

BOTTOM VIEW

# PMBT3904M

40 V, 200 mA NPN switching transistor

Rev. 01 — 21 July 2009

Product data sheet

## 1. Product profile

### 1.1 General description

NPN single switching transistor in a SOT883 (SC-101) leadless ultra small Surface-Mounted Device (SMD) plastic package.

PNP complement: PMBT3906M.

### 1.2 Features

- Single general-purpose switching transistor
- Board-space reduction
- Ultra small SMD plastic package

### 1.3 Applications

- General-purpose switching and amplification

### 1.4 Quick reference data

Table 1. Quick reference data

| Symbol    | Parameter                 | Conditions                                     | Min | Typ | Max | Unit |
|-----------|---------------------------|--|-----|-----|-----|------|
| $V_{CE0}$ | collector-emitter voltage | open base                                      | -   | -   | 40  | V    |
| $I_C$     | collector current         |  | -   | -   | 200 | mA   |
| $h_{FE}$  | DC current gain           | $V_{CE} = 1\text{ V};$<br>$I_C = 10\text{ mA}$ | 100 | 180 | 300 |      |

## 2. Pinning information

Table 2. Pinning

| Pin | Description | Simplified outline          | Graphic symbol |
|-----|-------------|-----------------------------|----------------|
| 1   | base        | <p>Transparent top view</p> | <p>sym021</p>  |
| 2   | emitter     |                             |                |
| 3   | collector   |                             |                |

### 3. Ordering information

Table 3. Ordering information

| Type number | Package |   |         |
|-------------|---------|---|---------|
|             | Name    | Description   | Version |
| PMBT3904M   | SC-101  | leadless ultra small plastic package; 3 solder lands; body 1.0 × 0.6 × 0.5 mm | SOT883  |

### 4. Marking

Table 4. Marking codes

| Type number | Marking code |
|-------------|--------------|
| PMBT3904M   | 6P           |

### 5. Limiting values

Table 5. Limiting values

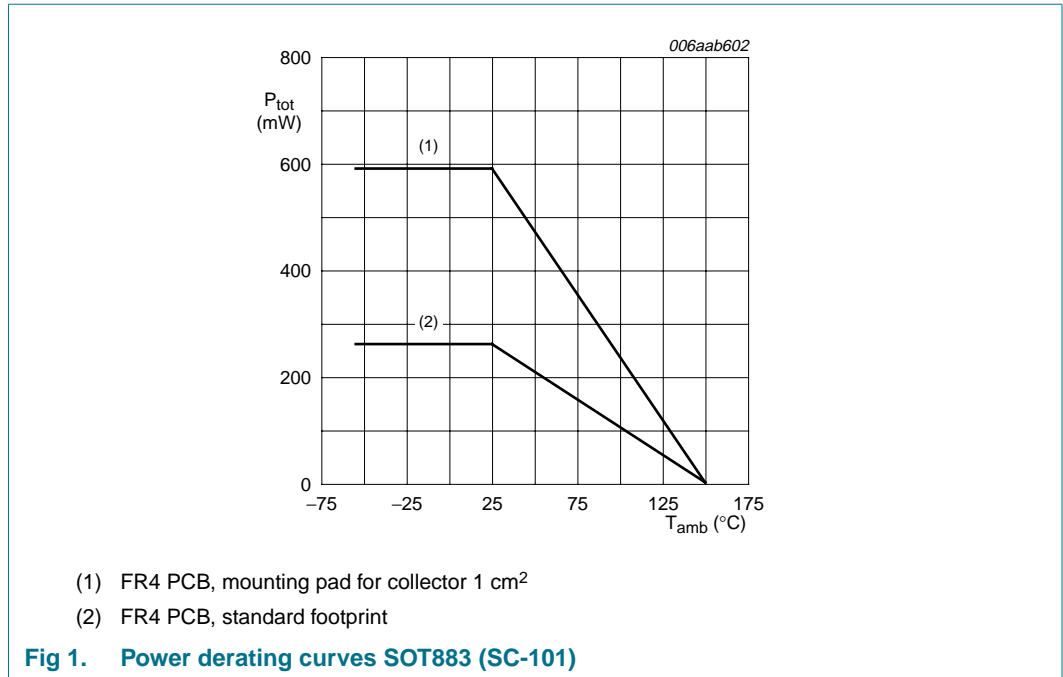
In accordance with the Absolute Maximum Rating System (IEC 60134).

