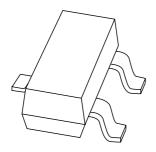
DISCRETE SEMICONDUCTORS

DATA SHEET



MMBT2222A NPN switching transistor

Product data sheet Supersedes data of 2000 Apr 11 2004 Jan 16



NPN switching transistor

MMBT2222A

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 complement: PMBT2907A.

MARKING

TYPE NUMBER	MARKING CODE ⁽¹⁾	
MMBT2222A	7C*	

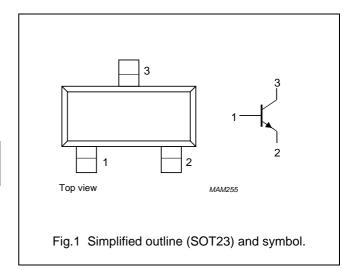
Note

* = p : Made in Hong Kong.
* = t : Made in Malaysia.

* = W : Made in China.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



ORDERING INFORMATION

TYPE	PACKAGE				
NUMBER	NAME	DESCRIPTION VERSION			
MMBT2222A	_	plastic surface mounted package; 3 leads	SOT23		

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 60134).

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} ≤ 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.

NPN switching transistor

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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

 $T_j = 25$ °C unless otherwise specified.

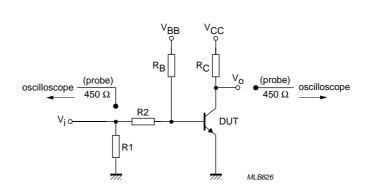
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	SYMBOL	PARAMETER CONDITIONS		MIN.	MAX.	UNIT
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	I _{CBO}	collector cut-off current	I _E = 0; V _{CB} = 60 V	_	10	nA
$\begin{array}{c} h_{FE} \\ h_{FE$			I _E = 0; V _{CB} = 60 V; T _j = 125 °C	_	10	μΑ
$ \begin{array}{ c c c c } \hline & I_{C} = 1 \text{ mA; } V_{CE} = 10 \text{ V} & 50 & - & & \\ \hline I_{C} = 10 \text{ mA; } V_{CE} = 10 \text{ V} & 75 & - & \\ \hline I_{C} = 10 \text{ mA; } V_{CE} = 10 \text{ V} & 75 & - & \\ \hline I_{C} = 10 \text{ mA; } V_{CE} = 10 \text{ V} & 35 & - & \\ \hline I_{C} = 10 \text{ mA; } V_{CE} = 10 \text{ V} & 35 & - & \\ \hline I_{C} = 150 \text{ mA; } V_{CE} = 10 \text{ V} & 100 & 300 & \\ \hline I_{C} = 150 \text{ mA; } V_{CE} = 10 \text{ V} & 50 & - & \\ \hline I_{C} = 150 \text{ mA; } V_{CE} = 10 \text{ V} & 40 & - & \\ \hline I_{C} = 500 \text{ mA; } V_{CE} = 10 \text{ V} & 40 & - & \\ \hline I_{C} = 500 \text{ mA; } V_{CE} = 10 \text{ V} & 40 & - & \\ \hline I_{C} = 500 \text{ mA; } V_{CE} = 10 \text{ V} & 40 & - & \\ \hline I_{C} = 500 \text{ mA; } V_{CE} = 10 \text{ V} & 40 & - & \\ \hline I_{C} = 500 \text{ mA; } V_{CE} = 10 \text{ V} & 40 & - & \\ \hline I_{C} = 500 \text{ mA; } V_{CE} = 10 \text{ V} & 40 & - & \\ \hline I_{C} = 500 \text{ mA; } V_{CE} = 10 \text{ V} & 40 & - & \\ \hline I_{C} = 500 \text{ mA; } V_{CE} = 10 \text{ V} & 40 & - & \\ \hline I_{C} = 500 \text{ mA; } V_{CE} = 10 \text{ V} & 40 & - & \\ \hline I_{C} = 500 \text{ mA; } V_{CE} = 10 \text{ V} & 40 & - & \\ \hline I_{C} = 500 \text{ mA; } V_{CE} = 10 \text{ V} & 40 & - & \\ \hline I_{C} = 500 \text{ mA; } V_{CE} = 10 \text{ V} & 10 & \\ \hline I_{C} = 500 \text{ mA; } V_{CE} = 10 \text{ V} & 10 & \\ \hline I_{C} = 500 \text{ mA; } I_{B} = 15 \text{ mA; note } & 1 & 0.6 & 1.2 & V \\ \hline I_{C} = 100 \text{ mA; } I_{B} = 15 \text{ mA; note } & 1 & 0.6 & 1.2 & V \\ \hline I_{C} = 100 \text{ mA; } I_{B} = 50 \text{ mA; note } & 1 & 0.6 & 1.2 & V \\ \hline I_{C} = 100 \text{ mA; } I_{B} = 50 \text{ mA; note } & 1 & 0.6 & 1.2 & V \\ \hline I_{C} = 100 \text{ mA; } V_{CE} = 10 \text{ V} & 1 & 0.6 & 1.2 & V \\ \hline I_{C} = 100 \text{ mA; } V_{CE} = 10 \text{ V} & 1 & 0.6 & 1.2 & V \\ \hline I_{C} = 100 \text{ mA; } V_{CE} = 10 \text{ V} & 1 & 0.6 & 1.2 & V \\ \hline I_{C} = 100 \text{ mA; } V_{CE} = 10 \text{ V} & 1 & 0.6 & 1.2 & V \\ \hline I_{C} = 100 \text{ mA; } V_{CE} = 20 \text{ V} & 1 & 0.6 & 1.2 & V \\ \hline I_{C} = 100 \text{ MHz} & 1 & 0.6 & 1.2 & 0.6 & 1.2 & 0.6 \\ \hline I_{C} = 100 \text{ MHz} & 1 & 0.6 & 1.2 & 0.6 & 0.6 \\ \hline I_{C} = 100 \text{ MHz} & 1 & 0.6 & 1.2 & 0.6 & 0.6 \\ \hline I_{C} = 100 \text{ MHz} & 1 & 0.6 & 1.2 & 0.6 & 0.6 \\ \hline I_{C} = 100 \text{ MHz} & 1 & 0.6 & 1.2 & 0.6 & 0.6 \\ \hline I_{C} = 100 \text{ MHz} & 1 & 0.6 & 0.6 & 0.