



# PDTC123YT

NPN resistor-equipped transistor; R1 = 2.2 k $\Omega$ , R2 = 10 k $\Omega$

17 April 2023

Product data sheet

## 1. General description

NPN Resistor-Equipped Transistor (RET) in a small SOT23 Surface-Mounted Device (SMD) plastic package.

PNP complement: PDTA123YT

## 2. Features and benefits

- Built-in bias resistors
- Simplifies circuit design
- Reduces component count
- Reduces pick and place costs
- AEC-Q101 qualified

## 3. Applications

- General-purpose switching and amplification
- Inverter and interface circuits
- Circuit drivers

## 4. Quick reference data

Table 1. Quick reference data

| Symbol           | Parameter                 | Conditions | Min  | Typ | Max  | Unit       |
|------------------|---------------------------|------------|------|-----|------|------------|
| V <sub>CEO</sub> | collector-emitter voltage | open base  | -    | -   | 50   | V          |
| I <sub>O</sub>   | output current            |            | -    | -   | 100  | mA         |
| R1               | bias resistor 1 (input)   | [1]        | 1.54 | 2.2 | 2.86 | k $\Omega$ |
| R2/R1            | bias resistor ratio       | [1]        | 3.6  | 4.5 | 5.5  |            |

[1] See "Section 11: 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)       | <br>SOT23          | <br>sym007     |
| 2   | GND    | ground (emitter)   |                    |                |
| 3   | O      | output (collector) |                    |                |

6. Ordering information

Table 3. Ordering information

| Type number               | Package |                                                                                          |                       |
|---------------------------|---------|------------------------------------------------------------------------------------------|-----------------------|
|                           | Name    | Description                                                                              | Version               |
| <a href="#">PDTC123YT</a> | SOT23   | plastic, surface-mounted package; 3 terminals; 1.9 mm pitch; 2.9 mm x 1.3 mm x 1 mm body | <a href="#">SOT23</a> |

7. Marking

Table 4. Marking codes

| Type number | Marking code[1] |
|-------------|-----------------|
| PDTC123YT   | %AL             |

[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                        |                     | -   | 50  | V    |
| V <sub>CEO</sub> | collector-emitter voltage | open base                           |                     | -   | 50  | V    |
| V <sub>EBO</sub> | emitter-base voltage      | open collector                      |                     | -   | 5   | V    |
| V <sub>I</sub>   | input voltage             | positive                            |                     | -   | 12  | V    |
|                  |                           | negative                            |                     | -   | -5  | V    |
| I <sub>O</sub>   | output current            |                                     |                     | -   | 100 | mA   |
| I <sub>CM</sub>  | peak collector current    | t <sub>p</sub> ≤ 1 ms; single pulse |                     | -   | 100 | mA   |
| P <sub>tot</sub> | total power dissipation   | T <sub>amb</sub> ≤ 25 °C            | <a href="#">[1]</a> | -   | 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] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided, 35 μm copper, tin-plated and standard footprint.

