



**THE DATASHEET OF  
PMBT3904,235**





# PMBT3904

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.

PNP complement: PMBT3906

## 2. Features and benefits

- Collector current capability  $I_C = 200$  mA
- Collector-emitter voltage  $V_{CEO} = 40$  V
- AEC-Q101 qualified

## 3. Applications

- General switching and amplification

## 4. Quick reference data

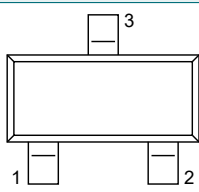
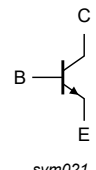
Table 1. Quick reference data

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	[1]	100	300	

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

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	B	base	 <p>SOT23</p>	 <p>sym021</p>
2	E	emitter		
3	C	collector		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
<a href="#">PMBT3904</a>	SOT23	plastic, surface-mounted package; 3 terminals; 1.9 mm pitch; 2.9 mm x 1.3 mm x 1 mm body	<a href="#">SOT23</a>

## 7. Marking

Table 4. Marking codes

Type number	Marking code[1]
PMBT3904	%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

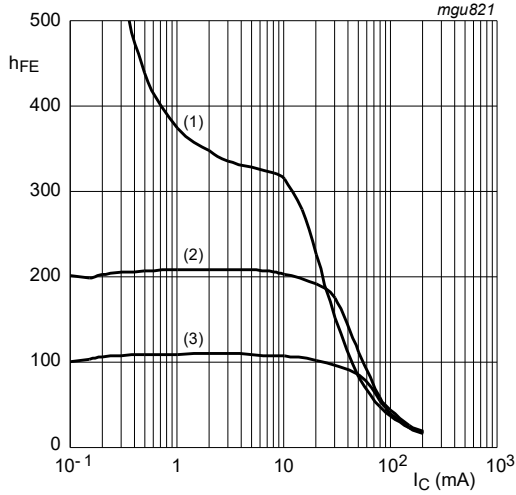
[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.

## 10. Characteristics

**Table 7. Characteristics**
 $T_{amb} = 25\text{ °C}$  unless otherwise specified.

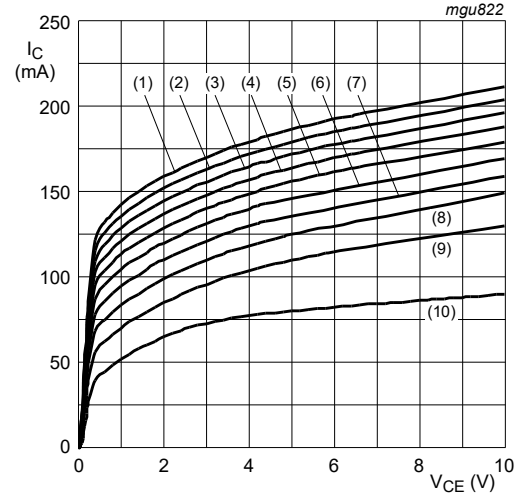
Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$I_{CBO}$	collector-base cut-off current	$V_{CB} = 30\text{ V}; I_E = 0\text{ A}$	-	-	50	nA	
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 6\text{ V}; I_C = 0\text{ A}$	-	-	50	nA	
$h_{FE}$	DC current gain	$V_{CE} = 1\text{ V}; I_C = 0.1\text{ mA}$	[1]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

[1] Pulsed test:  $t_p \leq 300\text{ }\mu\text{s}$ ;  $\delta \leq 0.02$



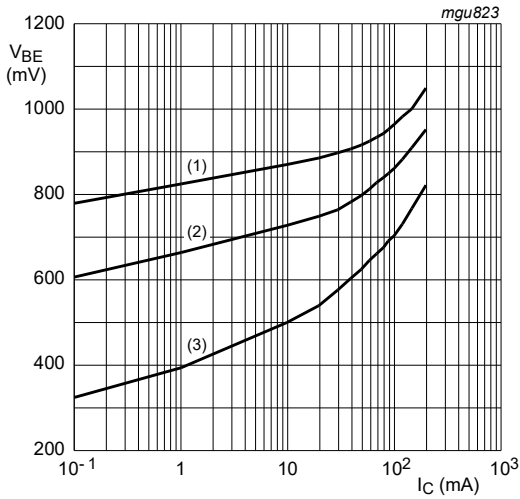
$V_{CE} = 1\text{ V}$   
 (1)  $T_{amb} = 150\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -55\text{ °C}$