$	I _{EBO}	emitter cut-off current	I _C = 0; V _{EB} = 5 V	_	10	nA
$ \begin{array}{ c c c c c } \hline & I_{C} = 10 \text{mA; } V_{CE} = 10 \text{V} & 75 & - & & \\ \hline I_{C} = 10 \text{mA; } V_{CE} = 10 \text{V; } \\ \hline I_{C} = 10 \text{mA; } V_{CE} = 10 \text{V; } \\ \hline I_{C} = 150 \text{mA; } V_{CE} = 10 \text{V} & 100 & 300 & \\ \hline I_{C} = 150 \text{mA; } V_{CE} = 10 \text{V} & 100 & 300 & \\ \hline I_{C} = 150 \text{mA; } V_{CE} = 10 \text{V} & 50 & - & \\ \hline I_{C} = 150 \text{mA; } V_{CE} = 10 \text{V} & 40 & - & \\ \hline I_{C} = 500 \text{mA; } V_{CE} = 10 \text{V} & 40 & - & \\ \hline I_{C} = 500 \text{mA; } V_{CE} = 10 \text{V} & 40 & - & \\ \hline I_{C} = 500 \text{mA; } I_{B} = 15 \text{mA; note } 1 & - & 300 & \text{mV} \\ \hline I_{C} = 500 \text{mA; } I_{B} = 15 \text{mA; note } 1 & - & 1 & V \\ \hline V_{DESat} & base-emitter saturation voltage & I_{C} = 150 \text{mA; } I_{B} = 15 \text{mA; note } 1 & - & 1 & V \\ \hline V_{DESat} & base-emitter saturation voltage & I_{C} = 150 \text{mA; } I_{B} = 15 \text{mA; note } 1 & - & 2 & V \\ \hline V_{C} & collector capacitance & I_{C} = 150 \text{mA; } I_{B} = 15 \text{mA; note } 1 & - & 2 & V \\ \hline I_{C} = 500 \text{mA; } I_{B} = 50 \text{mA; note } 1 & - & 2 & V \\ \hline I_{C} = 100 \text{mA; } V_{CB} = 10 \text{V; } & - & 8 & PF \\ \hline I_{T} & transition frequency & I_{C} = i_{C} = 0; V_{CB} = 500 \text{mV; } \\ \hline I_{T} & transition frequency & I_{C} = i_{C} = 0; V_{EB} = 500 \text{mV; } \\ \hline I_{T} & 100 \text{MHz} & 1 & - & 25 & PF \\ \hline \hline Switching time & I_{C} = 100 \mu\text{A; } V_{CE} = 20 \text{V; } \\ \hline I_{S} = 1 \text{kU; } f = 1 \text{kHz} & - & 4 & dB \\ \hline \hline Switching time & I_{C} = 100 \mu\text{A; } V_{CE} = 5 \text{V; } \\ \hline I_{S} = 1 \text{kU; } f = 1 \text{kHz} & - & 35 & \text{ns} \\ \hline I_{C} = 150 \text{mA; } I_{Bon} = 15 \text{mA; } \\ \hline I_{C} = 150 \text{mA; } I_{Bon} = 15 \text{mA; } \\ \hline I_{C} = 150 \text{mA; } I_{Bon} = 15 \text{mA; } \\ \hline I_{C} = 150 \text{mA; } I_{Bon} = 15 \text{mA; } \\ \hline I_{C} = 150 \text{mA; } I_{Bon} = 15 \text{mA; } \\ \hline I_{C} = 150 \text{mA; } I_{Bon} = 15 \text{mA; } \\ \hline I_{C} = 150 \text{mA; } I_{Bon} = 15 \text{mA; } \\ \hline I_{C} = 150 \text{mA; } I_{Bon} = 15 \text{mA; } \\ \hline I_{C} = 150 \text{mA; } I_{Bon} = 15 \text{mA; } \\ \hline I_{C} = 150 \text{mA; } I_{Bon} = 15 \text{mA; } \\ \hline I_{C} = 150 m$	h _{FE}	DC current gain	I _C = 0.1 mA; V _{CE} = 10 V	35	_	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			I _C = 1 mA; V _{CE} = 10 V	50	_	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			I _C = 10 mA; V _{CE} = 10 V	75	_	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$				35	_	
