



# PMBT3904YS

40 V, 200 mA NPN/NPN general-purpose double transistor

Rev. 01 — 12 May 2009

Product data sheet

## 1. Product profile

### 1.1 General description

NPN/NPN general-purpose double transistor in a SOT363 (SC-88) very small Surface-Mounted Device (SMD) plastic package.

Table 1. Product overview

| Type number | Package |       | PNP/PNP complement | NPN/PNP complement | Package configuration |
|-------------|---------|-------|--------------------|--------------------|-----------------------|
|             | NXP     | JEITA |                    |                    |                       |
| PMBT3904YS  | SOT363  | SC-88 | PMBT3906YS         | PMBT3946YPN        | very small            |

### 1.2 Features

- General-purpose double transistor
- Board-space reduction

### 1.3 Applications

- General-purpose switching and amplification

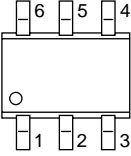
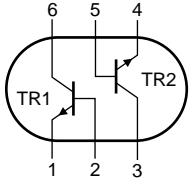
### 1.4 Quick reference data

Table 2. Quick reference data

| Symbol                | Parameter                 | Conditions                                     | Min | Typ | Max | Unit |
|-----------------------|---------------------------|--|-----|-----|-----|------|
| <b>Per transistor</b> |                           |  |     |     |     |      |
| $V_{CEO}$             | 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 3. Pinning**

| Pin | Description   | Simplified outline  | Graphic symbol  |
|-----|---------------|---|---|
| 1   | emitter TR1   |  |  |
| 2   | base TR1      |   |   |
| 3   | collector TR2 |   |   |
| 4   | emitter TR2   |   |   |
| 5   | base TR2      |   |   |
| 6   | collector TR1 |   |   |

*sym020*

## 3. Ordering information

**Table 4. Ordering information**

| Type number | Package |  | Version |
|-------------|---------|--|---------|
|             | Name    | Description                              |         |
| PMBT3904YS  | SC-88   | plastic surface-mounted package; 6 leads | SOT363  |

## 4. Marking

**Table 5. Marking codes**

| Type number | Marking code <sup>[1]</sup> |
|-------------|-----------------------------|
| PMBT3904YS  | BC*                         |

- [1] \* = -: made in Hong Kong  
 \* = p: made in Hong Kong  
 \* = t: made in Malaysia  
 \* = W: made in China

