



# PMBT3904MB

40 V, 200 mA NPN switching transistor

16 November 2018

Product data sheet

## 1. General description

NPN single switching transistor in a leadless ultra small DFN1006B-3 (SOT883B) Surface-Mounted Device (SMD) plastic package.

PNP complement: PMBT3906MB.

## 2. Features and benefits

- Single general-purpose switching transistor
- Ultra small SMD plastic package
- Board-space reduction
- Low package height of 0.37 mm
- AEC-Q101 qualified

## 3. Applications

- General-purpose switching and amplification
- Mobile applications

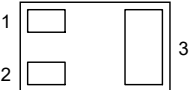
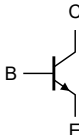
## 4. Quick reference data

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           | $V_{CE} = 1\text{ V}; I_C = 10\text{ mA}$ | 100 | 180 | 300 |      |

5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline                                                                                                                                | Graphic symbol                                                                                    |
|-----|--------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| 1   | B      | base        |  <p>Transparent<br/>top view</p> <p>DFN1006B-3<br/>(SOT883B)</p> |  <p>sym021</p> |
| 2   | E      | emitter     |                                                                                                                                                   |                                                                                                   |
| 3   | C      | collector   |                                                                                                                                                   |                                                                                                   |

6. Ordering information

Table 3. Ordering information

| Type number | Package    |                                                                                                              |         |
|-------------|------------|--------------------------------------------------------------------------------------------------------------|---------|
|             | Name       | Description                                                                                                  | Version |
| PMBT3904MB  | DFN1006B-3 | plastic, leadless ultra small plastic package; 3 solder lands; 0.35 mm pitch; 1.0 mm x 0.6 mm x 0.37 mm body | SOT883B |

7. Marking

Table 4. Marking codes

| Type number | Marking code |
|-------------|--------------|
| PMBT3904MB  | 0100 0111    |

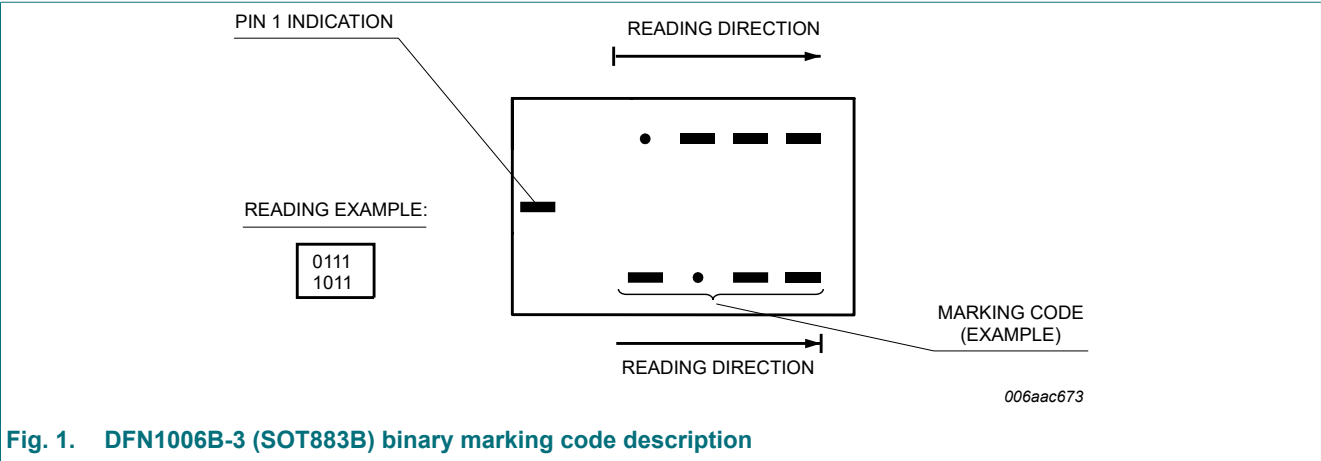


Fig. 1. DFN1006B-3 (SOT883B) binary marking code description

## 8. Limiting values

**Table 5. Limiting values**

*In accordance with the Absolute Maximum Rating System (IEC60134).*

| 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    | $t_p \leq 1$ ms; single pulse |         | -   | 200 | mA   |
| $I_{BM}$  | peak base current         |                               |         | -   | 100 | mA   |
| $P_{tot}$ | total power dissipation   | $T_{amb} \leq 25$ °C          | [1] [2] | -   | 250 | 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.