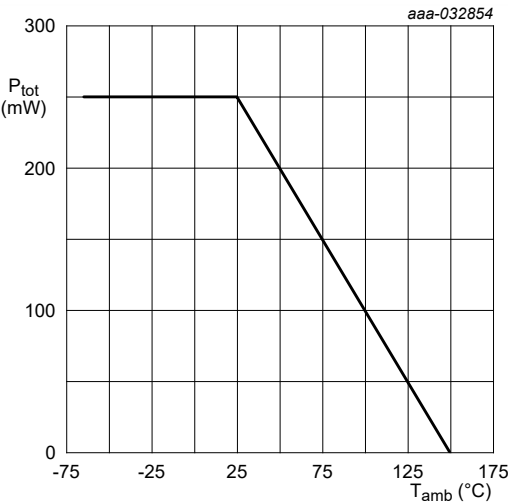


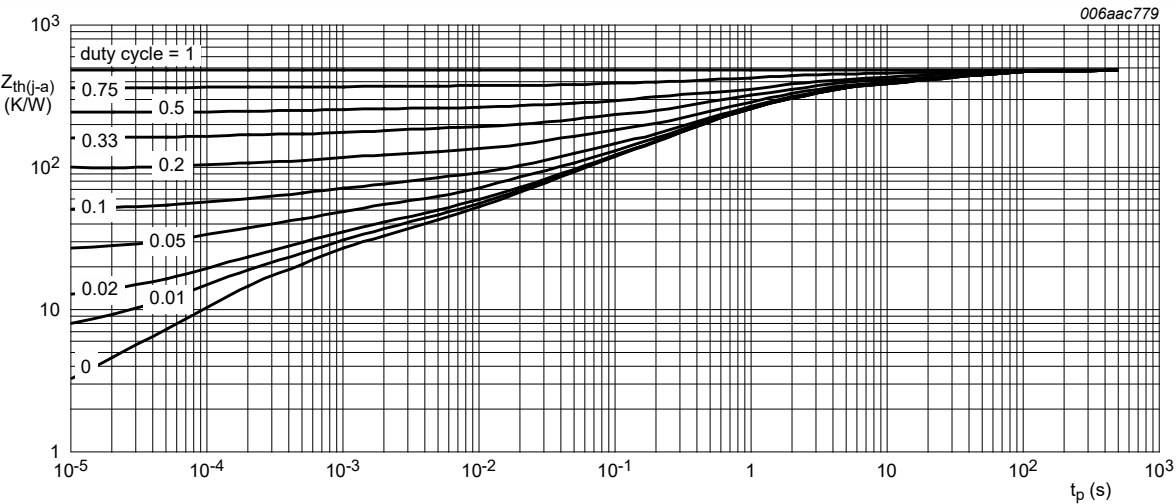
Fig. 1. Power derating curve

9. Thermal characteristics

Table 6. Thermal characteristics

| Symbol               | Parameter                                   | Conditions  |     | Min | Typ | Max | Unit |
|----------------------|---------------------------------------------|-------------|-----|-----|-----|-----|------|
| R <sub>th(j-a)</sub> | thermal resistance from junction to ambient | in free air | [1] | -   | -   | 500 | K/W  |

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



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

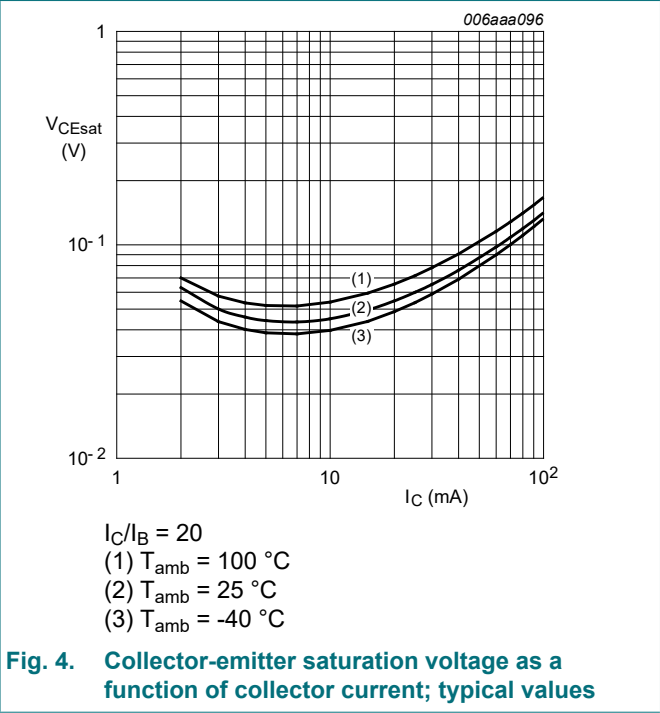
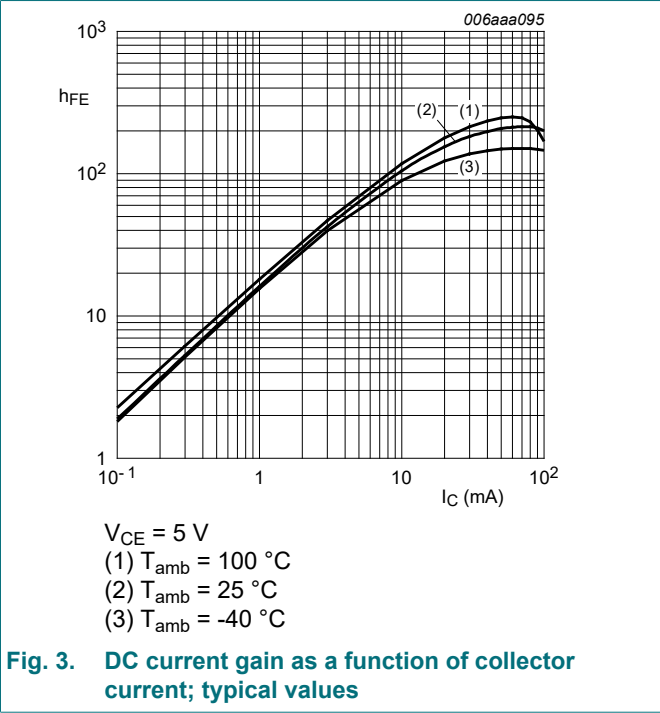
Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

