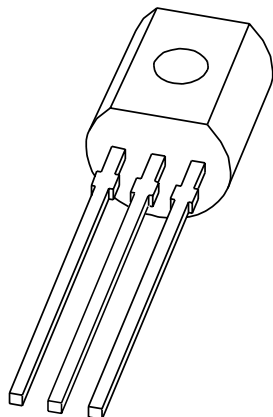


DATA SHEET



PN2222; PN2222A NPN switching transistors

Product specification
Supersedes data of September 1994
File under Discrete Semiconductors, SC04

1997 May 05

NPN switching transistors

PN2222; PN2222A

FEATURES

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

APPLICATIONS

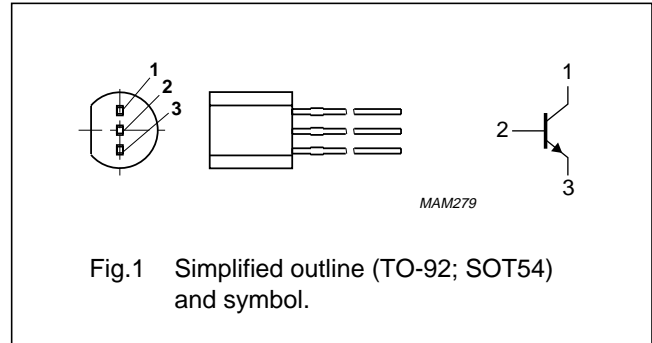
- General purpose switching and linear amplification.

DESCRIPTION

NPN switching transistor in a TO-92; SOT54 plastic package. PNP complement: PN2907A.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter



QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage PN2222 PN2222A	open emitter	–	60	V
			–	75	V
V_{CEO}	collector-emitter voltage PN2222 PN2222A	open base	–	30	V
			–	40	V
I_C	collector current (DC)		–	600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25\text{ }^\circ\text{C}$	–	500	mW
h_{FE}	DC current gain	$I_C = 150\text{ mA}; V_{CE} = 10\text{ V}$	100	300	
f_T	transition frequency PN2222 PN2222A	$I_C = 20\text{ mA}; V_{CE} = 20\text{ V}; f = 100\text{ MHz}$	250	–	MHz
			300	–	MHz
t_{off}	turn-off time PN2222A	$I_{Con} = 150\text{ mA}; I_{Bon} = 15\text{ mA}; I_{Boff} = -15\text{ mA}$	–	250	ns

NPN switching transistors

PN2222; PN2222A

LIMITING 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} ≤ 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-a}	thermal resistance from junction to ambient	note 1	250	K/W

Note

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

NPN switching transistors

PN2222; PN2222A

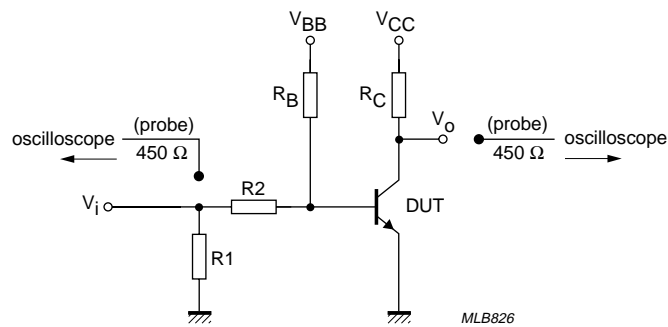
CHARACTERISTICS $T_j = 25\text{ °C}$ unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current PN2222	$I_E = 0; V_{CB} = 50\text{ V}$	–	10	nA
		$I_E = 0; V_{CB} = 50\text{ V}; T_{amb} = 125\text{ °C}$	–	10	μA
I_{CBO}	collector cut-off current PN2222A	$I_E = 0; V_{CB} = 60\text{ V}$	–	10	nA
		$I_E = 0; V_{CB} = 60\text{ V}; T_{amb} = 125\text{ °C}$	–	10	μA
I_{EBO}	emitter cut-off current	$I_C = 0; V_{EB} = 3\text{ V}$	–	10	nA
h_{FE}	DC current gain	$I_C = 0.1\text{ mA}; V_{CE} = 10\text{ V}$	35	–	
		$I_C = 1\text{ mA}; V_{CE} = 10\text{ V}$	50	–	
		$I_C = 10\text{ mA}; V_{CE} = 10\text{ V}$	75	–	
		$I_C = 150\text{ mA}; V_{CE} = 1\text{ V}$	50	–	
		$I_C = 150\text{ mA}; V_{CE} = 10\text{ V}$	100	300	
h_{FE}	DC current gain PN2222A	$I_C = 10\text{ mA}; V_{CE} = 10\text{ V}; T_{amb} = -55\text{ °C}$	35	–	
h_{FE}	DC current gain PN2222 PN2222A	$I_C = 500\text{ mA}; V_{CE} = 10\text{ V}$	30	–	
			40	–	
V_{CEsat}	collector-emitter saturation voltage PN2222 PN2222A	$I_C = 150\text{ mA}; I_B = 15\text{ mA}$	–	400	mV
			–	300	mV
V_{CEsat}	collector-emitter saturation voltage PN2222 PN2222A	$I_C = 500\text{ mA}; I_B = 50\text{ mA}$	1.6	–	V
			1	–	V
V_{BEsat}	base-emitter saturation voltage PN2222 PN2222A	$I_C = 150\text{ mA}; I_B = 15\text{ mA}$	–	1.3	V
			0.6	1.2	V
V_{BEsat}	base-emitter saturation voltage PN2222 PN2222A	$I_C = 500\text{ mA}; I_B = 50\text{ mA}$	–	2.6	V
			–	2	V
C_c	collector capacitance	$I_E = i_e = 0; V_{CB} = 10\text{ V}; f = 1\text{ MHz}$	–	8	pF
C_e	emitter capacitance PN2222 PN2222A	$I_C = i_c = 0; V_{EB} = 500\text{ mV}; f = 1\text{ MHz}$	–	30	pF
			–	25	pF
f_T	transition frequency PN2222 PN2222A	$I_C = 20\text{ mA}; V_{CE} = 20\text{ V}; f = 100\text{ MHz}$	250	–	MHz
			300	–	MHz
F	noise figure PN2222A	$I_C = 100\text{ }\mu\text{A}; V_{CE} = 5\text{ V}; R_S = 1\text{ k}\Omega; f = 1\text{ kHz}$	–	4	dB