| 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;<br>$t_p \leq 1$ ms | -      | 200  | mA   |    |
| $I_{BM}$  | peak base current         | single pulse;<br>$t_p \leq 1$ ms | -      | 100  | mA   |    |
| $P_{tot}$ | total power dissipation   | $T_{amb} \leq 25$ °C             | [1][2] | -    | 260  | mW |
|           |                           |                                  | [1][3] | -    | 590  | mW |
| $T_j$     | junction temperature      |                                  | -      | 150  | °C   |    |
| $T_{amb}$ | ambient temperature       |                                  | -55    | +150 | °C   |    |
| $T_{stg}$ | storage temperature       |                                  | -65    | +150 | °C   |    |

[1] Reflow soldering is the only recommended soldering method.

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

[3] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.



## 6. Thermal characteristics

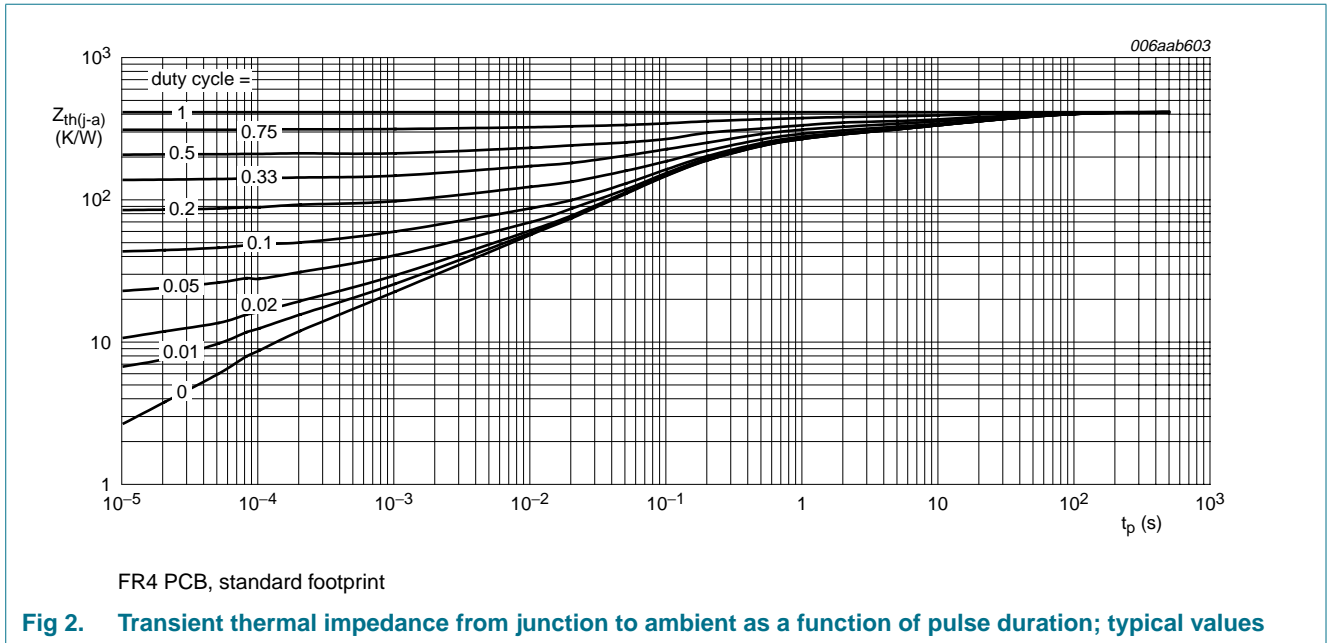
**Table 6. Thermal characteristics**

| Symbol               | Parameter                                   | Conditions  | Min    | Typ | Max | Unit |
|----------------------|---|-------------|--------|-----|-----|------|
| R <sub>th(j-a)</sub> | thermal resistance from junction to ambient | in free air | [1][2] | -   | 481 | K/W  |
|                      |   |             | [1][3] | -   | 212 | K/W  |

[1] Reflow soldering is the only recommended soldering method.

