

## Important notice

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Kind regards,

Team Nexperia



# PDTD113Z/123Y/143XQA series

50 V, 500 mA NPN resistor-equipped transistors

Rev. 1 — 31 March 2016

Product data sheet

## 1. Product profile

### 1.1 General description

NPN Resistor-Equipped Transistor (RET) family in a leadless ultra small DFN1010D-3 (SOT1215) Surface-Mounted Device (SMD) plastic package with visible and solderable side pads.

Table 1. Product overview

| Type number | R1             | R2            | Package NXP             | PNP complement |
|-------------|----------------|---------------|-------------------------|----------------|
| PDTD113ZQA  | 1 k $\Omega$   | 10 k $\Omega$ | DFN1010D-3<br>(SOT1215) | PDTB113ZQA     |
| PDTD123YQA  | 2.2 k $\Omega$ | 10 k $\Omega$ |                         | PDTB123YQA     |
| PDTD143XQA  | 4.7 k $\Omega$ | 10 k $\Omega$ |                         | PDTB143XQA     |

### 1.2 Features and benefits

- 500 mA output current capability
- Built-in bias resistors
- $\pm 10\%$  resistor ratio tolerance
- Simplifies circuit design
- Reduces component count
- Reduced pick and place costs
- Low package height of 0.37 mm
- Suitable for Automatic Optical Inspection (AOI) of solder joint
- AEC-Q101 qualified

### 1.3 Applications

- Digital applications
- Cost saving alternative for BC807/BC817 series in digital applications
- Controlling IC inputs
- Switching loads

### 1.4 Quick reference data

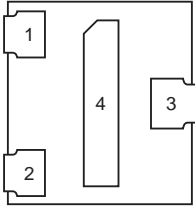
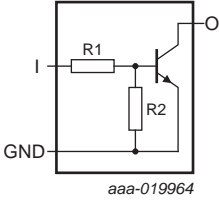
Table 2. Quick reference data

| Symbol           | Parameter                 | Conditions | Min | Typ | Max | Unit |
|------------------|---------------------------|------------|-----|-----|-----|------|
| V <sub>CEO</sub> | collector-emitter voltage | open base  | -   | -   | 50  | V    |
| I <sub>O</sub>   | output current            |            | -   | -   | 500 | mA   |



## 2. Pinning information

Table 3. Pinning

| Pin | Symbol | Description        | Simplified outline   | Graphic symbol  |
|-----|--------|--------------------|--|---|
| 1   | I      | input (base)       |  <p>Transparent top view</p> |  <p>aaa-019964</p> |
| 2   | GND    | GND (emitter)      |  |   |
| 3   | O      | output (collector) |  |   |
| 4   | O      | output (collector) |  |   |

## 3. Ordering information

Table 4. Ordering information

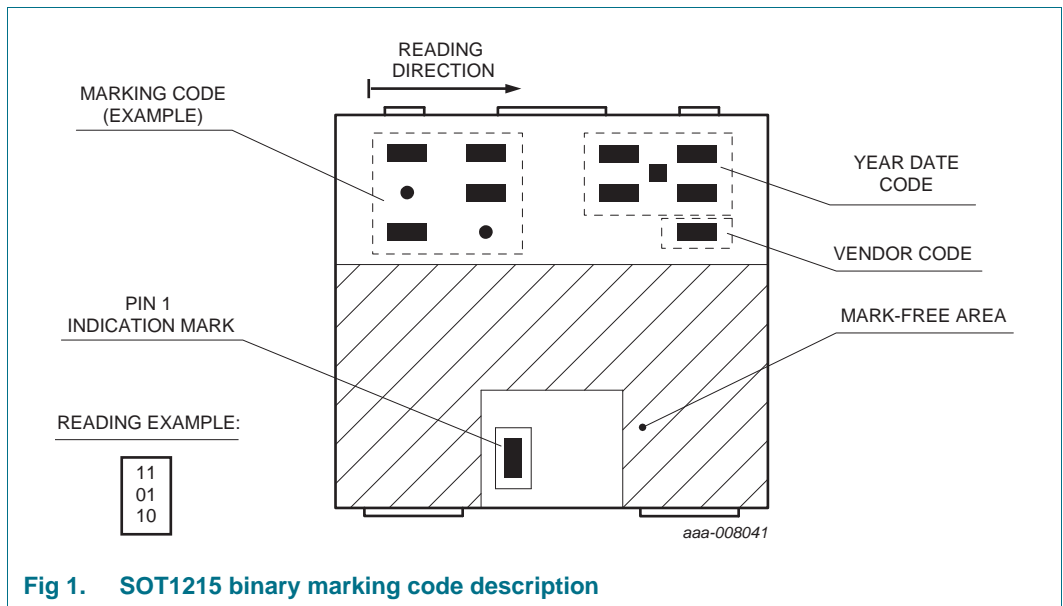
| Type number | Package    |   |         |
|-------------|------------|---|---------|
|             | Name       | Description   | Version |
| PDTD113ZQA  | DFN1010D-3 | plastic thermal enhanced ultra thin small outline package; no leads; 3 terminals; body: 1.1 × 1.0 × 0.37 mm | SOT1215 |
| PDTD123YQA  |            |   |         |
| PDTD143XQA  |            |   |         |

## 4. Marking

**Table 5. Marking codes**

| Type number | Marking code |
|-------------|--------------|
| PDTD113ZQA  | 01 11 11     |
| PDTD123YQA  | 10 00 11     |
| PDTD143XQA  | 01 10 01     |

