PMBT3904-Q

40 V, 200 mA NPN switching transistor

16 February 2024 Product data sheet

1. General description

NPN switching transistor in a small SOT23 Surface-Mounted Device (SMD) plastic package.

2. Features and benefits

- Collector current capability I_C = 200 mA
- Collector-emitter voltage V_{CEO} = 40 V
- Qualified according to AEC-Q101 and recommended for use in automotive applications

3. Applications

- General switching and amplification

4. Quick reference data

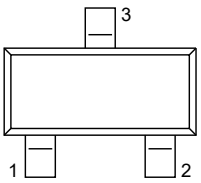
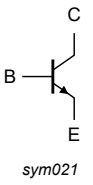
Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{CEO}	collector-emitter voltage	open base		-	-	40	V
I_C	collector current			-	-	200	mA
h_{FE}	DC current gain	V_{CE} = 1 V; I_C = 10 mA; T_{amb} = 25 °C	[1]	100	-	300	

[1] Pulsed test: $t_p \leq 300$ µs; $\delta \leq 0.02$

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	B	base		
2	E	emitter		
3	C	collector		

SOT23

sym021

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PMBT3904-Q	SOT23	plastic, surface-mounted package; 3 terminals; 1.9 mm pitch; 2.9 mm x 1.3 mm x 1 mm body	SOT23

7. Marking

Table 4. Marking codes

Type number	Marking code[1]
PMBT3904-Q	%1A

[1] % = placeholder for manufacturing site code

8. Limiting values

Table 5. 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			-	200	mA
I_{CM}	peak collector current	single pulse; $t_p \leq 1$ ms		-	200	mA
I_{BM}	peak base current			-	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	[1]	-	250	mW
T_j	junction temperature			-	150	°C
T_{amb}	ambient temperature			-65	150	°C
T_{stg}	storage temperature			-65	150	°C

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.

9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient		[1]	-	-	500	K/W

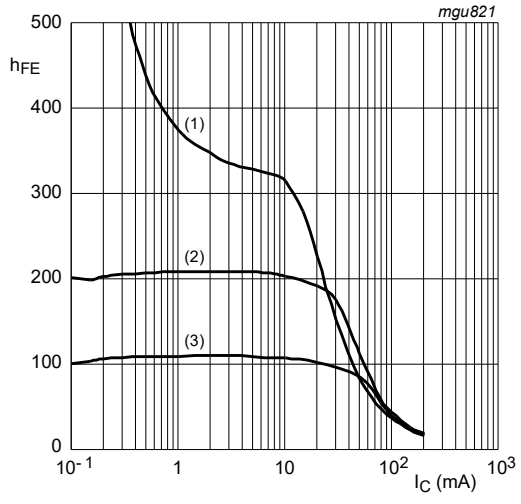
[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.