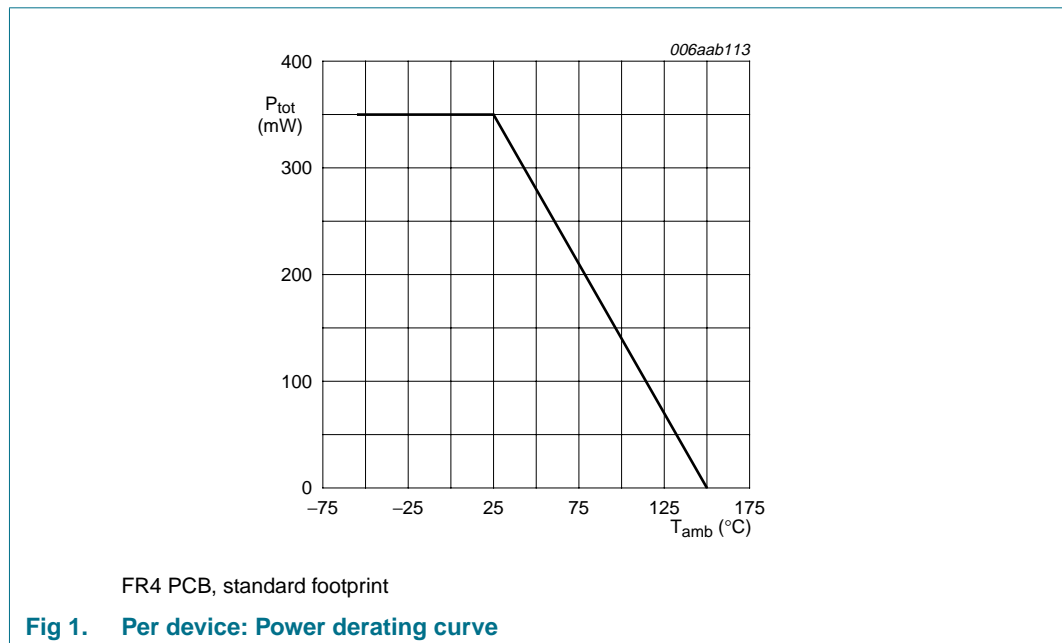
## 5. Limiting values

**Table 6. Limiting values**

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

| Symbol                | Parameter                 | Conditions                       | Min | Max  | Unit |
|-----------------------|---------------------------|----------------------------------|-----|------|------|
| <b>Per transistor</b> |                           |                                  |     |      |      |
| $V_{CBO}$             | 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] | 230  | mW   |
| <b>Per device</b>     |                           |                                  |     |      |      |
| $P_{tot}$             | total power dissipation   | $T_{amb} \leq 25$ °C             | [1] | 350  | mW   |
| $T_j$                 | junction temperature      |                                  | -   | 150  | °C   |
| $T_{amb}$             | ambient temperature       |                                  | -55 | +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.

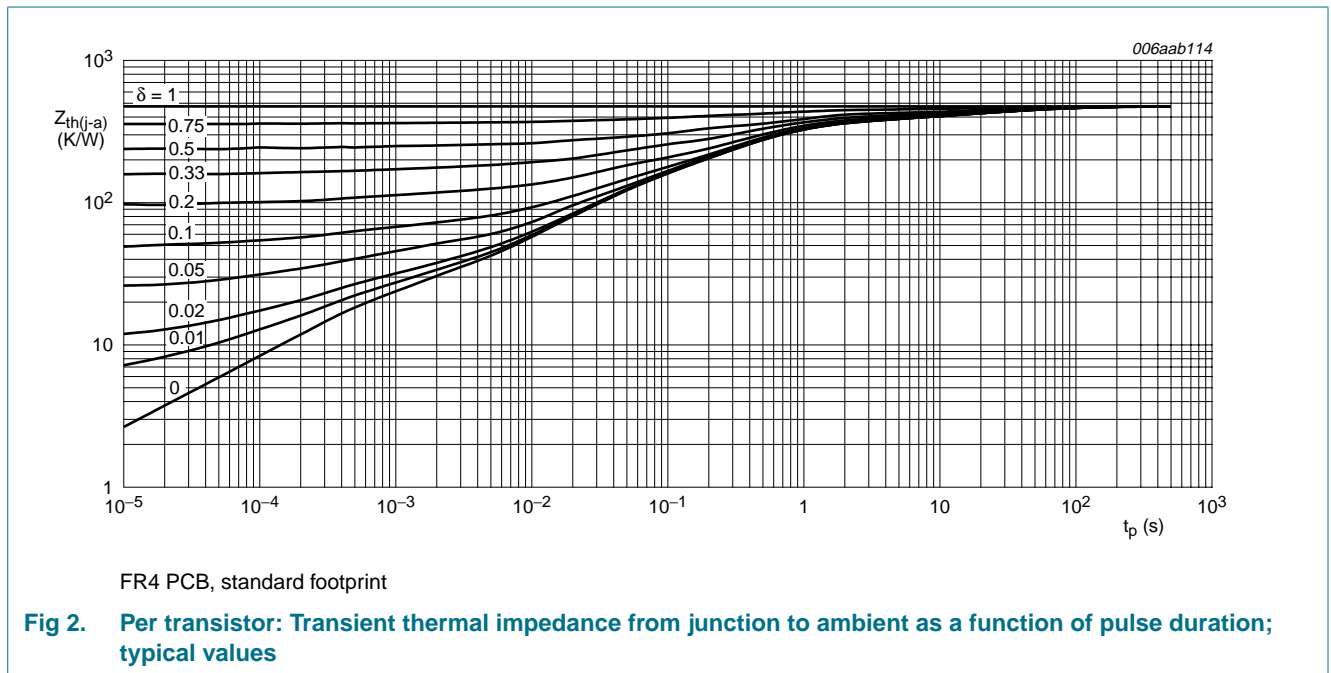


## 6. Thermal characteristics

Table 7. Thermal characteristics

| Symbol                | Parameter  | Conditions  | Min | Typ | Max | Unit |
|-----------------------|--|-------------|-----|-----|-----|------|
| <b>Per transistor</b> |  |             |     |     |     |      |
| $R_{th(j-a)}$         | thermal resistance from junction to ambient      | in free air | [1] | -   | 543 | K/W  |
| $R_{th(j-sp)}$        | thermal resistance from junction to solder point |             | -   | -   | 290 | K/W  |
| <b>Per device</b>     |  |             |     |     |     |      |
| $R_{th(j-a)}$         | thermal resistance from junction to ambient      | in free air | [1] | -   | 357 | K/W  |

