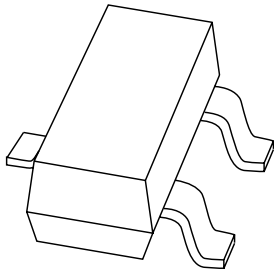


# DATA SHEET



## **PMBT3904** NPN switching transistor

Product data sheet  
Supersedes data of 1999 Apr 27

2004 Jan 12

# NPN switching transistor

# PMBT3904

### FEATURES

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

### APPLICATIONS

- General switching and amplification.

### DESCRIPTION

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

### MARKING

TYPE NUMBER	MARKING CODE <sup>(1)</sup>
PMBT3904	*1A

### Note

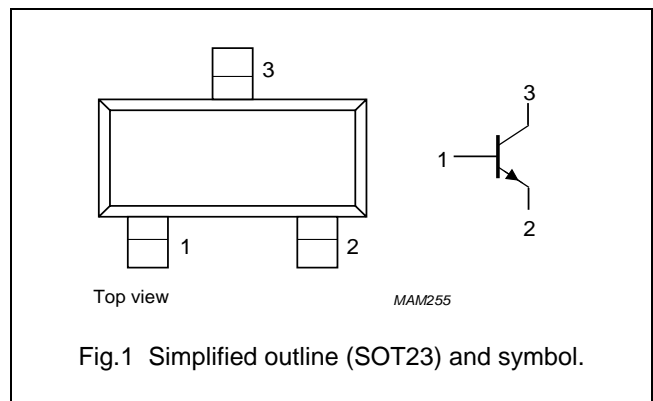
- \* = p : Made in Hong Kong.  
\* = t : Made in Malaysia.  
\* = W : Made in China.

### 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 NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
PMBT3904	-	plastic surface mounted package; 3 leads	SOT23

## 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
$I_C$	collector current (DC)		–	200	mA
$I_{CM}$	peak collector current		–	200	mA
$I_{BM}$	peak base current		–	100	mA
$P_{tot}$	total power dissipation	$T_{amb} \leq 25\text{ °C}$ ; 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.

**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**

$T_{amb} = 25\text{ °C}$  unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$I_{CBO}$	collector cut-off current	$I_E = 0$ ; $V_{CB} = 30\text{ V}$	–	50	nA
$I_{EBO}$	emitter cut-off current	$I_C = 0$ ; $V_{EB} = 6\text{ V}$	–	50	nA
$h_{FE}$	DC current gain	$V_{CE} = 1\text{ V}$ ; see Fig.2; note 1 $I_C = 0.1\text{ mA}$ $I_C = 1\text{ mA}$ $I_C = 10\text{ mA}$ $I_C = 50\text{ mA}$ $I_C = 100\text{ mA}$	60 80 100 60 30	– – 300 – –	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 10\text{ mA}$ ; $I_B = 1\text{ mA}$ $I_C = 50\text{ mA}$ ; $I_B = 5\text{ mA}$	– –	200 300	mV mV
$V_{BEsat}$	base-emitter saturation voltage	$I_C = 10\text{ mA}$ ; $I_B = 1\text{ mA}$ $I_C = 50\text{ mA}$ ; $I_B = 5\text{ mA}$	650 –	850 950	mV 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

