



# PMBT4401

## NPN switching transistor

7 December 2023

Product data sheet

## 1. General description

NPN switching transistor in a small SOT23 Surface-Mounted Device (SMD) plastic package.

PNP complement: PMBT4403

## 2. Features and benefits

- High current (max. 600 mA)
- Low voltage (max. 40 V)
- AEC-Q101 qualified

## 3. Applications

- Industrial and consumer switching applications

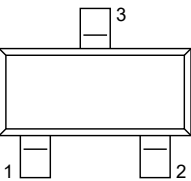
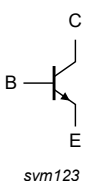
## 4. Quick reference data

Table 1. Quick reference data

| Symbol    | Parameter                 | Conditions                                                                                                                                            | Min | Typ | Max | Unit |
|-----------|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|------|
| $V_{CEO}$ | collector-emitter voltage | open base                                                                                                                                             | -   | -   | 40  | V    |
| $I_C$     | collector current         |                                                                                                                                                       | -   | -   | 600 | mA   |
| $h_{FE}$  | DC current gain           | $V_{CE} = 1\text{ V}$ ; $I_C = 150\text{ mA}$ ; pulsed; $t_p \leq 300\text{ }\mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{amb} = 25\text{ }^\circ\text{C}$ | 100 | -   | 300 |      |

## 5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline                                                                           | Graphic symbol                                                                                  |
|-----|--------|-------------|----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| 1   | B      | base        | <br>SOT23 | <br>sym123 |
| 2   | E      | emitter     |                                                                                              |                                                                                                 |
| 3   | C      | collector   |                                                                                              |                                                                                                 |

6. Ordering information

Table 3. Ordering information

| Type number | Package |                                                                                          |         |
|-------------|---------|------------------------------------------------------------------------------------------|---------|
|             | Name    | Description                                                                              | Version |
| PMBT4401    | SOT23   | plastic, surface-mounted package; 3 terminals; 1.9 mm pitch; 2.9 mm x 1.3 mm x 1 mm body | SOT23   |

7. Marking

Table 4. Marking codes

| Type number | Marking code[1] |
|-------------|-----------------|
| PMBT4401    | %2X             |

[1] % = placeholder for manufacturing site code

8. Limiting values

Table 5. Limiting values

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

| Symbol           | Parameter                 | Conditions               |     | Min | Max | Unit |
|------------------|---------------------------|--------------------------|-----|-----|-----|------|
| V <sub>CBO</sub> | collector-base voltage    | open emitter             |     | -   | 60  | V    |
| V <sub>CEO</sub> | collector-emitter voltage | open base                |     | -   | 40  | V    |
| V <sub>EBO</sub> | emitter-base voltage      | open collector           |     | -   | 6   | V    |
| I <sub>C</sub>   | collector current         |                          |     | -   | 600 | mA   |
| I <sub>CM</sub>  | peak collector current    |                          |     | -   | 800 | mA   |
| I <sub>BM</sub>  | peak base current         |                          |     | -   | 200 | mA   |
| P <sub>tot</sub> | total power dissipation   | T <sub>amb</sub> ≤ 25 °C | [1] | -   | 250 | mW   |
| T <sub>j</sub>   | junction temperature      |                          |     | -   | 150 | °C   |
| T <sub>amb</sub> | ambient temperature       |                          |     | -65 | 150 | °C   |
| T <sub>stg</sub> | storage temperature       |                          |     | -65 | 150 | °C   |

[1] Transistor mounted on an FR4 printed-circuit board, single-sided copper, tin-plated and standard footprint.

9. 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] | -   | -   | 500 | K/W  |

[1] Transistor mounted on an FR4 printed-circuit board, single-sided copper, tin-plated and standard footprint.

