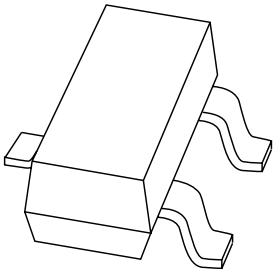
DATA SHEET



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

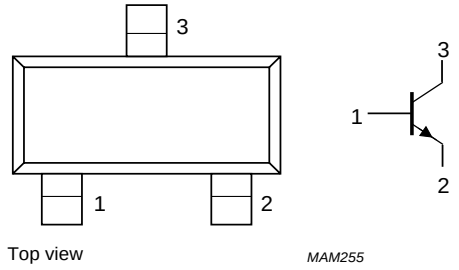


Fig.1 Simplified outline (SOT23) and symbol.

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
PMBT3904	–	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	–	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	$T_{amb} \leq 25$ °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

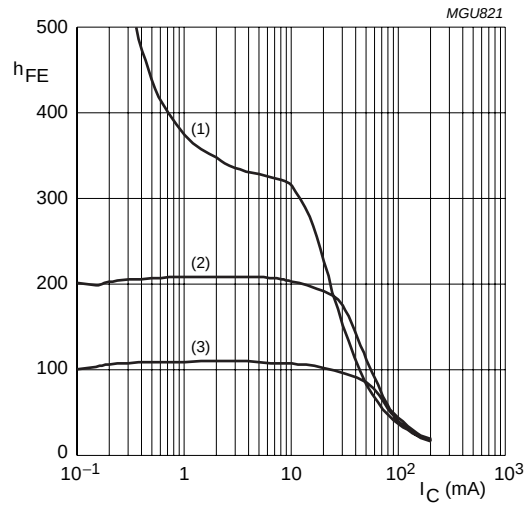
T_{amb} = 25 °C unless otherwise specified.

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			
		$I_C = 0.1$ 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 voltage	$I_C = 10$ mA; $I_B = 1$ mA	–	200	mV
		$I_C = 50$ mA; $I_B = 5$ 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	$I_E = I_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	4	pF
C_e	emitter capacitance	$I_C = I_c = 0$; $V_{BE} = 500$ mV; f = 1 MHz	–	8	pF

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

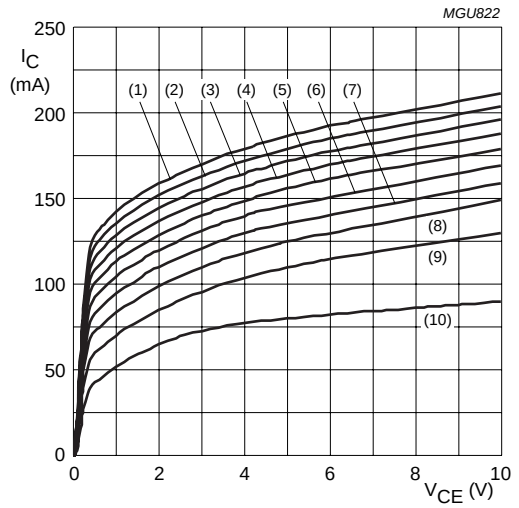
Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.02$.



V_{CE} = 1 V.
(1) T_{amb} = 150 °C.
(2) T_{amb} = 25 °C.
(3) T_{amb} = −55 °C.

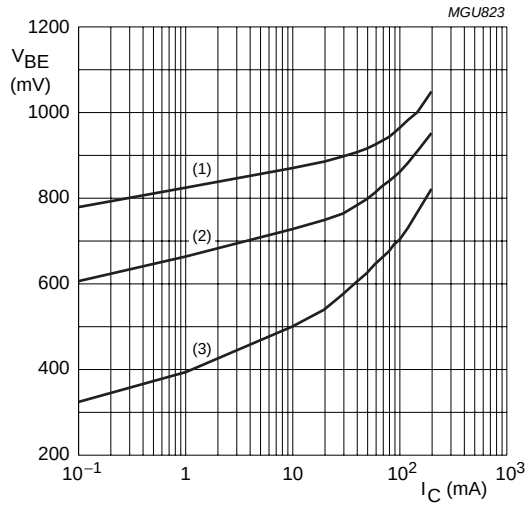
Fig.2 DC current gain; typical values.



T_{amb} = 25 °C.

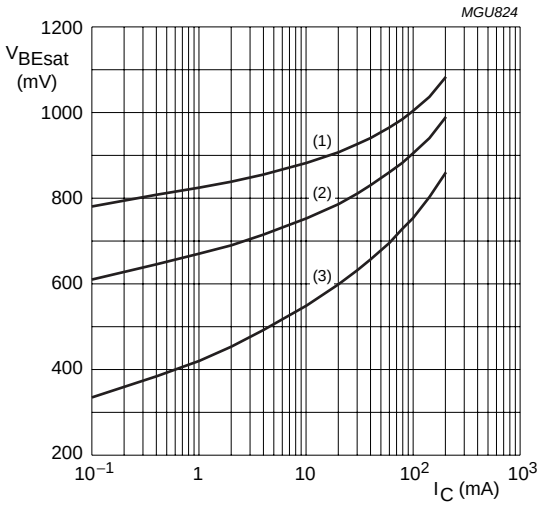
(1) I_B = 5.5 mA.
(2) I_B = 5 mA.
(3) I_B = 4.5 mA.
(4) I_B = 3.5 mA.
(5) I_B = 3 mA.
(6) I_B = 2.5 mA.
(7) I_B = 2 mA.
(8) I_B = 1.5 mA.
(9) I_B = 1 mA.
(10) I_B = 0.5 mA.

Fig.3 Collector current as a function of collector-emitter voltage.