$ \begin{array}{ c c c c c } \hline & I_{C} = 500 \text{ mA; } V_{CE} = 10 \text{ V} & 40 & - & & & \\ \hline V_{CEsat} & collector-emitter saturation voltage & I_{C} = 150 \text{ mA; } I_{B} = 15 \text{ mA; note } 1 & - & 300 & \text{mV} \\ \hline I_{C} = 500 \text{ mA; } I_{B} = 50 \text{ mA; note } 1 & - & 1 & \text{V} \\ \hline I_{C} = 500 \text{ mA; } I_{B} = 50 \text{ mA; note } 1 & - & 1 & \text{V} \\ \hline V_{BEsat} & base-emitter saturation voltage & I_{C} = 150 \text{ mA; } I_{B} = 15 \text{ mA; note } 1 & - & 2 & \text{V} \\ \hline I_{C} = 500 \text{ mA; } I_{B} = 50 \text{ mA; note } 1 & - & 2 & \text{V} \\ \hline I_{C} = 500 \text{ mA; } I_{B} = 50 \text{ mA; note } 1 & - & 2 & \text{V} \\ \hline I_{C} = 500 \text{ mA; } I_{B} = 50 \text{ mA; note } 1 & - & 2 & \text{V} \\ \hline I_{C} = 100 \text{ mA; note } 1 & - & 2 & \text{V} \\ \hline I_{C} = I_{C} = I_{C} = I_{C} \times I_{C} \times I_{C} = 100 \text{ V; note } 1 \\ \hline I_{C} = I_{C} \times I_{C} \times I_{C} \times I_{C} = 100 \text{ V; note } 1 \\ \hline I_{C} = I_{C} \times I_{C} \times I_{C} \times I_{C} \times I_{C} = 100 \text{ MA; note } 1 \\ \hline I_{C} = I_{C} \times I_{C} \times I_{C} \times I_{C} \times I_{C} = 100 \text{ mA; note } 1 \\ \hline I_{C} = I_{C} \times $			I _C = 150 mA; V _{CE} = 10 V	100	300	
$ \begin{array}{c} V_{CEsat} \\ V_{CEsat} \\ \end{array} \begin{array}{c} \text{Collector-emitter saturation voltage} \\ \end{array} \begin{array}{c} I_{C} = 150 \text{ mA; } I_{B} = 15 \text{ mA; note } 1 \\ I_{C} = 500 \text{ mA; } I_{B} = 50 \text{ mA; note } 1 \\ \end{array} \begin{array}{c} - 10 \\ 10 \\ \end{array} \begin{array}{c} V_{CEsat} \\ \end{array} \end{array} \begin{array}{c} \text{base-emitter saturation voltage} \\ \end{array} \begin{array}{c} I_{C} = 150 \text{ mA; } I_{B} = 15 \text{ mA; note } 1 \\ \end{array} \begin{array}{c} - 10 \\ \end{array} \begin{array}{c} 0.6 \\ 1.2 \\ \end{array} \begin{array}{c} V_{CEsat} \\ \end{array} \begin{array}{c} V_{CE$			I _C = 150 mA; V _{CE} = 1 V	50	_	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			I _C = 500 mA; V _{CE} = 10 V	40	_	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	V _{CEsat}	collector-emitter saturation voltage	$I_C = 150 \text{ mA}$; $I_B = 15 \text{ mA}$; note 1	_	300	mV
$ \begin{array}{ c c c c c } \hline & & & & & & & & & & & & & & & & & & $			$I_C = 500 \text{ mA}; I_B = 50 \text{ mA}; \text{ note } 1$	_	1	V
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	V _{BEsat}	base-emitter saturation voltage	$I_C = 150 \text{ mA}$; $I_B = 15 \text{ mA}$; note 1	0.6	1.2	V
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			$I_C = 500 \text{ mA}$; $I_B = 50 \text{ mA}$; note 1	_	2	V
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	C _c	collector capacitance		_	8	pF
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	C _e	emitter capacitance		_	25	pF
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	f _T	transition frequency		300	_	MHz
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	F	noise figure		_	4	dB
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Switching ti	mes (between 10% and 90% levels); (see F	ig.2)		•	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	t _{on}	turn-on time	I _{Con} = 150 mA; I _{Bon} = 15 mA;	_	35	ns
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		delay time		_	15	ns
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	<u> </u>	•		_	20	ns
t _s storage time – 200 ns		turn-off time		_	250	ns
		storage time		_	200	ns
		fall time		_	60	ns