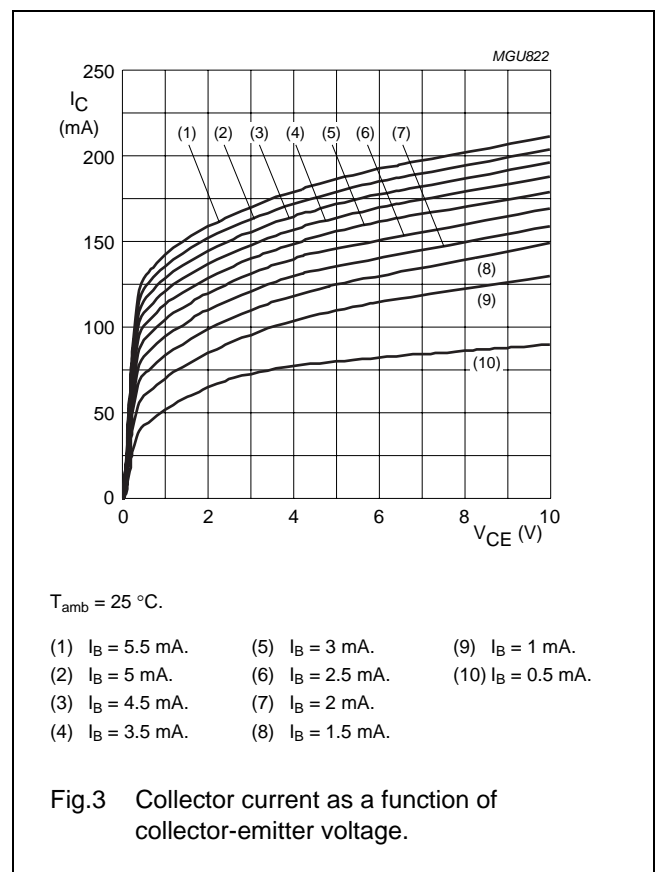
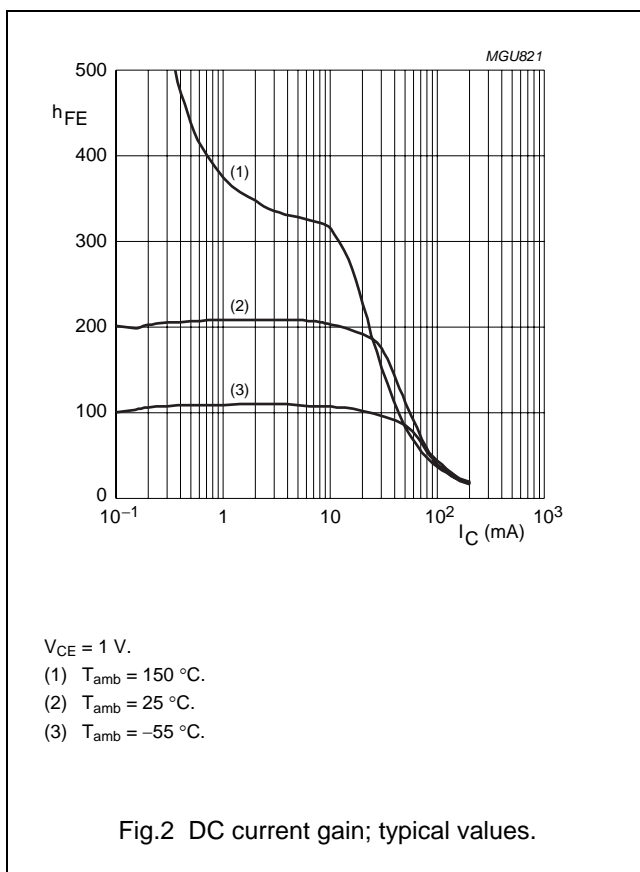
NPN switching transistor

PMBT3904

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$f_T$	transition frequency	$I_C = 10 \text{ mA}; V_{CE} = 20 \text{ V};$ $f = 100 \text{ MHz}$	300	–	MHz
F	noise figure	$I_C = 100 \mu\text{A}; V_{CE} = 5 \text{ V}; R_S = 1 \text{ k}\Omega;$ $f = 10 \text{ Hz to } 15.7 \text{ kHz}$	–	5	dB
<b>Switching times (between 10% and 90% levels); see Fig.3</b>					
$t_d$	delay time	$I_{Con} = 10 \text{ mA}; I_{Bon} = 1 \text{ mA};$ $I_{Boff} = -1 \text{ mA}$	–	35	ns
$t_r$	rise time		–	35	ns
$t_s$	storage time		–	200	ns
$t_f$	fall time		–	50	ns