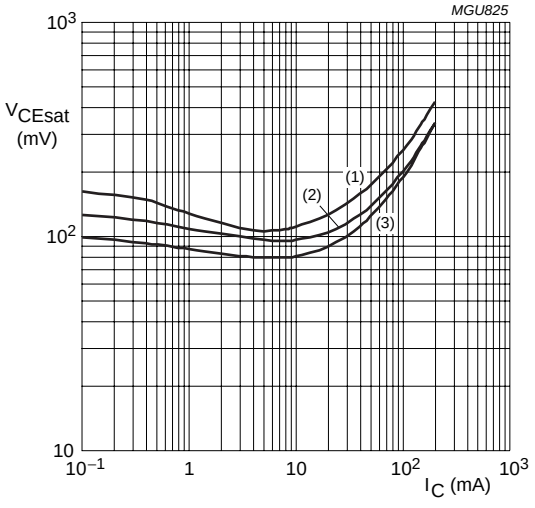
V_{CE} = 1 V.
(1) T_{amb} = –55 °C.
(2) T_{amb} = 25 °C.
(3) T_{amb} = 150 °C.

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



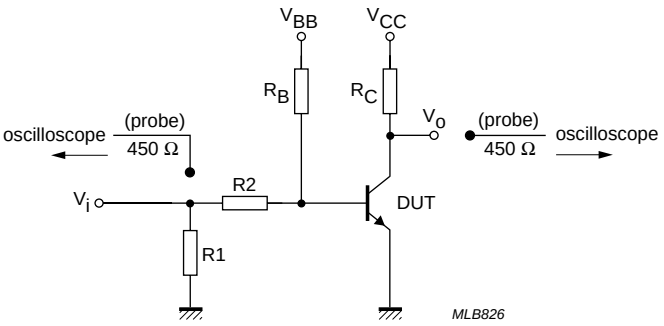
I_C/I_B = 10.
(1) T_{amb} = –55 °C.
(2) T_{amb} = 25 °C.
(3) T_{amb} = 150 °C.

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



I_C/I_B = 10.
(1) T_{amb} = 150 °C.
(2) T_{amb} = 25 °C.
(3) T_{amb} = –55 °C.

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

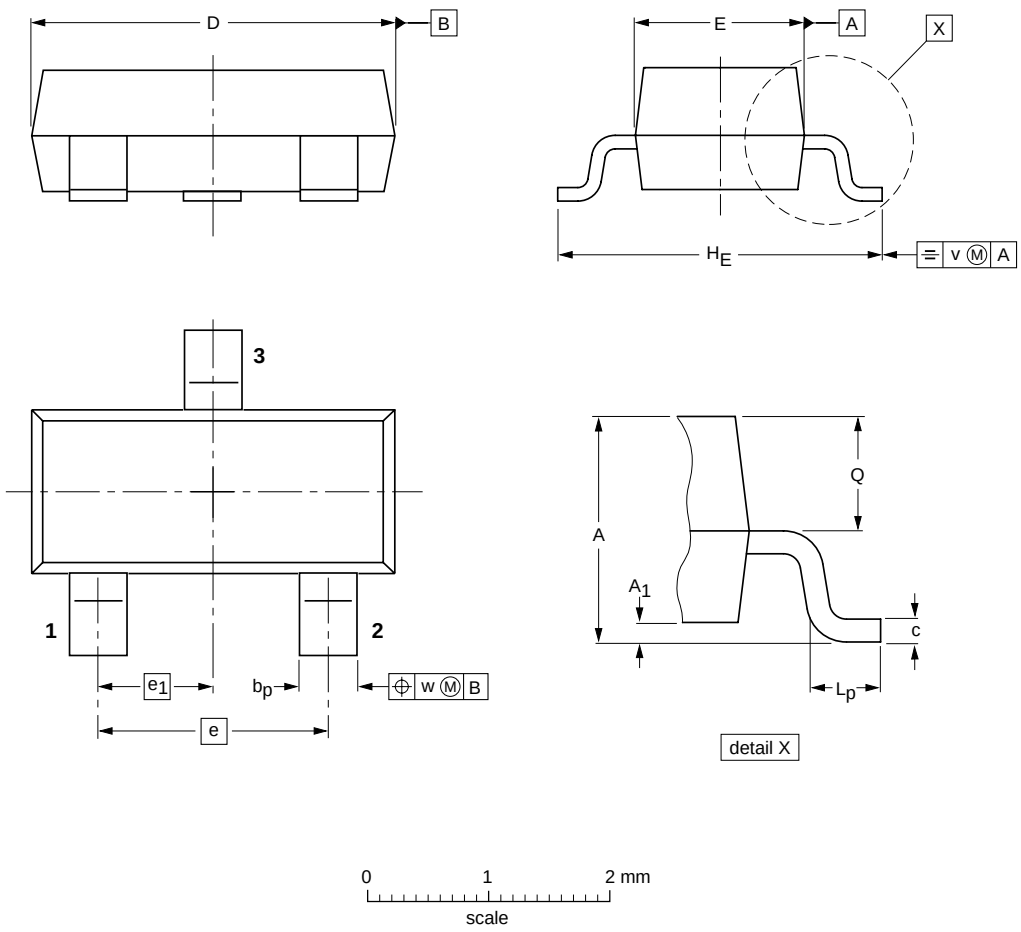


V_i = 5 V; T = 500 μs; t_p = 10 μs; t_r = t_f ≤ 3 ns.
R1 = 56 Ω; R2 = 2.5 kΩ; R_B = 3.9 kΩ; R_C = 270 Ω.
V_{BB} = −1.9 V; V_{CC} = 3 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.7 Test circuit for switching times.

PACKAGE OUTLINE

Plastic surface-mounted package; 3 leads **SOT23**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max.	b_p	c	D	E	e	e_1	H_E	L_p	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

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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