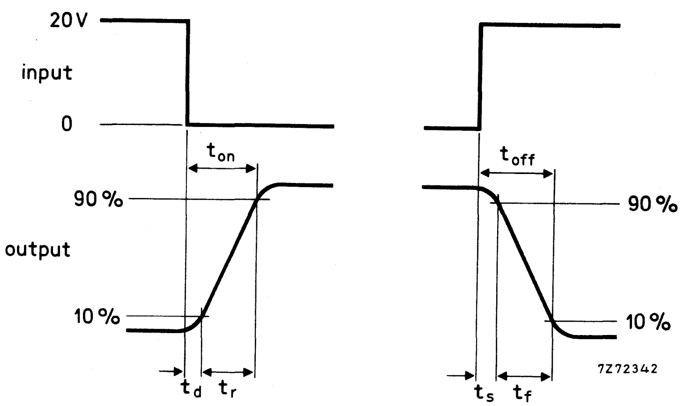


Fig. 3 Switching waveforms.

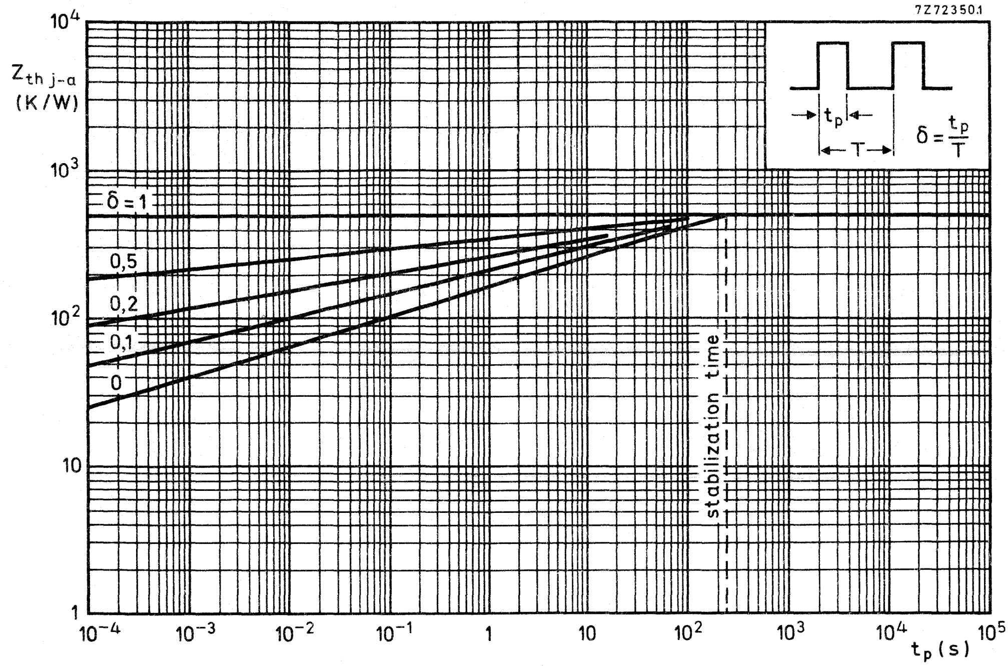

7Z72350.1
$Z_{th\ j-a}$ (K/W)
10^4
10^3
10^2
10
1
$\delta = 1$
0,5
0,2
0,1
0
t_p
T
$\delta = \frac{t_p}{T}$
stabilization time
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3
10^4
10^5
t_p (s)

Fig. 4.

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors in TO-18 metal packages, intended for use in amplifier and switching applications.

QUICK REFERENCE DATA

			BCY78	BCY79	
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	32	45	V
Collector current (d.c.)	$-I_C$	max.	200		mA
Total power dissipation					
up to T_{amb} = 45 °C	P_{tot}	max.	345		mW
up to T_{case} = 45 °C	P_{tot}	max.	1000		mW
Junction temperature	T_j	max.	200		°C

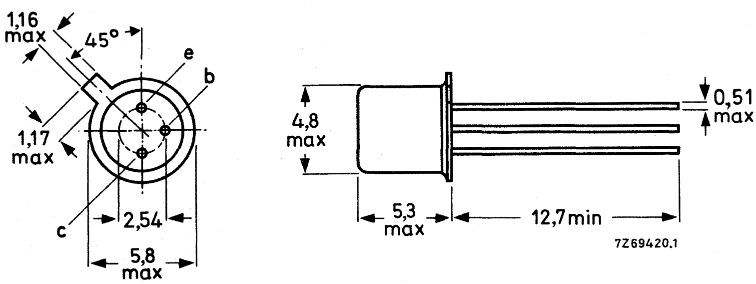
			BCY78–VII / BCY79–VII	VIII / VIII	IX / IX	X	
Small-signal current gain $-I_C$ = 2 mA; $-V_{CE}$ = 5 V	h_{fe}	>	120	175	250	350	
		<	250	350	500	700	
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	>	100				MHz
Noise figure at R_S = 2 kΩ $-I_C$ = 200 μA; $-V_{CE}$ = 5 V f = 1 kHz; B = 200 Hz	F	typ.	2				dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-18.

Collector connected to case



Accessories: 56246 (distance disc).

RATINGS

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

			BCY78	BCY79	
Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	32	45	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	32	45	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	V

Collector current (d.c.)	$-I_C$	max.	200	mA
Base current (d.c.)	$-I_B$	max.	20	mA
Total power dissipation				
up to T_{amb} = 45 °C	P_{tot}	max.	345	mW
up to T_{case} = 45 °C	P_{tot}	max.	1000	mW
Storage temperature range	T_{stg}		−65 to 150	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\,j\text{-}a}$	=	0,45	K/mW
From junction to case	$R_{th\,j\text{-}c}$	=	0,15	K/mW

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			BCY78	BCY79	
Collector cut-off currents					
$V_{BE} = 0; -V_{CE} = 25$ V	$-I_{CES}$	typ.	2	–	nA
		<	20	–	nA
$V_{BE} = 0; -V_{CE} = 35$ V	$-I_{CES}$	typ.	–	2	nA
		<	–	20	nA
$V_{BE} = 0; -V_{CE} = 25$ V; $T_{amb} = 150$ °C	$-I_{CES}$	<	10	–	μA
$V_{BE} = 0; -V_{CE} = 35$ V; $T_{amb} = 150$ °C	$-I_{CES}$	<	–	10	μA
$V_{BE} = 0; -V_{CE} = -V_{CEO\,max}$	$-I_{CES}$	<	100	100	nA
$-V_{EB} = 0{,}2$ V; $-V_{CE} = -V_{CEO\,max}$; $T_{amb} = 100$ °C	$-I_{CEX}$	<	20	20	μA
Emitter cut-off current					
$I_C = 0; -V_{EB} = 4$ V	$-I_{EBO}$	<	20	20	nA
Collector-emitter breakdown voltage					
$V_{BE} = 0; -I_C = 10$ μA	$-V_{(BR)CES}$	>	32	45	V
$I_B = 0; -I_C = 2$ mA	$-V_{(BR)CEO}$	>	32	45	V
Emitter-base breakdown voltage					
$I_C = 0; -I_E = 1$ μA	$-V_{(BR)EBO}$	>	5		V
Base-emitter voltage					
$-I_C = 10$ μA; $-V_{CE} = 5$ V	$-V_{BE}$	typ.	550		mV
$-I_C = 2$ mA; $-V_{CE} = 5$ V	$-V_{BE}$	typ.	650		mV
			600 to 750		mV
$-I_C = 10$ mA; $-V_{CE} = 1$ V	$-V_{BE}$	typ.	680		mV
$-I_C = 100$ mA; $-V_{CE} = 1$ V	$-V_{BE}$	typ.	750		mV
Saturation voltages					
$-I_C = 10$ mA; $-I_B = 250$ μA	$-V_{CEsat}$	typ.	120		mV
		<	250		mV
	$-V_{BEsat}$	typ.	700		mV
			600 to 850		mV
$-I_C = 100$ mA; $-I_B = 2{,}5$ mA	$-V_{CEsat}$	typ.	400		mV
		<	800		mV
	$-V_{BEsat}$	typ.	850		mV
			700 to 1200		mV
Transition frequency at f = 100 MHz					
$-I_C = 10$ mA; $-V_{CE} = 5$ V	f_T	>	100		MHz

Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $-V_{CB} = 10$ V	C_c	<	7,0	pF
Emitter capacitance at f = 1 MHz				
$I_C = I_c = 0$; $-V_{EB} = 0{,}5$ V	C_e	<	15	pF
Noise figure at $R_S = 2$ kΩ				
$-I_C = 200$ μA; $-V_{CE} = 5$ V				
f = 1 kHz; B = 200 Hz	F	typ.	2	dB
		<	6	dB

			BCY78-VII	VIII	IX	X
			BCY79-VII	VIII	IX	
D.C. current gain						
$-I_C = 10$ μA; $-V_{CE} = 5$ V	h_{FE}	>	–	30	40	100
		typ.	140	200	270	340
$-I_C = 2$ mA; $-V_{CE} = 5$ V	h_{FE}	>	120	180	250	380
		typ.	170	250	350	500
		<	220	310	460	630
$-I_C = 10$ mA; $-V_{CE} = 1$ V	h_{FE}	>	80	120	160	240
		typ.	180	260	360	500
		<	–	400	630	1000
$-I_C = 100$ mA; $-V_{CE} = 1$ V	h_{FE}	>	40	45	60	60
h-parameters at f = 1 kHz						
$-I_C = 2$ mA; $-V_{CE} = 5$ V						
Small-signal current gain	h_{fe}	typ.	200	260	330	520

Switching times

$-I_{C\,on} = 10$ mA; $-I_{B\,on} = I_{B\,off} = 1$ mA
R1 = R2 = 5 kΩ; $R_L = 990\ \Omega$
$V_B = 3{,}6$ V

delay time	t_d	typ.	35 ns
rise time	t_r	typ.	50 ns
turn-on time ($t_d + t_r$)	t_{on}	typ.	85 ns
		<	150 ns
storage time	t_s	typ.	400 ns
fall time	t_f	typ.	80 ns
turn-off time ($t_s + t_f$)	t_{off}	typ.	480 ns
		<	800 ns

$-I_{C\,on} = 100$ mA; $-I_{B\,on} = I_{B\,off} = 10$ mA
R1 = 500 Ω; R2 = 700 Ω; $R_L = 98\ \Omega$
$V_B = 5$ V

delay time	t_d	typ.	5 ns
rise time	t_r	typ.	50 ns
turn-on time ($t_d + t_r$)	t_{on}	typ.	55 ns
		<	150 ns
storage time	t_s	typ.	250 ns
fall time	t_f	typ.	200 ns
turn-off time ($t_s + t_f$)	t_{off}	typ.	450 ns
		<	800 ns

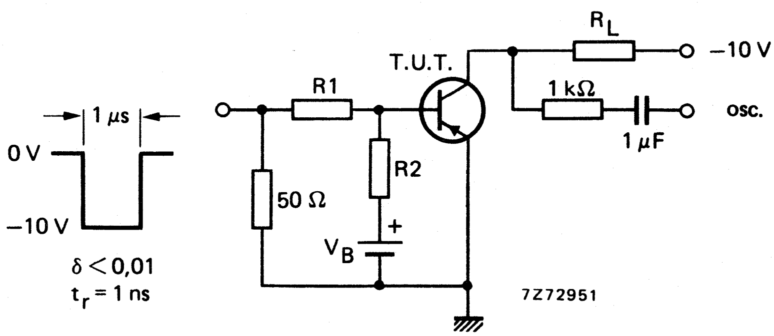


Fig. 2 Test circuit.

N-P-N SILICON PLANAR DUAL TRANSISTORS FOR DIFFERENTIAL AMPLIFIERS

Matched dual n-p-n transistors in a TO-71 metal package with all leads insulated from the case. They are primarily intended for differential amplifier applications in general industrial service; e.g. instrumentation and control.

Products are divided into three types according to their matching accuracy.
The BCY87 and BCY88 are intended for applications in pre-stages of differential amplifiers where low offset, drift and noise are of prime importance. The BCY89 is for second stages, long-tailed pairs and more general purposes.

QUICK REFERENCE DATA

Ratings

Collector-base voltage (open emitter)	V_{CBO}	max	45	V
Collector-emitter voltage (open base)	V_{CEO}	max	40	V
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max	150	mW
Junction temperature	T_j	max	175	°C

Characteristics of the complete device with collector-base voltage of 10 V and sum of emitter currents from 10 to 100 μA.

			BCY87	BCY88	BCY89	
Ratio of collector currents at $V_{1B-1E} = V_{2B-2E}$	I_{1C}/I_{2C}		0,9–1,11	0,8–1,25	0,67–1,5	
Base current difference at $V_{1B-1E} = V_{2B-2E}$	$\lvert I_{1B}-I_{2B} \rvert$	<	25	80	300	nA
Equivalent differential voltage change with temperature *	$\left\lvert \frac{\Delta V}{\Delta T} \right\rvert$	<	3	6	10	μV/K
Equivalent differential current change with temperature *	$\left\lvert \frac{\Delta I}{\Delta T} \right\rvert$	<	0,5	2	10	nA/K

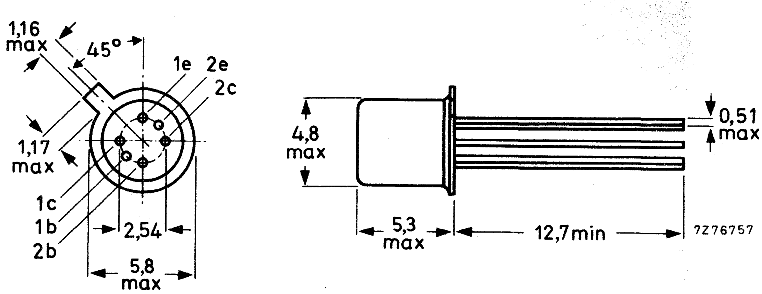
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-71.

All leads insulated from the case

Accessories:
56263 (cooling fin).



* T_{amb} = −20 °C to +90 °C.

RATINGS (see after Fig. 9)

CHARACTERISTICS of the individual transistors

T_{amb} = 25 °C unless otherwise specified

			BCY87	BCY88	BCY89	
Collector cut-off currents						
$I_E = 0$; $V_{CB} = 20$ V; $T_{amb} = 90$ °C	I_{CBO}	<	5	20	–	nA
$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	<	–	–	10	nA
D.C. current gain						
$I_C = 5\ \mu A$; $V_{CB} = 10$ V	h_{FE}	>	80	–	–	
$I_C = 50\ \mu A$; $V_{CB} = 10$ V	h_{FE}	>	100	100	100	
		<	450	450	450	
$I_C = 500\ \mu A$; $V_{CB} = 10$ V	h_{FE}	>	–	120	–	
		<	–	600	–	
$I_C = 10$ mA; $V_{CB} = 10$ V	h_{FE}	>	–	–	100	
		<	–	–	600	
Transition frequency at f = 100 MHz						
$-I_E = 50\ \mu A$; $V_{CB} = 10$ V	f_T	>	10	10	10	MHz
$-I_E = 500\ \mu A$; $V_{CB} = 10$ V	f_T	>	50	50	50	MHz
Collector capacitance at f = 1 MHz						
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	<	3,5	3,5	3,5	pF
Noise figures						
$I_C = 50\ \mu A$; $V_{CE} = 5$ V; $R_S = 10$ kΩ Bandwidth 10 Hz to 15 kHz	F	<	3	4	4	dB
1 kHz spot noise figure $I_C = 50\ \mu A$; $V_{CE} = 5$ V; R_S = opt. Bandwidth = 200 Hz	F	<	4	5	5	dB

CHARACTERISTICS of the complete device

These characteristics are valid under the following conditions:

a. Collector-base voltage of both transistors not exceeding 10 V ($V_{1C\text{-}1B} = V_{2C\text{-}2B} \leq 10$ V)

b. Sum of the emitter currents from 10 to 100 μA
$-(I_{1E} + I_{2E}) = 10$ to 100 μA

MATCHING CHARACTERISTICS

		BCY87	BCY88	BCY89	
Ratio of collector currents $V_{1B\text{-}1E} = V_{2B\text{-}2E}$	I_{1C}/I_{2C}	0,9-1,11	0,8-1,25	0,67-1,5	
Difference between base-emitter voltages $I_{1C} = I_{2C}$	$\lvert V_{1B\text{-}1E} - V_{2B\text{-}2E} \rvert$	< 3	6	10	mV
Difference between base currents $V_{1B\text{-}1E} = V_{2B\text{-}2E}$	$\lvert I_{1B} - I_{2B} \rvert$	< 25	80	300	nA
D.C. current gain ratio $I_{1C} = I_{2C}$	h_{1FE}/h_{2FE}	0,9-1,11	0,8-1,25	–	

Illustration of matching characteristics

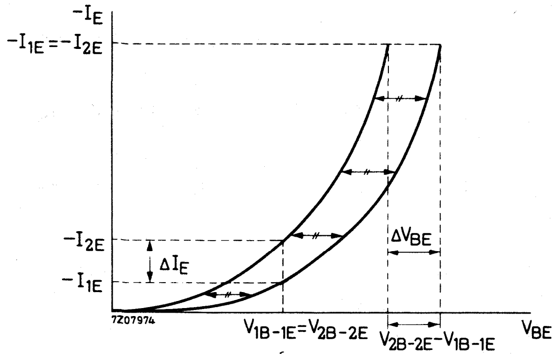


Fig. 2.

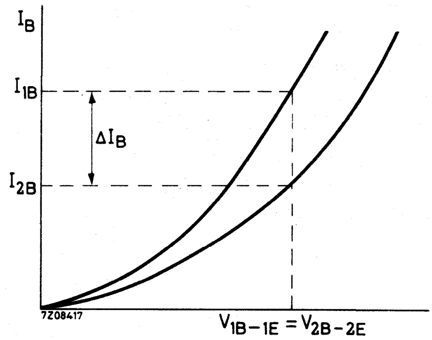


Fig. 3.

$$\frac{I_{2E}}{I_{1E}} = \exp.\frac{q}{KT} \cdot \Delta V_{BE}$$

$\frac{I_{2E}}{I_{1E}}$ measured at $\Delta V_{BE} = 0$

ΔV_{BE} measured at $\frac{I_{2E}}{I_{1E}} = 1$

CHARACTERISTICS of the complete device (continued)

Equivalent circuit for drift

In the equivalent circuit the transistors are considered to be drift free.

All temperature coefficients are concentrated in the voltage source $\frac{\Delta V}{\Delta T}$ and in the current source $\frac{\Delta I}{\Delta T}$.

It should be noted that the differential current change given is only valid when the source resistances are almost equal; the differential voltage change only when the base-emitter voltages are almost equal.

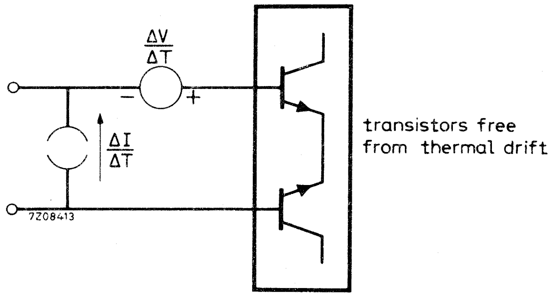


Fig. 4.

Block symbol of test amplifier

The test amplifier, used in the tests on page 5, is described on pages 6 and 7. It is represented by the following amplifier symbol:

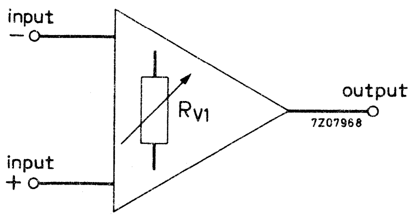


Fig. 5.

Equivalent differential voltage change with temperature

			BCY87	BCY88	BCY89	
T_{amb} = −20 to + 90 °C	$\left\|\frac{\Delta V}{\Delta T}\right\|$	typ.	1	2	4	μV/K
		<	3	6	10	μV/K

Equivalent differential current change with temperature

			BCY87	BCY88	BCY89	
T_{amb} = −20 to + 90 °C	$\left\|\frac{\Delta I}{\Delta T}\right\|$	<	0,5	2	10	nA/K

Test methods

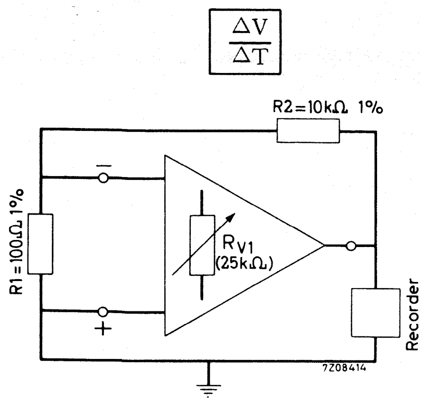


Fig. 6.

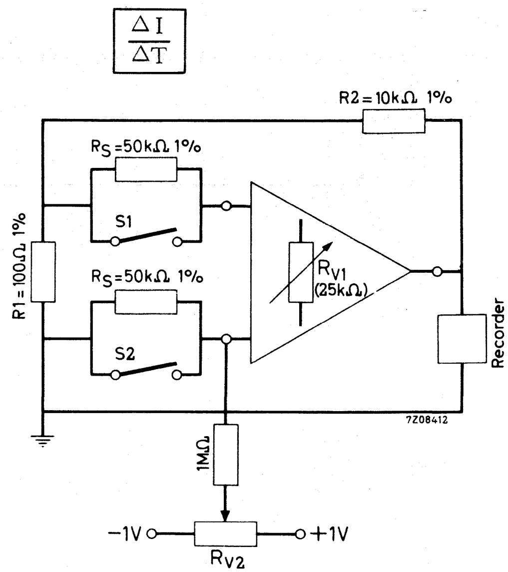


Fig. 7.

Note

To prevent contact potentials, connections should be soldered.

Amplification factor determined by feedback circuit: $\frac{R2}{R1} = 100$

Output voltage against time is recorded.

The temperature of the amplifier is adjusted to T_1 between −20 and + 90 °C. When it has stabilized, the output voltage is brought to zero ($|V_{T1}| < 1$ mV)*. The amplifier temperature is then adjusted to T_2 between −20 to + 90 °C. When it has stabilized the output voltage can be read off.

Then: $\frac{\Delta V}{\Delta T} = \frac{V_{T2} - V_{T1}}{T_2 - T_1} \cdot \frac{R1}{R2}$ or $\frac{\Delta I}{\Delta T} = \frac{V_{T2} - V_{T1}}{T_2 - T_1} \cdot \frac{R1}{R2} \cdot \frac{1}{2R_S}$

* For $\frac{\Delta V}{\Delta T}$: adjusted by R_{V1}

For $\frac{\Delta I}{\Delta T}$: first by R_{V1} with S1 and S2 closed, then by R_{V2} with the switches open.

Differential test-amplifier

The test amplifier (including feedback resistors, source-resistors and biasing-resistors) should be mounted in a small box to ensure a uniform temperature throughout.

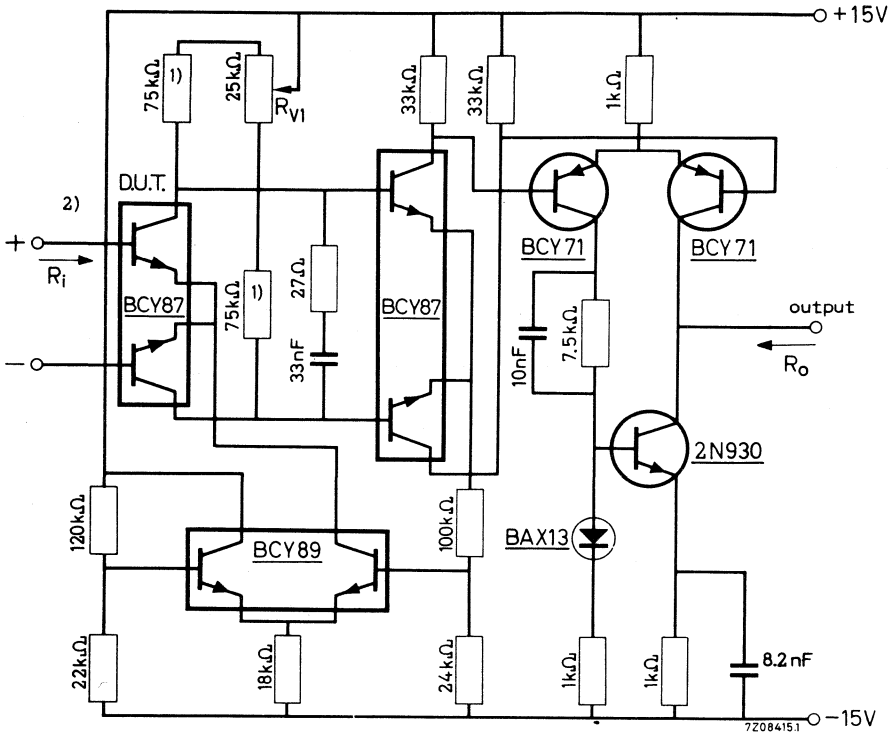


Fig. 8.

1) Relative temperature coefficient < $10^{-5}/^{o}C$.
2) The device at the input is the device under test.

Performance of the test amplifier

Open loop voltage gain (Z_L = 10 kΩ)	G_v	typ.	10^5
Frequency at which G_v = 1	f_1	typ.	10 MHz
Maximum common mode input voltage range			± 10 V
Maximum output current			± 2,5 mA
Maximum output voltage			± 10 V
Input resistance	R_i		100 kΩ
Output resistance	R_o	typ.	20 kΩ
Common mode rejection ratio			10^5

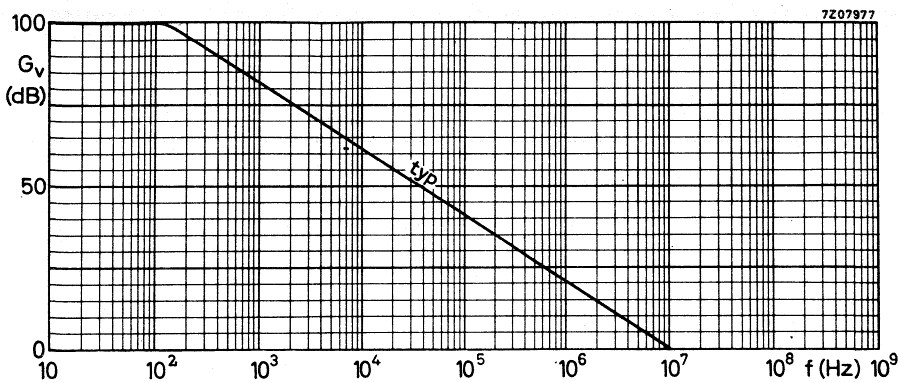


Fig. 9.

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	45 V
Collector-emitter voltage (open base) I_C = 10 mA	V_{CEO}	max.	40 V
Emitter-base voltage (open collector)	V_{EBO}	max.	5 V
Collector current (d.c.)	I_C	max.	30 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	150 mW
Storage temperature range	T_{stg}		−65 to + 150 °C
Junction temperature	T_j	max.	175 °C

THERMAL RESISTANCE

From junction to ambient	$R_{th\,j\text{-}a}$	=	1 K/mW

SILICON PLANAR EPITAXIAL POWER TRANSISTOR

N-P-N transistor in a SOT-32 plastic package for general purpose, medium power applications. P-N-P complement is BD132.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	70	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	V
Collector current (d.c.)	I_C	max.	3	A
Collector current (peak value)	I_{CM}	max.	6	A
Total power dissipation up to T_{mb} = 60 °C	P_{tot}	max.	15	W
Junction temperature	T_j	max.	150	°C
D.C. current gain I_C = 0,5 A; V_{CE} = 12 V	h_{FE}	>	40	
Transition frequency at f = 100 MHz I_C = 0,25 A; V_{CE} = 5 V	f_T	>	60	MHz

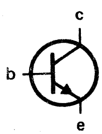
MECHANICAL DATA

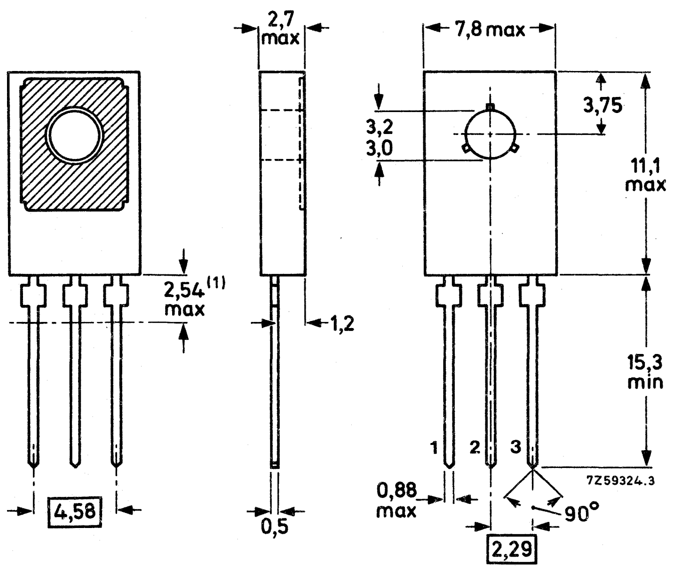
Dimensions in mm

Fig. 1 TO-126 (SOT-32).

Collector connected to metal part of mounting surface.

Pinning
1 = emitter
2 = collector
3 = base





See also chapters Mounting instructions and Accessories.

(1) Within this region the cross-section of the leads is uncontrolled.

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	70	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6	V
Collector current (d.c.)	I_C	max.	3	A
Collector current (peak value)	I_{CM}	max.	6	A
Base current (peak value)	I_{BM}	max.	0,5	A
Reverse base current (peak value)	$-I_{BM}$	max.	0,5	A
Total power dissipation up to T_{mb} = 60 °C	P_{tot}	max.	15	W
Storage temperature	T_{stg}		−65 to + 150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	6	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0$; $V_{CB} = 50$ V	I_{CBO}	<	5 μA
$I_E = 0$; $V_{CB} = 50$ V; $T_j = 150$ °C	I_{CBO}	<	500 μA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	<	5 μA
Saturation voltages			
$I_C = 0,5$ A; $I_B = 50$ mA	V_{CEsat}	<	0,3 V
	V_{BEsat}	<	1,2 V
$I_C = 2$ A; $I_B = 200$ mA	V_{CEsat}	<	0,7 V
	V_{BEsat}	<	1,5 V
D.C. current gain			
$I_C = 0,5$ A; $V_{CE} = 12$ V	h_{FE}	>	40
$I_C = 2$ A; $V_{CE} = 1$ V	h_{FE}	>	20
Collector capacitance at f = 1 MHz			
$I_E = I_e = 0$; $V_{CB} = 5$ V	C_c	<	60 pF
Transition frequency at f = 100 MHz			
$I_C = 0,25$ A; $V_{CE} = 5$ V; $T_{amb} = 25$ °C	f_T	>	60 MHz
D.C. current gain ratio of the complementary pairs			
$I_C = 0,5$ A; $V_{CE} = 12$ V	h_{FE1}/h_{FE2}	<	1,2

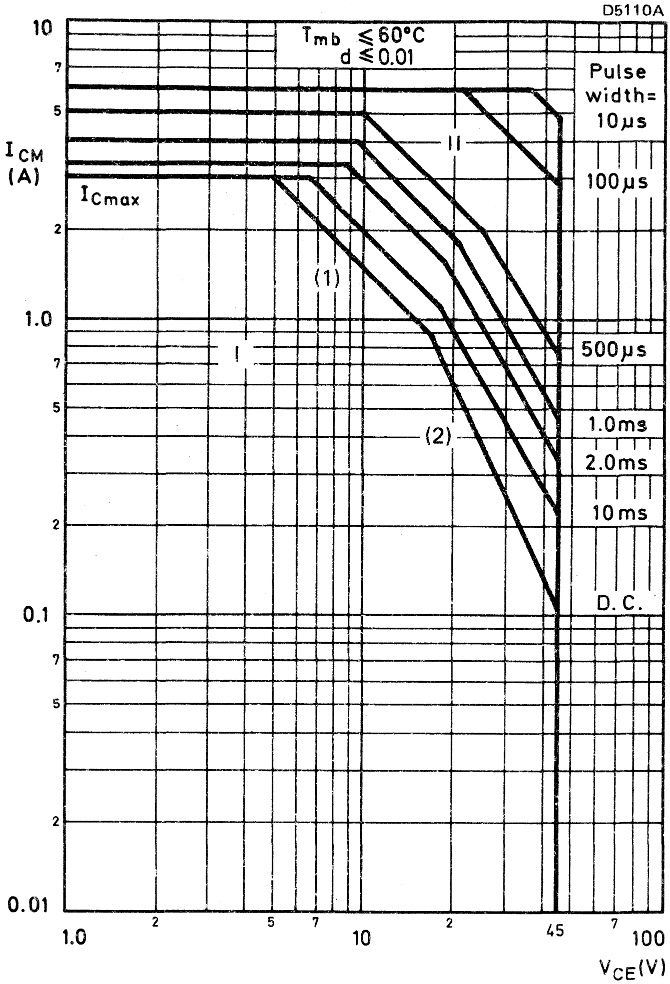


Fig. 2 Safe Operating Area with the transistor forward biased.

I Region of permissible d.c. operation.

II Permissible extension for repetitive pulse operation.

(1) $P_{tot\ max}$ and $P_{peak\ max}$ lines.

(2) Second breakdown limits.

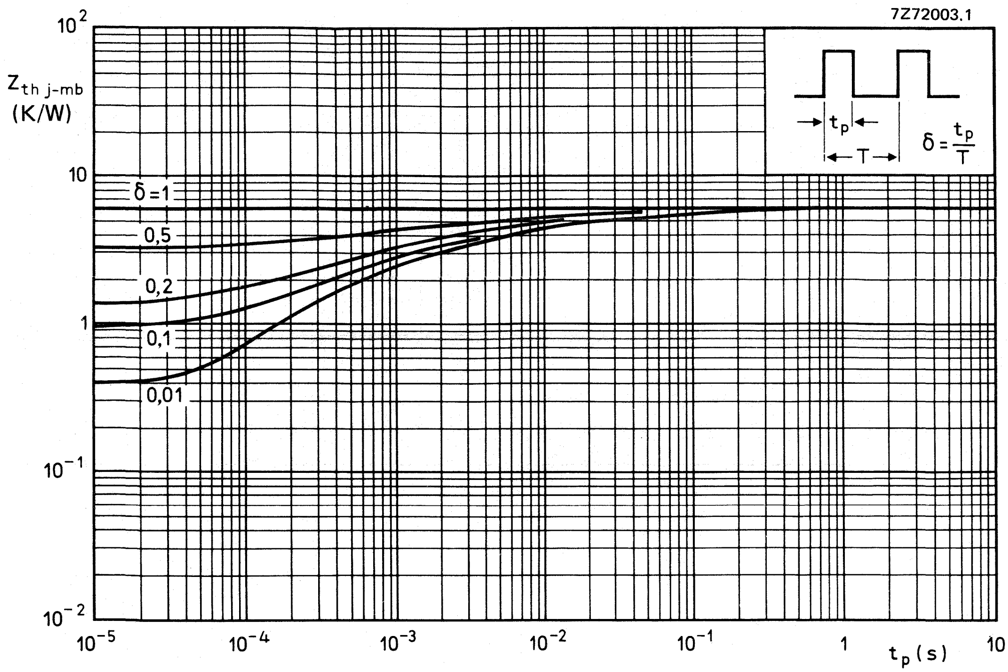


Fig. 3 Pulse power rating chart.

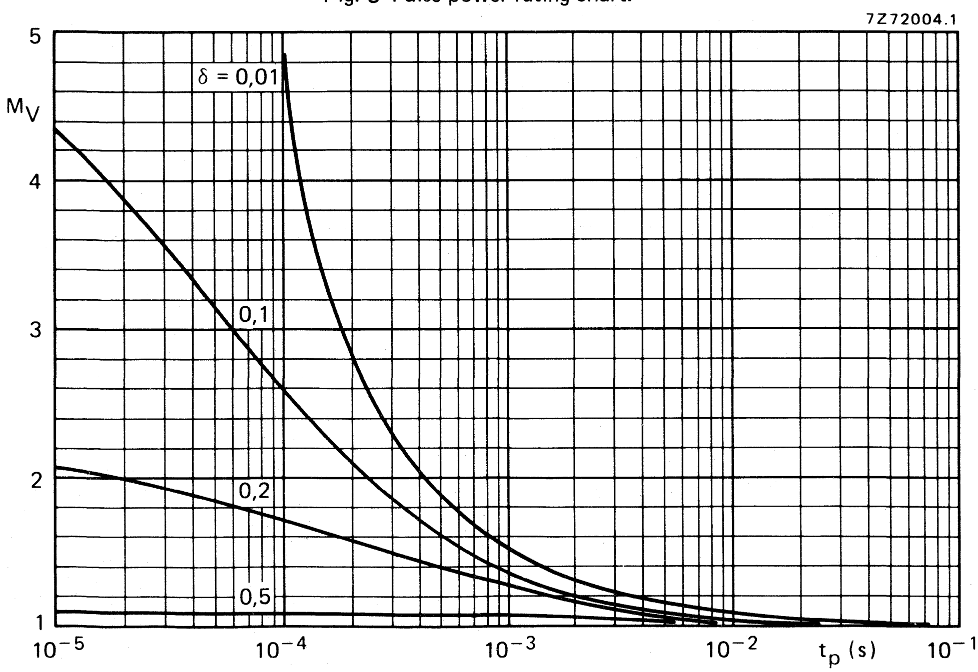


Fig. 4 S.B. voltage multiplying factor at the I_{Cmax} level.

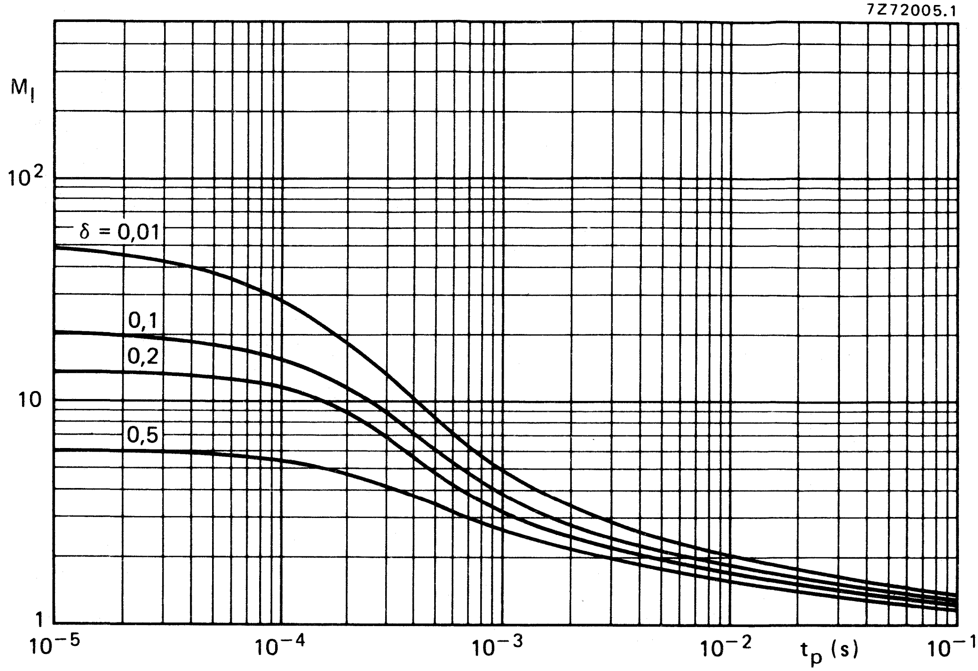


Fig. 5 S.B. current multiplying factor at the V_{CEOmax} level.

SILICON PLANAR EPITAXIAL POWER TRANSISTOR

P-N-P transistor in a SOT-32 plastic package for general purpose, medium power applications. N-P-N complement is BD131.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	45	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	V
Collector current (d.c.)	$-I_C$	max.	3	A
Collector current (peak value)	$-I_{CM}$	max.	6	A
Total power dissipation up to T_{mb} = 60 °C	P_{tot}	max.	15	W
Junction temperature	T_j	max.	150	°C
D.C. current gain $-I_C$ = 0,5 A; $-V_{CE}$ = 12 V	h_{FE}	>	40	
Transition frequency at f = 100 MHz $-I_C$ = 0,25 A; $-V_{CE}$ = 5 V	f_T	>	60	MHz

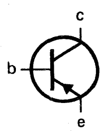
MECHANICAL DATA

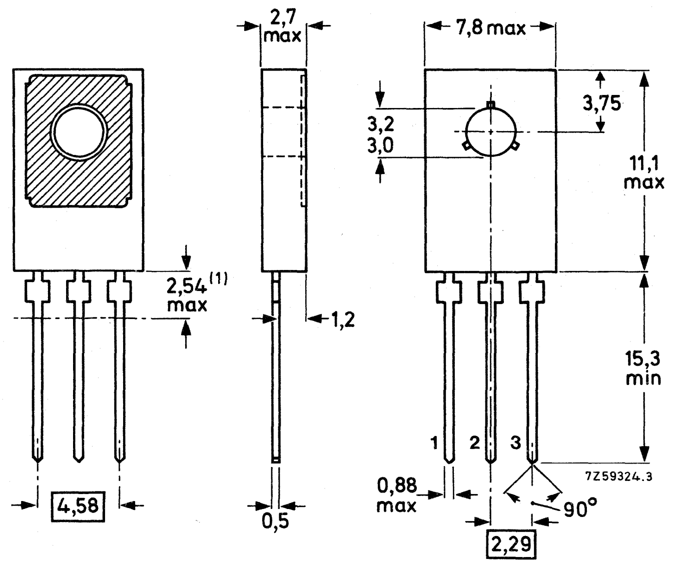
Dimensions in mm

Fig. 1 TO-126 (SOT-32)

Collector connected to metal part of mounting surface.

Pinning
1 = emitter
2 = collector
3 = base





See also chapters Mounting instructions and Accessories.

(1) Within this region the cross-section of the leads is uncontrolled.

RATINGS

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

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	45	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	4	V
Collector current (d.c.)	$-I_C$	max.	3	A
Collector current (peak value)	$-I_{CM}$	max.	6	A
Base current (peak value)	$-I_{BM}$	max.	0,5	A
Reverse base current (peak value)	$+I_{BM}$	max.	0,5	A
Total power dissipation up to T_{mb} = 60 °C	P_{tot}	max.	15	W
Storage temperature	T_{stg}	−65 to + 150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	6	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $-V_{CB} = 40$ V	$-I_{CBO}$	<	5	μA
$I_E = 0$; $-V_{CB} = 40$ V; $T_j = 150$ °C	$-I_{CBO}$	<	500	μA
Emitter cut-off current				
$I_C = 0$; $-V_{EB} = 3$ V	$-I_{EBO}$	<	5	μA
Saturation voltages				
$-I_C = 0{,}5$ A; $-I_B = 50$ mA	$-V_{CEsat}$	<	0,3	V
	$-V_{BEsat}$	<	1,2	V
$-I_C = 2$ A; $-I_B = 200$ mA	$-V_{CEsat}$	<	0,7	V
	$-V_{BEsat}$	<	1,5	V
D.C. current gain				
$-I_C = 0{,}5$ A; $-V_{CE} = 12$ V	h_{FE}	>	40	
$-I_C = 2$ A; $-V_{CE} = 1$ V	h_{FE}	>	20	
Transition frequency at f = 100 MHz				
$-I_C = 0{,}25$ A; $-V_{CE} = 5$ V; $T_{amb} = 25$ °C	f_T	>	60	MHz
D.C. current gain ratio of the complementary pairs				
$-I_C = 500$ mA; $-V_{CE} = 12$ V	h_{FE1}/h_{FE2}	<	1,2	

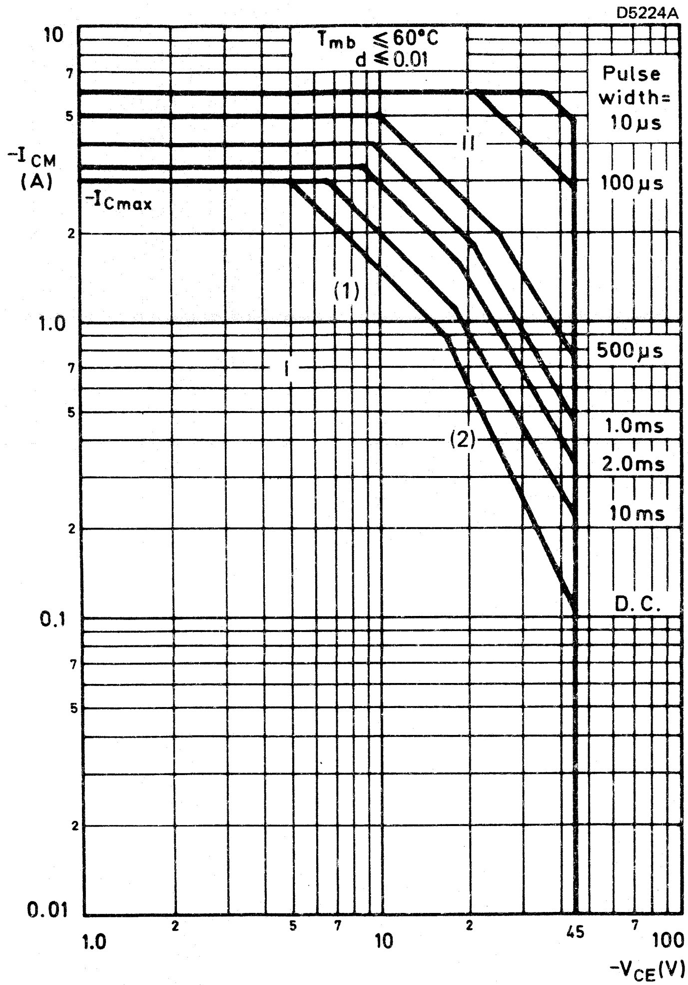


Fig. 2 Safe Operating Area with the transistor forward biased.

I Region of permissible d.c. operation.

II Permissible extension for repetitive pulse operation.

(1) $P_{tot\ max}$ and $P_{peak\ max}$ lines.

(2) Second breakdown limits.

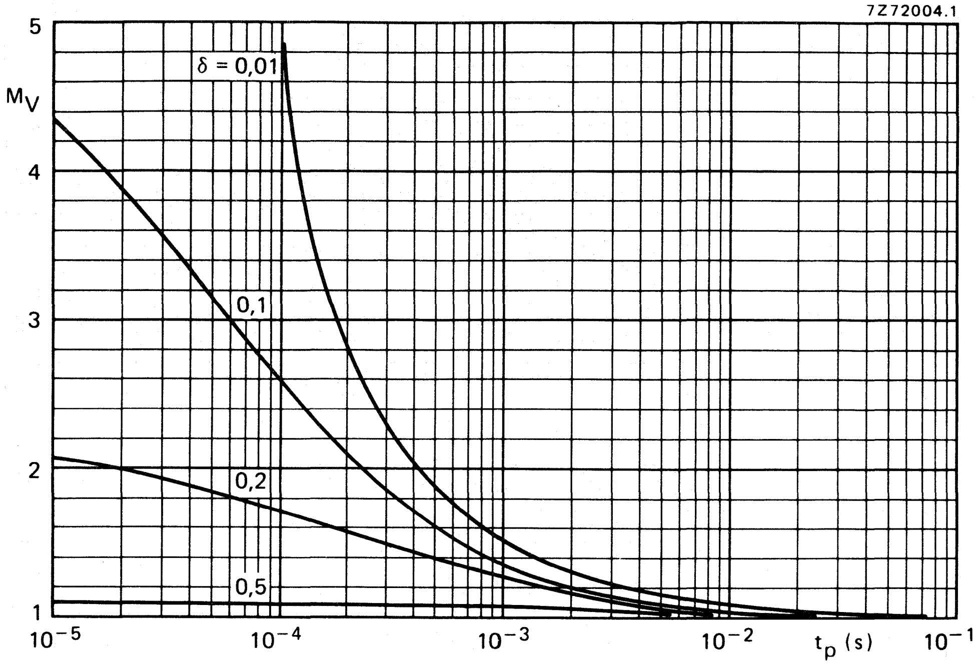


Fig. 3 S.B. voltage multiplying factor at the $-I_{Cmax}$ level.

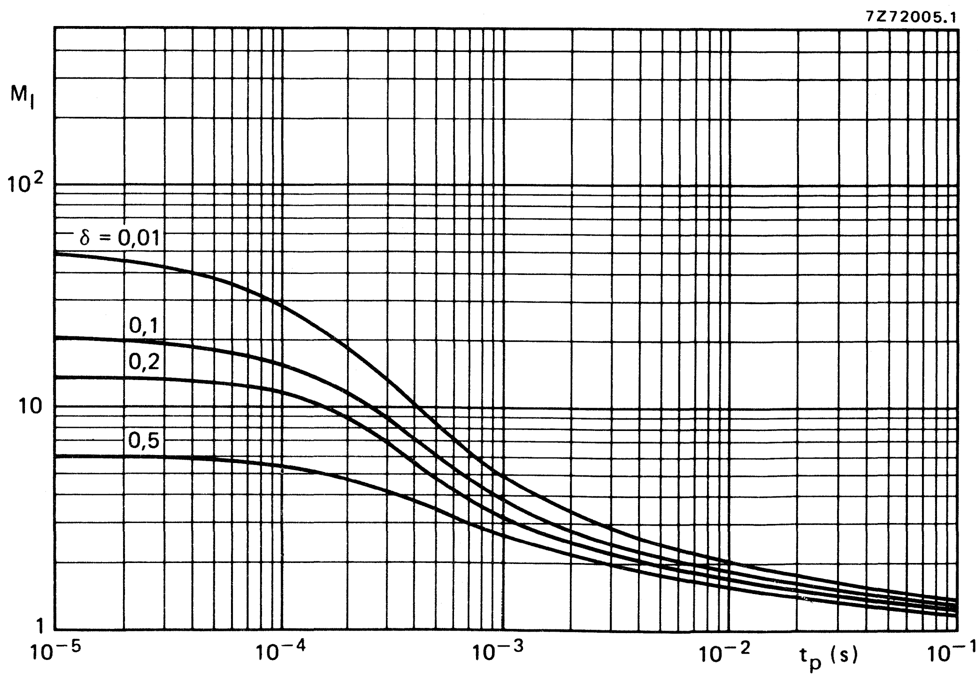


Fig. 4 S.B. current multiplying factor at the $-V_{CEOmax}$ level.

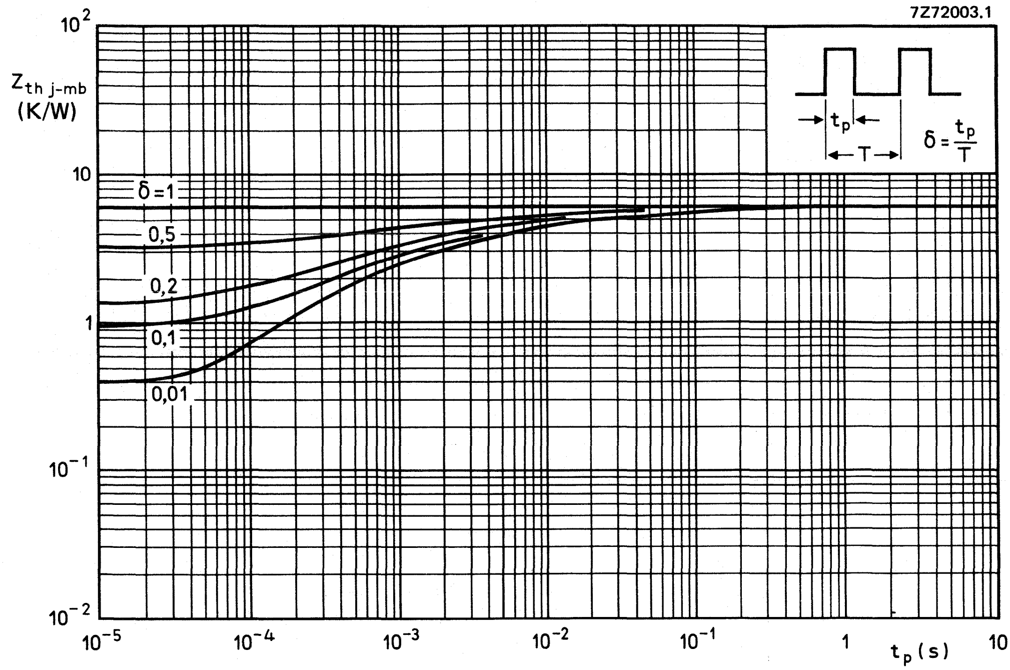


Fig. 5 Pulse power rating chart.

SILICON PLANAR EPITAXIAL POWER TRANSISTORS

General purpose n-p-n transistors in SOT-32 plastic package, recommended for driver stages in hi-fi amplifiers and television circuits.
The BD136, BD138 and BD140 are complementary to the BD135, BD137 and BD139 respectively.

QUICK REFERENCE DATA

			BD135	BD137	BD139	
Collector-base voltage (open emitter)	V_{CBO}	max.	45	60	100	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	V_{CER}	max.	45	60	100	V
Collector current (d.c.)	I_C	max.	1,5	1,5	1,5	A
Collector current (peak value)	I_{CM}	max.	2,0	2,0	2,0	A
Total power dissipation up to T_{mb} = 70 °C	P_{tot}	max.	8	8	8	W
Junction temperature	T_j	max.	150	150	150	°C
D.C. current gain I_C = 150 mA; V_{CE} = 2 V	h_{FE}	>	40	40	40	
		<	250	250	250	
Transition frequency at f = 100 MHz I_C = 50 mA; V_{CE} = 5 V	f_T	typ.	250	250	250	MHz

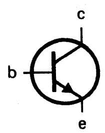
MECHANICAL DATA

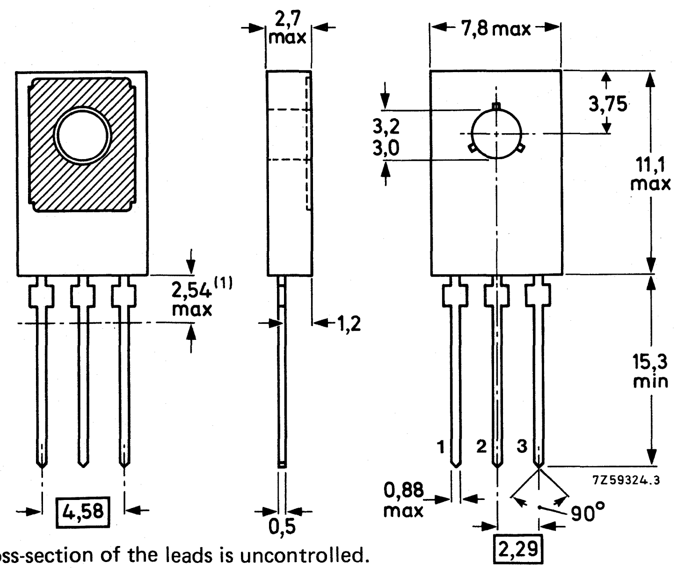
Dimensions in mm

Fig. 1 TO-126 (SOT-32).

Collector connected to metal part of mounting surface.

Pinning
1 = emitter
2 = collector
3 = base





(1) Within this region the cross-section of the leads is uncontrolled.

See also chapters Mounting instructions and Accessories.

RATINGS

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

			BD135	BD137	BD139	
Collector-base voltage (open emitter)	V_{CBO}	max.	45	60	100	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	V_{CER}	max.	45	60	100	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	5	V
Collector current (d.c.)	I_C	max.	1,5	1,5	1,5	A
Collector current (peak value)	I_{CM}	max.	2,0	2,0	2,0	A
Total power dissipation up to T_{mb} = 70 °C	P_{tot}	max.		8		W
Storage temperature	T_{stg}			−65 to +150		°C
Junction temperature	T_j	max.		150		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	100	K/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	10	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; V_{CB} = 30 V	I_{CBO}	<	100	nA
$I_E = 0$; V_{CB} = 30 V; T_j = 125 °C	I_{CBO}	<	10	μA
Emitter cut-off current				
$I_C = 0$; V_{EB} = 5 V	I_{EBO}	<	10	μA
Base-emitter voltage				
I_C = 500 mA; V_{CE} = 2 V	V_{BE}	<	1	V
Saturation voltage				
I_C = 500 mA; I_B = 50 mA	V_{CEsat}	<	0,5	V
D.C. current gain				
I_C = 5 mA; V_{CE} = 2 V	h_{FE}	>	25	
I_C = 150 mA; V_{CE} = 2 V				
BDxxx	h_{FE}		40 to 250	
BDxxx-6	h_{FE}		40 to 100	
BDxxx-10	h_{FE}		63 to 160	
BDxxx-16	h_{FE}		100 to 250	
I_C = 500 mA; V_{CE} = 2 V	h_{FE}	>	25	
Transition frequency at f = 100 MHz				
I_C = 50 mA; V_{CE} = 5 V	f_T	typ.	250	MHz
D.C. current gain ratio of matched pairs				
BD135/BD136; BD137/BD138; BD139/BD140				
$\|I_C\|$ = 150 mA; $\|V_{CE}\|$ = 2 V	h_{FE1}/h_{FE2}	typ.	1,3	
		<	1,6	

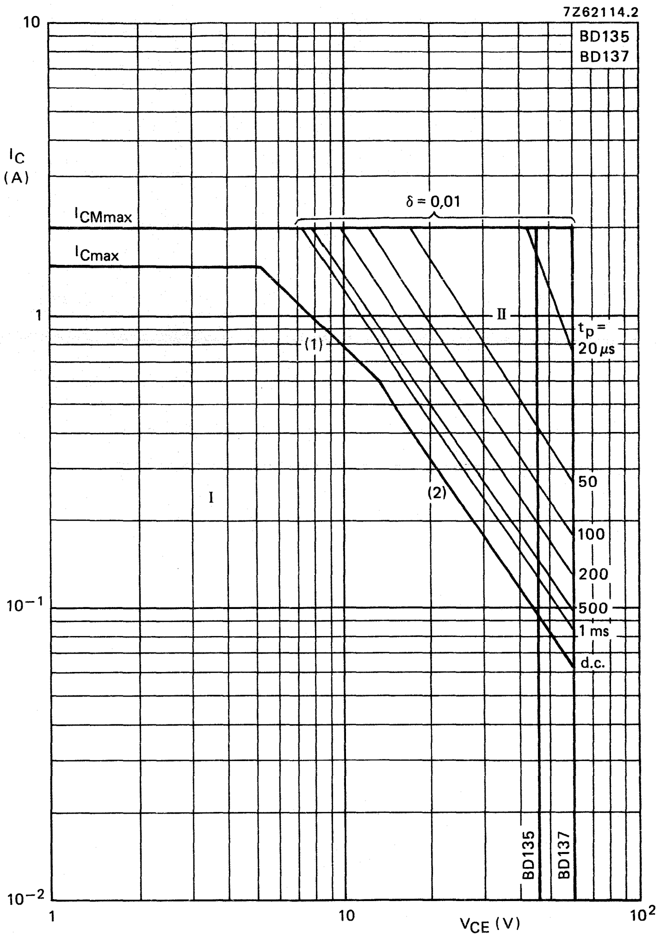


Fig. 2 Safe Operating Area with the transistor forward biased.

I Region of permissible d.c. operation
II Permissible extension for repetitive pulse operation

(1) $P_{tot\ max}$ line
(2) Second breakdown limits.

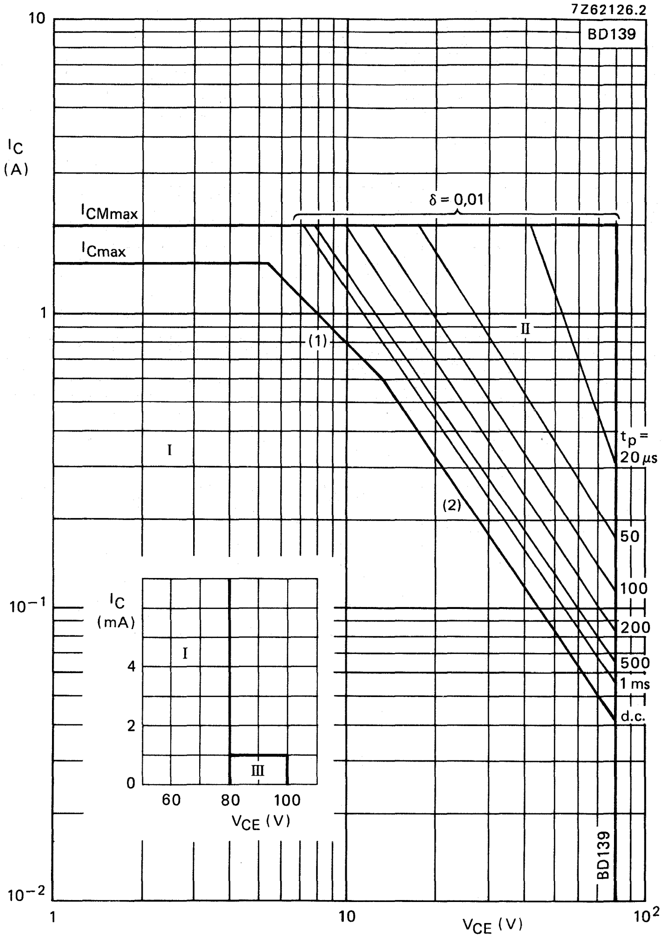


Fig. 3 Safe Operating Area with the transistor forward biased.

I Region of permissible d.c. operation
II Permissible extension for repetitive pulsed operation
III Repetitive pulse operation in this region is allowable, provided $R_{BE} \leqslant 1\ k\Omega$

(1) $P_{tot\ max}$ line
(2) Second breakdown limit

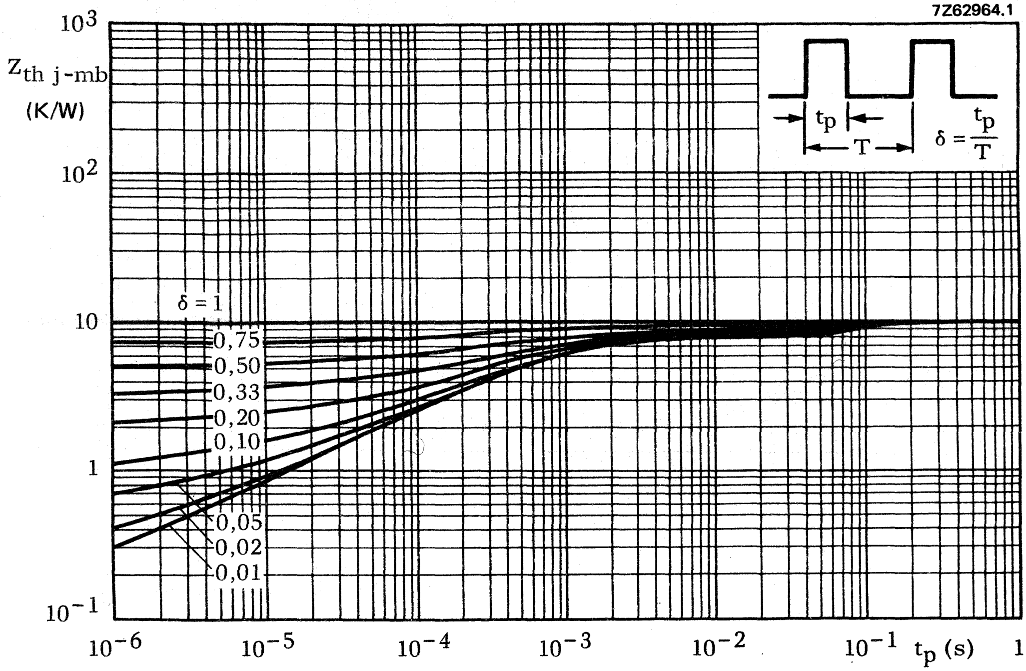

7Z62964.1
$Z_{th\ j\text{-}mb}$
(K/W)
10^3
10^2
10
1
10^{-1}
$\delta = 1$
0,75
0,50
0,33
0,20
0,10
0,05
0,02
0,01
t_p
T
$\delta = \frac{t_p}{T}$
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
t_p (s)
1

Fig. 4.

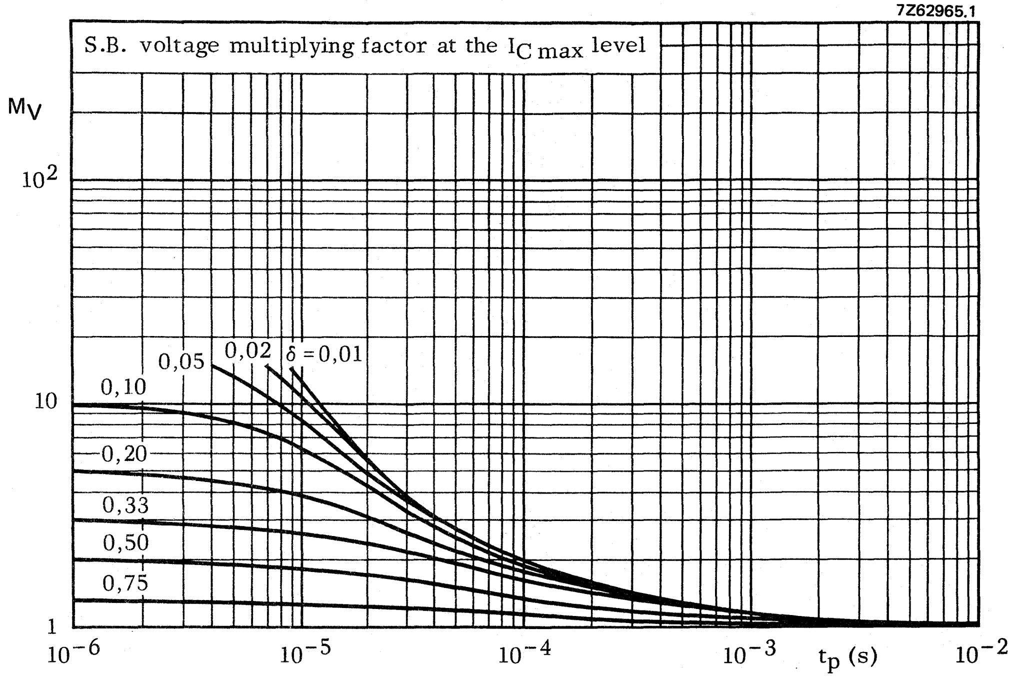

7Z62965.1
S.B. voltage multiplying factor at the $I_{C\,max}$ level
M_V
10^2
10
1
0,05
0,02
$\delta = 0,01$
0,10
0,20
0,33
0,50
0,75
10^{-6}
10^{-5}
10^{-4}
10^{-3}
t_p (s)
10^{-2}

Fig. 5.

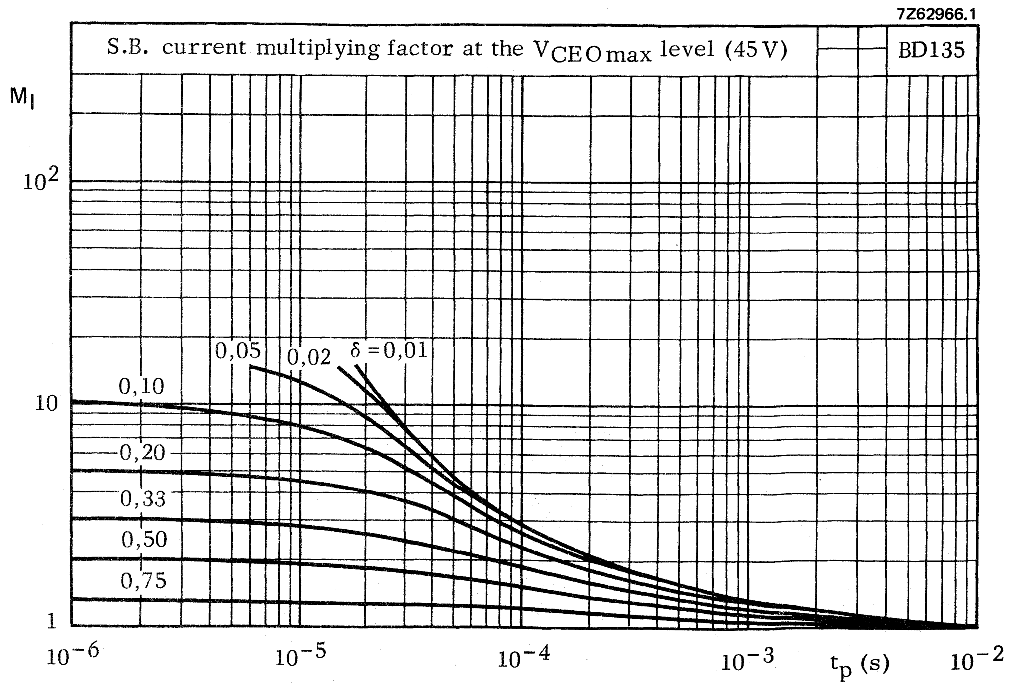

7Z62966.1
S.B. current multiplying factor at the $V_{CEO\,max}$ level (45 V)
BD135
M_I
10^2
10
1
0,05
0,02
$\delta = 0,01$
0,10
0,20
0,33
0,50
0,75
10^{-6}
10^{-5}
10^{-4}
10^{-3}
t_p (s)
10^{-2}

Fig. 6.

7Z62967.1

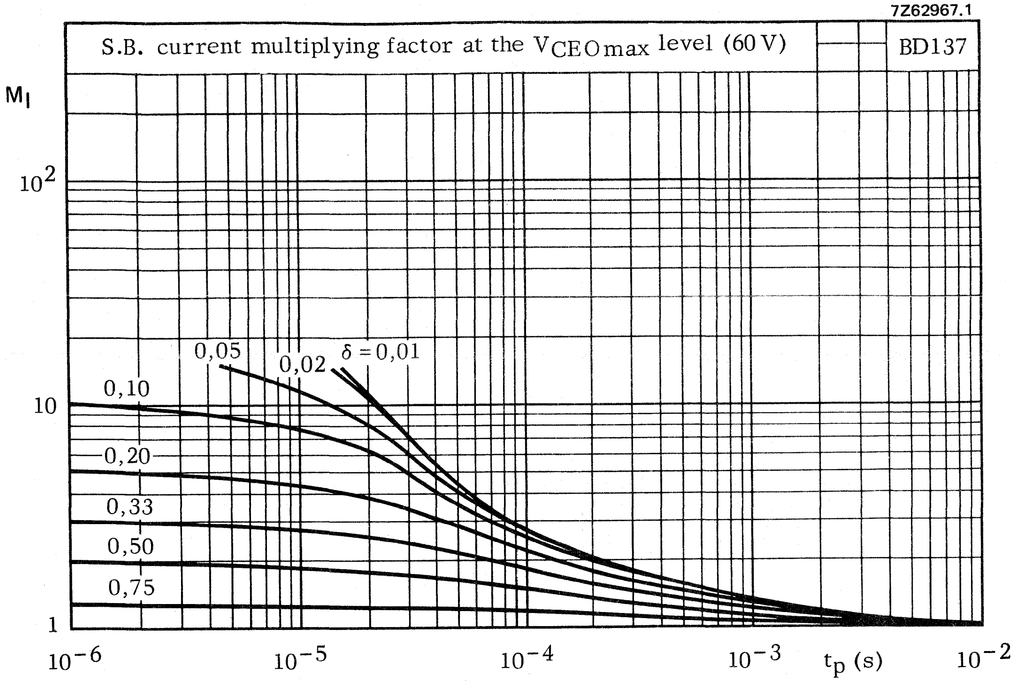


Fig. 7.

7Z62968.1

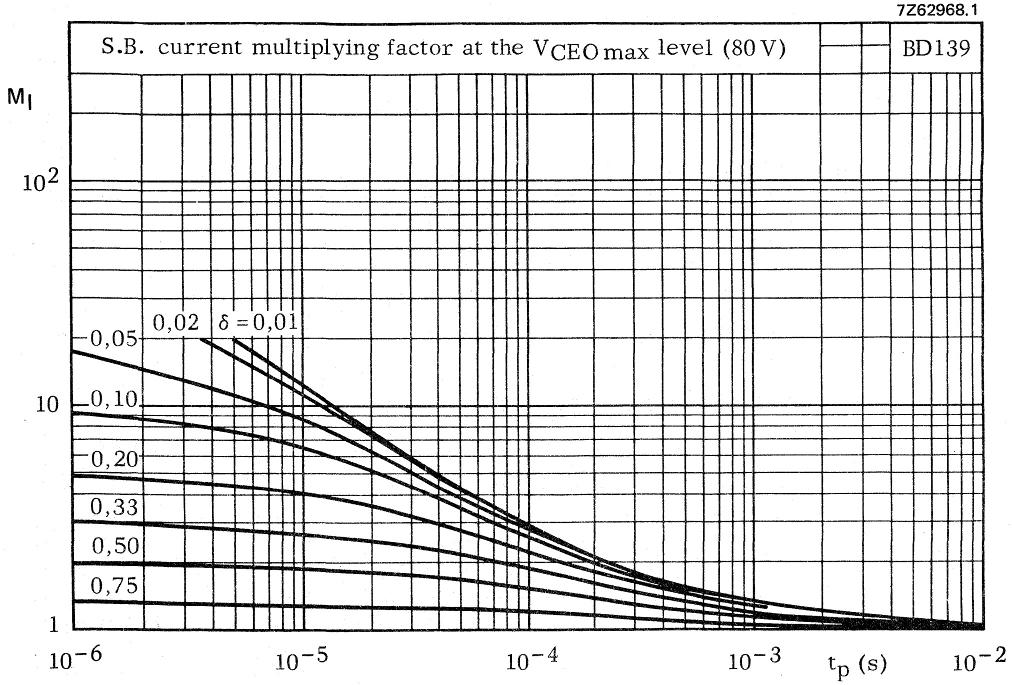


Fig. 8.

SILICON PLANAR EPITAXIAL POWER TRANSISTORS

General purpose p-n-p transistors in SOT-32 plastic package, recommended for driver stages in hi-fi amplifiers and television circuits.
The BD135, BD137 and BD139 are complementary to the BD136, BD138 and BD140 respectively.

QUICK REFERENCE DATA

			BD136	BD138	BD140	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	45	60	100	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	$-V_{CER}$	max.	45	60	100	V
Collector current (d.c.)	$-I_C$	max.	1,5	1,5	1,5	A
Collector current (peak value)	$-I_{CM}$	max.	2,0	2,0	2,0	A
Total power dissipation up to T_{mb} = 70 °C	P_{tot}	max.	8	8	8	W
Junction temperature	T_j	max.	150	150	150	°C
D.C. current gain $-I_C$ = 150 mA; $-V_{CE}$ = 2 V	h_{FE}	> <	40 250	40 250	40 250	
Transition frequency at f = 100 MHz $-I_C$ = 50 mA; $-V_{CE}$ = 5 V	f_T	typ.	75	75	75	MHz

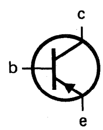
MECHANICAL DATA

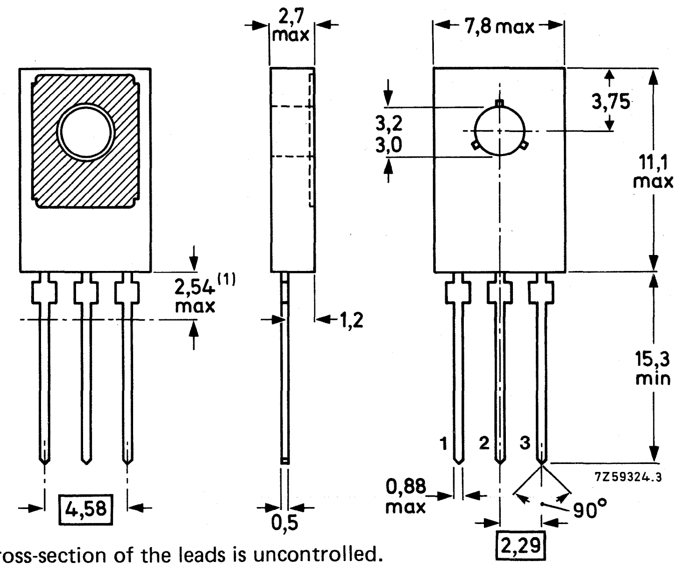
Dimensions in mm

Fig. 1 TO-126 (SOT-32).

Collector connected to metal part of mounting surface

Pinning
1 = emitter
2 = collector
3 = base





(1) Within this region the cross-section of the leads is uncontrolled.

See also chapters Mounting instructions and Accessories.

RATINGS

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

			BD136	BD138	BD140	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	45	60	100	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	$-V_{CER}$	max.	45	60	100	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	V
Collector current (d.c.)	$-I_C$	max.	1,5	1,5	1,5	A
Collector current (peak value)	$-I_{CM}$	max.	2,0	2,0	2,0	A
Total power dissipation up to T_{mb} = 70 °C	P_{tot}	max.		8		W
Storage temperature	T_{stg}			−65 to +150		°C
Junction temperature	T_j	max.		150		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	100	K/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	10	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $-V_{CB} = 30$ V	$-I_{CBO}$	<	100	nA
$I_E = 0$; $-V_{CB} = 30$ V; $T_j = 125$ °C	$-I_{CBO}$	<	10	μA
Emitter cut-off current				
$I_C = 0$; $-V_{EB} = 5$ V	$-I_{EBO}$	<	10	μA
Base-emitter voltage				
$-I_C = 500$ mA; $-V_{CE} = 2$ V	$-V_{EB}$	<	1	V
Saturation voltage				
$-I_C = 500$ mA; $-I_B = 50$ mA	$-V_{CEsat}$	<	0,5	V
D.C. current gain				
$-I_C = 5$ mA; $-V_{CE} = 2$ V	h_{FE}	>	25	
$-I_C = 150$ mA; $-V_{CE} = 2$ V				
BDxxx	h_{FE}		40 to 250	
BDxxx-06	h_{FE}		40 to 100	
BDxxx-10	h_{FE}		63 to 160	
BDxxx-16	h_{FE}		100 to 250	
$-I_C = 500$ mA; $-V_{CE} = 2$ V	h_{FE}	>	25	
Transition frequency at f = 100 MHz				
$-I_C = 50$ mA; $-V_{CE} = 5$ V	f_T	typ.	75	MHz
D.C. current gain ratio of matched pairs				
BD135/BD136; BD137/BD138; BD139/BD140				
$\lvert I_C \rvert = 150$ mA; $\lvert V_{CE} \rvert = 2$ V	h_{FE1}/h_{FE2}	typ.	1,3	
		<	1,6	

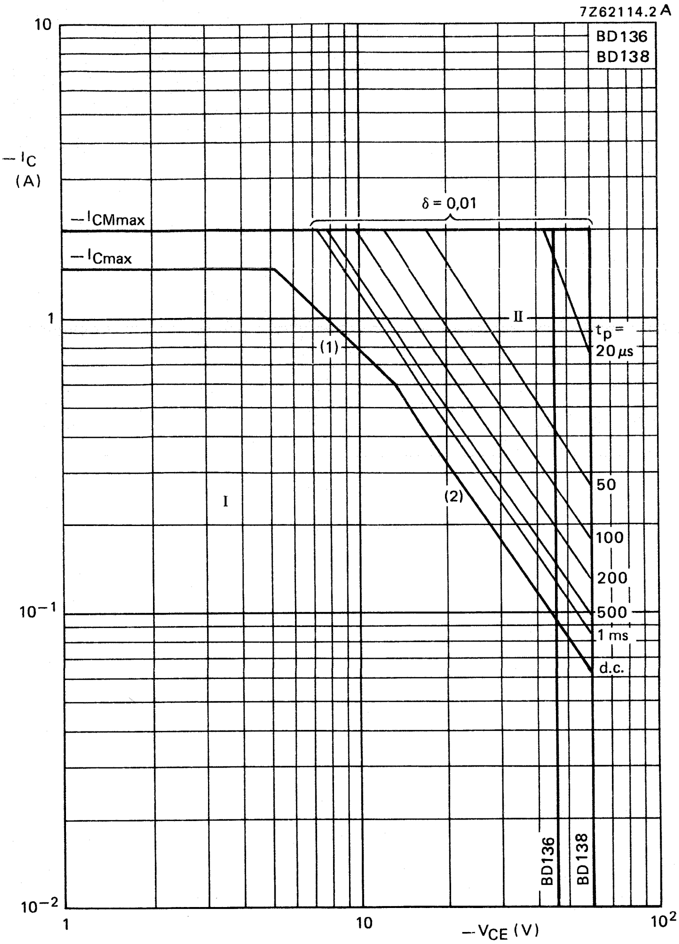


Fig. 2 Safe Operating Area with the transistor forward biased.

I Region of permissible d.c. operation
II Permissible extension for repetitive pulse operation

(1) $P_{tot\ max}$ line
(2) Second breakdown limits.

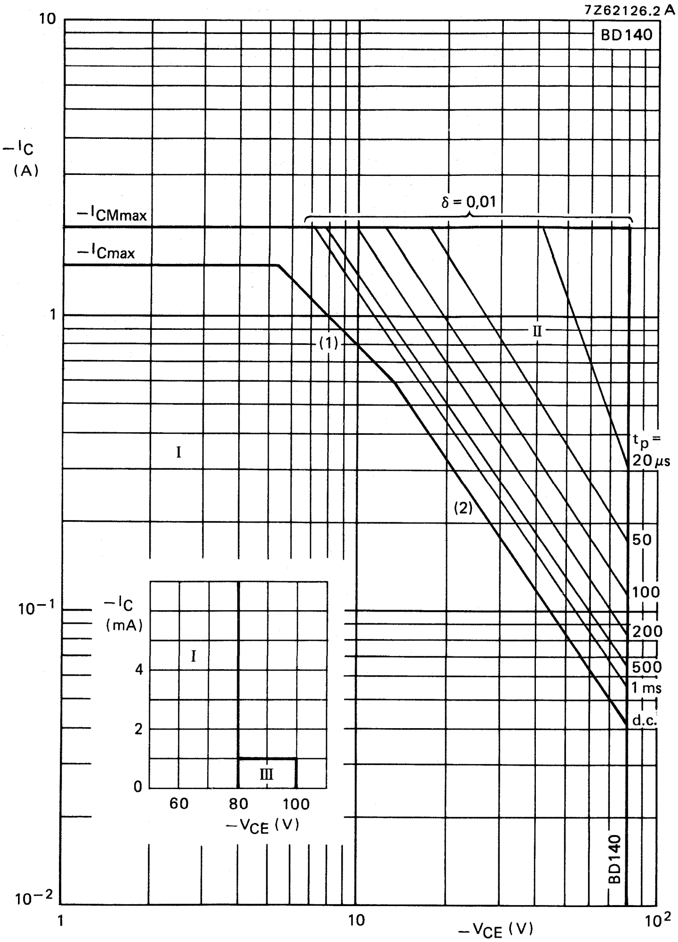


Fig. 3 Safe Operating Area with the transistor forward biased.

I Region of permissible d.c. operation
II Permissible extension for repetitive pulse operation
III Repetitive pulse operation in this region is allowable, provided $R_{BE} \leq 1\ k\Omega$

(1) $P_{tot\ max}$ line
(2) Second breakdown limits.

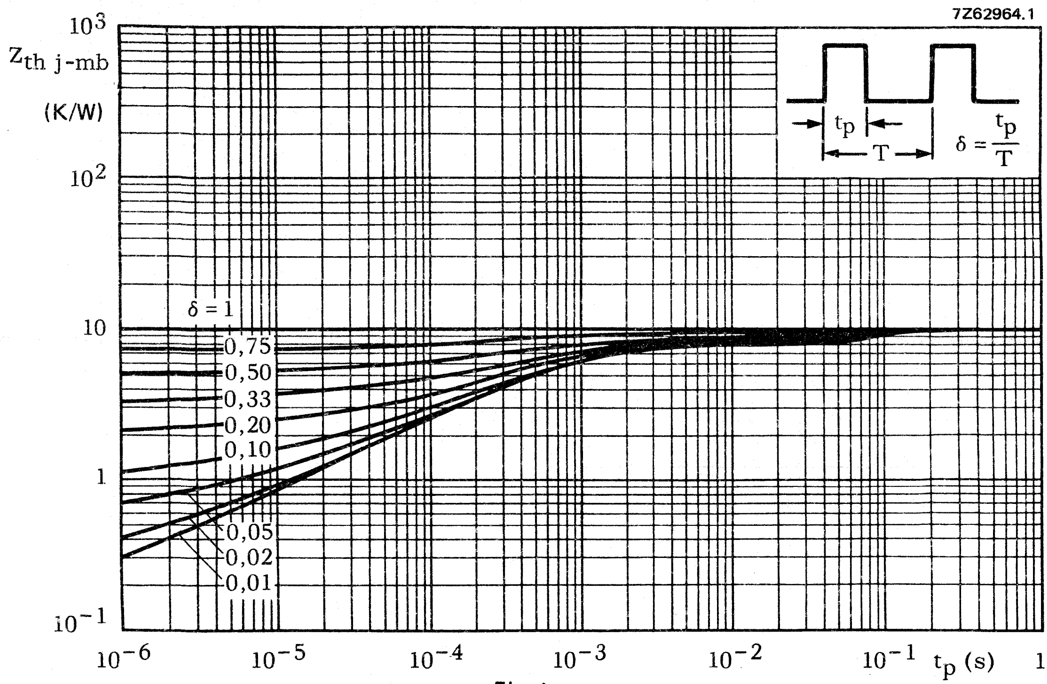

7Z62964.1
10^3
$Z_{th\ j\text{-}mb}$
(K/W)
10^2
10
1
10^{-1}
$\delta = 1$
0,75
0,50
0,33
0,20
0,10
0,05
0,02
0,01
t_p
T
$\delta = \frac{t_p}{T}$
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
t_p (s)
1

Fig. 4.

7Z62965.1

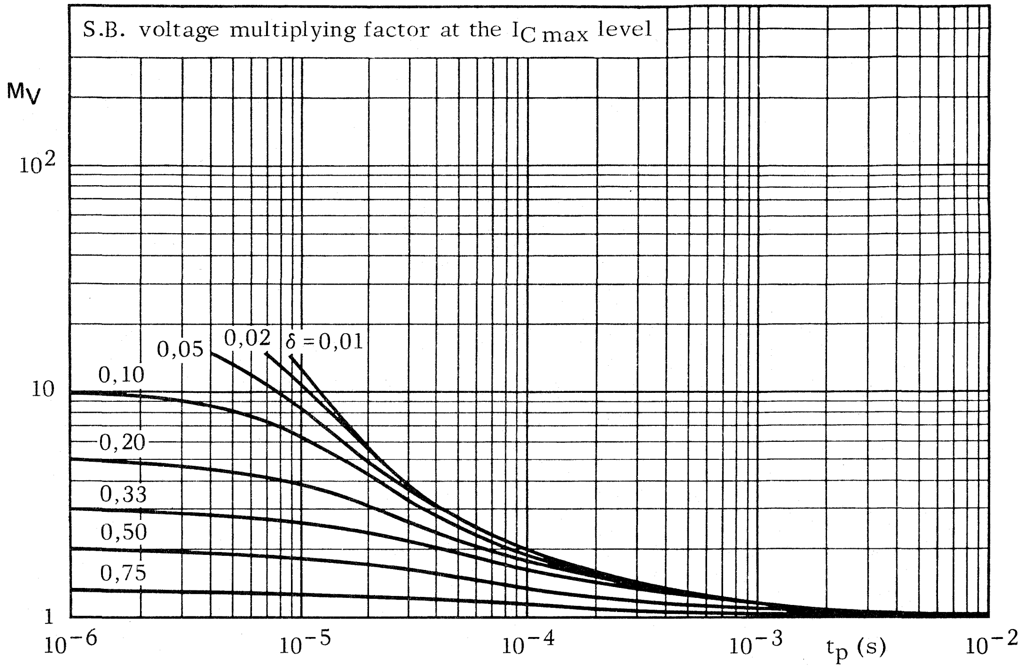


Fig. 5.

7Z62966A

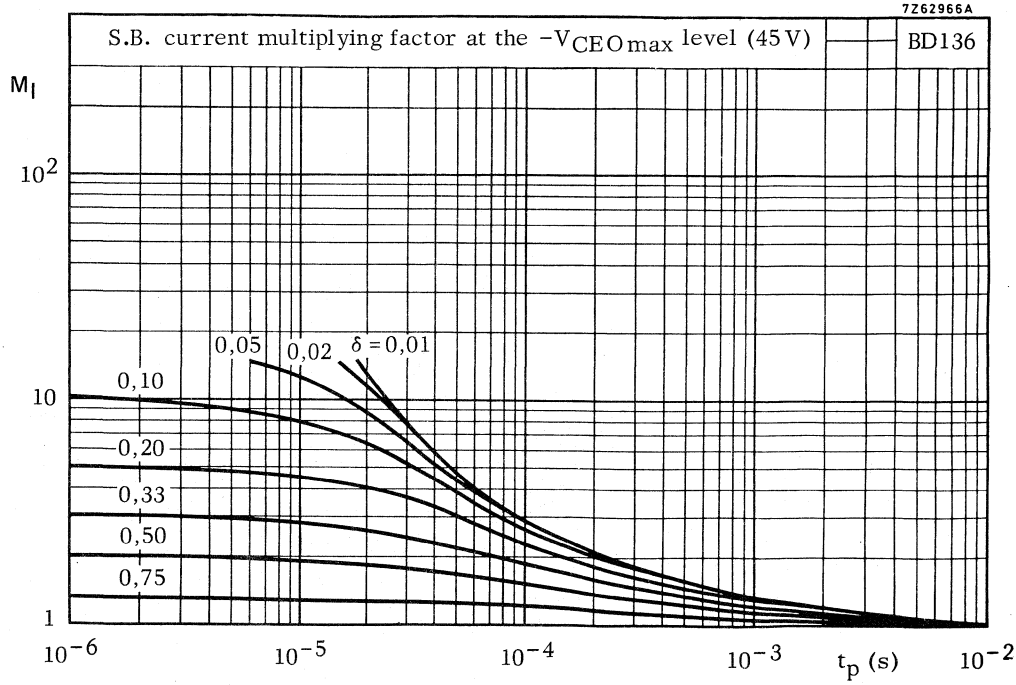


Fig. 6.

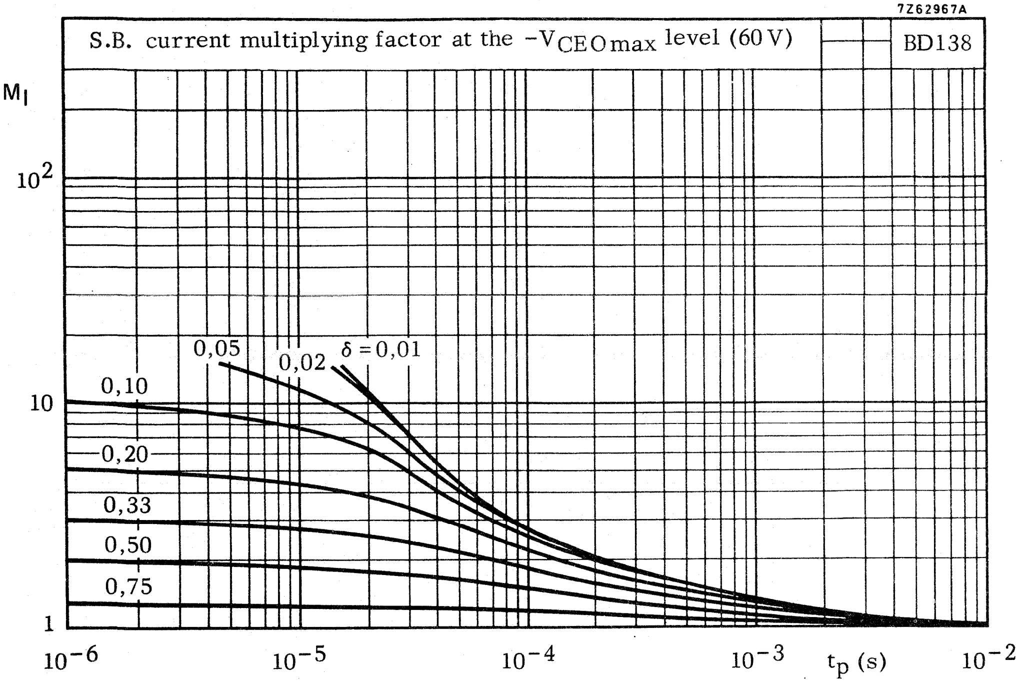

7Z62967A
S.B. current multiplying factor at the $-V_{CEO\,max}$ level (60 V)
BD138
M_I
10^2
10
1
0,05
0,02
$\delta = 0,01$
0,10
0,20
0,33
0,50
0,75
10^{-6}
10^{-5}
10^{-4}
10^{-3}
t_p (s)
10^{-2}

Fig. 7.

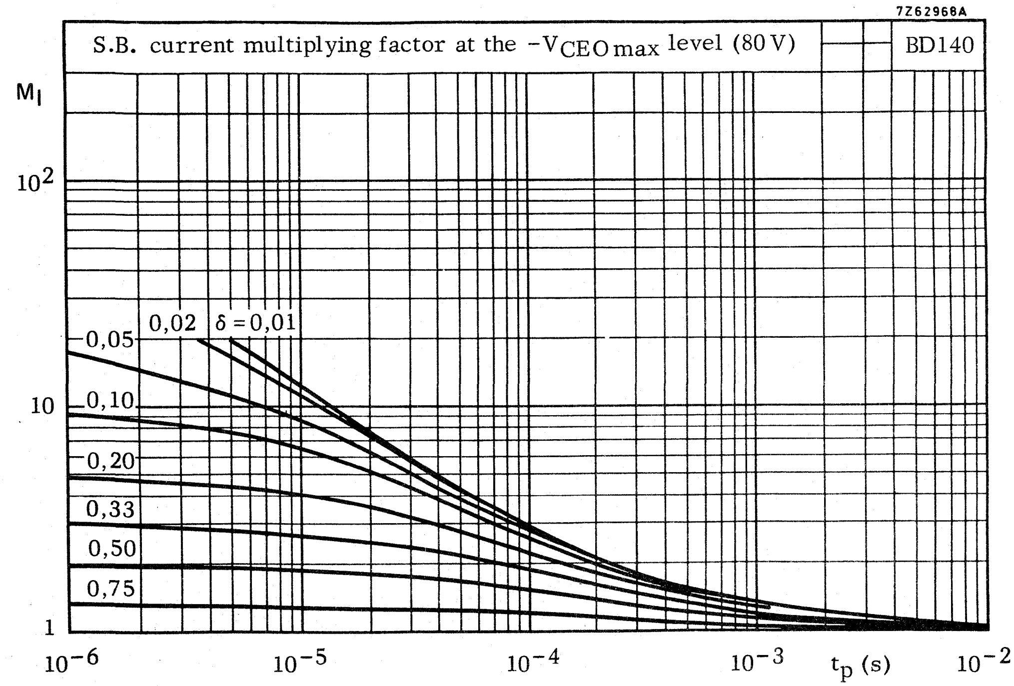

7Z62968A
S.B. current multiplying factor at the $-V_{CEO\,max}$ level (80 V)
BD140
M_I
10^2
10
1
0,02
$\delta = 0,01$
0,05
0,10
0,20
0,33
0,50
0,75
10^{-6}
10^{-5}
10^{-4}
10^{-3}
t_p (s)
10^{-2}

Fig. 8.

SILICON PLANAR EPITAXIAL POWER TRANSISTORS

General purpose n-p-n transistors in a SOT-32 plastic package especially recommended for television circuits. Their complements are BD227, BD229 and BD231.

QUICK REFERENCE DATA

			BD226	BD228	BD230	
Collector-base voltage (open emitter)	V_{CBO}	max.	45	60	100	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	V_{CER}	max.	45	60	100	V
Collector current (peak value)	I_{CM}	max.	3	3	3	A
Total power dissipation up to T_{mb} = 62 °C	P_{tot}	max.	12,5	12,5	12,5	W
Junction temperature	T_j	max.	150	150	150	°C
D.C. current gain						
I_C = 150 mA; V_{CE} = 2 V	h_{FE}			40 to 250		
I_C = 1 A; V_{CE} = 2 V	h_{FE}	>		25		
Transition frequency at f = 100 MHz						
I_C = 50 mA; V_{CE} = 5 V	f_T	typ.		125		MHz

MECHANICAL DATA

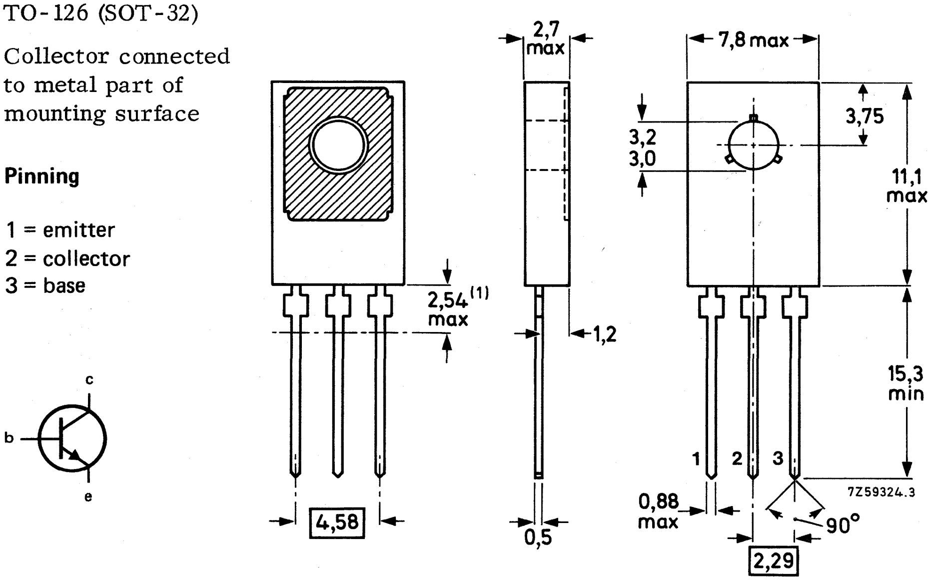
Dimensions in mm

TO-126 (SOT-32)

Collector connected to metal part of mounting surface

Pinning

1 = emitter
2 = collector
3 = base



See chapters Mounting Instructions and Accessories.

1) Within this region the cross-section of the leads is uncontrolled.

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

			BD226	BD228	BD230	
Collector-base voltage (open emitter)	V_{CBO}	max.	45	60	100	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	V_{CER}	max.	45	60	100	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	5	V

Collector current (d.c.)	I_C	max.	1,5	A
Collector current (peak value)	I_{CM}	max.	3	A
Total power dissipation up to T_{mb} = 62 °C	P_{tot}	max.	12,5	W
Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

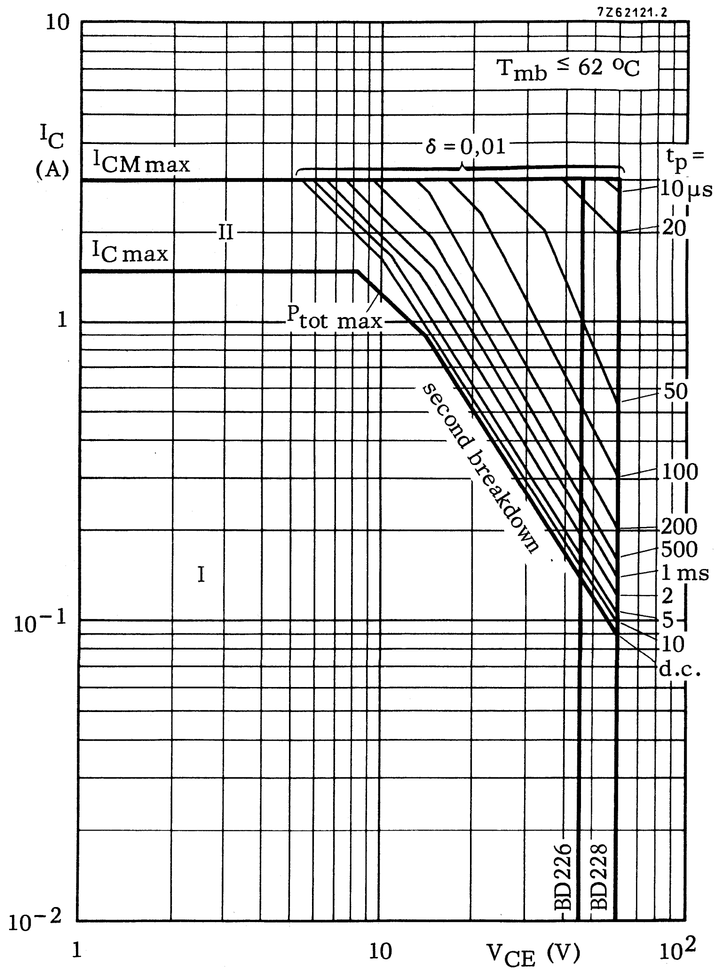
From junction to ambient in free air	$R_{th\ j-a}$	=	100	K/W
From junction to mounting base	$R_{th\ j-mb}$	=	7	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $V_{CB} = 30$ V	I_{CBO}	<	100	nA
$I_E = 0$; $V_{CB} = 30$ V; $T_j = 125$ °C	I_{CBO}	<	10	μA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	<	10	μA
Base-emitter voltage [1]				
$I_C = 1$ A; $V_{CE} = 2$ V	V_{BE}	<	1,3	V
Saturation voltage				
$I_C = 1$ A; $I_B = 0.1$ A	V_{CEsat}	<	0,8	V
D.C. current gain				
$I_C = 5$ mA; $V_{CE} = 2$ V	h_{FE}	>	25	
$I_C = 150$ mA; $V_{CE} = 2$ V	h_{FE}		40 to 250	
$I_C = 1$ A ; $V_{CE} = 2$ V	h_{FE}	>	25	
Transition frequency at f = 100 MHz				
$I_C = 50$ mA; $V_{CE} = 5$ V	f_T	typ.	125	MHz
D.C. current gain ratio of matched pairs				
BD226/BD227; BD228/BD229;				
BD230/BD231				
$\|I_C\| = 150$ mA; $\|V_{CE}\| = 2$ V	h_{FE1}/h_{FE2}	typ. <	1,3 1,6	

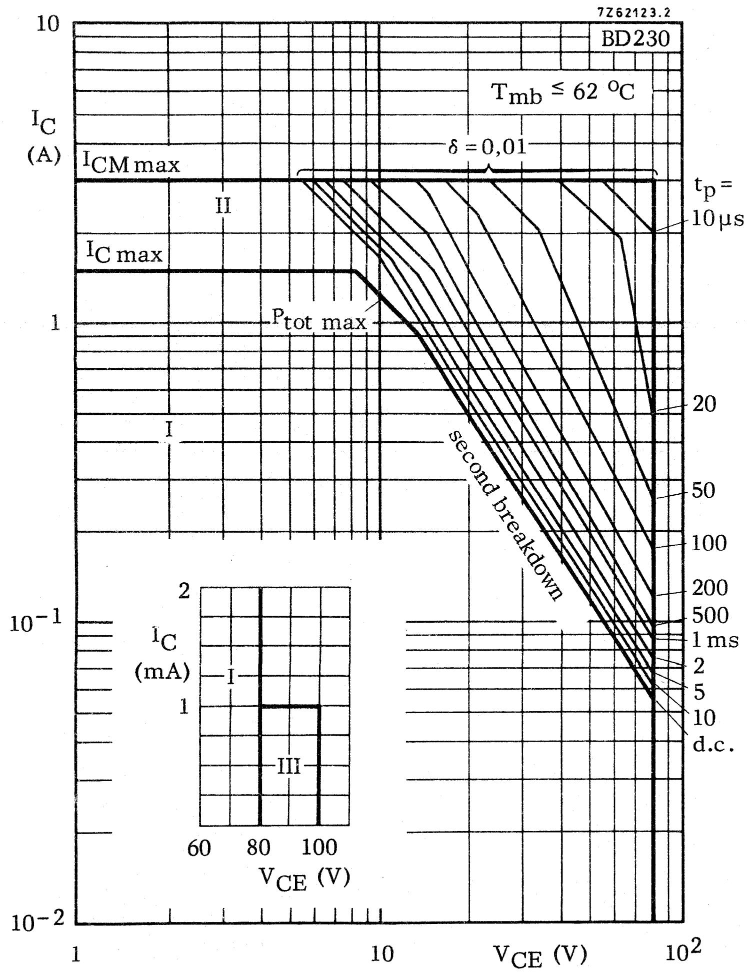
[1] V_{BE} decreases by about 2,3 mV/K with increasing temperature.



Safe Operating Area with the transistor forward biased

I Region of permissible d. c. operation

II Permissible extension for repetitive pulse operation

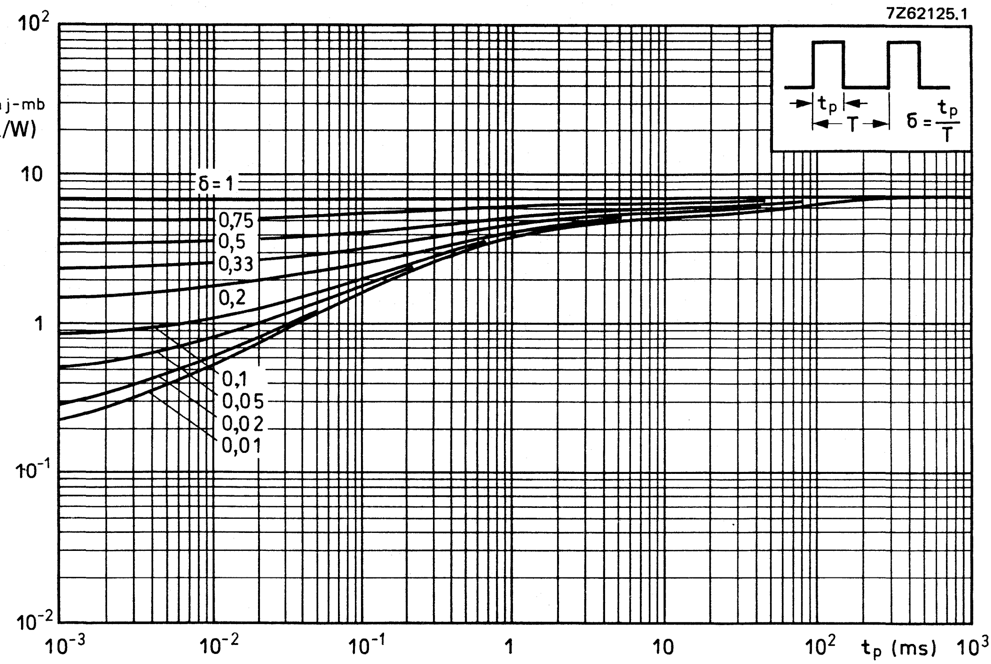


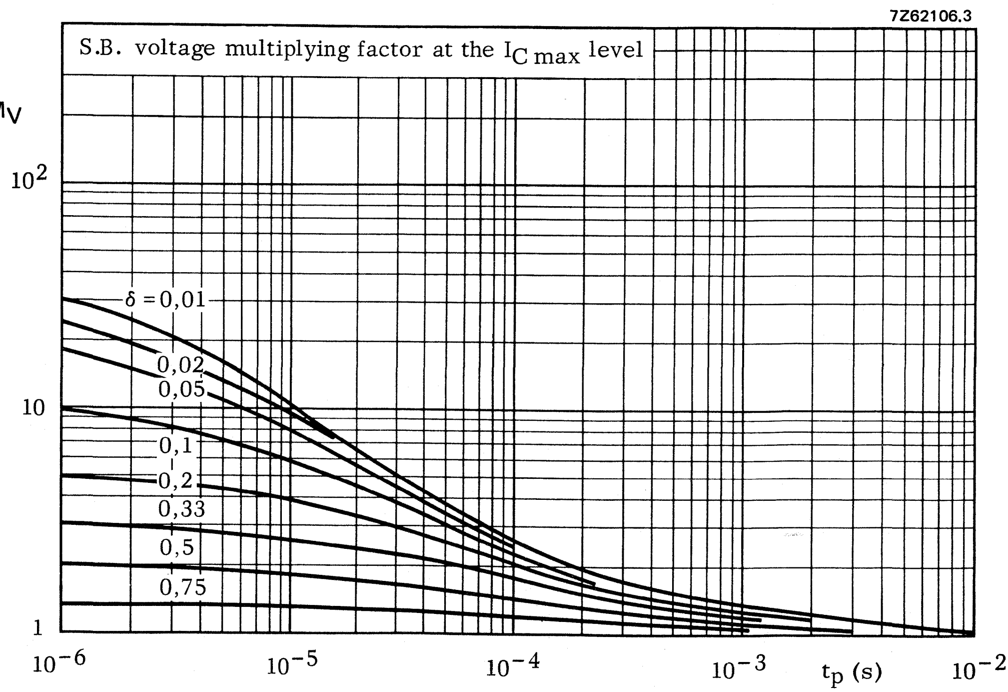
Safe Operating Area with the transistor forward biased

I Region of permissible d.c. operation

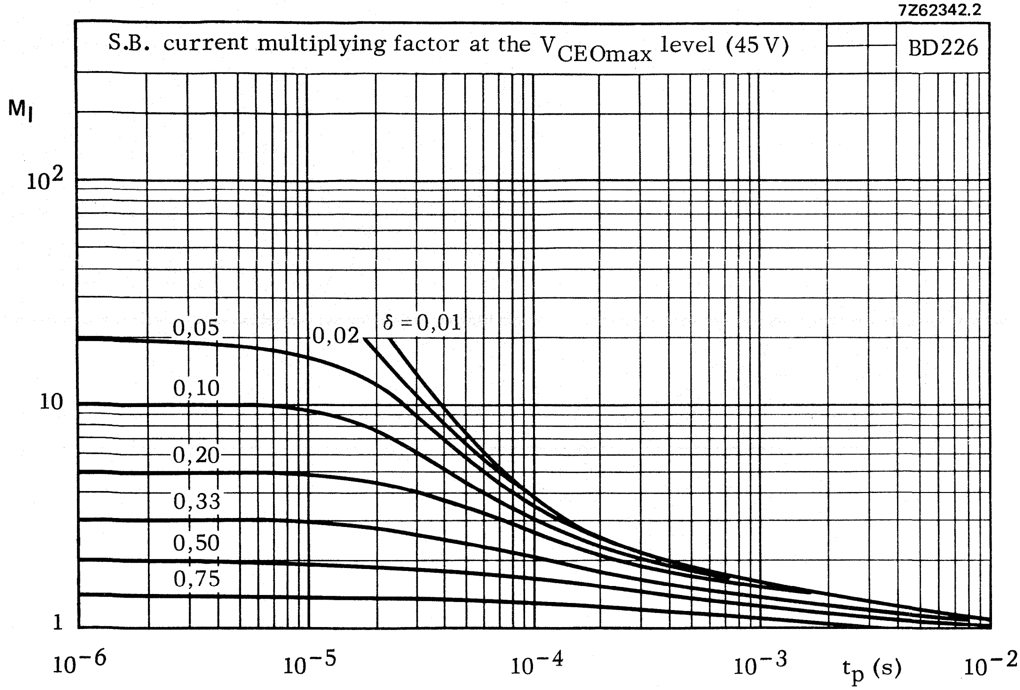
II Permissible extension for repetitive pulse operation

III Repetitive pulse operation in this region is allowable, provided $R_{BE} \leq 1\ k\Omega$

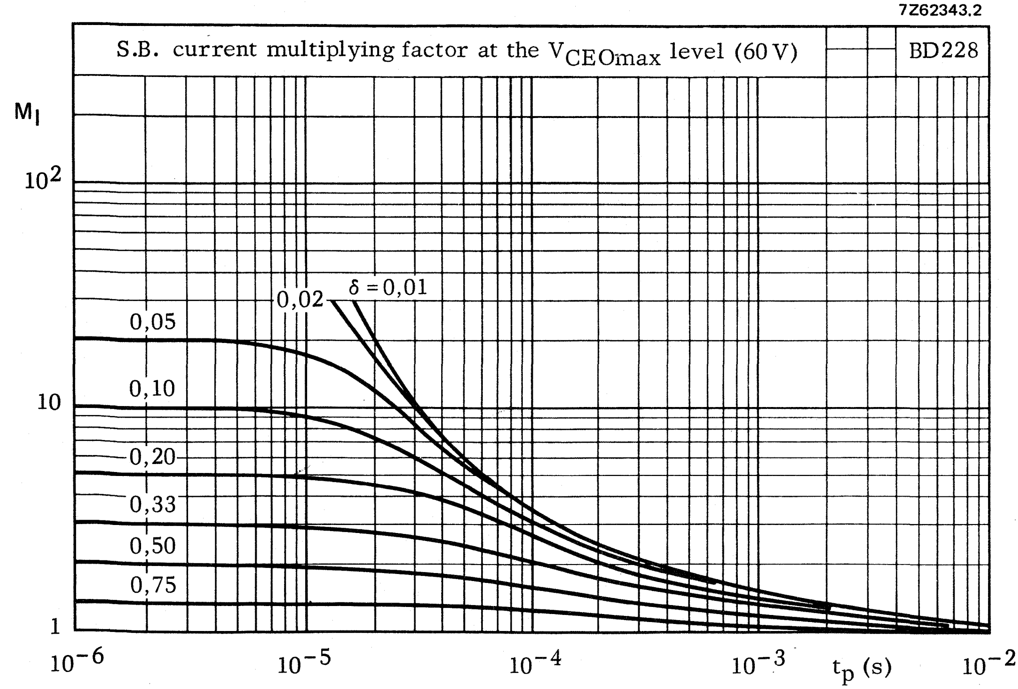

7Z62125.1
$Z_{th\,j\text{-}mb}$ (K/W)
10^2
10
1
10^{-1}
10^{-2}
δ = 1
0,75
0,5
0,33
0,2
0,1
0,05
0,02
0,01
t_p
T
$\delta = \frac{t_p}{T}$
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
t_p (ms)
10^3

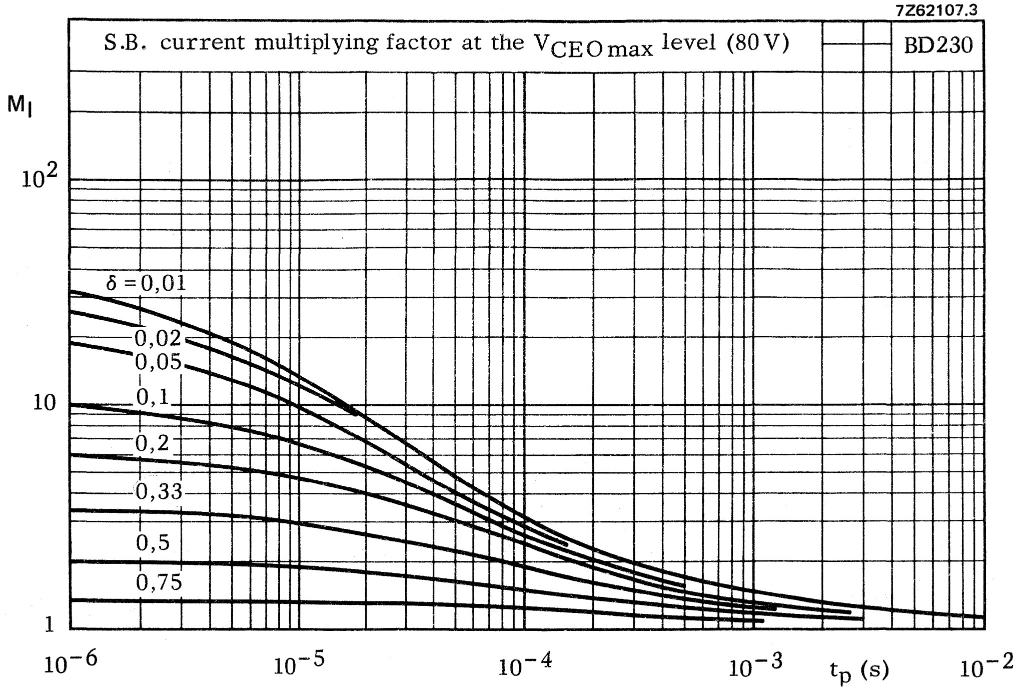

7Z62106.3
S.B. voltage multiplying factor at the $I_{C\,max}$ level
M_V
10^2
10
1
δ = 0,01
0,02
0,05
0,1
0,2
0,33
0,5
0,75
10^{-6}
10^{-5}
10^{-4}
10^{-3}
t_p (s)
10^{-2}

7Z62342.2



7Z62343.2




7Z62107.3
S.B. current multiplying factor at the $V_{CEO max}$ level (80 V)
BD230
M_I
10^2
10
1
δ = 0,01
0,02
0,05
0,1
0,2
0,33
0,5
0,75
10^{-6}
10^{-5}
10^{-4}
10^{-3}
t_p (s)
10^{-2}

SILICON PLANAR EPITAXIAL POWER TRANSISTORS

General purpose pnp transistors in a SOT-32 plastic package especially recommended for television circuits. Their complements are BD226, BD228 and BD230.

QUICK REFERENCE DATA

			BD227	BD229	BD231	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	45	60	100	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	$-V_{CER}$	max.	45	60	100	V
Collector current (peak value)	$-I_{CM}$	max.	3	3	3	A
Total power dissipation up to T_{mb} = 62 °C	P_{tot}	max.	12.5	12.5	12.5	W
Junction temperature	T_j	max.	150	150	150	°C
DC current gain						
$-I_C$ = 150 mA; $-V_{CE}$ = 2 V	h_{FE}			40 to 250		
$-I_C$ = 1 A; $-V_{CE}$ = 2 V	h_{FE}	>		25		
Transition frequency at f = 100 MHz						
$-I_C$ = 50 mA; $-V_{CE}$ = 5 V	f_T	typ.		50		MHz

MECHANICAL DATA

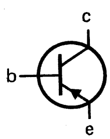
Dimensions in mm

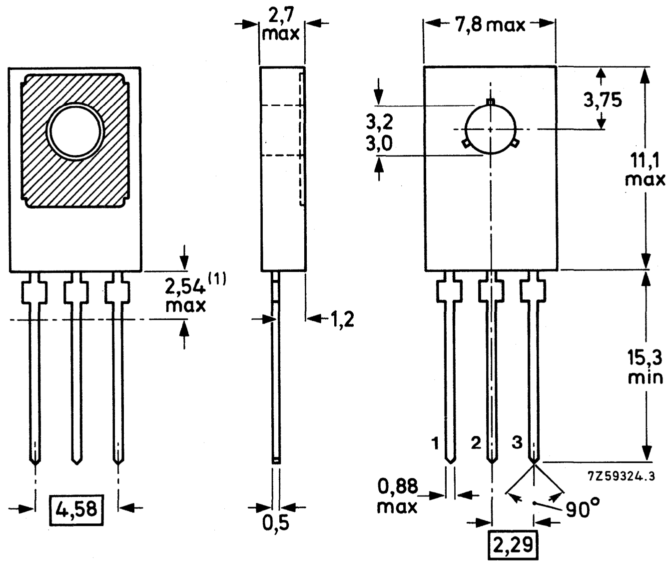
Fig. 1 TO-126 (SOT-32)

Collector connected to metal part of mounting surface.

Pinning:

1 = emitter
2 = collector
3 = base





See Mounting Instructions and Accessories

1) Within this region the cross-section of the leads is uncontrolled.

RATINGS

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

			BD227	BD229	BD231	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	45	60	100	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	$-V_{CER}$	max.	45	60	100	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	V
Collector current (DC)	$-I_C$	max.		1.5		A
Collector current (peak value)	$-I_{CM}$	max.		3		A
Total power dissipation up to T_{mb} = 62 °C	P_{tot}	max.		12.5		W
Storage temperature	T_{stg}			−65 to + 150		°C
Junction temperature	T_j	max.		150		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	100	K/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	7	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $-V_{CB} = 30$ V	$-I_{CBO}$	<	100	nA
$I_E = 0$; $-V_{CB} = 30$ V; $T_j = 125$ °C	$-I_{CBO}$	<	10	μA
Emitter cut-off current				
$I_C = 0$; $-V_{EB} = 5$ V	$-I_{EBO}$	<	10	μA
Base-emitter voltage *				
$-I_C = 1$ A; $-V_{CE} = 2$ V	$-V_{BE}$	<	1.3	V
Saturation voltage				
$-I_C = 1$ A; $-I_B = 0.1$ A	$-V_{CEsat}$	<	0.8	V
DC current gain				
$-I_C =$ 5 mA; $-V_{CE} = 2$ V	h_{FE}	>	25	
$-I_C = 150$ mA; $-V_{CE} = 2$ V	h_{FE}	<	40 to 250	
$-I_C =$ 1 A; $-V_{CE} = 2$ V	h_{FE}	>	25	
Transition frequency at f = 100 MHz				
$-I_C = 50$ mA; $-V_{CE} = 5$ V	f_T	typ.	50	MHz
DC current gain ratio of matched pairs BD226/BD227; BD228/BD229; BD230/BD231				
$\|I_C\| = 150$ mA; $\|V_{CE}\| = 2$ V	h_{FE1}/h_{FE2}	typ.	1.3	
		<	1.6	

* $-V_{BE}$ decreases by about 2.3 mV/K with increasing temperature.

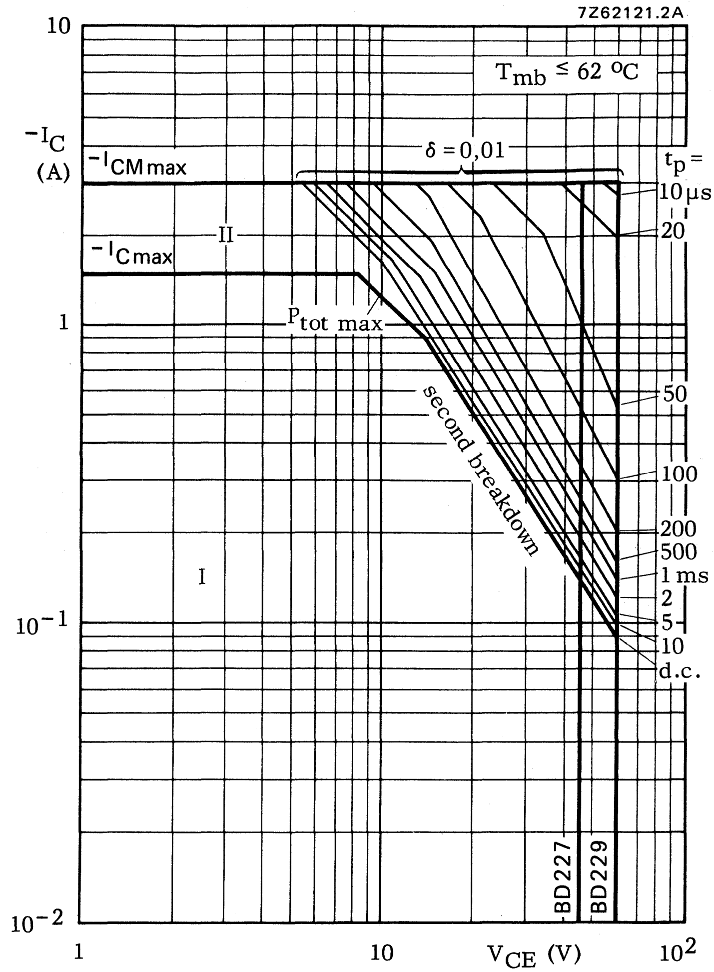


Fig. 2 Safe operating area with the transistor forward biased.

I Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.

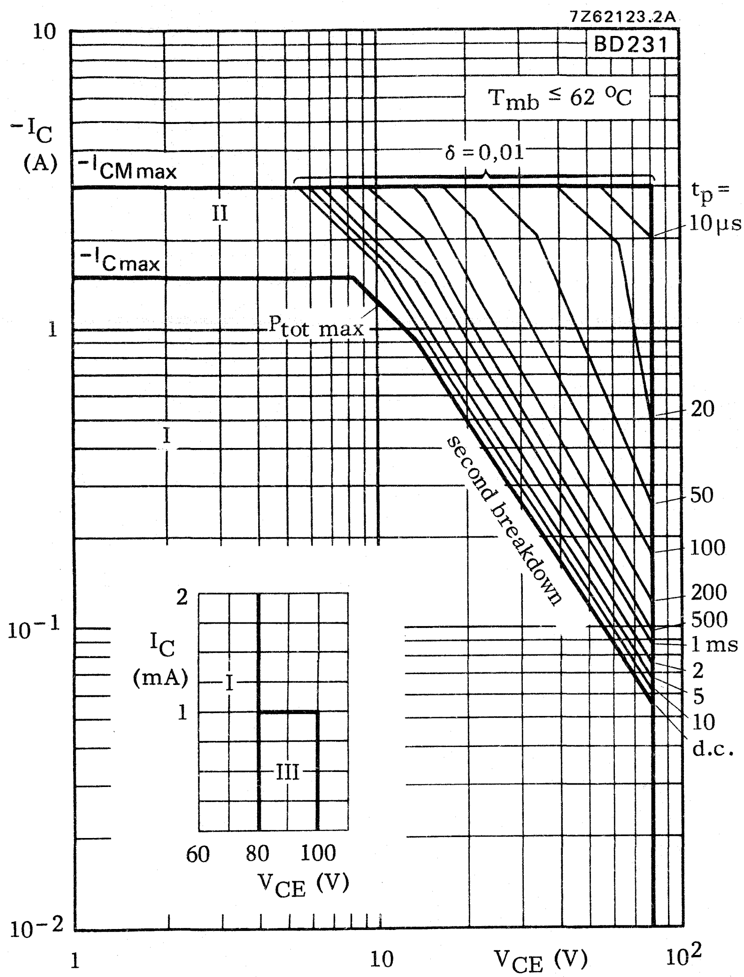


Fig. 3 Safe operating area with the transistor forward biased.

I Region of permissible DC operation.

II Permissible extension for repetitive pulse operation.

III Repetitive pulse operation in this region is allowable, provided $R_{BE} \leqslant 1\ k\Omega$.

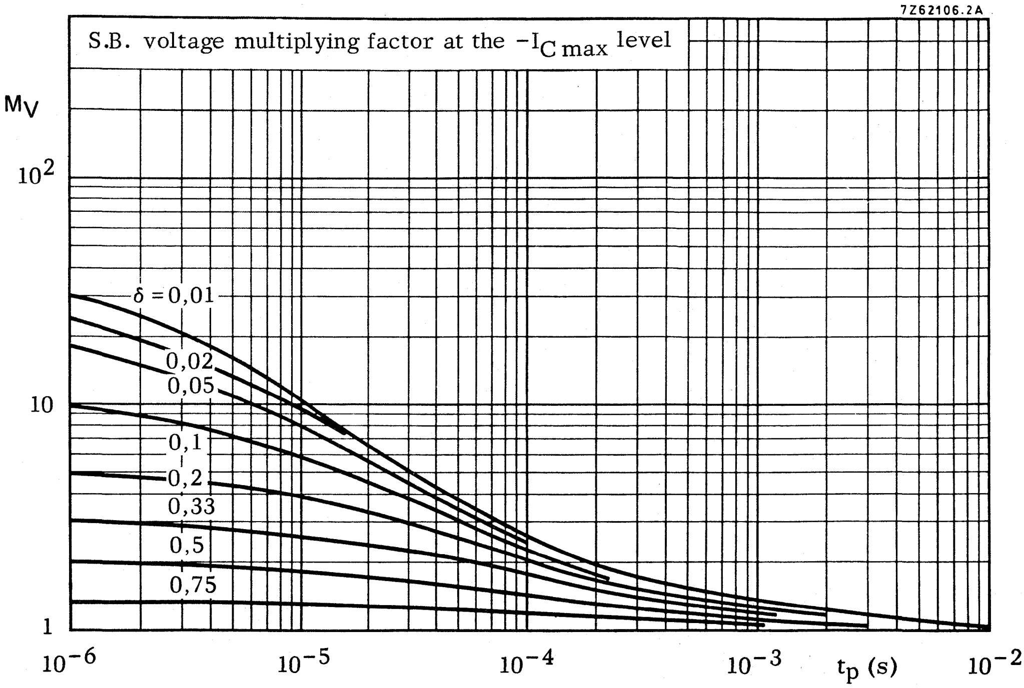

7Z62106.2A
S.B. voltage multiplying factor at the $-I_{C\,max}$ level
M_V
10^2
10
1
δ = 0,01
0,02
0,05
0,1
0,2
0,33
0,5
0,75
10^{-6}
10^{-5}
10^{-4}
10^{-3}
t_p (s)
10^{-2}

Fig. 4.

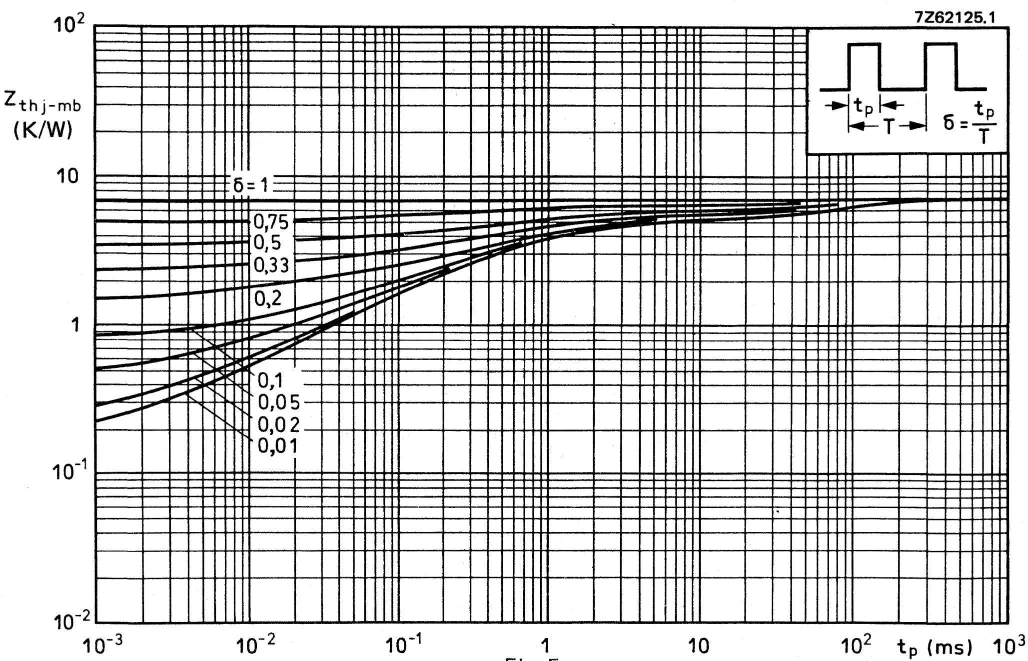

7Z62125.1
$Z_{th\,j\text{-}mb}$
(K/W)
10^2
10
1
10^{-1}
10^{-2}
δ = 1
0,75
0,5
0,33
0,2
0,1
0,05
0,02
0,01
t_p
T
$\delta = \frac{t_p}{T}$
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
t_p (ms)
10^3

Fig. 5.

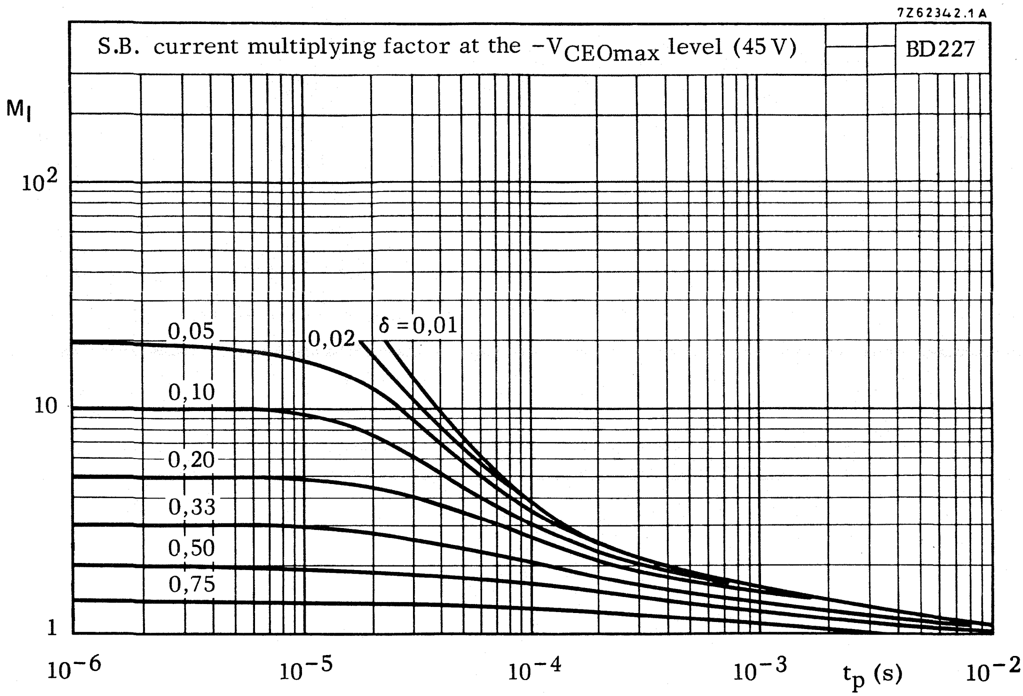

7Z62342.1A
S.B. current multiplying factor at the $-V_{CEOmax}$ level (45 V)
BD227
M_I
10^2
10
1
0,05
0,02
δ = 0,01
0,10
0,20
0,33
0,50
0,75
10^{-6}
10^{-5}
10^{-4}
10^{-3}
t_p (s)
10^{-2}

Fig. 6.

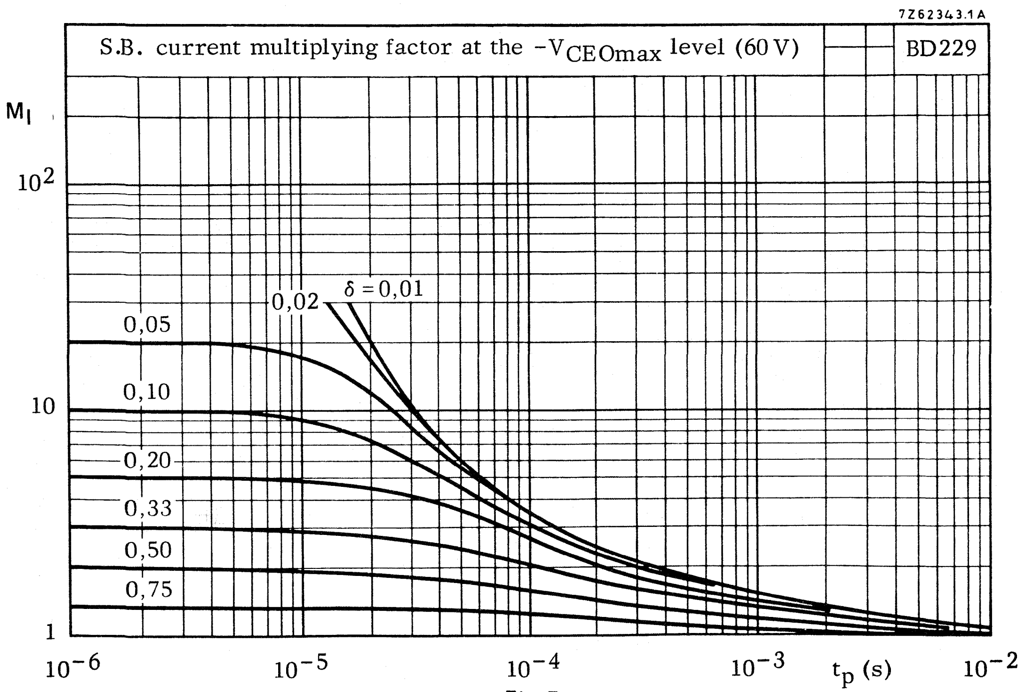

7Z62343.1A
S.B. current multiplying factor at the $-V_{CEOmax}$ level (60 V)
BD229
M_I
10^2
10
1
0,02
δ = 0,01
0,05
0,10
0,20
0,33
0,50
0,75
10^{-6}
10^{-5}
10^{-4}
10^{-3}
t_p (s)
10^{-2}

Fig. 7.

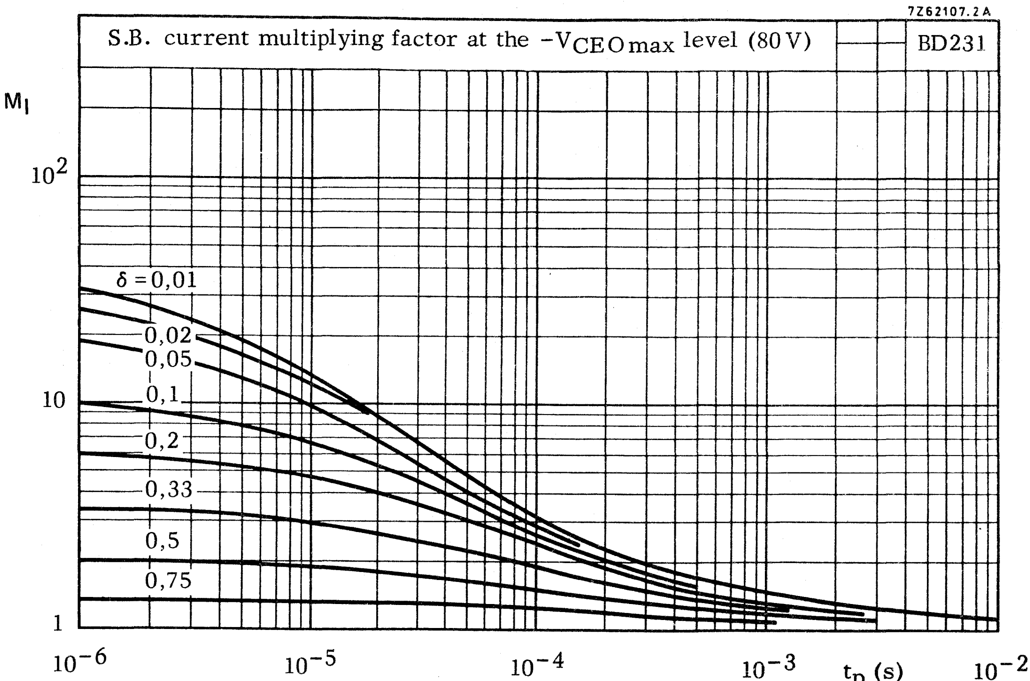

7Z62107.2A
S.B. current multiplying factor at the $-V_{CEOmax}$ level (80 V)
BD231
M_I
10^2
10
1
δ = 0,01
0,02
0,05
0,1
0,2
0,33
0,5
0,75
10^{-6}
10^{-5}
10^{-4}
10^{-3}
t_p (s)
10^{-2}

Fig. 8.

SILICON PLANAR EPITAXIAL POWER TRANSISTOR

N-P-N transistor in a SOT-32 plastic package, intended for car-radio output stages. P-N-P complement is BD330. Matched pairs can be supplied.

QUICK REFERENCE DATA

Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	32	V
Collector-emitter voltage (open base)	V_{CEO}	max.	20	V
Collector current (peak value)	I_{CM}	max.	3	A
Total power dissipation up to T_{mb} = 45 °C	P_{tot}	max.	15	W
Junction temperature	T_j	max.	150	°C
D.C. current gain I_C = 0,5 A; V_{CE} = 1 V	h_{FE}		85 to 375	
Transition frequency at 100 MHz I_C = 50 mA; V_{CE} = 5 V	f_T	typ.	130	MHz

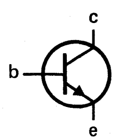
MECHANICAL DATA

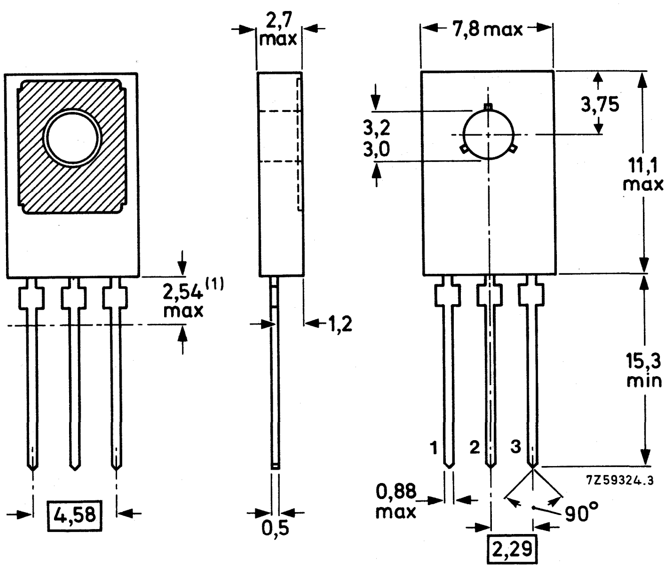
Dimensions in mm

TO-126 (SOT-32)

Collector connected to metal part of mounting surface

Pinning
1 = emitter
2 = collector
3 = base





See chapters Mounting Instructions and Accessories.

1) Within this region the cross-section of the leads is uncontrolled.

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

Collector-base voltage (open emitter)	V_{CBO}	max.	32	V
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	32	V
Collector-emitter voltage (open base)	V_{CEO}	max.	20	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V
Collector current (d.c.)	I_C	max.	3	A
Collector current (peak value)	I_{CM}	max.	3	A
Base current (d.c.)	I_B	max.	1	A
Emitter current (d.c.)	$-I_E$	max.	3	A
Total power dissipation up to T_{mb} = 45 °C	P_{tot}	max.	15	W
Storage temperature	T_{stg}		− 65 to +150	°C
Junction temperature	T_j	max.	150	°C

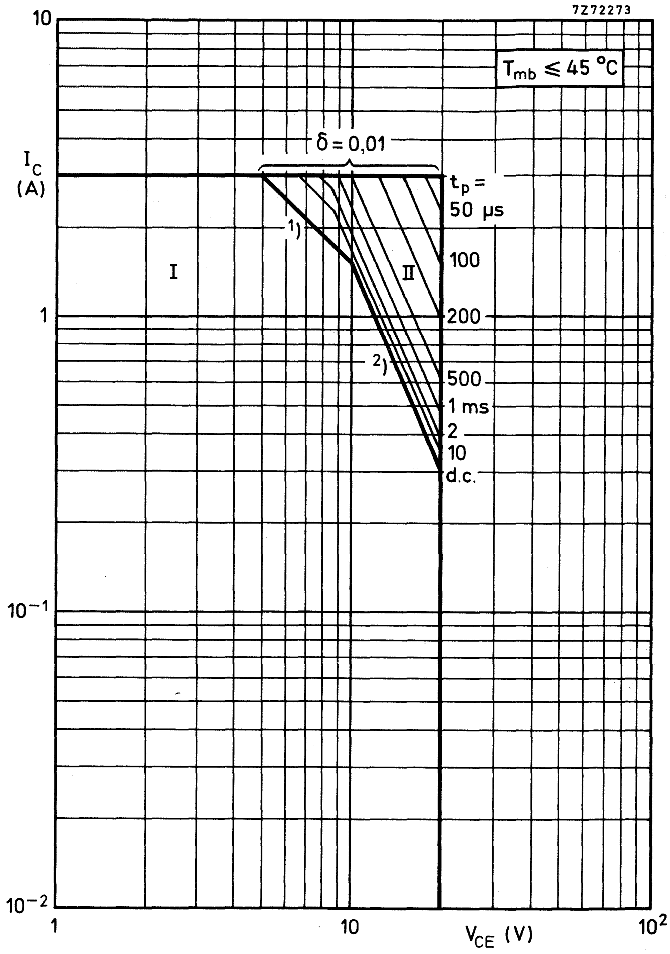
THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	7	K/W
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	100	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

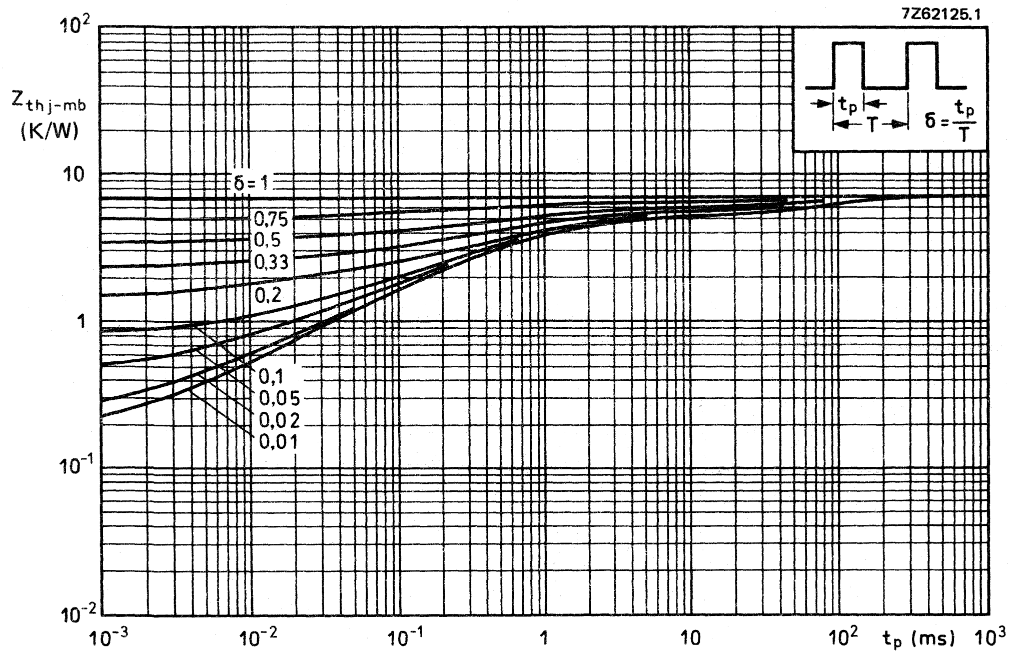
Collector cut-off current				
$I_E = 0$; $V_{CB} = 32$ V	I_{CBO}	<	10	μA
$I_E = 0$; $V_{CB} = 32$ V; $T_j = 150$ °C	I_{CBO}	<	1	mA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	<	10	μA
Base-emitter voltage				
$I_C = 5$ mA; $V_{CE} = 10$ V	V_{BE}	typ.	0,6	V
$I_C = 2$ A; $V_{CE} = 1$ V	V_{BE}	<	1,2	V
Collector-emitter saturation voltage				
$I_C = 2$ A; $I_B = 0,2$ A	V_{CEsat}	<	0,5	V
D.C. current gain				
$I_C = 5$ mA; $V_{CE} = 10$ V	h_{FE}	>	50	
$I_C = 0,5$ A; $V_{CE} = 1$ V	h_{FE}		85 to 375	
$I_C = 2$ A; $V_{CE} = 1$ V	h_{FE}	>	40	
Transition frequency at f = 100 MHz				
$I_C = 50$ mA; $V_{CE} = 5$ V	f_T	typ.	130	MHz
D.C. current gain ratio of matched pairs				
BD329/BD330				
$\|I_C\| = 0,5$ A; $\|V_{CE}\| = 1$ V	h_{FE1}/h_{FE2}	<	1,6	

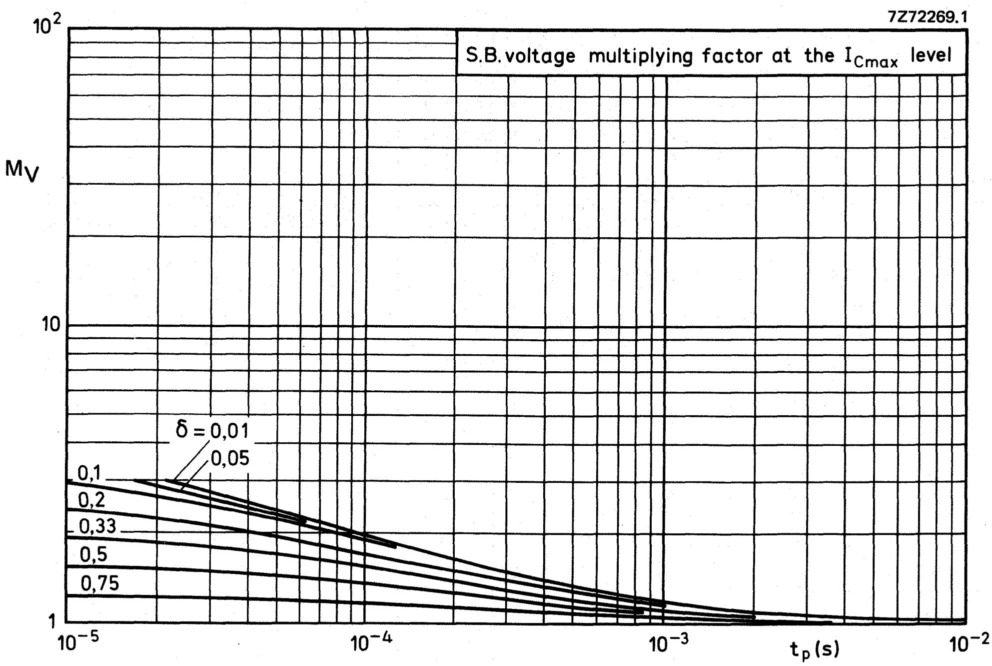


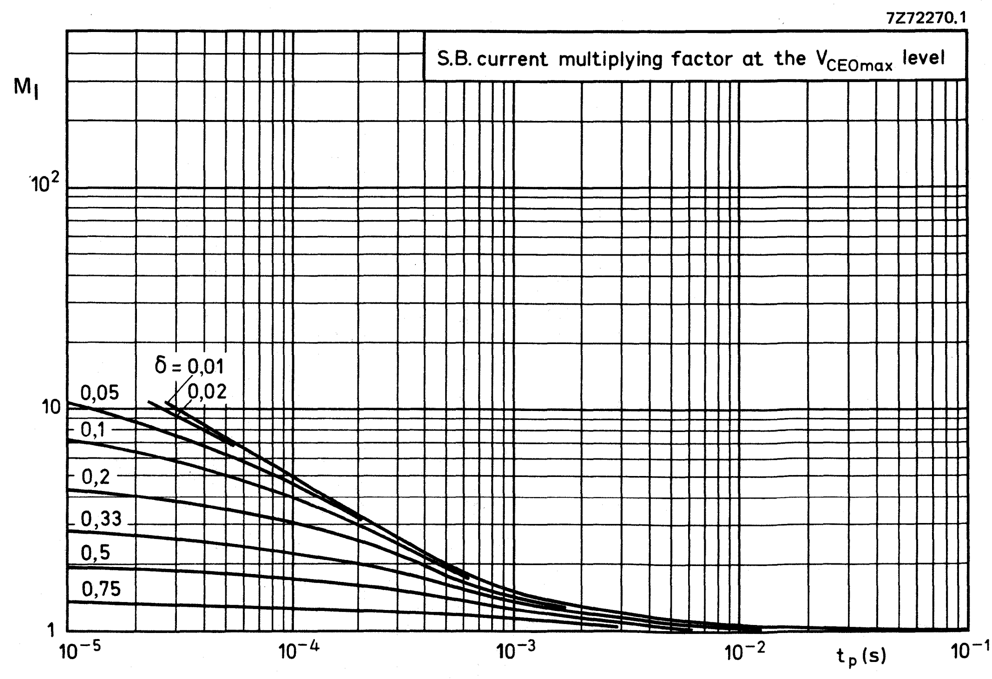
Safe Operating Area with the transistor forward biased

I Region of permissible d.c. operation
II Permissible extension for repetive pulse operation

1) $P_{tot\ max}$ and $P_{peak\ max}$ lines.
2) Second-breakdown limits


7Z62125.1
$Z_{th\,j\text{-}mb}$ (K/W)
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
t_p (ms)
10^3
δ = 1
0,75
0,5
0,33
0,2
0,1
0,05
0,02
0,01
t_p
T
$\delta = \frac{t_p}{T}$


7Z72269.1
S.B. voltage multiplying factor at the I_{Cmax} level
M_V
10^2
10
1
$\delta = 0,01$
0,05
0,1
0,2
0,33
0,5
0,75
10^{-5}
10^{-4}
10^{-3}
t_p (s)
10^{-2}


7Z72270.1
S.B. current multiplying factor at the V_{CEOmax} level
M_I
10^2
10
1
$\delta = 0,01$
0,02
0,05
0,1
0,2
0,33
0,5
0,75
10^{-5}
10^{-4}
10^{-3}
10^{-2}
t_p (s)
10^{-1}

SILICON PLANAR EPITAXIAL POWER TRANSISTOR

P-N-P transistor in a SOT-32 plastic package intended for car-radio output stages. N-P-N complement is BD329. Matched pairs can be supplied.

QUICK REFERENCE DATA

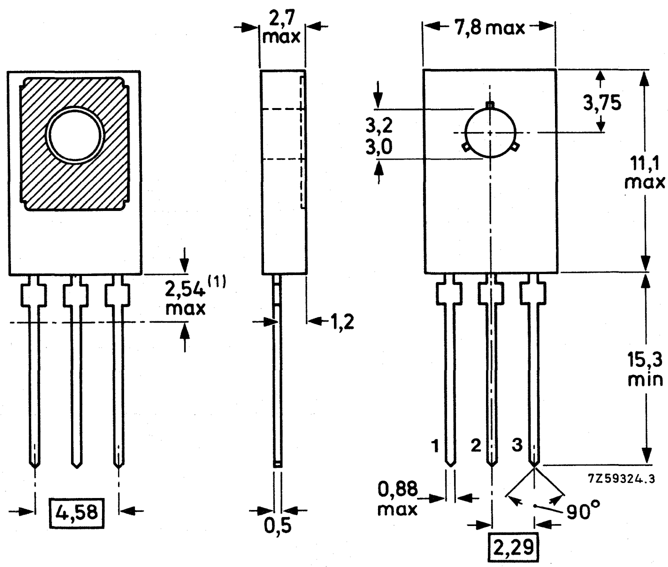
Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	32	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	20	V
Collector current (peak value)	$-I_{CM}$	max.	3	A
Total power dissipation up to T_{mb} = 45 °C	P_{tot}	max.	15	W
Junction temperature	T_j	max.	150	°C
D.C. current gain $-I_C$ = 0,5 A; $-V_{CE}$ = 1 V	h_{FE}		85 to 375	
Transition frequency at f = 100 MHz $-I_C$ = 50 mA; $-V_{CE}$ = 5 V	f_T	typ.	100	MHz

MECHANICAL DATA

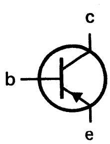
Dimensions in mm

TO-126 (SOT-32)

Collector connected to metal part of mounting surface



Pinning
1 = emitter
2 = collector
3 = base



See chapters Mounting Instructions and Accessories.

1) Within this region the cross-section of the leads is uncontrolled.

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

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	32	V
Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	32	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	20	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	V
Collector current (d.c.)	$-I_C$	max.	3	A
Collector current (peak value)	$-I_{CM}$	max.	3	A
Base current (d.c.)	$-I_B$	max.	1	A
Emitter current (d.c.)	I_E	max.	3	A
Total power dissipation up to T_{mb} = 45 °C	P_{tot}	max.	15	W
Storage temperature	T_{stg}		− 65 to +150	°C
Junction temperature	T_j	max.	150	°C

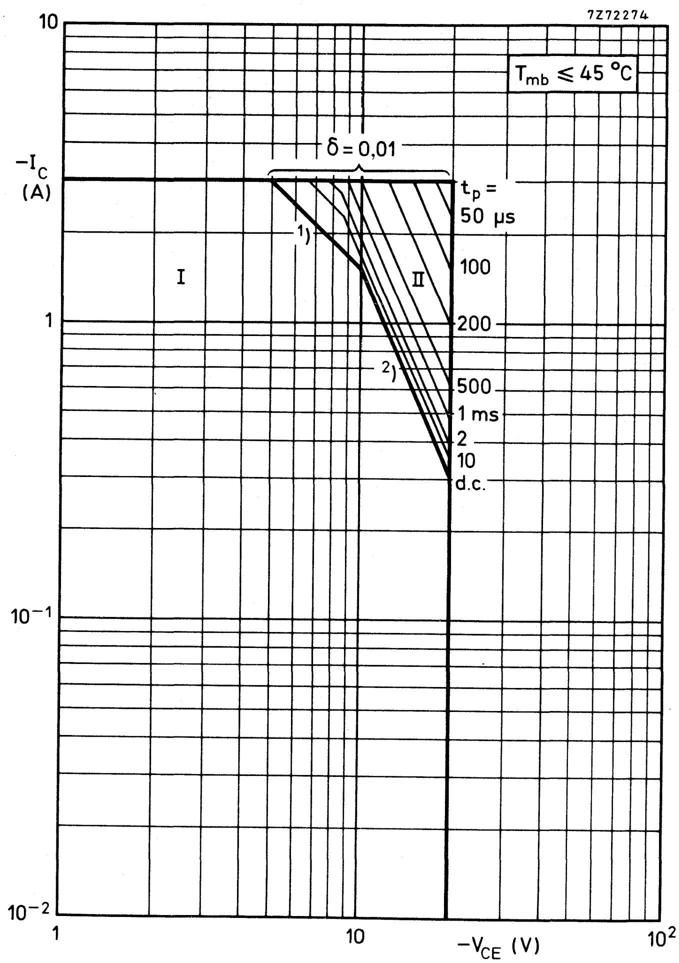
THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	7	K/W
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	100	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $-V_{CB} = 32$ V	$-I_{CBO}$	<	10	μA
$I_E = 0$; $-V_{CB} = 32$ V; $T_j = 150$ °C	$-I_{CBO}$	<	1	mA
Emitter cut-off current				
$I_C = 0$; $-V_{EB} = 5$ V	$-I_{EBO}$	<	10	μA
Base-emitter voltage				
$-I_C = 5$ mA; $-V_{CE} = 10$ V	$-V_{BE}$	typ.	0,6	V
$-I_C = 2$ A; $-V_{CE} = 1$ V	$-V_{BE}$	<	1,2	V
Collector-emitter saturation voltage				
$-I_C = 2$ A; $-I_B = 0,2$ A	$-V_{CEsat}$	<	0,5	V
D.C. current gain				
$-I_C = 5$ mA; $-V_{CE} = 10$ V	h_{FE}	>	50	
$-I_C = 0,5$ A; $-V_{CE} = 1$ V	h_{FE}		85 to 375	
$-I_C = 2$ A; $-V_{CE} = 1$ V	h_{FE}	>	40	
Transition frequency at f = 100 MHz				
$-I_C = 50$ mA; $-V_{CE} = 5$ V	f_T	typ.	100	MHz
D.C. current gain ratio of matched pairs				
BD329/BD330				
$\lvert I_C \rvert = 0,5$ A; $\lvert V_{CE} \rvert = 1$ V	h_{FE1}/h_{FE2}	<	1,6	

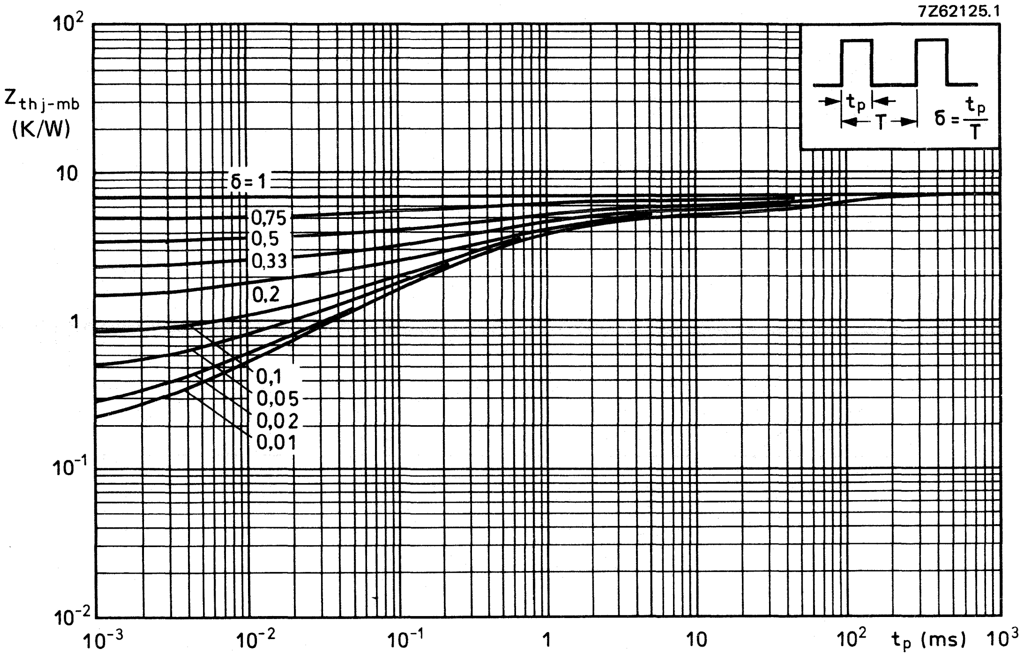


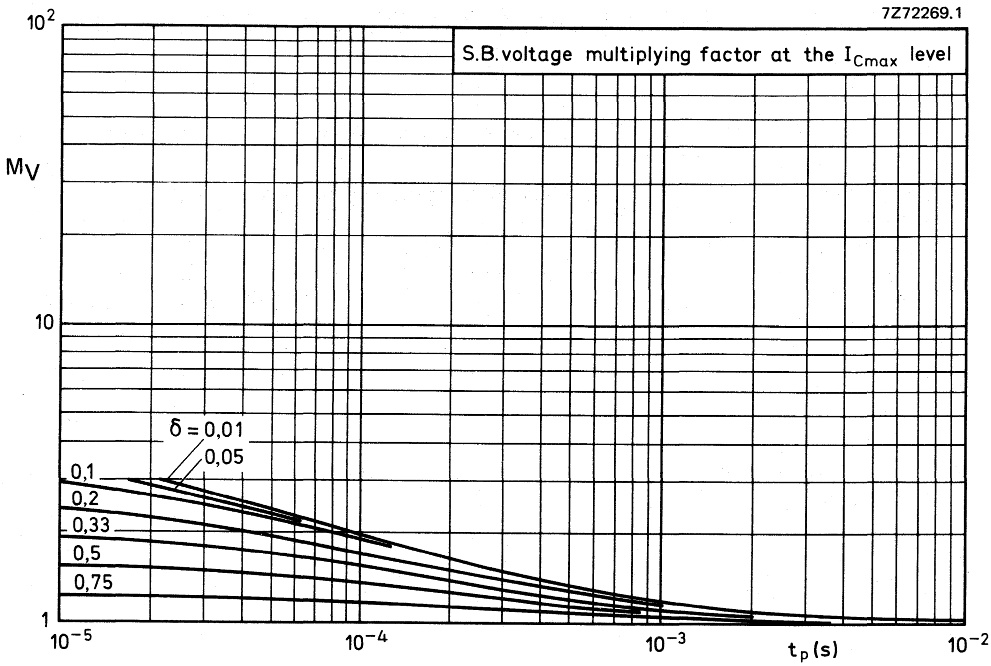
Safe Operating Area with the transistor forward biased

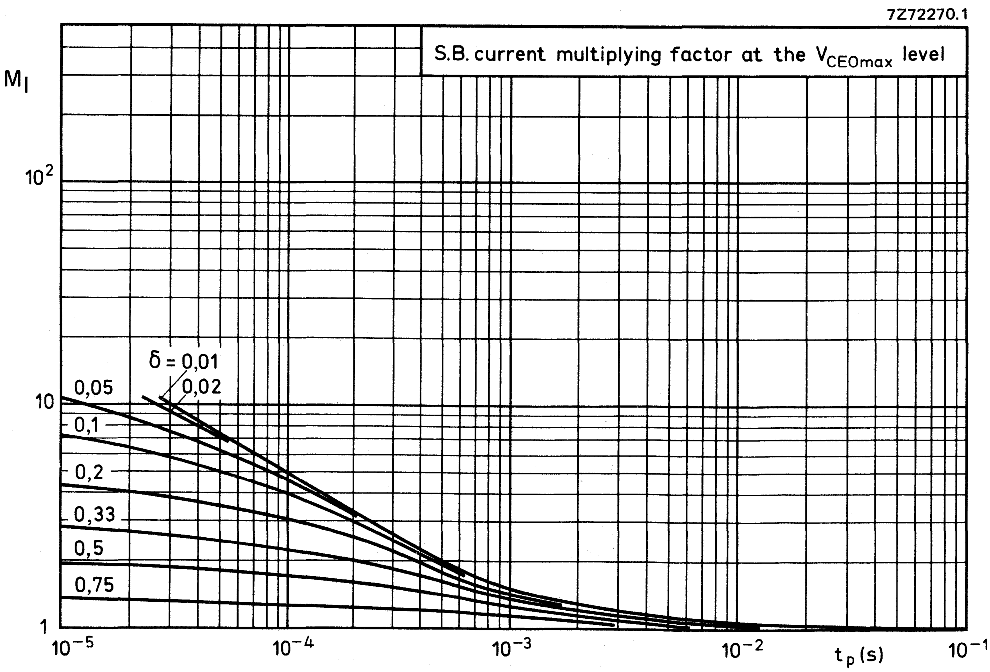
I Region of permissible d.c. operation
II Permissible extension for repetitive pulse operation

1) $P_{tot\ max}$ and $P_{peak\ max}$ lines.