## 10. Characteristics

Table 7. Characteristics

| Symbol                                                | Parameter                            | Conditions                                                                                                                   | Min | Typ | Max | Unit |
|-------------------------------------------------------|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|------|
| $V_{(BR)CBO}$                                         | collector-base breakdown voltage     | $I_C = 100 \mu A$ ; $T_{amb} = 25^\circ C$                                                                                   | 60  | -   | -   | V    |
| $V_{(BR)CEO}$                                         | collector-emitter breakdown voltage  | $I_C = 1 \text{ mA}$ ; $T_{amb} = 25^\circ C$                                                                                | 40  | -   | -   | V    |
| $V_{(BR)EBO}$                                         | emitter-base breakdown voltage       | $I_C = 100 \mu A$ ; $T_{amb} = 25^\circ C$                                                                                   | 6   | -   | -   | V    |
| $I_{CBO}$                                             | collector-base cut-off current       | $V_{CB} = 60 \text{ V}$ ; $I_E = 0 \text{ A}$ ; $T_{amb} = 25^\circ C$                                                       | -   | -   | 50  | nA   |
| $I_{EBO}$                                             | emitter-base cut-off current         | $V_{EB} = 6 \text{ V}$ ; $I_C = 0 \text{ A}$ ; $T_{amb} = 25^\circ C$                                                        | -   | -   | 50  | nA   |
| $h_{FE}$                                              | DC current gain                      | $V_{CE} = 1 \text{ V}$ ; $I_C = 0.1 \text{ mA}$ ; $T_{amb} = 25^\circ C$                                                     | 20  | -   | -   |      |
|                                                       |                                      | $V_{CE} = 1 \text{ V}$ ; $I_C = 1 \text{ mA}$ ; $T_{amb} = 25^\circ C$                                                       | 40  | -   | -   |      |
|                                                       |                                      | $V_{CE} = 1 \text{ V}$ ; $I_C = 10 \text{ mA}$ ; $T_{amb} = 25^\circ C$                                                      | 80  | -   | -   |      |
|                                                       |                                      | $V_{CE} = 1 \text{ V}$ ; $I_C = 150 \text{ mA}$ ; pulsed; $t_p \leq 300 \mu s$ ; $\delta \leq 0.02$ ; $T_{amb} = 25^\circ C$ | 100 | -   | 300 |      |
|                                                       |                                      | $V_{CE} = 2 \text{ V}$ ; $I_C = 500 \text{ mA}$ ; pulsed; $t_p \leq 300 \mu s$ ; $\delta \leq 0.02$ ; $T_{amb} = 25^\circ C$ | 40  | -   | -   |      |
| $V_{CEsat}$                                           | collector-emitter saturation voltage | $I_C = 150 \text{ mA}$ ; $I_B = 15 \text{ mA}$ ; pulsed; $t_p \leq 300 \mu s$ ; $\delta \leq 0.02$ ; $T_{amb} = 25^\circ C$  | -   | -   | 400 | mV   |
|                                                       |                                      | $I_C = 500 \text{ mA}$ ; $I_B = 50 \text{ mA}$ ; pulsed; $t_p \leq 300 \mu s$ ; $\delta \leq 0.02$ ; $T_{amb} = 25^\circ C$  | -   | -   | 750 | mV   |
| $V_{BEsat}$                                           | base-emitter saturation voltage      | $I_C = 150 \text{ mA}$ ; $I_B = 15 \text{ mA}$ ; pulsed; $t_p \leq 300 \mu s$ ; $\delta \leq 0.02$ ; $T_{amb} = 25^\circ C$  | -   | -   | 950 | mV   |
|                                                       |                                      | $I_C = 500 \text{ mA}$ ; $I_B = 50 \text{ mA}$ ; pulsed; $t_p \leq 300 \mu s$ ; $\delta \leq 0.02$ ; $T_{amb} = 25^\circ C$  | -   | -   | 1.2 | V    |
| $C_C$                                                 | collector capacitance                | $V_{CB} = 5 \text{ V}$ ; $I_E = 0 \text{ A}$ ; $i_e = 0 \text{ A}$ ; $f = 1 \text{ MHz}$ ; $T_{amb} = 25^\circ C$            | -   | -   | 8   | pF   |
| $C_e$                                                 | emitter capacitance                  | $V_{EB} = 500 \text{ mV}$ ; $I_C = 0 \text{ A}$ ; $i_c = 0 \text{ A}$ ; $f = 1 \text{ MHz}$ ; $T_{amb} = 25^\circ C$         | -   | -   | 30  | pF   |
| $f_T$                                                 | transition frequency                 | $V_{CE} = 10 \text{ V}$ ; $I_C = 20 \text{ mA}$ ; $f = 100 \text{ MHz}$ ; $T_{amb} = 25^\circ C$                             | 250 | -   | -   | MHz  |
| <b>Switching times (between 10 % and 90 % levels)</b> |                                      |                                                                                                                              |     |     |     |      |
| $t_d$                                                 | delay time                           | $I_C = 150 \text{ mA}$ ; $I_{Bon} = 15 \text{ mA}$ ; $I_{Boff} = -15 \text{ mA}$ ; $T_{amb} = 25^\circ C$                    | -   | -   | 15  | ns   |
| $t_r$                                                 | rise time                            |                                                                                                                              | -   | -   | 20  | ns   |
| $t_{on}$                                              | turn-on time                         |                                                                                                                              | -   | -   | 35  | ns   |
| $t_s$                                                 | storage time                         |                                                                                                                              | -   | -   | 200 | ns   |
| $t_f$                                                 | fall time                            |                                                                                                                              | -   | -   | 60  | ns   |
| $t_{off}$                                             | turn-off time                        |                                                                                                                              | -   | -   | 250 | ns   |