10. Characteristics

Table 7. Characteristics

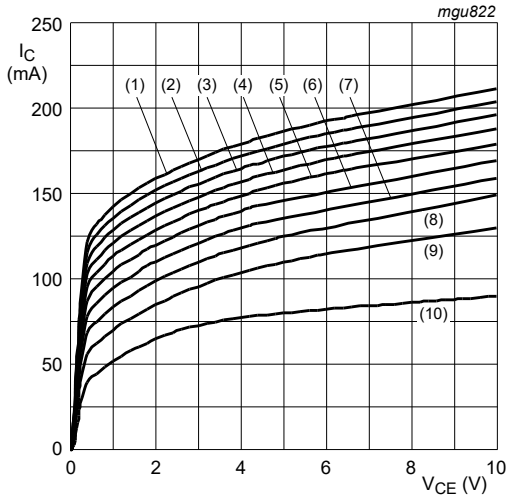
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_{CBO}	collector-base cut-off current	V_{CB} = 30 V; I_E = 0 A; T_{amb} = 25 °C		-	-	50	nA
I_{EBO}	emitter-base cut-off current	V_{EB} = 6 V; I_C = 0 A; T_{amb} = 25 °C		-	-	50	nA
h_{FE}	DC current gain	V_{CE} = 1 V; I_C = 0.1 mA; T_{amb} = 25 °C	[1]	60	-	-	
		V_{CE} = 1 V; I_C = 1 mA; T_{amb} = 25 °C	[1]	80	-	-	
		V_{CE} = 1 V; I_C = 10 mA; T_{amb} = 25 °C	[1]	100	-	300	
		V_{CE} = 1 V; I_C = 50 mA; T_{amb} = 25 °C	[1]	60	-	-	
		V_{CE} = 1 V; I_C = 100 mA; T_{amb} = 25 °C	[1]	30	-	-	
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA; I_B = 1 mA; T_{amb} = 25 °C		-	-	200	mV
		I_C = 50 mA; I_B = 5 mA; T_{amb} = 25 °C		-	-	300	mV
V_{BEsat}	base-emitter saturation voltage	I_C = 10 mA; I_B = 1 mA; T_{amb} = 25 °C		650	-	850	mV
		I_C = 50 mA; I_B = 5 mA; T_{amb} = 25 °C		-	-	950	mV
t_d	delay time	I_C = 10 mA; I_{Bon} = 1 mA; I_{Boff} = -1 mA; T_{amb} = 25 °C		-	-	35	ns
t_r	rise time			-	-	35	ns
t_s	storage time			-	-	200	ns
t_f	fall time			-	-	50	ns
C_c	collector capacitance	V_{CB} = 5 V; I_E = 0 A; i_e = 0 A; f = 1 MHz; T_{amb} = 25 °C		-	-	4	pF
C_e	emitter capacitance	V_{EB} = 500 mV; I_C = 0 A; i_c = 0 A; f = 1 MHz; T_{amb} = 25 °C		-	-	8	pF
f_T	transition frequency	V_{CE} = 20 V; I_C = 10 mA; f = 100 MHz; T_{amb} = 25 °C		300	-	-	MHz
NF	noise figure	V_{CE} = 5 V; I_C = 100 µA; R_S = 1 kΩ; f = 10 Hz to 15.7 kHz; T_{amb} = 25 °C		-	-	5	dB

[1] Pulsed test: $t_p \leq 300$ µs; $\delta \leq 0.02$



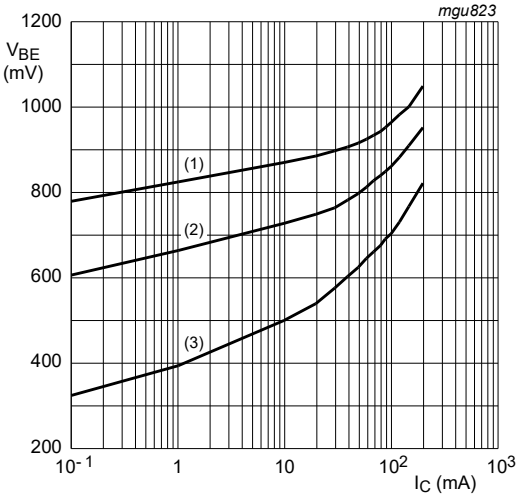
V_{CE} = 1 V
(1) T_{amb} = 150 °C
(2) T_{amb} = 25 °C
(3) T_{amb} = −55 °C

