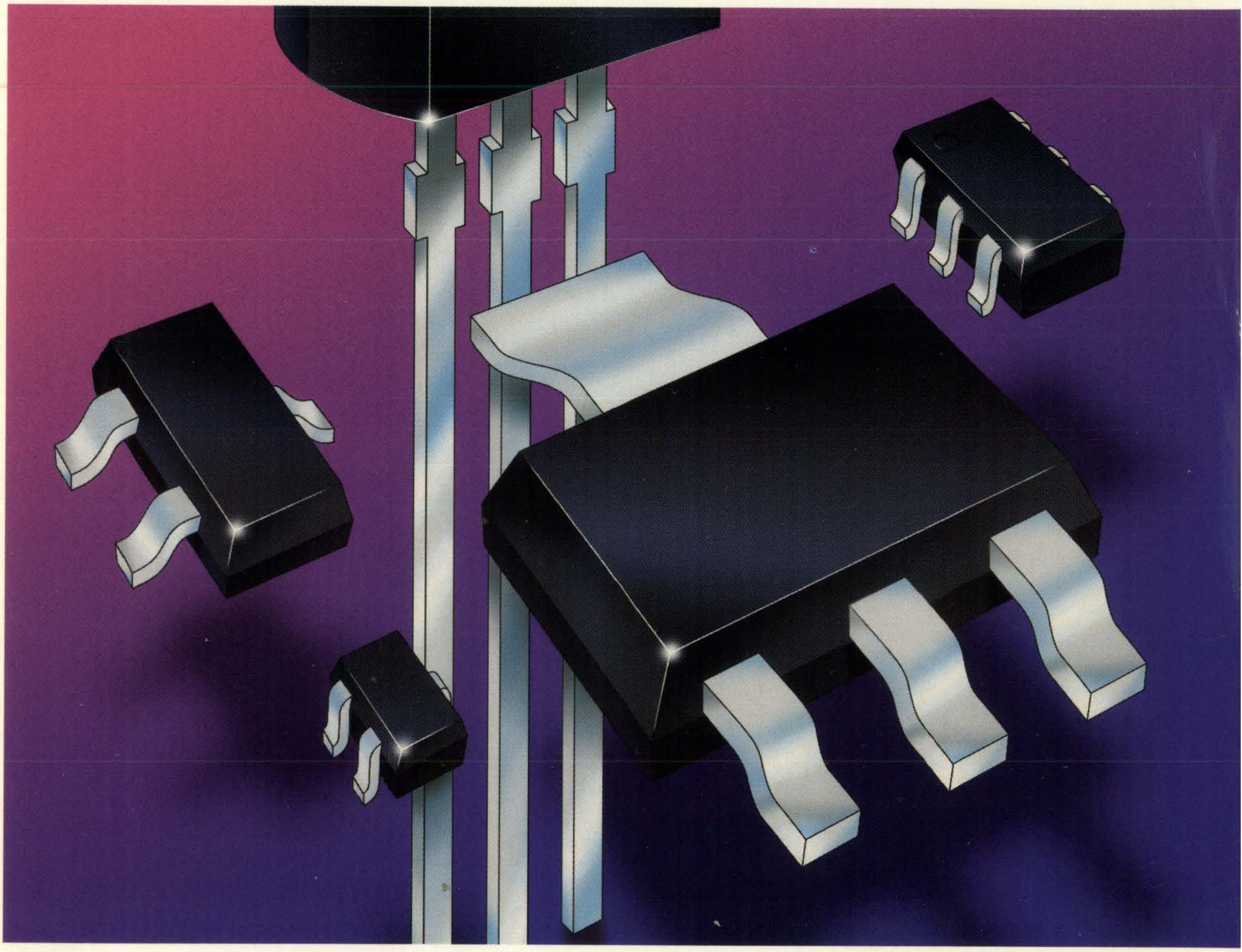
DISCRETE SEMICONDUCTORS

Small-signal Transistors



1998

Data Handbook SC04

Let's make things better.

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.

PREFACE

We are pleased to issue this update of Philips Semiconductors' Small-signal Transistors data handbook, SC04. The types listed are used for current amplification and switching at low to medium frequencies (<1 GHz) at voltages up to 500 V. Power dissipation, which is package dependent, extends from 150 mW to 12.5 W.

Care has been taken in preparing this book and making it easy to use. For example, a selection guide has been included as well as a data selection program (disks on inside back cover). The data, called 'Spice parameters', are available for most transistors.

Every customer requirement for low-frequency small-signal transistors can be met by our broad product range which includes (main market segments in italic):

- general-purpose transistors *(EDP, audio, video, telecom, automotive, consumer)*
- medium-frequency transistors *(audio and video)*
- high-voltage transistors *(telecom, automotive and video)*
- power transistors *(industrial, video and telecom)*
- resistor-equipped transistors *(all segments)*
- high-speed switching transistors *(EDP, audio, video, telecom, automotive and consumer).*

New products

Since the previous edition, many new types have been added including:

- video transistors
- resistor-equipped transistors (various packages)
- more SOT323 products
- dual transistors (including matched pairs) in SC-88 and SOT363 packages.

New product listings are clearly identified to assist readers.

Packages

Philips small-signal transistors are available in all common surface-mount and through-hole packages. Our extensive range of packages includes:

SMD	(Plastic):	SOT23, SOT223, SOT143, SOT89, SOT323, SOT363, SC-70, SC-88, SC-59, SC-75
Leaded	(Plastic):	TO-92, TO-126, TO-202
	(Metal):	TO-39, SOT18.

For more information

Although the information in this databook is up-to-date at the time of going to press, for the latest information, contact your local Philips organization (see the back page of this databook), or visit our Internet home page at:

http://www.semiconductors.philips.com/

Thank you for your interest in Philips Semiconductors small-signal transistors.

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Types added to the range since the last issue of Handbook SC04 (1995 issue) are shown in bold print

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SELECTION GUIDE

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LEADED DEVICES

NPN GENERAL PURPOSE LOW-POWER TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	PNP COMPL.	PAGE
2N2484	TO-18	60	50	360	250	800	60	–	133
2N4124	TO-92	25	200	500	120	360	300	2N4126	163
2N5088	TO-92	30	100	500	350	>350	50	2N5087	177
2PC945	TO-92	50	100	500	135	600	150	2PA733	208
2PC945K	TO-92	50	100	500	300	600	150	2PA733K	208
2PC945P	TO-92	50	100	500	200	400	150	2PA733P	208
2PC945Q	TO-92	50	100	500	135	270	150	2PA733Q	208
2PC1815	TO-92	50	150	500	120	700	80	2PA1015	210
2PC1815BL	TO-92	50	150	500	350	700	80	2PA1015BL	210
2PC1815GR	TO-92	50	150	500	200	400	80	2PA1015GR	210
2PC1815Y	TO-92	50	150	500	120	240	80	2PA1015Y	210
BC107	TO-18	45	100	300	110	450	100	BC177	224
BC107A	TO-18	45	100	300	110	220	100	BC177A	224
BC107B	TO-18	45	100	300	200	450	100	BC177B	224
BC108	TO-18	20	100	300	110	800	100	–	224
BC108A	TO-18	20	100	300	110	220	100	–	224
BC108B	TO-18	20	100	300	200	450	100	–	224
BC108C	TO-18	20	100	300	420	800	100	–	224
BC109	TO-18	20	100	300	200	800	100	–	224
BC109B	TO-18	20	100	300	200	450	100	–	224
BC109C	TO-18	20	100	300	420	800	100	–	224
BC237	TO-92	45	100	500	120	460	100	BC307	236
BC237B	TO-92	45	100	500	200	460	100	BC307B	236
BC337	TO-92	45	500	625	100	600	100	BC327	246
BC337A	TO-92	60	500	625	100	400	100	BC327A	246
BC337-16	TO-92	45	500	625	100	250	100	BC327-16	246
BC337-25	TO-92	45	500	625	160	400	100	BC327-25	246
BC337-40	TO-92	45	500	625	250	600	100	BC327-40	246
BC338	TO-92	25	500	625	100	600	100	BC328	246
BC338-16	TO-92	25	500	625	100	250	100	BC328-16	246
BC338-25	TO-92	25	500	625	160	400	100	BC328-25	246
BC338-40	TO-92	25	500	625	250	600	100	BC328-40	246
BC546	TO-92	65	100	500	110	450	100	BC556	263
BC546A	TO-92	65	100	500	110	220	100	BC556A	263
BC546B	TO-92	65	100	500	200	450	100	BC556B	263
BC547	TO-92	45	100	500	110	800	100	BC557	263

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	PNP COMPL.	PAGE
BC547A	TO-92	45	100	500	110	220	100	BC557A	263
BC547B	TO-92	45	100	500	200	450	100	BC557B	263
BC547C	TO-92	45	100	500	420	800	100	BC557C	263
BC548	TO-92	30	100	500	110	800	100	BC558	263
BC548A	TO-92	30	100	500	110	220	100	BC558A	263
BC548B	TO-92	30	100	500	200	450	100	BC558B	263
BC548C	TO-92	30	100	500	420	800	100	BC558C	263
BC549	TO-92	30	100	500	200	800	100	BC559	268
BC549B	TO-92	30	100	500	200	450	100	BC559B	268
BC549C	TO-92	30	100	500	420	800	100	BC559C	268
BC550	TO-92	45	100	500	200	800	100	BC560	268
BC550B	TO-92	45	100	500	200	450	100	BC560B	268
BC550C	TO-92	45	100	500	420	800	100	BC560C	268
ED1402	TO-92	20	200	500	120	900	100 max.	ED1602	764
ED1402A	TO-92	20	200	500	110	165	100 max.	ED1602A	764
ED1402B	TO-92	20	200	500	150	225	100 max.	ED1602B	764
ED1402C	TO-92	20	200	500	202	318	100 max.	ED1602C	764
ED1402D	TO-92	20	200	500	290	450	100 max.	ED1602D	764
ED1402E	TO-92	20	200	500	410	810	100 max.	ED1602E	764
ED1502	TO-92	20	25	500	36	210	825 max.	–	766
ED1502A	TO-92	20	25	500	36	55	825 max.	–	766
ED1502B	TO-92	20	25	500	48	75	825 max.	–	766
ED1502C	TO-92	20	25	500	66	100	825 max.	–	766
ED1502D	TO-92	20	25	500	84	127	825 max	–	766
ED1502E	TO-92	20	25	500	105	210	825 max	–	766
ED1702	TO-92	25	500	625	106	588	80	ED1802	771
ED1702K	TO-92	25	500	625	106	150	80	ED1802K	771
ED1702L	TO-92	25	500	625	132	189	80	ED1802L	771
ED1702M	TO-92	25	500	625	170	233	80	ED1802M	771
ED1702N	TO-92	25	500	625	213	300	80	ED1802N	771
ED1702O	TO-92	25	500	625	263	370	80	ED1802O	771
ED1702P	TO-92	25	500	625	333	476	80	ED1802P	771
ED1702Q	TO-92	25	500	625	435	588	80	ED1802Q	771
JC337	TO-92	45	500	625	100	600	100	JC327	783
JC337A	TO-92	60	500	625	100	600	100	JC327A	783
JC337-16	TO-92	60	500	625	100	250	100	JC327-16	783
JC337-25	TO-92	60	500	625	160	400	100	JC327-25	783
JC337-40	TO-92	60	500	625	250	600	100	JC327-40	783
JC338	TO-92	25	500	625	100	600	100	JC328	783

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	PNP COMPL.	PAGE
JC338-16	TO-92	25	500	625	100	250	100	JC328-16	783
JC338-25	TO-92	25	500	625	160	400	100	JC328-25	783
JC338-40	TO-92	25	500	625	250	600	100	JC328-40	783
JC501	TO-92	45	100	500	90	600	130 typ.	JA101	786
JC501O	TO-92	45	100	500	90	180	130 typ.	–	786
JC501P	TO-92	45	100	500	135	270	130 typ.	JA101P	786
JC501Q	TO-92	45	100	500	200	400	130 typ.	JA101Q	786
JC501R	TO-92	45	100	500	300	600	130 typ.	JA101R	786
JC546	TO-92	65	100	500	110	450	100	JC556	789
JC546A	TO-92	65	100	500	110	220	100	JC556A	789
JC546B	TO-92	65	100	500	200	290	100	JC556B	789
JC547	TO-92	45	100	500	110	800	100	JC557	789
JC547A	TO-92	45	100	500	110	220	100	JC557A	789
JC547B	TO-92	45	100	500	200	450	100	JC557B	789
JC547C	TO-92	45	100	500	420	800	100	JC557C	789
JC548	TO-92	30	100	500	110	800	100	JC558	789
JC548A	TO-92	30	100	500	110	220	100	JC558A	789
JC548B	TO-92	30	100	500	200	450	100	JC558B	789
JC548C	TO-92	30	100	500	420	800	100	JC558C	789
JC549	TO-92	30	100	500	200	800	100	JC559	794
JC549B	TO-92	30	100	500	200	450	100	JC559B	794
JC549C	TO-92	30	100	500	420	800	100	JC559C	794
JC550	TO-92	45	100	500	200	800	100	JC560	794
JC550B	TO-92	45	100	500	200	450	100	JC560B	794
JC550C	TO-92	45	100	500	420	800	100	JC560C	794
MPS8098	TO-92	60	100	500	100	300	150	–	814
MPSA05	TO-92	60	500	625	100	>100	100	MPSA55	816
MPSA06	TO-92	80	500	625	100	>100	100	MPSA56	816

LEADED DEVICES (continued)

PNP GENERAL PURPOSE LOW-POWER TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	NPN COMPL.	PAGE
2N4126	TO-92	25	200	500	120	360	250	2N4124	165
2N5087	TO-92	50	100	500	250	>250	40	2N5088	175
2PA733	TO-92	50	100	500	135	600	100	2PC945	192
2PA733K	TO-92	50	100	500	300	600	100	2PC945K	192
2PA733P	TO-92	50	100	500	200	400	100	2PC945P	192
2PA733Q	TO-92	50	100	500	135	270	100	2PC945Q	192
2PA1015	TO-92	50	150	500	120	700	80	2PC1815	194
2PA1015BL	TO-92	50	150	500	350	700	80	2PC1815BL	194
2PA1015GR	TO-92	50	150	500	200	400	80	2PC1815GR	194
2PA1015Y	TO-92	50	150	500	120	240	80	2PC1815Y	194
BC177	TO-18	45	100	300	125	500	100	BC107	233
BC177A	TO-18	45	100	300	125	260	100	BC107A	233
BC177B	TO-18	45	100	300	240	500	100	BC107B	233
BC307	TO-92	45	100	500	125	455	100	BC237	239
BC307B	TO-92	45	100	500	222	455	100	BC237B	239
BC327	TO-92	45	500	625	100	600	80	BC337	242
BC327A	TO-92	60	500	625	100	400	80	BC337A	242
BC327-16	TO-92	45	500	625	100	250	80	BC337-16	242
BC327-25	TO-92	45	500	625	160	400	80	BC337-25	242
BC327-40	TO-92	45	500	625	250	600	80	BC337-40	242
BC328	TO-92	25	500	625	100	600	80	BC338	242
BC328-16	TO-92	25	500	625	100	250	80	BC338-16	242
BC328-25	TO-92	25	500	625	160	400	80	BC338-25	242
BC328-40	TO-92	25	500	625	250	600	80	BC338-40	242
BC556	TO-92	65	100	500	125	475	100	BC546	272
BC556A	TO-92	65	100	500	125	250	100	BC546A	272
BC556B	TO-92	65	100	500	220	475	100	BC546B	272
BC557	TO-92	45	100	500	125	800	100	BC547	272
BC557A	TO-92	45	100	500	125	250	100	BC547A	272
BC557B	TO-92	45	100	500	220	475	100	BC547B	272
BC557C	TO-92	45	100	500	420	800	100	BC547C	272
BC558	TO-92	30	100	500	125	800	100	BC548	272
BC558A	TO-92	30	100	500	125	250	100	BC548A	272
BC558B	TO-92	30	100	500	220	475	100	BC548B	272
BC558C	TO-92	30	100	500	420	800	100	BC548C	272
BC559	TO-92	30	100	500	125	800	100	BC549	277

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	NPN COMPL.	PAGE
BC559A	TO-92	30	100	500	125	250	100	–	277
BC559B	TO-92	30	100	500	220	475	100	BC549B	277
BC559C	TO-92	30	100	500	420	800	100	BC549C	277
BC560	TO-92	45	100	500	125	800	100	BC550	277
BC560A	TO-92	45	100	500	125	250	100	–	277
BC560B	TO-92	45	100	500	220	475	100	BC550B	277
BC560C	TO-92	45	100	500	420	800	100	BC550C	277
BCY70	TO-18	40	200	350	100	>100	250	–	463
BCY71	TO-18	45	200	350	500	>500	250	–	463
ED1602	TO-92	20	100	500	70	800	100	ED1402	768
ED1602A	TO-92	20	100	500	70	105	100	ED1402A	768
ED1602B	TO-92	20	100	500	90	140	100	ED1402B	768
ED1602C	TO-92	20	100	500	125	190	100	ED1402C	768
ED1602D	TO-92	20	100	500	170	260	100	ED1402D	768
ED1602E	TO-92	20	100	500	223	475	100	ED1402E	768
ED1602F	TO-92	20	100	500	415	800	100	–	768
ED1802	TO-92	25	500	625	106	588	80	ED1702	774
ED1802K	TO-92	25	500	625	106	150	80	ED1702K	774
ED1802L	TO-92	25	500	625	132	189	80	ED1702L	774
ED1802M	TO-92	25	500	625	170	233	80	ED1702M	774
ED1802N	TO-92	25	500	625	213	300	80	ED1702N	774
ED1802O	TO-92	25	500	625	263	370	80	ED1702O	774
ED1802P	TO-92	25	500	625	333	476	80	ED1702P	774
ED1802Q	TO-92	25	500	625	435	588	80	ED1702Q	774
JA101	TO-92	45	100	500	135	600	100	JC501	777
JA101P	TO-92	45	100	500	135	270	100	JC501P	777
JA101Q	TO-92	45	100	500	200	400	100	JC501Q	777
JA101R	TO-92	45	100	500	300	600	100	JC501R	777
JC327	TO-92	45	500	625	100	600	80	JC337	780
JC327A	TO-92	60	500	625	100	400	80	JC337A	780
JC327-16	TO-92	45	500	625	100	250	80	JC337-16	780
JC327-25	TO-92	45	500	625	160	400	80	JC337-25	780
JC327-40	TO-92	45	500	625	250	600	80	JC337-40	780
JC328	TO-92	25	500	625	100	600	80	JC338	780
JC328-16	TO-92	25	500	625	100	250	80	JC338-16	780
JC328-25	TO-92	25	500	625	160	400	80	JC338-25	780
JC328-40	TO-92	25	500	625	250	600	80	JC338-40	780
JC556	TO-92	65	100	500	125	475	100	JC546	798
JC556A	TO-92	65	100	500	125	250	100	JC546A	798

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	NPN COMPL.	PAGE
JC556B	TO-92	65	100	500	220	475	100	JC546B	798
JC557	TO-92	45	100	500	125	800	100	JC547	798
JC557A	TO-92	45	100	500	125	250	100	JC547A	798
JC557B	TO-92	45	100	500	220	475	100	JC547B	798
JC557C	TO-92	45	100	500	420	800	100	JC547C	798
JC558	TO-92	30	100	500	125	800	100	JC548	798
JC558A	TO-92	30	100	500	125	250	100	JC548A	798
JC558B	TO-92	30	100	500	220	475	100	JC548B	798
JC558C	TO-92	30	100	500	420	800	100	JC548C	798
JC559	TO-92	30	100	500	125	800	100	JC549	803
JC559A	TO-92	30	100	500	125	250	100	–	803
JC559B	TO-92	30	100	500	220	475	100	JC549B	803
JC559C	TO-92	30	100	500	420	800	100	JC549C	803
JC560	TO-92	45	100	500	125	800	100	JC550	803
JC560A	TO-92	45	100	500	125	250	100	–	803
JC560B	TO-92	45	100	500	220	475	100	JC550B	803
JC560C	TO-92	45	100	500	420	800	100	JC550C	803
MPSA55	TO-92	60	500	625	100	>100	50	MPSA05	830
MPSA56	TO-92	80	500	625	100	>100	50	MPSA06	830

LEADED DEVICES (continued)

NPN GENERAL PURPOSE TRANSISTOR ARRAYS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	REMARKS	PAGE
BCY87	TO-71	40	30	150	100	450	10	matched pair	470
BCY88	TO-71	40	30	150	100	450	10	matched pair	470
BCY89	TO-71	40	30	150	100	450	10	matched pair	470

LEADED DEVICES (continued)

NPN GENERAL PURPOSE MEDIUM-POWER TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	t_{off} max. (ns)	PNP COMPL.	PAGE
2N1613	TO-39	50	500	800	40	120	60	–	–	112
2N1711	TO-39	50	500	800	100	300	70	–	–	115
2N1893	TO-39	80	500	800	40	120	–	–	–	117
2N3019	TO-39	80	1000	800	100	300	100	–	–	148
BC140	TO-39	40	1000	3700	63	250	50	–	BC160	227
BC140-10	TO-39	40	1000	3700	63	160	50	–	BC160-10	227
BC140-16	TO-39	40	1000	3700	100	250	50	–	BC160-16	227
BC141	TO-39	60	1000	3700	63	250	50	–	BC161	227
BC141-10	TO-39	60	1000	3700	63	160	50	–	BC161-10	227
BC141-16	TO-39	60	1000	3700	100	250	50	–	BC161-16	227
BC368	TO-92	20	1000	830	85	375	40	–	BC369	251
BC368-16	TO-92	20	1000	830	100	250	40	–	BC369-16	251
BC368-25	TO-92	20	1000	830	160	>160	40	–	BC369-25	251
BC635	TO-92	45	1000	830	40	250	100	–	BC636	285
BC635-10	TO-92	45	1000	830	63	160	100	–	BC636-10	285
BC635-16	TO-92	45	1000	830	100	250	100	–	BC636-16	285
BC637	TO-92	60	1000	830	40	250	100	–	BC638	285
BC637-10	TO-92	60	1000	830	63	160	100	–	BC638-10	285
BC637-16	TO-92	60	1000	830	100	250	100	–	BC638-16	285
BC639	TO-92	80	1000	830	40	250	100	–	BC640	285
BC639-10	TO-92	80	1000	830	63	160	100	–	BC640-10	285
BC639-16	TO-92	80	1000	830	100	250	100	–	BC640-16	285
BFY50	TO-39	35	1000	800	30	>112	60	–	–	622
BFY51	TO-39	30	1000	800	40	>123	50	–	–	622
BFY52	TO-39	20	1000	800	60	>142	50	–	–	622
BSV64	TO-39	60	2000	5000	40	>40	100 typ.	1200	–	741
BSX45	TO-39	40	1000	6250	63	250	50	850	–	755
BSX45-10	TO-39	40	1000	6250	63	160	50	850	–	755
BSX45-16	TO-39	40	1000	6250	100	250	50	850	–	755
BSX46	TO-39	60	1000	6250	63	250	50	850	–	755
BSX46-10	TO-39	60	1000	6250	63	160	50	850	–	755
BSX46-16	TO-39	60	1000	6250	100	250	50	850	–	755
BSX47	TO-39	80	1000	6250	63	250	50	850	–	755
BSX47-10	TO-39	80	1000	6250	63	160	50	850	–	755
BSX47-16	TO-39	80	1000	6250	100	250	50	850	–	755

LEADED DEVICES (continued)

PNP GENERAL PURPOSE MEDIUM-POWER TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	NPN COMPL.	PAGE
2N4031	TO-39	80	1000	800	25	>25	100	–	158
2N4033	TO-39	80	1000	800	70	>70	150	–	158
BC160	TO-39	40	1000	3700	63	250	50	BC140	230
BC160-10	TO-39	40	1000	3700	63	160	50	BC140-10	230
BC160-16	TO-39	40	1000	3700	100	250	50	BC140-16	230
BC161	TO-39	60	1000	3700	63	250	50	BC141	230
BC161-10	TO-39	60	1000	3700	63	160	50	BC141-10	230
BC161-16	TO-39	60	1000	3700	100	250	50	BC141-16	230
BC369	TO-92	20	1000	830	85	375	40	BC368	254
BC369-16	TO-92	20	1000	830	100	250	40	BC368-16	254
BC369-25	TO-92	20	1000	830	160	>160	40	BC368-25	254
BC636	TO-92	45	1000	830	40	250	100	BC635	288
BC636-10	TO-92	45	1000	830	63	160	100	BC635-10	288
BC636-16	TO-92	45	1000	830	100	250	100	BC635-16	288
BC638	TO-92	60	1000	830	40	250	100	BC637	288
BC638-10	TO-92	60	1000	830	63	160	100	BC637-10	288
BC638-16	TO-92	60	1000	830	100	250	100	BC637-16	288
BC640	TO-92	80	1000	830	40	250	100	BC639	288
BC640-10	TO-92	80	1000	830	63	160	100	BC639-10	288
BC640-16	TO-92	80	1000	830	100	250	100	BC639-16	288
BSV15	TO-39	40	1000	800	63	250	50	–	738
BSV15-10	TO-39	40	1000	800	63	160	50	–	738
BSV15-16	TO-39	40	1000	800	100	250	50	–	738
BSV16	TO-39	60	1000	800	63	250	50	–	738
BSV16-10	TO-39	60	1000	800	63	160	50	–	738
BSV16-16	TO-39	60	1000	800	100	250	50	–	738
BSV17	TO-39	80	1000	800	63	250	50	–	738
BSV17-10	TO-39	80	1000	800	63	160	50	–	738

LEADED DEVICES (continued)

NPN GENERAL PURPOSE POWER TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	PNP COMPL.	PAGE
BD131	TO-126	45	3000	15000	40	>40	60	BD132	473
BD135	TO-126	45	1500	8000	40	250	190 typ.	BD136	479
BD135-10	TO-126	45	1500	8000	63	160	190 typ.	BD136-10	479
BD135-16	TO-126	45	1500	8000	100	250	190 typ.	BD136-16	479
BD137	TO-126	60	1500	8000	40	250	190 typ.	BD138	479
BD137-10	TO-126	60	1500	8000	63	160	190 typ.	BD138-10	479
BD137-16	TO-126	60	1500	8000	100	250	190 typ.	BD138-16	479
BD139	TO-126	80	1500	8000	40	250	190 typ.	BD140	479
BD139-10	TO-126	80	1500	8000	63	160	190 typ.	BD140-10	479
BD139-16	TO-126	80	1500	8000	100	250	190 typ.	BD140-16	479
BD226	TO-126	45	1500	12500	40	250	125 typ.	BD227	485
BD228	TO-126	60	1500	12500	40	250	125 typ.	BD229	485
BD230	TO-126	80	1500	12500	40	250	125 typ.	BD231	485
BD329	TO-126	20	3000	15000	85	375	130 typ.	BD330	491
BD825	TO-202	45	1000	2000	40	250	250 typ.	BD826	497
BD825-10	TO-202	45	1000	2000	63	160	250 typ.	BD826-10	497
BD825-16	TO-202	45	1000	2000	100	250	250 typ.	BD826-16	497
BD829	TO-202	80	1000	2000	40	250	250 typ.	BD830	497
BD829-10	TO-202	80	1000	2000	63	160	250 typ.	BD830-10	497
BD829-16	TO-202	80	1000	2000	100	250	250 typ.	BD830-16	497

LEADED DEVICES (continued)

PNP GENERAL PURPOSE POWER TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	NPN COMPL.	PAGE
BD132	TO-126	45	3000	15000	40	>40	60	BD131	476
BD136	TO-126	45	1500	8000	40	250	160 typ.	BD135	482
BD136-10	TO-126	45	1500	8000	63	160	160 typ.	BD135-10	482
BD136-16	TO-126	45	1500	8000	100	250	160 typ.	BD135-16	482
BD138	TO-126	60	1500	8000	40	250	160 typ.	BD137	482
BD138-10	TO-126	60	1500	8000	63	160	160 typ.	BD137-10	482
BD138-16	TO-126	60	1500	8000	100	250	160 typ.	BD137-16	482
BD140	TO-126	80	1500	8000	40	250	160 typ.	BD139	482
BD140-10	TO-126	80	1500	8000	63	160	160 typ.	BD139-10	482
BD140-16	TO-126	80	1500	8000	100	250	160 typ.	BD139-16	482
BD227	TO-126	45	1500	12500	40	250	50 typ.	BD226	488
BD229	TO-126	60	1500	12500	40	250	50 typ.	BD228	488
BD231	TO-126	80	1500	12500	40	250	50 typ.	BD230	488
BD330	TO-126	20	3000	15000	85	375	100 typ.	BD329	494
BD826	TO-202	45	1000	2000	40	250	75 typ.	BD825	500
BD826-10	TO-202	45	1000	2000	63	160	75 typ.	BD825-10	500
BD826-16	TO-202	45	1000	2000	100	250	75 typ.	BD825-16	500
BD828	TO-202	60	1000	2000	40	250	75 typ.	–	500
BD828-10	TO-202	60	1000	2000	63	160	75 typ.	–	500
BD828-16	TO-202	60	1000	2000	100	250	75 typ.	–	500
BD830	TO-202	80	1000	2000	40	250	75 typ.	BD829	500
BD830-10	TO-202	80	1000	2000	63	160	75 typ.	BD830-10	500
BD830-16	TO-202	80	1000	2000	100	250	75 typ.	BD830-16	500

LEADED DEVICES (continued)

NPN RESISTOR-EQUIPPED TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_O max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	INPUT RES. (KΩ)	RES. RATIO	PNP COMPL.	PAGE
PDTC114ES	TO-92	50	100	500	30	>30	10	1	PDTA114ES	895
PDTC114TS	TO-92	50	100	500	100	600	10	–	PDTA114TS	905
PDTC124ES	TO-92	50	100	500	56	>56	22	1	PDTA124ES	915
PDTC143ES	TO-92	50	100	500	20	>20	4.7	1	PDTA143ES	925
PDTC144ES	TO-92	50	100	500	68	>68	47	1	PDTA144ES	935

PNP RESISTOR-EQUIPPED TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	INPUT RES. (KΩ)	RES. RATIO	NPN COMPL.	PAGE
PDTA114ES	TO-92	50	100	500	30	>30	10	1	PDTC114ES	842
PDTA114TS	TO-92	50	100	500	100	600	10	–	PDTC114TS	852
PDTA124ES	TO-92	50	100	500	56	>56	22	1	PDTC124ES	862
PDTA143ES	TO-92	50	100	500	20	>20	4.7	1	PDTC143ES	872
PDTA144ES	TO-92	50	100	500	68	>68	47	1	PDTC144ES	882

LEADED DEVICES (continued)

NPN LOW-POWER SWITCHING TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	t_{off} max. (ns)	PNP COMPL.	PAGE
2N2222	TO-18	30	800	500	100	300	250	250	2N2907A	123
2N2222A	TO-18	40	800	500	100	300	300	250	2N2907A	123
2N2369	TO-18	15	200	360	40	120	500	30	–	127
2N2369A	TO-18	15	200	360	40	>40	500	30	–	127
2N3904	TO-92	40	200	500	100	300	300	240	2N3906	152
2N4401	TO-92	40	600	630	150	300	250	250	2N4403	167
BCY58	TO-18	32	100	340	120	630	150	800	BCY78	460
BCY58/VII	TO-18	32	100	340	120	220	150	800	BCY78/VII	460
BCY58/VIII	TO-18	32	100	340	180	310	150	800	BCY78/VIII	460
BCY58/IX	TO-18	32	100	340	250	460	150	800	BCY78/IX	460
BCY58/X	TO-18	32	100	340	380	630	150	800	BCY78/X	460
BCY59	TO-18	45	100	340	120	630	150	800	BCY79	460
BCY59/VII	TO-18	45	100	340	120	220	150	800	BCY79/VII	460
BCY59/VIII	TO-18	45	100	340	180	310	150	800	BCY79/VIII	460
BCY59/IX	TO-18	45	100	340	250	460	150	800	BCY79/IX	460
BCY59/X	TO-18	45	100	340	380	630	150	800	BCY79/X	460
BSX20	TO-18	15	200	360	40	120	500	30	–	749
MPS3904	TO-92	40	100	500	100	300	180	990	MPS3906	808
PH2222	TO-92	30	600	500	75	>75	250	250	PH2907	944
PH2222A	TO-92	40	600	500	75	>75	300	250	PH2907A	944
PH2369	TO-92	15	200	500	40	120	500	30	–	948
PH2369A	TO-92	15	200	500	40	120	500	30	–	948
PN2222	TO-92	30	600	500	100	300	250	250	–	1076
PN2222A	TO-92	40	600	500	100	300	300	250	PN2907A	1076
PN2369	TO-92	15	200	500	40	120	500	30	–	1080
PN2369A	TO-92	15	600	500	40	120	500	30	–	1080

LEADED DEVICES (continued)

PNP LOW-POWER SWITCHING TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	t_{off} max. (ns)	NPN COMPL.	PAGE
2N2905	TO-39	40	600	600	100	300	200	300	2N2219	136
2N2905A	TO-39	60	600	600	100	300	200	300	2N2219A	136
2N2906	TO-18	40	600	400	40	120	200	300	2N2222	140
2N2906A	TO-18	60	600	400	40	120	200	300	2N2222A	140
2N2907	TO-18	40	600	400	100	300	200	300	2N2222	144
2N2907A	TO-18	60	600	400	100	300	200	300	2N2222A	144
2N3906	TO-92	40	200	500	100	300	250	300	2N3904	154
2N4403	TO-92	40	600	630	100	300	200	350	2N4401	171
BCY78	TO-18	32	100	340	120	630	100	400	BCY58	466
BCY78/VII	TO-18	32	100	340	120	220	100	400	BCY58/VII	466
BCY78/VIII	TO-18	32	100	340	180	310	100	400	BCY58/VIII	466
BCY78/IX	TO-18	32	100	340	250	460	100	400	BCY58/IX	466
BCY78/X	TO-18	32	100	340	380	630	100	400	BCY58/X	466
BCY79	TO-18	45	100	340	120	630	100	400	BCY59	466
BCY79/VII	TO-18	45	100	340	120	220	100	400	BCY59/VII	466
BCY79/VIII	TO-18	45	100	340	180	310	100	400	BCY59/VIII	466
BCY79/IX	TO-18	45	100	340	250	460	100	400	BCY59/IX	466
BCY79/X	TO-18	45	100	340	380	630	100	400	BCY59/X	466
BFX30	TO-39	65	600	600	50	200	100	300	–	613
MPS3906	TO-92	40	100	500	100	300	150	690	MPS3904	811
PH2907	TO-92	40	600	500	100	300	200	365	PH2222	952
PH2907A	TO-92	60	600	500	100	300	200	365	PH2222A	952
PN2907A	TO-92	60	600	500	100	300	200	365	PN2222A	1083

LEADED DEVICES (continued)

NPN MEDIUM-POWER SWITCHING TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	t_{off} max. (ns)	PNP COMPL.	PAGE
2N2219	TO-39	30	800	800	100	300	250	250	2N2905	119
2N2219A	TO-39	40	800	800	100	300	300	250	2N2905A	119
BFX34	TO-39	60	2000	870	40	150	70	1200	–	616
BFX85	TO-39	60	1000	800	70	>70	50	360 typ.	–	618
BSW66A	TO-39	100	1000	800	30	>30	130 typ.	900 typ.	–	746
BSW67A	TO-39	120	1000	800	30	>30	130 typ.	900 typ.	–	746
BSW68A	TO-39	150	1000	800	30	>30	130 typ.	900 typ.	–	746
BSX32	TO-39	40	1000	800	20	>60	300	60	–	752
BSX59	TO-39	45	1000	800	30	90	250	60	–	758
BSX61	TO-39	45	1000	800	30	90	250	100	–	758
BSX62	TO-39	40	3000	5000	63	250	70 typ.	1500	–	761
BSX62-10	TO-39	40	3000	5000	63	160	70 typ.	1500	–	761
BSX62-16	TO-39	40	3000	5000	100	250	70 typ.	1500	–	761
BSX63	TO-39	60	3000	5000	63	250	70 typ.	1500	–	761
BSX63-10	TO-39	60	3000	5000	63	160	70 typ.	1500	–	761
BSX63-16	TO-39	60	3000	5000	100	250	70 typ.	1500	–	761

PNP MEDIUM-POWER SWITCHING TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	t_{off} max. (ns)	REMARKS	PAGE
2N4036	TO-39	65	1000	7000	20	200	60	700	P_{tot} @ T_{mb} = ≤25 °C	161

NPN POWER SWITCHING TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	t_{off} max. (ns)	PAGE
BDX35	TO-126	60	5000	1250	45	450	350 typ.	500	515
BDX36	TO-126	60	5000	1250	45	450	350 typ.	500	515
BDX37	TO-126	80	5000	1250	45	450	350 typ.	500	515

LEADED DEVICES (continued)

NPN LOW-POWER DARLINGTON TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CES} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	t_{off} max. (ns)	PNP COMPL.	PAGE
2N6427	TO-92	30	500	625	10000	100000	125	–	–	190
BC517	TO-92	30	500	500	30000	>30000	220 typ.	–	BC516	260
BC617	TO-92	40	800	500	4000	>4000	155	–	–	281
BC618	TO-92	55	800	500	2000	>2000	155	–	–	281
MPSA13	TO-92	30	500	500	5000	>5000	125	–	MPSA63	818
MPSA14	TO-92	30	500	500	10000	>10000	125	–	MPSA64	818
MPSA25	TO-92	40	500	500	10000	>10000	125	–	MPSA75	821
MPSA26	TO-92	50	500	500	10000	>10000	125	–	MPSA76	821
MPSA27	TO-92	60	500	500	10000	>10000	125	–	MPSA77	821

PNP LOW-POWER DARLINGTON TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CES} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	NPN COMPL.	PAGE
BC516	TO-92	30	500	500	30000	>30000	220 typ.	BC517	257
MPSA63	TO-92	30	500	500	5000	>5000	125	MPSA13	832
MPSA64	TO-92	30	500	500	10000	>10000	125	MPSA14	832

LEADED DEVICES (continued)

NPN MEDIUM-POWER DARLINGTON TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CES} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	t_{off} max. (ns)	PNP COMPL.	PAGE
BC875	TO-92	45	1000	830	1000	>1000	200 typ.	1300	BC876	365
BC877	TO-92	60	1000	830	1000	>1000	200 typ.	1300	BC878	365
BC879	TO-92	80	1000	830	1000	>1000	200 typ.	1300	BC880	365
BSR50	TO-92	45	1000	830	2000	>2000	200 typ.	1300	BSR60	707
BSR51	TO-92	60	1000	830	2000	>2000	200 typ.	1300	BSR61	707
BSR52	TO-92	80	1000	830	2000	>2000	200 typ.	1300	BSR62	707
BSS50	TO-39	45	1000	800	2000	>2000	200 typ.	1500 typ.	–	715
BSS51	TO-39	60	1000	800	2000	>2000	200 typ.	1500 typ.	BSS61	715
BSS52	TO-39	80	1000	800	2000	>2000	200 typ.	1500 typ.	BSS62	715

PNP MEDIUM-POWER DARLINGTON TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CES} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	t_{off} max. (ns)	NPN COMPL.	PAGE
BC876	TO-92	45	1000	830	1000	>1000	200 typ.	700	BC875	368
BC878	TO-92	60	1000	830	1000	>1000	200 typ.	700	BC877	368
BC880	TO-92	80	1000	830	1000	>1000	200 typ.	700	BC879	368
BSR60	TO-92	45	1000	830	2000	>2000	200 typ.	–	BSR50	711
BSR61	TO-92	60	1000	830	2000	>2000	200 typ.	–	BSR51	711
BSR62	TO-92	80	1000	830	2000	>2000	200 typ.	–	BSR52	711
BSS61	TO-39	60	1000	800	2000	>2000	200 typ.	–	BSS51	718
BSS62	TO-39	80	1000	800	2000	>2000	200 typ.	–	BSS52	718

LEADED DEVICES (continued)

NPN POWER DARLINGTON TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CES} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	t_{off} max. (ns)	PNP COMPL.	PAGE
BDX42	TO-126	45	1000	1250	2000	>2000	200 typ.	–	BDX45	518
BDX43	TO-126	60	1000	1250	2000	>2000	200 typ.	–	–	518
BDX44	TO-126	80	1000	1250	2000	>2000	200 typ.	–	BDX47	518

PNP POWER DARLINGTON TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CES} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	t_{off} max. (ns)	NPN COMPL.	PAGE
BDX45	TO-126	45	1000	1250	2000	>2000	200 typ.	–	BDX42	522
BDX47	TO-126	80	1000	1250	2000	>2000	200 typ.	–	BDX44	522

LEADED DEVICES (continued)

NPN MEDIUM-FREQUENCY TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	PAGE
BF199	TO-92	25	25	500	38	>38	550 typ.	544
BF240	TO-92	40	25	300	67	220	150	528
BF240B	TO-92	40	25	300	100	220	150	528
BF370	TO-92	15	100	500	40	>40	490	532
BF370R	TO-92	15	100	500	40	>40	490	532
BF494	TO-92	20	30	300	67	220	120	558
BF494B	TO-92	20	30	300	100	220	120	558
BF495	TO-92	20	30	300	35	125	120	558
BF495B	TO-92	20	30	300	11	125	120	558
BFR54	TO-92	15	100	500	40	>40	500	598

PNP MEDIUM-FREQUENCY TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	PAGE
BF324	TO-92	30	25	300	25	>25	450 typ	530
BF450	TO-92	40	25	300	50	>50	350	544

LEADED DEVICES (continued)

NPN HIGH-VOLTAGE LOW-POWER TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	PNP COMPL.	PAGE
2N5550	TO-92	140	300	630	60	>60	100	2N5400	186
2N5551	TO-92	160	300	630	80	>80	100	2N5401	186
BF420L	TO-92	300	50	625	50	>50	60	BF421L	538
BF422L	TO-92	250	50	625	50	>50	60	BF423L	538
MPSA42	TO-92	300	100	500	40	>40	50	MPSA92	824
MPSA43	TO-92	200	100	500	40	>40	50	MPSA93	824
MPSA44	TO-92	400	300	625	40	>40	20	–	827
MPSA45	TO-92	350	300	625	40	>40	20	–	827
PN3439	TO-92	350	100	500	30	>30	70	MPSA93	1086
PN3440	TO-92	250	100	500	40	>40	70	MPSA92	1086

PNP HIGH-VOLTAGE LOW-POWER TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	NPN COMPL.	PAGE
2N5400	TO-92	120	300	630	40	>40	100	2N5550	179
2N5401	TO-92	150	300	630	60	>60	100	2N5551	179
BF421L	TO-92	300	50	625	50	>50	60	BF420L	542
BF423L	TO-92	250	50	625	50	>50	60	BF422L	542
MPSA92	TO-92	300	500	625	25	>25	50	MPSA42	835
MPSA93	TO-92	200	500	625	25	>25	50	MPSA43	835
PH5416	TO-92	300	1000	500	30	120	15	–	956

LEADED DEVICES (continued)

NPN HIGH-VOLTAGE MEDIUM-POWER TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	PNP COMPL.	PAGE
BF420	TO-92	300	50	830	50	>50	60	BF421	536
BF422	TO-92	250	50	830	50	>50	60	BF423	545
BF483	TO-92	250	50	830	50	>50	70	–	553
BF485	TO-92	300	50	830	50	>50	70	–	553
BF487	TO-92	350	50	830	50	>50	70	–	553
BFV420	TO-92	100	100	830	150	>150	150	BFV421; video appl.	606

PNP HIGH-VOLTAGE MEDIUM-POWER TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	NPN COMPL.	PAGE
2N5415	TO-39	200	200	1000	30	150	15	–	183
2N5416	TO-39	300	200	1000	30	120	15	–	183
BF421	TO-92	300	50	830	50	>50	60	BF420	540
BF423	TO-92	250	50	830	50	>50	60	BF422	540
BF486	TO-92	300	50	830	50	>50	70	–	540
BF488	TO-92	350	50	830	50	>50	70	–	555
BFT45	TO-39	250	500	5000	50	150	70 typ.	–	604
BFV421	TO-92	100	100	830	150	>150	150	BFV420; video appl.	608

LEADED DEVICES (continued)

NPN HIGH-VOLTAGE POWER TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	PNP COMPL.	PAGE
BF419	TO-126	250	300	6000	45 typ.	>45	90	–	534
BF457	TO-126	160	100	6000	26	>26	90 typ.	–	546
BF458	TO-126	250	100	6000	26	>26	90 typ.	–	546
BF459	TO-126	300	100	6000	26	>26	90 typ.	–	546
BF469	TO-126	250	50	1800	50	>50	60	BF470	549
BF471	TO-126	300	50	1800	50	>50	60	BF472	549
BF583	TO-202	250	50	1600	50	>50	70	–	564
BF585	TO-202	300	50	1600	50	>50	70	–	564
BF587	TO-202	350	50	1600	50	>50	70	–	564
BF591	TO-202	170	150	1300	30	>30	30	–	568
BF593	TO-202	210	150	1300	30	>30	30	–	568
BF819	TO-202	250	100	1200	45 typ.	>45	90 typ.	–	578
BF857	TO-202	160	100	2000	26	>26	90	–	592
BF858	TO-202	250	100	2000	26	>26	90	–	592
BF859	TO-202	300	100	2000	26	>26	90	–	592
BF869	TO-202	250	50	1600	50	>50	60	BF870	594
BF871	TO-202	300	50	1600	50	>50	60	BF872	594
BFV469	TO-126	100	100	2000	150	>150	150	video applications	610

PNP HIGH-VOLTAGE POWER TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	NPN COMPL.	PAGE
BF470	TO-126	250	50	1800	50	>50	60	BF469	551
BF472	TO-126	300	50	1800	50	>50	60	BF471	551
BF588	TO-202	300	50	1600	50	>50	70	–	566
BF870	TO-202	250	50	1600	50	>50	60	BF869	596
BF872	TO-202	300	50	1600	50	>50	60	BF871	596

LEADED DEVICES (continued)

PROGRAMMABLE UNIJUNCTION TRANSISTORS

TYPE NUMBER	PACKAGE	V_{GA} max. (V)	I_A max. (mA)	I_{ARM} max. (mA)	P_{tot} max. (mW)	dI_A/dt max. (A/μs)	I_P max. (μA)	I_V min. (μA)	t_r max. (ns)	PAGE
BRY39	TO-72	70	175	2500	275	20	0.2	2	80	630
BRY56	TO-92	70	175	2500	300	20	0.2	2	80	641

SILICON CONTROLLED SWITCHES

TYPE NUMBER	PACKAGE	V_{CBO} max. (V)	I_E max. (mA)	I_{ERM} max. (mA)	P_{tot} max. (mW)	V_{AK} max. (V)	I_H max. (mA)	t_{on} max. (μs)	t_{off} max. (μs)	PAGE
BR101	TO-72	50	175	2500	275	1.4	1	–	–	626
BRY39	TO-72	70	175	2500	275	1.4	1	0.25	15	630

SURFACE-MOUNT DEVICES

NPN GENERAL PURPOSE LOW-POWER TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	PNP COMPL.	PAGE
2PC4081	SC-70	40	100	200	120	560	100	2PA1576	212
2PC4081Q	SC-70	40	100	200	120	270	100	2PA1576Q	212
2PC4081R	SC-70	40	100	200	180	390	100	2PA1576R	212
2PC4081S	SC-70	40	100	200	270	560	100	2PA1576S	212
2PC4617	SC-75	50	100	150	120	560	100	2PA1774	214
2PC4617Q	SC-75	50	100	150	120	270	100	2PA1774Q	214
2PC4617R	SC-75	50	100	150	180	390	100	2PA1774R	214
2PC4617S	SC-75	50	100	150	270	560	100	2PA1774S	214
2PD601A	SC-59	50	100	250	160	460	100	2PB709A	216
2PD601AQ	SC-59	50	100	250	160	260	100	2PB709AQ	216
2PD601AR	SC-59	50	100	250	210	340	120	2PB709AR	216
2PD601AS	SC-59	50	100	250	290	460	140	2PB709AS	216
2PD602A	SC-59	50	500	250	85	340	140	2PB710A	219
2PD602AQ	SC-59	50	500	250	85	170	140	2PB710AQ	219
2PD602AR	SC-59	50	500	250	120	240	160	2PB710AR	219
2PD602AS	SC-59	50	500	250	170	340	180	2PB710AS	219
2PD1820A	SC-70	50	500	200	85	340	150	2PB1219A	222
2PD1820AQ	SC-70	50	500	200	85	170	150	2PB1219AQ	222
2PD1820AR	SC-70	50	500	200	120	240	150	2PB1219AR	222
2PD1820AS	SC-70	50	500	200	170	340	150	2PB1219AS	222
BC817	SOT23	45	500	250	100	600	100	BC807	299
BC817W	SOT323	45	500	200	100	600	100	BC807W	303
BC817-16	SOT23	45	500	250	100	250	100	BC807-16	299
BC817-16W	SOT323	45	500	200	100	250	100	BC807-16W	303
BC817-25	SOT23	45	500	250	160	400	100	BC807-25	299
BC817-25W	SOT323	45	500	200	160	400	100	BC807-25W	303
BC817-40	SOT23	45	500	250	250	600	100	BC807-40	299
BC817-40W	SOT323	45	500	200	250	600	100	BC807-40W	303
BC818	SOT23	25	500	250	100	600	100	BC808	299
BC818W	SOT323	25	500	200	100	600	100	BC808W	303
BC818-16	SOT23	25	500	250	100	250	100	BC808-16	299
BC818-16W	SOT323	25	500	200	100	250	100	BC808-16W	303
BC818-25	SOT23	25	500	250	160	400	100	BC808-25	299
BC818-25W	SOT323	25	500	200	160	400	100	BC808-25W	303
BC818-40	SOT23	25	500	250	250	600	100	BC808-40	299
BC818-40W	SOT323	25	500	200	250	600	100	BC808-40W	303

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	PNP COMPL.	PAGE
BC846	SOT23	65	100	250	110	450	100	BC856	307
BC846A	SOT23	65	100	250	110	220	100	BC856A	307
BC846AT	SC-75	65	100	150	110	220	100	BC856AT	312
BC846AW	SOT323	65	100	200	110	220	100	BC856AW	315
BC846B	SOT23	65	100	250	200	450	100	BC856B	307
BC846BT	SC-75	65	100	150	200	450	100	BC856BT	312
BC846BW	SOT323	65	100	200	200	450	100	BC856BW	315
BC846W	SOT323	65	100	200	110	450	100	BC856W	315
BC847	SOT23	45	100	250	110	800	100	BC857	307
BC847A	SOT23	45	100	250	110	220	100	BC857A	307
BC847AT	SC-75	45	100	150	110	220	100	BC857AT	312
BC847AW	SOT323	45	100	200	110	220	100	BC857AW	312
BC847B	SOT23	45	100	250	200	450	100	BC857B	307
BC847BT	SC-75	45	100	150	200	450	100	BC857BT	312
BC847BW	SOT323	45	100	200	200	450	100	BC857BW	312
BC847C	SOT23	45	100	250	420	800	100	BC857C	307
BC847CT	SC-75	45	100	150	420	800	100	BC857CT	312
BC847CW	SOT323	45	100	200	420	800	100	BC857CW	315
BC847W	SOT323	45	100	200	110	800	100	BC857W	315
BC848	SOT23	30	100	250	110	800	100	BC858	307
BC848A	SOT23	30	100	250	110	220	100	BC858A	307
BC848AT	SC-75	30	100	150	110	220	100	BC858AT	312
BC848AW	SOT323	30	100	200	110	220	100	BC858AW	315
BC848B	SOT23	30	100	250	200	450	100	BC858B	307
BC848BT	SC-75	30	100	150	200	450	100	BC858BT	312
BC848BW	SOT323	30	100	200	200	450	100	BC858BW	315
BC848C	SOT23	30	100	250	420	800	100	BC858C	307
BC848CT	SC-75	30	100	150	420	800	100	BC858CT	312
BC848CW	SOT323	30	100	200	420	800	100	BC858CW	315
BC848W	SOT323	30	100	200	110	800	100	BC858W	315
BC849	SOT23	30	100	250	200	800	100	BC859	326
BC849B	SOT23	30	100	250	200	450	100	BC859B	326
BC849BW	SOT323	30	100	200	200	450	100	BC859BW	330
BC849C	SOT23	30	100	250	420	800	100	BC859C	326
BC849CW	SOT323	30	100	200	420	800	100	BC859CW	330
BC849W	SOT323	30	100	200	200	800	100	BC859W	330
BC850	SOT23	45	100	250	200	800	100	BC860	326
BC850B	SOT23	45	100	250	200	450	100	BC860B	326
BC850BW	SOT323	45	100	200	200	450	100	BC860BW	330

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	PNP COMPL.	PAGE
BC850C	SOT23	45	100	250	420	800	100	BC860C	326
BC850CW	SOT323	45	100	200	420	800	100	BC860CW	330
BC850W	SOT323	45	100	200	200	800	100	BC860W	330
BCF32	SOT23	32	100	250	200	450	100	BCF29	374
BCF33	SOT23	32	100	250	420	800	100	BCF30	374
BCF81	SOT23	45	100	250	420	800	100	–	377
BCV71	SOT23	60	100	250	110	220	100	–	420
BCV72	SOT23	60	100	250	200	450	100	–	420
BCW31	SOT23	32	100	250	110	220	100	BCW29	424
BCW32	SOT23	32	100	250	200	450	100	BCW30	424
BCW33	SOT23	32	100	250	420	800	100	–	424
BCW60 series	SOT23	32	100	250	120	630	100	BCW61 series	427
BCW60A	SOT23	32	100	250	120	220	100	BCW61A	427
BCW60B	SOT23	32	100	250	180	310	100	BCW61B	427
BCW60C	SOT23	32	100	250	250	460	100	BCW61C	427
BCW60D	SOT23	32	100	250	380	630	100	BCW61D	427
BCW71	SOT23	45	100	250	110	220	100	BCW69	436
BCW72	SOT23	45	100	250	200	450	100	BCW70	436
BCW81	SOT23	45	100	250	420	800	100	–	438
BCX19	SOT23	45	500	250	100	600	100	BCX17	445
BCX20	SOT23	25	500	250	100	600	100	BCX18	445
BCX70 series	SOT23	45	100	250	120	630	100	BCX71 series	454
BCX70G	SOT23	45	100	250	120	220	100	BCX71G	454
BCX70H	SOT23	45	100	250	180	310	100	BCX71H	454
BCX70J	SOT23	45	100	250	250	460	100	BCX71J	454
BCX70K	SOT23	45	100	250	380	630	100	BCX71K	454
PMBS3904	SOT23	40	100	250	100	300	180	PMBS3906	958
PMBT5088	SOT23	30	100	250	350	>350	–	–	990
PMBT6428	SOT23	50	100	250	250	650	100	–	1001
PMBT6429	SOT23	45	100	250	500	1250	100	–	1001
PMBTA06	SOT23	80	500	250	50	>50	100	PMBTA56	1004
PMST5088	SOT323	30	100	200	350	>350	100		1053
PMST5089	SOT323	25	100	200	450	>450	100		1053
PMST6428	SOT323	50	100	200	250	650	100	–	1063
PMST6429	SOT323	45	100	200	500	1250	100	–	1063
PMSTA05	SOT323	60	500	200	50	>50	100	PMSTA55	1066
PMSTA06	SOT323	80	500	200	50	>50	100	PMSTA56	1066

SURFACE-MOUNT DEVICES (continued)

PNP GENERAL PURPOSE LOW-POWER TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	NPN COMPL.	PAGE
2PA1576	SC-70	40	100	200	120	560	100	2PC4081	196
2PA1576Q	SC-70	40	100	200	120	270	100	2PC4081Q	196
2PA1576R	SC-70	40	100	200	180	390	100	2PC4081R	196
2PA1576S	SC-70	40	100	200	270	560	100	2PC4081S	196
2PA1774	SC-75	40	100	150	120	560	100	2PC4617	198
2PA1774Q	SC-75	40	100	150	120	270	100	2PC4617Q	198
2PA1774R	SC-75	40	100	150	180	390	100	2PC4617R	198
2PA1774S	SC-75	40	100	150	270	560	100	2PC4617S	198
2PB709A	SC-59	45	200	250	160	460	80	2PB601A	200
2PB709AQ	SC-59	45	100	250	160	260	60	2PB601AQ	200
2PB709AR	SC-59	45	100	250	210	340	70	2PB601AR	200
2PB709AS	SC-59	45	100	250	290	460	80	2PB601AS	200
2PB710A	SC-59	50	500	250	85	340	100	2PD602A	202
2PB710AQ	SC-59	50	500	250	85	170	100	2PD602AQ	202
2PB710AR	SC-59	50	500	250	120	240	120	2PD602AR	202
2PB710AS	SC-59	50	500	250	170	340	140	2PD602AS	202
2PB1219A	SC-70	50	500	200	85	340	100	2PD1820A	205
2PB1219AQ	SC-70	50	500	200	85	170	100	2PD1820AQ	205
2PB1219AR	SC-70	50	500	200	120	240	120	2PD1820AR	205
2PB1219AS	SC-70	50	500	200	170	340	140	2PD1820AS	205
BC807	SOT23	45	500	250	100	600	80	BC817	291
BC807W	SOT323	45	500	200	100	600	80	BC817W	295
BC807-16	SOT23	45	500	250	100	250	80	BC817-16	291
BC807-16W	SOT323	45	500	200	100	250	80	BC817-16W	295
BC807-25	SOT23	45	500	250	160	400	80	BC817-25	291
BC807-25W	SOT323	45	500	200	160	400	80	BC817-25W	295
BC807-40	SOT23	45	500	250	250	600	80	BC817-40	291
BC807-40W	SOT323	45	500	200	250	600	80	BC817-40W	295
BC808	SOT23	25	500	250	100	600	80	BC818	291
BC808W	SOT323	25	500	200	100	600	80	BC818W	295
BC808-16	SOT23	25	500	250	100	250	80	BC818-16	291
BC808-16W	SOT323	25	500	200	100	250	80	BC818-16W	295
BC808-25	SOT23	25	500	250	160	400	80	BC818-25	291
BC808-25W	SOT323	25	500	200	160	400	80	BC818-25W	295
BC808-40	SOT23	25	500	250	250	600	80	BC818-40	291
BC808-40W	SOT323	25	500	200	250	600	80	BC818-40W	295

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	NPN COMPL.	PAGE
BC856	SOT23	65	100	250	125	475	100	BC846	334
BC856A	SOT23	65	100	250	125	250	100	BC846A	334
BC856AT	SC-75	65	100	150	125	250	100	BC846AT	339
BC856AW	SOT323	65	100	200	125	250	100	BC846AW	342
BC856B	SOT23	65	100	250	220	475	100	BC846B	334
BC856BT	SC-75	65	100	150	220	475	100	BC846BT	339
BC856BW	SOT323	65	100	200	220	475	100	BC846BW	342
BC856W	SOT323	65	100	200	125	475	100	BC846W	342
BC857	SOT23	45	100	250	125	800	100	BC847	334
BC857A	SOT23	45	100	250	125	250	100	BC847A	334
BC857AT	SC-75	45	100	150	125	250	100	BC847AT	339
BC857AW	SOT323	45	100	200	125	250	100	BC847AW	342
BC857B	SOT23	45	100	250	220	475	100	BC847B	334
BC857BT	SC-75	45	100	150	220	475	100	BC847BT	339
BC857BW	SOT323	45	100	200	220	475	100	BC847BW	342
BC857C	SOT23	45	100	250	420	800	100	BC847C	334
BC857CT	SC-75	45	100	150	420	800	100	BC847CT	339
BC857CW	SOT323	45	100	200	420	800	100	BC847CW	342
BC857W	SOT323	45	100	200	125	800	100	BC847W	342
BC858	SOT23	30	100	250	125	800	100	BC848	334
BC858A	SOT23	30	100	250	125	250	100	BC848A	334
BC858AT	SC-75	30	100	150	125	250	100	BC848AT	339
BC858AW	SOT323	30	100	200	125	250	100	BC848AW	342
BC858B	SOT23	30	100	250	220	475	100	BC848B	334
BC858BT	SC-75	30	100	150	220	475	100	BC848BT	339
BC858BW	SOT323	30	100	200	220	475	100	BC848BW	342
BC858C	SOT23	30	100	250	420	800	100	BC848C	334
BC858CT	SC-75	30	100	150	420	800	100	BC848CT	339
BC858CW	SOT323	30	100	200	420	800	100	BC848CW	342
BC858W	SOT323	30	100	200	125	800	100	BC848W	342
BC859	SOT23	30	100	250	125	800	100	BC849	349
BC859A	SOT23	30	100	250	125	250	100	–	349
BC859AW	SOT323	30	100	200	125	250	100	–	354
BC859B	SOT23	30	100	250	220	475	100	BC849B	349
BC859BW	SOT323	30	100	200	220	475	100	BC849BW	354
BC859C	SOT23	30	100	250	420	800	100	BC849C	349
BC859CW	SOT323	30	100	200	420	800	100	BC849CW	354
BC859W	SOT323	30	100	200	125	800	100	BC849W	354
BC860	SOT23	45	100	250	125	800	100	BC850	349

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	NPN COMPL.	PAGE
BC860A	SOT23	45	100	250	125	250	100	–	349
BC860AW	SOT323	45	100	200	125	250	100	–	354
BC860B	SOT23	45	100	250	220	475	100	BC850B	349
BC860BW	SOT323	45	100	200	220	475	100	BC850BW	354
BC860C	SOT23	45	100	250	420	800	100	BC850C	349
BC860CW	SOT323	45	100	200	420	800	100	BC850CW	354
BC860W	SOT323	45	100	200	125	800	100	BC850W	354
BCF29	SOT23	32	100	250	120	260	100	BCF32	371
BCF30	SOT23	32	100	250	215	500	100	BCF33	371
BCW29	SOT23	32	100	250	120	260	100	BCW31	422
BCW30	SOT23	32	100	250	215	500	100	BCW32	422
BCW61 series	SOT23	32	100	250	120	630	100	BCW60 series	430
BCW61A	SOT23	32	100	250	120	220	100	BCW60A	430
BCW61B	SOT23	32	100	250	180	310	100	BCW60B	430
BCW61C	SOT23	32	100	250	250	460	100	BCW60C	430
BCW61D	SOT23	32	100	250	380	630	100	BCW60D	430
BCW69	SOT23	45	100	250	120	260	100	BCW71	433
BCW70	SOT23	45	100	250	215	500	100	BCW72	433
BCW89	SOT23	60	100	250	120	260	100	–	440
BCX17	SOT23	45	500	250	100	600	80	BCX19	442
BCX18	SOT23	25	500	250	100	600	80	BCX20	442
BCX71 series	SOT23	45	100	250	120	630	100	BCX70 series	457
BCX71G	SOT23	45	100	250	120	220	100	BCX70G	457
BCX71H	SOT23	45	100	250	180	310	100	BCX70H	457
BCX71J	SOT23	45	100	250	250	460	100	BCX70J	457
BCX71K	SOT23	45	100	250	380	630	100	BCX70K	457
PMBS3906	SOT23	40	100	250	100	300	150	PMBS3904	961
PMBTA55	SOT23	60	500	250	100	>100	50	–	1012
PMBTA56	SOT23	80	500	250	100	>100	50	PMBTA06	1012
PMSTA55	SOT323	60	500	200	50	>50	50	PMSTA05	1071
PMSTA56	SOT323	80	500	200	50	>50	50	PMSTA06	1071

SURFACE-MOUNT DEVICES (continued)

NPN GENERAL PURPOSE TRANSISTOR ARRAYS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	PNP COMPL. / REMARKS	PAGE
BC847BS	SC-88	45	100	200	200	450	100	BC857BS; matched pair	323
BCV61	SOT143B	30	100	250	100	>100	100	BCV62; matched pair	404
BCV61A	SOT143B	30	100	250	110	220	100	BCV62A; matched pair	404
BCV61B	SOT143B	30	100	250	200	450	100	BCV62B; matched pair	404
BCV61C	SOT143B	30	100	250	420	800	100	BCV62C; matched pair	404
BCV63	SOT143B	30	100	250	110	800	100	–	410
BCV63B	SOT143B	30	100	250	200	450	100	BCV64B	410
PUMX1	SC-88	40	100	200	120	>120	100	PUMT1	1102

PNP GENERAL PURPOSE TRANSISTOR ARRAYS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	NPN COMPL./ REMARKS	PAGE
BC857BS	SC-88	45	100	200	200	450	100	BC847BS; matched pair	347
BCV62	SOT143B	30	100	250	100	>100	100	BCV61; matched pair	408
BCV62A	SOT143B	30	100	250	125	250	100	BCV61A; matched pair	408
BCV62B	SOT143B	30	100	250	220	475	100	BCV61B; matched pair	408
BCV62C	SOT143B	30	100	250	420	800	100	BCV61C; matched pair	408
BCV64B	SOT143B	30	100	250	220	475	100	BCV63B	414
PUMT1	SC-88	40	100	200	120	>120	100	PUMX1	1100

NPN/PNP GENERAL PURPOSE TRANSISTOR ARRAYS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	REMARKS	PAGE
BC847BPN	SC-88	45	100	200	200	450	100	matched pair	320
BCV65	SOT143B	30	100	250	75	800	–	matched pair	418
BCV65B	SOT143B	30	100	250	200	475	–	matched pair	418
PUMZ1	SC-88	40	100	200	120	>120	100	–	1104

SURFACE-MOUNT DEVICES (continued)

NPN GENERAL PURPOSE MEDIUM-POWER TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	t_{off} max. (ns)	PNP COMPL.	PAGE
BC868	SOT89	20	1000	1400	85	375	40	–	BC869	359
BC868-10	SOT89	20	1000	1400	100	160	40	–	–	359
BC868-16	SOT89	20	1000	1400	100	250	40	–	BC869-16	359
BC868-25	SOT89	20	1000	1400	160	>250	40	–	BC869-25	359
BCP54	SOT223	45	1000	1330	40	250	130 typ.	–	BCP51	382
BCP54-10	SOT223	45	1000	1330	63	160	130 typ.	–	BCP51-10	382
BCP54-16	SOT223	45	1000	1330	100	250	130 typ.	–	BCP51-16	382
BCP55	SOT223	60	1000	1330	40	250	130 typ.	–	BCP52	382
BCP55-10	SOT223	60	1000	1330	63	160	130 typ.	–	BCP52-10	382
BCP55-16	SOT223	60	1000	1330	100	250	130 typ.	–	BCP52-16	382
BCP56	SOT223	80	1000	1330	40	250	130 typ.	–	BCP53	382
BCP56-10	SOT223	80	1000	1330	63	160	130 typ.	–	BCP53-10	382
BCP56-16	SOT223	80	1000	1330	100	250	130 typ.	–	BCP53-16	382
BCP68	SOT223	20	1000	1370	85	375	40	–	BCP69	385
BCP68-10	SOT223	20	1000	1370	–	160	40	–	BCP69-10	385
BCP68-16	SOT223	20	1000	1370	100	250	40	–	BCP69-16	385
BCP68-25	SOT223	20	1000	1370	160	>160	40	–	BCP69-25	385
BCX54	SOT89	45	1000	1390	40	250	130 typ.	–	BCX51	451
BCX54-10	SOT89	45	1000	1390	63	160	130 typ.	–	BCX51-10	451
BCX54-16	SOT89	45	1000	1390	100	250	130 typ.	–	BCX51-16	451
BCX55	SOT89	60	1000	1390	40	250	130 typ.	–	BCX52	451
BCX55-10	SOT89	60	1000	1390	63	160	130 typ.	–	BCX52-10	451
BCX55-16	SOT89	60	1000	1390	100	250	130 typ.	–	BCX52-16	451
BCX56	SOT89	80	1000	1390	40	250	130 typ.	–	BCX53	451
BCX56-10	SOT89	80	1000	1390	63	160	130 typ.	–	BCX53-10	451
BCX56-16	SOT89	80	1000	1390	100	250	130 typ.	–	BCX53-16	451
BDL31	SOT223	10	5000	1350	200	>200	100	–	BDL32	503
BDP31	SOT223	45	3000	1350	40	>40	60	–	BDP32	509
BSP40	SOT223	60	1000	1300	40	120	100	–	BSP30	666
BSP41	SOT223	60	1000	1300	100	300	100	–	BSP31	666
BSP42	SOT223	80	1000	1300	40	120	100	–	BSP32	666
BSP43	SOT223	80	1000	1300	100	300	100	–	BSP33	666
BSR40	SOT89	60	1000	1000	40	120	100	1000	BSR30	704
BSR41	SOT89	60	1000	1000	100	300	100	1000	BSR31	704
BSR42	SOT89	80	1000	1000	40	120	100	1000	BSR32	704
BSR43	SOT89	80	1000	1000	100	300	100	1000	BSR33	704
PZTA06	SOT223	80	500	1200	100	>100	100	–	PZTA56	1159

SURFACE-MOUNT DEVICES (continued)

PNP GENERAL PURPOSE MEDIUM-POWER TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	t_{off} max. (ns)	NPN COMPL.	PAGE
BC869	SOT89	20	1000	1400	100	375	40	–	BC868	362
BC869-16	SOT89	20	1000	1400	100	250	40	–	BC868-16	362
BC869-25	SOT89	20	1000	1400	160	>160	40	–	BC868-25	362
BCP51	SOT223	45	1000	1300	40	250	115 typ.	–	BCP54	379
BCP51-10	SOT223	45	1000	1300	63	160	115 typ.	–	BCP54-10	379
BCP51-16	SOT223	45	1000	1300	100	250	115 typ.	–	BCP54-16	379
BCP52	SOT223	60	1000	1300	40	250	115 typ.	–	BCP55	379
BCP52-10	SOT223	60	1000	1300	63	160	115 typ.	–	BCP55-10	379
BCP52-16	SOT223	60	1000	1300	100	250	115 typ.	–	BCP55-16	379
BCP53	SOT223	80	1000	1300	40	250	115 typ.	–	BCP56	379
BCP53-10	SOT223	80	1000	1300	63	160	115 typ.	–	BCP56-10	379
BCP53-16	SOT223	80	1000	1300	100	250	115 typ.	–	BCP56-16	379
BCP69	SOT223	20	1000	1350	85	375	40	–	BCP68	388
BCP69-10	SOT223	20	1000	1350	–	160	40	–	BCP68-10	388
BCP69-16	SOT223	20	1000	1350	100	250	40	–	BCP68-16	388
BCP69-25	SOT223	20	1000	1350	160	>160	40	–	BCP68-25	388
BCX51	SOT89	45	1000	1300	40	250	50 typ.	–	BCX54	448
BCX51-10	SOT89	45	1000	1300	63	160	50 typ.	–	BCX54-10	448
BCX51-16	SOT89	45	1000	1300	100	250	50 typ.	–	BCX54-16	448
BCX52	SOT89	60	1000	1300	40	250	50 typ.	–	BCX55	448
BCX52-10	SOT89	60	1000	1300	63	160	50 typ.	–	BCX55-10	448
BCX52-16	SOT89	60	1000	1300	100	250	50 typ.	–	BCX55-16	448
BCX53	SOT89	80	1000	1300	40	250	50 typ.	–	BCX56	448
BCX53-10	SOT89	80	1000	1300	63	160	50 typ.	–	BCX56-10	448
BCX53-16	SOT89	80	1000	1300	100	250	50 typ.	–	BCX56-16	448
BDL32	SOT223	10	5000	1350	180	>180	100	–	BDL31	506
BDP32	SOT223	45	3000	1350	40	>40	60	–	BDP31	512
BSP30	SOT223	60	1000	1300	40	120	100	650	BSP40	663
BSP31	SOT223	60	1000	1300	100	300	100	650	BSP41	663
BSP32	SOT223	80	1000	1300	40	120	100	650	BSP42	663
BSP33	SOT223	80	1000	1300	100	300	100	650	BSP43	663
BSR30	SOT89	60	1000	1400	40	120	100	–	BSR40	701
BSR31	SOT89	60	1000	1400	100	300	100	–	BSR41	701
BSR32	SOT89	80	1000	1400	40	120	100	–	BSR42	701
BSR33	SOT89	80	1000	1400	100	300	100	–	BSR43	701
PZTA56	SOT223	80	500	1200	100	>100	50	–	PZTA06	1170

SURFACE-MOUNT DEVICES (continued)

NPN RESISTOR-EQUIPPED TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_O max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	INPUT RES. (KΩ)	RES. RATIO	PNP COMPL.	PAGE
PDTC114EE	SC-75	50	100	150	30	>30	10	1	PDTA114EE	891
PDTC114EK	SC-59	50	100	250	30	>30	10	1	PDTA114EK	893
PDTC114ET	SOT23	50	100	250	30	>30	10	1	PDTA114ET	897
PDTC114EU	SOT323	50	100	200	30	>30	10	1	PDTA114EU	899
PDTC114TE	SC-75	50	100	150	100	600	10	–	PDTA114TE	901
PDTC114TK	SC-59	50	100	250	100	600	10	–	PDTA114TK	903
PDTC114TT	SOT23	50	100	250	100	600	10	–	PDTA114TT	907
PDTC114TU	SOT323	50	100	200	100	600	10	–	PDTA114TU	909
PDTC124EE	SC-75	50	100	150	56	>56	22	1	PDTA124EE	911
PDTC124EK	SC-59	50	100	250	56	>56	22	1	PDTA124EK	913
PDTC124ET	SOT23	50	100	250	56	>56	22	1	PDTA124ET	917
PDTC124EU	SOT323	50	100	200	56	>56	22	1	PDTA124EU	919
PDTC143EE	SC-75	50	100	150	20	>20	4.7	1	PDTA143EE	921
PDTC143EK	SC-59	50	100	250	20	>20	4.7	1	PDTA143EK	923
PDTC143ET	SOT23	50	100	250	20	>20	4.7	1	PDTA143ET	927
PDTC143EU	SOT323	50	100	200	20	>20	4.7	1	PDTA143EU	929
PDTC144EE	SC-75	50	100	150	68	>68	47	1	PDTA144EE	931
PDTC144EK	SC-59	50	100	250	68	>68	47	1	PDTA144EK	933
PDTC144ET	SOT23	50	100	250	68	>68	47	1	PDTA144ET	937
PDTC144EU	SOT323	50	100	200	68	>68	47	1	PDTA144EU	939
PDTD114ET	SOT23	50	500	250	56	>56	10	1	PDTB144ET	941

SURFACE-MOUNT DEVICES (continued)

PNP RESISTOR-EQUIPPED TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	INPUT RES. (KΩ)	RES. RATIO	NPN COMPL.	PAGE
PDTA114EE	SC-75	50	100	150	30	>30	10	1	PDTC114EE	838
PDTA114EK	SC-59	50	100	250	30	>30	10	1	PDTC114EK	840
PDTA114ET	SOT23	50	100	250	30	>30	10	1	PDTC114ET	844
PDTA114EU	SOT323	50	100	200	30	>30	10	1	PDTC114EU	846
PDTA114TE	SC-75	50	100	150	100	600	10	–	PDTC114TE	848
PDTA114TK	SC-59	50	100	250	100	600	10	–	PDTC114TK	850
PDTA114TT	SOT23	50	100	250	100	600	10	–	PDTC114TT	854
PDTA114TU	SOT323	50	100	200	100	600	10	–	PDTC114TU	856
PDTA124EE	SC-75	50	100	150	56	>56	22	1	PDTC124EE	858
PDTA124EK	SC-59	50	100	250	56	>56	22	1	PDTC124EK	860
PDTA124ET	SOT23	50	100	250	56	>56	22	1	PDTC124ET	864
PDTA124EU	SOT323	50	100	200	56	>56	22	1	PDTC124EU	866
PDTA143EE	SC-75	50	100	150	20	>20	4.7	1	PDTC143EE	868
PDTA143EK	SC-59	50	100	250	20	>20	4.7	1	PDTC143EK	870
PDTA143ET	SOT23	50	100	250	20	>20	4.7	1	PDTC143ET	874
PDTA143EU	SOT323	50	100	200	20	>20	4.7	1	PDTC143EU	876
PDTA144EE	SC-75	50	100	150	68	>68	47	1	PDTC144EE	878
PDTA144EK	SC-59	50	100	250	68	>68	47	1	PDTC144EK	880
PDTA144ET	SOT23	50	100	250	68	>68	47	1	PDTC144ET	884
PDTA144EU	SOT323	50	100	200	68	>68	47	1	PDTC144EU	886
PDTB114ET	SOT23	50	500	250	56	>56	10	1	PDTD114ET	888

NPN, PNP AND NPN/PNP RESISTOR-EQUIPPED TRANSISTOR ARRAYS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	INPUT RES. (KΩ)	RES. RATIO	POLARITY	PAGE
PUMB4	SC-88	50	100	200	100	600	10	–	PNP double transistor	1089
PUMD2	SC-88	50	100	200	56	>56	22	1	NPN/PNP	1091
PUMD3	SC-88	50	100	200	30	>30	10	1	NPN/PNP	1094
PUMH11	SC-88	50	100	200	30	>30	10	1	NPN double transistor	1097

SURFACE-MOUNT DEVICES (continued)

NPN LOW-POWER SWITCHING TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	t_{off} max. (ns)	PNP COMPL.	PAGE
BSR13	SOT23	30	800	250	30	>30	250	250	BSR15	677
BSR14	SOT23	40	800	250	40	>40	300	250	BSR16	677
BSR17A	SOT23	40	100	250	100	300	300	240	BSR18A	685
BSV52	SOT23	12	100	250	40	120	500 typ.	30	–	741
PMBT2222	SOT23	30	600	250	100	300	250	250	PMBT2907	964
PMBT2222A	SOT23	40	600	250	100	300	300	250	PMBS2907A	964
PMBT2369	SOT23	15	200	250	40	120	500	30	–	968
PMBT3904	SOT23	40	100	250	100	300	300	240	PMBT3906	974
PMBT4401	SOT23	40	600	250	100	300	250	250	PMBT4403	982
PMSS3904	SOT323	40	100	200	100	300	180	1200	PMSS3906	1020
PMST2222	SOT323	30	600	200	100	300	250	250	–	1027
PMST2222A	SOT323	40	600	200	100	300	300	250	PMST2907A	1027
PMST2369	SOT323	15	200	200	40	120	500	30	–	1031
PMST3904	SOT323	40	200	200	100	300	300	240	PMST3906	1037
PMST4401	SOT323	40	600	200	100	300	250	285	PMST4403	1045

PNP LOW-POWER SWITCHING TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	t_{off} max. (ns)	NPN COMPL.	PAGE
BSR15	SOT23	40	600	250	30	>30	200	365	BSR13	681
BSR16	SOT23	60	600	250	50	>50	200	365	BSR14	681
BSR18A	SOT23	40	100	250	100	300	250	300	BSR17A	689
PMBT2907	SOT23	40	600	250	100	300	200	365	PMBT2222	971
PMBT2907A	SOT23	60	600	250	100	300	200	365	PMBT2222A	971
PMBT3906	SOT23	40	100	250	100	300	250	300	PMBT3904	978
PMBT4403	SOT23	40	600	250	100	300	200	350	PMBT4401	986
PMSS3906	SOT323	40	100	200	100	300	150	700	PMSS3904	1024
PMST2907A	SOT323	60	200	200	50	>50	200	300	PMST2222A	1034
PMST3906	SOT323	40	100	200	100	300	250	300	PMST3904	1041
PMST4403	SOT323	40	600	200	100	300	200	350	PMST4401	1049

SURFACE-MOUNT DEVICES (continued)

NPN MEDIUM-POWER SWITCHING TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	t_{off} max. (ns)	PNP COMPL.	PAGE
PXT2222A	SOT89	40	600	1200	100	300	300	250	PXT2907A	1106
PXT3904	SOT89	40	100	1150	100	300	300	240	PXT3906	1114
PXT4401	SOT89	40	600	1200	100	300	250	250	PXT4403	1122
PZT2222A	SOT223	40	600	1150	100	300	300	250	PZT2907A	1145
PZT3904	SOT223	40	200	1050	100	300	300	240	PZT3906	1151

PNP MEDIUM-POWER SWITCHING TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	t_{off} max. (ns)	NPN COMPL.	PAGE
PXT2907A	SOT89	60	600	1250	100	300	200	365	PXT2222A	1109
PXT3906	SOT89	40	100	1150	100	300	250	300	PXT3904	1118
PXT4403	SOT89	40	600	1250	100	300	200	350	PXT4401	1126
PZT2907A	SOT223	60	600	1150	100	300	200	365	PZT2222A	1148
PZT3906	SOT223	40	100	1050	100	300	250	300	PZT3904	1155

SURFACE-MOUNT DEVICES (continued)

NPN LOW-POWER DARLINGTON TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CES} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	PNP COMPL.	PAGE
BCV27	SOT23	30	500	250	20000	>20000	220 typ.	BCV26	394
BCV47	SOT23	60	500	250	10000	>10000	220 typ.	BCV46	394
PMBTA13	SOT23	30	500	250	5000	>5000	125	PMBTA63	1006
PMBTA14	SOT23	30	500	250	10000	>10000	125	PMBTA64	1006

SURFACE-MOUNT DEVICES (continued)

PNP LOW-POWER DARLINGTON TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CES} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	NPN COMPL.	PAGE
BCV26	SOT23	30	500	250	20000	>20000	220 typ.	BCV27	391
BCV46	SOT23	60	500	250	10000	>10000	220 typ.	BCV47	391
PMBTA63	SOT23	30	500	250	5000	>5000	125	PMBTA13	1014
PMBTA64	SOT23	30	500	250	10000	>10000	125	PMBTA14	1014

SURFACE-MOUNT DEVICES (continued)

NPN MEDIUM-POWER DARLINGTON TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CES} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	t_{off} max. (ns)	PNP COMPL.	PAGE
BCV29	SOT89	30	500	1340	20000	>20000	220 typ.	–	BCV28	401
BCV49	SOT89	60	500	1340	10000	>10000	220 typ.	–	BCV48	401
BSP50	SOT223	45	1000	1250	2000	>2000	200 typ.	1300 typ.	BSP60	669
BSP51	SOT223	60	1000	1250	2000	>2000	200 typ.	1300 typ.	BSP61	669
BSP52	SOT223	80	1000	1250	2000	>2000	200 typ.	1300 typ.	BSP62	669
BST50	SOT89	45	500	1350	2000	>2000	200 typ.	1500 typ.	BST60	730
BST51	SOT89	60	500	1350	2000	>2000	200 typ.	1500 typ.	BST61	730
BST52	SOT89	80	500	1350	2000	>2000	200 typ.	1500 typ.	BST62	730
PXTA14	SOT89	30	500	1300	20000	>20000	125	–	PXTA64	1130
PXTA27	SOT89	60	500	1300	10000	>10000	125	–	–	1133
PZTA14	SOT223	30	500	1250	10000	>10000	125	–	PZTA64	1161

PNP MEDIUM-POWER DARLINGTON TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CES} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	t_{off} max. (ns)	NPN COMPL.	PAGE
BCV28	SOT89	30	500	1300	20000	>20000	220 typ.	–	BCV29	397
BCV48	SOT89	60	500	1300	10000	>10000	220 typ.	–	BCV49	397
BSP60	SOT223	45	500	1250	2000	>2000	200 typ.	1500 typ.	BSP50	673
BSP61	SOT223	60	500	1250	2000	>2000	200 typ.	1500 typ.	BSP51	673
BSP62	SOT223	80	500	1250	2000	>2000	200 typ.	1500 typ.	BSP52	673
BST60	SOT89	45	500	1350	2000	>2000	200 typ.	700 typ.	BST50	734
BST61	SOT89	60	500	1350	2000	>2000	200 typ.	700 typ.	BST51	734
BST62	SOT89	80	500	1350	2000	>2000	200 typ.	700 typ.	BST52	734
PXTA64	SOT89	30	500	1300	10000	>10000	125	–	PXTA14	1139
PZTA64	SOT223	30	500	1250	10000	>10000	125	–	PZTA14	1172

SURFACE-MOUNT DEVICES (continued)

NPN MEDIUM-FREQUENCY TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	PAGE
BF570	SOT23	15	100	250	40	>40	490	562
BF840	SOT23	40	25	250	76	222	380 typ.	600
BF841	SOT23	40	25	250	36	125	380 typ.	600
BFS19	SOT23	20	30	250	65	225	260 typ.	600
BFS20	SOT23	20	25	250	40	>85	450 typ.	602

PNP MEDIUM-FREQUENCY TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	PAGE
BF550	SOT23	40	25	250	50	>50	325 typ.	560
BF824	SOT23	30	25	250	25	>50	450 typ.	586
BF824W	SC-70	30	25	200	25	>25	400	589

SURFACE-MOUNT DEVICES (continued)

NPN HIGH-VOLTAGE LOW-POWER TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	PNP COMPL.	PAGE
BF820	SOT23	300	50	250	50	>50	60	BF821	580
BF820W	SC-70	300	50	200	50	>50	60	–	582
BF822	SOT23	250	50	250	50	>50	60	BF823	580
BF822W	SC-70	250	50	200	50	>50	60	–	582
BSR19	SOT23	140	300	250	60	>60	100	BSR20	693
BSR19A	SOT23	160	300	250	80	>80	100	BSR20A	693
BSS64	SOT23	80	100	250	20	80	60	BSS63	723
PMBT5550	SOT23	140	300	250	60	250	100	PMBT5401	995
PMBT5551	SOT23	160	300	250	80	250	100	PMBT5401	998
PMBTA42	SOT23	300	100	250	40	>40	50	PMBTA92	1009
PMBTA43	SOT23	200	100	250	40	>40	50	PMBTA93	1009
PMST5550	SOT323	140	300	200	60	250	100	PMST5401	1059
PMST5551	SOT323	160	300	200	80	250	100	PMST5401	1059
PMSTA42	SOT323	300	500	200	40	>40	50	PMSTA92	1068
PMSTA43	SOT323	200	500	200	40	>40	50	PMSTA93	1068

PNP HIGH-VOLTAGE LOW-POWER TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	NPN COMPL.	PAGE
BF821	SOT23	300	50	250	50	>50	60	BF820	584
BF823	SOT23	250	50	250	50	>50	60	BF822	584
BSR20	SOT23	120	300	250	40	180	100	BSR19	697
BSR20A	SOT23	150	300	250	60	240	100	BSR19A	697
BSS63	SOT23	100	100	250	30	>30	85 typ.	BSS64	721
PMBT5401	SOT23	150	300	250	60	240	100	PMBT5550	992
PMBTA92	SOT23	300	100	250	40	>40	50	PMBTA42	1017
PMBTA93	SOT23	200	100	250	40	>40	50	PMBTA43	1017
PMST5401	SOT323	150	300	200	60	240	100	PMST5550 PMST5551	1056
PMSTA92	SOT323	300	500	200	40	>40	50	PMSTA42	1073
PMSTA93	SOT323	200	500	200	40	>40	50	PMSTA43	1073

SURFACE-MOUNT DEVICES (continued)

NPN HIGH-VOLTAGE MEDIUM-POWER TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	PNP COMPL.	PAGE
BF620	SOT89	300	50	1200	50	>50	60	BF621	570
BF622	SOT89	250	50	1200	50	>50	60	BF623	570
BF720	SOT223	300	50	1200	50	>50	60	BF721	574
BF722	SOT223	250	50	1200	50	>50	60	BF723	574
BSP19	SOT223	350	50	1200	40	>40	70	BSP15	661
BSP20	SOT223	250	50	1200	40	>40	70	BSP16	661
BST39	SOT89	350	100	1250	40	>40	70	BST15	728
BST40	SOT89	250	100	1250	40	>40	70	BST16	728
PXTA42	SOT89	300	100	1250	40	>40	50	PXTA92	1136
PXTA43	SOT89	200	100	1250	40	>40	50	PXTA93	1136
PZTA42	SOT223	300	100	1200	40	>40	50	PZTA92	1164
PZTA43	SOT223	200	100	1200	40	>40	50	–	1164
PZTA44	SOT223	400	300	1350	40	>40	20	–	1167
PZTA45	SOT223	350	300	1350	40	>40	20	–	1167

PNP HIGH-VOLTAGE MEDIUM-POWER TRANSISTORS

TYPE NUMBER	PACKAGE	V_{CEO} max. (V)	I_C max. (mA)	P_{tot} max. (mW)	h_{FE} min.	h_{FE} max.	f_T min. (MHz)	NPN COMPL.	PAGE
BF621	SOT89	300	50	1200	50	>50	60	BF620	572
BF623	SOT89	250	50	1200	50	>50	60	BF622	572
BF721	SOT223	300	50	1200	50	>50	60	BF720	576
BF723	SOT223	250	50	1200	50	>50	60	BF722	576
BSP15	SOT223	200	50	1280	30	150	15	BSP19	658
BSP16	SOT223	300	50	1280	30	120	15	BSP20	658
BST15	SOT89	200	200	1350	30	150	15	BST39	725
BST16	SOT89	300	200	1350	30	120	15	BST40	725
PXTA92	SOT89	300	100	1250	40	>40	50	PXTA42	1142
PXTA93	SOT89	200	100	1250	40	>40	50	PXTA43	1142
PZTA92	SOT223	300	100	1200	40	>40	50	PZTA42	1175

SURFACE-MOUNT DEVICES (continued)

PROGRAMMABLE UNIJUNCTION TRANSISTORS

TYPE NUMBER	PACKAGE	V_{GA} max. (V)	I_A max. (mA)	I_{ARM} max. (mA)	P_{tot} max. (mW)	dI_A/dt max. (A/μs)	I_P max. (μA)	I_V min. (μA)	t_r max. (ns)	PAGE
BRY61	SOT23	70	175	2500	250	20	0.2	2	80	646

SILICON CONTROLLED SWITCHES

TYPE NUMBER	PACKAGE	V_{CBO} max. (V)	I_E max. (mA)	I_{ERM} max. (mA)	P_{tot} max. (mW)	V_{AK} max. (V)	I_H max. (mA)	t_{on} max. (μs)	t_{off} max. (μs)	PAGE
BRY62	SOT143B	70	175	2500	250	1.4	1	0.25	15	651

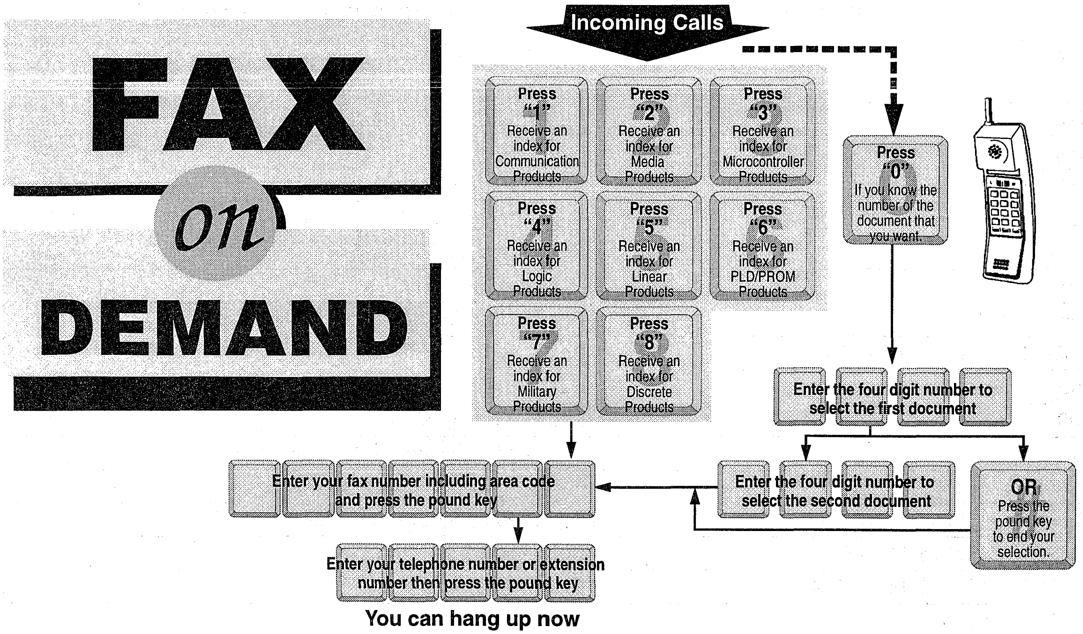
REPLACEMENT/WITHDRAWAL TYPES

The following type numbers were in the previous issue of this data handbook, but not in the current version:

TYPE NUMBER	REASON FOR DELETION
2N2297	Replaced by 2N3019
2N2483	Replaced by 2N2484
2N2904; 2N2904A	Replaced by 2N2905A
2N3020	Replaced by 2N3019
2N3053	Replaced by BSX45
2N3439; 2N3440	Replaced by TO92 MPSA44; MPSA45 or BF487 (BF483 pinning)
2N4030 ; 2N4032	Replaced by 2N4031; 2N4033
2N4123	Replaced by 2N4124
2N4125	Replaced by 2N4126
2N4400	Replaced by 2N4401
2N4402	Replaced by 2N4403
2N930	Replaced by BC107B
2PB1219	Replaced by 2PB1219A
2PB709	Replaced by 2PB709A
2PB710	Replaced by 2PB710A
2PC1815L	Replaced by 2PC1815
2PD601	Replaced by 2PD601A
2PD602	Replaced by 2PD602A
BBC178; BC179	Replaced by BC177
BC375	Replaced by BD635 (similar) pinning
BC376	Replaced by BC636 (similar) pinning
BCF70	Replaced by BC860
BCV64	Replaced by BCV64B
BCX58; BCX59	Replaced by BC548; BC547
BCX78; BCX79	Replaced by BC558; BC557
BCY56; BCY57	Replaced by BC107B; BC109C
BCY65	Replaced by 2N2222A; BC107
BCY72	Replaced by BCY71
BD136-6, BD138-6, BD140-6	Replaced by BD136; BD138; BD140
BD827	Replaced by BD829
BD839; BD841; BD843	Replaced by TO126 BD226; BD228; BD230
BD840; BD842; BD844	Replaced by TO126 BD227; BD229; BD231
BDX46	Replaced by BDX47
BF198	Replaced by BF199 (similar)
BF241	Replaced by BF240
BF451	Replaced by BF450
BF484	Replaced by BF486
BF584; BF586	Replaced by BF588

TYPE NUMBER	REASON FOR DELETION
BFS18	Replaced by BFS19
BFT44	Replaced by BFT45
BFX29	Replaced by 2N2905A
BFX84	Replaced by BFX85
BFX87; BFX88	Replaced by 2N2905A
BFY55	Replaced by BC140; BSX45-10
BSS38	Replaced by SOT23 BSS4
BSS60	Replaced by BSS61
BSX60	Replaced by BSX59
BSX62-10, -16, BSX63-10, -16	Replaced by BSX62
JA100	Replaced by JA101
JC500	Replaced by JC501
JF494	Replaced by BF494; BF495 (pinning)
MPS3702; MPS3703	Replaced by MPS39006 (similar)
MPS3704; MPS3705; MPS3706	Replaced by MPS3904 (similar)
MPS6513; MPS6514; MPS6515	Discontinued
MPS6517; MPS6518; MPS6519	Discontinued
MPS6520; MPS6521	Discontinued
MPS6522; MPS6523	Discontinued
MPS6531; MPS6532	Discontinued
MPS6534; MPS6535	Discontinued
MPSA75; MPSA76; MPSA77	Replaced by MPSA63/64
PH2907	Replaced by PN2907A
PH5415	Replaced by SMD BST16; BSP16
PMBT3640	Belongs to another Product Group
PMBTA05	Replaced by PMBTA06
PMST6429	Replaced by PMSR6428
PN2907	Replaced by PN2907A
PN5415; PN5416	Replaced by SMD BST16; BSP16
PXT2222	Replaced by PXT2222A
PXT2907	Replaced by PXT2907A
PZT2222	Replaced by PZT2222A
PZT2907	Replaced by PZT2907A
PZTA05	Replaced by PZTA06
PZTA13	Replaced by PZTA14
PZTA55	Discontinued
PZTA63	Replaced by PZTA64
PZTA93	Replaced by PZTA92

FAX-on-DEMAND System



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CONVERSION LIST

SC04/CATEGORY CROSS REFERENCE PER PACKAGE

General Purpose Low Power

LEADED		SURFACE-MOUNT						
METAL PACKAGE	TO-92	SC-59	SOT23	SOT143	SOT323	SOT363	SC-75	SOT223
General purpose low power NPN								
BC107 BC108 BC109 BCY58 BCY59 2N2484	BC546 BC547 JC501 JC546 JC547 JC548 MPS3904 2PC945 2PC1815 ED1402 ED1502 ED1602 ED1702	2PD601A	BC846 BC847 BCV71 BCV72 BCW31 BCW32 BCW33 BCW60 BCW71 BCW72 BCW81 BCX70 PMBS3904	BCV61 BCV63	BC846W BC847W 2PC4081 PMSS3904	PUMX1 BC847BS BC847BPN(1) PUMZ1(1)	2PC4617 BC847T	
BC109	BC549 BC550 2N5088 JC549 JC550		BC849 BC850 BCF32 BCF33 BCF81 PMBT5088		PMST5088 BC849W BC850W			
General purpose low power PNP								
BC177	BC556 BC557 JA101 JC556 JC557 JC558 MPS3906 2PA722 2PA1015 ED1802	2PB709A	BC856 BC857 BCX29 BCX30 BCXW61 BCW69 BCW70 BCW89 BCX71 PMBS3906	BCV62 BCV64	BC856W BC857W 2PA1576 PMSS3906	PUMT1 BC857BS	2PA1774 BC857T	
BCY70 BCY71	BC559 BC560 JC559 JC560		BC859 BC860 BCF29 BCF30		BC859W BC860W			
General purpose medium power NPN								
	BC337 BC338 JC337 JC338 MPSA05 MPSA06	2PD602A	BC817 BC818 BCX19 BCX20 PMBTA06		PMSTA06 2PD1820A BC817W BC818W			PZTA06

LEADED		SURFACE-MOUNT						
METAL PACKAGE	TO-92	SC-59	SOT23	SOT143	SOT323	SOT363	SC-75	SOT223
General purpose medium power PNP								
	BC327 BC328 JC327 JC328 MPSA55 MPSA56	2PB710A	BC807 BC808 BCX17 BCX18 PMBTA56		PMSTA56 2PB1219A BC807W BC808W			PZTA56

Note

1. NPN/PNP device.

Darlingtons

LEADED			SURFACE-MOUNT			
METAL PACKAGE	TO-92	TO-126	SOT23	SOT323	SOT89	SOT223
Darlingtons NPN						
BSS50 BSS51 BSS52	BC517 BC617 BC618 MPSA13 MPSA14 MPSA25 MPSA26 MPSA27 BC875 BC877 BC879 BSR50 BSR51 BSR52	BDX42 BDX43 BDX44	BCV27 BCV47 PMBTA13 PMBTA14 PMBT6428	PMST6428	BCV29 BCV49 PXTA14 PXTA27 BST50 BST51 BST52	BCP49 PZTA14 BSP50 BSP51 BSP52
Darlingtons PNP						
BSS61 BSS62	BC876 BC878 BC880 BSR60 BSR61 BSR62 BC516 MPSA63 MPSA64 BSS68	BDX45 BDX46 BDX47	BCV26 BCV46 PMBTA63 PMBTA64 BSS63		BST60 BST61 BST62 BCV28 BCV48 PXTA64	BSP60 BSP61 BSP62 PZTA63 PZTA64

Medium power/power

LEADED				SURFACE-MOUNT	
METAL PACKAGE	TO-92	TO-126	TO-202	SOT89	SOT223
Medium power/power NPN					
	BC635 BC637 BC639	BD135 BD137 BD139	BD825 BD829	BCX54 BCX55 BCX56	BCP54 BCP55 BCP56 BD131 BDP32
	BC368	BD329		BC868	BCP68
BC140; BC141 BFX85 BFY50 BFY51 BFY52 BSX45 BSX46 BSX47 2N1613 2N1711 2N1893				BSR40 BSR41 BSR42 BSR43	BSP40 BSP41 BSP42 BSP43
Medium power/power PNP					
BC160 BC161 BSV15 BSV16 BSV17 2N4031 2N4033	BC636 BC638 BC640 BC369	BD136 BD138 BD140 BD330	BD826 BD828 BD830	BSR30; BSR31 BSR32; BSR33 BCX51; BCX52 BCX53 BC869	BSP30; BSP31 BSP32; BSP33 BCP51; BCP52 BCP53 BD132 BDP32 BCP869

Medium frequency

LEADED		SURFACE-MOUNT	
METAL PACKAGE	TO-92	SOT23	SOT323
Medium frequency NPN			
	BF494; BF495 BF199 BFR54 BF240 BF370	BFS19 BF840 BF841 BF570	BF840W(1) (planned)
Medium frequency PNP			
	BF324 BF450	BF824 BF550	BF824W

Note

1. NPN/PNP device.

Switching

LEADED		SURFACE-MOUNT			
METAL PACKAGE	TO-92	SOT23	SOT323	SOT89	SOT223
Switching NPN					
BSX20 2N2369 2N2369A	PH2369 PH2369A PN2369 PN2369A	BSV52 PMBT2369	PMST2369		
	2N3904 2N4124	BSR17A PMBT3904	PMST3904	PXT3904	PZT3904
2N2222 2N2222A 2N2219 2N2219A	PH2222 PH2222A PN2222 PN2222A	BSR13 BSR14 PMBT2222 PMBT2222A PMBT4401	PMST2222A PMST4401	PXT2222A PXT4401	PZT2222A
Switching PNP					
BFX30	2N3906 2N4126	BSR18A PMBT3906	PMST3906	PXT3906	PZT3906
2N2905A 2N2906A 2N2907A	PH2907A PN2907A 2N4403	BSR15 BSR16 PMBT2907A PMBT4403	PMST4403	PXT2907A PXT4403	PZT2907A

High voltage

LEADED				SURFACE-MOUNT			
METAL PACKAGE	TO-92	TO-126	TO-202	SOT23	SOT323	SOT89	SOT223
High voltage NPN							
	BF420 BF422 BFV420 BF420L	BF469 BFV469 BF471	BF869 BF871	BF820 BF822	BF820W BF822W	BF620 BF622	BF720 BF722
	BF483 BF485 BF487 MPSA42 MPSA43	BF583 BF585 BF587	BF857 BF858 BF859	PMBTA42 PMBTA43	PMSTA42	PXTA42 PXTA43	PZTA42 PZTA43 BSP19 BSP20
	PN3439 PN3440	BF419	BF819			BST39 BST40	
	2N5550 2N5551			BSR19A PMBT5550 PMBT5551	PMST5550 PMST5551		

LEADED				SURFACE-MOUNT			
METAL PACKAGE	TO-92	TO-126	TO-202	SOT23	SOT323	SOT89	SOT223
High voltage PNP							
	BF421 BFV421 BF421L	BF470 BF472	BF870 BF872	BF821 BF823 PMBTA92 PMBTA93	PMSTA92 PMSTA93	BF621 BF623 PXTA92 PXTA93	BF721 BF723 PZTA92
	BF486 BF488 MPSA92 MPSA93	BF588					
2N5415 2N5416						BST15 BST16	BSP15 BSP16
	2N5400 2N5401			BSR20 BSR20A PMBT5401	PMST5401		

Resistor equipped (RETs)

LEADED	SURFACE-MOUNT				
TO-92	SC-59	SOT23	SOT323	SOT363	SC-75
Resistor equipped NPN					
PDTC114ES PDTC114TS PDTC124ES PDTC143ES PDTC144ES	PDTC114EK PDTC114TK PDTC124EK PDTC143EK PDTC144EK	PDTC114ET PDTC114TT PDTC124ET PDTC143ET PDTC144ET	PDTC114EU PDTC114TU PDTC124EU PDTC143EU PDTC144EU	PUMH11 PUMD2(1) PUMD3(1)	PDTC114EE PDTC114TE PDTC124EE PDTC143EE PDTC144EE
Resistor equipped PNP					
PDTA114ES PDTA114TS PDTA124ES PDTA143ES PDTA144ES	PDTA114EK PDTA114TK PDTA124EK PDTA143EK PDTA144EK	PDTA114ET PDTA114TT PDTA124ET PDTA143ET PDTA144ET	PDTA114EU PDTA114TU PDTA124EU PDTA143EU PDTA144EU	PUMB4	PDTA114EE PDTA114TE PDTA124EE PDTA143EE PDTA144EE

Note

1. NPN/PNP device.

MARKING CODES

TYPE NUMBER TO MARKING CODE

TYPE NUMBER	MARKING CODE	PACKAGE
2PA1576Q	FtQ	SC-70
2PA1576R	FtR	SC-70
2PA1576S	FtS	SC-70
2PA1774Q	YQ	SC-75
2PA1774R	YR	SC-75
2PA1774S	YS	SC-75
2PB709AQ	BQ	SC-59
2PB709AR	BR	SC-59
2PB709AS	BS	SC-59
2PB710AQ	DQ	SC-59
2PB710AR	DR	SC-59
2PB710AS	DS	SC-59
2PB1219AQ	DtQ	SC-70
2PB1219AR	DtR	SC-70
2PB1219AS	DtS	SC-70
2PC4081Q	ZtQ	SC-70
2PC4081R	ZtR	SC-70
2PC4081S	ZtS	SC-70
2PC4617Q	ZQ	SC-75
2PC4617R	ZR	SC-75
2PC4617S	ZS	SC-75
2PD601AQ	ZQ	SC-59
2PD601AR	ZR	SC-59
2PD601AS	ZS	SC-59
2PD602AQ	XQ	SC-59
2PD602AR	XR	SC-59
2PD602AS	XS	SC-59
2PD1820AQ	AtQ	SC-70
2PD1820AR	AtR	SC-70
2PD1820AS	AtS	SC-70
BC807	5Dp	SOT23
BC807W	5Dt	SOT323
BC807-16	5Ap	SOT23
BC807-16W	5At	SOT323
BC807-25	5Bp	SOT23
BC807-25W	5Bt	SOT323
BC807-40	5Cp	SOT23
BC807-40W	5Ct	SOT323
BC808	5Hp	SOT23

TYPE NUMBER	MARKING CODE	PACKAGE
BC808W	5Ht	SOT323
BC808-16	5Ep	SOT23
BC808-16W	5Et	SOT323
BC808-25	5Fp	SOT23
BC808-25W	5Ft	SOT323
BC808-40	5Gp	SOT23
BC808-40W	5Gt	SOT323
BC817	6Dp	SOT23
BC817W	6Dt	SOT323
BC817-16	6Ap	SOT23
BC817-16W	6At	SOT323
BC817-25	6Bp	SOT23
BC817-25W	6Bt	SOT323
BC817-40	6Cp	SOT23
BC817-40W	6Ct	SOT323
BC818	6Hp	SOT23
BC818W	6Ht	SOT323
BC818-16	6Ep	SOT23
BC818-16W	6Et	SOT323
BC818-25	6Fp	SOT23
BC818-25W	6Ft	SOT323
BC818-40	6Gp	SOT23
BC818-40W	6Gt	SOT323
BC846	1Dp	SOT23
BC846A	1Ap	SOT23
BC846AT	1A	SC-75
BC846AW	1At	SOT323
BC846B	1Bp	SOT23
BC846BT	1B	SC-75
BC846BW	1Bt	SOT323
BC846W	1Dt	SOT323
BC847	1Hp	SOT23
BC847A	1Ep	SOT23
BC847AT	1E	SC-75
BC847AW	1Et	SOT323
BC847B	1Fp	SOT23
BC847BPN	13t	SC-88
BC847BS	1Ft	SC-88
BC847BT	1F	SC-75

TYPE NUMBER	MARKING CODE	PACKAGE
BC847BW	1Ft	SOT323
BC847C	1Gp	SOT23
BC847CT	1G	SC-75
BC847CW	1Gt	SOT323
BC847W	1Ht	SOT323
BC848	1Mp	SOT23
BC848A	1Jp	SOT23
BC848AT	1J	SC-75
BC848AW	1Jt	SOT323
BC848B	1Kp	SOT23
BC848BT	1K	SC-75
BC848BW	1Kt	SOT323
BC848C	1Lp	SOT23
BC848CT	1L	SC-75
BC848CW	1Lt	SOT323
BC848W	1Mt	SOT323
BC849	2Dp	SOT23
BC849B	2Bp	SOT23
BC849BW	2Bt	SOT323
BC849C	2Cp	SOT23
BC849CW	2Ct	SOT323
BC849W	2Dt	SOT323
BC850	2Hp	SOT23
BC850B	2Fp	SOT23
BC850BW	2Ft	SOT323
BC850C	2Gp	SOT23
BC850CW	2Gt	SOT323
BC850W	2Ht	SOT323
BC856	3Dp	SOT23
BC856A	3Ap	SOT23
BC856AT	3A	SC-75
BC856AW	3At	SOT323
BC856B	3Bp	SOT23
BC856BT	3B	SC-75
BC856BW	3Bt	SOT323
BC856W	3Dt	SOT323
BC857	3Hp	SOT23
BC857A	3Ep	SOT23
BC857AT	3E	SC-75
BC857AW	3Et	SOT323

TYPE NUMBER	MARKING CODE	PACKAGE
BC857B	3Fp	SOT23
BC857BS	3Ft	SC-88
BC857BT	3F	SC-75
BC857BW	3Ft	SOT323
BC857C	3Gp	SOT23
BC857CT	3G	SC-75
BC857CW	3Gt	SOT323
BC857W	3Ht	SOT323
BC858	3Mp	SOT23
BC858A	3Jp	SOT23
BC858AT	3J	SC-75
BC858AW	3Jt	SOT323
BC858B	3Kp	SOT23
BC858BT	3K	SC-75
BC858BW	3Kt	SOT323
BC858C	3Lp	SOT23
BC858CT	3L	SC-75
BC858CW	3Lt	SOT323
BC858W	3Mt	SOT323
BC859	4Dp	SOT23
BC859A	4Ap	SOT23
BC859AW	4At	SOT323
BC859B	4Bp	SOT23
BC859BW	4Bt	SOT323
BC859C	4Cp	SOT23
BC859CW	4Ct	SOT323
BC859W	4Dt	SOT323
BC860	4Hp	SOT23
BC860A	4Ep	SOT23
BC860AW	4Et	SOT323
BC860B	4Fp	SOT23
BC860BW	4Ft	SOT323
BC860C	4Gp	SOT23
BC860CW	4Gt	SOT323
BC860W	4Ht	SOT323
BC868	CAC	SOT89
BC868-10	CBC	SOT89
BC868-16	CCC	SOT89
BC868-25	CDC	SOT89
BC869	CEC	SOT89

TYPE NUMBER	MARKING CODE	PACKAGE
BC869-16	CGC	SOT89
BC869-25	CHC	SOT89
BCF29	C7p	SOT23
BCF30	C8p	SOT23
BCF32	D7p	SOT23
BCF33	D8p	SOT23
BCF81	K9p	SOT23
BCP51	BCP51	SOT223
BCP51-10	BCP51/10	SOT223
BCP51-16	BCP51/16	SOT223
BCP52	BCP52	SOT223
BCP52-10	BCP52/10	SOT223
BCP52-16	BCP52/16	SOT223
BCP53	BCP53	SOT223
BCP53-10	BCP53/10	SOT223
BCP53-16	BCP53/16	SOT223
BCP54	BCP54	SOT223
BCP54-10	BCP54/10	SOT223
BCP54-16	BCP54/16	SOT223
BCP55	BCP55	SOT223
BCP55-10	BCP55/10	SOT223
BCP55-16	BCP55/16	SOT223
BCP56	BCP56	SOT223
BCP56-10	BCP56/10	SOT223
BCP56-16	BCP56/16	SOT223
BCP68	BCP68	SOT223
BCP68-10	BCP68/10	SOT223
BCP68-16	BCP68/16	SOT223
BCP68-25	BCP68/25	SOT223
BCP69	BCP69	SOT223
BCP69-10	BCP/10	SOT223
BCP69-16	BCP/16	SOT223
BCP69-25	BCP/25	SOT223
BCV26	FDp	SOT23
BCV27	FFp	SOT23
BCV28	ED	SOT89
BCV29	EF	SOT89
BCV46	FEp	SOT23
BCV47	FGp	SOT23
BCV48	EE	SOT89

TYPE NUMBER	MARKING CODE	PACKAGE
BCV49	EG	SOT89
BCV61	1Mp	SOT143B
BCV61A	1Jp	SOT143B
BCV61B	1Kp	SOT143B
BCV61C	1Lp	SOT143B
BCV62	3Mp	SOT143B
BCV62A	3Jp	SOT143B
BCV62B	3Kp	SOT143B
BCV62C	3Lp	SOT143B
BCV63	D95	SOT143B
BCV63B	D96	SOT143B
BCV64B	C96	SOT143B
BCV65	97p	SOT143B
BCV65B	98p	SOT143B
BCV71	K7p	SOT23
BCV72	K8p	SOT23
BCW29	C1p	SOT23
BCW30	C2p	SOT23
BCW31	D1p	SOT23
BCW32	D2p	SOT23
BCW33	D3p	SOT23
BCW60A	AAp	SOT23
BCW60B	ABp	SOT23
BCW60C	ACp	SOT23
BCW60D	ADp	SOT23
BCW61A	BAp	SOT23
BCW61B	BBp	SOT23
BCW61C	BCp	SOT23
BCW61D	BDp	SOT23
BCW69	H1p	SOT23
BCW70	H2p	SOT23
BCW71	K1p	SOT23
BCW72	K2p	SOT23
BCW81	K3p	SOT23
BCW89	H3p	SOT23
BCX17	T1p	SOT23
BCX18	T2p	SOT23
BCX19	U1p	SOT23
BCX20	U2p	SOT23
BCX51	AA	SOT89

TYPE NUMBER	MARKING CODE	PACKAGE
BCX51-10	AC	SOT89
BCX51-16	AD	SOT89
BCX52	AE	SOT89
BCX52-10	AG	SOT89
BCX52-16	AM	SOT89
BCX53	AH	SOT89
BCX53-10	AK	SOT89
BCX53-16	AL	SOT89
BCX54	BA	SOT89
BCX54-10	BC	SOT89
BCX54-16	BD	SOT89
BCX55	BE	SOT89
BCX55-10	BG	SOT89
BCX55-16	BM	SOT89
BCX56	BH	SOT89
BCX56-10	BK	SOT89
BCX56-16	BL	SOT89
BCX70G	AGp	SOT23
BCX70H	AHp	SOT23
BCX70J	AJp	SOT23
BCX70K	AKp	SOT23
BCX71G	BGp	SOT23
BCX71H	BHp	SOT23
BCX71J	BJp	SOT23
BCX71K	BKp	SOT23
BDL31	BDL31	SOT223
BDL32	BDL32	SOT223
BDP31	BDP31	SOT223
BDP32	BDP32	SOT223
BF550	LAp	SOT23
BF570	B26	SOT23
BF620	DC	SOT89
BF621	DF	SOT89
BF622	DA	SOT89
BF623	DB	SOT89
BF720	BF720	SOT223
BF721	BF721	SOT223
BF722	BF722	SOT223
BF723	BF723	SOT223
BF820	1Vp	SOT23

TYPE NUMBER	MARKING CODE	PACKAGE
BF820W	1Vt	SOT323
BF821	1Wp	SOT23
BF822	1Xp	SOT23
BF822W	1Wt	SOT323
BF823	1Yp	SOT23
BF824	F8p	SOT23
BF824W	F8t	SOT323
BF840	NCp	SOT23
BF841	NDp	SOT23
BFS19	F2p	SOT23
BFS20	G1p	SOT23
BRY61	A5p	SOT23
BRY62	A51	SOT143B
BSP15	BSP15	SOT223
BSP16	BSP16	SOT223
BSP19	BSP19	SOT223
BSP20	BSP20	SOT223
BSP30	BSP30	SOT223
BSP31	BSP31	SOT223
BSP32	BSP32	SOT223
BSP33	BSP33	SOT223
BSP40	BSP40	SOT223
BSP41	BSP41	SOT223
BSP42	BSP42	SOT223
BSP43	BSP43	SOT223
BSP50	BSP50	SOT223
BSP51	BSP51	SOT223
BSP52	BSP52	SOT223
BSP60	BSP60	SOT223
BSP61	BSP61	SOT223
BSP62	BSP62	SOT223
BSR13	U7p	SOT23
BSR14	U8p	SOT23
BSR15	T7p	SOT23
BSR16	T8p	SOT23
BSR17A	U92	SOT23
BSR18A	T92	SOT23
BSR19	U35	SOT23
BSR19A	U36	SOT23
BSR20	T35	SOT23

TYPE NUMBER	MARKING CODE	PACKAGE
BSR20A	T36	SOT23
BSR30	BR1	SOT89
BSR31	BR2	SOT89
BSR32	BR3	SOT89
BSR33	BR4	SOT89
BSR40	AR1	SOT89
BSR41	AR2	SOT89
BSR42	AR3	SOT89
BSR43	AR4	SOT89
BSS63	BMp	SOT23
BSS64	AMp	SOT23
BST15	BT1	SOT89
BST16	BT2	SOT89
BST39	AT1	SOT89
BST40	AT2	SOT89
BST50	AS1	SOT89
BST51	AS2	SOT89
BST52	AS3	SOT89
BST60	BS1	SOT89
BST61	BS2	SOT89
BST62	BS3	SOT89
BSV52	B2p	SOT23
PDTA114EE	03	SC-75
PDTA114EK	03	SC-59
PDTA114ET	p03	SOT23
PDTA114EU	t03	SC-70
PDTA114TE	11	SC-75
PDTA114TK	23	SC-59
PDTA114TT	p11	SOT23
PDTA114TU	t23	SC-70
PDTA124EE	05	SC-75
PDTA124EK	05	SC-59
PDTA124ET	p05	SOT23
PDTA124EU	t05	SC-70
PDTA143EE	01	SC-75
PDTA143EK	01	SC-59
PDTA143ET	p01	SOT23
PDTA143EU	01t	SC-70
PDTA144EE	07	SC-75
PDTA144EK	07	SC-59

TYPE NUMBER	MARKING CODE	PACKAGE
PDTA144ET	p07	SOT23
PDTA144EU	t07	SC-70
PDTB114ET	p09	SOT23
PDTC114EE	09	SC-75
PDTC114EK	04	SC-59
PDTC114ET	p16	SOT23
PDTC114EU	t09	SC-70
PDTC114TE	24	SC-75
PDTC114TK	24	SC-59
PDTC114TT	p12	SOT23
PDTC114TU	t24	SC-70
PDTC124EE	06	SC-75
PDTC124EK	06	SC-59
PDTC124ET	p17	SOT23
PDTC124EU	t06	SC-70
PDTC143EE	02	SC-75
PDTC143EK	02	SC-59
PDTC143ET	p02	SOT23
PDTC143EU	t02	SC-70
PDTC144EE	08	SC-75
PDTC144EK	08	SC-59
PDTC144ET	p08	SOT23
PDTC144EU	t08	SC-70
PDTD114ET	p10	SOT23
PMBS3904	pO4	SOT23
PMBS3906	pO6	SOT23
PMBT2222	p1B	SOT23
PMBT2222A	p1P	SOT23
PMBT2369	p1J	SOT23
PMBT2907	p2B	SOT23
PMBT2907A	p2F	SOT23
PMBT3904	p1A	SOT23
PMBT3906	p2A	SOT23
PMBT4401	p2X	SOT23
PMBT4403	p2T	SOT23
PMBT5088	p1Q	SOT23
PMBT5401	p2L	SOT23
PMBT5550	p1F	SOT23
PMBT5551	pG1	SOT23
PMBT6428	p1K	SOT23

TYPE NUMBER	MARKING CODE	PACKAGE
PMBT6429	p1L	SOT23
PMBTA06	p1G	SOT23
PMBTA13	p1M	SOT23
PMBTA14	p1N	SOT23
PMBTA42	p1D	SOT23
PMBTA43	p1E	SOT23
PMBTA55	p2H	SOT23
PMBTA56	p2G	SOT23
PMBTA63	p2U	SOT23
PMBTA64	p2V	SOT23
PMBTA92	p2D	SOT23
PMBTA93	p2E	SOT23
PMSS3904	t04	SOT323
PMSS3906	t06	SOT323
PMST2222	t1B	SOT323
PMST2222A	t1P	SOT323
PMST2369	t1J	SOT323
PMST2907A	t2F	SOT323
PMST3904	t1A	SOT323
PMST3906	t2A	SOT323
PMST4401	t2X	SOT323
PMST4403	t2T	SOT323
PMST5088	t1Q	SOT323
PMST5089	t1R	SOT323
PMST5401	t2L	SOT323
PMST5550	t1F	SOT323
PMST5551	tG3	SOT323
PMST6428	t1K	SOT323
PMST6429	t1L	SOT323
PMSTA05	t1H	SOT323
PMSTA06	t1G	SOT323
PMSTA42	t1D	SOT323
PMSTA43	t1E	SOT323
PMSTA55	t2H	SOT323
PMSTA56	t2G	SOT323
PMSTA92	t2D	SOT323
PMSTA93	t2E	SOT323
PUMB4	Bt4	SC-88
PUMD2	Dt2	SC-88
PUMD3	Dt3	SC-88

TYPE NUMBER	MARKING CODE	PACKAGE
PUMH11	Ht1	SC-88
PUMT1	FtF	SC-88
PUMX1	ZtZ	SC-88
PUMZ1	FtZ	SC-88
PXT2222A	p1P	SOT89
PXT2907A	p2F	SOT89
PXT3904	p1A	SOT89
PXT3906	p2A	SOT89
PXT4401	p2X	SOT89
PXT4403	p2T	SOT89
PXTA14	p1N	SOT89
PXTA27	A27	SOT89
PXTA42	p1D	SOT89
PXTA43	p1E	SOT89
PXTA64	p2V	SOT89
PXTA92	p2D	SOT89
PXTA93	p2E	SOT89
PZT2222A	ZT2222A	SOT223
PZT2907A	ZT2907A	SOT223
PZT3904	ZT3904	SOT223
PZT3906	ZT3906	SOT223
PZTA06	PZTA06	SOT223
PZTA14	PZTA14	SOT223
PZTA42	ZTA42	SOT223
PZTA43	ZTA43	SOT223
PZTA44	PZTA44	SOT223
PZTA45	PZTA45	SOT223
PZTA56	PZTA56	SOT223
PZTA64	PZTA64	SOT223
PZTA92	PZTA92	SOT223

MARKING CODE TO TYPE NUMBER

MARKING CODE	TYPE NUMBER	PACKAGE
01	PDTA143EE	SC-75
01	PDTA143EK	SC-59
01t	PDTA143EU	SC-70
02	PDTC143EE	SC-75
02	PDTC143EK	SC-59
03	PDTA114EE	SC-75
03	PDTA114EK	SC-59
04	PDTC114EK	SC-59
05	PDTA124EE	SC-75
05	PDTA124EK	SC-59
06	PDTC124EE	SC-75
06	PDTC124EK	SC-59
07	PDTA144EE	SC-75
07	PDTA144EK	SC-59
08	PDTC144EE	SC-75
08	PDTC144EK	SC-59
09	PDTC114EE	SC-75
11	PDTA114TE	SC-75
13t	BC847BPN	SC-88
1A	BC846AT	SC-75
1Ap	BC846A	SOT23
1At	BC846AW	SOT323
1B	BC846BT	SC-75
1Bp	BC846B	SOT23
1Bt	BC846BW	SOT323
1Dp	BC846	SOT23
1Dt	BC846W	SOT323
1E	BC847AT	SC-75
1Ep	BC847A	SOT23
1Et	BC847AW	SOT323
1F	BC847BT	SC-75
1Fp	BC847B	SOT23
1Ft	BC847BS	SC-88
1Ft	BC847BW	SOT323
1G	BC847CT	SC-75
1Gp	BC847C	SOT23
1Gt	BC847CW	SOT323
1Hp	BC847	SOT23
1Ht	BC847W	SOT323

MARKING CODE	TYPE NUMBER	PACKAGE
1J	BC848AT	SC-75
1Jp	BC848A	SOT23
1Jp	BCV61A	SOT143B
1Jt	BC848AW	SOT323
1K	BC848BT	SC-75
1Kp	BC848B	SOT23
1Kp	BCV61B	SOT143B
1Kt	BC848BW	SOT323
1L	BC848CT	SC-75
1Lp	BC848C	SOT23
1Lp	BCV61C	SOT143B
1Lt	BC848CW	SOT323
1Mp	BC848	SOT23
1Mp	BCV61	SOT143B
1Mt	BC848W	SOT323
1Vp	BF820	SOT23
1Vt	BF820W	SOT323
1Wp	BF821	SOT23
1Wt	BF822W	SOT323
1Xp	BF822	SOT23
1Yp	BF823	SOT23
23	PDTA114TK	SC-59
24	PDTC114TE	SC-75
24	PDTC114TK	SC-59
2Bp	BC849B	SOT23
2Bt	BC849BW	SOT323
2Cp	BC849C	SOT23
2Ct	BC849CW	SOT323
2Dp	BC849	SOT23
2Dt	BC849W	SOT323
2Fp	BC850B	SOT23
2Ft	BC850BW	SOT323
2Gp	BC850C	SOT23
2Gt	BC850CW	SOT323
2Hp	BC850	SOT23
2Ht	BC850W	SOT323
3A	BC856AT	SC-75
3Ap	BC856A	SOT23
3At	BC856AW	SOT323

MARKING CODE	TYPE NUMBER	PACKAGE
3B	BC856BT	SC-75
3Bp	BC856B	SOT23
3Bt	BC856BW	SOT323
3Dp	BC856	SOT23
3Dt	BC856W	SOT323
3E	BC857AT	SC-75
3Ep	BC857A	SOT23
3Et	BC857AW	SOT323
3F	BC857BT	SC-75
3Fp	BC857B	SOT23
3Ft	BC857BS	SC-88
3Ft	BC857BW	SOT323
3G	BC857CT	SC-75
3Gp	BC857C	SOT23
3Gt	BC857CW	SOT323
3Hp	BC857	SOT23
3Ht	BC857W	SOT323
3J	BC858AT	SC-75
3Jp	BC858A	SOT23
3Jp	BCV62A	SOT143B
3Jt	BC858AW	SOT323
3K	BC858BT	SC-75
3Kp	BC858B	SOT23
3Kp	BCV62B	SOT143B
3Kt	BC858BW	SOT323
3L	BC858CT	SC-75
3Lp	BC858C	SOT23
3Lp	BCV62C	SOT143B
3Lt	BC858CW	SOT323
3Mp	BC858	SOT23
3Mp	BCV62	SOT143B
3Mt	BC858W	SOT323
4Ap	BC859A	SOT23
4At	BC859AW	SOT323
4Bp	BC859B	SOT23
4Bt	BC859BW	SOT323
4Cp	BC859C	SOT23
4Ct	BC859CW	SOT323
4Dp	BC859	SOT23
4Dt	BC859W	SOT323

MARKING CODE	TYPE NUMBER	PACKAGE
4Ep	BC860A	SOT23
4Et	BC860AW	SOT323
4Fp	BC860B	SOT23
4Ft	BC860BW	SOT323
4Gp	BC860C	SOT23
4Gt	BC860CW	SOT323
4Hp	BC860	SOT23
4Ht	BC860W	SOT323
5Ap	BC807-16	SOT23
5At	BC807-16W	SOT323
5Bp	BC807-25	SOT23
5Bt	BC807-25W	SOT323
5Cp	BC807-40	SOT23
5Ct	BC807-40W	SOT323
5Dp	BC807	SOT23
5Dt	BC807W	SOT323
5Ep	BC808-16	SOT23
5Et	BC808-16W	SOT323
5Fp	BC808-25	SOT23
5Ft	BC808-25W	SOT323
5Gp	BC808-40	SOT23
5Gt	BC808-40W	SOT323
5Hp	BC808	SOT23
5Ht	BC808W	SOT323
6Ap	BC817-16	SOT23
6At	BC817-16W	SOT323
6Bp	BC817-25	SOT23
6Bt	BC817-25W	SOT323
6Cp	BC817-40	SOT23
6Ct	BC817-40W	SOT323
6Dp	BC817	SOT23
6Dt	BC817W	SOT323
6Ep	BC818-16	SOT23
6Et	BC818-16W	SOT323
6Fp	BC818-25	SOT23
6Ft	BC818-25W	SOT323
6Gp	BC818-40	SOT23
6Gt	BC818-40W	SOT323
6Hp	BC818	SOT23
6Ht	BC818W	SOT323

MARKING CODE	TYPE NUMBER	PACKAGE
97p	BCV65	SOT143B
98p	BCV65B	SOT143B
A27	PXTA27	SOT89
A51	BRY62	SOT143B
A5p	BRY61	SOT23
AA	BCX51	SOT89
AAp	BCW60A	SOT23
ABp	BCW60B	SOT23
AC	BCX51-10	SOT89
ACp	BCW60C	SOT23
AD	BCX51-16	SOT89
ADp	BCW60D	SOT23
AE	BCX52	SOT89
AG	BCX52-10	SOT89
AGp	BCX70G	SOT23
AH	BCX53	SOT89
AHp	BCX70H	SOT23
AJp	BCX70J	SOT23
AK	BCX53-10	SOT89
AKp	BCX70K	SOT23
AL	BCX53-16	SOT89
AM	BCX52-16	SOT89
AMp	BSS64	SOT23
AR1	BSR40	SOT89
AR2	BSR41	SOT89
AR3	BSR42	SOT89
AR4	BSR43	SOT89
AS1	BST50	SOT89
AS2	BST51	SOT89
AS3	BST52	SOT89
AT1	BST39	SOT89
AT2	BST40	SOT89
AtQ	2PD1820AQ	SC-70
AtR	2PD1820AR	SC-70
AtS	2PD1820AS	SC-70
B26	BF570	SOT23
B2p	BSV52	SOT23
BA	BCX54	SOT89
BAp	BCW61A	SOT23
BBp	BCW61B	SOT23

MARKING CODE	TYPE NUMBER	PACKAGE
BC	BCX54-10	SOT89
BCP51	BCP51	SOT223
BCP51/10	BCP51-10	SOT223
BCP51/16	BCP51-16	SOT223
BCP52	BCP52	SOT223
BCP52/10	BCP52-10	SOT223
BCP52/16	BCP52-16	SOT223
BCP53	BCP53	SOT223
BCP53/10	BCP53-10	SOT223
BCP53/16	BCP53-16	SOT223
BCP54	BCP54	SOT223
BCP54/10	BCP54-10	SOT223
BCP54/16	BCP54-16	SOT223
BCP55	BCP55	SOT223
BCP55/10	BCP55-10	SOT223
BCP55/16	BCP55-16	SOT223
BCP56	BCP56	SOT223
BCP56/10	BCP56-10	SOT223
BCP56/16	BCP56-16	SOT223
BCP68	BCP68	SOT223
BCP68/10	BCP68-10	SOT223
BCP68/16	BCP68-16	SOT223
BCP68/25	BCP68-25	SOT223
BCP69	BCP69	SOT223
BCP/10	BCP69-10	SOT223
BCP/16	BCP69-16	SOT223
BCP/25	BCP69-25	SOT223
BCp	BCW61C	SOT23
BD	BCX54-16	SOT89
BDL31	BDL31	SOT223
BDL32	BDL32	SOT223
BDP31	BDP31	SOT223
BDP32	BDP32	SOT223
BDp	BCW61D	SOT23
BE	BCX55	SOT89
BF720	BF720	SOT223
BF721	BF721	SOT223
BF722	BF722	SOT223
BF723	BF723	SOT223
BG	BCX55-10	SOT89

MARKING CODE	TYPE NUMBER	PACKAGE
BGp	BCX71G	SOT23
BH	BCX56	SOT89
BHp	BCX71H	SOT23
BJp	BCX71J	SOT23
BK	BCX56-10	SOT89
BKp	BCX71K	SOT23
BL	BCX56-16	SOT89
BM	BCX55-16	SOT89
BMp	BSS63	SOT23
BQ	2PB709AQ	SC-59
BR	2PB709AR	SC-59
BR1	BSR30	SOT89
BR2	BSR31	SOT89
BR3	BSR32	SOT89
BR4	BSR33	SOT89
BS	2PB709AS	SC-59
BS1	BST60	SOT89
BS2	BST61	SOT89
BS3	BST62	SOT89
BSP15	BSP15	SOT223
BSP16	BSP16	SOT223
BSP19	BSP19	SOT223
BSP20	BSP20	SOT223
BSP30	BSP30	SOT223
BSP31	BSP31	SOT223
BSP32	BSP32	SOT223
BSP33	BSP33	SOT223
BSP40	BSP40	SOT223
BSP41	BSP41	SOT223
BSP42	BSP42	SOT223
BSP43	BSP43	SOT223
BSP50	BSP50	SOT223
BSP51	BSP51	SOT223
BSP52	BSP52	SOT223
BSP60	BSP60	SOT223
BSP61	BSP61	SOT223
BSP62	BSP62	SOT223
BT1	BST15	SOT89
BT2	BST16	SOT89
Bt4	PUMB4	SC-88

MARKING CODE	TYPE NUMBER	PACKAGE
C1p	BCW29	SOT23
C2p	BCW30	SOT23
C7p	BCF29	SOT23
C8p	BCF30	SOT23
C96	BCV64B	SOT143B
CAC	BC868	SOT89
CBC	BC868-10	SOT89
CCC	BC868-16	SOT89
CDC	BC868-25	SOT89
CEC	BC869	SOT89
CGC	BC869-16	SOT89
CHC	BC869-25	SOT89
D1p	BCW31	SOT23
D2p	BCW32	SOT23
D3p	BCW33	SOT23
D7p	BCF32	SOT23
D8p	BCF33	SOT23
D95	BCV63	SOT143B
D96	BCV63B	SOT143B
DA	BF622	SOT89
DB	BF623	SOT89
DC	BF620	SOT89
DF	BF621	SOT89
DQ	2PB710AQ	SC-59
DR	2PB710AR	SC-59
DS	2PB710AS	SC-59
Dt2	PUMD2	SC-88
Dt3	PUMD3	SC-88
DtQ	2PB1219AQ	SC-70
DtR	2PB1219AR	SC-70
DtS	2PB1219AS	SC-70
ED	BCV28	SOT89
EE	BCV48	SOT89
EF	BCV29	SOT89
EG	BCV49	SOT89
F2p	BFS19	SOT23
F8p	BF824	SOT23
F8t	BF824W	SOT323
FDp	BCV26	SOT23
FEp	BCV46	SOT23

MARKING CODE	TYPE NUMBER	PACKAGE
FFp	BCV27	SOT23
FGp	BCV47	SOT23
FtF	PUMT1	SC-88
FtQ	2PA1576Q	SC-70
FtR	2PA1576R	SC-70
FtS	2PA1576S	SC-70
FtZ	PUMZ1	SC-88
G1p	BFS20	SOT23
H1p	BCW69	SOT23
H2p	BCW70	SOT23
H3p	BCW89	SOT23
Ht1	PUMH11	SC-88
K1p	BCW71	SOT23
K2p	BCW72	SOT23
K3p	BCW81	SOT23
K7p	BCV71	SOT23
K8p	BCV72	SOT23
K9p	BCF81	SOT23
LAp	BF550	SOT23
NCp	BF840	SOT23
NDp	BF841	SOT23
PZTA06	PZTA06	SOT223
PZTA14	PZTA14	SOT223
PZTA44	PZTA44	SOT223
PZTA45	PZTA45	SOT223
PZTA56	PZTA56	SOT223
PZTA64	PZTA64	SOT223
PZTA92	PZTA92	SOT223
T1p	BCX17	SOT23
T2p	BCX18	SOT23
T35	BSR20	SOT23
T36	BSR20A	SOT23
T7p	BSR15	SOT23
T8p	BSR16	SOT23
T92	BSR18A	SOT23
U1p	BCX19	SOT23
U2p	BCX20	SOT23
U35	BSR19	SOT23
U36	BSR19A	SOT23
U7p	BSR13	SOT23

MARKING CODE	TYPE NUMBER	PACKAGE
U8p	BSR14	SOT23
U92	BSR17A	SOT23
XQ	2PD602AQ	SC-59
XR	2PD602AR	SC-59
XS	2PD602AS	SC-59
YQ	2PA1774Q	SC-75
YR	2PA1774R	SC-75
YS	2PA1774S	SC-75
ZQ	2PC4617Q	SC-75
ZQ	2PD601AQ	SC-59
ZR	2PC4617R	SC-75
ZR	2PD601AR	SC-59
ZS	2PC4617S	SC-75
ZS	2PD601AS	SC-59
ZT2222A	PZT2222A	SOT223
ZT2907A	PZT2907A	SOT223
ZT3904	PZT3904	SOT223
ZT3906	PZT3906	SOT223
ZTA42	PZTA42	SOT223
ZTA43	PZTA43	SOT223
ZtQ	2PC4081Q	SC-70
ZtR	2PC4081R	SC-70
ZtS	2PC4081S	SC-70
ZtZ	PUMX1	SC-88
p01	PDTA143ET	SOT23
p02	PDTC143ET	SOT23
p03	PDTA114ET	SOT23
p05	PDTA124ET	SOT23
p07	PDTA144ET	SOT23
p08	PDTC144ET	SOT23
p09	PDTB114ET	SOT23
p10	PDTD114ET	SOT23
p11	PDTA114TT	SOT23
p12	PDTC114TT	SOT23
p16	PDTC114ET	SOT23
p17	PDTC124ET	SOT23
p1A	PMBT3904	SOT23
p1A	PXT3904	SOT89
p1B	PMBT2222	SOT23
p1D	PMBTA42	SOT23

MARKING CODE	TYPE NUMBER	PACKAGE
p1D	PXTA42	SOT89
p1E	PMBTA43	SOT23
p1E	PXTA43	SOT89
p1F	PMBT5550	SOT23
p1G	PMBTA06	SOT23
p1J	PMBT2369	SOT23
p1K	PMBT6428	SOT23
p1L	PMBT6429	SOT23
p1M	PMBTA13	SOT23
p1N	PMBTA14	SOT23
p1N	PXTA14	SOT89
p1P	PMBT2222A	SOT23
p1P	PXT2222A	SOT89
p1Q	PMBT5088	SOT23
p2A	PMBT3906	SOT23
p2A	PXT3906	SOT89
p2B	PMBT2907	SOT23
p2D	PMBTA92	SOT23
p2D	PXTA92	SOT89
p2E	PMBTA93	SOT23
p2E	PXTA93	SOT89
p2F	PMBT2907A	SOT23
p2F	PXT2907A	SOT89
p2G	PMBTA56	SOT23
p2H	PMBTA55	SOT23
p2L	PMBT5401	SOT23
p2T	PMBT4403	SOT23
p2T	PXT4403	SOT89
p2U	PMBTA63	SOT23
p2V	PMBTA64	SOT23
p2V	PXTA64	SOT89
p2X	PMBT4401	SOT23
p2X	PXT4401	SOT89
pG1	PMBT5551	SOT23
pO4	PMBS3904	SOT23
pO6	PMBS3906	SOT23
t02	PDTC143EU	SC-70
t03	PDTA114EU	SC-70
t04	PMSS3904	SC-70
t05	PDTA124EU	SC-70

MARKING CODE	TYPE NUMBER	PACKAGE
t06	PDTC124EU	SC-70
t06	PMSS3906	SC-70
t07	PDTA144EU	SC-70
t08	PDTC144EU	SC-70
t09	PDTC114EU	SC-70
t1A	PMST3904	SOT323
t1B	PMST2222	SOT323
t1D	PMSTA42	SOT323
t1E	PMSTA43	SOT323
t1F	PMST5550	SOT323
t1G	PMSTA06	SOT323
t1H	PMSTA05	SOT323
t1J	PMST2369	SOT323
t1K	PMST6428	SOT323
t1L	PMST6429	SOT323
t1P	PMST2222A	SOT323
t1Q	PMST5088	SOT323
t1R	PMST5089	SOT323
t23	PDTA114TU	SC-70
t24	PDTC114TU	SC-70
t2A	PMST3906	SOT323
t2D	PMSTA92	SOT323
t2E	PMSTA93	SOT323
t2F	PMST2907A	SOT323
t2G	PMSTA56	SOT323
t2H	PMSTA55	SOT323
t2L	PMST5401	SOT323
t2T	PMST4403	SOT323
t2X	PMST4401	SOT323
tG3	PMST5551	SOT323

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 which is described in our Quality manuals. The basis is outlined in the following paragraphs.

QUALITY ASSURANCE

Based on ISO 9000 standards, customer standards such as FDC, QS 9000 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 process parameters are detected and measures taken to ensure good performance on these parameters. The capability of process steps is also planned in this phase in preparation for production under statistical process control.

Product conformance

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

- Incoming material control through partnerships with suppliers.
- In-line quality assurance to monitor process reproducibility during manufacture and initiate any necessary corrective action. Process steps are 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 SNW-EQ-611 part A.
- Periodic inspections to monitor and measure the conformance of products (see SNW-EQ-611 part A).
- Qualification tests (see SNW-EQ-611 part A).

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 product's reliability evaluation. Rejects from reliability tests and from customer complaints are submitted to failure analysis, to result in corrective action.

Customer response

Our quality improvement depends on working together 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.

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, 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)

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.

(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.

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.

Letter symbols for currents, voltages and powers

BASIC LETTERS

I, i	current
V, v	voltage
P, p	power.

Upper-case letter symbols are used to represent all values except instantaneous values that vary with time, these are represented by lower-case letters.

SUBSCRIPTS

A, a	anode terminal
(AV), (av)	average value
B, b	base terminal
C, c	collector terminal
D, d	drain terminal
E, e	emitter terminal
F, f	forward
G, g	gate terminal
K, k	cathode terminal
M, m	peak value
O, o	as third subscript: the terminal not mentioned is open-circuit
R, r	as first subscript: reverse. As second subscript: repetitive. 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 or second subscript: source terminal (FETs only). As second subscript: non-repetitive (not FETs). As third subscript: short circuit between the terminal not mentioned and the reference terminal

X, x specified circuit

Z, z replaces R to indicate the actual working voltage, current or power of voltage reference and voltage reference diodes.

No additional subscript is used for DC values.

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. $I_{b(av)}$.

If more than one subscript is used, the subscript for which both styles exist are either all upper-case or all lower-case.

ADDITIONAL RULES FOR SUBSCRIPTS

Transistor currents

If it is necessary to indicate the terminal carrying the current, this should be done by the first subscript (conventional current flow from the external circuit into the terminal is positive).

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

Transistor voltages

If it is necessary to indicate the points between which a voltage is measured, this should be done by the first two subscripts. The first subscript indicates the terminal at which the voltage is measured and the second the reference terminal or the circuit node. Where there is no possibility of confusion, the second subscript may be omitted.

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_{CC}, I_{EE}.

If it is necessary to indicate a reference terminal, this should be done by a third subscript.

Example: V_{CCE}.

Subscripts for 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. In the case of multiple subscripts, hyphens may be necessary to avoid confusion.

Examples:

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

V_{B2-E} continuous (DC) voltage between the terminals of second base and emitter terminals.

Subscripts for multiple devices

For multiple unit devices, the subscripts are modified by a number preceding the letter subscript. In the case of multiple subscripts, hyphens may be necessary to avoid confusion.

Examples:

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

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

Application of the rules

Figure 1 represents a transistor collector current as a function of time. It comprises a continuous (DC) current and a varying component.

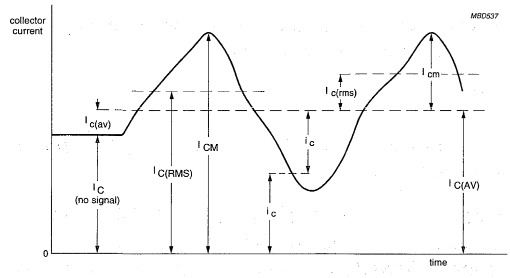


Fig.1 Collector current as a function of time.

Letter symbols for electrical parameters

DEFINITION

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

BASIC LETTERS

The following list comprises the most important basic letters used for electrical parameters of semiconductor devices.

B, b	susceptance (imaginary part of an admittance)
C	capacitance
G, g	conductance (real part of an admittance)
H, h	hybrid parameter
L	inductance
R, r	resistance (real part of an impedance)
X, x	reactance (imaginary part of an impedance)
Y, y	admittance
Z, z	impedance.

Upper-case letters are used for the representation of:

- Electrical parameters of external circuits and of circuits in which the device forms only a part
- All inductances and capacitances.

Lower-case letters are used for the representation of electrical parameters inherent in the device, with the exception of inductances and capacitances.

SUBSCRIPTS

General subscripts

The following list comprises the most important general subscripts used for electrical parameters of semiconductor devices.

F, f	forward (forward transfer)
I, i (or 1)	input
L, l	load
O, o (or 2)	output
R, r	reverse (reverse transfer)
S, s	source.

Examples: Z_s, h_f, h_F.

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 ratio 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 ratio in common-emitter configuration
$Z_e = R_e + jX_e$	small-signal value of the external impedance.

If more than one subscript is used, subscripts for which both styles exist are either all upper-case or all lower-case.

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

Subscripts for 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 should be 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 if they are not suitable, the following notation 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

S-parameters S_{11} and S_{22} (return losses)

In accordance with IEC 747-7.

DEFINITION

The 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.2).

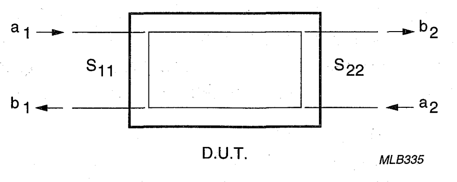


Fig.2 Two-port network with reflection coefficients S_{11} and S_{22}.

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

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

where:

$$a_1 = \frac{1}{2 \cdot \sqrt{Z_0}} \cdot (V_1 + Z_0 \cdot i_1) = \text{signal into port 1} \quad (3)$$

$$a_2 = \frac{1}{2 \cdot \sqrt{Z_0}} \cdot (V_2 + Z_0 \cdot i_2) = \text{signal into port 2} \quad (4)$$

$$b_1 = \frac{1}{2 \cdot \sqrt{Z_0}} \cdot (V_1 + Z_0 \cdot i_1) = \text{signal out of port 1}$$

$$b_2 = \frac{1}{2 \cdot \sqrt{Z_0}} \cdot (V_2 + Z_0 \cdot i_2) = \text{signal out of port 2}$$

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

$$S_{11} = \left.\frac{b_1}{a_1}\right| a_2 = 0 \quad (5)$$

$$S_{22} = \left.\frac{b_2}{a_2}\right| a_1 = 0 \quad (6)$$

In (5), $a_2 = 0$ means output port terminated with Z_0 (derived from formula (4)).

In (6), $a_1 = 0$ means input port terminated with Z_0 (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_0 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.

Spice parameter data

Spice parameters are included with this data handbook on floppy disks labelled "Philips simulation data selection program for LF small-signal transistors".

EQUIVALENT PACKAGE DESIGNATORS

Philips designator	Industry designator	Philips designator	Industry designator
Leaded metal can		**Surface-mount plastic**	
SOT5/11	TO-39	SOT23	SOT23
SOT18/9	TO-72	SOT89	SOT89
SOT18/13	TO-18	SOT143	SOT143
SOT31	TO-71	SOT223	SOT223
Leaded plastic		SOT323	SC-70
SOT32	TO-126	SOT346	SC-59
SOT54	TO-92	SOT363	SC-88
SOT128	TO-202	SOT416	SC-75

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.3). 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.4 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.

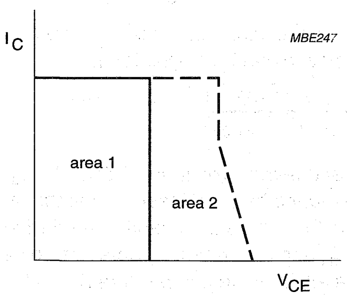


Fig.3 Graph of permissible operating areas.

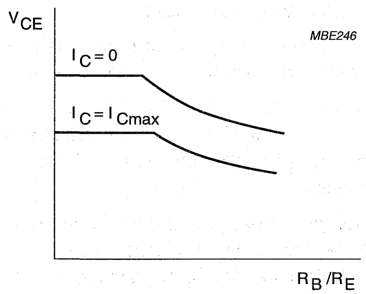


Fig.4 Graph showing effect of collector current on permissible operating areas.

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.5.

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.

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.

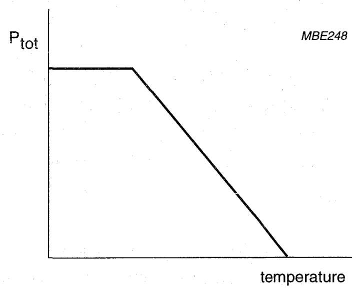


Fig.5 Permissible total power dissipation.

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 $R_{th\,j\text{-}a}$ 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 ($R_{th\,j\text{-}mb}$), 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.6

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

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

where $Z_{th\,t}$ and δ are given in Fig.6 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 package.

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

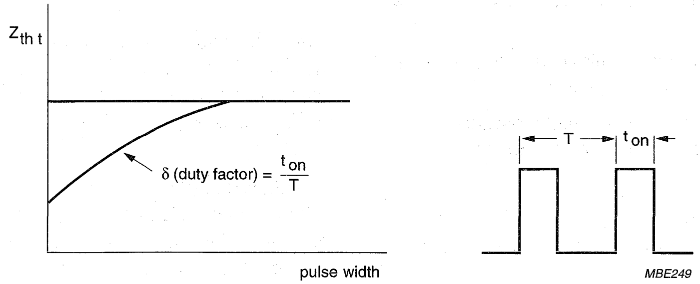


Fig.6 Pulse power operation.

THERMAL CONSIDERATIONS

Thermal resistance

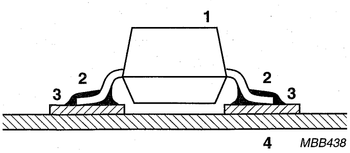
Circuit performance and long-term reliability are affected by the temperature of the transistor die. Normally, both are improved by keeping the die temperature (junction temperature) low.

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 printed board, a substrate or heatsink. Referring to Fig.7 (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.8 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.



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

Fig.7 Heat losses.

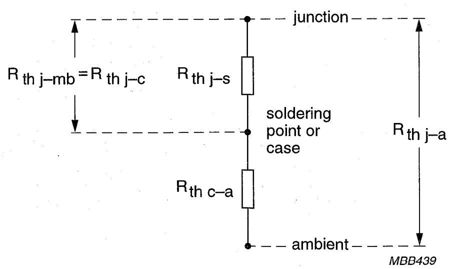


Fig.8 Representation of thermal resistance paths of a device mounted on a substrate or printed board.

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 $T_j = T_{solder} + P_{tot} \times R_{th\,j\text{-}s}$.

$R_{th\,s\text{-}a}$ for SMDs

The thermal resistance $R_{th\,s\text{-}a}$ for SMDs mounted on a ceramic substrate (Al_2O_3) is a function of the substrate area as shown in Fig.9.

The thermal resistance $R_{th\,s\text{-}a}$ for SMDs mounted on a printed circuit board (FR4) is a function of the board type (single-sided or double-sided), track area and plated or unplated tracks as shown in Fig.10.

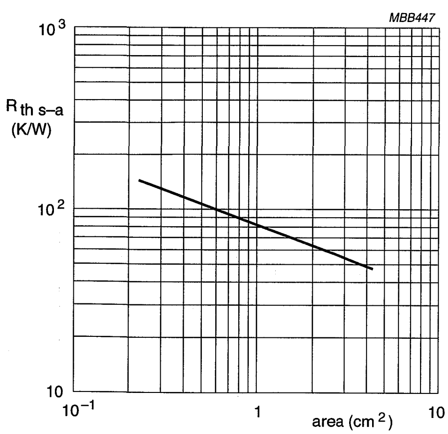
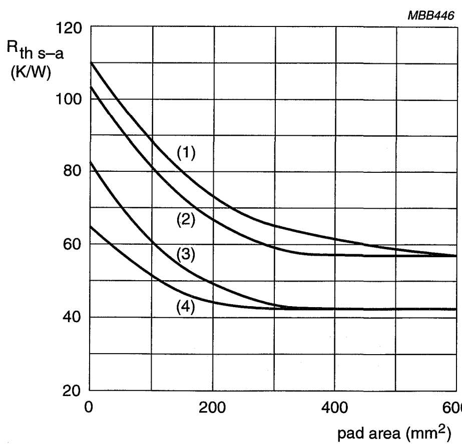


Fig.9 Thermal resistance ($R_{th\,s\text{-}a}$) as a function of area of ceramic substrate.



(1) Single-sided, unplated.
(2) Single-sided, plated.
(3) Double-sided, unplated.
(4) Double-sided, plated.

Fig.10 Thermal resistance ($R_{th\,s\text{-}a}$) as a function of copper area on different configurations of FR4 epoxy fibre-glass circuit board.

Temperature calculation under pulsed conditions

In pulsed power conditions, the peak temperature of the die depends on the pulse time and duty factor as well as the ability of the package and its mounting to disperse heat.

When power is applied in repetitive square-wave pulses with a certain duty factor (δ), the variation in junction temperature has a sawtooth characteristic.

The average steady-state junction temperature is:

$T_{j(av)} = T_{ref} + \delta \times P_d \times R_{th\ j\text{-}ref}$

The peak junction temperature, however, is the most relevant to performance reliability. This can be calculated by heating and cooling step functions that result in heating and cooling curves shifted in time as shown in Fig.11.

The peak value of T_j is reached at the end of a power pulse and the minimum value immediately before the next power pulse. The thermal ripple is the difference between $T_{j(peak)}$ and $T_{j(min)}$.

Calculation of $T_{j(peak)}$ after n pulses:

$$T_{j(peak)} = T_{ref} + P_d \times \sum_{a=0}^{a=n-1} [Z_{th(at+w)} - Z_{th(at)}]$$

where a is an integer number.

Approximation method of finding $T_{j(peak)}$

With this method it is assumed that the average load is immediately followed by two square power pulses as shown in Fig.12. This two-pulse approximation method is accurate enough for finding $T_{j(peak)}$.

The junction temperature at the end of the second pulse is:

$$T_{j(peak)} = T_{ref} + P_d \times [\delta \times R_{th(j\text{-}ref)} + (1 - \delta) \times Z_{th(t+w)} + Z_{th(w)} - Z_{th(t)}]$$

The junction temperature immediately before the second power pulse is:

$$T_{j(min)} = T_{ref} + P_d \times [\delta \times R_{th(j\text{-}ref)} + (1 - \delta) \times Z_{th(t)} - Z_{th(t-w)}]$$

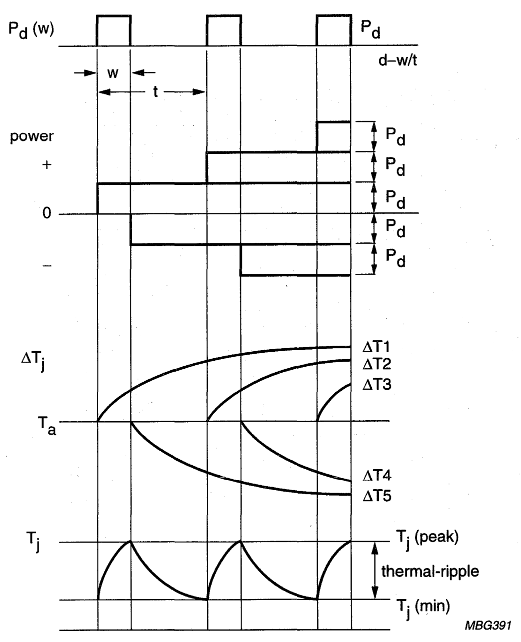


Fig.11 Heating effect of three identical power pulses after thermal stabilization.

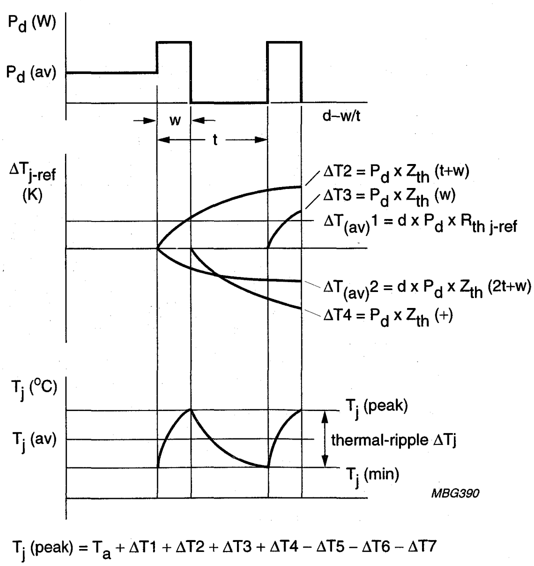


Fig.12 Two-pulse approximation method of finding peak steady-state junction temperature [$T_{j(peak)}$].

The thermal ripple is:

$\Delta T_j = T_{j(peak)} - T_{j(min)}$

$\Delta T_j = P_d \times [\delta \times (Z_{th(t)} - Z_{th(t+w)}) - 2 \times Z_{th(t)} + Z_{th(w)} + Z_{th(t-w)}]$

Reducing calculation time

To be able to point out the junction peak temperature at a certain pulse time and duty cycle, a graph similar to that shown in Fig.13 is included in relevant data sheets. In this example, the curves have been derived using the formula $T_{j(peak)} = T_{ref} + P_d \times [\delta \times R_{th(j\text{-}ref)} + (1 - \delta) \times Z_{th(t+w)} + Z_{th(w)} - Z_{th(t)}]$, with typical values inserted.

The pulse width along the X-axis meets a particular duty cycle curve, indicating the Z_{th} value in K/W along the Y-axis.

$T_{j(peak)} = P_{d(peak)} \times Z_{th(j\text{-}s)} + P_{d(av)} \times R_{th(s\text{-}a)} + T_a$ (°C)

Soldering point temperature provides a better reference point than ambient temperature as this is subject to many uncontrolled variables. Therefore, the thermal resistance from junction to soldering point [$R_{th(j\text{-}s)}$] is becoming a more relevant measurement path.

For transistors in small SMD packages which are usually mounted on FR4 epoxy fibre-glass printed circuit boards, only the thermal resistance from junction to ambient [$R_{th(j\text{-}a)}$] is published. In this case, the junction temperature can be calculated by:

$T_{j(peak)} = P_{d(peak)} \times Z_{th(j\text{-}a)} + T_a$ (°C)

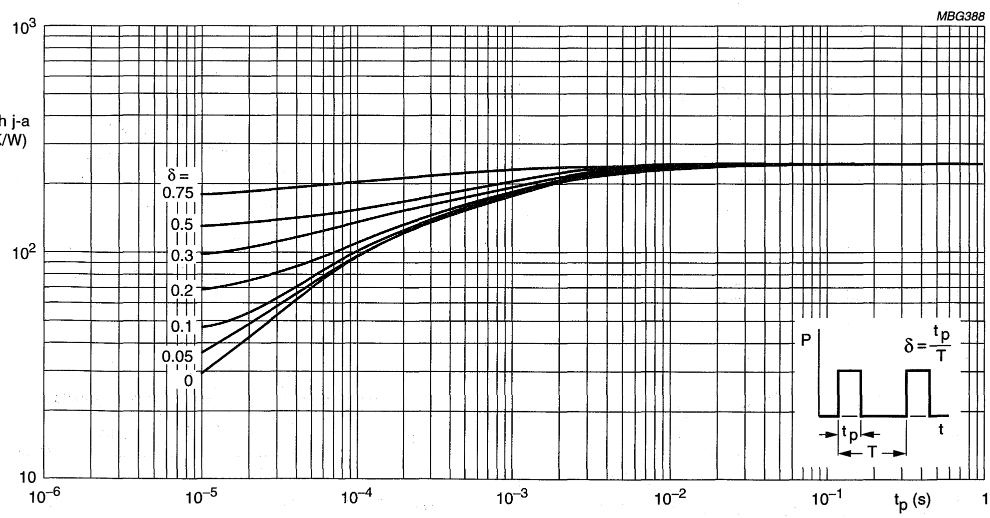


Fig.13 Direct reading of thermal impedance from junction to soldering point for calculation of junction temperature at pulsed power conditions.

POWER DERATING CURVES FOR SMDs

Figures 14 through 32 on the following pages show the power derating curves (P_{tot} versus T_{amb}) for transistors in SMD packages.

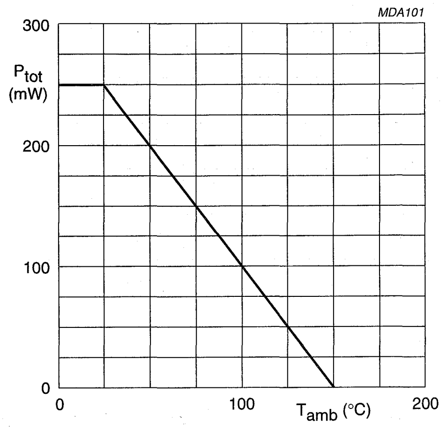


Fig.14 Power derating curve for SOT23.

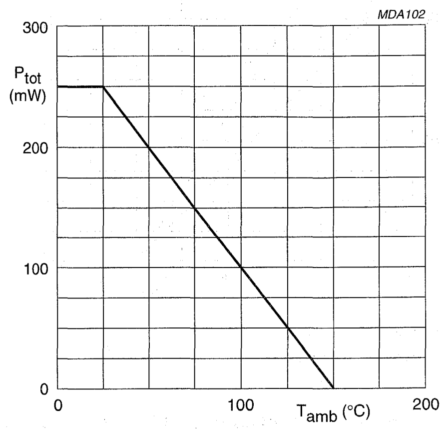


Fig.15 Power derating curve for SOT143.

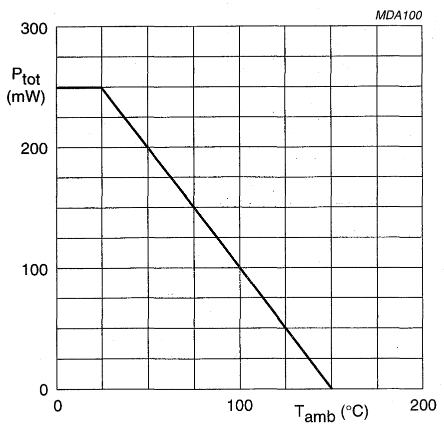


Fig.16 Power derating curve for SC-59 (SOT346).

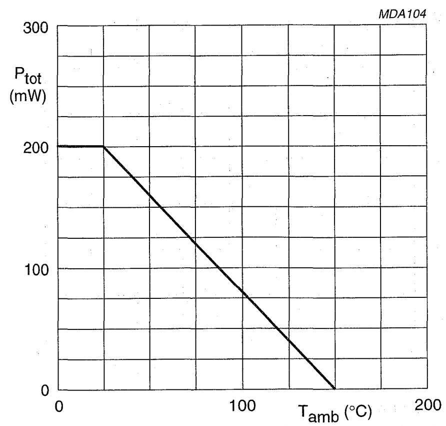
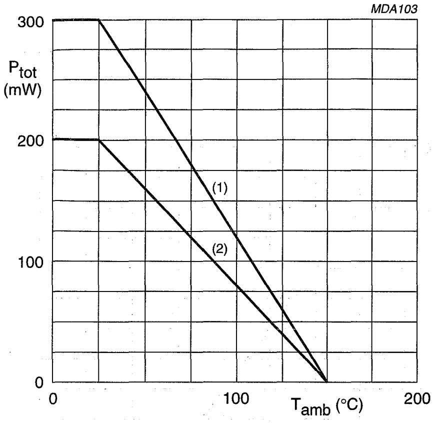


Fig.17 Power derating curve for SC-70 (SOT323).



(1) All transistors used.
(2) One transistor used.

Fig.18 Power derating curves for SC-88 (SOT363).

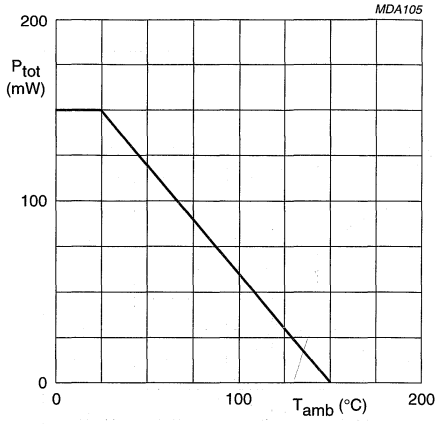
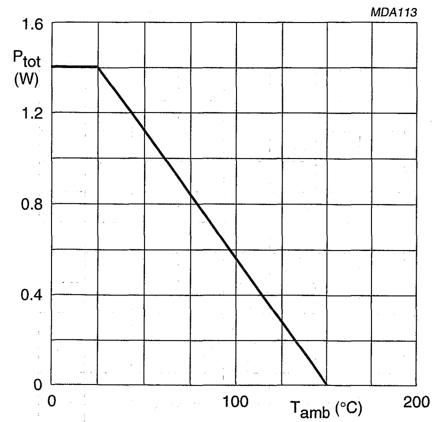
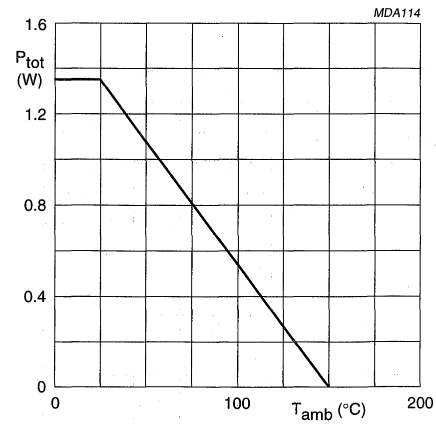


Fig.19 Power derating curve for SC-75 (SOT416).



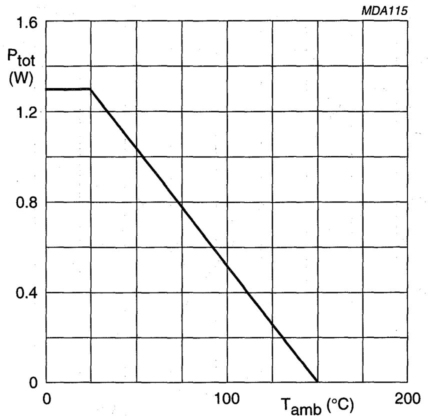
Device families:
BC868, BC869, BSR30, BSR40.

Fig.20 Power derating curve for SOT89.



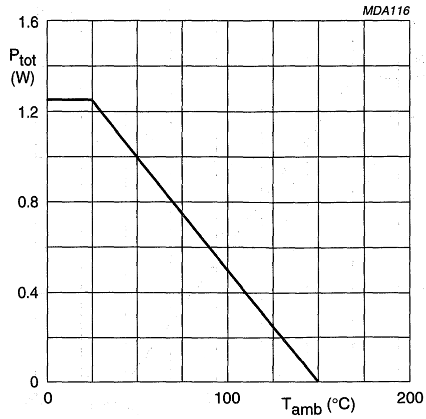
Device families:
BCX51, BCX54, BST15, BST50, BST60.

Fig.21 Power derating curve for SOT89.



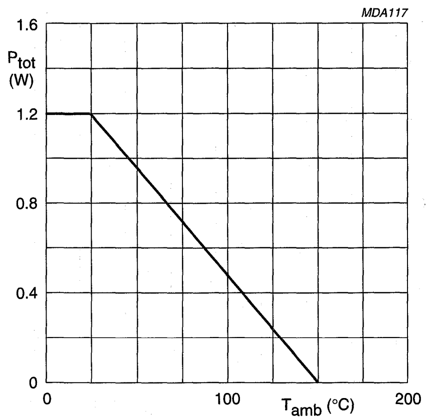
Device families:
BCV28/48, BCV29/49, PXTA14, PXTA27, PXTA64.

Fig.22 Power derating curve for SOT89.



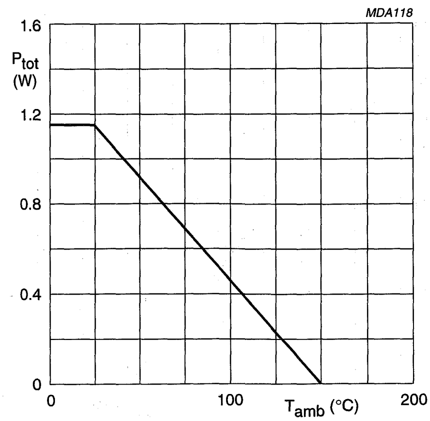
Device families:
BST39, PXTA42, PXTA92, PXT2907, PXT4403.

Fig.23 Power derating curve for SOT89.



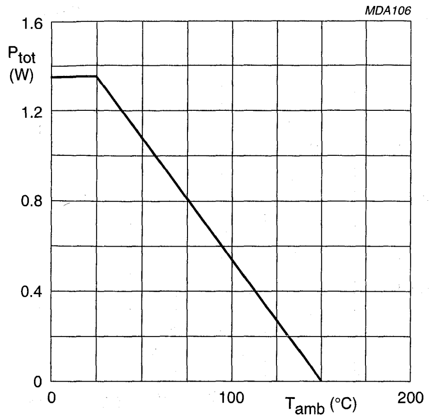
Device families:
BF620, BF621, PXT2222A, PXT4401.

Fig.24 Power derating curve for SOT89.



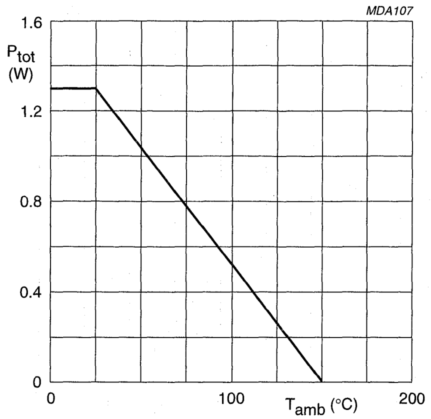
Device families:
PXT3904, PXT3906.