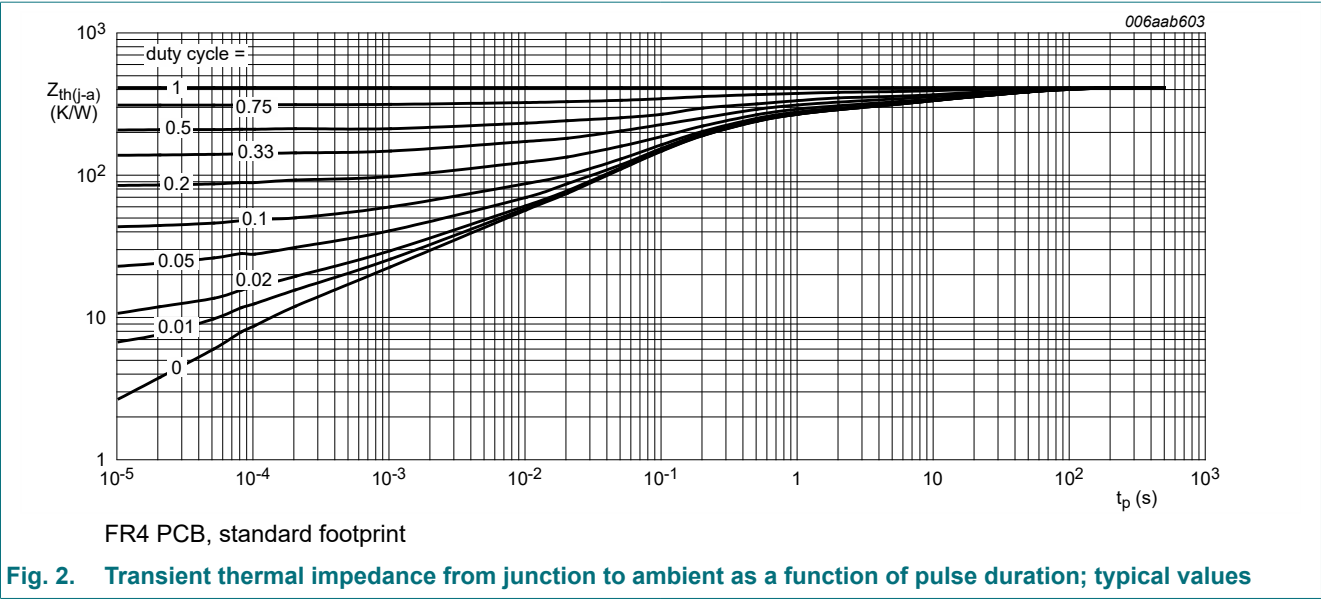
[3] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.

9. Thermal characteristics

Table 6. Thermal characteristics

| Symbol        | Parameter                                   | Conditions  |         | Min | Typ | Max | Unit |
|---------------|---------------------------------------------|-------------|---------|-----|-----|-----|------|
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | [1] [2] | -   | -   | 500 | 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>.



## 10. Characteristics

**Table 7. Characteristics**
 $T_{amb} = 25\text{ }^{\circ}\text{C}$  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                      | $V_{CE} = 1\text{ V}; I_C = 0.1\text{ mA}$                                                                       | 60  | 180 | -   |      |
|             |                                      | $V_{CE} = 1\text{ V}; I_C = 1\text{ mA}$                                                                         | 80  | 180 | -   |      |
|             |                                      | $V_{CE} = 1\text{ V}; I_C = 10\text{ mA}$                                                                        | 100 | 180 | 300 |      |
|             |                                      | $V_{CE} = 1\text{ V}; I_C = 50\text{ mA}$                                                                        | 60  | 105 | -   |      |
|             |                                      | $V_{CE} = 1\text{ V}; I_C = 100\text{ mA}$                                                                       | [1] | 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                           | $I_C = 10\text{ mA}; I_{Bon} = 1\text{ mA}; I_{Boff} = -1\text{ mA}; V_{CC} = 3\text{ V}$                        | -   | -   | 35  | ns   |
| $t_r$       | rise time                            |                                                                                                                  | -   | -   | 35  | ns   |
| $t_{on}$    | turn-on time                         |                                                                                                                  | -   | -   | 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                | $V_{CB} = 5\text{ V}; I_E = 0\text{ A}; i_e = 0\text{ A}; f = 1\text{ MHz}$                                      | -   | -   | 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:  $t_p \leq 300\text{ }\mu\text{s}$ ;  $\delta \leq 0.02$

