



PBRP123YT

40 V, 600 mA PNP PB RET; R1 = 2.2 k Ω , R2 = 10 k Ω

1 April 2021

Product data sheet

1. General description

PNP low V_{CEsat} Performance-Based (PB) Resistor-Equipped Transistor (RET) in a small SOT23 (TO-236AB) Surface-Mounted Device (SMD) plastic package.

NPN complement: PBRN123YT

2. Features and benefits

- 600 mA output current capability
- Low collector-emitter saturation voltage V_{CEsat}
- High current gain h_{FE}
- Reduces component count
- Built-in bias resistors
- Reduces pick and place costs
- Simplifies circuit design
- $\pm 10\%$ resistor ratio tolerance

3. Applications

- Digital application in automotive and industrial segments
- Switching loads
- Medium current peripheral driver

4. Quick reference data

Table 1. Quick reference data

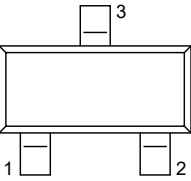
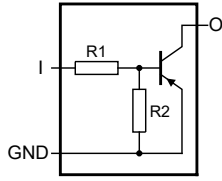
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|-----------|---------------------------|------------|-----|------|------|------|------------|
| V_{CEO} | collector-emitter voltage | open base | | - | - | -40 | V |
| I_O | output current | | [1] | - | - | -600 | mA |
| R1 | bias resistor 1 | | [2] | 1.54 | 2.2 | 2.86 | k Ω |
| R2/R1 | bias resistor ratio | | [2] | 4.1 | 4.55 | 5 | |

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided, 35 μ m copper, tin-plated and standard footprint.

[2] See section "Test information" for resistor calculation and test conditions

5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|-----|--------|--------------------|---|--|
| 1 | I | input (base) |  <p style="text-align: center;">SOT23</p> |  <p style="text-align: center;"><small>aaa-019606</small></p> |
| 2 | GND | ground (emitter) | | |
| 3 | O | output (collector) | | |

6. Ordering information

Table 3. Ordering information

| Type number | Package | | |
|-------------|---------|--|---------|
| | Name | Description | Version |
| PBRP123YT | 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] |
|-------------|-----------------------------|
| PBRP123YT | %7Q |

[1] % = placeholder for manufacturing site code

8. Limiting values

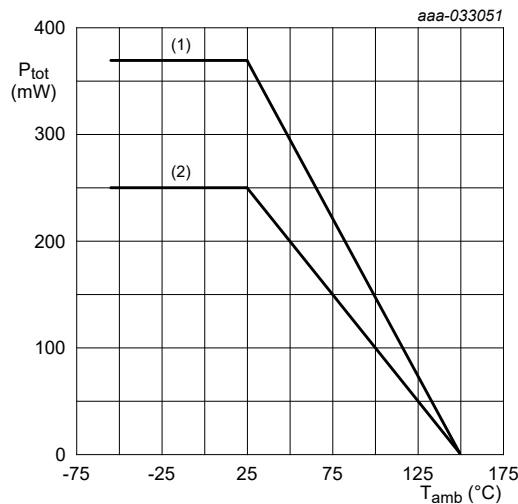
Table 5. Limiting values

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

| Symbol | Parameter | Conditions | Min | Max | Unit |
|------------------|--------------------------------|---------------------------------|-----|------|------|
| V _{CBO} | collector-base voltage | open emitter | - | -40 | V |
| V _{CEO} | collector-emitter voltage | open base | - | -40 | V |
| V _{EBO} | emitter-base voltage | open collector | - | -5 | V |
| V _I | input voltage | positive | - | 5 | V |
| | | negative | - | -22 | V |
| I _O | output current | | [1] | -600 | mA |
| I _{ORM} | repetitive peak output current | t _p ≤ 1 ms; δ ≤ 0.33 | - | -800 | mA |
| P _{tot} | total power dissipation | T _{amb} ≤ 25 °C | [1] | 250 | mW |
| | | | [2] | 370 | 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, 35 μm copper, tin-plated and standard footprint.

[2] Device mounted on an FR4 PCB, single-sided, 35 μm copper, tin-plated, mounting pad for collector 1 cm².



