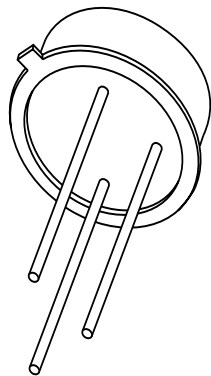


# DATA SHEET



## **2N2222; 2N2222A** NPN switching transistors

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

1997 May 29

# 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

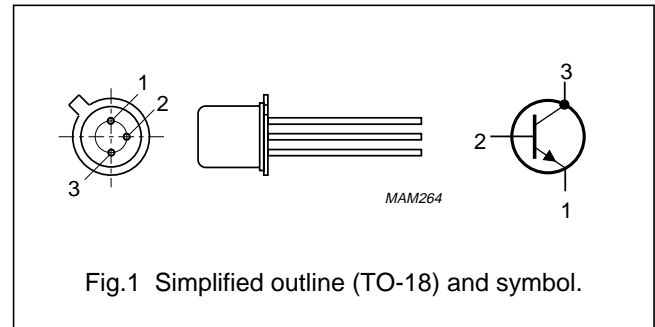


Fig.1 Simplified outline (TO-18) and symbol.

### 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	$T_{amb} \leq 25\text{ }^\circ\text{C}$	–	500	mW
$h_{FE}$	DC current gain	$I_C = 10\text{ mA}; V_{CE} = 10\text{ V}$	75	–	
$f_T$	transition frequency	$I_C = 20\text{ mA}; V_{CE} = 20\text{ V}; f = 100\text{ MHz}$			
	2N2222		250	–	MHz
	2N2222A		300	–	MHz
$t_{off}$	turn-off time	$I_{Con} = 150\text{ mA}; I_{Bon} = 15\text{ mA}; I_{Boff} = -15\text{ mA}$	–	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 <sub>CBO</sub>	collector-base voltage	open emitter	–	60	V
	2N2222			75	V
V <sub>CEO</sub>	collector-emitter voltage	open base	–	30	V
	2N2222A			40	V
V <sub>EBO</sub>	emitter-base voltage	open collector	–	5	V
	2N2222A			6	V
I <sub>C</sub>	collector current (DC)		–	800	mA
I <sub>CM</sub>	peak collector current		–	800	mA
I <sub>BM</sub>	peak base current		–	200	mA
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> ≤ 25 °C	–	500	mW
		T <sub>case</sub> ≤ 25 °C	–	1.2	W
T <sub>stg</sub>	storage temperature		–65	+150	°C
T <sub>j</sub>	junction temperature		–	200	°C
T <sub>amb</sub>	operating ambient temperature		–65	+150	°C

**THERMAL CHARACTERISTICS**

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
R <sub>th j-a</sub>	thermal resistance from junction to ambient	in free air	350	K/W
R <sub>th j-c</sub>	thermal resistance from junction to case		146	K/W

## NPN switching transistors

## 2N2222; 2N2222A

## CHARACTERISTICS

$T_j = 25\text{ °C}$  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
		$I_E = 0; V_{CB} = 50\text{ V}; T_{amb} = 150\text{ °C}$	–	10	$\mu\text{A}$
$I_{CBO}$	collector cut-off current 2N2222A	$I_E = 0; V_{CB} = 60\text{ V}$	–	10	nA
		$I_E = 0; V_{CB} = 60\text{ V}; T_{amb} = 150\text{ °C}$	–	10	$\mu\text{A}$
$I_{EBO}$	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	$I_C = 10\text{ mA}; V_{CE} = 10\text{ V}; T_{amb} = -55\text{ °C}$	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	$I_C = 200\text{ }\mu\text{A}; V_{CE} = 5\text{ V}; R_S = 2\text{ k}\Omega;$ $f = 1\text{ kHz}; B = 200\text{ Hz}$	–	4	dB

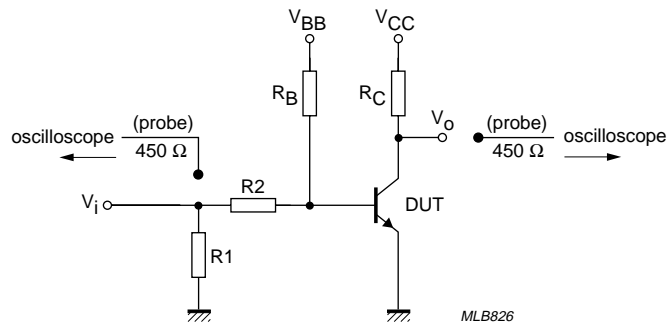
NPN switching transistors

2N2222; 2N2222A

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
<b>Switching times (between 10% and 90% levels); see Fig.2</b>					
$t_{on}$	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.

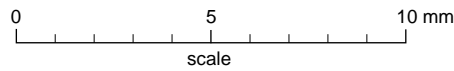
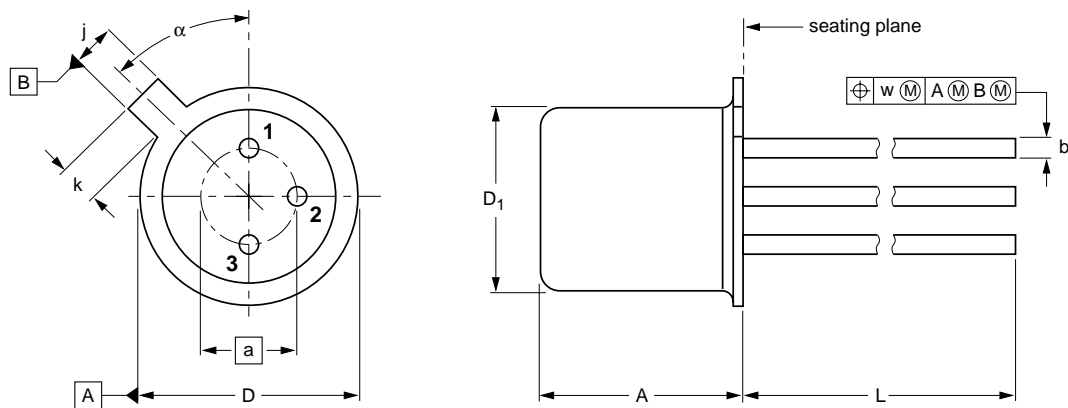
NPN switching transistors

2N2222; 2N2222A

PACKAGE OUTLINE

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 <sub>1</sub>	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

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**NPN switching transistors****2N2222; 2N2222A**

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**DEFINITIONS**

<b>Data sheet status</b>	
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.
<b>Limiting values</b>	
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.	
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