

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

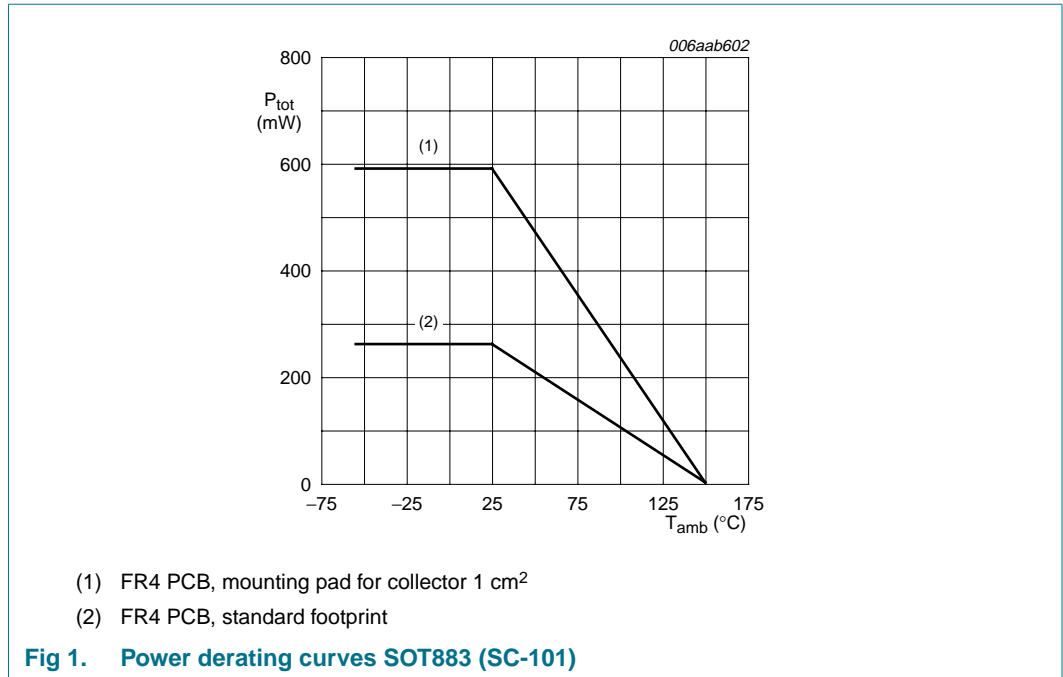
In accordance with the Absolute Maximum Rating System (IEC 60134).