### 4.1 Binary marking code description



## 5. Limiting values

**Table 6. Limiting values**

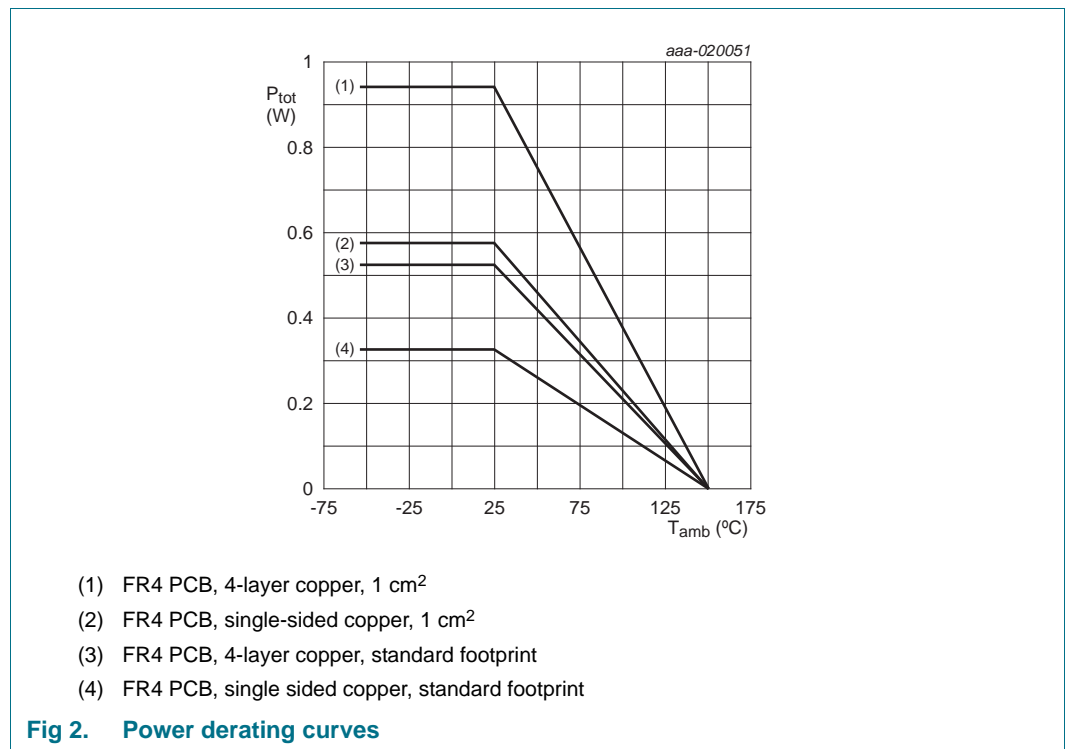
*In accordance with the Absolute Maximum Rating System (IEC 60134).*

| Symbol    | Parameter                 | Conditions     | Min | Max | Unit |
|-----------|---------------------------|----------------|-----|-----|------|
| $V_{CBO}$ | collector-base voltage    | open emitter   | -   | 50  | V    |
| $V_{CEO}$ | collector-emitter voltage | open base      | -   | 50  | V    |
| $V_{EBO}$ | emitter-base voltage      | open collector |     |     |      |
|           | PDTD113ZQA                |                | -   | 5   | V    |
|           | PDTD123YQA                |                | -   | 5   | V    |
|           | PDTD143XQA                |                | -   | 7   | V    |

**Table 6. Limiting values ...continued**  
 In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol           | Parameter               | Conditions               | Min | Max  | Unit |    |
|------------------|-------------------------|--------------------------|-----|------|------|----|
| V <sub>I</sub>   | input voltage           |                          |     |      |      |    |
|                  | PDTD113ZQA              |                          | -5  | +10  | V    |    |
|                  | PDTD123YQA              |                          | -5  | +12  | V    |    |
|                  | PDTD143XQA              |                          | -7  | +30  | V    |    |
| I <sub>O</sub>   | output current          |                          | -   | 500  | mA   |    |
| P <sub>tot</sub> | total power dissipation | T <sub>amb</sub> ≤ 25 °C | [1] | -    | 325  | mW |
|                  |                         |                          | [2] | -    | 575  | mW |
|                  |                         |                          | [3] | -    | 525  | mW |
|                  |                         |                          | [4] | -    | 940  | mW |
| T <sub>j</sub>   | junction temperature    |                          | -   | 150  | °C   |    |
| T <sub>amb</sub> | ambient temperature     |                          | -55 | +150 | °C   |    |
| T <sub>stg</sub> | storage temperature     |                          | -65 | +150 | °C   |    |

- [1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated; mounting pad for collector 1 cm<sup>2</sup>.
- [3] Device mounted on an FR4 PCB, 4-layer copper, tin-plated and standard footprint.
- [4] Device mounted on an FR4 PCB, 4-layer copper, tin-plated; mounting pad for collector 1 cm<sup>2</sup>.