2) Second-breakdown limits


7Z62125.1
10^2
$Z_{th\,j\text{-}mb}$ (K/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
t_p (ms)
10^3
δ = 1
0,75
0,5
0,33
0,2
0,1
0,05
0,02
0,01
t_p
T
$\delta = \frac{t_p}{T}$


7Z72269.1
S.B. voltage multiplying factor at the I_{Cmax} level
M_V
10^2
10
1
δ = 0,01
0,05
0,1
0,2
0,33
0,5
0,75
10^{-5}
10^{-4}
10^{-3}
t_p (s)
10^{-2}


7Z72270.1
S.B. current multiplying factor at the V_{CEOmax} level
M_I
10^2
10
1
δ = 0,01
0,02
0,05
0,1
0,2
0,33
0,5
0,75
10^{-5}
10^{-4}
10^{-3}
10^{-2}
t_p (s)
10^{-1}

SILICON PLANAR EPITAXIAL POWER TRANSISTORS

General purpose N-P-N transistors, in TO-202 plastic packages, recommended for driver-stages in hi-fi amplifiers and television circuits.

P-N-P complements are BD826, BD828 and BD830. Matched pairs can be supplied.

QUICK REFERENCE DATA

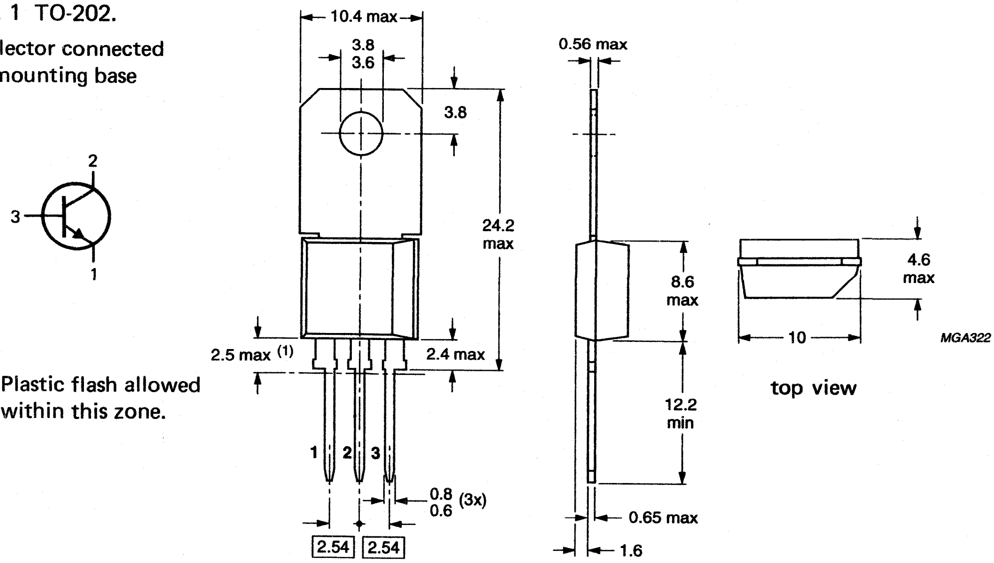
			BD825	BD827	BD829	
Collector-base voltage	V_{CBO}	max.	45	60	100	V
Collector-emitter voltage	V_{CEO}	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	V_{CER}	max.	45	60	100	V
Collector current (peak value)	I_{CM}	max.		1,5		A
Total power dissipation						
at T_{amb} = 25 °C (free air)	P_{tot}	max.		2		W
at T_{mb} = 50 °C	P_{tot}	max.		8		W
Junction temperature	T_j	max.		150		°C
D.C. current gain						
I_C = 150 mA; V_{CE} = 2 V	h_{FE}			40 to 250		
Transition frequency at f = 100 MHz						
I_C = 50 mA; V_{CE} = 5 V	f_T	typ.		250		MHz

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-202.

Collector connected to mounting base



(1) Plastic flash allowed within this zone.

RATINGS

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

			BD825	BD827	BD829	
Collector-base voltage (open emitter)	V_{CBO}	max.	45	60	100	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	V_{CER}	max.	45	60	100	V

Collector current (d.c.)	I_C	max.	1,0	A
Collector current (peak)	I_{CM}	max.	1,5	A
Total power dissipation				
T_{amb} = 25 °C (free air)	P_{tot}	max.	2	W
T_{mb} = 50 °C	P_{tot}	max.	8	W
Storage temperature	T_{stg}		−65 to + 150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	62,5	K/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	12,5	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off currents			
$I_E = 0$; $V_{CB} = 30$ V	I_{CBO}	<	100 nA
$I_E = 0$; $V_{CB} = 30$ V; $T_j = 125$ °C	I_{CBO}	<	10 μA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	<	10 μA
D.C. current gain			
$I_C =$ 5 mA; $V_{CE} = 2$ V	h_{FE}	>	25
$I_C = 150$ mA; $V_{CE} = 2$ V	h_{FE}		40 to 250
$I_C = 500$ mA; $V_{CE} = 2$ V	h_{FE}	>	25
Collector-emitter saturation voltage			
$I_C = 500$ mA; $I_B = 50$ mA	V_{CEsat}	<	0,5 V
Base-emitter voltage			
$I_C = 500$ mA; $V_{CE} = 2$ V	V_{BE}	<	1 V
Transition frequency at f = 100 MHz			
$I_C = 50$ mA; $V_{CE} = 5$ V	f_T	typ.	250 MHz
D.C. current gain ratio of matched complementary pairs			
$\|I_C\| = 150$ mA; $\|V_{CE}\| = 2$ V	h_{FE1}/h_{FE2}	typ.	1,3
		<	1,6

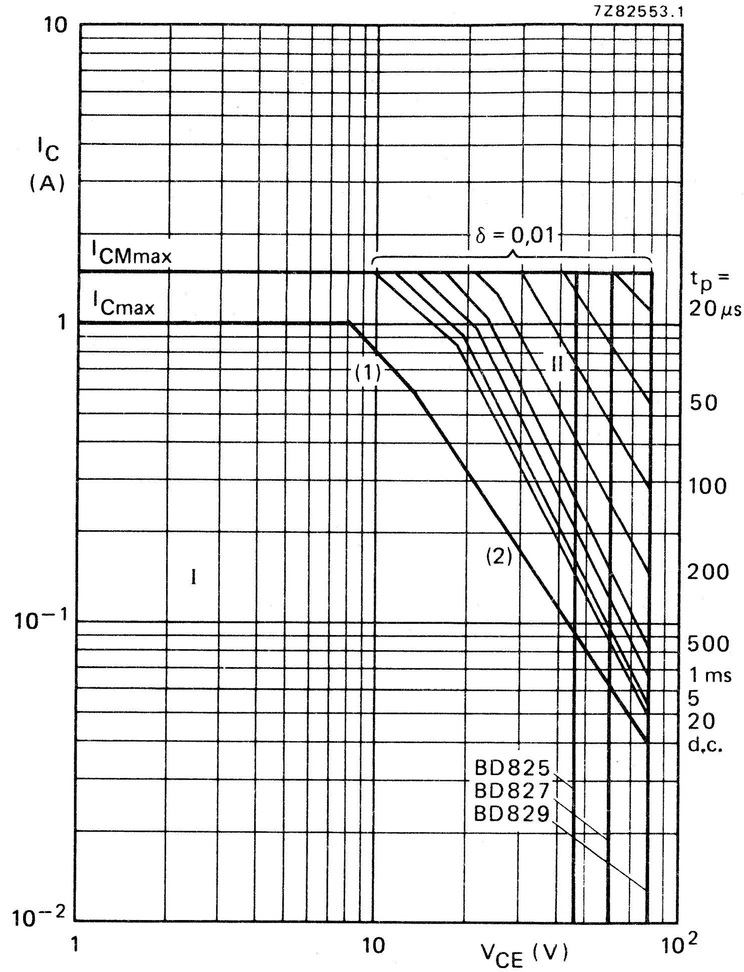


Fig. 2 Safe Operating Area, $T_{mb} \leqslant 25\ ^oC$.

I Region of permissible d.c. operation.

II Permissible extension for repetitive pulse operation.

(1) $P_{tot\,max}$ and $P_{peak\,max}$ lines.

(2) Second-breakdown limits.

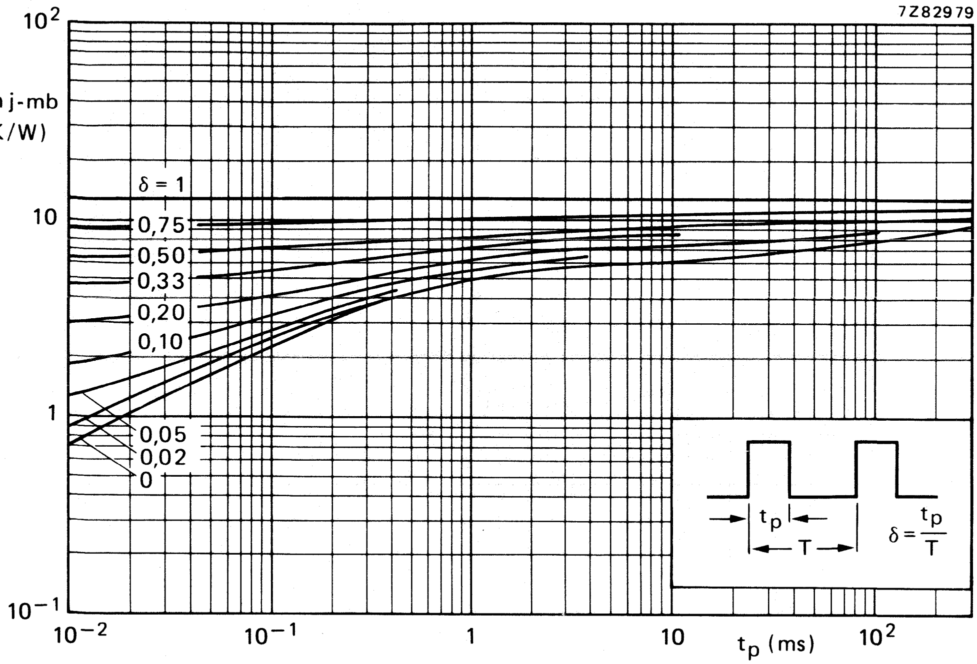


Fig. 3 Pulse power rating chart.

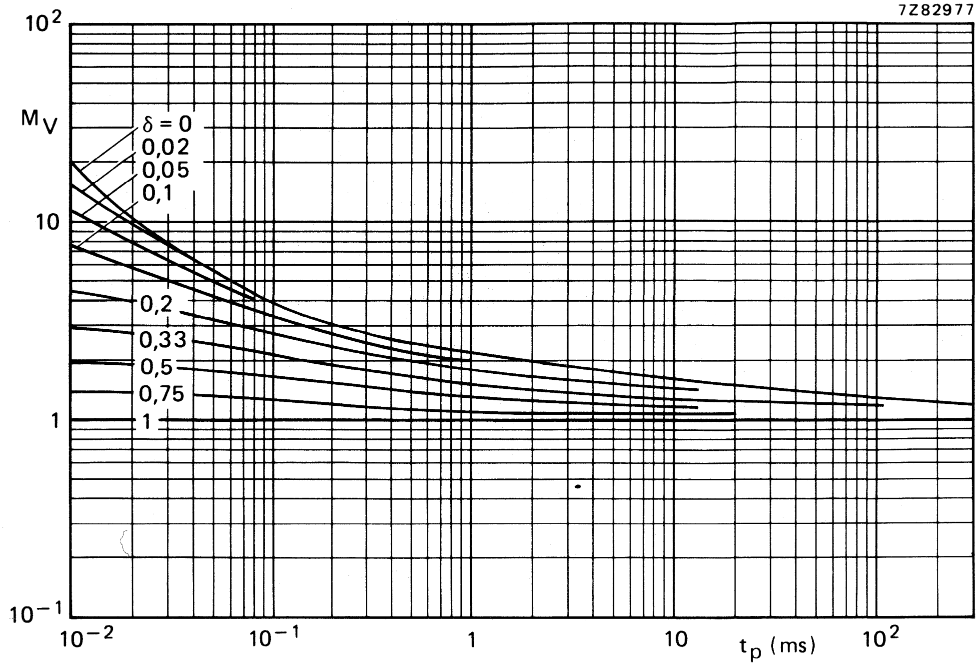


Fig. 4 S.B. voltage multiplying factor at I_{Cmax} level.

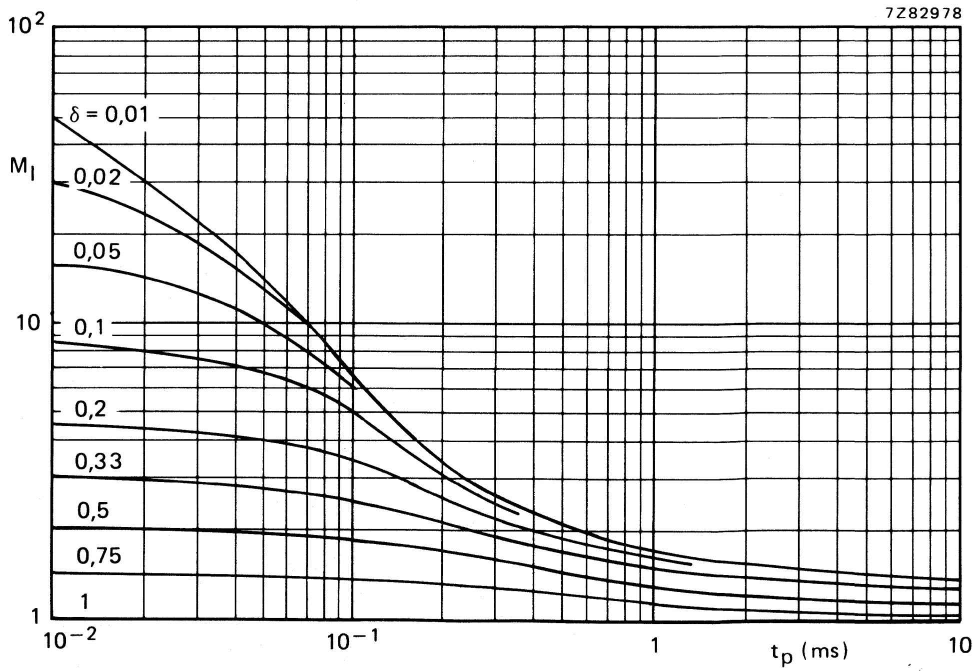


Fig. 5 S.B. current multiplying factor at V_{CEOmax} level.

SILICON PLANAR EPITAXIAL POWER TRANSISTORS

General purpose P-N-P transistors, in TO-202 plastic packages, recommended for driver stages in hi-fi amplifiers and television circuits.

N-P-N complements are BD825, BD827 and BD829. Matched pairs can be supplied.

QUICK REFERENCE DATA

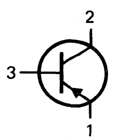
			BD826	BD828	BD830	
Collector-base voltage	$-V_{CBO}$	max.	45	60	100	V
Collector-emitter voltage	$-V_{CEO}$	max.	45	60	80	V
Collector-emitter voltage	$-V_{CER}$	max.	45	60	100	V
Collector current (peak value)	$-I_{CM}$	max.		1,5		A
Total power dissipation						
at T_{amb} = 25 °C (free air)	P_{tot}	max.		2		W
at T_{mb} = 50 °C	P_{tot}	max.		8		W
Junction temperature	T_j	max.		150		°C
D.C. current gain						
$-I_C$ = 150 mA; $-V_{CE}$ = 2 V	h_{FE}			40 to 250		
Transition frequency at f = 100 MHz						
$-I_C$ = 50 mA; $-V_{CE}$ = 5 V	f_T	typ.		75		MHz

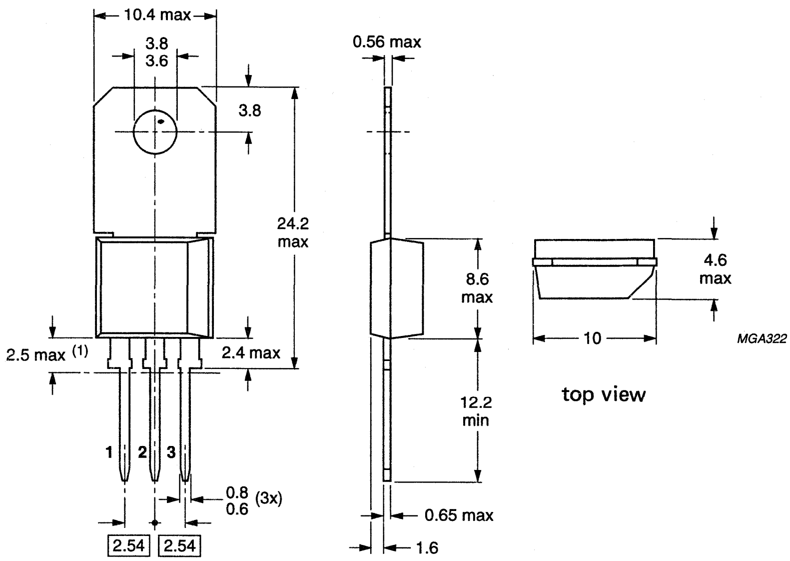
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-202.

Collector connected to mounting base.





(1) Plastic flash allowed within this zone.

RATINGS

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

			BD826	BD828	BD830	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	45	60	100	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	$-V_{CER}$	max.	45	60	100	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	V
Collector current (d.c.)	$-I_C$	max.		1		A
Collector current (peak value)	$-I_{CM}$	max.		1,5		A
Total power dissipation						
T_{amb} = 25 °C (free air)	P_{tot}	max.		2		W
T_{mb} = 50 °C	P_{tot}	max.		8		W
Storage temperature	T_{stg}			–65 to + 150		°C
Junction temperature	T_j	max.		150		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	62,5	K/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	12,5	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0$; $-V_{CB} = 30$ V	$-I_{CBO}$	<	100 nA
$I_E = 0$; $-V_{CB} = 30$ V; $T_j = 125$ °C	$-I_{CBO}$	<	10 μA
Emitter cut-off current			
$I_C = 0$; $-V_{EB} = 5$ V	$-I_{EBO}$	<	10 μA
D.C. current gain			
$-I_C =$ 5 mA; $-V_{CE} = 2$ V	h_{FE}	>	25
$-I_C = 150$ mA; $-V_{CE} = 2$ V	h_{FE}		40 to 250
$-I_C = 500$ mA; $-V_{CE} = 2$ V	h_{FE}	>	25
Collector-emitter saturation voltage			
$-I_C = 500$ mA; $-I_B = 50$ mA	$-V_{CEsat}$	<	0,5 V
Base-emitter voltage			
$-I_C = 500$ mA; $-V_{CE} = 2$ V	$-V_{BE}$	<	1 V
Transition frequency at f = 100 MHz			
$-I_C = 50$ mA; $-V_{CE} = 5$ V	f_T	typ.	75 MHz
D.C. current gain ratio of matched complementary pairs			
$\lvert I_C \rvert = 150$ mA; $\lvert V_{CE} \rvert = 2$ V	h_{FE1}/h_{FE2}	typ.	1,3
		<	1,6

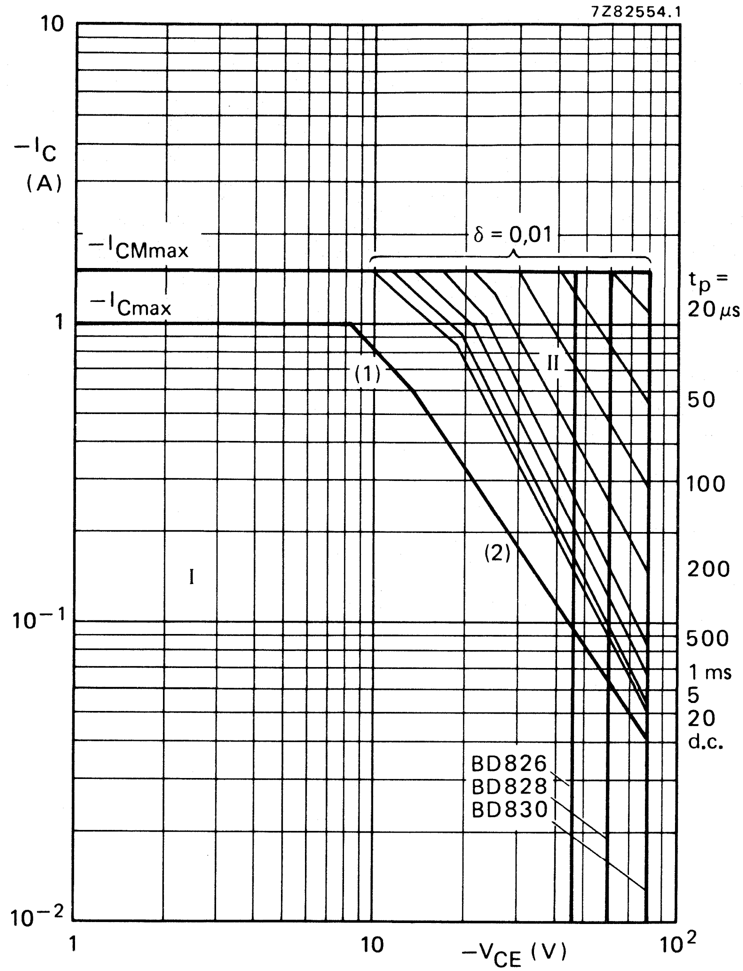


Fig. 2 Safe Operating Area, $T_{mb} \leqslant 25\ ^oC$.

I Region of permissible d.c. operation.
II Permissible extension for repetition pulse operation.

(1) $P_{tot\ max}$ and $P_{peak\ max}$ lines.
(2) Second-breakdown limits.

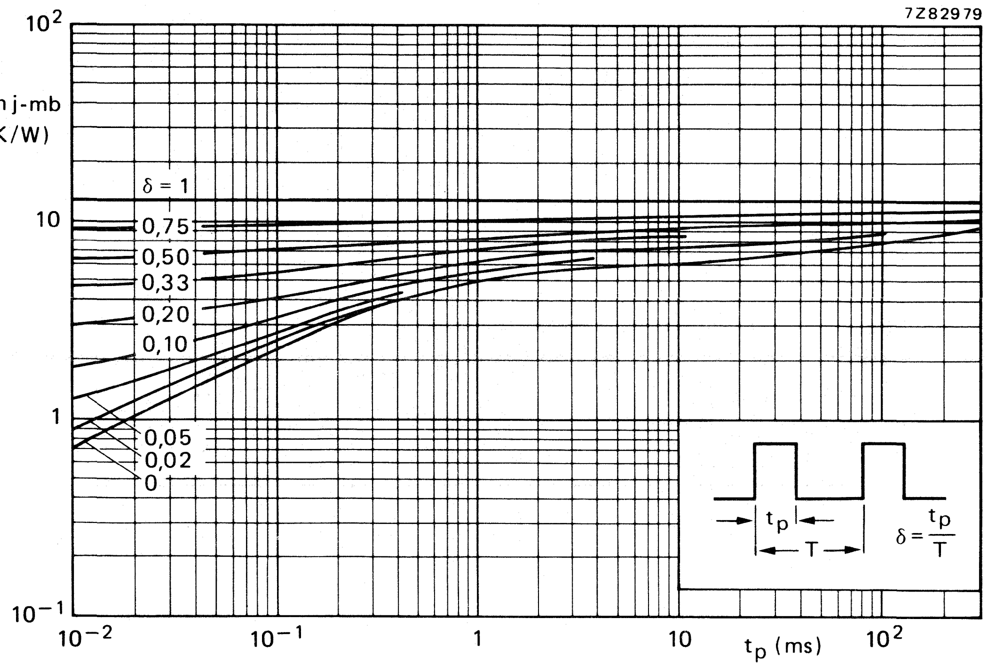


Fig. 3 Pulse power rating chart.

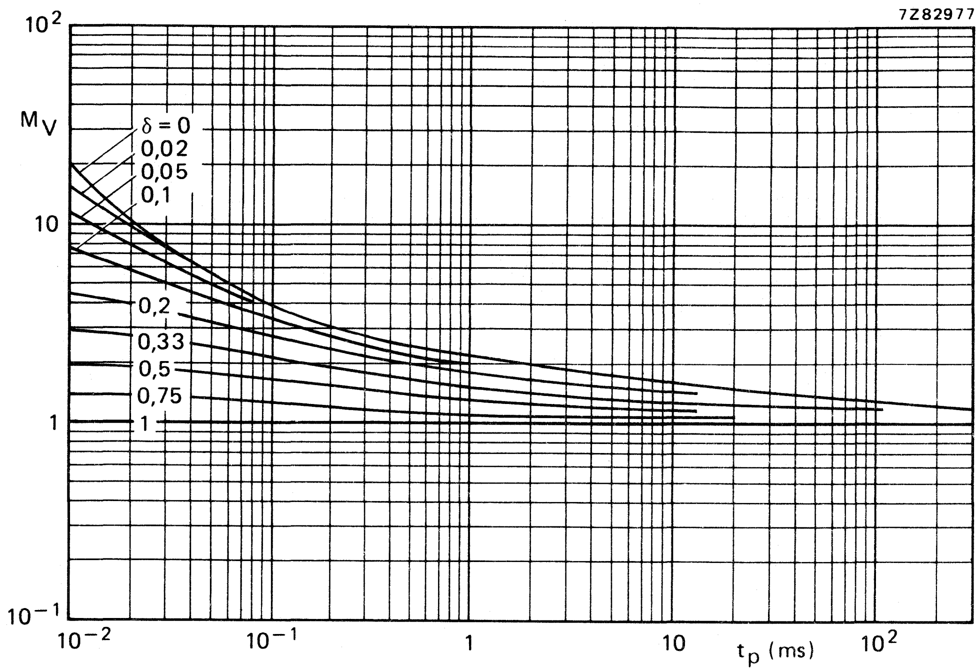


Fig. 4 S.B. voltage multiplying factor at I_{Cmax} level.

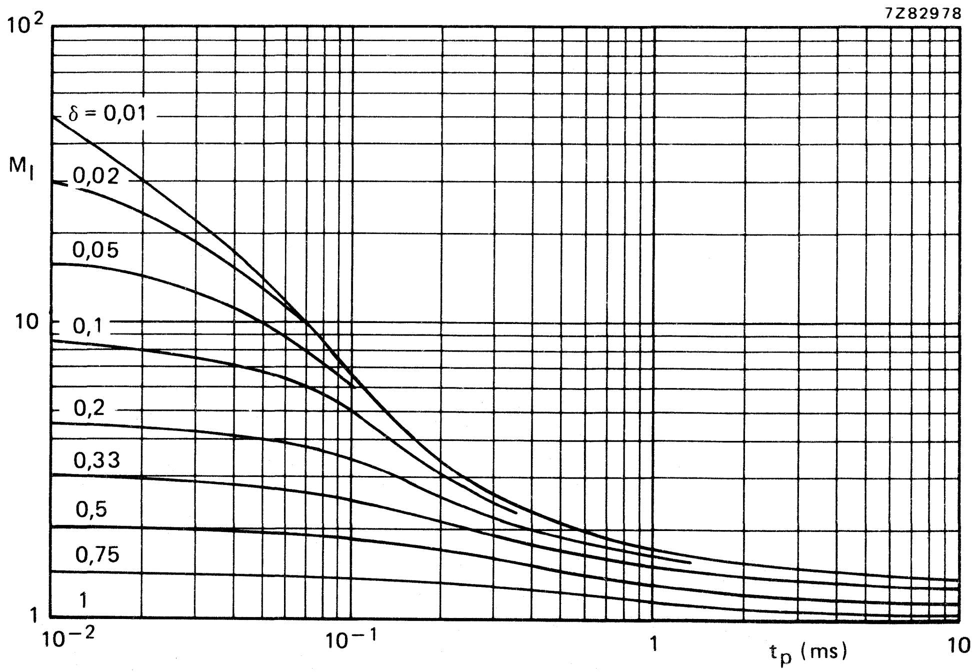


Fig. 5 S.B. current multiplying factor at V_{CEOmax} level.

SILICON PLANAR EPITAXIAL POWER TRANSISTORS

N-P-N silicon transistors, in a plastic TO-202 package, recommended for use in television circuits and audio applications.
P-N-P complements are BD840, BD842 and BD844.

QUICK REFERENCE DATA

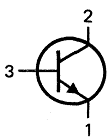
			BD839	BD841	BD843	
Collector-base voltage (open emitter)	V_{CBO}	max.	45	60	100	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	V_{CER}	max.	45	60	100	V
Collector current (peak value)	I_{CM}	max.		3		A
Total power dissipation						
T_{amb} = 25 °C (free air)	P_{tot}	max.		2		W
T_{mb} = 25 °C	P_{tot}	max.		10		W
Junction temperature	T_j	max.		150		°C
D.C. current gain						
I_C = 1 A; V_{CE} = 2 V	h_{FE}	>		25		
Transition frequency at f = 100 MHz						
I_C = 50 mA; V_{CE} = 5 V	f_T	typ.		125		MHz

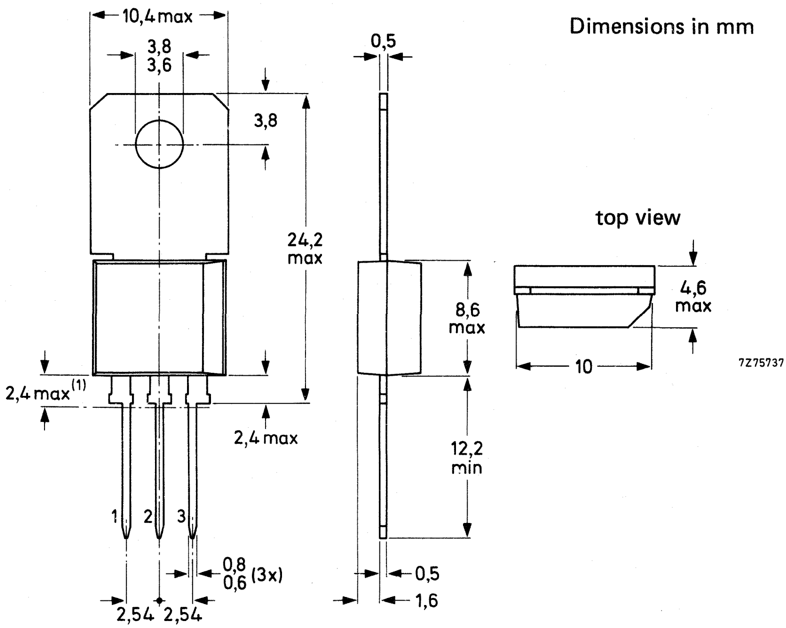
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-202.

Collector connected to mounting base.





(1) Plastic flash allowed within this zone.

RATINGS

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

			BD839	BD841	BD843	
Collector-base voltage (open emitter)	V_{CBO}	max.	45	60	100	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	V_{CER}	max.	45	60	100	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	5	V
Collector current (d.c.)	I_C	max.		1,5		A
Collector current (peak value)	I_{CM}	max.		3		A
Total power dissipation						
T_{amb} = 25 °C (free air)	P_{tot}	max.		2		W
T_{mb} = 25 °C	P_{tot}	max.		10		W
Storage temperature	T_{stg}			−65 to + 150		°C
Junction temperature	T_j	max.		150		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	62,5	K/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	12,5	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

Collector cut-off current				
$I_E = 0$; $V_{CB} = 30$ V	I_{CBO}	<	100	nA
$I_E = 0$; $V_{CB} = 30$ V; $T_j = 125$ °C	I_{CBO}	<	10	μA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	<	10	μA
Base-emitter voltage*				
$I_C = 1$ A; $V_{CE} = 2$ V	V_{BE}	<	1,3	V
Collector-emitter saturation voltage				
$I_C = 1$ A; $I_B = 0{,}1$ A	V_{CEsat}	<	0,8	V
D.C. current gain				
$I_C = 5$ mA; $V_{CE} = 2$ V	h_{FE}	>	25	
$I_C = 150$ mA; $V_{CE} = 2$ V	h_{FE}		40 to 250	
$I_C = 1$ A; $V_{CE} = 2$ V	h_{FE}	>	25	
Transition frequency at f = 100 MHz				
$I_C = 50$ mA; $V_{CE} = 5$ V	f_T	typ.	125	MHz
D.C. current gain ratio of BD839/BD840, BD841/BD842, BD843/BD844		typ.	1,3	
$\lvert I_C \rvert = 150$ mA; $\lvert V_{CE} \rvert = 2$ V	h_{FE1}/h_{FE2}	<	1,6	

* V_{BE} decreases by about 2,3 mV/K with increasing temperature.

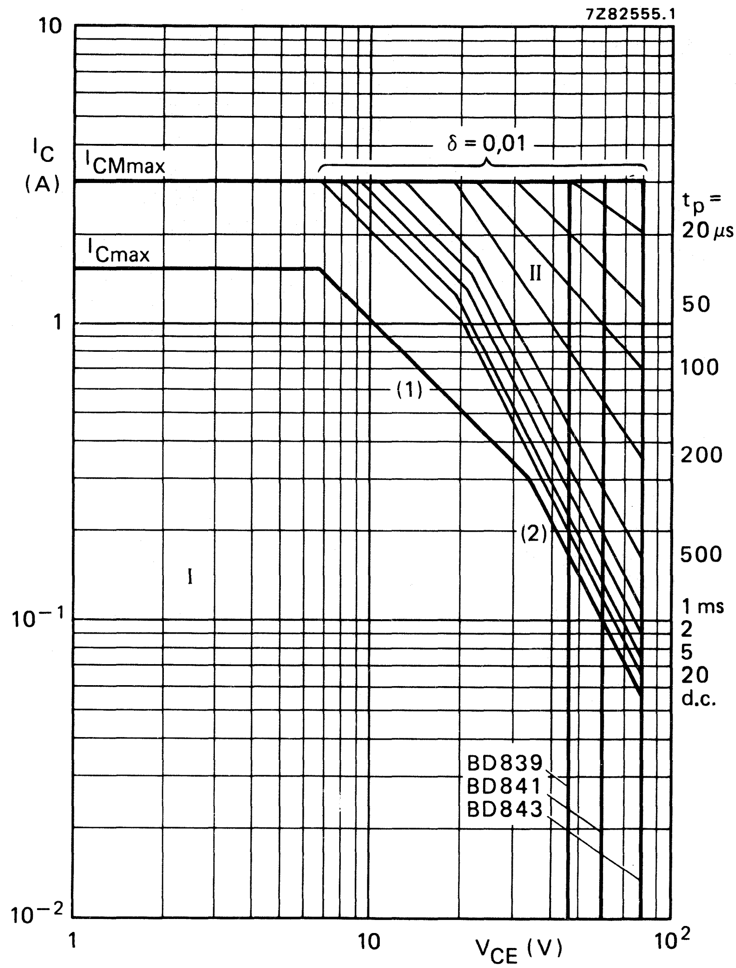


Fig. 2 Safe Operating Area, $T_{mb} \leqslant 25$ °C.

I Region of permissible d.c. operation.

II Permissible extension for repetitive pulse operation.

(1) $P_{tot\ max}$ and $P_{peak\ max}$ lines.

(2) Second-breakdown limits.

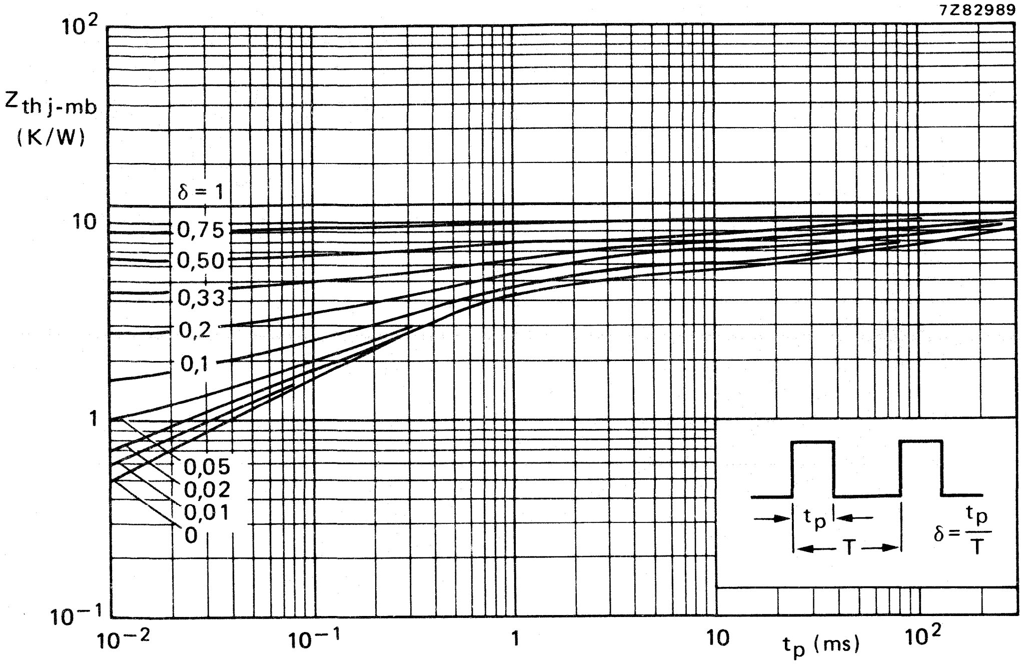


Fig. 3 Pulse power rating chart.

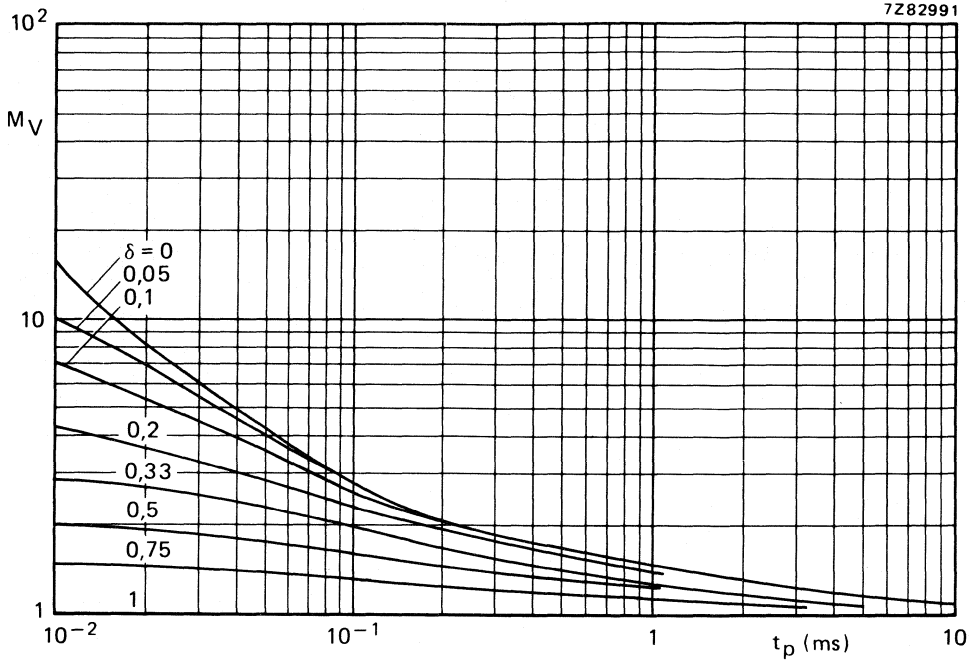


Fig. 4 S.B. voltage multiplying factor at the I_{Cmax} level.

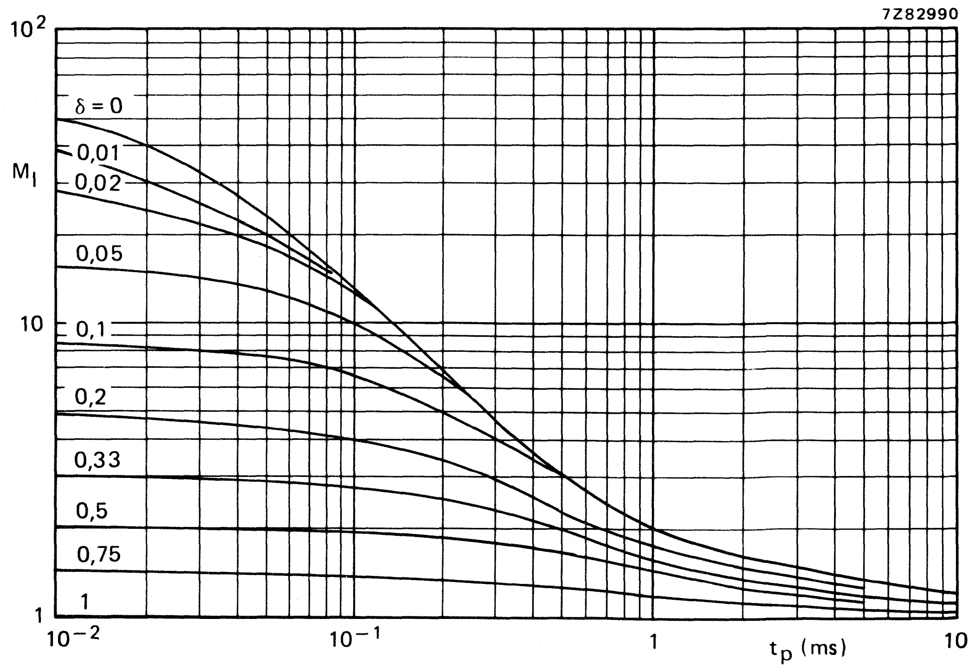


Fig. 5 S.B. current multiplying factor at the V_{CEOmax} level.

SILICON PLANAR EPITAXIAL POWER TRANSISTORS

P-N-P silicon transistors, in a plastic TO-202 package, recommended for use in television circuits and audio applications.
N-P-N complements are BD839, BD841 and BD843.

QUICK REFERENCE DATA

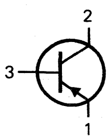
			BD840	BD842	BD844	
Collector-base voltage	$-V_{CBO}$	max.	45	60	100	V
Collector-emitter voltage	$-V_{CEO}$	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	$-V_{CER}$	max.	45	60	100	V
Emitter-base voltage	$-V_{EBO}$	max.	5	5	5	V
Collector current (peak value)	$-I_{CM}$	max.		3		A
Total power dissipation						
T_{amb} = 25 °C (free air)	P_{tot}	max.		2		W
T_{mb} = 25 °C	P_{tot}	max.		10		W
Junction temperature	T_j	max.		150		°C
D.C. current gain						
$-I_C$ = 1 A; $-V_{CE}$ = 2 V	h_{FE}	>		25		
Transition frequency at f = 100 MHz	f_T	typ.		50		MHz

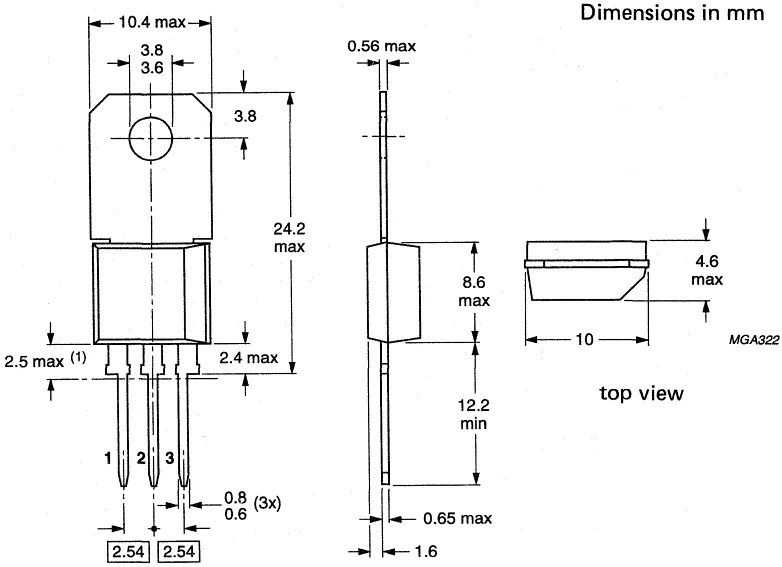
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-202.

Collector connected to mounting base.





(1) Plastic flash allowed within this zone.

RATINGS

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

			BD840	BD842	BD844	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	45	60	100	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	$-V_{CER}$	max.	45	60	100	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	V
Collector current (d.c.)	$-I_C$	max.		1,5		A
Collector current (peak value)	$-I_{CM}$	max.		3		A
Total power dissipation						
T_{amb} = 25 °C (free air)	P_{tot}	max.		2		W
T_{mb} = 25 °C	P_{tot}	max.		10		W
Storage temperature	T_{stg}			−65 to + 150		°C
Junction temperature	T_j	max.		150		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	62,5	K/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	12,5	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0; -V_{CB} = 30$ V	$-I_{CBO}$	<	100 nA
$I_E = 0; -V_{CB} = 30$ V; $T_j = 125$ °C	$-I_{CBO}$	<	10 μA
Emitter cut-off current			
$I_C = 0; -V_{EB} = 5$ V	$-I_{EBO}$	<	10 μA
Base-emitter voltage*			
$-I_C = 1$ A; $-V_{CE} = 2$ V	$-V_{BE}$	<	1,3 V
Collector-emitter saturation voltage			
$-I_C = 1$ A; $-I_B = 0,1$ A	$-V_{CEsat}$	<	0,8 V
D.C. current gain			
$-I_C = 5$ mA; $-V_{CE} = 2$ V	h_{FE}	>	25
$-I_C = 150$ mA; $-V_{CE} = 2$ V	h_{FE}		40 to 250
$-I_C = 1$ A; $-V_{CE} = 2$ V	h_{FE}	>	25
Transition frequency at f = 100 MHz			
$-I_C = 50$ mA; $-V_{CE} = 5$ V	f_T	typ.	50 MHz
D.C. current gain ratio			
of BD839/BD840, BD841/BD842, BD843/BD844		typ.	1,3
$\lvert I_C \rvert = 150$ mA; $\lvert V_{CE} \rvert = 2$ V	h_{FE1}/h_{FE2}	<	1,6

* V_{BE} decreases by about 2,3 mV/K with increasing temperature.

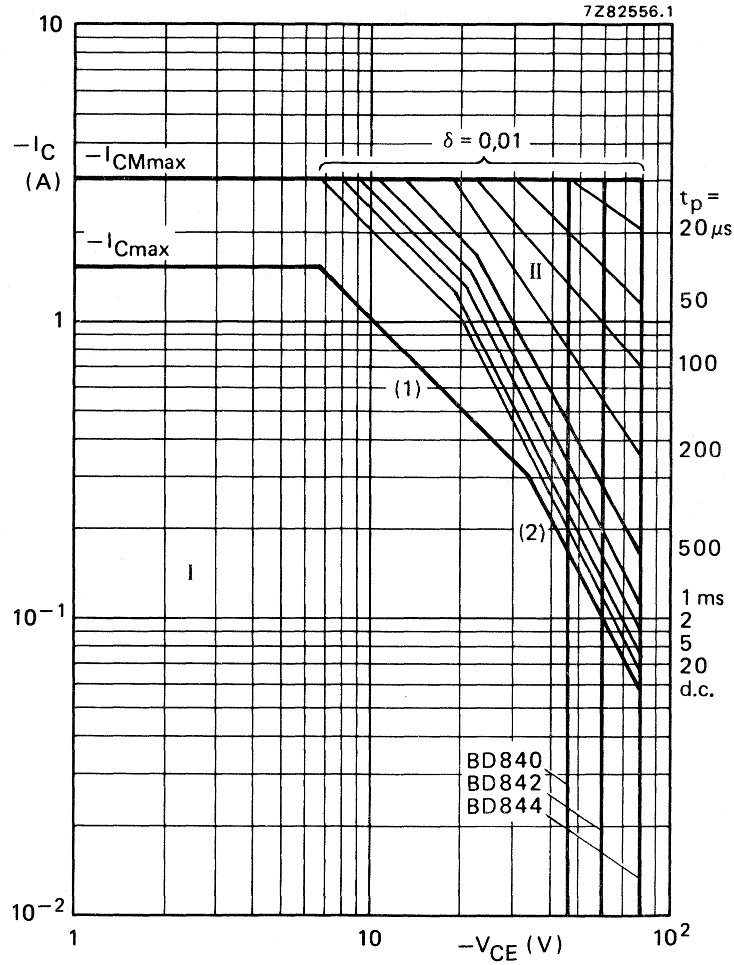


Fig. 2 Safe Operating Area, $T_{mb} \leq 25\ ^oC$.

I Region of permissible d.c. operation.

II Permissible extension for repetitive pulse operation.

(1) $P_{tot\ max}$ and $P_{peak\ max}$ lines.

(2) Second-breakdown limits.

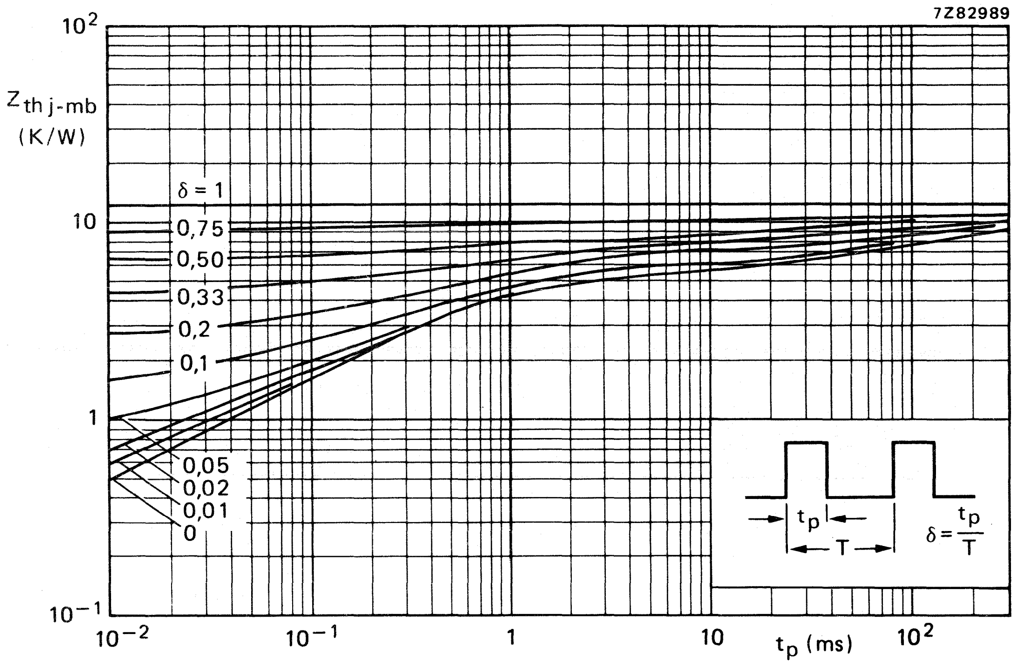


Fig. 3 Pulse power rating chart.

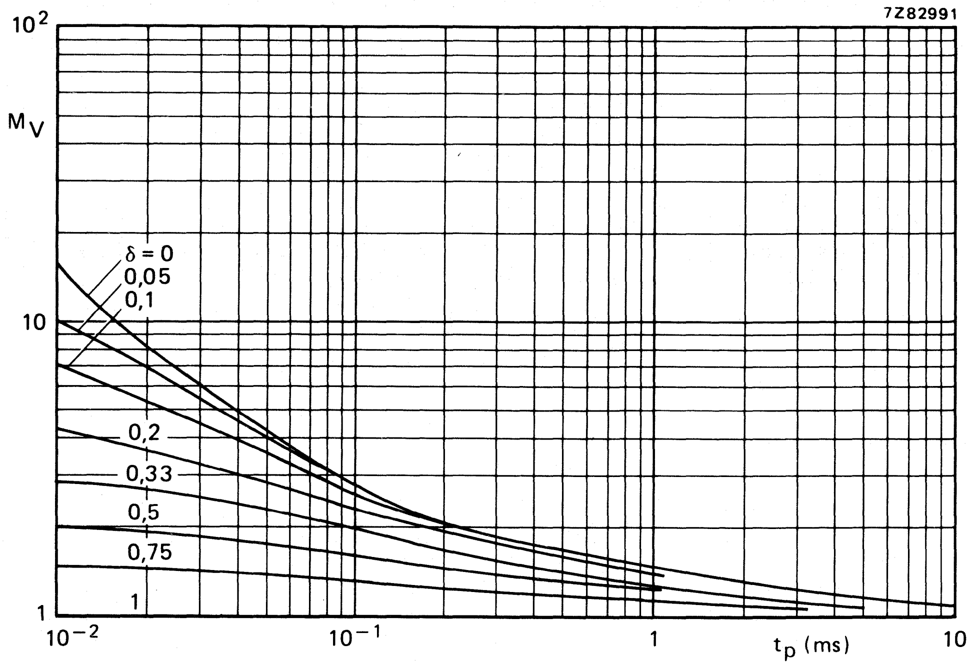


Fig. 4 S.B. voltage multiplying factor at the I_{Cmax} level.

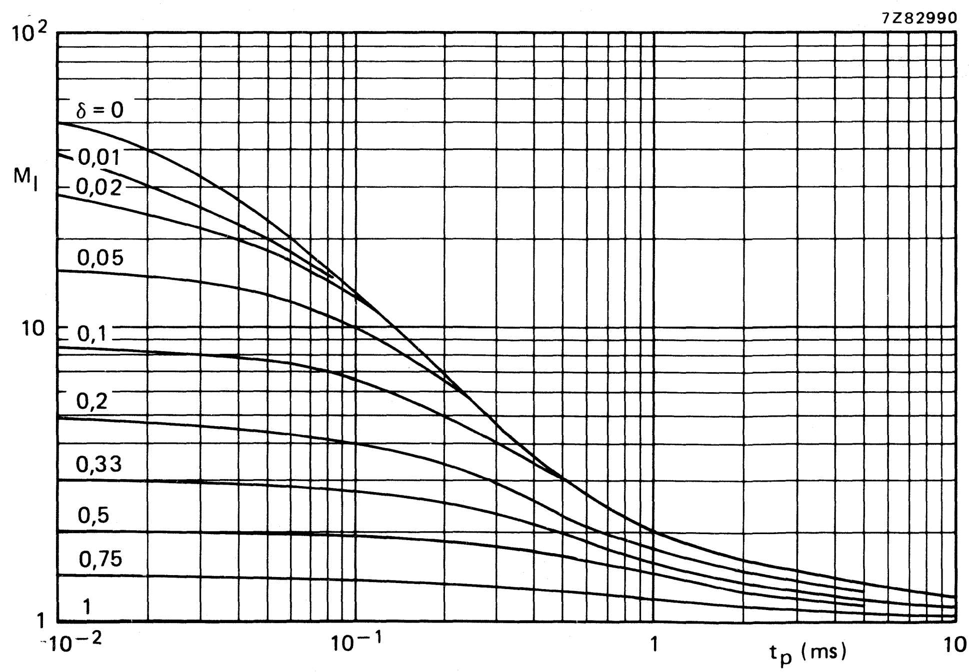


Fig. 5 S.B. current multiplying factor at the V_{CEOmax} level.

NPN power transistor BDP31

FEATURES

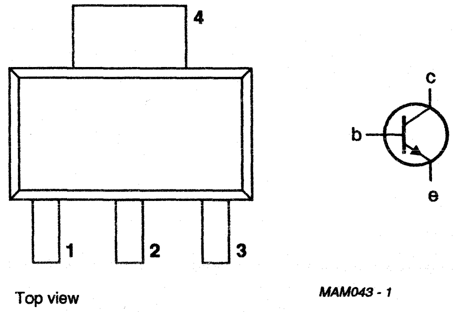
- SOT223 package.

DESCRIPTION

NPN power transistor in a plastic SOT223 package for general purpose, medium power applications. PNP complement is BDP32.

PINNING - SOT223

PIN	DESCRIPTION
1	base
2	collector
3	emitter
4	collector



Marking code: BPD31

Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	70	V
V_{CEO}	collector-emitter voltage	open base	–	45	V
I_C	DC collector current		–	3	A
I_{CM}	peak collector current		–	6	A
P_{tot}	total power dissipation	up to T_{mb} = 25 °C	–	1.5	W
f_T	transition frequency	I_C = 250 mA; V_{CE} = 5 V; f = 35 MHz	60	–	MHz
h_{FE}	DC current gain	I_C = 500 mA; V_{CE} = 12 V	40	–	

NPN power transistor BDP31

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	–	70	V
V_{CEO}	collector-emitter voltage	open base	–	45	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	DC collector current		–	3	A
I_{CM}	peak collector current		–	6	A
I_{BM}	peak base current		–	0.5	A
I_{RBM}	peak reverse base current		–	–0.5	A
P_{tot}	total power dissipation	up to T_{mb} = 25 °C; note 1	–	1.5	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

Note

1. Mounted on an epoxy printed-circuit board 40 × 40 × 1.5 mm; mounting pad for the collector lead minimum 6 cm^2.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	83.3	K/W

Note

1. Mounted on an epoxy printed-circuit board 40 × 40 × 1.5 mm; mounting pad for the collector lead minimum 6 cm^2.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CEsat}	collector-emitter saturation voltage	I_C = 500 mA; I_B = 50 mA; note 1	–	0.3	V
		I_C = 2 A; I_B = 200 mA; note 1	–	0.7	V
V_{BEsat}	base-emitter saturation voltage	I_C = 500 mA; I_B = 50 mA; note 1	–	1.2	V
		I_C = 2 A; I_B = 200 mA; note 1	–	1.5	V
I_{CBO}	collector cut-off current	V_{CB} = 50 V; I_E = 0	–	50	nA
		V_{CB} = 50 V; I_E = 0; T_j = 150 °C	–	500	μA
I_{EBO}	emitter cut-off current	V_{EB} = 5 V; I_C = 0	–	50	nA
C_c	collector capacitance	V_{CB} =5 V; I_E = I_e = 0; f = 1 MHz	–	60	pF
h_{FE}	DC current gain	I_C = 0.5 A; V_{CE} = 12 V; note 1	40	–	
		I_C = 2 A; V_{CE} = 1 V; note 1	20	–	
h_{FE1}/h_{FE2}	DC current gain ratio of the complementary pairs	I_C = 0.5 A; V_{CE} = 12 V; note 1	–	1.2	
f_T	transition frequency	V_{CE} = 5 V; I_C = 250 mA; f = 100 MHz	60	–	MHz

Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.02$.

PNP power transistor | BDP32

FEATURES

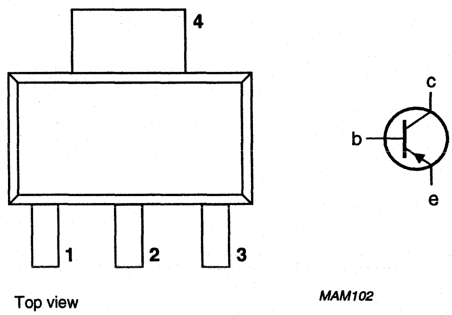
- SOT223 package.

DESCRIPTION

PNP power transistor in a plastic SOT223 package for general purpose, medium power applications. NPN complement is BDP31.

PINNING - SOT223

PIN	DESCRIPTION
1	base
2	collector
3	emitter
4	collector



Marking code: BDP32

Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–45	V
V_{CEO}	collector-emitter voltage	open base	–	–45	V
I_C	DC collector current		–	–3	A
I_{CM}	peak collector current		–	–6	A
P_{tot}	total power dissipation	up to T_{mb} = 25 °C	–	1.5	W
f_T	transition frequency	I_C = –250 mA; V_{CE} = –5 V; f = 35 MHz	60	–	MHz
h_{FE}	DC current gain	I_C = –500 mA; V_{CE} = –12 V	40	–	

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	–	–45	V
V_{CEO}	collector-emitter voltage	open base	–	–45	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	DC collector current		–	–3	A
I_{CM}	peak collector current		–	–6	A
I_{BM}	peak base current		–	–0.5	A
I_{RBM}	peak reverse base current		–	+0.5	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

Note

1. Mounted on an epoxy printed-circuit board 40 × 40 × 1.5 mm; mounting pad for the collector lead minimum 6 cm^2.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	83.3	K/W

Note

1. Mounted on an epoxy printed-circuit board 40 × 40 × 1.5 mm; mounting pad for the collector lead minimum 6 cm^2.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CEsat}	collector-emitter saturation voltage	I_C = –500 mA; I_B = –50 mA; note 1	–	–300	mV
		I_C = –2 A; I_B = –200 mA; note 1	–	–700	mV
V_{BEsat}	base-emitter saturation voltage	I_C = –500 mA; I_B = –50 mA; note 1	–	–1200	mV
		I_C = –2 A; I_B = –200 mA; note 1	–	–1500	mV
I_{CBO}	collector cut-off current	V_{CB} = –40 V; I_E = 0	–	–50	nA
		V_{CB} = –40 V; I_E = 0; T_j = 150 °C	–	–500	µA
I_{EBO}	emitter cut-off current	V_{EB} = –5 V; I_C = 0	–	–50	nA
h_{FE}	DC current gain	I_C = –0.5 A; V_{CE} = –12 V; note 1	40	–	
		I_C = –2 A; V_{CE} = –1 V; note 1	20	–	
h_{FE1}/h_{FE2}	DC current gain ratio of the complementary pairs	I_C = –0.5 A; V_{CE} = –12 V; note 1	–	1.2	
f_T	transition frequency	V_{CE} = –5 V; I_C = –250 mA; f = 100MHz	60	–	MHz

Note

1. Pulse test: $t_p \leq 300$ µs; $\delta \leq 0.02$.

SILICON PLANAR EPITAXIAL POWER TRANSISTORS

N-P-N transistors in TO-126 plastic packages intended for high current switching applications, e.g. inverters, and switching regulator circuits.

QUICK REFERENCE DATA

			BDX35	BDX36	BDX37	
Collector-base voltage (open emitter)	V_{CBO}	max.	100	120	120	V
Collector-emitter voltage (open base)	V_{CEO}	max.	60	60	80	V
Collector current (d.c.)	I_C	max.	5	5	5	A
Collector current (peak value)	I_{CM}	max.	10	10	10	A
Total power dissipation up to T_{mb} = 75 °C	P_{tot}	max.	15	15	15	W
D.C. current gain I_C = 0,5 A; V_{CE} = 10 V	h_{FE}	>	45	45	45	
Collector-emitter saturation voltage I_C = 5 A; I_B = 0,5 A	V_{CEsat}	<	0,9	0,7	0,9	V
Turn-off time I_{Con} = 5 A; I_{Bon} = $-I_{Boff}$ = 0,5 A	t_{off}	typ.	350	350	350	ns

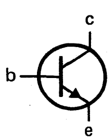
MECHANICAL DATA

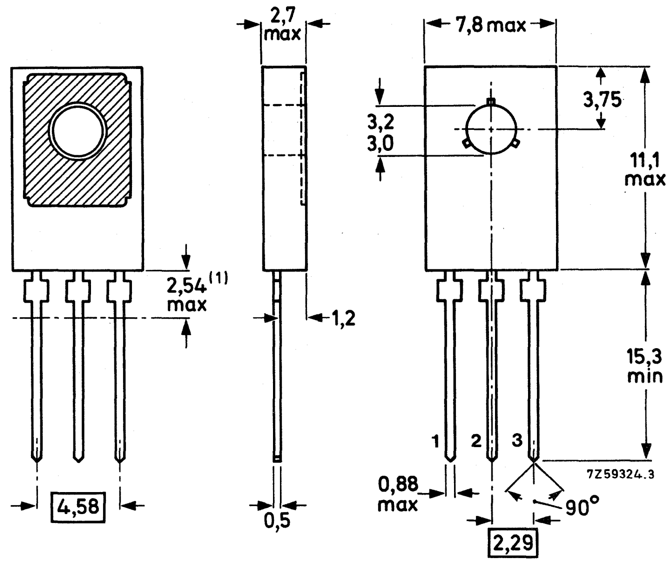
Dimensions in mm

Fig. 1 TO-126 (SOT-32)

Collector connected to the metal part of the mounting surface

Pinning
1 = emitter
2 = collector
3 = base





(1) Within this region the cross-section of the leads is uncontrolled.
See also chapters Mounting instructions and Accessories.

RATINGS

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

Voltages			BDX35	BDX36	BDX37	
Collector-base voltage (open emitter)	V_{CBO}	max.	100	120	120	V
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	100	120	120	V
Collector-emitter voltage (open base)	V_{CEO}	max.	60	60	80	V
Emitter-base voltage (open collector)	V_{EBO}	max.		5		V
Collector current (d.c.)	I_C	max.		5		A
Collector current (peak value)	I_{CM}	max.		10		A
Base current (d.c.)	I_B	max.		1		A
Base current (peak value)	I_{BM}	max.		2		A
Reverse base current (peak value)	$-I_{BM}$	max.		2		A
Total power dissipation						
up to T_{mb} = 75 °C	P_{tot}	max.		15		W
up to T_{amb} = 25 °C	P_{tot}	max.		1,25		W
Storage temperature	T_{stg}			−65 to + 150		°C
Junction temperature	T_j	max.		150		°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	5	K/W
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	100	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $V_{CB} = 80$ V	BDX35	I_{CBO}	<	10 μA
$I_E = 0$; $V_{CB} = 80$ V; $T_j = 100$ °C	BDX35	I_{CBO}	<	50 μA
$I_E = 0$; $V_{CB} = 100$ V	BDX36/37	I_{CBO}	<	10 μA
$I_E = 0$; $V_{CB} = 100$ V; $T_j = 100$ °C	BDX36/37	I_{CBO}	<	50 μA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 4$ V		I_{EBO}	typ.	5 nA
			<	10 μA
$I_C = 0$; $V_{EB} = 5$ V		I_{EBO}	<	1 mA
D.C. current gain		h_{FE}		45 to 450
$I_C = 0{,}5$ A; $V_{CE} = 10$ V	BDX35/36	h_{FE}	typ.	130
	BDX37	h_{FE}	typ.	80
Collector-emitter saturation voltage				
$I_C = 5$ A; $I_B = 0{,}5$ A	BDX35/37	V_{CEsat}	<	0,9 V
	BDX36	V_{CEsat}	<	0,7 V
$I_C = 7$ A; $I_B = 0{,}7$ A	BDX35/37	V_{CEsat}	<	1,2 V
$I_C = 10$ A; $I_B = 1$ A	BDX36	V_{CEsat}	<	1,5 V
Base-emitter saturation voltage				
$I_C = 5$ A; $I_B = 0{,}5$ A		V_{BEsat}	<	1,6 V
$I_C = 7$ A; $I_B = 0{,}7$ A	BDX35/37	V_{BEsat}	<	2,0 V
$I_C = 10$ A; $I_B = 1$ A	BDX36	V_{BEsat}	<	2,5 V
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 10$ V		C_c	typ.	40 pF
			<	60 pF
Transition frequency at f = 100 MHz				
$I_C = 0{,}5$ A; $V_{CE} = 5$ V; $T_{amb} = 25$ °C		f_T	typ.	100 MHz
Switching times (between 10% and 90% levels)				
$I_{Con} = 1$ A; $I_{Bon} = -I_{Boff} = 0{,}1$ A				
turn-on time		t_{on}	typ.	0,06 μs
			<	0,1 μs
turn-off time		t_{off}	typ.	0,6 μs
			<	0,8 μs
$I_{Con} = 2$ A; $I_{Bon} = -I_{Boff} = 0{,}2$ A				
turn-on time		t_{on}	<	80 ns
turn-off time		t_{off}	typ.	0,45 μs
			<	0,7 μs
$I_{Con} = 5$ A; $I_{Bon} = -I_{Boff} = 0{,}5$ A				
turn-on time		t_{on}	typ.	180 ns
			<	300 ns
turn-off time		t_{off}	typ.	320 ns
			<	500 ns

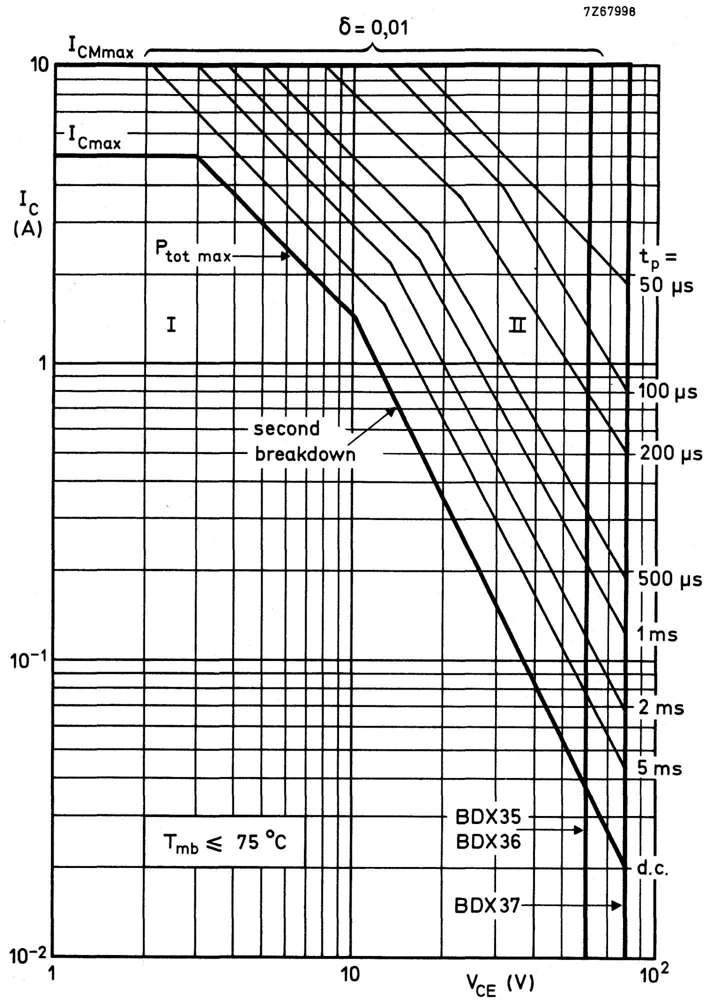


Fig. 2 Safe Operating Area with the transistor forward biased.

I Region of permissible d.c. operation

II Permissible extension for repetitive pulse operation.

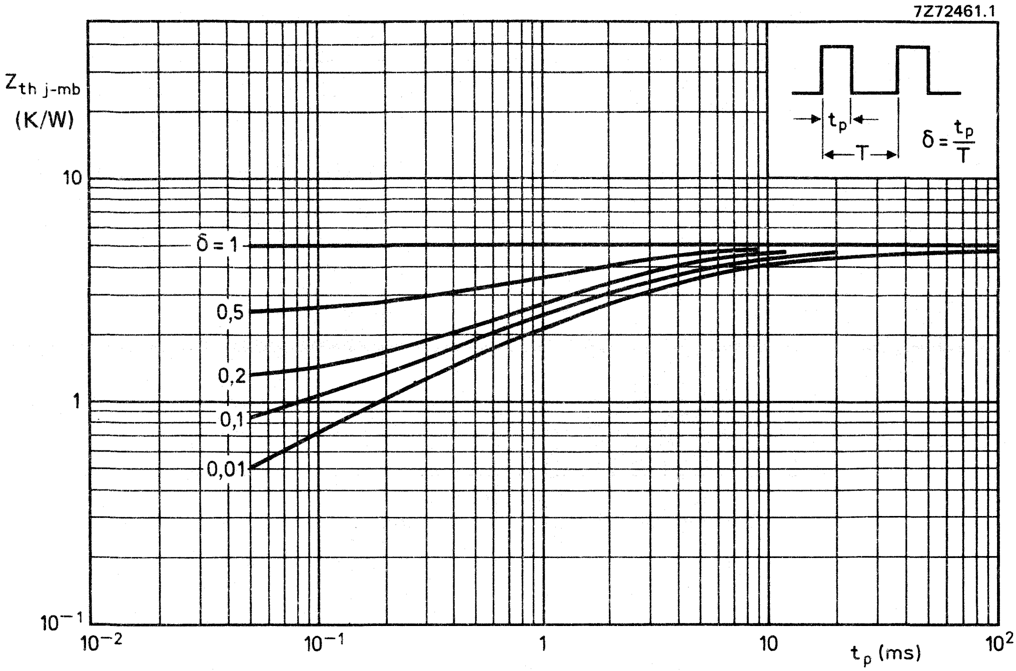


Fig. 3 Pulse power rating chart.

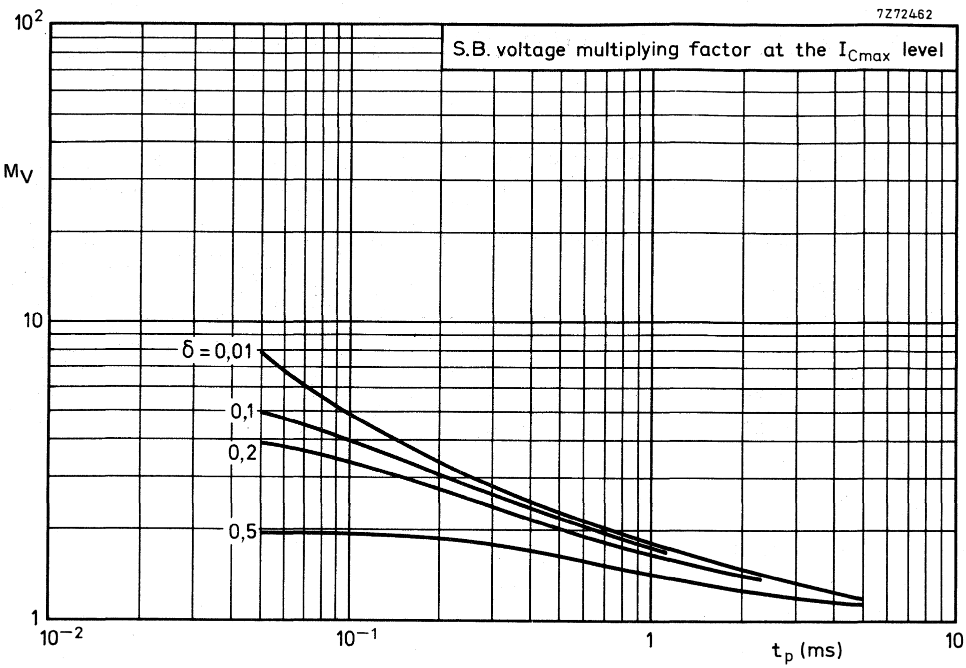


Fig. 4 S.B. voltage multiplying factor at the I_{Cmax} level.

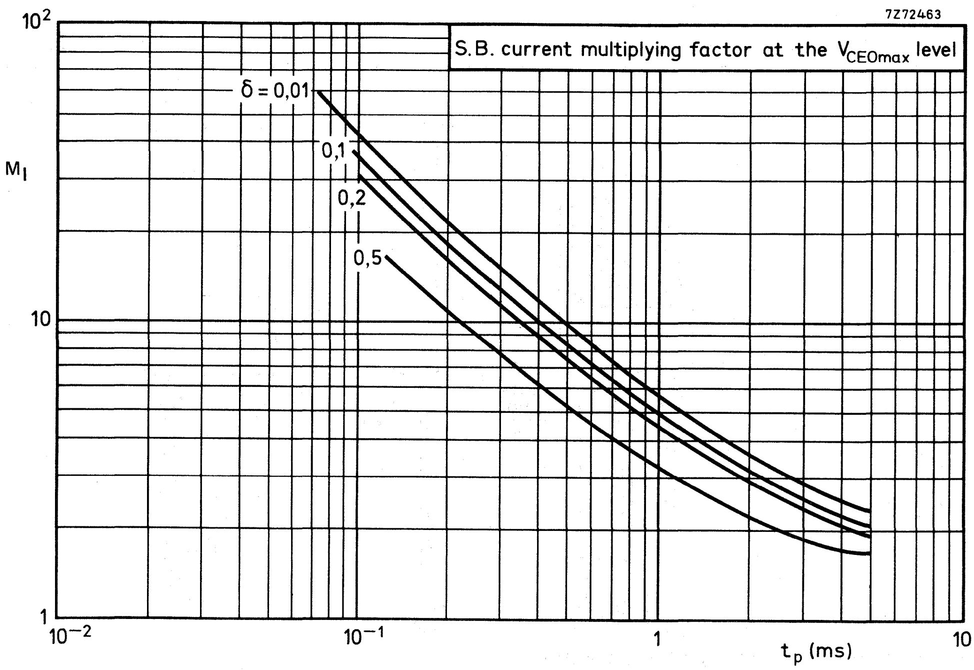


Fig. 5 S.B. current multiplying factor at the V_{CEOmax} level.

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 TO-126 plastic package with collector connected to the heatsink.
P-N-P complements are BDX45, BDX46 and BDX47 respectively.

QUICK REFERENCE DATA

			BDX42	BDX43	BDX44	
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.	1	1	1	A
Total power dissipation						
up to T_{amb} = 25 °C	P_{tot}	max.	1,25	1,25	1,25	W
up to T_{mb} = 100 °C	P_{tot}	max.	5	5	5	W
D.C. current gain						
I_C = 500 mA; V_{CE} = 10 V	h_{FE}	>	2000	2000	2000	
Collector-emitter saturation voltage						
I_C = 1 A; I_B = 1 mA	V_{CEsat}	<	–	1,6	–	V
I_C = 1 A; I_B = 4 mA	V_{CEsat}	<	1,6	–	1,6	V
Turn-off time						
I_C = 500 mA; I_{Bon} = $-I_{Boff}$ = 0,5 mA	t_{off}	typ.	1500	1500	1500	ns

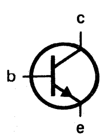
MECHANICAL DATA

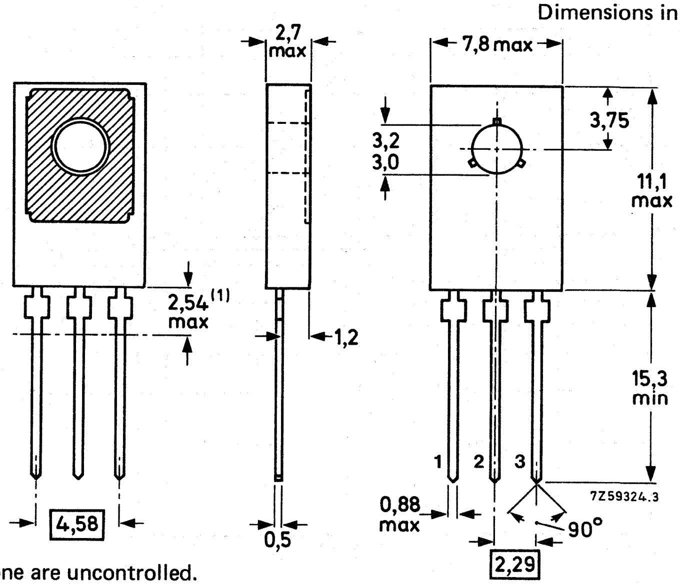
Dimensions in mm

Fig. 1 TO-126.

Collector connected to the metal part of mounting surface.

Pinning
1 = emitter
2 = collector
3 = base





(1) Dimensions within this zone are uncontrolled.

See also chapters Mounting Instructions and Accessories.

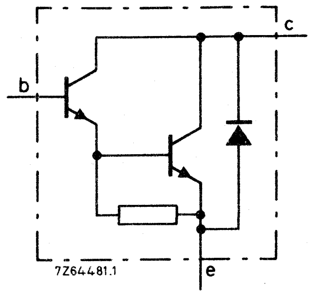


Fig. 2 Circuit diagram.

RATINGS

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

			BDX42	BDX43	BDX44	
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.		1		A
Collector current (peak)	I_{CM}	max.		2		A
Base current (d.c.)	I_B	max.		0,1		A
Total power dissipation						
up to T_{amb} = 25 °C	P_{tot}	max.		1,25		W
up to T_{mb} = 100 °C	P_{tot}	max.		5		W
Storage temperature	T_{stg}			−65 to + 150		°C
Junction temperature **	T_j	max.		150		°C

THERMAL RESISTANCE **

From junction to ambient	$R_{th\ j\text{-}a}$	=	100	K/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	10	K/W

* External R_{BE} not to exceed value shown in Fig. 12.

** 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.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current					
V_{BE} = 0; V_{CE} = 45 V	BDX42	I_{CES}	<	10	μA
V_{BE} = 0; V_{CE} = 60 V	BDX43	I_{CES}	<	10	μA
V_{BE} = 0; V_{CE} = 80 V	BDX44	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 = 1 A; I_B = 1 mA	BDX43	V_{CEsat}	<	1,6	V
I_C = 1 A; I_B = 4 mA	BDX42, 44	V_{CEsat}	<	1,6	V
I_C = 500 mA; I_B = 0,5 mA; T_j = 150 °C		V_{CEsat}	<	1,3	V
I_C = 1 A; I_B = 1 mA; T_j = 150 °C	BDX43	V_{CEsat}	<	1,8	V
I_C = 1 A; I_B = 4 mA; T_j = 150 °C	BDX42, 44	V_{CEsat}	<	1,6	V
Base-emitter saturation voltage					
I_C = 500 mA; I_B = 0,5 mA		V_{BEsat}	<	1,9	V
I_C = 1 A; I_B = 1 mA	BDX43	V_{BEsat}	<	2,2	V
I_C = 1 A; I_B = 4 mA	BDX42, 44	V_{BEsat}	<	2,2	V
Small signal current gain					
I_C = 500 mA; V_{CE} = 5 V; f = 35 MHz		h_{fe}	typ.	10	
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
I_C = 1 A; I_{Bon} = $-I_{Boff}$ = 1 mA					
Turn-on time		t_{on}	typ.	400	ns
Turn-off time		t_{off}	typ.	1500	ns

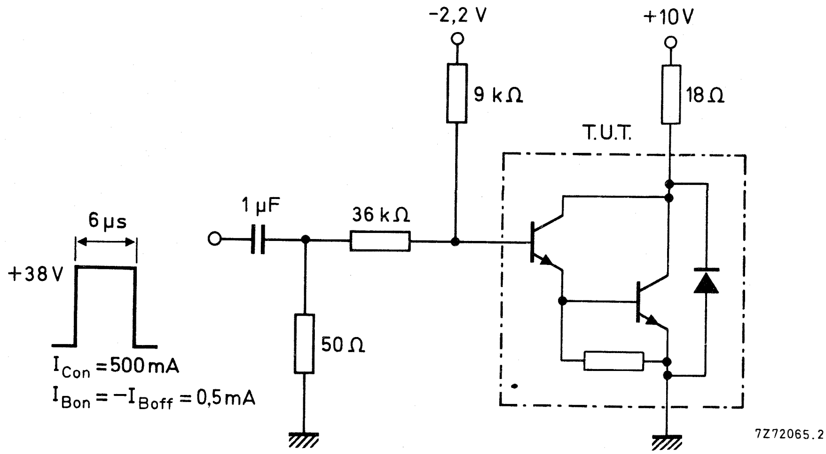


Fig. 3 Test circuit for 500 mA switching.

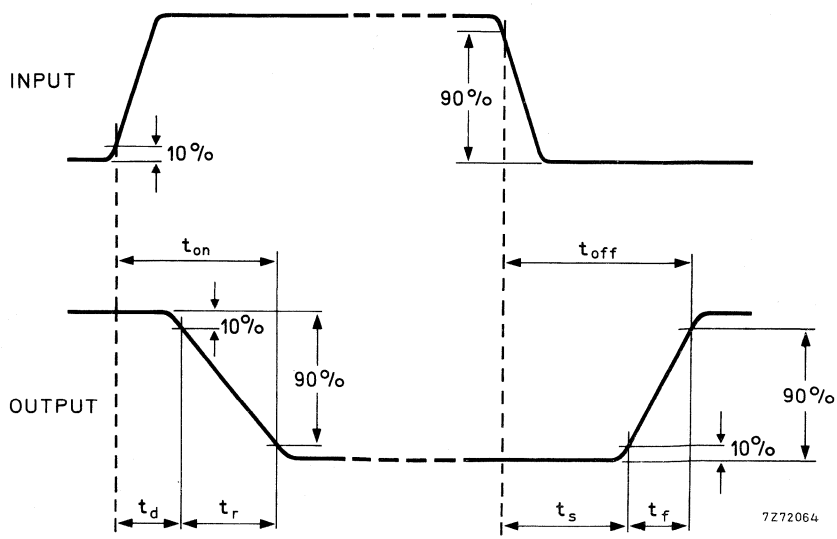


Fig. 4 Switching waveforms.

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 TO-126 plastic package with collector connected to the heatsink.
N-P-N complements are BDX42, BDX43 and BDX44 respectively.

QUICK REFERENCE DATA

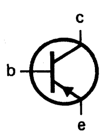
			BDX45	BDX46	BDX47	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60	80	90	V
Collector-emitter voltage	$-V_{CER}$	max.	45	60	80	V
Collector current	$-I_C$	max.	1	1	1	A
Total power dissipation						
up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	1,25	1,25	1,25	W
up to $T_{mb} = 100\ ^oC$	P_{tot}	max.	5	5	5	W
D.C. current gain						
$-I_C = 500$ mA; $-V_{CE} = 10$ V	h_{FE}	>	2000	2000	2000	
Collector-emitter saturation voltage						
$-I_C = 1$ A; $-I_B = 1$ mA	$-V_{CEsat}$	<	–	1,6	–	V
$-I_C = 1$ A; $-I_B = 4$ mA	$-V_{CEsat}$	<	1,6	–	1,6	V
Turn-off time						
$-I_C = 500$ mA; $-I_{Bon} = I_{Boff} = 0,5$ mA	t_{off}	typ.	1500	1500	1500	ns

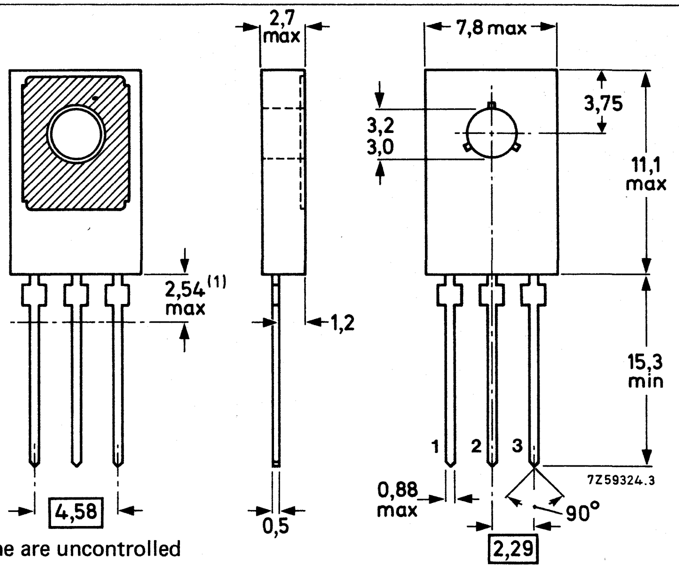
MECHANICAL DATA

Fig. 1 TO-126.

Collector connected to the metal part of mounting surface.

Pinning
1 = emitter
2 = collector
3 = base





(1) Dimensions within this zone are uncontrolled

See also chapters Mounting Instructions and Accessories.

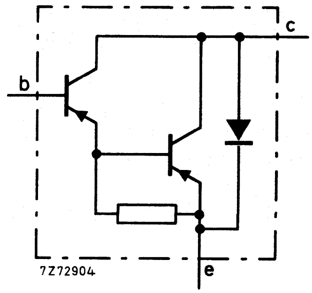


Fig. 2 Circuit diagram.

RATINGS

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

			BDX45	BDX46	BDX47	
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.		1		A
Collector current (peak)	$-I_{CM}$	max.		2		A
Base current (d.c.)	$-I_B$	max.		0,1		A
Total power dissipation						
up to T_{amb} = 25 °C	P_{tot}	max.		1,25		W
up to T_{mb} = 100 °C	P_{tot}	max.		5		W
Storage temperature	T_{stg}			−65 to + 150		°C
Junction temperature**	T_j	max.		150		°C

THERMAL RESISTANCE **

From junction to ambient	$R_{th\ j\text{-}a}$	=	100	K/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	10	K/W

* External R_{BE} not to exceed value shown in Fig. 12.
** 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.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$V_{BE} = 0; -V_{CE} = 45$ V	BDX45	$-I_{CES}$	<	10 μA
$V_{BE} = 0; -V_{CE} = 60$ V	BDX46	$-I_{CES}$	<	10 μA
$V_{BE} = 0; -V_{CE} = 80$ V	BDX47	$-I_{CES}$	<	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
$-I_C = 1$ A; $-I_B = 1$ mA	BDX46	$-V_{CEsat}$	<	1,6 V
$-I_C = 1$ A; $-I_B = 4$ mA	BDX45, 47	$-V_{CEsat}$	<	1,6 V
$-I_C = 500$ mA; $-I_B = 0,5$ mA; $T_j = 150$ °C		$-V_{CEsat}$	<	1,3 V
$-I_C = 1$ A; $-I_B = 1$ mA; $T_j = 150$ °C	BDX46	$-V_{CEsat}$	<	1,8 V
$-I_C = 1$ A; $-I_B = 4$ mA; $T_j = 150$ °C	BDX45, 47	$-V_{CEsat}$	<	1,6 V
Base-emitter saturation voltage				
$-I_C = 500$ mA; $-I_B = 0,5$ mA		$-V_{BEsat}$	<	1,9 V
$-I_C = 1$ A; $-I_B = 1$ mA	BDX46	$-V_{BEsat}$	<	2,2 V
$-I_C = 1$ A; $-I_B = 4$ mA	BDX45, 47	$-V_{BEsat}$	<	2,2 V
Small signal current gain				
$-I_C = 500$ mA; $-V_{CE} = 5$ V, f = 35 MHz		h_{fe}	typ.	10
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
$-I_C = 1$ A; $-I_{Bon} = I_{Boff} = 1$ mA				
Turn-on time		t_{on}	typ.	400 ns
Turn-off time		t_{off}	typ.	1500 ns

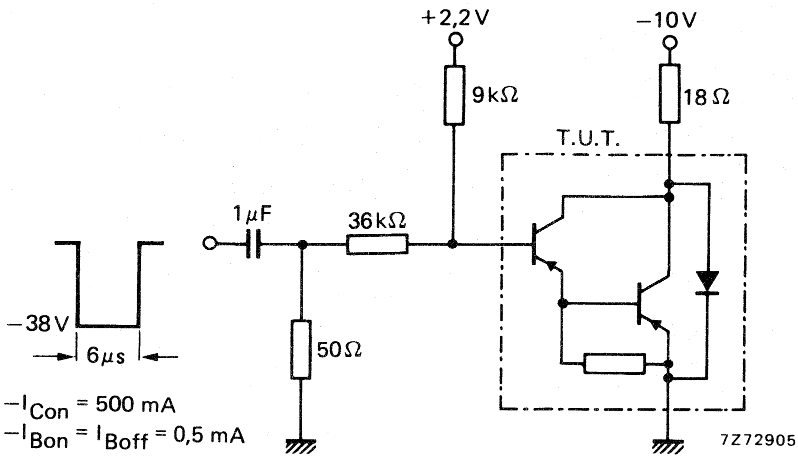


Fig. 3 Test circuit for 500 mA switching.

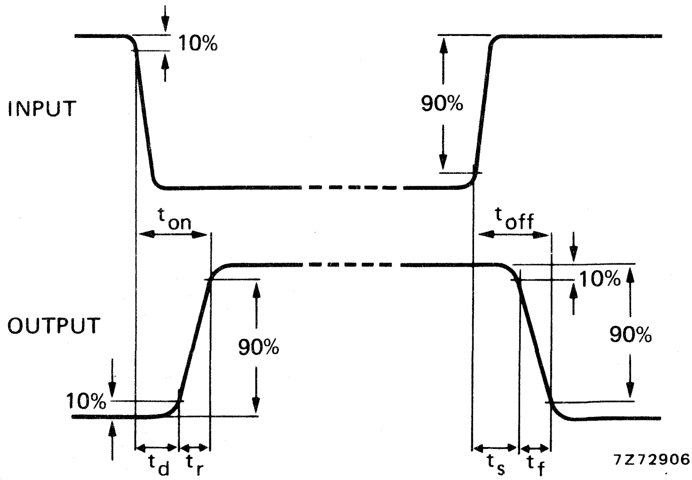


Fig. 4 Switching waveforms.

SILICON PLANAR TRANSISTOR

N-P-N transistor in a plastic TO-92 package. The BF198 has a very low feedback capacitance and is intended for use in the forward gain control stage of the television i.f. amplifier.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	40	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Collector current (d.c.)	I_C	max.	25	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	mW
Junction temperature	T_j	max.	150	°C
Transition frequency at f = 100 MHz I_C = 4 mA; V_{CE} = 10 V	f_T	typ.	400	MHz
Feedback capacitance at f = 10,7 MHz I_C = 1 mA; V_{CE} = 10 V	C_{re}	typ.	200	fF

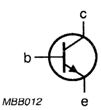
MECHANICAL DATA

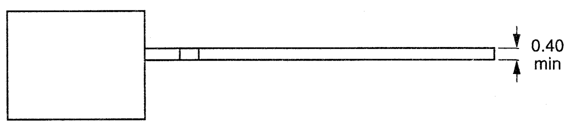
Dimensions in mm

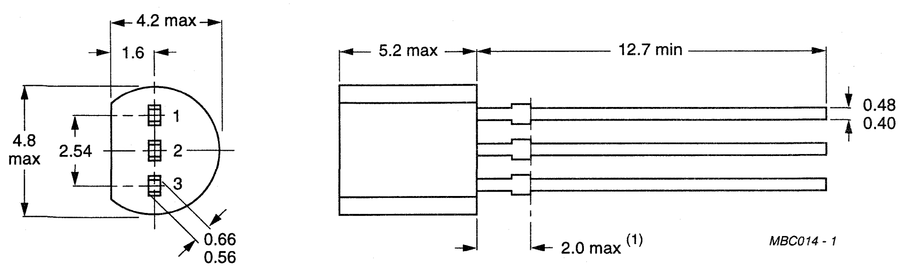
Fig. 1 TO-92.

Pinning

1 = base
2 = emitter
3 = collector







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

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.	30	V
Emitter-base voltage (open collector)	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.	500	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	$R_{th\ j\text{-}a}$	=	0,25	K/mW

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Base current at about 50 dB gain control				
I_C = 6 mA; V_{CE} = 2 V	I_B	<	270	μA
I_C = 15 mA; V_{CE} = 5 V	I_B	<	1,5	mA
Base current				
I_C = 4 mA; V_{CE} = 10 V	I_B	typ. <	60 150	μA μA
Base-emitter voltage [1]				
I_C = 4 mA; V_{CE} = 10 V	V_{BE}	typ. <	760 850	mV mV
Feedback capacitance at f = 10.7 MHz				
I_C = 1 mA; V_{CE} = 10 V	C_{re}	typ.	200	fF
Transition frequency at f = 100 MHz				
I_C = 4 mA; V_{CE} = 10 V	f_T	typ.	400	MHz

1) V_{BE} decreases by about 1,7 mV/K with increasing temperature.

SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a plastic TO-92 package.

The BF199 has a very low feedback capacitance and is intended for use in the output stage of a vision i.f. amplifier.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	40	V
Collector-emitter voltage (open base)	V_{CEO}	max.	25	V
Collector current (d.c.)	I_C	max.	25	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	mW
Junction temperature	T_j	max.	150	°C
Transition frequency at f = 100 MHz I_C = 5 mA; V_{CE} = 10 V	f_T	typ.	550	MHz
Feedback capacitance at f = 10,7 MHz I_C = 1 mA; V_{CE} = 10 V	C_{re}	max.	0,5	pF

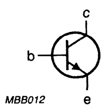
MECHANICAL DATA

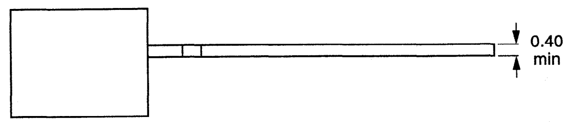
Dimensions in mm

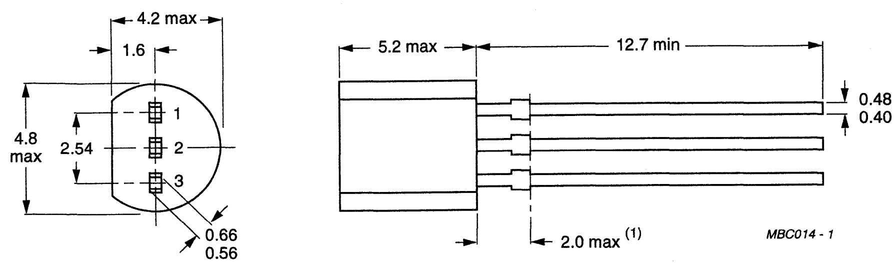
Fig. 1 TO-92.

Pinning

1 = base
2 = emitter
3 = collector







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

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.	25	V
Emitter-base voltage (open collector)	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.	500	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	$R_{th\ j\text{-}a}$	=	0,25	K/mW

CHARACTERISTICS

T_{amb} = 25 °C

Base current I_C = 7 mA; V_{CE} = 10 V	I_B	typ. <	60 185	μA μA
Base-emitter voltage * I_C = 7 mA; V_{CE} = 10 V	V_{BE}	typ. <	775 925	mV mV
Transition frequency at f = 100 MHz I_C = 5 mA; V_{CE} = 10 V	f_T	typ.	550	MHz
Feedback capacitance at f = 10,7 MHz I_C = 1 mA; V_{CE} = 10 V	C_{re}	max.	0,5	pF

* V_{BE} decreases by about 1,7 mV/K with increasing temperature.

HF SILICON PLANAR EPITAXIAL TRANSISTORS

NPN transistors in a plastic package, recommended for AM mixers and IF amplifiers in AM/FM receivers.

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.		25	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		300	mW
Junction temperature	T_j	max.		150	°C
		BF240	BF241		
DC current gain I_C = 1 mA; V_{CE} = 10 V	h_{FE}	67 to 220	35 to 125		
Transition frequency I_C = 1 mA; V_{CE} = 10 V	f_T	min.	150		MHz
Feedback capacitance at f = 1 MHz I_C = 1 mA; V_{CE} = 10 V	C_{re}	max.		0,5	pF

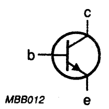
MECHANICAL DATA

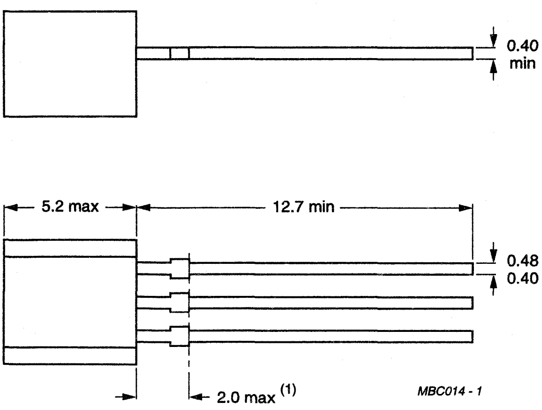
Dimensions in mm

Fig. 1 TO-92.

Pinning

1 = base
2 = emitter
3 = collector





Note (1) Terminal dimensions within this zone are uncontrolled to allow for plastic and terminal irregularities.

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.	4	V
Collector current (DC)	I_C	max.	25	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	$R_{th\,j\text{-}a}$	=	420	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector cut-off current				
I_E = 0; V_{CB} = 20 V	I_{CBO}	max.	100	nA
I_E = 0; V_{CB} = 20 V; T_{amb} = 150 °C	I_{CBO}	max.	4	μA
Base-emitter voltage				
I_C = 1 mA; V_{CE} = 10 V	V_{BE}	typ.	700	mV
			650 to 740	mV
DC current gain				
I_C = 1 mA; V_{CE} = 10 V	h_{FE}	**BF240**	67 to 220	
		BF240B	100 to 220	
		BF241	35 to 125	
		BF241C	67 to 125	
		BF241D	35 to 76	
Transition frequency at f = 100 MHz				
I_C = 1 mA; V_{CE} = 10 V	f_T	min.	150	MHz
Feedback capacitance at f = 1 MHz				
I_C = 1 mA; V_{CE} = 10 V	C_{re}	max.	0,5	pF
Emitter-base cut-off current				
I_C = 0; V_{EB} = 3 V	I_{EBO}	max.	100	nA

H.F. SILICON PLANAR EPITAXIAL TRANSISTOR

P-N-P transistor in a plastic package especially intended for r.f. stages in f.m. front-ends in common base configuration.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	30	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	30	V
Collector current (d.c.)	$-I_C$	max.	25	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Junction temperature	T_j	max.	150	°C
Base current $-I_C$ = 4 mA; $-V_{CE}$ = 10 V	$-I_B$	typ. >	80 160	μA μA
Transition frequency at f = 100 MHz $-I_C$ = 4 mA; $-V_{CE}$ = 10 V	f_T	typ.	450	MHz
Noise figure at f = 100 MHz $-I_C$ = 2 mA; $-V_{CE}$ = 10 V; G_s = 16,7 mA/V	F	typ.	3	dB
Feedback capacitance at f = 1 MHz V_{EB} = 0; $-V_{CB}$ = 10 V	C_{rb}	<	0,3	pF

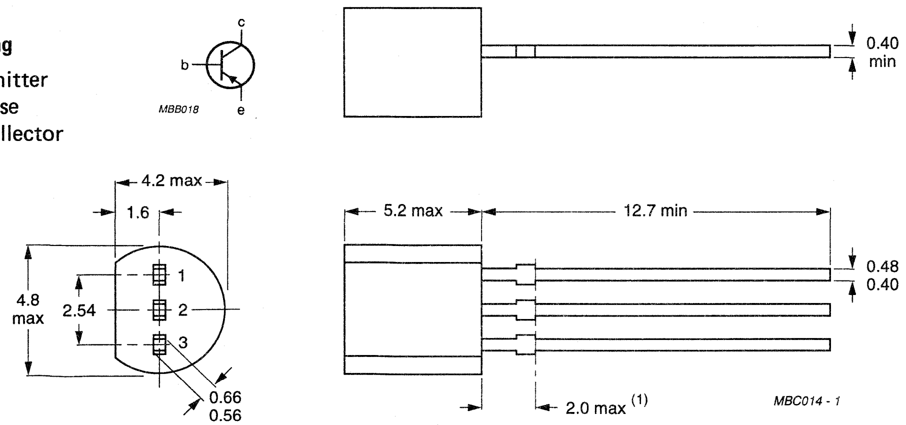
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92.

Pinning

1 = emitter
2 = base
3 = collector



Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

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)	$-V_{CEO}$	max.	30	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	4	V
Collector current (d.c.)	$-I_C$	max.	25	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Storage temperature	T_{stg}	−65 to + 150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	420	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0; -V_{CB} = 30$ V	$-I_{CBO}$	<	50	nA
Emitter cut-off current				
$I_C = 0; -V_{EB} = 4$ V	$-I_{EBO}$	<	10	µA
Base current				
$-I_C = 4$ mA; $-V_{CE} = 10$ V	$-I_B$	typ. <	80 160	µA µA
$-I_C = 1$ mA; $-V_{CE} = 10$ V	$-I_B$	typ.	22	µA
Base-emitter voltage				
$-I_C = 4$ mA; $-V_{CE} = 10$ V	$-V_{BE}$	typ.	0,76	V
Transition frequency at f = 100 MHz				
$-I_C = 1$ mA; $-V_{CE} = 10$ V	f_T	typ.	350	MHz
$-I_C = 4$ mA; $-V_{CE} = 10$ V	f_T	typ.	450	MHz
$-I_C = 8$ mA; $-V_{CE} = 10$ V	f_T	typ.	440	MHz
Feedback capacitance at f = 1 MHz				
$V_{EB} = 0; -V_{CB} = 10$ V	C_{rb}	<	0,3	pF
Noise factor at f = 100 MHz				
$-I_C = 2$ mA; $-V_{CE} = 10$ V; $G_s = 16,7$ mS	F	typ.	3	dB
$-I_C = 5$ mA; $-V_{CE} = 10$ V; $G_s = 6,7$ mA/V; $-jB_s = 5$ mS	F	typ.	3,5	dB

SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a plastic TO-92 package, intended for use in large-signal handling i.f. pre-amplifiers of TV receivers in combination with surface acoustic wave filters.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	40 V
Collector-emitter voltage (open base)	V_{CEO}	max.	15 V
Collector current (d.c.)	I_C	max.	100 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500 mW
Junction temperature	T_j	max.	150 °C
D.C. current gain I_C = 10 mA; V_{CE} = 1 V	h_{FE}	>	40
Transition frequency at f = 100 MHz I_C = 40 mA; V_{CE} = 10 V	f_T	>	490 MHz

MECHANICAL DATA

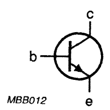
Dimensions in mm

Fig. 1 TO-92.

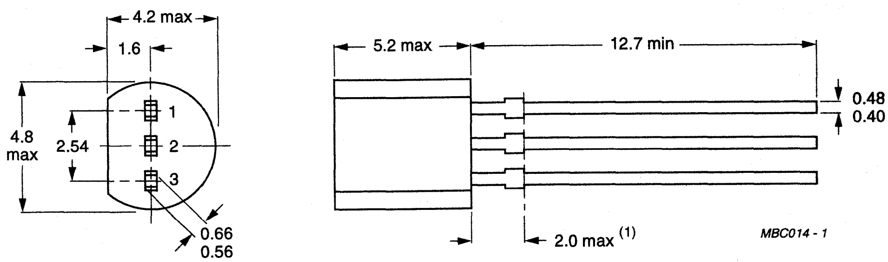
Pinning

BF370

1 = emitter
2 = base
3 = collector



BF370R



Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

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.	15	V
Emitter-base voltage (open collector)	V_{EBO}	max.	4,5	V
Collector current (d.c.)	I_C	max.	100	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	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	$R_{th\ j\text{-}a}$	=	250	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
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 2$ V	I_{EBO}	<	100	nA
D.C. current gain				
$I_C = 10$ mA; $V_{CE} = 1$ V	h_{FE}	>	40	
Transition frequency at f = 100 MHz				
$I_C = 10$ mA; $V_{CE} = 10$ V	f_T	>	500	MHz
$I_C = 40$ mA; $V_{CE} = 10$ V	f_T	>	490	MHz
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	2,2	pF
Emitter capacitance at f = 1 MHz				
$I_C = I_c = 0$; $V_{EB} = 1$ V	C_e	<	4,5	pF
Feedback capacitance at f = 1 MHz				
$I_C = 0$; $V_{CE} = 10$ V	C_{re}	typ.	1,6	pF

HIGH—VOLTAGE TRANSISTOR

Silicon n-p-n transistor in TO-126 plastic package intended for use as a driver for line output transistors in colour tv receivers.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	300	V
Collector-emitter voltage (open base)	V_{CEO}	max.	250	V
Collector current (peak value)	I_{CM}	max.	300	mA
Total power dissipation up to T_{mb} = 90 °C	P_{tot}	max.	6	W
Junction temperature	T_j	max.	150	°C
D.C. current gain I_C = 20 mA; V_{CE} = 10 V	h_{FE}	typ.	45	
Storage time	t_s	typ.	0.5	μs

MECHANICAL DATA

Dimensions in mm

Fig.1 TO-126 (SOT-32)

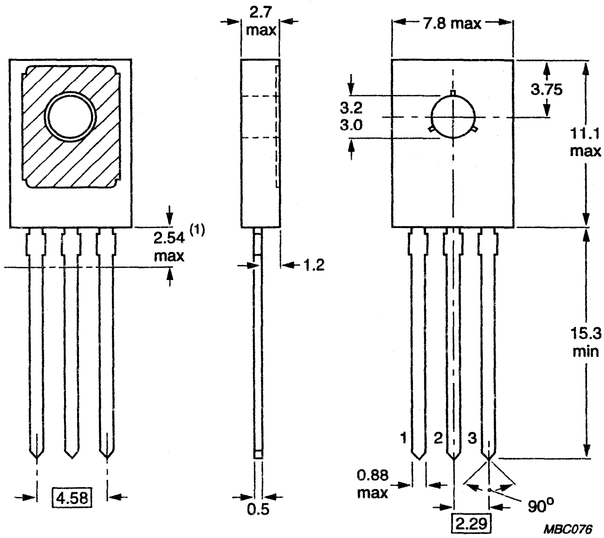
Collector connected to mounting base

Pinning:

1 = emitter

2 = collector

3 = base



(1) Within this region the cross-section of the leads is uncontrolled

See also chapters Mounting Instructions and Accessories.

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	300	V
Collector-emitter voltage ($R_{BE} \leqslant 1\ k\Omega$)	V_{CER}	max.	300	V
Collector-emitter voltage (open base)	V_{CEO}	max.	250	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V
Collector current (continuous)	I_C	max.	100	mA
Collector current (peak value) *	I_{CM}	max.	300	mA
Total power dissipation up to $T_{mb} = 90\ ^oC$	P_{tot}	max.	6	W
up to $T_{amb} = 70\ ^oC$	P_{tot}	max.	0.8	W
Storage temperature	T_{stg}		−65 to +150	^oC
Operating junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	10	K/W
From junction to ambient	$R_{th\ j\text{-}a}$	=	100	K/W

* Precautions should be taken during switch-on of the BF419 where an overshoot of current is likely to occur. The amplitude of the overshoot depends on the relative magnitude of stray external capacities to the transistor collector capacity. It is desirable to keep the stray capacities to a minimum by short lead lengths etc. so as to minimise the area of the switching path.

CHARACTERISTICS

$T_j = 25\ ^oC$

Collector cut-off current $I_E = 0$; $V_{CB} = 250$ V	I_{CBO}	<	50	nA
Emitter cut-off current $I_C = 0$; $V_{EB} = 3$ V	I_{EBO}	<	50	nA
D.C. current gain $I_C = 20$ mA; $V_{CE} = 10$ V	h_{FE}	typ.	45	
Collector-emitter saturation voltage $I_C = 200$ mA; $I_B = 20$ mA *	V_{CEsat}	<	11	V
Collector output capacitance at f = 1 MHz $I_E = 0$; $V_{CB} = 30$ V	C_{Tc}	<	4.5	pF
Storage time (in the typical circuit below)	t_s	typ.	0.5	μs

* The BF419 is controlled to V_{CEsat} max. 11.0 V and is thermally stable under all operating conditions where T_j max of 150 ^oC is not exceeded. For the typical circuit shown below, a heatsink is not required for operation with $T_{amb} \leqslant 70\ ^oC$.

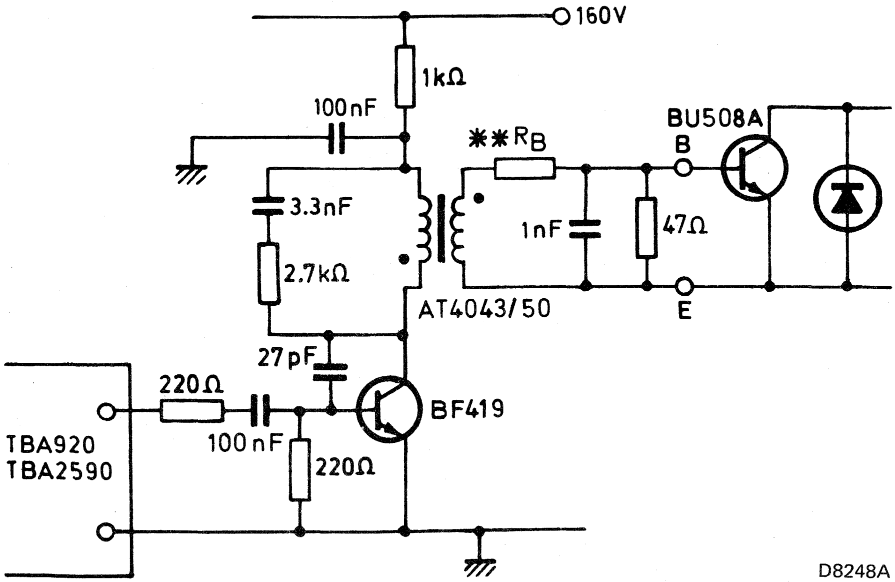


Fig.2 Typical circuit.

** R_B is chosen so that the end-of-scan base current for the BU508A is 1.4 A under nominal conditions. Typical value of R_B is 0.5 Ω plus 0.1 Ω lead resistance.

SILICON EPITAXIAL TRANSISTORS

N-P-N transistors in plastic TO-92 package primarily intended for class-B video output stages in colour television and professional monitor equipment. P-N-P complements are BF421 and BF423.

QUICK REFERENCE DATA

			BF420	BF422	
Collector-base voltage (open emitter)	V_{CBO}	max.	300	250	V
Collector-emitter voltage	V_{CER}	max.	300		V
	V_{CEO}	max.		250	V
Collector current (peak value)	I_{CM}	max.	100		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	830		mW
Junction temperature	T_j	max.	150		°C
D.C. current gain at T_j = 25 °C; I_C = 25 mA; V_{CE} = 20 V	h_{FE}	>	50		
Transition frequency at f = 100 MHz; I_C = 10 mA; V_{CE} = 10 V	f_T	>	60		MHz
Feedback capacitance at f = 1 MHz; I_C = 0; V_{CE} = 30 V	C_{re}	<	1,6		pF

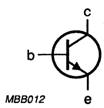
MECHANICAL DATA

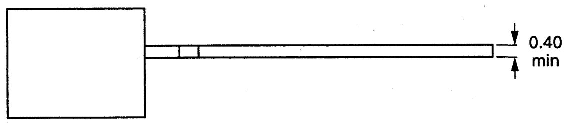
Dimensions in mm

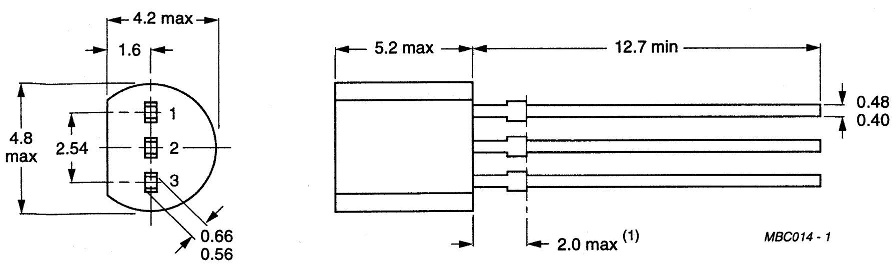
Fig. 1 TO-92.

Pinning

1 = base
2 = collector
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			BF420	BF422	
Collector-base voltage (open emitter)	V_{CBO}	max.	300	250	V
Collector-emitter voltage					
R_{BE} = 2,7 kΩ	V_{CER}	max.	300		V
I_B = 0	V_{CEO}	max.		250	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5		V
Collector current (d.c.)	I_C	max.	50		mA
Collector current (peak value)	I_{CM}	max.	100		mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	830		mW
Storage temperature	T_{stg}		−65 to + 150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	150	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

			BF420	BF422	
Collector cut-off currents					
I_E = 0; V_{CB} = 200 V	I_{CBO}	<	10	10	nA
R_{BE} = 2,7 kΩ; V_{CE} = 200 V; T_j = 150 °C	I_{CER}	<	10	10	μA
Emitter cut-off current					
I_C = 0; V_{EB} = 5 V	I_{EBO}	<	10		μA
D.C. current gain					
I_C = 25 mA; V_{CE} = 20 V	h_{FE}	>	50		
High-frequency knee voltage**					
I_C = 25 mA; T_j = 150 °C	V_{CEK}	typ.	20		V
Saturation voltage					
I_C = 30 mA; I_B = 5 mA	V_{CEsat}	<	0,6		V
Transition frequency at f = 100 MHz					
I_C = 10 mA; V_{CE} = 10 V	f_T	>	60		MHz
Feedback capacitance at f = 1 MHz					
I_C = 0; V_{CE} = 30 V	C_{re}	<	1,6		pF

* Transistor mounted on a printed-circuit board, mounting pad for collector lead minimum 10 mm x 10 mm; maximum length 4 mm.

** The high-frequency knee voltage of a transistor is that value of the collector-emitter voltage at which the small-signal gain, measured in a practical circuit, has dropped to 80% of the gain at V_{CE} = 50 V. A further reduction of the collector-emitter voltage results in a rapid increase of the distortion of the signal.

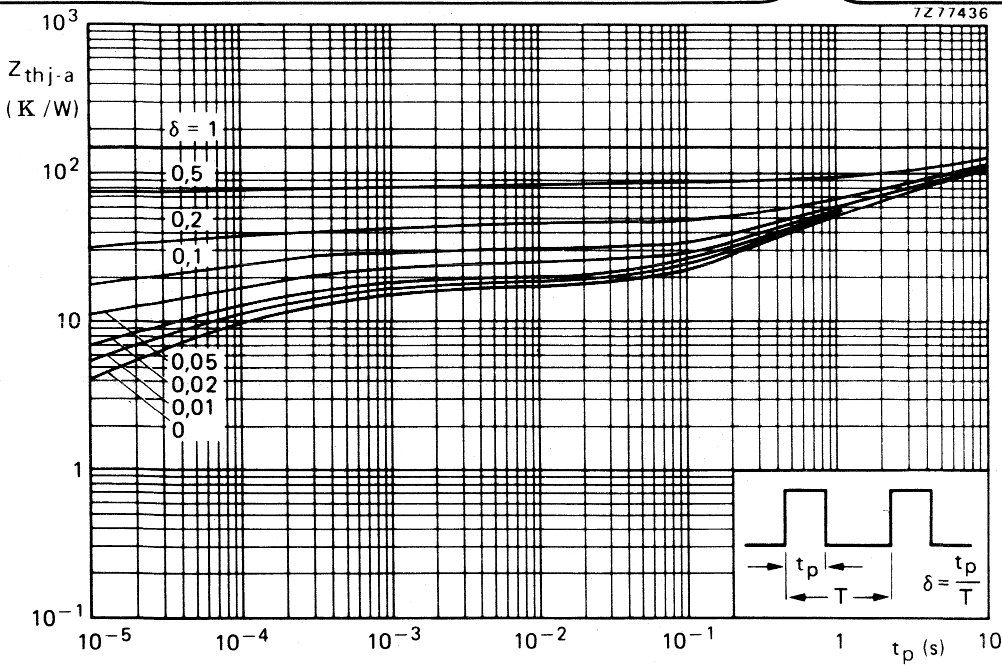


Fig. 2 Thermal impedance from junction to ambient versus pulse duration. Maximum lead length 3 mm; mounting pad for collector lead minimum 10 mm x 10 mm.

SILICON EPITAXIAL TRANSISTORS

P-N-P transistors in plastic TO-92 package primarily intended for class-B video output stages in colour television and professional monitor equipment. N-P-N complements are BF420 and BF422.

QUICK REFERENCE DATA

			BF421	BF423	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	300	250	V
Collector-emitter voltage (R_{BE} = 2.7 kΩ)	$-V_{CER}$	max.	300		V
(open base)	$-V_{CEO}$	max.		250	V
Collector current (peak value)	$-I_{CM}$	max.	100		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	830		mW
Junction temperature	T_j	max.	150		°C
D.C. current gain at T_j = 25 °C $-I_C$ = 25 mA; $-V_{CE}$ = 20 V	h_{FE}	>	50		
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 10 V	f_T	>	60		MHz
Feedback capacitance at f = 1 MHz $-I_C$ = 0; $-V_{CE}$ = 30 V	C_{re}	<	1,6		pF

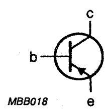
MECHANICAL DATA

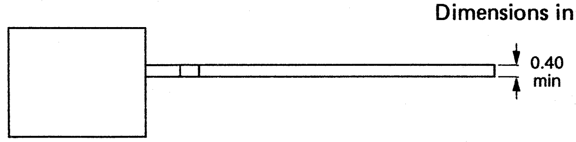
Dimensions in mm

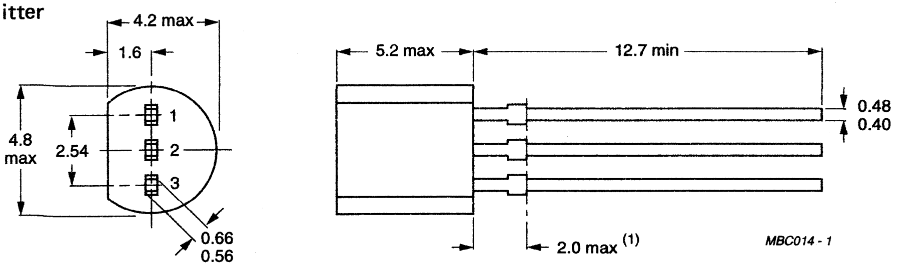
Fig. 1 TO-92.

Pinning:

1 = base
2 = collector
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			BF421	BF423	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	300	250	V
Collector-emitter voltage					
R_{BE} = 2,7 kΩ	$-V_{CER}$	max.	300		V
I_B = 0	$-V_{CEO}$	max.		250	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5		V
Collector current (d.c.)	$-I_C$	max.	50		mA
Collector current (peak value)	$-I_{CM}$	max.	100		mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	830		mW
Storage temperature	T_{stg}		−65 to + 150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	150	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

			BF421	BF423	
Collector cut-off currents					
$I_E = 0; -V_{CB}$ = 200 V	$-I_{CBO}$	<	10	10	nA
R_{BE} = 2,7 kΩ; $-V_{CE}$ = 200 V; T_j = 150 °C	$-I_{CER}$	<	10	10	µA
Emitter cut-off current					
$I_C = 0; -V_{EB}$ = 5 V	$-I_{EBO}$	<	10		µA
D.C. current gain					
$-I_C$ = 25 mA; $-V_{CE}$ = 20 V	h_{FE}	>	50		
High-frequency knee voltage**					
$-I_C$ = 25 mA; T_j = 150 °C	$-V_{CEK}$	typ.	20		V
Saturation voltage					
$-I_C$ = 30 mA; $-I_B$ = 5 mA	$-V_{CE\ sat}$	<	0,6		V
Transition frequency at f = 100 MHz					
$-I_C$ = 10 mA; $-V_{CE}$ = 10 V	f_T	>	60		MHz
Feedback capacitance at f = 1 MHz					
$-I_C = 0; -V_{CE}$ = 30 V	C_{re}	<	1,6		pF

* Transistor mounted on a printed-circuit board, mounting pad for collector lead minimum 10 mm x 10 mm; maximum length 4 mm.

** The high-frequency knee voltage of a transistor is that value of the collector-emitter voltage at which the small-signal gain, measured in a practical circuit, has dropped to 80% of the gain at V_{CE} = 50 V. A further reduction of the collector-emitter voltage results in a rapid increase of the distortion of the signal.

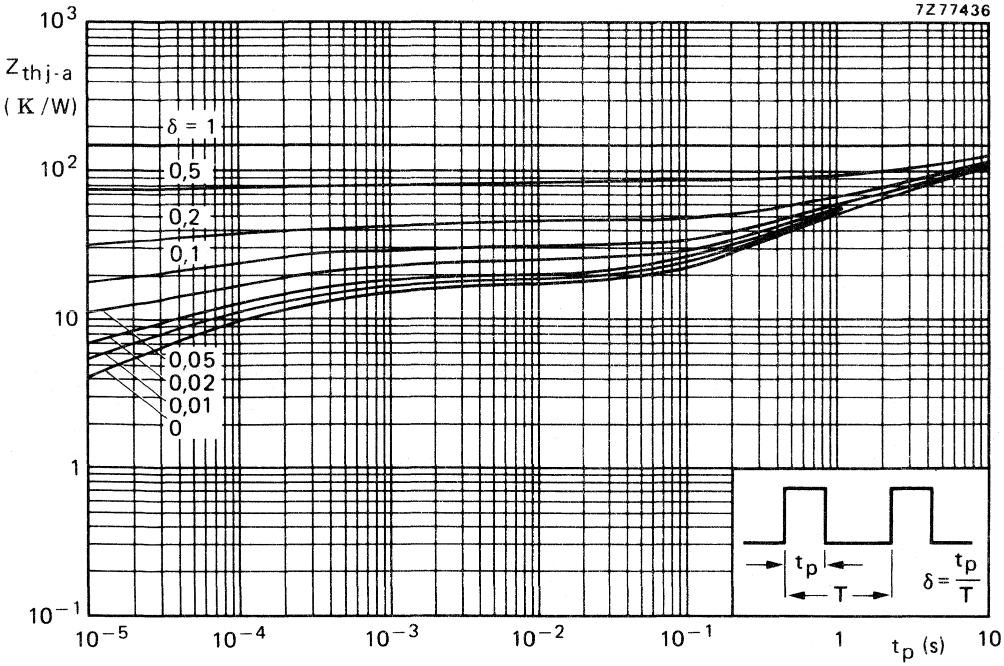


Fig. 2 Thermal impedance from junction to ambient versus pulse duration. Maximum lead length 4 mm; mounting pad for collector lead minimum 10 mm x 10 mm.

HF SILICON PLANAR EPITAXIAL TRANSISTORS

PNP transistors in a plastic package intended for HF and IF applications in radio receivers, especially for mixer stages in AM receivers and IF stages in AM/FM receivers with negative earth.

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.	25	mA
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	300	mW
Junction temperature		T_j	max.	150	°C
DC current gain $-I_C$ = 1 mA; $-V_{CE}$ = 10 V	BF450:	h_{FE}		62 to 200	
	BF451:	h_{FE}		30 to 90	
Transition frequency at f = 100 MHz $-I_C$ = 1 mA; $-V_{CE}$ = 10 V		f_T	min.	350	MHz

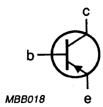
MECHANICAL DATA

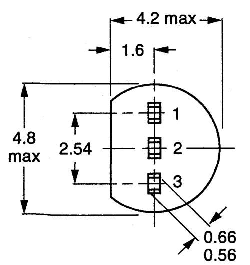
Dimensions in mm

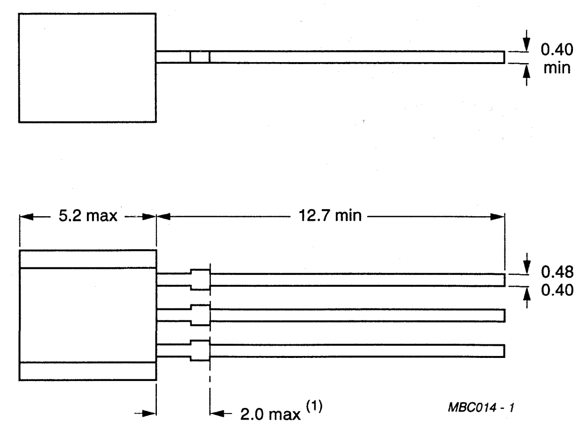
Fig. 1 TO-92.

Pinning:

1 = base
2 = emitter
3 = collector







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

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.	4	V
Collector current (DC)	$-I_C$	max.	25	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	$R_{th\ j\text{-}a}$	=	420	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise stated

Collector cut-off current					
$I_E = 0$; $-V_{CB} = 30$ V		$-I_{CBO}$	max.	50	nA
$I_E = 0$; $-V_{CB} = 30$ V; $T_{amb} = 150$ °C		$-I_{CBO}$	max.	4	μA
Emitter-cut-off current					
$I_C = 0$; $-V_{EB} = 3$ V		$-I_{EBO}$	max.	100	nA
DC current gain					
$-I_C = 1$ mA; $-V_{CE} = 10$ V	BF450	h_{FE}		62 to 200	
	BF451	h_{FE}		30 to 90	
Base-emitter voltage					
$-I_C = 1$ mA; $-V_{CE} = 10$ V		$-V_{BE}$		680 to 780	mV
Transition frequency at f = 100 MHz					
$-I_C = 1$ mA; $-V_{CE} = 10$ V		f_T	min.	350	MHz
Feedback capacitance at f = 1 MHz					
$-I_C = 1$ mA; $-V_{CE} = 10$ V		C_{re}	max.	0.55	pF

SILICON PLANAR TRANSISTORS

for video output stages

N-P-N transistors in a SOT-32 plastic package intended for video output stages in black-and-white and in colour television receivers.

QUICK REFERENCE DATA

			BF457	BF458	BF459	
Collector-base voltage (open emitter)	V_{CBO}	max.	160	250	300	V
Collector-emitter voltage (open base)	V_{CEO}	max.	160	250	300	V
Collector current (peak value)	I_{CM}	max.		300		mA
Total power dissipation up to T_{mb} = 90 °C	P_{tot}	max.		6		W
Junction temperature	T_j	max.		150		°C
D.C. current gain at T_j = 25 °C I_C = 30 mA; V_{CE} = 10 V	h_{FE}	>		26		
Transition frequency at f = 100 MHz I_C = 15 mA; V_{CE} = 10 V	f_T	typ.		90		MHz
Feedback capacitance at f = 1 MHz I_E = 0; V_{CB} = 30 V	C_{re}	<		3,5		pF

MECHANICAL DATA

Dimensions in mm

Collector connected to metal part of mounting surface

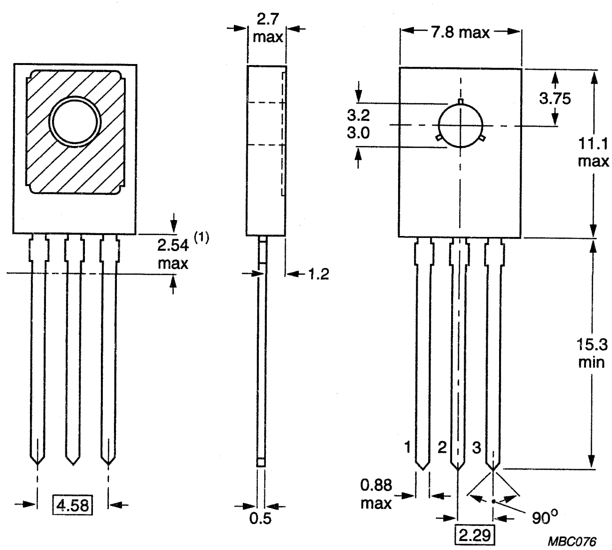
TO-126 (SOT-32)

Pinning:

1 = emitter

2 = collector

3 = base



(1) Within this region the cross-section of the leads is uncontrolled.

See also chapters Mounting instructions and Accessories.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

			BF457	BF458	BF459	
Collector-base voltage (open emitter)	V_{CBO}	max.	160	250	300	V
Collector-emitter voltage (open base)	V_{CEO}	max.	160	250	300	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	5	V

Collector current (d.c.)	I_C	max.	100	mA
Collector current (peak value)	I_{CM}	max.	300	mA
Base current (d.c.)	I_B	max.	50	mA
Total power dissipation up to T_{mb} = 90 °C	P_{tot}	max.	6	W
Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j-a}$	=	104	K/W
From junction to mounting base	$R_{th\ j-mb}$	=	10	K/W

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; V_{CB} = 100 V for BF457				
$I_E = 0$; V_{CB} = 200 V for BF458	I_{CBO}	<	50	nA
$I_E = 0$; V_{CB} = 250 V for BF459				
Emitter cut-off current				
$I_C = 0$; V_{EB} = 3 V	I_{EBO}	<	50	nA
D.C. current gain				
I_C = 30 mA; V_{CE} = 10 V	h_{FE}	>	26	
Collector-emitter saturation voltage				
I_C = 30 mA; I_B = 6 mA	V_{CEsat}	<	1	V
High frequency knee voltage at T_j = 150 °C				
I_C = 50 mA	V_{CEK}	typ.	15	V

The high frequency knee voltage of a transistor is that value of the collector-emitter voltage at which the small signal gain, measured in a practical circuit, has dropped to 80% of the gain at V_{CE} = 50 V. A further reduction of the collector-emitter voltage results in a rapid increase of the distortion of the signal.

Transition frequency at f = 100 MHz				
I_C = 15 mA; V_{CE} = 10 V	f_T	typ.	90	MHz
Feedback capacitance at f = 1 MHz				
$I_E = 0$; V_{CB} = 30 V	C_{re}	<	3,5	pF
Output capacitance at f = 1 MHz				
$I_E = 0$; V_{CB} = 30 V	C_c	<	4,5	pF

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in plastic package intended for class-B video output stages in television receivers and for high-voltage i.f. output stages.
P-N-P complements are BF470 and BF472 respectively.

QUICK REFERENCE DATA

			BF469	BF471	
Collector-base voltage (open emitter)	V_{CBO}	max.	250	300	V
Collector-emitter voltage					
open base	V_{CEO}	max.	250	–	V
R_{BE} = 2,7 kΩ	V_{CER}	max.	–	300	V
Collector current (peak value)	I_{CM}	max.	100		mA
Total power dissipation up to $T_{mb} \leq 114$ °C	P_{tot}	max.	1,8		W
Junction temperature	T_j	max.	150		°C
D.C. current gain I_C = 25 mA; V_{CE} = 20 V	h_{FE}	>	50		
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 10 V	f_T	>	60		MHz
Feedback capacitance at f = 0,5 MHz I_E = 0; V_{CB} = 30 V	C_{re}	<	1,8		pF

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-126 (SOT-32).

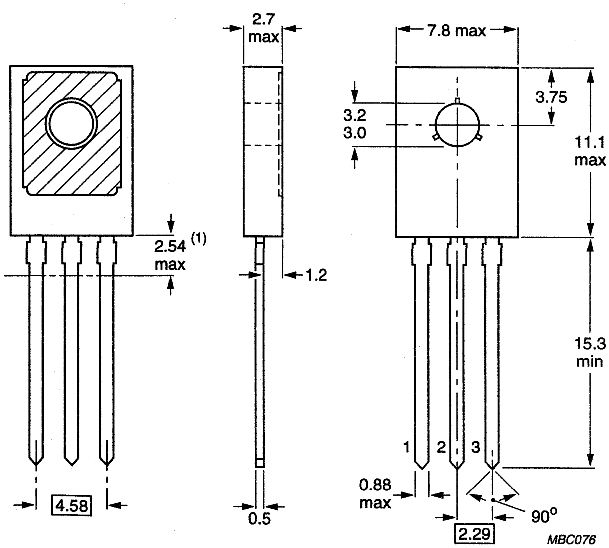
Collector connected to mounting base

Pinning:

1 = emitter

2 = collector

3 = base



(1) Within this region the cross section of the leads is uncontrolled.

RATINGS

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

			BF469	BF471	
Collector-base voltage (open emitter)	V_{CBO}	max.	250	300	V
Collector-emitter voltage					
R_{BE} = 2,7 kΩ	V_{CER}	max.	–	300	V
open base	V_{CEO}	max.	250	–	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5		V
Collector current (d.c.)	I_C	max.	50		mA
Collector current (peak value)	I_{CM}	max.	100		mA
Total power dissipation up to T_{mb} = 114 °C *	P_{tot}	max.	1,8		W
Storage temperature	T_{stg}		–65 to + 150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	20	K/W
From junction to ambient in free air *	$R_{th\ j\text{-}a}$	=	100	K/W

* Transistor mounted on a printed-circuit board, maximum lead length 4 mm, mounting pad for collector lead minimum 10 mm x 10 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $V_{CB} = 200$ V	I_{CBO}	<	10	nA
$R_{BE} = 2{,}7$ kΩ; $V_{CE} = 200$ V; $T_j = 150$ °C	I_{CER}	<	10	μA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	<	10	μA
D.C. current gain				
$I_C = 25$ mA; $V_{CE} = 20$ V	h_{FE}	>	50	
High-frequency knee voltage at $T_j = 150$ °C*				
$I_C = 25$ mA	V_{CEK}	typ.	20	V
Transistion frequency at f = 100 MHz				
$I_C = 10$ mA; $V_{CE} = 10$ V	f_T	>	60	MHz
Feedback capacitance at f = 0,5 MHz				
$I_E = 0$; $V_{CB} = 30$ V	C_{re}	<	1,8	pF

* The high-frequency knee voltage of a transistor is that value of the collector-emitter voltage at which the small-signal gain, measured in a practical circuit, has dropped to 80% of the gain at $V_{CE} = 50$ V.
A further reduction of the collector-emitter voltage results in a rapid increase of the distortion of the signal.

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors in a plastic package intended for class-B video output stages in television receivers and for high-voltage i.f. output stages.
N-P-N complements are BF469 and BF471 respectively.

QUICK REFERENCE DATA

			BF470	BF472	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	250	300	V
Collector-emitter voltage					
open base	$-V_{CEO}$	max.	250	–	V
R_{BE} = 2,7 kΩ	$-V_{CER}$	max.	–	300	V
Collector current (peak value)	$-I_{CM}$	max.	100		mA
Total power dissipation up to T_{mb} = 114 °C	P_{tot}	max.	1,8		W
Junction temperature	T_j	max.	150		°C
D.C. current gain					
$-I_C$ = 25 mA; $-V_{CE}$ = 20 V	h_{FE}	>	50		
Transition frequency at f = 100 MHz					
$-I_C$ = 10 mA; $-V_{CE}$ = 10 V	f_T	>	60		MHz
Feedback capacitance at f = 0,5 MHz					
I_E = 0; $-V_{CB}$ = 30 V	C_{re}	<	1,8		pF

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-126 (SOT-32).

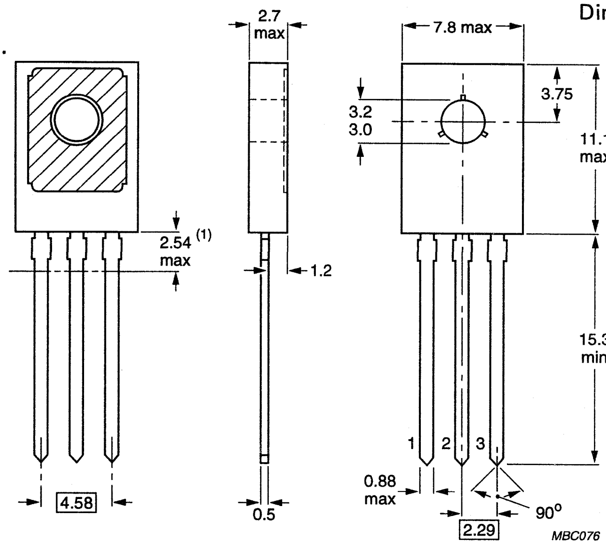
Collector connected to mounting base.

Pinning:

1 = emitter

2 = collector

3 = base



(1) Within this region the cross section of the leads is uncontrolled.

RATINGS

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

			BF470	BF472	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	250	300	V
Collector-emitter voltage					
R_{BE} = 2,7 kΩ	$-V_{CER}$	max.	–	300	V
open base	$-V_{CEO}$	max.	250	–	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5		V
Collector current (d.c.)	$-I_C$	max.	50		mA
Collector current (peak value)	$-I_{CM}$	max.	100		mA
Total power dissipation up to T_{mb} = 114 °C *	P_{tot}	max.	1,8		W
Storage temperature	T_{stg}		–65 to + 150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	20	K/W
From junction to ambient in free air *	$R_{th\ j\text{-}a}$	=	100	K/W

* Transistor mounted on a printed-circuit board, maximum lead length 4 mm; mounting pad for collector lead minimum 10 mm x 10 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $-V_{CB} = 200$ V	$-I_{CBO}$	<	10	nA
$R_{BE} = 2{,}7$ kΩ; $-V_{CE} = 200$ V; $T_j = 150$ °C	$-I_{CER}$	<	10	μA
Emitter cut-off current				
$I_C = 0$; $-V_{EB} = 5$ V	$-I_{EBO}$	<	10	μA
D.C. current gain				
$-I_C = 25$ mA; $-V_{CE} = 20$ V	h_{FE}	>	50	
High-frequency knee voltage at $T_j = 150$ °C*				
$-I_C = 25$ mA	$-V_{CEK}$	typ.	20	V
Transition frequency at f = 100 MHz				
$-I_C = 10$ mA; $-V_{CE} = 10$ V	f_T	>	60	MHz
Feedback capacitance at f = 0,5 MHz				
$I_E = 0$; $-V_{CB} = 30$ V	C_{re}	<	1,8	pF

* The high-frequency knee voltage of a transistor is that value of the collector-emitter voltage at which the small-signal gain, measured in a practical circuit, has dropped to 80% of the gain at $-V_{CE} = 50$ V. A further reduction of the collector-emitter voltage results in a rapid increase of the distortion of the signal.

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in TO-92 package and intended for use in video output stages in black-and-white and in colour television receivers.

QUICK REFERENCE DATA

			BF483	BF485	BF487	
Collector-base voltage (open emitter)	V_{CBO}	max.	300	350	400	V
Collector-emitter voltage (open base)	V_{CEO}	max.	250	300	350	V
Collector current (peak value)	I_{CM}	max.		100		mA
Total power dissipation (free air)	P_{tot}	max.		830		mW
D.C. current gain $I_C = 25$ mA; $V_{CE} = 20$ V	h_{FE}	≥		50		
Transition frequency at f = 100 MHz $-I_E = 10$ mA; $V_{CB} = 10$ V	f_T			70 to 110		MHz
Junction temperature	T_j	max.		150		°C

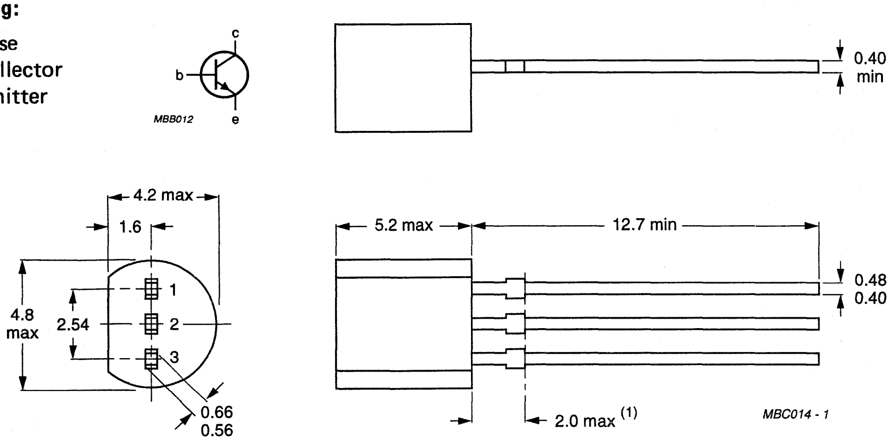
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92.

Pinning:

1 = base
2 = collector
3 = emitter



Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			BF483	BF485	BF487	
Collector-base voltage (open emitter)	V_{CBO}	max.	300	350	400	V
Collector-emitter voltage (open base)	V_{CEO}	max.	250	300	350	V
Emitter-base voltage (open collector)	V_{EBO}	max.		5		V
Collector current						
d.c.	I_C	max.		50		mA
peak value	I_{CM}	max.		100		mA
Total power dissipation in free air up to T_{amb} = 25 °C	P_{tot}	max.		830		mW
Storage temperature	T_{stg}			−65 to + 150		°C
Junction temperature	T_j	max.		150		°C

THERMAL RESISTANCE

From junction to ambient when mounted on a p.c. board and mounting pad for collector lead minimum 10 mm x 10 mm and maximum lead length 4 mm	$R_{th\ j\text{-}a}$	max.	150	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; V_{CB} = 300 V	I_{CBO}	≤	20	nA
Collector-emitter cut-off current				
V_{CE} = 250 V; R_{BE} = 2,7 kΩ; T_j = 150 °C	I_{CER}	≤	20	μA
Emitter cut-off current				
$I_C = 0$; V_{EB} = 5 V	I_{EBO}	≤	10	μA
High-frequency knee voltage				
I_C = 25 mA; T_j = 150 °C	V_{CEK}	≤	20	V
D.C. current gain				
I_C = 25 mA; V_{CE} = 20 V	h_{FE}	≥	50	
I_C = 40 mA; V_{CE} = 20 V	h_{FE}	≥	20	
Transition frequency at f = 100 MHz				
$-I_E$ = 10 mA; V_{CB} = 10 V	f_T		70 to 110	MHz
Feedback capacitance at f = 1 MHz				
$I_E = 0$; V_{CB} = 30 V	C_{re}	≤	1,4	pF

SILICON PLANAR EPITAXIAL TRANSISTORS

PNP transistors in a TO-92 package and intended for use in video output stages of black and white and colour television receivers.

QUICK REFERENCE DATA

			BF484	BF486	BF488	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	250	300	350	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	250	300	350	V
Collector current (peak value)	$-I_{CM}$	max.		100		mA
Total power dissipation (free air)	P_{tot}	max.		830		mW
DC current gain $-I_C = 25$ mA; $-V_{CE} = 20$ V	h_{FE}	min.		50		
Transition frequency at f = 100 MHz $-I_C = 10$ mA; $-V_{CE} = 10$ V	f_T			70 to 110		MHz
Junction temperature	T_j	max.		150		^oC

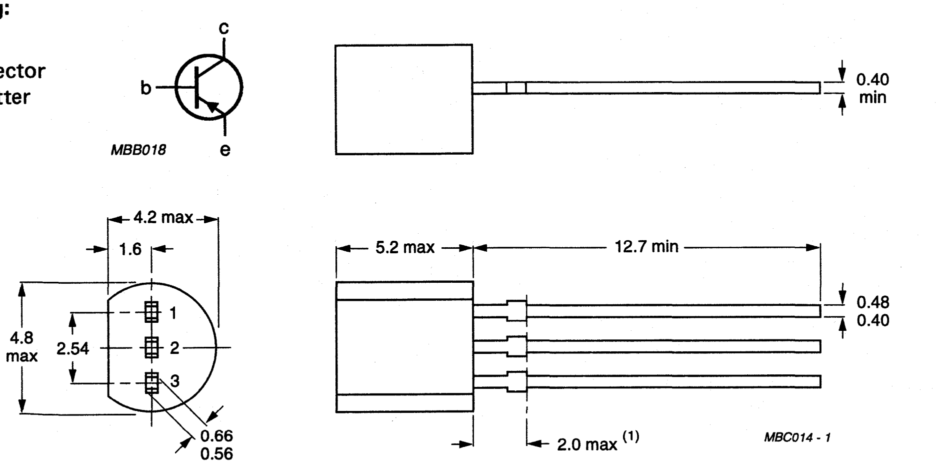
MECHANICAL DATA

Dimensions in mm

Fig.1 TO-92.

Pinning:

1. Base
2. Collector
3. Emitter



Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			BF484	BF486	BF488	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	250	300	350	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	250	300	350	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.		5		V
Collector current						
DC	$-I_C$	max.		100		mA
peak value	$-I_{CM}$	max.		100		mA
Total power dissipation in free air up to T_{amb} = 25 °C	P_{tot}	max.		830		mW
Storage temperature range	T_{stg}			−65 to 150		°C
Junction temperature	T_j			150		°C

THERMAL RESISTANCE

From junction to ambient when mounted on a printed-circuit board and mounting pad for collector lead minimum 10 mm x 10 mm and maximum lead length 4 mm	$R_{th\ j\text{-}a}$	max.	150	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise stated

			BF484	BF486	BF488	
Collector-emitter breakdown voltage $-I_C$ = 2.5 mA; I_B = 0	$-V_{(BR)CEO}$	max.	250	300	350	V
Collector-base breakdown voltage $-I_C$ = 10 μA; I_E = 0	$-V_{(BR)CBO}$	max.	250	300	350	V
Emitter-base breakdown voltage $-I_E$ = 100 μA; I_C = 0	$-V_{(BR)EBO}$	max.	5	5	5	V
Collector cut-off current						
I_E = 0; $-V_{CB}$ = 200 V	$-I_{CBO}$	max.	20			nA
I_E = 0; $-V_{CB}$ = 250 V	$-I_{CBO}$	max.		20		nA
I_E = 0; $-V_{CB}$ = 300 V	$-I_{CBO}$	max.			20	nA
Collector-emitter cut-off current $-V_{CE}$ = 200 V; R_{BE} = 2.7 kΩ; T_j = 150 °C	$-I_{CER}$	max.		20		μA
High frequency knee voltage $-I_C$ = 25 mA; T_j = 150 °C	$-V_{CEK}$	max.		15		V
DC current gain						
$-I_C$ = 25 mA; $-V_{CE}$ = 20 V	h_{FE}	min.		50		
$-I_C$ = 40 mA; $-V_{CE}$ = 20 V	h_{FE}	min.		20		

Saturation voltages				
$-I_C = 20$ mA; $-I_B = 2$ mA	$-V_{CEsat}$	max.	0.5	V
	$-V_{BEsat}$	max.	0.9	V
Transition frequency at f = 100 MHz				
$-I_C = 10$ mA; $-V_{CE} = 10$ V	f_T		70 to 110	MHz
Feedback capacitance at f = 1 MHz				
$I_E = 0$; $-V_{CB} = 30$ V	C_{re}	max.	2.5	pF
Output capacitance at f = 1 MHz				
$I_E = 0$; $-V_{CB} = 20$ V	C_c	max.	4	pF

SILICON PLANAR EPITAXIAL TRANSISTOR

NPN transistor in a plastic TO-92 package intended for HF applications in radio and television receivers; it is especially recommended for FM tuners, low noise AM mixer-oscillators with high source impedance and IF amplifiers in AM/FM receivers where a high current gain is of importance.

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 (DC)		I_C	max.	30 mA
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	300 mW
Junction temperature		T_j	max.	150 °C
DC current gain I_C = 1 mA; V_{CE} = 10 V	BF494	h_{FE}		67 to 220
	BF495	h_{FE}		35 to 125
Transition frequency at f = 100 MHz I_C = 1 mA; V_{CE} = 10 V		f_T	min.	120 MHz

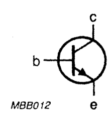
MECHANICAL DATA

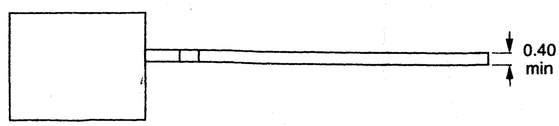
Dimensions in mm

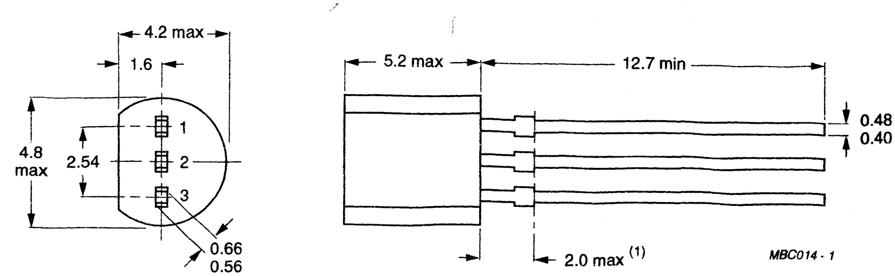
Fig. 1 TO-92.

Pinning

1 = base
2 =emitter
3 = collector







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

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)	V_{CEO}	max.	20 V
Emitter-base voltage (open collector)	V_{EBO}	max.	5 V
Collector current (DC)	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.	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	$R_{th\ j\text{-}a}$	=	420 K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Base-emitter voltage				
I_C = 1 mA; V_{CE} = 10 V		V_{BE}		0.65 to 0.74 V
DC current gain				
I_C = 1 mA, V_{CE} = 10 V	BF494	h_{FE}		67 to 220
	BF494B	h_{FE}		100 to 220
	BF495	h_{FE}		35 to 125
	BF495C	h_{FE}		67 to 125
	BF495D	h_{FE}		35 to 76
Feedback capacitance at f = 0.45 MHz				
I_C = 1 mA; V_{CE} = 10 V		C_{re}	max.	1 pF
Transition frequency				
I_C = 1 mA; V_{CE} = 10 V		f_T	min.	120 MHz
Collector cut-off current				
I_E = 0; V_{CB} = 20 V		I_{CBO}	max.	100 nA
I_E = 0; V_{CB} = 20 V; T_{amb} = 150 °C		I_{CBO}	max.	4 μA
Emitter-base cut-off current				
I_C = 0; V_{EB} = 4 V		I_{EBO}	max.	100 nA

SILICON PLANAR EPITAXIAL TRANSISTOR

P-N-P transistor, in a microminiature plastic package, intended for applications in thick and thin-film circuits. This transistor is primarily intended for use in i.f. detection applications.

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.	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 at T_j = 25 °C $-I_C$ = 1 mA; $-V_{CE}$ = 10 V	h_{FE}	>	50	
Transition frequency at f = 100 MHz $-I_C$ = 1 mA; $-V_{CE}$ = 10 V	f_T	typ.	325	MHz
Noise figure at R_S = 300 Ω $-I_C$ = 1 mA; $-V_{CE}$ = 10 V; f = 100 kHz	F	typ.	2	dB

MECHANICAL DATA

Dimensions in mm

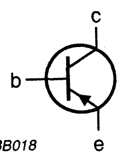
Marking code

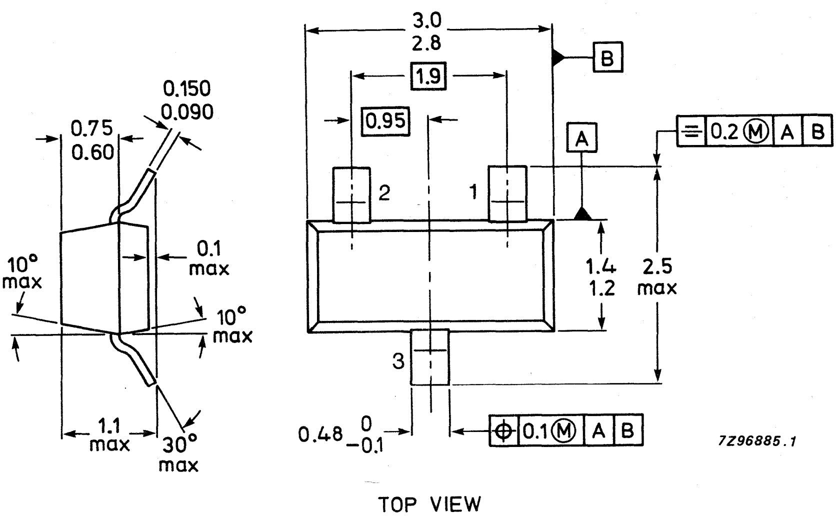
BF550 = LAp

Fig. 1 SOT-23

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.	40 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40 V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	4 V
Collector current (d.c.)	$-I_C$	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_{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	$-I_{EBO}$	<	100 μA
Base-emitter voltage $-I_C = 1$ mA; $-V_{CE} = 10$ V	$-V_{BE}$	typ.	750 mV
D.C. current gain $-I_C = 1$ mA; $-V_{CE} = 10$ V	h_{FE}	>	50
Transition frequency at f = 100 MHz $-I_C = 1$ mA; $-V_{CE} = 10$ V	f_T	typ.	325 MHz
Feedback capacitance at f = 1 MHz $-I_C = 1$ mA; $-V_{CE} = 10$ V	C_{re}	typ.	0,5 pF
Noise figure at $R_S = 300\ \Omega$ $-I_C = 1$ mA; $-V_{CE} = 10$ V; f = 100 kHz	F	typ.	2 dB

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a plastic SOT-23 variant package, intended for use in large-signal handling i.f. pre-amplifiers of TV receivers in combination with surface acoustic wave filters.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	40	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	V
Collector current (d.c.)	I_C	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 I_C = 10 mA; V_{CE} = 1 V	h_{FE}	>	40	
Transition frequency at f = 100 MHz I_C = 40 mA; V_{CE} = 10 V	f_T	>	490	MHz

MECHANICAL DATA

Dimensions in mm

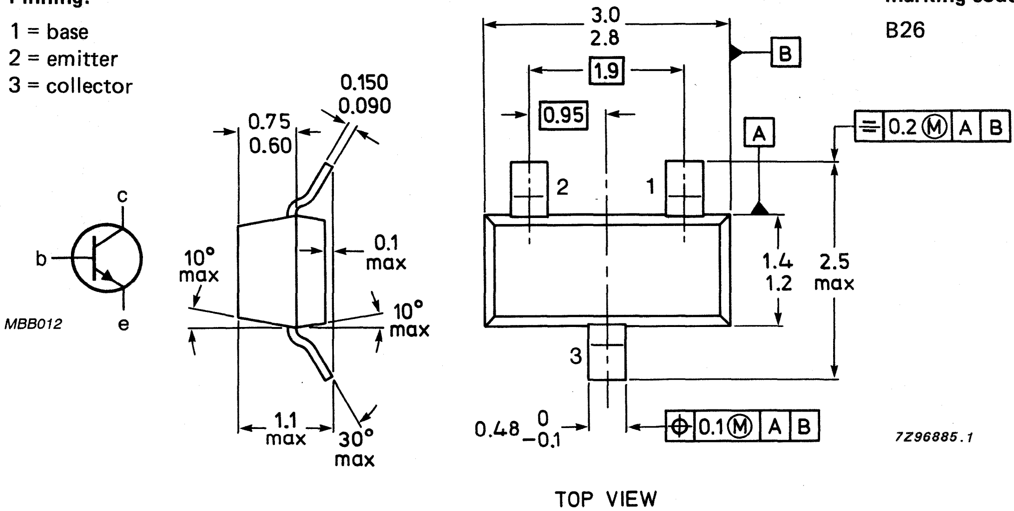
Fig. 1 SOT-23.

Pinning:

1 = base
2 = emitter
3 = collector

Marking code

B26



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.	15	V
Emitter-base voltage (open collector)	V_{EBO}	max.	4,5	V
Collector current (d.c.)	I_C	max.	100	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	mW
Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to tab	$R_{th\ j\text{-}t}$	=	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
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 2$ V	I_{EBO}	<	100	nA
D.C. current gain				
$I_C = 10$ mA; $V_{CE} = 1$ V	h_{FE}	>	40	
Transition frequency at f = 100 MHz				
$I_C = 10$ mA; $V_{CE} = 10$ V	f_T	>	500	MHz
$I_C = 40$ mA; $V_{CE} = 10$ V	f_T	>	490	MHz
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	2,2	pF
		<	3,5	pF
Emitter capacitance at f = 1 MHz				
$I_C = I_c = 0$; $V_{EB} = 1$ V	C_e	<	4,5	pF
Feedback capacitance at f = 1 MHz				
$I_C = 0$; $V_{CE} = 10$ V	C_{re}	typ.	1,6	pF
		<	2,2	pF

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in TO-202 plastic package, intended for use in video output stages in black-and-white and in colour television receivers.

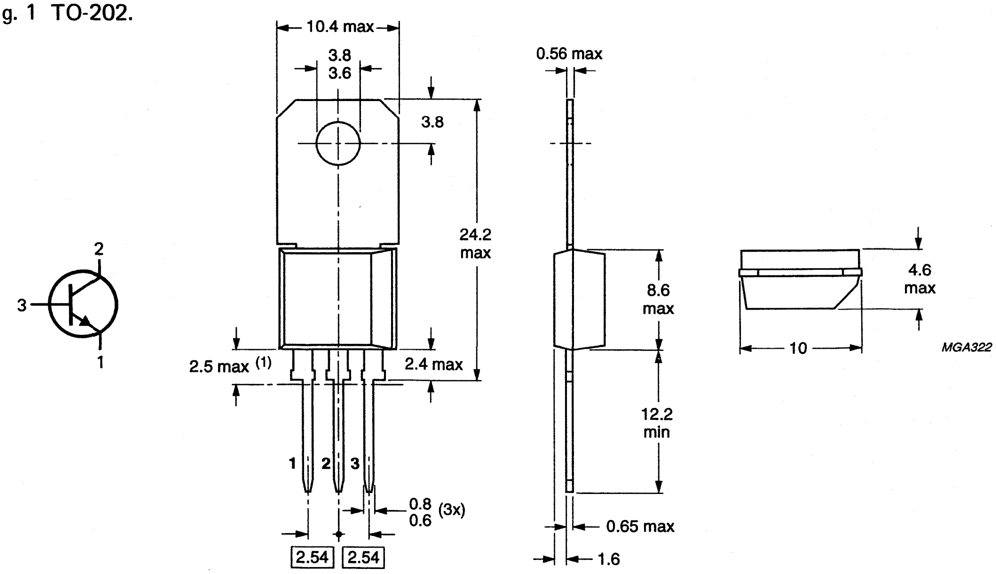
QUICK REFERENCE DATA

			BF583	BF585	BF587	
Collector-base voltage (open emitter)	V_{CBO}	max.	300	350	400	V
Collector-emitter voltage (open base)	V_{CEO}	max.	250	300	350	V
Collector current (peak value)	I_{CM}	max.		100		mA
Total power dissipation (free air)	P_{tot}	max.		1,6		W
D.C. current gain I_C = 25 mA; V_{CE} = 20 V	h_{FE}	min.		50		
Transition frequency at f = 100 MHz $-I_E$ = 10 mA; V_{CB} = 10 V	f_T			70 to 110		MHz
Junction temperature	T_j	max.		150		°C

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-202.



(1) Plastic flash allowed within this zone.

RATINGS

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

			BF583	BF585	BF587	
Collector-base voltage (open emitter)	V_{CBO}	max.	300	350	400	V
Collector-emitter voltage (open base)	V_{CEO}	max.	250	300	350	V
Emitter-base voltage (open collector)	V_{EBO}	max.		5		V
Collector current						
d.c.	I_C	max.		50		mA
peak value	I_{CM}	max.		100		mA
Total power dissipation in free air up to T_{amb} = 25 °C	P_{tot}	max.		1,6		W
Total power dissipation up to T_{mb} = 25 °C	P_{tot}	max.		5,0		W
Storage temperature	T_{stg}			−65 to + 150		°C
Junction temperature	T_j	max.		150		°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	max.	78	K/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	25	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current I_E = 0; V_{CB} = 300 V	I_{CBO}	≤	20	nA
Collector-emitter cut-off current V_{CE} = 250 V; R_{BE} = 2,7 kΩ; T_j = 150 °C	I_{CER}	≤	20	μA
Emitter cut-off current I_C = 0; V_{EB} = 5 V	I_{EBO}	≤	10	μA
High-frequency knee voltage I_C = 25 mA; T_j = 150 °C	V_{CEK}	=	20	V
D.C. current gain I_C = 25 mA; V_{CE} = 20 V	h_{FE}	≥	50	
I_C = 40 mA; V_{CE} = 20 V	h_{FE}	≥	20	
Transition frequency $-I_E$ = 10 mA; V_{CB} = 10 V	f_T		70 to 110	MHz
Feedback capacitance at f = 1 MHz I_E = 0; V_{CB} = 30 V	C_{re}	≤	1,8	pF
Collector capacitance at f = 1 MHz I_E = 0; V_{CB} = 30 V	C_c	≤	2,5	pF

SILICON PLANAR EPITAXIAL TRANSISTORS

PNP transistors in a TO-202 plastic package. Intended for use in video output stages of black and white and colour television receivers.

