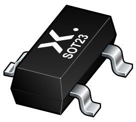


# PBRP123YT

## 40 V, 600 mA PNP PB RET; R1 = 2.2 kΩ, R2 = 10 kΩ

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
- ± 10 % resistor ratio tolerance

## 3. Applications

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

## 4. Quick reference data

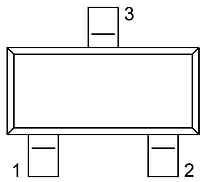
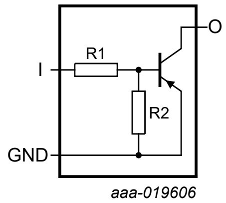
**Table 1. Quick reference data**

| 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 | kΩ |
| R2/R1 | bias resistor ratio | | [2] | 4.1 | 4.55 | 5 | |

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided, 35 µm 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) |   SOT23 |   |
| 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

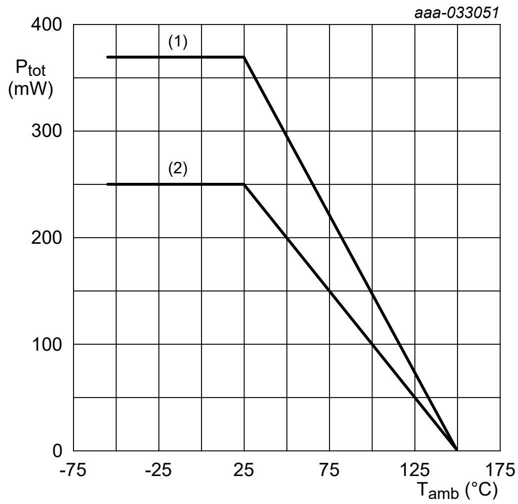
## 8. Limiting values

**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 | $t_p \leq 1$ ms; $\delta \leq 0.33$ | | - | -800 | mA |
| $P_{tot}$ | total power dissipation | $T_{amb} \leq 25$ °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 $cm^2$.




(1) FR4 PCB, single-sided, 35 µm copper, tin-plated, mounting pad for collector 1 $cm^2$
(2) FR4 PCB, single-sided, 35 µm copper, tin-plated and standard footprint