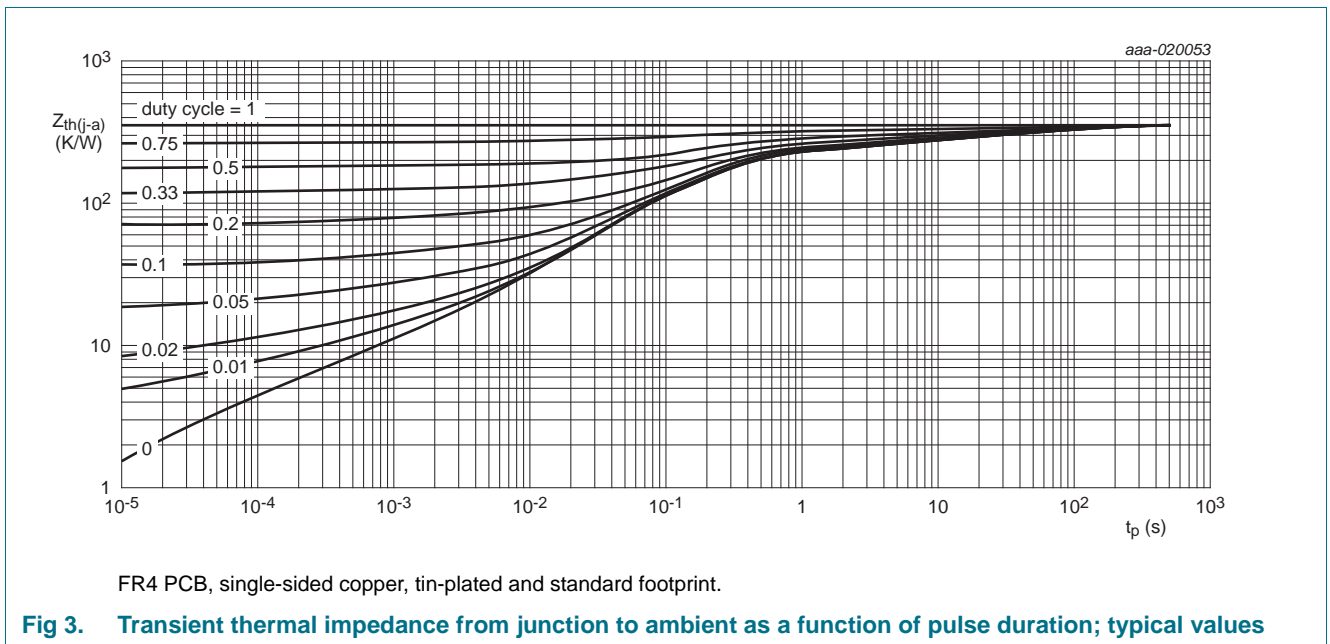


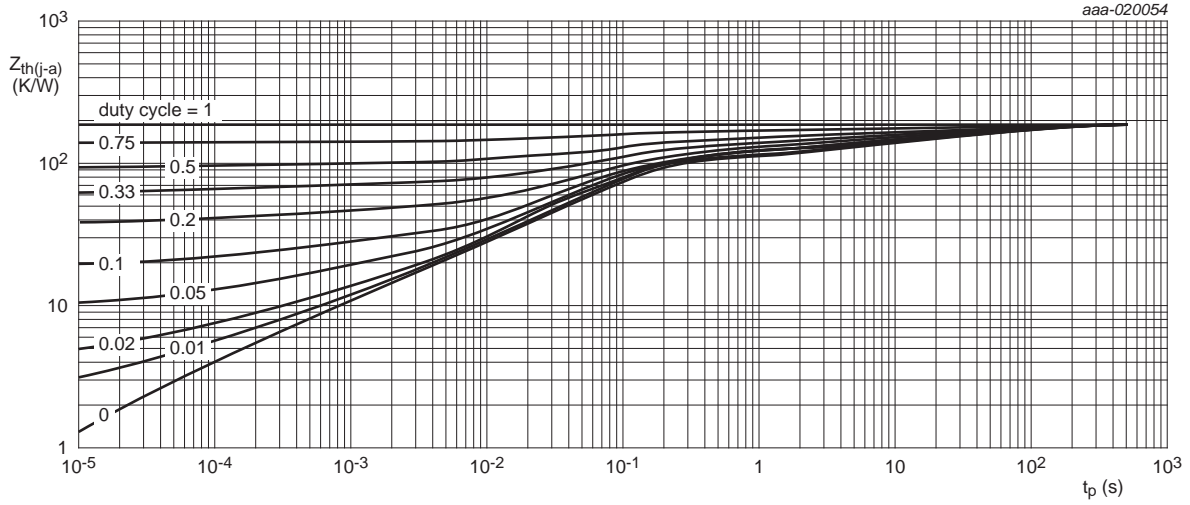
## 6. Thermal characteristics

Table 7. Thermal characteristics

| Symbol         | Parameter  | Conditions  | Min | Typ | Max | Unit |     |
|----------------|--|-------------|-----|-----|-----|------|-----|
| $R_{th(j-a)}$  | thermal resistance from junction to ambient      | in free air | [1] | -   | -   | 385  | K/W |
|                |  |             | [2] | -   | -   | 218  | K/W |
|                |  |             | [3] | -   | -   | 239  | K/W |
|                |  |             | [4] | -   | -   | 133  | K/W |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point |             | -   | -   | 40  | K/W  |     |

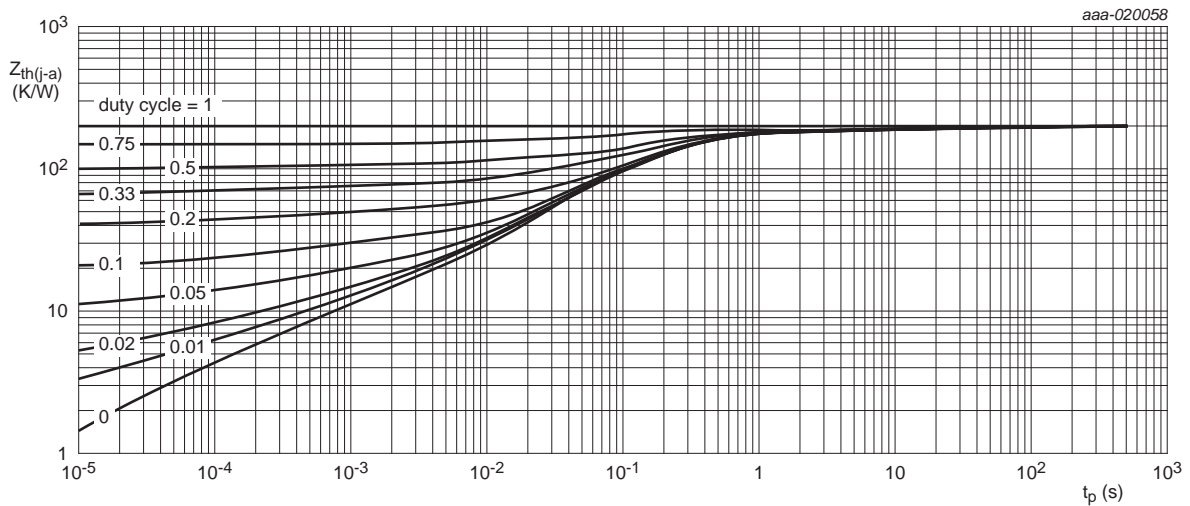
- [1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated; mounting pad for collector 1 cm<sup>2</sup>.
- [3] Device mounted on an FR4 PCB, 4-layer copper, tin-plated and standard footprint.
- [4] Device mounted on an FR4 PCB, 4-layer copper, tin-plated; mounting pad for collector 1 cm<sup>2</sup>.





FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.

**Fig 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values**



FR4 PCB, 4-layer copper, tin-plated and standard footprint.