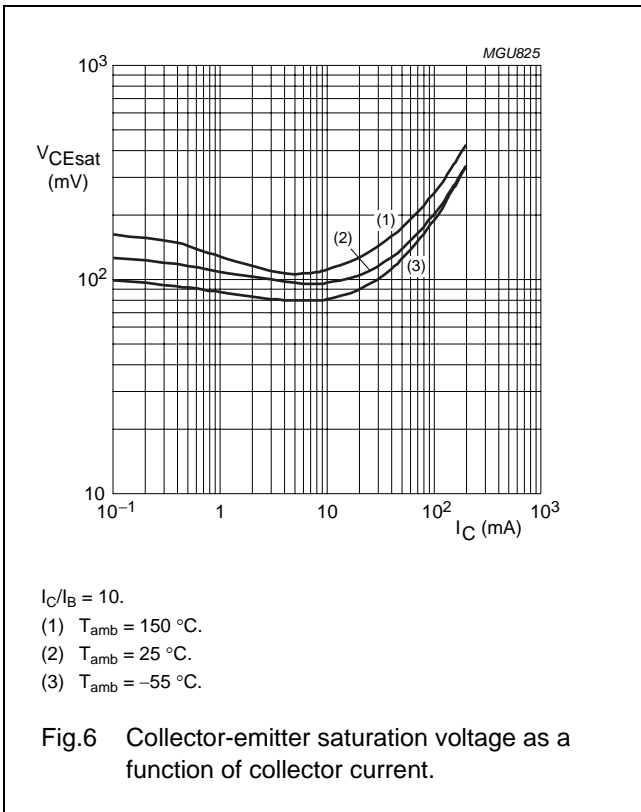
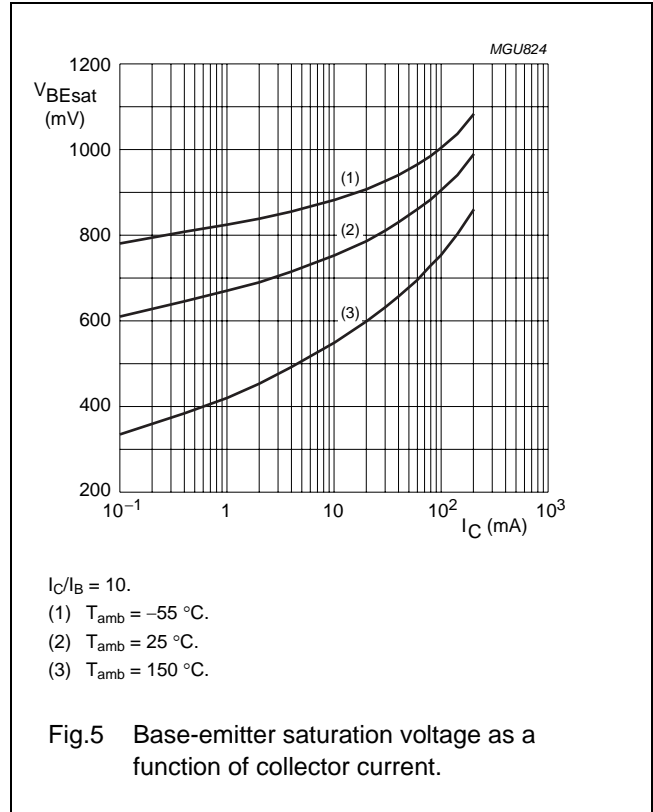
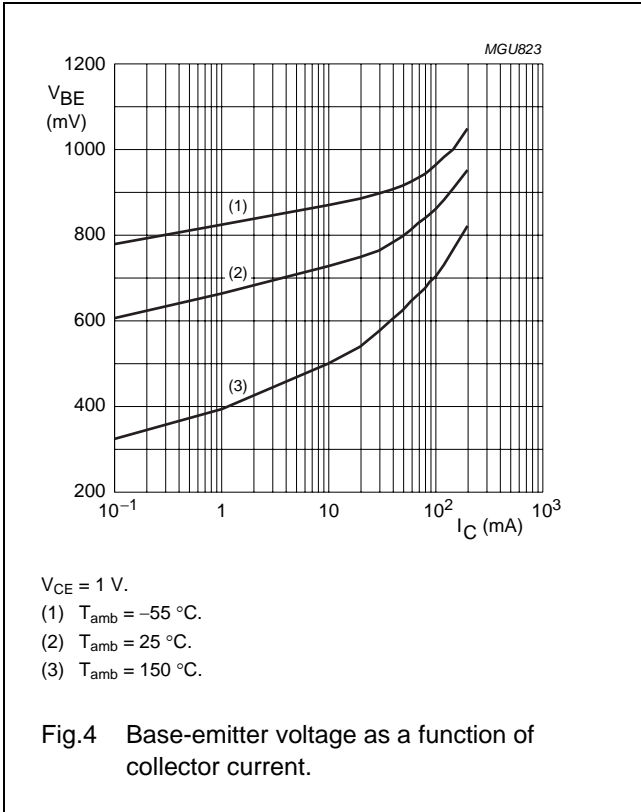
Note