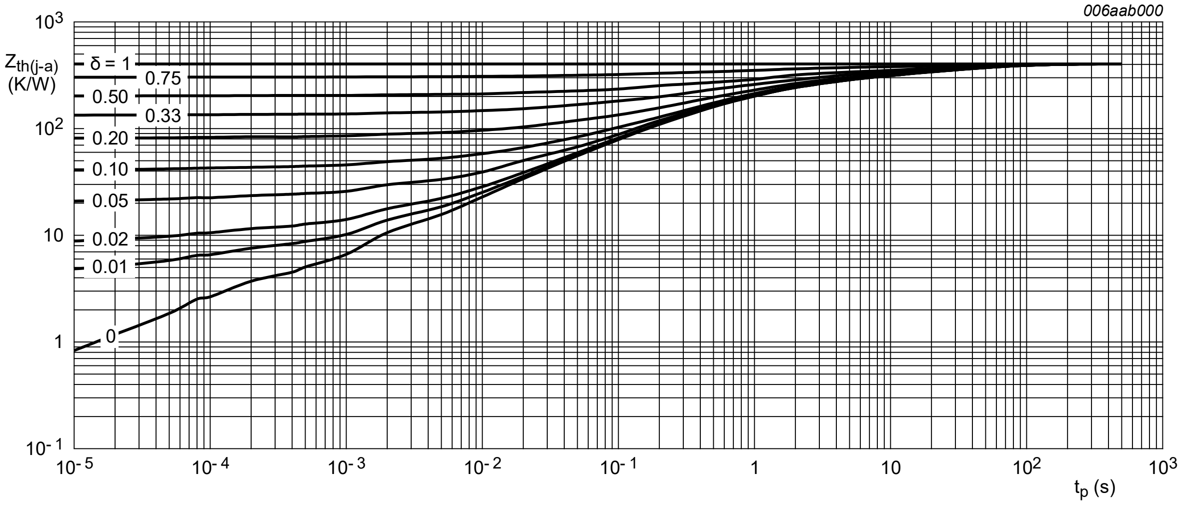
**Fig. 1. Power derating curve**

## 9. Thermal characteristics

**Table 6. Thermal characteristics**

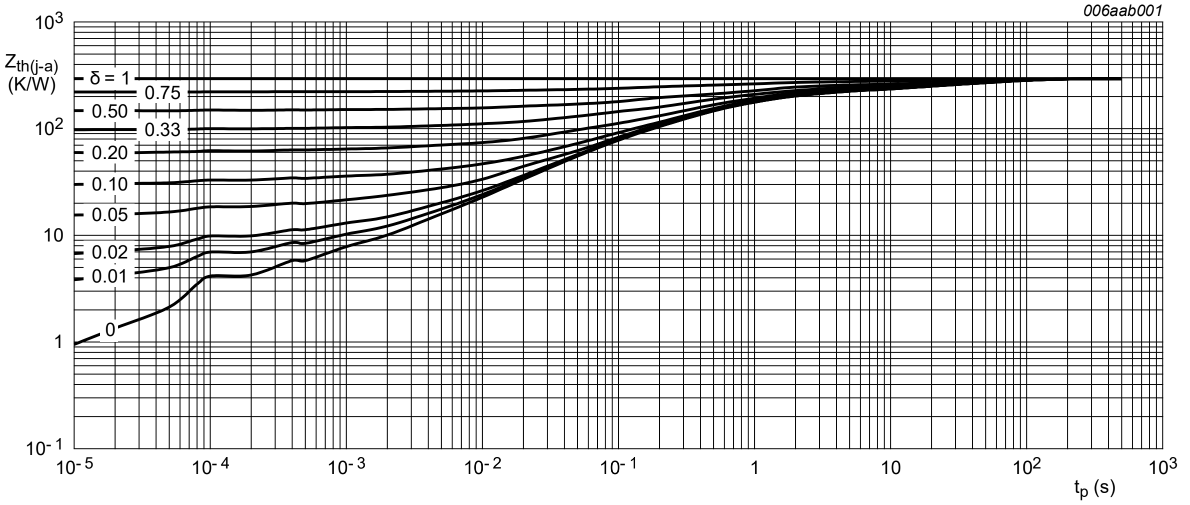
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | [1] | - | - | 500 | K/W |
| | | | [2] | - | - | 338 | K/W |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | | - | - | 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 cm$^2$.




FR4 PCB, single-sided, 35 µm copper, tin-plated and standard footprint.

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




FR4 PCB, single-sided, 35 µm copper, tin-plated, mounting pad for collector 1 cm$^2$.

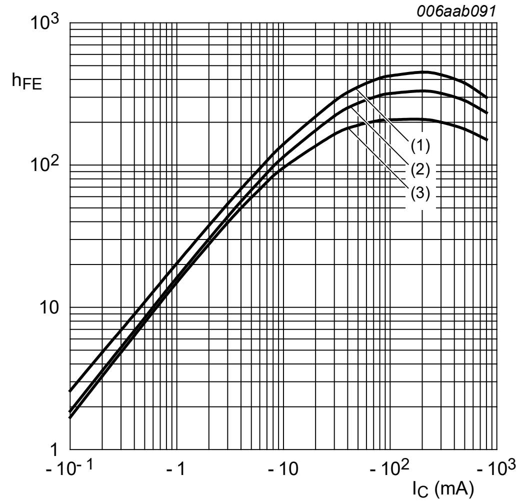
**Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values**