**Fig 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values**

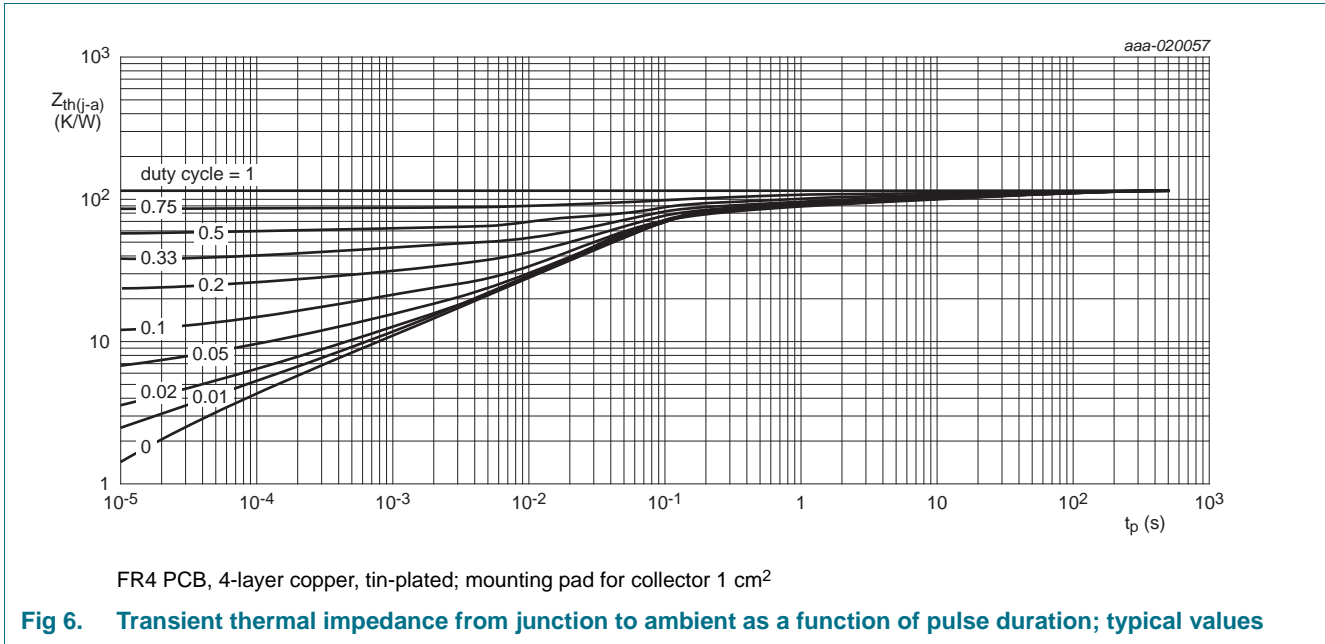


Fig 6. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values



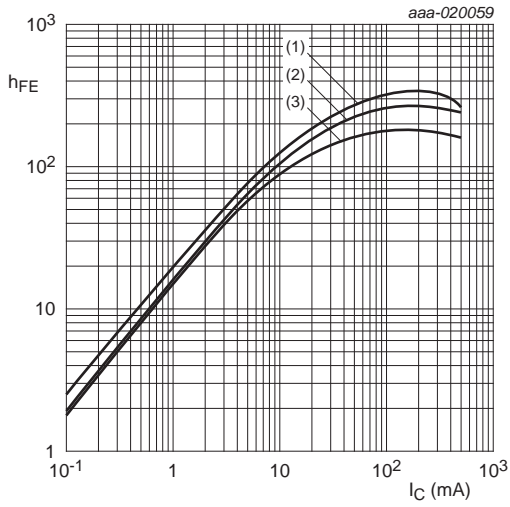
## 7. Characteristics

**Table 8. Characteristics**
 $T_{amb} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

| Symbol       | Parameter                                   | Conditions  | Min  | Typ  | Max  | Unit          |
|--------------|---|---|------|------|------|---------------|
| $I_{CBO}$    | collector-base cut-off current              | $V_{CB} = 50\text{ V}; I_E = 0\text{ A}$  | -    | -    | 100  | nA            |
| $I_{CEO}$    | collector-emitter cut-off current           | $V_{CE} = 50\text{ V}; I_B = 0\text{ A};$   | -    | -    | 0.5  | $\mu\text{A}$ |
| $I_{EBO}$    | emitter-base cut-off current                |   |      |      |      |               |
|              | PDTD113ZQA                                  | $V_{EB} = 5\text{ V}; I_C = 0\text{ A}$   | -    | -    | 0.8  | mA            |
|              | PDTD123YQA                                  |   | -    | -    | 0.65 | mA            |
|              | PDTD143XQA                                  |   | -    | -    | 0.6  | mA            |
| $h_{FE}$     | DC current gain                             | $V_{CE} = 5\text{ V}; I_C = 50\text{ mA}$   | 70   | -    | -    |               |
| $V_{CEsat}$  | collector-emitter saturation voltage        | $I_C = 50\text{ mA}; I_B = 2.5\text{ mA}$   | -    | -    | 100  | mV            |
| $V_{I(off)}$ | off-state input voltage                     |   |      |      |      |               |
|              | PDTD113ZQA                                  | $V_{CE} = 5\text{ V}; I_C = 100\text{ }\mu\text{A}$                               | 0.3  | 0.65 | 1    | V             |
|              | PDTD123YQA                                  |   | 0.4  | 0.65 | 1    | V             |
|              | PDTD143XQA                                  |   | 0.5  | 0.75 | 1.1  | V             |
| $V_{I(on)}$  | on-state input voltage                      |   |      |      |      |               |
|              | PDTD113ZQA                                  | $V_{CE} = 0.3\text{ V}; I_C = 20\text{ mA}$                                       | 0.4  | 0.8  | 1.4  | V             |
|              | PDTD123YQA                                  |   | 0.5  | 1    | 1.4  | V             |
|              | PDTD143XQA                                  |   | 1    | 1.4  | 2    | V             |
| R1           | bias resistor 1 (input) <a href="#">[1]</a> |   |      |      |      |               |
|              | PDTD113ZQA                                  |   | 0.7  | 1    | 1.3  | k $\Omega$    |
|              | PDTD123YQA                                  |   | 1.54 | 2.2  | 2.86 | k $\Omega$    |
|              | PDTD143XQA                                  |   | 3.3  | 4.7  | 6.1  | k $\Omega$    |
| R2/R1        | bias resistor ratio <a href="#">[1]</a>     |   |      |      |      |               |
|              | PDTD113ZQA                                  |   | 9    | 10   | 11   |               |
|              | PDTD123YQA                                  |   | 4.1  | 4.55 | 5    |               |
|              | PDTD143XQA                                  |   | 1.91 | 2.13 | 2.34 |               |
| $C_c$        | collector capacitance                       | $V_{CB} = 10\text{ V}; I_E = i_e = 0\text{ A}; f = 1\text{ MHz}$                  | -    | 5    | -    | pF            |
| $f_T$        | transition frequency                        | $V_{CE} = 5\text{ V}; I_C = 50\text{ mA}; f = 100\text{ MHz}$ <a href="#">[2]</a> | -    | 210  | -    | MHz           |

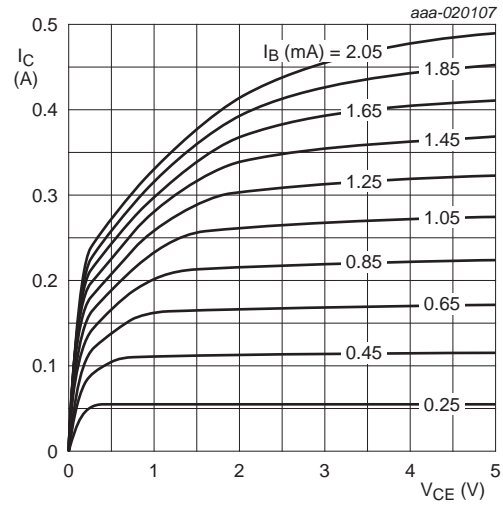
[1] See section test information for resistor calculation and test conditions.

[2] Characteristics of built-in transistor.