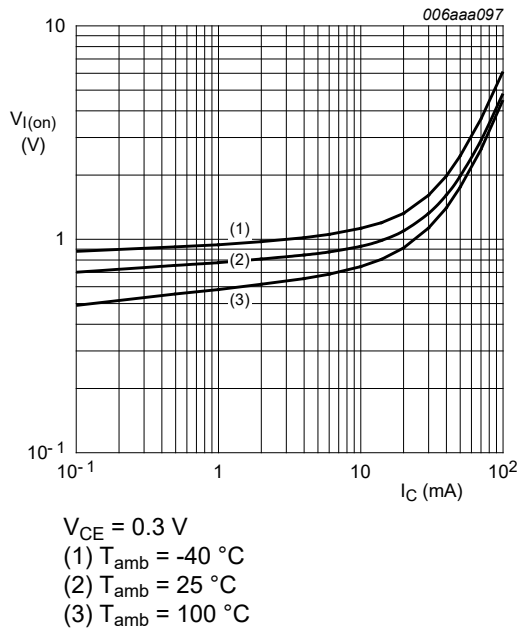
10. Characteristics

Table 7. Characteristics

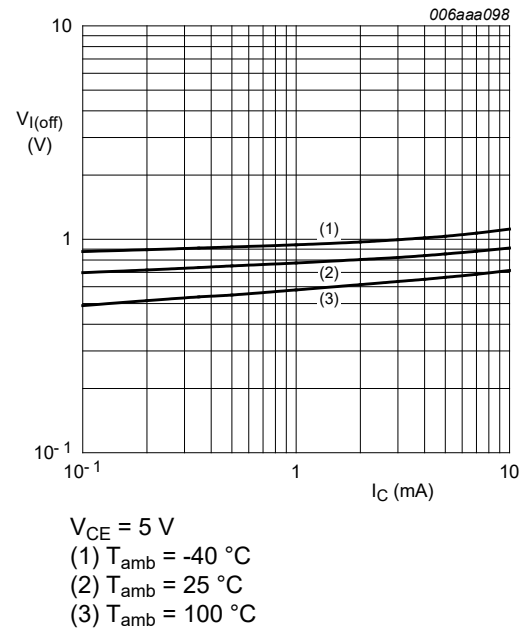
| Symbol        | Parameter                            | Conditions                                                                                                                   | Min  | Typ  | Max  | Unit          |
|---------------|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage     | $I_C = 100\text{ }\mu\text{A}$ ; $I_E = 0\text{ A}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$                                   | 50   | -    | -    | V             |
| $V_{(BR)CEO}$ | collector-emitter breakdown voltage  | $I_C = 2\text{ mA}$ ; $I_B = 0\text{ A}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$                                              | 50   | -    | -    | V             |
| $I_{CBO}$     | collector-base cut-off current       | $V_{CB} = 50\text{ V}$ ; $I_E = 0\text{ A}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$                                           | -    | -    | 100  | nA            |
| $I_{CEO}$     | collector-emitter cut-off current    | $V_{CE} = 30\text{ V}$ ; $I_B = 0\text{ A}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$                                           | -    | -    | 100  | nA            |
|               |                                      | $V_{CE} = 30\text{ V}$ ; $I_B = 0\text{ A}$ ; $T_j = 150\text{ }^\circ\text{C}$                                              | -    | -    | 5    | $\mu\text{A}$ |
| $I_{EBO}$     | emitter-base cut-off current         | $V_{EB} = 5\text{ V}$ ; $I_C = 0\text{ A}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$                                            | -    | -    | 700  | $\mu\text{A}$ |
| $h_{FE}$      | DC current gain                      | $V_{CE} = 5\text{ V}$ ; $I_C = 5\text{ mA}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$                                           | 35   | -    | -    |               |
| $V_{CEsat}$   | collector-emitter saturation voltage | $I_C = 10\text{ mA}$ ; $I_B = 0.5\text{ mA}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$                                          | -    | -    | 150  | mV            |
| $V_{I(off)}$  | off-state input voltage              | $V_{CE} = 5\text{ V}$ ; $I_C = 100\text{ }\mu\text{A}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$                                | -    | 0.75 | 0.3  | V             |
| $V_{I(on)}$   | on-state input voltage               | $V_{CE} = 300\text{ mV}$ ; $I_C = 20\text{ mA}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$                                       | 2.5  | 1.15 | -    | V             |
| R1            | bias resistor 1 (input)              | [1]                                                                                                                          | 1.54 | 2.2  | 2.86 | kΩ            |
| R2/R1         | bias resistor ratio                  | [1]                                                                                                                          | 3.6  | 4.5  | 5.5  |               |
| $C_c$         | collector capacitance                | $V_{CB} = 10\text{ V}$ ; $I_E = 0\text{ A}$ ; $i_e = 0\text{ A}$ ; $f = 1\text{ MHz}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$ | -    | -    | 2    | pF            |

