
# PMBT3904VS

## 40 V, 200 mA NPN/NPN switching transistor

28 December 2022 Product data sheet

## 1. General description

NPN/NPN double switching transistor in a SOT666 ultra small and flat lead Surface-Mounted Device (SMD) plastic package.

## 2. Features and benefits

- Double general-purpose switching transistor
- Board-space reduction
- Ultra small and flat lead SMD plastic package

## 3. Applications

- General-purpose switching and amplification

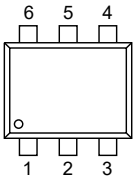
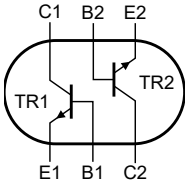
## 4. Quick reference data

**Table 1. Quick reference data**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Per transistor** | | | | | | | |
| $V_{CEO}$ | 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; $T_{amb}$ = 25 °C | | 100 | 180 | 300 | |

## 5. Pinning information

**Table 2. Pinning information**

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|---|---|---|---|---|
| 1 | E1 | emitter TR1 |   **SOT666** |   *sym020* |
| 2 | B1 | base TR1 | | |
| 3 | C2 | collector TR2 | | |
| 4 | E2 | emitter TR2 | | |
| 5 | B2 | base TR2 | | |
| 6 | C1 | collector TR1 | | |

# 6. Ordering information

**Table 3. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| PMBT3904VS | SOT666 | plastic, surface-mounted package; 6 leads; 0.5 mm pitch; 1.6 mm x 1.2 mm x 0.55 mm body | SOT666 |

# 7. Marking

**Table 4. Marking codes**

| Type number | Marking code |
|---|---|
| PMBT3904VS | ZC |

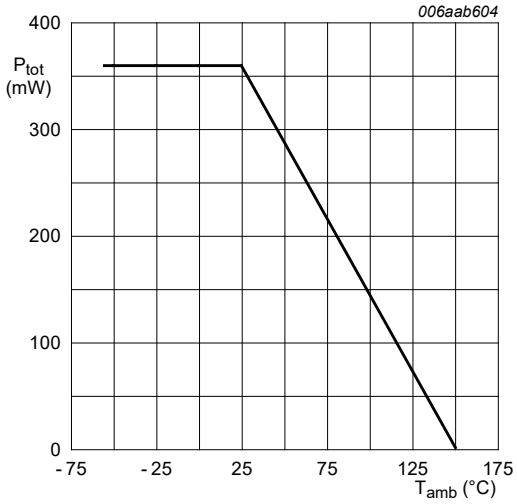
# 8. Limiting values

**Table 5. Limiting values**

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

| Symbol | Parameter | Conditions | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| **Per transistor** | | | | | | |
| $V_{CBO}$ | 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] [2] | - | 240 | mW |
| **Per device** | | | | | | |
| $P_{tot}$ | total power dissipation | $T_{amb} \leq 25$ °C | [1] [2] | - | 360 | 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.
[2] Reflow soldering is the only recommended soldering method.




FR4 PCB, standard footprint

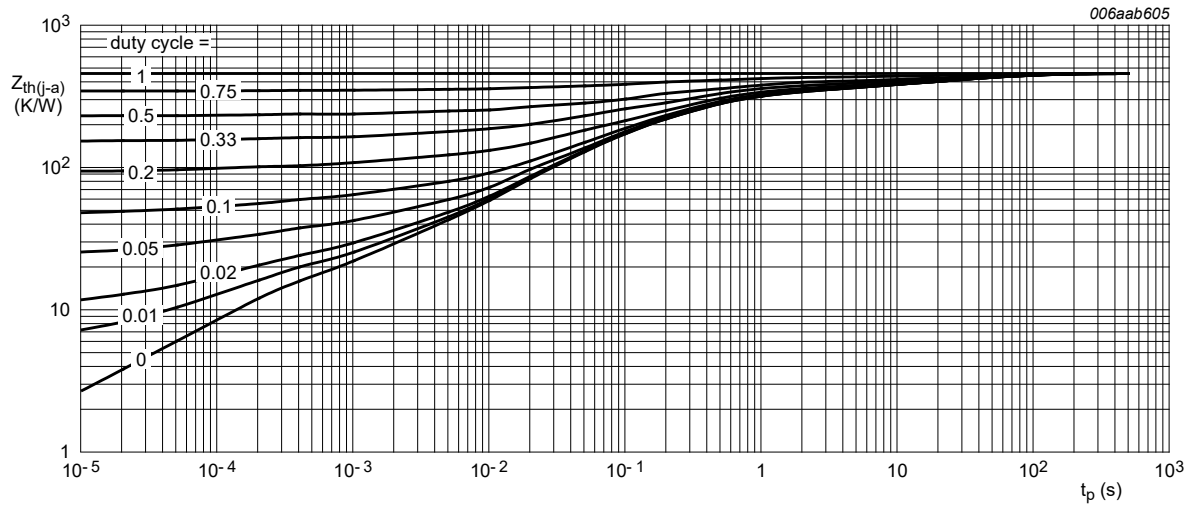
**Fig. 1. Per device: Power derating curve**