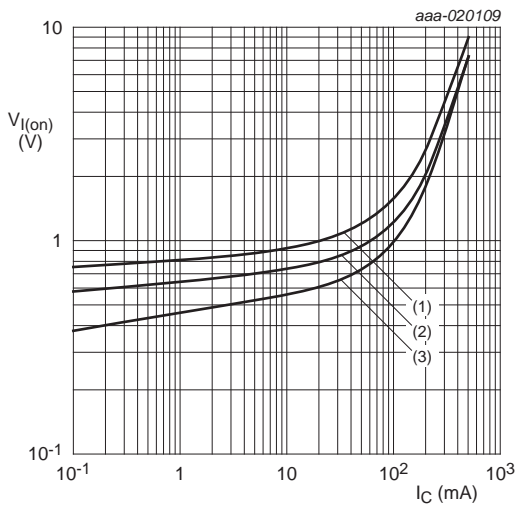
$V_{CE} = 5\text{ V}$   
 (1)  $T_{amb} = 100\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = -40\text{ }^{\circ}\text{C}$

**Fig 7. PDTD113ZQA: DC current gain as a function of collector current; typical values**



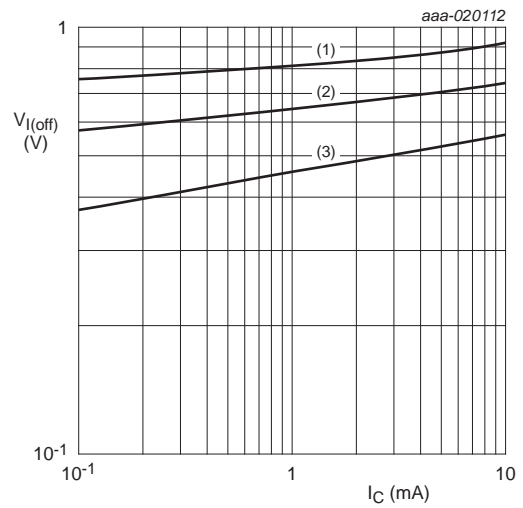
$T_{amb} = 25\text{ }^{\circ}\text{C}$

**Fig 8. PDTD113ZQA: Collector current as a function of collector-emitter voltage; typical values**



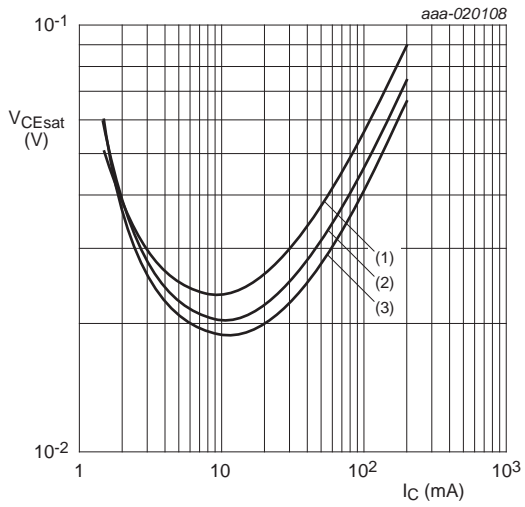
$V_{CE} = 0.3\text{ V}$   
 (1)  $T_{amb} = -40\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = 100\text{ }^{\circ}\text{C}$

**Fig 9. PDTD113ZQA: On-state input voltage as a function of collector current; typical values**



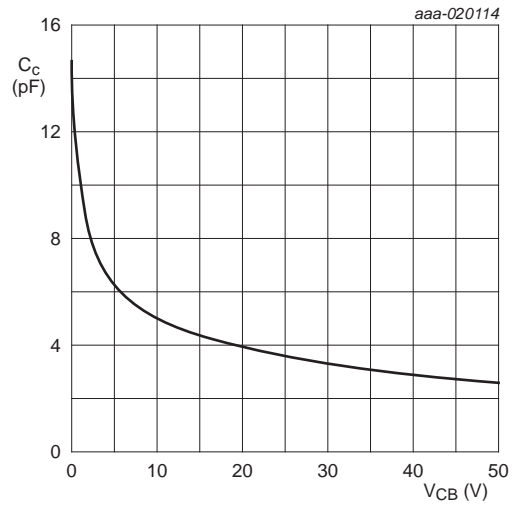
$V_{CE} = 5\text{ V}$   
 (1)  $T_{amb} = -40\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = 100\text{ }^{\circ}\text{C}$

**Fig 10. PDTD113ZQA: Off-state input voltage as a function of collector current; typical values**



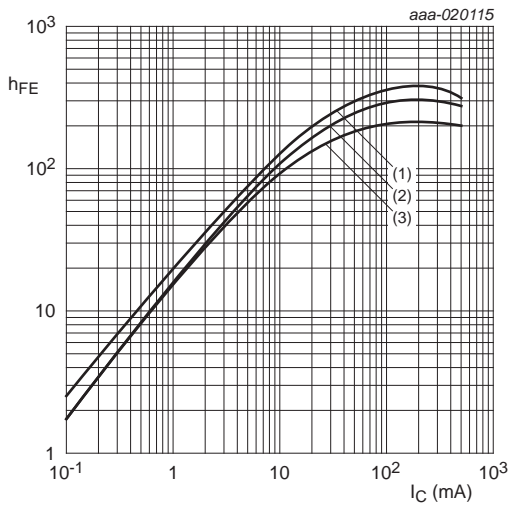
- $I_C/I_B = 20$
- (1)  $T_{amb} = 100\text{ °C}$
  - (2)  $T_{amb} = 25\text{ °C}$
  - (3)  $T_{amb} = -40\text{ °C}$

**Fig 11. PDTD113ZQA: Collector-emitter saturation voltage as a function of collector current; typical values**



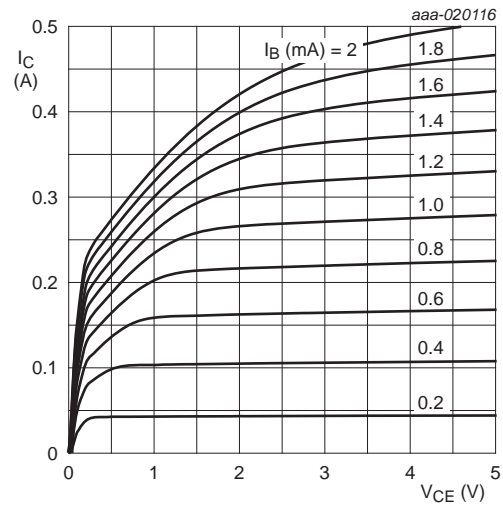
$f = 1\text{ MHz}; T_{amb} = 25\text{ °C}$

**Fig 12. PDTD113ZQA: Collector capacitance as a function of collector-base voltage; typical values**



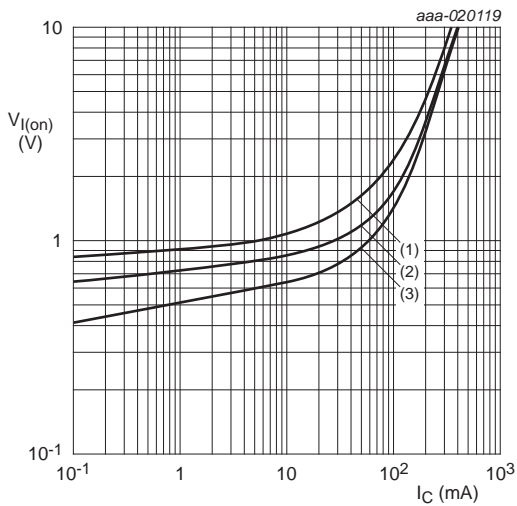
$V_{CE} = 5\text{ V}$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -40\text{ °C}$