QUICK REFERENCE DATA

			BF584	BF586	BF588	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	250	300	350	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	250	300	350	V
Collector current (peak value)	$-I_{CM}$	max.		100		mA
Total power dissipation (free air)	P_{tot}	max.		1.6		W
DC current gain $-I_C = 25$ mA; $-V_{CE} = 20$ V	h_{FE}	min.		50		
Transition frequency at f = 100 MHz $-I_C = 10$ mA; $-V_{CE} = 10$ V	f_T			70 to 110		MHz
Junction temperature	T_j	max.		150		^oC

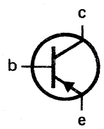
MECHANICAL DATA

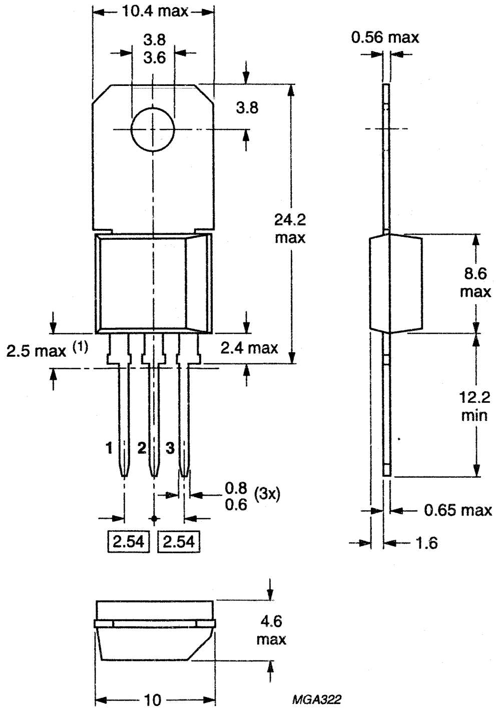
Dimensions in mm

Fig.1 TO-202.

Pinning:

1 = Emitter
2 = Collector
3 = Base





Note

1. Plastic flash allowed within this zone.

RATINGS

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

			BF584	BF586	BF588	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	250	300	350	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	250	300	350	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.		5		V
Collector current						
DC	$-I_C$	max.		50		mA
peak value	$-I_{CM}$	max.		100		mA
Total power dissipation in free air up to T_{amb} = 25 °C	P_{tot}	max.		1.6		W
Total power dissipation up to T_{mb} = 25 °C	P_{tot}	max.		5.0		W
Storage temperature range	T_{stg}			–65 to 150		°C
Junction temperature	T_j	max.		150		°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	max.	78	K/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	25	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise stated

			BF584	BF586	BF588	
Collector-emitter breakdown voltage $-I_C$ = 2.5 mA; I_B = 0	$-V_{(BR)CEO}$	min.	250	300	350	V
Collector-base breakdown voltage $-I_C$ = 10 μA; I_E = 0	$-V_{(BR)CBO}$	min.	250	300	350	V
Collector cut-off current						
I_E = 0; $-V_{CB}$=200 V	$-I_{CBO}$	max.	20			nA
I_E = 0; $-V_{CB}$=250 V	$-I_{CBO}$	max.		20		nA
I_E = 0; $-V_{CB}$=300 V	$-I_{CBO}$	max.			20	nA
Emitter-base breakdown voltage $-I_E$ = 10 μA; I_C = 0	$-V_{(BR(EBO}$	min.		5		V
Collector-emitter cut-off current $-V_{CE}$ = 200 V; R_{BE} = 2.7 kΩ; T_j = 150 °C	$-I_{CER}$	max.		20		μA
Emitter cut-off current I_C = 0; $-V_{EB}$ = 5 V	$-I_{EBO}$	max.		10		μA
High frequency knee voltage $-I_C$ = 25 mA; T_j = 150 °C	$-V_{CEK}$	=		15		V

DC current gain				
$-I_C = 25$ mA; $-V_{CE} = 20$ V	h_{FE}	min.	50	
$-I_C = 40$ mA; $-V_{CE} = 20$ V	h_{FE}	min.	20	
Collector-emitter saturation voltage				
$-I_C = 20$ mA; $-I_B = 2$ mA	$-V_{CEsat}$	max.	0.5	V
Base-emitter saturation voltage				
$-I_C = 20$ mA; $-I_B = 2$ mA	$-V_{BEsat}$	max.	0.9	V
Transition frequency at f = 100 MHz				
$-I_C = 10$ mA; $-V_{CE} = 10$ V	f_T		70 to 110	MHz
Feedback capacitance at f = 1 MHz				
$I_E = 0$; $-V_{CB} = 30$ V	C_{re}	max.	2.2	pF
Output capacitance at f = 1 MHz				
$I_E = 0$; $-V_{CB} = 30$ V	C_c	max.	3.0	pF

SWITCHING TRANSISTORS FOR TELEPHONY APPLICATIONS

Silicon n-p-n transistors in a TO-202 outline, intended for use in PABX and similar telephone systems.

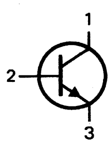
QUICK REFERENCE DATA

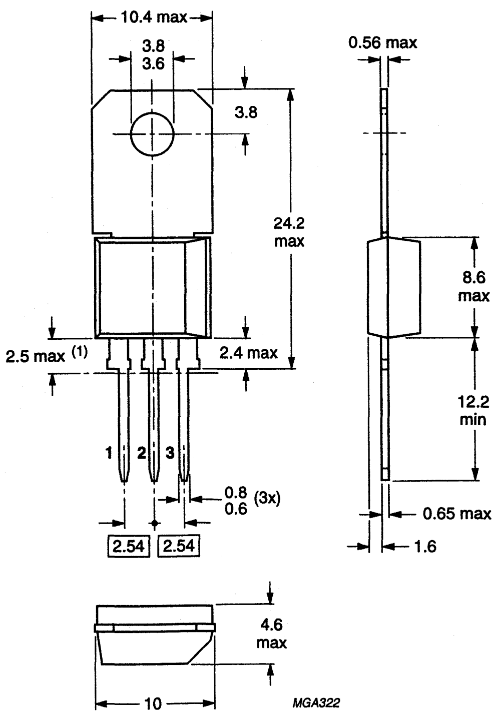
			BF591	BF593	
Collector-emitter voltage (open base)	V_{CEO}	max.	170	210	V
Collector-base voltage (open emitter)	V_{CBO}	max.	210	250	V
Collector current	I_C	max.	150		mA
Total power dissipation up to T_{amb} = 55 °C	P_{tot}	max.	1,3		W
Current gain I_C = 20 mA; V_{CE} = 5 V	h_{FE}	min.	30		
I_C = 100 mA; V_{CE} = 6 V	h_{FE}	min.	30		

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-202.





(1) Plastic flash allowed within this zone.

RATINGS

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

			BF591	BF593	
Collector-emitter voltage (open base)	V_{CEO}	max.	170	210	V
Collector-base voltage (open emitter)	V_{CBO}	max.	210	250	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5		V
Collector current (d.c.)	I_C	max.	150		mA
Total power dissipation up to T_{amb} = 55 °C	P_{tot}	max.	1,3		W
Storage temperature	T_{stg}		−65 to + 150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	max.	73	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BF591	BF593	
Collector-emitter breakdown voltage open base; I_C = 10 mA	$V_{(BR)CEO}$	⩾	170	210	V
Collector-base breakdown voltage open emitter; I_C = 0,1 mA	$V_{(BR)CBO}$	⩾	210	250	V
Emitter-base breakdown voltage open collector; I_E = 0,1 mA	$V_{(BR)EBO}$	⩾	5		V
Base-emitter voltage I_C = 25 mA; V_{CE} = 5 V	V_{BE}	⩾	0,65		V
		⩽	0,85		V
Collector cut-off current open emitter; V_{CB} = 60 V	I_{CBO}	<	50		nA
V_{BE} = 0; V_{CE} = 60 V; T_j = 140 °C	I_{CES}	<	1,0		μA
D.C. current gain* I_C = 20 mA; V_{CE} = 5 V	h_{FE}	⩾	30		
I_C = 100 mA; V_{CE} = 6 V	h_{FE}	⩾	30		
I_C = 150 mA; V_{CE} = 7 V	h_{FE}	⩾	20		

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

SILICON EPITAXIAL TRANSISTORS

- **For video output stages**

N-P-N transistors in a microminiature plastic package intended for class-B video output stages in colour television receivers.

P-N-P complements are BF621 and BF623 respectively.

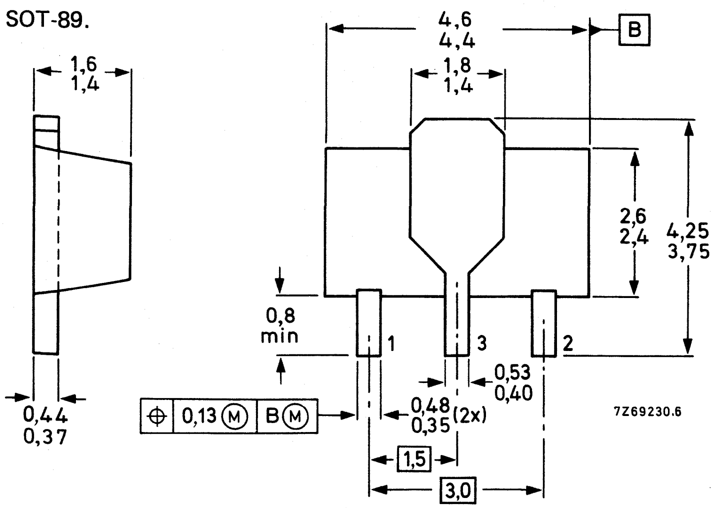
QUICK REFERENCE DATA

			BF620	BF622	
Collector-base voltage (open emitter)	V_{CBO}	max.	300	250	V
Collector-emitter voltage (open base)	V_{CEO}	max.	–	250	V
Collector-emitter voltage (R_{BE} = 2,7 kΩ)	V_{CER}	max.	300	–	V
Collector current (peak value)	I_{CM}	max.	100		mA
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 I_C = 25 mA; V_{CE} = 20 V	h_{FE}	>	50		
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 10 V	f_T	>	60		MHz
Feedback capacitance at f = 1 MHz I_C = 0; V_{CE} = 30 V	C_{re}	<	1,6		pF

MECHANICAL DATA

Fig. 1 SOT-89.

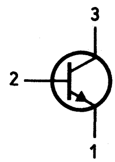
Dimensions in mm



BOTTOM VIEW

Marking code

BF620 = DC
BF622 = DA



RATINGS

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

			BF620	BF622	
Collector-base voltage (open emitter)	V_{CBO}	max.	300	250	V
Collector-emitter voltage (open base)	V_{CEO}	max.	–	250	V
Collector-emitter voltage (R_{BE} = 2,7 kΩ)	V_{CER}	max.	300	–	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5		V
Collector current (d.c.)	I_C	max.	50		mA
Collector current (peak value)	I_{CM}	max.	100		mA
Total power dissipation up to T_{amb} = 25 °C mounted on a ceramic substrate area = 2,5 cm²; thickness = 0,7 mm	P_{tot}	max.	1		W
Storage temperature	T_{stg}		−65 to + 150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE*

From junction to collector tab	$R_{th\ j\text{-}tab}$	=	25	K/W
From junction to ambient in free air mounted on a ceramic substrate area = 2,5 cm²; thickness = 0,7 mm	$R_{th\ j\text{-}a}$	=	125	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BF620	BF622	
Collector cut-off current I_E = 0; V_{CB} = 200 V	I_{CBO}	<	10	10	nA
Collector-emitter voltage R_{BE} = 2,7 kΩ; V_{CE} = 250 V	I_{CER}	<	50	–	nA
R_{BE} = 2,7 kΩ; V_{CE} = 200 V; T_j = 150 °C	I_{CER}	<	10	10	μA
Saturation voltage I_C = 30 mA; I_B = 5 mA	$V_{CE\ sat}$	<	0,6		V
D.C. current gain I_C = 25 mA; V_{CE} = 20 V	h_{FE}	>	50		
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 10 V	f_T	>	60		MHz
Feedback capacitance at f = 1 MHz I_C = 0; V_{CE} = 30 V	C_{re}	<	1,6		pF

* See *Thermal characteristics.*

SILICON EPITAXIAL TRANSISTORS

- **For video output stages**

P-N-P transistors in a microminiature plastic package intended for application in class-B video output stages in colour television receivers.

N-P-N complements are BF620 and BF622 respectively.

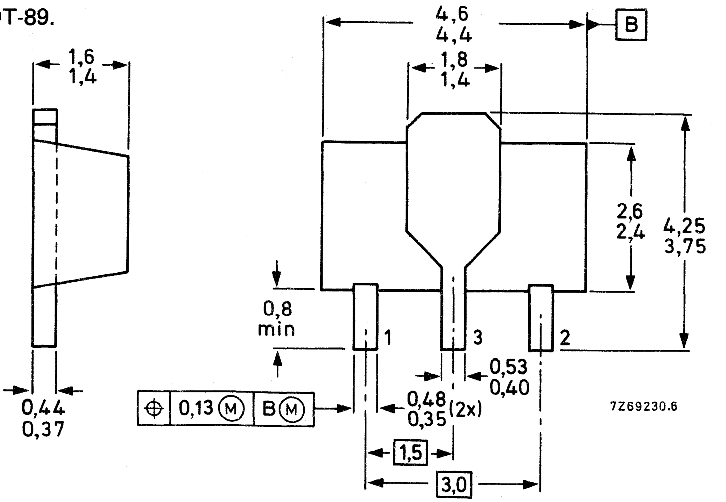
QUICK REFERENCE DATA

			BF621	BF623	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	300	250	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	–	250	V
Collector-emitter voltage (R_{BE} = 2,7 kΩ)	$-V_{CER}$	max.	300	–	V
Collector current (peak value)	$-I_{CM}$	max.	100		mA
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 $-I_C$ = 25 mA; $-V_{CE}$ = 20 V	h_{FE}	>	50		
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 10 V	f_T	>	60		MHz
Feedback capacitance at f = 1 MHz I_C = 0; $-V_{CE}$ = 30 V	C_{re}	<	1,6		pF

MECHANICAL DATA

Dimensions in mm

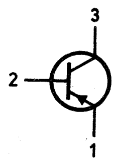
Fig. 1 SOT-89.



BOTTOM VIEW

Marking code

BF621 = DF
BF623 = DB



RATINGS

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

			BF621	BF623	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	300	250	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	–	250	V
Collector-emitter voltage (R_{BE} = 2,7 kΩ)	$-V_{CER}$	max.	300	–	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5		V
Collector current (d.c.)	$-I_C$	max.	50		mA
Collector current (peak value)	$-I_{CM}$	max.	100		mA
Total power dissipation up to T_{amb} = 25 °C mounted on a ceramic substrate area = 2,5 cm^2; thickness = 0,7 mm	P_{tot}	max.	1		W
Storage temperature	T_{stg}		–65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE*

From junction to collector tab	$R_{th\ j\text{-}tab}$	=	25	K/W
From junction to ambient in free air mounted on a ceramic substrate area = 2,5 cm^2; thickness = 0,7 mm	$R_{th\ j\text{-}a}$	=	125	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BF621	BF623	
Collector cut-off current $I_E = 0$; $-V_{CB}$ = 200 V	$-I_{CBO}$	<	10	10	nA
Collector-emitter voltage R_{BE} = 2,7 kΩ; $-V_{CE}$ = 250 V	$-I_{CER}$	<	50	–	nA
R_{BE} = 2,7 kΩ; $-V_{CE}$ = 200 V; T_j = 150 °C	$-I_{CER}$	<	10	10	μA
Saturation voltage $-I_C$ = 30 mA; $-I_B$ = 5 mA	$-V_{CEsat}$	<	0,8		V
D.C. current gain $-I_C$ = 25 mA; $-V_{CE}$ = 20 V	h_{FE}	>	50		
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 10 V	f_T	>	60		MHz
Feedback capacitance at f = 1 MHz $I_C = 0$; $-V_{CE}$ = 30 V	C_{re}	<	1,6		pF

* See *Thermal characteristics.*

SILICON EPITAXIAL TRANSISTORS

NPN transistors in a microminiature plastic package intended for class-B video output stages in colour television receivers, and general purpose high voltage circuits.

PNP complements are BF721 and BF723 respectively.

QUICK REFERENCE DATA

			BF720	BF722	
Collector-base voltage (open emitter)	V_{CBO}	max.	300	250	V
Collector-emitter voltage (open base)	V_{CEO}	max.	–	250	V
Collector-emitter voltage (R_{BE} = 2,7 kΩ)	V_{CER}	max.	300	–	V
Collector current (peak value)	I_{CM}	max.	100		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 = 25 mA; V_{CE} = 20 V	h_{FE}	>	50		
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 10 V	f_T	>	60		MHz
Feedback capacitance at f = 1 MHz I_C = 0; V_{CE} = 30 V	C_{re}	<	1,6		pF

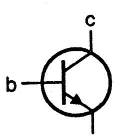
MECHANICAL DATA

Dimensions in mm

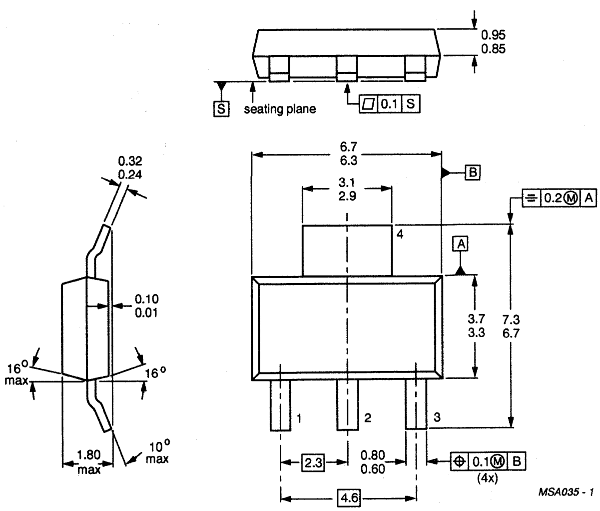
Fig. 1 SOT-223

Pinning

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



MBB012



MSA035 - 1

RATINGS

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

			BF720	BF722	
Collector-base voltage (open emitter)	V_{CBO}	max.	300	250	V
Collector-emitter voltage (open base)	V_{CEO}	max.	–	250	V
Collector-emitter voltage (R_{BE} = 2,7 kΩ)	V_{CER}	max.	300	–	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5		V
Collector current (DC)	I_C	max.	50		mA
Collector current (peak value)	I_{CM}	max.	100		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

			BF720	BF722	
Collector cut-off current					
I_E = 0; V_{CB} = 200 V	I_{CBO}	<	10	10	nA
Collector-emitter voltage					
R_{BE} = 2,7 kΩ; V_{CE} = 250 V	I_{CER}	<	50	–	nA
R_{BE} = 2,7 kΩ; V_{CE} = 200 V; T_j = 150 °C	I_{CER}	<	10	10	μA
Saturation voltage					
I_C = 30 mA; I_B = 5 mA	$V_{CE\ sat}$	<	0,6		V
DC current gain					
I_C = 25 mA; V_{CE} = 20 V	h_{FE}	>	50		
Transition frequency at f = 100 MHz					
I_C = 10 mA; V_{CE} = 10 V	f_T	>	60		MHz
Feedback capacitance at f = 1 MHz					
I_C = 0; V_{CE} = 30 V	C_{re}	<	1,6		pF

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

SILICON EPITAXIAL TRANSISTORS

PNP transistors in a microminiature plastic **package** intended for application in class-B video output stages in colour television receivers, and general purpose high voltage circuits.

NPN complements are BF720 and BF722 respectively.

QUICK REFERENCE DATA

			BF721	BF723	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	300	250	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	–	250	V
Collector-emitter voltage (R_{BE} = 2,7 kΩ)	$-V_{CER}$	max.	300	–	V
Collector current (peak value)	$-I_{CM}$	max.	100		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 $-I_C$ = 25 mA; $-V_{CE}$ = 20 V	h_{FE}	>	50		
Transition frequency at f = **100 MHz** $-I_C$ = 10 mA; $-V_{CE}$ = 10 V	f_T	>	60		MHz
Feedback capacitance at f = 1 MHz I_C = 0; $-V_{CE}$ = 30 V	C_{re}	<	1,6		pF

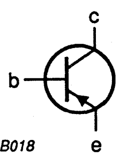
MECHANICAL DATA

Dimensions in mm

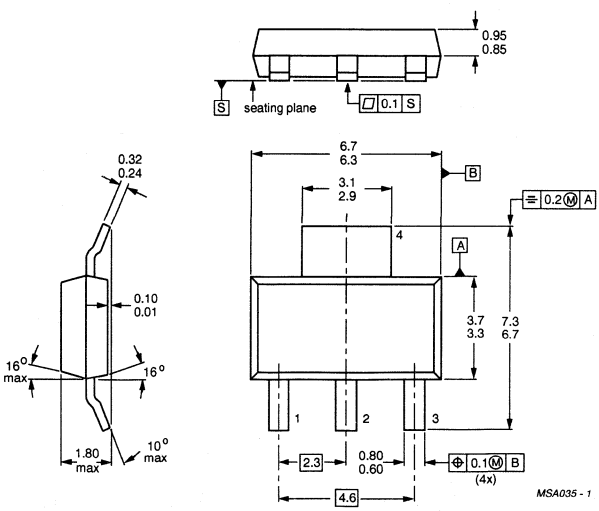
Fig. 1 SOT-223

Pinning

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



MBB018



MSA035 - 1

RATINGS

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

			BF721	BF723	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	300	250	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	–	250	V
Collector-emitter voltage (R_{BE} = 2,7 kΩ)	$-V_{CER}$	max.	300	–	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5		V
Collector current (DC)	$-I_C$	max.	50		mA
Collector current (peak value)	$-I_{CM}$	max.	100		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

			BF721	BF723	
Collector cut-off current					
I_E = 0; $-V_{CB}$ = 200 V	$-I_{CBO}$	<	10	10	nA
Collector-emitter voltage					
R_{BE} = 2.7 kΩ; $-V_{CE}$ = 250 V	$-I_{CER}$	<	50	–	nA
R_{BE} = 2,7 kΩ; $-V_{CE}$ = 200 V; T_j = 150 °C	$-I_{CER}$	<	10	10	µA
Saturation voltage					
$-I_C$ = 30 mA; $-I_B$ = 5 mA	$-V_{CEsat}$	<	0,8		V
DC current gain					
$-I_C$ = 25 mA; $-V_{CE}$ = 20 V	h_{FE}	>	50		
Transition frequency at f = 100 MHz					
$-I_C$ = 10 mA; $-V_{CE}$ = 10 V	f_T	>	60		MHz
Feedback capacitance at f = 1 MHz					
I_C = 0; $-V_{CE}$ = 30 V	C_{re}	<	1,6		pF

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

SILICON PLANAR TRANSISTOR

N-P-N transistor in TO-202 plastic package intended for use as a driver for line output transistors in colour television receivers.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	300 V
Collector-emitter voltage (open base)	V_{CEO}	max.	250 V
Collector current (peak value)	I_{CM}	max.	300 mA
Total power dissipation up to T_{mb} = 75 °C	P_{tot}	max.	6 W
Junction temperature	T_j	max.	150 °C
D.C. current gain I_C = 20 mA, V_{CE} = 10 V	h_{FE}	typ.	45
Storage time	t_s	typ.	0,5 μs

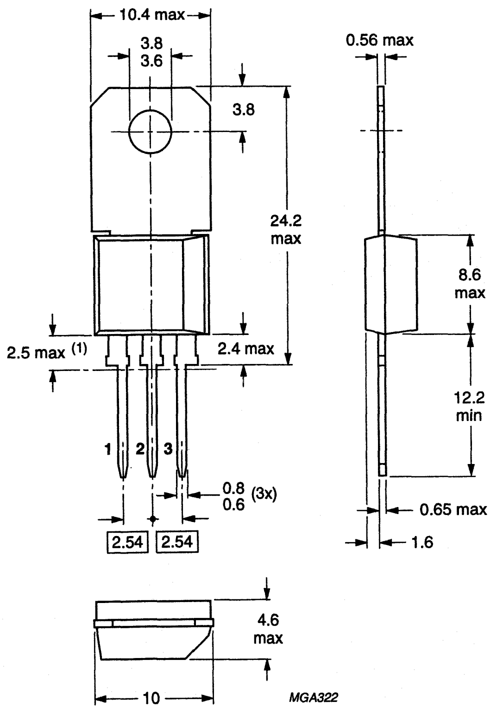
MECHANICAL DATA

Dimensions in mm

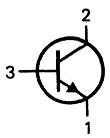
Fig. 1 TO-202.

Collector connected to mounting base.

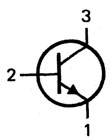
(1) Plastic flash allowed within this zone.



BF819



BF819A



BF819A is available on request. It has ebc pinning instead of ecb.

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	300	V
Collector-emitter voltage (open base)	V_{CEO}	max.	250	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.	300	mA
Base current (d.c.)	I_B	max.	50	mA
Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	1,2	W
Total power dissipation up to T_{mb} = 75 °C	P_{tot}	max.	6	W
Storage temperature	T_{stg}	−65 to +150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	62,5	K/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	12,5	K/W

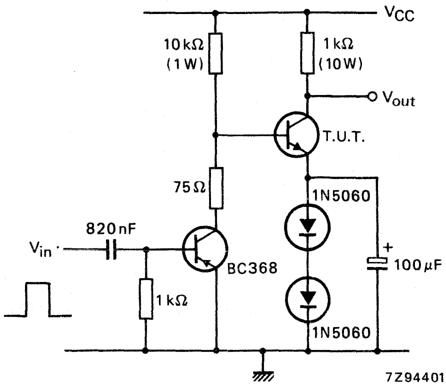
CHARACTERISTICS

T_j = 25 °C

Collector cut-off current $I_E = 0$; V_{CB} = 250 V	I_{CBO}	<	50	nA
Emitter cut-off current $I_C = 0$; V_{EB} = 3 V	I_{EBO}	<	50	nA
D.C. current gain I_C = 20 mA; V_{CE} = 10 V	h_{FE}	typ.	45	
Collector-emitter saturation voltage I_C = 200 mA; I_B = 20 mA**	V_{CEsat}	<	11	V
Collector output capacitance at f = 1 MHz $I_E = 0$; V_{CB} = 30 V	C_c	<	4,5	pF
Storage time (see Fig. 2) I_{Con} = 100 mA; I_{Bon} = 10 mA; $-I_{Boff}$ = 20 mA	t_s	≤	1,4	μs

* Precautions should be taken during switch-on of the BF819 where an overshoot of current is likely to occur. The amplitude of the overshoot depends on the relative magnitude of stray external capacities to the transistor collector capacity. It is desirable to keep the stray capacities to a minimum by short lead lengths etc. so as to minimize the area of the switching path.

** The BF819 is controlled to V_{CEsat} max. 11,0 V and is thermally stable under all operating conditions where $T_{j\ max}$ of 150 °C is not exceeded. For the typical circuit shown in Fig. 2, a heatsink is not required for operation with T_{amb} ≤ 75 °C.



V_{in} = 5 V
T = 60 μs
δ = 0,2

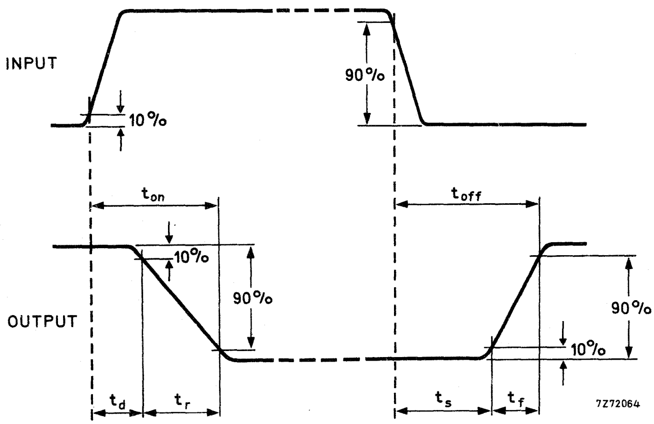


Fig. 2 Test circuit and switching waveforms.

SILICON EPITAXIAL TRANSISTORS

N-P-N transistors in a microminiature plastic package intended for application in thick and thin-film circuits. Primarily intended for use in telephony and professional communication equipment. P-N-P components are BF821, BF823 respectively.

QUICK REFERENCE DATA

			BF820	BF822	
Collector-base voltage (open emitter)	V_{CBO}	max.	300	250	V
Collector-emitter voltage (open base)	V_{CEO}	max.	–	250	V
Collector-emitter voltage (R_{BE} = 2,7 kΩ)	V_{CER}	max.	300	–	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 I_C = 25 mA; V_{CE} = 20 V	h_{FE}	>	50		
Feedback capacitance at f = 1 MHz I_C = 0; V_{CE} = 30 V	C_{re}	<	1,6		pF
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 10 V	f_T	>	60		MHz

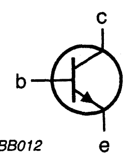
MECHANICAL DATA

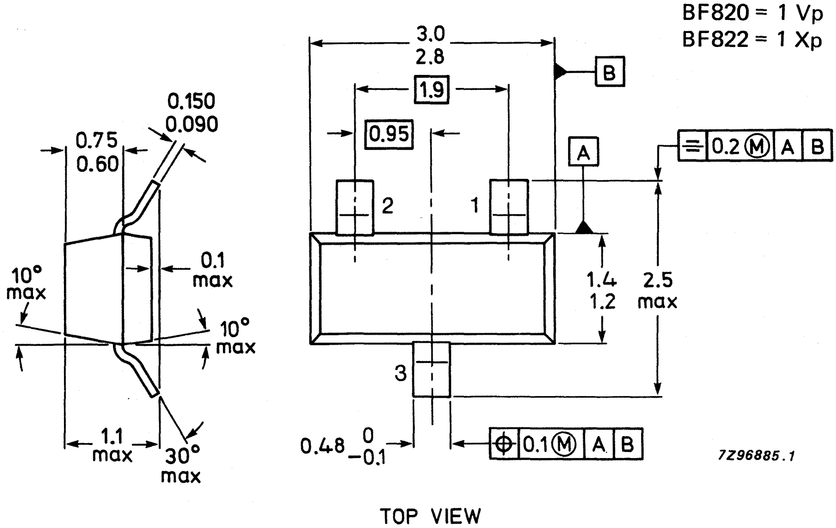
Dimensions in mm

Fig. 1 SOT-23.

Pinning:

1 = base
2 = emitter
3 = collector





Marking code

BF820 = 1 Vp
BF822 = 1 Xp

RATINGS

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

			BF820	BF822	
Collector-base voltage (open emitter)	V_{CBO}	max.	300	250	V
Collector-emitter voltage (open base)	V_{CEO}	max.	–	250	V
Collector-emitter voltage (R_{BE} = 2,7 kΩ)	V_{CER}	max.	300	–	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5		V
Collector current (d.c.)	I_C	max.	50		mA
Collector current (peak value)	I_{CM}	max.	100		mA
Total power dissipation* up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Storage temperature	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BF820	BF822	
Collector cut-off current I_E = 0; V_{CB} = 200 V	I_{CBO}	<	10	10	nA
Collector-emitter voltage R_{BE} = 2,7 kΩ; V_{CE} = 250 V	I_{CER}	<	50	50	nA
R_{BE} = 2,7 kΩ; V_{CE} = 200 V; T_j = 150 °C	I_{CER}	<	10	10	μA
Saturation voltage I_C = 30 mA; I_B = 5 mA	$V_{CE\ sat}$	<	0,6		V
D.C. current gain I_C = 25 mA; V_{CE} = 20 V	h_{FE}	>	50		
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 10 V	f_T	>	60		MHz
Feedback capacitance at f = 1 MHz I_C = 0; V_{CE} = 30 V	C_{re}	<	1,6		pF

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

NPN high voltage transistor | BF820W; BF822W

FEATURES

- S-mini package
- High voltage.

APPLICATIONS

Especially intended for telephony and professional communication equipment.

DESCRIPTION

NPN transistors in a plastic SOT323 (S-mini) package.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

MARKING

TYPE NUMBER	MARKING CODE
BF820W	–1V
BF822W	–1X

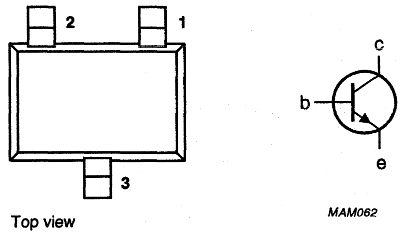


Fig.1 Simplified outline (SOT323) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BF820W		–	300	V
	BF822W		–	250	V
V_{CEO}	collector-emitter voltage	open base			
	BF822W		–	250	V
V_{CER}	collector-emitter voltage	R_{BE} = 2.7 kΩ			
	BF820W		–	300	V
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	200	mW
h_{FE}	DC current gain	I_C = 25 mA; V_{CE} = 20 V	50	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; V_{CE} = 10 V; f = 1 MHz	–	1.6	pF
f_T	transition frequency	I_C = 10 mA; V_{CE} = 10 V; f = 100 MHz	60	–	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			
	BF820W		–	300	V
	BF822W		–	250	V
V_{CEO}	collector-emitter voltage	open base			
	BF822W		–	250	V
V_{CER}	collector-emitter voltage	R_{BE} = 2.7 kΩ			
	BF820W		–	300	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	50	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C; note 1	–	200	mW
T_{amb}	operating ambient temperature		–65	+150	°C
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j-a}$	thermal resistance from junction to ambient	in free air; note 1	625	K/W

Note to the "Limiting values" and "Thermal characteristics"

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 = 0			
	BF820W		300	–	V
	BF822W		250	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 2.5 mA; I_B = 0; note 1			
	BF822W		250	–	V
$V_{(BR)CER}$	collector-emitter breakdown voltage	R_{BE} = 2.7 kΩ; I_C = 2.5 mA			
	BF820W		300	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 10 μA; I_C = 0	5	–	V
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 200 V	–	10	nA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 4 V	–	50	nA
I_{CER}	collector cut-off current	R_{BE} = 2.7 kΩ; V_{CE} = 250 V	–	50	nA
		R_{BE} = 2.7 kΩ; I_E = 0; V_{CE} = 200 V; T_j = 150 °C	–	10	μA
V_{CEsat}	saturation voltage	I_B = 5mA; I_C = 30 mA; note 1	–	600	mV
C_{re}	feedback capacitance	I_C = i_C= 0; V_{CE} = 30 V; f = 1 MHz	–	1.6	pF
f_T	transition frequency	I_C = −10 mA; V_{CE} = 10 V; f = 100 MHz	60	–	MHz
h_{FE}	DC current gain	I_C = 25 mA; V_{CE} = 20 V	50	–	

Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.02$.

SILICON EPITAXIAL TRANSISTORS

P-N-P transistors in a microminiature plastic package intended for application in thick and thin-film circuits. Primarily intended for use in telephony and professional communication equipment. N-P-N complements are BF820, BF822 respectively.

QUICK REFERENCE DATA

			BF821	BF823	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	300	250	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	–	250	V
Collector-emitter voltage (R_{BE} = 2,7 kΩ)	$-V_{CER}$	max.	300	–	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 $-I_C$ = 25 mA; $-V_{CE}$ = 20 V	h_{FE}	>	50		
Feedback capacitance at f = 1 MHz $-I_C$ = 0; $-V_{CE}$ = 30 V	C_{re}	<	1,6		pF
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 10 V	f_T	>	60		MHz

MECHANICAL DATA

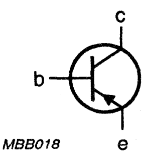
Dimensions in mm

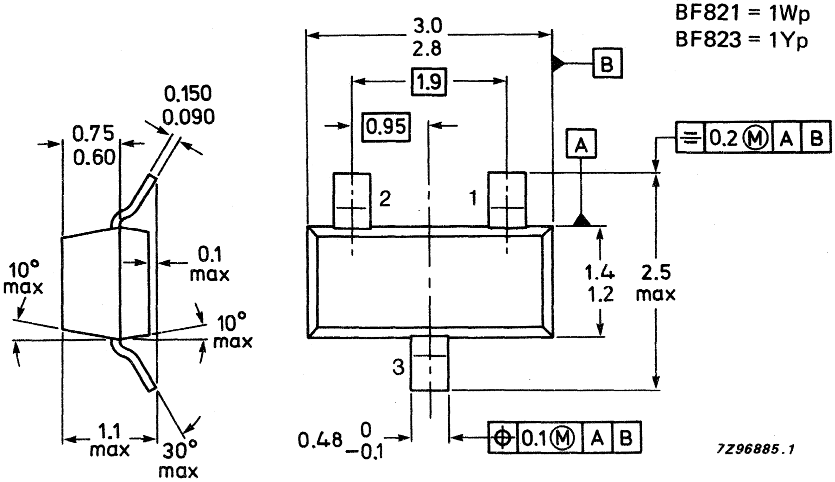
Fig. 1 SOT-23.

Marking code
BF821 = 1Wp
BF823 = 1Yp

Pinning:

1 = base
2 = emitter
3 = collector





TOP VIEW

RATINGS

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

			BF821	BF823	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	300	250	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	–	250	V
Collector-emitter voltage (R_{BE} = 2,7 kΩ)	$-V_{CER}$	max.	300	–	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5		V
Collector current (d.c.)	$-I_C$	max.	50		mA
Collector current (peak value)	$-I_{CM}$	max.	100		mA
Total power dissipation* up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Storage temperature	T_{stg}		–65 to + 150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BF821	BF823	
Collector cut-off current $I_E = 0$; $-V_{CB}$ = 200 V	$-I_{CBO}$	<	10	10	nA
Collector-emitter voltage R_{BE} = 2,7 kΩ; $-V_{CE}$ = 250 V	$-I_{CER}$	<	50	50	nA
R_{BE} = 2,7 kΩ; $-V_{CE}$ = 200 V; T_j = 150 °C	$-I_{CER}$	<	10	10	μA
Saturation voltage $-I_C$ = 30 mA; $-I_B$ = 5 mA	$-V_{CEsat}$	<	0,8		V
D.C. current gain $-I_C$ = 25 mA; $-V_{CE}$ = 20 V	h_{FE}	>	50		
Transition frequency at f =100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 10 V	f_T	>	60		MHz
Feedback capacitance at f = 1 MHz $I_C = 0$; $-V_{CE}$ = 30 V	C_{re}	<	1,6		pF

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

H.F. SILICON PLANAR EPITAXIAL TRANSISTOR

P-N-P transistor in a plastic SOT-23 package especially intended for r.f. stages in f.m. front-ends in common base configuration for SMD applications.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	30	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	30	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
Base current $-I_C$ = 4 mA; $-V_{CE}$ = 10 V	$-I_B$	typ. <	80 160	μA μA
Transition frequency at f = 100 MHz $-I_C$ = 4 mA; $-V_{CE}$ = 10 V	f_T	typ.	450	MHz
Noise figure at f = 100 MHz $-I_C$ = 2 mA; $-V_{CE}$ = 10 V; G_s = 16,7 mS	F	typ.	3	dB
Feedback capacitance at f = 1 MHz V_{EB} = 0; $-V_{CB}$ = 10 V	C_{rb}	typ.	0,1	pF

MECHANICAL DATA

Fig. 1 SOT-23.

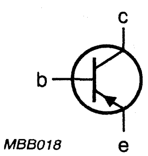
Dimensions in mm

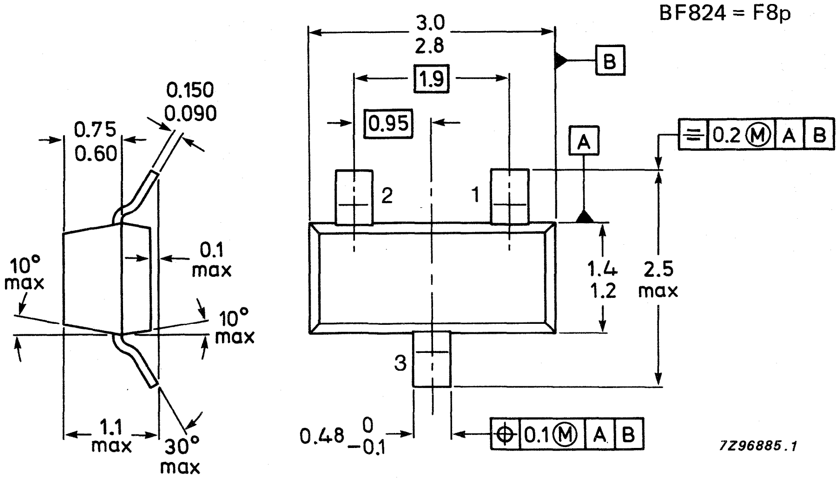
Marking code

BF824 = F8p

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.	30	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	30	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	4	V
Collector current (d.c.)	$-I_C$	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 in free air*	$R_{th\ j\text{-}a}$	=	500	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $-V_{CB} = 30$ V	$-I_{CBO}$	<	50	nA
Emitter cut-off current				
$I_C = 0$; $-V_{EB} = 4$ V	$-I_{EBO}$	<	10	µA
Base current				
$-I_C = 4$ mA; $-V_{CE} = 10$ V	$-I_B$	typ.	80	µA
		<	160	µA
$-I_C = 1$ mA; $-V_{CE} = 10$ V	$-I_B$	typ.	22	µA
Base-emitter voltage				
$-I_C = 4$ mA; $-V_{CE} = 10$ V	$-V_{BE}$	typ.	0,76	V
Transition frequency at f = 100 MHz				
$-I_C = 1$ mA; $-V_{CE} = 10$ V	f_T	typ.	350	MHz
$-I_C = 4$ mA; $-V_{CE} = 10$ V	f_T	typ.	450	MHz
$-I_C = 8$ mA; $-V_{CE} = 10$ V	f_T	typ.	440	MHz
Feedback capacitance at f = 1 MHz				
$V_{EB} = 0$; $-V_{CB} = 10$ V	C_{rb}	typ.	0,1	pF
Noise factor at f = 100 MHz				
$-I_C = 2$ mA; $-V_{CE} = 10$ V; $G_s = 16{,}7$ mS	F	typ.	3	dB
$-I_C = 5$ mA; $-V_{CE} = 10$ V; $G_s = 6{,}7$ mS; $-jB_s = 5$ mS	F	typ.	3,5	dB

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

PNP RF transistor — BF824W

FEATURES

- S-mini package.

APPLICATIONS

It is especially intended for RF stages in FM front-ends in common base configuration.

DESCRIPTION

PNP transistor in a plastic SOT323 (S-mini) package.

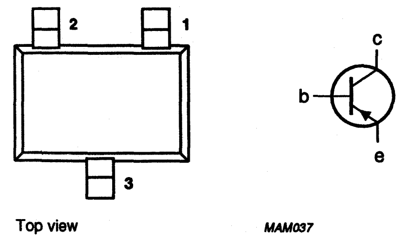


Fig.1 Simplified outline (SOT323) and symbol.

MARKING

TYPE NUMBER	MARKING CODE
BF824W	–F8

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

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	–	–30	V
I_C	collector current (DC)		–	–25	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	200	mW
h_{FE}	DC current gain	I_C = –4 mA; V_{CE} = –10 V	25	–	
f_T	transition frequency	I_C = –4 mA; V_{CE} = –10 V; f = 100 MHz	400	–	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	–	–30	V
V_{CEO}	collector-emitter voltage	open base	–	–30	V
V_{EBO}	emitter-base voltage	open collector	–	–4	V
I_C	collector current (DC)		–	–25	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C; note 1	–	200	mW
T_{amb}	operating ambient temperature		–65	+150	°C
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

Note

1. Refer to SOT323 standard mounting conditions.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance 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; $I_E = 0$	–30	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; $I_C = -10$ mA; $I_B = 0$; note 1	–30	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; $I_E = -10$ μA; $I_C = 0$	–4	–	V
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -30$ V	–	–50	nA
		$I_E = 0$; $V_{CB} = -30$ V; $T_j = 150$ °C	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -4$ V	–	–10	μA
V_{BE}	base-emitter voltage	$I_C = -4$ mA; $V_{CE} = -10$ V	–	–900	mV
C_{rb}	feedback capacitance	$V_{EB} = 0$; $V_{CE} = -10$ V; f = 1 MHz	–	0.3	pF
f_T	transition frequency	$I_C = -1$ mA; $V_{CE} = -10$ V; f = 100 MHz; note 1	250	–	MHz
		$I_C = -4$ mA; $V_{CE} = -10$ V; f = 100 MHz; note 1	400	–	MHz
		$I_C = -8$ mA; $V_{CE} = -10$ V; f = 100 MHz; note 1	390	–	MHz
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -10$ V	25	–	
		$I_C = -4$ mA; $V_{CE} = -10$ V	25	–	
F	noise figure	$I_C = -2$ mA; $V_{CE} = -10$ V; $G_s = 16.7$ mS; f = 100 MHz	–	3.5	dB
		$I_C = -5$ mA; $V_{CE} = -10$ V; $G_S = 6.7$ mS; $-jB_s = 5$ mS; f = 100 MHz	–	4	dB

Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.02$.

SILICON PLANAR TRANSISTORS

N-P-N transistors in a plastic SOT-23 package.

Primarily intended for a.m. mixers and i.f. amplifiers in a.m./f.m. receivers using SMD technology.

QUICK REFERENCE DATA

			BF840	BF841	
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.	25		mA
Base current $I_C = 1$ mA; $V_{CE} = 10$ V	I_B		4,5–15	8–28	μA
Total power dissipation up to $T_{amb} = 25$ °C	P_{tot}	max.	250		mW
Junction temperature	T_j	max.	150		°C
Feedback capacitance at f = 1 MHz $I_C = 1$ mA; $V_{CE} = 10$ V	C_{re}	typ.	0,3		pF

MECHANICAL DATA

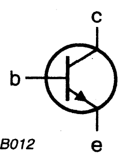
Fig. 1 SOT-23.

Dimensions in mm

Marking code:
BF840 : NCp
BF841 : NDp

Pinning:

1 = base
2 = emitter
3 = collector



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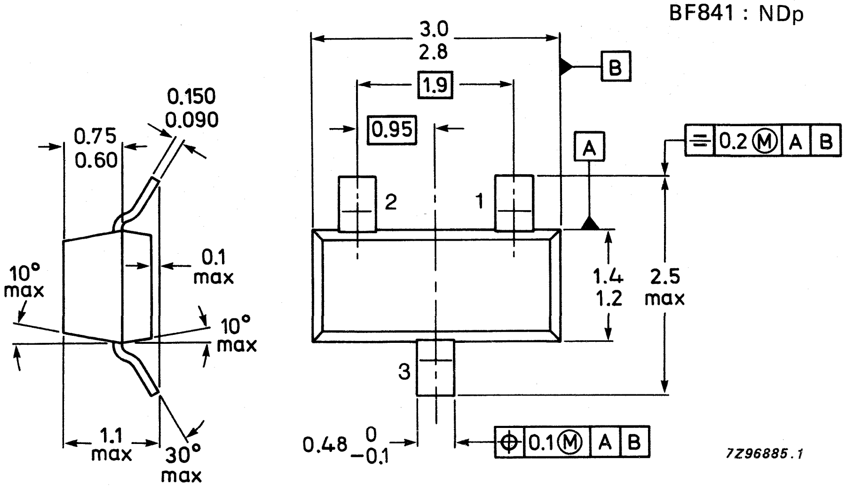


TOP VIEW

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	40	V
Collector-emitter voltage (open base)	V_{CEO}	max.	40	V
Emitter-base voltage (open collector)	V_{EBO}	max.	4	V
Collector current (d.c.)	I_C	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}	max.	100	nA
Base-emitter voltage $I_C = 1$ mA; $V_{CE} = 10$ V	V_{BE}	typ.	700	mV
			650 to 740	mV

			BF840	BF841	
Base current $I_C = 1$ mA; $V_{CE} = 10$ V	I_B		4,5–15	8–28	μA
Transition frequency at f = 100 MHz $I_C = 1$ mA; $V_{CE} = 10$ V	f_T	typ.	380	380	MHz
Feedback capacitance at f = 1 MHz $I_C = 1$ mA; $V_{CE} = 10$ V	C_{re}	typ.	0,3	0,3	pF
Noise figure $I_C = 1$ mA; $V_{CE} = 10$ V; f = 0,2 MHz; $R_S = 200\ \Omega$	F	typ.	1,5	2,0	dB

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

SILICON PLANAR VIDEO OUTPUT TRANSISTORS

N-P-N transistors in TO-202 plastic packages intended for video output stages in black-and-white and in colour television receivers.

QUICK REFERENCE DATA

			BF857	BF858	BF859	
Collector-base voltage (open emitter)	V_{CBO}	max.	160	250	300	V
Collector-emitter voltage (open base)	V_{CEO}	max.	160	250	300	V
Collector current (peak value)	I_{CM}	max.		300		mA
Total power dissipation up to T_{mb} = 75 °C	P_{tot}	max.		6		W
Junction temperature	T_j	max.		150		°C
D.C. current gain I_C = 30 mA; V_{CE} = 10 V	h_{FE}	>		26		
Transition frequency at f = 100 MHz I_C = 15 mA; V_{CE} = 10 V	f_T	typ.		90		MHz
Feedback capacitance at f = 1 MHz I_E = 0; V_{CB} = 30 V	C_{re}	<		3		pF

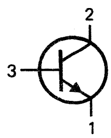
MECHANICAL DATA

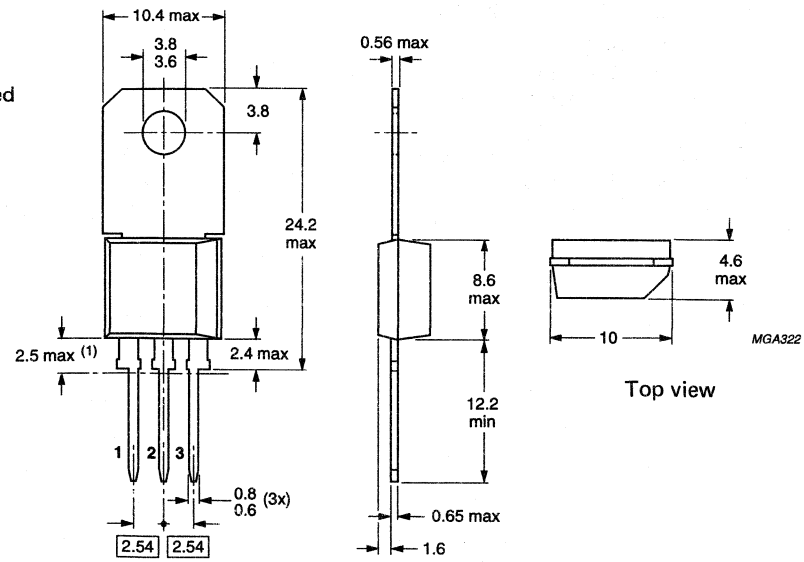
Dimensions in mm

Fig. 1 TO-202.

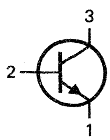
Collector connected to mounting base.

(1) Plastic flash allowed within this zone.





A-version



An A-version is available on request. It has ebc pinning instead of ecb.

RATINGS

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

			BF857	BF858	BF859	
Collector-base voltage (open emitter)	V_{CBO}	max.	160	250	300	V
Collector-emitter voltage (open base)	V_{CEO}	max.	160	250	300	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	5	V
Collector current (d.c.)	I_C	max.		100		mA
Collector current (peak value)	I_{CM}	max.		300		mA
Base current (d.c.)	I_B	max.		50		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		2		W
Total power dissipation up to T_{mb} = 75 °C	P_{tot}	max.		6		W
Storage temperature	T_{stg}			−65 to + 150		°C
Junction temperature	T_j	max.		150		°C

THERMAL RESISTANCE

from junction to ambient in free air	$R_{th\ j\text{-}a}$	=	62,5	K/W
from junction to mounting base	$R_{th\ j\text{-}mb}$	=	12,5	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; V_{CB} = 100 V for BF857	I_{CBO}	<	0,1	μA
$I_E = 0$; V_{CB} = 200 V for BF858	I_{CBO}	<	0,1	μA
$I_E = 0$; V_{CB} = 250 V for BF859	I_{CBO}	<	0,1	μA
Emitter cut-off current				
$I_C = 0$; V_{EB} = 5 V	I_{EBO}	<	100	μA
D.C. current gain				
I_C = 30 mA; V_{CE} = 10 V	h_{FE}	>	26	
Collector-emitter saturation voltage				
I_C = 30 mA; I_B = 6 mA	V_{CEsat}	<	1	V
Transition frequency at f = 100 MHz				
I_C = 15 mA; V_{CE} = 10 V	f_T	typ.	90	MHz
Feedback capacitance at f = 1 MHz				
$I_E = 0$; V_{CB} = 30 V	C_{re}	<	3	pF

SILICON PLANAR VIDEO OUTPUT TRANSISTORS

N-P-N transistors in a TO-202 plastic package intended for class-B video output stages in colour television receivers. P-N-P complements are BF870 and BF872.

QUICK REFERENCE DATA

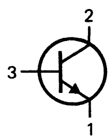
			BF869	BF871	
Collector-base voltage (open emitter)	V_{CBO}	max.	250	300	V
Collector-emitter voltage (open base)	V_{CEO}	max.	250	–	V
Collector-emitter voltage (R_{BE} = 2,7 kΩ)	V_{CER}	max.	–	300	V
Collector current (peak value)	I_{CM}	max.	100		mA
Total power dissipation up to T_{mb} = 25 °C	P_{tot}	max.	5		W
Junction temperature	T_j	max.	150		°C
D.C. current gain I_C = 25 mA; V_{CE} = 20 V; T_j = 25 °C	h_{FE}	>	50		
Transition frequency at f = 100 MHz $-I_E$ = 10 mA; V_{CB} = 10 V	f_T	>	60		MHz
Feedback capacitance at f = 1 MHz I_E = 0; V_{CB} = 30 V	C_{re}	<	2		pF

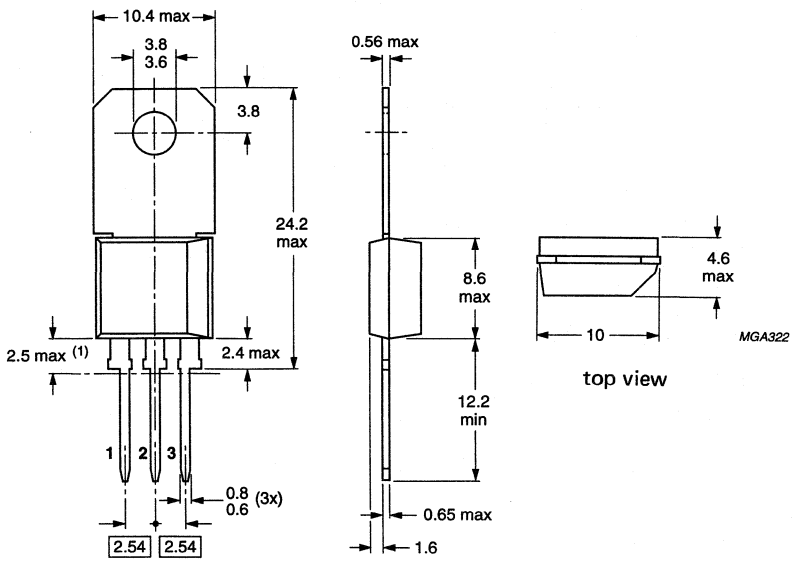
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-202.

Collector connected to mounting base.





(1) Plastic flash allowed within this zone.

RATINGS

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

			BF869	BF871	
Collector-base voltage (open emitter)	V_{CBO}	max.	250	300	V
Collector-emitter voltage (open base)	V_{CEO}	max.	250	–	V
Collector-emitter voltage (R_{BE} = 2,7 kΩ)	V_{CER}	max.	–	300	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5		V
Collector current (d.c.)	I_C	max.	50		mA
Collector current (peak value)	I_{CM}	max.	100		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1,6		W
Total power dissipation up to T_{mb} = 25 °C	P_{tot}	max.	5		W
Storage temperature	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	=	78	K/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	25	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BF869	BF871	
Collector cut-off current					
I_E = 0; V_{CB} = 200 V	I_{CBO}	<	10	10	nA
R_{BE} = 2,7 kΩ; V_{CE} = 300 V	I_{CER}	<	–	1	μA
R_{BE} = 2,7 kΩ; V_{CE} = 200 V; T_j = 150 °C	I_{CER}	<	10		μA
Emitter cut-off current					
I_C = 0; V_{EB} = 5 V	I_{EBO}	<	10		μA
D.C. current gain					
I_C = 25 mA; V_{CE} = 20 V	h_{FE}	>	50		
Base-emitter voltage					
I_C = 25 mA; V_{CE} = 20 V	V_{BE}	typ.	0,75		V
High frequency knee voltage					
I_C = 25 mA; T_j = 150 °C	V_{CEK}	typ.	20		V
Transition frequency at f = 100 MHz					
$-I_E$ = 10 mA; V_{CB} = 10 V	f_T	>	60		MHz
Feedback capacitance at f = 1 MHz					
I_E = 0; V_{CB} = 30 V	C_{re}	<	2		pF

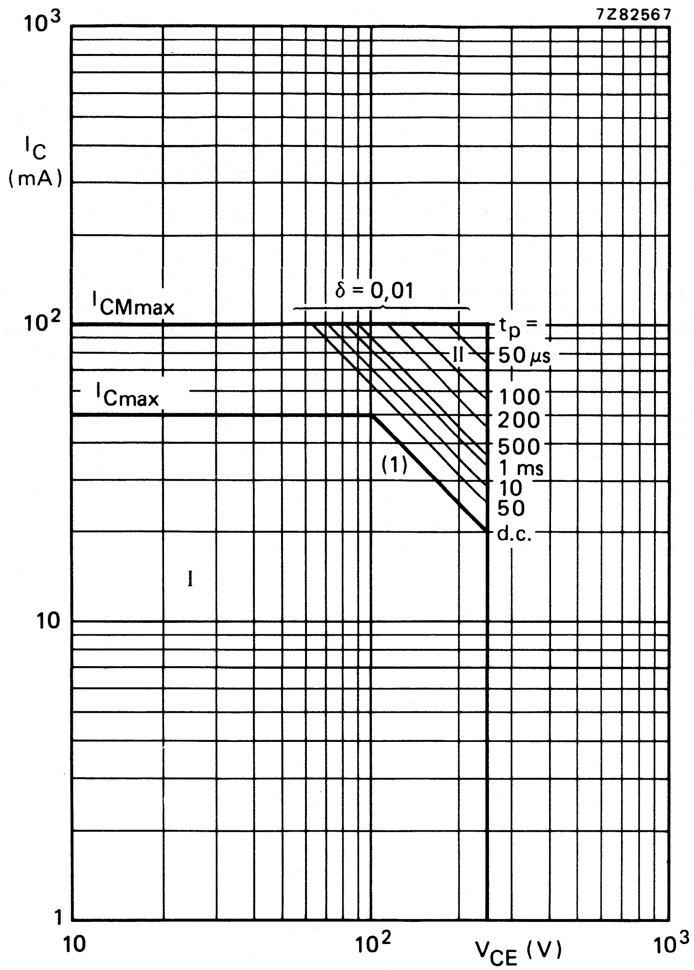


Fig. 2 Safe Operating ARea at T_{mb} = 25 °C.

I Region of permissible d.c. operation.

II Permissible extension for repetitive pulse operation.

(1) $P_{tot\ max}$ and $P_{tot\ peak\ max}$ lines.

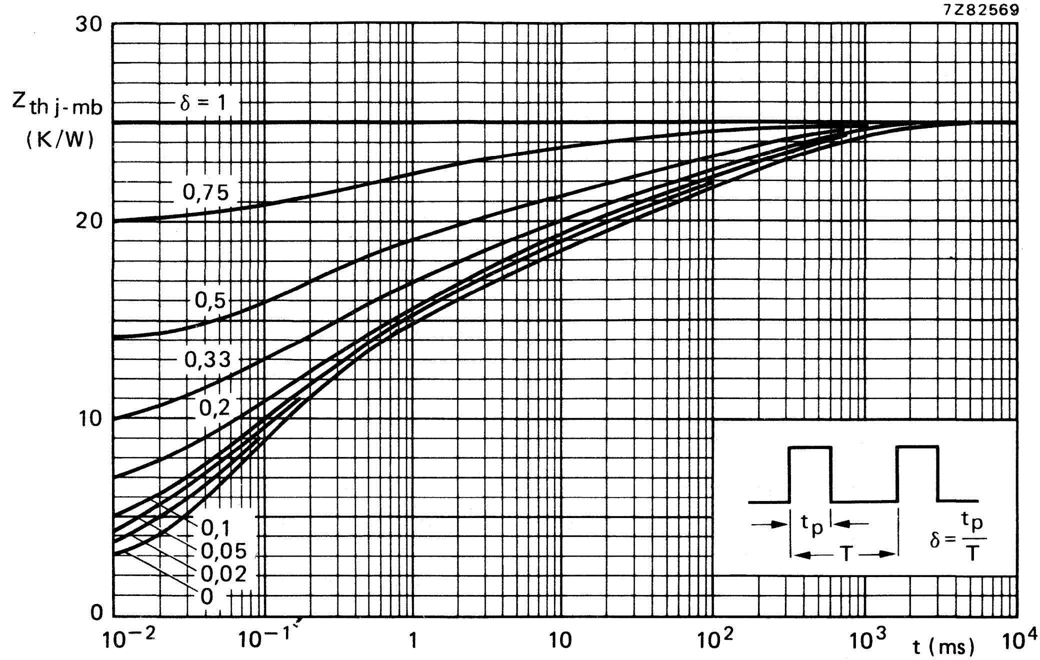


Fig. 3 Pulse power rating chart.

SILICON PLANAR VIDEO OUTPUT TRANSISTORS

P-N-P transistors in a TO-202 plastic envelope package for class-B video output stages in colour television receivers. N-P-N complements are BF869 and BF871.

QUICK REFERENCE DATA

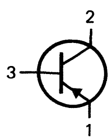
			BF870	BF872	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	250	300	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	250	–	V
Collector-emitter voltage (R_{BE} = 2,7 kΩ)	$-V_{CER}$	max.	–	300	V
Collector current (peak value)	$-I_{CM}$	max.	100		mA
Total power dissipation up to T_{mb} = 25 °C	P_{tot}	max.	5		W
Junction temperature	T_j	max.	150		°C
D.C. current gain $-I_C$ = 25 mA; $-V_{CE}$ = 20 V; T_j = 25 °C	h_{FE}	>	50		
Transition frequency at f = 100 MHz I_E = 10 mA; $-V_{CB}$ = 10 V	f_T	>	60		MHz
Feedback capacitance at f = 1 MHz I_E = 0; $-V_{CB}$ = 30 V	C_{re}	<	2,2		pF

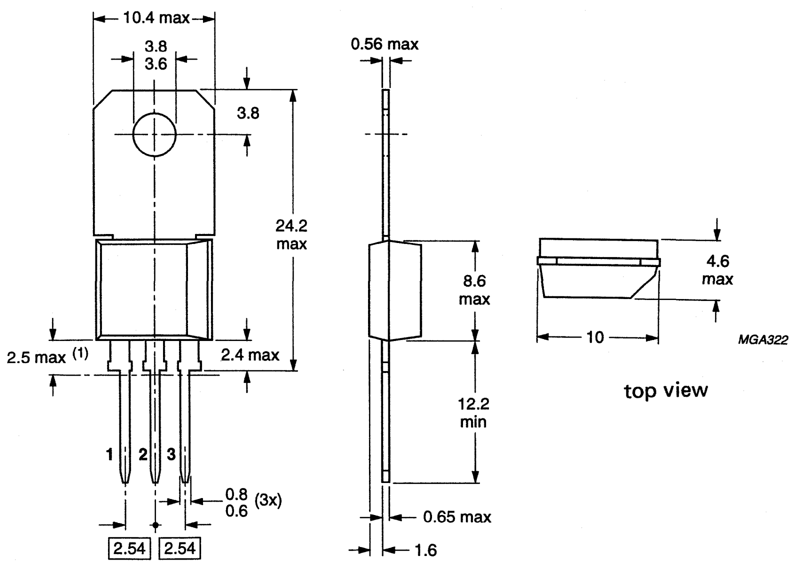
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-202.

Collector connected to mounting base.





(1) Plastic flash allowed within this zone.

RATINGS

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

			BF870	BF872	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	250	300	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	250	–	V
Collector-emitter voltage (R_{BE} = 2,7 kΩ)	$-V_{CER}$	max.	–	300	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5		V
Collector current (d.c.)	$-I_C$	max.	50		mA
Collector current (peak value)	$-I_{CM}$	max.	100		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1,6		W
Total power dissipation up to T_{mb} = 25 °C	P_{tot}	max.	5		W
Storage temperature	T_{stg}		–65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	=	78	K/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	25	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BF870	BF872	
Collector cut-off current					
$I_E = 0$; $-V_{CB}$ = 200 V	$-I_{CBO}$	<	10	10	nA
R_{BE} = 2,7 kΩ; $-V_{CE}$ = 300 V	$-I_{CER}$	<	–	1	μA
R_{BE} = 2,7 kΩ; $-V_{CE}$ = 200 V; T_j = 150 °C	$-I_{CER}$	<	10		μA
Emitter cut-off current					
$I_C = 0$; $-V_{EB}$ = 5 V	$-I_{EBO}$	<	10		μA
D.C. current gain					
$-I_C$ = 25 mA; $-V_{CE}$ = 20 V	h_{FE}	>	50		
Base emitter voltage					
$-I_C$ = 25 mA; $-V_{CE}$ = 20 V	$-V_{BE}$	typ.	0,75		V
High-frequency knee voltage					
$-I_C$ = 25 mA; T_j = 150 °C	$-V_{CEK}$	typ.	20		V
Transition frequency at f = 100 MHz					
I_E = 10 mA; $-V_{CB}$ = 10 V	f_T	>	60		MHz
Feedback capacitance at f = 1 MHz					
$I_E = 0$; $-V_{CB}$ = 30 V	C_{re}	<	2,2		pF

SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a plastic TO-92 package primarily intended for use in active probes, frequency multipliers and linear amplifiers.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	40 V
Collector-emitter voltage (open base)	V_{CEO}	max.	15 V
Collector current (peak value)	I_{CM}	max.	500 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500 mW
D.C. current I_C = 10 mA; V_{CE} = 1 V	h_{FE}	>	40
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 10 V	f_T	>	500 MHz

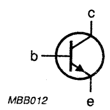
MECHANICAL DATA

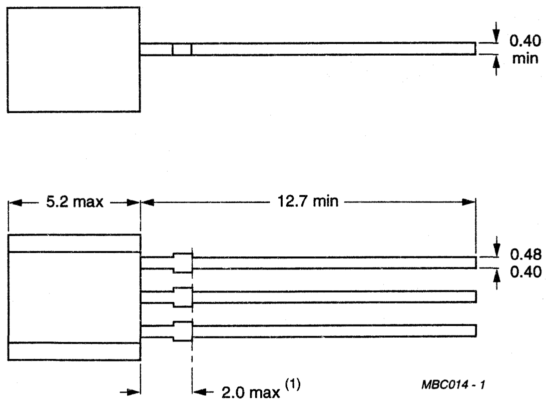
Dimensions in mm

Fig. 1 TO-92.

Pinning

1 = emitter
2 = base
3 = collector





Note (1) Terminal dimensions within this zone are uncontrolled to allow for plastic and terminal irregularities.

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 (peak value; $t_p = 10\ \mu s$)	I_{CM}	max.	500	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	500	mW
Storage temperature	T_{stg}	−65 to + 150		^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	250	K/W

CHARACTERISTICS

$T_{amb} = 25\ ^oC$ 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; $T_j = 125\ ^oC$	I_{CBO}	<	30	μA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 2$ V	I_{EBO}	<	100	nA
Saturation voltage				
$I_C = 10$ mA; $I_B = 1$ mA	V_{CEsat}	<	0,25	V
	V_{BEsat}	0,70 to 0,85		V
Knee voltage				
$I_C = 45$ mA; I_B = value for which $I_C = 50$ mA at $V_{CE} = 2$ V	V_{CEK}	<	0,8	V
D.C. current gain				
$I_C = 10$ mA; $V_{CE} = 1$ V	h_{FE}	>	40	
Transition frequency at f = 100 MHz				
$I_C = 10$ mA; $V_{CE} = 10$ V	f_T	>	500	MHz
$I_C = 40$ mA; $V_{CE} = 10$ V	f_T	>	490	MHz
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

Maximum unilateral power gain (y_{re} assumed to be zero)

$$G_{UM} = 10 \log \frac{|y_{fe}|^2}{4 g_{ie} g_{oe}}$$

$I_C = 10$ mA; $V_{CE} = 10$ V; f = 200 MHz	G_{UM}	typ.	19	dB

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in a microminiature plastic package. 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

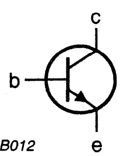
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-23.

Marking code
BFS18 = F1p
BFS19 = F2p

Pinning:
1 = base
2 = emitter
3 = collector



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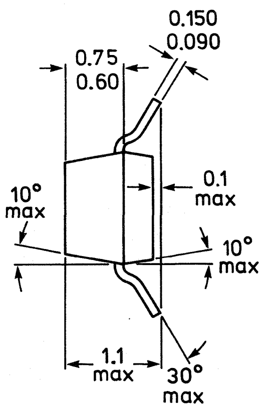

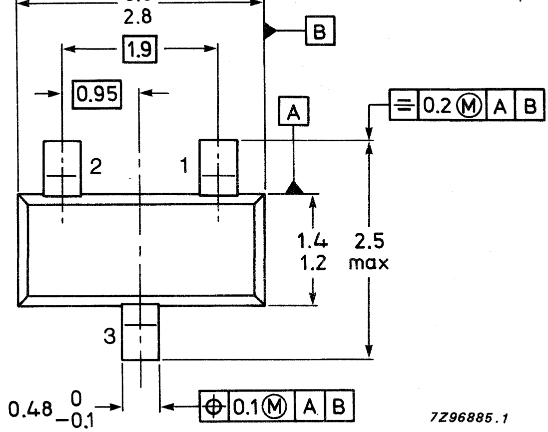

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TOP VIEW

Reverse pinning types are available on request.

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 $T_{amb} = 25\ ^oC$	P_{tot}	max.	250	mW
Storage temperature	T_{stg}		−65 to + 150	^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

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

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

Collector cut-off current $I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	<	100		nA
$I_E = 0$; $V_{CB} = 20$ V; $T_j = 100\ ^oC$	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 an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.
** Crystal mounted in a BF115 envelope.

SILICON PLANAR EPITAXIAL TRANSISTORS

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

QUICK REFERENCE DATA

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

MECHANICAL DATA

Dimensions in mm

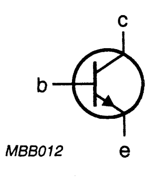
Marking code

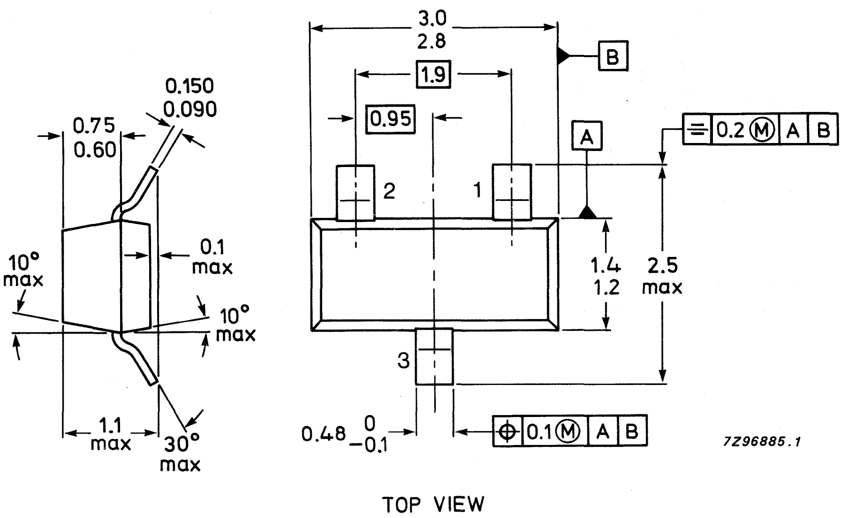
BFS20 = G1p

Fig. 1 SOT-23.

Pinning:

1 = base
2 = emitter
3 = collector





Reverse pinning types are available on request.

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 $T_{amb} = 25\ ^{o}C$	P_{tot}	max.	250	mW
Storage temperature	T_{stg}	−65 to	+150	^{o}C
Junction temperature	T_j	max.	150	^{o}C

THERMAL RESISTANCE

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

CHARACTERISTICS

$T_j = 25\ ^{o}C$ 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; $T_j = 100\ ^{o}C$	I_{CBO}	<	10	μA
Base-emitter voltage				
$I_C = 7$ mA; $V_{CE} = 10$ V	V_{BE}	typ.	740	mV
		<	900	mV
D.C. current gain				
$I_C = 7$ mA; $V_{CE} = 10$ V	h_{FE}	>	40	
		typ.	85	
Transition frequency at f = 100 MHz				
$I_C = 5$ mA; $V_{CE} = 10$ V	f_T	>	275	MHz
		typ.	450	MHz
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	0,8	pF
Feedback capacitance at f = 1 MHz				
$I_C = 1$ mA; $V_{CE} = 10$ V	C_{re}	typ.	350	fF

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

SILICON P-N-P HIGH-VOLTAGE TRANSISTORS

Planar epitaxial transistors in TO-39 metal packages, intended as general purpose amplifiers and switching devices in industrial and telephone applications.

QUICK REFERENCE DATA

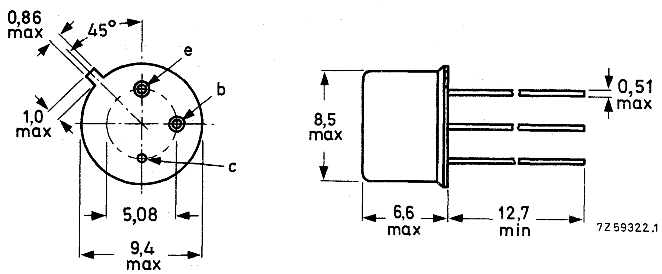
			BFT44	BFT45	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	300	250	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	300	250	V
Collector current (d.c.)	$-I_C$	max.	0,5		A
Total power dissipation up to T_{case} = 50 °C	P_{tot}	max.	5,0		W
Junction temperature	T_j	max.	200		°C
D.C. current gain $-I_C$ = 10 mA; $-V_{CE}$ = 10 V	h_{FE}		50 to 150		
Transition frequency at f = 35 MHz $-I_C$ = 15 mA; $-V_{CE}$ = 10 V	f_T	typ.	70		MHz

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case.



Maximum lead diameter is guaranteed only for 12,7 mm.

RATINGS

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

			BFT44	BFT45	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	300	250	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	300	250	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	V
Collector current (d.c.)	$-I_C$	max.	0,5		A
Total power dissipation up to T_{case} = 50 °C	P_{tot}	max.	5,0		W

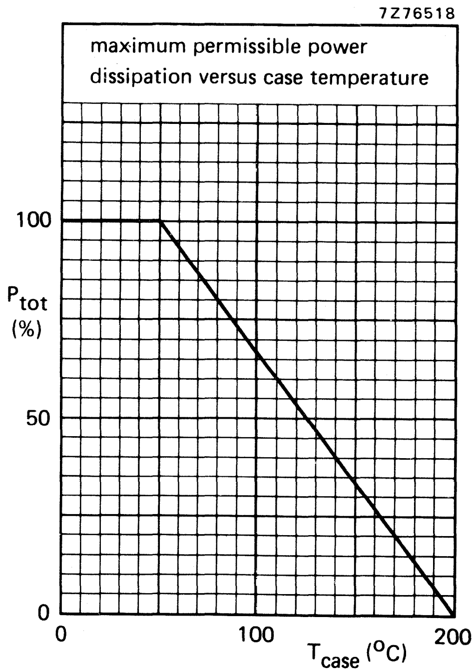


Fig. 2.

Storage temperature range	T_{stg}		–65 to + 150	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\,j\text{-}a}$	=	200	K/W
From junction to case	$R_{th\,j\text{-}c}$	=	30	K/W

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

Collector cut-off current					
$I_E = 0; -V_{CB} = 200$ V	$-I_{CBO}$	<	5		μA
Emitter cut-off current					
$I_C = 0; -V_{EB} = 3$ V	$-I_{EBO}$	<	5		μA
Collector-emitter sustaining voltage			BFT44	BFT45	
$-I_C = 10$ mA; $I_B = 0$; L = 25 mH	$-V_{CEOsust}$	>	300	250	V*

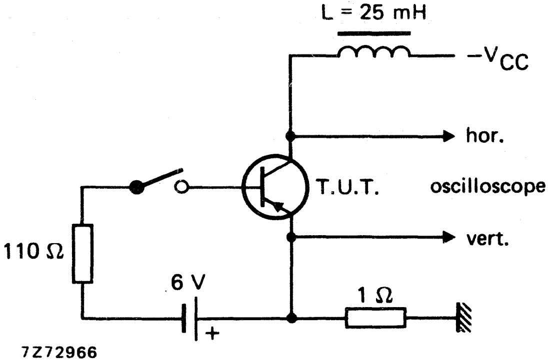


Fig. 3 Test circuit for $V_{CEOsust}$.

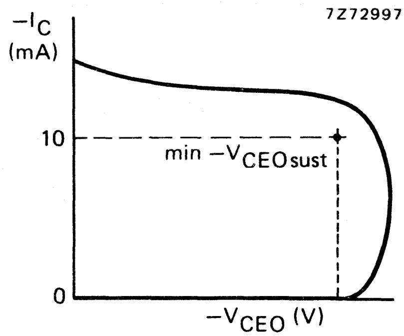


Fig. 4 Oscilloscope display for $V_{CEOsust}$.

Saturation voltages					
$-I_C = 10$ mA; $-I_B = 1$ mA		$-V_{CEsat}$	<	0,5	V
		$-V_{BEsat}$	<	0,8	V
$-I_C = 100$ mA; $-I_B = 10$ mA		$-V_{CEsat}$	<	1,4	V
		$-V_{BEsat}$	<	0,9	V
$-I_C = 500$ mA; $-I_B = 100$ mA	BFT44	$-V_{CEsat}$	<	5,0	V**
	BFT45	$-V_{CEsat}$	<	3,0	V**
		$-V_{BEsat}$	<	1,2	V**
D.C. current gain					
$-I_C = 1$ mA; $-V_{CE} = 10$ V		h_{FE}	>	30	
$-I_C = 10$ mA; $-V_{CE} = 10$ V		h_{FE}		50 to 150	
$-I_C = 100$ mA; $-V_{CE} = 10$ V		h_{FE}	>	50	**
Collector capacitance at f = 1 MHz					
$I_E = I_e = 0; -V_{CB} = 20$ V		C_c	<	15	pF

* $-V_{CC} = 0$ to 50 V; f = 400 Hz; $\delta = 0,5$ (see also test circuit).
** Measured under pulse conditions: $t_p = 300\ \mu s$; $\delta \leq 0,02$.

CHARACTERISTICS (continued)

T_j = 25 °C

Transition frequency at f = 35 MHz $-I_C$ = 15 mA; $-V_{CE}$ = 10 V	f_T	typ.	70 MHz
Switching times $-I_{Con}$ = 50 mA; $-I_{Bon}$ = I_{Boff} = 5 mA (test circuit 1)	t_{on}	typ.	125 ns
	t_{off}	typ.	850 ns
$-I_{Con}$ = 500 mA; $-I_{Bon}$ = I_{Boff} = 100 mA (test circuit 2)	t_{on}	typ.	125 ns
	t_{off}	typ.	125 ns

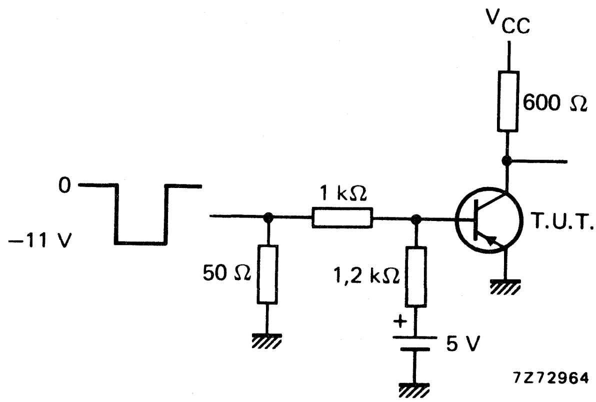


Fig. 5 Test circuit 1.

V_{CC} = −31 V
t_p = 10 μs

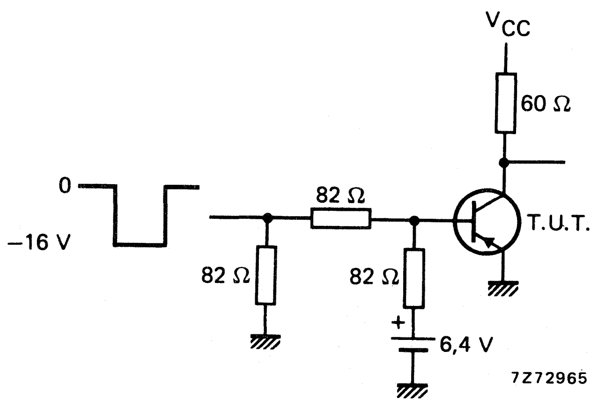


Fig. 6 Test circuit 2.

V_{CC} = −31 V
t_p = 10 μs

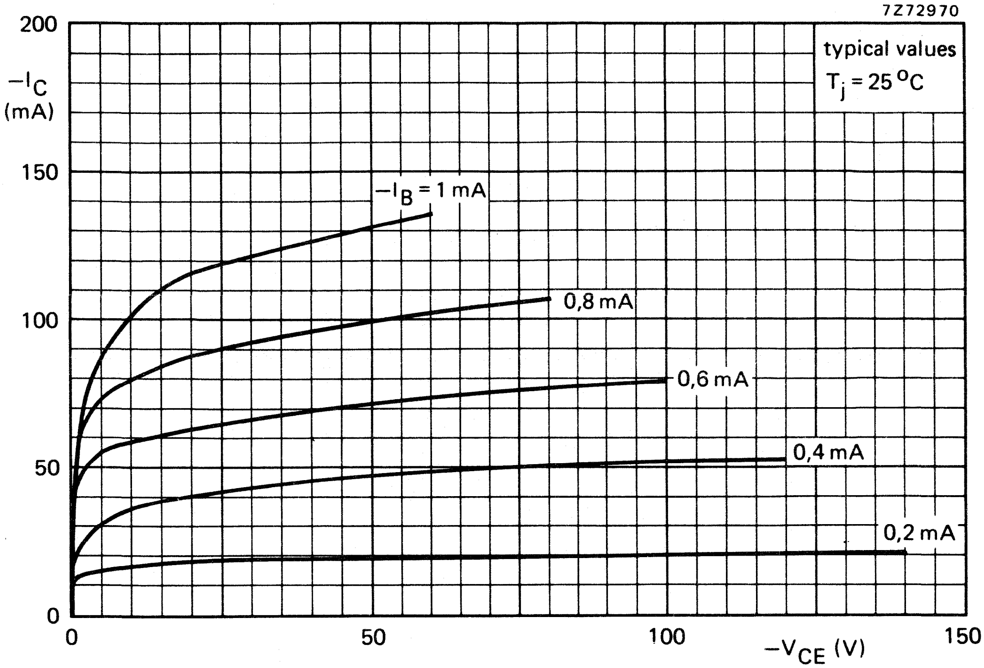

7Z72970
typical values
$T_j = 25\,^oC$
$-I_C$ (mA)
$-I_B = 1$ mA
0,8 mA
0,6 mA
0,4 mA
0,2 mA
$-V_{CE}$ (V)
0
50
100
150
200

Fig. 7.

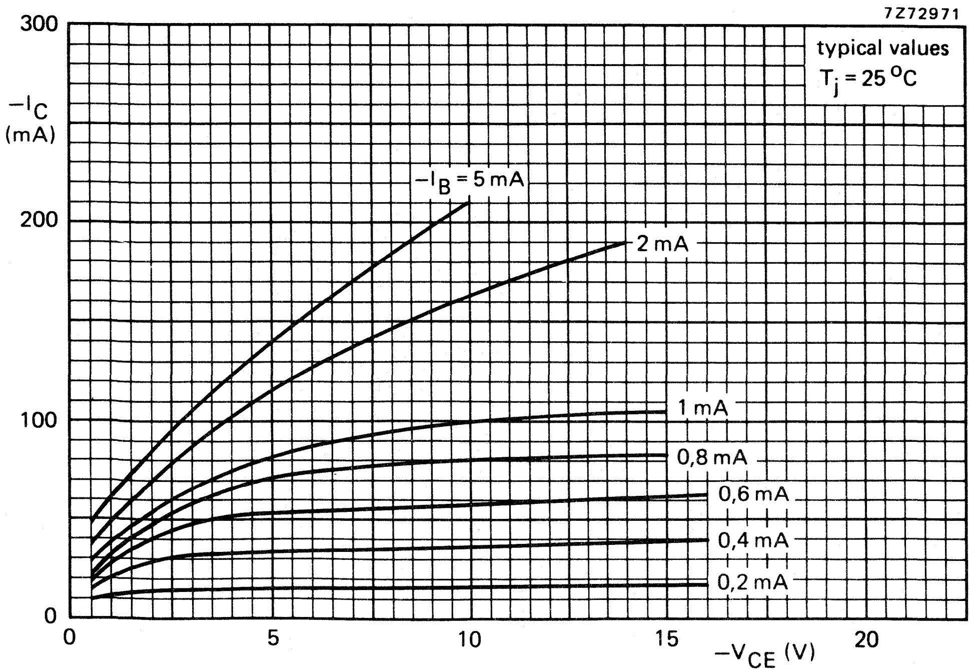

7Z72971
typical values
$T_j = 25\,^oC$
$-I_C$ (mA)
$-I_B = 5$ mA
2 mA
1 mA
0,8 mA
0,6 mA
0,4 mA
0,2 mA
$-V_{CE}$ (V)
0
5
10
15
20
100
200
300

Fig. 8.

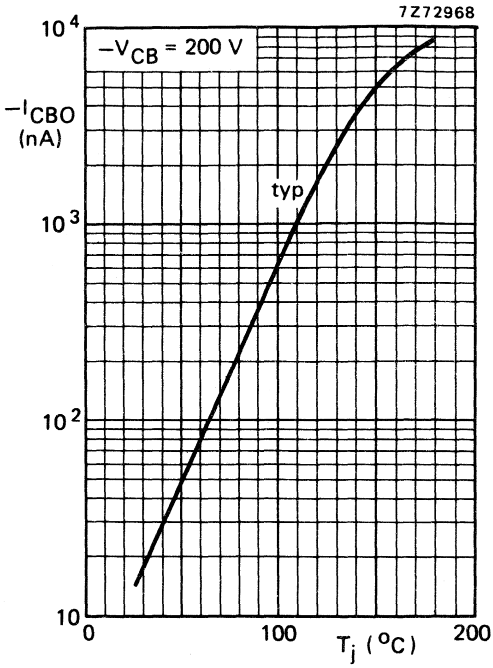


Fig. 9.

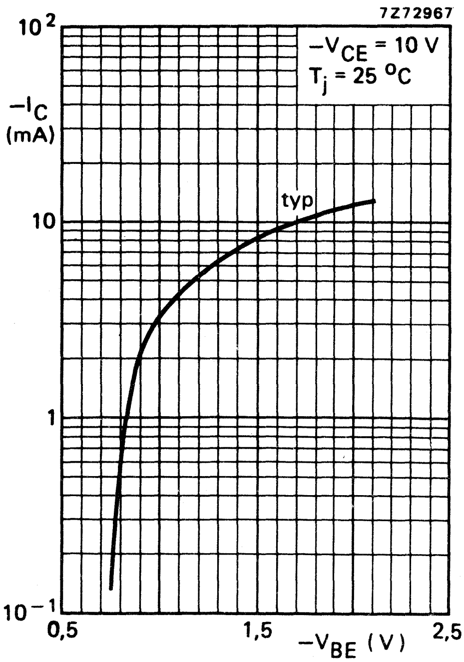


Fig. 10.

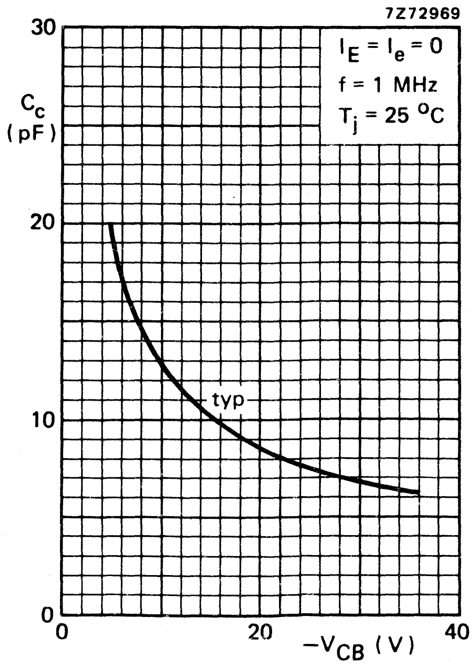


Fig. 11.

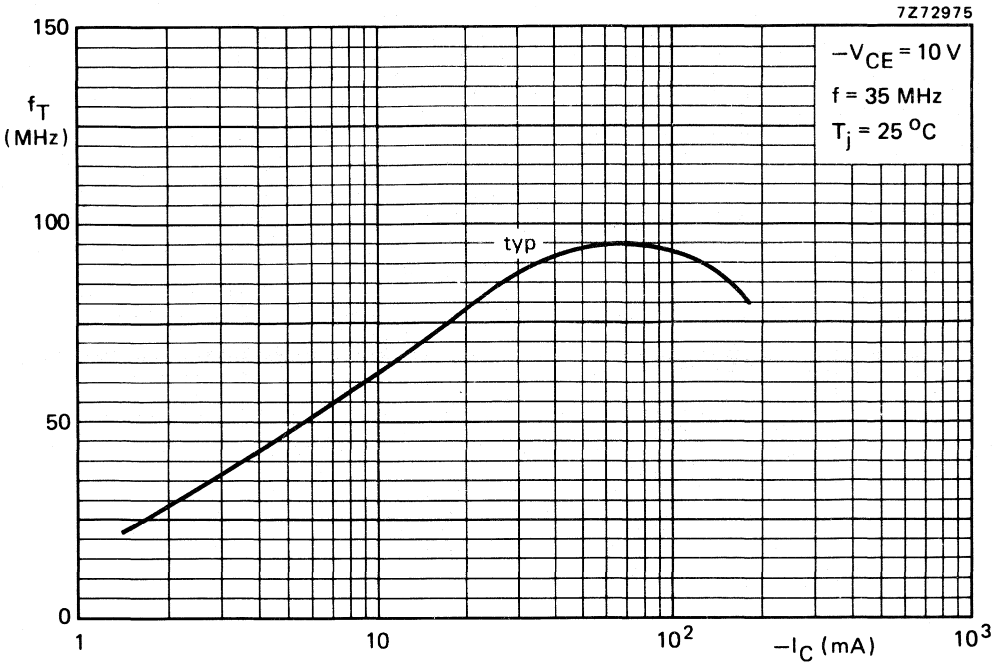

7Z72975
150
100
50
0
f_T (MHz)
typ
$-V_{CE}$ = 10 V
f = 35 MHz
T_j = 25 °C
1
10
10^2
10^3
$-I_C$ (mA)

Fig. 12.

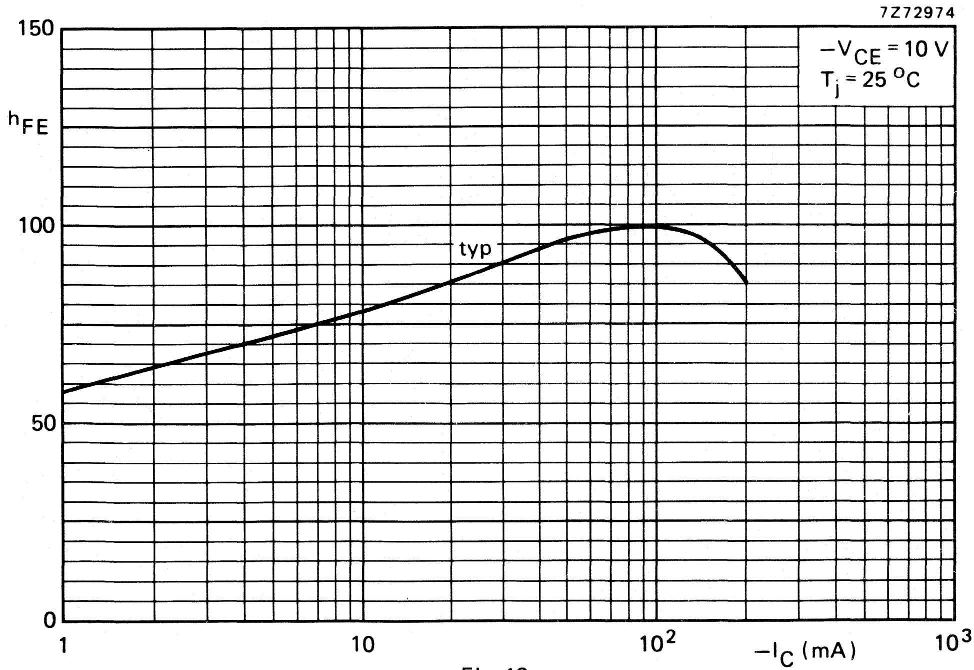

7Z72974
150
100
50
0
h_{FE}
typ
$-V_{CE}$ = 10 V
T_j = 25 °C
1
10
10^2
10^3
$-I_C$ (mA)

Fig. 13.

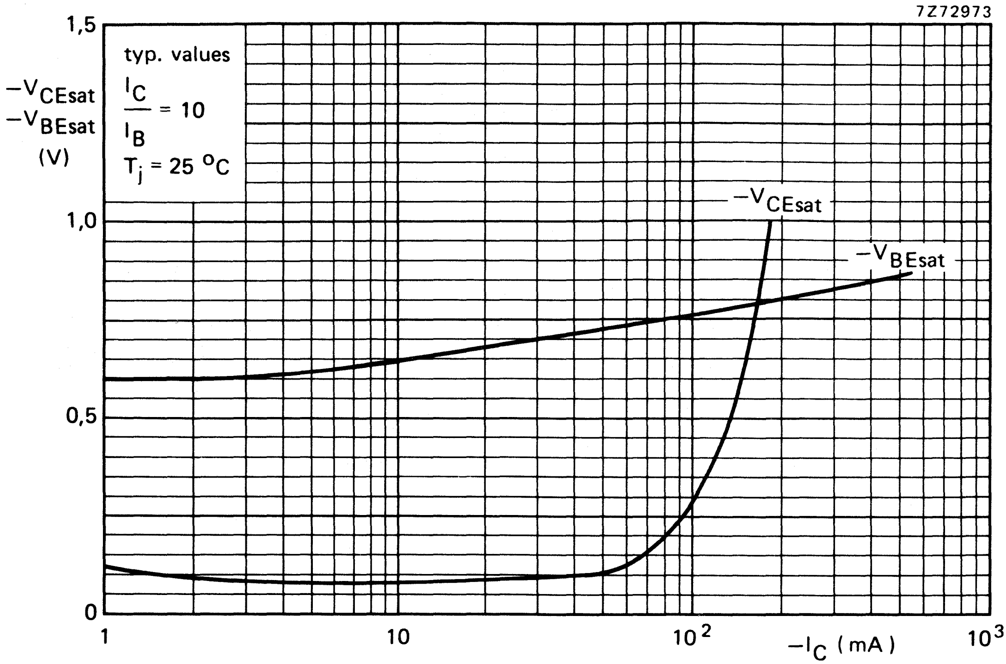

7Z72973
typ. values
$\frac{I_C}{I_B}$ = 10
T_j = 25 °C
$-V_{CEsat}$
$-V_{BEsat}$
(V)
1,5
1,0
0,5
0
1
10
10^2
10^3
$-I_C$ (mA)
$-V_{CEsat}$
$-V_{BEsat}$

Fig. 14.

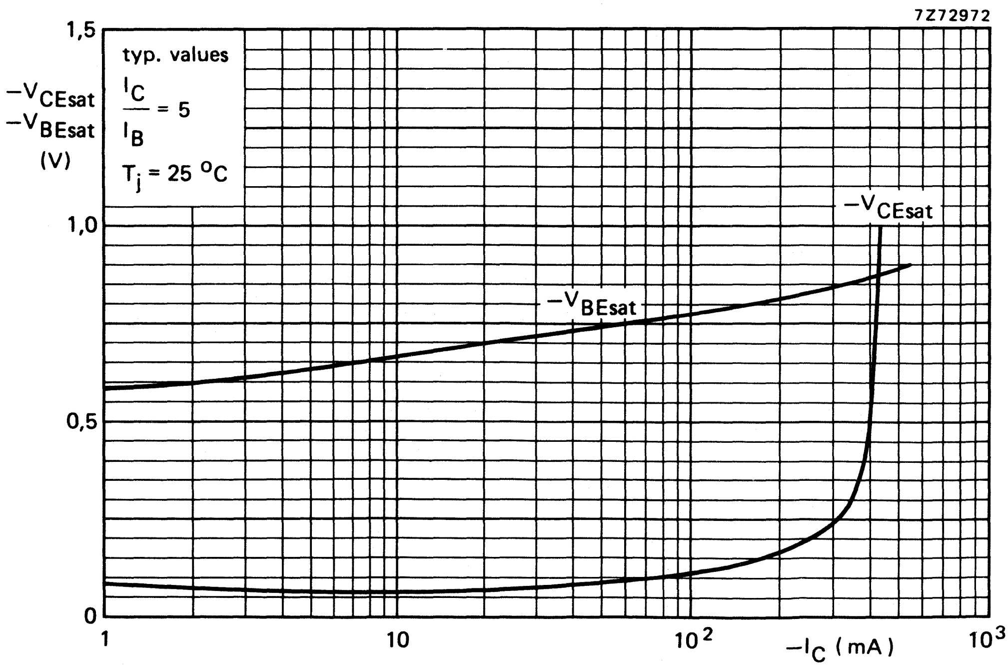

7Z72972
typ. values
$\frac{I_C}{I_B}$ = 5
T_j = 25 °C
$-V_{CEsat}$
$-V_{BEsat}$
(V)
1,5
1,0
0,5
0
1
10
10^2
10^3
$-I_C$ (mA)
$-V_{CEsat}$
$-V_{BEsat}$

Fig. 15.

SILICON PLANAR EPITAXIAL TRANSISTOR

PNP transistor in a TO-39 metal package for general industrial applications.

QUICK REFERENCE DATA

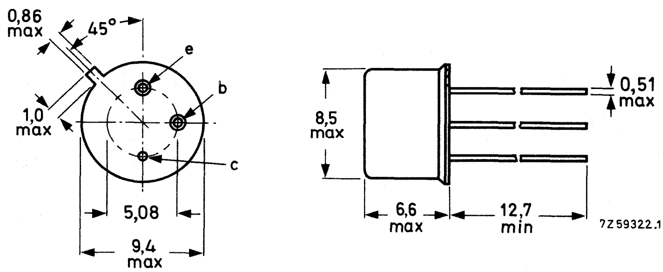
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	60 V
Collector current (peak value)	$-I_{CM}$	max.	600 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	600 mW
DC current gain $-I_C$ = 10 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	50
Transition frequency at f = 100 MHz $-I_C$ = 50 mA; $-V_{CE}$ = 10 V	f_T	min.	100 MHz

MECHANICAL DATA

Dimensions in mm

Fig.1 TO-39.

Collector connected to case



Maximum lead diameter is guaranteed only for 12.7 mm.

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.	60	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5.0	V
Collector current (DC)	$-I_C$	max.	600	mA
peak value	$-I_{CM}$	max.	600	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	600	mW
Storage temperature range	T_{stg}	–65 to + 150		°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	300	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

DC current gain				
$-I_C$ = 0.1 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	20	
$-I_C$ = 1.0 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	40	
$-I_C$ = 10 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	50	
$-I_C$ = 50 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	50	
$-I_C$ = 150 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	40	
Transition frequency at f = 100 MHz				
$-I_C$ = 50 mA; $-V_{CE}$ = 10 V	f_T	min.	100	MHz
Collector-emitter saturation voltage				
$-I_C$ = 150 mA; $-I_B$ = 15 mA	$-V_{CE(sat)}$	typ.	0.15	V
		max.	0.40	V
Base-emitter saturation voltage				
$-I_C$ = 30 mA; $-I_B$ = 1.0 mA	$-V_{BE(sat)}$	typ.	0.77	V
		max.	0.90	V
$-I_C$ = 30 mA; $-I_B$ = 1.0 mA	$-V_{BE(sat)}$	typ.	1.05	V
		max.	1.30	V
Collector capacitance				
$-V_{CB}$ = 10 V; I_E = I_e = 0; f = 1.0 MHz	C_c	typ.	6.0	pF
		max.	12	pF
Emitter capacitance				
$-V_{EB}$ = 2.0 V; I_C = I_c = 0; f = 1.0 MHz	C_e	typ.	18	pF
		max.	30	pF

Saturated switching times (see Figs 2 and 3)

Turn-on time	t_{on}	typ.	25	ns
		max.	60	ns
Turn-off time	t_{off}	typ.	55	ns
		max.	150	ns

h-parameters

Measured at $-I_C$ = 10 mA; $-V_{CE}$ = 10 V; f = 1.0 kHz; T_{amb} = 25 °C

Input impedance	h_{ie}	typ.	600	Ω
Voltage feedback ratio	h_{re}	typ.	1.5×10^{-4}	
Forward current transfer ratio	h_{fe}	typ.	155	
Output admittance	h_{oe}	typ.	104	μmho

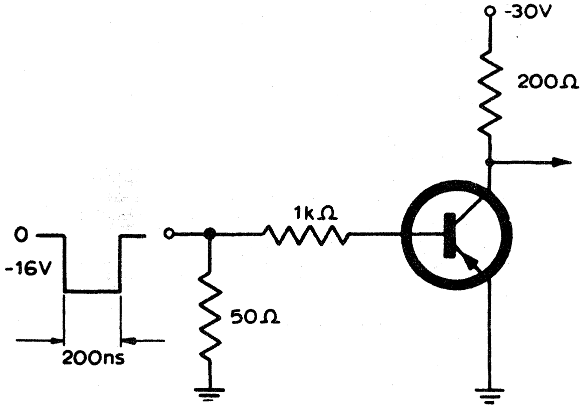


Fig.2 Saturated turn-on switching time.

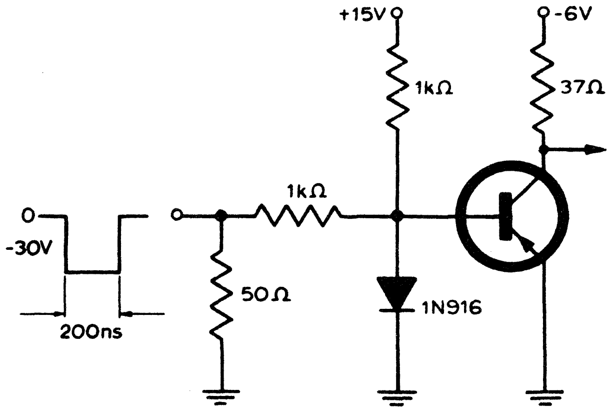


Fig.3 Saturated turn-off switching time.

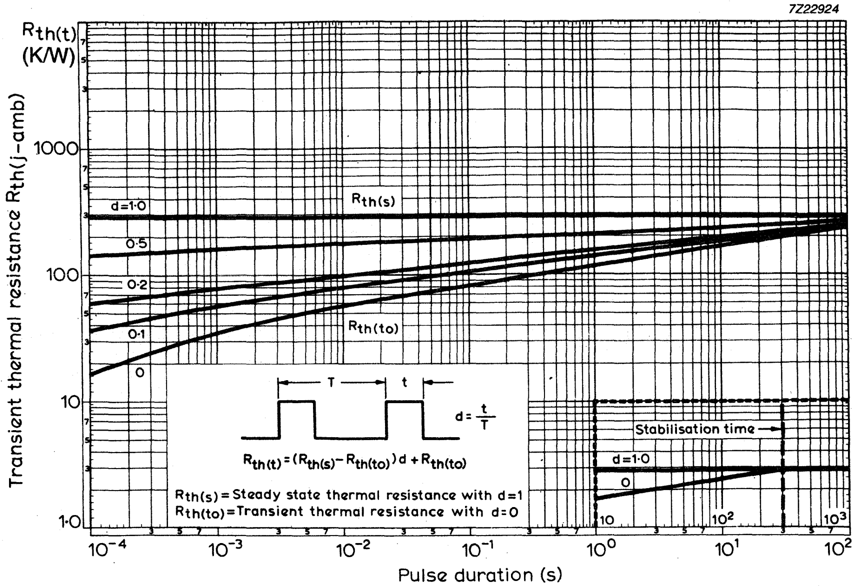


Fig. 4. Transient thermal resistance for various duty factors plotted against pulse duration.

SILICON PLANAR EPITAXIAL TRANSISTOR

PNP transistor in a TO-39 metal package intended for switching applications.

QUICK REFERENCE DATA

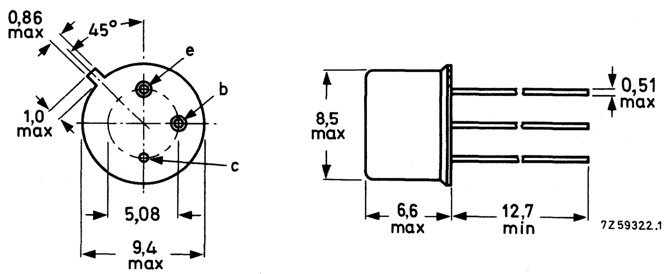
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	65	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	65	V
Collector current (peak value)	$-I_{CM}$	max.	600	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	600	mW
DC current gain $-I_C$ = 10 mA; $-V_{CE}$ = 0.4 V	h_{FE}	typ. 50 to 200	90	
Storage time $-I_{Con}$ = 100 mA; $-I_{Bon}$ = I_{Boff} = 10 mA	t_s	max.	250	ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case



Maximum lead diameter is guaranteed only for 12.7 mm.

RATINGS

Limiting values of operation according to the Absolute Maximum System.

Electrical

$-V_{CBO}$	max.	65	V
$-V_{CEO}$	max.	65	V
$-V_{EBO}$	max.	5.0	V
$-I_C$	max.	600	mA
$-I_{CM}$	max.	600	mA
$-I_{EM}$	max.	600	mA
P_{tot} max. ($T_{amb} \leqslant 25$ °C	max.	600	mW

Temperature

T_{stg}	min.	−65	°C
T_{stg}	max.	150	°C
T_j	max.	200	°C

THERMAL CHARACTERISTIC

$R_{th(j\text{-}amb)}$	300	K/W

CHARACTERISTICS (T_j = 25 °C unless otherwise stated)

$-I_{CBO}$	Collector cut-off current			
	$-V_{CB}$ = 65 V; I_E = 0	max.	500	nA
	$-V_{CB}$ = 50 V; I_E = 0	max.	50	nA
	$-V_{CB}$ = 50 V; I_E = 0, T_j = 100 °C	max.	2.0	μA
$-I_{EBO}$	Emitter cut-off current			
	$-V_{EB}$ = 5.0 V; I_C = 0	max.	500	nA
	$-V_{EB}$ = 3.0 V; I_C = 0	max.	100	nA
$-V_{BE(sat)}$	Base-emitter saturation voltage			
	$-I_C$ = 30 mA; $-I_B$ = 1.0 mA	max.	0.90	V
	$-I_C$ = 150 mA; $-I_B$ = 15 mA	max.	1.30	V
h_{FE}	DC current gain			
	$-I_C$ = 1.0 mA; $-V_{CE}$ = 0.4 V	min.	40	
	$-I_C$ = 10 mA; $-V_{CE}$ = 0.4 V	min.	50	
		max.	200	
	$-I_C$ = 50 mA; $-V_{CE}$ = 0.4 V	min.	20	
	$-I_C$ = 150 mA; $-V_{CE}$ = 0.4 V	min.	10	

C_c	Collector capacitance $-V_{CB} = 10$ V; $I_E = I_e = 0$; f = 1.0 MHz	typ.	6.0 pF
C_e	Emitter capacitance $-V_{EB} = 2.0$ V; $I_C = I_c = 0$; f = 1.0 MHz	typ.	18 pF

Saturated switching times

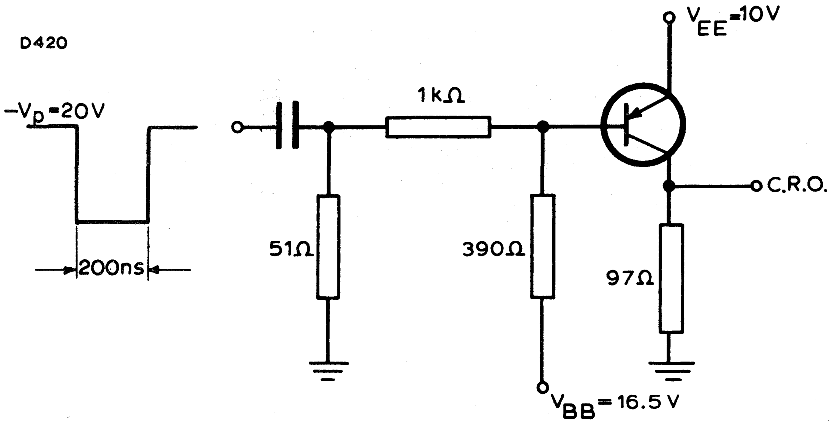
$-I_C = 100$ mA; $-I_{Bon} = I_{Boff} = 10$ mA; $V_{EE} = 10$ V; $V_{BEoff} = 2.0$ V

t_d	Delay time	typ. max.	9 ns 15 ns
t_r	Rise time	typ. max.	18 ns 40 ns
t_{on}	Turn-on time ($t_d + t_r$)	typ. max.	27 ns 50 ns
t_s	Storage time	typ. max.	95 ns 250 ns
t_f	Fail time	typ. max.	30 ns 50 ns
t_{off}	Turn-off time ($t_s + t_f$)	typ. max.	125 ns 290 ns

ELECTRICAL CHARACTERISTICS (cont'd)

Saturated switching times

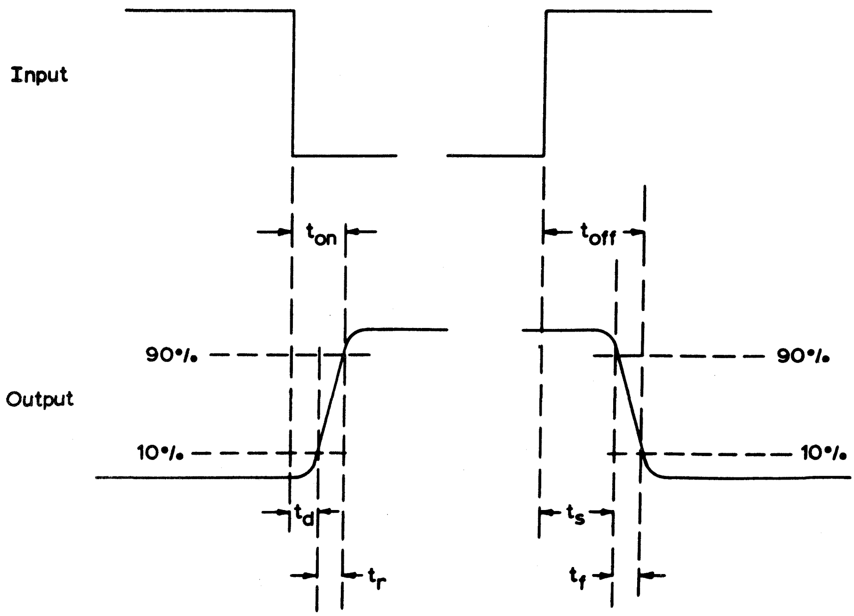
Test circuit

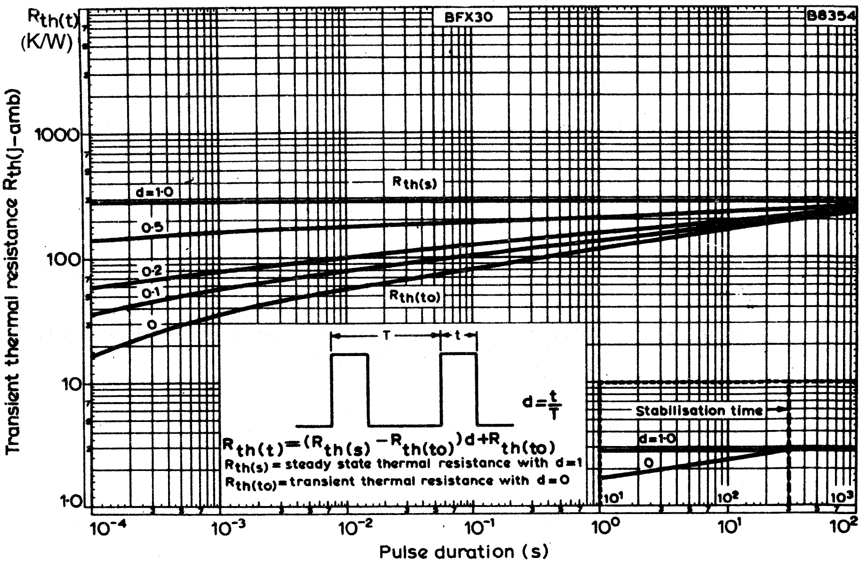


$-I_C = 100mA, -I_{B(on)} = I_{B(off)} = 10mA$

$V_{BE(off)} = 2 \cdot 0V$

Waveforms





TRANSIENT THERMAL RESISTANCE FOR VARIOUS DUTY FACTORS PLOTTED AGAINST PULSE DURATION

SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a TO-39 metal package primarily intended for use as high-current switching device, e.g. inverters and switching regulators.

QUICK REFERENCE DATA

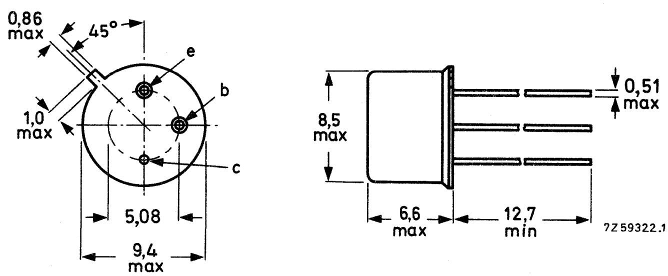
Collector-base voltage (open emitter)	V_{CBO}	max.	120	V
Collector-emitter voltage (open base)	V_{CEO}	max.	60	V
Collector current (peak value)	I_{CM}	max.	5,0	A
Total power dissipation up to T_{case} = 25 °C	P_{tot}	max.	5,0	W
Junction temperature	T_j	max.	200	°C
D.C. current gain I_C = 2 A; V_{CE} = 2 V	h_{FE}	40 to	150	
Transition frequency at f = 100 MHz I_C = 0,5 A; V_{CE} = 5 V	f_T	>	70	MHz
Turn-off time when switched from I_C = 5 A; I_B = 0,5 A to cut-off with $-I_{BM}$ = 0,5 A	t_{off}	<	1,2	μs

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case



Maximum lead diameter is guaranteed only for 12,7 mm.

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	120	V
Collector-emitter voltage (open base)	V_{CEO}	max.	60	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6	V
Collector current (d.c.)	I_C	max.	2,0	A
Collector current (peak value)	I_{CM}	max.	5,0	A
Base current (d.c.)	I_B	max.	1,0	A
Total power dissipation up to T_{case} = 25 °C	P_{tot}	max.	5,0	W
up to T_{amb} = 25 °C	P_{tot}	max.	0,87	W
Storage temperature range	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	200	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	35	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
V_{EB} = 0; V_{CE} = 60 V	I_{CES}	<	10	μA
Emitter cut-off current				
I_C = 0; V_{EB} = 4 V	I_{EBO}	<	10	μA
Saturation voltage				
I_C = 5 A; I_B = 0,5 A	V_{CEsat}	typ.	0,77	V
		<	1,0	V
	V_{BEsat}	typ.	1,43	V
		<	1,8	V
D.C. current gain				
I_C = 1,0 A; V_{CE} = 2,0 V	h_{FE}	typ.	130	
I_C = 1,5 A; V_{CE} = 0,6 V	h_{FE}	typ.	60	
I_C = 2,0 A; V_{CE} = 2,0 V	h_{FE}	typ.	110	
			40 to 150	
Collector capacitance at f = 1 MHz				
I_E = I_e = 0; V_{CB} = 10 V	C_c	typ.	36	pF
Emitter-capacitance at f = 1 MHz				
I_C = I_c = 0; V_{EB} = 0,5 V	C_e	typ.	440	pF
Transition frequency at f = 100 MHz				
I_C = 0,5 A; V_{CE} = 5 V	f_T	>	70	MHz
		typ.	100	MHz
Turn on time when switched from $-V_{BE}$ = 2,0 V to I_C = 5 V; I_B = 0,5 A with I_{BM} = 0,5 A	t_{on}	typ.	0,2	μs
		<	0,6	μs
Turn off time when switched from I_C = 5 A; I_B = 0,5 A to $-V_{BE}$ = 2,0 V with $-I_{BM}$ = 0,5 A	t_{off}	typ.	0,34	μs
		<	1,2	μs

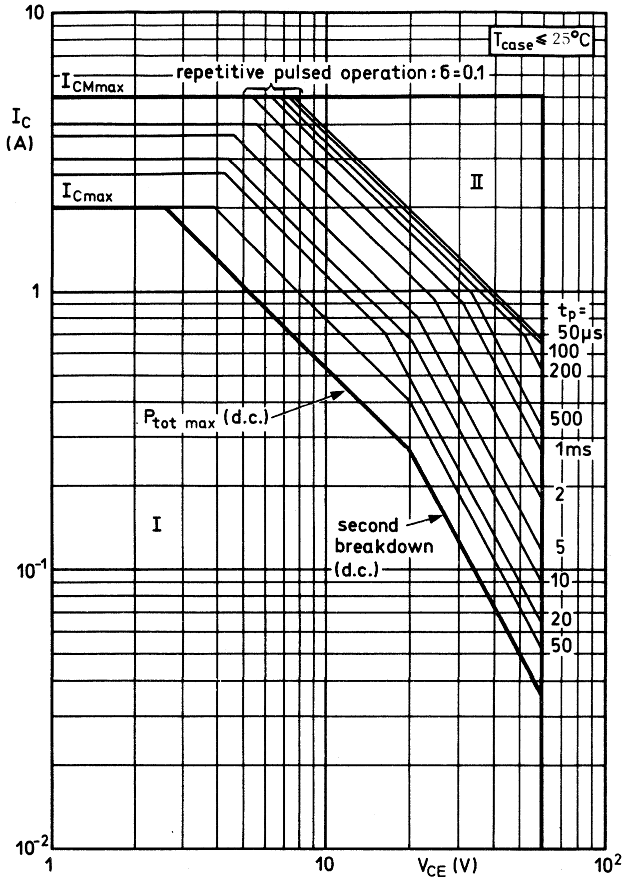


Fig. 2.

Safe Operation Area with the transistor forward biased

I Region of permissible d.c. operation
II Permissible extension for repetitive pulsed operation

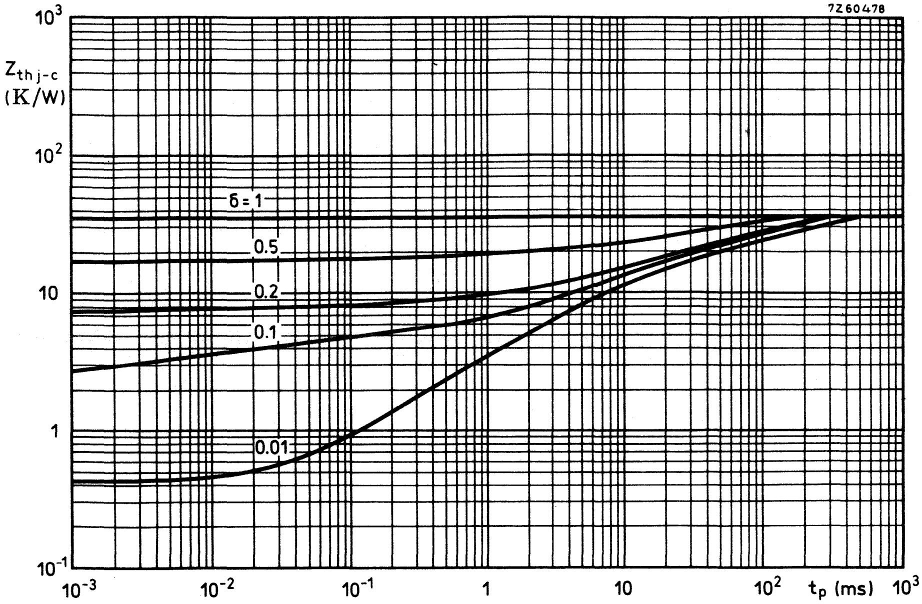

7Z60478
$Z_{th\ j-c}$ (K/W)
10^3
10^2
10
1
10^{-1}
δ = 1
0.5
0.2
0.1
0.01
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
t_p (ms)
10^3

Fig. 3.

SILICON PLANAR EPITAXIAL TRANSISTORS

NPN transistors in TO-39 metal packages for general purpose industrial applications.

QUICK REFERENCE DATA

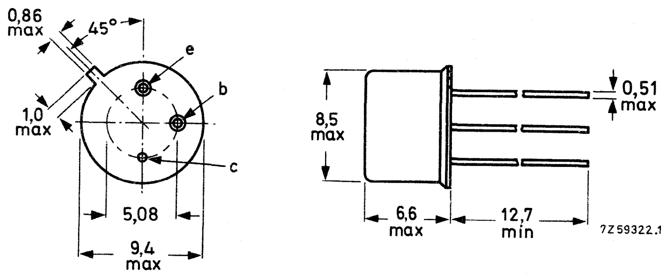
			BFX84	BFX85	
Collector-base voltage (open emitter)	V_{CBO}	max.	100	100	V
Collector-emitter voltage (open base)	V_{CEO}	max.	60	60	V
Collector current (peak value)	I_{CM}	max.	1.0	1.0	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	800	800	mW
Total power dissipation up to T_{case} = 100 °C	P_{tot}	max.	2.86	2.86	W
DC current gain I_C = 150 mA; V_{CE} = 10 V	h_{FE}	min. typ.	30 112	70 142	
Transition frequency at f = 100 MHz I_C = 50 mA; V_{CE} = 10 V; T_{amb} = 25 °C	f_T	min.	50	50	MHz

MECHANICAL DATA

Dimensions in mm

Fig.1 TO-39.

Collector connected to case.



Maximum lead diameter is guaranteed only for 12.7 mm.

RATINGS

Limiting values of operation according to the absolute maximum system.

Electrical

		BFX84	BFX85	
V_{CBO} max.		100	100	V
V_{CE} max. (cut-off, $I_C \leq 1mA$)		100	100	V
V_{CEO} max.		60	60	V
V_{EBO} max.		6.0		V
I_C max.		1.0		A
I_{CM} max.		1.0		A
$-I_E$ max.		1.0		A
$-I_{EM}$ max.		1.0		A
I_B max.		100		mA
$\pm I_{BM}$ max.		100		mA
P_{tot} max.	$T_{amb} \leq 25^oC$	800		mW
	$T_{case} \leq 25^oC$	5.0		W
	$T_{case} > 25, < 100^oC$	2.86		W

Temperature

T_{stg}	-65 to +150	^oC
T_j max.	175	^oC

THERMAL CHARACTERISTICS

$R_{th(j-amb)}$ in free air	200	K/W
$R_{th(j-case)}$	35	K/W

BFX84

ELECTRICAL CHARACTERISTICS ($T_j = 25^oC$ unless otherwise stated)

		Min.	Typ.	Max.	
I_{CBO}	Collector cut-off current				
	$V_{CB} = 100V$, $I_E = 0$	-	10	500	nA
	$V_{CB} = 100V$, $I_E = 0$, $T_j = 100^oC$	-	0.5	30	μA
	$V_{CB} = 80V$, $I_E = 0$	-	2.0	50	nA
	$V_{CB} = 80V$, $I_E = 0$, $T_j = 100^oC$	-	0.1	2.5	μA
I_{EBO}	Emitter cut-off current				
	$V_{EB} = 6.0V$, $I_C = 0$	-	10	500	nA
	$V_{EB} = 5.0V$, $I_C = 0$	-	2.0	50	nA
	$V_{EB} = 5.0V$, $I_C = 0$, $T_j = 100^oC$	-	0.1	2.5	μA
h_{FE}	Static forward current transfer ratio				
	$I_C = 10mA$, $V_{CE} = 10V$	20	80	-	
	$I_C = 150mA$, $V_{CE} = 10V$	30	112	-	
	$I_C = 500mA$, $V_{CE} = 10V$	20	70	-	
	$I_C = 1.0A$, $V_{CE} = 10V$	15	35	-	
$V_{CE(sat)}$	Collector-emitter saturation voltage				
	$I_C = 10mA$, $I_B = 1.0mA$	-	0.15	0.20	V
	$I_C = 150mA$, $I_B = 15mA$	-	0.15	0.35	V
	$I_C = 500mA$, $I_B = 50mA$	-	0.35	1.00	V
	$I_C = 1.0A$, $I_B = 100mA$	-	0.66	1.60	V
$V_{BE(sat)}$	Base-emitter saturation voltage				
	$I_C = 10mA$, $I_B = 1.0mA$	-	0.69	1.2	V
	$I_C = 150mA$, $I_B = 15mA$	-	0.92	1.3	V
	$I_C = 500mA$, $I_B = 50mA$	-	1.15	1.5	V
	$I_C = 1.0A$, $I_B = 100mA$	-	1.40	2.0	V
C_C	Collector capacitance $V_{CB} = 10V$, $I_E = I_e = 0$, f = 1.0MHz	-	7.0	12	pF

BFX84

ELECTRICAL CHARACTERISTICS (contd.)

		Min.	Typ.	Max.	
f_T	Transition frequency $I_C = 50mA$, $V_{CE} = 10V$, $f = 100\ MHz$, $T_{amb} = 25^{o}C$	50	140	-	MHz
Saturated switching times $I_C = 150mA$, $I_{B(on)} = -I_{B(off)} = 15mA$, $-V_{EE} = 10V$, $-V_{BE(off)} = 2.0V$					
t_d	Delay time	-	15	-	ns
t_r	Rise time	-	40	-	ns
t_{on}	Turn-on time	-	55	-	ns
t_s	Storage time	-	300	-	ns
t_f	Fall time	-	60	-	ns
t_{off}	Turn-off time	-	360	-	ns
h-parameters					
h_{fe}	$I_C = 1.0mA$, $V_{CE} = 5.0V$, $f = 1.0kHz$, $T_{amb} = 25^{o}C$	10	65	-	
h_{ie}	$I_C = 10mA$, $V_{CE} = 5.0V$, $f = 1.0kHz$, $T_{amb} = 25^{o}C$	-	750	-	Ω
h_{re}		-	0.85	5.0	$\times 10^{-4}$
h_{fe}		15	80	-	
h_{oe}		-	35	80	μmho

BFX85

ELECTRICAL CHARACTERISTICS ($T_j = 25^oC$ unless otherwise stated)

		Min.	Typ.	Max.	
I_{CBO}	Collector cut-off current				
	$V_{CB} = 100V$, $I_E = 0$	-	10	500	nA
	$V_{CB} = 100V$, $I_E = 0$, $T_j = 100^oC$	-	0.5	30	μA
	$V_{CB} = 80V$, $I_E = 0$	-	2.0	50	nA
	$V_{CB} = 80V$, $I_E = 0$, $T_j = 100^oC$	-	0.1	2.5	μA
I_{EBO}	Emitter cut-off current				
	$V_{EB} = 6.0V$, $I_C = 0$	-	10	500	nA
	$V_{EB} = 5.0V$, $I_C = 0$	-	2.0	50	nA
	$V_{EB} = 5.0V$, $I_C = 0$, $T_j = 100^oC$	-	0.1	2.5	μA
h_{FE}	Static forward current transfer ratio				
	$I_C = 10mA$, $V_{CE} = 10V$	50	90	-	
	$I_C = 150mA$, $V_{CE} = 10V$	70	142	-	
	$I_C = 500mA$, $V_{CE} = 10V$	30	90	-	
	$I_C = 1.0A$, $V_{CE} = 10V$	15	50	-	
$V_{CE(sat)}$	Collector-emitter saturation voltage				
	$I_C = 10mA$, $I_B = 1.0mA$	-	0.15	0.20	V
	$I_C = 150mA$, $I_B = 15mA$	-	0.15	0.35	V
	$I_C = 500mA$, $I_B = 50mA$	-	0.35	1.00	V
	$I_C = 1.0A$, $I_B = 100mA$	-	0.66	1.60	V
$V_{BE(sat)}$	Base-emitter saturation voltage				
	$I_C = 10mA$, $I_B = 1.0mA$	-	0.69	1.2	V
	$I_C = 150mA$, $I_B = 15mA$	-	0.92	1.3	V
	$I_C = 500mA$, $I_B = 50mA$	-	1.15	1.5	V
	$I_C = 1.0A$, $I_B = 100mA$	-	1.40	2.0	V
C_C	Collector capacitance				
	$V_{CB} = 10V$, $I_E = I_e = 0$, f = 1.0MHz	-	7.0	12	pF

BFX85

ELECTRICAL CHARACTERISTICS (contd.)

		Min.	Typ.	Max.	
f_T	Transition frequency $I_C = 50mA$, $V_{CE} = 10V$, $f = 35MHz$, $T_{amb} = 25^oC$	50	185	-	MHz

Saturated switching times

$I_C = 150mA$, $I_{B(on)} = -I_{B(off)} = 15mA$,
$-V_{EE} = 10V$, $-V_{BE(off)} = 2.0V$

		Min.	Typ.	Max.	
t_d	Delay time	-	15	-	ns
t_r	Rise time	-	40	-	ns
t_{on}	Turn-on time	-	55	-	ns
t_s	Storage time	-	300	-	ns
t_f	Fall time	-	60	-	ns
t_{off}	Turn-off time	-	360	-	ns

h-parameters

		Min.	Typ.	Max.	
h_{fe}	$I_C = 1.0mA$, $V_{CE} = 5.0V$, $f = 1.0kHz$, $T_{amb} = 25^oC$	20	65	-	
h_{ie}	$I_C = 10mA$, $V_{CE} = 5.0V$, $f = 1.0kHz$, $T_{amb} = 25^oC$	-	750	-	Ω
h_{re}		-	0.85	5.0×10^{-4}	
h_{fe}		25	80	-	
h_{oe}		-	35	80	μmho

MEASUREMENT OF SATURATED SWITCHING TIMES

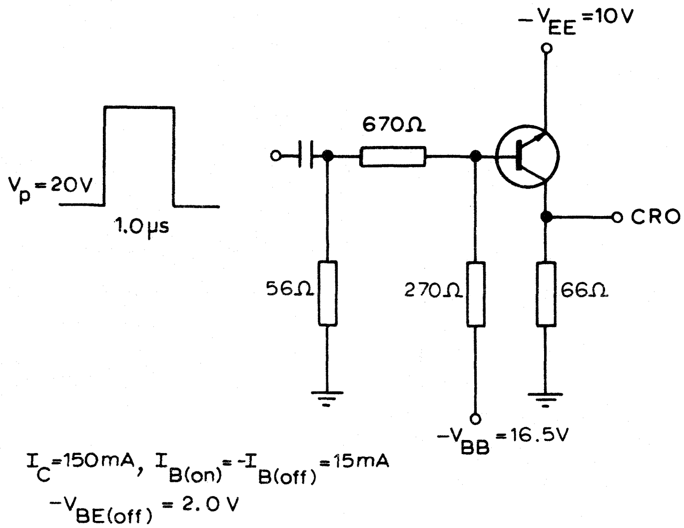


Fig.2 Test circuit.

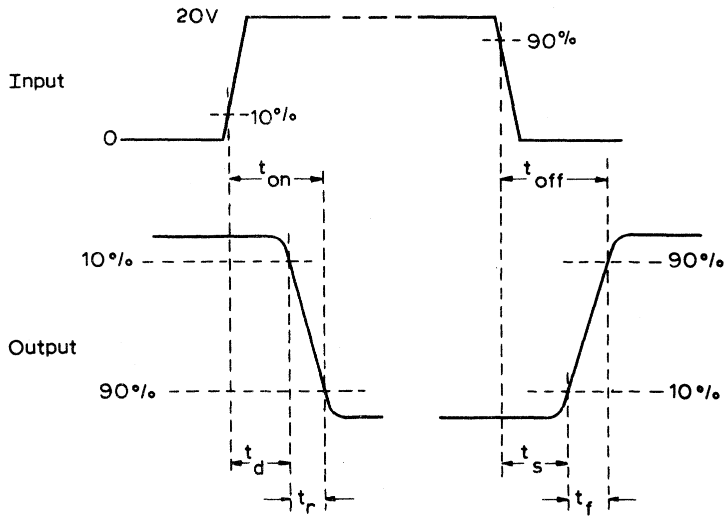


Fig.3 Switching waveforms.

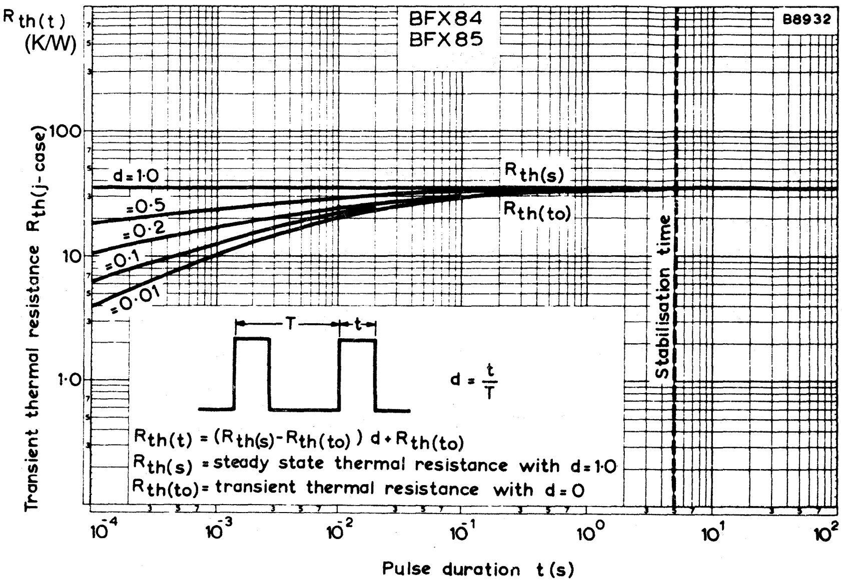


Fig.4 Transient thermal resistance for various duty factors plotted against pulse duration.

SILICON PLANAR EPITAXIAL TRANSISTORS

PNP transistors in TO-39 metal packages for general industrial applications.

QUICK REFERENCE DATA

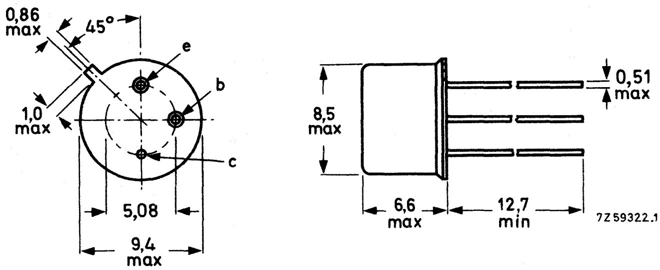
			BFX87	BFX88	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	50	40	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	50	40	V
Collector current (peak value)	$-I_{CM}$	max.	600	600	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	600	600	mW
DC current gain $-I_C$ = 10 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	40	40	
		typ.	125	125	
Transition frequency at f = 100 MHz $-I_C$ = 50 mA; $-V_{CE}$ = 10 V	f_T	min.	100	100	MHz

MECHANICAL DATA

Dimensions in mm

Fig.1 TO-39.

Collector connected to case



Maximum lead diameter is guaranteed only for 12.7 mm.

RATINGS

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

			BFX87	BFX88	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	50	40	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	50	40	V
Collector current (DC)	$-I_C$	max.	600		mA
Collector current (peak value)	$-I_{CM}$	max.	600		mA
Emitter current	I_{EM}	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	600		mW
Storage temperature range	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	+200		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\,j\text{-}a}$	=	300	K/W

CHARACTERISTICS

			BFX87	BFX88	
Collector cut-off current					
$-V_{CB}$ = 50 V; I_E = 0	$-I_{CBO}$	typ.	1.0	—	nA
		max.	500	—	nA
$-V_{CB}$ = 40 V; I_E = 0	$-I_{CBO}$	typ.	0.5	1.0	nA
		max.	50	500	nA
$-V_{CB}$ = 30 V; I_E = 0	$-I_{CBO}$	typ.	—	0.5	nA
		max.	—	50	nA
$-V_{CB}$ = 40 V; I_E = 0; T_j = 100 °C	$-I_{CBO}$	typ.	0.03	—	μA
		max.	2.0	—	μA
$-V_{CB}$ = 30 V; I_E = 0; T_j = 100 °C	$-I_{CBO}$	typ.	—	0.03	μA
		max.	—	2.0	μA
Emitter cut-off current					
$-V_{EB}$ = 4.0 V; I_C = 0	$-I_{EBO}$	typ.	2.0		nA
		max.	500		nA
$-V_{EB}$ = 3.0 V; I_C = 0	$-I_{EBO}$	typ.	1.0		nA
		max.	100		nA

DC current gain				
$-I_C$ = 1.0 mA; $-V_{CE}$ = 10 V	h_{FE}	min. typ.	40 105	
$-I_C$ = 10 mA; $-V_{CE}$ = 10 V	h_{FE}	min. typ.	40 125	
$-I_C$ = 150 mA; $-V_{CE}$ = 10 V	h_{FE}	min. typ.	40 90	
$-I_C$ = 500 mA; $-V_{CE}$ = 10 V	h_{FE}	min. typ.	25 40	
Collector-emitter saturation voltage $-I_C$ = 150 mA; $-I_B$ = 15 mA	$-V_{CE(sat)}$	typ. max.	0.15 0.40	V V
Base-emitter saturation voltage $-I_C$ = 30 mA; $-I_B$ = 1.0 mA	$-V_{BE(sat)}$	typ. max.	0.77 0.90	V V
$-I_C$ = 150 mA; $-I_B$ = 15 mA	$-V_{BE(sat)}$	typ. max.	1.05 1.30	V V
Collector capacitance $-V_{CB}$ = 10 V; $I_E = I_e$ = 0; f = 1.0 MHz	C_c	typ. max.	6.0 12	pF pF
Emitter capacitance $-V_{EB}$ = 2.0 V; $I_C = I_c$ = 0; f = 1.0 MHz	C_e	typ. max.	18 30	pF pF
Transition frequency $-I_C$ = 50 mA; $-V_{CE}$ = 10 V; f = 100 MHz; T_{amb} = 25 °C	f_T	min. typ.	100 360	MHz MHz
Saturated switching times Turn-on time	t_{on}	typ. max.	25 60	ns ns
Turn-off time	t_{off}	typ. max.	55 150	ns ns

h-parameters

Measured at $-I_C$ = 10 mA; $-V_{CE}$ = 10 V; f = 1.0 kHz; T_{amb} = 25 °C

Input impedance	h_{ie}	typ.	600	Ω
Voltage feedback ratio	h_{re}	typ.	1.50×10^{-4}	
Forward current transfer ratio	h_{fe}	typ.	155	
Output admittance	h_{oe}	typ.	104	μmho

TEST CIRCUITS

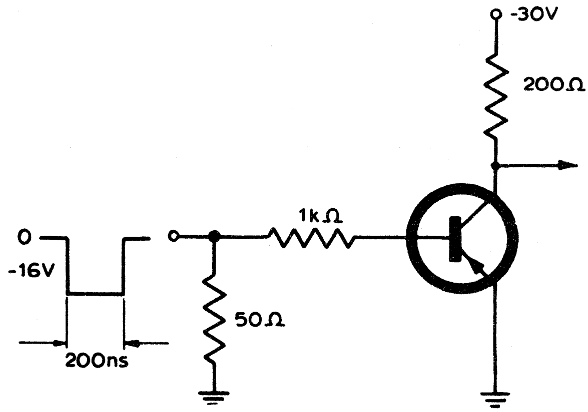


Fig.2 Saturated turn-on switching time.

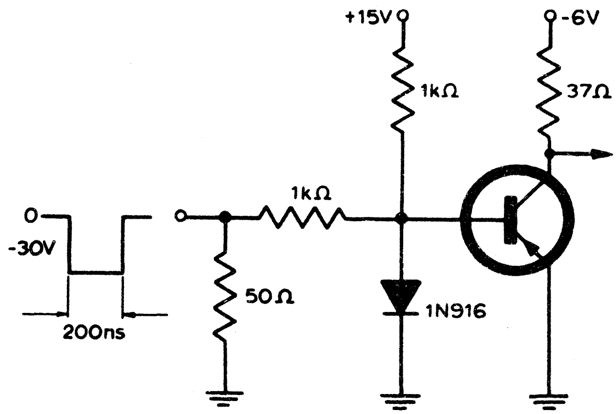


Fig.3 Saturated turn-off switching time.

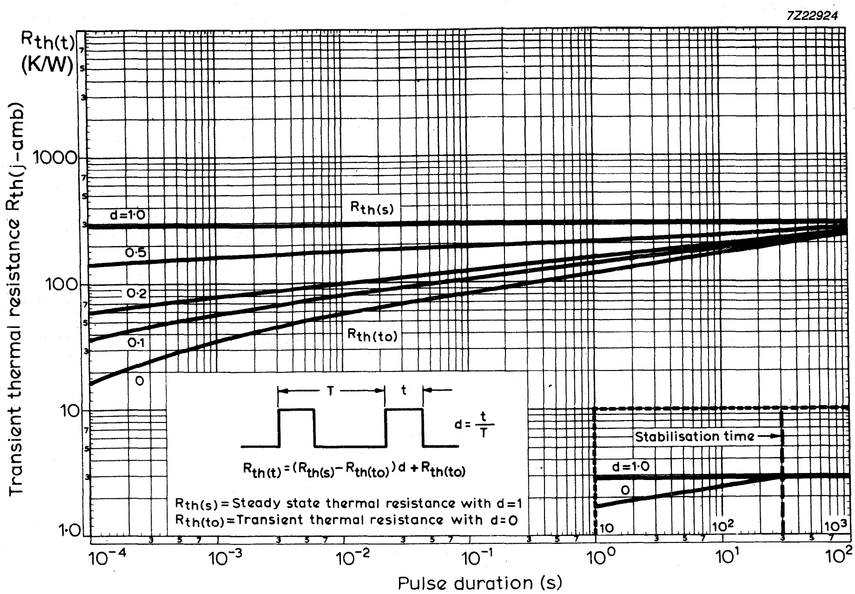


Fig.4 Transient thermal resistance for various duty factors plotted against pulse duration.

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in TO-39 metal packages intended for general purpose industrial applications.

QUICK REFERENCE DATA

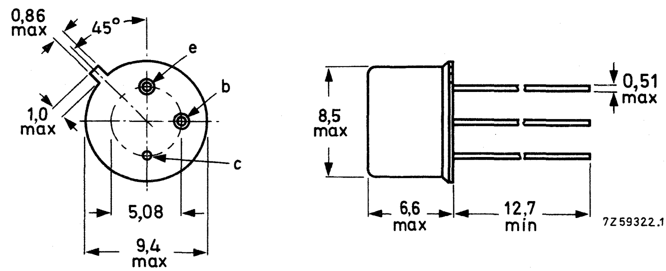
			BFY50	BFY51	BFY52	
Collector-base voltage (open emitter)	V_{CBO}	max.	80	60	40	V
Collector-emitter voltage (open base)	V_{CEO}	max.	35	30	20	V
Collector current (peak value)	I_{CM}	max.	1,0	1,0	1,0	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	800	800	800	mW
Total power dissipation up to T_{case} = 100 °C	P_{tot}	max.	2,86	2,86	2,86	W
D.C. current gain I_C = 150 mA; V_{CE} = 10 V	h_{FE}	>	30	40	60	
		typ.	112	123	142	
Transition frequency at f = 100 MHz I_C = 50 mA; V_{CE} = 10 V; T_{amb} = 25 °C	f_T	>	60	50	50	MHz

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case



Maximum lead diameter is guaranteed only for 12,7 mm.

RATINGS

Limiting values of operation according to the absolute maximum system.

Electrical

	BFY50	BFY51	BFY52	
V_{CBO} max.	80	60	40	V
V_{CE} max. (cut-off, $I_C \leq 1mA$)	80	60	40	V
V_{CEO} max.	35	30	20	V
V_{EBO} max.		6.0		V
I_C max.		1.0		A
I_{CM} max.		1.0		A
$-I_E$ max.		1.0		A
$-I_{EM}$ max.		1.0		A
I_B max.		100		mA
$\pm I_{BM}$ max.		100		mA
P_{tot} max. $T_{amb} \leq 25^oC$		800		mW
$T_{case} \leq 25^oC$		5.0		W
$T_{case} > 25, < 100^oC$		2.86		W

Temperature

T_{stg}	-65 to +150	^oC
T_j max.	200	^oC

THERMAL CHARACTERISTICS

$R_{th(j-amb)}$ in free air	220	K/W
$R_{th(j-case)}$	35	K/W

BFY50

ELECTRICAL CHARACTERISTICS ($T_j = 25^oC$ unless otherwise stated)

		Min.	Typ.	Max.	
I_{CBO}	Collector cut-off current				
	$V_{CB} = 80V$, $I_E = 0$	-	–	500	nA
	$V_{CB} = 80V$, $I_E = 0$, $T_j = 100^oC$	-	–	30	μA
	$V_{CB} = 60V$, $I_E = 0$	-	–	50	nA
	$V_{CB} = 60V$, $I_E = 0$, $T_j = 100^oC$	-	–	2.5	μA
I_{EBO}	Emitter cut-off current				
	$V_{EB} = 6.0V$, $I_C = 0$	-	–	500	nA
	$V_{EB} = 5.0V$, $I_C = 0$	-	–	50	nA
	$V_{EB} = 5.0V$, $I_C = 0$, $T_j = 100^oC$	-	–	2.5	μA
h_{FE}	Static forward current transfer ratio				
	$I_C = 10mA$, $V_{CE} = 10V$	20	–	-	
	$I_C = 150mA$, $V_{CE} = 10V$	30	–	-	
	$I_C = 500mA$, $V_{CE} = 10V$	20	–	-	
	$I_C = 1.0A$, $V_{CE} = 10V$	15	–	-	
$V_{CE(sat)}$	Collector-emitter saturation voltage				
	$I_C = 10mA$, $I_B = 1.0mA$	-	–	0.20	V
	$I_C = 150mA$, $I_B = 15mA$	-	–	0.20	V
	$I_C = 500mA$, $I_B = 50mA$	-	–	0.70	V
	$I_C = 1.0A$, $I_B = 100mA$	-	–	1.00	V
$V_{BE(sat)}$	Base-emitter saturation voltage				
	$I_C = 10mA$, $I_B = 1.0mA$	-	–	1.2	V
	$I_C = 150mA$, $I_B = 15mA$	-	–	1.3	V
	$I_C = 500mA$, $I_B = 50mA$	-	–	1.5	V
	$I_C = 1.0A$, $I_B = 100mA$	-	–	2.0	V
C_C	Collector capacitance				
	$V_{CB} = 10V$, $I_E = I_e = 0$, $f = 1.0MHz$	-	7.0	12	pF

BFY50

ELECTRICAL CHARACTERISTICS (contd.)

Symbol	Parameter	Min.	Typ.	Max.	Unit
f_T	Transition frequency $I_C = 50mA$, $V_{CE} = 10V$, $f = 100$ MHz, $T_{amb} = 25^oC$	60	140	-	MHz
	Saturated switching times $I_C = 150mA$, $I_{B(on)} = -I_{B(off)} = 15mA$, $-V_{EE} = 10V$, $-V_{BE(off)} = 2.0V$				
t_d	Delay time	-	15	-	ns
t_r	Rise time	-	40	-	ns
t_{on}	Turn-on time	-	55	-	ns
t_s	Storage time	-	300	-	ns
t_f	Fall time	-	60	-	ns
t_{off}	Turn-off time	-	360	-	ns
	h-parameters				
h_{fe}	$I_C = 1.0mA$, $V_{CE} = 5.0V$, $f = 1.0kHz$, $T_{amb} = 25^oC$	–	65	-	
h_{ie}	$I_C = 10mA$, $V_{CE} = 5.0V$, $f = 1.0kHz$, $T_{amb} = 25^oC$	-	750	-	Ω
h_{re}		-	0.85	–	$\times 10^{-4}$
h_{fe}		–	80	-	
h_{oe}		-	35	–	μS

BFY51

ELECTRICAL CHARACTERISTICS ($T_j = 25^{\circ}C$ unless otherwise stated)

Symbol	Parameter / Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cut-off current				
	$V_{CB} = 60V$, $I_E = 0$	-	–	500	nA
	$V_{CB} = 60V$, $I_E = 0$, $T_j = 100^{\circ}C$	-	–	30	μA
	$V_{CB} = 40V$, $I_E = 0$	-	–	50	nA
	$V_{CB} = 40V$, $I_E = 0$, $T_j = 100^{\circ}C$	-	–	2.5	μA
I_{EBO}	Emitter cut-off current				
	$V_{EB} = 6.0V$, $I_C = 0$	-	–	500	nA
	$V_{EB} = 5.0V$, $I_C = 0$	-	–	50	nA
	$V_{EB} = 5.0V$, $I_C = 0$, $T_j = 100^{\circ}C$	-	–	2.5	μA
h_{FE}	Static forward current transfer ratio				
	$I_C = 10mA$, $V_{CE} = 10V$	30	–	-	
	$I_C = 150mA$, $V_{CE} = 10V$	40	–	-	
	$I_C = 500mA$, $V_{CE} = 10V$	25	–	-	
	$I_C = 1.0A$, $V_{CE} = 10V$	15	–	-	
$V_{CE(sat)}$	Collector-emitter saturation voltage				
	$I_C = 10mA$, $I_B = 1.0mA$	-	–	0.20	V
	$I_C = 150mA$, $I_B = 15mA$	-	–	0.35	V
	$I_C = 500mA$, $I_B = 50mA$	-	–	1.00	V
	$I_C = 1.0A$, $I_B = 100mA$	-	–	1.60	V
$V_{BE(sat)}$	Base-emitter saturation voltage				
	$I_C = 10mA$, $I_B = 1.0mA$	-	–	1.2	V
	$I_C = 150mA$, $I_B = 15mA$	-	–	1.3	V
	$I_C = 500mA$, $I_B = 50mA$	-	–	1.5	V
	$I_C = 1.0A$, $I_B = 100mA$	-	–	2.0	V
C_C	Collector capacitance				
	$V_{CB} = 10V$, $I_E = I_e = 0$, $f = 1.0MHz$	-	7.0	12	pF

BFY51/BFY52

ELECTRICAL CHARACTERISTICS (contd.)

		Min.	Typ.	Max.	
f_T	Transition frequency $I_C = 50mA$, $V_{CE} = 10V$, $f = 100$ MHz, $T_{amb} = 25^oC$	50	-	-	MHz
Saturated switching times					
	$I_C = 150mA$, $I_{B(on)} = -I_{B(off)} = 15mA$, $-V_{EE} = 10V$, $-V_{BE(off)} = 2.0V$				
t_d	Delay time	-	15	-	ns
t_r	Rise time	-	40	-	ns
t_{on}	Turn-on time	-	55	-	ns
t_s	Storage time	-	300	-	ns
t_f	Fall time	-	60	-	ns
t_{off}	Turn-off time	-	360	-	ns
h-parameters					
h_{fe}	$I_C = 1.0mA$, $V_{CE} = 5.0V$, $f = 1.0kHz$, $T_{amb} = 25^oC$	—	65	-	
h_{ie}	$I_C = 10mA$, $V_{CE} = 5.0V$, $f = 1.0kHz$, $T_{amb} = 25^oC$	—	750	—	Ω
h_{re}		—	0.85	—	$\times 10^{-4}$
h_{fe}		—	80	—	
h_{oe}		—	35	—	µS

BFY52

ELECTRICAL CHARACTERISTICS ($T_j = 25^oC$ unless otherwise stated)

		Min.	Typ.	Max.	
I_{CBO}	Collector cut-off current				
	$V_{CB} = 40V$, $I_E = 0$	-	–	500	nA
	$V_{CB} = 40V$, $I_E = 0$, $T_j = 100^oC$	-	–	30	μA
	$V_{CB} = 30V$, $I_E = 0$	-	–	50	nA
	$V_{CB} = 30V$, $I_E = 0$, $T_j = 100^oC$	-	–	2.5	μA
I_{EBO}	Emitter cut-off current				
	$V_{EB} = 6.0V$, $I_C = 0$	-	–	500	nA
	$V_{EB} = 5.0V$, $I_C = 0$	-	–	50	nA
	$V_{EB} = 5.0V$, $I_C = 0$, $T_j = 100^oC$	-	–	2.5	μA
h_{FE}	Static forward current transfer ratio				
	$I_C = 10mA$, $V_{CE} = 10V$	30	–	-	
	$I_C = 150mA$, $V_{CE} = 10V$	60	–	-	
	$I_C = 500mA$, $V_{CE} = 10V$	30	–	-	
	$I_C = 1.0A$, $V_{CE} = 10V$	15	–	-	
$V_{CE(sat)}$	Collector-emitter saturation voltage				
	$I_C = 10mA$, $I_B = 1.0mA$	-	–	0.20	V
	$I_C = 150mA$, $I_B = 15mA$	-	–	0.35	V
	$I_C = 500mA$, $I_B = 50mA$	-	–	1.00	V
	$I_C = 1.0A$, $I_B = 100mA$	-	–	1.60	V
$V_{BE(sat)}$	Base-emitter saturation voltage				
	$I_C = 10mA$, $I_B = 1.0mA$	-	–	1.2	V
	$I_C = 150mA$, $I_B = 15mA$	-	–	1.3	V
	$I_C = 500mA$, $I_B = 50mA$	-	–	1.5	V
	$I_C = 1.0A$, $I_B = 100mA$	-	–	2.0	V
C_C	Collector capacitance				
	$V_{CB} = 10V$, $I_E = I_e = 0$, f = 1.0MHz	-	7.0	12	pF

MEASUREMENT OF SATURATED SWITCHING TIMES

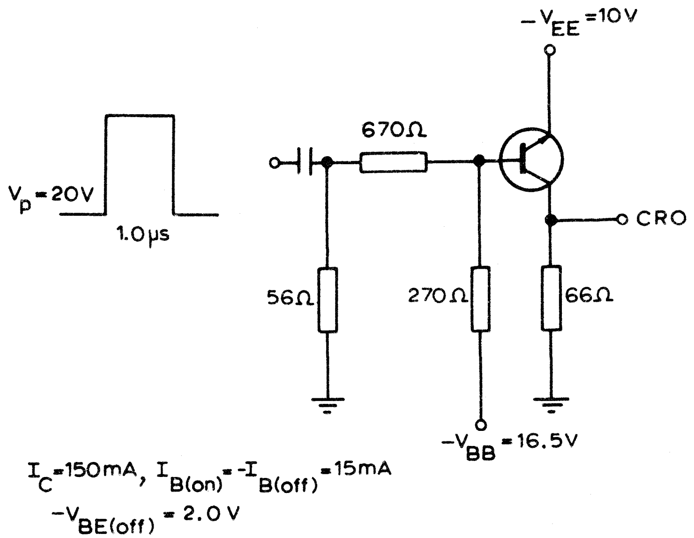


Fig. 2 Test circuit.

Switching waveforms

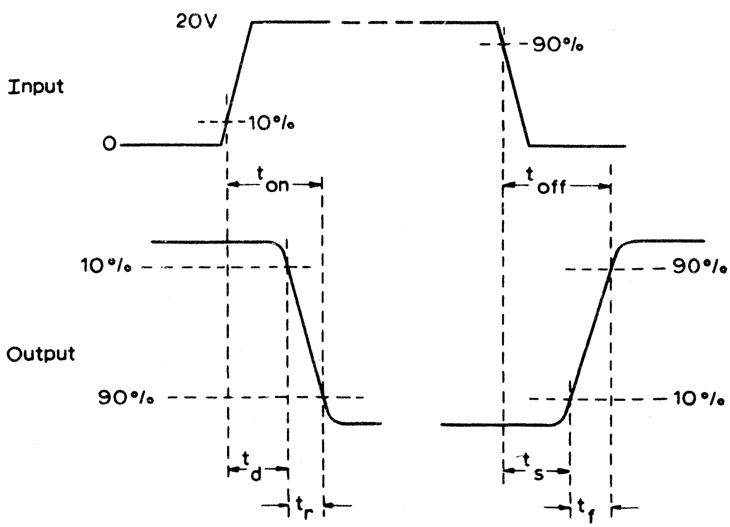


Fig. 3 Waveforms.

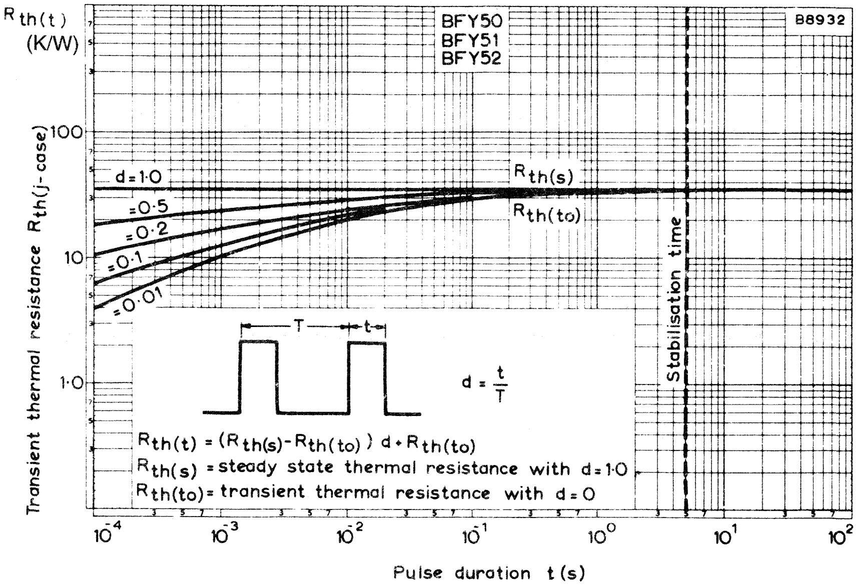

Rth(t) (K/W)
Transient thermal resistance Rth(j-case)
BFY50
BFY51
BFY52
B8932
d = 1·0
= 0·5
= 0·2
= 0·1
= 0·01
Rth(s)
Rth(to)
Stabilisation time
T
t
d = t/T
Rth(t) = (Rth(s) - Rth(to)) d + Rth(to)
Rth(s) = steady state thermal resistance with d = 1·0
Rth(to) = transient thermal resistance with d = 0
100
10
1·0
10^-4
10^-3
10^-2
10^-1
10^0
10^1
10^2
Pulse duration t (s)

Fig. 4.

SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in TO-39 metal package, with collector connected to the case. It is primarily intended for use in high frequency and very high frequency oscillators and amplifiers as well as for output stages of servo amplifiers.

QUICK REFERENCE DATA

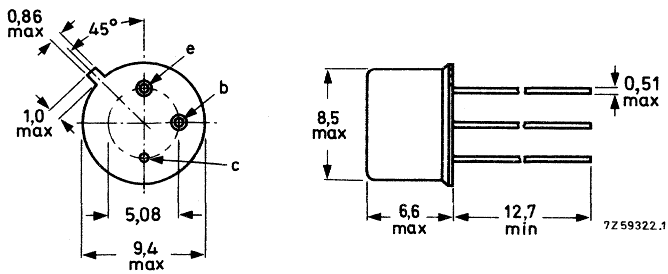
Collector-base voltage (open emitter)	V_{CBO}	max.	80	V
Collector-emitter voltage (open base)	V_{CEO}	max.	35	V
Collector current (d.c.)	I_C	max.	1	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	800	mW
Junction temperature	T_j	max.	200	°C
D.C. current gain at T_j = 25 °C I_C = 150 mA; V_{CE} = 10 V	h_{FE}		40 to 120	
Transition frequency at f = 100 MHz I_C = 50 mA; V_{CE} = 10 V	f_T	>	60	MHz
Collector-emitter saturation voltage I_C = 1 A; I_B = 100 mA	V_{CEsat}	<	1	V

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case



Maximum lead diameter is guaranteed only for 12,7 mm.

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	80	V
Collector-emitter voltage (open base)	V_{CEO}	max.	35	V
Emitter-base voltage (open collector)	V_{EBO}	max.	7	V
Collector current (d.c.)	I_C	max.	1	A
Collector current (peak value)	I_{CM}	max.	1	A
Emitter current (d.c.)	$-I_E$	max.	1	A
Emitter current (peak value)	$-I_{EM}$	max.	1	A
Total power dissipation up to T_{amb} = 40 °C	P_{tot}	max.	4	W
Total power dissipation without cooling fin up to T_{amb} = 25 °C	P_{tot}	max.	0,8	W
Storage temperature range	T_{stg}		–65 to +150	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,22	K/mW
From junction to case	$R_{th\ j\text{-}c}$	=	0,035	K/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0$; $V_{CB} = 60$ V	I_{CBO}	<	10 nA
$I_E = 0$; $V_{CB} = 60$ V; $T_j = 150$ °C	I_{CBO}	<	10 µA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	<	10 nA
Saturation voltages			
$I_C = 150$ mA; $I_B = 15$ mA	V_{CEsat}	<	0,2 V
$I_C = 1$ A; $I_B = 100$ mA *) **)	V_{CEsat}	<	1,0 V
	V_{BEsat}	<	1,6 V
Sustaining voltage			
$I_C = 30$ mA; $I_B = 0$ **	$V_{CEOsust}$	>	35 V
D.C. current gain **			
$I_C = 10$ mA; $V_{CE} = 10$ V	h_{FE}	>	30
$I_C = 150$ mA; $V_{CE} = 10$ V	h_{FE}		40 to 120
$I_C = 1$ A; $V_{CE} = 10$ V	h_{FE}	>	15
Feedback time constant			
$I_C = 10$ mA; $V_{CB} = 10$ V; f = 4 MHz	r_b, C_c	<	800 ps
Collector capacitance at f = 500 kHz			
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	<	12 pF
Emitter capacitance at f = 500 kHz			
$I_C = I_c = 0$; $V_{EB} = 0,5$ V	C_e	<	80 pF
Transition frequency at f = 100 MHz			
$I_C = 50$ mA; $V_{CE} = 10$ V	f_T	>	60 MHz

* Measured with a lead length of 1 cm.

** Measured under pulsed conditions to avoid excessive dissipation.
Pulse duration = 300 µs; duty cycle $\delta < 0{,}01$.