## 9. Thermal characteristics

**Table 6. Thermal characteristics**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Per transistor** | | | | | | | |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | [1] [2] | - | - | 521 | K/W |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | | - | - | 100 | K/W |
| **Per device** | | | | | | | |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | [1] [2] | - | - | 347 | K/W |

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
[2] Reflow soldering is the only recommended soldering method.



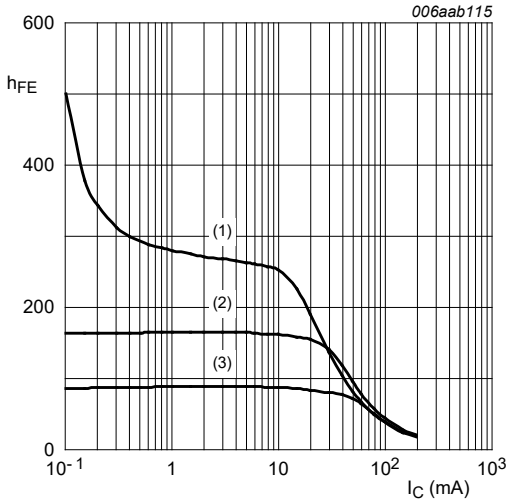

FR4 PCB, standard footprint

**Fig. 2. Per transistor: Transient thermal impedance from junction to ambient as a function of pulse duration; typical values**

# 10. Characteristics

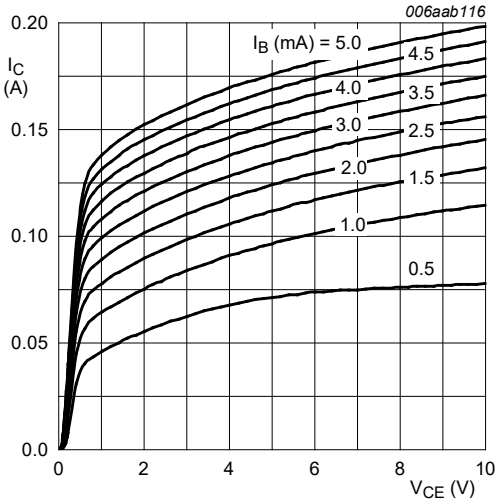
**Table 7. Characteristics**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Per transistor** | | | | | | | |
| $I_{CBO}$ | collector-base cut-off current | $V_{CB}$ = 30 V; $I_E$ = 0 A; $T_{amb}$ = 25 °C | | - | - | 50 | nA |
| $I_{EBO}$ | emitter-base cut-off current | $V_{EB}$ = 6 V; $I_C$ = 0 A; $T_{amb}$ = 25 °C | | - | - | 50 | nA |
| $h_{FE}$ | DC current gain | $V_{CE}$ = 1 V; $I_C$ = 0.1 mA; $T_{amb}$ = 25 °C | | 60 | 180 | - | |
| | | $V_{CE}$ = 1 V; $I_C$ = 1 mA; $T_{amb}$ = 25 °C | | 80 | 180 | - | |
| | | $V_{CE}$ = 1 V; $I_C$ = 10 mA; $T_{amb}$ = 25 °C | | 100 | 180 | 300 | |
| | | $V_{CE}$ = 1 V; $I_C$ = 50 mA; $T_{amb}$ = 25 °C | | 60 | 105 | - | |
| | | $V_{CE}$ = 1 V; $I_C$ = 100 mA; pulsed; $t_p \leq$ 300 µs; $\delta \leq$ 0.02; $T_{amb}$ = 25 °C | | 30 | 50 | - | |
| $V_{CEsat}$ | collector-emitter saturation voltage | $I_C$ = 10 mA; $I_B$ = 1 mA; $T_{amb}$ = 25 °C | | - | 75 | 200 | mV |
| | | $I_C$ = 50 mA; $I_B$ = 5 mA; $T_{amb}$ = 25 °C | | - | 120 | 300 | mV |
| $V_{BEsat}$ | base-emitter saturation voltage | $I_C$ = 10 mA; $I_B$ = 1 mA; $T_{amb}$ = 25 °C | | 650 | 750 | 850 | mV |
| | | $I_C$ = 50 mA; $I_B$ = 5 mA; $T_{amb}$ = 25 °C | | - | 850 | 950 | mV |
| $t_d$ | delay time | $I_C$ = 10 mA; $I_{Bon}$ = 1 mA; $I_{Boff}$ = -1 mA; $V_{CC}$ = 3 V; $T_{amb}$ = 25 °C | | - | - | 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 V; $I_E$ = 0 A; $i_e$ = 0 A; f = 1 MHz; $T_{amb}$ = 25 °C | | - | - | 4 | pF |
| $C_e$ | emitter capacitance | $V_{EB}$ = 500 mV; $I_C$ = 0 A; $i_c$ = 0 A; f = 1 MHz; $T_{amb}$ = 25 °C | | - | - | 8 | pF |
| $f_T$ | transition frequency | $V_{CE}$ = 20 V; $I_C$ = 10 mA; f = 100 MHz; $T_{amb}$ = 25 °C | | 300 | - | - | MHz |
| NF | noise figure | $V_{CE}$ = 5 V; $I_C$ = 100 µA; $R_S$ = 1 kΩ; f = 10 Hz to 15.7 kHz; $T_{amb}$ = 25 °C | | - | - | 5 | dB |