Fig.25 Power derating curve for SOT89.



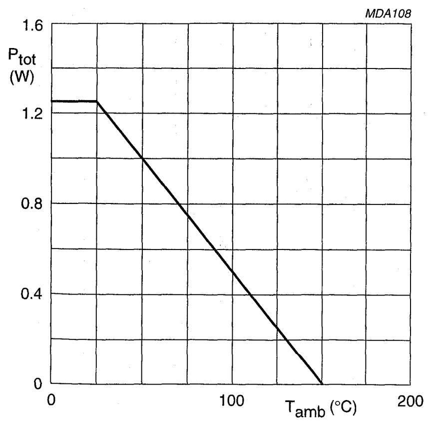
Device families:
BCP68, BCP69, BDL31, BDL32, BDP31, BDP32, PZTA44.

Fig.26 Power derating curve for SOT223.



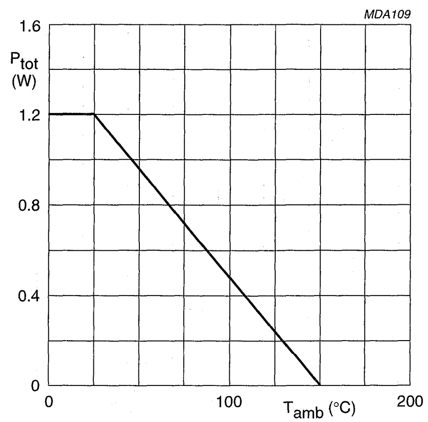
Device families:
BSP30, BSP40, BCP51, BCP54, BSP15.

Fig.27 Power derating curve for SOT223.



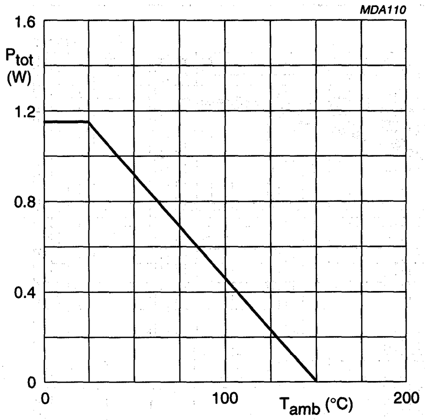
Device families:
BSP50, BSP60, BCP48, BCP49, PZTA13, PZTA63.

Fig.28 Power derating curve for SOT223.



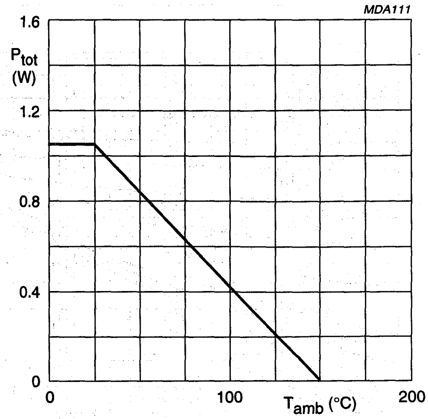
Device families:
PZTA05, PZTA55, BF720, BF721, BSP19, PZTA42, PZTA92.

Fig.29 Power derating curve for SOT223.



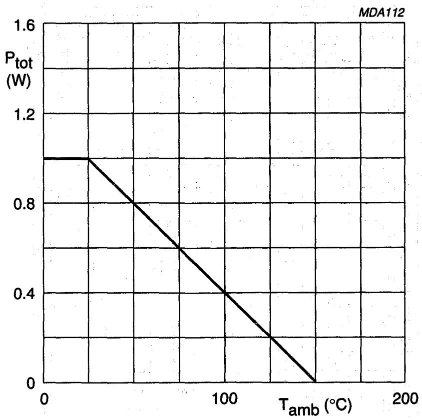
Device families:
PZTA2907A, PZT4403, PZT2222A, PZT4401, PZT5401, PZT5551.

Fig.30 Power derating curve for SOT223.



Device families:
PZT3904, PZT3906.

Fig.31 Power derating curve for SOT223.



Device family:
PZT2369A.

Fig.32 Power derating curve for SOT223.

THERMAL IMPEDANCE CURVES

Figures 33 through 54 on the following pages show the thermal impedance curves (Z_{th} versus t_p) for various duty cycles.

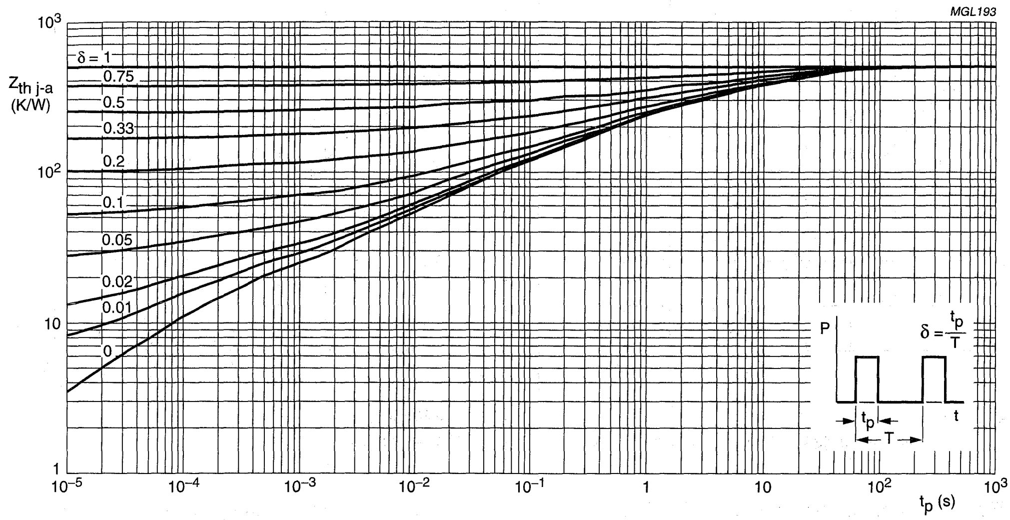


Fig.33 Thermal impedance curves (junction to ambient) for transistors mounted onto a PCB for SOT23.

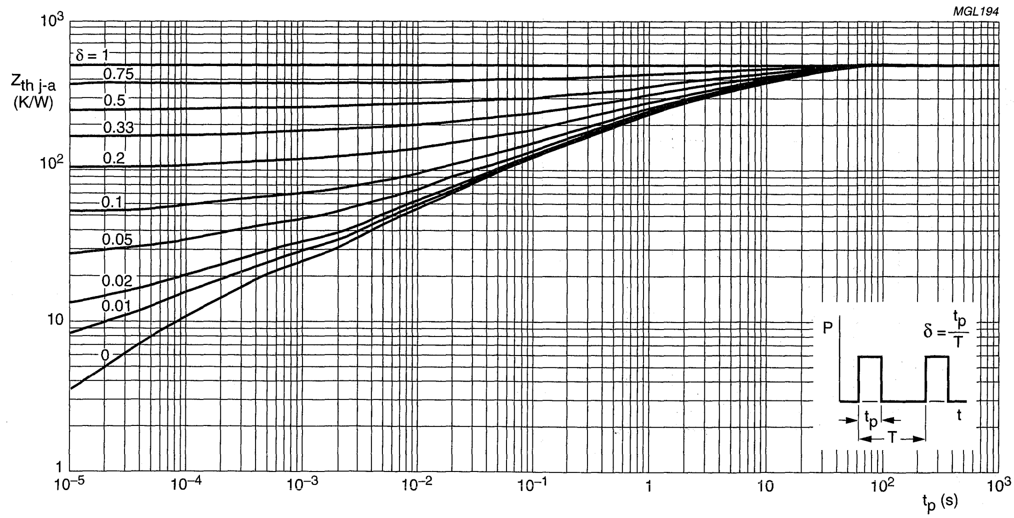


Fig.34 Thermal impedance curves (junction to ambient) for transistors mounted onto a PCB for SOT143.

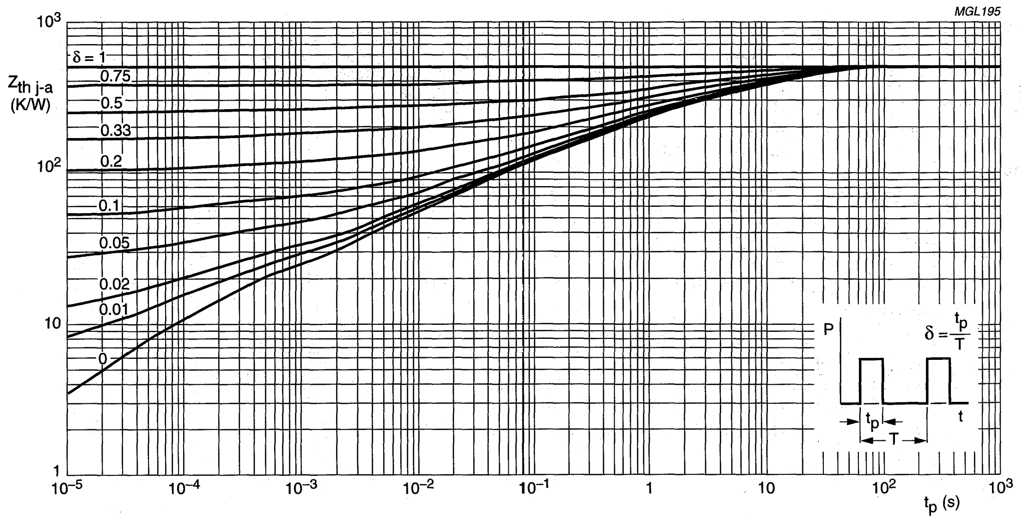


Fig.35 Thermal impedance curves (junction to ambient) for transistors mounted onto a PCB for SC-59 (SOT346).

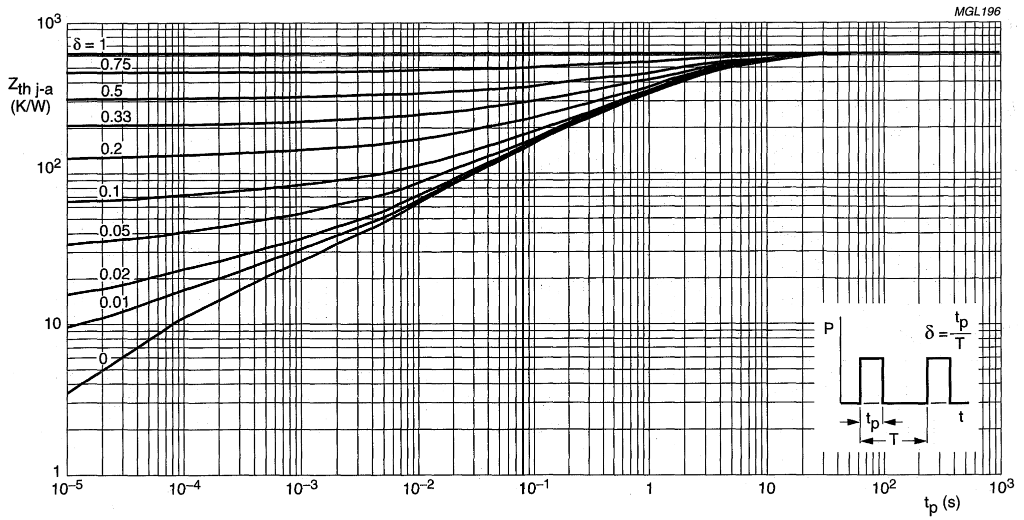


Fig.36 Thermal impedance curves (junction to ambient) for transistors mounted onto a PCB for SC-70 (SOT323).

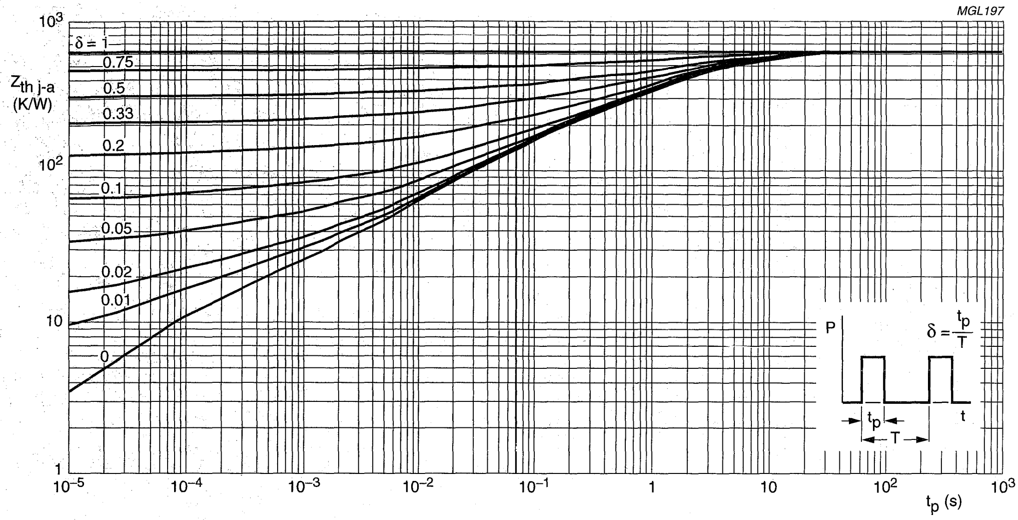


Fig.37 Thermal impedance curves (junction to ambient) for transistors mounted onto a PCB for SC-88 (SOT363).

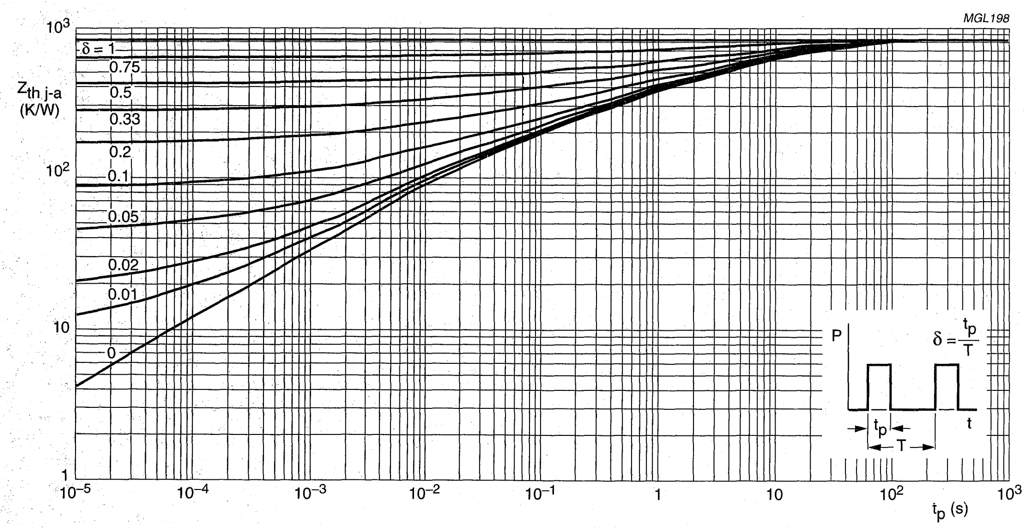
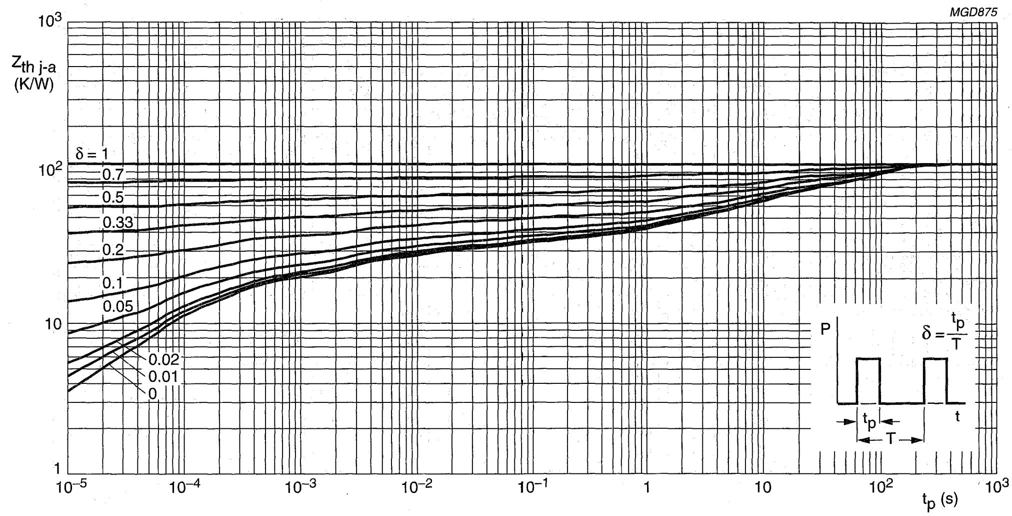
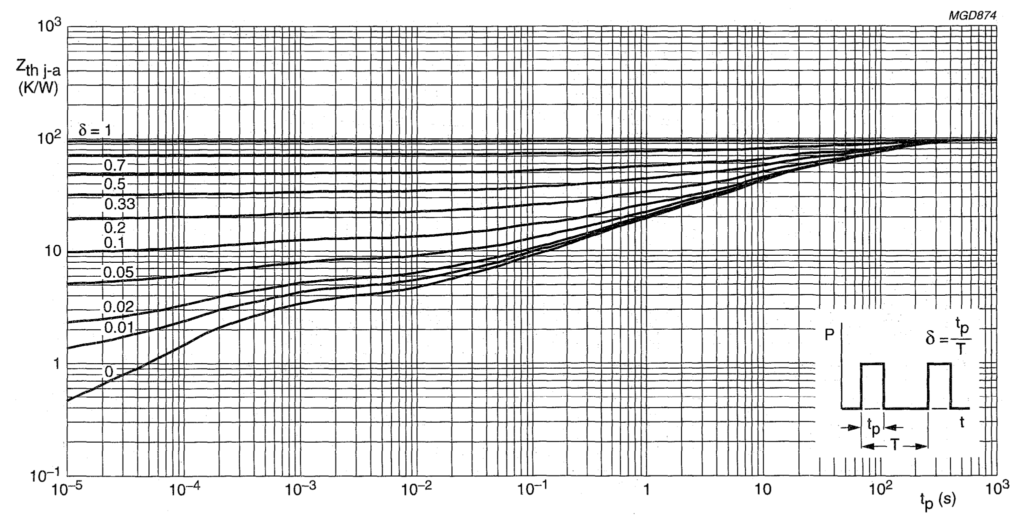


Fig.38 Thermal impedance curves (junction to ambient) for transistors mounted onto a PCB for SC-75 (SOT416).



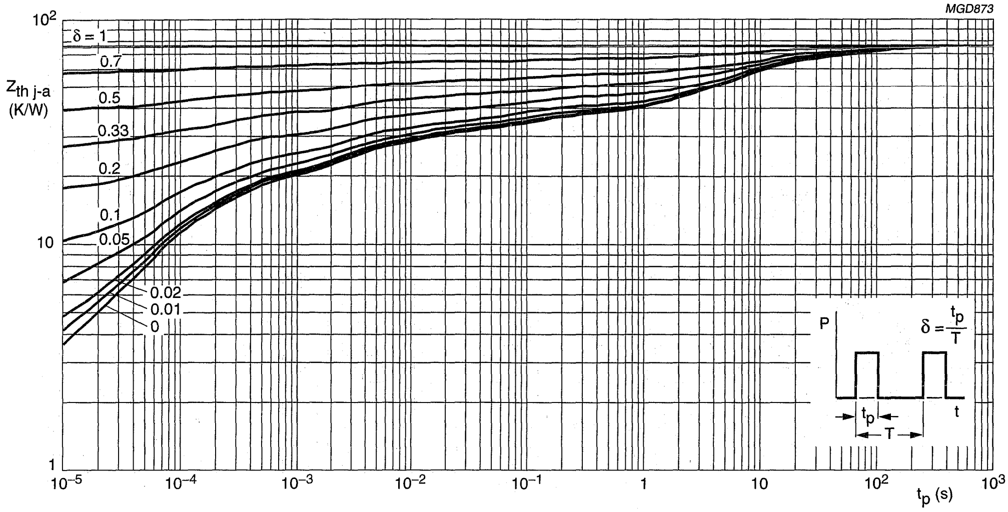
PCB, single-sided, unplated, Rth j-s = 25 K/W, Rth j-a = 113 K/W.
See also Fig.10 curve (1).

Fig.39 Thermal impedance curves (junction to ambient) for transistors mounted onto a PCB for SOT89.



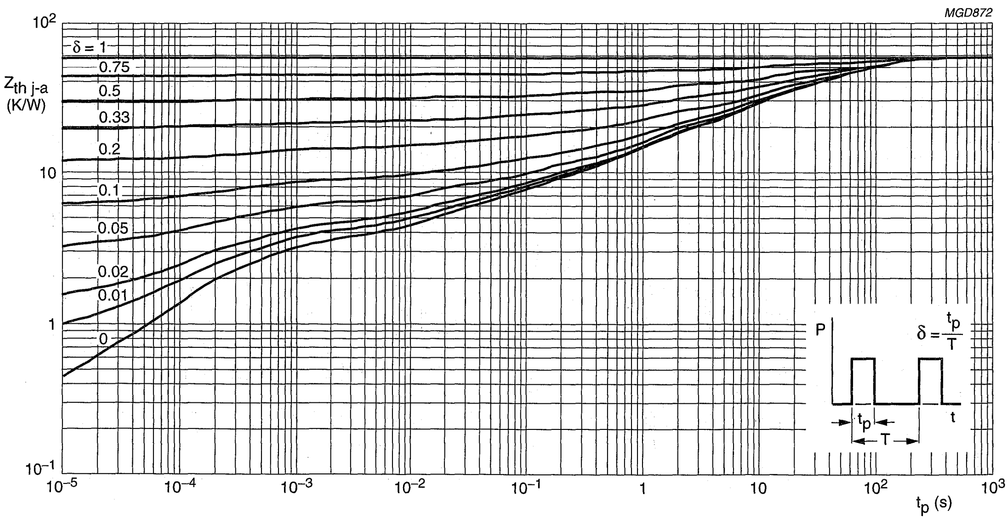
PCB, single-sided, plated, Rth j-s = 7 K/W, Rth j-a = 95 K/W.
See also Fig.10 curve (2).

Fig.40 Thermal impedance curves (junction to ambient) for transistors mounted onto a PCB for SOT89.



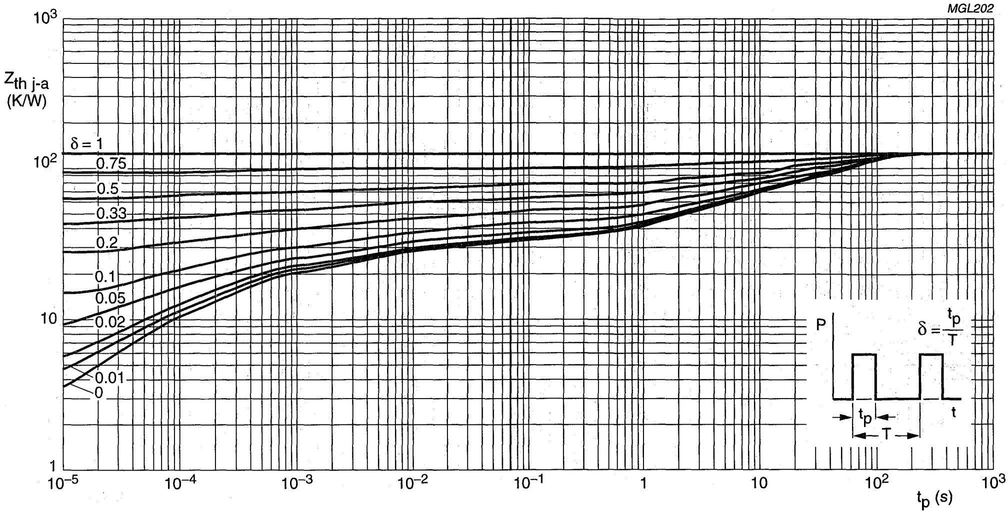
PCB, double-sided, unplated, Rth j-s = 25 K/W, Rth j-a = 76 K/W.
See also Fig.10 curve (3).

Fig.41 Thermal impedance curves (junction to ambient) for transistors mounted onto a PCB for SOT89.



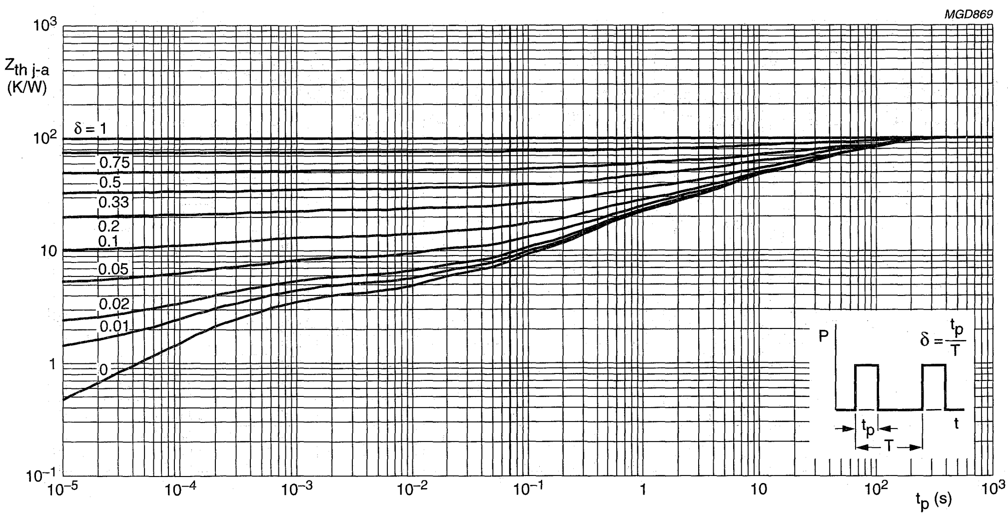
PCB, double-sided, plated, Rth j-s = 7 K/W, Rth j-a = 58 K/W.
See also Fig.10 curve (4).

Fig.42 Thermal impedance curves (junction to ambient) for transistors mounted onto a PCB for SOT89.



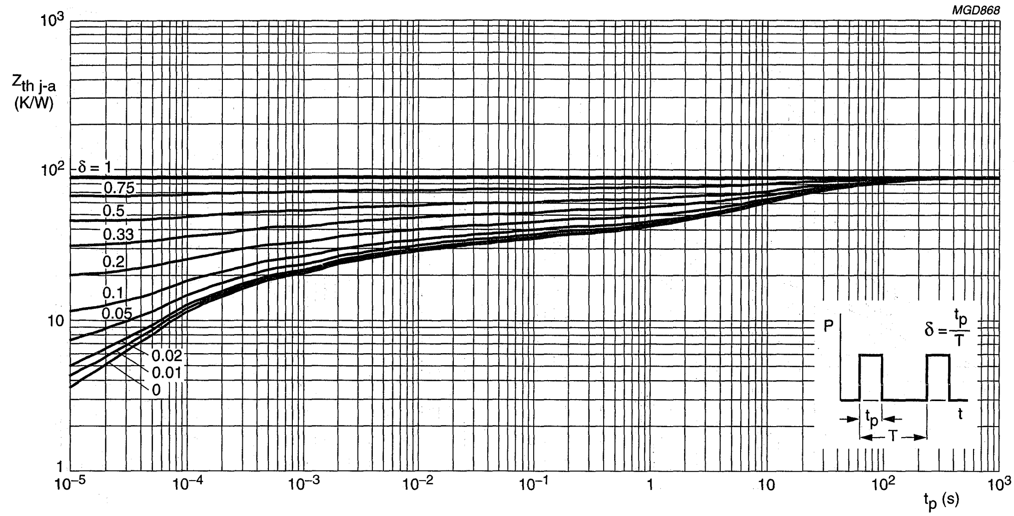
PCB, single-sided, unplated, Rth j-s = 36 K/W, Rth j-a = 124 K/W.
See also Fig.10 curve (1).

Fig.43 Thermal impedance curves (junction to ambient) for transistors mounted onto a PCB for SOT223.



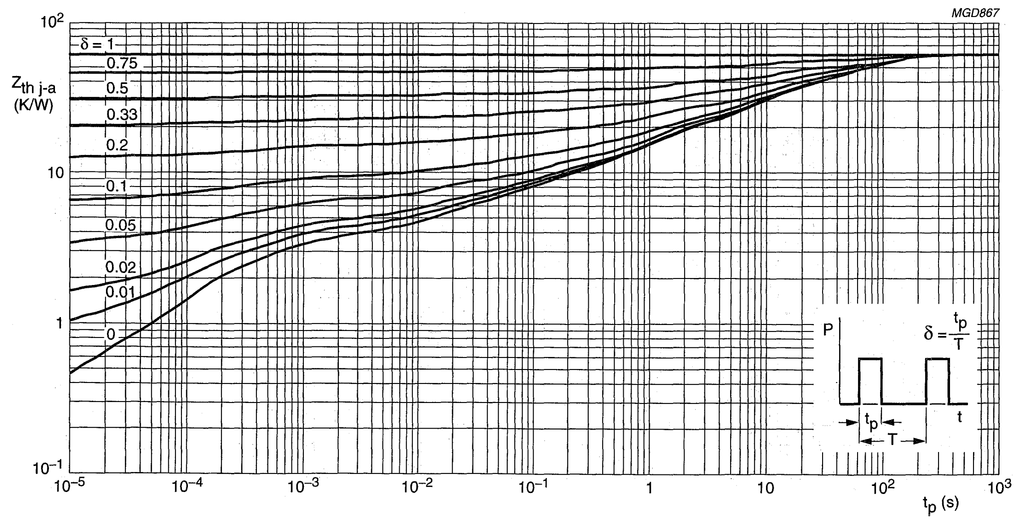
PCB, single-sided, plated, Rth j-s = 10 K/W, Rth j-a = 98 K/W.
See also Fig.10 curve (2).

Fig.44 Thermal impedance curves (junction to ambient) for transistors mounted onto a PCB for SOT223.



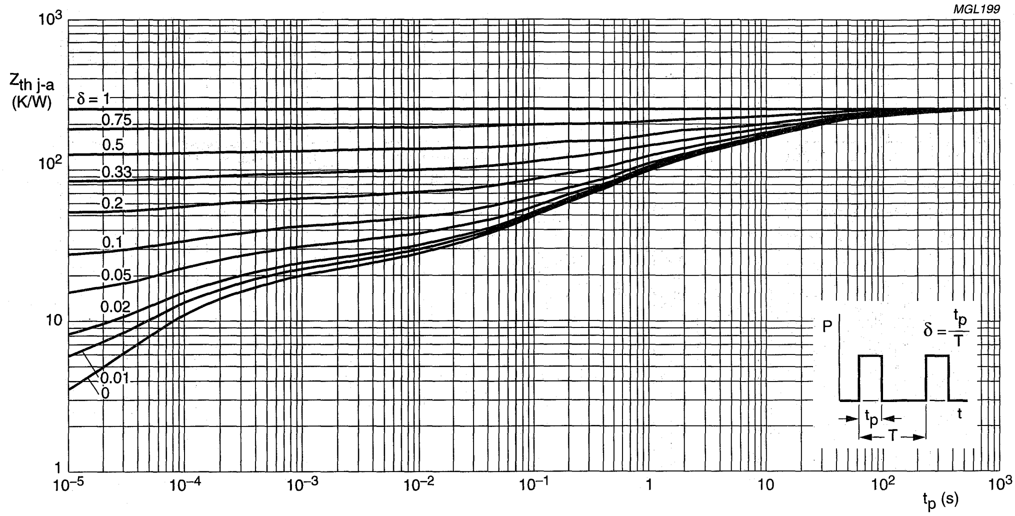
PCB, double-sided, unplated, Rth j-s = 36 K/W, Rth j-a = 87 K/W.
See also Fig.10 curve (3).

Fig.45 Thermal impedance curves (junction to ambient) for transistors mounted onto a PCB for SOT223.



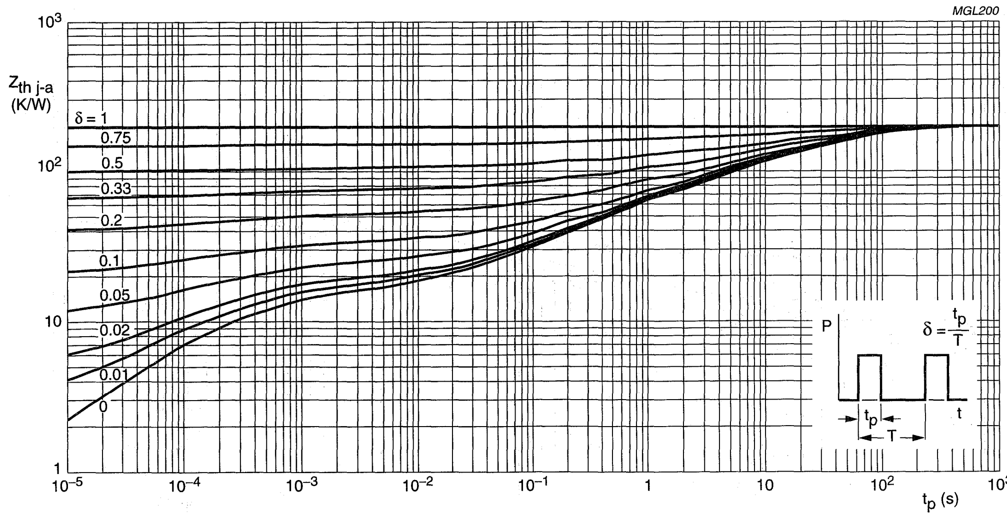
PCB, double-sided, plated, Rth j-s = 10 K/W, Rth j-a = 61 K/W.
See also Fig.10 curve (4).

Fig.46 Thermal impedance curves (junction to ambient) for transistors mounted onto a PCB for SOT223.



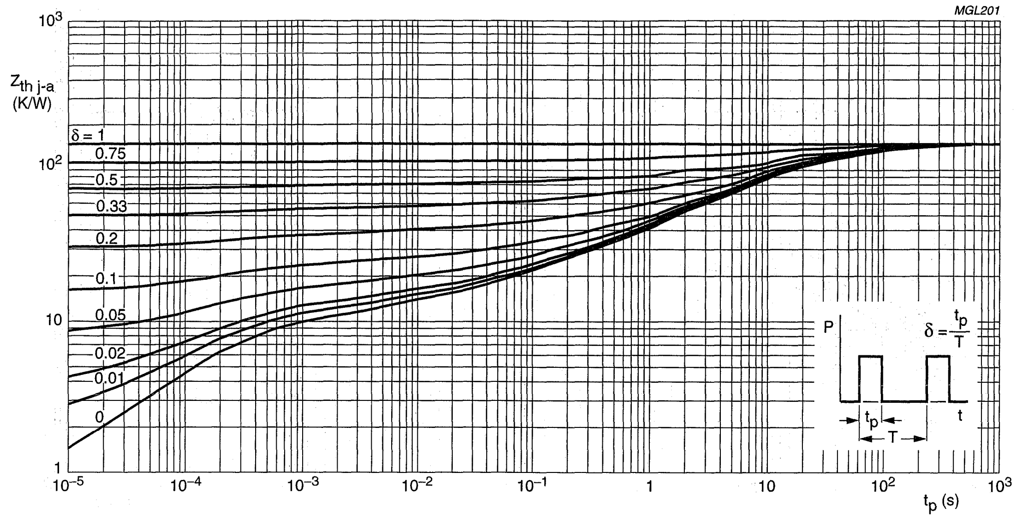
Curves are for devices with P_{tot} = 500 mW.

Fig.47 Thermal impedance curves (junction to ambient) for transistors mounted onto a PCB for SOT54.



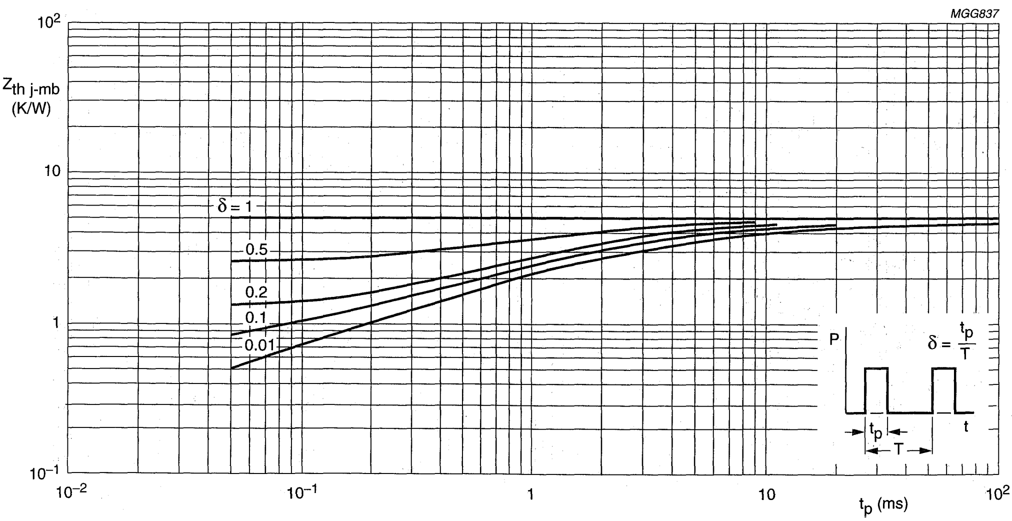
Curves are for devices with P_{tot} = 625 mW.

Fig.48 Thermal impedance curves (junction to ambient) for transistors mounted onto a PCB for SOT54.



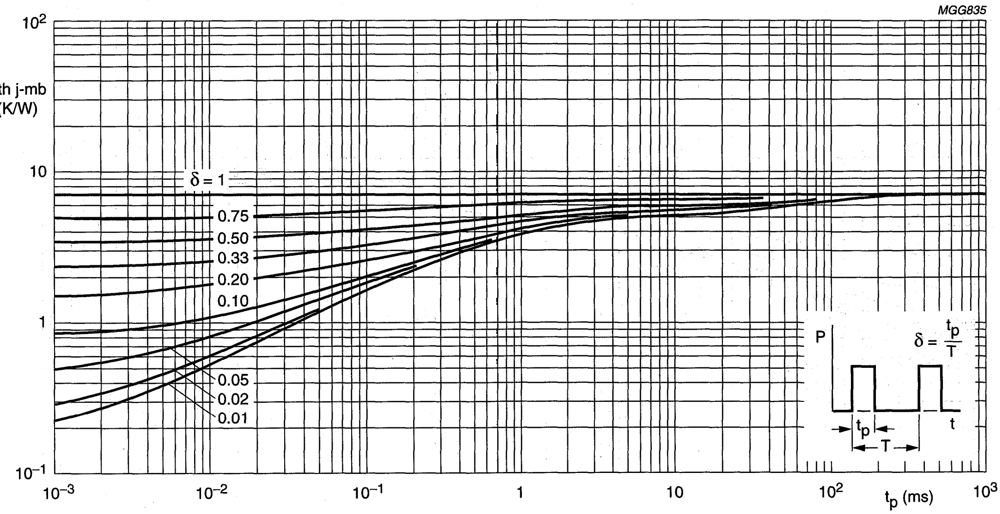
Curves are for devices with P_{tot} = 830 mW.

Fig.49 Thermal impedance curves (junction to ambient) for transistors mounted onto a PCB for SOT54.



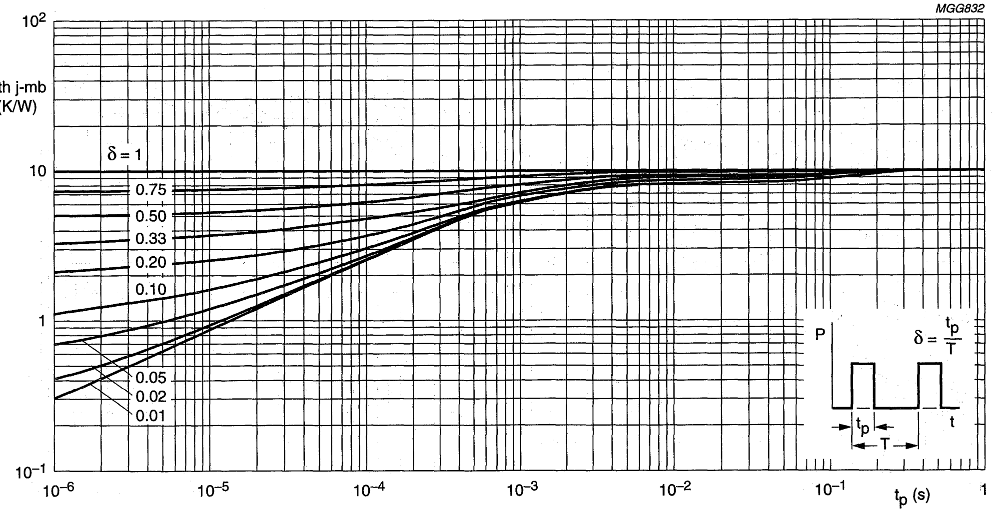
Device example: BDX35.

Fig.50 Thermal impedance curves (junction to mounting-base) for transistors mounted onto a PCB for TO-126 (SOT32).



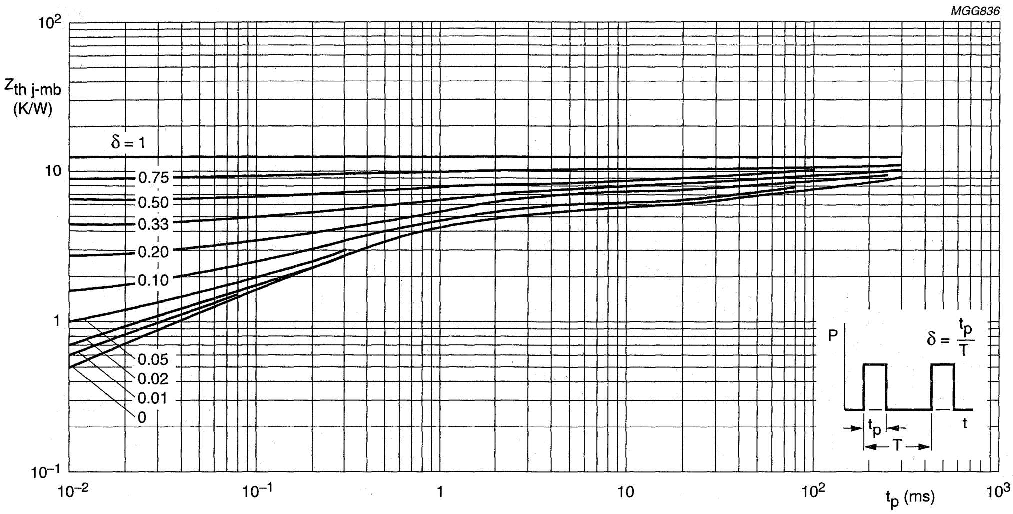
Device example: BD226.

Fig.51 Thermal impedance curves (junction to mounting-base) for transistors mounted onto a PCB for TO-126 (SOT32).



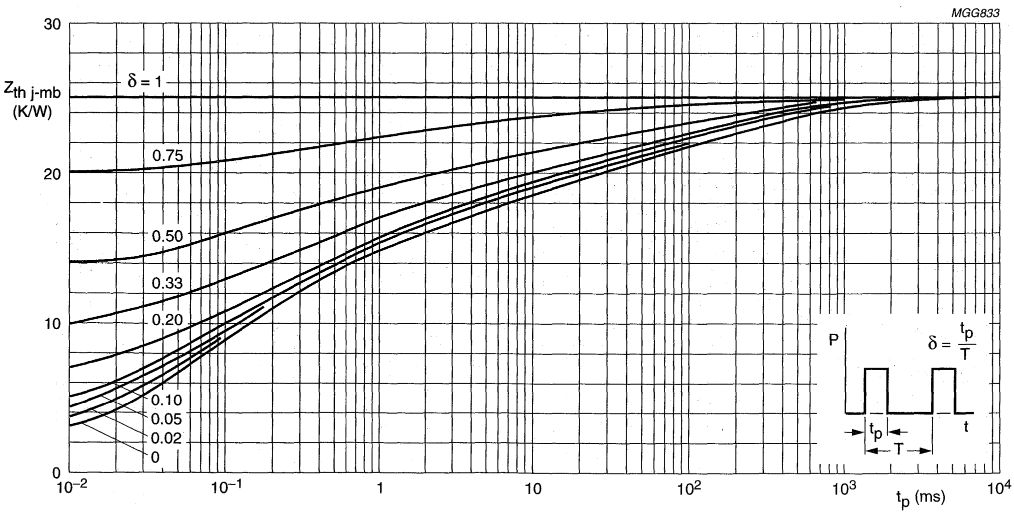
Device example: BD136.

Fig.52 Thermal impedance curves (junction to mounting-base) for transistors mounted onto a PCB for TO-126 (SOT32).



Device example: BD839.

Fig.53 Thermal impedance curves (junction to mounting-base) for transistors mounted onto a PCB for TO-202 (SOT128).



Device example: BF869.

Fig.54 Thermal impedance curves (junction to mounting-base) for transistors mounted onto a PCB for TO-202 (SOT128).

DEVICE DATA

in alphanumeric sequence

NPN medium power transistor | 2N1613

FEATURES

- Low current (max. 500 mA)
- Low voltage (max. 50 V).

APPLICATIONS

- High-speed switching and amplification.

DESCRIPTION

NPN medium power transistor in a TO-39 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

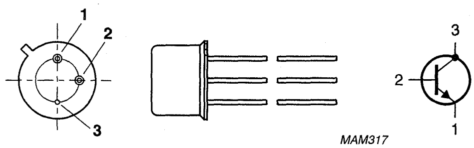


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	75	V
V_{CEO}	collector-emitter voltage	open base	–	50	V
I_{CM}	peak collector current		–	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	0.8	W
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 10$ V	40	120	
f_T	transition frequency	$I_C = 50$ 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	–	75	V
V_{CEO}	collector-emitter voltage	open base	–	50	V
V_{EBO}	emitter-base voltage	open collector	–	7	V
I_C	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	1	A
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	0.8	W
		$T_{case} = 100$ °C	–	1.7	W
		$T_{case} \leq 25$ °C	–	3	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°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	note 1	218	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		58.3	K/W

Note

1. Refer to TO-39 standard mounting conditions.

NPN medium power transistor 2N1613

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 60$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 60$ V; $T_{amb} = 150$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	10	nA
h_{FE}	DC current gain	$I_C = 0.1$ mA; $V_{CE} = 10$ V	20	–	
		$I_C = 10$ mA; $V_{CE} = 10$ V; note 1	35	–	
		$I_C = 10$ mA; $V_{CE} = 10$ V; $T_{amb} = -55$ °C	20	–	
		$I_C = 150$ mA; $V_{CE} = 10$ V; note 1	40	120	
		$I_C = 500$ mA; $V_{CE} = 10$ V; note 1	20	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA	–	1.5	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA	–	1.3	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V	–	25	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V	–	80	pF
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 10$ V; f = 100 MHz	60	–	MHz

Note

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

NPN medium power transistor — 2N1711

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 50 V).

APPLICATIONS

- DC and wideband amplifiers.

DESCRIPTION

NPN medium power transistor in a TO-39 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

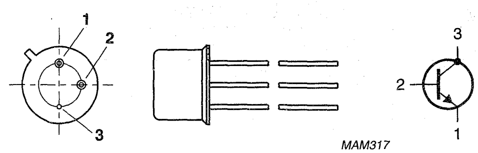


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	75	V
V_{CEO}	collector-emitter voltage	open base	–	50	V
I_{CM}	peak collector current		–	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	0.8	W
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 10$ V	100	300	
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 10$ V; f = 100 MHz	70	–	MHz

NPN medium power transistor 2N1711

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	–	75	V
V_{CEO}	collector-emitter voltage	open base	–	50	V
V_{EBO}	emitter-base voltage	open collector	–	7	V
I_C	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	1	A
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	0.8	W
		$T_{case} \leq 100$ °C	–	1.7	W
		$T_{case} \leq 25$ °C	–	3	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°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	219	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		58.3	K/W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 60$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 60$ V; $T_{amb} = 150$ °C	–	10	µA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	5	nA
h_{FE}	DC current gain	$I_C = 10$ µA; $V_{CE} = 10$ V	20	–	
		$I_C = 0.1$ mA; $V_{CE} = 10$ V	35	–	
		$I_C = 10$ mA; $V_{CE} = 10$ V; note 1	75	–	
		$I_C = 10$ mA; $V_{CE} = 10$ V; $T_{amb} = -55$ °C	35	–	
		$I_C = 150$ mA; $V_{CE} = 10$ V; note 1	100	300	
		$I_C = 500$ mA; $V_{CE} = 10$ V; note 1	40	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA; note 1	–	500	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA; note 1	–	1.3	V
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 10$ V; f = 100 MHz	70	–	MHz
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	25	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	80	pF

Note

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

NPN medium power transistor — 2N1893

FEATURES

- Low current (max. 500 mA)
- Low voltage (max. 80 V).

APPLICATIONS

- High performance amplifiers
- Oscillator and switching applications.

DESCRIPTION

NPN medium power transistor in a TO-39 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

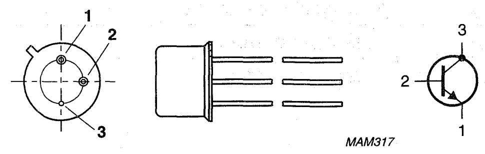


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	120	V
V_{CEO}	collector-emitter voltage	open base	–	80	V
I_{CM}	peak collector current		–	1	A
P_{tot}	total power dissipation	$T_{case} \leq 25$ °C	–	3	W
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 10$ V	40	120	

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	–	120	V
V_{CEO}	collector-emitter voltage	open base	–	80	V
V_{EBO}	emitter-base voltage	open collector	–	7	V
I_C	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	1	A
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	800	mW
		$T_{case} \leq 100$ °C	–	1.7	W
		$T_{case} \leq 25$ °C	–	3	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°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	219	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		58.3	K/W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 90$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 90$ V; $T_{amb} = 150$ °C	–	15	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	10	nA
h_{FE}	DC current gain	$I_C = 0.1$ mA; $V_{CE} = 10$ V	20	–	
		$I_C = 10$ mA; $V_{CE} = 10$ V; $T_{amb} = -55$ °C	20	–	
		$I_C = 10$ mA; $V_{CE} = 10$ V; note 1	35	–	
		$I_C = 150$ mA; $V_{CE} = 10$ V; note 1	40	120	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 50$ mA; $I_B = 5$ mA; note 1	–	900	mV
		$I_C = 150$ mA; $I_B = 15$ mA; note 1	–	500	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 50$ mA; $I_B = 5$ mA; note 1	–	1.2	V
		$I_C = 150$ mA; $I_B = 15$ mA; note 1	–	1.3	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	15	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	85	pF

Note

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

NPN switching transistors 2N2219; 2N2219A

FEATURES

- High current (max. 800 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- High-speed switching
- DC and VHF/UHF amplification, for 2N2219 only.

DESCRIPTION

NPN switching transistor in a TO-39 metal package.
PNP complement: 2N2905 and 2N2905A.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

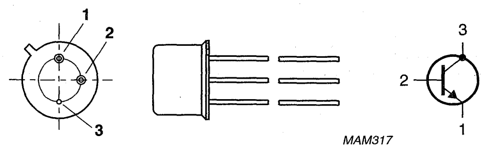


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	2N2219		–	60	V
	2N2219A		–	75	V
V_{CEO}	collector-emitter voltage	open base			
	2N2219		–	30	V
	2N2219A		–	40	V
I_C	collector current (DC)		–	800	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	800	mW
h_{FE}	DC current gain	I_C = 10 mA; V_{CE} = 10 V	75	–	
f_T	transition frequency	I_C = 20 mA; V_{CE} = 20 V; f = 100 MHz			
	2N2219		250	–	MHz
	2N2219A		300	–	MHz
t_{off}	turn-off time	I_{Con} = 150 mA; I_{Bon} = 15 mA; I_{Boff} = −15 mA	–	250	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			
	2N2219		–	60	V
	2N2219A		–	75	V
V_{CEO}	collector-emitter voltage				
	2N2219	open base	–	30	V
	2N2219A	open base; $I_C \leq 500$ mA	–	40	V
V_{EBO}	emitter-base voltage	open collector			
	2N2219		–	5	V
	2N2219A		–	6	V
I_C	collector current (DC)		–	800	mA
I_{CM}	peak collector current		–	800	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	800	mW
		$T_{case} \leq 25$ °C	–	3	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°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	190	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		50	K/W

CHARACTERISTICS

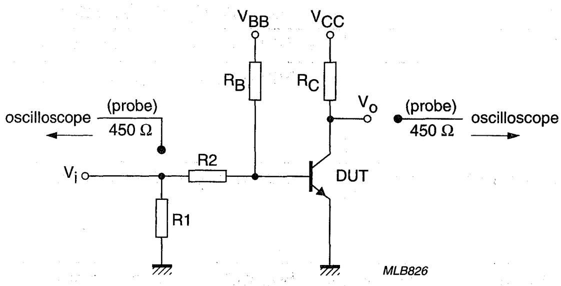
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	2N2219	$I_E = 0$; $V_{CB} = 50$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 50$ V; $T_{amb} = 150$ °C	–	10	μA
I_{CBO}	collector cut-off current				
	2N2219A	$I_E = 0$; $V_{CB} = 60$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 60$ V; $T_{amb} = 150$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 3$ V	–	10	nA
h_{FE}	DC current gain	$I_C = 0.1$ mA; $V_{CE} = 10$ V	35	–	
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 10$ V	50	–	
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 10$ V	75	–	
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 10$ V; $T_{amb} = -55$ °C			
	2N2219A		35	–	
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 1$ V; note 1	50	–	
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 10$ V; note 1	100	300	
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 10$ V; note 1			
	2N2219		30	–	
	2N2219A		40	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA; note 1			
	2N2219		–	400	mV
	2N2219A		–	300	mV
V_{CEsat}	collector-emitter saturation voltage	$I_C = 500$ mA; $I_B = 50$ mA; note 1			
	2N2219		–	1.6	V
	2N2219A		–	1	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA; note 1			
	2N2219		–	1.3	V
	2N2219A		0.6	1.2	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 500$ mA; $I_B = 50$ mA; note 1			
	2N2219		–	2.6	V
	2N2219A		–	2	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V	–	8	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 500$ mV			
	2N2219A		–	25	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 20$ V; f = 100 MHz;			
	2N2219		250	–	MHz
	2N2219A		300	–	MHz
F	noise figure	$I_C = 0.2$ mA; $V_{CE} = 5$ V; $R_S = 2$ kΩ;			
	2N2219A	f = 1 kHz; B = 200 Hz	–	4	dB

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Switching times (between 10% and 90% levels) for type 2N2219A; see Fig.2					
t_{on}	turn-on time	I_{Con} = 150 mA; I_{Bon} = 15 mA; I_{Boff} = −15 mA	–	35	ns
t_d	delay time		–	15	ns
t_r	rise time		–	20	ns
t_{off}	turn-off time		–	250	ns
t_s	storage time		–	200	ns
t_f	fall time		–	60	ns

Note

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



V_i = 9.5 V; T = 500 μs; t_p = 10 μs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; R_B = 325 Ω; R_C = 160 Ω.
V_{BB} = −3.5 V; V_{CC} = 29.5 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.2 Test circuit for switching times.

NPN switching transistors 2N2222; 2N2222A

FEATURES

- High current (max. 800 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- Linear amplification and switching.

DESCRIPTION

NPN switching transistor in a TO-18 metal package.
PNP complement: 2N2907A.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

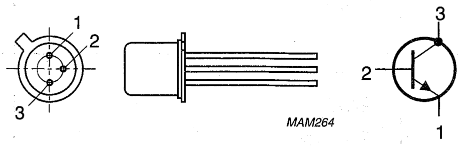


Fig.1 Simplified outline (TO-18) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	2N2222		–	60	V
	2N2222A		–	75	V
V_{CEO}	collector-emitter voltage	open base			
	2N2222		–	30	V
	2N2222A		–	40	V
I_C	collector current (DC)		–	800	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 10$ V	75	–	
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 20$ V; f = 100 MHz			
	2N2222		250	–	MHz
	2N2222A		300	–	MHz
t_{off}	turn-off time	$I_{Con} = 150$ mA; $I_{Bon} = 15$ mA; $I_{Boff} = -15$ mA	–	250	ns

NPN switching transistors 2N2222; 2N2222A

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			
	2N2222		–	60	V
	2N2222A		–	75	V
V_{CEO}	collector-emitter voltage	open base			
	2N2222		–	30	V
	2N2222A		–	40	V
V_{EBO}	emitter-base voltage	open collector			
	2N2222		–	5	V
	2N2222A		–	6	V
I_C	collector current (DC)		–	800	mA
I_{CM}	peak collector current		–	800	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
		$T_{case} \leq 25$ °C	–	1.2	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°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	350	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		146	K/W

CHARACTERISTICS

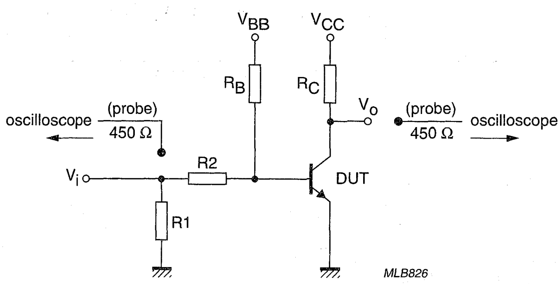
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	2N2222	$I_E = 0$; $V_{CB} = 50$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 50$ V; $T_{amb} = 150$ °C	–	10	μA
I_{CBO}	collector cut-off current				
	2N2222A	$I_E = 0$; $V_{CB} = 60$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 60$ V; $T_{amb} = 150$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 3$ V	–	10	nA
h_{FE}	DC current gain	$I_C = 0.1$ mA; $V_{CE} = 10$ V	35	–	
		$I_C = 1$ mA; $V_{CE} = 10$ V	50	–	
		$I_C = 10$ mA; $V_{CE} = 10$ V	75	–	
		$I_C = 150$ mA; $V_{CE} = 1$ V; note 1	50	–	
		$I_C = 150$ mA; $V_{CE} = 10$ V; note 1	100	300	
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 10$ V; $T_{amb} = -55$ °C			
	2N2222A		35	–	
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 10$ V; note 1			
	2N2222		30	–	
	2N2222A		40	–	
V_{CEsat}	collector-emitter saturation voltage				
	2N2222	$I_C = 150$ mA; $I_B = 15$ mA; note 1	–	400	mV
		$I_C = 500$ mA; $I_B = 50$ mA; note 1	–	1.6	V
V_{CEsat}	collector-emitter saturation voltage				
	2N2222A	$I_C = 150$ mA; $I_B = 15$ mA; note 1	–	300	mV
		$I_C = 500$ mA; $I_B = 50$ mA; note 1	–	1	V
V_{BEsat}	base-emitter saturation voltage				
	2N2222	$I_C = 150$ mA; $I_B = 15$ mA; note 1	–	1.3	V
		$I_C = 500$ mA; $I_B = 50$ mA; note 1	–	2.6	V
V_{BEsat}	base-emitter saturation voltage				
	2N2222A	$I_C = 150$ mA; $I_B = 15$ mA; note 1	0.6	1.2	V
		$I_C = 500$ mA; $I_B = 50$ mA; note 1	–	2	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	8	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 500$ mV; f = 1 MHz			
	2N2222A		–	25	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 20$ V; f = 100 MHz			
	2N2222		250	–	MHz
	2N2222A		300	–	MHz
F	noise figure	$I_C = 200$ μA; $V_{CE} = 5$ V; $R_S = 2$ kΩ; f = 1 kHz; B = 200 Hz			
	2N2222A		–	4	dB

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	I_{Con} = 150 mA; I_{Bon} = 15 mA; I_{Boff} = −15 mA	–	35	ns
t_d	delay time		–	10	ns
t_r	rise time		–	25	ns
t_{off}	turn-off time		–	250	ns
t_s	storage time		–	200	ns
t_f	fall time		–	60	ns

Note

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



V_i = 9.5 V; T = 500 μs; t_p = 10 μs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; R_B = 325 Ω; R_C = 160 Ω.
V_{BB} = −3.5 V; V_{CC} = 29.5 V.
Oscilloscope input impedance Z_i = 50 Ω.

Fig.2 Test circuit for switching times.

FEATURES

- Low current (max. 200 mA)
- Low voltage (max. 15 V).

APPLICATIONS

- High-speed switching
- VHF amplification.

DESCRIPTION

NPN switching transistor in a TO-18 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

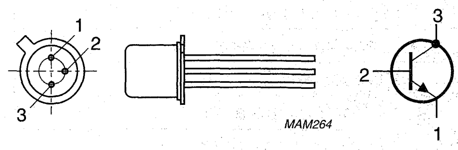


Fig.1 Simplified outline (TO-18) and symbol.

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
I_C	collector current (DC)		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	360	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 1$ V; $T_j = 25$ °C	40	120	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	500	–	MHz
t_{off}	turn-off time	$I_{Con} = 10$ mA; $I_{Bon} = 3$ mA; $I_{Boff} = -1.5$ mA	–	30	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_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	200	mA
I_{CM}	peak collector current	t_p = 10 ms	–	300	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	360	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°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	480	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		145	K/W

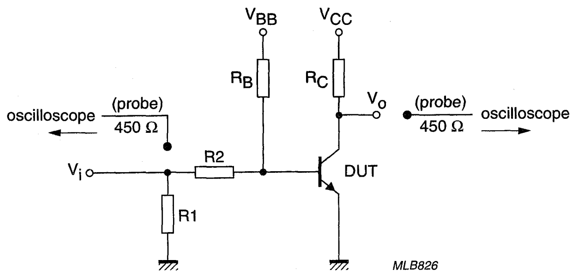
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 20 V	–	400	nA
		I_E = 0; V_{CB} = 20 V; T_j = 125 °C	–	30	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 4 V	–	100	nA
h_{FE}	DC current gain	I_C = 10 mA; V_{CE} = 1 V; note 1	40	120	
		I_C = 10 mA; V_{CE} = 1 V; T_j = −55 °C; note 1	20	–	
		I_C = 100 mA; V_{CE} = 2 V; note 1	20	–	
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	$I_E = i_e$ = 0; V_{CB} = 5 V; f = 1 MHz	–	4	pF
f_T	transition frequency	I_C = 10 mA; V_{CE} = 10 V; f = 100 MHz	500	–	MHz
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	I_{Con} = 10 mA; I_{Bon} = 3 mA; I_{Boff} = −1.5 mA	–	10	ns
t_d	delay time		–	4	ns
t_r	rise time		–	6	ns
t_{off}	turn-off time		–	30	ns
t_s	storage time		–	15	ns
t_f	fall time		–	15	ns

Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.01$.



V_i = 0.5 V to 4.2 V; T = 500 μs; t_p = 10 μs; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 1 kΩ; R_B = 1 kΩ; R_C = 270 Ω.
V_{BB} = 0.2 V; V_{CC} = 2.7 V.
Oscilloscope input impedance Z_i = 50 Ω.

Fig.2 Test circuit for switching times.

NPN switching transistor | 2N2369A

FEATURES

- Low current (max. 200 mA)
- Low voltage (max.15 V).

APPLICATIONS

- High-speed saturated switching and high frequency amplifier applications.

DESCRIPTION

NPN switching transistor in a TO-18 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

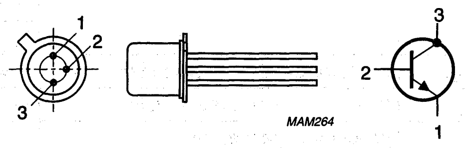


Fig.1 Simplified outline (TO-18) and symbol.

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
I_C	collector current (DC)		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	360	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 350$ mV	40	–	
		$I_C = 10$ mA; $V_{CE} = 1$ V	–	120	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	500	–	MHz
t_{off}	turn-off time	$I_{Con} = 10$ mA; $I_{Bon} = 3$ mA; $I_{Boff} = -1.5$ mA	–	30	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_{EBO}	emitter-base voltage	open collector; I_C = 10 μA to 10 mA	–	4.5	V
I_C	collector current (DC)		–	200	mA
I_{CM}	peak collector current		–	300	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	360	mW
		$T_{case} \leq 25$ °C	–	1.2	W
		$T_{case} \leq 100$ °C	–	680	mW
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	200	°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	486	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		146	K/W

CHARACTERISTICS

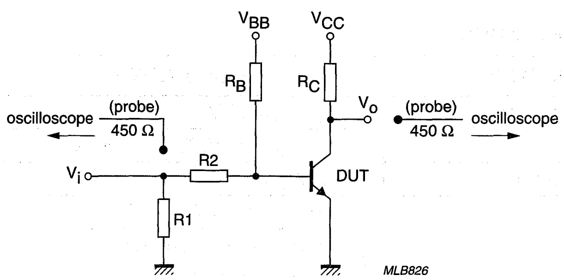
T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	400	nA
		$I_E = 0$; $V_{CB} = 20$ V; $T_{amb} = 150$ °C	–	30	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	100	nA
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 350$ mV; note 1	40	–	
		$I_C = 10$ mA; $V_{CE} = 350$ mV; $T_{amb} = -55$ °C; note 1	20	–	
		$I_C = 10$ mA; $V_{CE} = 1$ V; note 1	–	120	
		$I_C = 30$ mA; $V_{CE} = 400$ mV; note 1	30	–	
		$I_C = 100$ mA; $V_{CE} = 1$ V; note 1	20	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	–	200	mV
		$I_C = 10$ mA; $I_B = 1$ mA; $T_{amb} = 125$ °C	–	300	mV
		$I_C = 30$ mA; $I_B = 3$ mA	–	250	mV
		$I_C = 100$ mA; $I_B = 10$ mA	–	500	mV

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{BEsat}	base-emitter saturation voltage	I_C = 10 mA; I_B = 1 mA	700	850	mV
		I_C = 10 mA; I_B = 1 mA; T_{amb} = 125 °C	590	–	mV
		I_C = 10 mA; I_B = 1 mA; T_{amb} = –55 °C	–	1.02	V
		I_C = 30 mA; I_B = 3 mA	–	1.15	V
		I_C = 100 mA; I_B = 10 mA	–	1.6	V
C_c	collector capacitance	$I_E = I_e = 0$; V_{CB} = 5 V; f = 1 MHz	–	4	pF
f_T	transition frequency	I_C = 10 mA; V_{CE} = 10 V; f = 100 MHz	500	–	MHz
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	I_{Con} = 10 mA; I_{Bon} = 3 mA; I_{Boff} = –1.5 mA	–	10	ns
t_d	delay time		–	4	ns
t_r	rise time		–	6	ns
t_{off}	turn-off time		–	30	ns
t_s	storage time		–	15	ns
t_f	fall time		–	15	ns

Note

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



V_i = 0.5 V to 4.2 V; T = 500 µs; t_p = 10 µs; $t_r = t_f \le 1$ ns.
R1 = 56 Ω; R2 = 1 kΩ; R_B = 1 kΩ; R_C = 270 Ω.
V_{BB} = 0.2 V; V_{CC} = 2.7 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.2 Test circuit for switching times.

NPN general purpose transistor | 2N2484

FEATURES

- Low current (max. 50 mA)
- Low voltage (max. 60 V)

APPLICATIONS

- General purpose switching and amplification
- High performance (low-level), low-noise amplifier applications both for direct current and frequencies up to 100 MHz.

DESCRIPTION

NPN transistor in a TO-18; SOT18 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to the case

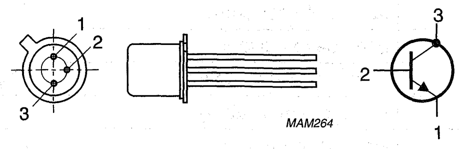


Fig.1 Simplified outline (TO-18; SOT18) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	60	V
V_{CEO}	collector-emitter voltage	open base	–	–	60	V
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	360	mW
h_{FE}	DC current gain	$I_C = 10$ μA; $V_{CE} = 5$ V	100	–	500	
		$I_C = 1$ mA; $V_{CE} = 5$ V	250	–	–	
		$I_C = 10$ mA; $V_{CE} = 5$ V	–	–	800	
f_T	transition frequency	$I_C = 0.5$ mA; $V_{CE} = 5$ V; f = 100 MHz	60	80	–	MHz

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	60	V
V_{CEO}	collector-emitter voltage	open base	–	60	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	50	mA
I_{CM}	peak collector current		–	100	mA
I_{BM}	peak base current		–	50	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	360	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°C
T_{amb}	operating ambient temperature		–65	+150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j-a}$	thermal resistance from junction to ambient	480	K/W
$R_{th\ j-c}$	thermal resistance from junction to case	150	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 45$ V	–	–	10	nA
		$I_E = 0$; $V_{CB} = 45$ V; $T_j = 150$ °C	–	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	10	nA
h_{FE}	DC current gain	$I_C = 1$ μA; $V_{CE} = 5$ V	30	–	–	
		$I_C = 10$ μA; $V_{CE} = 5$ V	100	–	500	
		$I_C = 10$ μA; $V_{CE} = 5$ V; $T_j = 55$ °C	20	–	–	
		$I_C = 100$ μA; $V_{CE} = 5$ V	175	–	–	
		$I_C = 500$ μA; $V_{CE} = 5$ V	200	–	–	
		$I_C = 1$ mA; $V_{CE} = 5$ V	250	–	–	
		$I_C = 10$ mA; $V_{CE} = 5$ V; note 1	–	–	800	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 1$ mA; $I_B = 0.1$ mA	–	–	350	mV
V_{BE}	base-emitter voltage	$I_C = 0.1$ mA; $V_{CE} = 5$ V	500	–	700	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	–	6	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	9	–	pF
f_T	transition frequency	$I_C = 50$ μA; $V_{CE} = 5$ V; f = 100 MHz	15	–	–	MHz
		$I_C = 500$ μA; $V_{CE} = 5$ V; f = 100 MHz	60	80	–	MHz
F	noise figure	$I_C = 10$ μA; $V_{CE} = 5$ V; $R_S = 10$ kΩ				
		f = 100 Hz; B = 20 Hz	–	–	10	dB
		f = 1 kHz; B = 200 Hz	–	–	3	dB
		f = 10 kHz; B = 2 kHz	–	–	2	dB
		Wide band; B = 15.7 kHz	–	–	3	dB

Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.01$.

PNP switching transistors 2N2905; 2N2905A

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 60 V).

APPLICATIONS

- High-speed switching
- Driver applications for industrial service.

DESCRIPTION

PNP switching transistor in a TO-39 metal package.
NPN complements: 2N2219 and 2N2219A.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

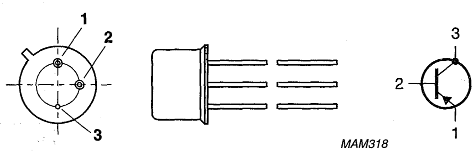


Fig.1 Simplified outline (TO-39) and symbol.

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			
	2N2905		–	–40	V
	2N2905A		–	–60	V
I_C	collector current (DC)		–	–600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	600	mW
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -10$ V	100	300	
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -20$ V; f = 100 MHz	200	–	MHz
t_{off}	turn-off time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	300	ns

PNP switching transistors 2N2905; 2N2905A

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			
	2N2905		–	–40	V
	2N2905A		–	–60	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–600	mA
I_{CM}	peak collector current		–	–800	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	600	mW
		$T_{case} \leq 25$ °C	–	3	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°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	292	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		58	K/W

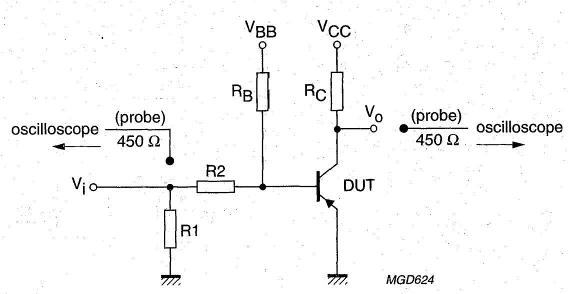
CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	2N2905	$I_E = 0$; $V_{CB} = -50$ V	–	–20	nA
		$I_E = 0$; $V_{CB} = -50$ V; $T_{amb} = 150$ °C	–	–20	μA
I_{CBO}	collector cut-off current				
	2N2905A	$I_E = 0$; $V_{CB} = -50$ V	–	–10	nA
		$I_E = 0$; $V_{CB} = -50$ V; $T_{amb} = 150$ °C	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	50	nA
h_{FE}	DC current gain	$V_{CE} = -10$ V			
	2N2905	$I_C = -0.1$ mA	35	–	
		$I_C = -1$ mA	50	–	
		$I_C = -10$ mA	75	–	
		$I_C = -150$ mA; note 1	100	300	
		$I_C = -500$ mA; note 1	30	–	
h_{FE}	DC current gain	$V_{CE} = -10$ V			
	2N2905A	$I_C = -0.1$ mA	75	–	
		$I_C = -1$ mA	100	–	
		$I_C = -10$ mA	100	–	
		$I_C = -150$ mA; note 1	100	300	
		$I_C = -500$ mA; note 1	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA; note 1	–	–400	mV
		$I_C = -500$ mA; $I_B = -50$ mA; note 1	–	–1.6	V
V_{BEsat}	base-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA; note 1	–	–1.3	V
		$I_C = -500$ mA; $I_B = -50$ mA; note 1	–	–2.6	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	8	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -2$ V; f = 1 MHz	–	30	pF
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -20$ V; f = 100 MHz; note 1	200	–	MHz
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	45	ns
t_d	delay time		–	15	ns
t_r	rise time		–	35	ns
t_{off}	turn-off time		–	300	ns
t_s	storage time		–	250	ns
t_f	fall time		–	50	ns

Note

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



$V_i = -9.5$ V; T = 500 µs; $t_p = 10$ µs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 µs; $R_B = 325$ Ω; $R_C = 160$ Ω.
$V_{BB} = 3.5$ V; $V_{CC} = -29.5$ V.
Oscilloscope input impedance $Z_i = 50$ Ω.

Fig.2 Test circuit for switching times.

PNP switching transistors — 2N2906; 2N2906A

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 60 V).

APPLICATIONS

- High-speed switching
- Driver applications for industrial service.

DESCRIPTION

PNP switching transistor in a TO-18 metal package.
NPN complements: 2N2222 and 2N2222A.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

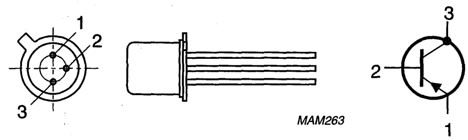


Fig.1 Simplified outline (TO-18) and symbol.

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			
	2N2906		–	–40	V
	2N2906A		–	–60	V
I_C	collector current (DC)		–	–600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	400	mW
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -10$ V	40	120	
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -20$ V; f = 100 MHz	200	–	MHz
t_{off}	turn-off time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	300	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			
	2N2906		–	–40	V
	2N2906A		–	–60	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–600	mA
I_{CM}	peak collector current		–	–800	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	400	mW
		$T_{case} \leq 25$ °C	–	1.2	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°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	438	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		146	K/W

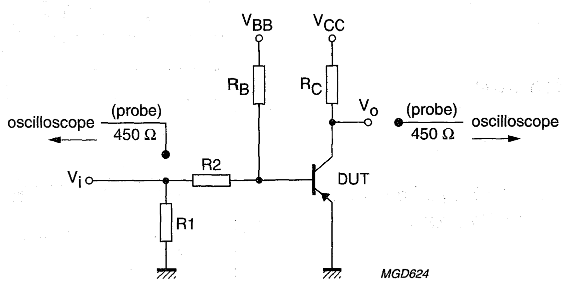
CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	2N2906	$I_E = 0$; $V_{CB} = -50$ V	–	–20	nA
		$I_E = 0$; $V_{CB} = -50$ V; $T_{amb} = 150$ °C	–	–20	μA
I_{CBO}	collector cut-off current				
	2N2906A	$I_E = 0$; $V_{CB} = -50$ V	–	–10	nA
		$I_E = 0$; $V_{CB} = -50$ V; $T_{amb} = 150$ °C	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–50	nA
h_{FE}	DC current gain	$V_{CE} = -10$ V			
	2N2906	$I_C = -0.1$ mA	20	–	
		$I_C = -1$ mA	25	–	
		$I_C = -10$ mA	35	–	
		$I_C = -150$ mA; note 1	40	120	
		$I_C = -500$ mA; note 1	20		
h_{FE}	DC current gain	$V_{CE} = -10$ V		–	
	2N2906A	$I_C = -0.1$ mA	40	–	
		$I_C = -1$ mA	40	–	
		$I_C = -10$ mA	40	–	
		$I_C = -150$ mA; note 1	40	120	
		$I_C = -500$ mA; note 1	40	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA; note 1		–400	mV
		$I_C = -500$ mA; $I_B = -50$ mA; note 1		–1.6	V
V_{BEsat}	base-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA; note 1		–1.3	V
		$I_C = -500$ mA; $I_B = -50$ mA; note 1		–2.6	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	8	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -2$ V; f = 1 MHz	–	30	pF
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -20$ V; f = 100 MHz; note 1	200	–	MHz
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	45	ns
t_d	delay time		–	15	ns
t_r	rise time		–	35	ns
t_{off}	turn-off time		–	300	ns
t_s	storage time		–	250	ns
t_f	fall time		–	50	ns

Note

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



$V_i = -9.5$ V; T = 500 μs; $t_p = 10$ μs; $t_r = t_f \le 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; $R_B = 325$ Ω; $R_C = 160$ Ω.
$V_{BB} = 3.5$ V; $V_{CC} = -29.5$ V.
Oscilloscope input impedance $Z_i = 50$ Ω.

Fig.2 Test circuit for switching times.

PNP switching transistors 2N2907; 2N2907A

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 60 V).

APPLICATIONS

- Switching and linear amplification.

DESCRIPTION

PNP switching transistor in a TO-18 metal package.
NPN complements: 2N2222 and 2N2222A.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

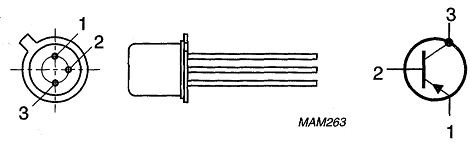


Fig.1 Simplified outline (TO-18) and symbol.

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			
	2N2907		–	–40	V
	2N2907A		–	–60	V
I_C	collector current (DC)		–	–600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	400	mW
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -10$ V	100	300	
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -20$ V; f = 100 MHz	200	–	MHz
t_{off}	turn-off time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	300	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; $I_C < -100$ mA			
	2N2907		–	–40	V
	2N2907A		–	–60	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–600	mA
I_{CM}	peak collector current		–	–800	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	400	mW
		$T_{case} \leq 25$ °C	–	1.2	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°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	438	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		146	K/W

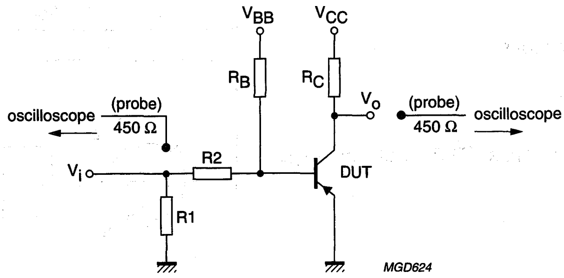
CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	2N2907	$I_E = 0$; $V_{CB} = -50$ V	–	–20	nA
		$I_E = 0$; $V_{CB} = -50$ V; $T_{amb} = 150$ °C	–	–20	μA
I_{CBO}	collector cut-off current				
	2N2907A	$I_E = 0$; $V_{CB} = -50$ V	–	–10	nA
		$I_E = 0$; $V_{CB} = -50$ V; $T_{amb} = 150$ °C	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–50	nA
h_{FE}	DC current gain	$V_{CE} = -10$ V			
	2N2907	$I_C = -0.1$ mA	35	–	
		$I_C = -1$ mA	50	–	
		$I_C = -10$ mA	75	–	
		$I_C = -150$ mA; note 1	100	300	
		$I_C = -500$ mA; note 1	30		
h_{FE}	DC current gain	$V_{CE} = -10$ V			
	2N2907A	$I_C = -0.1$ mA	75	–	
		$I_C = -1$ mA	100	–	
		$I_C = -10$ mA	100	–	
		$I_C = -150$ mA; note 1	100	300	
		$I_C = -500$ mA; note 1	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA; note 1		–400	mV
		$I_C = -500$ mA; $I_B = -50$ mA; note 1		–1.6	V
V_{BEsat}	base-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA; note 1		–1.3	V
		$I_C = -500$ mA; $I_B = -50$ mA; note 1		–2.6	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	8	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -2$ V; f = 1 MHz	–	30	pF
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -20$ V; f = 100 MHz; note 1	200	–	MHz
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	45	ns
t_d	delay time		–	15	ns
t_r	rise time		–	35	ns
t_{off}	turn-off time		–	300	ns
t_s	storage time		–	250	ns
t_f	fall time		–	50	ns

Note

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



$V_i = -9.5$ V; T = 500 μs; $t_p = 10$ μs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; $R_B = 325$ Ω; $R_C = 160$ Ω.
$V_{BB} = 3.5$ V; $V_{CC} = -29.5$ V.
Oscilloscope input impedance $Z_i = 50$ Ω.

Fig.2 Test circuit for switching times.

NPN medium power transistor | 2N3019

FEATURES

- High current (max. 1 A)
- Low voltage (max. 80 V).

APPLICATIONS

- Amplifier and switching circuits.

DESCRIPTION

NPN medium power transistor in a TO-39 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

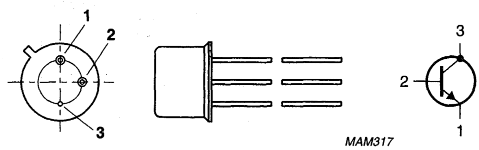


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	140	V
V_{CEO}	collector-emitter voltage	open base	–	80	V
I_C	collector current (DC)		–	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	800	mW
		$T_{case} \leq 25$ °C	–	5	W
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 10$ V	100	300	
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 10$ V; f = 100 MHz	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	–	140	V
V_{CEO}	collector-emitter voltage	open base	–	80	V
V_{EBO}	emitter-base voltage	open collector	–	7	V
I_C	collector current (DC)		–	1	A
I_{CM}	peak collector current		–	1	A
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	800	mW
		$T_{case} \leq 25$ °C	–	5	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°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	218	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		35	K/W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 90$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 90$ V; $T_{amb} = 150$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	10	nA
h_{FE}	DC current gain	$V_{CE} = 10$ V; note 1			
		$I_C = 0.1$ mA	50	–	
		$I_C = 10$ mA	90	–	
		$I_C = 150$ mA	100	300	
		$I_C = 150$ mA; $T_{case} = -55$ °C	40	–	
		$I_C = 500$ mA	50	–	
		$I_C = 1$ A	15	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA	–	200	mV
		$I_C = 500$ mA; $I_B = 50$ mA; note 1	–	500	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA; note 1	–	1.1	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	12	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 500$ mV; f = 1 MHz	–	60	pF
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 10$ V; f = 20 MHz	100	–	MHz
F	noise figure	$I_C = 0.1$ mA; $V_{CE} = 5$ V; $R_S = 1$ kΩ; f = 1 kHz; B = 200 Hz	–	4	dB

Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.01$.

NPN switching transistor 2N3904

FEATURES

- Low current (max. 200 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- High-speed switching.

DESCRIPTION

NPN switching transistor in a TO-92; SOT54 plastic package. PNP complement: 2N3906.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

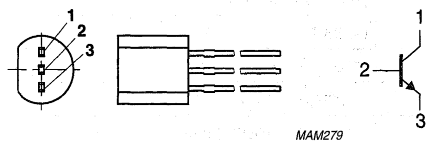


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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	collector current (DC)		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	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_{off}	turn-off time	$I_{Con} = 10$ mA; $I_{Bon} = 1$ mA; $I_{Boff} = -1$ mA	–	240	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	collector current (DC)		–	200	mA
I_{CM}	peak collector current		–	300	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

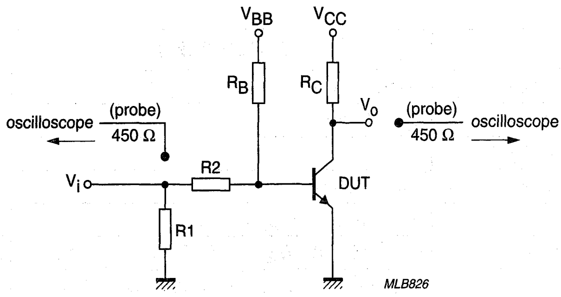
$T_{amb} = 25$ °C.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30$ V	–	50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 6$ V	–	50	nA
h_{FE}	DC current gain	$V_{CE} = 1$ V; note 1			
		$I_C = 0.1$ mA	60	–	
		$I_C = 1$ mA	80	–	
		$I_C = 10$ mA	100	300	
		$I_C = 50$ mA	60	–	
		$I_C = 100$ mA	30	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA; note 1	–	200	mV
		$I_C = 50$ mA; $I_B = 5$ mA; note 1	–	200	mV
V_{BEsat}	base-emitter 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	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	4	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 500$ mV; f = 1 MHz	–	8	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 20$ V; f = 100 MHz	300	–	MHz

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
F	noise figure	I_C = 100 μA; V_{CE} = 5 V; R_S = 1 kΩ; f = 10 Hz to 15.7 kHz	–	5	dB
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	I_{Con} = 10 mA; I_{Bon} = 1 mA; I_{Boff} = −1 mA	–	65	ns
t_d	delay time		–	35	ns
t_r	rise time		–	35	ns
t_{off}	turn-off time		–	240	ns
t_s	storage time		–	200	ns
t_f	fall time		–	50	ns

Note

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



V_i = 5 V; T = 500 μs; t_p = 10 μs; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 2.5 kΩ; R_B = 3.9 kΩ; R_C = 270 Ω.
V_{BB} = −1.9 V; V_{CC} = 3 V.
Oscilloscope input impedance Z_i = 50 Ω.

Fig.2 Test circuit for switching times.

PNP switching transistor — 2N3906

FEATURES

- Low current (max. 200 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- High-speed switching in industrial applications.

DESCRIPTION

PNP switching transistor in a TO-92; SOT54 plastic package. NPN complement: 2N3904.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

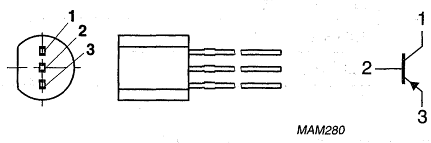


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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	collector current (DC)		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	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_{off}	turn-off time	$I_{Con} = -10$ mA; $I_{Bon} = -1$ mA; $I_{Boff} = 1$ mA	–	300	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	–	–6	V
I_C	collector current (DC)		–	–200	mA
I_{CM}	peak collector current		–	–300	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	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	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

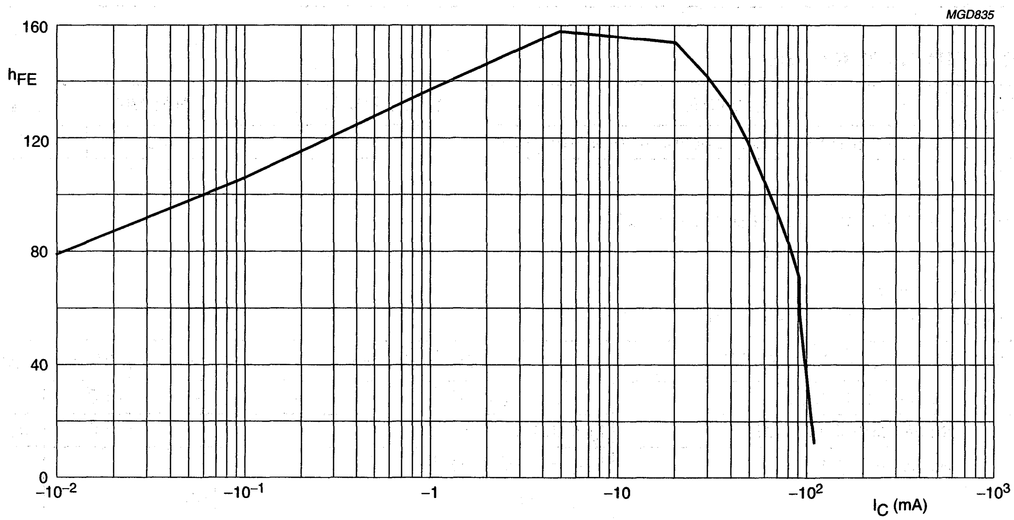
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -30$ V	–	–50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -6$ V	–	–50	nA
h_{FE}	DC current gain	$V_{CE} = -1$ V; note 1; see Fig.2			
		$I_C = -0.1$ mA	60	–	
		$I_C = -1$ mA	80	–	
		$I_C = -10$ mA	100	300	
		$I_C = -50$ mA	60	–	
		$I_C = -100$ mA	30	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -1$ mA; note 1	–	–200	mV
		$I_C = -50$ mA; $I_B = -5$ mA; note 1	–	–200	mV
V_{BEsat}	base-emitter 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	$I_E = i_e = 0$; $V_{CB} = -5$ V; f = 1 MHz	–	4.5	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -500$ mV; f = 1 MHz	–	10	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -20$ V; f = 100 MHz	250	–	MHz
F	noise figure	$I_C = -100$ µA; $V_{CE} = -5$ V; $R_S = 1$ kΩ; f = 10 Hz to 15.7 kHz	–	4	dB

PNP switching transistor | 2N3906

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Switching times (between 10% and 90% levels); see Fig.3					
t_{on}	turn-on time	I_{Con} = −10 mA; I_{Bon} = −1 mA; I_{Boff} = 1 mA	–	65	ns
t_d	delay time		–	35	ns
t_r	rise time		–	35	ns
t_{off}	turn-off time		–	300	ns
t_s	storage time		–	225	ns
t_f	fall time		–	75	ns

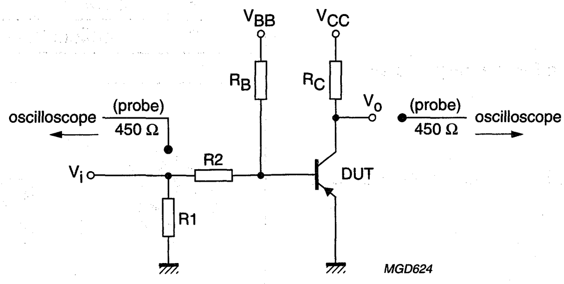
Note

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



V_{CE} = 1 V.

Fig.2 DC current gain; typical values.



$V_i = -5$ V; T = 500 µs; $t_p = 10$ µs; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 2.5 kΩ; $R_B = 3.9$ kΩ; $R_C = 270$ Ω.
$V_{BB} = 1.9$ V; $V_{CC} = -3$ V.
Oscilloscope input impedance $Z_i = 50$ Ω.

Fig.3 Test circuit for switching times.

PNP medium power transistors | 2N4031; 2N4033

FEATURES

- High current (max. 1 A)
- Low voltage (max. 80 V).

APPLICATIONS

- Audio frequency applications for industrial service.

DESCRIPTION

PNP medium power transistor in a TO-39 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

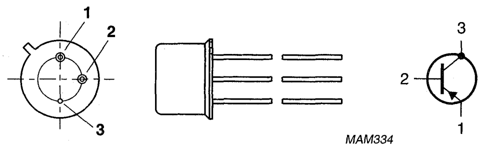


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–80	V
V_{CEO}	collector-emitter voltage	open base	–	–80	V
I_{CM}	peak collector current		–	–1.5	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	0.8	W
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -5$ V			
	2N4031		25	–	
	2N4033		70	–	
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -10$ V; f = 100 MHz			
	2N4031		100	400	MHz
	2N4033		150	500	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	–	–80	V
V_{CEO}	collector-emitter voltage	open base	–	–80	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–1	A
I_{CM}	peak collector current		–	–1.5	A
I_{BM}	peak base current		–	–0.2	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	0.8	W
		$T_{case} \leq 25$ °C	–	4	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°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	218	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		44	K/W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −60 V	−	−50	nA
		I_E = 0; V_{CB} = −60 V; T_{amb} = 150 °C	−	−50	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −5 V	−	−10	μA
h_{FE}	DC current gain	V_{CE} = −5 V			
	2N4031	I_C = −100 μA	30	−	
		I_C = −100 mA	40	120	
		I_C = −100 mA; T_{amb} = −55 °C	15	−	
		I_C = −500 mA	25	−	
		I_C = −1 000 mA	10	−	
h_{FE}	DC current gain	V_{CE} = −5 V			
	2N4033	I_C = −100 μA	75	−	
		I_C = −100 mA	100	300	
		I_C = −100 mA; T_{amb} = −55 °C	40	−	
		I_C = −500 mA	70	−	
		I_C = −1 000 mA	25	−	
V_{CEsat}	collector-emitter saturation voltage	I_C = −150 mA; I_B = −15 mA	−	−150	mV
		I_C = −500 mA; I_B = −50 mA	−	−500	mV
V_{BEsat}	base-emitter saturation voltage	I_C = −150 mA; I_B = −15 mA; note 1	−	−900	mV
V_{BE}	base-emitter voltage	I_C = −500 mA; V_{CE} = −0.5 V; note 1	−	−1.1	V
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = −10 V; f = 1 MHz	−	20	pF
C_e	emitter capacitance	I_C = i_c = 0; V_{EB} = −0.5 V; f = 1 MHz	−	110	pF
f_T	transition frequency	I_C = −50 mA; V_{CE} = −10 V; f = 100 MHz			
	2N4031		100	400	MHz
	2N4033		150	500	MHz
Switching times (between 10% and 90% levels)					
t_{on}	turn-on time	I_{Con} = 500 mA; I_{Bon} = −50 mA; I_{Boff} = 50 mA	−	100	ns
t_{off}	turn-off time		−	400	ns

Note

1. Pulse test: t_p ≤ 300 μs; δ ≤ 0.01.

PNP switching transistor 2N4036

FEATURES

- High current (max. 1 A)
- Low voltage (max. 65 V).

APPLICATIONS

- Amplifier and switching applications.

DESCRIPTION

PNP switching transistor in a TO-39 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

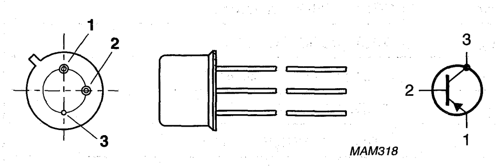


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–90	V
V_{CEO}	collector-emitter voltage	open base	–	–65	V
I_C	collector current (DC)		–	–1	A
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C	–	7	W
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -2$ V	20	200	
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -10$ V; f = 100 MHz	60	–	MHz
t_{off}	turn-off time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	700	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	–	–90	V
V_{CEO}	collector-emitter voltage	open base	–	–65	V
V_{EBO}	emitter-base voltage	open collector	–	–7	V
I_C	collector current (DC)		–	–1	A
I_{CM}	peak collector current		–	–1	A
I_{BM}	peak base current		–	–500	mA
P_{tot}	total power dissipation	$T_{mb} \le 25$ °C	–	7	W
T_{stg}	storage temperature		–55	+200	°C
T_j	junction temperature		–	200	°C
T_{amb}	operating ambient temperature		–55	+200	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}c}$	thermal resistance from junction to case	in free air	25	K/W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -60$ V	–	–50	nA
		$I_E = 0$; $V_{CB} = -60$ V; $T_{amb} = 150$ °C	–	–5	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -4$ V	–	–50	nA
h_{FE}	DC current gain	$I_C = -0.1$ mA; $V_{CE} = -10$ V	20	–	
		$I_C = -150$ mA; $V_{CE} = -2$ V	20	200	
		$I_C = -150$ mA; $V_{CE} = -10$ V	40	140	
		$I_C = -150$ mA; $V_{CE} = -10$ V; $T_{amb} = 55$ °C	20	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA	–	–650	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA	–	–1.4	V
V_{BEon}	base-emitter on-stage voltage	$I_C = -150$ mA; $V_{CE} = -10$ V	–	–1.5	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	30	pF
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -10$ V; f = 100 MHz	60	–	MHz
Switching times (between 10% and 90% levels)					
t_{on}	turn-on time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	110	ns
t_r	rise time		–	70	ns
t_{off}	turn-off time		–	700	ns
t_s	storage time		–	600	ns
t_f	fall time		–	100	ns

NPN general purpose transistor 2N4124

FEATURES

- Low current (max. 200 mA)
- Low voltage (max. 25 V).

APPLICATIONS

- General purpose switching and amplification, e.g. small-signal audio-frequency applications.

DESCRIPTION

NPN transistor in a TO-92; SOT54 plastic package.
PNP complement: 2N4126.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

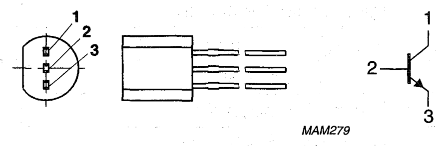


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter		30	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
I_{CM}	peak collector current		–	300	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 1$ V	120	360	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 20$ V; f = 100 MHz	300	–	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	–	25	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	200	mA
I_{CM}	peak collector current		–	300	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 3$ V	–	50	nA
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 1$ V; note 1	120	360	
		$I_C = 50$ mA; $V_{CE} = 1$ V; note 1	60	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 50$ mA; $I_B = 5$ mA; note 1	–	300	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 50$ mA; $I_B = 5$ mA; note 1	–	950	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	4	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	8	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 20$ V; f = 100 MHz	300	–	MHz
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; $\delta \leq 0.02$.

PNP general purpose transistor — 2N4126

FEATURES

- Low current (max. 200 mA)
- Low voltage (max. 25 V).

APPLICATIONS

- General purpose switching and amplification, e.g. small-signal audio-frequency applications.

DESCRIPTION

PNP transistor in a TO-92; SOT54 plastic package.
NPN complement: 2N4124.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

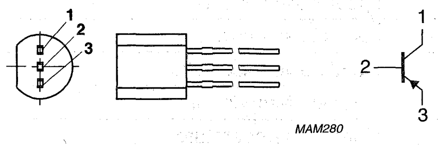


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–25	V
V_{CEO}	collector-emitter voltage	open base	–	–25	V
I_{CM}	peak collector current		–	–300	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -1$ V	120	360	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -20$ V; f = 100 MHz	250	–	MHz

PNP general purpose transistor 2N4126

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	–	–25	V
V_{CEO}	collector-emitter voltage	open base	–	–25	V
V_{EBO}	emitter-base voltage	open collector	–	–4	V
I_C	collector current (DC)		–	–200	mA
I_{CM}	peak collector current		–	–300	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -20$ V	–	–50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -3$ V	–	–50	nA
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -1$ V; note 1	120	360	
		$I_C = -50$ mA; $V_{CE} = -1$ V; note 1	60	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -50$ mA; $I_B = -5$ mA; note 1	–	–400	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -50$ mA; $I_B = -5$ mA; note 1	–	–950	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -5$ V; f = 1 MHz	–	4.5	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -0.5$ V; f = 1 MHz	–	10	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -20$ V; f = 100 MHz	250	–	MHz
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; $\delta \leq 0.02$.

NPN switching transistor 2N4401

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- Industrial and consumer switching applications.

DESCRIPTION

NPN switching transistor in a TO-92; SOT54 plastic package. PNP complement: 2N4403.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

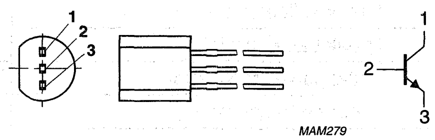


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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	collector current (DC)		–	600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	630	mW
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 1$ V	150	300	
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 10$ V; f = 100 MHz	250	–	MHz
t_{off}	turn-off time	$I_{Con} = 150$ mA; $I_{Bon} = 15$ mA; $I_{Boff} = -15$ mA	–	250	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	collector current (DC)		–	600	mA
I_{CM}	peak collector current		–	800	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	630	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	200	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 60$ V	–	50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 6$ V	–	50	nA
h_{FE}	DC current gain	$V_{CE} = 1$ V; see Fig.2			
		$I_C = 0.1$ mA	20	–	
		$I_C = 1$ mA	40	–	
		$I_C = 10$ mA	80	–	
		$I_C = 150$ mA; note 1	100	300	
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 2$ V; note 1	40	–	
V_{CEsat}	collector-emitter 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}	base-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA; note 1	–	950	mV
		$I_C = 500$ mA; $I_B = 50$ mA; note 1	–	1.2	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	6.5	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 500$ mV; f = 1 MHz	–	30	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 10$ V; f = 100 MHz	250	–	MHz
Switching times (between 10% and 90% levels); see Fig.3					
t_{on}	turn-on time	$I_{Con} = 150$ mA; $I_{Bon} = 15$ mA; $I_{Boff} = -15$ mA	–	35	ns
t_d	delay time		–	15	ns
t_r	rise time		–	20	ns
t_{off}	turn-off time		–	250	ns
t_s	storage time		–	200	ns
t_f	fall time		–	60	ns

Note

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

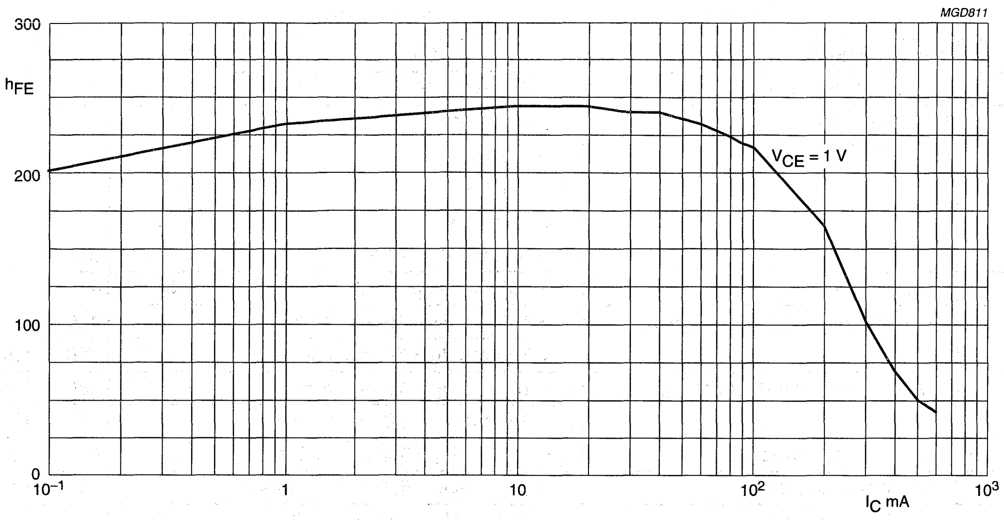
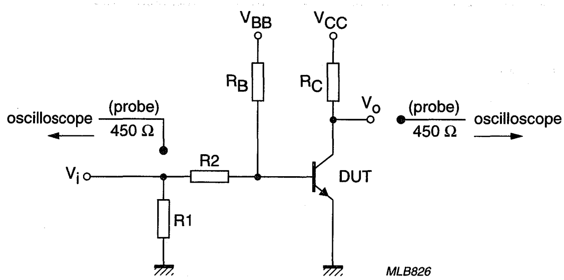


Fig.2 DC current gain; typical values.



V_i = 9.5 V; T = 500 μs; t_p = 10 μs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; R_B = 325 Ω; R_C = 160 Ω.
V_{BB} = −3.5 V; V_{CC} = 29.5 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.3 Test circuit for switching times.

PNP switching transistor — 2N4403

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- Industrial and consumer switching applications.

DESCRIPTION

PNP switching transistor in a TO-92; SOT54 plastic package. NPN complement: 2N4401.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

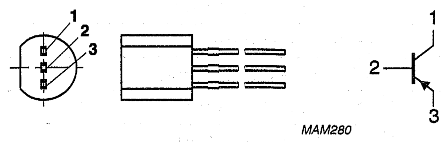


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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	collector current (DC)		–	–600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	630	mW
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -2$ V	100	300	
f_T	transition frequency	$I_C = -20$ mA; $V_{CE} = -10$ V; f = 100 MHz	200	–	MHz
t_{off}	turn-off time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	350	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	collector current (DC)		–	–600	mA
I_{CM}	peak collector current		–	–800	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	630	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	note 1	200	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$ mA; $V_{CB} = -40$ V	–	–50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$ mA; $V_{EB} = -5$ V	–	–50	nA
h_{FE}	DC current gain	$V_{CE} = -1$ V; see Fig.2			
		$I_C = -0.1$ mA	30	–	
		$I_C = -1$ mA	60	–	
		$I_C = -10$ mA	100	–	
h_{FE}	DC current gain	$V_{CE} = -2$ V			
		$I_C = -150$ mA	100	300	
		$I_C = -500$ mA	20	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA	–	–400	mV
		$I_C = -500$ mA; $I_B = -50$ mA	–	–750	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA	–	–950	mV
		$I_C = -500$ mA; $I_B = -50$ mA	–	–1.3	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	8.5	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -500$ mV; f = 1 MHz	–	30	pF
f_T	transition frequency	$I_C = -20$ mA; $V_{CE} = -10$ V; f = 100 MHz	200	–	MHz

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Switching times (between 10% and 90% levels); see Fig.3					
t_{on}	turn-on time	I_{Con} = –150 mA; I_{Bon} = –15 mA; I_{Boff} = 15 mA	–	40	ns
t_d	delay time		–	15	ns
t_r	rise time		–	30	ns
t_{off}	turn-off time		–	350	ns
t_s	storage time		–	300	ns
t_f	fall time		–	50	ns

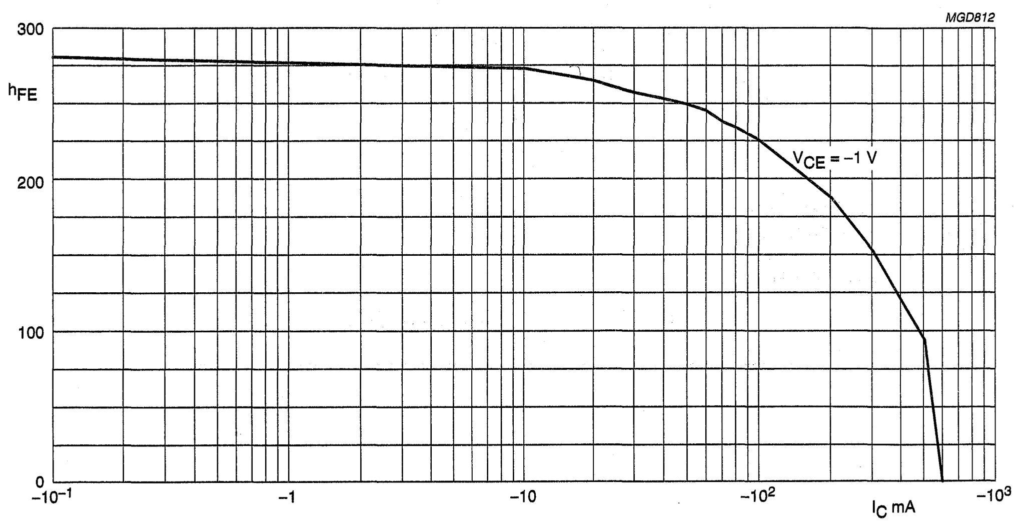
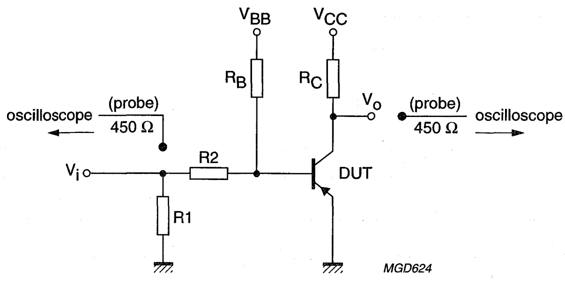


Fig.2 DC current gain; typical values.



$V_i = -9.5$ V; T = 500 µs; $t_p = 10$ µs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; $R_B = 325$ Ω; $R_C = 160$ Ω.
$V_{BB} = 3.5$ V; $V_{CC} = -29.5$ V.
Oscilloscope: input impedance $Z_i = 50$ Ω.

Fig.3 Test circuit for switching times.

PNP general purpose transistor | 2N5087

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 50 V).

APPLICATIONS

- Low noise stages in audio equipment.

DESCRIPTION

PNP transistor in a TO-92; SOT54 plastic package
NPN complement: 2N5088.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

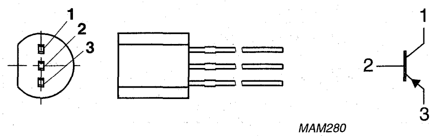


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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	–	–50	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -5$ V	250	–	
f_T	transition frequency	$I_C = -500$ µA; $V_{CE} = -5$ V; f = 100 MHz	40	–	MHz

PNP general purpose transistor 2N5087

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	–	–3	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -10$ V	–	–	–10	nA
		$I_E = 0$; $V_{CB} = -35$ V	–	–	–50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -3$ V	–	–	–50	nA
h_{FE}	DC current gain	$I_C = -100$ μA; $V_{CE} = -5$ V	250	–	800	
		$I_C = -1$ mA; $V_{CE} = -5$ V	250	–	–	
		$I_C = -10$ mA; $V_{CE} = -5$ V	250	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -1$ mA	–	–	–300	mV
V_{BE}	base-emitter voltage	$I_C = -1$ mA; $V_{CE} = -5$ V	–	–	–850	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -5$ V; f = 100 kHz	–	–	4	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -500$ mV; f = 1 MHz	–	12	–	pF
f_T	transition frequency	$I_C = -500$ μA; $V_{CE} = -5$ V; f = 100 MHz	40	–	–	MHz
F	noise figure	$I_C = -200$ μA; $V_{CE} = -5$ V; $R_S = 2$ kΩ; f = 10 Hz to 15.7 kHz	–	–	3	dB
		$I_C = -200$ μA; $V_{CE} = -5$ V; $R_S = 2$ kΩ; f = 1 kHz; B = 200 Hz	–	–	4	dB

NPN general purpose transistor 2N5088

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 30 V)

APPLICATIONS

- Low noise stages in audio equipment.

DESCRIPTION

NPN low noise transistor in a TO-92; SOT54 plastic package. PNP complement: 2N5087.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

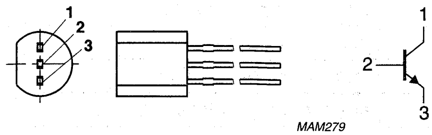


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	35	V
V_{CEO}	collector-emitter voltage	open base	–	30	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 5$ V	350	–	
f_T	transition frequency	$I_C = 500$ µA; $V_{CE} = 5$ V; f = 100 MHz	50	–	MHz
F	noise figure	$I_C = 200$ µA; $V_{CE} = 5$ V; $R_S = 2$ kΩ; f = 10 Hz to 15.7 kHz	–	3	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	–	35	V
V_{CEO}	collector-emitter voltage	open base	–	30	V
V_{EBO}	emitter-base voltage	open collector	–	4.5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4.5$ V	–	50	nA
h_{FE}	DC current gain	$I_C = 100$ µA; $V_{CE} = 5$ V	300	900	
		$I_C = 1$ mA; $V_{CE} = 5$ V	350	–	
		$I_C = 10$ mA; $V_{CE} = 5$ V	300	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	–	500	mV
V_{BE}	base-emitter voltage	$I_C = 10$ mA; $V_{CE} = 5$ V	–	800	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	4	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	12	pF
f_T	transition frequency	$I_C = 500$ µA; $V_{CE} = 5$ V; f = 100 MHz	50	–	MHz
F	noise figure	$I_C = 200$ µA; $V_{CE} = 5$ V; $R_S = 2$ kΩ; f = 10 Hz to 15.7 kHz	–	3	dB

PNP high-voltage transistors — 2N5400; 2N5401

FEATURES

- Low current (max. 300 mA)
- High voltage (max. 150 V).

APPLICATIONS

- General purpose switching and amplification
- Telephony applications.

DESCRIPTION

PNP high-voltage transistor in a TO-92; SOT54 plastic package. NPN complements: 2N5550 and 2N5551.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

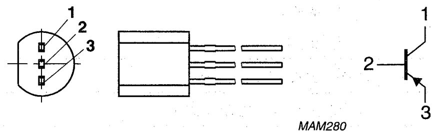


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	2N5400		–	–130	V
	2N5401		–	–160	V
V_{CEO}	collector-emitter voltage	open base			
	2N5400		–	–120	V
	2N5401		–	–150	V
I_{CM}	peak collector current		–	–600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	630	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = -5$ V			
	2N5400		40	–	
	2N5401		60	–	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 100 MHz			
	2N5400		100	400	MHz
	2N5401		100	300	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			
	2N5400		–	–130	V
	2N5401		–	–160	V
V_{CEO}	collector-emitter voltage	open base			
	2N5400		–	–120	V
	2N5401		–	–150	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–300	mA
I_{CM}	peak collector current		–	–600	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	630	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	note 1	200	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	2N5400	$I_E = 0$; $V_{CB} = -100$ V	–	−100	nA
		$I_E = 0$; $V_{CB} = -100$ V; $T_{amb} = 100$ °C	–	−100	μA
I_{CBO}	collector cut-off current				
	2N5401	$I_E = 0$; $V_{CB} = -120$ V	–	−50	nA
		$I_E = 0$; $V_{CB} = -120$ V; $T_{amb} = 100$ °C	–	−50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -4$ V	–	−50	nA
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -5$ V; see Fig.2			
	2N5400		30	–	
	2N5401		50	–	
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -5$ V; see Fig.2			
	2N5400		40	180	
	2N5401		60	240	
h_{FE}	DC current gain	$I_C = -50$ mA; $V_{CE} = -5$ V; see Fig.2			
	2N5400		40	–	
	2N5401		50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -1$ mA	–	−200	mV
		$I_C = -50$ mA; $I_B = -5$ mA	–	−500	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	6	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 100 MHz			
	2N5400		100	400	MHz
	2N5401		100	300	MHz
F	noise figure	$I_C = -200$ μA; $V_{CE} = -5$ V; $R_S = 2$ kΩ; f = 10 Hz to 15.7 kHz	–	8	pF

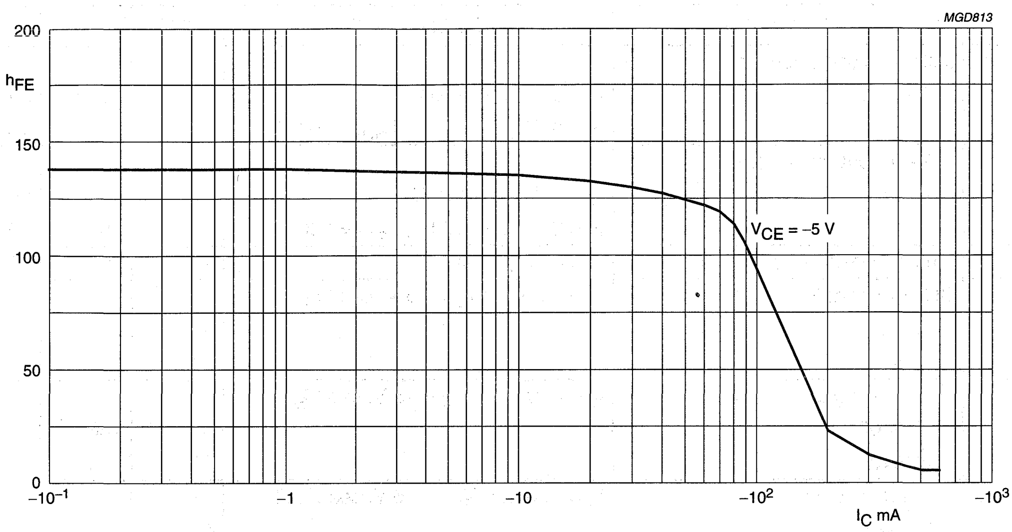


Fig.2 DC current gain; typical values.

PNP high-voltage transistors — 2N5415; 2N5416

FEATURES

- Low current (max. 200 mA)
- High voltage (max. 300 V).

APPLICATIONS

- Switching and linear amplification in military, industrial and consumer equipment.

DESCRIPTION

PNP high-voltage transistor in a TO-39 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

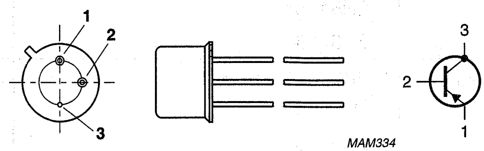


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	2N5415		–	–200	V
	2N5416		–	–350	V
V_{CEO}	collector-emitter voltage	open base			
	2N5415		–	–200	V
	2N5416		–	–300	V
I_{CM}	peak collector current		–	400	mA
P_{tot}	total power dissipation	$T_{amb} \leq 50$ °C	–	1	W
h_{FE}	DC current gain	$I_C = -50$ mA; $V_{CE} = -10$ V			
	2N5415		30	150	
	2N5416		30	120	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 5 MHz	15	–	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			
	2N5415		–	–200	V
	2N5416		–	–350	V
V_{CEO}	collector-emitter voltage	open base			
	2N5415		–	–200	V
	2N5416		–	–300	V
V_{EBO}	emitter-base voltage	open collector			
	2N5415		–	–4	V
	2N5416		–	–6	V
I_C	collector current (DC)		–	–200	mA
I_{CM}	peak collector current		–	–400	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 50$ °C	–	1	W
		$T_{case} \leq 25$ °C	–	10	W
T_{stg}	storage temperature		–65	+200	°C
T_j	junction temperature		–	200	°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	150	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		17.5	K/W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	2N5415	$I_E = 0$; $V_{CB} = -175$ V	–	–50	μA
	2N5416	$I_E = 0$; $V_{CB} = -280$ V	–	–50	μA
I_{EBO}	emitter cut-off current				
	2N5415	$I_C = 0$; $V_{EB} = -4$ V	–	–20	μA
	2N5416	$I_C = 0$; $V_{EB} = -6$ V	–	–20	μA
h_{FE}	DC current gain	$I_C = -50$ mA; $V_{CE} = -10$ V			
	2N5415		30	150	
	2N5416		30	120	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -50$ mA; $I_B = -5$ mA	–	–500	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	15	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -6$ V; f = 1 MHz	–	75	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 5 MHz	15	–	MHz

NPN high-voltage transistors 2N5550; 2N5551

FEATURES

- Low current (max. 300 mA)
- High voltage (max. 160 V).

APPLICATIONS

- Switching and amplification in high voltage applications such as telephony.

DESCRIPTION

NPN high-voltage transistor in a TO-92; SOT54 plastic package. PNP complements: 2N5400 and 2N5401.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

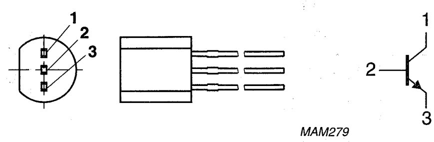


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	2N5550		–	160	V
	2N5551		–	180	V
V_{CEO}	collector-emitter voltage	open base			
	2N5550		–	140	V
	2N5551		–	160	V
I_{CM}	peak collector current		–	600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	630	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V			
	2N5550		60	–	
	2N5551		80	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	6	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	100	300	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			
	2N5550		–	160	V
	2N5551		–	180	V
V_{CEO}	collector-emitter voltage	open base			
	2N5550		–	140	V
	2N5551		–	160	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	300	mA
I_{CM}	peak collector current		–	600	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	630	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	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	200	K/W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	2N5550	$I_E = 0$; $V_{CB} = 100$ V	–	100	nA
		$I_E = 0$; $V_{CB} = 100$ V; $T_{amb} = 100$ °C	–	100	μA
I_{CBO}	collector cut-off current				
	2N5551	$I_E = 0$; $V_{CB} = 120$ V	–	50	nA
		$I_E = 0$; $V_{CB} = 120$ V; $T_{amb} = 100$ °C	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	50	nA
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 5$ V; see Fig.2			
	2N5550		60	–	
	2N5551		80	–	
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V; see Fig.2			
	2N5550		60	250	
	2N5551		80	250	
h_{FE}	DC current gain	$I_C = 50$ mA; $V_{CE} = 5$ V; see Fig.2			
	2N5550		20	–	
	2N5551		30	–	
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			
	2N5550		–	250	mV
	2N5551		–	200	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	–	1	V
		$I_C = 50$ mA; $I_B = 5$ mA	–	1	V
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
F	noise figure	$I_C = 200$ μA; $V_{CE} = 5$ V; $R_S = 2$ kΩ; f = 10 Hz to 15.7 kHz			
	2N5550		–	10	dB
	2N5551		–	8	dB

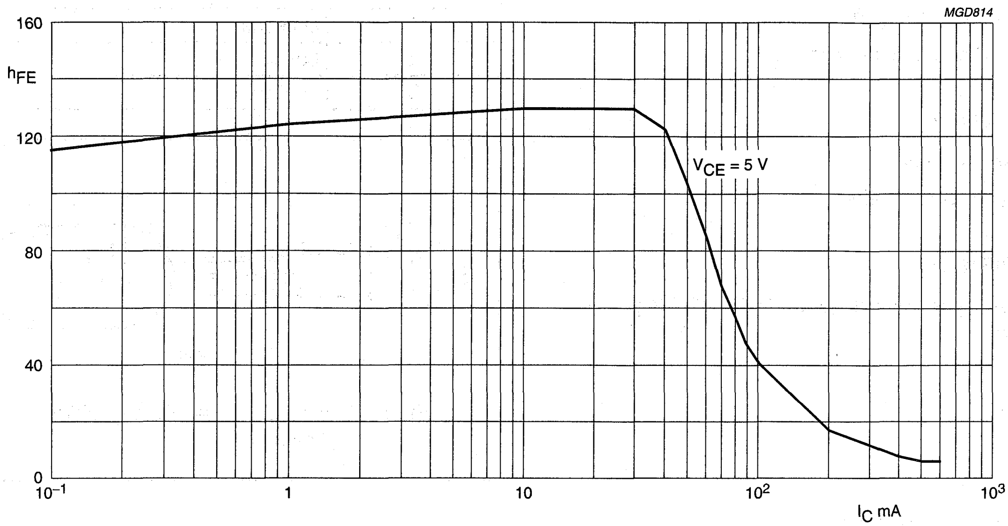


Fig.2 DC current gain; typical values.

NPN Darlington transistor | 2N6427

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 30 V)
- High DC current gain (min. 10000).

APPLICATIONS

- General purpose
- High gain amplification.

DESCRIPTION

NPN Darlington transistor in a TO-92; SOT54 plastic package.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

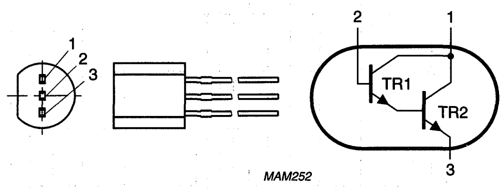


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	40	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	30	V
I_C	collector current		–	500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	625	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V	10000	100000	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	125	–	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_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	30	V
V_{EBO}	emitter-base voltage	open collector	–	10	V
I_C	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	800	mA
I_B	base current (DC)		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	625	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	200	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30$ V	–	100	nA
		$I_E = 0$; $V_{CB} = 30$ V; $T_j = 150$ °C	–	10	μA
I_{CES}	collector cut-off current	$V_{BE} = 0$; $I_B = 0$; $V_{CE} = 30$ V	–	100	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 10$ V	–	100	nA
h_{FE}	DC current gain	$V_{CE} = 5$ V; note 1			
		$I_C = 10$ mA	10000	100000	
		$I_C = 100$ mA	20000	200000	
		$I_C = 500$ mA	14000	140000	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 50$ mA; $I_B = 0.5$ mA; note 1	–	1.2	V
		$I_C = 500$ mA; $I_B = 0.5$ mA; note 1	–	1.5	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 500$ mA; $I_B = 0.5$ mA; note 1	–	2	V
V_{BEon}	base-emitter on-state voltage	$I_C = 50$ mA; $V_{CE} = 5$ V	–	1.75	V
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	125	–	MHz

Note

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

PNP general purpose transistor — 2PA733

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 50 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a TO-92; SOT54 plastic package.
NPN complement: 2PC945.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

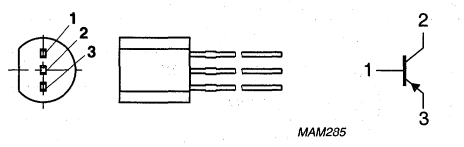


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	–60	V
V_{CEO}	collector-emitter voltage	open base	–	–	–50	V
I_{CM}	peak collector current		–	–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	500	mW
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -6$ V	135	–	600	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -6$ V; f = 100 MHz	100	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	–	–50	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless other specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -60$ V	–	–	–100	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–100	nA
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -6$ V				
	2PA733Q		135	–	270	
	2PA733P		200	–	400	
	2PA733K		300	–	600	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -100$ mA; $I_B = -10$ mA	–	–	–300	mV
V_{BE}	base-emitter voltage	$I_C = -1$ mA; $V_{CE} = -6$ V	–600	–	–700	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	4.5	6	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -0.5$ V; f = 1 MHz	–	10	–	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -6$ V; f = 100 MHz	100	180	–	MHz
F	noise figure	$I_C = -200$ μA; $V_{CE} = -5$ V; $R_S = 2$ kΩ; f = 1 kHz; B = 100 Hz	–	–	10	dB

PNP general purpose transistor | 2PA1015

FEATURES

- Low current (max. 150 mA)
- Low voltage (max. 50 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a plastic TO-92; SOT54 package.
NPN complement: 2PC1815.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

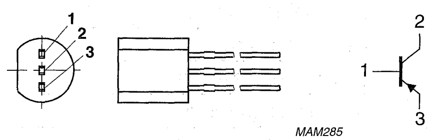


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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	–	–50	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -6$ V	120	700	
f_T	transition frequency	$I_E = -1$ mA; $V_{CB} = -10$ V; f = 100 MHz	80	–	MHz

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–50	V
V_{CEO}	collector-emitter voltage	open base	–	–50	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–150	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–100	nA
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -6$ V				
	2PA1015Y		120	–	240	
	2PA1015GR		200	–	400	
	2PA1015BL		350	–	700	
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -6$ V	25	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -100$ mA; $I_B = -10$ mA	–	–	–300	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -100$ mA; $I_B = -10$ mA	–	–	–1.1	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	4	7	pF
f_T	transition frequency	$I_C = -1$ mA; $V_{CB} = -10$ V; f = 100 MHz	80	–	–	MHz
F	noise figure	$I_C = -200$ μA; $V_{CE} = -5$ V; $R_S = 2$ kΩ; f = 1 kHz; B = 200 Hz	–	–	10	dB

PNP general purpose transistor 2PA1576

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 40 V)
- Low collector capacitance (typ. 2.5 pF).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a SC70; SOT323 plastic package.
NPN complement: 2PC4081.

MARKING

TYPE NUMBER	MARKING CODE
2PA1576Q	FtQ
2PA1576R	FtR
2PA1576S	FtS

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

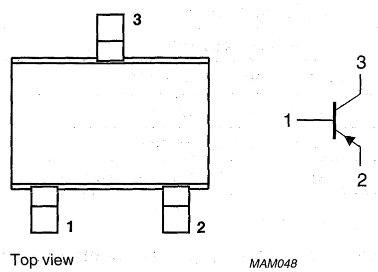


Fig.1 Simplified outline (SC70; SOT323) and symbol.

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	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -6$ V	120	560	
f_T	transition frequency	$I_C = -2$ mA; $V_{CE} = -12$V; f = 100 MHz	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
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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 SC70; SOT323 standard mounting conditions.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Refer to SC70; SOT323 standard mounting conditions.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -30$ V	–	–	–100	nA
		$I_E = 0$; $V_{CB} = -30$ V; $T_j = 150$ °C	–	–	–5	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -4$ V	–	–	–100	nA
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -6$ V				
	2PA1576Q		120	–	270	
	2PA1576R		180	–	390	
	2PA1576S		270	–	560	
V_{CEsat}	saturation voltage	$I_C = -50$ mA; $I_B = -5$ mA; note 1	–	–	–500	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -12$ V; f = 1 MHz	–	2.5	3.5	pF
f_T	transition frequency	$I_C = -2$ mA; $V_{CE} = -12$ V; f = 100 MHz	100	–	–	MHz

Note

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

PNP general purpose transistor 2PA1774

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- General purpose switching and amplification in communication, electronic data processing (EDP) and consumer applications.

DESCRIPTION

PNP transistor in an SC-75 plastic package.
NPN complement: 2PC4617.

MARKING

TYPE NUMBER	MARKING CODE
2PA1774Q	YQ
2PA1774R	YR
2PA1774S	YS

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

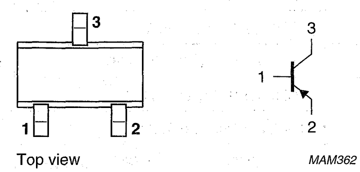


Fig.1 Simplified outline (SC-75) and symbol.

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_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	150	mW
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -6$ V	120	560	
f_T	transition frequency	$I_C = -2$ mA; $V_{CE} = -12$ V	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
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	150	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	833	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -30$ V	–	–100	nA
		$I_E = 0$; $V_{CB} = -30$ V; $T_j = 150$ °C	–	–5	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -4$ V	–	–100	nA
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -6$ V; note 1			
	2PA1774Q		120	270	
	2PA1774R		180	390	
	2PA1774S		270	560	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -50$ mA; $I_B = -5$ mA; note 1	–	–200	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -12$ V; f = 1 MHz	–	2.2	pF
f_T	transition frequency	$I_E = -2$ mA; $V_{CE} = -12$ V; f = 100 MHz; note 1	100	–	MHz

Note

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

PNP general purpose transistor | 2PB709A

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in an SC-59 plastic package.
NPN complement: 2PB601A.

MARKING

TYPE NUMBER	MARKING CODE
2PB709AQ	BQ
2PB709AR	BR
2PB709AS	BS

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

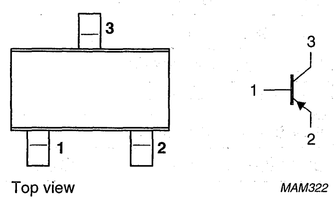


Fig.1 Simplified outline (SC-59) and symbol.

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_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -10$ V	160	460	
f_T	transition frequency	$I_C = -1$ mA; $V_{CE} = -10$ V; f = 100 MHz			
	2PB709AQ		60	–	MHz
	2PB709AR		70	–	MHz
	2PB709AS		80	–	MHz

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–45	V
V_{CEO}	collector-emitter voltage	open base	–	–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
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -45$ V	–	–10	nA
		$I_E = 0$; $V_{CB} = -45$ V; $T_j = 150$ °C	–	–5	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–10	nA
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -10$ V			
	2PB709AQ		160	260	
	2PB709AR		210	340	
	2PB709AS		290	460	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -100$ mA; $I_B = -10$ mA; note 1	–	–500	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	5	pF
f_T	transition frequency	$I_C = -1$ mA; $V_{CE} = -10$ V; f = 100 MHz			
	2PB709AQ		60	–	MHz
	2PB709AR		70	–	MHz
	2PB709AS		80	–	MHz

Note

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

PNP general purpose transistor — 2PB710A

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 50 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in an SC-59 plastic package.
NPN complement: 2PD602A.

MARKING

TYPE NUMBER	MARKING CODE
2PD710AQ	DQ
2PD710AR	DR
2PD710AS	DS

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

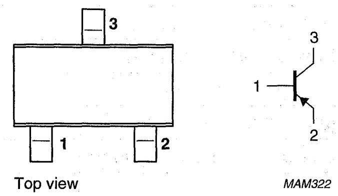


Fig.1 Simplified outline (SC-59) and symbol.

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	–	−50	V
I_{CM}	peak collector current		–	−1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -10$ V	85	340	
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -10$ V; f = 100 MHz			
	2PB710AQ		100	–	MHz
	2PB710AR		120	–	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	–	–60	V
V_{CEO}	collector-emitter voltage	open base	–	–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
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -60$ V	–	−10	nA
		$I_E = 0$; $V_{CB} = -60$ V; $T_j = 150$ °C	–	−5	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	−10	nA
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -10$ V; note 1			
	2PB710AQ		85	170	
	2PB710AR		120	240	
	2PB710AS		170	340	
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -10$ V; note 1	40	–	
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
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	15	pF
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -10$ V; f = 100 MHz; note 1			
	2PB710AQ		100	–	MHz
	2PB710AR		120	–	MHz
	2PB710AS		140	–	MHz

Note

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

PNP general purpose transistor 2PB1219A

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 50 V)
- Low collector-emitter saturation voltage (max. 600 mV).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a SOT323; SC70 plastic package.
NPN complement: 2PD1820A.

MARKING

TYPE NUMBER	MARKING CODE
2PB1219AQ	DtQ
2PB1219AR	DtR
2PB1219AS	DtS

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

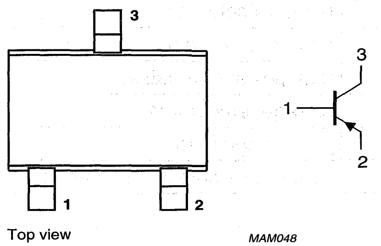


Fig.1 Simplified outline (SOT323; SC70) and symbol.

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	–	−50	V
I_{CM}	peak collector current		–	−1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -10$ V	85	340	
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = -10$ V; f = 100 MHz			
	2PB1219AQ		100	–	MHz
	2PB1219AR		120	–	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	–	–60	V
V_{CEO}	collector-emitter voltage	open base	–	–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
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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; SC70 standard mounting conditions.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Refer to SOT323; SC70 standard mounting conditions.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector 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	$I_C = 0$; $V_{EB} = -4$ V	–	−100	nA
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -10$ V; note 1			
	2PB1219AQ		85	170	
	2PB1219AR		120	240	
	2PB1219AS		170	340	
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -10$ V; note 1	40	–	
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
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	15	pF
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = -10$ V; f = 100 MHz; note 1			
	2PB1219AQ		100	–	MHz
	2PB1219AR		120	–	MHz
	2PB1219AS		140	–	MHz

Note

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

NPN general purpose transistor 2PC945

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 50 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistor in a TO-92; SOT54 plastic package.
PNP complement: 2PA733.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

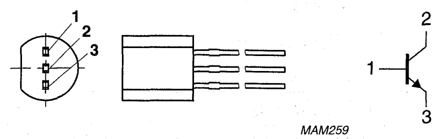


Fig.1 Simplified outline (TO-92; SO54) and symbol.

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	–	50	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 6$ V	135	600	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 6$ V; f = 100 MHz	150	450	MHz

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	60	V
V_{CEO}	collector-emitter voltage	open base	–	50	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 60$ V	–	–	100	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 0.1$ mA; $V_{CE} = 6$ V	50	–	–	
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 6$ V				
	2PC945Q		135	–	270	
	2PC945P		200	–	400	
	2PC945K		300	–	600	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 100$ mA; $I_B = 10$ mA	–	–	300	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 100$ mA; $I_B = 10$ mA	–	–	1.1	V
V_{BE}	base-emitter voltage	$I_C = 1$ mA; $V_{CE} = 6$ V	600	–	700	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	–	4	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	11	–	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 6$ V; f = 100 MHz	150	–	450	MHz
F	noise figure	$I_C = 200$ µA; $V_{CE} = 5$ V; $R_S = 2$ kΩ f = 1 kHz, B = 200 Hz	–	–	15	dB

NPN general purpose transistor 2PC1815

FEATURES

- Low current (max. 150 mA)
- Low voltage (max. 50 V).

APPLICATIONS

- General purpose switching and amplification, e.g. audio amplifier driver stages.

DESCRIPTION

NPN transistor in a TO-92; SOT54 plastic package.
PNP complement: 2PA1015.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

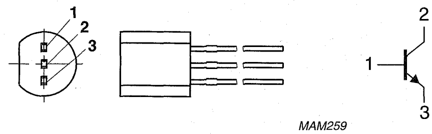


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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	–	50	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 6$ V	120	700	
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 6$ V; f = 100 MHz	80	–	MHz

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	60	V
V_{CEO}	collector-emitter voltage	open base	–	50	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	150	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 60$ V	–	–	100	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 6$ V	25	–	–	
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 6$ V				
	2PC1815Y		120	–	240	
	2PC1815GR		200	–	400	
	2PC1815BL		350	–	700	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 100$ mA; $I_B = 10$ mA	–	–	300	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 100$ mA; $I_B = 10$ mA	–	–	1.1	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	2.5	3.5	pF
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 6$ V; f = 100 MHz	80	–	–	MHz
F	noise figure	$I_C = 200$ μA; $V_{CE} = 5$ V; $R_S = 2$ kΩ; f = 1 kHz	–	–	10	dB

NPN general purpose transistor 2PC4081

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- General purpose switching
- Small signal amplification.

DESCRIPTION

NPN transistor in an SC-70 plastic package.
PNP complement: 2PA1576.

MARKING

TYPE NUMBER	MARKING CODE
2PC4081Q	ZtQ
2PC4081R	ZtR
2PC4081S	ZtS

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

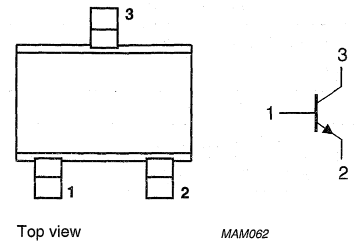


Fig.1 Simplified outline (SC-70) and symbol.

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_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 6$ V	120	560	
f_T	transition frequency	$I_C = 2$ mA; $V_{CE} = 12$ V; f = 100 MHz	100	–	MHz

NPN general purpose transistor 2PC4081

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
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30$ V	–	–	100	nA
		$I_E = 0$; $V_{CB} = 30$ V; $T_j = 150$ °C	–	–	5	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 6$ V				
	2PC4081Q		120	–	270	
	2PC4081R		180	–	390	
	2PC4081S		270	–	560	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 50$ mA; $I_B = 5$ mA; note 1	–	–	400	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 12$ V; f = 1 MHz	–	2	3.5	pF
f_T	transition frequency	$I_C = 2$ mA; $V_{CE} = 12$ V; f = 100 MHz	100	–	–	MHz

Note

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

NPN general purpose transistor 2PC4617

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 50 V).

APPLICATIONS

- General purpose switching and amplification in communication, electronic data processing (EDP) and consumer applications.

DESCRIPTION

NPN transistor in an SC-75 plastic package.
PNP complement: 2PA1774.

MARKING

TYPE NUMBER	MARKING CODE
2PC4617Q	ZQ
2PC4617R	ZR
2PC4617S	ZS

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

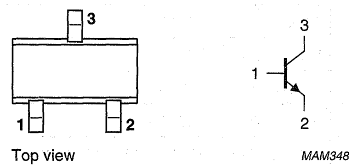


Fig.1 Simplified outline (SC-75) and symbol.

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	–	50	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	150	mW
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 6$ V	120	560	
f_T	transition frequency	$I_C = 2$ mA; $V_{CE} = 12$ V; f = 100 MHz	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	–	50	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	150	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	833	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30$ V	–	100	nA
		$I_E = 0$; $V_{CB} = 30$ V; $T_j = 150$ °C	–	5	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	100	nA
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 6$ V; note 1			
	2PC4617Q		120	270	
	2PC4617R		180	390	
	2PC4617S		270	560	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 50$ mA; $I_B = 5$ mA; note 1	–	200	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 12$ V; f = 1 MHz	–	1.5	pF
f_T	transition frequency	$I_C = 2$ mA; $V_{CE} = 12$ V; f = 100 MHz; note 1	100	–	MHz

Note

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

NPN general purpose transistor | 2PD601A

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 50 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistor in an SC-59 plastic package.
PNP complement: 2PB709A.

MARKING

TYPE NUMBER	MARKING CODE
2PD601AQ	ZQ
2PD601AR	ZR
2PD601AS	ZS

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

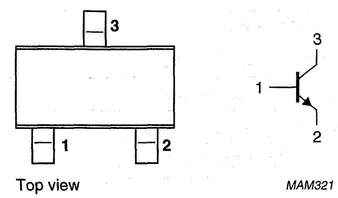


Fig.1 Simplified outline (SC-59) and symbol.

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	–	50	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 10$ V	160	460	
f_T	transition frequency	$I_C = 2$ mA; $V_{CE} = 10$ V; f = 100 MHz			
	2PD601AQ		100	–	MHz
	2PD601AR		120	–	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	–	60	V
V_{CEO}	collector-emitter voltage	open base	–	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
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 60 V	–	10	nA
		I_E = 0; V_{CB} = 60 V; T_j = 150 °C	–	5	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 5 V	–	10	nA
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 2 V; note 1	90	–	
h_{FE}	DC current gain	I_C = 2 mA; V_{CE} = 10 V; note 1			
	2PD601AQ		160	260	
	2PD601AR		210	340	
	2PD601AS		290	460	
V_{CEsat}	collector-emitter saturation voltage	I_C = 100 mA; I_B = 10 mA; note 1	–	500	mV
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = 10 V; f = 1 MHz	–	3.5	pF
f_T	transition frequency	I_C = 2 mA; V_{CE} = 10 V; f = 100 MHz			
	2PD601AQ		100	–	MHz
	2PD601AR		120	–	MHz
	2PD601AS		140	–	MHz

Note

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

NPN general purpose transistor 2PD602A

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 50 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistor in an SC-59 plastic package.
PNP complement: 2PB710A.

MARKING

TYPE NUMBER	MARKING CODE
2PD602AQ	XQ
2PD602AR	XR
2PD602AS	XS

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

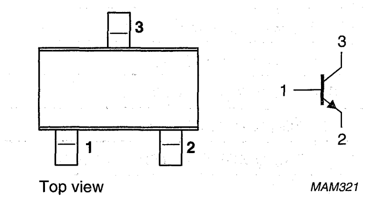


Fig.1 Simplified outline (SC-59) and symbol.

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	–	50	V
I_{CM}	peak collector current		–	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 10$ V	85	340	
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 10$ V; f = 100 MHz; note 1			
	2PD602AQ		140	–	MHz
	2PD602AR		160	–	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	–	60	V
V_{CEO}	collector-emitter voltage	open base	–	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
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 60$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 60$ V; $T_j = 150$ °C	–	5	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	10	nA
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 10$ V; note 1			
	2PD602AQ		85	170	
	2PD602AR		120	240	
	2PD602AS		170	340	
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 10$ V; note 1	40	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 300$ mA; $I_B = 30$ mA; note 1	–	600	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	15	pF
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 10$ V; f = 100 MHz; note 1			
	2PD602AQ		140	–	MHz
	2PD602AR		160	–	MHz
	2PD602AS		180	–	MHz

Note

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

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 50 V)
- Low collector-emitter saturation voltage (max. 600 mV).

APPLICATIONS

- General purpose switching and amplification, especially for portable equipment.

DESCRIPTION

NPN transistor in an SC-70; SOT323 plastic package.
PNP complement: 2PB1219A.

MARKING

TYPE NUMBER	MARKING CODE
2PD1820AQ	AtQ
2PD1820AR	AtR
2PD1820AS	AtS

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

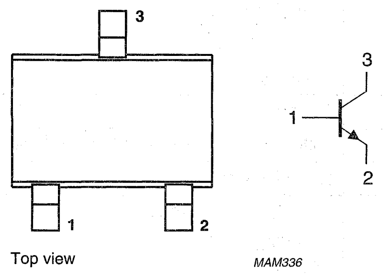


Fig.1 Simplified outline (SC-70; SOT323) and symbol.

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	–	50	V
I_{CM}	peak collector current		–	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 10$ V	85	340	
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 10$ 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	–	60	V
V_{CEO}	collector-emitter voltage	open base	–	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
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 20$ V; $T_j = 150$ °C	–	5	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	10	nA
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 10$ V; note 1			
	2PD1820AQ		85	170	
	2PD1820AR		120	240	
	2PD1820AS		170	340	
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 10$ V; note 1	40	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 300$ mA; $I_B = 30$ mA; note 1	–	600	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	15	pF
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 10$ V; f = 100 MHz; note 1	150	–	MHz

Note

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

NPN general purpose transistors | BC107; BC108; BC109

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistor in a TO-18; SOT18 metal package.
PNP complement: BC177..

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to the case

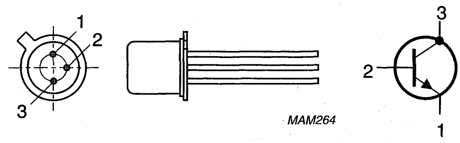


Fig.1 Simplified outline (TO-18; SOT18) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC107		–	50	V
	BC108; BC109		–	30	V
V_{CEO}	collector-emitter voltage	open base			
	BC107		–	45	V
	BC108; BC109		–	20	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	300	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V			
	BC107		110	450	
	BC108		110	800	
	BC109		200	800	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	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			
	BC107		–	50	V
	BC108; BC109		–	30	V
V_{CEO}	collector-emitter voltage	open base			
	BC107		–	45	V
	BC108; BC109		–	20	V
V_{EBO}	emitter-base voltage	open collector			
	BC107		–	6	V
	BC108; BC109		–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	300	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°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	note 1	0.5	K/mW
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		0.2	K/mW

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	–	15	nA
		$I_E = 0$; $V_{CB} = 20$ V; $T_j = 150$ °C	–	–	15	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 10$ μA; $V_{CE} = 5$ V				
	BC107A; BC108A		–	90	–	
	BC107B; BC108B; BC109B		40	150	–	
	BC108C; BC109C		100	270	–	
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V				
	BC107A; BC108A		110	180	220	
	BC107B; BC108B; BC109B		200	290	450	
	BC108C; BC109C		420	520	800	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	90	250	mV
		$I_C = 100$ mA; $I_B = 5$ mA	–	200	600	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA; note 1	–	700	–	mV
		$I_C = 100$ mA; $I_B = 5$ mA; note 1	–	900	–	mV
V_{BE}	base-emitter voltage	$I_C = 2$ mA; $V_{CE} = 5$ V; note 2	550	620	700	mV
		$I_C = 10$ mA; $V_{CE} = 5$ V; note 2	–	–	770	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	2.5	6	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	9	–	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CB} = 5$ V; f = 100 MHz	100	–	–	MHz
F	noise figure BC109B; BC109C	$I_C = 200$ μA; $V_{CE} = 5$ V; $R_S = 2$ kΩ; f = 30 Hz to 15.7 kHz	–	–	4	dB
F	noise figure BC107A; BC108A BC107B; BC108B; BC108C	$I_C = 200$ μA; $V_{CE} = 5$ V; $R_S = 2$ kΩ; f = 1 kHz; B = 200 Hz	–	–	10	dB
	BC109B; BC109C		–	–	4	dB

Notes

1. V_{BEsat} decreases by about 1.7 mV/K with increasing temperature.
2. V_{BE} decreases by about 2 mV/K with increasing temperature.

NPN medium power transistors BC140; BC141

FEATURES

- High current (max. 1 A)
- Low voltage (max. 60 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN medium power transistor in a TO-39 metal package.
PNP complements: BC160 and BC161.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

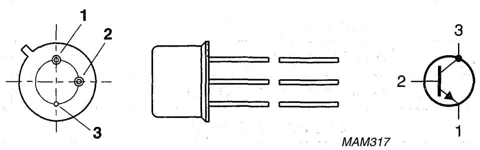


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BC140		–	–	80	V
	BC141		–	–	100	V
V_{CEO}	collector-emitter voltage	open base				
	BC140		–	–	40	V
	BC141		–	–	60	V
I_{CM}	peak collector current		–	–	1.5	A
P_{tot}	total power dissipation	$T_{case} \leq 45$ °C	–	–	3.7	W
h_{FE}	DC current gain	$I_C = 100$ mA; $V_{CE} = 1$ V				
	BC140-10; BC141-10		63	100	160	
	BC140-16; BC141-16		100	160	250	
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 10$ V; f = 100 MHz	50	–	–	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			
	BC140		–	80	V
	BC141		–	100	V
V_{CEO}	collector-emitter voltage	open base			
	BC140		–	40	V
	BC141		–	60	V
V_{EBO}	emitter-base voltage	open collector	–	7	V
I_C	collector current (DC)		–	1	A
I_{CM}	peak collector current		–	1.5	A
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{case} \leq 45$ °C	–	3.7	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°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	200	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		35	K/W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 60$ V	–	10	100	nA
		$I_E = 0$; $V_{CB} = 60$ V; $T_j = 150$ °C	–	10	100	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 100$ μA; $V_{CE} = 1$ V				
	BC140-10; BC141-10		–	40	–	
	BC140-16; BC141-16		–	90	–	
h_{FE}	DC current gain	$I_C = 100$ mA; $V_{CE} = 1$ V				
	BC140-10; BC141-10		63	100	160	
	BC140-16; BC141-16		100	160	250	
h_{FE}	DC current gain	$I_C = 1$ A; $V_{CE} = 1$ V				
	BC140-10; BC141-10		–	20	–	
	BC140-16; BC141-16		–	30	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 1$ A; $I_B = 100$ mA	–	0.6	1	V
V_{BE}	base-emitter voltage	$I_C = 1$ A; $V_{CE} = 1$ V	–	1.2	1.8	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	25	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	–	80	pF
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 10$ V; f = 100 MHz	50	–	–	MHz
Switching times (between 10% and 90% levels)						
t_{on}	turn-on time	$I_{Con} = 100$ mA; $I_{Bon} = 5$ mA; $I_{Boff} = -5$ mA	–	–	250	ns
t_{off}	turn-off time		–	–	850	ns

PNP medium power transistors BC160; BC161

FEATURES

- High current (max. 1 A)
- Low voltage (max. 60 V).

APPLICATIONS

- General purpose applications.

DESCRIPTION

PNP medium power transistor in a TO-39 metal package.
NPN complements: BC140 and BC141.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

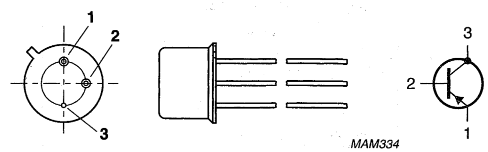


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BC160		–	–	–40	V
	BC161		–	–	–60	V
V_{CES}	collector-emitter voltage	open base				
	BC160		–	–	–40	V
	BC161		–	–	–60	V
I_{CM}	peak collector current		–	–	–1.5	A
P_{tot}	total power dissipation	$T_{case} \leq 45$ °C	–	–	3.7	W
h_{FE}	DC current gain	$I_C = -100$ mA; $V_{CE} = -1$ V				
	BC160-10; BC161-10		63	100	160	
	BC160-16; BC161-16		100	160	250	
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -10$ V; f = 100 MHz	50	–	–	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			
	BC160		–	–40	V
	BC161		–	–60	V
V_{CEO}	collector-emitter voltage	open base			
	BC160		–	–40	V
	BC161		–	–60	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–1	A
I_{CM}	peak collector current		–	–1.5	A
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{case} \leq 45$ °C	–	3.7	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°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	200	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		35	K/W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -40$ V	–	–10	–100	nA
		$I_E = 0$; $V_{CB} = -40$ V; $T_j = 150$ °C	–	–10	–100	µA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–100	nA
h_{FE}	DC current gain	$I_C = -100$ µA; $V_{CE} = -1$ V				
	BC160-10; BC161-10		–	80	–	
	BC160-16; BC161-16		–	120	–	
h_{FE}	DC current gain	$I_C = -100$ mA; $V_{CE} = -1$ V				
	BC160-10; BC161-10		63	100	160	
	BC160-16; BC161-16		100	160	250	
h_{FE}	DC current gain	$I_C = -1$ A; $V_{CE} = -1$ V				
	BC160-10; BC161-10		–	20	–	
	BC160-16; BC161-16		–	30	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -1$ A; $I_B = -100$ mA	–	–0.6	–1	V
V_{BE}	base-emitter voltage	$I_C = -1$ A; $V_{CE} = -1$ V	–	–1	–1.7	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	30	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -0.5$ V; f = 1 MHz	–	–	180	pF
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -10$ V; f = 100 MHz	50	–	–	MHz
Switching times (between 10% and 90% levels)						
t_{on}	turn-on time	$I_{Con} = -100$ mA; $I_{Bon} = -5$ mA; $I_{Boff} = 5$ mA	–	–	500	ns
t_{off}	turn-off time		–	–	650	ns

PNP general purpose transistor BC177

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a TO-18; SOT18 metal package.
NPN complement: BC107.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to the case

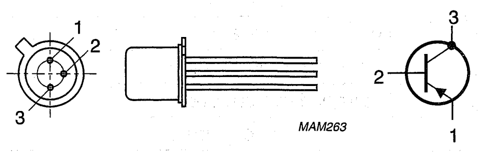


Fig.1 Simplified outline (TO-18; SOT18) and symbol.

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	–	–45	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	300	mW
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V	125	500	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	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	–	–45	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	300	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°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	note 1	0.5	K/mW
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		0.2	K/mW

Note

1. Transistor mounted on an FR4 printed-circuit board.

PNP general purpose transistor BC177

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −20 V	–	−1	−15	nA
		I_E = 0; V_{CB} = −20 V; T_j = 150 °C	–	–	−10	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −5 V	–	–	50	nA
h_{FE}	DC current gain	I_C = −2 mA; V_{CE} = −5 V	125	140	500	
h_{FE}	DC current gain	I_C = −2 mA; V_{CE} = −5 V				
	BC177A		125	180	260	
	BC177B		240	290	500	
V_{CEsat}	collector-emitter saturation voltage	I_C = −10 mA; I_B = −0.5 mA	–	−75	−300	mV
		I_C = −100 mA; I_B = −5 mA	–	−250	–	mV
V_{BEsat}	base-emitter saturation voltage	I_C = −10 mA; I_B = −0.5 mA	–	−700	–	mV
		I_C = −100 mA; I_B = −5 mA	–	−850	–	mV
V_{BE}	base-emitter voltage	I_C = −2 mA; V_{CE} = −5 V; note 1	−600	−650	−750	mV
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = −10 V; f = 1 MHz	–	4	6	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

Note

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

NPN general purpose transistor BC237

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistor in a TO-92; SOT54 plastic package.
PNP complement: BC307.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

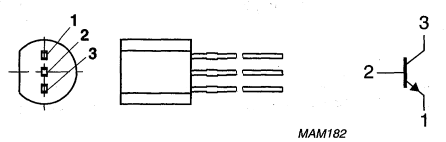


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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	–	45	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V			
	BC237		120	460	
	BC237B		200	460	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	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	–	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
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector 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
h_{FE}	DC current gain	$I_C = 0.1$ mA; $V_{CE} = 5$ V; see Fig.2	–	250	–	
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V; see Fig.2				
	BC237		120	–	460	
	BC237B		200	–	460	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 100$ mA; $I_B = 5$ mA; note 1	–	–	600	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 100$ mA; $I_B = 5$ mA	–	–	1200	mV
V_{BE}	base-emitter voltage	$I_C = 2$ mA; $V_{CE} = 5$ V	580	–	700	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	11	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	1.5	–	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

Note

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

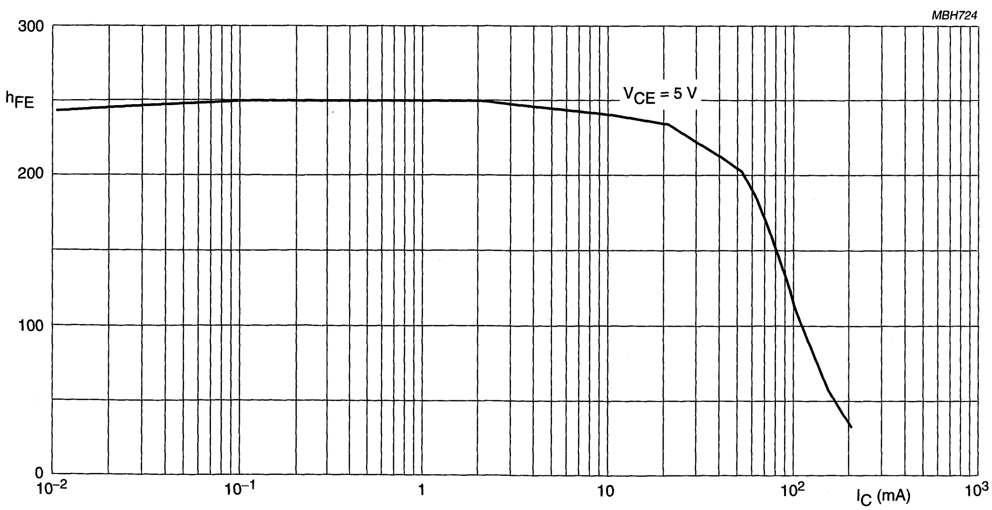


Fig.2 DC current gain; typical values.

PNP general purpose transistors | BC307; BC307B

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a TO-92; SOT54 plastic package.
NPN complements: BC237 and BC237B.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

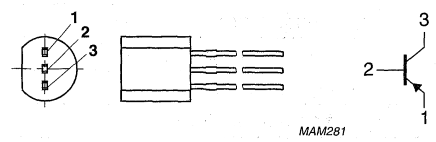


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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	–	–45	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V			
	BC307		125	455	
	BC307B		222	455	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	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	–	–45	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

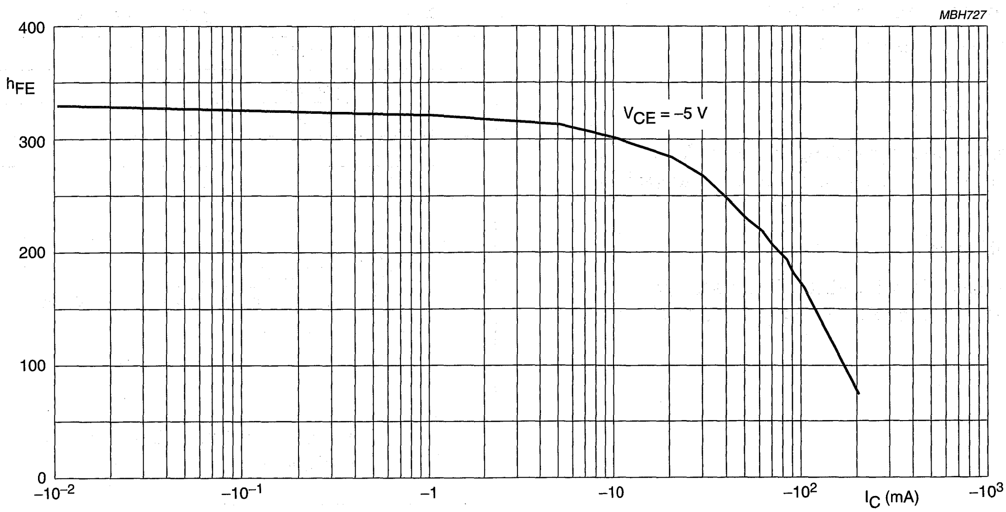
1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.



BC307B.

Fig.2 DC current gain; typical values.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector 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} = –4 V	–	–15	nA
h_{FE}	DC current gain	I_C = –2 mA; V_{CE} = –5 V; see Fig.2			
	BC307		125	455	
	BC307B		222	455	
V_{CEsat}	collector-emitter saturation voltage	I_C = –100 mA; I_B = –5 mA; note 1	–	–600	mV
V_{BEsat}	base-emitter saturation voltage	I_C = –100 mA; I_B = –5 mA; note 1	–	–1.1	V
V_{BE}	base-emitter voltage	I_C = –2 mA; V_{CE} = –5 V; note 1	600	720	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; note 1	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

Note

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

PNP general purpose transistors

BC327; BC327A; BC328

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 60 V).

APPLICATIONS

- General purpose switching and amplification, e.g. driver and output stages of audio amplifiers.

DESCRIPTION

PNP transistor in a TO-92; SOT54 plastic package.
NPN complements: BC337, BC337A and BC338.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

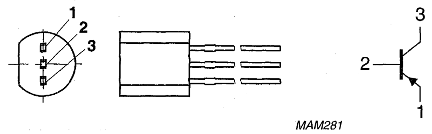


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC327		–	–50	V
	BC327A		–	–60	V
	BC328		–	–30	V
V_{CEO}	collector-emitter voltage	open base			
	BC327		–	–45	V
	BC327A		–	–60	V
	BC328		–	–25	V
I_{CM}	peak collector current		–	–1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	625	mW
h_{FE}	DC current gain	$I_C = -100$ mA; $V_{CE} = -1$ V			
	BC327; BC328		100	600	
	BC327A		100	400	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	80	–	MHz

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC327		–	–50	V
	BC327A		–	–60	V
	BC328		–	–30	V
V_{CEO}	collector-emitter voltage	open base			
	BC327		–	–45	V
	BC327A		–	–60	V
	BC328		–	–25	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–500	mA
I_{CM}	peak collector current		–	–1	A
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	625	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	0.2	K/mW

Note

1. Transistor mounted on an FR4 printed-circuit board.

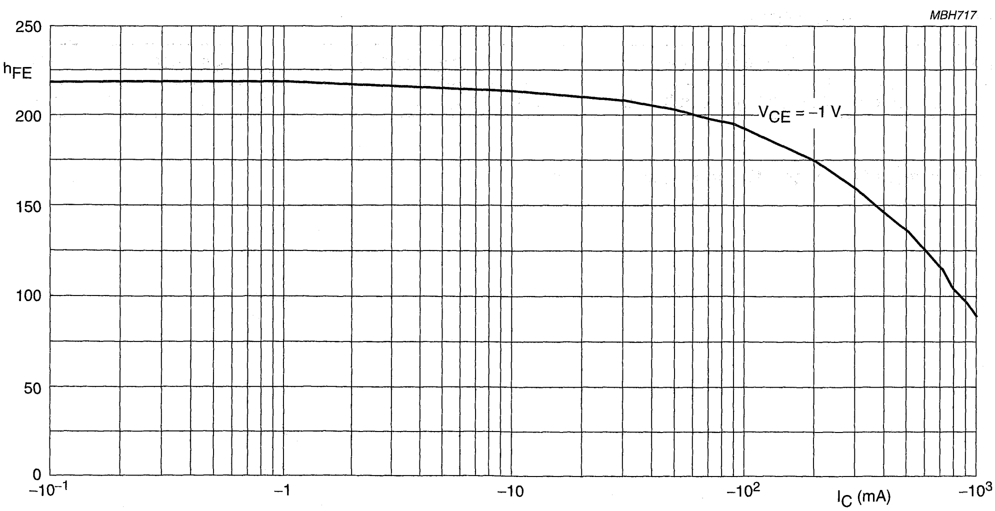
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −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
h_{FE}	DC current gain	I_C = −100 mA; V_{CE} = −1 V; see Figs 2, 3 and 4				
	BC327; BC328		100	–	600	
	BC327A		100	–	400	
	BC327-16; BC328-16		100	–	250	
	BC327-25; BC328-25		160	–	400	
	BC327-40; BC328-40		250	–	600	
h_{FE}	DC current gain	I_C = −500 mA; V_{CE} = −1 V; see Figs 2, 3 and 4	40	–	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = −500 mA; I_B = −50 mA	–	–	−700	mV
V_{BE}	base-emitter voltage	I_C = −500 mA; V_{CE} = −1 V; note 1	–	–	−1.2	V
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

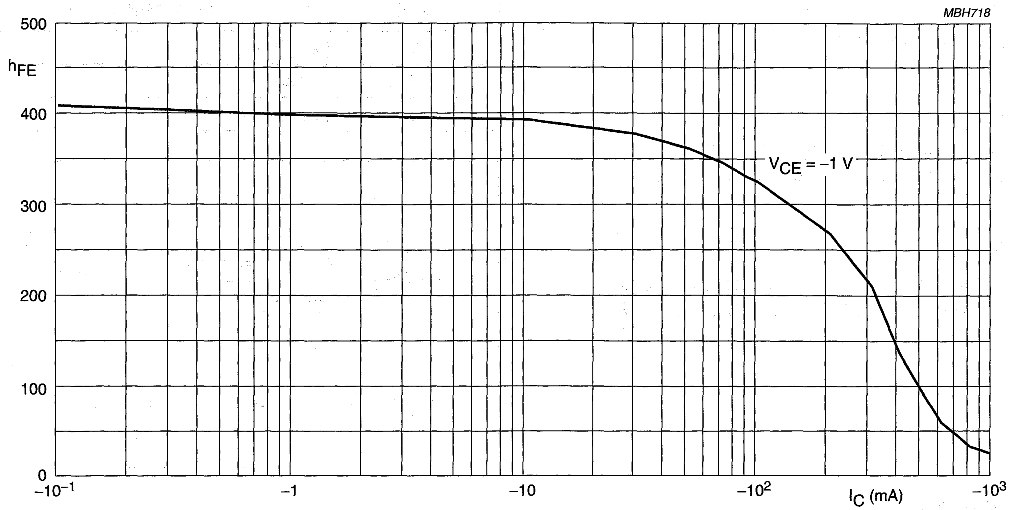
Note

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



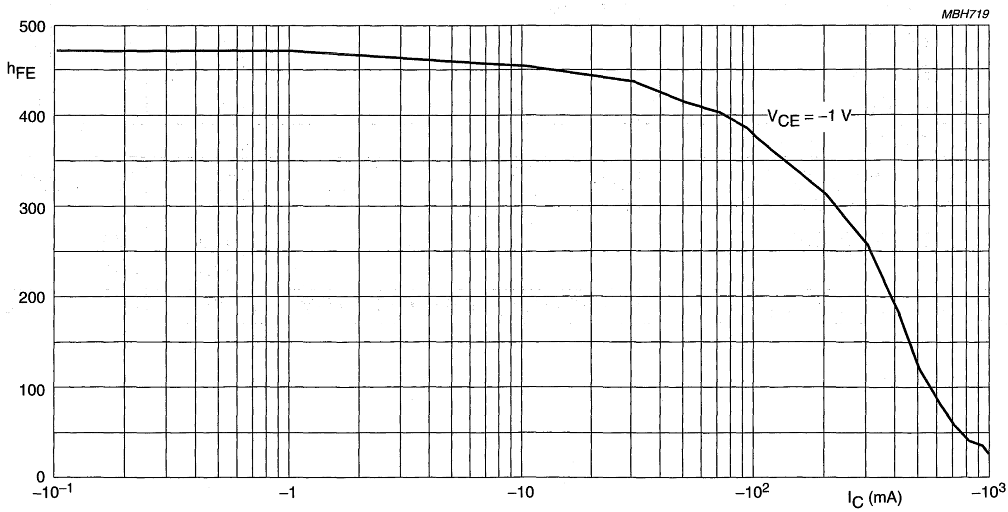
BC327-16; BC328-16.

Fig.2 DC current gain; typical values.



BC337-25; BC3378-25.

Fig.3 DC current gain; typical values.



BC327-40; BC328-40.

Fig.4 DC current gain; typical values.

NPN general purpose transistors | BC337; BC337A; BC338

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 60 V).

APPLICATIONS

- General purpose switching and amplification, e.g. driver and output stages of audio amplifiers.

DESCRIPTION

NPN transistor in a TO-92; SOT54 plastic package.
PNP complements: BC327, BC327A and BC328.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

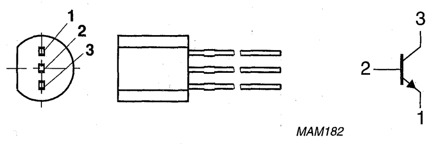


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC337		–	50	V
	BC337A		–	60	V
	BC338		–	30	V
V_{CEO}	collector-emitter voltage	open base			
	BC337		–	45	V
	BC337A		–	60	V
	BC338		–	25	V
I_{CM}	peak collector current		–	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	625	mW
h_{FE}	DC current gain	$I_C = 100$ mA; $V_{CE} = 1$ V			
	BC337; BC338		100	600	
	BC337A		100	400	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	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			
	BC337		–	50	V
	BC337A		–	60	V
	BC338		–	30	V
V_{CEO}	collector-emitter voltage	open base			
	BC337		–	45	V
	BC337A		–	60	V
	BC338		–	25	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	1	A
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	625	mW
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		−65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	0.2	K/mW

Note

1. Transistor mounted on an FR4 printed-circuit board.

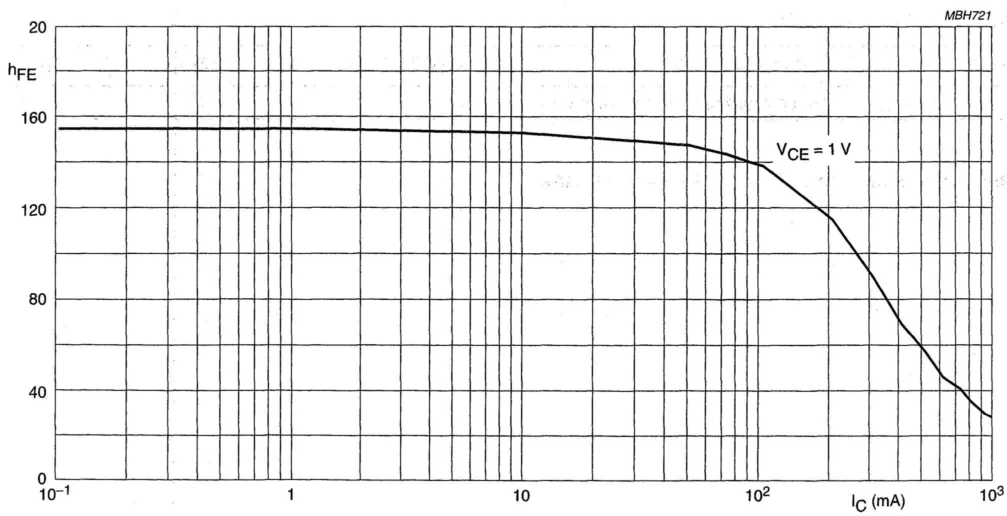
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 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
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 1 V; see Figs 2, 3 and 4				
	BC337; BC338		100	–	600	
	BC337A		100	–	400	
	BC337-16; BC338-16		100	–	250	
	BC337-25; BC338-25		160	–	400	
	BC337-40; BC338-40		250	–	600	
h_{FE}	DC current gain	I_C = 500 mA; V_{CE} = 1 V; see Figs 2, 3 and 4	40	–	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = 500 mA; I_B = 50 mA	–	–	700	mV
V_{BE}	base-emitter voltage	I_C = 500 mA; V_{CE} = 1 V; note 1	–	–	1.2	V
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

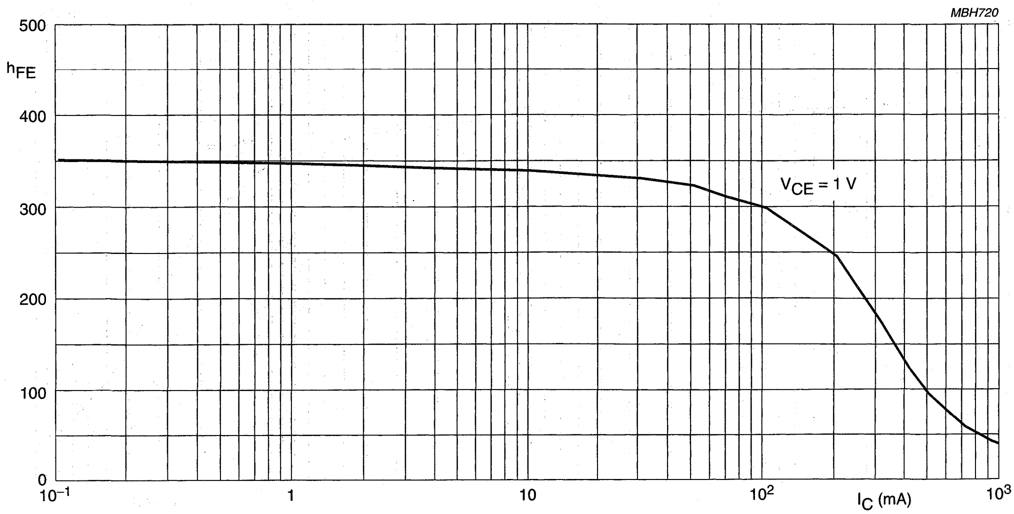
Note

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



BC337-16; BC338-16.