[1] See "Section 11: Test information" for resistor calculation and test conditions.





**Fig. 5. On-state input voltage as a function of collector current; typical values**



**Fig. 6. Off-state input voltage as a function of collector current; typical values**

## 11. Test information

## 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.

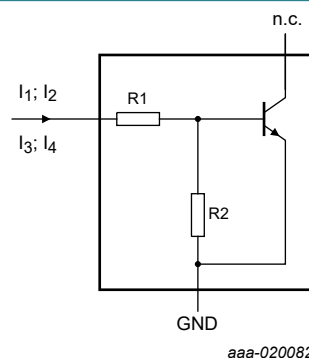
## Resistor calculation

- Calculation of bias resistor 1 (R1)

$$R_l = \frac{V(I_2) - V(I_1)}{I_2 - I_1}$$

- Calculation of bias resistor ratio ( $R_2/R_1$ )

$$\frac{R2}{R1} = \frac{V(I4) - V(I3)}{R1 \cdot (I4 - I3)} - 1$$



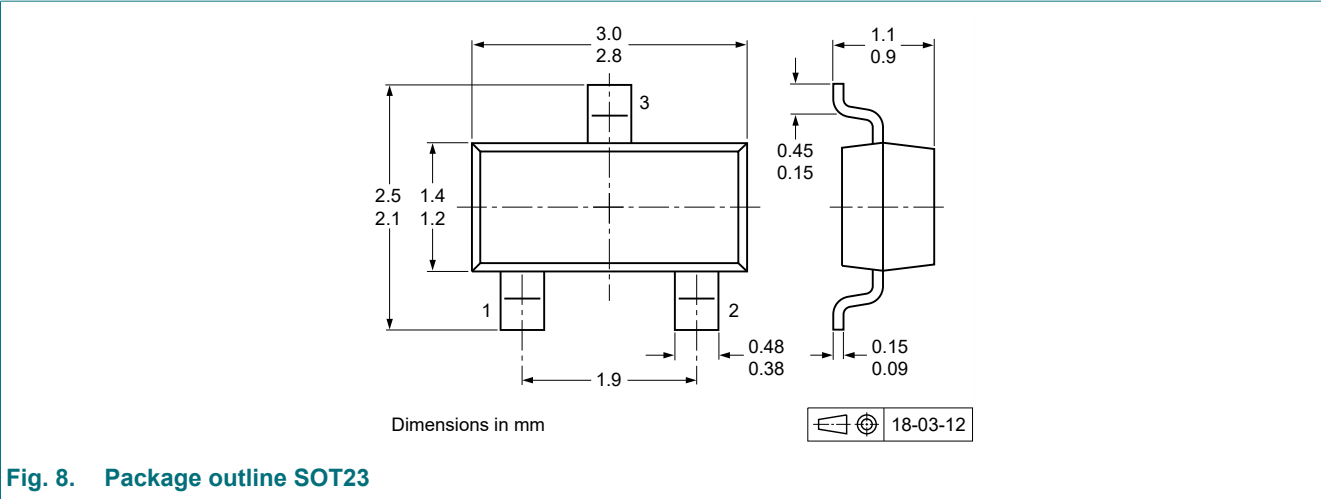
**Fig. 7. Resistor test circuit**

Resistor test conditions

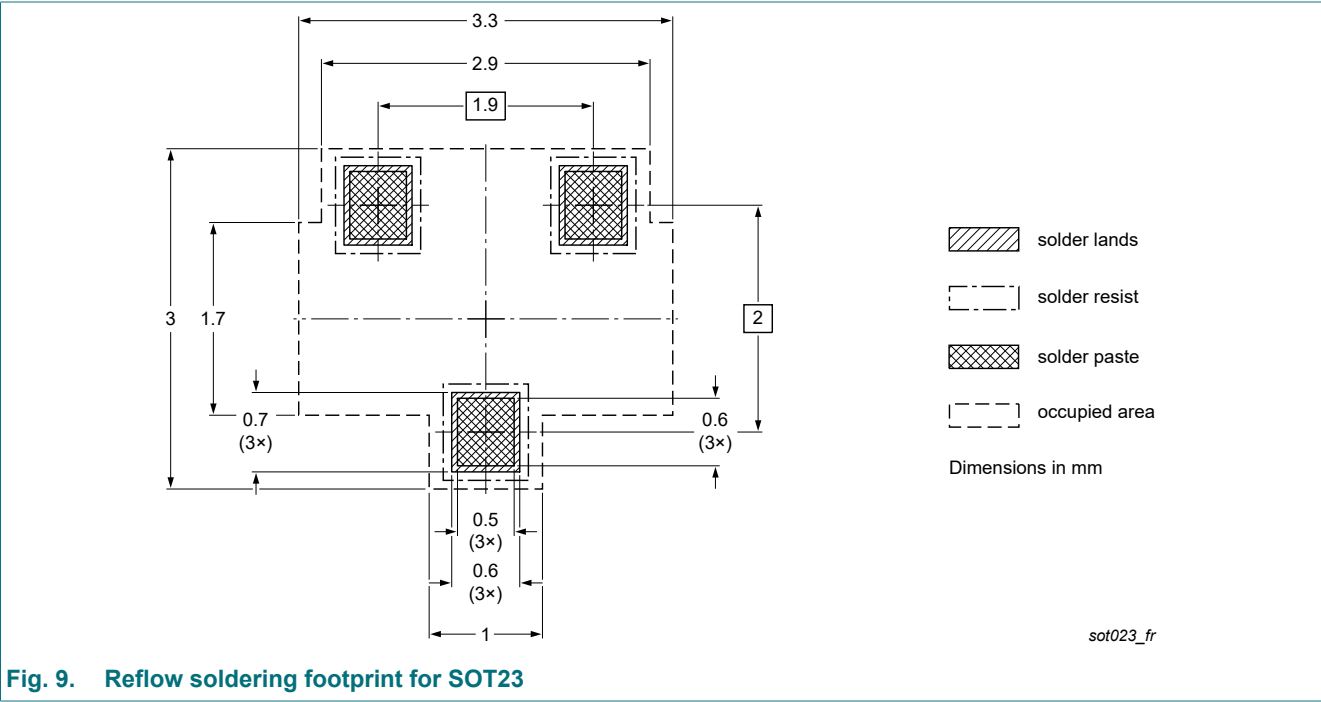
Table 8. Resistor test conditions

| PDTC123YT | R1 (kΩ) | R2 (kΩ) | Test conditions |                |                |                |
|-----------|---------|---------|-----------------|----------------|----------------|----------------|
|           |         |         | I <sub>1</sub>  | I <sub>2</sub> | I <sub>3</sub> | I <sub>4</sub> |
| NPN       | 2.2     | 10      | 1300 μA         | 1500 μA        | -350 μA        | -450 μA        |