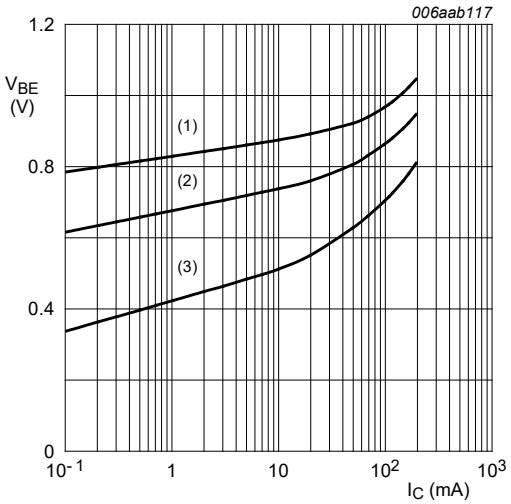

$V_{CE}$ = 1 V
(1) $T_{amb}$ = 150 °C
(2) $T_{amb}$ = 25 °C
(3) $T_{amb}$ = −55 °C

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



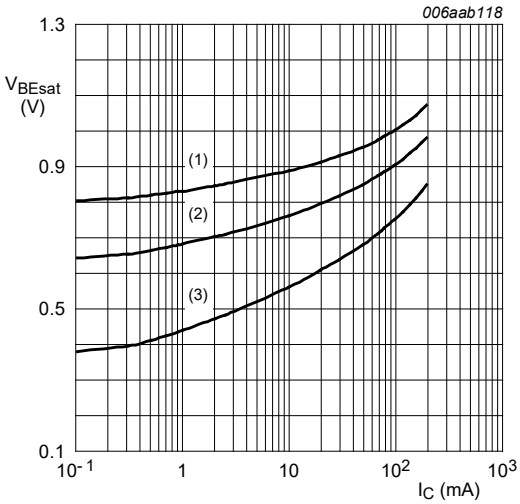

$T_{amb}$ = 25 °C

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



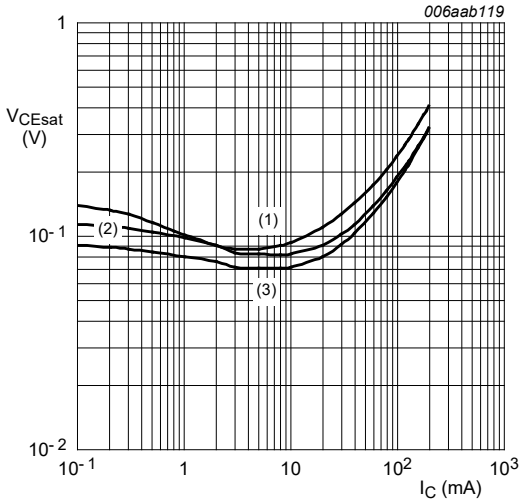

$V_{CE}$ = 1 V
(1) $T_{amb}$ = −55 °C
(2) $T_{amb}$ = 25 °C
(3) $T_{amb}$ = 150 °C