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

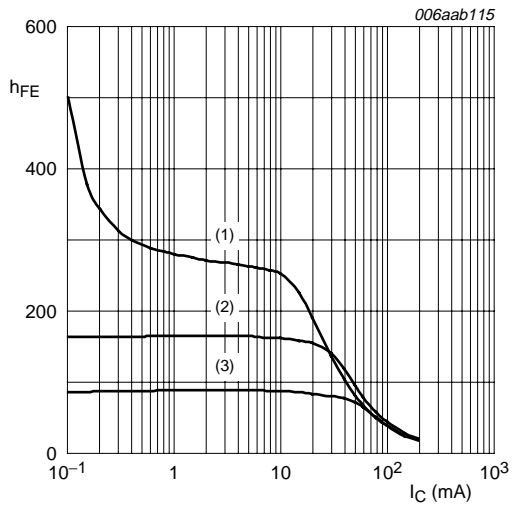


## 7. Characteristics

**Table 8. Characteristics**

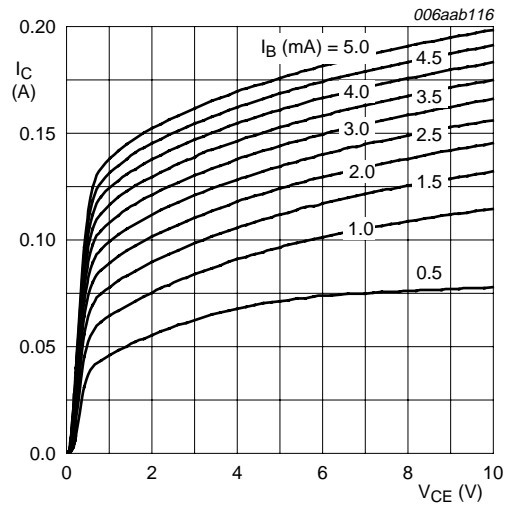
$T_{amb} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

| Symbol                | Parameter                            | Conditions   | Min | Typ | Max | Unit |
|-----------------------|--------------------------------------|--|-----|-----|-----|------|
| <b>Per transistor</b> |                                      |  |     |     |     |      |
| $I_{CBO}$             | 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 |      |
|                       |                                      | $I_C = 50\text{ mA}$   | 60  | 105 | -   |      |
| $V_{CEsat}$           | 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   |
| $f_T$                 | transition frequency                 | $V_{CE} = 20\text{ V}; I_C = 10\text{ mA}; f = 100\text{ MHz}$   | 300 | -   | -   | MHz  |
| $C_c$                 | collector capacitance                | $V_{CB} = 5\text{ V}; I_E = i_e = 0\text{ A}; f = 1\text{ MHz}$  | -   | -   | 4   | pF   |
| $C_e$                 | emitter capacitance                  | $V_{BE} = 0.5\text{ V}; I_C = i_c = 0\text{ A}; f = 1\text{ MHz}$  | -   | -   | 8   | pF   |
| 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   |
| $t_d$                 | delay time                           | $V_{CC} = 3\text{ V}; I_C = 10\text{ mA}; I_{Bon} = 1\text{ mA}; I_{Boff} = -1\text{ mA}$                        | -   | -   | 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   |



