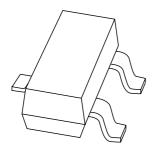
DISCRETE SEMICONDUCTORS

DATA SHEET



PMBT3904 NPN switching transistor

Product data sheet Supersedes data of 1999 Apr 27 2004 Jan 12



NPN switching transistor

PMBT3904

FEATURES

- Collector current capability I_C = 200 mA
- Collector-emitter voltage V_{CEO} = 40 V.

APPLICATIONS

• General switching and amplification.

DESCRIPTION

NPN switching transistor in a SOT23 plastic package. PNP complement: PMBT3906.

MARKING

TYPE NUMBER	MARKING CODE(1)
PMBT3904	*1A

Note

1. * = p: Made in Hong Kong.

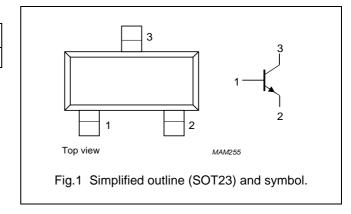
* = t : Made in Malaysia. * = W : Made in China.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MAX.	UNIT
V _{CEO}	collector-emitter voltage	40	V
I _C	collector current (DC)	200	mA

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



ORDERING INFORMATION

TYPE	PACKAGE		
NUMBER	NAME	DESCRIPTION	VERSION
PMBT3904	_	plastic surface mounted package; 3 leads SOT	

NPN switching transistor

PMBT3904

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	-	60	V
V_{CEO}	collector-emitter voltage	open base	_	40	V
V _{EBO}	emitter-base voltage	open collector	_	6	V
Ic	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} ≤ 25 °C; note 1	_	250	mW
T _{stg}	storage temperature		-65	+150	°C
Tj	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} = 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; note 1			
		$I_{C} = 0.1 \text{ mA}$	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	I _C = 10 mA; I _B = 1 mA	_	200	mV
	voltage	$I_C = 50 \text{ mA}; I_B = 5 \text{ mA}$	-	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	$I_E = I_e = 0$; $V_{CB} = 5 \text{ V}$; $f = 1 \text{ MHz}$	_	4	pF
C _e	emitter capacitance	$I_C = I_c = 0$; $V_{BE} = 500 \text{ mV}$; $f = 1 \text{ MHz}$	_	8	pF

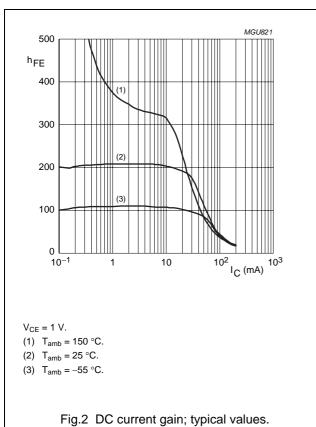
NPN switching transistor

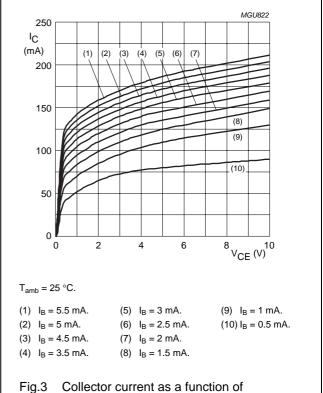
PMBT3904

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
f _T	transition frequency	$I_C = 10 \text{ mA}; V_{CE} = 20 \text{ V};$ 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 ti	imes (between 10% and 90% lev	els); see Fig.3			
t _d	delay time	I _{Con} = 10 mA; I _{Bon} = 1 mA;	_	35	ns
t _r	rise time	$I_{Boff} = -1 \text{ mA}$	_	35	ns
t _s	storage time		_	200	ns
t _f	fall time		_	50	ns

Note

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



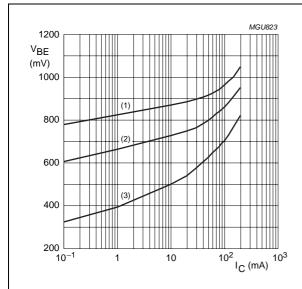


collector-emitter voltage.