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




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

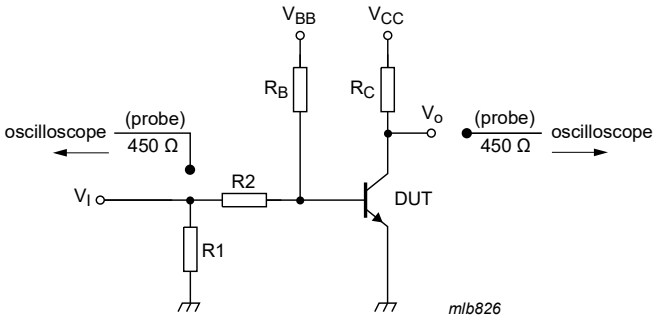
**Fig. 6. Per transistor: Base-emitter saturation voltage as a function of collector current; typical values**




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

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

## 11. Test information




$V_I$ = 5 V; t = 600 µs; $t_p$ = 10 µs; $t_r = t_f \leq$ 3ns
R1 = 56 Ω; R2 = 2.5 kΩ; $R_B$ = 3.9 kΩ; $R_C$ = 270 Ω
$V_{BB}$ = -1.9 V; $V_{CC}$ = 3 V

**Fig. 8. Test circuit for switching times**

## 12. Package outline

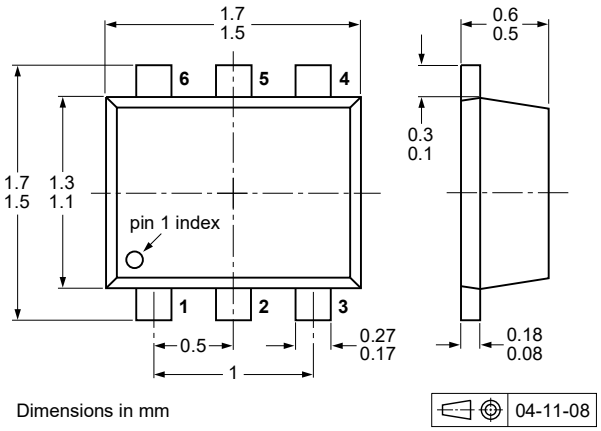



**Fig. 9. Package outline SOT666**

## 13. Soldering

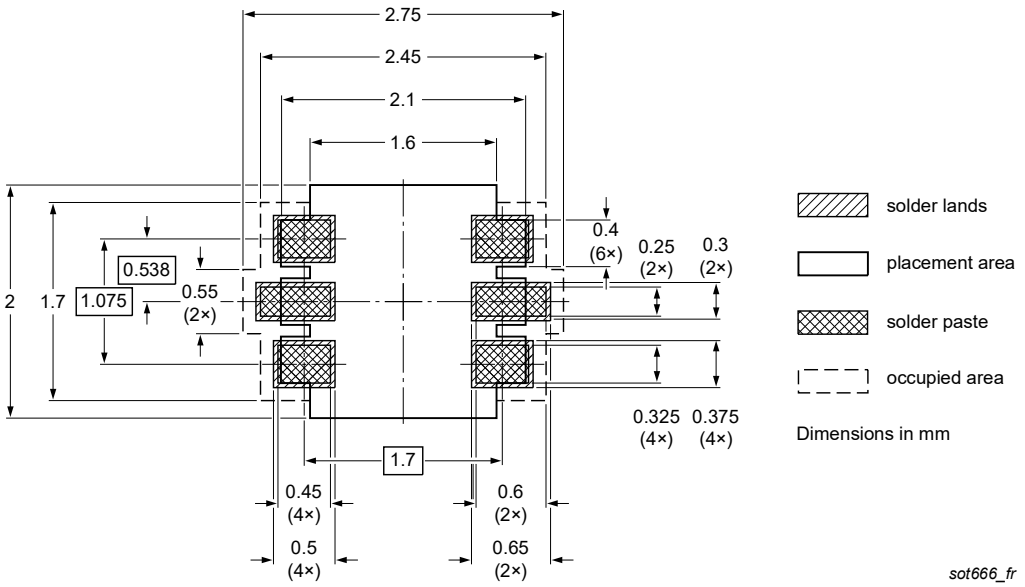



**Fig. 10. Reflow soldering footprint for SOT666**

# 14. Revision history

**Table 8. Revision history**

| Data sheet ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| PMBT3904VS v. 3 | 20221228 | Product data sheet | - | PMBT3904VS v. 2 |
| Modifications: | • Product(s) changed to non-automotive qualification. | | | |
| PMBT3904VS v. 2 | 20190917 | Product data sheet | - | PMBT3904VS v. 1 |
| PMBT3904VS v. 1 | 20090708 | 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. |

[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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