NPN switching transistors

PN2222; PN2222A

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Switching times (between 10% and 90% levels) for type PN2222A; see Fig.2					
t_{on}	turn-on time	$I_{Con} = 150 \text{ mA}; I_{Bon} = 15 \text{ mA}; I_{Boff} = -15 \text{ mA};$ $T_{amb} = 25 \text{ }^\circ\text{C}$	–	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



$V_i = 9.5 \text{ V}; T = 500 \text{ } \mu\text{s}; t_p = 10 \text{ } \mu\text{s}; t_r = t_f \leq 3 \text{ ns.}$
 $R_1 = 68 \text{ } \Omega; R_2 = 325 \text{ } \Omega; R_B = 325 \text{ } \Omega; R_C = 160 \text{ } \Omega.$
 $V_{BB} = -3.5 \text{ V}; V_{CC} = 29.5 \text{ V.}$
 Oscilloscope: input impedance $Z_i = 50 \text{ } \Omega.$

Fig.2 Test circuit for switching times.

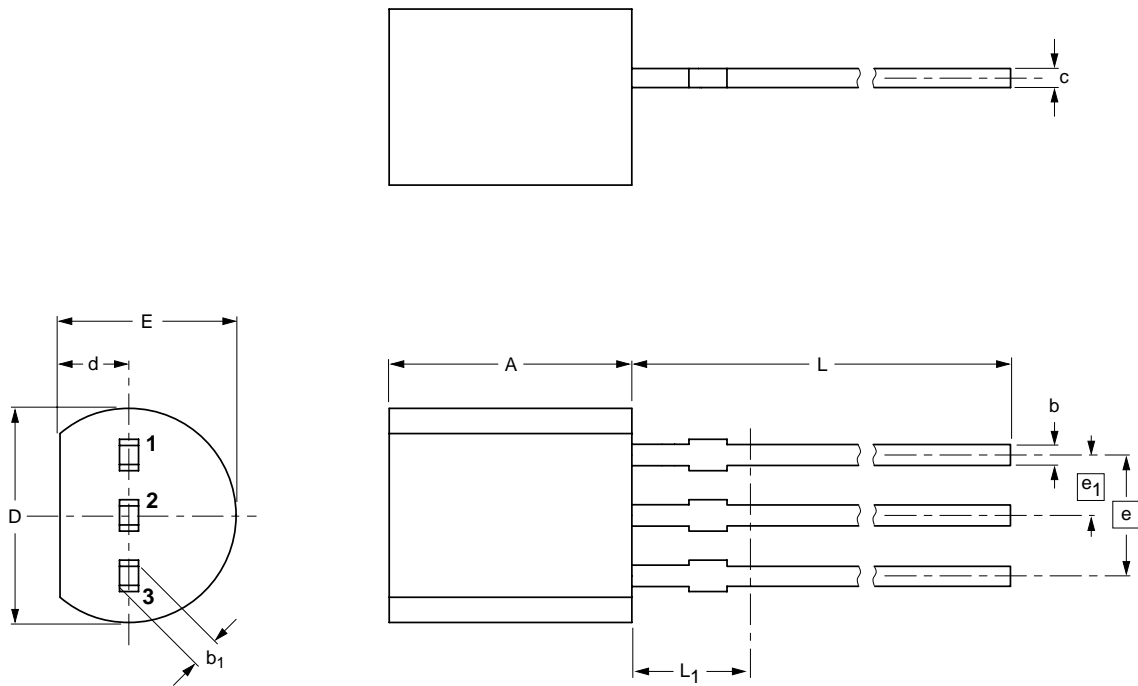
NPN switching transistors

PN2222; PN2222A

PACKAGE OUTLINE

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	0.48	0.66	0.45	4.8	1.7	4.2	2.54	1.27	14.5	2.5
	5.0	0.40	0.56	0.40	4.4	1.4	3.6				

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

NPN switching transistors

PN2222; PN2222A

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.	

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Printed in The Netherlands

117047/00/02/pp8

Date of release: 1997 May 05

Document order number: 9397 750 02067

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