2004 Jan 12 4

NPN switching transistor

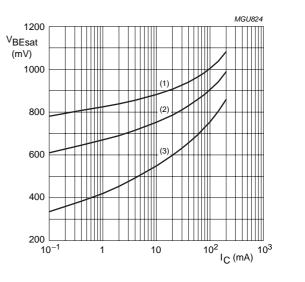
PMBT3904



 $V_{CE} = 1 V$.

- (1) $T_{amb} = -55 \, ^{\circ}C$.
- (2) $T_{amb} = 25 \, ^{\circ}C$.
- (3) $T_{amb} = 150 \, ^{\circ}C$.

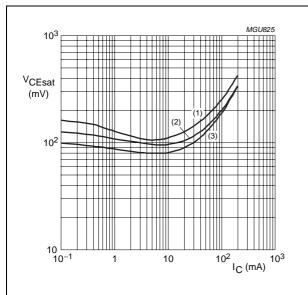
Fig.4 Base-emitter voltage as a function of collector current.



 $I_{\rm C}/I_{\rm B} = 10.$

- (1) $T_{amb} = -55 \, ^{\circ}C$.
- (2) $T_{amb} = 25 \, ^{\circ}C$.
- (3) $T_{amb} = 150 \, ^{\circ}C$.

Fig.5 Base-emitter saturation voltage as a function of collector current.



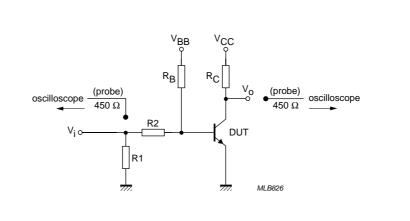
 $I_{\rm C}/I_{\rm B}=10.$

- (1) T_{amb} = 150 °C.
- (2) $T_{amb} = 25 \, ^{\circ}C$.
- (3) $T_{amb} = -55 \, ^{\circ}C$.

Fig.6 Collector-emitter saturation voltage as a function of collector current.

NPN switching transistor

PMBT3904



$$\begin{split} V_i = 5 \; V; \; T = 500 \; \mu s; \; t_p = 10 \; \mu s; \; t_r = t_f \leq 3 \; ns. \\ R1 = 56 \; \Omega; \; R2 = 2.5 \; k\Omega; \; R_B = 3.9 \; k\Omega; \; R_C = 270 \; \Omega. \end{split}$$

 $V_{BB} = -1.9 \text{ V}$; $V_{CC} = 3 \text{ V}$.

Oscilloscope: input impedance Z_i = 50 Ω .

Fig.7 Test circuit for switching times.

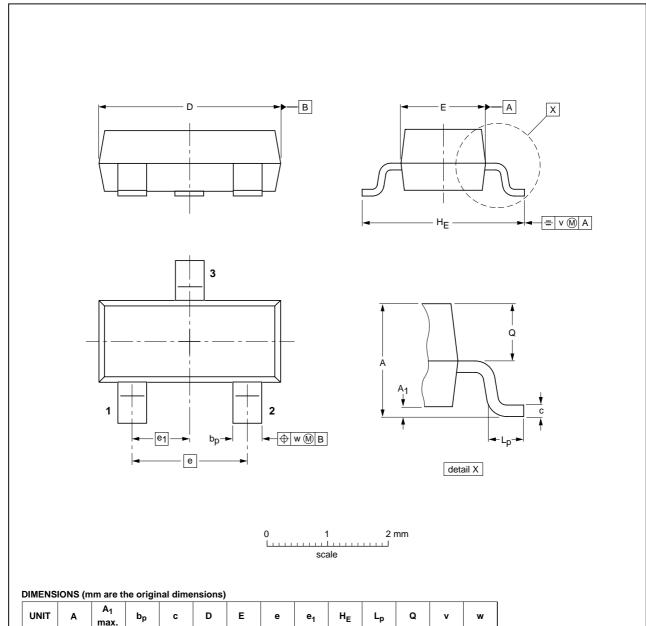
NPN switching transistor

PMBT3904

PACKAGE OUTLINE



SOT23



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

1.9

0.45

0.55

0.1

2004 Jan 12 7

max

0.9

0.48

0.38

NPN switching transistor

PMBT3904

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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