SILICON CONTROLLED SWITCH

The BR101 is a planar p-n-p-n switch in a TO-72 metal package, intended for time base circuits and other television applications. It is also suitable as trigger device for thyristors. It is an integrated p-n-p/n-p-n transistor pair of which all electrodes are accessible. The collector of the n-p-n transistor is connected to the case.

QUICK REFERENCE DATA

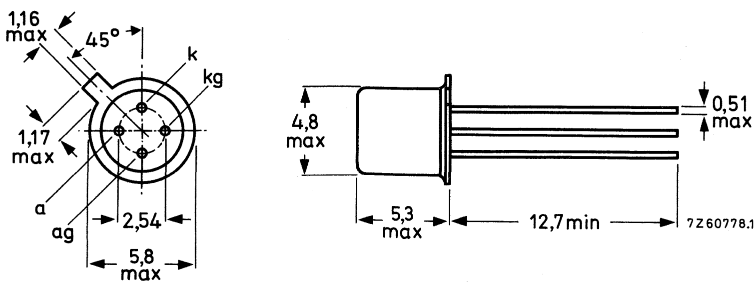
p-n-p transistor				
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	50	V
n-p-n transistor				
Collector-base voltage (open emitter)	V_{CBO}	max.	50	V
Repetitive peak emitter current (peak value)	$-I_{ERM}$	max.	2,5	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	275	mW
Junction temperature	T_j	max.	150	°C
Forward on-state voltage I_A = 50 mA; I_{AG} = 0; $R_{KG\text{-}K}$ = 10 kΩ	V_{AK}	$<$	1,4	V
Holding current I_{AG} = 10 mA; $-V_{BB}$ = 2 V; $R_{KG\text{-}K}$ = 10 kΩ	I_H	$<$	1,0	mA

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-72.

Collector of the n-p-n transistor (ag = anode gate) connected to the case



RATINGS

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

			p-n-p	n-p-n	
Collector-base voltage (open emitter)	V_{CBO}	max.	–50	50	V
Collector-emitter voltage (R_{BE} = 10 kΩ)	V_{CER}	max.	–	50	V
Collector-emitter voltage (open base)	V_{CEO}	max.	–50	–	V
Emitter-base voltage (open collector)	V_{EBO}	max.	–50	5	V *
Emitter current (d.c.)	I_E	max.	175	–175	mA
Repetitive peak emitter current (peak value) t_p = 10 μs; δ = 0,01	I_{ERM}	max.	2,5	–2,5	A
Collector current (d.c.)	I_C	max.	–	175	mA **
Collector current (peak value)	I_{CM}	max.	–	175	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	275		mW
Storage temperature range	T_{stg}		–65 to +150		°C
Operating junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	=	0,45	K/mW

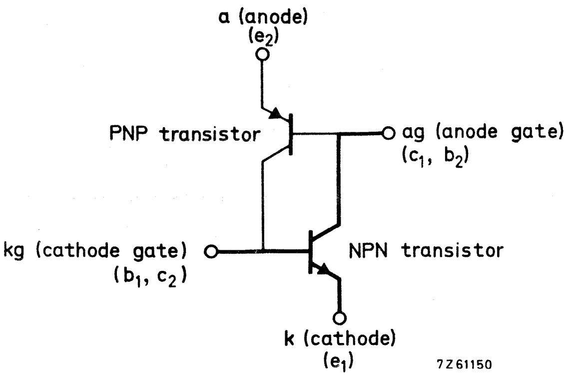
* Exceeding of this voltage is allowed during the discharge of a capacitor of max. 390 pF, provided the charge does not exceed 50 nC.

** Provided the I_E rating will not be exceeded.

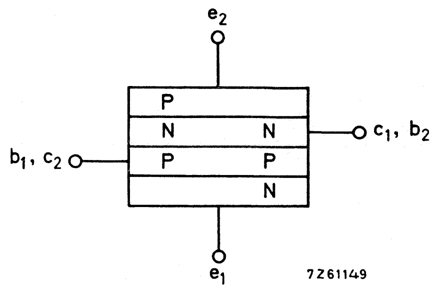
MEANING OF SYMBOLS, used in the schematic presentation of the S.C.S.

2 transistors equivalent circuit

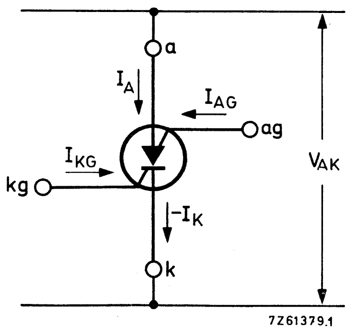
n-p-n transistor + p-n-p transistor



p-n-p-n S.C.S. equivalent circuit



S.C.S. symbol



CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Individual N-P-N transistor

Collector cut-off current			
V_{CE} = 50 V; R_{BE} = 10 kΩ	I_{CER}	<	0,5 μA
V_{CE} = 50 V; R_{BE} = 10 kΩ; T_j = 150 °C	I_{CER}	<	50 μA
Emitter cut-off current			
I_C = 0; V_{EB} = 5 V; T_j = 150 °C	I_{EBO}	<	50 μA

CHARACTERISTICS (continued)

Individual N-P-N transistor

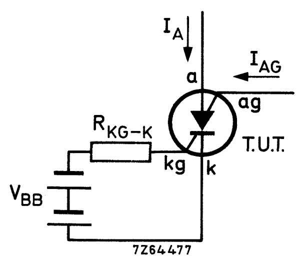
Saturation voltages			
I_C = 10 mA; I_B = 1 mA	V_{CEsat}	<	500 mV
	V_{BEsat}	<	900 mV
D.C. current gain			
I_C = 10 mA; V_{CE} = 2 V	h_{FE}	>	50
Transition frequency			
I_C = 10 mA; V_{CE} = 2 V	f_T	typ.	300 MHz
Collector capacitance			
$I_E = I_e$ = 0; V_{CB} = 20 V	C_c	<	5 pF
Emitter capacitance			
$I_C = I_c$ = 0; V_{EB} = 1 V	C_e	<	25 pF

Individual P-N-P transistor

Collector cut-off current			
I_B = 0; $-V_{CE}$ = 50 V; T_j = 150 °C	$-I_{CEO}$	<	50 μA
Emitter cut-off current			
I_C = 0; $-V_{EB}$ = 50 V; T_j = 150 °C	$-I_{EBO}$	<	50 μA
D.C. current gain			
I_E = 1 mA; V_{CB} = 0	h_{FE}		0,25 to 2,5

Combined device

Forward on-state voltage at $R_{KG\text{-}K}$ = 10 kΩ			
I_A = 50 mA; I_{AG} = 0	V_{AK}	<	1,4 V
I_A = 1 mA; I_{AG} = 10 mA	V_{AK}	<	1,2 V
Holding current at $R_{KG\text{-}K}$ = 10 kΩ			
I_{AG} = 10 mA; $-V_{BB}$ = 2 V	I_H	<	1,0 mA



Data sheet	
status	Product specification
date of issue	September 1994

BRY39
Programmable unijunction transistor

DESCRIPTION

A planar pnpn trigger device in a TO-72 metal package, intended for use in switching applications such as motor control, oscillators, relay replacement, timers, pulse shapers, etc.

PINNING

Anode gate (ag) connected to case.

PIN	DESCRIPTION
1	cathode
2	cathode gate
3	anode gate
4	anode

ACCESSORIES

56246 (distance disc).

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{GA}	gate-anode voltage		–	70	V
I_A	anode current	DC value up to T_{amb} = 25 °C	–	175	mA
T_j	operating junction temperature		–	150	°C
$I_{(P)}$	peak point current	V_S = 10 V R_G = 10 kΩ	–	0.2	μA

PIN CONFIGURATION

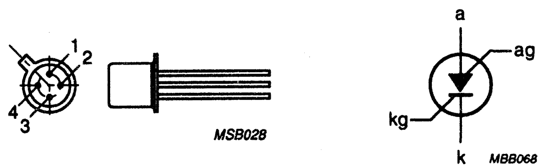


Fig.1 Simplified outline and symbol.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{GA}	gate-anode voltage		–	70	V
I_A	anode current	average value up to T_{amb} = 25 °C	–	175	mA
I_{ARM}	repetitive peak anode current	t_p = 10 µs δ = 0.01	–	2.5	A
I_{ASM}	non-repetitive peak anode current	t_p = 10 µs T_j = 150 °C	–	3	A
dI_A/dt	rate of rise of anode current	up to I_A = 2.5 A	–	20	A/µs
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	275	mW
T_{stg}	storage temperature range		−65	200	°C
T_j	junction temperature		–	150	°C
T_{amb}	ambient operating temperature range		−65	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	MAX.	UNIT
$R_{th\ j\text{-}a}$	from junction to ambient in free air	450	K/W

EXPLANATION OF SYMBOLS

For application of the BRY39 as a programmable unijunction transistor, only the anode gate is used. To simplify the symbols, the term gate, instead of anode gate, will be used (see Fig.2).

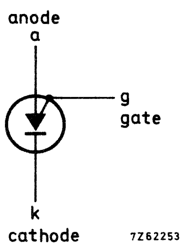


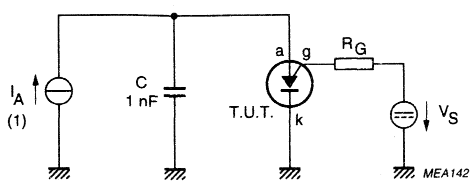
Fig.2 Explanation of symbols.

Programmable unijunction transistor BRY39

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$I_{(P)}$	peak point current (see Figs 3 and 8)	V_S = 10 V R_G = 10 kΩ	–	–	0.2	μA
		V_S = 10 V R_G = 100 kΩ	–	–	0.06	μA
$I_{(V)}$	valley point current (see Figs 3 and 8)	V_S = 10 V R_G = 10 kΩ	–	–	2	μA
		V_S = 10 V R_G = 100 kΩ	–	–	1	μA
V_{offset}	offset voltage (for V_P and V_S, see Fig.8)	typical curve I_A = 0	–	V_P–V_S	–	V
I_{GAO}	gate-anode leakage current	I_K = 0 V_{GA} = 70 V	–	–	10	nA
I_{GKS}	gate-cathode leakage current	V_{AK} = 0 V_{KG} = 70 V	–	–	100	nA
V_{AK}	anode-cathode voltage	I_A = 100 mA	–	–	1.4	V
V_{OM}	peak output voltage (see Figs 9 and 10)	V_{AA} = 20 V C = 10 nF	6	–	–	V
t_r	rise time (see Fig.10)	V_{AA} = 20 V C = 10 nF	–	–	80	ns



(1) Controllable current source.

Fig.3 Test circuit for peak and valley point currents.

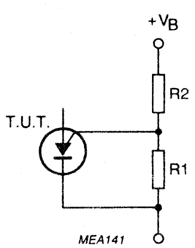


Fig.4 BRY39 with 'program' resistors R1 and R2.

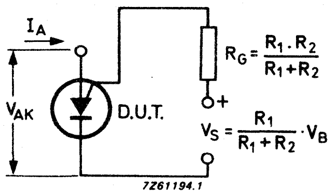


Fig.5 Equivalent test circuit for characteristics testing.

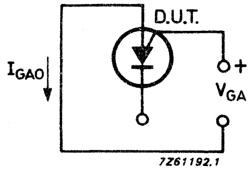


Fig.6 Equivalent test circuit for gate-anode leakage current.

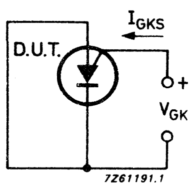


Fig.7 Equivalent test circuit for gate-cathode leakage current.

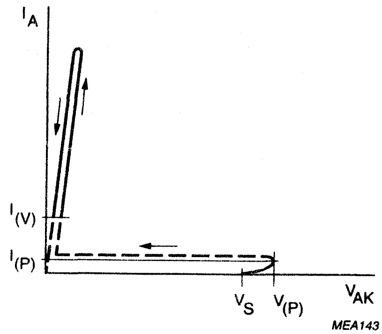


Fig.8 Offset voltage.

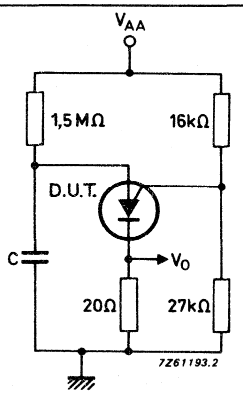


Fig.9 Test circuit for peak output voltage.

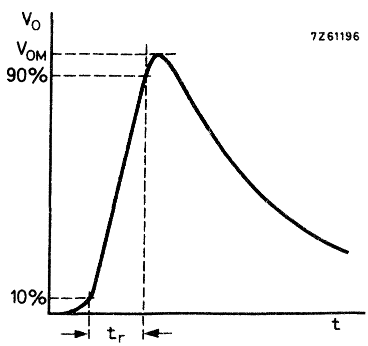
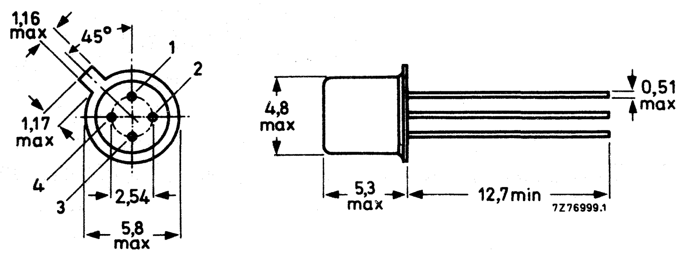


Fig.10 Peak output voltage.

PACKAGE OUTLINE



Dimensions in mm.

Fig.11 TO-72.

Silicon controlled switch BRY39

DESCRIPTION

Silicon planar PNPN switch in a TO-72 metal package intended for use in switching applications. It is an integrated PNP/NPN transistor pair, with all electrodes accessible.

PINNING - TO-72

PIN	DESCRIPTION
1	cathode
2	cathode gate
3	anode gate
4	anode

PIN CONFIGURATION

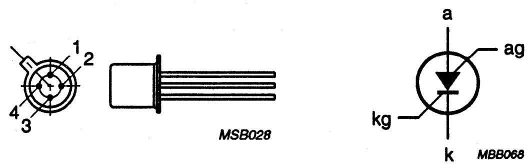


Fig.1 Simplified outline and symbol.

Collector of the npn transistor (ag,anode gate) connected to case.

ACCESSORIES

56246 (distance disc)

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
PNP transistor				
V_{EBO}	emitter-base voltage		−70	V
NPN transistor				
V_{CBO}	collector-base voltage		70	V
I_{ERM}	repetitive peak emitter current		−2.5	A
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	275	mW
T_j	junction temperature		150	°C
V_{AK}	forward on-state voltage	I_A = 50 mA; I_{AG} = 0; R_{KG-K} = 10 kΩ	1.4	V
I_H	holding current	I_{AG} = 10 mA; V_{BB} = −2 V; R_{KG-K} = 10 kΩ	1	mA
t_{on}	turn-on time		0.25	µs
t_q	turn-off time		15	µs

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PNP		–	–70	V
	NPN		–	70	V
V_{CER}	collector-emitter voltage	R_{BE} = 10 kΩ			
	PNP		–	–	V
	NPN		–	70	V
V_{CEO}	collector-emitter voltage	open base			
	PNP		–	–70	V
	NPN		–	–	V
V_{EBO}	emitter-base voltage	open collector			
	PNP		–	–70	V
	NPN		–	5	V
I_C	DC collector current	(note 1)			
	PNP		–	–	
	NPN		–	175	mA
I_{CM}	peak collector current	(note 2)			
	PNP		–	–	
	NPN		–	175	mA
I_E	DC emitter current				
	PNP		–	175	mA
	NPN		–	–175	mA
I_{ERM}	repetitive peak emitter current	t_p = 10 µs; δ = 0.01			
	PNP		–	2.5	A
	NPN		–	–2.5	A
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	275	mW
T_{stg}	storage temperature range		–65	200	°C
T_{amb}	ambient operating temperature range		–65	150	°C
T_j	junction temperature		–	150	°C

Notes

1. Provided the I_E rating is not exceeded
2. During switching on, the device can withstand the discharge of a capacitor of a 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.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	from junction to ambient	in free air	450 K/W

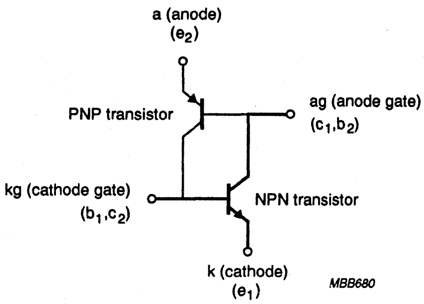


Fig.2 Two transistor equivalent circuit.

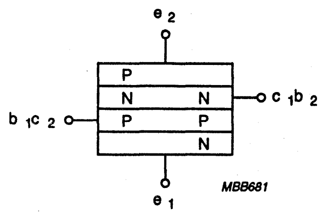


Fig.3 PNPN silicon controlled switch structure.

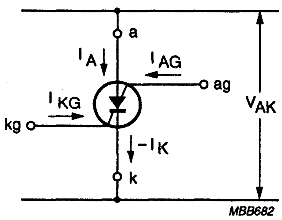


Fig.4 Silicon controlled switch symbol.

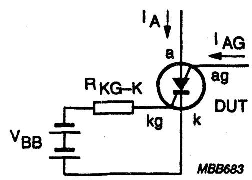


Fig.5 Equivalent test circuit for holding current.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Individual NPN transistor					
I_{CER}	collector cut-off current	V_{CE} =70 V; R_{BE} = 10 kΩ	–	100	nA
		V_{CE} = 70 V; R_{BE} = 10 kΩ; T_j = 150 °C	–	10	µA
I_{EBO}	emitter cut-off current	V_{EB} = 5 V; I_C = 0; T_j = 150 °C	–	10	µA
$V_{CE\ sat}$	collector-emitter saturation voltage	I_C = 10 mA; I_B = 1 mA	–	500	mV
$V_{BE\ sat}$	base-emitter saturation voltage	I_C = 10 mA; I_B = 1 mA	–	900	mV
h_{FE}	DC current gain	I_C = 10 mA; V_{CE} = 2 V	50	–	
f_T	transition frequency	I_C = 10 mA; V_{CE} = 2 V; f = 100 MHz	100	–	MHz
C_c	collector capacitance	$I_E = I_e$ = 0; V_{CB} = 20 V	–	5	pF
C_e	emitter capacitance	$I_C = I_c$ = 0; V_{EB} = 1 V	–	25	pF
Individual PNP transistor					
I_{CEO}	collector cut-off current	V_{CE} = –70 V; I_B = 0; T_j = 150 °C	–	–10	µA
I_{EBO}	emitter cut-off current	V_{EB} = –70 V; I_C = 0; T_j = 150 °C	–	–10	µA
h_{FE}	DC current gain	I_E = 1 mA; V_{CB} = –5 V	3	15	
Combined device					
V_{AK}	forward on-state voltage	R_{KG-K} = 10 kΩ; I_A = 50 mA; I_{AG} = 0	–	1.4	V
		R_{KG-K} = 10 kΩ; I_A = 50 mA; I_{AG} = 0; T_j = –55 °C	–	1.9	V
		R_{KG-K} = 10 kΩ; I_A = 1 mA; I_{AG} = 10 mA	–	1.2	V
I_H	holding current	R_{KG-K} = 10 kΩ; I_{AG} = 10 mA; V_{BB} = –2 V; (see Fig. 5)	–	1	mA
Switching times					
t_{on}	turn-on time	V_{KG-K} = –0.5 to 4.5 V; R_{KG-K} = 1 kΩ (see figs 6 and 7)	–	0.25	µs
		V_{KG-K} = –0.5 to 0.5 V; R_{KG-K} = 10 kΩ	–	1.5	µs
t_q	turn-off time	R_{KG-K} = 10 kΩ; (see Figs 8 and 9)	–	15	µs

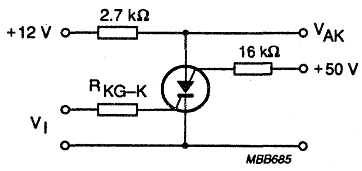


Fig.6 Test circuit for turn-on time.

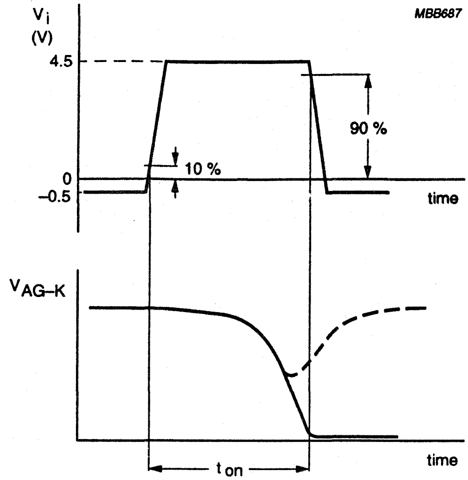


Fig.7 Pulse duration increased until dashed curve disappears.

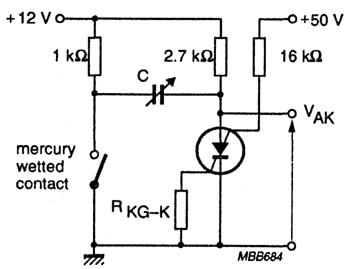


Fig.8 Test circuit for turn-off time.

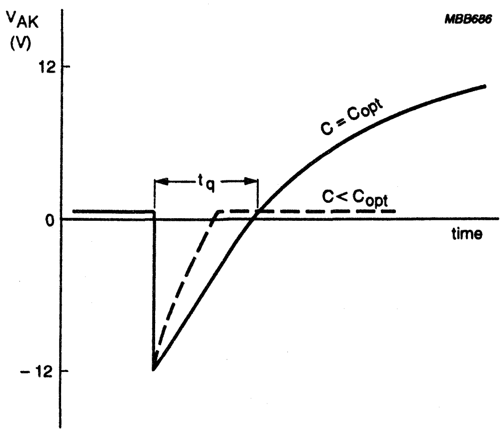
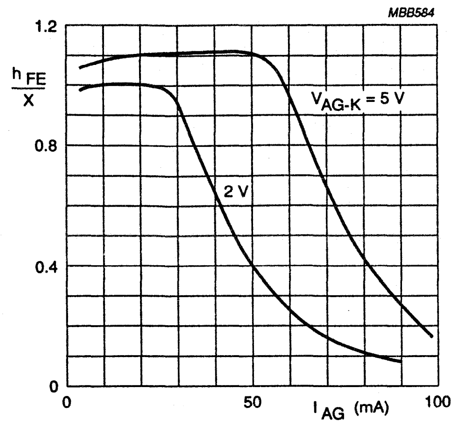
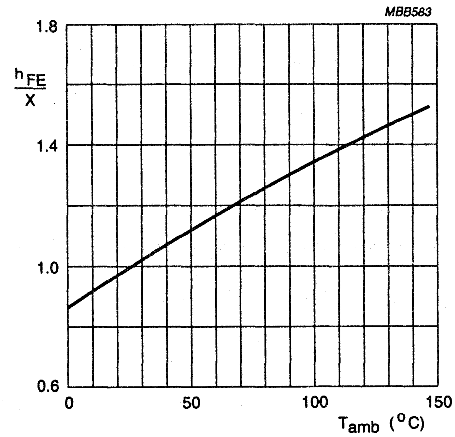


Fig.9 Capacitance increased until C = C_{opt} dashed curve disappears.



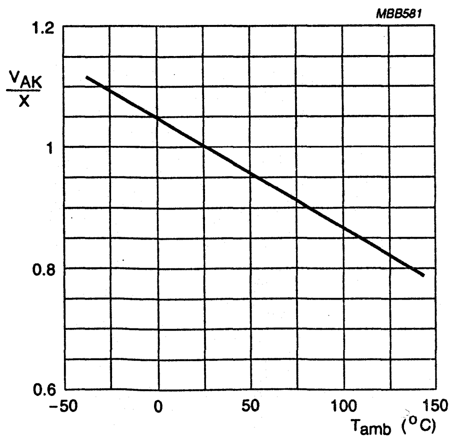
X is the value of h_{FE} at I_C = 10 mA, V_{AG-k} = 2 V; T_{amb} = 25 °C

Fig.10 Normalized DC current gain as a function of anode gate current.



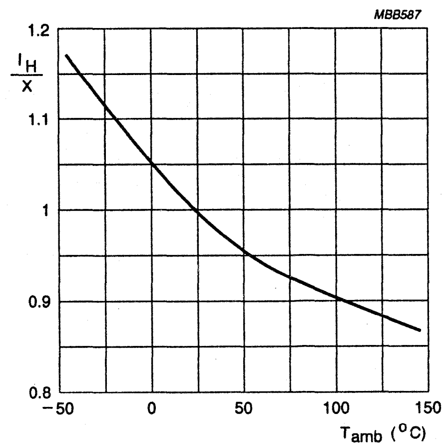
X is the value of h_{FE} at T_{amb} = 25 °C; V_{AG-k} = 2 V, I_{AG} = 10 mA

Fig.11 Normalized DC current gain as a function of ambient temperature.



X is the value of V_{AK} at T_{amb} = 25 °C; I_A = 1 mA, I_{AG} = 10 mA; $-V_{BB}$ = 2 V, R_{KG-K} = 10 kΩ

Fig.12 Normalized anode-cathode voltage as a function of ambient temperature.



X is the value of I_H at T_{amb} = 25 °C; I_{AG} = 10 mA, $-V_{BB}$ = 2 V; R_{kg-K} = 10 kΩ

Fig.13 Normalized holding current as a function of ambient temperature.

Silicon controlled switch BRY39

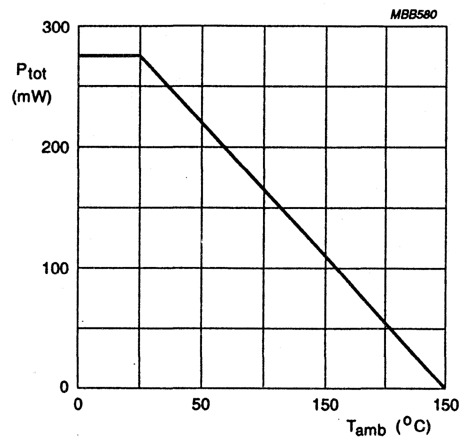


Fig.14 Power derating curve.

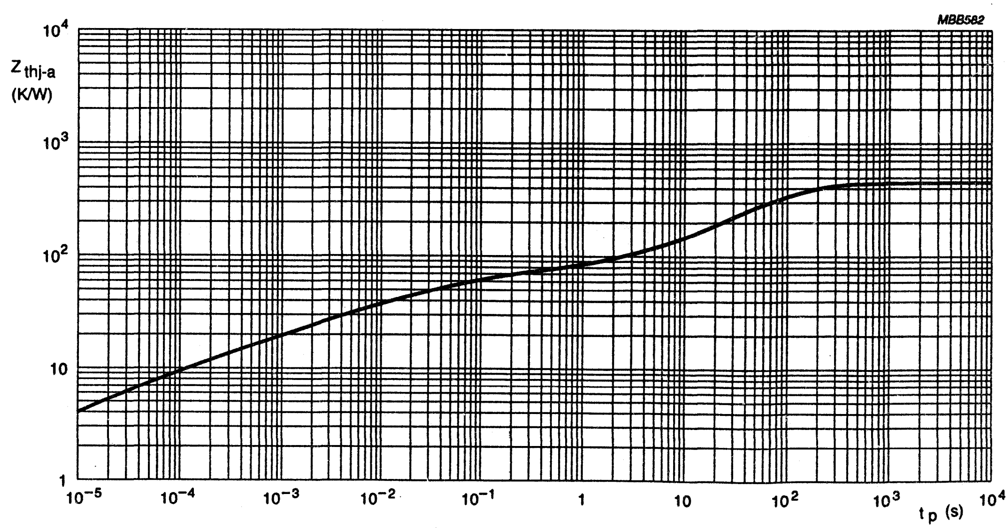


Fig.15 Thermal impedance as a function of pulse duration.

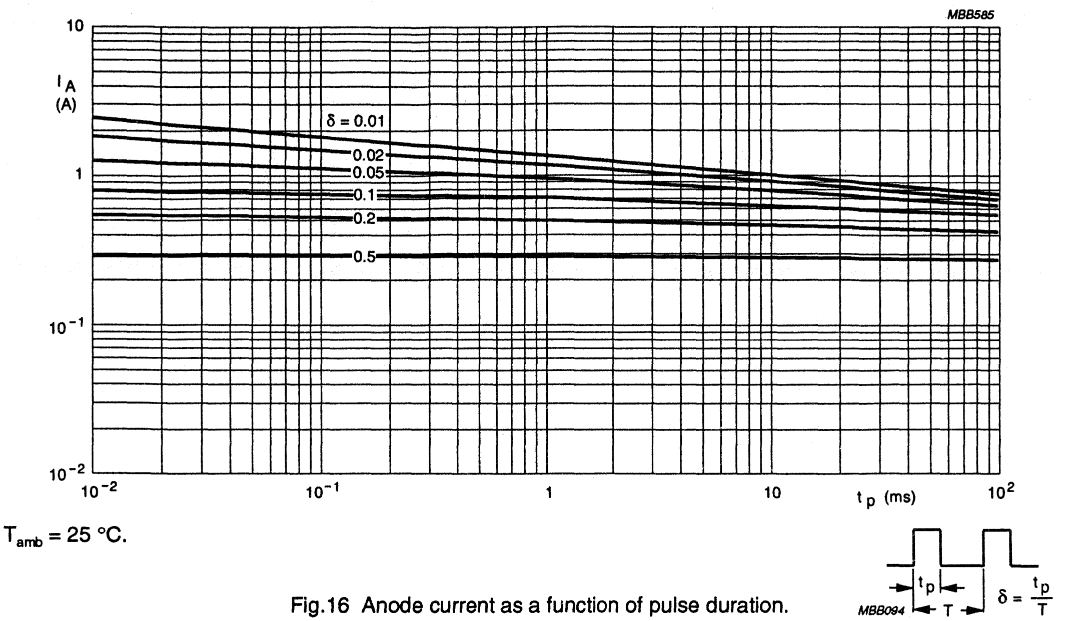


Fig.16 Anode current as a function of pulse duration.

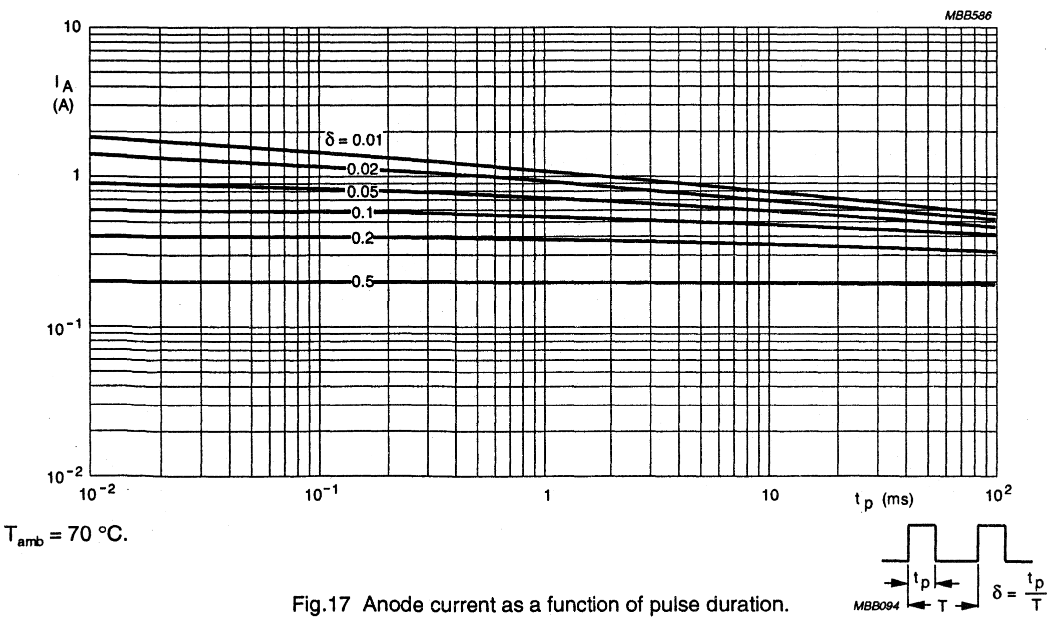
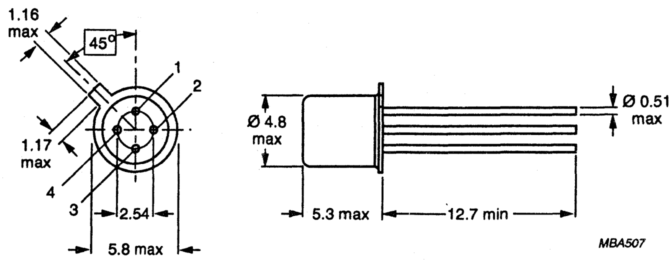


Fig.17 Anode current as a function of pulse duration.

PACKAGE OUTLINE



Dimensions in mm

Fig.18 TO-72.

PROGRAMMABLE UNIJUNCTION TRANSISTOR

Silicon planar PNPN trigger device in a plastic TO-92 package, intended for use in switching applications such as motor control, oscillators, relay replacement, timers, pulse shaper etc.

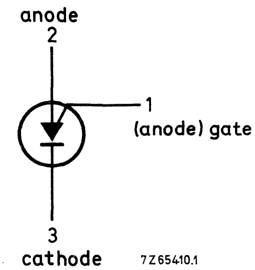
QUICK REFERENCE DATA

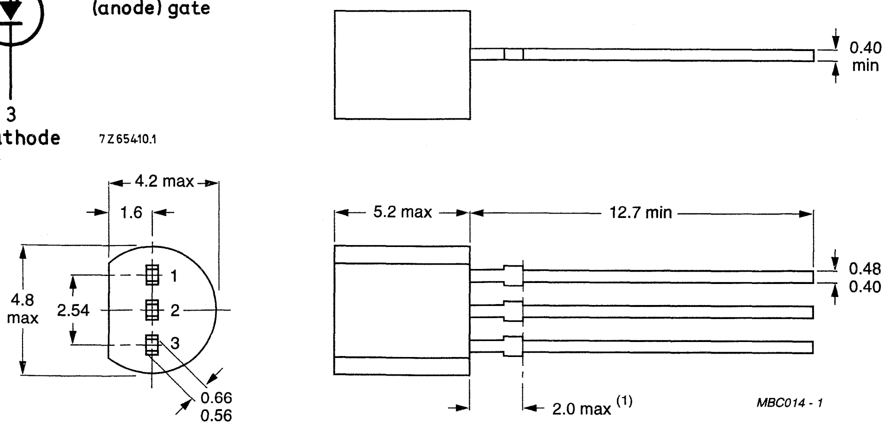
Gate-anode voltage	V_{GA}	max.	70	V
Anode current (average)	$I_{A(AV)}$	max.	175	mA
Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	300	mW
Junction temperature	T_j	max.	150	°C
Peak point current V_S = 10 V; R_G = 10 kΩ	I_P	max.	0.2	μA
Valley point current V_S = 10 V; R_G = 10 kΩ	I_V	min.	2	μA

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92.





Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

A and B selections are available on request.

RATINGS

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

Gate-anode voltage	V_{GA}	max.	70	V
Anode current (average)	$I_{A(AV)}$	max.	175	mA
Repetitive peak anode current t_p = 10 μs; δ = 0,01	I_{ARM}	max.	2,5	A
Non-repetitive peak anode current t_p = 10 μs	I_{ASM}	max.	3,0	A
Rate of rise of anode current up to I_A = 2,5 A	$\frac{dI_A}{dt}$	max.	20	A/μs
Total power dissipation up to T_{amb} = 75 ^oC	P_{tot}	max.	300	mW
Storage temperature	T_{stg}	−65 to + 150		^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	250	K/W

CHARACTERISTICS

$T_{amb} = 25\ ^oC$

Peak point current (see Fig. 10)			
$V_S = 10\ V$; $R_G = 10\ k\Omega$	I_P	max.	0.2 μA
$V_S = 10\ V$; $R_G = 100\ k\Omega$	I_P	max.	0.06 μA
Valley point current (see Fig. 10)			
$V_S = 10\ V$; $R_G = 10\ k\Omega$	I_V	min.	2 μA
$V_S = 10\ V$; $R_G = 100\ k\Omega$	I_V	min.	1 μA

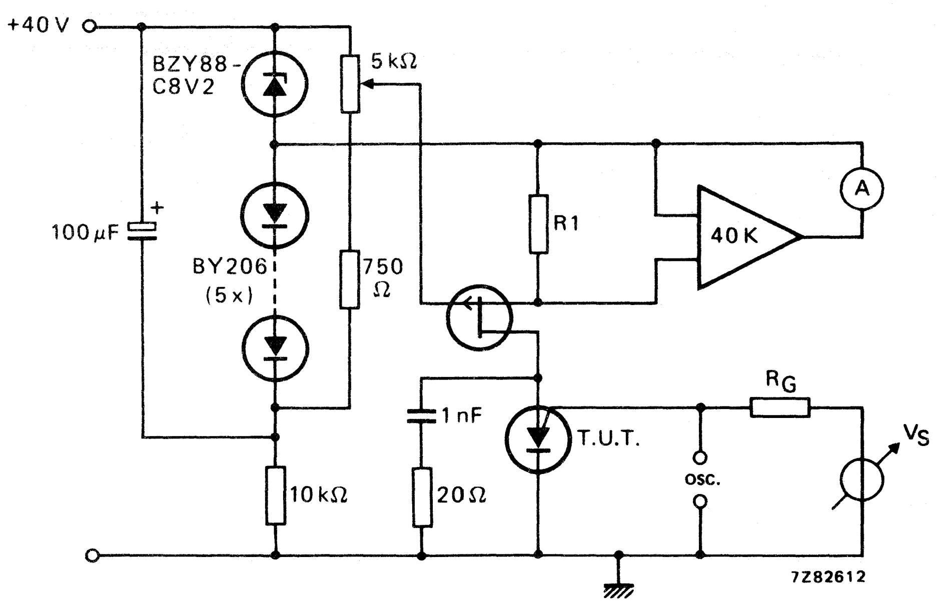


Fig. 3 Measuring circuit for I_P and I_V by means of value of R1. $R1 = \frac{1}{I_A}$ (that is maximum voltage drop over R1 is 1 V). Internal resistance of oscilloscope is 10 MΩ.

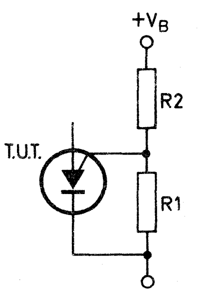


Fig. 4 **BRY56** with "program" resistors R1 and R2.

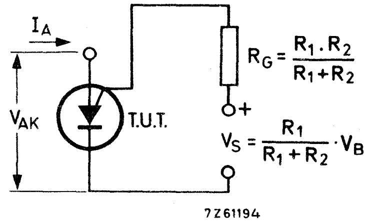


Fig. 5 Equivalent test circuit for characteristics testing.

Gate-anode leakage current (see Fig. 6) $I_K = 0$; $V_{GA} = 70$ V	I_{GAO}	max.	10 nA
Gate-cathode leakage current (see Fig. 7) $V_{AK} = 0$; $V_{GK} = 70$ V	I_{GKS}	max.	100 nA

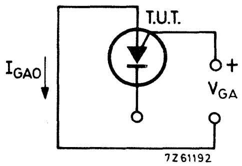


Fig. 6.

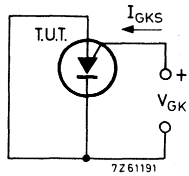


Fig. 7.

Anode-cathode voltage $I_A = 100$ mA	V_{AK}	max.	1,4 V
Peak output voltage (see Figs 8 and 9) $V_{AA} = 20$ V; C = 10 nF	V_{OM}	min.	6 V
Offset voltage (see Fig. 10) $V_{offset} = V_P - V_S$ ($I_A = 0$)			
Rise time (see Fig. 9) $V_{AA} = 20$ V; C = 10 nF	t_r	max.	80 ns

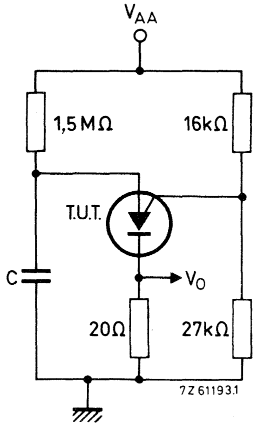


Fig. 8.

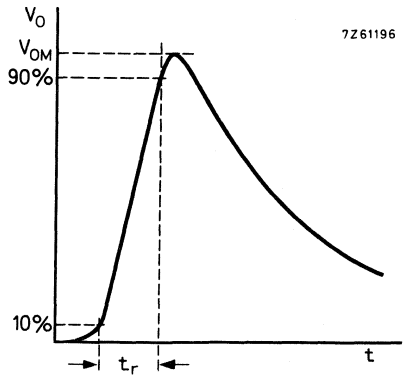


Fig. 9.

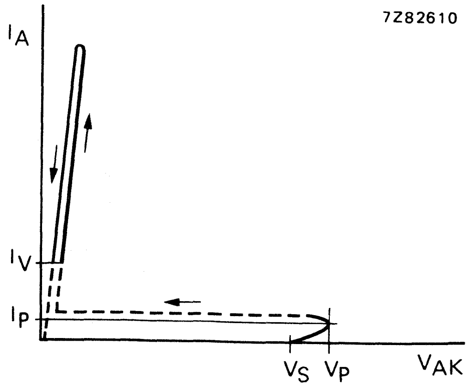


Fig. 10.

PROGRAMMABLE UNIJUNCTION TRANSISTOR

Planar p-n-p-n trigger device in a microminiature plastic package 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

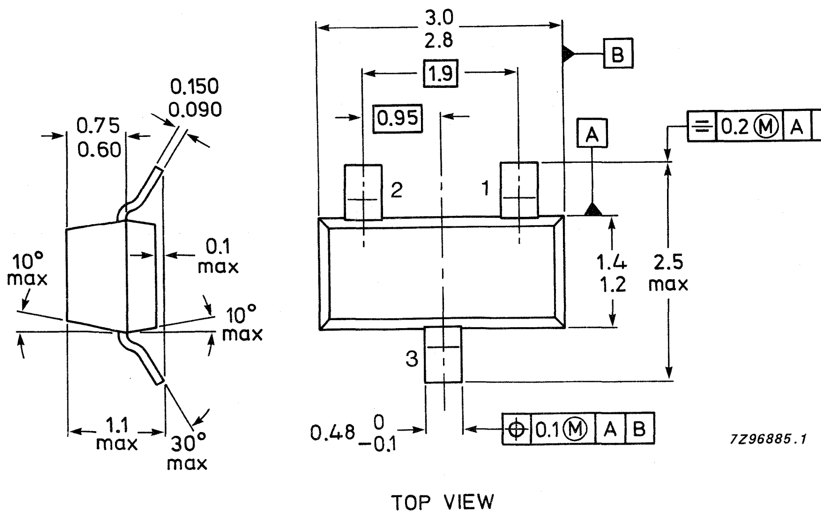
MECHANICAL DATA

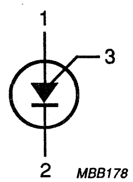
Dimensions in mm

Marking code

Fig. 1 SOT-23.

BRY61 = A5p





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 I_A = 0 (for V_P see Fig. 2; for V_S see Fig. 4)	V_{offset}	=	$V_P - V_S$ V

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

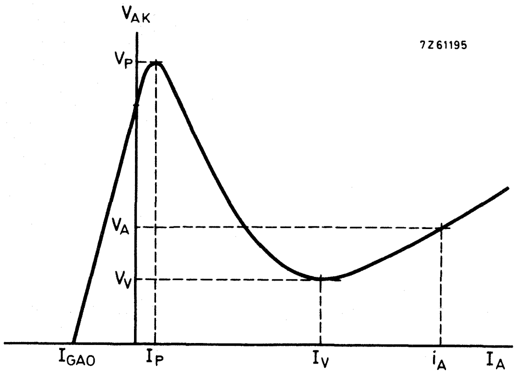


Fig. 2

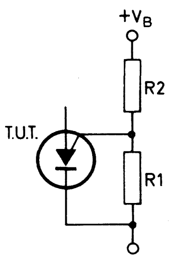


Fig. 3 BRY61 with "program" resistors R1 and R2.

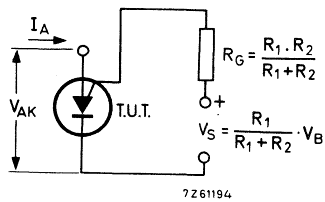


Fig. 4 Equivalent test circuit for characteristics testing.

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

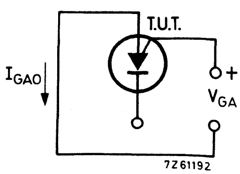


Fig. 5a.

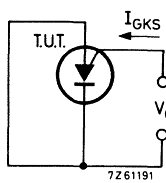


Fig. 5b.

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

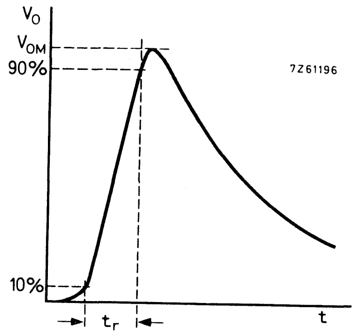


Fig. 6 Output voltage waveform.

SILICON P-N-P-N PLANAR TETRODE THYRISTOR

Planar p-n-p-n trigger device in a microminiature plastic package. 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

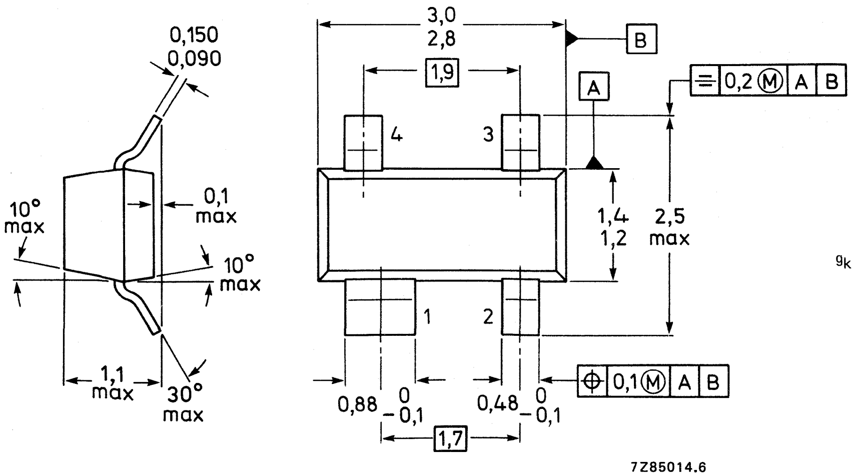
MECHANICAL DATA

Fig. 1 SOT-143.

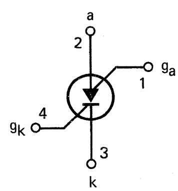
Dimensions in mm

Marking code

BRY62 = A51



TOP VIEW



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.

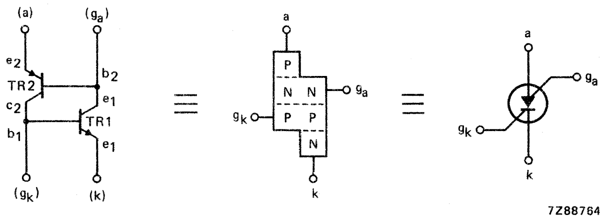


Fig. 2 Circuit diagram.

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	>	100 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} = − 5 V; I_E = 1 mA	h_{FE}		3 to 15

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

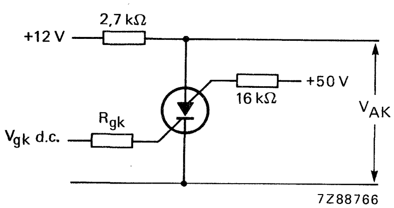


Fig. 3 Switching times test circuit.
The pulse time of V_{gk} can be adjusted in such a way that the broken line in Fig. 4 disappears, which means that the thyristor starts triggering.

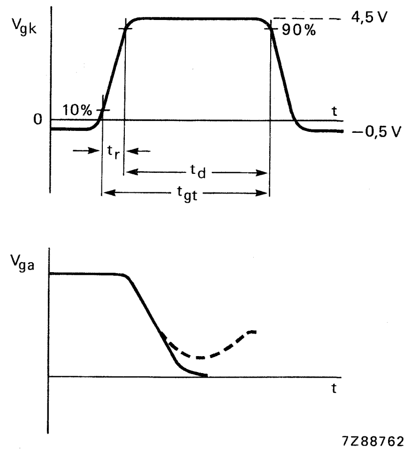


Fig. 4 Switching times waveforms.

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

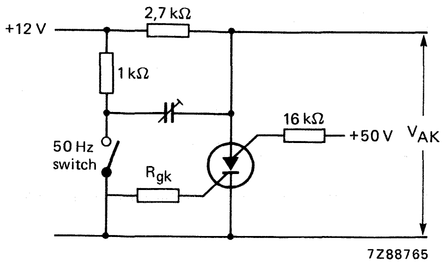


Fig. 5 Switching times test circuit.

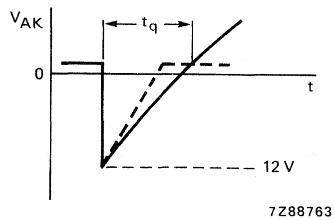


Fig. 6 Switching times waveforms.

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

SILICON PLANAR EPITAXIAL TRANSISTORS

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

QUICK REFERENCE DATA

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

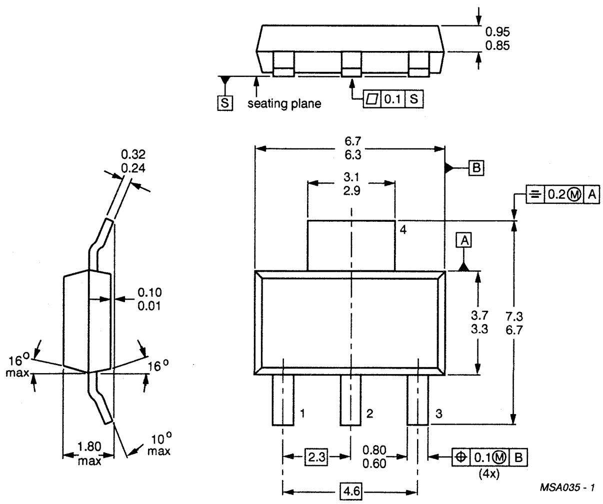
MECHANICAL DATA

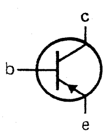
Dimensions in mm

Fig. 1 SOT-223

Pinning

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





RATINGS

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

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

THERMAL RESISTANCE

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

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

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

SILICON PLANAR EPITAXIAL TRANSISTORS

NPN transistors in miniature plastic packages 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 = 100 MHz V_{CE} = 10 V; I_C = 10 mA	f_T	min.	70		MHz

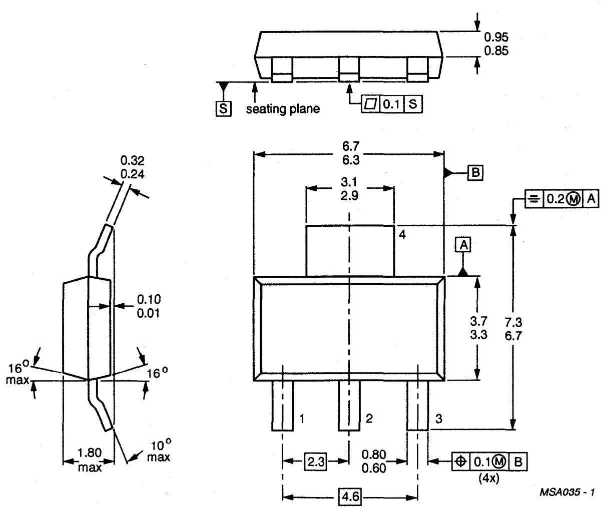
MECHANICAL DATA

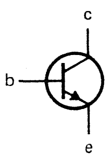
Dimensions in mm

Fig. 1 SOT-223

Pinning

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





RATINGS

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

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

THERMAL RESISTANCE

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current $I_B = 0$; $V_{CE} = 300$ V	I_{CBO}	⩽	20	nA
Emitter cut-off current $I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	⩽	10	μA
Collector-emitter saturation voltage $I_C = 50$ mA; $I_B = 4$ mA	V_{CEsat}	⩽	0,5	V
Base-emitter saturation voltage $I_C = 50$ mA; $I_B = 4$ mA	V_{BEsat}	⩽	1,3	V
DC current gain $V_{CE} = 10$ V; $I_C = 20$ mA	h_{FE}	⩽	40	
Collector capacitance at f = 1 MHz $I_E = i_e = 0$; $V_{CB} = 10$ V	C_c	⩽	2,5	pF
Emitter capacitance at f = 1 MHz $I_C = I_c = 0$; $V_{EB} = 5$ V	C_e	⩽	20	pF
Transition frequency at f = **100 MHz** $V_{CE} = 10$ V; $I_C = 10$ mA	f_T	⩾	70	MHz

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

SILICON PLANAR EPITAXIAL TRANSISTORS

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

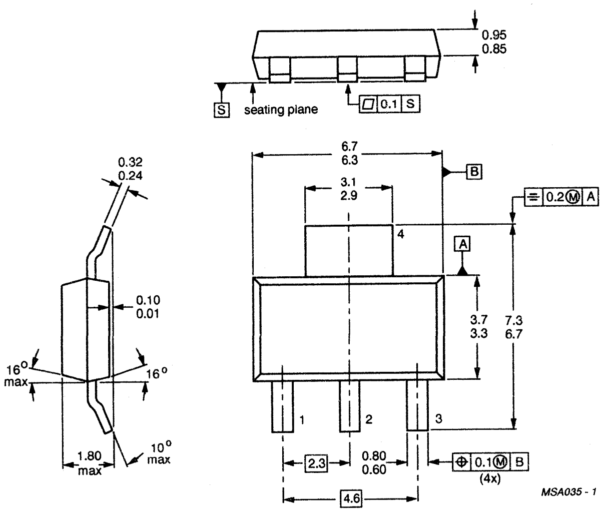
QUICK REFERENCE DATA

			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 = **100 MHz** $-I_C$ = 50 mA; $-V_{CE}$ = 10 V	f_T	>	100	100	100	100	MHz

MECHANICAL DATA

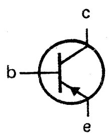
Dimensions in mm

Fig. 1 SOT-223



Pinning

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



RATINGS

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

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

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

THERMAL RESISTANCE

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

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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

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

Switching times see next page.

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

CHARACTERISTICS (continued)

$T_{amb} = 25\ ^{o}C$

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

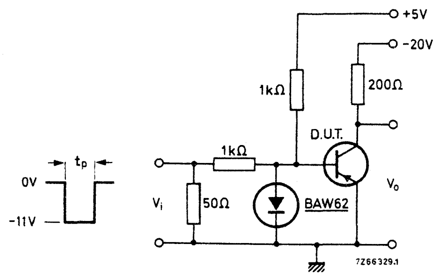


Fig. 2 Switching times test circuit.

Pulse generator:

Pulse duration	$t_p = 10\ \mu s$
Rise time	$t_r \leq 15$ ns
Fall time	$t_f \leq 15$ ns
Source impedance	$Z_S = 50\ \Omega$

Oscilloscope:

Rise time	$t_r \leq 15$ ns
Input impedance	$Z_I \geq 100$ kΩ

SILICON PLANAR EPITAXIAL TRANSISTORS

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

QUICK REFERENCE DATA

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

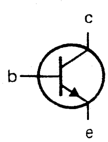
MECHANICAL DATA

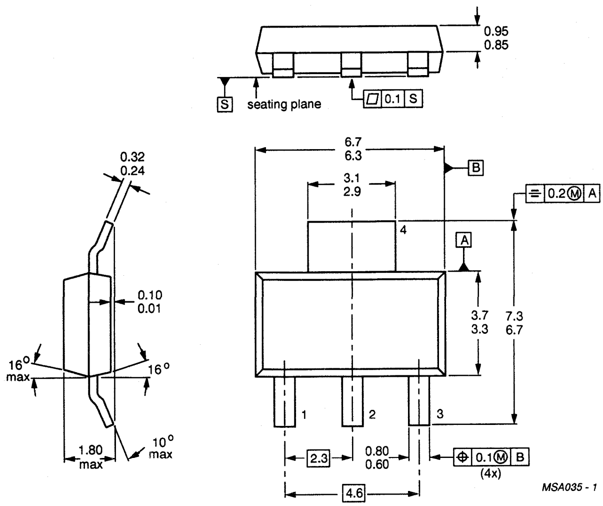
Dimensions in mm

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

			BSP40	BSP41	BSP42	BSP43	
Collector cut-off current							
$I_E = 0$; $V_{CB} = 60$ V	I_{CBO}	<	100				nA
$I_E = 0$; $V_{CB} = 60$ V; $T_j = 150$ °C	I_{CBO}	<	50				μA
Breakdown voltages							
$I_B = 0$; $I_C = 10$ 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 = 100 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

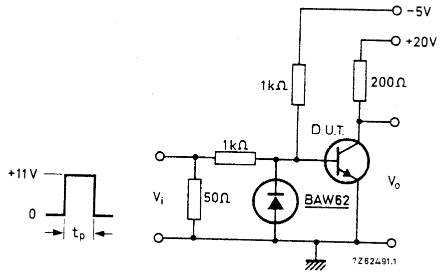


Fig. 2 Switching times test circuit.

Pulse generator:

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

Oscilloscope:

Rise time	t_r ⩽ 15 ns
Input impedance	Z_I ⩾ 100 kΩ

NPN SILICON PLANAR DARLINGTON TRANSISTORS

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

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

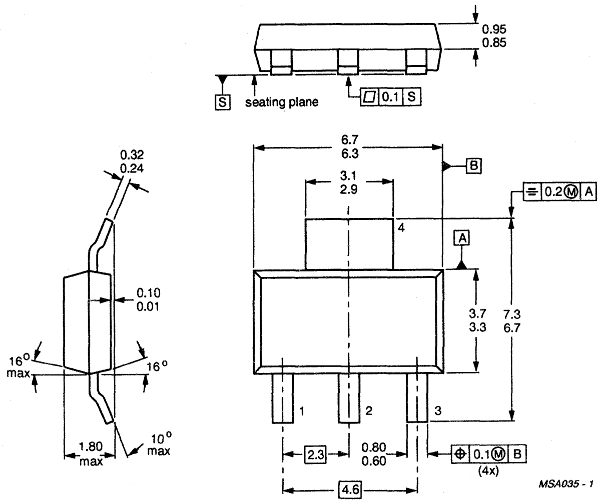
MECHANICAL DATA

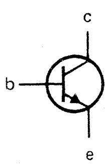
Dimensions in mm

Fig. 1 SOT-223

Pinning

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





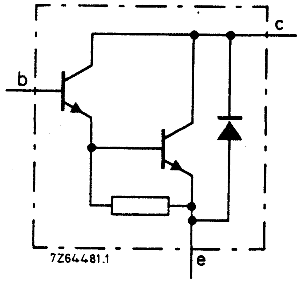


Fig. 2 Circuit diagram.

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_{CEO}	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

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

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

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

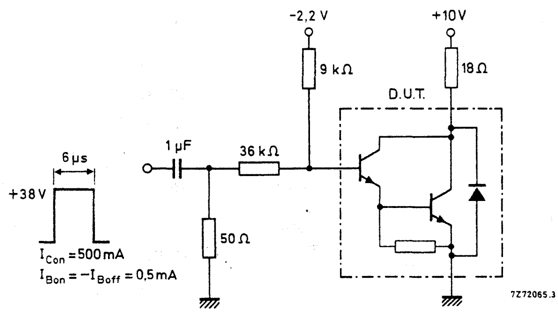


Fig. 3 Switching times test circuit.

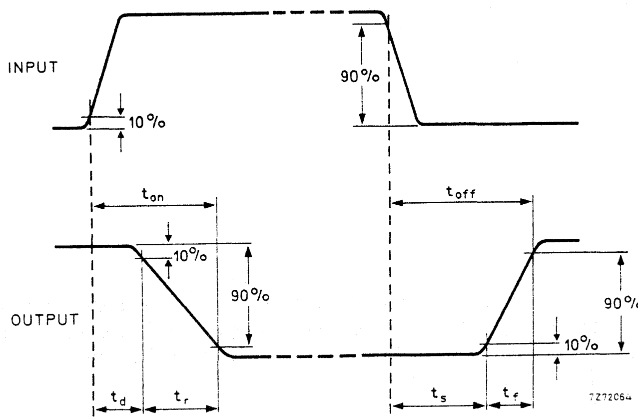


Fig. 4 Switching times waveform.

* Measured under pulsed conditions.

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 **package.**

NPN complements are BSP50, BSP51 and BSP52 respectively.

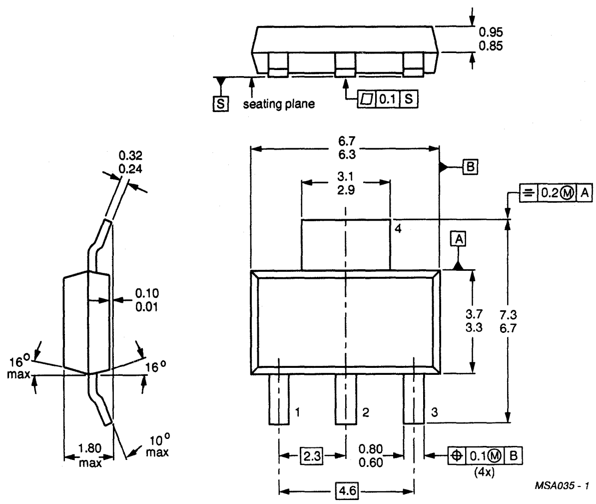
QUICK REFERENCE DATA

			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

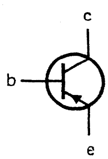
Dimensions in mm

Fig. 1 SOT-223



Pinning

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



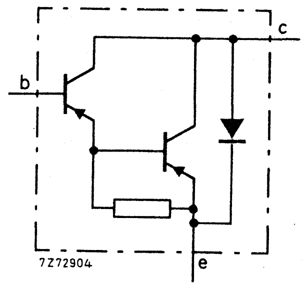


Fig. 2 Circuit diagram.

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	$-V_{CEO}$	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

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

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

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

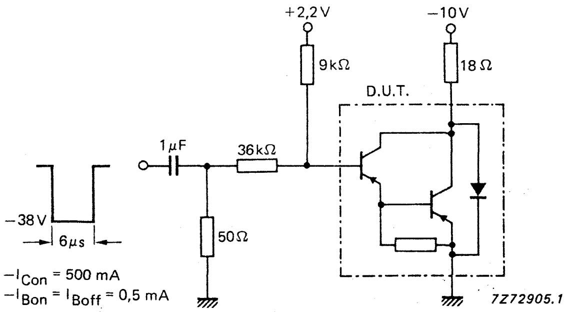


Fig. 3 Switching times test circuit.

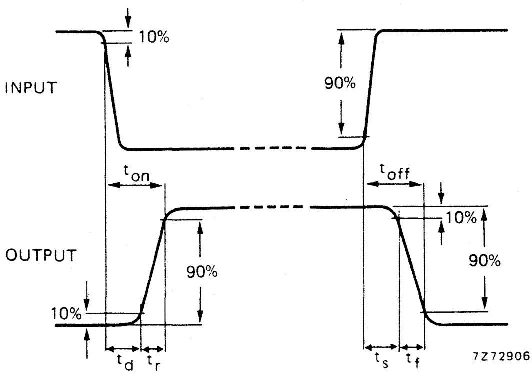


Fig. 4 Switching times waveform.

* Measured under pulsed conditions.

SILICON PLANAR EPITAXIAL TRANSISTORS

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

QUICK REFERENCE DATA

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

MECHANICAL DATA

Dimensions in mm

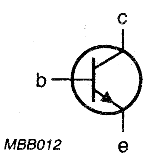
Fig. 1 SOT-23.

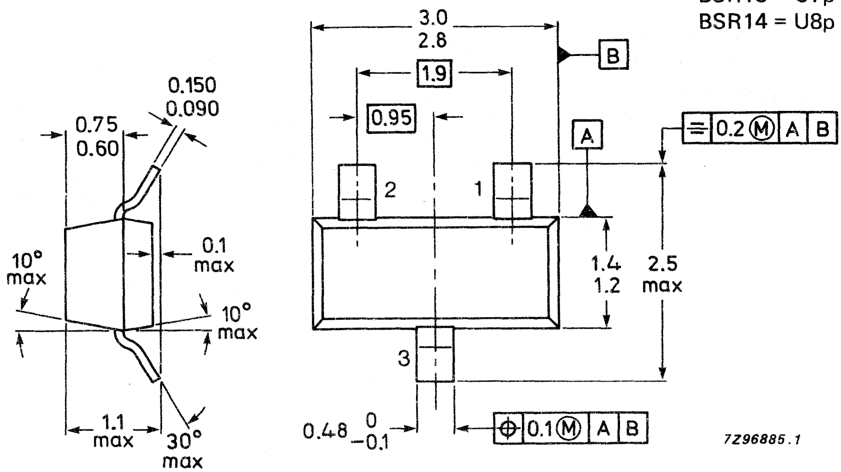
Marking code

BSR13 = U7p
BSR14 = U8p

Pinning:

1 = base
2 = emitter
3 = collector





TOP VIEW

Reverse pinning types are available on request.

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

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

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

* Measured under pulsed conditions to avoid excessive dissipation; pulse duration $t_p \leqslant 300\ \mu s$; 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

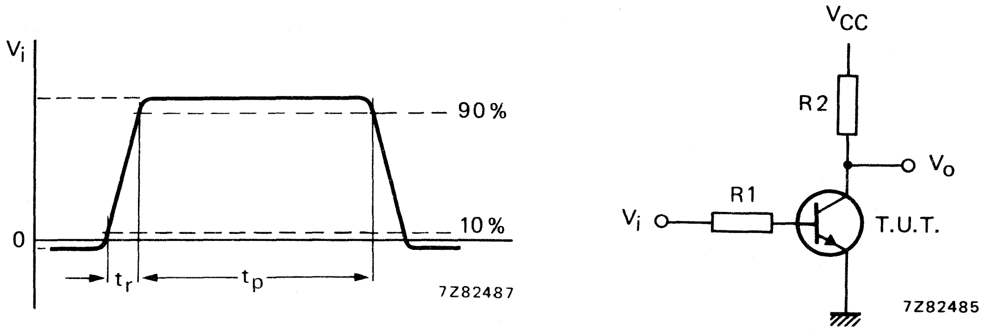


Fig. 2 Waveform and test circuit delay and rise time.
V_i = −0,5 to + 9,9 V; V_{CC} = 30 V; R1 = 619 Ω; R2 = 200 Ω.

Pulse generator:			
pulse duration	t_p	⩽	200 ns
rise time	t_r	⩽	2 ns
duty factor	δ	=	2 %

Oscilloscope:			
input impedance	Z_i	>	100 kΩ
input capacitance	C_i	<	12 pF
rise time	t_r	<	5 ns

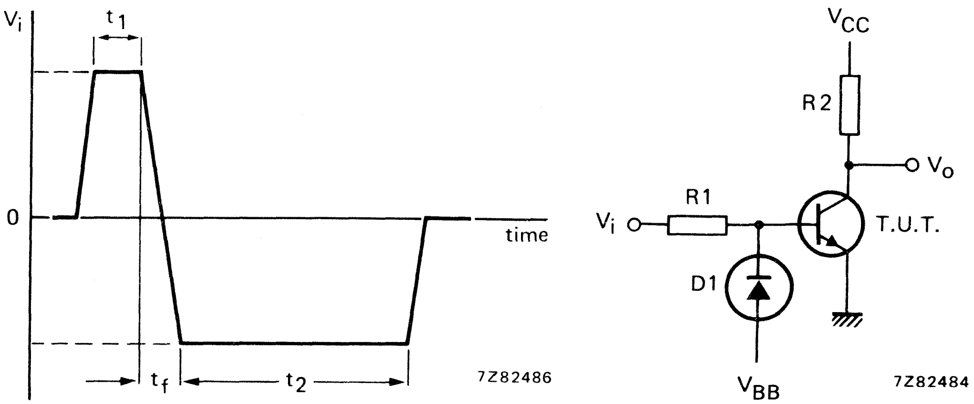


Fig. 3 Waveform and test circuit storage and fall time.
V_i = −13,8 to + 16,2 V; V_{CC} = 30 V; $-V_{BB}$ = 3 V; R1 = 1 kΩ; R2 = 200 Ω.

Pulse generator:			
fall time	t_f	<	5 ns
pulse time	t_1	=	100 µs
	t_2	=	500 µs

Oscilloscope:			
input impedance	Z_i	>	100 kΩ
input capacitance	C_i	<	12 pF
rise time	t_r	<	5 ns

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P silicon transistors, in a microminiature plastic package, 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

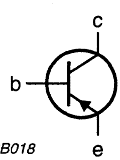
Fig. 1 SOT-23.

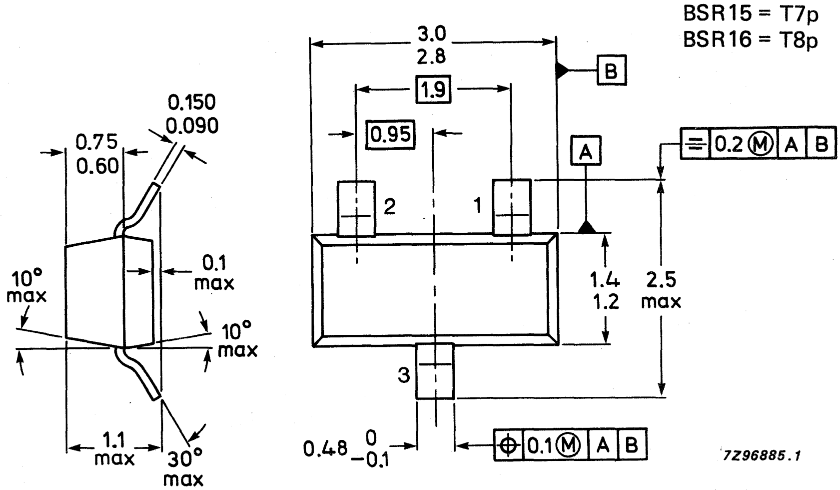
Marking code

BSR15 = T7p
BSR16 = T8p

Pinning:

1 = base
2 = emitter
3 = collector





TOP VIEW

Reverse pinning types are available on request.

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

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

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

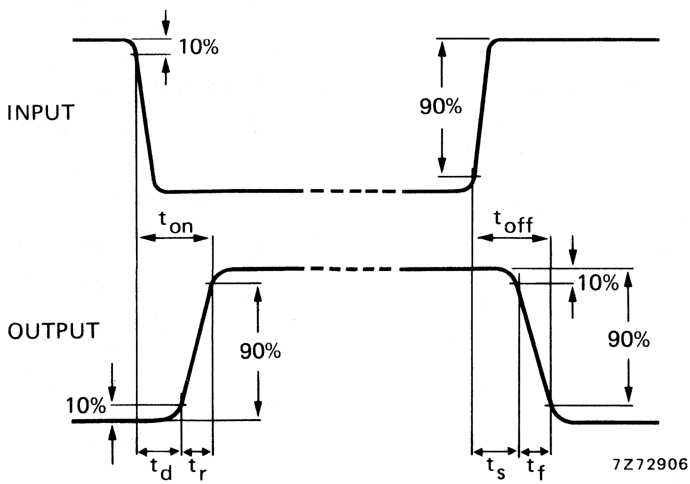


Fig. 2 Switching time waveforms.

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

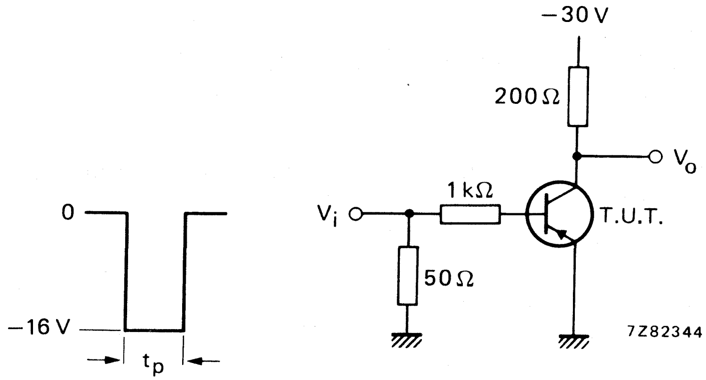


Fig. 3 Turn-on switching time test circuit.

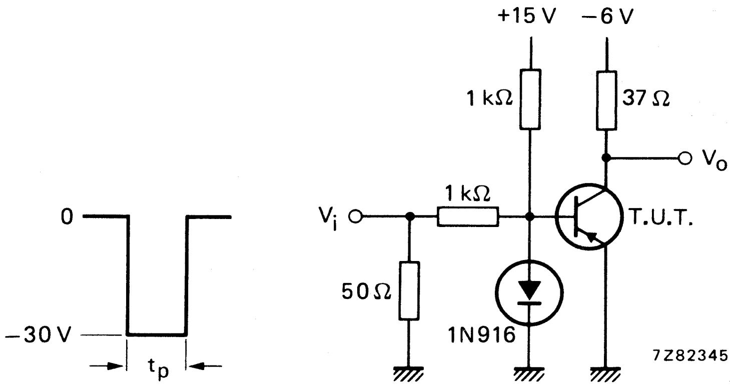


Fig. 4 Turn-off switching time test circuit.

Input pulse generator: Fig. 3 and Fig. 4	frequency	f	=	150	Hz
	pulse duration	t_p	=	200	ns
	rise time	t_r	$\leqslant$	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 package 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 = 100 MHz I_C = 10 mA; V_{CE} = 20 V	f_T	>	300	MHz

MECHANICAL DATA

Dimensions in mm

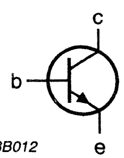
Fig.1 SOT-23.

Marking code

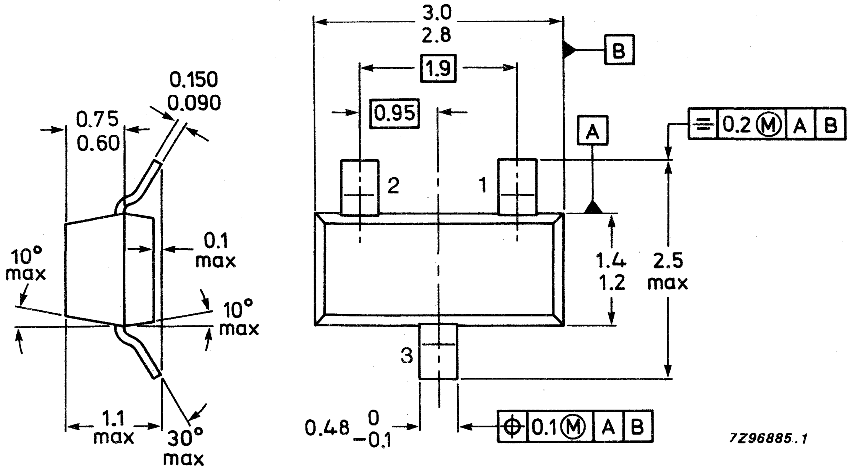
BSR17A = U92

Pinning:

1 = base
2 = emitter
3 = collector



MBB012



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TOP VIEW

Reverse pinning types are available on request.

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

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

** Measured under pulsed conditions; pulse duration $t_p \leqslant 300$ µs; duty factor $\delta \leqslant 0{,}02$.

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

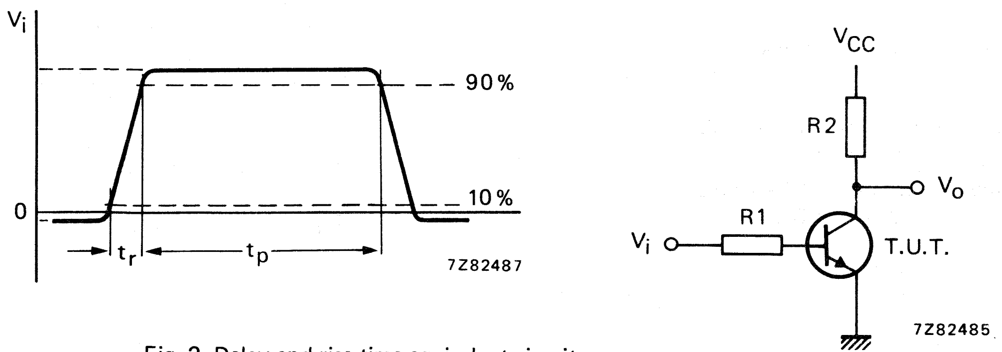


Fig. 2 Delay and rise time equivalent circuit.
$V_i = -0{,}5$ to $+10{,}6$ V; $V_{CC} = 3$ V; R1 = 10 kΩ; R2 = 275 Ω;
total shunt capacitance of test jig and connectors = $C_s \leqslant 4$ pF.
Pulse generator: pulse duration 300 ns; fall time < 1 ns; duty factor 2%.

* Measured under pulsed conditions to avoid excessive dissipation; pulse duration $t_p \leq 300$ µs; duty factor $\delta \leq 0.02$.

Turn off time switched from

$I_C = 10$ mA; $I_{Bon} = -I_{Boff} = 1$ mA

storage time	t_s	<	200 ns
fall time	t_f	<	50 ns

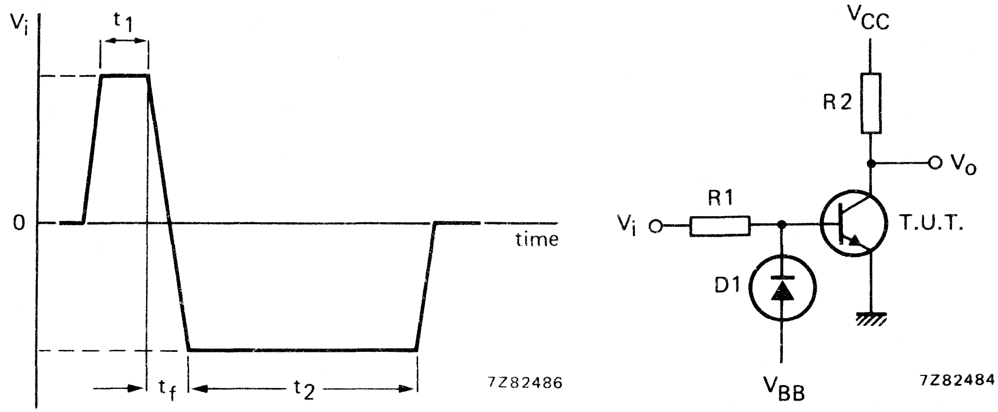


Fig. 3 Storage and fall time equivalent test circuit.

$V_i = -9{,}1$ to $+10{,}9$ V; $V_{CC} = 3$ V; $V_{BB} = 0$ V (ground); R1 = 10 kΩ; R2 = 275 Ω;
total shunt capacitance of test jig and connectors = $C_s \leqslant 4$ pF.
Pulse generator: pulse duration $t_1 = 10$ to 500 μs; fall time $t_f < 1$ ns; duty factor $\delta = 2\%$.

SILICON LOW-POWER SWITCHING TRANSISTORS

P-N-P silicon transistor in a microminiature plastic package, 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 = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 20 V	f_T	>	250	MHz

MECHANICAL DATA

Dimensions in mm

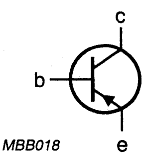
Fig.1 SOT-23.

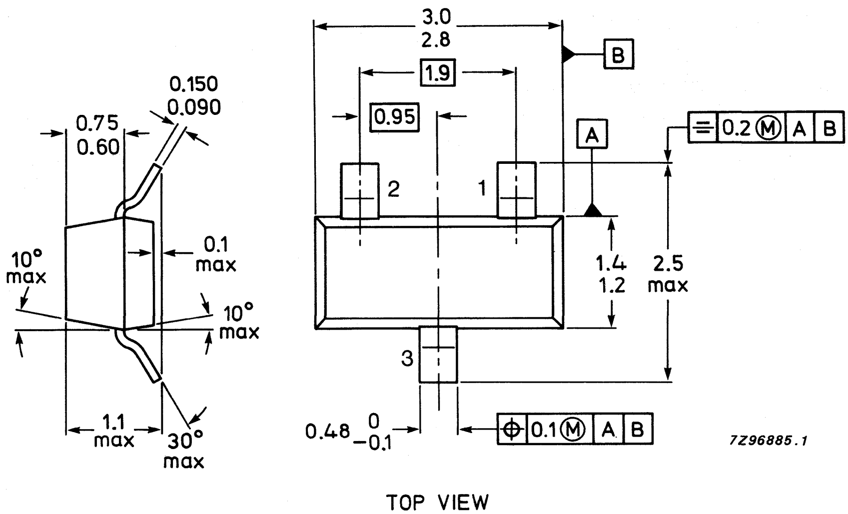
Marking code

BSR18A = T92

Pinning:

1 = base
2 = emitter
3 = collector





Reverse pinning types are available on request.

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 an FR4 printed-circuit board 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

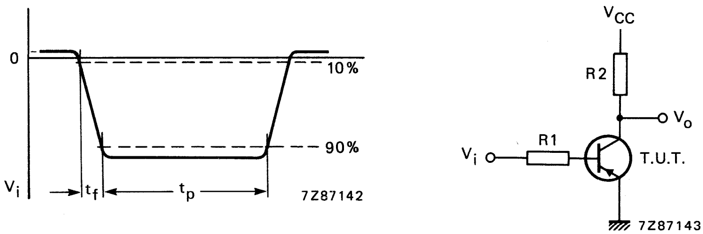
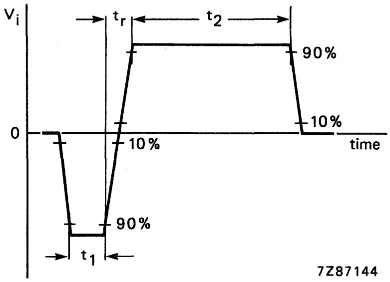


Fig. 2 Waveform and test circuit delay and rise time.
V_i = +0,5 to −10,6 V; $-V_{CC}$ = 3 V; R1 = 10 kΩ; R2 = 275 Ω.
Total shunt capacitance of test jig and connectors = $C_s \leqslant 4$ pF.
Pulse generator: pulse duration 300 ns; fall time < 1 ns; duty factor 2%.

* Measured under pulsed conditions to avoid excessive dissipation; pulse duration $t_p \leq 300$ μs; duty factor $\delta \leq 0.01$.

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



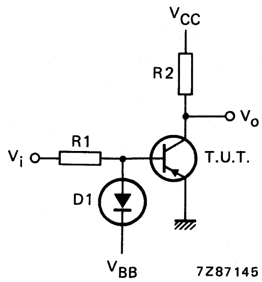


Fig. 3 Waveform and test circuit fall and storage time.
$V_i = -9,1$ to $+10,9$ V; $V_{CC} = 3$ V; $V_{BB} = 0$ V (ground); R1 = 10 kΩ; R2 = 275 Ω; D1 = 1N916.
Total shunt capacitance of test jig and connectors = $C_s \leqslant 4$ pF.
Pulse generator: pulse duration $t_1 = 10$ to 500 μs; rise time $t_r < 1$ ns; duty factor δ = 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 package.

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

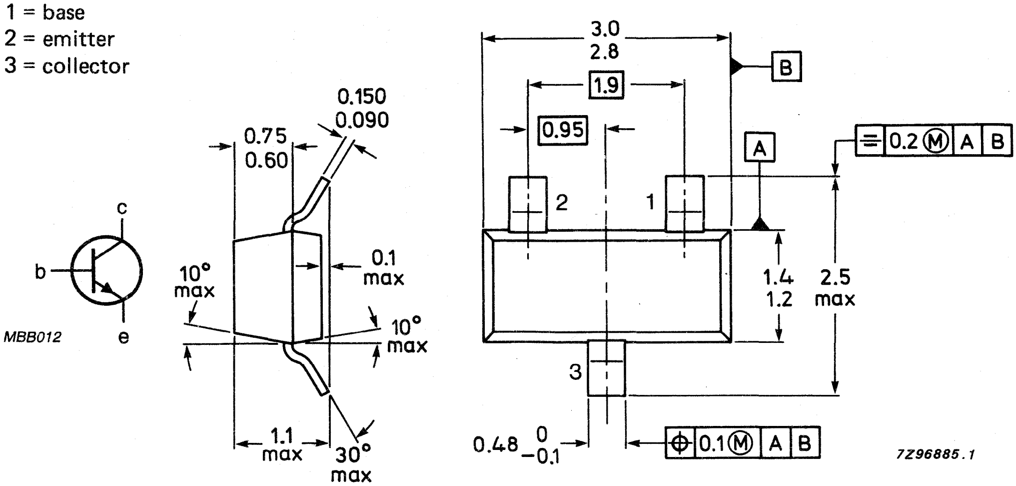
Dimensions in mm

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_c	max.	6	6	pF

* Mounted on an FR4 printed-circuit board 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.	100	100 MHz
		max.	300	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 package.

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

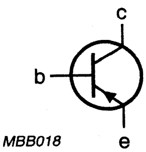
Fig. 1 SOT-23.

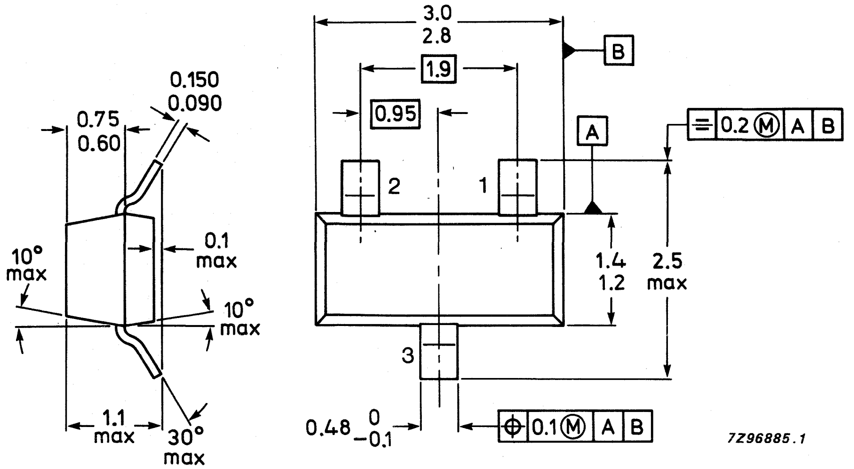
Marking code

BSR20 = T35
BSR20A = T36

Pinning:

1 = base
2 = emitter
3 = collector





TOP VIEW

RATINGS

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

			BSR20	BSR20A	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	130	160	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	120	150	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5		V
Collector current	$-I_C$	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Junction temperature	T_j	max.	150		°C
Storage temperature	T_{stg}		−65 to + 150		°C

THERMAL RESISTANCE

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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			BSR20	BSR20A	
Collector cut-off current					
$I_E = 0$; $-V_{CB}$ = 100 V	$-I_{CBO}$	max.	100		nA
$I_E = 0$; $-V_{CB}$ = 120 V	$-I_{CBO}$	max.		50	nA
$I_E = 0$; $-V_{CB}$ = 100 V; T_{amb} = 100 °C	$-I_{CBO}$	max.	100		μA
$I_E = 0$; $-V_{CB}$ = 120 V; T_{amb} = 100 °C	$-I_{CBO}$	max.		50	μA
Emitter cut-off current					
$I_C = 0$; $-V_{EB}$ = 4,0 V	$-I_{EBO}$	max.	50	50	nA
Breakdown voltages					
I_C = 1,0 mA; I_B = 0	$-V_{(BR)CEO}$	min.	120	150	V
I_C = 100 μA; I_E = 0	$-V_{(BR)CBO}$	min.	130	160	V
I_C = 0; I_E = 10 μA	$-V_{(BR)EBO}$	min.	5,0	5,0	V
Saturation voltages					
$-I_C$ = 10 mA; $-I_B$ = 1,0 mA	$-V_{CEsat}$	max.	0,2	0,2	V
	$-V_{BEsat}$	max.	1,0	1,0	V
$-I_C$ = 50 mA; $-I_B$ = 5,0 mA	$-V_{CEsat}$	max.	0,5	0,5	V
	$-V_{BEsat}$	max.	1,0	1,0	V
D.C. current gain					
I_C = 1,0 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	30	50	
I_C = 10 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	40	60	
		max.	180	240	
I_C = 50 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	40	50	
Small-signal current gain					
I_C = 1,0 mA; $-V_{CE}$ = 10 V; f = 1 kHz	h_{fe}	min.	30	40	
		max.	200	200	
Output capacitance at f = 1 MHz					
$I_E = 0$; $-V_{CB}$ = 10 V	C_c	max.	6	6	pF

* Mounted on an FR4 printed-circuit board 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.	100	100	MHz
		max.	400	300	MHz
Noise figure at R_S = 1 kΩ					
I_C = 250 μA; $-V_{CE}$ = 5 V;					
f = 10 Hz to 15,7 kHz	F	max.	8	8	dB

SILICON PLANAR EPITAXIAL TRANSISTORS

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

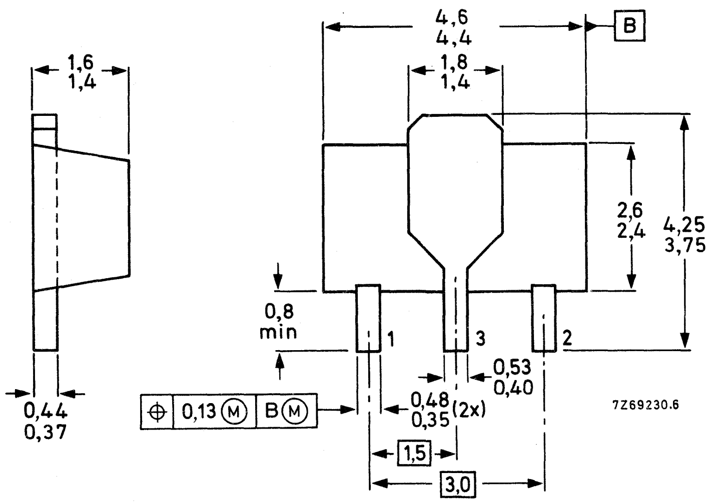
QUICK REFERENCE DATA

			BSR30	BSR31	BSR32	BSR33	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	70	70	90	90	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	60	60	80	80	V
Collector current (d.c.)	$-I_C$	max.	1	1	1	1	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1	1	1	1	W
Junction temperature	T_j	max.	150	150	150	150	°C
D.C. current gain $-I_C$ = 100 mA; $-V_{CE}$ = 5 V	h_{FE}	> <	40 120	100 300	40 120	100 300	
Transition frequency at f = 100 MHz $-I_C$ = 50 mA; $-V_{CE}$ = 10 V	f_T	>	100	100	100	100	MHz

MECHANICAL DATA

Dimensions in mm

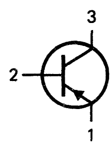
Fig. 1 SOT-89.



BOTTOM VIEW

Marking code

BSR30 = BR1
BSR31 = BR2
BSR32 = BR3
BSR33 = BR4



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 °C unless otherwise specified

Parameter	Symbol		BSR30	BSR31	BSR32	BSR33	Unit
Collector cut-off current							
$I_E = 0; -V_{CB} = 60$ V	$-I_{CBO}$	<	100				nA
$I_E = 0; -V_{CB} = 60$ V; $T_j = 150$ °C	$-I_{CBO}$	<	50				μA
Breakdown voltages							
$I_B = 0; -I_C = 10$ mA	$-V_{(BR)CEO}$	>	60	60	80	80	V
$V_{BE} = 0; -I_C = 10$ μA	$-V_{(BR)CES}$	>	70	70	90	90	V
$I_C = 0; -I_E = 10$ μA	$-V_{(BR)EBO}$	>	5	5	5	5	V
Saturation voltages *							
$-I_C = 150$ mA; $-I_B = 15$ mA	$-V_{CEsat}$	<	0,25	0,25	0,25	0,25	V
	$-V_{BEsat}$	<	1,0	1,0	1,0	1,0	V
$-I_C = 500$ mA; $-I_B = 50$ mA	$-V_{CEsat}$	<	0,5	0,5	0,5	0,5	V
	$-V_{BEsat}$	<	1,2	1,2	1,2	1,2	V
D.C. current gain *							
$-I_C = 100$ μA; $V_{CE} = 5$ V	h_{FE}	>	10	30	10	30	
$-I_C = 100$ mA; $V_{CE} = 5$ V	h_{FE}	>	40	100	40	100	
		<	120	300	120	300	
$-I_C = 500$ mA; $V_{CE} = 5$ V	h_{FE}	>	30	50	30	50	
Transition frequency at f = 100 MHz							
$-I_C = 50$ mA; $-V_{CE} = 10$ V	f_T	>	100				MHz
Collector capacitance at f = 1 MHz							
$I_E = I_e = 0; -V_{CB} = 10$ V	C_c	<	20				pF
Emitter capacitance at f = 1 MHz							
$I_C = I_c = 0; -V_{EB} = 0,5$ V	C_e	<	120				pF

Switching times see next page.

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

CHARACTERISTICS (continued)

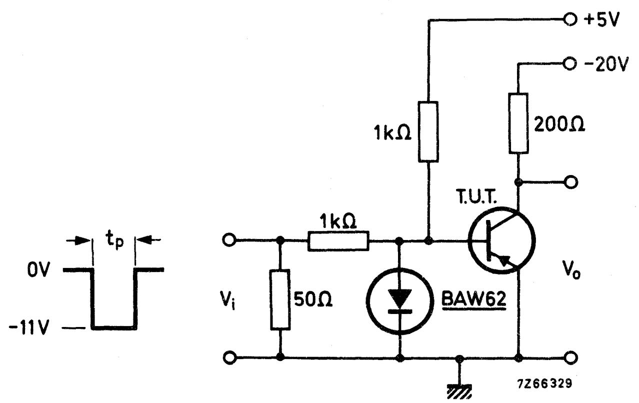
T_{amb} = 25 °C

Switching times

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

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

Test circuit



Pulse generator:

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

Oscilloscope:

Rise time	t_r ⩽ 15 ns
Input impedance	Z_I ⩾ 100 kΩ

SILICON PLANAR EPITAXIAL TRANSISTORS

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

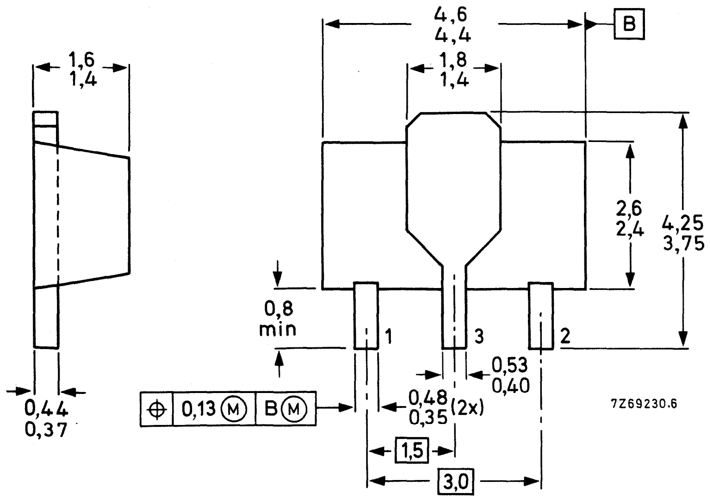
QUICK REFERENCE DATA

			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 = 100 MHz I_C = 50 mA; V_{CE} = 10 V	f_T	>	100	100	100	100	MHz

MECHANICAL DATA

Dimensions in mm

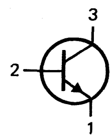
Fig. 1 SOT-89.



BOTTOM VIEW

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
Breakdown voltages			BSR40	BSR41	BSR42	BSR43	
$I_B = 0$; $I_C = 10$ 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 = 100 MHz							
$I_C = 50$ mA; $V_{CE} = 10$ V	f_T	>		100			MHz
Collector capacitance at f = 1 MHz							
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	<		12			pF
Emitter capacitance at f = 1 MHz							
$I_C = I_c = 0$; $V_{EB} = 0,5$ V	C_e	<		90			pF

Switching times see next page.

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

CHARACTERISTICS (continued)

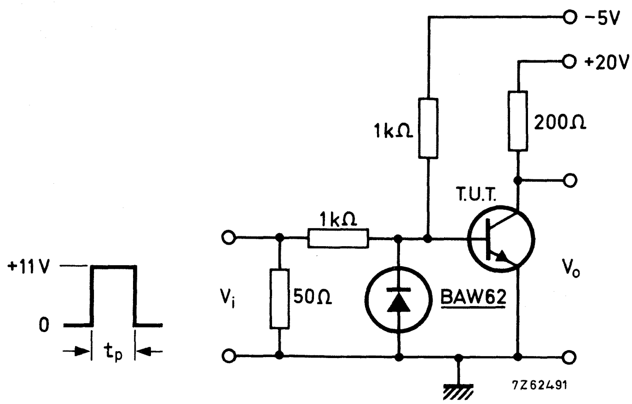
T_{amb} = 25 °C

Switching times

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

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

Test circuit



Pulse generator:

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

Oscilloscope:

Rise time	t_r ⩽ 15 ns
Input impedance	Z_I ⩾ 100 kΩ

N-P-N DARLINGTON TRANSISTORS

Silicon planar transistors in plastic TO-92 packages, intended for industrial switching applications e.g. print hammer, solenoid, relay and lamp driving.

P-N-P complements are the BSR60, BSR61 and BSR62.

QUICK REFERENCE DATA

			BSR50	BSR51	BSR52	
Collector-base voltage (open emitter)	V_{CBO}	max.	60	80	90	V
Collector-emitter voltage (see Fig. 5)	V_{CER}	max.	45	60	80	V
Collector current (average)	$I_{C(AV)}$	max.		1,0		A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		0,8		W
Junction temperature	T_j	max.		150		°C
Collector-emitter saturation voltage I_C = 0,5 A; I_B = 0,5 mA	V_{CEsat}	<		1,3		V
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		
Turn-off time when switched from I_{Con} = 500 mA; I_{Bon} = 0,5 mA to cut-off with $-I_{Boff}$ = 0,5 mA	t_{off}	<		1,5		μs

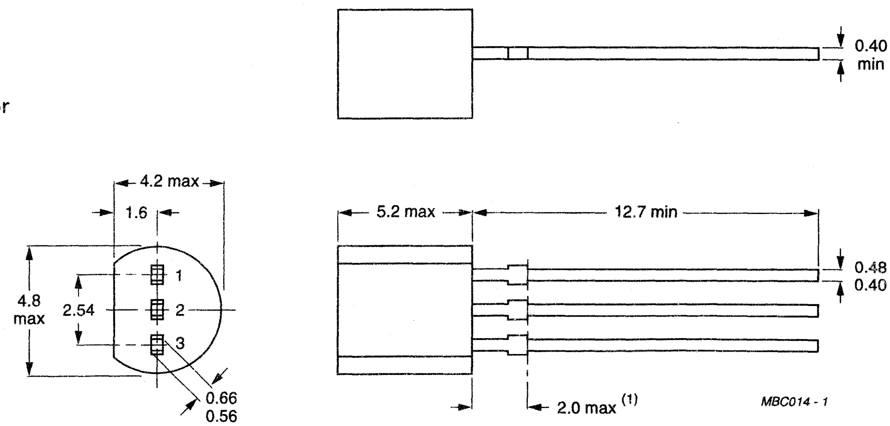
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92. For circuit diagram, see Fig. 2.

Pinning

1 = base
2 = collector
3 = emitter



Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			BSR50	BSR51	BSR52	
Collector-base voltage (open emitter)	V_{CBO}	max.	60	80	90	V
Collector-emitter voltage	V_{CEO}	max.	45	60	80	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	5	V
Collector current (average)	$I_{C(AV)}$	max.		1,0		A
Collector current (peak value)	I_{CM}	max.		2,0		A
Base current (d.c.)	I_B	max.		0,1		A
Total power dissipation						
up to T_{amb} = 25 °C	P_{tot}	max.		0,8		W
up to T_{amb} = 25 °C *	P_{tot}	max.		1,0		W
Storage temperature	T_{stg}			−65 to + 150		°C
Junction temperature **	T_j	max.		150		°C

THERMAL RESISTANCE **

From junction to ambient in free air $R_{th\ j\text{-}a}$ = 156 K/W

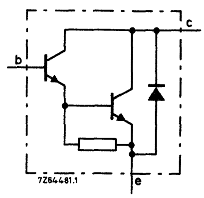


Fig. 2 Circuit diagram.

* Transistor mounted on printed-circuit board, maximum lead length 3 mm, mounting pad for collector lead minimum 10 mm x 10 mm.

** 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.

CHARACTERISTICS

$T_j = 25\ ^oC$

Collector cut-off voltage				
$I_E = 0$; $V_{CB} = 45$ V	**BSR50**	I_{CBO}	<	50 nA
$I_E = 0$; $V_{CB} = 60$ V	**BSR51**	I_{CBO}	<	50 nA
$I_E = 0$; $V_{CB} = 80$ V	**BSR52**	I_{CBO}	<	50 nA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 4$ V		I_{EBO}	<	50 nA
Saturation voltages				
$I_C = 0,5$ A; $I_B = 0,5$ mA		V_{CEsat}	<	1,3 V
		V_{BEsat}	<	1,9 V
$I_C = 1,0$ A; $I_B = 1,0$ mA	**BSR51**	V_{CEsat}	<	1,6 V
		V_{BEsat}	<	2,2 V
$I_C = 1,0$ A; $I_B = 4,0$ mA	**BSR50; BSR52**	V_{CEsat}	<	1,6 V
		V_{BEsat}	<	2,2 V
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
Small-signal current gain at f = 35 MHz				
$I_C = 500$ mA; $V_{CE} = 5$ V		h_{fe}	typ.	10

Switching times (see Figs 3 and 4)

I_{Con} = 500 mA; I_{Bon} = $-I_{Boff}$ = 0,5 mA

Turn-on time	t_{on}	typ.	0,4 μs
Turn-off time	t_{off}	<	1,5 μs

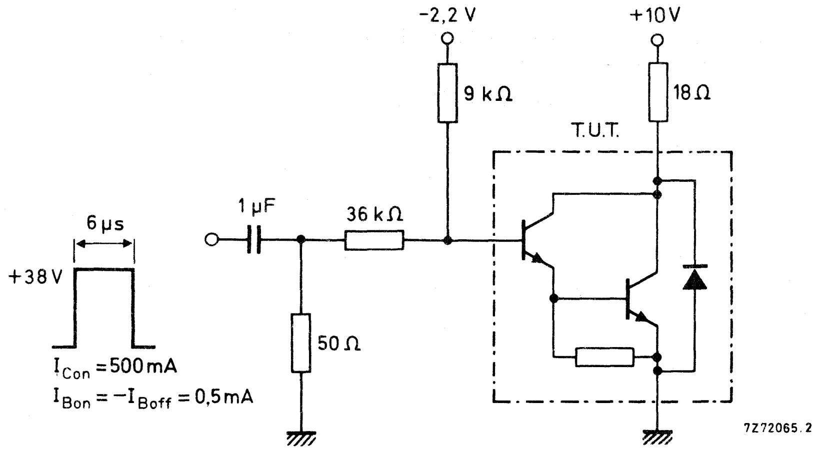


Fig. 3 Test circuit for 500 mA switching.

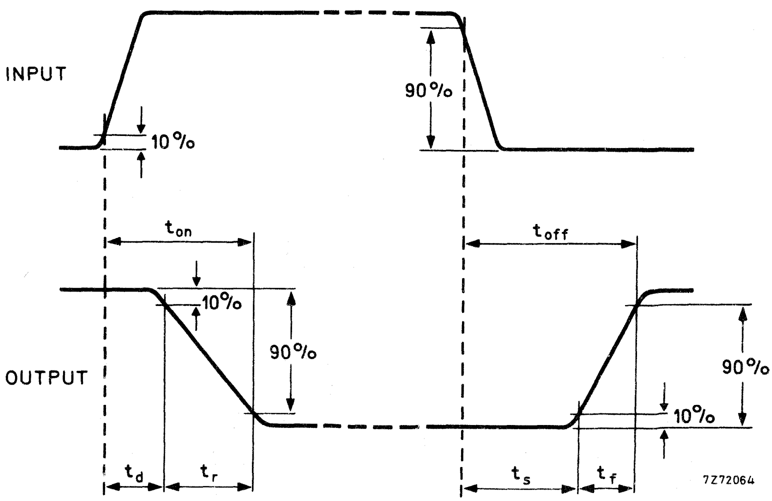


Fig. 4 Switching waveforms.

P-N-P DARLINGTON TRANSISTORS

Silicon planar transistors in plastic TO-92 packages, intended for industrial applications e.g. print hammer, solenoid, relay and lamp driving.

N-P-N complements are the BSR50, BSR51 and BSR52.

QUICK REFERENCE DATA

			BSR60	BSR61	BSR62	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60	80	90	V
Collector-emitter voltage (see Fig. 6)	$-V_{CER}$	max.	45	60	80	V
Collector current (average)	$-I_{C(AV)}$	max.	1,0	1,0	1,0	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	0,8	0,8	0,8	W
Junction temperature	T_j	max.	150	150	150	°C
Collector-emitter saturation voltage $-I_C$ = 0,5 A; $-I_B$ = 0,5 mA	$-V_{CEsat}$	<	1,3	1,3	1,4	V
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		
Turn-off time when switched from $-I_{Con}$ = 500 mA; $-I_{Bon}$ = 0,5 mA to cut-off with + I_{Boff} = 0,5 mA	t_{off}	<		1,5		μs

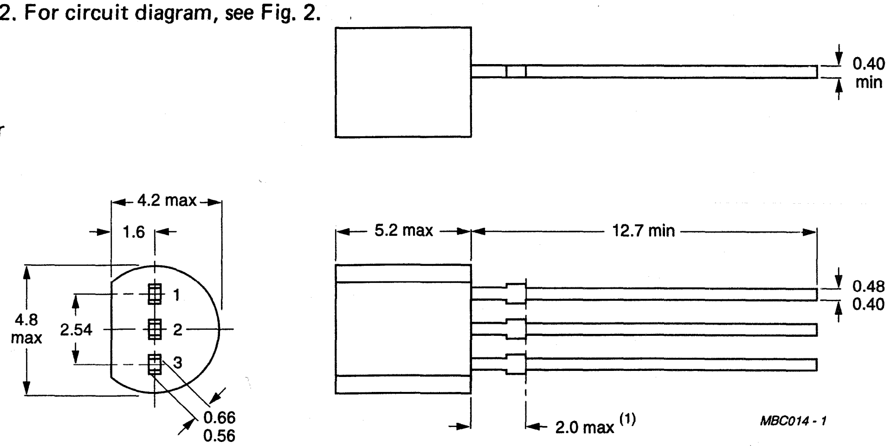
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92. For circuit diagram, see Fig. 2.

Pinning

1 = base
2 = collector
3 = emitter



Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			BSR60	BSR61	BSR62	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60	80	90	V
Collector-emitter voltage	$-V_{CEO}$	max.	45	60	80	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	V
Collector current (average)	$-I_{C(AV)}$	max.		1,0		A
Collector current (peak value)	$-I_{CM}$	max.		2,0		A
Base current (d.c.)	$-I_B$	max.		0,1		A
Total power dissipation						
up to T_{amb} = 25 °C	P_{tot}	max.		0,8		W
up to T_{amb} = 25 °C *	P_{tot}	max.		1,0		W
Storage temperature	T_{stg}			−65 to + 150		°C
Junction temperature **	T_j	max.		150		°C

THERMAL RESISTANCE **

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	156	K/W

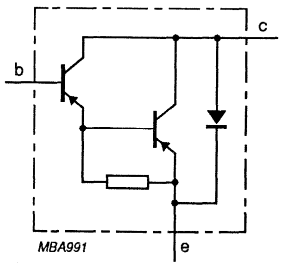


Fig. 2 Circuit diagram.

* Transistor mounted on printed-circuit board, maximum lead length 3 mm, mounting pad for collector lead minimum 10 mm x 10 mm.

** 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.

CHARACTERISTICS

$T_j = 25\ ^oC$

Collector cut-off current				
$I_E = 0; -V_{CB} = 45\ V$	**BSR60**	$-I_{CBO}$	<	50 nA
$I_E = 0; -V_{CB} = 60\ V$	**BSR61**	$-I_{CBO}$	<	50 nA
$I_E = 0; -V_{CB} = 80\ V$	**BSR62**	$-I_{CBO}$	<	50 nA
Emitter cut-off current				
$I_C = 0; -V_{EB} = 4\ V$		$-I_{EBO}$	<	50 nA
Saturation voltages				
$-I_C = 0{,}5\ A; -I_B = 0{,}5\ mA$	**BSR60; BSR61**	$-V_{CEsat}$	<	1,3 V
		$-V_{BEsat}$	<	1,9 V
$-I_C = 0{,}5\ A; -I_B = 0{,}5\ mA$	**BSR62**	$-V_{CEsat}$	<	1,4 V
		$-V_{BEsat}$	<	2,0 V
$-I_C = 1{,}0\ A; -I_B = 1{,}0\ mA$	**BSR61**	$-V_{CEsat}$	<	1,6 V
		$-V_{BEsat}$	<	2,2 V
$-I_C = 1{,}0\ A; -I_B = 4{,}0\ mA$	**BSR60**	$-V_{CEsat}$	<	1,6 V
		$-V_{BEsat}$	<	2,2 V
$-I_C = 1{,}0\ A; -I_B = 4{,}0\ mA$	**BSR62**	$-V_{CEsat}$	<	1,8 V
		$-V_{BEsat}$	<	2,4 V
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
Small-signal current gain at f = 35 MHz				
$-I_C = 500\ mA; -V_{CE} = 5\ V$		h_{fe}	typ.	10

Switching times (see Figs 3 and 4)

$-I_{Con} = 500$ mA; $-I_{Bon} = +I_{Boff} = 0{,}5$ mA

Turn-on time	t_{on}	<	1,0 μs
Turn-off time	t_{off}	<	1,5 μs

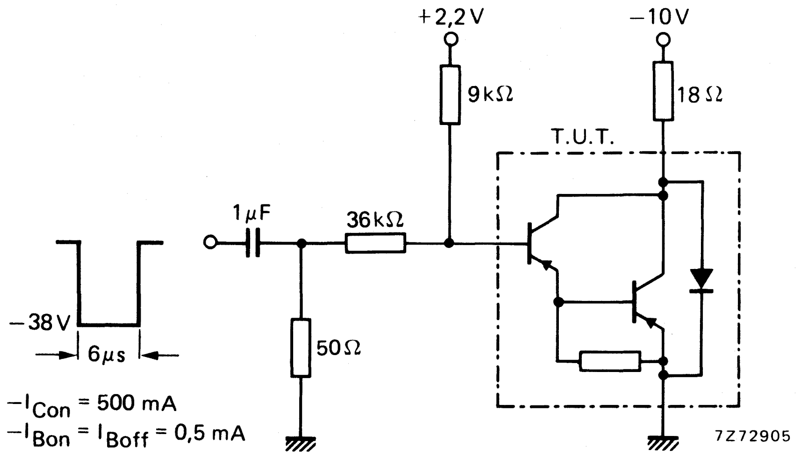


Fig. 3 Test circuit for 500 mA switching.

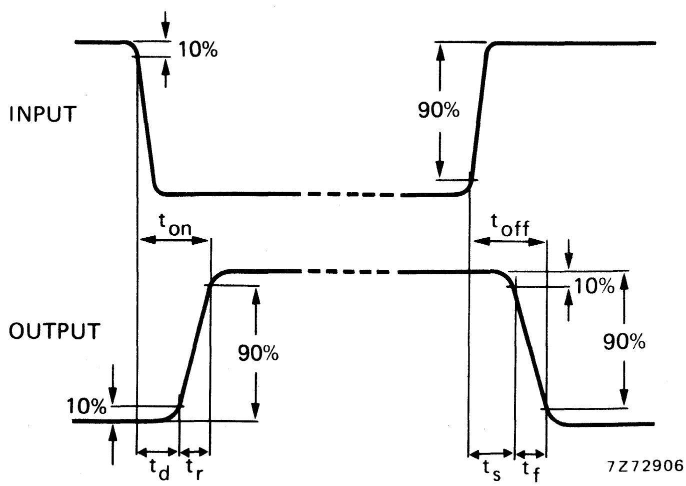


Fig. 4 Switching waveforms.

SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a plastic TO-92 package. It is primarily intended for general purpose switching and as driver for numerical indicator tubes.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	120	V
Collector-emitter voltage (open base)	V_{CEO}	max.	100	V
Collector current (peak value)	I_{CM}	max.	250	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	mW
Junction temperature	T_j	max.	150	°C
D.C. current gain I_C = 4 mA; V_{CE} = 1 V	h_{FE}	> typ.	20 80	
Transition frequency at f = 100 MHz I_C = 4 mA; V_{CE} = 10 V	f_T	>	60	MHz
Turn-off time I_{Con} = 15 mA; I_{Bon} = 1 mA; $-I_{Boff}$ = 1 mA	t_{off}	<	1	μs

Note
The BSS38 may be operated in the breakdown region up to V_{CE} = 160 V, provided P_{tot} at T_{amb} = 85 °C does not exceed 100 mW.

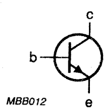
MECHANICAL DATA

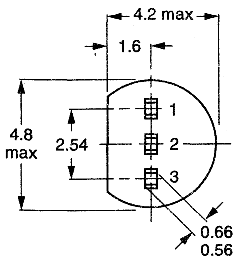
Dimensions in mm

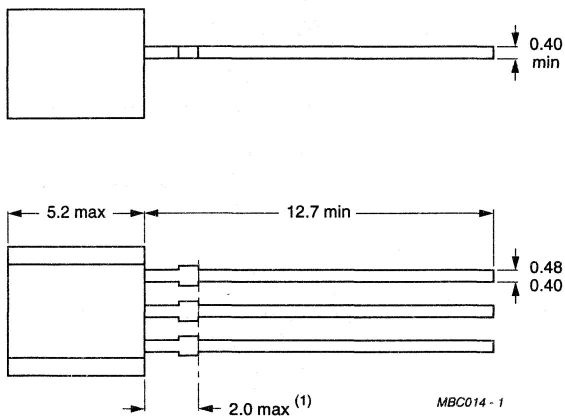
Fig. 1 TO-92.

Pinning

1 = emitter
2 = base
3 = collector







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	120	V*
Collector-emitter voltage (open base)	V_{CEO}	max.	100	V*
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V
Collector current (d.c. or averaged over any 20 ms period)	$I_{C(AV)}$	max.	100	mA
Collector current (peak value)	I_{CM}	max.	250	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	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	$R_{th\ j\text{-}a}$	=	0,25	(K/mW)

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

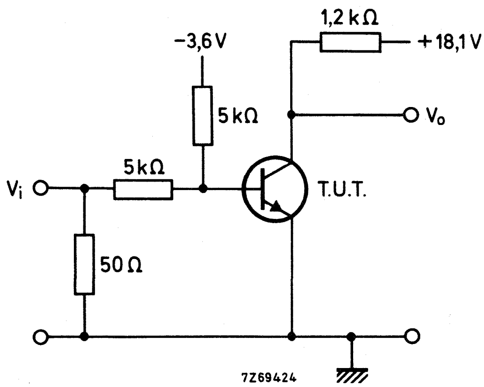
Collector cut-off current				
$I_E = 0$; $V_{CB} = 90$ V	I_{CBO}	<	200	nA
$I_E = 0$; $V_{CB} = 90$ V; $T_j = 150$ °C	I_{CBO}	<	50	μA
$V_{BE} = 0$; $V_{CE} = 80$ V; $T_j = 85$ °C	I_{CES}	<	20	μA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 4$ V	I_{EBO}	<	200	nA
$I_C = 0$; $V_{EB} = 4$ V; $T_j = 150$ °C	I_{EBO}	<	50	μA
Saturation voltages				
$I_C = 4$ mA; $I_B = 0,4$ mA	V_{CEsat}	<	0,7	V
	V_{BEsat}	<	1,2	V
$I_C = 50$ mA; $I_B = 15$ mA	V_{CEsat}	<	3,0	V
D.C. current gain				
$I_C = 4$ mA; $V_{CE} = 1$ V	h_{FE}	>	20	
		typ.	80	
$I_C = 10$ mA; $V_{CE} = 1$ V	h_{FE}	typ.	80	

* The BSS38 may be operated in the breakdown region up to V_{CE} = 160 V, provided P_{tot} at T_{amb} = 85 °C does not exceed 100 mW.

CHARACTERISTICS (continued)

Transition frequency at f = 100 MHz I_C = 4 mA; V_{CE} = 10 V	f_T	>	60 MHz
Collector capacitance at f = 1 MHz $I_E = I_e = 0$; V_{CB} = 10 V	C_c	<	4,5 pF
Emitter capacitance at f = 1 MHz $I_C = I_c = 0$; V_{EB} = 0,5 V	C_e	<	17 pF
Switching time Turn-off time when switched from I_{Con} = 15 mA; I_{Bon} = 1 mA to cut-off with $-I_{Boff}$ = 1 mA	t_{off}	<	1 μs

Test circuit for measuring turn-off time:



Pulse generator:

Input voltage	V_i	=	+ 10 V
Pulse duration	t_p	=	1 μs
Duty factor	δ	=	0,01
Source impedance	Z_S	=	50 Ω

N-P-N DARLINGTON TRANSISTORS

Silicon planar transistors in TO-39 metal packages, intended for industrial switching applications e.g. print hammer, solenoid, relay and lamp driving.

P-N-P complements are the BSS60, BSS61 and BSS62.

QUICK REFERENCE DATA

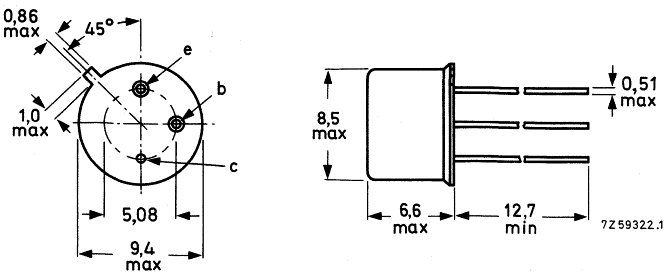
				BSS50	BSS51	BSS52	
Collector-base voltage (open emitter)		V_{CBO}	max.	60	80	90	V
Collector-emitter voltage		V_{CER}	max.	45	60	80	V
Collector current (d.c.)		I_C	max.		1,0		A
Total power dissipation							
up to T_{amb} = 25 °C		P_{tot}	max.		0,8		W
up to T_{case} = 25 °C		P_{tot}	max.		5,0		W
Collector-emitter saturation voltage							
I_C = 1,0 A; I_B = 1,0 mA	**BSS51**	V_{CEsat}	<		1,6		V
I_C = 1,0 A; I_B = 4,0 mA	**BSS50; BSS52**	V_{CEsat}	<		1,6		V
D.C. current gain							
I_C = 500 mA; V_{CE} = 10 V		h_{FE}	>		2000		
Turn-off time when switched from I_{Con} = 500 mA; I_{Bon} = 0,5 mA to cut-off with $-I_{Boff}$ = 0,5 mA		t_{off}	typ.		1,5		μs

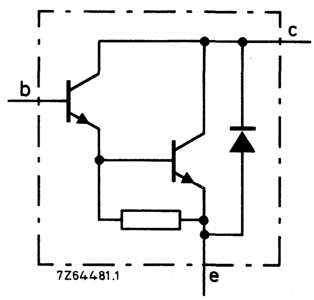
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case





Maximum lead diameter is guaranteed only for 12,7 mm.

RATINGS

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

			BSS50	BSS51	BSS52	
Collector-base voltage (open emitter)	V_{CBO}	max.	60	80	90	V
Collector-emitter voltage	V_{CEO}	max.	45	60	80	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5,0	5,0	5,0	V

Collector current (d.c.)	I_C	max.	1,0	A
Collector current (peak value)	I_{CM}	max.	2,0	A
Base current (d.c.)	I_B	max.	0,1	A
Total power dissipation				
up to T_{amb} = 25 °C	P_{tot}	max.	0,8	W
up to T_{case} = 25 °C	P_{tot}	max.	5,0	W
Storage temperature range	T_{stg}		−65 to + 150	°C
Junction temperature *	T_j	max.	200	°C

THERMAL RESISTANCE *

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	220	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	35	K/W

* 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.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $V_{CB} = 45$ V	BSS50	I_{CBO}	<	50 nA
$I_E = 0$; $V_{CB} = 60$ V	BSS51	I_{CBO}	<	50 nA
$I_E = 0$; $V_{CB} = 80$ V	BSS52	I_{CBO}	<	50 nA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 4{,}0$ V		I_{EBO}	<	50 nA
Base-emitter voltage				
$I_C = 150$ mA; $V_{CE} = 10$ V		V_{BE}	1,3 to	1,65 V
$I_C = 500$ mA; $V_{CE} = 10$ V		V_{BE}	1,4 to	1,75 V
Saturation voltages				
$I_C = 500$ mA; $I_B = 0{,}5$ mA		V_{CEsat}	<	1,3 V
		V_{BEsat}	<	1,9 V
$I_C = 500$ mA; $I_B = 0{,}5$ mA; $T_j = 200$ °C		V_{CEsat}	<	1,3 V
$I_C = 1{,}0$ A; $I_B = 1{,}0$ mA	BSS51	V_{CEsat}	<	1,6 V
		V_{BEsat}	<	2,2 V
$I_C = 1{,}0$ A; $I_B = 1{,}0$ mA; $T_j = 200$ °C	BSS51	V_{CEsat}	<	2,3 V
$I_C = 1{,}0$ A; $I_B = 4{,}0$ mA	BSS50; BSS52	V_{CEsat}	<	1,6 V
		V_{BEsat}	<	2,2 V
$I_C = 1{,}0$ A; $I_B = 4{,}0$ mA; $T_j = 200$ °C	BSS50; BSS52	V_{CEsat}	<	1,6 V
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
Small-signal current gain at f = 35 MHz				
$I_C = 500$ mA; $V_{CE} = 5$ V		h_{fe}	typ.	10

Switching times (see Figs 2 and 3)

I_{Con} = 500 mA; I_{Bon} = $-I_{Boff}$ = 0,5 mA			
Turn-on time	t_{on}	typ.	0,4 μs
Turn-off time	t_{off}	typ.	1,5 μs
I_{Con} = 1,0 A; I_{Bon} = $-I_{Boff}$ = 1,0 mA			
Turn-on time	t_{on}	typ.	0,4 μs
Turn-off time	t_{off}	typ.	1,5 μs

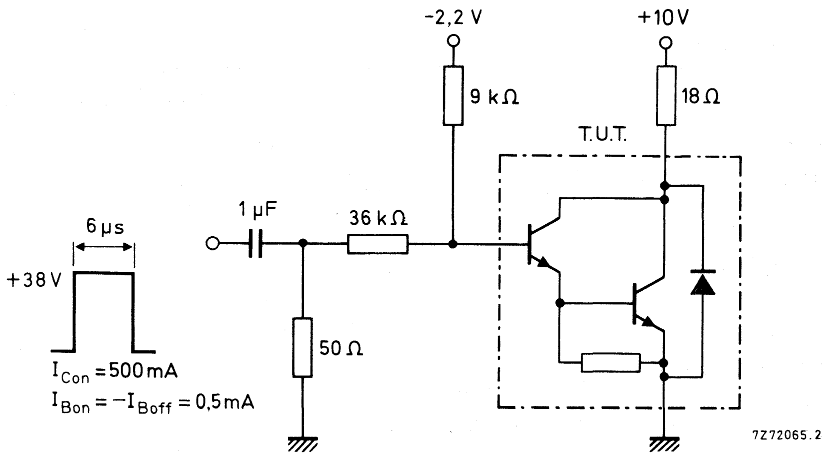


Fig. 2 Test circuit for 500 mA switching.

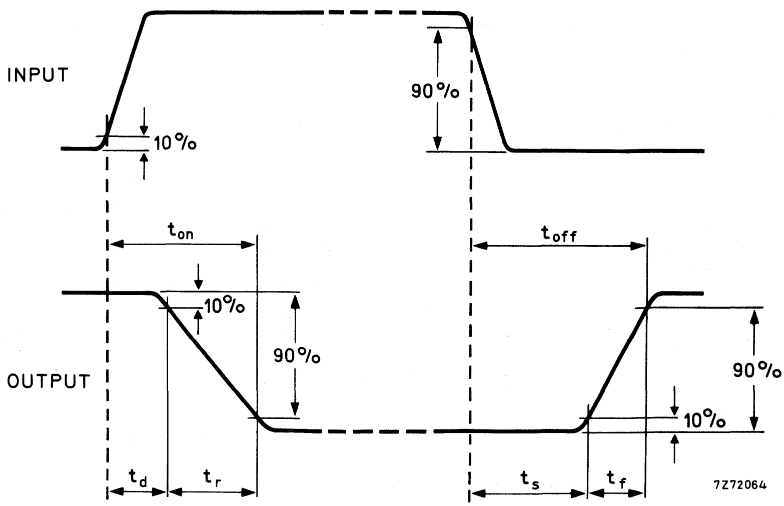


Fig. 3 Switching waveforms.

P-N-P DARLINGTON TRANSISTORS

Silicon planar transistors in TO-39 metal packages, intended for industrial switching applications e.g. print hammer, solenoid, relay and lamp driving.

N-P-N complements are the BSS50, BSS51 and BSS52.

QUICK REFERENCE DATA

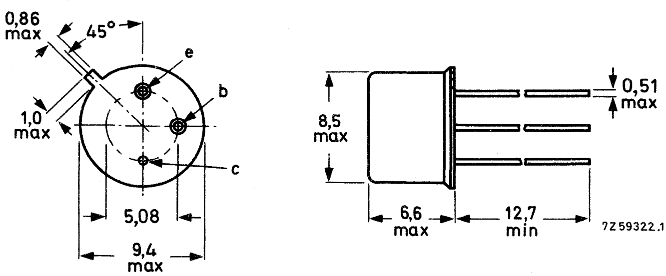
				BSS60	BSS61	BSS62	
Collector-base voltage (open emitter)		$-V_{CBO}$	max.	60	80	90	V
Collector-emitter voltage (see Fig. 4)		$-V_{CER}$	max.	45	60	80	V
Collector current (d.c.)		$-I_C$	max.		1,0		A
Total power dissipation							
up to T_{amb} = 25 °C		P_{tot}	max.		0,8		W
up to T_{case} = 25 °C		P_{tot}	max.		5,0		W
Collector-emitter saturation voltage							
$-I_C$ = 1,0 A; $-I_B$ = 1,0 mA	**BSS61**	$-V_{CEsat}$	<		1,6		V
$-I_C$ = 1,0 A; $-I_B$ = 4,0 mA	**BSS60; BSS62**	$-V_{CEsat}$	<		1,6		V
D.C. current gain							
$-I_C$ = 500 mA; $-V_{CE}$ = 10 V		h_{FE}	>		2000		
Turn-off time when switched from $-I_{Con}$ = 500 mA; $-I_{Bon}$ = 0,5 mA to cut-off with $-I_{Boff}$ = 0,5 mA		t_{off}	typ.		1,5		μs

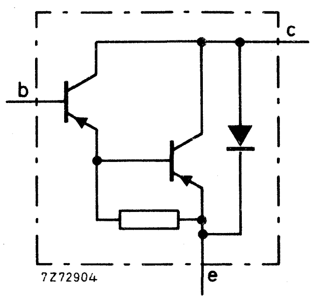
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case





Maximum lead diameter is guaranteed only for 12,7 mm

RATINGS

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

			BSS60	BSS61	BSS62	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60	80	90	V
Collector-emitter voltage	$-V_{CEO}$	max.	45	60	80	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5,0	5,0	5,0	V
Collector current (d.c.)	$-I_C$	max.		1,0		A
Collector current (peak value)	$-I_{CM}$	max.		2,0		A
Base current (d.c.)	$-I_B$	max.		0,1		A
Total power dissipation						
up to T_{amb} = 25 °C	P_{tot}	max.		0,8		W
up to T_{case} = 25 °C	P_{tot}	max.		5,0		W
Storage temperature range	T_{stg}			−65 to + 150		°C
Junction temperature *	T_j	max.		200		°C

THERMAL RESISTANCE *

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	220	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	35	K/W

* 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.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current					
I_E = 0; $-V_{CB}$ = 45 V	**BSS60**	$-I_{CBO}$	<	50	nA
I_E = 0; $-V_{CB}$ = 60 V	**BSS61**	$-I_{CBO}$	<	50	nA
I_E = 0; $-V_{CB}$ = 80 V	**BSS62**	$-I_{CBO}$	<	50	nA
Emitter cut-off current					
I_C = 0; $-V_{EB}$ = 4,0 V		$-I_{EBO}$	<	100	nA
Saturation voltages					
$-I_C$ = 500 mA; $-I_B$ = 0,5 mA		$-V_{CEsat}$	<	1,3	V
		$-V_{BEsat}$	<	1,9	V
$-I_C$ = 500 mA; $-I_B$ = 0,5 mA; T_j = 200 °C		$-V_{CEsat}$	<	1,3	V
$-I_C$ = 1,0 A; $-I_B$ = 1,0 mA	**BSS61**	$-V_{CEsat}$	<	1,6	V
		$-V_{BEsat}$	<	2,2	V
$-I_C$ = 1,0 A; $-I_B$ = 1,0 mA; T_j = 200 °C	**BSS61**	$-V_{CEsat}$	<	1,6	V
$-I_C$ = 1,0 A; $-I_B$ = 4,0 mA	**BSS60; BSS62**	$-V_{CEsat}$	<	1,6	V
		$-V_{BEsat}$	<	2,2	V
$-I_C$ = 1,0 A; $-I_B$ = 4,0 mA; T_j = 200 °C	**BSS60; BSS62**	$-V_{CEsat}$	<	1,6	V
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	
Small-signal current gain at f = 35 MHz					
$-I_C$ = 500 mA; $-V_{CE}$ = 5 V		h_{fe}	typ.	10	

Switching times (see Figs 2 and 3)

$-I_{Con}$ = 500 mA; $-I_{Bon}$ = I_{Boff} = 0,5 mA

Turn-on time	t_{on}	typ.	0,4 μs
Turn-off time	t_{off}	typ.	1,5 μs

$-I_{Con}$ = 1,0 A; $-I_{Bon}$ = I_{Boff} = 1,0 mA

Turn-on time	t_{on}	typ.	0,4 μs
Turn-off time	t_{off}	typ.	1,5 μs

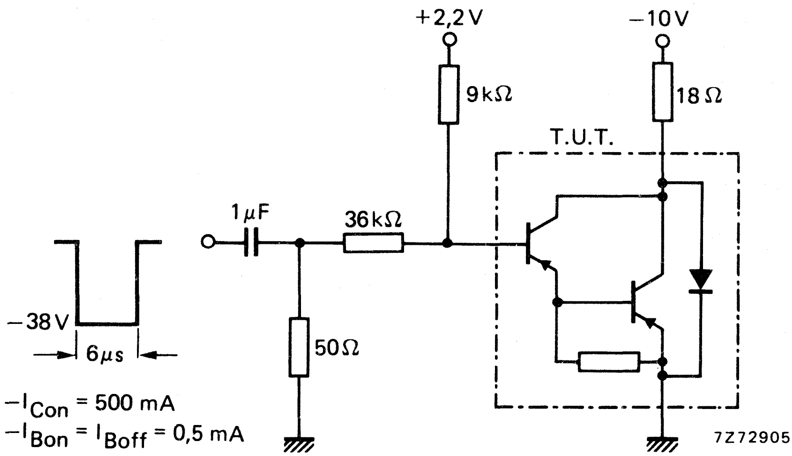


Fig. 2 Test circuit for 500 mA switching.

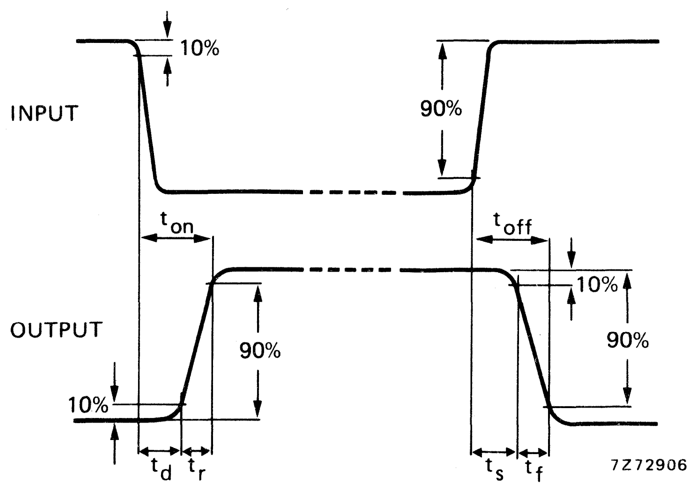


Fig. 3 Switching waveforms.

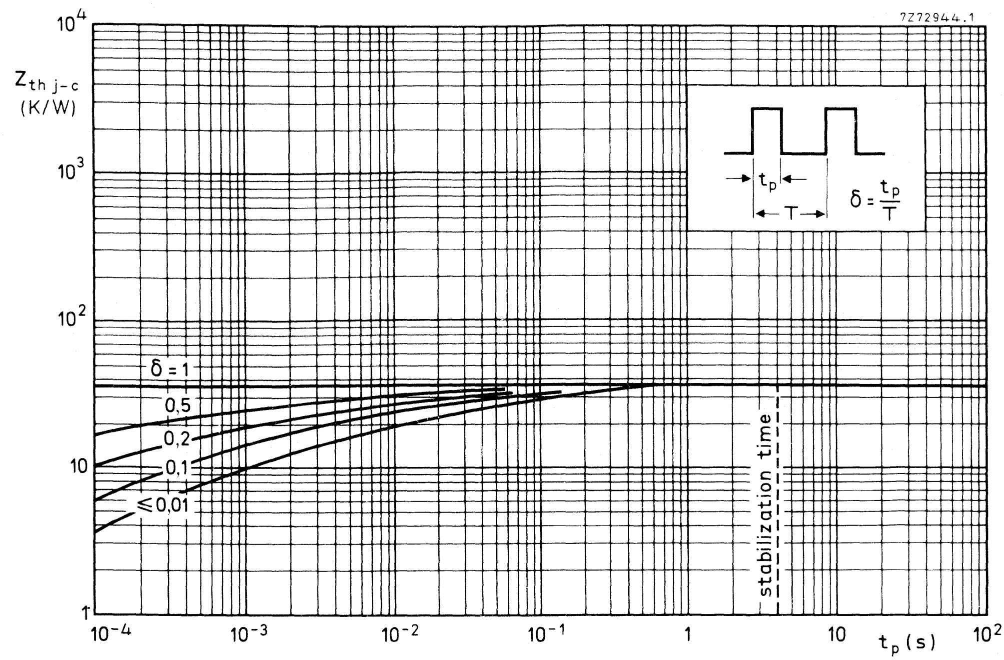


Fig. 4. Thermal impedance as a function of pulse duration.

HIGH VOLTAGE P-N-P TRANSISTORS

Silicon planar epitaxial transistor in a microminiature plastic package 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 = 100 MHz $-I_C$ = 25 mA; $-V_{CE}$ = 5 V	f_T	> typ.	50 MHz 85 MHz

MECHANICAL DATA

Dimensions in mm

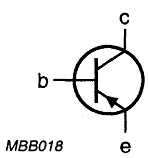
Marking code

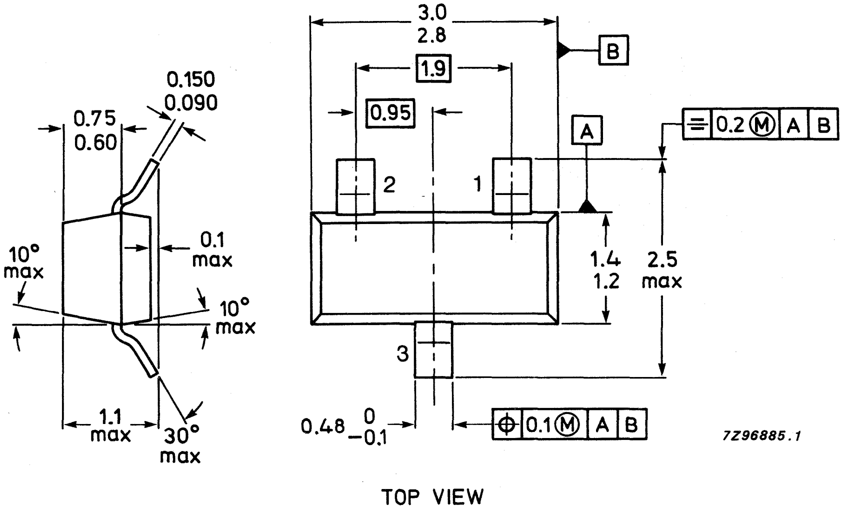
BSS63 = BMp

Fig. 1 SOT-23.

Pinning:

1 = base
2 = emitter
3 = collector





Reverse pinning types are available on request.

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 °C	P_{tot}	max.	250	mW
Storage temperature	T_{stg}	−65 to + 150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current $I_E = 0$; $-V_{CB} = 90$ V	$-I_{CBO}$	<	100	nA
$I_E = 0$; $-V_{CB} = 90$ V; $T_j = 150$ °C	$-I_{CBO}$	<	50	μA
Emitter cut-off current $I_C = 0$; $-V_{EB} = 6$ 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 = 100 MHz $-I_C = 25$ mA; $-V_{CE} = 5$ V	f_T	>	50	MHz
		typ.	85	MHz

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

HIGH VOLTAGE N-P-N TRANSISTORS

Silicon planar epitaxial transistor in a microminiature plastic package 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 = 100 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

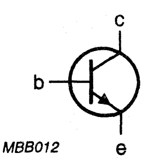
Marking code

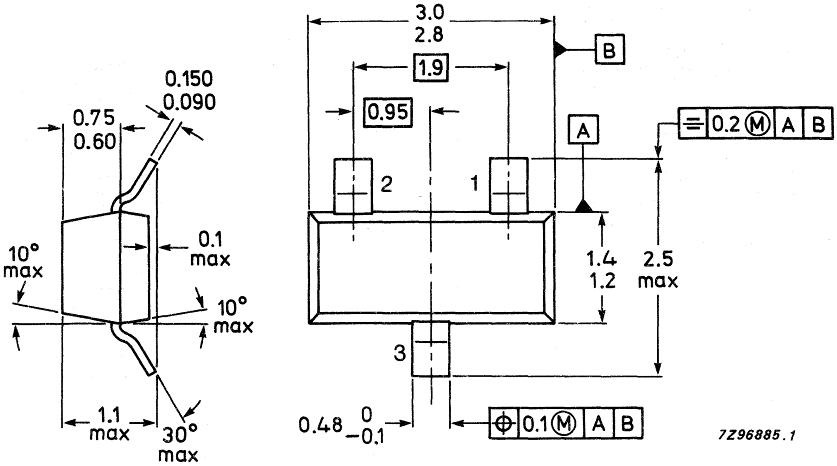
BSS64 = AMp

Fig. 1 SOT-23.

Pinning:

1 = base
2 = emitter
3 = collector





Reverse pinning types are available on request.

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 nA
		<	200 nA
Saturation voltages			
$I_C = 4$ mA; $I_B = 400\ \mu A$	V_{CEsat}	<	150 mV
	V_{BEsat}	<	1200 mV
$I_C = 50$ mA; $I_B = 15$ mA	V_{CEsat}	<	200 mV
D.C. current gain			
$I_C = 1$ mA; $V_{CE} = 1$ V	h_{FE}	typ.	60
$I_C = 10$ mA; $V_{CE} = 1$ V	h_{FE}	>	20
		typ.	80
$I_C = 20$ mA; $V_{CE} = 1$ V	h_{FE}	typ.	55

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

Transition frequency at f = 100 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

HIGH-VOLTAGE P-N-P TRANSISTOR

Silicon planar epitaxial transistor in a plastic TO-92 package. It is intended for anode switching in dynamically driven numerical indicator tubes and as general purpose switching device.

QUICK REFERENCE DATA

Collector-emitter voltage (R_{BE} = 10 kΩ)	$-V_{CER}$	max.	110	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	100	V
Collector current (d.c.)	$-I_C$	max.	100	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	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	>	50	MHz

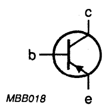
MECHANICAL DATA

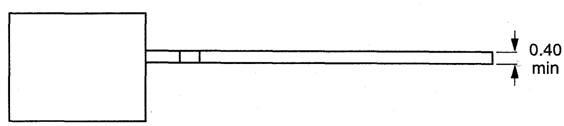
Dimensions in mm

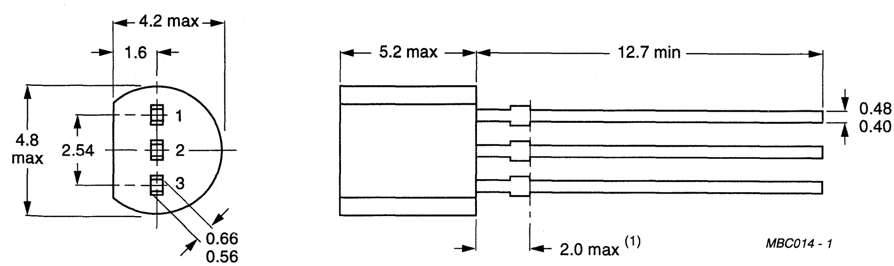
Fig. 1 TO-92.

Pinning

1 = emitter
2 = base
3 = collector







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	110	V
Collector-emitter voltage (R_{BE} = 10 kΩ)	$-V_{CER}$	max.	110	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	100	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	6	V
Collector current (d.c.)	$-I_C$	max.	100	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	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	$R_{th\ j\text{-}a}$	=	0,25	K/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current $I_E = 0; -V_{CB} = 100$ V; $T_j = 70$ °C	$-I_{CBO}$	<	10	μA
Saturation voltages $-I_C = 25$ mA; $-I_B = 2,5$ mA	$-V_{CEsat}$	<	250	mV
	$-V_{BEsat}$	<	900	mV
D.C. current gain $-I_C = 10$ mA; $-V_{CE} = 5$ V	h_{FE}	>	30	
$-I_C = 25$ mA; $-V_{CE} = 5$ V	h_{FE}	>	30	
Collector capacitance at f = 1 MHz $I_E = I_e = 0; -V_{CB} = 10$ V	C_c	<	5	pF
Transition frequency at f = 35 MHz $-I_C = 25$ mA; $-V_{CE} = 5$ V	f_T	>	50	MHz

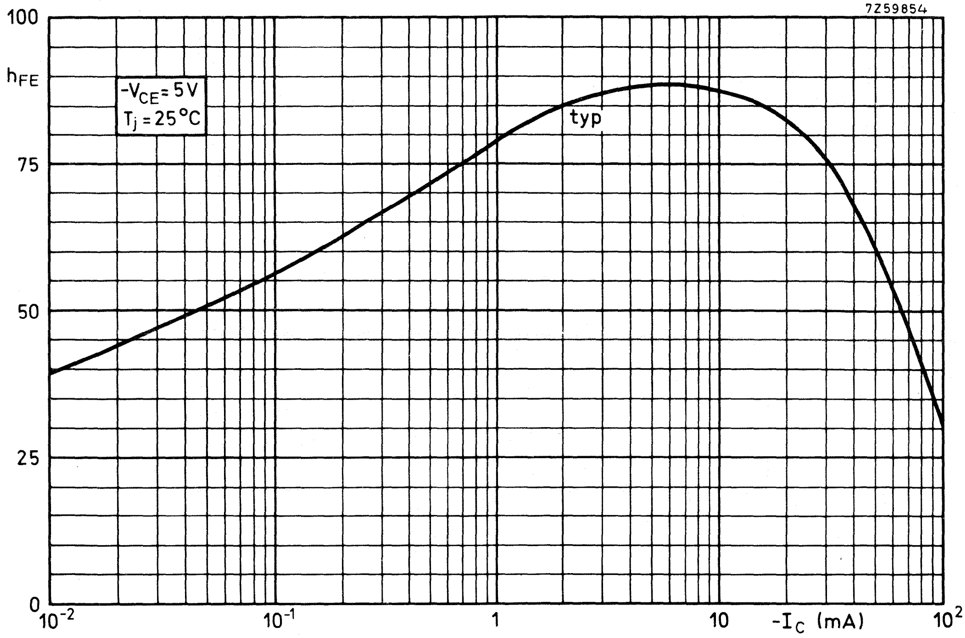

7Z59854
100
h_{FE}
75
50
25
0
$-V_{CE} = 5\ V$
$T_j = 25\ °C$
typ
10^{-2}
10^{-1}
1
10
$-I_C$ (mA)
10^2

Fig. 2.

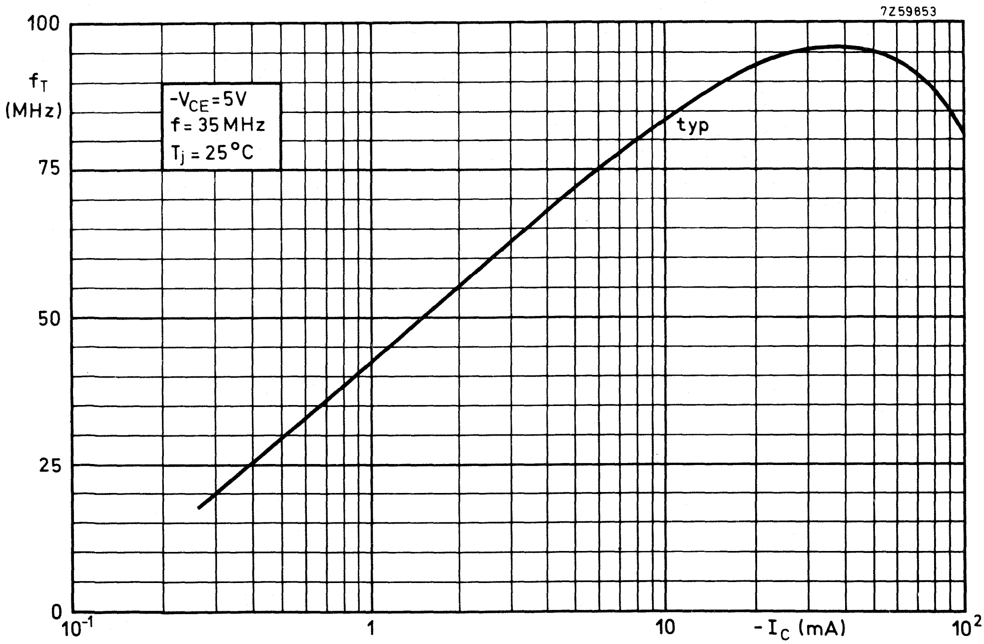

7Z59853
100
f_T
(MHz)
75
50
25
0
$-V_{CE} = 5\ V$
f = 35 MHz
$T_j = 25\ °C$
typ
10^{-1}
1
10
$-I_C$ (mA)
10^2

Fig. 3.

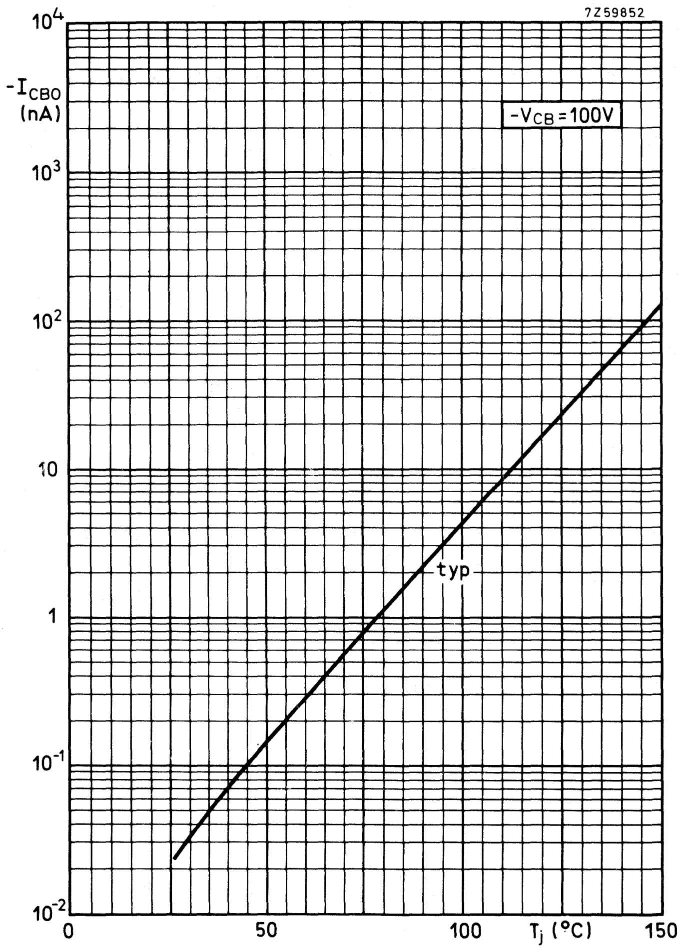

7Z59852
$-I_{CBO}$ (nA)
10^4
10^3
10^2
10
1
10^{-1}
10^{-2}
$-V_{CB} = 100V$
typ
0
50
100
T_j (°C)
150

Fig. 4.

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors in miniature plastic packages intended for use in amplifier and switching applications. Complementary types are BST39/40.

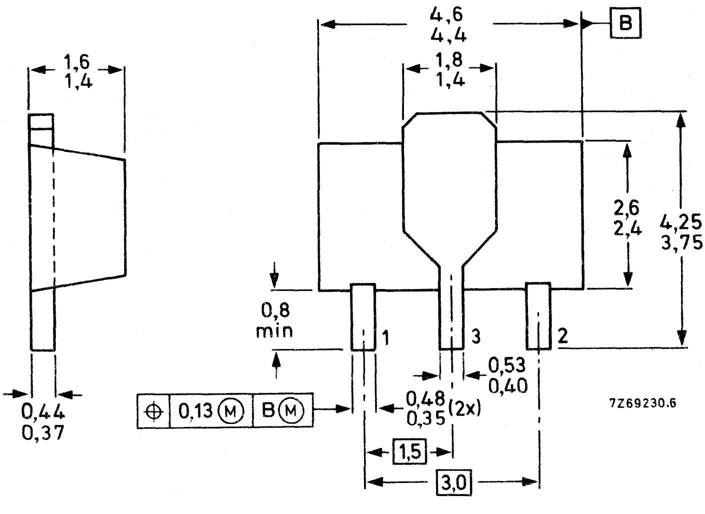
QUICK REFERENCE DATA

			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 at f = 100 MHz $-V_{CE}$ = 10 V; $-I_C$ = 10 mA	f_T	>	15		MHz

MECHANICAL DATA

Dimensions in mm

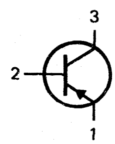
Fig. 1 SOT-89.



BOTTOM VIEW

Marking code

BST15 = BT1
BST16 = BT2



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 = 100 MHz					
$-I_C$ = 10 mA; $-V_{CE}$ = 10 V	f_T	>	15		MHz
Collector capacitance at f = 1 MHz					
$I_E = I_e = 0$; $-V_{CB}$ = 10 V	C_c	<	15		pF

* Mounted on an area of 2,5 cm^2 of a ceramic substrate; thickness 0,7 mm.

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in miniature plastic packages intended for use in amplifier and switching applications. Complementary p-n-p types are BST15/16.

QUICK REFERENCE DATA

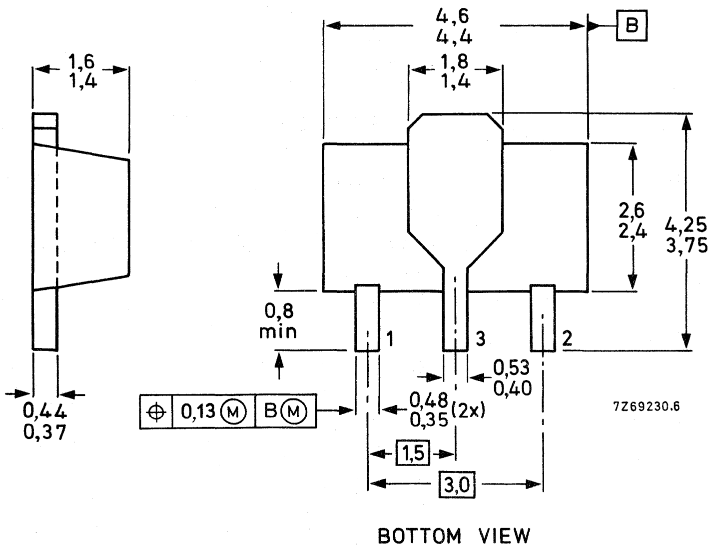
			BST39	BST40	
Collector-base voltage (open emitter)	V_{CBO}	max.	400	300	V
Collector-emitter voltage (open base)	V_{CEO}	max.	350	250	V
Collector current (d.c.)	I_C	max.	1		A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1		W
Junction temperature	T_j	max.	150		°C
D.C. current gain V_{CE} = 10 V; I_C = 20 mA	h_{FE}	min.	40		
Transition frequency at f = 100 MHz V_{CE} = 10 V; I_C = 10 mA	f_T	min.	70		MHz

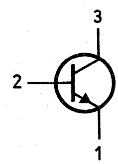
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-89.

Marking code
BST39 = AT1
BST40 = AT2





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}	$\leqslant$	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
D.C. 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	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 = 100 MHz $V_{CE} = 10$ V; $I_C = 10$ mA	f_T	$\geqslant$	70	MHz

* Mounted on an area of 2,5 cm^2 of a ceramic substrate; thickness 0,7 mm.

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 package.

P-N-P complements are BST60, 61, 62 respectively.

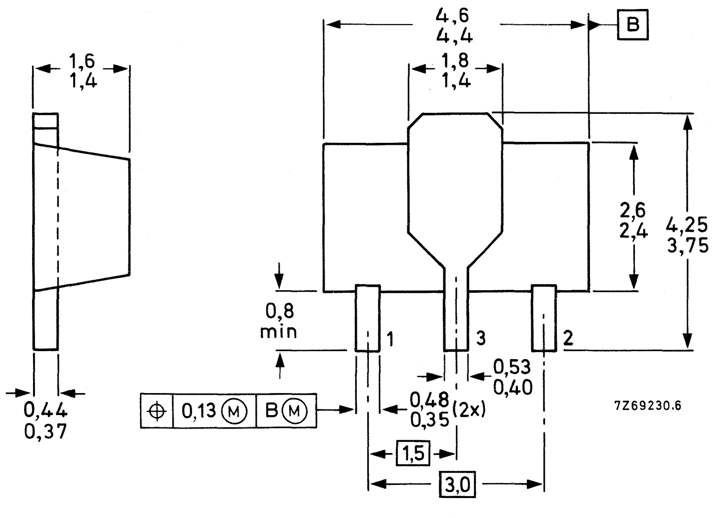
QUICK REFERENCE DATA

			BST50	BST51	BST52	
Collector-base voltage (open emitter)	V_{CBO}	max.	60	80	90	V
Collector-emitter voltage	V_{CER}	max.	45	60	80	V
Collector current	I_C	max.	0,5	0,5	0,5	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		1		W
D.C. current gain I_C = 500 mA; V_{CE} = 10 V	h_{FE}	>		2000		
Collector-emitter saturation voltage I_C = 500 mA; I_B = 0,5 mA	V_{CEsat}	<		1,3		V
Turn-off time I_C = 500 mA; $I_{Bon} = -I_{Boff}$ = 0,5 mA	t_{off}	typ.		1500		ns

MECHANICAL DATA

Dimensions in mm

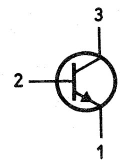
Fig. 1 SOT-89.



BOTTOM VIEW

Marking code

BST50 = AS1
BST51 = AS2
BST52 = AS3



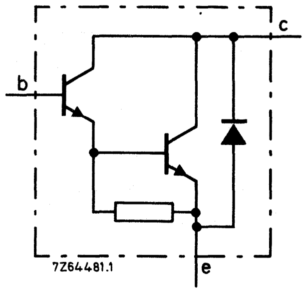


Fig. 2 Circuit diagram.

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_{CEO}	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

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

▲ Device mounted on a ceramic substrate; area = 2,5 cm^2, thickness = 0,7 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

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

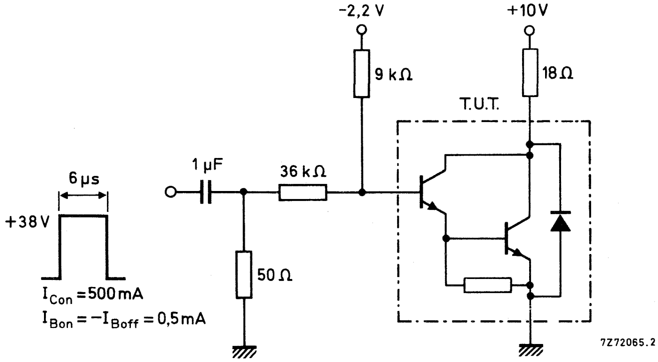


Fig. 3 Switching times test circuit.

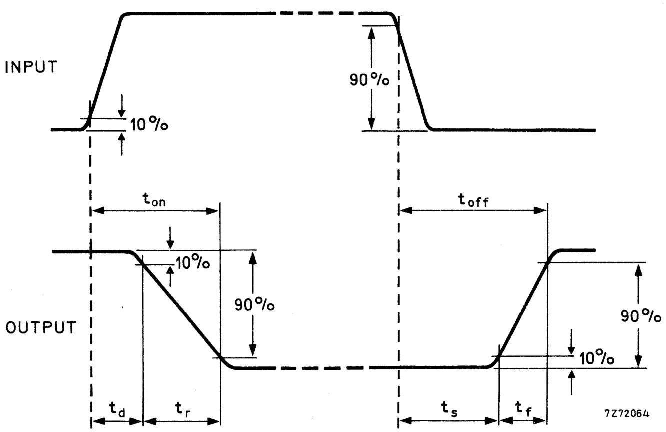


Fig. 4 Switching times waveform.

* Measured under pulsed conditions.

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 package.

N-P-N complements are BST50, BST51 and BST52 respectively.

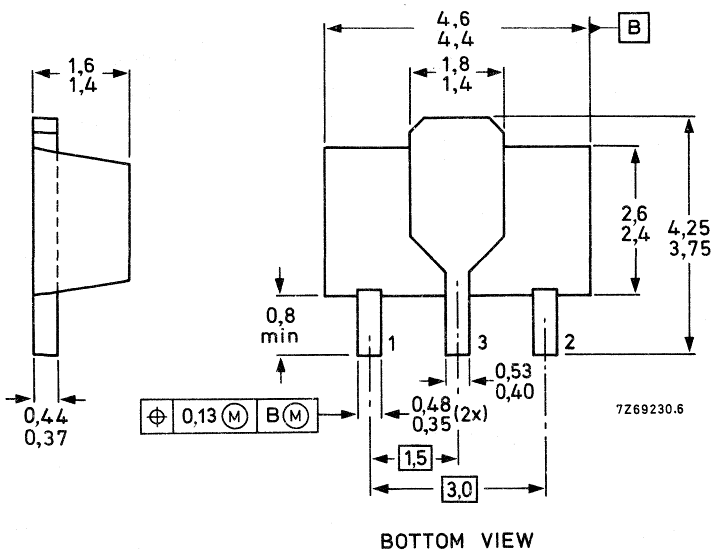
QUICK REFERENCE DATA

			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

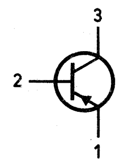
Dimensions in mm

Fig. 1 SOT-89.



Marking code

BST60 = BS1
BST61 = BS2
BST62 = BS3



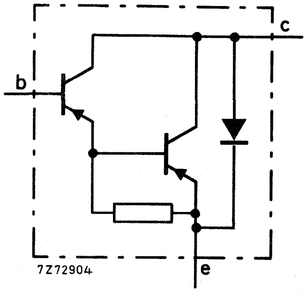


Fig. 2 Circuit diagram.

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	$-V_{CEO}$	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

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

▲ Device mounted on a ceramic substrate area 2,5 cm^2, thickness = 0,7 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

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

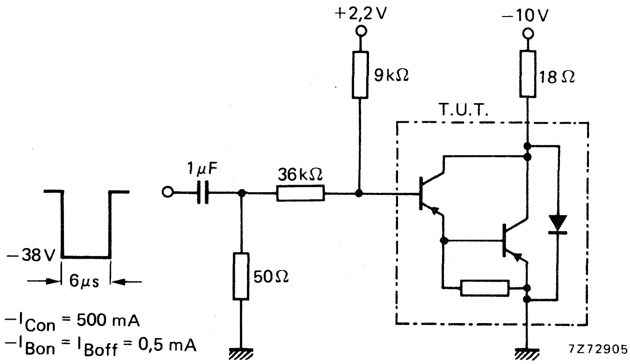


Fig. 3 Switching times test circuit.

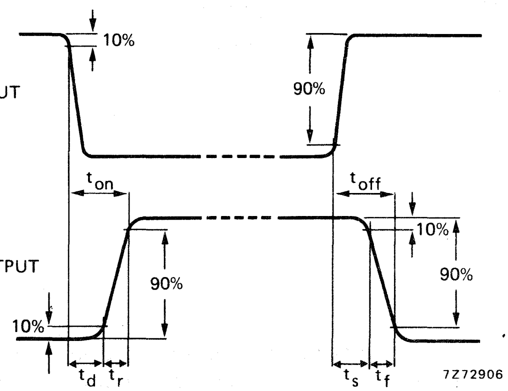


Fig. 4 Switching times waveform.

* Measured under pulsed conditions.

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors in TO-39 metal packages with the collector connected to the case. These transistors are intended for general industrial applications.

QUICK REFERENCE DATA

			BSV15	BSV16	BSV17	
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40	60	80	V
Collector current (d.c.)	$-I_C$	max.		1,0		A
Total power dissipation						
up to T_{amb} = 25 °C	P_{tot}	max.		0,8		W
up to T_{case} = 25 °C	P_{tot}	max.		5,0		W
Junction temperature	T_j	max.		200		°C
Transition frequency at f = 100 MHz $-I_C$ = 50 mA; $-V_{CE}$ = 10 V	f_T	>		50		MHz

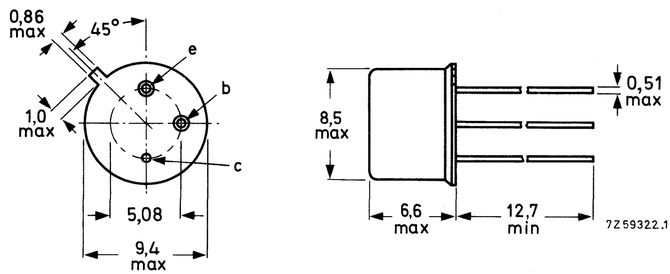
		BSV15–10 BSV16–10 BSV17–10	BSV15–16 BSV16–16
D.C. current gain $-I_C$ = 100 mA; $-V_{CE}$ = 1 V	h_{FE}	63–160	100–250

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case



Maximum lead diameter is guaranteed only for 12,7 mm.