**Fig 13. PDTD123YQA: DC current gain as a function of collector current; typical values**



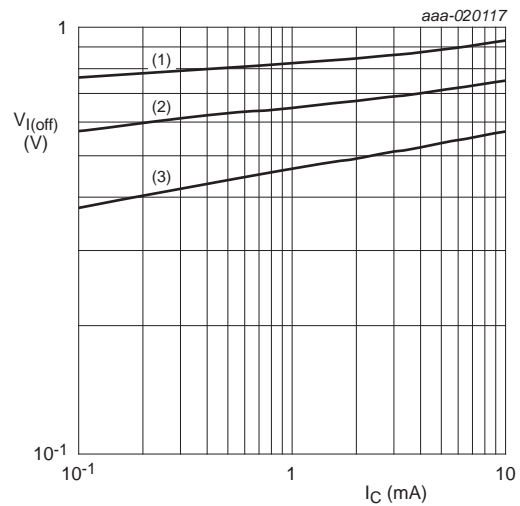
$T_{amb} = 25\text{ °C}$

**Fig 14. PDTD123YQA: Collector current as a function of collector-emitter voltage; typical values**



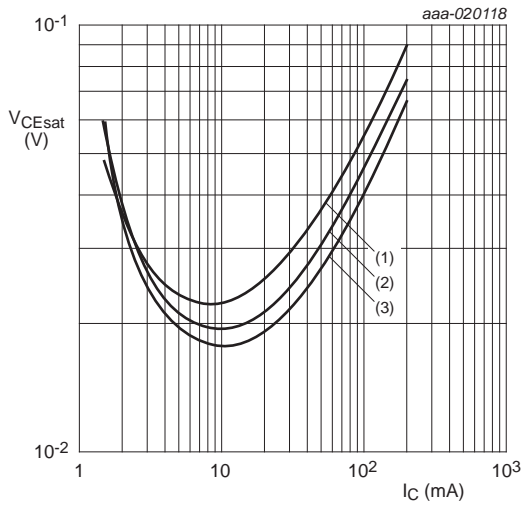
$V_{CE} = 0.3\text{ V}$   
 (1)  $T_{amb} = -40\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 100\text{ °C}$

**Fig 15. PDTD123YQA: On-state input voltage as a function of collector current; typical values**



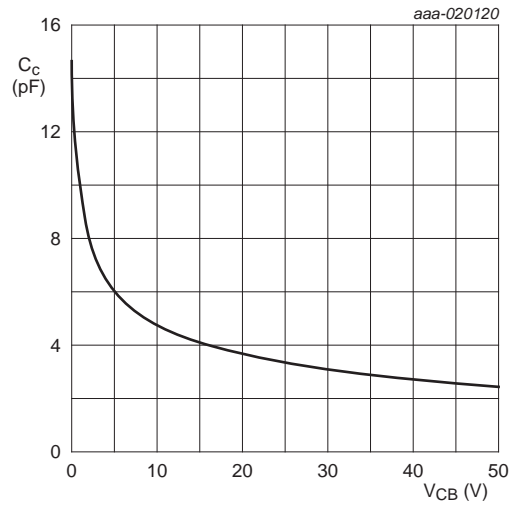
$V_{CE} = 5\text{ V}$   
 (1)  $T_{amb} = -40\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 100\text{ °C}$

**Fig 16. PDTD123YQA: Off-state input voltage as a function of collector current; typical values**



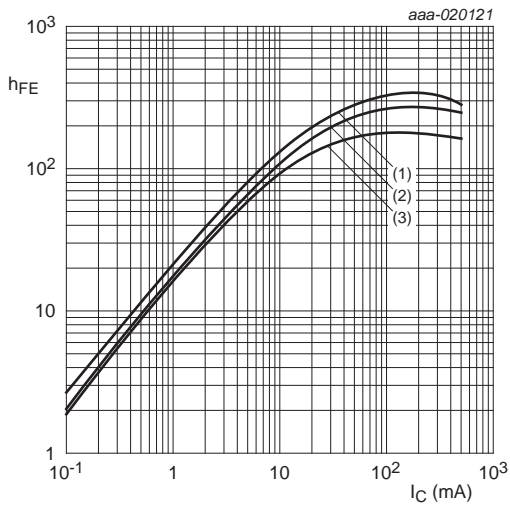
- $I_C/I_B = 20$
- (1)  $T_{amb} = 100\text{ }^\circ\text{C}$
  - (2)  $T_{amb} = 25\text{ }^\circ\text{C}$
  - (3)  $T_{amb} = -40\text{ }^\circ\text{C}$

**Fig 17. PDTD123YQA: Collector-emitter saturation voltage as a function of collector current; typical values**



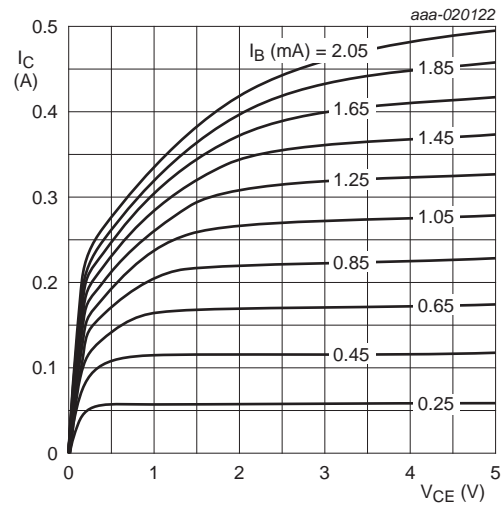
$f = 1\text{ MHz}; T_{amb} = 25\text{ }^\circ\text{C}$

**Fig 18. PDTD123YQA: Collector capacitance as a function of collector-base voltage; typical values**



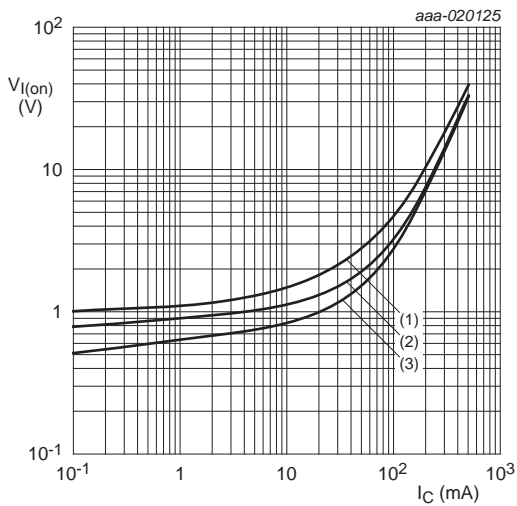
$V_{CE} = 5 \text{ V}$   
 (1)  $T_{amb} = 100 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -40 \text{ }^\circ\text{C}$