[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

[3] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.



## 7. Characteristics

**Table 7. Characteristics**

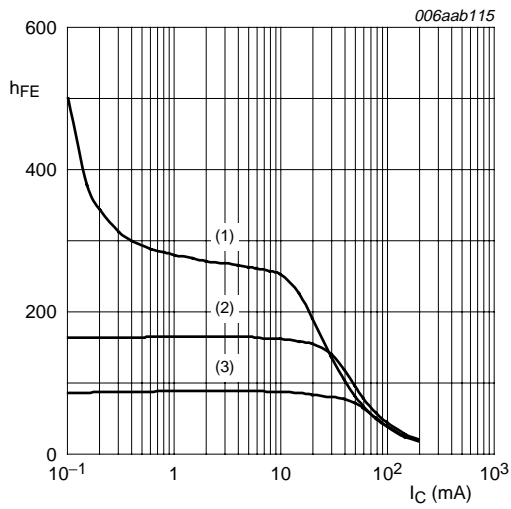
$T_{amb} = 25^{\circ}C$  unless otherwise specified.

| 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                      | $V_{CE} = 1\text{ V}$  |     |     |     |      |
|             |                                      | $I_C = 0.1\text{ mA}$  | 60  | 180 | -   |      |
|             |                                      | $I_C = 1\text{ mA}$  | 80  | 180 | -   |      |
|             |                                      | $I_C = 10\text{ mA}$   | 100 | 180 | 300 |      |
|             |                                      | $I_C = 100\text{ mA}$  | 30  | 50  | -   |      |
| $V_{CEsat}$ | collector-emitter saturation voltage | $I_C = 10\text{ mA}; I_B = 1\text{ mA}$                              | -   | 75  | 200 | mV   |
|             |                                      | $I_C = 50\text{ mA}; I_B = 5\text{ mA}$                              | -   | 120 | 300 | mV   |
| $V_{BEsat}$ | base-emitter saturation voltage      | $I_C = 10\text{ mA}; I_B = 1\text{ mA}$                              | 650 | 750 | 850 | mV   |
|             |                                      | $I_C = 50\text{ mA}; I_B = 5\text{ mA}$                              | -   | 850 | 950 | mV   |
| $t_d$       | delay time                           | $V_{CC} = 3\text{ V}; I_C = 10\text{ mA};$                           | -   | -   | 35  | ns   |
| $t_r$       | rise time                            | $I_{Bon} = 1\text{ mA};$   | -   | -   | 35  | ns   |
| $t_{on}$    | turn-on time                         | $I_{Boff} = -1\text{ mA}$  | -   | -   | 70  | ns   |
| $t_s$       | storage time                         |  | -   | -   | 200 | ns   |
| $t_f$       | fall time                            |  | -   | -   | 50  | ns   |
| $t_{off}$   | turn-off time                        |  | -   | -   | 250 | ns   |
| $C_c$       | collector capacitance                | $V_{CB} = 5\text{ V}; I_E = I_e = 0\text{ A};$<br>$f = 1\text{ MHz}$ | -   | -   | 4   | pF   |

**Table 7. Characteristics ...continued**

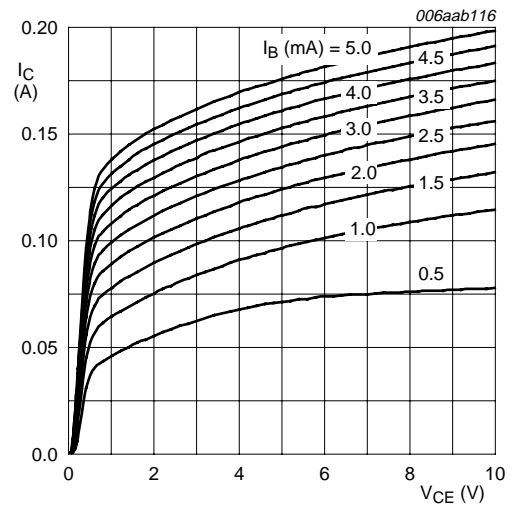
$T_{amb} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