RATINGS

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

			BSV15	BSV16	BSV17	
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40	60	80	V
Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	40	60	90	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	V
Collector current (d.c.)	$-I_C$	max.		1,0		A
Base current (d.c.)	$-I_B$	max.		200		mA
Total power dissipation						
up to T_{amb} = 25 °C	P_{tot}	max.		0,8		W
up to T_{case} = 25 °C	P_{tot}	max.		5,0		W
up to T_{mb} = 50 °C	P_{tot}	max.		5,0		W
Storage temperature range	T_{stg}			--65 to +150		°C
Junction temperature	T_j	max.		200		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	220	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	35	K/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	30	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			BSV15	BSV16	BSV17	
Collector cut-off currents						
$V_{BE} = 0; -V_{CE} = 40$ V	$-I_{CES}$	<	100	–	–	nA
$V_{BE} = 0; -V_{CE} = 40$ V; $T_{amb} = 150$ °C	$-I_{CES}$	<	50	–	–	μA
$V_{BE} = 0; -V_{CE} = 60$ V	$-I_{CES}$	<	–	100	–	nA
$V_{BE} = 0; -V_{CE} = 60$ V; $T_{amb} = 150$ °C	$-I_{CES}$	<	–	50	–	μA
$V_{BE} = 0; -V_{CE} = 80$ V	$-I_{CES}$	<	–	–	100	nA
$V_{BE} = 0; -V_{CE} = 80$ V; $T_{amb} = 150$ °C	$-I_{CES}$	<	–	–	50	μA
$-V_{BE} = 0,2$ V; $-V_{CE} = 40$ V; $T_{amb} = 100$ °C	$-I_{CEX}$	<	50	–	–	μA
$-V_{BE} = 0,2$ V; $-V_{CE} = 60$ V; $T_{amb} = 100$ °C	$-I_{CEX}$	<	–	50	–	μA
$-V_{BE} = 0,2$ V; $-V_{CE} = 80$ V; $T_{amb} = 100$ °C	$-I_{CEX}$	<	–	–	50	μA
Emitter cut-off current						
$I_C = 0; -V_{EB} = 4$ V	$-I_{EBO}$	<	50	50	50	nA
Breakdown voltages						
$I_B = 0; -I_C = 50$ mA; $t_p = 200$ μs; $\delta = 0{,}01$	$-V_{(BR)CEO}$	>	40	60	80	V
$V_{BE} = 0; -I_C = 10$ μA	$-V_{(BR)CES}$	>	40	60	90	V
$I_C = 0; -I_E = 10$ μA	$-V_{(BR)EBO}$	>	5	5	5	V

Base-emitter voltage				
$-I_C = 100$ mA; $-V_{CE} = 1$ V	$-V_{BE}$	<	1,0	V
$-I_C = 500$ mA; $-V_{CE} = 1$ V	$-V_{BE}$	typ.	0,85	V
			0,7 to 1,4	V
Saturation voltage				
$-I_C = 500$ mA; $-I_B = 25$ mA	$-V_{CEsat}$	<	1,0	V
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0; -V_{CB} = 10$ V **BSV15; BSV16**	C_c	typ.	20	pF
		<	30	pF
$I_E = I_e = 0; -V_{CB} = 10$ V **BSV17**	C_c	typ.	15	pF
		<	25	pF
Emitter capacitance at f = 1 MHz				
$I_C = I_c = 0; -V_{EB} = 0{,}5$ V	C_e	typ.	180	pF
Transition frequency at f = 100 MHz				
$-I_C = 50$ mA; $-V_{CE} = 10$ V	f_T	>	50	MHz

CHARACTERISTICS (continued)

			BSV15–10 BSV16–10 BSV17–10	BSV15–16 BSV16–16	
D.C. current gain					
$-I_C = 0{,}1$ mA; $-V_{CE} = 1$ V	h_{FE}	>	20	30	
		typ.	75	120	
$-I_C = 100$ mA; $-V_{CE} = 1$ V	h_{FE}	typ.	100	160	
			63 to 160	100 to 250	
$-I_C = 500$ mA; $-V_{CE} = 1$ V	h_{FE}	>	25	35	
		typ.	55	85	
h-parameter at f = 1 kHz					
$-I_C = 1$ mA; $-V_{CE} = 5$ V					
Small signal current gain	h_{fe}	>	20		
Switching times					
Turn-on time					
$-I_C = 100$ mA; $-I_B = +I_{BM} = 5$ mA	t_{on}	<	500		ns
Turn-off time					
$-I_C = 100$ mA; $-I_B = +I_{BM} = 5$ mA					
Storage time	t_s	<	500		ns
Fall time	t_f	<	150		ns

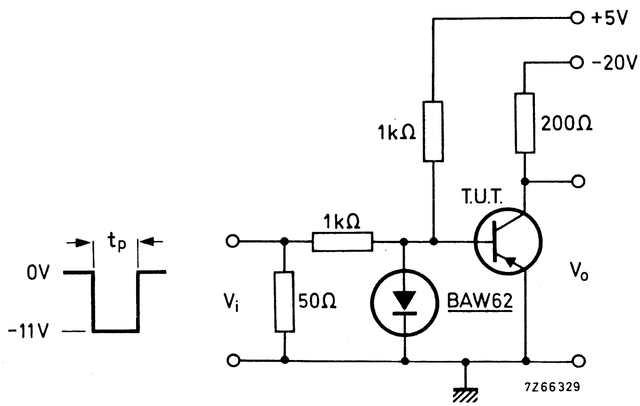


Fig. 2 Test circuit.

Pulse generator:

Pulse duration	t_p	⩾ 10 μs
Rise time	t_r	⩽ 15 ns
Fall time	t_f	⩽ 15 ns
Source impedance	R_S	= 50 Ω

Oscilloscope:

Rise time	⩽ 15 ns
Input impedance	⩾ 100 kΩ

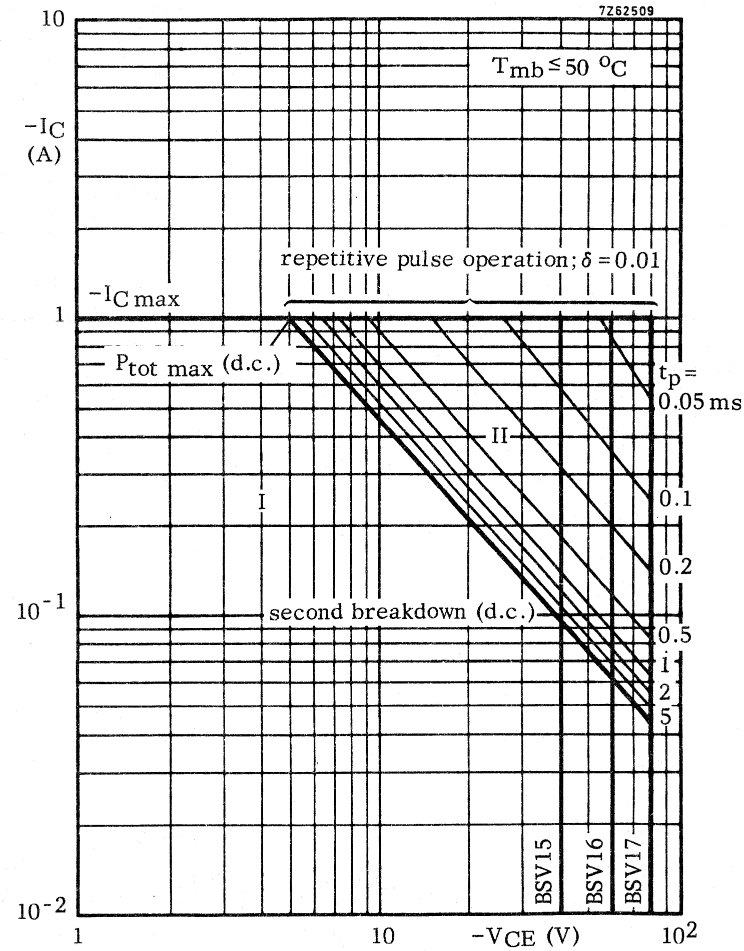


Fig. 3.

Safe Operating Area with the transistor forward biased

I Region of permissible d.c. operation

II Permissible extension for repetitive pulse operation.

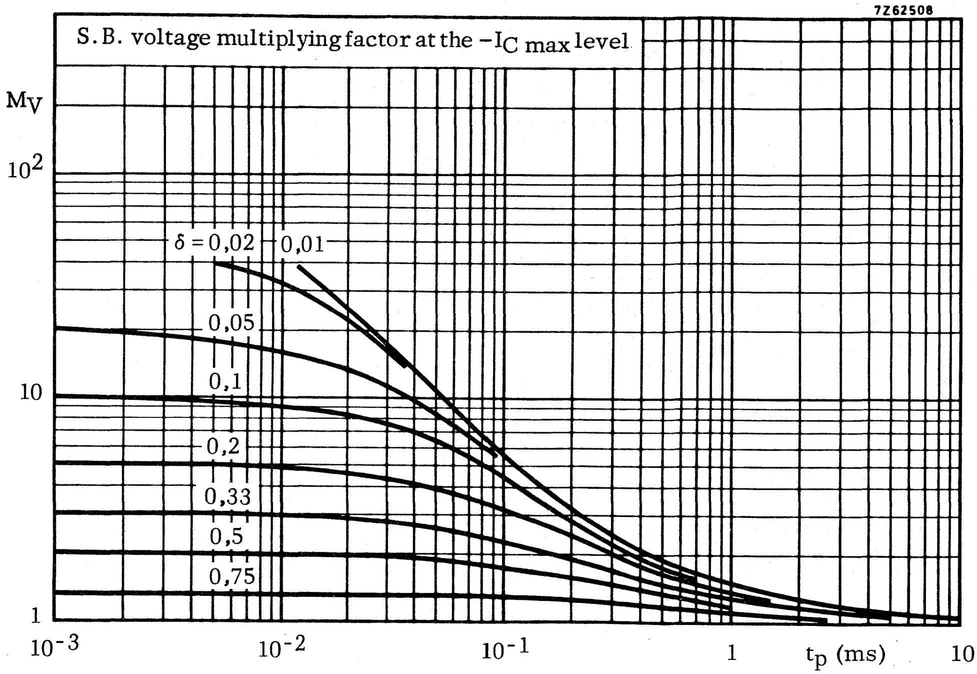

7Z62508
S.B. voltage multiplying factor at the $-I_{C\,max}$ level
M_V
10^2
10
1
$\delta = 0{,}02$
0,01
0,05
0,1
0,2
0,33
0,5
0,75
10^{-3}
10^{-2}
10^{-1}
1
t_p (ms)
10

Fig. 4.

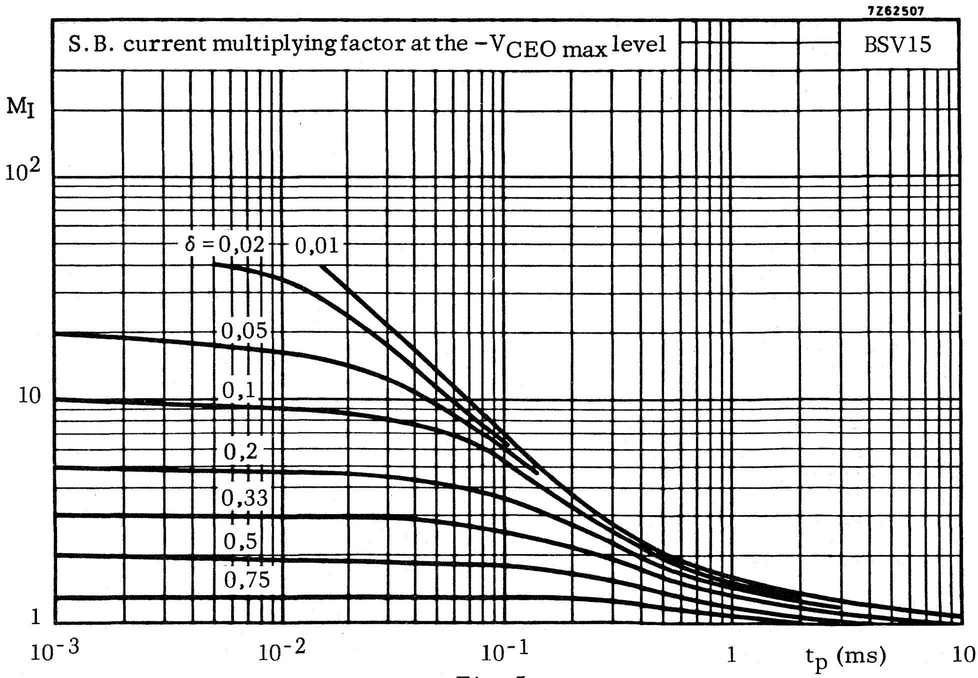

7Z62507
S.B. current multiplying factor at the $-V_{CEO\,max}$ level
BSV15
M_I
10^2
10
1
$\delta = 0{,}02$
0,01
0,05
0,1
0,2
0,33
0,5
0,75
10^{-3}
10^{-2}
10^{-1}
1
t_p (ms)
10

Fig. 5.

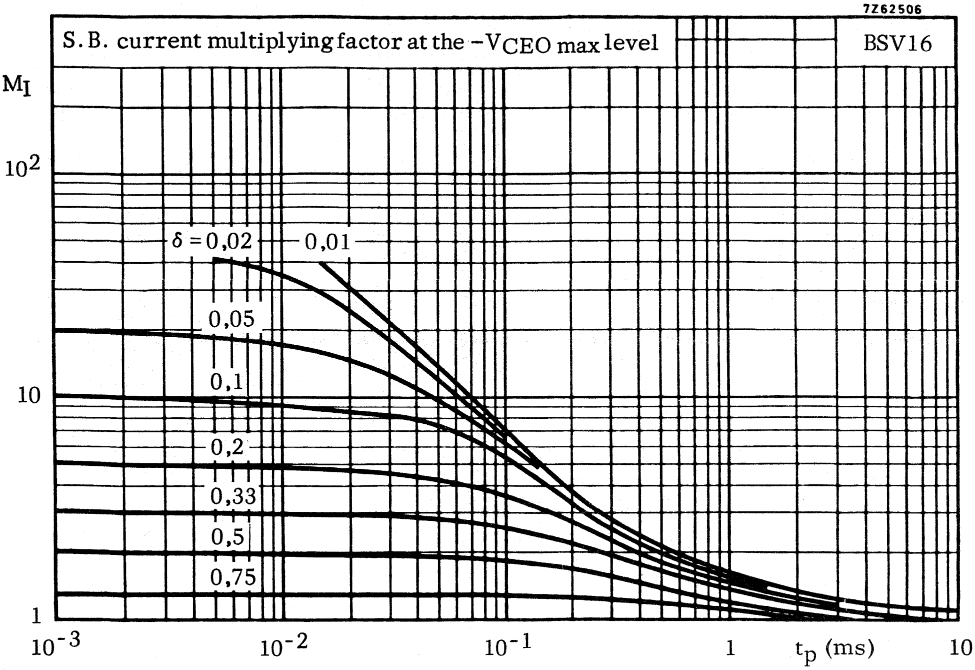

7Z62506
S.B. current multiplying factor at the $-V_{CEO\,max}$ level
BSV16
M_I
10^2
10
1
δ = 0,02
0,01
0,05
0,1
0,2
0,33
0,5
0,75
10^{-3}
10^{-2}
10^{-1}
1
t_p (ms)
10

Fig. 6.

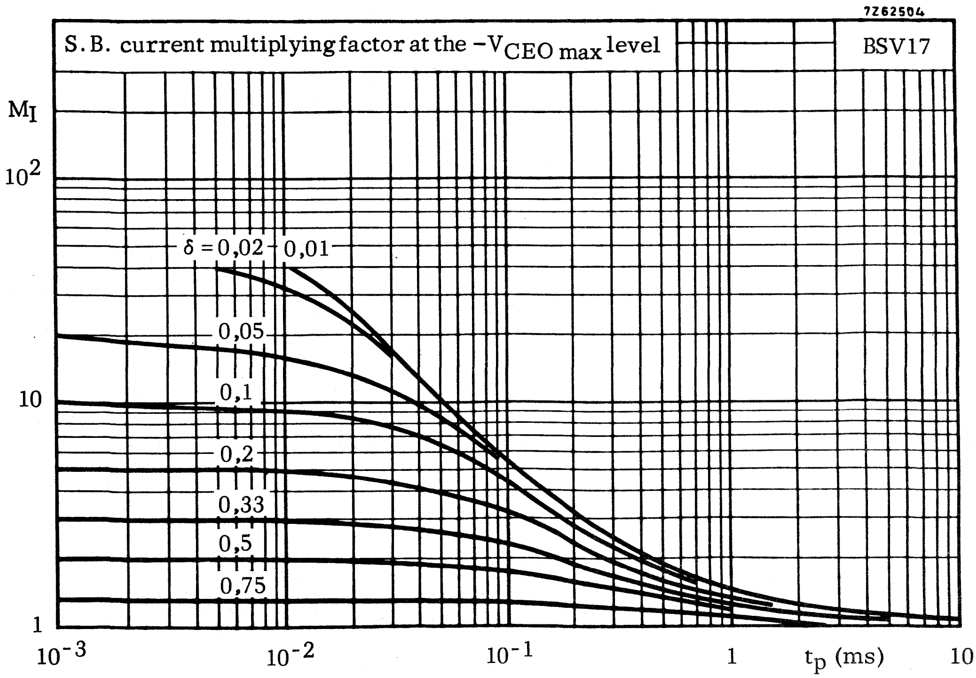

7Z62504
S.B. current multiplying factor at the $-V_{CEO\,max}$ level
BSV17
M_I
10^2
10
1
δ = 0,02
0,01
0,05
0,1
0,2
0,33
0,5
0,75
10^{-3}
10^{-2}
10^{-1}
1
t_p (ms)
10

Fig. 7.

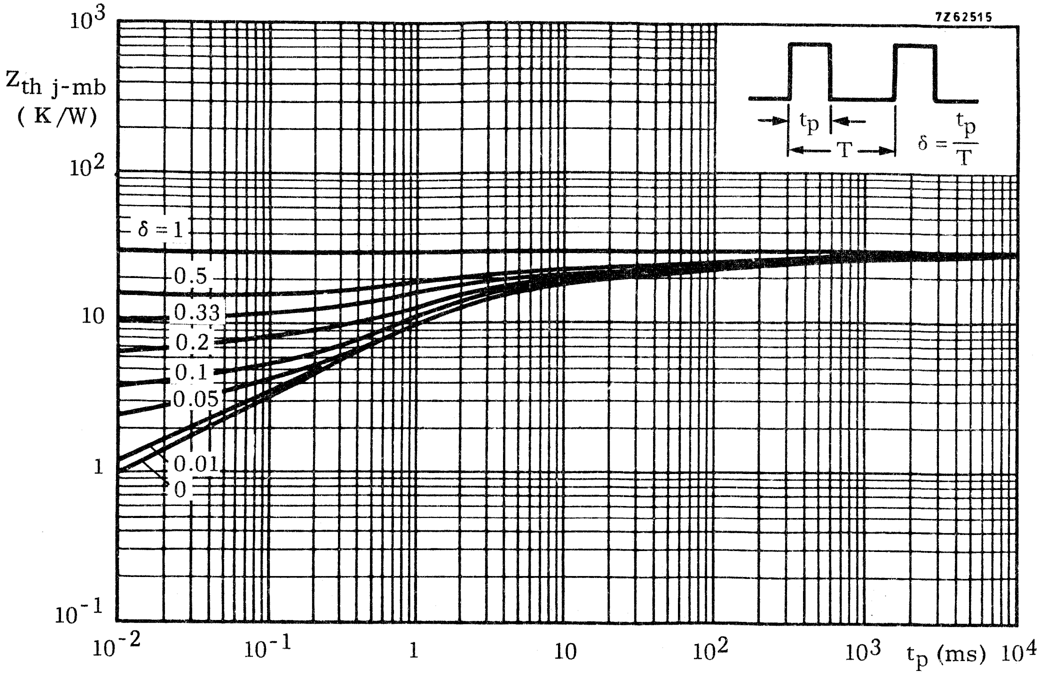

7Z62515
$Z_{th\ j\text{-}mb}$ (K/W)
10^3
10^2
10
1
10^{-1}
$\delta = 1$
0.5
0.33
0.2
0.1
0.05
0.01
0
t_p
T
$\delta = \frac{t_p}{T}$
10^{-2}
10^{-1}
1
10
10^2
10^3
t_p (ms)
10^4

Fig. 8.

SILICON PLANAR EPITAXIAL TRANSISTORS

- **High-speed switching**

N-P-N transistor in a microminiature plastic package. 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		>	400	MHz
$I_C = 10$ mA; $V_{CE} = 10$ V	f_T	typ.	500	MHz
Storage time				
$I_C = I_B = -I_{BM} = 10$ mA	t_s	<	13	ns

MECHANICAL DATA

Dimensions in mm

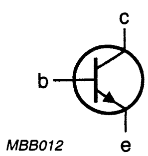
Marking code

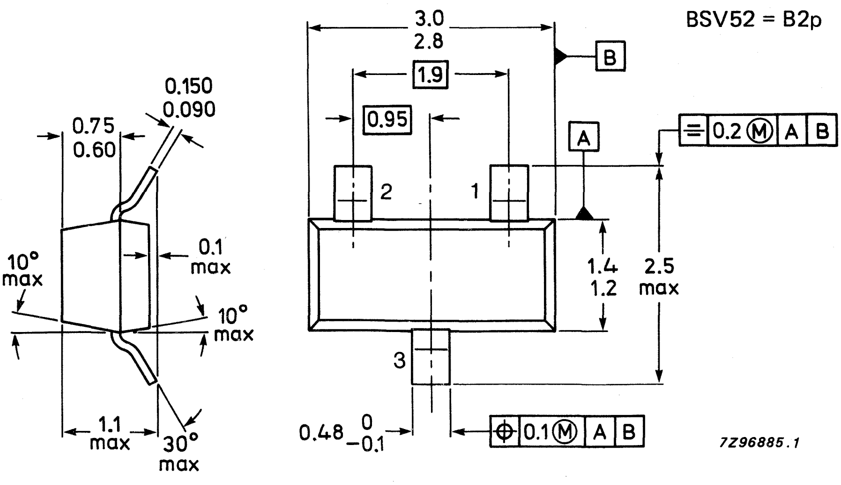
BSV52 = B2p

Fig. 1 SOT-23.

Pinning:

1 = base
2 = emitter
3 = collector





Reverse pinning types are available on request.

TOP VIEW

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	20	V
Collector-emitter voltage (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 an FR4 printed-circuit board 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

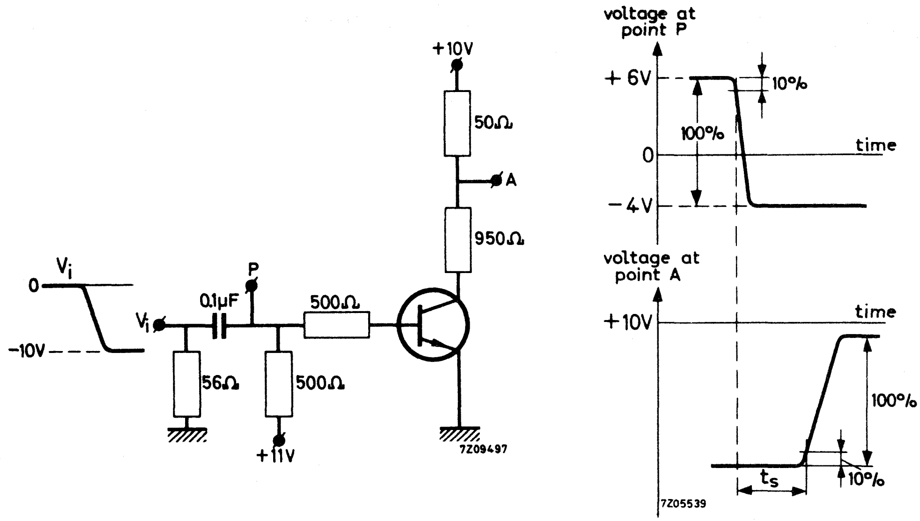


Fig. 2 Test circuit and waveform storage time.

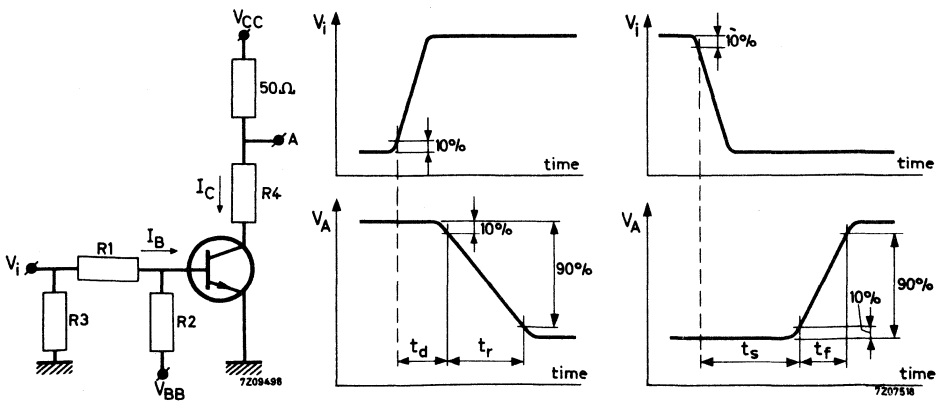


Fig. 3 Test circuit and waveforms turn on and turn off time.

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.

SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a TO-39 metal package primarily intended for use as a print hammer drive. It has good high current saturation characteristics.

QUICK REFERENCE DATA

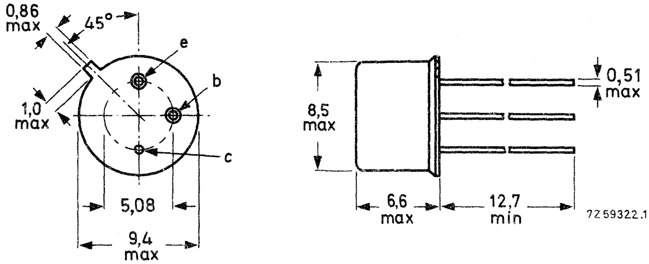
Collector-base voltage (open emitter)	V_{CBO}	max.	100 V
Collector-emitter voltage (open base)	V_{CEO}	max.	60 V
Collector current (peak value)	I_{CM}	max.	5,0 A
Total power dissipation up to T_{case} = 50 °C	P_{tot}	max.	5,0 W
Junction temperature	T_j	max.	175 °C
D.C. current gain I_C = 2 A; V_{CE} = 2 V	h_{FE}	>	40
Transition frequency at f = 100 MHz I_C = 0,5 A; V_{CE} = 5 V	f_T	typ.	100 MHz
Turn-off time when switched from I_{Con} = 5 A; I_{Bon} = 0,5 A to cut-off with $-I_{Boff}$ = 0,5 A	t_{off}	<	1,2 μs

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case



Maximum lead diameter is guaranteed only for 12,7 mm.

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	100	V
Collector-emitter voltage ($R_{BE} \leqslant 50\ \Omega$)	V_{CER}	max.	80	V
Collector-emitter voltage (open base)	V_{CEO}	max.	60	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V
Collector current (d.c.)	I_C	max.	2,0	A
Collector current (peak value)	I_{CM}	max.	5,0	A
Base current (d.c.)	I_B	max.	1,0	A
Total power dissipation up to T_{case} = 50 °C	P_{tot}	max.	5,0	W
Storage temperature range	T_{stg}		−65 to + 150	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to case	$R_{th\ j\text{-}c}$	=	25	K/W

CHARACTERISTICS

T_j = 25 °C

Collector cut-off current $I_E = 0$; V_{CB} = 60 V	I_{CBO}	<	10	μA
Emitter cut-off current $I_C = 0$; V_{EB} = 4 V	I_{EBO}	<	10	μA
Saturation voltages I_C = 5 A; I_B = 0,5 A	V_{CEsat}	<	1,0	V
	V_{BEsat}	<	1,8	V
D.C. current gain I_C = 2 A; V_{CE} = 2 V	h_{FE}	>	40	
Collector capacitance at f = 1 MHz $I_E = I_e = 0$; V_{CB} = 10 V	C_c	<	80	pF
Transition frequency at f = 100 MHz I_C = 0,5 A; V_{CE} = 5 V	f_T	typ.	100	MHz
Switching times I_{Con} = 5 A; $I_{Bon} = -I_{Boff}$ = 0,5 A $-V_{BEoff}$ = 2 V turn-on time	t_{on}	<	0,6	μs
turn-off time	t_{off}	<	1,2	μs

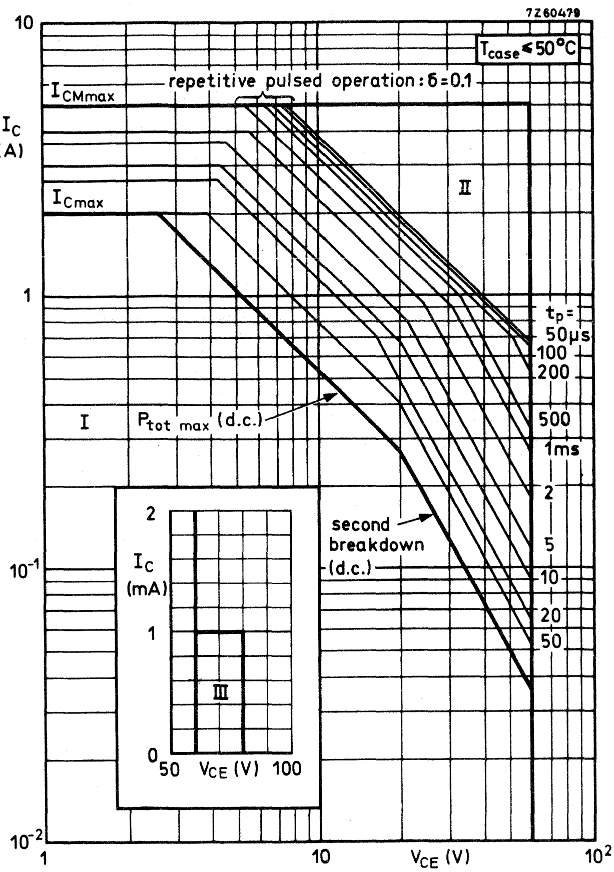


Fig. 2.

Safe Operating Area

I Region of permissible d.c. operation
II Permissible extension for repetitive pulsed operation
III D.C. operation in this region is allowable, provided $R_{BE} \leq 50\ \Omega$.

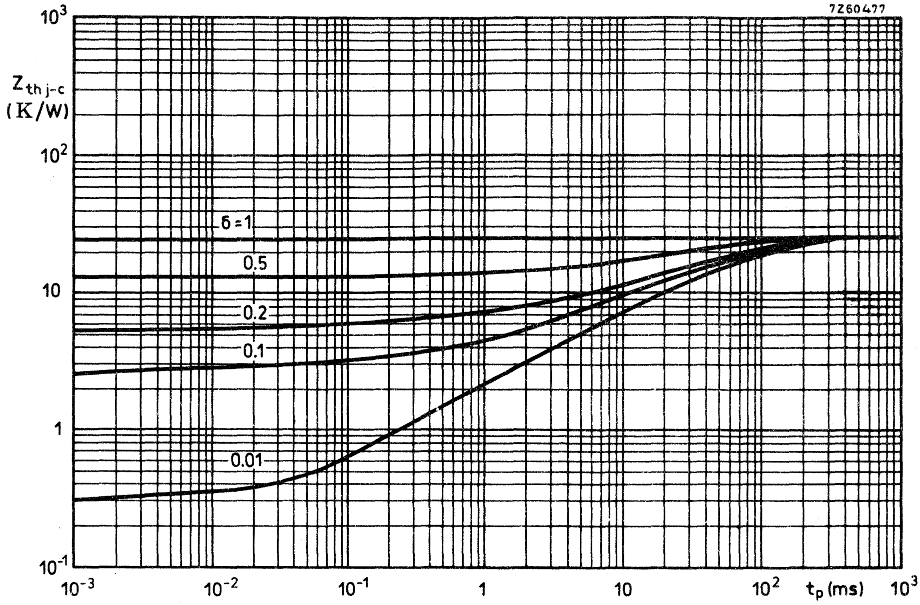

7Z60477
$Z_{th\,j\text{-}c}$ (K/W)
10^3
10^2
10
1
10^{-1}
δ = 1
0.5
0.2
0.1
0.01
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
t_p (ms)
10^3

Fig. 3.

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors primarily intended for general purpose industrial and switching applications.

QUICK REFERENCE DATA

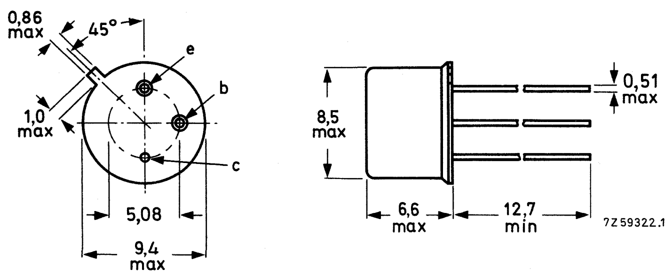
			BSW66A	BSW67A	BSW68A	
Collector-base voltage (open emitter)	V_{CBO}	max.	100	120	150	V
Collector-emitter voltage (open base)	V_{CEO}	max.	100	120	150	V
Collector current (peak value)	I_{CM}	max.		2		A
Total power dissipation up to T_{case} = 25 °C	P_{tot}	max.		5,0		W
Collector-emitter saturation voltage I_C = 500 mA; I_B = 50 mA	V_{CEsat}	<		400		mV
D.C. current gain I_C = 10 mA; V_{CE} = 5 V	h_{FE}	>		30		
I_C = 500 mA; V_{CE} = 5 V	h_{FE}	>		30		
Transition frequency at f = 100 MHz I_C = 100 mA; V_{CE} = 20 V	f_T	typ.		130		MHz

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case.



Maximum lead diameter is guaranteed only for 12,7 mm.

RATINGS

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

			BSW66A	BSW67A	BSW68A	
Collector-base voltage (open emitter)	V_{CBO}	max.	100	120	150	V
Collector-emitter voltage (open base)	V_{CEO}	max.	100	120	150	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6	6	6	V

Collector current (d.c. or average)	I_C	max.	1	A
Collector current (peak value; $t_p \leq 20$ ms)	I_{CM}	max.	2	A
Total power dissipation up to				
$T_{amb} = 25\ ^oC$	P_{tot}	max.	0,8	W
$T_{case} = 25\ ^oC$	P_{tot}	max.	5,0	W
Storage temperature range	T_{stg}		−65 to + 150	^oC
Junction temperature	T_j	max.	200	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	220	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	35	K/W

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

Collector cut-off current				
$I_E = 0$; $V_{CB} = V_{CBOmax}$	I_{CBO}	<	100	μA
$I_E = 0$; $V_{CB} = ½V_{CBOmax}$	I_{CBO}	<	100	nA
$I_E = 0$; $V_{CB} = ½V_{CBOmax}$; $T_j = 150\ ^oC$	I_{CBO}	<	50	μA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 6$ V	I_{EBO}	<	100	μA
$I_C = 0$; $V_{EB} = 3$ V	I_{EBO}	<	100	nA

			BSW66A	BSW67A	BSW68A	
Collector-emitter breakdown voltage						
$I_B = 0$; $I_C = 10$ mA	$V_{(BR)CEO}$	>	100	120	150	V

Saturation voltages				
$I_C = 100$ mA; $I_B = 10$ mA	V_{CEsat}	<	150	mV
	V_{BEsat}	<	900	mV
$I_C = 500$ mA; $I_B = 50$ mA	V_{CEsat}	<	400	mV
	V_{BEsat}	<	1,1	V
$I_C = 1,0$ A; $I_B = 150$ mA	V_{CEsat}	<	1,0	V
	V_{BEsat}	<	1,4	V

D.C. current gain				
I_C = 10 mA; V_{CE} = 5 V	h_{FE}	>	30	
I_C = 100 mA; V_{CE} = 5 V	h_{FE}	>	40	
I_C = 500 mA; V_{CE} = 5 V	h_{FE}	>	30	
I_C = 1,0 A; V_{CE} = 5 V	h_{FE}	>	10	
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	C_e	<	300	pF
Transition frequency at f = 100 MHz				
I_C = 100 mA; V_{CE} = 20 V	f_T	typ.	130	MHz
Turn-on time (see Fig. 2)				
I_{Con} = 500 mA; I_{Bon} = 50 mA; $-V_{BEoff}$ = 4 V	t_{on}	typ.	0,5	μs
Turn-off time (see Fig. 2)				
I_{Con} = 500 mA; $I_{Bon} = -I_{Boff}$ = 50 mA	t_{off}	typ.	0,9	μs

Pulse generator:
$t_p \geqslant$ 5 μs
$t_r \leqslant$ 10 ns
$t_f \leqslant$ 10 ns

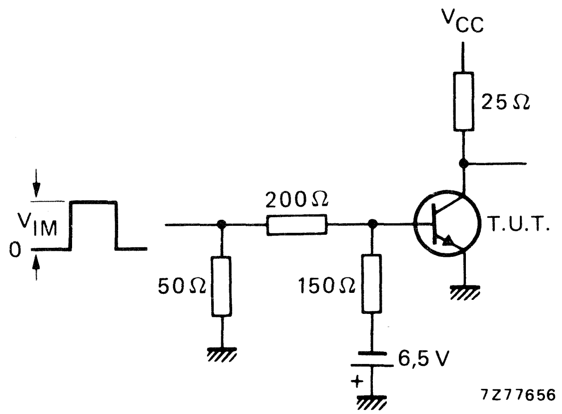


Fig. 2 Test circuit for saturated switching characteristics.
V_{CC} = 13 V; V_{IM} = 21 V.

SILICON PLANAR EPITAXIAL TRANSISTORS

NPN transistors in TO-18 metal packages, primarily intended for high-speed saturated switching and HF amplifier applications.

QUICK REFERENCE DATA

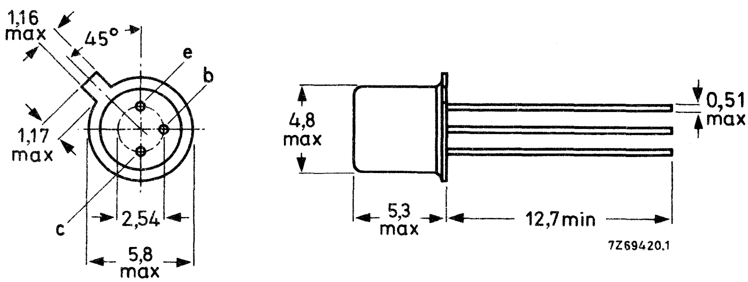
Collector-base voltage (open emitter)	V_{CBO}	max.	40 V
Collector-emitter voltage (open base)	V_{CEO}	max.	15 V
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	40 V
Collector current (peak value)	I_{CM}	max.	500 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	360 mW
DC current gain at T_j = 25 °C			
I_C = 10 mA; V_{CE} = 1 V	h_{FE}		40 to 120
I_C = 100 mA; V_{CE} = 2 V	h_{FE}	min.	20
Transition frequency at f = 100 MHz			
I_C = 10 mA; V_{CE} = 10 V	f_T	min.	500 MHz
Storage time			
$I_C = I_B = -I_{BM}$ = 10 mA	t_s	max.	13 ns

MECHANICAL DATA

Dimensions in mm

Fig.1 TO-18.

Collector connected to case



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.	15	V
Collector-emitter voltage with V_{BE} = 0	V_{CES}	max.	40	V
Emitter-base voltage (open collector)	V_{EBO}	max.	4.5	V
Collector current (peak value; t = 10 μs)	I_{CM}	max.	500	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	360	mW
Storage temperature range	T_{stg}	−65 to +150		°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	480	K/W
From junction to case	$R_{th\ j-c}$	=	150	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	max.	400	nA
$I_E = 0$; $V_{CB} = 20$ V; $T_j = 150$ °C	I_{CBO}	max.	30	μA
$V_{BE} = 0$; $V_{CE} = 15$ V; $T_j = 55$ °C	I_{CES}	max.	0.40	μA
$V_{BE} = 0$; $V_{CE} = 40$ V	I_{CES}	max.	1.0	μA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 4.5$ V	I_{EBO}	max.	10	μA
Currents at reverse biased emitter junction				
$V_{CE} = 15$ V; $-V_{BE} = 3$ V; $T_j = 55$ °C	I_{CEX}	max.	0.60	μA
	$-I_{BEX}$	max.	0.60	μA
Sustaining voltages				
$I_C = 10$ mA; $I_B = 0$	$V_{CEOsust}$	min.	15	V
$I_C = 10$ mA; $R_{BE} = 10\ \Omega$	$V_{CERsust}$	min.	20	V
Base-emitter voltage				
$I_C = 30\ \mu$A; $V_{CE} = 20$ V; $T_j = 100$ °C	V_{BE}	min.	0.35	V
Saturation voltages				
$I_C = 10$ mA; $I_B = 0.3$ mA	V_{CEsat}	max.	0.3	V
$I_C = 10$ mA; $I_B = 1$ mA	V_{CEsat}	max.	0.25	V
	V_{BEsat}		0.70 to 0.85	V
$I_C = 100$ mA; $I_B = 10$ mA	V_{CEsat}	max.	0.60	V
	V_{BEsat}	max.	1.50	V
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 5$ V	C_c	max.	4	pF
Emitter capacitance at f = 1 MHz				
$I_C = I_c = 0$; $V_{EB} = 1$ V	C_e	max.	4.5	pF

CHARACTERISTICS (continued)

DC current gain

I_C = 10 mA; V_{CE} = 1 V	h_{FE}		40 to 120
I_C = 10 mA; V_{CE} = 1 V; T_j = −55 °C	h_{FE}	min.	20
I_C = 100 mA; V_{CE} = 2 V	h_{FE}	min.	20

Transition frequency at 100 MHz

I_C = 10 mA; V_{CE} = 10 V	f_T	min.	500	MHz
		typ.	600	MHz

Switching times

Storage time

$I_C = I_B = -I_{BM}$ = 10 mA	t_s	typ.	6	ns
		max.	13	ns

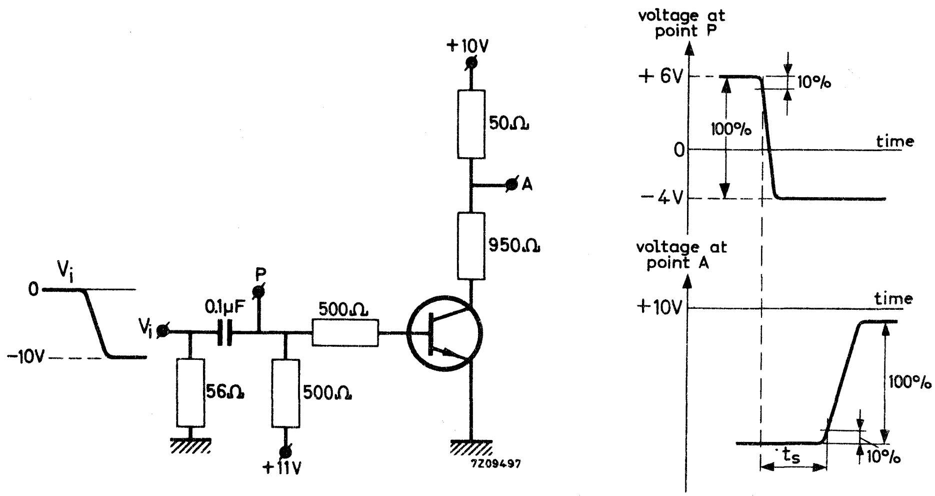


Fig. 2 Test circuit and timing waveforms.

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

Switching times

Turn on time

from $-V_{BE}$ = 1.5 V to I_C = 10 mA; I_B = 3 mA	t_{on}	max. 12	ns
from $-V_{BE}$ = 2.25 V to I_C = 100 mA; I_B = 40 mA	t_{on}	max. 7	ns

Turn off time

from I_C = 10 mA; I_B = 3 mA to cut-off with $-I_{BM}$ = 1.5 mA	t_{off}	max. 18	ns
from I_C = 100 mA; I_B = 40 mA to cut-off with $-I_{BM}$ = 20 mA	t_{off}	max. 21	ns

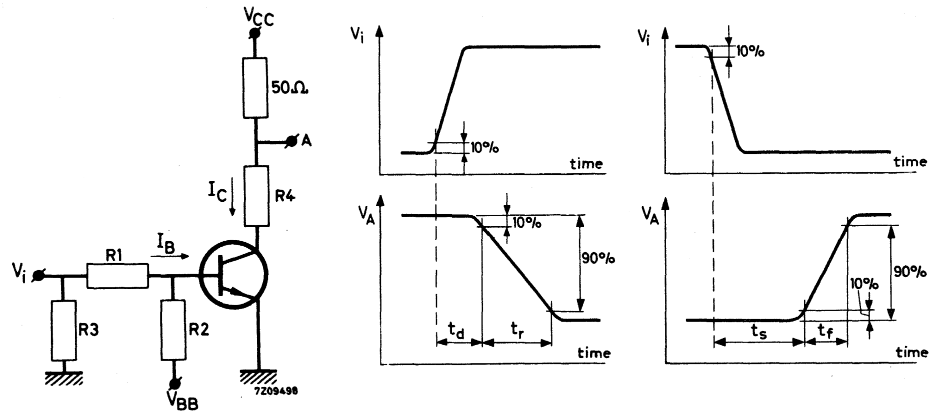


Fig. 3 Test circuit and timing waveforms.

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)	R1;R2 (kΩ)	R3 (Ω)	R4 (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
100	40	20	6	0.33	56	0	4.5	2.25	20	15.3	20

Note

$-I_{BM}$ 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.

SILICON PLANAR EPITAXIAL TRANSISTOR

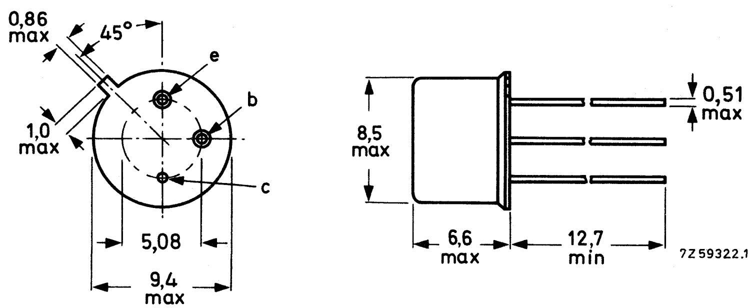
N-P-N silicon planar epitaxial transistor in a TO-39 package.

The BSX32 is designed for use in high current switching applications.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	65	V
Collector-emitter voltage (open base)	V_{CEO}	max.	40	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6	V
Collector current	I_C	max.	1	A
D.C. current gain I_C = 1 A; V_{CE} = 5 V	h_{FE}	min. typ.	20 60	
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	800	mW
Junction temperature	T_j	max.	200	°C
Transition frequency at f = 100 MHz I_C = 50 mA; V_{CE} = 10 V	f_T	min.	300	MHz

Fig. 1 TO-39. Dimensions in mm



RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	65	V
Collector-emitter voltage (open base)	V_{CEO}	max.	40	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6	V
Collector current	I_C	max.	1	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	800	mW
Total power dissipation up to T_{case} = 25 °C	P_{tot}	max.	3,5	W
Storage temperature range	T_{stg}		–65 to 150	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to case	$R_{th\ j\text{-}case}$	max.	50	K/W
From junction to ambient	$R_{th\ j\text{-}amb}$	max.	219	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector cut-off current $I_E = 0$; V_{CB} = 50 V	I_{CBO}	max.	4	μA
Collector-base breakdown voltage $I_E = 0$; I_C = 100 μA	$V_{(BR)CBO}$	min.	65	V
Emitter-base breakdown voltage $I_C = 0$; I_E = 100 μA	$V_{(BR)EBO}$	min.	6	V
Collector-emitter sustaining voltage $I_B = 0$; I_C = 10 mA	$V_{CEOsust}$	min.	40	V
Saturation voltages* I_C = 100 mA; I_B = 10 mA	V_{CEsat}	typ. max.	0,17 0,25	V V
I_C = 500 mA; I_B = 50 mA	V_{CEsat}	typ. max.	0,36 0,5	V V
I_C = 1 A; I_B = 100 mA	V_{CEsat}	typ. max.	0,6 0,85	V V
I_C = 100 mA; I_B = 10 mA	V_{BEsat}	typ. max.	0,8 0,9	V V
I_C = 500 mA; I_B = 50 mA	V_{BEsat}	max.	1,5	V
I_C = 1 A; I_B = 100 mA	V_{BEsat}	max.	2	V

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

CHARACTERISTICS (continued)

D.C. current gain*				
$I_C = 10$ mA; $V_{CE} = 1$ V	h_{FE}	min.	30	
$I_C = 100$ mA; $V_{CE} = 1$ V	h_{FE}	min. max.	60 150	
$I_C = 500$ mA; $V_{CE} = 1$ V	h_{FE}	min. typ.	25 60	
$I_C = 1$ A; $V_{CE} = 5$ V	h_{FE}	min. typ.	20 60	
$I_C = 100$ mA; $V_{CE} = 1$ V; $T_{amb} = -55$ ^oC	h_{FE}	min.	30	
$I_C = 500$ mA; $V_{CE} = 1$ V; $T_{amb} = -55$ ^oC	h_{FE}	min.	15	
Transition frequency at f = 100 MHz				
$I_C = 50$ mA; $V_{CE} = 10$ V	f_T	min.	300	MHz
Emitter-base capacitance at f = 1 MHz				
$I_C = 0$; $V_{EB} = 0{,}5$ V	C_e	max.	55	pF
Collector-base capacitance at f = 1 MHz				
$I_E = 0$; $V_{CB} = 10$ V	C_c	max.	10	pF
Turn-off time				
$I_C = 500$ mA; $V_{CC} = 30$ V $I_{B1} = 50$ mA	t_{on}	max.	35	ns
Turn-off time				
$I_C = 500$ mA; $V_{CC} = 30$ V $I_B = -I_{B2} = 50$ mA	t_{off}	max.	60	ns

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

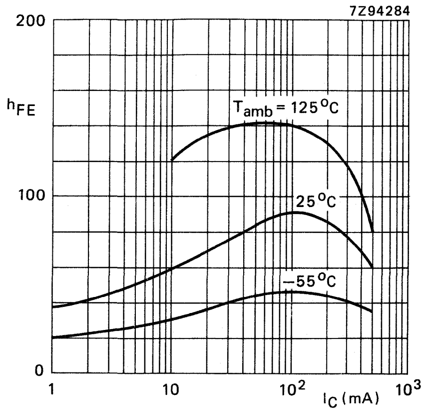


Fig. 2 D.C. current gain; V_{CE} = 1 V.

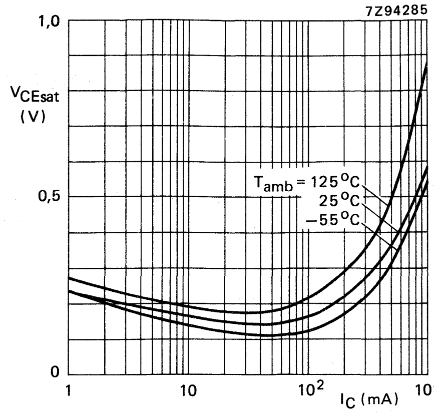


Fig. 3 Collector-emitter saturation voltage; $I_C = 10 \times I_B$.

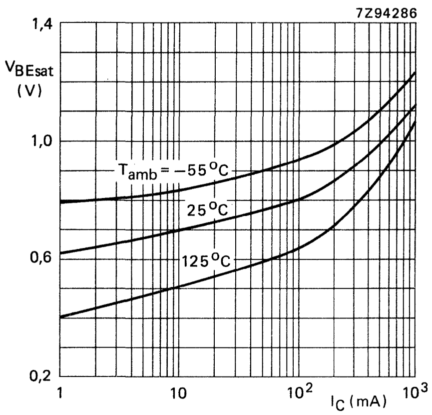


Fig. 4 Base-emitter saturation voltage; $I_C = 10 \times I_B$.

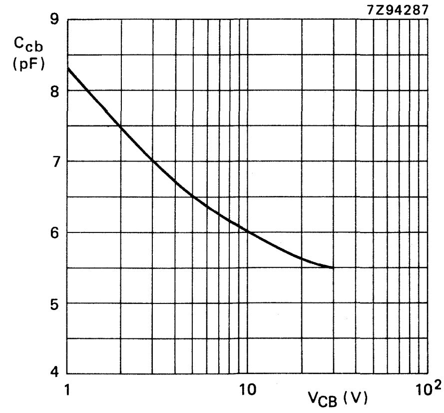


Fig. 5 Collector-base capacitance; I_E = 0.

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in TO-39 metal packages with the collector connected to the case. These transistors are intended for general industrial applications.

QUICK REFERENCE DATA

			BSX45	BSX46	BSX47	
Collector-emitter voltage (open base)	V_{CEO}	max.	40	60	80	V
Collector current (d.c.)	I_C	max.		1		A
Total power dissipation up to T_{case} = 25 °C	P_{tot}	max.		6,25		W
Junction temperature	T_j	max.		200		°C
Transition frequency at f = 100 MHz I_C = 50 mA; V_{CE} = 10 V	f_T	>		50		MHz

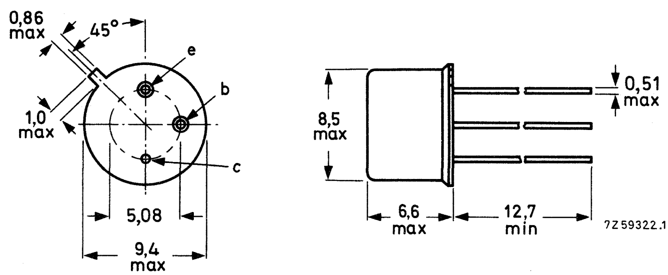
			BSX45–10 BSX46–10 BSX47–10	BSX45–16 BSX46–16
D.C. current gain I_C = 100 mA; V_{CE} = 1 V	h_{FE}	>	63	100
		<	160	250

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case.



Maximum lead diameter is guaranteed only for 12,7 mm.

RATINGS

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

			BSX45	BSX46	BSX47	
Collector-emitter voltage (open base)	V_{CEO}	max.	40	60	80	V
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	80	100	120	V
Emitter-base voltage (open collector)	V_{EBO}	max.	7	7	7	V
Collector current (d.c.)	I_C	max.		1		A
Base current (d.c.)	I_B	max.		200		mA
Total power dissipation up to T_{case} = 25 °C	P_{tot}	max.		6,25		W
Storage temperature range	T_{stg}			−65 to + 150		°C
Junction temperature	T_j	max.		200		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	200	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	28	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified			BSX45	BSX46	BSX47	
Collector cut-off currents						
V_{BE} = 0; V_{CE} = 60 V	I_{CES}	<	30	30	–	nA
V_{BE} = 0; V_{CE} = 60 V; T_{amb} = 150 °C	I_{CES}	<	10	10	–	μA
V_{BE} = 0; V_{CE} = 80 V	I_{CES}	<	–	–	30	nA
V_{BE} = 0; V_{CE} = 80 V; T_{amb} = 150 °C	I_{CES}	<	–	–	10	μA
V_{BE} = 0,2 V; V_{CE} = 60 V; T_{amb} = 100 °C	I_{CEX}	<	50	50	–	μA
V_{BE} = 0,2 V; V_{CE} = 80 V; T_{amb} = 100 °C	I_{CEX}	<	–	–	50	μA
Emitter cut-off current						
I_C = 0; V_{EB} = 5 V	I_{EBO}	<	10	10	10	nA
Collector-emitter breakdown voltage						
open base; I_C = 50 mA	$V_{(BR)CEO}$	>	40	60	80	V
V_{BE} = 0; I_C = 100 μA	$V_{(BR)CES}$	>	80	100	120	V
Emitter-base breakdown voltage						
open collector; I_E = 100 μA	$V_{(BR)EBO}$	>	7	7	7	V
Base-emitter voltage						
I_C = 100 mA; V_{CE} = 1 V	V_{BE}	<	1	1	1	V
I_C = 500 mA; V_{CE} = 1 V	V_{BE}	>	0,75	0,75	0,75	V
		<	1,50	1,50	1,50	V
I_C = 1 A; V_{CE} = 1 V	V_{BE}	<	2,00	2,00	2,00	V
Saturation voltage						
I_C = 1000 mA; I_B = 100 mA	V_{CEsat}	<	1,0	1,0	–	V
I_C = 500 mA; I_B = 25 mA	V_{CEsat}	<	–	–	0,9	V
Transition frequency at f = 100 MHz						
I_C = 50 mA; V_{CE} = 10 V	f_T	>	50	50	50	MHz
Collector capacitance at f = 1 MHz						
$I_E = I_e$ = 0; V_{CB} = 10 V	C_c	<	25	20	15	pF
Emitter capacitance at f = 1 MHz						
$I_C = I_c$ = 0; V_{EB} = 0,5 V	C_e	<	80	80	80	pF
Noise figure at f = 1 kHz						
I_C = 100 μA; V_{CE} = 10 V						
R_S = 1 kΩ; B = 200 Hz	F	typ.	3,5	3,5	3,5	dB

			BSX45–10 BSX46–10 BSX47–10	BSX45–16 BSX46–16	
D.C. current gain					
I_C = 100 μA; V_{CE} = 1 V	h_{FE}	>	15	25	
		typ.	40	90	
I_C = 100 mA; V_{CE} = 1 V	h_{FE}	>	63	100	
		typ.	100	160	
		<	160	250	
I_C = 500 mA; V_{CE} = 1 V	h_{FE}	>	25	35	
		typ.	40	60	
I_C = 1 A; V_{CE} = 1 V	h_{FE}	typ.	20	30	
Switching times (see Fig. 2)					
I_{Con} = 100 mA; I_{Bon} = $-I_{Boff}$ = 5 mA					
Turn-on time	t_{on}	<	200		ns
Turn-off time	t_{off}	<	850		ns

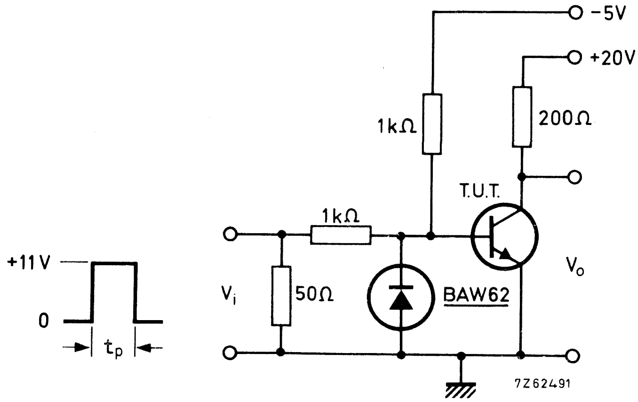


Fig. 2 Switching times test circuit.

Pulse generator:

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

Oscilloscope:

Rise time	t_r	⩽	15 ns
Input impedance	Z_I	⩾	100 kΩ

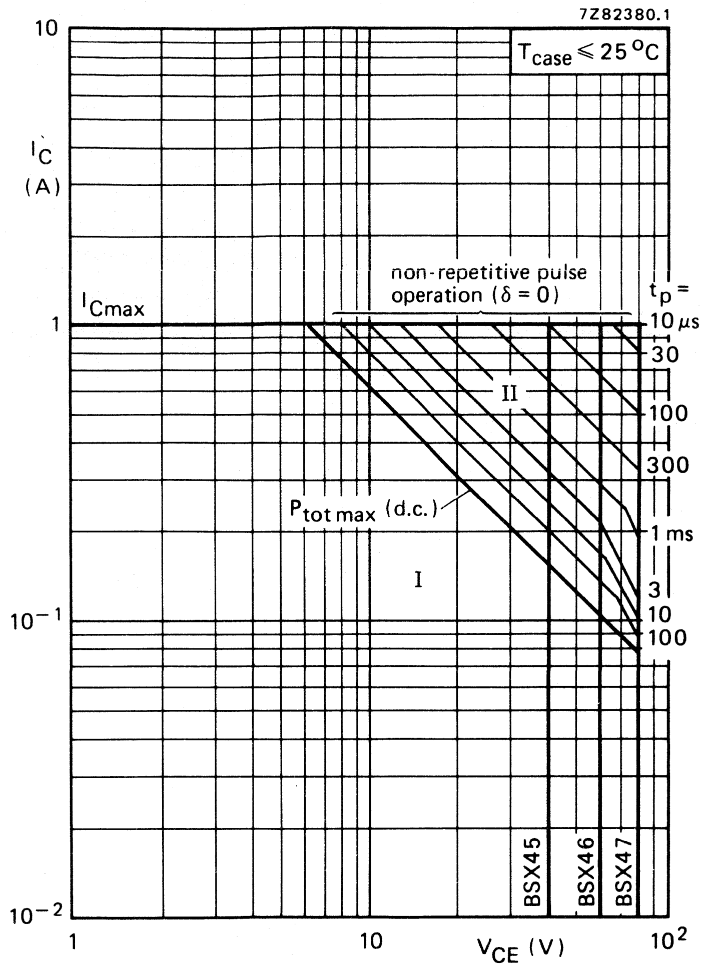


Fig. 3 Safe Operating ARea; $T_{case} \leqslant 25\,^oC$*.

I Region of permissible d.c. operation.
II Permissible extension for non-repetitive pulse operation.

* At case temperatures > 25 °C derate constant power portion of boundaries such that:

$$P_{(t_p,\,o)} = \frac{200 - T_{case}}{Z_{th\,(t_p,\,o)}}.$$ (For very short forward mode pulse durations, i.e. $t_p < 3$ μs, assume 3 μs values for Z_{th}.)

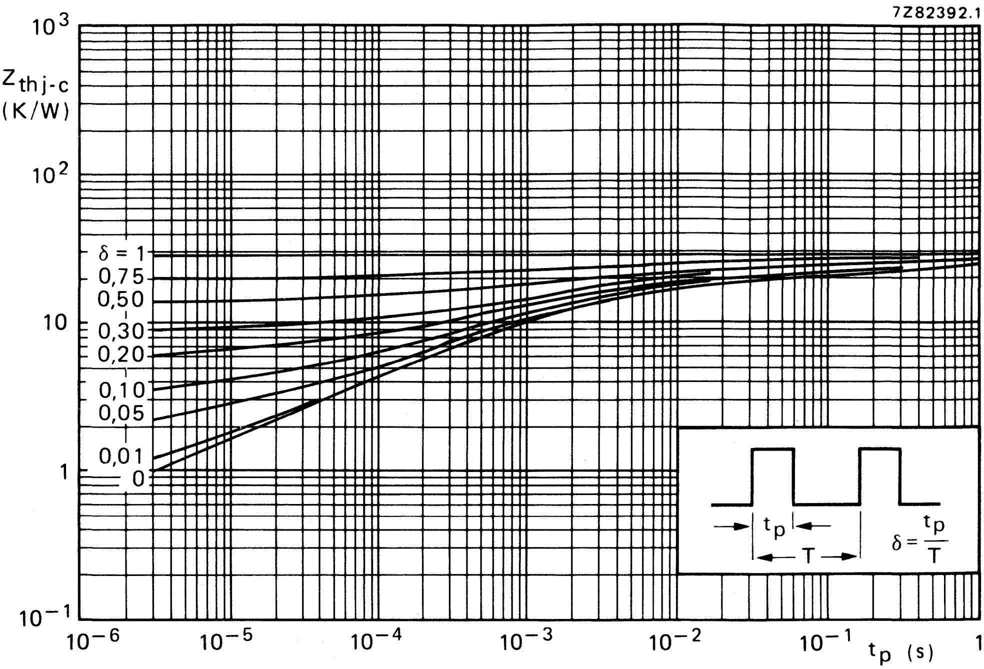


Fig. 4 Thermal impedance versus pulse duration. Stabilization time is 10 s.

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in a TO-39 metal package with the collector connected to the case. The BSX59, BSX60 and BSX61 are primarily intended for very high speed core-driving purposes.

QUICK REFERENCE DATA

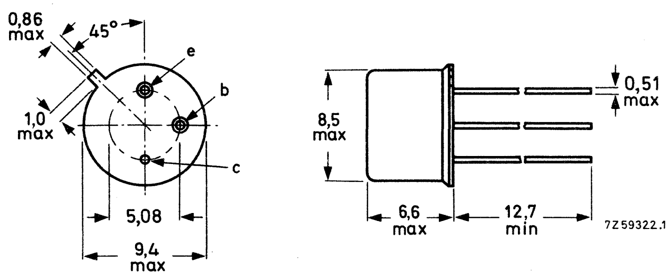
			BSX59	BSX60	BSX61	
Collector-base voltage (open emitter)	V_{CBO}	max.	70	70	70	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	30	45	V
Collector current (peak value)	I_{CM}	max.	1	1	1	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	0,8	0,8	0,8	W
Junction temperature	T_j	max.	200	200	200	°C
D.C. current gain I_C = 500 mA; V_{CE} = 1 V	h_{FE}	>	30	30	30	
Saturation voltage I_C = 500 mA; I_B = 50 mA	V_{CEsat}	<	0,5	0,5	0,7	V
Transition frequency at f = 100 MHz I_C = 50 mA; V_{CE} = 10 V	f_T	>	250	250	250	MHz
Turn-off time I_{Con} = 500 mA; I_{Bon} = $-I_{Boff}$ = 50 mA	t_{off}	<	60	70	100	ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case.



Maximum lead diameter is guaranteed only for 12,7 mm.

RATINGS

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

			BSX59	BSX60	BSX61	
Collector-base voltage (open emitter)	V_{CBO}	max.	70	70	70	V
Collector-emitter voltage (open base) I_C = 10 mA	V_{CEO}	max.	45	30	45	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	5	V

Collector current (d.c.)	I_C	max.	1	A
Collector current (peak value)	I_{CM}	max.	1	A
Emitter current (peak value)	$-I_{EM}$	max.	1	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	0,8	W
Storage temperature range	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	220	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	43	K/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	35	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BSX59	BSX60	BSX61	
Collector cut-off current						
$I_E = 0$; $V_{CB} = 40$ V	I_{CBO}	<	500	500	500	nA
$I_E = 0$; $V_{CB} = 40$ V; $T_j = 150$ °C	I_{CBO}	<	300	300	300	μA
Emitter cut-off current						
$I_C = 0$; $V_{EB} = 4$ V	I_{EBO}	<	300	300	500	nA
$I_C = 0$; $V_{EB} = 4$ V; $T_j = 150$ °C	I_{EBO}	<	50	50	50	μA
Currents at reverse biased emitter junction						
$-V_{BE} = 4$ V; $V_{CE} = 40$ V	$+I_{CEX}$	<	500	500	1000	nA
	$-I_{BEX}$	<	500	500	1000	nA
$-V_{BE} = 4$ V; $V_{CE} = 40$ V; $T_j = 150$ °C	$+I_{CEX}$	<	300	300	500	μA
	$-I_{BEX}$	<	300	300	500	μA
Saturation voltages						
$I_C = 150$ mA; $I_B = 15$ mA	V_{CEsat}	<	0,3	0,3	0,5	V
	V_{BEsat}	<	1,0	1,0	1,0	V
$I_C = 500$ mA; $I_B = 50$ mA	V_{CEsat}	<	0,5	0,5	0,7	V
	V_{BEsat}	>	0,85	0,7	0,7	V
		<	1,2	1,3	1,3	V
$I_C = 1$ A; $I_B = 100$ mA	V_{CEsat}	<	1,0	1,0	1,3	V
	V_{BEsat}	<	1,8	1,8	1,8	V
D.C. current gain						
$I_C = 150$ mA; $V_{CE} = 1$ V	h_{FE}	>	30	30	30	
$I_C = 500$ mA; $V_{CE} = 1$ V	h_{FE}	>	30	30	30	
		<	90	90	90	
$I_C = 1$ A; $V_{CE} = 5$ V	h_{FE}	>	20	25	20	
Transition frequency at f = 100 MHz						
$I_C = 50$ mA; $V_{CE} = 10$ V	f_T	>	250	250	250	MHz
Collector capacitance at f = 1 MHz						
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	6	6	6	pF
		<	10	10	10	pF
Emitter capacitance at f = 1 MHz						
$I_C = I_c = 0$; $V_{EB} = 0,5$ V	C_e	typ.	36	36	36	pF
		<	50	50	50	pF

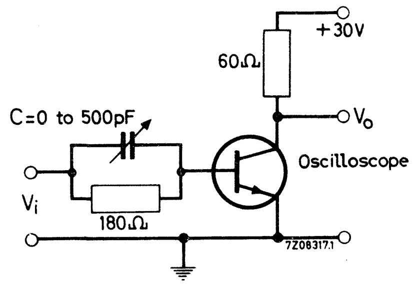
CHARACTERISTICS

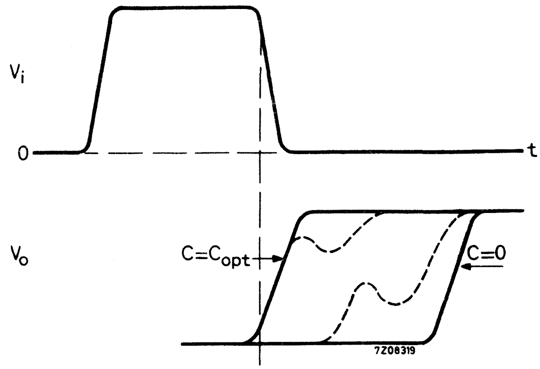
T_j = 25 °C unless otherwise specified

Recovered charge

I_C = 500 mA; I_B = 50 mA — BSX60 — Q_s < 5 nC

Test circuit:





Adjust C from zero to C_{opt}

$Q_s = C_{opt} \cdot V_i$

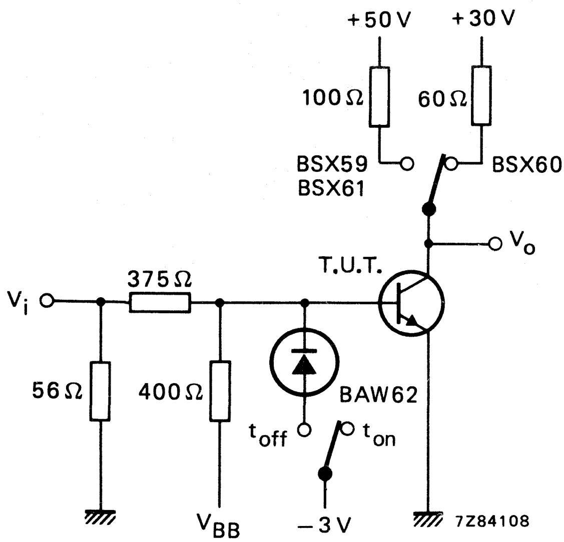
Pulse generator:

Pulse duration t_p = 10 μs

Duty cycle δ = 0,02

Switching times (see also Fig. 4)

			BSX59	BSX60	BSX61	
Turn-on time when switched from $-V_{BE}$ = 2 V to I_{Con} = 500 mA; I_{Bon} = 50 mA	t_{on}	typ.	17	17	18	ns
		<	35	40	50	ns
Turn-off time when switched from I_{Con} = 500 mA; I_{Bon} = 50 mA to cut-off with $-I_{Boff}$ = 50 mA*	t_{off}	typ.	45	58	70	ns
		<	60	70	100	ns



	t_{on}	t_{off}	
$-V_{BB}$	4	16,7	V
V_i	24,75	37,5	V

Fig. 4 Switching circuit.

Pulse generator:

Pulse duration	t_p	⩾	500 ns
Rise time	t_r	⩽	5 ns
Fall time	t_f	⩽	5 ns
Output resistance	R_o	=	50 Ω (during pulse, otherwise infinite)

* $-I_{Boff}$ is the reverse current that can flow during switching off. The indicated $-I_{Boff}$ is determined and limited by the applied cut-off voltage and the series resistance.

Data sheet	
status	Product specification
date of issue	September 1994

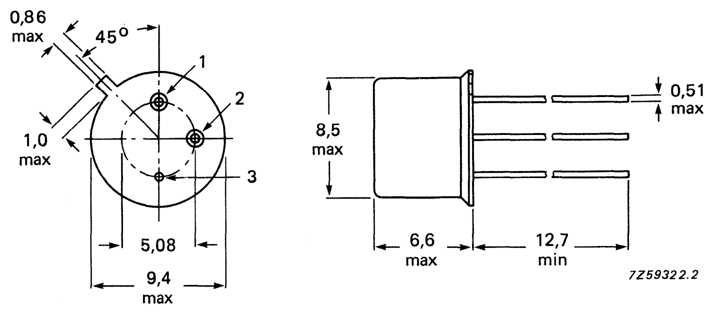
BSX62-10, -16/BSX63-10, -16
Silicon planar epitaxial transistors

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS		MIN.	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage		BSX62 BSX63	- -	- -	40 60	V V
I_C	collector current			-	-	3	A
P_{tot}	total power dissipation	T_{amb} = 25 °C		-	-	875	mW
P_{tot}	total power dissipation	T_{case} = 25 °C		-	-	5	W
T_j	junction temperature			-	-	200	°C
h_{FE}	DC current gain	V_{CE} = 1 V I_C = 1 A	BSX62-10 BSX63-10	63	-	160	
			BSX62-16 BSX63-16	100	-	250	
f_T	transition frequency	V_{CE} = 10 V f = 100 MHz I_C = 200 mA		-	70	-	MHz

MECHANICAL DATA

Dimensions in mm



Collector connected to case.

Fig.1 TO-39.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS		MIN.	MAX.	UNIT
V_{CES}	collector-emitter voltage	$V_{BE} = 0$	BSX62 BSX63	- -	60 80	V V
V_{CEO}	collector-emitter voltage	$I_B = 0$	BSX62 BSX63	- -	40 60	V V
V_{EBO}	emitter-base voltage	$I_C = 0$		-	5	V
I_C	collector current			-	3	A
I_B	base current			-	500	mA
P_{tot}	total power dissipation	$T_{case} \leq 25$ °C		-	5	W
T_j	junction temperature			-	200	°C
T_{stg}	storage temperature range			–65	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}a}$	from junction to ambient	200	K/W
$R_{th\ j\text{-}c}$	from junction to case	28	K/W

CHARACTERISTICS

T_{case} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS		MIN.	TYP.	MAX.	UNIT
I_{CES}	collector-emitter cut-off current	V_{BE} = 0 V_{CE} = 40 V	BSX62	-	-	100	nA
I_{CES}	collector-emitter cut-off current	V_{BE} = 0 V_{CE} = 40 V T_{case} = 150 °C	BSX62	-	-	100	μA
I_{CES}	collector-emitter cut-off current	V_{BE} = 0 V_{CE} = 60 V	BSX63	-	-	100	nA
I_{CES}	collector-emitter cut-off current	V_{BE} = 0 V_{CE} = 60 V T_{case} = 150 °C	BSX63	-	-	100	μA
$V_{(BR)CBO}$	collector-base breakdown voltage	I_E = 0 I_C = 100 μA	BSX62 BSX63	60 80	- -	- -	V V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_B = 0 I_C = 100 mA	BSX62 BSX63	40 60	- -	- -	V V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 10 μA I_C = 0		5	-	-	V
V_{CEsat}	collector-emitter saturation voltage	I_B = 100 mA I_C = 1 A		-	-	0.7	V
V_{CEsat}	collector-emitter saturation voltage	I_B = 200 mA I_C = 2 A		-	-	0.8	V
V_{BEsat}	base-emitter saturation voltage	I_B = 100 mA I_C = 1 A		-	-	1.2	V
V_{BEsat}	base-emitter saturation voltage	I_B = 200 mA I_C = 2 A		-	-	1.3	V
V_{BE}	base-emitter voltage	V_{CE} = 1 V I_C = 100 mA		-	-	1	V
V_{BE}	base-emitter voltage	V_{CE} = 1 V I_C = 1 A		-	-	1.2	V
V_{BE}	base-emitter voltage	V_{CE} = 5 V I_C = 2 A		-	-	1.3	V
f_T	transition frequency	V_{CE} = 10 V f = 100 MHz I_C = 200 mA		30	-	-	MHz
C_c	collector capacitance	V_{CB} = 10 V I_E = 0		-	-	70	pF

SYMBOL	PARAMETER	CONDITIONS		MIN.	TYP.	MAX.	UNIT
Switching times							
t_{on}	turn-on time	$I_{CX} \approx 1$ A $I_{BX} = -I_{BY} \approx 50$ mA		-	-	0.3	µs
t_{off}	turn-off time	$I_{CX} \approx 1$ A $I_{BX} = -I_{BY} \approx 50$ mA		-	-	1.5	µs
h_{FE}	DC current gain	$V_{CE} = 1$ V $I_C = 100$ mA	BSX62-10 BSX63-10	-	110	-	
			BSX62-16 BSX63-16	-	180	-	
h_{FE}	DC current gain	$V_{CE} = 1$ V $I_C = 1$ A	BSX62-10 BSX63-10	63	100	160	
			BSX62-16 BSX63-16	100	160	250	
h_{FE}	DC current gain	$V_{CE} = 5$ V $I_C = 2$ A	BSX62-10 BSX63-10	-	70	-	
			BSX62-16 BSX63-16	-	120	-	

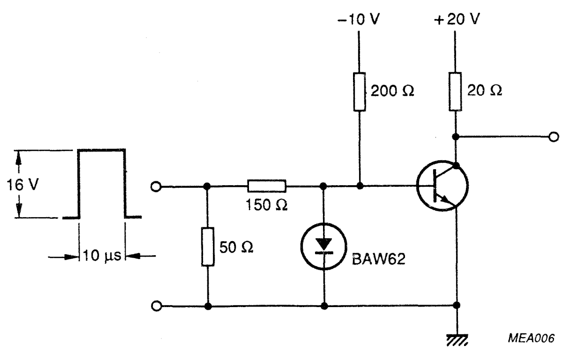


Fig.2 Switching times test circuit.

Silicon planar epitaxial transistors BSX62-10, -16/BSX63-10, -16

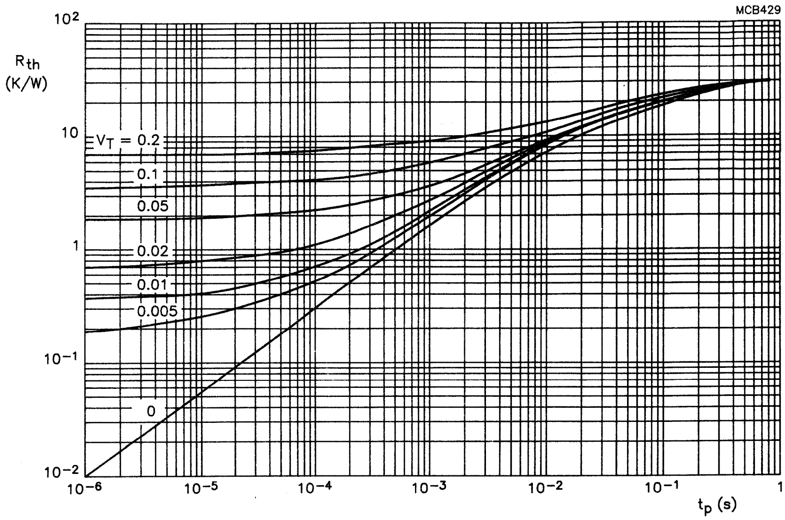


Fig.3 Thermal resistance as a function of pulse time.

PNP SMALL-SIGNAL TRANSISTORS

PNP small-signal transistors with centre collector pinning, in a TO-92 package, recommended for general purpose amplifier applications.
The complementary types are the JC500 and JC501 respectively.

QUICK REFERENCE DATA

			JA100	JA101	
Collector-base voltage	$-V_{CBS}$	max.	30	50	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	25	45	V
Collector current (DC)	$-I_C$	max.	100		mA
DC current gain $-I_C = 1$ mA; $-V_{CE} = 5$ V	h_{FE}		90 to 600		
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	500		mW

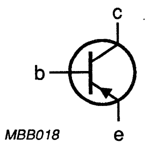
MECHANICAL DATA

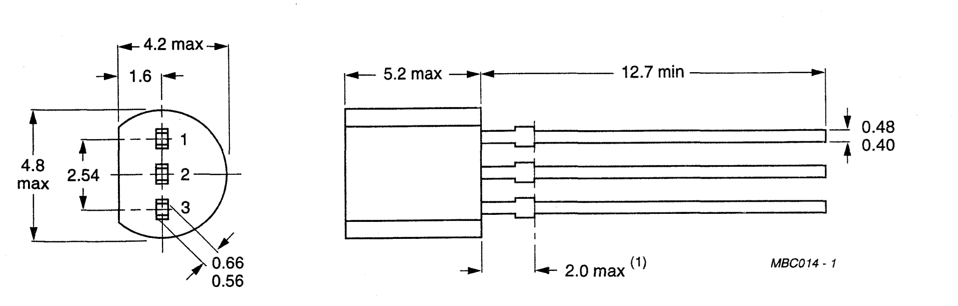
Dimensions in mm

Fig.1 TO-92.

Pinning:

1 = base
2 = collector
3 = emitter





Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			JA100	JA101	
Collector-base voltage	$-V_{CBS}$	max.	30	50	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	25	45	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5.0		V
Collector current (DC)	$-I_C$	max.	100		mA
Collector current (peak)	$-I_{CM}$	max.	200		mA
Base current (DC)	$-I_B$	max.	50		mA
Base current (peak)	$-I_{BM}$	max.	100		mA
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	500		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	$R_{th\ j\text{-}a}$	=	250	K/W

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

			JA100	JA101	
Collector-emitter breakdown voltage					
$-I_{CES} = 10\ \mu A$	$-V_{(BR)CES}$	>	30	50	V
$-I_{CEO} = 2$ mA	$-V_{(BR)CEO}$	>	25	45	V
Emitter-base breakdown voltage					
$-I_{EBO} = 10\ \mu A$	$-V_{(BR)EBO}$	>	5.0	5.0	V
Collector cut-off current					
$-V_{CE} = 25$ V	$-I_{CES}$	<	15	–	nA
$-V_{CE} = 45$ V	$-I_{CES}$	<	–	15	nA
$-V_{CE} = 25$ V; $T_j = 125\ ^oC$	$-I_{CES}$	<	4.0	–	μA
$-V_{CE} = 45$ V; $T_j = 125\ ^oC$	$-I_{CES}$	<	–	4.0	μA
DC current gain*					
$-I_C = 1$ mA; $-V_{CE} = 5$ V	h_{FE}		90 to 600		
Collector-emitter saturation voltage					
$-I_C = 10$ mA; $-I_B = 0.5$ mA	$-V_{CE\ sat}$	<	0.3		V
$-I_C = 100$ mA; $-I_B = 5$ mA	$-V_{CE\ sat}$	typ.	0.5		V
Base-emitter saturation voltage					
$-I_C = 10$ mA; $-I_B = 0.5$ mA	$-V_{BE\ sat}$	typ.	0.7		V
$-I_C = 100$ mA; $-I_B = 5$ mA	$-V_{BE\ sat}$	typ.	0.85		V
Base-emitter voltage					
$-I_C = 2$ mA; $-V_{CE} = 5$ V	$-V_{BE\ on}$		0.55 to 0.7		V

* Group	O	P	Q	R
Range	90 - 180	135 - 270	200 - 400	300 - 600

Transition frequency at f = 100 MHz; $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	typ.	130	MHz
Collector-base capacitance $-V_{CBO}$ = 10 V; f = 1 MHz	C_c	<	6.0	pF
Emitter-base capacitance $-V_{EBO}$ = 0.5 V; f = 1 MHz	C_e	typ.	12	pF
Noise figure at R_S = 2 kΩ; f = 1 kHz; $-I_C$ = 200 μA; $-V_{CE}$ = 5 V	NF	<	10	dB

SILICON PLANAR EPITAXIAL TRANSISTORS

PNP transistors with centre collector pinning, in a plastic TO-92 variant package, primarily intended for use in driver and output stages of audio amplifiers.

The JC327, JC327A, JC328 are complementary to the JC337, JC337A and JC338 respectively.

QUICK REFERENCE DATA

			JC327	JC327A	JC328	
Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	50	60	30	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	60	25	V
Collector current (peak value)	$-I_{CM}$	max.		1000		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		800		mW
Junction temperature	T_j	max.		150		°C
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	>		80		MHz
DC current gain $-I_C$ = 100 mA; $-V_{CE}$ = 1 V	h_{FE}			100 to 600		

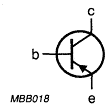
MECHANICAL DATA

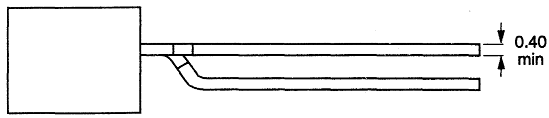
Dimensions in mm

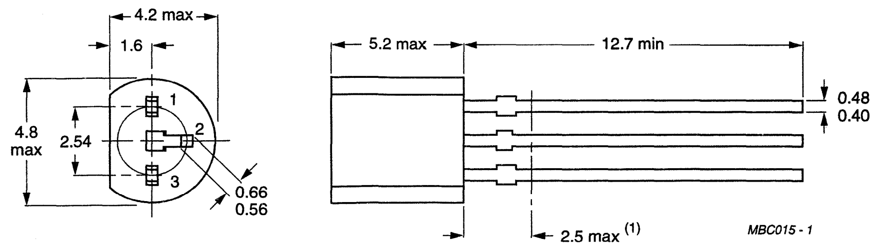
Fig. 1 TO-92 variant.

Pinning:

1 = base
2 = collector
3 = emitter







(1) Terminal dimensions within this zone are uncontrolled to allow for plastic and terminal irregularities.

RATINGS

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

			JC327	JC327A	JC328	
Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	50	60	30	V
Collector-emitter voltage (open base) $-I_C$ = 10 mA	$-V_{CEO}$	max.	45	60	25	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.		5		V
Collector current (DC)	$-I_C$	max.		500		mA
Collector current (peak value)	$-I_{CM}$	max.		1000		mA
Emitter current (peak value)	I_{EM}	max.		1000		mA
Base current (DC)	$-I_B$	max.		100		mA
Base current (peak value)	$-I_{BM}$	max.		200		mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.		625		mW
up to T_{amb} = 25 °C	P_{tot}	max.		800		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	$R_{th\ j\text{-}a}$	=	0.2	K/mW
From junction to ambient	$R_{th\ j\text{-}a}$	=	0.156	K/mW*

* Transistor mounted on printed-circuit board, max. lead length 4 mm, mounting pad for collector lead min. 10 mm x 10 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0$; $-V_{CB} = 20$ V; T_j = 25 °C	$-I_{CBO}$	max.	100 nA
$I_E = 0$; $-V_{CB} = 20$ V; T_j = 150 °C	$-I_{CBO}$	max.	5 μA
Emitter cut-off current			
$I_C = 0$; $-V_{EB} = 5$ V	$-I_{EBO}$	max.	10 μA
Base emitter voltage*			
$-I_C = 500$ mA; $-V_{CE} = 1$ V	$-V_{BE}$	max.	1.2 V
Saturation voltage			
$-I_C = 500$ mA; $-I_B = 50$ mA	$-V_{CEsat}$	max.	700 mV
DC current gain			
$-I_C = 500$ mA; $-V_{CE} = 1$ V	h_{FE}	min.	40
$-I_C = 100$ mA; $-V_{CE} = 1$ V; JC327; JC328	h_{FE}		100 to 600
JC327A	h_{FE}		100 to 400
JC327-16, JC328-16	h_{FE}		100 to 250
JC327-25, JC328-25	h_{FE}		160 to 400
JC327-40, JC328-40	h_{FE}		250 to 600
Transition frequency at f = 100 MHz			
$-I_C = 10$ mA; $-V_{CE} = 5$ V	f_T	>	80 MHz
Collector capacitance at f = 1 MHz			
$I_E = I_e = 0$; $-V_{CB} = 10$ V	C_c	typ.	8 pF

* $-V_{BE}$ decreases by about 2 mV/K with increasing temperature.

SILICON PLANAR EPITAXIAL TRANSISTORS

NPN transistors with centre collector pinning in plastic TO-92 variant envelopes, primarily intended for use in driver and output stages of audio amplifiers.

The JC337, JC337A, JC338 are complementary to the JC327, JC327A and JC328 respectively.

QUICK REFERENCE DATA

			JC337	JC337A	JC338	
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	50	60	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	60	25	V
Collector current (peak value)	I_{CM}	max.		1000		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		800		mW
Junction temperature	T_j	max.		150		°C
Transition frequency at f = 35 MHz; I_C = 10 mA; V_{CE} = 5 V	f_T	typ.		100		MHz
DC current gain; I_C = 100 mA; V_{CE} = 1 V	h_{FE}			100 to 600		

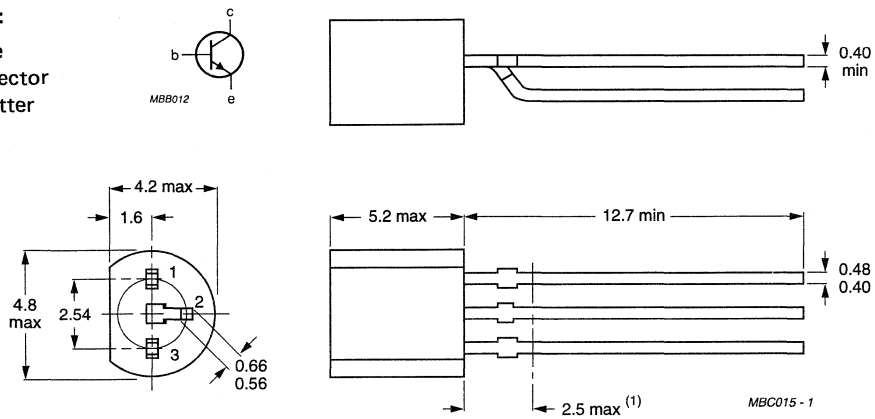
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92 variant.

Pinning:

1 = base
2 = collector
3 = emitter



(1) Terminal dimensions within this zone are uncontrolled to allow for plastic and terminal irregularities.

RATINGS

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

			JC337	JC337A	JC338	
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	50	60	30	V
Collector-emitter voltage (open base) I_C = 10 mA	V_{CEO}	max.	45	60	25	V
Emitter-base voltage (open collector)	V_{EBO}	max.		5		V
Collector current (DC)	I_C	max.		500		mA
Collector current (peak value)	I_{CM}	max.		1000		mA
Emitter current (peak value)	$-I_{EM}$	max.		1000		mA
Base current (DC)	I_B	max.		100		mA
Base current (peak value)	I_{BM}	max.		200		mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.		625		mW
up to T_{amb} = 25 °C	P_{tot}	max.		800		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	$R_{th\ j\text{-}a}$	=	0.2	K/mW
From junction to ambient	$R_{th\ j\text{-}a}$	=	0.156	K/mW*

* Transistor mounted on printed circuit board, max. lead length 4 mm, mounting pad for collector lead min. 10 mm x 10 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0$; $V_{CB} = 20$ V; $T_j = 25$ °C	I_{CBO}	max.	100 nA
$I_E = 0$; $V_{CB} = 20$ V; $T_j = 150$ °C	I_{CBO}	max.	5 μA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	max.	10 μA
Base emitter voltage*			
$I_C = 500$ mA; $V_{CE} = 1$ V	V_{BE}	max.	1.2 V
Saturation voltage			
$I_C = 500$ mA; $I_B = 50$ mA	V_{CEsat}	max.	700 mV
DC current gain			
$I_C = 500$ mA; $V_{CE} = 1$ V	h_{FE}	min.	40
$I_C = 100$ mA; $V_{CE} = 1$ V; JC337; JC338	h_{FE}		100 to 600
JC337A	h_{FE}		100 to 400
JC337-16, JC338-16	h_{FE}		100 to 250
JC337-25, JC338-25	h_{FE}		160 to 400
JC337-40, JC338-40	h_{FE}		250 to 600
Transition frequency at f = 100 MHz			
$I_C = 10$ mA; $V_{CE} = 5$ V	f_T	>	100 MHz
Collector capacitance at f = 1 MHz			
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	5 pF

* V_{BE} decreases by about 2 mV/K with increasing temperature.

NPN SMALL-SIGNAL TRANSISTORS

NPN small-signal transistors with centre collector pinning, in a TO-92 package, recommended for general purpose amplifier applications.

The complementary types are the JA100 and the JA101 respectively.

QUICK REFERENCE DATA

			JC500	JC501	
Collector-emitter voltage	V_{CES}	max.	30	50	V
Collector-emitter voltage (open base)	V_{CEO}	max.	25	45	V
Collector current (DC)	I_C	max.	100		mA
DC current gain $I_C = 1$ mA; $V_{CE} = 5$ V	h_{FE}		90 to 600		
Total power dissipation up to $T_{amb} = 25$ °C	P_{tot}	max.	500		mW

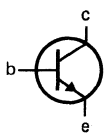
MECHANICAL DATA

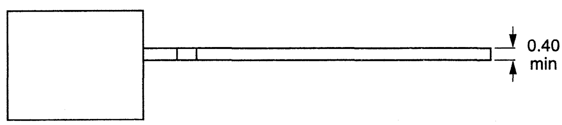
Dimensions in mm

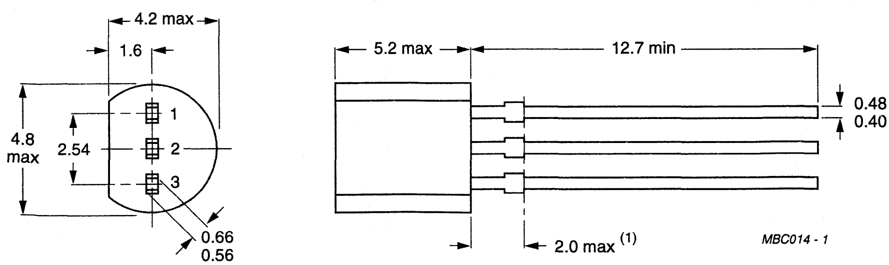
Fig. 1 TO-92.

Pinning:

1 = base
2 = collector
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			JC500	JC501	
Collector-emitter voltage	V_{CES}	max.	30	50	V
Collector-emitter voltage (open base)	V_{CEO}	max.	25	45	V
Emitter-base voltage (open vollector)	V_{EBO}	max.	6.0		V
Collector current (DC)	I_C	max.	100		mA
Collector current (peak)	I_{CM}	max.	200		mA
Base current (DC)	I_B	max.	50		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500		mW
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	$R_{th\ j\text{-}a}$	=	250	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			JC500	JC501	
Collector-emitter breakdown voltage I_{CEO} = 2 mA	$V_{(BR)CEO}$	>	25	45	V
Emitter-base breakdown voltage I_{EBO} = 1 μA	$V_{(BR)EBO}$	>	6.0	6.0	V
Collector cut-off current					
V_{CE} = 25 V	I_{CES}	<	15	–	nA
V_{CE} = 45 V	I_{CES}	<	–	15	nA
V_{CE} = 25 V; T_j = 125 °C	I_{CES}	<	4.0	–	μA
V_{CE} = 45 V; T_j = 125 °C	I_{CES}	<	–	4.0	μA
Emitter-base cut-off current V_{EB} = 6 V	I_{EBO}	<	1.0		μA
DC current gain * I_C = 1 mA; V_{CE} = 5 V	h_{FE}		90 to 600		
Collector-emitter saturation voltage					
I_C = 10 mA; I_B = 0.5 mA	$V_{CE\ sat}$	<	0.2		V
I_C = 100 mA; I_B = 5 mA	$V_{CE\ sat}$	<	0.6		V
Base-emitter saturation voltage					
I_C = 10 mA; I_B = 0.5 mA	$V_{BE\ sat}$	<	0.83		V
I_C = 100 mA; I_B = 5 mA	$V_{BE\ sat}$	<	1.06		V
Base-emitter voltage I_C = 2 mA; V_{CE} = 5 V	V_{BE}		0.55 to 0.7		V

* Group	O	P	Q	R
Range	90 - 180	135 - 270	200 - 400	300 - 600

Transition frequency at f = 100 MHz; I_C = 10 mA; V_{CE} = 5 V	f_T	typ.	130	MHz
Collector-base capacitance V_{CBO} = 10 V; f = 1 MHz	C_c	<	6.0	pF
Emitter-base capacitance V_{EBO} = 0.5 V; f = 1 MHz	C_e	typ.	8.0	pF
Noise figure at R_S = 2 kΩ; f = 1 kHz; I_C = 200 μA; $-V_{CE}$ = 5 V	F	<	10	dB

SILICON PLANAR EPITAXIAL TRANSISTORS

General purpose NPN transistors with centre collector pinning, in a plastic TO-92 package, especially suited for use in driver stages of audio amplifiers.

QUICK REFERENCE DATA

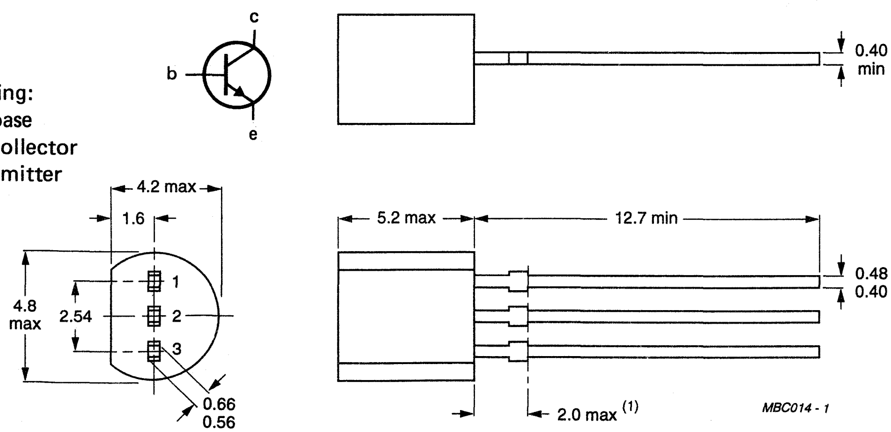
			JC546	JC547	JC548	
Collector-emitter voltage ($V_{BE} = 0$)	V_{CES}	max.	80	50	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	65	45	30	V
Collector current (peak value)	I_{CM}	max.	200	200	200	mA
Total power dissipation up to $T_{amb} = 25\ ^{o}C$	P_{tot}	max.	500	500	500	mW
Junction temperature	T_j	max.	150	150	150	^{o}C
DC current gain $I_C = 2$ mA; $V_{CE} = 5$ V	h_{FE}	>	110	110	110	
		<	450	800	800	
Transition frequency at f = 100 MHz $I_C = 10$ mA; $V_{CE} = 5$ V	f_T	typ.	100	100	100	MHz
Noise figure at $R_S = 2\ k\Omega$ $I_C = 200\ \mu A$; $V_{CE} = 5$ V f = 1 kHz; B = 200 Hz	F	typ.	2	2	2	dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92.

Pinning:
1 = base
2 = collector
3 = emitter



Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			JC546	JC547	JC548	
Collector-base voltage (open emitter)	V_{CBO}	max.	80	50	30	V
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	80	50	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	65	45	30	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6	6	5	V

Collector current (DC)	I_C	max.	100	mA
Collector current (peak value)	I_{CM}	max.	200	mA
Emitter current (peak value)	$-I_{EM}$	max.	200	mA
Base current (peak value)	I_{BM}	max.	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	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	$R_{th\,j\text{-}a}$	=	0,25	K/mW
From junction to case	$R_{th\,j\text{-}c}$	=	0,15	K/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; V_{CB} = 30 V	I_{CBO}	<	15	nA
$I_E = 0$; V_{CB} = 30 V; T_j = 150 °C	I_{CBO}	<	5	μA
Base-emitter voltage*				
I_C = 2 mA; V_{CE} = 5 V	V_{BE}	typ.	660	mV
			580 to 700	mV
I_C = 10 mA; V_{CE} = 5 V	V_{BE}	<	770	mV

* V_{BE} decreases by about 2 mV/K with increasing temperature.

Saturation voltage*				
I_C = 10 mA; I_B = 0,5 mA	V_{CEsat}	typ.	90	mV
		<	250	mV
	V_{BEsat}	typ.	700	mV
I_C = 100 mA; I_B = 5 mA	V_{CEsat}	typ.	200	mV
		<	600	mV
	V_{BEsat}	typ.	900	mV
Collector capacitance at f = 1 MHz $I_E = I_e$ = 0; V_{CB} = 10 V	C_c	typ.	2,5	pF
Emitter capacitance at f = 1 MHz $I_C = I_c$ = 0; V_{EB} = 0,5 V	C_e	typ.	9	pF
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 5 V	f_T	>	100	MHz
Small signal current gain at f = 1 kHz I_C = 2 mA; V_{CE} = 5 V	h_{fe}		125 to 900	

			JC546	JC547	JC548	
Noise figure at R_S = 2 kΩ I_C = 200 μA; V_{CE} = 5 V f = 1 kHz; B = 200 Hz	F	typ.	2	2	2	dB
		<	10	10	10	dB

			JC546A JC547A JC548A	JC546B JC547B JC548B	JC547C JC548C	JC547 JC548	JC546
DC current gain I_C = 10 μA; V_{CE} = 5 V	h_{FE}	typ.	90	150	270		
		>	110	200	420	110	110
I_C = 2 mA; V_{CE} = 5 V	h_{FE}	typ.	180	290	520		
		<	220	450	800	800	450

* V_{BEsat} decreases by about 1,7 mV/K with increasing temperature.

SILICON PLANAR EPITAXIAL TRANSISTORS

NPN transistors with centre collector pinning, in a plastic TO-92 variant package, primarily intended for low-noise input stages in tape recorders, hi-fi amplifiers and other audio-frequency equipment.

QUICK REFERENCE DATA

			JC549	JC550	
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	30	50	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	45	V
Collector current (peak value)	I_{CM}	max.	200	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	500	mW
Junction temperature	T_j	max.	150	150	°C
DC current gain I_C = 2 mA; V_{CE} = 5 V	h_{FE}	min. max.	200 800	200 800	
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 5 V	f_T	>	100	100	MHz
Noise figure at R_S = 2 kΩ I_C = 200 μA; V_{CE} = 5 V f = 30 Hz to 15 kHz	F	typ. max.	1.4 4	1.4 3	dB dB
f = 1 kHz; B = 200 Hz	F	typ.	1.2	1	dB
f = 10 Hz to 50 Hz (equivalent noise voltage)	V_n	min.	–	0.135	μV

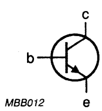
MECHANICAL DATA

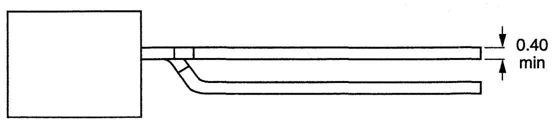
Dimensions in mm

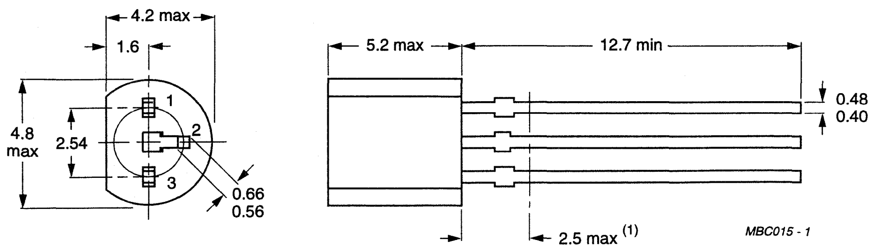
Fig. 1 TO-92 variant.

Pinning:

1 = base
2 = collector
3 = emitter







(1) Terminal dimensions within this zone are uncontrolled to allow for plastic and terminal irregularities.

RATINGS

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

			JC549	JC550	
Collector-base voltage (open emitter)	V_{CBO}	max.	30	50	V
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	30	50	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	45	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	V

Collector current (DC)	I_C	max.	100	mA
Collector current (peak value)	I_{CM}	max.	200	mA
Emitter current (peak value)	$-I_{EM}$	max.	200	mA
Base current (peak value)	I_{BM}	max.	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	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	$R_{th\ j\text{-}a}$	=	0.25	K/mW
From junction to case	$R_{th\ j\text{-}c}$	=	0.15	K/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
I_E = 0; V_{CB} = 30 V	I_{CBO}	max.	15	nA
I_E = 0; V_{CB} = 30 V; T_j = 150 °C	I_{CBO}	max.	5	μA
Base emitter voltage*				
I_C = 2 mA; V_{CE} = 5 V	V_{BE}	typ.	660	mV
			580 to 700	mV
I_C = 10 mA; V_{CE} = 5 V	V_{BE}	max.	770	mV
Saturation voltages **				
I_C = 10 mA; I_B = 0,5 mA	V_{CEsat}	typ.	90	mV
		max.	250	mV
	V_{BEsat}	typ.	700	mV
I_C = 100 mA; I_B = 5 mA	V_{CEsat}	typ.	200	mV
		max.	600	mV
	V_{BEsat}	typ.	900	mV

* V_{BE} decreases by about 2 mV/K with increasing temperature.
** V_{BEsat} decreases by about 1.7 mV/K with increasing temperature.

Collector capacitance at f = 1 MHz $I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	2.5 pF
Emitter capacitance at f = 1 MHz $I_C = I_c = 0$; $V_{EB} = 0{,}5$ V	C_e	typ.	9 pF
Transition frequency at f = 100 MHz $I_C = 10$ mA; $V_{CE} = 5$ V	f_T	>	100 MHz
Small signal current gain at f = 1 kHz $I_C = 2$ mA; $V_{CE} = 5$ V	h_{fe}		110 to 800

			JC549	JC550
Noise figure at $R_S = 2$ kΩ $I_C = 200$ μA; $V_{CE} = 5$ V				
f = 30 Hz to 15 kHz	F	typ.	1.4	1.4 dB
		max.	4	3 dB
f = 1 kHz; B = 200 Hz	F	typ.	1.2	1 dB
		max.	4	4 dB
Equivalent noise voltage at $R_S = 2$ kΩ $I_C = 200$ μA; $V_{CE} = 5$ V				
f = 10 Hz to 50 Hz; $T_{amb} = 25$ °C	V_n	max.	–	0.135 μV

			JC549B JC550B	JC549C JC550C	JC549 JC550
DC current gain $I_C = 10$ μA; $V_{CE} = 5$ V	h_{FE}	typ.	150	270	
$I_C = 2$ mA; $V_{CE} = 5$ V	h_{FE}	min.	200	420	200
		typ.	290	520	
		max.	450	800	800

SILICON PLANAR EPITAXIAL TRANSISTORS

General purpose pnp transistors in plastic TO-92 packages, especially suitable for use in driver stages of audio amplifiers.

QUICK REFERENCE DATA

			JC556	JC557	JC558	
Collector-emitter voltage (+ V_{BE} = 0 V)	$-V_{CES}$	max.	80	50	30	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	65	45	30	V
DC current gain $-I_C$ = 2 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	75	75	75	
		max.	475	800	800	
Collector current (peak value)	$-I_{CM}$	max.		200		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		500		mW
Junction temperature	T_j	max.		150		°C
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	>		100		MHz
Noise figure at R_S = 2 kΩ $-I_C$ = 200 μA; $-V_{CE}$ = 5 V f = 1 kHz; B = 200 Hz	F	typ.		2		dB

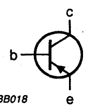
MECHANICAL DATA

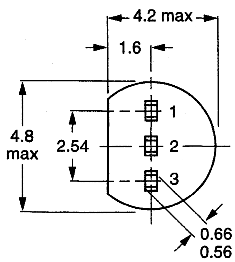
Dimensions in mm

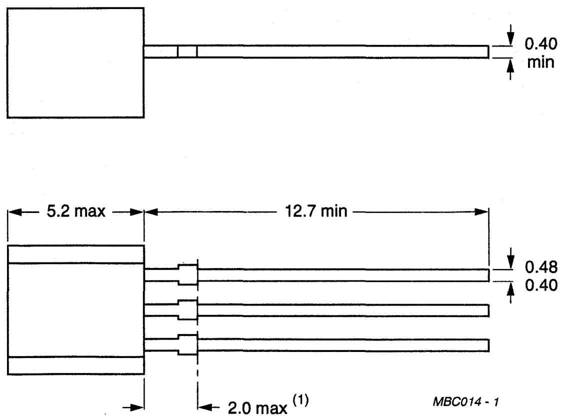
Fig. 1 TO-92

Pinning:

1 = base
2 = collector
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			JC556	JC557	JC558	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	80	50	30	V
Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	80	50	30	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	65	45	30	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	V

Collector current (DC)	$-I_C$	max.	100	mA
Collector current (peak value)	$-I_{CM}$	max.	200	mA
Emitter current (peak value)	I_{EM}	max.	200	mA
Base current (peak value)	$-I_{BM}$	max.	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	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	$R_{th\ j\text{-}a}$	=	250	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	150	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

Collector cut-off current				
$I_E = 0$; $-V_{CB}$ = 30 V; T_j = 25 °C	$-I_{CBO}$	typ.	1	nA
		max.	15	nA
T_j = 150 °C	$-I_{CBO}$	max.	4	µA
Base-emitter voltage (see note 1)				
$-I_C$ = 2 mA; $-V_{CE}$ = 5 V	$-V_{BE}$	typ.	650	mV
			600 to 750	mV
$-I_C$ = 10 mA; $-V_{CE}$ = 5 V	$-V_{BE}$	max.	820	mV
Saturation voltages (see note 2)				
$-I_C$ = 10 mA; $-I_B$ = 0.5 mA	$-V_{CEsat}$	typ.	60	mV
		max.	300	mV
	$-V_{BEsat}$	typ.	750	mV
$-I_C$ = 100 mA; $-I_B$ = 5 mA	$-V_{CEsat}$	typ.	180	mV
		max.	650	mV
	$-V_{BEsat}$	typ.	930	mV

Notes

1. $-V_{BE}$ decreases by about 2 mV/K with increasing temperature.
2. $-V_{BEsat}$ decreases by about 1.7 mV/K with increasing temperature.

Collector capacitance at f = 1 MHz $I_E = I_e = 0; -V_{CE} = 10$ V	C_c	typ. 4	pF
Transition frequency at f = 100 MHz $-I_C = 10$ mA; $-V_{CE} = 5$ V	f_T	> 100	MHz
Small-signal current gain at f = 1 kHz $-I_C = 2$ mA; $-V_{CE} = 5$ V	h_{fe}	125 to 800	
Noise figure at $R_S = 2$ kΩ $-I_C = 200$ μA; $-V_{CE} = 5$ V f = 1 kHz; B = 200 Hz	F	typ. 2 max. 10	dB dB

			JC556 **JC557** **JC558**	**JC556A** **JC557A** **JC558A**	**JC556B** **JC557B** **JC558B**	 **JC557C** **JC558C**
DC current gain $-I_C = 2$ mA; $-V_{CE} = 5$ V	h_{FE}	min.	125	125	220	420
		max.	800	250	475	800

SILICON PLANAR EPITAXIAL TRANSISTORS

PNP transistors with centre collector pinning, in a plastic TO-92 variant package, primarily intended for low-noise input stages in tape recorders, hi-fi amplifiers and other audio-frequency equipment.

QUICK REFERENCE DATA

			JC559	JC560	
Collector-emitter voltage ($+V_{BE}$ = 0 V)	$-V_{CES}$	max.	30	50	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	30	45	V
Collector current (peak value)	$-I_{CM}$	max.	200	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	500	mW
Junction temperature	T_j	max.	150	150	°C
DC current gain $-I_C$ = 2 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	125	125	
		max.	800	800	
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	>	100	100	MHz
Noise figure at R_s = 2 kΩ $-I_C$ = 200 μA; $-V_{CE}$ = 5 V f = 30 Hz to 15 kHz	F	typ.	1.2	1	dB
		max.	4	3	dB
f = 1 kHz; B = 200 Hz	F	max.	4	4	dB
f = 10 kHz to 50 Hz (equivalent noise voltage)	V_N	max.	–	0.11	μV

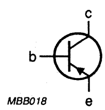
MECHANICAL DATA

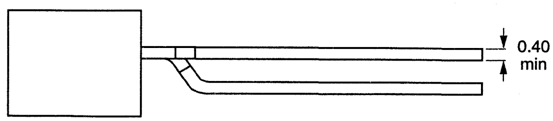
Dimensions in mm

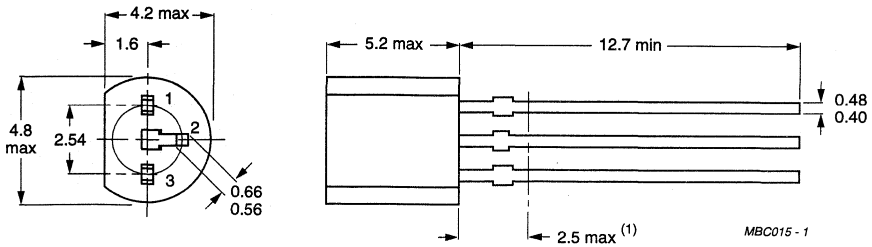
Fig. 1 TO-92 variant.

Pinning:

1 = base
2 = collector
3 = emitter







(1) Terminal dimensions within this zone are uncontrolled to allow for plastic and terminal irregularities.

RATINGS

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

			JC559	JC560	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	30	50	V
Collector-emitter voltage ($+V_{BE}$ = 0 V)	$-V_{CES}$	max.	30	50	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	30	45	V
Emitter-base voltage (open collector)	$-V_{CBO}$	max.	5	5	V

Collector current (DC)	$-I_C$	max.	100	mA
Collector current (peak value)	$-I_{CM}$	max.	200	mA
Emitter current (peak value)	I_{EM}	max.	200	mA
Base current (peak value)	$-I_{BM}$	max.	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	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	$R_{th\ j\text{-}a}$	=	250	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	150	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
I_E = 0; $-V_{CB}$ = 30 V; T_j = 25 °C	$-I_{CBO}$	typ.	1	nA
		max.	15	nA
T_j = 150 °C	$-I_{CBO}$	max.	4	μA
Base-emitter voltage*				
$-I_C$ = 2 mA; $-V_{CE}$ = 5 V	$-V_{BE}$	typ.	650	mV
			600 to 750	mV
$-I_C$ = 10 mA; $-V_{CE}$ = 5 V	$-V_{BE}$	max.	820	mV
Saturation voltages**				
$-I_C$ = 10 mA; $-I_B$ = 0,5 mA	$-V_{CEsat}$	typ.	60	mV
		max.	300	mV
	$-V_{BEsat}$	typ.	750	mV
$-I_C$ = 100 mA; $-I_B$ = 5 mA	$-V_{CEsat}$	typ.	180	mV
		max.	650	mV
	$-V_{BEsat}$	typ.	930	mV

* $-V_{BE}$ decreases by about 2 mV/K with increasing temperature.
** $-V_{BEsat}$ decreases by about 1.7 mV/K with increasing temperature.

Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $-V_{CB} = 10$ V	C_c	typ.	4	pF
Transition frequency at f = 100 MHz				
$-I_C = 10$ mA; $-V_{CE} = 5$ B	f_T	>	100	MHz
Small-signal current gain at f = 1 kHz				
$-I_C = 2$ mA; $-V_{CE} = 5$ V	h_{fe}		125 to 800	

Noise figure at $R_S = 2$ kΩ; $-I_C = 200$ μA; $-V_{CE} = 5$ V			JC559	JC560	
f = 30 Hz to 15 kHz	F	typ.	1.2	1	dB
		max.	4	3	dB
f = 1 kHz; B = 200 Hz	F	typ.	1	1	dB
		max.	4	4	dB
Equivalent noise voltage at $R_S = 2$ kΩ; $-I_C = 200$ μA; $-V_{CE} = 5$ V; f = 10 Hz to 50 Hz; $T_{amb} = 25$ °C	V_n	max.	–	0.11	μV

			JC559 JC560	JC559A JC560A	JC559B JC560B	JC559C JC560C
DC current gain $-I_C = 2$ mA; $-V_{CE} = 5$ V	h_{FE}	min.	125	125	220	420
		max.	800	250	475	800

SILICON PLANAR EPITAXIAL TRANSISTOR

NPN transistor in a plastic TO-92package intended for HF applications in radio and television receivers; it is especially recommended for FM tuners, low noise AM mixer-oscillators with high source impedance and IF amplifiers in AM/FM receivers where a high current gain is of importance.

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 (DC)		I_C	max.	30	mA
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	300	mW
Junction temperature		T_j	max.	150	°C
DC current gain I_C = 1 mA; V_{CE} = 10 V	**JF494**	h_{FE}	67 to 220		
	JF495	h_{FE}	35 to125		
Transition frequency at f = 100 MHz I_C = 1 mA; V_{CE} = 10 V		f_T	min.	120	MHz
			typ.	260	MHz

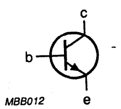
MECHANICAL DATA

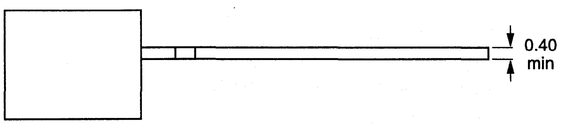
Dimensions in mm

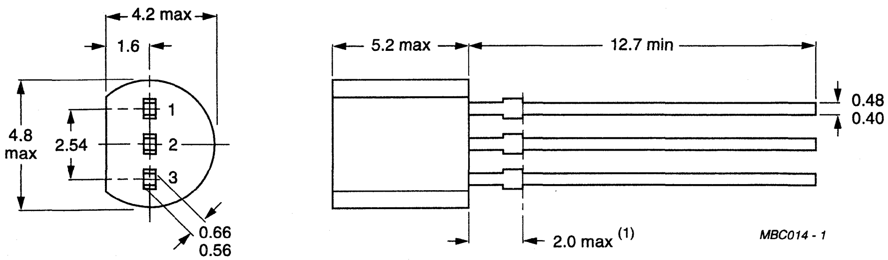
Fig.1 TO-92.

Pinning:

1 = base
2 = collector
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

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)	V_{CEO}	max.	20	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V
Collector current (DC)	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.	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	$R_{th\ j\text{-}a}$	=	420	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Base-emitter voltage I_C = 1 mA; V_{CE} = 10 V		V_{BE}		0.65 to 0.74	V
DC current gain I_C = 1 mA; V_{CE} = 10 V	JF494	h_{FE}		67 to 220	
	JF495	h_{FE}		35 – 125	
Feedback capacitance at f = 0.45 MHz I_C = 1 mA; V_{CE} = 10 V		C_{re}	max.	1,2	pF
Transition frequency I_C = 1 mA; V_{CE} = 10 V		f_T	min.	120	MHz
Collector cut-off current I_E = 0; V_{CB} = 20 V		I_{CBO}	max.	100	nA
I_E = 0; V_{CB} = 20 V; T_{amb} = 150 °C		I_{CBO}	max.	4	μA
Emitter-base cut-off current I_C = 0; V_{EB} = 4 V		I_{EBO}	max.	100	nA

SILICON PLANAR EPITAXIAL TRANSISTORS

PNP silicon planar epitaxial transistors, each in a plastic TO-92 package.
They are intended for use in amplifier applications.

QUICK REFERENCE DATA

			MPS3702	MPS3703	
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	25	30	V
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40	50	V
Collector current (DC)	$-I_C$	max.	600		mA
Total power dissipation at $T_{amb} \leq 25\ ^oC$	P_{tot}	max.	625		mW
Collector-emitter saturation voltage $-I_C = 50$ mA; $-I_B = 5$ mA	$-V_{CEsat}$	max.	0.25		V
DC current gain $-I_C = 50$ mA; $-V_{CE} = 5$ V	h_{FE}	min.	60	30	
		max.	300	150	

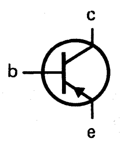
MECHANICAL DATA

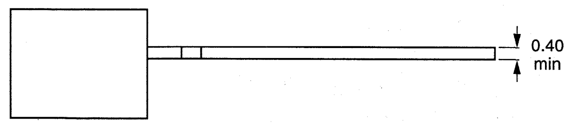
Dimensions in mm

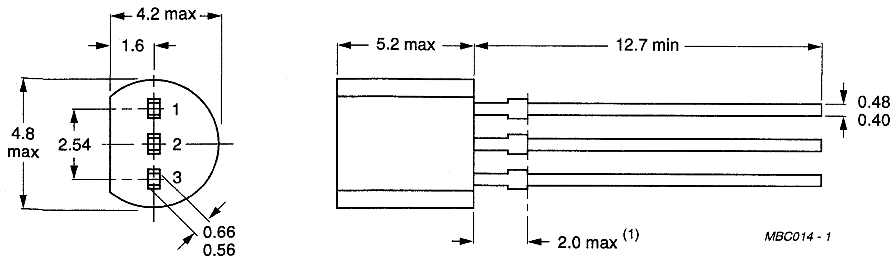
Fig. 1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			MPS3702	MPS3703	
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	25	30	V
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40	50	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5		V
Collector current (DC)	$-I_C$	max.	600		mA
Total power dissipation at $T_{amb} \leqslant 25\ ^oC$	P_{tot}	max.	625		mW
Storage temperature range	T_{stg}		−65 to + 150		^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	200	K/W

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

			MPS3702	MPS3703	
Collector-emitter breakdown voltage $I_B = 0$; $-I_C = 10$ mA	$-V_{(BR)CEO}$	min.	25	30	V
Collector-base breakdown voltage $-I_C = 100\ \mu A$; $I_E = 0$	$-V_{(BR)CBO}$	min.	40	50	V
Emitter-base breakdown voltage $-I_E = 100\ \mu A$; $I_C = 0$	$-V_{(BR)EBO}$	min.	5		V
Collector cut-off current $I_E = 0$; $-V_{CB} = 20$ V	$-I_{CBO}$	max.	100		nA
Emitter cut-off current $I_C = 0$; $-V_{EB} = 3$ V	$-I_{EBO}$	max.	100		nA
DC current gain $-I_C = 50$ mA; $-V_{CE} = 5$ V	h_{FE}	min.	60	30	
		max.	300	150	
Base-emitter on-state voltage $-I_C = 50$ mA; $-V_{CE} = 5$ V	$-V_{BE(on)}$	min.	0.6	0.6	V
		max.	1	1	V
Collector-emitter saturation voltage $-I_C = 50$ mA; $-I_B = 5$ mA	$-V_{CEsat}$	min.	0.25		V
Transition frequency at f = 100 MHz $-I_C = 50$ mA; $-V_{CE} = 5$ V	f_T	min.	100		MHz
Collector-base capacitance at f = 1 MHz $I_E = 0$; $-V_{CB} = 10$ V	C_c	max.	12		pF

SILICON PLANAR EPITAXIAL TRANSISTORS

NPN silicon planar epitaxial transistors, each in a plastic TO-92 package.
They are intended for use in amplifier applications.

QUICK REFERENCE DATA

			MPS3704	05	06	
Collector-emitter voltage (open base)	V_{CEO}	max.	30	30	20	V
Collector-base voltage (open emitter)	V_{CBO}	max.	50	50	40	V
Collector current (DC)	I_C	max.		600		mA
Total power dissipation at $T_{amb} \leqslant 25\ ^{o}C$	P_{tot}	max.		625		mW
Collector-emitter saturation voltage $I_C = 100$ mA; $I_B = 5$ mA	V_{CEsat}	max.	0.6	0.8	1.0	V
DC current gain $I_C = 50$ mA; $V_{CE} = 5$ V	h_{FE}	min.	100	50	30	
		max.	300	150	600	

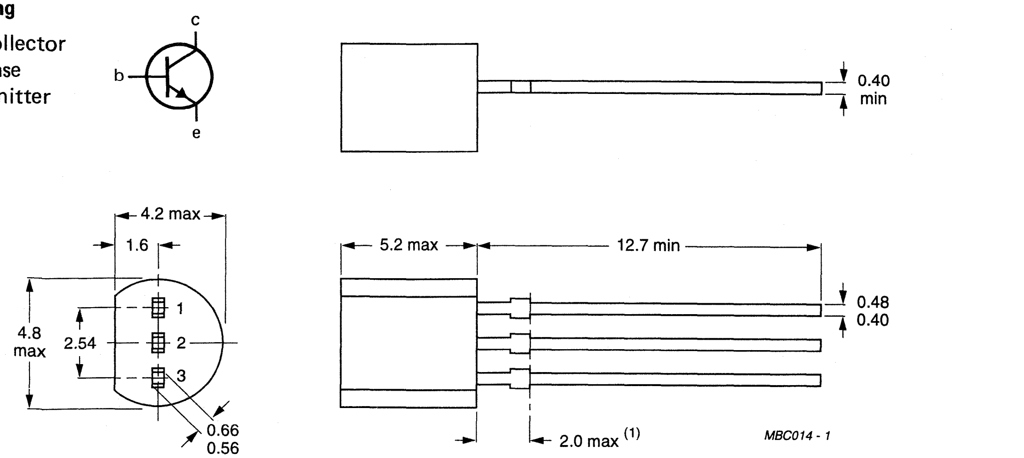
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter



Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			MPS3704	05	06	
Collector-emitter voltage (open base)	V_{CEO}	max.	30	30	20	V
Collector-base voltage (open emitter)	V_{CBO}	max.	50	50	40	V
Emitter-base voltage (open collector)	V_{EBO}	max.		5		V
Collector current (DC)	I_C	max.		600		mA
Total power dissipation at $T_{amb} \leqslant 25\ ^oC$	P_{tot}	max.		625		mW
Storage temperature range	T_{stg}			−65 to + 150		^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	200	K/W

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

			MPS3704	05	06	
Collector-emitter breakdown voltage $I_B = 0$; $I_C = 10$ mA	$V_{(BR)CEO}$	min.	30	30	20	V
Collector-base breakdown voltage $I_C = 100\ \mu A$; $I_E = 0$	$V_{(BR)CBO}$	min.	50	50	40	V
Emitter-base breakdown voltage $I_C = 0$; $I_E = 100\ \mu A$	$V_{(BR)EBO}$	min.		5		V
Collector cut-off current $I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	max.		100		nA
Emitter cut-off current $I_C = 0$; $V_{EB} = 3$ V	I_{EBO}	max.		100		nA
DC current gain $I_C = 50$ mA; $V_{CE} = 5$ V	h_{FE}	min. max.	100 300	50 150	30 600	
Collector-emitter saturation voltage $I_C = 100$ mA; $I_B = 5$ mA	V_{CEsat}	max.	0.6	0.8	1.0	V
Base-emitter on-state voltage $I_C = 100$ mA; $V_{CE} = 5$ V	$V_{BE(on)}$	min. max.		0.5 1.0		V V
Transition frequency at f = 100 MHz $I_C = 50$ mA; $V_{CE} = 5$ V	f_T	min.		100		MHz
Collector-base capacitance at f = 1 MHz $I_E = 0$; $V_{CB} = 10$ V	C_c	max.		12		pF

SILICON PLANAR EPITAXIAL TRANSISTOR

NPN transistors in plastic TO-92 packages, primarily intended for industrial applications (e.g. Telecom).

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.	500 mW
DC current gain I_C = 10 mA; V_{CE} = 1 V	h_{FE}	min. max.	100 300
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 20 V	f_T	min.	180 MHz

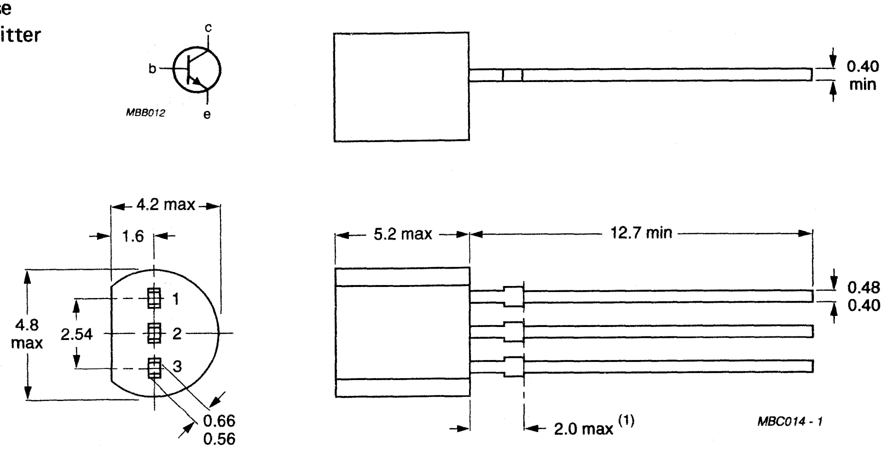
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter



Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

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.	500 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	$R_{th\ j\text{-}a}$	=	250 K/W

CHARACTERISTICS

T_{amb} = 25 °C

Currents at reverse biased emitter junction V_{CE} = 30 V; $-V_{BE}$ = 3 V	I_{CEX} $-I_{BEX}$	max. max.	50 nA 50 nA
Saturation voltages (see note 1) I_C = 10 mA; I_B = 1 mA	V_{CEsat} V_{BEsat}	max. 	200 mV 650 to 850 mV
I_C = 50 mA; I_B = 5 mA	V_{CEsat} V_{BEsat}	max. max.	300 mV 950 mV
DC current gain (see note 1) I_C = 0.1 mA; V_{CE} = 1 V	h_{FE}	min.	40
I_C = 1 mA; V_{CE} = 1 V	h_{FE}	min.	70
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
Collector capacitance at 100 kHz ⩽ f ⩽ 1 MHz $I_E = I_e$ = 0; V_{CB} = 5 V	C_c	max.	5 pF
Emitter capacitance at 100 kHz ⩽ f ⩽ 1 MHz $I_C = I_c$ = 0; V_{EB} = 0.5 V	C_e	max.	15 pF
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 20 V	f_T	min.	180 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

Note

1. Measured under pulse conditions: t_p = 300 μs; δ = 0.02.

SWITCHING CHARACTERISTICS

Delay time V_{CC} = 3.0 V DC, V_{BE}(off) = 0.5 V DC I_C = 10 mA DC, I_{B1} = 1 mA DC	t_d	max.	45 ns
Rise time V_{CC} = 3.0 V DC, V_{BE}(off) = 0.5 V DC I_C = 10 mA DC, I_{B1} = 1 mA DC	t_r	max.	55 ns
Storage time V_{CC} = 3.0 V DC, I_C = 10 mA DC I_{B1} = I_{B2} = 1 mA DC	t_{stg}	max.	900 ns
Fall time V_{CC} = 3.0 V DC, I_C = 10 mA DC I_{B1} = I_{B2} = 1 mA DC	t_f	max.	90 ns

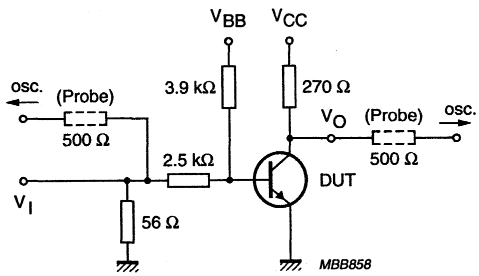


Fig. 2 Test circuit for switching times;
V_1 = 5 V; $t_p \geqslant 4\ \mu s$; $t_r = t_f \leqslant 3$ ns.

SILICON PLANAR EPITAXIAL TRANSISTOR

PNP transistors in plastic TO-92 packages, primarily intended for industrial applications (e.g. Telecom).

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.	500	mW
DC current gain $-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}	min. max.	100 300	
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 20 V	f_T	min.	150	MHz

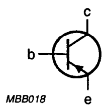
MECHANICAL DATA

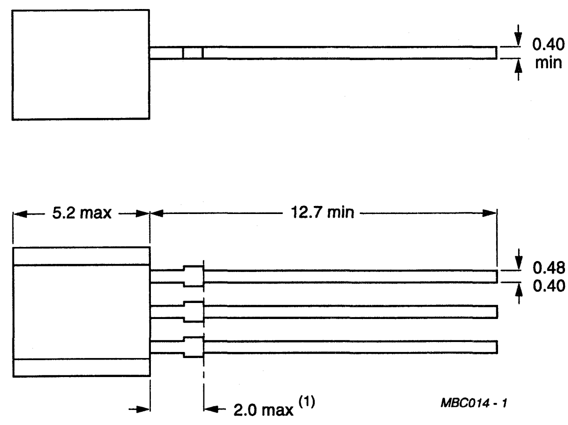
Dimensions in mm

Fig. 1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter





Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

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.	500	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	$R_{th\ j\text{-}a}$	=	250	K/W

CHARACTERISTICS

T_{amb} = 25 °C

Currents at reverse biased emitter junction				
$-V_{CE}$ = 30 V; $+V_{BE}$ = 3 V	$-I_{CEX}$	max.	50	nA
	$+I_{BEX}$	max.	50	nA
Saturation voltages (see note 1)				
$-I_C$ = 10 mA; $-I_B$ = 1 mA	$-V_{CEsat}$	max.	250	mV
	$-V_{BEsat}$		650 to 850	mV
$-I_C$ = 50 mA; $-I_B$ = 5 mA	$-V_{CEsat}$	max.	400	mV
	$-V_{BEsat}$	max.	950	mV
DC current gain (see note 1)				
$-I_C$ = 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.	100	
		max.	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	
Collector capacitance at 100 kHz ⩽ f ⩽ 1 MHz				
$I_E = I_e = 0$; $-V_{CB}$ = 5 V	C_c	max.	5	pF
Emitter capacitance at 100 kHz ⩽ f ⩽ 1 MHz				
$I_C = I_c = 0$; $-V_{EB}$ = 0.5 V	C_e	max.	15	pF
Transition frequency at f = 100 MHz				
$-I_C$ = 10 mA; $-V_{CE}$ = 20 V	f_T	min.	150	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

Note

1. Measured under pulse conditions: t_p = 300 μs; δ = 0.02.

SWITCHING CHARACTERISTICS

Delay time V_{CC} = 3.0 V DC, $V_{BE(off)}$ = 0.5 V DC I_C = 10 mA DC, I_{B1} = 1 mA DC	t_d	max.	45 ns
Rise time V_{CC} = 3.0 V DC, $V_{BE(off)}$ = 0.5 V DC I_C = 10 mA DC, I_{B1} = 1 mA DC	t_r	max.	55 ns
Storage time V_{CC} = 3.0 V DC, I_C = 10 mA DC I_{B1} = I_{B2} = 1 mA DC	t_{stg}	max.	600 ns
Fall time V_{CC} = 3.0 V DC, I_C = 10 mA DC I_{B1} = I_{B2} = 1 mA DC	t_f	max.	90 ns

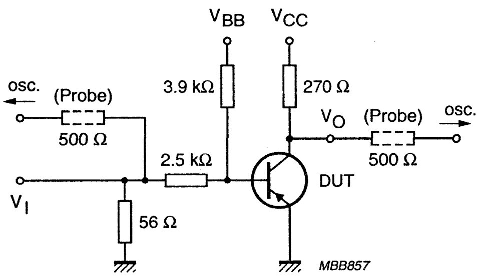


Fig. 2 Test circuit for switching times;
V_1 = –5 V; $t_p \geqslant 4\ \mu s$; $t_r = t_f \leqslant 3$ ns.

SILICON PLANAR EPITAXIAL TRANSISTORS

General purpose n-p-n transistors in TO-92 packages. The complementary types are MPS6517 to MPS6519.

QUICK REFERENCE DATA

			MPS6513	6514	6515	
Collector-emitter voltage	V_{CEO}	max.	30	25	25	V
Collector current (d.c.)	I_C	max.	100	100	100	mA
D.C. current gain I_C = 100 mA; V_{CE} = 10 V	h_{FE}	>	60	90	150	
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		625		mW

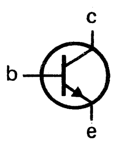
MECHANICAL DATA

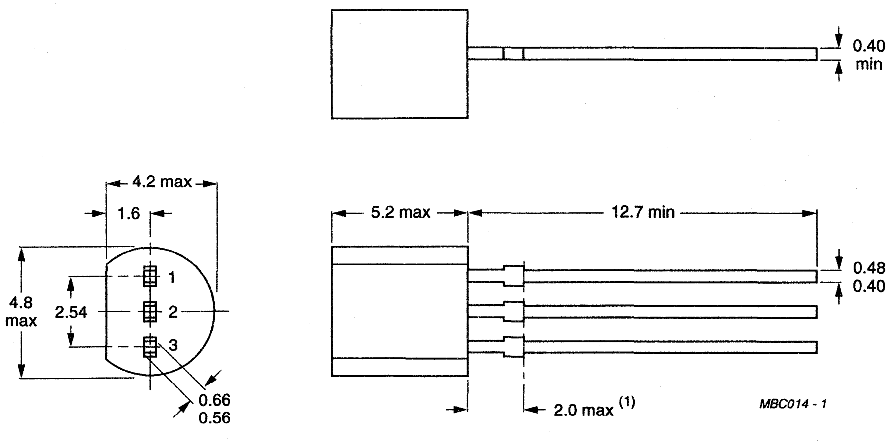
Dimensions in mm

Fig. 1 TO-92.

Pinning;

1 = collector
2 = base
3 = emitter





Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			MPS6513	6514	6515	
Collector-emitter voltage	V_{CEO}	max.	30	25	25	V
Collector-base voltage	V_{CBO}	max.	40			V
Emitter-base voltage	V_{EBO}	max.	4,0			V
Collector current (d.c.)	I_C	max.	100			mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	625			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	$R_{th\ j\text{-}a}$	=	200	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			MPS6513	6514	6515	
Collector-emitter breakdown voltage I_C = 0,5 mA; I_B = 0	$V_{(BR)CEO}$	>	30	25	25	V
Emitter-base breakdown voltage I_E = 10 μA; I_C = 0	$V_{(BR)EBO}$	>	4,0	4,0	4,0	V
Collector cut-off current V_{CB} = 30 V; I_E = 0	I_{CBO}	<	50	50	50	nA
D.C. current gain I_C = 2 mA; V_{CE} = 10 V	h_{FE}	=	90 to 180	150 to 300	250 to 500	
I_C = 100 mA; V_{CE} = 10 V	h_{FE}	>	60	90	150	
Collector-emitter saturation voltage I_C = 50 mA; I_B = 5 mA	V_{CEsat}	<	0,5			V
Output capacitance V_{CB} = 10 V; I_E = 0; f = 100 kHz	C_c	<	3,5			pF

SILICON PLANAR EPITAXIAL TRANSISTORS

General purpose p-n-p transistors in TO-92 packages. The complementary types are MPS6513 to MPS6515.

QUICK REFERENCE DATA

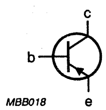
			MPS6517	6518	6519	
Collector-emitter voltage	$-V_{CEO}$	max.	40	40	25	V
Collector current (d.c.)	$-I_C$	max.	100	100	100	mA
D.C. current gain $-I_C = 100$ mA; $-V_{CE} = 10$ V	h_{FE}	>	60	90	150	
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.		625		mW

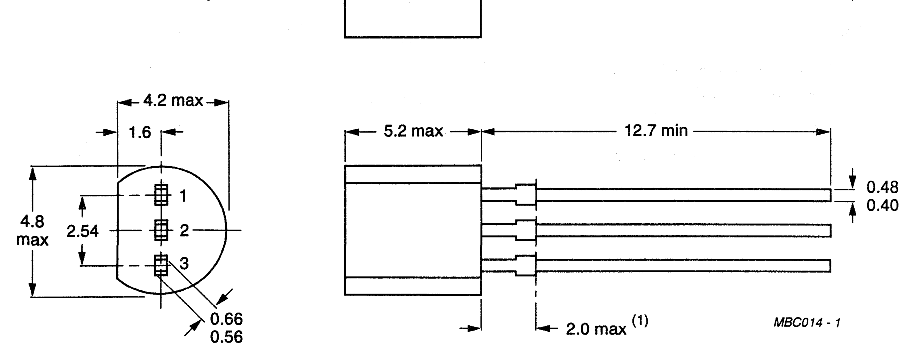
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92.

Pinning;
1 = collector
2 = base
3 = emitter





Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			MPS6517	6518	6519	
Collector-emitter voltage	$-V_{CEO}$	max.	40	40	25	V
Collector-base voltage	$-V_{CBO}$	max.	40	40	25	V
Emitter-base voltage	$-V_{EBO}$	max.	4,0			V
Collector current (d.c.)	$-I_C$	max.	100			mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	625			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	$R_{th\ j\text{-}a}$	=	200	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			MPS6517	6518	6519	
Collector-emitter breakdown voltage $-I_C$ = 0,5 mA; I_B = 0	$-V_{(BR)CEO}$	>	40	40	25	V
Emitter-base breakdown voltage $-I_E$ = 10 μA; I_C = 0	$-V_{(BR)EBO}$	>	4,0	4,0	4,0	V
Collector cut-off current $-V_{CB}$ = 30 V; I_E = 0	$-I_{CBO}$	<	50	50	−	nA
$-V_{CB}$ = 20 V; I_E = 0	$-I_{CBO}$	<	−	−	50	nA
D.C. current gain $-I_C$ = 2 mA; $-V_{CE}$ = 10 V	h_{FE}	=	90 to 180	150 to 300	250 to 500	
$-I_C$ = 100 mA; $-V_{CE}$ = 10 V	h_{FE}	>	60	90	150	
Collector-emitter saturation voltage $-I_C$ = 50 mA; $-I_B$ = 5 mA	$-V_{CEsat}$	<	0,5			V
Output capacitance $-V_{CB}$ = 10 V; I_E = 0; f = 100 kHz	C_c	<	3,5			pF

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N small-signal transistors in plastic TO-92 package intended for low-noise applications in audio equipment.

Complementary types are MPS6522 and MPS6523.

QUICK REFERENCE DATA

Collector-emitter voltage (open base)	V_{CEO}	max.	25		V
Collector-base voltage (open emitter)	V_{CBO}	max.	40		V
Collector current (d.c.)	I_C	max.	100		mA
Total device dissipation up to T_{amb} = 25 °C	P_{tot}	max.	625		mW
Collector-emitter saturation voltage I_C = 50 mA; I_B = 5 mA	V_{CEsat}	max.	0,5		V
			MPS6520	MPS6521	
D.C. current gain I_C = 100 μA; V_{CE} = 10 V	h_{FE}	min.	100	150	
I_C = 2 mA; V_{CE} = 10 V	h_{FE}	min.	200	300	
		max.	400	600	

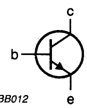
MECHANICAL DATA

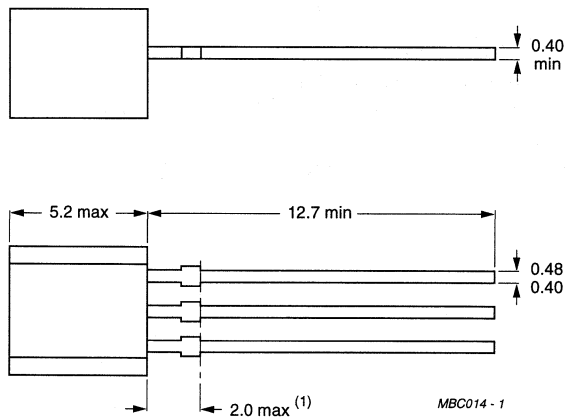
Dimensions in mm

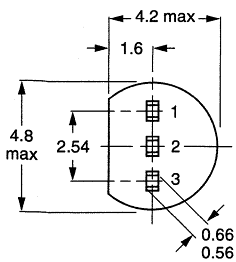
Fig. 1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

Collector-emitter voltage (open base)	V_{CEO}	max.	25	V
Collector-base voltage (open emitter)	V_{CBO}	max.	40	V
Emitter-base voltage (open collector)	V_{EBO}	max.	4,0	V
Collector current (d.c.)	I_C	max.	100	mA
Total device dissipation up to T_{amb} = 25 °C	P_{tot}	max.	625	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	$R_{th\ j\text{-}a}$	=	200	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector-emitter breakdown voltage $I_B = 0$; I_C = 0,5 mA	$V_{(BR)CEO}$	min.	25	V
Emitter-base breakdown voltage I_E = 10 μA; $I_C = 0$	$V_{(BR)EBO}$	min.	4,0	V
Collector cut-off current V_{CB} = 30 V; $I_E = 0$	I_{CBO}	max.	50	nA
Collector-emitter saturation voltage I_C = 50 mA; I_B = 5 mA	V_{CEsat}	max.	0,5	V
Output capacitance at f = 100 kHz V_{CB} = 10 V; $I_E = 0$	C_c	max.	3,5	pF
Noise figure at T_{amb} = 25 °C I_C = 10 μA; V_{CE} = 5 V; R_S = 10 kΩ; f = 10 Hz to 10 kHz	F	max.	3,0	dB

			MPS6520	MPS6521
D.C. current gain I_C = 100 μA; V_{CE} = 10 V	h_{FE}	min.	100	150
I_C = 2 mA; V_{CE} = 10 V	h_{FE}	min.	200	300
		max.	400	600

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P small-signal transistors in plastic TO-92 package intended for low-noise applications in audio equipment.

Complementary types are MPS6520 and MPS6521.

QUICK REFERENCE DATA

Collector-emitter voltage (open base)	$-V_{CEO}$	max.	25		V
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	25		V
Collector current (d.c.)	$-I_C$	max.	100		mA
Total device dissipation up to T_{amb} = 25 °C	P_{tot}	max.	625		mW
Collector-emitter saturation voltage $-I_C$ = 50 mA; $-I_B$ = 5 mA	$-V_{CEsat}$	max.	0,5		V
			MPS6522	MPS6523	
D.C. current gain $-I_C$ = 100 µA; $-V_{CE}$ = 10 V	h_{FE}	min.	100	150	
$-I_C$ = 2 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	200	300	
		max.	400	600	

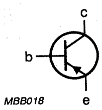
MECHANICAL DATA

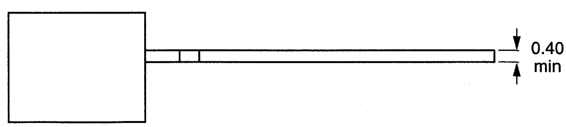
Dimensions in mm

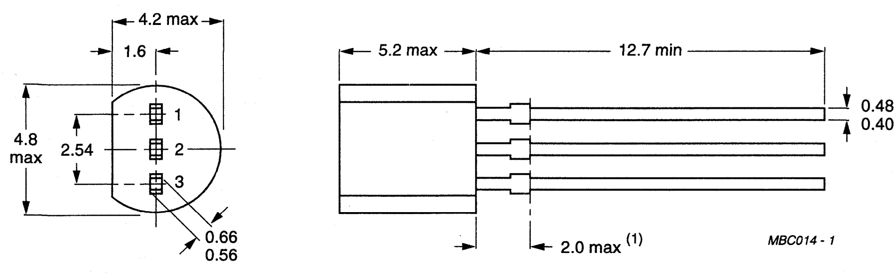
Fig. 1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

Collector-emitter voltage (open base)	$-V_{CEO}$	max.	25	V
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	25	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	4,0	V
Collector current (d.c.)	$-I_C$	max.	100	mA
Total device dissipation up to T_{amb} = 25 °C	P_{tot}	max.	625	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	$R_{th\ j\text{-}a}$	=	200	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector-emitter breakdown voltage $I_B = 0$; $-I_C$ = 0,5 mA	$-V_{(BR)CEO}$	min.	25	V
Emitter-base breakdown voltage $-I_E$ = 10 μA; $I_C = 0$	$-V_{(BR)EBO}$	min.	4,0	V
Collector cut-off current $-V_{CB}$ = 30 V; $I_E = 0$	$-I_{CBO}$	max.	50	nA
Collector-emitter saturation voltage $-I_C$ = 50 mA; $-I_B$ = 5 mA	$-V_{CEsat}$	max.	0,5	V
Output capacitance at f = 100 kHz $-V_{CB}$ = 10 V; $I_E = 0$	C_c	max.	3,5	pF
Noise figure at T_{amb} = 25 °C $-I_C$ = 10 μA; $-V_{CE}$ = 5 V; R_S = 10 kΩ; f = 10 Hz to 10 kHz	F	max.	3,0	dB

			MPS6522	MPS6523
D.C. current gain $-I_C$ = 100 μA; $-V_{CE}$ = 10 V	h_{FE}	min.	100	150
$-I_C$ = 2 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	200	300
		max.	400	600

SILICON PLANAR EPITAXIAL TRANSISTORS

NPN silicon planar epitaxial small-signal transistors, each in a plastic TO-92 package.
They are intended for amplifier applications.
PNP complementary types are MPS6534 and MPS6535.

QUICK REFERENCE DATA

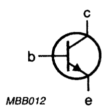
			MPS6531	MPS6532	
Collector-emitter voltage (open base)	V_{CEO}	max.	40	30	V
Collector-base voltage (open emitter)	V_{CBO}	max.	60	50	V
DC collector current	I_C	max.	600		mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	625		mW
Collector-emitter saturation voltage I_C = 100 mA; I_B = 10 mA	V_{CEsat}	max.	0.3	0.5	V
DC current gain I_C = 100 mA; V_{CE} = 1 V	h_{FE}	min.	90	30	
		max.	270	–	

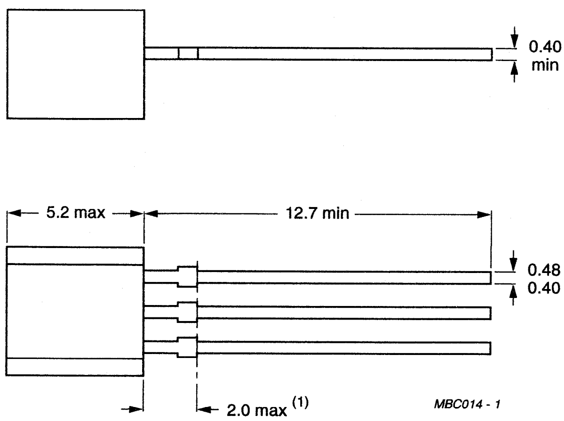
MECHANICAL DATA

Dimensions in mm

Pinning

1 = collector
2 = base
3 = emitter





Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

Fig. 1 TO-92.

RATINGS

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

			MPS6531	MPS6532	
Collector-emitter voltage (open base)	V_{CEO}	max.	40	30	V
Collector-base voltage (open emitter)	V_{CBO}	max.	60	50	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5.0		V
DC collector current	I_C	max.	600		mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	625		mW
Storage temperature range	T_{stg}		−65 to + 150		°C
Junction temperature	T_j	=	150		°C

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			MPS6531	MPS6532	
Collector-emitter breakdown voltage I_B = 0; I_C = 10 mA	$V_{(BR)CEO}$	min.	40	30	V
Collector-base breakdown voltage I_E = 0; I_C = 10 μA	$V_{(BR)CBO}$	min.	60	50	V
Collector cut-off currents					
I_E = 0; V_{CB} = 40 V	I_{CBO}	max.	50	—	nA
I_E = 0; V_{CB} = 30 V	I_{CBO}	max.	—	100	nA
I_E = 0; V_{CB} = 40 V; T_{amb} = 60 °C	I_{CBO}	max.	2	—	μA
I_E = 0; V_{CB} = 30 V; T_{amb} = 60 °C	I_{CBO}	max.	—	5	μA
DC current gain					
I_C = 10 mA; V_{CE} = 1 V	h_{FE}	min.	60	—	
I_C = 100 mA; V_{CE} = 1 V	h_{FE}	min.	90	30	
		max.	270	—	
I_C = 500 mA; V_{CE} = 10 V	h_{FE}	min.	50	—	
Collector-emitter saturation voltage I_C = 100 mA; I_B = 10 mA	V_{CEsat}	max.	0.3	0.5	V
Base-emitter saturation voltage I_C = 100 mA; I_B = 10 mA	V_{BEsat}	max.	1.0	1.2	V
Collector-base capacitance I_E = 0; V_{CB} = 10 V; f = 1 MHz	C_c	max.	5	5	pF

SILICON PLANAR EPITAXIAL TRANSISTORS

PNP silicon planar epitaxial small-signal transistors, each in a plastic TO-92 package.
They are intended for amplifier applications.
NPN complementary types are MPS6531 and MPS6532.

QUICK REFERENCE DATA

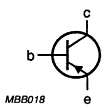
			MPS6534	MPS6535	
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40	30	V
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40	30	V
DC collector current	$-I_C$	max.	600		mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	625		mW
Collector-emitter saturation voltage $-I_C$ = 100 mA; $-I_B$ = 10 mA	$-V_{CEsat}$	max.	0.3	0.5	V
DC current gain $-I_C$ = 100 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	90	30	
		max.	270	–	

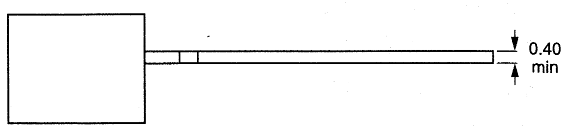
MECHANICAL DATA

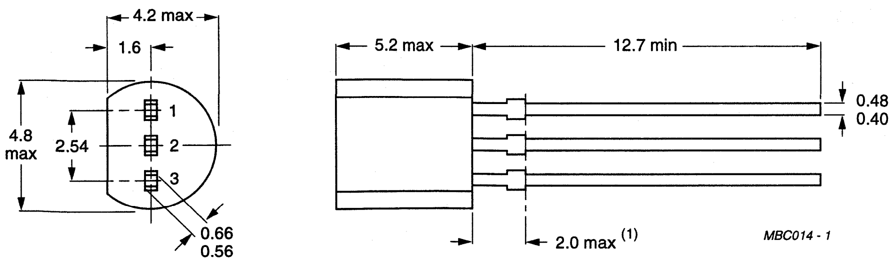
Dimensions in mm

Pinning

1 = collector
2 = base
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

Fig. 1 TO-92.

RATINGS

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

			MPS6534	MPS6535	
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40	30	V
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40	30	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5.0		V
DC collector current	$-I_C$	max.	600		mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	625		mW
Storage temperature range	T_{stg}		−65 to + 150		°C
Junction temperature	T_j	=	150		°C

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			MPS6534	MPS6535	
Collector-emitter breakdown voltage $-I_B = 0$; $-I_C$ = 10 mA	$-V_{(BR)CEO}$	min.	40	30	V
Collector-base breakdown voltage $-I_E = 0$; $-I_C$ = 10 μA	$-V_{(BR)CBO}$	min.	40	30	V
Collector cut-off currents					
$-I_E = 0$; $-V_{CB}$ = 30 V	$-I_{CBO}$	max.	50	50	nA
$-I_E = 0$; $-V_{CB}$ = 30 V; T_{amb} = 60 °C	$-I_{CBO}$	max.	2	–	μA
$-I_E = 0$; $-V_{CB}$ = 20 V; T_{amb} = 60 °C	$-I_{CBO}$	max.	–	5	μA
DC current gain					
$-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	60	–	
$-I_C$ = 100 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	90	30	
		max.	270	–	
$-I_C$ = 500 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	50	–	
Collector-emitter saturation voltage $-I_C$ = 100 mA; $-I_B$ = 10 mA	$-V_{CEsat}$	max.	0.3	0.5	V
Base-emitter saturation voltage $-I_C$ = 100 mA; $-I_B$ = 10 mA	$-V_{BEsat}$	max.	1.0	1.2	V
Collector capacitance $-I_E = -i_e = 0$; $-V_{CB}$ = 10 V; f = 1 MHz	C_c	max.	10	10	pF

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N silicon planar epitaxial transistors in plastic TO-92 package for general purpose applications.

QUICK REFERENCE DATA

			MPSA05	MPSA06	
Collector-emitter voltage (open base)	V_{CEO}	max.	60	80	V
Collector-base voltage (open emitter)	V_{CBO}	max.	60	80	V
Collector current (d.c.)	I_C	max.	500		mA
Total device dissipation at T_{amb} = 25 °C	P_{tot}	max.	625		mW
Collector-emitter saturation voltage I_C = 100 mA; I_B = 10 mA	V_{CEsat}	max.	0,25		V
D.C. current gain I_C = 10 mA; V_{CE} = 1,0 V	h_{FE}	min.	50		

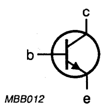
MECHANICAL DATA

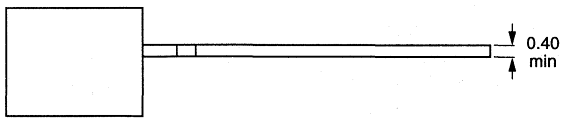
Dimensions in mm

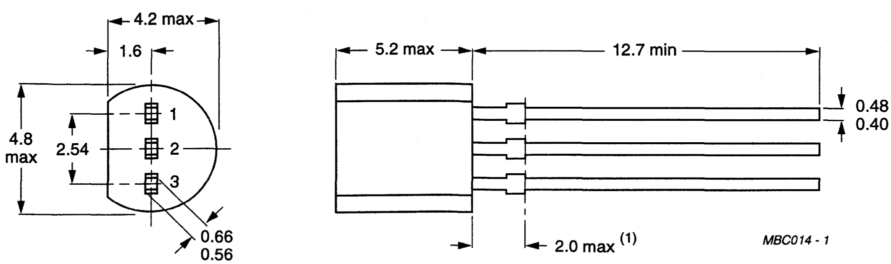
Fig. 1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			MPSA05	MPSA06	
Collector-emitter voltage (open base)	V_{CEO}	max.	60	80	V
Collector-base voltage (open emitter)	V_{CBO}	max.	60	80	V
Emitter-base voltage (open collector)	V_{EBO}		4,0		V
Collector current (d.c.)	I_C	max.	500		mA
Total device dissipation at T_{amb} = 25 °C	P_{tot}	max.	625		mW
Storage temperature	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	=	200	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			MPSA05	MPSA06	
Collector-emitter breakdown voltage $I_B = 0$; I_C = 1,0 mA	$V_{(BR)CEO}$		60	80	V
Emitter-base breakdown voltage I_E = 100 μA; $I_C = 0$	$V_{(BR)EBO}$		4,0		V
Collector-emitter cut-off current $I_B = 0$; V_{CE} = 60 V	I_{CEO}	max.	0,1		μA
Collector cut-off current $I_E = 0$; V_{CB} = 60 V	I_{CBO}	max.	0,1		μA
$I_E = 0$; V_{CB} = 80 V	I_{CBO}	max.		0,1	μA
D.C. current gain I_C = 10 mA; V_{CE} = 1,0 V	h_{FE}	min.	50		
I_C = 100 mA; V_{CE} = 1,0 V	h_{FE}	min.	50		
Saturation voltage I_C = 100 mA; I_B = 10 mA	V_{CEsat}	max.	0,25		V
Base-emitter ON-voltage I_C = 100 mA; V_{CE} = 1,0 V	$V_{BE(on)}$	max.	1,2		V
Transition frequency at f = 100 MHz* I_C = 10 mA; V_{CE} = 2,0 V	f_T	min.	100		MHz

* f_T is defined as the frequency at which $|h_{fe}|$ extrapolates to unity.

SILICON PLANAR EPITAXIAL DARLINGTON TRANSISTORS

N-P-N silicon planar epitaxial darlington transistors in plastic TO-92 package for general purpose applications.

QUICK REFERENCE DATA

<table>
<tr><th></th><th></th><th></th><th>MPSA13</th><th>MPSA14</th><th></th></tr>
<tr><td>Collector-emitter voltage
$V_{BE} = 0$</td><td>V_{CES}</td><td>max.</td><td colspan="2">30</td><td>V</td></tr>
<tr><td>Collector-base voltage
(open emitter)</td><td>V_{CBO}</td><td>max.</td><td colspan="2">30</td><td>V</td></tr>
<tr><td>Collector current (d.c.)</td><td>I_C</td><td>max.</td><td colspan="2">500</td><td>mA</td></tr>
<tr><td>Total device dissipation
at $T_{amb} = 25\ ^oC$</td><td>P_{tot}</td><td>max.</td><td colspan="2">625</td><td>mW</td></tr>
<tr><td>Collector-emitter saturation voltage
$I_C = 100$ mA; $I_B = 0,1$ mA</td><td>V_{CEsat}</td><td>max.</td><td colspan="2">1,5</td><td>V</td></tr>
<tr><td>D.C. current gain
$I_C = 10$ mA; $V_{CE} = 5,0$ V</td><td>h_{FE}</td><td>min.</td><td>5000</td><td>10 000</td><td></td></tr>
</table>

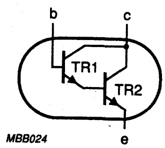
MECHANICAL DATA

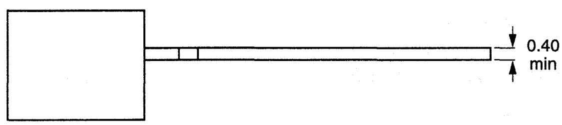
Dimensions in mm

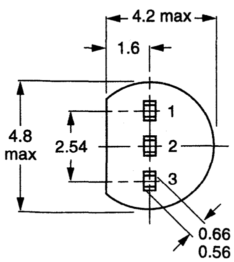
Fig. 1 TO-92.

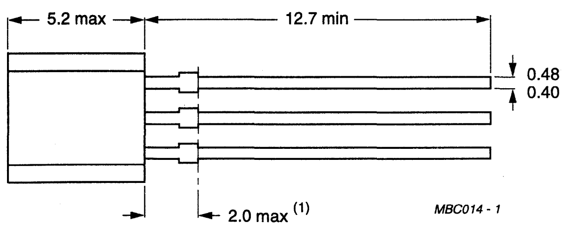
Pinning

1 = collector
2 = base
3 = emitter









Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			MPSA13	MPSA14	
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 (d.c.)	I_C	max.	500		mA
Total device dissipation at $T_{amb} = 25\ ^oC$	P_{tot}	max.	625		mW
Storage temperature range	T_{stg}		−65 to +150		^oC
Junction temperature	T_j	max.	150		^oC

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	=	200	K/W

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

			MPSA13	MPSA14	
Collector-emitter breakdown voltage $I_B = 0$; $I_C = 100\ \mu A$	$V_{(BR)CES}$	min.	30		V
Collector cut-off current $I_E = 0$; $V_{CB} = 30\ V$	I_{CBO}	max.	0,1		μA
Emitter cut-off current $I_C = 0$; $V_{BE} = 10\ V$	I_{EBO}	max.	0,1		μA
D.C current gain $I_C = 10\ mA$; $V_{CE} = 5,0\ V$	h_{FE}	min.	5000	10 000	
$I_C = 100\ mA$; $V_{CE} = 5,0\ V$	h_{FE}	min.	10 000	20 000	
Saturation voltage $I_C = 100\ mA$; $I_B = 0,1\ mA$	V_{CEsat}	max.	1,5		V
Base-emitter ON-voltage $I_C = 100\ mA$; $V_{CE} = 5,0\ V$	$V_{BE(on)}$	max.	2,0		V
Transition frequency at f = 100 MHz* $I_C = 10\ mA$; $V_{CE} = 5,0\ V$; $T_{amb} = 25\ ^oC$	f_T	min.	125		MHz

* f_T is defined as the frequency at which $|h_{fe}|$ extrapolates to unity.

NPN DARLINGTON TRANSISTOR

NPN small-signal Darlington transistors, each in a plastic TO-92 package.
PNP complementary types are MPSA75, MPSA76, and MPSA77.

