

## Important notice

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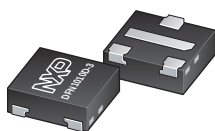
Should be replaced with:

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If you have any questions related to the data sheet, please contact our nearest sales office via e-mail or telephone (details via **[salesaddresses@nexperia.com](mailto:salesaddresses@nexperia.com)**). Thank you for your cooperation and understanding,

Kind regards,

Team Nexperia



# PDTD113/123/143/114EQA series

50 V, 500 mA NPN resistor-equipped transistors

Rev. 1 — 4 February 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 |
|-------------|----------------|----------------|-------------------------|----------------|
| PDTD113EQA  | 1 k $\Omega$   | 1 k $\Omega$   | DFN1010D-3<br>(SOT1215) | PDTB113EQA     |
| PDTD123EQA  | 2.2 k $\Omega$ | 2.2 k $\Omega$ |                         | PDTB123EQA     |
| PDTD143EQA  | 4.7 k $\Omega$ | 4.7 k $\Omega$ |                         | PDTB143EQA     |
| PDTD114EQA  | 10 k $\Omega$  | 10 k $\Omega$  |                         | PDTB114EQA     |

### 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

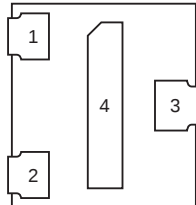
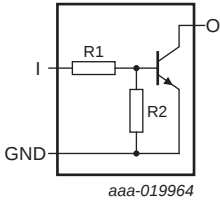
Table 2. Quick reference data

| 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

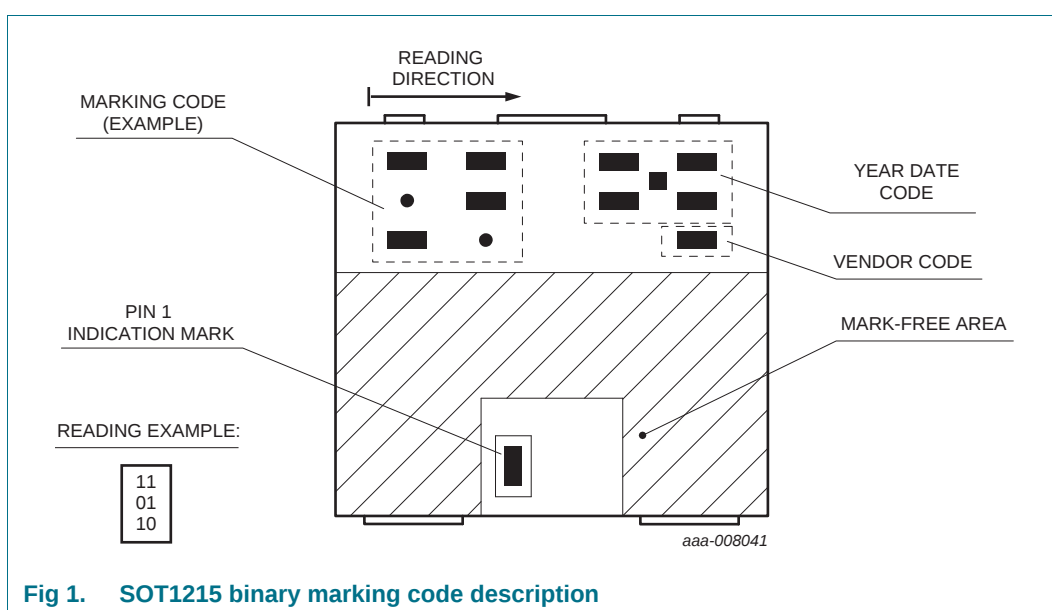
| Type number | Package    |                                                                                                                |         |
|-------------|------------|----------------------------------------------------------------------------------------------------------------|---------|
|             | Name       | Description                                                                                                    | Version |
| PDTD113EQA  | DFN1010D-3 | plastic thermal enhanced ultra thin small outline package; no leads; 3 terminals;<br>body: 1.1 × 1.0 × 0.37 mm | SOT1215 |
| PDTD123EQA  |            |                                                                                                                |         |
| PDTD143EQA  |            |                                                                                                                |         |
| PDTD114EQA  |            |                                                                                                                |         |

## 4. Marking

Table 5. Marking codes

| Type number | Marking code |
|-------------|--------------|
| PDTD113EQA  | 01 00 11     |
| PDTD123EQA  | 01 01 10     |
| PDTD143EQA  | 01 10 01     |
| PDTD114EQA  | 01 11 01     |