## 10. Characteristics

**Table 7. Characteristics**

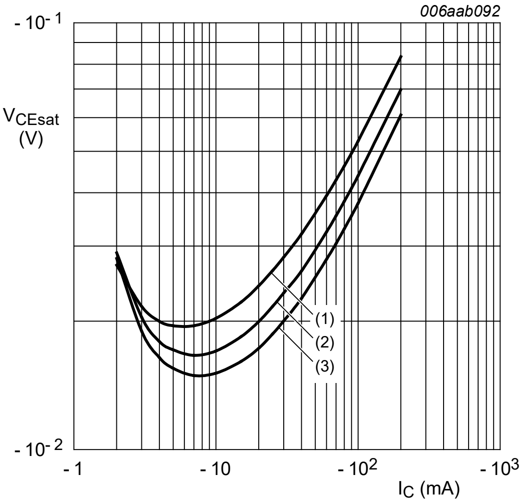
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{(BR)CBO}$ | collector-base breakdown voltage | $I_C$ = -100 μA; $I_E$ = 0 A; $T_{amb}$ = 25 °C | | -40 | - | - | V |
| $V_{(BR)CEO}$ | collector-emitter breakdown voltage | $I_C$ = -10 mA; $I_B$ = 0 A; $T_{amb}$ = 25 °C | | -40 | - | - | V |
| $I_{CBO}$ | collector-base cut-off current | $V_{CB}$ = -30 V; $I_E$ = 0 A; $T_{amb}$ = 25 °C | | - | - | -100 | nA |
| $I_{CEO}$ | collector-emitter cut-off current | $V_{CE}$ = -30 V; $I_B$ = 0 A; $T_{amb}$ = 25 °C | | - | - | -0.5 | μA |
| $I_{EBO}$ | emitter-base cut-off current | $V_{EB}$ = -5 V; $I_C$ = 0 A; $T_{amb}$ = 25 °C | | - | - | -0.65 | mA |
| $h_{FE}$ | DC current gain | $V_{CE}$ = -5 V; $I_C$ = -50 mA; $T_{amb}$ = 25 °C | | 190 | 270 | - | |
| | | $V_{CE}$ = -5 V; $I_C$ = -300 mA; pulsed; $t_p$ ≤ 300 μs; δ ≤ 0.02; $T_{amb}$ = 25 °C | | 230 | 320 | - | |
| | | $V_{CE}$ = -5 V; $I_C$ = -600 mA; pulsed; $t_p$ ≤ 300 μs; δ ≤ 0.02; $T_{amb}$ = 25 °C | | 190 | 270 | - | |
| $V_{CEsat}$ | collector-emitter saturation voltage | $I_C$ = -50 mA; $I_B$ = -2.5 mA; $T_{amb}$ = 25 °C | | - | -35 | -45 | mV |
| | | $I_C$ = -200 mA; $I_B$ = -10 mA; pulsed; $t_p$ ≤ 300 μs; δ ≤ 0.02; $T_{amb}$ = 25 °C | | - | -70 | -100 | mV |
| | | $I_C$ = -500 mA; $I_B$ = -10 mA; pulsed; $t_p$ ≤ 300 μs; δ ≤ 0.02; $T_{amb}$ = 25 °C | | - | -200 | -300 | mV |
| | | $I_C$ = -600 mA; $I_B$ = -6 mA; pulsed; $t_p$ ≤ 300 μs; δ ≤ 0.02; $T_{amb}$ = 25 °C | | - | -450 | -750 | mV |
| $V_{I(off)}$ | off-state input voltage | $V_{CE}$ = -5 V; $I_C$ = -100 μA; $T_{amb}$ = 25 °C | | -0.4 | -0.6 | -1 | V |
| $V_{I(on)}$ | on-state input voltage | $V_{CE}$ = -0.3 V; $I_C$ = -20 mA; $T_{amb}$ = 25 °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 V; $I_E$ = 0 A; $i_e$ = 0 A; f = 1 MHz; $T_{amb}$ = 25 °C | | - | 11 | - | pF |

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



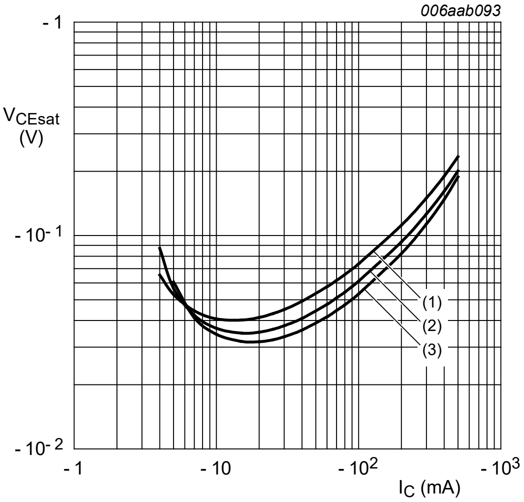

$V_{CE}$ = -5 V
(1) $T_{amb}$ = 100 °C
(2) $T_{amb}$ = 25 °C
(3) $T_{amb}$ = −40 °C