**Fig 19. PDTD143XQA: DC current gain as a function of collector current; typical values**



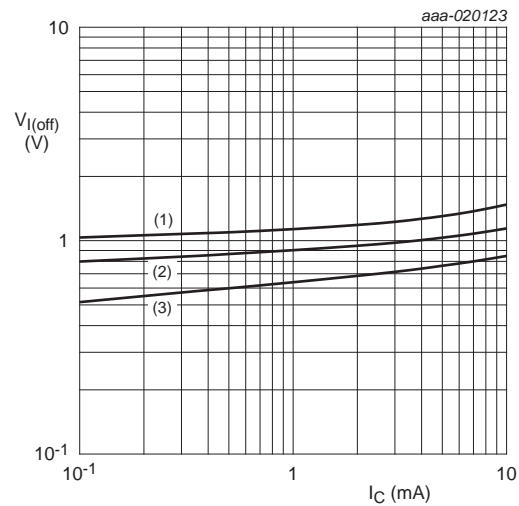
$T_{amb} = 25 \text{ }^\circ\text{C}$

**Fig 20. PDTD143XQA: Collector current as a function of collector-emitter voltage; typical values**



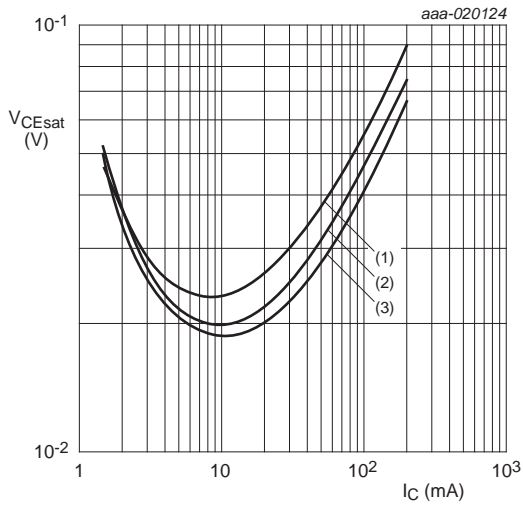
$V_{CE} = 0.3 \text{ V}$   
 (1)  $T_{amb} = -40 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100 \text{ }^\circ\text{C}$

**Fig 21. PDTD143XQA: On-state input voltage as a function of collector current; typical values**



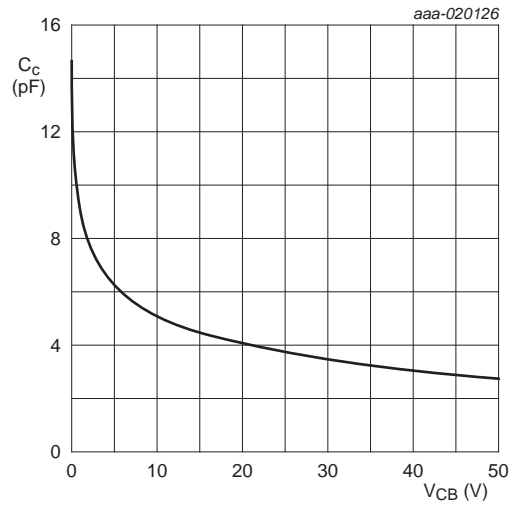
$V_{CE} = 5 \text{ V}$   
 (1)  $T_{amb} = -40 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100 \text{ }^\circ\text{C}$

**Fig 22. PDTD143XQA: Off-state input voltage as a function of collector current; typical values**



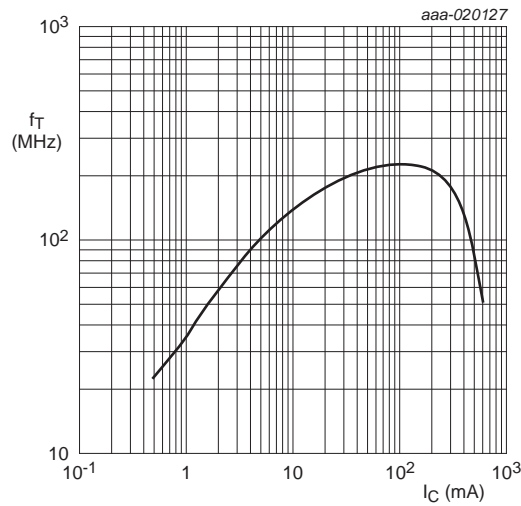
- $I_C/I_B = 20$
- (1)  $T_{amb} = 100^\circ C$
  - (2)  $T_{amb} = 25^\circ C$
  - (3)  $T_{amb} = -40^\circ C$

**Fig 23. PDTD143XQA: Collector-emitter saturation voltage as a function of collector current; typical values**



$f = 1$  MHz;  $T_{amb} = 25^\circ C$

**Fig 24. PDTD143XQA: Collector capacitance as a function of collector-base voltage; typical values**



$V_{CE} = 5$  V;  $f = 100$  MHz;  $T_{amb} = 25^\circ C$

**Fig 25. Transition frequency as a function of collector current; typical values of built-in transistor**

## 8. Test information

### 8.1 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.

### 8.2 Resistor calculation

- Calculation of bias resistor 1 (R1):

$$R1 = \frac{V(I_{I2}) - V(I_{I1})}{I_{I2} - I_{I1}}$$

- Calculation of bias resistor ratio (R2/R1):

