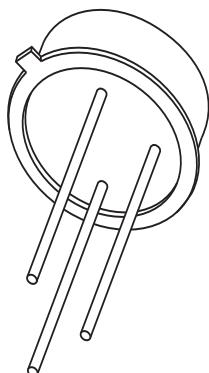


DATA SHEET



2N2222; 2N2222A NPN switching transistors

Product specification

1997 May 29

Supersedes data of September 1994

File under Discrete Semiconductors, SC04

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

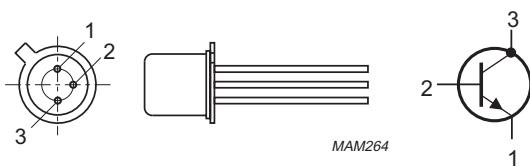


Fig.1 Simplified outline (TO-18) and symbol.

QUICK REFERENCE DATA

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

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LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage 2N2222 2N2222A	open emitter	– –	60 75	V V
V_{CEO}	collector-emitter voltage 2N2222 2N2222A	open base	– –	30 40	V V
V_{EBO}	emitter-base voltage 2N2222 2N2222A	open collector	– –	5 6	V 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	$T_{amb} \leq 25^\circ\text{C}$	–	500	mW
		$T_{case} \leq 25^\circ\text{C}$	–	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
$R_{th j-a}$	thermal resistance from junction to ambient	in free air	350	K/W
$R_{th j-c}$	thermal resistance from junction to case		146	K/W

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CHARACTERISTICS

 $T_j = 25^\circ\text{C}$ unless otherwise specified.

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

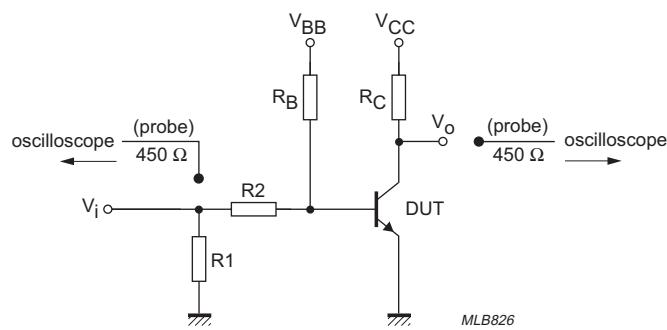
NPN switching transistors

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SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Switching times (between 10% and 90% levels); see Fig.2					
t_{on}	turn-on time	$I_{Con} = 150 \text{ mA}; I_{Bon} = 15 \text{ mA}; I_{Boff} = -15 \text{ mA}$	-	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: $t_p \leq 300 \mu\text{s}$; $\delta \leq 0.02$.



$V_i = 9.5 \text{ V}$; $T = 500 \mu\text{s}$; $t_p = 10 \mu\text{s}$; $t_r = t_f \leq 3 \text{ ns}$.

$R_1 = 68 \Omega$; $R_2 = 325 \Omega$; $R_B = 325 \Omega$; $R_C = 160 \Omega$.

$V_{BB} = -3.5 \text{ V}$; $V_{CC} = 29.5 \text{ V}$.

Oscilloscope input impedance $Z_i = 50 \Omega$.

Fig.2 Test circuit for switching times.