### 4.1 Binary marking code description



## 5. Limiting values

Table 6. Limiting values

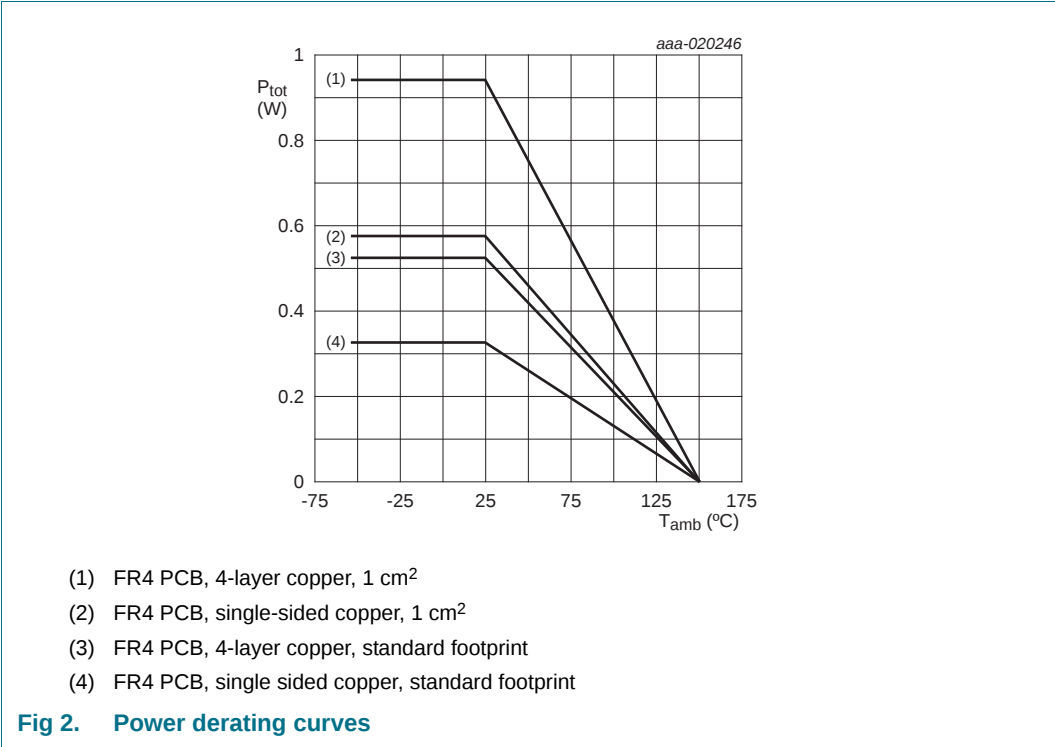
In accordance with the Absolute Maximum Rating System (IEC 60134).

| 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 | -   | 10  | 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           |                          |                     |      |      |    |
|                  | PDTD113EQA              |                          | −10                 | +10  | V    |    |
|                  | PDTD123EQA              |                          | −10                 | +12  | V    |    |
|                  | PDTD143EQA              |                          | −10                 | +30  | V    |    |
|                  | PDTD114EQA              |                          | −10                 | +50  | V    |    |
| I <sub>O</sub>   | output current          |                          | -                   | 500  | mA   |    |
| P <sub>tot</sub> | total power dissipation | T <sub>amb</sub> ≤ 25 °C | <a href="#">[1]</a> | -    | 325  | mW |
|                  |                         |                          | <a href="#">[2]</a> | -    | 575  | mW |
|                  |                         |                          | <a href="#">[3]</a> | -    | 525  | mW |
|                  |                         |                          | <a href="#">[4]</a> | -    | 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>.