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



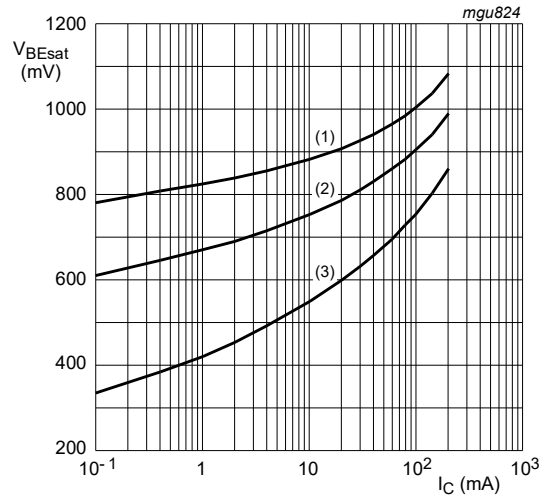
$T_{amb} = 25\text{ °C}$   
 (1)  $I_B = 5.0\text{ mA}$   
 (2)  $I_B = 4.5\text{ mA}$   
 (3)  $I_B = 4.0\text{ mA}$   
 (4)  $I_B = 3.5\text{ mA}$   
 (5)  $I_B = 3.0\text{ mA}$   
 (6)  $I_B = 2.5\text{ mA}$   
 (7)  $I_B = 2.0\text{ mA}$   
 (8)  $I_B = 1.5\text{ mA}$   
 (9)  $I_B = 1.0\text{ mA}$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

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



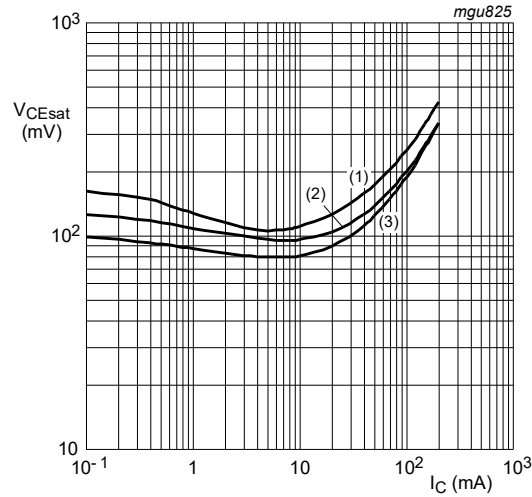
$V_{CE} = 1\text{ V}$   
 (1)  $T_{amb} = -55\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 150\text{ °C}$

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



$I_C/I_B = 10$   
 (1)  $T_{amb} = -55\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 150\text{ °C}$

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



$I_C/I_B = 10$   
 (1)  $T_{amb} = 150\text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25\text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -55\text{ }^\circ\text{C}$