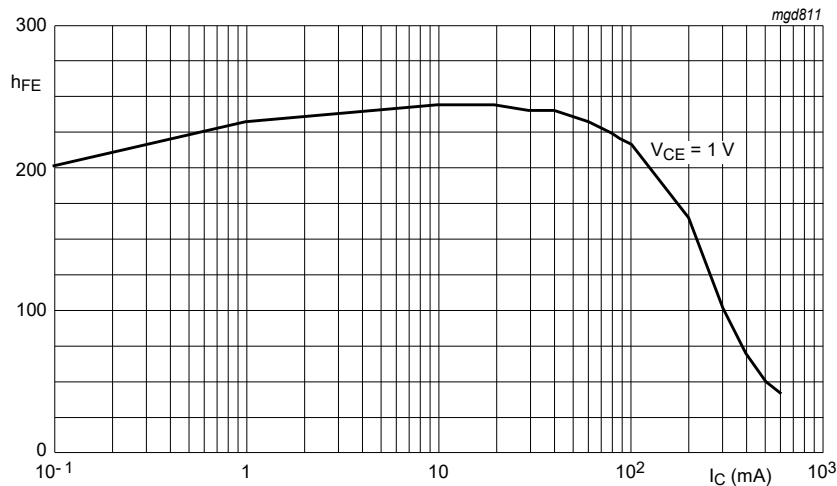


Fig. 1. DC current gain; typical value

11. Test information

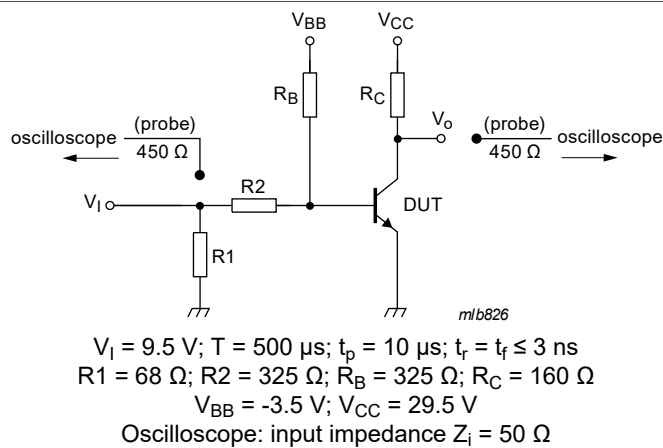
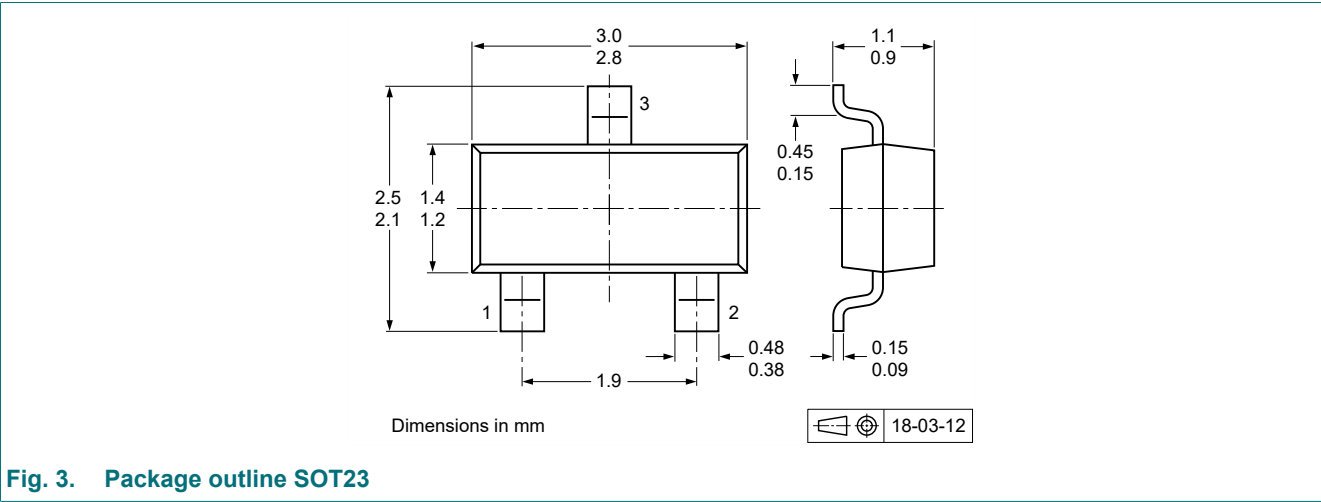