1. Pulse test:  $t_p \leq 300 \mu\text{s}; \delta \leq 0.02$ .



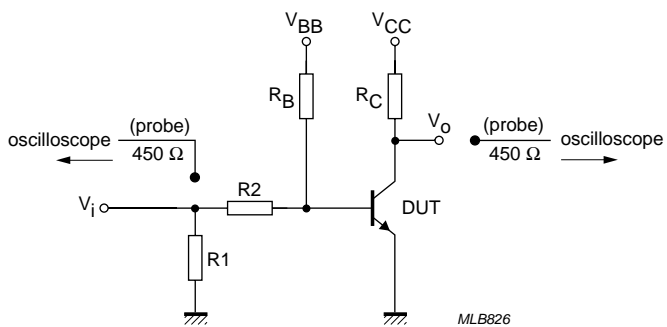
NPN switching transistor

PMBT3904



NPN switching transistor

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$V_i = 5\text{ V}$ ;  $T = 500\ \mu\text{s}$ ;  $t_p = 10\ \mu\text{s}$ ;  $t_r = t_f \leq 3\ \text{ns}$ .  
 $R_1 = 56\ \Omega$ ;  $R_2 = 2.5\ \text{k}\Omega$ ;  $R_B = 3.9\ \text{k}\Omega$ ;  $R_C = 270\ \Omega$ .  
 $V_{BB} = -1.9\ \text{V}$ ;  $V_{CC} = 3\ \text{V}$ .  
 Oscilloscope: input impedance  $Z_i = 50\ \Omega$ .

Fig.7 Test circuit for switching times.

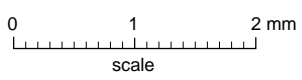
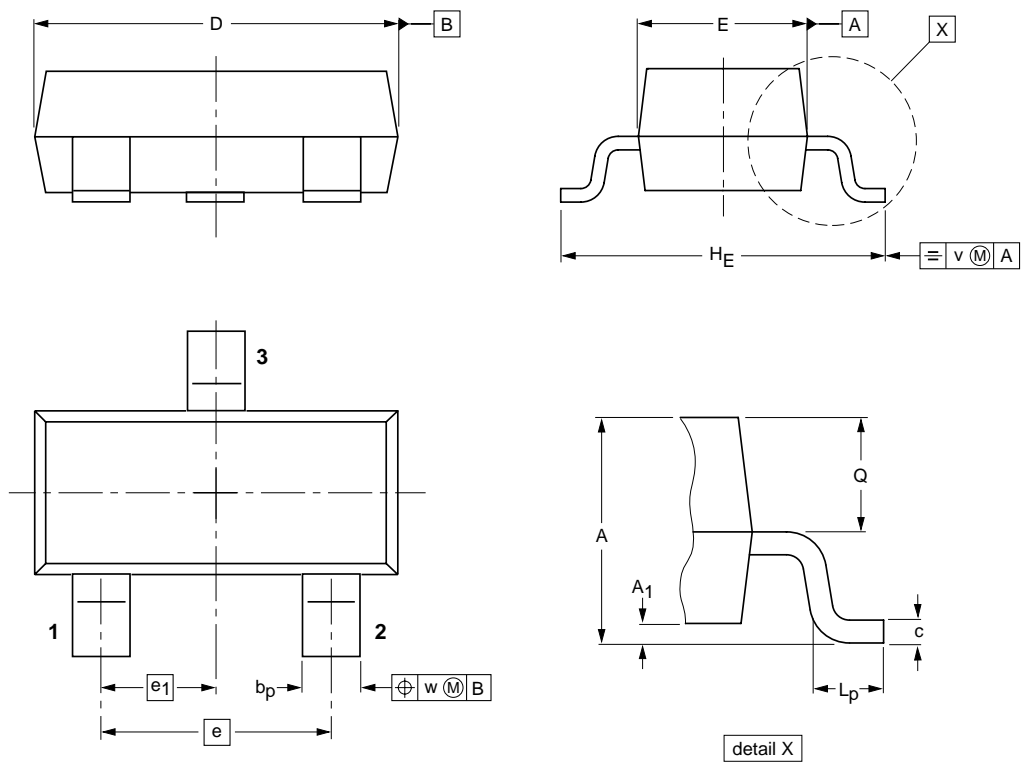
NPN switching transistor

PMBT3904

PACKAGE OUTLINE

Plastic surface-mounted package; 3 leads

SOT23



DIMENSIONS (mm are the original dimensions)

UNIT	A	A <sub>1</sub> max.	b <sub>p</sub>	c	D	E	e	e <sub>1</sub>	H <sub>E</sub>	L <sub>p</sub>	Q	v	w
mm	1.1 0.9	0.1	0.48 0.38	0.15 0.09	3.0 2.8	1.4 1.2	1.9	0.95	2.5 2.1	0.45 0.15	0.55 0.45	0.2	0.1

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

NPN switching transistor

PMBT3904

**DATA SHEET STATUS**

DOCUMENT STATUS <sup>(1)</sup>	PRODUCT STATUS <sup>(2)</sup>	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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Printed in The Netherlands

R75/04/pp9

Date of release: 2004 Jan 12

Document order number: 9397 750 12461