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

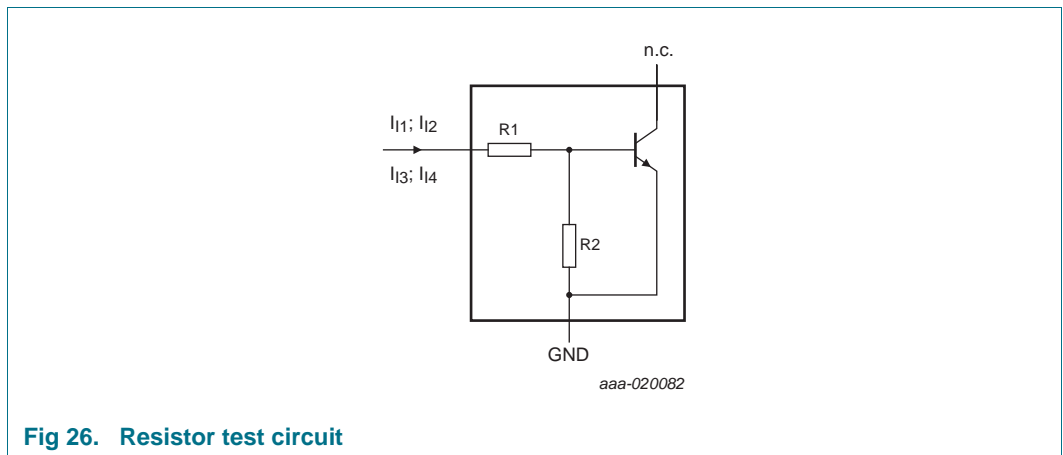


Fig 26. Resistor test circuit

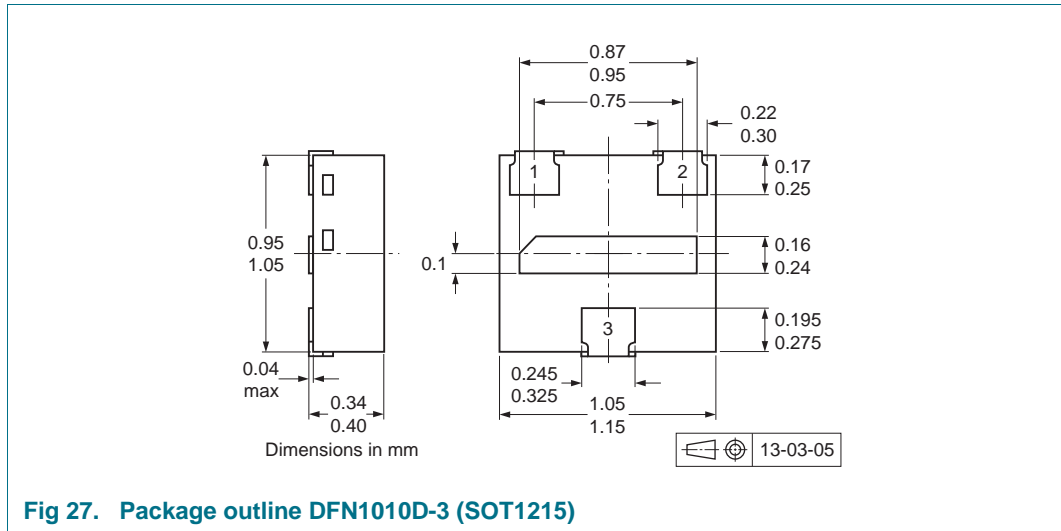
### 8.3 Resistor test conditions

Table 9. Resistor test conditions

| Type number | R1  | R2 | Test conditions |                 |                 |                 |
|-------------|-----|----|-----------------|-----------------|-----------------|-----------------|
|             | kΩ  | kΩ | I <sub>I1</sub> | I <sub>I2</sub> | I <sub>I3</sub> | I <sub>I4</sub> |
| PDTD113ZQA  | 1   | 10 | 0.7 mA          | 0.8 mA          | -0.45 mA        | -0.55 mA        |
| PDTD123YQA  | 2.2 | 10 | 0.7 mA          | 0.8 mA          | -0.45 mA        | -0.55 mA        |
| PDTD143XQA  | 4.7 | 10 | 1.3 mA          | 1.5 mA          | -0.45 mA        | -0.55 mA        |



**9. Package outline**



**Fig 27. Package outline DFN1010D-3 (SOT1215)**

## 10. Soldering

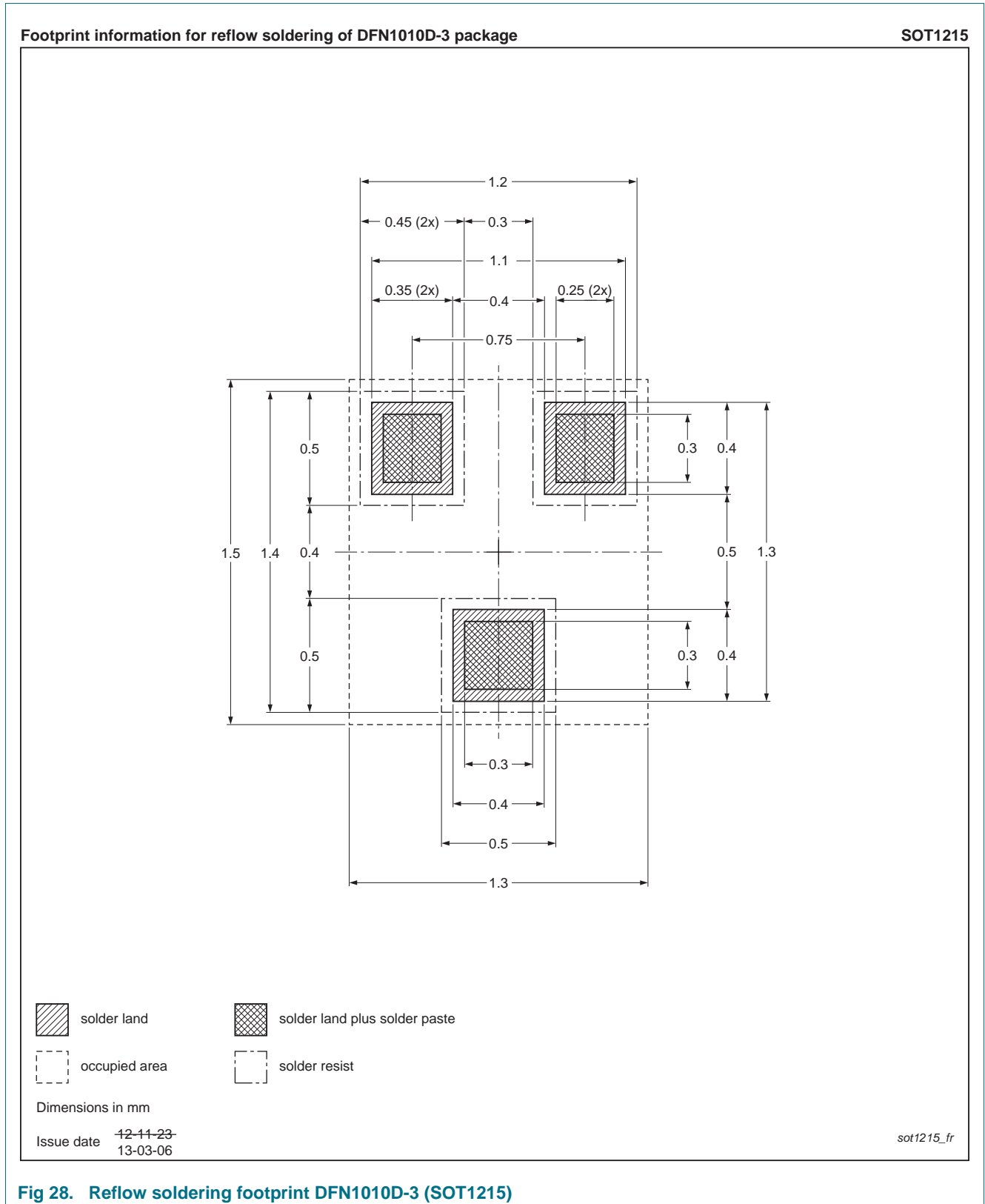


Fig 28. Reflow soldering footprint DFN1010D-3 (SOT1215)

## 11. Revision history

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**Table 10. Revision history**

| Document ID                  | Release date | Data sheet status  | Change notice | Supersedes |
|------------------------------|--------------|--------------------|---------------|------------|
| PDTD113Z_123Y_143XQA_SER v.1 | 20160331     | Product data sheet | -             | -          |

## 12. Legal information

### 12.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | 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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