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

### 11. Test information

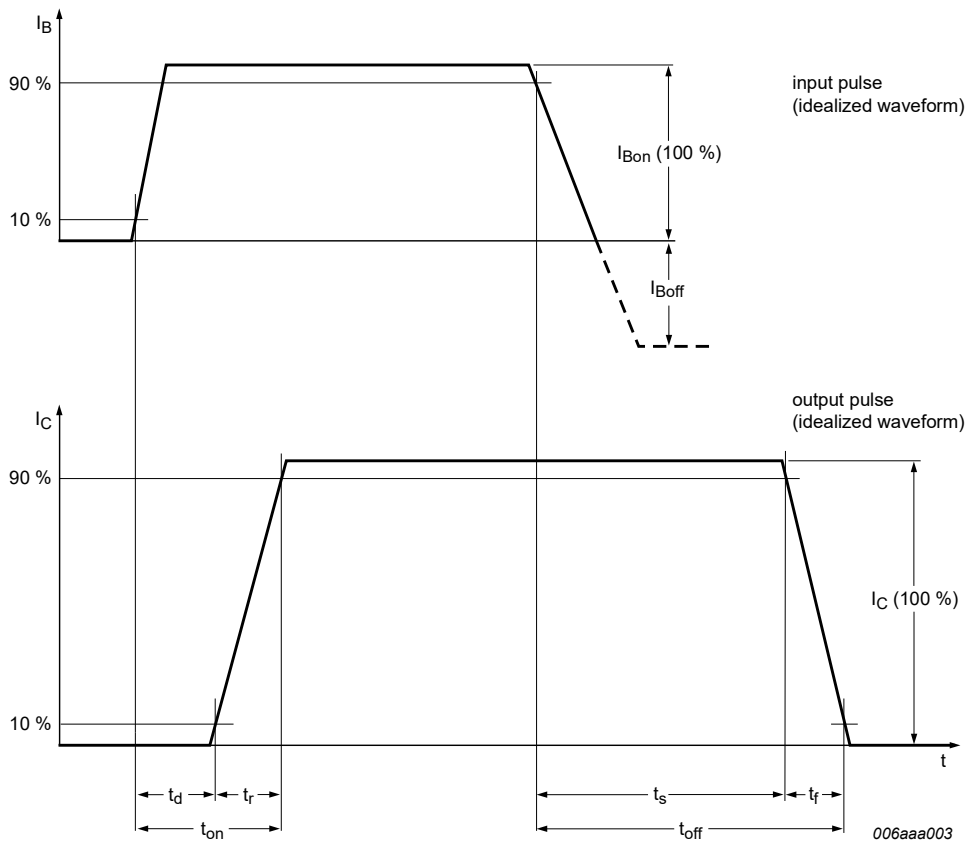


Fig. 6. Switching time definition

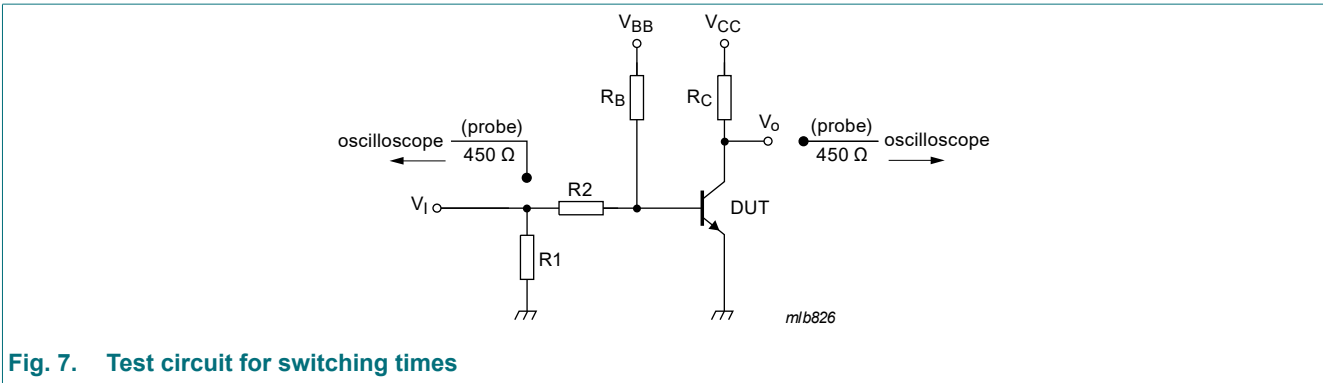


Fig. 7. Test circuit for switching times

**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**

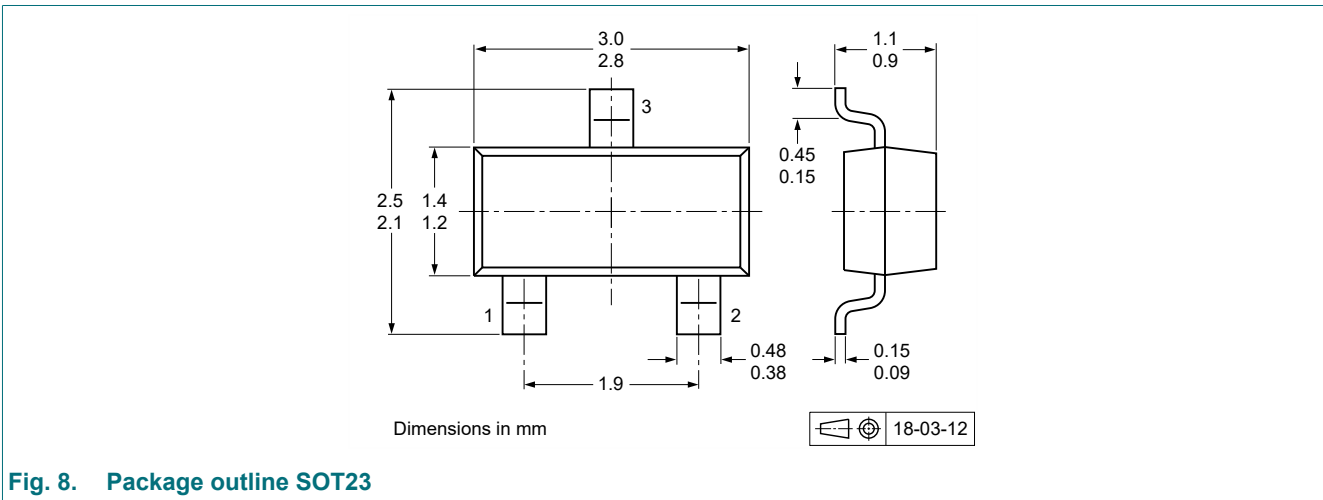


Fig. 8. Package outline SOT23