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



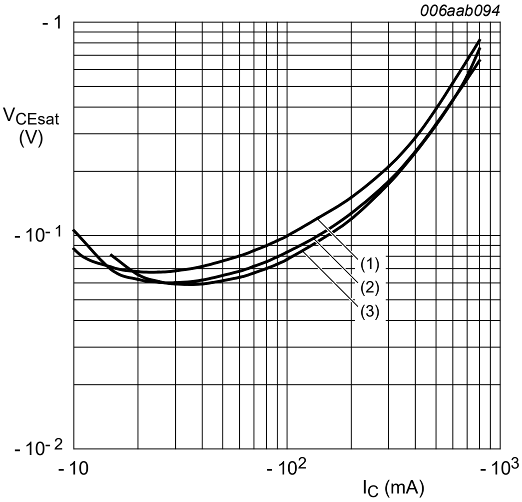

$I_C/I_B$ = 20
(1) $T_{amb}$ = 100 °C
(2) $T_{amb}$ = 25 °C
(3) $T_{amb}$ = −40 °C

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



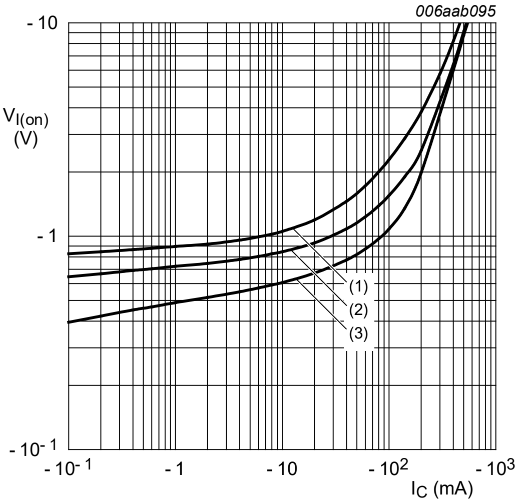

$I_C/I_B$ = 50
(1) $T_{amb}$ = 100 °C
(2) $T_{amb}$ = 25 °C
(3) $T_{amb}$ = −40 °C

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



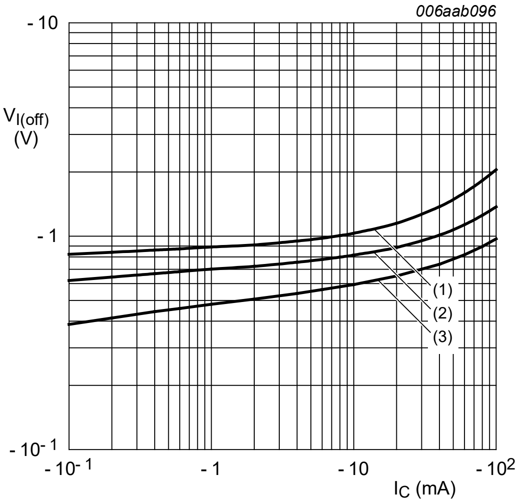

$I_C/I_B$ = 100
(1) $T_{amb}$ = 100 °C
(2) $T_{amb}$ = 25 °C
(3) $T_{amb}$ = −40 °C