Fig.2 DC current gain; typical values.



BC337-25; BC3378-25.

Fig.3 DC current gain; typical values.

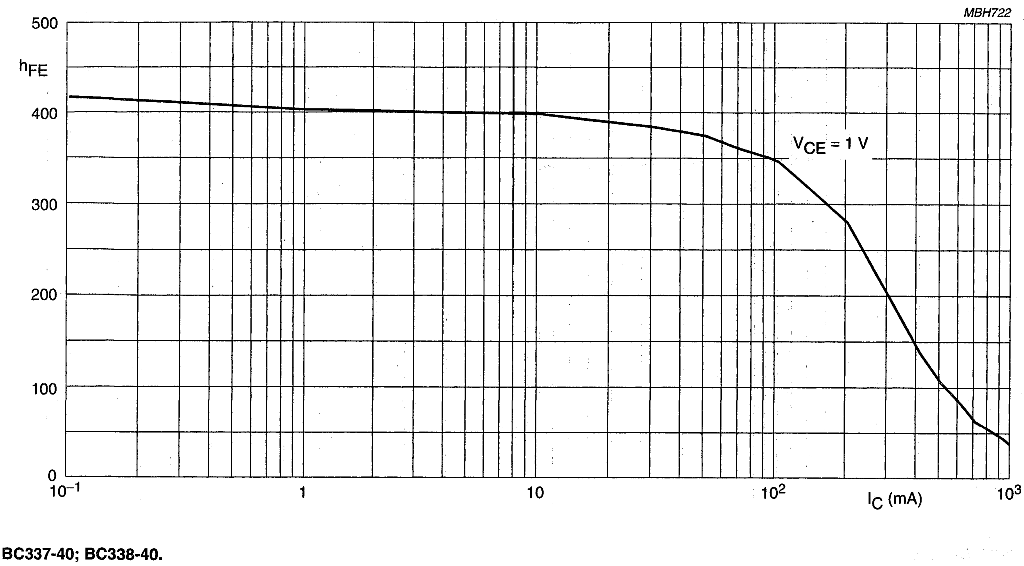


Fig.4 DC current gain; typical values.

NPN medium power transistor BC368

FEATURES

- High current (1 A)
- Low voltage (20 V).

APPLICATIONS

- General purpose switching and amplification
- Power applications such as audio output stages.

DESCRIPTION

NPN medium power transistor in a TO-92; SOT54 plastic package. PNP complement: BC369.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

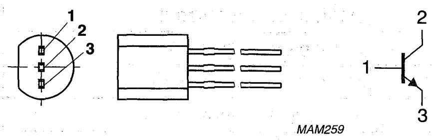


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	32	V
V_{CEO}	collector-emitter voltage	open base	–	20	V
I_{CM}	peak collector current		–	2	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	0.83	W
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 1$ V	85	375	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	40	–	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	–	32	V
V_{CEO}	collector-emitter voltage	open base	–	20	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	1	A
I_{CM}	peak collector current		–	2	A
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	0.83	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	150	K/W

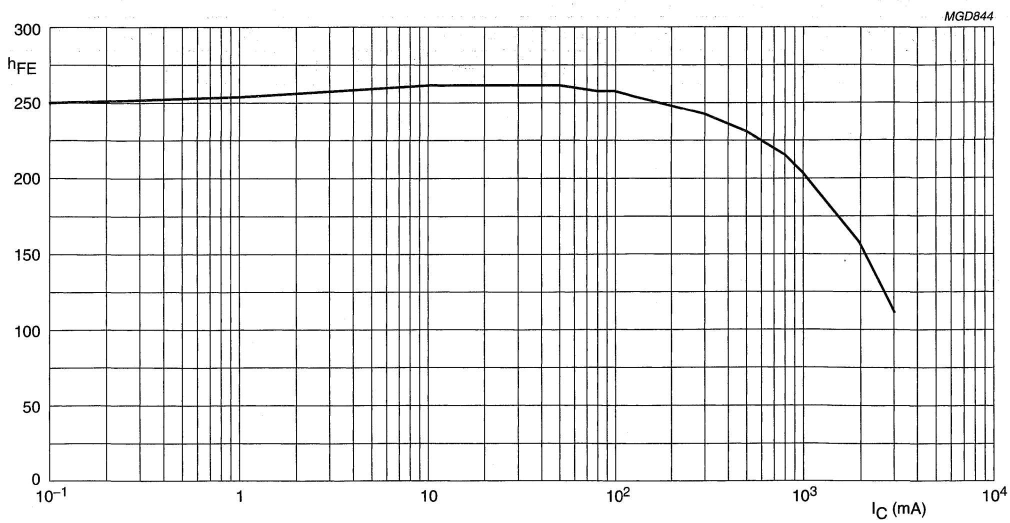
Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 25$ V	–	100	nA
		$I_E = 0$; $V_{CB} = 25$ V; $T_j = 150$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	100	nA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 10$ V	50	–	
		$I_C = 500$ mA; $V_{CE} = 1$ V; see Fig.2	85	375	
		$I_C = 1$ A; $V_{CE} = 1$ V; see Fig.2	60	–	
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 1$ V; see Fig.2			
	BC368-16		100	250	
	BC368-25		160	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 1$ A; $I_B = 100$ mA	–	500	mV
V_{BE}	base-emitter voltage	$I_C = 5$ mA; $V_{CE} = 10$ V	–	700	mV
		$I_C = 1$ A; $V_{CE} = 1$ V	–	1	V
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	40	–	MHz
$\frac{h_{FE1}}{h_{FE2}}$	DC current gain ratio of the complementary pairs	$\lvert I_C \rvert = 500$ mA; $\lvert V_{CE} \rvert = 1$ V	–	1.6	



$V_{CE} = 1$ V.

Fig.2 DC current gain; typical values.

PNP medium power transistor | BC369

FEATURES

- High current (max. 1 A)
- Low voltage (max. 20 V).

APPLICATIONS

- General purpose switching and amplification
- Power applications such as audio output stages.

DESCRIPTION

NPN medium power transistor in a TO-92; SOT54 plastic package. PNP complement: BC368.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

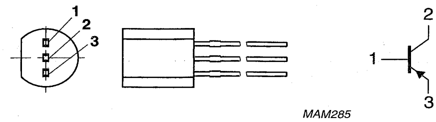


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–32	V
V_{CEO}	collector-emitter voltage	open base	–	–20	V
I_{CM}	peak collector current		–	–2	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	0.83	W
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -1$ V	85	375	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	40	–	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	–	–32	V
V_{CEO}	collector-emitter voltage	open base	–	–20	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–1	A
I_{CM}	peak collector current		–	–2	A
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	0.83	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	150	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −25 V	−	−100	nA
		I_E = 0; V_{CB} = −25 V; T_j = 150 °C	−	−10	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −5 V	−	−100	nA
h_{FE}	DC current gain	I_C = −5 mA; V_{CE} = −10 V	50	−	
		I_C = −500 mA; V_{CE} = −1 V; see Fig.2	85	375	
		I_C = −1 A; V_{CE} = −1 V; see Fig.2	60	−	
h_{FE}	DC current gain	I_C = −500 mA; V_{CE} = −1 V; see Fig.2			
	BC369-16		100	250	
	BC369-25		160	−	
V_{CEsat}	collector-emitter saturation voltage	I_C = −1 A; I_B = −100 mA	−	−0.5	V
V_{BE}	base-emitter voltage	I_C = −5 mA; V_{CE} = −10 V	−	−0.7	V
		I_C = −1 A; V_{CE} = −1 V	−	−1	V
f_T	transition frequency	I_C = −10 mA; V_{CE} = −5 V; f = 100 MHz	40	−	MHz
$\frac{h_{FE1}}{h_{FE2}}$	DC current gain ratio of the complementary pairs	$\lvert I_C \rvert$ = 500 mA; $\lvert V_{CE} \rvert$ = 1 V	−	1.6	

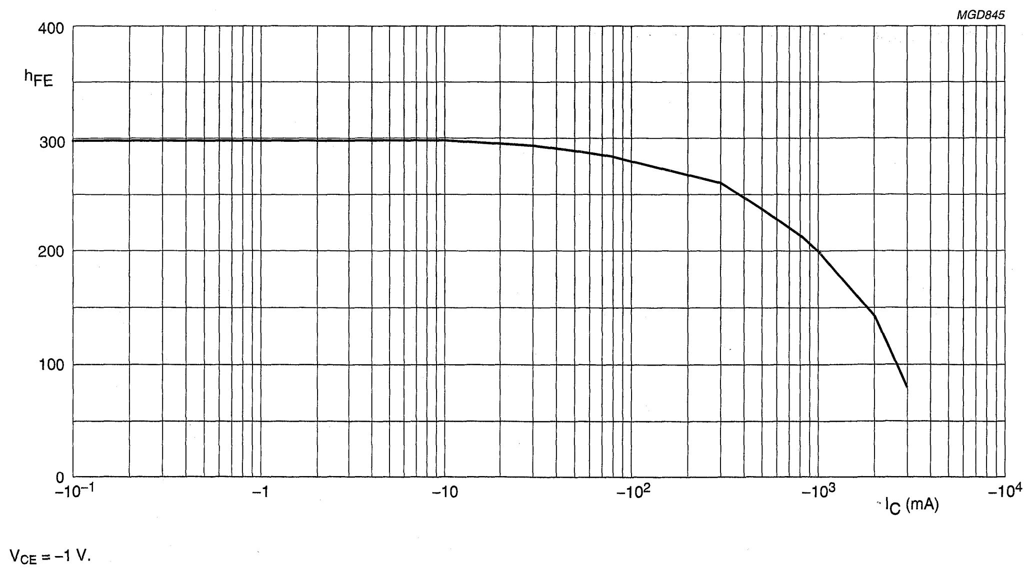


Fig.2 DC current gain; typical values.

PNP Darlington transistor | BC516

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 30 V)
- Very high DC current gain (min. 30000).

APPLICATIONS

- Where very high amplification is required.

DESCRIPTION

PNP Darlington transistor in a TO-92; SOT54 plastic package. NPN complement: BC517.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

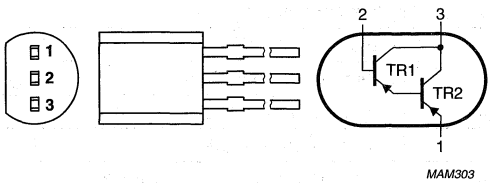


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	–40	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	–	–30	V
I_C	collector current (DC)		–	–	–500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	500	mW
h_{FE}	DC current gain	$I_C = -20$ mA; $V_{CE} = -2$ V	30000	–	–	
f_T	transition frequency	$I_C = -30$ mA; $V_{CE} = -5$ V; f = 100 MHz	–	220	–	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)	open emitter	–	–40	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	–30	V
V_{EBO}	emitter-base voltage	open collector	–	–10	V
I_C	collector current (DC)		–	–500	mA
I_{CM}	peak collector current		–	–800	mA
I_B	base current (DC)		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -30$ V	–	–	–100	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -10$ V	–	–	–100	nA
h_{FE}	DC current gain	$I_C = -20$ mA; $V_{CE} = -2$ V; see Fig.2	30000	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -100$ mA; $I_B = -0.1$ mA	–	–	–1	V
V_{BEsat}	base-emitter saturation voltage	$I_C = -100$ mA; $I_B = -0.1$ mA	–	–	–1.5	V
V_{BEon}	base-emitter on-state voltage	$I_C = -10$ mA; $V_{CE} = -5$ V	–	–	–1.4	V
f_T	transition frequency	$I_C = -30$ mA; $V_{CE} = -5$ V; f = 100 MHz	–	220	–	MHz

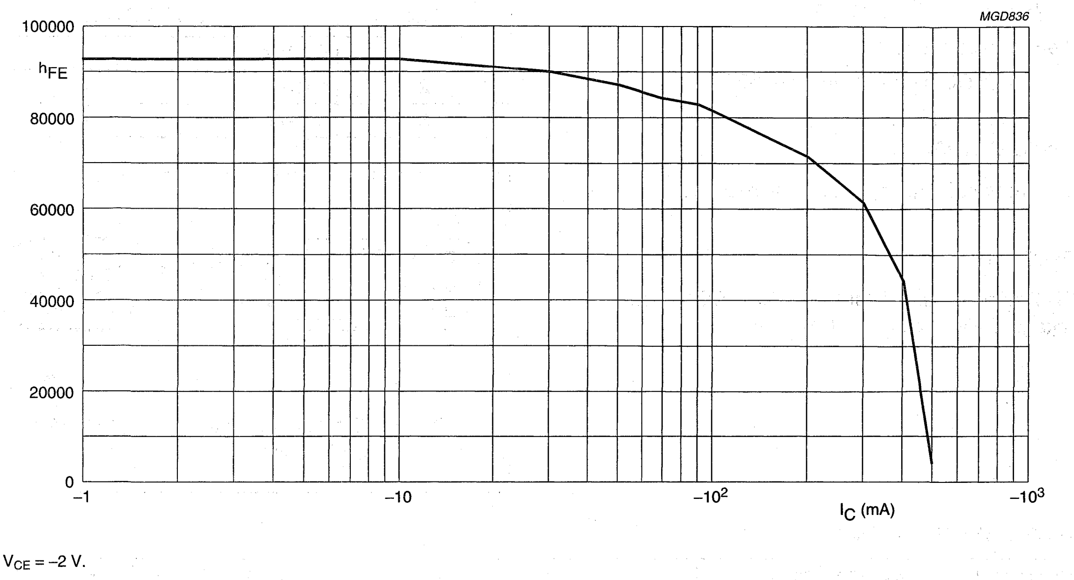


Fig.2 DC current gain; typical values.

NPN Darlington transistor BC517

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 30 V)
- Very high DC current gain (min. 30000).

APPLICATIONS

- Where very high amplification is required.

DESCRIPTION

NPN Darlington transistor in a TO-92; SOT54 plastic package. PNP complement: BC516.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

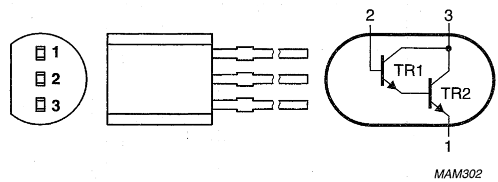


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	40	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	–	30	V
I_C	collector current (DC)		–	–	500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	500	mW
h_{FE}	DC current gain	$I_C = 20$ mA; $V_{CE} = 2$ V	30000	–	–	
f_T	transition frequency	$I_C = 30$ mA; $V_{CE} = 5$ V; f = 100 MHz	–	220	–	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_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	30	V
V_{EBO}	emitter-base voltage	open collector	–	10	V
I_C	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	800	mA
I_B	base current (DC)		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		−65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j-a}$	thermal resistance from junction to ambient	note 1	250	K/W

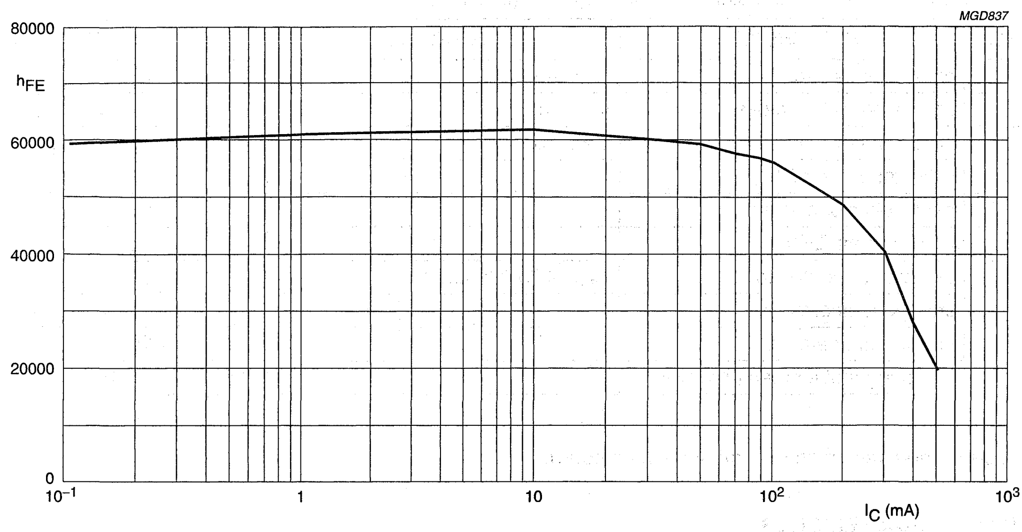
Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30$ V	–	–	100	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 10$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 20$ mA; $V_{CE} = 2$ V; see Fig.2	30000	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 100$ mA; $I_B = 0.1$ mA	–	–	1	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 100$ mA; $I_B = 0.1$ mA	–	–	1.5	V
V_{BEon}	base-emitter on-state voltage	$I_C = 10$ mA; $V_{CE} = 5$ V	–	–	1.4	V
f_T	transition frequency	$I_C = 30$ mA; $V_{CE} = 5$ V; f = 100 MHz	–	220	–	MHz



V_{CE} = 2 V.

Fig.2 DC current gain; typical values.

NPN general purpose transistors BC546; BC547; BC548

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 65 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistor in a TO-92; SOT54 plastic package.
PNP complements: BC556, BC557 and BC558.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

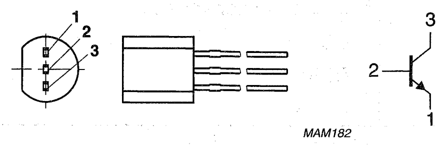


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC546		–	80	V
	BC547		–	50	V
	BC548		–	30	V
V_{CEO}	collector-emitter voltage	open base			
	BC546		–	65	V
	BC547		–	45	V
	BC548		–	30	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V			
	BC546		110	450	
	BC547		110	800	
	BC548		110	800	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	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			
	BC546		–	80	V
	BC547		–	50	V
	BC548		–	30	V
V_{CEO}	collector-emitter voltage	open base			
	BC546		–	65	V
	BC547		–	45	V
	BC548		–	30	V
V_{EBO}	emitter-base voltage	open collector			
	BC546		–	6	V
	BC547		–	6	V
	BC548		–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	0.25	K/mW

Note

1. Transistor mounted on an FR4 printed-circuit board.

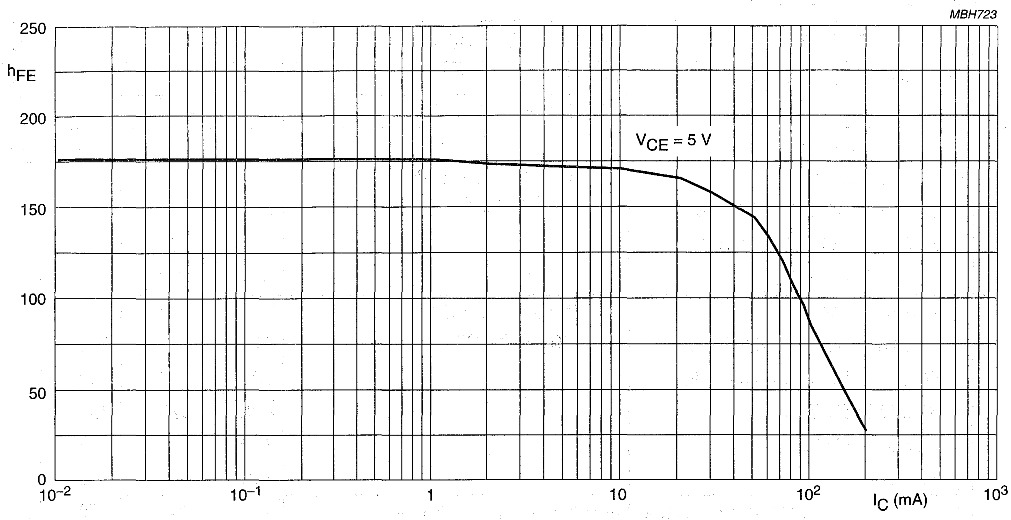
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30$ 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
h_{FE}	DC current gain	$I_C = 10$ μA; $V_{CE} = 5$ V; see Figs 2, 3 and 4				
	BC546A; BC547A; BC548A		–	90	–	
	BC546B; BC547B; BC548B		–	150	–	
	BC547C; BC548C		–	270	–	
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V; see Figs 2, 3 and 4				
	BC546A; BC547A; BC548A		110	180	220	
	BC546B; BC547B; BC548B		200	290	450	
	BC547C; BC548C		420	520	800	
	BC547; BC548		110	–	800	
	BC546		110	–	450	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	90	250	mV
		$I_C = 100$ mA; $I_B = 5$ mA	–	200	600	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA; note 1	–	700	–	mV
		$I_C = 100$ mA; $I_B = 5$ mA; note 1	–	900	–	mV
V_{BE}	base-emitter voltage	$I_C = 2$ mA; $V_{CE} = 5$ V; note 2	580	660	700	mV
		$I_C = 10$ mA; $V_{CE} = 5$ V	–	–	770	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	1.5	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	11	–	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	–	2	10	dB

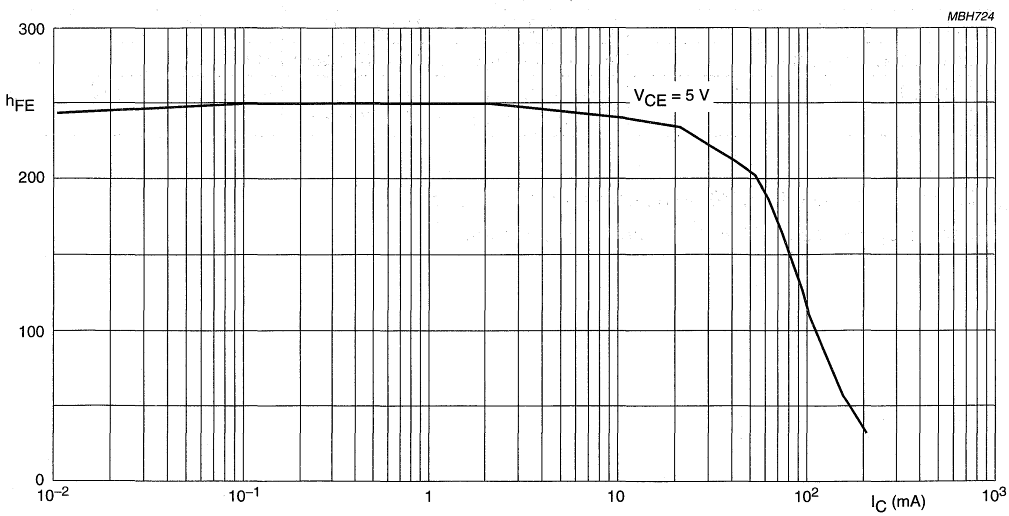
Notes

1. V_{BEsat} decreases by about 1.7 mV/K with increasing temperature.
2. V_{BE} decreases by about 2 mV/K with increasing temperature.



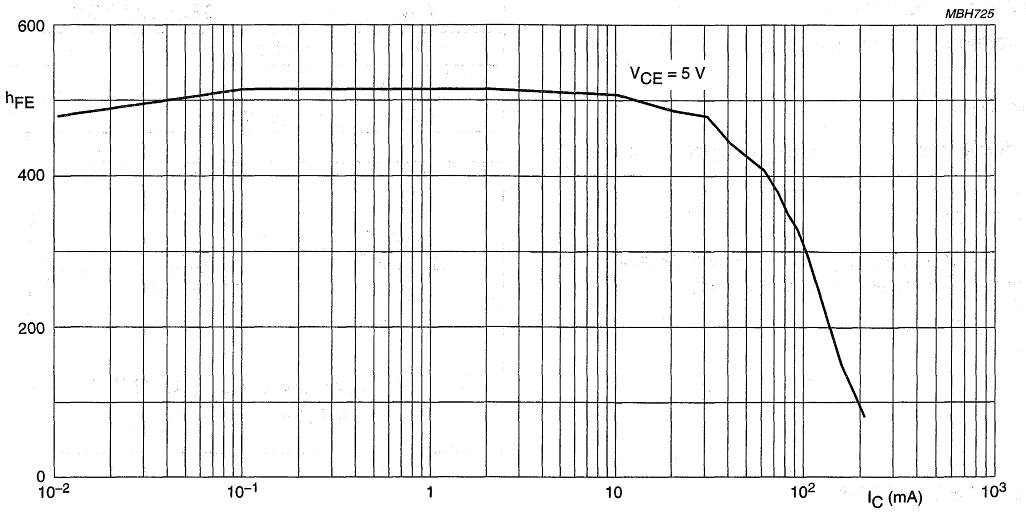
BC546A; BC547A; BC548A.

Fig.2 DC current gain; typical values.



BC546B; BC547B; BC548B.

Fig.3 DC current gain; typical values.



BC547C; BC548C.

Fig.4 DC current gain; typical values.

NPN general purpose transistors — BC549; BC550

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- Low noise stages in audio frequency equipment.

DESCRIPTION

NPN transistor in a TO-92; SOT54 plastic package.
PNP complements: BC559 and BC560.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

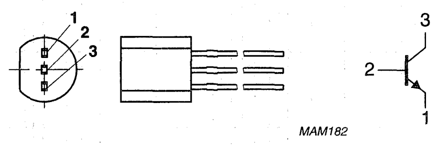


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC549		–	30	V
	BC550		–	50	V
V_{CEO}	collector-emitter voltage	open base			
	BC549		–	30	V
	BC550		–	45	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V	200	800	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	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			
	BC549		–	30	V
	BC550		–	50	V
V_{CEO}	collector-emitter voltage	open base			
	BC549		–	30	V
	BC550		–	45	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

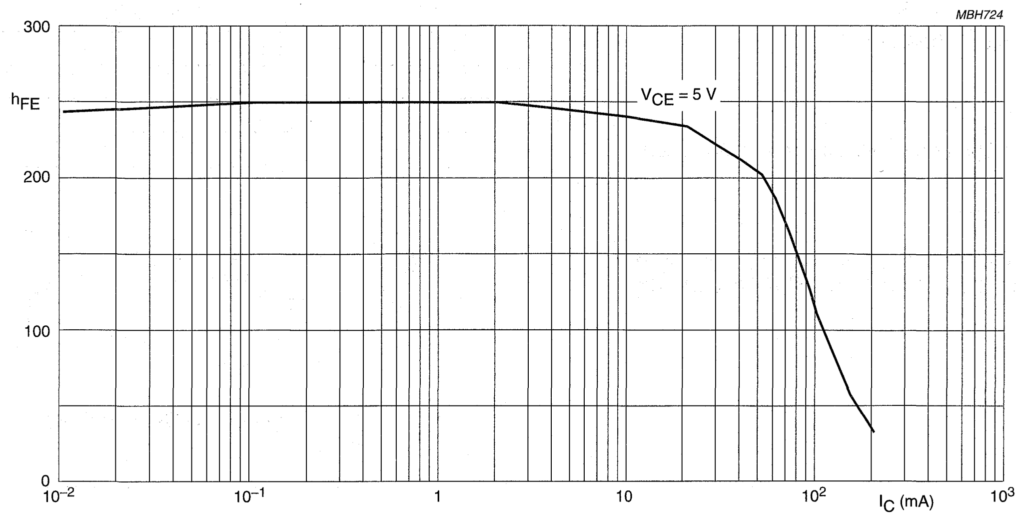
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 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
h_{FE}	DC current gain	I_C = 10 μA; V_{CE} = 5 V; see Figs 2 and 3				
	BC549B; BC550B		–	150	–	
	BC549C; BC550C		–	270	–	
h_{FE}	DC current gain	I_C = 2 mA; V_{CE} = 5 V; see Figs 2 and 3				
	BC549; BC550		200	–	800	
	BC549B; BC550B		200	290	450	
	BC549C; BC550C		420	520	800	
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA; I_B = 0.5 mA	–	90	250	mV
		I_C = 100 mA; I_B = 5 mA	–	200	600	mV
V_{BEsat}	base-emitter saturation voltage	I_C = 10 mA; I_B = 0.5 mA; note 1	–	700	–	mV
		I_C = 100 mA; I_B = 5 mA; note 1	–	900	–	mV
V_{BE}	base-emitter voltage	I_C = 2 mA; V_{CE} = 5 V; note 2	580	660	700	mV
		I_C = 10 mA; V_{CE} = 5 V; note 2	–	–	770	mV
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 10 V; f = 1 MHz	–	1.5	–	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = 0.5 V; f = 1 MHz	–	11	–	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 = 10 Hz to 15.7 kHz	–	–	4	dB
		I_C = 200 μA; V_{CE} = 5 V; R_S = 2 kΩ; f = 1 kHz; B = 200 Hz	–	–	4	dB

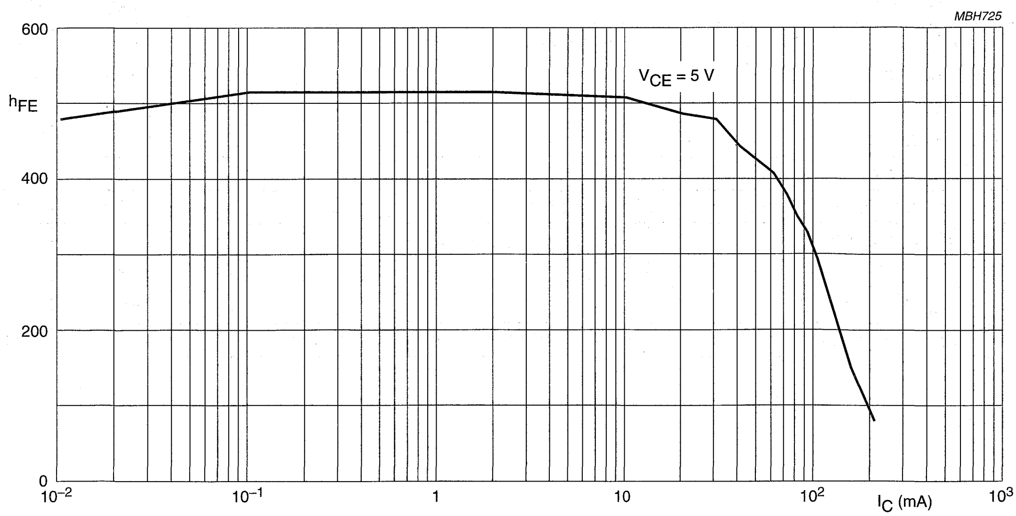
Notes

1. V_{BEsat} decreases by about 1.7 mV/K with increasing temperature.
2. V_{BE} decreases by about 2 mV/K with increasing temperature.



BC549B; BC550B.

Fig.2 DC current gain; typical values.



BC549C; BC550C.

Fig.3 DC current gain; typical values.

PNP general purpose transistors — BC556; BC557; BC558

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 65 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a TO-92; SOT54 plastic package.
NPN complements: BC546, BC547 and BC548.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

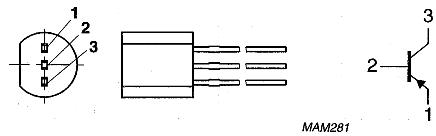


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC556		–	–80	V
	BC557		–	–50	V
	BC558		–	–30	V
V_{CEO}	collector-emitter voltage	open base			
	BC556		–	–65	V
	BC557		–	–45	V
	BC558		–	–30	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V			
	BC556		125	475	
	BC557; BC558		125	800	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	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			
	BC556		–	–80	V
	BC557		–	–50	V
	BC558		–	–30	V
V_{CEO}	collector-emitter voltage	open base			
	BC556		–	–65	V
	BC557		–	–45	V
	BC558		–	–30	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	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	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

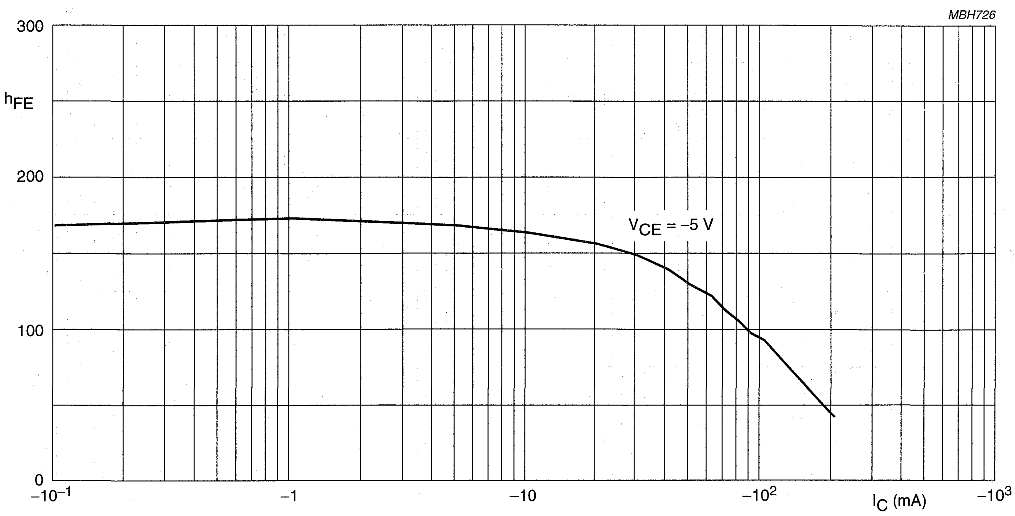
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −30 V	–	−1	−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
h_{FE}	DC current gain	I_C = −2 mA; V_{CE} = −5 V; see Figs 2, 3 and 4				
	BC556		125	–	475	
	BC557; BC558		125	–	800	
	BC556A; BC557A; BC558A		125	–	250	
	BC556B; BC557B; BC558B		220	–	475	
	BC557C; BC558C		420	–	800	
V_{CEsat}	collector-emitter saturation voltage	I_C = −10 mA; I_B = −0.5 mA	–	−60	−300	mV
		I_C = −100 mA; I_B = −5 mA	–	−180	−650	mV
V_{BEsat}	base-emitter saturation voltage	I_C = −10 mA; I_B = −0.5 mA; note 1	–	−750	–	mV
		I_C = −100 mA; I_B = −5 mA; note 1	–	−930	–	mV
V_{BE}	base-emitter voltage	I_C = −2 mA; V_{CE} = −5 V; note 2	−600	−650	−750	mV
		I_C = −10 mA; V_{CE} = −5 V; note 2	–	–	−820	mV
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = −10 V; f = 1 MHz	–	3	–	pF
C_e	emitter capacitance	I_C = i_c = 0; V_{EB} = −0.5 V; f = 1 MHz	–	10	–	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	–	2	10	dB

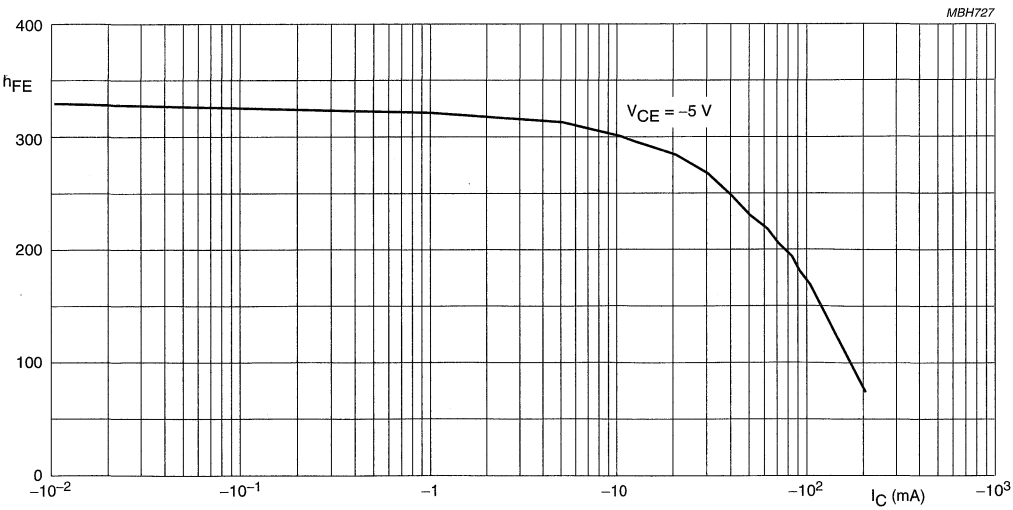
Notes

1. V_{BEsat} decreases by about −1.7 mV/K with increasing temperature.
2. V_{BE} decreases by about −2 mV/K with increasing temperature.



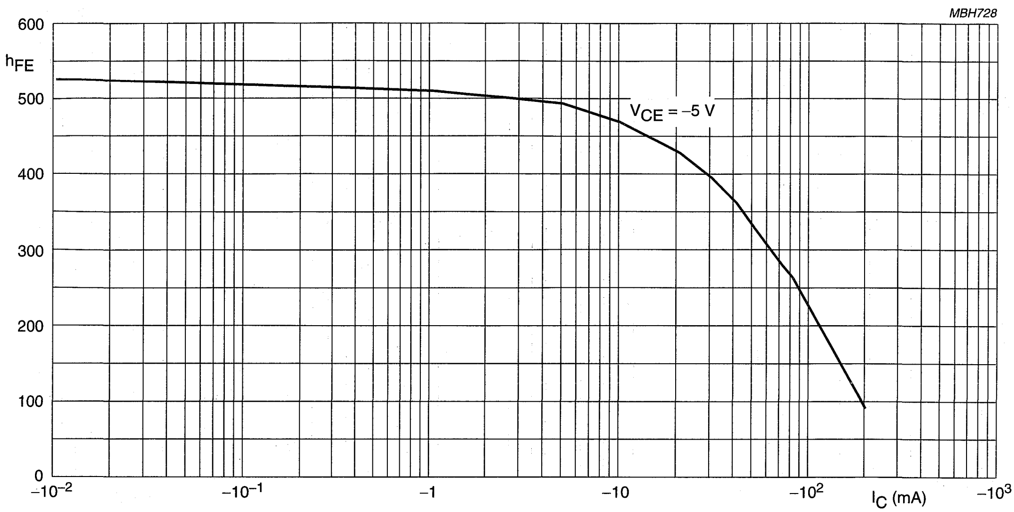
BC556A; BC557A; BC558A.

Fig.2 DC current gain; typical values.



BC556B; BC557B; BC558B.

Fig.3 DC current gain; typical values.



BC557C; BC558C.

Fig.4 DC current gain; typical values.

PNP general purpose transistors — BC559; BC560

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a TO-92; SOT54 plastic package.
NPN complements: BC549 and BC550.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

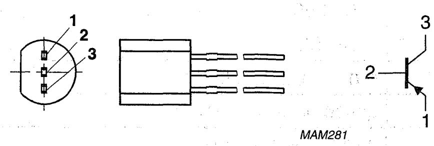


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC559		–	–30	V
	BC560		–	–50	V
V_{CEO}	collector-emitter voltage	open base			
	BC559		–	–30	V
	BC560		–	–45	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V	125	800	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	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			
	BC559		–	–30	V
	BC560		–	–50	V
V_{CEO}	collector-emitter voltage	open base			
	BC559		–	–30	V
	BC560		–	–45	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	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	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

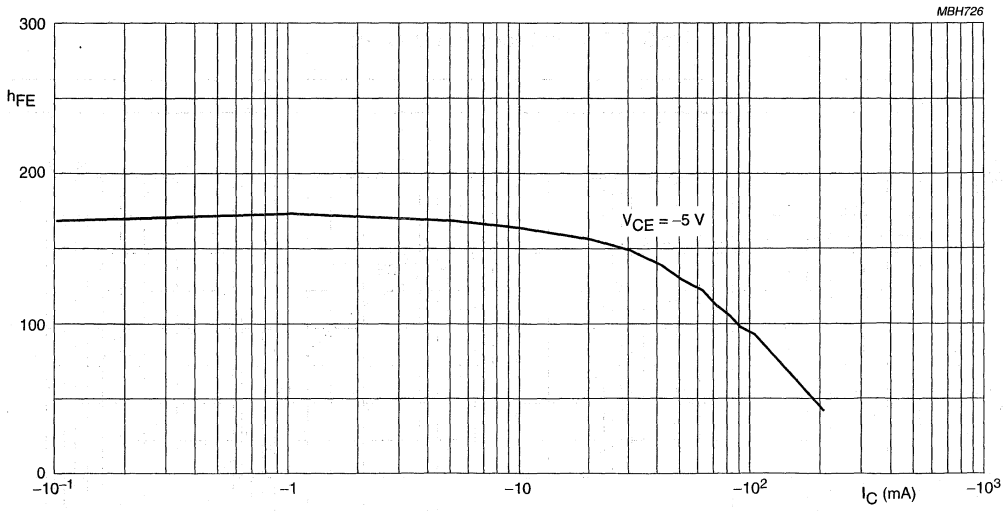
$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -30$ V	–	–1	–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
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V; see Figs 2, 3 and 4	125	–	800	
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V; see Figs 2, 3 and 4				
	BC559A		125	–	250	
	BC559B; BC560B		220	–	475	
	BC559C; BC560C		420	–	800	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–60	–300	mV
		$I_C = -100$ mA; $I_B = -5$ mA	–	–180	–650	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA; note 1	–	–750	–	mV
		$I_C = -100$ mA; $I_B = -5$ mA; note 1	–	–930	–	mV

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{BE}	base-emitter voltage	I_C = −2 mA; V_{CE} = −5 V; note 2	−600	−650	−750	mV
		I_C = −10 mA; V_{CE} = −5 V; note 2	−	−	−820	mV
C_c	collector capacitance	$I_E = i_e = 0$; V_{CB} = −10 V; f = 1 MHz	−	4	−	pF
f_T	transition frequency	I_E = −10 mA; V_{CB} = −5 V; f = 100 MHz	100	−	−	MHz
F	noise figure	I_C = −200 μA; V_{CE} = −5 V; R_S = 2 kΩ; f = 30 Hz to 15.7 kHz				
	BC559A; BC560A		−	−	10	dB
	BC559B; BC560B; BC559C; BC560C		−	−	4	dB
F	noise figure	I_C = −200 μA; V_{CE} = −5 V; R_S = 2 kΩ; f = 1 kHz; B = 200 Hz				
	BC559A; BC560A		−	−	10	dB
	BC559B; BC560B; BC559C; BC560C		−	−	4	dB

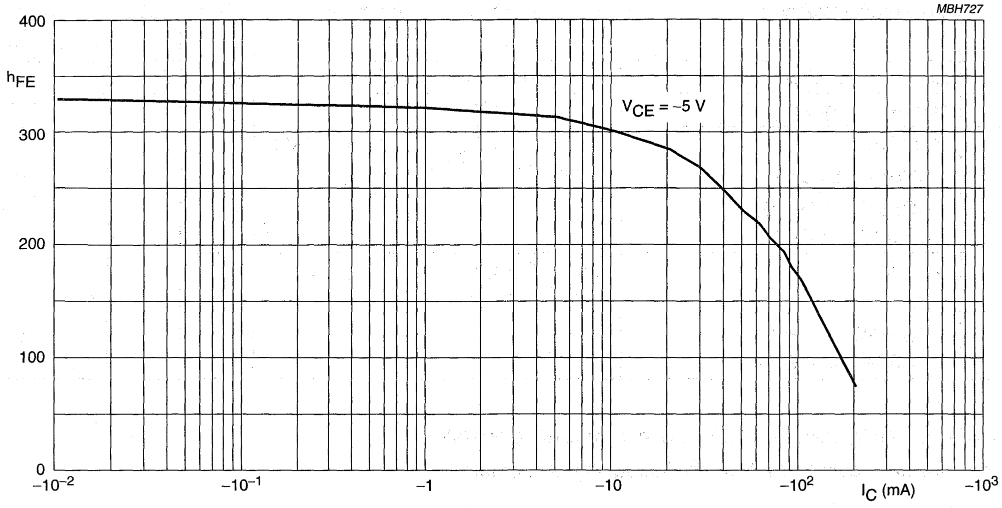
Notes

1. V_{BEsat} decreases by about −1.7 mV/K with increasing temperature.
2. V_{BE} decreases by about −2 mV/K with increasing temperature.



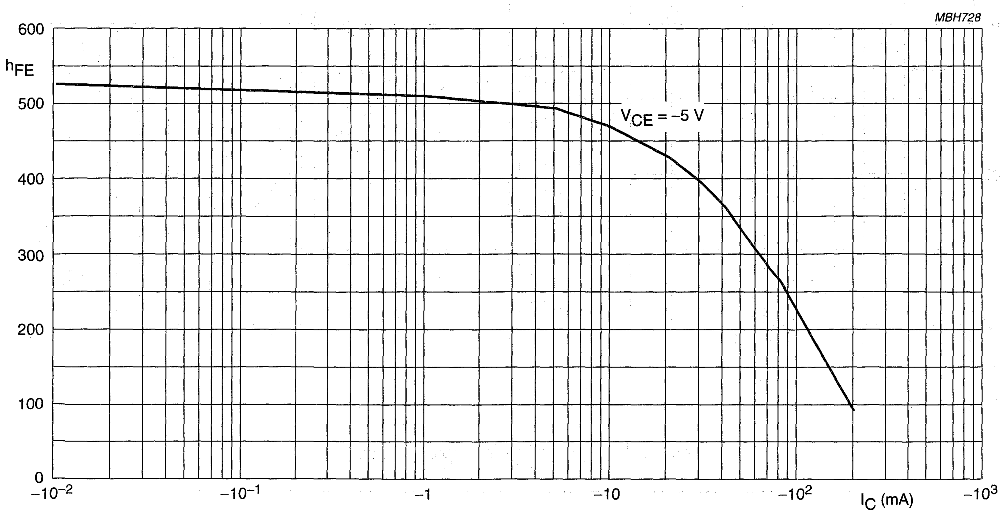
BC559A.

Fig.2 DC current gain; typical values.



BC559B; BC560B.

Fig.3 DC current gain; typical values.



B559C; BC560C.

Fig.4 DC current gain; typical values.

NPN Darlington transistors BC617; BC618

FEATURES

- Low current (max. 500 mA)
- Low voltage (max. 55 V)
- High DC current gain.

APPLICATIONS

- General purpose low frequency
- Relay drivers.

DESCRIPTION

NPN Darlington transistor in a TO-92; SOT54 plastic package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

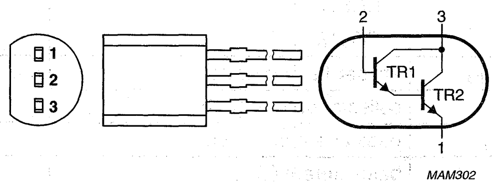


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC617		–	50	V
	BC618		–	80	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BC617		–	40	V
	BC618		–	55	V
I_C	collector current		–	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 5$ V			
	BC617		4000	–	
	BC618		2000	–	
f_T	transition frequency	$I_C = 500$ mA; $V_{CE} = 5$ V; f = 100 MHz	155	–	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			
	BC617		–	50	V
	BC618		–	80	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BC617		–	40	V
	BC618		–	55	V
V_{EBO}	emitter-base voltage	open collector	–	12	V
I_C	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	800	mA
I_B	base current (DC)		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		−65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j-a}$	thermal resistance from junction to ambient	note 1	250	K/W

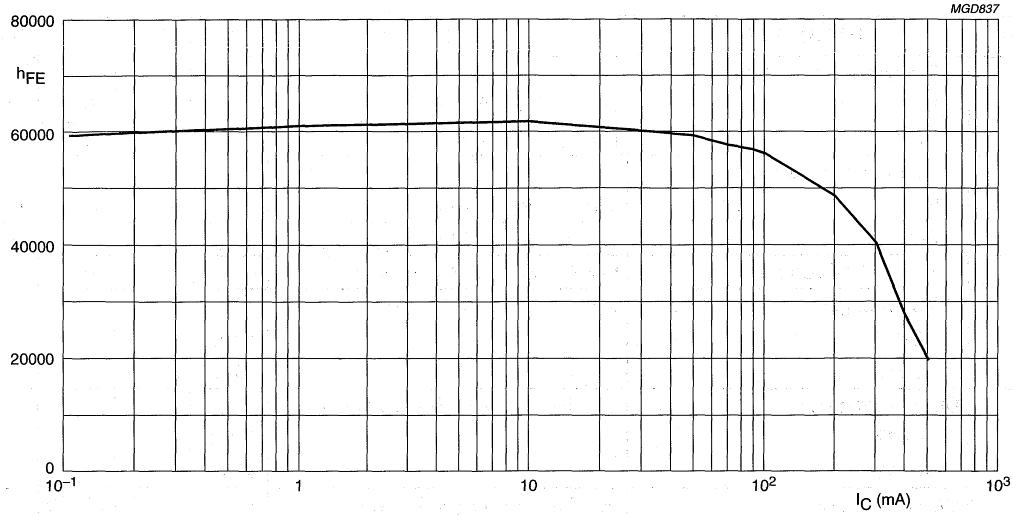
Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current					
	BC617	$I_E = 0$; $V_{CB} = 40$ V	–	–	50	nA
	BC618	$I_E = 0$; $V_{CB} = 60$ V	–	–	50	nA
I_{CES}	collector cut-off current					
	BC617	$V_{BE} = 0$; $V_{CE} = 40$ V	–	–	50	μA
	BC618	$V_{BE} = 0$; $V_{CE} = 60$ V	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 10$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 5$ V; see Fig.2		–		
	BC617		4000	–	–	
	BC618		2000	–	–	
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V; see Fig.2		–		
	BC617		10000	–	–	
	BC618		4000	–	–	
h_{FE}	DC current gain	$I_C = 200$ mA; $V_{CE} = 5$ V; see Fig.2	10000	–	70000	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 200$ mA; $I_B = 0.2$ mA	–	–	1.1	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 200$ mA; $I_B = 0.2$ mA	–	–	1.6	V
C_c	collector capacitance	$I_E = 0$; $V_{CB} = 30$ V	–	3.5	–	pF
f_T	transition frequency	$I_C = 500$ mA; $V_{CE} = 5$ V; f = 100 MHz	155	–	–	MHz



V_{CE} = 2 V.

Fig.2 DC current gain; typical values.

NPN medium power transistors BC635; BC637; BC639

FEATURES

- High current (max. 1 A)
- Low voltage (max. 80 V).

APPLICATIONS

- Driver stages of audio/video amplifiers.

DESCRIPTION

NPN transistor in a TO-92; SOT54 plastic package.
PNP complements: BC636, BC638 and BC640.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

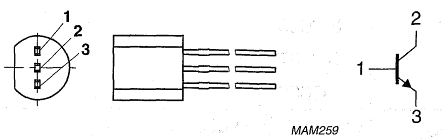


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC635		–	45	V
	BC637		–	60	V
	BC639		–	100	V
V_{CEO}	collector-emitter voltage	open base			
	BC635		–	45	V
	BC637		–	60	V
	BC639		–	80	V
I_{CM}	peak collector current		–	1.5	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	0.83	W
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 2$ V	40	250	
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 5$ V; f = 100 MHz	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			
	BC635		–	45	V
	BC637		–	60	V
	BC639		–	100	V
V_{CEO}	collector-emitter voltage	open base			
	BC635		–	45	V
	BC637		–	60	V
	BC639		–	80	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	1	A
I_{CM}	peak collector current		–	1.5	A
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	0.83	W
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	note 1	150	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30$ V	–	100	nA
		$I_E = 0$; $V_{CB} = 30$ V; $T_j = 150$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	100	nA
h_{FE}	DC current gain	$V_{CE} = 2$ V; see Fig.2			
		$I_C = 5$ mA	40	–	
		$I_C = 150$ mA	40	250	
		$I_C = 500$ mA	25	–	
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 2$ V; see Fig.2			
	BC635-10; BC637-10; BC639-10		63	160	
	BC635-16; BC637-16; BC639-16		100	250	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 500$ mA; $I_B = 50$ mA	–	500	mV
V_{BE}	base-emitter voltage	$I_C = 500$ mA; $V_{CE} = 2$ V	–	1	V
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 5$ V; f = 100 MHz	100	–	MHz
$\frac{h_{FE1}}{h_{FE2}}$	DC current gain ratio of the complementary pairs	$\lvert I_C \rvert = 150$ mA; $\lvert V_{CE} \rvert = 2$ V	–	1.6	

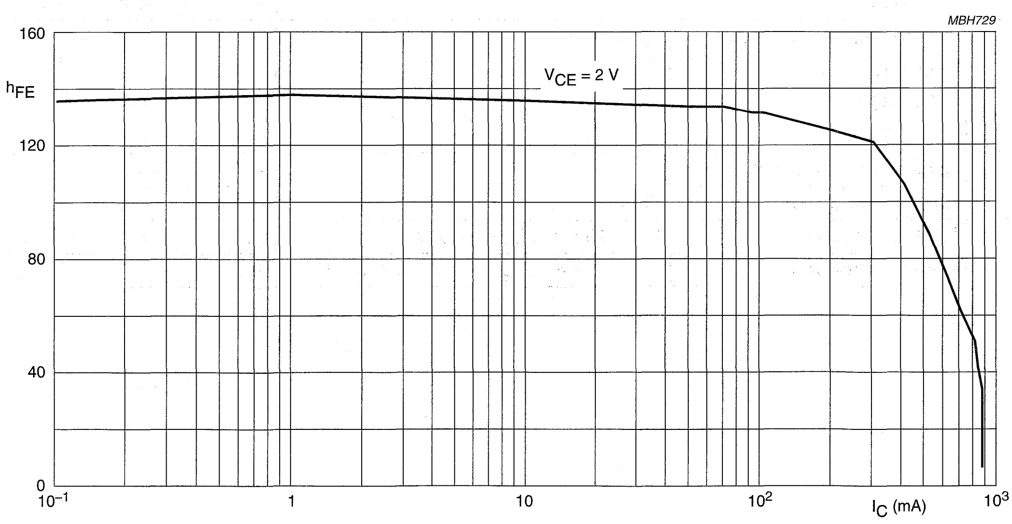


Fig.2 DC current gain; typical values.

PNP medium power transistors — BC636; BC638; BC640

FEATURES

- High current (max. 1 A)
- Low voltage (max. 80 V).

APPLICATIONS

- Audio and video amplifiers.

DESCRIPTION

PNP medium power transistor in a TO-92; SOT54 plastic package. NPN complements: BC635, BC637 and BC639.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

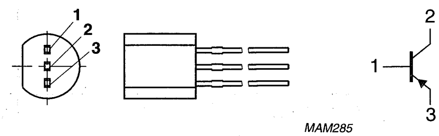


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC636		–	–45	V
	BC638		–	–60	V
	BC640		–	–100	V
V_{CEO}	collector-emitter voltage	open base			
	BC636		–	–45	V
	BC638		–	–60	V
	BC640		–	–80	V
I_{CM}	peak collector current		–	–1.5	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	0.83	W
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -2$ V	40	250	
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -5$ V; f = 100 MHz	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			
	BC636		–	–45	V
	BC638		–	–60	V
	BC640		–	–100	V
V_{CEO}	collector-emitter voltage	open base			
	BC636		–	–45	V
	BC638		–	–60	V
	BC640		–	–80	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–1	A
I_{CM}	peak collector current		–	–1.5	A
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	0.83	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	150	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −30 V	–	−100	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} = −5 V	–	−100	nA
h_{FE}	DC current gain	V_{CE} = −2 V; see Fig.2			
		I_C = −5 mA	40	–	
		I_C = −150 mA	40	250	
		I_C = −500 mA	25	–	
h_{FE}	DC current gain	I_C = −150 mA; V_{CE} = −2 V; see Fig.2			
	BC636-10; BC638-10; BC640-10		63	160	
	BC636-16; BC638-16; BC640-16		100	250	
V_{CEsat}	collector-emitter saturation voltage	I_C = −500 mA; I_B = −50 mA	–	−0.5	V
V_{BE}	base-emitter voltage	I_C = −500 mA; V_{CE} = −2 V	–	−1	V
f_T	transition frequency	I_C = −50 mA; V_{CE} = −5 V; f = 100 MHz	100	–	MHz
$\frac{h_{FE1}}{h_{FE2}}$	DC current gain ratio of the complementary pairs	$\lvert I_C \rvert$ = 150 mA; $\lvert V_{CE} \rvert$ = 2 V	–	1.6	

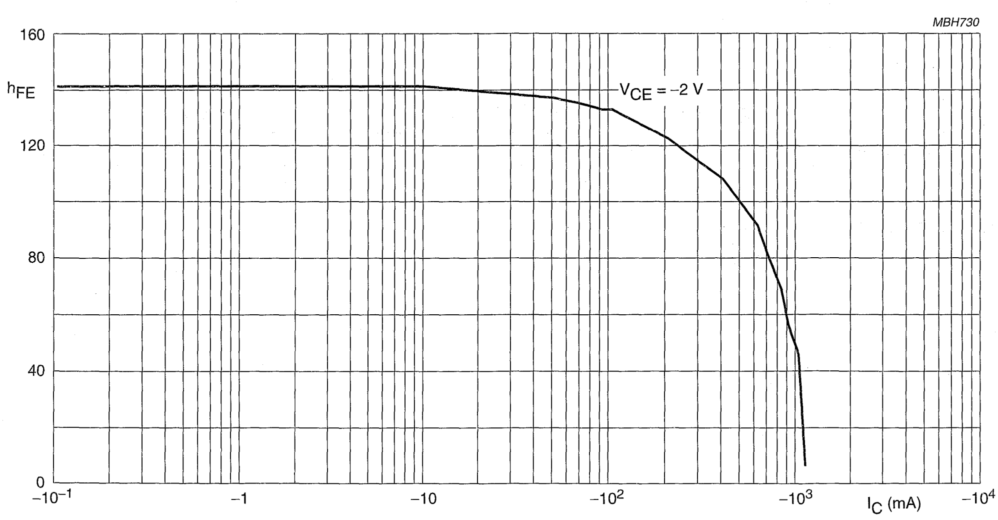


Fig.2 DC current gain; typical values.

PNP general purpose transistors BC807; BC808

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a SOT23 plastic package.
NPN complements: BC817 and BC818.

MARKING

TYPE NUMBER	MARKING CODE	TYPE NUMBER	MARKING CODE
BC807	5Dp	BC808	5Hp
BC807-16	5Ap	BC808-16	5Ep
BC807-25	5Bp	BC808-25	5Fp
BC807-40	5Cp	BC808-40	5Gp

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

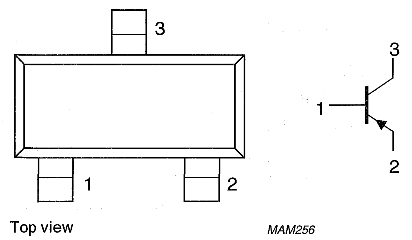


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC807		–	–50	V
	BC808		–	–30	V
V_{CEO}	collector-emitter voltage	open base			
	BC807		–	–45	V
	BC808		–	–25	V
I_{CM}	peak collector current		–	–1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = -100$ mA; $V_{CE} = -1$ V	100	600	
		$I_C = -500$ mA; $V_{CE} = -1$ V	40	–	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	80	–	MHz

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC807		–	–50	V
	BC808		–	–30	V
V_{CEO}	collector-emitter voltage	open base; $I_C = -10$ mA			
	BC807		–	–45	V
	BC808		–	–25	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–500	mA
I_{CM}	peak collector current		–	–1	A
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

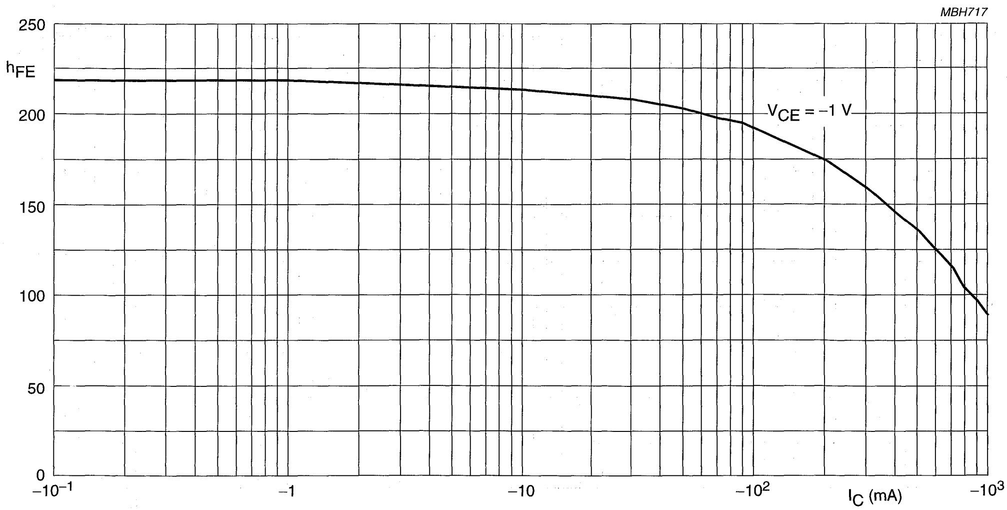
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −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
h_{FE}	DC current gain	I_C = −100 mA; V_{CE} = −1 V; note 1 see Figs 2, 3 and 4				
	BC807; BC808		100	−	600	
	BC807-16; BC808-16		100	−	250	
	BC807-25; BC808-25		160	−	400	
	BC807-40; BC808-40		250	−	600	
h_{FE}	DC current gain	I_C = −500 mA; V_{CE} = −1 V; note 1	40	−	−	
V_{CEsat}	collector-emitter saturation voltage	I_C = −500 mA; I_B = −50 mA; note 1	−	−	−700	mV
V_{BE}	base-emitter voltage	I_C = −500 mA; V_{CE} = −1 V; notes 1 and 2	−	−	−1.2	V
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = −10 V; f = 1 MHz	−	9	−	pF
f_T	transition frequency	I_C = −10 mA; V_{CE} = −5 V; f = 100 MHz	80	−	−	MHz

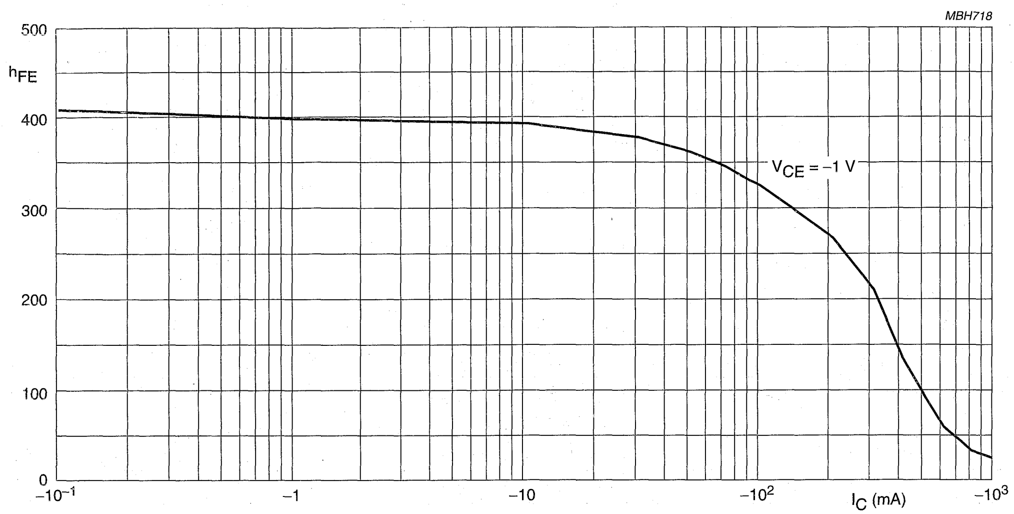
Notes

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.02$.
2. V_{BE} decreases by about −2 mV/K with increasing temperature.



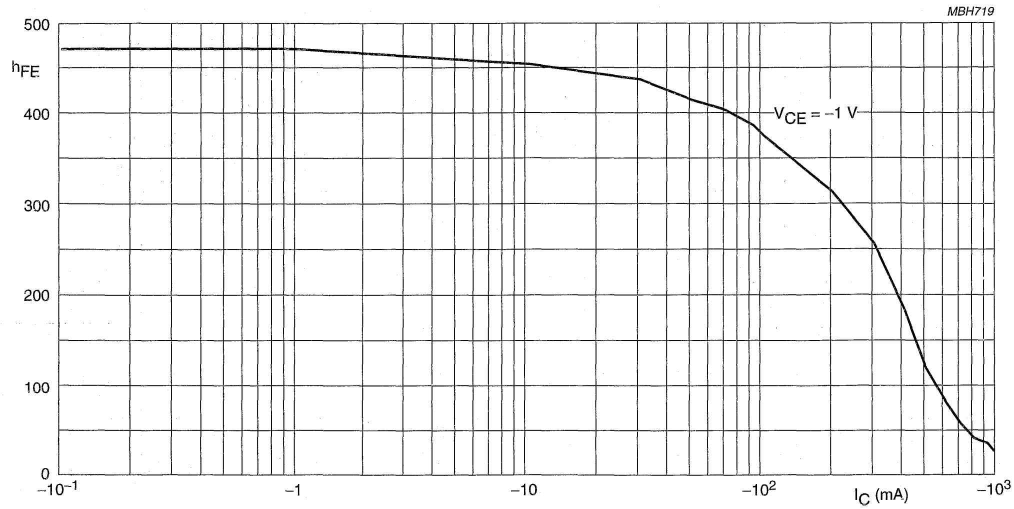
BC807-16; BC808-16.

Fig.2 DC current gain; typical values.



BC807-25; BC808-25.

Fig.3 DC current gain; typical values.



BC807-40; BC808-40.

Fig.4 DC current gain; typical values.

PNP general purpose transistors — BC807W; BC808W

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a SOT323 plastic package.
NPN complements: BC817W and BC818W.

MARKING

TYPE NUMBER	MARKING CODE	TYPE NUMBER	MARKING CODE
BC807W	5Dt	BC808W	5Ht
BC807-16W	5At	BC808-16W	5Et
BC807-25W	5Bt	BC808-25W	5Ft
BC807-40W	5Ct	BC808-40W	5Gt

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

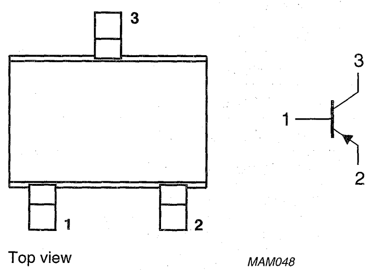


Fig.1 Simplified outline (SOT323) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	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	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = -100$ mA; $V_{CE} = -1$ V	100	600	
		$I_C = -500$ mA; $V_{CE} = -1$ V	40	–	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	80	–	MHz

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	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	collector current (DC)		–	–500	mA
I_{CM}	peak collector current		–	–1	A
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

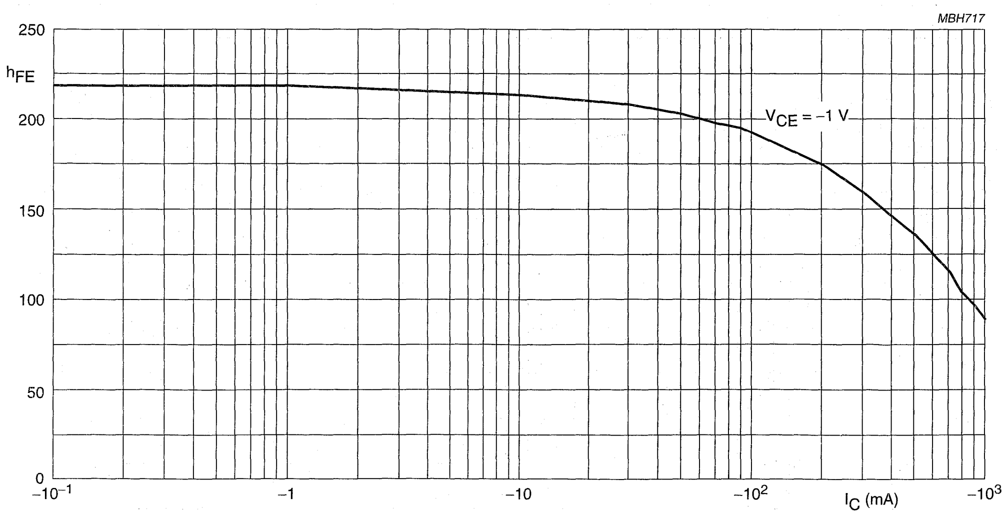
CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector 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
h_{FE}	DC current gain	$I_C = -100$ mA; $V_{CE} = -1$ V; note 1; see Figs 2, 3 and 4			
	BC807W; BC808W		100	600	
	BC807-16W; BC808-16W		100	250	
	BC807-25W; BC808-25W		160	400	
	BC807-40W; BC808-40W		250	600	
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -1$ V; note 1	40	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -500$ mA; $I_B = -50$ mA; note 1	–	–700	mV
V_{BE}	base-emitter voltage	$I_C = -500$ mA; $V_{CE} = -1$ V; note 1	–	–1.2	V
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

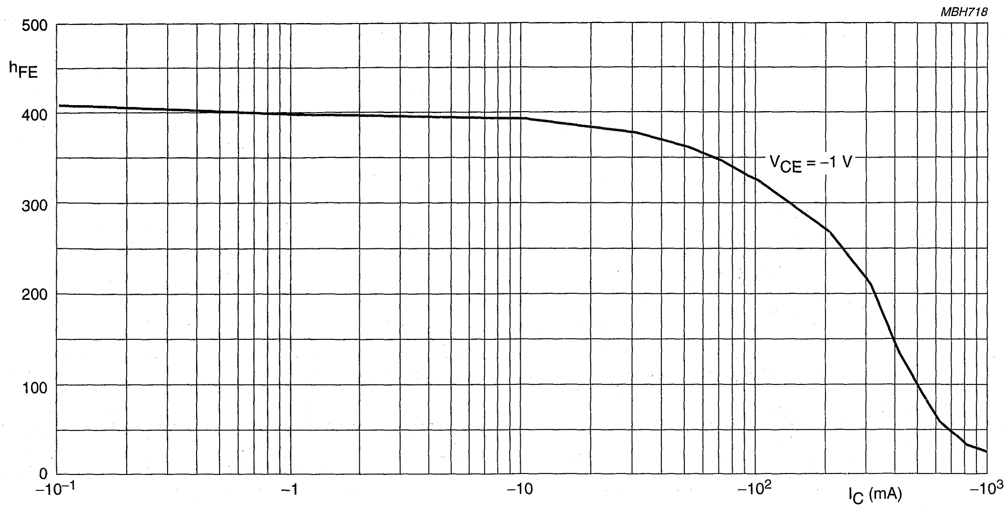
Note

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



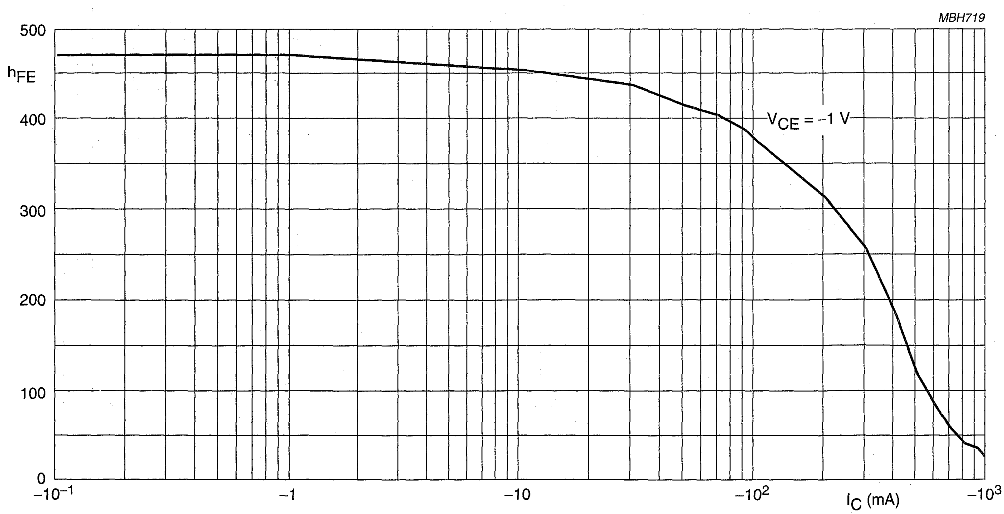
BC807-16W; BC808-16W.

Fig.2 DC current gain; typical values.



BC807-25W; BC808-25W.

Fig.3 DC current gain; typical values.



BC807-40W; BC808-40W.

Fig.4 DC current gain; typical values.

NPN general purpose transistors BC817; BC818

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistor in a SOT23 plastic package.
PNP complements: BC807 and BC808.

MARKING

TYPE NUMBER	MARKING CODE	TYPE NUMBER	MARKING CODE
BC817	6Dp	BC818	6Hp
BC817-16	6Ap	BC818-16	6Ep
BC817-25	6Bp	BC818-25	6Fp
BC817-40	6Cp	BC818-40	6Gp

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

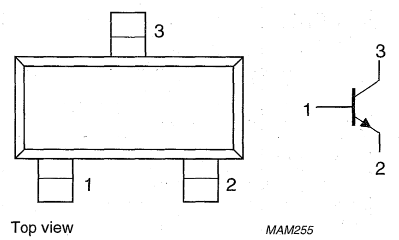


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC817		–	50	V
	BC818		–	30	V
V_{CEO}	collector-emitter voltage	open base			
	BC817		–	45	V
	BC818		–	25	V
I_{CM}	peak collector current		–	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 100$ mA; $V_{CE} = 1$ V	100	600	
		$I_C = 500$ mA; $V_{CE} = 1$ V	40	–	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	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			
	BC817		–	50	V
	BC818		–	30	V
V_{CEO}	collector-emitter voltage	open base; I_C = 10 mA			
	BC817		–	45	V
	BC818		–	25	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	1	A
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

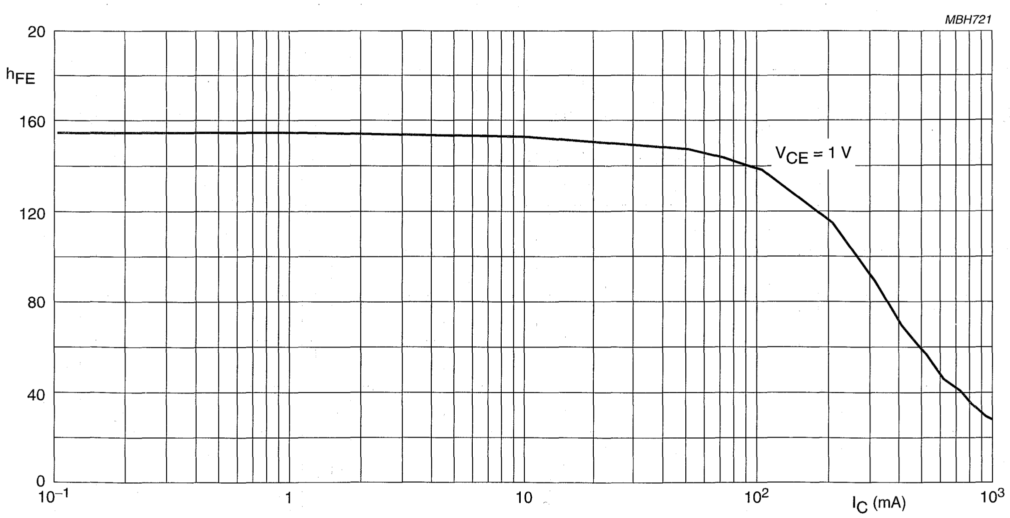
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 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
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 1 V; note 1; see Figs 2, 3 and 4				
	BC817; BC818		100	–	600	
	BC817-16; BC818-16		100	–	250	
	BC817-25; BC818-25		160	–	400	
	BC817-40; BC818-40		250	–	600	
h_{FE}	DC current gain	I_C = 500 mA; V_{CE} = 1 V; note 1	40	–	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = 500 mA; I_B = 50 mA; note 1	–	–	700	mV
V_{BE}	base-emitter voltage	I_C = 500 mA; V_{CE} = 1 V; note 2	–	–	1.2	V
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

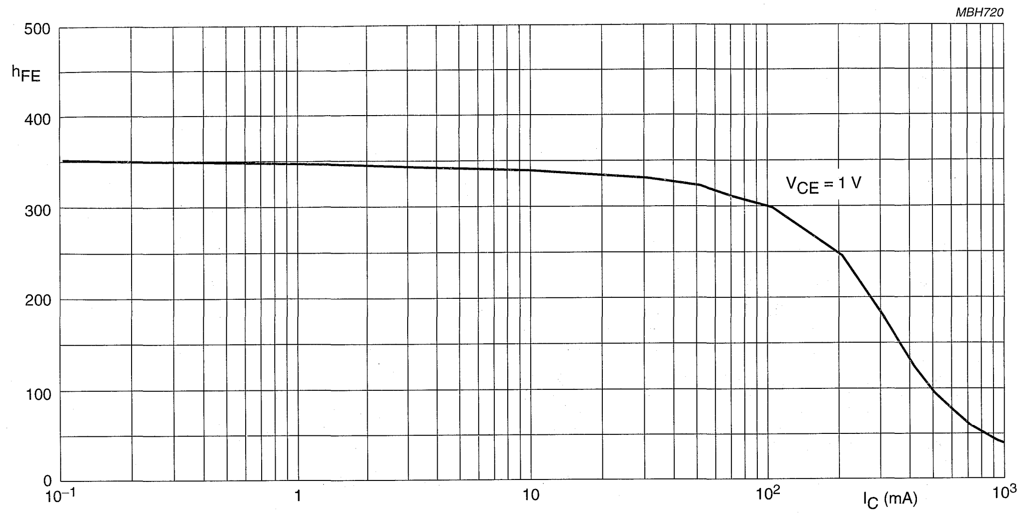
Notes

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.02$.
2. V_{BE} decreases by about 2 mV/K with increasing temperature.



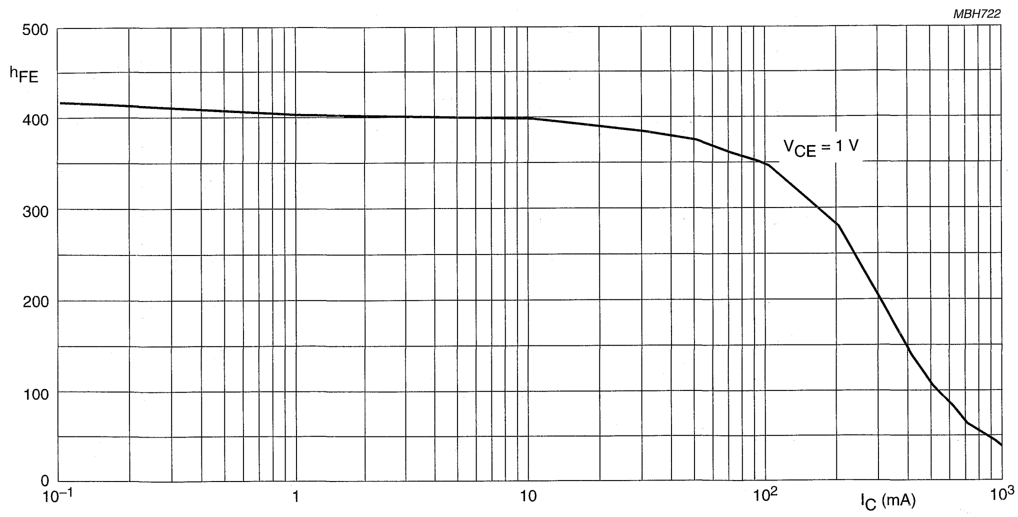
BC817-16; BC818-16.

Fig.2 DC current gain; typical values.



BC817-25; BC818-25.

Fig.3 DC current gain; typical values.



BC817-40; BC818-40.

Fig.4 DC current gain; typical values.

NPN general purpose transistors

BC817W; BC818W

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistor in a SOT323 plastic package.
PNP complements: BC807W and BC808W.

MARKING

TYPE NUMBER	MARKING CODE	TYPE NUMBER	MARKING CODE
BC817W	6Dt	BC818W	6Ht
BC817-16W	6At	BC818-16W	6Et
BC817-25W	6Bt	BC818-25W	6Ft
BC817-40W	6Ct	BC818-40W	6Gt

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

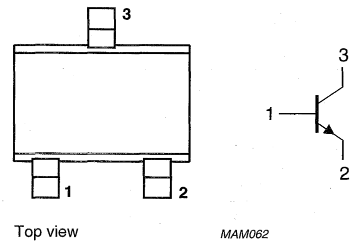


Fig.1 Simplified outline (SOT323) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	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	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = 100$ mA; $V_{CE} = 1$ V	100	600	
		$I_C = 500$ mA; $V_{CE} = 1$ V	40	–	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	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			
	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	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	1	A
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

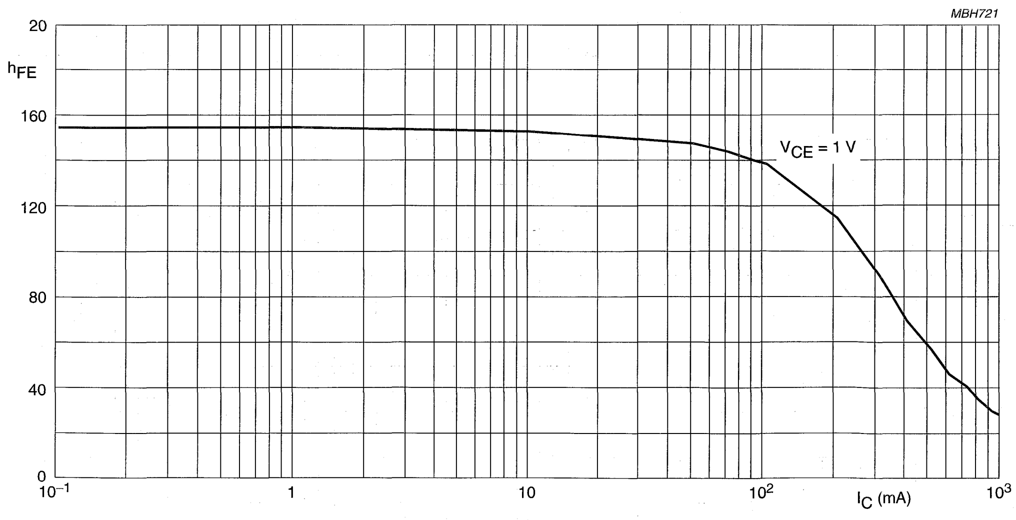
CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector 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
h_{FE}	DC current gain	$I_C = 100$ mA; $V_{CE} = 1$ V; note 1; see Figs 2, 3 and 4			
	BC817W; BC818W		100	600	
	BC817-16W; BC818-16W		100	250	
	BC817-25W; BC818-25W		160	400	
	BC817-40W; BC818-40W		250	600	
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 1$ V; note 1	40	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 500$ mA; $I_B = 50$ mA; note 1	–	700	mV
V_{BE}	base-emitter voltage	$I_C = 500$ mA; $V_{CE} = 1$ V; note 1	–	1.2	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

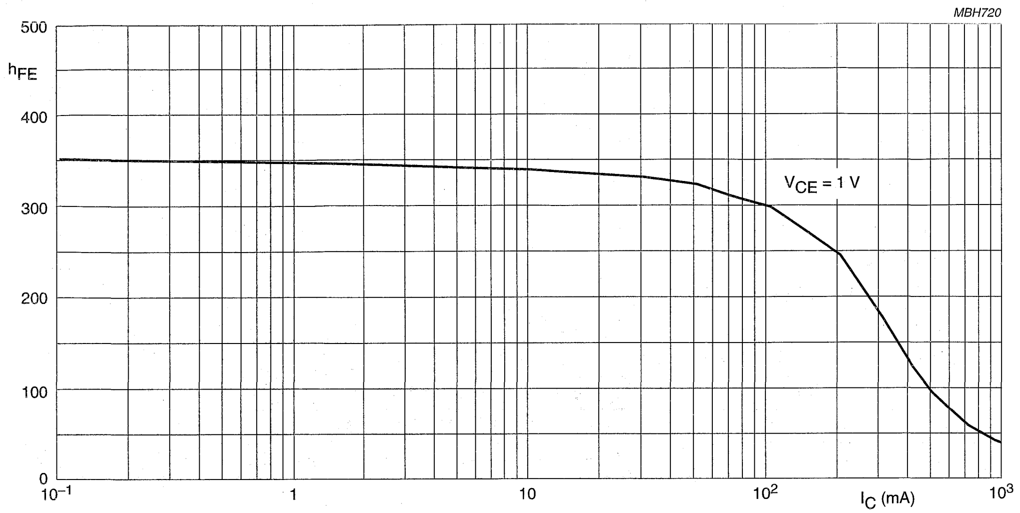
Note

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



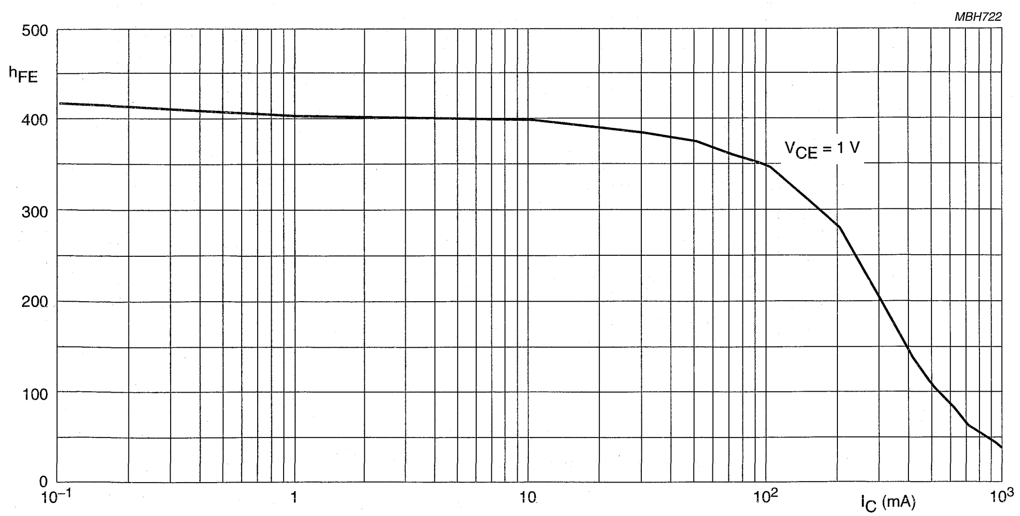
BC817-16W; BC818-16W.

Fig.2 DC current gain; typical values.



BC817-25W; BC818-25W.

Fig.3 DC current gain; typical values.



BC817-40W; BC818-40W.

Fig.4 DC current gain; typical values.

NPN general purpose transistors BC846; BC847; BC848

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 65 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistor in a SOT23 plastic package.
PNP complements: BC856; BC857; BC858.

MARKING

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

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

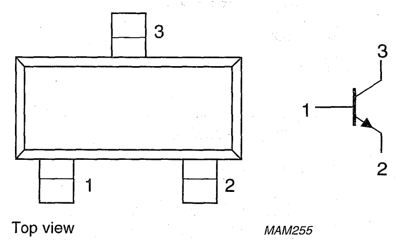


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC846		–	80	V
	BC847		–	50	V
	BC848		–	30	V
V_{CEO}	collector-emitter voltage	open base			
	BC846		–	65	V
	BC847		–	45	V
	BC848		–	30	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V			
	BC846		110	450	
	BC847; BC848		110	800	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	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			
	BC846		–	80	V
	BC847		–	50	V
	BC848		–	30	V
V_{CEO}	collector-emitter voltage	open base			
	BC846		–	65	V
	BC847		–	45	V
	BC848		–	30	V
V_{EBO}	emitter-base voltage	open collector			
	BC846; BC847		–	6	V
	BC848		–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

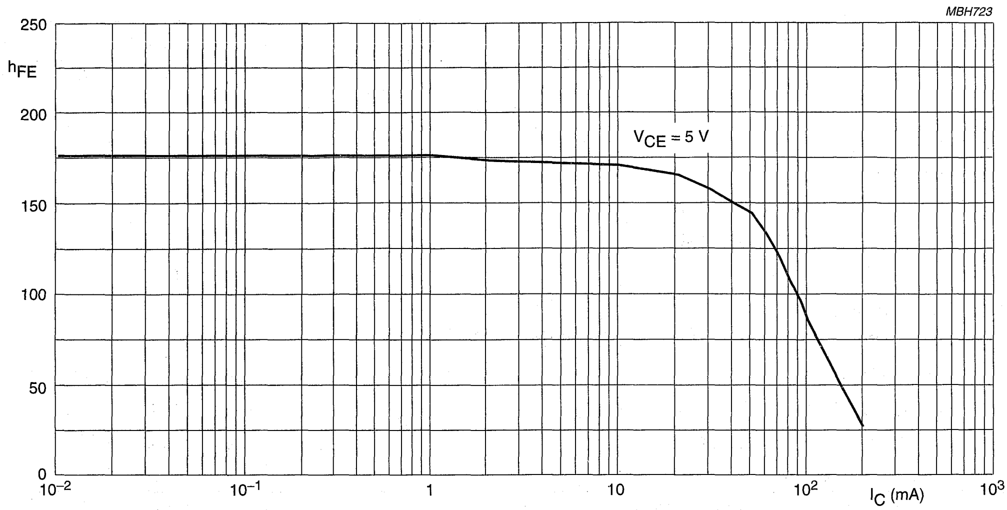
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 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
h_{FE}	DC current gain	I_C = 10 μA; V_{CE} = 5 V; see Figs 2, 3 and 4				
	BC846A; BC847A; BC848A		–	90	–	
	BC846B; BC847B; BC848B		–	150	–	
	BC847C; BC848C		–	270	–	
h_{FE}	DC current gain	I_C = 2 mA; V_{CE} = 5 V; see Figs 2, 3 and 4				
	BC846		110	–	450	
	BC847; BC848		110	–	800	
	BC846A;BC847A; BC848A		110	180	220	
	BC846B; BC847B; BC848B		200	290	450	
	BC847C; BC848C		420	520	800	
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA; I_B = 0.5 mA	–	90	250	mV
		I_C = 100 mA; I_B = 5 mA	–	200	600	mV
V_{BEsat}	base-emitter saturation voltage	I_C = 10 mA; I_B = 0.5 mA; note 1	–	700	–	mV
		I_C = 100 mA; I_B = 5 mA; note 1	–	900	–	mV
V_{BE}	base-emitter voltage	I_C = 2 mA; V_{CE} = 5 V; note 2	580	660	700	mV
		I_C = 10 mA; V_{CE} = 5 V; note 2	–	–	770	mV
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 10 V; f = 1 MHz;	–	2.5	–	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	–	2	10	dB

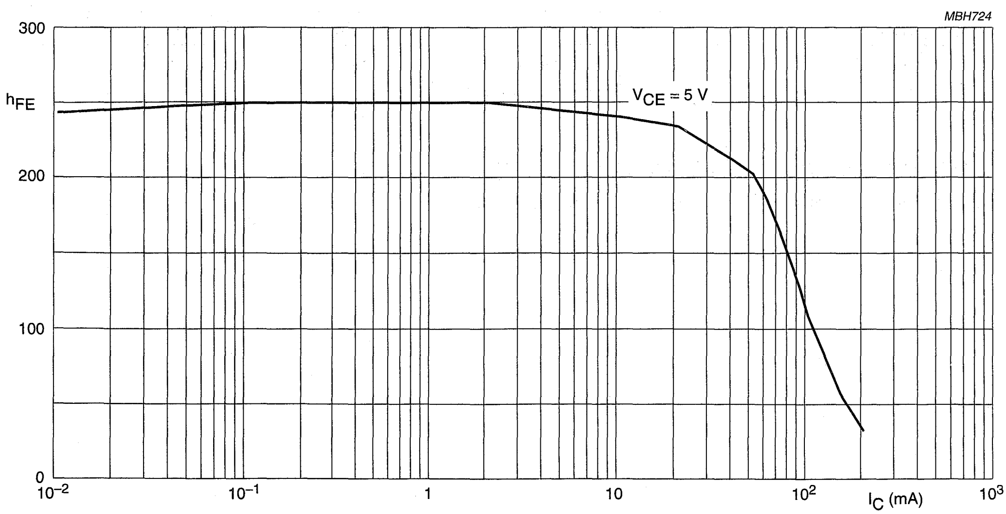
Notes

1. V_{BEsat} decreases by about 1.7 mV/K with increasing temperature.
2. V_{BE} decreases by about 2 mV/K with increasing temperature.



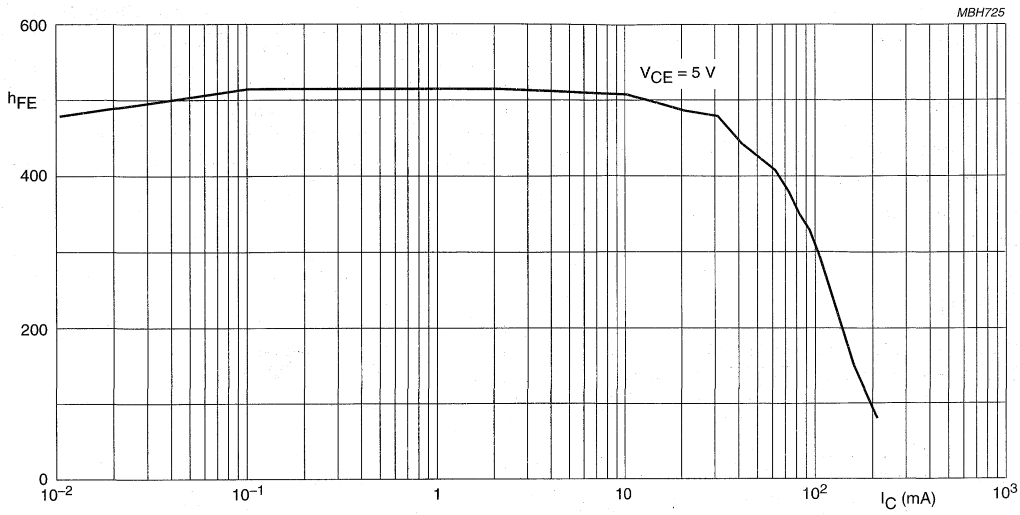
BC846A; BC847A; BC848A.

Fig.2 DC current gain; typical values.



BC846B; BC847B; BC848B.

Fig.3 DC current gain; typical values.



BC847C; BC848C.

Fig.4 DC current gain; typical values.

NPN general purpose transistors | BC846T; BC847T; BC848T series

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 65 V).

APPLICATIONS

- General purpose switching and amplification, especially in portable communication equipment
- Electronic data processing (EDP) and consumer applications.

DESCRIPTION

NPN transistor in an SC-75 plastic package.
PNP complements: BC856T, BC857T and BC858T series.

MARKING

TYPE NUMBER	MARKING CODE	TYPE NUMBER	MARKING CODE
BC846AT	1A	BC847CT	1G
BC846BT	1B	BC848AT	1J
BC847AT	1E	BC848BT	1K
BC847BT	1F	BC848CT	1L

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

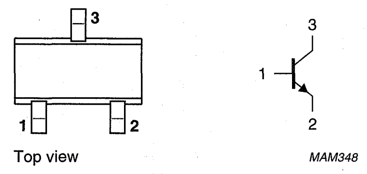


Fig.1 Simplified outline (SC-75) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC846AT; BC846BT		–	80	V
	BC847AT; BC847BT; BC847CT		–	50	V
	BC848AT; BC848BT; BC848CT		–	30	V
V_{CEO}	collector-emitter voltage	open base			
	BC846AT; BC846BT		–	65	V
	BC847AT; BC847BT; BC847CT		–	45	V
	BC848AT; BC848BT; BC848CT		–	30	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	150	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V	110	800	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	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			
	BC846AT; BC846BT		–	80	V
	BC847AT; BC847BT; BC847CT		–	50	V
	BC848AT; BC848BT; BC848CT		–	30	V
V_{CEO}	collector-emitter voltage	open base			
	BC846AT; BC846BT		–	65	V
	BC847AT; BC847BT; BC847CT		–	45	V
	BC848AT; BC848BT; BC848CT		–	30	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	150	mW
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		−65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	833	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector 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
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V				
	BC846AT; BC847AT; BC848AT		110	–	220	
	BC846BT; BC847BT; BC848BT		200	–	450	
	BC847CT; BC848CT		420	–	800	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	200	mV
		$I_C = 100$ mA; $I_B = 5$ mA; note 1	–	–	400	mV
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
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	1.5	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 500$ mV; f = 1 MHz	–	11	–	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

Note

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

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 65 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistor in a SC70; SOT323 plastic package.
PNP complements: BC856W, BC857W, and BC858W.

MARKING

TYPE NUMBER	MARKING CODE	TYPE NUMBER	MARKING CODE
BC846W	1Dt	BC847CW	1Gt
BC846AW	1At	BC848W	1Mt
BC846BW	1Bt	BC848AW	1Jt
BC847W	1Ht	BC848BW	1Kt
BC847AW	1Et	BC848CW	1Lt
BC847BW	1Ft		

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

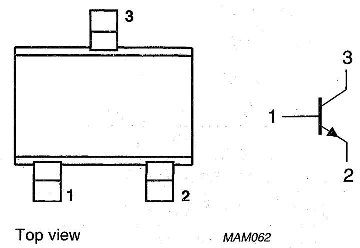


Fig.1 Simplified outline (SC70; SOT323) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	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	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V			
	BC846W		110	450	
	BC847W; BC848W		110	800	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	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			
	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	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

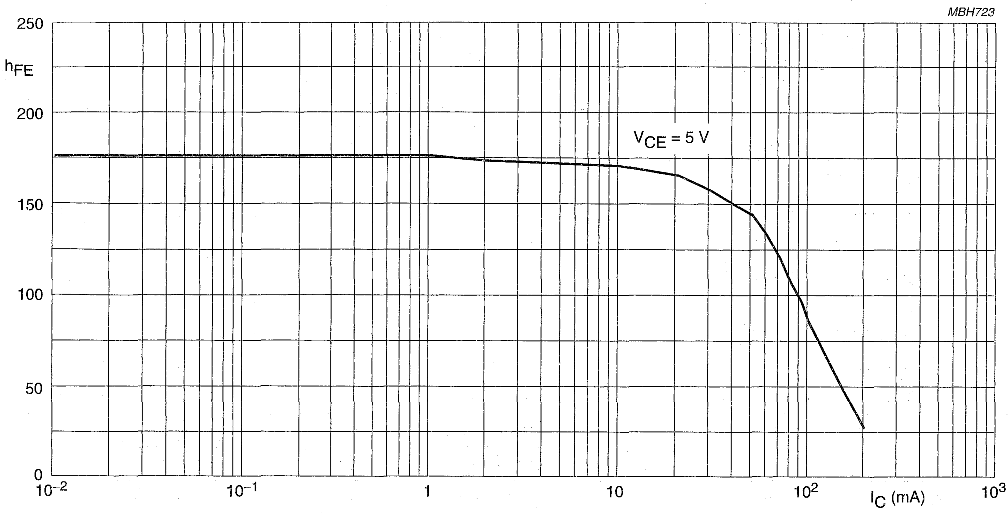
CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector 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
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V; see Figs 2, 3 and 4				
	BC846W		110	–	450	
	BC847W; BC848W		110	–	800	
	BC846AW; BC847AW; BC848AW		110	–	220	
	BC846BW; BC847BW; BC848BW		200	–	450	
	BC847CW; BC848CW		420	–	800	
V_{CEsat}	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
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	700	–	mV
		$I_C = 100$ mA; $I_B = 5$ mA	–	900	–	mV
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
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

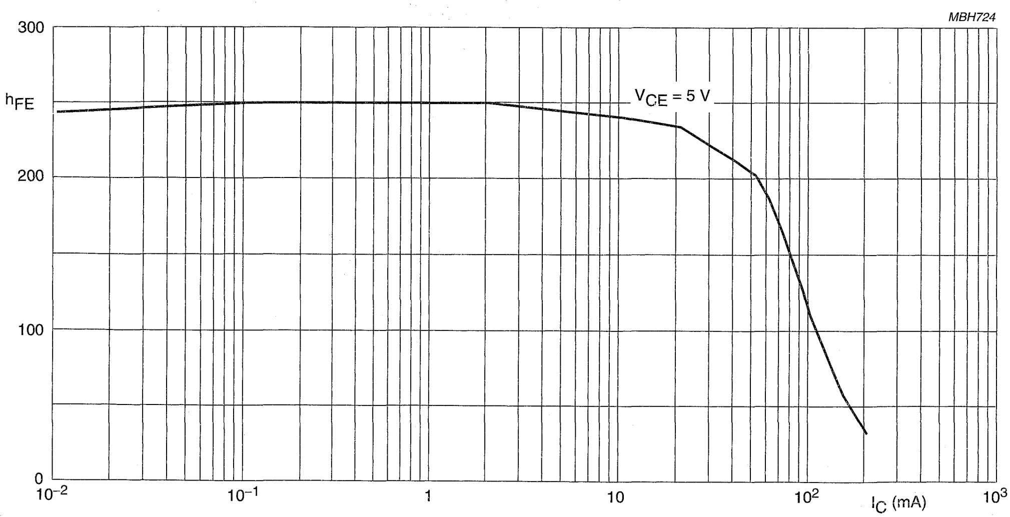
Note

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



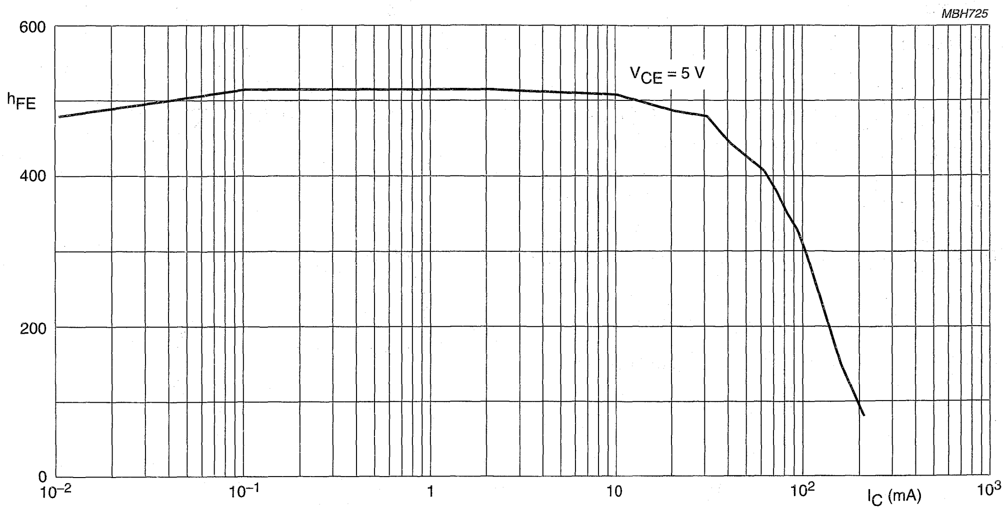
BC846AW; BC847AW; BC848AW.

Fig.2 DC current gain; typical values.



BC846BW; BC847BW; BC848BW.

Fig.3 DC current gain; typical values.



BC847CW; BC848CW.

Fig.4 DC current gain; typical values.

NPN/PNP general purpose transistor BC847BPN

FEATURES

- Low collector capacitance
- Low collector-emitter saturation voltage
- Closely matched current gain
- Reduces number of components and boardspace
- No mutual interference between the transistors.

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN/PNP transistor pair in an SC-88; SOT363 plastic package.

MARKING

TYPE NUMBER	MARKING CODE
BC847BPN	13t

PINNING

PIN	DESCRIPTION
1, 4	emitter TR1; TR2
2, 5	base TR1; TR2
6, 3	collector TR1; TR2

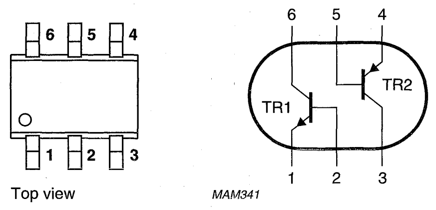


Fig.1 Simplified outline (SC-88; SOT363) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per transistor; for the PNP transistor with negative polarity					
V_{CBO}	collector-base voltage	open emitter	–	50	V
V_{CEO}	collector-emitter voltage	open base	–	45	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V	200	450	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	100	–	MHz
Per device					
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	300	mW

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per transistor; for the PNP transistor with negative polarity					
V_{CBO}	collector-base voltage	open emitter	–	50	V
V_{CEO}	collector-emitter voltage	open base	–	45	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C
Per device					
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	300	mW

Note

1. Device mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
Per device				
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	416	K/W

Note

1. Device mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Per transistor unless otherwise specified; for the PNP transistor with negative polarity						
I_{CBO}	collector 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
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V	200	–	450	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	100	mV
		$I_C = 100$ mA; $I_B = 5$ mA; note 1	–	–	300	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	755	–	mV
V_{BE}	base-emitter voltage	$I_C = 2$ mA; $V_{CE} = 5$ V				
	TR1 NPN		580	655	700	mV
	TR2 PNP		600	655	750	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz				
	TR1 NPN		–	–	1.5	pF
	TR2 PNP		–	–	2.2	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 500$ mV; f = 1 MHz				
	TR1 NPN		–	11	–	pF
	TR2 PNP		–	10	–	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	100	–	–	MHz

Note

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

NPN general purpose double transistor BC847BS

FEATURES

- Low collector capacitance
- Low collector-emitter saturation voltage
- Closely matched current gain
- Reduces number of components and board space
- No mutual interference between the transistors.

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN double transistor in an SC-88 plastic package.
PNP complement: BC857BS.

MARKING

TYPE NUMBER	MARKING CODE
BC847BS	1Ft

PINNING

PIN	DESCRIPTION
1, 4	emitter TR1; TR2
2, 5	base TR1; TR2
6, 3	collector TR1; TR2

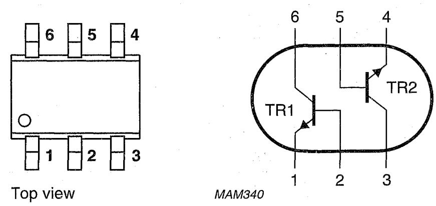


Fig.1 Simplified outline (SC-88) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per transistor					
V_{CBO}	collector-base voltage	open emitter	–	50	V
V_{CEO}	collector-emitter voltage	open base	–	45	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V	200	450	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	100	–	MHz
Per device					
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	300	mW

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per transistor					
V_{CBO}	collector-base voltage	open emitter	–	50	V
V_{CEO}	collector-emitter voltage	open base	–	45	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C
Per device					
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	300	mW

Note

1. Device mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
Per device				
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	416	K/W

Note

1. Device mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Per transistor						
I_{CBO}	collector 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
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V	200	–	450	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	100	mV
		$I_C = 100$ mA; $I_B = 5$ mA; note 1	–	–	300	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	755	–	mV
V_{BE}	base-emitter voltage	$I_C = 2$ mA; $V_{CE} = 5$ V	580	655	700	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	1.5	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 500$ mV; f = 1 MHz	–	11	–	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	100	–	–	MHz

Note

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

NPN general purpose transistors — BC849; BC850

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistor in a SOT23 plastic package.

PNP complements: BC859 and BC860.

MARKING

TYPE NUMBER	MARKING CODE	TYPE NUMBER	MARKING CODE
BC849	2Dp	BC850	2Hp
BC849B	2Bp	BC850B	2Fp
BC849C	2Cp	BC850C	2Gp

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

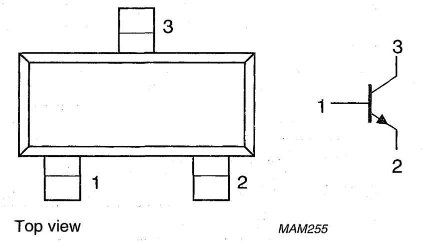


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BC849		–	–	30	V
	BC850		–	–	50	V
V_{CEO}	collector-emitter voltage	open base				
	BC849		–	–	30	V
	BC850		–	–	45	V
I_{CM}	peak collector current		–	–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V				
	BC849B; BC850B;		200	290	450	
	BC849C; BC850C		420	520	800	
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 = 10 Hz to 15.7 kHz	–	–	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			
	BC849		–	30	V
	BC850		–	50	V
V_{CEO}	collector-emitter voltage	open base			
	BC849		–	30	V
	BC850		–	45	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

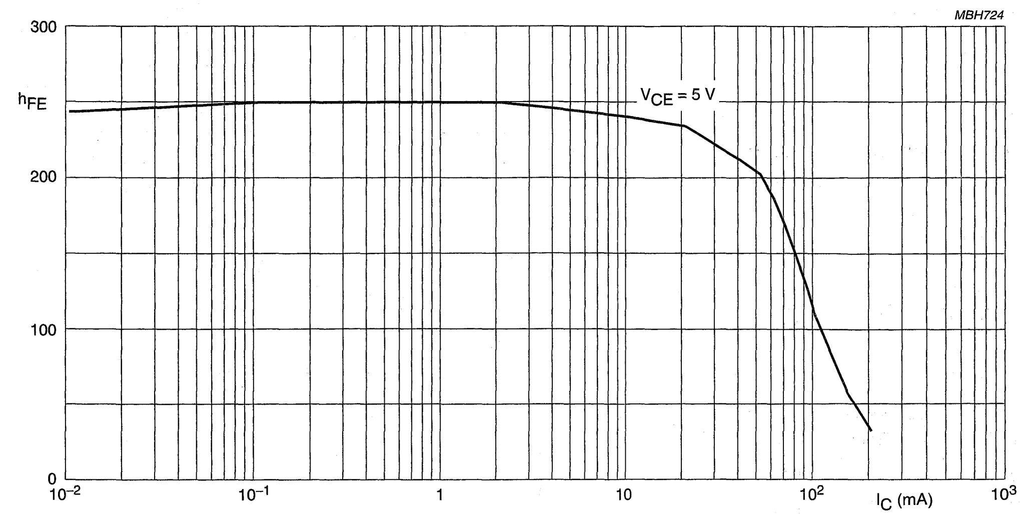
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30$ 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
h_{FE}	DC current gain	$I_C = 10$ μA; $V_{CE} = 5$ V; see Figs 2 and 3				
	BC849B; BC850B		–	240	–	
	BC849C; BC850C		–	450	–	
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V; see Figs 2 and 3				
	BC849; BC850		200	–	800	
	BC849B; BC850B		200	290	450	
	BC849C; BC850C		420	520	800	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	90	250	mV
		$I_C = 100$ mA; $I_B = 5$ mA	–	200	600	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA; note 1	–	700	–	mV
		$I_C = 100$ mA; $I_B = 5$ mA; note 1	–	900	–	mV
V_{BE}	base-emitter voltage	$I_C = 2$ mA; $V_{CE} = 5$ V; note 2	580	660	700	mV
		$I_C = 10$ mA; $V_{CE} = 5$ V; note 2	–	–	770	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	2.5	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 500$ mV; f = 1 MHz	–	11	–	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 = 10 Hz to 15.7 kHz	–	–	4	dB
		$I_C = 200$ μA; $V_{CE} = 5$ V; $R_S = 2$ kΩ; f = 1 kHz; B = 200 Hz	–	–	4	dB

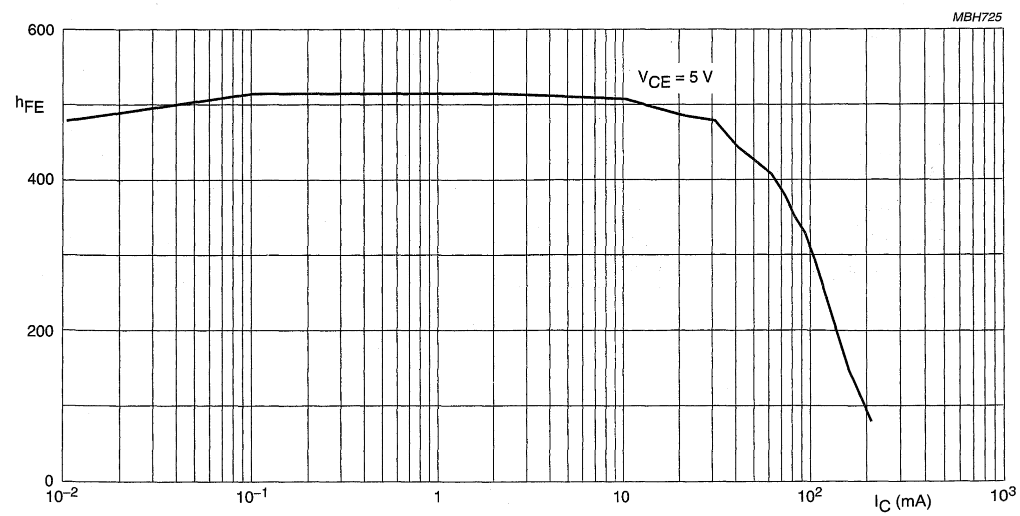
Notes

1. V_{BEsat} decreases by about 1.7 mV/K with increasing temperature.
2. V_{BE} decreases by about 2 mV/K with increasing temperature.



BC849B; BC850B.

Fig.2 DC current gain; typical values.



BC849C; BC850C.

Fig.3 DC current gain; typical values.

NPN general purpose transistors — BC849W; BC850W

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- Low noise stages in tape recorders, hi-fi amplifiers and other audio-frequency equipment.

DESCRIPTION

NPN transistor in a SOT323 plastic package.
PNP complements: BC859W and BC860W.

MARKING

TYPE NUMBER	MARKING CODE	TYPE NUMBER	MARKING CODE
BC849W	2Dt	BC850W	2Ht
BC849BW	2Bt	BC850BW	2Ft
BC849CW	2Ct	BC850CW	2Gt

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

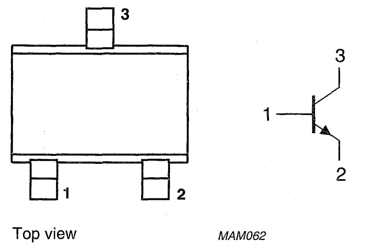


Fig.1 Simplified outline (SOT323) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	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	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V	200	800	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	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			
	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	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

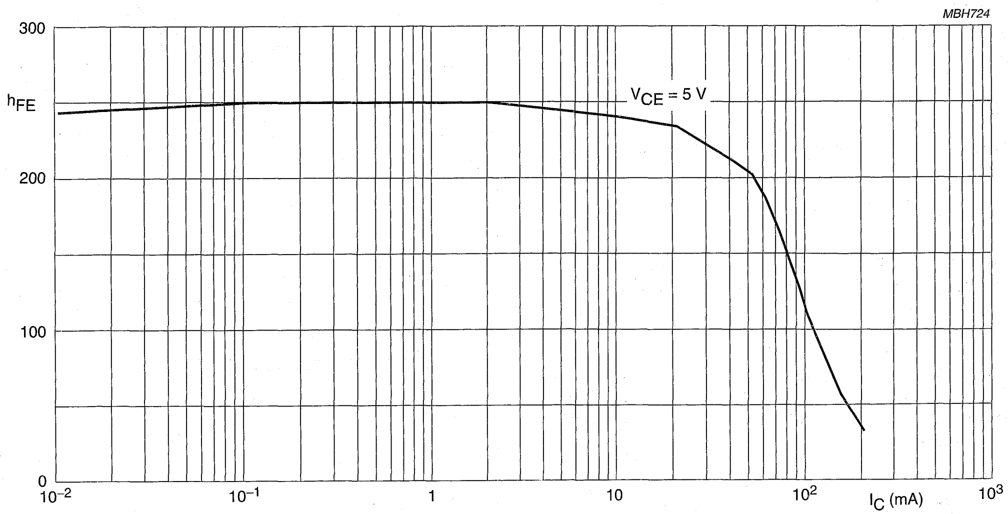
CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector 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
h_{FE}	DC current gain	I_C = 2 mA; V_{CE} = 5 V; see Figs 2 and 3				
	BC849W; BC850W		200	–	800	
	BC849BW; BC850BW		200	–	450	
	BC849CW; BC850CW		420	–	800	
V_{CEsat}	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
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
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = 10 V; f = 1 MHz	–	–	3	pF
C_e	emitter capacitance	I_C = i_c = 0; V_{EB} = 500 mV; f = 1 MHz	–	11	–	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 = 10 Hz to 15.7 kHz	–	–	4	dB
		I_C = 200 μA; V_{CE} = 5 V; R_S = 2 kΩ; f = 1 kHz; B = 200 Hz	–	–	4	dB

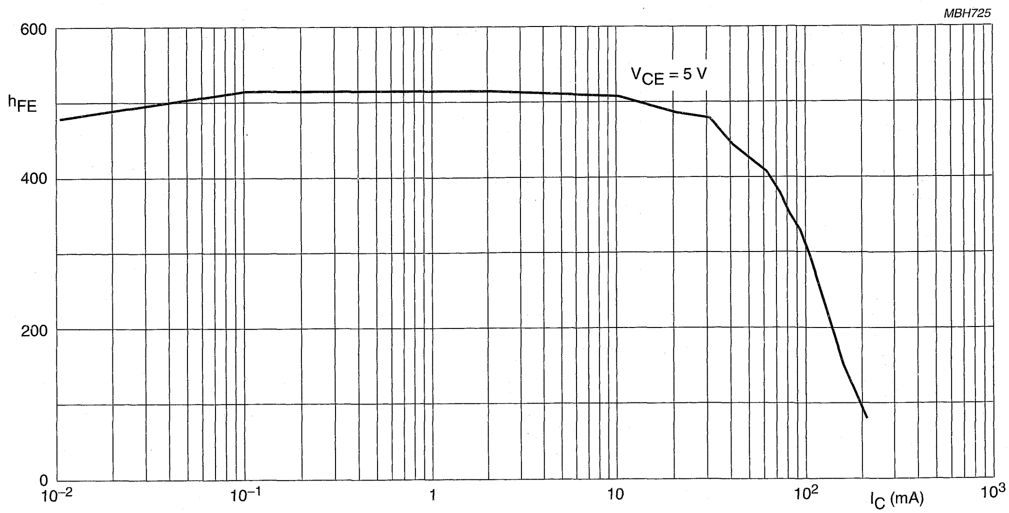
Note

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



BC849BW; BC850BW.

Fig.2 DC current gain; typical values.



BC849CW; BC850CW.

Fig.3 DC current gain; typical values.

PNP general purpose transistors — BC856; BC857; BC858

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 65 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a SOT23 plastic package.
NPN complements: BC846, BC847 and BC848.

MARKING

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

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

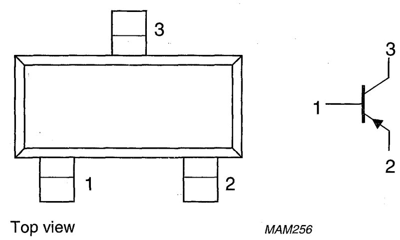


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC856		–	–80	V
	BC857		–	–50	V
	BC858		–	–30	V
V_{CEO}	collector-emitter voltage	open base			
	BC856		–	–65	V
	BC857		–	–45	V
	BC858		–	–30	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -5$ V	125	800	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	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			
	BC856		–	–80	V
	BC857		–	–50	V
	BC858		–	–30	V
V_{CEO}	collector-emitter voltage	open base			
	BC856		–	–65	V
	BC857		–	–45	V
	BC858		–	–30	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Mounted on an FR4 printed-circuit board.

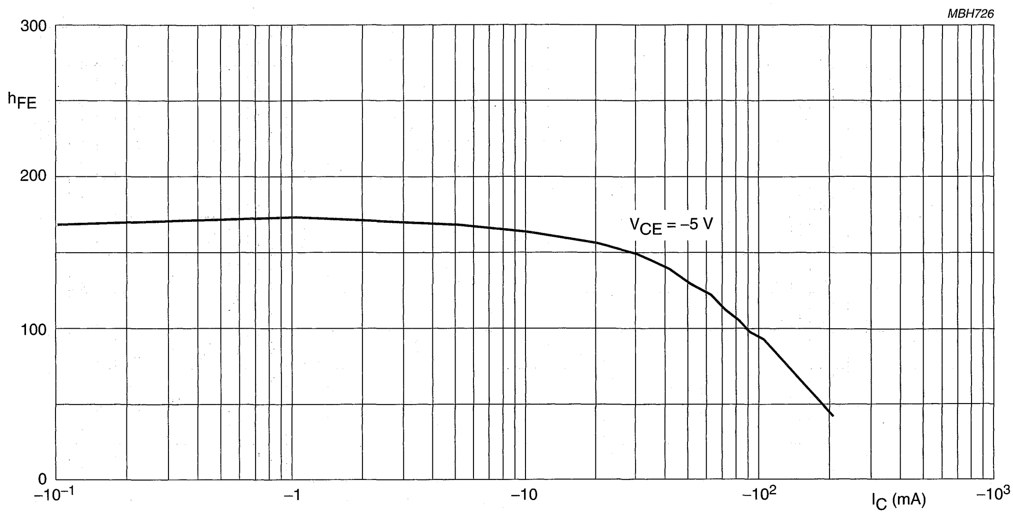
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −30 V	–	−1	−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
h_{FE}	DC current gain	I_C = −2 mA; V_{CE} = −5 V; see Figs 2, 3 and 4				
	BC856		125	–	475	
	BC857; BC858		125	–	800	
	BC856A; BC857A; BC858A		125	–	250	
	BC856B; BC857B; BC858B		220	–	475	
	BC857C; BC858C		420	–	800	
V_{CEsat}	collector-emitter saturation voltage	I_C = −10 mA; I_B = −0.5 mA	–	−75	−300	mV
		I_C = −100 mA; I_B = −5 mA	–	−250	−650	mV
V_{BEsat}	base-emitter saturation voltage	I_C = −10 mA; I_B = −0.5 mA; note 1	–	−700	–	mV
		I_C = −100 mA; I_B = −5 mA; note 1	–	−850	–	mV
V_{BE}	base-emitter voltage	I_C = −2 mA; V_{CE} = −5 V; note 2	−600	−650	−750	mV
		I_C = −10 mA; V_{CE} = −5 V; note 2	–	–	−820	mV
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = −10 V; f = 1 MHz	–	4.5	–	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	–	2	10	dB

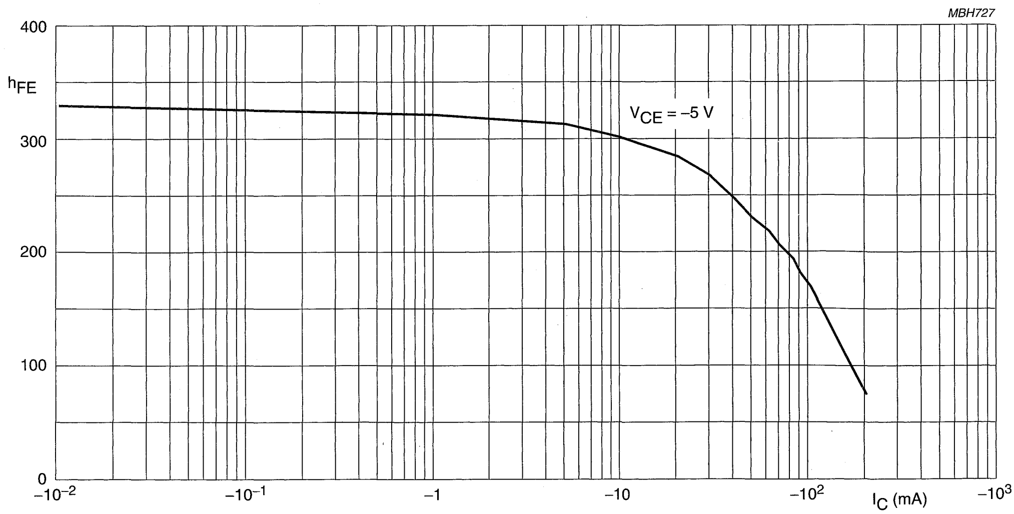
Notes

1. V_{BEsat} decreases by about −1.7 m K/V with increasing temperature.
2. V_{BE} decreases by about −2 mV/K with increasing temperature.



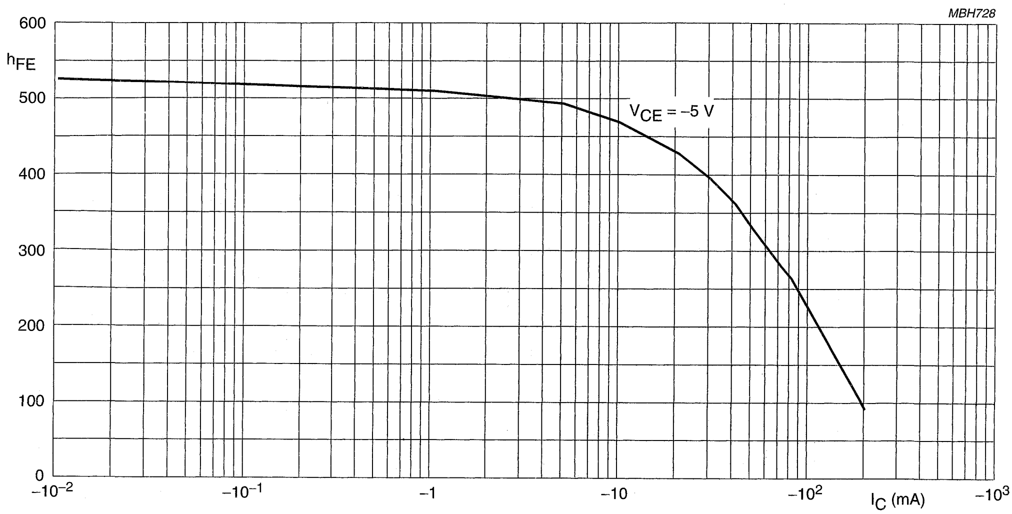
BC856A; BC857A; BC858A.

Fig.2 DC current gain; typical values.



BC856B; BC857B; BC858B.

Fig.3 DC current gain; typical values.



BC857C; BC858C.

Fig.4 DC current gain; typical values.

PNP general purpose transistors — BC856T; BC857T; BC858T series

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 65 V).

APPLICATIONS

- General purpose switching and amplification especially in portable equipment.

DESCRIPTION

PNP transistor in an SC-75 plastic package.
NPN complements: BC846T, BC847T and BC848T series.

MARKING

TYPE NUMBER	MARKING CODE	TYPE NUMBER	MARKING CODE
BC856AT	3A	BC857CT	3G
BC856BT	3B	BC858AT	3J
BC857AT	3E	BC858BT	3K
BC857BT	3F	BC858CT	3L

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

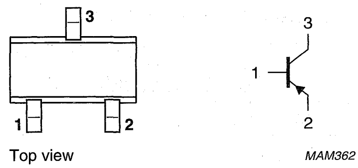


Fig.1 Simplified outline (SC-75) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC856AT; BC856BT		–	–80	V
	BC857AT; BC857BT; BC857CT		–	–50	V
	BC858AT; BC858BT; BC858CT		–	–30	V
V_{CEO}	collector-emitter voltage	open base			
	BC856AT; BC856BT		–	–65	V
	BC857AT; BC857BT; BC857CT		–	–45	V
	BC858AT; BC858BT; BC858CT		–	–30	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	150	mW
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V	125	800	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$V; f = 100 MHz	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			
	BC856AT; BC856BT		–	–80	V
	BC857AT; BC857BT; BC857CT		–	–50	V
	BC858AT; BC858BT; BC858CT		–	–30	V
V_{CEO}	collector-emitter voltage	open base			
	BC856AT; BC856BT		–	–65	V
	BC857AT; BC857BT; BC857CT		–	–45	V
	BC858AT; BC858BT; BC858CT		–	–30	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note1	–	150	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	833	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector 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
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V				
	BC856AT; BC857AT; BC858AT		125	–	250	
	BC856BT; BC857BT; BC858BT		220	–	475	
	BC857CT; BC858CT		420	–	800	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	−200	mV
		$I_C = -100$ mA; $I_B = -5$ mA; note 1	–	–	−400	mV
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
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	2.5	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -500$ mV; f = 1 MHz	–	10	–	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 = 220 Hz	–	–	10	dB

Note

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

PNP general purpose transistors — BC856W; BC857W; BC858W

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 80)
- S-mini package.

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a plastic SOT323 package.
NPN complements: BC846W, BC847W and BC848W.

MARKING

TYPE NUMBER	MARKING CODE	TYPE NUMBER	MARKING CODE
BC856W	3Dt	BC857CW	3Gt
BC856AW	3At	BC858W	3Mt
BC856BW	3Bt	BC858AW	3Jt
BC857W	3Ht	BC858BW	3Kt
BC857AW	3Et	BC858CW	3Lt
BC857BW	3Ft		

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

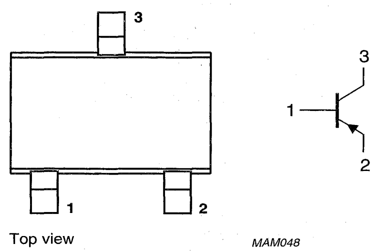


Fig.1 Simplified outline (SOT323) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	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	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V			
	BC856W		125	475	
	BC857W; BC858W		125	800	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	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			
	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	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

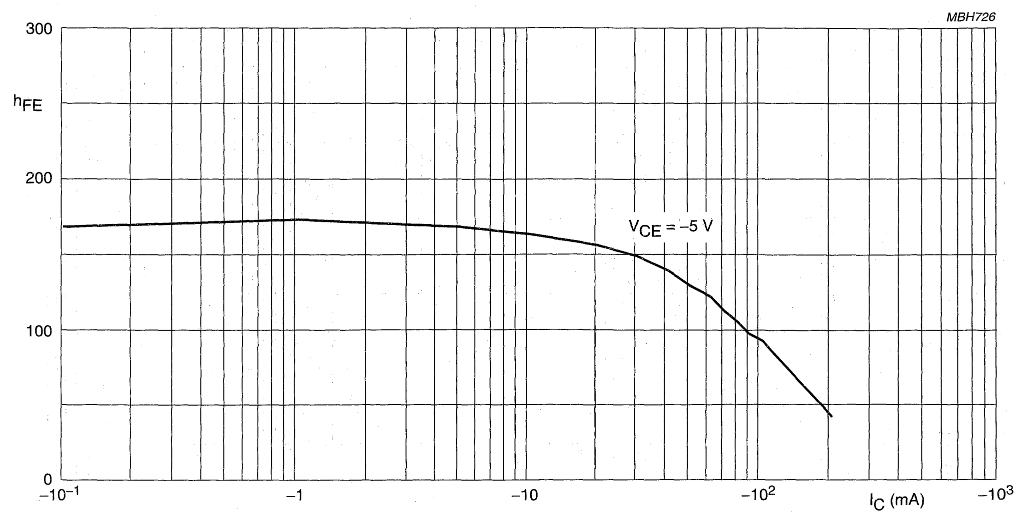
CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector 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
h_{FE}	DC current gain	I_C = −2 mA; V_{CE} = −5 V; see Figs 2, 3 and 4			
	BC856W		125	475	
	BC857W; BC858W		125	800	
	BC856AW; BC857AW; BC858AW		125	250	
	BC856BW; BC857BW; BC858BW		220	475	
	BC857CW; BC858CW		420	800	
V_{CEsat}	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
V_{BEsat}	base-emitter saturation voltage	I_C = −100 mA; I_B = −5 mA; note 1	–	−950	mV
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
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = −10 V; f = 1 MHz	–	5	pF
C_e	emitter capacitance	$I_C = i_c$ =0; V_{EB} = −0.5 V; f = 1 MHz	–	12	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

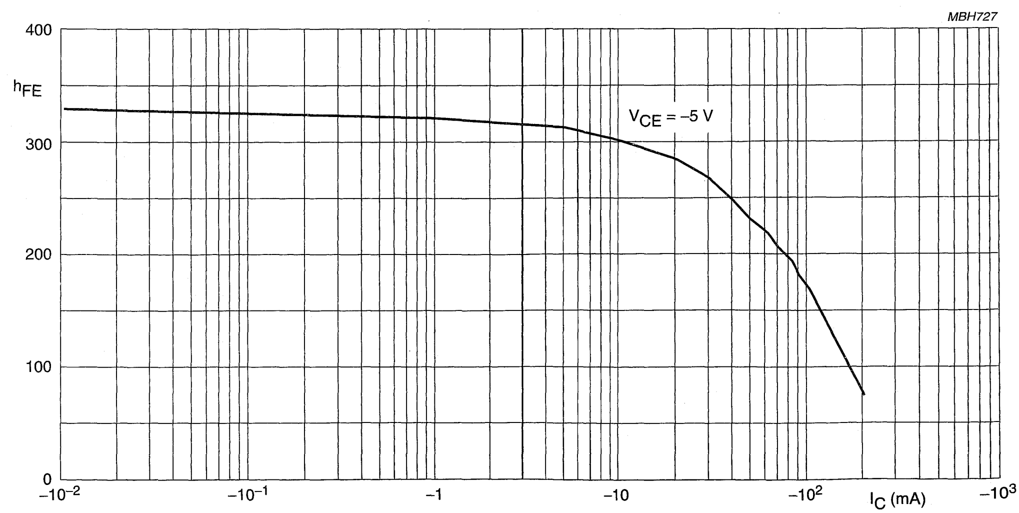
Note

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



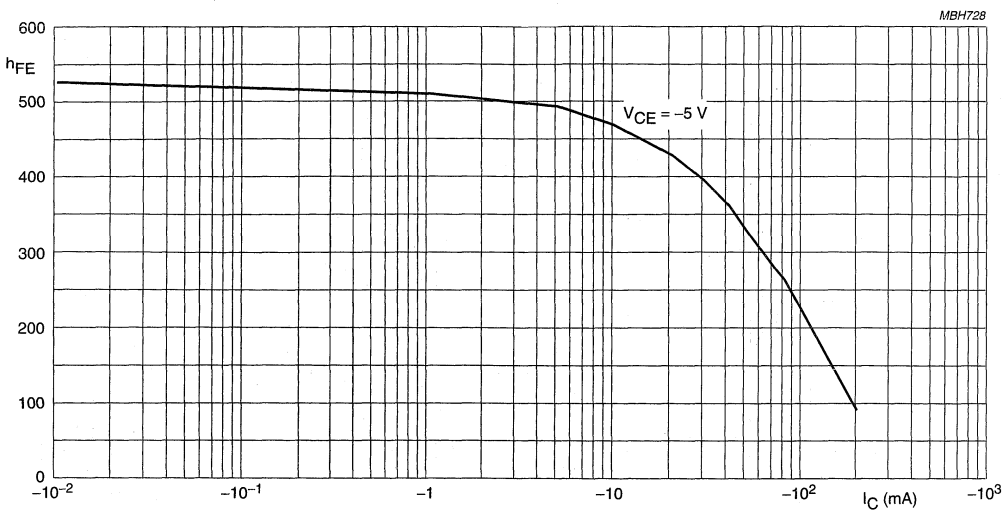
BC856AW; BC857AW; BC858AW.

Fig.2 DC current gain; typical values.



BC856BW; BC857BW; BC858BW.

Fig.3 DC current gain; typical values.



BC857CW; BC858CW.

Fig.4 DC current gain; typical values.

PNP general purpose double transistor BC857BS

FEATURES

- Low collector capacitance
- Low collector-emitter saturation voltage
- Closely matched current gain
- Reduces number of components and boardspace
- No mutual interference between the transistors.

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP double transistor in an SC-88; SOT363 plastic package. NPN complement: BC847BS.

MARKING

TYPE NUMBER	MARKING CODE
BC857BS	3Ft

PINNING

PIN	DESCRIPTION
1, 4	emitter TR1; TR2
2, 5	base TR1; TR2
6, 3	collector TR1; TR2

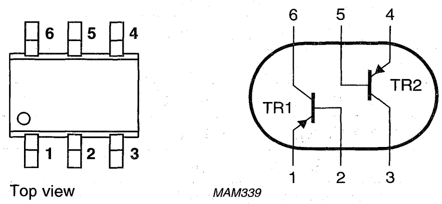


Fig.1 Simplified outline (SC-88; SOT363) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per transistor					
V_{CBO}	collector-base voltage	open emitter	–	–50	V
V_{CEO}	collector-emitter voltage	open base	–	–45	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V	200	450	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	100	–	MHz
Per device					
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	300	mW

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per transistor					
V_{CBO}	collector-base voltage	open emitter	–	–50	V
V_{CEO}	collector-emitter voltage	open base	–	–45	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C
Per device					
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	300	mW

Note

1. Device mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
Per device				
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	416	K/W

Note

1. Device mounted on an FR4 printed-circuit board.

PNP general purpose transistors BC859; BC860

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- Low noise input stages of audio frequency equipment.

DESCRIPTION

PNP transistor in a SOT23 plastic package.
NPN complements: BC849 and BC850.

MARKING

TYPE NUMBER	MARKING CODE	TYPE NUMBER	MARKING CODE
BC859	4Dp	BC860	4Hp
BC859A	4Ap	BC860A	4Ep
BC859B	4Bp	BC860B	4Fp
BC859C	4Cp	BC860C	4Gp

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

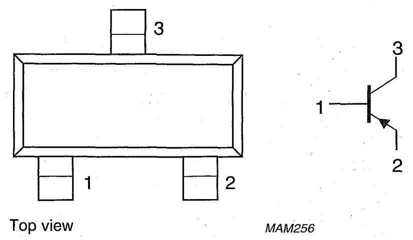


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC859		–	–30	V
	BC860		–	–50	V
V_{CEO}	collector-emitter voltage	open base			
	BC859		–	–30	V
	BC860		–	–45	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 60$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V	125	800	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	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			
	BC859		–	–30	V
	BC860		–	–50	V
V_{CEO}	collector-emitter voltage	open base			
	BC859		–	–30	V
	BC860		–	–45	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

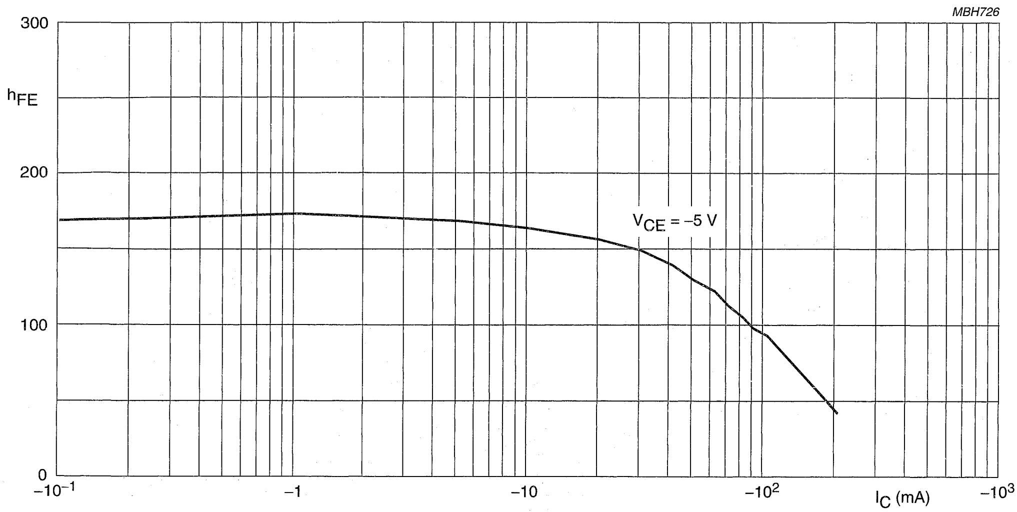
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -30$ V	–	–1	–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
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V	125	–	800	
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V; see Figs 2, 3 and 4				
	BC859A; BC860A		125	–	250	
	BC859B; BC860B		220	–	475	
	BC859C; BC860C		420	–	800	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–75	–300	mV
		$I_C = -100$ mA; $I_B = -5$ mA	–	–250	–650	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA; note 1	–	–700	–	mV
		$I_C = -100$ mA; $I_B = -5$ mA; note 1	–	–850	–	mV
V_{BE}	base-emitter voltage	$I_C = -2$ mA; $V_{CE} = -5$ V; note 2	–600	–650	–750	mV
		$I_C = -10$ mA; $V_{CE} = -5$ V; note 2	–	–	–820	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	4.5	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -500$ mV; f = 1 MHz	–	10	–	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 = 30 Hz to 15 kHz				
	BC859A; BC860A		–	–	10	dB
	BC859B; BC860B BC859C; BC860C		–	–	4	dB
F	noise figure	$I_C = -200$ μA; $V_{CE} = -5$ V; $R_S = 2$ kΩ; f = 1 kHz; B = 200 Hz				
	BC859A; BC860A		–	–	10	dB
	BC859B; BC860B BC859C; BC860C		–	–	4	dB

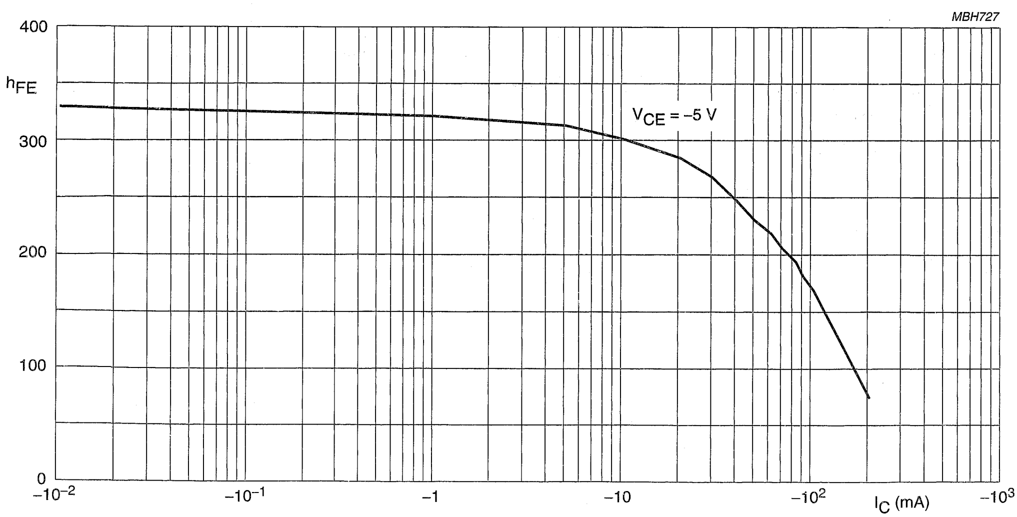
Notes

1. V_{BEsat} decreases by about –1.7 mV/K with increasing temperature.
2. V_{BE} decreases by about –2 mV/K with increasing temperature.



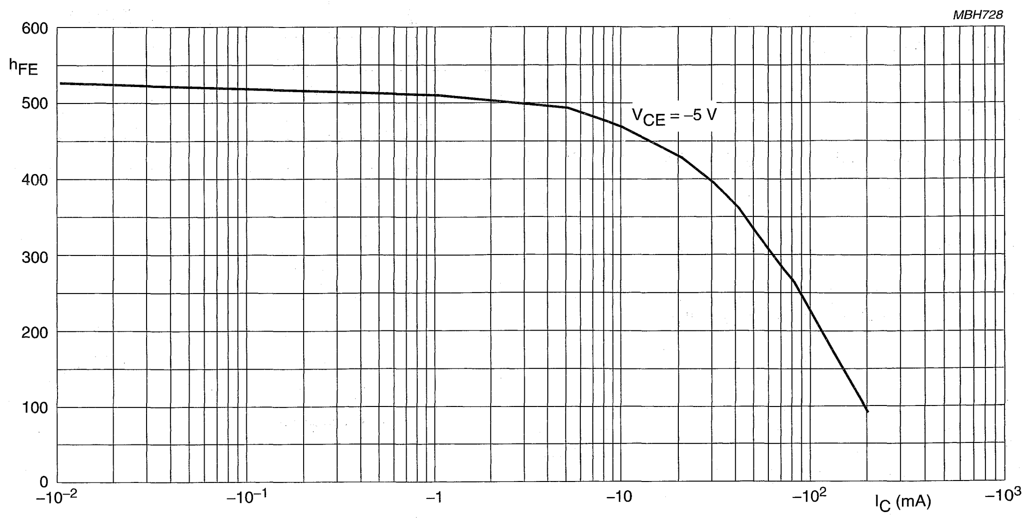
BC859A; BC860A.

Fig.2 DC current gain; typical values.



BC859B; BC860B.

Fig.3 DC current gain; typical values.



BC859C; BC860C.

Fig.4 DC current gain; typical values.

PNP general purpose transistors BC859W; BC860W

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- Low noise stages in tape recorders, hi-fi amplifiers and other audio-frequency equipment.

DESCRIPTION

PNP transistor in a SOT323 plastic package.
NPN complements: BC849W and BC850W.

MARKING

TYPE NUMBER	MARKING CODE	TYPE NUMBER	MARKING CODE
BC859W	4Dt	BC860W	4Ht
BC859AW	4At	BC860AW	4Et
BC859BW	4Bt	BC860BW	4Ft
BC859CW	4Ct	BC860CW	4Gt

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

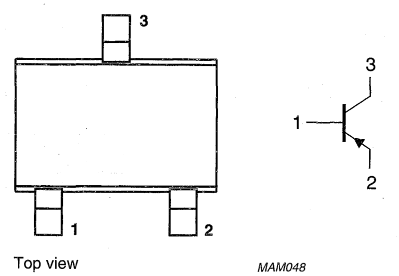


Fig.1 Simplified outline (SOT323) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	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	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V	125	800	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	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			
	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	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

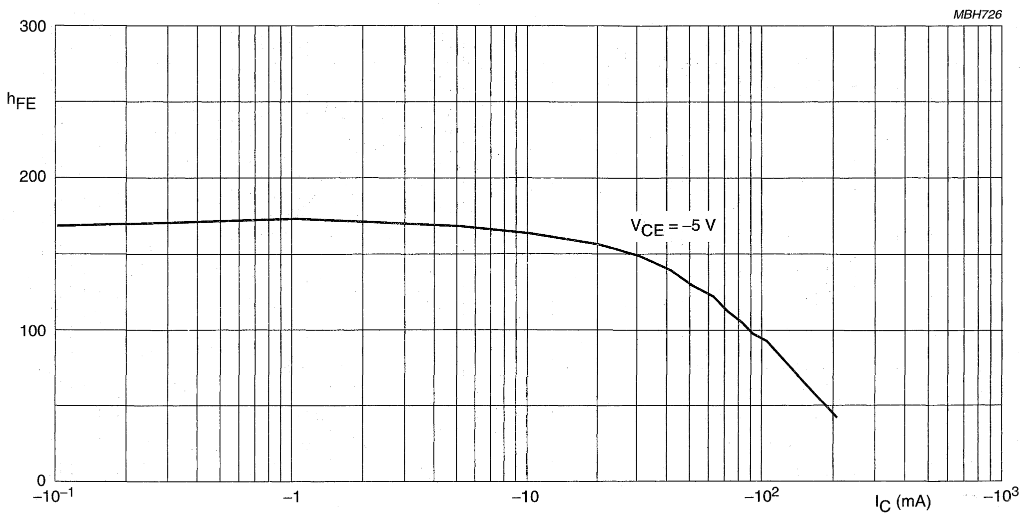
CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector 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
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V; see Figs 2, 3 and 4				
	BC859W; BC860W		125	–	800	
	BC859AW; BC860AW		125	–	250	
	BC859BW; BC860BW		220	–	475	
	BC859CW; BC860CW		420	–	800	
V_{CEsat}	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
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
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -500$ mV; f = 1 MHz	–	10	–	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	100	–	–	MHz
F	noise figure BC859W; BC860W BC859AW; BC860AW	$I_C = -200$ μA; $V_{CE} = -5$ V; $R_S = 2$ kΩ; f = 10 Hz to 15.7 kHz	–	–	10	dB
		$I_C = -200$ μA; $V_{CE} = -5$ V; $R_S = 2$ kΩ; f = 1 kHz; B = 200 Hz	–	–	10	dB
F	noise figure BC859BW; BC860BW BC859CW; BC860CW	$I_C = -200$ μA; $V_{CE} = -5$ V; $R_S = 2$ kΩ; f = 10 Hz to 15.7 kHz	–	–	4	dB
		$I_C = -200$ μA; $V_{CE} = -5$ V; $R_S = 2$ kΩ; f = 1 kHz; B = 200 Hz	–	–	4	dB

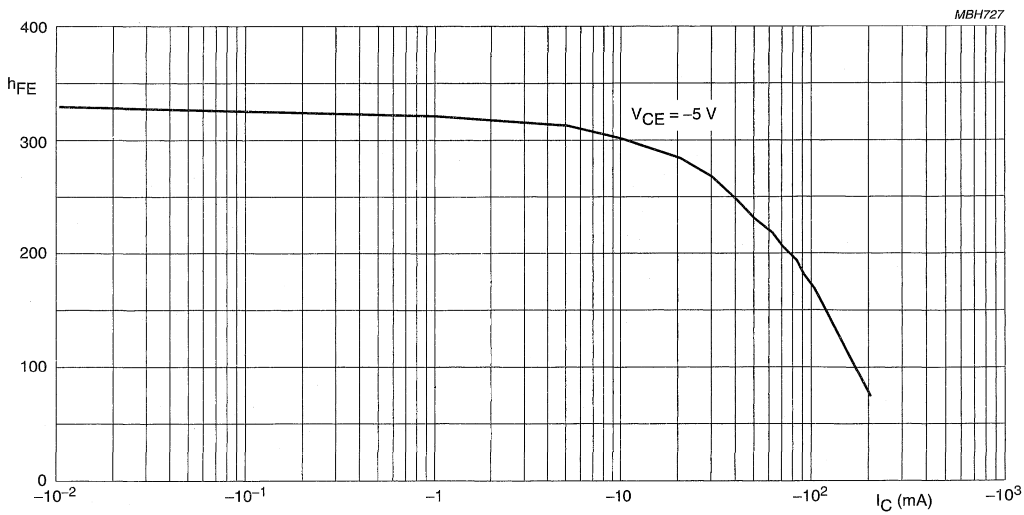
Note

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



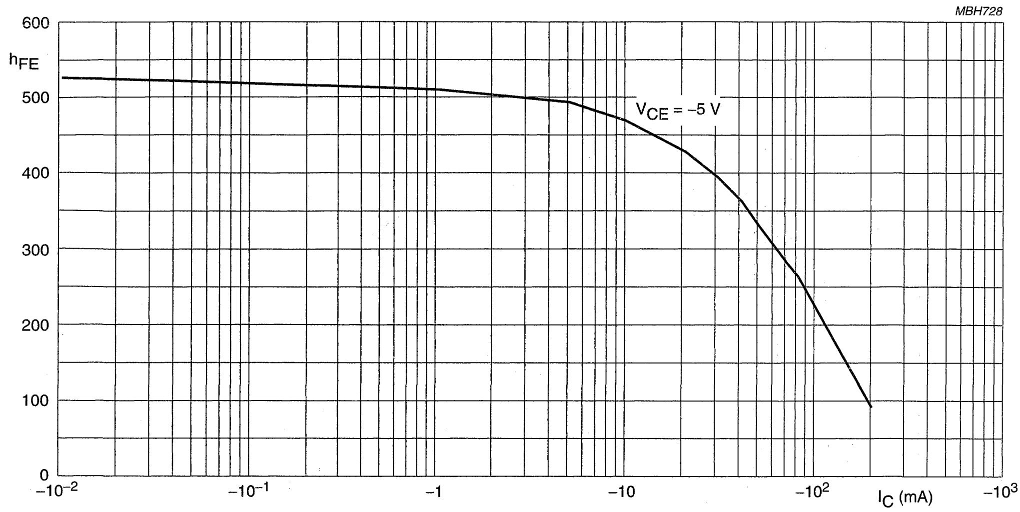
BC859AW; BC860AW.

Fig.2 DC current gain; typical values.



BC859BW; BC860BW.

Fig.3 DC current gain; typical values.



BC859CW; BC860CW.

Fig.4 DC current gain; typical values.

NPN medium power transistor | BC868

FEATURES

- High current (max. 1 A)
- Low voltage (max. 20 V).

APPLICATIONS

- General purpose switching and amplification
- Power applications such as audio output stages.

DESCRIPTION

NPN medium power transistor in a SOT89 plastic package. PNP complement: BC869.

MARKING

TYPE NUMBER	MARKING CODE
BC868	CAC
BC868-10	CBC
BC868-16	CCC
BC868-25	CDC

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

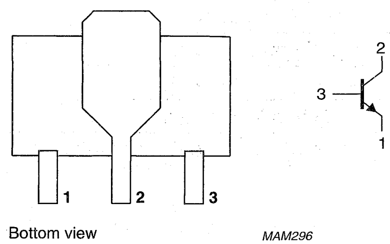


Fig.1 Simplified outline (SOT89) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	32	V
V_{CEO}	collector-emitter voltage	open base	–	20	V
I_{CM}	peak collector current		–	2	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.4	W
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 1$ V	85	375	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	40	–	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	–	32	V
V_{CEO}	collector-emitter voltage	open base	–	20	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	1	A
I_{CM}	peak collector current		–	2	A
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.4	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	89	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		8	K/W

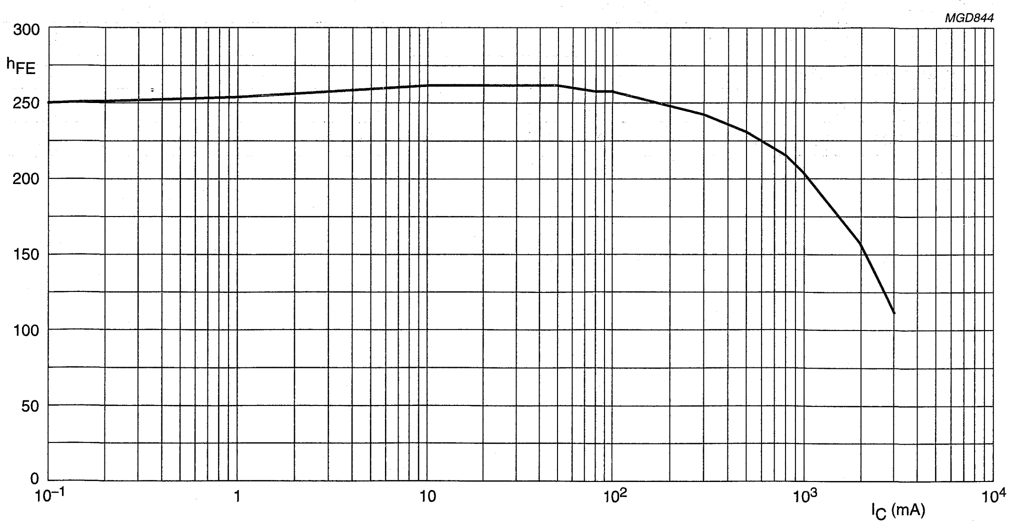
Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 25 V	–	–	100	nA
		I_E = 0; V_{CB} = 25 V; T_j = 150 °C	–	–	10	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 5 V	–	–	100	nA
h_{FE}	DC current gain	I_C = 5 mA; V_{CE} = 10 V	50	–	–	
h_{FE}	DC current gain	V_{CE} = 1 V; see Fig.2				
		I_C = 500 mA	85	–	375	
		I_C = 1 A	60	–	–	
h_{FE}	DC current gain	I_C = 500 mA; V_{CE} = 1 V; see Fig.2				
	BC868-10		–	–	160	
	BC868-16		100	–	250	
	BC868-25		160	–	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = 1 A; I_B = 100 mA	–	–	500	mV
V_{BE}	base-emitter voltage	I_C = 5 mA; V_{CE} = 10 V	–	620	–	mV
		I_C = 1 A; V_{CE} = 1 V	–	–	1	V
f_T	transition frequency	I_C = 10 mA; V_{CE} = 5 V; f = 100 MHz	40	–	–	MHz
$\frac{h_{FE1}}{h_{FE2}}$	DC current gain ratio of the complementary pairs	$\|I_C\|$ = 0.5 A; $\|V_{CE}\|$ = 1 V	–	–	1.6	



V_{CE} = 1 V.

Fig.2 DC current gain; typical values.

PNP medium power transistor | BC869

FEATURES

- High current (max. 1 A)
- Low voltage (max. 20 V).

APPLICATIONS

- Low voltage, high current LF applications.

DESCRIPTION

PNP medium power transistor in a SOT89 plastic package. NPN complement: BC868.

MARKING

TYPE NUMBER	MARKING CODE
BC869	CEC
BC869-16	CGC
BC869-25	CHC

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

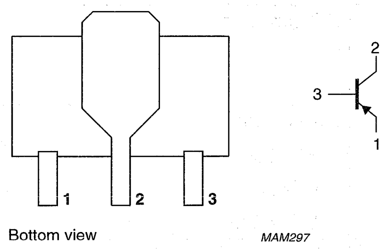


Fig.1 Simplified outline (SOT89) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–32	V
V_{CEO}	collector-emitter voltage	open base	–	–20	V
I_{CM}	peak collector current		–	–2	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.4	W
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -1$ V	100	375	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	40	–	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	–	–32	V
V_{CEO}	collector-emitter voltage	open base	–	–20	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–1	A
I_{CM}	peak collector current		–	–2	A
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.4	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04".*

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	99	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		8	K/W

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04".*

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −25 V	–	–	−100	nA
		I_E = 0; V_{CB} = −25 V; T_j = 150 °C	–	–	−10	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −5 V	–	–	−100	nA
h_{FE}	DC current gain	I_C = −5 mA; V_{CE} = −10 V; see Fig.2	50	–	–	
		I_C = −500 mA; V_{CE} = −1 V; see Fig.2	100	–	375	
		I_C = −1 A; V_{CE} = −1 V; see Fig.2	60	–	–	
h_{FE}	DC current gain	I_C = −500 mA; V_{CE} = −1 V; see Fig.2				
	BC869-16		100	–	250	
	BC869-25		160	–	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = −1 A; I_B = −100 mA	–	–	−500	mV
V_{BE}	base-emitter voltage	I_C = −5 mA; V_{CE} = −10 V	–	−620	–	mV
		I_C = −1 A; V_{CE} = −1 V	–	–	−1	V
f_T	transition frequency	I_C = −10 mA; V_{CE} = −5 V; f = 100 MHz	40	–	–	MHz

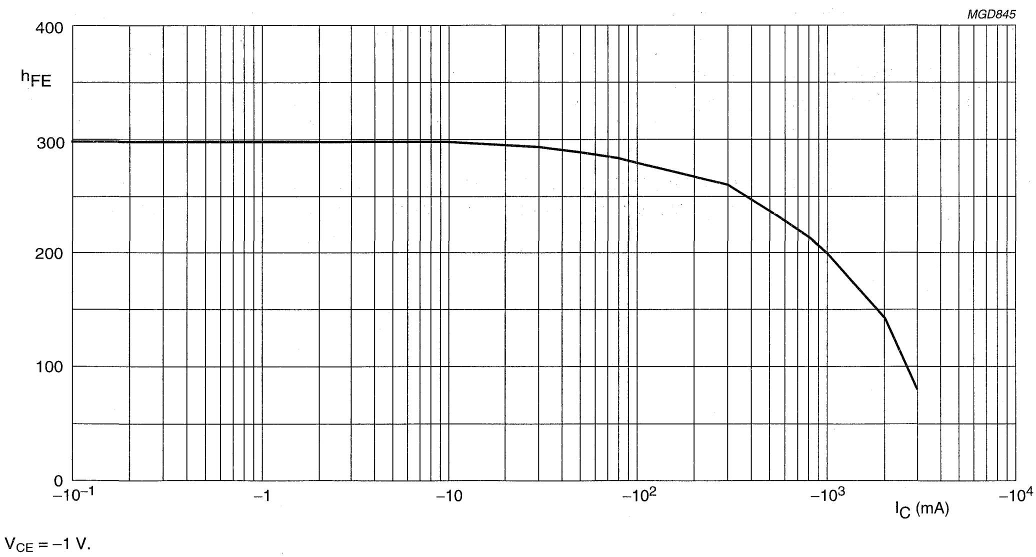


Fig.2 DC current gain; typical values.

NPN Darlington transistors BC875; BC877; BC879

FEATURES

- High DC current gain (min. 1000)
- High current (max. 1 A)
- Low voltage (max. 80 V)
- Integrated diode and resistor.

APPLICATIONS

- Relay drivers.

DESCRIPTION

NPN Darlington transistor in a TO-92; SOT54 plastic package. PNP complements: BC876, BC878, and BC880.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

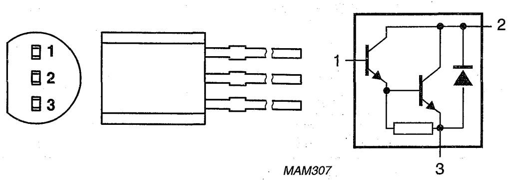


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BC875		–	–	60	V
	BC877		–	–	80	V
	BC879		–	–	100	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$				
	BC875		–	–	45	V
	BC877		–	–	60	V
	BC879		–	–	80	V
I_C	collector current (DC)		–	–	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	0.83	W
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 10$ V	1000	–	–	
f_T	transition frequency	$I_C = 0.5$ A; $V_{CE} = 5$ V; f = 100 MHz	–	200	–	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			
	BC875		–	60	V
	BC877		–	80	V
	BC879		–	100	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BC875		–	45	V
	BC877		–	60	V
	BC879		–	80	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	1	A
I_{CM}	peak collector current		–	2	A
I_B	base current (DC)		–	0.2	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	0.83	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	150	K/W

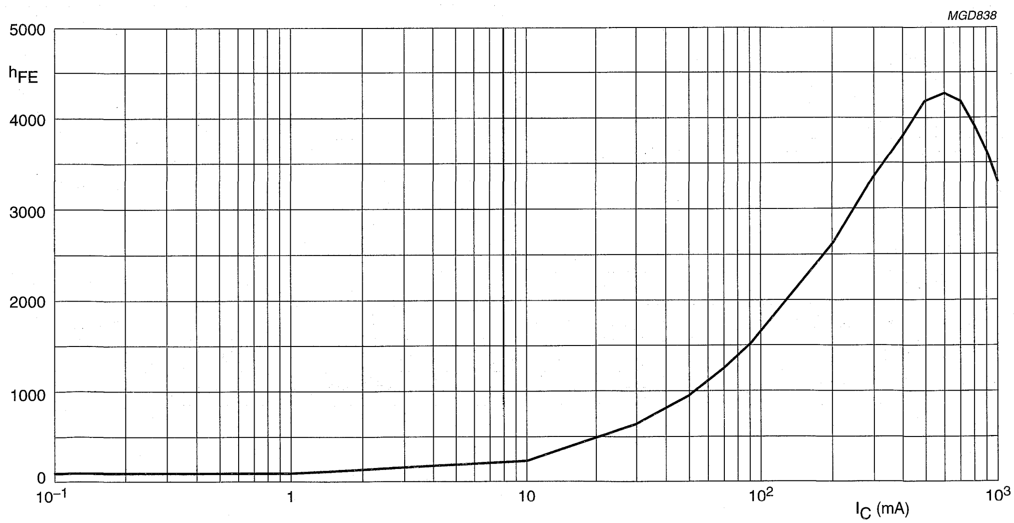
Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25\ °C$ unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	collector cut-off current					
	BC875	$V_{BE} = 0$; $V_{CE} = 45$ V	–	–	50	nA
	BC877	$V_{BE} = 0$; $V_{CE} = 60$ V	–	–	50	nA
	BC879	$V_{BE} = 0$; $V_{CE} = 80$ V	–	–	50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 10$ V; see Fig.2	1000	–	–	
		$I_C = 0.5$ A; $V_{CE} = 10$ V; see Fig.2	2000	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 0.5$ A; $I_B = 0.5$ mA	–	–	1.3	V
		$I_C = 1$ A; $I_B = 1$ mA	–	–	1.8	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 1$ A; $I_B = 1$ mA	–	–	2.2	V
f_T	transition frequency	$I_C = 0.5$ A; $V_{CE} = 5$ V; f = 100 MHz	–	200	–	MHz
Switching times (between 10% and 90% levels)						
t_{on}	turn-on time	$I_{Con} = 500$ mA; $I_{Bon} = 0.5$ mA; $I_{Boff} = -0.5$ mA	–	500	–	ns
t_{off}	turn-off time		–	1300	–	ns



$V_{CE} = 10$ V.

Fig.2 DC current gain; typical values.

FEATURES

- High DC current gain (min. 1 000)
- High current (max. 1 A)
- Low voltage (max. 80 V)
- Integrated diode and resistor.

APPLICATIONS

- Relay drivers.

DESCRIPTION

PNP Darlington transistor in a TO-92; SOT54 plastic package. NPN complements: BC875, BC877 and BC879.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

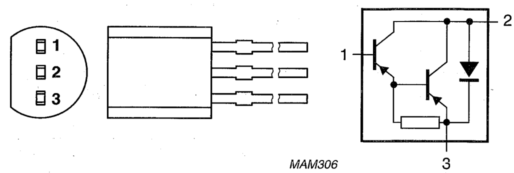


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BC876		–	–	–60	V
	BC878		–	–	–80	V
	BC880		–	–	–100	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$				
	BC876		–	–	–45	V
	BC878		–	–	–60	V
	BC880		–	–	–80	V
I_C	collector current (DC)		–	–	–1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	0.83	W
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -10$ V	1000	–	–	
f_T	transition frequency	$I_C = -0.5$ A; $V_{CE} = -5$ V; f = 100 MHz	–	200	–	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			
	BC876		–	–60	V
	BC878		–	–80	V
	BC880		–	–100	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BC876		–	–45	V
	BC878		–	–60	V
	BC880		–	–80	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–1	A
I_{CM}	peak collector current		–	–2	A
I_B	base current (DC)		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	0.83	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	150	K/W

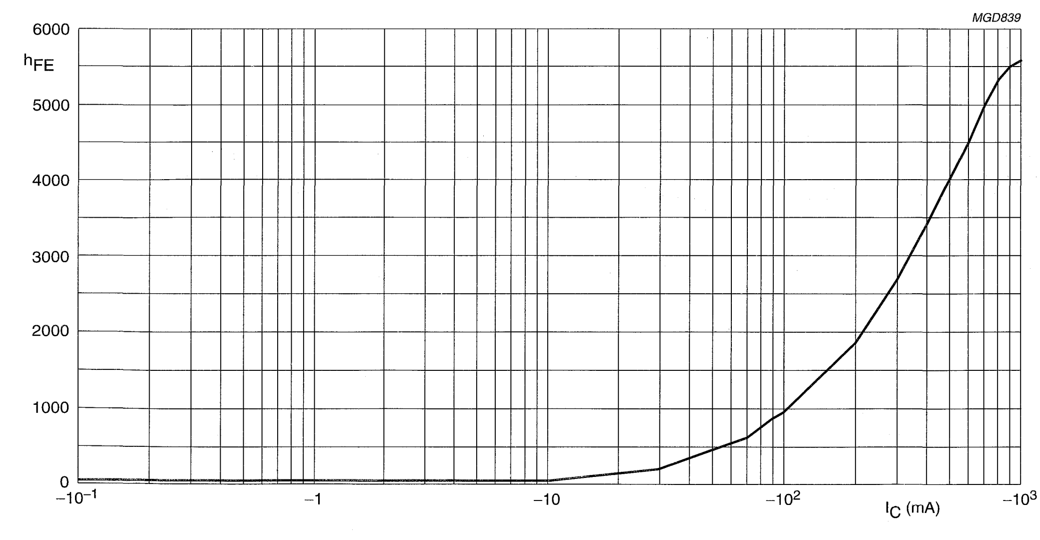
Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	collector cut-off current					
	BC875	V_{BE} = 0; V_{CE} = −45 V	–	–	−50	nA
	BC877	V_{BE} = 0; V_{CE} = −60 V	–	–	−50	nA
	BC879	V_{BE} = 0; V_{CE} = −80 V	–	–	−50	nA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −4 V	–	–	−50	nA
h_{FE}	DC current gain	I_C = −150 mA; V_{CE} = −10 V; see Fig.2	1000	–	–	
		I_C = −0.5 A; V_{CE} = −10 V; see Fig.2	2000	–	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = −0.5 A; I_B = −0.5 mA	–	–	−1.3	V
		I_C = −1 A; I_B = −1 mA	–	–	−1.8	V
V_{BEsat}	base-emitter saturation voltage	I_C = −1 A; I_B = −1 mA	–	–	−2.2	V
f_T	transition frequency	I_C = −0.5 A; V_{CE} = −5 V; f = 100 MHz	–	200	–	MHz
Switching times (between 10% and 90% levels)						
t_{on}	turn-on time	I_{Con} = −500 mA; I_{Bon} = −0.5 mA; I_{Boff} = 0.5 mA	–	–	500	ns
t_{off}	turn-off time		–	–	700	ns



V_{CE} = −10 V.