Fig. 2. Test circuit for switching times

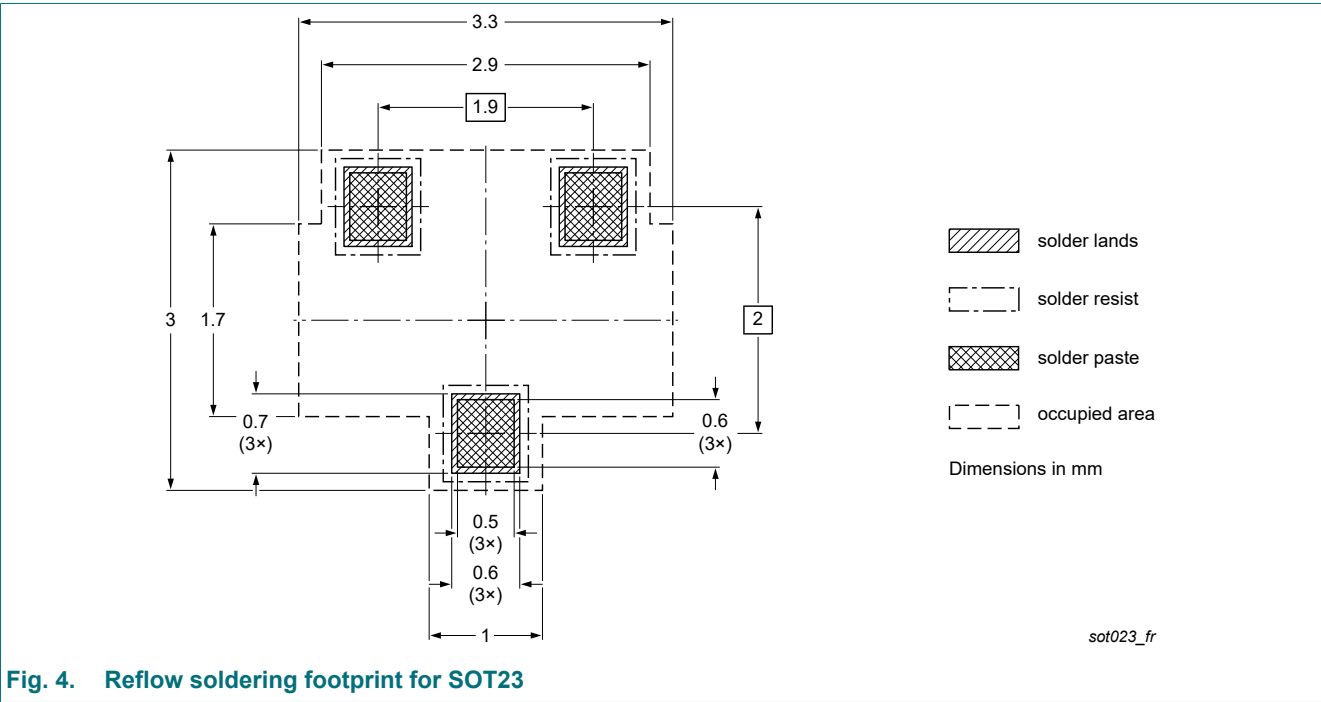
Quality information

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



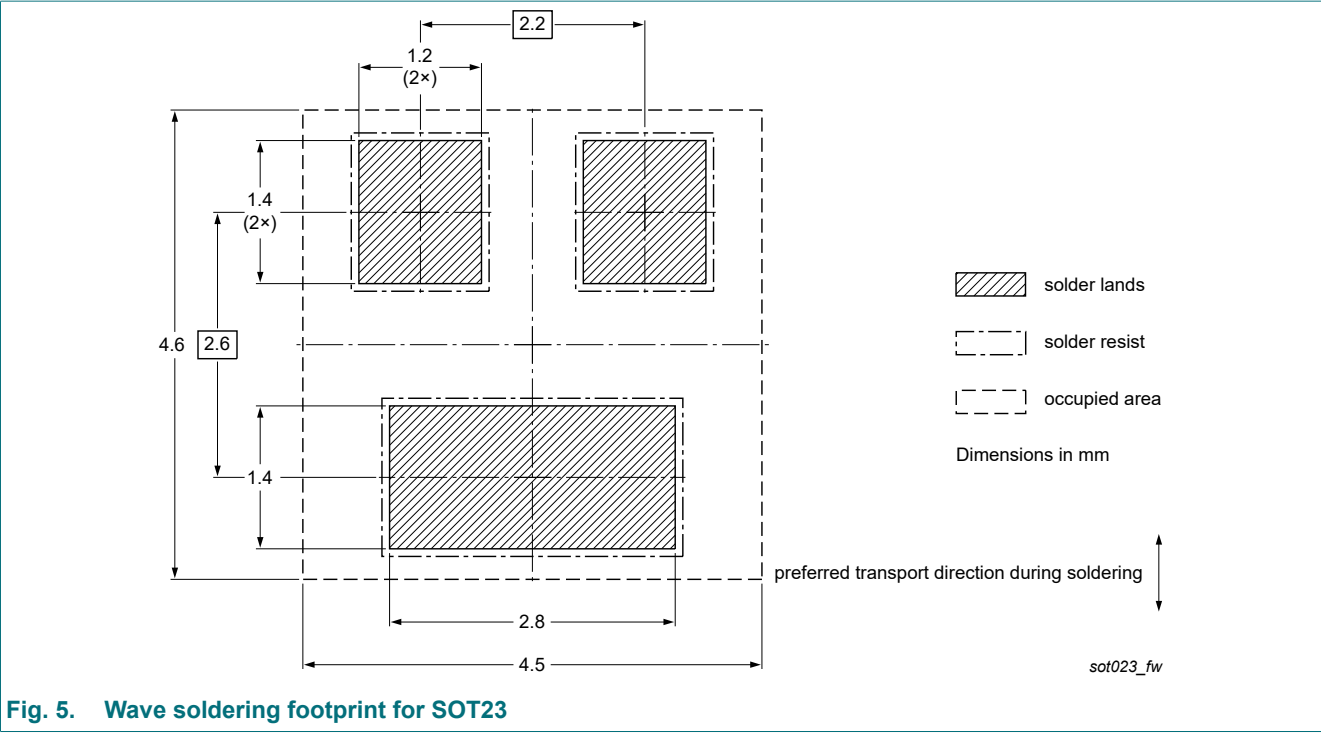


Fig. 5. Wave soldering footprint for SOT23

14. Revision history

Table 8. Revision history

| Data sheet ID  | Release date                                           | Data sheet status  | Change notice | Supersedes   |
|----------------|--------------------------------------------------------|--------------------|---------------|--------------|
| PMBT4401 v.4   | 20231207                                               | Product data sheet | -             | PMBT4401 v.3 |
| Modifications: | • Characteristics: Unit corrected to mV at $V_{CEsat}$ |                    |               |              |
| PMBT4401 v.3   | 20231117                                               | Product data sheet | -             | PMBT4401 v.2 |
| PMBT4401 v.2   | 20040121                                               | Product data sheet | -             | PMBT4401 v.1 |
| PMBT4401 v.1   | 19990415                                               | 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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Contents

1. General description..... 1

2. Features and benefits..... 1

3. Applications..... 1

4. Quick reference data..... 1

5. Pinning information..... 1

6. Ordering information..... 2

7. Marking..... 2

8. Limiting values..... 2

9. Thermal characteristics..... 2

10. Characteristics..... 3

11. Test information..... 4

12. Package outline..... 5

13. Soldering..... 5

14. Revision history..... 7

15. Legal information..... 8

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