### 13. Soldering

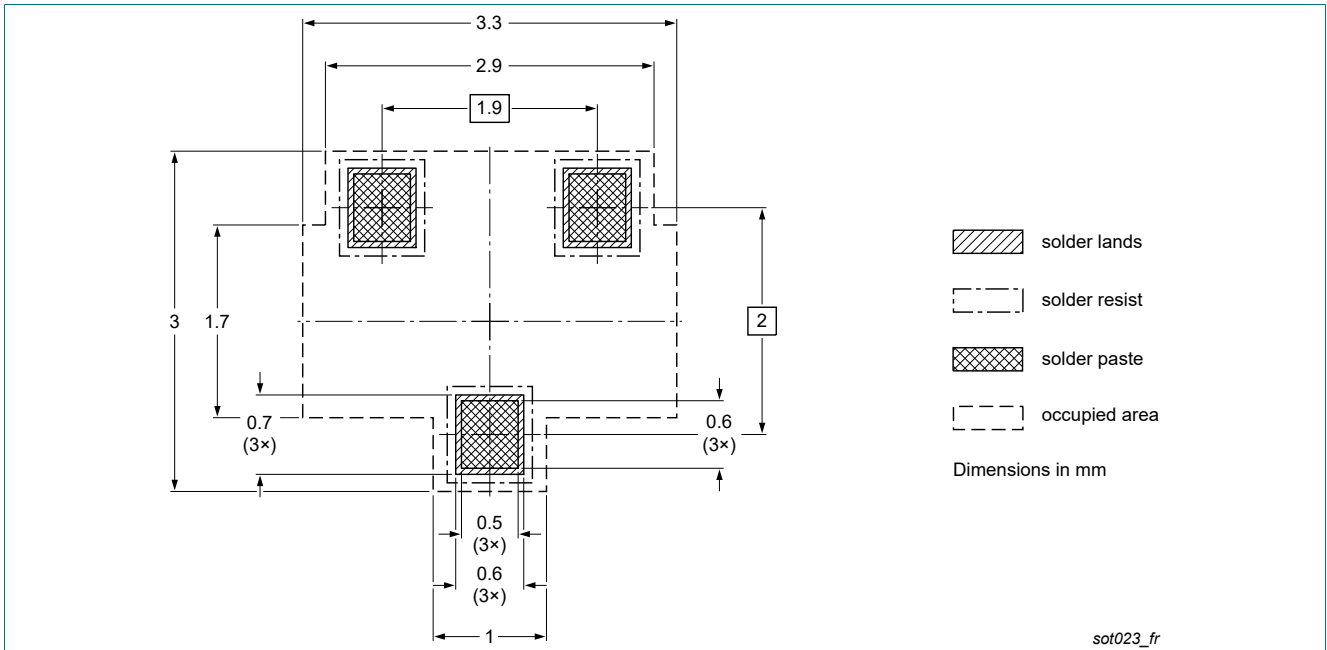


Fig. 9. Reflow soldering footprint for SOT23

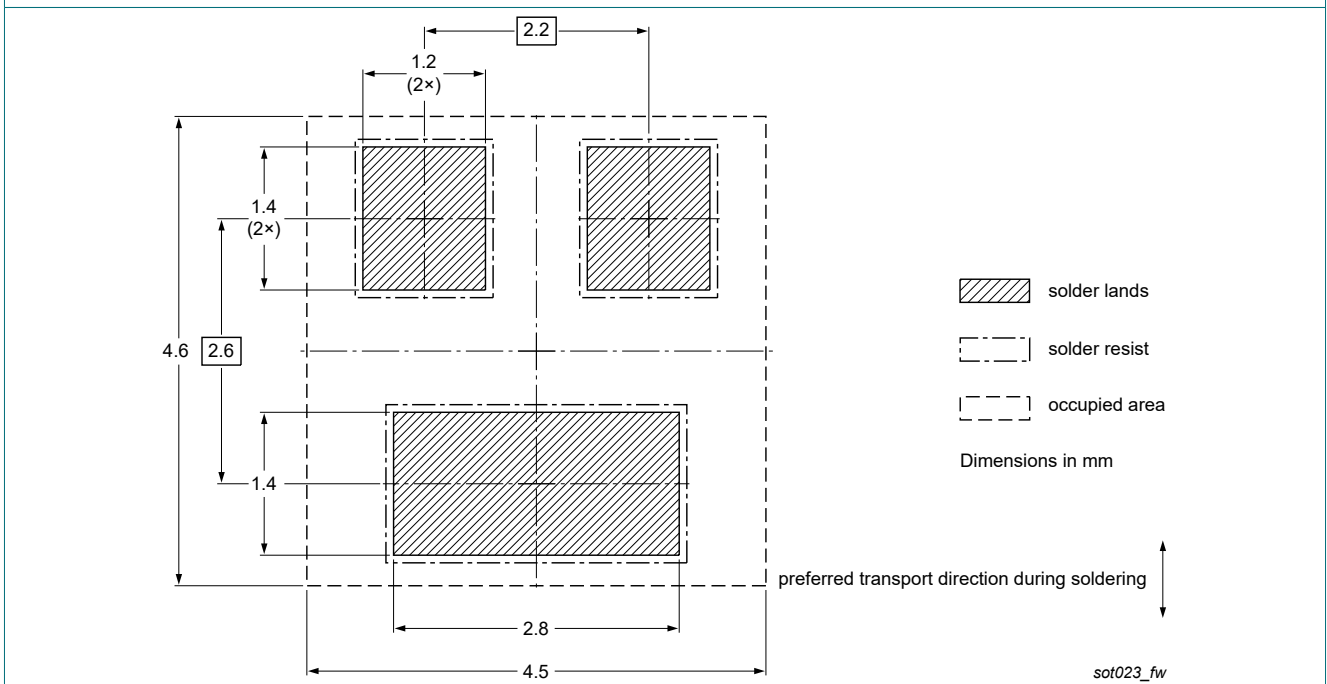


Fig. 10. Wave soldering footprint for SOT23

## 14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PMBT3904 v.5	20240216	Product data sheet	-	PMBT3904 v.4
Modifications:	• Characteristics: Legend of Figure 2 corrected			
PMBT3904 v.4	20230419	Product data sheet	-	PMBT3904 v.3
PMBT3904 v.3	20201105	Product data sheet	-	PMBT3904 v.2
PMBT3904 v.2	20040112	Product data sheet	-	PMBT3904 v.1
PMBT3904 v.1	19990427	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.

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Date of release: 16 February 2024

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