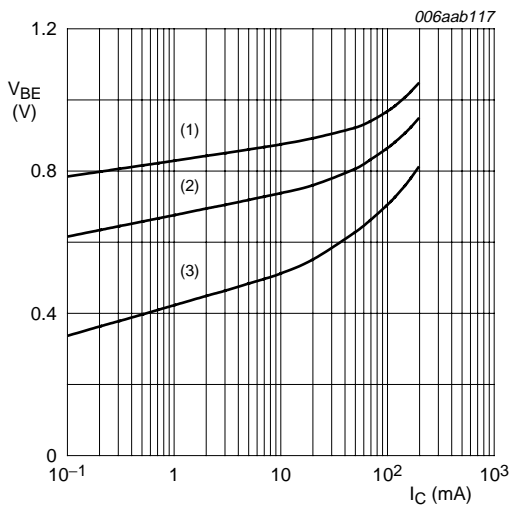
$V_{CE} = 1\text{ V}$   
 (1)  $T_{amb} = 150\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = -55\text{ }^{\circ}\text{C}$

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



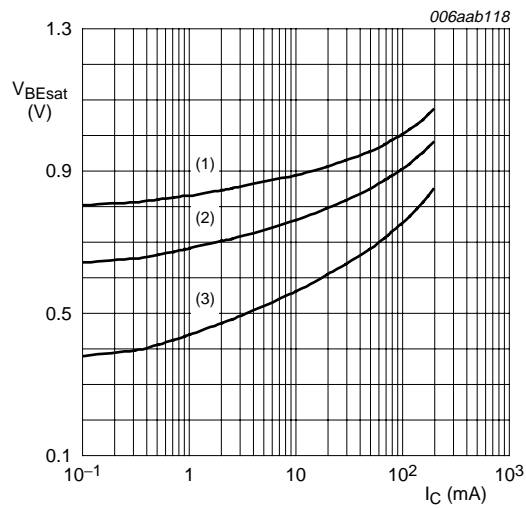
$T_{amb} = 25\text{ }^{\circ}\text{C}$

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



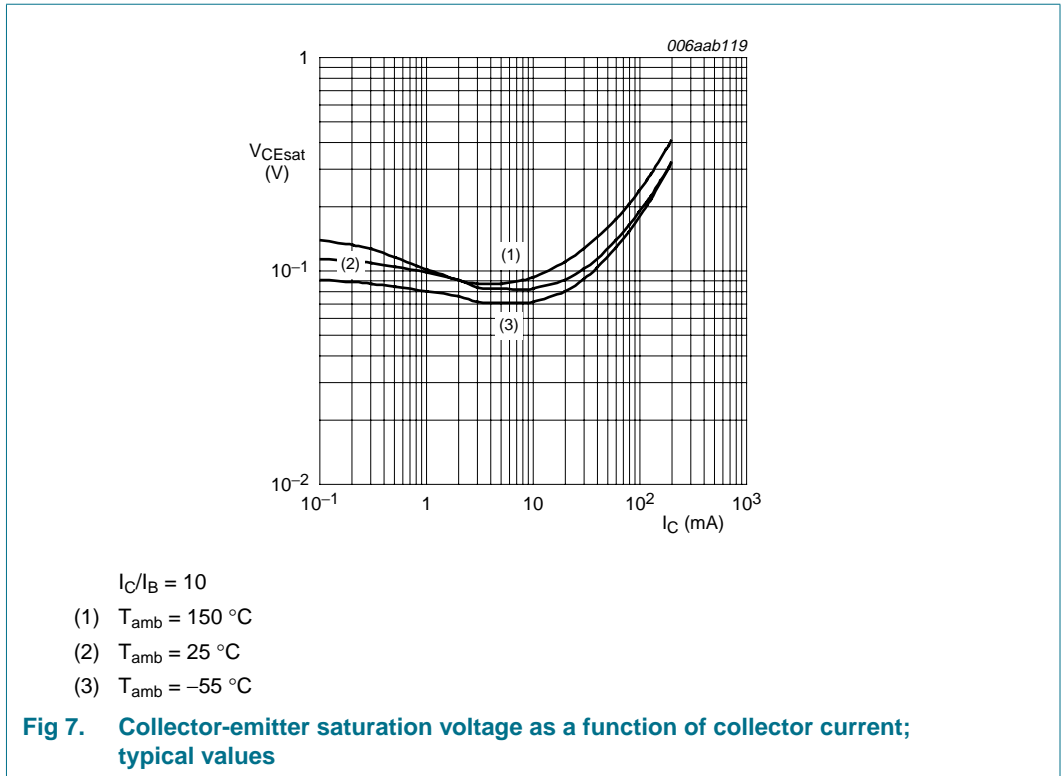
$V_{CE} = 1\text{ V}$   
 (1)  $T_{amb} = -55\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = 150\text{ }^{\circ}\text{C}$