(1) FR4 PCB, single-sided, 35 μm copper, tin-plated, mounting pad for collector 1 cm²

(2) FR4 PCB, single-sided, 35 μm copper, tin-plated and standard footprint

Fig. 1. Power derating curve

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] | - | - | 500 | K/W |
| | | | [2] | - | - | 338 | K/W |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | | - | - | 105 | K/W |

[1] Device mounted on an FR4 PCB, single-sided, 35 μm copper, tin-plated and standard footprint.

[2] Device mounted on an FR4 PCB, single-sided, 35 μm copper, tin-plated, mounting pad for collector 1 cm².

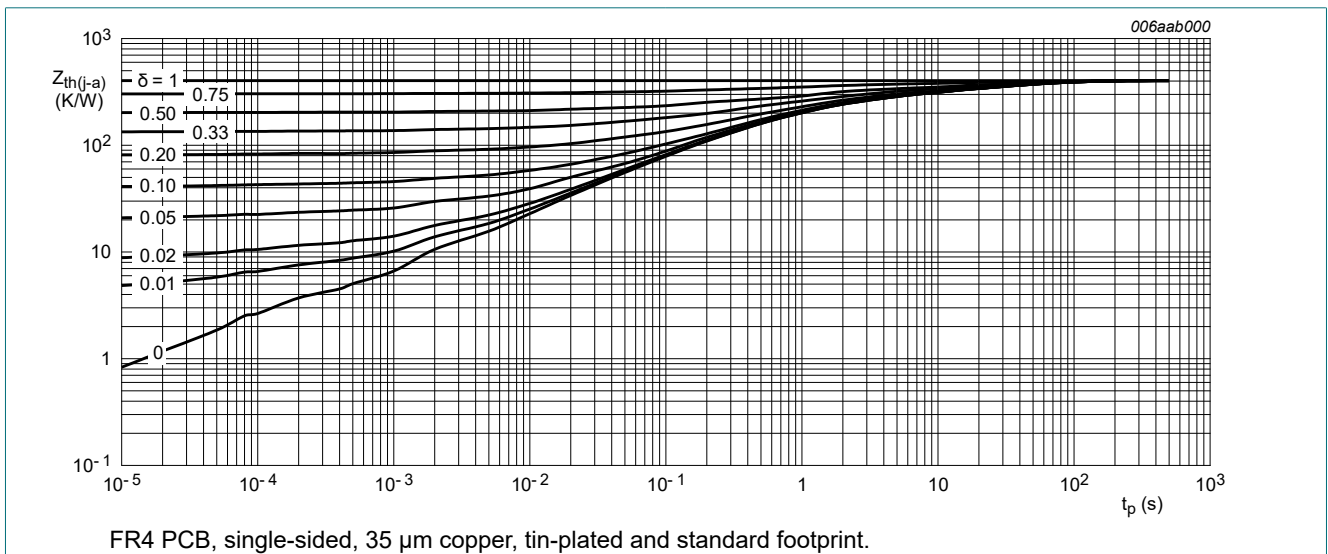


Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

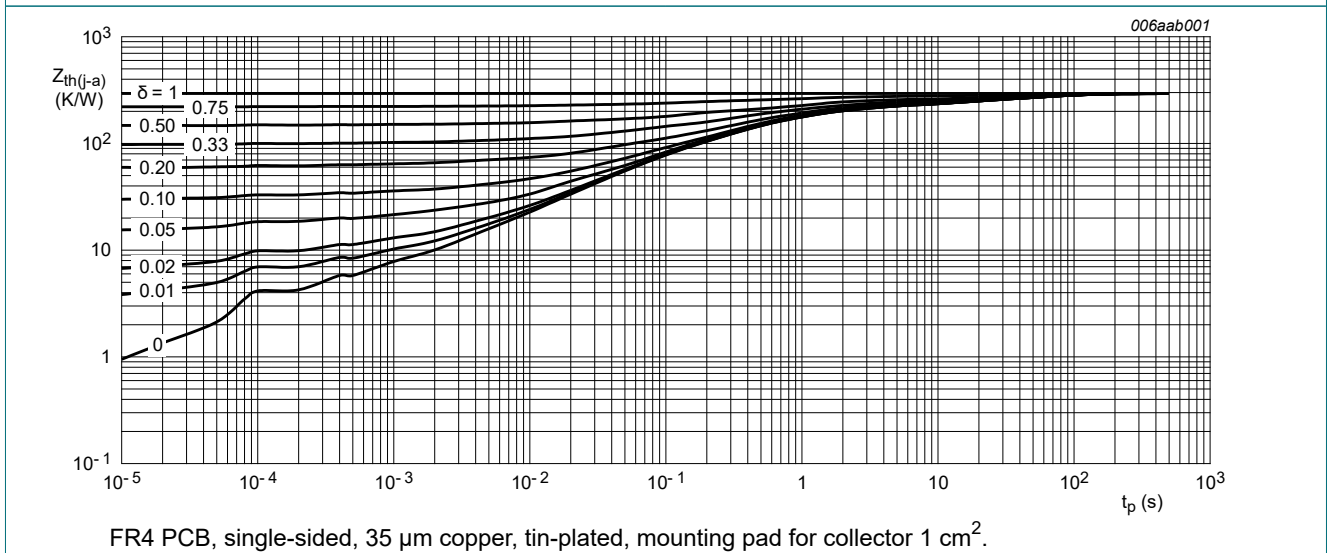


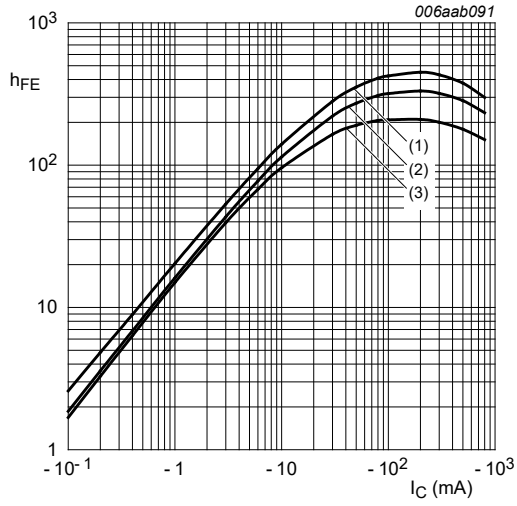
Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