Fig. 1. DC current gain as a function of collector current; typical values



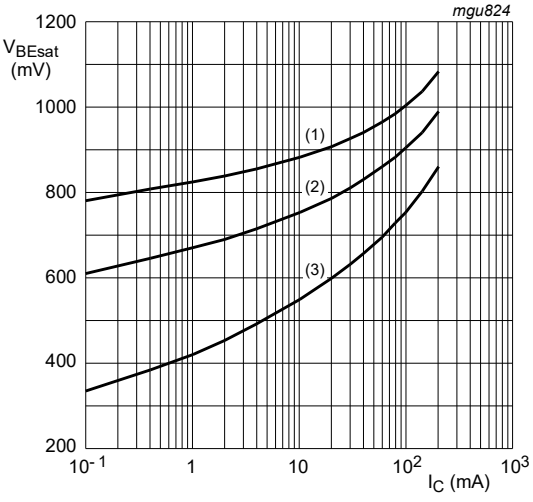
T_{amb} = 25 °C
(1) I_B = 5.0 mA
(2) I_B = 4.5 mA
(3) I_B = 4.0 mA
(4) I_B = 3.5 mA
(5) I_B = 3.0 mA
(6) I_B = 2.5 mA
(7) I_B = 2.0 mA
(8) I_B = 1.5 mA
(9) I_B = 1.0 mA
(10) I_B = 0.5 mA

Fig. 2. Collector current as a function of collector-emitter voltage; typical values



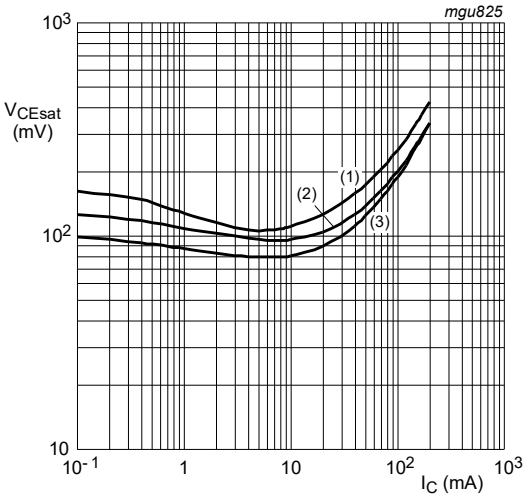
V_{CE} = 1 V
(1) T_{amb} = −55 °C
(2) T_{amb} = 25 °C
(3) T_{amb} = 150 °C

Fig. 3. Base-emitter voltage as a function of collector current; typical values



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

Fig. 4. Base-emitter saturation voltage as a function of collector current; typical values



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

Fig. 5. Collector-emitter saturation voltage as a function of collector current; typical values