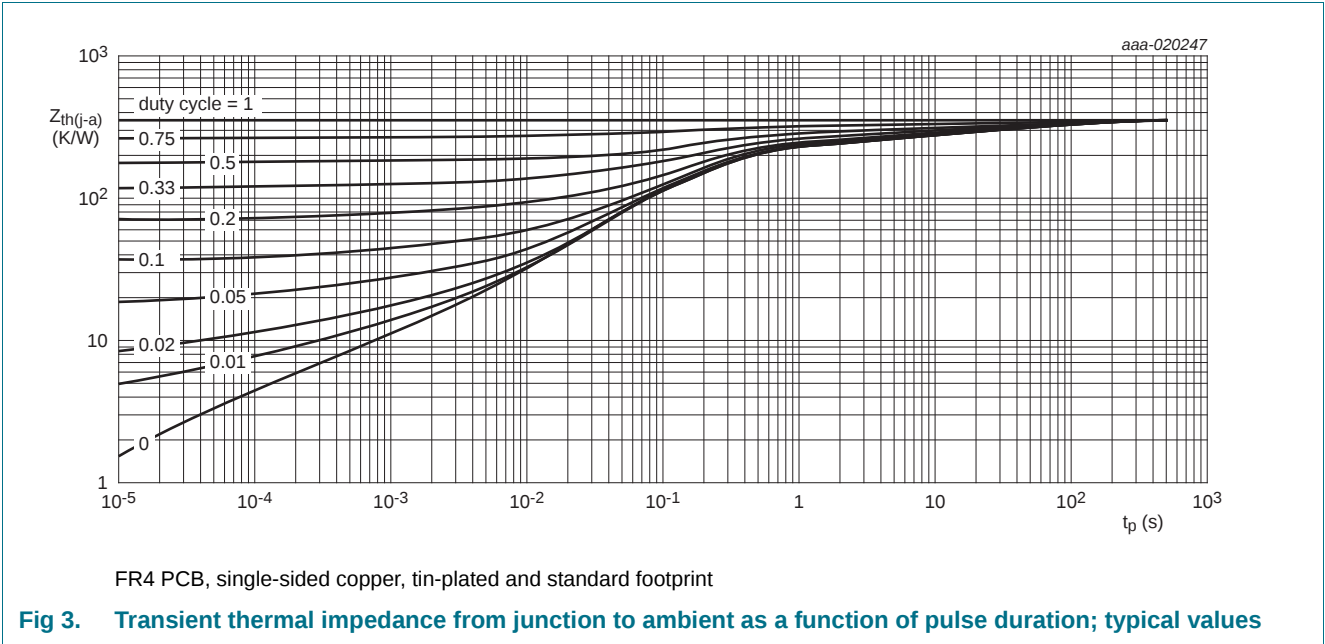


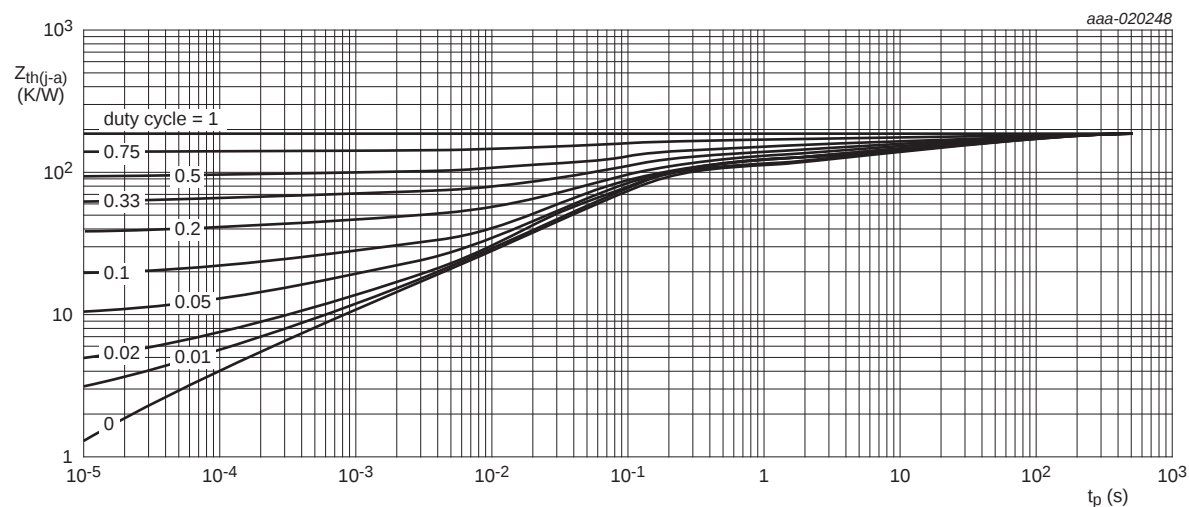
6. Thermal characteristics

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  |

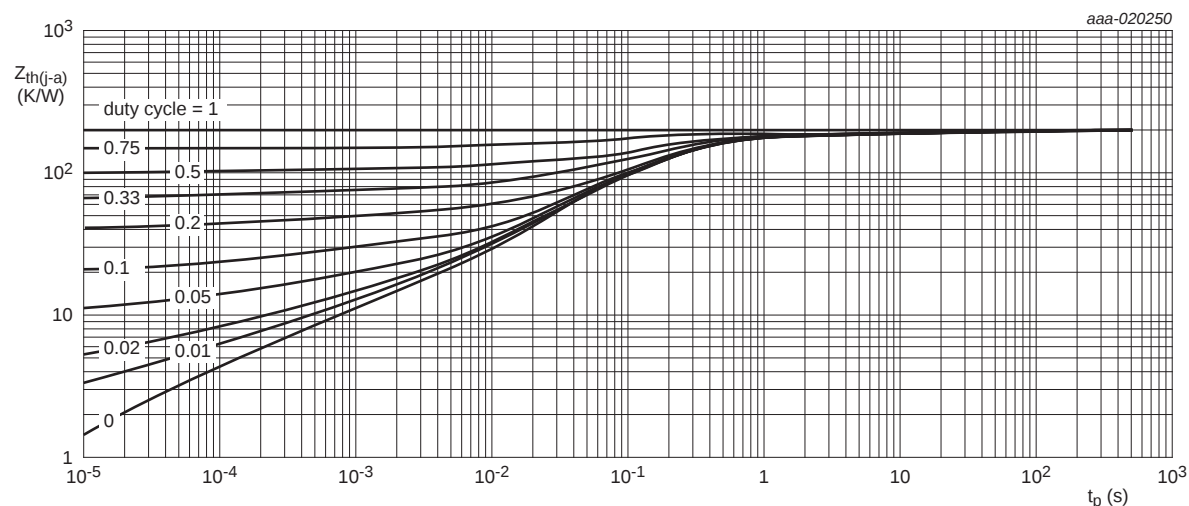
- [1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated; mounting