Note

1. Pulse test: $t_p \leq 300~\mu s;~\delta \leq 0.02.$

NPN switching transistor

MMBT2222A



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

Fig.2 Test circuit for switching times.

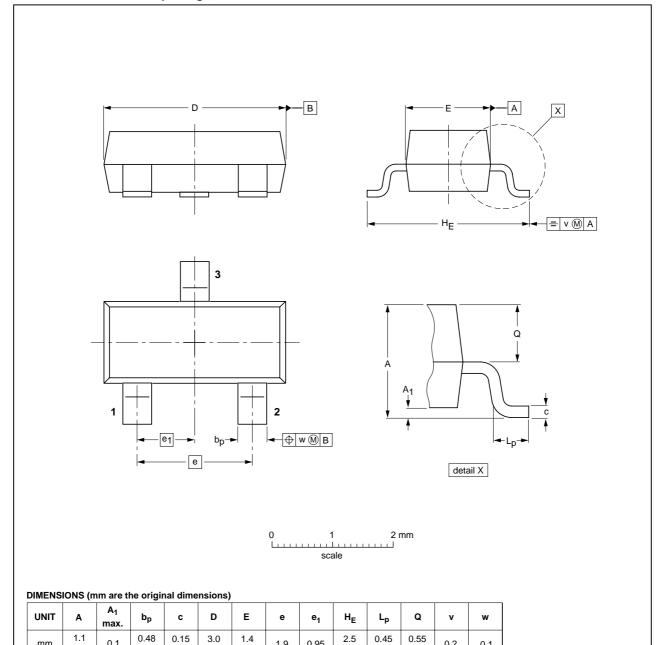
NPN switching transistor

MMBT2222A

PACKAGE OUTLINE

Plastic surface-mounted package; 3 leads

SOT23



OUTLINE	REFERENCES		EUROPEAN	ISSUE DATE		
VERSION	IEC	JEDEC	JEITA		PROJECTION	ISSUE DATE
SOT23		TO-236AB				-04-11-04 06-03-16

0.1

1.9

2004 Jan 16 5

0.38

0.9

NPN switching transistor

MMBT2222A

DATA SHEET STATUS

DOCUMENT STATUS ⁽¹⁾	PRODUCT STATUS ⁽²⁾	DEFINITION
Objective data sheet	Development	This document contains data from the objective specification for product development.
Preliminary data sheet	Qualification	This document contains data from the preliminary specification.
Product data sheet	Production	This document contains the product specification.

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NXP Semiconductors

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