11. Test information

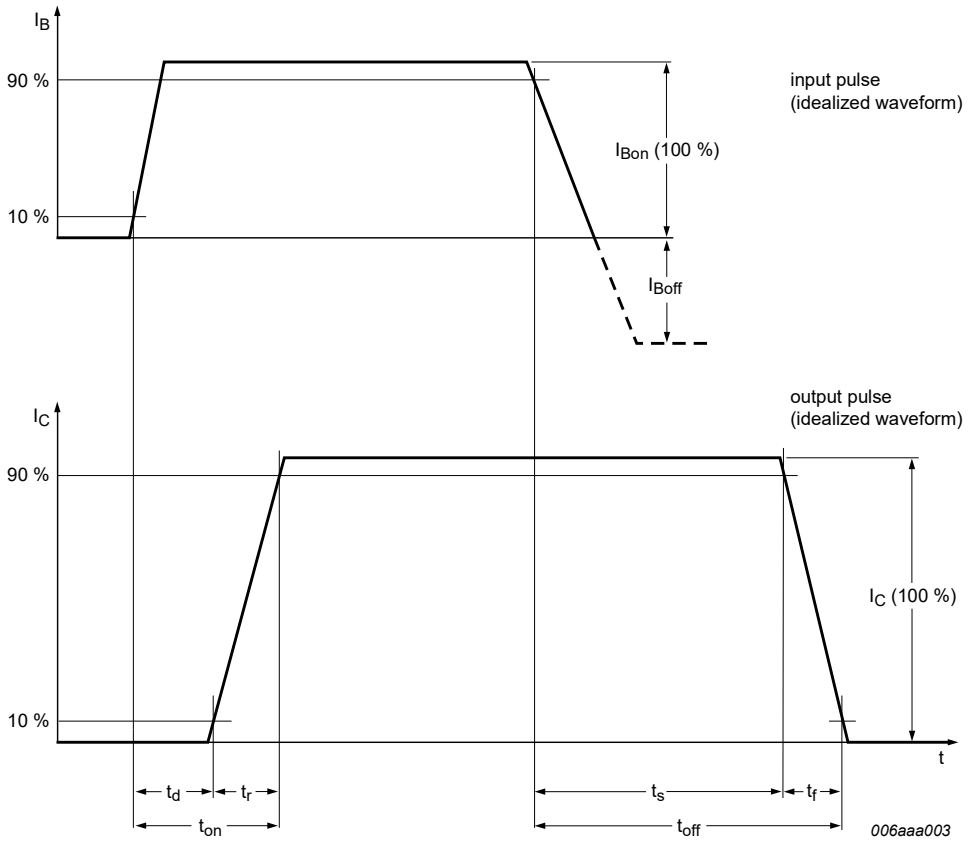


Fig. 6. Switching time definition

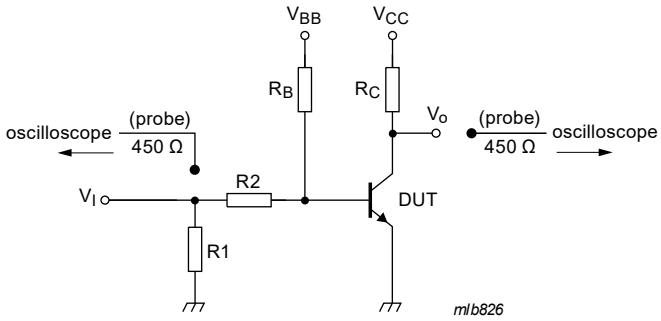


Fig. 7. Test circuit for switching times

Quality information

This product has been qualified in accordance with the Automotive Electronics Council (AEC) standard *Q101 - Stress test qualification for discrete semiconductors*, and is suitable for use in automotive applications.