pad for collector 1 cm<sup>2</sup>.
- [3] Device mounted on an FR4 PCB, 4-layer copper, tin-plated and standard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





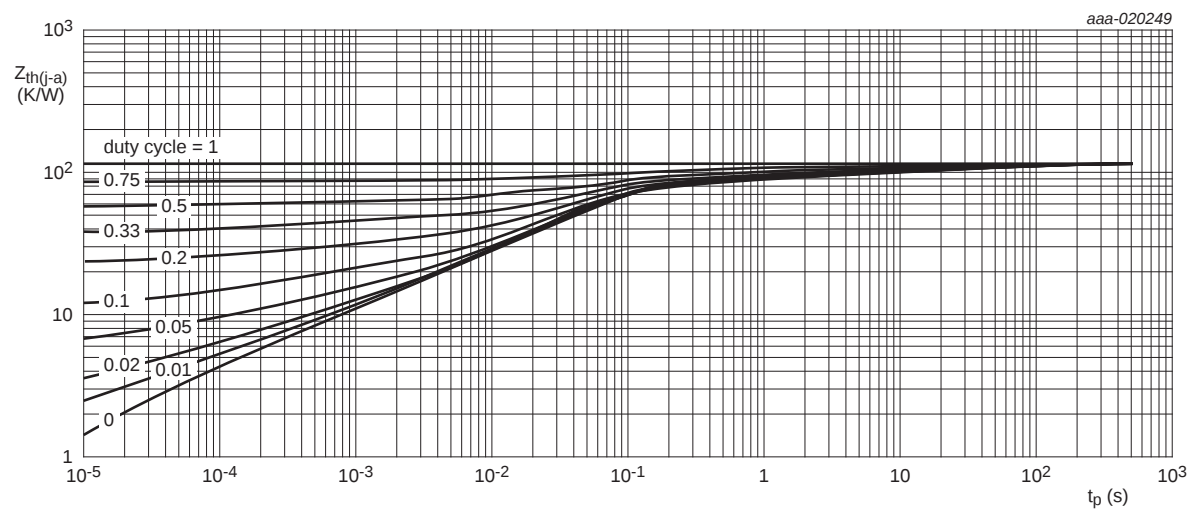
FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>