Fig.2 DC current gain; typical values.

PNP general purpose transistors — BCF29; BCF30

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 32 V).

APPLICATIONS

- Low level, low noise general purpose applications in thick and thin-film circuits.

DESCRIPTION

PNP transistor in a SOT23 plastic package.
NPN complements: BCF32 and BCF33.

MARKING

TYPE NUMBER	MARKING CODE
BCF29	C7p
BCF30	C8p

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

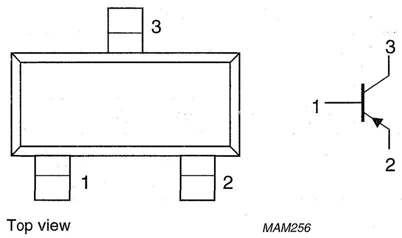


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–32	V
V_{CEO}	collector-emitter voltage	open base	–	–32	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V			
	BCF29		120	260	
	BCF30		215	500	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	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	–	–32	V
V_{CEO}	collector-emitter voltage	open base	–	–32	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

PNP general purpose transistors BCF29; BCF30

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −32 V	−	−	−100	nA
		I_E = 0; V_{CB} = −32 V; T_j = 100 °C	−	−	−10	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −5 V	−	−	−100	nA
h_{FE}	DC current gain	I_C = −10 μA; V_{CE} = −5 V				
	BCF29		−	90	−	
	BCF30		−	150	−	
h_{FE}	DC current gain	I_C = −2 mA; V_{CE} = −5 V				
	BCF29		120	−	260	
	BCF30		215	−	500	
V_{CEsat}	collector-emitter saturation voltage	I_C = −10 mA; I_B = −0.5 mA	−	−80	−300	mV
		I_C = −50 mV; I_B = −2.5 mA	−	−150	−	mV
V_{BEsat}	base-emitter saturation voltage	I_C = −10 mA; I_B = −0.5 mA	−	−720	−	mV
		I_C = −50 mA; I_B = −2.5 mA	−	−810	−	mV
V_{BE}	base-emitter voltage	I_C = −2 mA; V_{CE} = −5 V	−600	−	−750	mV
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = −10 V; f = 1 MHz	−	4.5	−	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	−	1	4	dB

NPN general purpose transistors | BCF32; BCF33

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 32 V).

APPLICATIONS

- Low level, low noise general purpose applications in thick and thin-film circuits.

DESCRIPTION

NPN transistor in a SOT23 plastic package.
PNP complements: BCF29 and BCF30.

MARKING

TYPE NUMBER	MARKING CODE
BCF32	D7p
BCF33	D8p

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

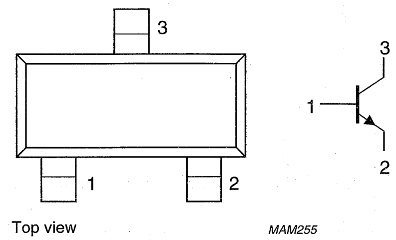


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	32	V
V_{CEO}	collector-emitter voltage	open base	–	32	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V			
	BCF32		200	450	
	BCF33		420	800	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	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	–	32	V
V_{CEO}	collector-emitter voltage	open base	–	32	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 32 V	–	–	100	nA
		I_E = 0; V_{CB} = 32 V; T_j = 100 °C	–	–	10	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 5 V	–	–	100	nA
h_{FE}	DC current gain	I_C = 10 μA; V_{CE} = 5 V				
	BCF32		–	150	–	
	BCF33		–	270	–	
h_{FE}	DC current gain	I_C = 2 mA; V_{CE} = 5 V				
	BCF32		200	–	450	
	BCF33		420	–	800	
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA; I_B = 0.5 mA	–	120	250	mV
		I_C = 50 mA; I_B = 2.5 mA	–	210	–	mV
V_{BEsat}	base-emitter saturation voltage	I_C = 10 mA; I_B = 0.5 mA	–	750	–	mV
		I_C = 50 mA; I_B = 2.5 mA	–	850	–	mV
V_{BE}	base-emitter voltage	I_C = 2 mA; V_{CE} = 5 V	550	–	700	mV
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = 10 V; f = 1 MHz	–	2.5	–	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	–	1.2	4	dB

NPN general purpose transistor BCF81

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- Low level, low noise general purpose applications in thick and thin-film circuits.

DESCRIPTION

NPN transistor in a SOT23 plastic package.

MARKING

TYPE NUMBER	MARKING CODE
BCF81	K9p

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

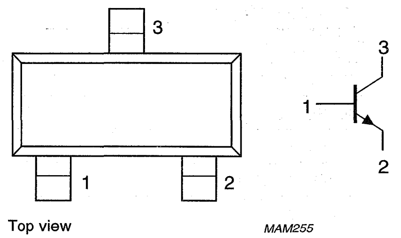


Fig.1 Simplified outline (SOT23) and symbol.

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	–	45	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V	420	800	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	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	–	45	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	–	100	nA
		$I_E = 0$; $V_{CB} = 20$ V; $T_j = 100$ °C	–	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V	420	–	800	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	120	250	mV
		$I_C = 50$ mA; $I_B = 2.5$ mA	–	210	–	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	750	–	mV
		$I_C = 50$ mA; $I_B = 2.5$ mA	–	850	–	mV
V_{BE}	base-emitter voltage	$I_C = 2$ mA; $V_{CE} = 5$ V	550	–	700	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	2.5	–	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	–	1.2	4	dB

PNP medium power transistors | BCP51; BCP52; BCP53

FEATURES

- High current (max. 1 A)
- Low voltage (max. 80 V)
- Medium power (max. 1.3 W).

APPLICATIONS

- Audio, telephony and automotive applications
- Thick and thin-film circuits.

DESCRIPTION

PNP medium power transistor in a SOT223 plastic package. NPN complements: BCP54, BCP55 and BCP56.

PINNING

PIN	DESCRIPTION
1	base
2, 4	collector
3	emitter

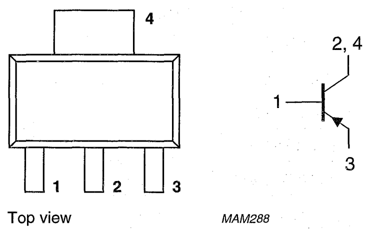


Fig.1 Simplified outline (SOT223) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BCP51		–	–	–45	V
	BCP52		–	–	–60	V
	BCP53		–	–	–100	V
V_{CEO}	collector-emitter voltage	open base				
	BCP51		–	–	–45	V
	BCP52		–	–	–60	V
	BCP53		–	–	–80	V
I_{CM}	peak collector current		–	–	–1.5	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	1.3	W
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -2$ V	40	–	250	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	–	115	–	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			
	BCP51		–	–45	V
	BCP52		–	–60	V
	BCP53		–	–100	V
V_{CEO}	collector-emitter voltage	open base			
	BCP51		–	–45	V
	BCP52		–	–60	V
	BCP53		–	–80	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–1	A
I_{CM}	peak collector current		–	–1.5	A
I_{BM}	peak base current		–	–0.2	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.3	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	95	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		14	K/W

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −30 V	–	–	−100	nA
		I_E = 0; V_{CB} = −30 V; T_j = 125 °C	–	–	−10	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −5 V	–	–	−100	nA
h_{FE}	DC current gain	V_{CE} = −2 V; see Fig.2				
		I_C = −5 mA	40	–	–	
		I_C = −150 mA	40	–	250	
		I_C = −500 mA	25	–	–	
h_{FE}	DC current gain	I_C = 150 mA; V_{CE} = −2 V; see Fig.2				
	BCP51-10; BCP52-10; BCP53-10		63	–	160	
	BCP51-16; BCP52-16; BCP53-16		100	–	250	
V_{CEsat}	collector-emitter saturation voltage	I_C = −500 mA; I_B = −50 mA	–	–	−0.5	V
V_{BE}	base-emitter voltage	I_C = −500 mA; V_{CE} = −2 V	–	–	−1	V
f_T	transition frequency	I_C = −10 mA; V_{CE} = −5 V; f = 100 MHz	–	115	–	MHz

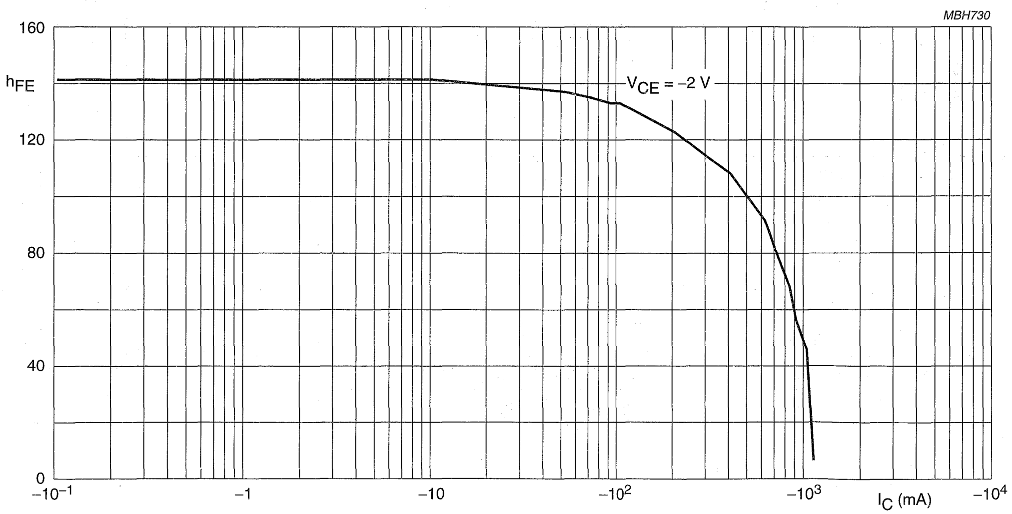


Fig.2 DC current gain; typical values.

NPN medium power transistors | BCP54; BCP55; BCP56

FEATURES

- High current (max. 1 A)
- Low voltage (max. 80 V).

APPLICATIONS

- Switching.

DESCRIPTION

NPN medium power transistor in a SOT223 plastic package. PNP complements: BCP51, BCP52 and BCP53.

PINNING

PIN	DESCRIPTION
1	base
2, 4	collector
3	emitter

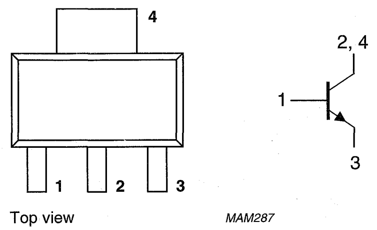


Fig.1 Simplified outline (SOT223) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BCP54		–	–	45	V
	BCP55		–	–	60	V
	BCP56		–	–	100	V
V_{CEO}	collector-emitter voltage	open base				
	BCP54		–	–	45	V
	BCP55		–	–	60	V
	BCP56		–	–	80	V
I_{CM}	peak collector current		–	–	1.5	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	1.33	W
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 2$ V	40	–	250	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	–	130	–	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			
	BCP54		–	45	V
	BCP55		–	60	V
	BCP56		–	100	V
V_{CEO}	collector-emitter voltage	open base			
	BCP54		–	45	V
	BCP55		–	60	V
	BCP56		–	80	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	1	A
I_{CM}	peak collector current		–	1.5	A
I_{BM}	peak base current		–	0.2	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.33	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	94	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		13	K/W

Note

1. Device mounted on printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30$ V	–	–	100	nA
		$I_E = 0$; $V_{CB} = 30$ V; $T_j = 125$ °C	–	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 2$ V	25	–	–	
		$I_C = 150$ mA; $V_{CE} = 2$ V	40	–	250	
		$I_C = 500$ mA; $V_{CE} = 2$ V	25	–	–	
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 2$ V		–		
	BCP54-10; 55-10; 56-10		63	–	160	
	BCP54-16; 55-16; 56-16		100	–	250	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 0.5$ A; $I_B = 50$ mA	–	–	500	mV
V_{BE}	base-emitter voltage	$I_C = 0.5$ A; $V_{CE} = 2$ V	–	–	1	V
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	–	130	–	MHz
$\frac{h_{FE1}}{h_{FE2}}$	DC current gain ratio of the complementary pairs	$\lvert I_C \rvert = 150$ mA; $\lvert V_{CE} \rvert = 2$ V	–	–	1.6	

NPN medium power transistor BCP68

FEATURES

- High current (max. 1 A)
- Low voltage (max. 20 V).

APPLICATIONS

- General purpose switching and amplification under high current conditions.

DESCRIPTION

NPN medium power transistor in a SOT223 plastic package.
PNP complement: BCP69.

PINNING

PIN	DESCRIPTION
1	base
2, 4	collector
3	emitter

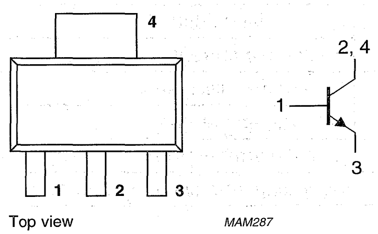


Fig.1 Simplified outline (SOT223) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	32	V
V_{CEO}	collector-emitter voltage	open base	–	20	V
I_{CM}	peak collector current		–	2	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.37	W
h_{FE}	DC current gain	I_C = 500 mA; V_{CE} = 1 V	85	375	
f_T	transition frequency	I_C = 10 mA; V_{CE} = 5 V; f = 100 MHz	40	–	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	–	32	V
V_{CEO}	collector-emitter voltage	open base	–	20	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	1	A
I_{CM}	peak collector current		–	2	A
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.37	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	91	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		10	K/W

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 25 V	–	–	100	nA
		I_E = 0; V_{CB} = 25 V; T_j = 150 °C	–	–	10	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 5 V	–	–	100	nA
h_{FE}	DC current gain	I_C = 5 mA; V_{CE} = 10 V	50	–	–	
		I_C = 500 mA; V_{CE} = 1 V; see Fig.2	85	–	375	
		I_C = 1 A; V_{CE} = 1 V; see Fig.2	60	–	–	
h_{FE}	DC current gain	I_C = 500 mA; V_{CE} = 1 V; see Fig.2				
	BCP68-10		–	–	160	
	BCP68-16		100	–	250	
	BCP68-25		160	–	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = 1 A; I_B = 100 mA	–	–	500	mV
V_{BE}	base-emitter voltage	I_C = 5 mA; V_{CE} = 10 V	–	620	–	mV
		I_C = 1 A; V_{CE} = 1 V	–	–	1	V
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 5 V; f = 1 MHz	–	38	–	pF
f_T	transition frequency	I_C = 10 mA; V_{CE} = 5 V; f = 100 MHz	40	–	–	MHz
$\frac{h_{FE1}}{h_{FE2}}$	DC current gain ratio of the complementary pairs	$\lvert I_C \rvert$ = 0.5 A; $\lvert V_{CE} \rvert$ = 1 V	–	–	1.6	

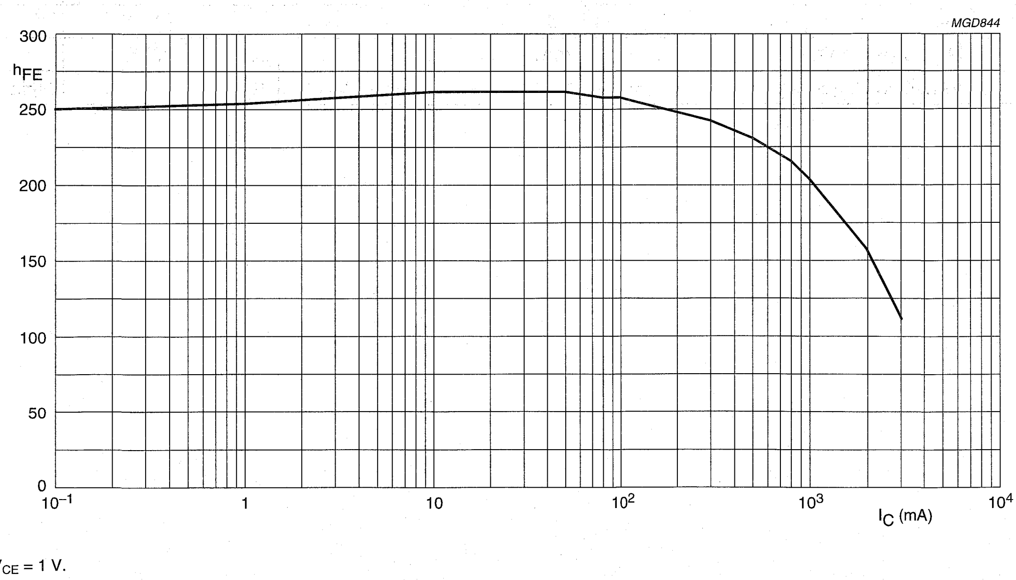


Fig.2 DC current gain; typical values.

PNP medium power transistor | BCP69

FEATURES

- High current (max. 1 A)
- Low voltage (max. 20 V).

APPLICATIONS

- General purpose switching and amplification
- Power applications such as audio output stages.

DESCRIPTION

PNP medium power transistor in a SOT223 plastic package. NPN complement: BCP68.

PINNING

PIN	DESCRIPTION
1	base
2, 4	collector
3	emitter

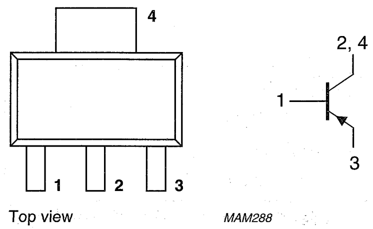


Fig.1 Simplified outline (SOT223) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–32	V
V_{CEO}	collector-emitter voltage	open base	–	–20	V
I_{CM}	peak collector current		–	–2	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.35	W
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -1$ V	85	375	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	40	–	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	–	–32	V
V_{CEO}	collector-emitter voltage	open base	–	–20	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–1	A
I_{CM}	peak collector current		–	–2	A
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.35	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	91	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		10	K/W

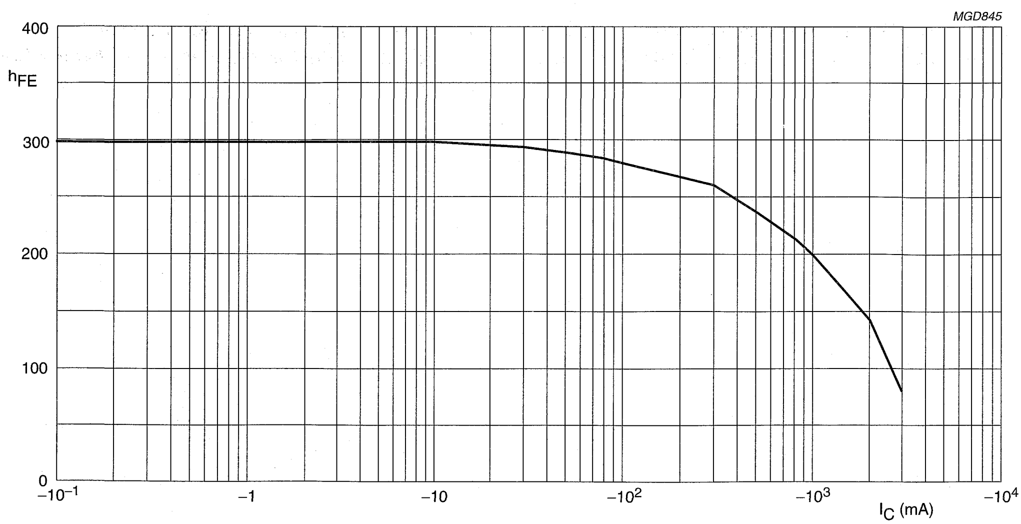
Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -25$ V	–	–	–100	nA
		$I_E = 0$; $V_{CB} = -25$ V; $T_j = 150$ °C	–	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–100	nA
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -10$ V	50	–	–	
		$I_C = -500$ mA; $V_{CE} = -1$ V; see Fig.2	85	375	–	
		$I_C = -1$ A; $V_{CE} = -1$ V; see Fig.2	60	–	–	
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -1$ V; see Fig.2				
	BCP69-10		–	–	160	
	BCP69-16		100	–	250	
	BCP69-25		160	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -1$ A; $I_B = -100$ mA	–	–	–500	mV
V_{BE}	base-emitter voltage	$I_C = -5$ mA; $V_{CE} = -10$ V	–	–620	–	mV
		$I_C = -1$ A; $V_{CE} = -1$ V	–	–	–1	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -5$ V; f = 1 MHz	–	48	–	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	40	–	–	MHz
$\frac{h_{FE1}}{h_{FE2}}$	DC current gain ratio of the complementary pairs	$\|I_C\| = 0.5$ A; $\|V_{CE}\| = 1$ V	–	–	1.6	



$V_{CE} = -1$ V.

Fig.2 DC current gain; typical values.

PNP Darlington transistors BCV26; BCV46

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 60 V)
- Very high DC current gain (min. 10000).

APPLICATIONS

- Where very high amplification is required.

DESCRIPTION

PNP Darlington transistor in a SOT23 plastic package.
NPN complements: BCV27 and BCV47.

MARKING

TYPE NUMBER	MARKING CODE
BCV26	FDp
BCV46	FEp

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

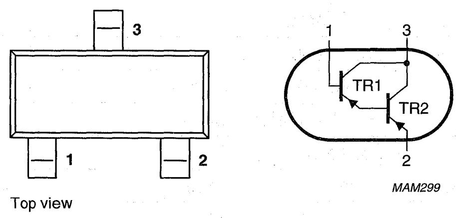


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BCV26		–	–	–40	V
	BCV46		–	–	–80	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$				
	BCV26		–	–	–30	V
	BCV46		–	–	–60	V
I_C	collector current (DC)		–	–	–500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -5$ V				
	BCV26		10000	–	–	
	BCV46		4000	–	–	
f_T	transition frequency	$I_C = -30$ mA; $V_{CE} = -5$ V; f = 100 MHz	–	220	–	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			
	BCV26		–	–40	V
	BCV46		–	–80	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BCV26		–	–30	V
	BCV46		–	–60	V
V_{EBO}	emitter-base voltage	open collector	–	–10	V
I_C	collector current (DC)		–	–500	mA
I_{CM}	peak collector current		–	–800	mA
I_B	base current (DC)		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \le 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

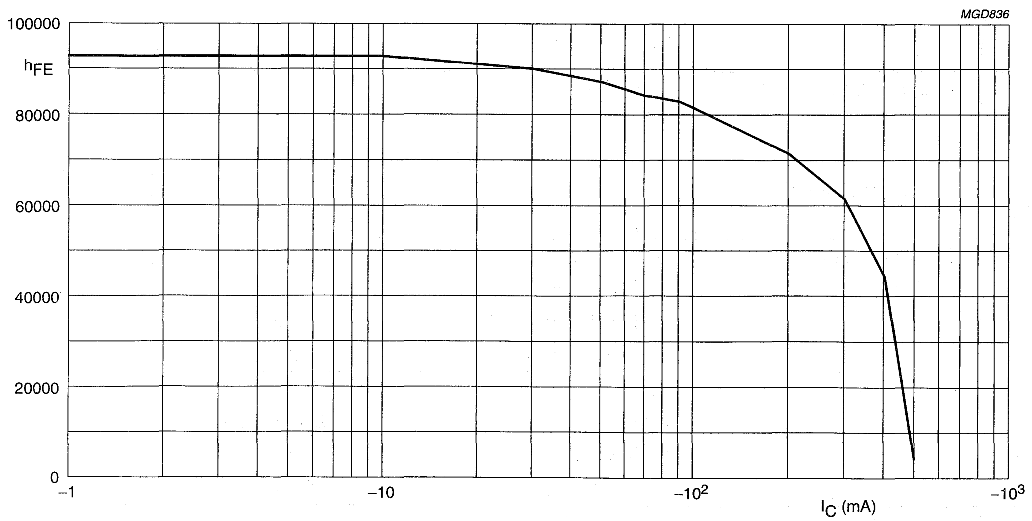
Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current					
	BCV26	$I_E = 0$; $V_{CB} = -30$ V	–	–	–100	nA
	BCV46	$I_E = 0$; $V_{CB} = -60$ V	–	–	–100	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -10$ V	–	–	–100	nA
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -5$ V; see Fig.2				
	BCV26		4000	–	–	
	BCV46		2000	–	–	
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -5$ V; see Fig.2				
	BCV26		10000	–	–	
	BCV46		4000	–	–	
h_{FE}	DC current gain	$I_C = -100$ mA; $V_{CE} = -5$ V; see Fig.2				
	BCV26		20000	–	–	
	BCV46		10000	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -100$ mA; $I_B = -0.1$ mA	–	–	–1	V
V_{BEsat}	base-emitter saturation voltage	$I_C = -100$ mA; $I_B = -0.1$ mA	–	–	–1.5	V
V_{BEon}	base-emitter on-state voltage	$I_C = -10$ mA; $V_{CE} = -5$ V	–	–	–1.4	V
f_T	transition frequency	$I_C = -30$ mA; $V_{CE} = -5$ V; f = 100 MHz	–	220	–	MHz



$V_{CE} = -2$ V.

Fig.2 DC current gain; typical values.

NPN Darlington transistors | BCV27; BCV47

FEATURES

- Medium current (max. 500 mA)
- Low voltage (max. 60 V)
- High DC current gain (min. 20000).

APPLICATIONS

- Preamplifier input applications.

DESCRIPTION

NPN Darlington transistor in a SOT23 plastic package.
PNP complements: BCV26 and BCV46.

MARKING

TYPE NUMBER	MARKING CODE
BCV27	FFp
BCV47	FGp

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

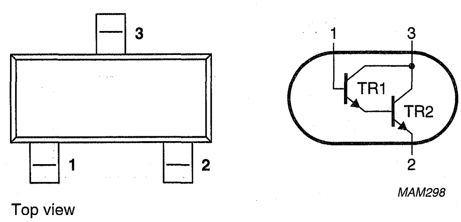


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BCV27		–	–	40	V
	BCV47		–	–	80	V
V_{CEO}	collector-emitter voltage	open base				
	BCV27		–	–	30	V
	BCV47		–	–	60	V
I_C	collector current (DC)		–	–	500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25\ °C$	–	–	250	mW
h_{FE}	DC current gain	$V_{CE} = 5\ V$				
	BCV27	$I_C = 1\ mA$	4000	–	–	
		$I_C = 10\ mA$	10000	–	–	
		$I_C = 100\ mA$	20000	–	–	
h_{FE}	DC current gain	$V_{CE} = 5\ V$				
	BCV47	$I_C = 1\ mA$	2000	–	–	
		$I_C = 10\ mA$	4000	–	–	
		$I_C = 100\ mA$	10000	–	–	
f_T	transition frequency	$I_C = 30\ mA$; $V_{CE} = 5\ V$	–	220	–	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			
	BCV27		–	40	V
	BCV47		–	80	V
V_{CEO}	collector-emitter voltage	open base			
	BCV27		–	30	V
	BCV47		–	60	V
V_{EBO}	emitter-base voltage	open collector	–	10	V
I_C	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	800	mA
I_B	base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

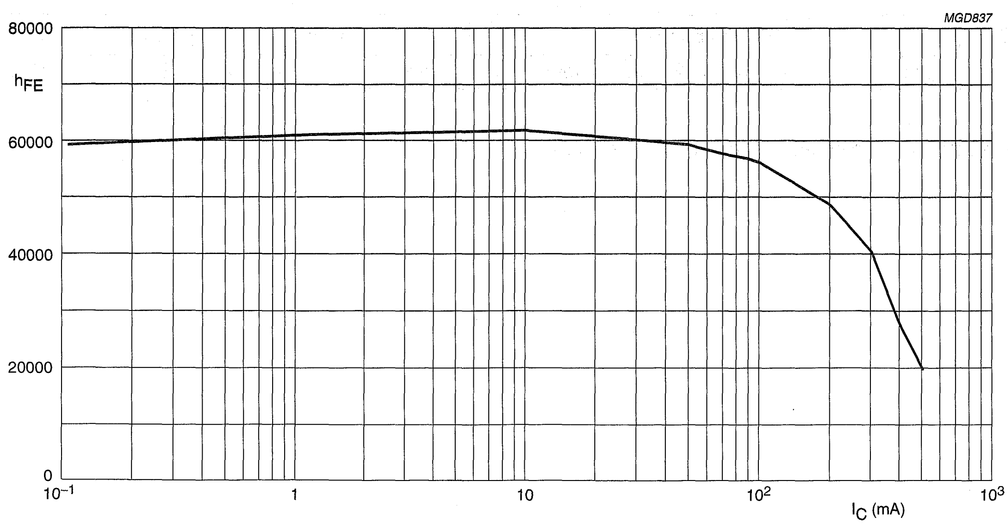
Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current					
	BCV27	I_E = 0; V_{CBO} = 30 V	–	–	100	nA
	BCV47	I_E = 0; V_{CBO} = 60 V	–	–	100	nA
I_{EBO}	emitter cut-off current	I_E = 0; V_{EB} = 10 V	–	–	100	nA
h_{FE}	DC current gain	V_{CE} = 5 V; see Fig.2				
	BCV27	I_C = 1 mA	4000	–	–	
		I_C = 10 mA	10000	–	–	
		I_C = 100 mA	20000	–	–	
h_{FE}	DC current gain	V_{CE} = 5 V; see Fig.2				
	BCV47	I_C = 1 mA	2000	–	–	
		I_C = 10 mA	4000	–	–	
		I_C = 100 mA	10000	–	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = 100 mA; I_B = 0.1 mA	–	–	1	V
V_{BEsat}	base-emitter saturation voltage	I_C = 100 mA; I_B = 0.1 mA	–	–	1.5	V
V_{BEon}	base-emitter on-state voltage	I_C = 10 mA; V_{CE} = 5 V	–	–	1.4	V
f_T	transition frequency	I_C = 30 mA; V_{CE} = 5 V; f = 100 MHz	–	220	–	MHz



V_{CE} = 2 V.

Fig.2 DC current gain; typical values.

PNP Darlington transistors | BCV28; BCV48

FEATURES

- Very high DC current gain (min. 10000)
- High current (max. 500 mA)
- Low voltage (max. 60 V).

APPLICATIONS

- Where very high amplification is required.

DESCRIPTION

PNP Darlington transistor in a SOT89 plastic package.
NPN complements: BCV29 and BCV49.

MARKING

TYPE NUMBER	MARKING CODE
BCV28	ED
BCV48	EE

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

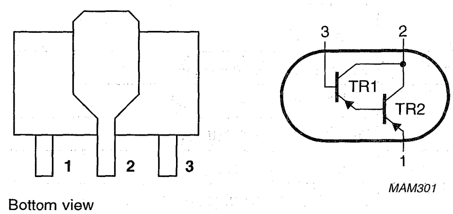


Fig.1 Simplified outline (SOT89) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BCV28		–	–	–40	V
	BCV48		–	–	–80	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$				
	BCV28		–	–	–30	V
	BCV48		–	–	–60	V
I_C	collector current (DC)		–	–	–500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	1.3	W
h_{FE}	DC current gain	$I_C = -100$ mA; $V_{CE} = -5$ V				
	BCV28		20000	–	–	
	BCV48		10000	–	–	
f_T	transition frequency	$I_C = -30$ mA; $V_{CE} = -5$ V; f = 100 MHz	–	220	–	MHz

PNP Darlington transistors BCV28; BCV48

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			
	BCV28		–	–40	V
	BCV48		–	–80	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BCV28		–	–30	V
	BCV48		–	–60	V
V_{EBO}	emitter-base voltage	open collector	–	–10	V
I_C	collector current (DC)		–	–500	mA
I_{CM}	peak collector current		–	–800	mA
I_B	base current (DC)		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.3	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for the SOT89 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	93	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		12	K/W

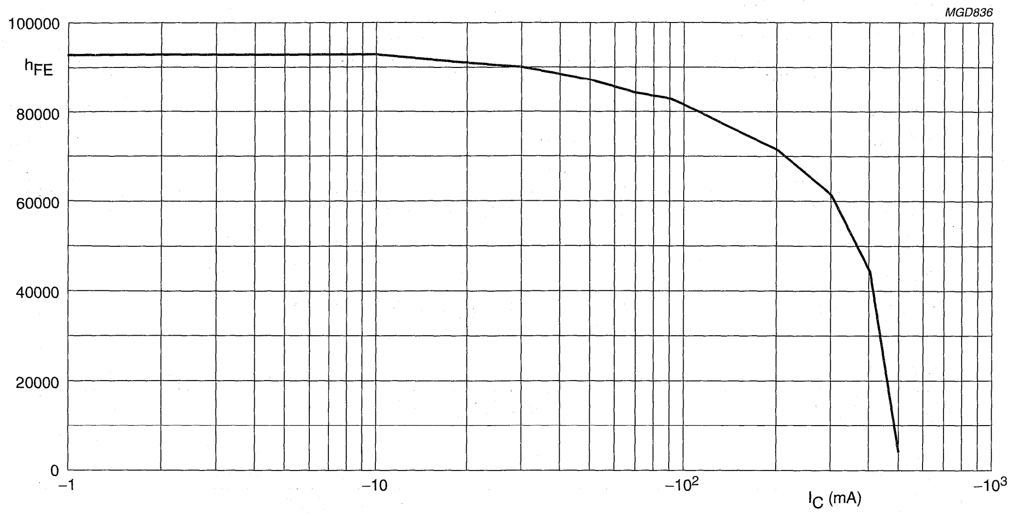
Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for the SOT89 in the General part of handbook SC04"*.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current					
	BCV28	I_E = 0; V_{CB} = −30 V	–	–	−100	nA
	BCV48	I_E = 0; V_{CB} = −60 V	–	–	−100	nA
I_{EBO}	emitter cut-off current	I_C = 0; V_{BE} = −10 V	–	–	−100	nA
h_{FE}	DC current gain	I_C = −1 mA; V_{CE} = −5 V; see Fig.2				
	BCV28		4000	–	–	
	BCV48		2000	–	–	
h_{FE}	DC current gain	I_C = −10 mA; V_{CE} = −5 V; see Fig.2				
	BCV28		10000	–	–	
	BCV48		4000	–	–	
h_{FE}	DC current gain	I_C = −100 mA; V_{CE} = −5 V; see Fig.2				
	BCV28		20000	–	–	
	BCV48		10000	–	–	
h_{FE}	DC current gain	I_C = −500 mA; V_{CE} = −5 V; see Fig.2				
	BCV28		4000	–	–	
	BCV48		2000	–	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = −100 mA; I_B = −0.1 mA	–	–	−1	V
V_{BEsat}	base-emitter saturation voltage	I_C = −100 mA; I_B = −0.1 mA	–	–	−1.5	V
V_{BEon}	base-emitter on-state voltage	I_C = −10 mA; I_B = −5 mA	–	–	−1.4	V
f_T	transition frequency	I_C = −30 mA; V_{CE} = −5 V; f = 100 MHz	–	220	–	MHz



$V_{CE} = -5$ V.

Fig.2 DC current gain; typical values.

NPN Darlington transistors BCV29; BCV49

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 60 V)
- High DC current gain (min. 20000).

APPLICATIONS

- Preamplifier input applications.

DESCRIPTION

NPN small-signal Darlington transistor in a surface mount SOT89 plastic package.
PNP complements: BCV28 and BCV48.

MARKING

TYPE NUMBER	MARKING CODE
BCV29	EF
BCV49	EG

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

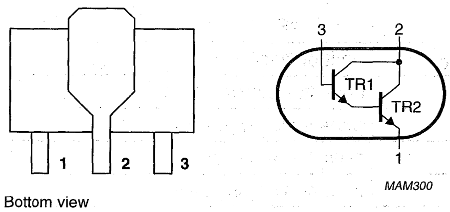


Fig.1 Simplified outline (SOT89) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BCV29		–	–	40	V
	BCV49		–	–	80	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$				
	BCV29		–	–	30	V
	BCV49		–	–	60	V
I_C	collector current (DC)		–	–	500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	1.34	W
h_{FE}	DC current gain	$V_{CE} = 5$ V				
	BCV29	$I_C = 1$ mA	4000	–	–	
		$I_C = 10$ mA	10000	–	–	
		$I_C = 100$ mA	20000	–	–	
		$I_C = 500$ mA	4000	–	–	
h_{FE}	DC current gain	$V_{CE} = 5$ V				
	BCV49	$I_C = 1$ mA	2000	–	–	
		$I_C = 10$ mA	4000	–	–	
		$I_C = 100$ mA	10000	–	–	
		$I_C = 500$ mA	2000	–	–	
f_T	transition frequency	$I_C = 30$ mA; $V_{CE} = 5$ V; f = 100 MHz	–	220	–	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			
	BCV29		–	40	V
	BCV49		–	80	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BCV29		–	30	V
	BCV49		–	60	V
V_{EBO}	emitter-base voltage	open collector	–	10	V
I_C	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	1	A
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.34	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j-a}$	thermal resistance from junction to ambient	note 1	93	K/W

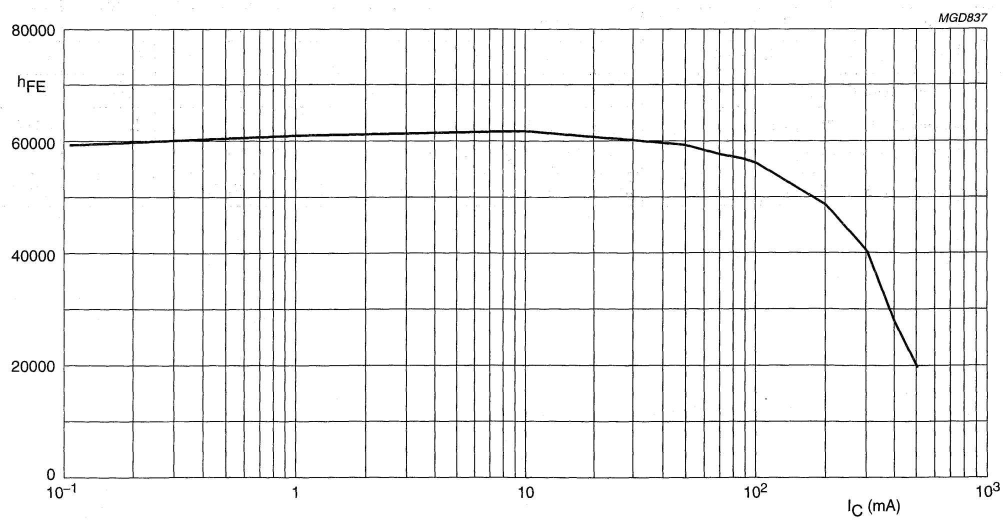
Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current					
	BCV29	$I_E = 0$; $V_{CB} = 30$ V	–	–	100	nA
	BCV49	$I_E = 0$; $V_{CB} = 60$ V	–	–	100	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 10$ V	–	–	100	nA
h_{FE}	DC current gain	$V_{CE} = 5$ V; see Fig.2				
	BCV29	$I_C = 1$ mA	4000	–	–	
		$I_C = 10$ mA	10000	–	–	
		$I_C = 100$ mA	20000	–	–	
		$I_C = 500$ mA	4000	–	–	
h_{FE}	DC current gain	$V_{CE} = 5$ V; see Fig.2				
	BCV49	$I_C = 1$ mA	2000	–	–	
		$I_C = 10$ mA	4000	–	–	
		$I_C = 100$ mA	10000	–	–	
		$I_C = 500$ mA	2000	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 100$ mA; $I_B = 0.1$ mA	–	–	1	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 100$ mA; $I_B = 0.1$ mA	–	–	1.5	V
V_{BEon}	base-emitter on-state voltage	$I_C = 10$ mA; $V_{CE} = 5$ V	–	–	1.4	V
f_T	transition frequency	$I_C = 30$ mA; $V_{CE} = 5$ V; f = 100 MHz	–	220	–	MHz



V_{CE} = 2 V.

Fig.2 DC current gain; typical values.

NPN general purpose double transistor BCV61

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 30 V)
- Matched pairs.

APPLICATIONS

- For use in applications where the working point must be independent of temperature
- Current mirrors.

DESCRIPTION

NPN double transistor in a SOT143B plastic package.
PNP complement: BCV62.

MARKING

TYPE NUMBER	MARKING CODE	TYPE NUMBER	MARKING CODE
BCV61	1Mp	BCV61B	1Kp
BCV61A	1Jp	BCV61C	1Lp

PINNING

PIN	DESCRIPTION
1	collector TR2; base TR1 and TR2
2	collector TR1
3	emitter TR1
4	emitter TR2

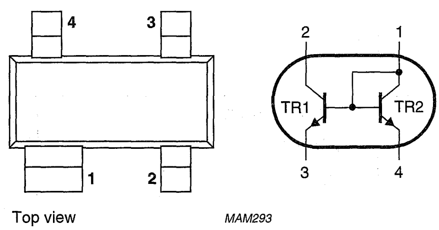


Fig.1 Simplified outline (SOT143B) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage TR1	open emitter	–	30	V
V_{CEO}	collector-emitter voltage TR1	open base	–	30	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 100$ µA; $V_{CE} = 5$ V	100	–	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	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 TR1	open emitter	–	30	V
V_{CEO}	collector-emitter voltage TR1	open base	–	30	V
V_{EBS}	emitter-base voltage	$V_{CE} = 0$	–	6	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current TR1		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

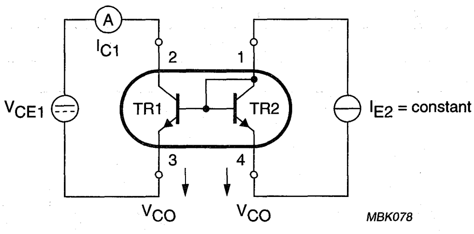
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Transistor TR1						
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 30 V	–	–	15	nA
		I_E = 0; V_{CB} = 30 V; T_j = 150 °C	–	–	5	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 5 V	–	–	100	nA
h_{FE}	DC current gain	I_C = 100 μA; V_{CE} = 5 V	100	–	–	
		I_C = 2 mA; V_{CE} = 5 V	110	–	800	
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA; I_B = 0.5 mA	–	90	250	mV
		I_C = 100 mA; I_B = 5 mA	–	200	600	mV
V_{BEsat}	base-emitter saturation voltage	I_C = 10 mA; I_B = 0.5 mA; note 1	–	700	–	mV
		I_C = 100 mA; I_B = 5 mA; note 1	–	900	–	mV
V_{BE}	base-emitter voltage	I_C = 2 mA; V_{CE} = 5 V; note 2	580	660	700	mV
		I_C = 10 mA; V_{CE} = 5 V; note 2	–	–	770	mV
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = 10 V; f = 1 MHz	–	2.5	–	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
Transistor TR2						
V_{EBS}	base-emitter forward voltage	V_{CB} = 0; I_E = –250 mA	–	–	–1.8	V
		V_{CB} = 0; I_E = –10 μA	–400	–	–	mV
h_{FE}	DC current gain	I_C = 2 mA; V_{CE} = 5 V				
	BCV61A		110	–	220	
	BCV61B		200	–	450	
	BCV61C		420	–	800	
Transistors TR1 and TR2						
$\frac{I_{C1}}{I_{E2}}$	current matching of transistors TR1 and TR2	I_{E2} = –0.5 mA; V_{CE1} = 5 V; $T_{amb} \leq$ 25 °C	0.7	–	1.3	
		I_{E2} = –0.5 mA; V_{CE1} = 5 V; $T_{amb} \leq$ 150 °C	0.7	–	1.3	
I_{E2}	emitter current for thermal stability of I_{C1}	V_{CE1} = 5 V; note 3; see Fig.2	–	–	–5	mA

Notes

1. Decreasing 1.7 mV/°C with increasing temperature.
2. Decreasing 2 mV/°C with increasing temperature.
3. Device, without emitter resistors, mounted on an FR4 printed-circuit board.

NPN general purpose double transistor

BCV61



V_{CE1} = 5 V; device, without emitter resistors, mounted on an FR4 printed-circuit board.

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

Fig.2 Test circuit current matching.

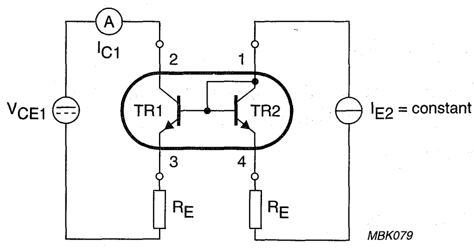
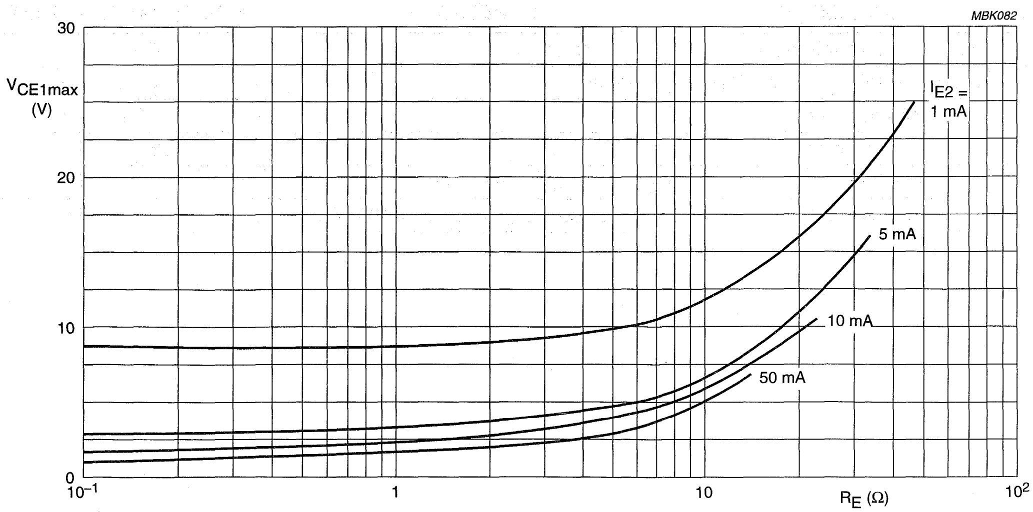


Fig.3 BCV61 with emitter resistors.



$\frac{I_{C1}}{I_{E2}}$ = 1.3 (see Fig.3).

Fig.4 Maximum collector-emitter voltage as a function of emitter resistance.

PNP general purpose double transistor BCV62

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 30 V)
- Matched pair.

APPLICATIONS

- For use in applications where the working point must be independent of temperature
- Current mirrors.

DESCRIPTION

PNP double transistor in a SOT143B plastic package.
NPN complement: BCV61.

MARKING

TYPE NUMBER	MARKING CODE	TYPE NUMBER	MARKING CODE
BCV62	3Mp	BCV62B	3Kp
BCV62A	3Jp	BCV62C	3Lp

PINNING

PIN	DESCRIPTION
1	collector TR2; base TR1 and TR2
2	collector TR1
3	emitter TR1
4	emitter TR2

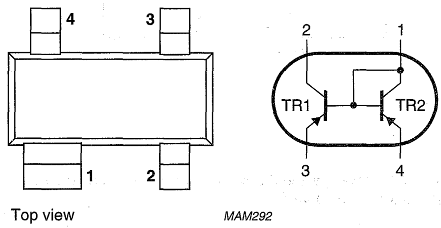


Fig.1 Simplified outline (SOT143B) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage TR1	open emitter	–	–30	V
V_{CEO}	collector-emitter voltage TR1	open base	–	–30	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = -100$ µA; $V_{CE} = -5$ V	100	–	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	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 TR1	open emitter	–	–30	V
V_{CEO}	collector-emitter voltage TR1	open base	–	–30	V
V_{EBS}	emitter-base voltage	$V_{CE} = 0$	–	–6	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current TR1		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Device mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Device mounted on an FR4 printed-circuit board.

NPN general purpose double transistors | BCV63; BCV63B

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 30 and 6 V).

APPLICATIONS

- General purpose switching and amplification
- For use in Schmitt-trigger applications.

DESCRIPTION

NPN double transistor in a SOT143B plastic package.
PNP complement: BCV64B.

MARKING

TYPE NUMBER	MARKING CODE
BCV63	D95
BCV63B	D96

PINNING

PIN	DESCRIPTION
1	collector TR2, base TR1
2	collector TR1
3	emitter TR1 and TR2
4	base TR2

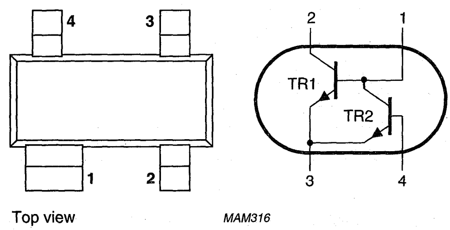


Fig.1 Simplified outline (SOT143B) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	TR1		–	30	V
	TR2		–	6	V
V_{CEO}	collector-emitter voltage	open base			
	TR1		–	30	V
	TR2		–	6	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V			
	BCV63		110	800	
	BCV63B		200	450	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz			
	TR1		100	–	MHz
	TR2		–	–	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			
	TR1		–	30	V
	TR2		–	6	V
V_{CEO}	collector-emitter voltage	open base			
	TR1		–	30	V
	TR2		–	6	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_B	base current (DC)		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on a printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on a printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector 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
h_{FE}	DC current gain					
	BCV63 TR1	$I_C = 2$ mA; $V_{CE} = 5$ V	110	–	800	
	BCV63 TR2	$I_C = 2$ mA; $V_{CE} = 700$ mV; note 1	110	–	800	
h_{FE}	DC current gain					
	BCV63B TR1	$I_C = 2$ mA; $V_{CE} = 5$ V	200	–	450	
	BCV63B TR2	$I_C = 2$ mA; $V_{CE} = 700$ mV; note 1	200	–	450	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	75	300	mV
V_{CEsat}	collector-emitter saturation voltage	$I_C = 100$ mA; $I_B = 5$ mA				
	TR1		–	250	650	mV
	TR2		–	250	–	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA; note 2	–	700	–	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 100$ mA; $I_B = 5$ mA; note 2				
	TR1		–	–850	–	mV
V_{BE}	base-emitter voltage	$I_C = 2$ mA; $V_{CE} = 5$ V; note 3				
	TR1		600	650	750	mV
V_{BE}	base-emitter voltage	$I_C = 10$ mA; $V_{CE} = 5$ V; note 3				
	TR1		–	–	820	mV
V_{BE}	base-emitter voltage	$I_C = 2$ mA; $V_{CE} = 700$ mV; note 3				
	TR2		–	700	–	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz				
	TR1		–	4	–	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz				
	TR1		100	–	–	MHz

Notes

1. Group selection will be done on TR1. Due to matched dies, h_{FE} values for TR2 are the same as for TR1.
2. V_{BEsat} decreases by approximately 1.7 mV/K with increasing temperature.
3. V_{BE} decreases by approximately 2 mV/K with increasing temperature.

APPLICATION INFORMATION

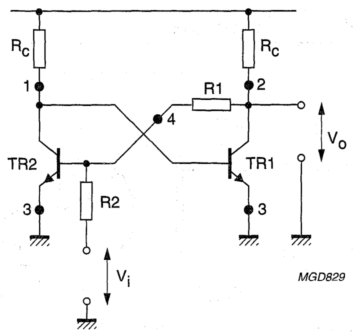


Fig.2 Schmitt-trigger application.

PNP general purpose double transistor | BCV64B

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 30 and 6 V).

APPLICATIONS

- General purpose switching and amplification
- For use in Schmitt-trigger applications.

DESCRIPTION

PNP double transistor in a SOT143B plastic package.
NPN complement: BCV63B.

MARKING

TYPE NUMBER	MARKING CODE
BCV64B	C96

PINNING

PIN	DESCRIPTION
1	collector TR2, base TR1
2	collector TR1
3	emitter TR1 and TR2
4	base TR2

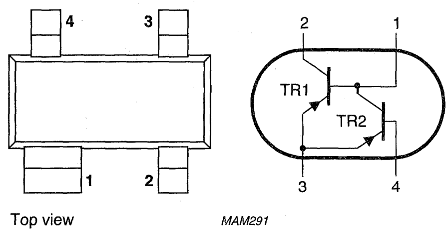


Fig.1 Simplified outline (SOT143B) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	TR1		–	–30	V
	TR2		–	–6	V
V_{CEO}	collector-emitter voltage	open base			
	TR1		–	–30	V
	TR2		–	–6	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain				
	TR1	$I_C = -2$ mA; $V_{CE} = -5$ V	220	–	475
	TR2	$I_C = -2$ mA; $V_{CE} = -700$ mV	220	–	475
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz			
	TR1		100	–	MHz
	TR2		–	–	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			
	TR1		–	–30	V
	TR2		–	–6	V
V_{CEO}	collector-emitter voltage	open base			
	TR1		–	–30	V
	TR2		–	–6	V
V_{EBO}	emitter-base voltage	open collector	–	–6	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_B	base current (DC)		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on a printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on a printed-circuit board.

PNP general purpose double transistor BCV64B

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −30 V	−	−	−15	nA
		I_E = 0; V_{CB} = −30 V; T_j = 150 °C	−	−	−5	μA
h_{FE}	DC current gain					
	TR1	I_C = −2 mA; V_{CE} = −5 V	220	−	475	
	TR2	I_C = −2 mA; V_{CE} = −700 mV; note 1	220	−	475	
V_{CEsat}	collector-emitter saturation voltage	I_C = −10 mA; I_B = −0.5 mA	−	−75	−300	mV
V_{CEsat}	collector-emitter saturation voltage	I_C = −100 mA; I_B = −5 mA				
	TR1		−	−250	−650	mV
	TR2		−	−250	−	mV
V_{BEsat}	base-emitter saturation voltage	I_C = −10 mA; I_B = −0.5 mA; note 2	−	−700	−	mV
V_{BEsat}	base-emitter saturation voltage	I_C = −100 mA; I_B = −5 mA; note 2				
	TR1		−	−850	−	mV
V_{BE}	base-emitter voltage	I_C = −2 mA; V_{CE} = −5 V; note 3				
	TR1		−600	−650	−750	mV
V_{BE}	base-emitter voltage	I_C = −10 mA; V_{CE} = −5 V; note 3				
	TR1		−	−	−820	mV
V_{BE}	base-emitter voltage	I_C = −2 mA; V_{CE} = −700 mV; note 3				
	TR2		−	−700	−	mV
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = −10 V; f = 1 MHz				
	TR1		−	4	−	pF
f_T	transition frequency	I_C = −10 mA; V_{CE} = −5 V; f = 100 MHz				
	TR1		100	−	−	MHz

Notes

1. Group selection will be done on TR1. Due to matched dies, h_{FE} values for TR2 are the same as for TR1.
2. V_{BEsat} decreases by approximately 1.7 mV/K with increasing temperature.
3. V_{BE} decreases by approximately −2 mV/K with increasing temperature.

APPLICATION INFORMATION

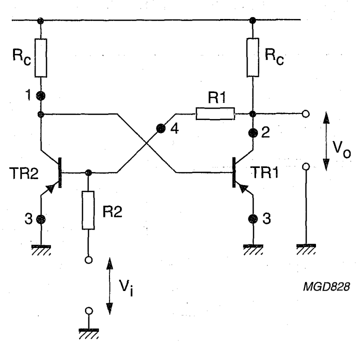


Fig.2 Schmitt-trigger application.

NPN/PNP general purpose transistors BCV65; BCV65B

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 30 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

An NPN/PNP matched pair transistor in a SOT143B plastic package.

MARKING

TYPE NUMBER	MARKING CODE
BCV65	97p
BCV65B	98p

PINNING

PIN	DESCRIPTION
1, 3	collector
2	common base
4	common emitter

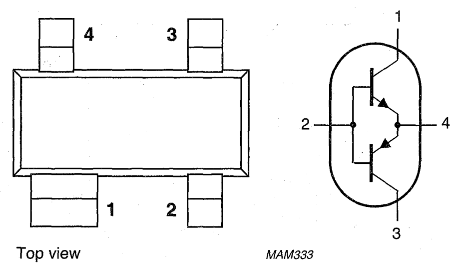


Fig.1 Simplified outline (SOT143B) and symbol.

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_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V			
	BCV65		75	800	
	BCV65B		200	475	

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per transistor					
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	30	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation (per device)	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Per transistor						
I_{CBO}	collector 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
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V				
	BCV65		75	–	800	
	BCV65B		200	–	475	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	90	300	mV
		$I_C = 100$ mA; $I_B = 5$ mA	–	250	650	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA; note 1	–	700	–	mV
		$I_C = 100$ mA; $I_B = 5$ mA; note 1	–	900	–	mV
V_{BE}	base-emitter voltage	$I_C = 2$ mA; $V_{CE} = 5$ V; note 2	580	650	750	mV
		$I_C = 10$ mA; $V_{CE} = 5$ V; note 2	–	–	820	mV

Notes

1. V_{BEsat} decreases by approximately $|1.7|$ mV/K with increasing temperature.
2. V_{BE} decreases by approximately $|2|$ mV/K with increasing temperature.

NPN general purpose transistors BCV71; BCV72

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 60 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistor in a SOT23 plastic package.

MARKING

TYPE NUMBER	MARKING CODE
BCV71	K7p
BCV72	K8p

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

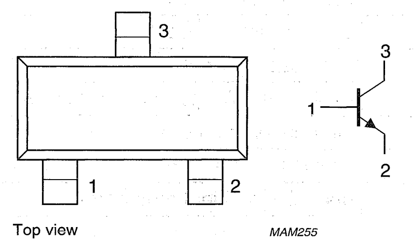


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	80	V
V_{CEO}	collector-emitter voltage	open base	–	60	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V			
	BCV71		110	220	
	BCV72		200	450	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	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	–	80	V
V_{CEO}	collector-emitter voltage	open base; I_C = 2 mA	–	60	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	–	100	nA
		$I_E = 0$; $V_{CB} = 20$ V; $T_j = 100$ °C	–	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 10$ μA; $V_{CE} = 5$ V				
	BCV71		–	90	–	
	BCV72		–	150	–	
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V				
	BCV71		110	–	220	
	BCV72		200	–	450	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	120	250	mV
		$I_C = 50$ mA; $I_B = 2.5$ mA	–	210	–	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	750	–	mV
		$I_C = 50$ mA; $I_B = 2.5$ mA	–	850	–	mV
V_{BE}	base-emitter voltage	$I_C = 2$ mA; $V_{CE} = 5$ V	550	–	700	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	2.5	–	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

PNP general purpose transistors BCW29; BCW30

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 32 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a SOT23 plastic package.
NPN complements: BCW31 and BCW32.

MARKING

TYPE NUMBER	MARKING CODE
BCW29	C1p
BCW30	C2p

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

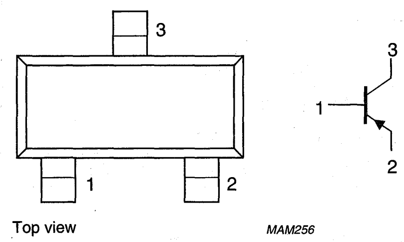


Fig.1 Simplified outline SOT23 and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–32	V
V_{CEO}	collector-emitter voltage	open base	–	–32	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V			
	BCW29		120	260	
	BCW30		215	500	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	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	–	–32	V
V_{CEO}	collector-emitter voltage	open base; I_C = –2 mA	–	–32	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = –32 V	–	–	–100	nA
		I_E = 0; V_{CB} = –32 V; T_j = 100 °C	–	–	–10	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = –5 V	–	–	–100	nA
h_{FE}	DC current gain	I_C = –10 μA; V_{CE} = –5 V				
	BCW29		–	90	–	
	BCW30		–	150	–	
h_{FE}	DC current gain	I_C = –2 mA; V_{CE} = –5 V				
	BCW29		120	–	260	
	BCW30		215	–	500	
V_{CEsat}	collector-emitter saturation voltage	I_C = –10 mA; I_B = –0.5 mA	–	–80	–300	mV
		I_C = –50 mA; I_B = –2.5 mA	–	–150	–	mV
V_{BEsat}	base-emitter saturation voltage	I_C = –10 mA; I_B = –0.5 mA	–	–720	–	mV
		I_C = –50 mA; I_B = –2.5 mA	–	–810	–	mV
V_{BE}	base-emitter voltage	I_C = –2 mA; V_{CE} = –5 V	–600	–	–750	mV
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = –10 V; f = 1 MHz	–	4.5	–	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

NPN general purpose transistors | BCW31; BCW32; BCW33

FEATURES

- Low current (100 mA)
- Low voltage (32 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistors in a plastic SOT23 package.
PNP complements: BCW29 and BCW30.

MARKING

TYPE NUMBER	MARKING CODE
BCW31	D1p
BCW32	D2p
BCW33	D3p

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

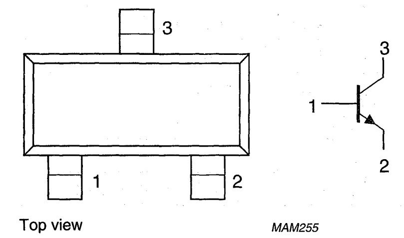


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	32	V
V_{CEO}	collector-emitter voltage	open base	–	32	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V			
	BCW31		110	220	
	BCW32		200	450	
	BCW33		420	800	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	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	–	32	V
V_{CEO}	collector-emitter voltage	open base; I_C = 2 mA	–	32	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 32$ V	–	–	100	nA
		$I_E = 0$; $V_{CB} = 32$ V; $T_j = 100$ °C	–	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 10$ μA; $V_{CE} = 5$ V				
	BCW31		–	90	–	
	BCW32		–	150	–	
	BCW33		–	270	–	
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V				
	BCW31		110	–	220	
	BCW32		200	–	450	
	BCW33		420	–	800	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	120	250	mV
		$I_C = 50$ mA; $I_B = 2.5$ mA	–	210	–	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	750	–	mV
		$I_C = 50$ mA; $I_B = 2.5$ mA	–	850	–	mV
V_{BE}	base-emitter voltage	$I_C = 2$ mA; $V_{CE} = 5$ V	550	–	700	mV
C_c	collector capacitance	$I_E = I_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	2.5	–	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

NPN general purpose transistors — BCW60 series

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 32 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistor in a SOT23 plastic package.
PNP complements: BCW61 series.

MARKING

TYPE NUMBER	MARKING CODE
BCW60A	AAp
BCW60B	ABp
BCW60C	ACp
BCW60D	ADp

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

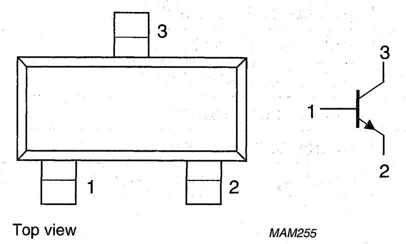


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	32	V
V_{CEO}	collector-emitter voltage	open base	–	32	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V			
	BCW60A		120	220	
	BCW60B		180	310	
	BCW60C		250	460	
	BCW60D		380	630	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	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	–	32	V
V_{CEO}	collector-emitter voltage	open base	–	32	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 32$ V	–	–	20	nA
		$I_E = 0$; $V_{CB} = 32$ V; $T_{amb} = 150$ °C	–	–	20	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	–	20	nA
h_{FE}	DC current gain	$I_C = 10$ μA; $V_{CE} = 5$ V				
	BCW60B		20	–	–	
	BCW60C		40	–	–	
	BCW60D		100	–	–	
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V				
	BCW60A		120	–	220	
	BCW60B		180	–	310	
	BCW60C		250	–	460	
	BCW60D		380	–	630	
h_{FE}	DC current gain	$I_C = 50$ mA; $V_{CE} = 1$ V				
	BCW60A		50	–	–	
	BCW60B		70	–	–	
	BCW60C		90	–	–	
	BCW60D		100	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.25$ mA	50	–	350	mV
		$I_C = 50$ mA; $I_B = 1.25$ mA	100	–	550	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.25$ mA	600	–	850	mV
		$I_C = 50$ mA; $I_B = 1.25$ mA	0.7	–	1.05	V
V_{BE}	base-emitter voltage	$I_C = 10$ μA; $V_{CE} = 5$ V	–	520	–	mV
		$I_C = 2$ mA; $V_{CE} = 5$ V	550	650	750	mV
		$I_C = 50$ mA; $V_{CE} = 1$ V	–	780	–	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	1.7	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	11	–	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz; note 1	100	250	–	MHz
F	noise figure	$I_C = 200$ μA; $V_{CE} = 5$ V; $R_S = 2$ kΩ; f = 1 kHz; B = 200 Hz	–	2	6	dB

Note

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

PNP general purpose transistors BCW61 series

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 32 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a SOT23 plastic package.
NPN complement: BCW60.

MARKING

TYPE NUMBER	MARKING CODE
BCW61A	BAp
BCW61B	BBp
BCW61C	BCp
BCW61D	BDp

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

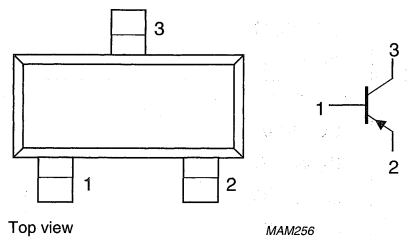


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–32	V
V_{CEO}	collector-emitter voltage	open base	–	–32	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V			
	BCW61A		120	220	
	BCW61B		180	310	
	BCW61C		250	460	
	BCW61D		380	630	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	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	–	–32	V
V_{CEO}	collector-emitter voltage	open base	–	–32	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -32$ V	–	–	–20	nA
		$I_E = 0$; $V_{CB} = -32$ V; $T_{amb} = 150$ °C	–	–	–20	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -4$ V	–	–	–20	nA
h_{FE}	DC current gain	$I_C = -10$ μA; $V_{CE} = -5$ V				
	BCW61B		30	–	–	
	BCW61C		40	–	–	
	BCW61D		100	–	–	
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V				
	BCW61A		120	–	220	
	BCW61B		180	–	310	
	BCW61C		250	–	460	
	BCW61D		380	–	630	
h_{FE}	DC current gain	$I_C = -50$ mA; $V_{CE} = -1$ V				
	BCW61A		60	–	–	
	BCW61B		80	–	–	
	BCW61C		100	–	–	
	BCW61D		110	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.25$ mA	–60	–	–250	mV
		$I_C = -50$ mA; $I_B = -1.25$ mA	–120	–	–550	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.25$ mA	–600	–	–850	mV
		$I_C = -50$ mA; $I_B = -1.25$ mA	–0.68	–	–1.05	V
V_{BE}	base-emitter voltage	$I_C = -2$ mA; $V_{CE} = -5$ V	–600	–650	–750	mV
		$I_C = -10$ μA; $V_{CE} = -5$ V	–	–550	–	mV
		$I_C = -50$ mA; $V_{CE} = -1$ V	–	–720	–	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	4.5	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -0.5$ V; f = 1 MHz	–	11	–	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz; note 1	100	–	–	MHz
F	noise figure	$I_C = -200$ μA; $V_{CE} = -5$ V; $R_S = 2$ kΩ; f = 1 kHz; B = 200 Hz	–	2	6	dB

Note

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

PNP general purpose transistors — BCW69; BCW70

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a SOT23 plastic package.
NPN complements: BCW71 and BCW72.

MARKING

TYPE NUMBER	MARKING CODE
BCW69	H1p
BCW70	H2p

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

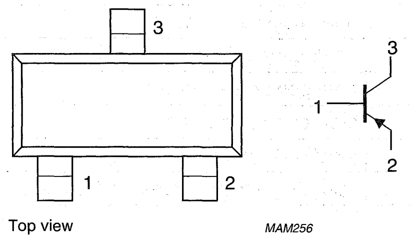


Fig.1 Simplified outline (SOT23) and symbol.

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	–	–45	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V			
	BCW69		120	260	
	BCW70		215	500	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	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; $I_C = -2$ mA	–	–45	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −20 V	−	−	−100	nA
		I_E = 0; V_{CB} = −20 V; T_j = 100 °C	−	−	−10	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −5 V	−	−	−100	nA
h_{FE}	DC current gain	I_C = −10 μA; V_{CE} = −5 V				
	BCW69		−	90	−	
	BCW70		−	150	−	
h_{FE}	DC current gain	I_C = −2 mA; V_{CE} = −5 V				
	BCW69		120	−	260	
	BCW70		215	−	500	
V_{CEsat}	collector-emitter saturation voltage	I_C = −10 mA; I_B = −0.5 mA	−	−80	−300	mV
		I_C = −50 mA; I_B = −2.5 mA; note 1	−	−150	−	mV
V_{BEsat}	base-emitter saturation voltage	I_C = −10 mA; I_B = −0.5 mA	−	−720	−	mV
		I_C = −50 mA; I_B = −2.5 mA; note 1	−	−810	−	mV
V_{BE}	base-emitter voltage	I_C = −2 mA; V_{CE} = −5 V	−600	−	−750	mV
C_c	collector capacitance	I_E = I_e = 0; V_{CB} = −10 V; f = 1 MHz	−	4.5	−	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

Note

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

NPN general purpose transistors BCW71; BCW72

FEATURES

- Low current (100 mA)
- Low voltage (45 V)
- Low noise.

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistor in a SOT23 plastic package.
PNP complements: BCW69 and BCW70.

MARKING

TYPE NUMBER	MARKING CODE
BCW71	K1p
BCW72	K2p

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

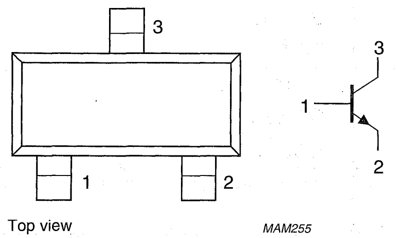


Fig.1 Simplified outline (SOT23) and symbol.

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	–	45	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V			
	BCW71		110	220	
	BCW72		200	450	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	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; $I_C = 2$ mA	–	45	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	–	100	nA
		$I_E = 0$; $V_{CB} = 20$ V; $T_j = 100$ °C	–	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	100	μA
h_{FE}	DC current gain	$I_C = 10$ μA; $V_{CE} = 5$ V				
	BCW71		–	90	–	
	BCW72		–	150	–	
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V				
	BCW71		110	–	220	
	BCW72		200	–	450	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	120	250	mV
		$I_C = 50$ mA; $I_B = 2.5$ mA	–	210	–	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	750	–	mV
		$I_C = 50$ mA; $I_B = 2.5$ mA	–	850	–	mV
V_{BE}	base-emitter voltage	$I_C = 2$ mA; $V_{CE} = 5$ V	550	–	700	mV
C_c	collector capacitance	$I_E = I_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	2.5	–	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

NPN general purpose transistor BCW81

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- General purpose switching and high gain amplification.

DESCRIPTION

NPN transistor in a SOT23 plastic package.

MARKING

TYPE NUMBER	MARKING CODE
BCW81	K3p

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

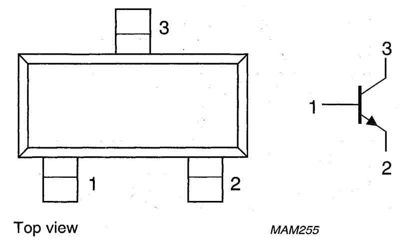


Fig.1 Simplified outline (SOT23) and symbol.

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	–	45	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V	420	800	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	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; I_C = 2 mA	–	45	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 20 V	–	–	100	nA
		I_E = 0; V_{CB} = 20 V; T_j = 100 °C	–	–	10	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 5 V	–	–	100	nA
h_{FE}	DC current gain	I_C = 2 mA; V_{CE} = 5 V	420	–	800	
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA; I_B = 0.5 mA	–	120	250	mV
		I_C = 50 mA; I_B = 2.5 mA	–	210	–	mV
V_{BEsat}	base-emitter saturation voltage	I_C = 10 mA; I_B = 0.5 mA	–	750	–	mV
		I_C = 50 mA; I_B = 2.5 mA	–	850	–	mV
V_{BE}	base-emitter voltage	I_C = 2 mA; V_{CE} = 5 V	550	–	700	mV
C_c	collector capacitance	$I_E = I_e$ = 0; V_{CB} = 10 V; f = 1 MHz	–	2.5	–	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

PNP general purpose transistor BCW89

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 60 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a SOT23 plastic package.

MARKING

TYPE NUMBER	MARKING CODE
BCW89	H3p

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

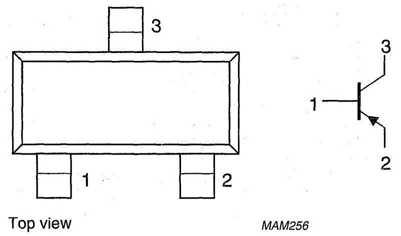


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–80	V
V_{CEO}	collector-emitter voltage	open base	–	–60	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V	120	260	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	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	–	–80	V
V_{CEO}	collector-emitter voltage	open base; $I_C = -2$ mA	–	–60	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -20$ V	–	–	–100	nA
		$I_E = 0$; $V_{CB} = -20$ V; $T_j = 100$ °C	–	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–100	nA
h_{FE}	DC current gain	$I_C = -10$ μA; $V_{CE} = -5$ V	–	90	–	
		$I_C = -2$ mA; $V_{CE} = -5$ V	120	–	260	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–80	–300	mV
		$I_C = -50$ mA; $I_B = -2.5$ mA	–	–150	–	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–720	–	mV
		$I_C = -50$ mA; $I_B = -2.5$ mA	–	–810	–	mV
V_{BE}	base-emitter voltage	$I_C = -2$ mA; $V_{CE} = -5$ V	–600	–	–750	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	4.5	–	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	–	150	–	MHz
F	noise figure	$I_C = -200$ μA; $V_{CE} = -5$ V; $R_S = 2$ kΩ; f = 1 kHz; B = 200 Hz	–	–	10	dB

PNP general purpose transistors BCX17; BCX18

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- Saturated switching and driver applications e.g. for industrial service
- Thick and thin-film circuits.

DESCRIPTION

PNP transistor in a SOT23 plastic package.
NPN complements: BCX19 and BCX20.

MARKING

TYPE NUMBER	MARKING CODE
BCX17	T1p
BCX18	T2p

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

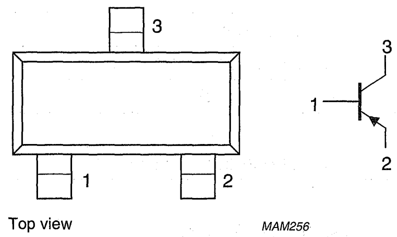


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BCX17		–	–50	V
	BCX18		–	–30	V
V_{CEO}	collector-emitter voltage	open base			
	BCX17		–	–45	V
	BCX18		–	–25	V
I_{CM}	peak collector current		–	–1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = -100$ mA; $V_{CE} = -1$ V	100	600	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	80	–	MHz

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BCX17		–	–50	V
	BCX18		–	–30	V
V_{CEO}	collector-emitter voltage	open base			
	BCX17		–	–45	V
	BCX18		–	–25	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–500	mA
I_{CM}	peak collector current		–	–1	A
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -20$ 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
h_{FE}	DC current gain	$I_C = -100$ mA; $V_{CE} = -1$ V	100	–	600	
		$I_C = -300$ mA; $V_{CE} = -1$ V	70	–	–	
		$I_C = -500$ mA; $V_{CE} = -1$ V	40	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -500$ mA; $I_B = -50$ mA	–	–	−620	mV
V_{BE}	base-emitter voltage	$I_C = -500$ mA; $V_{CE} = -1$ V; note 1	–	–	−1.2	V
C_c	collector capacitance	$I_E = I_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	9	–	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	80	–	–	MHz

Note

1. V_{BE} decreases by approximately −2 mV/°C with increasing temperature.

NPN general purpose transistors — BCX19; BCX20

FEATURES

- High current (500 mA)
- Low voltage (45 V).

APPLICATIONS

- General purpose amplification
- Saturated switching and driver applications.

DESCRIPTION

NPN transistor in a SOT23 plastic package.
PNP complements: BCX17 and BCX18.

MARKING

TYPE NUMBER	MARKING CODE
BCX19	U1p
BCX20	U2p

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

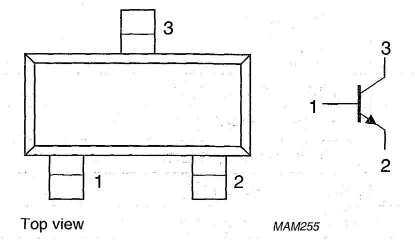


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BCX19		–	50	V
	BCX20		–	30	V
V_{CEO}	collector-emitter voltage	open base			
	BCX19		–	45	V
	BCX20		–	25	V
I_{CM}	peak collector current		–	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 100$ mA; $V_{CE} = 1$ V	100	600	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	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			
	BCX19		–	50	V
	BCX20		–	30	V
V_{CEO}	collector-emitter voltage	open base; I_C = 10 mA			
	BCX19		–	45	V
	BCX20		–	25	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	1	A
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ 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
h_{FE}	DC current gain	$V_{CE} = 1$ V; note 1				
		$I_C = 100$ mA	100	–	600	
		$I_C = 300$ mA	70	–	–	
		$I_C = 500$ mA	40	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 500$ mA; $I_B = 50$ mA; note 2	–	–	620	mV
V_{BE}	base-emitter voltage	$I_C = 500$ mA; $V_{CE} = 1$ V; notes 1 and 2	–	–	1.2	V
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

Notes

1. Pulse test: $t_p \leq 300$ µs; $\delta \leq 0.02$.
2. V_{BE} decreases by approximately –2 mV/°C with increasing temperature.

PNP medium power transistors — BCX51; BCX52; BCX53

FEATURES

- High current (max. 1 A)
- Low voltage (max. 80 V).

APPLICATIONS

- Medium power general purposes
- Driver stages of audio amplifiers.

DESCRIPTION

PNP medium power transistor in a SOT89 plastic package. NPN complements: BCX54, BCX55 and BCX56.

MARKING

TYPE NUMBER	MARKING CODE	TYPE NUMBER	MARKING CODE
BCX51	AA	BCX52-16	AM
BCX51-10	AC	BCX53	AH
BCX51-16	AD	BCX53-10	AK
BCX52	AE	BCX53-16	AL
BCX52-10	AG		

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

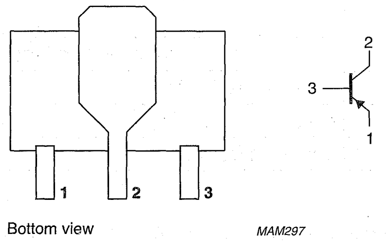


Fig.1 Simplified outline (SOT89) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BCX51		–	–	–45	V
	BCX52		–	–	–60	V
	BCX53		–	–	–100	V
V_{CEO}	collector-emitter voltage	open base				
	BCX51		–	–	–45	V
	BCX52		–	–	–60	V
	BCX53		–	–	–80	V
I_{CM}	peak collector current		–	–	–1.5	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	1.3	W
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -2$ V	40	–	250	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	–	50	–	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			
	BCX51		–	–45	V
	BCX52		–	–60	V
	BCX53		–	–100	V
V_{CEO}	collector-emitter voltage	open base			
	BCX51		–	–45	V
	BCX52		–	–60	V
	BCX53		–	–80	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–1	A
I_{CM}	peak collector current		–	–1.5	A
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.3	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04".*

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	90	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	note 1	9	K/W

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04".*

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −30 V	–	–	−100	nA
		I_E = 0; V_{CB} = −30 V; T_j = 125 °C	–	–	−10	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −5 V	–	–	−100	nA
h_{FE}	DC current gain	V_{CE} = −2 V; see Fig.2				
		I_C = −5 mA	40	–	–	
		I_C = −150 mA	40	–	250	
		I_C = −500 mA	25	–	–	
h_{FE}	DC current gain	I_C = −150 mA; V_{CE} = −2 V; see Fig.2				
	BCX51-10; BCX52-10; BCX53-10		63	–	160	
	BCX51-16; BCX52-16; BCX53-16		100	–	250	
V_{CEsat}	collector-emitter saturation voltage	I_C = −500 mA; I_B = −50 mA	–	–	−500	mV
V_{BE}	base-emitter voltage	I_C = −500 mA; V_{CE} = −2 V	–	–	−1	V
f_T	transition frequency	I_C = −10 mA; V_{CE} = −5 V; f = 100 MHz	–	50	–	MHz

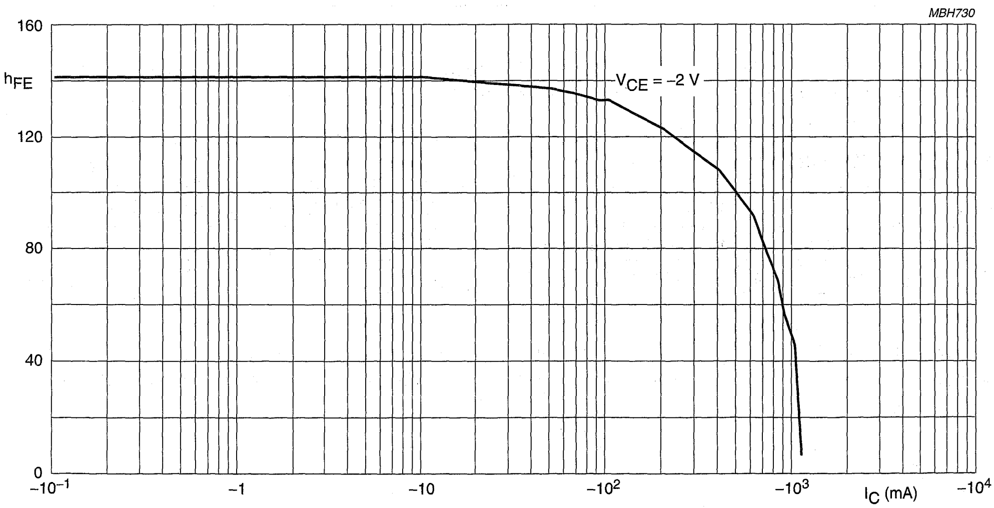


Fig.2 DC current gain; typical values.

NPN medium power transistors BCX54; BCX55; BCX56

FEATURES

- High current (max. 1 A)
- Low voltage (max. 80 V).

APPLICATIONS

- Driver stages of audio and video amplifiers.

DESCRIPTION

NPN medium power transistor in a SOT89 plastic package. PNP complements: BCX51, BCX52 and BCX53.

MARKING

TYPE NUMBER	MARKING CODE	TYPE NUMBER	MARKING CODE
BCX54	BA	BCX55-16	BM
BCX54-10	BC	BCX56	BH
BCX54-16	BD	BCX56-10	BK
BCX55	BE	BCX56-16	BL
BCX55-10	BG		

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

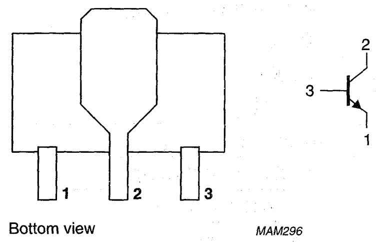


Fig.1 Simplified outline (SOT89) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BCX54		–	–	45	V
	BCX55		–	–	60	V
	BCX56		–	–	100	V
V_{CEO}	collector-emitter voltage	open base				
	BCX54		–	–	45	V
	BCX55		–	–	60	V
	BCX56		–	–	80	V
I_{CM}	peak collector current		–	–	1.5	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	1.39	W
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 2$ V	40	–	250	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	–	130	–	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			
	BCX54		–	45	V
	BCX55		–	60	V
	BCX56		–	100	V
V_{CEO}	collector-emitter voltage	open base			
	BCX54		–	45	V
	BCX55		–	60	V
	BCX56		–	80	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	1	A
I_{CM}	peak collector current		–	1.5	A
I_{BM}	peak base current		–	0.2	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.39	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	90	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		9	K/W

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30$ V	–	–	100	nA
		$I_E = 0$; $V_{CB} = 30$ V; $T_j = 125$ °C	–	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	100	nA
h_{FE}	DC current gain	$V_{CE} = 2$ V; see Fig.2				
		$I_C = 5$ mA	40	–	–	
		$I_C = 150$ mA	40	–	250	
		$I_C = 500$ mA	25	–	–	
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 2$ V; see Fig.2				
	BCX54-10; 55-10; 56-10		63	–	160	
	BCX54-16; 55-16; 56-16		100	–	250	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 500$ mA; $I_B = 50$ mA	–	–	0.5	V
V_{BE}	base-emitter voltage	$I_C = 500$ mA; $V_{CE} = 2$ V	–	–	1	V
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	–	130	–	MHz
$\frac{h_{FE1}}{h_{FE2}}$	DC current gain ratio of the complementary pairs	$\lvert I_C \rvert = 150$ mA; $\lvert V_{CE} \rvert = 2$ V	–	1.3	1.6	

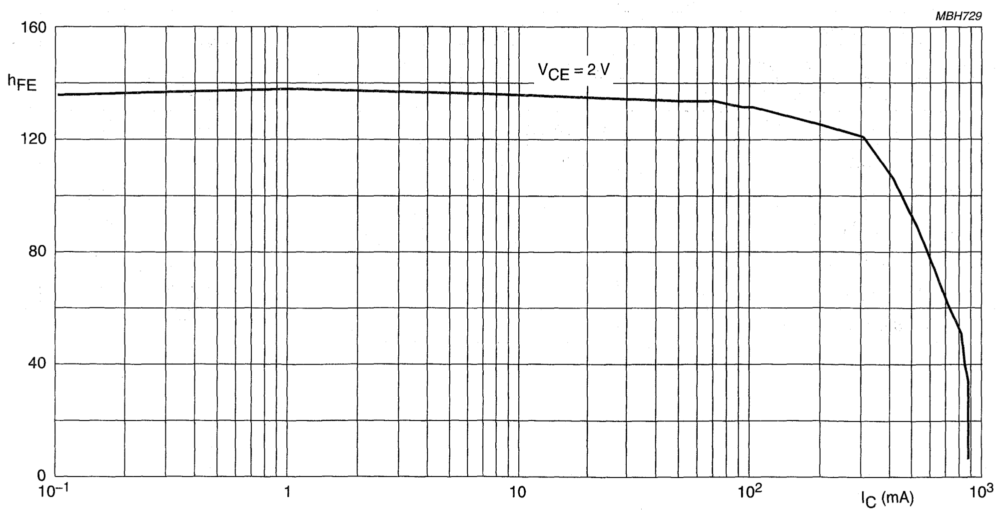


Fig.2 DC current gain; typical values.

NPN general purpose transistors — BCX70 series

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistor in a SOT23 plastic package.
PNP complements: BCX71 series.

MARKING

TYPE NUMBER	MARKING CODE
BCX70G	AGp
BCX70H	AHp
BCX70J	AJp
BCX70K	AKp

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

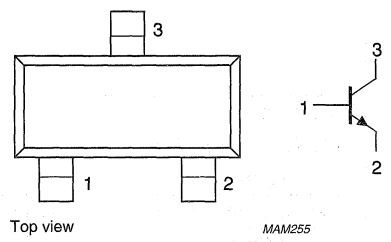


Fig.1 Simplified outline (SOT23) and symbol.

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_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V			
	BCX70G		120	220	
	BCX70H		180	310	
	BCX70J		250	460	
	BCX70K		380	630	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	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	–	45	V
V_{CEO}	collector-emitter voltage	open base	–	45	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 45$ V	–	–	20	nA
		$I_E = 0$; $V_{CB} = 45$ V; $T_{amb} = 150$ °C	–	–	20	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	–	20	nA
h_{FE}	DC current gain	$I_C = 10$ μA; $V_{CE} = 5$ V				
	BCX70G		–	–	–	
	BCX70H		40	–	–	
	BCX70J		30	–	–	
	BCX70K		100	–	–	
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V				
	BCX70G		120	–	220	
	BCX70H		180	–	310	
	BCX70J		250	–	460	
	BCX70K		380	–	630	
h_{FE}	DC current gain	$I_C = 50$ mA; $V_{CE} = 1$ V				
	BCX70G		50	–	–	
	BCX70H		70	–	–	
	BCX70J		90	–	–	
	BCX70K		100	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.25$ mA	50	–	350	mV
		$I_C = 50$ mA; $I_B = 1.25$ mA	100	–	550	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.25$ mA	600	–	850	mV
		$I_C = 50$ mA; $I_B = 1.25$ mA	700	–	1050	mV
V_{BE}	base-emitter voltage	$I_C = 10$ μA; $V_{CE} = 5$ V	–	520	–	mV
		$I_C = 2$ mA; $V_{CE} = 5$ V	550	650	750	mV
		$I_C = 50$ mA; $V_{CE} = 1$ V	–	780	–	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	1.7	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	11	–	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz; note 1	100	250	–	MHz
F	noise figure	$I_C = 200$ μA; $V_{CE} = 5$ V; $R_S = 2$ kΩ; f = 1 kHz; B = 200 Hz	–	2	6	dB

Note

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

PNP general purpose transistors | BCX71 series

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 45 V)
- Low noise.

APPLICATIONS

- Low level, low noise, low frequency applications in hybrid circuits
- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a plastic SOT23 package.
NPN complements: BCX70 series.

MARKING

TYPE NUMBER	MARKING CODE	TYPE NUMBER	MARKING CODE
BCX71G	BGp	BCX71J	BJp
BCX71H	BHp	BCX71K	BKp

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

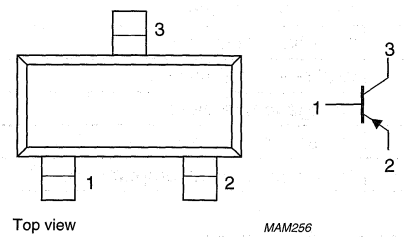


Fig.1 Simplified outline (SOT23) and symbol.

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_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V			
	BCX71G		120	220	
	BCX71H		180	310	
	BCX71J		250	460	
	BCX71K		380	630	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	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	–	–45	V
V_{CEO}	collector-emitter voltage	open base	–	–45	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −45 V	–	–	−20	nA
		I_E = 0; V_{CB} = −45 V; T_{amb} = 150 °C	–	–	−20	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −4 V	–	–	−20	nA
h_{FE}	DC current gain	I_C = −10 μA; V_{CE} = −5 V				
	BCX71G		–	–	–	
	BCX71H		30	–	–	
	BCX71J		40	–	–	
	BCX71K		100	–	–	
h_{FE}	DC current gain	I_C = −2 mA; V_{CE} = −5 V				
	BCX71G		120	–	220	
	BCX71H		180	–	310	
	BCX71J		250	–	460	
	BCX71K		380	–	630	
h_{FE}	DC current gain	I_C = −50 mA; V_{CE} = −1 V; note 1				
	BCX71G		60	–	–	
	BCX71H		80	–	–	
	BCX71J		100	–	–	
	BCX71K		110	–	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = −10 mA; I_B = −0.25 mA	−60	–	−250	mV
		I_C = −50 mA; I_B = −1.25 mA; note 1	−120	–	−550	mV
V_{BEsat}	base-emitter saturation voltage	I_C = −10 mA; I_B = −0.25 mA	−600	–	−850	mV
		I_C = −50 mA; I_B = −1.25 mA; note 1	−680	–	−1050	mV
V_{BE}	base-emitter voltage	I_C = −2 mA; V_{CE} = −5 V	−600	−650	−750	mV
		I_C = −10 μA; V_{CE} = −5 V	–	−550	–	mV
		I_C = −50 mA; V_{CE} = −1 V; note 1	–	−720	–	mV
C_c	collector capacitance	I_E = I_e = 0; V_{CB} = −10 V; f = 1 MHz	–	4.5	–	pF
C_e	emitter capacitance	I_C = I_c = 0; V_{EB} = −0.5 V; f = 1 MHz	–	11	–	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	–	2	6	dB

Note

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

NPN switching transistors BCY58; BCY59

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- Switching and amplification.

DESCRIPTION

NPN switching transistor in a TO-18 metal package.
PNP complements: BCY78 and BCY79.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

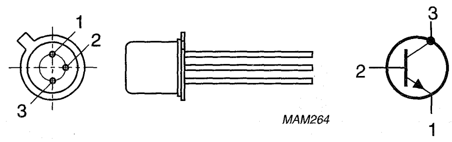


Fig.1 Simplified outline (TO-18) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BCY58		–	–	32	V
	BCY59		–	–	45	V
V_{CEO}	collector-emitter voltage	open base				
	BCY58		–	–	32	V
	BCY59		–	–	45	V
I_C	collector current (DC)		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 45$ °C	–	–	340	mW
		$T_{case} \leq 45$ °C	–	–	1	W
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V				
	BCY58/VII; BCY59/VII		120	170	220	
	BCY58/VIII; BCY59/VIII		180	250	310	
	BCY58/IX; BCY59/IX		250	350	460	
	BCY58/X; BCY59/X		380	500	630	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	150	–	–	MHz
t_{off}	turn-off time	$I_{Con} = 10$ mA; $I_{Bon} = 1$ mA; $I_{Boff} = -1$ mA	–	480	800	ns
		$I_{Con} = 100$ mA; $I_{Bon} = 10$ mA; $I_{Boff} = -10$ mA	–	450	800	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			
	BCY58		–	32	V
	BCY59		–	45	V
V_{CEO}	collector-emitter voltage	open base			
	BCY58		–	32	V
	BCY59		–	45	V
V_{EBO}	emitter-base voltage	open collector	–	7	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 45$ °C	–	340	mW
		$T_{case} \leq 45$ °C	–	1	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°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	450	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		150	K/W

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current					
	BCY58	$I_E = 0$; $V_{CB} = 32$ V	–	–	10	nA
		$I_E = 0$; $V_{CB} = 32$ V; $T_j = 150$ °C	–	–	10	μA
I_{CBO}	collector cut-off current					
	BCY59	$I_E = 0$; $V_{CB} = 45$ V	–	–	10	nA
		$I_E = 0$; $V_{CB} = 45$ V; $T_j = 150$ °C	–	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	10	nA
h_{FE}	DC current gain	$I_C = 10$ μA; $V_{CE} = 5$ V				
	BCY58/VII; BCY59/VII		–	20	–	
	BCY58/VIII; BCY59/VIII		20	95	–	
	BCY58/IX; BCY59/IX		40	190	–	
	BCY58/X; BCY59/X		100	300	–	

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
h_{FE}	DC current gain	I_C = 2 mA; V_{CE} = 5 V				
	BCY58/VII; BCY59/VII		120	170	220	
	BCY58/VIII; BCY59/VIII		180	250	310	
	BCY58/IX; BCY59/IX		250	350	460	
	BCY58/X; BCY59/X		380	500	630	
h_{FE}	DC current gain	I_C = 10 mA; V_{CE} = 1 V				
	BCY58/VII; BCY59/VII		80	250	–	
	BCY58/VIII; BCY59/VIII		120	300	400	
	BCY58/IX; BCY59/IX		160	390	630	
	BCY58/X; BCY59/X		240	550	1000	
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 1 V				
	BCY58/VII; BCY59/VII		40	–	–	
	BCY58/VIII; BCY59/VIII		45	–	–	
	BCY58/IX; BCY59/IX		60	–	–	
	BCY58/X; BCY59/X		60	–	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA; I_B = 0.25 mA	50	100	350	mV
		I_C = 100 mA; I_B = 2.5 mA	150	250	700	mV
V_{BEsat}	base-emitter saturation voltage	I_C = 10 mA; I_B = 0.25 mA	600	700	850	mV
		I_C = 100 mA; I_B = 2.5 mA	750	875	1200	mV
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 10 V; f = 1 MHz	–	–	5	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = 500 mV; f = 1 MHz	–	–	15	pF
f_T	transition frequency	I_C = 10 mA; V_{CE} = 5 V; f = 100 MHz	150	–	–	MHz
F	noise figure	I_C = 200 μA; V_{CE} = 5 V; R_S = 2 kΩ; f = 1 kHz; B = 200 Hz	–	–	10	dB
Switching times (between 10% and 90% levels)						
t_{on}	turn-on time	I_{Con} = 10 mA; I_{Bon} = 1 mA; I_{Boff} = −1 mA	–	85	150	ns
t_d	delay time		–	35	–	ns
t_r	rise time		–	50	–	ns
t_{off}	turn-off time		–	480	800	ns
t_s	storage time		–	400	–	ns
t_f	fall time		–	80	–	ns
t_{on}	turn-on time	I_{Con} = 100 mA; I_{Bon} = 10 mA; I_{Boff} = −10 mA	–	55	150	ns
t_d	delay time		–	5	–	ns
t_r	rise time		–	50	–	ns
t_{off}	turn-off time		–	450	800	ns
t_s	storage time		–	250	–	ns
t_f	fall time		–	200	–	ns

PNP general purpose transistors | BCY70; BCY71

FEATURES

- Low current (max. 200 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- General purpose industrial applications.

DESCRIPTION

PNP transistor in a TO-18 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

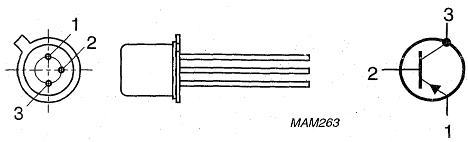


Fig.1 Simplified outline (TO-18) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BCY70		–	–50	V
	BCY71		–	–45	V
V_{CEO}	collector-emitter voltage	open base			
	BCY70		–	–40	V
	BCY71		–	–45	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	350	mW
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -1$ V	100	–	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -20$ V; f = 100 MHz	250	–	MHz

PNP general purpose transistors BCY70; BCY71

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			
	BCY70		–	–50	V
	BCY71		–	–45	V
V_{CEO}	collector-emitter voltage	open base			
	BCY70		–	–40	V
	BCY71		–	–45	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–200	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	350	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°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	500	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		150	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	BCY70	I_E = 0; V_{CB} = −50 V	–	−20	nA
		I_E = 0; V_{CB} = −50 V; T_j = 100 °C	–	−5	μA
I_{CBO}	collector cut-off current				
	BCY71	I_E = 0; V_{CB} = −45 V	–	−20	nA
		I_E = 0; V_{CB} = −45 V; T_j = 100 °C	–	−5	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −4 V	–	−10	nA
		I_C = 0; V_{EB} = −4 V; T_j = 100 °C	–	−2	μA
		I_C = 0; V_{EB} = −5 V	–	−500	nA
h_{FE}	DC current gain	V_{CE} = −1 V			
		I_C = −10 μA	60	–	
		I_C = −0.1 mA	80	–	
		I_C = −1 mA	100	–	
		I_C = −50 mA	45	–	
h_{FE}	DC current gain	I_C = −10 mA; V_{CE} = −1 V			
	BCY70		100	–	
	BCY71		–	500	
V_{CEsat}	collector-emitter saturation voltage	I_C = −10 mA; I_B = −1 mA	–	−250	mV
		I_C = −50 mA; I_B = −5 mA	–	−500	mV
V_{BEsat}	base-emitter saturation voltage	I_C = −10 mA; I_B = −1 mA	−600	−900	mV
		I_C = −50 mA; I_B = −5 mA	–	−1.2	V
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} = −1 V; f = 1 MHz	–	8	pF
f_T	transition frequency	I_C = −10 mA; V_{CE} = −20 V; f = 100 MHz	250	–	MHz
F	noise figure	I_C = −100 μA; V_{CE} = −5 V; R_S = 1 kΩ; f = 10 Hz to 15.7 kHz			
	BCY70		–	6	dB
	BCY71		–	2	dB
Switching times (between 10% and 90% levels)					
BCY70					
t_{on}	turn-on time	I_{Con} = −10 mA; I_{Bon} = −1 mA; I_{Boff} = 1 mA	–	65	ns
t_d	delay time		–	35	ns
t_r	rise time		–	35	ns
t_{off}	turn-off time		–	500	ns
t_s	storage time		–	420	ns
t_f	fall time		–	80	ns

PNP switching transistors | BCY78; BCY79

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- Switching and amplification.

DESCRIPTION

PNP switching transistor in a TO-18 metal package.
NPN complements: BCY58 and BCY59.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

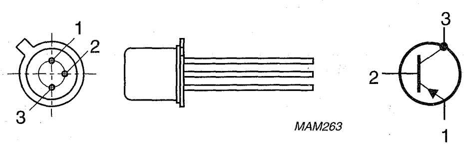


Fig.1 Simplified outline (TO-18) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BCY78		–	–32	V
	BCY79		–	–45	V
V_{CEO}	collector-emitter voltage	open base			
	BCY78		–	–32	V
	BCY79		–	–45	V
I_C	collector current (DC)		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 45$ °C	–	340	mW
		$T_{case} \leq 45$ °C	–	1	W
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V			
	BCY78/VII; BCY79/VII		120	220	
	BCY78/VIII; BCY79/VIII		180	310	
	BCY78/IX; BCY79/IX		250	460	
	BCY78/X		380	630	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V	100	–	MHz
t_{off}	turn-off time	$I_{Con} = -100$ mA; $I_{Bon} = -10$ mA; $I_{Boff} = 10$ mA	–	400	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			
	BCY78		–	–32	V
	BCY79		–	–45	V
V_{CEO}	collector-emitter voltage	open base			
	BCY78		–	–32	V
	BCY79		–	–45	V
V_{EBO}	emitter-base voltage	open collector		–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 45$ °C	–	340	mW
		$T_{case} \leq 45$ °C	–	1	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°C
T_{amb}	operating ambient temperature		–65	+150	°C

THERMAL CHARACTERISTICS

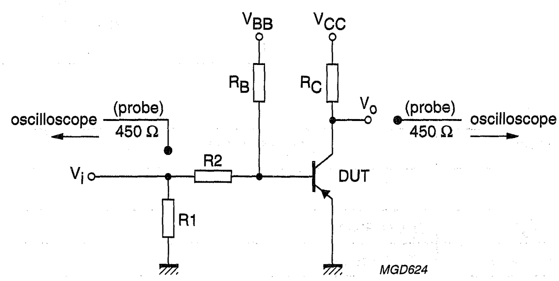
SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air	450	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		150	K/W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current					
	BCY78	$I_E = 0$; $V_{CB} = -32$ V	–	–2	–15	nA
		$I_E = 0$; $V_{CB} = -32$ V; $T_{amb} = 150$ °C	–	–	–10	μA
I_{CBO}	collector cut-off current					
	BCY79	$I_E = 0$; $V_{CB} = -45$ V	–	–2	–15	nA
		$I_E = 0$; $V_{CB} = -45$ V; $T_{amb} = 150$ °C	–	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–20	nA
h_{FE}	DC current gain	$I_C = -10$ μA; $V_{CE} = -5$ V				
	BCY78/VII; BCY79/VII		–	140	–	
	BCY78/VIII; BCY79/VIII		30	200	–	
	BCY78/IX; BCY79/IX		40	270	–	
	BCY78/X		100	340	–	
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V				
	BCY78/VII; BCY79/VII		120	170	220	
	BCY78/VIII; BCY79/VIII		180	250	310	
	BCY78/IX; BCY79/IX		250	350	460	
	BCY78/X		380	500	630	
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -1$ V				
	BCY78/VII; BCY79/VII		80	180	–	
	BCY78/VIII; BCY79/VIII		120	260	400	
	BCY78/IX; BCY79/IX		160	360	630	
	BCY78/X		240	500	1000	
h_{FE}	DC current gain	$I_C = -100$ mA; $V_{CE} = -1$ V				
	BCY78/VII; BCY79/VII		40	–	–	
	BCY78/VIII; BCY79/VIII		45	–	–	
	BCY78/IX; BCY79/IX		60	–	–	
	BCY78/X		60	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -250$ μA	–	–120	–250	mV
		$I_C = -100$ mA; $I_B = -2.5$ mA	–	–400	–800	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -10$ mA; $I_B = -250$ μA	–600	–700	–850	mV
		$I_C = -100$ mA; $I_B = -2.5$ mA	–700	–850	–1200	mV
V_{BE}	base-emitter voltage	$I_C = -10$ μA; $V_{CE} = -5$ V	–	–550	–	mV
		$I_C = -2$ mA; $V_{CE} = -5$ V	–600	–650	–750	mV
		$I_C = -10$ mA; $V_{CE} = -1$ V	–	–650	–	mV
		$I_C = -100$ mA; $V_{CE} = -1$ V	–	–750	–	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	7	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -500$ mV; f = 1 MHz	–	–	15	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	100	–	–	MHz

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
F	noise figure	I_C = −200 μA; V_{CE} = −5 V; R_S = 2 kΩ; f = 1 kHz; B = 200 Hz	–	–	10	dB
Switching times (between 10% and 90% levels); see Fig.2						
t_{on}	turn-on time	I_{Con} = −10 mA; I_{Bon} = −1 mA; I_{Boff} = 1 mA; test conditions A	–	–	100	ns
t_d	delay time		–	–	50	ns
t_r	rise time		–	–	50	ns
t_{off}	turn-off time		–	–	700	ns
t_s	storage time		–	–	600	ns
t_f	fall time		–	–	100	ns
t_{on}	turn-on time	I_{Con} = −100 mA; I_{Bon} = −10 mA; I_{Boff} = 10 mA; test conditions B	–	–	100	ns
t_d	delay time		–	–	35	ns
t_r	rise time		–	–	65	ns
t_{off}	turn-off time		–	–	400	ns
t_s	storage time		–	–	300	ns
t_f	fall time		–	–	100	ns



Test conditions A

V_i = −5 V; T = 500 μs; t_p = 10 μs; t_r = t_f ≤ 3 ns.
R1 = 56 Ω; R2 = 2.5 kΩ; R_B = 3.9 kΩ; R_C = 270 Ω.
V_{BB} = 1.9 V; V_{CC} = −3 V
Oscilloscope input impedance Z_i = 50 Ω.

Test conditions B

V_i = −9.8 V; T = 500 μs; t_p = 10 μs; t_r = t_f ≤ 3 ns.
R1 = 62 Ω; R2 = 470 Ω; R_B = 470 Ω; R_C = 100 Ω.
V_{BB} = 3.4 V; V_{CC} = −10.8 V
Oscilloscope input impedance Z_i = 50 Ω.

Fig.2 Test circuit for switching times.

NPN general purpose transistors | BCY87; BCY88; BCY89

FEATURES

- Low current (max. 30 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- Differential amplifier applications in general industrial service e.g. instrumentation and control
- The BCY87 and BCY88 are intended for use in pre-stages of differential amplifiers where low offset, low drift and low noise are of prime importance
- The BCY89 is intended for use in second stages of differential amplifiers, long-tailed pairs and more general applications.

DESCRIPTION

Matched dual NPN transistors in a TO-71; SOT31 metal package. Products are divided into 3 types according to their matching accuracy.

PINNING

PIN(1)	DESCRIPTION
1	emitter TR1
2	emitter TR2
3	collector TR2
4	basis TR2
5	basis TR1
6	collector TR1

Note

1. All leads insulated from the case.

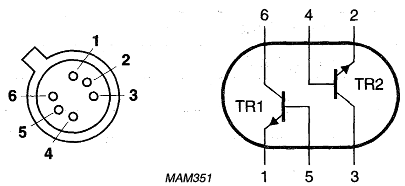


Fig.1 Simplified outline (TO-71; SOT31) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per transistor					
V_{CBO}	collector-base voltage	open emitter	–	45	V
V_{CEO}	collector-emitter voltage	open base	–	40	V
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	150	mW
h_{FE}	DC current gain	$V_{CE} = 10$ V			
	BCY87	$I_C = 5$ μA	80	–	
	BCY88	$I_C = 500$ μA	120	600	
	BCY89	$I_C = 10$ mA	100	600	
h_{FE}	DC current gain	$I_C = 50$ μA; $V_{CE} = 10$ V	100	450	
f_T	transition frequency	$I_C = -50$ μA; $V_{CE} = 10$ V; f = 100 MHz	10	–	MHz
		$I_C = -500$ μA; $V_{CE} = 10$ V; f = 100 MHz	50	–	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	–	45	V
V_{CEO}	collector-emitter voltage	open base	–	40	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	30	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	150	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air	1	K/mW

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Per transistor						
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V; $T_{amb} = 90$ °C				
	BCY87		–	–	5	nA
	BCY88		–	–	20	nA
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V				
	BCY89		–	–	10	nA
h_{FE}	DC current gain	$V_{CE} = 10$ V				
	BCY87	$I_C = 5$ μA	80	–	–	
	BCY88	$I_C = 500$ μA	120	–	600	
	BCY89	$I_C = 10$ mA	100	–	600	
h_{FE}	DC current gain	$I_C = 50$ μA; $V_{CE} = 10$ V	100	–	450	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF
f_T	transition frequency	$I_E = -50$ μA; $V_{CE} = 10$ V; f = 100 MHz	10	–	–	MHz
		$I_E = -500$ μA; $V_{CE} = 10$ V; f = 100 MHz	50	–	–	MHz
F	noise figure	$I_C = 200$ μA; $V_{CE} = 5$ V; $R_S = 2$ kΩ; f = 10 Hz to 15.7 kHz	–	–	4	dB
F	noise figure	$I_C = 200$ μA; $V_{CE} = 5$ V; $R_S = 2$ kΩ; f = 1 kHz; B = 200 Hz				
	BCY87		–	–	4	dB
	BCY88; BCY89		–	–	5	dB

NPN general purpose transistors BCY87; BCY88; BCY89

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Complete device; note 1						
$\frac{I_{1C}}{I_{2C}}$	ratio of collector currents	$V_{1B-1E} = V_{2B-2E}$				
	BCY87		0.9	–	1.11	
	BCY88		0.8	–	1.25	
	BCY89		0.67	–	1.5	
$\|V_{1B-1E} - V_{2B-2E}\|$	difference between base-emitter voltages	$I_{1C} = I_{2C}$				
	BCY87		–	–	3	mV
	BCY88		–	–	6	mV
	BCY89		–	–	10	mV
$\|I_{1B} - I_{2B}\|$	difference between base currents	$V_{1B-1E} = V_{2B-2E}$				
	BCY87		–	–	25	nA
	BCY88		–	–	80	nA
	BCY89		–	–	300	nA
$\frac{h_{1FE}}{h_{2FE}}$	DC current gain ratio	$I_{1C} = I_{2C}$				
	BCY87		0.9	–	1.11	
	BCY88		0.8	–	1.25	
$\left\|\frac{\Delta V}{\Delta T}\right\|$	equivalent differential voltage	$T_{amb} = -20$ °C to +90 °C				
	BCY87		–	1	3	μV/K
	BCY88		–	2	6	μV/K
	BCY89		–	4	10	μV/K
$\left\|\frac{\Delta I}{\Delta T}\right\|$	equivalent differential current	$T_{amb} = -20$ °C to +90 °C				
	BCY87		–	–	0.5	nA/K
	BCY88		–	–	2	nA/K
	BCY89		–	–	10	nA/K

Note

1. These characteristics are valid under the following conditions:
   a) Collector-base voltage of both transistors not exceeding 10 V; ($V_{1C-1B} = V_{2C-2B} \leq 10$ V).
   b) Sum of the emitter currents from 10 to 100 μA; $-(I_{1E} + I_{2E}) = 10$ to 100 μA.

NPN power transistor BD131

FEATURES

- High current (max. 3 A)
- Low voltage (max. 45 V).

APPLICATIONS

- General purpose power applications.

DESCRIPTION

NPN power transistor in a TO-126; SOT32 plastic package. PNP complement: BD132.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector, connected to metal part of mounting surface
3	base

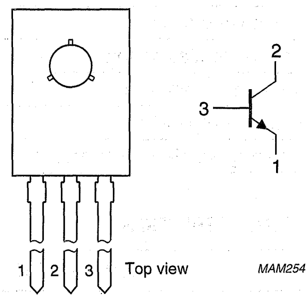


Fig.1 Simplified outline (TO-126; SOT32) and symbol.

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_{CM}	peak collector current		–	6	A
P_{tot}	total power dissipation	$T_{mb} \leq 60$ °C	–	15	W
h_{FE}	DC current gain	$I_C = 0.5$ A; $V_{CE} = 12$ V	40	–	
f_T	transition frequency	$I_C = 0.25$ A; $V_{CE} = 5$ 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	–	70	V
V_{CEO}	collector-emitter voltage	open base	–	45	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	3	A
I_{CM}	peak collector current		–	6	A
I_{BM}	peak base current		–	0.5	A
P_{tot}	total power dissipation	$T_{mb} \leq 60$ °C	–	15	W
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	note 1	100	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base		6	K/W

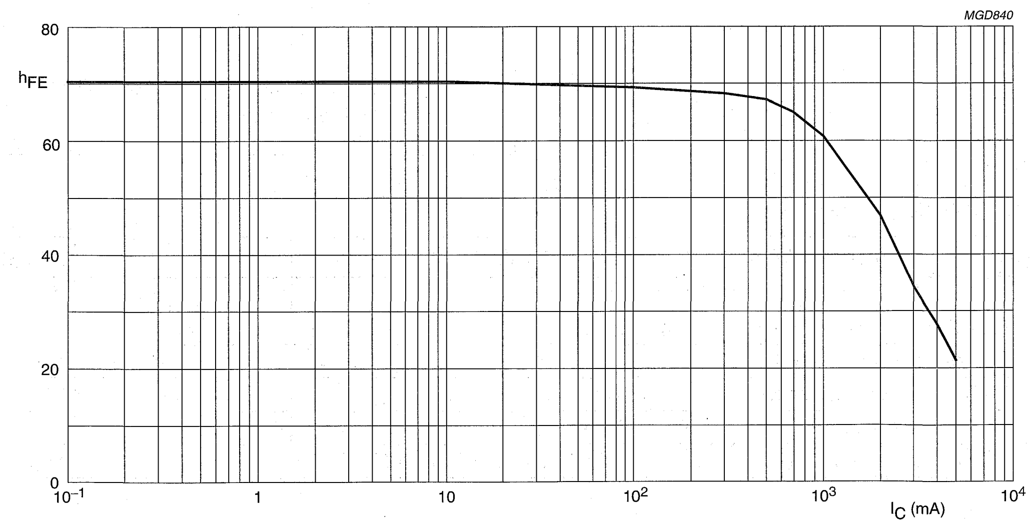
Note

1. Refer to TO-126; SOT32 standard mounting conditions.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	50	mA
		$I_E = 0$; $V_{CB} = 50$ V; $T_j = 150$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	50	nA
h_{FE}	DC current gain	$I_C = 0.5$ A; $V_{CE} = 12$ V; see Fig.2	40	–	
		$I_C = 2$ A; $V_{CE} = 1$ V; see Fig.2	20	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 0.5$ A; $I_B = 50$ mA	–	300	mV
		$I_C = 2$ A; $I_B = 200$ mA	–	700	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 0.5$ A; $I_B = 50$ mA	–	1.2	V
		$I_C = 2$ A; $I_B = 200$ mA	–	1.5	V
f_T	transition frequency	$I_C = 0.25$ A; $V_{CE} = 5$ V; f = 100 MHz; $T_{amb} = 25$ °C	60	–	MHz



$V_{CE} = 1$ V.

Fig.2 DC current gain; typical values.

PNP power transistor BD132

FEATURES

- High current (max. 3 A)
- Low voltage (max. 45 V).

APPLICATIONS

- General purpose power applications.

DESCRIPTION

PNP power transistor in a TO-126; SOT32 plastic package. NPN complement: BD131.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector, connected to metal part of mounting surface
3	base

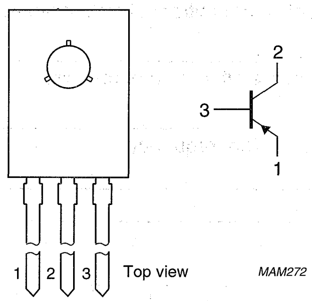


Fig.1 Simplified outline (TO-126; SOT32) and symbol.

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_{CM}	peak collector current		–	−6	A
P_{tot}	total power dissipation	$T_{mb} \leq 60$ °C	–	15	W
h_{FE}	DC current gain	$I_C = -0.5$ A; $V_{CE} = -12$ V	40	–	
f_T	transition frequency	$I_C = -0.25$ A; $V_{CE} = -5$ V; f = 100 MHz	60	–	MHz

PNP power transistor BD132

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	–	–4	V
I_C	collector current (DC)		–	–3	A
I_{CM}	peak collector current		–	–6	A
I_{BM}	peak base current		–	–0.5	A
P_{tot}	total power dissipation	$T_{mb} \leq 60$ °C	–	15	W
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	note 1	100	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base		6	K/W

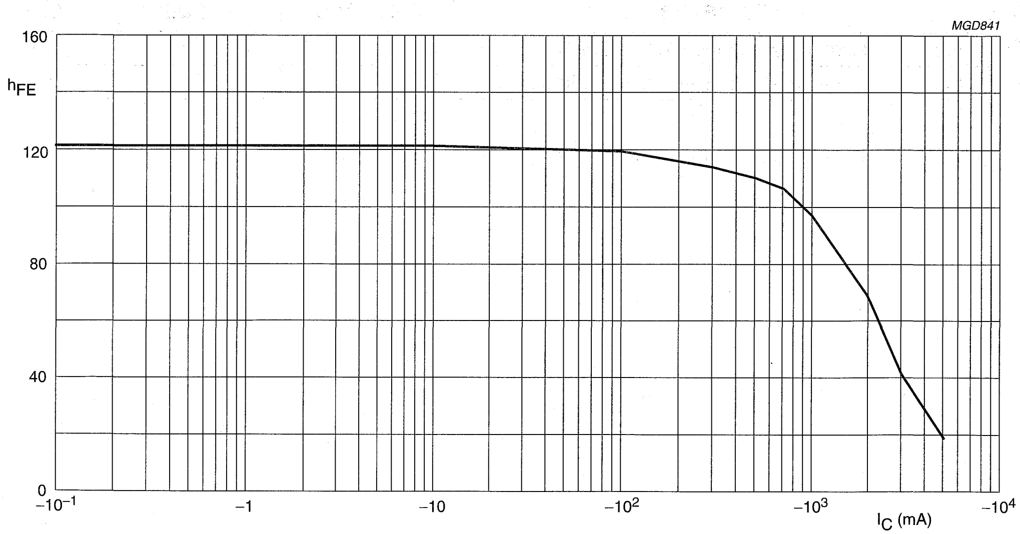
Note

1. Refer to TO-126; SOT32 standard mounting conditions.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = –40 V	–	–50	nA
		I_E = 0; V_{CB} = –40 V; T_j = 150 °C	–	–10	µA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = –3 V	–	–50	nA
h_{FE}	DC current gain	I_C = –0.5 A; V_{CE} = –12 V	40	–	
		I_C = –2 A; V_{CE} = –1 V; see Fig.2	20	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = –0.5 A; I_B = –50 mA	–	–300	mV
		I_C = –2 A; I_B = –200 mA	–	–700	mV
V_{BEsat}	base-emitter saturation voltage	I_C = –0.5 A; I_B = –50 mA	–	–1.2	V
		I_C = –2 A; I_B = –200 mA	–	–1.5	V
f_T	transition frequency	I_C = –0.25 A; V_{CE} = –5 V; f = 100 MHz; T_{amb} = 25 °C	60	–	MHz



V_{CE} = –1 V.

Fig.2 DC current gain; typical values.

FEATURES

- High current (max. 1.5 A)
- Low voltage (max. 80 V).

APPLICATIONS

- Driver stages in hi-fi amplifiers and television circuits.

DESCRIPTION

NPN power transistor in a TO-126; SOT32 plastic package. PNP complements: BD136, BD138 and BD140.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector, connected to metal part of mounting surface
3	base

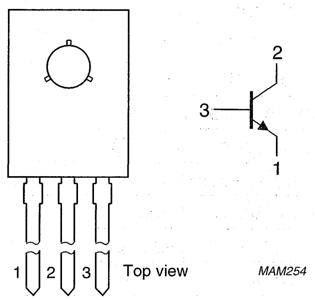


Fig.1 Simplified outline (TO-126; SOT32) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BD135		–	–	45	V
	BD137		–	–	60	V
	BD139		–	–	100	V
V_{CEO}	collector-emitter voltage	open base				
	BD135		–	–	45	V
	BD137		–	–	60	V
	BD139		–	–	80	V
I_{CM}	peak collector current		–	–	2	A
P_{tot}	total power dissipation	$T_{mb} \leq 70$ °C	–	–	8	W
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 2$ V	40	–	250	
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 5$ V; f = 100 MHz	–	190	–	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			
	BD135		–	45	V
	BD137		–	60	V
	BD139		–	100	V
V_{CEO}	collector-emitter voltage	open base			
	BD135		–	45	V
	BD137		–	60	V
	BD139		–	80	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	1.5	A
I_{CM}	peak collector current		–	2	A
I_{BM}	peak base current		–	1	A
P_{tot}	total power dissipation	$T_{mb} \leq 70$ °C	–	8	W
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	note 1	100	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base		10	K/W

Note

1. Refer to TO-126; SOT32 standard mounting conditions.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 30 V	–	–	100	nA
		I_E = 0; V_{CB} = 30 V; T_j = 125 °C	–	–	10	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 5 V	–	–	100	nA
h_{FE}	DC current gain	V_{CE} = 2 V; see Fig.2				
		I_C = 5 mA	40	–	–	
		I_C = 150 mA	40	–	250	
		I_C = 500 mA	25	–	–	
h_{FE}	DC current gain	I_C = 150 mA; V_{CE} = 2 V; see Fig.2				
	BD135-10; BD137-10; BD139-10		63	–	160	
	BD135-16; BD137-16; BD139-16		100	–	250	
V_{CEsat}	collector-emitter saturation voltage	I_C = 500 mA; I_B = 50 mA	–	–	0.5	V
V_{BE}	base-emitter voltage	I_C = 500 mA; V_{CE} = 2 V	–	–	1	V
f_T	transition frequency	I_C = 50 mA; V_{CE} = 5 V; f = 100 MHz	–	190	–	MHz
$\frac{h_{FE1}}{h_{FE2}}$	DC current gain ratio of the complementary pairs	$\lvert I_C \rvert$ = 150 mA; $\lvert V_{CE} \rvert$ = 2 V	–	1.3	1.6	

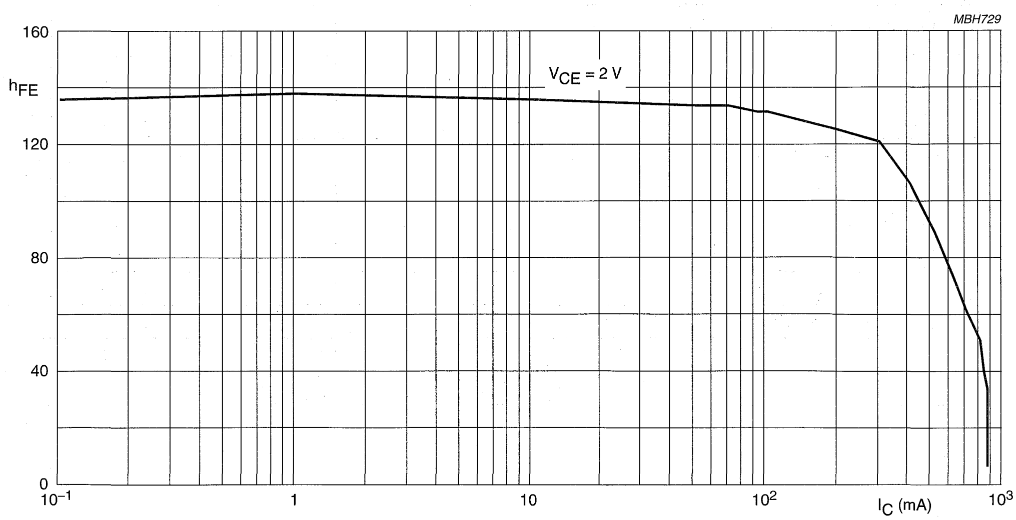


Fig.2 DC current gain; typical values.

PNP power transistors

BD136; BD138; BD140

FEATURES

- High current (max. 1.5 A)
- Low voltage (max. 80 V).

APPLICATIONS

- General purpose power applications, e.g. driver stages in hi-fi amplifiers and television circuits.

DESCRIPTION

PNP power transistor in a TO-126; SOT32 plastic package. NPN complements: BD135, BD137 and BD139.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector, connected to metal part of mounting surface
3	base

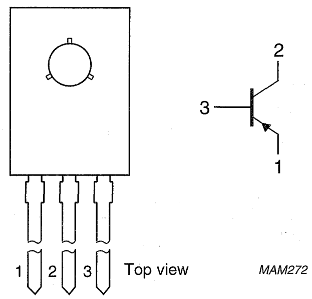


Fig.1 Simplified outline (TO-126; SOT32) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BD136		–	–	–45	V
	BD138		–	–	–60	V
	BD140		–	–	–100	V
V_{CEO}	collector-emitter voltage	open base				
	BD136		–	–	–45	V
	BD138		–	–	–60	V
	BD140		–	–	–80	V
I_{CM}	peak collector current		–	–	–2	A
P_{tot}	total power dissipation	$T_{mb} \leq 70$ °C	–	–	8	W
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -2$ V	40	–	250	
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -5$ V; f = 100 MHz	–	160	–	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			
	BD136		–	–45	V
	BD138		–	–60	V
	BD140		–	–100	V
V_{CEO}	collector-emitter voltage	open base			
	BD136		–	–45	V
	BD138		–	–60	V
	BD140		–	–80	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–1.5	A
I_{CM}	peak collector current		–	–2	A
I_{BM}	peak base current		–	–1	A
P_{tot}	total power dissipation	$T_{mb} \leq 70$ °C	–	8	W
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	note 1	100	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base		10	K/W

Note

1. Refer to TO-126 (SOT32) standard mounting conditions.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -30$ V	–	–	–100	nA
		$I_E = 0$; $V_{CB} = -30$ V; $T_j = 125$ °C	–	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–100	nA
h_{FE}	DC current gain	$V_{CE} = -2$ V; see Fig.2				
		$I_C = -5$ mA	40	–	–	
		$I_C = -150$ mA	40	–	250	
		$I_C = -500$ mA	25	–	–	
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -2$ V; see Fig.2				
	BD136-10; BD138-10; BD140-10		63	–	160	
	BD136-16; BD138-16; BD140-16		100	–	250	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -500$ mA; $I_B = -50$ mA	–	–	–0.5	V
V_{BE}	base-emitter voltage	$I_C = -500$ mA; $V_{CE} = -2$ V	–	–	–1	V
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -5$ V; f = 100 MHz	–	160	–	MHz
$\frac{h_{FE1}}{h_{FE2}}$	DC current gain ratio of the complementary pairs	$\lvert I_C \rvert = 150$ mA; $\lvert V_{CE} \rvert = 2$ V	–	1.3	1.6	

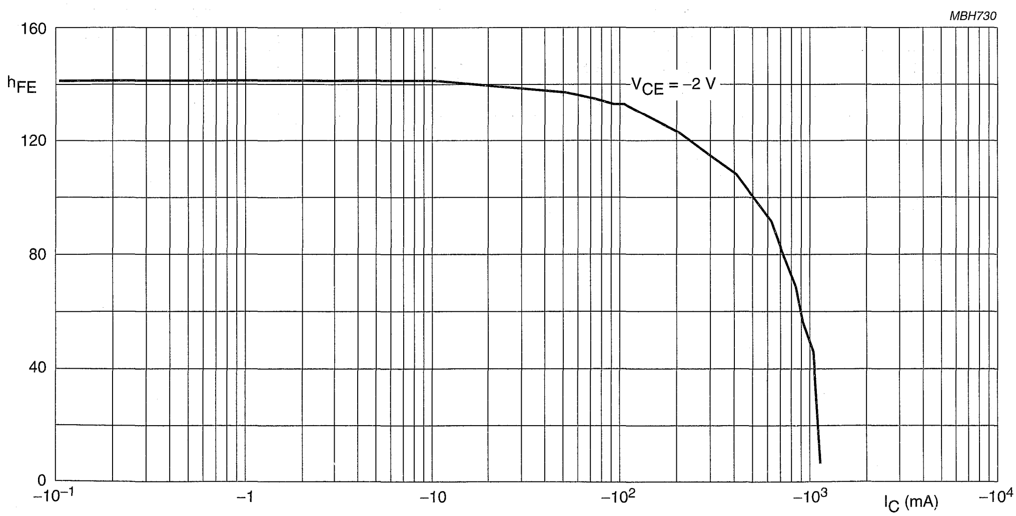


Fig.2 DC current gain; typical values.

NPN power transistors | BD226; BD228; BD230

FEATURES

- High current (max. 1.5 A)
- Low voltage (max. 80 V).

APPLICATIONS

- Driver stages in television circuits.

DESCRIPTION

NPN power transistor in a TO-126; SOT32 plastic package. PNP complements: BD227, BD229 and BD231.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector, connected to metal part of mounting surface
3	base

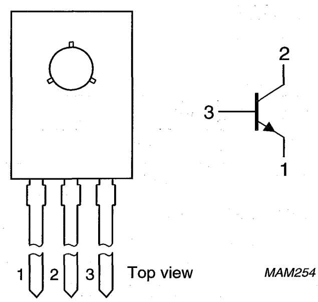


Fig.1 Simplified outline (TO-126; SOT32) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BD226		–	–	45	V
	BD228		–	–	60	V
	BD230		–	–	100	V
V_{CEO}	collector-emitter voltage	open base				
	BD226		–	–	45	V
	BD228		–	–	60	V
	BD230		–	–	80	V
I_{CM}	peak collector current		–	–	3	A
P_{tot}	total power dissipation	$T_{mb} \leq 62$ °C	–	–	12.5	W
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 2$ V	40	–	250	
		$I_C = 1$ A; $V_{CE} = 2$ V	25	–	–	
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 5$ V; f = 100 MHz	–	125	–	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			
	BD226		–	45	V
	BD228		–	60	V
	BD230		–	100	V
V_{CEO}	collector-emitter voltage	open base			
	BD226		–	45	V
	BD228		–	60	V
	BD230		–	80	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	1.5	A
I_{CM}	peak collector current		–	3	A
I_{BM}	peak base current		–	1	A
P_{tot}	total power dissipation	$T_{mb} \leq 62$ °C	–	12.5	W
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	note 1	100	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base		7	K/W

Note

1. Refer to TO-126; SOT32 standard mounting conditions.

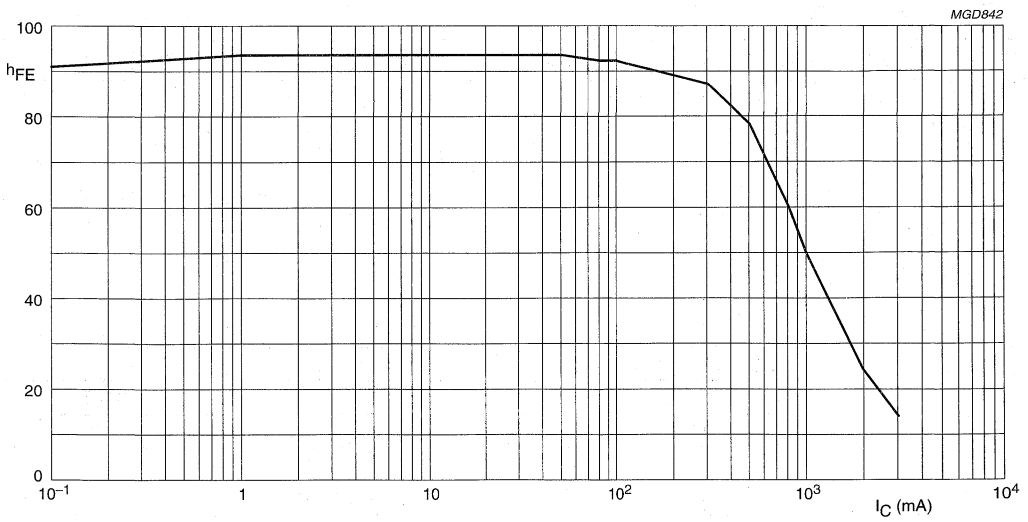
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 30 V	–	–	100	nA
		I_E = 0; V_{CB} = 30 V; T_j = 125 °C	–	–	10	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 5 V	–	–	100	nA
h_{FE}	DC current gain	V_{CE} = 2 V; see Fig.2				
		I_C = 5 mA	40	–	–	
		I_C = 150 mA	40	–	250	
		I_C = 1 A	25	–	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = 1 A; I_B = 0.1 A	–	–	0.8	V
V_{BEsat}	base-emitter saturation voltage	I_C = 1 A; I_B = 0.1 A	–	–	1.2	V
V_{BE}	base-emitter voltage	I_C = 1 A; V_{CE} = 2 V; note 1	–	–	1.3	V
f_T	transition frequency	I_C = 50 mA; V_{CE} = 5 V; f = 100 MHz	–	125	–	MHz
$\frac{h_{FE1}}{h_{FE2}}$	DC current gain ratio of the complementary pairs	$\lvert I_C \rvert$ = 150 mA; $\lvert V_{CE} \rvert$ = 2 V	–	1.3	1.6	

Note

1. V_{BE} decreases by about 2.3 mV/K with increasing temperature.



V_{CE} = 2 V.

Fig.2 DC current gain; typical values.

PNP power transistors BD227; BD229; BD231

FEATURES

- High current (max. 1.5 A)
- Low voltage (max. 80 V).

APPLICATIONS

- Driver stages in television circuits.

DESCRIPTION

PNP power transistor in a TO-126; SOT32 plastic package. NPN complements: BD226, BD228 and BD230.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector, connected to metal part of mounting surface
3	base

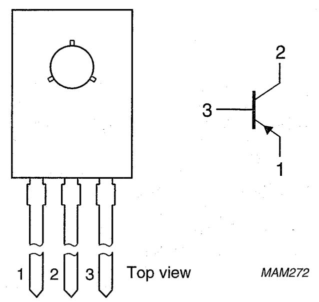


Fig.1 Simplified outline (TO-126; SOT32) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BD227		–	–	–45	V
	BD229		–	–	–60	V
	BD231		–	–	–100	V
V_{CEO}	collector-emitter voltage	open base				
	BD227		–	–	–45	V
	BD229		–	–	–60	V
	BD231		–	–	–80	V
I_{CM}	peak collector current		–	–	–3	A
P_{tot}	total power dissipation	$T_{mb} \leq 62$ °C	–	–	12.5	W
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -2$ V	40	–	250	
		$I_C = -1$ A; $V_{CE} = -2$ V	25	–	–	
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -5$ V; f = 100 MHz	–	50	–	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			
	BD227		–	–45	V
	BD229		–	–60	V
	BD231		–	–100	V
V_{CEO}	collector-emitter voltage	open base			
	BD227		–	–45	V
	BD229		–	–60	V
	BD231		–	–80	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–1.5	A
I_{CM}	peak collector current		–	–3	A
I_{BM}	peak base current		–	–1	A
P_{tot}	total power dissipation	$T_{mb} \leq 62$ °C	–	12.5	W
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	note 1	100	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base		7	K/W

Note

1. Refer to TO-126; SOT32 standard mounting conditions.

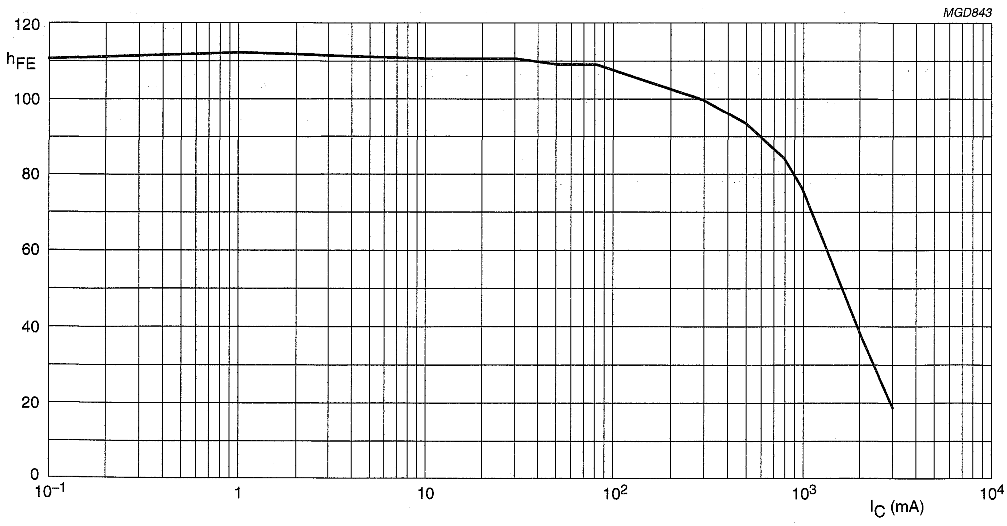
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −30 V	–	–	−100	nA
		I_E = 0; V_{CB} = −30 V; T_j = 125 °C	–	–	−10	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −5 V	–	–	−100	nA
h_{FE}	DC current gain	V_{CE} = −2 V; see Fig.2				
		I_C = −5 mA	40	–	–	
		I_C = −150 mA	40	–	250	
		I_C = −1 A	25	–	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = −1 A; I_B = −0.1 A	–	–	−0.8	V
V_{BEsat}	base-emitter saturation voltage	I_C = −1 A; I_B = −0.1 A	–	–	−1.1	V
V_{BE}	base-emitter voltage	I_C = −1 A; V_{CE} = −2 V; note 1	–	–	−1.3	V
f_T	transition frequency	I_C = −50 mA; V_{CE} = −5 V; f = 100 MHz	–	50	–	MHz
$\frac{h_{FE1}}{h_{FE2}}$	DC current gain ratio of the complementary pairs	$\|I_C\|$ = −150 mA; $\|V_{CE}\|$ = −2 V	–	1.3	1.6	

Note

1. V_{BE} decreases by about −2.3 mV/K with increasing temperature.



V_{CE} = −2 V.

Fig.2 DC current gain; typical values.

NPN power transistor | BD329

FEATURES

- High current (max. 3 A)
- Low voltage (max. 20 V).

APPLICATIONS

- Especially for battery equipped applications.

DESCRIPTION

NPN power transistor in a TO-126; SOT32 plastic package. PNP complement: BD330.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector, connected to metal part of mounting surface
3	base

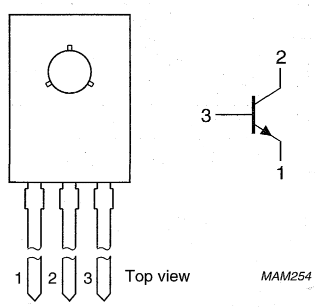


Fig.1 Simplified outline (TO-126; SOT32) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	32	V
V_{CEO}	collector-emitter voltage	open base	–	–	20	V
I_{CM}	peak collector current		–	–	3	A
P_{tot}	total power dissipation	$T_{mb} \leq 45$ °C	–	–	15	W
h_{FE}	DC current gain	$I_C = 0.5$ A; $V_{CE} = 1$ V	85	–	375	
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 5$ V; f = 100 MHz	–	130	–	MHz

NPN power transistor BD329

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	–	32	V
V_{CEO}	collector-emitter voltage	open base	–	20	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	3	A
I_{CM}	peak collector current		–	3	A
I_{BM}	peak base current		–	1	A
P_{tot}	total power dissipation	$T_{mb} \leq 45$ °C	–	15	W
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	note 1	100	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base		7	K/W

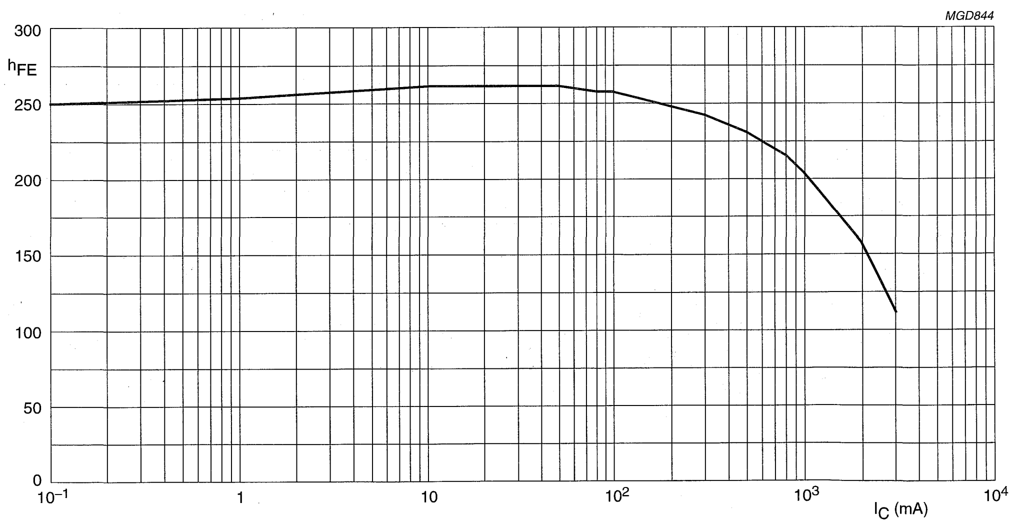
Note

1. Refer to TO-126; SOT32 standard mounting conditions.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 32$ V	–	–	100	nA
		$I_E = 0$; $V_{CB} = 32$ V; $T_j = 150$ °C	–	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 0.5$ A; $V_{CE} = 1$ V; see Fig.2	85	–	375	
		$I_C = 2$ A; $V_{CE} = 1$ V; see Fig.2	40	–	–	
		$I_C = 5$ mA; $V_{CE} = 10$ V	50	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 2$ A; $I_B = 0.2$ A	–	–	0.5	V
V_{BE}	base-emitter voltage	$I_C = 5$ mA; $V_{CE} = 10$ V	–	0.6	–	V
		$I_C = 2$ A; $V_{CE} = 1$ V	–	–	1.2	V
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 5$ V; f = 100 MHz	–	130	–	MHz
$\frac{h_{FE1}}{h_{FE2}}$	DC current gain ratio of the complementary pairs	$\lvert I_C \rvert = 0.5$ A; $\lvert V_{CE} \rvert = 1$ V	–	–	1.6	



$V_{CE} = 1$ V.

Fig.2 DC current gain; typical values.

PNP power transistor BD330

FEATURES

- High current (max. 3 A)
- Low voltage (max. 20 V).

APPLICATIONS

- Power switching and amplification, especially in portable equipment or e.g. car radio output stages.

DESCRIPTION

PNP power transistor in a TO-126; SOT32 plastic package. NPN complement: BD329.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector, connected to metal part of mounting surface
3	base

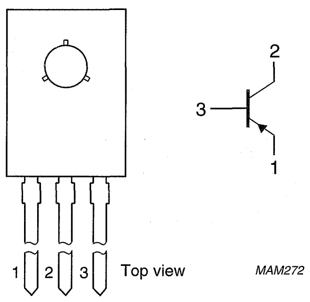


Fig.1 Simplified outline (TO-126; SOT32) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	–32	V
V_{CEO}	collector-emitter voltage	open base	–	–	–20	V
I_{CM}	peak collector current		–	–	–3	A
P_{tot}	total power dissipation	$T_{mb} \leq 45$ °C	–	–	15	W
h_{FE}	DC current gain	$I_C = -0.5$ A; $V_{CE} = -1$ V	85	–	375	
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -5$ V; f = 100 MHz	–	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	–	–32	V
V_{CEO}	collector-emitter voltage	open base	–	–20	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–3	A
I_{CM}	peak collector current		–	–3	A
I_{BM}	peak base current		–	–1	A
P_{tot}	total power dissipation	$T_{mb} \leq 45$ °C	–	15	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

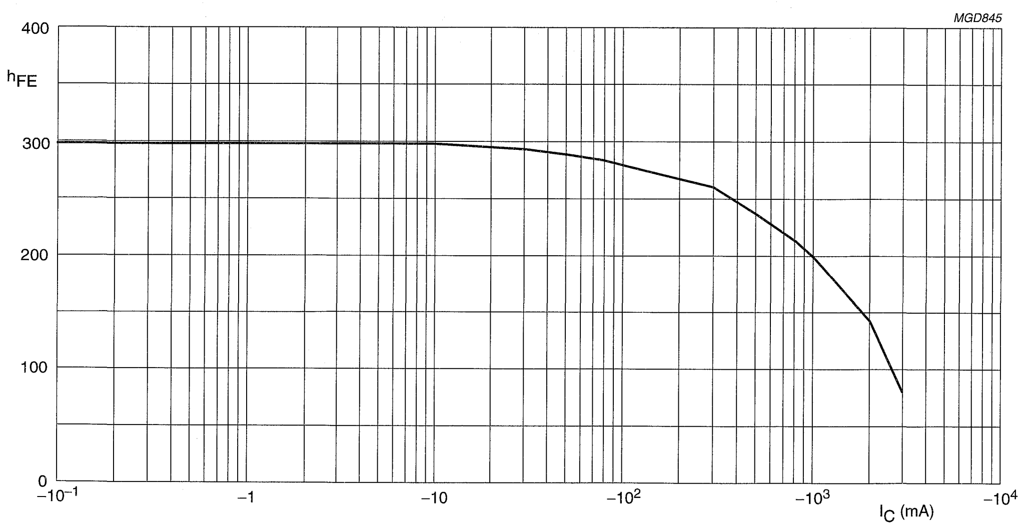
THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air	100	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base		7	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -32$ V	–	–	–100	nA
		$I_E = 0$; $V_{CB} = -32$ V; $T_j = 150$ °C	–	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–100	nA
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -10$ V	50	–	–	
		$I_C = -0.5$ A; $V_{CE} = -1$ V; see Fig.2	85	–	375	
		$I_C = -2$ A; $V_{CE} = -1$ V; see Fig.2	40	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -2$ A; $I_B = -0.2$ A	–	–	–0.5	V
V_{BE}	base-emitter voltage	$I_C = -5$ mA; $V_{CE} = -10$ V	–	–600	–	mV
		$I_C = -2$ A; $V_{CE} = -1$ V	–	–	–1.2	V
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -5$ V; f = 100 MHz	–	100	–	MHz



$V_{CE} = -1$ V.

Fig.2 DC current gain; typical values.

NPN power transistors BD825; BD829

FEATURES

- High current (max. 1 A)
- Low voltage (max. 80 V).

APPLICATIONS

- General purpose
- Driver stages in hi-fi amplifiers and television circuits.

DESCRIPTION

NPN power transistor in a TO-202; SOT128B plastic package. PNP complements: BD826 and BD830.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector, connected to metal part of mounting surface
3	base

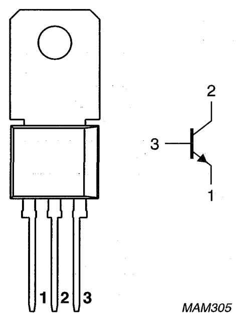


Fig.1 Simplified outline (TO-202; SOT128B) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BD825		–	–	45	V
	BD829		–	–	100	V
V_{CEO}	collector-emitter voltage	open base				
	BD825		–	–	45	V
	BD829		–	–	80	V
I_{CM}	peak collector current		–	–	1.5	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	2	W
		$T_{mb} \leq 50$ °C	–	–	8	W
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 2$ V	40	–	250	
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 5$ V; f = 100 MHz	–	250	–	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			
	BD825		–	45	V
	BD829		–	100	V
V_{CEO}	collector-emitter voltage	open base			
	BD825		–	45	V
	BD829		–	80	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	1	A
I_{CM}	peak collector current		–	1.5	A
I_{BM}	peak base current		–	500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	2	W
		$T_{mb} \leq 50$ °C	–	8	W
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	62.5	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base		12.5	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 30 V	–	–	100	nA
		I_E = 0; V_{CB} = 30 V; T_j = 125 °C	–	–	10	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 5 V	–	–	100	nA
h_{FE}	DC current gain	V_{CE} = 2 V; see Fig.2				
		I_C = 5 mA	40	–	–	
		I_C = 150 mA	40	–	250	
		I_C = 500 mA	25	–	–	
h_{FE}	DC current gain	I_C = 150 mA; V_{CE} = 2 V; see Fig.2				
	BD825-10; BD829-10		63	–	160	
	BD825-16; BD829-16		100	–	250	
V_{CEsat}	collector-emitter saturation voltage	I_C = 500 mA	–	–	500	mV
V_{BE}	base-emitter voltage	I_C = 500 mA; V_{CE} = 2 V	–	–	1	V
f_T	transition frequency	I_C = 50 mA; V_{CE} = 5 V; f = 100 MHz	–	250	–	MHz

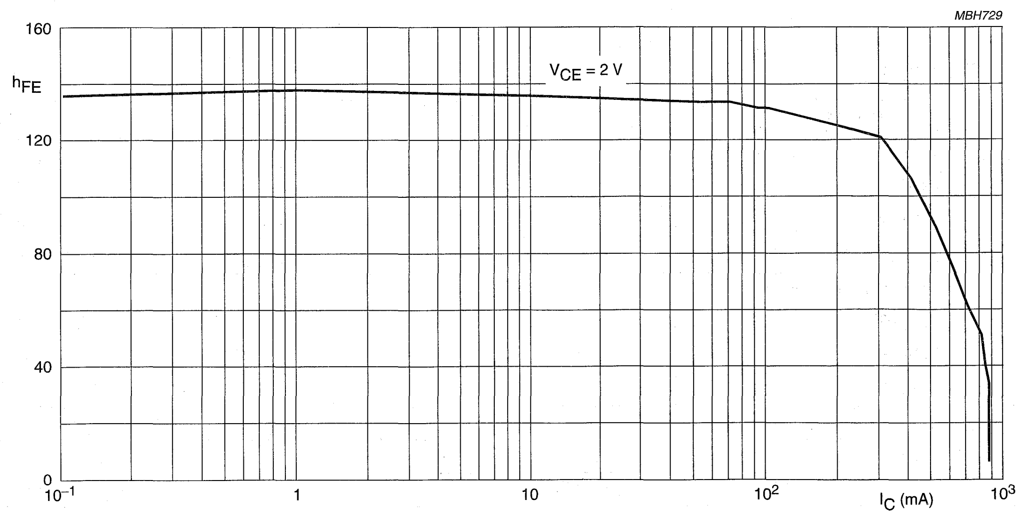


Fig.2 DC current gain; typical values.

PNP power transistors | BD826; BD828; BD830

FEATURES

- High current (max. 1 A)
- Low voltage (max. 80 V).

APPLICATIONS

- General purpose
- Driver stages in hi-fi amplifiers and television circuits.

DESCRIPTION

PNP power transistor in a TO-202; SOT128B plastic package. NPN complements: BD825 and BD829.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector, connected to metal part of mounting surface
3	base

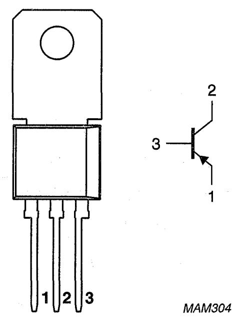


Fig.1 Simplified outline (TO-202; SOT128B) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BD826		–	–	–45	V
	BD828		–	–	–60	V
	BD830		–	–	–100	V
V_{CEO}	collector-emitter voltage	open base				
	BD826		–	–	–45	V
	BD828		–	–	–60	V
	BD830		–	–	–80	V
I_{CM}	peak collector current		–	–	–1.5	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	2	W
		$T_{mb} \leq 50$ °C	–	–	8	W
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -2$ V	40	–	250	
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -5$ V; f = 100 MHz	–	75	–	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			
	BD826		–	–45	V
	BD828		–	–60	V
	BD830		–	–100	V
V_{CEO}	collector-emitter voltage	open base			
	BD826		–	–45	V
	BD828		–	–60	V
	BD830		–	–80	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–1	A
I_{CM}	peak collector current		–	–1.5	A
I_{BM}	peak base current		–	–500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	2	W
		$T_{mb} \leq 50$ °C	–	8	W
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	62.5	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base		12.5	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −30 V	–	–	−100	nA
		I_E = 0; V_{CB} = −30 V; T_j = 125 °C	–	–	−10	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −5 V	–	–	−100	nA
h_{FE}	DC current gain	V_{CE} = −2 V; see Fig.2				
		I_C = −5 mA	40	–	–	
		I_C = −150 mA	40	–	250	
		I_C = −500 mA	25	–	–	
h_{FE}	DC current gain	I_C = −150 mA; V_{CE} = −2 V; see Fig.2				
	BD826-10; BD828-10; BD830-10		63	–	160	
	BD826-16; BD828-16; BD830-16		100	–	250	
V_{CEsat}	collector-emitter saturation voltage	I_C = −500 mA; I_B = −50 mA	–	–	−500	mV
V_{BE}	base-emitter voltage	I_C = −500 mA; V_{CE} = −2 V	–	–	−1	V
f_T	transition frequency	I_C = −50 mA; V_{CE} = −5 V; f = 100 MHz	–	75	–	MHz

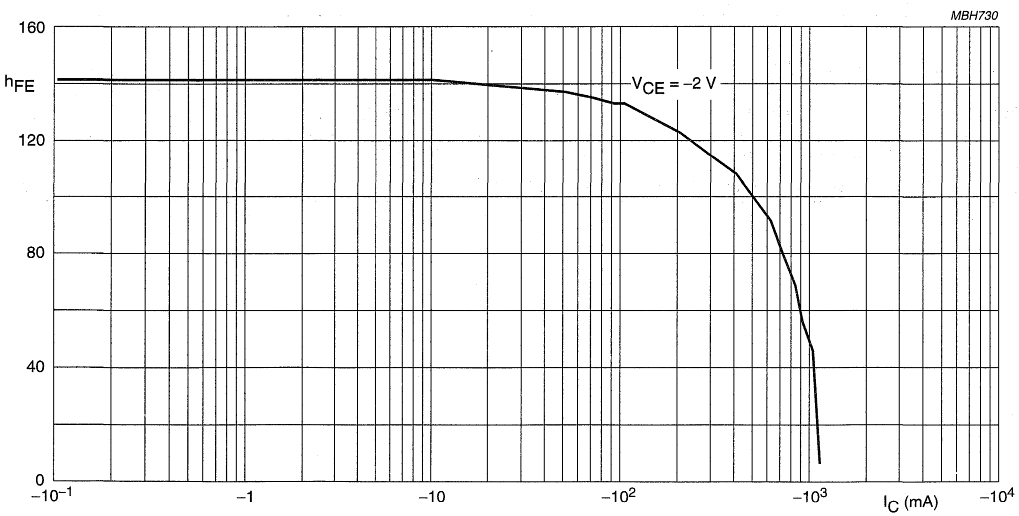


Fig.2 DC current gain; typical values.

NPN medium power transistor BDL31

FEATURES

- High current (max. 5 A)
- Low voltage (max. 10 V)
- Low collector-emitter saturation voltage ensures reduced power dissipation.

APPLICATIONS

- Battery powered units where high current and low power dissipation are important.

DESCRIPTION

NPN medium power transistor in a SOT223 plastic package. PNP complement: BDL32.

PINNING

PIN	DESCRIPTION
1	base
2	not connected
3	emitter
4	collector

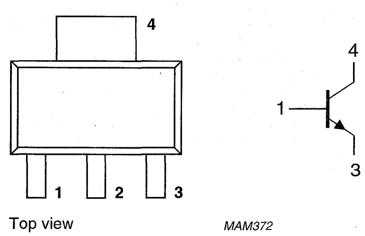


Fig.1 Simplified outline (SOT223) and symbol.

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	–	10	V
I_{CM}	peak collector current		–	10	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.35	W
h_{FE}	DC current gain	$I_C = 1$ A; $V_{CE} = 2$ V	200	–	
f_T	transition frequency	$I_C = 500$ mA; $V_{CE} = 10$ V; f = 100 MHz	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	–	40	V
V_{CEO}	collector-emitter voltage	open base	–	10	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	5	A
I_{CM}	peak collector current		–	10	A
I_{BM}	peak base current		–	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.35	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	92	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		10	K/W

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
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	–	50	µA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	50	nA
h_{FE}	DC current gain	$V_{CE} = 2$ V; note 1			
		$I_C = 0.5$ A	200	–	
		$I_C = 1$ A	200	–	
		$I_C = 3$ A	150	–	
		$I_C = 5$ A	100	–	
h_{FE}	DC current gain	$I_C = 2$ A; $V_{CE} = 1$ V; note 1	180	–	
V_{CEsat}	collector-emitter saturation voltage	note 1			
		$I_C = 1$ A; $I_B = 20$ mA	–	180	mV
		$I_C = 2$ A; $I_B = 200$ mA	–	350	mV
		$I_C = 3$ A; $I_B = 60$ mA	–	450	mV
		$I_C = 5$ A; $I_B = 100$ mA	–	800	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	130	pF
f_T	transition frequency	$I_C = 500$ mA; $V_{CE} = 10$ V; f = 100 MHz	100	–	MHz

Note

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

PNP medium power transistor BDL32

FEATURES

- High current (max. 5 A)
- Low voltage (max. 10 V).
- Low collector-emitter saturation voltage ensures reduced power dissipation.

APPLICATIONS

- Battery powered units where high current and low power dissipation are important.

DESCRIPTION

PNP medium power transistor in a SOT223 plastic package. NPN complement: BDL31.

PINNING

PIN	DESCRIPTION
1	base
2	not connected
3	emitter
4	collector

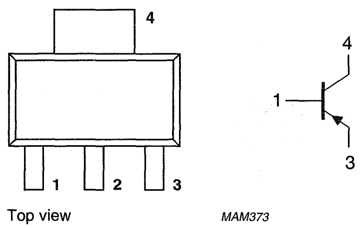


Fig.1 Simplified outline (SOT223) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	−15	V
V_{CEO}	collector-emitter voltage	open base	–	−10	V
I_{CM}	peak collector current		–	−10	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.35	W
h_{FE}	DC current gain	$I_C = -1$ A; $V_{CE} = -2$ V	180	–	
f_T	transition frequency	$I_C = -500$ mA; $V_{CE} = -10$ V; f = 100 MHz	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	–	−15	V
V_{CEO}	collector-emitter voltage	open base	–	−10	V
V_{EBO}	emitter-base voltage	open collector	–	−5	V
I_C	collector current (DC)		–	−5	A
I_{CM}	peak collector current		–	−10	A
I_{BM}	peak base current		–	−1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.35	W
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		−65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	92	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		10	K/W

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -10$ V	–	–50	nA
		$I_E = 0$; $V_{CB} = -10$ V; $T_j = 150$ °C	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–50	nA
h_{FE}	DC current gain	$V_{CE} = -2$ V; note 1			
		$I_C = -0.5$ A	200	–	
		$I_C = -1$ A	180	–	
		$I_C = -3$ A	120	–	
		$I_C = -5$ A	50	–	
h_{FE}	DC current gain	$I_C = -2$ A; $V_{CE} = -1$ V; note 1	120	–	
V_{CEsat}	collector-emitter saturation voltage	note 1			
		$I_C = -1$ A; $I_B = -20$ mA	–	–250	mV
		$I_C = -2$ A; $I_B = -200$ mA	–	–400	mV
		$I_C = -3$ A; $I_B = -60$ mA	–	–600	mV
		$I_C = -5$ A; $I_B = -100$ mA	–	–1	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -5$ V; f = 1 MHz	–	150	pF
f_T	transition frequency	$I_C = -500$ mA; $V_{CE} = -10$ V; f = 100 MHz	100	–	MHz

Note

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

NPN medium power transistor BDP31

FEATURES

- High current (max. 3 A)
- Low voltage (max. 45 V).

APPLICATIONS

- General purpose medium power applications.

DESCRIPTION

NPN medium power transistor in a SOT223 plastic package. PNP complement: BDP32.

PINNING

PIN	DESCRIPTION
1	base
2,4	collector
3	emitter

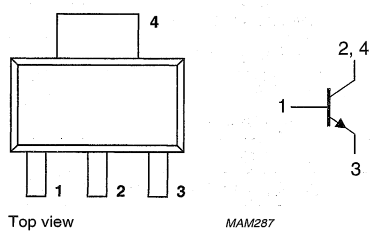


Fig.1 Simplified outline (SOT223) and symbol.

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_{CM}	peak collector current		–	6	A
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C	–	1.35	W
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 12$ V	40	–	
f_T	transition frequency	$I_C = 250$ mA; $V_{CE} = 5$ 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	–	70	V
V_{CEO}	collector-emitter voltage	open base	–	45	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	3	A
I_{CM}	peak collector current		–	6	A
I_{BM}	peak base current		–	0.5	A
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C; note 1	–	1.35	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for the SOT223 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	91	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		10	K/W

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for the SOT223 in the General part of handbook SC04"*.

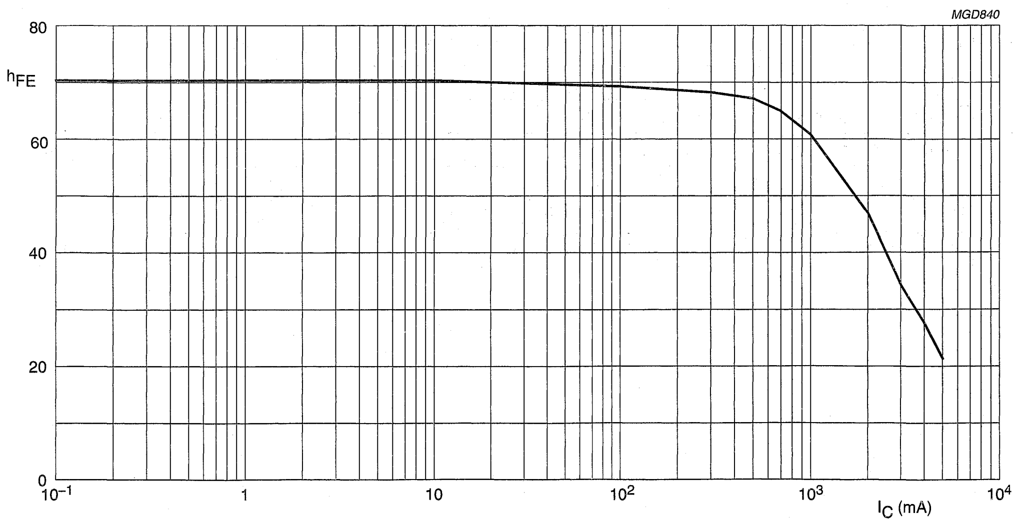
CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V;	–	50	nA
		$I_E = 0$; $V_{CB} = 50$ V; $T_j = 150$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V;	–	50	nA
h_{FE}	DC current gain	$I_C = 0.5$ A; $V_{CE} = 12$ V; note 1; see Fig.2	40	–	
		$I_C = 2$ A; $V_{CE} = 1$ V; note 1; see Fig.2	20	–	
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	–	1.2	V
		$I_C = 2$ A; $I_B = 200$ mA; note 1	–	1.5	V
f_T	transition frequency	$I_C = 250$ mA; $V_{CE} = 5$ V; f = 100 MHz	60	–	MHz

Note

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



$V_{CE} = 1$ V.

Fig.2 DC current gain; typical values.

PNP medium power transistor BDP32

FEATURES

- High current (max. 3 A)
- Low voltage (max. 45 V).

APPLICATIONS

- General purpose medium power applications.

DESCRIPTION

PNP medium power transistor in a SOT223 plastic package. NPN complement: BDP31.

PINNING

PIN	DESCRIPTION
1	base
2,4	collector
3	emitter

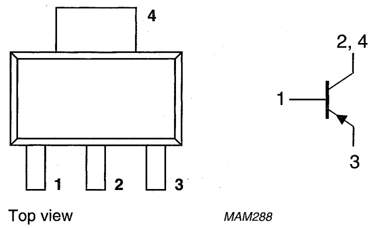


Fig.1 Simplified outline (SOT223) and symbol.

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_{CM}	peak collector current		–	–6	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.35	W
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -12$ V	40	–	
f_T	transition frequency	$I_C = -250$ mA; $V_{CE} = -5$ 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	–	–45	V
V_{CEO}	collector-emitter voltage	open base	–	–45	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–3	A
I_{CM}	peak collector current		–	–6	A
I_{BM}	peak base current		–	–0.5	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.35	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for the SOT223 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	91	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		10	K/W

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for the SOT223 in the General part of handbook SC04"*.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -40$ V	–	–50	nA
		$I_E = 0$; $V_{CB} = -40$ V; $T_j = 150$ °C	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–50	nA
h_{FE}	DC current gain	$I_C = -0.5$ A; $V_{CE} = -12$ V; note 1; see Fig.2	40	–	
		$I_C = -2$ A; $V_{CE} = -1$ V; note 1; see Fig.2	20	–	
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	–	–1.2	V
		$I_C = -2$ A; $I_B = -200$ mA; note 1	–	–1.5	V
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; $\delta \leq 0.02$.

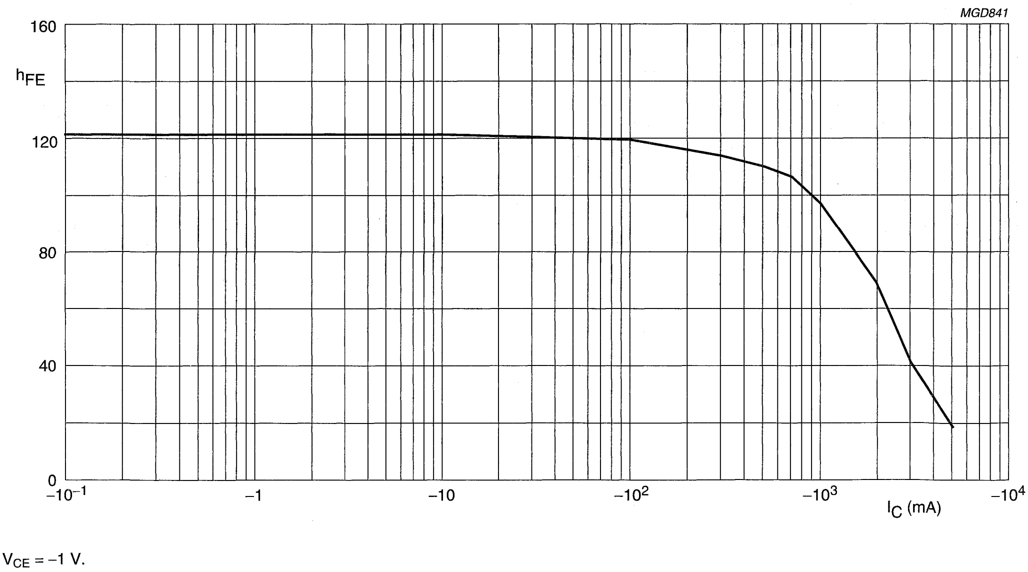


Fig.2 DC current gain; typical values.

NPN switching transistors

BDX35; BDX36; BDX37

FEATURES

- High current (max. 5 A)
- Low voltage (max. 75 V).

APPLICATIONS

- High-current switching in power applications.

DESCRIPTION

NPN switching transistor in a TO-126; SOT32 plastic package.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector, connected to the metal part of the mounting surface
3	base

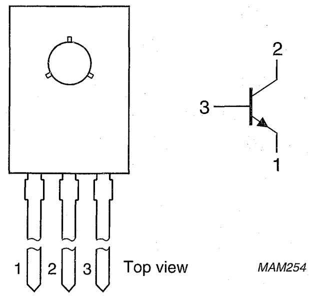


Fig.1 Simplified outline (TO-126; SOT32) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BDX35		–	–	100	V
	BDX36; BDX37		–	–	120	V
V_{CEO}	collector-emitter voltage	open base				
	BDX35; BDX36		–	–	60	V
	BDX37		–	–	75	V
I_C	collector current (DC)		–	–	5	A
P_{tot}	total power dissipation	$T_{mb} \leq 75$ °C	–	–	15	W
h_{FE}	DC current gain	$I_C = 0.5$ A; $V_{CE} = 10$ V	45	–	450	
f_T	transition frequency	$I_C = 0.5$ A; $V_{CE} = 5$ V; f = 100 MHz	–	100	–	MHz
t_{off}	turn-off time	$I_{Con} = 5$ A; $I_{Bon} = 0.5$ A; $I_{Boff} = -0.5$ A	–	350	500	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			
	BDX35		–	100	V
	BDX36; BDX37		–	120	V
V_{CEO}	collector-emitter voltage	open base			
	BDX35; BDX36		–	60	V
	BDX37		–	75	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	5	A
I_{CM}	peak collector current		–	10	A
I_{BM}	peak base current		–	2	A
P_{tot}	total power dissipation	$T_{mb} \leq 75$ °C	–	15	W
		$T_{amb} \leq 25$ °C	–	1.25	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

THERMAL CHARACTERISTICS

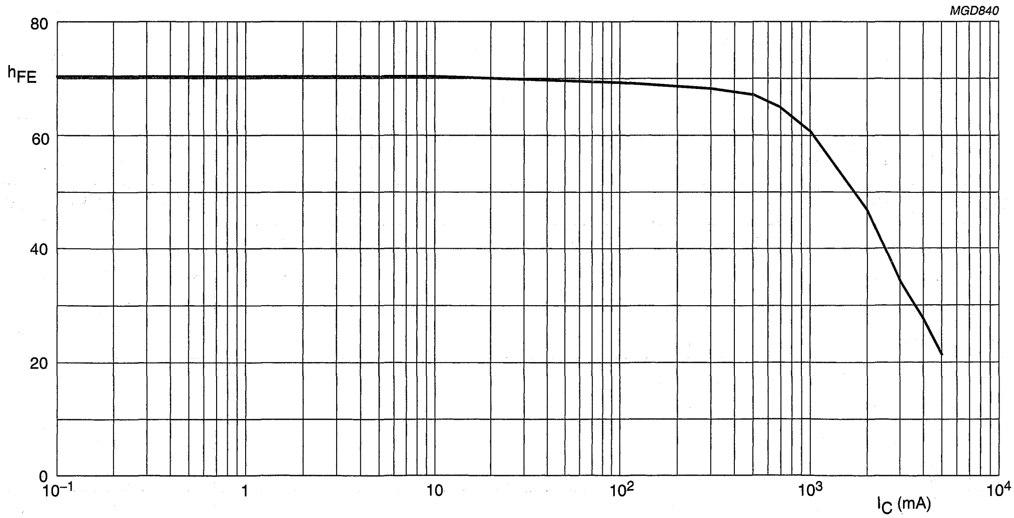
SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air	100	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base		5	K/W

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current					
	BDX35	$I_E = 0$; $V_{CB} = 80$ V	–	–	100	nA
		$I_E = 0$; $V_{CB} = 80$ V; $T_j = 100$ °C	–	–	10	μA
I_{CBO}	collector cut-off current					
	BDX36; BDX37	$I_E = 0$; $V_{CB} = 100$ V	–	–	100	nA
		$I_E = 0$; $V_{CB} = 100$ V; $T_j = 100$ °C	–	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 0.5$ A; $V_{CE} = 10$ V; see Fig.2				
	BDX35; BDX36		45	130	450	
	BDX37		45	80	450	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 5$ A; $I_B = 0.5$ A	–	–	900	mV
V_{CEsat}	collector-emitter saturation voltage					
	BDX35; BDX37	$I_C = 7$ A; $I_B = 0.7$ A	–	–	1.2	V
	BDX36	$I_C = 10$ A; $I_B = 1$ A	–	–	2	V

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{BEsat}	base-emitter saturation voltage	$I_C = 5$ A; $I_B = 0.5$ A	–	–	1.7	V
V_{BEsat}	base-emitter saturation voltage					
	BDX35; BDX37	$I_C = 7$ A; $I_B = 0.7$ A	–	–	2	V
	BDX36	$I_C = 10$ A; $I_B = 1$ A	–	–	2.5	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	40	60	pF
f_T	transition frequency	$I_C = 0.5$ A; $V_{CE} = 5$ V; f = 100 MHz	–	100	–	MHz
Switching times (between 10% and 90% levels)						
t_{on}	turn-on time	$I_{Con} = 1$ A; $I_{Bon} = 0.1$ A; $I_{Boff} = -0.1$ A	–	60	100	ns
		$I_{Con} = 2$ A; $I_{Bon} = 0.2$ A; $I_{Boff} = -0.2$ A	–	–	80	ns
		$I_{Con} = 5$ A; $I_{Bon} = 0.5$ A; $I_{Boff} = -0.5$ A	–	180	300	ns
t_{off}	turn-off time	$I_{Con} = 1$ A; $I_{Bon} = 0.1$ A; $I_{Boff} = -0.1$ A	–	600	800	ns
		$I_{Con} = 2$ A; $I_{Bon} = 0.2$ A; $I_{Boff} = -0.2$ A	–	450	700	ns
		$I_{Con} = 5$ A; $I_{Bon} = 0.5$ A; $I_{Boff} = -0.5$ A	–	350	500	ns



$V_{CE} = 1$ V.