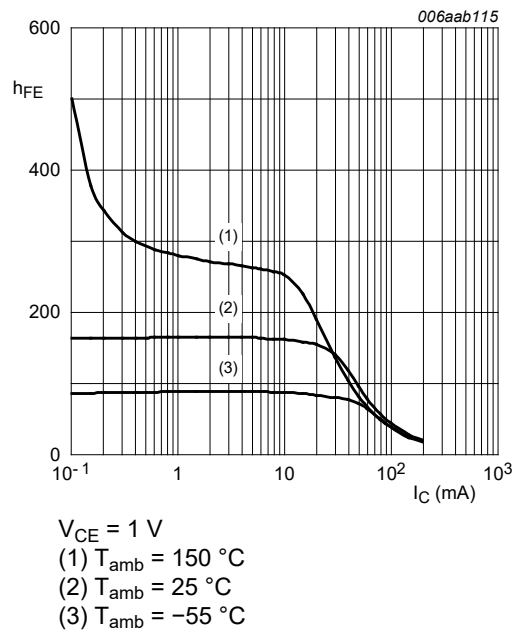


Fig. 3. DC current gain as a function of collector current; typical values

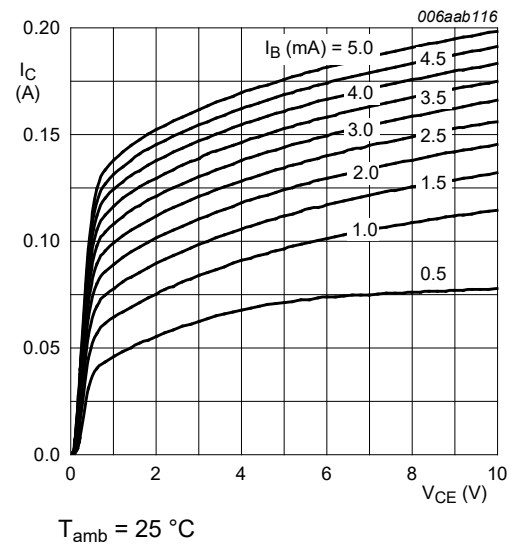


Fig. 4. Collector current as a function of collector-emitter voltage; typical values