| 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

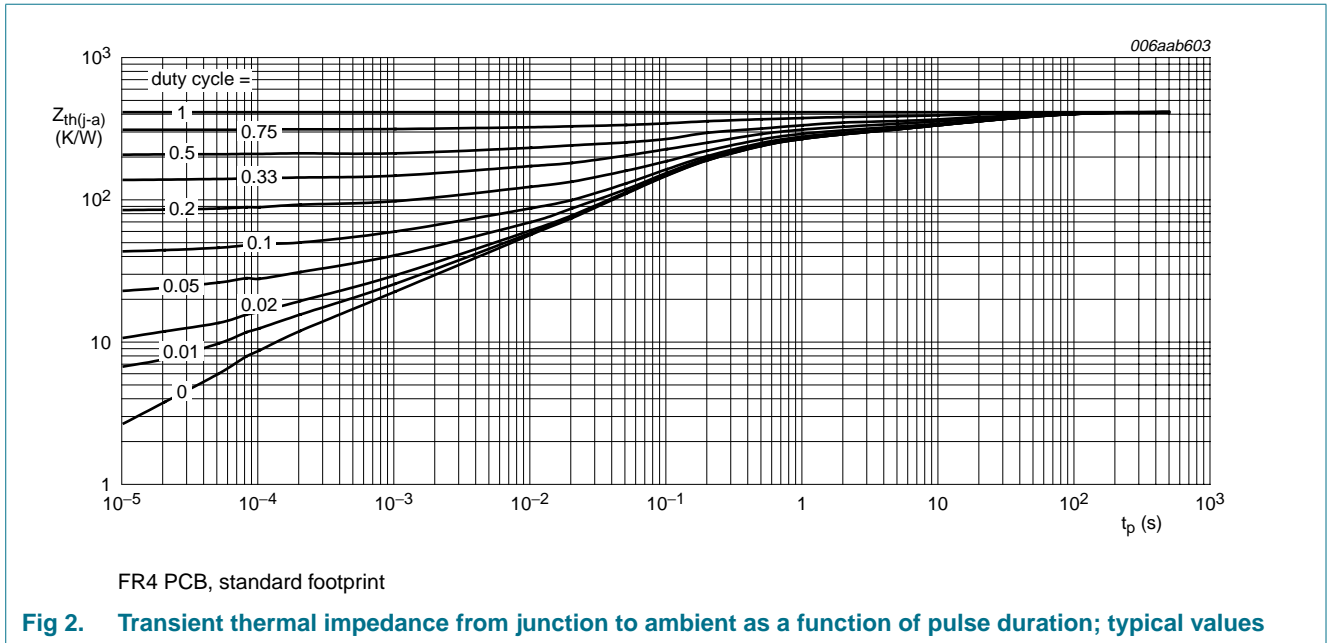
**Table 6. Thermal characteristics**

| 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**

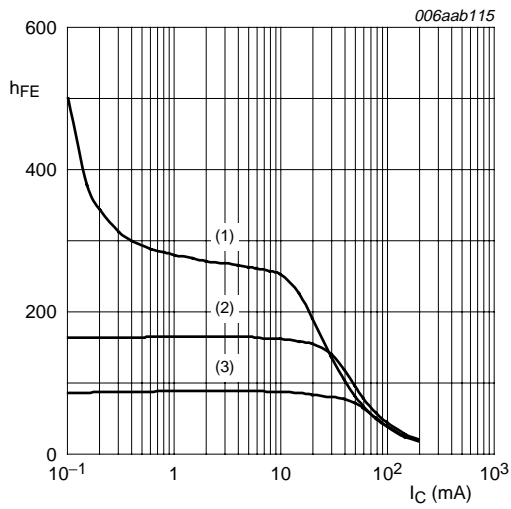
$T_{amb} = 25^{\circ}C$  unless otherwise specified.

| Symbol      | Parameter                            | Conditions                                      | Min | Typ | Max | Unit |
|-------------|--------------------------------------|---|-----|-----|-----|------|
| $I_{CBO}$   | collector-base cut-off current       | $V_{CB} = 30 V; I_E = 0 A$                      | -   | -   | 50  | nA   |
| $I_{EBO}$   | emitter-base cut-off current         | $V_{EB} = 6 V; I_C = 0 A$                       | -   | -   | 50  | nA   |
| $h_{FE}$    | DC current gain                      | $V_{CE} = 1 V$                                  |     |     |     |      |
|             |                                      | $I_C = 0.1 mA$                                  | 60  | 180 | -   |      |
|             |                                      | $I_C = 1 mA$                                    | 80  | 180 | -   |      |
|             |                                      | $I_C = 10 mA$                                   | 100 | 180 | 300 |      |
|             |                                      | $I_C = 50 mA$                                   | 60  | 105 | -   |      |
| $V_{CEsat}$ | collector-emitter saturation voltage | $I_C = 10 mA; I_B = 1 mA$                       | -   | 75  | 200 | mV   |
|             |                                      | $I_C = 50 mA; I_B = 5 mA$                       | -   | 120 | 300 | mV   |
| $V_{BEsat}$ | base-emitter saturation voltage      | $I_C = 10 mA; I_B = 1 mA$                       | 650 | 750 | 850 | mV   |
|             |                                      | $I_C = 50 mA; I_B = 5 mA$                       | -   | 850 | 950 | mV   |
| $t_d$       | delay time                           | $V_{CC} = 3 V; I_C = 10 mA;$                    | -   | -   | 35  | ns   |
| $t_r$       | rise time                            | $I_{Bon} = 1 mA;$                               | -   | -   | 35  | ns   |
| $t_{on}$    | turn-on time                         | $I_{Boff} = -1 mA$                              | -   | -   | 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                | $V_{CB} = 5 V; I_E = I_e = 0 A;$<br>$f = 1 MHz$ | -   | -   | 4   | pF   |