Fig.2 DC current gain; typical values.

NPN Darlington transistors | BDX42; BDX43; BDX44

FEATURES

- High current (max. 1 A)
- Low voltage (max. 80 V)
- Integrated diode and resistor.

APPLICATIONS

- Industrial switching applications such as:
  - print hammers
  - solenoids
  - relay and lamp drivers.

DESCRIPTION

NPN Darlington transistor in a TO-126; SOT32 plastic package. PNP complements: BDX45 and BDX47.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector, connected to metal part of mounting surface
3	base

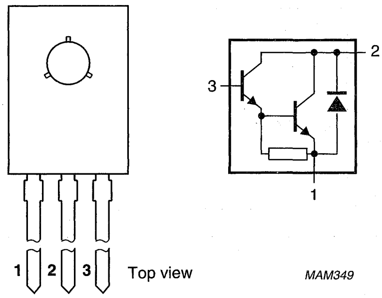


Fig.1 Simplified outline (TO-126; SOT32) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BDX42		–	–	60	V
	BDX43		–	–	80	V
	BDX44		–	–	90	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$				
	BDX42		–	–	45	V
	BDX43		–	–	60	V
	BDX44		–	–	80	V
I_C	collector current (DC)		–	–	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	1.25	W
		$T_{mb} \leq 100$ °C	–	–	5	W
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 10$ V	1000	–	–	
		$I_C = 500$ mA; $V_{CE} = 10$ V	2000	–	–	
f_T	transition frequency	$I_C = 500$ mA; $V_{CE} = 5$ V; f = 100 MHz	–	200	–	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			
	BDX42		–	60	V
	BDX43		–	80	V
	BDX44		–	90	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BDX42		–	45	V
	BDX43		–	60	V
	BDX44		–	80	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	1	A
I_{CM}	peak collector current		–	2	A
I_B	base current (DC)		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.25	W
		$T_{mb} \leq 100$ °C	–	5	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

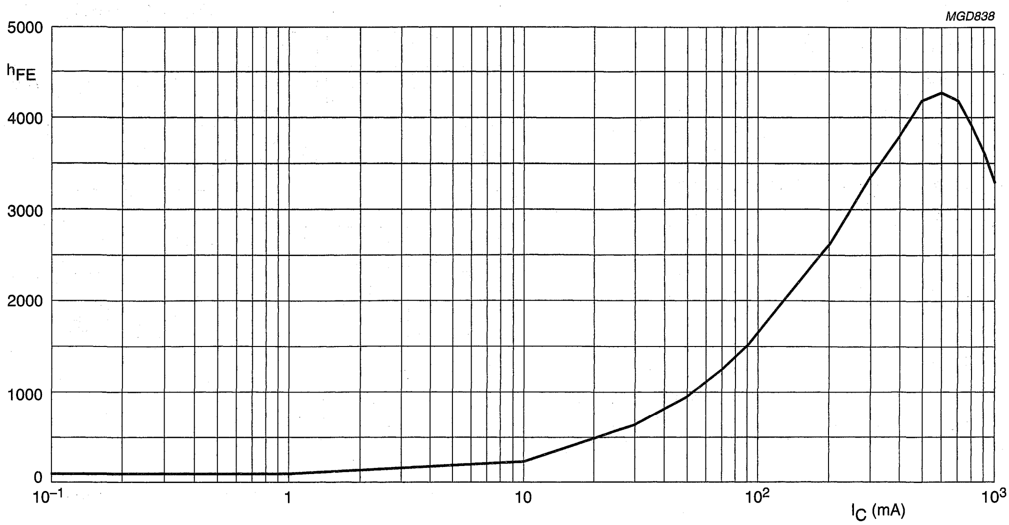
THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air	100	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base		10	K/W

CHARACTERISTICS

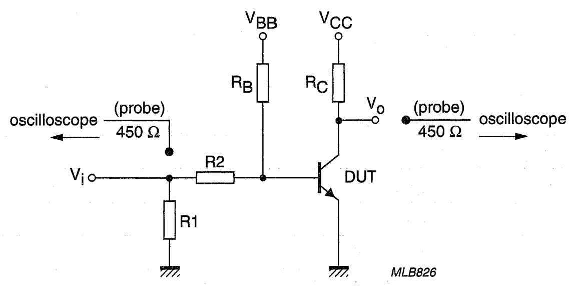
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current					
	BDX42	$I_E = 0$; $V_{CB} = 60$ V	–	–	100	nA
	BDX43	$I_E = 0$; $V_{CB} = 80$ V	–	–	100	nA
	BDX44	$I_E = 0$; $V_{CB} = 100$ V	–	–	100	nA
I_{CES}	collector cut-off current					
	BDX42	$V_{BE} = 0$; $V_{CE} = 45$ V	–	–	50	nA
	BDX43	$V_{BE} = 0$; $V_{CE} = 60$ V	–	–	50	nA
	BDX44	$V_{BE} = 0$; $V_{CE} = 80$ V	–	–	50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	–	50	nA
h_{FE}	DC current gain	$V_{CE} = 10$ V; see Fig. 2				
		$I_C = 150$ mA	1000	–	–	
		$I_C = 500$ mA	2000	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 500$ mA; $I_B = 0.5$ mA	–	–	1.3	V
		$I_C = 500$ mA; $I_B = 0.5$ mA; $T_j = 150$ °C	–	–	1.3	V
V_{CEsat}	collector-emitter saturation voltage					
	BDX42; BDX44	$I_C = 1$ A; $I_B = 4$ mA	–	–	1.6	V
		$I_C = 1$ A; $I_B = 4$ mA; $T_j = 150$ °C	–	–	1.6	V
V_{CEsat}	collector-emitter saturation voltage					
	BDX43	$I_C = 1$ A; $I_B = 1$ mA	–	–	1.6	V
		$I_C = 1$ A; $I_B = 1$ mA; $T_j = 150$ °C	–	–	1.8	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 500$ mA; $I_B = 0.5$ mA	–	–	1.9	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 1$ A; $I_B = 4$ mA				
	BDX42; BDX44		–	–	2.2	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 1$ A; $I_B = 1$ mA				
	BDX43		–	–	2.2	V
f_T	transition frequency	$I_C = 500$ mA; $V_{CE} = 5$ V; f = 100 MHz	–	200	–	MHz
Switching times (between 10% and 90% levels); see Fig.3						
t_{on}	turn-on time	$I_{Con} = 500$ mA; $I_{Bon} = 0.5$ mA; $I_{Boff} = -0.5$ mA	–	–	500	ns
t_d	delay time		–	–	200	ns
t_r	rise time		–	–	300	ns
t_{off}	turn-off time		–	–	1300	ns
t_s	storage time		–	–	950	ns
t_f	fall time		–	–	350	ns



V_{CE} = 10 V.

Fig.2 DC current gain; typical values.



V_i = 10 V; T = 200 μs; t_p = 6 μs; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 10 kΩ; R_B = 10 kΩ; R_C = 18 Ω.
V_{BB} = −1.8 V; V_{CC} = 10.7 V.
Oscilloscope input impedance Z_i = 50 Ω.

Fig.3 Test circuit for switching times.

PNP Darlington transistors — BDX45; BDX47

FEATURES

- High current (max. 1 A)
- Low voltage (max. 80 V)
- Integrated diode and resistor.

APPLICATIONS

- Industrial switching applications such as:
  - print hammers
  - solenoids
  - relay and lamp drivers.

DESCRIPTION

PNP Darlington transistor in a TO-126; SOT32 plastic package. NPN complements: BDX42 and BDX44.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector, connected to metal part of mounting surface
3	base

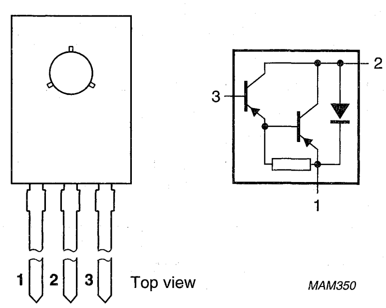


Fig.1 Simplified outline (TO-126; SOT32) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BDX45		–	–	–60	V
	BDX47		–	–	–90	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$				
	BDX45		–	–	–45	V
	BDX47		–	–	–80	V
I_C	collector current (DC)		–	–	–1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	1.25	W
		$T_{mb} \leq 100$ °C	–	–	5	W
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -10$ V	1000	–	–	
		$I_C = -500$ mA; $V_{CE} = -10$ V	2000	–	–	
f_T	transition frequency	$I_C = -500$ mA; $V_{CE} = -5$ V; f = 100 MHz	–	200	–	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			
	BDX45		–	–60	V
	BDX47		–	–90	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BDX45		–	–45	V
	BDX47		–	–80	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–1	A
I_{CM}	peak collector current		–	–2	A
I_B	base current (DC)		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.25	W
		$T_{mb} \leq 100$ °C	–	5	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

THERMAL CHARACTERISTICS

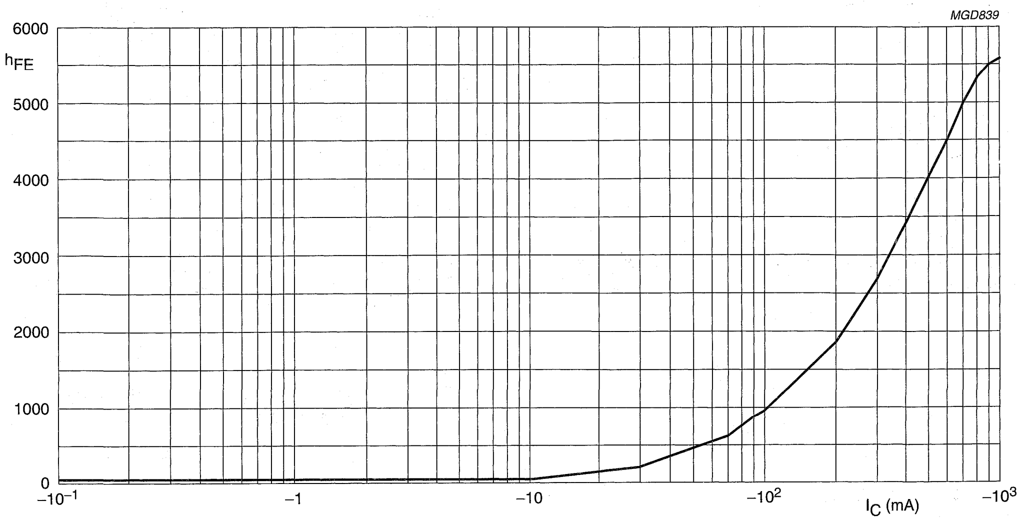
SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air	100	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base		10	K/W

PNP Darlington transistors BDX45; BDX47

CHARACTERISTICS

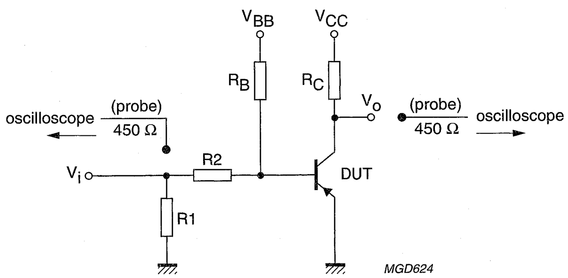
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current					
	BDX45	$I_E = 0$; $V_{CB} = -60$ V	–	–	–100	nA
	BDX47	$I_E = 0$; $V_{CB} = -90$ V	–	–	–100	nA
I_{CES}	collector cut-off current					
	BDX45	$V_{BE} = 0$; $V_{CE} = -45$ V	–	–	–50	nA
	BDX47	$V_{BE} = 0$; $V_{CE} = -80$ V	–	–	–50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -4$ V	–	–	–50	nA
h_{FE}	DC current gain	$V_{CE} = -10$ V; see Fig. 2				
		$I_C = -150$ mA	1000	–	–	
		$I_C = -500$ mA	2000	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -500$ mA; $I_B = -0.5$ mA	–	–	–1.3	V
		$I_C = -500$ mA; $I_B = -0.5$ mA; $T_j = 150$ °C	–	–	–1.3	V
		$I_C = -1$ A; $I_B = -4$ mA	–	–	–1.6	V
		$I_C = -1$ A; $I_B = -4$ mA; $T_j = 150$ °C	–	–	–1.6	V
V_{BEsat}	base-emitter saturation voltage	$I_C = -500$ mA; $I_B = -0.5$ mA	–	–	–1.9	V
		$I_C = -1$ A; $I_B = -4$ mA	–	–	–2.2	V
f_T	transition frequency	$I_C = -500$ mA; $V_{CE} = -5$ V; f = 100 MHz	–	200	–	MHz
Switching times (between 10% and 90% levels); see Fig.3						
t_{on}	turn-on time	$I_{Con} = -500$ mA; $I_{Bon} = -0.5$ mA; $I_{Boff} = 0.5$ mA	–	–	500	ns
t_d	delay time		–	–	200	ns
t_r	rise time		–	–	300	ns
t_{off}	turn-off time		–	–	700	ns
t_s	storage time		–	–	550	ns
t_f	fall time		–	–	150	ns



$V_{CE} = -10$ V.

Fig.2 DC current gain; typical values.



$V_i = -10$ V; T = 200 μs; $t_p = 6$ μs; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 10 kΩ; $R_B = 10$ kΩ; $R_C = 18$ Ω.
$V_{BB} = 1.8$ V; $V_{CC} = -10.7$ V.
Oscilloscope input impedance $Z_i = 50$ Ω.

Fig.3 Test circuit for switching times.

NPN medium frequency transistor | BF199

FEATURES

- Low current (max. 25 mA)
- Low voltage (max. 25 V).

APPLICATIONS

- Output stage of a vision IF amplifier.

DESCRIPTION

NPN medium frequency transistor in a TO-92; SOT54 plastic package.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

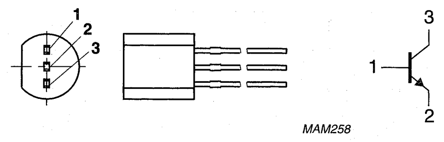


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	40	V
V_{CEO}	collector-emitter voltage	open base	–	–	25	V
I_{CM}	peak collector current		–	–	25	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	500	mW
h_{FE}	DC current gain	$I_C = 7$ mA; $V_{CE} = 10$ V	38	–	–	
f_T	transition frequency	$I_C = 5$ mA; $V_{CE} = 10$ V; f = 100 MHz	–	550	–	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	–	25	V
V_{EBO}	emitter-base voltage	open collector	–	4	V
I_C	collector current (DC)		–	25	mA
I_{CM}	peak collector current		–	25	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		−65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 40$ V	–	–	100	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 7$ mA; $V_{CE} = 10$ V	38	–	–	
V_{BE}	base-emitter voltage	$I_C = 7$ mA; $V_{CE} = 10$ V	–	775	925	mV
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	0.5	pF
f_T	transition frequency	$I_C = 5$ mA; $V_{CE} = 10$ V; f = 100 MHz	–	550	–	MHz

NPN medium frequency transistor BF240

FEATURES

- Low current (max. 25 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- AM mixers
- IF amplifiers in AM/FM receivers.

DESCRIPTION

NPN medium frequency transistor in a TO-92; SOT54 plastic package.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

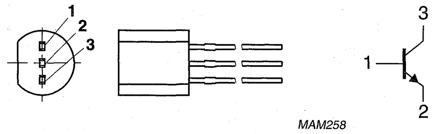


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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_{CM}	peak collector current		–	25	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	300	mW
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 10$ V	67	220	
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 10$ 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	–	4	V
I_C	collector current (DC)		–	25	mA
I_{CM}	peak collector current		–	25	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	300	mW
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		−65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	420	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	–	100	nA
		$I_E = 0$; $V_{CB} = 20$ V; $T_{amb} = 150$ °C	–	–	4	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 10$ V		–		
	BF240		67	–	220	
	BF240B		100	–	220	
V_{BE}	base-emitter voltage	$I_C = 1$ mA; $V_{CE} = 10$ V	650	700	740	mV
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	0.5	pF
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 10$ V; f = 100 MHz	150	–	–	MHz

PNP medium frequency transistor BF324

FEATURES

- Low current (max. 25 mA)
- Low voltage (max. 30 V).

APPLICATIONS

- RF stages in FM front-ends in common base configuration.

DESCRIPTION

PNP medium frequency transistor in a TO-92; SOT54 plastic package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

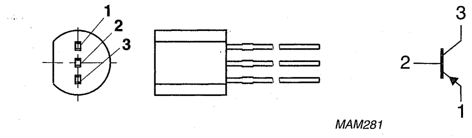


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	–30	V
V_{CEO}	collector-emitter voltage	open base	–	–	–30	V
I_{CM}	peak collector current		–	–	–25	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	300	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	–	450	–	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
I_{CM}	peak collector current		–	–25	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	300	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	420	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -30$ V	–	–	–50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -4$ V	–	–	–100	nA
h_{FE}	DC current gain	$V_{CE} = -10$ V				
		$I_C = -1$ mA	–	45	–	
		$I_C = -4$ mA	25	–	–	
V_{BE}	base-emitter voltage	$I_C = -4$ mA; $V_{CE} = -10$ V	–	760	–	mV
C_{rb}	feedback capacitance	$I_C = 0$; $V_{CE} = -10$ V; f = 1 MHz	–	–	0.3	pF
f_T	transition frequency	$V_{CE} = -10$ V; f = 100 MHz				
		$I_C = -1$ mA	–	350	–	MHz
		$I_C = -4$ mA	400	450	–	MHz
		$I_C = -8$ mA	–	440	–	MHz

NPN medium frequency transistors BF370; BF370R

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 15 V).

APPLICATIONS

- IF pre-amplifiers of television receivers.

DESCRIPTION

NPN medium frequency transistor in a TO-92; SOT54 plastic package.

PINNING

PIN	DESCRIPTION	PIN	DESCRIPTION
BF370		**BF370R**	
1	emitter	1	base
2	base	2	emitter
3	collector	3	collector

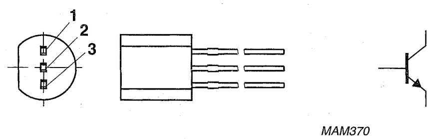


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 1$ V	40	–	
f_T	transition frequency	$I_C = 40$ mA; $V_{CE} = 10$ V; f = 100 MHz	490	–	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	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	4.5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	–	400	nA
		$I_E = 0$; $V_{CB} = 20$ V; $T_j = 125$ °C	–	–	30	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 2$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 1$ V	40	–	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	2.2	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 1$ V; f = 1 MHz	–	–	4.5	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	1.6	–	pF
f_T	transition frequency	$V_{CE} = 10$ V; f = 100 MHz				
		$I_C = 10$ mA	500	–	–	MHz
		$I_C = 40$ mA	490	–	–	MHz

NPN high-voltage transistor BF419

FEATURES

- Low current (max. 100 mA)
- High voltage (max. 250 V).

APPLICATIONS

- Driver for line output transistors in colour television receivers.

DESCRIPTION

NPN high-voltage transistor in a TO-126; SOT32 plastic package.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector connected to mounting base
3	base

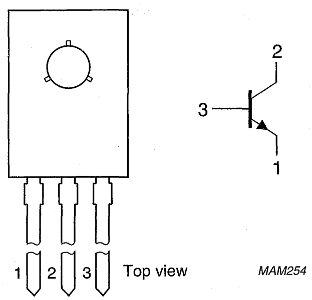


Fig.1 Simplified outline (TO-126; SOT32) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	300	V
V_{CEO}	collector-emitter voltage	open base	–	250	V
I_{CM}	peak collector current		–	300	mA
P_{tot}	total power dissipation	$T_{mb} \leq 90$ °C	–	6	W
h_{FE}	DC current gain	I_C = 20 mA; V_{CE} = 10 V	45	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; V_{CE} = 30 V; f = 1 MHz	–	3.5	pF
f_T	transition frequency	I_C = 15 mA; V_{CE} = 10 V; f = 100 MHz	90	–	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	–	300	V
V_{CEO}	collector-emitter voltage	open base	–	250	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current	note 1	–	300	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{mb} \leq 90$ °C	–	6	W
		$T_{amb} \leq 70$ °C	–	800	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. 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 minimize the area of the switching path.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	100	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	10	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 250$ V	–	50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 3$ V	–	50	nA
h_{FE}	DC current gain	$I_C = 20$ mA; $V_{CE} = 10$ V	45	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 200$ mA; $I_B = 20$ mA; note 1	–	6	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 30$ V; f = 1 MHz	–	4.5	pF
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 30$ V; f = 1 MHz	–	3.5	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 100 MHz	90	–	MHz

Note

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

NPN high-voltage transistors | BF420; BF422

FEATURES

- Low feedback capacitance.

APPLICATIONS

- Class-B video output stages in colour television and professional monitor equipment.

DESCRIPTION

NPN transistors in a TO-92 plastic package.
PNP complements: BF421 and BF423.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

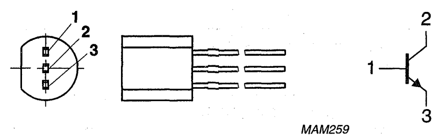


Fig.1 Simplified outline (TO-92) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BF420		–	300	V
	BF422		–	250	V
V_{CEO}	collector-emitter voltage	open base			
	BF420		–	300	V
	BF422		–	250	V
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	830	mW
h_{FE}	DC current gain	$I_C = 25$ mA; $V_{CE} = 20$ V	50	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 30$ V; f = 1 MHz	–	1.6	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	60	–	MHz

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			
	BF420		–	300	V
	BF422		–	250	V
V_{CEO}	collector-emitter voltage	open base			
	BF420		–	300	V
	BF422		–	250	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	50	mA
I_{CM}	peak collector current		–	100	mA
I_{BM}	peak base current		–	50	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	830	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on a printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	150	K/W

Note

1. Transistor mounted on a printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
		$I_E = 0$; $V_{CB} = 200$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 200$ V; $T_j = 150$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	50	nA
h_{FE}	DC current gain	$I_C = 25$ mA; $V_{CE} = 20$ V	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 30$ mA; $I_B = 5$ mA	–	0.6	V
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

NPN high-voltage transistors | BF420L; BF422L

FEATURES

- Low current (max. 50 mA)
- High voltage (max. 300 V).

APPLICATIONS

- Telephony.

DESCRIPTION

NPN high-voltage transistor in a TO-92; SOT54 plastic package. PNP complements: BF421L and BF423L.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

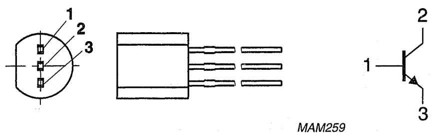


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BF420L		–	300	V
	BF422L		–	250	V
V_{CEO}	collector-emitter voltage	open base			
	BF420L		–	300	V
	BF422L		–	250	V
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	625	mW
h_{FE}	DC current gain	$I_C = 25$ mA; $V_{CE} = 20$ V	50	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 30$ V; f = 1 MHz	–	1.6	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	60	–	MHz

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			
	BF420L		–	300	V
	BF422L		–	250	V
V_{CEO}	collector-emitter voltage	open base			
	BF420L		–	300	V
	BF422L		–	250	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	50	mA
I_{CM}	peak collector current		–	100	mA
I_{BM}	peak base current		–	50	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	625	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	200	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 200$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 200$ V; $T_{amb} = 150$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	50	nA
h_{FE}	DC current gain	$I_C = 25$ mA; $V_{CE} = 20$ V	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 30$ mA; $I_B = 5$ mA; note 1	–	600	mV
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 30$ V; f = 1 MHz	–	1.6	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	60	–	MHz

Note

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

PNP high-voltage transistors BF421; BF423

FEATURES

- Low feedback capacitance.

APPLICATIONS

- Class-B video output stages in colour television and professional monitor equipment.

DESCRIPTION

PNP transistors in a TO-92 plastic package.
NPN complements: BF420 and BF422.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

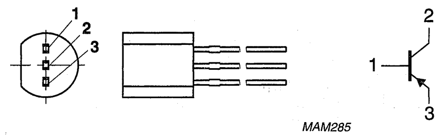


Fig.1 Simplified outline (TO-92) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BF421		–	–300	V
	BF423		–	–250	V
V_{CEO}	collector-emitter voltage	open base			
	BF421		–	–300	V
	BF423		–	–250	V
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	830	mW
h_{FE}	DC current gain	$I_C = -25$ mA; $V_{CE} = -20$ V	50	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = -30$ V; f = 1 MHz	–	1.6	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 100 MHz	60	–	MHz

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			
	BF421		–	–300	V
	BF423		–	–250	V
V_{CEO}	collector-emitter voltage	open base			
	BF421		–	–300	V
	BF423		–	–250	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–50	mA
I_{CM}	peak collector current		–	–100	mA
I_{BM}	peak base current		–	–50	mA
P_{tot}	total power dissipation	$T_{amb} \le 25$ °C; note 1	–	830	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on a printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	150	K/W

Note

1. Transistor mounted on a printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -200$ V	–	–10	nA
		$I_E = 0$; $V_{CB} = -200$ V; $T_j = 150$ °C	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–50	nA
h_{FE}	DC current gain	$I_C = -25$ mA; $V_{CE} = -20$ V	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -30$ mA; $I_B = -5$ mA	–	–0.6	V
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

PNP high-voltage transistors — BF421L; BF423L

FEATURES

- Low current (max. 50 mA)
- High voltage (max. 300 V)
- Available with a higher power rating (830 mW) under type numbers: BF421 and BF423.

APPLICATIONS

- Primarily intended for telephony applications.

DESCRIPTION

PNP transistor in a TO-92; SOT54 plastic package.
NPN complements: BF420L and BF422L.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

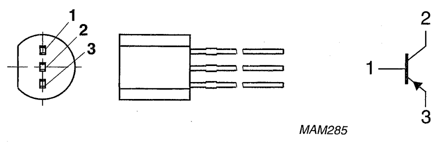


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BF421L		–	–300	V
	BF423L		–	–250	V
V_{CEO}	collector-emitter voltage	open base			
	BF421L		–	–300	V
	BF423L		–	–250	V
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	625	mW
h_{FE}	DC current gain	$I_C = -25$ mA; $V_{CE} = -20$ V	50	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = -30$ V; f = 1 MHz	–	1.6	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 100 MHz	60	–	MHz

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			
	BF421L		–	–300	V
	BF423L		–	–250	V
V_{CEO}	collector-emitter voltage	open base			
	BF421L		–	–300	V
	BF423L		–	–250	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–50	mA
I_{CM}	peak collector current		–	–100	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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 CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	200	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -200$ V	–	–10	nA
		$I_E = 0$; $V_{CB} = -200$ V; $T_j = 150$ °C	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–10	μA
h_{FE}	DC current gain	$I_C = -25$ mA; $V_{CE} = -20$ V	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -30$ mA; $I_B = -5$ 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

Note

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

PNP medium frequency transistor BF450

FEATURES

- Low current (max. 25 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- HF and IF stages in radio receivers
- Mixer stages in AM receivers.

DESCRIPTION

PNP medium frequency transistor in a TO-92; SOT54 plastic package.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

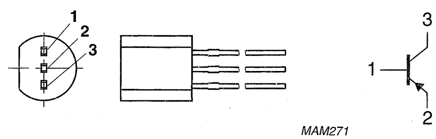


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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_{CM}	peak collector current		–	–25	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	300	mW
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -10$ V	50	–	
f_T	transition frequency	$I_C = -1$ mA; $V_{CE} = -10$ V; f = 100 MHz	350	–	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	–	–4	V
I_C	collector current (DC)		–	–25	mA
I_{CM}	peak collector current		–	–25	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	300	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	420	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -30$ V	–	–50	nA
		$I_E = 0$; $V_{CB} = -30$ V; $T_{amb} = 150$ °C	–	–4	µA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -3$ V	–	–100	nA
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -10$ V	50	–	
V_{BE}	base-emitter voltage	$I_C = -1$ mA; $V_{CE} = -10$ V	–680	–780	mV
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	0.55	pF
f_T	transition frequency	$I_C = -1$ mA; $V_{CE} = -10$ V; f = 100 MHz	350	–	MHz

NPN high-voltage transistors — BF457; BF458; BF459

DESCRIPTION

NPN transistors in a TO-126; SOT32 plastic package.

APPLICATIONS

- Intended for video output stages in black-and-white and in colour television receivers.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector, connected to mounting base
3	base

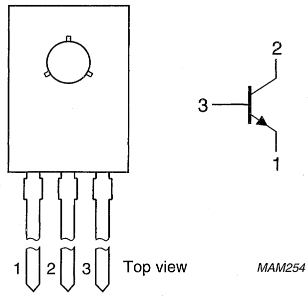


Fig.1 Simplified outline (TO-126; SOT32) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BF457		–	–	160	V
	BF458		–	–	250	V
	BF459		–	–	300	V
V_{CEO}	collector-emitter voltage	open base				
	BF457		–	–	160	V
	BF458		–	–	250	V
	BF459		–	–	300	V
I_{CM}	peak collector current		–	–	300	mA
P_{tot}	total power dissipation	$T_{mb} \leq 90$ °C	–	–	6	W
h_{FE}	DC current gain	$I_C = 30$ mA; $V_{CE} = 10$ V	26	–	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 30$ V; f = 1 MHz	–	–	3.5	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 100 MHz	–	90	–	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			
	BF457		–	160	V
	BF458		–	250	V
	BF459		–	300	V
V_{CEO}	collector-emitter voltage	open base			
	BF457		–	160	V
	BF458		–	250	V
	BF459		–	300	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	300	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{mb} \leq 90$ °C	–	6	W
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		104	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base		10	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current					
	BF457	$I_E = 0$; $V_{CB} = 100$ V	–	–	50	nA
		$I_E = 0$; $V_{CB} = 100$ V; $T_j = 150$ °C	–	–	5	μA
I_{CBO}	collector cut-off current					
	BF458	$I_E = 0$; $V_{CB} = 200$ V	–	–	50	nA
		$I_E = 0$; $V_{CB} = 200$ V; $T_j = 150$ °C	–	–	5	μA
I_{CBO}	collector cut-off current					
	BF459	$I_E = 0$; $V_{CB} = 250$ V	–	–	50	nA
		$I_E = 0$; $V_{CB} = 250$ V; $T_j = 150$ °C	–	–	5	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 30$ mA; $V_{CE} = 10$ V	26	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 30$ mA; $I_B = 6$ mA	–	–	1	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 30$ V; f = 1 MHz	–	–	4.5	pF
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 30$ V; f = 1 MHz	–	–	3.5	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 100 MHz	–	90	–	MHz

NPN high-voltage transistors BF469; BF471

FEATURES

- Low feedback capacitance.

APPLICATIONS

- Intended for class-B video output stages in television receivers and for high-voltage IF output stages.

DESCRIPTION

NPN transistors in a TO-126; SOT32 plastic package.
PNP complements: BF470 and BF472.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector, connected to mounting base
3	base

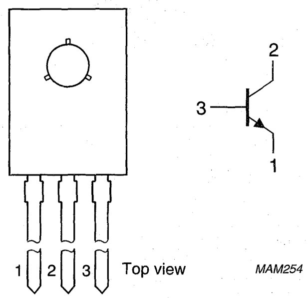


Fig.1 Simplified outline (TO-126; SOT32) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BF469		–	250	V
	BF471		–	300	V
V_{CEO}	collector-emitter voltage	open base			
	BF469		–	250	V
	BF471		–	300	V
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{mb} \leq 114$ °C	–	1.8	W
h_{FE}	DC current gain	$I_C = 25$ mA; $V_{CE} = 20$ V	50	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 30$ V; f = 1 MHz	–	1.8	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			
	BF469		–	250	V
	BF471		–	300	V
V_{CEO}	collector-emitter voltage	open base			
	BF469		–	250	V
	BF471		–	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
I_{BM}	peak base current		–	50	mA
P_{tot}	total power dissipation	$T_{mb} \leq 114$ °C	–	1.8	W
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	100	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base		20	K/W

Note

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 200$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 200$ V; $T_j = 150$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	50	nA
h_{FE}	DC current gain	$I_C = 25$ mA; $V_{CE} = 20$ V	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 30$ mA; $I_B = 5$ mA	–	0.6	V
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 30$ V; f = 1 MHz	–	1.8	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	60	–	MHz

PNP high-voltage transistors BF470; BF472

FEATURES

- Low feedback capacitance.

APPLICATIONS

- Class-B video output stages in television receivers and for high-voltage IF output stages.

DESCRIPTION

PNP transistors in a TO-126; SOT32 plastic package.
NPN complements: BF469 and BF471.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector, connected to mounting base
3	base

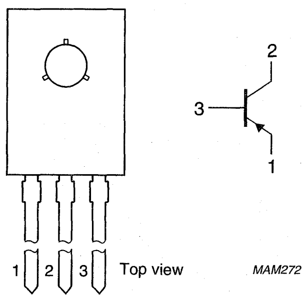


Fig.1 Simplified outline (TO-126; SOT32) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BF470		–	–250	V
	BF472		–	–300	V
V_{CEO}	collector-emitter voltage	open base			
	BF470		–	–250	V
	BF472		–	–300	V
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{mb} \leq 114$ °C	–	1.8	W
h_{FE}	DC current gain	$I_C = -25$ mA; $V_{CE} = -20$ V	50	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = -30$ V; f = 1 MHz	–	1.8	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			
	BF470		–	–250	V
	BF472		–	–300	V
V_{CEO}	collector-emitter voltage	open base			
	BF470		–	–250	V
	BF472		–	–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
I_{BM}	peak base current		–	–50	mA
P_{tot}	total power dissipation	$T_{mb} \leq 114$ °C	–	1.8	W
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	100	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base		20	K/W

Note

1. Transistor mounted on a printed-circuit board, maximum lead length 4 mm; mounting pad for collector lead minimum 10 × 10 mm.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -200$ V	–	–10	nA
		$I_E = 0$; $V_{CB} = -200$ V; $T_j = 150$ °C	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–50	nA
h_{FE}	DC current gain	$I_C = -25$ mA; $V_{CE} = -20$ V	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -30$ mA; $I_B = -5$ mA	–	–600	mV
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = -30$ V; f = 1 MHz	–	1.8	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 100 MHz	60	–	MHz

FEATURES

- Low feedback capacitance.

APPLICATIONS

- Intended for use in video output stages in black-and-white and in colour television receivers.

DESCRIPTION

NPN transistors in a TO-92 plastic package.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

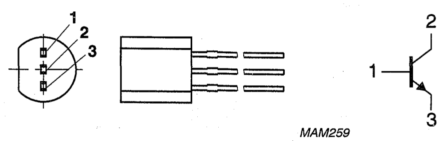


Fig.1 Simplified outline (TO-92) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BF483		–	300	V
	BF485		–	350	V
	BF487		–	400	V
V_{CEO}	collector-emitter voltage	open base			
	BF483		–	250	V
	BF485		–	300	V
	BF487		–	350	V
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	830	mW
h_{FE}	DC current gain	$I_C = 25$ mA; $V_{CE} = 20$ V	50	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 30$ V; f = 1 MHz	–	1.4	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = 10$ V; f = 100 MHz	70	110	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			
	BF483		–	300	V
	BF485		–	350	V
	BF487		–	400	V
V_{CEO}	collector-emitter voltage	open base			
	BF483		–	250	V
	BF485		–	300	V
	BF487		–	350	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	50	mA
I_{CM}	peak collector current		–	100	mA
I_{BM}	peak base current		–	50	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	830	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on a printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	150	K/W

Note

1. Transistor mounted on a printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 300$ V	–	20	nA
		$I_E = 0$; $V_{CB} = 250$ V; $T_j = 150$ °C	–	20	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	100	nA
h_{FE}	DC current gain	$I_C = 25$ mA; $V_{CE} = 20$ V	50	–	
		$I_C = 40$ mA; $V_{CE} = 20$ V	20	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 30$ mA; $I_B = 5$ mA	–	600	mV
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 30$ V; f = 1 MHz	–	1.4	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = 10$ V; f = 100 MHz	70	110	MHz

PNP high-voltage transistors BF486; BF488

FEATURES

- Low feedback capacitance.

APPLICATIONS

- Intended for use in video output stages of black and white and colour television receivers.

DESCRIPTION

PNP transistors in a TO-92 plastic package.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

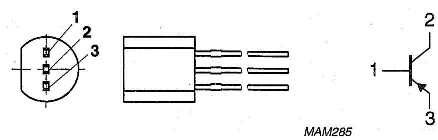


Fig.1 Simplified outline (TO-92) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BF486		–	–300	V
	BF488		–	–350	V
V_{CEO}	collector-emitter voltage	open base			
	BF486		–	–300	V
	BF488		–	–350	V
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	830	mW
h_{FE}	DC current gain	$I_C = -25$ mA; $V_{CE} = -20$ V	50	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = -30$ V; f = 1 MHz	–	2.5	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 100 MHz;	70	110	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			
	BF486		–	–300	V
	BF488		–	–350	V
V_{CEO}	collector-emitter voltage	open base			
	BF486		–	–300	V
	BF488		–	–350	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–50	mA
I_{CM}	peak collector current		–	–100	mA
I_{BM}	peak base current		–	–50	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	830	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on a printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	150	K/W

Note

1. Transistor mounted on a printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise stated.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	BF486	$I_E = 0$; $V_{CB} = -250$ V	–	–20	nA
		$I_E = 0$; $V_{CB} = -200$ V; $T_j = 150$ °C	–	–20	μA
I_{CBO}	collector cut-off current				
	BF488	$I_E = 0$; $V_{CB} = -300$ V	–	–20	nA
		$I_E = 0$; $V_{CB} = -200$ V; $T_j = 150$ °C	–	–20	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–100	nA
h_{FE}	DC current gain	$I_C = -25$ mA; $V_{CE} = -20$ V	50	–	
		$I_C = -40$ mA; $V_{CE} = -20$ V	20	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -20$ mA; $I_B = -2$ mA	–	–0.5	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -20$ V; f = 1 MHz	–	4	pF
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = -30$ V; f = 1 MHz	–	2.5	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 100 MHz	70	110	MHz

NPN medium frequency transistors BF494; BF495

FEATURES

- Low current (max. 30 mA)
- Low voltage (max. 20 V).

APPLICATIONS

- HF applications in radio and television receivers
- FM tuners
- Low noise AM mixer-oscillators
- IF amplifiers in AM/FM receivers.

DESCRIPTION

NPN medium frequency transistor in a TO-92; SOT54 plastic package.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

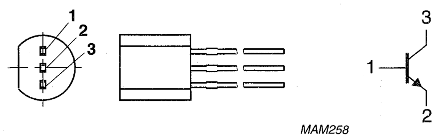


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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	–	20	V
I_{CM}	peak collector current		–	30	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	300	mW
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 10$ V			
	BF494		67	220	
	BF495		35	125	
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 10$ V; f = 100 MHz	120	–	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	–	20	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	30	mA
I_{CM}	peak collector current		–	30	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	300	mW
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		−65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	420	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	100	nA
		$I_E = 0$; $V_{CB} = 20$ V; $T_{amb} = 150$ °C	–	4	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	100	nA
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 10$ V			
	BF494		67	220	
	BF494B		100	220	
	BF495		35	125	
	BF495B		100	125	
V_{BE}	base-emitter voltage	$I_C = 1$ mA; $V_{CE} = 10$ V	650	740	mV
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	1	pF
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 10$ V; f = 100 MHz	120	–	MHz

PNP medium frequency transistor BF550

FEATURES

- Low current (max. 25 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- Medium frequency applications in thick and thin film circuits.

DESCRIPTION

PNP medium frequency transistor in a SOT23 plastic package.

MARKING

TYPE NUMBER	MARKING CODE
BF550	LAp

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

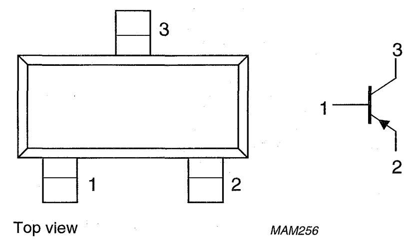


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	–40	V
V_{CEO}	collector-emitter voltage	open base	–	–	–40	V
I_{CM}	peak collector current		–	–	–25	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -10$ V	50	–	–	
f_T	transition frequency	$I_C = -1$ mA; $V_{CE} = -10$ V; f = 100 MHz	–	325	–	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	–	–4	V
I_C	collector current (DC)		–	–25	mA
I_{CM}	peak collector current		–	–25	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j-a}$	thermal resistance from junction to ambient	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -30$ V	–	–	–50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -3$ V	–	–	–100	nA
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -10$ V	50	–	–	
V_{BE}	base-emitter voltage	$I_C = -1$ mA; $V_{CE} = -10$ V	–	750	–	mV
C_{re}	feedback capacitance	$I_C = -1$ mA; $V_{CB} = -10$ V; f = 1 MHz	–	0.5	–	pF
f_T	transition frequency	$I_C = -1$ mA; $V_{CE} = -10$ V; f = 100 MHz	–	325	–	MHz

NPN medium frequency transistor | BF570

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 15 V)
- Low feedback capacitance (max. 2.2 pF).

APPLICATIONS

- Monitors
- Battery equipped applications.

DESCRIPTION

NPN transistor in a SOT23 plastic package.

MARKING

TYPE NUMBER	MARKING CODE
BF570	B26

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

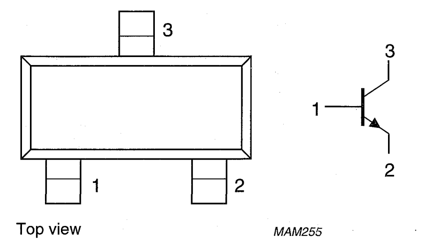


Fig.1 Simplified outline (SOT23) and symbol.

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
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 1$ V	40	–	
f_T	transition frequency	$I_C = 40$ mA; $V_{CE} = 10$ V; f = 100 MHz	490	–	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	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	4.5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	500	K/W

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	–	400	nA
		$I_E = 0$; $V_{CB} = 20$ V; $T_j = 125$ °C	–	–	30	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 2$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 1$ V	40	–	–	
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = 10$ V; f = 1 MHz	–	1.6	2.2	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	500	–	–	MHz
		$I_C = 40$ mA; $V_{CE} = 10$ V; f = 100 MHz	490	–	–	MHz

NPN high-voltage transistors BF583; BF585; BF587

FEATURES

- Low feedback capacitance.

APPLICATIONS

- For use in video output stages of black and white and colour television receivers.

DESCRIPTION

NPN transistors in a TO-202 plastic package.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

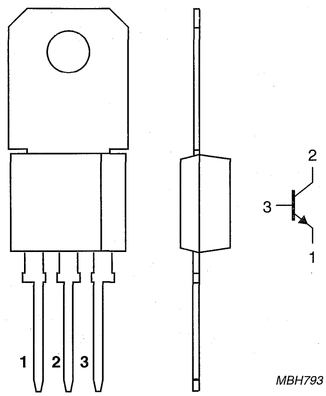


Fig.1 Simplified outline (TO-202) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BF583		–	300	V
	BF585		–	350	V
	BF587		–	400	V
V_{CEO}	collector-emitter voltage	open base			
	BF583		–	250	V
	BF585		–	300	V
	BF587		–	350	V
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	in free air; $T_{amb} \leq 25$ °C	–	1.6	W
h_{FE}	DC current gain	$I_C = 25$ mA; $V_{CE} = 20$ V	–	50	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 30$ V; f = 1 MHz	–	1.8	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V	70	110	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			
	BF583		–	300	V
	BF585		–	350	V
	BF587		–	400	V
V_{CEO}	collector-emitter voltage	open base			
	BF583		–	250	V
	BF585		–	300	V
	BF587		–	350	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		50	–	mA
I_{CM}	peak collector current		–	100	mA
I_{BM}	peak base current		–	50	mA
P_{tot}	total power dissipation	in free air; $T_{amb} \leq 25$ °C	–	1.6	W
		in free air; $T_{mb} \leq 25$ °C	–	5	W
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	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	78	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	25	K/W

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 300$ V	–	20	nA
		$I_E = 0$; $V_{CB} = 250$ V; $T_j = 150$ °C	–	20	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	100	nA
h_{FE}	DC current gain	$I_C = 25$ mA; $V_{CE} = 20$ V	50	–	
		$I_C = 40$ mA; $V_{CE} = 20$ V	20	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 30$ mA; $I_B = 5$ mA	–	600	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 30$ V; f = 1 MHz	–	2.5	pF
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 30$ V; f = 1 MHz	–	1.8	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V	70	110	MHz

PNP high-voltage transistor BF588

FEATURES

- Low feedback capacitance.

APPLICATIONS

- For use in video output stages of black and white and colour television receivers.

DESCRIPTION

PNP transistor in a TO-202 plastic package.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

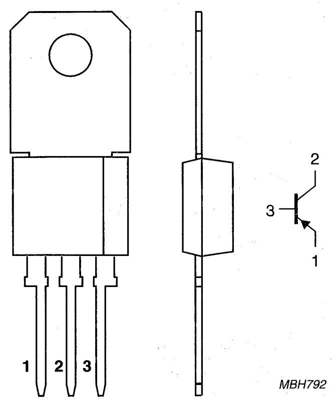


Fig.1 Simplified outline (TO-202) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–350	V
V_{CEO}	collector-emitter voltage	open base	–	–350	V
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	free air	–	1.6	W
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} = –30 V; f = 1 MHz	–	2.2	pF
f_T	transition frequency	I_C = –10 mA; V_{CE} = –10 V; f = 100 MHz	70	110	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	–	–350	V
V_{CEO}	collector-emitter voltage	open base	–	–350	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–50	mA
I_{CM}	peak collector current		–	–100	mA
I_{BM}	peak base current		–	–50	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.6	W
		$T_{mb} \leq 25$ °C	–	5	W
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	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	78	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	25	K/W

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -300$ V	–	–20	nA
		$I_E = 0$; $V_{CB} = -200$ V; $T_j = 150$ °C	–	–20	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–100	nA
h_{FE}	DC current gain	$I_C = -25$ mA; $V_{CE} = -20$ V	50	–	
		$I_C = -40$ mA; $V_{CE} = -20$ V	20	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -20$ mA; $I_B = -2$ mA	–	–0.5	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -30$ V; f = 1 MHz	–	3	pF
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = -30$ V; f = 1 MHz	–	2.2	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 100 MHz	70	110	MHz

NPN high-voltage transistors BF591; BF593

FEATURES

- Low current (max. 150 mA)
- High voltage (max. 210 V).

APPLICATIONS

- Telephone systems.

DESCRIPTION

NPN high-voltage transistor in a TO-202; SOT128B plastic package.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector, connected to mounting base
3	base

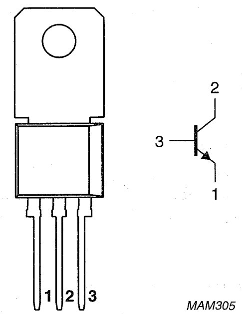


Fig.1 Simplified outline (TO-202; SOT128B) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BF591		–	210	V
	BF593		–	250	V
V_{CEO}	collector-emitter voltage	open base			
	BF591		–	170	V
	BF593		–	210	V
I_{CM}	peak collector current		–	300	mA
P_{tot}	total power dissipation	$T_{amb} \leq 55$ °C	–	1.3	W
h_{FE}	DC current gain	$I_C = 20$ mA; $V_{CE} = 5$ V	30	–	
		$I_C = 100$ mA; $V_{CE} = 6$ 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			
	BF591		–	210	V
	BF593		–	250	V
V_{CEO}	collector-emitter voltage	open base			
	BF591		–	170	V
	BF593		–	210	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	150	mA
I_{CM}	peak collector current		–	300	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 55$ °C	–	1.3	W
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	73	K/W

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 60$ V	–	50	nA
		$I_E = 0$; $V_{CB} = 60$ V; $T_j = 140$ °C	–	1	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	100	nA
h_{FE}	DC current gain	note 1			
		$I_C = 20$ mA; $V_{CE} = 5$ V	30	–	
		$I_C = 100$ mA; $V_{CE} = 6$ V	30	–	
		$I_C = 150$ mA; $V_{CE} = 7$ V	20	–	

Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.01$.

NPN high-voltage transistors BF620; BF622

FEATURES

- Low current (max. 50 mA)
- High voltage (max. 300 V).

APPLICATIONS

- Video output stages.

DESCRIPTION

NPN high-voltage transistor in a SOT89 plastic package.
PNP complements: BF621 and BF623.

MARKING

TYPE NUMBER	MARKING CODE
BF620	DC
BF622	DA

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

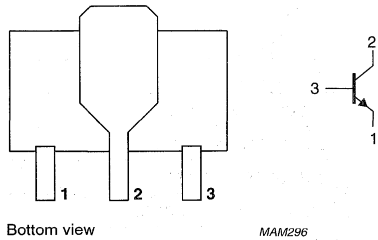


Fig.1 Simplified outline (SOT89) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BF620		–	300	V
	BF622		–	250	V
V_{CEO}	collector-emitter voltage	open base			
	BF620		–	300	V
	BF622		–	250	V
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.2	W
h_{FE}	DC current gain	$I_C = 25$ mA; $V_{CE} = 20$ V	50	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 30$ V; f = 1 MHz	–	1.6	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	60	–	MHz

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			
	BF620		–	300	V
	BF622		–	250	V
V_{CEO}	collector-emitter voltage	open-base			
	BF620		–	300	V
	BF622		–	250	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	50	mA
I_{CM}	peak collector current		–	100	mA
I_{BM}	peak base current		–	50	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.2	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	101	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		20	K/W

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 200$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 200$ V; $T_j = 150$ °C	–	10	µA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	50	nA
h_{FE}	DC current gain	$I_C = 25$ mA; $V_{CE} = 20$ V	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 30$ mA; $I_B = 5$ mA	–	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

PNP high-voltage transistors — BF621; BF623

FEATURES

- Low current (max. 50 mA)
- High voltage (max. 300 V).

APPLICATIONS

- Video output stages.

DESCRIPTION

PNP high-voltage transistor in a SOT89 plastic package.
NPN complements: BF620 and BF622.

MARKING

TYPE NUMBER	MARKING CODE
BF621	DF
BF623	DB

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

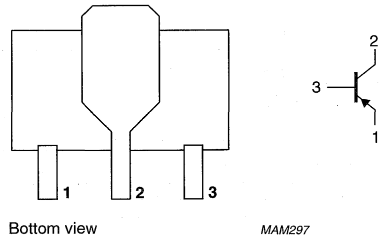


Fig.1 Simplified outline (SOT89) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BF621		–	–300	V
	BF623		–	–250	V
V_{CEO}	collector-emitter voltage	open base			
	BF621		–	–300	V
	BF623		–	–250	V
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.2	W
h_{FE}	DC current gain	$I_C = -25$ mA; $V_{CE} = -20$ V	50	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = -30$ V; f = 1 MHz	–	1.6	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 100 MHz	60	–	MHz

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			
	BF621		–	–300	V
	BF623		–	–250	V
V_{CEO}	collector-emitter voltage	open base			
	BF621		–	–300	V
	BF623		–	–250	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–50	mA
I_{CM}	peak collector current		–	–100	mA
I_{BM}	peak base current		–	–50	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.2	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	101	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		20	K/W

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -200$ V	–	–10	nA
		$I_E = 0$; $V_{CB} = -200$ V; $T_j = 150$ °C	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–50	nA
h_{FE}	DC current gain	$I_C = -25$ mA; $V_{CE} = -20$ V	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -30$ mA; $I_B = -5$ mA	–	–800	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

FEATURES

- Low feedback capacitance.

APPLICATIONS

- Class-B video output stages of colour television receivers.
- General purpose high voltage circuits.

DESCRIPTION

NPN transistors in a SOT223 plastic package.
PNP complements: BF721 and BF723.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter
4	collector

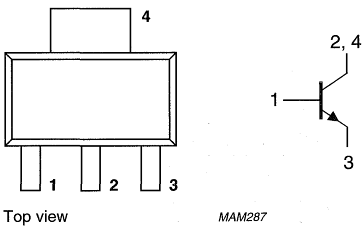


Fig.1 Simplified outline (SOT223) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BF720		–	300	V
	BF722		–	250	V
V_{CEO}	collector-emitter voltage	open base			
	BF720		–	300	V
	BF722		–	250	V
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.2	W
h_{FE}	DC current gain	$I_C = 25$ mA; $V_{CE} = 20$ V	50	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 30$ V; f = 1 MHz	–	1.6	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	60	–	MHz

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			
	BF720		–	300	V
	BF722		–	250	V
V_{CEO}	collector-emitter voltage	open base			
	BF720		–	300	V
	BF722		–	250	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	50	mA
I_{CM}	peak collector current		–	100	mA
I_{BM}	peak base current		–	50	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.2	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04".*

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	106	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	note 1	25	K/W

Note

1. Device mounted on printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04".*

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 200$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 200$ V; $T_j = 150$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	50	nA
h_{FE}	DC current gain	$I_C = 25$ mA; $V_{CE} = 20$ V	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 30$ mA; $I_B = 5$ mA	–	0.6	V
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

PNP high-voltage transistors | BF721; BF723

FEATURES

- Low feedback capacitance.

APPLICATIONS

- Class-B video output stages of colour television receivers.
- General purpose high voltage circuits.

DESCRIPTION

PNP transistors in a SOT223 plastic package.
NPN complements: BF720 and BF722.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter
4	collector

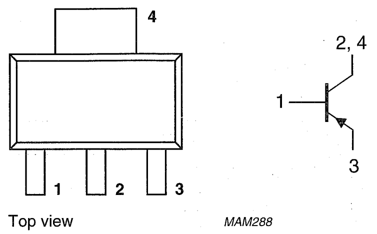


Fig.1 Simplified outline (SOT223) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BF721		–	–300	V
	BF723		–	–250	V
V_{CEO}	collector-emitter voltage	open base			
	BF721		–	–300	V
	BF723		–	–250	V
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.2	W
h_{FE}	DC current gain	$I_C = -25$ mA; $V_{CE} = -20$ V	50	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = -30$ V; f = 1 MHz	–	2.5	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			
	BF721		–	–300	V
	BF723		–	–250	V
V_{CEO}	collector-emitter voltage	open base			
	BF721		–	–300	V
	BF723		–	–250	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–50	mA
I_{CM}	peak collector current		–	–100	mA
I_{BM}	peak base current		–	–50	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.2	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	106	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	note 1	25	K/W

Note

1. Device mounted on printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -200$ V	–	–10	nA
		$I_E = 0$; $V_{CB} = -200$ V; $T_j = 150$ °C	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–50	nA
h_{FE}	DC current gain	$I_C = -25$ mA; $V_{CE} = -20$ V	–50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -30$ mA; $I_B = -5$ mA	–	–0.6	V
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = -30$ V; f = 1 MHz	–	2.5	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 100 MHz	60	–	MHz

NPN high-voltage transistor — BF819

FEATURES

- Low current (max. 100 mA)
- High voltage (max. 250 V).

APPLICATIONS

- Driver for a line output transistor in colour television receivers.

DESCRIPTION

NPN high-voltage transistor in a TO-202; SOT128B plastic package.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector, connected to mounting base
3	base

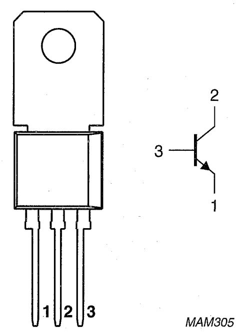


Fig.1 Simplified outline (TO-202; SOT128B) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	300	V
V_{CEO}	collector-emitter voltage	open base	–	250	V
I_{CM}	peak collector current		–	300	mA
P_{tot}	total power dissipation	$T_{amb} \leq 75$ °C	–	6	W
h_{FE}	DC current gain	$I_C = 20$ mA, $V_{CE} = 10$ V	45	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 30$ V; f = 1 MHz	–	3.5	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 100 MHz	90	–	MHz

NPN high-voltage transistor BF819

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	–	300	V
V_{CEO}	collector-emitter voltage	open base	–	250	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	300	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 75$ °C	–	1.2	W
		$T_{mb} \leq 75$ °C	–	6	W
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	62.5	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base		12.5	K/W

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 250$ V	–	50	nA
		$I_E = 0$; $V_{CB} = 250$ V; $T_j = 150$ °C	–	5	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	100	nA
h_{FE}	DC current gain	$I_C = 20$ mA; $V_{CE} = 10$ V	45	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 200$ mA; $I_B = 20$ mA	–	11	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 30$ V; f = 1 MHz	–	4.5	pF
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 30$ V; f = 1 MHz	–	3.5	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 100 MHz	90	–	MHz

NPN high-voltage transistors | BF820; BF822

FEATURES

- Low current (max. 50 mA)
- High voltage (max. 300 V).

APPLICATIONS

- Telephony and professional communication equipment.

DESCRIPTION

NPN high-voltage transistor in a SOT23 plastic package.
PNP complements: BF821; BF823.

MARKING

TYPE NUMBER	MARKING CODE
BF820	1Vt
BF822	1Wt

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

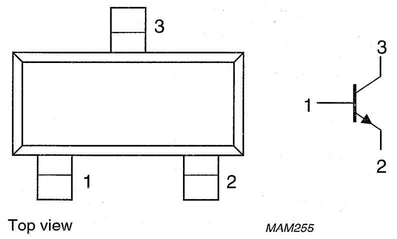


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BF820		–	300	V
	BF822		–	250	V
V_{CEO}	collector-emitter voltage	open base			
	BF820		–	300	V
	BF822		–	250	V
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 25$ mA; $V_{CE} = 20$ V	50	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 30$ V; f = 1 MHz	–	1.6	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	60	–	MHz

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			
	BF820		–	300	V
	BF822		–	250	V
V_{CEO}	collector-emitter voltage	open base			
	BF820		–	300	V
	BF822		–	250	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	50	mA
I_{CM}	peak collector current		–	100	mA
I_{BM}	peak base current		–	50	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 200$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 200$ V; $T_j = 150$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	50	nA
h_{FE}	DC current gain	$I_C = 25$ mA; $V_{CE} = 20$ V	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 30$ mA; $I_B = 5$ mA	–	600	mV
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 30$ V; f = 1 MHz	–	1.6	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	60	–	MHz

NPN high-voltage transistors BF820W; BF822W

FEATURES

- Low current (max. 50 mA)
- High voltage (max. 300 V).

APPLICATIONS

- Telephony and professional communication equipment.

DESCRIPTION

NPN high-voltage transistor in a SOT323 plastic package.

MARKING

TYPE NUMBER	MARKING CODE
BF820W	−1v
BF822W	−1x

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

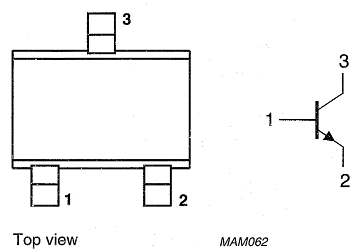


Fig.1 Simplified outline (SOT323) and symbol.

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			
	BF820W		−	300	V
	BF822W		−	250	V
I_{CM}	peak collector current		−	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	−	200	mW
h_{FE}	DC current gain	$I_C = 25$ mA; $V_{CE} = 20$ V	50	−	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 30$ V; f = 1 MHz	−	1.6	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	60	−	MHz

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			
	BF820W		–	300	V
	BF822W		–	250	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	50	mA
I_{CM}	peak collector current		–	100	mA
I_{BM}	peak base current		–	50	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 200$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 200$ V; $T_j = 150$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	50	nA
h_{FE}	DC current gain	$I_C = 25$ mA; $V_{CE} = 20$ V	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 30$ mA; $I_B = 5$mA; note 1	–	600	mV
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 30$ V; f = 1 MHz	–	1.6	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	60	–	MHz

Note

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

PNP high-voltage transistors | BF821; BF823

FEATURES

- Low current (max. 50 mA)
- High voltage (max. 300 V).

APPLICATIONS

- Telephony and professional communication equipment.

DESCRIPTION

PNP transistor in a SOT23 plastic package.
NPN complements: BF820, BF822.

MARKING

TYPE NUMBER	MARKING CODE
BF821	1Wp
BF823	1Yp

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

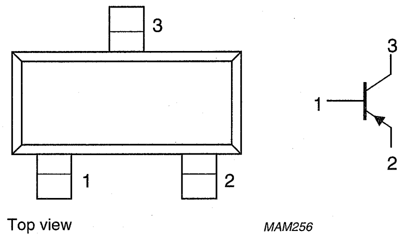


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BF821		–	–300	V
	BF823		–	–250	V
V_{CEO}	collector-emitter voltage	open base			
	BF821		–	–300	V
	BF823		–	–250	V
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = -25$ mA; $V_{CE} = -20$ V	50	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = -30$ V; f = 1 MHz	–	1.6	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 100 MHz	60	–	MHz

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			
	BF821		–	–300	V
	BF823		–	–250	V
V_{CEO}	collector-emitter voltage	open base			
	BF821		–	–300	V
	BF823		–	–250	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–50	mA
I_{CM}	peak collector current		–	–100	mA
I_{BM}	peak base current		–	–50	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -200$ V	–	–10	nA
		$I_E = 0$; $V_{CB} = -200$ V; $T_j = 150$ °C	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–50	nA
h_{FE}	DC current gain	$I_C = -25$ mA; $V_{CE} = -20$ V	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -30$ mA; $I_B = -5$ mA	–	–800	mV
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = -30$ V; f = 1 MHz	–	1.6	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 100 MHz	60	–	MHz

PNP medium frequency transistor | BF824

FEATURES

- Low current (max. 25 mA)
- Low voltage (max. 30 V).

APPLICATIONS

- RF stages in FM front-ends in common base configuration.

DESCRIPTION

PNP medium frequency transistor in a SOT23 plastic package.

MARKING

TYPE NUMBER	MARKING CODE
BF824	F8p

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

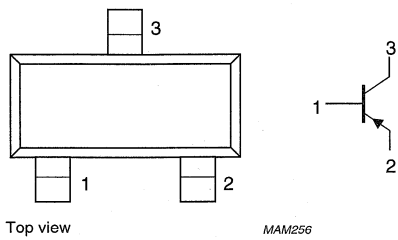


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	–30	V
V_{CEO}	collector-emitter voltage	open base	–	–	–30	V
I_{CM}	peak collector current		–	–	–25	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = -4$ mA; $V_{CE} = -10$ V	25	50	–	
f_T	transition frequency	$I_C = -4$ mA; $V_{CE} = -10$ V; f = 100 MHz	–	450	–	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
I_{CM}	peak collector current		–	–25	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -30$ V	–	–	–50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -4$ V	–	–	–100	nA
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -10$ V	25	45	–	
		$I_C = -4$ mA; $V_{CE} = -10$ V	25	50	–	
V_{BE}	base-emitter voltage	$I_C = -4$ mA; $V_{CE} = -10$ V	–	–	–900	mV
C_{rb}	feedback capacitance	$I_C = 0$; $V_{CE} = -10$ V; f = 1 MHz	–	–	0.3	pF
f_T	transition frequency	$V_{CE} = -10$ V; f = 100 MHz				
		$I_C = -1$ mA	250	350	–	MHz
		$I_C = -4$ mA	400	450	–	MHz
		$I_C = -8$ mA	390	440	–	MHz

PNP medium frequency transistor BF824W

FEATURES

- Low current (max. 25 mA)
- Low voltage (max. 30 V).

APPLICATIONS

- RF stages in FM front-ends in common base configuration.

DESCRIPTION

PNP medium frequency transistor in a SOT323 plastic package.

MARKING

TYPE NUMBER	MARKING CODE
BF824W	F8t

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

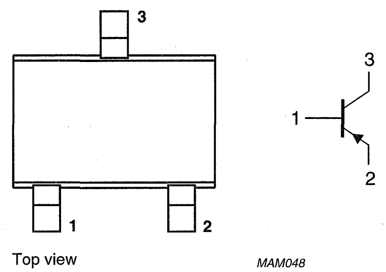


Fig.1 Simplified outline (SOT323) and symbol.

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_{CM}	peak collector current		–	–25	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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
I_{CM}	peak collector current		–	–25	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
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	–	–100	nA
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -10$ V	25	–	
		$I_C = -4$ mA; $V_{CE} = -10$ V	25	–	
V_{BE}	base-emitter voltage	$I_C = -4$ mA; $V_{CE} = -10$ V	–	–900	mV
C_{rb}	feedback capacitance	$I_C = 0$; $V_{CE} = -10$ V; f = 1 MHz	–	0.3	pF
f_T	transition frequency	$V_{CE} = -10$ V; f = 100 MHz; note 1			
		$I_C = -1$ mA	250	–	MHz
		$I_C = -4$ mA	400	–	MHz
		$I_C = -8$ mA	390	–	MHz

Note

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

NPN medium frequency transistors — BF840; BF841

FEATURES

- Low current (max. 25 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- AM mixers
- IF amplifiers in AM/FM receivers.

DESCRIPTION

NPN medium frequency transistor in a SOT23 plastic package.

MARKING

TYPE NUMBER	MARKING CODE
BF840	NCp
BF841	NDp

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

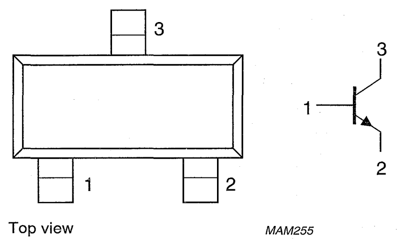


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	40	V
V_{CEO}	collector-emitter voltage	open base	–	–	40	V
I_{CM}	peak collector current		–	–	25	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 10$ V				
	BF840		67	–	222	
	BF841		36	–	125	
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 10$ V; f = 100 MHz	–	380	–	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	–	4	V
I_C	collector current (DC)		–	25	mA
I_{CM}	peak collector current		–	25	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	–	100	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 10$ V				
	BF840		67	–	222	
	BF841		36	–	125	
V_{BE}	base-emitter voltage	$I_C = 1$ mA; $V_{CE} = 10$ V	650	700	740	mV
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	0.3	–	pF
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 10$ V; f = 100 MHz	–	380	–	MHz

DESCRIPTION

NPN transistors in a TO-202 plastic package.

An A-version with e-b-c pinning instead of e-c-b is available on request.

APPLICATIONS

- For use in video output stages of black and white and colour television receivers.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector, connected to mounting base
3	base

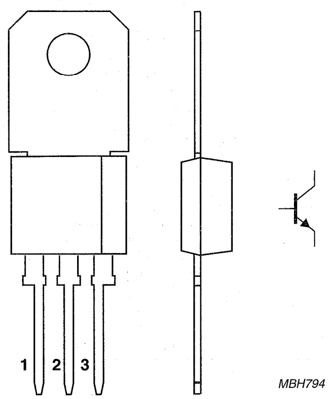


Fig.1 Simplified outline (TO-202) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BF857		–	160	V
	BF858		–	250	V
	BF859		–	300	V
V_{CEO}	collector-emitter voltage	open base			
	BF857		–	160	V
	BF858		–	250	V
	BF859		–	300	V
I_{CM}	peak collector current		–	300	mA
P_{tot}	total power dissipation	$T_{mb} \leq 75$ °C	–	6	W
h_{FE}	DC current gain	$I_C = 30$ mA; $V_{CE} = 10$ V	26	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 30$ V; f = 1 MHz	–	3	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 100 MHz	90	–	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			
	BF857		–	160	V
	BF858		–	250	V
	BF859		–	300	V
V_{CEO}	collector-emitter voltage	open base			
	BF857		–	160	V
	BF858		–	250	V
	BF859		–	300	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	300	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	2	W
		$T_{mb} \leq 75$ °C	–	6	W
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	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	62.5	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	12.5	K/W

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current BF857	$I_E = 0$; $V_{CB} = 100$ V	–	0.1	μA
I_{CBO}	collector cut-off current BF858	$I_E = 0$; $V_{CB} = 200$ V	–	0.1	μA
I_{CBO}	collector cut-off current BF859	$I_E = 0$; $V_{CB} = 250$ V	–	0.1	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	100	nA
h_{FE}	DC current gain	$I_C = 30$ mA; $V_{CE} = 10$ V	26	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 30$ mA; $I_B = 6$ mA	–	1	V
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 30$ V; f = 1 MHz	–	3	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 100 MHz	90	–	MHz

NPN high-voltage transistors

BF869; BF871

FEATURES

- Low feedback capacitance.

APPLICATIONS

- For use in class-B video output stages in colour television receivers.

DESCRIPTION

NPN transistors in a TO-202 plastic package.
PNP complements: BF870 and BF872.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector, connected to mounting base
3	base

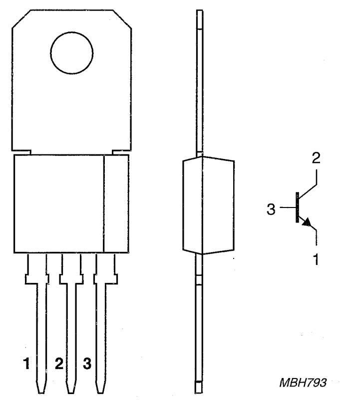


Fig.1 Simplified outline (TO-202) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BF869		–	250	V
	BF871		–	300	V
V_{CEO}	collector-emitter voltage	open base			
	BF869		–	250	V
	BF871		–	300	V
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C	–	5	W
h_{FE}	DC current gain	$I_C = 25$ mA; $V_{CE} = 20$ V; $T_j = 25$ °C	50	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 30$ V; f = 1 MHz	–	2	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			
	BF869		–	250	V
	BF871		–	300	V
V_{CEO}	collector-emitter voltage	open base			
	BF869		–	250	V
	BF871		–	300	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	50	mA
I_{CM}	peak collector current	peak value	–	100	mA
I_{BM}	peak base current		–	50	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.6	W
		$T_{mb} \leq 25$ °C	–	5	W
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	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	78	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	25	K/W

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 200$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 200$ V; $T_j = 150$ °C		10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	50	nA
h_{FE}	DC current gain	$I_C = 25$ mA; $V_{CE} = 20$ V	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 30$ mA; $I_B = 5$ mA	–	600	mV
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 30$ V; f = 1 MHz	–	2	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	60	–	MHz

FEATURES

- Low feedback capacitance.

APPLICATIONS

- For use in class-B video output stages of colour television receivers.

DESCRIPTION

PNP transistors in a TO-202 plastic package.
NPN complements: BF869 and BF871.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector, connected to mounting base
3	base

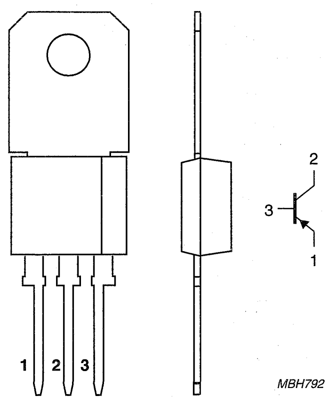


Fig.1 Simplified outline (TO-202) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BF870		–	–250	V
	BF872		–	–300	V
V_{CEO}	collector-emitter voltage	open base			
	BF870		–	–250	V
	BF872		–	–300	V
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C	–	5	W
h_{FE}	DC current gain	$I_C = -25$ mA; $V_{CE} = -20$ V; $T_j = 25$ °C	50	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = -30$ V; f = 1MHz	–	2.2	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			
	BF870		–	–250	V
	BF872		–	–300	V
V_{CEO}	collector-emitter voltage	open base			
	BF870		–	–250	V
	BF872		–	–300	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–50	nA
I_{CM}	peak collector current		–	–100	mA
I_{BM}	peak base current		–	–50	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.6	W
		$T_{mb} \leq 25$ °C	–	5	W
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	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	78	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	25	K/W

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -200$ V	–	–10	nA
		$I_E = 0$; $V_{CB} = -200$ V; $T_j = 150$ °C	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–50	nA
h_{FE}	DC current gain	$I_C = -25$ mA; $V_{CE} = -20$ V	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -30$ mA; $I_B = -5$ mA	–	–600	mV
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = -30$ V; f = 1MHz	–	2.2	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 100 MHz	60	–	MHz

NPN medium frequency transistor | BFR54

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 15 V).

APPLICATIONS

- Active probes
- Frequency multipliers
- Linear amplifiers.

DESCRIPTION

NPN medium frequency transistor in a TO-92; SOT54 plastic package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

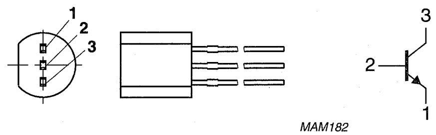


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 1$ V	40	–	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	500	–	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	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	4.5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	–	400	nA
		$I_E = 0$; $V_{CB} = 20$ V; $T_j = 125$ °C	–	–	30	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 2$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 1$ V	40	–	–	
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	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	–	4	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 1$ V; f = 1 MHz	–	–	4.5	pF
C_{re}	feedback capacitance	$I_C = 0$ mA; $V_{CB} = 10$ V; f = 1 MHz	–	1.6	–	pF
f_T	transition frequency	$V_{CE} = 10$ V; f = 100 MHz				
		$I_C = 10$ mA	500	–	–	MHz
		$I_C = 40$ mA	490	–	–	MHz

NPN medium frequency transistor | BFS19

FEATURES

- Low current (max. 30 mA)
- Low voltage (max. 20 V).

APPLICATIONS

- Medium frequency applications in thick and thin-film circuits.

DESCRIPTION

NPN medium frequency transistor in a SOT23 plastic package.

MARKING

TYPE NUMBER	MARKING CODE
BFS19	F2p

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

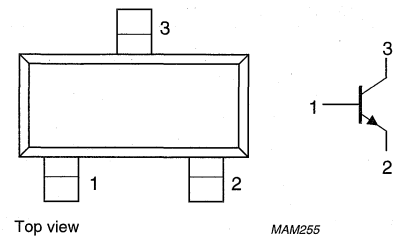


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	–	20	V
I_{CM}	peak collector current		–	–	30	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 10$ V	65	–	225	
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 10$ V; f = 100 MHz	–	260	–	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	–	20	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	30	mA
I_{CM}	peak collector current		–	30	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	–	100	nA
		$I_E = 0$; $V_{CB} = 20$ V; $T_j = 100$ °C	–	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 10$ V	65	–	225	
V_{BE}	base-emitter voltage	$I_C = 1$ mA; $V_{CE} = 10$ V	650	–	740	mV
C_c	collector capacitance	$I_E = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	1	–	pF
C_{re}	feedback capacitance	$I_C = 0$ mA; $V_{CB} = 10$ V; f = 1 MHz	–	0.85	–	pF
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 10$ V; f = 100 MHz	–	260	–	MHz

NPN medium frequency transistor BFS20

FEATURES

- Low current (max. 25 mA)
- Low voltage (max. 20 V)
- Very low feedback capacitance (typ. 350 fF).

APPLICATIONS

- IF and VHF applications in thick and thin-film circuits.

DESCRIPTION

NPN medium frequency transistor in a SOT23 plastic package.

MARKING

TYPE NUMBER	MARKING CODE
BFS20	G1p

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

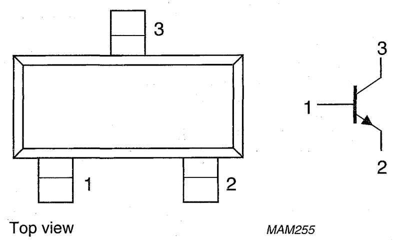


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	–	20	V
I_{CM}	peak collector current		–	–	25	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = 7$ mA; $V_{CE} = 10$ V	40	85	–	
f_T	transition frequency	$I_C = 5$ mA; $V_{CE} = 5$ V; f = 100 MHz	275	450	–	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	–	20	V
V_{EBO}	emitter-base voltage	open collector	–	4	V
I_C	collector current (DC)		–	25	mA
I_{CM}	peak collector current		–	25	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	–	100	nA
		$I_E = 0$; $V_{CB} = 20$ V; $T_j = 100$ °C	–	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 7$ mA; $V_{CE} = 10$ V	40	85	–	
V_{BE}	base-emitter voltage	$I_C = 7$ mA; $V_{CE} = 10$ V	–	740	900	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	1	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	350	–	fF
f_T	transition frequency	$I_C = 5$ mA; $V_{CE} = 10$ V; f = 100 MHz	275	450	–	MHz

PNP high-voltage transistor | BFT45

FEATURES

- Low current (max. 500 mA)
- High voltage (max. 250 V).

APPLICATIONS

- High voltage switching and amplification
- Industrial and telephone applications.

DESCRIPTION

PNP high-voltage transistor in a TO-39 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

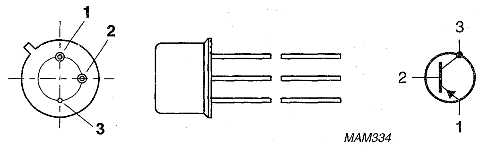


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	–250	V
V_{CEO}	collector-emitter voltage	open base	–	–	–250	V
I_{CM}	peak collector current		–	–	–1	A
P_{tot}	total power dissipation	$T_{case} \leq 50$ °C	–	–	5	W
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -10$ V	50	–	150	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CE} = -20$ V; f = 1 MHz	–	–	15	pF
f_T	transition frequency	$I_C = -15$ mA; $V_{CE} = -10$ V; f = 100 MHz	–	70	–	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	–	–250	V
V_{CEO}	collector-emitter voltage	open base	–	–250	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–500	mA
I_{CM}	peak collector current		–	–1	A
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{case} \leq 50$ °C	–	5	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°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	200	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		30	K/W

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -200$ V	–	–	–5	µA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -3$ V	–	–	–5	µA
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -10$ V	30	–	–	
		$I_C = -10$ mA; $V_{CE} = -10$ V	50	–	150	
		$I_C = -100$ mA; $V_{CE} = -10$ V; note 1	50	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -1$ mA	–	–	–0.5	V
		$I_C = -100$ mA; $I_B = -10$ mA	–	–	–1.4	V
		$I_C = -500$ mA; $I_B = -100$ mA; note 1	–	–	–3	V
V_{BEsat}	base-emitter saturation voltage	$I_C = -10$ mA; $I_B = -1$ mA	–	–	–0.5	V
		$I_C = -100$ mA; $I_B = -10$ mA	–	–	–0.9	V
		$I_C = -500$ mA; $I_B = -100$ mA; note 1	–	–	–1.2	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -20$ V; f = 1 MHz	–	–	15	pF
f_T	transition frequency	$I_C = -15$ mA; $V_{CE} = -10$ V; f = 100 MHz	–	70	–	MHz

Note

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

NPN high-voltage transistor — BFV420

FEATURES

- Low current (max. 100 mA)
- High voltage (max. 100 V).

APPLICATIONS

- Primarily intended for video applications (monitors).

DESCRIPTION

NPN high-voltage transistor in a TO-92; SOT54 plastic package. PNP complement: BFV421.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

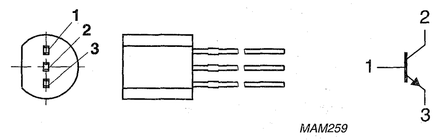


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	140	V
V_{CEO}	collector-emitter voltage	open base	–	100	V
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	830	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 10$ V	150	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 25$ V; f = 1 MHz	–	1.5	pF
f_T	transition frequency	$I_C = 20$ 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	–	140	V
V_{CEO}	collector-emitter voltage	open base	–	100	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	100	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	830	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	150	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 100$ V	–	100	nA
		$I_E = 0$; $V_{CB} = 100$ V; $T_{amb} = 150$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	100	nA
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 10$ V	150	–	
		$I_C = 50$ mA; $V_{CE} = 10$ V	20	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 30$ mA; $I_B = 5$ mA	–	200	mV
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 25$ V; f = 1 MHz	–	1.5	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 20$ V; f = 100 MHz	150	–	MHz

PNP high voltage transistor BFV421

FEATURES

- High voltage
- High transition frequency
- Low output capacitance.

APPLICATIONS

- Primarily intended for video applications (monitors).

DESCRIPTION

PNP transistor in a plastic TO-92; SOT54 package.
NPN complement: BFV420.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

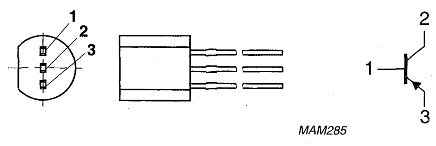


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–140	V
V_{CEO}	collector-emitter voltage	open base	–	–100	V
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	830	mW
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -10$ V	150	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = -25$ V; f = 1 MHz	–	2.3	pF
f_T	transition frequency	$I_C = -20$ 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	–	–140	V
V_{CEO}	collector-emitter voltage	open base	–	–100	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–100	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	830	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	150	K/W

Note

1. Transistor mounted on a printed-circuit board; maximum lead length 4 mm; mounting pad for collector lead minimum 10 × 10 mm.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -100$ V	–	–100	nA
		$I_E = 0$; $V_{CB} = -100$ V; $T_{amb} = 150$ °C	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -4$ V	–	–100	nA
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -10$ V	150	–	
		$I_C = -50$ mA; $V_{CE} = -10$ V	20	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -30$ mA; $I_B = -5$ mA	–	–200	mV
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = -25$ V; f = 1 MHz	–	2.3	pF
f_T	transition frequency	$I_C = -20$ mA; $V_{CE} = -20$ V; f = 100 MHz	150	–	MHz

FEATURES

- High transition frequency
- Low feedback capacitance.

APPLICATIONS

- Buffer transistor in monitors.

DESCRIPTION

NPN high-voltage transistor in a TO-126; SOT32 plastic package.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

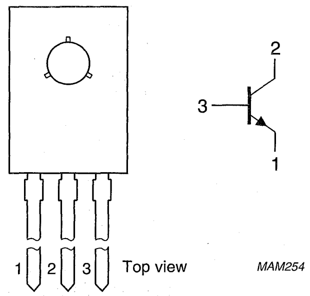


Fig.1 Simplified outline (TO-126; SOT32) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	140	V
V_{CEO}	collector-emitter voltage	open base	–	100	V
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	2	W
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 10$ V	150	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 25$ V; f = 1 MHz	–	1.5	pF
f_T	transition frequency	$I_C = 20$ 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	–	140	V
V_{CEO}	collector-emitter voltage	open base	–	100	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	100	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	2	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	100	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base		10	K/W

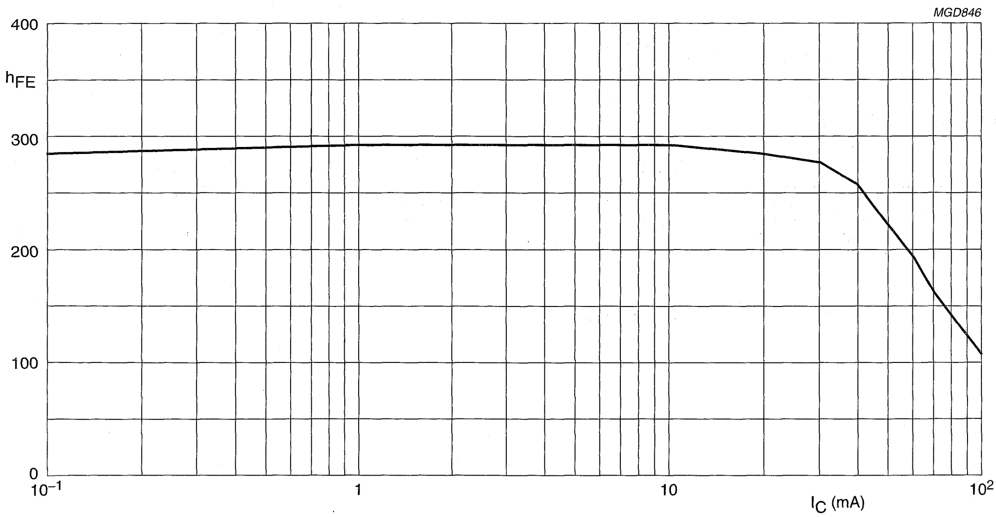
Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 100$ V	–	100	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	100	nA
h_{FE}	DC current gain	$V_{CE} = 10$ V; see Fig.2			
		$I_C = 10$ mA	150	–	
		$I_C = 50$ mA	20	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 30$ mA; $I_B = 5$ mA	–	200	mV
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 25$ V; f = 1 MHz	–	1.5	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 20$ V; f = 100 MHz	150	–	MHz



V_{CE} = 10 V.

Fig.2 DC current gain; typical values.

PNP switching transistor | BFX30

FEATURES

- High current (max.600 mA)
- Low voltage (max. 65 V).

APPLICATIONS

- Switching applications.

DESCRIPTION

PNP transistor in a TO-39 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

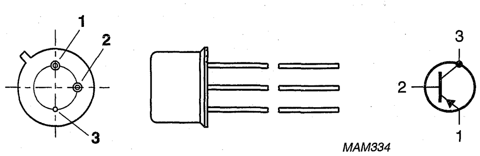


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	–65	V
V_{CEO}	collector-emitter voltage	open base	–	–	–65	V
I_C	collector current (DC)		–	–	–600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	600	mW
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -400$ mV	50	90	200	
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -10$ V; f = 100 MHz	100	–	–	MHz
t_{off}	turn-off time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 10$ mA	–	–	300	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	–	–65	V
V_{CEO}	collector-emitter voltage	open base	–	–65	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–600	mA
I_{CM}	peak collector current		–	–600	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	600	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°C
T_{amb}	operating ambient temperature		–65	+150	°C

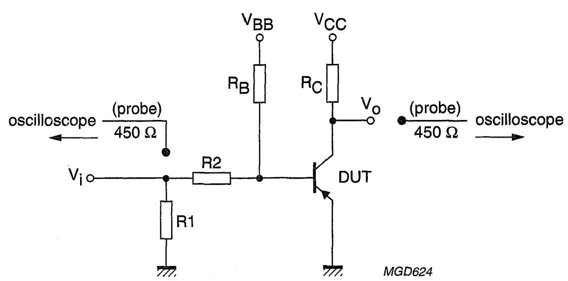
THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air	300	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -65$ V	–	–	–500	nA
		$I_E = 0$; $V_{CB} = -50$ V	–	–	–50	nA
		$I_E = 0$; $V_{CB} = -50$ V; $T_j = 100$ °C	–	–	–2	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–500	nA
		$I_C = 0$; $V_{EB} = -3$ V	–	–	–100	nA
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -400$ mV	40	–	–	
		$I_C = -10$ mA; $V_{CE} = -400$ mV	50	90	200	
		$I_C = -50$ mA; $V_{CE} = -400$ mV	20	–	–	
		$I_C = -150$ mA; $V_{CE} = -400$ mV	10	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ μA	–	–	–400	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -30$ mA; $I_B = -1$ mA	–	–	–900	mV
		$I_C = -150$ mA; $I_B = -15$ mA	–	–	–1.3	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	6	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -2$ V; f = 1 MHz	–	18	–	pF
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -10$ V; f = 100 MHz	100	–	–	MHz
Switching Times (between 10% and 90% levels); see Fig.2						
t_{on}	turn-on time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	–	45	ns
t_d	delay time		–	–	15	ns
t_r	rise time		–	–	35	ns
t_{off}	turn-off time		–	–	300	ns
t_s	storage time		–	–	250	ns
t_f	fall time		–	–	50	ns



$V_{CC} = -29.5$ V; $V_{BB} = 3.5$ V; $V_i = -9.5$ V;
T = 500 μs; $t_p = 10$ μs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; $R_B = 325$ Ω; $R_C = 160$ Ω.
Oscilloscope: input impedance $Z_i = 50$ Ω.

Fig.2 Test circuit for switching times.

NPN switching transistor — BFX34

FEATURES

- High current (max. 2 A)
- Low voltage (max. 60 V).

APPLICATIONS

- High-current switching, e.g. inverters and switching regulators.

DESCRIPTION

NPN switching transistor in a TO-39 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

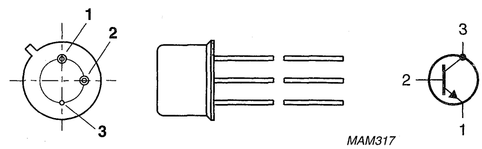


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	120	V
V_{CEO}	collector-emitter voltage	open base	–	60	V
I_C	collector current (DC)		–	2	A
P_{tot}	total power dissipation	$T_{case} \leq 25$ °C	–	5	W
h_{FE}	DC current gain	$I_C = 2$ A; $V_{CE} = 2$ V	40	150	
f_T	transition frequency	$I_C = 0.5$ A; $V_{CE} = 5$ V; f = 100 MHz	70	–	MHz
t_{off}	turn-off time	$I_{Con} = 5$ A; $I_{Bon} = 0.5$ A; $I_{Boff} = -0.5$ A	–	1.2	μs

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	–	120	V
V_{CEO}	collector-emitter voltage	open base	–	60	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	2	A
I_{CM}	peak collector current		–	5	A
I_{BM}	peak base current		–	1.5	A
P_{tot}	total power dissipation	$T_{case} \leq 25$ °C	–	5	W
		$T_{amb} \leq 25$ °C	–	0.87	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°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	200	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		35	K/W

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 60$ V	–	–	10	µA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	–	10	µA
h_{FE}	DC current gain	$I_C = 1$ A; $V_{CE} = 2$ V	–	130	–	
		$I_C = 1.5$ A; $V_{CE} = 0.6$ V	–	60	–	
		$I_C = 2$ A; $V_{CE} = 2$ V	40	110	150	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 5$ A; $I_B = 0.5$ A	–	0.77	1	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 5$ A; $I_B = 0.5$ A	–	1.43	1.8	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	36	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	440	–	pF
f_T	transition frequency	$I_C = 0.5$ A; $V_{CE} = 5$ V; f = 100 MHz	70	100	–	MHz
Switching times (between 10% and 90% levels)						
t_{on}	turn-on time	$I_{Con} = 5$ A; $I_{Bon} = 0.5$ A; $I_{Boff} = -0.5$ A	–	0.2	0.6	µs
t_{off}	turn-off time		–	0.34	1.2	µs

NPN switching transistor BFX85

FEATURES

- High current (max. 1 A)
- Low voltage (max. 60 V).

APPLICATIONS

- General purpose switching and amplification
- Industrial applications.

DESCRIPTION

NPN transistor in a TO-39 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

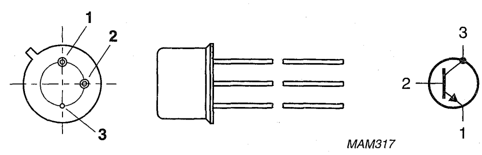


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	100	V
V_{CEO}	collector-emitter voltage	open base	–	–	60	V
I_C	collector current (DC)		–	–	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	800	mW
		$T_{case} \leq 100$ °C	–	–	2.86	W
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 10$ V	70	142	–	
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 10$ V; f = 100 MHz	50	–	–	MHz
t_{off}	turn-off time	$I_{Con} = 150$ mA; $I_{Bon} = 15$ mA; $I_{Boff} = -15$ mA	–	360	–	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	–	100	V
V_{CEO}	collector-emitter voltage	open base	–	60	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	1	A
I_{CM}	peak collector current		–	1	A
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	800	mW
		$T_{case} \leq 25$ °C	–	5	W
		25° C $\leq T_{case} \leq 100$ °C	–	2.86	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C
T_{amb}	operating ambient temperature		–65	+150	°C

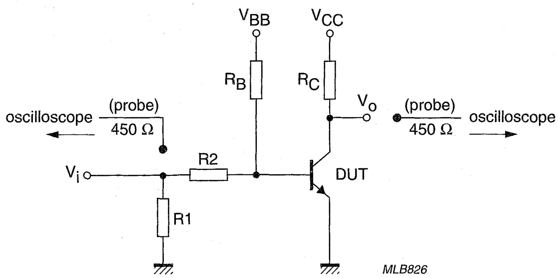
THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air	200	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		35	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 80$ V	–	2	50	nA
		$I_E = 0$; $V_{CB} = 80$ V; $T_j = 100$ °C	–	0.1	2.5	μA
		$I_E = 0$; $V_{CB} = 100$ V	–	10	500	nA
		$I_E = 0$; $V_{CB} = 100$ V; $T_j = 100$ °C	–	0.5	30	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	2	50	nA
		$I_C = 0$; $V_{EB} = 5$ V; $T_j = 100$ °C	–	0.1	2.5	μA
		$I_C = 0$; $V_{EB} = 6$ V	–	10	500	nA
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 10$ V	50	90	–	
		$I_C = 150$ mA; $V_{CE} = 10$ V	70	142	–	
		$I_C = 500$ mA; $V_{CE} = 10$ V	30	90	–	
		$I_C = 1$ A; $V_{CE} = 10$ V	15	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	–	150	200	mV
		$I_C = 150$ mA; $I_B = 15$ mA	–	150	350	mV
		$I_C = 500$ mA; $I_B = 50$ mA	–	0.35	1	V
		$I_C = 1$ A; $I_B = 100$ mA	–	0.66	1.6	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	–	0.69	1.2	V
		$I_C = 150$ mA; $I_B = 15$ mA	–	0.92	1.3	V
		$I_C = 500$ mA; $I_B = 50$ mA	–	1.15	1.5	V
		$I_C = 1$ A; $I_B = 100$ mA	–	1.4	2	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	7	12	pF
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 10$ V; f = 100 MHz	50	185	–	MHz
Switching Times (between 10% and 90% levels) see Fig.2						
t_{on}	turn-on time	$I_{Con} = 150$ mA; $I_{Bon} = 15$ mA; $I_{Boff} = -15$ mA	–	55	–	ns
t_d	delay time		–	15	–	ns
t_r	rise time		–	40	–	ns
t_{off}	turn-off time		–	360	–	ns
t_s	storage time		–	300	–	ns
t_f	fall time		–	60	–	ns



V_i = 9.5 V; T = 500 μs; t_p = 10 μs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; R_B = 325 Ω; R_C = 160 Ω.
V_{BB} = −3.5 V; V_{CC} = 29.5 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.2 Test circuit for switching times.

NPN medium power transistors | BFY50; BFY51; BFY52

FEATURES

- High current (max. 1 A)
- Low voltage (max. 35 V).

APPLICATIONS

- General purpose industrial applications.

DESCRIPTION

NPN medium power transistor in a TO-39 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

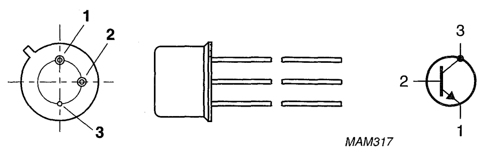


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BFY50		–	–	80	V
	BFY51		–	–	60	V
	BFY52		–	–	40	V
V_{CEO}	collector-emitter voltage	open base				
	BFY50		–	–	35	V
	BFY51		–	–	30	V
	BFY52		–	–	20	V
I_{CM}	peak collector current		–	–	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	800	mW
		$T_{case} \leq 100$ °C	–	–	2.86	W
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 10$ V				
	BFY50		30	112	–	
	BFY51		40	123	–	
	BFY52		60	142	–	
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 10$ V; f = 100 MHz				
	BFY50		60	–	–	MHz
	BFY51; BFY52		50	–	–	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			
	BFY50		–	80	V
	BFY51		–	60	V
	BFY52		–	40	V
V_{CEO}	collector-emitter voltage	open base			
	BFY50		–	35	V
	BFY51		–	30	V
	BFY52		–	20	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	1	A
I_{CM}	peak collector current		–	1	A
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	800	mW
		$T_{case} \leq 25$ °C	–	5	W
		25 °C < T_{case} < 100 °C	–	2.86	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°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	220	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		35	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current					
	BFY50	$I_E = 0$; $V_{CB} = 60$ V	–	–	50	nA
		$I_E = 0$; $V_{CB} = 60$ V; $T_j = 100$ °C	–	–	2.5	μA
		$I_E = 0$; $V_{CB} = 80$ V	–	–	500	nA
		$I_E = 0$; $V_{CB} = 80$ V; $T_j = 100$ °C	–	–	30	μA
I_{CBO}	collector cut-off current					
	BFY51	$I_E = 0$; $V_{CB} = 40$ V	–	–	50	nA
		$I_E = 0$; $V_{CB} = 40$ V; $T_j = 100$ °C	–	–	2.5	μA
		$I_E = 0$; $V_{CB} = 60$ V	–	–	500	nA
		$I_E = 0$; $V_{CB} = 60$ V; $T_j = 100$ °C	–	–	30	μA
I_{CBO}	collector cut-off current					
	BFY52	$I_E = 0$; $V_{CB} = 30$ V	–	–	50	nA
		$I_E = 0$; $V_{CB} = 30$ V; $T_j = 100$ °C	–	–	2.5	μA
		$I_E = 0$; $V_{CB} = 40$ V	–	–	500	nA
		$I_E = 0$; $V_{CB} = 40$ V; $T_j = 100$ °C	–	–	30	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	50	nA
		$I_C = 0$; $V_{EB} = 5$ V; $T_j = 100$ °C	–	–	2.5	μA
		$I_C = 0$; $V_{EB} = 6$ V	–	–	500	nA
h_{FE}	DC current gain					
	BFY50	$I_C = 10$ mA; $V_{CE} = 10$ V	20	–	–	
		$I_C = 150$ mA; $V_{CE} = 10$ V	30	–	–	
		$I_C = 500$ mA; $V_{CE} = 10$ V	20	–	–	
		$I_C = 1$ A; $V_{CE} = 10$ V	15	–	–	
h_{FE}	DC current gain					
	BFY51	$I_C = 10$ mA; $V_{CE} = 10$ V	30	–	–	
		$I_C = 150$ mA; $V_{CE} = 10$ V	40	–	–	
		$I_C = 500$ mA; $V_{CE} = 10$ V	25	–	–	
		$I_C = 1$ A; $V_{CE} = 10$ V	15	–	–	
h_{FE}	DC current gain					
	BFY52	$I_C = 10$ mA; $V_{CE} = 10$ V	30	–	–	
		$I_C = 150$ mA; $V_{CE} = 10$ V	60	–	–	
		$I_C = 500$ mA; $V_{CE} = 10$ V	30	–	–	
		$I_C = 1$ A; $V_{CE} = 10$ V	15	–	–	

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CEsat}	collector-emitter saturation voltage					
	BFY50	I_C = 10 mA; I_B = 1 mA	–	–	200	mV
		I_C = 150 mA; I_B = 15 mA	–	–	200	mV
		I_C = 500 mA; I_B = 50 mA	–	–	700	mV
		I_C = 1 A; I_B = 100 mA	–	–	1	V
V_{CEsat}	collector-emitter saturation voltage					
	BFY51; BFY52	I_C = 10 mA; I_B = 1 mA	–	–	200	mV
		I_C = 150 mA; I_B = 15 mA	–	–	350	mV
		I_C = 500 mA; I_B = 50 mA	–	–	1	V
		I_C = 1 A; I_B = 100 mA	–	–	1.6	V
V_{BEsat}	base-emitter saturation voltage	I_C = 10 mA; I_B = 1 mA	–	–	1.2	V
		I_C = 150 mA; I_B = 15 mA	–	–	1.3	V
		I_C = 500 mA; I_B = 50 mA	–	–	1.5	V
		I_C = 1 A; I_B = 100 mA	–	–	2	V
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = 10 V; f = 1 MHz	–	7	12	pF
f_T	transition frequency	I_C = 50 mA; V_{CE} = 10 V; f = 100 MHz; T_{amb} = 25 °C				
	BFY50		60	140	–	MHz
	BFY51; BFY52		50	–	–	MHz
Switching times (between 10% and 90% levels)						
t_{on}	turn-on time	I_{Con} = 150 mA; I_{Bon} = 15 mA; I_{Boff} = −15 mA	–	55	–	ns
t_d	delay time		–	15	–	ns
t_r	rise time		–	40	–	ns
t_{off}	turn-off time		–	360	–	ns
t_s	storage time		–	300	–	ns
t_f	fall time		–	60	–	ns

Silicon controlled switch — BR101

DESCRIPTION

Silicon planar PNPN switch in a TO-72 metal package. It is an integrated PNP/NPN transistor pair, with all electrodes accessible.

APPLICATIONS

- Time base circuits
- Switching in television circuits
- Trigger device for thyristors.

PINNING

PIN	DESCRIPTION
1	cathode
2	cathode gate
3	anode gate (connected to case)
4	anode

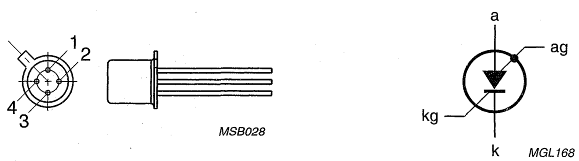


Fig.1 Simplified outline (TO-72) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
PNP transistor				
V_{EBO}	emitter-base voltage	open collector	−50	V
NPN transistor				
V_{CBO}	collector-base voltage	open emitter	50	V
I_{ERM}	repetitive peak emitter current		−2.5	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	275	mW
T_j	junction temperature		150	°C
V_{AK}	forward on-state voltage	$I_A = 50$ mA; $I_{AG} = 0$; $R_{KG\text{-}K} = 10$ kΩ	1.4	V
I_H	holding current	$I_{AG} = 10$ mA; $V_{BB} = -2$ V; $R_{KG\text{-}K} = 10$ kΩ	1	mA

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
NPN transistor					
V_{CBO}	collector-base voltage	open emitter	–	50	V
V_{CER}	collector-emitter voltage	R_{BE} = 10 kΩ	–	50	V
V_{EBO}	emitter-base voltage	open collector; note 1	–	5	V
I_C	collector current (DC)	note 2	–	175	mA
I_{CM}	peak collector current		–	175	mA
I_E	emitter current (DC)		–	–175	mA
I_{ERM}	repetitive peak emitter current	t_p = 10 µs; δ = 0.01	–	–2.5	A
PNP transistor					
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	–	–50	V
I_E	emitter current (DC)		–	175	mA
I_{ERM}	repetitive peak emitter current	t_p = 10 µs; δ = 0.01	–	2.5	A
Combined device					
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	275	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Notes

1. It is permitted to exceed this voltage during the discharge of a capacitor of max. 390 pF, provided the charge does not exceed 50 nC.
2. Provided the I_E rating is not exceeded.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air	0.45	K/mW

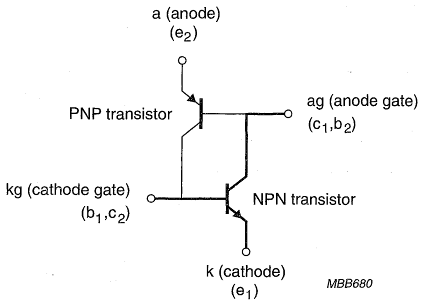


Fig.2 Two transistor equivalent circuit.

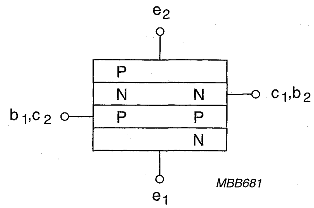


Fig.3 PNPN silicon controlled switch structure.

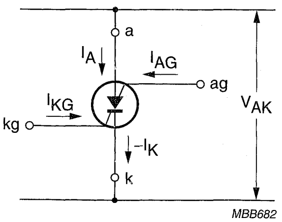


Fig.4 Silicon controlled switch symbol.

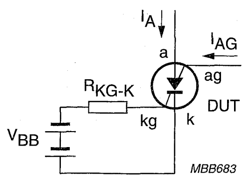


Fig.5 Equivalent test circuit for holding current.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
NPN transistor						
I_{CER}	collector cut-off current	V_{CE} = 50 V; R_{BE} = 10 kΩ	–	–	500	nA
		V_{CE} = 50 V; R_{BE} = 10 kΩ; T_j = 150 °C	–	–	50	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 5 V; T_j = 150 °C	–	–	50	μA
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA; I_B = 1 mA	–	–	500	mV
V_{BEsat}	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	–	300	–	MHz
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 20 V; f = 1 MHz	–	–	5	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = 1 V	–	–	25	pF
PNP transistor						
I_{CEO}	collector cut-off current	I_B = 0; V_{CE} = –50 V; T_j = 150 °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = –50 V; T_j = 150 °C	–	–	–50	μA
h_{FE}	DC current gain	I_E = 1 mA; V_{CB} = 0 V	0.25	–	2.5	
Combined device						
V_{AK}	forward on-state voltage	$R_{KG\text{-}K}$ = 10 kΩ				
		I_A = 50 mA; I_{AG} = 0	–	–	1.4	V
		I_A = 1 mA; I_{AG} = 10 mA	–	–	1.2	V
I_H	holding current	$R_{KG\text{-}K}$ = 10 kΩ; I_{AG} = 10 mA; V_{BB} = –2 V	–	–	1	mA

Programmable unijunction transistor/ Silicon controlled switch

BRY39

FEATURES

- Silicon controlled switch
- Programmable unijunction transistor.

APPLICATIONS

- Switching applications such as:
  - Motor control
  - Oscillators
  - Relay replacement
  - Timers
  - Pulse shapers, etc.

DESCRIPTION

Silicon planar PNPN switch or trigger device in a TO-72 metal package.
It is an integrated PNP/NPN transistor pair with all electrodes accessible.

PINNING

PIN	DESCRIPTION
1	cathode
2	cathode gate
3	anode gate (connected to case)
4	anode

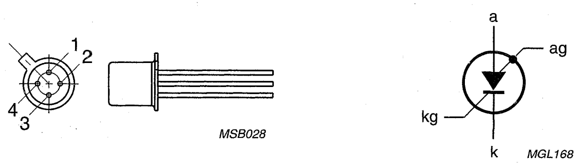


Fig.1 Simplified outline (TO-72) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
Silicon controlled switch				
PNP TRANSISTOR				
V_{EBO}	emitter-base voltage	open collector	−70	V
NPN TRANSISTOR				
V_{CBO}	collector-base voltage	open emitter	70	V
I_{ERM}	repetitive peak emitter current		−2.5	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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_{off}	turn-off time		15	µs
Programmable unijunction transistor				
V_{GA}	gate-anode voltage		70	V
I_A	anode current (DC)	$T_{amb} \leq 25$ °C	175	mA
T_j	junction temperature		150	°C
I_p	peak point current	$V_S = 10$ V; $R_G = 10$ kΩ	0.2	µA

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	275	mW
T_{stg}	storage temperature		–65	+200	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C
Silicon controlled switch					
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	collector current (DC)	note 1			
	PNP		–	–	
	NPN		–	175	mA
I_{CM}	peak collector current	note 2			
	PNP		–	–	
	NPN		–	175	mA
I_E	emitter current (DC)				
	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
Programmable unijunction transistor					
V_{GA}	gate-anode voltage		–	70	V
I_A	anode current (AV)	$T_{amb} \leq 25$ °C	–	175	mA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{ARM}	repetitive peak anode current	$t_p = 10\ \mu s$; $\delta = 0.01$	–	2.5	A
I_{ASM}	non-repetitive peak anode current	$t_p = 10\ \mu s$; $T_j = 150\ °C$	–	3	A
dI_A/dt	rate of rise of anode current	$I_A \leq 2.5$ A	–	20	A/µs

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 CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air	450	K/W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Silicon controlled switch					
INDIVIDUAL PNP TRANSISTOR					
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -70$ V; $T_j = 150\ °C$	–	−10	µA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -70$ V; $T_j = 150\ °C$	–	−10	µA
h_{FE}	DC current gain	$I_E = 1$ mA; $V_{CE} = -5$ V	3	15	
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	$I_C = 0$; $V_{EB} = 5$ V; $T_j = 150\ °C$	–	10	µA
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	–	0.5	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	–	0.9	V
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 2$ V	50	–	
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; f = 1 MHz	–	25	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 2$ V; f = 100 MHz	100	–	MHz
COMBINED DEVICE					
V_{AK}	forward on-state voltage	$R_{KG\text{-}K} = 10$ kΩ			
		$I_A = 50$ mA; $I_{AG} = 0$	–	1.4	V
		$I_A = 50$ mA; $I_{AG} = 0$; $T_j = -55\ °C$	–	1.9	V
		$I_A = 1$ mA; $I_{AG} = 10$ mA	–	1.2	V
I_H	holding current	$V_{BB} = -2$ V; $I_{AG} = 10$ mA; $R_{KG\text{-}K} = 10$ kΩ; see Fig.14	–	1	mA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
SWITCHING TIMES					
t_{on}	turn-on time	$V_{KG\text{-}K}$ = −0.5 to 4.5 V; $R_{KG\text{-}K}$ = 1 kΩ; see Figs 15 and 16	–	0.25	μs
		$V_{KG\text{-}K}$ = −0.5 to 0.5 V; $R_{KG\text{-}K}$ = 10 kΩ	–	1.5	μs
t_{off}	turn-off time	$R_{KG\text{-}K}$ = 10 kΩ; see Figs 17 and 18	–	15	μs
Programmable unijunction transistor					
I_p	peak point current	V_S = 10 V; R_G = 10 kΩ; see Figs 3 and 8	–	0.2	μA
		V_S = 10 V; R_G = 100 kΩ; see Figs 3 and 8	–	0.06	μA
I_v	valley point current	V_S = 10 V; R_G = 10 kΩ; see Figs 3 and 8	–	2	μA
		V_S = 10 V; R_G = 100 kΩ; see Figs 3 and 8	–	1	μA
V_{offset}	offset voltage	typical curve; I_A = 0; for V_P and V_S see Fig.8	–	–	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	V_{AA} = 20 V; C = 10 nF; see Figs 9 and 11	6	–	V
t_r	rise time	V_{AA} = 20 V; C = 10 nF; see Fig.11	–	80	ns

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).

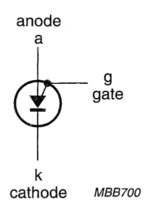


Fig.2 Programmable unijunction transistor explanation of symbols.

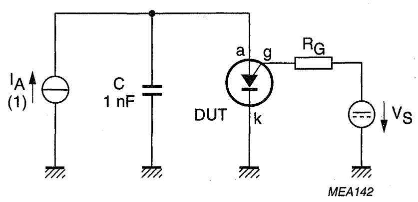


Fig.3 Programmable unijunction transistor test circuit for peak and valley points.

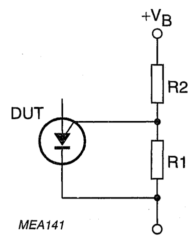


Fig.4 Programmable unijunction transistor with 'program' resistors R1 and R2.

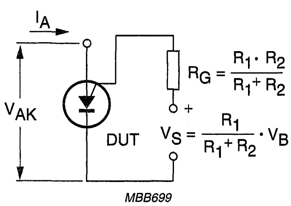


Fig.5 Programmable unijunction transistor equivalent test circuit for characteristics testing.

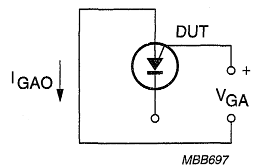


Fig.6 Programmable unijunction transistor equivalent test circuit for gate-anode leakage current.

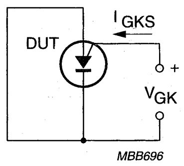


Fig.7 Programmable unijunction transistor equivalent test circuit for gate-cathode leakage current.

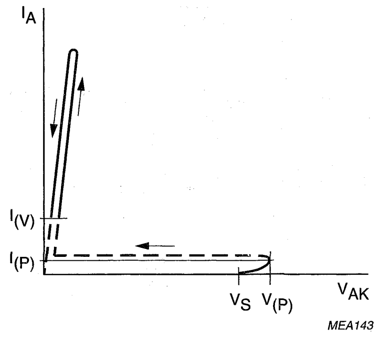


Fig.8 Programmable unijunction transistor offset voltage.

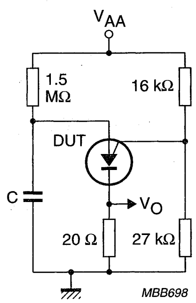


Fig.9 Programmable unijunction transistor test circuit for peak output voltage.

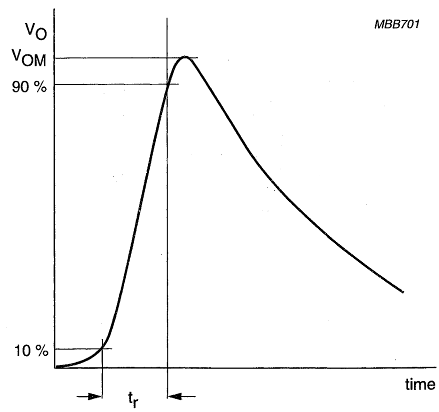


Fig.10 Programmable unijunction transistor peak output voltage.

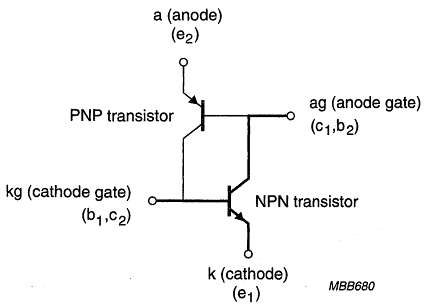


Fig.11 Silicon controlled switch two transistor equivalent circuit.

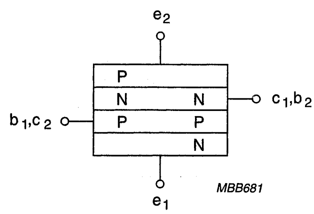


Fig.12 PNPN silicon controlled switch structure.

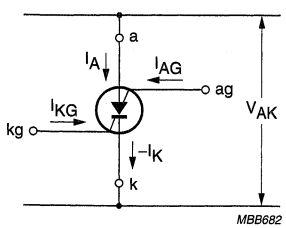


Fig.13 Silicon controlled switch symbol.

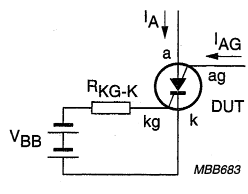


Fig.14 Silicon controlled switch equivalent test circuit for holding current.

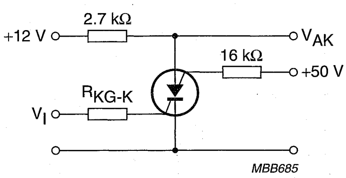


Fig.15 Silicon controlled switch test circuit for turn-on time.

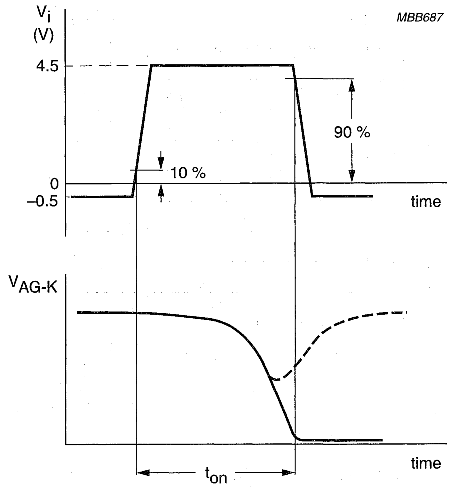


Fig.16 Silicon controlled switch pulse duration increased until dashed curve disappears.

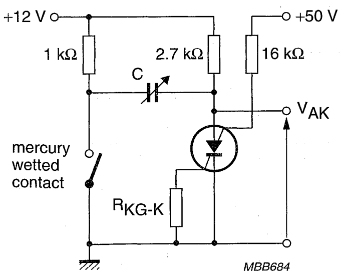


Fig.17 Silicon controlled switch test circuit for turn-on time.

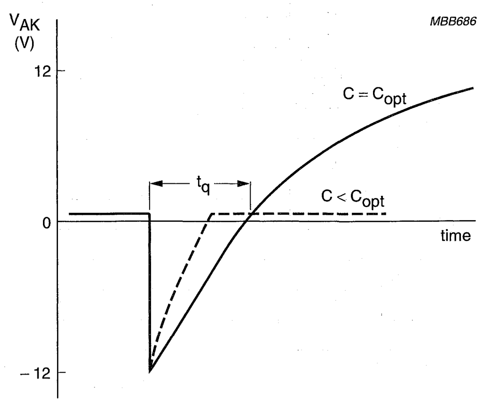
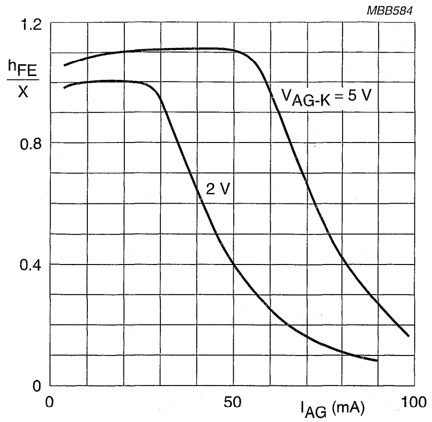
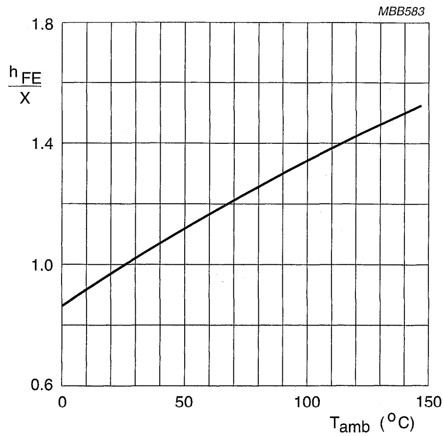


Fig.18 Silicon controlled switch capacitance increased until $C = C_{opt}$ dashed curve disappears.



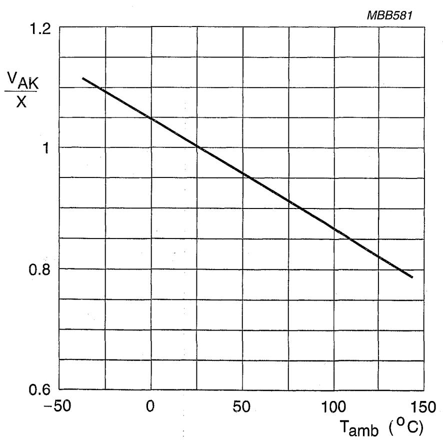
X = value of h_{FE} at I_C = 10 mA; V_{AG-K} = 2 V; T_{amb} = 25 °C.

Fig.19 Silicon controlled switch normalized DC current gain as a function of anode gate current.



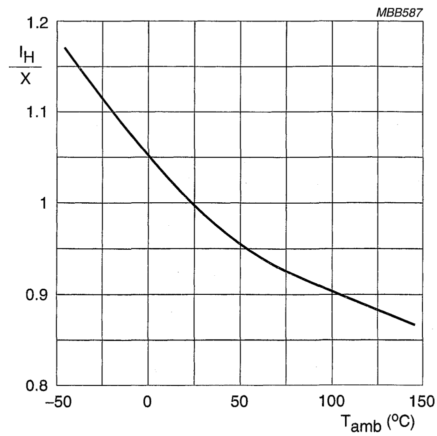
X = value of h_{FE} at I_{AG} = 10 mA; V_{AG-K} = 2 V; T_{amb} = 25 °C.

Fig.20 Silicon controlled switch normalized DC current gain as a function of ambient temperature.



X = value of V_{AK} at I_A = 1 mA; I_{AG} = 10 mA; V_{BB} = −2 V; R_{KG-K} = 10 kΩ; T_{amb} = 25 °C.

Fig.21 Silicon controlled switch normalized anode-cathode voltage as a function of ambient temperature.



X = value of I_H at I_{AG} = 10 mA; V_{BB} = −2 V; R_{KG-K} = 10 kΩ; T_{amb} = 25 °C.

Fig.22 Silicon controlled switch normalized holding current as a function of ambient temperature.

Programmable unijunction transistor/ Silicon controlled switch

BRY39

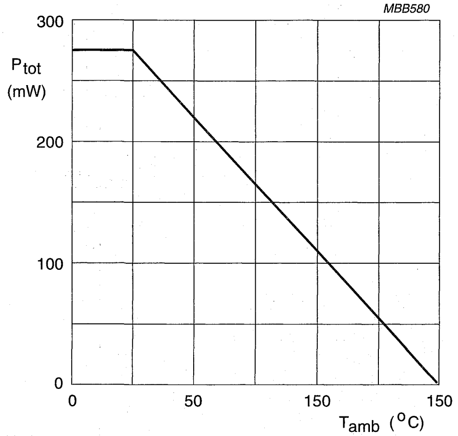


Fig.23 Silicon controlled switch power derating curve.

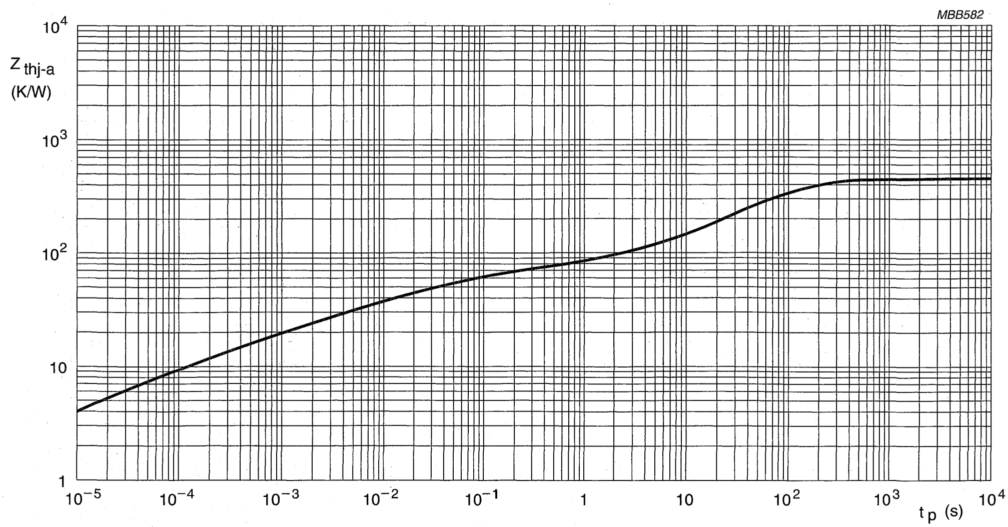
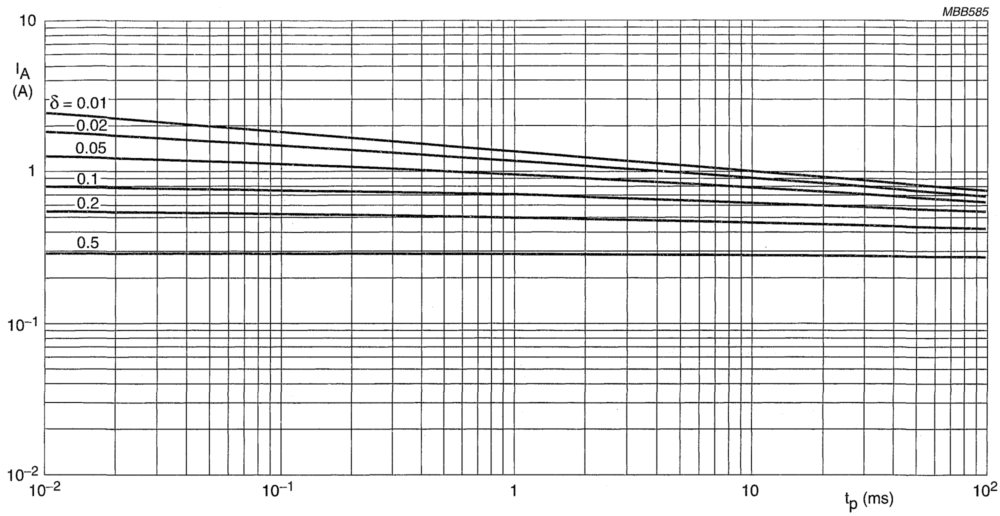
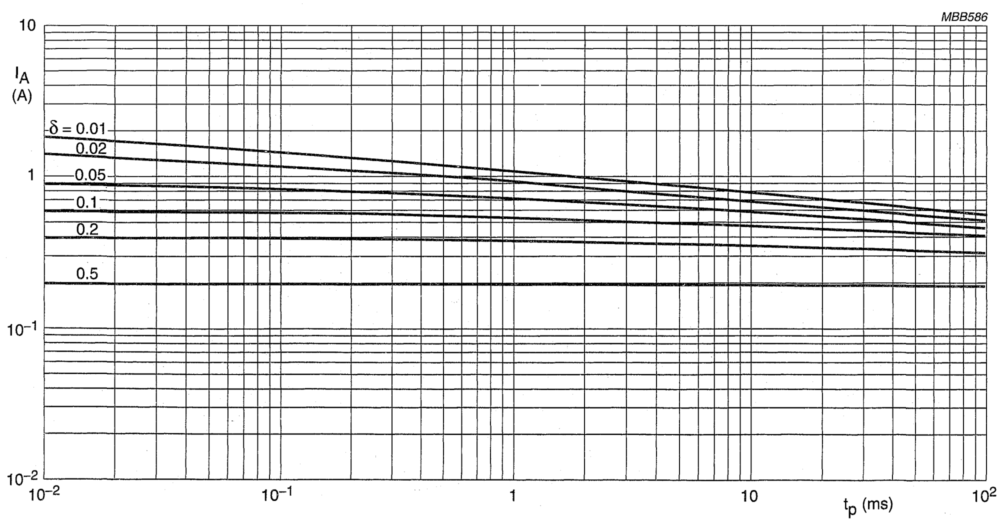


Fig.24 Silicon controlled switch thermal impedance as a function of pulse duration.



T_{amb} = 25 °C.

Fig.25 Silicon controlled switch anode current as a function of pulse duration.



T_{amb} = 70 °C.

Fig.26 Silicon controlled switch anode current as a function of pulse duration.

Programmable unijunction transistor — BRY56

DESCRIPTION

Planar PNPN trigger device in a TO-92; SOT54 plastic package.

APPLICATIONS

- Switching applications such as:
  - Motor control
  - Oscillators
  - Relay replacement
  - Timers
  - Pulse shapers, etc.

PINNING

PIN	DESCRIPTION
1	gate
2	anode
3	cathode

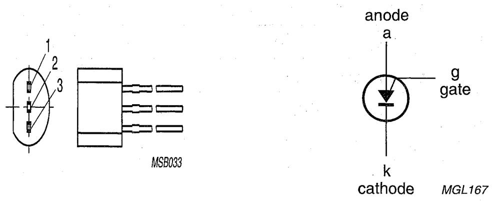


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{GA}	gate-anode voltage		–	70	V
$I_{A(AV)}$	average anode current		–	175	mA
P_{tot}	total power dissipation	$T_{amb} \leq 75$ °C	–	300	mW
T_j	operating junction temperature		–	150	°C
I_P	peak point current	$V_S = 10$ V; $R_G = 10$ kΩ	–	0.2	μA
I_V	valley point current	$V_S = 10$ V; $R_G = 10$ kΩ	2	–	μA

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{GA}	gate-anode voltage		–	70	V
$I_{A(AV)}$	average anode current		–	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	–	3	A
dI_A/dt	rate of rise of anode current	$I_A \leq 2.5$ A	–	20	A/μs
P_{tot}	total power dissipation	$T_{amb} \leq 75$ °C	–	300	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

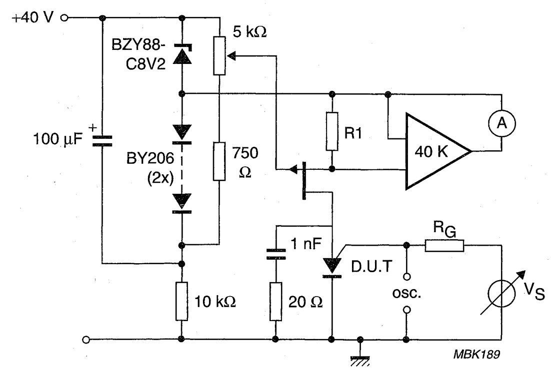
THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air	250	K/W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_P	peak point current	V_S = 10 V; R_G = 10 kΩ; see Fig.7	–	–	200	nA
		V_S = 10 V; R_G = 100 kΩ; see Fig.7	–	–	60	nA
I_V	valley point current	V_S = 10 V; R_G = 10 kΩ; see Fig.7	2	–	–	μA
		V_S = 10 V; R_G = 100 kΩ; see Fig.7	1	–	–	μA
V_{offset}	offset voltage	typical curve; I_A = 0; see Fig.7	–	V_P–V_S	–	V
I_{GAO}	gate-anode leakage current	I_K = 0; V_{GA} = 70 V; see Fig.5	–	–	10	nA
I_{GKS}	gate-cathode leakage current	V_{AK} = 0; V_{KG} = 70 V; see Fig.6	–	–	100	nA
V_{AK}	anode-cathode voltage	I_A = 100 mA	–	–	1.4	V
V_{OM}	peak output voltage	V_{AA} = 20 V; C = 10 nF; see Figs 8 and 9	6	–	–	V
t_r	rise time	V_{AA} = 20 V; C = 10 nF; see Fig.9	–	–	80	ns



I_P and I_V determined by value of R1.

$R1 = \frac{1}{I_A}$; i.e. maximum voltage drop over R1 = 1 V.

Internal resistance of oscilloscope = 10 MΩ.

Fig.2 Measuring circuit for peak and valley point currents.

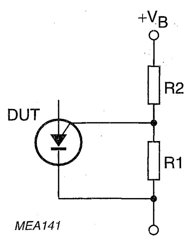


Fig.3 BRY56 with ‘program’ resistors R1 and R2.

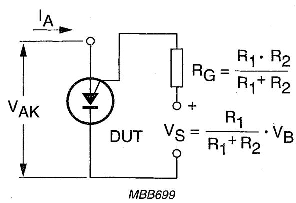


Fig.4 Equivalent test circuit for characteristics testing.

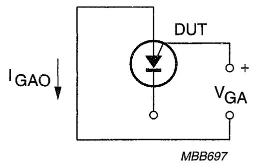


Fig.5 Equivalent test circuit for gate-anode leakage current.

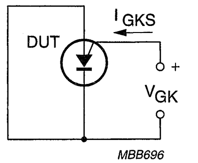


Fig.6 Equivalent test circuit for gate-cathode leakage current.

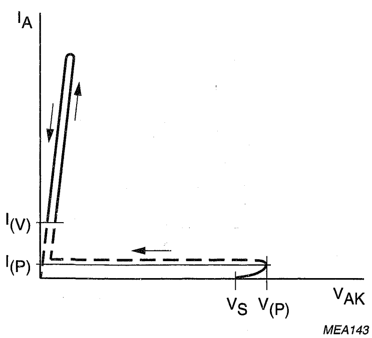


Fig.7 Offset voltage.

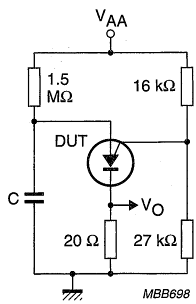


Fig.8 Test circuit for peak output voltage.

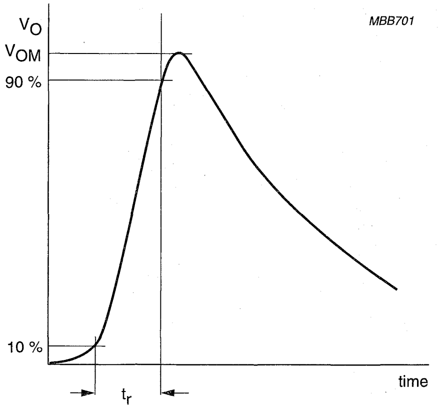


Fig.9 Peak output voltage.

Programmable unijunction transistor BRY61

DESCRIPTION

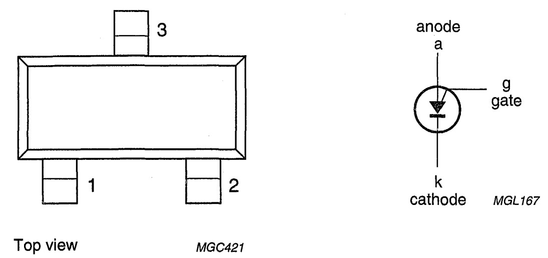
Planar PNPN trigger device in a SOT23 plastic package.

APPLICATIONS

- Switching applications such as:
  - Motor control
  - Oscillators
  - Relay replacement
  - Timers
  - Pulse shapers, etc.

PINNING

PIN	DESCRIPTION
1	anode
2	cathode
3	gate



Marking code: A5p.

Fig.1 Simplified outline SOT23 and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{GA}	gate-anode voltage		–	70	V
$I_{A(AV)}$	average anode current		–	175	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
T_j	operating junction temperature		–	150	°C
I_P	peak point current	$V_S = 10$ V; $R_G = 10$ kΩ	–	0.2	μA
I_V	valley point current	$V_S = 10$ V; $R_G = 10$ kΩ	2	–	μA

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{GA}	gate-anode voltage		–	70	V
$I_{A(AV)}$	average anode current		–	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	–	3	A
dI_A/dt	rate of rise of anode current	$1_A \leq 2.5$ A	–	20	A/µs
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

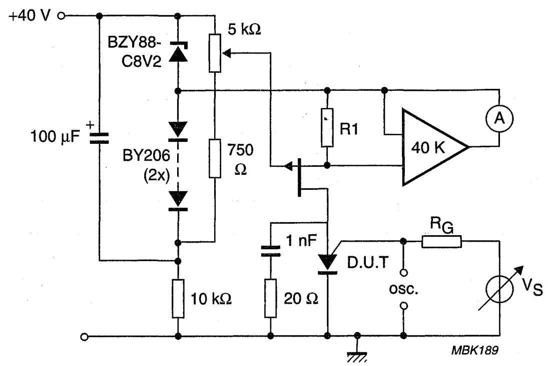
THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air	500	K/W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_P	peak point current	V_S = 10 V; R_G = 10 kΩ; see Fig.7	–	–	0.2	µA
		V_S = 10 V; R_G = 100 kΩ; see Fig.7	–	–	0.06	µA
I_V	valley point current	V_S = 10 V; R_G = 10 kΩ; see Fig.7	2	–	–	µA
		V_S = 10 V; R_G = 100 kΩ; see Fig.7	1	–	–	µA
V_{offset}	offset voltage	typical curve; I_A = 0; see Fig.7	–	V_P–V_S	–	V
I_{GAO}	gate-anode leakage current	I_K = 0; V_{GA} = 70 V; see Fig.5	–	–	10	nA
I_{GKS}	gate-cathode leakage current	V_{AK} = 0; V_{KG} = 70 V; see Fig.6	–	–	100	nA
V_{AK}	anode-cathode voltage	I_A = 100 mA	–	–	1.4	V
V_{OM}	peak output voltage	V_{AA} = 20 V; C = 10 nF; see Figs 8 and 9	6	–	–	V
t_r	rise time	V_{AA} = 20 V; C = 10 nF; see Fig.9	–	–	80	ns



I_P and I_V determined by value of R1.

$R1 = \frac{1}{I_A}$; i.e. maximum voltage drop over R1 = 1 V.

Internal resistance of oscilloscope = 10 MΩ.

Fig.2 Measuring circuit for peak and valley point currents.

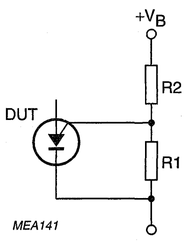


Fig.3 BRY61 with ‘program’ resistors R1 and R2.

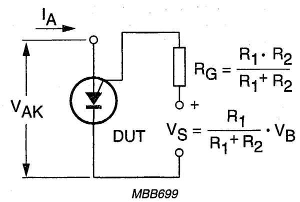


Fig.4 Equivalent test circuit for characteristics testing.

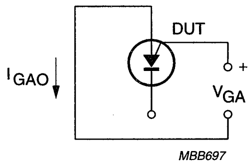


Fig.5 Equivalent test circuit for gate-anode leakage current.

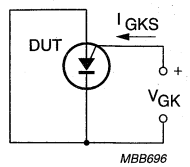


Fig.6 Equivalent test circuit for gate-cathode leakage current.

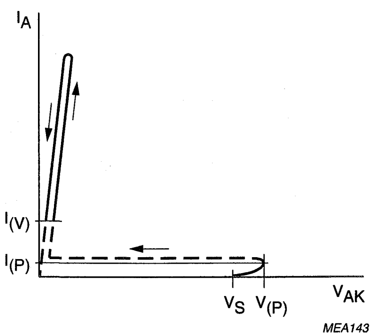


Fig.7 Offset voltage.

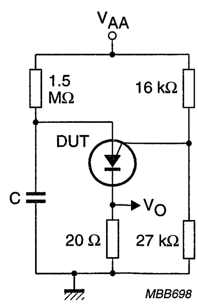


Fig.8 Test circuit for peak output voltage.

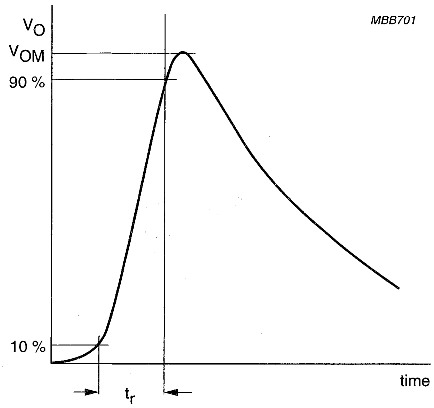


Fig.9 Peak output voltage.

DESCRIPTION

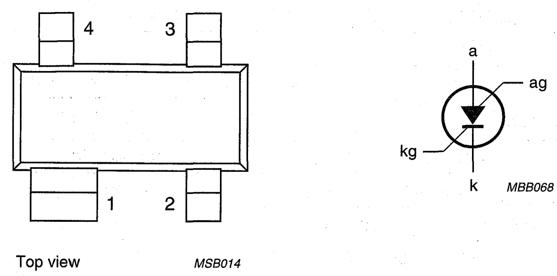
Silicon planar PNPN switch in a SOT143B plastic package. It is an integrated PNP/NPN transistor pair, with all electrodes accessible.

APPLICATIONS

- Switching applications.

PINNING

PIN	DESCRIPTION
1	anode gate
2	anode
3	cathode
4	cathode gate



Marking code: A51.

Fig.1 Simplified outline (SOT143B) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
PNP transistor				
V_{EBO}	emitter-base voltage	open collector	−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	$T_{amb} \leq 25$ °C	250	mW
T_j	junction temperature		150	°C
V_{AK}	forward on-state voltage	$I_A = 50$ mA; $I_{AG} = 0$; $R_{KG\text{-}K} = 10$ kΩ	1.4	V
I_H	holding current	$I_{AG} = 10$ mA; $V_{BB} = -2$ V; $R_{KG\text{-}K} = 10$ kΩ	1	mA
t_{on}	turn-on time		0.25	μs
t_{off}	turn-off time		15	μs

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
NPN transistor					
V_{CBO}	collector-base voltage	open emitter	–	70	V
V_{CER}	collector-emitter voltage	R_{BE} = 10 kΩ	–	70	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)	note 1	–	175	mA
I_{CM}	peak collector current	note 2	–	175	mA
I_E	emitter current (DC)		–	–175	mA
I_{ERM}	repetitive peak emitter current	t_p = 10 μs; δ = 0.01	–	–2.5	A
PNP transistor					
V_{CBO}	collector-base voltage	open emitter	–	–70	V
V_{CEO}	collector-emitter voltage	open base	–	–70	V
V_{EBO}	emitter-base voltage	open collector	–	–70	V
I_E	emitter current (DC)		–	175	mA
I_{ERM}	repetitive peak emitter current	t_p = 10 μs; δ = 0.01	–	2.5	A
Combined device					
P_{tot}	total power dissipation	T_{amb} ≤ 25 °C	–	250	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature	see Fig.14	–65	+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 CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air	500	K/W

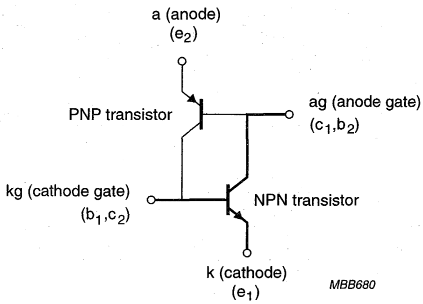


Fig.2 Two transistor equivalent circuit.

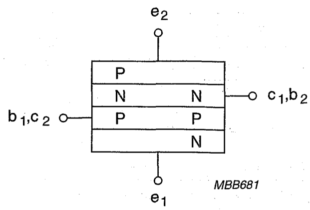


Fig.3 PNPN silicon controlled switch structure.

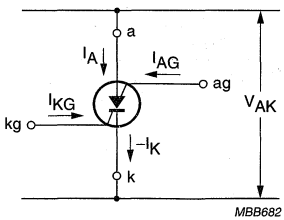


Fig.4 Silicon controlled switch symbol.

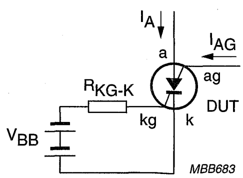


Fig.5 Equivalent test circuit for holding current.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
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	I_C = 0; V_{EB} = 5 V; T_j = 150 °C	–	10	μA
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA; I_B = 1 mA	–	500	mV
V_{BEsat}	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; f = 1 MHz	–	5	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = 1 V; f = 1 MHz	–	25	pF
PNP transistor					
I_{CEO}	collector cut-off current	I_B = 0; V_{CE} = –70 V; T_j = 150 °C	–	–10	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = –70 V; 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
		I_A = 50 mA; I_{AG} = 0; T_j = – 55 °C	–	1.9	V
		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_{off}	turn-off time	R_{KG-K} = 10 kΩ; see Figs 8 and 9	–	15	μs

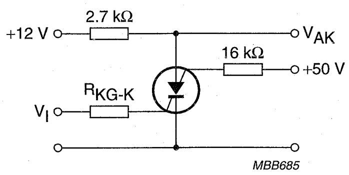


Fig.6 Test circuit for turn-on time.

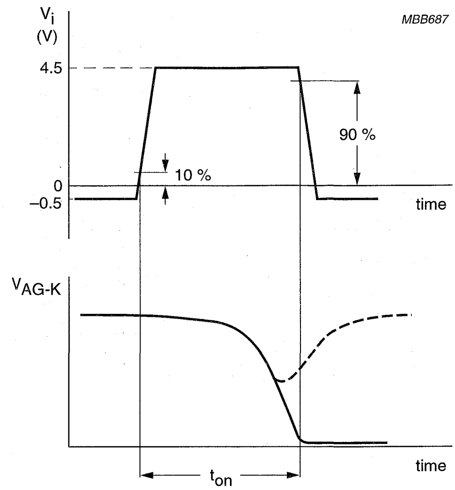


Fig.7 Pulse duration increased until dashed curve disappears.

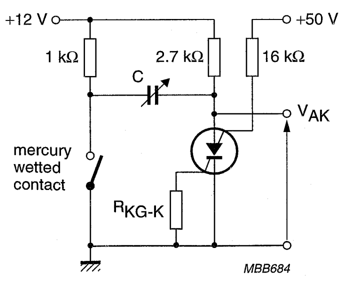


Fig.8 Test circuit for turn-off time.

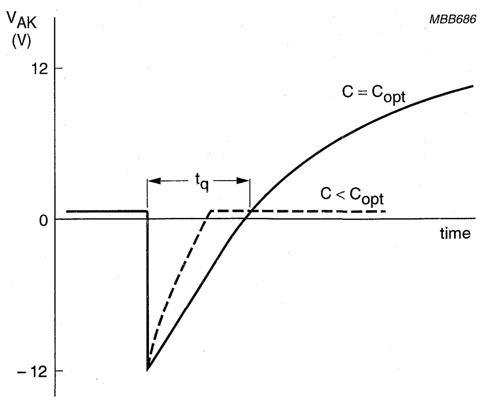
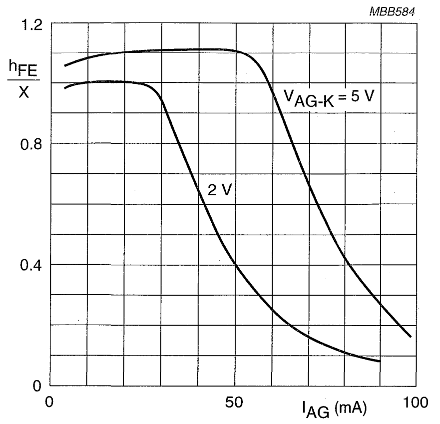
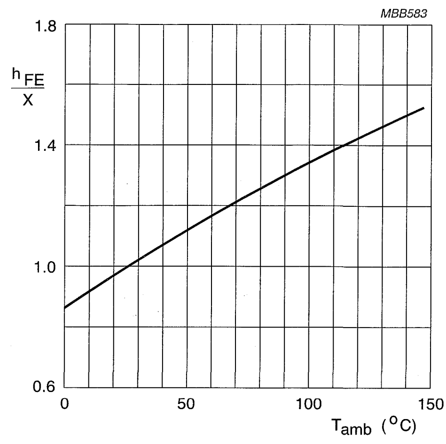


Fig.9 Capacitance increased until $C = C_{opt}$ dashed curve disappears.



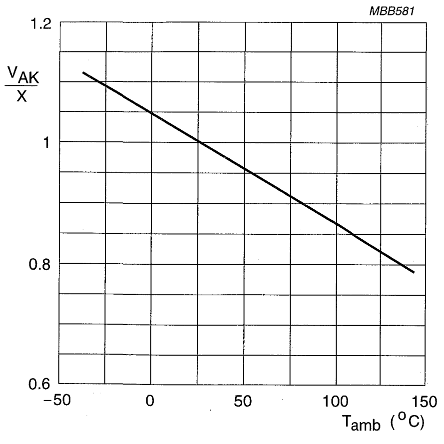
X is the value of h_{FE} at I_C = 10 mA; $V_{AG\text{-}K}$ = 2 V; T_{amb} = 25 °C.

Fig.10 Normalized DC current gain as a function of anode gate current.



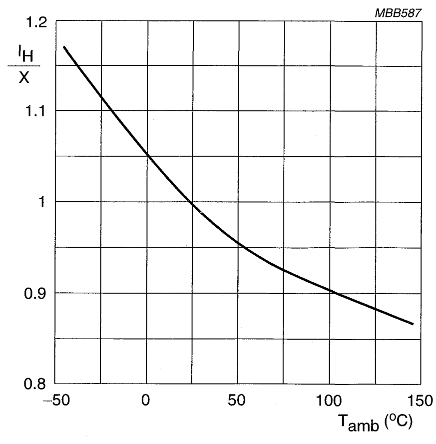
X is the value of h_{FE} at I_{AG} = 10 mA; $V_{AG\text{-}K}$ = 2 V; T_{amb} = 25 °C.

Fig.11 Normalized DC current gain as a function of ambient temperature.



X is the value of V_{AK} at I_C = 10 mA; I_{AG} = 10 mA; I_A = 1 mA; V_{BB} = −2 V; $R_{KG\text{-}K}$ = 10 kΩ; T_{amb} = 25 °C.

Fig.12 Normalized anode-cathode voltage as a function of ambient temperature.



X is the value of I_H at I_C = 10 mA; I_{AG} = 10 mA; V_{BB} = −2 V; $R_{kg\text{-}K}$ = 10 kΩ; T_{amb} = 25 °C.

Fig.13 Normalized holding current as a function of ambient temperature.

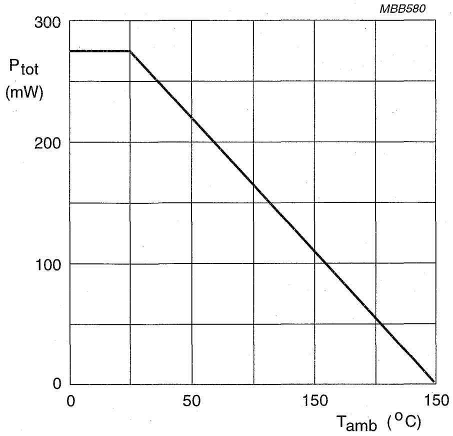


Fig.14 Power derating curve.

PNP high-voltage transistors BSP15; BSP16

FEATURES

- High voltage (max. 350 V).

APPLICATIONS

- Switching and amplification
- Especially used in telephony and automotive applications.

DESCRIPTION

PNP high-voltage transistor in a SOT223 plastic package. NPN complements: BSP19 and BSP20.

PINNING

PIN	DESCRIPTION
1	base
2, 4	collector
3	emitter

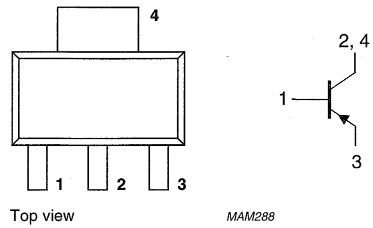


Fig.1 Simplified outline (SOT223) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BSP15		–	–200	V
	BSP16		–	–350	V
V_{CEO}	collector-emitter voltage	open base			
	BSP15		–	–200	V
	BSP16		–	–300	V
I_C	collector current (DC)		–	–50	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.28	W
h_{FE}	DC current gain	$V_{CE} = -10$ V; $I_C = -50$ mA			
	BSP15		30	150	
	BSP16		30	120	
f_T	transition frequency	$V_{CE} = -10$ V; $I_C = -10$ mA; f = 100 MHz	15	–	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			
	BSP15		–	–200	V
	BSP16		–	–350	V
V_{CEO}	collector-emitter voltage	open base			
	BSP15		–	–200	V
	BSP16		–	–300	V
V_{EBO}	emitter-base voltage	open collector			
	BSP15		–	–4	V
	BSP16		–	–6	V
I_C	collector current (DC)		–	–50	mA
I_B	base current (DC)		–	–500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.28	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	97	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		16	K/W

Note

1. Device mounted on printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	BSP15	$I_E = 0$; $V_{CB} = -175$ V	–	−100	nA
	BSP16	$I_E = 0$; $V_{CB} = -280$ V	–	−100	nA
I_{EBO}	emitter cut-off current				
	BSP15	$I_C = 0$; $V_{EB} = -4$ V	–	−100	nA
	BSP16	$I_C = 0$; $V_{EB} = -6$ V	–	−100	nA
h_{FE}	DC current gain	$I_C = -50$ mA; $V_{CE} = -10$ V			
	BSP15		30	150	
	BSP16		30	120	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -50$ mA; $I_B = -5$ mA			
	BSP15		–	−2.5	V
	BSP16		–	−2	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	15	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 100 MHz	15	–	MHz

FEATURES

- Low current (max. 50 mA)
- High voltage (max. 350 V).

APPLICATIONS

- Switching and amplification
- Especially used in telephony and automotive applications.

DESCRIPTION

NPN transistor in a SOT223 plastic package.
PNP complements: BSP15 and BSP16.

PINNING

PIN	DESCRIPTION
1	base
2, 4	collector
3	emitter

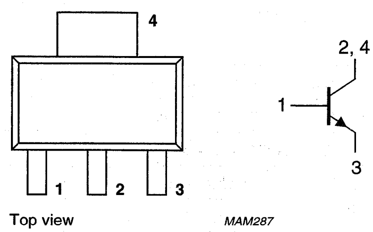


Fig.1 Simplified outline (SOT223) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BSP19		–	400	V
	BSP20		–	300	V
V_{CEO}	collector-emitter voltage	open base			
	BSP19		–	350	V
	BSP20		–	250	V
I_C	collector current (DC)		–	50	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.2	W
h_{FE}	DC current gain	$V_{CE} = 10$ V; $I_C = 20$ mA	40	–	
f_T	transition frequency	$V_{CE} = 10$ V; $I_C = 10$ mA; f = 100 MHz	70	–	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			
	BSP19		–	400	V
	BSP20		–	300	V
V_{CEO}	collector-emitter voltage	open base			
	BSP19		–	350	V
	BSP20		–	250	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	50	mA
I_B	base current (DC)		–	50	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.2	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2.
For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04".*

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	104	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		23	K/W

Note

1. Device mounted on printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2.
For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04".*

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_B = 0$; $V_{CE} = 300$ V	–	20	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	100	nA
h_{FE}	DC current gain	$V_{CE} = 10$ V; $I_C = 20$ mA	40	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 50$ mA; $I_B = 4$ mA	–	0.5	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	2.5	pF
f_T	transition frequency	$V_{CE} = 10$ V; $I_C = 10$ mA; f = 100 MHz	70	–	MHz

PNP medium power transistors BSP30; BSP31; BSP32; BSP33

FEATURES

- High current (max. 1 A)
- Low voltage (max. 80 V).

APPLICATIONS

- Telephony and general industrial applications.

DESCRIPTION

PNP medium power transistor in a SOT223 plastic package. NPN complements: BSP40, BSP41, BSP42 and BSP43.

PINNING

PIN	DESCRIPTION
1	base
2, 4	collector
3	emitter

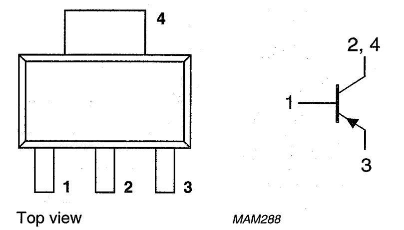


Fig.1 Simplified outline (SOT223) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BSP30; BSP31		–	–70	V
	BSP32; BSP33		–	–90	V
V_{CEO}	collector-emitter voltage	open base			
	BSP30; BSP31		–	–60	V
	BSP32; BSP33		–	–80	V
I_{CM}	peak collector current		–	–2	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.3	W
h_{FE}	DC current gain	$I_C = -100$ mA; $V_{CE} = -5$ V			
	BSP30; BSP32		40	120	
	BSP31; BSP33		100	300	
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -10$ V; f = 100 MHz	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			
	BSP30; BSP31		–	−70	V
	BSP32; BSP33		–	−90	V
V_{CEO}	collector-emitter voltage	open base			
	BSP30; BSP31		–	−60	V
	BSP32; BSP33		–	−80	V
V_{EBO}	emitter-base voltage	open collector	–	−5	V
I_C	collector current (DC)		–	−1	A
I_{CM}	peak collector current		–	−2	A
I_{BM}	peak base current		–	−200	mA
P_{tot}	total power dissipation	T_{amb} = 25 °C; note 1	–	1.3	W
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		−65	+150	°C

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	93	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		12	K/W

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -60$ V	–	−100	nA
		$I_E = 0$; $V_{CB} = -60$ V; $T_j = 150$ °C	–	−50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	−100	nA
h_{FE}	DC current gain	$I_C = -100$ μA; $V_{CE} = -5$ V; note 1			
	BSP30; BSP32		10	–	
	BSP31; BSP33		30	–	
h_{FE}	DC current gain	$I_C = -100$ mA; $V_{CE} = -5$ V; note 1			
	BSP30; BSP32		40	120	
	BSP31; BSP33		100	300	
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -5$ V; note 1			
	BSP30; BSP32		30	–	
	BSP31; BSP33		50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA; note 1	–	−250	mV
		$I_C = -500$ mA; $I_B = -50$ mA; note 1	–	−500	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA; note 1	–	−1	V
		$I_C = -500$ mA; $I_B = -50$ mA; note 1	–	−1.2	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	20	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -0.5$ V; f = 1 MHz	–	120	pF
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -10$ V; f = 100 MHz	100	–	MHz
Switching times (between 10% and 90% levels)					
t_{on}	turn-on time	$I_{Con} = -100$ mA; $I_{Bon} = -5$ mA; $I_{Boff} = 5$ mA	–	500	ns
t_{off}	turn-off time		–	650	ns

Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.01$.

NPN medium power transistors — BSP40; BSP41; BSP42; BSP43

FEATURES

- High current (max. 1 A)
- Low voltage (max. 80 V).

APPLICATIONS

- Telephony and general industrial applications
- Thick and thin-film circuits.

DESCRIPTION

NPN medium power transistor in a SOT223 plastic package.
PNP complements: BSP30, BSP31, BSP32 and BSP33.

PINNING

PIN	DESCRIPTION
1	base
2,4	collector
3	emitter

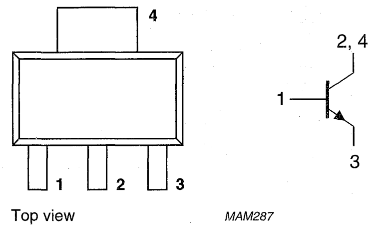


Fig.1 Simplified outline (SOT223) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BSP40; BSP41		–	70	V
	BSP42; BSP43		–	90	V
V_{CEO}	collector-emitter voltage	open base			
	BSP40; BSP41		–	60	V
	BSP42; BSP43		–	80	V
I_{CM}	peak collector current		–	2	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.3	W
h_{FE}	DC current gain	$I_C = 100$ mA; $V_{CE} = 5$ V			
	BSP40; BSP42		40	120	
	BSP41; BSP43		100	300	
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 10$ V; f = 100 MHz	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			
	BSP40; BSP41		–	70	V
	BSP42; BSP43		–	90	V
V_{CEO}	collector-emitter voltage	open base			
	BSP40; BSP41		–	60	V
	BSP42; BSP43		–	80	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	1	A
I_{CM}	peak collector current		–	2	A
I_{BM}	peak base current		–	0.2	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.3	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for the SOT223 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	93	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		12	K/W

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for the SOT223 in the General part of handbook SC04"*.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 60$ V	–	100	nA
		$I_E = 0$; $V_{CB} = 60$ V; $T_j = 150$ °C	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	100	nA
h_{FE}	DC current gain	$I_C = 100$ μA; $V_{CE} = 5$ V; note 1			
	BSP40; BSP42		10	–	
	BSP41; BSP43		30	–	
h_{FE}	DC current gain; note 1	$I_C = 100$ mA; $V_{CE} = 5$ V; note 1			
	BSP40; BSP42		40	120	
	BSP41; BSP43		100	300	
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 5$ V; note 1			
	BSP40; BSP42		30	–	
	BSP41; BSP43		50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA; note 1	–	0.25	V
		$I_C = 500$ mA; $I_B = 50$ mA; note 1	–	0.5	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA; note 1	–	1	V
		$I_C = 500$ mA; $I_B = 50$ mA; note 1	–	1.2	V
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 10$ V; f = 100 MHz	100	–	MHz

Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.01$.

FEATURES

- High current (max. 1 A)
- Low voltage (max. 80 V)
- Integrated diode and resistor.

APPLICATIONS

- Industrial high gain amplification.

DESCRIPTION

NPN Darlington transistor in a SOT223 plastic package.
PNP complements: BSP60, BSP61 and BSP62.

PINNING

PIN	DESCRIPTION
1	base
2,4	collector
3	emitter

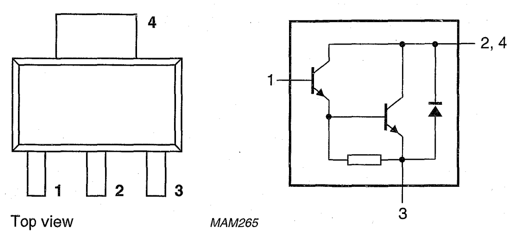


Fig.1 Simplified outline (SOT223) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BSP50		–	–	60	V
	BSP51		–	–	80	V
	BSP52		–	–	90	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$				
	BSP50		–	–	45	V
	BSP51		–	–	60	V
	BSP52		–	–	80	V
I_C	collector current (DC)		–	–	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	1.25	W
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 10$ V	2000	–	–	
f_T	transition frequency	$I_C = 500$ mA; $V_{CE} = 5$ V; f = 100 MHz	–	200	–	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			
	BSP50		–	60	V
	BSP51		–	80	V
	BSP52		–	90	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BSP50		–	45	V
	BSP51		–	60	V
	BSP52		–	80	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	1	A
I_{CM}	peak collector current		–	2	A
I_B	base current (DC)		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.25	W
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		−65	+150	°C

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for the SOT223 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	96	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to solder point		17	K/W

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for the SOT223 in the General part of handbook SC04"*.

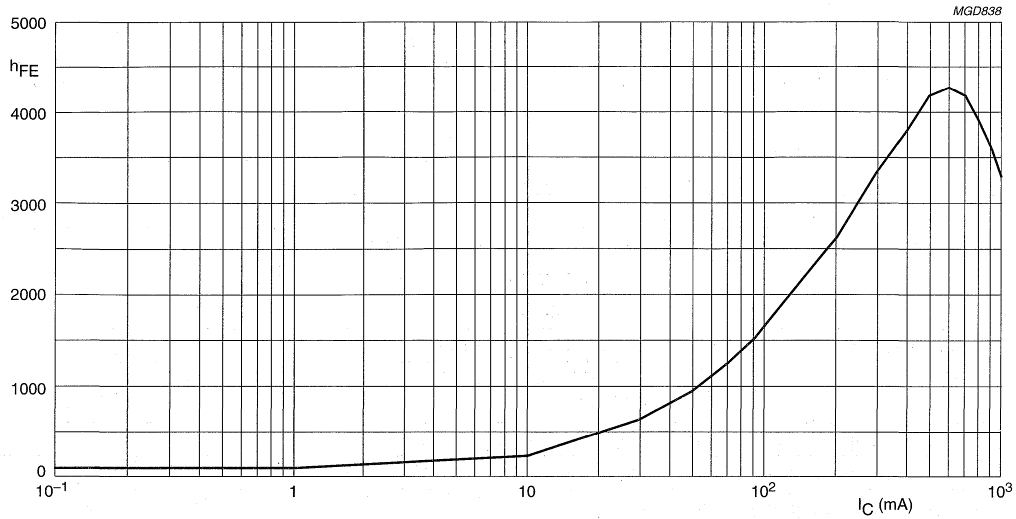
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	collector cut-off current					
	BSP50	V_{BE} = 0; V_{CE} = 45 V	–	–	50	nA
	BSP51	V_{BE} = 0; V_{CE} = 60 V	–	–	50	nA
	BSP52	V_{BE} = 0; V_{CE} = 80 V	–	–	50	nA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 4 V	–	–	50	nA
h_{FE}	DC current gain	V_{CE} = 10 V; note 1; see Fig.2				
		I_C = 150 mA	1000	–	–	
		I_C = 500 mA	2000	–	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = 500 mA; I_B = 0.5 mA	–	–	1.3	V
		I_C = 500 mA; I_B = 0.5 mA; T_j = 150 °C	–	–	1.3	V
V_{BEsat}	base-emitter saturation voltage	I_C = 500 mA; I_B = 0.5 mA	–	–	1.9	V
f_T	transition frequency	I_C = 500 mA; V_{CE} = 5 V; f = 100 MHz	–	200	–	MHz
Switching times (between 10% and 90% levels); see Fig.3						
t_{on}	turn-on time	I_{Con} = 500 mA; I_{Bon} = 0.5 mA; I_{Boff} = −0.5 mA	–	500	–	ns
t_{off}	turn-off time		–	1300	–	ns

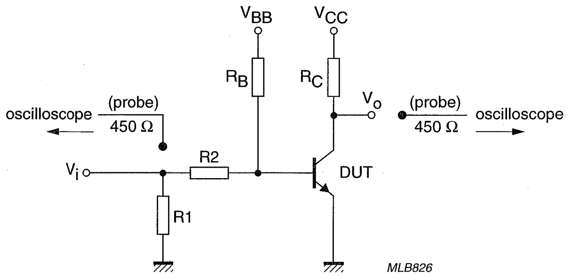
Note

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



V_{CE} = 10 V.

Fig.2 DC current gain; typical values.



V_i = 10 V; T = 200 µs; t_p = 6 µs; $t_r = t_f \leq$ 3 ns.
R1 = 56 Ω; R2 = 10 kΩ; R_B = 10 kΩ; R_C = 18 Ω.
V_{BB} = −1.8 V; V_{CC} = 10.7 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.3 Test circuit for switching times.

PNP Darlington transistors BSP60; BSP61; BSP62

FEATURES

- High current (max. 0.5 A)
- Low voltage (max. 80 V)
- Integrated diode and resistor.

APPLICATIONS

- Industrial switching applications such as:
  - print hammer
  - solenoid
  - relay and lamp drivers.

DESCRIPTION

PNP Darlington transistor in a SOT223 plastic package. NPN complements: BSP50, BSP51 and BSP52.

PINNING

PIN	DESCRIPTION
1	base
2,4	collector
3	emitter

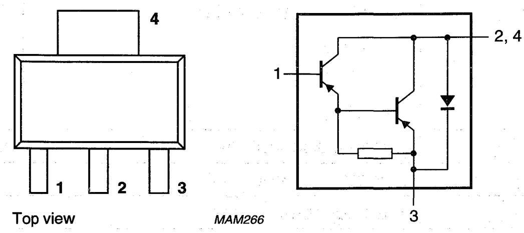


Fig.1 Simplified outline (SOT223) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BSP60		–	–	–60	V
	BSP61		–	–	–80	V
	BSP62		–	–	–90	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$				
	BSP60		–	–	–45	V
	BSP61		–	–	–60	V
	BSP62		–	–	–80	V
I_C	collector current (DC)		–	–	–0.5	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	1.25	W
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -10$ V	2000	–	–	
f_T	transition frequency	$I_C = -500$ mA; $V_{CE} = -5$ V; f = 100 MHz	–	200	–	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			
	BSP60		–	–60	V
	BSP61		–	–80	V
	BSP62		–	–90	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BSP60		–	–45	V
	BSP61		–	–60	V
	BSP62		–	–80	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–0.5	A
I_{CM}	peak collector current		–	–1.5	A
I_B	base current (DC)		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.25	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Notes

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2.
   For other mounting conditions, see *"Thermal considerations for the SOT223 in the General part of handbook SC04"*

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	98	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to solder point		17	K/W

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2.
   For other mounting conditions, see *"Thermal considerations for the SOT223 in the General part of handbook SC04"*

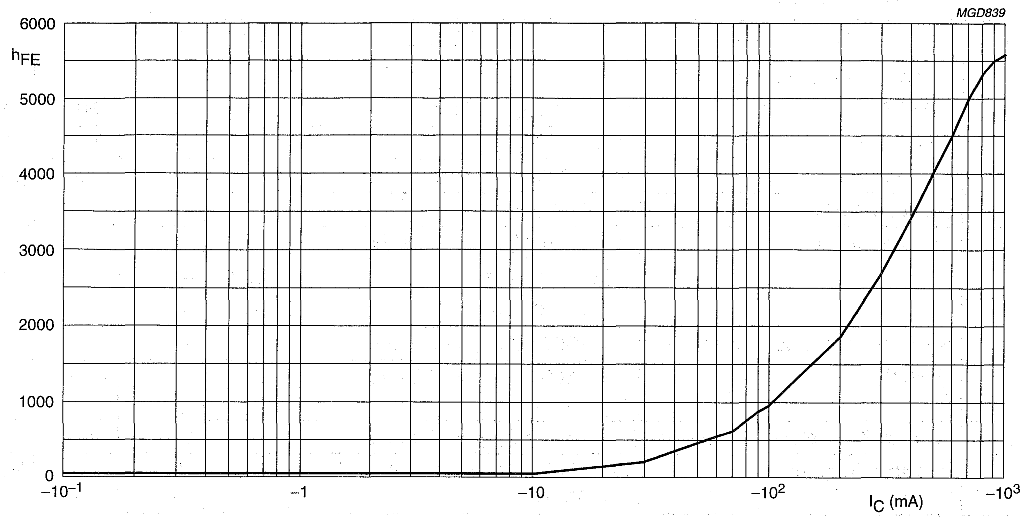
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	collector cut-off current					
	BSP60	V_{BE} = 0; V_{CE} = −45 V	–	–	−50	μA
	BSP61	V_{BE} = 0; V_{CE} = −60 V	–	–	−50	μA
	BSP62	V_{BE} = 0; V_{CE} = −80 V	–	–	−50	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −4 V	–	–	−50	nA
h_{FE}	DC current gain	V_{CE} = −10 V; note 1; see Fig.2				
		I_C = −150 mA	1000	–	–	
		I_C = −500 mA	2000	–	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = −500 mA; I_B = −0.5 mA	–	–	−1.3	V
		I_C = −500 mA; I_B = −0.5 mA; T_j = 150 °C	–	–	−1.3	V
V_{BEsat}	base-emitter saturation voltage	I_C = −500 mA; I_B = −0.5 mA	–	–	−1.9	V
f_T	transition frequency	I_C = −500 mA; V_{CE} = −5 V; f = 100 MHz	–	200	–	MHz
Switching times (between 10% and 90% levels) see Fig.3						
t_{on}	turn-on time	I_{Con} = −500 mA; I_{Bon} = −0.5 mA; I_{Boff} = 0.5 mA	–	400	–	ns
t_{off}	turn-off time		–	1500	–	ns

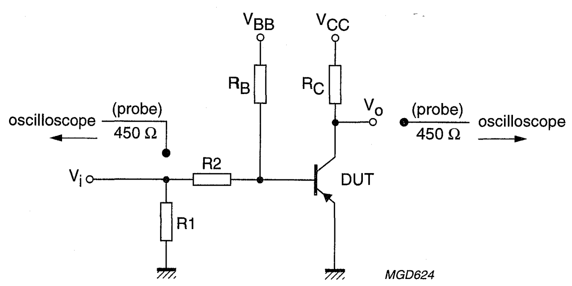
Note

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



$V_{CE} = -10$ V.