QUICK REFERENCE DATA

			MPSA25	26	27	
Collector-emitter voltage	V_{CEO}	max.	40	50	60	V
Emitter-base voltage	V_{EBO}	max.		10		V
DC collector current	I_C	max.		500		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		500		mW
DC current gain I_C = 10 mA, V_{CE} = 5 V	h_{FE}	min.		10000		

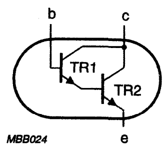
MECHANICAL DATA

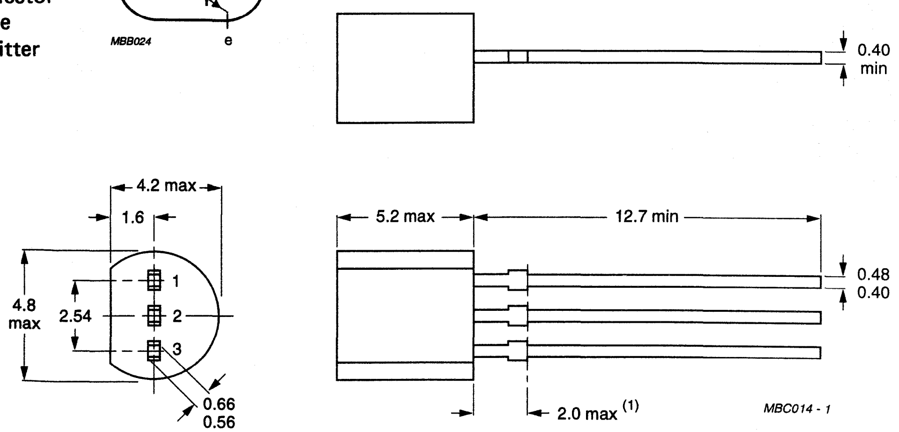
Dimensions in mm

Fig.1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter





Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			MPSA25	26	27	
Collector-emitter voltage	V_{CEO}	max	40	50	60	V
Emitter-base voltage	V_{EBO}	max.		10		V
DC collector current	I_C	max.		500		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		500		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	$R_{th\ j\text{-}a}$	=	250	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			MPSA25	26	27	
Collector-emitter breakdown voltage I_C = 100 μA; V_{BE} = 0	$V_{(BR)CES}$	min.	50	50	60	V
Collector-base breakdown voltage I_C = 100 μA; I_E = 0	$V_{(BR)CBO}$	min.	40	50	60	V
Collector cut-off current V_{CB} = 40 V; I_E = 0	I_{CBO}	max.	100	100	–	nA
V_{CB} = 50 V; I_E = 0	I_{CBO}	max.	–	–	100	nA
Emitter cut-off current V_{EB} = 10 V; I_C = 0	I_{EBO}	max.		100		nA
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_{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 T_{amb} = 25 °C I_C = 30 mA; V_{CE} = 5 V; f = 100 MHz	f_T	min.		125		MHz
		typ.		220		MHz

HIGH VOLTAGE SILICON PLANAR TRANSISTORS

N-P-N high voltage silicon planar transistors in plastic TO-92 package for use in general purpose applications.

QUICK REFERENCE DATA

			MPSA42	MPSA43	
Collector-emitter voltage (open base)	V_{CEO}	max.	300	200	V
Collector-base voltage (open emitter)	V_{CBO}	max.	300	200	V
Collector current (d.c.)	I_C	max.	500		mA
Total device dissipation at T_{amb} = 25 °C	P_{tot}	max.	625		mW
Collector-emitter saturation voltage I_C = 20 mA; I_B = 2,0 mA	V_{CEsat}	max.	0,5		V
D.C. current gain I_C = 30 mA; V_{CE} = 10 V	h_{FE}	min.	40		

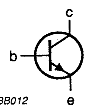
MECHANICAL DATA

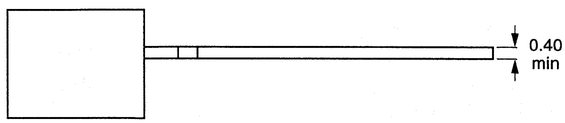
Dimensions in mm

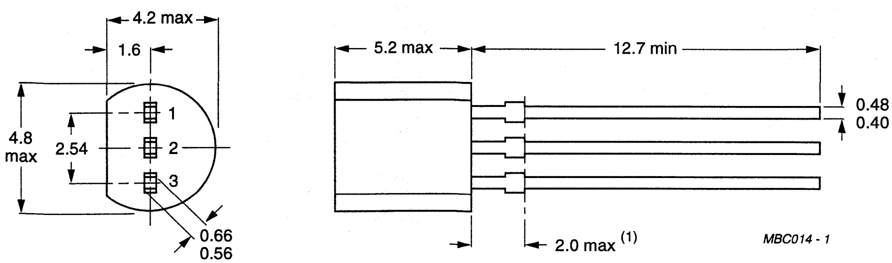
Fig. 1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			MPSA42	MPSA43	
Collector-emitter voltage (open base)	V_{CEO}	max.	300	200	V
Collector-base voltage (open emitter)	V_{CBO}	max.	300	200	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6,0		V
Collector current (d.c.)	I_C	max.	500		mA
Total device dissipation at T_{amb} = 25 °C	P_{tot}	max.	625		mW
Storage temperature range	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	=	200	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			MPSA42	MPSA43	
Collector-emitter breakdown voltage* $I_B = 0$; I_C = 1,0 mA	$V_{(BR)CES}$		300	200	V
Collector-base breakdown voltage $I_E = 0$; I_C = 100 µA	$V_{(BR)CBO}$		300	200	V
Emitter-base breakdown voltage $I_C = 0$; I_E = 100 µA	$V_{(BR)EBO}$		6,0		V
Collector cut-off current $I_E = 0$; V_{CB} = 200 V	I_{CBO}	max.	0,1		µA
$I_E = 0$; V_{CB} = 160 V	I_{CBO}	max.		0,1	µA
Emitter cut-off current $I_C = 0$; V_{BE} = 6,0 V	I_{EBO}	max.	0,1		µA
$I_C = 0$; V_{BE} = 4,0 V	I_{EBO}	max.		0,1	µA
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.	40		
Saturation voltages* I_C = 20 mA; I_B = 2,0 mA	V_{CEsat}	max.	0,5		V
I_C = 20 mA; I_B = 2,0 mA	V_{BEsat}	max.	0,9		V
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 kHz V_{CB} = 20 V; $I_E = 0$	C_c	max.	3,0	4,0	pF

* Pulse test: pulse width ⩽ 300 µs, duty cycle ⩽ 2%.

NPN high voltage transistor — MPSA44; MPSA45

FEATURES

- High voltage
- High current.

DESCRIPTION

High voltage NPN transistor in a SOT54 (TO-92) package, especially suitable for use in telecommunications applications.

PINNING - SOT54

PIN	DESCRIPTION
1	collector
2	base
3	emitter

PIN CONFIGURATION

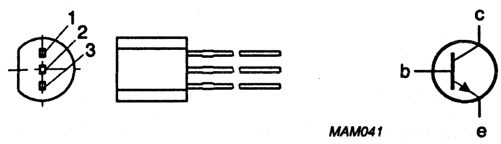


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	MPSA44		–	500	V
	MPSA45		–	400	V
V_{CEO}	collector-emitter voltage	open base			
	MPSA44		–	400	V
	MPSA45		–	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	–	625	mW

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			
	MPSA44		–	500	V
	MPSA45		–	400	V
V_{CEO}	collector-emitter voltage	open base			
	MPSA44		–	400	V
	MPSA45		–	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;	–	625	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air	max. 200 K/W

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			
	MPSA44		500	–	V
	MPSA45		400	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 1 mA; I_B = 0 (note 1)			
	MPSA44		400	–	V
	MPSA45		350	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	R_{BE} = 0; I_C = 100 µA; V_{BE} = 0			
	MPSA44		500	–	V
	MPSA45		400	–	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 = 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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector-base cut-off current				
	MPSA44	$I_E = 0$; $V_{CB} = 400$ V	–	100	nA
		$I_E = 0$; $V_{CB} = 400$ V; $T_j = 150$ °C	–	10	μA
	MPSA45	$I_E = 0$; $V_{CB} = 320$ 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				
	MPSA44	$V_{BE} = 0$; $V_{CE} = 400$ V	–	500	nA
	MPSA45	$V_{BE} = 0$; $V_{CE} = 320$ 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_c	output capacitance	$I_E = 0$; $V_{CB} = 20$ V; f = 1 MHz	–	7	pF
C_e	input capacitance	$I_C = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	180	pF

Note

1. Pulse test : $t_p \leq 300$ μs; $\delta \leq 0.02$.

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P silicon planar epitaxial transistors in plastic TO-92 package for general purpose applications.

QUICK REFERENCE DATA

			MPSA55	MPSA56	
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	60	80	V
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60	80	V
Collector current (d.c.)	$-I_C$	max.	500		mA
Total device dissipation at T_{amb} = 25 °C	P_{tot}	max.	625		mW
Collector-emitter saturation voltage $-I_C$ = 100 mA; $-I_B$ = 10 mA	$-V_{CEsat}$	max.	0,25		V
D.C. current gain $-I_C$ = 100 mA; $-V_{CE}$ = 1,0 V	h_{FE}	min.	50		

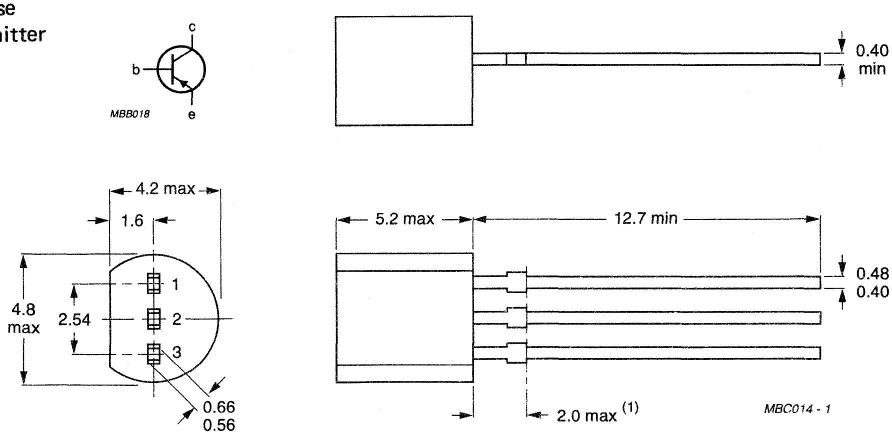
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter



Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			MPSA55	MPSA56	
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	60	80	V
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60	80	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	4,0		V
Collector current (d.c.)	$-I_C$	max.	500		mA
Total device dissipation at T_{amb} = 25 °C	P_{tot}	max.	625		mW
Storage temperature range	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	=	200	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			MPSA55	MPSA56	
Collector-emitter breakdown voltage $I_B = 0$; I_C = 1,0 mA	$-V_{(BR)CEO}$	min.	60	80	V
Emitter-base breakdown voltage $-I_E$ = 100 μA; $-I_C = 0$	$-V_{(BR)EBO}$	min.	4,0		V
Collector cut-off current $I_E = 0$; $-V_{CB}$ = 60 V	$-I_{CBO}$	max.	0,1		μA
$I_E = 0$; $-V_{CB}$ = 80 V	$-I_{CBO}$	max.		0,1	μA
Collector-emitter cut-off current $I_B = 0$; $-V_{CE}$ = 60 V	$-I_{CEO}$	max.	0,1		μA
D.C. current gain $-I_C$ = 10 mA; $-V_{CE}$ = 1,0 V	h_{FE}	min.	50		
$-I_C$ = 100 mA; $-V_{CE}$ = 1,0 V	h_{FE}	min.	50		
Saturation voltage $-I_C$ = 100 mA; $-I_B$ = 10 mA	$-V_{CEsat}$	max.	0,25		V
Base-emitter on-voltage $-I_C$ = 100 mA; $-V_{CE}$ = 1,0 V	$-V_{BE(on)}$	max.	1,2		V
Transition frequency at f = 100 MHz* $-I_C$ = 100 mA; $-V_{CE}$ = 1,0 V	f_T	min.	50		MHz

* f_T is defined as the frequency at which $|h_{fe}|$ extrapolates to unity.

P-N-P DARLINGTON TRANSISTORS

P-N-P darlington transistors in a plastic TO-92 package for general purpose applications.

QUICK REFERENCE DATA

<table>
<tr><th></th><th></th><th></th><th>MPSA63</th><th>MPSA64</th><th></th></tr>
<tr><td>Collector-emitter voltage
$V_{BE} = 0$</td><td>$-V_{CES}$</td><td>max.</td><td colspan="2">30</td><td>V</td></tr>
<tr><td>Collector-base voltage
(open emitter)</td><td>$-V_{CBO}$</td><td>max.</td><td colspan="2">30</td><td>V</td></tr>
<tr><td>Collector current (d.c.)</td><td>$-I_C$</td><td>max.</td><td colspan="2">500</td><td>mA</td></tr>
<tr><td>Total device dissipation
at $T_{amb} = 25\ ^oC$</td><td>P_{tot}</td><td>max.</td><td colspan="2">625</td><td>mW</td></tr>
<tr><td>Collector-emitter saturation voltage
$-I_C = 100$ mA; $-I_B = 0,1$ mA</td><td>$-V_{CEsat}$</td><td>max.</td><td colspan="2">1,5</td><td>V</td></tr>
<tr><td>D.C. current gain
$-I_C = 10$ mA; $-V_{CE} = 5,0$ V</td><td>h_{FE}</td><td>min.</td><td>5000</td><td>10 000</td><td></td></tr>
</table>

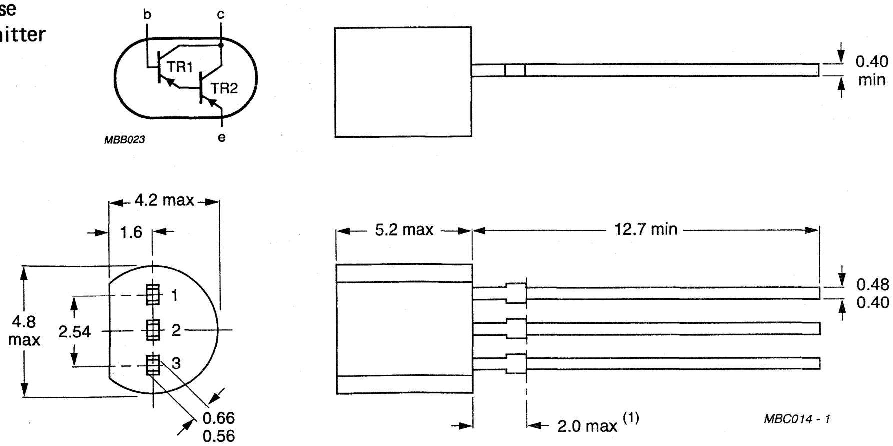
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter



Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			MPSA63	MPSA64	
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 (d.c.)	$-I_C$	max.	500		mA
Total device dissipation at $T_{amb} = 25\ ^oC$	P_{tot}	max.	625		mW
Storage temperature range	T_{stg}		−65 to +150		^oC
Junction temperature	T_j	max.	150		^oC

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	=	200	K/W

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

			MPSA63	MPSA64	
Collector-emitter breakdown voltage $-I_C = 100\ \mu A$; $-V_{BE} = 0$	$-V_{(BR)CES}$	min.	30		V
Collector cut-off current $I_E = 0$; $-V_{CB} = 30$ V	$-I_{CBO}$	max.	100		nA
Emitter cut-off current $I_C = 0$; $-V_{BE} = 10$ V	$-I_{EBO}$	max.	100		nA
D.C. current gain $-I_C = 10$ mA; $-V_{CE} = 5{,}0$ V	h_{FE}	min.	5000	10 000	
$-I_C = 100$ mA; $-V_{CE} = 5{,}0$ V	h_{FE}	min.	10 000	20 000	
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; $-V_{CE} = 5{,}0$ V	$-V_{BE(on)}$		2,0		V
Transition frequency at f = 100 MHz* $-I_C = 100$ mA; $-V_{CE} = 5{,}0$ V	f_T	min.	125		MHz

* f_T is defined as the frequency at which $|h_{fe}|$ extrapolates to unity.

PNP DARLINGTON TRANSISTOR

PNP small-signal Darlington transistors, each in a plastic TO-92 package.

NPN complementary types are MPSA25, 26, and 27.

QUICK REFERENCE DATA

			MPSA75	76	77	
Collector-emitter voltage	$-V_{CEO}$	max.	40	50	60	V
Emitter-base voltage	$-V_{EBO}$	max.		10		V
Collector current (DC)	$-I_C$	max.		500		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		500		mW
DC current gain $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	h_{FE}	min.		10 000		

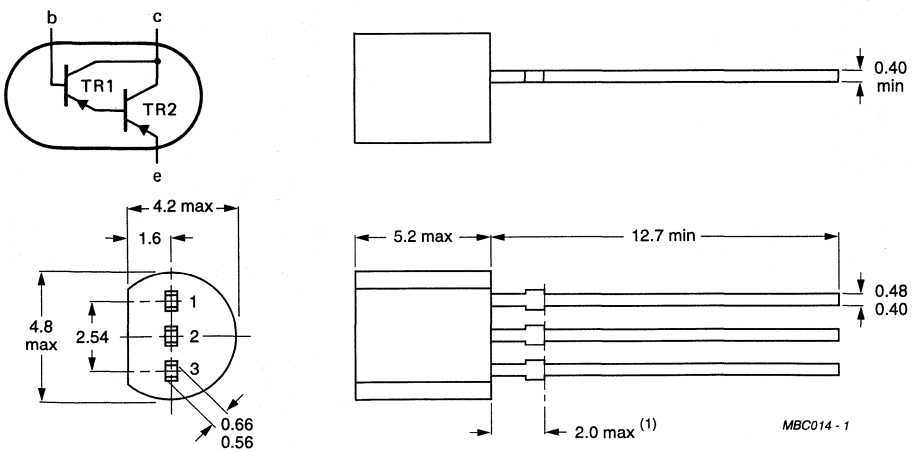
MECHANICAL DATA

Dimensions in mm

Fig.1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter



Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			MPSA75	76	77	
Collector-emitter voltage	$-V_{CEO}$	max.	40	50	60	V
Emitter-base voltage	$-V_{EBO}$	max.		10		V
Collector current (DC)	$-I_C$	max.		500		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		500		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	$R_{th\,j\text{-}a}$	=	250	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			MPSA75	76	77	
Collector-emitter breakdown voltage $-I_C$ = 100 μA; $-V_{BE}$ = 0	$-V_{(BR)CES}$	min.	40	50	60	V
Collector-base breakdown voltage $-I_C$ = 100 μA; $-I_E$ = 0	$-V_{(BR)CBO}$	min.	40	50	60	V
Collector cut-off current $-V_{CB}$ = 40 V; $-I_E$ = 0	$-I_{CBO}$	max.	100	100	–	nA
$-V_{CB}$ = 50 V; $-I_E$ = 0	$-I_{CBO}$	max.	–	–	100	nA
Emitter cut-off current $-V_{EB}$ = 40 V; $-I_C$ = 0	$-I_{EBO}$	max.		100		nA
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	$-V_{CEsat}$	max.		1.5		V
Base-emitter on-voltage $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	$-V_{BEon}$	max.		2.0		V
Transition frequency at T_{amb} = 25 °C $-I_C$ = 30 mA; $-V_{CE}$ = 5 V; f = 100 MHz	f_T	min.		125		MHz
		typ.		220		MHz

HIGH VOLTAGE SILICON PLANAR TRANSISTORS

P-N-P high voltage silicon planar transistors in plastic TO-92 package for general purpose applications.

QUICK REFERENCE DATA

			MPSA92	MPSA93	
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	300	200	V
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	300	200	V
Collector current (d.c.)	$-I_C$	max.	500		mA
Total device dissipation at T_{amb} = 25 °C	P_{tot}	max.	625		mW
Collector-emitter saturation voltage $-I_C$ = 20 mA; $-I_B$ = 2,0 mA	$-V_{CEsat}$	max.	0,5		V
D.C. current gain $-I_C$ = 30 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	25		

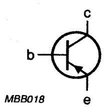
MECHANICAL DATA

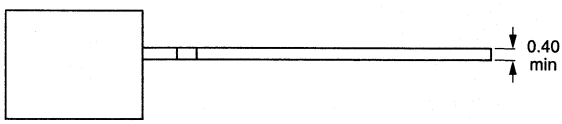
Dimensions in mm

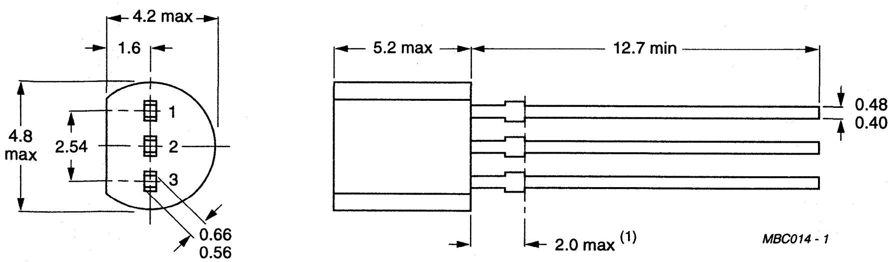
Fig. 1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			MPSA92	MPSA93	
Collector-emitter voltage (open base)	V_{CEO}	max.	300	200	V
Collector-base voltage (open emitter)	V_{CBO}	max.	300	200	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5,0		V
Collector current (d.c.)	I_C	max.	500		mA
Total device dissipation at T_{amb} = 25 °C	P_{tot}	max.	625		mW
Storage temperature range	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	=	200		K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			MPSA92	MPSA93	
Collector-emitter breakdown voltage $I_B = 0$; $-I_C = 1{,}0$ mA	$-V_{(BR)CEO}$	min.	300	200	V
Collector-base breakdown voltage $I_E = 0$; $-I_C = 100\ \mu$A	$-V_{(BR)CBO}$	min.	300	200	V
Emitter-base breakdown voltage $I_C = 0$; $-I_E = 100\ \mu$A	$-V_{(BR)EBO}$	min.	5,0		V
Collector cut-off current $I_E = 0$; $-V_{CB} = 200$ V	$-I_{CBO}$	max.	0,25		μA
$I_E = 0$; $-V_{CB} = 160$ V	$-I_{CBO}$	max.		0,25	μA
Emitter cut-off current $I_C = 0$; $-V_{BE} = 3{,}0$ V	$-I_{EBO}$	max.	0,1		μA
D.C. current gain* $-I_C = 1{,}0$ 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		
Saturation voltages* $-I_C = 20$ mA; $-I_B = 2{,}0$ mA	$-V_{CEsat}$	max.	0,5		V
$-I_C = 20$ mA; $-I_B = 2{,}0$ mA	$-V_{BEsat}$	max.	0,9		V
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 $-V_{CB} = 20$ V; $I_E = 0$	C_c	max.	6,0	8,0	pF

* Pulse test: pulse width ⩽ 300 μs, duty cycle ⩽ 2%.

PNP digital transistor | PDTA114ET

FEATURES

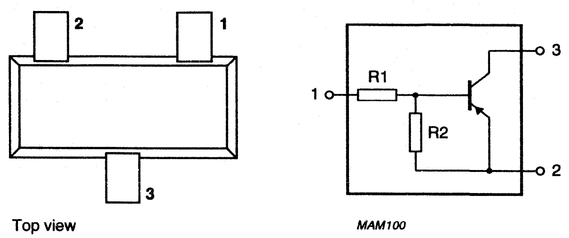
- Built-in bias resistors
- Simplification of circuit design
- Reduces number of components and boardspace.

DESCRIPTION

PNP digital transistor in a plastic SOT23 package. Built-in bias resistors (R1 = R2 = 10 kΩ) allow inverter circuit configuration without external resistors. Especially suitable for space reduction in, for example, interface and driver circuit applications.

PINNING - SOT23

PIN	DESCRIPTION
1	base/input
2	emitter/GND (+)
3	collector/output



Marking code: p03

Fig.1 Simplified outline and symbol.

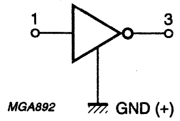


Fig.2 Equivalent circuit.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	–	–50	V
I_o	output current (DC)		–	–	–50	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	–	250	mW
R1	input resistor		7	10	13	kΩ
R2/R1	resistor ratio		0.8	1	1.2	
h_{FE}	DC current gain	I_C = –5 mA; V_{CE} = –5 V	30	–	–	

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	–	–50	V
V_{CEO}	collector-emitter voltage	open base	–	–50	V
V_{EBO}	emitter-base voltage	open collector	–	–10	V
V_I	input voltage				
	positive		–	+10	V
	negative		–	–40	V
I_O	output current (DC)		–	–50	mA
I_{CM}	peak collector current		–	–100	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
T_{amb}	operating ambient temperature		–65	+150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air; note 1	500	K/W

Note to the "Limiting values" and "Thermal characteristics"

1. Refer to SOT23 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = –10 μA; I_E = 0	–50	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = –100 μA; I_B = 0	–50	–	–	V
I_{CEO}	collector-emitter cut-off current	V_{CE} = –30 V; I_B = 0	–	–	–1	μA
		V_{CE} = –30 V; I_B = 0; T_j = 150 °C	–	–	–50	μA
I_{EBO}	emitter-base cut-off current	V_{EB} = –5 V; I_C = 0	–	–	–500	μA
V_{CEsat}	collector-emitter saturation voltage	I_C = –10 mA; I_B = –0.5 mA	–	–	–300	mV
$V_{i(off)}$	input off voltage	V_{CE} = –5 V; I_C = –100 μA	–	–	–0.5	V
$V_{i(on)}$	input on voltage	V_{CE} = –0.3 V; I_C = –10 mA	–3	–	–	V
R1	input resistor		7	10	13	kΩ
R2/R1	resistor ratio		0.8	1	1.2	
h_{FE}	DC current gain	V_{CE} = –5 V; I_C = –5 mA	30	–	–	
C_c	collector capacitance	V_{CB} = –10 V; I_E = I_e = 0; f = 1 MHz	–	–	5	pF

PNP digital transistor PDTA124ET

FEATURES

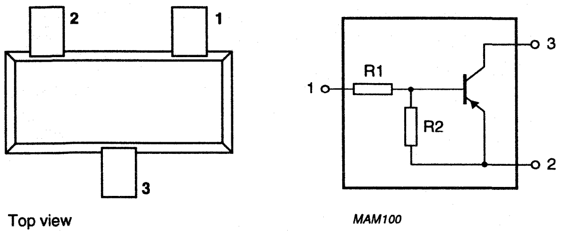
- Built-in bias resistors
- Simplification of circuit design
- Reduces number of components and boardspace.

DESCRIPTION

PNP digital transistor in a plastic SOT23 package. Built-in bias resistors (R1 = R2 = 22 kΩ) allow inverter circuit configuration without external resistors. Especially suitable for space reduction in, for example, interface and driver circuit applications.

PINNING - SOT23

PIN	DESCRIPTION
1	base/input
2	emitter/GND (+)
3	collector/output



Marking code: p05.

Fig.1 Simplified outline and symbol.

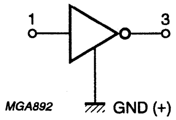


Fig.2 Equivalent circuit.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	–	–50	V
I_O	output current (DC)		–	–	–30	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	–	250	mW
R1	input resistor		15.4	22	28.6	kΩ
R2/R1	resistor ratio		0.8	1	1.2	
h_{FE}	DC current gain	I_C = –5 mA; V_{CE} = –5 V	56	–	–	

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	–	–50	V
V_{CEO}	collector-emitter voltage	open base	–	–50	V
V_{EBO}	emitter-base voltage	open collector	–	–10	V
V_I	input voltage				
	positive		–	+10	V
	negative		–	–40	V
I_O	output current (DC)		–	–30	mA
I_{CM}	peak collector current		–	–100	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
T_{amb}	operating ambient temperature		–65	+150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air; note 1	500	K/W

Note to the "Limiting values" and "Thermal characteristics"

1. Refer to SOT23 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = –10 μA; I_E = 0	–50	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = –100 μA; I_B = 0	–50	–	–	V
I_{CEO}	collector-emitter cut-off current	V_{CE} = –30 V; I_B = 0	–	–	–1	μA
		V_{CE} = –30 V; I_B = 0; T_j = 150 °C	–	–	–50	μA
I_{EBO}	emitter-base cut-off current	V_{EB} = –5 V; I_C = 0	–	–	–500	μA
V_{CEsat}	collector-emitter saturation voltage	I_C = –10 mA; I_B = –0.5 mA	–	–	–300	mV
$V_{i(off)}$	input off voltage	V_{CE} = –5 V; I_C = –100 μA	–	–	–0.5	V
$V_{i(on)}$	input on voltage	V_{CE} = –0.3 V; I_C = –5 mA	–3	–	–	V
R1	input resistor		15.4	22	28.6	kΩ
R2/R1	resistor ratio		0.8	1	1.2	
h_{FE}	DC current gain	V_{CE} = –5 V; I_C = –5 mA	56	–	–	
C_c	collector capacitance	V_{CB} = –10 V; I_E = I_e = 0; f = 1 MHz	–	–	5	pF

PNP digital transistor | PDTA143ET

FEATURES

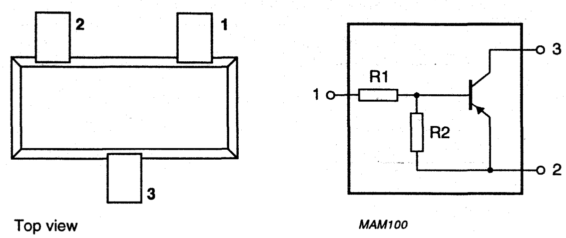
- Built-in bias resistors
- Simplification of circuit design
- Reduces number of components and boardspace.

DESCRIPTION

PNP digital transistor in a plastic SOT23 package. Built-in bias resistors (R1 = R2 = 4.7 kΩ) allow inverter circuit configuration without external resistors. Especially suitable for space reduction in, for example, interface and driver circuit applications.

PINNING - SOT23

PIN	DESCRIPTION
1	base/input
2	emitter/GND (+)
3	collector/output



Marking code: p01.

Fig.1 Simplified outline and symbol.

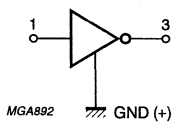


Fig.2 Equivalent circuit.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	–	–50	V
I_O	output current (DC)		–	–	–100	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	–	250	mW
R1	input resistor		3.3	4.7	6.1	kΩ
R2/R1	resistor ratio		0.8	1	1.2	
h_{FE}	DC current gain	I_C = –10 mA; V_{CE} = –5 V	20	–	–	

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	–	–50	V
V_{CEO}	collector-emitter voltage	open base	–	–50	V
V_{EBO}	emitter-base voltage	open collector	–	–10	V
V_I	input voltage				
	positive		–	+10	V
	negative		–	–30	V
I_O	output current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–100	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
T_{amb}	operating ambient temperature		–65	+150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air; note 1	500 K/W

Note to the "Limiting values" and "Thermal resistance"

1. Refer to SOT23 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

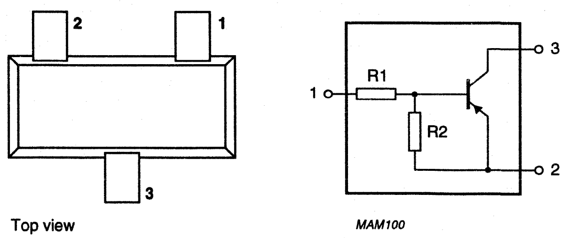
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = –10 μA; I_E = 0	–50	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = –100 μA; I_B = 0	–50	–	–	V
I_{CEO}	collector-emitter cut-off current	V_{CE} = –30 V; I_B = 0	–	–	–1	μA
		V_{CE} = –30 V; I_B = 0; T_j = 150 °C	–	–	–50	μA
I_{EBO}	emitter-base cut-off current	V_{EB} = –5 V; I_C = 0	–	–	–1	mA
V_{CEsat}	collector-emitter saturation voltage	I_C = –10 mA; I_B = –0.5 mA	–	–	–300	mV
$V_{i(off)}$	input off voltage	V_{CE} = –5 V; I_C = –100 μA	–	–	–0.5	V
$V_{i(on)}$	input on voltage	V_{CE} = –0.3 V; I_C = –20 mA	–3	–	–	V
R1	input resistor		3.3	4.7	6.1	kΩ
R2/R1	resistor ratio		0.8	1	1.2	
h_{FE}	DC current gain	V_{CE} = –5 V; I_C = –10 mA	20	–	–	
C_c	collector capacitance	V_{CB} = –10 V; I_E = i_e = 0; f = 1 MHz	–	–	5	pF

FEATURES

- Built-in bias resistors
- Simplification of circuit design
- Reduces number of components and boardspace.

DESCRIPTION

PNP digital transistor in a plastic SOT23 package. Built-in bias resistors (R1 = R2 = 47 kΩ) allow inverter circuit configuration without external resistors. Especially suitable for space reduction in, for example, interface and driver circuit applications.



Marking code: p07.

Fig.1 Simplified outline and symbol.

PINNING - SOT23

PIN	DESCRIPTION
1	base/input
2	emitter/GND (+)
3	collector/output

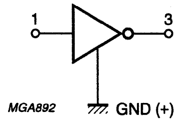


Fig.2 Equivalent circuit.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	–	–50	V
I_O	output current (DC)		–	–	–30	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	–	250	mW
R1	input resistor		33	47	61	kΩ
R2/R1	resistor ratio		0.8	1	1.2	
h_{FE}	DC current gain	I_C = –5 mA; V_{CE} = –5 V	68	–	–	

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	–	–50	V
V_{CEO}	collector-emitter voltage	open base	–	–50	V
V_{EBO}	emitter-base voltage	open collector	–	–10	V
V_I	input voltage				
	positive		–	+10	V
	negative		–	–40	V
I_O	output current (DC)		–	–30	mA
I_{CM}	peak collector current		–	–100	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
T_{amb}	operating ambient temperature		–65	+150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air; note 1	500	K/W

Note to the "Limiting values" and "Thermal characteristics"

1. Refer to SOT23 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = –10 μA; I_E = 0	–50	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = –100 μA; I_B = 0	–50	–	–	V
I_{CEO}	collector-emitter cut-off current	V_{CE} = –30 V; I_B = 0	–	–	–1	μA
		V_{CE} = –30 V; I_B = 0; T_j = 150 °C	–	–	–50	μA
I_{EBO}	emitter-base cut-off current	V_{EB} = –5 V; I_C = 0	–	–	–500	μA
V_{CEsat}	collector-emitter saturation voltage	I_C = –10 mA; I_B = –0.5 mA	–	–	–300	mV
$V_{i(off)}$	input off voltage	V_{CE} = –5 V; I_C = –100 μA	–	–	–0.5	V
$V_{i(on)}$	input on voltage	V_{CE} = –0.3 V; I_C = –2 mA	–3	–	–	V
R1	input resistor		33	47	61	kΩ
R2/R1	resistor ratio		0.8	1	1.2	
h_{FE}	DC current gain	V_{CE} = –5 V; I_C = –5 mA	68	–	–	
C_c	collector capacitance	V_{CB} = –10 V; I_E = I_e = 0; f = 1 MHz	–	–	5	pF

PNP digital transistor | PDTB114ET

FEATURES

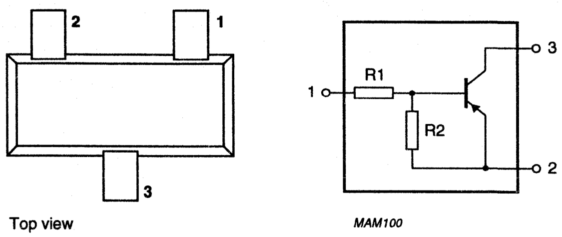
- Built-in bias resistors
- Simplification of circuit design
- Reduces number of components and boardspace.

DESCRIPTION

PNP digital transistor in a plastic SOT23 package. Built-in bias resistors (R1 = R2 = 10 kΩ) allow inverter circuit configuration without external resistors. Especially suitable for space reduction in, for example, interface and driver circuit applications.

PINNING - SOT23

PIN	DESCRIPTION
1	base/input
2	emitter/GND (+)
3	collector/output



Marking code: p09

Fig.1 Simplified outline and symbol.

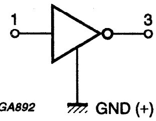


Fig.2 Equivalent circuit.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open emitter	–	–	–50	V
I_C	DC collector current		–	–	–500	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	–	250	mW
R1	input resistor		7	10	13	kΩ
R2/R1	resistor ratio		0.8	1	1.2	
h_{FE}	DC current gain	I_C = –50 mA; V_{CE} = –5 V	56	–	–	

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	–	–50	V
V_{CEO}	collector-emitter voltage	open base	–	–50	V
V_{EBO}	emitter-base voltage	open collector	–	–10	V
I_C	DC collector current		–	–500	mA
V_I	input voltage				
	positive		–	+10	V
	negative		–	–40	V
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
T_{amb}	operating ambient temperature		–65	+150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air; note 1	500	K/W

Note to the "Limiting values" and "Thermal characteristics"

1. Refer to SOT23 standard mounting conditions.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = –10 μA; I_E = 0	–50	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = –100 μA; I_B = 0	–50	–	–	V
I_{CEO}	collector-emitter cut-off current	V_{CE} = –30 V; I_B = 0	–	–	–1	μA
		V_{CE} = –30 V; I_B = 0; T_j = 150 °C	–	–	–50	μA
I_{EBO}	emitter-base cut-off current	V_{EB} = –5 V; I_C = 0	–	–	–500	μA
V_{CEsat}	collector-emitter saturation voltage	I_C = –50 mA; I_B = –2.5 mA; note 1	–	–	–300	mV
$V_{i(off)}$	input off voltage	V_{CE} = –5 V; I_C = –100 μA	–	–	–0.5	V
$V_{i(on)}$	input on voltage	V_{CE} = –0.3 V; I_C = –10 mA	–3	–	–	V
R1	input resistor		7	10	13	kΩ
R2/R1	resistor ratio		0.8	1	1.2	
h_{FE}	DC current gain	I_C = –50 mA; V_{CE} = –5 V; note 1	56	–	–	
C_c	collector capacitance	V_{CB} = –10 V; I_E = I_e = 0; f = 1 MHz	–	–	9	pF

Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.02$.

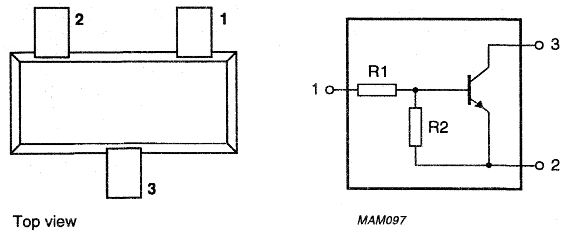
NPN digital transistor PDTC114ET

FEATURES

- Built-in bias resistors
- Simplification of circuit design
- Reduces number of components and boardspace.

DESCRIPTION

NPN digital transistor in a plastic SOT23 package. Built-in bias resistors (R1 = R2 = 10 kΩ) allow inverter circuit configuration without external resistors. Especially suitable for space reduction in, for example, interface and driver circuit applications.



Marking code: p04.

Fig.1 Simplified outline and symbol.

PINNING - SOT23

PIN	DESCRIPTION
1	base/input
2	emitter/GND
3	collector/output

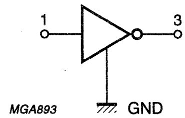


Fig.2 Equivalent circuit.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	–	50	V
I_O	output current (DC)		–	–	50	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	–	250	mW
R1	input resistor		7	10	13	kΩ
R2/R1	resistor ratio		0.8	1	1.2	
h_{FE}	DC current gain	I_C = 5 mA; V_{CE} = 5 V	30	–	–	

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	–	50	V
V_{CEO}	collector-emitter voltage	open base	–	50	V
V_{EBO}	emitter-base voltage	open collector	–	10	V
V_I	input voltage				
	positive		–	+40	V
	negative		–	–10	V
I_O	output current (DC)		–	50	mA
I_{CM}	peak collector current		–	100	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
T_{amb}	operating ambient temperature		–65	+150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air; note 1	500	K/W

Note to the "Limiting values" and "Thermal characteristics"

1. Refer to SOT23 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C =10 µA; I_E = 0	50	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 100 µA; I_B = 0	50	–	–	V
I_{CEO}	collector-emitter cut-off current	V_{CE} = 30 V; I_B = 0	–	–	1	µA
		V_{CE} = 30 V; I_B = 0; T_j = 150 °C	–	–	50	µA
I_{EBO}	emitter-base cut-off current	V_{EB} = 5 V; I_C = 0	–	–	500	µA
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA; I_B = 0.5 mA	–	–	300	mV
$V_{i(off)}$	input off voltage	V_{CE} = 5 V; I_C = 100 µA	–	–	0.5	V
$V_{i(on)}$	input on voltage	V_{CE} = 0.3 V; I_C = 10 mA	3	–	–	V
R1	input resistor		7	10	13	kΩ
R2/R1	resistor ratio		0.8	1	1.2	
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 5 mA	30	–	–	
C_c	collector capacitance	V_{CB} =10 V; I_E = I_e = 0; f = 1 MHz	–	–	3.5	pF

NPN digital transistor PDTC124ET

FEATURES

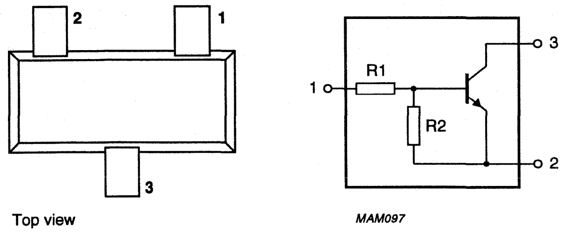
- Built-in bias resistors
- Simplification of circuit design
- Reduces number of components and boardspace.

DESCRIPTION

NPN digital transistor in a plastic SOT23 package. Built-in bias resistors (R1 = R2 = 22 kΩ) allow inverter circuit configuration without external resistors. Especially suitable for space reduction in, for example, interface and driver circuit applications.

PINNING - SOT23

PIN	DESCRIPTION
1	base/input
2	emitter/GND
3	collector/output



Marking code: p06.

Fig.1 Simplified outline and symbol.

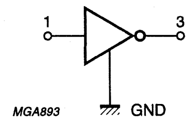


Fig.2 Equivalent circuit.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	–	50	V
I_O	output current (DC)		–	–	30	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	–	250	mW
R1	input resistor		15.4	22	28.6	kΩ
R2/R1	resistor ratio		0.8	1	1.2	
h_{FE}	DC current gain	I_C = 5 mA; V_{CE} = 5 V	56	–	–	

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	–	50	V
V_{CEO}	collector-emitter voltage	open base	–	50	V
V_{EBO}	emitter-base voltage	open collector	–	10	V
V_I	input voltage				
	positive		–	+40	V
	negative		–	–10	V
I_O	output current (DC)		–	30	mA
I_{CM}	peak collector current		–	100	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
T_{amb}	operating ambient temperature		–65	+150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air; note 1	500	K/W

Note to the "Limiting values" and "Thermal characteristics"

1. Refer to SOT23 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C =10 μA; I_E = 0	50	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 100 μA; I_B = 0	50	–	–	V
I_{CEO}	collector-emitter cut-off current	V_{CE} = 30 V; I_B = 0	–	–	1	μA
		V_{CE} = 30 V; I_B = 0; T_j = 150 °C	–	–	50	μA
I_{EBO}	emitter-base cut-off current	V_{EB} = 5 V; I_C = 0	–	–	500	μA
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA; I_B = 0.5 mA	–	–	300	mV
$V_{i(off)}$	input off voltage	V_{CE} = 5 V; I_C = 100 μA	–	–	0.5	V
$V_{i(on)}$	input on voltage	V_{CE} = 0.3 V; I_C = 5 mA	3	–	–	V
R1	input resistor		15.4	22	28.6	kΩ
R2/R1	resistor ratio		0.8	1	1.2	
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 5 mA	56	–	–	
C_c	collector capacitance	V_{CB} =10 V; I_E = I_e = 0; f = 1 MHz	–	–	3.5	pF

NPN digital transistor PDTC143ET

FEATURES

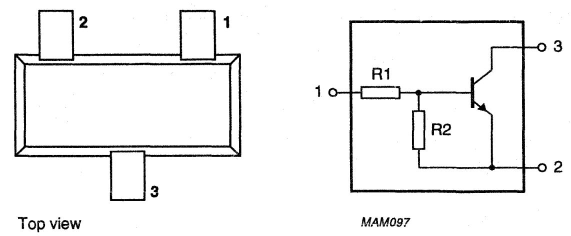
- Built-in bias resistors
- Simplification of circuit design
- Reduces number of components and boardspace.

DESCRIPTION

NPN digital transistor in a plastic SOT23 package. Built-in bias resistors (R1 = R2 = 4.7 kΩ) allow inverter circuit configuration without external resistors. Especially suitable for space reduction in, for example, interface and driver circuit applications.

PINNING - SOT23

PIN	DESCRIPTION
1	base/input
2	emitter/GND
3	collector/output



Marking code: p02.

Fig.1 Simplified outline and symbol.

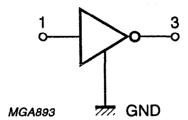


Fig.2 Equivalent circuit.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	–	50	V
I_O	output current (DC)		–	–	100	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	–	250	mW
R1	input resistor		3.3	4.7	6.1	kΩ
R2/R1	resistor ratio		0.8	1	1.2	
h_{FE}	DC current gain	I_C = 10 mA; V_{CE} = 5 V	20	–	–	

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	–	50	V
V_{CEO}	collector-emitter voltage	open base	–	50	V
V_{EBO}	emitter-base voltage	open collector	–	10	V
V_I	input voltage				
	positive		–	+30	V
	negative		–	–10	V
I_O	output current (DC)		–	100	mA
I_{CM}	peak collector current		–	100	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
T_{amb}	operating ambient temperature		–65	+150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air; note 1	500 K/W

Note to the "Limiting values" and "Thermal resistance"

1. Refer to SOT23 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

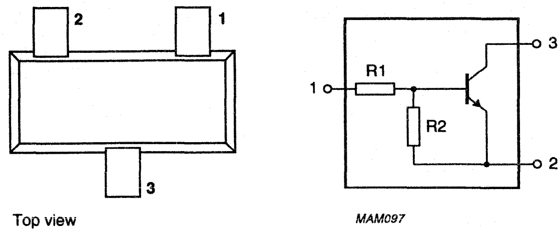
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C =10 µA; I_E = 0	50	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 100 µA; I_B = 0	50	–	–	V
I_{CEO}	collector-emitter cut-off current	V_{CE} = 30 V; I_B = 0	–	–	1	µA
		V_{CE} = 30 V; I_B = 0; T_j = 150 °C	–	–	50	µA
I_{EBO}	emitter-base cut-off current	V_{EB} = 5 V; I_C = 0	–	–	1	mA
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA; I_B = 0.5 mA	–	–	300	mV
$V_{i(off)}$	input off voltage	V_{CE} = 5 V; I_C = 100 µA	–	–	0.5	V
$V_{i(on)}$	input on voltage	V_{CE} = 0.3 V; I_C = 20 mA	3	–	–	V
R1	input resistor		3.3	4.7	6.1	kΩ
R2/R1	resistor ratio		0.8	1	1.2	
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 10 mA	20	–	–	
C_c	collector capacitance	V_{CB} = 10 V; I_E = i_E = 0; f = 1 MHz	–	–	3.5	pF

FEATURES

- Built-in bias resistors
- Simplification of circuit design
- Reduces number of components and boardspace.

DESCRIPTION

NPN digital transistor in a plastic SOT23 package. Built-in bias resistors (R1 = R2 = 47 kΩ) allow inverter circuit configuration without external resistors. Especially suitable for space reduction in, for example, interface and driver circuit applications.



Marking code: p08.

Fig.1 Simplified outline and symbol.

PINNING - SOT23

PIN	DESCRIPTION
1	base/input
2	emitter/GND
3	collector/output

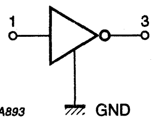


Fig.2 Equivalent circuit.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	–	50	V
I_O	output current (DC)		–	–	30	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	–	250	mW
R1	input resistor		33	47	61	kΩ
R2/R1	resistor ratio		0.8	1	1.2	
h_{FE}	DC current gain	I_C = 5 mA; V_{CE} = 5 V	68	–	–	

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	–	50	V
V_{CEO}	collector-emitter voltage	open base	–	50	V
V_{EBO}	emitter-base voltage	open collector	–	10	V
V_I	input voltage				
	positive		–	+40	V
	negative		–	–10	V
I_O	output current (DC)		–	30	mA
I_{CM}	peak collector current		–	100	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
T_{amb}	operating ambient temperature		–65	+150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air; note 1	500	K/W

Note to the “Limiting values” and “Thermal characteristics”

1. Refer to SOT23 standard mounting conditions.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C =10 µA; I_E = 0	50	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 100 µA; I_B = 0	50	–	–	V
I_{CEO}	collector-emitter cut-off current	V_{CE} = 30 V; I_B = 0	–	–	1	µA
		V_{CE} = 30 V; I_B = 0; T_j = 150 °C	–	–	50	µA
I_{EBO}	emitter-base cut-off current	V_{EB} = 5 V; I_C = 0	–	–	500	µA
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA; I_B = 0.5 mA	–	–	300	mV
$V_{i(off)}$	input off voltage	V_{CE} = 5 V; I_C = 100 µA	–	–	0.5	V
$V_{i(on)}$	input on voltage	V_{CE} = 0.3 V; I_C = 2 mA	3	–	–	V
R1	input resistor		33	47	61	kΩ
R2/R1	resistor ratio		0.8	1	1.2	
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 5 mA	68	–	–	
C_c	collector capacitance	V_{CB} = 10 V; I_E = I_e = 0; f = 1 MHz	–	–	3.5	pF

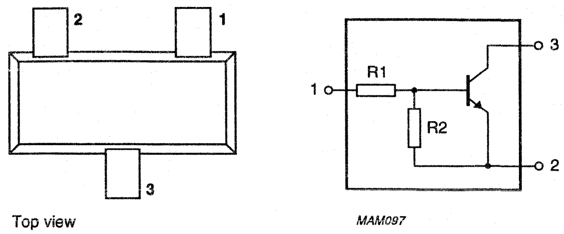
NPN digital transistor | PDTD114ET

FEATURES

- Built-in bias resistors
- Simplification of circuit design
- Reduces number of components and boardspace.

DESCRIPTION

NPN digital transistor in a plastic SOT23 package. Built-in bias resistors (R1 = R2 = 10 kΩ) allow inverter circuit configuration without external resistors. Especially suitable for space reduction in, for example, interface and driver circuit applications.



Marking code: p10

Fig.1 Simplified outline and symbol.

PINNING - SOT23

PIN	DESCRIPTION
1	base/input
2	emitter/GND
3	collector/output

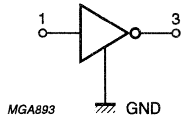


Fig.2 Equivalent circuit.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	–	50	V
I_C	DC collector current		–	–	500	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	–	250	mW
R1	input resistor		7	10	13	kΩ
R2/R1	resistor ratio		0.8	1	1.2	
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 5 V	56	–	–	

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	–	50	V
V_{CEO}	collector-emitter voltage	open base	–	50	V
V_{EBO}	emitter-base voltage	open collector	–	10	V
V_I	input voltage				
	positive		–	+40	V
	negative		–	–10	V
I_C	DC collector current		–	500	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
T_{amb}	operating ambient temperature		–65	+150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air; note 1	500	K/W

Note to the "Limiting values" and "Thermal characteristics"

1. Refer to SOT23 standard mounting conditions.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C =10 µA; I_E = 0	50	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 100 µA; I_B = 0	50	–	–	V
I_{CEO}	collector-emitter cut-off current	V_{CE} = 30 V; I_B = 0	–	–	1	µA
		V_{CE} = 30 V; I_B = 0; T_j = 150 °C	–	–	50	µA
I_{EBO}	emitter-base cut-off current	V_{EB} = 5 V; I_C = 0	–	–	500	µA
V_{CEsat}	collector-emitter saturation voltage	I_C = 50 mA; I_B = 2.5 mA; note 1	–	–	300	mV
$V_{i(off)}$	input off voltage	V_{CE} = 5 V; I_C = 100 µA	–	–	0.5	V
$V_{i(on)}$	input on voltage	V_{CE} = 0.3 V; I_C = 10 mA	3	–	–	V
R1	input resistor		7	10	13	kΩ
R2/R1	resistor ratio		0.8	1	1.2	
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 5 V; note 1	56	–	–	
C_c	collector capacitance	V_{CB} =10 V; I_E = I_e = 0; f = 1 MHz	–	–	8	pF

Note

1. Pulse test: $t_p \leq 300$ µs; $\delta \leq 0.02$.

SILICON PLANAR EPITAXIAL TRANSISTORS

NPN transistors in plastic TO-92 packages, primarily intended for switching and linear applications.

QUICK REFERENCE DATA

			PH2222	PH2222A	
Collector-base voltage (open emitter)	V_{CBO}	max.	60	75	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	40	V
Collector current (DC)	I_C	max.	600	600	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	500	mW
Junction temperature	T_j	max.	150	150	°C
DC current gain at T_j = 25 °C I_C = 10 mA; V_{CE} = 10 V	h_{FE}	min.	75	75	
Transition frequency at f = 100 MHz I_C = 20 mA; V_{CE} = 20 V	f_T	min.	250	300	MHz
Storage time I_{Con} = 150 mA; I_{Bon} = $-I_{Boff}$ = 15 mA	t_s	max.	—	225	ns

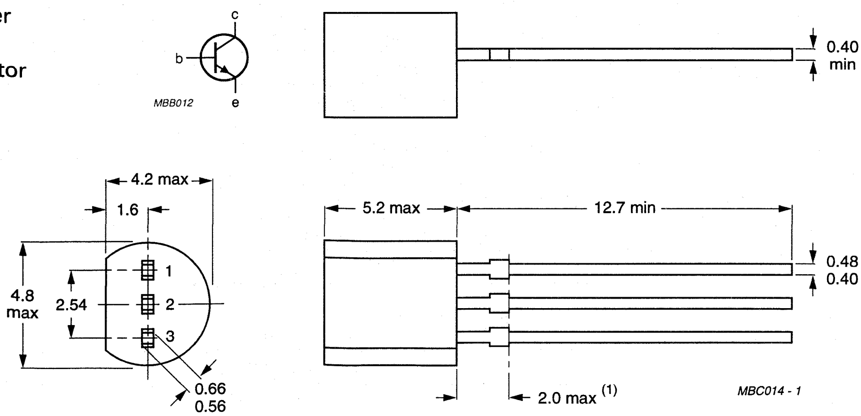
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92.

Pinning

1 = emitter
2 = base
3 = collector



Note (1) Terminal dimensions within this zone are uncontrolled to allow for plastic and terminal irregularities.

RATINGS

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

			PH2222	PH2222A	
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 (DC)	I_C	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500		mW
Storage temperature range	T_{stg}	max.	−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	250	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			PH2222	PH2222A	
Collector cut-off current					
$I_E = 0$; $V_{CB} = 50$ V	I_{CBO}	max.	10	–	nA
$I_E = 0$; $V_{CB} = 50$ V; $T_{amb} = 150$ °C	I_{CBO}	max.	10	–	μA
$I_E = 0$; $V_{CB} = 60$ V	I_{CBO}	max.	–	10	nA
$I_E = 0$; $V_{CB} = 60$ V; $T_{amb} = 150$ °C	I_{CBO}	max.	–	10	μA
Emitter cut-off current					
$I_C = 0$; $V_{EB} = 3$ V	I_{EBO}	max.	10	10	nA
Currents are reverse biased emitter junction					
$V_{CE} = 60$ V; $-V_{BE} = 3$ V	I_{CEX}	max.	–	10	nA
	$-I_{BEX}$	max.	–	20	nA
Breakdown voltages					
$I_E = 0$; $I_C = 10$ μA	$V_{(BR)CBO}$	min.	60	75	V
$I_B = 0$; $I_C = 10$ mA	$V_{(BR)CEO}$	min.	30	40	V
$I_C = 0$; $I_E = 10$ μA	$V_{(BR)EBO}$	min.	5	6	V
Saturation voltages (see Note 1)					
$I_C = 150$ mA; $I_B = 15$ mA	V_{CEsat}	max.	0.4	0.3	V
	V_{BEsat}	min.	–	0.6	V
		max.	1.3	1.2	V
$I_C = 500$ mA; $I_B = 50$ mA	V_{CEsat}	max.	1.6	1.0	V
	V_{BEsat}	max.	2.6	2.0	V

Note

1. Measured under pulse conditions: $t_p \leqslant 300$ μs, $\delta \leqslant 0.02$.

			PH2222	PH2222A	
DC current gain					
I_C = 0.1 mA; V_{CE} = 10 V	h_{FE}	min.	35	35	
I_C = 1 mA; V_{CE} = 10 V	h_{FE}	min.	50	50	
I_C = 10 mA; V_{CE} = 10 V	h_{FE}	min.	75	75	
I_C = 10 mA; V_{CE} = 10 V; T_{amb} = −55 °C	h_{FE}	min.	—	35	
I_C = 150 mA; V_{CE} = 1 V (see note 1)	h_{FE}	min.	50	50	
I_C = 150 mA; V_{CE} = 10 V (see note 1)	h_{FE}	min.	100	100	
		max.	300	300	
I_C = 500 mA; V_{CE} = 10 V (see note 1)	h_{FE}	min.	30	40	
Transition frequency at f = 100 MHz					
I_C = 20 mA; V_{CE} = 20 V	f_T	min.	250	300	MHz
Collector capacitance at f = 100 kHz					
$I_E = I_e = 0$; V_{CB} = 10 V	C_c	max.	8	8	pF
Emitter capacitance at f = 100 kHz					
$I_C = I_c = 0$; V_{EB} = 0.5 V	C_e	max.	—	25	pF
I_C = 20 mA; V_{CE} = 20 V; f = 100 MHz					
Small-signal current gain	h_{fe}	min.	2.5	3.0	
Noise figure at f = 1 kHz					
I_C = 0.1 mA; V_{CE} = 10 V					
R_G = 1 kΩ; B = 1 Hz	F	max.	—	4	dB

Note

1. Measured under pulse conditions: $t_p \leqslant 300\ \mu s$; $\delta \leqslant 0.02$.

Switching times (between 10% and 90% levels) for **PH2222A**

Turn-on time when switched to I_{Con} = 150 mA (see Fig. 2)				
delay time	t_d	max.	10	ns
rise time	t_r	max.	25	ns
Turn-off time when switched from I_{Con} = 150 mA (see Fig. 3)				
storage time	t_s	max.	225	ns
fall time	t_f	max.	60	ns

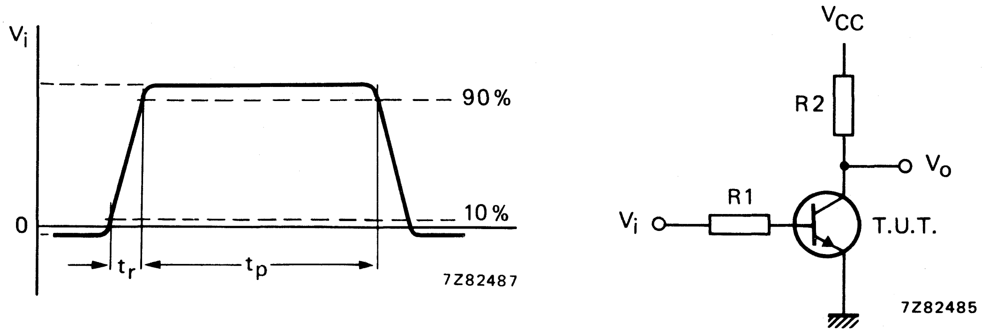


Fig. 2 Input waveform and test circuit for determining delay time and rise time.

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

Pulse generator:				
pulse duration	t_p	⩽	200	ns
rise time	t_r	⩽	2	ns
duty factor	δ	=	0,02	

Oscilloscope:				
input impedance	Z_i	min.	100	kΩ
input capacitance	C_i	max.	12	pF
rise time	t_r	max.	5	ns

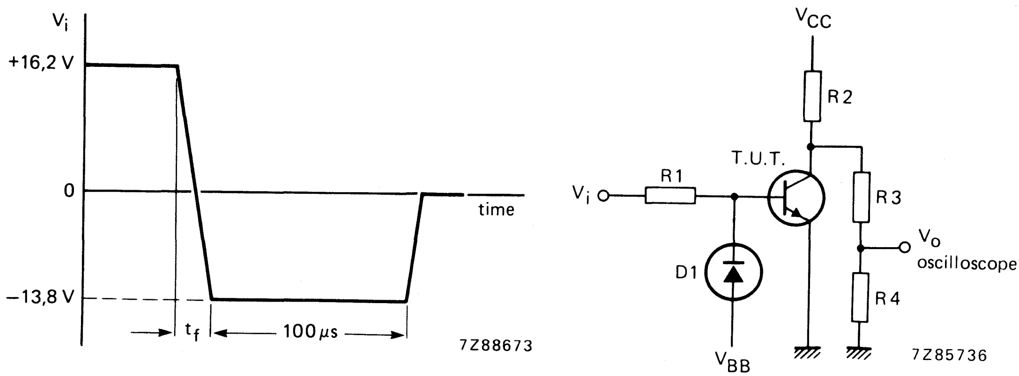


Fig. 3 Input waveform and test circuit for determining storage time and fall time.

V_{CC} = + 30 V; V_{BB} = –3 V; R1 = 1 kΩ; R2 = 200 Ω; R3 = 20 kΩ; R4 = 50 Ω; D1 = 1N916.

Pulse generator:				
fall time	t_f	max.	5	ns

Oscilloscope:				
input impedance	Z_i	min.	100	kΩ
input capacitance	C_i	max.	12	pF
rise time	t_r	max.	5	ns

SILICON PLANAR EPITAXIAL SWITCHING TRANSISTOR

N-P-N transistor in a plastic TO-92 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 (peak value)		I_{CM}	max.	500	mA
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	500	mW
D.C. current gain					
I_C = 10 mA; V_{CE} = 1 V	**PH2369**	h_{FE}		40 to 120	
I_C = 10 mA; V_{CE} = 0.35 V	**PH2369A**	h_{FE}		40 to 120	
Transition frequency at f = 100 MHz					
I_C = 10 mA; V_{CE} = 10 V		f_T	>	500	MHz
Storage time					
$I_{Con} = I_{Bon} = -I_{Boff}$ = 10 mA		t_s	<	13	ns

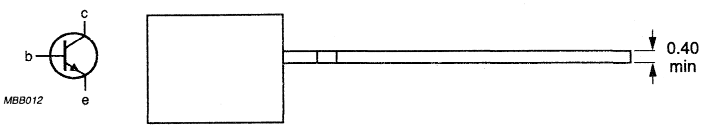
MECHANICAL DATA

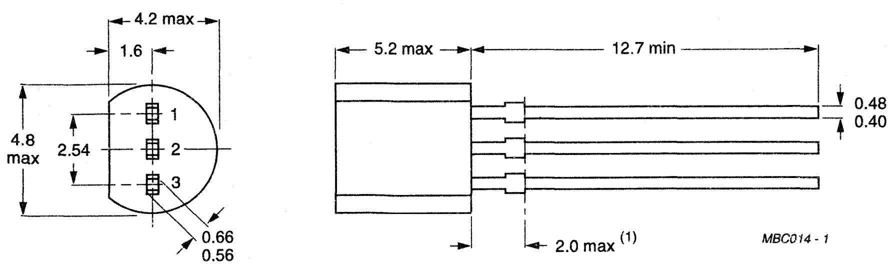
Dimensions in mm

Fig. 1 TO-92.

Pinning

1 = emitter
2 = base
3 = collector





Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

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 (peak value; t_p = 10 μs)	I_{CM}	max.	500	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	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	$R_{th\ j\text{-}a}$	=	250	K/W

CHARACTERISTICS

T_{amb} = 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
Emitter cut-off current					
I_C = 0; V_{EB} = 2 V		I_{EBO}	<	100	nA
Saturation voltages					
I_C = 10 mA; I_B = 1 mA	**PH2369**	V_{CEsat}	max.	0,25	V
I_C = 10 mA; I_B = 1 mA		V_{BEsat}	min.	0,70	V
			max.	0,85	V
I_C = 10 mA; I_B = 1 mA	**PH2369A**	V_{CEsat}	<	0,20	V
I_C = 30 mA; I_B = 3 mA		V_{CEsat}	<	0,25	V
I_C = 100 mA; I_B = 10 mA		V_{CEsat}	<	0,50	V
I_C = 10 mA; I_B = 10 mA		V_{CEsat}	<	0,30	V
I_C = 10 mA; I_B = 1 mA		V_{BEsat}	min.	0,70	V
			max.	0,85	V
D.C. current gain					
I_C = 10 mA; V_{CE} = 1 V	**PH2369**	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	
I_C = 10 mA; V_{CE} = 0.35 V	**PH2369A**	h_{FE}	>	40 to 120	
I_C = 30 mA; V_{CE} = 0.4 V		h_{FE}	>	30	
I_C = 100 mA; V_{CE} = 1 V		h_{FE}	>	20	
I_C = 10 mA; V_{CE} = 0.35 V; T_{amb} = −55 °C		h_{FE}	>	20	
Transition frequency at f = 100 MHz					
I_C = 10 mA; V_{CE} = 10 V		f_T	>	500	MHz
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 (see Fig. 2) $I_{Con} = I_{Bon} = -I_{Boff} = 10$ mA	t_s	typ. <	6 ns 13 ns

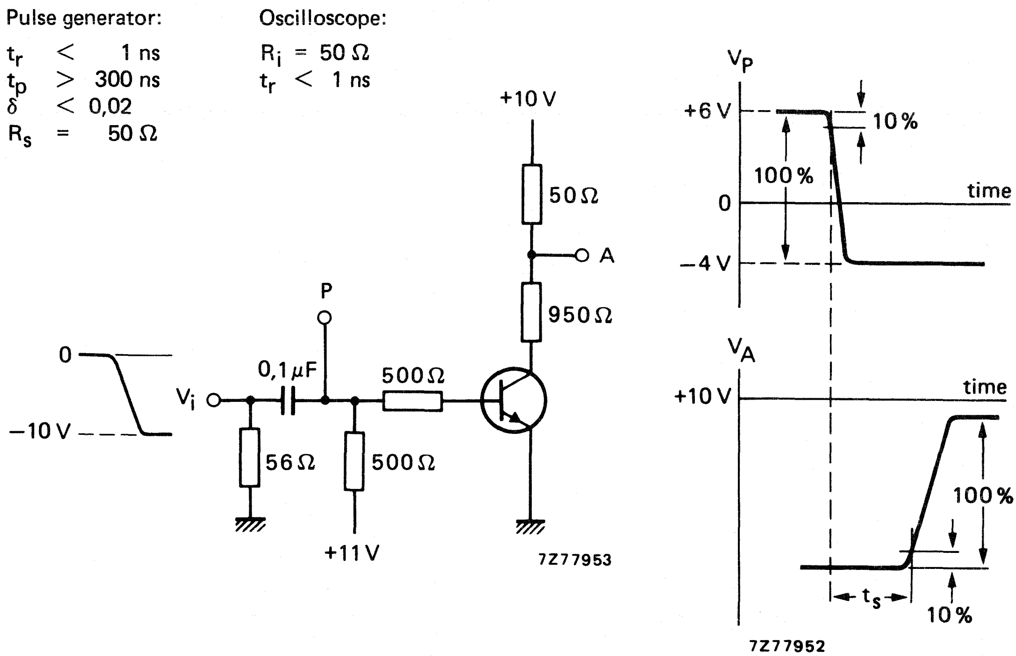


Fig. 2 Test circuit and waveforms.

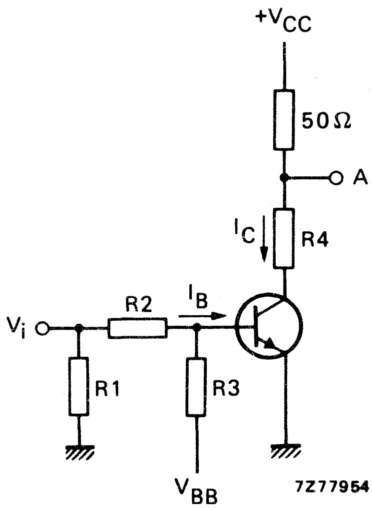
Turn-on time (see Fig. 3)			
from $-V_{BEoff} = 1,5$ V to $I_{Con} = 10$ mA; $I_{Bon} = 3$ mA	t_{on}	<	12 ns
from $-V_{BEoff} = 2,25$ V to $I_{Con} = 100$ mA; $I_{Bon} = 40$ mA	t_{on}	<	7 ns
Turn-off time (see Fig. 3)			
$I_{Con} = 10$ mA; $I_{Bon} = 3$ mA; $-I_{Boff} = 1,5$ mA	t_{off}	<	18 ns
$I_{Con} = 100$ mA; $I_{Bon} = 40$ mA; $-I_{Boff} = 20$ mA	t_{off}	<	21 ns

Pulse generator:

t_r < 1 ns
t_p > 300 ns
δ < 0,02
R_s = 50 Ω

Oscilloscope:

R_i = 50 Ω
t_r < 1 ns



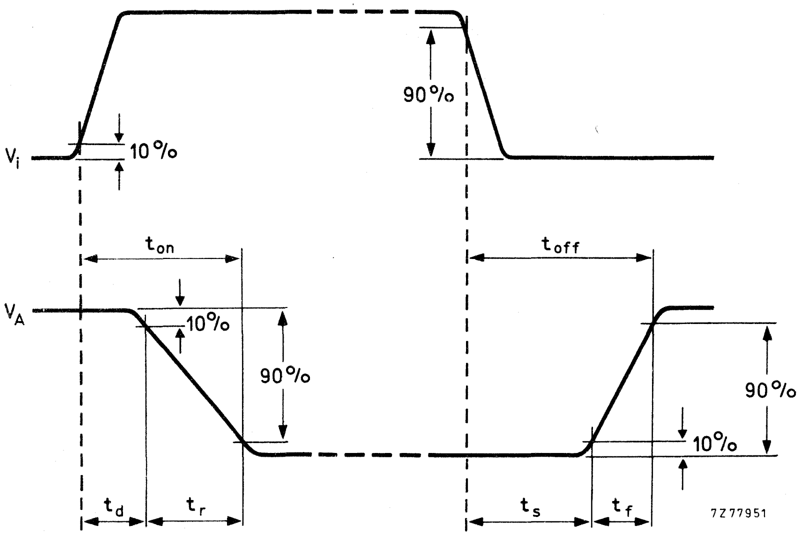


Fig. 3 Test circuit and waveforms.

							turn-on time			turn-off time	
I_{Con} mA	I_{Bon} mA	I_{Boff} mA	V_{CC} V	R1 Ω	R2; R3 kΩ	R4 Ω	V_{BB} V	V_{BE} V	V_i V	V_{BB} V	V_i V
10	3	−1,5	3	50	3,30	220	−3,0	−1,50	15	12,0	−15
100	40	−20	6	56	0,33	0	−4,5	−2,25	20	15,3	−20

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P medium power transistors in plastic TO-92 packages, primarily designed for high-speed switching and driver applications for industrial service.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)		$-V_{CBO}$	max.	60	V
Collector-emitter voltage (open base)	**PH2907**	$-V_{CEO}$	max.	40	V
	PH2907A	$-V_{CEO}$	max.	60	V
Collector current (d.c.)		$-I_C$	max.	600	mA
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	500	mW
Junction temperature		T_j	max.	150	°C
D.C. 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	>	200	MHz
Storage time $-I_{Con}$ = 150 mA; $-I_{Bon}$ = I_{Boff} = 15 mA		t_s	<	80	ns

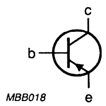
MECHANICAL DATA

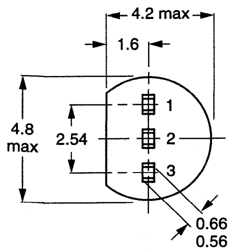
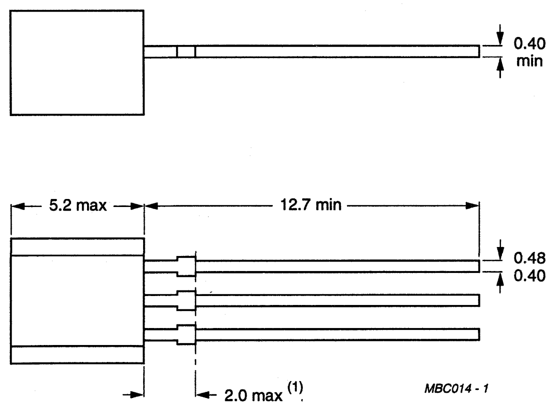
Dimensions in mm

Fig. 1 TO-92.

Pinning

1 = emitter
2 = base
3 = collector



Note (1) Terminal dimensions within this zone are uncontrolled to allow for plastic and terminal irregularities.

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)	**PH2907**	$-V_{CEO}$	max.	40	V
	PH2907A	$-V_{CEO}$	max.	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.	500	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	$R_{th\ j-a}$	=	250	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			2N2907	2N2907A	
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
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	100	
		<	300	300	
$-I_C = 500$ mA; $-V_{CE} = 10$ V*	h_{FE}	>	30	50	
Collector capacitance at f = 100 kHz					
$I_E = I_e = 0; -V_{CB} = 10$ V	C_c	<	8		pF
Emitter capacitance at f = 100 kHz					
$I_C = I_c = 0; -V_{EB} = 2$ V	C_e	<	30		pF
Transition frequency at f = 100 MHz					
$-I_C = 50$ mA; $-V_{CE} = 20$ V*	f_T	>	200		MHz

* Measured under pulse conditions to avoid excessive dissipation: $t_p \leqslant 300$ μs; $\delta \leqslant 0,02$.

Turn-on time (see Fig. 2)
when switched to $-I_{Con}$ = 150 mA; $-I_{Bon}$ = 15 mA

delay time	t_d	<	10 ns
rise time	t_r	<	40 ns
turn-on time	t_{on}	<	45 ns

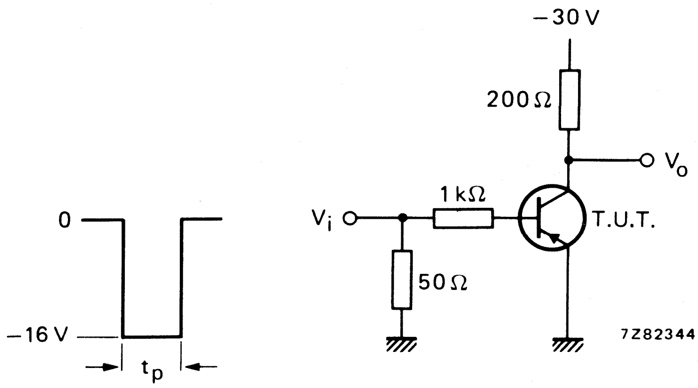


Fig. 2 Input waveform and test circuit for determining delay, rise and turn-on time.

Turn-off time (see Fig. 3)
when switched from $-I_{Con}$ = 150 mA; $-I_{Bon}$ = 15 mA
to cut-off with + I_{Boff} = 15 mA

storage time	t_s	<	80 ns
fall time	t_f	<	30 ns
turn-off time	t_{off}	<	100 ns

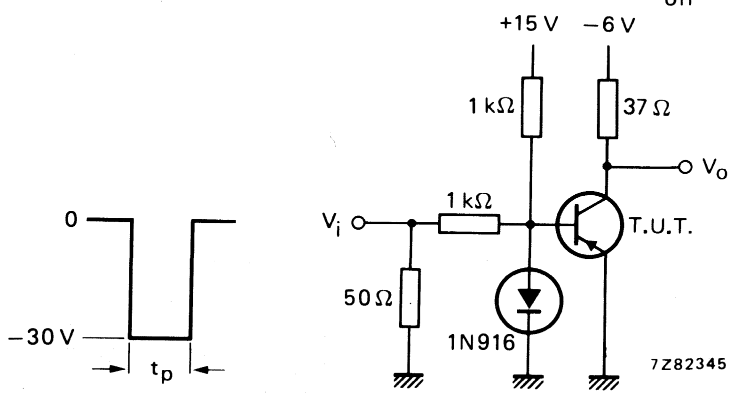


Fig. 3 Input waveform and test circuit for determining storage, fall and turn-off time.

Pulse generator (see Figs 2 and 3)

frequency	f	=	150 Hz
pulse duration	t_p	=	200 ns
rise time	t_r	⩽	2 ns
output impedance	Z_o	=	50 Ω

Oscilloscope (see Figs 2 and 3)

rise time	t_r	⩽	5 ns
input impedance	Z_i	⩽	10 MΩ

SILICON P-N-P HIGH-VOLTAGE TRANSISTORS

P-N-P high-voltage small-signal transistors, primarily intended for use in telephony applications and encapsulated in a TO-92 package.

QUICK REFERENCE DATA

			PH5415	PH5416	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	200	350	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	200	300	V
Collector current	$-I_C$	max.	1,0	1,0	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	500	mW
Junction temperature	T_j	max.	150	150	°C
Collector-emitter saturation voltage $-I_C$ = 50 mA; $-I_B$ = 5 mA	$-V_{CEsat}$	<	0,8	0,8	V
D.C. current gain $-I_C$ = 50 mA; $-V_{CE}$ = 10 V	h_{FE}	>	30	30	
		<	150	120	

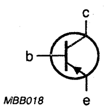
MECHANICAL DATA

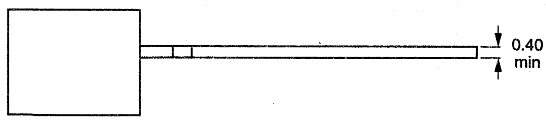
Dimension in mm

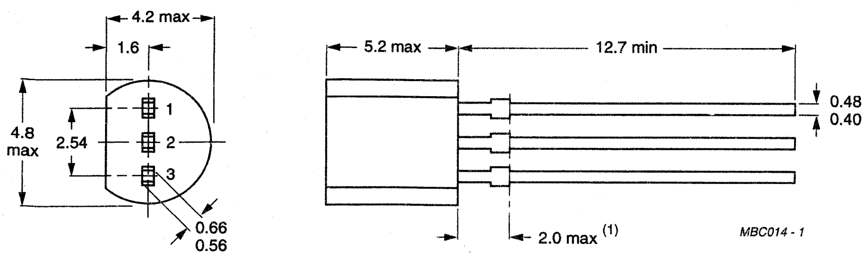
Fig. 1 TO-92.

Pinning

1 = emitter
2 = base
3 = collector







Note (1) Terminal dimensions within this zone are uncontrolled to allow for plastic and terminal irregularities.

RATINGS

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

			PH5415	PH5416	
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.	4,0	6,0	V
Collector current (d.c.)	$-I_C$	max.	1,0		A
Base current	$-I_B$	max.	0,5		A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500		mW
Junction temperature	T_j	max.	150		°C
Storage temperature range	T_{stg}		−65 to 150		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	250	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			PH5415	PH5416	
Collector cut-off currents					
$I_E = 0$; $-V_{CB}$ = 175 V	$-I_{CBO}$	<	0,1		μA
$I_E = 0$; $-V_{CB}$ = 280 V	$-I_{CBO}$	<		0,1	μA
$I_B = 0$; $-V_{CE}$ = 150 V	$-I_{CEO}$	<	1,0		μA
$I_B = 0$; $-V_{CE}$ = 250 V	$-I_{CEO}$	<		1,0	μA
Emitter cut-off current					
$I_C = 0$; $-V_{EB}$ = 4 V	$-I_{EBO}$	<	1,0		μA
$I_C = 0$; $-V_{EB}$ = 6 V	$-I_{EBO}$	<		1,0	μA
Collector-emitter sustaining voltage $I_B = 0$; $-I_C$ = 50 mA	$-V_{CEOsust}$	>	200	300	V
Saturation voltages $-I_C$ = 50 mA; $-I_B$ = 5 mA	$-V_{CEsat}$	<	0,8	0,8	V
	$-V_{BEsat}$	<	1,0	1,0	V
D.C. current gain $-I_C$ = 50 mA; $-V_{CE}$ = 10 V	h_{FE}	>	30	30	
		<	150	120	
Transition frequency at f = 5 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 10 V; T_{amb} = 25 °C	f_T	>	15		MHz
Small-signal current gain at f = 5 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 10 V; T_{amb} = 25 °C	h_{fe}	>	25		
Real part (Re) of input impedance (h_{ie}) $-V_{CE}$ = 10 V; $-I_C$ = 5 mA; f = 1 MHz; T_{amb} = 25 °C	$Re(h_{ie})$	<	300		Ω
Input capacitance at f = 1 MHz $I_C = 0$; $-V_{EB}$ = 5 V; T_{amb} = 25 °C	C_e	<	75		pF
Output capacitance at f = 1 MHz $I_E = 0$; $-V_{CB}$ = 10 V; T_{amb} = 25 °C	C_c	<	15		pF

SILICON EPITAXIAL TRANSISTORS

NPN transistors in a microminiature (SMD) plastic package 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.	300	mW
DC 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.	300	MHz

MECHANICAL DATA

Dimensions in mm

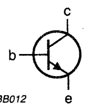
Fig.1 SOT23.

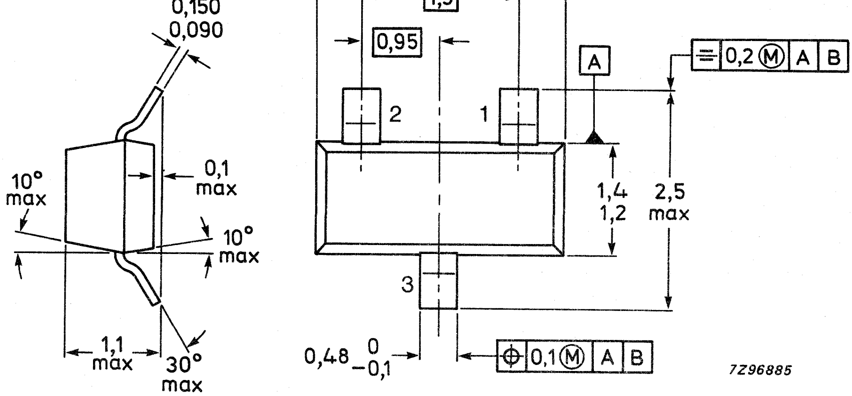
Marking code

PMBS3904: P9A

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.	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.	300	mW
Storage temperature range	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*	$R_{th\ j\text{-}a}$	=	430	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector-emitter breakdown voltage** I_C = 1 mA; I_B = 0	$V_{(BR)CEO}$	min.	40	V
Collector-base breakdown voltage I_C = 10 μA; I_E = 0	$V_{(BR)CBO}$	min.	60	V
Emitter-base breakdown voltage I_E = 10 μA; I_C = 0	$V_{(BR)EBO}$	min.	6	V
Collector cut-off current V_{CE} = 30 V; V_{EB} = 3 V	I_{CEX}	max.	50	nA
Output capacitance at f = 1 MHz I_E = 0; V_{CB} = 5 V	C_c	max.	4	pF
Input capacitance at f = 1 MHz I_C = 0; V_{BE} = 0,5 V	C_e	max.	8	pF
Base current with reverse biased emitter junction V_{EB} = 3 V; V_{CE} = 30 V	I_{BEX}	max.	50	nA

* Mounted on a ceramic substrate: area = 10 x 8 mm²; thickness = 0.7 mm.

** Pulse test conditions: t_p = 300 μs; duty factor ≤ 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
DC current gain*				
I_C = 0.1 mA; V_{CE} = 1 V	h_{FE}	min.	40	
I_C = 1 mA; V_{CE} = 1 V	h_{FE}	min.	70	
I_C = 10 mA; V_{CE} = 1 V	h_{FE}	min.	100	
		max.	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.	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

* Pulse test condition: t_p = 300 μs; duty factor ⩽ 2%.

SILICON EPITAXIAL TRANSISTOR

PNP 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 (DC)	$-I_C$	max.	200 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300 mW
DC 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

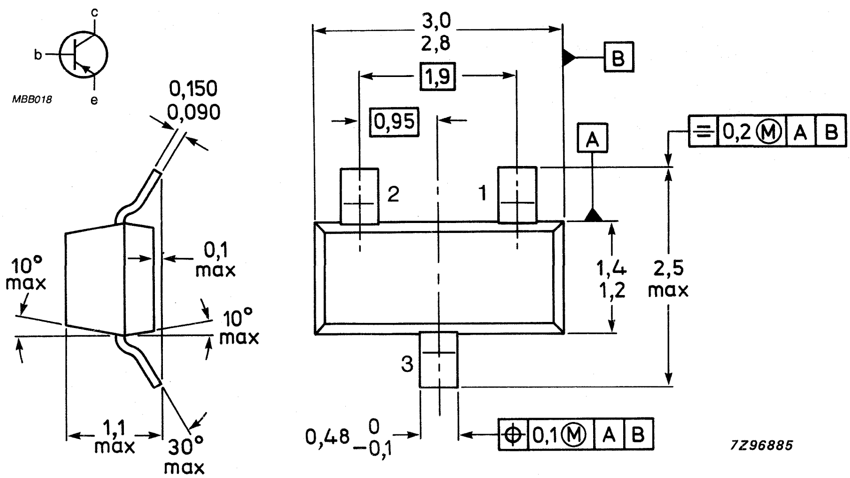
Dimensions in mm

Fig. 1 SOT-23.

Pinning

1 = base
2 = emitter
3 = collector

Marking code
PMBS3906 : PO6



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 (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* up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Storage temperature range	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	$R_{th\ j\text{-}a}$	=	430	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector-emitter breakdown voltage▲ $-I_C$ = 1 mA; I_B = 0	$-V_{(BR)CEO}$	min.	40	V
Collector-base breakdown voltage $-I_C$ = 10 μA; I_E = 0	$-V_{(BR)CBO}$	min.	40	V
Emitter-base breakdown voltage $-I_E$ = 10 μA; I_C = 0	$-V_{(BR)EBO}$	min.	5	V
Collector cut-off current $-V_{CE}$ = 30 V; $-V_{EB}$ = 3 V	$-I_{CE}$	max.	50	nA
Base current with reverse biased emitter junction	$-I_{BEX}$	max.	50	nA
Output capacitance at f = 100 kHz I_E = 0; $-V_{CB}$ = 5 V	C_c	max.	4.5	pF
Input capacitance at f = 100 kHz I_C = 0; $-V_{BE}$ = 0.5 V	C_e	max.	10	pF

* Mounted on a ceramic substrate: area = 10 x 8 mm; thickness = 0.7 mm.
** See Thermal characteristics.
▲ Pulse test conditions: t_p = 300 μs; duty factor ≤ 2%.

Saturation voltages			
$-I_C = 10$ mA; $-I_B = 1$ mA	$-V_{CEsat}$	max.	0.25 V
$-I_C = 50$ mA; $-I_B = 5$ mA	$-V_{CEsat}$	max. min.	0.4 V 0.65 V
$-I_C = 10$ mA; $-I_B = 1$ mA	$-V_{BEsat}$	max.	0.85 V
$-I_C = 50$ mA; $-I_B = 5$ mA	$-V_{BBsat}$	max.	0.95 V
D.C. current gain			
$-I_C = 0.1$ mA; $-V_{CE} = 1$ V	h_{FE}	min.	60
$-I_C = 1$ mA; $-V_{CE} = 1$ V	h_{FE}	min.	80
$-I_C = 10$ mA; $-V_{CE} = 1$ V	h_{FE}	min. max.	100 300
$-I_C = 50$ mA; $-V_{CE} = 1$ V	h_{FE}	min.	60
$-I_C = 100$ mA; $-V_{CE} = 1$ V	h_{FE}	min.	30
Transition frequency at f = 100 MHz			
$-I_C = 10$ mA; $-V_{CE} = 20$ V	f_T	min.	250 MHz
Noise figure at $R_S = 1$ kΩ			
$-I_C = 100$ μA; $-V_{CE} = 5$ V f = 10 Hz to 15,7 kHz	F	max.	4 dB
h-parameters (common emitter)			
$-I_C = 1$ mA; $-V_{CE} = 10$ V; f = 1 kHz			
Input impedance	h_{ie}	min. max.	2.0 kΩ 12 kΩ
Reverse voltage transfer ratio	h_{re}	min. max.	1.0 10^{-4} 10 10^{-4}
Small signal current gain	h_{fe}	min. max.	100 400
Output admittance	h_{oe}	min. max.	30 μS 60 μS

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N silicon transistors, in a microminiature plastic **package** 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

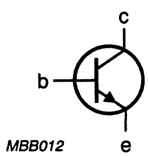
Fig. 1 SOT-23.

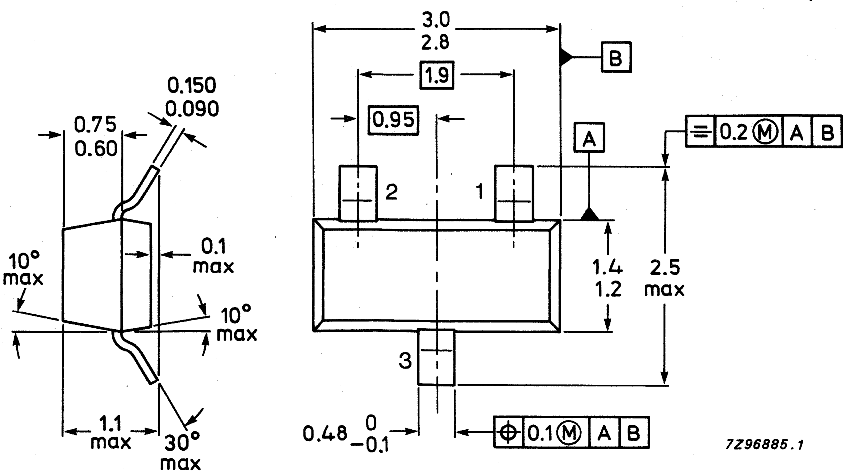
Pinning:

1 = base
2 = emitter
3 = collector

Marking code

PMBT2222 = p1B
PMBT2222A = p1P





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

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

** Measured under pulsed conditions to avoid excessive dissipation; $t_p \leqslant 300$ μs; $\delta \leqslant 0{,}02$.

<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_c</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_e</td><td><</td><td>30</td><td>25</td><td></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>

* f_T is defined as the frequency at which h_{fe} extrapolates to unity.

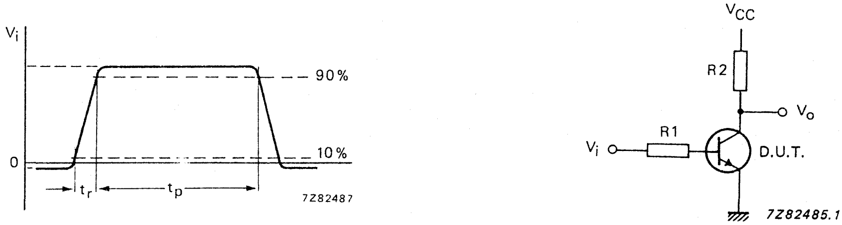


Fig. 2 Waveform and test circuit delay and rise time.

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

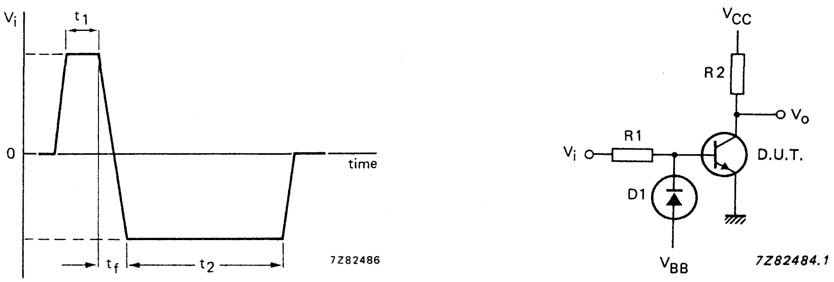


Fig. 3 Waveform and test circuit storage and fall time.

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 package 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

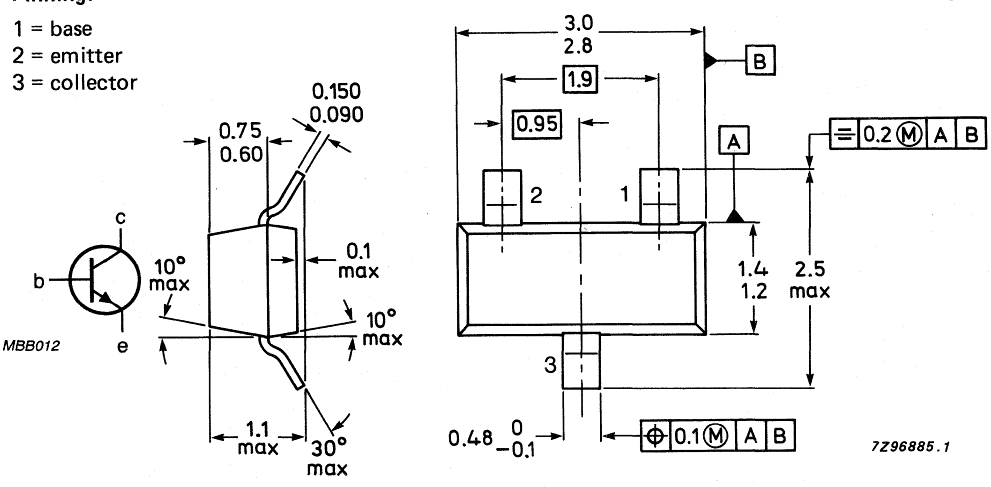
Fig. 1 SOT-23.

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_c	<	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				
$I_{Con} = I_{Bon} = -I_{Boff}$ = 10 mA	t_s	typ.	5,0	ns
		<	13	ns
Turn-on time				
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				
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

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

SILICON PLANAR EPITAXIAL TRANSISTORS

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

QUICK REFERENCE DATA

			PMBT2907	PMBT2907A	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60	60	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40	60	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5,0		V
Collector current (d.c.)	$-I_C$	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Junction temperature	T_j	max.	150		°C
D.C. current gain $-I_C$ = 500 mA; $-V_{CE}$ = 10 V	h_{FE}	>	30	50	
Turn-off switching time $-I_{Con}$ = 150 mA; $-I_{Bon}$ = I_{Boff} = 15 mA	t_{off}	<	100		ns
Transition frequency at f = 100 MHz $-I_C$ = 50 mA; $-V_{CE}$ = 20 V	f_T	>	200		MHz

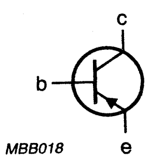
MECHANICAL DATA

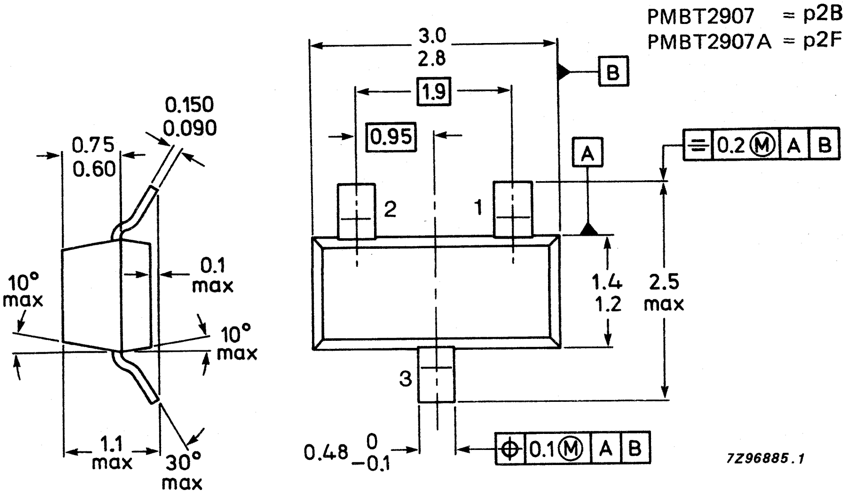
Dimensions in mm

Fig. 1 SOT-23.

Pinning:
1 = base
2 = emitter
3 = collector

Marking code
PMBT2907 = p2B
PMBT2907A = p2F





TOP VIEW

RATINGS

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

			PMBT2907	PMBT2907A	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60	60	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40	60	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5,0		V
Collector current (d.c.)	$-I_C$	max.	600		mA
Power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Storage temperature range	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE *

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			PMBT2907	PMBT2907A	
Collector cut-off current					
$I_E = 0$; $-V_{CB} = 50$ V	$-I_{CBO}$	<	20	10	nA
$I_E = 0$; $-V_{CB} = 50$ V; $T_j = 125$ °C	$-I_{CBO}$	<	20	10	μA
$-V_{EB} = 0,5$ V; $-V_{CE} = 30$ V	$-I_{CEX}$	<	50		nA
Base current with reverse biased emitter junction					
$-V_{EB} = 3$ V; $-V_{CE} = 30$ V	$-I_{BEX}$	<	50		nA
Saturation voltages					
$-I_C = 150$ mA; $-I_B = 15$ mA	$-V_{CEsat}$	<	0,4		V
	$-V_{BEsat}$	<	1,3		V
$-I_C = 500$ mA; $-I_B = 50$ mA	$-V_{CEsat}$	<	1,6		V
	$-V_{BEsat}$	<	2,6		V
Collector-base breakdown voltage open emitter; $-I_C = 10$ μA; $I_E = 0$	$-V_{(BR)CBO}$		60		V
Collector-emitter breakdown voltage open base; $-I_C = 10$ mA; $I_B = 0$	$-V_{(BR)CEO}$	>	40	60	V
Emitter-base breakdown voltage open collector; $-I_E = 10$ μA; $I_C = 0$	$-V_{(BR)EBO}$		5,0		V

* Mounted on an FR4 printed-circuit board 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_c	<	8,0		pF
Input 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; 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

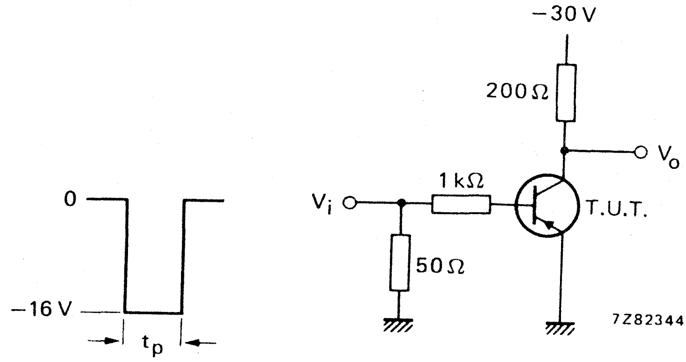


Fig. 2 Turn-on switching time test circuit.

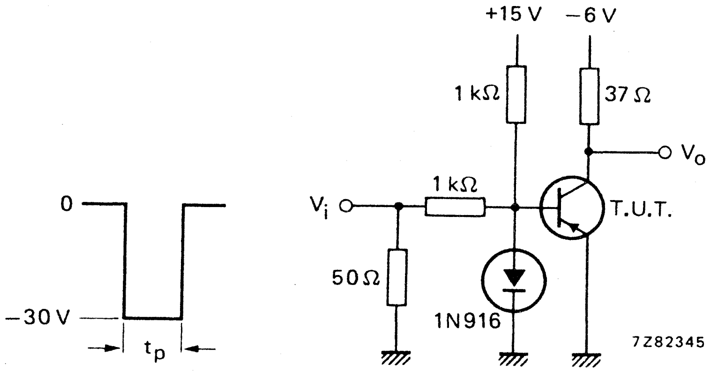


Fig. 3 Turn-off switching time test circuit.

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

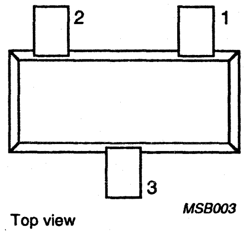


Fig.1 SOT23.

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_c	output capacitance	I_E = 0; $-V_{CB}$ = 5 V; f = 1 MHz	–	3.5	pF
C_e	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 package 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.

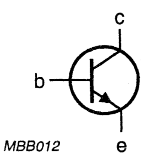
Dimensions in mm

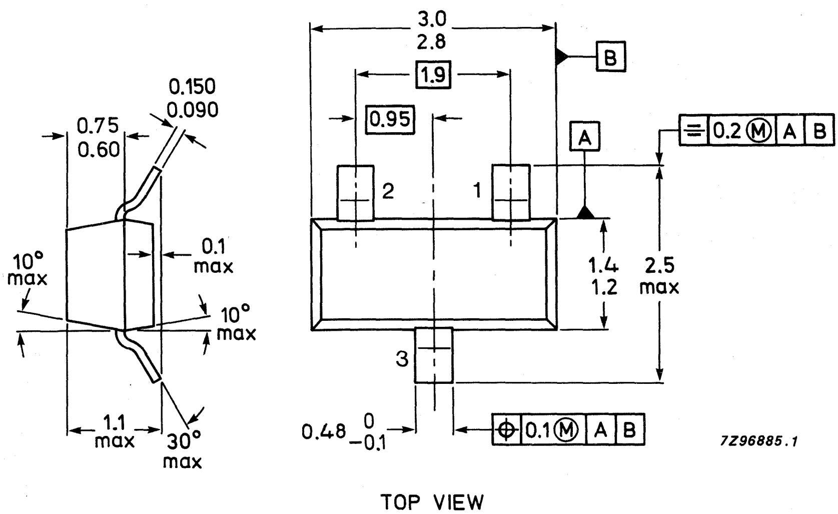
Marking code

PMBT3904: p1A

Pinning:

1 = base
2 = emitter
3 = collector





RATINGS

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

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

THERMAL RESISTANCE

$T_j = P\,(R_{th\ j\text{-}t} + R_{th\ t\text{-}s} + R_{th\ s\text{-}a}) + T_{amb}$

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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector-emitter breakdown voltage▲ I_C = 1 mA; I_B = 0	$V_{(BR)CEO}$	min.	40	V
Collector-base breakdown voltage I_C = 10 μA; I_E = 0	$V_{(BR)CBO}$	min.	60	V
Emitter-base breakdown voltage I_E = 10 μA; I_C = 0	$V_{(BR)EBO}$	min.	6	V
Collector cut-off current V_{CE} = 30 V; V_{EB} = 3 V	I_{CEX}	max.	50	nA
Output capacitance at f = 1 MHz I_E = 0; V_{CB} = 5 V	C_c	max.	4	pF
Input capacitance at f = 1 MHz I_C = 0; V_{BE} = 0,5 V	C_e	max.	8	pF
Base current with reverse biased emitter junction V_{EB} = 3 V; V_{CE} = 30 V	I_{BEX}	max.	50	nA

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 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
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 package 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

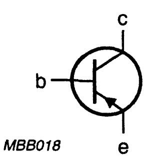
Fig. 1 SOT-23.

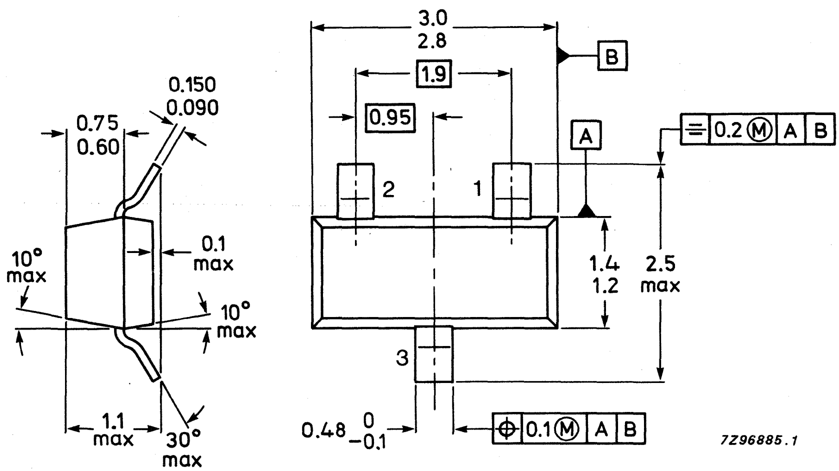
Marking code

PMBT3906 : p2A

Pinning:

1 = base
2 = emitter
3 = collector





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 (open base)	$-V_{CEO}$	max.	40	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	V
Collector current (d.c.)	$-I_C$	max.	200	mA
Total power dissipation* up to T_{amb} = 25 °C	P_{tot}	max.	250	mW
Storage temperature	T_{stg}		−65 to +150	°C

THERMAL CHARACTERISTICS

$T_j = P(R_{th\ j\text{-}t} + R_{th\ t\text{-}s} + R_{th\ s\text{-}a}) + T_{amb}$

Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	500	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector-emitter breakdown voltage▲ $-I_C$ = 1 mA; I_B = 0	$-V_{(BR)CEO}$	min.	40	V
Collector-base breakdown voltage $-I_C$ = 10 μA; I_E = 0	$-V_{(BR)CBO}$	min.	40	V
Emitter-base breakdown voltage $-I_E$ = 10 μA; I_C = 0	$-V_{(BR)EBO}$	min.	5	V
Collector cut-off current $-V_{CE}$ = 30 V; $-V_{EB}$ = 3 V	$-I_{CE}$	max.	50	nA
Base current with reverse biased emitter junction	$-I_{BEX}$	max.	50	nA
Output capacitance at f = 100 kHz I_E = 0; $-V_{CB}$ = 5 V	C_c	max.	4,5	pF
Input capacitance at f = 100 kHz I_C = 0; $-V_{BE}$ = 0,5 V	C_e	max.	10	pF

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 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 V 0,65 V
$-I_C$ = 10 mA; $-I_B$ = 1 mA	$-V_{BEsat}$	max.	0,85 V
$-I_C$ = 50 mA; $-I_B$ = 5 mA	$-V_{BBsat}$	max.	0,95 V
D.C. current gain			
$-I_C$ = 0,1 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	60
$-I_C$ = 1 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	80
$-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}	min. max.	100 300
$-I_C$ = 50 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	60
$-I_C$ = 100 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	30
Transition frequency at f = 100 MHz			
$-I_C$ = 10 mA; $-V_{CE}$ = 20 V	f_T	min.	250 MHz
Noise figure at R_S = 1 kΩ $-I_C$ = 100 μA; $-V_{CE}$ = 5 V f = 10 Hz to 15,7 kHz	F	max.	4 dB
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 package.
It is intended for use in linear, switching, and general purpose applications.
The complementary type is the PMBT4403.

QUICK REFERENCE DATA

Collector-emitter voltage	V_{CEO}	max.	40 V
Collector current (DC)	I_C	max.	600 mA
DC current gain I_C = 150 mA; V_{CE} = 1 V	h_{FE}	min. max.	100 300
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	250 mW

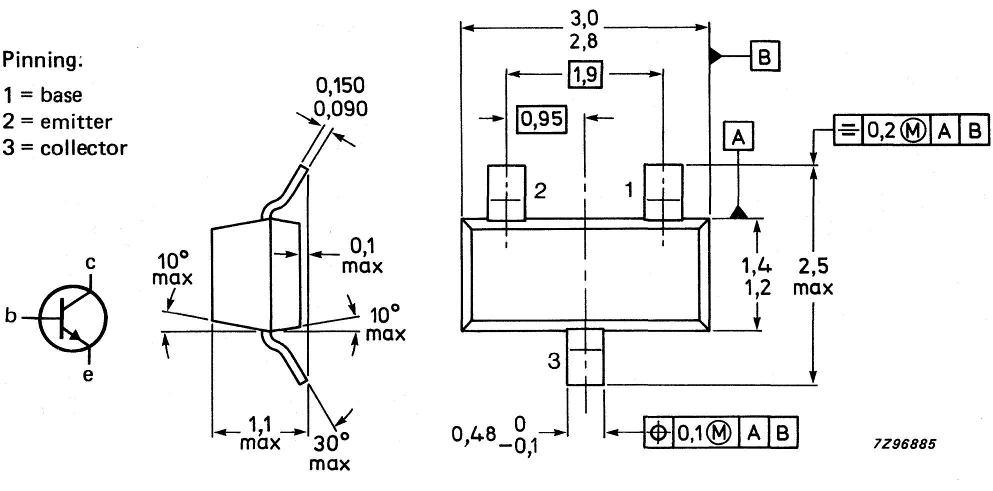
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-23

Marking code = p2X

Pinning:
1 = base
2 = emitter
3 = collector



TOP VIEW

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

RATINGS

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

Collector-emitter voltage	V_{CEO}	max.	40 V
Collector-base voltage	V_{CBO}	max.	60 V
Emitter-base voltage	V_{EBO}	max.	6.0 V
Collector current (DC)	I_C	max.	600 mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	250 mW
Storage temperature range	T_{stg}		−65 to +150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector-emitter breakdown voltage I_C = 1.0 mA; I_B = 0	$V_{(BR)CEO}$	>	40 V
Collector-base breakdown voltage I_C = 100 μA; I_E = 0	$V_{(BR)CBO}$	>	60 V
Emitter-base breakdown voltage I_E = 100 μA; I_C = 0	$V_{(BR)EBO}$	>	6.0 V
Base cut-off current V_{CE} = 35 V; V_{EB} = 0.4 V	I_{BEX}	<	0.1 μA
Collector cut-off current V_{CE} = 35 V; V_{EB} = 0.4 V	I_{CEX}	<	0.1 μA
DC current gain			
I_C = 0.1 mA; V_{CE} = 1 V	h_{FE}	>	20
I_C = 1.0 mA; V_{CE} = 1 V	h_{FE}	>	40
I_C = 10 mA; V_{CE} = 1 V	h_{FE}	>	80
I_C = 150 mA; V_{CE} = 1 V	h_{FE}		100 to 300
I_C = 500 mA; V_{CE} = 2 V	h_{FE}	>	40
Saturation voltage			
I_C = 150 mA; I_B = 15 mA	$V_{CE\ sat}$	<	0.4 V
	$V_{BE\ sat}$		0.75 to 0.95 V
I_C = 500 mA; I_B = 50 mA	$V_{CE\ sat}$	<	0.75 V
	$V_{BE\ sat}$	<	1.2 V

* Mounted on an FR4 printed-circuit board 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_c	<	8.0 pF
Emitter-base capacitance I_C = 0; V_{BE} = 0.5 V; f = 100 kHz	C_e	<	30 pF

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 package.
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

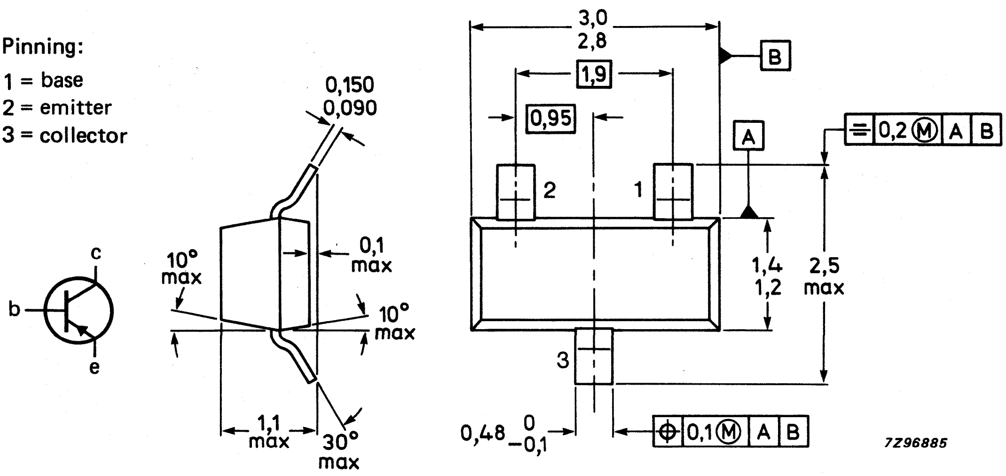
MECHANICAL DATA

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 μA; I_E = 0	$-V_{(BR)CBO}$	>	40 V
Emitter-base breakdown voltage			
$-I_E$ = 100 μA; I_C = 0	$-V_{(BR)EBO}$	>	5.0 V
Base cut-off current			
$-V_{CE}$ = 35 V; $-V_{EB}$ = 0.4 V	$-I_{BEX}$	<	0.1 μA
Collector cut-off current			
$-V_{CE}$ = 35 V; $-V_{EB}$ = 0.4 V	$-I_{CEX}$	<	0.1 μA
DC current gain			
$-I_C$ = 0.1 mA; $-V_{CE}$ = 1 V	h_{FE}	>	30
$-I_C$ = 1.0 mA; $-V_{CE}$ = 1 V	h_{FE}	>	60
$-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}	>	100
$-I_C$ = 150 mA; $-V_{CE}$ = 2 V	h_{FE}		100 to 300
$-I_C$ = 500 mA; $-V_{CE}$ = 2 V	h_{FE}	>	20
Saturation voltage			
$-I_C$ = 150 mA; $-I_B$ = 15 mA	$-V_{CE\ sat}$	<	0.4 V
	$-V_{BE\ sat}$		0.75 to 0.95 V
$-I_C$ = 500 mA; $-I_B$ = 50 mA	$-V_{CE\ sat}$	<	0.75 V
	$-V_{BE\ sat}$	<	1.3 V

* Mounted on an FR4 printed-circuit board 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_c	<	8.5 pF
Emitter-base capacitance at $f = 100$ kHz; $I_C = 0$; $-V_{BE} = 0.5$ V	C_e	<	35 pF

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 package 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

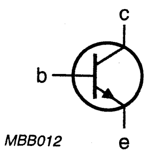
Dimensions in mm

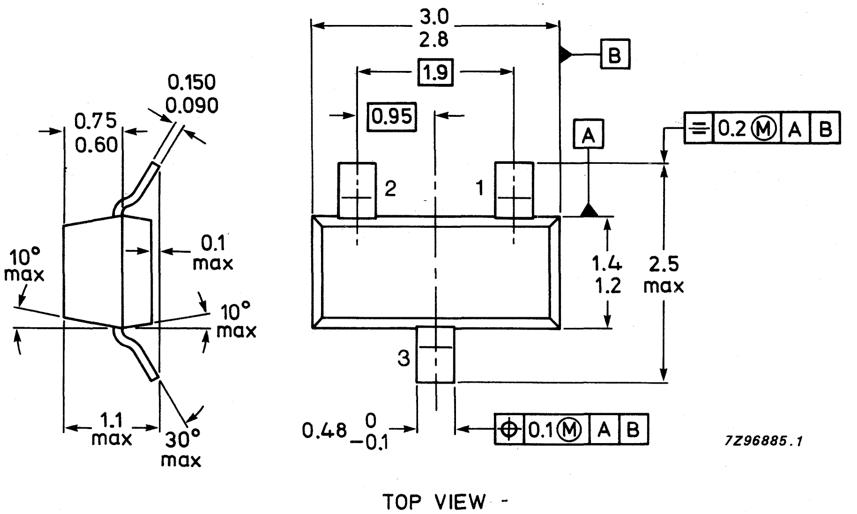
Fig. 1 SOT-23.

Marking code: p1Q

Pinning:

1 = base
2 = emitter
3 = collector





RATINGS

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

Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Collector-base voltage (open emitter)	V_{CBO}	max.	35	V
Emitter-base voltage (open collector)	V_{EBO}	max.	4,5	V
Collector current (d.c.)	I_C	max.	50	mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	250	mW
Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

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

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

CHARACTERISTICS

T_j = 25 °C 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 μA	$V_{(BR)CBO}$	min.	35 V
Collector cut-off current V_{CB} = 20 V; $I_E = 0$	I_{CBO}	max.	50 nA
Emitter cut-off current V_{EBoff} = 3 V; $I_C = 0$	I_{EBO}	max.	50 nA
Saturation voltages I_C = 10 mA; I_B = 1 mA	V_{CEsat}	max.	0,5 V
	V_{BEsat}	max.	0,8 V
D.C. current gain I_C = 100 μA; V_{CE} = 5 V	h_{FE}	min.	300
		max.	900
I_C = 1 mA; V_{CE} = 5 V	h_{FE}	min.	350
I_C = 10 mA; V_{CE} = 5 V		min.	300
Small-signal current gain I_C = 1 mA; V_{CE} = 5 V; f = 1 kHz	h_{fe}	min.	350
		max.	1400
Noise figure at R_S = 10 kΩ; T_{amb} = 25 °C I_C = 100 μA; 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 package.

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

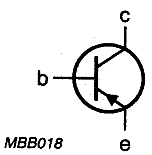
Dimensions in mm

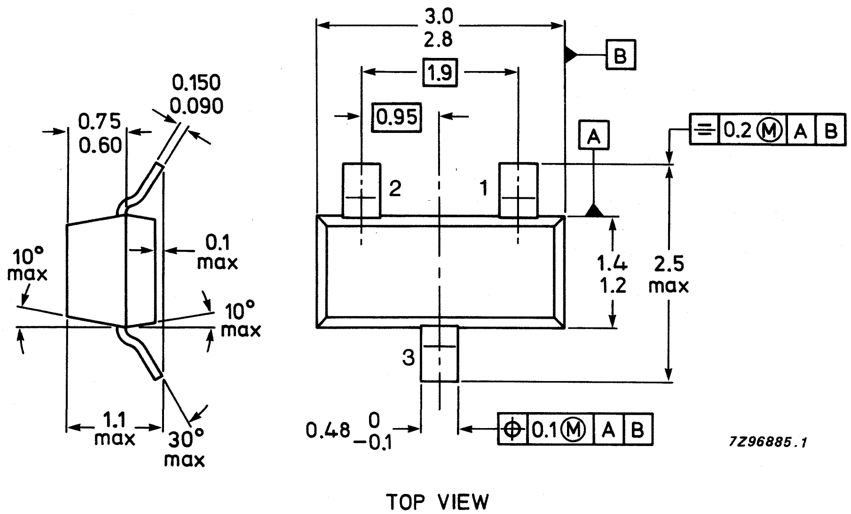
Fig. 1 SOT-23.

Marking code: p2L

Pinning:

1 = base
2 = emitter
3 = collector





RATINGS

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

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	160	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	150	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5,0	V
Collector current	$-I_C$	max.	500	mA
Total power dissipation * up to T_{amb} = 25 °C	P_{tot}	max.	250	mW
Junction temperature	T_j	max.	150	°C
Storage temperature	T_{stg}		−65 to +150	°C

THERMAL RESISTANCE

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0; -V_{CB}$ = 120 V	$-I_{CBO}$	max.	50	nA
$I_E = 0; -V_{CB}$ = 120 V; T_{amb} = 150 °C	$-I_{CBO}$	max.	50	μA
Breakdown voltages				
I_C = 1,0 mA; I_B = 0	$-V_{(BR)CEO}$	min.	150	V
I_C = 100 μA; I_E = 0	$-V_{(BR)CBO}$	min.	160	V
I_C = 0; I_E = 10 μA	$-V_{(BR)EBO}$	min.	5,0	V
Saturation voltages				
$-I_C$ = 10 mA; $-I_B$ = 1,0 mA	$-V_{CEsat}$	max.	0,2	V
	$-V_{BEsat}$	max.	1,0	V
$-I_C$ = 50 mA; $-I_B$ = 5,0 mA	$-V_{CEsat}$	max.	0,5	V
	$-V_{BEsat}$	max.	1,0	V
D.C. current gain				
I_C = 1,0 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	50	
I_C = 10 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	60	
		max.	240	
I_C = 50 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	50	
Small-signal current gain				
I_C = 1,0 mA; $-V_{CE}$ = 10 V; f = 1 kHz	h_{fe}	min.	40	
		max.	200	
Output capacitance at f = 1 MHz				
$I_E = 0; -V_{CB}$ = 10 V	C_c	max.	6,0	pF
Transition frequency at f = 100 MHz				
$-I_C$ = 10 mA; $-V_{CE}$ = 10 V; T_{amb} = 25 °C	f_T	min.	100	MHz
		max.	300	MHz
Noise figure at R_S = 10 Ω				
I_C = 200 μA; $-V_{CE}$ = 5 V; f = 10 Hz to 15,7 kHz; T_{amb} = 25 °C	F	max.	8,0	dB

* Mounted on an FR4 printed-circuit board 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 package.

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

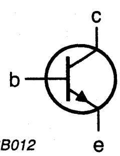
Dimensions in mm

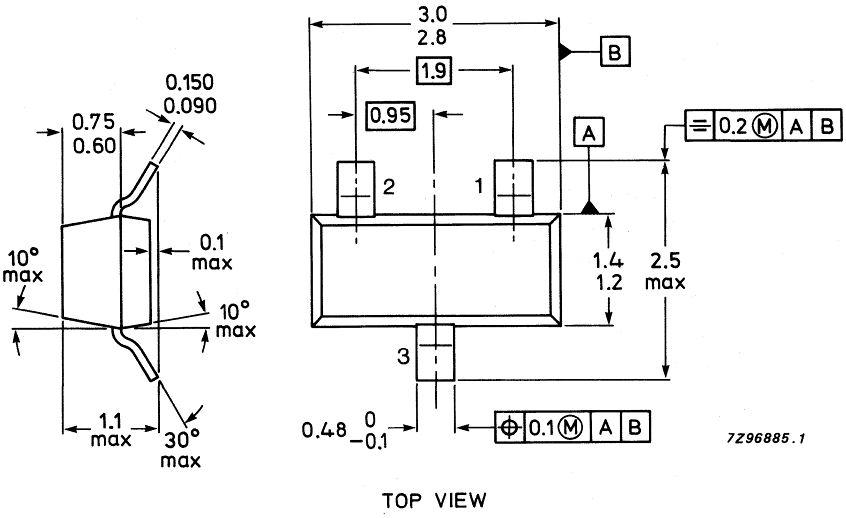
Fig. 1 SOT-23.

Marking code: p1F

Pinning:

1 = base
2 = emitter
3 = collector





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_c	max.	6	pF
Input capacitance at f = 1 MHz				
I_C = 0; V_{EB} = 0,5 V	C_e	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 an FR4 printed-circuit board 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 package.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	180	V
Collector-emitter voltage (open base)	V_{CEO}	max.	160	V
Collector current	I_C	max.	600	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	mW
Junction temperature	T_j	max.	150	°C
Collector-emitter saturation voltage I_C = 50 mA; I_B = 5 mA	V_{CEsat}	max.	0.20	V
DC current gain I_C = 10 mA; V_{CE} = 5 V	h_{FE}	min.	80	

MECHANICAL DATA

Dimensions in mm

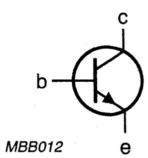
Fig.1 SOT23.

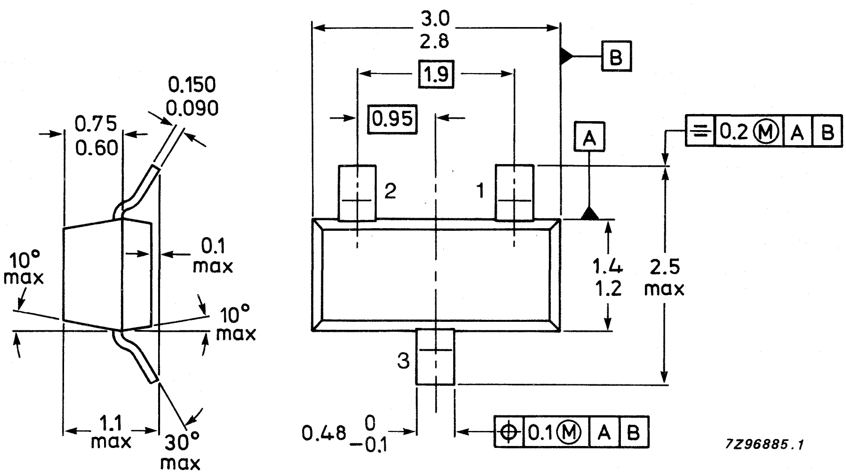
Marking code

PMBT5551 = pGI

Pinning:

1 = base
2 = emitter
3 = collector





TOP VIEW

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	180	V
Collector-emitter voltage (open base)	V_{CEO}	max.	160	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6	V
Collector current	I_C	max.	600	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	mW
Junction temperature	T_j	max.	150	°C
Storage temperature range	T_{stg}		−65 to +150	°C

THERMAL RESISTANCE

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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector cut-off current				
I_E = 0; V_{CB} = 120 V	I_{CBO}	max.	50	nA
I_E = 0; V_{CB} = 120 V; T_{amb} = 100 °C	I_{CBO}	max.	50	μA
Emitter cut-off current				
I_C = 0; V_{EB} = 4.0 V	I_{EBO}	max.	50	nA
Breakdown voltages				
I_C = 1.0 mA; I_B = 0	$V_{(BR)CEO}$	min.	160	V
I_C = 100 μA; I_E = 0	$V_{(BR)CBO}$	min.	180	V
I_C = 0; I_E = 10 μA	$V_{(BR)EBO}$	min.	6.0	V
Saturation voltages				
I_C = 10 mA; I_B = 1.0 mA	V_{CEsat}	max.	0.15	V
	V_{BEsat}	max.	1.0	V
I_C = 50 mA; I_B = 5.0 mA	V_{CEsat}	max.	0.20	V
	V_{BEsat}	max.	1.0	V
DC current gain				
I_C = 1.0 mA; V_{CE} = 5 V	h_{FE}	min.	80	
I_C = 10 mA; V_{CE} = 5 V	h_{FE}	min.	80	
		max.	250	
I_C = 50 mA; V_{CE} = 5 V	h_{FE}	min.	30	
Small-signal current gain				
I_C = 1.0 mA; V_{CE} = 10 V; f = 1 kHz	h_{fe}	min.	50	
		max.	200	
Output capacitance at f = 1 MHz				
I_E = 0; V_{CB} = 10 V	C_c	max.	6	pF
Input capacitance at f = 1 MHz				
I_C = 0; V_{EB} = 0.5 V	C_e	max.	30	pF
Transition frequency at f = 100 MHz				
I_C = 10 mA; V_{CE} = 10 V	f_T	min.	100	MHz
		max.	300	MHz
Noise figure at R_S = 1 kΩ				
I_C = 250 μA; V_{CE} = 5 V; f = 10 Hz to 15.7 kHz	F	max.	8	dB

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

SILICON EPITAXIAL TRANSISTORS

N-P-N transistors in a microminiature (SMD) plastic package 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.	250	500	
		max.	650	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.	100		MHz
		max.	700		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

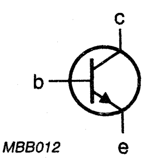
Fig. 1 SOT-23.

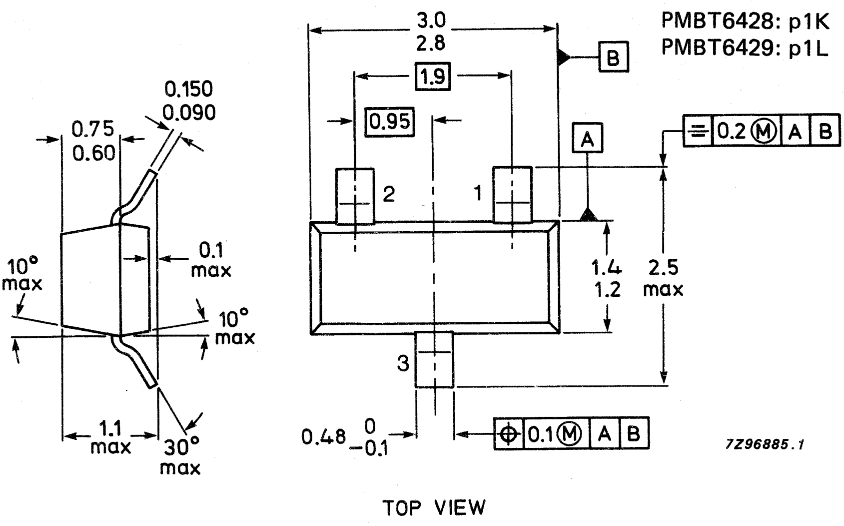
Marking code

PMBT6428: p1K
PMBT6429: p1L

Pinning:

1 = base
2 = emitter
3 = collector





RATINGS

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

			PMBT6428	PMBT6429	
Collector-base voltage (open emitter)	V_{CBO}	max.	60	55	V
Collector-emitter voltage (open base)	V_{CEO}	max.	50	45	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6,0		V
Collector current (d.c.)	I_C	max.	200		mA
Total power dissipation* up to T_{amb} = 25 °C	P_{tot}		250		mW
Storage temperature	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL CHARACTERISTICS

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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			PMBT6428	PMBT6429	
Collector-emitter breakdown voltage I_C = 1 mA; I_B = 0	$V_{(BR)CEO}$	min.	50	45	V
Collector-base breakdown voltage I_C = 0,1 mA; I_E = 0	$V_{(BR)CBO}$	min.	60	55	V
Collector cut-off current V_{CE} = 30 V	I_{CEO}	max.	100		nA
I_E = 0; V_{CB} = 30 V	I_{CBO}	max.	10		nA
Emitter cut-off current I_C = 0; V_{EB} = 5 V	I_{EBO}	max.	10		nA
Base-emitter On-voltage I_C = 1 mA; V_{CE} = 5 V	$V_{BE(on)}$	min.	560		mV
		max.	660		mV

* Mounted on an FR4 printed-circuit board 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 package 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

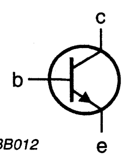
Fig. 1 SOT-23.

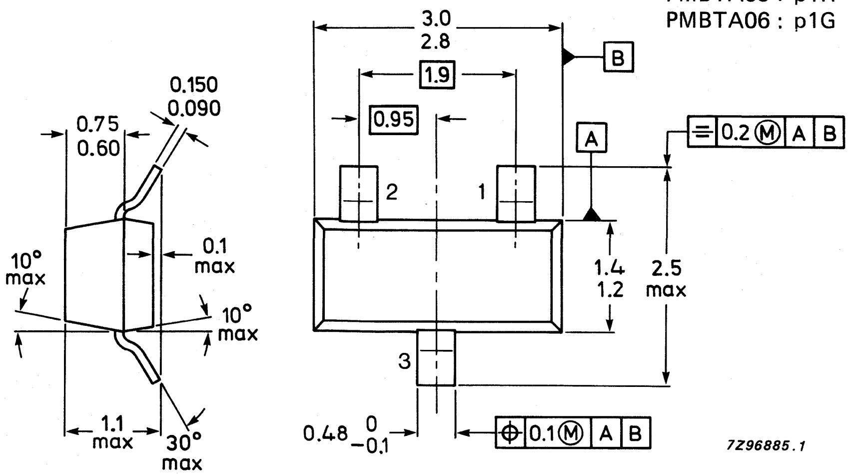
Marking code

PMBTA05 : p1H
PMBTA06 : p1G

Pinning:

1 = base
2 = emitter
3 = collector





TOP VIEW

RATINGS

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

			PMBTA05	PMBTA06	
Collector-base voltage	V_{CBO}	max.	60	80	V
Collector-emitter voltage (open base)	V_{CEO}	max.	60	80	V
Emitter-base voltage (open collector)	V_{EBO}	max.	4		V
Collector current (d.c.)	I_C	max.	500		mA
Total power dissipation * up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Storage temperature	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL CHARACTERISTICS **

$T_j = P\,(R_{th\ j\text{-}t} + R_{th\ t\text{-}s} + R_{th\ s\text{-}a}) + T_{amb}$

Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	500	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			PMBTA05	PMBTA06	
Collector-emitter breakdown voltage ▲ I_C = 1 mA; I_B = 0	$V_{(BR)CEO}$	min.	60	80	V
Emitter-base breakdown voltage I_C = 0; I_E = 100 μA	$V_{(BR)EBO}$	min.	4		V
Collector cut-off current V_{CE} = 60 V; I_B = 0	I_{CEO}	max.	0,1		μA
Collector cut-off current V_{CB} = 60 V; I_E = 0	I_{CBO}	max.	0,1		μA
V_{CB} = 80 V; I_E = 0	I_{CBO}	max.	0,1		μA
Saturation voltages I_C = 100 mA; I_B = 10 mA	V_{CEsat}	max.	0,25		V
Base-emitter on voltage I_C = 100 mA; V_{CE} = 1 V	$V_{BE(on)}$	max.	1,2		V
D.C. current gain I_C = 10 mA; V_{CE} = 1 V	h_{FE}	min.	50		
I_C = 100 mA; V_{CE} = 1 V	h_{FE}	min.	50		
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 2 V	f_T	min.	100		MHz

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 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 package (SOT-23).
Designed primarily for preamplifier input applications requiring high input impedance.
P-N-P complement is the PMBTA63/64.

QUICK REFERENCE DATA

Collector-emitter voltage $V_{BE} = 0$		V_{CES}	max.	30	V
Collector current (d.c.)		I_C	max.	300	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$		P_{tot}	max.	250	mW
Junction temperature		T_j	max.	150	^oC
D.C. current gain $I_C = 10$ mA; $V_{CE} = 5$ V	PMBTA13	h_{FE}	min.	5000	
	PMBTA14	h_{FE}	min.	10 000	
Transition frequency at f = 100 MHz $I_C = 10$ mA; $V_{CE} = 5$ V		f_T	min.	125	MHz

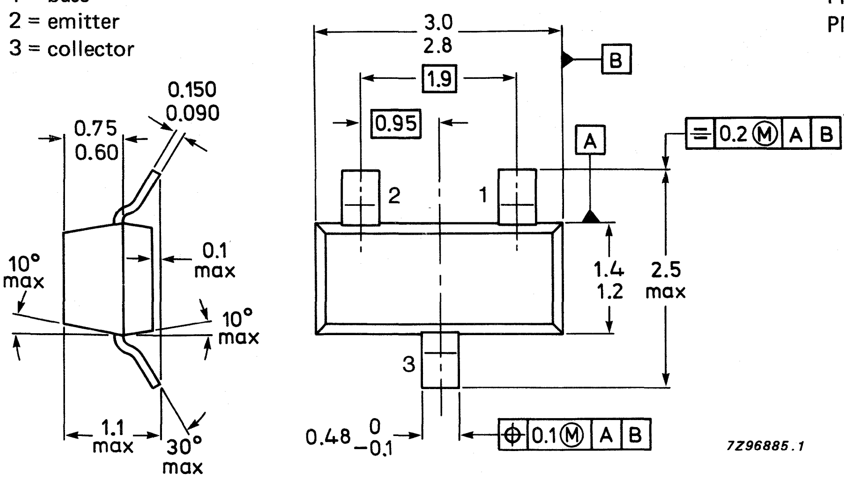
MECHANICAL DATA

Dimensions in mm

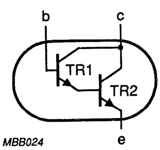
Fig. 1 SOT-23.

Pinning:
1 = base
2 = emitter
3 = collector

Marking code
PMBTA13: p1M
PMBTA14: p1N



TOP VIEW



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 °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 µA		$V_{(BR)CES}$	min.	30	V
Emitter-base cut-off current V_{BE} = 10 V		I_{EBO}	max.	0,1	µA
Collector-base cut-off current V_{CB} = 30 V		I_{CBO}	max.	0,1	µA
D.C. current gain I_C = 10 mA; V_{CE} = 5 V	PMBTA13	h_{FE}	min.	5000	
	PMBTA14	h_{FE}	min.	10 000	
I_C = 100 mA; V_{CE} = 5 V	PMBTA13	h_{FE}	min.	10 000	
	PMBTA14	h_{FE}	min.	20 000	
Collector-emitter saturation voltage I_C = 100 mA; I_B = 0,1 mA		V_{CEsat}	max.	1,5	V
Base-emitter ON-voltage I_C = 100 mA; V_{CE} = 5 V		$V_{BE(on)}$	max.	2,0	V
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 5 V		f_T	min.	125	MHz

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

SILICON EPITAXIAL TRANSISTORS

N-P-N transistors in a microminiature (SMD) plastic package 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 = 100 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

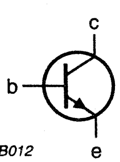
MECHANICAL DATA

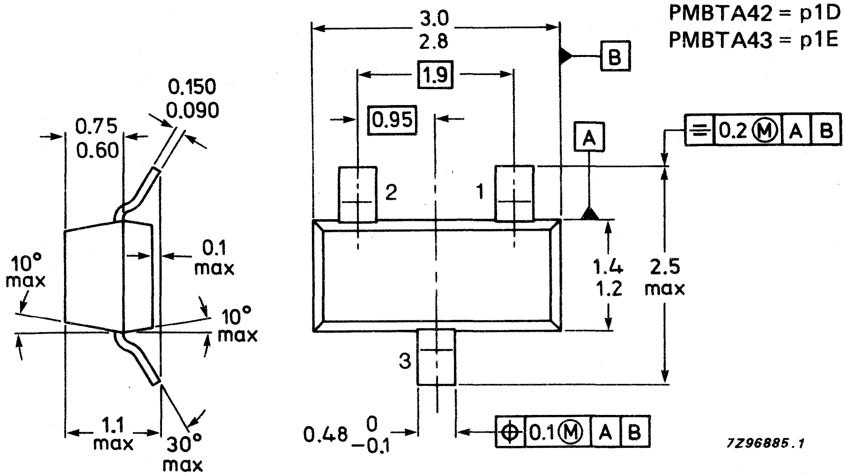
Dimensions in mm

Fig. 1 SOT-23.

Marking code
PMBTA42 = p1D
PMBTA43 = p1E

Pinning:
1 = base
2 = emitter
3 = collector





TOP VIEW

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	I_{CBO}	max.	—	0,1	μA
Emitter cut-off current I_C = 0; V_{BE} = 6 V	I_{EBO}	max.	0,1	—	μA
I_C = 0; V_{BE} = 4 V	I_{EBO}	max.	—	0,1	μA
Feedback capacitance at f = 1 MHz I_E = 0; V_{CB} = 20 V	C_{re}	max.	3	4	pF

Notes

1. Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 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

SILICON EPITAXIAL TRANSISTORS

P-N-P transistors in a microminiature (SMD) plastic package 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

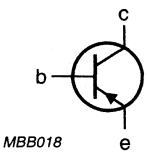
MECHANICAL DATA

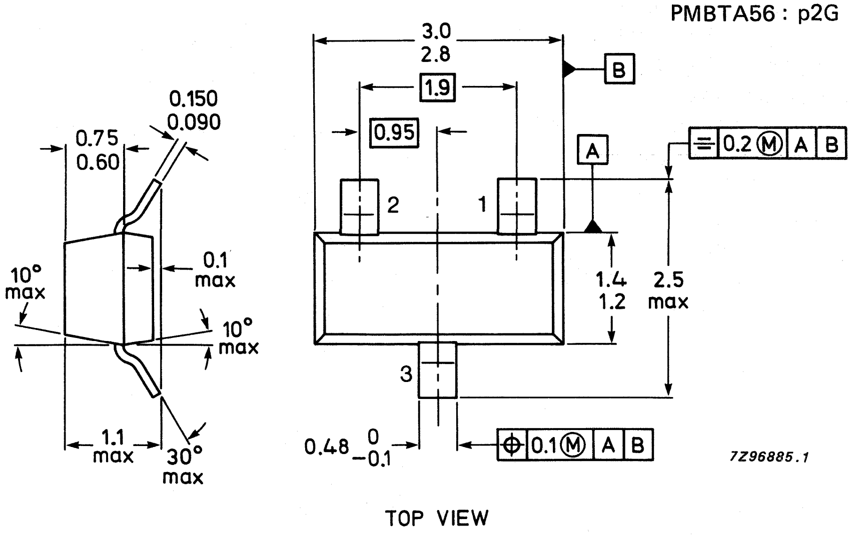
Fig. 1 SOT-23.

Dimensions in mm

Marking code
PMBTA55 : p2H
PMBTA56 : p2G

Pinning:
1 = base
2 = emitter
3 = collector





RATINGS

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

			PMBTA55	PMBTA56	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60	80	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	60	80	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	4		V
Collector current (d.c.)	$-I_C$	max.	500		mA
Total power dissipation * up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Storage temperature	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL CHARACTERISTICS**

$T_j = P\,(R_{th\,j\text{-}t} + R_{th\,t\text{-}s} + R_{th\,s\text{-}a}) + T_{amb}$

Thermal resistance from junction to ambient	$R_{th\,j\text{-}a}$	=	500	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			PMBTA55	PMBTA56	
Collector-emitter breakdown voltage▲ $-I_C$ = 1 mA; I_B = 0	$-V_{(BR)CEO}$	min.	60	80	V
Emitter-base breakdown voltage $-I_C$ = 0; I_E = 100 μA	$-V_{(BR)EBO}$	min.	4		V
Collector cut-off current $-V_{CE}$ = 60 V; I_B = 0	$-I_{CEO}$	max.	0,1		μA
Collector cut-off current $-V_{CB}$ = 60 V; I_E = 0	$-I_{CBO}$	max.	0,1		μA
$-V_{CB}$ = 80 V; I_E = 0	$-I_{CBO}$	max.	0,1		μA
Saturation voltages $-I_C$ = 100 mA; $-I_B$ = 10 mA	$-V_{CEsat}$	max.	0,25		V
Base-emitter on voltage $-I_C$ = 100 mA; $-V_{CE}$ = 1 V	$-V_{BE(on)}$	max.	1,2		V
D.C. current gain $-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	50		
$-I_C$ = 100 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	50		
Transition frequency at f = 100 MHz $-I_C$ = 100 mA; $-V_{CE}$ = 1 V	f_T	min.	50		MHz

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 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 package (SOT-23).
Designed primarily for preamplifier input applications requiring high input impedance.
N-P-N complement is the PMBTA13/14.

QUICK REFERENCE DATA

Collector-emitter voltage $V_{BE} = 0$		$-V_{CES}$	max.	30	V
Collector current (d.c.)		$-I_C$	max.	500	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$		P_{tot}	max.	250	mW
Junction temperature		T_j	max.	150	^oC
D.C. current gain $-I_C = 10$ mA; $-V_{CE} = 5$ V	PMBTA63	h_{FE}	min.	5000	
	PMBTA64	h_{FE}	min.	10 000	
Transition frequency at f = 100 MHz $-I_C = 10$ mA; $-V_{CE} = 50$ V		f_T	min.	125	MHz

MECHANICAL DATA

Dimensions in mm

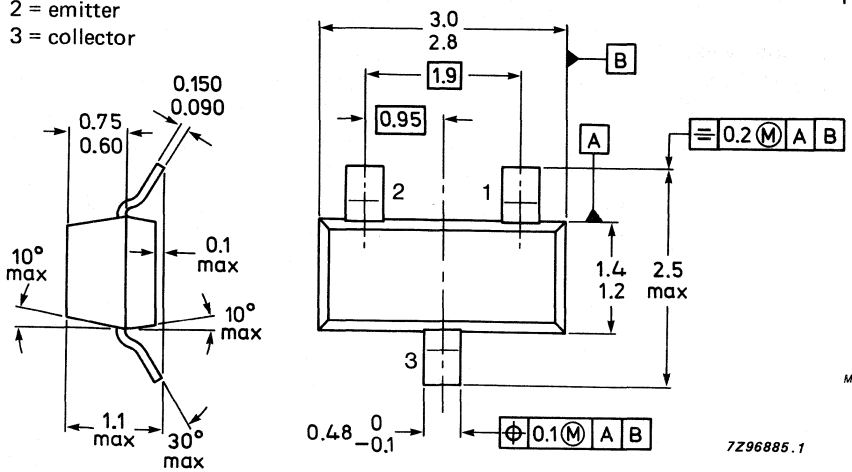
Fig. 1 SOT-23.

Pinning:

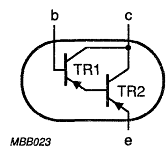
1 = base
2 = emitter
3 = collector

Marking code

PMBTA63: p2U
PMBTA64: p2V



TOP VIEW



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

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.

SILICON EPITAXIAL TRANSISTORS

P-N-P transistors in a microminiature (SMD) plastic package 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_c	max.	6	8	pF

MECHANICAL DATA

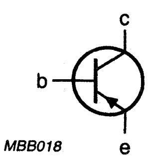
Dimensions in mm

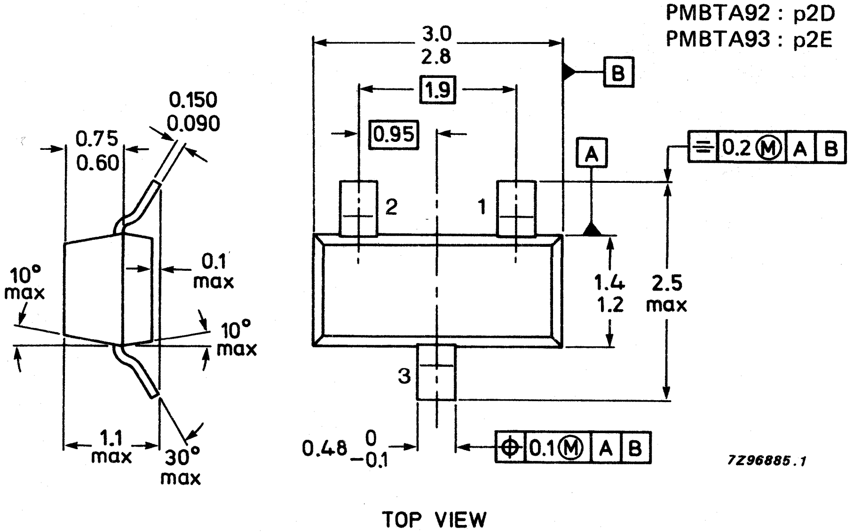
Fig. 1 SOT-23.

Marking code
PMBTA92 : p2D
PMBTA93 : p2E

Pinning:

1 = base
2 = emitter
3 = collector





RATINGS

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

			PMBTA92	PMBTA93	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	300	200	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	300	200	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5		V
Collector current (d.c.)	$-I_C$	max.	500		mA
Total power dissipation * up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Storage temperature	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL CHARACTERISTICS **

$T_j = P (R_{th\ j\text{-}t} + R_{th\ t\text{-}s} + R_{th\ s\text{-}a}) + T_{amb}$

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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			PMBTA92	PMBTA93	
Collector-emitter breakdown voltage $-I_C$ = 1 mA; I_B = 0	$-V_{(BR)CEO}$	min.	300	200	V
Collector-base breakdown voltage $-I_C$ = 100 μA; I_E = 0	$-V_{(BR)CBO}$	min.	300	200	V
Collector cut-off current $-V_{CB}$ = 200 V; I_E = 0	$-I_{CBO}$	max.	0,25	–	μA
$-V_{CB}$ = 160 V; I_E = 0	$-I_{CBO}$	max.	–	0,25	μA
Emitter-base breakdown voltage $-I_E$ = 100 μA; I_C = 0	$-V_{(BR)EBO}$	min.	5		V
Emitter cut-off current I_C = 0; $-V_{BE}$ = 3 V	$-I_{EBO}$	max.	0,1		μA
Collector-base capacitance at f = 1 MHz; I_E = 0; $-V_{CB}$ = 20 V	C_c	max.	6	8	pF
Saturation voltages $-I_C$ = 20 mA; $-I_B$ = 2 mA	$-V_{CEsat}$	max.	0,5		V
$-I_C$ = 20 mA; $-I_B$ = 2 mA	$-V_{BEsat}$	max.	0,9		V
D.C. current gain ▲ $-I_C$ = 1 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	25		
$-I_C$ = 10 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	40		
$-I_C$ = 30 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	25		

* Mounted on an FR4 printed-circuit board 8 mm x 10 mm x 0.7 mm.
** See Thermal characteristics.
▲ Pulse test conditions: t_p = 300 μs; duty cycle ≤ 2%.

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

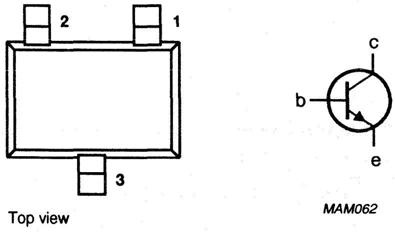


Fig.1 Simplified outline and symbol.

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.

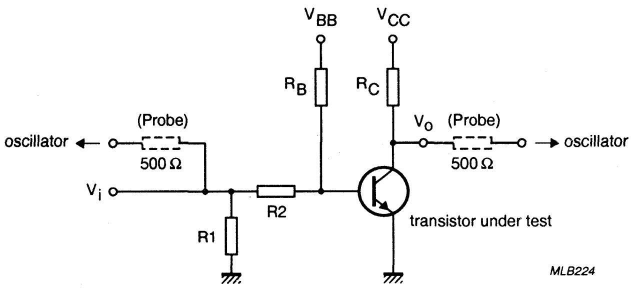
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter I_C = 10 μA; $I_E = I_e$ = 0	60	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base I_C = 1 mA; $I_B = I_b$ = 0; note 1	40	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector I_E = 10 μA; $I_C = I_c$ = 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 μA; V_{CE} = 5 V; R_S = 1 kΩ; f = 10 Hz to 15.7 kHz	–	5	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		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).

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

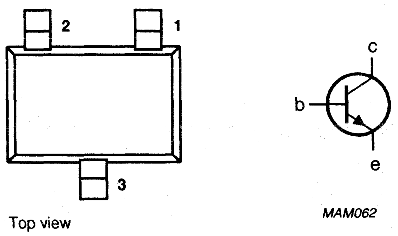


Fig.1 Simplified outline and symbol.

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.

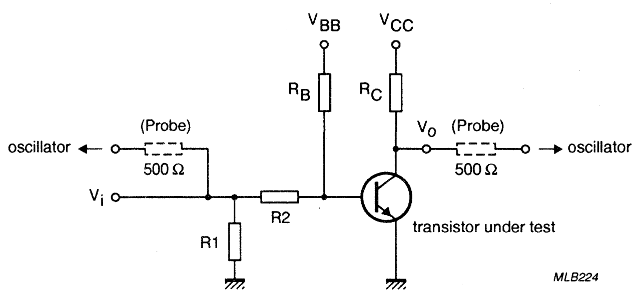
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter I_C = −10 µA; I_E = I_e = 0	−40	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base I_C = −1 mA; I_B = I_b = 0; note 1	−40	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector 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).

NPN switching transistor | PMST2369

FEATURES

- S-mini package
- High speed switching.

APPLICATIONS

It is intended for high speed switching applications.

MARKING

TYPE NUMBER	MARKING CODE
PMST2369	–1J

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

DESCRIPTION

NPN transistor in a plastic SOT323 (S-mini) package.

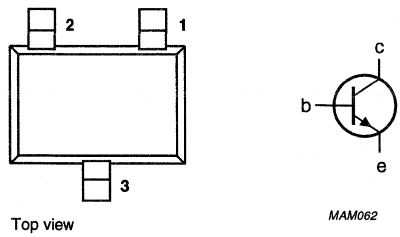


Fig.1 Simplified outline (SOT323) and symbol.

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	–	15	V
V_{CES}	collector-emitter voltage	base short-circuited to emitter	–	40	V
I_C	collector current (DC)		–	500	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	40	120	
		I_C = 100 mA; V_{CE} = 2 V	20	–	
t_s	storage time	I_{Con} = I_{Bon} = 10 mA; I_{Boff} = –10 mA	–	13	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	–	15	V
V_{CES}	collector-emitter voltage	base short-circuited to emitter	–	40	V
V_{EBO}	emitter-base voltage	open collector	–	4.5	V
I_C	collector current (DC)		–	500	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C; note 1	–	200	mW
T_{amb}	operating ambient temperature		–65	+150	°C
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air; note 1	625	K/W

Note to the "Limiting values" and "Thermal characteristics"

1. Refer to SOT323 standard mounting conditions.

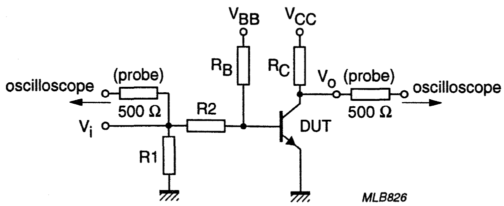
CHARACTERISTICS

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 = 0	40	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 10 mA; I_B = 0; note 1	15	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	base short-circuited to emitter; I_C = 10 μA; V_{BE} = 0	40	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 10 μA; I_C = 0	4.5	–	V
I_{CBO}	collector cut-off current	V_{CB} = 20 V; I_E = 0	–	400	nA
		V_{CB} = 20 V; I_E = 0; T_j = 150 °C	–	100	μA
I_{EBO}	emitter cut-off current	V_{EB} = 4.5 V; I_C = 0	–	10	μA
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA; I_B = 1 mA	–	250	mV
V_{BEsat}	base-emitter saturation voltage	I_C = 10 mA; I_B = 1 mA	700	850	mV
C_c	collector capacitance	V_{CB} = 5 V; $I_E = i_e$ = 0; f = 1 MHz	–	4	pF
h_{FE}	DC current gain	I_C = 10 mA; V_{CE} = 1 V	40	120	
		I_C = 100 mA; V_{CE} = 2 V; note 1	20	–	
		I_C = 10 mA; V_{CE} = 1 V; T_{amb} = −55 °C	20	–	
Switching times					
t_s	storage time	$I_{Con} = I_{Bon}$ = 10 mA; I_{Boff} = −10 mA; see Fig.2	–	13	ns
t_{on}	turn-on time	I_{Con} = 10 mA; I_{Bon} = 3 mA; V_{CC} = 3 V; see Fig.2	–	12	ns
t_{off}	turn-off time	I_{Con} = 10 mA; I_{Bon} = 3 mA; I_{Boff} = −1.5 mA; V_{CC} = 3 V; see Fig.2	–	18	ns

Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.02$.



V_i = −0.5 V; $t_p \geq$ 1μs; $t_r \leq$ 3 ns;
R1 = 56 Ω; R2 = 1 kΩ; R_B = 1 kΩ; R_C = 270 Ω.

Fig.2 Test circuit for switching times.

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

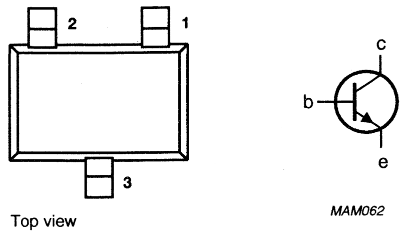


Fig.1 Simplified outline and symbol.

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.

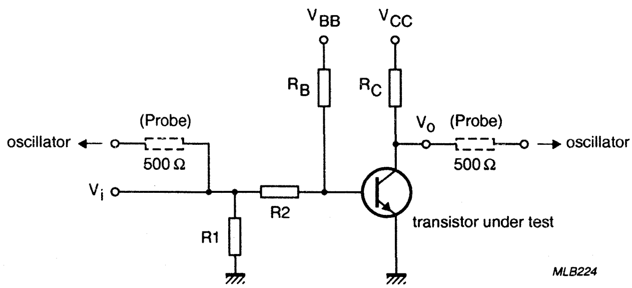
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter I_C = 10 μA; $I_E = I_e$ = 0	60	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base I_C = 1 mA; $I_B = I_b$ = 0; note 1	40	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector I_E = 10 μA; $I_C = I_c$ = 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 μA; V_{CE} = 5 V; R_S = 1 kΩ; f = 10 Hz to 15.7 kHz	–	5	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		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).

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

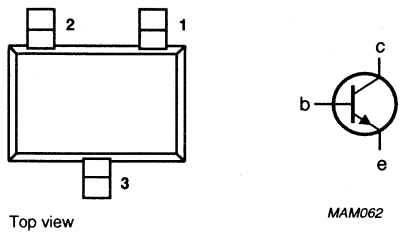


Fig.1 Simplified outline and symbol.

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.

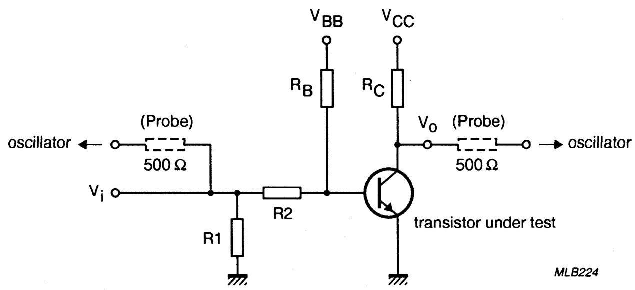
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter $I_C = -10\ \mu A$; $I_E = I_e = 0$	−40	−	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base $I_C = -1$ mA; $I_B = I_b = 0$; note 1	−40	−	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open 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 kΩ; 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).

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

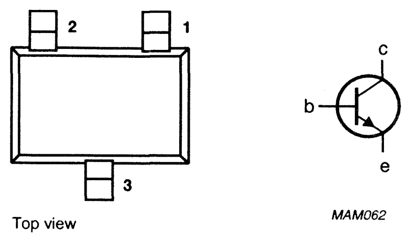


Fig.1 Simplified outline and symbol.

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.

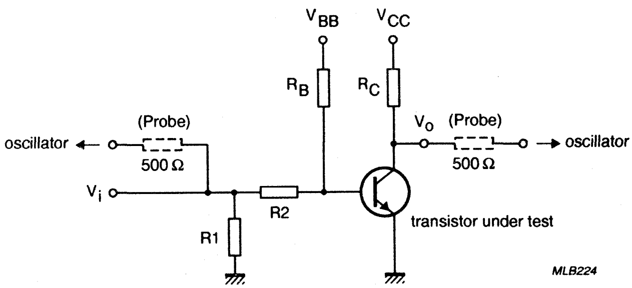
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter I_C = 100 μA; $I_E = I_e$ = 0	60	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base I_C = 1 mA; $I_B = I_b$ = 0; note 1	40	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector I_E = 100 μA; $I_C = I_c$ = 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: $t_p \leq 300$ 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).

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

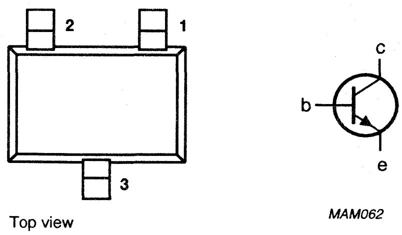


Fig.1 Simplified outline and symbol.

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.

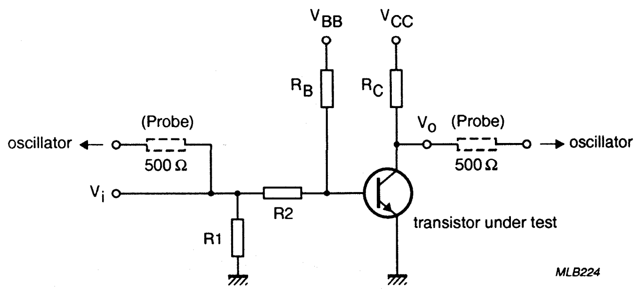
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter I_C = −100 μA; I_E = I_e = 0	−	−40	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base I_C = −1 mA; I_B = I_b = 0; note 1	−	−40	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector 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).

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

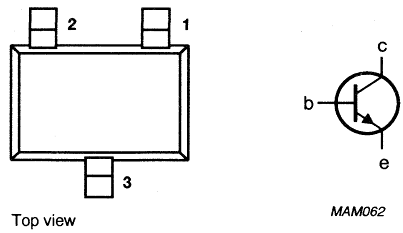


Fig.1 Simplified outline and symbol.

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; $\delta \leq 0.02$.

PNP high voltage transistor PMST5401

FEATURES

- S-mini package
- High voltage.

APPLICATIONS

General purposes and especially intended for telephony applications.

MARKING

TYPE NUMBER	MARKING CODE
PMST5401	–2L

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

DESCRIPTION

PNP high-voltage small-signal transistor in a plastic SOT323 (S-mini) package.

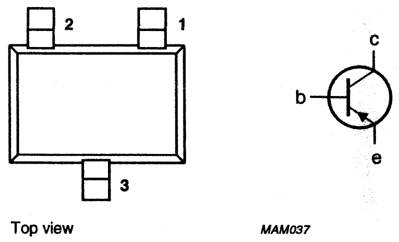


Fig.1 Simplified outline (SOT323) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–160	V
V_{CEO}	collector-emitter voltage	open base	–	–150	V
I_C	collector current (DC)		–	–500	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} = –5 V	60	240	
V_{CEsat}	collector-emitter saturation voltage	I_C = –50 mA; I_B = –5 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	–	–160	V
V_{CEO}	collector-emitter voltage	open base	–	–150	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–500	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C; note 1	–	200	mW
T_{amb}	operating ambient temperature		–65	+150	°C
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j-a}$	thermal resistance from junction to ambient	in free air; note 1	625	K/W

Note to the "Limiting values" and "Thermal characteristics"

1. Refer to SOT323 standard mounting conditions.

PNP high voltage transistor PMST5401

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	−160	−	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = −1 mA; I_B = 0; note 1	−150	−	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = −10 μA; I_C = i_c = 0	−5	−	V
I_{CBO}	collector cut-off current	V_{CB} = −120 V; I_E = 0	−	−50	nA
		V_{CB} = −120 V; I_E = 0; T_j = 150 °C	−	−50	μA
I_{EBO}	emitter cut-off current	V_{EB} = −4 V; I_C = 0	−	−50	nA
V_{CEsat}	collector-emitter saturation voltage	I_C = −10 mA; I_B = −1 mA	−	−200	mV
		I_C = −50 mA; I_B = −5 mA; note 1	−	−500	mV
V_{BEsat}	base-emitter saturation voltage	I_C = −10 mA; I_B = −1 mA	−	−1 000	mV
		I_C = −50 mA; I_B = −5 mA; note 1	−	−1 000	mV
C_c	collector capacitance	V_{CB} = −10 V; I_E = i_e = 0; f = 1 MHz	−	6	pF
f_T	transition frequency	I_C = −10 mA; V_{CE} = −10 V; f = 100 MHz	100	300	MHz
h_{FE}	DC current gain	I_C = −1 mA; V_{CE} = −5 V	50	−	
		I_C = −10 mA; V_{CE} = −5 V	60	240	
		I_C = −50 mA; V_{CE} = −5 V; note 1	50	−	
F	noise figure	I_C = −200 μA; V_{CE} = −5 V; f = 10 Hz to 15.7 kHz; R_s = 10 Ω	−	8	dB

Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.02$.

NPN high voltage transistors PMST5550; PMST5551

FEATURES

- S-mini package
- High voltage.

APPLICATIONS

General purposes and telephony applications.

DESCRIPTION

NPN high-voltage small-signal transistor in a plastic SOT323 (S-mini) package.

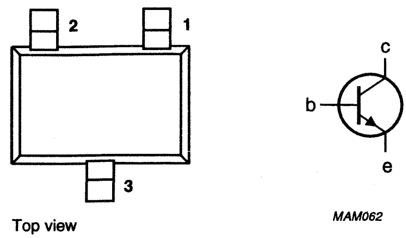


Fig.1 Simplified outline (SOT323) and symbol.

MARKING

TYPE NUMBER	MARKING CODE
PMST5550	–1F
PMST5551	–G1

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PMST5550		–	160	V
	PMST5551		–	180	V
V_{CEO}	collector-emitter voltage	open base			
	PMST5550		–	140	V
	PMST5551		–	160	V
I_C	collector current (DC)		–	600	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	200	mW
V_{CEsat}	collector-emitter saturation voltage	I_C = 50 mA; I_B = 5 mA			
	PMST5550		–	250	mV
	PMST5551		–	200	mV
h_{FE}	DC current gain	I_C = 10 mA; V_{CE} = 5 V			
	PMST5550		60	250	
	PMST5551		80	250	

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			
	PMST5550		–	160	V
	PMST5551		–	180	V
V_{CEO}	collector-emitter voltage	open base			
	PMST5550		–	140	V
	PMST5551		–	160	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	600	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C; note 1	–	200	mW
T_{amb}	operating ambient temperature		–65	+150	°C
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air; note 1	625	K/W

Note to the “Limiting values” and “Thermal characteristics”

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 = 0			
	PMST5550		160	–	V
	PMST5551		180	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 1 mA; I_B = 0; note 1			
	PMST5550		140	–	V
	PMST5551		160	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 10 μA; I_C = 0	6	–	V
I_{CBO}	collector cut-off current				
	PMST5550	V_{CB} = 100 V; I_E = 0	–	100	nA
		V_{CB} = 100 V; I_E = 0; T_{amb} = 100 °C	–	100	μA
I_{CBO}	collector cut-off current				
	PMST5551	V_{CB} = 120 V; I_E = 0	–	50	nA
		V_{CB} = 120 V; I_E = 0; T_{amb} = 100 °C	–	50	μA
I_{EBO}	emitter cut-off current	V_{EB} = 4 V; I_C = 0	–	50	nA
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA; I_B = 1 mA	–	150	mV
V_{CEsat}	collector-emitter saturation voltage	I_C = 50 mA; I_B = 5 mA; note 1			
	PMST5550		–	250	mV
	PMST5551		–	200	mV
V_{BEsat}	base-emitter saturation voltage	I_C = 10 mA; I_B = 1 mA	–	1000	mV
V_{BEsat}	base-emitter saturation voltage	I_C = 50 mA; I_B = 5 mA; note 1			
	PMST5550		–	1200	mV
	PMST5551		–	1000	mV
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = 10 V; f = 1 MHz	–	6	pF
C_e	emitter capacitance	I_C = i_c = 0; V_{EB} = 0.5 V; f = 1 MHz	–	30	pF
f_T	transition frequency	I_C = 10 mA; V_{CE} = 10 V; f = 100 MHz	100	300	MHz
h_{FE}	DC current gain				
	PMST5550	I_C = 1 mA; V_{CE} = 5 V	60	–	
		I_C = 10 mA; V_{CE} = 5 V	60	250	
		I_C = 50 mA; V_{CE} = 5 V; note 1	20	–	
h_{FE}	DC current gain				
	PMST5551	I_C = 1 mA; V_{CE} = 5 V	80	–	
		I_C = 10 mA; V_{CE} = 5 V	80	250	
		I_C = 50 mA; V_{CE} = 5 V; note 1	30	–	
F	noise figure				
	PMST5551	I_C = 250 μA; V_{CE} = 5 V; f = 10 Hz to 15.7 kHz; R_s = 1 kΩ	–	8	dB

Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.02$.