Table 7. Characteristics

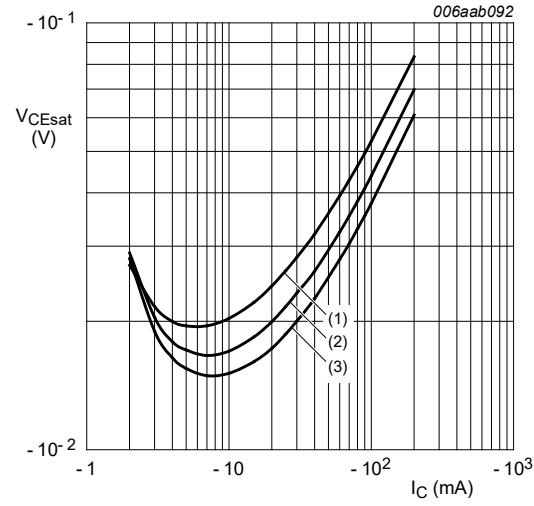
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit | |
|---------------|--------------------------------------|--|------|------|-------|---------------|----|
| $V_{(BR)CBO}$ | collector-base breakdown voltage | $I_C = -100 \mu\text{A}$; $I_E = 0 \text{ A}$; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ | -40 | - | - | V | |
| $V_{(BR)CEO}$ | collector-emitter breakdown voltage | $I_C = -10 \text{ mA}$; $I_B = 0 \text{ A}$; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ | -40 | - | - | V | |
| I_{CBO} | collector-base cut-off current | $V_{CB} = -30 \text{ V}$; $I_E = 0 \text{ A}$; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ | - | - | -100 | nA | |
| I_{CEO} | collector-emitter cut-off current | $V_{CE} = -30 \text{ V}$; $I_B = 0 \text{ A}$; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ | - | - | -0.5 | μA | |
| I_{EBO} | emitter-base cut-off current | $V_{EB} = -5 \text{ V}$; $I_C = 0 \text{ A}$; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ | - | - | -0.65 | mA | |
| h_{FE} | DC current gain | $V_{CE} = -5 \text{ V}$; $I_C = -50 \text{ mA}$; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ | 190 | 270 | - | | |
| | | $V_{CE} = -5 \text{ V}$; $I_C = -300 \text{ mA}$; pulsed; $t_p \leq 300 \mu\text{s}$; $\delta \leq 0.02$; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ | 230 | 320 | - | | |
| | | $V_{CE} = -5 \text{ V}$; $I_C = -600 \text{ mA}$; pulsed; $t_p \leq 300 \mu\text{s}$; $\delta \leq 0.02$; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ | 190 | 270 | - | | |
| V_{CEsat} | collector-emitter saturation voltage | $I_C = -50 \text{ mA}$; $I_B = -2.5 \text{ mA}$; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ | - | -35 | -45 | mV | |
| | | $I_C = -200 \text{ mA}$; $I_B = -10 \text{ mA}$; pulsed; $t_p \leq 300 \mu\text{s}$; $\delta \leq 0.02$; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ | - | -70 | -100 | mV | |
| | | $I_C = -500 \text{ mA}$; $I_B = -10 \text{ mA}$; pulsed; $t_p \leq 300 \mu\text{s}$; $\delta \leq 0.02$; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ | - | -200 | -300 | mV | |
| | | $I_C = -600 \text{ mA}$; $I_B = -6 \text{ mA}$; pulsed; $t_p \leq 300 \mu\text{s}$; $\delta \leq 0.02$; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ | - | -450 | -750 | mV | |
| $V_{I(off)}$ | off-state input voltage | $V_{CE} = -5 \text{ V}$; $I_C = -100 \mu\text{A}$; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ | -0.4 | -0.6 | -1 | V | |
| $V_{I(on)}$ | on-state input voltage | $V_{CE} = -0.3 \text{ V}$; $I_C = -20 \text{ mA}$; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ | -0.5 | -0.8 | -1.4 | V | |
| R1 | bias resistor 1 | | [1] | 1.54 | 2.2 | 2.86 | kΩ |
| R2/R1 | bias resistor ratio | | [1] | 4.1 | 4.55 | 5 | |
| C_c | collector capacitance | $V_{CB} = -10 \text{ V}$; $I_E = 0 \text{ A}$; $i_e = 0 \text{ A}$; $f = 1 \text{ MHz}$; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ | - | 11 | - | pF | |

[1] See section "Test information" for resistor calculation and test conditions



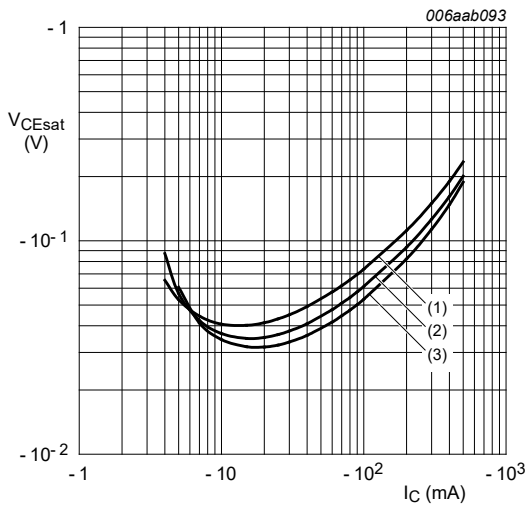
$V_{CE} = -5$ V
 (1) $T_{amb} = 100$ °C
 (2) $T_{amb} = 25$ °C
 (3) $T_{amb} = -40$ °C