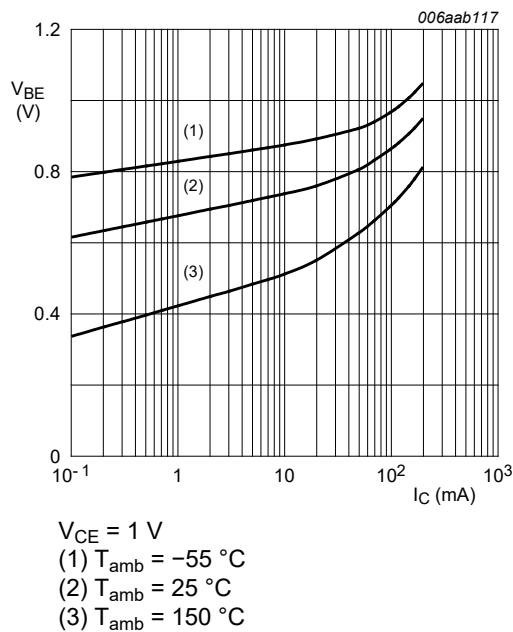


Fig. 5. Base-emitter voltage as a function of collector current; typical values

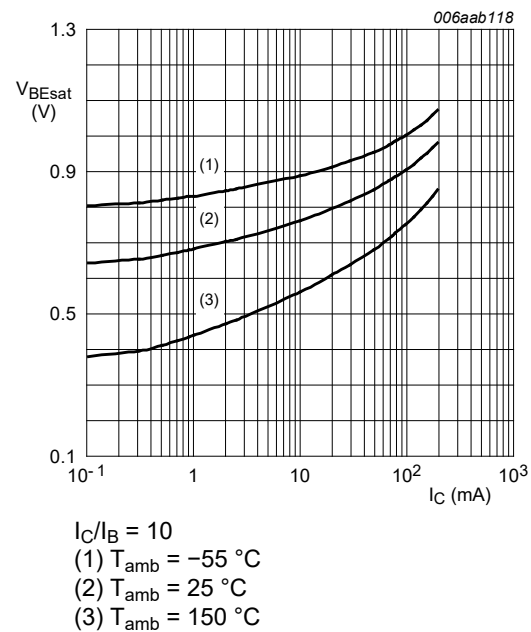
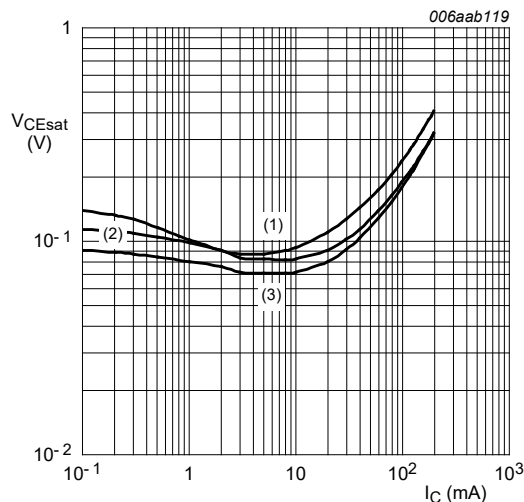


Fig. 6. Base-emitter saturation voltage as a function of collector current; typical values



$$I_C/I_B = 10$$

(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

## 11. Test information

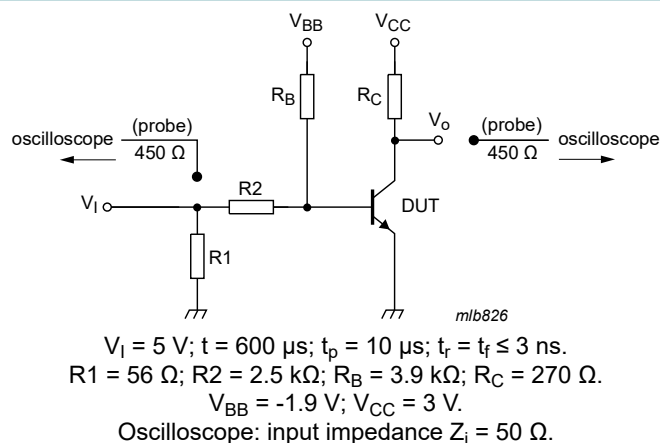
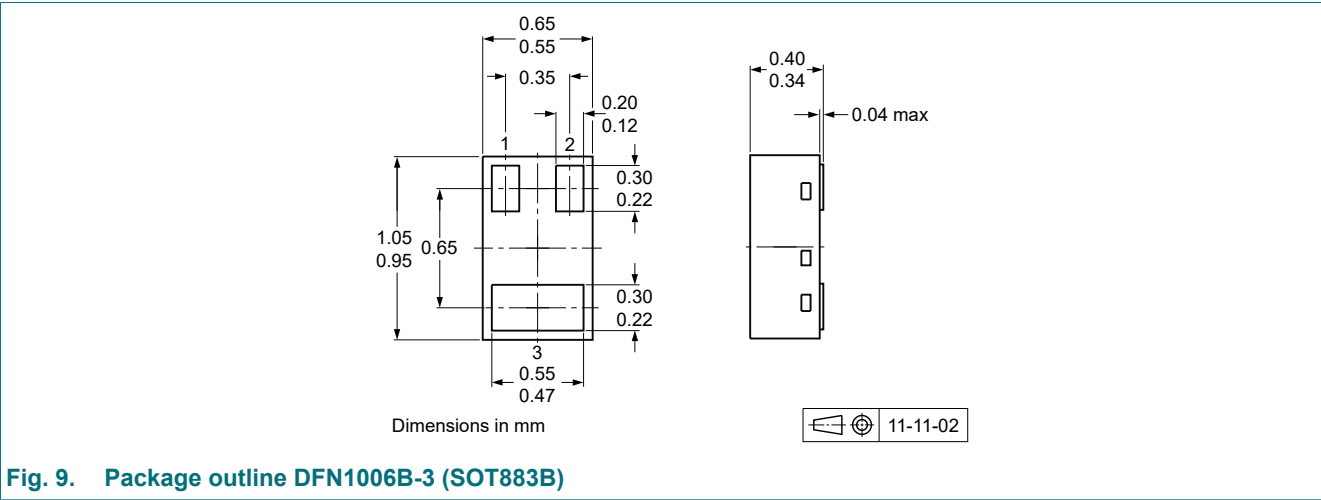