NPN amplifier transistors PMST6428; PMST6429

FEATURES

- S-mini package.

APPLICATIONS

Primarily intended for use in telephony and professional communication equipment.

DESCRIPTION

NPN transistors in a plastic SOT323 (S-mini) package.

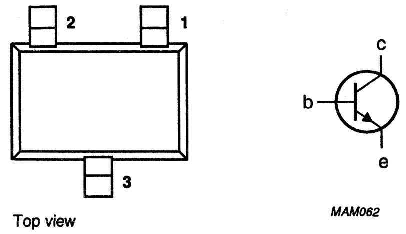


Fig.1 Simplified outline (SOT323) and symbol.

MARKING

TYPE NUMBER	MARKING CODE
PMST6428	–1K
PMST6429	–1L

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PMST6428		–	60	V
	PMST6429		–	55	V
V_{CEO}	collector-emitter voltage	open base			
	PMST6428		–	50	V
	PMST6429		–	45	V
I_C	collector current (DC)		–	200	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	200	mW
h_{FE}	DC current gain				
	PMST6428	I_C = 0.1 mA; V_{CE} = 5 V	250	650	
		I_C = 1.0 mA; V_{CE} = 5 V	250	–	
h_{FE}	DC current gain				
	PMST6429	I_C = 0.1 mA; V_{CE} = 5 V	500	1250	
		I_C = 1.0 mA; V_{CE} = 5 V	500	–	
f_T	transition frequency	I_C = 1.0 mA; V_{CE} = 5 V; f = 100 MHz	100	700	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			
	PMST6428		–	60	V
	PMST6429		–	55	V
V_{CEO}	collector-emitter voltage	open base			
	PMST6428		–	50	V
	PMST6429		–	45	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	200	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C; note 1	–	200	mW
T_{amb}	operating ambient temperature		–65	+150	°C
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air; note 1	625	K/W

Note to the "Limiting values" and "Thermal characteristics"

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 = 0			
	PMST6428		60	–	V
	PMST6429		55	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 1 mA; I_B = 0; note 1			
	PMST6428		50	–	V
	PMST6429		45	–	V
I_{CBO}	collector cut-off current	V_{CB} = 30 V; I_E = 0	–	10	nA
		V_{CB} = 30 V; I_E = 0; T_j = 150 °C	–	10	μA
I_{CEO}	collector cut-off current	V_{CE} = 30 V; I_B = 0	–	100	nA
I_{EBO}	emitter cut-off current	V_{EB} = 5 V; I_C = 0	–	10	nA
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA; I_B = 0.5 mA; note 1	–	200	mV
		I_C = 100 mA; I_B = 5 mA; note 1	–	600	mV
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 10 V; f = 1 MHz	–	3	pF
h_{FE}	DC current gain				
	PMST6428	I_C = 0.01 mA; V_{CE} = 5 V	250	–	
		I_C = 0.1 mA; V_{CE} = 5 V	250	650	
		I_C = 1.0 mA; V_{CE} = 5 V	250	–	
		I_C = 10 mA; V_{CE} = 5 V	250	–	
h_{FE}	DC current gain				
	PMST6429	I_C = 0.01 mA; V_{CE} = 5 V	500	–	
		I_C = 0.1 mA; V_{CE} = 5 V	500	1250	
		I_C = 1.0 mA; V_{CE} = 5 V	500	–	
		I_C = 10 mA; V_{CE} = 5 V	500	–	
f_T	transition frequency	I_C = 1.0 mA; V_{CE} = 5 V; f = 100 MHz	100	700	MHz

Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.02$.

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N silicon planar epitaxial transistors in a plastic TO-92 package primarily intended for linear and switching applications.

P-N-P complement is PN2907/2907A.

QUICK REFERENCE DATA

			PN2222	PN2222A	
Collector-emitter voltage (open base)	V_{CEO}	max.	30	40	V
Collector-base voltage (open emitter)	V_{CBO}	max.	60	75	V
Collector current (d.c.)	I_C	max.	500		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	625		mW
Collector-emitter saturation voltage I_C = 150 mA; I_B = 15 mA	V_{CEsat}	max.	0,4	0,3	V
D.C. current gain I_C = 150 mA; V_{CE} = 10 V	h_{FE}	min.	100		
		max.	300		

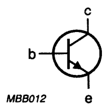
MECHANICAL DATA

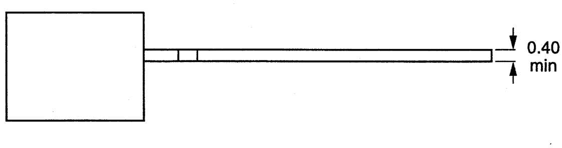
Dimensions in mm

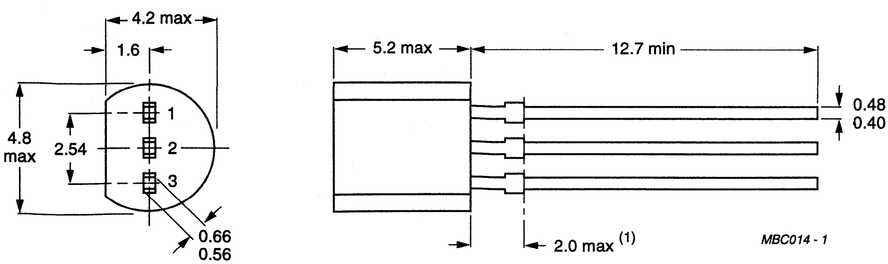
Fig. 1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			PN2222	PN2222A	
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 (d.c.)	I_C	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500		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	$R_{th\ j\text{-}a}$	=	250	K/W

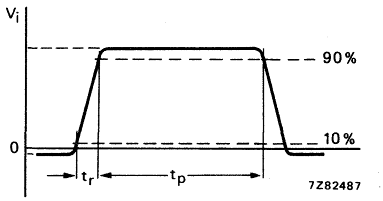
CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			PN2222	PN2222A	
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}	max.	—	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

			PN2222		PN2222A	
D.C. 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. max.		100 300		
I_C = 150 mA; V_{CE} = 1 V	h_{FE}	min.	30	50	–	
I_C = 500 mA; V_{CE} = 10 V	h_{FE}	min.	30		40	
Saturation voltages						
I_C = 150 mA; I_B = 15 mA	V_{CEsat}	max.	0,4		0,3	V
I_C = 500 mA; I_B = 50 mA	V_{CEsat}	min.	1,6		1,0	V
I_C = 150 mA; I_B = 15 mA	V_{BEsat}	max.	1,3		–	V
I_C = 150 mA; I_B = 15 mA	V_{BEsat}	min. max.			0,6 1,2	V V
I_C = 500 mA; I_B = 50 mA	V_{BEsat}	max.	2,6		2,0	V
Transition frequency at f = 100 MHz						
I_C = 20 mA; V_{CE} = 20 V ; T_{amb} = 25 °C	f_T	min.	250		300	MHz
Output capacitance at f = 1 MHz						
I_E = 0; V_{CB} = 10 V	C_c	max.		8,0		pF
Input capacitance at f = 1 MHz						
I_C = 0; V_{EB} = 0,5 V	C_e	max.	30		25	pF

			PN2222	PN2222A
Noise figure at R_S = 1 kΩ I_C = 100 μA; V_{CE} = 10 V; f = 1 kHz; T_{amb} = 25 °C	F	max.	—	4,0 dB
Switching times at T_{amb} = 25 °C				
Turn-on time (see Fig. 2) I_C = 150 mA; I_{Bon} = 15 mA V_{CC} = 30 V; $V_{EB(off)}$ = 0,5 V				
delay time	t_d	max.	—	10 ns
rise time	t_r	max.	—	25 ns
Turn-off time (see Fig. 3) I_C = 150 mA; I_{Bon} = I_{Boff} = 15 mA V_{CC} = 30 V				
storage time	t_s	max.	—	225 ns
fall time	t_f	max.	—	60 ns



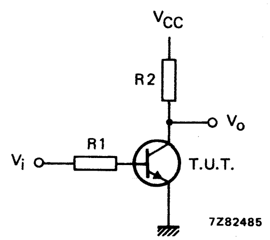
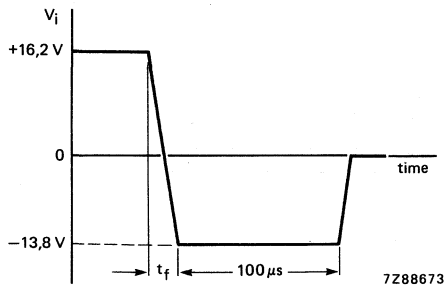


Fig. 2 Input waveform and test circuit for determining delay time and rise time.

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

Pulse generator:			Oscilloscope:		
pulse duration	t_p	⩽ 200 ns	input impedance	Z_i	> 100 kΩ
rise time	t_r	⩽ 2 ns	input capacitance	C_i	< 12 pF
duty factor	δ	= 0,02	rise time	t_r	< 5 ns



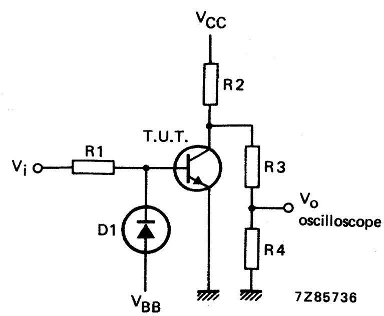


Fig. 3 Input waveform and test circuit for determining storage time and fall time.

SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N silicon planar epitaxial transistor in plastic TO-92 package intended for switching applications.

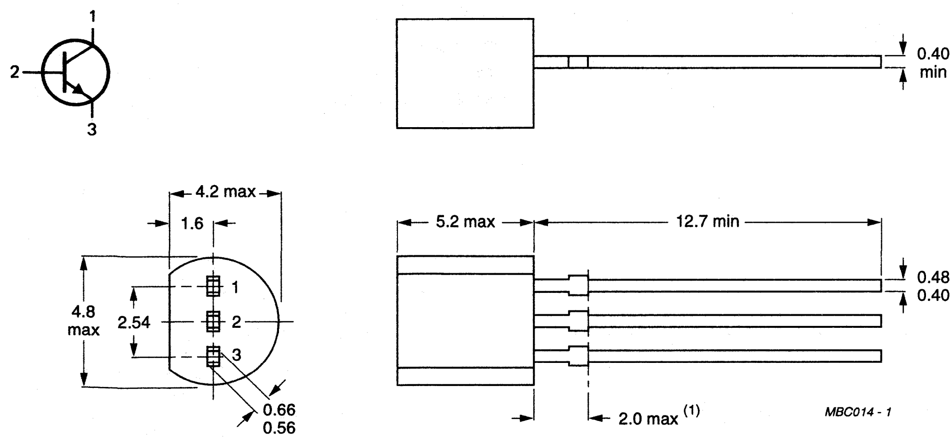
QUICK REFERENCE DATA

Collector-emitter voltage (open base)		V_{CEO}	max.	15	V
Collector-base voltage (open emitter)		V_{CBO}	max.	40	V
Collector current (peak value)		I_C	max.	500	mA
Total device dissipation up to T_{amb} = 25 °C		P_{tot}	max.	500	mW
Collector-emitter saturation voltage					
I_C = 10 mA; I_B = 1 mA	PN2369	V_{CEsat}	max.	0,25	V
I_C = 10 mA; I_B = 1 mA	PN2369A	V_{CEsat}	max.	0,20	V
D.C. current gain					
I_C = 10 mA; V_{CE} = 1 V	PN2369	h_{FE}	min.	40	
			max.	120	
I_C = 10 mA; V_{CE} = 0,35 V	PN2369A	h_{FE}	min.	40	
			max.	120	

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92.



Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

Collector-emitter voltage (open base)	V_{CEO}	max.	15	V
Collector-base voltage (open emitter)	V_{CBO}	max.	40	V
Emitter-base voltage (open collector)	V_{EBO}	max.	4,5	V
Collector current (peak value, t_p = 10 μS)	I_C	max.	500	mA
Total device dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	mW
Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	250	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector-emitter breakdown voltage I_B = 0; I_C = 10 mA		$V_{(BR)CEO}$	min.	15	V
Collector-emitter breakdown voltage I_B = 10 μA; V_{BE} = 0		$V_{(BR)CES}$	min.	40	V
Collector-base breakdown voltage I_E = 0; I_C = 10 μA		$V_{(BR)CBO}$	min.	40	V
Emitter-base breakdown voltage I_E = 10 μA; I_C = 0		$V_{(BR)EBO}$	min.	4,5	V
Collector cut-off current					
V_{CB} = 20 V; I_E = 0		I_{CBO}	max.	0,4	μA
V_{CB} = 20 V; I_E = 0; T_A = 125 °C		I_{CBO}	max.	30	μA
D.C. current gain					
I_C = 10 mA; V_{CE} = 1 V	PN2369	h_{FE}	min.	40	
			max.	120	
I_C = 10 mA; V_{CE} = 1 V; T_{amb} = −55 °C		h_{FE}	min.	20	
I_C = 100 mA; V_{CE} = 2 V		h_{FE}	min.	20	
I_C = 10 mA; V_{CE} = 0,35 V	PN2369A	h_{FE}	min.	40	
			max.	120	
I_C = 30 mA; V_{CE} = 0,40 V		h_{FE}	$>$	30	
I_C = 100 mA; V_{CE} = 1,0 V		h_{FE}	$>$	20	
I_C = 10 mA; V_{CE} = 0,35 V; T_{amb} = −55 °C		h_{FE}	$>$	20	

Saturation voltages				
I_C = 10 mA; I_B = 1 mA	PN2369	V_{CEsat}	max.	0,25 V
I_C = 10 mA; I_B = 1 mA		V_{BEsat}	min. max.	0,70 V 0,85 V
I_C = 10 mA; I_B = 1 mA	PN2369A	V_{CEsat}	$<$	0,20 V
I_C = 30 mA; I_B = 3 mA		V_{CEsat}	$<$	0,25 V
I_C = 100 mA; I_B = 10 mA		V_{CEsat}	$<$	0,50 V
I_C = 10 mA; I_B = 10 mA		V_{CEsat}	$<$	0,30 V
I_C = 10 mA; I_B = 1 mA		V_{BEsat}	min. max.	0,70 V 0,85 V
Output capacitance at f = 1 MHz I_E = 0; V_{CB} = 5 V		C_c	max.	4 pF
Small-signal current gain at f = 100 MHz I_C = 10 mA; V_{CE} = 10 V; T_{amb} = 25 °C		h_{fe}	min.	5

Switching times

Storage time (see Fig. 2) I_{Bon} = I_{Boff} = I_C = 10 mA; T_{amb} = 25 °C	t_s	typ. max.	5 ns 13 ns
Turn-on time (see Fig. 3) I_C = 10 mA; V_{CC} = 3 V; I_{Bon} = 3 mA; T_{amb} = 25 °C	t_{on}	typ. max.	8 ns 12 ns
Turn-off time (see Fig. 3) I_C = 10 mA; V_{CC} = 3 V; I_{Bon} = 3 mA; I_{Boff} = 1,5 mA; T_{amb} = 25 °C	t_{off}	typ. max.	10 ns 18 ns

Pulse generator:

t_r < 1 ns
t_p > 300 ns
δ < 0,02
R_s = 50 Ω

Oscilloscope:

R_i = 50 Ω
t_r < 1 ns

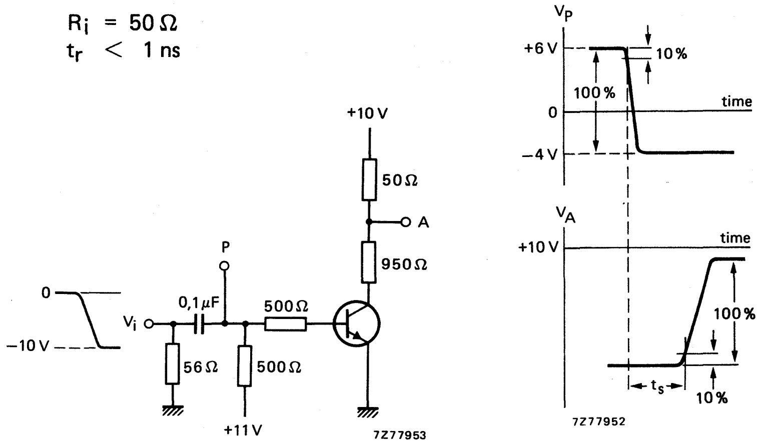


Fig. 2 Test circuit and waveforms.

Pulse generator:

t_r < 1 ns
t_p > 300 ns
δ < 0,02
R_s = 50 Ω

Oscilloscope:

R_i = 50 Ω
t_r < 1 ns

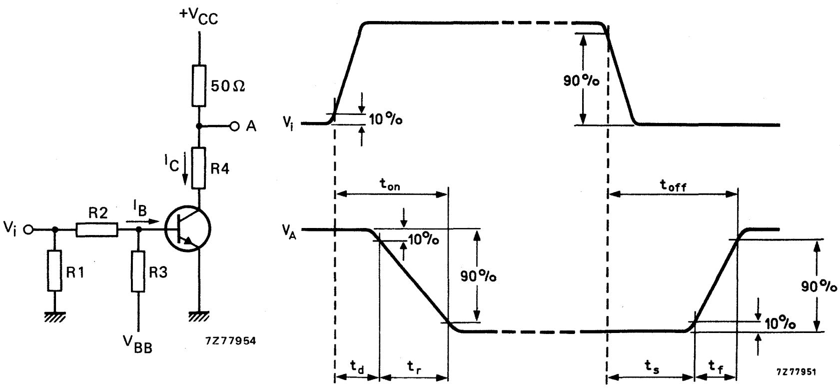


Fig. 3 Test circuit and waveforms.

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P silicon planar epitaxial transistors in plastic TO-92 package for general purpose applications.
N-P-N complement is PN2222/A.

QUICK REFERENCE DATA

			PN2907	PN2907A	
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40	60	V
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60		V
Collector current (d.c.)	$-I_C$	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500		mW
Collector-emitter saturation voltage $-I_C$ = 150 mA; $-I_B$ = 15 mA	$-V_{CEsat}$	max.	0,4		V
D.C. current gain $-I_C$ = 150 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	100		
		max.	300		

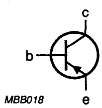
MECHANICAL DATA

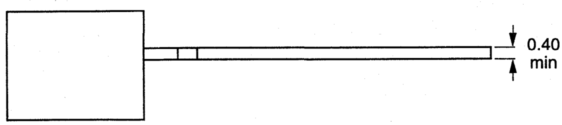
Dimensions in mm

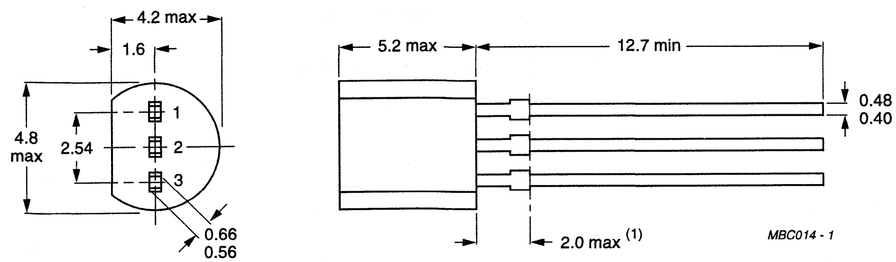
Fig. 1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			PN2907	PN2907A	
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 (d.c.)	$-I_C$	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500		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	$R_{th\ j\text{-}a}$	=	250	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			PN2907	PN2907A	
Collector-emitter breakdown voltage I_B = 0; $-I_C$ = 10 mA	$-V_{(BR)CEO}$	min.	40	60	V
Collector-base breakdown voltage I_E = 0; $-I_C$ = 10 μA	$-V_{(BR)CBO}$	min.	60		V
Emitter-base breakdown voltage $-I_E$ = 10 μA; I_C = 0	$-V_{(BR)EBO}$	min.	5,0		V
Base cut-off current $-V_{CE}$ = 30 V; $-V_{BE}$ = 0,5 V	$-I_{BEX}$	max.	50		nA
Collector cut-off current $-V_{CE}$ = 30 V; $-V_{BE}$ = 0,5 V	$-I_{CEX}$	max.	50		nA
Collector cut-off current I_E = 0; V_{CB} = 50 V	$-I_{CBO}$	max.	20	10	nA
I_E = 0; V_{CB} = 50 V; T_{amb} = 125 °C	$-I_{CBO}$	max.	20	10	μA
D.C. current gain $-I_C$ = 0,1 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	35	75	
$-I_C$ = 1,0 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	50	100	
$-I_C$ = 10 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	75	100	
$-I_C$ = 150 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	100	100	
		max.	300	300	
$-I_C$ = 500 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	30	50	

			PN2907 | PN2907A	
Saturation voltages				
$-I_C$ = 150 mA; $-I_B$ = 15 mA	$-V_{CEsat}$	max.	0,4	V
$-I_C$ = 500 mA; $-I_B$ = 50 mA	$-V_{CEsat}$	max.	1,6	V
$-I_C$ = 150 mA; $-I_B$ = 15 mA	$-V_{BEsat}$	max.	1,3	V
$-I_C$ = 150 mA; $-I_B$ = 50 mA	$-V_{BEsat}$	max.	2,6	V
Transition frequency at f = 100 MHz				
$-I_C$ = 50 mA; $-V_{CE}$ = 20 V; T_{amb} = 25 °C	f_T	min.	200	MHz
Output capacitance at f = 1 MHz				
I_E = 0; $-V_{CB}$ = 10 V; T_{amb} = 25 °C	C_c	max.	8,0	pF
Input capacitance at f = 1 MHz				
I_C = 0; $-V_{EB}$ = 2,0 V; T_{amb} = 25 °C	C_e	max.	30	pF

Switching times

Turn-on time (see Fig. 2)				
$-I_C$ = 150 mA; $-I_{Bon}$ = 15 mA; $-V_{CC}$ = 30 V	t_{on}	max.	45	ns
delay time	t_d	max.	10	ns
rise time	t_r	max.	40	ns
Turn-off time (see Fig. 3)				
$-I_C$ = 150 mA; $-I_{Bon}$ = I_{Boff} = 15 mA; $-V_{CC}$ = 6,0 V	t_{off}	max.	100	ns
storage time	t_s	max.	80	ns
fall time	t_f	max.	30	ns

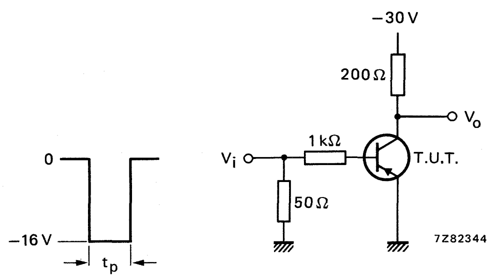


Fig. 2 Input waveform and test circuit for determining delay, rise and turn-on time.

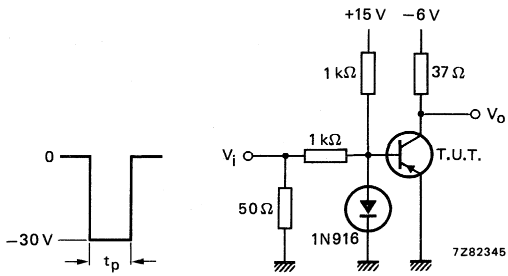


Fig. 3 Input waveform and test circuit for determining storage, fall and turn-off time.

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 N-P-N HIGH-VOLTAGE TRANSISTORS

N-P-N high-voltage small-signal transistors in a TO-92 package and intended for use in telephony and professional communication equipment.

Complementary type is PN5415/5416.

QUICK REFERENCE DATA

			PN3439	PN3440	
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.	0,6	0,6	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	500	mW
Junction temperature	T_j	max.	150	150	°C
Collector-emitter saturation voltage I_C = 50 mA; I_B = 4 mA	V_{CEsat}	$<$	0,5	0,5	V
D.C. current gain I_C = 2 mA; V_{CE} = 10 V	h_{FE}	$>$	30		
I_C = 20 mA; V_{CE} = 10 V	h_{FE}	$>$		40	

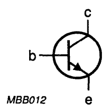
MECHANICAL DATA

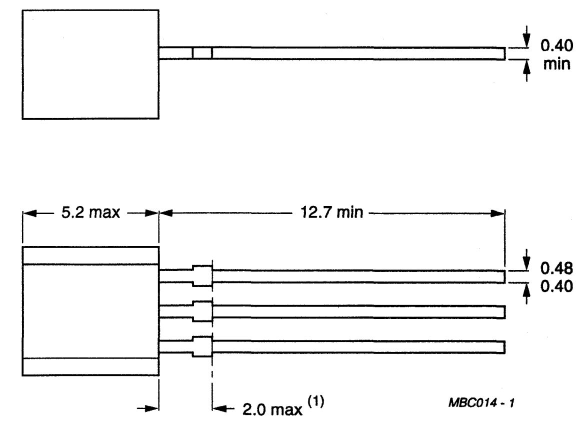
Dimensions in mm

Fig. 1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter





Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			PN3439	PN3440	
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.	5,0		V
Collector current (d.c.)	I_C	max.	0,6		A
Base current	I_B	max.	0,5		A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500		mW
Junction temperature	T_j	max.	150		°C
Storage temperature range	T_{stg}		−65 to 150		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	250	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			PN3439	PN3440	
Collector cut-off currents					
$I_E = 0$; V_{CB} = 360 V	I_{CBO}	<	0,1		μA
$I_E = 0$; V_{CB} = 250 V	I_{CBO}	<		0,1	μA
$I_B = 0$; V_{CE} = 300 V	I_{CEO}	<	1,0		μA
$I_B = 0$; V_{CE} = 200 V	I_{CEO}	<		1,0	μA
Emitter cut-off current $I_C = 0$; V_{EB} = 5 V	I_{EBO}	<	10	10	μA
Collector-emitter sustaining voltage $I_B = 0$; I_C = 50 mA	V_{CEOsus}	>	350	250	V
Saturation voltages I_C = 50 mA; I_B = 4 mA	V_{CEsat}	<	0,5	0,5	V
	V_{BEsat}	<	1,3	1,3	V
D.C. current gain					
I_C = 2 mA; V_{CE} = 10 V	h_{FE}	>	30		
I_C = 20 mA; V_{CE} = 10 V	h_{FE}	>		40	
Transition frequency at f = 5 MHz I_C = 10 mA; V_{CE} = 10 V; T_{amb} = 25 °C	f_T	>	70		MHz
Small-signal current gain at f = 1 kHz I_C = 5 mA; V_{CE} = 10 V; T_{amb} = 25 °C	h_{fe}	>	25		
Real part (Re) of input impedance (h_{ie}) V_{CE} = 10 V; I_C = 5 mA; f = 1 MHz; T_{amb} = 25 °C	$Re(h_{ie})$	<	300		Ω
Input capacitance at f = 1 MHz $I_C = 0$; V_{EB} = 5 V; T_{amb} = 25 °C	C_e	<	20		pF
Output capacitance at f = 1 MHz $I_E = 0$; V_{CB} = 10 V; T_{amb} = 25 °C	C_c	<	2,0		pF

SILICON P-N-P HIGH-VOLTAGE TRANSISTORS

P-N-P high-voltage small-signal transistors in a TO-92 package and intended for use in telephony and professional communication equipment.

Complementary type is PN3439/3440.

QUICK REFERENCE DATA

			PN5415	PN5416	
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.	0,5	0,5	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	500	mW
Junction temperature	T_j	max.	150	150	°C
Collector-emitter saturation voltage $-I_C$ = 50 mA; $-I_B$ = 5 mA	$-V_{CEsat}$	<	0,8	0,8	V
D.C. current gain $-I_C$ = 50 mA; $-V_{CE}$ = 10 V	h_{FE}	>	30	30	
		<	150	120	

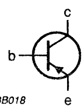
MECHANICAL DATA

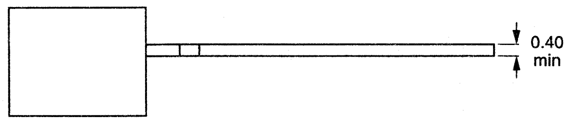
Dimensions in mm

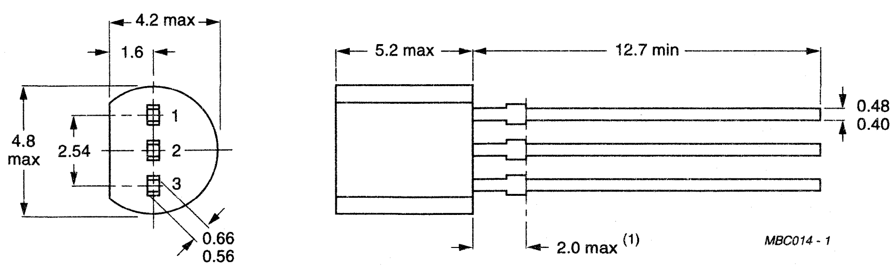
Fig. 1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			PN5415	PN5416	
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.	4,0	6,0	V
Collector current (d.c.)	$-I_C$	max.	0,5		A
Base current	$-I_B$	max.	0,5		A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500		mW
Junction temperature	T_j	max.	150		°C
Storage temperature range	T_{stg}		−65 to 150		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	250	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			PN5415	PN5416	
Collector cut-off currents					
$I_E = 0$; $-V_{CB}$ = 175 V	$-I_{CBO}$	<	0,1		μA
$I_E = 0$; $-V_{CB}$ = 280 V	$-I_{CBO}$	<		0,1	μA
$I_B = 0$; $-V_{CE}$ = 150 V	$-I_{CEO}$	<	1,0		μA
$I_B = 0$; $-V_{CE}$ = 250 V	$-I_{CEO}$	<		1,0	μA
Emitter cut-off current					
$I_C = 0$; $-V_{EB}$ = 4 V	$-I_{EBO}$	<	1,0		μA
$I_C = 0$; $-V_{EB}$ = 6 V	$-I_{EBO}$	<		1,0	μA
Collector-emitter sustaining voltage $I_B = 0$; $-I_C$ = 50 mA	$-V_{CEOsus}$	>	200	300	V
Saturation voltages $-I_C$ = 50 mA; $-I_B$ = 5 mA	$-V_{CEsat}$	<	0,8	0,8	V
	$-V_{BEsat}$	<	1,0	1,0	V
D.C. current gain $-I_C$ = 50 mA; $-V_{CE}$ = 10 V	h_{FE}	>	30	30	
		<	150	120	
Transition frequency at f = 5 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 10 V; T_{amb} = 25 °C	f_T	>	15		MHz
Small-signal current gain at f = 5 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 10 V; T_{amb} = 25 °C	h_{fe}	>	25		
Real part (Re) of input impedance (h_{ie}) $-V_{CE}$ = 10 V; $-I_C$ = 5 mA; f = 1 MHz; T_{amb} = 25 °C	$Re(h_{ie})$	<	300		Ω
Input capacitance at f = 1 MHz $I_C = 0$; $-V_{EB}$ = 5 V; T_{amb} = 25 °C	C_e	<	75		pF
Output capacitance at f = 1 MHz $I_E = 0$; $-V_{CB}$ = 10 V; T_{amb} = 25 °C	C_c	<	15		pF

SILICON PLANAR EPITAXIAL TRANSISTOR

NPN silicon planar epitaxial transistor, housed in a SOT89 package.
It is intended for switching and linear applications.
The complementary type is PXT2907/A.

QUICK REFERENCE DATA

			PXT2222	PXT2222A	
Collector-emitter voltage (open base)	V_{CEO}	max.	30	40	V
Collector-base voltage (open emitter)	V_{CBO}	max.	60	75	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5.0	6.0	V
Collector current (DC)	I_C	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	1.0		W
DC current gain I_C = 150 mA; V_{CE} = 10 V	h_{FE}		100 to 300	100 to 300	
Transition frequency at f = 100 MHz I_C = 20 mA; V_{CE} = 20 V	f_T	min.	250	300	MHz
Saturation voltage I_C = 150 mA; I_B = 15 mA	$V_{CE\,sat}$	max.	400	300	mV

MECHANICAL DATA

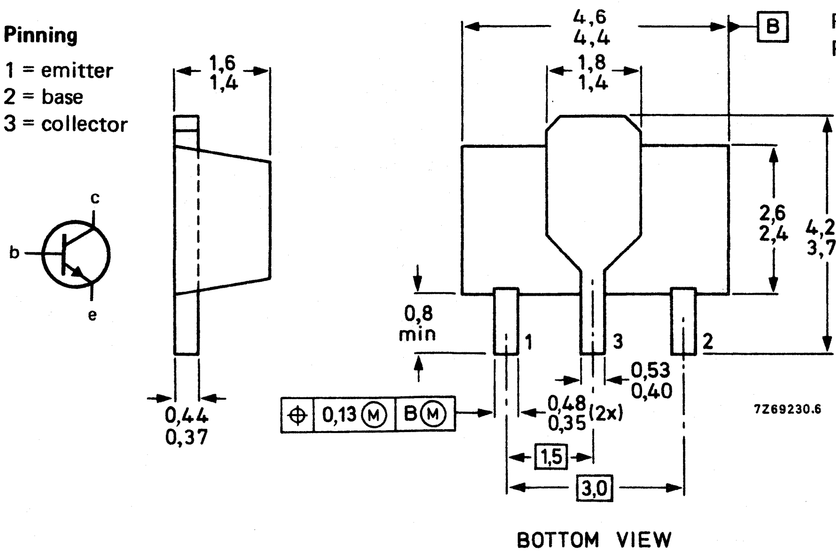
Dimensions in mm

Fig.1 SOT89.

Marking codes:
PXT2222 : p1B
PXT2222A: p1P

Pinning

1 = emitter
2 = base
3 = collector



* Mounted on a ceramic substrate; area = 2.5 cm²; thickness = 0.7 mm.

RATINGS

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

			PXT2222	PXT2222A	
Collector-emitter voltage	V_{CEO}	max.	30	40	V
Collector-base voltage	V_{CBO}	max.	60	75	V
Emitter-base voltage	V_{EBO}	max.	5.0	6.0	V
Collector current (DC)	I_C	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	1.0		W
Storage temperature range	T_{stg}		−65 to + 150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\,j\text{-}a}$	=	125	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			PXT2222	PXT2222A	
Collector cut-off current					
V_{CB} = 50 V; I_E = 0	I_{CBO}	max.	10	–	nA
V_{CB} = 50 V; I_E = 0; T_{amb} = 125 °C	I_{CBO}	max.	10	–	μA
V_{CB} = 60 V; I_E = 0	I_{CBO}	max.	–	10	nA
V_{CB} = 60 V; I_E = 0; T_{amb} = 125 °C	I_{CBO}	max.	–	10	μA
V_{CE} = 60 V; V_{EB} = 3 V	I_{CEX}	min.	–	10	nA
Base current with reverse biased emitter junction					
V_{CE} = 60 V; V_{BE} = 3 V	I_{BEX}	max.	–	20	nA
Emitter cut-off current					
V_{BE} = 3 V; I_C = 0	I_{EBO}	max.	–	10	nA
Saturation voltage					
I_C = 150 mA; I_B = 15 mA	$V_{CE\,sat}$	max.	0.4	0.3	V
	$V_{BE\,sat}$	max.	1.3	0.6 to 1.2	V
I_C = 500 mA; I_B = 50 mA	$V_{CE\,sat}$	max.	1.6	1.0	V
	$V_{BE\,sat}$	max.	2.6	2.0	V
Breakdown voltages					
I_C = 10 mA; I_B = 0	$V_{(BR)CEO}$	min.	30	40	V
I_C = 10 μA; I_E = 0	$V_{(BR)CBO}$	min.	60	75	V
I_E = 10 μA; I_C = 0	$V_{(BR)EBO}$	min.	5.0	6.0	V

* Mounted on a ceramic substrate; area = 2.5 cm^2; thickness = 0.7 mm.

			PXT2222	PXT2222A	
DC current gain					
$I_C = 0.1$ mA; $V_{CE} = 10$ V	h_{FE}	min.	35	35	
$I_C = 1.0$ mA; $V_{CE} = 10$ V	h_{FE}	min.	50	50	
$I_C = 10$ mA; $V_{CE} = 10$ V	h_{FE}	min.	75	75	
$I_C = 10$ mA; $V_C = 10$ V; $T_{amb} = -55$ °C	h_{FE}	min.	–	35	
$I_C = 150$ mA; $V_{CE} = 10$ V	h_{FE}	min.	100	100	
		max.	300	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_c	max.	8.0	8.0	pF
Input capacitance at f = 1 MHz					
$V_{EB} = 0.5$ V; $I_C = 0$	C_e	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

Switching times

			PXT2222 / PXT2222A	
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 package.
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

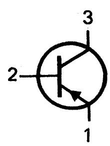
Fig.1 SOT89.

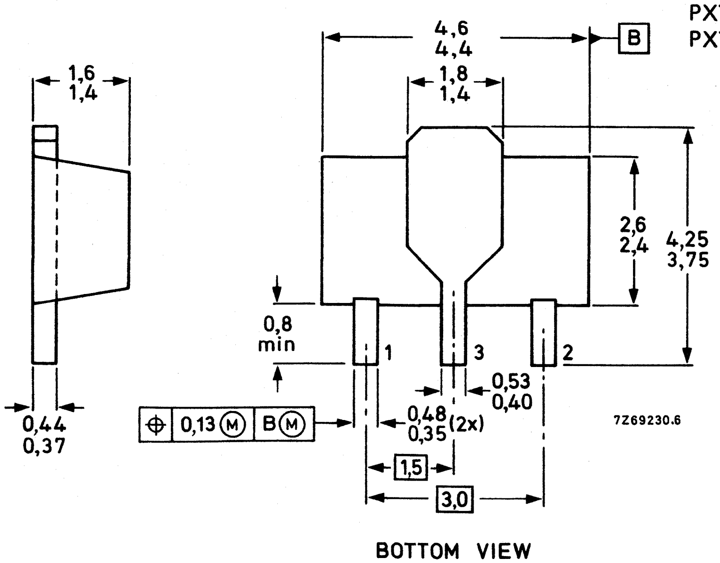
Dimensions in mm

Marking code:
PXT2907 : p2B
PXT2907A: p2F

Pinning

1 = emitter
2 = base
3 = collector





* Mounted on a ceramic substrate; area = 2.5 cm^2; thickness = 0.7 mm.

RATINGS

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

			PXT2907	PXT2907A	
Collector-emitter voltage	$-V_{CEO}$	max.	40	60	V
Collector-base voltage	$-V_{CBO}$	max.	60		V
Emitter-base voltage	$-V_{EBO}$	max.	5.0		V
Collector current (DC)	$-I_C$	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	1.0		W
Storage temperature range	T_{stg}		−65 to + 150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\,j\text{-}a}$	=	125	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			PXT2907	PXT2907A	
Collector-cut-off current					
$-V_{CB}$ = 50 V; I_E = 0	$-I_{CBO}$	max.	20	10	nA
$-V_{CB}$ = 50 V; I_E = 0; T_{amb} = 125 °C	$-I_{CBO}$	max.	20	10	μA
$-V_{CE}$ = 30 V; $-V_{EB}$ = 0.5 V	$-I_{CEX}$	max.	50		nA
Base current with reverse biased emitter junction					
$-V_{CE}$ = 60 V; $-V_{BE}$ = 0.5 V	$-I_{BEX}$	max.	50		nA
Saturation voltage					
$-I_C$ = 150 mA; $-I_B$ = 15 mA	$-V_{CE\,sat}$	max.	0.4		V
	$-V_{BE\,sat}$	max.	1.3		V
$-I_C$ = 500 mA; $-I_B$ = 50 mA	$-V_{CE\,sat}$	max.	1.6		V
	$-V_{BE\,sat}$	max.	2.6		V
Breakdown voltages					
$-I_C$ = 10 mA; I_B = 0	$-V_{(BR)CEO}$	min.	40	60	V
$-I_C$ = 10 μA; I_E = 0	$-V_{(BR)CBO}$	min.	60		V
$-I_E$ = 10 μA; I_C = 0	$-V_{(BR)EBO}$	min.	5.0		V

* Mounted on a ceramic substrate; area = 2.5 cm^2; thickness = 0.7 mm.

			PXT2907	PXT2907A	
DC current gain					
$-I_C = 0.1$ mA; $-V_{CE} = 1$ V	h_{FE}	min.	35	75	
$-I_C = 1.0$ mA; $-V_{CE} = 1$ V	h_{FE}	min.	50	100	
$-I_C = 10$ mA; $-V_{CE} = 1$ V	h_{FE}	min.	75	100	
$-I_C = 150$ mA; $-V_{CE} = 2$ V	h_{FE}		100 to 300	100 to 300	
$-I_C = 500$ mA; $-V_{CE} = 2$ V	h_{FE}	min.	30	50	
Transition frequency at f = 100 MHz					
$-I_C = 20$ mA; $-V_{CE} = 10$ V	f_T	min.	200		MHz
Output capacitance at f = 1 MHz					
$-V_{CB} = 10$ V; $I_E = 0$	C_c	max.	8.0		pF
Input capacitance at f = 1 MHz					
$-V_{EB} = 0.5$ V; $I_C = 0$	C_e	max.	35		pF
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 package 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

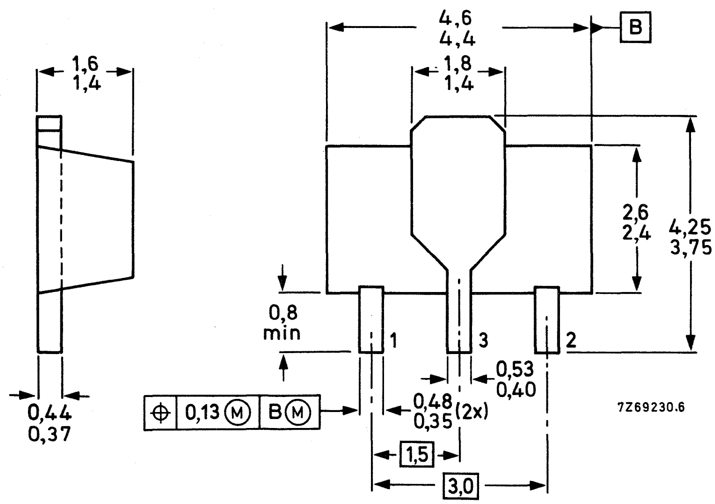
MECHANICAL DATA

Dimensions in mm

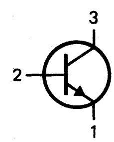
Fig. 1 SOT-89.

Marking code

p1A



BOTTOM VIEW



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} $-I_{BEX}$	< <	50 nA 50 nA
Saturation voltages I_C = 10 mA; I_B = 1 mA	V_{CEsat} V_{BEsat}	<	200 mV 650 to 850 mV
I_C = 50 mA; I_B = 5 mA	V_{CEsat} V_{BEsat}	< <	300 mV 950 mV
D.C. current gain I_C = 0,1 mA; V_{CE} = 1 V	h_{FE}	>	40
I_C = 1 mA; V_{CE} = 1 V	h_{FE}	>	70
I_C = 10 mA; V_{CE} = 1 V	h_{FE}	> <	100 300
I_C = 50 mA; V_{CE} = 1 V	h_{FE}	>	60
I_C = 100 mA; V_{CE} = 1 V	h_{FE}	>	30
Collector capacitance at 100 kHz ≤ f ≤ 1 MHz $I_E = I_e = 0$; V_{CB} = 5 V	C_c	<	4,0 pF
Emitter capacitance at 100 kHz ≤ f ≤ 1 MHz $I_C = I_c = 0$; V_{EB} = 0,5 V	C_e	<	8,0 pF
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 20 V; T_{amb} = 25 °C	f_T	>	300 MHz
Noise figure at R_S = 1 kΩ I_C = 100 μA; V_{CE} = 5 V f = 10 Hz to 15,7 kHz; T_{amb} = 25 °C	F	<	5,0 dB

* Mounted on a ceramic substrate area = 2,5 cm²; thickness = 0,7 mm.

Switching times

Turn-on time (see Figs 2 and 3) when switched from $-V_{BEoff}$ = 0,5 V to I_{Con} = 10 mA; I_{Bon} = 1 mA			
Delay time	t_d	<	35 ns
Rise time	t_r	<	35 ns

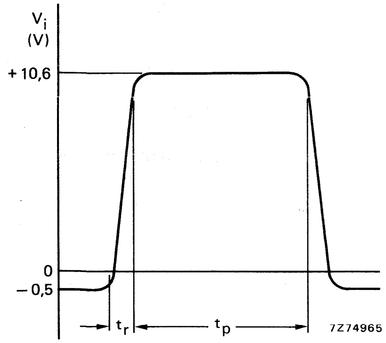


Fig. 2 Input waveform; t_r < 1 ns; t_p = 300 ns; δ = 0,02.

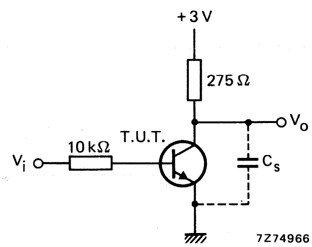


Fig. 3 Delay and rise time test circuit; total shunt capacitance of test jig and connectors C_s < 4 pF; scope impedance = 10 MΩ.

Turn-off time (see Figs 4 and 5) I_{Con} = 10 mA; I_{Bon} = $-I_{Boff}$ = 1 mA			
Storage time	t_s	<	200 ns
Fall time	t_f	<	50 ns

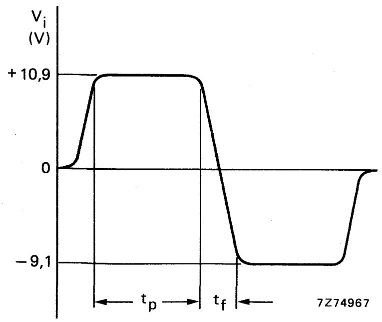


Fig. 4 Input waveform; t_f < 1 ns; 10 μs < t_p < 500 μs; δ = 0,02.

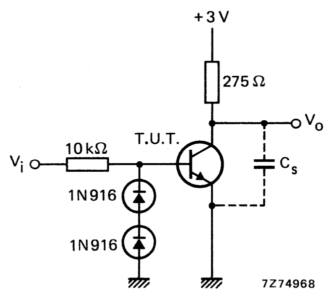


Fig. 5 Storage and fall time test circuit; total shunt capacitance of test jig and connectors C_s < 4 pF; scope impedance = 10 MΩ.

SILICON PLANAR EPITAXIAL TRANSISTOR

P-N-P transistor in a SOT-89 package 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

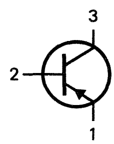
MECHANICAL DATA

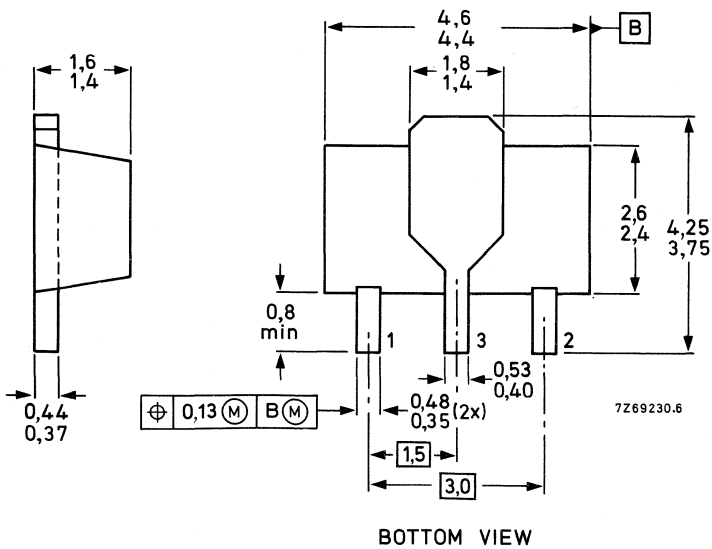
Dimensions in mm

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 ⩽ f ⩽ 1 MHz $I_E = I_e = 0$; $-V_{CB}$ = 5 V	C_c	<	4,5	pF
Emitter capacitance at 100 kHz ⩽ f ⩽ 1 MHz $I_C = I_c = 0$; $-V_{EB}$ = 0,5 V	C_e	<	10	pF
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 20 V; T_{amb} = 25 °C	f_T	>	250	MHz
Noise figure at R_S = 1 kΩ $-I_C$ = 100 μA; $-V_{CE}$ = 5 V f = 10 Hz to 15,7 kHz; T_{amb} = 25 °C	F	<	4,0	dB

* Mounted on a ceramic substrate area = 2,5 cm²; thickness = 0,7 mm.

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

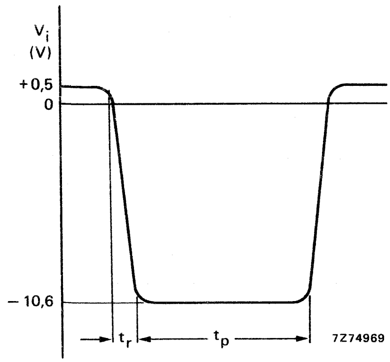


Fig. 2 Input waveform; $t_r < 1$ ns; t_p = 300 ns; δ = 0,02.

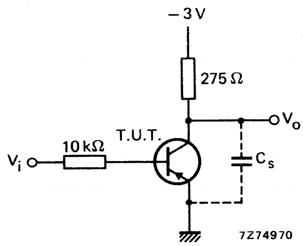


Fig. 3 Delay and rise time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

Turn-off time (see Figs 4 and 5)
$-I_{Con}$ = 10 mA; $-I_{Bon}$ = I_{Boff} = 1 mA

Storage time	t_s	<	225 ns
Fall time	t_f	<	75 ns

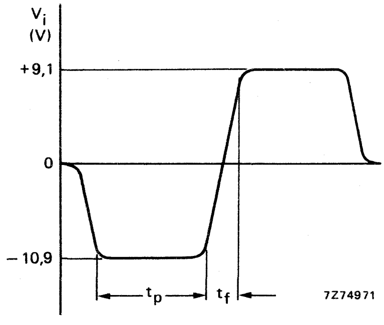


Fig. 4 Input waveform; $t_f < 1$ ns; 10 μs $< t_p <$ 500 μs; δ = 0,02.

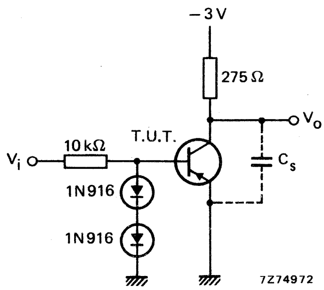


Fig. 5 Storage and fall time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

SILICON PLANAR EPITAXIAL TRANSISTOR

NPN silicon planar epitaxial transistor, housed in a SOT-89 package.

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

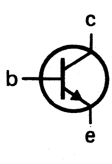
Dimensions in mm

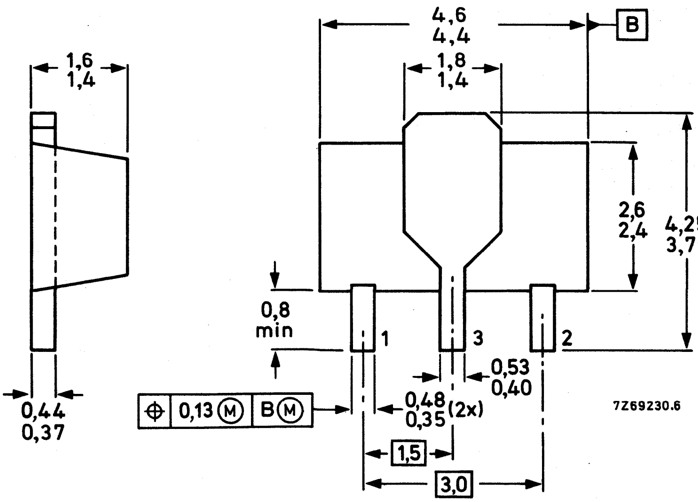
Fig. 1 SOT-89

Marking code = p2X

Pinning:

1 = emitter
2 = base
3 = collector





BOTTOM VIEW

* 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*	$R_{th\ j-a}$	=	125	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector-emitter breakdown voltage I_C = 1.0 mA; I_B = 0	$V_{(BR)CEO}$	min.	40	V
Collector-base breakdown voltage I_C = 0.1 mA; I_E = 0	$V_{(BR)CBO}$	min.	60	V
Emitter-base breakdown voltage I_E = 0.1 mA; I_C = 0	$V_{(BR)EBO}$	min.	6.0	V
Base cut-off current V_{CE} = 35 V; $-V_{EB}$ = 0.4 V	I_{BEX}	max.	0.1	μA
Collector cut-off current V_{CE} = 35 V; $-V_{EB}$ = 0.4 V	I_{CEX}	max.	0.1	μA
DC current gain				
I_C = 0.1 mA; V_{CE} = 1 V	h_{FE}	min.	20	
I_C = 1.0 mA; V_{CE} = 1 V	h_{FE}	min.	40	
I_C = 10 mA; V_{CE} = 1 V	h_{FE}	min.	80	
I_C = 150 mA; V_{CE} = 1 V	h_{FE}		100 to 300	
I_C = 500 mA; V_{CE} = 2 V	h_{FE}	min.	40	
Saturation voltage				
I_C = 150 mA; I_B = 15 mA	$V_{CE\ sat}$	max.	0.4	V
	$V_{BE\ sat}$		0.75 to 0.95	V
I_C = 500 mA; I_B = 50 mA	$V_{CE\ sat}$	max.	0.75	V
	$V_{BE\ sat}$	max.	1.2	V

* Mounted on a ceramic substrate; area = 2.5 cm^2; thickness = 0.7 mm.

Transition frequency; f = 100 MHz; I_C = 20 mA; V_{CE} = 10 V	f_T	min.	250 MHz
Collector-base capacitance I_E = 0; V_{CB} = 5 V; f = 100 kHz	C_c	max.	8.0 pF
Emitter-base capacitance I_C = 0; V_{BE} = 0.5 V; f = 100 kHz	C_e	max.	30 pF

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 package.

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

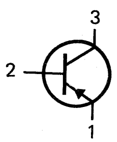
Dimensions in mm

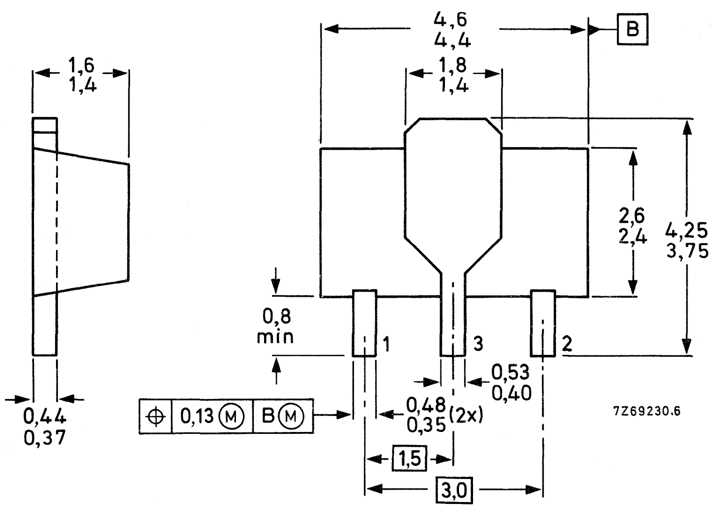
Fig.1 SOT89.

Marking code = p2T

Pinning

1 = emitter
2 = base
3 = collector





BOTTOM VIEW

* Mounted on a ceramic substrate; area = 2.5 cm^2; thickness = 0.7 mm.

RATINGS

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

Collector-emitter voltage	$-V_{CEO}$	max.	40 V
Emitter-base voltage	$-V_{EBO}$	max.	5.0 V
Collector-base voltage	$-V_{CBO}$	max.	40 V
Collector current (DC)	$-I_C$	max.	600 mA
Total power dissipation up to T_{amb} = 25 °C*	P_{tot}	max.	1.0 W
Storage temperature range	T_{stg}		−55 to + 150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient*	$R_{th\,j\text{-}a}$	=	125 K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector-emitter breakdown voltage $-I_C$ = 1.0 mA; I_B = 0	$-V_{(BR)CEO}$	min.	40 V
Collector-base breakdown voltage $-I_C$ = 100 μA; I_E = 0	$-V_{(BR)CBO}$	min.	40 V
Emitter-base breakdown voltage $-I_E$ = 100 μA; I_C = 0	$-V_{(BR)EBO}$	min.	5.0 V
Base cut-off current $-V_{CE}$ = 35 V; $-V_{BE}$ = 0.4 V	$-I_{BEV}$	max.	0.1 μA
Collector cut-off current $-V_{CE}$ = 35 V; V_{BE} = 0.4 V	$-I_{CEX}$	max.	0.1 μA
DC current gain			
$-I_C$ = 0.1 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	30
$-I_C$ = 1.0 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	60
$-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	100
$-I_C$ = 150 mA; $-V_{CE}$ = 2 V	h_{FE}	min.	100 to 300
$-I_C$ = 500 mA; $-V_{CE}$ = 2 V	h_{FE}	min.	20
Saturation voltage			
$-I_C$ = 150 mA; $-I_B$ = 15 mA	$-V_{CE\,sat}$	max.	0.4 V
	$-V_{BE\,sat}$		0.70 to 0.95 V
$-I_C$ = 500 mA; $-I_B$ = 50 mA	$-V_{CE\,sat}$	max.	0.75 V
	$-V_{BE\,sat}$	max.	1.3 V
Transition frequency at f = 100 MHz $-I_C$ = 20 mA; $-V_{CE}$ = 10 V	f_T	min.	200 MHz

* Mounted on a ceramic substrate; area = 2.5 cm^2; thickness = 0.7 mm.

Collector-base capacitance			
$-V_{CB} = 10$ V; $I_E = 0$; f = 0.14 MHz	C_c	max.	8.5 pF
Emitter-base capacitance			
$-V_{EB} = 0.5$ V; $I_C = 0$; f = 0.14 MHz	C_e	max.	35 pF

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 package (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 $T_{amb} = 25\ ^oC$*	P_{tot}	max.	1.0	W
Transition frequency at f = 100 MHz; $I_C = 30$ mA; $V_{CE} = 5$ V	f_T	min.	125	MHz

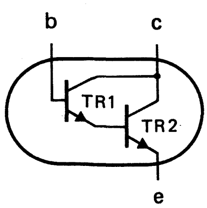
MECHANICAL DATA

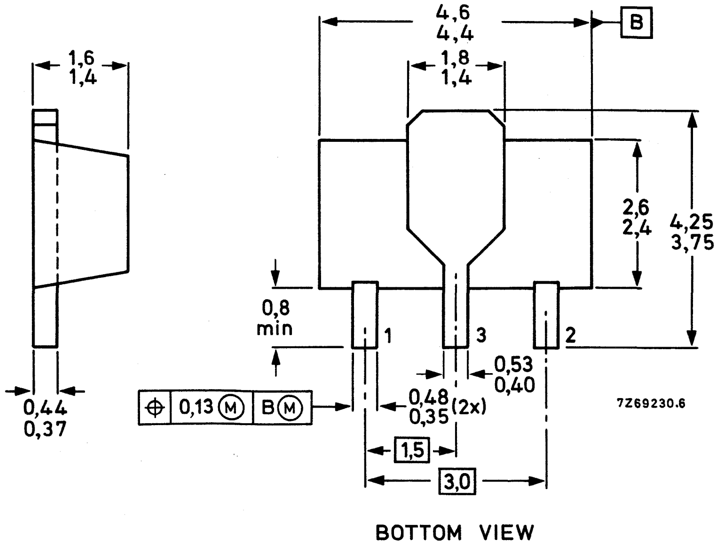
Dimensions in mm

Fig. 1 SOT-89.

Marking code = p1N

Pinning:
1 = emitter
2 = base
3 = collector





RATINGS

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

Collector-emitter voltage			
$V_{BE} = 0$	V_{CES}	max.	30 V
Collector-base voltage (open emitter)	V_{CBO}	max.	30 V
Emitter-base voltage (open collector)	V_{EBO}	max.	10 V
Collector current (DC)	I_C	max.	300 mA
Total power dissipation			
up to $T_{amb} = 25\ ^oC$*	P_{tot}	max.	1.0 W
Storage temperature range	T_{stg}	−65 to + 150	^oC
Junction temperature	T_j	max.	150 ^oC

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	125 K/W

CHARACTERISTICS

$T_{amb} = 25\ ^oC$ unless otherwise specified

Collector-emitter breakdown voltage			
$I_C = 100\ \mu A$	$V_{(BR)CES}$	min.	30 V
Emitter-base cut-off current			
$V_{BE} = 10$ V	I_{EBO}	max.	0.1 μA
Collector-base cut-off current			
$V_{CB} = 30$ V	I_{CBO}	max.	0.1 μA
DC current gain			
$I_C = 10$ mA; $V_{CE} = 5$ V	h_{FE}	min.	10 000
$I_C = 100$ mA; $V_{CE} = 5$ V	h_{FE}	min.	20 000
Collector-emitter saturation voltage			
$I_C = 100$ mA; $I_B = 0.1$ mA	$V_{CE\ sat}$	max.	1.5 V
Base-emitter on-state voltage			
$I_C = 100$ mA; $V_{CE} = 5$ V	$V_{BE(on)}$	max.	2.0 V
Transition frequency at f = 100 MHz;			
$I_C = 30$ mA; $V_{CE} = 5$ V	f_T	min.	125 MHz

* Mounted on a ceramic substrate; area = 2.5 cm^2 ; thickness = 0.7 mm.

SMALL-SIGNAL DARLINGTON TRANSISTOR

NPN small-signal darlington transistors, housed in a microminiature package (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 $T_{amb} = 25$ °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

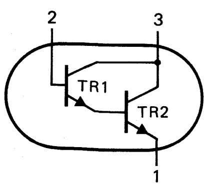
MECHANICAL DATA

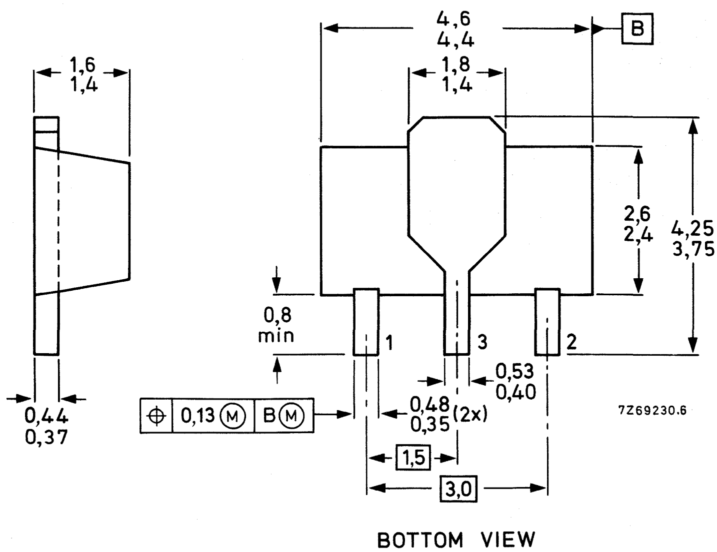
Dimensions in mm

Fig.1 SOT89.

Pinning

1 = emitter
2 = collector
3 = base





* Mounted on a ceramic substrate; area = 2.5 cm²; thickness = 0.7 mm.

RATINGS

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

Collector-emitter voltage $V_{BE} = 0$	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.	10000
$I_C = 100\ mA; V_{CE} = 5\ V$	h_{FE}	min.	10000
Collector-emitter saturation voltage $I_C = 100\ mA; I_B = 0.1\ mA$	$V_{CE\ sat}$	max.	1.5 V
Base-emitter on-state voltage $I_C = 100\ mA; V_{CE} = 5\ V$	$V_{BE(on)}$	max.	2.0 V
Transition frequency at f = 100 MHz $I_C = 30\ mA; V_{CE} = 5\ V$	f_T	min.	125 MHz

* Mounted on a ceramic substrate; area = 2.5 cm^2 ; thickness = 0.7 mm.

SILICON EPITAXIAL TRANSISTORS

NPN high voltage transistors in a SOT89 package, intended for surface-mounted applications. They are primarily intended for use in telephony and professional communications equipment.

QUICK REFERENCE DATA

			PXTA42	PXTA43	
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.	1.0		W
Junction temperature	T_j	max.	150		°C
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
Feedback capacitance at f = 1 MHz I_C = 0; V_{CE} = 20 V	C_{re}	max.	3	4	pF

MECHANICAL DATA

Dimensions in mm

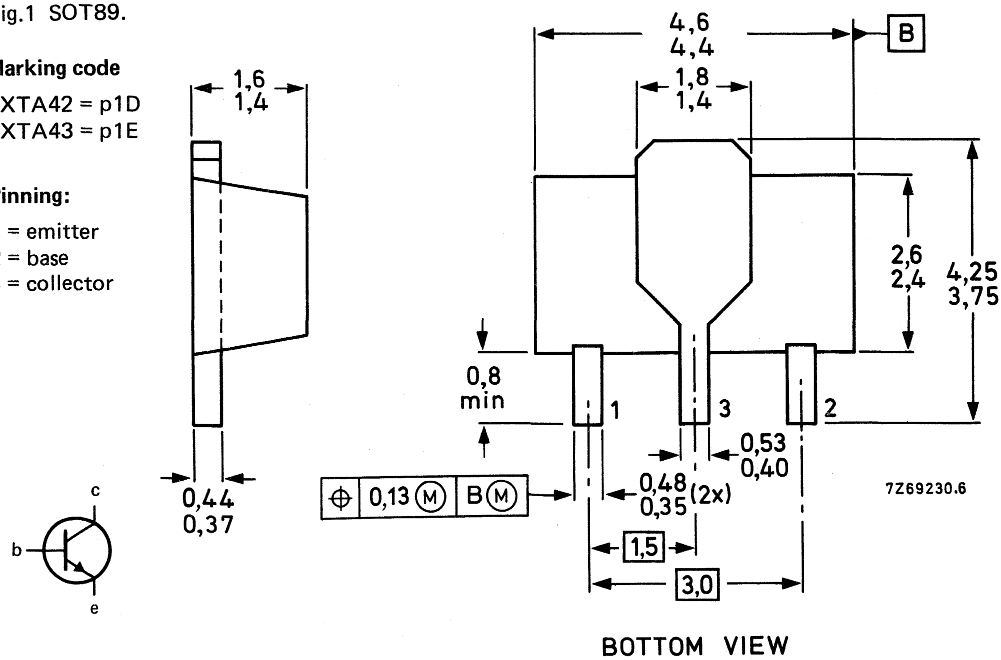
Fig.1 SOT89.

Marking code

PXTA42 = p1D
PXTA43 = p1E

Pinning:

1 = emitter
2 = base
3 = collector



RATINGS

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

			PXTA42	PXTA43	
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.	1.0		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

			PXTA42	PXTA43	
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
Emitter-base breakdown voltage I_E = 100 μA; I_C = 0	$V_{(BR)EBO}$	min.	6	6	V
Collector cut-off current I_E = 0; V_{CB} = 200 V	I_{CBO}	max.	0.1	–	μA
I_E = 0; V_{CB} = 160 V	I_{CBO}	max.	–	0.1	μA
Emitter cut-off current I_C = 0; V_{BE} = 6 V	I_{EBO}	max.	0.1	–	μA
I_C = 0; V_{BE} = 4 V	I_{EBO}	max.	–	0.1	μA
Feedback capacitance at f = 1 MHz I_E = 0; V_{CB} = 20 V	C_{re}	max.	3	4	pF

* Mounted on a ceramic substrate; area = 2.5 cm^2; thickness = 0.7 mm.
** 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
DC 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

PNP SMALL-SIGNAL DARLINGTON TRANSISTOR

PNP small-signal darlington transistor, housed in a microminiature package (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 $T_{amb} = 25$ °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

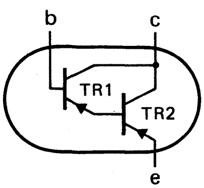
Dimensions in mm

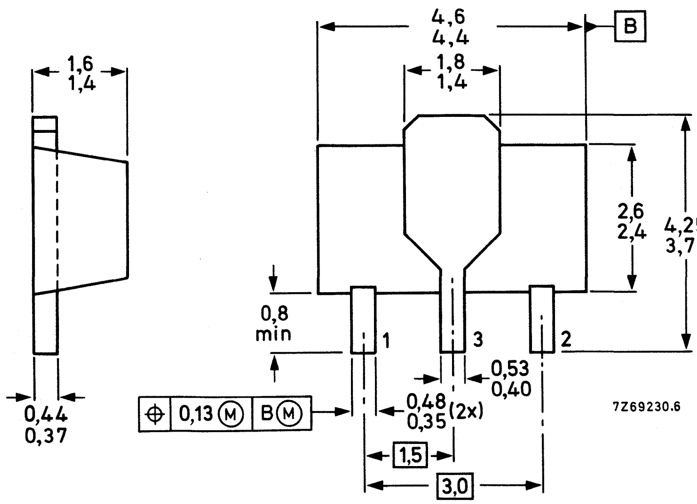
Fig. 1 SOT-89

Marking code = p2V

Pinning:

1 = emitter
2 = base
3 = collector





BOTTOM VIEW

* Mounted on a ceramic substrate; area = 2.5 cm²; thickness = 0.7 mm.

RATINGS

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

Collector-emitter voltage $V_{BE} = 0$	$-V_{CES}$	max.	30	V
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	30	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	10	V
Collector current (DC)	$-I_C$	max.	300	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	1.0	W
Storage temperature range	T_{stg}		−65 to +150	^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

From junction to ambient*	$R_{th\ j\text{-}a}$	=	125	K/W

CHARACTERISTICS

$T_{amb} = 25\ ^oC$ unless otherwise specified

Collector-emitter breakdown voltage $-I_C = 100\ \mu A$	$-V_{(BR)CES}$	min.	30	V
Emitter-base cut-off current $-V_{BE} = 10$ V	$-I_{EBO}$	max.	0.1	μA
Collector-base cut-off current $-V_{CB} = 30$ V	$-I_{CBO}$	max.	0.1	μA
DC current gain $-I_C = 10$ mA; $-V_{CE} = 5$ V	h_{FE}	min.	10 000	
$-I_C = 100$ mA; $-V_{CE} = 5$ V	h_{FE}	min.	20 000	
Collector-emitter saturation voltage $-I_C = 100$ mA; $-I_B = 0.1$ mA	$-V_{CEsat}$	max.	1.5	V
Base-emitter on-state voltage $-I_C = 100$ mA; $-V_{CE} = 5$ V	$-V_{BE(on)}$	max.	2.0	V
Transition frequency at f = 100 MHz; $-I_C = 100$ mA; $-V_{CE} = 5$ V	f_T	min.	125	MHz

* Mounted on a ceramic substrate; area = 2.5 cm^2; thickness = 0.7 mm.

SILICON EPITAXIAL TRANSISTORS

PNP high voltage transistors in a SOT89 package, 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

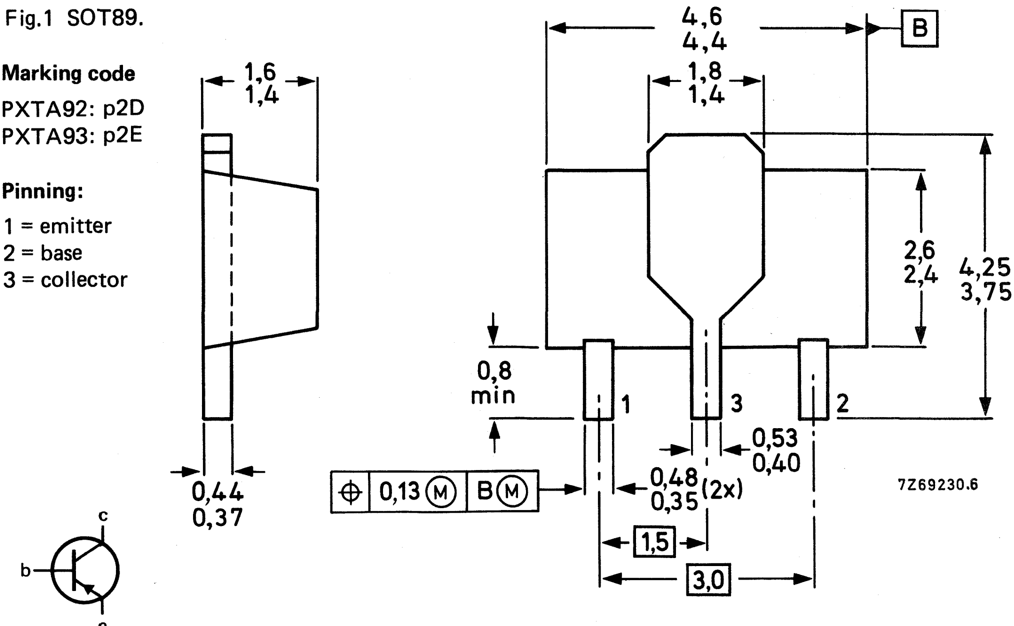
Fig.1 SOT89.

Marking code

PXTA92: p2D
PXTA93: p2E

Pinning:

1 = emitter
2 = base
3 = collector



BOTTOM VIEW

RATINGS

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

			PXTA92	PXTA93	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	300	200	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	300	200	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5		V
Collector current (DC)	$-I_C$	max.	500		mA
Total power dissipation * up to T_{amb} = 25 °C	P_{tot}	max.	1.0		W
Storage temperature range	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL CHARACTERISTICS

Thermal resistance from junction to ambient*	$R_{th\ j\text{-}a}$	=	125	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			PXTA92	PXTA93	
Collector-emitter breakdown voltage $-I_C$ = 1 mA; I_B = 0	$-V_{(BR)CEO}$	min.	300	200	V
Collector-base breakdown voltage $-I_C$ = 100 μA; I_E = 0	$-V_{(BR)CBO}$	min.	300	200	V
Collector cut-off current $-V_{CB}$ = 200 V; I_E = 0	$-I_{CBO}$	max.	0.25	–	μA
$-V_{CB}$ = 160 V; I_E = 0	$-I_{CBO}$	max.	–	0.25	μA
Emitter-base breakdown voltage $-I_E$ = 100 μA; I_C = 0	$-V_{(BR)EBO}$	min.	5		V
Emitter cut-off current I_C = 0; $-V_{BE}$ = 3 V	$-I_{EBO}$	max.	0.1		μA
Collector-base capacitance at f = 1 MHz; I_E = 0; $-V_{CB}$ = 20 V	C_c	max.	6	8	pF
Saturation voltages $-I_C$ = 20 mA; $-I_B$ = 2 mA	$-V_{CEsat}$	max.	0.5		V
$-I_C$ = 20 mA; $-I_B$ = 2 mA	$-V_{BEsat}$	max.	0.9		V
DC current gain** $-I_C$ = 1 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	25		
$-I_C$ = 10 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	40		
$-I_C$ = 30 mA; $-V_{CE}$ = 10 V	h_{FE}	min.	25		
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 20 V	f_T	min.	50		MHz

* Device mounted on a ceramic substrate; area 2.5 cm^2; thickness 0.7 mm.
** Pulse test conditions: t_p = 300 μs; duty factor ≤ 2%.

SILICON PLANAR EPITAXIAL TRANSISTORS

NPN silicon planar epitaxial transistors in a microminiature SMD package (SOT-223), primarily intended for linear and switching applications.

PNP complements are PZT2907/2907A.

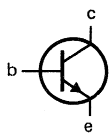
QUICK REFERENCE DATA

			PZT2222	PZT2222A	
Collector-emitter voltage (open base)	V_{CEO}	max.	30	40	V
Collector-base voltage (open emitter)	V_{CBO}	max.	60	75	V
Collector current (DC)	I_C	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C *	P_{tot}	max.	1,5		W
Collector-emitter saturation voltage I_C = 150 mA; I_B = 15 mA	V_{CEsat}	max.	0,4	0,3	V
DC current gain I_C = 150 mA; V_{CE} = 10 V	h_{FE}	min.	100		
		max.	300		

MECHANICAL DATA

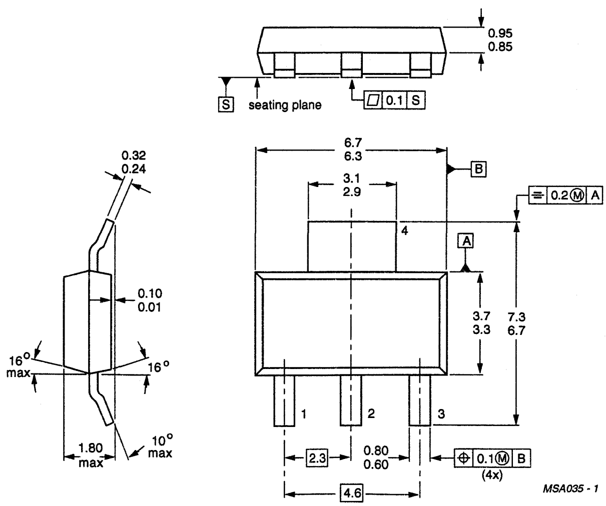
Dimensions in mm

Fig. 1 SOT-223



Pinning:

1 = base
2 = collector
3 = emitter
4 = collector



RATINGS

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

			PZT2222	PZT2222A	
Collector-emitter voltage (open base)	V_{CEO}	max.	30	40	V
Collector-base voltage (open emitter)	V_{CBO}	max.	60	75	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5,0	6,0	V
Collector current (DC)	I_C	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C *	P_{tot}	max.	1,5		W
Storage temperature range	T_{stg}		−55 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			PZT2222	PZT2222A	
Collector-emitter breakdown voltage $I_B = 0$; I_C = 10 mA	$V_{(BR)CEO}$	min.	30	40	V
Collector-base breakdown voltage $I_E = 0$; I_C = 10 μA	$V_{(BR)CBO}$	min.	60	75	V
Emitter-base breakdown voltage I_E = 10 μA; $I_C = 0$	$V_{(BR)EBO}$	min.	5,0	6,0	V
Base cut-off current V_{CE} = 60 V; $-V_{BE}$ = 3 V	I_{BEX}	max.	–	20	nA
Collector cut-off current V_{CE} = 60 V; $-V_{BE}$ = 3 V	I_{CEX}	max.	–	10	nA
Emitter cut-off current $I_C = 0$; V_{EB} = 3 V	I_{EBO}	max.	–	10	nA
Collector cut-off current $I_E = 0$; V_{CB} = 50 V	I_{CBO}	max.	10	–	nA
$I_E = 0$; V_{CB} = 60 V	I_{CBO}	max.	–	10	nA
$I_E = 0$; V_{CB} = 50 V; T_{amb} = 125 °C	I_{CBO}	max.	10	–	μA
$I_E = 0$; V_{CB} = 60 V; T_{amb} = 125 °C	I_{CBO}	max.	–	10	μA

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

			PZT2222	PZT2222A	
DC current gain					
I_C = 0,1 mA; V_{CE} = 10 V	h_{FE}	min.	35		
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. max.	100 300		
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. max.		0,6 1,2	V V
I_C = 500 mA; I_B = 50 mA	V_{BEsat}	max.	2,6	2,0	V
Transition frequency at f = 100 MHz					
I_C = 20 mA; V_{CE} = 20 V; T_{amb} = 25 °C	f_T	min.	250	300	MHz
Output capacitance at f = 1 MHz					
I_E = 0; V_{CB} = 10 V	C_c	max.	8,0		pF
Input capacitance at f = 1 MHz					
I_C = 0; V_{EB} = 0,5 V	C_e	max.	30	25	pF

			PZT2222A
Noise figure at R_S = 1 kΩ I_C = 100 μA; V_{CE} = 10 V; f = 1 kHz; T_{amb} = 25 °C	F	max.	4,0 dB
Switching times at T_{amb} = 25 °C			
Turn-on time (see Fig. 2) I_C = 150 mA; I_{Bon} = 15 mA V_{CC} = 30 V; $V_{EB(off)}$ = 0,5 V			
delay time	t_d	max.	10 ns
rise time	t_r	max.	25 ns
Turn-off time (see Fig. 3) I_C = 150 mA; I_{Bon} = I_{Boff} = 15 mA V_{CC} = 30 V			
storage time	t_s	max.	225 ns
fall time	t_f	max.	60 ns

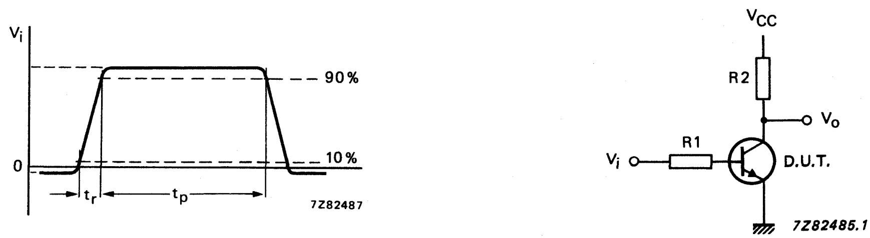


Fig. 2 Input waveform and test circuit for determining delay time and rise time.

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

Pulse generator:				Oscilloscope:			
pulse duration	t_p	⩽	200 ns	input impedance	Z_i	>	100 kΩ
rise time	t_r	⩽	2 ns	input capacitance	C_i	<	12 pF
duty factor	δ	=	0,02	rise time	t_r	<	5 ns

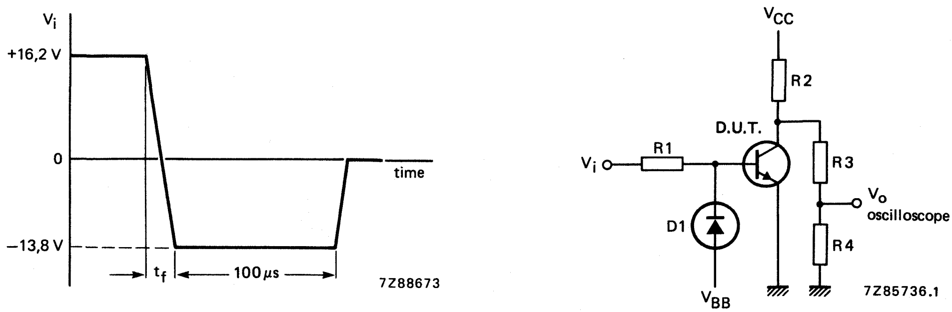


Fig. 3 Input waveform and test circuit for determining storage time and fall time.

SILICON PLANAR EPITAXIAL TRANSISTORS

PNP medium power transistors in a microminiature SMD package (SOT-223). Designed primarily for high-speed switching and driver applications.

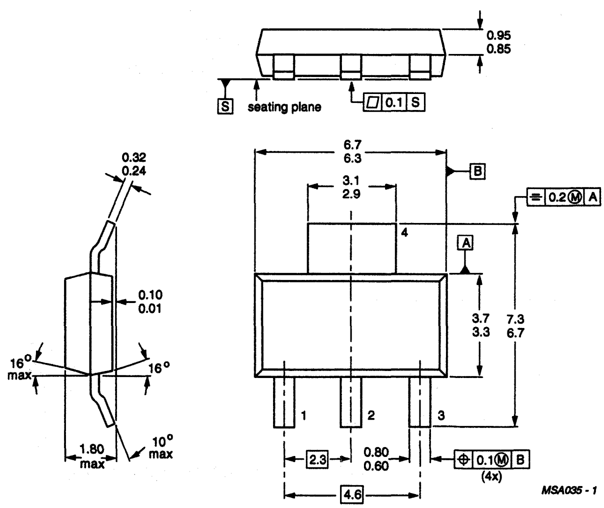
QUICK REFERENCE DATA

Collector-base voltage (open emitter)		$-V_{CBO}$	max.	60 V
Collector-emitter voltage (open base)	**PZT2907**	$-V_{CEO}$	max.	40 V
	PZT2907A	$-V_{CEO}$	max.	60 V
Collector current (DC)		$-I_C$	max.	600 mA
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	1,5 W
Junction temperature		T_j	max.	150 °C
DC current gain at T_j = 25 °C $-I_C$ = 150 mA; $-V_{CE}$ = 10 V		h_{FE}		100 to 300
Transition frequency at f = 100 MHz $-I_C$ = 50 mA; $-V_{CE}$ = 20 V; T_j = 25 °C		f_T	min.	200 MHz
Storage time $-I_{Con}$ = 150 mA; $-I_{Bon}$ = I_{Boff} = 15 mA		t_s	max.	80 ns

MECHANICAL DATA

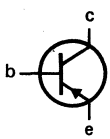
Dimensions in mm

Fig. 1 SOT-223



Pinning

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



RATINGS

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

Collector-base voltage (open emitter)		$-V_{CBO}$	max.	60	V
Collector-emitter voltage (open base)	**PZT2907**	$-V_{CEO}$	max.	40	V
	PZT2907A	$-V_{CEO}$	max.	60	V
Emitter-base voltage (open collector)		$-V_{EBO}$	max.	5	V
Collector current (DC)		$-I_C$	max.	600	mA
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	1,5	W
Storage temperature range		T_{stg}	−65 to	+150	°C
Junction temperature		T_j	max.	150	°C

THERMAL RESISTANCE

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

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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			PZT2907	PZT2907A	
Collector cut-off current					
$I_E = 0$; $-V_{CB} = 50$ V	$-I_{CBO}$	<	20	10	nA
$I_E = 0$; $-V_{CB} = 50$ V; $T_{amb} = 150$ °C	$-I_{CBO}$	<	20	10	μA
$+V_{BE} = 0,5$ V; $-V_{CE} = 30$ V	$-I_{CEX}$	<	50	50	nA
Base current					
$+V_{BE} = 0,5$ V; $-V_{CE} = 30$ V	I_{BEX}	<	50	50	nA
Collector-base breakdown voltage					
open emitter; $-I_C = 10$ μA	$-V_{(BR)CBO}$	>	60	60	V
Collector-emitter breakdown voltage*					
open base; $-I_C = 10$ mA	$-V_{(BR)CEO}$	>	40	60	V
Emitter-base breakdown voltage					
open collector; $-I_E = 10$ μA	$-V_{(BR)EBO}$	>	5	5	V
Saturation voltages*					
$-I_C = 150$ mA; $-I_B = 15$ mA	$-V_{CEsat}$	<	0,4	0,4	V
	$-V_{BEsat}$	<	1,3	1,3	V
$-I_C = 500$ mA; $-I_B = 50$ mA	$-V_{CEsat}$	<	1,6	1,6	V
	$-V_{BEsat}$	<	2,6	2,6	V
DC current gain					
$-I_C = 0,1$ mA; $-V_{CE} = 10$ V	h_{FE}	>	35	75	
$-I_C = 1$ mA; $-V_{CE} = 10$ V	h_{FE}	>	50	100	
$-I_C = 10$ mA; $-V_{CE} = 10$ V	h_{FE}	>	75	100	
$-I_C = 150$ mA; $-V_{CE} = 10$ V*	h_{FE}	>	100	100	
		<	300	300	
$-I_C = 500$ mA; $-V_{CE} = 10$ V*	h_{FE}	>	30	50	
Collector capacitance at f = 100 kHz					
$I_E = I_e = 0$; $-V_{CB} = 10$ V	C_c	<	8		pF
Emitter capacitance at f = 100 kHz					
$I_C = I_c = 0$; $-V_{EB} = 2$ V	C_e	<	30		pF
Transition frequency at f = 100 MHz					
$-I_C = 50$ mA; $-V_{CE} = 20$ V*	f_T	>	200		MHz

* Measured under pulse conditions to avoid excessive dissipation: $t_p \leqslant 300$ μs; $\delta \leqslant 0,02$.

Turn-on time (see Fig. 2)
when switched to $-I_{Con}$ = 150 mA; $-I_{Bon}$ = 15 mA

delay time	t_d	<	10 ns
rise time	t_r	<	40 ns
turn-on time	t_{on}	<	45 ns

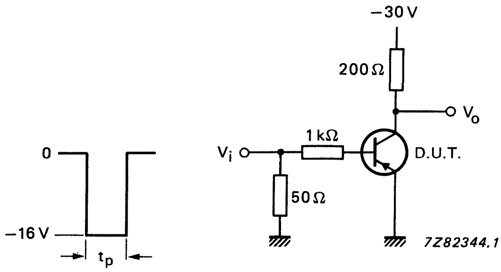


Fig. 2 Input waveform and test circuit for determining delay, rise and turn-on time.

Turn-off time (see Fig. 3)
when switched from $-I_{Con}$ = 150 mA; $-I_{Bon}$ = 15 mA
to cut-off with + I_{Boff} = 15 mA

storage time	t_s	<	80 ns
fall time	t_f	<	30 ns
turn-off time	t_{off}	<	100 ns

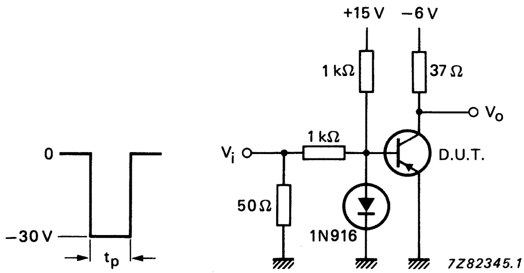


Fig. 3 Input waveform and test circuit for determining storage, fall and turn-off time.

Pulse generator (see Figs 2 and 3)

frequency	f	=	150 Hz
pulse duration	t_p	=	200 ns
rise time	t_r	⩽	2 ns
output impedance	Z_o	=	50 Ω

Oscilloscope (see Figs 2 and 3)

rise time	t_r	⩽	5 ns
input impedance	Z_i	⩽	10 MΩ

SILICON PLANAR EPITAXIAL TRANSISTOR

NPN transistor in a microminiature SMD package (SOT-223). Designed primarily for high-speed, saturated switching applications in industrial service.

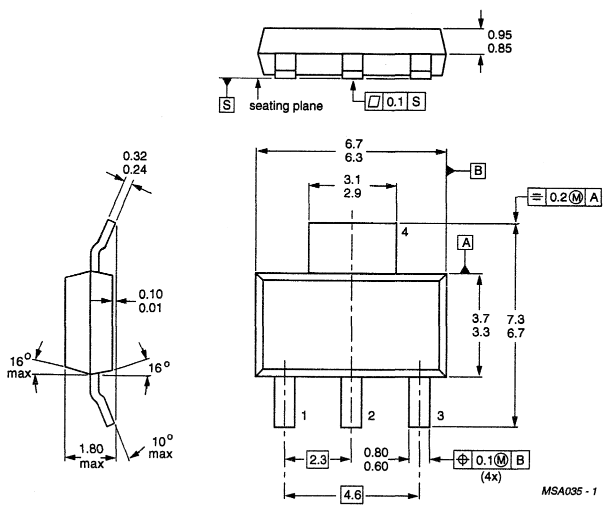
QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	60	V
Collector-emitter voltage (open base)	V_{CEO}	max.	40	V
Collector current (DC)	I_C	max.	200	mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	1,5	W
Junction temperature	T_j	max.	150	°C
DC current gain I_C = 10 mA; V_{CE} = 1 V	h_{FE}	> <	100 300	
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 20 V	f_T	>	300	MHz
Storage time I_{Con} = 10 mA; I_{Bon} = $-I_{Boff}$ = 1 mA	t_s	<	200	ns

MECHANICAL DATA

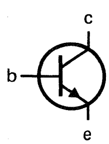
Dimensions in mm

Fig. 1 SOT-223



Pinning

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



RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	60 V
Collector-emitter voltage (open base)	V_{CEO}	max.	40 V
Emitter-base voltage (open collector)	V_{EBO}	max.	6 V
Collector current (DC)	I_C	max.	200 mA
Total power dissipation at T_{amb} = 25 °C*	P_{tot}	max.	1,5 W
Storage temperature range	T_{stg}		−65 to +150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Currents at reverse biased emitter junction			
V_{CE} = 30 V; $-V_{BE}$ = 3 V	I_{CEX}	<	50 nA
	$-I_{BEX}$	<	50 nA
Saturation voltages			
I_C = 10 mA; I_B = 1 mA	V_{CEsat}	<	200 mV
	V_{BEsat}		650 to 850 mV
I_C = 50 mA; I_B = 5 mA	V_{CEsat}	<	300 mV
	V_{BEsat}	<	950 mV
DC current gain			
I_C = 0,1 mA; V_{CE} = 1 V	h_{FE}	>	40
I_C = 1 mA; V_{CE} = 1 V	h_{FE}	>	70
I_C = 10 mA; V_{CE} = 1 V	h_{FE}	>	100
		<	300
I_C = 50 mA; V_{CE} = 1 V	h_{FE}	>	60
I_C = 100 mA; V_{CE} = 1 V	h_{FE}	>	30
Collector capacitance at 100 kHz ≤ f ≤ 1 MHz			
$I_E = I_e$ = 0; V_{CB} = 5 V	C_c	<	4,0 pF
Emitter capacitance at 100 kHz ≤ f ≤ 1 MHz			
$I_C = I_c$ = 0; V_{EB} = 0,5 V	C_e	<	8,0 pF
Transition frequency at f = 100 MHz			
I_C = 10 mA; V_{CE} = 20 V; T_{amb} = 25 °C	f_T	>	300 MHz
Noise figure at R_S = 1 kΩ			
I_C = 100 μA; V_{CE} = 5 V			
f = 10 Hz to 15,7 kHz; T_{amb} = 25 °C	F	<	5,0 dB

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

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

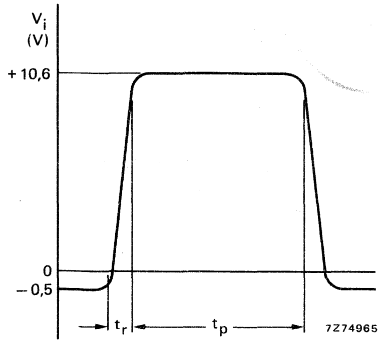


Fig. 2 Input waveform; $t_r < 1$ ns; t_p = 300 ns; δ = 0,02.

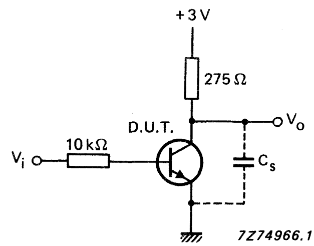


Fig. 3 Delay and rise time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

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

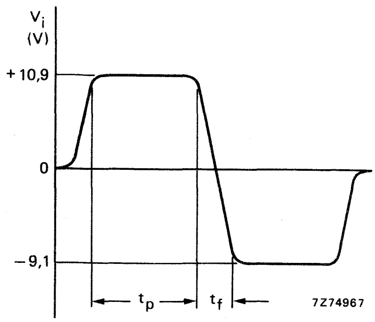


Fig. 4 Input waveform; $t_f < 1$ ns; 10 μs $< t_p <$ 500 μs; δ = 0,02.

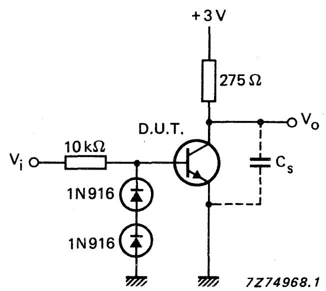


Fig. 5 Storage and fall time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

SILICON PLANAR EPITAXIAL TRANSISTOR

PNP transistor in a microminiature SMD package (SOT-223). Designed primarily for high-speed, saturated switching applications in industrial service.

QUICK REFERENCE DATA

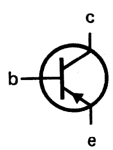
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40	V
Collector current (DC)	$-I_C$	max.	200	mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	1,5	W
Junction temperature	T_j	max.	150	°C
DC current gain $-I_C$ = 10 mA; $-V_{CE}$ = 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

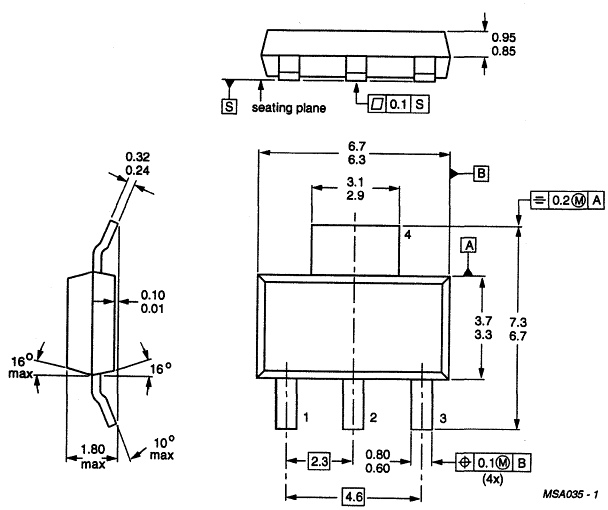
MECHANICAL DATA

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	$-I_{CEX}$	<	50	nA
	$+I_{BEX}$	<	50	nA
Saturation voltages				
$-I_C$ = 10 mA; $-I_B$ = 1 mA	$-V_{CEsat}$	<	250	mV
	$-V_{BEsat}$		650 to 850	mV
$-I_C$ = 50 mA; $-I_B$ = 5 mA	$-V_{CEsat}$	<	400	mV
	$-V_{BEsat}$	<	950	mV
DC current gain				
$-I_C$ = 0,1 mA; $-V_{CE}$ = 1 V	h_{FE}	>	60	
$-I_C$ = 1 mA; $-V_{CE}$ = 1 V	h_{FE}	>	80	
$-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}	>	100	
		<	300	
$-I_C$ = 50 mA; $-V_{CE}$ = 1 V	h_{FE}	>	60	
$-I_C$ = 100 mA; $-V_{CE}$ = 1 V	h_{FE}	>	30	
Collector capacitance at 100 kHz ⩽ f ⩽ 1 MHz				
$I_E = I_e = 0$; $-V_{CB}$ = 5 V	C_c	<	4,5	pF
Emitter capacitance at 100 kHz ⩽ f ⩽ 1 MHz				
$I_C = I_c = 0$; $-V_{EB}$ = 0,5 V	C_e	<	10	pF
Transition frequency at f = 100 MHz				
$-I_C$ = 10 mA; $-V_{CE}$ = 20 V; T_{amb} = 25 °C	f_T	>	250	MHz
Noise figure at R_S = 1 kΩ				
$-I_C$ = 100 μA; $-V_{CE}$ = 5 V				
f = 10 Hz to 15,7 kHz; T_{amb} = 25 °C	F	<	4,0	dB

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

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

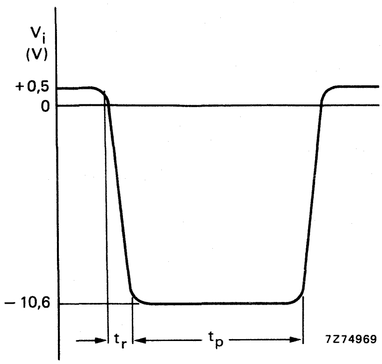


Fig. 2 Input waveform; $t_r < 1$ ns; t_p = 300 ns; δ = 0,02.

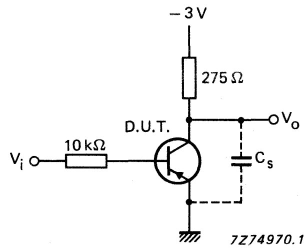


Fig. 3 Delay and rise time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

Turn-off time (see Figs 4 and 5)
$-I_{Con}$ = 10 mA; $-I_{Bon} = I_{Boff}$ = 1 mA

Storage time	t_s	<	225 ns
Fall time	t_f	<	75 ns

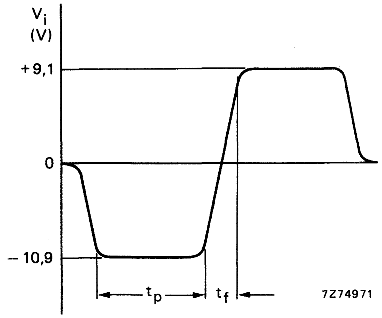


Fig. 4 Input waveform; $t_f < 1$ ns; 10 μs < t_p < 500 μs; δ = 0,02.

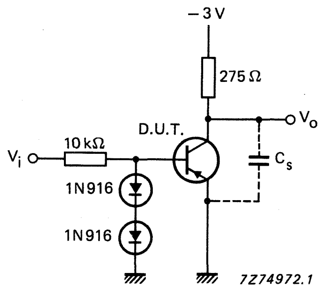


Fig. 5 Storage and fall time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

Data sheet	
status	Product specification
date of issue	September 1994

PZTA05/PZTA06
Silicon epitaxial transistors

DESCRIPTION

NPN transistors in a microminiature plastic package 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

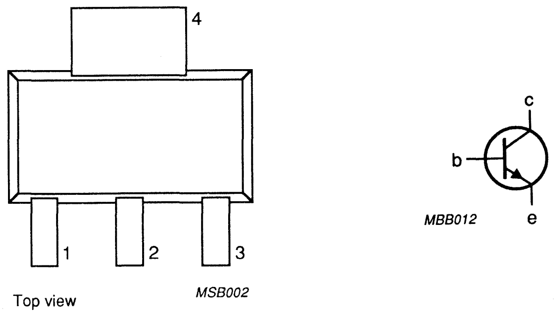


Fig.1 Simplified outline and symbol.

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 an FR4 printed-circuit board 8 mm x 10 mm x 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 package (SOT-223).
Designed primarily for preamplifier input applications requiring high input impedance.
PNP complement is the PZTA63/64.

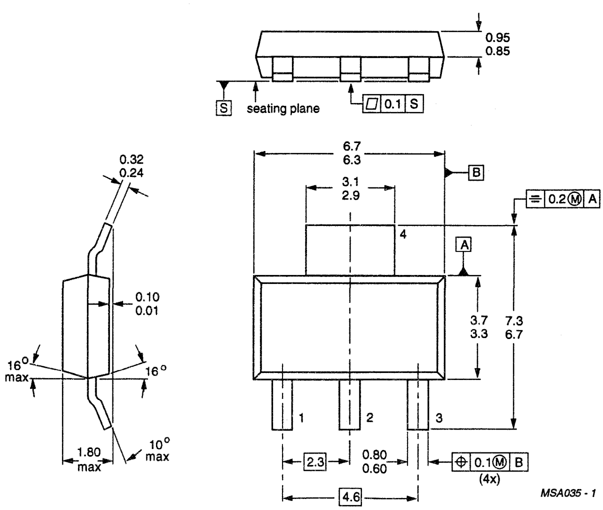
QUICK REFERENCE DATA

Collector-emitter voltage $V_{BE} = 0$		V_{CES}	max.	30 V
Collector current (DC)		I_C	max.	300 mA
Total power dissipation up to $T_{amb} = 25\ ^oC$		P_{tot}	max.	1,5 W
Junction temperature		T_j	max.	150 ^oC
DC current gain $I_C = 10$ mA; $V_{CE} = 5$ V	**PZTA13**	h_{FE}	min.	5000
	PZTA14	h_{FE}	min.	10 000
Transition frequency at f = 100 MHz $I_C = 10$ mA; $V_{CE} = 5$ V		f_T	min.	125 MHz

MECHANICAL DATA

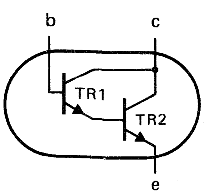
Dimensions in mm

Fig. 1 SOT-223



Pinning

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



RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage $V_{BE} = 0$	V_{CES}	max.	30	V
Emitter-base voltage (open collector)	V_{EBO}	max.	10	V
Collector current (DC)	I_C	max.	300	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$*	P_{tot}	max.	1,5	W
Storage temperature range	T_{stg}		−65 to +150	^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

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

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

Collector-emitter breakdown voltage $I_C = 100\ \mu A$		$V_{(BR)CES}$	min.	30	V
Emitter-base cut-off current $V_{BE} = 10\ V$		I_{EBO}	max.	0,1	μA
Collector-base cut-off current $V_{CB} = 30\ V$		I_{CBO}	max.	0,1	μA
DC current gain $I_C = 10\ mA;\ V_{CE} = 5\ V$	**PZTA13**	h_{FE}	min.	5000	
	PZTA14	h_{FE}	min.	10 000	
$I_C = 100\ mA;\ V_{CE} = 5\ V$	**PZTA13**	h_{FE}	min.	10 000	
	PZTA14	h_{FE}	min.	20 000	
Collector-emitter saturation voltage $I_C = 100\ mA;\ I_B = 0,1\ mA$		V_{CEsat}	max.	1,5	V
Base-emitter ON-voltage $I_C = 100\ mA;\ V_{CE} = 5\ V$		$V_{BE(on)}$	max.	2,0	V
Transition frequency at f = 100 MHz $I_C = 10\ mA;\ V_{CE} = 5\ V$		f_T	min.	125	MHz

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

SILICON EPITAXIAL TRANSISTORS

NPN transistors in a microminiature SMD package (SOT-223).
They are primarily intended for use in telephony and professional communication equipment.

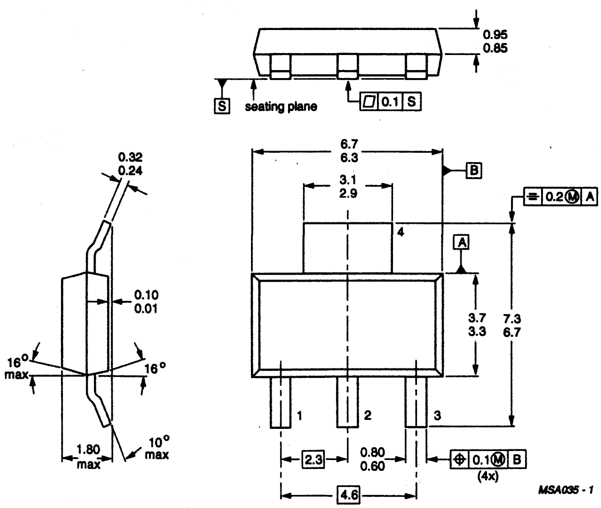
QUICK REFERENCE DATA

			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 = 100 MHz I_C = 10 mA; V_{CE} = 20 V	f_T	>	50		MHz
Feedback capacitance at f = 1 MHz I_C = 0; V_{CE} = 20 V	C_{re}	<	3	4	pF

MECHANICAL DATA

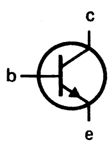
Dimensions in mm

Fig. 1 SOT-223



Pinning

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



RATINGS

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

			PZTA42	PZTA43	
Collector-base voltage (open emitter)	V_{CBO}	max.	300	200	V
Collector-emitter voltage (open base)	V_{CEO}	max.	300	200	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6		V
Collector current (DC)	I_C	max.	500		mA
Total power dissipation* up to T_{amb} = 25 °C	P_{tot}	max.	1,5		W
Storage temperature range	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL CHARACTERISTICS

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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			PZTA42	PZTA43	
Collector-emitter breakdown voltage** I_C = 1 mA; I_B = 0	$V_{(BR)CEO}$	>	300	200	V
Collector-base breakdown voltage I_C = 100 μA; I_E = 0	$V_{(BR)CBO}$	>	300	200	V
Emitter-base breakdown voltage I_E = 100 μA; I_C = 0	$V_{(BR)EBO}$	>	6	6	V
Collector cut-off current I_E = 0; V_{CB} = 200 V	I_{CBO}	<	0,1	–	μA
I_E = 0; V_{CB} = 160 V	I_{CBO}	<	–	0,1	μA
Emitter cut-off current I_C = 0; V_{BE} = 6 V	I_{EBO}	<	0,1	–	μA
I_C = 0; V_{BE} = 4 V	I_{EBO}	<	–	0,1	μA
Feedback capacitance at f = 1 MHz I_E = 0; V_{CB} = 20 V	C_{re}	<	3	4	pF

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

** Pulse test conditions t_p = 300 μs; δ = 0,02.

Saturation voltages				
I_C = 20 mA; I_B = 2 mA	V_{CEsat}	<	0,5	V
	V_{BEsat}	<	0,9	V
DC current gain				
I_C = 1 mA; V_{CE} = 10 V		>	25	
I_C = 10 mA; V_{CE} = 10 V	h_{FE}	>	40	
I_C = 30 mA; V_{CE} = 10 V		>	40	
Transition frequency at f = 100 MHz				
I_C = 10 mA; V_{CE} = 20 V	f_T	>	50	MHz

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

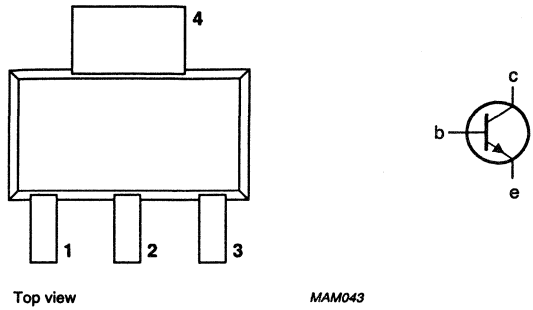


Fig.1 Simplified outline and symbol.

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_c	output capacitance	I_E = 0; V_{CB} = 20 V; f = 1 MHz	–	7	pF
C_e	input capacitance	I_C = 0; V_{EB} = 0.5 V; f = 1 MHz	–	180	pF

Note

1. Pulse test : $t_p \leq 300$ µs; $\delta \leq 0.02$.

Data sheet	
status	Product specification
date of issue	September 1994

PZTA55/PZTA56
Silicon epitaxial transistors

DESCRIPTION

PNP transistors in a microminiature plastic package, 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

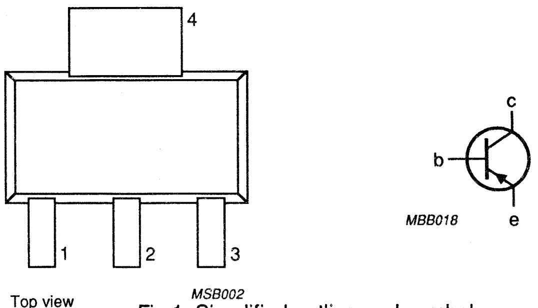


Fig.1 Simplified outline and symbol.

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 an FR4 printed-circuit board 8 mm x 10 mm x 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 package (SOT-223).
Designed primarily for preamplifier input applications requiring high input impedance.
NPN complement is the PZTA13/14.

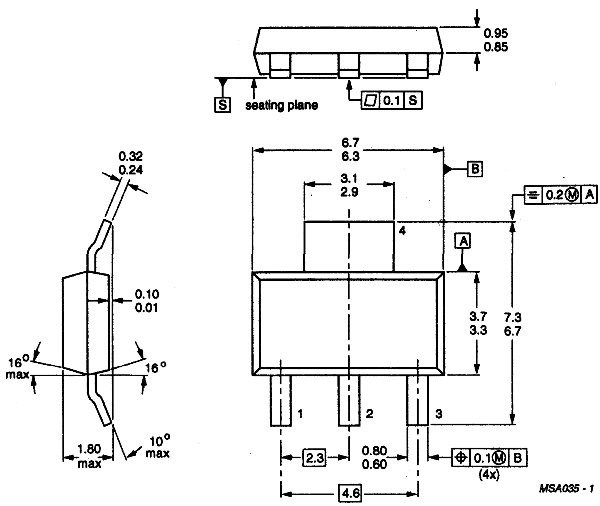
QUICK REFERENCE DATA

Collector-emitter voltage $V_{BE} = 0$		$-V_{CES}$	max.	30	V
Collector current (DC)		$-I_C$	max.	500	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$		P_{tot}	max.	1,5	W
Junction temperature		T_j	max.	150	^oC
DC current gain $-I_C = 10$ mA; $-V_{CE} = 5$ V	**PZTA63**	h_{FE}	min.	5000	
	PZTA64	h_{FE}	min.	10 000	
Transition frequency at f = 100 MHz $-I_C = 10$ mA; $-V_{CE} = 50$ V		f_T	min.	125	MHz

MECHANICAL DATA

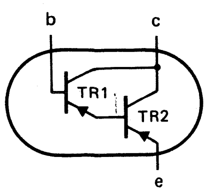
Dimensions in mm

Fig. 1 SOT-223



Pinning

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



RATINGS

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

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	30	V
Collector-emitter voltage $V_{BE} = 0$	$-V_{CES}$	max.	30	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	10	V
Collector current (DC)	$-I_C$	max.	500	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$*	P_{tot}	max.	1,5	W
Storage temperature range	T_{stg}		−65 to +150	^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	**PZTA63**	h_{FE}	min.	5000	
	PZTA64	h_{FE}	min.	10 000	
$-I_C = 100$ mA; $-V_{CE} = 5$ V	**PZTA63**	h_{FE}	min.	10 000	
	PZTA64	h_{FE}	min.	20 000	
Collector-emitter saturation voltage $-I_C = 100$ mA; $-I_B = 0,1$ mA		$-V_{CEsat}$	max.	1,5	V
Base-emitter ON-voltage $-I_C = 100$ mA; $-V_{CE} = 5$ V		$-V_{BE(on)}$	max.	2,0	V
Transition frequency at f = 100 MHz $-I_C = 10$ mA; $-V_{CE} = 50$ V; $T_{amb} = 25\ ^oC$		f_T	min.	125	MHz

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

SILICON EPITAXIAL TRANSISTORS

PNP transistors in a microminiature SMD package (SOT-223).
They are primarily intended for use in telephony and professional communication equipment.

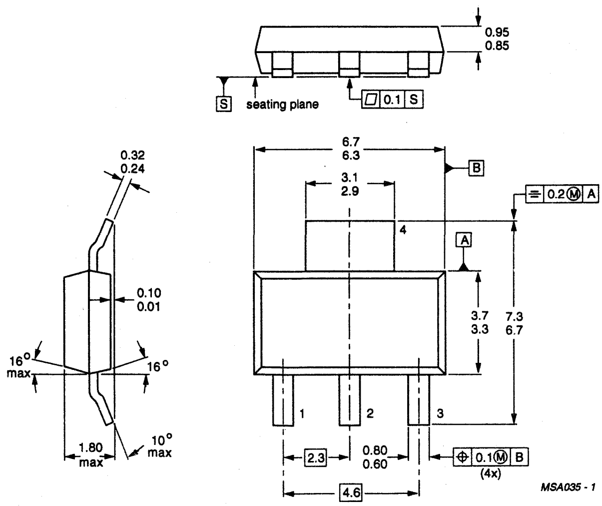
QUICK REFERENCE DATA

			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_c	max.	6	8	pF

MECHANICAL DATA

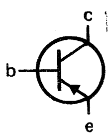
Dimensions in mm

Fig. 1 SOT-223



Pinning

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



RATINGS

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

			PZTA92	PZTA93	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	300	200	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	300	200	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5		V
Collector current (DC)	$-I_C$	max.	500		mA
Total power dissipation * up to T_{amb} = 25 °C	P_{tot}	max.	1,5		W
Storage temperature range	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL CHARACTERISTICS

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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			PZTA92	PZTA93	
Collector-emitter breakdown voltage $-I_C$ = 1 mA; I_B = 0	$-V_{(BR)CEO}$	min.	300	200	V
Collector-base breakdown voltage $-I_C$ = 100 µA; I_E = 0	$-V_{(BR)CBO}$	min.	300	200	V
Collector cut-off current $-V_{CB}$ = 200 V; I_E = 0	$-I_{CBO}$	max.	0,25	−	µA
$-V_{CB}$ = 160 V; I_E = 0	$-I_{CBO}$	max.	−	0,25	µA
Emitter-base breakdown voltage $-I_E$ = 100 µA; I_C = 0	$-V_{(BR)EBO}$	min.	5		V
Emitter cut-off current I_C = 0; $-V_{BE}$ = 3 V	$-I_{EBO}$	max.	0,1		µA
Collector-base capacitance at f = 1 MHz; I_E = 0; $-V_{CB}$ = 20 V	C_c	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 ≤2%.

N-P-N SILICON PLANAR TRANSISTOR

N-P-N transistors in TO-18 metal packages with the collector connected to the case.

These devices are primarily intended for use in high performance, low-level, low-noise amplifier applications both for direct current and for frequencies of up to 100 MHz.

QUICK REFERENCE DATA

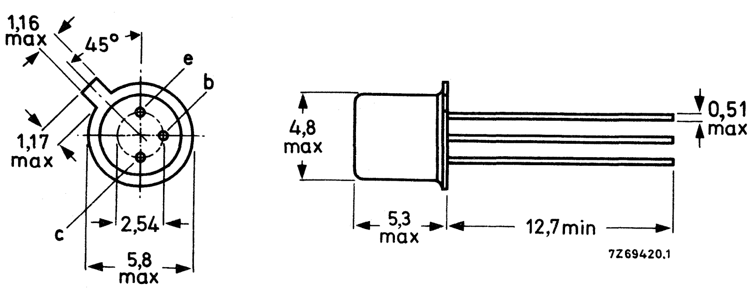
Collector-base voltage (open emitter)	V_{CBO}	max.	45	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	V
Collector current (peak value)	I_{CM}	max.	60	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Junction temperature	T_j	max.	175	°C
D.C. current gain at T_j = 25 °C I_C = 10 μA; V_{CE} = 5 V	h_{FE}	> <	100 300	
I_C = 10 mA; V_{CE} = 5 V	h_{FE}	> <	150 600	
Transition frequency I_C = 0,5 mA; V_{CE} = 5 V	f_T	typ.	80	MHz
Noise figure at R_S = 10 kΩ I_C = 10 μA; V_{CE} = 5 V f = 10 Hz to 15 kHz	F	typ. <	2 3	dB dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-18.

Collector connected to case.



RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	45	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	V
Collector-emitter voltage at $V_{EB} = 0$	V_{CES}	max.	45	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V
Collector current (d.c. or average over any 50 ms period)	I_C	max.	30	mA
Collector current (peak value)	I_{CM}	max.	60	mA
Emitter current (d.c. or average over any 50 ms period)	$-I_E$	max.	35	mA
Emitter current (peak value)	$-I_{EM}$	max.	70	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	300	mW
Storage temperature range	T_{stg}	−65 to + 150		^oC
Junction temperature	T_j	max.	175	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,5	K/mW
From junction to case	$R_{th\ j\text{-}c}$	=	0,25	K/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current		
$I_E = 0$; $V_{CB} = 45$ V	I_{CBO}	< 10 nA
$I_B = 0$; $V_{CE} = 5$ V	I_{CEO}	< 2 nA
$V_{EB} = 0$; $V_{CB} = 45$ V	I_{CES}	< 10 nA
Emitter cut-off current		
$I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	< 10 nA
Emitter-base voltage		
$-I_E = 0,5$ mA; $V_{CB} = 5$ V	$-V_{EB}$	0,6 to 0,8 V
Saturation voltages		
$I_C = 10$ mA; $I_B = 0,5$ mA	V_{CEsat}	< 1 V
	V_{BEsat}	0,6 to 1 V
D.C. current gain		
$I_C = 10\ \mu$A; $V_{CE} = 5$ V	h_{FE}	100 to 300
$I_C = 10\ \mu$A; $V_{CE} = 5$ V; $T_j = -55$ °C	h_{FE}	> 20
$I_C = 500\ \mu$A; $V_{CE} = 5$ V	h_{FE}	> 150
$I_C = 10$ mA; $V_{CE} = 5$ V	h_{FE}	150 to 600
Collector capacitance at f = 1 MHz		
$I_E = I_e = 0$; $V_{CB} = 5$ V	C_c	< 8 pF
Transition frequency		
$I_C = 0,5$ mA; $V_{CE} = 5$ V	f_T	> 50 MHz
Cut-off frequency		
$I_C = 0,5$ mA; $V_{CE} = 5$ V	f_{hfe}	> 100 kHz
Noise figure (f = 10 Hz to 15 kHz)		
$I_C = 10\ \mu$A; $V_{CE} = 5$ V; $R_S = 10$ kΩ	F	typ. 2 dB < 3 dB
h parameters at f = 1 kHz		
$I_C = 1$ mA; $V_{CE} = 5$ V		
Input impedance	h_{ie}	typ. 10,0 kΩ
Reverse voltage transfer	h_{re}	typ. 5,5 10^{-4}
Small signal current gain	h_{fe}	typ. 350 150 to 600
Output admittance	h_{oe}	typ. 25 μS

SILICON PLANAR TRANSISTOR

N-P-N double diffused transistor in a TO-39 metal package designed for a wide variety of applications including d.c. amplifiers, high-speed switching and high-speed amplifiers.

QUICK REFERENCE DATA

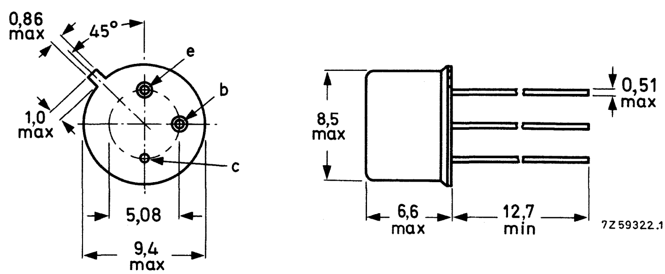
Collector-base voltage (open emitter)	V_{CBO}	max.	75	V
Collector-emitter voltage ($R_{BE} \leqslant 10\ \Omega$)	V_{CER}	max.	50	V
Collector current (peak value)	I_{CM}	max.	500	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	0,8	W
D.C. current gain at T_j = 25 °C I_C = 150 mA; V_{CE} = 10 V	h_{FE}		40 to 120	
Transition frequency at f = 20 MHz I_C = 50 mA; V_{CE} = 10 V	f_T	>	60	MHz

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case



Maximum lead diameter is guaranteed only for 12,7 mm.

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	75	V
Collector-emitter voltage ($R_{BE} \leqslant 10\ \Omega$)	V_{CER}	max.	50	V
Emitter-base voltage (open collector)	V_{EBO}	max.	7	V
Collector current (peak value)*	I_{CM}	max.	500	mA
Total power dissipation				
up to T_{amb} = 25 °C	P_{tot}	max.	0,8	W
at T_{case} = 100 °C	P_{tot}	max.	1,7	W
up to T_{case} = 25 °C	P_{tot}	max.	3,0	W
Storage temperature range	T_{stg}	−65 to + 150		°C
Junction temperature	T_j	max.	200	°C
Lead soldering temperature				
> 1,5 mm from the seating plane; t_{sld} < 10 s.	T_{sld}	max.	300	°C

THERMAL RESISTANCE

From junction to case	$R_{th\ j\text{-}c}$	=	58,3	K/W

* With the exception of the collector current all other data are Jedec registered.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0$; $V_{CB} = 60$ V	I_{CBO}	<	10 nA
$I_E = 0$; $V_{CB} = 60$ V; $T_{amb} = 150$ °C	I_{CBO}	<	10 μA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	<	10 nA
Collector-base breakdown voltage			
open emitter; $I_C = 100$ μA	$V_{(BR)CBO}$	>	75 V
Collector-emitter breakdown voltage*			
$I_C = 100$ mA; $R_{BE} \leqslant 10\ \Omega$	$V_{(BR)CER}$	>	50 V
Emitter-base breakdown voltage			
open collector; $I_E = 100$ μA	$V_{(BR)EBO}$	>	7 V
Saturation voltages*			
$I_C = 150$ mA; $I_B = 15$ mA	V_{CEsat}	<	1,5 V
	V_{BEsat}	<	1,3 V
D.C. current gain			
$I_C = 0,1$ mA; $V_{CE} = 10$ V	h_{FE}	>	20
$I_C = 10$ mA; $V_{CE} = 10$ V*	h_{FE}	>	35
$I_C = 10$ mA; $V_{CE} = 10$ V; $T_{amb} = -55$ °C	h_{FE}	>	20
$I_C = 150$ mA; $V_{CE} = 10$ V*	h_{FE}		40 to 120
$I_C = 500$ mA; $V_{CE} = 10$ V*	h_{FE}	>	20
Transition frequency at f = 20 MHz			
$I_C = 50$ mA; $V_{CE} = 10$ V	f_T	>	60 MHz
Collector capacitance			
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	<	25 pF
Emitter capacitance			
$I_C = I_c = 0$; $V_{EB} = 0,5$ V	C_e	<	80 pF
Noise figure at f = 1 kHz			
$I_C = 0,3$ mA; $V_{CE} = 10$ V; $R_S = 510\ \Omega$; B = 1 Hz	F	<	12 dB

h-parameters at f = 1 kHz

Input impedance			
$I_C = 1$ mA; $V_{CB} = 5$ V	h_{ib}		24 to 34 Ω
$I_C = 5$ mA; $V_{CB} = 10$ V	h_{ib}		4 to 8 Ω
Reverse voltage transfer ratio			
$I_C = 1$ mA; $V_{CE} = 5$ V	h_{rb}	<	3 10^{-4}
$I_C = 5$ mA; $V_{CE} = 10$ V	h_{rb}	<	3 10^{-4}
Small-signal current gain			
$I_C = 1$ mA; $V_{CE} = 5$ V	h_{fe}		30 to 100
$I_C = 5$ mA; $V_{CE} = 10$ V	h_{fe}		35 to 150

* Measured under pulse conditions to avoid excessive dissipation: $t_p = 300$ μs; $\delta \leqslant 0,02$.

Output admittance			
$I_C = 1$ mA; $V_{CE} = 5$ V	h_{ob}		0,05 to 0,5 μS
$I_C = 5$ mA; $V_{CE} = 10$ V	h_{ob}		0,05 to 0,5 μS
Total switching time (see Figs 3 to **5**)			
$I_{Con} = 50$ mA; $V_{BEon} = -V_{BEoff} = 1$ V	$t_{on} + t_{off}$	<	30 ns

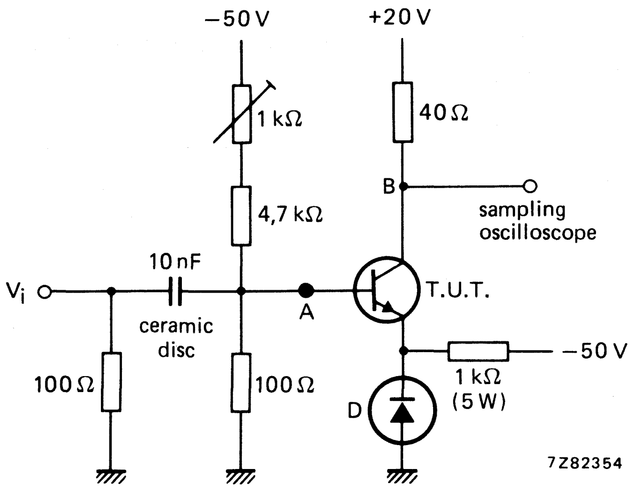


Fig. 2 Turn-on plus turn-off measuring circuit. D = BAW62.

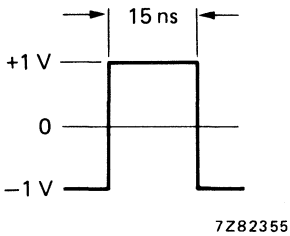


Fig. 3 Waveform at "A".
Pulse generator: t_r; $t_f < 1$ ns.

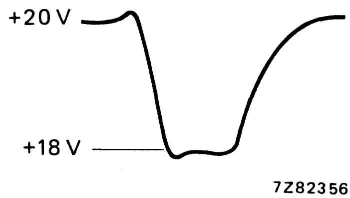


Fig. 4 Waveform at "B".

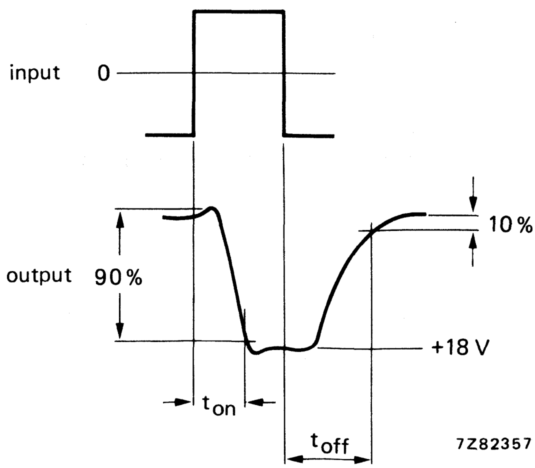


Fig. 5 Turn-on and turn-off time.

SILICON PLANAR TRANSISTOR

N-P-N double diffused transistor in a TO-39 metal package designed for a wide variety of applications such as d.c. and wideband amplifiers.

QUICK REFERENCE DATA

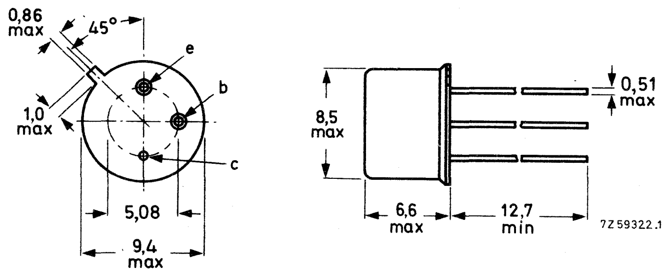
Collector-base voltage (open emitter)	V_{CBO}	max.	75	V
Collector-emitter voltage ($R_{BE} \leqslant 10\ \Omega$)	V_{CER}	max.	50	V
Collector current (peak value)	I_{CM}	max.	1,0	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	0,8	W
D.C. current gain I_C = 150 mA; V_{CE} = 10 V	h_{FE}		100 to 300	
Transition frequency at f = 20 MHz I_C = 50 mA; V_{CE} = 10 V	f_T	>	70	MHz

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case



Maximum lead diameter is guaranteed only for 12,7 mm.

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	75	V
Collector-emitter voltage ($R_{BE} \leqslant 10\ \Omega$)	V_{CER}	max.	50	V
Emitter-base voltage (open collector)	V_{EBO}	max.	7,0	V
Collector current (peak value)	I_{CM}	max.	1,0	A
Total power dissipation				
up to T_{amb} = 25 °C	P_{tot}	max.	0,8	W
up to T_{case} = 100 °C	P_{tot}	max.	1,7	W
up to T_{case} = 25 °C	P_{tot}	max.	3,0	W
Storage temperature range	T_{stg}	−65 to + 150		°C
Junction temperature	T_j	max.	200	°C
Lead soldering temperature				
> 1,5 mm from the seating plane; t_{sld} < 10 s	T_{sld}	max.	300	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	219	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	58,3	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector cut-off current			
I_E = 0; V_{CB} = 60 V	I_{CBO}	<	10 nA
I_E = 0; V_{CB} = 60 V; T_{amb} = 150 °C	I_{CBO}	<	10 μA
Emitter cut-off current			
I_C = 0; V_{EB} = 5,0 V	I_{EBO}	<	5 nA
Collector-base breakdown voltage			
open emitter; I_C = 100 μA	$V_{(BR)CBO}$	>	75 V
Emitter-base breakdown voltage			
open collector; I_E = 100 μA	$V_{(BR)EBO}$	>	7,0 V
Collector-emitter sustaining voltage *			
I_C = 100 mA; $R_{BE} \leqslant$ 10 Ω	$V_{CERsust}$	>	50 V
Saturation voltages *			
I_C = 150 mA; I_B = 15 mA	V_{CEsat}	<	0.5 V
	V_{BEsat}	<	1.3 V
D.C. current gain			
I_C = 10 μA ; V_{CE} = 10 V	h_{FE}	>	20
I_C = 0,1 mA; V_{CE} = 10 V	h_{FE}	>	35
I_C = 10 mA; V_{CE} = 10 V *	h_{FE}	>	75
I_C = 10 mA; V_{CE} = 10 V; T_{amb} = −55 °C	h_{FE}	>	35
I_C = 150 mA; V_{CE} = 10 V *	h_{FE}		100 to 300
I_C = 500 mA; V_{CE} = 10 V *	h_{FE}	>	40
Transition frequency at f = 20 MHz			
I_C = 50 mA; V_{CE} = 10 V	f_T	>	70 MHz
Collector capacitance			
I_E = I_e = 0; V_{CB} = 10 V	C_c	<	25 pF
Emitter capacitance			
I_C = I_c = 0; V_{EB} = 0,5 V	C_e	<	80 pF
Noise figure at f = 1 kHz			
I_C = 300 μA; V_{CE} = 10 V; R_S = 510 Ω; B = 1 Hz	F	<	8,0 dB

h-parameters at f = 1 kHz

Input impedance			
I_C = 1,0 mA; V_{CB} = 5,0 V	h_{ib}		24 to 34 Ω
I_C = 5,0 mA; V_{CB} = 10 V	h_{ib}		4,0 to 8,0 Ω
Reverse voltage transfer ratio			
I_C = 1,0 mA; V_{CB} = 5,0 V	h_{rb}	<	5,0 10^{-4}
I_C = 5,0 mA; V_{CB} = 10 V	h_{rb}	<	5,0 10^{-4}
Small-signal current gain			
I_C = 1,0 mA; V_{CE} = 5,0 V	h_{fe}		50 to 200
I_C = 5,0 mA; V_{CE} = 10 V	h_{fe}		70 to 300

* Measured under pulse conditions to avoid excessive dissipation: $t_p \leqslant$ 300 μs; $\delta \leqslant$ 0,02.

Output admittance		
I_C = 1,0 mA; V_{CE} = 5,0 V	h_{ob}	0,05 to 0,5 μS
I_C = 5,0 mA; V_{CE} = 10 V	h_{ob}	0,05 to 0,5 μS

SILICON TRANSISTOR

High voltage n-p-n transistor in a TO-39 metal package with the collector connected to the case. It is intended for use in high performance amplifier, oscillator and switching applications.

QUICK REFERENCE DATA

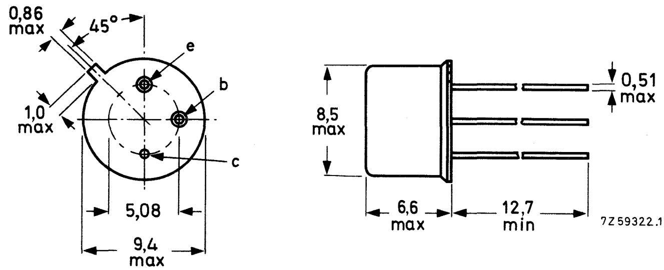
Collector-base voltage (open emitter)	V_{CBO}	max.	120	V
Collector-emitter voltage ($R_{BE} \leqslant 10\ \Omega$)	V_{CER}	max.	100	V
Collector current (d.c.)	I_C	max.	500	mA
Total power dissipation up to $T_{case} = 25\ ^oC$	P_{tot}	max.	3,0	W
Junction temperature	T_j	max.	200	^oC
D.C. current gain				
$I_C = 0,1$ mA; $V_{CE} = 10$ V	h_{FE}	>	20	
$I_C = 10$ mA; $V_{CE} = 10$ V; $T = -55\ ^oC$	h_{FE}	>	20	
$I_C = 10$ mA; $V_{CE} = 10$ V	h_{FE}	>	35	
$I_C = 150$ mA; $V_{CE} = 10$ V	h_{FE}	40 to	120	

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case



Maximum lead diameter is guaranteed only for 12,7 mm.

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	120	V
Collector-emitter voltage (open base)	V_{CEO}	max.	80	V
Collector-emitter voltage ($R_{BE} \leqslant 10\ \Omega$)	V_{CER}	max.	100	V
Emitter-base voltage (open collector)	V_{EBO}	max.	7	V
Collector current (d.c.)	I_C	max.	500	mA
Total power dissipation				
up to T_{amb} = 25 °C	P_{tot}	max.	0,8	W
up to T_{case} = 100 °C	P_{tot}	max.	1,7	W
up to T_{case} = 25 °C	P_{tot}	max.	3,0	W
Storage temperature range	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	219	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	58,3	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0$; $V_{CB} = 90$ V	I_{CBO}	<	10 nA
$I_E = 0$; $V_{CB} = 90$ V; $T_{amb} = 150$ °C	I_{CBO}	<	15 μA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	<	10 nA
Collector-emitter sustaining voltage *			
$I_C = 100$ mA; $R_{BE} \geqslant 10\ \Omega$	$V_{CERsust}$	>	100 V
$I_C = 30$ mA; $I_B = 0$	$V_{CEOsust}$	>	80 V
Saturation voltages *			
$I_C = 150$ mA; $I_B = 15$ mA	V_{CEsat}	<	0.5 V
	V_{BEsat}	<	1.3 V
$I_C = 50$ mA; $I_B = 5$ mA	V_{CEsat}	<	0.9 V
	V_{BEsat}	<	1.2 V
Breakdown voltages			
$I_E = 0$; $I_C = 100$ μA	$V_{(BR)CBO}$	>	120 V
$I_C = 0$; $I_E = 100$ μA	$V_{(BR)EBO}$	>	7,0 V
D.C. current gain			
$I_C = 0{,}1$ mA; $V_{CE} = 10$ V	h_{FE}	>	20
$I_C = 10$ mA; $V_{CE} = 10$ V; T = –55 °C	h_{FE}	>	20
$I_C = 10$ mA; $V_{CE} = 10$ V *	h_{FE}	>	35
$I_C = 150$ mA; $V_{CE} = 10$ V *	h_{FE}		40 to 120

* Measured under pulsed conditions to avoid excessive dissipation.
Pulse duration $t \leqslant 300$ μs, duty cycle $\delta < 0{,}02$.

CHARACTERISTICS (continued)

h parameters at f = 1 kHz (common base)

I_C = 1 mA; V_{CE} = 5 V			
Input impedance	h_{ib}		20 to 30 Ω
Reverse voltage transfer ratio	h_{rb}		1,25 10^{-4}
Output conductance	h_{ob}		0,5 μS
I_C = 5 mA; V_{CE} = 10 V			
Input impedance	h_{ib}		4 to 8 Ω
Reverse voltage transfer ratio	h_{rb}		1,50 10^{-4}
Output conductance	h_{ob}		0,5 μS
Small signal current gain (common emitter)			
I_C = 1 mA; V_{CE} = 5 V; f = 1 kHz	h_{fe}		30 to 100
I_C = 5 mA; V_{CE} = 10 V; f = 1 kHz	h_{fe}	>	45
I_C = 50 mA; V_{CE} = 10 V; f = 20 MHz	h_{fe}	>	2,5
Collector capacitance			
$I_E = I_e = 0$; V_{CB} = 10 V	C_c	<	15 pF
Emitter capacitance			
$I_C = I_c = 0$; V_{EB} = 0,5 V	C_e	<	85 pF

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in a TO-39 metal package with the collector connected to the case. They are primarily intended for high speed switching. The 2N2219 is also suitable for d.c. and v.h.f./u.h.f. amplifiers.

QUICK REFERENCE DATA

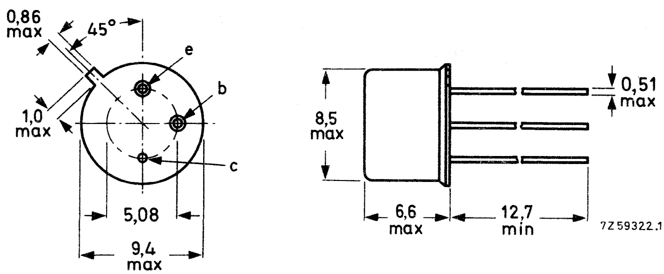
			2N2219	2N2219A	
Collector-base voltage (open emitter)	V_{CBO}	max.	60	75	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	40	V
Collector current (d.c.)	I_C	max.	800	800	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	0,8	0,8	W
Junction temperature	T_j	max.	200	200	°C
D.C. current gain at T_j = 25 °C					
I_C = 10 mA; V_{CE} = 10 V	h_{FE}	>	75	75	
Transition frequency at f = 100 MHz					
I_C = 20 mA; V_{CE} = 20 V	f_T	>	250	300	MHz
Storage time					
I_C = 150 mA; I_B = $-I_{BM}$ = 15 mA	t_s	<	–	225	ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case



Maximum lead diameter is guaranteed only for 12,7 mm.

RATINGS

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

			2N2219	2N2219A	
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.	0,8		W
up to T_{case} = 25 °C	P_{tot}	max.	3		W
Storage temperature range	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	200		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	190	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	50	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			2N2219	2N2219A	
Collector cut-off current					
$I_E = 0$; V_{CB} = 50 V	I_{CBO}	<	10	–	nA
$I_E = 0$; V_{CB} = 50 V; T_{amb} = 150 °C	I_{CBO}	<	10	–	μA
$I_E = 0$; V_{CB} = 60 V	I_{CBO}	<	–	10	nA
$I_E = 0$; V_{CB} = 60 V; T_{amb} = 150 °C	I_{CBO}	<	–	10	μA
Emitter cut-off current					
$I_C = 0$; V_{EB} = 3 V	I_{EBO}	<	10	10	nA
Currents at reverse biased emitter junction					
V_{CE} = 60 V; $-V_{BE}$ = 3 V	I_{CEX}	<	–	10	nA
	$-I_{BEX}$	<	–	20	nA

* Applicable up to I_C = 500 mA

			2N2219	2N2219A	
Breakdown voltages					
$I_E = 0; I_C = 10\ \mu A$	$V_{(BR)CBO}$	>	60	75	V
$I_B = 0; I_C = 10$ mA	$V_{(BR)CEO}$	>	30	40	V
$I_C = 0; I_E = 10\ \mu A$	$V_{(BR)EBO}$	>	5	6	V
Saturation voltages *					
$I_C = 150$ mA; $I_B = 15$ mA	V_{CEsat}	<	0,4	0,3	V
	V_{BEsat}	>	–	0,6	V
		<	1,3	1,2	V
$I_C = 500$ mA; $I_B = 50$ mA	V_{CEsat}	<	1,6	1,0	V
	V_{BEsat}	<	2,6	2,0	V
D.C. current gain					
$I_C =$ 0,1 mA; $V_{CE} = 10$ V	h_{FE}	>	35	35	
$I_C =$ 1 mA; $V_{CE} = 10$ V	h_{FE}	>	50	50	
$I_C =$ 10 mA; $V_{CE} = 10$ V	h_{FE}	>	75	75	
$I_C =$ 10 mA; $V_{CE} = 10$ V; $T_{amb} = -55\ ^oC$	h_{FE}	>	–	35	
$I_C = 150$ mA; $V_{CE} =$ 1 V *	h_{FE}	>	50	50	
$I_C = 150$ mA; $V_{CE} = 10$ V *	h_{FE}		100 to 300	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
Collector capacitance at f = 100 kHz					
$I_E = I_e = 0; V_{CB} = 10$ V	C_c	<	8	8	pF
Emitter capacitance at f = 100 kHz					
$I_C = I_c = 0; V_{EB} = 0,5$ V	C_e	<	–	25	pF
Feedback time constant at f = 31,8 MHz					
$I_C = 20$ mA; $V_{CE} = 20$ V	$r_{b'}C_c$	<	–	150	ps

* Pulse duration ⩽ 300 μs; duty cycle ⩽ 2%.

h-parameters (common emitter)

			2N2219	2N2219A
I_C = 1 mA; V_{CE} = 10 V; f = 1 kHz				
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; f = 1 kHz				
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
I_C = 20 mA; V_{CE} = 20 V; f = 100 MHz				
Small signal current gain	h_{fe}	>	2,5	3,0
I_C = 20 mA; V_{CE} = 20 V; f = 300 MHz Real part of input impedance	$Re(h_{ie})$	<	60	60 Ω
Noise figure at f = 1 kHz I_C = 0,1 mA; V_{CE} = 10 V R_G = 1 kΩ; B = 1 Hz	F	<	–	4 dB
Switching times for 2N2219A Turn on time when wsitched from $-V_{BE}$ = 0,5 V to I_C = 150 mA; I_B = 15 mA				
Delay time	t_d	<		10 ns
Rise time	t_r	<		25 ns

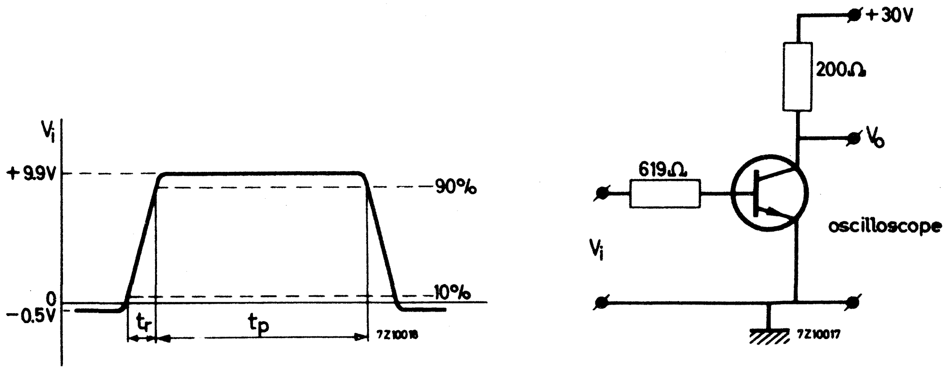


Fig. 2 Test circuit and waveforms.

Pulse generator:

pulse duration	$t_p \leqslant$ 200 ns
rise time	$t_r \leqslant$ 2 ns

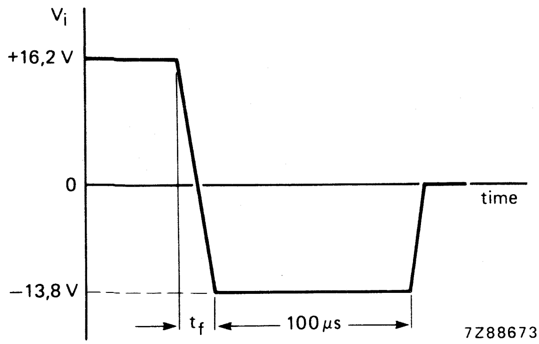
Oscilloscope:

input resistance	$R_i >$ 100 kΩ
input capacitance	$C_i <$ 12 pF
rise time	$t_r <$ 5 ns

Switching times for 2N2219A

Turn off time
I_C = 150 mA; I_B = $-I_{BM}$ = 15 mA

Storage time	t_s	<	225 ns
Fall time	t_f	<	60 ns



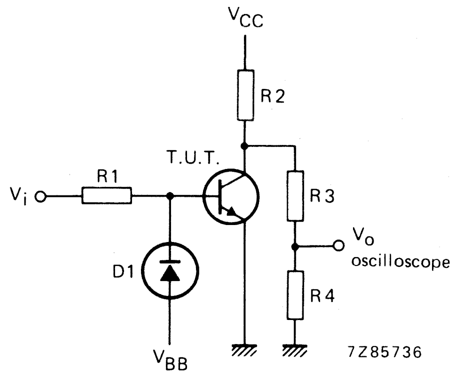


Fig. 3 Test circuit and waveform.
V_{CC} = + 30 V; V_{BB} = −3 V; R1 = 1 kΩ; R2 = 200 Ω; R3 = 20 kΩ; R4 = 50 Ω; D1 = 1N916.

Pulse generator:

fall time	t_f	<	5 ns

Oscilloscope:

input impedance	R_i	>	100 kΩ
input capacitance	C_i	<	12 pF
rise time	t_r	<	5 ns

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in a TO-18 metal package with the collector connected to the case. They are primarily intended for high speed switching. The 2N2222 is also suitable for d.c. and v.h.f./u.h.f. amplifiers.

QUICK REFERENCE DATA

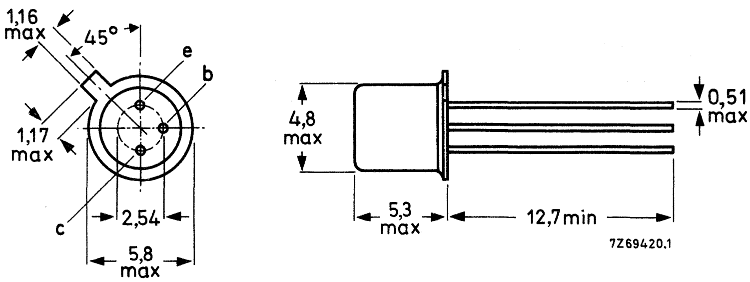
			2N2222	2N2222A	
Collector-base voltage (open emitter)	V_{CBO}	max.	60	75	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	40	V
Collector current (d.c.)	I_C	max.	800	800	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	0,5	0,5	W
Junction temperature	T_j	max.	200	200	°C
D.C. current gain at T_j = 25 °C; I_C = 10 mA; V_{CE} = 10 V	h_{FE}	>	75	75	
Transition frequency at f = 100 MHz; I_C = 20 mA; V_{CE} = 20 V	f_T	>	250	300	MHz
Storage time; I_C = 150 mA; $I_B = -I_{BM}$ = 15 mA	t_s	<	–	225	ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-18.

Collector connected to case



RATINGS

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

			2N2222	2N2222A	
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.	0,5		W
up to T_{case} = 25 °C	P_{tot}	max.	1,2		W
Storage temperature range	T_{stg}		−65 to + 150		°C
Junction temperature	T_j	max.	200		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	350	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	146	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			2N2222	2N2222A	
Collector cut-off current					
I_E = 0; V_{CB} = 50 V	I_{CBO}	<	10	–	nA
I_E = 0; V_{CB} = 50 V; T_{amb} = 150 °C	I_{CBO}	<	10	–	μA
I_E = 0; V_{CB} = 60 V	I_{CBO}	<	–	10	nA
I_E = 0; V_{CB} = 60 V; T_{amb} = 150 °C	I_{CBO}	<	–	10	μA
Emitter cut-off current					
I_C = 0; V_{EB} = 3 V	I_{EBO}	<	10	10	nA
Currents at reverse biased emitter junction					
V_{CE} = 60 V; $-V_{BE}$ = 3 V	I_{CEX}	<	–	10	nA
	$-I_{BEX}$	<	–	20	nA

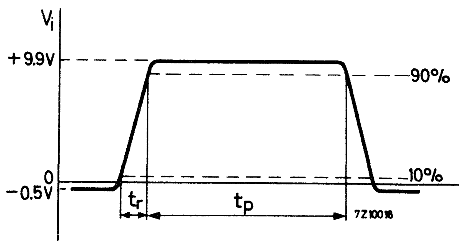
* Applicable up to I_C = 500 mA.

			2N2222	2N2222A	
Breakdown voltages					
$I_E = 0$; $I_C = 10\ \mu A$	$V_{(BR)CBO}$	>	60	75	V
$I_B = 0$; $I_C = 10$ mA	$V_{(BR)CEO}$	>	30	40	V
$I_C = 0$; $I_E = 10\ \mu A$	$V_{(BR)EBO}$	>	5	6	V
Saturation voltages *					
$I_C = 150$ mA; $I_B = 15$ mA	V_{CEsat}	<	0,4	0,3	V
	V_{BEsat}	>	–	0,6	V
		<	1,3	1,2	V
$I_C = 500$ mA; $I_B = 50$ mA	V_{CEsat}	<	1,6	1,0	V
	V_{BEsat}	<	2,6	2,0	V
D.C. current gain					
$I_C = 0,1$ mA; $V_{CE} = 10$ V	h_{FE}	>	35	35	
$I_C = 1$ mA; $V_{CE} = 10$ V	h_{FE}	>	50	50	
$I_C = 10$ mA; $V_{CE} = 10$ V	h_{FE}	>	75	75	
$I_C = 10$ mA; $V_{CE} = 10$ V; $T_{amb} = -55\ ^oC$	h_{FE}	>	–	35	
$I_C = 150$ mA; $V_{CE} = 1$ V *	h_{FE}	>	50	50	
$I_C = 150$ mA; $V_{CE} = 10$ V *	h_{FE}		100 to 300	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
Collector capacitance at f = 100 kHz					
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	<	8	8	pF
Emitter capacitance at f = 100 kHz					
$I_C = I_c = 0$; $V_{EB} = 0,5$ V	C_e	<	–	25	pF
Feedback time constant at f = 31,8 MHz					
$I_C = 20$ mA; $V_{CE} = 20$ V	r_b, C_c	<	–	150	ps

* Pulse duration ≤ 300 μs; duty cycle ≤ 2%.

h-parameters (common emitter)

			2N2222	2N2222A	
I_C = 1 mA; V_{CE} = 10 V; f = 1 kHz					
Input impedance	h_{ie}			2 to 8	kΩ
Reverse voltage transfer ratio	h_{re}	<		8	10^{-4}
Small signal current	h_{fe}			50 to 300	
Output admittance	h_{oe}			5 to 35	μS
I_C = 10 mA; V_{CE} = 10 V; f = 1 kHz					
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
I_C = 20 mA; V_{CE} = 20 V; f = 100 MHz			2N2222	2N2222A	
Small signal current gain	h_{fe}	>	2,5	3,0	
I_C = 20 mA; V_{CE} = 20 V; f = 300 MHz					
Real part of input impedance	Re(h_{ie})	<	60	60	Ω
Noise figure at f = 1 kHz; I_C = 0,1 mA; V_{CE} = 10 V; R_G = 1 kΩ; B = 1 Hz	F	<	–	4	dB
Switching times for 2N2222A					
Turn on time when switched from $-V_{BE}$ = 0,5 V to I_C = 150 mA; I_B = 15 mA					
Delay time	t_d	<		10	ns
Rise time	t_r	<		25	ns



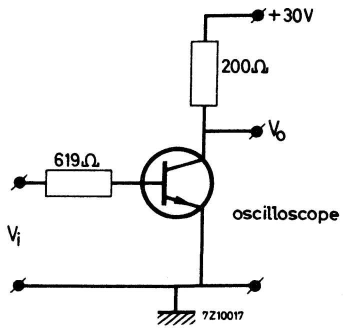


Fig. 2 Test circuit and waveform.

Pulse generator:

pulse duration $t_p \leqslant$ 200 ns
rise time $t_r \leqslant$ 2 ns

Oscilloscope:

input resistance R_i > 100 kΩ
input capacitance C_i < 12 pF
rise time t_r < 5 ns

Switching times for 2N2222A

Turn off time

$I_C = 150$ mA; $I_B = -I_{BM} = 15$ mA

Storage time	t_s	<	225	ns
Fall time	t_f	<	60	ns

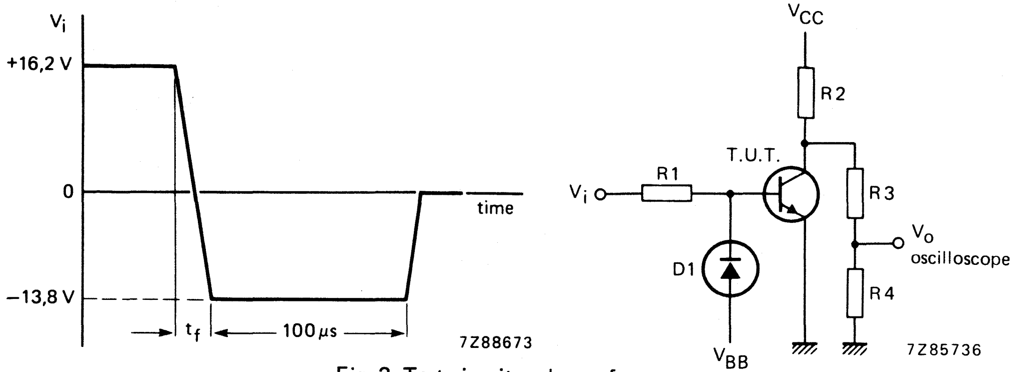


Fig. 3 Test circuit and waveform.

$V_{CC} = +30$ V; $V_{BB} = -3$ V; R1 = 1 kΩ; R2 = 200 Ω; R3 = 20 kΩ; R4 = 50 Ω; D1 = 1N916.

Pulse generator:

fall time	t_f	<	5	ns

Oscilloscope:

input impedance	R_i	>	100	kΩ
input capacitance	C_i	<	12	pF
rise time	t_r	<	5	ns

SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor intended for large signal h.f. and v.h.f. amplifier applications.

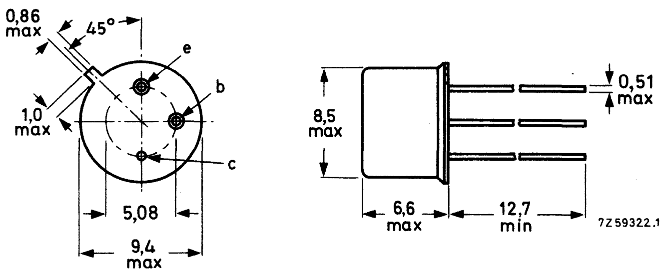
QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	80	V
Collector-emitter voltage (open base)	V_{CEO}	max.	35	V
Collector current (d.c.)	I_C	max.	1,0	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	0,8	W
Junction temperature	T_j	max.	200	°C
D.C. current gain I_C = 150 mA; V_{CE} = 10 V	h_{FE}		40 to 120	
Transition frequency at f = 20 MHz I_C = 50 mA; V_{CE} = 10 V	f_T	>	60	MHz

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39; collector connected to case.



Maximum lead diameter is guaranteed only for 12,7 mm.

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	80	V
Collector-emitter voltage (open base)	V_{CEO}	max.	35	V
Emitter-base voltage (open collector)	V_{EBO}	max.	7,0	V
Collector current (d.c.)	I_C	max.	1,0	A
Total power dissipation				
up to T_{case} = 25 °C	P_{tot}	max.	5,0	W
up to T_{case} = 100 °C	P_{tot}	max.	2,8	W
up to T_{amb} = 25 °C	P_{tot}	max.	0,8	W
Storage temperature range	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to case	$R_{th\ j\text{-}c}$	=	35	K/W
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	219	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0$; $V_{CB} = 60$ V	I_{CBO}	<	10 nA
$I_E = 0$; $V_{CB} = 60$ V; $T_{amb} = 150$ °C	I_{CBO}	<	10 μA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 5{,}0$ V	I_{EBO}	<	10 nA
Collector-emitter sustaining voltage*			
$I_C = 30$ mA; $I_B = 0$	$V_{CEOsust}$	>	35 V
Saturation voltages*			
$I_C = 150$ mA; $I_B = 15$ mA	V_{CEsat}	<	0,2 V
$I_C = 1$ A; $I_B = 100$ mA**	V_{CEsat}	<	1,0 V
	V_{BEsat}	<	1,6 V
D.C. current gain*			
$I_C = 10$ mA; $V_{CE} = 10$ V	h_{FE}	>	30
$I_C = 150$ mA; $V_{CE} = 10$ V	h_{FE}		40 to 120
$I_C = 1{,}0$ A; $V_{CE} = 10$ V	h_{FE}	>	15
Feedback time constant			
$I_C = 10$ mA; $V_{CB} = 10$ V; f = 4,0 MHz	$r_{bb'} C_{b'c}$	<	800 ps
Collector capacitance at f = 500 kHz			
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	<	12 pF
Emitter capacitance at f = 500 kHz			
$I_C = I_c = 0$; $V_{EB} = 0{,}5$ V	C_e	<	80 pF
Transition frequency at f = 20 MHz			
$I_C = 50$ mA; $V_{CE} = 10$ V	f_T	>	60 MHz

* Measured under pulse conditions to avoid excessive dissipation: $t_p = 300\ \mu s$; $\delta \leqslant 0{,}01$.

** Measured with a lead length of 1 cm.

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistor in a TO-18 metal package with the collector connected to the case. The 2N2369 is primarily intended for use in very high-speed saturated switching and v.h.f. amplification.

QUICK REFERENCE DATA

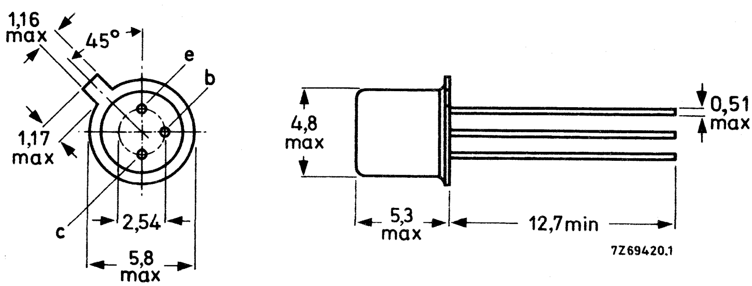
Collector-base voltage (open emitter)	V_{CBO}	max.	40	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	V
Collector current (peak value)	I_{CM}	max.	500	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	360	mW
Junction temperature	T_j	max.	200	°C
D.C. current gain at T_j = 25 °C I_C = 10 mA; V_{CE} = 1 V	h_{FE}		40 to 120	
Transition frequency I_C = 10 mA; V_{CE} = 10 V	f_T	>	500	MHz
Storage time $I_C = I_B = -I_{BM}$ = 10 mA	t_s	<	13	ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-18.

Collector connected to case



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.	15	V
Collector-emitter voltage with $V_{BE} = 0$	V_{CES}	max.	40	V
Emitter-base voltage (open collector)	V_{EBO}	max.	4,5	V
Collector current (peak value; t = 10 μs)	I_{CM}	max.	500	mA
Total power dissipation up to T_{amb} = 25 ^{o}C	P_{tot}	max.	360	mW
Storage temperature range	T_{stg}		−65 to +150	^{o}C
Junction temperature	T_j	max.	200	^{o}C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	480	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	145	K/W

CHARACTERISTICS

T_j = 25 ^{o}C unless otherwise specified

Collector cut-off current				
$I_E = 0$; V_{CB} = 20 V	I_{CBO}	<	0,4	μA
$I_E = 0$; V_{CB} = 20 V; T_j = 150 ^{o}C	I_{CBO}	<	30	μA
Sustaining voltage *				
I_C = 10 mA; $I_B = 0$	$V_{CEOsust}$	>	15	V*
Saturation voltages				
I_C = 10 mA; I_B = 1 mA	V_{CEsat}	<	0,25	V
	V_{BEsat}		0,7 to 0,85	V
Collector capacitance at f = 140 kHz				
$I_E = I_e = 0$; V_{CB} = 5 V	C_c	<	4	pF
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_j = −55 ^{o}C	h_{FE}	>	20	
I_C = 100 mA; V_{CE} = 2 V	h_{FE}	>	20	
Transition frequency				
I_C = 10 mA; V_{CE} = 10 V	f_T	>	500	MHz

* Measured under pulsed conditions to avoid excessive dissipation.
Pulse duration t = 300 μs; duty cycle δ = 0,01.

CHARACTERISTICS (continued)

$T_j = 25\ ^oC$

Storage time

$I_C = I_B = -I_{BM} = 10$ mA	t_s	<	13 ns

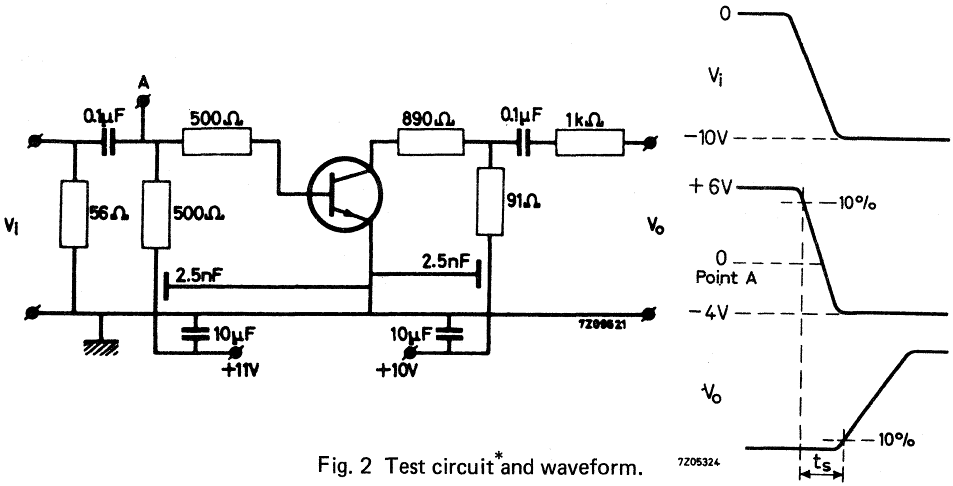


Fig. 2 Test circuit* and waveform.