Fig.2 DC current gain; typical values.



$V_i = -10$ V; T = 200 μs; $t_p = 6$ μs; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 10 kΩ; $R_B = 10$ kΩ; $R_C = 18$ Ω.
$V_{BB} = 1.8$ V; $V_{CC} = -10.7$ V.
Oscilloscope: input impedance $Z_i = 50$ Ω.

Fig.3 Test circuit for switching times.

NPN switching transistors BSR13; BSR14

FEATURES

- High current (max. 800 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- Switching and linear applications.

DESCRIPTION

NPN switching transistor in a SOT23 plastic package.
PNP complements: BSR15 and BSR16.

MARKING

TYPE NUMBER	MARKING CODE
BSR13	U7p
BSR14	U8p

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

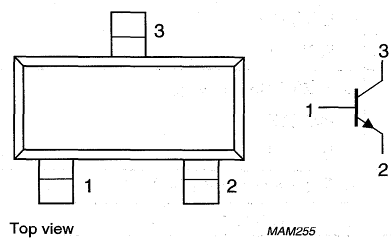


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BSR13		–	60	V
	BSR14		–	75	V
V_{CEO}	collector-emitter voltage	open base			
	BSR13		–	30	V
	BSR14		–	40	V
I_C	collector current (DC)		–	800	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 10$ V	100	300	
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 10$ V			
	BSR13		30	–	
	BSR14		40	–	
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 20$ V; f = 100 MHz			
	BSR13		250	–	MHz
	BSR14		300	–	MHz
t_{off}	turn-off time	$I_{Con} = 150$ mA; $I_{Bon} = 15$ mA; $I_{Boff} = -15$ mA	–	250	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			
	BSR13		–	60	V
	BSR14		–	75	V
V_{CEO}	collector-emitter voltage	open base			
	BSR13		–	30	V
	BSR14		–	40	V
V_{EBO}	emitter-base voltage	open collector			
	BSR13		–	5	V
	BSR14		–	6	V
I_C	collector current (DC)		–	800	mA
I_{CM}	peak collector current		–	800	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

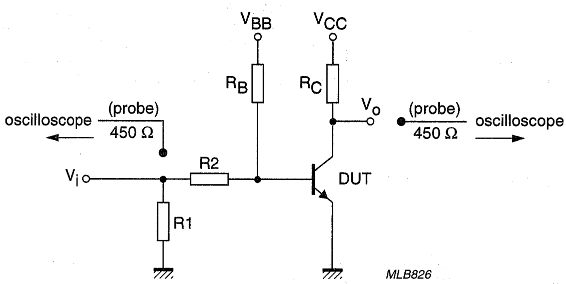
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	BSR13	$I_E = 0$; $V_{CB} = 50$ V	–	30	nA
		$I_E = 0$; $V_{CB} = 50$ V; $T_j = 150$ °C	–	10	μA
I_{CBO}	collector cut-off current				
	BSR14	$I_E = 0$; $V_{CB} = 60$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 60$ V; $T_j = 150$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V			
	BSR13		–	30	nA
	BSR14		–	10	nA
h_{FE}	DC current gain	$I_C = 0.1$ mA; $V_{CE} = 10$ V; note 1	35	–	
		$I_C = 1$ mA; $V_{CE} = 10$ V; note 1	50	–	
		$I_C = 10$ mA; $V_{CE} = 10$ V; note 1	75	–	
		$I_C = 150$ mA; $V_{CE} = 10$ V; note 1	100	300	
		$I_C = 150$ mA; $V_{CE} = 1$ V; note 1	50	–	
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 10$ V; note 1			
	BSR13		30	–	
	BSR14		40	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA			
	BSR13		–	400	mV
	BSR14		–	300	mV
V_{CEsat}	collector-emitter saturation voltage	$I_C = 500$ mA; $I_B = 50$ mA			
	BSR13		–	1.6	V
	BSR14		–	1	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA			
	BSR13		–	1.3	V
	BSR14		0.6	1.2	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 500$ mA; $I_B = 50$ mA			
	BSR13		–	2.6	V
	BSR14		–	2	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	8	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 20$ V; f = 100 MHz			
	BSR13		250	–	MHz
	BSR14		300	–	MHz

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	I_{Con} = 150 mA; I_{Bon} = 15 mA; I_{Boff} = −15 mA	–	35	ns
t_d	delay time		–	15	ns
t_r	rise time		–	20	ns
t_{off}	turn-off time		–	250	ns
t_s	storage time		–	200	ns
t_f	fall time		–	60	ns

Note

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



V_i = 9.5 V; T = 500 µs; t_p = 10 µs; $t_r = t_f \leq$ 3 ns.
R1 = 68 Ω; R2 = 325 Ω; R_B = 325 Ω; R_C = 160 Ω.
V_{BB} = −3.5 V; V_{CC} = 29.5 V.
Oscilloscope: input impedance Z_i = ≥ 100 Ω.

Fig.2 Test circuit for switching times.

PNP switching transistors BSR15; BSR16

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 60 V).

APPLICATIONS

- Medium power switching.

DESCRIPTION

PNP switching transistor in a SOT23 plastic package.
NPN complements: BSR13 and BSR14.

MARKING

TYPE NUMBER	MARKING CODE
BSR15	T7p
BSR16	T8p

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

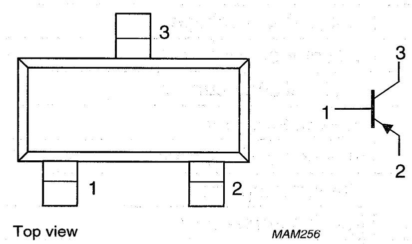


Fig.1 Simplified outline (SOT23) and symbol.

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			
	BSR15		–	–40	V
	BSR16		–	–60	V
I_C	collector current (DC)		–	–600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -10$ V			
	BSR15		30	–	
	BSR16		50	–	
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -20$ V; f = 100 MHz	200	–	MHz
t_{off}	turn-off time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	365	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			
	BSR15		–	–40	V
	BSR16		–	–60	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–600	mA
I_{CM}	peak collector current		–	–800	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

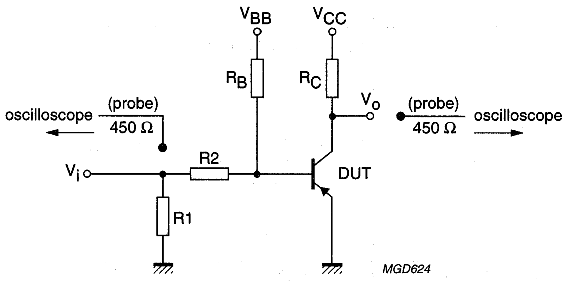
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	BSR15	$I_E = 0$; $V_{CB} = -50$ V	–	–20	nA
		$I_E = 0$; $V_{CB} = -50$ V; $T_j = 150$ °C	–	–20	μA
I_{CBO}	collector cut-off current				
	BSR16	$I_E = 0$; $V_{CB} = -50$ V	–	–10	nA
		$I_E = 0$; $V_{CB} = -50$ V; $T_j = 150$ °C	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–50	nA
h_{FE}	DC current gain	$I_C = -0.1$ mA; $V_{CE} = -10$ V			
	BSR15		35	–	
	BSR16		75	–	
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -10$ V			
	BSR15		50	–	
	BSR16		100	–	
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -10$ V			
	BSR15		75	–	
	BSR16		100	–	
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -10$ V; note 1	100	300	
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -10$ V; note 1			
	BSR15		30	–	
	BSR16		50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA	–	–400	mV
		$I_C = -500$ mA; $I_B = -50$ mA	–	–1.6	V
V_{BEsat}	base-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA	–	–1.3	V
		$I_C = -500$ mA; $I_B = -50$ mA	–	–2.6	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	8	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -2$ V; f = 1 MHz	–	30	pF
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -20$ V; f = 100 MHz	200	–	MHz

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	I_{Con} = −150 mA; I_{Bon} = −15 mA; I_{Boff} = 15 mA	–	40	ns
t_d	delay time		–	12	ns
t_r	rise time		–	30	ns
t_{off}	turn-off time		–	365	ns
t_s	storage time		–	300	ns
t_f	fall time		–	65	ns

Note

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



V_i = −9.5 V; T = 500 µs; t_p = 10 µs; $t_r = t_f \leq$ 3 ns.
R1 = 68 Ω; R2 = 325 Ω; R_B = 325 Ω; R_C = 160 Ω.
V_{BB} = 3.5 V; V_{CC} = −29.5 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.2 Test circuit for switching times.

NPN switching transistor BSR17A

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- Switching and linear amplification.

DESCRIPTION

NPN switching transistor in a SOT23 plastic package.
PNP complement: BSR18A.

MARKING

TYPE NUMBER	MARKING CODE
BSR17A	U92

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

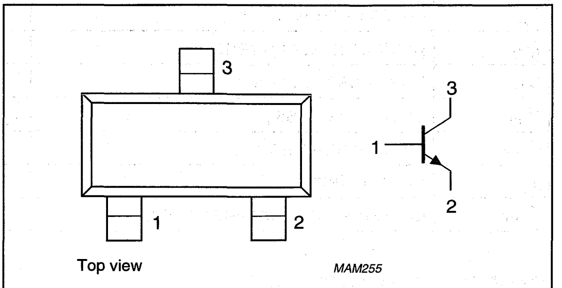


Fig.1 Simplified outline (SOT23) and symbol.

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	collector current (DC)		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	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_{off}	turn-off time	$I_{Con} = 10$ mA; $I_{Bon} = 1$ mA; $I_{Boff} = -1$ mA	–	240	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	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

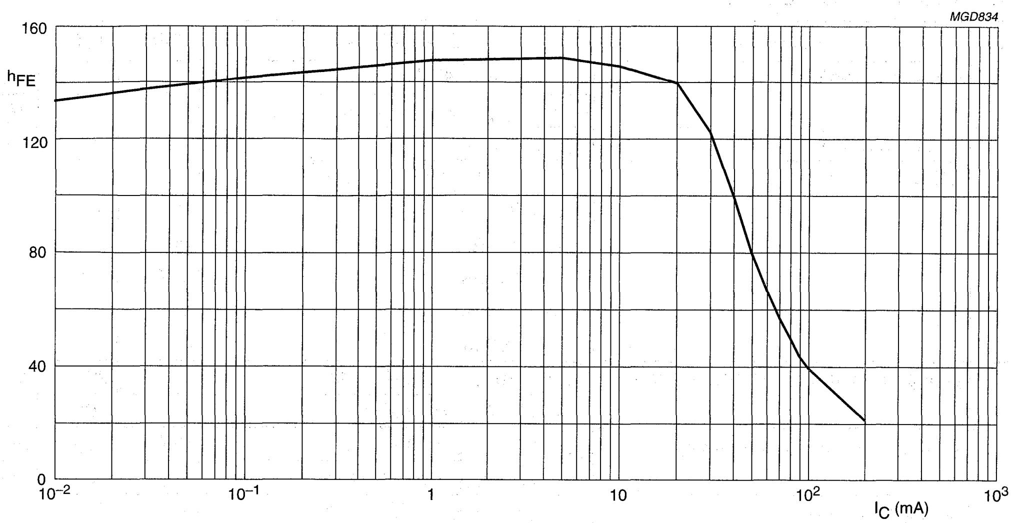
CHARACTERISTICS

$T_j = 25\ °C$ unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30\ V$	–	50	nA
		$I_E = 0$; $V_{CB} = 30\ V$; $T_j = 150\ °C$	–	5	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 6\ V$	–	50	nA
h_{FE}	DC current gain	$V_{CE} = 1\ V$; note 1; see Fig.2			
		$I_C = 0.1\ mA$	60	–	
		$I_C = 1\ mA$	80	–	
		$I_C = 10\ mA$	100	300	
		$I_C = 50\ mA$	60	–	
		$I_C = 100\ mA$	30	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10\ mA$; $I_B = 1\ mA$; note 1	–	200	mV
		$I_C = 50\ mA$; $I_B = 5\ mA$; note 1	–	200	mV
V_{BEsat}	base-emitter 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	$I_E = i_e = 0$; $V_{CB} = 5\ V$; $f = 1\ MHz$	–	4	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 500\ mV$; $f = 1\ MHz$	–	8	pF
f_T	transition frequency	$I_C = 10\ mA$; $V_{CE} = 20\ V$; $f = 100\ MHz$	300	–	MHz
F	noise figure	$I_C = 100\ \mu A$; $V_{CE} = 5\ V$; $R_S = 1\ k\Omega$; $f = 10\ Hz$ to $15.7\ kHz$	–	5	dB
Switching times (between 10% and 90% levels); see Fig.3					
t_{on}	turn-on time	$I_{Con} = 10\ mA$; $I_{Bon} = 1\ mA$; $I_{Boff} = -1\ mA$	–	65	ns
t_d	delay time		–	35	ns
t_r	rise time		–	35	ns
t_{off}	turn-off time		–	240	ns
t_s	storage time		–	200	ns
t_f	fall time		–	50	ns

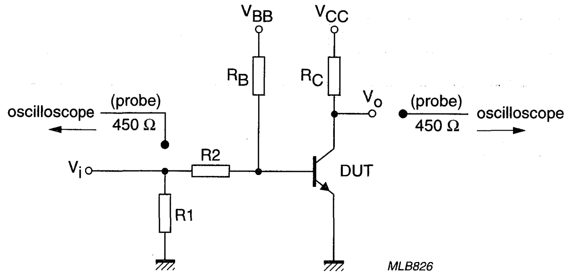
Note

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



V_{CE} = 1 V.

Fig.2 DC current gain; typical values.



V_i = 5 V; T = 500 μs; t_p = 10 μs; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 2.5 kΩ; R_B = 3.9 kΩ; R_C = 270 Ω.
V_{BB} = −1.9 V; V_{CC} = 3 V.
Oscilloscope input impedance Z_i = 50 Ω.

Fig.3 Test circuit for switching times.

PNP switching transistor BSR18A

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- High-speed saturated switching.

DESCRIPTION

PNP switching transistor in a SOT23 plastic package.
NPN complement: BSR17A.

MARKING

TYPE NUMBER	MARKING CODE
BSR18A	T92

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

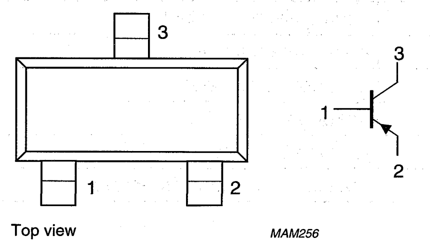


Fig.1 Simplified outline (SOT23) and symbol.

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	collector current (DC)		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	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_{off}	turn-off time	$I_{Con} = -10$ mA; $I_{Bon} = -1$ mA; $I_{Boff} = 1$ mA	–	300	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	–	–6	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

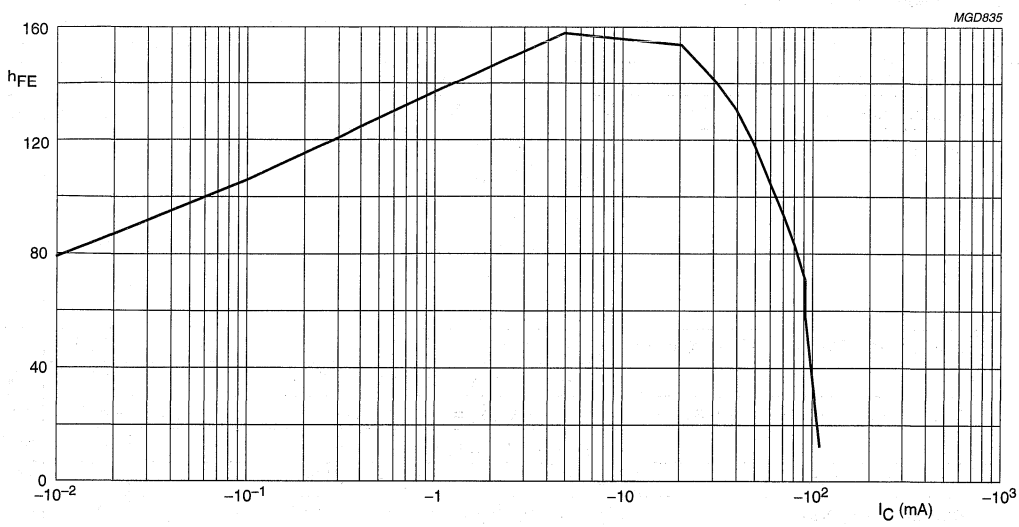
CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −30 V	–	−50	nA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −6 V	–	−50	nA
h_{FE}	DC current gain	V_{CE} = −1 V; note 1; see Fig.2			
		I_C = −0.1 mA	60	–	
		I_C = −1 mA	80	–	
		I_C = −10 mA	100	300	
		I_C = −50 mA	60	–	
		I_C = −100 mA	30	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = −10 mA; I_B = −1 mA; note 1	–	−200	mV
		I_C = −50 mA; I_B = −5 mA; note 1	–	−200	mV
V_{BEsat}	base-emitter 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	$I_E = i_e$ = 0; V_{CB} = −5 V; f = 1 MHz	–	4.5	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = −500 mV; f = 1 MHz	–	10	pF
f_T	transition frequency	I_C = −10 mA; V_{CE} = −20 V; f = 100 MHz	250	–	MHz
F	noise figure	I_C = −100 μA; V_{CE} = −5 V; R_S = 1 kΩ; f = 10 Hz to 15.7 kHz	–	4	dB
Switching times (between 10% and 90% levels); see Fig.3					
t_{on}	turn-on time	I_{Con} = −10 mA; I_{Bon} = −1 mA; I_{Boff} = 1 mA	–	65	ns
t_d	delay time		–	35	ns
t_r	rise time		–	35	ns
t_{off}	turn-off time		–	300	ns
t_s	storage time		–	225	ns
t_f	fall time		–	75	ns

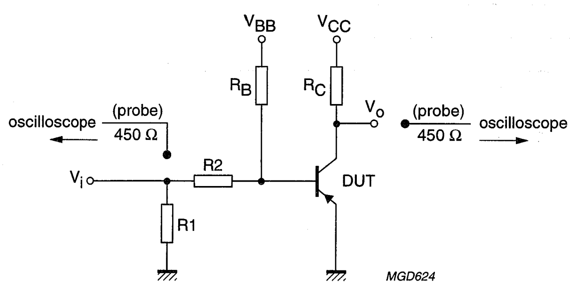
Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.01$.



$V_{CE} = -1$ V.

Fig.2 DC current gain; typical value.



$V_i = -5$ V; T = 500 µs; $t_p = 10$ µs; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 2.5 kΩ; $R_B = 3.9$ kΩ; $R_C = 270$ Ω.
$V_{BB} = 1.9$ V; $V_{CC} = -3$ V.
Oscilloscope input impedance $Z_i = 50$ Ω.

Fig.3 Test circuit for switching times.

NPN high-voltage transistors | BSR19; BSR19A

FEATURES

- Low current (max. 300 mA)
- High voltage (max. 160 V).

APPLICATIONS

- General purpose switching and amplification
- Especially used for telephony applications.

DESCRIPTION

NPN high-voltage transistor in a SOT23 plastic package.
PNP complements: BSR20 and BSR20A.

MARKING

TYPE NUMBER	MARKING CODE
BSR19	U35
BSR19A	U36

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

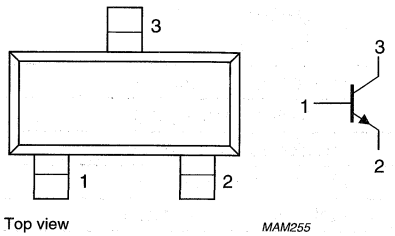


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BSR19		–	160	V
	BSR19A		–	180	V
V_{CEO}	collector-emitter voltage	open base			
	BSR19		–	140	V
	BSR19A		–	160	V
I_{CM}	peak collector current		–	600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V			
	BSR19		60	–	
	BSR19A		80	–	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	100	300	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			
	BSR19		–	160	V
	BSR19A		–	180	V
V_{CEO}	collector-emitter voltage	open base			
	BSR19		–	140	V
	BSR19A		–	160	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	300	mA
I_{CM}	peak collector current		–	600	mA
I_B	base current (DC)		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	BSR19	$I_E = 0$; $V_{CB} = 100$ V	–	100	nA
		$I_E = 0$; $V_{CB} = 100$ V; $T_{amb} = 100$ °C	–	100	μA
I_{CBO}	collector cut-off current				
	BSR19A	$I_E = 0$; $V_{CB} = 120$ V	–	50	nA
		$I_E = 0$; $V_{CB} = 120$ V; $T_{amb} = 100$ °C	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	50	nA
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 5$ V			
	BSR19		60	–	
	BSR19A		80	–	
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V			
	BSR19		60	250	
	BSR19A		80	250	
h_{FE}	DC current gain	$I_C = 50$ mA; $V_{CE} = 5$ V			
	BSR19		20	–	
	BSR19A		30	–	
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			
	BSR19		–	250	mV
	BSR19A		–	200	mV
C_c	collector capacitance	$I_E = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	6	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	100	300	MHz

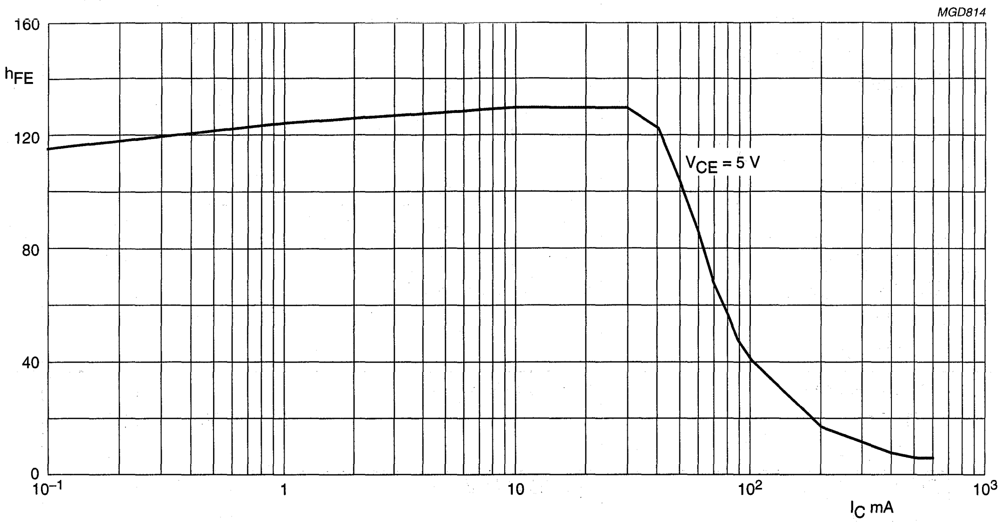


Fig.2 DC current gain; typical values.

FEATURES

- Low current (max. 300 mA)
- High voltage (max. 150 V).

APPLICATIONS

- General purpose switching and amplification
- Telephony applications.

DESCRIPTION

PNP high-voltage transistor in a SOT23 plastic package.
NPN complements: BSR19 and BSR19A.

MARKING

TYPE NUMBER	MARKING CODE
BSR20	T35
BSR20A	T36

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

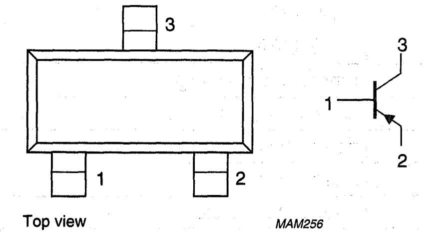


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BSR20		–	−130	V
	BSR20A		–	−160	V
V_{CEO}	collector-emitter voltage	open base			
	BSR20		–	−120	V
	BSR20A		–	−150	V
I_{CM}	peak collector current		–	−600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -5$ V			
	BSR20		40	180	
	BSR20A		60	240	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 100 MHz	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			
	BSR20		–	–130	V
	BSR20A		–	–160	V
V_{CEO}	collector-emitter voltage	open base			
	BSR20		–	–120	V
	BSR20A		–	–150	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–300	mA
I_{CM}	peak collector current		–	–600	mA
I_B	base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	BSR20	I_E = 0; V_{CB} = −100 V	−	−100	nA
		I_E = 0; V_{CB} = −100 V; T_{amb} = 100 °C	−	−100	μA
I_{CBO}	collector cut-off current				
	BSR20A	I_E = 0; V_{CB} = −120 V	−	−50	nA
		I_E = 0; V_{CB} = −120 V; T_{amb} = 100 °C	−	−50	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −4 V	−	−50	nA
h_{FE}	DC current gain	I_C = −1 mA; V_{CE} = −5 V			
	BSR20		30	−	
	BSR20A		50	−	
h_{FE}	DC current gain	I_C = −10 mA; V_{CE} = −5 V			
	BSR20		40	180	
	BSR20A		60	240	
h_{FE}	DC current gain	I_C = −50 mA; V_{CE} = −5 V			
	BSR20		40	−	
	BSR20A		50	−	
V_{CEsat}	collector-emitter saturation voltage	I_C = −10 mA; I_B = −1 mA	−	−200	mV
		I_C = −50 mA; I_B = −5 mA	−	−500	mV
C_c	collector capacitance	I_E = 0; V_{CB} = −10 V; f = 1 MHz	−	6	pF
f_T	transition frequency	I_C = −10 mA; V_{CE} = −10 V; f = 100 MHz			
	BSR20		100	400	MHz
	BSR20A		100	300	MHz

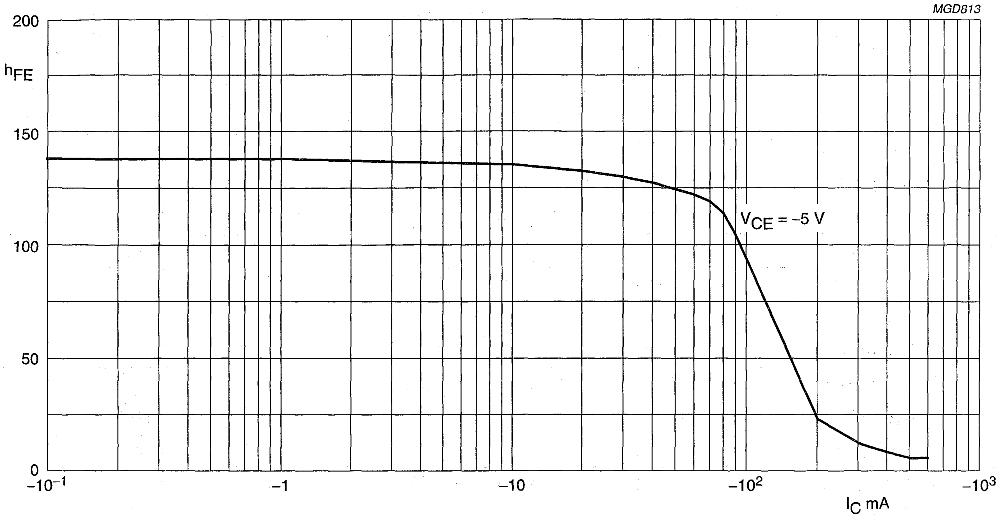


Fig.2 DC current gain; typical values.

PNP medium power transistors BSR30; BSR31; BSR32; BSR33

FEATURES

- High current (max. 1 A)
- Low voltage (max. 80 V).

APPLICATIONS

- Telephony and general industrial applications
- Thick and thin-film circuits.

DESCRIPTION

PNP medium power transistor in a SOT89 plastic package. NPN complements: BSR40; BSR41; BSR42 and BSR43.

MARKING

TYPE NUMBER	MARKING CODE	TYPE NUMBER	MARKING CODE
BRS30	BR1	BRS32	BR3
BRS31	BR2	BRS33	BR4

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

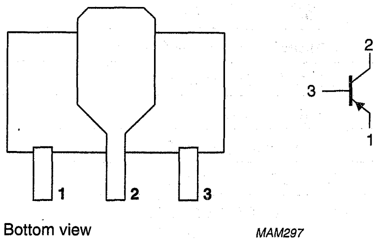


Fig.1 Simplified outline (SOT89) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BSR30; BSR31		–	–70	V
	BSR32; BSR33		–	–90	V
V_{CEO}	collector-emitter voltage	open base			
	BSR30; BSR31		–	–60	V
	BSR32; BSR33		–	–80	V
I_{CM}	peak collector current		–	–2	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.4	W
h_{FE}	DC current gain	$I_C = -100$ mA; $V_{CE} = -5$ V			
	BSR30; BSR32		40	120	
	BSR31; BSR33		100	300	
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -10$ V; f = 100 MHz	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			
	BSR30; BSR31		–	–70	V
	BSR32; BSR33		–	–90	V
V_{CEO}	collector-emitter voltage	open base			
	BSR30; BSR31		–	–60	V
	BSR32; BSR33		–	–80	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–1	A
I_{CM}	peak collector current		–	–2	A
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.4	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for the SOT89 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	89	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		8	K/W

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for the SOT89 in the General part of handbook SC04"*.

PNP medium power transistors BSR30; BSR31; BSR32; BSR33

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -60$ V	–	–100	nA
		$I_E = 0$; $V_{CB} = -60$ V; $T_j = 150$ °C	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–100	nA
h_{FE}	DC current gain	$I_C = -100$ μA; $V_{CE} = -5$ V; note 1			
	BSR30; BSR32		10	–	
	BSR31; BSR33		30	–	
h_{FE}	DC current gain	$I_C = -100$ mA; $V_{CE} = -5$ V; note 1			
	BSR30; BSR32		40	120	
	BSR31; BSR33		100	300	
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -5$ V; note 1			
	BSR30; BSR32		30	–	
	BSR31; BSR33		50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA; note 1	–	–0.25	V
		$I_C = -500$ mA; $I_B = -50$ mA; note 1	–	–0.5	V
V_{BEsat}	base-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA; note 1	–	–1	V
		$I_C = -500$ mA; $I_B = -50$ mA; note 1	–	–1.2	V
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -10$ V; f = 100 MHz	100	–	MHz

Note

1. Pulse test: $t_p = 300$ μs; $\delta < 0.01$.

NPN medium power transistors BSR40; BSR41; BSR42; BSR43

FEATURES

- High current (max. 1 A)
- Low voltage (max. 80 V).

APPLICATIONS

- Thick and thin-film circuits
- Telephony and general industrial applications.

DESCRIPTION

NPN medium power transistor in a SOT89 plastic package. PNP complements: BSR30; BSR31; BSR32 and BSR33.

MARKING

TYPE NUMBER	MARKING CODE	TYPE NUMBER	MARKING CODE
BSR40	AR1	BSR42	AR3
BSR41	AR2	BSR43	AR4

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

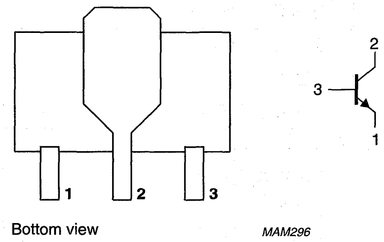


Fig.1 Simplified outline (SOT89) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BSR40; BSR41		–	70	V
	BSR42; BSR43		–	90	V
V_{CEO}	collector-emitter voltage	open base			
	BSR40; BSR41		–	60	V
	BSR42; BSR43		–	80	V
I_{CM}	peak collector current		–	2	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.4	W
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V			
	BSR40; BSR42		40	120	
	BSR41; BSR43		100	300	
f_T	transition frequency	I_C = 50 mA; V_{CE} = 10 V; f = 100 MHz	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			
	BSR40; BSR41		–	70	V
	BSR42; BSR43		–	90	V
V_{CEO}	collector-emitter voltage	open base			
	BSR40; BSR41		–	60	V
	BSR42; BSR43		–	80	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	1	A
I_{CM}	peak collector current		–	2	A
I_{BM}	peak base current		–	0.2	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1	W
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		−65	+150	°C

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	89	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		8	K/W

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 60$ V	–	100	nA
		$I_E = 0$; $V_{CB} = 60$ V; $T_j = 150$ °C	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	100	nA
h_{FE}	DC current gain	$I_C = 100$ μA; $V_{CE} = 5$ V; note 1			
	BSR40; BSR42		10	–	
	BSR41; BSR43		30	–	
h_{FE}	DC current gain	$I_C = 100$ mA; $V_{CE} = 5$ V; note 1			
	BSR40; BSR42		40	120	
	BSR41; BSR43		100	300	
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 5$ V; note 1			
	BSR40; BSR42		30	–	
	BSR41; BSR43		50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA; note 1	–	250	mV
		$I_C = 500$ mA; $I_B = 50$ mA; note 1	–	500	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA; note 1	–	1	V
		$I_C = 500$ mA; $I_B = 50$ mA; note 1	–	1.2	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	12	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	90	pF
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 10$ V; f = 100 MHz	100	–	MHz
Switching times (between 10% and 90% levels)					
t_{on}	turn-on time	$I_{Con} = 100$ mA; $I_{Bon} = 5$ mA; $I_{Boff} = -5$ mA	–	250	ns
t_{off}	turn-off time		–	1	μs

Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.01$.

FEATURES

- High current (max. 1 A)
- Low voltage (max. 80 V)
- Integrated diode and resistor.

APPLICATIONS

- Industrial high gain amplification.

DESCRIPTION

NPN Darlington transistor in a TO-92; SOT54 plastic package. PNP complements: BSR60, BSR61 and BSR62.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

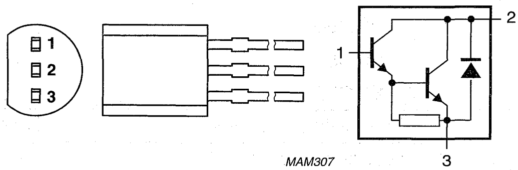


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BSR50		–	–	60	V
	BSR51		–	–	80	V
	BSR52		–	–	90	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$				
	BSR50		–	–	45	V
	BSR51		–	–	60	V
	BSR52		–	–	80	V
I_C	collector current (DC)		–	–	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	0.83	W
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 10$ V	1000	–	–	
		$I_C = 500$ mA; $V_{CE} = 10$ V	2000	–	–	
f_T	transition frequency	$I_C = 500$ mA; $V_{CE} = 5$ V; f = 100 MHz	–	200	–	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			
	BSR50		–	60	V
	BSR51		–	80	V
	BSR52		–	90	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BSR50		–	45	V
	BSR51		–	60	V
	BSR52		–	80	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	1	A
I_{CM}	peak collector current		–	2	A
I_B	base current (DC)		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	0.83	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	150	K/W

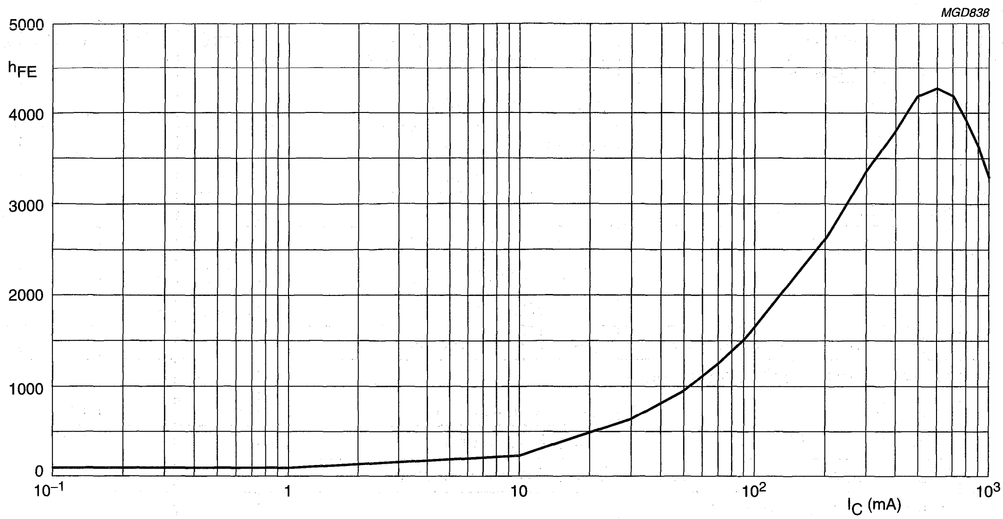
Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

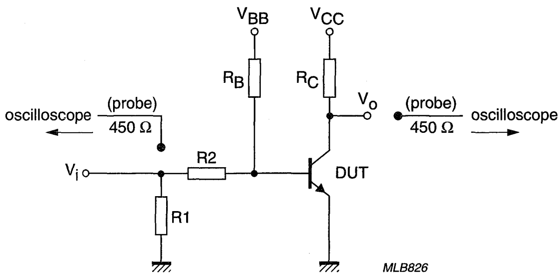
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	collector cut-off current					
	BSR50	V_{BE} = 0; V_{CE} = 45 V	–	–	50	nA
	BSR51	V_{BE} = 0; V_{CE} = 60 V	–	–	50	nA
	BSR52	V_{BE} = 0; V_{CE} = 80 V	–	–	50	nA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 4 V	–	–	50	nA
h_{FE}	DC current gain	V_{CE} = 10 V; see Fig.2				
		I_C = 150 mA	1000	–	–	
		I_C = 500 mA	2000	–	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = 0.5 A; I_B = 0.5 mA	–	–	1.3	V
V_{CEsat}	collector-emitter saturation voltage					
	BSR51	I_C = 1 A; I_B = 1 mA	–	–	1.6	V
	BSR50; BSR52	I_C = 1 A; I_B = 4 mA	–	–	1.6	V
V_{BEsat}	base-emitter saturation voltage	I_C = 0.5 A; I_B = 0.5 mA	–	–	1.9	V
V_{BEsat}	base-emitter saturation voltage					
	BSR51	I_C = 1 A; I_B = 1 mA	–	–	2.2	V
	BSR50; BSR52	I_C = 1 A; I_B = 4 mA	–	–	2.2	V
f_T	transition frequency	I_C = 500 mA; V_{CE} = 5 V; f = 100 MHz	–	200	–	MHz
Switching times (between 10% and 90% levels); see Fig.3						
t_{on}	turn-on time	I_{Con} = 500 mA; I_{Bon} = 0.5 mA; I_{Boff} = −0.5 mA	–	–	500	ns
t_{off}	turn-off time		–	–	1300	ns



V_{CE} = 10 V.

Fig.2 DC current gain; typical values.



V_i = 10 V; T = 200 μs; t_p = 6 μs; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 10 kΩ; R_B = 10 kΩ; R_C = 18 Ω.
V_{BB} = −1.8 V; V_{CC} = 10.7 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.3 Test circuit for switching times.

PNP Darlington transistors BSR60; BSR61; BSR62

FEATURES

- High current (max. 1 A)
- Low voltage (max. 80 V)
- Integrated diode and resistor.

APPLICATIONS

- Industrial applications such as:
  - Print hammer
  - Solenoid
  - Relay and lamp driving.

DESCRIPTION

PNP Darlington transistor in a TO-92; SOT54 plastic package. NPN complements: BSR50, BSR51 and BSR52.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

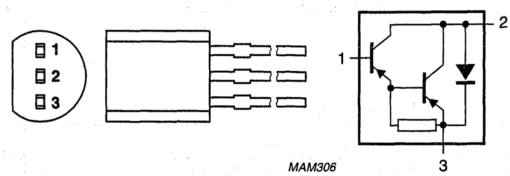


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BSR60		–	–	–60	V
	BSR61		–	–	–80	V
	BSR62		–	–	–90	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$				
	BSR60		–	–	–45	V
	BSR61		–	–	–60	V
	BSR62		–	–	–80	V
I_C	collector current (DC)		–	–	–1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–		0.83	W
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -10$ V	1000	–	–	
		$I_C = -500$ mA; $V_{CE} = -10$ V	2000	–	–	
f_T	transition frequency	$I_C = -500$ mA; $V_{CE} = -5$ V; f = 100 MHz	–	200	–	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			
	BSR60		–	–60	V
	BSR61		–	–80	V
	BSR62		–	–90	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BSR60		–	–45	V
	BSR61		–	–60	V
	BSR62		–	–80	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–1	A
I_{CM}	peak collector current		–	–2	A
I_B	base current (DC)		–	–0.2	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	0.83	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	150	K/W

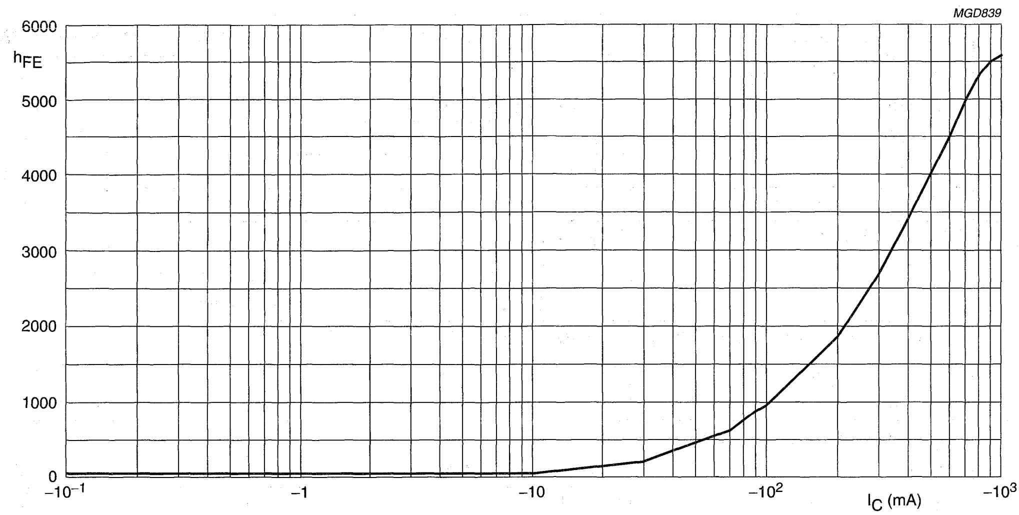
Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

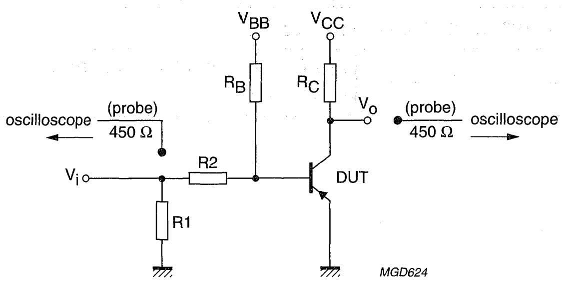
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	collector cut-off current					
	BSR60	V_{BE} = 0; V_{CE} = −45 V	–	–	−50	nA
	BSR61	V_{BE} = 0; V_{CE} = −60 V	–	–	−50	nA
	BSR62	V_{BE} = 0; V_{CE} = −80 V	–	–	−50	nA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −4 V	–	–	−50	nA
h_{FE}	DC current gain	V_{CE} = −10 V; see Fig.2				
		I_C = −150 mA	1000	–	–	
		I_C = −500 mA	2000	–	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = −0.5 A; I_B = −0.5 mA				
	BSR60; BSR61		–	–	−1.3	V
	BSR62		–	–	−1.4	V
V_{CEsat}	collector-emitter saturation voltage					
	BSR60	I_C = −1 A; I_B = −4 mA	–	–	−1.6	V
	BSR61	I_C = −1 A; I_B = −1 mA	–	–	−1.6	V
	BSR62	I_C = −1 A; I_B = −4 mA	–	–	−1.8	V
V_{BEsat}	base-emitter saturation voltage	I_C = −0.5 A; I_B = −0.5 mA				
	BSR60; BSR61		–	–	−1.9	V
	BSR62		–	–	−2	V
V_{BEsat}	base-emitter saturation voltage					
	BSR60	I_C = −1 A; I_B = −4 mA	–	–	−2.2	V
	BSR61	I_C = −1 A; I_B = −1 mA	–	–	−2.2	V
	BSR62	I_C = −1 A; I_B = −4 mA	–	–	−2.4	V
f_T	transition frequency	I_C = −500 mA; V_{CE} = −5 V; f = 100 MHz	–	200	–	MHz
Switching times (between 10% and 90% levels); see Fig.3						
t_{on}	turn-on time	I_{Con} = −500 mA; I_{Bon} = −0.5 mA; I_{Boff} = 0.5 mA	–	–	0.5	μs
t_{off}	turn-off time		–	–	0.7	μs



$V_{CE} = -10$ V.

Fig.2 DC current gain; typical values.



$V_i = -10$ V; T = 200 μs; $t_p = 6$ μs; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 10 kΩ; $R_B = 10$ kΩ; $R_C = 18$ Ω.
$V_{BB} = 1.8$ V; $V_{CC} = -10.7$ V.
Oscilloscope: input impedance $Z_i = 50$ Ω.

Fig.3 Test circuit for switching times.

FEATURES

- High current (max. 1 A)
- Low voltage (max. 80 V)
- Integrated diode and resistor.

APPLICATIONS

- Industrial high gain amplification.

DESCRIPTION

NPN Darlington transistor in a TO-39 metal package.
PNP complements: BSS61 and BSS62.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

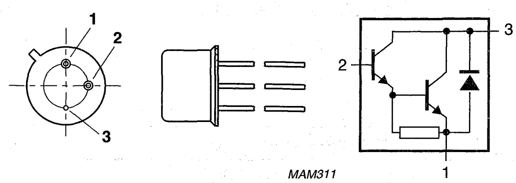


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BSS50		–	–	60	V
	BSS51		–	–	80	V
	BSS52		–	–	90	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$				
	BSS50		–	–	45	V
	BSS51		–	–	60	V
	BSS52		–	–	80	V
I_C	collector current		–	–	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	0.8	W
		$T_{case} \leq 25$ °C	–	–	5	W
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 10$ V	2000	–	–	
f_T	transition frequency	$I_C = 500$ mA; $V_{CE} = 5$ V; f = 100 MHz	–	200	–	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			
	BSS50		–	60	V
	BSS51		–	80	V
	BSS52		–	90	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BSS50		–	45	V
	BSS51		–	60	V
	BSS52		–	80	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	1	A
I_{CM}	peak collector current		–	2	A
I_B	base current (DC)		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	0.8	W
		$T_{case} \leq 25$ °C	–	5	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°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	220	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		35	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	collector cut-off current					
	BSS50	V_{BE} = 0; V_{CE} = 45 V	–	–	50	nA
	BSS51	V_{BE} = 0; V_{CE} = 60 V	–	–	50	nA
	BSS52	V_{BE} = 0; V_{CE} = 80 V	–	–	50	nA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 4 V	–	–	50	nA
h_{FE}	DC current gain	V_{CE} = 10 V				
		I_C = 150 mA	1000	–	–	
		I_C = 500 mA	2000	–	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = 500 mA; I_B = 0.5 mA	–	–	1.3	V
		I_C = 500 mA; I_B = 0.5 mA; T_j = 200 °C	–	–	1.3	V
V_{CEsat}	collector-emitter saturation voltage					
	BSS51	I_C = 1 A; I_B = 1 mA	–	–	1.6	V
		I_C = 1 A; I_B = 1 mA; T_j = 200 °C	–	–	2.3	V
V_{CEsat}	collector-emitter saturation voltage					
	BSS50; BSS52	I_C = 1 A; I_B = 4 mA	–	–	1.6	V
		I_C = 1 A; I_B = 4 mA; T_j = 200 °C	–	–	1.6	V
V_{BEsat}	base-emitter saturation voltage	I_C = 500 mA; I_B = 0.5 mA	–	–	1.9	V
V_{BEsat}	base-emitter saturation voltage					
	BSS51	I_C = 1 A; I_B = 1 mA	–	–	2.2	V
	BSS50; BSS52	I_C = 1 A; I_B = 4 mA	–	–	2.2	V
V_{BEon}	base-emitter on-state voltage	I_C = 150 mA; V_{CE} = 10 V	1.3	–	1.65	V
		I_C = 500 mA; V_{CE} = 10 V	1.4	–	1.75	V
f_T	transition frequency	I_C = 500 mA; V_{CE} = 5 V; f = 100 MHz	–	200	–	MHz
Switching times (between 10% and 90% levels)						
t_{on}	turn-on time	I_{Con} = 500 mA; I_{Bon} = 0.5 mA; I_{Boff} = −0.5 mA	–	0.5	–	µs
		I_{Con} = 1 A; I_{Bon} = 1 mA; I_{Boff} = −1 mA	–	0.4	–	µs
t_{off}	turn-off time	I_{Con} = 500 mA; I_{Bon} = 0.5 mA; I_{Boff} = −0.5 mA	–	1.3	–	µs
		I_{Con} = 1 A; I_{Bon} = 1 mA; I_{Boff} = −1 mA	–	1.5	–	µs

PNP Darlington transistors BSS61; BSS62

FEATURES

- High current (max. 1 A)
- Low voltage (max. 80 V)
- Integrated diode and resistor.

APPLICATIONS

- Industrial high gain amplification.

DESCRIPTION

PNP Darlington transistor in a TO-39 metal package.
NPN complements: BSS51 and BSS52.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

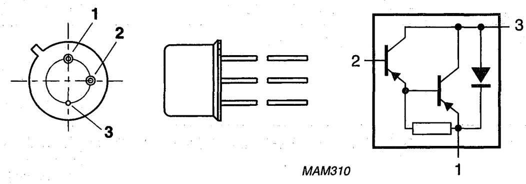


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BSS61		–	–	–80	V
	BSS62		–	–	–90	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$				
	BSS61		–	–	–60	V
	BSS62		–	–	–80	V
I_C	collector current (DC)		–	–	–1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	0.8	W
		$T_{case} \leq 25$ °C	–	–	5	W
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -10$ V	2000	–	–	
f_T	transition frequency	$I_C = -500$ mA; $V_{CE} = -5$ V; f = 100 MHz	–	200	–	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			
	BSS61		–	–80	V
	BSS62		–	–90	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BSS61		–	–60	V
	BSS62		–	–80	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–1	A
I_{CM}	peak collector current		–	–2	A
I_B	base current (DC)		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	0.8	W
		$T_{case} \leq 25$ °C	–	5	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°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	220	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		35	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	collector cut-off current					
	BSS61	V_{BE} = 0; V_{CE} = −60 V	–	–	−50	nA
	BSS62	V_{BE} = 0; V_{CE} = −80 V	–	–	−50	nA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −4 V	–	–	−100	nA
h_{FE}	DC current gain	I_C = −150 mA; V_{CE} = −10 V	1000	–	–	
		I_C = −500 mA; V_{CE} = −10 V	2000	–	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = −500 mA; I_B = −0.5 mA	–	–	−1.3	V
		I_C = −500 mA; I_B = −0.5 mA; T_j = 200 °C	–	–	−1.3	V
V_{CEsat}	collector-emitter saturation voltage					
	BSS61	I_C = −1 A; I_B = −1 mA	–	–	−1.6	V
		I_C = −1 A; I_B = −1 mA; T_j = 200 °C	–	–	−1.6	V
V_{CEsat}	collector-emitter saturation voltage					
	BSS62	I_C = −1 A; I_B = −4 mA	–	–	−1.6	V
		I_C = −1 A; I_B = −4 mA; T_j = 200 °C	–	–	−1.6	V
V_{BEsat}	base-emitter saturation voltage	I_C = −500 mA; I_B = −0.5 mA	–	–	−1.9	V
V_{BEsat}	base-emitter saturation voltage					
	BSS61	I_C = −1 A; I_B = −1 mA	–	–	−2.2	V
	BSS62	I_C = −1 A; I_B = −4 mA	–	–	−2.2	V
f_T	transition frequency	I_C = −500 mA; V_{CE} = −5 V; f = 100 MHz	–	200	–	MHz
Switching times (between 10% and 90% levels)						
t_{on}	turn-on time	I_{Con} = −500 mA; I_{Bon} = −0.5 mA; I_{Boff} = 0.5 mA	–	0.5	–	µs
		I_{Con} = −1 A; I_{Bon} = −1 mA; I_{Boff} = 1 mA	–	0.4	–	µs
t_{off}	turn-off time	I_{Con} = −500 mA; I_{Bon} = −0.5 mA; I_{Boff} = 0.5 mA	–	0.7	–	µs
		I_{Con} = −1 A; I_{Bon} = −1 mA; I_{Boff} = 1 mA	–	1.5	–	µs

PNP high-voltage transistor — BSS63

FEATURES

- Low current (max. 100 mA)
- High voltage (max. 100 V).

APPLICATIONS

- High-voltage general purpose
- Switching applications.

DESCRIPTION

PNP high-voltage transistor in a SOT23 plastic package.
NPN complement: BSS64.

MARKING

TYPE NUMBER	MARKING CODE
BSS63	BMp

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

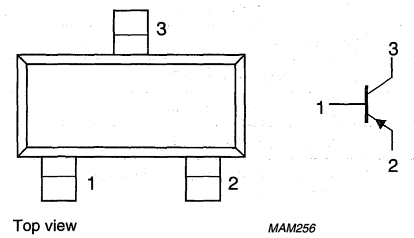


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	–110	V
V_{CEO}	collector-emitter voltage	open base	–	–	–100	V
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = -25$ mA; $V_{CE} = -5$ V	30	–	–	
f_T	transition frequency	$I_C = -25$ mA; $V_{CE} = -5$ V; f = 100 MHz	50	85	–	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	–	–110	V
V_{CEO}	collector-emitter voltage	open base	–	–100	V
V_{EBO}	emitter-base voltage	open collector	–	–6	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–100	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -90$ V	–	–	–100	nA
		$I_E = 0$; $V_{CB} = -90$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -6$ V			–100	nA
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -1$ V	30	–	–	
		$I_C = -25$ mA; $V_{CE} = -1$ V	30	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -25$ mA; $I_B = -2.5$ mA	–	–	–250	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -25$ mA; $I_B = -2.5$ mA	–	–	–900	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	3	–	pF
f_T	transition frequency	$I_C = -25$ mA; $V_{CE} = -5$ V; f = 100 MHz	50	85	–	MHz

NPN high-voltage transistor | BSS64

FEATURES

- Low current (max. 100 mA)
- High voltage (max. 80 V).

APPLICATIONS

- High-voltage general purpose and switching applications
- Intended for application in thick and thin-film circuits.

DESCRIPTION

NPN transistor in a SOT23 plastic package.
PNP complement: BSS63.

MARKING

TYPE NUMBER	MARKING CODE
BSS64	AMp

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

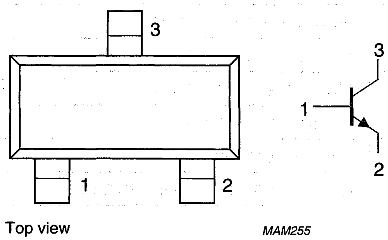


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	120	V
V_{CEO}	collector-emitter voltage	open base	–	–	80	V
I_{CM}	peak collector current		–	–	250	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 1$ V	20	80	–	
f_T	transition frequency	$I_C = 4$ 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	–	120	V
V_{CEO}	collector-emitter voltage	open base	–	80	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	250	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 90$ V	–	–	100	nA
		$I_E = 0$; $V_{CB} = 90$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	0.5	200	nA
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 1$ V	–	60	–	
		$I_C = 10$ mA; $V_{CE} = 1$ V	20	80	–	
		$I_C = 20$ mA; $V_{CE} = 1$ V	–	55	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 4$ mA; $I_B = 400$ μA	–	–	150	mV
		$I_C = 50$ mA; $I_B = 15$ mA	–	–	200	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	3	–	pF
f_T	transition frequency	$I_C = 4$ mA; $V_{CE} = 10$ V; f = 100 MHz	60	100	–	MHz

FEATURES

- Low current (max. 200 mA)
- High voltage (max. 300 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP high-voltage transistor in a SOT89 plastic package.
NPN complements: BST39 and BST40.

MARKING

TYPE NUMBER	MARKING CODE
BST15	BT1
BST16	BT2

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

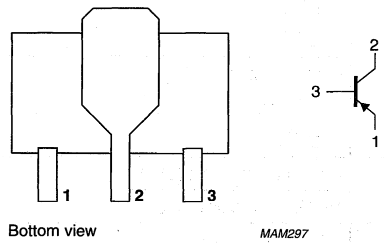


Fig.1 Simplified outline (SOT89) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BST15		–	–200	V
	BST16		–	–350	V
V_{CEO}	collector-emitter voltage	open base			
	BST15		–	–200	V
	BST16		–	–300	V
I_{CM}	collector current (DC)		–	–400	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.35	W
h_{FE}	DC current gain	$I_C = -50$ mA; $V_{CE} = -10$ V			
	BST15		30	150	
	BST16		30	120	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 100 MHz	15	–	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			
	BST15		–	–200	V
	BST16		–	–350	V
V_{CEO}	collector-emitter voltage	open base			
	BST15		–	–200	V
	BST16		–	–300	V
V_{EBO}	emitter-base voltage	open collector			
	BST15		–	–4	V
	BST16		–	–6	V
I_C	collector current (DC)		–	–200	mA
I_{CM}	peak collector current		–	–400	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.35	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	91	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		10	K/W

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	BST15	$I_E = 0$; $V_{CB} = -175$ V	–	−100	nA
	BST16	$I_E = 0$; $V_{CB} = -280$ V	–	−100	nA
I_{EBO}	emitter cut-off current				
	BST15	$I_C = 0$; $V_{EB} = -4$ V	–	−100	nA
	BST16	$I_C = 0$; $V_{EB} = -6$ V	–	−100	nA
h_{FE}	DC current gain	$I_C = -50$ mA; $V_{CE} = -10$ V			
	BST15		30	150	
	BST16		30	120	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -50$ mA; $I_B = -5$ mA			
	BST15		–	−2.5	V
	BST16		–	−2	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	15	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 100 MHz	15	–	MHz

FEATURES

- Low current (max. 100 mA)
- High voltage (max. 350 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN high-voltage transistor in a SOT89 plastic package.
PNP complements: BST15 and BST16.

MARKING

TYPE NUMBER	MARKING CODE
BST39	AT1
BST40	AT2

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

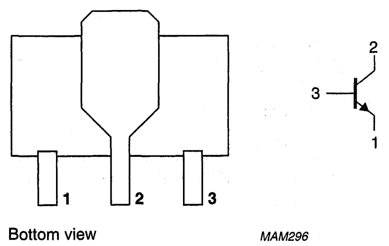


Fig.1 Simplified outline (SOT89) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BST39		–	400	V
	BST40		–	300	V
V_{CEO}	collector-emitter voltage	open base			
	BST39		–	350	V
	BST40		–	250	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.25	W
h_{FE}	DC current gain	$I_C = 20$ mA; $V_{CE} = 10$ V	40	–	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	70	–	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			
	BST39		–	400	V
	BST40		–	300	V
V_{CEO}	collector-emitter voltage	open base			
	BST39		–	350	V
	BST40		–	250	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.25	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	97	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		16	K/W

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 300$ V	–	20	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	100	nA
h_{FE}	DC current gain	$I_C = 20$ mA; $V_{CE} = 10$ V	–	40	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 50$ mA; $I_B = 4$ mA	–	500	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	2	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	70	–	MHz

NPN Darlington transistors BST50; BST51; BST52

FEATURES

- High current (max. 0.5 A)
- Low voltage (max. 80 V)
- Integrated diode and resistor.

APPLICATIONS

- Industrial switching applications such as:
  - print hammer
  - solenoid
  - relay and lamp driving.

DESCRIPTION

NPN Darlington transistor in a SOT89 plastic package.
PNP complements: BST60, BST61 and BST62.

MARKING

TYPE NUMBER	MARKING CODE
BST50	AS1
BST51	AS2
BST52	AS3

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

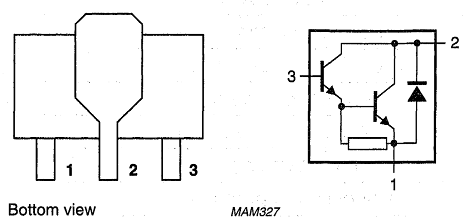


Fig.1 Simplified outline (SOT89) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BST50		–	–	60	V
	BST51		–	–	80	V
	BST52		–	–	90	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$				
	BST50		–	–	45	V
	BST51		–	–	60	V
	BST52		–	–	80	V
I_C	collector current (DC)		–	–	0.5	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	1.35	W
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 10$ V	2000	–	–	
f_T	transition frequency	$I_C = 500$ mA; $V_{CE} = 5$ V; f = 100 MHz	–	200	–	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			
	BST50		–	60	V
	BST51		–	80	V
	BST52		–	90	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BST50		–	45	V
	BST51		–	60	V
	BST52		–	80	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	0.5	A
I_{CM}	peak collector current		–	1.5	A
I_B	base current (DC)		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.35	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for the SOT89 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	92	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		11	K/W

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for the SOT89 in the General part of handbook SC04"*.

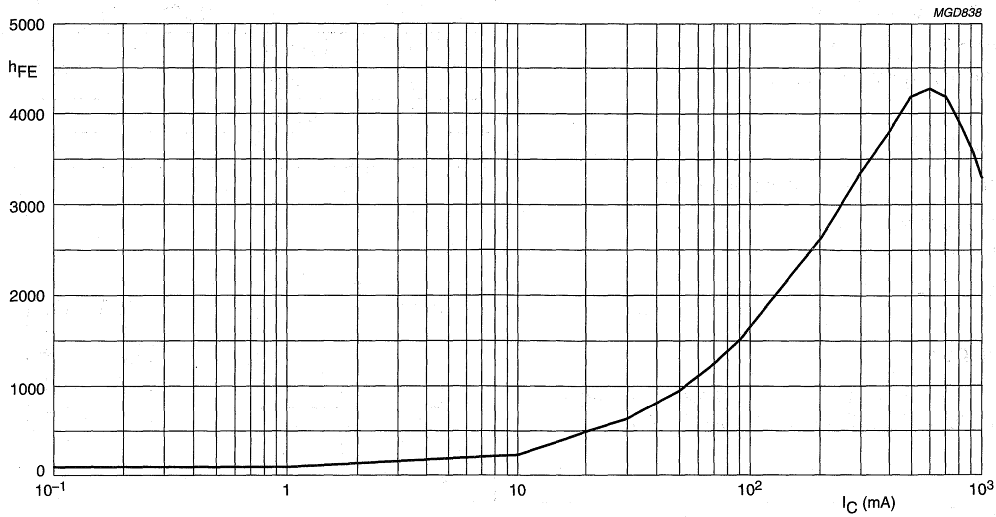
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	collector cut-off current					
	BST50	V_{BE} = 0; V_{CE} = 45 V	–	–	50	nA
	BST51	V_{BE} = 0; V_{CE} = 60 V	–	–	50	nA
	BST52	V_{BE} = 0; V_{CE} = 80 V	–	–	50	nA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 4 V	–	–	50	nA
h_{FE}	DC current gain	V_{CE} = 10 V; note 1; see Fig.2				
		I_C = 150 mA	1000	–	–	
		I_C = 500 mA	2000	–	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = 500 mA; I_B = 0.5 mA	–	–	1.3	V
		I_C = 500 mA; I_B = 0.5 mA; T_j = 150 °C	–	–	1.3	V
V_{BEsat}	base-emitter saturation voltage	I_C = 500 mA; I_B = 0.5 mA	–	–	1.9	V
f_T	transition frequency	I_C = 500 mA; V_{CE} = 5 V; f = 100 MHz	–	200	–	MHz
Switching times (between 10% and 90% levels); see Fig.3						
t_{on}	turn-on time	I_{Con} = 500 mA; I_{Bon} = 0.5 mA; I_{Boff} = −0.5 mA	–	400	–	ns
t_{off}	turn-off time		–	1500	–	ns

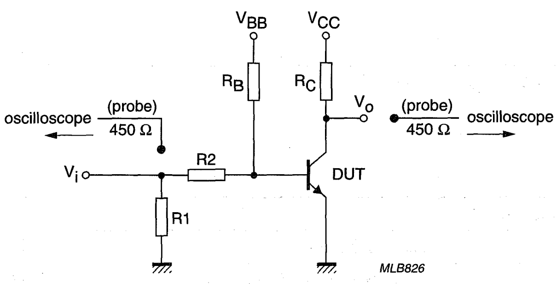
Note

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



V_{CE} = 10 V.

Fig.2 DC current gain; typical values.



V_i = 10 V; T = 200 µs; t_p = 6 µs; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 10 kΩ; R_B = 10 kΩ; R_C = 18 Ω.
V_{BB} = −1.8 V; V_{CC} = 10.7 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.3 Test circuit for switching times.

PNP Darlington transistors
BST60; BST61; BST62

FEATURES

- High current (max. 0.5 A)
- Low voltage (max. 80 V)
- Integrated diode and resistor.

APPLICATIONS

- Industrial switching applications such as:
  - print hammer
  - solenoid
  - relay and lamp driving.

DESCRIPTION

PNP Darlington transistor in a SOT89 plastic package. NPN complements: BST50, BST51 and BST52.

MARKING

TYPE NUMBER	MARKING CODE
BST60	BS1
BST61	BS2
BST62	BS3

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

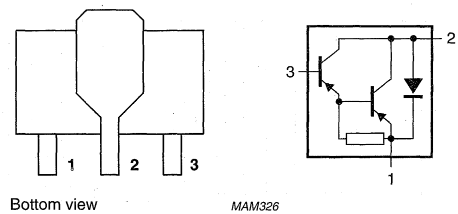


Fig.1 Simplified outline (SOT89) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BST60		–	–	–60	V
	BST61		–	–	–80	V
	BST62		–	–	–90	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$				
	BST60		–	–	–45	V
	BST61		–	–	–60	V
	BST62		–	–	–80	V
I_C	collector current (DC)		–	–	–0.5	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	1.35	W
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -10$ V	2000	–	–	
f_T	transition frequency	$I_C = -500$ mA; $V_{CE} = -5$ V; f = 100 MHz	–	200	–	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			
	BST60		–	–60	V
	BST61		–	–80	V
	BST62		–	–90	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	BST60		–	–45	V
	BST61		–	–60	V
	BST62		–	–80	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–0.5	A
I_{CM}	peak collector current		–	–1.5	A
I_B	base current (DC)		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.35	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for the SOT89 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	92	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		11	K/W

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for the SOT89 in the General part of handbook SC04"*.

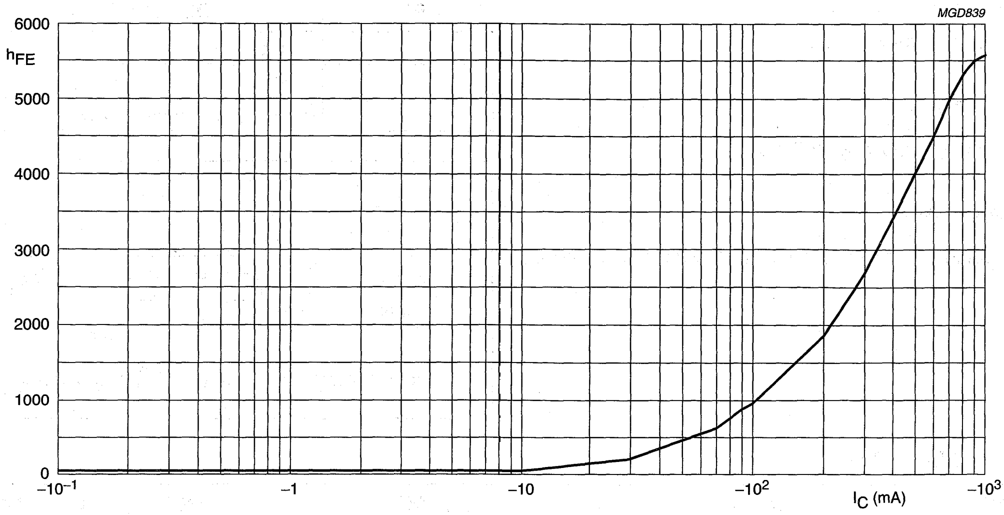
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	collector cut-off current					
	BST60	V_{BE} = 0; V_{CE} = −45 V	–	–	−50	nA
	BST61	V_{BE} = 0; V_{CE} = −60 V	–	–	−50	nA
	BST62	V_{BE} = 0; V_{CE} = −80 V	–	–	−50	nA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −4 V	–	–	−50	nA
h_{FE}	DC current gain	V_{CE} = −10 V; note 1; see Fig.2				
		I_C = −150 mA	1000			
		I_C = −500 mA	2000	–	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = −500 mA; I_B = −0.5 mA	–	–	−1.3	V
		I_C = −500 mA; I_B = −0.5 mA; T_j = 150 °C	–	–	−1.3	V
V_{BEsat}	base-emitter saturation voltage	I_C = −500 mA; I_B = −0.5 mA	–	–	−1.9	V
f_T	transition frequency	I_C = −500 mA; V_{CE} = −5 V; f = 100 MHz	–	200	–	MHz
Switching times (between 10% and 90% levels); see Fig.3						
t_{on}	turn-on time	I_{Con} = −500 mA; I_{Bon} = −0.5 mA; I_{Boff} = 0.5 mA	–	500	–	ns
t_{off}	turn-off time		–	700	–	ns

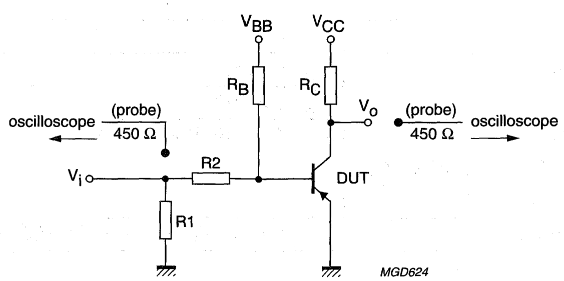
Note

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



$V_{CE} = -10$ V.

Fig.2 DC current gain; typical values.



$V_i = -10$ V; T = 200 µs; $t_p = 6$ µs; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 10 kΩ; $R_B = 10$ kΩ; $R_C = 18$ Ω.
$V_{BB} = 1.8$ V; $V_{CC} = -10.7$ V.
Oscilloscope: input impedance $Z_i = 50$ Ω.

Fig.3 Test circuit for switching times.

PNP medium power transistors — BSV15; BSV16; BSV17

FEATURES

- High current (max. 1 A)
- Low voltage (max. 80 V).

APPLICATIONS

- General industrial applications.

DESCRIPTION

PNP medium power transistor in a TO-39 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

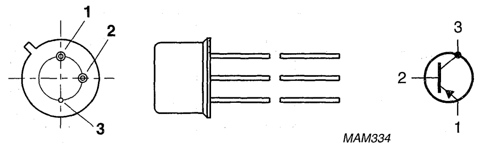


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BSV15		–	–40	V
	BSV16		–	–60	V
	BSV17		–	–90	V
V_{CEO}	collector-emitter voltage	open base			
	BSV15		–	–40	V
	BSV16		–	–60	V
	BSV17		–	–80	V
I_{CM}	peak collector current		–	–2	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	0.8	W
		$T_{case} \leq 25$ °C	–	5	W
h_{FE}	DC current gain	$I_C = -100$ mA; $V_{CE} = -1$ V			
	BSV15-10; BSV16-10; BSV17-10		63	160	
	BSV15-16; BSV16-16		100	250	
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -10$ V; f = 100 MHz	50	–	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			
	BSV15		–	–40	V
	BSV16		–	–60	V
	BSV17		–	–90	V
V_{CEO}	collector-emitter voltage	open base			
	BSV15		–	–40	V
	BSV16		–	–60	V
	BSV17		–	–80	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–1	A
I_{CM}	peak collector current		–	–2	A
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	800	mW
		$T_{case} \leq 25$ °C	–	5	W
		$T_{mb} \leq 50$ °C	–	5	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°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	220	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base		30	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		35	K/W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current					
	BSV15	I_E = 0; V_{CB} = −40 V	–	–	−100	nA
		I_E = 0; V_{CB} = −40 V; T_{amb} = 150 °C	–	–	−50	μA
I_{CBO}	collector cut-off current					
	BSV16	I_E = 0; V_{CB} = −60 V	–	–	−100	nA
		I_E = 0; V_{CB} = −60 V; T_{amb} = 150 °C	–	–	−50	μA
I_{CBO}	collector cut-off current					
	BSV17	I_E = 0; V_{CB} = −80 V	–	–	−100	nA
		I_E = 0; V_{CB} = −80 V; T_{amb} = 150 °C	–	–	−50	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −4 V	–	–	−50	nA
h_{FE}	DC current gain	I_C = −0.1 mA; V_{CE} = −1 V				
	BSV15-10; BSV16-10; BSV17-10		20	75	–	
	BSV15-16; BSV16-16		30	120	–	
h_{FE}	DC current gain	I_C = −100 mA; V_{CE} = −1 V				
	BSV15-10; BSV16-10; BSV17-10		63	100	160	
	BSV15-16; BSV16-16		100	160	250	
h_{FE}	DC current gain	I_C = −500 mA; V_{CE} = −1 V				
	BSV15-10; BSV16 -10; BSV17-10		25	55	–	
	BSV15-16; BSV16-16		35	85	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = −500 mA; I_B = −25 mA	–	–	−1	V
V_{BE}	base-emitter voltage	I_C = −100 mA; V_{CE} = −1 V	–	–	−1	V
		I_C = −500 mA; V_{CE} = −1 V	−0.7	−0.85	−1.4	V
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = −10 V; f = 1 MHz				
	BSV15; BSV16		–	20	30	pF
	BSV17		–	15	25	pF
C_e	emitter capacitance	I_C = i_c = 0; V_{EB} = −0.5 V; f = 1 MHz	–	180	–	pF
f_T	transition frequency	I_C = −50 mA; V_{CE} = −10 V; f = 100 MHz	50	–	–	MHz
Switching times (between 10% and 90% levels)						
t_{on}	turn-on time	I_{Con} = −100 mA; I_{Bon} = −5 mA; I_{Boff} = 5 mA	–	–	500	ns
t_{off}	turn-off time		–	–	650	ns

NPN switching transistor — BSV52

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 12 V).

APPLICATIONS

- High speed saturated switching applications, especially in portable equipment.

DESCRIPTION

NPN switching transistor in a SOT23 plastic package.

MARKING

TYPE NUMBER	MARKING CODE
BSV52	B2p

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

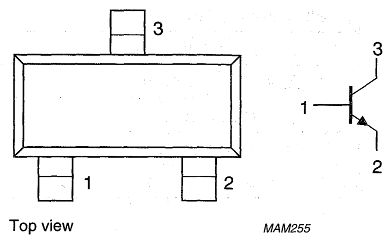


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	20	V
V_{CEO}	collector-emitter voltage	open base	–	–	12	V
I_C	collector current (DC)		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 1$ V	40	–	120	
		$I_C = 50$ mA; $V_{CE} = 1$ V	25	–	–	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	400	500	–	MHz
t_{off}	turn-off time	$I_{Con} = 10$ mA; $I_{Bon} = 3$ mA; $I_{Boff} = -1.5$ mA	–	–	30	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	–	20	V
V_{CEO}	collector-emitter voltage	open base	–	12	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

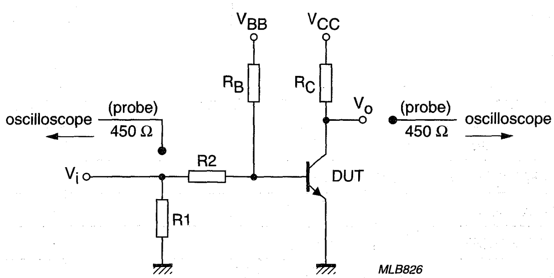
1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	–	400	nA
		$I_E = 0$; $V_{CB} = 20$ V; $T_j = 125$ °C	–	–	30	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	–	100	nA
h_{FE}	DC current gain	$V_{CE} = 1$ V				
		$I_C = 1$ mA	25	–	–	
		$I_C = 10$ mA	40	–	120	
		$I_C = 50$ mA	25	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 300$ μA	–	–	300	mV
		$I_C = 10$ mA; $I_B = 1$ mA	–	–	250	mV
		$I_C = 50$ mA; $I_B = 5$ mA	–	–	400	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	700	–	850	mV
		$I_C = 50$ mA; $I_B = 5$ mA	–	–	1.2	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	–	4	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 1$ V; f = 1 MHz	–	–	4.5	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	400	500	–	MHz

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Switching times (between 10% and 90% levels); see Fig.2						
t_{on}	turn-on time	I_{Con} = 10 mA; I_{Bon} = 3 mA; I_{Boff} = −1.5 mA	–	–	10	ns
t_d	delay time		–	–	4	ns
t_r	rise time		–	–	6	ns
t_{off}	turn-off time		–	–	30	ns
t_s	storage time		–	–	15	ns
t_f	fall time		–	–	15	ns



V_i = 0.5 V to 4.2 V; T = 500 µs; t_p = 10 µs; t_r = t_s ≤ 3 ns.
R1 = 56 Ω; R2 = 1 kΩ; R_B = 1 kΩ; R_C = 270 Ω.
V_{BB} = 0.2 V; V_{CC} = 2.7 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.2 Test circuit for switching times.

NPN general purpose transistor BSV64

FEATURES

- High current (max. 2 A)
- Low voltage (max. 60 V)
- Good high current saturation characteristics.

APPLICATIONS

- General purpose switching and amplification
- Print hammer driver.

DESCRIPTION

NPN transistor in a TO-39 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

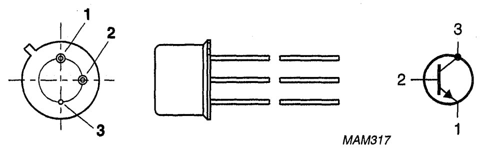


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	100	V
V_{CEO}	collector-emitter voltage	open base	–	–	60	V
I_{CM}	peak collector current		–	–	5	A
P_{tot}	total power dissipation	$T_{case} \le 50$ °C	–	–	5	W
h_{FE}	DC current gain	$I_C = 2$ A; $V_{CE} = 2$ V	40	–	–	
f_T	transition frequency	$I_C = 0.5$ A; $V_{CE} = 5$ V; f = 100 MHz	–	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	–	100	V
V_{CEO}	collector-emitter voltage	open base	–	60	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	2	A
I_{CM}	peak collector current		–	5	A
I_{BM}	peak base current		–	500	mA
P_{tot}	total power dissipation	$T_{case} \leq 50$ °C	–	5	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C
T_{amb}	operating ambient temperature		–65	+150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}c}$	thermal resistance from junction to case	25	K/W

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 60$ V	–	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	–	10	μA
h_{FE}	DC current gain	$I_C = 2$ A; $V_{CE} = 2$ V	40	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 5$ A; $I_B = 0.5$ A	–	–	1	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 5$ A; $I_B = 0.5$ A	–	–	1.8	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	80	pF
f_T	transition frequency	$I_C = 0.5$ A; $V_{CE} = 5$ V; f = 100 MHz	–	100	–	MHz
Switching times (between 10% and 90% levels)						
t_{on}	turn on time	$I_{Con} = 5$ A; $I_{Bon} = 500$ mA; $I_{Boff} = -500$ mA	–	–	0.6	μs
t_{off}	turn-off time		–	–	1.2	μs

NPN switching transistors BSW66A; BSW67A; BSW68A

FEATURES

- High current (max. 1 A)
- High voltage (max. 150 V).

APPLICATIONS

- General purpose switching and amplification
- Industrial applications.

DESCRIPTION

NPN transistor in a TO-39 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

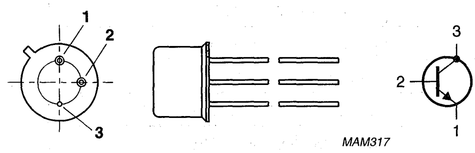


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BSW66A		–	–	100	V
	BSW67A		–	–	120	V
	BSW68A		–	–	150	V
V_{CEO}	collector-emitter voltage	open base				
	BSW66A		–	–	100	V
	BSW67A		–	–	120	V
	BSW68A		–	–	150	V
I_C	collector current (DC)		–	–	1	A
P_{tot}	total power dissipation	$T_{case} \leq 25$ °C	–	–	5	W
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V	30	–	–	
		$I_C = 500$ mA; $V_{CE} = 5$ V	30	–	–	
f_T	transition frequency	$I_C = 100$ mA; $V_{CE} = 20$ V; f = 100 MHz	–	130	–	MHz
t_{off}	turn-off time	$I_{Con} = 500$ mA; $I_{Bon} = 50$ mA; $I_{Boff} = -50$ mA	–	900	–	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			
	BSW66A		–	100	V
	BSW67A		–	120	V
	BSW68A		–	150	V
V_{CEO}	collector-emitter voltage	open base			
	BSW66A		–	100	V
	BSW67A		–	120	V
	BSW68A		–	150	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	1	A
I_{CM}	peak collector current	$t_p \leq 20$ ms	–	2	A
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	800	mW
		$T_{case} \leq 25$ °C	–	5	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°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	free air	220	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		35	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current					
	BSW66A	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
		$I_E = 0$; $V_{CB} = 50$ V; $T_j = 150$ °C	–	–	50	μA
		$I_E = 0$; $V_{CB} = 100$ V	–	–	100	μA
I_{CBO}	collector cut-off current					
	BSW67A	$I_E = 0$; $V_{CB} = 60$ V	–	–	100	nA
		$I_E = 0$; $V_{CB} = 60$ V; $T_j = 150$ °C	–	–	50	μA
		$I_E = 0$; $V_{CB} = 120$ V	–	–	100	μA
I_{CBO}	collector cut-off current					
	BSW68A	$I_E = 0$; $V_{CB} = 75$ V	–	–	100	nA
		$I_E = 0$; $V_{CB} = 75$ V; $T_j = 150$ °C	–	–	50	μA
		$I_E = 0$; $V_{CB} = 150$ V	–	–	100	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 3$ V	–	–	100	nA
		$I_C = 0$; $V_{EB} = 6$ V	–	–	100	μA
h_{FE}	DC current gain	$V_{CE} = 5$ V				
		$I_C = 10$ mA	30	–	–	
		$I_C = 100$ mA	40	–	–	
		$I_C = 500$ mA	30	–	–	
		$I_C = 1$ A	10	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 100$ mA; $I_B = 10$ mA	–	–	150	mV
		$I_C = 500$ mA; $I_B = 50$ mA	–	–	400	mV
		$I_C = 1$ A; $I_B = 150$ mA	–	–	1	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 100$ mA; $I_B = 10$ mA	–	–	900	mV
		$I_C = 500$ mA; $I_B = 50$ mA	–	–	1.1	V
		$I_C = 1$ A; $I_B = 150$ mA	–	–	1.4	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	20	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0$; f = 1 MHz	–	–	300	pF
f_T	transition frequency	$I_C = 100$ mA; $V_{CE} = 20$ V; f = 100 MHz	–	130	–	MHz
Switching times (between 10% and 90% levels)						
t_{on}	turn-on time	$I_{Con} = 500$ mA; $I_{Bon} = 50$ mA; $I_{Boff} = -50$ mA	–	500	–	ns
t_{off}	turn-off time		–	900	–	ns

NPN switching transistor | BSX20

FEATURES

- Low current (max. 200 mA)
- Low voltage (max. 15 V).

APPLICATIONS

- High-speed saturated switching (and HF amplifier applications).

DESCRIPTION

NPN switching transistor in a TO-18 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

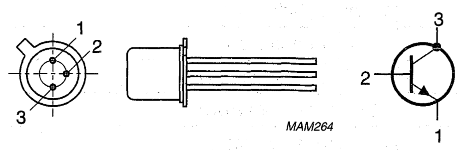


Fig.1 Simplified outline (TO-18) and symbol.

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
I_C	collector current (DC)		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	360	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	–	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	500	–	MHz
t_{off}	turn-off time	$I_{Con} = 10$ mA; $I_{Bon} = 3$ mA; $I_{Boff} = -1.5$ mA	–	30	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_{EBO}	emitter-base voltage	open collector	–	4.5	V
I_C	collector current (DC)		–	200	mA
I_{CM}	peak collector current	$t \leq 10\ \mu s$	–	300	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation		–	360	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°C
T_{amb}	operating ambient temperature		–65	+150	°C

THERMAL CHARACTERISTICS

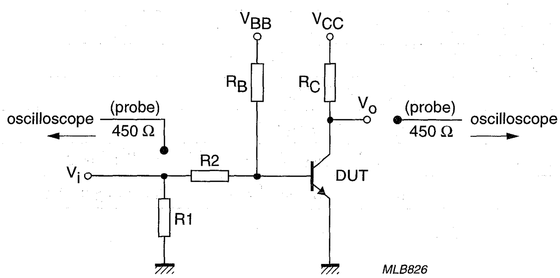
SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air	480	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		150	K/W

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	–	400	nA
		$I_E = 0$; $V_{CB} = 20$ V; $T_j = 150$ °C	–	–	30	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 1$ V	40	–	120	
		$I_C = 10$ mA; $V_{CE} = 1$ V; $T_j = -55$ °C	20	–	–	
		$I_C = 100$ mA; $V_{CE} = 2$ V	20	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.3$ mA	–	–	300	mV
		$I_C = 10$ mA; $I_B = 1$ mA	–	–	250	mV
		$I_C = 100$ mA; $I_B = 10$ mA	–	–	600	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	700	–	850	mV
		$I_C = 100$ mA; $I_B = 10$ mA	–	–	1.5	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	–	4	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 1$ V; f = 1 MHz	–	–	4.5	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	500	600	–	MHz

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Switching times (between 10% and 90% levels)						
t_{on}	turn-on time	I_{Con} = 10 mA; I_{Bon} = 3 mA; I_{Boff} = −1.5 mA; see Fig.2, test conditions A	–	–	10	ns
t_d	delay time		–	–	4	ns
t_r	rise time		–	–	6	ns
t_{off}	turn-off time		–	–	30	ns
t_s	storage time		–	–	15	ns
t_f	fall time		–	–	15	ns
t_{on}	turn-on time	I_{Con} = 100 mA; I_{Bon} = 40 mA; I_{Boff} = −20 mA; see Fig.2, test conditions B	–	–	13	ns
t_d	delay time		–	–	3	ns
t_r	rise time		–	–	10	ns
t_{off}	turn-off time		–	–	35	ns
t_s	storage time		–	–	25	ns
t_f	fall time		–	–	10	ns



Test conditions A.
V_i = 0.5 to 4.2 V; T = 500 μs; t_p = 10 μs; $t_r = t_f \leq 1$ ns.
R1 = 56 Ω; R2 = 1 kΩ; R_B = 1 kΩ; R_C = 270 Ω.
V_{BB} = 0.2 V; V_{CC} = 2.7 V.

Test conditions B.
V_i = 0.5 to 4.52 V; T = 200 μs; t_p = 10 μs; $t_r = t_f \leq 1$ ns.
R1 = 100 Ω; R2 = 68 Ω; R_B = 390 Ω; R_C = 47 Ω.
V_{BB} = −3 V; V_{CC} = 4.6 V.

Fig.2 Test circuit for switching times.

NPN switching transistor — BSX32

FEATURES

- High current (max. 1 A)
- Low voltage (max. 40 V).

APPLICATIONS

- High-current switching in industrial applications.

DESCRIPTION

NPN switching transistor in a TO-39 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

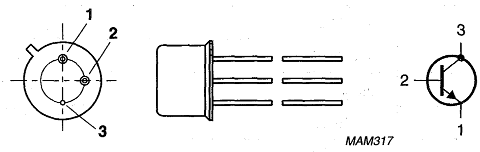


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	65	V
V_{CEO}	collector-emitter voltage	open base	–	–	40	V
I_C	collector current (DC)		–	–	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	800	mW
h_{FE}	DC current gain	$I_C = 1$ A; $V_{CE} = 5$ V	20	60	–	
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 10$ V; f = 100 MHz	300	–	–	MHz
t_{off}	turn-off time	$I_{Con} = 500$ mA; $I_{Bon} = 50$ mA; $I_{Boff} = -50$ mA	–	–	60	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	–	65	V
V_{CEO}	collector-emitter voltage	open base	–	40	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	1	A
I_{CM}	peak collector current		–	1	A
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	800	mW
		$T_{case} \leq 25$ °C	–	3.5	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°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	219	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		50	K/W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 50 V	–	–	4	μA
I_{EBO}	emitter cut-off current	I_E = 0; V_{EB} = 4 V	–	–	300	nA
h_{FE}	DC current gain	V_{CE} = 1 V; note 1				
		I_C = 10 mA	30	–	–	
		I_C = 100 mA	60	–	150	
		I_C = 500 mA	25	60	–	
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V; note 1	20	60	–	
h_{FE}	DC current gain	V_{CE} = 1 V; T_{amb} = −55 °C; note 1				
		I_C = 100 mA	30	–	–	
		I_C = 500 mA	15	–	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = 100 mA; I_B = 10 mA; note 1	–	170	250	mV
		I_C = 500 mA; I_B = 50 mA; note 1	–	360	500	mV
		I_C = 1 A; I_B = 100 mA; note 1	–	600	850	mV
V_{BEsat}	base-emitter saturation voltage	I_C = 100 mA; I_B = 10 mA; note 1	–	800	900	mV
		I_C = 500 mA; I_B = 50 mA; note 1	–	–	1.5	V
		I_C = 1 A; I_B = 100 mA; note 1	–	–	2	V
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 10 V; f = 1 MHz	–	–	10	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = 500 mV; f = 1 MHz	–	–	55	pF
f_T	transition frequency	I_C = 50 mA; V_{CE} = 10 V; f = 100 MHz	300	–	–	MHz
Switching times (between 10% and 90% levels)						
t_{on}	turn-on time	I_{Con} = 500 mA; I_{Bon} = 50 mA; I_{Boff} = −50 mA	–	–	35	ns
t_{off}	turn-off time		–	–	60	ns

Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.01$.

NPN medium power transistors BSX45; BSX46; BSX47

FEATURES

- High current (max. 1 A)
- Low voltage (max. 80 V).

APPLICATIONS

- General industrial applications.

DESCRIPTION

NPN medium power transistor in a TO-39 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

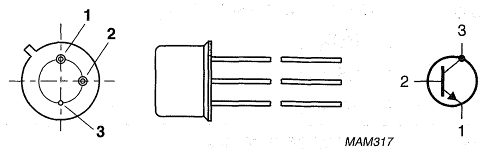


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BSX45		–	–	80	V
	BSX46		–	–	100	V
	BSX47		–	–	120	V
V_{CEO}	collector-emitter voltage	open base				
	BSX45		–	–	40	V
	BSX46		–	–	60	V
	BSX47		–	–	80	V
I_{CM}	peak collector current		–	–	1.5	A
P_{tot}	total power dissipation	$T_{case} \leq 25$ °C	–	–	6.25	W
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 1 V				
	BSX45-10; BSX46-10; BSX47-10		63	100	160	
	BSX45-16; BSX46-16; BSX47-16		100	160	250	
f_T	transition frequency	I_C = 50 mA; V_{CE} = 10 V; f = 100 MHz	50	–	–	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			
	BSX45		–	80	V
	BSX46		–	100	V
	BSX47		–	120	V
V_{CEO}	collector-emitter voltage	open base			
	BSX45		–	40	V
	BSX46		–	60	V
	BSX47		–	80	V
V_{EBO}	emitter-base voltage	open collector	–	7	V
I_C	collector current (DC)		–	1	A
I_{CM}	peak collector current		–	1.5	A
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{case} \leq 25$ °C	–	6.25	W
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	200	°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	200	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		28	K/W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current					
	BSX45; BSX46	I_E = 0; V_{CB} = 60 V	–	–	30	nA
		I_E = 0; V_{CB} = 60 V; T_{amb} = 150 °C	–	–	10	μA
I_{CBO}	collector cut-off current					
	BSX47	I_E = 0; V_{CB} = 80 V	–	–	30	nA
		I_E = 0; V_{CB} = 80 V; T_{amb} = 150 °	–	–	10	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 5 V	–	–	10	nA
h_{FE}	DC current gain	I_C = 100 μA; V_{CE} = 1 V				
	BSX45-10; BSX46-10; BSX47-10		15	40	–	
	BSX45-16; BSX46-16		25	90	–	
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 1 V				
	BSX45-10; BSX46-10; BSX47-10		63	100	160	
	BSX45-16; BSX46-16; BSX47-16		100	160	250	
h_{FE}	DC current gain	I_C = 500 mA; V_{CE} = 1 V				
	BSX45-10; BSX46-10; BSX47-10		25	40	–	
	BSX45-16; BSX46-16		35	60	–	
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 1 V				
	BSX45-10; BSX46-10; BSX47-10		–	20	–	
	BSX45-16; BSX46-16		–	30	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = 1 A; I_B = 100 mA				
	BSX45; BSX46		–	–	1	V
V_{CEsat}	collector-emitter saturation voltage	I_C = 500 mA; I_B = 25 mA				
	BSX47		–	–	900	mV
V_{BE}	base-emitter voltage	I_C = 100 mA; V_{CE} = 1 V	–	–	1	V
		I_C = 500 mA; V_{CE} = 1 V	0.75	–	1.5	V
		I_C = 1 A; V_{CE} = 1 V	–	–	2	V
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = 10 V; f = 1 MHz				
	BSX45		–	–	25	pF
	BSX46		–	–	20	pF
	BSX47		–	–	15	pF
C_e	emitter capacitance	I_C = i_c = 0; V_{EB} = 0.5 V; f = 1 MHz	–	–	80	pF
f_T	transition frequency	I_C = 50 mA; V_{CE} = 10 V; f = 100 MHz	50	–	–	MHz
F	noise figure	I_C = 100 μA; V_{CE} = 5 V; R_S = 1 kΩ; f = 1 kHz; B = 200 Hz	–	3.5	–	dB
Switching times (between 10% and 90% levels)						
t_{on}	turn-on time	I_{Con} = 100 mA; I_{Bon} = 5 mA; I_{Boff} = –5 mA	–	–	200	ns
t_{off}	turn-off time		–	–	850	ns

NPN switching transistors BSX59; BSX61

FEATURES

- High current (max. 1 A)
- Low voltage (max. 45 V).

APPLICATIONS

- High-speed switching in industrial applications.

DESCRIPTION

NPN switching transistor in a TO-39 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

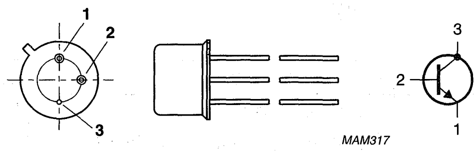


Fig.1 Simplified outline (TO-39) and symbol.

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	collector current (DC)		–	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	800	mW
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 1$ V	30	–	
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 10$ V; f = 100 MHz	250	–	MHz
t_{off}	turn-off time	$I_{Con} = 500$ mA; $I_{Bon} = 50$ mA; $I_{Boff} = -50$ mA			
	BSX59		–	60	ns
	BSX61		–	100	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	–	70	V
V_{CEO}	collector-emitter voltage	open base	–	45	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	1	A
I_{CM}	peak collector current		–	1	A
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	800	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°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	220	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		43	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 40$ V	–	–	500	nA
		$I_E = 0$; $V_{CB} = 40$ V; $T_j = 150$ °C	–	–	300	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V				
	BSX59		–	–	300	nA
	BSX61		–	–	500	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V; $T_j = 150$ °C	–	–	50	μA
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 1$ V	30	–	–	
		$I_C = 500$ mA; $V_{CE} = 1$ V	30	–	90	
		$I_C = 1$ A; $V_{CE} = 5$ V	20	–	–	
V_{CEsat}	collector-emitter saturation voltage					
	BSX59	$I_C = 150$ mA; $I_B = 15$ mA	–	–	300	mV
		$I_C = 500$ mA; $I_B = 50$ mA	–	–	500	mV
		$I_C = 1$ A; $I_B = 100$ mA	–	–	1	V
V_{CEsat}	collector-emitter saturation voltage					
	BSX61	$I_C = 150$ mA; $I_B = 15$ mA	–	–	500	mV
		$I_C = 500$ mA; $I_B = 50$ mA	–	–	700	mV
		$I_C = 1$ A; $I_B = 100$ mA	–	–	1.3	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA	–	–	1	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 500$ mA; $I_B = 50$ mA				
	BSX59		0.85	–	1.2	V
	BSX61		0.7	–	1.3	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 1$ A; $I_B = 100$ mA	–	–	1.8	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	6	10	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 500$ mV; f = 1 MHz	–	36	50	pF
f_T	transition frequency	$I_C = 50$ mA; $V_{CE} = 10$ V; f = 100 MHz	250	–	–	MHz
Switching times (between 10% and 90% levels)						
t_{on}	turn-on time	$I_{Con} = 500$ mA; $I_{Bon} = 50$ mA; $I_{Boff} = -50$ mA				
	BSX59		–	17	35	ns
	BSX61		–	18	50	ns
t_{off}	turn-off time	$I_{Con} = 500$ mA; $I_{Bon} = 50$ mA; $I_{Boff} = -50$ mA				
	BSX59		–	45	60	ns
	BSX61		–	70	100	ns

NPN switching transistors | BSX62; BSX63

FEATURES

- High current (max. 3 A)
- Low voltage (max. 60 V).

APPLICATIONS

- Medium power switching.

DESCRIPTION

NPN switching transistor in a TO-39 metal package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

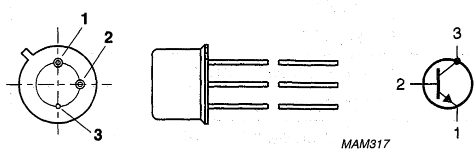


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BSX62		–	–	60	V
	BSX63		–	–	80	V
V_{CEO}	collector-emitter voltage	open base				
	BSX62		–	–	40	V
	BSX63		–	–	60	V
I_C	collector current (DC)		–	–	3	A
P_{tot}	total power dissipation	$T_{case} \leq 25$ °C	–	–	5	W
h_{FE}	DC current gain	$I_C = 1$ A; $V_{CE} = 1$ V				
	BSX62-10; BSX63-10		63	100	160	
	BSX62-16; BSX63-16		100	160	250	
f_T	transition frequency	$I_C = 200$ mA; $V_{CE} = 10$ V; f = 100 MHz	30	70	–	MHz
t_{off}	turn-off time	$I_{Con} = 1$ A; $I_{Bon} = 50$ mA; $I_{Boff} = -50$ mA	–	–	1.5	μs

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			
	BSX62		–	60	V
	BSX63		–	80	V
V_{CEO}	collector-emitter voltage	open base			
	BSX62		–	40	V
	BSX63		–	60	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	3	A
I_{CM}	peak collector current		–	3	A
I_{BM}	peak base current		–	500	mA
P_{tot}	total power dissipation	$T_{case} \leq 25$ °C	–	5	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°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	200	K/W
$R_{th\ j\text{-}c}$	thermal resistance from junction to case		28	K/W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current					
	BSX62	V_{CB} = 40 V	–	–	100	nA
		V_{CB} = 40 V; T_{case} = 150 °C	–	–	100	μA
I_{CBO}	collector cut-off current					
	BSX63	V_{CB} = 60 V	–	–	100	nA
		V_{CB} = 60 V; T_{case} = 150 °C	–	–	100	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 5 V	–	–	100	nA
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 1 V				
	BSX62-10; BSX63-10		–	110	–	
	BSX62-16; BSX63-16		–	180	–	
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 1 V				
	BSX62-10; BSX63-10		63	100	160	
	BSX62-16; BSX63-16		100	160	250	
h_{FE}	DC current gain	I_C = 2 A; V_{CE} = 5 V				
	BSX62-10; BSX63-10		–	70	–	
	BSX62-16; BSX63-16		–	120	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = 1 A; I_B = 100 mA	–	–	700	mV
		I_C = 2 A; I_B = 200 mA	–	–	800	mV
V_{BEsat}	base-emitter saturation voltage	I_C = 1 A; I_B = 100 mA	–	–	1.2	V
		I_C = 2 A; I_B = 200 mA	–	–	1.3	V
V_{BE}	base-emitter voltage	I_C = 100 mA; V_{CE} = 1 V	–	–	1	V
		I_C = 1 A; V_{CE} = 1 V	–	–	1.2	V
		I_C = 2 A; V_{CE} = 5 V	–	–	1.3	V
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = 10 V; f = 1 MHz	–	–	70	pF
f_T	transition frequency	I_C = 200 mA; V_{CE} = 10 V; f = 100 MHz	30	70	–	MHz
Switching times (between 10% and 90% levels)						
t_{on}	turn-on time	I_{Con} = 1 A; I_{Bon} = 50 mA; I_{Boff} = −50 mA	–	–	300	ns
t_{off}	turn-off time		–	–	1.5	μs

NPN general purpose transistor ED1402

FEATURES

- Low current (max. 200 mA)
- Low voltage (max. 20 V)
- High gain.

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistor in a plastic TO-92; SOT54 package.
PNP complement: ED1602.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

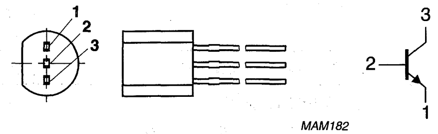


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	28	V
V_{CEO}	collector-emitter voltage	open base	–	20	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V	120	900	
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 10$ V; f = 100 MHz	–	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	–	28	V
V_{CEO}	collector-emitter voltage	open base	–	20	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	200	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	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 TO-92; SOT54 standard mounting conditions.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Refer to TO-92; SOT54 standard mounting conditions.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector 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
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V			
	ED1402A		110	165	
	ED1402B		150	225	
	ED1402C		202	318	
	ED1402D		290	450	
	ED1402E		410	810	
V_{BE}	base-emitter voltage	$I_C = 2$ mA; $V_{CE} = 5$ V; note 1	–	770	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	5	pF
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 10$ V; f = 100 MHz	100	–	MHz

Note

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

NPN general purpose transistor ED1502

FEATURES

- Low current (max. 25 mA)
- Low voltage (max. 20 V)
- High gain.

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistor in a plastic TO-92; SOT54 package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

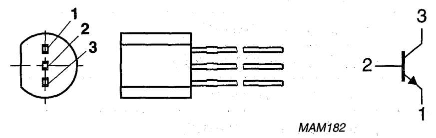


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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	–	20	V
I_{CM}	peak collector current		–	25	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = 7$ mA; $V_{CE} = 10$ V	36	210	
f_T	transition frequency	$I_C = 5$ mA; $V_{CE} = 10$ V; f = 100 MHz	361	825	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	–	20	V
V_{EBO}	emitter-base voltage	open collector	–	4	V
I_C	collector current (DC)		–	25	mA
I_{CM}	peak collector current		–	25	mA
I_{BM}	peak base current		–	25	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	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 TO-92; SOT54 standard mounting conditions.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Refer to TO-92; SOT54 standard mounting conditions.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 40$ V	–	–	10	μA
		$I_E = 0$; $V_{CB} = 20$ V; $T_j = 150$ °C	–	–	5	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	–	10	μA
h_{FE}	DC current gain	$I_C = 7$ mA; $V_{CE} = 10$ V				
	ED1502A		36	–	55	
	ED1502B		48	–	75	
	ED1502C		66	–	100	
	ED1502D		84	–	127	
	ED1502E		105	–	210	
V_{BE}	base-emitter voltage	$I_C = 7$ mA; $V_{CE} = 10$ V; note 1	–	–	925	mV
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	0.5	–	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	361	–	825	MHz

Note

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

PNP general purpose transistor | ED1602

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 20 V).

APPLICATIONS

- Audio pre-amplifiers and driver stages
- FM multiplex stereo decoders
- Small-signal circuits in television receivers
- Medium speed switching.

DESCRIPTION

PNP transistor in a TO-92; SOT54 plastic package.
NPN complement: ED1402.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

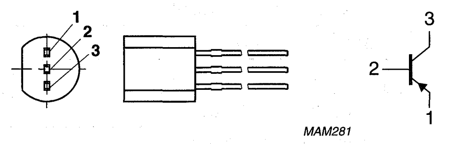


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–25	V
V_{CEO}	collector-emitter voltage	open base	–	–20	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V	70	800	
f_T	transition frequency	$I_C = -5$ mA; $V_{CE} = -5$ V; f = 100 MHz	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	–	−25	V
V_{CEO}	collector-emitter voltage	open base	–	−20	V
V_{EBO}	emitter-base voltage	open collector	–	−4	V
I_C	collector current (DC)		–	−100	mA
I_{CM}	peak collector current		–	−200	mA
I_{BM}	peak base current		–	−200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		−65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -20$ V	–	−15	nA
		$I_E = 0$; $V_{CB} = -10$ V; $T_j = 150$ °C	–	−20	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -4$ V	–	−100	nA
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V			
	ED1602A		70	105	
	ED1602B		90	140	
	ED1602C		125	190	
	ED1602D		170	260	
	ED1602E		223	475	
	ED1602F		415	800	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	−300	mV
		$I_C = -100$ mA; $I_B = -5$ mA	–	−650	mV
V_{BE}	base-emitter voltage	$I_C = -2$ mA; $V_{CE} = -5$ V	−500	−750	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$V; f = 1 MHz	–	5	pF
f_T	transition frequency	$I_C = -5$ mA; $V_{CE} = -5$ V; f = 100 MHz	100	–	MHz
F	noise figure	$I_C = -0.2$ mA; $V_{CE} = -5$ V; $R_S = 2$ kΩ; f = 1 kHz; B = 200 Hz	–	4	dB

NPN general purpose transistor — ED1702

FEATURES

- Low current (max. 500 mA)
- Low voltage (max. 25 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistor in a TO-92; SOT54 plastic package.
PNP complement: ED1802.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

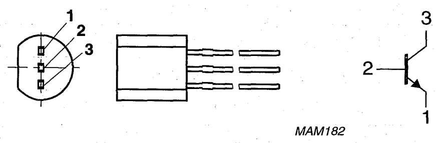


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
I_{CM}	peak collector current		–	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	625	mW
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 1$ V	40	–	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	80	–	MHz

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	1	A
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	625	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	200	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector 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	–	500	nA
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 1$ V	40	–	
		$I_C = 100$ mA; $V_{CE} = 1$ V	106	588	
h_{FE}	DC current gain	$I_C = 100$ mA; $V_{CE} = 1$ V			
	ED1702K		106	150	
	ED1702L		132	189	
	ED1702M		170	233	
	ED1702N		213	300	
	ED1702O		263	370	
	ED1702P		333	476	
	ED1702Q		435	588	
V_{CEsat}	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	–	6	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	80	–	MHz

Note

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

PNP general purpose transistor | ED1802

FEATURES

- Low current (max. 500 mA)
- Low voltage (max. 25 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a TO-92; SOT54 plastic package.
NPN complement: ED1702.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

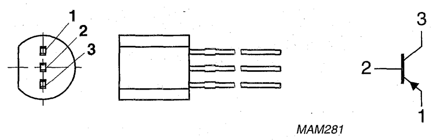


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–30	V
V_{CEO}	collector-emitter voltage	open base	–	–25	V
I_{CM}	peak collector current		–	–1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	625	mW
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -1$ V	40	–	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	80	–	MHz

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–30	V
V_{CEO}	collector-emitter voltage	open base	–	–25	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–500	mA
I_{CM}	peak collector current		–	–1	A
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	625	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	200	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector 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	–	–500	nA
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -1$ V	40	–	
		$I_C = -100$ mA; $V_{CE} = -1$ V	106	588	
h_{FE}	DC current gain	$I_C = -100$ mA; $V_{CE} = -1$ V			
	ED1802K		106	150	
	ED1802L		132	189	
	ED1802M		170	233	
	ED1802N		213	300	
	ED1802O		263	370	
	ED1802P		333	476	
	ED1802Q		435	588	
V_{CEsat}	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	–	15	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	80	–	MHz

Note

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

PNP general purpose transistor JA101

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a TO-92; SOT54 plastic package.
NPN complement: JC501.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

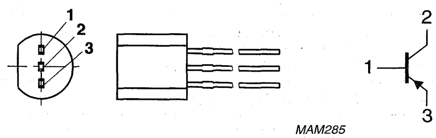


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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	–	–45	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -5$ V	135	600	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	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	–	–45	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -45$ V	–	–	–15	nA
		$I_E = 0$; $V_{CB} = -45$ V; $T_j = 125$ °C	–	–	–4	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–100	nA
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -5$ V	135	–	600	
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -5$ V				
	JA101P		135	–	270	
	JA101Q		200	–	400	
	JA101R		300	–	600	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
		$I_C = -100$ mA; $I_B = -5$ mA	–	–500	–	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–700	–	mV
		$I_C = -100$ mA; $I_B = -5$ mA	–	–850	–	mV
V_{BE}	base-emitter voltage	$I_C = -2$ mA; $V_{CE} = -5$ V	–550	–	–700	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	–	12	–	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	100	130	–	MHz
F	noise figure	$I_C = -200$ μA; $V_{CE} = -5$ V; $R_S = 2$ kΩ; f = 1 kHz; B = 200 Hz	–	–	10	dB

PNP general purpose transistors JC327; JC327A; JC328

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 60 V).

APPLICATIONS

- General purpose switching and amplification, e.g. driver and output stages of audio amplifiers.

DESCRIPTION

PNP transistor in a TO-92; SOT54 plastic package. NPN complements: JC337, JC337A and JC338.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

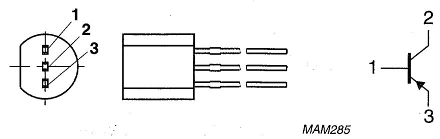


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	JC327		–	–50	V
	JC327A		–	–60	V
	JC328		–	–30	V
V_{CEO}	collector-emitter voltage	open base			
	JC327		–	–45	V
	JC327A		–	–60	V
	JC328		–	–25	V
I_{CM}	peak collector current		–	–1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	625	mW
h_{FE}	DC current gain	$I_C = -100$ mA; $V_{CE} = -1$ V			
	BC327; BC328		100	600	
	BC327A		100	400	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	80	–	MHz

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	JC327		–	–50	V
	JC327A		–	–60	V
	JC328		–	–30	V
V_{CEO}	collector-emitter voltage	open base; I_C = –10 mA			
	JC327		–	–45	V
	JC327A		–	–60	V
	JC328		–	–25	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–500	mA
I_{CM}	peak collector current		–	–1	A
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	625	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit-board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	0.2	K/mW

Note

1. Transistor mounted on an FR4 printed-circuit-board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −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
h_{FE}	DC current gain	I_C = −100 mA; V_{CE} = −1 V				
	JC327; JC328		100	−	600	
	JC327A		100	−	400	
	JC327-16; JC328-16		100	−	250	
	JC327-25; JC328-25		160	−	400	
	JC327-40; JC328-40		250	−	600	
h_{FE}	DC current gain	I_C = −500 mA; V_{CE} = −1 V	40	−	−	
V_{CEsat}	collector-emitter saturation voltage	I_C = −500 mA; I_B = −50 mA	−	−	−700	mV
V_{BE}	base-emitter voltage	I_C = −500 mA; V_{CE} = −1 V; note 1	−	−	−1.2	V
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = −10 V; f = 1 MHz	−	8	−	pF
f_T	transition frequency	I_C = −10 mA; V_{CE} = −5 V; f = 100 MHz	80	−	−	MHz

Note

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

FEATURES

- Low current (max. 500 mA)
- Low voltage (max. 60 V).

APPLICATIONS

- General purpose switching and amplification, e.g. driver and output stages of audio amplifiers.

DESCRIPTION

NPN transistor in a TO-92; SOT54 plastic package. PNP complements: JC327, JC327A and JC328.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

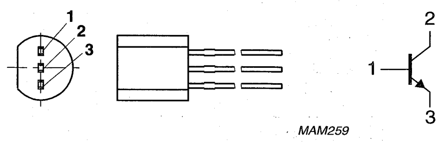


Fig.1 Simplified outline TO-92; SOT54 and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	JC337		–	50	V
	JC337A		–	60	V
	JC338		–	30	V
V_{CEO}	collector-emitter voltage	open base			
	JC337		–	45	V
	JC337A		–	60	V
	JC338		–	25	V
I_{CM}	peak collector current		–	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	625	mW
h_{FE}	DC current gain	$I_C = 100$ mA; $V_{CE} = 1$ V	100	600	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	100	–	MHz

NPN general purpose transistors JC337; JC337A; JC338

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			
	JC337		–	50	V
	JC337A		–	60	V
	JC338		–	30	V
V_{CEO}	collector-emitter voltage	open base			
	JC337		–	45	V
	JC337A		–	60	V
	JC338		–	25	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	1	A
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	625	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	0.2	K/mW

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ 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
h_{FE}	DC current gain	$I_C = 100$ mA; $V_{CE} = 1$ V				
	JC337; JC338		100	–	600	
	JC337A		100	–	400	
	JC337-16; JC338-16		100	–	250	
	JC337-25; JC338-25		160	–	400	
	JC337-40; JC338-40		250	–	600	
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 1$ V	40	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 500$ mA; $I_B = 50$ mA	–	–	700	mV
V_{BE}	base-emitter voltage	$I_C = 500$ mA; $V_{CE} = 1$ V; note 1	–	–	1.2	V
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

Note

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

NPN general purpose transistor JC501

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistor in a TO-92; SOT54 plastic package.
PNP complement: JA101.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

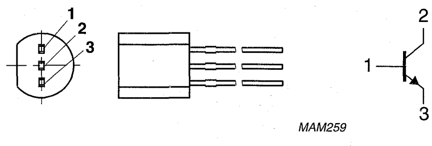


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–		50	V
V_{CEO}	collector-emitter voltage	open base	–		45	V
I_{CM}	peak collector current		–		200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–		500	mW
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 5$ V	90		600	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	–	130	–	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	–	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
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	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	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 45 V	–	–	15	nA
		I_E = 0; V_{CB} = 45 V; T_j = 125 °C	–	–	4	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 6 V	–	–	100	nA
h_{FE}	DC current gain	I_C = 1 mA; V_{CE} = 5 V	90	–	600	
h_{FE}	DC current gain	I_C = 1 mA; V_{CE} = 5 V				
	JC501O		90	–	180	
	JC501P		135	–	270	
	JC501Q		200	–	400	
	JC501R		300	–	600	
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA; I_B = 0.5 mA	–	–	200	mV
		I_C = 100 mA; I_B = 5 mA	–	–	600	mV
V_{BEsat}	base-emitter saturation voltage	I_C = 10 mA; I_B = 0.5 mA	–	–	830	mV
		I_C = 100 mA; I_B = 5 mA	–	–	1.06	V
V_{BE}	base-emitter voltage	I_C = 2 mA; V_{CE} = 5 V	550	–	700	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	–	11.5	–	pF
f_T	transition frequency	I_C = 10 mA; V_{CE} = 5 V; f = 100 MHz	–	130	–	MHz
F	noise figure	I_C = 200 μA; V_{CE} = 5 V; R_S = 2 kΩ; f = 1 kHz; B = 200 Hz	–	–	10	dB

NPN general purpose transistors — JC546; JC547; JC548

FEATURES

- Low current max. 100 mA)
- Low voltage (max. 65 V).

APPLICATIONS

- General purpose switching and amplification, e.g. driver and output stages of audio amplifiers.

DESCRIPTION

NPN transistor in a TO-92; SOT54 plastic package.
PNP complements: JC556, JC557 and JC558.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

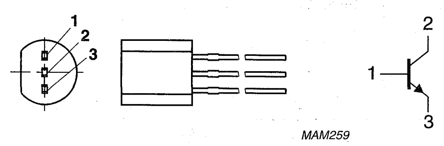


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	JC546		–	80	V
	JC547		–	50	V
	JC548		–	30	V
V_{CEO}	collector-emitter voltage	open base			
	JC546		–	65	V
	JC547		–	45	V
	JC548		–	30	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V			
	JC546		110	450	
	JC547; JC548		110	800	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; $f = 100$ MHz	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			
	JC546		–	80	V
	JC547		–	50	V
	JC548		–	30	V
V_{CEO}	collector-emitter voltage	open-base			
	JC546		–	65	V
	JC547		–	45	V
	JC548		–	30	V
V_{EBO}	emitter-base voltage	open collector			
	JC546; JC547		–	6	V
	JC548		–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	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	note 1	0.25	K/mW

Note

1. Transistor mounted on an FR4 printed-circuit board.

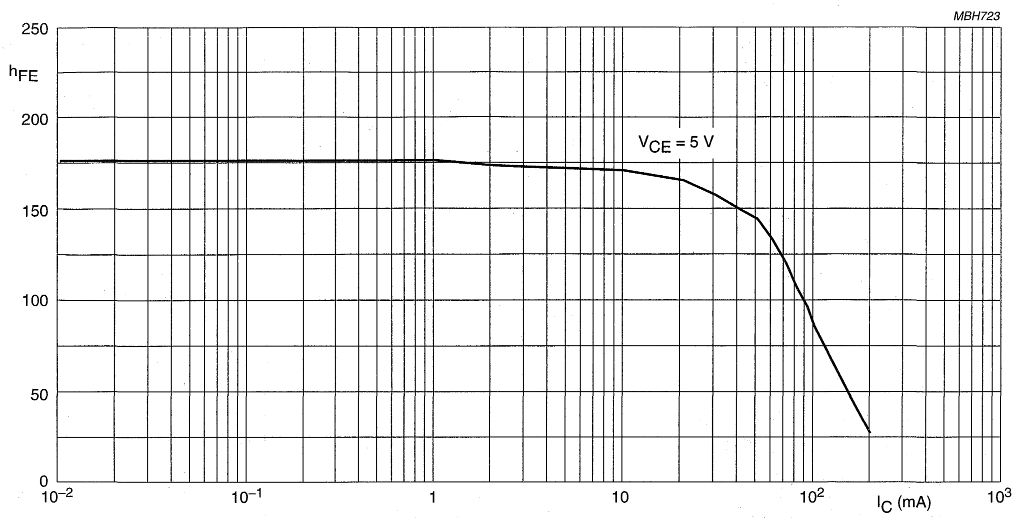
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30$ 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
h_{FE}	DC current gain	$I_C = 10$ μA; $V_{CE} = 5$ V; see Figs 2, 3 and 4				
	JC546A; JC547A; JC548A		–	90	–	
	JC546B; JC547B; JC548B		–	150	–	
	JC547C; JC548C		–	270	–	
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V; see Figs 2, 3 and 4				
	JC546		110	–	450	
	JC547; JC548		110	–	800	
	JC546A; JC547A; JC548A		110	180	220	
	JC546B; JC547B; JC548B		200	290	450	
	JC547C; JC548C		420	520	800	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	90	250	mV
		$I_C = 100$ mA; $I_B = 5$ mA	–	200	600	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA; note 1	–	700	–	mV
		$I_C = 100$ mA; $I_B = 5$ mA; note 1	–	900	–	mV
V_{BE}	base-emitter voltage	$I_C = 2$ mA; $V_{CE} = 5$ V; note 2	580	660	700	mV
		$I_C = 10$ mA; $V_{CE} = 5$ V; note 2	–	–	770	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	2.5	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	11.5	–	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	–	2	10	dB

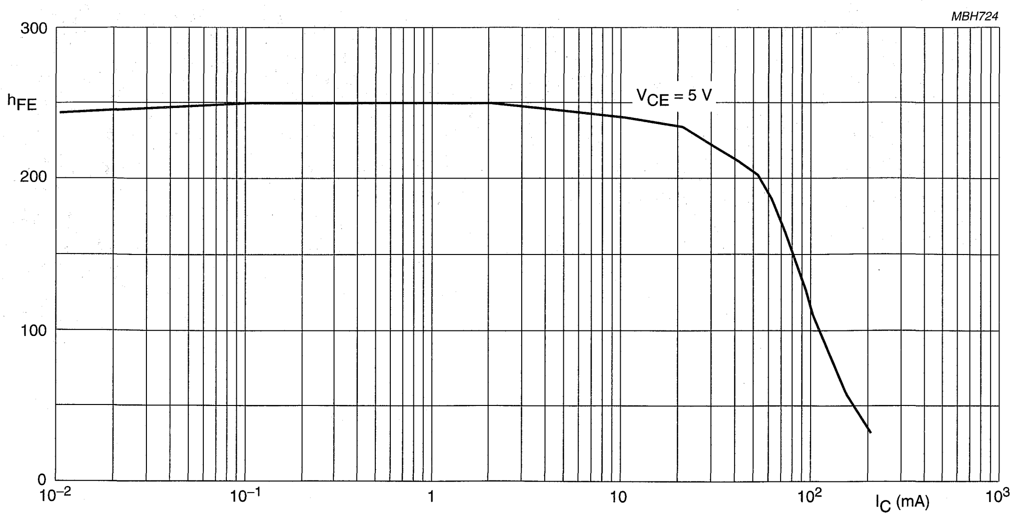
Notes

1. V_{BEsat} decreases by about 1.7 mV/K with increasing temperature.
2. V_{BE} decreases by about 2 mV/K with increasing temperature.



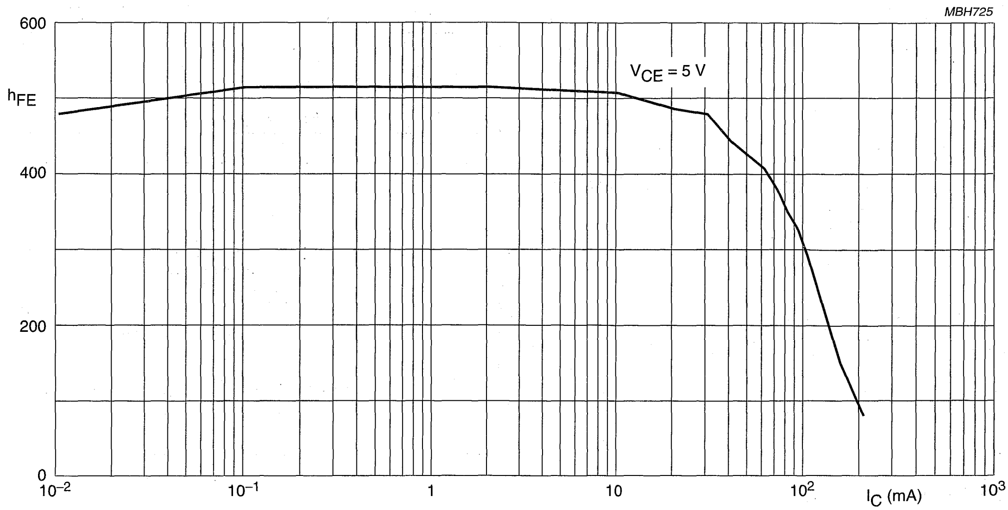
JC846A; JC847A; JC848A.

Fig.2 DC current gain; typical values.



JC846B; JC847B; JC848B.

Fig.3 DC current gain; typical values.



JC847C; JC848C.

Fig.4 DC current gain; typical values.

NPN general purpose transistors JC549; JC550

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- General purpose switching and amplification
- Low noise stages in tape recorders, hi-fi amplifiers and other audio-frequency equipment.

DESCRIPTION

NPN transistor in a TO-92; SOT54 plastic package.
PNP complements: JC559 and JC560.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

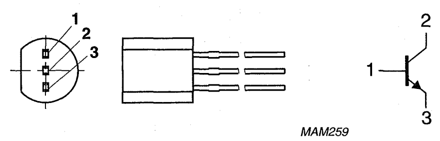


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	JC549		–	30	V
	JC550		–	50	V
V_{CEO}	collector-emitter voltage	open base			
	JC549		–	30	V
	JC550		–	45	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 5$ V	200	800	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	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			
	JC549		–	30	V
	JC550		–	50	V
V_{CEO}	collector-emitter voltage	open base			
	JC549		–	30	V
	JC550		–	45	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

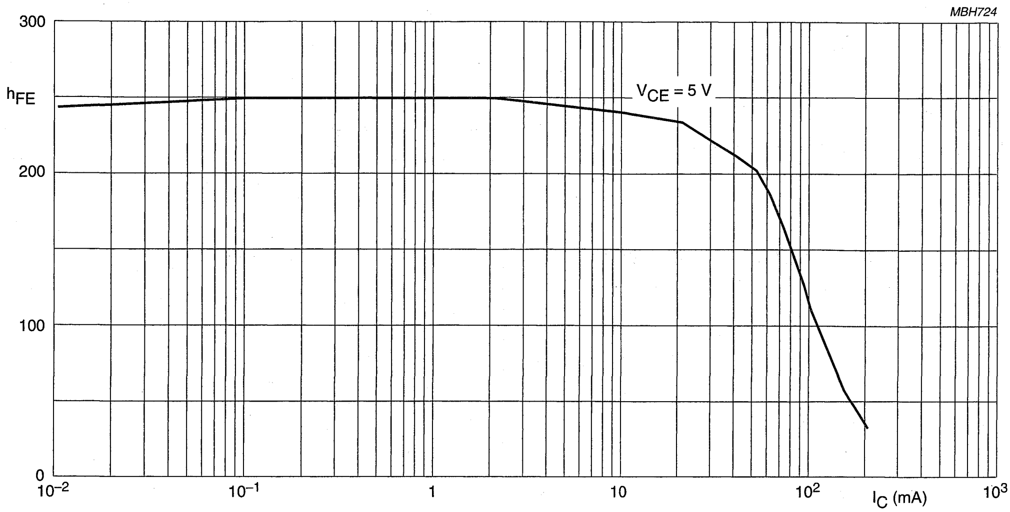
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 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
h_{FE}	DC current gain	I_C = 10 μA; V_{CE} = 5 V; see Figs 2 and 3				
	JC549B; JC550B		–	150	–	
	JC549C; JC550C		–	270	–	
h_{FE}	DC current gain	I_C = 2 mA; V_{CE} = 5 V; see Figs 2 and 3				
	JC549; JC550		200	–	800	
	JC549B; JC550B		200	290	450	
	JC549C; JC550C		420	520	800	
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA; I_B = 0.5 mA	–	90	250	mV
		I_C = 100 mA; I_B = 5 mA	–	200	600	mV
V_{BEsat}	base-emitter saturation voltage	I_C = 10 mA; I_B = 0.5 mA; note 1	–	700	–	mV
		I_C = 100 mA; I_B = 5 mA; note 1	–	900	–	mV
V_{BE}	base-emitter voltage	I_C = 2 mA; V_{CE} = 5 V; note 2	580	660	700	mV
		I_C = 10 mA; V_{CE} = 5 V; note 2	–	–	770	mV
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = 10 V; f = 1 MHz	–	2.5	–	pF
C_e	emitter capacitance	I_C = i_c = 0; V_{EB} = 500 mV; f = 1 MHz	–	11.5	–	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 = 10 Hz to 15.7 kHz	–	–	4	dB
		I_C = 200 μA; V_{CE} = 5 V; R_S = 2 kΩ; f = 1 kHz; B = 200 Hz	–	–	4	dB

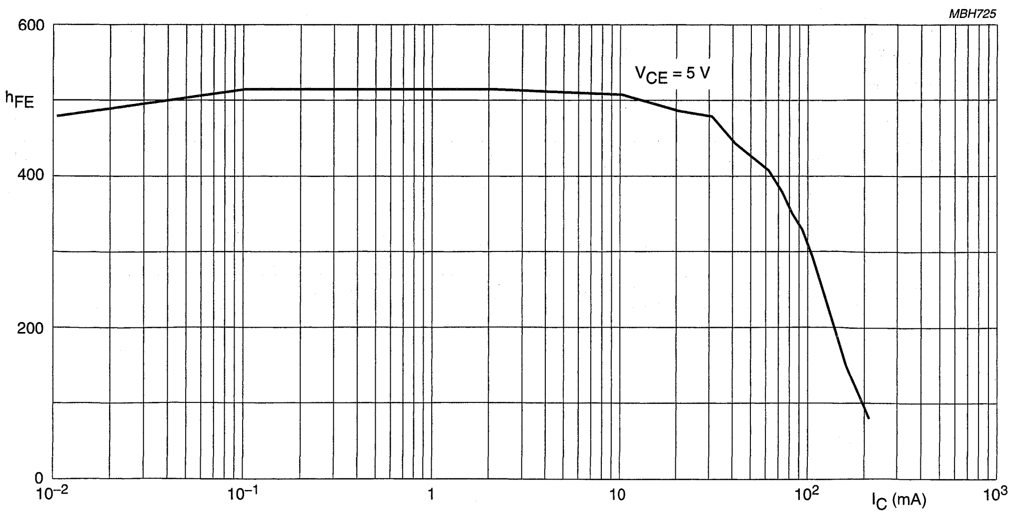
Notes

1. V_{BEsat} decreases by about 1.7 mV/K with increasing temperature.
2. V_{BE} decreases by about 2 mV/K with increasing temperature.



JC549B; JC550B.

Fig.2 DC current gain; typical values.



JC549C; JC550C.

Fig.3 DC current gain; typical values.

PNP general purpose transistors — JC556; JC557; JC558

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 65 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a TO-92; SOT54 plastic package.
NPN complements: JC546, JC547 and JC548.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

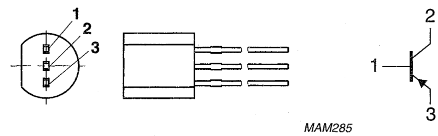


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	JC556		–	–80	V
	JC557		–	–50	V
	JC558		–	–30	V
V_{CEO}	collector-emitter voltage	open base			
	JC556		–	–65	V
	JC557		–	–45	V
	JC558		–	–30	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V			
	JC556		125	475	
	JC557; JC558		125	800	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	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			
	JC556		–	–80	V
	JC557		–	–50	V
	JC558		–	–30	V
V_{CEO}	collector-emitter voltage	open base			
	JC556		–	–65	V
	JC557		–	–45	V
	JC558		–	–30	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	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	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

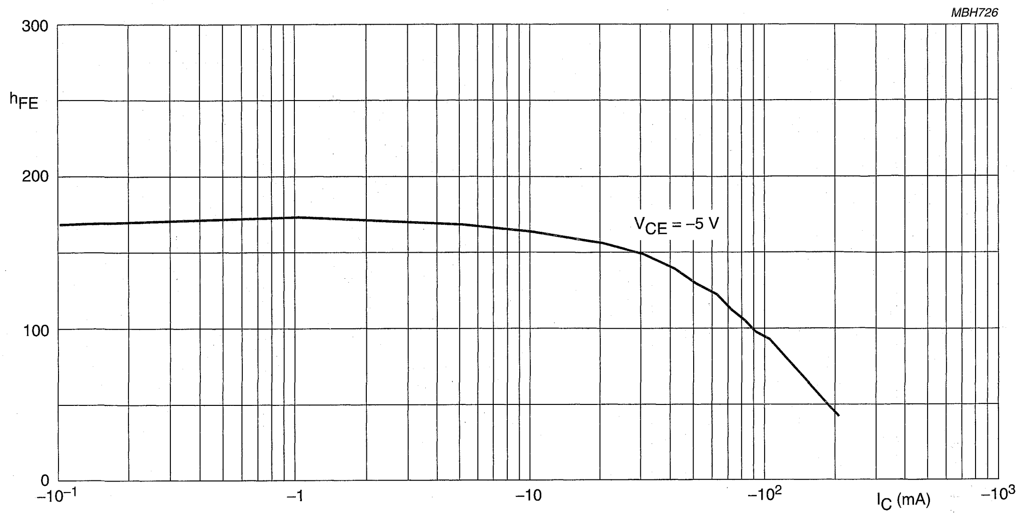
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = –30 V	–	–1	–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
h_{FE}	DC current gain	I_C = –2 mA; V_{CE} = –5 V; see Figs 2, 3 and 4				
	JC556		125	–	475	
	JC557; JC558		125	–	800	
	JC556A; JC557A; JC558A		125	–	250	
	JC556B; JC557B; JC558B		220	–	475	
	JC557C; JC558C		420	–	800	
V_{CEsat}	collector-emitter saturation voltage	I_C = –10 mA; I_B = –0.5 mA	–	–60	–300	mV
		I_C = –100 mA; I_B = –5 mA	–	–180	–650	mV
V_{BEsat}	base-emitter saturation voltage	I_C = –10 mA; I_B = –0.5 mA; note 1	–	–750	–	mV
		I_C = –100 mA; I_B = –5 mA; note 1	–	–930	–	mV
V_{BE}	base-emitter voltage	I_C = –2 mA; V_{CE} = –5 V; note 2	–600	–650	–750	mV
		I_C = –10 mA; V_{CE} = –5 V; note 2	–	–	–820	mV
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CE} = –10 V; f = 1 MHz	–	4	–	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = –500 mV; f = 1 MHz	–	10	–	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

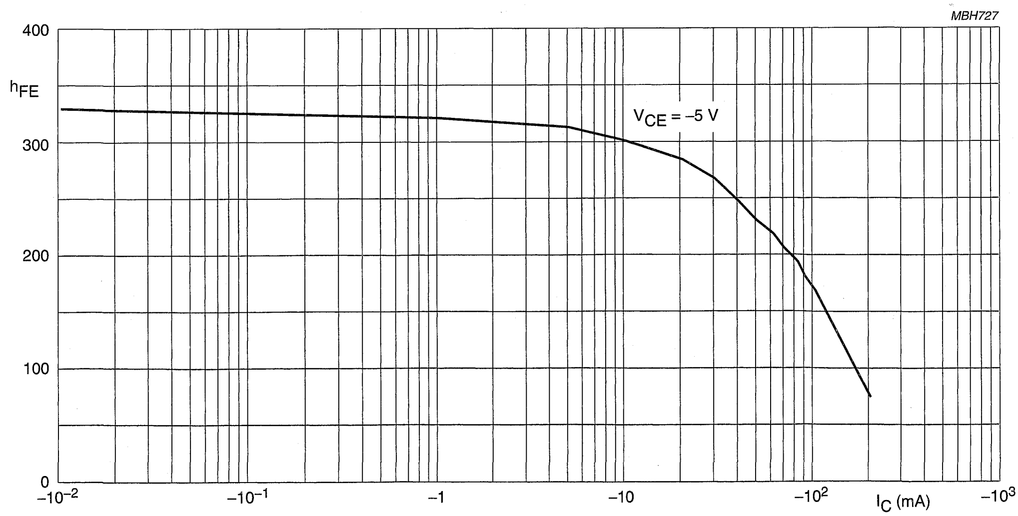
Notes

1. V_{BEsat} decreases by about –1.7 mV/K with increasing temperature.
2. V_{BE} decreases by about –2 mV/K with increasing temperature.



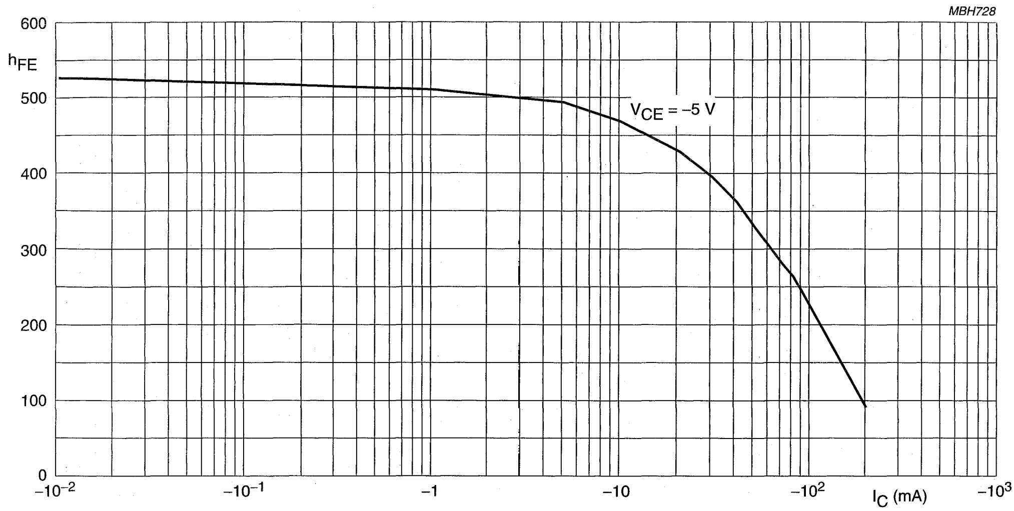
JC556A; JC557A; JC558A.

Fig.2 DC current gain; typical values.



JC556B; JC557B; JC558B.

Fig.3 DC current gain; typical values.



JC557C; JC558C.

Fig.4 DC current gain; typical values.

PNP general purpose transistors | JC559; JC560

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- General purpose switching and amplification
- Low-noise input stages in tape recorders, hi-fi amplifiers and other audio-frequency equipment.

DESCRIPTION

PNP transistor in a TO-92; SOT54 plastic package.
NPN complements: JC549 and JC550.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

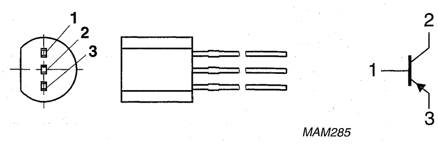


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	JC559			−30	V
	JC560			−50	V
V_{CEO}	collector-emitter voltage	open base			
	JC559		−	−30	V
	JC560		−	−45	V
I_{CM}	peak collector current		−	−200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	−	500	mW
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V	125	800	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	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			
	JC559		–	–30	V
	JC560		–	–50	V
V_{CEO}	collector-emitter voltage	open base			
	JC559		–	–30	V
	JC560		–	–45	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

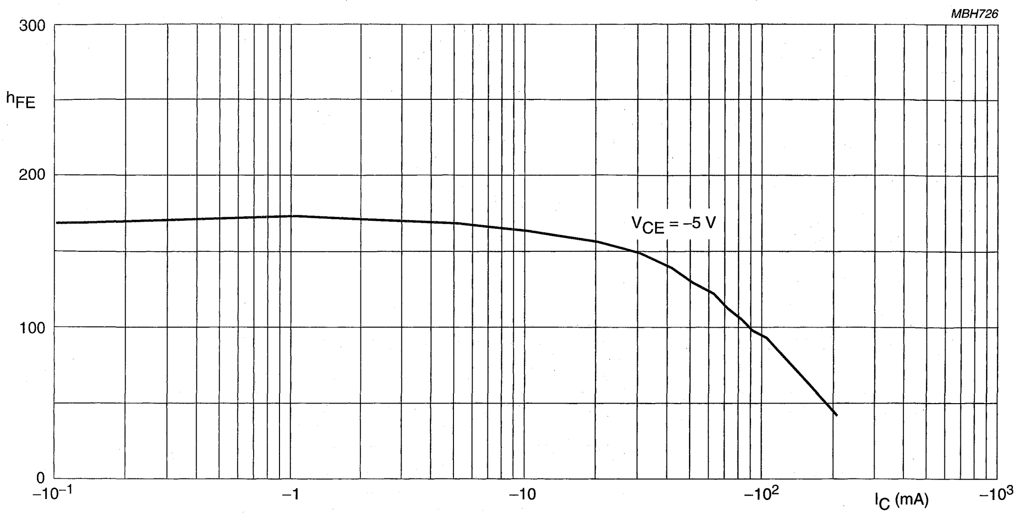
CHARACTERISTICS

T_j = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −30 V	–	−1	−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
h_{FE}	DC current gain	I_C = −2 mA; V_{CE} = −5 V see Figs 2, 3 and 4				
	JC559; JC560		125	–	800	
	JC559A; JC560A		125	–	250	
	JC559B; JC560B		220	–	475	
	JC559C; JC560C		420	–	800	
V_{CEsat}	collector-emitter saturation voltage	I_C = −10 mA; I_B = −0.5 mA; note 1	–	−60	−300	mV
		I_C = −100 mA; I_B = −5 mA; note 1	–	−180	−650	mV
V_{BEsat}	base-emitter saturation voltage	I_C = −10 mA; I_B = −0.5 mA; note 1	–	−750	–	mV
		I_C = −100 mA; I_B = −5 mA; note 1	–	−930	–	mV
V_{BE}	base-emitter voltage	I_C = −2 mA; V_{CE} = −5 V; note 2	−600	−650	−750	mV
		I_C = −10 mA; V_{CE} = −5 V; note 2	–	–	−820	mV
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = −10 V; f = 1 MHz	–	4	–	pF
C_e	emitter capacitance	I_C = i_c = 0; V_{EB} = −500 mV; f = 1 MHz	–	12	–	pF
f_T	transition frequency	I_C = −10 mA; V_{CE} = −5 V; f = 100 MHz	100	–	–	MHz
F	noise figure JC559B; JC560B; JC559C; JC560C	I_C = −200 μA; V_{CE} = −5 V; R_S = 2 kΩ; f = 10 Hz to 15.7 kHz	–	–	4	dB
F	noise figure JC559B; JC560B; JC559C; JC560C	I_C = −200 μA; V_{CE} = −5 V; R_S = 2 kΩ; f = 1 kHz; B = 200 Hz	–	–	4	dB

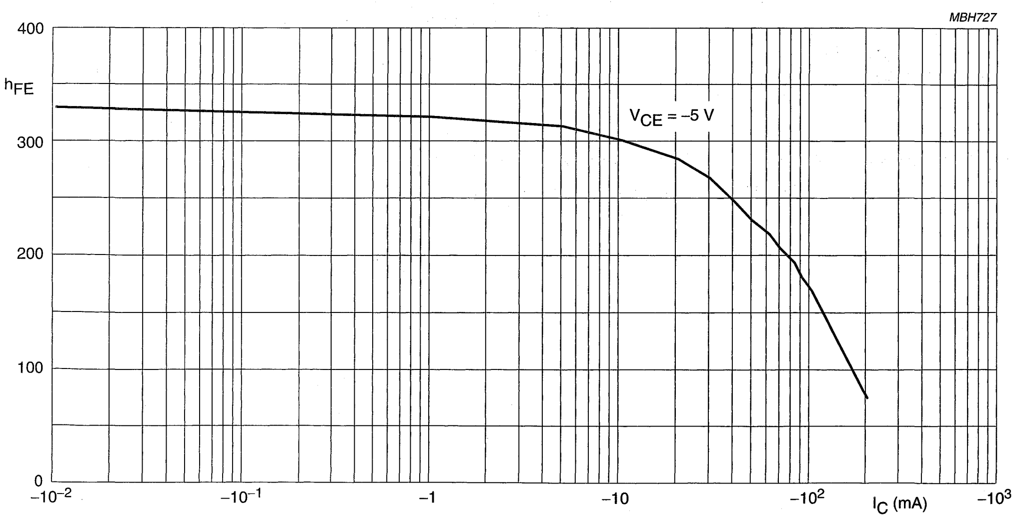
Notes

1. V_{BEsat} decreases by about −1.7 mV/K with increasing temperature.
2. V_{BE} decreases by about −2 mV/K with increasing temperature.



JC559A; JC560A.

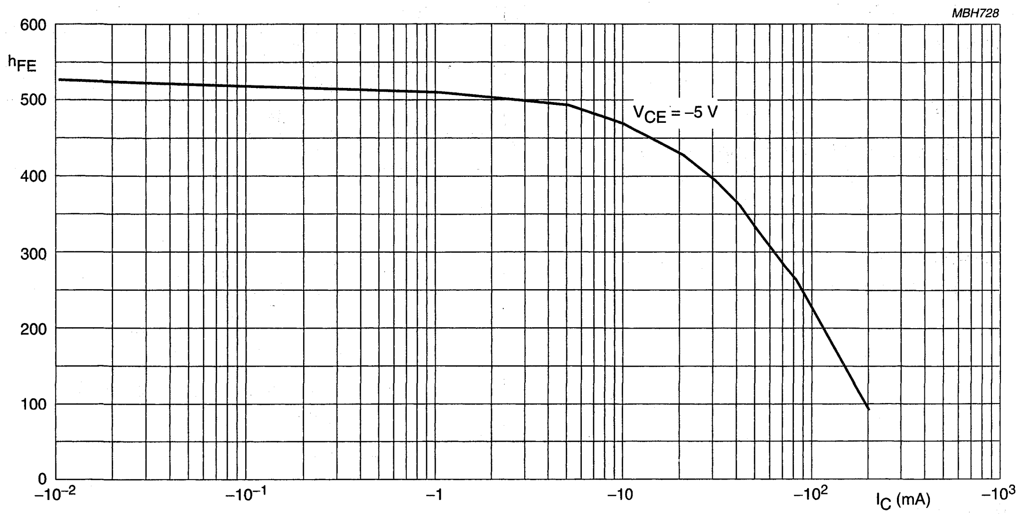
Fig.2 DC current gain; typical values.



JC559B; JC560B.

Fig.3 DC current gain; typical values.

PNP general purpose transistors JC559; JC560



JC559C; JC560C.

Fig.4 DC current gain; typical values.

NPN switching transistor MPS3904

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistor in a TO-92; SOT54 plastic package.
PNP complement: MPS3906.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

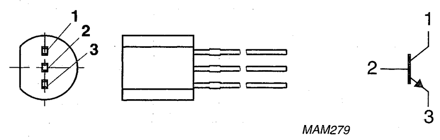


Fig.1 Simplified outline TO-92; SOT54 and symbol.

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	collector current (DC)		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	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
t_{off}	turn-off time		–	990	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	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	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	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

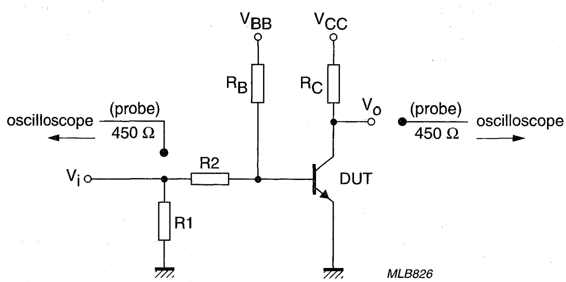
$T_{amb} = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30$ V	–	50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	50	nA
h_{FE}	DC current gain	$V_{CE} = 1$ V; note 1			
		$I_C = 0.1$ mA	40	–	
		$I_C = 1$ mA	70	–	
		$I_C = 10$ mA	100	300	
		$I_C = 50$ mA	60	–	
		$I_C = 100$ mA	30	–	
V_{CEsat}	collector-emitter 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}	base-emitter 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	$I_E = i_e = 0$; $V_{CB} = 5$ V; 100 kHz $\leq f \leq$ 1 MHz	–	5	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; 100 kHz $\leq f \leq$ 1 MHz	–	15	pF

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
f_T	transition frequency	I_C = 10 mA; V_{CE} = 20 V; f = 100 MHz	180	–	MHz
F	noise figure	I_C = 100 μA; V_{CE} = 5 V; R_S = 1 kΩ; f = 10 Hz to 15.7 kHz	–	5	dB
Switching times (between 10% and 90% levels) see Fig.2					
t_{on}	turn-on time	I_{Con} = 10 mA; I_{Bon} = 1 mA; I_{Boff} = −1 mA; V_{CC} = 3 V; V_{BB} = −1.9 V	–	100	ns
t_d	delay time		–	45	ns
t_r	rise time		–	55	ns
t_{off}	turn-off time		–	990	ns
t_s	storage time		–	900	ns
t_f	fall time		–	90	ns

Note

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



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.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.2 Test circuit for switching times.

PNP switching transistor MPS3906

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a plastic TO-92; SOT54 package.
NPN complement: MPS3904.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

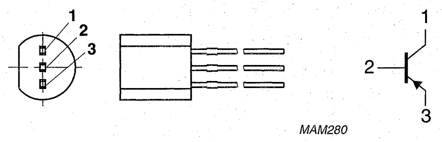


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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	collector current (DC)		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	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
t_{off}	turn-off time		–	690	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	collector current (DC)		–	−100	mA
I_{CM}	peak collector current		–	−200	mA
I_{BM}	peak base current		–	−200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	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	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

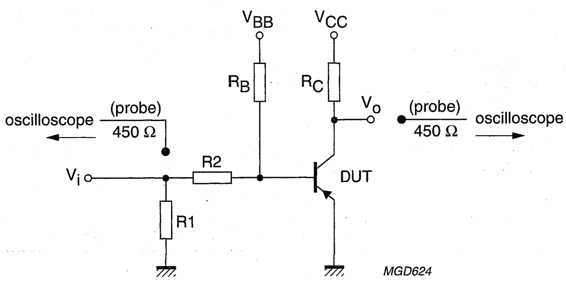
$T_{amb} = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -30$ V	–	−50	nA
I_{EBO}	emitter cut-off current	$I_E = 0$; $V_{EB} = -5$ V	–	−50	nA
h_{FE}	DC current gain	$V_{CE} = -1$ V; note 1			
		$I_C = -0.1$ mA	60	–	
		$I_C = -1$ mA	80	–	
		$I_C = -10$ mA	100	300	
		$I_C = -50$ mA	60	–	
		$I_C = -100$ mA	30	–	
V_{CEsat}	collector-emitter 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}	base-emitter 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	$I_E = i_e = 0$; $V_{CB} = -5$ V; 100 kHz $\leq f \leq$ 1 MHz	–	5	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -0.5$ V; 100 kHz $\leq f \leq$ 1 MHz	–	15	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -20$ V; f = 100 MHz	150	–	MHz

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
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
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	$I_{Con} = -10$ mA; $I_{Bon} = -1$ mA; $I_{Boff} = 1$ mA; $V_{CC} = -3$ V; $V_{BB} = 1.9$ V	–	100	ns
t_d	delay time		–	45	ns
t_r	rise time		–	55	ns
t_{off}	turn-off time		–	690	ns
t_s	storage time		–	600	ns
t_f	fall time		–	90	ns

Note

1. Pulse test: $t_p = 300\ \mu s$; $\delta = 0.02$.



$V_i = -5$ V; $t_p \geq 4\ \mu s$; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 2.5 kΩ; $R_B = 3.9$ kΩ; $R_C = 270$ Ω.
Oscilloscope: input impedance $Z_i = 50$ Ω.

Fig.2 Test circuit for switching times.

NPN general purpose transistor MPS8098

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 60 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistor in a plastic TO-92; SOT54 package.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

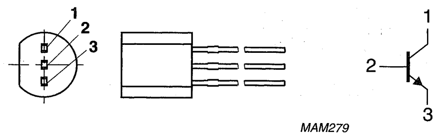


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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	–	60	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 5$ V	100	300	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ 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	–	60	V
V_{CEO}	collector-emitter voltage	open base	–	60	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 60$ V	–	100	nA
		$I_E = 0$; $V_{CB} = 60$ V; $T_j = 150$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 6$ V	–	100	nA
h_{FE}	DC current gain	$V_{CE} = 5$ V			
		$I_C = 1$ mA	100	300	
		$I_C = 10$ mA	100	–	
		$I_C = 100$ mA	75	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 100$ mA; $I_B = 5$ mA; note 1	–	400	mV
V_{BE}	base-emitter voltage	$I_C = 1$ mA; $V_{CE} = 5$ V; note 1	500	700	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	6	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	25	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz; note 1	100	–	MHz

Note

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

NPN general purpose transistors | MPSA05; MPSA06

FEATURES

- Low current (max. 500 mA)
- Low voltage (max. 80 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistor in a TO-92; SOT54 plastic package.
PNP complements: MPSA55 and MPSA56.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

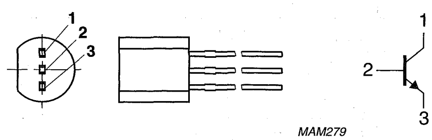


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	MPSA05		–	60	V
	MPSA06		–	80	V
V_{CEO}	collector-emitter voltage	open base			
	MPSA05		–	60	V
	MPSA06		–	80	V
I_{CM}	peak collector current		–	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	625	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 1$ V	100	–	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 2$ V; f = 100 MHz	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			
	MPSA05		–	60	V
	MPSA06		–	80	V
V_{CEO}	collector-emitter voltage	open base			
	MPSA05		–	60	V
	MPSA06		–	80	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	1	A
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	625	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	200	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	MPSA05	$I_E = 0$; $V_{CB} = 60$ V	–	100	mA
	MPSA06	$I_E = 0$; $V_{CB} = 80$ V	–	100	mA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	50	nA
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 1$ V	100	–	
		$I_C = 100$ mA; $V_{CE} = 1$ V	100	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 100$ mA; $I_B = 10$ mA	–	250	mV
V_{BE}	base-emitter voltage	$I_C = 100$ mA; $V_{CE} = 1$ V	–	1.2	V
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 2$ V; f = 100 MHz	100	–	MHz

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 30 V)
- High DC current gain (min. 10000).

APPLICATIONS

- High gain amplification.

DESCRIPTION

NPN Darlington transistor in a TO-92; SOT54 plastic package. PNP complements: MPSA63 and MPSA64.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

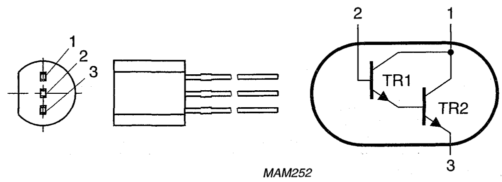


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	30	V
I_C	collector current (DC)		–	500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V			
	MPSA13		5000	–	
	MPSA14		10000	–	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz; $T_{amb} = 25$ °C	125	–	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_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	30	V
V_{EBO}	emitter-base voltage	open collector	–	10	V
I_C	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	1	A
I_B	base current (DC)		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	50	K/W

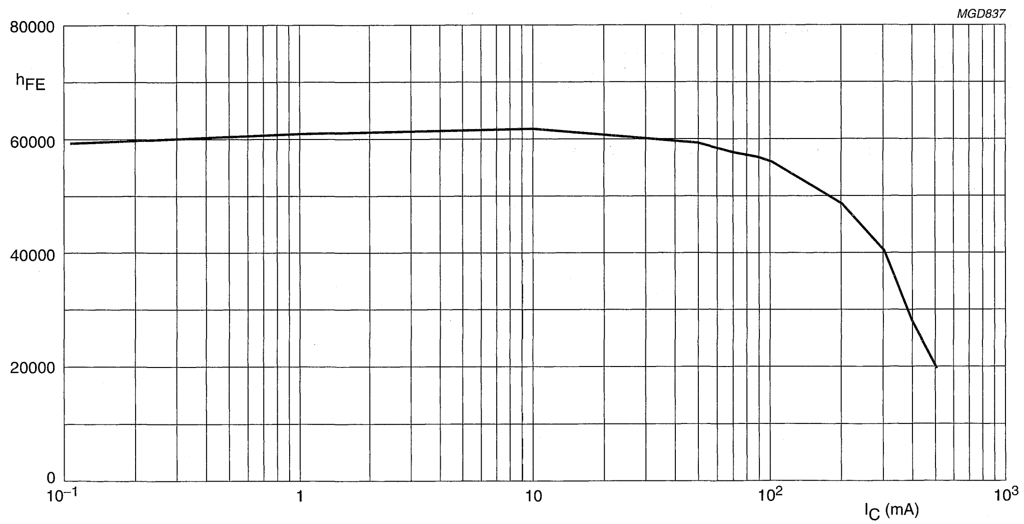
Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30$ V	–	0.1	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 10$ V	–	0.1	μA
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V; see Fig.2			
	MPSA13		5000	–	
	MPSA14		10000	–	
h_{FE}	DC current gain	$I_C = 100$ mA; $V_{CE} = 5$ V; see Fig.2			
	MPSA13		10000	–	
	MPSA14		20000	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 100$ mA; $I_B = 0.1$ mA	–	1.5	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 100$ mA; $I_B = 0.1$ mA	–	1.5	V
V_{BEon}	base-emitter on-state voltage	$I_C = 100$ mA; $V_{CE} = 5$ V	–	2	V
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	125	–	MHz



$V_{CE} = 5$ V.

Fig.2 DC current gain; typical values.

NPN Darlington transistors
MPSA25; MPSA26; MPSA27

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 60 V)
- High DC current gain (min. 10000).

APPLICATIONS

- High gain amplification.

DESCRIPTION

NPN Darlington transistor in a TO-92; SOT54 plastic package. PNP complements: MPSA75, MPSA76, and MPSA77.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

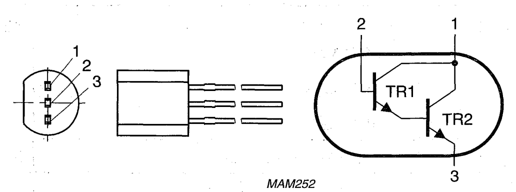


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	MPSA25		–	–	40	V
	MPSA26		–	–	50	V
	MPSA27		–	–	60	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$				
	MPSA25		–	–	40	V
	MPSA26		–	–	50	V
	MPSA27		–	–	60	V
I_C	collector current (DC)		–	–	500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	500	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V	10000	–	–	
f_T	transition frequency	$I_C = 30$ mA; $V_{CE} = 5$ V; f = 100 MHz	125	220	–	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			
	MPSA25		–	40	V
	MPSA26		–	50	V
	MPSA27		–	60	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$			
	MPSA25		–	40	V
	MPSA26		–	50	V
	MPSA27		–	60	V
V_{EBO}	emitter-base voltage	open collector	–	10	V
I_C	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	1	A
I_B	base current (DC)		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

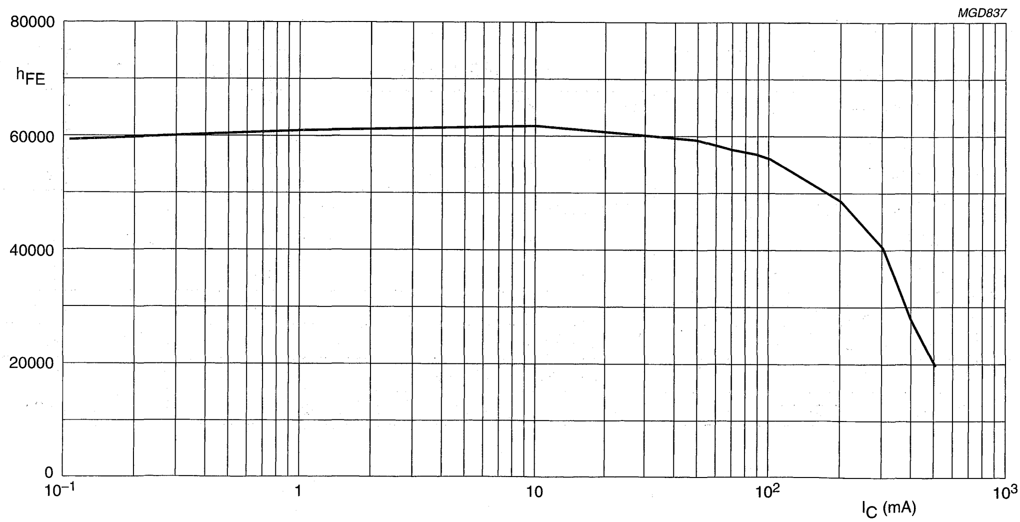
Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current MPSA25; MPSA26	I_E = 0; V_{CB} = 40 V	–	–	100	nA
I_{CBO}	collector cut-off current MPSA27	I_E = 0; V_{CB} = 50 V	–	–	100	nA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 10 V	–	–	100	nA
h_{FE}	DC current gain	I_C = 10 mA; V_{CE} = 5 V; see Fig.2	10000	–	–	
		I_C = 100 mA; V_{CE} = 5 V; see Fig.2	10000	–	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = 100 mA; I_B = 0.1 mA	–	–	1.5	V
V_{BEsat}	base-emitter saturation voltage	I_C = 100 mA; I_B = 0.1 mA	–	–	1.5	V
V_{BEon}	base-emitter on-state voltage	I_C = 100 mA; V_{CE} = 5 V	–	–	2	V
f_T	transition frequency	I_C = 30 mA; V_{CE} = 5 V; f = 100 MHz	125	220	–	MHz



V_{CE} = 5 V.

Fig.2 DC current gain; typical values.

NPN high-voltage transistors | MPSA42; MPSA43

FEATURES

- Low current (max. 100 mA)
- High voltage (max. 300 V).

APPLICATIONS

- Video
- Telephony
- Professional communication equipment.

DESCRIPTION

NPN high-voltage transistor in a TO-92; SOT54 plastic package. PNP complements: MPSA92 and MPSA93.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

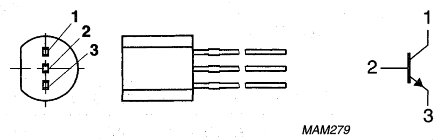


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	MPSA42		–	300	V
	MPSA43		–	200	V
V_{CEO}	collector-emitter voltage	open base			
	MPSA42		–	300	V
	MPSA43		–	200	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = 30$ mA; $V_{CE} = 10$ V	40	–	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 20$ V; f = 100 MHz	50	–	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			
	MPSA42		–	300	V
	MPSA43		–	200	V
V_{CEO}	collector-emitter voltage	open base			
	MPSA42		–	300	V
	MPSA43		–	200	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	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	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	MPSA42	$I_E = 0$; $V_{CB} = 200$ V	–	100	nA
	MPSA43	$I_E = 0$; $V_{CB} = 160$ V	–	100	nA
I_{EBO}	emitter cut-off current				
	MPSA42	$I_C = 0$; $V_{EB} = 6$ V	–	100	nA
	MPSA43	$I_C = 0$; $V_{EB} = 4$ V	–	100	nA
h_{FE}	DC current gain	$V_{CE} = 10$ V; note 1			
		$I_C = 1$ mA	25	–	
		$I_C = 10$ mA	40	–	
		$I_C = 30$ mA	40	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 20$ mA; $I_B = 2$ mA; note 1	–	500	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 20$ mA; $I_B = 2$ mA; note 1	–	900	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 20$ V; f = 1 MHz			
	MPSA42		–	3	pF
	MPSA43		–	4	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 20$ V; f = 100 MHz	50	–	MHz

Note

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

NPN high-voltage transistors MPSA44; MPSA45

FEATURES

- Low current (max. 300 mA)
- High voltage (max. 400 V).

APPLICATIONS

- Telecommunication applications.

DESCRIPTION

NPN high-voltage transistor in a TO-92; SOT54 plastic package.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

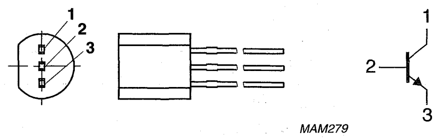


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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
I_{CM}	peak collector current		–	600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	625	mW
h_{FE}	DC current gain	$I_C = 100$ mA; $V_{CE} = 10$ V	40	–	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	20	–	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			
	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	collector current (DC)		–	300	mA
I_{CM}	peak collector current		–	600	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	625	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	200	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector 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
I_{CBO}	collector cut-off current				
	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 cut-off current	I_C = 0; V_{EB} = 4 V	–	100	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	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = 1 mA; I_B = 0.1 mA	–	400	mV
		I_C = 10 mA; I_B = 1 mA	–	500	mV
		I_C = 50 mA; I_B = 5 mA; note 1	–	750	mV
V_{BEsat}	base-emitter saturation voltage	I_C = 10 mA; I_B = 1 mA; note 1	–	750	mV
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 20 V; f = 1 MHz	–	7	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = 0.5 V; f = 1 MHz	–	180	pF
f_T	transition frequency	I_C = 10 mA; V_{CE} = 10 V; f = 100 MHz	20	–	MHz

Note

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

PNP general purpose transistors MPSA55; MPSA56

FEATURES

- Low current (max. 500 mA)
- Low voltage (max. 80 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a TO-92; SOT54 plastic package.
NPN complements: MPSA05 and MPSA06.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

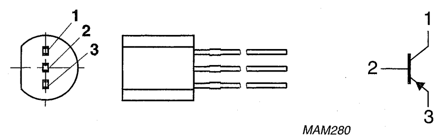


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	MPSA55		–	–60	V
	MPSA56		–	–80	V
V_{CEO}	collector-emitter voltage	open base			
	MPSA55		–	–60	V
	MPSA56		–	–80	V
I_{CM}	peak collector current		–	–1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	625	mW
h_{FE}	DC current gain	$I_C = -100$ mA; $V_{CE} = -1$ V	100	–	
f_T	transition frequency	$I_C = -100$ mA; $V_{CE} = -1$ V; f = 100 MHz	50	–	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			
	MPSA55		–	–60	V
	MPSA56		–	–80	V
V_{CEO}	collector-emitter voltage	open base			
	MPSA55		–	–60	V
	MPSA56		–	–80	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–500	mA
I_{CM}	peak collector current		–	–1	A
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	625	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	200	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -60$ V	–	–50	nA
		$I_E = 0$; $V_{CB} = -80$ V	–	–50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–50	nA
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -1$ V	100	–	
		$I_C = -100$ mA; $V_{CE} = -1$ V	100	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -100$ mA; $I_B = -10$ mA	–	–250	mV
V_{BE}	base-emitter voltage	$I_C = -100$ mA; $V_{CE} = -1$ V	–	–1.2	V
f_T	transition frequency	$I_C = -100$ mA; $V_{CE} = -1$ V; f = 100 MHz	50	–	MHz

PNP Darlington transistors MPSA63; MPSA64

FEATURES

- Low current (max. 500 mA)
- Low voltage (max. 30 V)
- High DC current gain (min. 10000).

APPLICATIONS

- High gain amplification.

DESCRIPTION

PNP Darlington transistor in a TO-92; SOT54 plastic package. NPN complements: MPSA13 and MPSA14.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

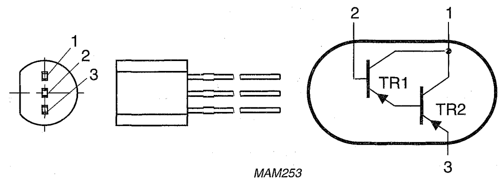


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–30	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	–30	V
I_C	collector current (DC)		–	–500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -5$ V			
	MPSA63		5000	–	
	MPSA64		10000	–	
f_T	transition frequency	$I_C = -100$ mA; $V_{CE} = -5$ V; f = 100 MHz	125	–	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_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	–30	V
V_{EBO}	emitter-base voltage	open collector	–	–10	V
I_C	collector current (DC)		–	–500	mA
I_{CM}	peak collector current		–	–1	A
I_B	base current (DC)		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j-a}$	thermal resistance from junction to ambient	note 1	250	K/W

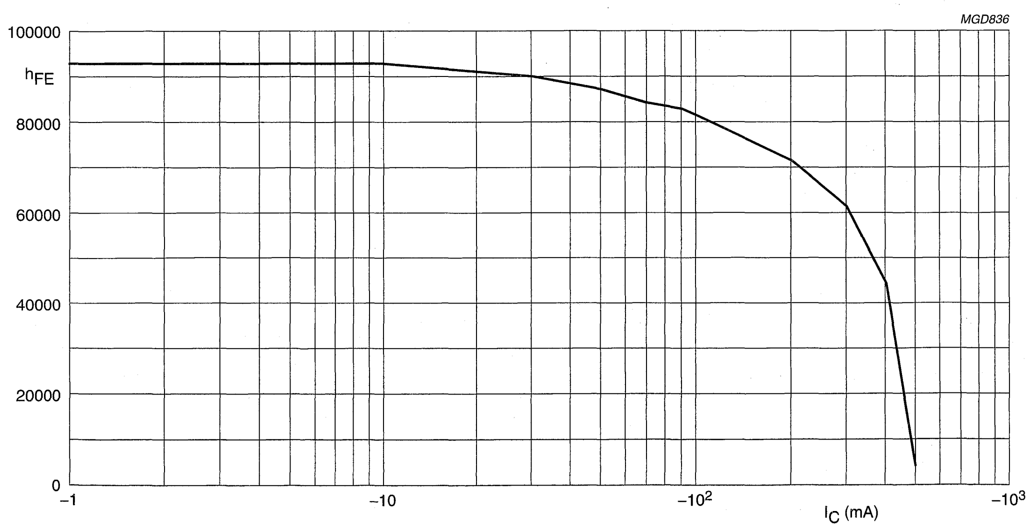
Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −30 V	–	−100	nA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −10 V	–	−100	nA
h_{FE}	DC current gain	I_C = −10 mA; V_{CE} = −5 V; see Fig.2			
	MPSA63		5000	–	
	MPSA64		10000	–	
h_{FE}	DC current gain	I_C = −100 mA; V_{CE} = −5 V; see Fig.2			
	MPSA63		10000	–	
	MPSA64		20000	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = −100 mA; I_B = −0.1 mA	–	−1.5	V
V_{BEsat}	base-emitter saturation voltage	I_C = −100 mA; I_B = −0.1 mA	–	−1.5	V
V_{BEon}	base-emitter on-state voltage	I_C = −100 mA; V_{CE} = −5 V	–	−2	V
f_T	transition frequency	I_C = −100 mA; V_{CE} = −5 V; f = 100 MHz	125	–	MHz



V_{CE} = −2 V.

Fig.2 DC current gain; typical values.