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

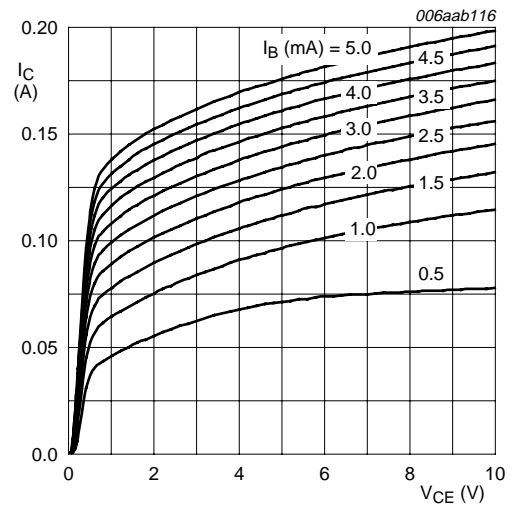
$T_{amb} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

| 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   |



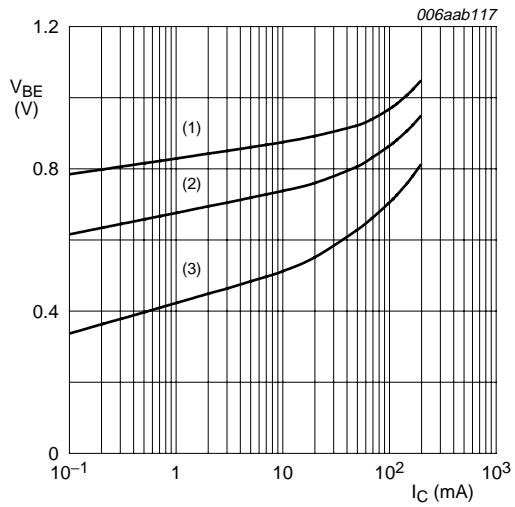
$V_{CE} = 1\text{ V}$   
 (1)  $T_{amb} = 150\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = -55\text{ }^{\circ}\text{C}$

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



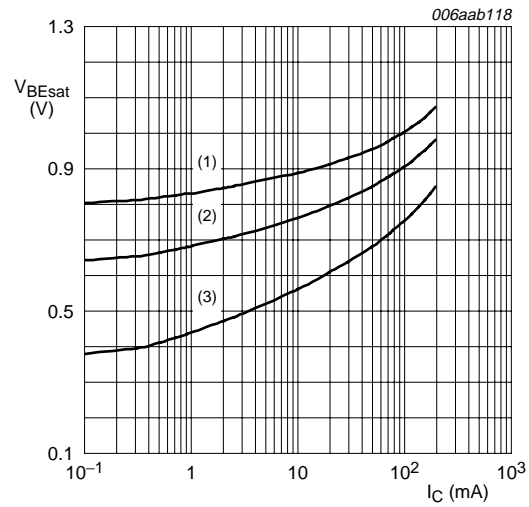
$T_{amb} = 25\text{ }^{\circ}\text{C}$

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



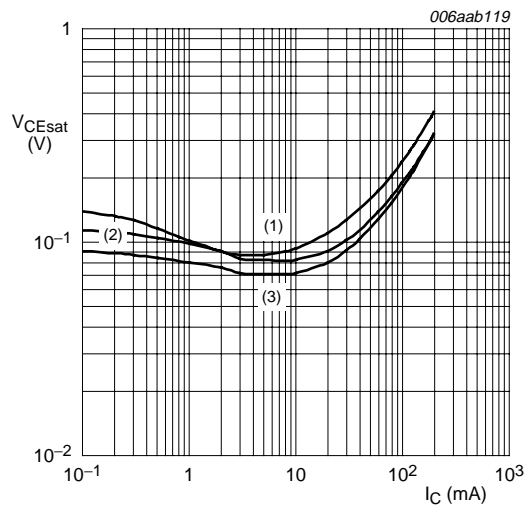
$V_{CE} = 1\text{ V}$   
 (1)  $T_{amb} = -55\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 150\text{ °C}$