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

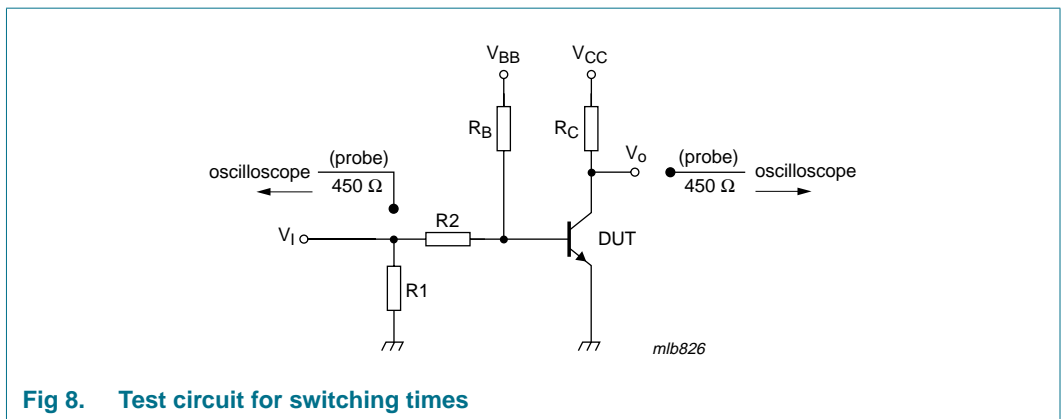


$I_C/I_B = 10$   
 (1)  $T_{amb} = -55\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = 150\text{ }^{\circ}\text{C}$

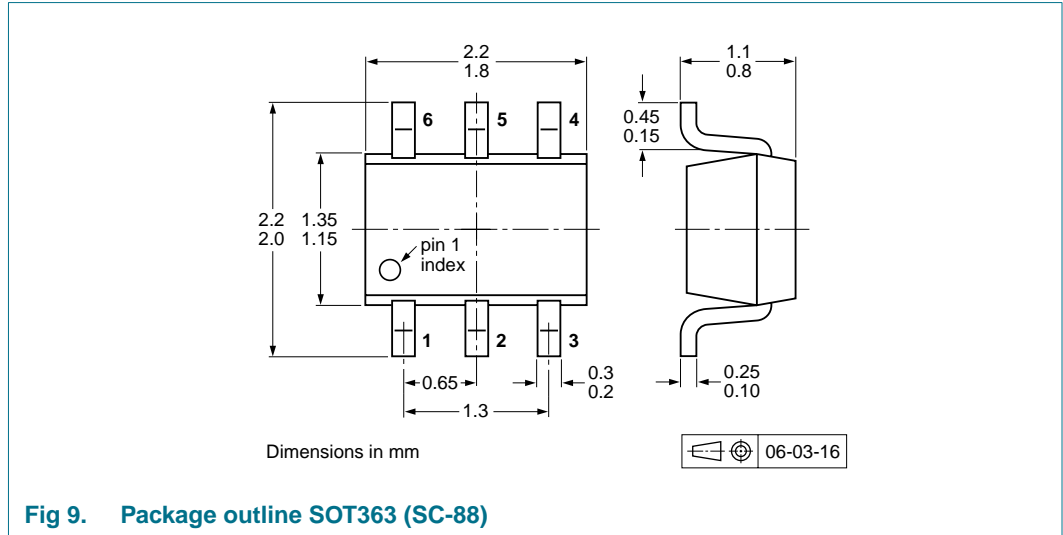
**Fig 6. Base-emitter saturation voltage as a function of collector current; typical values**



## 8. Test information



**9. Package outline**



**Fig 9. Package outline SOT363 (SC-88)**

**10. Packing information**

**Table 9. Packing methods**

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

| Type number | Package | Description                        | Packing quantity    |       |
|-------------|---------|------------------------------------|---------------------|-------|
|             |         |                                    | 3000                | 10000 |
| PMBT3904YS  | SOT363  | 4 mm pitch, 8 mm tape and reel; T1 | <sup>[2]</sup> -115 | -135  |
|             |         | 4 mm pitch, 8 mm tape and reel; T2 | <sup>[3]</sup> -125 | -165  |