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




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

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




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

$$\frac{R2}{R1} = \frac{V(I_{I3})}{R1 \cdot I_{I3}} - 1$$

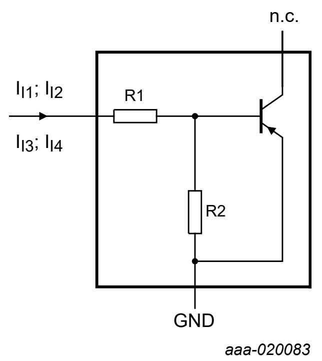



Fig. 10. Resistor test circuit

### 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

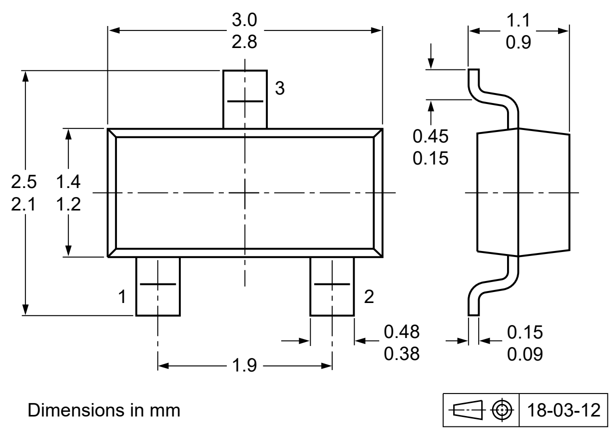



Fig. 11. Package outline SOT23

## 13. Soldering

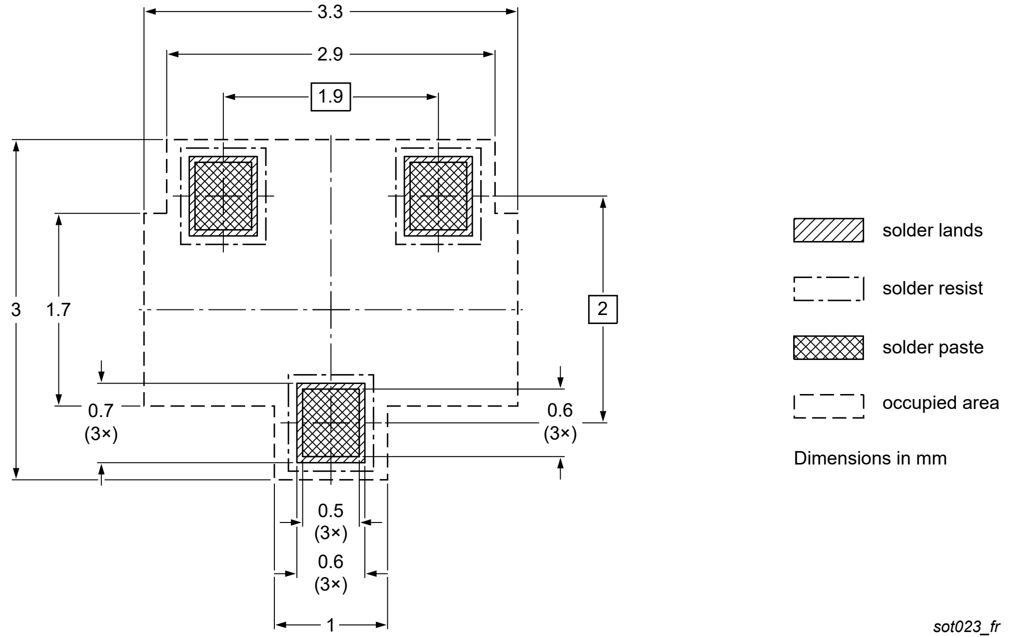



**Fig. 12. Reflow soldering footprint for SOT23**

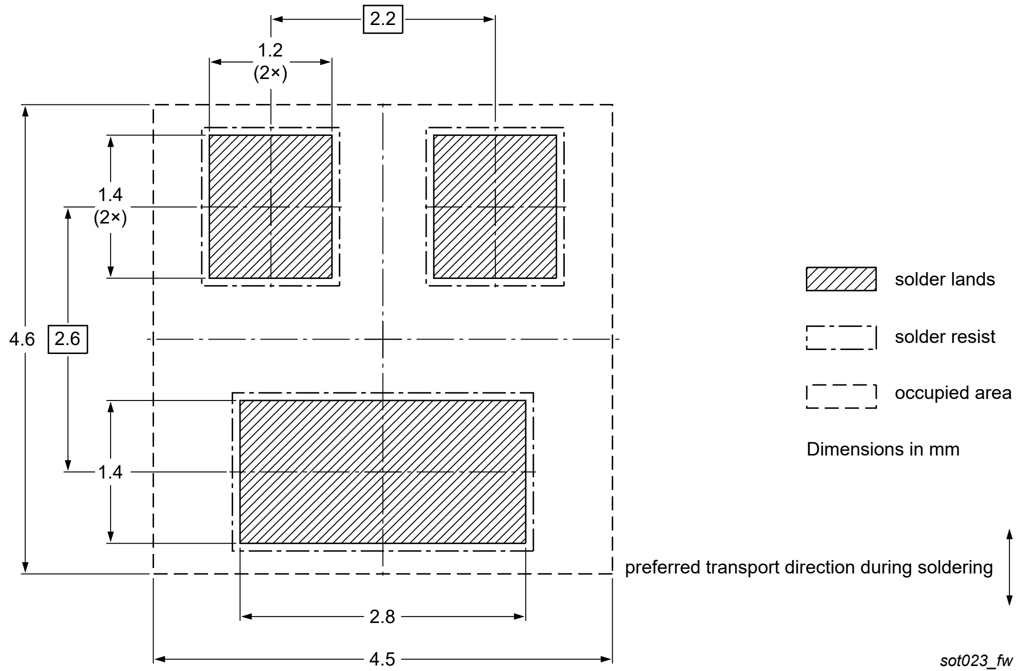



**Fig. 13. Wave soldering footprint for SOT23**

# 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: | • Product description changed from BISS to PB RET<br>• The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.<br>• 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. |
| 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".
[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at https://www.nexperia.com.

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