Turn on time

$I_C = 10$ mA; $I_B = 3$ mA; $-V_{BE} = 1,5$ V	t_{on}	<	12 ns

Turn off time

$I_C = 10$ mA; $I_B = 3$ mA; $-I_{BM} = 1,5$ mA	t_{off}	<	18 ns

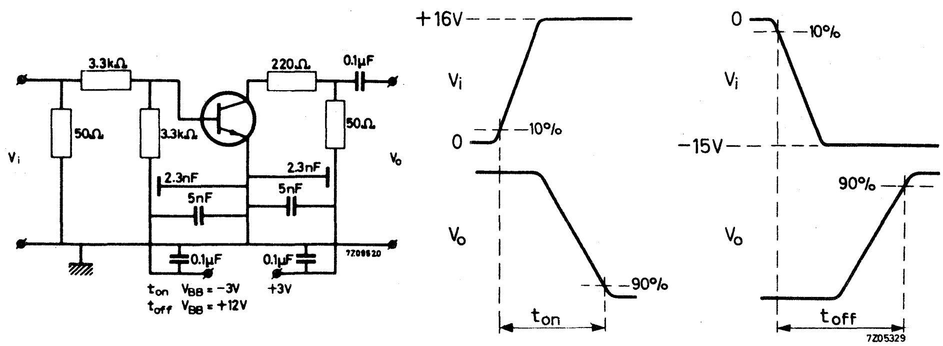


Fig. 3 Test circuit* and waveform.

* Pulse generator

Pulse duration	t	⩾	300 ns
Duty cycle	δ	⩽	0,02
Rise time	t_r	⩽	1 ns
Source impedance	R_S	=	50 Ω

Oscilloscope

Rise time	t_r	⩽	1 ns
Input impedance	R_i	=	50 Ω

SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a TO-18 metal package primarily intended for high-speed saturated switching and high frequency amplifier applications.

QUICK REFERENCE DATA

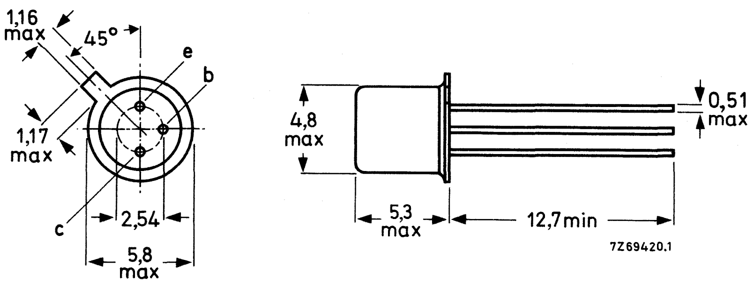
Collector-base voltage (open emitter)	V_{CBO}	max.	40	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	V
Collector current (peak value; t_p = 10 μs)	I_{CM}	max.	500	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	360	mW
Junction temperature	T_j	max.	200	°C
D.C. current gain at T_j = 25 °C				
I_C = 10 mA; V_{CE} = 0,35 V	h_{FE}	>	40	
I_C = 10 mA; V_{CE} = 1,0 V	h_{FE}	<	120	
Transition frequency at f = 100 MHz				
I_C = 10 mA; V_{CE} = 10 V	f_T	>	500	MHz
Storage time				
$I_{Con} = I_{Bon} = -I_{Boff}$ = 10 mA	t_s	<	13	ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-18.

Collector connected to case.



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) I_C = 0,01 mA to 10 mA	V_{CEO}	max.	15	V
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	40	V
Emitter-base voltage (open collector)	V_{EBO}	max.	4,5	V
Collector current (d.c.)	I_C	max.	200	mA
Collector current (peak value; t_p = 10 μs)	I_{CM}	max.	500	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	360	mW
up to T_{case} = 25 °C	P_{tot}	max.	1200	mW
up to T_{case} = 100 °C	P_{tot}	max.	680	mW
Storage temperature range	T_{stg}	−65 to + 150		°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	486	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	146	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector cut-off current			
V_{BE} = 0; V_{CE} = 20 V	I_{CES}	<	0,4 μA
I_E = 0; V_{CB} = 20 V; T_{amb} = 150 °C	I_{CBO}	<	30 μA
Base current			
V_{BE} = 0; V_{CE} = 20 V	$-I_{BEX}$	<	0,4 μA
Collector-base breakdown voltage			
open emitter; I_C = 10 μA	$V_{(BR)CBO}$	>	40 V
Collector-emitter breakdown voltage			
V_{BE} = 0; I_C = 10 μA	$V_{(BR)CES}$	>	40 V
Emitter-base breakdown voltage			
open collector; I_E = 10 μA	$V_{(BR)EBO}$	>	4,5 V
Collector-emitter sustaining voltage*			
open base; I_C = 10 mA	$V_{CEOsust}$	>	15 V
Saturation voltages			
I_C = 10 mA; I_B = 1,0 mA	V_{CEsat}	<	0,20 V
	V_{BEsat}		0,70 to 0,85 V
I_C = 10 mA; I_B = 1,0 mA; T_{amb} = 125 °C	V_{CEsat}	<	0,30 V
	V_{BEsat}	>	0,59 V
I_C = 10 mA; I_B = 1,0 mA; T_{amb} = −55 °C	V_{BEsat}	<	1,02 V
I_C = 30 mA; I_B = 3,0 mA	V_{CEsat}	<	0,25 V
	V_{BEsat}	<	1,15 V
I_C = 100 mA; I_B = 10 mA	V_{CEsat}	<	0,50 V
	V_{BEsat}	<	1,60 V
D.C. current gain*			
I_C = 10 mA; V_{CE} = 0,35 V	h_{FE}	>	40
I_C = 10 mA; V_{CE} = 0,35 V; T_{amb} = −55 °C	h_{FE}	>	20
I_C = 10 mA; V_{CE} = 1,0 V	h_{FE}	<	120
I_C = 30 mA; V_{CE} = 0,4 V	h_{FE}	>	30
I_C = 100 mA; V_{CE} = 1,0 V	h_{FE}	>	20
Collector capacitance at f = 140 kHz			
I_E = I_e = 0; V_{CB} = 5,0 V	C_c	<	4,0 pF
Transition frequency at f = 100 MHz			
I_C = 10 mA; V_{CE} = 10 V	f_T	>	500 MHz

* Measured under pulse conditions to avoid excessive dissipation: t_p = 300 μs; $\delta \leqslant 0{,}02$.

Storage time (see Figs 2 and 3) $I_{Con} = I_{Bon} = -I_{Boff} = 10$ mA	t_s	<	13 ns

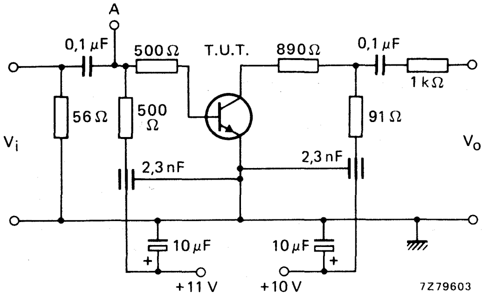


Fig. 2 Storage time test circuit.

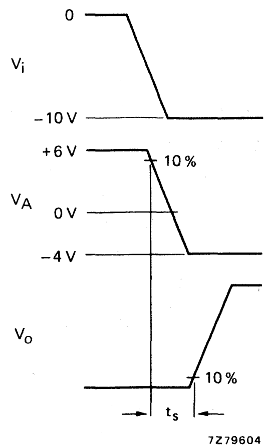


Fig. 3 Waveforms at input, point A and output.

Turn-on time (see Figs 4 and 5) $I_{Con} = 10$ mA; $I_{Bon} = 3$ mA; $-V_{BEoff} = 1{,}5$ V	t_{on}	<	12 ns
Turn-off time (see Figs 4 and 5) $I_{Con} = 10$ mA; $I_{Bon} = 3$ mA; $-I_{Boff} = 1{,}5$ mA	t_{off}	<	18 ns

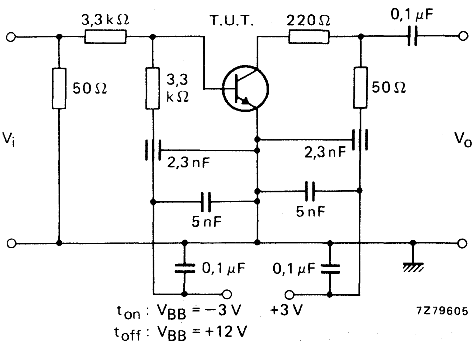


Fig. 4 Turn-on and turn-off test circuit.

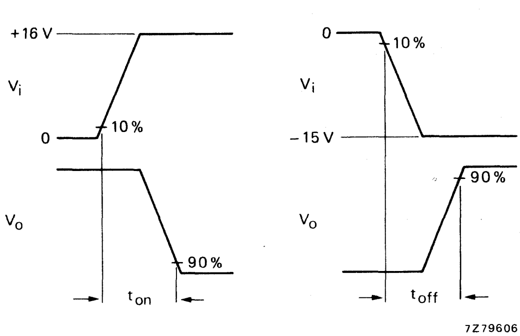


Fig. 5 Input and output waveforms.

Pulse generator:

Rise time	t_r	≤	1 ns
Pulse duration	t_p	≥	300 ns
Duty factor	δ	≤	0,02
Source impedance	R_S	=	50 Ω

Oscilloscope:

Rise time	t_r	≤	1 ns
Input impedance	R_i	=	50 Ω

SILICON PLANAR TRANSISTORS

N-P-N transistors in TO-18 metal packages with the collector connected to the case.

These transistors are primarily intended for use in high performance, low-level, low-noise amplifier applications both for direct current and frequencies of up to 100 MHz.

QUICK REFERENCE DATA

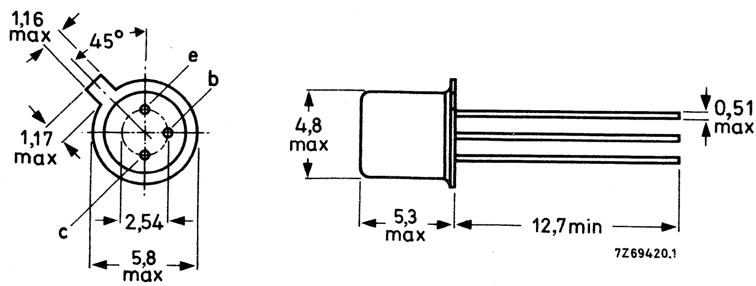
			2N2483	2N2484	
Collector-base voltage (open emitter)	V_{CBO}	max	60	60	V
Collector-emitter voltage (open base)	V_{CEO}	max	60	60	V
Collector current (peak value)	I_{CM}	max	50	50	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max	360	360	mW
Junction temperature	T_j	max	200	200	°C
D.C. current gain at T_j = 25 °C					
I_C = 10 μA; V_{CE} = 5 V	h_{FE}	>	40	100	
		<	120	500	
I_C = 1 mA; V_{CE} = 5 V	h_{FE}	>	175	250	
I_C = 10 mA; V_{CE} = 5 V	h_{FE}	<	500	800	
Transition frequency					
I_C = 0,5 mA; V_{CE} = 5 V	f_T	typ	80	80	MHz
Noise figure at R_S = 10 kΩ					
I_C = 10 μA; V_{CE} = 5 V; B = 15,7 kHz	F	<	4	3	dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-18.

Collector connected to case



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.	60	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6	V
Collector current (peak value)	I_{CM}	max.	50	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	360	mW
Storage temperature range	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	480	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	150	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current					
$I_E = 0$; V_{CB} = 45 V	I_{CBO}	<		10	nA
$I_E = 0$; V_{CB} = 45 V; T_j = 150 °C	I_{CBO}	<		10	µA
Emitter cut-off current					
$I_C = 0$; V_{EB} = 5 V	I_{EBO}	<		10	nA
Base-emitter voltage					
I_C = 0,1 mA; V_{CE} = 5 V	V_{BE}			0,5 to 0,7	V
Collector-emitter saturation voltage					
I_C = 1 mA; I_B = 0,1 mA	V_{CEsat}	<		350	mV
			2N2483	**2N2484**	
D.C. current gain					
I_C = 1 µA; V_{CE} = 5 V	h_{FE}	>		30	
I_C = 10 µA; V_{CE} = 5 V	h_{FE}		40 to 120	100 to 500	
I_C = 10 µA; V_{CE} = 5 V; T_j = 55 °C	h_{FE}	>	10	20	
I_C = 100 µA; V_{CE} = 5 V	h_{FE}	>	75	175	
I_C = 500 µA; V_{CE} = 5 V	h_{FE}	>	100	200	
I_C = 1 mA; V_{CE} = 5 V	h_{FE}	>	175	250	
I_C = 10 mA; V_{CE} = 5 V*	h_{FE}	<	500	800	
Collector capacitance at f = 1 MHz					
$I_E = I_e = 0$; V_{CB} = 5 V	C_c	<	6	6	pF
Emitter capacitance at f = 1 MHz					
$I_C = I_c = 0$; V_{EB} = 0,5 V	C_e	<	6	6	pF
Transition frequency					
I_C = 50 µA; V_{CE} = 5 V	f_T	>	12	15	MHz
I_C = 500 µA; V_{CE} = 5 V	f_T	>	60	60	MHz
		typ.	80	80	MHz
Noise figure					
I_C = 10 µA; V_{CE} = 5 V; R_S = 10 kΩ					
f = 100 Hz; bandwidth 20 Hz	F	<	15	10	dB
f = 1 kHz; bandwidth 200 Hz	F	<	4	3	dB
f = 10 kHz; bandwidth 2 kHz	F	<	3	2	dB
Wide band: bandwidth 15,7 kHz	F	<	4	3	dB
h parameters at f = 1 kHz					
I_C = 1 mA; V_{CE} = 5 V					
Input impedance	h_{ie}		1,5 to 13	3,5 to 24	kΩ
Reverse voltage transfer	h_{re}	<	8	8	10^{-4}
Small signal current gain	h_{fe}		80 to 450	150 to 900	
Output admittance	h_{oe}	<	30	40	µS

* Measured under pulsed conditions to prevent excessive dissipation. Pulse duration t < 300 µs; duty cycle δ < 0,01.

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors in TO-39 metal packages designed primarily for high-speed switching and driver applications for industrial service.

QUICK REFERENCE DATA

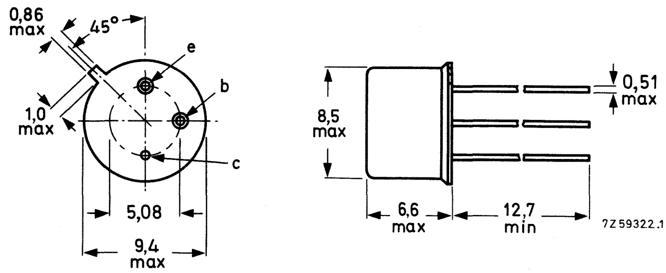
Collector-base voltage (open emitter)		$-V_{CBO}$	max.	60	V
Collector-emitter voltage (open base)	**2N2904**	$-V_{CEO}$	max.	40	V
	2N2904A	$-V_{CEO}$	max.	60	V
Collector current (d.c.)		$-I_C$	max.	600	mA
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	0,6	W
Junction temperature		T_j	max.	200	°C
D.C. current gain at T_j = 25 °C $-I_C$ = 150 mA; $-V_{CE}$ = 10 V		h_{FE}		40 to 120	
Transition frequency at f = 100 MHz $-I_C$ = 50 mA; $-V_{CE}$ = 20 V; T_j = 25 °C		f_T	>	200	MHz
Storage time $-I_{Con}$ = 150 mA; $-I_{Bon}$ = I_{Boff} = 15 mA		t_s	<	80	ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case.



Maximum lead diameter is guaranteed only for 12,7 mm.

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) $-I_C < 100$ mA	2N2904	$-V_{CEO}$	max.	40	V
	2N2904A	$-V_{CEO}$	max.	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.	0,6	W
up to T_{case} = 25 °C		P_{tot}	max.	3,0	W
Storage temperature range		T_{stg}	−65 to +150		°C
Junction temperature		T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	292	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	58	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			2N2904	2N2904A	
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
D.C. current gain					
$-I_C = 0,1$ mA; $-V_{CE} = 10$ V	h_{FE}	>	20	40	
$-I_C = 1$ mA; $-V_{CE} = 10$ V	h_{FE}	>	25	40	
$-I_C = 10$ mA; $-V_{CE} = 10$ V	h_{FE}	>	35	40	
$-I_C = 150$ mA; $-V_{CE} = 10$ V *	h_{FE}	>	40	40	
		<	120	120	
$-I_C = 500$ mA; $-V_{CE} = 10$ V *	h_{FE}	>	20	40	
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

(The values 8, 30 and 200 apply to both 2N2904 and 2N2904A.)

* 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

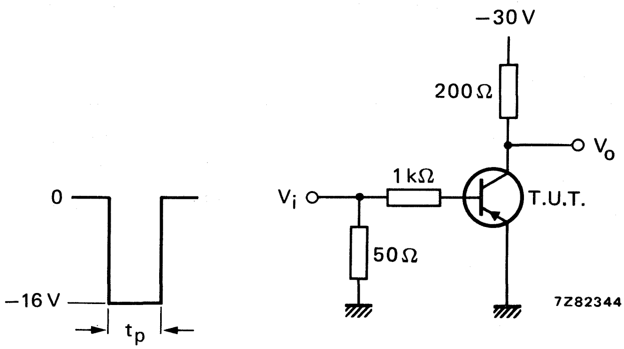


Fig. 2 Input waveform and test circuit for determining delay, rise and turn-on time.

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
turn-off time	t_{off}	<	100 ns

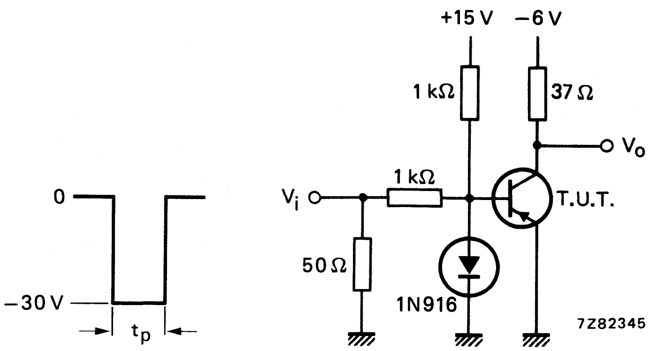


Fig. 3 Input waveform and test circuit for determining storage, fall and turn-off time.

Pulse generator (see Figs 2 and 3)

frequency	f	=	150 Hz
pulse duration	t_p	=	200 ns
rise time	t_r	⩽	2 ns
output impedance	Z_o	=	50 Ω

Oscilloscope (see Figs 2 and 3)

rise time	t_r	⩽	5 ns
input impedance	Z_i	=	10 MΩ

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors in TO-39 metal packages designed primarily for high-speed switching and driver applications for industrial service.

QUICK REFERENCE DATA

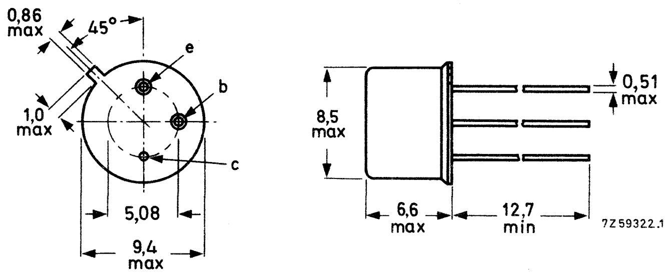
Collector-base voltage (open emitter)		$-V_{CBO}$	max.	60	V
Collector-emitter voltage (open base)	**2N2905**	$-V_{CEO}$	max.	40	V
	2N2905A	$-V_{CEO}$	max.	60	V
Collector current (d.c.)		$-I_C$	max.	600	mA
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	0,6	W
Junction temperature		T_j	max.	200	°C
D.C. 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	>	200	MHz
Storage time $-I_{Con}$ = 150 mA; $-I_{Bon}$ = I_{Boff} = 15 mA		t_s	<	80	ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case.



Maximum lead diameter is guaranteed only for 12,7 mm.

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) $-I_C < 100$ mA	**2N2905**	$-V_{CEO}$	max.	40	V
	2N2905A	$-V_{CEO}$	max.	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.	0,6	W
up to T_{case} = 25 °C		P_{tot}	max.	3,0	W
Storage temperature range		T_{stg}	−65 to + 150		°C
Junction temperature		T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	292	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	58	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			2N2905	2N2905A	
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
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	100	
		<	300	300	
$-I_C = 500$ mA; $-V_{CE} = 10$ V*	h_{FE}	>	30	50	
Collector capacitance at f = 100 kHz					
$I_E = I_e = 0$; $-V_{CB} = 10$ V	C_c	<	8		pF
Emitter capacitance at f = 100 kHz					
$I_C = I_c = 0$; $-V_{EB} = 2$ V	C_e	<	30		pF
Transition frequency at f = 100 MHz					
$-I_C = 50$ mA; $-V_{CE} = 20$ V*	f_T	>	200		MHz

* Measured under pulse conditions to avoid excessive dissipation; $t_p \leqslant 300$ μs; $\delta \leqslant 0,02$.

Turn-on time (see Fig. 2)
when switched to $-I_{Con}$ = 150 mA; $-I_{Bon}$ = 15 mA

delay time	t_d	<	10 ns
rise time	t_r	<	40 ns
turn-on time	t_{on}	<	45 ns

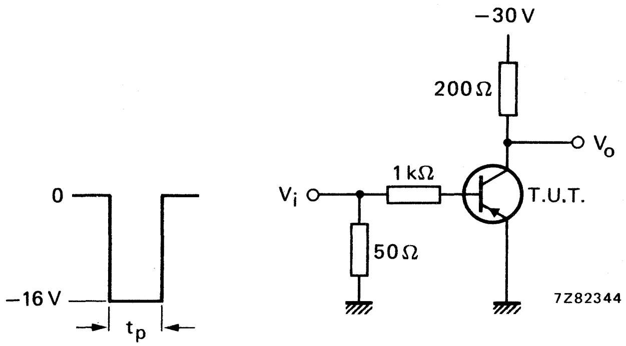


Fig. 2 Input waveform and test circuit for determining delay, rise and turn-on time.

Turn-off time (see Fig. 3)
when switched from $-I_{Con}$ = 150 mA; $-I_{Bon}$ = 15 mA
to cut-off with $+I_{Boff}$ = 15 mA

storage time	t_s	<	80 ns
turn-off time	t_{off}	<	100 ns

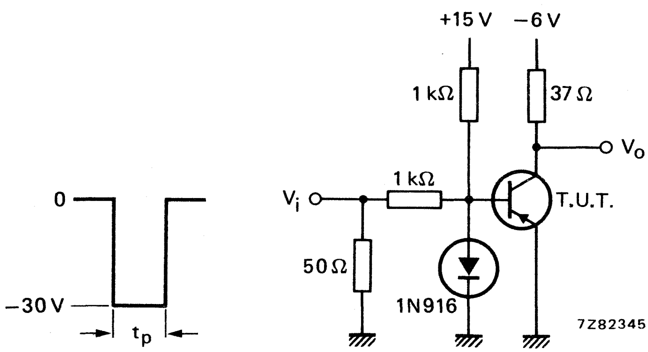


Fig. 3 Input waveform and test circuit for determining storage, fall and turn-off time.

Pulse generator (see Figs 2 and 3)

frequency	f	=	150 Hz
pulse duration	t_p	=	200 ns
rise time	t_r	⩽	2 ns
output impedance	Z_o	=	50 Ω

Oscilloscope (see Figs 2 and 3)

rise time	t_r	⩽	5 ns
input impedance	Z_i	=	10 MΩ

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P medium power transistors in TO-18 metal packages designed primarily for high-speed switching and driver applications for industrial service.

QUICK REFERENCE DATA

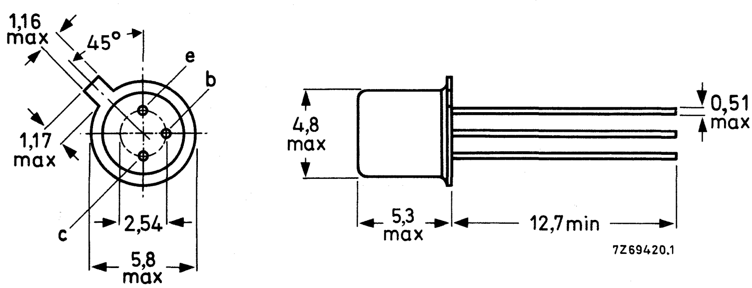
Collector-base voltage (open emitter)		$-V_{CBO}$	max.	60	V
Collector-emitter voltage (open base)	**2N2906**	$-V_{CEO}$	max.	40	V
	2N2906A	$-V_{CEO}$	max.	60	V
Collector current (d.c.)		$-I_C$	max.	600	mA
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	0,4	W
Junction temperature		T_j	max.	200	°C
D.C. current gain at T_j = 25 °C $-I_C$ = 150 mA; $-V_{CE}$ = 10 V		h_{FE}		40 to 120	
Transition frequency at f = 100 MHz $-I_C$ = 50 mA; $-V_{CE}$ = 20 V; T_j = 25 °C		f_T	>	200	MHz
Storage time $-I_{Con}$ = 150 mA; $-I_{Bon}$ = I_{Boff} = 15 mA		t_s	<	80	ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-18.

Collector connected to case.



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) $-I_C < 100$ mA	**2N2906**	$-V_{CEO}$	max.	40	V
	2N2906A	$-V_{CEO}$	max.	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.	0,4	W
up to T_{case} = 25 °C		P_{tot}	max.	1,2	W
Storage temperature range		T_{stg}	−65 to + 150		°C
Junction temperature		T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	438	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	146	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			2N2906	2N2906A	
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
D.C. current gain					
$-I_C = 0{,}1$ mA; $-V_{CE} = 10$ V	h_{FE}	>	20	40	
$-I_C = 1$ mA; $-V_{CE} = 10$ V	h_{FE}	>	25	40	
$-I_C = 10$ mA; $-V_{CE} = 10$ V	h_{FE}	>	35	40	
$-I_C = 150$ mA; $-V_{CE} = 10$ V*	h_{FE}	>	40	40	
		<	120	120	
$-I_C = 500$ mA; $-V_{CE} = 10$ V*	h_{FE}	>	20	40	
Collector capacitance at f = 100 kHz					
$I_E = I_e = 0$; $-V_{CB} = 10$ V	C_c	<	8		pF
Emitter capacitance at f = 100 kHz					
$I_C = I_c = 0$; $-V_{EB} = 2$ V	C_e	<	30		pF
Transition frequency at f = 100 MHz					
$-I_C = 50$ mA; $-V_{CE} = 20$ V*	f_T	>	200		MHz

* Measured under pulse conditions to avoid excessive dissipation: $t_p \leqslant 300$ μs; $\delta \leqslant 0{,}02$.

Turn-on time (see Fig. 2)
when switched to $-I_{Con}$ = 150 mA; $-I_{Bon}$ = 15 mA

delay time	t_d	<	10 ns
rise time	t_r	<	40 ns
turn-on time	t_{on}	<	45 ns

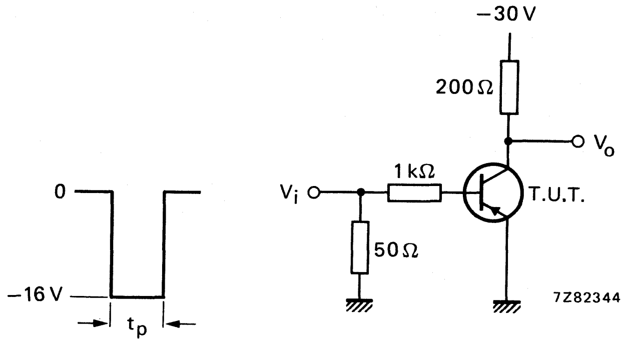


Fig. 2 Input waveform and test circuit for determining delay, rise and turn-on time.

Turn-off time (see Fig. 3)
when switched from $-I_{Con}$ = 150 mA; $-I_{Bon}$ = 15 mA
to cut-off with + I_{Boff} = 15 mA

storage time	t_s	<	80 ns
turn-off time	t_{off}	<	100 ns

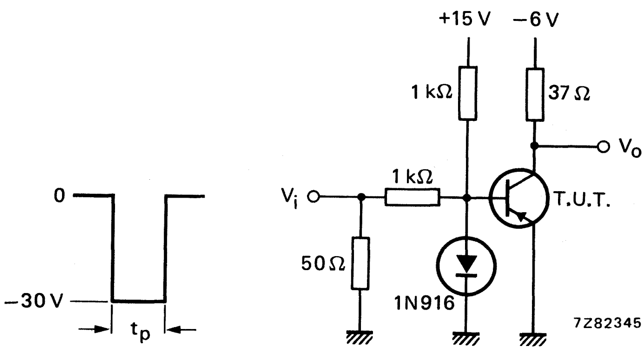


Fig. 3 Input waveform and test circuit for determining storage, fall and turn-off time.

Pulse generator (see Figs 2 and 3)

frequency	f	=	150 Hz
pulse duration	t_p	=	200 ns
rise time	t_r	⩽	2 ns
output impedance	Z_o	=	50 Ω

Oscilloscope (see Figs 2 and 3)

rise time	t_r	⩽	5 ns
input impedance	Z_i	⩽	10 MΩ

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P medium power transistors in TO-18 metal packages designed primarily for high-speed switching and driver applications for industrial service.

QUICK REFERENCE DATA

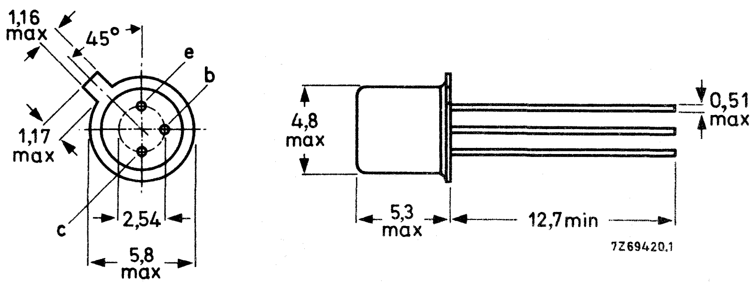
Collector-base voltage (open emitter)		$-V_{CBO}$	max.	60	V
Collector-emitter voltage (open base)	**2N2907**	$-V_{CEO}$	max.	40	V
	2N2907A	$-V_{CEO}$	max.	60	V
Collector current (d.c.)		$-I_C$	max.	600	mA
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	0,4	W
Junction temperature		T_j	max.	200	°C
D.C. 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	>	200	MHz
Storage time $-I_{Con}$ = 150 mA; $-I_{Bon}$ = I_{Boff} = 15 mA		t_s	<	80	ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-18.

Collector connected to case.



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)					
$-I_C < 100$ mA	**2N2907**	$-V_{CEO}$	max.	40	V
	2N2907A	$-V_{CEO}$	max.	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.	0,4	W
up to $T_{case} = 25$ °C		P_{tot}	max.	1,2	W
Storage temperature range		T_{stg}	−65 to	+150	°C
Junction temperature		T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	438	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	146	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			2N2907	2N2907A	
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
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	100	
		<	300	300	
$-I_C = 500$ mA; $-V_{CE} = 10$ V *	h_{FE}	>	30	50	
Collector capacitance at f = 100 kHz					
$I_E = I_e = 0$; $-V_{CB} = 10$ V	C_c	<	8		pF
Emitter capacitance at f = 100 kHz					
$I_C = I_c = 0$; $-V_{EB} = 2$ V	C_e	<	30		pF
Transition frequency at f = 100 MHz					
$-I_C = 50$ mA; $-V_{CE} = 20$ V *	f_T	>	200		MHz

* Measured under pulse conditions to avoid excessive dissipation: $t_p \leqslant 300$ μs; $\delta \leqslant 0{,}02$.

Turn-on time (see Fig. 2)
when switched to $-I_{Con}$ = 150 mA; $-I_{Bon}$ = 15 mA

delay time	t_d	<	10 ns
rise time	t_r	<	40 ns
turn-on time	t_{on}	<	45 ns

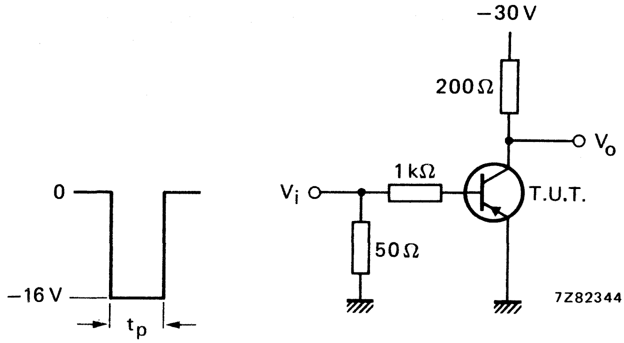


Fig. 2 Input waveform and test circuit for determining delay, rise and turn-on time.

Turn-off time (see Fig. 3)
when switched from $-I_{Con}$ = 150 mA; $-I_{Bon}$ = 15 mA
to cut-off with $+I_{Boff}$ = 15 mA

storage time	t_s	<	80 ns
turn-off time	t_{off}	<	100 ns

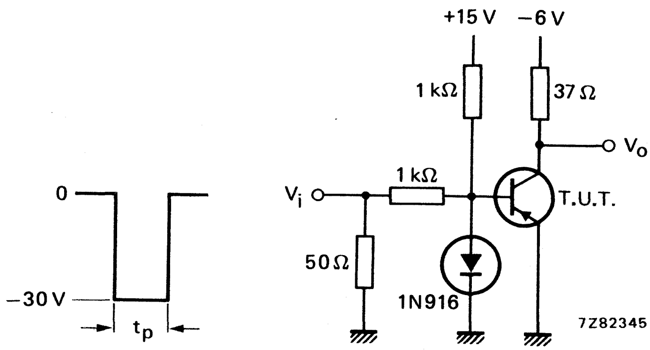


Fig. 3 Input waveform and test circuit for determining storage, fall and turn-off time.

Pulse generator (see Figs 2 and 3)

frequency	f	=	150 Hz
pulse duration	t_p	=	200 ns
rise time	t_r	⩽	2 ns
output impedance	Z_o	=	50 Ω

Oscilloscope (see Figs 2 and 3)

rise time	t_r	⩽	5 ns
input impedance	Z_i	⩽	10 MΩ

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in TO-39 metal packages intended for use as amplifiers and in switching circuits.

QUICK REFERENCE DATA

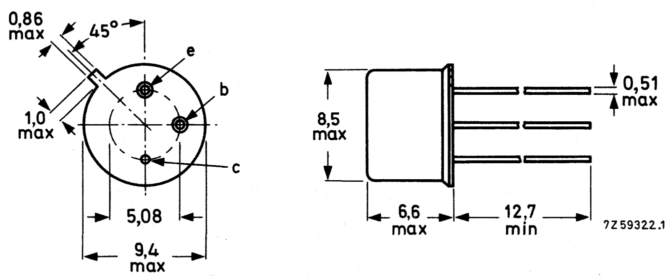
Collector-base voltage (open emitter)	V_{CBO}	max.	140		V
Collector-emitter voltage (open base)	V_{CEO}	max.	80		V
Collector current (d.c.)	I_C	max.	1		A
Total power dissipation					
up to T_{amb} = 25 °C	P_{tot}	max.	0,8		W
up to T_{case} = 25 °C	P_{tot}	max.	5,0		W
Junction temperature	T_j	max.	200		°C
			2N3019	**2N3020**	
D.C. current gain					
I_C = 150 mA; V_{CE} = 10 V	h_{FE}	>	100	40	
		<	300	120	
Transition frequency at f = 20 MHz					
I_C = 50 mA; V_{CE} = 10 V	f_T	>	100	80	MHz

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case



Maximum lead diameter is guaranteed only for 12,7 mm.

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	140	V
Collector-emitter voltage (open base)	V_{CEO}	max.	80	V
Emitter-base voltage (open collector)	V_{EBO}	max.	7	V
Collector current (d.c.)	I_C	max.	1	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	0,8	W
up to T_{case} = 25 °C	P_{tot}	max.	5,0	W
Storage temperature range	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	218	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	35	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; V_{CB} = 90 V	I_{CBO}	<	10	nA
$I_E = 0$; V_{CB} = 90 V; T_{amb} = 150 °C	I_{CBO}	<	10	μA
Emitter cut-off current				
$I_C = 0$; V_{EB} = 5 V	I_{EBO}	<	10	nA
Breakdown voltages				
$I_E = 0$; I_C = 100 μA	$V_{(BR)CBO}$	>	140	V
$I_B = 0$; I_C = 30 mA	$V_{(BR)CEO}$	>	80	V *
$I_C = 0$; I_E = 100 μA	$V_{(BR)EBO}$	>	7	V
Saturation voltages				
I_C = 150 mA; I_B = 15 mA	V_{CEsat}	<	0,2	V
	V_{BEsat}	<	1,1	V *
I_C = 500 mA; I_B = 50 mA	V_{CEsat}	<	0,5	V *

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

			2N3019	2N3020	
D.C. current gain *					
I_C = 0,1 mA; V_{CE} = 10 V	h_{FE}	>	50	30	
		<	–	100	
I_C = 10 mA; V_{CE} = 10 V	h_{FE}	>	90	40	
		<	–	120	
I_C = 150 mA; V_{CE} = 10 V	h_{FE}	>	100	40	
		<	300	120	
I_C = 150 mA; V_{CE} = 10 V; T_{case} = –55 °C	h_{FE}	>	40	–	
I_C = 500 mA; V_{CE} = 10 V	h_{FE}	>	50	30	
		<	–	100	
I_C = 1000 mA; V_{CE} = 10 V	h_{FE}	>	15	15	
Transition frequency at f = 20 MHz					
I_C = 50 mA; V_{CE} = 10 V	f_T	>	100	80	MHz
Collector capacitance at f = 1 MHz					
$I_E = I_e = 0$; V_{CB} = 10 V	C_c	<	12	12	pF
Emitter capacitance at f = 1 MHz					
$I_C = I_c = 0$; V_{EB} = 0,5 V	C_e	<	60	60	pF
Feedback time constant at f = 4 MHz					
I_C = 10 mA; V_{CB} = 10 V	$r_{bb'}C_{b'c}$	<	400	400	ps
Small-signal current gain at f = 1 kHz					
I_C = 1,0 mA; V_{CE} = 5 V	h_{fe}	>	80	30	
		<	400	200	
Noise figure at f = 1 kHz					
I_C = 0,1 mA; V_{CE} = 10 V; R_S = 1 kΩ	F	<	4	–	dB

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

SILICON PLANAR TRANSISTOR

N-P-N transistor in a TO-39 metal package designed for medium speed, saturated and non-saturated switching applications for industrial service.

QUICK REFERENCE DATA

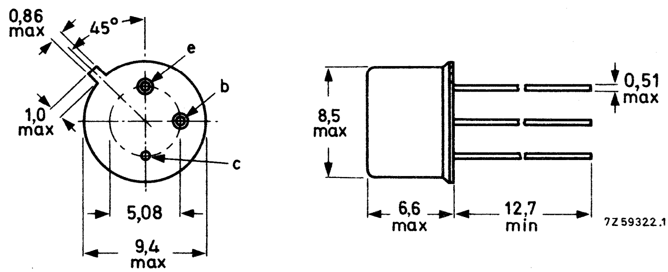
Collector-base voltage (open emitter)	V_{CBO}	max.	60	V
Collector-emitter voltage (open base)	V_{CEO}	max.	40	V
Collector current (d.c.)	I_C	max.	700	mA
Total power dissipation up to T_{case} = 25 °C	P_{tot}	max.	5,0	W
Junction temperature	T_j	max.	200	°C
D.C. current gain I_C = 150 mA; V_{CE} = 10 V	h_{FE}		50 to 250	
Transition frequency at f = 20 MHz I_C = 50 mA; V_{CE} = 10 V	f_T	>	100	MHz

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case



Maximum lead diameter is guaranteed only for 12,7 mm.

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.	5	V
Collector current (d.c.)	I_C	max.	700	mA
Total power dissipation up to T_{case} = 25 °C	P_{tot}	max.	5,0	W
Storage temperature range	T_{stg}	−65 to + 150		°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to case	$R_{th\ j\text{-}c}$	=	35	K/W

CHARACTERISTICS

T_{amb} = 25 °C

Collector cut-off current				
V_{CE} = 30 V; $-V_{BE}$ = 1,5 V	I_{CEX}	<	0,25	μA
Emitter cut-off current				
I_C = 0; V_{EB} = 4 V	I_{EBO}	<	0,25	μA
Collector-base breakdown voltage				
open emitter; I_C = 100 μA	$V_{(BR)CBO}$	>	60	V
Collector-emitter breakdown voltage**				
open emitter; I_C = 100 μA	$V_{(BR)CEO}$	>	40	V
I_C = 100 mA; R_{BE} = 10 Ω	$V_{(BR)CER}$	>	50	V
Emitter-base breakdown voltage				
open collector; I_E = 100 μA	$V_{(BR)EBO}$	>	5	V
Base-emitter voltage				
I_C = 150 mA; V_{CE} = 2,5 V	V_{BE}	<	1,7	V
Saturation voltages				
I_C = 150 mA; I_B = 15 mA	V_{CEsat}	<	1,4	V
	V_{BEsat}	<	1,7	V
D.C. current gain				
I_C = 150 mA; V_{CE} = 2,5 V	h_{FE}	>	25	
I_C = 150 mA; V_{CE} = 10 V**	h_{FE}		50 to 250	
Collector capacitance at f = 140 kHz				
$I_E = I_e = 0$; V_{CB} = 10 V	C_c	<	15	pF
Emitter capacitance at f = 140 kHz				
$I_C = I_c = 0$; V_{EB} = 0,5 V	C_e	<	80	pF
Transition frequency at f = 20 MHz				
I_C = 50 mA; V_{CE} = 10 V	f_T	>	100	MHz

* For I_C = 0 to 100 mA (pulse conditions): t_p = 300 μs; δ = 0,018, 0 to 700 mA for shorter pulses.
** Measured under pulse conditions to avoid excessive dissipation: t_p = 300 μs; δ = 0,018.

SILICON NPN HIGH-VOLTAGE TRANSISTORS

NPN high-voltage small-signal transistors in a TO-39 package and intended for use in telephony and professional communication equipment.

Complementary type is 2N5415/5416.

QUICK REFERENCE DATA

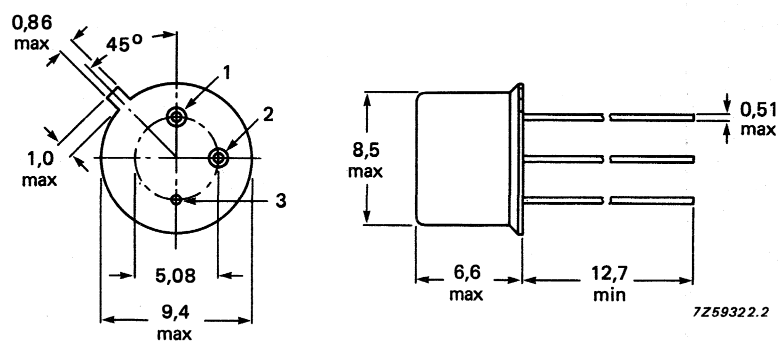
			2N3439	2N3440	
Collector-base voltage (open emitter)	V_{CBO}	max.	400	300	V
Collector-emitter voltage (open base)	V_{CEO}	max.	350	250	V
Collector current (DC)	I_C	max.	1.0	1.0	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1	1	W
Junction temperature	T_j	max.	200	200	°C
Collector-emitter saturation voltage I_C = 50 mA; I_B = 4 mA	V_{CEsat}	max.	0.5	0.5	V
DC current gain I_C = 2 mA; V_{CE} = 10 V	h_{FE}	min.	30		
I_C = 20 mA; V_{CE} = 10 V	h_{FE}	min.		40	

MECHANICAL DATA

Dimensions in mm

Fig.1 TO-39.

Collector connected to case



Maximum lead diameter is guaranteed only for 12.7 mm.

RATINGS

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

			2N3439	2N3440	
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.	5.0		V
Collector current (DC)	I_C	max.	1.0		A
Base current	I_B	max.	0.5		A
Total power dissipation					
up to T_{amb} = 25 °C	P_{tot}	max.	1		W
T_{case} = 25 °C	P_{tot}	max.	10		W
Junction temperature	T_j	max.	200		°C
Storage temperature range	T_j		–65 to 150		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\,j\text{-}a}$	=	219	K/W
From junction to case	$R_{th\,j\text{-}c}$	=	58.3	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			2N3439	2N3440	
Collector cut-off currents					
$I_E = 0$; V_{CB} = 360 V	I_{CBO}	max.	0.1		μA
$I_E = 0$; V_{CB} = 250 V	I_{CBO}	max.		0.1	μA
$I_B = 0$; V_{CE} = 300 V	I_{CEO}	max.	1.0		μA
$I_B = 0$; V_{CE} = 200 V	I_{CEO}	max.		1.0	μA
Emitter cut-off current					
$I_C = 0$; V_{EB} = 5 V	I_{EBO}	max.	10	10	μA
Collector-emitter sustaining voltage					
$I_B = 0$; I_C = 50 mA	V_{CEOsus}	min.	350	250	V
Saturation voltages					
I_C = 50 mA; I_B = 4 mA	V_{CEsat}	max.	0.5	0.5	V
	V_{BEsat}	max.	1.3	1.3	V
DC current gain					
I_C = 2 mA; V_{CE} = 10 V	h_{FE}	min.	30		
I_C = 20 mA; V_{CE} = 10 V	h_{FE}	min.		40	
Transition frequency at f = 5 MHz					
I_C = 10 mA; V_{CE} = 10 V; T_{amb} = 25 °C	f_T	min.	70		MHz
Small-signal current gain at f = 1 kHz					
I_C = 5 mA; V_{CE} = 10 V; T_{amb} = 25 °C	h_{fe}	min.	25		
Real part (Re) of input impedance (h_{ie})					
V_{CE} = 10 V; I_C = 5 mA; f = 1 MHz; T_{amb} = 25 °C	Re(h_{ie})	max.	300		Ω
Input capacitance at f = 1 MHz					
$I_C = 0$; V_{EB} = 5 V; T_{amb} = 25 °C	C_e	max.	20		pF
Output capacitance at f = 1 MHz					
$I_E = 0$; V_{CB} = 10 V; T_{amb} = 25 °C	C_c	max.	2.0		pF

SILICON PLANAR EPITAXIAL TRANSISTOR

NPN transistor in a plastic TO-92 package, primarily intended for high-speed, saturated switching applications for industrial service.

PNP complement is 2N3906.

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.	350	mW
Junction temperature	T_j	max.	150	°C
DC current gain I_C = 10 mA; V_{CE} = 1 V	h_{FE}	min. max.	100 300	
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 20 V	f_T	min.	300	MHz
Storage time I_{Con} = 10 mA; I_{Bon} = $-I_{Boff}$ = 1 mA	t_s	max.	200	ns

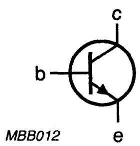
MECHANICAL DATA

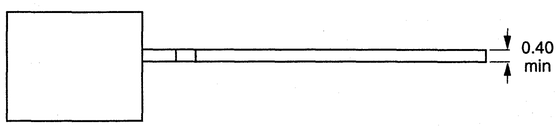
Dimensions in mm

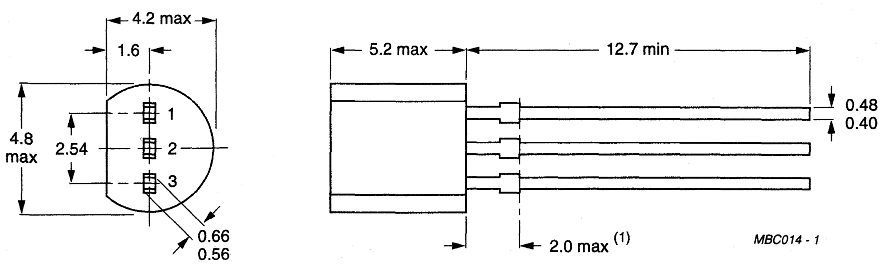
Fig.1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

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.	350	mW
Storage temperature range	T_{stg}		−65 to + 150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	357	K/W

CHARACTERISTICS

T_{amb} = 25 °C

Currents at reverse biased emitter junction V_{CE} = 30 V; $-V_{BE}$ = 3 V	I_{CEX} $-I_{BEX}$	max. max.	50 50	nA nA
Saturation voltages * I_C = 10 mA; I_B = 1 mA	V_{CEsat} V_{BEsat}	max.	200 650 to 850	mV mV
I_C = 50 mA; I_B = 5 mA	V_{CEsat} V_{BEsat}	max. max.	300 950	mV mV
DC current gain*				
I_C = 0.1 mA; V_{CE} = 1 V	h_{FE}	min.	40	
I_C = 1 mA; V_{CE} = 1 V	h_{FE}	min.	70	
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	
Collector capacitance at 100 kHz ⩽ f ⩽ 1 MHz $I_E = I_e = 0$; V_{CB} = 5 V	C_c	max.	4	pF
Emitter capacitance at 100 kHz ⩽ f ⩽ 1 MHz $I_C = I_c = 0$; V_{EB} = 0.5 V	C_e	max.	8	pF
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

* Measured under pulse conditions: t_p = 300 μs; δ = 0.02.

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	max.	35 ns
Rise time	t_r	max.	35 ns

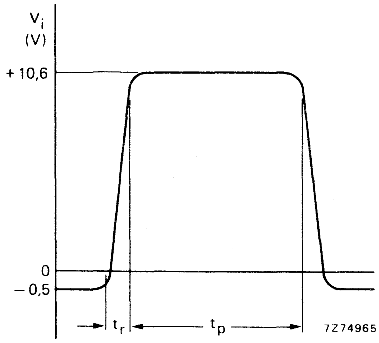


Fig. 2 Input waveform; $t_r < 1$ ns; $t_p = 300$ ns; $\delta = 0.02$.

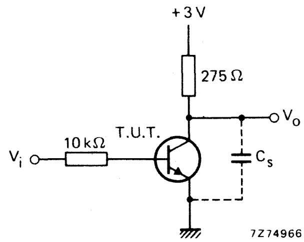


Fig. 3 Delay and rise time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

Turn-off time (see Figs 4 and 5)
$I_{Con} = 10$ mA; $I_{Bon} = -I_{Boff} = 1$ mA

Storage time	t_s	max.	200 ns
Fall time	t_f	max.	50 ns

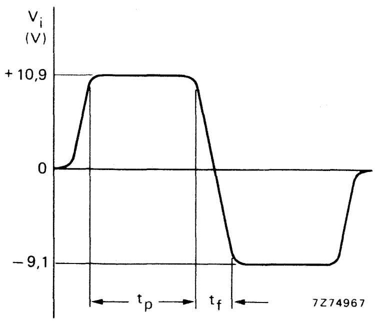


Fig. 4 Input waveform; $t_f < 1$ ns; $10\ \mu s < t_p < 500\ \mu s$; $\delta = 0.02$.

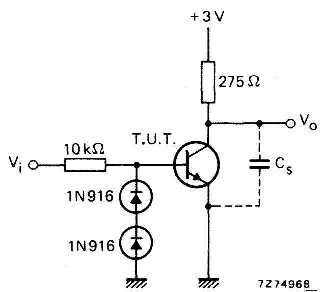


Fig. 5 Storage and fall time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

SILICON PLANAR EPITAXIAL TRANSISTOR

PNP transistor in a plastic TO-92 package, primarily intended for high-speed, saturated switching applications for industrial service.

NPN complement is 2N3904.

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.	350	mW
Junction temperature	T_j	max.	150	°C
DC current gain $-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}	min. max.	100 300	
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 20 V	f_T	min.	250	MHz
Storage time $-I_{Con}$ = 10 mA; $-I_{Bon}$ = I_{Boff} = 1 mA	t_s	max.	225	ns

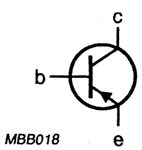
MECHANICAL DATA

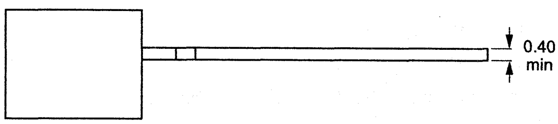
Dimensions in mm

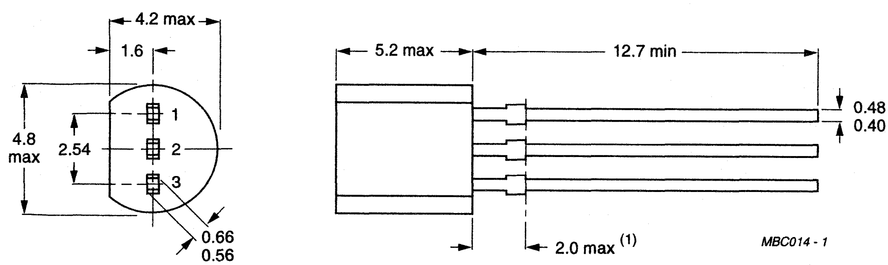
Fig.1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

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 $T_{amb} = 25\ ^oC$	P_{tot}	max.	350 mW
Storage temperature range	T_{stg}		−65 to + 150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	357 K/W

CHARACTERISTICS

$T_{amb} = 25\ ^oC$

Currents at reverse biased emitter junction $-V_{CE} = 30$ V; $+V_{BE} = 3$ V	$-I_{CEX}$	max.	50 nA
	$+I_{BEX}$	max.	50 nA
Saturation voltages * $-I_C = 10$ mA; $-I_B = 1$ mA	$-V_{CEsat}$	max.	250 mV
	$-V_{BEsat}$		650 to 850 mV
$-I_C = 50$ mA; $-I_B = 5$ mA	$-V_{CEsat}$	max.	400 mV
	$-V_{BEsat}$	max.	950 mV
DC 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.	100
		max.	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
Collector capacitance at 100 kHz ⩽ f ⩽ 1 MHz $I_E = I_e = 0$; $-V_{CB} = 5$ V	C_c	max.	4.5 pF
Emitter capacitance at 100 kHz ⩽ f ⩽ 1 MHz $I_C = I_c = 0$; $-V_{EB} = 0.5$ V	C_e	max.	10 pF
Transition frequency at f = 100 MHz $-I_C = 10$ mA; $-V_{CE} = 20$ V	f_T	min.	250 MHz
Noise figure at $R_S = 1\ k\Omega$ $-I_C = 100\ \mu A$; $-V_{CE} = 5$ V f = 10 Hz to 15.7 kHz	F	max.	4 dB

* Measured under pulse conditions: $t_p = 300\ \mu s$; $\delta = 0.02$.

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	max.	35 ns
Rise time	t_r	max.	35 ns

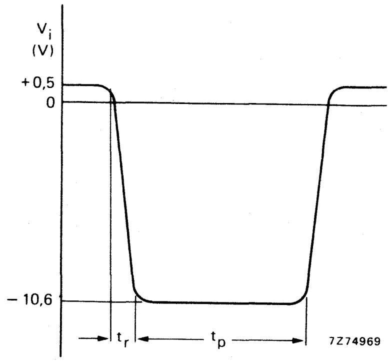


Fig. 2 Input waveform; $t_r < 1$ ns; $t_p = 300$ ns; $\delta = 0.02$.

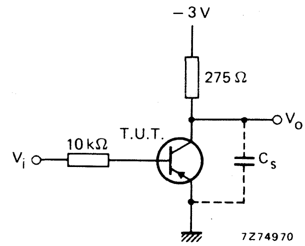


Fig. 3 Delay and rise time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

Turn-off time (see Figs 4 and 5)
$-I_{Con} = 10$ mA; $-I_{Bon} = I_{Boff} = 1$ mA

Storage time	t_s	max.	225 ns
Fall time	t_f	max.	75 ns

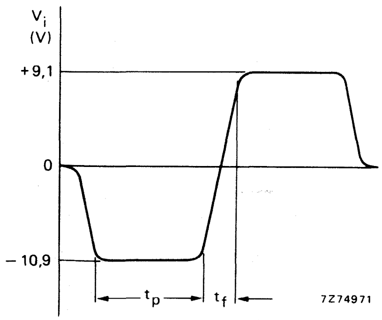


Fig. 4 Input waveform; $t_f < 1$ ns; $10\ \mu s < t_p < 500\ \mu s$; $\delta = 0.02$.

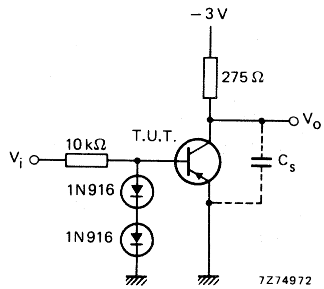


Fig. 5 Storage and fall time test circuit; total shunt capacitance of test jig and connectors $C_s < 4$ pF; scope impedance = 10 MΩ.

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors in TO-39 metal packages primarily intended for large signal, low-noise, low-power audio frequency applications for industrial service.

QUICK REFERENCE DATA

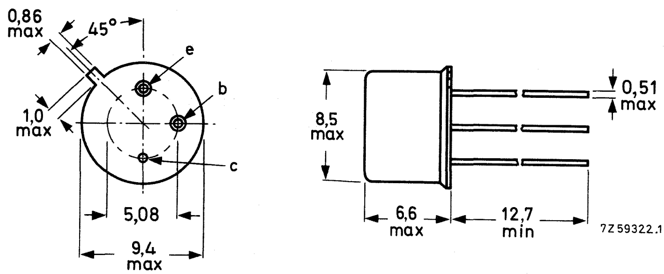
			2N4030 2N4032	2N4031 2N4033	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60	80	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	60	80	V
Collector current (d.c.)	$-I_C$	max.	1		A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	0,8		W
Junction temperature	T_j	max.	200		°C
			2N4030 2N4031	2N4032 2N4033	
D.C. current gain $-I_C$ = 500 mA; $-V_{CE}$ = 5 V	h_{FE}	>	25	70	
Transition frequency at f = 100 MHz $-I_C$ = 50 mA; $-V_{CE}$ = 10 V	f_T	>	100	150	MHz

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case



Maximum lead diameter is guaranteed only for 12,7 mm.

Accessories: 56245 (distance disc).

RATINGS

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

			2N4030 2N4032	2N4031 2N4033	
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.	5	5	V
Collector current (d.c.)	$-I_C$	max.	1		A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	0,8		W
up to T_{case} = 25 °C	P_{tot}	max.	4,0		W
Storage temperature	T_{stg}		−65 to +200		°C
Junction temperature	T_j	max.	200		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	218	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	44	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			2N4030 2N4032	2N4031 2N4033	
Collector cut-off current					
$I_E = 0; -V_{CB} = 50$ V	$-I_{CBO}$	<	50	–	nA
$I_E = 0; -V_{CB} = 60$ V	$-I_{CBO}$	<	–	50	nA
$I_E = 0; -V_{CB} = 50$ V; T_{amb} = 150 °C	$-I_{CBO}$	<	50	–	μA
$I_E = 0; -V_{CB} = 60$ V; T_{amb} = 150 °C	$-I_{CBO}$	<	–	50	μA
Emitter cut-off current					
$I_C = 0; -V_{EB} = 5$ V	$-I_{EBO}$	<	10	10	μA
Breakdown voltages					
$I_E = 0; -I_C = 10$ μA	$-V_{(BR)CBO}$	>	60	80	V
$I_B = 0; -I_C = 10$ mA	$-V_{(BR)CEO}$	>	60	80	V *
$I_C = 0; -I_E = 10$ μA	$-V_{(BR)EBO}$	>	5	5	V

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

			2N4030 2N4032	2N4031 2N4033	
Base-emitter voltage					
$-I_C$ = 500 mA; $-V_{CE}$ = 0,5 V	$-V_{BE}$	<	1,1	1,1	V *
$-I_C$ = 1000 mA; $-V_{CE}$ = 1,0 V	$-V_{BE}$	<	1,2	–	V *
Saturation voltages					
$-I_C$ = 150 mA; $-I_B$ = 15 mA	$-V_{CEsat}$	<	0,15	0,15	V
	$-V_{BEsat}$	<	0,90	0,90	V *
$-I_C$ = 500 mA; $-I_B$ = 50 mA	$-V_{CEsat}$	<	0,50	0,50	V
$-I_C$ = 1000 mA; $-I_B$ = 100 mA	$-V_{CEsat}$	<	1,00	–	V

				2N4030 2N4031	2N4032 2N4033	
D.C. current gain *						
$-I_C$ = 100 μA; $-V_{CE}$ = 5 V		h_{FE}	>	30	75	
$-I_C$ = 100 mA; $-V_{CE}$ = 5 V		h_{FE}	>	40	100	
			<	120	300	
$-I_C$ = 100 mA; $-V_{CE}$ = 5 V; T_{amb} = –55 °C		h_{FE}	>	15	40	
$-I_C$ = 5000 mA; $-V_{CE}$ = 5 V		h_{FE}	>	25	70	
$-I_C$ = 1000 mA; $-V_{CE}$ = 5 V	**2N4030**	h_{FE}	>	15		
	2N4031	h_{FE}	>	10		
	2N4032	h_{FE}	>	40		
	2N4033	h_{FE}	>	25		
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	<	110		pF

			2N4030 2N4031	2N4032 2N4033	
Transition frequency at f = 100 MHz					
$-I_C$ = 50 mA; $-V_{CE}$ = 10 V	f_T	>	100	150	MHz
		<	400	500	MHz

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

Switching times

$-I_{Con}$ = 500 mA; $-I_{Bon}$ = 50 mA

Turn-on time	t_{on}	<	100 ns

$-I_{Con}$ = 500 mA; $-I_{Bon}$ = $+I_{Boff}$ = 50 mA

Storage time	t_s	<	350 ns
Fall time	t_f	<	50 ns

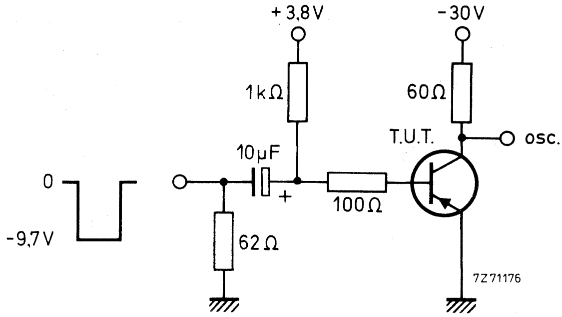


Fig. 2 Switching circuit.

Pulse generator:

Rise time	t_r	<	20 ns
Fall time	t_f	<	20 ns
Pulse duration	t_p	=	10 μs
Duty factor	δ	<	0,02
Source impedance	Z_S	=	50 Ω

Oscilloscope:

Rise time	t_r	=	10 ns
Input impedance	Z_I	>	100 kΩ

PNP POWER TRANSISTOR

PNP power transistor, housed in a TO-39 metal package. It is intended for use in amplifier and switching applications.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	90 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	65 V
Collector current (DC)	$-I_C$	max.	1.0 A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	7.0 W
DC current gain $-I_C$ = 150 mA; $-V_{CE}$ = 2 V	h_{FE}		20 to 200

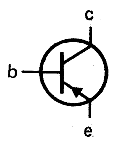
MECHANICAL DATA

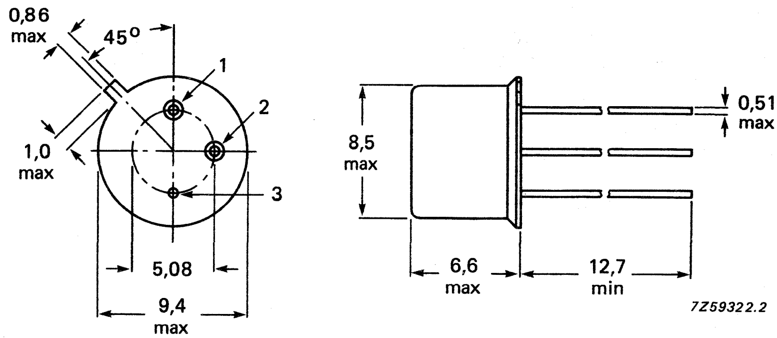
Dimensions in mm

Fig. 1 TO-39.

Pinning:

1 = emitter
2 = base
3 = collector





RATINGS

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

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	90 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	65 V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	7.0 V
Collector current (DC)	$-I_C$	max.	1.0 A
Base current	$-I_B$	max.	0.5 A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	7.0 W
Storage temperature range	T_{stg}		−55 to + 200 °C
Junction temperature	T_j	max.	200 °C

THERMAL RESISTANCE

From junction to case	$R_{th\ j\text{-}c}$		25 K/W

CHARACTERISTICS

T_{amb} = 25 °C unless stated otherwise

Collector-emitter sustaining voltage			
$-I_C$ = 100 mA; I_B = 0	$-V_{CEOsus}$	>	65 V
Collector cut-off current			
$-V_{CE}$ = 85 V; $-V_{EB}$ = 1.5 V	$-I_{CEX}$	<	100 mA
$-V_{CE}$ = 30 V; $-V_{EB}$ = 1.5 V; T_c = 150 °C	$-I_{CEX}$	<	0.1 mA
Collector cut-off current			
$-V_{CB}$ = 90 V; I_E = 0	$-I_{CEO}$	<	100 μA
Emitter cut-off current			
$-V_{EB}$ = 7 V; I_C = 0	$-I_{EBO}$	<	10 μA
DC current gain			
$-I_C$ = 150 mA; $-V_{CE}$ = 2 V	h_{FE}		20 to 200
$-I_C$ = 0.1 mA; $-V_{CE}$ = 10 V	h_{FE}	>	20
$-I_C$ = 150 mA; $-V_{CE}$ = 10 V	h_{FE}		40 to 140
$-I_C$ = 150 mA; $-V_{CE}$ = 10 V	h_{FE}	>	20
Saturation voltages			
$-I_C$ = 150 mA; $-I_B$ = 15 mA	$-V_{CEsat}$	<	0.65 V
	$-V_{BEsat}$	<	1.4 V
Base-emitter on-state voltage			
$-I_C$ = 150 mA; $-V_{CE}$ = 10 V	$-V_{BE\ on}$	<	1.5 V
Collector-base capacitance			
$-V_{CB}$ = 10 V; f = 1 MHz	C_c	<	30 pF
High-frequency current gain			
$-I_C$ = 50 mA; $-V_{CE}$ = 10 V; f = 20 MHz	h_{FE}	>	3.0
Switching characteristics			
rise time; I_{B1} = 15 mA	t_r	<	70 ns
storage time; I_{B2} = 15 mA	t_s	<	600 ns
fall time; I_{B2} = 15 mA	t_f	<	100 ns
turn-on time; I_{B1} = I_{B2}	t_{on}	<	110 ns
turn-off time; I_{B1} = I_{B2}	t_{off}	<	700 ns

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in plastic TO-92 packages, primarily intended for low-power, small-signal audio-frequency applications for consumer service.

P-N-P complements are 2N4125 and 2N4126.

QUICK REFERENCE DATA

			2N4123	2N4124	
Collector-base voltage (open emitter)	V_{CBO}	max.	40	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	25	V
Collector current (d.c.)	I_C	max.	200	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	350	350	mW
Junction temperature	T_j	max.	150	150	°C
Small-signal current gain I_C = 2 mA; V_{CE} = 10 V; f = 1 kHz	h_{fe}	>	50	120	
		<	200	480	
Transition frequency at f = 100 MHz I_C = 10 mA; V_{CE} = 20 V	f_T	>	250	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	<	6	5	dB

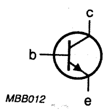
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter



Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			2N4123	2N4124	
Collector-base voltage (open emitter)	V_{CBO}	max.	40	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	25	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.	350		mW
Total power dissipation up to T_{case} = 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 in free air	$R_{th\ j\text{-}a}$	=	357	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	125	K/W

CHARACTERISTICS

T_{amb} = 25 °C

Collector cut-off current $I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	<	50	nA
Emitter cut-off current $I_C = 0$; $V_{EB} = 3$ V	I_{EBO}	<	50	nA
Saturation voltages * $I_C = 50$ mA; $I_B = 5$ mA	V_{CEsat}	<	300	mV
	V_{BEsat}	<	950	mV

			2N4123	2N4124	
D.C. current gain * $I_C = 2$ mA; $V_{CE} = 1$ V	h_{FE}	>	50	120	
		<	150	360	
$I_C = 50$ mA; $V_{CE} = 1$ V	h_{FE}	>	25	60	
Collector capacitance at f = 100 kHz $I_E = I_e = 0$; $V_{CB} = 5$ V	C_c	<	4	4	pF
Emitter capacitance at f = 100 kHz $I_C = I_c = 0$; $V_{EB} = 0{,}5$ V	C_e	<	8	8	pF
Transition frequency at f = 100 MHz $I_C = 10$ mA; $V_{CE} = 20$ V	f_T	>	250	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	<	6	5	dB
Small-signal current gain $I_C = 2$ mA; $V_{CE} = 10$ V; f = 1 kHz	h_{fe}	>	50	120	
		<	200	480	

* Measured under pulse conditions: $t_p = 300$ μs; δ = 0,02.

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors in plastic TO-92 packages, primarily intended for low-power, small-signal audio-frequency applications for consumer service.

N-P-N complements are 2N4123 and 2N4124.

QUICK REFERENCE DATA

			2N4125	2N4126	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	30	25	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	30	25	V
Collector current (d.c.)	$-I_C$	max.	200	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	350	350	mW
Junction temperature	T_j	max.	150	150	°C
Small-signal current gain $-I_C$ = 2 mA; $-V_{CE}$ = 10 V; f = 1 kHz	h_{fe}	> <	50 200	120 480	
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 20 V	f_T	>	200	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	<	5	4	dB

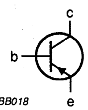
MECHANICAL DATA

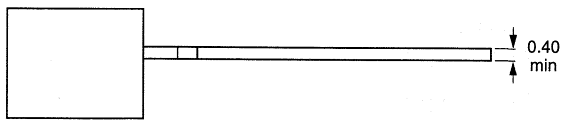
Dimensions in mm

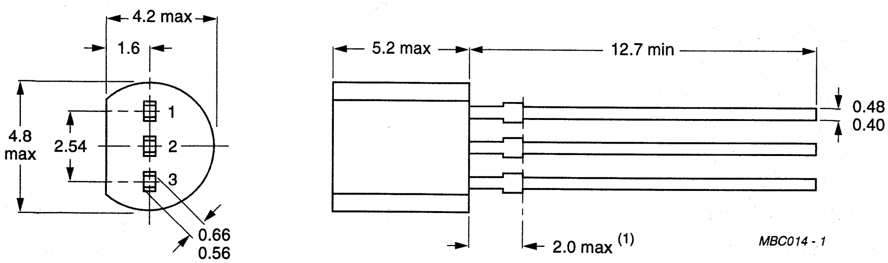
Fig. 1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			2N4125	2N4126	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	30	25	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	30	25	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	4		V
Collector current (d.c.)	$-I_C$	max.	200		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	350		mW
Total power dissipation up to T_{case} = 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 in free air	$R_{th\ j\text{-}a}$	=	357	K/W
From junction to case	$R_{th\ j\text{-}c}$	=	125	K/W

CHARACTERISTICS

T_{amb} = 25 °C

Collector cut-off current $I_E = 0$; $-V_{CB}$ = 20 V	$-I_{CBO}$	<	50	nA
Emitter cut-off current $I_C = 0$; $-V_{EB}$ = 3 V	$-I_{EBO}$	<	50	nA
Saturation voltages * $-I_C$ = 50 mA; $-I_B$ = 5 mA	$-V_{CEsat}$	<	400	mV
	$-V_{BEsat}$	<	950	mV

			2N4125	2N4126	
D.C. current gain * $-I_C$ = 2 mA; $-V_{CE}$ = 1 V	h_{FE}	>	50	120	
		<	150	360	
$-I_C$ = 50 mA; $-V_{CE}$ = 1 V	h_{FE}	>	25	60	
Collector capacitance at f = 100 kHz $I_E = I_e = 0$; $-V_{CB}$ = 5 V	C_c	<	4,5	4,5	pF
Emitter capacitance at f = 100 kHz $I_C = I_c = 0$; $-V_{EB}$ = 0,5 V	C_e	<	10	10	pF
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 20 V	f_T	>	200	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	<	5	4	dB
Small-signal current gain $-I_C$ = 2 mA; $-V_{CE}$ = 10 V; f = 1 kHz	h_{fe}	>	50	120	
		<	200	480	

* Measured under pulse conditions: t_p = 300 μs; δ = 0,02.

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N silicon planar epitaxial transistors in plastic TO-92 package for use in general purpose applications.

QUICK REFERENCE DATA

			2N4400	2N4401	
Collector-emitter voltage (open base)	V_{CEO}	max.	40		V
Collector-base voltage (open emitter)	V_{CBO}	max.	60		V
Collector current (d.c.)	I_C	max.	600		mA
Total device dissipation at T_{amb} = 25 °C	P_{tot}	max.	625		mW
Collector-emitter saturation voltage I_C = 500 mA; I_B = 50 mA	V_{CEsat}	max.	0,75		V
D.C. current gain I_C = 100 mA; V_{CE} = 2 V	h_{FE}	min.	50	150	
		max.	100	300	

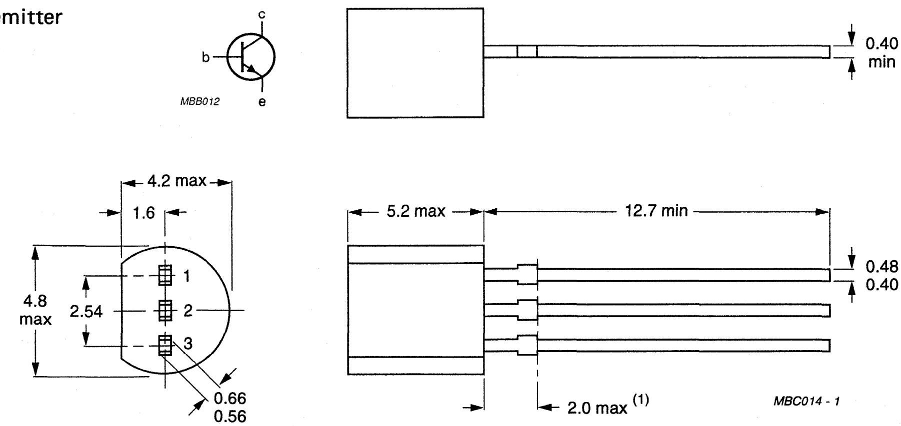
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter



Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			2N4400	2N4401	
Collector-emitter voltage (open base)	V_{CEO}	max.	40		V
Collector-base voltage (open emitter)	V_{CBO}	max.	60		V
Emitter-base voltage (open collector)	V_{EBO}	max.	6		V
Collector current (d.c.)	I_C	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	625		mW
Storage temperature range	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	=	200	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			2N4400	2N4401	
Collector-emitter breakdown voltage $I_B = 0$; I_C = 1 mA	$V_{(BR)CEO}$	min.	40		V
Collector-base breakdown voltage $I_E = 0$; I_C = 0,1 mA	$V_{(BR)CBO}$	min.	60		V
Emitter-base breakdown voltage I_E = 0,1 mA; $I_C = 0$	$V_{(BR)EBO}$	min.	6		V
Base cut-off current V_{CE} = 35 V; $-V_{BE}$ = 0,4 V	I_{BEX}	max.	0,1		μA
Collector cut-off current V_{CE} = 35 V; $-V_{BE}$ = 0,4 V	I_{CEX}	max.	0,1		μA
D.C. current gain I_C = 0,1 mA; V_{CE} = 1 V	h_{FE}	min.	20		
I_C = 1 mA; V_{CE} = 1 V	h_{FE}	min.	20	40	
I_C = 10 mA; V_{CE} = 1 V	h_{FE}	min.	40	80	
I_C = 150 mA; V_{CE} = 1 V	h_{FE}	min.	50	100	
		max.	150	300	
I_C = 500 mA; V_{CE} = 2 V	h_{FE}	min.	20	40	
Saturation voltages I_C = 150 mA; I_B = 15 mA	V_{CEsat}	max.	0,4		V
	V_{BEsat}	min.	0,75		V
		max.	0,95		V
I_C = 500 mA; I_B = 50 mA	V_{CEsat}	max.	0,75		V
	V_{BEsat}	max.	1,2		V

			2N4400		2N4401	
Transition frequency at f = 100 MHz I_C = 20 mA; V_{CE} = 10 V	f_T	min.	200		250	MHz
Collector-base capacitance I_E = 0; V_{CB} = 5 V; f = 100 kHz	C_c	max.		6,5		pF
Emitter-base capacitance I_C = 0; V_{BE} = 0,5 V; f = 100 kHz	C_e	max.		30		pF
Input impedance at f = 1 kHz I_C = 1 mA; V_{CE} = 10 V	h_{ie}	min. max.	0,5 7,5		1,0 15	kΩ kΩ
Voltage feedback ratio at f = 1 kHz I_C = 1 mA; V_{CE} = 10 V	h_{re}	min. max.		0,1 8,0		$\times 10^{-4}$ $\times 10^{-4}$
Small-signal current gain I_C = 1 mA; V_{CE} = 10 V; f = 1 kHz	h_{fe}	min. max.	20 250		40 500	
Output admittance at f = 1 kHz I_C = 1 mA; V_{CE} = 10 V	h_{oe}	min. max.		1,0 30		μS 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; I_{B1} = I_{B2} = 15 mA; V_{CC} = 30 V				
storage time	t_s	max.	225	ns
fall time	t_f	max.	30	ns

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P silicon planar epitaxial transistors in plastic TO-92 package for use in general purpose applications.

QUICK REFERENCE DATA

			2N4402	2N4403	
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40		V
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40		V
Collector current (d.c.)	$-I_C$	max.	600		mA
Total device dissipation at T_{amb} = 25 °C	P_{tot}	max.	625		mW
Collector-emitter saturation voltage $-I_C$ = 500 mA; $-I_B$ = 50 mA	$-V_{CEsat}$	max.	0,75		V
D.C. current gain $-I_C$ = 150 mA; $-V_{CE}$ = 2 V	h_{FE}	min.	50	100	
		max.	150	300	

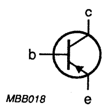
MECHANICAL DATA

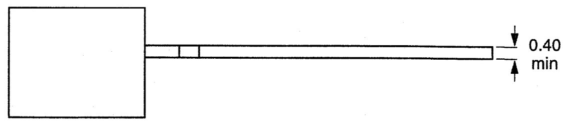
Dimensions in mm

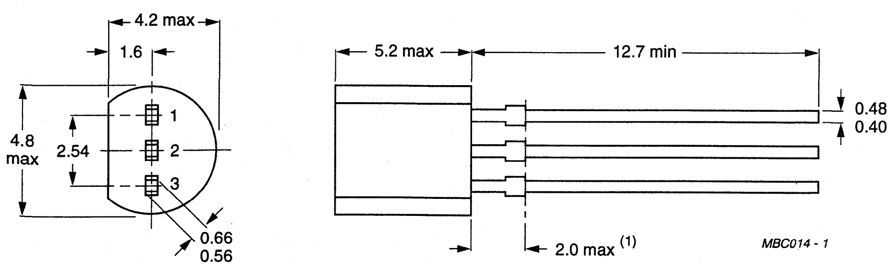
Fig. 1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			2N4402	2N4403	
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40		V
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40		V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5		V
Collector current (d.c.)	$-I_C$	max.	600		mA
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	625		mW
Storage temperature range	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	=	200	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			2N4402	2N4403	
Collector-emitter breakdown voltage I_B = 0; $-I_C$ = 1 mA	$-V_{(BR)CEO}$	min.	40		V
Collector-base breakdown voltage I_E = 0; $-I_C$ = 0,1 mA	$-V_{(BR)CBO}$	min.	40		V
Emitter-base breakdown voltage $-I_E$ = 0,1 mA; I_C = 0	$-V_{(BR)EBO}$	min.	5		V
Base cut-off current $-V_{CE}$ = 35 V; V_{BE} = 0,4 V	$-I_{BEX}$	max.	0,1		μA
Collector cut-off current $-V_{CE}$ = 35 V; V_{BE} = 0,4 V	$-I_{CEX}$	max.	0,1		μA
D.C. current gain					
$-I_C$ = 0,1 mA; $-V_{CE}$ = 1 V	h_{FE}	min.		30	
$-I_C$ = 1 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	30	60	
$-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}	min.	50	100	
$-I_C$ = 150 mA; $-V_{CE}$ = 2 V	h_{FE}	min.	50	100	
		max.	150	300	
$-I_C$ = 500 mA; $-V_{CE}$ = 2 V	h_{FE}	min.	20		
Saturation voltages					
$-I_C$ = 150 mA; $-I_B$ = 15 mA	$-V_{CEsat}$	max.	0,4		V
	$-V_{BEsat}$	min.	0,75		V
		max.	0,95		V
$-I_C$ = 500 mA; $-I_B$ = 50 mA	$-V_{CEsat}$	max.	0,75		V
	$-V_{BEsat}$	max.	1,3		V

			2N4402	2N4403	
Transition frequency at f = 100 MHz $-I_C$ = 20 mA; $-V_{CE}$ = 10 V	f_T	min.	150	200	MHz
Collector-base capacitance I_E = 0; $-V_{CB}$ = 10 V; f = 140 kHz	C_c	max.	8,5		pF
Emitter-base capacitance I_C = 0; $-V_{BE}$ = 0,5 V; f = 140 kHz	C_e	max.	30		pF

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; $-I_{B1}$ = I_{B2} = 15 mA; $-V_{CC}$ = 30 V				
storage time	t_s	max.	225	ns
fall time	t_f	max.	30	ns

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P small-signal transistors in plastic TO-92 package intended for low-noise stages in audio equipment. Complementary types are 2N5088/2N5089.

QUICK REFERENCE DATA

Collector-emitter voltage (open base)	$-V_{CEO}$	max.	50		V
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	50		V
Collector current (d.c.)	$-I_C$	max.	50		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	625		mW
Collector-emitter saturation voltage $-I_C$ = 10 mA; $-I_B$ = 1 mA	$-V_{CEsat}$	max.	0,3		V
			2N5086	2N5087	
D.C. current gain $-I_C$ = 1 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	150	250	

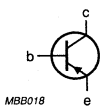
MECHANICAL DATA

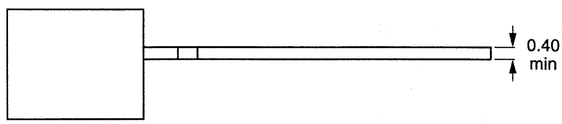
Dimensions in mm

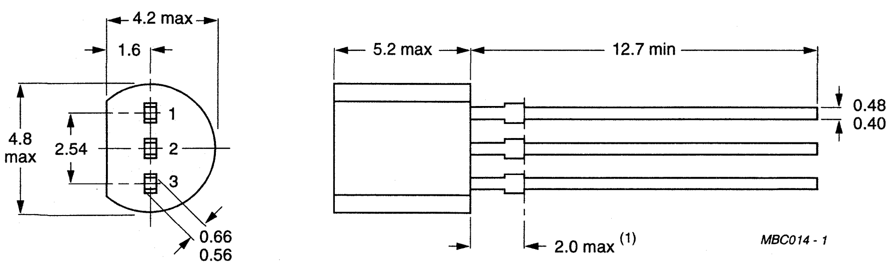
Fig. 1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

Collector-emitter voltage (open base)	$-V_{CEO}$	max.	50	V
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	50	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	3,0	V
Collector current (d.c.)	$-I_C$	max.	50	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	625	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	$R_{th\ j\text{-}a}$	=	200	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector-emitter breakdown voltage $I_B = 0$; $-I_C$ = 1 mA	$-V_{(BR)CEO}$	min.	50	V
Collector-base breakdown voltage $I_E = 0$; $-I_C$ = 100 μA	$-V_{(BR)CBO}$	min.	50	V
Collector cut-off current $-V_{CB}$ = 10 V; $I_E = 0$	$-I_{CBO}$	max.	10	nA
$-V_{CB}$ = 35 V; $I_E = 0$	$-I_{CBO}$	max.	50	nA
Emitter cut-off current $-V_{EB}$ = 3 V; $I_C = 0$	$-I_{EBO}$	max.	50	nA
Collector-emitter saturation voltage $-I_C$ = 10 mA; $-I_B$ = 1 mA	$-V_{CEsat}$	max.	0,3	V
Base-emitter ON-voltage $-I_C$ = 1 mA; $-V_{CE}$ = 5 V	$-V_{BEon}$	max.	0,85	V
Transition frequency at f = 20 MHz $-I_C$ = 500 μA; $-V_{CE}$ = 5 V	f_T	min.	40	MHz
Collector capacitance at f = 100 kHz $-V_{CB}$ = 5 V; $I_E = 0$	C_c	max.	4,0	pF

			2N5086	2N5087
D.C. current gain $-I_C$ = 100 μA; $-V_{CE}$ = 5 V	h_{FE}	min.	150	250
		max.	500	800
$-I_C$ = 1 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	150	250
$-I_C$ = 10 mA; $-V_{CE}$ = 5 V	h_{FE}	min.	150	250
Small-signal current gain at f = 1 kHz $-I_C$ = 1 mA; $-V_{CE}$ = 5 V	h_{fe}	min.	150	250
		max.	600	900

			2N5086	2N5087	
Noise figure at $-V_{CE}$ = 5 V; T_{amb} = 25 °C					
$-I_C$ = 20 μA; R_S = 10 kΩ; f = 10 Hz to 15,7 kHz	F	max.	3,0	2,0	dB
$-I_C$ = 100 μA; R_S = 3 kΩ; f = 1 kHz	F	max.	3,0	2,0	dB

SILICON PLANAR EPITAXIAL TRANSISTOR

NPN small-signal transistor in plastic TO-92 package intended for low-noise stages in audio equipment. Complementary type is 2N5086.

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 (DC)	I_C	max.	50	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	625	mW
Collector-emitter saturation voltage I_C = 10 mA; I_B = 1 mA	V_{CEsat}	max.	0.5	V
DC current gain I_C = 1 mA; V_{CE} = 5 V	h_{FE}	min.	350	

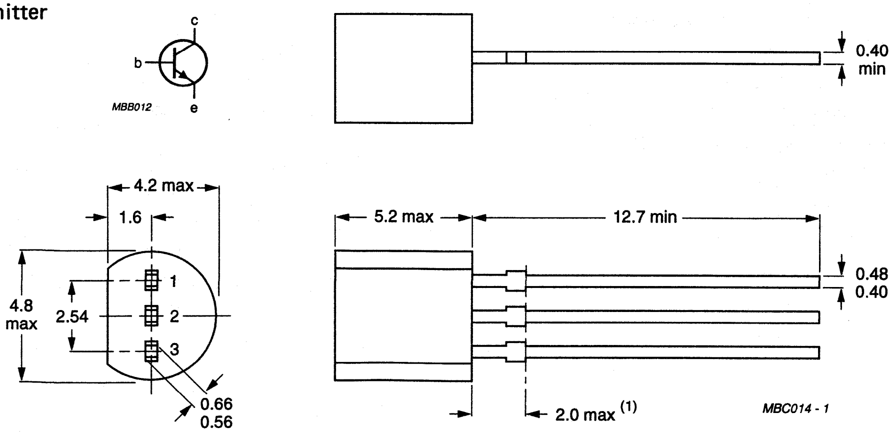
MECHANICAL DATA

Dimensions in mm

Fig.1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter



Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

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 (DC)	I_C	max.	50 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	625 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	$R_{th\ j\text{-}a}$	=	200 K/W

CHARACTERISTICS

T_j = 25 °C 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 μA	$V_{(BR)CBO}$	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
V_{EBoff} = 4.5 V; $I_C = 0$	I_{EBO}	max.	100 nA
Collector-emitter saturation voltage I_C = 10 mA; I_B = 1 mA	V_{CEsat}	max.	0.5 V
Base-emitter ON-voltage I_C = 10 mA; V_{CE} = 5 V	V_{BEon}	max.	0.8 V
Transition frequency at f = 20 MHz I_C = 500 μA; V_{CE} = 5 V	f_T	min.	50 MHz
DC current gain I_C = 100 μA; V_{CE} = 5 V	h_{FE}	min.	300
		max.	900
I_C = 1 mA; V_{CE} = 5 V	h_{FE}	min.	350
I_C = 10 mA; V_{CE} = 5 V		min.	300
Small-signal current gain at f = 1 kHz I_C = 1 mA; V_{CE} = 5 V	h_{fe}	min.	350
		max.	1400
Noise figure at R_S = 10 kΩ; T_{amb} = 25 °C I_C = 100 μA; 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 TRANSISTORS

P-N-P high-voltage small-signal transistors for general purposes and especially in telephony applications and encapsulated in a TO-92 package.

N-P-N complements are 2N5550 and 2N5551.

QUICK REFERENCE DATA

			2N5400	2N5401	
Collector-base voltage (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.	500	500	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	

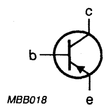
MECHANICAL DATA

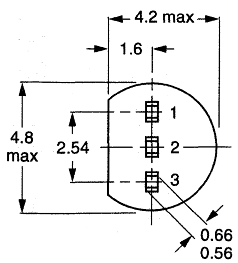
Dimensions in mm

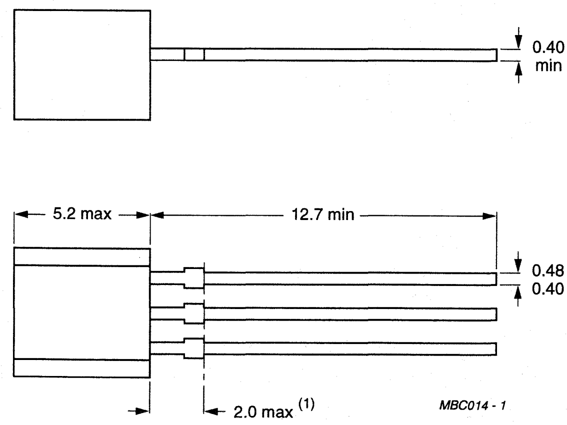
Fig. 1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			2N5400	2N5401	
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.	500		mW
Junction temperature	T_j	max.	150		°C
Storage temperature range	T_{stg}		−65 to + 150		°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	max.	250	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			2N5400	2N5401	
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_e	max.	6	6	pF

			2N5400	2N5401	
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 10 V	f_T	min.	100	100	MHz
		max.	400	300	MHz
Noise figure at R_S = 1 kΩ I_C = 250 μA; $-V_{CE}$ = 5 V; f = 10 Hz to 15,7 kHz	F	max.	8	8	dB

SILICON P-N-P HIGH-VOLTAGE TRANSISTORS

Transistors in TO-39 metal packages with the collector connected to the case. They are intended for high-speed switching and linear amplifier applications in military, industrial and commercial equipment.

QUICK REFERENCE DATA

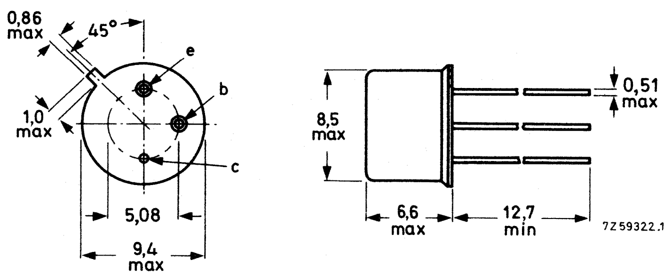
			2N5415	2N5416	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	200	350	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	200	300	V
Collector current (d.c.)	$-I_C$	max.	1	1	A
Total power dissipation up to T_{amb} = 50 °C	P_{tot}	max.	1	1	W
Junction temperature	T_j	max.	200	200	°C
D.C. current gain $-I_C$ = 50 mA; $-V_{CE}$ = 10 V	h_{FE}	> <	30 150	30 120	

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case



Maximum lead diameter is guaranteed only for 12,7 mm.

Accessories: 56245 (distance disc).

RATINGS

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

			2N5415	2N5416	
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 (d.c.)	$-I_B$	max.	0,5		A
Total power dissipation up to T_{case} = 25 °C	P_{tot}	max.	10		W
Total power dissipation up to T_{amb} = 50 °C	P_{tot}	max.	1		W

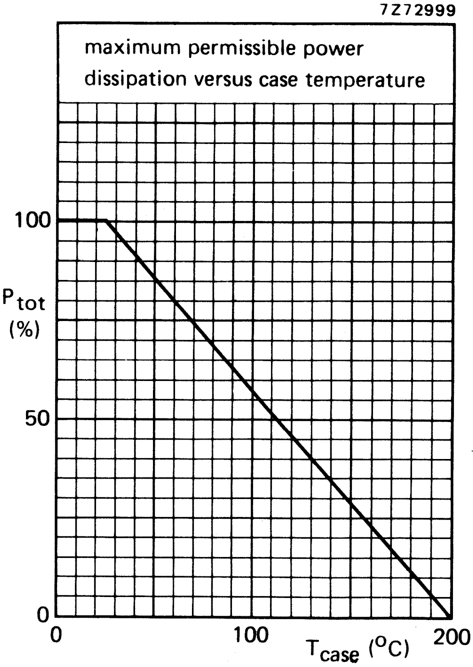


Fig. 2.

Storage temperature	T_{stg}		−65 to + 200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to case	$R_{th\ j\text{-}c}$	=	17,5	K/W
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	150	K/W

CHARACTERISTICS

T_{case} = 25 °C unless otherwise specified

			2N5415	2N5416	
Collector cut-off currents					
$I_E = 0; -V_{CB} = 175$ V	$-I_{CBO}$	<	50	–	μA
$I_E = 0; -V_{CB} = 280$ V	$-I_{CBO}$	<	–	50	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
Sustaining voltage					
$I_B = 0; -I_C = 0$ to 50 mA	$-V_{CEOsust}$	>	200	300	V* ←

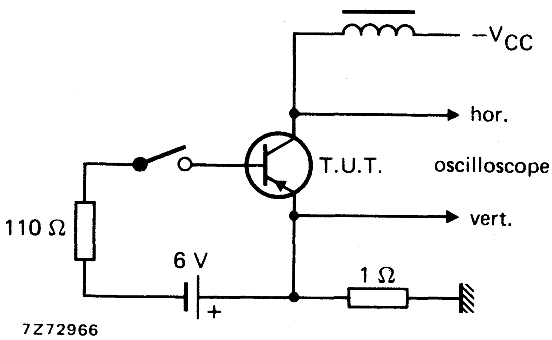


Fig. 3 Test circuit for $V_{CEOsust}$.

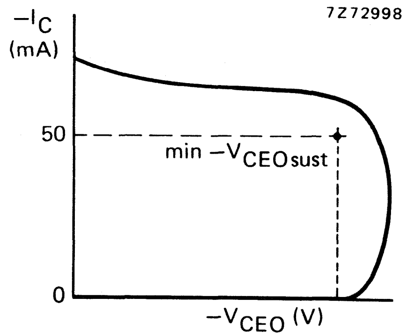


Fig. 4 Oscilloscope display for $V_{CEOsust}$.

			2N5415	2N5416	
Saturation voltages					
$-I_C = 50$ mA; $-I_B = 5$ mA	$-V_{CEsat}$	<	0,5	0,5	V
	$-V_{BEsat}$	<	1,5	1,5	V
D.C. current gain					
$-I_C = 50$ mA; $-V_{CE} = 10$ V	h_{FE}	>	30	30	
		<	150	120	
Collector capacitance at f = 1 MHz					
$I_E = I_e = 0; -V_{CB} = 10$ V	C_c	<	15		pF
Emitter capacitance at f = 1 MHz					
$I_C = I_c = 0; -V_{EB} = -V_{EBOmax}$	C_e	<	75		pF

* Measured under pulse conditions to avoid excessive dissipation.

Transition frequency at f = 5 MHz			
$-I_C$ = 10 mA; $-V_{CE}$ = 10 V	f_T	>	15 MHz
h-parameters (common emitter)			
$-I_C$ = 5 mA; $-V_{CE}$ = 10 V			
real part of input impedance at f = 1 MHz	$R_e(h_{ie})$	<	300 Ω
small-signal current gain at f = 1 kHz	h_{fe}	>	25

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 TO-92 package.

P-N-P complements are 2N5400 and 2N5401.

QUICK REFERENCE DATA

			2N5550	2N5551	
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.	500	500	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	

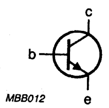
MECHANICAL DATA

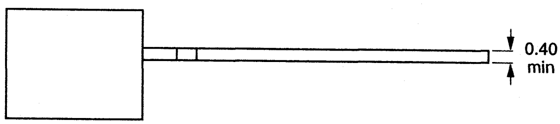
Dimensions in mm

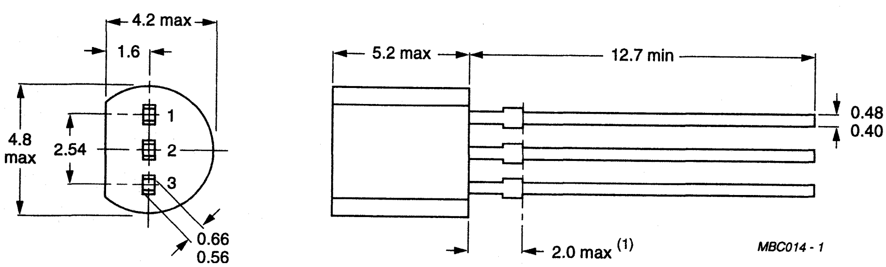
Fig. 1 TO-92.

Pinning

1 = collector
2 = base
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

			2N5550	2N5551	
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.	500		mW
Junction temperature	T_j	max.	150		°C
Storage temperature range	T_{stg}		−65 to + 150		°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	max.	250	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			2N5550	2N5551	
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_c	max.	6	6	pF
Input capacitance at f = 1 MHz					
$I_C = 0$; $V_{EB} = 0{,}5$ V	C_e	max.	30	30	pF

			2N5550	2N5551	
Transition frequency at f = 100 MHz					
I_C = 10 mA; V_{CE} = 10 V	f_T	min.	100	100	MHz
		max.	300	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 SMALL-SIGNAL TRANSISTOR

PNP small-signal transistor, in a plastic TO-92 package.

It is intended for use in audio amplifier driver stages and low speed switching applications etc.

NPN complementary type is the 2PC945.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	50	V
Collector current (DC)	$-I_C$	max.	100	mA
Total power dissipation at $T_{amb} \leq 25\ ^oC$	P_{tot}	max.	500	mW
Collector-emitter saturation voltage $-I_C = 100$ mA; $-I_B = 10$ mA	$-V_{CEsat}$	max.	0.3	V
DC current gain $-I_C = 1$ mA; $-V_{CE} = 6$ V	h_{FE}	min.	90	
		max.	600	

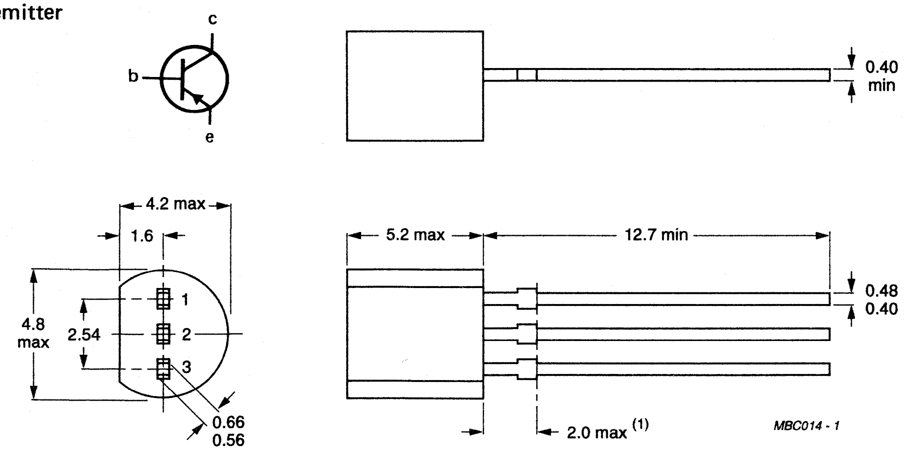
MECHANICAL DATA

Dimensions in mm

Fig.1 TO-92

Pinning

1 = base
2 = collector
3 = emitter



Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

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.	50 V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5.0 V
Collector current (DC)	$-I_C$	max.	100 mA
Base current (DC)	$-I_B$	max.	20 mA
Total power dissipation at $T_{amb} \leq 25$ °C	P_{tot}	max.	500 mW
Junction temperature	T_j	max.	150 °C
Storage temperature range	T_{stg}	−65 to + 150 °C	

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\,j\text{-}a}$	=	250 K/W

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified

Collector cut-off current $-I_E = 0$; $-V_{CB} = 60$ V	$-I_{CBO}$	max.	100 nA
Emitter cut-off current $-I_C = 0$; $-V_{EB} = 5$ V	$-I_{EBO}$	max.	100 nA
DC current gain $-I_C = 1$ mA; $-V_{CE} = 6$ V*	h_{FE}	min. max.	90 600
Collector-emitter saturation voltage $-I_C = 100$ mA; $-I_B = 10$ mA	$-V_{CEsat}$	max.	0.3 V
Base-emitter on-state voltage $-I_C = 1$ mA; $-V_{CE} = 6$ V	$-V_{BEon}$	min. max.	0.6 V 0.7 V
Transition frequency $-I_C = 10$ mA; $-V_{CE} = 6$ V	f_T	min. typ.	100 MHz 180 MHz
Collector-base capacitance $-I_E = 0$; $-V_{CB} = 10$ V; f = 1 MHz	C_c	max. typ.	6.0 pF 4.5 pF
Noise figure $-I_C = 300\ \mu$A; $-V_{CE} = 6$ V; $R_s = 2$ kΩ; f = 100 Hz	F	max. typ.	20 dB 6.0 dB

* Classification of h_{FE}

Group	R	Q	P	K
Range	90 - 180	135 - 270	200 - 400	300 - 600

SILICON SMALL-SIGNAL TRANSISTORS

PNP small-signal transistors, each in a plastic TO-92 package.

They are intended for use in audio amplifier driver stages and other general purpose applications.

NPN complementary types are 2PC1815 and 2PC1815L.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	50	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	50	V
Collector current (DC)	$-I_C$	max.	150	mA
Total power dissipation at $T_{amb} \leqslant 25\ ^oC$	P_{tot}	max.	500	mW
Collector-emitter saturation voltage $-I_C = 100$ mA; $-I_B = 10$ mA	$-V_{CEsat}$	max.	0.3	V
DC current gain $-I_C = 2$ mA; $-V_{CE} = 6$ V	h_{FE}	min. max.	120 700	

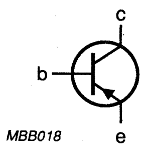
MECHANICAL DATA

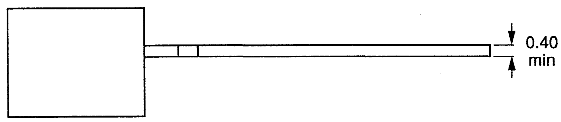
Dimensions in mm

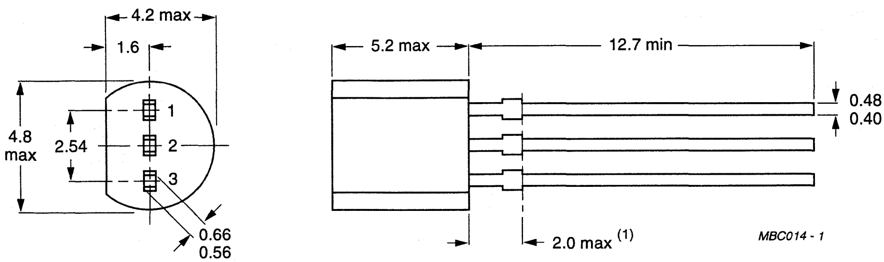
Fig.1 TO-92

Pinning

1 = base
2 = collector
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

RATINGS

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

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	50 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	50 V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5.0 V
Collector current (DC)	$-I_C$	max.	150 mA
Base current (DC)	$-I_B$	max.	50 mA
Total power dissipation at $T_{amb} \leqslant 25\ ^oC$	P_{tot}	max.	500 mW
Junction temperature	T_j	max.	150 ^oC
Storage temperature range	T_{stg}		−65 to + 150 ^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	250 K/W

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

Collector cut-off current $-I_E = 0; -V_{CB} = 50$ V		$-I_{CBO}$	max.	100 nA
Emitter cut-off current $-I_C = 0; -V_{EB} = 5$ V		$-I_{EBO}$	max.	100 nA
DC current gain $-I_C = 150$ mA; $-V_{CE} = 6$ V		h_{FE}	min.	25
$-I_C = 2$ mA; $-V_{CE} = 6$ V *		h_{FE}	min. max.	120 700
Collector-emitter saturation voltage $-I_C = 100$ mA; $-I_B = 10$ mA		$-V_{CEsat}$	max.	0.3 V
Base-emitter saturation voltage $-I_C = 100$ mA; $-I_B = 10$ mA		$-V_{BEsat}$	max.	1.1 V
Transition frequency $-I_C = 1$ mA; $-V_{CE} = 10$ V		f_T	min.	80 MHz
Collector-output capacitance $-I_E = 0; -V_{CB} = 10$ V; f = 1 MHz		C_c	typ. max.	4 pF 7 pF
Noise figure $-I_C = 100\ \mu A; -V_{CE} = 6$ V; $R_s = 10\ k\Omega$; f = 1 kHz	2PA1015	F	max.	10 dB
	2PA1015L	F	max.	6 dB

* Classification of h_{FE}

Group	Y	GR	BL
Range	120 – 240	200 – 400	350 – 700

PNP general purpose transistor 2PA1576

FEATURES

- S-mini package
- Low output capacitance, C_{ob} = 2.5 pF (typ.).

DESCRIPTION

PNP transistor in a plastic three lead SC70 (S-mini) package. It is intended for general purpose switching and small signal amplification.

PINNING SC70

PIN	DESCRIPTION
1	base
2	emitter
3	collector

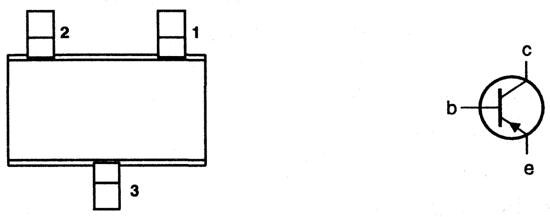


Fig.1 Simplified outline and symbol.

MARKING

TYPE NUMBER	MARKING CODE
2PA1576Q	FQ
2PA1576R	FR
2PA1576S	FS

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–50	V
V_{CEO}	collector-emitter voltage	open base	–	–40	V
I_C	collector current (DC)		–	–100	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} = –6 V	120	560	
f_T	transition frequency	I_E = 2 mA; V_{CE} = –12 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	–	–50	V
V_{CEO}	collector-emitter voltage	open base	–	–40	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C; note 1	–	200	mW
T_{amb}	operating ambient temperature		–65	+150	°C
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air; note 1	625	K/W

Note to the "Limiting values" and "Thermal characteristics"

1. In accordance with standard mounting conditions SC70, three lead version.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = –50 µA; I_E = 0	–50	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = –1 mA; I_B = 0	–40	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = –50 µA; I_C = 0	–5	–	–	V
V_{CEsat}	saturation voltage	I_C = –50 mA; I_B = –5 mA; note 1	–	–	–500	mV
I_{CBO}	collector-base cut-off current	V_{CB} = –30 V; I_E = 0	–	–	–100	nA
		V_{CB} = –30 V; I_E = 0; T_j = 150 °C	–	–	–5	µA
I_{EBO}	emitter-base cut-off current	V_{EB} = –4 V; I_C = 0	–	–	–100	nA
h_{FE}	DC current gain	I_C = –1 mA; V_{CE} = –6 V				
	2PA1576Q		120	–	270	
	2PA1576R		180	–	390	
	2PA1576S		270	–	560	
f_T	transition frequency	I_E = 2 mA; V_{CE} = –12 V; f = 100 MHz	100	–	–	MHz
C_c	output capacitance	$I_E = i_e$ = 0; V_{CB} = –12 V; f = 1 MHz	–	2.5	3.5	pF

Note to the "Characteristics"

1. Pulse test: $t_p \leq 300$ µs; $\delta \leq 0.02$.

PNP general purpose transistors | 2PB709; 2PB709A

FEATURES

- High DC current gain
- Low collector-emitter saturation voltage
- S-mini package.

APPLICATIONS

Intended for general purpose switching and amplification.

DESCRIPTION

PNP transistor in a plastic SC59 package. Complementary pairs are 2PD601 and 2PD601A respectively.

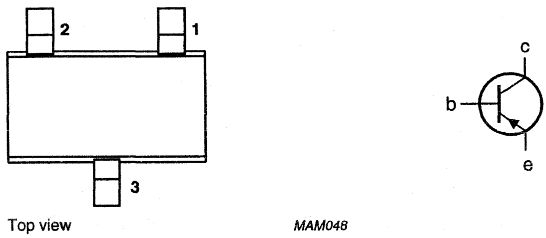


Fig.1 Simplified outline (SC59) and symbol.

MARKING

TYPE NUMBER	MARKING CODE
2PB709Q	AQ
2PB709R	AR
2PB709S	AS
2PB709AQ	BQ
2PB709AR	BR
2PB709AS	BS

PINNING SC59

PIN	DESCRIPTION
1	base
2	emitter
3	collector

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
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	250	mW
h_{FE}	DC current gain	I_C = –2 mA; V_{CE} = –10 V	160	460	
f_T	transition frequency	I_E = 2 mA; V_{CB} = –10 V			
	2PB709S		80	–	MHz
	2PB709AS		80	–	MHz

PNP general purpose transistors 2PB709; 2PB709A

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	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	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
T_{amb}	operating ambient temperature		–65	+150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air; note 1	500	K/W

Note to the “Limiting values” and “Thermal characteristics”

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_{CEsat}	collector-emitter saturation voltage	I_C = −100 mA; I_B = −10 mA; note 1	−	−500	mV
I_{CBO}	collector cut-off current	V_{CB} = −20 V; I_E = 0	−	−100	nA
		V_{CB} = −20 V; I_E = 0; T_j = 150 °C	−	−5	μA
I_{EBO}	emitter cut-off current	V_{EB} = −5 V; I_C = 0	−	−100	nA
h_{FE}	DC current gain	V_{CE} = −10 V; I_C = −2 mA			
	2PB709Q; 2PB709AQ		160	260	
	2PB709R; 2PB709AR		210	340	
	2PB709S; 2PB709AS		290	460	
f_T	transition frequency	V_{CB} = −10 V; I_E = 1 mA; f = 100 MHz			
	2PB709Q; 2PB709AQ		60	−	MHz
	2PB709R; 2PB709AR		70	−	MHz
	2PB709S; 2PB709AS		80	−	MHz
C_c	collector capacitance	V_{CB} = −10 V; I_E = i_E = 0; f = 1 MHz	−	5	pF

Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.02$.

PNP general purpose transistors — 2PB710; 2PB710A

FEATURES

- High collector current
- Low collector-emitter saturation voltage
- S-mini package.

APPLICATIONS

Intended for general purpose switching or amplification.

DESCRIPTION

PNP transistor in a plastic SC59 package. Complementary pairs are 2PD602 and 2PD602A respectively.

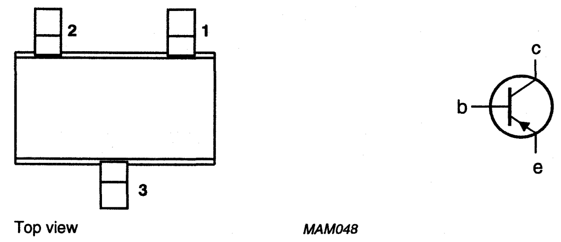


Fig.1 Simplified outline (SC59) and symbol.

MARKING

TYPE NUMBER	MARKING CODE
2PD710Q	CQ
2PD710R	CR
2PD710S	CS
2PD710AQ	DQ
2PD710AR	DR
2PD710AS	DS

PINNING SC59

PIN	DESCRIPTION
1	emitter
2	base
3	collector

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
I_{CM}	peak collector current		–	–1	A
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	250	mW
h_{FE}	DC current gain	I_C = –150 mA; V_{CE} = –10 V	85	340	
f_T	transition frequency	I_E = 50 mA; V_{CB} = –10 V			
	2PB710S		140	–	MHz
	2PB710AS		140	–	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	collector current (DC)		–	–500	mA
I_{CM}	peak collector current		–	–1	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	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j-a}$	thermal resistance from junction to ambient	in free air; note 1	500	K/W

Note to the "Limiting values" and "Thermal characteristics"

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_{CEsat}	collector-emitter saturation voltage	I_C = −300 mA; I_B = −30 mA; note 1	−	−600	mV
V_{BEsat}	base-emitter saturation voltage	I_C = −300 mA; I_B = −30 mA; note 1	−	−1.5	V
I_{CBO}	collector cut-off current	V_{CB} = −20 V; I_E = 0	−	−100	nA
		V_{CB} = −20 V; I_E = 0; T_j = 150 °C	−	−5	μA
I_{EBO}	emitter cut-off current	V_{EB} = −4 V; I_C = 0	−	−100	nA
h_{FE}	DC current gain	V_{CE} = −10 V; I_C = −500 mA; note 1	40	−	
h_{FE}	DC current gain	V_{CE} = −10 V; I_C = −150 mA; note 1			
	2PB710Q; 2PB710AQ		85	170	
	2PB710R; 2PB710AR		120	240	
	2PB710S; 2PB710AS		170	340	
f_T	transition frequency	V_{CB} = −10 V; I_E = 50 mA; f = 100 MHz; note 1			
	2PB710Q; 2PB710AQ		100	−	MHz
	2PB710R; 2PB710AR		120	−	MHz
	2PB710S; 2PB710AS		140	−	MHz
C_c	collector capacitance	V_{CB} = 10 V; I_E = i_e = 0; f = 1 MHz	−	15	pF

Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.02$.

PNP general purpose transistors 2PB1219; 2PB1219A

FEATURES

- Large collector current
- Low collector-emitter saturation voltage
- S-mini package.

APPLICATIONS

Intended for general amplification.

DESCRIPTION

PNP transistor in a plastic SC70 package.

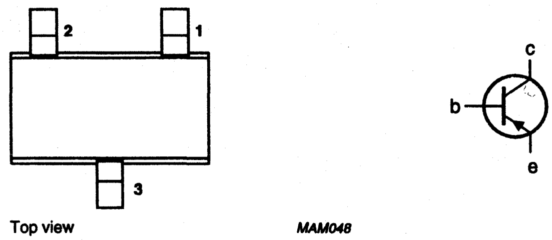


Fig.1 Simplified outline (SC70) and symbol.

MARKING

TYPE NUMBER	MARKING CODE
2PB1219Q	CQ
2PB1219R	CR
2PB1219S	CS
2PB1219AQ	DQ
2PB1219AR	DR
2PB1219AS	DS

PINNING SC70

PIN	DESCRIPTION
1	base
2	emitter
3	collector

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	2PB1219		–	–30	V
	2PB1219A		–	–60	V
V_{CEO}	collector-emitter voltage	open base			
	2PB1219		–	–25	V
	2PB1219A		–	–50	V
I_{CM}	peak collector current		–	–1	A
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	200	mW
h_{FE}	DC current gain	I_C = –150 mA; V_{CE} = –10 V	85	340	
f_T	transition frequency	I_E = 50 mA; V_{CB} = –10 V			
	2PB1219S		140	–	MHz
	2PB1219AS		140	–	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			
	2PB1219		–	–30	V
	2PB1219A		–	–60	V
V_{CEO}	collector-emitter voltage	open base			
	2PB1219		–	–25	V
	2PB1219A		–	–50	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–500	mA
I_{CM}	peak collector current		–	–1	A
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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air; note 1	625	K/W

Note to the "Limiting values"and "Thermal characteristics"

1. Refer to SC70 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			
	2PB1219		−30	−	V
	2PB1219A		−60	−	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = −2 mA; I_B = 0; note 1			
	2PB1219		−25	−	V
	2PB1219A		−50	−	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = −10 μA; I_C = 0	−5	−	V
V_{CEsat}	collector-emitter saturation voltage	I_C = −300 mA; I_B = −30 mA; note 1	−	−600	mV
V_{BEsat}	base-emitter saturation voltage	I_C = −300 mA; I_B = −30 mA; note 1	−	−1.5	V
I_{CBO}	collector cut-off current	V_{CB} = −20 V; I_E = 0	−	−100	nA
		V_{CB} = −20 V; I_E = 0; T_j = 150 °C	−	−5	μA
I_{EBO}	emitter cut-off current	V_{EB} = −4 V; I_C = 0	−	−100	nA
h_{FE}	DC current gain	V_{CE} = −10 V; I_C = −500 mA; note 1	40	−	
h_{FE}	DC current gain	V_{CE} = −10 V; I_C = −150 mA; note 1			
	2PB1219Q; 2PB1219AQ		85	170	
	2PB1219R; 2PB1219AR		120	240	
	2PB1219S; 2PB1219AS		170	340	
f_T	transition frequency	V_{CB} = −10 V; I_E = 50 mA; f = 100 MHz; note 1			
	2PB1219Q; 2PB1219AQ		100	−	MHz
	2PB1219R; 2PB1219AR		120	−	MHz
	2PB1219S; 2PB1219AS		140	−	MHz
C_c	collector capacitance	V_{CB} = −10 V; I_E = i_E = 0; f = 1 MHz	−	15	pF

Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.02$.

SILICON SMALL-SIGNAL TRANSISTOR

NPN small-signal transistor, in a plastic TO-92 package.

It is intended for use in audio amplifier driver stages and low speed switching applications etc.

PNP complementary type is the 2PA733.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	60	V
Collector-emitter voltage (open base)	V_{CEO}	max.	50	V
Collector current (DC)	I_C	max.	100	mA
Total power dissipation at $T_{amb} \leq 25\ ^oC$	P_{tot}	max.	500	mW
Collector-emitter saturation voltage $I_C = 100$ mA; $I_B = 10$ mA	V_{CEsat}	max.	0.3	V
DC current gain $I_C = 1$ mA; $V_{CE} = 6$ V	h_{FE}	min.	90	
		max.	600	

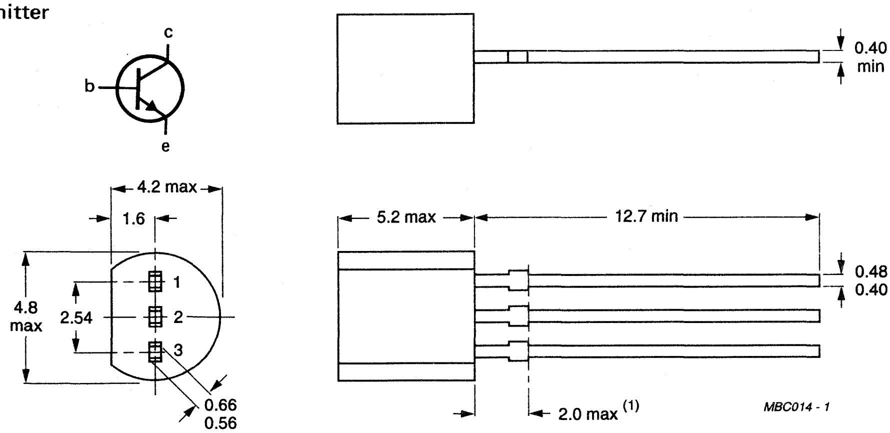
MECHANICAL DATA

Dimensions in mm

Fig.1 TO-92.

Pinning

1 = base
2 = collector
3 = emitter



Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

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.	50	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5.0	V
Collector current (DC)	I_C	max.	100	mA
Base current (DC)	I_B	max.	20	mA
Total power dissipation at $T_{amb} \leq 25$ °C	P_{tot}	max.	500	mW
Junction temperature	T_j	max.	150	°C
Storage temperature range	T_{stg}		−65 to + 150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	250	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current $I_E = 0$; $V_{CB} = 60$ V	I_{CBO}	max.	100	nA
Emitter cut-off current $I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	max.	100	nA
DC current gain $I_C = 0.1$ mA; $V_{CE} = 6$ V	h_{FE}	min.	50	
$I_C = 1$ mA; $V_{CE} = 6$ V*	h_{FE}	min. max.	90 600	
Collector-emitter saturation voltage $I_C = 100$ mA; $I_B = 10$ mA	V_{CEsat}	max.	0.3	V
Base-emitter on-state voltage $I_C = 1$ mA; $V_{CE} = 6$ V	V_{BEon}	min. max.	0.6 0.7	V V
Base-emitter saturation voltage $I_C = 100$ mA; $I_B = 10$ mA	V_{BEsat}	max.	1.1	V
Transition frequency $I_C = 10$ mA; $V_{CE} = 6$ V	f_T	min. max.	150 450	MHz MHz
Collector-base capacitance $I_E = 0$; $V_{CB} = 6$ V; f = 1 MHz	C_c	max.	4.0	pF
Noise figure $I_C = 100$ μA; $V_{CE} = 6$ V; $R_s = 2$ kΩ; f = 1 kHz	F	max.	15	dB

* Classification of h_{FE}

Group	R	Q	P	K
Range	90 - 180	135 - 270	200 - 400	300 - 600

SILICON SMALL-SIGNAL TRANSISTORS

NPN small-signal transistors, each in a TO-92 package.

They are intended for use in audio amplifier driver stages and other general purpose applications.

PNP complementary types are 2PA1015 and 2PA1015L.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	60	V
Collector-emitter voltage (open base)	V_{CEO}	max.	50	V
Collector current (DC)	I_C	max.	150	mA
Total power dissipation at $T_{amb} \leqslant 25\ ^oC$	P_{tot}	max.	500	mW
Collector-emitter saturation voltage I_C = 100 mA; I_B = 10 mA	V_{CEsat}	max.	0.3	V
DC current gain I_C = 2 mA; V_{CE} = 6 V	h_{FE}	min. max.	120 700	

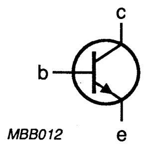
MECHANICAL DATA

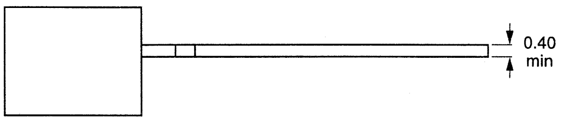
Dimensions in mm

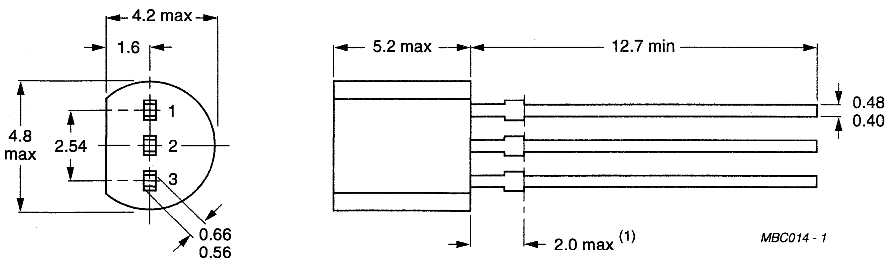
Fig.1 TO-92

Pinning

1 = base
2 = collector
3 = emitter







Note (1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

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.	50 V
Emitter-base voltage (open collector)	V_{EBO}	max.	5.0 V
Collector current (DC)	I_C	max.	150 mA
Base current (DC)	I_B	max.	50 mA
Total power dissipation at $T_{amb} \leqslant 25\ ^oC$	P_{tot}	max.	500 mW
Junction temperature	T_j	max.	150 ^oC
Storage temperature range	T_{stg}		−65 to + 150 ^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	250 K/W

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

Collector cut-off current $I_E = 0$; $V_{CB} = 60$ V		I_{CBO}	max.	100 nA
Emitter cut-off current $I_C = 0$; $V_{EB} = 5$ V		I_{EBO}	max.	100 nA
DC current gain $I_C = 150$ mA; $V_{CE} = 6$ V		h_{FE}	min.	25
$I_C = 2$ mA; $V_{CE} = 6$ V *		h_{FE}	min. max.	120 700
Collector-emitter saturation voltage $I_C = 100$ mA; $I_B = 10$ mA		V_{CEsat}	max.	0.3 V
Base-emitter saturation voltage $I_C = 100$ mA; $I_B = 10$ mA		V_{BEsat}	max.	1.1 V
Transition frequency $I_C = 1$ mA; $V_{CE} = 6$ V		f_T	min.	80 MHz
Collector-output capacitance $I_E = 0$; $V_{CB} = 10$ V; f = 1 MHz		C_c	max. typ.	3.5 pF 2.5 pF
Noise figure $I_C = 100\ \mu A$; $V_{CE} = 6$ V; $R_s = 10\ k\Omega$; f = 1 kHz	2PC1815	F	max. typ.	10 dB 1 dB
	2PC1815L	F	max. typ.	3 dB 0.2 dB

* Classification of h_{FE}

Group	Y	GR	BL
Range	120 – 240	200 – 400	350 – 700

NPN general purpose transistor — 2PC4081

FEATURES

- S-mini package
- Low output capacitance, C_{ob} = 2 pF (typ.).

DESCRIPTION

NPN transistor in a plastic three lead SC70 (S-mini) package. It is intended for general purpose switching and small signal amplification.

PINNING SC70

PIN	DESCRIPTION
1	base
2	emitter
3	collector

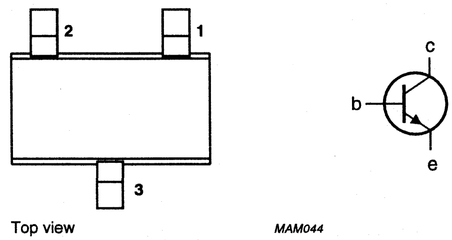


Fig.1 Simplified outline and symbol.

MARKING

TYPE NUMBER	MARKING CODE
2PC4081Q	ZQ
2PC4081R	ZR
2PC4081S	ZS

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	50	V
V_{CEO}	collector-emitter voltage	open base	–	40	V
I_C	collector current (DC)		–	100	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} = 6 V	120	560	
f_T	transition frequency	I_E = −2 mA; V_{CE} = 12 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	–	50	V
V_{CEO}	collector-emitter voltage	open base	–	40	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C; note 1	–	200	mW
T_{amb}	operating ambient temperature		–65	+150	°C
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air; note 1	625	K/W

Note to the "Limiting values" and "Thermal characteristics"

1. In accordance with standard mounting conditions SC70, three lead version.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 50 μA; I_E = 0	50	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = I_C = 1 mA; I_B = 0	40	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 50 μA; I_C = 0	5	–	–	V
V_{CEsat}	saturation voltage	I_C = 50 mA; I_B = 5 mA; note 1	–	–	400	mV
I_{CBO}	collector-base cut-off current	V_{CB} = 30 V; I_E = 0	–	–	100	nA
		V_{CB} = 30 V; I_E = 0; T_j = 150 °C	–	–	5	μA
I_{EBO}	emitter-base cut-off current	V_{EB} = 4 V; I_C = 0	–	–	100	nA
h_{FE}	DC current gain	I_C = 1 mA; V_{CE} = 6 V				
	2PC4081Q		120	–	270	
	2PC4081R		180	–	390	
	2PC4081S		270	–	560	
f_T	transition frequency	I_E = –2 mA; V_{CE} = 12 V; f = 100 MHz	100	–	–	MHz
C_c	output capacitance	I_E = i_e = 0; V_{CB} = 12 V; f = 1 MHz	–	2	3.5	pF

Note to the "Characteristics"

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.02$.

NPN general purpose transistors — 2PD601; 2PD601A

FEATURES

- High DC current gain
- Low collector-emitter saturation voltage
- S-mini package.

APPLICATIONS

Intended for general amplification.

DESCRIPTION

NPN transistor in a plastic SC59 package. Complementary pairs are 2PB709 and 2PB709A respectively.

MARKING

TYPE NUMBER	MARKING CODE
2PD601Q	YQ
2PD601R	YR
2PD601S	YS
2PD601AQ	ZQ
2PD601AR	ZR
2PD601AS	ZS

PINNING SC59

PIN	DESCRIPTION
1	base
2	emitter
3	collector

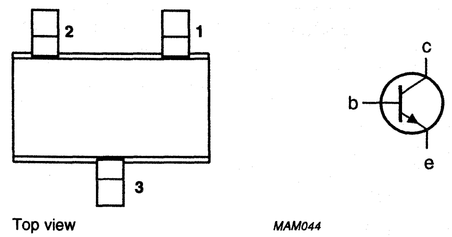


Fig.1 Simplified outline (SC59) and symbol.

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
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	250	mW
h_{FE}	DC current gain	I_C = 2 mA; V_{CE} = 10 V	160	460	
f_T	transition frequency	I_E = −2 mA; V_{CB} = 10 V			
	2PD601S		140	–	MHz
	2PD601AS		140	–	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	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	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
T_{amb}	operating ambient temperature		–65	+150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air; note 1	500	K/W

Note to the "Limiting values" and "Thermal characteristics"

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; note 1			
	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_{CEsat}	collector-emitter saturation voltage	I_C = 100 mA; I_B = 10 mA; note 1	–	500	mV
I_{CBO}	collector cut-off current	V_{CB} = 20 V; I_E = 0	–	100	nA
		V_{CB} = 20 V; I_E = 0; T_j = 150 °C	–	5	μA
I_{EBO}	emitter cut-off current	V_{EB} = 5 V; I_C = 0	–	100	nA
h_{FE}	DC current gain	V_{CE} = 2 V; I_C = 100 mA; note 1	90	–	
h_{FE}	DC current gain	V_{CE} = 10 V; I_C = 2 mA; note 1			
	2PD601Q; 2PD601AQ		160	260	
	2PD601R; 2PD601AR		210	340	
	2PD601S; 2PD601AS		290	460	
f_T	transition frequency	V_{CB} = 10 V; I_E = −2 mA; f = 100 MHz			
	2PD601Q; 2PD601AQ		100	–	MHz
	2PD601R; 2PD601AR		120	–	MHz
	2PD601S; 2PD601AS		140	–	MHz
C_c	collector capacitance	V_{CB} = 10 V; I_E = i_e = 0; f = 1 MHz	–	3.5	pF

Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.02$.

NPN general purpose transistors | 2PD602; 2PD602A

FEATURES

- Large collector current
- Low collector-emitter saturation voltage
- S-mini package.

APPLICATIONS

Intended for general purpose switching or amplification.

DESCRIPTION

NPN transistor in a plastic SC59 package. Complementary pairs are 2PB710 and 2PB710A respectively.

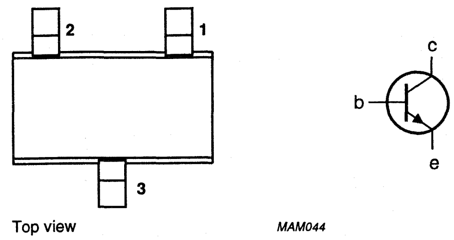


Fig.1 Simplified outline (SC59) and symbol.

MARKING

TYPE NUMBER	MARKING CODE
2PD602Q	WQ
2PD602R	WR
2PD602S	WS
2PD602AQ	XQ
2PD602AR	XR
2PD602AS	XS

PINNING SC59

PIN	DESCRIPTION
1	base
2	emitter
3	collector

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
I_{CM}	peak collector current		–	1	A
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	250	mW
h_{FE}	DC current gain	I_C = 150 mA; V_{CE} = 10 V	85	340	
f_T	transition frequency	I_E = –50 mA; V_{CB} = 10 V			
	2PD602S		180	–	MHz
	2PD602AS		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			
	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	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	1	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	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air; note 1	500	K/W

Note to the "Limiting values" and "Thermal characteristics"

1. Refer to SC59 standard mounting conditions.

CHARACTERISTICS

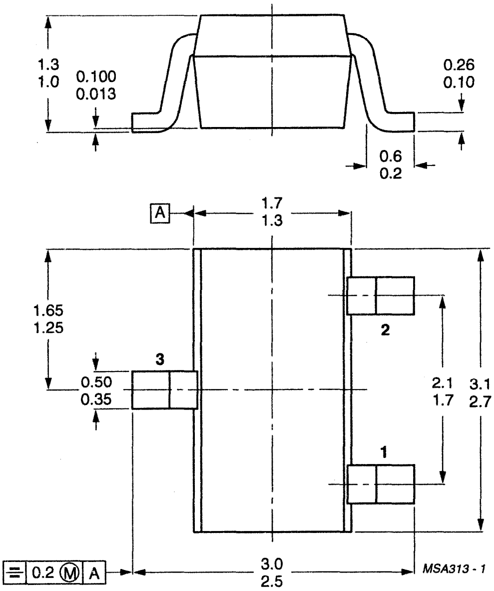
T_{amb} = 25 °C unless otherwise specified.

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_{CEsat}	collector-emitter saturation voltage	I_C = 300 mA; I_B = 30 mA; note 1	–	600	mV
I_{CBO}	collector cut-off current	V_{CB} = 20 V; I_E = 0	–	100	nA
		V_{CB} = 20 V; I_E = 0; T_j = 150 °C	–	5	μA
I_{EBO}	emitter cut-off current	V_{EB} = 4 V; I_C = 0	–	100	nA
h_{FE}	DC current gain	V_{CE} = 10 V; I_C = 500 mA; note 1	40	–	
h_{FE}	DC current gain	V_{CE} = 10 V; I_C = 150 mA; note 1			
	2PD602Q; 2PD602AQ		85	170	
	2PD602R; 2PD602AR		120	240	
	2PD602S; 2PD602AS		170	340	
f_T	transition frequency	V_{CB} = 10 V; I_E = –50 mA; f = 100 MHz; note 1			
	2PD602Q; 2PD602AQ		140	–	MHz
	2PD602R; 2PD602AR		160	–	MHz
	2PD602S; 2PD602AS		180	–	MHz
C_c	collector capacitance	V_{CB} = 10 V; I_E = i_E = 0; f = 1 MHz	–	15	pF

Note

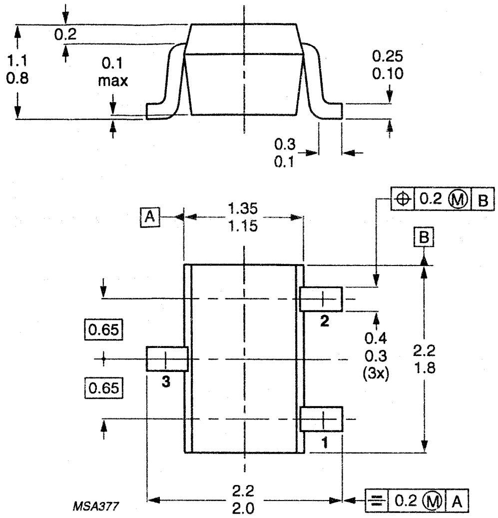
1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.02$.

PACKAGE OUTLINES



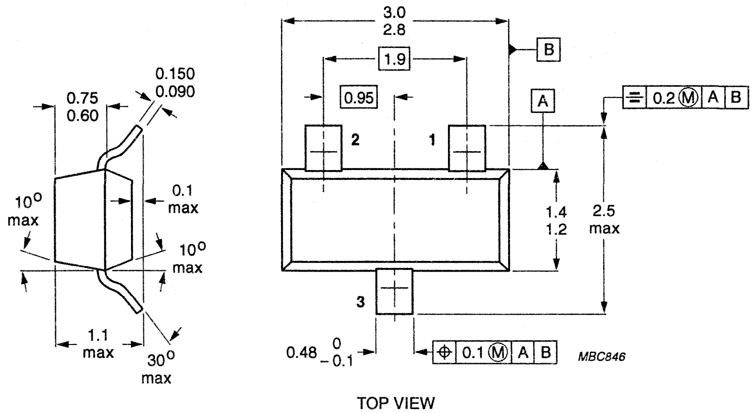
Dimensions in mm.

Fig.1 SC59.



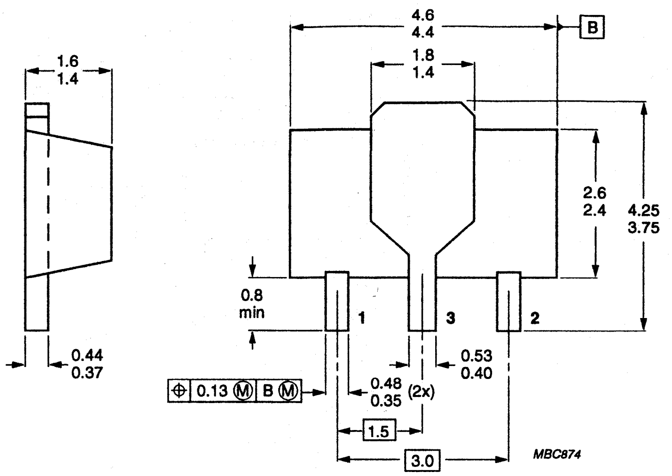
Dimensions in mm.

Fig.2 SC70.



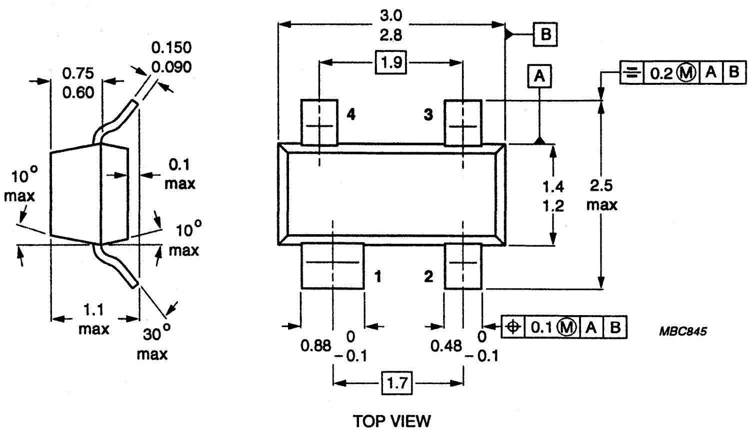
Dimensions in mm.

Fig.3 SOT23.



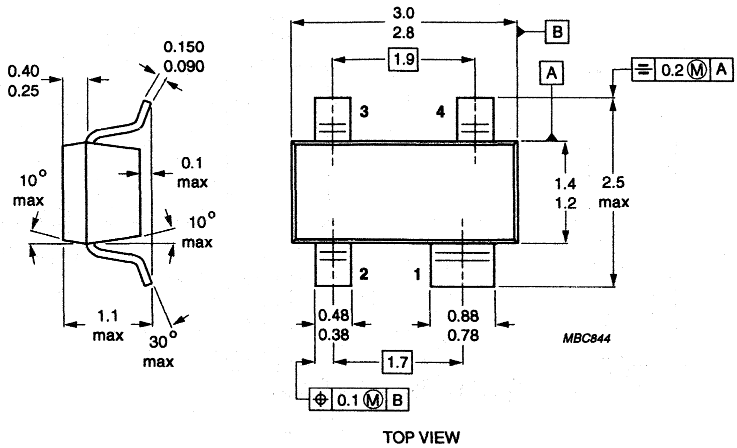
Dimensions in mm.

Fig.4 SOT89.



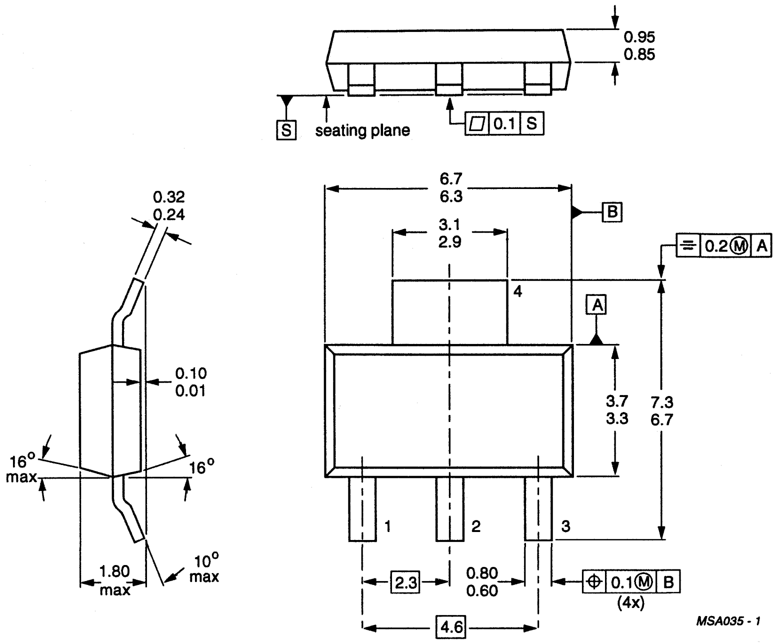
Dimensions in mm.

Fig.5 SOT143.



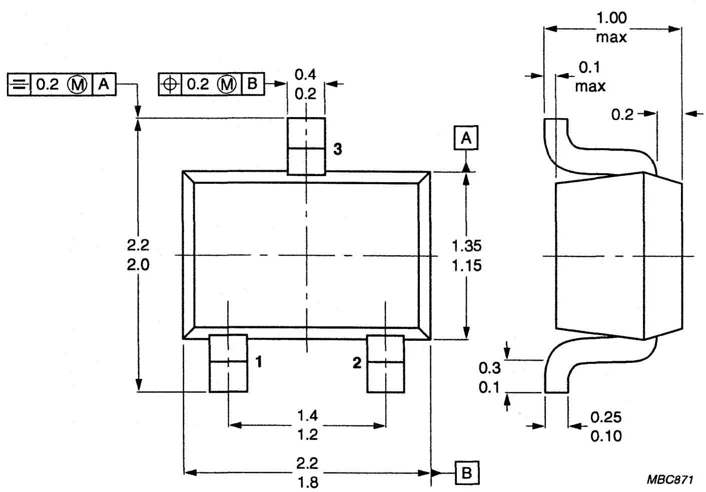
Dimensions in mm.

Fig.6 SOT143R.



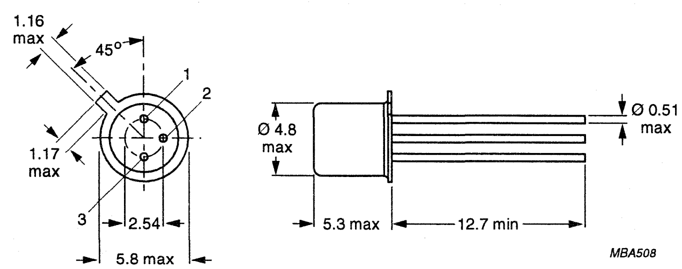
Dimensions in mm.

Fig.7 SOT223.



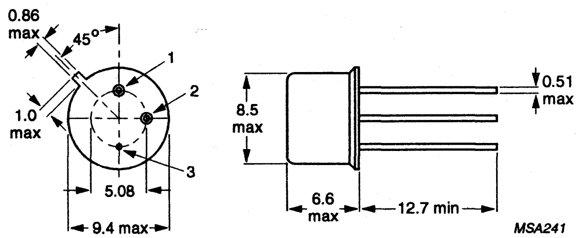
Dimensions in mm.

Fig.8 SOT323.



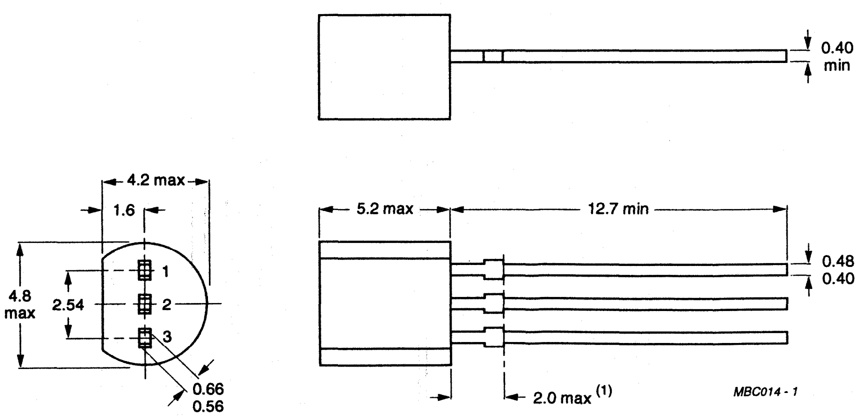
Dimensions in mm.

Fig.9 TO-18 / SOT18.



Dimensions in mm.

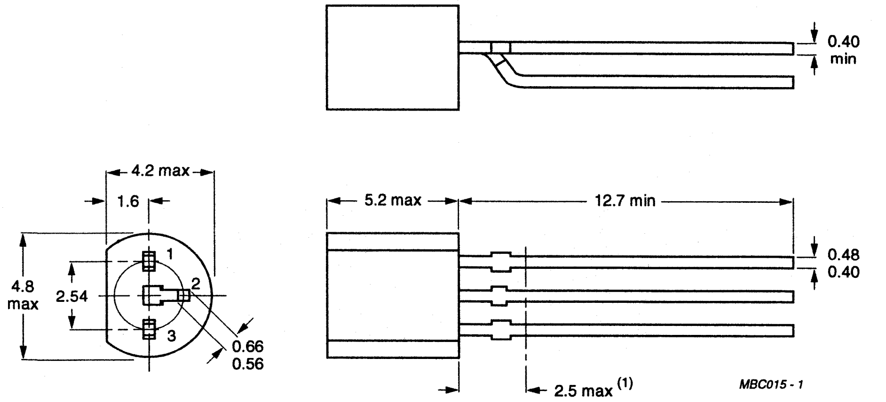
Fig.10 TO-39 / SOT05.



Dimensions in mm.

(1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

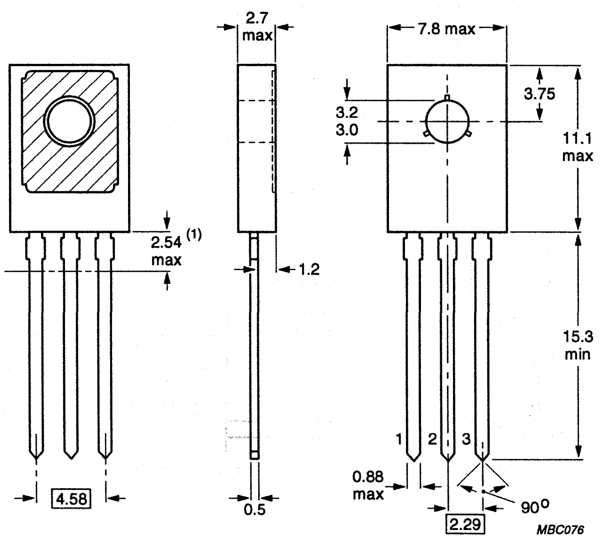
Fig.11 TO-92 / SOT54.



Dimensions in mm.

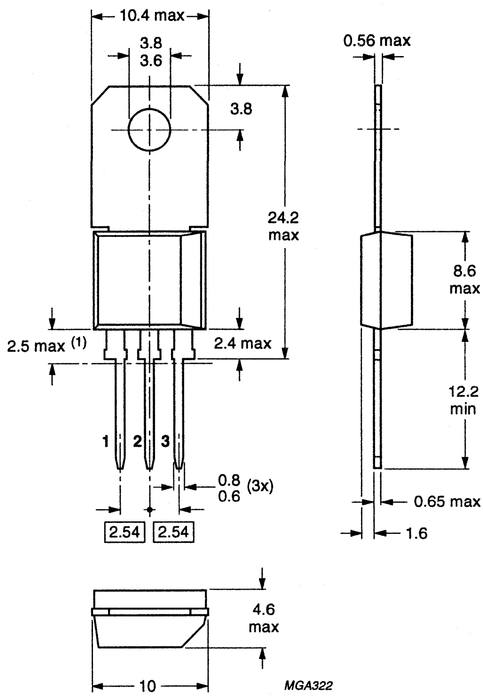
(1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

Fig.12 TO-92 variant / SOT59 variant.



Dimensions in mm.

Fig.13 TO-126 / SOT32.



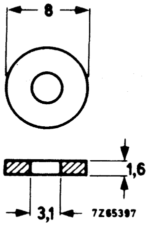
Dimensions in mm.

(1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

Fig.14 TO-202 / SOT128.

ACCESSORIES FOR TO-126 PACKAGES

MECHANICAL DATA

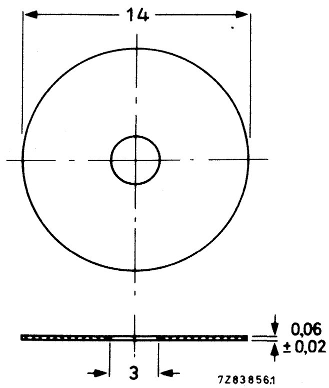


Dimensions in mm.

Material: brass, nickel plated.

Part no. 56326, for direct mounting of TO-126 packages.

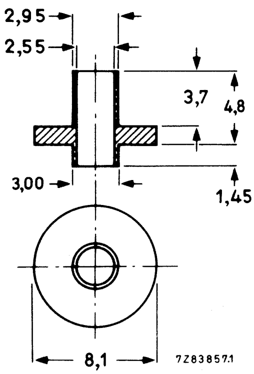
Fig.1 Metal washer.



Dimensions in mm.

Part no. 56387a, for insulated screw mounting of TO-126 packages up to 300 V.

Fig.2 Mica insulator.



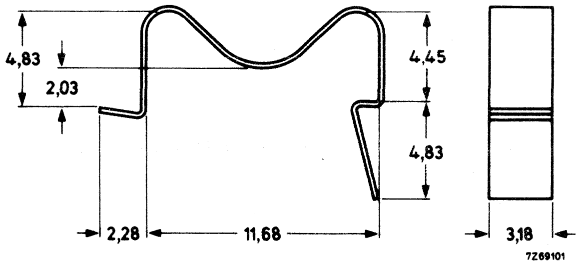
Dimensions in mm.

Material: polyester.

Maximum permissible temperature (T_{max}) = 150 °C.

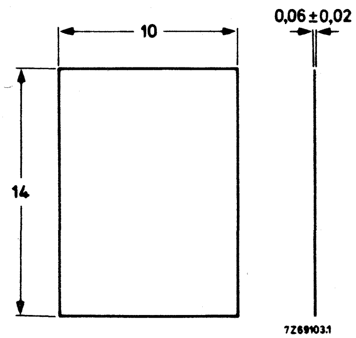
Part no. 56387b, for insulated screw mounting of TO-126 packages up to 300 V.

Fig.3 Insulating bush.



Dimensions in mm.
Material: high carbon spring steel.
Suitable for heatsink of 1.5 to 2 mm.
Part no. 56353, for TO-126 and SOT82 packages.

Fig.4 Spring clip.



Dimensions in mm.
Part no. 56354, for TO-126 packages.

Fig.5 Mica washer.

MOUNTING INSTRUCTIONS FOR TO-126 PACKAGES

Mounting instructions TO-126

GENERAL DATA AND INSTRUCTIONS

General rules

1. Fasten the device to the heatsink before soldering the leads.
2. Avoid stress to the leads.
3. Keep mounting tool (e.g. screwdriver) clear of the plastic body.

Mounting methods

CLIP MOUNTING

Mounting by means of spring clip offers:

a) A good thermal contact under the crystal area.

b) Safe insulation for mains and high voltage operation.

Minimum force for good heat transfer is 10 N.

Maximum force to avoid damaging the device is 80 N.

M2.5 AND M3 SCREW MOUNTING

The spacing washer should be inserted between screw head and body.

Minimum torque for good heat transfer is 0.4 Nm.

Maximum torque to avoid damaging the device is 0.6 Nm.

When the driven nut or screw is in direct contact with a toothed lock washer the torques are as follows:

Minimum torque for good heat transfer is 0.55 Nm.

Maximum torque to avoid damaging the device is 0.8 Nm.

RIVET MOUNTING

It is not permitted to rivet mount the TO126 outline.

Heatsink requirements

Flatness in the mounting area: 0.02 mm maximum per 10 mm.
Mounting holes must be deburred, for further information see clip and screw mounting instructions.

Heatsink compound

The thermal resistance from mounting base to heatsink ($R_{th\ mb-h}$) can be reduced by applying a metallic oxide compound between the contact surfaces. Values given are of thermal resistance using this type of compound. Dow Corning 340 Heat sink compound is recommended. For insulated mounting, the compound should be applied to the bottom of both device and insulator.

Mounting instructions TO-126

Thermal data for heatsink mounting methods

$R_{th\ mb-h}$	Thermal resistance from mounting base to heatsink	K/W			
Envelope	**Mounting Method**	**clip**		**screw**	
		direct	**insulated**	**direct**	**insulated**
TO126	with heatsink compound	1.0	3.0	0.5	3.0
	without heatsink compound	3.0	6.0	1.0	6.0

Soldering

LEAD SOLDERING

For devices with a maximum junction temperature < 150 ˚C.

DIP OR WAVE SOLDERING.

Maximum permissible solder temperature is 260 ˚C at a distance from the body of > 5 mm and for a total contact time with soldering bath or waves of < 7 s.

HAND SOLDERING.

Maximum permissible temperature is 275 ˚C at a distance from the body of > 3 mm and for a total contact time with the soldering iron of < 5 s.

Maximum permissible temperature is 250 ˚C at a distance from the body of > 3 mm and for a total contact time with the soldering iron of < 10 s.

The body of the device must not touch anything with a temperature > 200 ˚C.

Avoid any force on body and leads during or after soldering; do not correct the position of the device or of its leads after soldering.

MOUNTING BASE SOLDERING

Recommended metal-alloy of solder paste (85% metal weight)
62% Sn / 36% Pb / 2% Ag or 60% Sn / 40% Pb.

Maximum soldering temperature < 200 ˚C (mounting base temperature).
Soldering cycle duration including pre-heating < 30 sec.

For good soldering and avoiding damage to the encapsulation pre-heating is recommended to a temperature < 165 ˚C at a duration < 10 s.

Lead bending

Maximum permissible tensile force on the body for 5 seconds is 20 N.

The leads can be bent, twisted or straightened. To keep forces within the above mentioned limits the leads should always be clamped rigidly near the body during bending. This is also to prevent damage to the seal of the leads within the plastic body.

Leads can be bent as near to the body as required, but adequate length should always be allowed for clamping. This is a minimum of 1.75 mm from the body to the start of a bend radius.

The internal radius of bend should never be less than the thickness of the lead. A minimum radius of at least 1.5 x lead thickness is preferred. See figure 1. Surface cracks in the dip tin coating on the lead are common when a radius less than 1.5 x lead thickness is used. Although exposing the copper material, these cracks do not affect the mechanical strength of the lead.

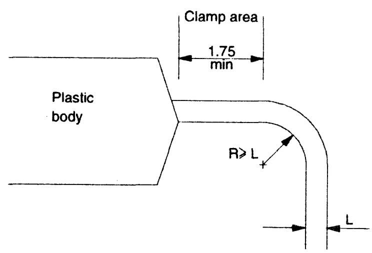


Fig 1. Minimum lead bend radius.

Additional guide-lines

It is recommended that where a device is rigidly secured to a heatsink which is in turn rigidly secured to a PCB, that a bend is put in the leads to act as an expansion loop. This will prevent differential expansion of the mounting parts transferring stress to the soldering joint, as shown in figure 2 below. This is only necessary where the device is mounted so rigidly that expansion forces are transmitted through the assembly.

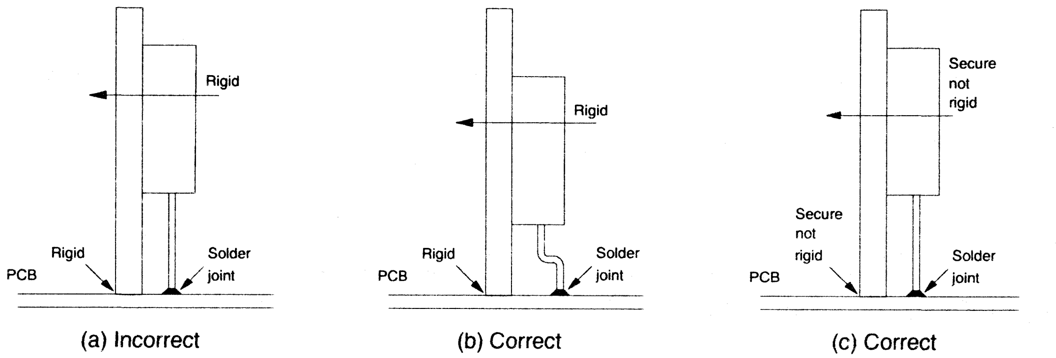


Fig 2. Printed circuit board and heatsink mounting.

INSTRUCTIONS FOR CLIP MOUNTING

Direct mounting with clip 56353

1. Apply heatsink compound to the mounting base, then place the device on the heatsink.
2. Push the short end of the clip into the narrow slot in the heatsink with the clip at an angle of 10° to 30° to the vertical. See figures 3 and 4).
3. Push down the clip over the device until the long end of the clip snaps into the wide slot in the heatsink. The clip should bear on the plastic body. See figure 5.

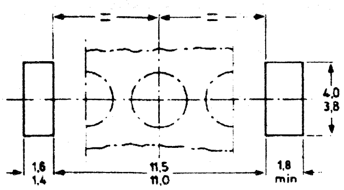


Fig. 3. Heatsink requirements

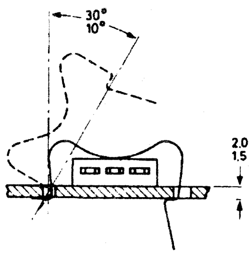


Fig. 4. Mounting
(1) spring clip 56353.

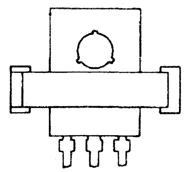


Fig. 5. Position of device (top view)

Insulated mounting with clip 56353

With the insulator 56354 insulation up to 1 kV is obtained.

1. Apply heatsink compound to the bottom of both device and insulator, then place the device with the insulator on the heatsink.
2. Push the short end of the clip into the narrow slot in the heatsink with the clip at an angle of 10° to 30° to the vertical. See figures 6, 7 and 8).
3. Push down the clip over the device until the long end of the clip snaps into the wide slot in the heatsink. The clip should bear on the plastic body. Ensure that the device is centred on the mica insulator to prevent unwanted movement.

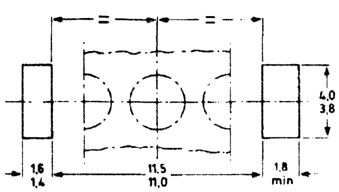


Fig 6. Heatsink requirements.

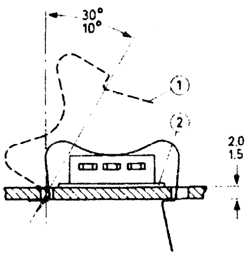


Fig 7. Mounting.
(1) spring clip 56353
(2) insulator 56354

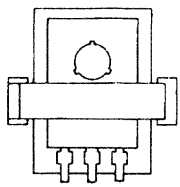


Fig 8. Position of device (top view).

INSTRUCTIONS FOR SCREW MOUNTING

Direct mounting with screw and spacing washer

THROUGH HEATSINK WITH NUT.

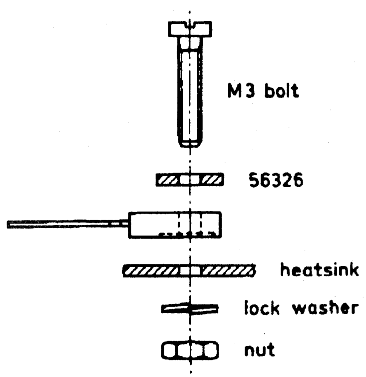


Fig 9. Assembly.

Dimensions in mm

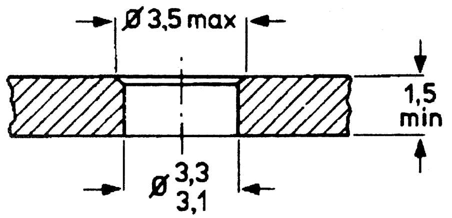


Fig 10. Heatsink requirements.

INTO TAPPED HEATSINK

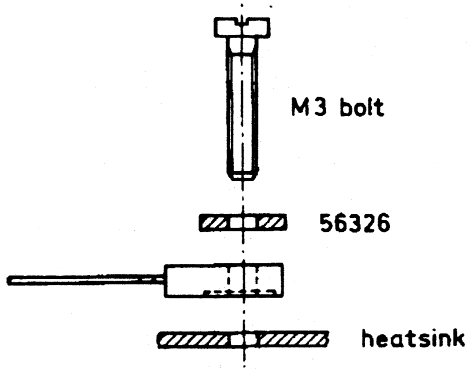


Fig 11. Assembly.

Dimensions in mm

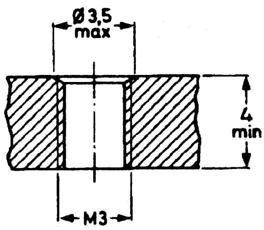


Fig 12. Heatsink requirements.

Insulated mounting with mica insulator

With the insulators 56387a & 56387b insulation up to 300 V is obtained.

THROUGH HEATSINK WITH NUT

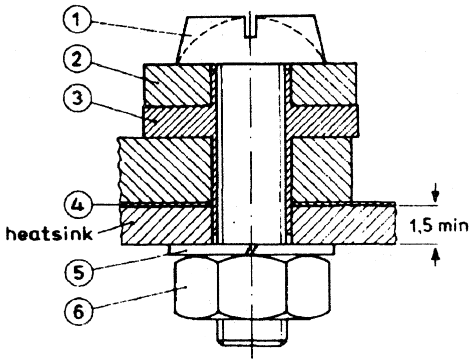


Fig 13. Assembly.

(1) M2.5 screw
(2) metal washer 56326
(3) insulating bush 56387b
(4) mica insulator 56387a
(5) lock washer
(6) M2.5 nut

Dimensions in mm

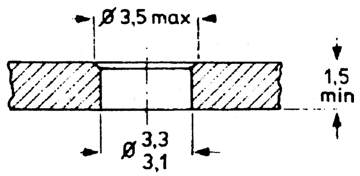


Fig 14. Heatsink requirements.

INTO TAPPED HEATSINK

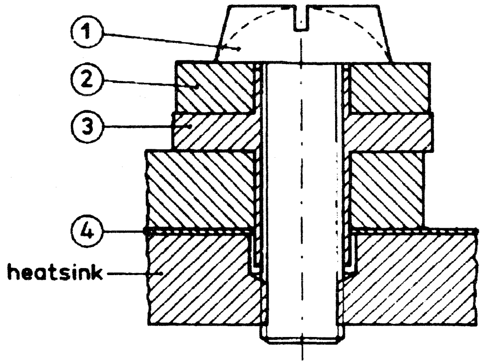


Fig 15. Assembly.

(1) M2.5 screw
(2) metal washer 56326
(3) insulating bush 56387b
(4) mica insulator 56387a

Dimensions in mm

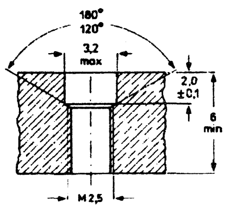


Fig 16. Heatsink requirements.

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Data handbook system

DATA HANDBOOK SYSTEM

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