Fig. 4. DC current gain as a function of collector current; typical values



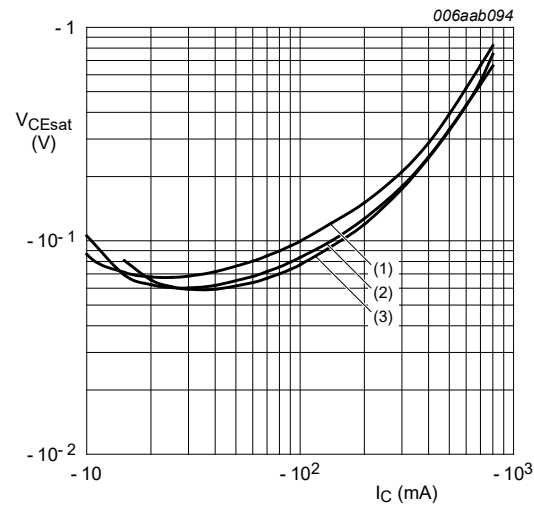
$I_C/I_B = 20$
 (1) $T_{amb} = 100$ °C
 (2) $T_{amb} = 25$ °C
 (3) $T_{amb} = -40$ °C

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



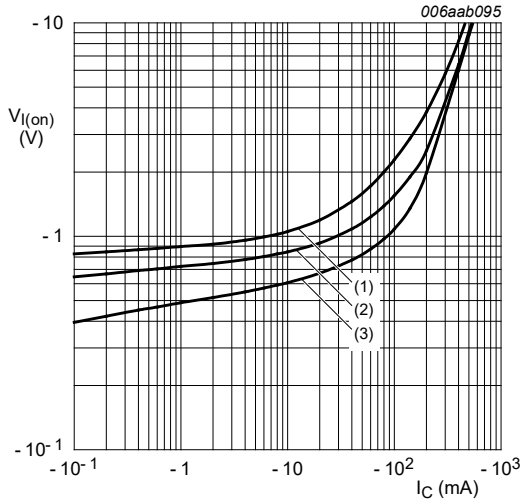
$I_C/I_B = 50$
 (1) $T_{amb} = 100$ °C
 (2) $T_{amb} = 25$ °C
 (3) $T_{amb} = -40$ °C

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



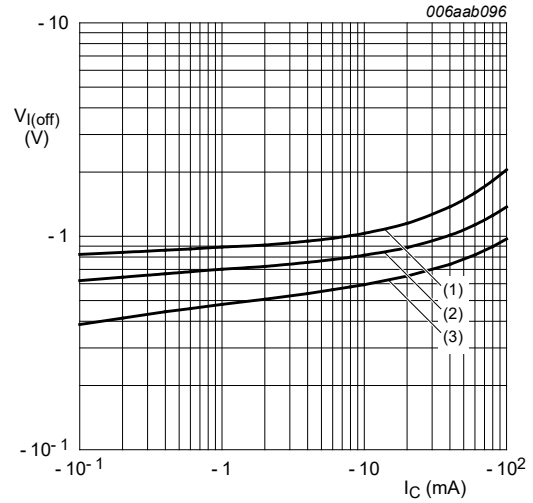
$I_C/I_B = 100$
 (1) $T_{amb} = 100$ °C
 (2) $T_{amb} = 25$ °C
 (3) $T_{amb} = -40$ °C

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



$V_{CE} = -0.3 \text{ V}$
 (1) $T_{amb} = -40 \text{ °C}$
 (2) $T_{amb} = 25 \text{ °C}$
 (3) $T_{amb} = 100 \text{ °C}$

Fig. 8. On-state input voltage as a function of collector current; typical values



$V_{CE} = -5 \text{ V}$
 (1) $T_{amb} = -40 \text{ °C}$
 (2) $T_{amb} = 25 \text{ °C}$
 (3) $T_{amb} = 100 \text{ °C}$

Fig. 9. Off-state input voltage as a function of collector current; typical values