| Symbol | Parameter            | Conditions   | Min | Typ | Max | Unit |
|--------|----------------------|--|-----|-----|-----|------|
| $C_e$  | emitter capacitance  | $V_{EB} = 500\text{ mV};$<br>$I_C = i_c = 0\text{ A}; f = 1\text{ MHz}$  | -   | -   | 8   | pF   |
| $f_T$  | transition frequency | $V_{CE} = 20\text{ V}; I_C = 10\text{ mA};$<br>$f = 100\text{ MHz}$  | 300 | -   | -   | MHz  |
| NF     | noise figure         | $V_{CE} = 5\text{ V}; I_C = 100\text{ }\mu\text{A};$<br>$R_S = 1\text{ k}\Omega;$<br>$f = 10\text{ Hz to }15.7\text{ kHz}$ | -   | -   | 5   | dB   |



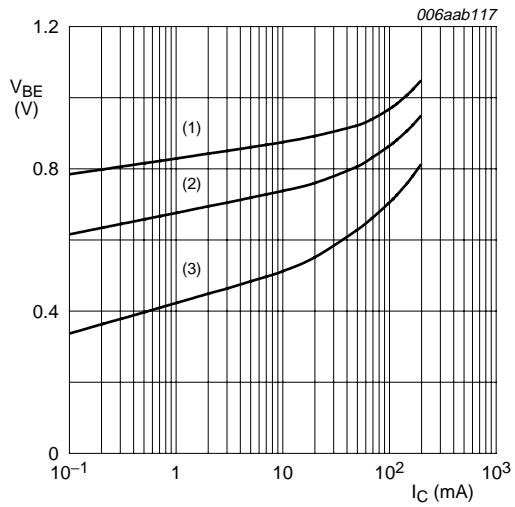
$V_{CE} = 1\text{ V}$   
 (1)  $T_{amb} = 150\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = -55\text{ }^{\circ}\text{C}$

**Fig 3. DC current gain as a function of collector current; typical values**



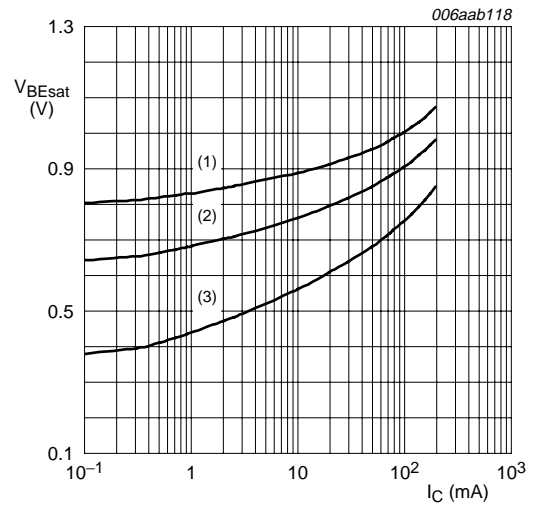
$T_{amb} = 25\text{ }^{\circ}\text{C}$

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



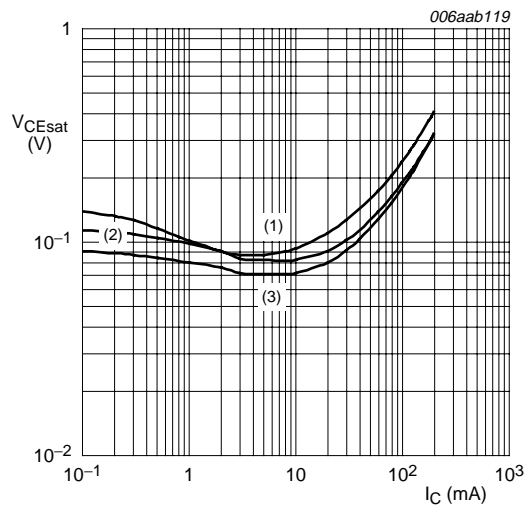
$V_{CE} = 1 \text{ V}$   
 (1)  $T_{amb} = -55 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 150 \text{ }^\circ\text{C}$