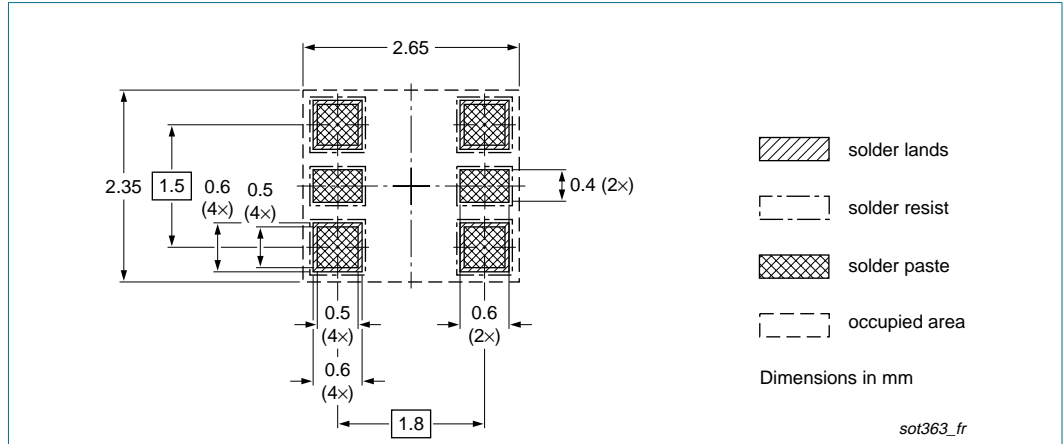
[1] For further information and the availability of packing methods, see [Section 14](#).

[2] T1: normal taping

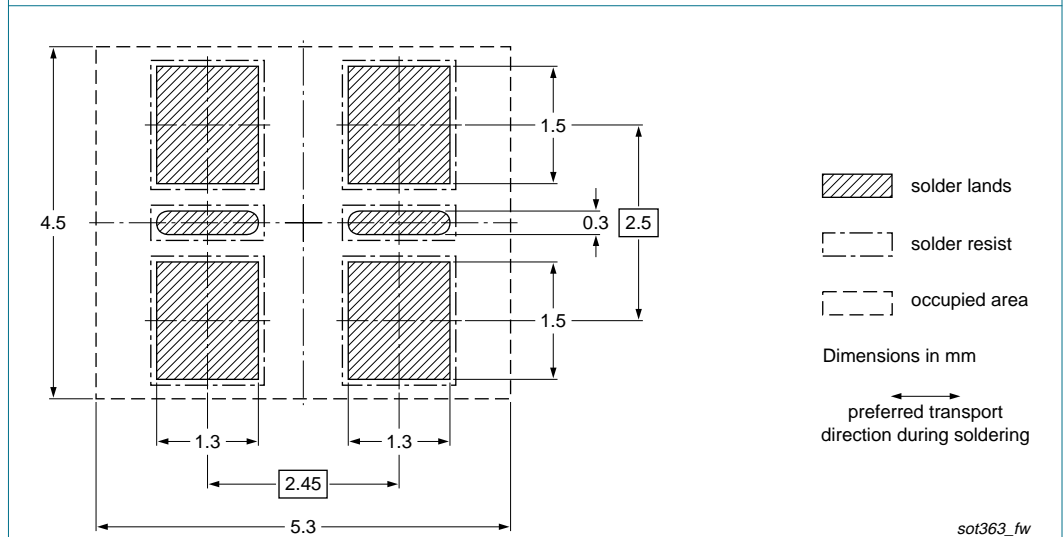
[3] T2: reverse taping



**11. Soldering**



**Fig 10. Reflow soldering footprint SOT363 (SC-88)**



**Fig 11. Wave soldering footprint SOT363 (SC-88)**

## 12. Revision history

Table 10. Revision history

| Document ID  | Release date | Data sheet status  | Change notice | Supersedes |
|--------------|--------------|--------------------|---------------|------------|
| PMBT3904YS_1 | 20090512     | Product data sheet | -             | -          |

## 13. Legal information

### 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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Date of release: 12 May 2009

Document identifier: PMBT3904YS\_1

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