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



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

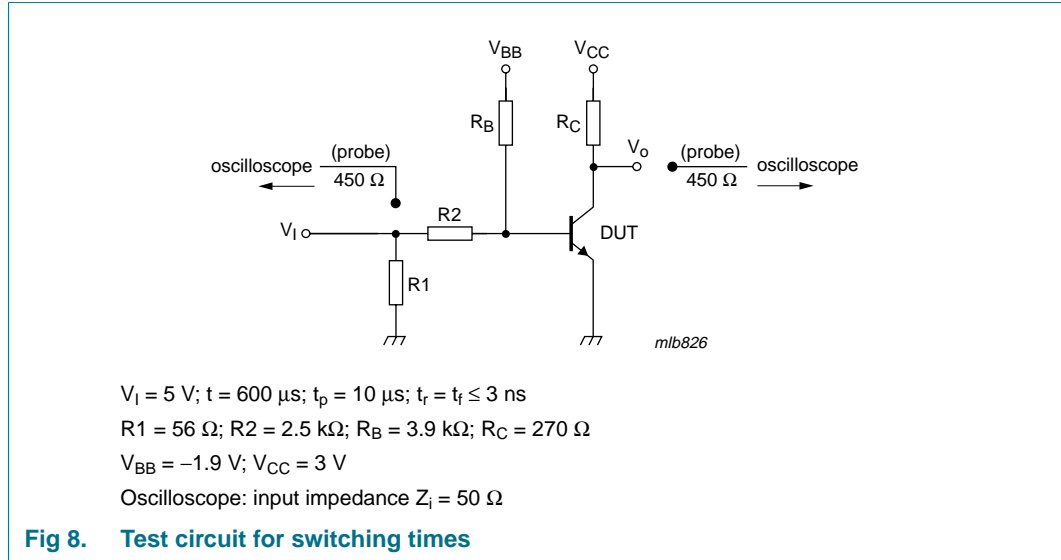
**Fig 6. Base-emitter saturation voltage as a function of collector current; typical values**



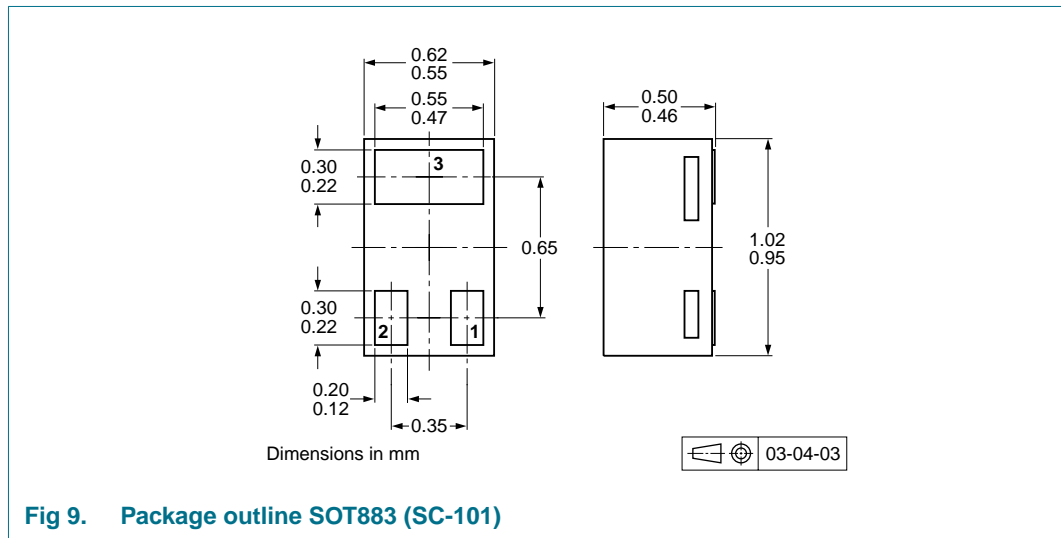
$I_C/I_B = 10$   
 (1)  $T_{amb} = 150\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -55\text{ °C}$