12. Package outline



13. Soldering



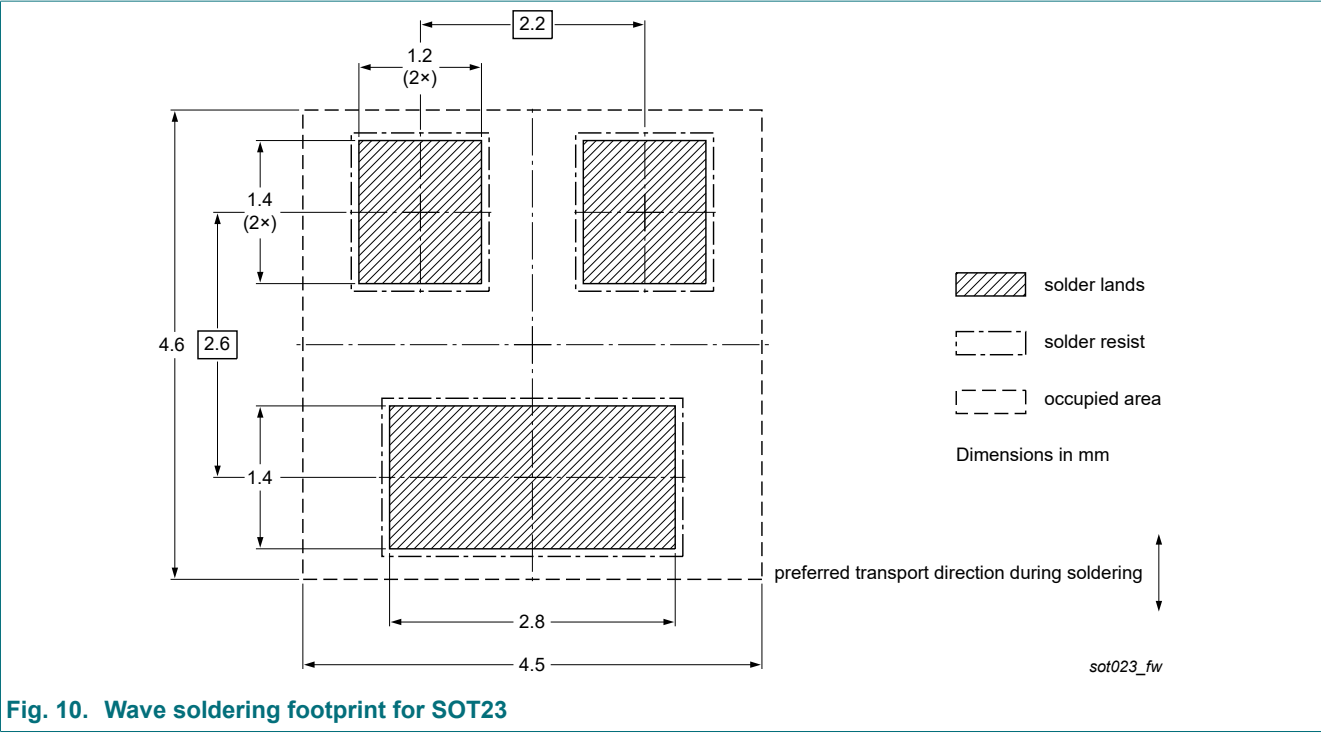


Fig. 10. Wave soldering footprint for SOT23

14. Revision history

Table 9. Revision history

| Data sheet ID  | Release date                                                                                                                                                                                                                                                                                                                                         | Data sheet status    | Change notice | Supersedes     |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|---------------|----------------|
| PDTC123YT v.5  | 20230417                                                                                                                                                                                                                                                                                                                                             | Product data sheet   | -             | PDTC123Y_SER_4 |
| Modifications: | <ul style="list-style-type: none"><li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li><li>Legal texts have been adapted to the new company name where appropriate.</li><li>Section "Packing information" removed.</li><li>Family data sheet splitted to single type data sheets.</li></ul> |                      |               |                |
| PDTC123Y_SER_4 | 20091116                                                                                                                                                                                                                                                                                                                                             | Product data sheet   | -             | PDTC123Y_SER_3 |
| PDTC123Y_SER_3 | 20050324                                                                                                                                                                                                                                                                                                                                             | Product data sheet   | -             | PDTC123YT_2    |
| PDTC123YT_2    | 20040510                                                                                                                                                                                                                                                                                                                                             | Objective data sheet | -             | PDTC123YT_1    |
| PDTC123YT_1    | 20040406                                                                                                                                                                                                                                                                                                                                             | Objective 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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Date of release: 17 April 2023

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