PNP high-voltage transistors MPSA92; MPSA93

FEATURES

- Low current (max. 500 mA)
- High voltage (max. 300 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP high-voltage transistor in a TO-92; SOT54 plastic package. NPN complements: MPSA42 and MPSA43.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

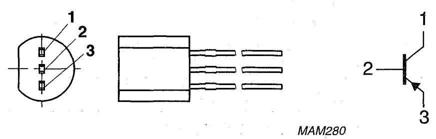


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	MPSA92		–	–300	V
	MPSA93		–	–200	V
V_{CEO}	collector-emitter voltage	open base			
	MPSA92		–	–300	V
	MPSA93		–	–200	V
I_{CM}	peak collector current		–	–500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	625	mW
h_{FE}	DC current gain	$I_C = -30$ mA; $V_{CE} = -10$ V	25	–	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -20$ V; f = 100 MHz	50	–	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			
	MPSA92		–	–300	V
	MPSA93		–	–200	V
V_{CEO}	collector-emitter voltage	open base			
	MPSA92		–	–300	V
	MPSA93		–	–200	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–500	mA
I_{CM}	peak collector current		–	–500	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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 CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	200	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	MPSA92	I_E = 0; V_{CB} = −200 V	−	−250	nA
	MPSA93	I_E = 0; V_{CB} = −160 V	−	−250	nA
I_{EBO}	emitter cut-off current	I_C = 0; V_{BE} = −3 V	−	−100	nA
h_{FE}	DC current gain	V_{CE} = −10 V; note 1			
		I_C = −1 mA	25	−	
		I_C = −10 mA	40	−	
		I_C = −30 mA	25	−	
V_{CEsat}	collector-emitter saturation voltage	I_C = −20 mA; I_B = −2 mA; note 1	−	−500	mV
V_{BEsat}	base-emitter saturation voltage	I_C = −20 mA; I_B = −2 mA; note 1	−	−900	mV
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = −20 V; f = 1 MHz			
	MPSA92		−	6	pF
	MPSA93		−	8	pF
f_T	transition frequency	I_C = −10 mA; V_{CE} = −20 V; f = 100 MHz	50	−	MHz

Note

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

PNP resistor-equipped transistor PDTA114EE

FEATURES

- Built-in bias resistors R1 and R2 (typ. 10 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

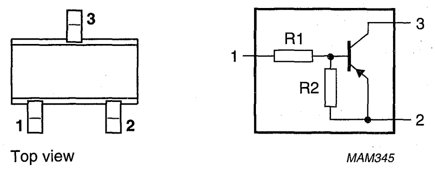


Fig.1 Simplified outline (SC-75) and symbol.

DESCRIPTION

PNP resistor-equipped transistor in an SC-75 plastic package.
NPN complement: PDTC114EE.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground (+)
3	collector/output

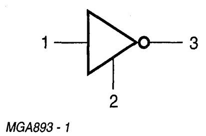


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTA114EE	03

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	150	mW
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	30	–	–	
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	−100	mA
I_{CM}	peak collector current		–	−100	mA
P_{tot}	total power dissipation	$T_{amb} \le 25$ °C; note 1	–	150	mW
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		−65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	833	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_C = 0$; $V_{CB} = -50$ V	–	–	−100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	−1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	−50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	−500	μA
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	30	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	−300	mV
$V_{i(off)}$	input-off voltage	$I_C = -100$ μA; $V_{CE} = -5$ V	–	–	−500	mV
$V_{i(on)}$	input-on voltage	$I_C = -10$ mA; $V_{CE} = -300$ mV	−3	–	–	V
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

PNP resistor-equipped transistor PDTA114EK

FEATURES

- Built-in bias resistors R1 and R2 (typ. 10 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

PNP resistor-equipped transistor in an SC-59 plastic package.
NPN complement: PDTC114EK.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground (+)
3	collector/output

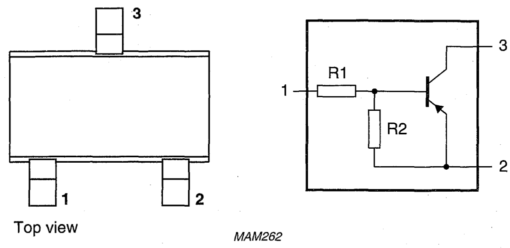


Fig.1 Simplified outline (SC-59) and symbol.

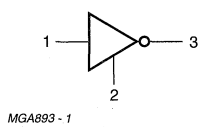


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTA114EK	03

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	30	–	–	
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	–100	mA
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	250	mW
T_{stg}	storage temperature		–55	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–55	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–500	μA
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	30	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
$V_{i(off)}$	input-off voltage	$I_C = -100$ μA; $V_{CE} = -5$ V	–	–	–500	mV
$V_{i(on)}$	input-on voltage	$I_C = -10$ mA; $V_{CE} = -300$ mV	–3	–	–	V
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

FEATURES

- Built-in bias resistors R1 and R2 (typ. 10 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuit applications
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

PNP resistor-equipped transistor in a TO-92; SOT54 plastic package.
NPN complement: PDTC114ES.

PINNING

PIN	DESCRIPTION
1	base/input
2	collector/output
3	emitter/ground (+)

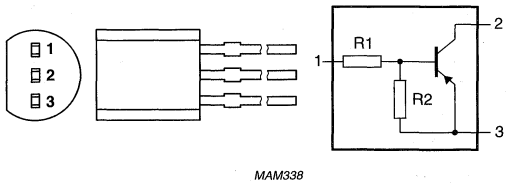


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

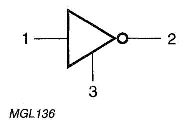


Fig.2 Equivalent inverter symbol.

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	500	mW
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	30	–	–	
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	–100	mA
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE.	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–500	μA
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	30	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
$V_{i(off)}$	input-off voltage	$I_C = -100$ μA; $V_{CE} = -5$ V	–	–	–500	mV
$V_{i(on)}$	input-on voltage	$I_C = -10$ mA; $V_{CE} = -300$ mV	–3	–	–	V
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

PNP resistor-equipped transistor | PDTA114ET

FEATURES

- Built-in bias resistors R1 and R2 (typ. 10 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

PNP resistor-equipped transistor in a SOT23 plastic package.
NPN complement: PDTC114ET.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground (+)
3	collector/output

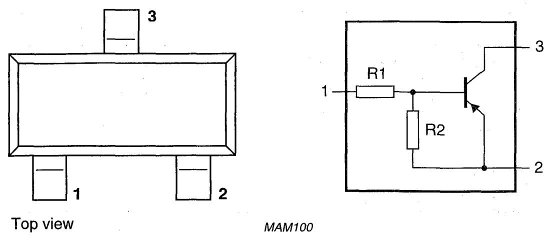


Fig.1 Simplified outline (SOT23) and symbol.

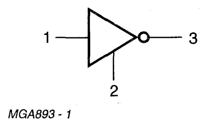


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTA114ET	p03

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	30	–	–	
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	–100	mA
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–500	μA
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	30	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
$V_{i(off)}$	input-off voltage	$I_C = -100$ μA; $V_{CE} = -5$ V	–	–	–500	mV
$V_{i(on)}$	input-on voltage	$I_C = -10$ mA; $V_{CE} = -300$ mV	–3	–	–	V
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

PNP resistor-equipped transistor — PDTA114EU

FEATURES

- Built-in bias resistors R1 and R2 (typ. 10 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

PNP resistor-equipped transistor in a SOT323 plastic package.
NPN complement: PDTC114EU.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground (+)
3	collector/output

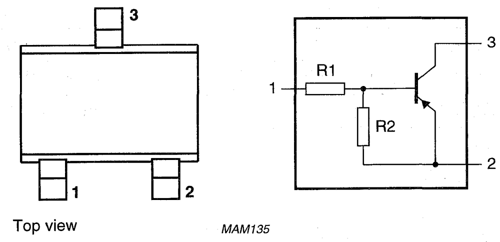


Fig.1 Simplified outline (SOT323) and symbol.

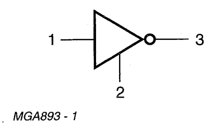


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTA114EU	t03

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	200	mW
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	30	–	–	
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	–100	mA
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–500	μA
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	30	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
$V_{i(off)}$	input-off voltage	$I_C = -100$ μA; $V_{CE} = -5$ V	–	–	–500	mV
$V_{i(on)}$	input-on voltage	$I_C = -10$ mA; $V_{CE} = -300$ mV	–3	–	–	V
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

PNP resistor-equipped transistor PDTA114TE

FEATURES

- Built-in bias resistor R1 (typ. 10 kΩ)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuit applications
- Inverter circuit configurations without use of an external resistor.

DESCRIPTION

PNP resistor-equipped transistor in an SC-75 plastic package.
NPN complement: PDTC114TE.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground (+)
3	collector/output

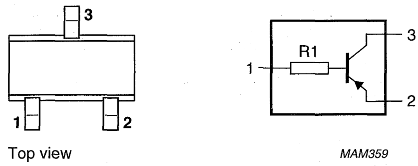


Fig.1 Simplified outline (SC-75) and symbol.

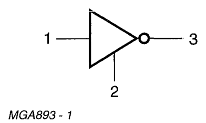


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTA114TE	11

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	150	mW
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -5$ V	100	–	600	
R1	input resistor		7	10	13	kΩ

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	–	–5	V
I_O	output current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \le 25$ °C; note 1	–	150	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j-a}$	thermal resistance from junction to ambient	note 1	833	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–100	nA
h_{FE}	DC current gain	$I_C = -5$ V; $I_C = -1$ mA	100	–	600	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
R1	input resistor		7	10	13	kΩ
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

PNP resistor-equipped transistor PDTA114TK

FEATURES

- Built-in bias resistor R1 (typ. 10 kΩ)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistor.

DESCRIPTION

PNP resistor-equipped transistor in a SC-59 plastic package.
NPN complement: PDTC114TK.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground (+)
3	collector/output

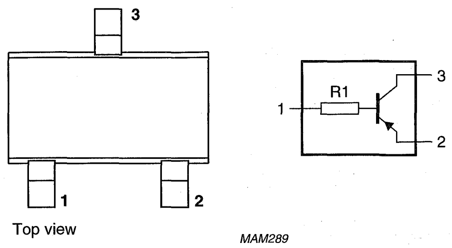


Fig.1 Simplified outline (SC-59) and symbol.

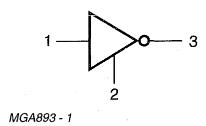


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTA114TK	23

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -5$ V	100	–	600	
R1	input resistor		7	10	13	kΩ

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	–	–5	V
I_O	output current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -4$ V	–	–	–100	nA
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -5$ V	100	–	600	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
R1	input resistor		7	10	13	kΩ
C_c	collector capacitance	$I_E = I_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

FEATURES

- Built-in bias resistor R1 (typ. 10 kΩ)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of an external resistor.

DESCRIPTION

PNP resistor-equipped transistor in a TO-92; SOT54 plastic package.
NPN complement: PDTC114TS.

PINNING

PIN	DESCRIPTION
1	base/input
2	collector/output
3	emitter/ground (+)

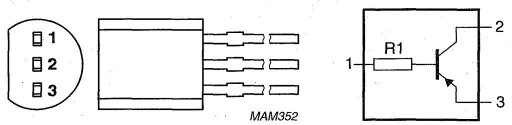


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

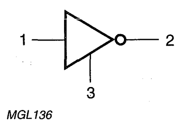


Fig.2 Equivalent inverter symbol.

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	500	mW
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -5$ V	100	–	600	
R1	input resistor		7	10	13	kΩ

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	–	–5	V
I_O	output current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–100	nA
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -5$ V	100	–	600	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
R1	input resistor		7	10	13	kΩ
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

PNP resistor-equipped transistor — PDTA114TT

FEATURES

- Built-in bias resistor R1 (typ. 10 kΩ)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of an external resistor.

DESCRIPTION

PNP resistor-equipped transistor in a SOT23 plastic package.
NPN complement: PDTC114TT.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground (+)
3	collector/output

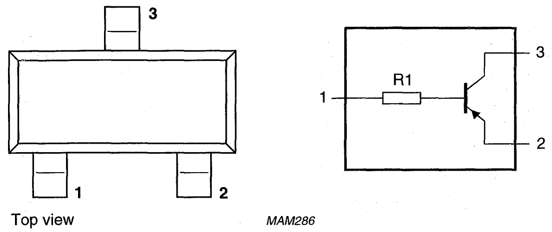


Fig.1 Simplified outline (SOT23) and symbol.

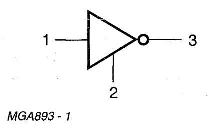


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTA114TT	p11

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -5$ V	100	–	600	
R1	input resistor		7	10	13	kΩ

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	–	–5	V
I_O	output current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -4$ V	–	–	–100	nA
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -5$ V	100	–	600	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
R1	input resistor		7	10	13	kΩ
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

FEATURES

- Built-in bias resistor R1 (typ. 10 kΩ)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of an external resistor.

DESCRIPTION

PNP resistor-equipped transistor in a SOT323 plastic package.
NPN complement: PDTC114TU.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground (+)
3	collector/output

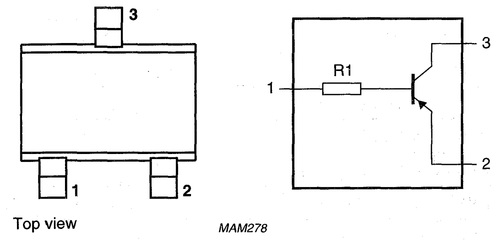


Fig.1 Simplified outline (SOT323) and symbol.

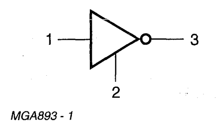


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTA114TU	t23

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	200	mW
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -5$ V	100	–	600	
R1	input resistor		7	10	13	kΩ

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	–	–5	V
I_O	output current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–100	nA
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -5$ V	100	–	600	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
R1	input resistor		7	10	13	kΩ
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

FEATURES

- Built-in bias resistors R1 and R2 (typ. 22 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

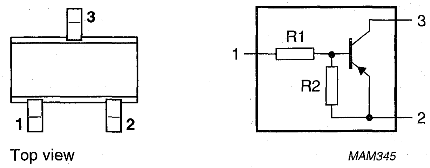


Fig.1 Simplified outline (SC-75) and symbol.

DESCRIPTION

PNP resistor-equipped transistor in an SC-75 plastic package.
NPN complement: PDTC124EE.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground (+)
3	collector/output

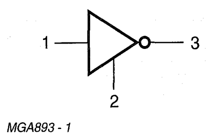


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTA124EE	05

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25\ °C$	–	–	150	mW
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	56	–	–	
R1	input resistor		15.4	22	28.6	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	–100	mA
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	150	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	833	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_C = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–500	μA
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	56	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
$V_{i(off)}$	input-off voltage	$I_C = -100$ μA; $V_{CE} = -5$ V	–	–	–500	mV
$V_{i(on)}$	input-on voltage	$I_C = -5$ mA; $V_{CE} = -300$ mV	–3	–	–	V
R1	input resistor		15.4	22	28.6	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

PNP resistor-equipped transistor | PDTA124EK

FEATURES

- Built-in bias resistors R1 and R2 (typ. 22 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

PNP resistor-equipped transistor in a SC-59 plastic package.
NPN complement: PDTC124EK.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground (+)
3	collector/output

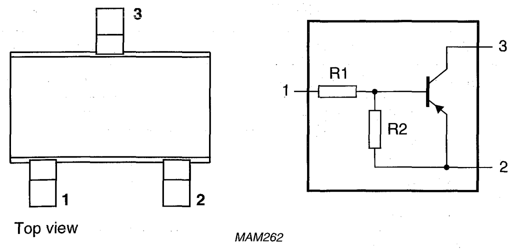


Fig.1 Simplified outline (SC-59) and symbol.

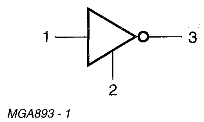


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTA124EK	05

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	56	–	–	
R1	input resistor		15.4	22	28.6	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	–100	mA
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–500	μA
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	56	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
$V_{i(off)}$	input-off voltage	$I_C = -100$ μA; $V_{CE} = -5$ V	–	–	–0.5	V
$V_{i(on)}$	input-on voltage	$I_C = -5$ mA; $V_{CE} = -0.3$ V	–3	–	–	V
R1	input resistor		15.4	22	28.6	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

PNP resistor-equipped transistor PDTA124ES

FEATURES

- Built-in bias resistors R1 and R2 (typ. 22 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

PNP resistor-equipped transistor in a TO-92; SOT54 plastic package.
NPN complement: PDTC124ES.

PINNING

PIN	DESCRIPTION
1	base/input
2	collector/output
3	emitter/ground (+)

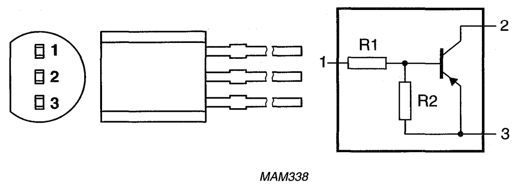


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

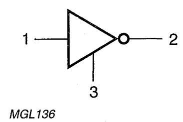


Fig.2 Equivalent inverter symbol.

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	500	mW
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	56	–	–	
R1	input resistor		15.4	22	28.6	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	–100	mA
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_C = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–500	μA
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	56	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
$V_{i(off)}$	input-off voltage	$I_C = -100$ μA; $V_{CE} = -5$ V	–	–	–500	mV
$V_{i(on)}$	input-on voltage	$I_C = -5$ mA; $V_{CE} = -300$ mV	–3	–	–	V
R1	input resistor		15.4	22	28.6	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

PNP resistor-equipped transistor | PDTA124ET

FEATURES

- Built-in bias resistors R1 and R2 (typ. 22 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

PNP resistor-equipped transistor in a SOT23 plastic package.
NPN complement: PDTC124ET.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground (+)
3	collector/output

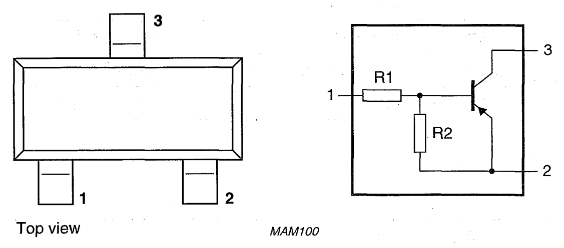


Fig.1 Simplified outline (SOT23) and symbol.

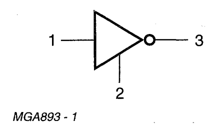


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTA124ET	p05

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	56	–	–	
R1	input resistor		15.4	22	28.6	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	–100	mA
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–500	μA
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	56	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
$V_{i(off)}$	input-off voltage	$I_C = -100$ μA; $V_{CE} = -5$ V	–	–	–0.5	V
$V_{i(on)}$	input-on voltage	$I_C = -5$ mA; $V_{CE} = -0.3$ V	–3	–	–	V
R1	input resistor		15.4	22	28.6	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

PNP resistor-equipped transistor PDTA124EU

FEATURES

- Built-in bias resistors R1 and R2 (typ. 22 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

PNP resistor-equipped transistor in a SOT323 plastic package.
NPN complement: PDTC124EU.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground (+)
3	collector/output

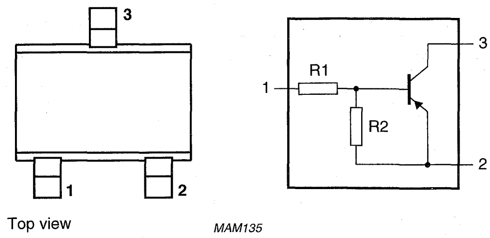


Fig.1 Simplified outline (SOT323) and symbol.

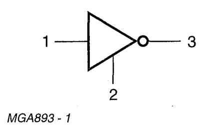


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTA124EU	t05

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	200	mW
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	56	–	–	
R1	input resistor		15.4	22	28.6	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	–100	mA
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–500	μA
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	56	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
$V_{i(off)}$	input-off voltage	$I_C = -100$ μA; $V_{CE} = -5$ V	–	–	–500	mV
$V_{i(on)}$	input-on voltage	$I_C = -5$ mA; $V_{CE} = -300$ mV	–3	–	–	V
R1	input resistor		15.4	22	28.6	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

PNP resistor-equipped transistor PDTA143EE

FEATURES

- Built-in bias resistors R1 and R2 (typ. 4.7 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

PNP resistor-equipped transistor in an SC-75 plastic package.
NPN complement: PDTC143EE.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground (+)
3	collector/output

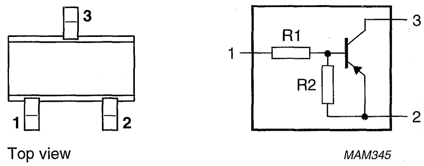


Fig.1 Simplified outline (SC-75) and symbol.

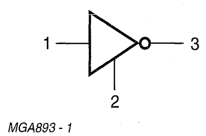


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTA143EE	01

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	150	mW
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -5$ V	20	–	–	
R1	input resistor		3.3	4.7	6.1	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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	$T_{amb} \leq 25$ °C; note 1	–	150	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	833	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_C = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–1	mA
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -5$ V	20	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
$V_{i(off)}$	input-off voltage	$I_C = -100$ μA; $V_{CE} = -5$ V	–	–	–500	mV
$V_{i(on)}$	input-on voltage	$I_C = -20$ mA; $V_{CE} = -300$ mV	–3	–	–	V
R1	input resistor		3.3	4.7	6.1	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

PNP resistor-equipped transistor — PDTA143EK

FEATURES

- Built-in bias resistors R1 and R2 (typ. 4.7 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits.
- Inverter circuit configurations without use of external resistors.

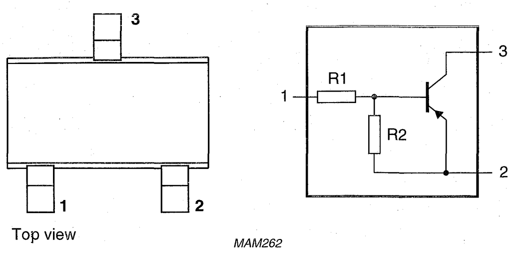


Fig.1 Simplified outline (SC-59) and symbol.

DESCRIPTION

PNP resistor-equipped transistor in a plastic SC-59 package.
NPN complement: PDTC143EK.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground (+)
3	collector/output

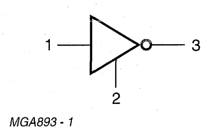


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTA143EK	01

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -5$ V	20	–	–	
R1	input resistor		3.3	4.7	6.1	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–1	mA
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -5$ V	20	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
$V_{i(off)}$	input-off voltage	$I_C = -100$ μA; $V_{CE} = -5$ V	–	–	–500	mV
$V_{i(on)}$	input-on voltage	$I_C = -20$ mA; $V_{CE} = -300$ mV	–3	–	–	V
R1	input resistor		3.3	4.7	6.1	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

PNP resistor-equipped transistor PDTA143ES

FEATURES

- Built-in bias resistors R1 and R2 (typ. 4.7 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

PNP resistor-equipped transistor in a TO-92; SOT54 plastic package. NPN complement: PDTC143ES.

PINNING

PIN	DESCRIPTION
1	base/input
2	collector/output
3	emitter/ground (+)

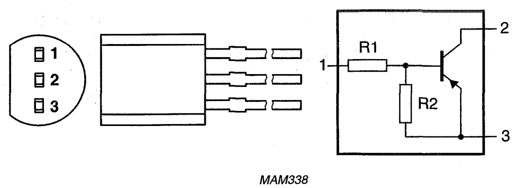


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

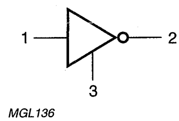


Fig.2 Equivalent inverter symbol.

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	500	mW
h_{FE}	DC current gain	$V_{CE} = -5$ V; $I_C = -10$ mA	20	–	–	
R1	input resistor		3.3	4.7	6.1	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	µA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	µA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–1	mA
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -5$ V	20	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
$V_{i(off)}$	input-off voltage	$I_C = -100$ µA; $V_{CE} = -5$ V	–	–	–500	mV
$V_{i(on)}$	input-on voltage	$I_C = -20$ mA; $V_{CE} = -300$ mV	–3	–	–	V
R1	input resistor		3.3	4.7	6.1	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

PNP resistor-equipped transistor — PDTA143ET

FEATURES

- Built-in bias resistors R1 and R2 (typ. 4.7 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits.
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

PNP resistor-equipped transistor in a SOT23 plastic package.
NPN complement: PDTC143ET.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground (+)
3	collector/output

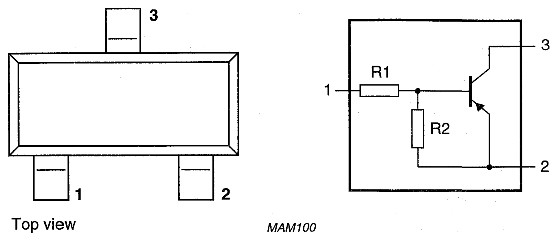


Fig.1 Simplified outline (SOT23) and symbol.

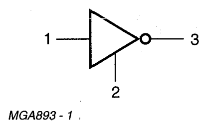


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTA143ET	p01

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -5$ V	20	–	–	
R1	input resistor		3.3	4.7	6.1	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–1	mA
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -5$ V	20	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
$V_{i(off)}$	input-off voltage	$I_C = -100$ μA; $V_{CE} = -5$ V	–	–	–500	mV
$V_{i(on)}$	input-on voltage	$I_C = -20$ mA; $V_{CE} = -300$ mV	–3	–	–	V
R1	input resistor		3.3	4.7	6.1	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

PNP resistor-equipped transistor — PDTA143EU

FEATURES

- Built-in bias resistors R1 and R2 (typ. 4.7 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

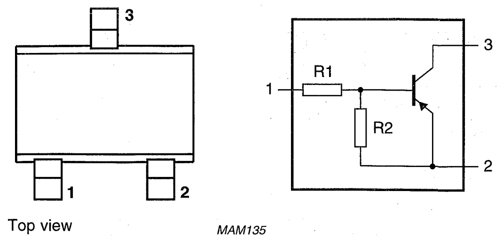


Fig.1 Simplified outline (SOT323) and symbol.

DESCRIPTION

PNP resistor-equipped transistor in a SOT323 plastic package.
NPN complement: PDTC143EU.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground (+)
3	collector/output

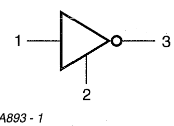


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTA143EU	01t

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	200	mW
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -5$ V	20	–	–	
R1	input resistor		3.3	4.7	6.1	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–1	mA
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -5$ V	20	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
$V_{i(off)}$	input-off voltage	$I_C = -100$ μA; $V_{CE} = -5$ V	–	–	–500	mV
$V_{i(on)}$	input-on voltage	$I_C = -20$ mA; $V_{CE} = -300$ mV	–3	–	–	V
R1	input resistor		33	4.7	6.1	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

PNP resistor-equipped transistor — PDTA144EE

FEATURES

- Built-in bias resistors R1 and R2 (typ. 47 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

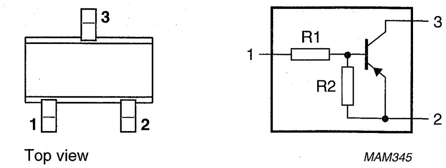


Fig.1 Simplified outline (SC-75) and symbol.

DESCRIPTION

PNP resistor-equipped transistor in an SC-75 plastic package.
NPN complement: PDTC144EE.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground (+)
3	collector/output

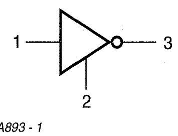


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTA144EE	07

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	150	mW
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	68	–	–	
R1	input resistor		33	47	61	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	–100	mA
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	150	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	833	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_C = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–500	μA
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	68	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
$V_{i(off)}$	input-off voltage	$I_C = -100$ μA; $V_{CE} = -5$ V	–	–	–500	mV
$V_{i(on)}$	input-on voltage	$I_C = -2$ mA; $V_{CE} = -300$ mV	–3	–	–	V
R1	input resistor		33	47	61	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

PNP resistor-equipped transistor PDTA144EK

FEATURES

- Built-in bias resistors R1 and R2 (typ. 47 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

PNP resistor-equipped transistor in an SC-59 plastic package.
NPN complement: PDTC144EK.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground (+)
3	collector/output

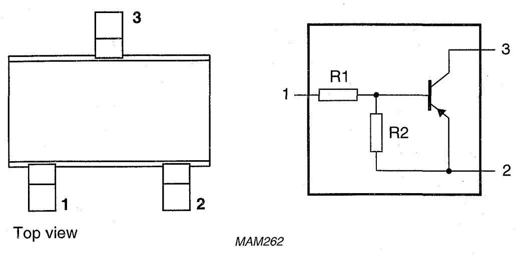


Fig.1 Simplified outline (SC-59) and symbol.

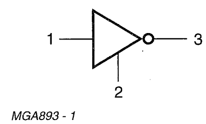


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTA144EK	07

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \le 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	68	–	–	
R1	input resistor		33	47	61	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	–100	mA
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–500	μA
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	68	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
$V_{i(off)}$	input-off voltage	$I_C = -100$ μA; $V_{CE} = -5$ V	–	–	–500	mV
$V_{i(on)}$	input-on voltage	$I_C = -2$ mA; $V_{CE} = -300$ mV	–3	–	–	V
R1	input resistor		33	47	61	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

FEATURES

- Built-in bias resistors R1 and R2 (typ. 47 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

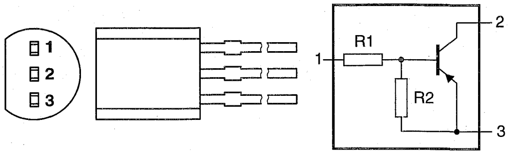


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

DESCRIPTION

PNP resistor-equipped transistor in a TO-92; SOT54 plastic package.
NPN complement: PDTC144ES.

PINNING

PIN	DESCRIPTION
1	base/input
2	collector/output
3	emitter/ground (+)

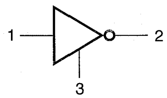


Fig.2 Equivalent inverter symbol.

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	500	mW
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	68	–	–	
R1	input resistor		33	47	61	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	–100	mA
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–500	μA
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	68	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
$V_{i(off)}$	input-off voltage	$I_C = -100$ μA; $V_{CE} = -5$ V	–	–	–500	mV
$V_{i(on)}$	input-on voltage	$I_C = -2$ mA; $V_{CE} = -300$ mV	–3	–	–	V
R1	input resistor		33	47	61	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

FEATURES

- Built-in bias resistors R1 and R2 (typ. 47 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

PNP resistor-equipped transistor in a SOT23 plastic package.
NPN complement: PDTC144ET.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground (+)
3	collector/output

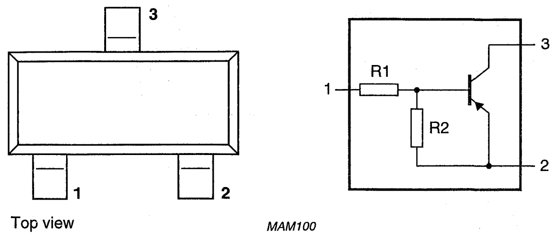


Fig.1 Simplified outline (SOT23) and symbol.

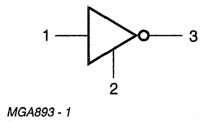


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTA144ET	p07

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	68	–	–	
R1	input resistor		33	47	61	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	–100	mA
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–500	μA
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	68	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
$V_{i(off)}$	input-off voltage	$I_C = -100$ μA; $V_{CE} = -5$ V	–	–	–500	mV
$V_{i(on)}$	input-on voltage	$I_C = -2$ mA; $V_{CE} = -300$ mV	–3	–	–	V
R1	input resistor		33	47	61	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

PNP resistor-equipped transistor PDTA144EU

FEATURES

- Built-in bias resistors R1 and R2 (typ. 47 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

PNP resistor-equipped transistor in a SOT323 plastic package.
NPN complement: PDTC144EU.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground (+)
3	collector/output

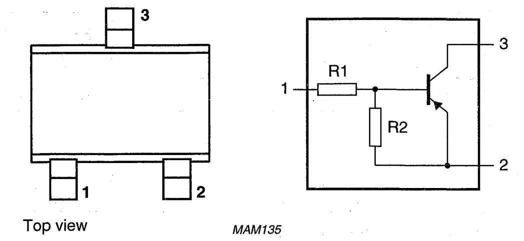


Fig.1 Simplified outline (SOT323) and symbol.

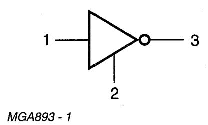


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTA144EU	t07

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
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	200	mW
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	68	–	–	
R1	input resistor		33	47	61	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	–100	mA
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–500	μA
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V	68	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
$V_{i(off)}$	input-off voltage	$I_C = -100$ μA; $V_{CE} = -5$ V	–	–	–0.5	V
$V_{i(on)}$	input-on voltage	$I_C = -2$ mA; $V_{CE} = -300$ mV	–3	–	–	V
R1	input resistor		33	47	61	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

FEATURES

- Built-in bias resistors R1 and R2 (typ. 10 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

PNP resistor-equipped transistor in a SOT23 plastic package.
NPN complement: PDTD114ET.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground (+)
3	collector/output

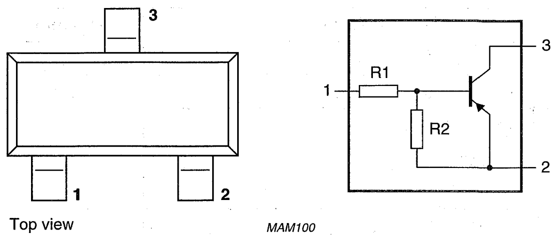


Fig.1 Simplified outline (SOT23) and symbol.

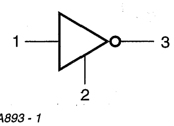


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTB114ET	p09

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	–	–50	V
I_O	output current (DC)		–	–	–500	mA
I_{CM}	peak collector current		–	–	–500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = -50$ mA; $V_{CE} = -5$ V	56	–	–	
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	–500	mA
I_{CM}	peak collector current		–	–500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–500	μA
h_{FE}	DC current gain	$I_C = -5$ mA; $V_{CE} = -5$ V; note 1	56	–	–	
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	$I_C = -100$ μA; $V_{CE} = -5$ V	–	–	–500	mV
$V_{i(on)}$	input-on voltage	$I_C = -10$ mA; $V_{CE} = -300$ mV	–3	–	–	V
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	9	pF

Note

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

NPN resistor-equipped transistor PDTC114EE

FEATURES

- Built-in bias resistors R1 and R2 (typ. 10 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

NPN resistor-equipped transistor in an SC-75 plastic package.
PNP complement: PDTA114EE.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground
3	collector/output

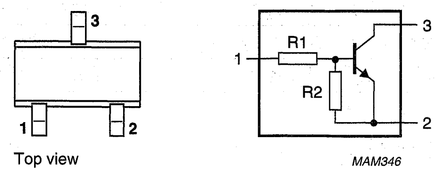


Fig.1 Simplified outline (SC-75) and symbol.

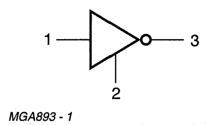


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTC114EE	09

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \le 25$ °C	–	–	150	mW
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	30	–	–	
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	100	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	150	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	833	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	500	μA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	30	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
$V_{i(off)}$	input-off voltage	$I_C = 100$ μA; $V_{CE} = 5$ V	–	–	500	mV
$V_{i(on)}$	input-on voltage	$I_C = 10$ mA; $V_{CE} = 300$ mV	3	–	–	V
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

FEATURES

- Built-in bias resistors R1 and R2 (typ. 10 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

NPN resistor-equipped transistor in an SC-59 plastic package.
PNP complement: PDTA114EK.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground
3	collector/output

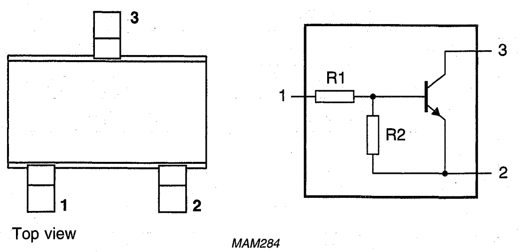


Fig.1 Simplified outline (SC-59) and symbol.

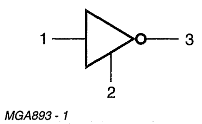


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTC114EK	04

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	30	–	–	
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	100	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	500	μA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	30	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
$V_{i(off)}$	input-off voltage	$I_C = 100$ μA; $V_{CE} = 5$ V	–	–	500	mV
$V_{i(on)}$	input-on voltage	$I_C = 10$ mA; $V_{CE} = 300$ mV	3	–	–	V
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

NPN resistor-equipped transistor | PDTC114ES

FEATURES

- Built-in bias resistors R1 and R2 (typ. 10 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

NPN resistor-equipped transistor in a TO-92; SOT54 plastic package.
PNP complement: PDTA114ES.

PINNING

PIN	DESCRIPTION
1	base/input
2	collector/output
3	emitter/ground

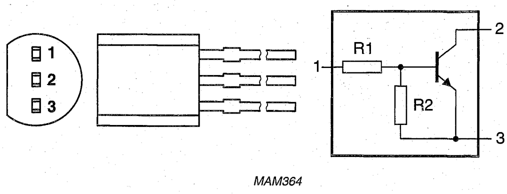


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

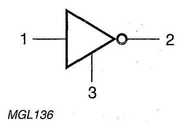


Fig.2 Equivalent inverter symbol.

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	500	mW
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	30	–	–	
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	100	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	500	μA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	30	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
$V_{i(off)}$	input-off voltage	$I_C = 100$ μA; $V_{CE} = 5$ V	–	–	500	mV
$V_{i(on)}$	input-on voltage	$I_C = 10$ mA; $V_{CE} = 300$ mV	3	–	–	V
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

NPN resistor-equipped transistor | PDTC114ET

FEATURES

- Built-in bias resistors R1 and R2 (typ. 10 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

NPN resistor-equipped transistor in a SOT23 plastic package.
PNP complement: PDTA114ET.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground
3	collector/output

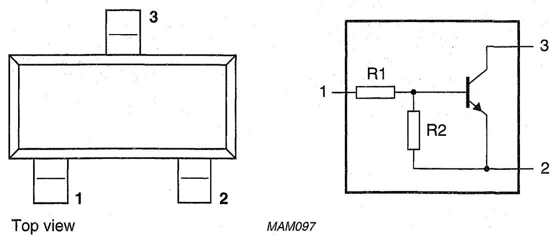


Fig.1 Simplified outline (SOT23) and symbol.

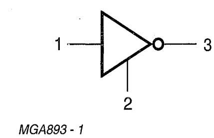


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTC114ET	p16

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	30	–	–	
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	100	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector-emitter cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter-base cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	500	μA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	30	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
$V_{i(off)}$	input off voltage	$I_C = 100$ μA; $V_{CE} = 5$ V	–	–	500	mV
$V_{i(on)}$	input on voltage	$I_C = 10$ mA; $V_{CE} = 300$ mV	3	–	–	V
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

FEATURES

- Built-in bias resistors R1 and R2 (typ. 10 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

NPN resistor-equipped transistor in a SOT323 plastic package.
PNP complement: PDTA114EU.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground
3	collector/output

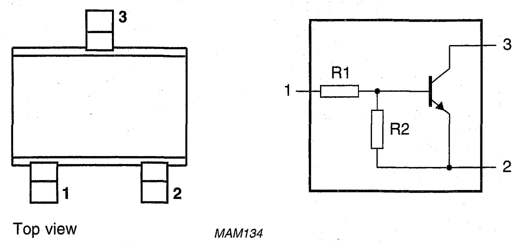


Fig.1 Simplified outline (SOT323) and symbol.

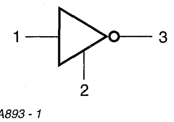


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTC114EU	t09

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	200	mW
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	30	–	–	
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	100	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	500	μA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	30	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
$V_{i(off)}$	input-off voltage	$I_C = 100$ μA; $V_{CE} = 5$ V	–	–	500	mV
$V_{i(on)}$	input-on voltage	$I_C = 10$ mA; $V_{CE} = 300$ mV	3	–	–	V
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

NPN resistor-equipped transistor | PDTC114TE

FEATURES

- Built-in bias resistor R1 (typ. 10 kΩ)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of an external resistor.

DESCRIPTION

NPN resistor-equipped transistor in an SC-75; SOT416 plastic package. PNP complement: PDTA114TE.

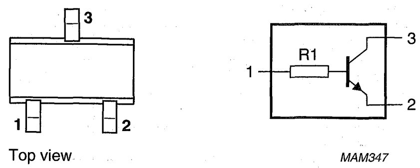


Fig.1 Simplified outline (SC-75; SOT416) and symbol.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground
3	collector/output

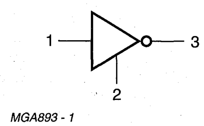


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTC114TE	24

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	150	mW
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 5$ V	100	–	600	
R1	input resistor		7	10	13	kΩ

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	–	5	V
I_O	output current (DC)		–	100	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	150	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	833	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 5$ V	100	–	600	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
R1	input resistor		7	10	13	kΩ
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

NPN resistor-equipped transistor PDTC114TK

FEATURES

- Built-in bias resistor R1 (typ. 10 kΩ)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of an external resistor.

DESCRIPTION

NPN resistor-equipped transistor in an SC-59 plastic package.
PNP complement: PDTA114TK.

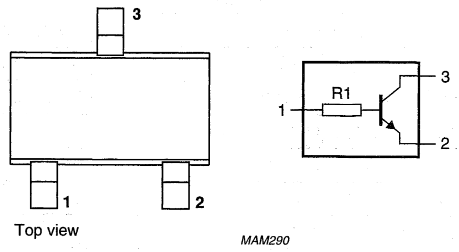


Fig.1 Simplified outline (SC-59) and symbol.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground
3	collector/output

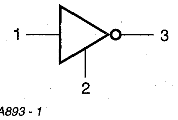


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTC114TK	24

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 5$ V	100	–	600	
R1	input resistor		7	10	13	kΩ

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	–	5	V
I_O	output current (DC)		–	100	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 5$ V	100	–	600	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
R1	input resistor		7	10	13	kΩ
C_c	collector capacitance	$I_E = I_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

FEATURES

- Built-in bias resistor R1 (typ. 10 kΩ)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of an external resistor.

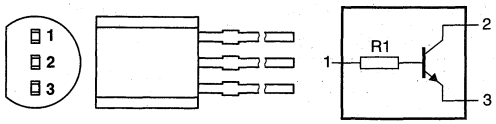


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

DESCRIPTION

NPN resistor-equipped transistor in a TO-92; SOT54 plastic package.
PNP complement: PDTA114TS.

PINNING

PIN	DESCRIPTION
1	base/input
2	collector/output
3	emitter/ground

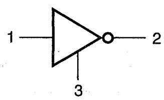


Fig.2 Equivalent inverter symbol.

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	500	mW
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 5$ V	100	–	600	
R1	input resistor		7	10	13	kΩ

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	–	5	V
I_O	output current (DC)		–	100	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 5$ V	100	–	600	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
R1	input resistor		7	10	13	kΩ
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

NPN resistor-equipped transistor | PDTC114TT

FEATURES

- Built-in bias resistor R1 (typ. 10 kΩ)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of an external resistor.

DESCRIPTION

NPN resistor-equipped transistor in a SOT23 plastic package.
PNP complement: PDTA114TT.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground
3	collector/output

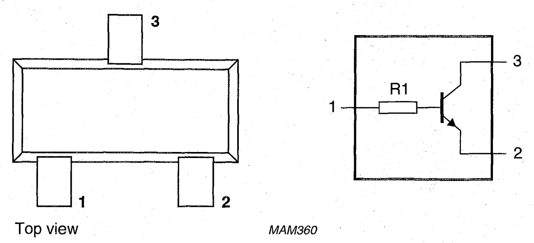


Fig.1 Simplified outline (SOT23) and symbol.

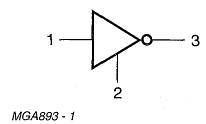


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTC114TT	p12

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 5$ V	100	–	600	
R1	input resistor		7	10	13	kΩ

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	–	5	V
I_O	output current (DC)		–	100	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 5$ V	100	–	600	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
R1	input resistor		7	10	13	kΩ
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

NPN resistor-equipped transistor | PDTC114TU

FEATURES

- Built-in bias resistor R1 (typ. 10 kΩ)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of an external resistor.

DESCRIPTION

NPN resistor-equipped transistor in a SOT323 plastic package.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground
3	collector/output

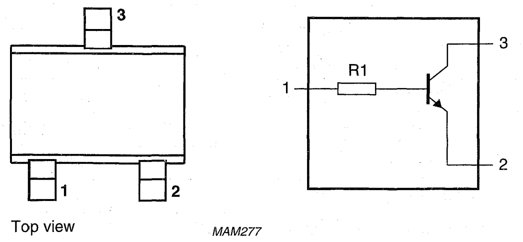


Fig.1 Simplified outline (SOT323) and symbol.

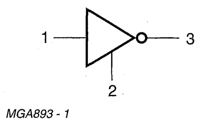


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTC114TU	t24

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	200	mW
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 5$ V	100	–	600	
R1	input resistor		7	10	13	kΩ

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	–	5	V
I_O	output current (DC)		–	100	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	100	nA
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 5$ V	100	–	600	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
R1	input resistor		7	10	13	kΩ
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

NPN resistor-equipped transistor — PDTC124EE

FEATURES

- Built-in bias resistors R1 and R2 (typ. 22 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

NPN resistor-equipped transistor in an SC-75; SOT416 plastic package. PNP complement: PDTA124EE.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground
3	collector/output

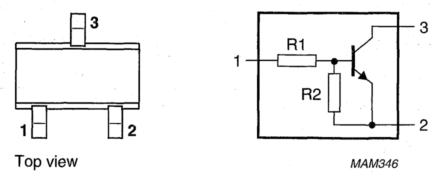


Fig.1 Simplified outline (SC-75; SOT416) and symbol.

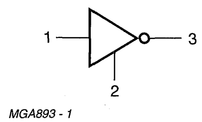


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTC124EE	06

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	150	mW
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	56	–	–	
R1	input resistor		15.4	22	28.6	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	100	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	150	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	833	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	500	μA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	56	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
$V_{i(off)}$	input-off voltage	$I_C = 100$ μA; $V_{CE} = 5$ V	–	–	500	mV
$V_{i(on)}$	input-on voltage	$I_C = 5$ mA; $V_{CE} = 300$ mV	3	–	–	V
R1	input resistor		15.4	22	28.6	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

NPN resistor-equipped transistor PDTC124EK

FEATURES

- Built-in bias resistors R1 and R2 (typ. 22 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

NPN resistor-equipped transistor in an SC-59 plastic package.
PNP complement: PDTA124EK.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground
3	collector/output

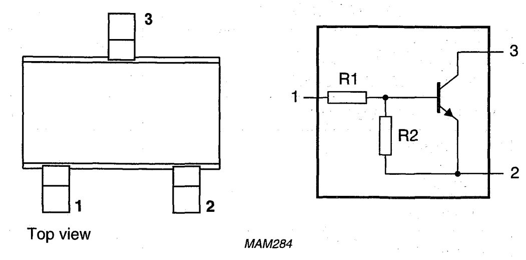


Fig.1 Simplified outline (SC-59) and symbol.

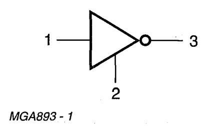


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTC124EK	06

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	56	–	–	
R1	input resistor		15.4	22	28.6	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	100	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	500	μA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	56	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
$V_{i(off)}$	input-off voltage	$I_C = 100$ μA; $V_{CE} = 5$ V	–	–	500	mV
$V_{i(on)}$	input-on voltage	$I_C = 5$ mA; $V_{CE} = 300$ mV	3	–	–	V
R1	input resistor		15.4	22	28.6	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

NPN resistor-equipped transistor — PDTC124ES

FEATURES

- Built-in bias resistors R1 and R2 (typ. 22 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

NPN resistor-equipped transistor in a TO-92; SOT54 plastic package.
PNP complement: PDTA124ES.

PINNING

PIN	DESCRIPTION
1	base/input
2	collector/output
3	emitter/ground

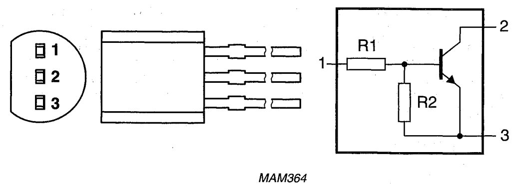


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

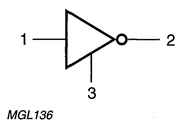


Fig.2 Equivalent inverter symbol.

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	500	mW
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	56	–	–	
R1	input resistor		15.4	22	28.6	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	100	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	500	μA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	56	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
$V_{i(off)}$	input-off voltage	$I_C = 100$ μA; $V_{CE} = 5$ V	–	–	500	mV
$V_{i(on)}$	input-on voltage	$I_C = 5$ mA; $V_{CE} = 300$ mV	3	–	–	V
R1	input resistor		15.4	22	28.6	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

NPN resistor-equipped transistor PDTC124ET

FEATURES

- Built-in bias resistors R1 and R2 (typ. 22 kΩ each)
- Simplification of circuit design
- Reduces number of components and boardspace.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

NPN resistor-equipped transistor in a SOT23 plastic package.
PNP complement: PDTA124ET.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground
3	collector/output

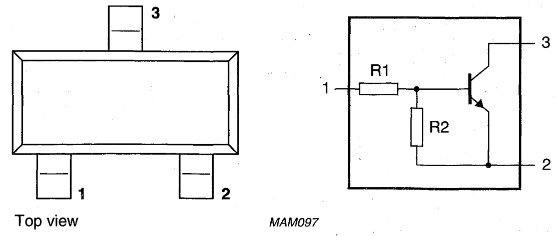


Fig.1 Simplified outline (SOT23) and symbol.

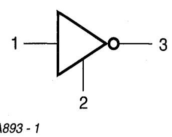


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTC124ET	p17

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	56	–	–	
R1	input resistor		15.4	22	28.6	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	100	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	500	μA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	56	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
$V_{i(off)}$	input-off voltage	$I_C = 100$ μA; $V_{CE} = 5$ V	–	–	500	mV
$V_{i(on)}$	input-on voltage	$I_C = 5$ mA; $V_{CE} = 300$ mV	3	–	–	V
R1	input resistor		15.4	22	28.6	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

NPN resistor-equipped transistor | PDTC124EU

FEATURES

- Built-in bias resistors R1 and R2 (typ. 22 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

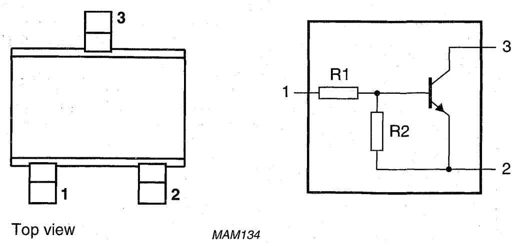


Fig.1 Simplified outline (SOT323) and symbol.

DESCRIPTION

NPN resistor-equipped transistor in a SOT323 plastic package.
PNP complement: PDTA124EU.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground
3	collector/output

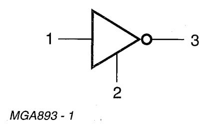


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTC124EU	t06

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	200	mW
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	56	–	–	
R1	input resistor		15.4	22	28.6	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	100	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	500	μA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	56	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
$V_{i(off)}$	input-off voltage	$I_C = 100$ μA; $V_{CE} = 5$ V	–	–	500	mV
$V_{i(on)}$	input-on voltage	$I_C = 5$ mA; $V_{CE} = 300$ mV	3	–	–	V
R1	input resistor		15.4	22	28.6	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

NPN resistor-equipped transistor | PDTC143EE

FEATURES

- Built-in bias resistors R1 and R2 (typ. 4.7 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

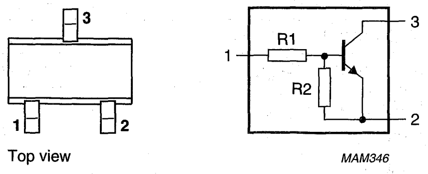


Fig.1 Simplified outline (SC-75) and symbol.

DESCRIPTION

NPN resistor-equipped transistor in an SC-75 plastic package.
PNP complement: PDTA143EE.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground
3	collector/output

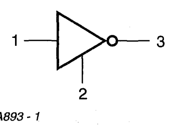


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTC143EE	02

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	150	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V	20	–	–	
R1	input resistor		3.3	4.7	6.1	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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	$T_{amb} \leq 25$ °C; note 1	–	150	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	833	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	500	μA
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V	20	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
$V_{i(off)}$	input-off voltage	$I_C = 100$ μA; $V_{CE} = 5$ V	–	–	500	mV
$V_{i(on)}$	input-on voltage	$I_C = 20$ mA; $V_{CE} = 0.3$ V	3	–	–	V
R1	input resistor		3.3	4.7	6.1	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

NPN resistor-equipped transistor — PDTC143EK

FEATURES

- Built-in bias resistors R1 and R2 (typ. 4.7 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

NPN resistor-equipped transistor in an SC-59 plastic package.
PNP complement: PDTA143EK.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground
3	collector/output

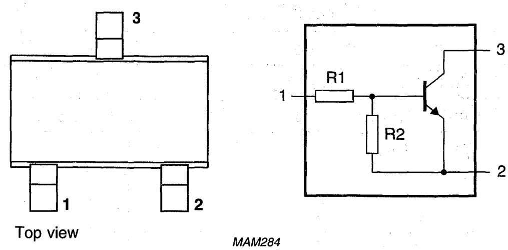


Fig.1 Simplified outline (SC-59) and symbol.

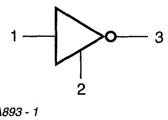


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTC143EK	02

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V	20	–	–	
R1	input resistor		3.3	4.7	6.1	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	1	mA
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V	20	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
$V_{i(off)}$	input-off voltage	$I_C = 100$ μA; $V_{CE} = 5$ V	–	–	500	mV
$V_{i(on)}$	input-on voltage	$I_C = 20$ mA; $V_{CE} = 300$ mV	3	–	–	V
R1	input resistor		3.3	4.7	6.1	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

NPN resistor-equipped transistor PDTC143ES

FEATURES

- Built-in bias resistors R1 and R2 (typ. 4.7 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

NPN resistor-equipped transistor in a TO-92; SOT54 plastic package.
PNP complement: PDTA143ES.

PINNING

PIN	DESCRIPTION
1	base/input
2	collector/output
3	emitter/ground

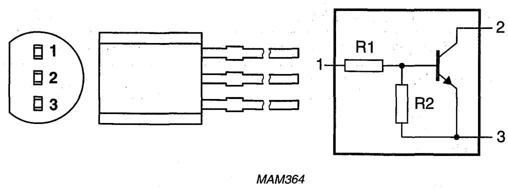


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

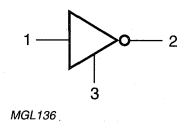


Fig.2 Equivalent inverter symbol.

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	500	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V	20	–	–	
R1	input resistor		3.3	4.7	6.1	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	1	mA
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V	20	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
$V_{i(off)}$	input-off voltage	$I_C = 100$ μA; $V_{CE} = 5$ V	–	–	500	mV
$V_{i(on)}$	input-on voltage	$I_C = 20$ mA; $V_{CE} = 300$ mV	3	–	–	V
R1	input resistor		3.3	4.7	6.1	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

FEATURES

- Built-in bias resistors R1 and R2 (typ. 4.7 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

NPN resistor-equipped transistor in a SOT23 plastic package.
PNP complement: PDTA143ET.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground
3	collector/output

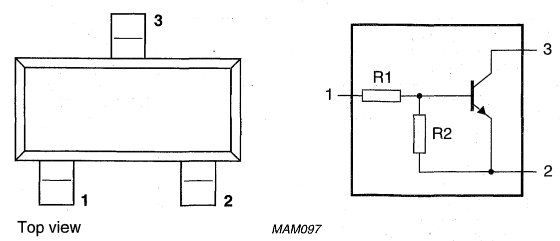


Fig.1 Simplified outline (SOT23) and symbol.

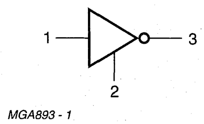


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTC143ET	p02

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V	20	–	–	
R1	input resistor		3.3	4.7	6.1	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	1	mA
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V	20	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
$V_{i(off)}$	input-off voltage	$I_C = 100$ μA; $V_{CE} = 5$ V	–	–	500	mV
$V_{i(on)}$	input-on voltage	$I_C = 20$ mA; $V_{CE} = 300$ mV	3	–	–	V
R1	input resistor		3.3	4.7	6.1	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

NPN resistor-equipped transistor PDTC143EU

FEATURES

- Built-in bias resistors R1 and R2 typ. 4.7 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

NPN resistor-equipped transistor in a SOT323 plastic package.
PNP complement: PDTA143EU.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground
3	collector/output

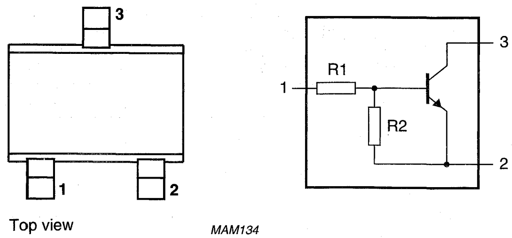


Fig.1 Simplified outline (SOT323) and symbol.

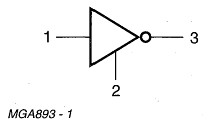


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTC143EU	t02

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	200	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V	20	–	–	
R1	input resistor		3.3	4.7	6.1	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	1	mA
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V	20	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
$V_{i(off)}$	input-off voltage	$I_C = 100$ μA; $V_{CE} = 5$ V	–	–	500	mV
$V_{i(on)}$	input-on voltage	$I_C = 20$ mA; $V_{CE} = 300$ mV	3	–	–	V
R1	input resistor		3.3	4.7	6.1	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

NPN resistor-equipped transistor — PDTC144EE

FEATURES

- Built-in bias resistors R1 and R2 (typ. 47 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

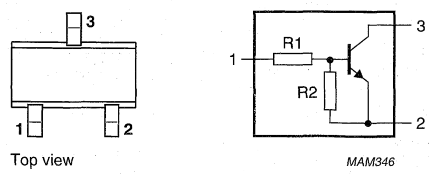


Fig.1 Simplified outline (SC-75) and symbol.

DESCRIPTION

NPN resistor-equipped transistor in an SC-75 plastic package.
PNP complement: PDTA144EE.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground
3	collector/output

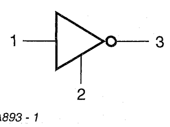


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTC144EE	08

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	150	mW
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	68	–	–	
R1	input resistor		33	47	61	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	100	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	150	mW
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		−65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	833	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	µA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	µA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	500	µA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	68	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
$V_{i(off)}$	input-off voltage	$I_C = 100$ µA; $V_{CE} = 5$ V	–	–	500	mV
$V_{i(on)}$	input-on voltage	$I_C = 2$ mA; $V_{CE} = 300$ mV	3	–	–	V
R1	input resistor		33	47	61	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

NPN resistor-equipped transistor

PDTC144EK

FEATURES

- Built-in bias resistors R1 and R2 (typ. 47 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

NPN resistor-equipped transistor in an SC-59 plastic package.
PNP complement: PDTA144EK.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground
3	collector/output

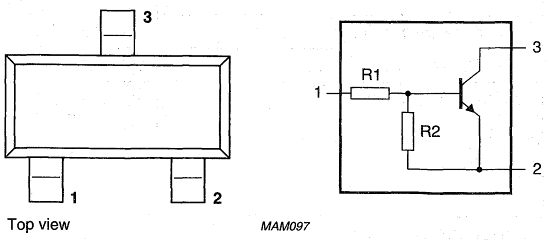


Fig.1 Simplified outline (SC-59) and symbol.

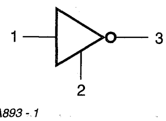


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTC144EK	08

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	68	–	–	
R1	input resistor		33	47	61	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	100	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	250	mW
T_{stg}	storage temperature		−55	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		−55	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	500	μA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	68	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
$V_{i(off)}$	input-off voltage	$I_C = 100$ μA; $V_{CE} = 5$ V	–	–	500	mV
$V_{i(on)}$	input-on voltage	$I_C = 2$ mA; $V_{CE} = 300$ mV	3	–	–	V
R1	input resistor		33	47	61	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

FEATURES

- Built-in bias resistors R1 and R2 (typ. 47 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

NPN resistor-equipped transistor in a TO-92; SOT54 plastic package.
PNP complement: PDTA144ES.

PINNING

PIN	DESCRIPTION
1	base/input
2	collector/output
3	emitter/ground

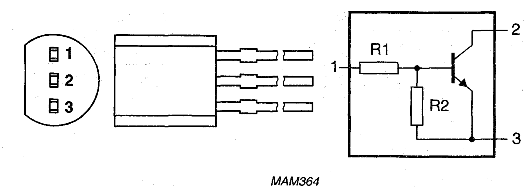


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

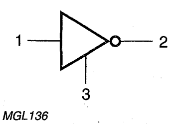


Fig.2 Equivalent inverter symbol.

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	500	mW
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	68	–	–	
R1	input resistor		33	47	61	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	100	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	500	μA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	68	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
$V_{i(off)}$	input-off voltage	$I_C = 100$ μA; $V_{CE} = 5$ V	–	–	500	mV
$V_{i(on)}$	input-on voltage	$I_C = 2$ mA; $V_{CE} = 300$ mV	3	–	–	V
R1	input resistor		33	47	61	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

NPN resistor-equipped transistor

PDTC144ET

FEATURES

- Built-in bias resistors R1 and R2 (typ. 47 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

NPN resistor-equipped transistor in a SOT23 plastic package.
PNP complement: PDTA144ET.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground
3	collector/output

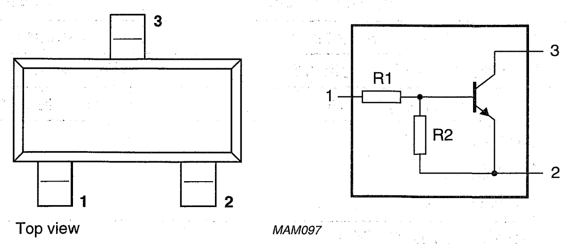


Fig.1 Simplified outline (SOT23) and symbol.

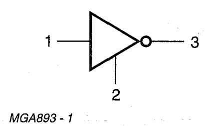


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTC144ET	p08

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	68	–	–	
R1	input resistor		33	47	61	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	100	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	500	μA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	68	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
$V_{i(off)}$	input-off voltage	$I_C = 100$ μA; $V_{CE} = 5$ V	–	–	500	mV
$V_{i(on)}$	input-on voltage	$I_C = 2$ mA; $V_{CE} = 300$ mV	3	–	–	V
R1	input resistor		33	47	61	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

NPN resistor-equipped transistor — PDTC144EU

FEATURES

- Built-in bias resistors R1 and R2 (typ. 47 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

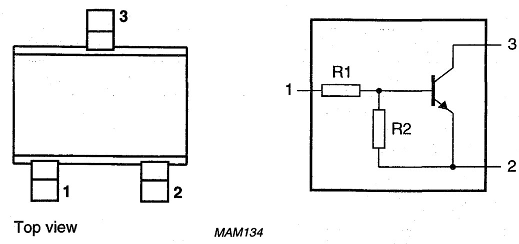


Fig.1 Simplified outline (SC-70; SOT323) and symbol.

DESCRIPTION

NPN resistor-equipped transistor in an SC-70; SOT323 plastic package. PNP complement: PDTA144EU.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground
3	collector/output

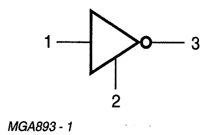


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTC144EU	t08

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
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	200	mW
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	68	–	–	
R1	input resistor		33	47	61	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	100	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	500	μA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	68	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
$V_{i(off)}$	input-off voltage	$I_C = 100$ μA; $V_{CE} = 5$ V	–	–	500	mV
$V_{i(on)}$	input-on voltage	$I_C = 2$ mA; $V_{CE} = 300$ mV	3	–	–	V
R1	input resistor		33	47	61	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

NPN resistor-equipped transistor PDTD114ET

FEATURES

- Built-in bias resistors R1 and R2 (typ. 10 kΩ each)
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

NPN resistor-equipped transistor in a SOT23 plastic package.
PNP complement: PDTB114ET.

PINNING

PIN	DESCRIPTION
1	base/input
2	emitter/ground
3	collector/output

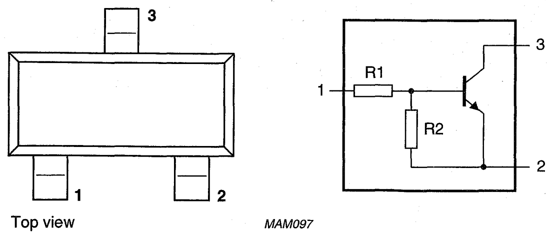


Fig.1 Simplified outline (SOT23) and symbol.

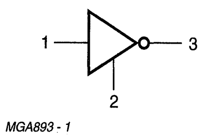


Fig.2 Equivalent inverter symbol.

MARKING

TYPE NUMBER	MARKING CODE
PDTD114ET	p10

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	–	50	V
I_O	output current (DC)		–	–	500	mA
I_{CM}	peak collector current		–	–	500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = 50$ mA; $V_{CE} = 5$ V	56	–	–	
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	

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)		–	500	mA
I_{CM}	peak collector current		–	500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 50 V	–	–	100	nA
I_{CEO}	collector-emitter cut-off current	I_B = 0; V_{CE} = 30 V	–	–	1	μA
		I_B = 0; V_{CE} = 30 V; T_j = 150 °C	–	–	50	μA
I_{EBO}	emitter-base cut-off current	I_C = 0; V_{EB} = 5 V	–	–	500	μA
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 5 V; note 1	56	–	–	
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	I_C = 100 μA; V_{CE} = 5 V	–	–	500	mV
$V_{i(on)}$	input on voltage	I_C = 10 mA; V_{CE} = 300 mV	3	–	–	V
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 10 V; f = 1 MHz	–	–	8	pF

Note

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

NPN switching transistors PH2222; PH2222A

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- Switching and linear amplification.

DESCRIPTION

NPN switching transistor in a TO-92; SOT54 plastic package. PNP complements: PH2907 and PH2907A.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

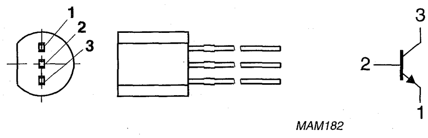


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PH2222		–	60	V
	PH2222A		–	75	V
V_{CEO}	collector-emitter voltage	open base			
	PH2222		–	30	V
	PH2222A		–	40	V
I_C	collector current (DC)		–	600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 10$ V	75	–	
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 20$ V; f = 100 MHz			
	PH2222		250	–	MHz
	PH2222A		300	–	MHz
t_{off}	turn-off time	$I_{Con} = 150$ mA; $I_{Bon} = 15$ mA; $I_{Boff} = -15$ mA	–	250	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			
	PH2222		–	60	V
	PH2222A		–	75	V
V_{CEO}	collector-emitter voltage	open base			
	PH2222		–	30	V
	PH2222A		–	40	V
V_{EBO}	emitter-base voltage	open collector			
	PH2222		–	5	V
	PH2222A		–	6	V
I_C	collector current (DC)		–	600	mA
I_{CM}	peak collector current		–	800	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	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	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

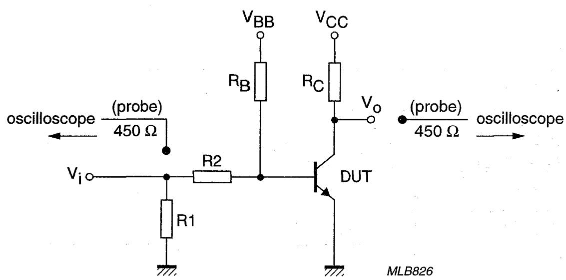
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	PH2222	$I_E = 0$; $V_{CB} = 50$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 50$ V; $T_{amb} = 150$ °C	–	10	μA
I_{CBO}	collector cut-off current				
	PH2222A	$I_E = 0$; $V_{CB} = 60$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 60$ V; $T_{amb} = 150$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 3$ V	–	10	nA
h_{FE}	DC current gain	$I_C = 0.1$ mA; $V_{CE} = 10$ V	35	–	
		$I_C = 1$ mA; $V_{CE} = 10$ V	50	–	
		$I_C = 10$ mA; $V_{CE} = 10$ V	75	–	
		$I_C = 150$ mA; $V_{CE} = 1$ V; note 1	50	–	
		$I_C = 150$ mA; $V_{CE} = 10$ V; note 1	100	300	
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 10$ V; $T_{amb} = -55$ °C			
	PH2222A		35	–	
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 10$ V; note 1			
	PH2222		30	–	
	PH2222A		40	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA; note 1			
	PH2222		–	400	mV
	PH2222A		–	300	mV
V_{CEsat}	collector-emitter saturation voltage	$I_C = 500$ mA; $I_B = 50$ mA; note 1			
	PH2222		–	1.6	V
	PH2222A		–	1	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA; note 1			
	PH2222		–	1.3	V
	PH2222A		0.6	1.2	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 500$ mA; $I_B = 50$ mA; note 1			
	PH2222		–	2.6	V
	PH2222A		–	2	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	8	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 500$ mV; f = 1 MHz			
	PH2222A		–	25	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 20$ V; f = 100 MHz			
	PH2222		250	–	MHz
	PH2222A		300	–	MHz
F	noise figure	$I_C = 200$ μA; $V_{CE} = 5$ V; $R_S = 2$ kΩ; f = 1 kHz; B = 200 Hz			
	PH2222A		–	4	db

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	I_{Con} = 150 mA; I_{Bon} = 15 mA; I_{Boff} = −15 mA	–	35	ns
t_d	delay time		–	15	ns
t_r	rise time		–	20	ns
t_{off}	turn-off time		–	250	ns
t_s	storage time		–	200	ns
t_f	fall time		–	60	ns

Note

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



V_i = 9.5 V; T = 500 µs; t_p = 10 µs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; R_B = 325 Ω; R_C = 160 Ω.
V_{BB} = −3.5 V; V_{CC} = 29.5 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.2 Test circuit for switching times.

FEATURES

- Low current (max. 200 mA)
- Low voltage (max. 15 V).

APPLICATIONS

- High-speed switching.

DESCRIPTION

NPN switching transistor in a TO-92; SOT54 plastic package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

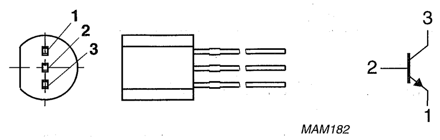


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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
I_C	collector current (DC)		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain				
	PH2369	$I_C = 10$ mA; $V_{CE} = 1$ V	40	120	
	PH2369A	$I_C = 10$ mA; $V_{CE} = 350$ mV	40	120	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	500	–	MHz
t_{off}	turn-off time	$I_{Con} = 10$ mA; $I_{Bon} = 3$ mA; $I_{Boff} = -1.5$ mA	–	30	ns
		$I_{Con} = 100$ mA; $I_{Bon} = 40$ mA; $I_{Boff} = -20$ mA	–	35	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_{EBO}	emitter-base voltage	open collector	–	4.5	V
I_C	collector current (DC)		–	200	mA
I_{CM}	peak collector current		–	300	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	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	note 1	250	K/W

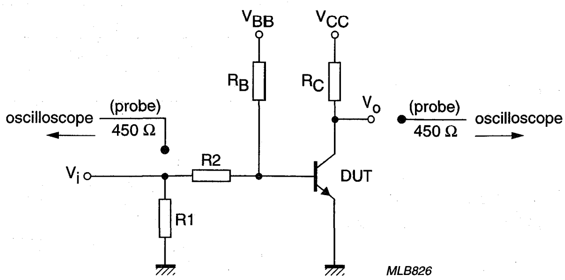
Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 20 V	–	400	nA
		I_E = 0; V_{CB} = 20 V; T_j = 125 °C	–	30	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 4 V	–	100	nA
h_{FE}	DC current gain				
	PH2369	I_C = 10 mA; V_{CE} = 1 V	40	120	
		I_C = 10 mA; V_{CE} = 1 V; T_{amb} = −55 °C	20	–	
		I_C = 100 mA; V_{CE} = 2 V	20	–	
h_{FE}	DC current gain				
	PH2369A	I_C = 10 mA; V_{CE} = 350 mV	40	120	
		I_C = 10 mA; V_{CE} = 350 mV; T_{amb} = −55 °C	20	–	
		I_C = 30 mA; V_{CE} = 400 mV	30	–	
		I_C = 100 mA; V_{CE} = 1 V	20	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA; I_B = 1 mA			
	PH2369		–	250	mV
V_{CEsat}	collector-emitter saturation voltage				
	PH2369A	I_C = 10 mA; I_B = 1 mA	–	200	mV
		I_C = 10 mA; I_B = 10 mA	–	300	mV
		I_C = 30 mA; I_B = 3 mA	–	250	mV
		I_C = 100 mA; I_B = 10 mA	–	500	mV
V_{BEsat}	base-emitter saturation voltage	I_C = 10 mA; I_B = 1 mA	700	850	mV
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 5 V; f = 1 MHz	–	4	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = 1 V; f = 1 MHz	–	4.5	pF
f_T	transition frequency	I_C = 10 mA; V_{CE} = 10 V; f = 100 MHz	500	–	MHz
Switching times (between 10% and 90% levels)					
t_{on}	turn-on time	I_{Con} = 10 mA; I_{Bon} = 3 mA; I_{Boff} = −1.5 mA; see Fig.2 test conditions A	–	10	ns
t_d	delay time		–	4	ns
t_r	rise time		–	6	ns
t_{off}	turn-off time		–	30	ns
t_s	storage time		–	15	ns
t_f	fall time		–	15	ns
t_{on}	turn-on time	I_{Con} = 100 mA; I_{Bon} = 40 mA; I_{Boff} = −20 mA; see Fig.2 test conditions B	–	13	ns
t_{off}	turn-off time		–	35	ns



Test conditions A.
V_i = 0.5 to 4.2 V; T = 500 μs; t_p = 10 μs; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 1 kΩ; R_B = 1 kΩ; R_C = 270 Ω.
V_{BB} = 0.2 V; V_{CC} = 2.7 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Test conditions B.
V_i = 0.5 to 4.52 V; T = 200 μs; t_p = 10 μs; $t_r = t_f \leq 3$ ns.
R1 = 100 Ω; R2 = 68 Ω; R_B = 390 Ω; R_C = 47 Ω.
V_{BB} = −3 V; V_{CC} = 4.6 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.2 Test circuit for switching times.

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 60 V).

APPLICATIONS

- Switching and linear amplification.

DESCRIPTION

PNP switching transistor in a TO-92; SOT54 plastic package. NPN complements: PH2222 and PH2222A.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

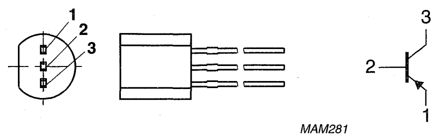


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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			
	PH2907		–	–40	V
	PH2907A		–	–60	V
I_C	collector current (DC)		–	–600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -10$ V	100	300	
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -20$ V; f = 100 MHz	200	–	MHz
t_{off}	turn-off time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	365	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			
	PH2907		–	–40	V
	PH2907A		–	–60	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–600	mA
I_{CM}	peak collector current		–	–800	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	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	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

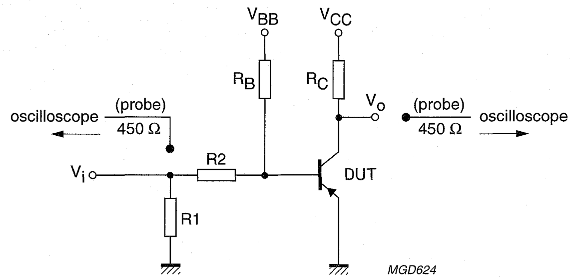
CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	2N2907	$I_E = 0$; $V_{CB} = -50$ V	–	–20	nA
		$I_E = 0$; $V_{CB} = -50$ V; $T_{amb} = 150$ °C	–	–20	μA
I_{CBO}	collector cut-off current				
	2N2907A	$I_E = 0$; $V_{CB} = -50$ V	–	–10	nA
		$I_E = 0$; $V_{CB} = -50$ V; $T_{amb} = 150$ °C	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–50	nA
h_{FE}	DC current gain	$I_C = -0.1$ mA; $V_{CE} = -10$ V			
	2N2907		35	–	
	2N2907A		75	–	
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -10$ V			
	2N2907		50	–	
	2N2907A		100	–	
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -10$ V			
	2N2907		75	–	
	2N2907A		100	–	
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -10$ V; note 1	100	300	
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -10$ V; note 1			
	2N2907		30	–	
	2N2907A		50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA; note 1	–	–400	mV
		$I_C = -500$ mA; $I_B = -50$ mA; note 1	–	–1.6	V
V_{BEsat}	base-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA; note 1	–	–1.3	V
		$I_C = -500$ mA; $I_B = -50$ mA; note 1	–	–2.6	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 100 kHz	–	8	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -2$ V; f = 100 kHz	–	30	pF
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -20$ V; f = 100 MHz; note 1	200	–	MHz
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	40	ns
t_d	delay time		–	12	ns
t_r	rise time		–	30	ns
t_{off}	turn-off time		–	365	ns
t_s	storage time		–	300	ns
t_f	fall time		–	65	ns

Note

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



$V_i = -9.5$ V; T = 500 µs; $t_p = 10$ µs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; $R_B = 325$ Ω; $R_C = 160$ Ω.
$V_{BB} = 3.5$ V; $V_{CC} = -29.5$ V.
Oscilloscope input impedance $Z_i = 50$ Ω.

Fig.2 Test circuit for switching times.

PNP high-voltage transistor PH5416

FEATURES

- High current (max. 1 A)
- High voltage (max. 300 V).

APPLICATIONS

- Telephony applications.

DESCRIPTION

PNP high-voltage transistor in a TO-92; SOT54 plastic package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

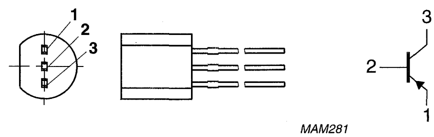


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–350	V
V_{CEO}	collector-emitter voltage	open base	–	–300	V
I_{CM}	peak collector current		–	–1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = -50$ mA; $V_{CE} = -10$ V	30	120	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 100 MHz	15	–	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	–	–350	V
V_{CEO}	collector-emitter voltage	open base	–	–300	V
V_{EBO}	emitter-base voltage	open collector	–	–6	V
I_C	collector current (DC)		–	–1	A
I_{CM}	peak collector current		–	–1	A
I_{BM}	peak base current		–	–500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	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	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -280$ V	–	–100	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -6$ V	–	–100	nA
h_{FE}	DC current gain	$I_C = -50$ mA; $V_{CE} = -10$ V	30	120	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -50$ mA; $I_B = -5$ mA	–	–800	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -50$ mA; $I_B = -5$ mA	–	–1	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	15	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -5$ V; f = 1 MHz	–	75	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 100 MHz	15	–	MHz

NPN general purpose transistor PMBS3904

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- General purpose switching and amplification, e.g. telephony and professional communication equipment.

DESCRIPTION

NPN transistor in a plastic SOT23 package.
PNP complement: PMBS3906.

MARKING

TYPE NUMBER	MARKING CODE
PMBS3904	pO4

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

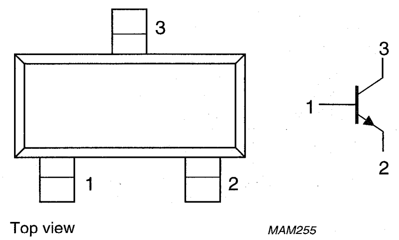


Fig.1 Simplified outline (SOT23) and symbol.

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_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	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	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30$ V	–	50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	50	nA
h_{FE}	DC current gain	$V_{CE} = 1$ V; note 1; see Fig.2			
		$I_C = 0.1$ mA	40	–	
		$I_C = 1$ mA	70	–	
		$I_C = 10$ mA	100	300	
		$I_C = 50$ mA	60	–	
		$I_C = 100$ mA	30	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	–	200	mV
		$I_C = 50$ mA; $I_B = 5$ mA	–	300	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	650	850	mV
		$I_C = 50$ mA; $I_B = 5$ mA	–	950	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	4	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	12	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 20$ V; f = 100 MHz	180	–	MHz
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; $\delta \leq 0.02$.

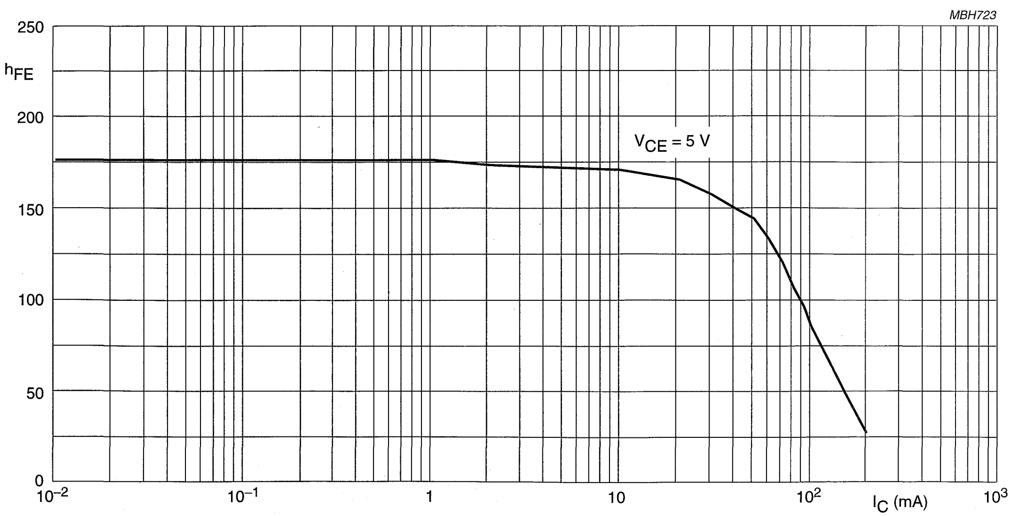


Fig.2 DC current gain; typical values.

PNP general purpose transistor — PMBS3906

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- General purpose switching and amplification, e.g. telephony and professional communication equipment.

DESCRIPTION

PNP transistor in a SOT23 plastic package.
NPN complement: PMBS3904.

MARKING

TYPE NUMBER	MARKING CODE
PMBS3906	pO6

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

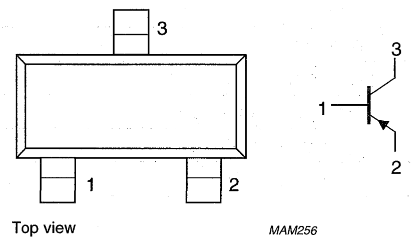


Fig.1 Simplified outline (SOT23) and symbol.

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_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	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	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −30 V	–	−50	nA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −5 V	–	−50	nA
h_{FE}	DC current gain	V_{CE} = −1 V; see Fig.2			
		I_C = −0.1 mA	60	–	
		I_C = −1 mA	80	–	
		I_C = −10 mA	100	300	
		I_C = −50 mA; note 1	60	–	
		I_C = −100 mA; note 1	30	–	
V_{CEsat}	collector-emitter 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}	base-emitter 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	$I_E = i_e$ = 0; V_{CB} = −5 V; f = 100 kHz	–	4.5	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = −0.5 V; f = 100 kHz	–	12	pF
f_T	transition frequency	I_C = −10 mA; V_{CE} = −20 V; f = 100 MHz	150	–	MHz
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; $\delta \leq 0.02$.

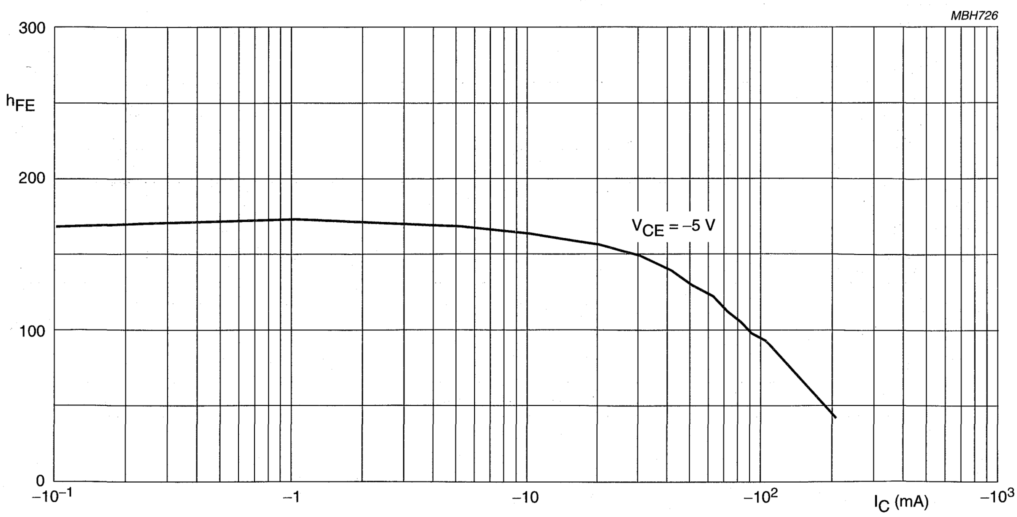


Fig.2 DC current gain; typical values.

NPN switching transistors PMBT2222; PMBT2222A

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- Switching and linear amplification.

DESCRIPTION

NPN switching transistor in a SOT23 plastic package.
PNP complements: PMBT2907 and PMBT2907A.

MARKING

TYPE NUMBER	MARKING CODE
PMBT2222	p1B
PMBT2222A	p1P

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

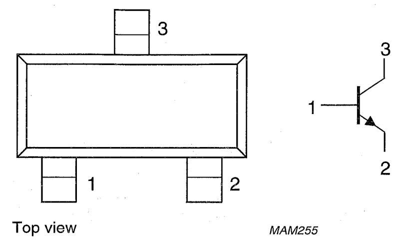


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PMBT2222		–	60	V
	PMBT2222A		–	75	V
V_{CEO}	collector-emitter voltage	open base			
	PMBT2222		–	30	V
	PMBT2222A		–	40	V
I_C	collector current (DC)		–	600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	I_C = 150 mA; V_{CE} = 10 V	100	300	
h_{FE}	DC current gain	I_C = 500 mA; V_{CE} = 10 V			
	PMBT2222		30	–	
	PMBT2222A		40	–	
f_T	transition frequency	I_C = 20 mA; V_{CE} = 20 V; f = 100 MHz			
	PMBT2222		250	–	MHz
	PMBT2222A		300	–	MHz
t_{off}	turn-off time	I_{Con} = 150 mA; I_{Bon} = 15 mA; I_{Boff} = –15 mA	–	250	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			
	PMBT2222		–	60	V
	PMBT2222A		–	75	V
V_{CEO}	collector-emitter voltage	open base			
	PMBT2222		–	30	V
	PMBT2222A		–	40	V
V_{EBO}	emitter-base voltage	open collector			
	PMBT2222		–	5	V
	PMBT2222A		–	6	V
I_C	collector current (DC)		–	600	mA
I_{CM}	peak collector current		–	800	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

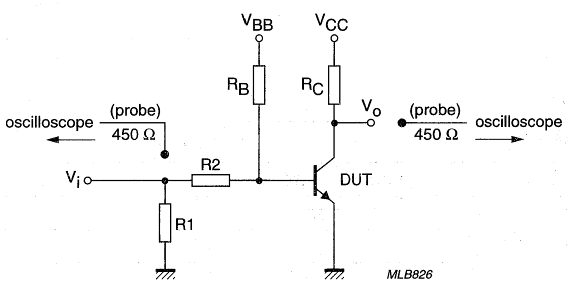
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	PMBT2222	I_E = 0; V_{CB} = 50 V	–	10	nA
		I_E = 0; V_{CB} = 50 V; T_j = 125 °C	–	10	μA
I_{CBO}	collector cut-off current				
	PMBT2222A	I_E = 0; V_{CB} = 60 V	–	10	nA
		I_E = 0; V_{CB} = 60 V; T_j = 125 °C	–	10	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 5 V			
	PMBT2222A		–	10	nA
h_{FE}	DC current gain	I_C = 0.1 mA; V_{CE} = 10 V	35	–	
		I_C = 1 mA; V_{CE} = 10 V	50	–	
		I_C = 10 mA; V_{CE} = 10 V	75	–	
		I_C = 10 mA; V_{CE} = 10 V; T_{amb} = –55 °C	35	–	
		I_C = 150 mA; V_{CE} = 10 V	100	300	
		I_C = 150 mA; V_{CE} = 1 V	50	–	
h_{FE}	DC current gain	I_C = 500 mA; V_{CE} = 10 V			
	PMBT2222		30	–	
	PMBT2222A		40	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = 150 mA; I_B = 15 mA; note 1			
	PMBT2222		–	400	mV
	PMBT2222A		–	300	mV
V_{CEsat}	collector-emitter saturation voltage	I_C = 500 mA; I_B = 50 mA; note 1			
	PMBT2222		–	1.6	V
	PMBT2222A		–	1	V
V_{BEsat}	base-emitter saturation voltage	I_C = 150 mA; I_B = 15 mA; note 1			
	PMBT2222		–	1.3	V
	PMBT2222A		0.6	1.2	V
V_{BEsat}	base-emitter saturation voltage	I_C = 500 mA; I_B = 50 mA; note 1			
	PMBT2222		–	2.6	V
	PMBT2222A		–	2	V
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 10 V; f = 1 MHz	–	8	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = 500 mV; f = 1 MHz			
	PMBT2222		–	30	
	PMBT2222A		–	25	
f_T	transition frequency	I_C = 20 mA; V_{CE} = 20 V; f = 100 MHz			
	PMBT2222		250	–	MHz
	PMBT2222A		300	–	MHz
F	noise figure	I_C = 100 μA; V_{CE} = 5 V; R_S = 1 kΩ; f = 1 kHz	–	4	dB

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	I_{Con} = 150 mA; I_{Bon} = 15 mA; I_{Boff} = −15 mA	–	35	ns
t_d	delay time		–	15	ns
t_r	rise time		–	20	ns
t_{off}	turn-off time		–	250	ns
t_s	storage time		–	200	ns
t_f	fall time		–	60	ns

Note

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



V_i = 9.5 V; T = 500 μs; t_p = 10 μs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; R_B = 325 Ω; R_C = 160 Ω.
V_{BB} = −3.5 V; V_{CC} = 29.5 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.2 Test circuit for switching times.

NPN switching transistor | PMBT2369

FEATURES

- Low current (max. 200 mA)
- Low voltage (max. 15 V).

APPLICATIONS

- High-speed switching, especially in portable equipment.

DESCRIPTION

NPN switching transistor in a SOT23 plastic package.

MARKING

TYPE NUMBER	MARKING CODE
PMBT2369	p1J

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

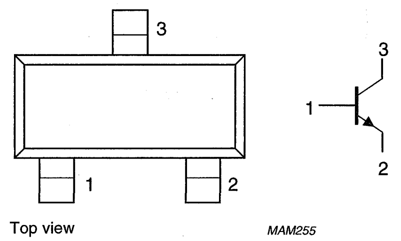


Fig.1 Simplified outline (SOT23) and symbol.

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
I_C	collector current (DC)		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	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	–	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	500	–	MHz
t_{off}	turn-off time	$I_{Con} = 10$ mA; $I_{Bon} = 3$ mA; $I_{Boff} = -1.5$ mA	–	30	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_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	200	mA
I_{CM}	peak collector current		–	300	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

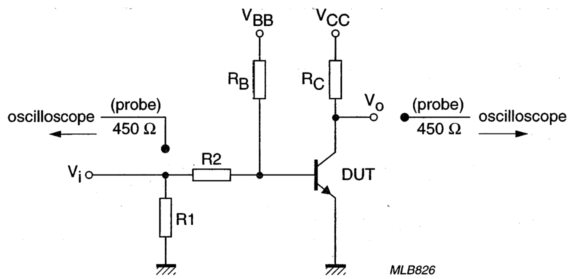
1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	400	nA
		$I_E = 0$; $V_{CB} = 20$ V; $T_j = 125$ °C	–	30	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	100	nA
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 1$ V	40	120	
		$I_C = 10$ mA; $V_{CE} = 1$ V; $T_{amb} = -55$ °C	20	–	
		$I_C = 100$ mA; $V_{CE} = 2$ V	20	–	
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	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	4	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	500	–	MHz

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	I_{Con} = 10 mA; I_{Bon} = 3 mA; I_{Boff} = −1.5 mA	–	10	ns
t_d	delay time		–	4	ns
t_r	rise time		–	6	ns
t_{off}	turn-off time		–	30	ns
t_s	storage time		–	15	ns
t_f	fall time		–	15	ns



V_i = 0.5 to 4.2 V; T = 500 µs; t_p = 10 µs; $t_r = t_f \leq$ 3 ns.
R1 = 56 Ω; R2 = 1 kΩ; R_B = 1 kΩ; R_C = 270 Ω.
V_{BB} = 0.2 V; V_{CC} = 2.7 V.
Oscilloscope input impedance Z_i = 50 Ω.

Fig.2 Test circuit for switching times.

PNP switching transistors | PMBT2907; PMBT2907A

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 60 V).

APPLICATIONS

- Switching and linear amplification.

DESCRIPTION

PNP switching transistor in a SOT23 plastic package.
NPN complements: PMBT2222 and PMBT2222A.

MARKING

TYPE NUMBER	MARKING CODE
PMBT2907	p2B
PMBT2907A	p2F

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

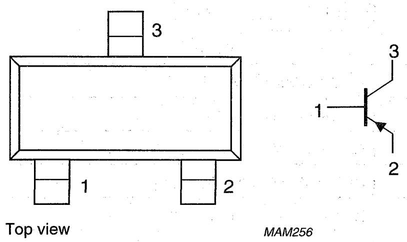


Fig.1 Simplified outline (SOT23) and symbol.

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			
	PMBT2907		–	–40	V
	PMBT2907A		–	–60	V
I_C	collector current (DC)		–	–600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -10$ V			
	PMBT2907		30	–	
	PMBT2907A		50	–	
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -20$ V; f = 100 MHz	200	–	MHz
t_{off}	turn-off time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	365	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			
	PMBT2907		–	–40	V
	PMBT2907A		–	–60	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–600	mA
I_{CM}	peak collector current		–	–800	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

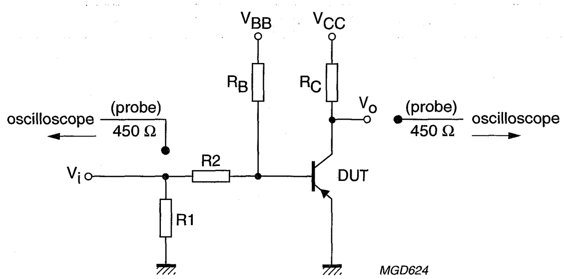
1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V			
	PMBT2907		–	–20	nA
	PMBT2907A		–	–10	nA
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V; $T_j = 125$ °C			
	PMBT2907		–	–20	μA
	PMBT2907A		–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–50	nA
h_{FE}	DC current gain	$I_C = -0.1$ mA; $V_{CE} = -10$ V			
	PMBT2907		35	–	
	PMBT2907A		75	–	
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -10$ V			
	PMBT2907		50	–	
	PMBT2907A		100	–	

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -10$ V			
	PMBT2907		75	–	
	PMBT2907A		100	–	
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -10$ V	100	300	
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -10$ V			
	PMBT2907		30	–	
	PMBT2907A		50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA	–	−400	mV
		$I_C = -500$ mA; $I_B = -50$ mA	–	−1.6	V
V_{BEsat}	base-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA	–	−1.3	V
		$I_C = -500$ mA; $I_B = -50$ mA	–	−2.6	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	8	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -2$ V; f = 1 MHz	–	30	pF
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -20$ V; f = 100 MHz	200	–	MHz
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	40	ns
t_d	delay time		–	12	ns
t_r	rise time		–	30	ns
t_{off}	turn-off time		–	365	ns
t_s	storage time		–	300	ns
t_f	fall time		–	65	ns



$V_i = -9.5$ V; T = 500 µs; $t_p = 10$ µs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; $R_B = 325$ Ω; $R_C = 160$ Ω.
$V_{BB} = 3.5$ V; $V_{CC} = -29.5$ V.
Oscilloscope: input impedance $Z_i = 50$ Ω.

Fig.2 Test circuit for switching times.

NPN switching transistor — PMBT3904

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- Telephony and professional communication equipment.

DESCRIPTION

NPN switching transistor in a SOT23 plastic package.
PNP complement: PMBT3906.

MARKING

TYPE NUMBER	MARKING CODE
PMBT3904	p1A

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

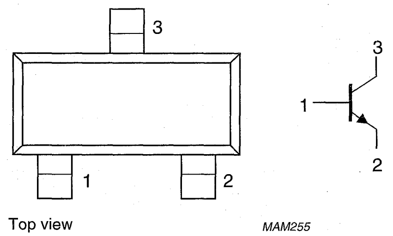


Fig.1 Simplified outline (SOT23) and symbol.

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	collector current (DC)		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	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_{off}	turn-off time	$I_{Con} = 10$ mA; $I_{Bon} = 1$ mA; $I_{Boff} = -1$ mA	–	240	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	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

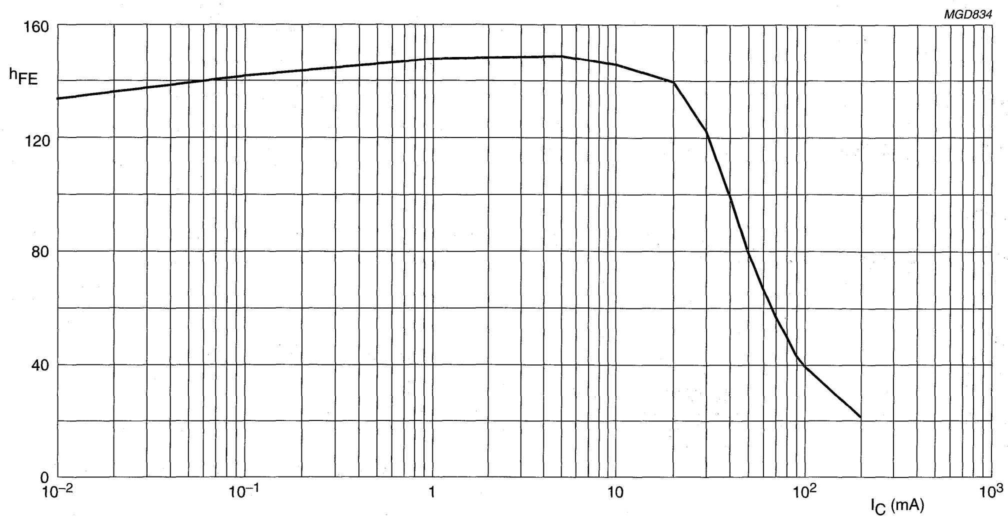
CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30$ V	–	50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 6$ V	–	50	nA
h_{FE}	DC current gain	$V_{CE} = 1$ V; note 1; see Fig.2			
		$I_C = 0.1$ mA	60	–	
		$I_C = 1$ mA	80	–	
		$I_C = 10$ mA	100	300	
		$I_C = 50$ mA	60	–	
		$I_C = 100$ mA	30	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	–	200	mV
		$I_C = 50$ mA; $I_B = 5$ mA	–	200	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	650	850	mV
		$I_C = 50$ mA; $I_B = 5$ mA	–	950	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	4	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{BE} = 500$ mV; f = 1 MHz	–	8	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 20$ V; f = 100 MHz	300	–	MHz
F	noise figure	$I_C = 100$ μA; $V_{CE} = 5$ V; $R_S = 1$ kΩ; f = 10 Hz to 15.7 kHz	–	5	dB
Switching times (between 10% and 90% levels); see Fig.3					
t_{on}	turn-on time	$I_{Con} = 10$ mA; $I_{Bon} = 1$ mA; $I_{Boff} = -1$ mA	–	65	ns
t_d	delay time		–	35	ns
t_r	rise time		–	35	ns
t_{off}	turn-off time		–	240	ns
t_s	storage time		–	200	ns
t_f	fall time		–	50	ns

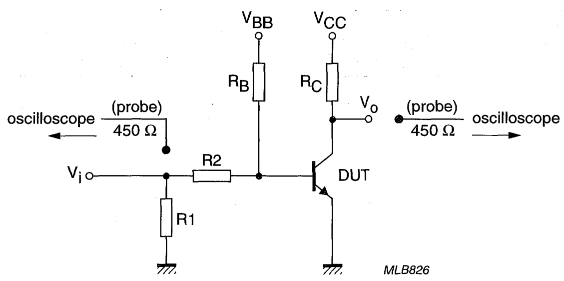
Note

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



V_{CE} = 1 V.

Fig.2 DC current gain; typical values.



V_i = 5 V; T = 500 μs; t_p = 10 μs; t_r = t_f ≤ 3 ns.
R1 = 56 Ω; R2 = 2.5 kΩ; R_B = 3.9 kΩ; R_C = 270 Ω.
V_{BB} = −1.9 V; V_{CC} = 3 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.3 Test circuit for switching times.

PNP switching transistor PMBT3906

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- Telephony and professional communication equipment.

DESCRIPTION

PNP switching transistor in a SOT23 plastic package.
NPN complement: PMBT3904.

MARKING

TYPE NUMBER	MARKING CODE
PMBT3906	p2A

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

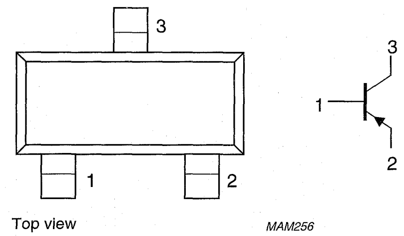


Fig.1 Simplified outline (SOT23) and symbol.

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	collector current (DC)		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	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_{off}	turn-off time	$I_{Con} = -10$ mA; $I_{Bon} = -1$ mA; $I_{Boff} = 1$ mA	–	300	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	–	–6	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

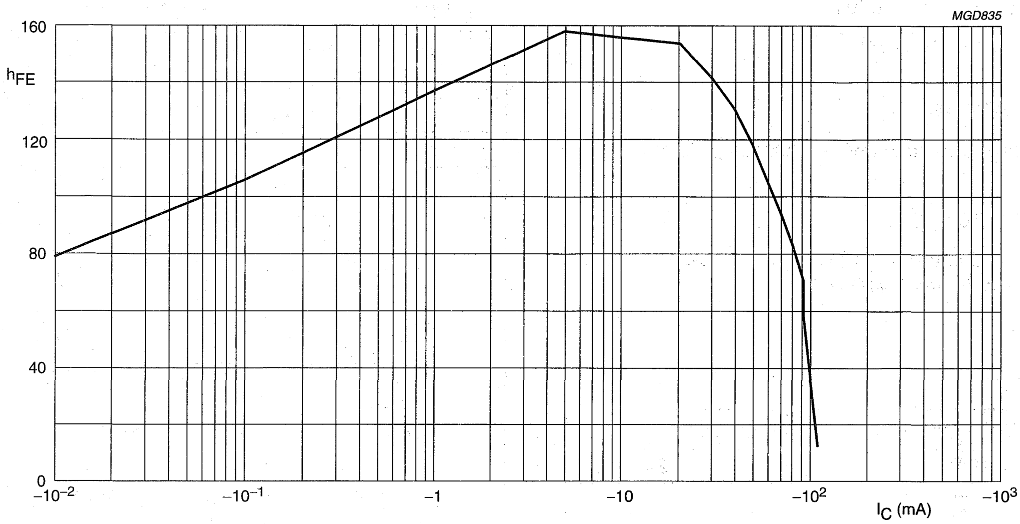
Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

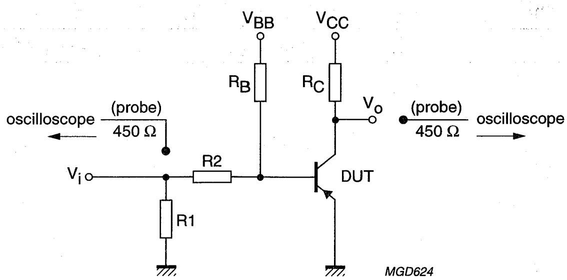
T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -30$ V	–	–50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -6$ V	–	–50	nA
h_{FE}	DC current gain	$V_{CE} = -1$ V; see Fig.2			
		$I_C = -0.1$ mA	60	–	
		$I_C = -1$ mA	80	–	
		$I_C = -10$ mA	100	300	
		$I_C = -50$ mA	60	–	
		$I_C = -100$ mA	30	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -1$ mA	–	–200	mV
		$I_C = -50$ mA; $I_B = -5$ mA	–	–200	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -10$ mA; $I_B = -1$ mA	–	–850	mV
		$I_C = -50$ mA; $I_B = -5$ mA	–	–950	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -5$ V; f = 1 MHz	–	4.5	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -500$ mV; f = 1 MHz	–	10	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -20$ V; f = 100 MHz	250	–	MHz
F	noise figure	$I_C = -100$ μA; $V_{CE} = -5$ V; $R_S = 1$ kΩ; f = 10 Hz to 15.7 kHz	–	4	dB
Switching times (between 10% and 90% levels); see Fig.3					
t_{on}	turn-on time	$I_{Con} = -10$ mA; $I_{Bon} = -1$ mA; $I_{Boff} = 1$ mA	–	65	ns
t_d	delay time		–	35	ns
t_r	rise time		–	35	ns
t_{off}	turn-off time		–	300	ns
t_s	storage time		–	225	ns
t_f	fall time		–	75	ns



$V_{CE} = -1$ V.

Fig.2 DC current gain; typical values.



$V_i = 5$ V; T = 500 µs; $t_p = 10$ µs; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 2.5 kΩ; $R_B = 3.9$ kΩ; $R_C = 270$ Ω.
$V_{BB} = 1.9$ V; $V_{CC} = -3$ V.
Oscilloscope: input impedance $Z_i = 50$ Ω.

Fig.3 Test circuit for switching times.

NPN switching transistor PMBT4401

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- Industrial and consumer switching applications.

DESCRIPTION

NPN switching transistor in a SOT23 plastic package.
PNP complement: PMBT4403.

MARKING

TYPE NUMBER	MARKING CODE
PMBT4401	p2X

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

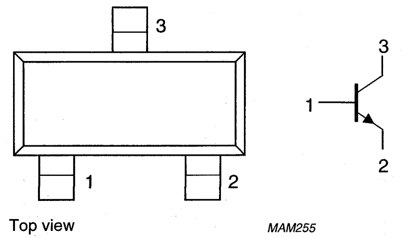


Fig.1 Simplified outline (SOT23) and symbol.

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	collector current (DC)		–	600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 1$ V	100	300	
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 10$ V; f = 100 MHz	250	–	MHz
t_{off}	turn-off time	$I_{Con} = 150$ mA; $I_{Bon} = 15$ mA; $I_{Boff} = -15$ mA	–	250	ns

NPN switching transistor PMBT4401

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	collector current (DC)		–	600	mA
I_{CM}	peak collector current		–	800	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 60$ V	–	50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 6$ V	–	50	nA
h_{FE}	DC current gain	$V_{CE} = 1$ V; see Fig.2			
		$I_C = 0.1$ mA	20	–	
		$I_C = 1$ mA	40	–	
		$I_C = 10$ mA	80	–	
		$I_C = 150$ mA; note 1	100	300	
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 2$ V; note 1	40	–	
V_{CEsat}	collector-emitter 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}	base-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA; note 1	–	950	mV
		$I_C = 500$ mA; $I_B = 50$ mA; note 1	–	1.2	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	8	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 500$ mV; f = 1 MHz	–	30	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 10$ V; f = 100 MHz	250	–	MHz
Switching times (between 10% and 90% levels); see Fig.3					
t_{on}	turn-on time	$I_{Con} = 150$ mA; $I_{Bon} = 15$ mA; $I_{Boff} = -15$ mA	–	35	ns
t_d	delay time		–	15	ns
t_r	rise time		–	20	ns
t_{off}	turn-off time		–	250	ns
t_s	storage time		–	200	ns
t_f	fall time		–	60	ns

Note

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

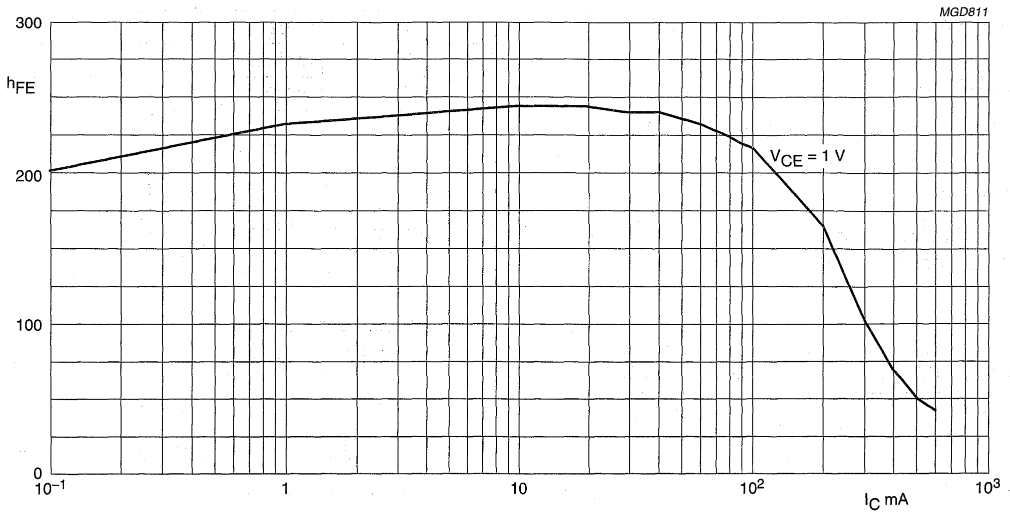
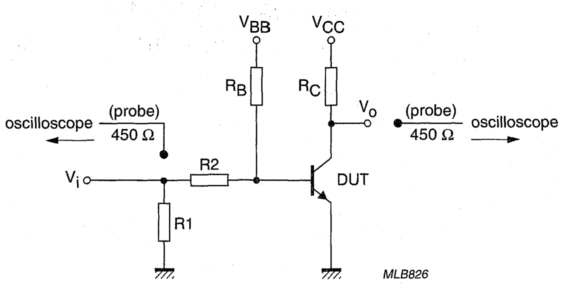


Fig.2 DC current gain; typical values.



V_i = 9.5 V; T = 500 μs; t_p = 10 μs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; R_B = 325 Ω; R_C = 160 Ω.
V_{BB} = −3.5 V; V_{CC} = 29.5 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.3 Test circuit for switching times.

PNP switching transistor PMBT4403

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- Industrial and consumer switching applications.

DESCRIPTION

PNP switching transistor in a SOT23 plastic package.
NPN complement: PMBT4401.

MARKING

TYPE NUMBER	MARKING CODE
PMBT4403	p2T

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

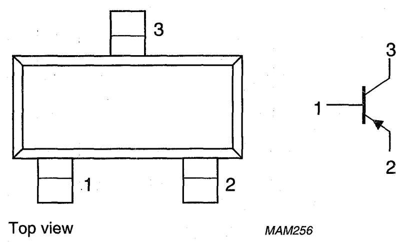


Fig.1 Simplified outline (SOT23) and symbol.

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	collector current (DC)		–	–600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -2$ V	100	300	
f_T	transition frequency	$I_C = -20$ mA; $V_{CE} = -10$ V; f = 100 MHz	200	–	MHz
t_{off}	turn-off time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	350	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	collector current (DC)		–	–600	mA
I_{CM}	peak collector current		–	–800	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j-a}$	thermal resistance from junction to ambient	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -40$ V	–	–50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–50	nA
h_{FE}	DC current gain	$V_{CE} = -1$ V; see Fig.2			
		$I_C = -0.1$ mA	30	–	
		$I_C = -1$ mA	60	–	
		$I_C = -10$ mA	100	–	
h_{FE}	DC current gain	$V_{CE} = -2$ V			
		$I_C = -150$ mA	100	300	
		$I_C = -500$ mA	20	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA	–	–400	mV
		$I_C = -500$ mA; $I_B = -50$ mA	–	–750	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA	–	–950	mV
		$I_C = -500$ mA; $I_B = -50$ mA	–	–1.3	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	8.5	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -500$ mV; f = 1 MHz	–	35	pF
f_T	transition frequency	$I_C = -20$ mA; $V_{CE} = -10$ V; f = 100 MHz	200	–	MHz
Switching times (between 10% and 90% levels); see Fig.3					
t_{on}	turn-on time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	40	ns
t_d	delay time		–	15	ns
t_r	rise time		–	30	ns
t_{off}	turn-off time		–	350	ns
t_s	storage time		–	300	ns
t_f	fall time		–	50	ns

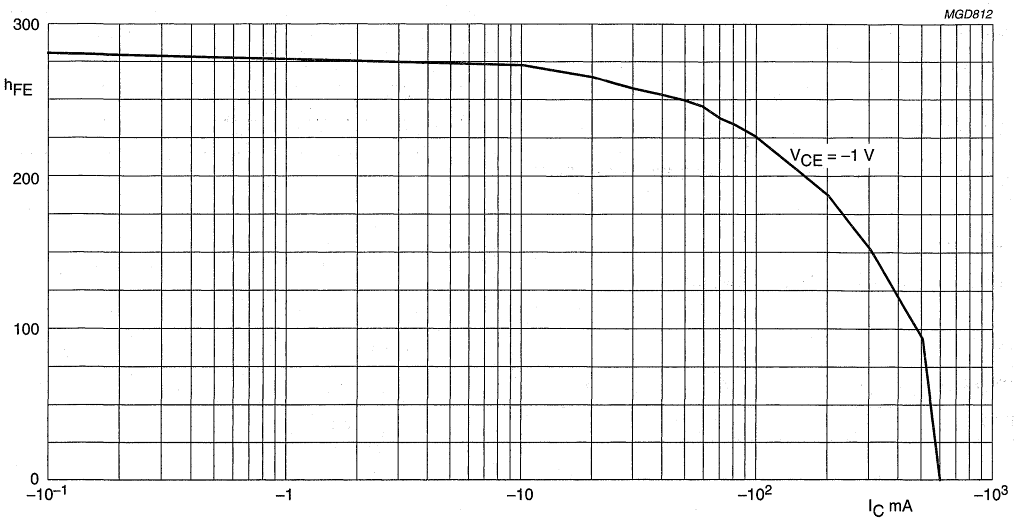
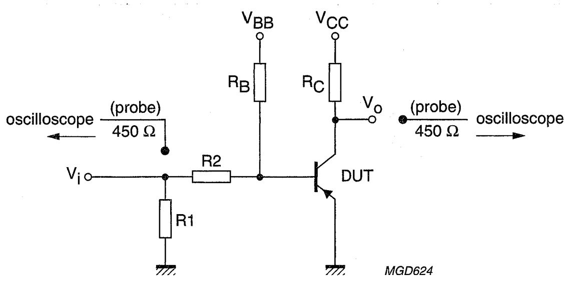


Fig.2 DC current gain; typical values.



$V_i = -9.5$ V; T = 500 μs; $t_p = 10$ μs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; $R_B = 325$ Ω; $R_C = 160$ Ω.
$V_{BB} = 3.5$ V; $V_{CC} = -29.5$ V.
Oscilloscope: input impedance $Z_i = 50$ Ω.

Fig.3 Test circuit for switching times.

NPN general purpose transistor — PMBT5088

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 30 V).

APPLICATIONS

- Intended for low-noise input stages in audio equipment.

DESCRIPTION

NPN transistor in a SOT23 plastic package.

MARKING

TYPE NUMBER	MARKING CODE
PMBT5088	p1Q

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

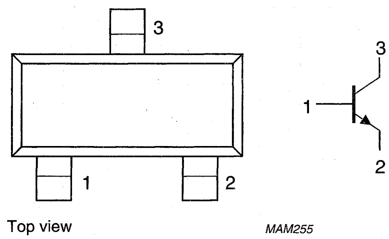


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	35	V
V_{CEO}	collector-emitter voltage	open base	–	30	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 5$ V	350	–	

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	–	35	V
V_{CEO}	collector-emitter voltage	open base	–	30	V
V_{EBO}	emitter-base voltage	open collector	–	4.5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 3$ V	–	50	nA
h_{FE}	DC current gain	$I_C = 100$ µA; $V_{CE} = 5$ V	300	900	
		$I_C = 1$ mA; $V_{CE} = 5$ V	350	–	
		$I_C = 10$ mA; $V_{CE} = 5$ V	300	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	–	500	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	–	800	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	4	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 500$ mV; f = 1 MHz	–	10	pF
F	noise figure	$I_C = 100$ µA; $V_{CE} = 5$ V; $R_S = 1$ kΩ; f = 10 Hz to 15.7 kHz	–	3	dB

PNP high-voltage transistor

PMBT5401

FEATURES

- Low current (max. 300 mA)
- High voltage (max. 150 V).

APPLICATIONS

- Switching and amplification in high voltage applications such as telephony.

DESCRIPTION

PNP high-voltage transistor in a SOT23 plastic package.
NPN complement: PMBT5550.

MARKING

TYPE NUMBER	MARKING CODE
PMBT5401	p2L

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

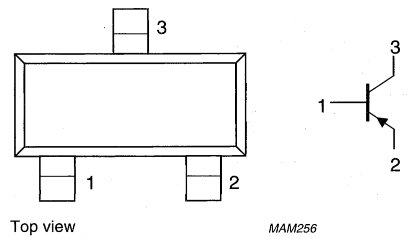


Fig.1 Simplified outline (SOT23) and symbol.

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_{CM}	peak collector current		–	–600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -5$ V	60	240	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	6	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 100 MHz	100	300	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	–	–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)		–	–300	mA
I_{CM}	peak collector current		–	–600	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -120$ V	–	–50	nA
		$I_E = 0$; $V_{CB} = -120$ V; $T_{amb} = 150$ °C	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -4$ V	–	–50	nA
h_{FE}	DC current gain	$V_{CE} = -5$ V; see Fig.2			
		$I_C = -1$ mA	50	–	
		$I_C = -10$ mA	60	240	
		$I_C = -50$ mA	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -1$ mA	–	–200	mV
		$I_C = -50$ mA; $I_B = -5$ mA	–	–500	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -10$ mA; $I_B = -1$ mA	–	–1	V
		$I_C = -50$ mA; $I_B = -5$ mA	–	–1	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	6	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 100 MHz; $T_{amb} = 25$ °C	100	300	MHz
F	noise figure	$I_C = -200$ μA; $V_{CE} = -5$ V; $R_S = 2$ kΩ; f = 10 Hz to 15.7 kHz; $T_{amb} = 25$ °C	–	8	dB

PNP high-voltage transistor PMBT5401

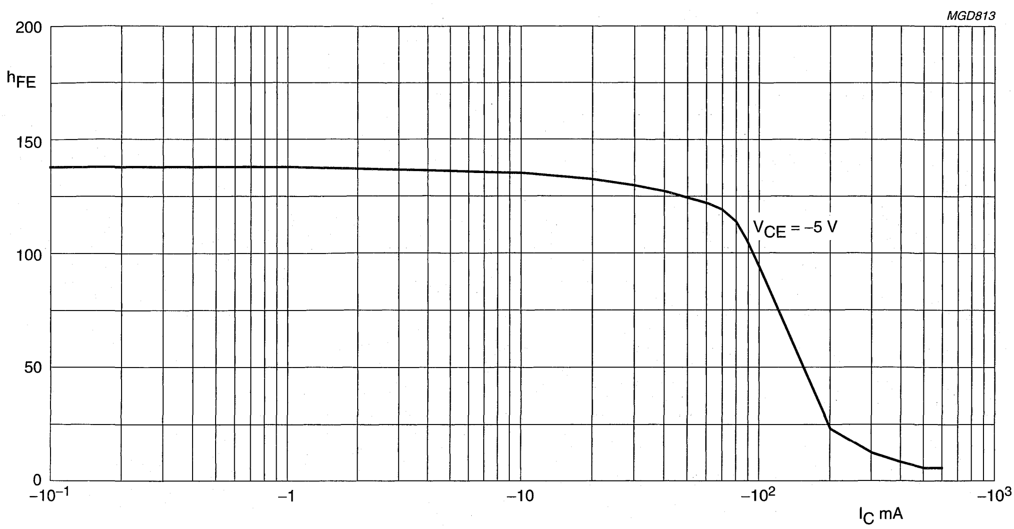


Fig.2 DC current gain; typical values.

NPN high-voltage transistor PMBT5550

FEATURES

- Low current (max. 300 mA)
- Low voltage (max. 140 V).

APPLICATIONS

- Telephony.

DESCRIPTION

NPN high-voltage transistor in a SOT23 plastic package.
PNP complement: PMBT5401.

MARKING

TYPE NUMBER	MARKING CODE
PMBT5550	p1F

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

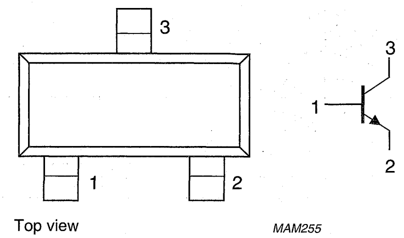


Fig.1 Simplified outline (SOT23) and symbol.

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	–	140	V
I_{CM}	peak collector current		–	600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V	60	250	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	100	300	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	–	160	V
V_{CEO}	collector-emitter voltage	open base	–	140	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	300	mA
I_{CM}	peak collector current		–	600	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 100$ V	–	50	nA
		$I_E = 0$; $V_{CB} = 100$ V; $T_{amb} = 100$ °C	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	50	nA
h_{FE}	DC current gain	$V_{CE} = 5$ V; see Fig.2			
		$I_C = 1$ mA	60	–	
		$I_C = 10$ mA	60	250	
		$I_C = 50$ mA	20	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	–	150	mV
		$I_C = 50$ mA; $I_B = 5$ mA	–	250	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	–	1	V
		$I_C = 50$ mA; $I_B = 5$ mA	–	1.2	V
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
F	noise figure	$I_C = 200$ μA; $V_{CE} = 5$ V; $R_S = 2$ kΩ; f = 10 Hz to 15.7 kHz	–	10	dB

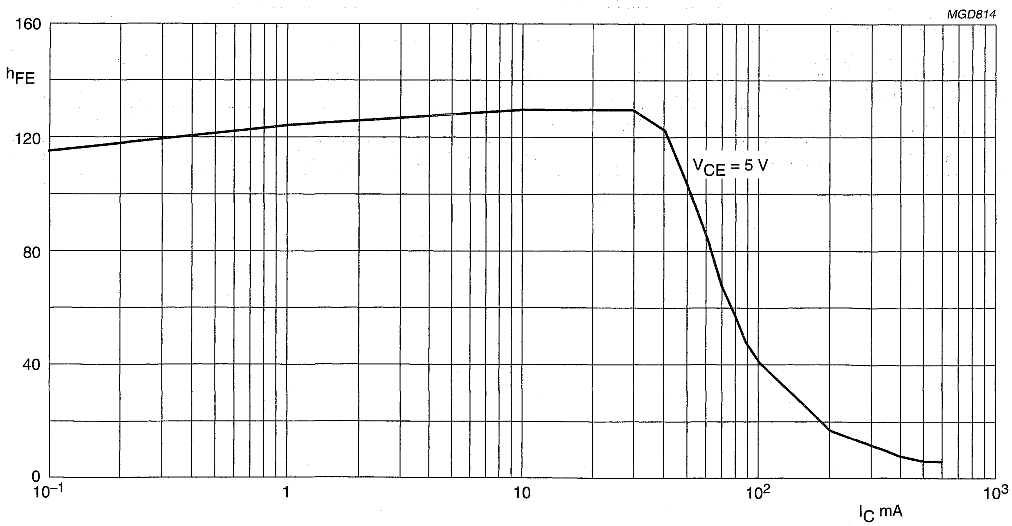


Fig.2 DC current gain; typical values.

NPN high-voltage transistor PMBT5551

FEATURES

- Low current (max. 300 mA)
- High voltage (max. 160 V).

APPLICATIONS

- General purpose
- Telephony.

DESCRIPTION

NPN high-voltage transistor in a SOT23 plastic package.
PNP complement: PMBT5401.

MARKING

TYPE NUMBER	MARKING CODE
PMBT5551	pG1

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

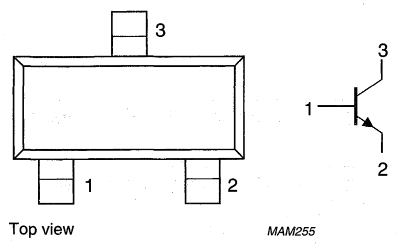


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	180	V
V_{CEO}	collector-emitter voltage	open base	–	160	V
I_{CM}	peak collector current		–	600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V	80	250	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	100	300	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	–	180	V
V_{CEO}	collector-emitter voltage	open base	–	160	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	300	mA
I_{CM}	peak collector current		–	600	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 120$ V	–	50	nA
		$I_E = 0$; $V_{CB} = 120$ V; $T_{amb} = 100$ °C	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	50	nA
h_{FE}	DC current gain	$V_{CE} = 5$ V; see Fig.2			
		$I_C = 1$ mA	80	–	
		$I_C = 10$ mA	80	250	
		$I_C = 50$ mA	30	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	–	150	mV
		$I_C = 50$ mA; $I_B = 5$ mA	–	200	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	–	1	V
		$I_C = 50$ mA; $I_B = 5$ mA	–	1	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	6	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 500$ mV; f = 1 MHz	–	30	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	100	300	MHz
F	noise figure	$I_C = 200$ μA; $V_{CE} = 5$ V; $R_S = 2$ kΩ; f = 10 Hz to 15.7 kHz	–	8	dB

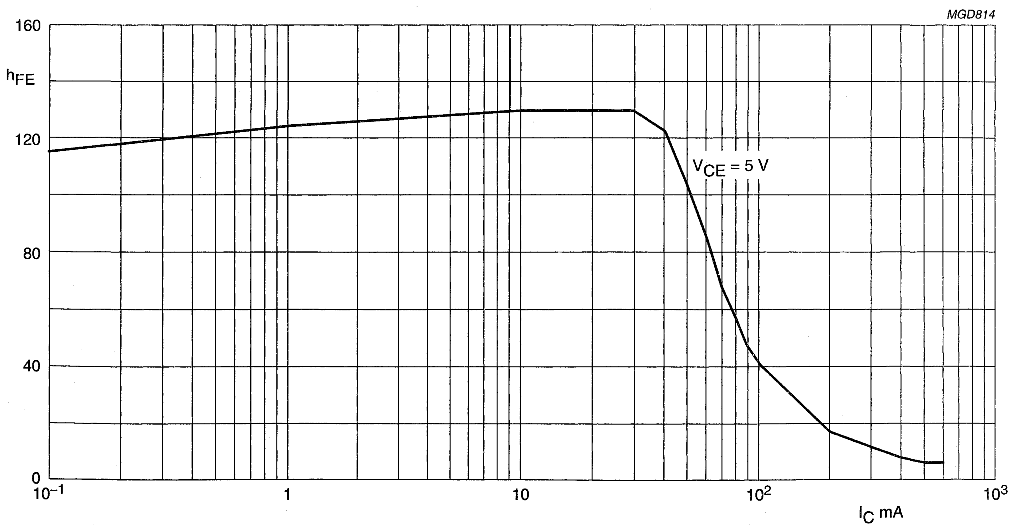


Fig.2 DC current gain; typical values.

NPN general purpose transistors — PMBT6428; PMBT6429

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 50 V).

APPLICATIONS

- General purpose switching and amplification
- Telephony and professional communication equipment.

DESCRIPTION

NPN transistor in a SOT23 plastic package.

MARKING

TYPE NUMBER	MARKING CODE
PMBT6428	p1K
PMBT6429	p1L

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

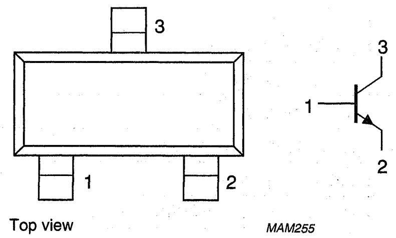


Fig.1 Simplified outline SOT23 and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PMBT6428		–	60	V
	PMBT6429		–	55	V
V_{CEO}	collector-emitter voltage	open base			
	PMBT6428		–	50	V
	PMBT6429		–	45	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 0.1$ mA; $V_{CE} = 5$ V			
	PMBT6428		250	650	
	PMBT6429		500	1250	
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 5$ V; f = 100 MHz	100	700	MHz

NPN general purpose transistors PMBT6428; PMBT6429

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			
	PMBT6428		–	60	V
	PMBT6429		–	55	V
V_{CEO}	collector-emitter voltage	open base			
	PMBT6428		–	50	V
	PMBT6429		–	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
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 30 V	–	10	nA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 5 V	–	10	nA
h_{FE}	DC current gain	I_C = 0.1 mA; V_{CE} = 5 V			
	PMBT6428		250	650	
	PMBT6429		500	1250	
h_{FE}	DC current gain	I_C = 1 mA; V_{CE} = 5 V			
	PMBT6428		250	–	
	PMBT6429		500	–	
h_{FE}	DC current gain	I_C = 10 mA; V_{CE} = 5 V			
	PMBT6428		250	–	
	PMBT6429		500	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA; I_B = 0.5 mA	–	200	mV
		I_C = 100 mA; I_B = 5 mA	–	600	mV
V_{BE}	base-emitter voltage	I_C = 1 mA; V_{CE} = 5 V	560	660	mV
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 10 V; f = 1 MHz	–	3	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = 0.5 V; f = 1 MHz	–	12	pF
f_T	transition frequency	I_C = 1 mA; V_{CE} = 5 V; f = 100 MHz	100	700	MHz

NPN general purpose transistor | PMBTA06

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 80 V).

APPLICATIONS

- General purpose switching and amplification in e.g. telephony and professional communication equipment.

DESCRIPTION

NPN transistor in a SOT23 plastic package.
PNP complement: PMBTA56.

MARKING

TYPE NUMBER	MARKING CODE
PMBTA06	p1G

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

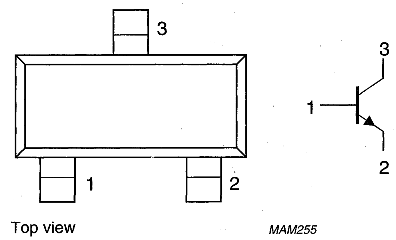


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	80	V
V_{CEO}	collector-emitter voltage	open base	–	80	V
I_{CM}	peak collector current		–	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
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

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	–	80	V
V_{CEO}	collector-emitter voltage	open base	–	80	V
V_{EBO}	emitter-base voltage	open collector	–	4	V
I_C	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	1	A
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 60$ V	–	50	nA
		$I_E = 0$; $V_{CB} = 80$ V	–	50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	50	nA
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 1$ V	100	–	
		$I_C = 100$ mA; $V_{CE} = 1$ V	100	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 100$ mA; $I_B = 10$ mA	–	0.25	V
V_{BE}	base-emitter voltage	$I_C = 100$ mA; $V_{CE} = 1$ V	–	1.2	V
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 2$ V; f = 100 MHz	100	–	MHz

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 30 V)
- High DC current gain (min. 10000).

APPLICATIONS

- High input impedance preamplifiers.

DESCRIPTION

NPN Darlington transistor in a SOT23 plastic package.
PNP complements: PMBTA63 and PMBTA64.

MARKING

TYPE NUMBER	MARKING CODE
PMBTA13	p1M
PMBTA14	p1N

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

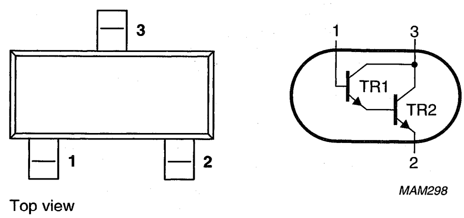


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	30	V
I_C	collector current (DC)		–	500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V			
	PMBTA13		5000	–	
	PMBTA14		10000	–	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	125	–	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_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	30	V
V_{EBO}	emitter-base voltage	open collector	–	10	V
I_C	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	800	mA
I_B	base current (DC)		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

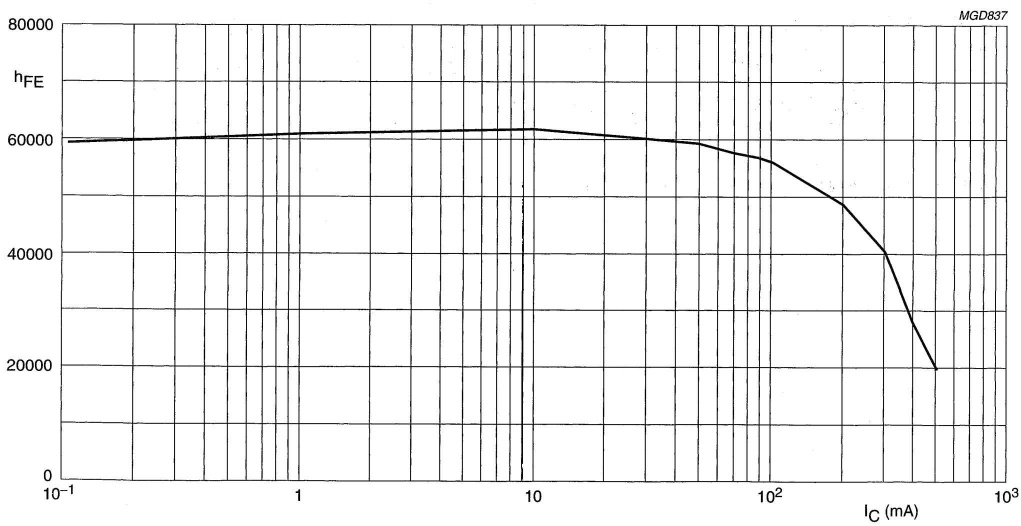
Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30$ V	–	100	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 10$ V	–	100	nA
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V; see Fig.2			
	PMBTA13		5000	–	
	PMBTA14		10000	–	
h_{FE}	DC current gain	$I_C = 100$ mA; $V_{CE} = 5$ V; see Fig.2			
	PMBTA13		10000	–	
	PMBTA14		20000	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 100$ mA; $I_B = 0.1$ mA	–	1.5	V
V_{BEon}	base-emitter on-state voltage	$I_C = 100$ mA; $V_{CE} = 5$ V	–	1.4	V
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	125	–	MHz



$V_{CE} = 2$ V.

Fig.2 DC current gain; typical values.

NPN high-voltage transistors PMBTA42; PMBTA43

FEATURES

- Low current (max. 100 mA)
- High voltage (max. 300 V).

APPLICATIONS

- Telephony and professional communication equipment.

DESCRIPTION

NPN high-voltage transistor in a SOT23 plastic package.
PNP complements: PMBTA92 and PMBTA93.

MARKING

TYPE NUMBER	MARKING CODE
PMBTA42	p1D
PMBTA43	p1E

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

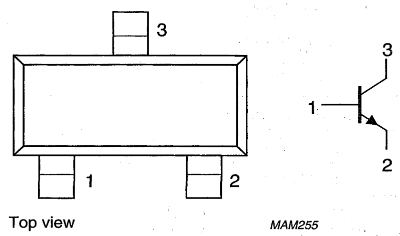


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PMBTA42		–	300	V
	PMBTA43		–	200	V
V_{CEO}	collector-emitter voltage	open base			
	PMBTA42		–	300	V
	PMBTA43		–	200	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 10$ V	40	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 20$ V; f = 1 MHz			
	PMBTA42		–	3	pF
	PMBTA43		–	4	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 20$ V; f = 100 MHz	50	–	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			
	PMBTA42		–	300	V
	PMBTA43		–	200	V
V_{CEO}	collector-emitter voltage	open base			
	PMBTA42		–	300	V
	PMBTA43		–	200	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	PMBTA42	$I_E = 0$; $V_{CB} = 200$ V	–	100	nA
	PMBTA43	$I_E = 0$; $V_{CB} = 160$ V	–	100	nA
I_{EBO}	emitter cut-off current				
	PMBTA42	$I_C = 0$; $V_{EB} = 6$ V	–	100	nA
	PMBTA43	$I_C = 0$; $V_{EB} = 4$ V	–	100	nA
h_{FE}	DC current gain	$V_{CE} = 10$ V			
		$I_C = 1$ mA	25	–	
		$I_C = 10$ mA	40	–	
		$I_C = 30$ mA	40	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 20$ mA; $I_B = 2$ mA	–	500	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 20$ mA; $I_B = 2$ mA	–	900	mV
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 20$ V; f = 1 MHz			
	PMBTA42		–	3	pF
	PMBTA43		–	4	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 20$ V; f = 100 MHz	50	–	MHz

PNP general purpose transistors PMBTA55; PMBTA56

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 80 V).

APPLICATIONS

- General purpose switching and amplification, e.g. telephony and professional communication equipment.

DESCRIPTION

PNP transistor in a SOT23 plastic package.
NPN complement: PMBTA06.

MARKING

TYPE NUMBER	MARKING CODE
PMBTA55	p2H
PMBTA56	p2G

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

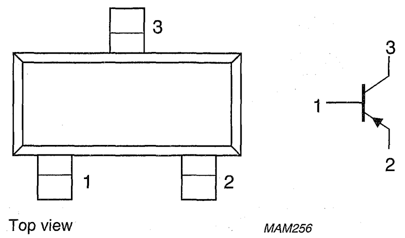


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PMBTA55		–	–60	V
	PMBTA56		–	–80	V
V_{CEO}	collector-emitter voltage	open base			
	PMBTA55		–	–60	V
	PMBTA56		–	–80	V
I_{CM}	peak collector current		–	–1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = -100$ mA; $V_{CE} = -1$ V	100	–	
f_T	transition frequency	$I_C = -100$ mA; $V_{CE} = -1$ V; f = 100 MHz	50	–	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			
	PMBTA55		–	–60	V
	PMBTA56		–	–80	V
V_{CEO}	collector-emitter voltage	open base			
	PMBTA55		–	–60	V
	PMBTA56		–	–80	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–500	mA
I_{CM}	peak collector current		–	–1	A
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	PMBTA55	$I_E = 0$; $V_{CB} = -60$ V	–	–50	nA
	PMBTA56	$I_E = 0$; $V_{CB} = -80$ V	–	–50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–50	nA
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -1$ V	100	–	
		$I_C = -100$ mA; $V_{CE} = -1$ V	100	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -100$ mA; $I_B = -10$ mA	–	–250	mV
V_{BE}	base-emitter voltage	$I_C = -100$ mA; $V_{CE} = -1$ V	–	–1.2	V
f_T	transition frequency	$I_C = -100$ mA; $V_{CE} = -1$ V; f = 100 MHz	50	–	MHz

PNP Darlington transistors PMBTA63; PMBTA64

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 30 V)
- High DC current gain (min. 5000).

APPLICATIONS

- High input impedance preamplifiers.

DESCRIPTION

PNP Darlington transistor in a SOT23 plastic package.
NPN complements: PMBTA13 and PMBTA14.

MARKING

TYPE NUMBER	MARKING CODE
PMBTA63	p2U
PMBTA64	p2V

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

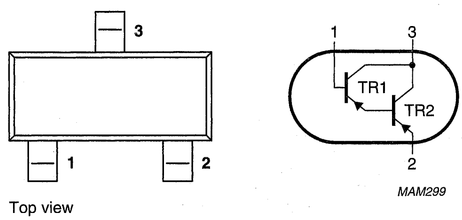


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–30	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	–30	V
I_C	collector current (DC)		–	–500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -5$ V			
	PMBTA63		5000	–	
	PMBTA64		10000	–	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -50$ V; f = 100 MHz	125	–	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_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	–30	V
V_{EBO}	emitter-base voltage	open collector	–	–10	V
I_C	collector current (DC)		–	–500	mA
I_{CM}	peak collector current		–	–800	mA
I_B	base current (DC)		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

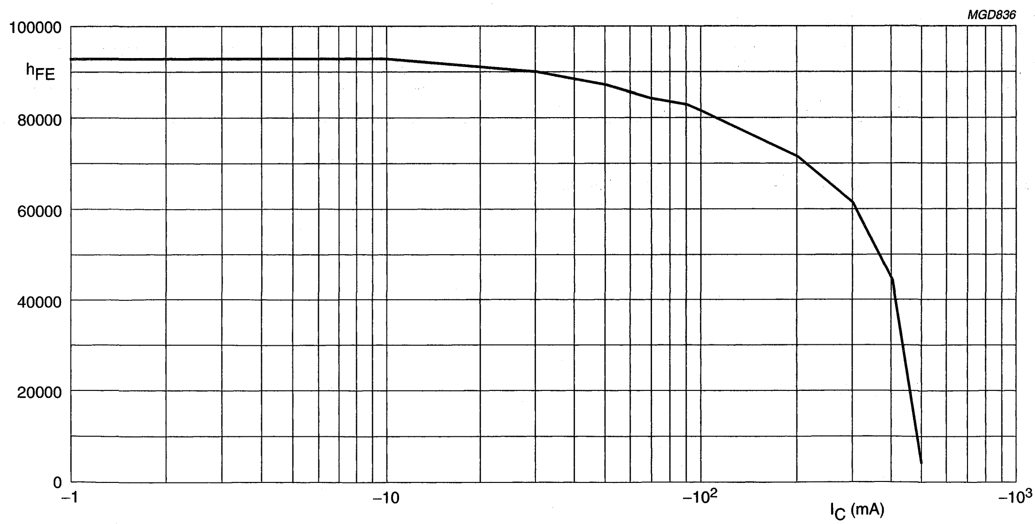
Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −30 V	–	−100	nA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −10 V;	–	−100	nA
h_{FE}	DC current gain	I_C = −10 mA; V_{CE} = −5 V; see Fig.2			
	PMBTA63		5000	–	
	PMBTA64		10000	–	
h_{FE}	DC current gain	I_C = −100 mA; V_{CE} = −5 V; see Fig.2			
	PMBTA63		10000	–	
	PMBTA64		20000	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = −100 mA; I_B = −0.1 mA	–	−1.5	V
V_{BEon}	base-emitter on-state voltage	I_C = −100 mA; V_{CE} = −5 V	–	−1.4	V
f_T	transition frequency	I_C = −10 mA; V_{CE} = −50 V; f = 100 MHz	125	–	MHz



V_{CE} = −2 V.

Fig.2 DC gain current; typical values.

PNP high-voltage transistors PMBTA92; PMBTA93

FEATURES

- Low current (max. 100 mA)
- High voltage (max. 300 V).

APPLICATIONS

- Telephony
- Professional communication equipment.

DESCRIPTION

PNP high-voltage transistor in a SOT23 plastic package. NPN complements: PMBTA42 and PMBTA43.

MARKING

TYPE NUMBER	MARKING CODE
PMBTA92	p2D
PMBTA93	p2E

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

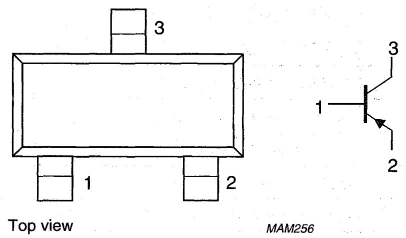


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PMBTA92		–	–300	V
	PMBTA93		–	–200	V
V_{CEO}	collector-emitter voltage	open base			
	PMBTA92		–	–300	V
	PMBTA93		–	–200	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	250	mW
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -10$ V	40	–	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -20$ V; f = 100 MHz	50	–	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			
	PMBTA92		–	–300	V
	PMBTA93		–	–200	V
V_{CEO}	collector-emitter voltage	open base			
	PMBTA92		–	–300	V
	PMBTA93		–	–200	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

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

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current PMBTA92	$I_E = 0$; $V_{CB} = -200$ V	–	−250	nA
I_{CBO}	collector cut-off current PMBTA93	$I_E = 0$; $V_{CB} = -160$ V	–	−250	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -3$ V	–	−100	nA
h_{FE}	DC current gain	$V_{CE} = -10$ V; note 1 $I_C = -1$ mA; $I_C = -10$ mA $I_C = -30$ mA	 25 40 25	 – – –	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -20$ mA; $I_B = -2$ mA	–	−500	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -20$ mA; $I_B = -2$ mA	–	−900	mV
C_c	collector capacitance PMBTA92 PMBTA93	$I_E = i_e = 0$; $V_{CB} = -20$ V; f = 1 MHz	 – –	 6 8	 pF pF

Note

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

NPN switching transistor | PMSS3904

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- General purpose switching and amplification
- Telephony and professional communication equipment.

DESCRIPTION

NPN transistor in a SOT323 plastic package.
PNP complement: PMSS3906.

MARKING CODE

TYPE NUMBER	MARKING CODE
PMSS3904	t04

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

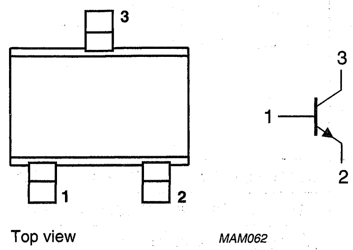


Fig.1 Simplified outline (SOT323) and symbol.

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_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
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	$I_C = 0$; $V_{EB} = 5$ V	–	50	nA
h_{FE}	DC current gain	$V_{CE} = 1$ V; see Fig.2			
		$I_C = 0.1$ mA	40	–	
		$I_C = 1$ mA	70	–	
		$I_C = 10$ mA	100	300	
		$I_C = 50$ mA; note 1	60	–	
		$I_C = 100$ mA; note 1	30	–	
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	–	300	mV
V_{BEsat}	base-emitter 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	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	4	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	12	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 20$ V; f = 100 MHz	180	–	MHz
F	noise figure	$I_C = 100$ μA; $V_{CE} = 5$ V; $R_S = 1$ kΩ f = 10 Hz to 15.7 KHz	–	5	dB
Switching times (between 10% and 90% levels) see Fig.3					
t_{on}	turn-on time	$I_{Con} = 10$ mA; $I_{Bon} = 1$ mA; $I_{Boff} = -1$ mA; $V_{CC} = 3$ V; $V_{BB} = -1.9$ V	–	110	ns
t_d	delay time		–	50	ns
t_r	rise time		–	60	ns
t_{off}	turn-off time		–	1200	ns
t_s	storage time		–	1000	ns
t_f	fall time		–	200	ns

Note

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

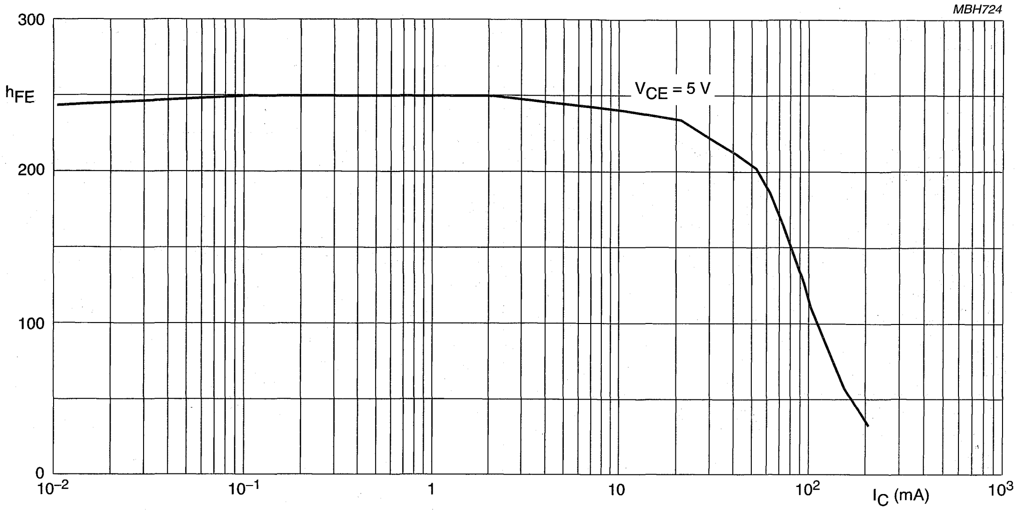
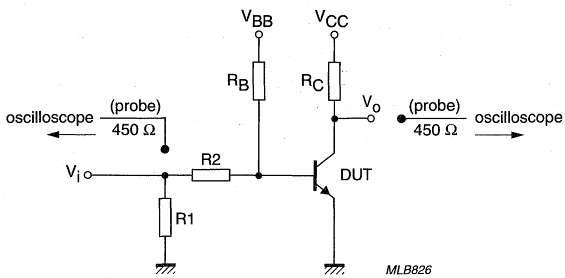


Fig.2 DC gain current; typical values.



V_i = 5 V; T = 500 µs; t_p = 10 µs; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 2.5 kΩ; R_B = 3.9 kΩ; R_C = 270 Ω.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.3 Test circuit for switching times.

PNP switching transistor | PMSS3906

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- Switching in e.g. telephony and professional communication equipment.

DESCRIPTION

PNP switching transistor in an SC-70; SOT323 plastic package. NPN complement: PMSS3904.

MARKING

TYPE NUMBER	MARKING CODE
PMSS3906	t06

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

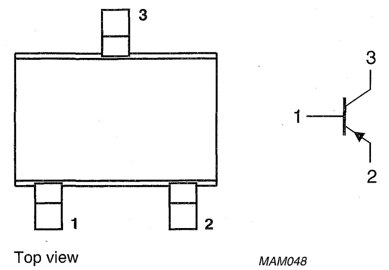


Fig.1 Simplified outline (SC-70; SOT323) and symbol.

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	–	–40	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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
t_{off}	turn-off time	$I_{Con} = -10$ mA; $I_{Bon} = -1$ mA; $I_{Boff} = 1$ mA	–	700	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	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

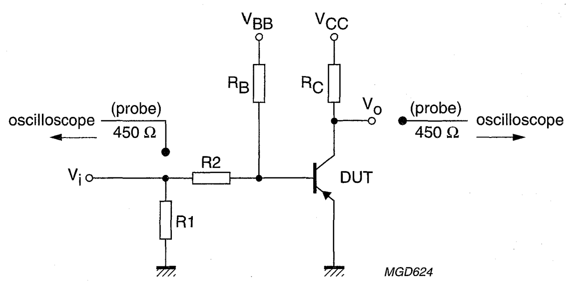
$T_{amb} = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
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	$I_C = 0$; $V_{EB} = -5$ V	–	–50	nA
h_{FE}	DC current gain	$V_{CE} = -1$ V			
		$I_C = -0.1$ mA	60	–	
		$I_C = -1$ mA	80	–	
		$I_C = -10$ mA	100	300	
		$I_C = -50$ mA; note 1	60	–	
		$I_C = -100$ mA; note 1	30	–	
V_{CEsat}	collector-emitter 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}	base-emitter 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	$I_E = i_e = 0$; $V_{CB} = -5$ V; f = 1 MHz	–	4.5	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -0.5$ V; f = 1 MHz	–	14	pF

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
f_T	transition frequency	$I_E = -10$ mA; $V_{CB} = -20$ V; f = 100 MHz	150	–	MHz
F	noise figure	$I_C = -100$ µA; $V_{CE} = -5$ V; $R_S = 1$ kΩ; f = 10 Hz to 15.7 kHz	–	4	dB
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	$I_{Con} = -10$ mA; $I_{Bon} = -1$ mA; $I_{Boff} = 1$ mA	–	100	ns
t_d	delay time		–	50	ns
t_r	rise time		–	50	ns
t_{off}	turn-off time		–	700	ns
t_s	storage time		–	600	ns
t_f	fall time		–	100	ns

Note

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



$V_i = -5$ V; T = 500 µs; $t_p = 10$ µs; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 2.5 kΩ; $R_B = 3.9$ kΩ; $R_C = 270$ Ω.
$V_{BB} = 1.9$ V; $V_{CC} = 3$ V.
Oscilloscope input impedance $Z_i = 50$ Ω.

Fig.2 Test circuit for switching times.

NPN switching transistors PMST2222; PMST2222A

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- High-speed switching and linear amplification.

DESCRIPTION

NPN switching transistor in a SOT323 plastic package.
PNP complement: PMST2907A.

MARKING

TYPE NUMBER	MARKING CODE
PMST2222	t1B
PMST2222A	t1P

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

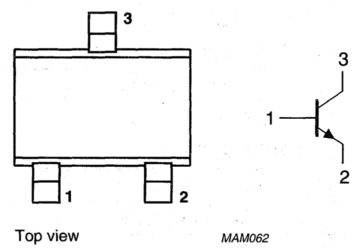


Fig.1 Simplified outline (SOT323) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PMST2222		–	60	V
	PMST2222A		–	75	V
V_{CEO}	collector-emitter voltage	open base			
	PMST2222		–	30	V
	PMST2222A		–	40	V
I_C	collector current (DC)		–	600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 10$ V	100	300	
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 20$ V; f = 100 MHz			
	PMST2222		250	–	MHz
	PMST2222A		300	–	MHz
t_{off}	turn-off time	$I_{Con} = 150$ mA; $I_{Bon} = 15$ mA; $I_{Boff} = -15$ mA	–	250	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			
	PMST2222		–	60	V
	PMST2222A		–	75	V
V_{CEO}	collector-emitter voltage	open base			
	PMST2222		–	30	V
	PMST2222A		–	40	V
V_{EBO}	emitter-base voltage	open collector			
	PMST2222		–	5	V
	PMST2222A		–	6	V
I_C	collector current (DC)		–	600	mA
I_{CM}	peak collector current		–	800	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

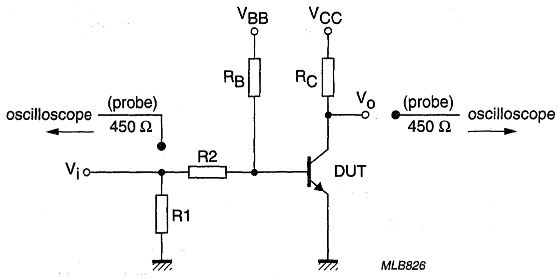
T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	PMST2222	$I_E = 0$; $V_{CB} = 50$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 50$ V; $T_j = 125$ °C	–	10	μA
I_{CBO}	collector cut-off current				
	PMST2222A	$I_E = 0$; $V_{CB} = 60$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 60$ V; $T_j = 125$ °C	–	10	μA
I_{EBO}	collector cut-off current	$I_C = 0$; $V_{EB} = 3$ V	–	10	nA
h_{FE}	DC current gain	$I_C = 0.1$ mA; $V_{CE} = 10$ V	35	–	
		$I_C = 1$ mA; $V_{CE} = 10$ V	50	–	
		$I_C = 10$ mA; $V_{CE} = 10$ V	75	–	
		$I_C = 10$ mA; $V_{CE} = 10$ V; $T_{amb} = -55$ °C	35	–	
		$I_C = 150$ mA; $V_{CE} = 1$ V; note 1	50	–	
		$I_C = 150$ mA; $V_{CE} = 10$ V; note 1	100	300	
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 10$ V; note 1			
	PMST2222		30	–	
	PMST2222A		40	–	
V_{CEsat}	collector-emitter saturation voltage				
	PMST2222	$I_C = 150$ mA; $I_B = 15$ mA; note 1	–	400	mV
		$I_C = 500$ mA; $I_B = 50$ mA; note 1	–	1.6	V
V_{CEsat}	collector-emitter saturation voltage				
	PMST2222A	$I_C = 150$ mA; $I_B = 15$ mA; note 1	–	300	mV
		$I_C = 500$ mA; $I_B = 50$ mA; note 1	–	1	V
V_{BEsat}	base-emitter saturation voltage				
	PMST2222	$I_C = 150$ mA; $I_B = 15$ mA; note 1	–	1.3	V
		$I_C = 500$ mA; $I_B = 50$ mA; note 1	–	2.6	V
V_{BEsat}	base-emitter saturation voltage				
	PMST2222A	$I_C = 150$ mA; $I_B = 15$ mA; note 1	0.6	1.2	V
		$I_C = 500$ mA; $I_B = 50$ mA; note 1	–	2	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	8	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz			
	PMST2222		–	30	pF
	PMST2222A		–	25	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 20$ V; f = 100 MHz			
	PMST2222		250	–	MHz
	PMST2222A		300	–	MHz
F	noise figure	$I_C = 200$ μA; $V_{CE} = 5$ V; $R_S = 2$ kΩ; f = 1 kHz; B = 200 Hz	–	4	dB

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	I_{Con} = 150 mA; I_{Bon} = 15 mA; I_{Boff} = −15 mA	–	35	ns
t_d	delay time		–	15	ns
t_r	rise time		–	20	ns
t_{off}	turn-off time		–	250	ns
t_s	storage time		–	200	ns
t_f	fall time		–	60	ns

Note

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



V_i = 9.5 V; T = 500 µs; t_p = 10 µs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; R_B = 325 Ω; R_C = 160 Ω.
V_{BB} = −3.5 V; V_{CC} = 29.5 V.
Oscilloscope input impedance Z_i = 50 Ω.

Fig.2 Test circuit for switching times.

NPN switching transistor | PMST2369

FEATURES

- Low current (max. 200 mA)
- Low voltage (max. 15 V).

APPLICATIONS

- High-speed switching applications, primarily in portable and consumer equipment.

DESCRIPTION

NPN switching transistor in a SOT323 plastic package.

MARKING

TYPE NUMBER	MARKING CODE
PMST2369	t1J

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

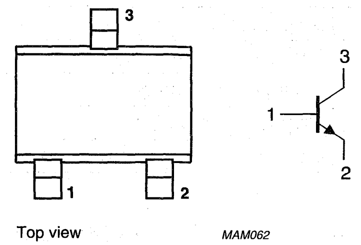


Fig.1 Simplified outline (SOT323) and symbol.

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
I_C	collector current (DC)		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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	–	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	500	–	MHz
t_{off}	turn-off time	$I_{Con} = 10$ mA; $I_{Bon} = 3$ mA; $I_{Boff} = -1.5$ mA	–	30	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_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	200	mA
I_{CM}	peak collector current	$t_p \leq 10\ \mu s$	–	300	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

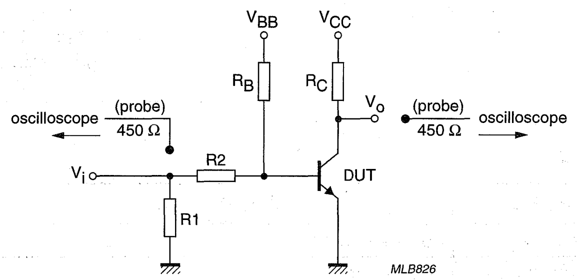
$T_{amb} = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	400	nA
		$I_E = 0$; $V_{CB} = 20$ V; $T_j = 125$ °C	–	30	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	100	nA
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 1$ V	40	120	
		$I_C = 10$ mA; $V_{CE} = 1$ V; $T_{amb} = -55$ °C	20	–	
		$I_C = 100$ mA; $V_{CE} = 2$ V; note 1	20	–	
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	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	4	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	500	–	MHz

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	I_{Con} = 10 mA; I_{Bon} = 3 mA; I_{Boff} = −1.5 mA	–	10	ns
t_d	delay time		–	4	ns
t_r	rise time		–	6	ns
t_{off}	turn-off time		–	30	ns
t_s	storage time		–	15	ns
t_f	fall time		–	15	ns

Note

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



V_i = 0.5 V to 4.2 V; T = 500 μs; t_p = 10 μs; $t_r = t_f \leq$ 1 ns.
R1 = 56 Ω; R2 = 1 kΩ; R_B = 1 kΩ; R_C = 270 Ω.
V_{BB} = 0.2 V; V_{CC} = 2.7 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.2 Test circuit for switching times.

PNP switching transistor PMST2907A

FEATURES

- Low current (max. 200 mA)
- Low voltage (max. 60 V).

APPLICATIONS

- Medium power switching
- General purpose amplification.

DESCRIPTION

PNP switching transistor in an SC-70; SOT323 plastic package. NPN complement: PMST2222A.

MARKING

TYPE NUMBER	MARKING CODE
PMST2907A	t2F

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

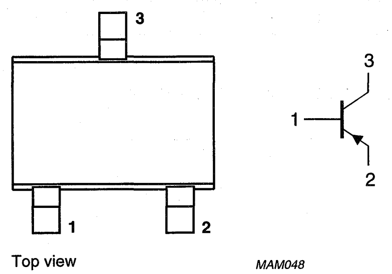


Fig.1 Simplified outline (SC-70; SOT323) and symbol.

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	–	–60	V
I_C	collector current (DC)		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = -500$ mA; $V_{CE} = -10$ V	50	–	
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -20$ V; f = 100 MHz	200	–	MHz
t_{off}	turn-off time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	300	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	–	–60	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–200	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

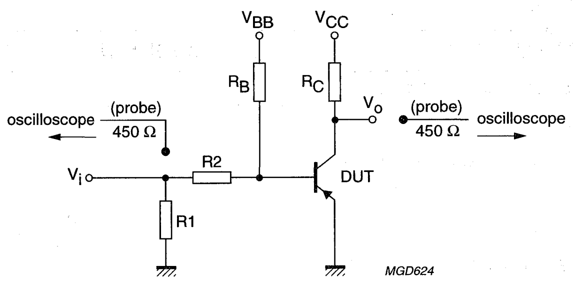
$T_{amb} = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–10	nA
		$I_E = 0$; $V_{CB} = -50$ V; $T_j = 150$ °C	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -3$ V	–	–50	nA
h_{FE}	DC current gain	$V_{CE} = -10$ V			
		$I_C = -0.1$ mA	75	–	
		$I_C = -1$ mA	100	–	
		$I_C = -10$ mA; note 1	100	–	
		$I_C = -150$ mA; note 1	100	300	
		$I_C = -500$ mA; note 1	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA; note 1	–	–400	mV
		$I_C = -500$ mA; $I_B = -50$ mA; note 1	–	–1.6	V
V_{BEsat}	base-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA; note 1	–	–1.3	V
		$I_C = -500$ mA; $I_B = -50$ mA; note 1	–	–2.6	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	8	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -2$ V; f = 1 MHz	–	30	pF

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -20$ V; f = 100 MHz; note 1	200	–	MHz
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	45	ns
t_d	delay time		–	15	ns
t_r	rise time		–	35	ns
t_{off}	turn-off time		–	300	ns
t_s	storage time		–	250	ns
t_f	fall time		–	50	ns

Note

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



$V_i = -9.5$ V; T = 500 µs; $t_p = 10$ µs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; $R_B = 325$ Ω; $R_C = 160$ Ω.
$V_{BB} = 3.5$ V; $V_{CC} = -29.5$ V.
Oscilloscope input impedance $Z_i = 50$ Ω.

Fig.2 Test circuit for switching times.

NPN switching transistor PMST3904

FEATURES

- Low current (max. 200 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- Telephony
- Professional communication equipment.

DESCRIPTION

NPN switching transistor in a SOT323 plastic package.
PNP complement: PMST3906.

MARKING

TYPE NUMBER	MARKING CODE
PMST3904	t1A

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

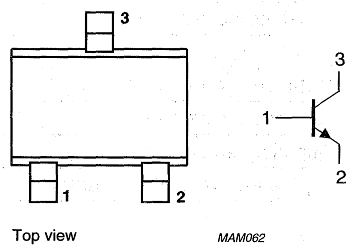


Fig.1 Simplified outline (SOT323) and symbol.

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	collector current (DC)		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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_{off}	turn-off time	$I_{Con} = 10$ mA; $I_{Bon} = 1$ mA; $I_{Boff} = -1$ mA	–	240	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	collector current (DC)		–	200	mA
I_{CM}	peak collector current		–	300	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

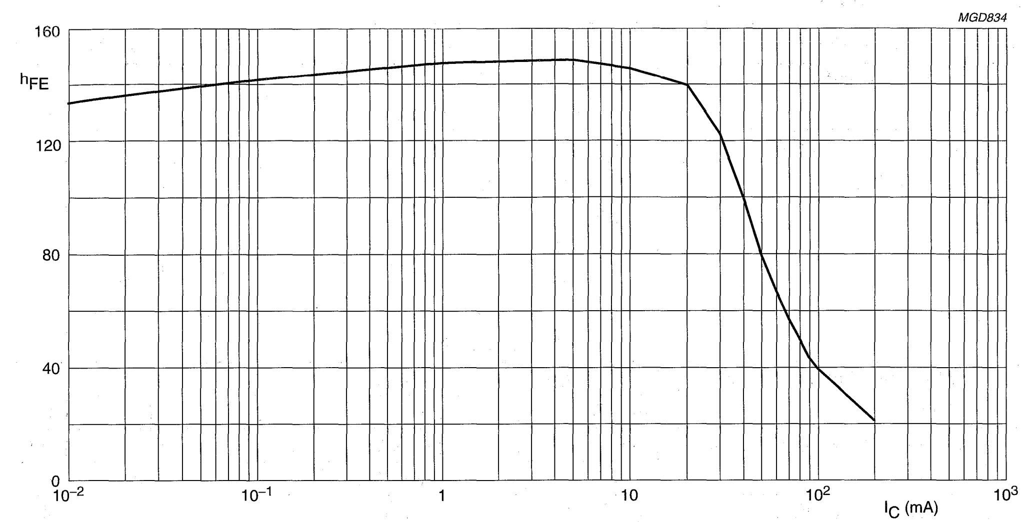
CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
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	$I_C = 0$; $V_{EB} = 6$ V	–	50	nA
h_{FE}	DC current gain	$V_{CE} = 1$ V; see Fig.2			
		$I_C = 0.1$ mA	60	–	
		$I_C = 1$ mA	80	–	
		$I_C = 10$ mA	100	300	
		$I_C = 50$ mA; note 1	60	–	
		$I_C = 100$ mA; note 1	30	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA; note 1	–	200	mV
		$I_C = 50$ mA; $I_B = 5$ mA; note 1	–	200	mV
V_{BEsat}	base-emitter 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	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	4	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 500$ mV; f = 1 MHz	–	8	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 20$ V; f = 100 MHz	300	–	MHz
F	noise figure	$I_C = 100$ μA; $V_{CE} = 5$ V; $R_S = 1$ kΩ f = 10 Hz to 15.7 kHz	–	5	dB
Switching times (between 10% and 90% levels); see Fig.3					
t_{on}	turn-on time	$I_{Con} = 10$ mA; $I_{Bon} = 1$ mA; $I_{Boff} = -1$ mA	–	65	ns
t_d	delay time		–	35	ns
t_r	rise time		–	35	ns
t_{off}	turn-off time		–	240	ns
t_s	storage time		–	200	ns
t_f	fall time		–	50	ns

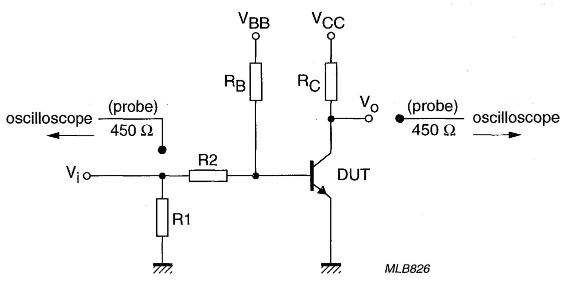
Note

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



V_{CE} = 1 V.

Fig.2 DC current gain; typical values.



V_i = 5 V; T = 500 µs; t_p = 10 µs; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 2.5 kΩ; R_B = 3.9 kΩ; R_C = 270 Ω.
V_{BB} = −1.9 V; V_{CC} = 3 V.
Oscilloscope input impedance Z_i = 50 Ω.

Fig.3 Test circuit for switching times.

PNP switching transistor PMST3906

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- Switching in telephony and professional communication equipment.

DESCRIPTION

PNP switching transistor in a SOT323 plastic package.
NPN complement: PMST3904.

MARKING

TYPE NUMBER	MARKING CODE
PMST3906	t2A

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

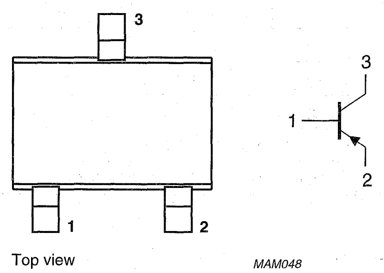


Fig.1 Simplified outline (SOT323) and symbol.