**Fig 5. Base-emitter voltage as a function of collector current; typical values**



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

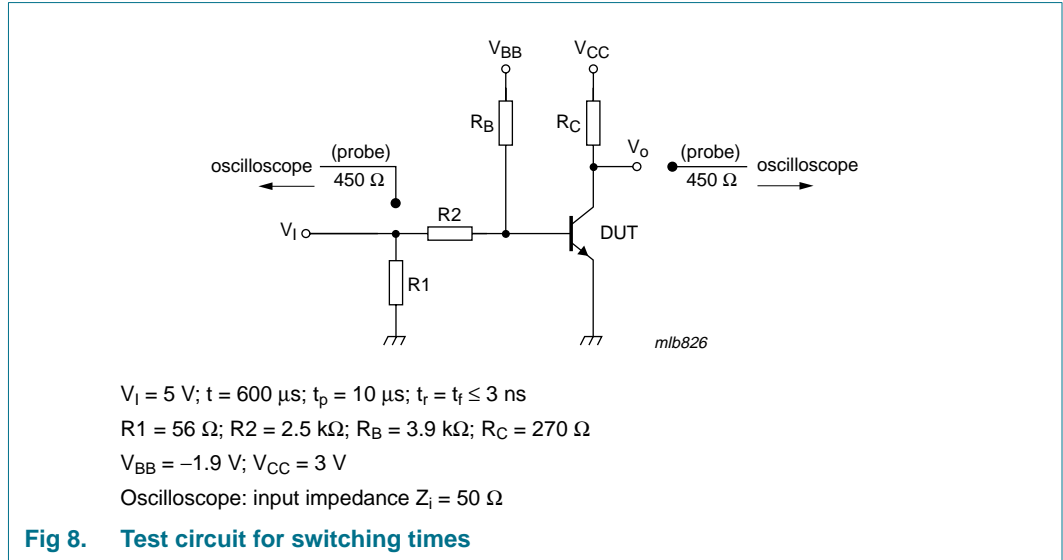
**Fig 6. Base-emitter saturation voltage as a function of collector current; typical values**



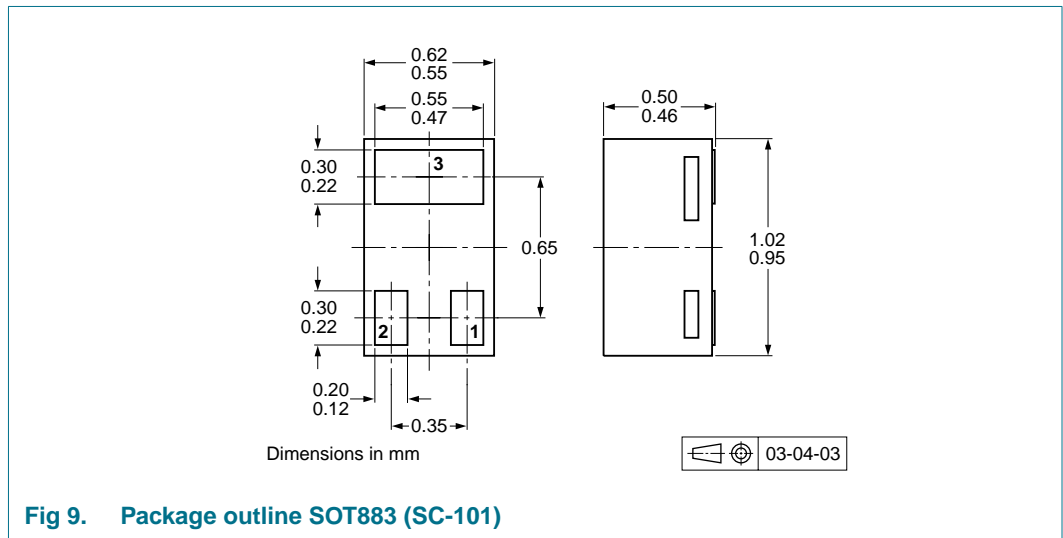
$I_C/I_B = 10$   
 (1)  $T_{amb} = 150 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -55 \text{ }^\circ\text{C}$

**Fig 7. Collector-emitter saturation voltage as a function of collector current; typical values**

**8. Test information**



**9. Package outline**







## 12. Revision history

Table 9. Revision history

| Document ID | Release date | Data sheet status  | Change notice | Supersedes |
|-------------|--------------|--------------------|---------------|------------|
| PMBT3904M_1 | 20090721     | Product data sheet | -             | -          |

## 13. Legal information

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| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | 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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