11. Test information

Resistor calculation

- Calculation of bias resistor 1 (R1)

$$R_1 = \frac{V(I_{I2}) - V(I_{I1})}{I_{I2} - I_{I1}}$$

- Calculation of bias resistor ratio (R2/R1)

$$\frac{R_2}{R_1} = \frac{V(I_{I3})}{R_1 \cdot I_{I3}} - 1$$

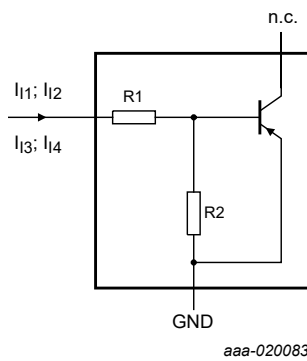


Fig. 10. Resistor test circuit

Resistor test conditions

Table 8. Resistor test conditions

| Type number | R1 (kΩ) | R2 (kΩ) | Test conditions | | |
|-------------|---------|---------|-----------------|-----------------|-----------------|
| | | | I _{I1} | I _{I2} | I _{I3} |
| PBRP123YT | 2.2 | 10 | -700 μA | -800 μA | 750 μA |

12. Package outline

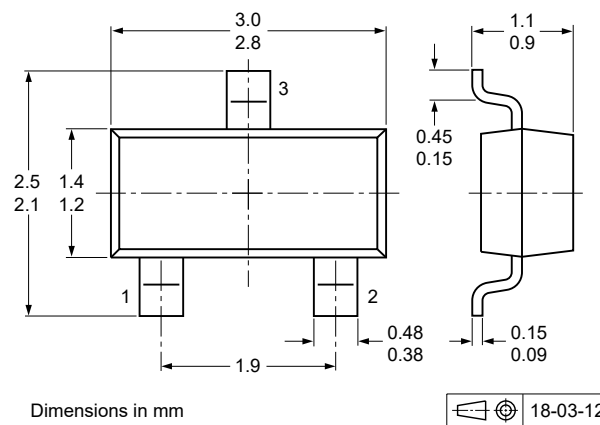


Fig. 11. Package outline SOT23

13. Soldering

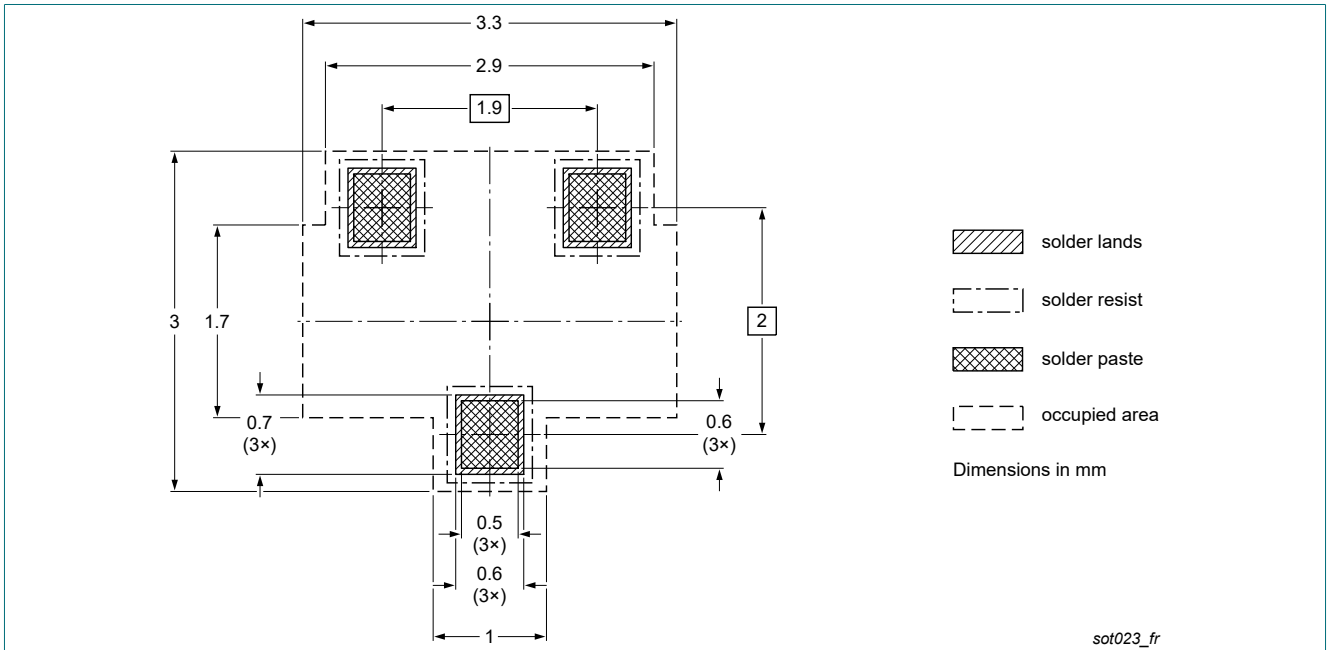


Fig. 12. Reflow soldering footprint for SOT23