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	–	–40	V
I_C	collector current (DC)		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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_{off}	turn-off time	$I_{Con} = -10$ mA; $I_{Bon} = -1$ mA; $I_{Boff} = 1$ mA	–	300	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	–	–6	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

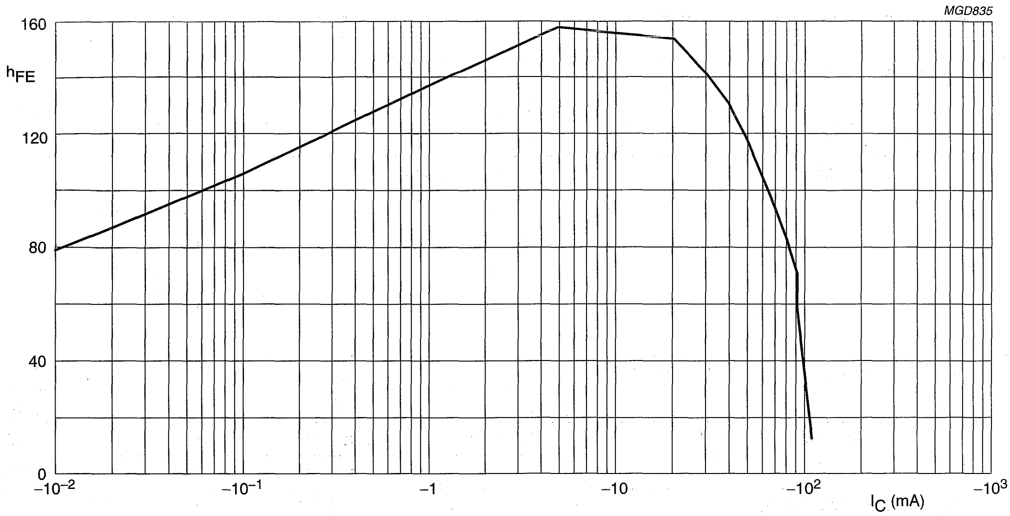
CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
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	$I_C = 0$; $V_{EB} = -6$ V	–	–50	nA
h_{FE}	DC current gain	$V_{CE} = -1$ V; see Fig.2			
		$I_C = -0.1$ mA	60	–	
		$I_C = -1$ mA	80	–	
		$I_C = -10$ mA	100	300	
		$I_C = -50$ mA; note 1	60	–	
		$I_C = -100$ mA; note 1	30	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -1$ mA; note 1	–	–200	mV
		$I_C = -50$ mA; $I_B = -5$ mA; note 1	–	–200	mV
V_{BEsat}	base-emitter 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	$I_E = i_e = 0$; $V_{CB} = -5$ V; f = 1 MHz	–	4.5	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -500$ mV; f = 1 MHz	–	10	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -20$ V; f = 100 MHz	250	–	MHz
F	noise figure	$I_C = -100$ μA; $V_{CE} = -5$ V; $R_S = 1$ kΩ; f = 10 Hz to 15.7 kHz	–	4	dB
Switching times (between 10% and 90% levels); see Fig.3					
t_{on}	turn-on time	$I_{Con} = -10$ mA; $I_{Bon} = -1$ mA; $I_{Boff} = 1$ mA	–	65	ns
t_d	delay time		–	35	ns
t_r	rise time		–	35	ns
t_{off}	turn-off time		–	300	ns
t_s	storage time		–	225	ns
t_f	fall time		–	75	ns

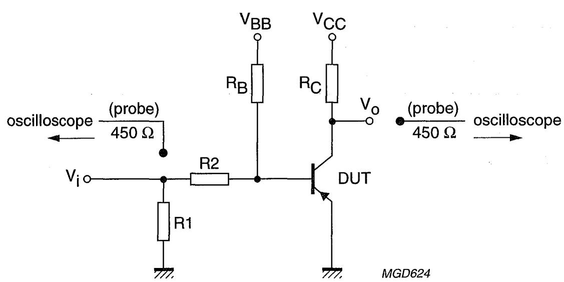
Note

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



$V_{CE} = -1$ V

Fig.2 DC current gain; typical values.



$V_i = -5$ V; T = 500 µs; $t_p = 10$ µs; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 2.5 kΩ; $R_B = 3.9$ kΩ; $R_C = 270$ Ω.
$V_{BB} = 1.9$ V; $V_{CC} = -3$ V.
Oscilloscope input impedance $Z_i = 50$ Ω.

Fig.3 Test circuit for switching times.

NPN switching transistor PMST4401

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- General purpose switching and linear amplification, especially in portable equipment.

DESCRIPTION

NPN switching transistor in a SOT323 plastic package.
PNP complement: PMST4403.

MARKING

TYPE NUMBER	MARKING CODE
PMST4401	t2X

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

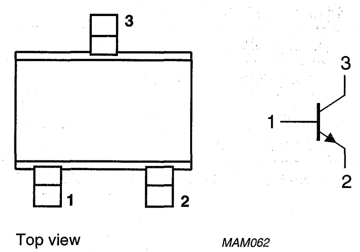


Fig.1 Simplified outline (SOT323) and symbol.

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	collector current (DC)		–	600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 1$ V	100	300	
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 10$ V; f = 100 MHz	250	–	MHz
t_{off}	turn-off time	$I_{Con} = 150$ mA; $I_{Bon} = 15$ mA; $I_{Boff} = -15$ mA	–	285	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	collector current (DC)		–	600	mA
I_{CM}	peak collector current		–	600	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 60$ V	–	50	nA
		$I_E = 0$; $V_{CB} = 60$ V; $T_j = 150$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 6$ V	–	50	nA
h_{FE}	DC current gain	$V_{CE} = 1$ V; see Fig.2			
		$I_C = 0.1$ mA	20	–	
		$I_C = 1$ mA	40	–	
		$I_C = 10$ mA	80	–	
		$I_C = 150$ mA; note 1	100	300	
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 2$ V; note 1	40	–	
V_{CEsat}	collector-emitter 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}	base-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA; note 1	–	950	mV
		$I_C = 500$ mA; $I_B = 50$ mA; note 1	–	1.2	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	8	pF
C_e	emitter capacitance	$I_E = i_e = 0$; $V_{EB} = 500$ mV; f = 1 MHz	–	30	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 10$ V; f = 100 MHz	250	–	MHz
Switching times (between 10% and 90% levels); see Fig.3					
t_{on}	turn-on time	$I_{Con} = 150$ mA; $I_{Bon} = 15$ mA; $I_{Boff} = -15$ mA	–	35	ns
t_d	delay time		–	15	ns
t_r	rise time		–	20	ns
t_{off}	turn-off time		–	250	ns
t_s	storage time		–	200	ns
t_f	fall time		–	60	ns

Note

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

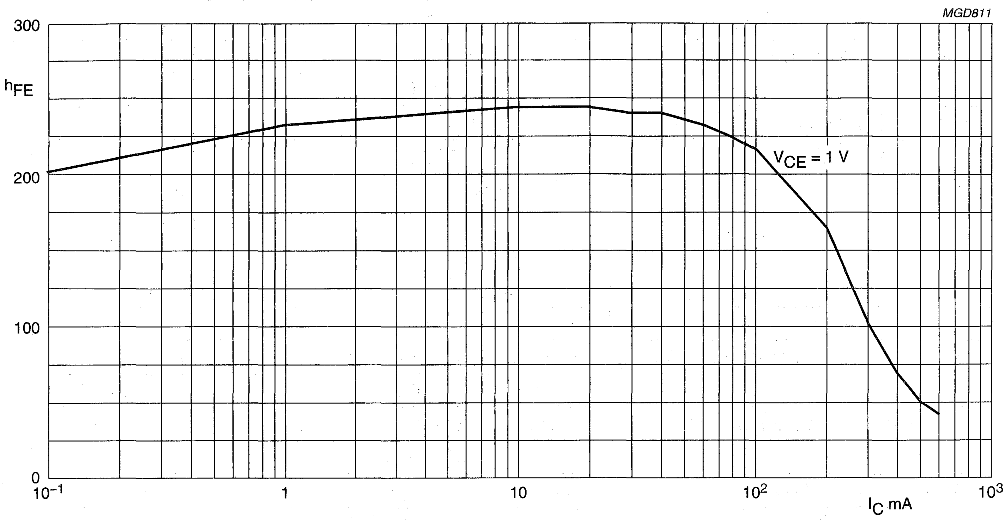
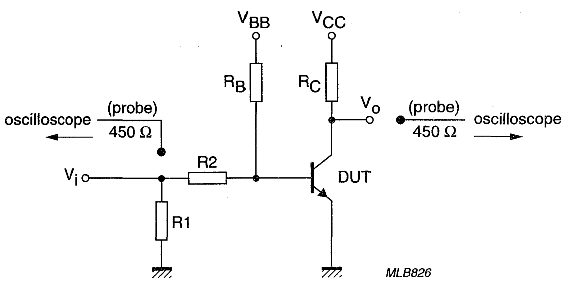


Fig.2 DC current gain; typical values.



V_i = 9.5 V; T = 500 μs; t_p = 10 μs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; R_B = 325 Ω; R_C = 160 Ω.
V_{BB} = −3.5 V; V_{CC} = 29.5 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.3 Test circuit for switching times.

PNP switching transistor | PMST4403

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- Switching and linear amplification.

DESCRIPTION

PNP switching transistor in a SOT323 plastic package.
NPN complement: PMST4401.

MARKING

TYPE NUMBER	MARKING CODE
PMST4403	t2T

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

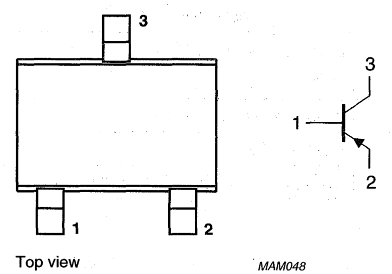


Fig.1 Simplified outline (SOT323) and symbol.

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	–	–40	V
I_C	collector current (DC)		–	–600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -2$ V	100	300	
f_T	transition frequency	$I_C = -20$ mA; $V_{CE} = -10$ V; f = 100 MHz	200	–	MHz
t_{off}	turn-off time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	350	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	collector current (DC)		–	–600	mA
I_{CM}	peak collector current		–	–800	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −40 V	−	−50	nA
		I_E = 0; V_{CB} = −40 V; T_j = 150 °C	−	−10	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −5 V	−	−50	nA
h_{FE}	DC current gain	V_{CE} = −1 V; see Fig.2	−	−	
		I_C = −0.1 mA	30	−	
		I_C = −1 mA	60	−	
		I_C = −10 mA	100	−	
h_{FE}	DC current gain	I_C = −150 mA; V_{CE} = −2 V; note 1	100	300	
		I_C = −500 mA; V_{CE} = −2 V; note 1	20	−	
V_{CEsat}	collector-emitter 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}	base-emitter 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	−	−1.3	V
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = −10 V; f = 1 MHz	−	8.5	pF
C_e	emitter capacitance	I_C = i_c = 0; V_{EB} = −500 mV; f = 1 MHz	−	35	pF
f_T	transition frequency	I_C = −20 mA; V_{CE} = −10 V; f = 100 MHz	200	−	MHz
Switching times (between 10% and 90% levels); see Fig.3					
t_{on}	turn-on time	I_{Con} = −150 mA; I_{Bon} = −15 mA; I_{Boff} = 15 mA	−	40	ns
t_d	delay time		−	15	ns
t_r	rise time		−	30	ns
t_{off}	turn-off time		−	350	ns
t_s	storage time		−	300	ns
t_f	fall time		−	50	ns

Note

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

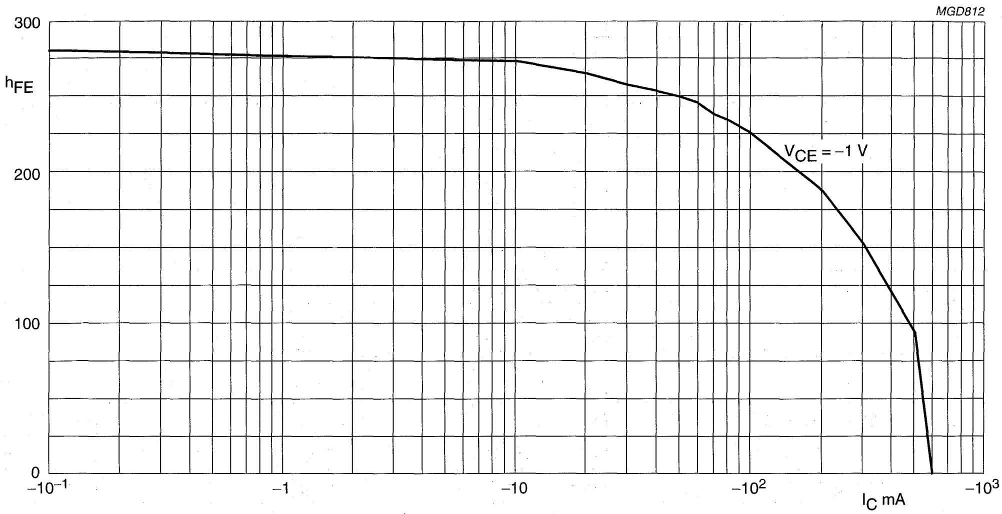
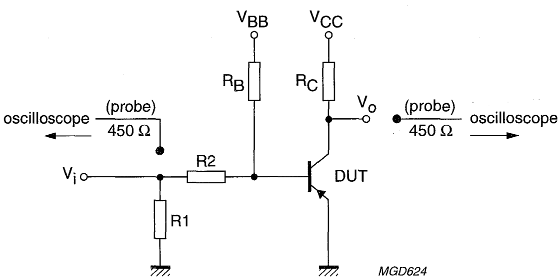


Fig.2 DC current gain; typical values.



$V_i = -9.5$ V; T = 500 µs; $t_p = 10$ µs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; $R_B = 325$ Ω; $R_C = 160$ Ω.
$V_{BB} = 3.5$ V; $V_{CC} = -29.5$ V.
Oscilloscope input impedance $Z_i = 50$ Ω.

Fig.3 Test circuit for switching times.

NPN general purpose transistors | PMST5088; PMST5089

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 30 V).

APPLICATIONS

- Low-noise input stages in audio equipment.

DESCRIPTION

NPN transistor in a SC-70; SOT323 plastic package.

MARKING

TYPE NUMBER	MARKING CODE
PMST5088	t1Q
PMST5089	t1R

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

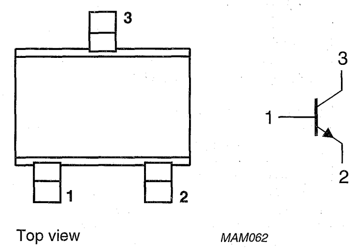


Fig.1 Simplified outline (SC-70; SOT323) and symbol.

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_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 5$ V			
	PMST5088		350	–	
	PMST5089		450	–	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	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			
	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	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	50	nA
		$I_E = 0$; $V_{CB} = 20$ V; $T_j = 150$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 3$ V	–	50	nA
		$I_C = 0$; $V_{EB} = 4.5$ V	–	100	nA
h_{FE}	DC current gain	$V_{CE} = 5$ V			
	PMST5088	$I_C = 0.1$ mA	300	900	
		$I_C = 1$ mA	350	–	
		$I_C = 10$ mA	300	–	
h_{FE}	DC current gain	$V_{CE} = 5$ V			
	PMST5089	$I_C = 0.1$ mA	400	1200	
		$I_C = 1$ mA	450	–	
		$I_C = 10$ mA	400	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	–	500	mV
V_{BE}	base-emitter voltage	$I_C = 10$ mA; $V_{CE} = 5$ V	–	800	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	4	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	12	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	100	–	MHz
F	noise figure	$I_C = 100$ μA; $V_{CE} = 5$ V; $R_S = 1$ kΩ f = 10 Hz to 15.7 kHz			
	PMST5088		–	3	dB
	PMST5089		–	2	dB

PNP high-voltage transistor — PMST5401

FEATURES

- Low current (max. 300 mA)
- High voltage (max. 150 V).

APPLICATIONS

- General purpose
- Telephony.

DESCRIPTION

PNP high-voltage transistor in a SOT323 plastic package.
NPN complements: PMST5550 and PMST5551.

MARKING

TYPE NUMBER	MARKING CODE
PMST5401	t2L

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

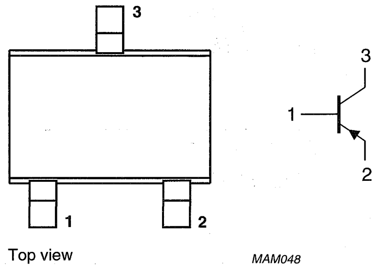


Fig.1 Simplified outline (SOT323) and symbol.

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_{CM}	peak collector current		–	–600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -5$ V	60	240	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 100 MHz	100	300	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	–	–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)		–	–300	mA
I_{CM}	peak collector current		–	–600	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

PNP high-voltage transistor PMST5401

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −120 V	–	−50	nA
		I_E = 0; V_{CB} = −120 V; T_j = 150 °C	–	−50	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −4 V	–	−50	nA
h_{FE}	DC current gain	V_{CE} = −5 V; see Fig.2			
		I_C = −1 mA	50	–	
		I_C = −10 mA	60	240	
		I_C = −50 mA; note 1	50	–	
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	V
		I_C = −50 mA; I_B = −5 mA	–	−1	V
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = −10 V; f = 1 MHz	–	6	pF
f_T	transition frequency	I_C = −10 mA; V_{CE} = −10 V; f = 100 MHz	100	300	MHz
F	noise figure	I_C = −200 μA; V_{CE} = −5 V; R_S = 2 kΩ f = 10 Hz to 15.7 kHz	–	8	dB

Note

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

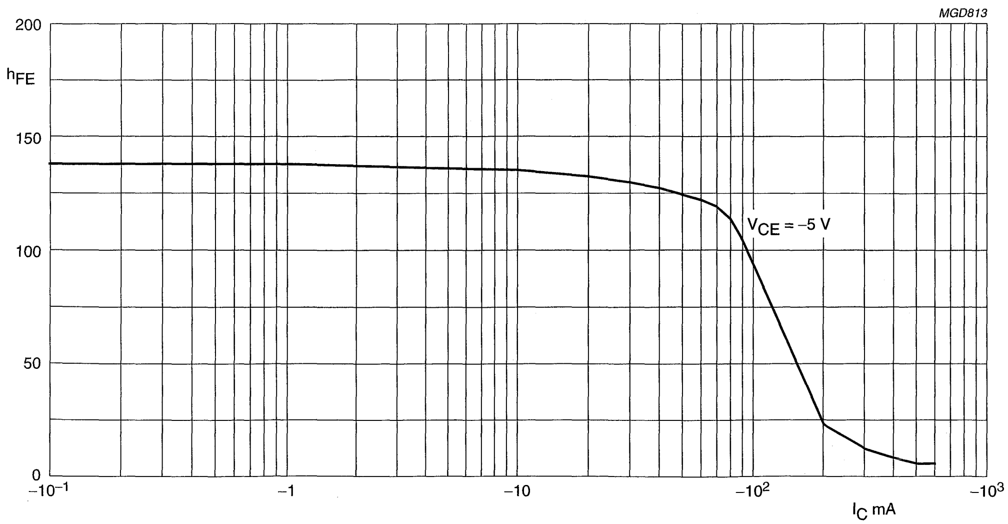


Fig.2 DC current gain; typical values.

NPN high-voltage transistors | PMST5550; PMST5551

FEATURES

- Low current (max. 300 mA)
- High voltage (max. 160 V).

APPLICATIONS

- Switching and amplification in high voltage applications such as telephony.

DESCRIPTION

NPN high-voltage transistor in a SOT323 plastic package.
PNP complement: PMST5401.

MARKING

TYPE NUMBER	MARKING CODE
PMST5550	t1F
PMST5551	tG3

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

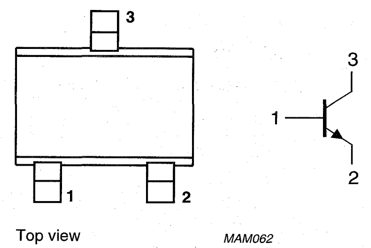


Fig.1 Simplified outline (SOT323) and symbol.

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_{CM}	peak collector current		–	600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V			
	PMST5550		60	250	
	PMST5551		80	250	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	6	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	100	300	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			
	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)		–	300	mA
I_{CM}	peak collector current		–	600	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	PMST5550	I_E = 0; V_{CB} = 100 V	–	100	nA
		I_E = 0; V_{CB} = 100 V; T_{amb} = 100 °C	–	100	μA
I_{CBO}	collector cut-off current				
	PMST5551	I_E = 0; V_{CB} = 120 V	–	50	nA
		I_E = 0; V_{CB} = 120 V; T_{amb} = 100 °C	–	50	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 4 V	–	50	nA
h_{FE}	DC current gain	V_{CE} = 5 V; see Fig.2			
	PMST5550	I_C = 1 mA	60	–	
		I_C = 10 mA	60	250	
		I_C = 50 mA; note 1	20	–	
h_{FE}	DC current gain	V_{CE} = 5 V; see Fig.2			
	PMST5551	I_C = 1 mA	80	–	
		I_C = 10 mA	80	250	
		I_C = 50 mA; note 1	30	–	
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	–	1	V
V_{BEsat}	base-emitter saturation voltage	I_C = 50 mA; I_B = 5 mA; note 1			
	PMST5550		–	1.2	V
	PMST5551		–	1	V
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
F	noise figure PMST5551	I_C = 200 μA; V_{CE} = 5 V; R_S = 2 kΩ; f = 10 Hz to 15.7 kHz	–	8	dB

Note

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

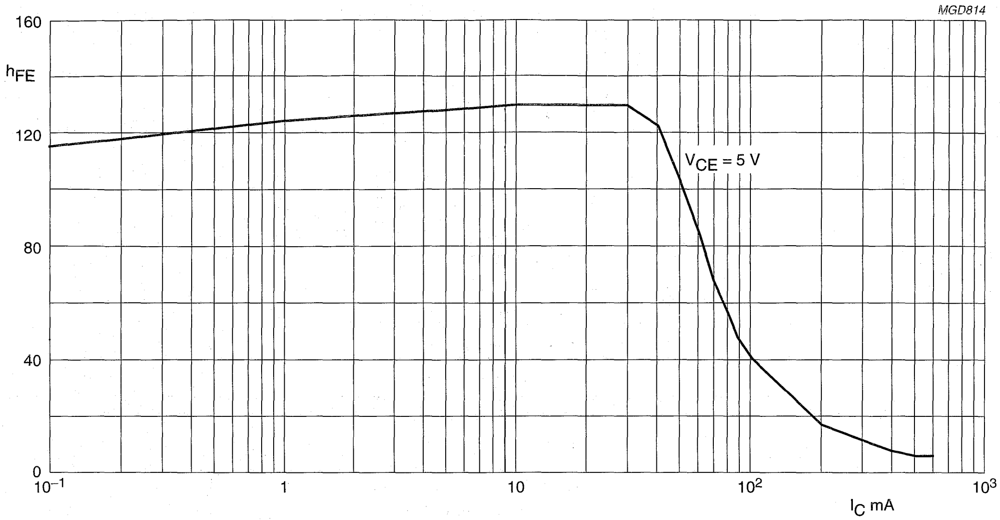


Fig.2 DC current gain; typical values.

NPN general purpose transistors | PMST6428; PMST6429

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 50 V).

APPLICATIONS

- General purpose switching and amplification in e.g. telephony and professional communication equipment.

DESCRIPTION

NPN transistor in an SC-70; SOT323 plastic package.

MARKING

TYPE NUMBER	MARKING CODE
PMST6428	t1K
PMST6429	t1L

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

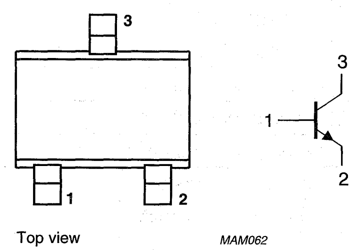


Fig.1 Simplified outline (SC-70; SOT323) and symbol.

QUICK REFERENCE

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_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain				
	PMST6428	$I_C = 0.1$ mA; $V_{CE} = 5$ V	250	650	
		$I_C = 1$ mA; $V_{CE} = 5$ V	250	–	
h_{FE}	DC current gain				
	PMST6429	$I_C = 0.1$ mA; $V_{CE} = 5$ V	500	1250	
		$I_C = 1$ mA; $V_{CE} = 5$ V	500	–	
f_T	transition frequency	$I_C = 1$ 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)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_{amb} \leq 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 30$ V; $T_j = 150$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	10	nA
h_{FE}	DC current gain	$V_{CE} = 5$ V			
	PMST6428	$I_C = 0.01$ mA	250	–	
		$I_C = 0.1$ mA	250	650	
		$I_C = 1$ mA	250	–	
		$I_C = 10$ mA	250	–	
h_{FE}	DC current gain	$V_{CE} = 5$ V			
	PMST6429	$I_C = 0.01$ mA	500	–	
		$I_C = 0.1$ mA	500	1250	
		$I_C = 1$ mA	500	–	
		$I_C = 10$ mA	500	–	
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
V_{BE}	base-emitter voltage	$I_C = 1$ mA; $V_{CE} = 5$ V	560	660	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	3	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	12	pF
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 5$ V; f = 100 MHz	100	700	MHz

Note

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

NPN general purpose transistors | PMSTA05; PMSTA06

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 80 V).

APPLICATIONS

- Primarily intended for telephony and professional communication equipment.

DESCRIPTION

NPN transistor in a SOT323 plastic package.
PNP complements: PMSTA55 and PMSTA56.

MARKING

TYPE NUMBER	MARKING CODE
PMSTA05	t1H
PMATA06	t1G

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

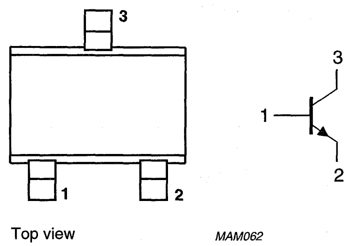


Fig.1 Simplified outline (SOT323) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PMSTA05		–	60	V
	PMSTA06		–	80	V
V_{CEO}	collector-emitter voltage	open base			
	PMSTA05		–	60	V
	PMSTA06		–	80	V
I_{CM}	peak collector current		–	500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
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

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			
	PMSTA05		–	60	V
	PMSTA06		–	80	V
V_{CEO}	collector-emitter voltage	open base			
	PMSTA05		–	60	V
	PMSTA06		–	80	V
V_{EBO}	emitter-base voltage	open collector	–	4	V
I_C	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	500	mA
I_{BM}	peak base current		–	500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	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	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	PMSTA05	$I_E = 0$; $V_{CB} = 60$ V	–	100	nA
	PMSTA06	$I_E = 0$; $V_{CB} = 80$ V	–	100	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 3$ V	–	500	nA
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 2$ V	50	–	
		$I_C = 100$ mA; $V_{CE} = 1$ V; note 1	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 100$ mA; $I_B = 10$ mA; note 1	–	250	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 100$ mA; $I_B = 10$ mA; note 1	–	900	mV
V_{BE}	base-emitter voltage	$I_C = 100$ mA; $V_{CE} = 1$ V	–	1.2	V
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 2$ V; f = 100 MHz	100	–	MHz

Note

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

NPN high-voltage transistors PMSTA42; PMSTA43

FEATURES

- High current (max. 500 mA)
- High voltage (max. 200 V).

APPLICATIONS

- High-voltage switching in telephony applications.

DESCRIPTION

NPN high-voltage transistor in a SOT323 plastic package.
PNP complements: PMSTA92 and PMSTA93.

MARKING

TYPE NUMBER	MARKING CODE
PMSTA42	t1D
PMSTA43	t1E

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

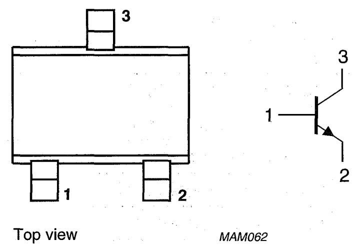


Fig.1 Simplified outline (SOT323) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PMSTA42		–	300	V
	PMSTA43		–	200	V
V_{CEO}	collector-emitter voltage	open base			
	PMSTA42		–	300	V
	PMSTA43		–	200	V
I_{CM}	peak collector current		–	500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 10$ V	40	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 20$ V; f = 1 MHz			
	PMSTA42		–	3	pF
	PMSTA43		–	4	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 20$ V; f = 100 MHz	50	–	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			
	PMSTA42		–	300	V
	PMSTA43		–	200	V
V_{CEO}	collector-emitter voltage	open base			
	PMSTA42		–	300	V
	PMSTA43		–	200	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	500	mA
I_{BM}	peak base current		–	500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	PMSTA42	$I_E = 0$; $V_{CB} = 200$ V	–	100	nA
	PMSTA43	$I_E = 0$; $V_{CB} = 160$ V	–	100	nA
I_{EBO}	emitter cut-off current				
	PMSTA42	$I_C = 0$; $V_{EB} = 6$ V	–	100	nA
	PMSTA43	$I_C = 0$; $V_{EB} = 4$ V	–	100	nA
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 10$ V	25	–	
		$I_C = 10$ mA; $V_{CE} = 10$ V	40	–	
		$I_C = 30$ mA; $V_{CE} = 10$ V; note 1	40	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 20$ mA; $I_B = 2$ mA	–	500	mV
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 20$ V; f = 1 MHz			
	PMSTA42		–	3	pF
	PMSTA43		–	4	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 20$ V; f = 100 MHz	50	–	MHz

Note

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

PNP general purpose transistors PMSTA55; PMSTA56

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 80 V).

APPLICATIONS

- Intended for telephony and professional communication equipment.

DESCRIPTION

PNP transistor in a SOT323 plastic package.
NPN complements: PMSTA05 and PMSTA06.

MARKING

TYPE NUMBER	MARKING CODE
PMSTA55	t2H
PMATA56	t2G

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

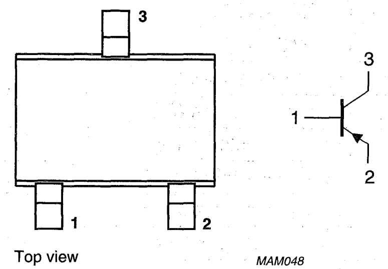


Fig.1 Simplified outline (SOT323) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PMSTA55		–	–60	V
	PMSTA56		–	–80	V
V_{CEO}	collector-emitter voltage	open base			
	PMSTA55		–	–60	V
	PMSTA56		–	–80	V
I_{CM}	peak collector current		–	–500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
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	50	–	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			
	PMSTA55		–	–60	V
	PMSTA56		–	–80	V
V_{CEO}	collector-emitter voltage	open base			
	PMSTA55		–	–60	V
	PMSTA56		–	–80	V
V_{EBO}	emitter-base voltage	open collector	–	–4	V
I_C	collector current (DC)		–	–500	mA
I_{CM}	peak collector current		–	–500	mA
I_{BM}	peak base current		–	–500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	PMSTA55	$I_E = 0$; $V_{CB} = -60$ V	–	–100	nA
	PMSTA56	$I_E = 0$; $V_{CB} = -80$ V	–	–100	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -4$ V	–	–500	nA
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -1$ V	50	–	
		$I_C = -100$ mA; $V_{CE} = -1$ V; note 1	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -100$ mA; $I_B = -10$ mA	–	–250	mV
V_{BE}	base-emitter voltage	$I_C = -100$ mA; $V_{CE} = -1$ V; note 1	–	–1.2	mV
f_T	transition frequency	$I_C = -100$ mA; $V_{CE} = -1$ V; f = 100 MHz	50	–	MHz

Note

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

PNP high-voltage transistors — PMSTA92; PMSTA93

FEATURES

- High voltage.

APPLICATIONS

- High voltage switching in telephony.

DESCRIPTION

PNP transistor in a SOT323 plastic package.
NPN complements: PMSTA42 and PMSTA43.

MARKING

TYPE NUMBER	MARKING CODE
PMSTA92	t2D
PMSTA93	t2E

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

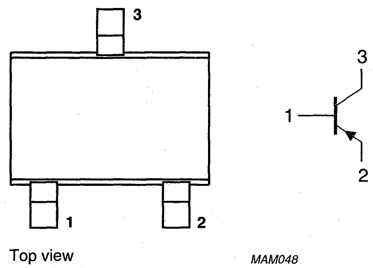


Fig.1 Simplified outline (SOT323) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PMSTA92		–	–300	V
	PMSTA93		–	–200	V
V_{CEO}	collector-emitter voltage	open base			
	PMSTA92		–	–300	V
	PMSTA93		–	–200	V
I_{CM}	peak collector current		–	–500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -10$ V	40	–	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -20$ V; f = 100 MHz	50	–	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			
	PMSTA92		–	–300	V
	PMSTA93		–	–200	V
V_{CEO}	collector-emitter voltage	open base			
	PMSTA92		–	–300	V
	PMSTA93		–	–200	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–500	mA
I_{CM}	peak collector current		–	–500	mA
I_{BM}	peak base current		–	–500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	625	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	PMSTA92	$I_E = 0$; $V_{CB} = -200$ V	–	–250	nA
	PMSTA93	$I_E = 0$; $V_{CB} = -160$ V	–	–250	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -3$ V	–	–100	nA
h_{FE}	DC current gain	$V_{CE} = -10$ V			
		$I_C = -1$ mA	25	–	
		$I_C = -10$ mA	40	–	
		$I_C = -30$ mA	25	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -20$ mA; $I_B = -2$ mA	–	–500	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -20$ mA; $I_B = -2$ mA	–	–900	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -20$ V; f = 1 MHz			
	PMSTA92		–	6	pF
	PMSTA93		–	8	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -20$ V; f = 100 MHz	50	–	MHz

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- General purpose switching and linear amplification.

DESCRIPTION

NPN switching transistor in a TO-92; SOT54 plastic package. PNP complement: PN2907A.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

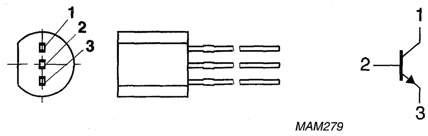


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PN2222		–	60	V
	PN2222A		–	75	V
V_{CEO}	collector-emitter voltage	open base			
	PN2222		–	30	V
	PN2222A		–	40	V
I_C	collector current (DC)		–	600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 10$ V	100	300	
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 20$ V; f = 100 MHz			
	PN2222		250	–	MHz
	PN2222A		300	–	MHz
t_{off}	turn-off time	$I_{Con} = 150$ mA; $I_{Bon} = 15$ mA; $I_{Boff} = -15$ mA			
	PN2222A		–	250	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			
	PN2222		–	60	V
	PN2222A		–	75	V
V_{CEO}	collector-emitter voltage	open base			
	PN2222		–	30	V
	PN2222A		–	40	V
V_{EBO}	emitter-base voltage	open collector			
	PN2222		–	5	V
	PN2222A		–	6	V
I_C	collector current (DC)		–	600	mA
I_{CM}	peak collector current		–	800	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	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	note 1	250	K/W

Note

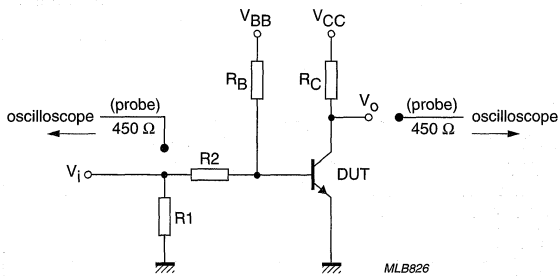
1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current				
	PN2222	$I_E = 0$; $V_{CB} = 50$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 50$ V; $T_{amb} = 125$ °C	–	10	μA
I_{CBO}	collector cut-off current				
	PN2222A	$I_E = 0$; $V_{CB} = 60$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 60$ V; $T_{amb} = 125$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 3$ V	–	10	nA
h_{FE}	DC current gain	$I_C = 0.1$ mA; $V_{CE} = 10$ V	35	–	
		$I_C = 1$ mA; $V_{CE} = 10$ V	50	–	
		$I_C = 10$ mA; $V_{CE} = 10$ V	75	–	
		$I_C = 150$ mA; $V_{CE} = 1$ V	50	–	
		$I_C = 150$ mA; $V_{CE} = 10$ V	100	300	
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 10$ V; $T_{amb} = -55$ °C			
	PN2222A		35	–	
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 10$ V			
	PN2222		30	–	
	PN2222A		40	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA			
	PN2222		–	400	mV
	PN2222A		–	300	mV
V_{CEsat}	collector-emitter saturation voltage	$I_C = 500$ mA; $I_B = 50$ mA			
	PN2222		1.6	–	V
	PN2222A		1	–	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA			
	PN2222		–	1.3	V
	PN2222A		0.6	1.2	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 500$ mA; $I_B = 50$ mA			
	PN2222		–	2.6	V
	PN2222A		–	2	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	8	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 500$ mV; f = 1 MHz			
	PN2222		–	30	pF
	PN2222A		–	25	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 20$ V; f = 100 MHz			
	PN2222		250	–	MHz
	PN2222A		300	–	MHz
F	noise figure	$I_C = 100$ μA; $V_{CE} = 5$ V; $R_S = 1$ kΩ; f = 1 kHz			
	PN2222A		–	4	dB

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Switching times (between 10% and 90% levels) for type PN2222A; see Fig.2					
t_{on}	turn-on time	I_{Con} = 150 mA; I_{Bon} = 15 mA; I_{Boff} = −15 mA; T_{amb} = 25 °C	–	35	ns
t_d	delay time		–	15	ns
t_r	rise time		–	20	ns
t_{off}	turn-off time		–	250	ns
t_s	storage time		–	200	ns
t_f	fall time		–	60	ns



V_i = 9.5 V; T = 500 μs; t_p = 10 μs; t_r = t_f ≤ 3 ns.
R1 = 68 Ω; R2 = 325 Ω; R_B = 325 Ω; R_C = 160 Ω.
V_{BB} = −3.5 V; V_{CC} = 29.5 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.2 Test circuit for switching times.

NPN switching transistors PN2369; PN2369A

FEATURES

- Low current (max. 200 mA)
- Low voltage (max. 15 V).

APPLICATIONS

- High-speed switching applications.

DESCRIPTION

NPN switching transistor in a TO-92; SOT54 plastic package.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

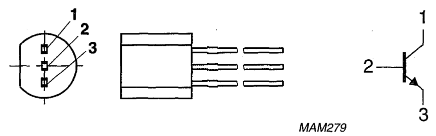


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	40	V
V_{CEO}	collector-emitter voltage	open base	–	–	15	V
I_C	collector current (DC)		–	–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	500	mW
h_{FE}	DC current gain					
	PN2369	$I_C = 10$ mA; $V_{CE} = 1$ V	40	–	120	
	PN2369A	$I_C = 10$ mA; $V_{CE} = 350$ mV	40	–	120	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	500	–	–	MHz
t_{off}	turn-off time	$I_{Con} = 10$ mA; $I_{Bon} = 3$ mA; $I_{Boff} = -1.5$ mA	–	–	30	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_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	200	mA
I_{CM}	peak collector current		–	300	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
T_{stg}	storage temperature		–55	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–55	+150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

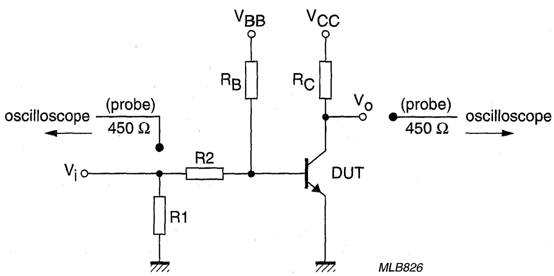
1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	–	400	nA
		$I_E = 0$; $V_{CB} = 20$ V; $T_{amb} = 125$ °C	–	–	30	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	–	100	nA
h_{FE}	DC current gain					
	PN2369	$I_C = 10$ mA; $V_{CE} = 1$ V	40	–	120	
		$I_C = 10$ mA; $V_{CE} = 1$ V; $T_{amb} = -55$ °C	20	–	–	
		$I_C = 100$ mA; $V_{CE} = 2$ V	20	–	–	
h_{FE}	DC current gain					
	PN2369A	$I_C = 10$ mA; $V_{CE} = 350$ mV	40	–	120	
		$I_C = 10$ mA; $V_{CE} = 350$ mV; $T_{amb} = -55$ °C	20	–	–	
		$I_C = 30$ mA; $V_{CE} = 400$ mV	30	–	–	
		$I_C = 100$ mA; $V_{CE} = 1$ V	20	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA				
	PN2369		–	–	250	mV

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CEsat}	collector-emitter saturation voltage					
	PN2369A	I_C = 10 mA; I_B = 1 mA	–	–	200	mV
		I_C = 10 mA; I_B = 10 mA	–	–	300	mV
		I_C = 30 mA; I_B = 3 mA	–	–	250	mV
		I_C = 100 mA; I_B = 10 mA	–	–	500	mV
V_{BEsat}	base-emitter saturation voltage	I_C = 10 mA; I_B = 1 mA	700	–	850	mV
C_c	collector capacitance	$I_E = i_e = 0$; V_{CB} = 5 V; f = 1 MHz	–	–	4	pF
f_T	transition frequency	I_C = 10 mA; V_{CE} = 10 V; f = 100 MHz	500	–	–	MHz
Switching times (between 10% and 90% levels); see Fig.2						
t_{on}	turn-on time	I_{Con} = 10 mA; I_{Bon} = 3 mA; I_{Boff} = −1.5 mA	–	8	10	ns
t_d	delay time		–	–	4	ns
t_r	rise time		–	–	6	ns
t_{off}	turn-off time		–	10	30	ns
t_s	storage time		–	–	15	ns
t_f	fall time		–	–	15	ns



V_i = 0.5 V to 4.2 V; T = 500 µs; t_p = 10 µs; $t_r = t_f \leq 1$ ns.
R1 = 56 Ω; R2 = 1 kΩ; R_B = 1 kΩ; R_C = 270 Ω.
V_{BB} = 0.2 V; V_{CC} = 2.7 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.2 Test circuit for switching times.

PNP switching transistor PN2907A

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 60 V).

APPLICATIONS

- Switching and linear amplification.

DESCRIPTION

PNP switching transistor in a TO-92; SOT54 plastic package. NPN complement: PN2222A.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

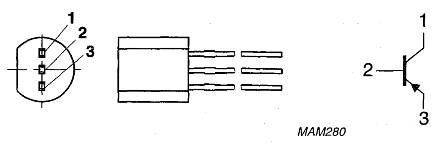


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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	–	–60	V
I_C	collector current (DC)		–	–600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -10$ V	100	300	
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -20$ V; f = 100 MHz	200	–	MHz
t_{off}	turn-off time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	365	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	–	–60	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–600	mA
I_{CM}	peak collector current		–	–800	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	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	note 1	250	K/W

Note

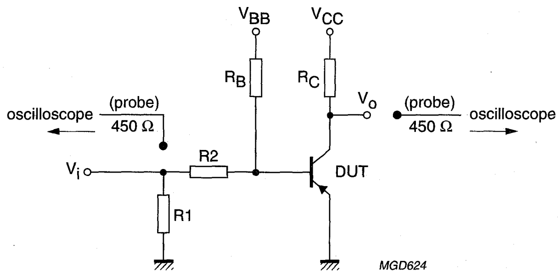
1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–10	nA
		$I_E = 0$; $V_{CB} = -50$ V; $T_{amb} = 125$ °C	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–50	nA
h_{FE}	DC current gain	$I_C = -0.1$ mA; $V_{CE} = -10$ V	75	–	
		$I_C = -1$ mA; $V_{CE} = -10$ V	100	–	
		$I_C = -10$ mA; $V_{CE} = -10$ V	100	–	
		$I_C = -150$ mA; $V_{CE} = -10$ V	100	300	
		$I_C = -500$ mA; $V_{CE} = -10$ V	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA	–	–400	mV
		$I_C = -500$ mA; $I_B = -50$ mA	–	–1.6	V
V_{BEsat}	base-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA	–	–1.3	V
		$I_C = -150$ mA; $I_B = -50$ mA	–	–2.6	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	8	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -2$ V; f = 1 MHz	–	30	pF
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -20$ V; f = 100 MHz	200	–	MHz

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	I_{Con} = −150 mA; I_{Bon} = −15 mA; I_{Boff} = 15 mA	−	40	ns
t_d	delay time		−	12	ns
t_r	rise time		−	30	ns
t_{off}	turn-off time		−	365	ns
t_s	storage time		−	300	ns
t_f	fall time		−	65	ns



V_i = −9.5 V; T = 500 µs; t_p = 10 µs; t_r = t_f ≤ 3 ns.
R1 = 68 Ω; R2 = 325 Ω; R_B = 325 Ω; R_C = 160 Ω.
V_{BB} = 3.5 V; V_{CC} = −29.5 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.2 Test circuit for switching times.

NPN high-voltage transistors | PN3439; PN3440

FEATURES

- Low current (max. 100 mA)
- High voltage (max. 350 V).

APPLICATIONS

- Telephony and professional communication equipment.

DESCRIPTION

NPN high-voltage transistor in a TO-92; SOT54 plastic package.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

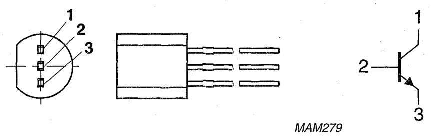


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PN3439		–	400	V
	PN3440		–	300	V
V_{CEO}	collector-emitter voltage	open base			
	PN3439		–	350	V
	PN3440		–	250	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 10$ V			
	PN3439		30	–	
h_{FE}	DC current gain	$I_C = 20$ mA; $V_{CE} = 10$ V			
	PN3440		40	–	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	70	–	MHz

NPN high-voltage transistors PN3439; PN3440

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			
	PN3439		–	400	V
	PN3440		–	300	V
V_{CEO}	collector-emitter voltage	open base			
	PN3439		–	350	V
	PN3440		–	250	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	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	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 360$ V			
	PN3439		–	100	nA
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 250$ V			
	PN3440		–	100	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	100	nA
h_{FE}	DC current gain	$I_C = 2$ mA; $V_{CE} = 10$ V			
	PN3439		30	–	
h_{FE}	DC current gain	$I_C = 20$ mA; $V_{CE} = 10$ V			
	PN3440		40	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 50$ mA; $I_B = 4$ mA	–	500	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 50$ mA; $I_B = 4$ mA	–	1.3	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	2	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 5$ V; f = 1 MHz	–	20	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	70	–	MHz

PNP resistor-equipped double transistor — PUMB4

FEATURES

- Transistors with built-in bias resistor R1 (typ. 10 kΩ)
- No mutual interference between the transistors
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

PNP resistor-equipped double transistor in an SC-88 plastic package.

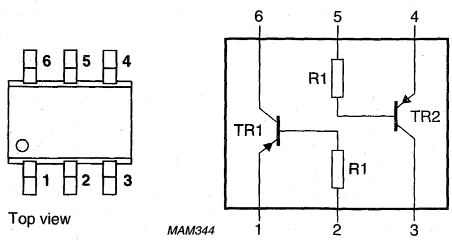


Fig.1 Simplified outline (SC-88) and symbol.

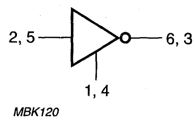


Fig.2 Equivalent inverter symbol.

PINNING

PIN	DESCRIPTION
1, 4	emitter TR1; TR2
2, 5	base TR1; TR2
6, 3	collector TR1; TR2

MARKING

TYPE NUMBER	MARKING CODE
PUMB4	Bt4

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Per transistor						
V_{CEO}	collector-emitter voltage	open base	–	–	–50	V
I_O	output current (DC)		–	–	–100	mA
I_{CM}	peak collector current		–	–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	200	mW
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -5$ V	100	–	600	
R1	input resistor		7	10	13	kΩ
Per device						
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	300	mW

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per transistor					
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	–	–5	V
I_O	output current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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
Per device					
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	300	mW

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	416	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Per transistor						
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–	–100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = -30$ V	–	–	–1	μA
		$I_B = 0$; $V_{CE} = -30$ V; $T_j = 150$ °C	–	–	–50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–100	nA
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -5$ V	100	–	600	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–	–300	mV
R1	input resistor		7	10	13	kΩ
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	–	5	pF

FEATURES

- Transistors with different polarity and built-in bias resistors R1 and R2 (typ. 22 kΩ each)
- No mutual interference between the transistors
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

NPN/PNP resistor-equipped transistors in an SC-88 plastic package.

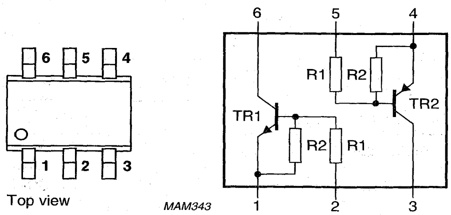


Fig.1 Simplified outline (SC-88) and symbol.

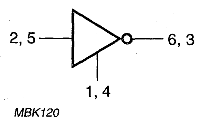


Fig.2 Equivalent inverter symbol.

PINNING

PIN	DESCRIPTION
1, 4	emitter TR1; TR2
2, 5	base TR1; TR2
6, 3	collector TR1; TR2

MARKING

TYPE NUMBER	MARKING CODE
PUMD2	Dt2

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Per transistor; for the PNP transistor with negative polarity						
V_{CEO}	collector-emitter voltage	open base	–	–	50	V
I_O	output current (DC)		–	–	100	mA
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	200	mW
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	56	–	–	
R1	input resistor		15.4	22	28.6	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
Per device						
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	300	mW

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per transistor; for the PNP transistor with negative polarity					
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)		–	100	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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
Per device					
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	300	mW

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	416	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Per transistor; for the PNP transistor with negative polarity						
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	500	μA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	56	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
$V_{i(off)}$	input-off voltage	$I_C = 100$ μA; $V_{CE} = 5$ V	–	–	500	mV
$V_{i(on)}$	input-on voltage	$I_C = 5$ mA; $V_{CE} = 300$ mV	3	–	–	V
R1	input resistor		15.4	22	28.6	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz				
	TR1		–	–	3.5	pF
	TR2		–	–	5	pF

NPN/PNP resistor-equipped transistors PUMD3

FEATURES

- Transistors with different polarity and built-in bias resistors R1 and R2 (typ. 10 kΩ each)
- No mutual interference between the transistors
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

NPN/PNP resistor-equipped transistors in an SC-88 plastic package.

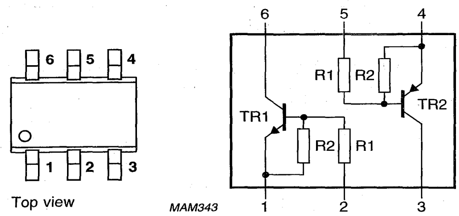


Fig.1 Simplified outline (SC-88) and symbol.

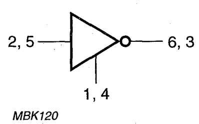


Fig.2 Equivalent inverter symbol.

PINNING

PIN	DESCRIPTION
1, 4	emitter TR1; TR2
2, 5	base TR1; TR2
6, 3	collector TR1; TR2

MARKING

TYPE NUMBER	MARKING CODE
PUMD3	Dt3

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Per transistor; for the PNP transistor with negative polarity						
V_{CEO}	collector-emitter voltage	open base	–	–	50	V
I_O	output current (DC)		–	–	100	mA
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	200	mW
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	30	–	–	
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
Per device						
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	300	mW

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per transistor; for the PNP transistor with negative polarity					
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)		–	100	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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
Per device					
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	300	mW

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	416	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Per transistor; for the PNP transistor with negative polarity						
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	500	μA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	30	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
$V_{i(off)}$	input-off voltage	$I_C = 100$ μA; $V_{CE} = 5$ V	–	–	500	mV
$V_{i(on)}$	input-on voltage	$I_C = 10$ mA; $V_{CE} = 300$ mV	3	–	–	V
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz				
	TR1		–	–	3.5	pF
	TR2		–	–	5	pF

NPN resistor-equipped double transistor PUMH11

FEATURES

- Transistors with built-in bias resistors R1 and R2 (typ. 10 kΩ each)
- No mutual interference between the transistors
- Simplification of circuit design
- Reduces number of components and board space.

APPLICATIONS

- Especially suitable for space reduction in interface and driver circuits
- Inverter circuit configurations without use of external resistors.

DESCRIPTION

NPN resistor-equipped double transistor in an SC-88 plastic package.

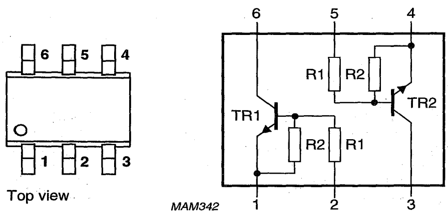


Fig.1 Simplified outline (SC-88) and symbol.

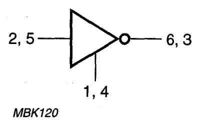


Fig.2 Equivalent inverter symbol.

PINNING

PIN	DESCRIPTION
1, 4	emitter TR1; TR2
2, 5	base TR1; TR2
6, 3	collector TR1; TR2

MARKING

TYPE NUMBER	MARKING CODE
PUMH11	Ht1

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Per transistor						
V_{CEO}	collector-emitter voltage	open base	–	–	50	V
I_O	output current (DC)		–	–	100	mA
I_{CM}	peak collector current		–	–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	200	mW
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	30	–	–	
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
Per device						
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	–	300	mW

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per transistor					
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)		–	100	mA
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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
Per device					
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	300	mW

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	416	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Per transistor						
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	–	100	nA
I_{CEO}	collector cut-off current	$I_B = 0$; $V_{CE} = 30$ V	–	–	1	μA
		$I_B = 0$; $V_{CE} = 30$ V; $T_j = 150$ °C	–	–	50	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	500	μA
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 5$ V	30	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	–	300	mV
$V_{i(off)}$	input-off voltage	$I_C = 100$ μA; $V_{CE} = 5$ V	–	–	500	mV
$V_{i(on)}$	input-on voltage	$I_C = 10$ mA; $V_{CE} = 300$ mV	3	–	–	V
R1	input resistor		7	10	13	kΩ
$\frac{R2}{R1}$	resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	–	3.5	pF

PNP general purpose double transistor PUMT1

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 40 V)
- Reduces number of components and boardspace.

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

Two independently operating PNP transistors in an SC-88; SOT363 plastic package. NPN complement: PUMX1.

MARKING

TYPE NUMBER	MARKING CODE
PUMT1	FtF

PINNING

PIN	DESCRIPTION
1, 4	emitter TR1; TR2
2, 5	base TR1; TR2
3, 6	collector TR2; TR1

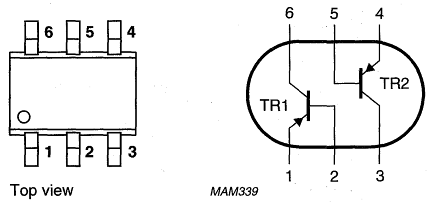


Fig.1 Simplified outline (SC-88; SOT363) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per transistor					
V_{CBO}	collector-base voltage	open emitter	–	–50	V
V_{CEO}	collector-emitter voltage	open base	–	–40	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -6$ V	120	–	
f_T	transition frequency	$I_C = -2$ mA; $V_{CE} = -12$ V; f = 100 MHz	100	–	MHz
Per device					
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	300	mW

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per transistor					
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
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C
Per device					
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	300	mW

Note

1. Device mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
Per device				
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	416	K/W

Note

1. Device mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per transistor					
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -30$ V	–	–100	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	–	–100	nA
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -6$ V	120	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -50$ mA; $I_B = -5$ mA; note 1	–	–200	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -12$ V; f = 1 MHz	–	2.2	pF
f_T	transition frequency	$I_C = -2$ mA; $V_{CE} = -12$ V; f = 100 MHz	100	–	MHz

Note

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

NPN general purpose double transistor PUMX1

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 40 V)
- Reduces number of components and boardspace.

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

Two independently operating NPN transistors in an SC-88 plastic package. PNP complement: PUMT1.

MARKING

TYPE NUMBER	MARKING CODE
PUMX1	ZtZ

PINNING

PIN	DESCRIPTION
1, 4	emitter TR1; TR2
2, 5	base TR1; TR2
3, 6	collector TR2; TR1

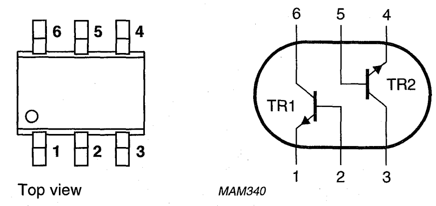


Fig.1 Simplified outline (SC-88) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per transistor					
V_{CBO}	collector-base voltage	open emitter	–	50	V
V_{CEO}	collector-emitter voltage	open base	–	40	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 6$ V	120	–	
f_T	transition frequency	$I_C = 2$ mA; $V_{CE} = 12$ V; f = 100 MHz	100	–	MHz
Per device					
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	300	mW

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per transistor					
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
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C
Per device					
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	300	mW

Note

1. Device mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
Per device				
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	416	K/W

Note

1. Device mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per transistor					
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30$ V	–	100	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	–	100	nA
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 6$ V	120	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 50$ mA; $I_B = 5$ mA; note 1	–	200	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 12$ V; f = 1 MHz	–	1.5	pF
f_T	transition frequency	$I_C = 2$ mA; $V_{CE} = 12$ V; f = 100 MHz	100	–	MHz

Note

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

NPN/PNP general purpose transistors PUMZ1

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 40 V)
- Reduces number of components and boardspace.

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

Two independently operating NPN/PNP transistors in an SC-88 plastic package.

MARKING

TYPE NUMBER	MARKING CODE
PUMZ1	FtZ

PINNING

PIN	DESCRIPTION
1, 4	emitter TR1; TR2
2, 5	base TR1; TR2
3, 6	collector TR2; TR1

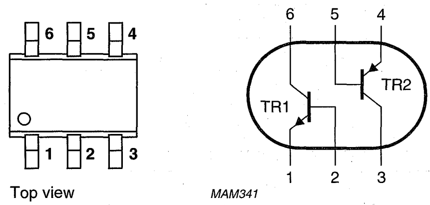


Fig.1 Simplified outline (SC-88) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per transistor; for the PNP transistor with negative polarity					
V_{CBO}	collector-base voltage	open emitter	–	50	V
V_{CEO}	collector-emitter voltage	open base	–	40	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 6$ V	120	–	
f_T	transition frequency	$I_C = 2$ mA; $V_{CE} = 12$ V; f = 100 MHz	100	–	MHz
Per device					
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	300	mW

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per transistor; for the PNP transistor with negative polarity					
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
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	200	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C
Per device					
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	300	mW

Note

1. Device mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
Per device				
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	416	K/W

Note

1. Device mounted on an FR4 printed-circuit board.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per transistor; for the PNP transistor with negative polarity					
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30$ V	–	100	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	–	100	nA
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 6$ V	120	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 50$ mA; $I_B = 5$ mA; note 1	–	200	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 12$ V; f = 1 MHz			
	TR1		–	1.5	pF
	TR2		–	2.2	pF
f_T	transition frequency	$I_C = 2$ mA; $V_{CE} = 12$ V; f = 100 MHz	100	–	MHz

Note

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

NPN switching transistor PXT2222A

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- General purpose switching and linear amplification.

DESCRIPTION

NPN switching transistor in a SOT89 plastic package.
PNP complement: PXT2907A.

MARKING

TYPE NUMBER	MARKING CODE
PXT2222A	p1P

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

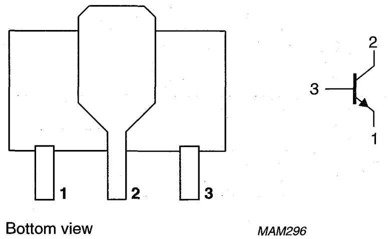


Fig.1 Simplified outline (SOT89) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	75	V
V_{CEO}	collector-emitter voltage	open base	–	40	V
I_C	collector current (DC)		–	600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.2	W
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 10$ V	100	300	
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 20$ V; f = 100 MHz	300	–	MHz
t_{off}	turn-off time	$I_{Con} = 150$ mA; $I_{Bon} = 15$ mA; $I_{Boff} = -15$ mA	–	250	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	–	75	V
V_{CEO}	collector-emitter voltage	open base	–	40	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	600	mA
I_{CM}	peak collector current		–	800	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.2	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, m
   a) ounting pad for collector 1 cm^2.
   For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	101	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		20	K/W

Note

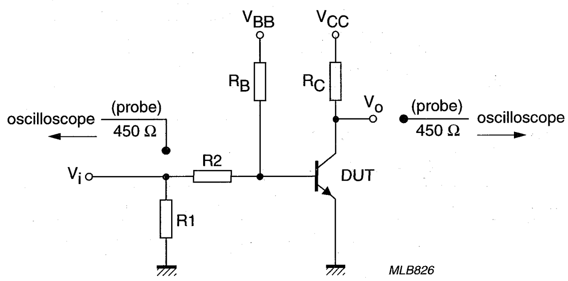
1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2.
   For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 60$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 60$ V; $T_{amb} = 125$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{BE} = 5$ V	–	10	nA
h_{FE}	DC current gain	$I_C = 0.1$ mA; $V_{CE} = 10$V	35	–	
		$I_C = 1$ mA; $V_{CE} = 10$ V	50	–	
		$I_C = 10$ mA; $V_{CE} = 10$ V	75	–	
		$I_C = 10$ mA; $V_C = 10$ V; $T_{amb} = -55$ °C	35	–	
		$I_C = 150$ mA; $V_{CE} = 1$ V	50	–	
		$I_C = 150$ mA; $V_{CE} = 10$ V	100	300	
		$I_C = 500$ mA; $V_{CE} = 10$ V	40	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA	–	300	mV
		$I_C = 500$ mA; $I_B = 50$ mA	–	1	V

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{BEsat}	base-emitter saturation voltage	I_C = 150 mA; I_B = 15 mA	0.6	1.2	V
		I_C = 500 mA; I_B = 50 mA	–	2	V
C_c	collector capacitance	$I_E = i_e = 0$; V_{CB} = 10 V; f = 1 MHz	–	8	pF
C_e	emitter capacitance	$I_C = i_c = 0$; V_{EB} = 500 mV; f = 1 MHz	–	25	pF
f_T	transition frequency	I_C = 20 mA; V_{CE} = 10 V; f = 100 MHz	300	–	MHz
F	noise figure	I_C = 200 μA; V_{CE} = 5 V; R_S = 2 kΩ; f = 1 kHz; B = 200 Hz	–	4	dB
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	I_{Con} = 150 mA; I_{Bon} = 15 mA; I_{Boff} = −15 mA	–	35	ns
t_d	delay time		–	15	ns
t_r	rise time		–	20	ns
t_{off}	turn-off time		–	250	ns
t_s	storage time		–	200	ns
t_f	fall time		–	60	ns



V_i = 9.5 V; T = 500 μs; t_p = 10 μs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; R_B = 325 Ω; R_C = 160 Ω.
V_{BB} = −3.5 V; V_{CC} = 29.5 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.2 Test circuit for switching times.

PNP switching transistor PXT2907A

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 60 V).

APPLICATIONS

- Switching and linear amplification.

DESCRIPTION

PNP switching transistor in a SOT89 plastic package.
NPN complement: PXT2222A.

MARKING

TYPE NUMBER	MARKING CODE
PXT2907A	p2F

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

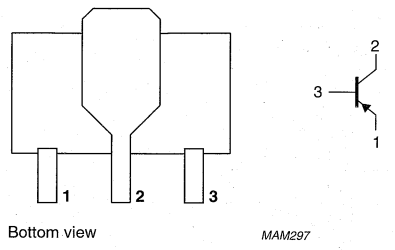


Fig.1 Simplified outline (SOT89) and symbol.

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	–	–60	V
I_C	collector current (DC)		–	–600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.25	W
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -10$ V	100	300	
f_T	transition frequency	$I_C = -20$ mA; $V_{CE} = -20$ V; f = 100 MHz	200	–	MHz
t_{off}	turn-off time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	365	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	–	–60	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–600	mA
I_{CM}	peak collector current		–	–800	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.25	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	98	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		17	K/W

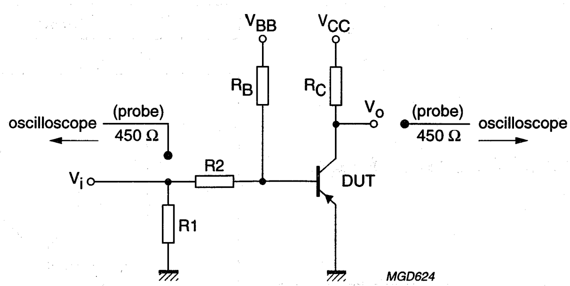
Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	−10	nA
		$I_E = 0$; $V_{CB} = -50$ V; $T_{amb} = 125$ °C	–	−10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	−50	nA
h_{FE}	DC current gain	$I_C = -0.1$ mA; $V_{CE} = -1$ V	75	–	
		$I_C = -1$ mA; $V_{CE} = -1$ V	100	–	
		$I_C = -10$ mA; $V_{CE} = -1$ V	100	–	
		$I_C = -150$ mA; $V_{CE} = -2$ V	100	300	
		$I_C = -500$ mA; $V_{CE} = -2$ V	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA	–	−400	mV
		$I_C = -500$ mA; $I_B = -50$ mA	–	−1.6	V
V_{BEsat}	base-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA	–	−1.3	V
		$I_C = -500$ mA; $I_B = -50$ mA	–	−2.6	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	8	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -500$ mV; f = 1 MHz	–	35	pF
f_T	transition frequency	$I_C = -20$ mA; $V_{CE} = -10$ V; f = 100 MHz	200	–	MHz
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	40	ns
t_d	delay time		–	12	ns
t_r	rise time		–	30	ns
t_{off}	turn-off time		–	365	ns
t_s	storage time		–	300	ns
t_f	fall time		–	65	ns



$V_i = -9.5$ V; T = 500 µs; $t_p = 10$ µs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; $R_B = 325$ Ω; $R_C = 160$ Ω.
$V_{BB} = 3.5$ V; $V_{CC} = -29.5$ V.
Oscilloscope input impedance $Z_i = 50$ Ω.

Fig.2 Test circuit for switching times.

NPN switching transistor PXT3904

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- High-speed switching.

DESCRIPTION

NPN switching transistor in a SOT89 plastic package.
PNP complement: PXT3906.

MARKING

TYPE NUMBER	MARKING CODE
PXT3904	p1A

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

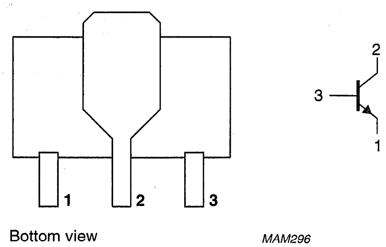


Fig.1 Simplified outline (SOT89) and symbol.

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	collector current (DC)		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.15	W
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_{off}	turn-off time	$I_{Con} = 10$ mA; $I_{Bon} = 1$ mA; $I_{Boff} = -1$ mA	–	240	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	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.15	W
T_{stg}	storage temperature		–55	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–55	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	106	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		25	K/W

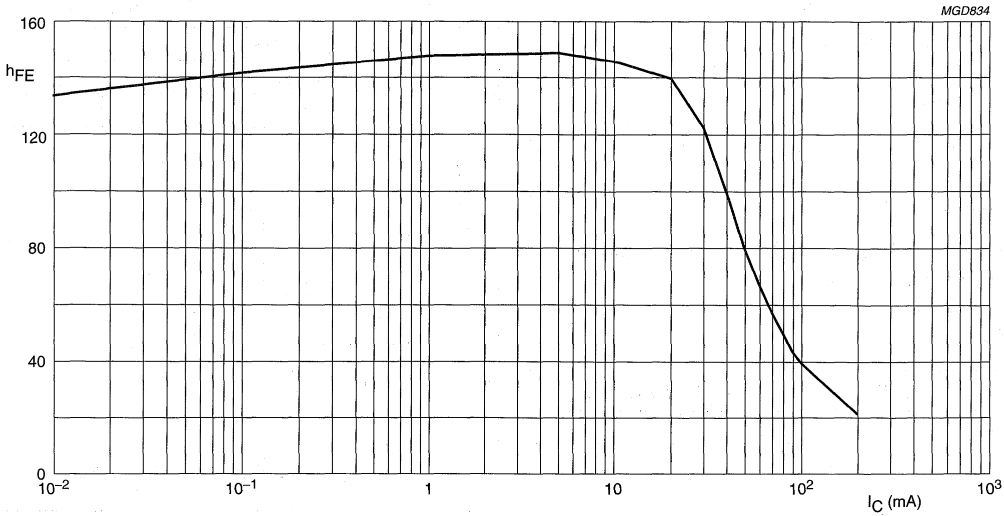
Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

CHARACTERISTICS

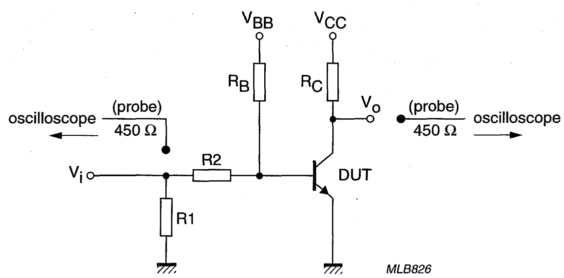
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30$ V	–	50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 6$ V	–	50	nA
h_{FE}	DC current gain	$V_{CE} = 1$ V; see Fig.2		–	
		$I_C = 0.1$ mA	60	–	
		$I_C = 1$ mA	80	–	
		$I_C = 10$ mA	100	300	
		$I_C = 50$ mA	60	–	
		$I_C = 100$ mA	30	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	–	200	mV
		$I_C = 50$ mA; $I_B = 5$ mA	–	200	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	650	850	mV
		$I_C = 50$ mA; $I_B = 5$ mA	–	950	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	4	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 500$ mV; f = 1 MHz	–	8	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 20$ V; f = 100 MHz	300	–	MHz
F	noise figure	$I_C = 100$ μA; $V_{CE} = 5$ V; $R_S = 1$ kΩ; f = 10 Hz to 15.7 kHz	–	5	dB
Switching times (between 10% and 90% levels); see Fig.3					
t_{on}	turn-on time	$I_{Con} = 10$ mA; $I_{Bon} = 1$ mA; $I_{Boff} = -1$ mA	–	65	ns
t_d	delay time		–	35	ns
t_r	rise time		–	35	ns
t_{off}	turn-off time		–	240	ns
t_s	storage time		–	200	ns
t_f	fall time		–	50	ns



V_{CE} = 1 V.

Fig.2 DC current gain; typical values.



V_i = 5 V; T = 500 μs; t_p = 10 μs; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 2.5 kΩ; R_B = 3.9 kΩ; R_C = 270 Ω.
V_{BB} = 1.9 V; V_{CC} = −3 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.3 Test circuit for switching times.

PNP switching transistor | PXT3906

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- High-speed saturated switching applications.

DESCRIPTION

PNP switching transistor in a SOT89 plastic package.
NPN complement: PXT3904.

MARKING

TYPE NUMBER	MARKING CODE
PXT3906	p2A

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

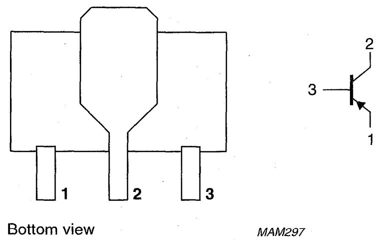


Fig.1 Simplified outline (SOT89) and symbol.

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	collector current (DC)		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.15	W
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_{off}	turn-off time	$I_{Con} = -10$ mA; $I_{Bon} = -1$ mA; $I_{Boff} = 1$ mA	–	300	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	–	–6	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.15	W
T_{stg}	storage temperature		–55	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–55	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	106	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		25	K/W

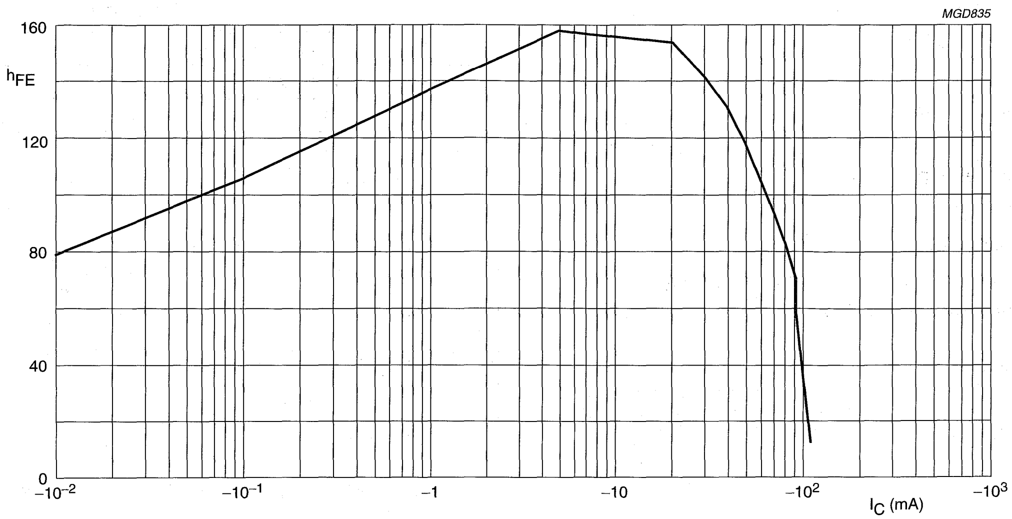
Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

CHARACTERISTICS

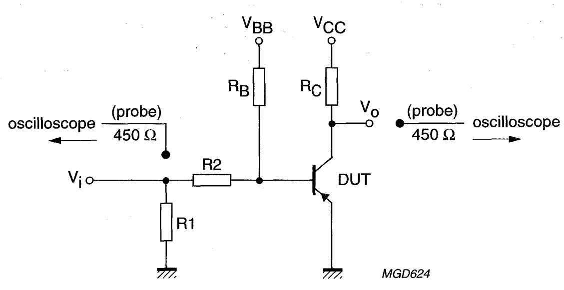
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -30$ V	–	–50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -6$ V	–	–50	nA
h_{FE}	DC current gain	$V_{CE} = -1$ V; see Fig.2			
		$I_C = -0.1$ mA	60	–	
		$I_C = -1$ mA	80	–	
		$I_C = -10$ mA	100	300	
		$I_C = -50$ mA	60	–	
		$I_C = -100$ mA	30	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -1$ mA	–	–250	mV
		$I_C = -50$ mA; $I_B = -5$ mA	–	–400	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -10$ mA; $I_B = -1$ mA	–650	–850	mV
		$I_C = -50$ mA; $I_B = -5$ mA	–	–950	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -5$ V; f = 1 MHz	–	4.5	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -500$ mV; f = 1 MHz	–	10	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -20$ V; f = 100 MHz	250	–	MHz
F	noise figure	$I_C = -100$ μA; $V_{CE} = -5$ V; $R_S = 1$ kΩ; f = 10 Hz to 15.7 kHz	–	4	dB
Switching times (between 10% and 90% levels); see Fig.3					
t_{on}	turn-on time	$I_{Con} = -10$ mA; $I_{Bon} = -1$ mA; $I_{Boff} = 1$ mA	–	65	ns
t_d	delay time		–	35	ns
t_r	rise time		–	35	ns
t_{off}	turn-off time		–	300	ns
t_s	storage time		–	225	ns
t_f	fall time		–	75	ns



$V_{CE} = -1$ V.

Fig.2 DC current gain; typical values.



$V_i = 5$ V; $T = 500$ µs; $t_p = 10$ µs; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 2.5 kΩ; $R_B = 3.9$ kΩ; $R_C = 270$ Ω.
$V_{BB} = 1.9$ V; $V_{CC} = -3$ V.
Oscilloscope: input impedance $Z_i = 50$ Ω.

Fig.3 Test circuit for switching times.

NPN switching transistor | PXT4401

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- Switching and linear amplification in industrial and consumer applications.

DESCRIPTION

NPN switching transistor in a SOT89 plastic package.
PNP complement: PXT4403.

MARKING

TYPE NUMBER	MARKING CODE
PXT4401	p2X

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

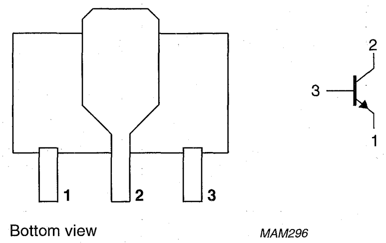


Fig.1 Simplified outline (SOT89) and symbol.

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	collector current (DC)		–	600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.2	W
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 1$ V	100	300	
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 10$ V; f = 100 MHz	250	–	MHz
t_{off}	turn-off time	$I_{Con} = 150$ mA; $I_{Bon} = 15$ mA; $I_{Boff} = -15$ mA	–	250	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	collector current (DC)		–	600	mA
I_{CM}	peak collector current		–	800	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.2	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	101	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		20	K/W

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 60 V	–	50	nA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 6 V	–	50	nA
h_{FE}	DC current gain	V_{CE} = 1 V; see Fig.2	20	–	
		I_C = 0.1 mA	20	–	
		I_C = 1 mA	40	–	
		I_C = 10 mA	80	–	
		I_C = 150 mA; note 1	100	300	
h_{FE}	DC current gain	I_C = 500 mA; V_{CE} = 2 V; note 1	40	–	
V_{CEsat}	collector-emitter 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}	base-emitter saturation voltage	I_C = 150 mA; I_B = 15 mA; note 1	–	950	mV
		I_C = 500 mA; I_B = 50 mA; note 1	–	1.2	V
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = 5 V; f = 1 MHz	–	8	pF
C_e	emitter capacitance	I_C = i_c = 0; V_{EB} = 500 mV; f = 1 MHz	–	30	pF
f_T	transition frequency	I_C = 20 mA; V_{CE} = 10 V; f =100 MHz	250	–	MHz
Switching times (between 10% and 90% levels); see Fig.3					
t_{on}	turn-on time	I_{Con} = 150 mA; I_{Bon} = 15 mA; I_{Boff} = −15 mA	–	35	ns
t_d	delay time		–	15	ns
t_r	rise time		–	20	ns
t_{off}	turn-off time		–	250	ns
t_s	storage time		–	200	ns
t_f	fall time		–	60	ns

Note

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

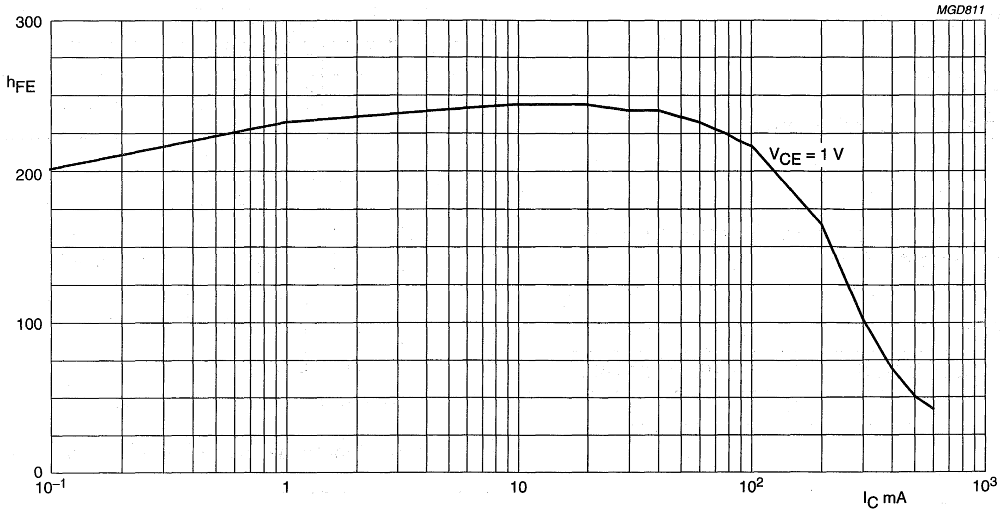
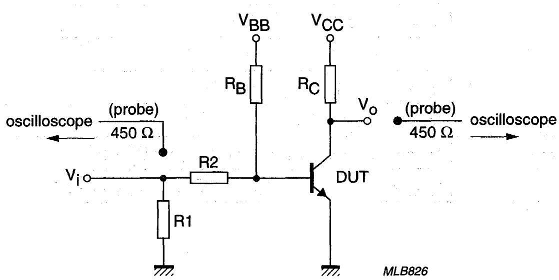


Fig.2 DC current gain; typical values.



V_i = 9.5 V; T = 500 μs; t_p = 10 μs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; R_B = 325 Ω; R_C = 160 Ω.
V_{BB} = −3.5 V; V_{CC} = 29.5 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.3 Test circuit for switching times.

PNP switching transistor | PXT4403

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- Switching and linear amplification.

DESCRIPTION

PNP switching transistor in a SOT89 plastic package.
NPN complement: PXT4401.

MARKING

TYPE NUMBER	MARKING CODE
PXT4403	p2T

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

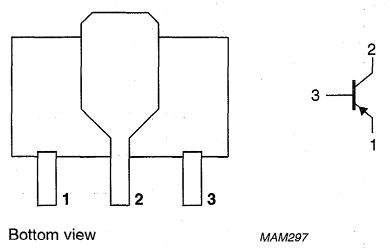


Fig.1 Simplified outline (SOT89) and symbol.

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	collector current (DC)		–	–600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.25	W
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	100	300	
		$I_C = -500$ mA; $V_{CE} = -2$ V	20	–	
f_T	transition frequency	$I_C = -20$ mA; $V_{CE} = -10$ V; f = 100 MHz	200	–	MHz
t_{off}	turn-off time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	350	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	collector current (DC)		–	–600	mA
I_{CM}	peak collector current		–	–800	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.25	W
T_{stg}	storage temperature		–55	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–55	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	98	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		17	K/W

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −40 V	−	−50	nA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −5 V	−	−50	nA
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	100	300	
		I_C = −500 mA; V_{CE} = −2 V	20	−	
V_{CEsat}	collector-emitter saturation voltage	I_C = −150 mA; I_B = −15 mA	−	−400	mV
		I_C = −500 mA; I_B = −50 mA	−	−750	mV
V_{BEsat}	base-emitter saturation voltage	I_C = −150 mA; I_B = −15 mA	−	−950	mV
		I_C = −500 mA; I_B = −50 mA	−	−1.3	V
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = −10 V; f = 1 MHz	−	8.5	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = −500 mV; f = 1 MHz	−	35	pF
f_T	transition frequency	I_C = −20 mA; V_{CE} = −10 V; f = 100 MHz	200	−	MHz
Switching times (between 10% and 90% levels); see Fig.3					
t_{on}	turn-on time	I_{Con} = −150 mA; I_{Bon} = −15 mA; I_{Boff} = 15 mA	−	40	ns
t_d	delay time		−	15	ns
t_r	rise time		−	30	ns
t_{off}	turn-off time		−	350	ns
t_s	storage time		−	300	ns
t_f	fall time		−	50	ns

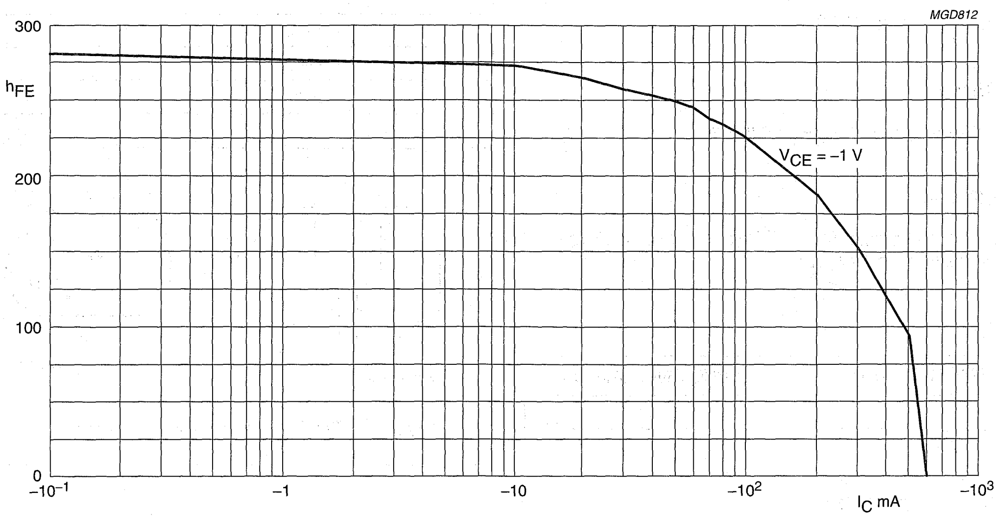
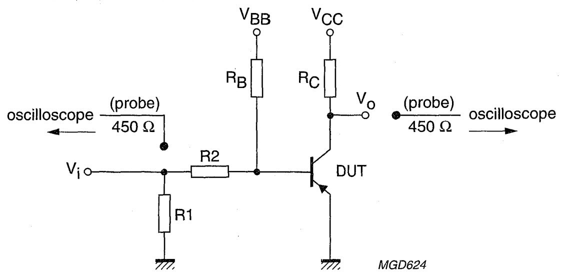


Fig.2 DC current gain; typical values.



$V_i = -9.5$ V; T = 500 μs; $t_p = 10$ μs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; $R_B = 325$ Ω; $R_C = 160$ Ω.
$V_{BB} = 3.5$ V; $V_{CC} = -29.5$ V.
Oscilloscope input impedance $Z_i = 50$ Ω.

Fig.3 Test circuit for switching times.

NPN Darlington transistor PXTA14

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 30 V).

APPLICATIONS

- High input impedance preamplifiers.

DESCRIPTION

NPN Darlington transistor in a SOT89 plastic package.
PNP complement: PXTA64.

MARKING

TYPE NUMBER	MARKING CODE
PXTA14	p1N

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

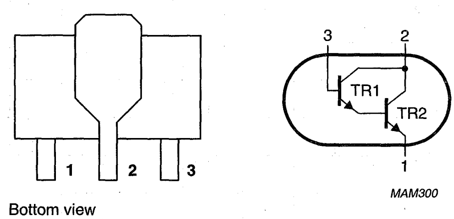


Fig.1 Simplified outline (SOT89) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	30	V
I_C	collector current (DC)		–	500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.3	W
h_{FE}	DC current gain	$I_C = 100$ mA; $V_{CE} = 5$ V	20000	–	
f_T	transition frequency	$I_C = 30$ mA; $V_{CE} = 5$ V; f = 100 MHz	125	–	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_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	30	V
V_{EBO}	emitter-base voltage	open collector	–	10	V
I_C	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	1	A
I_B	base current (DC)		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.3	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2.
   For other mounting conditions, see *"Thermal considerations for the SOT89 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	93	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to solder point		12	K/W

Note

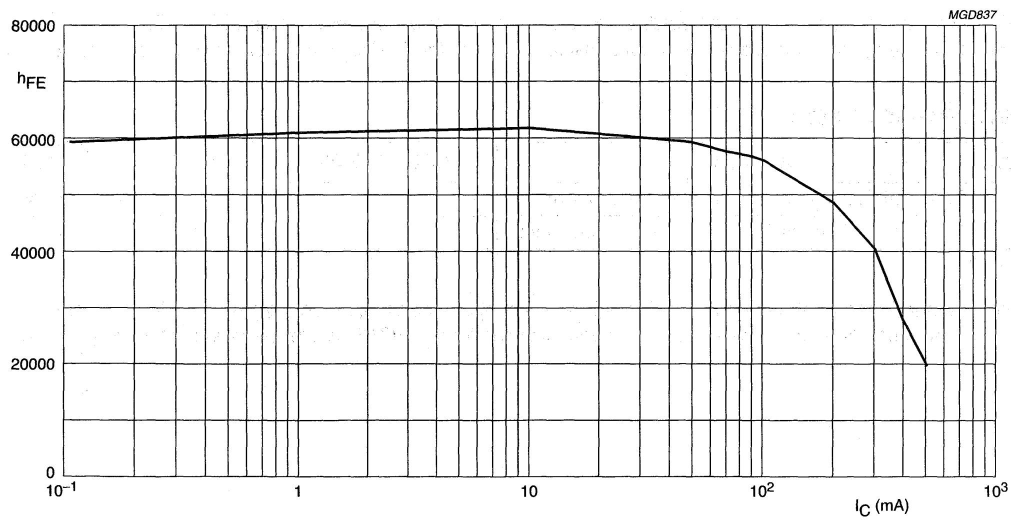
1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2.
   For other mounting conditions, see *"Thermal considerations for the SOT89 in the General part of handbook SC04"*.

NPN Darlington transistor PXTA14

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30$ V	–	100	nA
I_{CES}	collector cut-off current	$V_{BE} = 0$; $V_{CE} = 30$ V	–	100	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 10$ V	–	100	nA
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V; see Fig.2	10000	–	
		$I_C = 100$ mA; $V_{CE} = 5$ V; see Fig.2	20000	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 100$ mA; $I_B = 0.1$ mA	–	1.5	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 100$ mA; $I_B = 0.1$ mA	–	1.5	V
V_{BEon}	base-emitter on-state voltage	$I_C = 100$ mA; $V_{CE} = 5$ V	–	2	V
f_T	transition frequency	$I_C = 30$ mA; $V_{CE} = 5$ V; f = 100 MHz	125	–	MHz



$V_{CE} = 2$ V.

Fig.2 DC current gain; typical values.

NPN Darlington transistor PXTA27

FEATURES

- High current (max. 0.5 A)
- Low voltage (max. 60 V).

APPLICATIONS

- High input impedance preamplifiers.

DESCRIPTION

NPN Darlington transistor in a SOT89 plastic package.

MARKING

TYPE NUMBER	MARKING CODE
PXTA27	A27

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

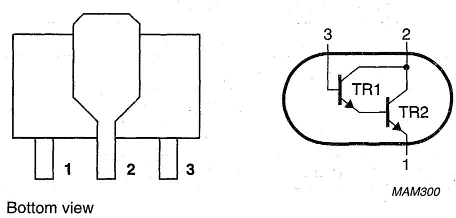


Fig.1 Simplified outline (SOT89) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	60	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	60	V
I_C	collector current (DC)		–	0.5	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.3	W
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V	10000	–	
		$I_C = 100$ mA; $V_{CE} = 5$ V	10000	–	
f_T	transition frequency	$I_C = 30$ mA; $V_{CE} = 5$ V; f = 100 MHz	125	–	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_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	60	V
V_{EBO}	emitter-base voltage	open collector	–	10	V
I_C	collector current (DC)		–	0.5	A
I_{CM}	peak collector current		–	1	A
I_B	base current (DC)		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.3	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for the SOT89 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	93	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		12	K/W

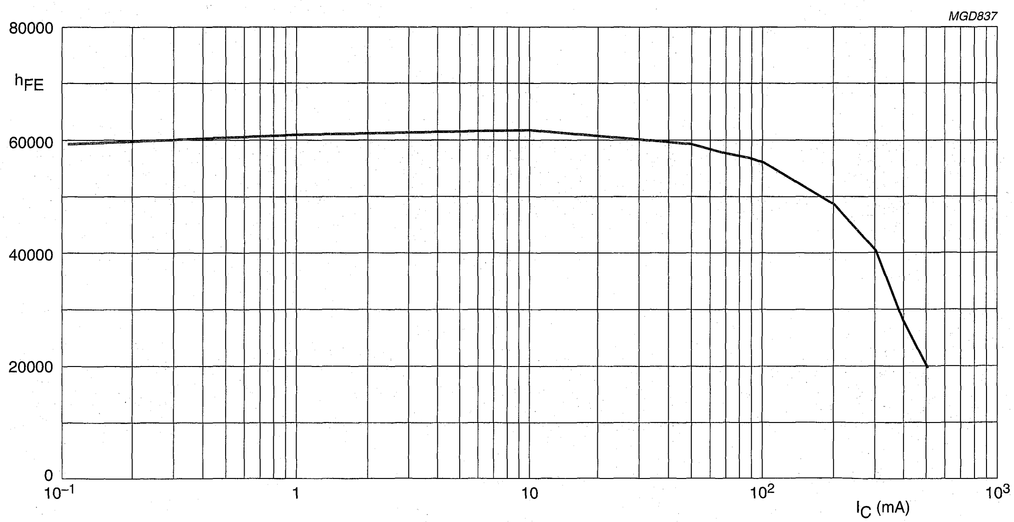
Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for the SOT89 in the General part of handbook SC04"*.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	–	100	nA
I_{CES}	collector cut-off current	$V_{BE} = 0$; $V_{CE} = 50$ V	–	100	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 10$ V	–	100	nA
h_{FE}	DC current gain	$V_{CE} = 5$ V; see Fig.2			
		$I_C = 10$ mA	10000	–	
		$I_C = 100$ mA	10000	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 100$ mA; $I_B = 0.1$ mA	–	1.5	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 100$ mA; $I_B = 0.1$ mA	–	1.5	V
V_{BEon}	base-emitter on-state voltage	$I_C = 100$ mA; $V_{CE} = 5$ V	–	2	V
f_T	transition frequency	$I_C = 30$ mA; $V_{CE} = 5$ V; f = 100 MHz	125	–	MHz



$V_{CE} = 2$ V.

Fig.2 DC current gain; typical values.

NPN high-voltage transistors PXTA42; PXTA43

FEATURES

- Low current (max. 100 mA)
- High voltage (max. 300 V).

APPLICATIONS

- Telephony and professional communication equipment.

DESCRIPTION

NPN high-voltage transistor in a SOT89 plastic package.
PNP complements: PXTA92 and PXTA93.

MARKING

TYPE NUMBER	MARKING CODE
PXTA42	p1D
PXTA43	p1E

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

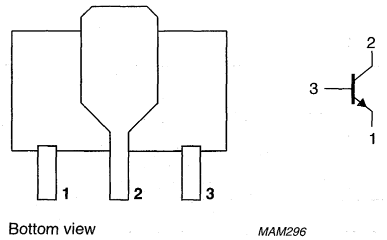


Fig.1 Simplified outline (SOT89) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PXTA42		–	300	V
	PXTA43		–	200	V
V_{CEO}	collector-emitter voltage	open base			
	PXTA42		–	300	V
	PXTA43		–	200	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.25	W
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 10$ V	40	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 20$ V; f = 1 MHz			
	PXTA42		–	3	pF
	PXTA43		–	4	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 20$ V; f = 100 MHz	50	–	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			
	PXTA42		–	300	V
	PXTA43		–	200	V
V_{CEO}	collector-emitter voltage	open base			
	PXTA42		–	300	V
	PXTA43		–	200	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.25	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	97	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		16	K/W

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current PXTA42	$I_E = 0$; $V_{CB} = 200$ V	–	100	nA
I_{CBO}	collector cut-off current PXTA43	$I_E = 0$; $V_{CB} = 160$ V	–	100	nA
I_{EBO}	emitter cut-off current PXTA42	$I_C = 0$; $V_{BE} = 6$ V	–	100	nA
I_{EBO}	emitter cut-off current PXTA43	$I_C = 0$; $V_{BE} = 4$ V	–	100	nA
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 10$ V	25	–	
		$I_C = 10$ mA; $V_{CE} = 10$ V	40	–	
		$I_C = 30$ mA; $V_{CE} = 10$ V	40	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 20$ mA; $I_B = 2$ mA	–	500	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 20$ mA; $I_B = 2$ mA	–	900	mV
C_{re}	feedback capacitance PXTA42 PXTA43	$I_C = i_c = 0$; $V_{CB} = 20$ V; f = 1 MHz	 – –	 3 4	 pF pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 20$ V; f = 100 MHz	50	–	MHz

# PNP Darlington transistor	PXTA64

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 30 V).

APPLICATIONS

- High input impedance preamplifiers.

DESCRIPTION

PNP Darlington transistor in a SOT89 plastic package.
NPN complement: PXTA14.

MARKING

TYPE NUMBER	MARKING CODE
PXTA64	p2V

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

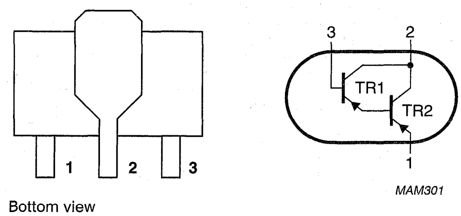


Fig.1 Simplified outline (SOT89) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–30	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	–30	V
I_C	collector current (DC)		–	–500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.3	W
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -5$ V	10000	–	
f_T	transition frequency	$I_C = -100$ mA; $V_{CE} = -5$ V; f = 100 MHz	125	–	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_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	–30	V
V_{EBO}	emitter-base voltage	open collector	–	–10	V
I_C	collector current (DC)		–	–500	mA
I_{CM}	peak collector current		–	–1	A
I_B	base current (DC)		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.3	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for the SOT89 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	93	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to solder point		12	K/W

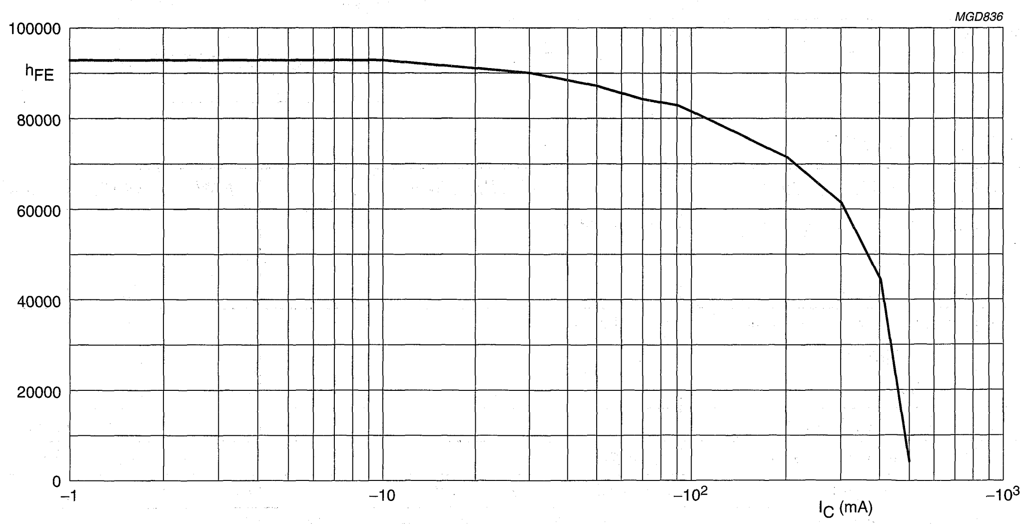
Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for the SOT89 in the General part of handbook SC04"*.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -30$ V	–	−100	nA
I_{CES}	collector cut-off current	$V_{BE} = 0$; $V_{CE} = -30$ V	–	−100	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{BE} = -10$ V	–	−100	nA
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -5$ V; see Fig.2	10000	–	
		$I_C = -100$ mA; $V_{CE} = -5$ V; see Fig.2	20000	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -100$ mA; $I_B = -0.1$ mA	–	−1.5	V
V_{BEsat}	base-emitter saturation voltage	$I_C = -100$ mA; $I_B = -0.1$ mA	–	−1.5	V
V_{BEon}	base-emitter on-state voltage	$I_C = -100$ mA; $V_{CE} = -5$ V	–	−2	V
f_T	transition frequency	$I_C = -100$ mA; $V_{CE} = -5$ V; f = 100 MHz	125	–	MHz



$V_{CE} = -2$ V.

Fig.2 DC current gain; typical values.

PNP high-voltage transistors PXTA92; PXTA93

FEATURES

- Low current (max. 100 mA)
- High voltage (max. 300 V).

APPLICATIONS

- Telephony and professional communication equipment.

DESCRIPTION

PNP high-voltage transistor in a SOT89 plastic package.
NPN complements: PXTA42 and PXTA43.

MARKING

TYPE NUMBER	MARKING CODE
PXTA92	p2D
PXTA93	p2E

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

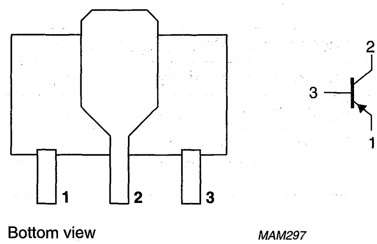


Fig.1 Simplified outline (SOT89) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PXTA92		–	–300	V
	PXTA93		–	–200	V
V_{CEO}	collector-emitter voltage	open base			
	PXTA92		–	–300	V
	PXTA93		–	–200	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.25	W
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -10$ V	40	–	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -20$ V; f = 100 MHz	50	–	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			
	PXTA92		–	–300	V
	PXTA93		–	–200	V
V_{CEO}	collector-emitter voltage	open base			
	PXTA92		–	–300	V
	PXTA93		–	–200	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.25	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	97	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		16	K/W

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT89 in the General part of handbook SC04"*.

PNP high-voltage transistors PXTA92; PXTA93

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -200$ V			
	PXTA92		–	–250	nA
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -160$ V			
	PXTA93		–	–250	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{BE} = -3$ V	–	–100	nA
h_{FE}	DC current gain	$V_{CE} = -10$ V; note 1			
		$I_C = -1$ mA	25	–	
		$I_C = -10$ mA	40	–	
		$I_C = -30$ mA	25	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -20$ mA; $I_B = -2$ mA	–	–500	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -20$ mA; $I_B = -2$ mA		–900	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -20$ V; f = 1 MHz			
	PXTA92		–	6	pF
	PXTA93		–	8	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -20$ V; f = 100 MHz	50	–	MHz

Note

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

NPN switching transistor PZT2222A

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- Switching and linear amplification.

DESCRIPTION

NPN switching transistor in a SOT223 plastic package. PNP complement: PZT2907A.

PINNING

PIN	DESCRIPTION
1	base
2, 4	collector
3	emitter

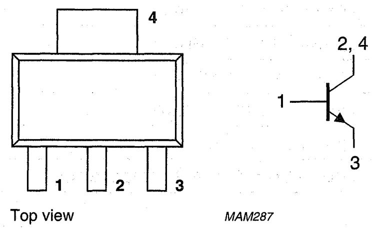


Fig.1 Simplified outline (SOT223) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	75	V
V_{CEO}	collector-emitter voltage	open base	–	40	V
I_C	collector current (DC)		–	600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.15	W
h_{FE}	DC current gain	$I_C = 150$ mA; $V_{CE} = 10$ V	100	300	
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 20$ V; f = 100 MHz	300	–	MHz
t_{off}	turn-off time	$I_{Con} = 150$ mA; $I_{Bon} = 15$ mA; $I_{Boff} = -15$ mA	–	250	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	–	75	V
V_{CEO}	collector-emitter voltage	open base	–	40	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	600	mA
I_{CM}	peak collector current		–	800	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.15	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	109	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		28	K/W

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

CHARACTERISTICS

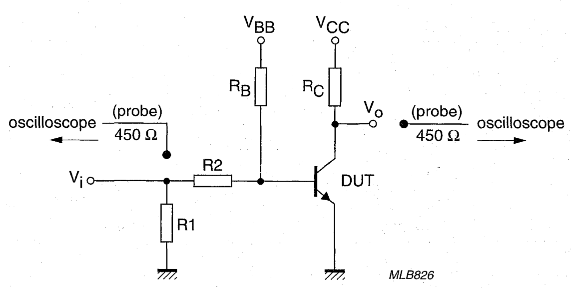
$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 60$ V	–	10	nA
		$I_E = 0$; $V_{CB} = 60$ V; $T_{amb} = 125$ °C	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	10	nA
h_{FE}	DC current gain	$I_C = 0.1$ mA; $V_{CE} = 10$ V	35	–	
		$I_C = 1$ mA; $V_{CE} = 10$ V	50	–	
		$I_C = 10$ mA; $V_{CE} = 10$ V	75	–	
		$I_C = 10$ mA; $V_{CE} = 10$ V; $T_{amb} = -55$ °C	35	–	
		$I_C = 150$ mA; $V_{CE} = 1$ V; note 1	50	–	
		$I_C = 150$ mA; $V_{CE} = 10$ V; note 1	100	300	
		$I_C = 500$ mA; $V_{CE} = 10$ V; note 1	40	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 150$ mA; $I_B = 15$ mA	–	300	mV
		$I_C = 500$ mA; $I_B = 50$ mA	–	1	V

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{BEsat}	base-emitter saturation voltage	I_C = 150 mA; I_B = 15 mA	0.6	1.2	V
		I_C = 500 mA; I_B = 50 mA	–	2	V
C_c	collector capacitance	$I_E = i_e = 0$; V_{CB} = 10 V; f = 1 MHz	–	8	pF
C_e	emitter capacitance	$I_C = i_c = 0$; V_{EB} = 500 mV; f = 1 MHz	–	25	pF
f_T	transition frequency	I_C = 20 mA; V_{CE} = 20 V; f = 100 MHz	300	–	MHz
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	I_{Con} = 150 mA; I_{Bon} = 15 mA; I_{Boff} = −15 mA; T_{amb} = 25 °C	–	35	ns
t_d	delay time		–	10	ns
t_r	rise time		–	25	ns
t_{off}	turn-off time		–	250	ns
t_s	storage time		–	200	ns
t_f	fall time		–	60	ns

Note

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



V_i = 9.5 V; T = 500 µs; t_p = 10 µs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; R_B = 325 Ω; R_C = 160 Ω.
V_{BB} = −3.5 V; V_{CC} = 29.5 V.
Oscilloscope input impedance Z_i = 50 Ω.

Fig.2 Test circuit for switching times.

PNP switching transistor PZT2907A

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 60 V).

APPLICATIONS

- Switching and linear amplification.

DESCRIPTION

PNP switching transistor in a SOT223 plastic package.
NPN complement: PZT2222A.

PINNING

PIN	DESCRIPTION
1	base
2, 4	collector
3	emitter

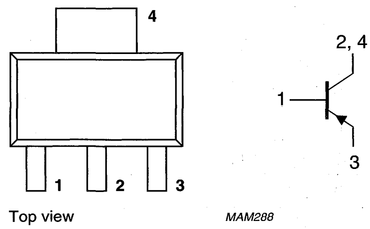


Fig.1 Simplified outline (SOT223) and symbol.

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	–	–60	V
I_C	collector current (DC)		–	–600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.15	W
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -10$ V	100	300	
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -20$ V; f = 100 MHz	200	–	MHz
t_{off}	turn-off time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	365	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	–	–60	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–600	mA
I_{CM}	peak collector current		–	–800	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.15	W
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	note 1	106	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		25	K/W

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

CHARACTERISTICS

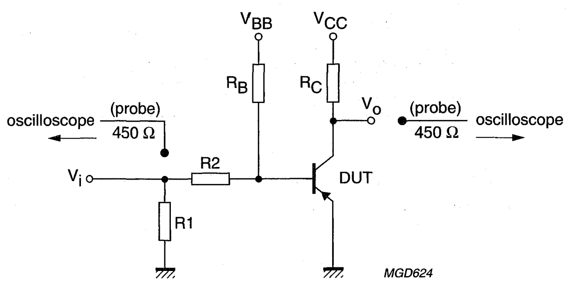
$T_{amb} = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -50$ V	–	–10	nA
		$I_E = 0$; $V_{CB} = -50$ V; $T_{amb} = 150$ °C	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–50	nA
h_{FE}	DC current gain	$I_C = -0.1$ mA; $V_{CE} = -10$ V	75	–	
		$I_C = -1$ mA; $V_{CE} = -10$ V	100	–	
		$I_C = -10$ mA; $V_{CE} = -10$ V	100	–	
		$I_C = -150$ mA; $V_{CE} = -10$ V; note 1	100	300	
		$I_C = -500$ mA; $V_{CE} = -10$ V; note 1	50	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA; note 1	–	–400	mV
		$I_C = -500$ mA; $I_B = -50$ mA; note 1	–	–1.6	V
V_{BEsat}	base-emitter saturation voltage	$I_C = -150$ mA; $I_B = -15$ mA; note 1	–	–1.3	V
		$I_C = -500$ mA; $I_B = -50$ mA; note 1	–	–2.6	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	8	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -2$ V; f = 1 MHz	–	30	pF
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -20$ V; f = 100 MHz; note 1	200	–	MHz

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	40	ns
t_d	delay time		–	12	ns
t_r	rise time		–	30	ns
t_{off}	turn-off time		–	365	ns
t_s	storage time		–	300	ns
t_f	fall time		–	65	ns

Note

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



$V_i = -9.5$ V; T = 500 µs; $t_p = 10$ µs; $t_r = t_f \leq 3$ ns.
R1 = 68 Ω; R2 = 325 Ω; $R_B = 325$ Ω; $R_C = 160$ Ω.
$V_{BB} = 3.5$ V; $V_{CC} = -29.5$ V.
Oscilloscope input impedance $Z_i = 50$ Ω.

Fig.2 Test circuit for switching times.

NPN switching transistor | PZT3904

FEATURES

- Low current (max. 200 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- High-speed saturated switching.

DESCRIPTION

NPN switching transistor in a SOT223 plastic package.
PNP complement: PZT3906.

PINNING

PIN	DESCRIPTION
1	base
2, 4	collector
3	emitter

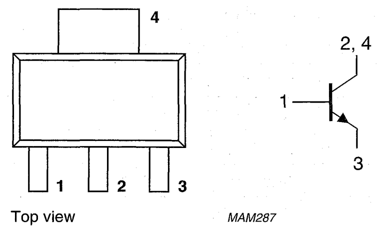


Fig.1 Simplified outline (SOT223) and symbol.

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	collector current (DC)		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.05	W
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_{off}	turn-off time	$I_{Con} = 10$ mA; $I_{Bon} = 1$ mA; $I_{Boff} = -1$ mA	–	240	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	collector current (DC)		–	200	mA
I_{CM}	peak collector current		–	300	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.05	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	117	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		36	K/W

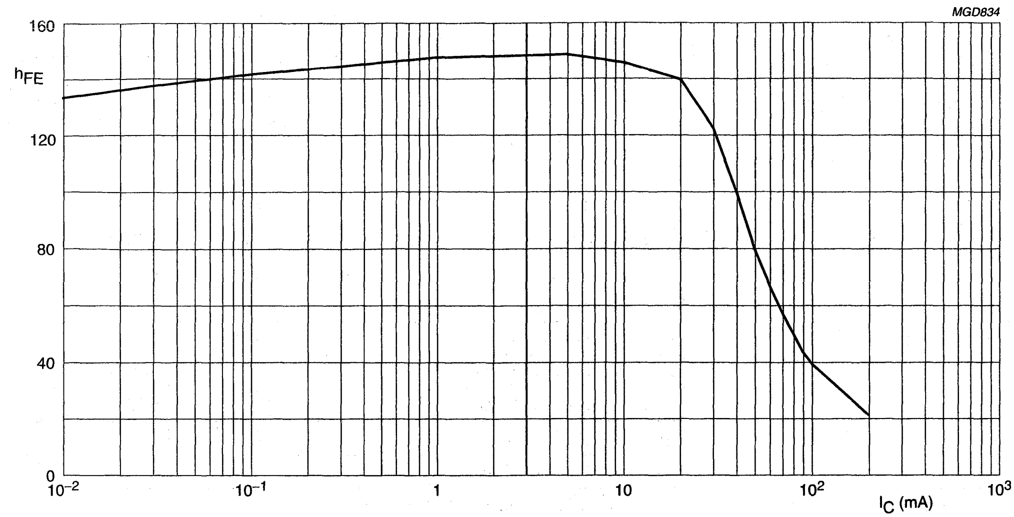
Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

CHARACTERISTICS

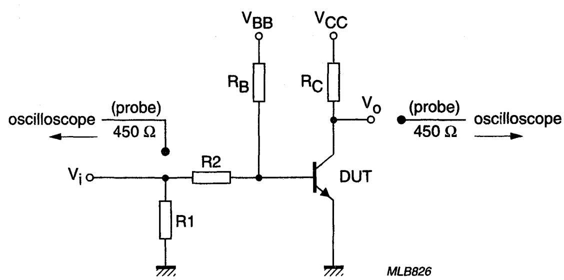
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30$ V	–	50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 6$ V	–	50	nA
h_{FE}	DC current gain	$V_{CE} = 1$ V; see Fig.2			
		$I_C = 0.1$ mA	60	–	
		$I_C = 1$ mA	80	–	
		$I_C = 10$ mA	100	300	
		$I_C = 50$ mA	60	–	
		$I_C = 100$ mA	30	–	
V_{CEsat}	saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	–	200	mV
		$I_C = 50$ mA; $I_B = 5$ mA	–	200	mV
V_{BEsat}	saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	–	850	mV
		$I_C = 50$ mA; $I_B = 5$ mA	–	950	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	4	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 500$ mV; f = 1 MHz	–	8	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 20$ V; f = 100 MHz	300	–	MHz
F	noise figure	$I_C = 100$ μA; $V_{CE} = 5$ V; $R_S = 1$ kΩ; f = 10 Hz to 15.7 kHz	–	5	dB
Switching times (between 10% and 90% levels); see Fig.3					
t_{on}	turn-on time	$I_{Con} = 10$ mA; $I_{Bon} = 1$ mA; $I_{Boff} = -1$ mA	–	65	ns
t_d	delay time		–	35	ns
t_r	rise time		–	35	ns
t_{off}	turn-off time		–	240	ns
t_s	storage time		–	200	ns
t_f	fall time		–	50	ns



V_{CE} = 1 V.

Fig.2 DC current gain; typical values.



V_i = 5 V; T = 500 μs; t_p = 10 μs; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 2.5 kΩ; R_B = 3.9 kΩ; R_C = 270 Ω.
V_{BB} = −1.9 V; V_{CC} = 3 V.
Oscilloscope input impedance Z_i = 50 Ω.

Fig.3 Test circuit for switching times.

PNP switching transistor PZT3906

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- High-speed switching.

DESCRIPTION

PNP switching transistor in a SOT223 plastic package. NPN complement: PZT3904.

PINNING

PIN	DESCRIPTION
1	base
2, 4	collector
3	emitter

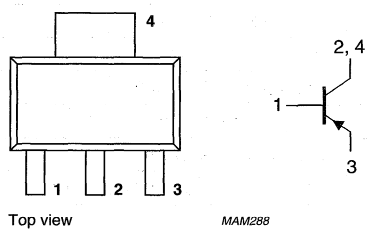


Fig.1 Simplified outline (SOT223) and symbol.

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	collector current (DC)		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.05	W
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_{off}	turn-off time	$I_{Con} = -10$ mA; $I_{Bon} = -1$ mA; $I_{Boff} = 1$ mA	–	300	ns

PNP switching transistor PZT3906

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	–	–6	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.05	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	115	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		34	K/W

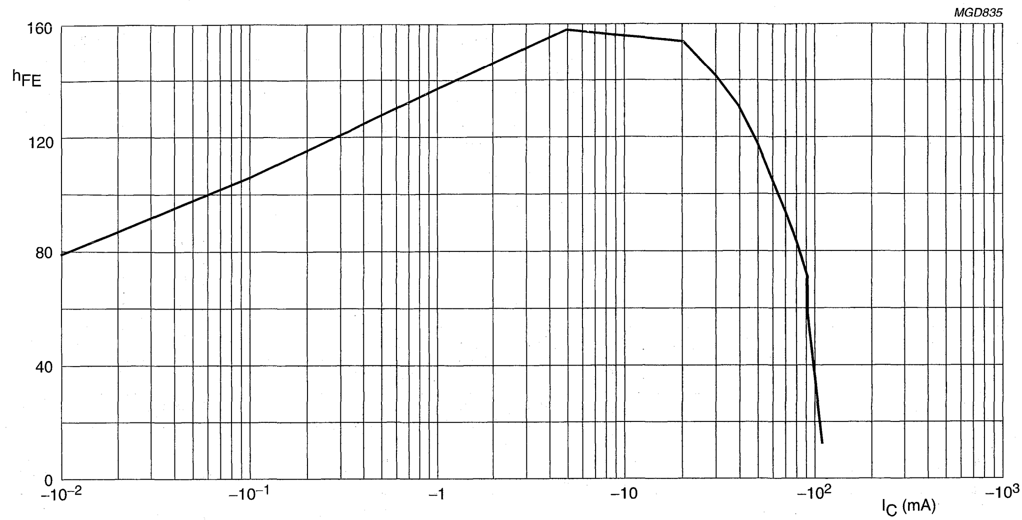
Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

CHARACTERISTICS

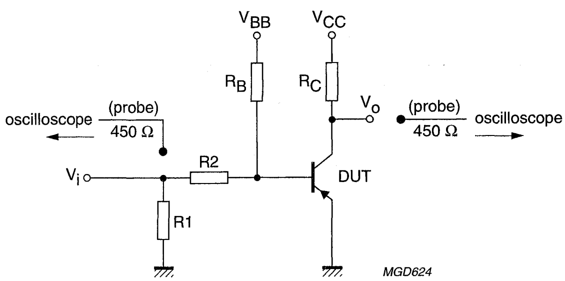
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -30$ V	–	–50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -6$ V	–	–50	nA
h_{FE}	DC current gain	$V_{CE} = -1$ V; see Fig.2			
		$I_C = -0.1$ mA	60	–	
		$I_C = -1$ mA	80	–	
		$I_C = -10$ mA	100	300	
		$I_C = -50$ mA	60	–	
		$I_C = -100$ mA	30	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -1$ mA	–	–200	mV
		$I_C = -50$ mA; $I_B = -5$ mA	–	–200	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -10$ mA; $I_B = -1$ mA	–650	–850	mV
		$I_C = -50$ mA; $I_B = -5$ mA	–	–950	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -5$ V; f = 1 MHz	–	4.5	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -500$ mV; f = 1 MHz	–	10	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -20$ V; f = 100 MHz	250	–	MHz
F	noise figure	$I_C = -100$ µA; $V_{CE} = -5$ V; $R_S = 1$ kΩ; f = 10 Hz to 15.7 kHz	–	4	dB
Switching times (between 10% and 90% levels); see Fig.3					
t_{on}	turn-on time	$I_{Con} = -10$ mA; $I_{Bon} = -1$ mA; $I_{Boff} = 1$ mA	–	65	ns
t_d	delay time		–	35	ns
t_r	rise time		–	35	ns
t_{off}	turn-off time		–	300	ns
t_s	storage time		–	225	ns
t_f	fall time		–	75	ns



$V_{CE} = -1$ V.

Fig.2 DC current gain; typical values.



$V_i = -5$ V; T = 500 μs; $t_p = 10$ μs; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 2.5 kΩ; $R_B = 3.9$ kΩ; $R_C = 270$ Ω.
$V_{BB} = 1.9$ V; $V_{CC} = -3$ V.
Oscilloscope input impedance $Z_i = 50$ Ω.

Fig.3 Test circuit for switching times.

NPN general purpose transistor — PZTA06

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 80 V).

APPLICATIONS

- Medium power switching in e.g. telephony and professional communication.

DESCRIPTION

NPN transistor in a SOT223 plastic package.
PNP complement: PZTA56.

PINNING

PIN	DESCRIPTION
1	base
2, 4	collector
3	emitter

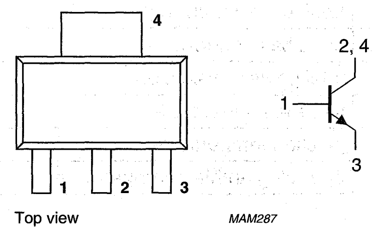


Fig.1 Simplified outline (SOT223) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	80	V
V_{CEO}	collector-emitter voltage	open base	–	80	V
I_C	collector current (DC)		–	500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.2	W
h_{FE}	DC current gain	$I_C = 100$ mA; $V_{CE} = 1$ V	100	–	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 2$ V; f = 100 MHz	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	–	80	V
V_{CEO}	collector-emitter voltage	open base	–	80	V
V_{EBO}	emitter-base voltage	open collector	–	4	V
I_C	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	800	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.2	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	103	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		22	K/W

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 80$ V	–	50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	50	nA
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 1$ V	100	–	
		$I_C = 100$ mA; $V_{CE} = 1$ V	100	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 100$ mA; $I_B = 10$ mA	–	250	mV
V_{BE}	base-emitter voltage	$I_C = 100$ mA; $V_{CE} = 1$ V	–	1.2	V
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 2$ V; f = 100 MHz	100	–	MHz

NPN Darlington transistor PZTA14

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 30 V).

APPLICATIONS

- Pre-amplifiers requiring high input impedance.

DESCRIPTION

NPN Darlington transistor in a SOT223 plastic package.
PNP complement: PZTA64.

PINNING

PIN	DESCRIPTION
1	base/input
2, 4	collector/output
3	emitter/ground

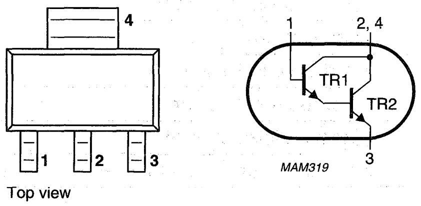


Fig.1 Simplified outline (SOT223) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	30	V
I_C	collector current (DC)		–	500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.25	W
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 5$ V	10000	–	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	125	–	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_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	30	V
V_{EBO}	emitter-base voltage	open collector	–	10	V
I_C	collector current (DC)		–	500	mA
I_{CM}	peak collector current		–	800	A
I_B	base current (DC)		–	200	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.25	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	100	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		19	K/W

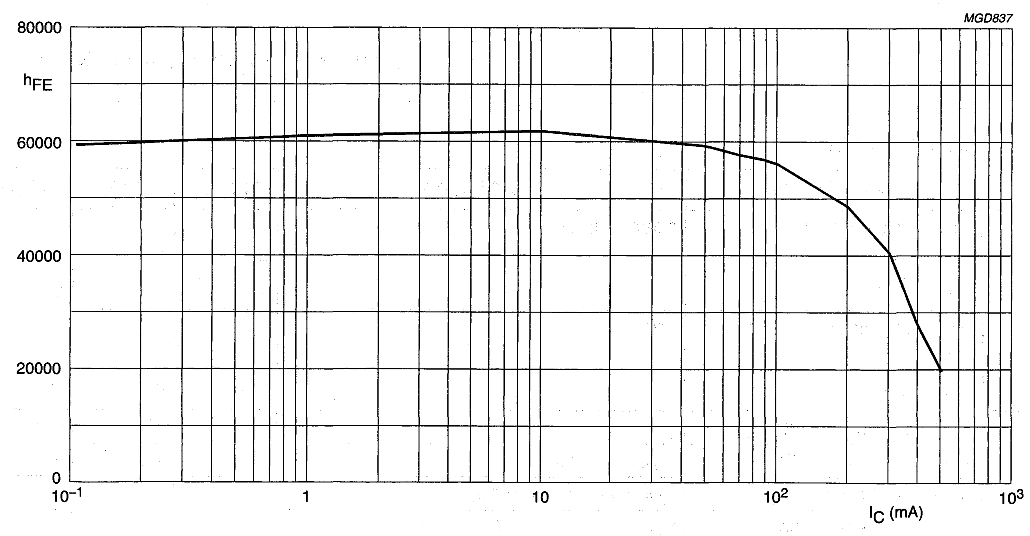
Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 30 V	–	100	nA
I_{CES}	collector cut-off current	V_{BE} = 0; V_{CE} = 30 V	–	100	nA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 10 V	–	100	nA
h_{FE}	DC current gain	V_{CE} = 5 V; see Fig.2			
		I_C = 10 mA	10000	–	
		I_C = 100 mA	20000	–	
V_{CEsat}	collector-emitter saturation voltage	I_C = 100 mA; I_B = 0.1 mA	–	1.5	V
V_{BEon}	base-emitter on-state voltage	I_C = 100 mA; V_{CE} = 5 V	–	2	V
f_T	transition frequency	I_C = 10 mA; V_{CE} = 5 V; f = 100 MHz	125	–	MHz



V_{CE} = 2 V.

Fig.2 DC current gain; typical values.

NPN high-voltage transistors — PZTA42; PZTA43

FEATURES

- Low current (max. 100 mA)
- High voltage (max. 300 V).

APPLICATIONS

- Telephony and professional communication equipment.

DESCRIPTION

NPN high-voltage transistor in a SOT223 plastic package.
PNP complement: PZTA92.

PINNING

PIN	DESCRIPTION
1	base
2,4	collector
3	emitter

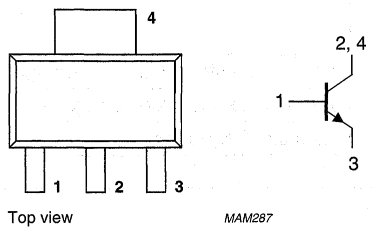


Fig.1 Simplified outline (SOT223) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	PZTA42		–	300	V
	PZTA43		–	200	V
V_{CEO}	collector-emitter voltage	open base			
	PZTA42		–	300	V
	PZTA43		–	200	V
I_{CM}	peak collector current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.2	W
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 10$ V	40	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 20$ V; f = 1 MHz;			
	PZTA42		–	3	pF
	PZTA43		–	4	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 20$ V; f = 100 MHz	50	–	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			
	PZTA42		–	300	V
	PZTA43		–	200	V
V_{CEO}	collector-emitter voltage	open base			
	PZTA42		–	300	V
	PZTA43		–	200	V
V_{EBO}	emitter-base voltage	open collector	–	6	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.2	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	104	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		23	K/W

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current PZTA42	$I_E = 0$; $V_{CB} = 200$ V	–	20	nA
I_{CBO}	collector cut-off current PZTA43	$I_E = 0$; $V_{CB} = 160$ V	–	20	nA
I_{EBO}	emitter cut-off current PZTA42	$I_C = 0$; $V_{BE} = 6$ V	–	100	nA
I_{EBO}	emitter cut-off current PZTA43	$I_C = 0$; $V_{BE} = 4$ V	–	100	nA
h_{FE}	DC current gain	$V_{CE} = 10$ V $I_C = 1$ mA $I_C = 10$ mA $I_C = 30$ mA	 25 40 40	 – – –	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 20$ mA; $I_B = 2$ mA	–	500	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 20$ mA; $I_B = 2$ mA	–	900	mV
C_{re}	feedback capacitance PZTA42 PZTA43	$I_C = i_c = 0$; $V_{CB} = 20$ V; f = 1 MHz	 – –	 3 4	 pF pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 20$ V; f = 100 MHz	50	–	MHz

NPN high-voltage transistors | PZTA44; PZTA45

FEATURES

- Low current (max. 300 mA)
- High voltage (max. 400 V).

APPLICATIONS

- Telecommunication.

DESCRIPTION

NPN high-voltage transistor in a SOT223 plastic package.

PINNING

PIN	DESCRIPTION
1	base
2, 4	collector
3	emitter

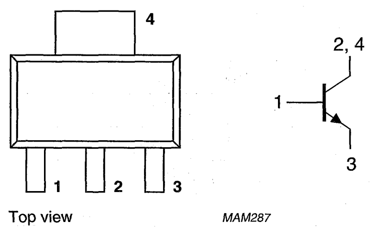


Fig.1 Simplified outline (SOT223) and symbol.

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
I_{CM}	peak collector current		–	300	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.35	W
h_{FE}	DC current gain	$I_C = 100$ mA; $V_{CE} = 10$ V	40	–	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	20	–	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			
	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	collector current (DC)		–	300	mA
I_{CM}	peak collector current		–	300	mA
I_{BM}	peak base current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.35	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	91	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		10	K/W

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector 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
I_{CBO}	collector cut-off current				
	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 cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	100	nA
h_{FE}	DC current gain	$V_{CE} = 10$ V			
		$I_C = 1$ mA	40	–	
		$I_C = 10$ mA	50	200	
		$I_C = 50$ mA; note 1	45	–	
		$I_C = 100$ mA; note 1	40	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 1$ mA; $I_B = 0.1$ mA	–	400	mV
		$I_C = 10$ mA; $I_B = 1$ mA	–	500	mV
		$I_C = 50$ mA; $I_B = 5$ mA; note 1	–	750	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 20$ V; f = 1 MHz	–	7	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 500$ mV; f = 1 MHz	–	180	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	20	–	MHz

Note

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

PNP general purpose transistor | PZTA56

FEATURES

- Low current (max. 500 mA)
- Low voltage (max. 80 V).

APPLICATIONS

- Telephony and professional communication equipment.

DESCRIPTION

PNP transistor in a SOT223 plastic package.
NPN complement: PZTA06.

PINNING

PIN	DESCRIPTION
1	base
2, 4	collector
3	emitter

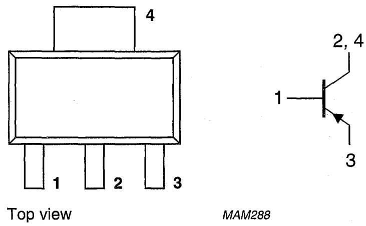


Fig.1 Simplified outline (SOT223) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–80	V
V_{CEO}	collector-emitter voltage	open base	–	–80	V
I_{CM}	peak collector current		–	–1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.2	W
h_{FE}	DC current gain	$I_C = -100$ mA; $V_{CE} = -1$ V	100	–	
f_T	transition frequency	$I_C = -100$ mA; $V_{CE} = -1$ V; f = 100 MHz	50	–	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	–	–80	V
V_{CEO}	collector-emitter voltage	open base	–	–80	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–500	mA
I_{CM}	peak collector current		–	–1	A
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.2	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	103	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		22	K/W

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -80$ V	–	–50	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–50	nA
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -1$ V	100	–	
		$I_C = -100$ mA; $V_{CE} = -1$ V	100	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -100$ mA; $I_B = -10$ mA	–	–250	mV
V_{BE}	base-emitter voltage	$I_C = -100$ mA; $V_{CE} = -1$ V	–	–1.2	V
f_T	transition frequency	$I_C = -100$ mA; $V_{CE} = -1$ V; f = 100 MHz	50	–	MHz

PNP Darlington transistor | PZTA64

FEATURES

- High current (max. 500 mA)
- Low voltage (max. 30 V).

APPLICATIONS

- Preamplifiers requiring high input impedance.

DESCRIPTION

PNP Darlington transistor in a SOT223 plastic package. NPN complement: PZTA14.

PINNING

PIN	DESCRIPTION
1	base
2, 4	collector
3	emitter

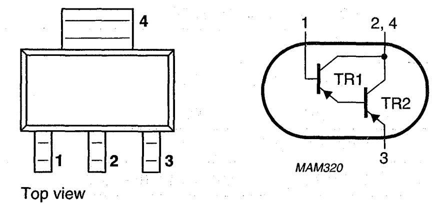


Fig.1 Simplified outline (SOT223) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–30	V
V_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	–30	V
I_C	collector current (DC)		–	–500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.25	W
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -5$ V	10000	–	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	125	–	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_{CES}	collector-emitter voltage	$V_{BE} = 0$	–	–30	V
V_{EBO}	emitter-base voltage	open collector	–	–10	V
I_C	collector current (DC)		–	–500	mA
I_{CM}	peak collector current		–	–800	mA
I_B	base current (DC)		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.25	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	100	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		19	K/W

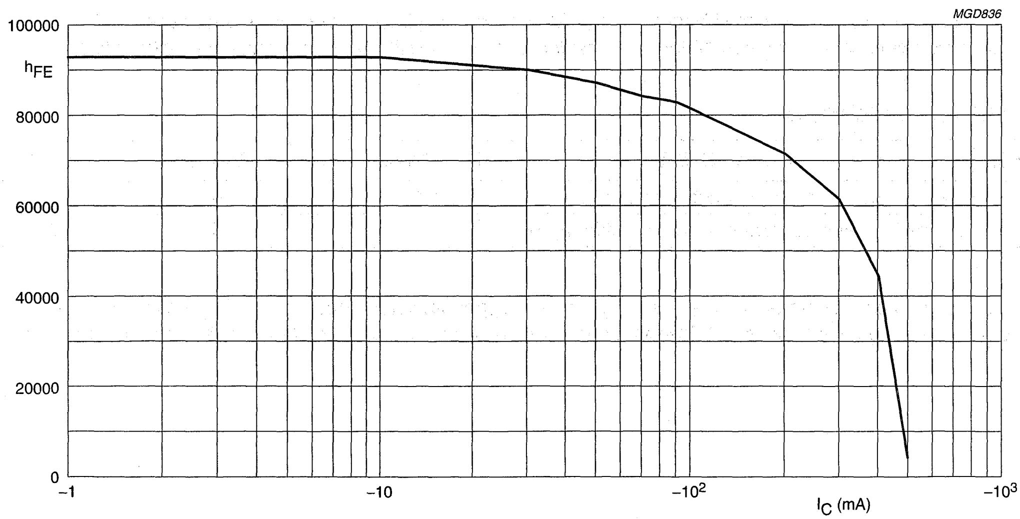
Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -30$ V	–	−100	nA
I_{CES}	collector cut-off current	$V_{BE} = 0$; $V_{CE} = -30$ V	–	−100	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -10$ V	–	−100	nA
h_{FE}	DC current gain	$V_{CE} = -5$ V; see Fig.2			
		$I_C = -10$ mA	10000	–	
		$I_C = -100$ mA	20000	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -100$ mA; $I_B = -0.1$ mA	–	−1.5	V
V_{BEon}	base-emitter voltage	$I_C = -100$ mA; $V_{CE} = -5$ V	–	−2	V
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	125	–	MHz



$V_{CE} = -2$ V.

Fig.2 DC current gain; typical values.

PNP high-voltage transistor | PZTA92

FEATURES

- Low current (max. 100 mA)
- High voltage (max. 300 V).

APPLICATIONS

- Video equipment
- Telephony
- Professional communication equipment.

DESCRIPTION

PNP high-voltage transistor in a SOT223 plastic package.
NPN complement: PZTA42.

PINNING

PIN	DESCRIPTION
1	base
2, 4	collector
3	emitter

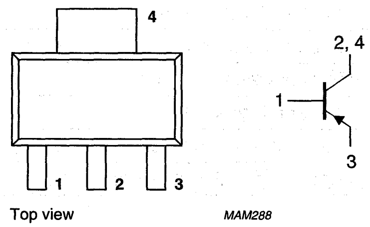


Fig.1 Simplified outline (SOT223) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–300	V
V_{CEO}	collector-emitter voltage	open base	–	–300	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	1.2	W
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -10$ V	40	–	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -20$ V; f = 100 MHz	50	–	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	–	–300	V
V_{CEO}	collector-emitter voltage	open base	–	–300	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.2	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	104	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point		23	K/W

Note

1. Device mounted on a printed-circuit board, single-sided copper, tinplated, mounting pad for collector 1 cm^2. For other mounting conditions, see *"Thermal considerations for SOT223 in the General part of handbook SC04"*.

CHARACTERISTICS

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

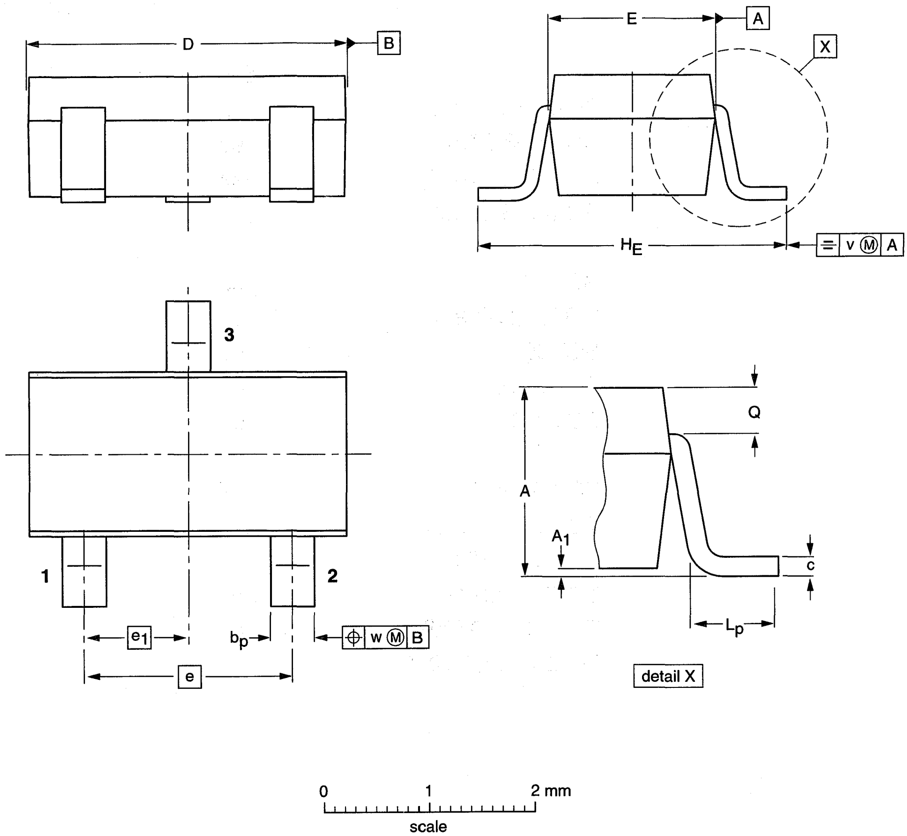
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -200$ V	–	–20	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{BE} = -5$ V	–	–100	nA
h_{FE}	DC current gain	$I_C = -1$ mA; $V_{CE} = -10$ V; note 1	25	–	
		$I_C = -10$ mA; $V_{CE} = -10$ V; note 1	40	–	
		$I_C = -30$ mA; $V_{CE} = -10$ V; note 1	25	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -20$ mA; $I_B = -2$ mA	–	–500	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -20$ mA; $I_B = -2$ mA	–	–900	mV
C_c	collector capacitance	$I_E = 0$; $V_{CB} = -20$ V; f = 1 MHz	–	6	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -20$ V; f = 100 MHz	50	–	MHz

Note

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

PACKAGE OUTLINES

Plastic surface mounted package; 3 leads **SOT346**

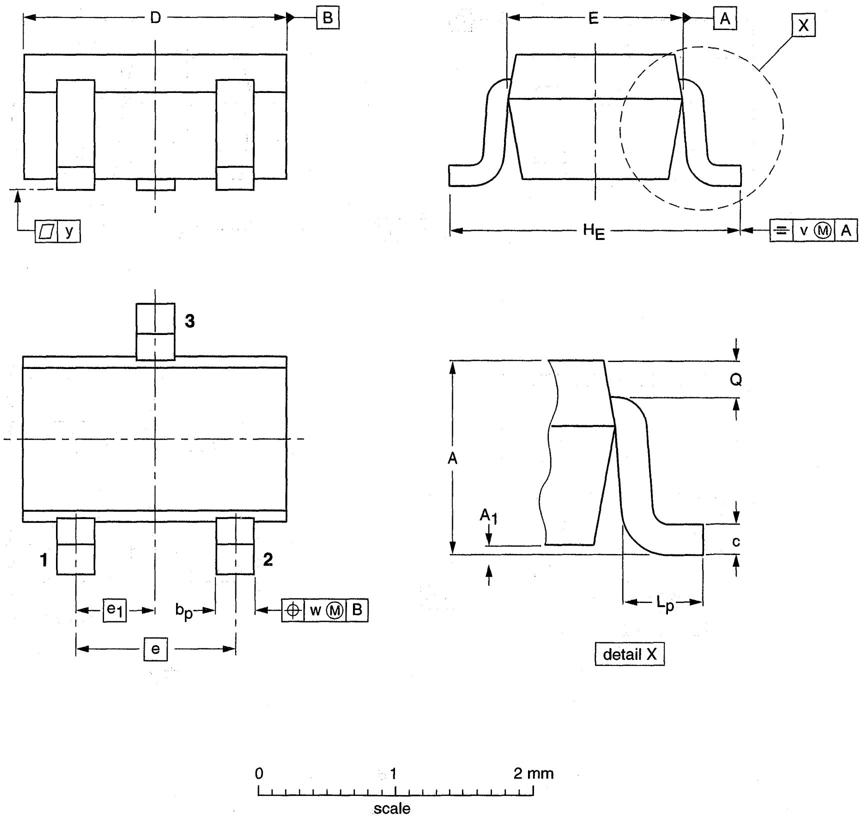


DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w
mm	1.3 1.0	0.1 0.013	0.50 0.35	0.26 0.10	3.1 2.7	1.7 1.3	1.9	0.95	3.0 2.5	0.6 0.2	0.33 0.23	0.2	0.2

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT346		TO-236	SC-59			97-02-28

Plastic surface mounted package; 3 leads **SOT323**

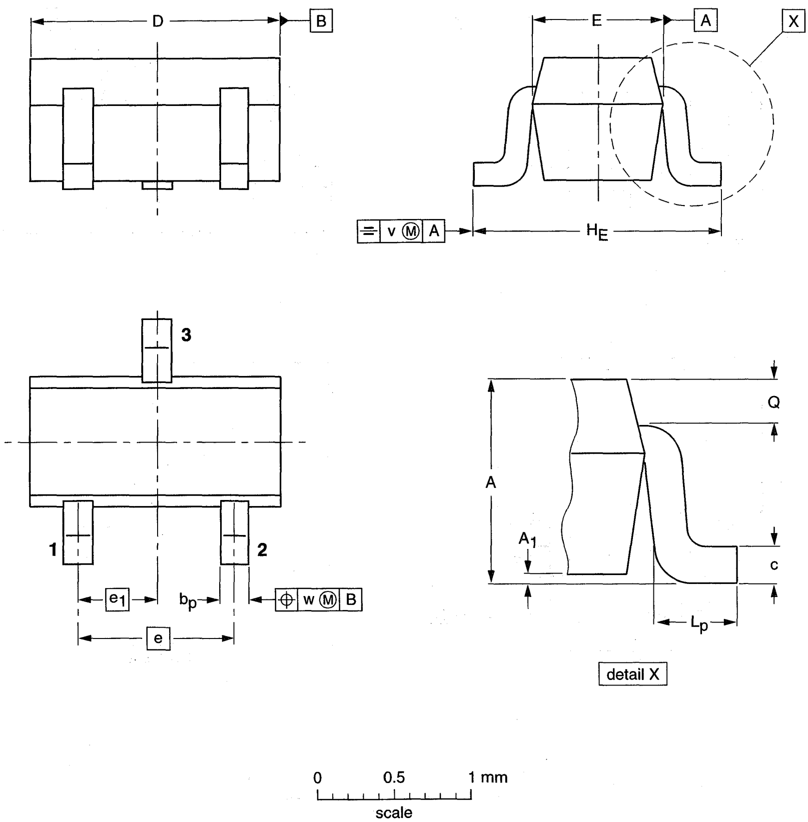


DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w
mm	1.1 0.8	0.1	0.4 0.3	0.25 0.10	2.2 1.8	1.35 1.15	1.3	0.65	2.2 2.0	0.45 0.15	0.23 0.13	0.2	0.2

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT323			SC-70			97-02-28

Plastic surface mounted package; 3 leads **SOT416**

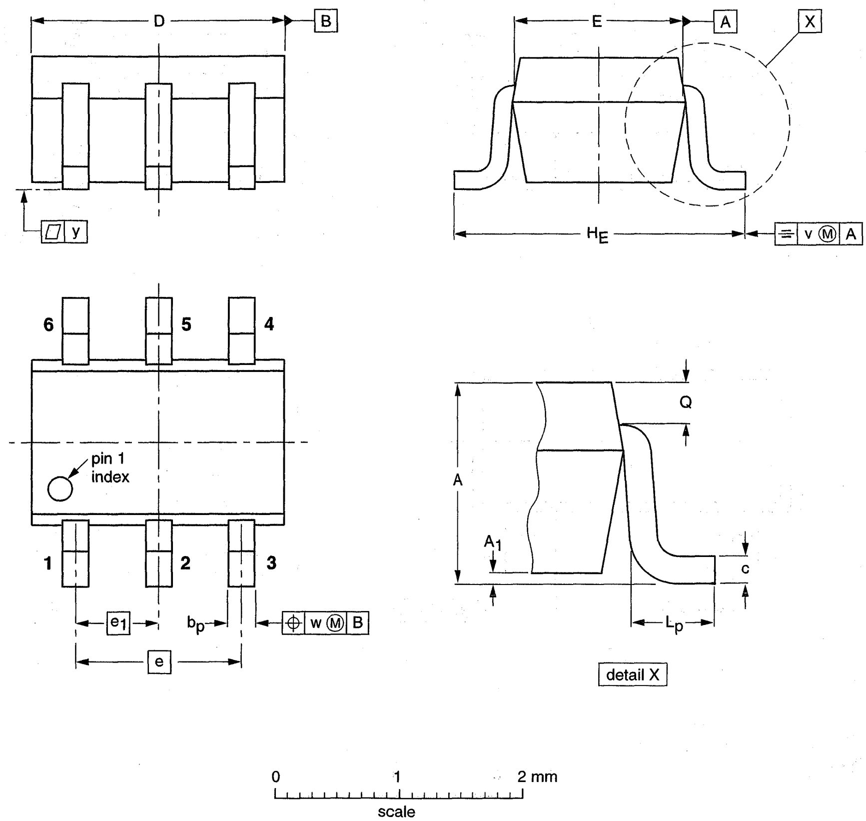


DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w
mm	0.95 0.60	0.1	0.30 0.15	0.25 0.10	1.8 1.4	0.9 0.7	1	0.5	1.75 1.45	0.45 0.15	0.23 0.13	0.2	0.2

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT416			SC-75			97-02-28

Plastic surface mounted package; 6 leads **SOT363**

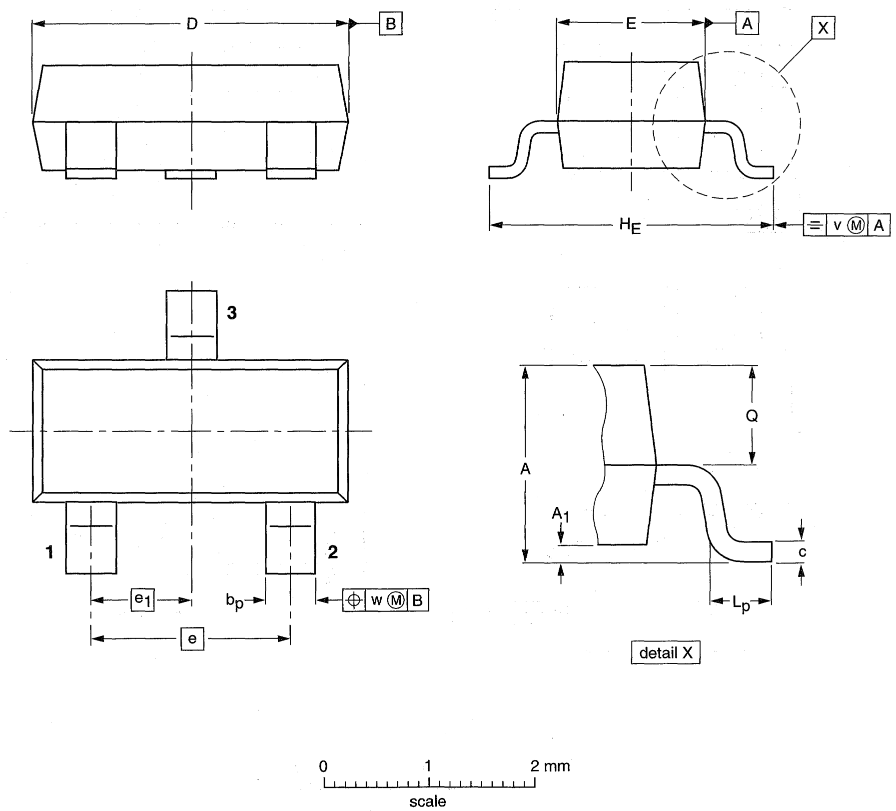


DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.1 0.8	0.1	0.30 0.20	0.25 0.10	2.2 1.8	1.35 1.15	1.3	0.65	2.2 2.0	0.45 0.15	0.25 0.15	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT363			SC-88			97-02-28

Plastic surface mounted package; 3 leads **SOT23**

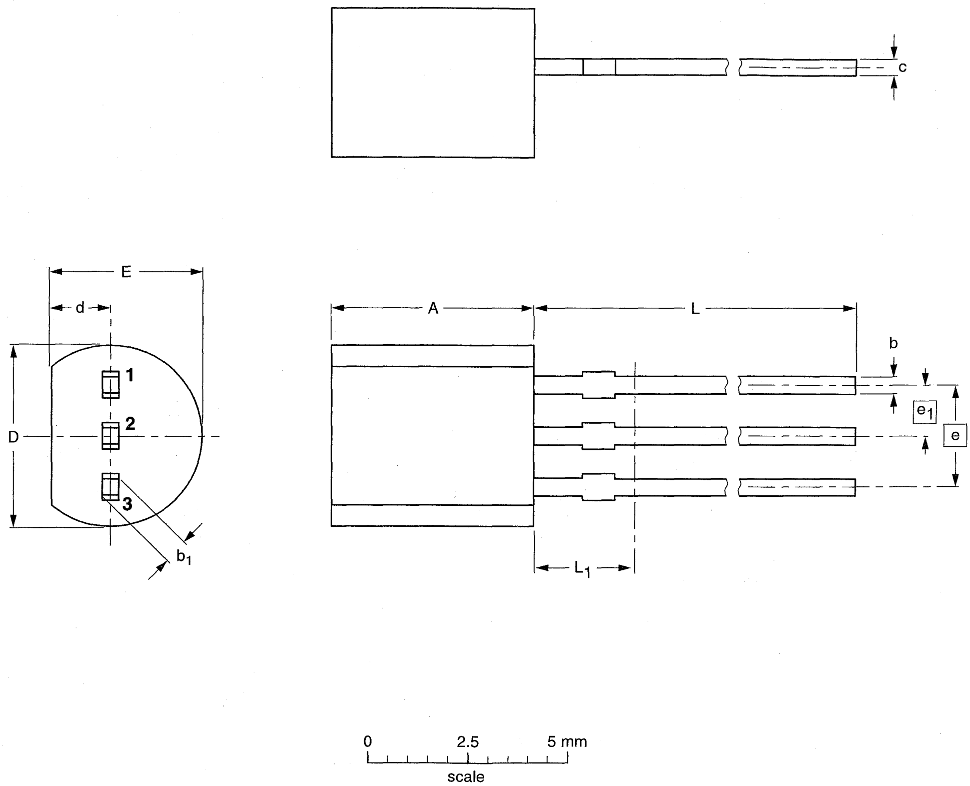


DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max.	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w
mm	1.1 0.9	0.1	0.48 0.38	0.15 0.09	3.0 2.8	1.4 1.2	1.9	0.95	2.5 2.1	0.45 0.15	0.55 0.45	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT23						97-02-28

Plastic single-ended leaded (through hole) package; 3 leads **SOT54**



DIMENSIONS (mm are the original dimensions)

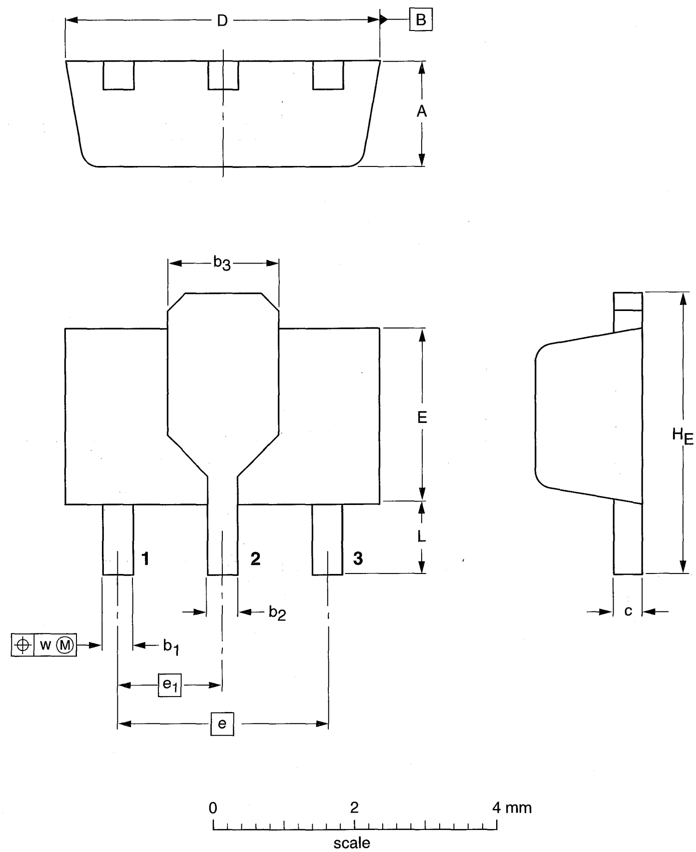
UNIT	A	b	b_1	c	D	d	E	e	e_1	L	L_1[(1)]
mm	5.2 5.0	0.48 0.40	0.66 0.56	0.45 0.40	4.8 4.4	1.7 1.4	4.2 3.6	2.54	1.27	14.5 12.7	2.5

Note

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

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT54		TO-92	SC-43			97-02-28

Plastic surface mounted package; collector pad for good heat transfer; 3 leads **SOT89**

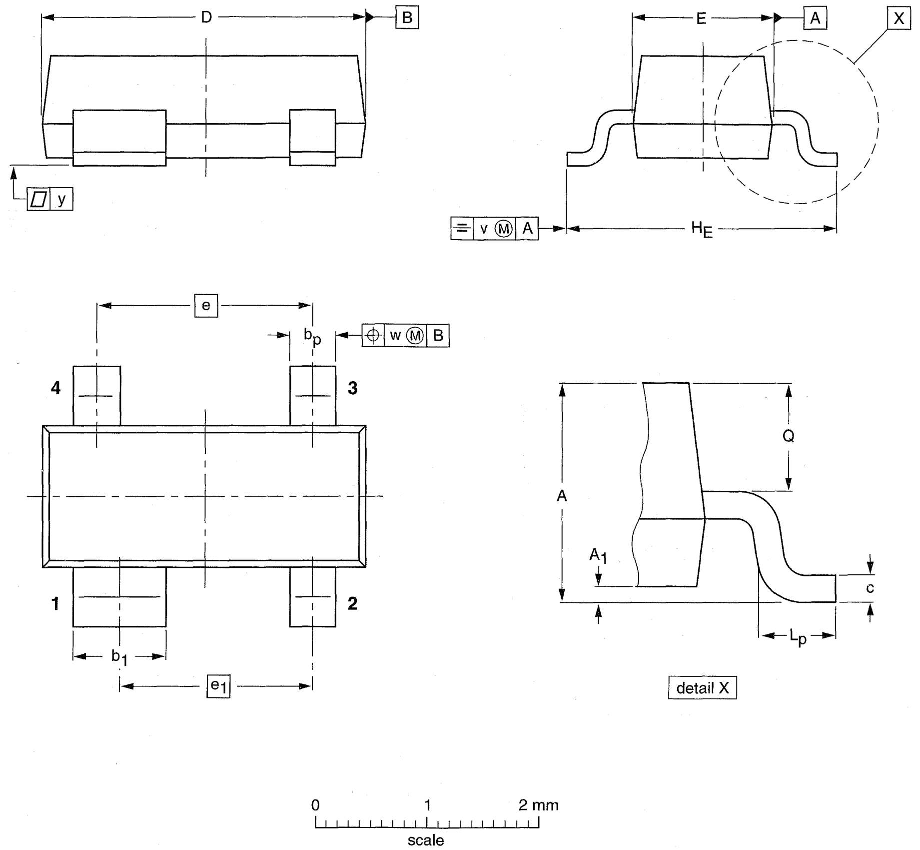


DIMENSIONS (mm are the original dimensions)

UNIT	A	b_1	b_2	b_3	c	D	E	e	e_1	H_E	L min.	w
mm	1.6 1.4	0.48 0.35	0.53 0.40	1.8 1.4	0.44 0.37	4.6 4.4	2.6 2.4	3.0	1.5	4.25 3.75	0.8	0.13

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT89						97-02-28

Plastic surface mounted package; 4 leads **SOT143B**

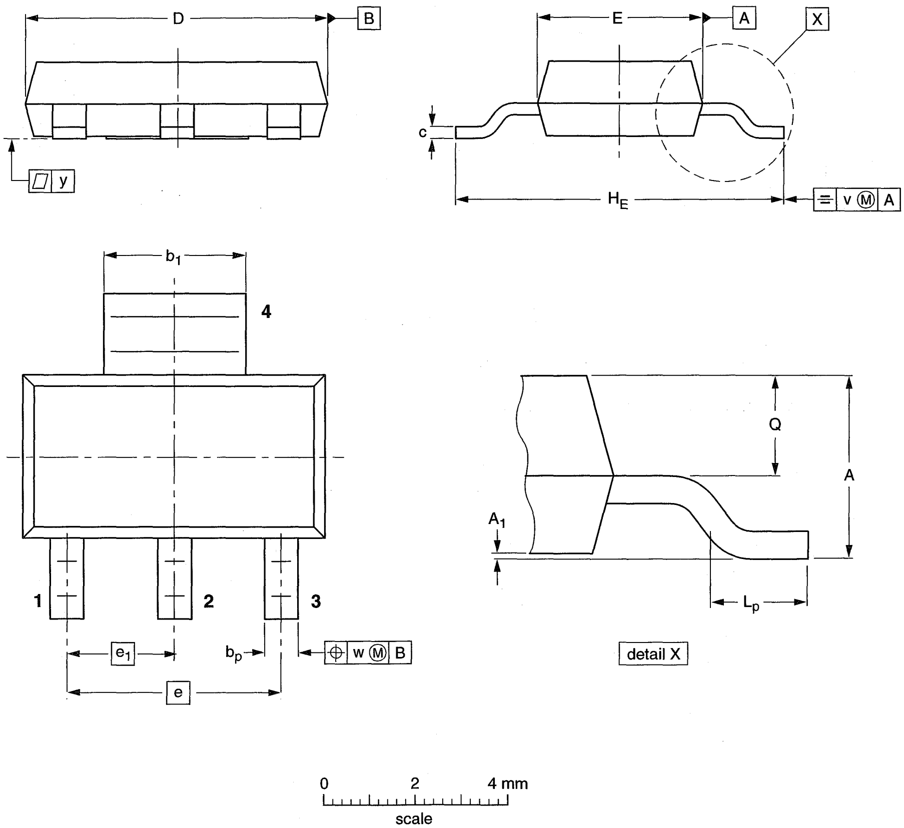


DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	b_1	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.1 0.9	0.1	0.48 0.38	0.88 0.78	0.15 0.09	3.0 2.8	1.4 1.2	1.9	1.7	2.5 2.1	0.45 0.15	0.55 0.45	0.2	0.1	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT143B						97-02-28

Plastic surface mounted package; collector pad for good heat transfer; 4 leads **SOT223**

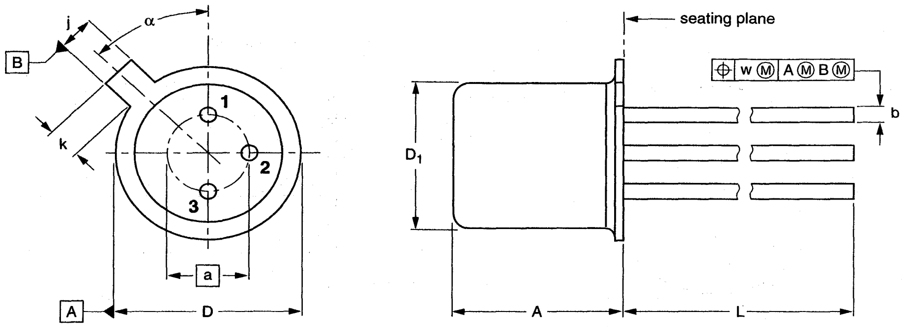


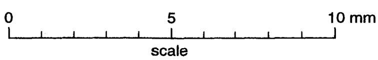
DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b_p	b_1	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.8 1.5	0.10 0.01	0.80 0.60	3.1 2.9	0.32 0.22	6.7 6.3	3.7 3.3	4.6	2.3	7.3 6.7	1.1 0.7	0.95 0.85	0.2	0.1	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT223						~~96-11-11~~ 97-02-28

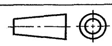
Metal-can cylindrical single-ended package; 3 leads | SOT18/13



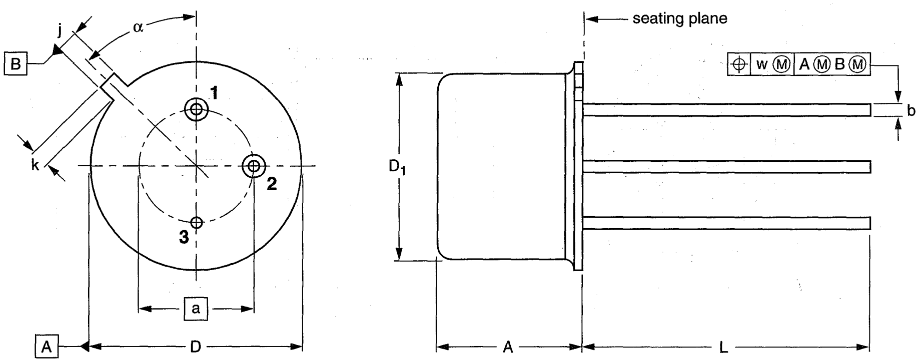


DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

UNIT	A	a	b	D	D_1	j	k	L	w	α
mm	5.31 4.74	2.54	0.47 0.41	5.45 5.30	4.70 4.55	1.03 0.94	1.1 0.9	15.0 12.7	0.40	45°

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT18/13	B11/C7 type 3	TO-18				97-04-18

Metal-can cylindrical single-ended package; 3 leads **SOT5/11**



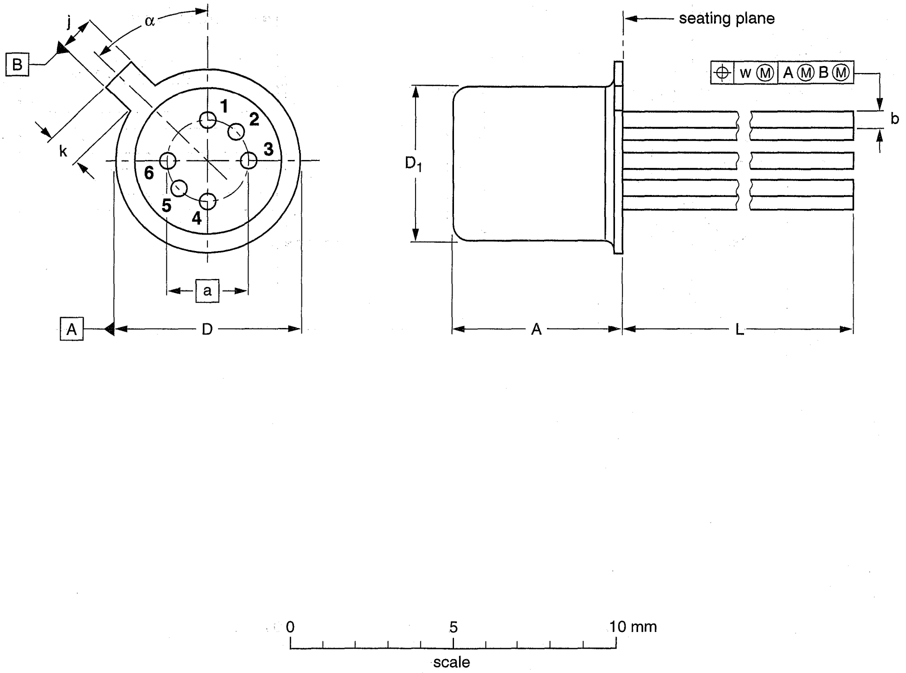
0 5 10 mm
scale

DIMENSIONS (mm are the original dimensions)

UNIT	A	a	b	D	D_1	j	k	L	w	α
mm	6.60 6.35	5.08	0.48 0.41	9.39 9.08	8.33 8.18	0.85 0.75	0.95 0.75	14.2 12.7	0.2	45°

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT5/11		TO-39				97-04-11

Metal-can cylindrical single-ended package; 6 leads — SOT31

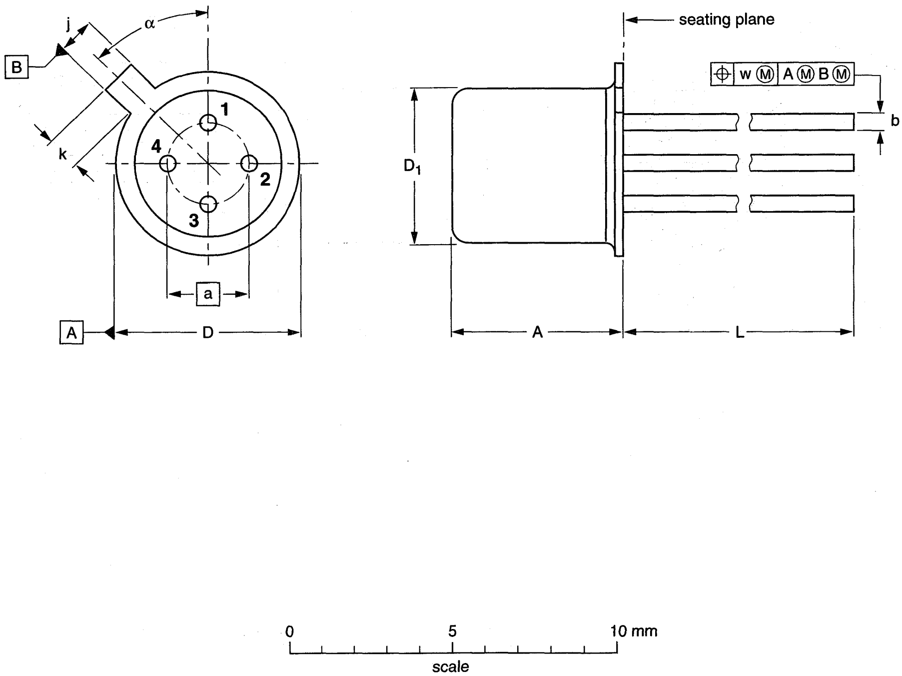


DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

UNIT	A max.	a	b max.	D max.	D_1 max.	j max.	k max.	L min.	w	α
mm	5.3	2.54	0.51	5.8	4.8	1.16	1.17	12.7	0.35	45°

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT31		TO-71				97-06-18

Metal-can cylindrical single-ended package; 4 leads SOT18/9

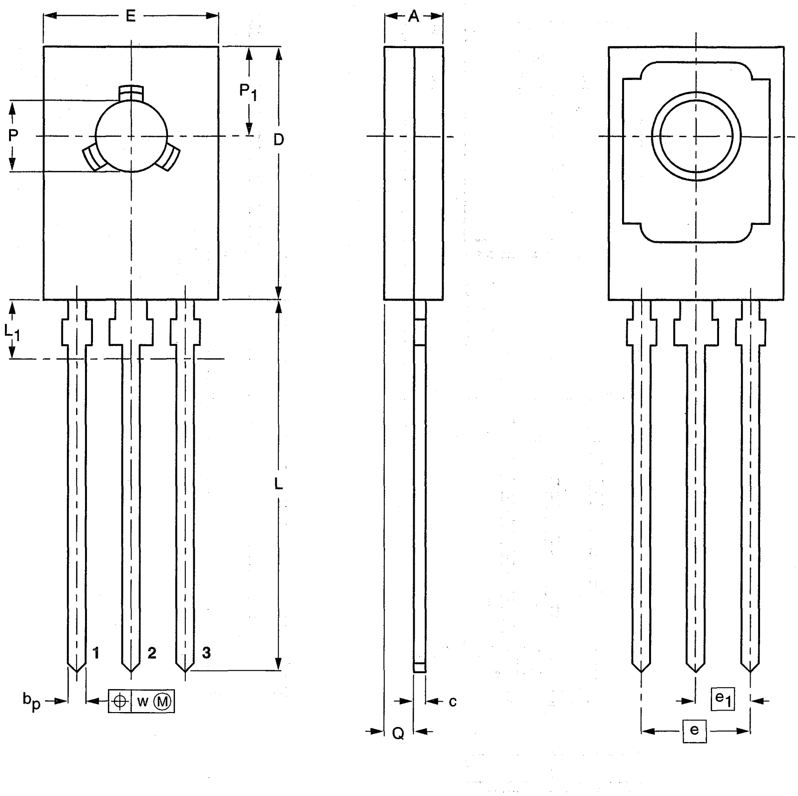


DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

UNIT	A	a	b	D	D_1	j	k	L	w	α
mm	5.31 4.74	2.54	0.46 0.42	5.45 5.30	4.70 4.55	1.05 0.95	1.0 0.9	14.5 13.5	0.36	45°

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT18/9	B12/C7 type 3	TO-72				97-04-18

Plastic single-ended leaded (through hole) package; mountable to heatsink, 1 mounting hole; 3 leads SOT32

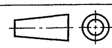


DIMENSIONS (mm are the original dimensions)

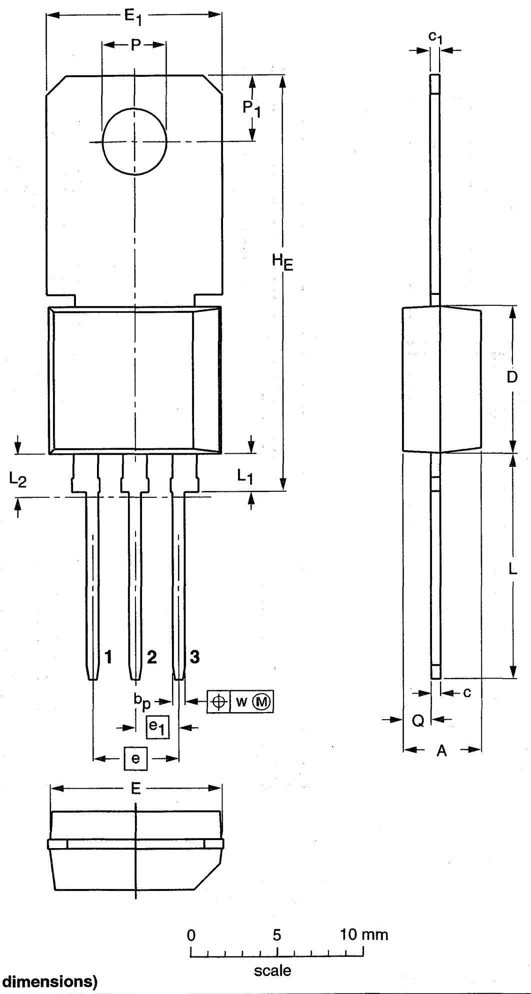
UNIT	A	b_p	c	D	E	e	e_1	L	L_1(1) max	Q	P	P_1	w
mm	2.7 2.3	0.88 0.65	0.60 0.45	11.1 10.5	7.8 7.2	4.58	2.29	16.5 15.3	2.54	1.5 0.9	3.2 3.0	3.9 3.6	0.254

Note

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

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT32		TO-126				97-03-04

Plastic single-ended leaded (through hole) package; with cooling fin, mountable to heatsink, 1 mounting hole; 3 leads (in-line) — SOT128B



DIMENSIONS (mm are the original dimensions)

UNIT	A	b_p	c	c_1	D	E	E_1	e	e_1	H_E	L	L_1	$L_2^{(1)}$ max	P	P_1	Q	w
mm	4.6 4.4	0.8 0.6	0.65 0.5	0.56 0.46	8.6 8.4	10.1 9.9	10.4 10.0	5.08	2.54	24.2 23.8	13.3 12.2	2.4 2.0	2.5	3.8 3.6	3.9 3.7	1.7 1.5	0.25

Note

1. Plastic flash allowed within this zone

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT128B		TO-202				97-02-28

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Data handbook system

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DC04	Colour Monitor and Multimedia Tubes
DC05	Wire Wound Components

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MA03	Piezoelectric Ceramics Specialty Ferrites
MA04	Dry-reed Switches

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PA03	Potentiometers
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PA05	Film Capacitors
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