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

**8. Test information**



**9. Package outline**



## 10. Packing information

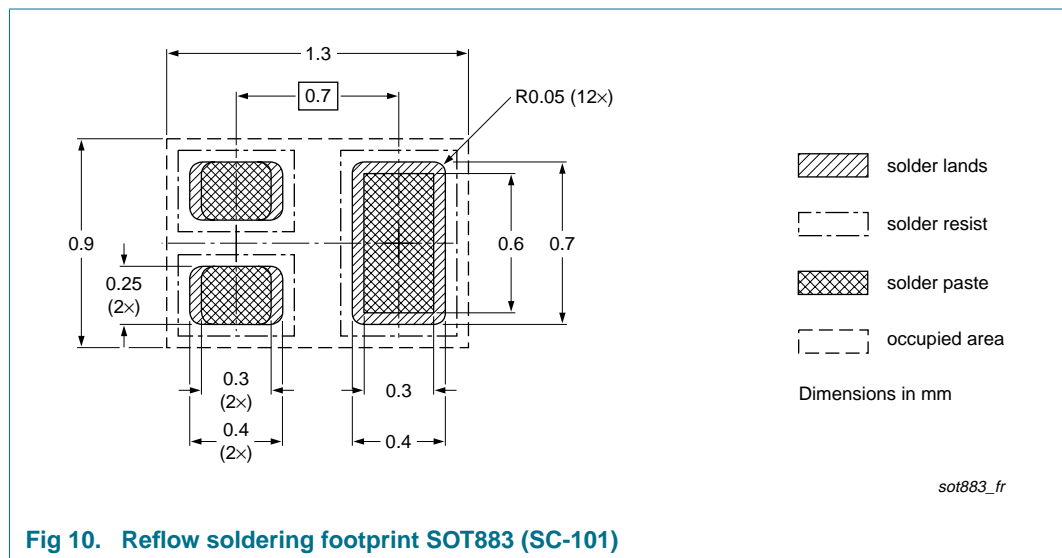
**Table 8. Packing methods**

The indicated -xxx are the last three digits of the 12NC ordering code.<sup>[1]</sup>

| Type number | Package | Description                    | Packing quantity |
|-------------|---------|--------------------------------|------------------|
|             |         |                                | 10000            |
| PMBT3904M   | SOT883  | 2 mm pitch, 8 mm tape and reel | -315             |

[1] For further information and the availability of packing methods, see [Section 14](#).

## 11. Soldering



**Fig 10. Reflow soldering footprint SOT883 (SC-101)**



## 12. Revision history

Table 9. Revision history

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

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### 13.1 Data sheet status

| 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.                                     |

[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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## 15. Contents

|           |                                      |           |
|-----------|--------------------------------------|-----------|
| <b>1</b>  | <b>Product profile</b> .....         | <b>1</b>  |
| 1.1       | General description .....            | 1         |
| 1.2       | Features .....                       | 1         |
| 1.3       | Applications .....                   | 1         |
| 1.4       | Quick reference data .....           | 1         |
| <b>2</b>  | <b>Pinning information</b> .....     | <b>1</b>  |
| <b>3</b>  | <b>Ordering information</b> .....    | <b>2</b>  |
| <b>4</b>  | <b>Marking</b> .....                 | <b>2</b>  |
| <b>5</b>  | <b>Limiting values</b> .....         | <b>2</b>  |
| <b>6</b>  | <b>Thermal characteristics</b> ..... | <b>3</b>  |
| <b>7</b>  | <b>Characteristics</b> .....         | <b>4</b>  |
| <b>8</b>  | <b>Test information</b> .....        | <b>7</b>  |
| <b>9</b>  | <b>Package outline</b> .....         | <b>7</b>  |
| <b>10</b> | <b>Packing information</b> .....     | <b>8</b>  |
| <b>11</b> | <b>Soldering</b> .....               | <b>8</b>  |
| <b>12</b> | <b>Revision history</b> .....        | <b>9</b>  |
| <b>13</b> | <b>Legal information</b> .....       | <b>10</b> |
| 13.1      | Data sheet status .....              | 10        |
| 13.2      | Definitions .....                    | 10        |
| 13.3      | Disclaimers .....                    | 10        |
| 13.4      | Trademarks .....                     | 10        |
| <b>14</b> | <b>Contact information</b> .....     | <b>10</b> |
| <b>15</b> | <b>Contents</b> .....                | <b>11</b> |

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Date of release: 21 July 2009

Document identifier: PMBT3904M\_1