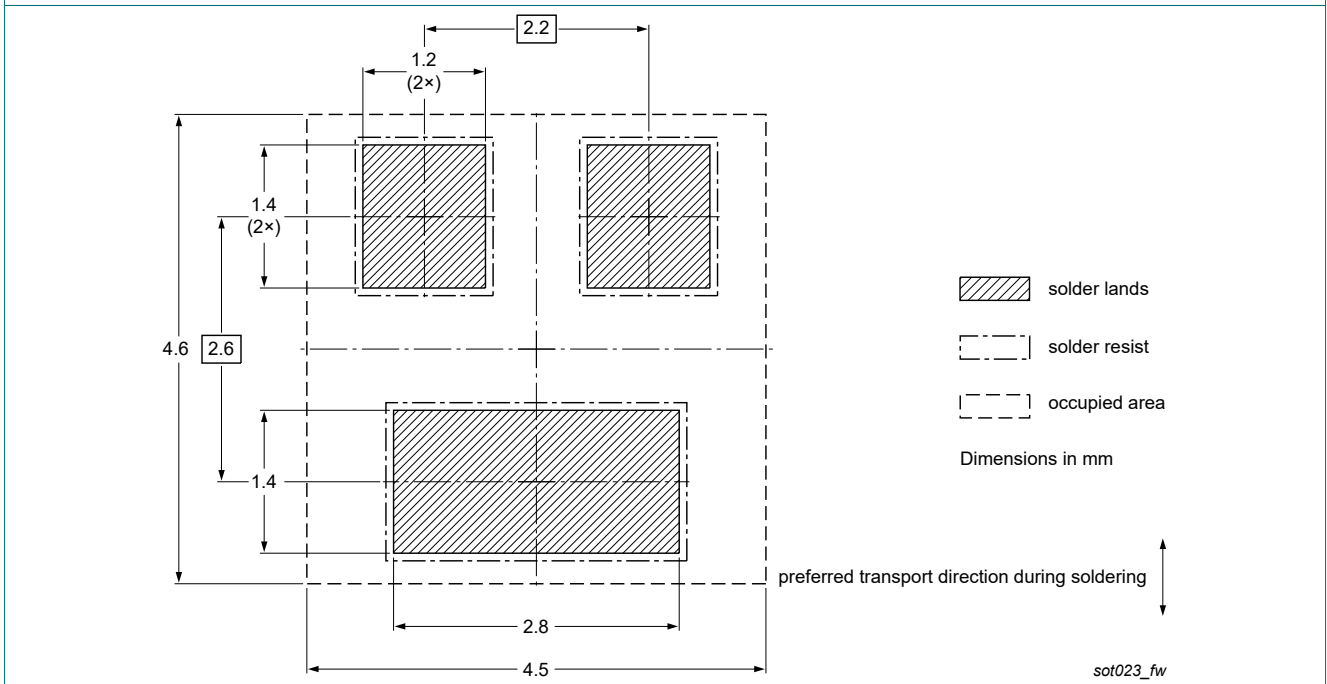


Fig. 13. Wave soldering footprint for SOT23

14. Revision history

Table 9. Revision history

| Data sheet ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|--|--------------------|---------------|---------------|
| PBRP123YT v.2 | 20210401 | Product data sheet | - | PBRP123YT v.1 |
| Modifications: | <ul style="list-style-type: none">• Product description changed from BISS to PB RET• The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.• Legal texts have been adapted to the new company name where appropriate. | | | |
| PBRP123YT v.1 | 20071217 | 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. |
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| Product [short] data sheet | Production | This document contains the product specification. |

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