12. Package outline

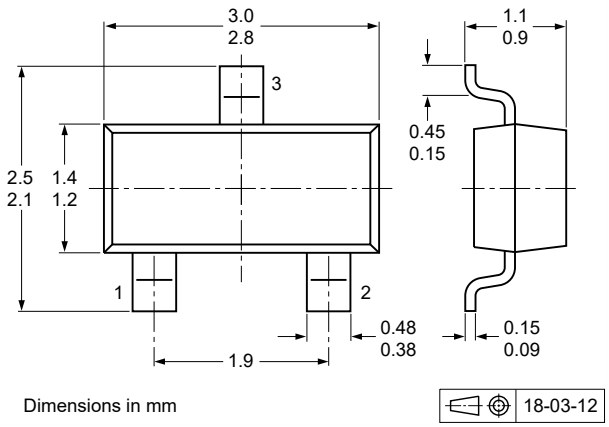


Fig. 8. Package outline SOT23

13. Soldering

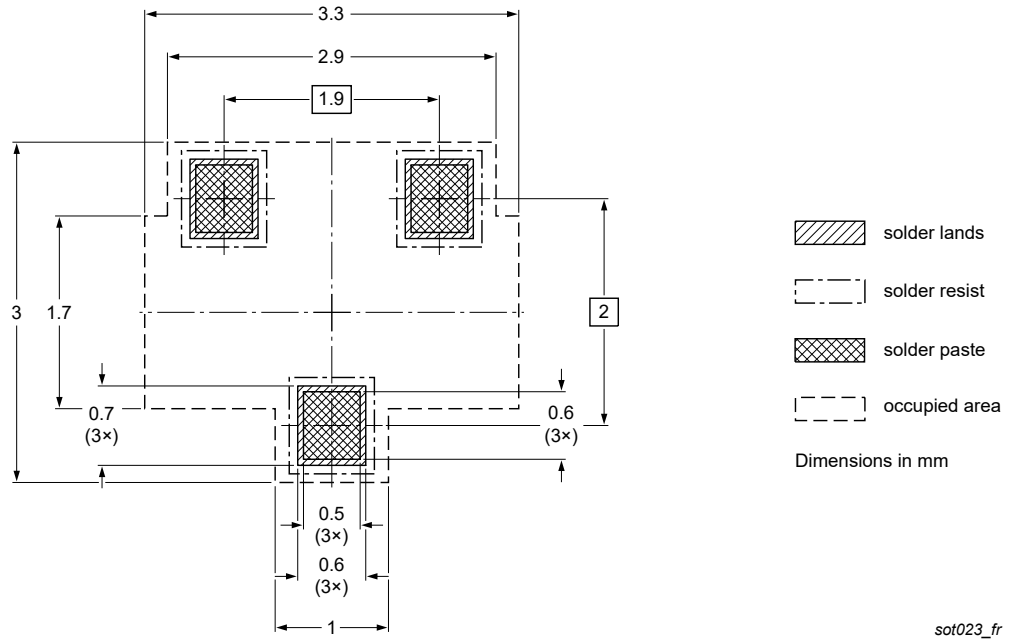


Fig. 9. Reflow soldering footprint for SOT23

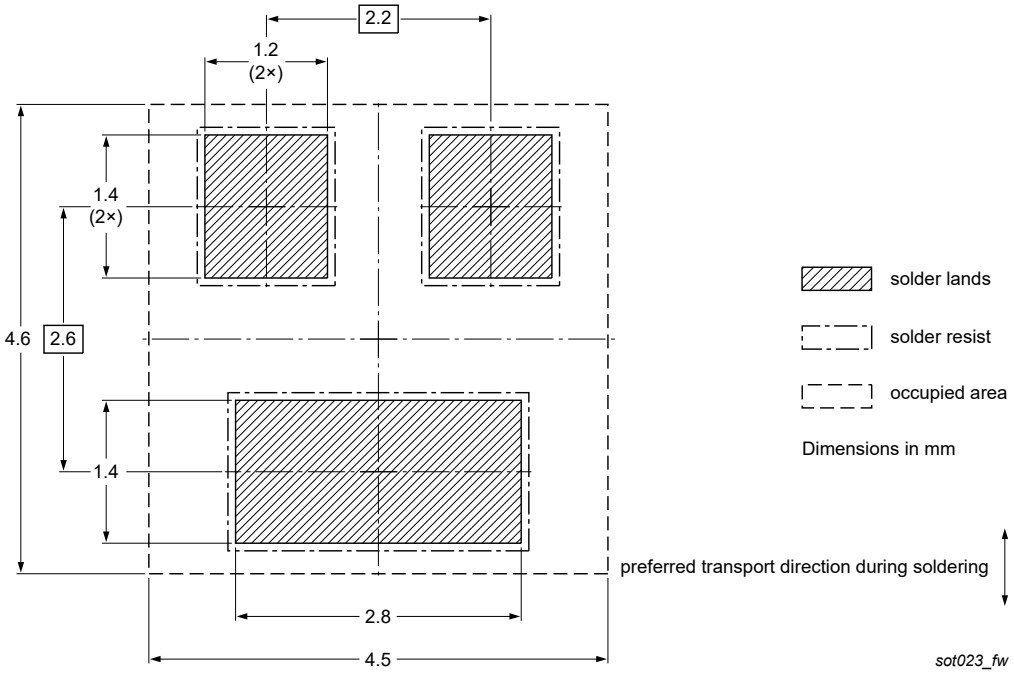


Fig. 10. Wave soldering footprint for SOT23

14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PMBT3904-Q v.2	20240216	Product data sheet	-	PMBT3904-Q v.1
Modifications:	• Characteristics: Legend of Figure 2 corrected			
PMBT3904-Q v.1	20230111	Product data sheet	-	-

15. Legal information

Data sheet status

Document status [1][2]	Product status [3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.
[2] The term 'short data sheet' is explained in section "Definitions".
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