Fig. 8. Test circuit for switching times

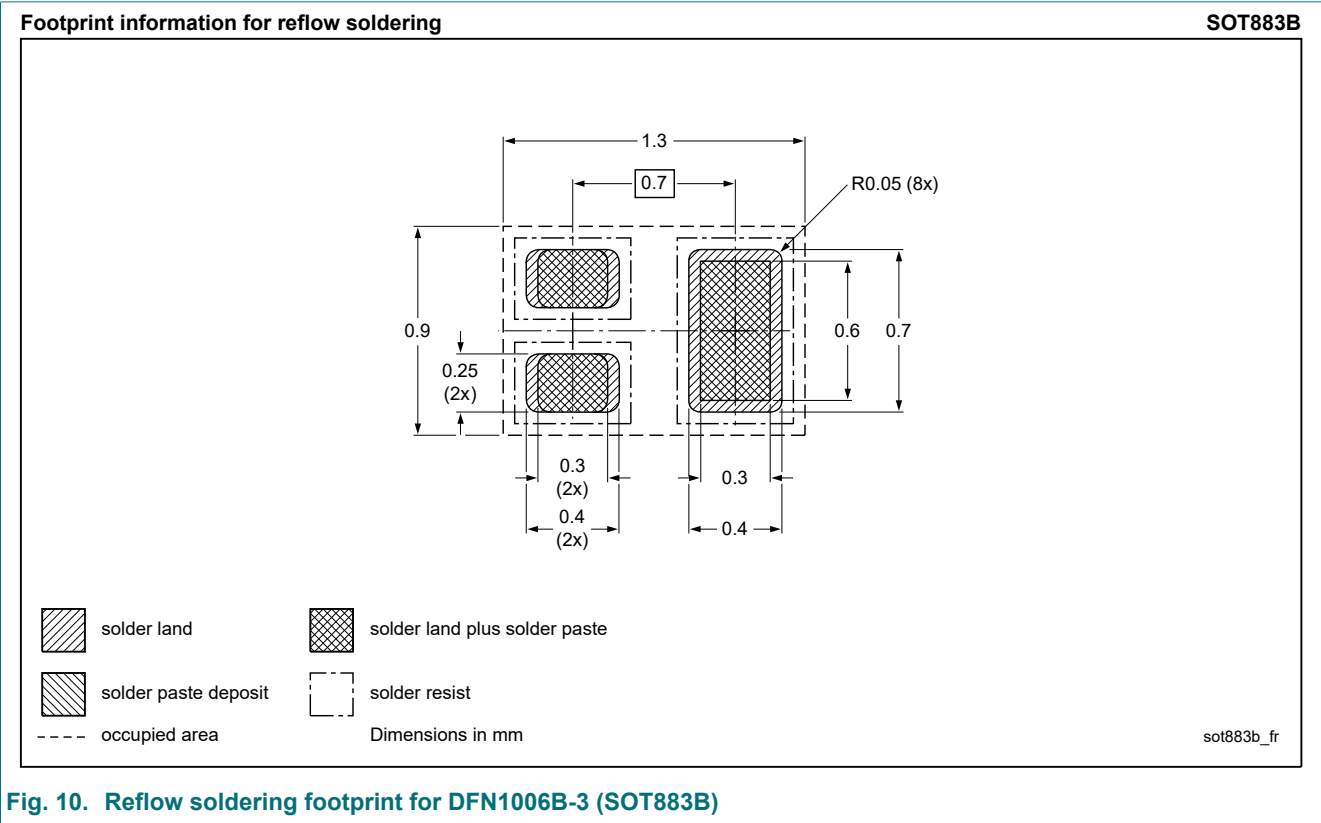
### Quality information

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



13. Soldering



## 14. Revision history

Table 8. Revision history

| Data sheet ID  | Release date                                                                                                                                                                                                                           | Data sheet status  | Change notice | Supersedes     |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------|----------------|
| PMBT3904MB v.2 | 20181116                                                                                                                                                                                                                               | Product data sheet | -             | PMBT3904MB v.1 |
| Modifications: | <ul style="list-style-type: none"><li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li><li>Legal texts have been adapted to the new company name where appropriate.</li></ul> |                    |               |                |
| PMBT3904MB v.1 | 20120307                                                                                                                                                                                                                               | Product data sheet | -             | -              |

## 15. Legal information

### Data sheet status

| Document status<br>[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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