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



FR4 PCB, 4-layer copper, tin-plated; mounting pad for collector 1 cm<sup>2</sup>

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

## 7. Characteristics

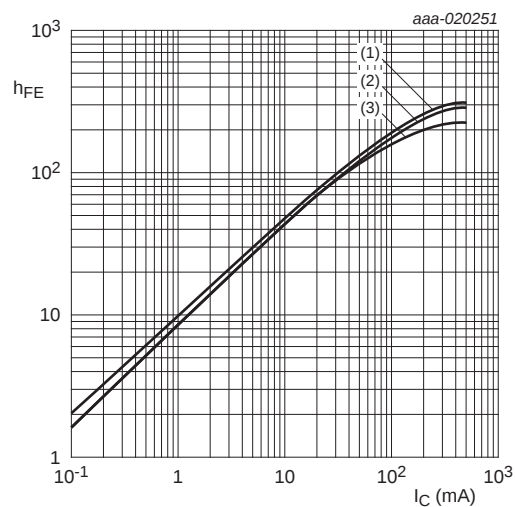
**Table 8. Characteristics**

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

| Symbol              | Parameter                            | Conditions                                                               | Min                 | Typ  | Max  | Unit |     |
|---------------------|--------------------------------------|--------------------------------------------------------------------------|---------------------|------|------|------|-----|
| I <sub>CBO</sub>    | collector-base cut-off current       | V <sub>CB</sub> = 50 V; I <sub>E</sub> = 0 A                             | -                   | -    | 100  | nA   |     |
| I <sub>CEO</sub>    | collector-emitter cut-off current    | V <sub>CE</sub> = 50 V; I <sub>B</sub> = 0 A                             | -                   | -    | 0.5  | μA   |     |
| I <sub>EBO</sub>    | emitter-base cut-off current         |                                                                          |                     |      |      |      |     |
|                     | PDTD113EQA                           | V <sub>EB</sub> = 5 V; I <sub>C</sub> = 0 A                              | -                   | -    | 4    | mA   |     |
|                     | PDTD123EQA                           |                                                                          | -                   | -    | 2    | mA   |     |
|                     | PDTD143EQA                           |                                                                          | -                   | -    | 0.9  | mA   |     |
|                     | PDTD114EQA                           |                                                                          |                     |      | 0.4  | mA   |     |
| h <sub>FE</sub>     | DC current gain                      |                                                                          |                     |      |      |      |     |
|                     | PDTD113EQA                           | V <sub>CE</sub> = 5 V; I <sub>C</sub> = 50 mA                            | 33                  | -    | -    |      |     |
|                     | PDTD123EQA                           |                                                                          | 40                  | -    | -    |      |     |
|                     | PDTD143EQA                           |                                                                          | 60                  | -    | -    |      |     |
|                     | PDTD114EQA                           |                                                                          | 70                  | -    | -    |      |     |
| V <sub>CEsat</sub>  | collector-emitter saturation voltage | I <sub>C</sub> = 50 mA; I <sub>B</sub> = 2.5 mA                          | -                   | -    | 100  | mV   |     |
| V <sub>I(off)</sub> | off-state input voltage              |                                                                          |                     |      |      |      |     |
|                     | PDTD113EQA                           | V <sub>CE</sub> = 5 V; I <sub>C</sub> = 100 μA                           | 0.6                 | 1.05 | 1.5  | V    |     |
|                     | PDTD123EQA                           |                                                                          | 0.6                 | 1.05 | 1.8  | V    |     |
|                     | PDTD143EQA                           |                                                                          | 0.6                 | 1.05 | 1.5  | V    |     |
|                     | PDTD114EQA                           |                                                                          | 0.6                 | 1.05 | 1.5  | V    |     |
| V <sub>I(on)</sub>  | on-state input voltage               |                                                                          |                     |      |      |      |     |
|                     | PDTD113EQA                           | V <sub>CE</sub> = 0.3 V; I <sub>C</sub> = 20 mA                          | 1                   | 1.45 | 1.8  | V    |     |
|                     | PDTD123EQA                           |                                                                          | 1                   | 1.5  | 2    | V    |     |
|                     | PDTD143EQA                           |                                                                          | 1                   | 1.7  | 2.2  | V    |     |
|                     | PDTD114EQA                           |                                                                          | 1                   | 2.2  | 3    | V    |     |
| R1                  | bias resistor 1 (input)              | <a href="#">[1]</a>                                                      |                     |      |      |      |     |
|                     | PDTD113EQA                           |                                                                          | 0.7                 | 1    | 1.3  | kΩ   |     |
|                     | PDTD123EQA                           |                                                                          | 1.54                | 2.2  | 2.86 | kΩ   |     |
|                     | PDTD143EQA                           |                                                                          | 3.3                 | 4.7  | 6.1  | kΩ   |     |
|                     | PDTD114EQA                           |                                                                          | 7                   | 10   | 13   | kΩ   |     |
| R2/R1               | bias resistor ratio                  |                                                                          | <a href="#">[1]</a> | 0.9  | 1    | 1.1  |     |
| C <sub>c</sub>      | collector capacitance                | V <sub>CB</sub> = 10 V; I <sub>E</sub> = i <sub>e</sub> = 0 A; f = 1 MHz | -                   | 5    | -    | pF   |     |
| f <sub>T</sub>      | transition frequency                 | V <sub>CE</sub> = 5 V; I <sub>C</sub> = 50 mA; f = 100 MHz               | <a href="#">[2]</a> | -    | 210  | -    | MHz |

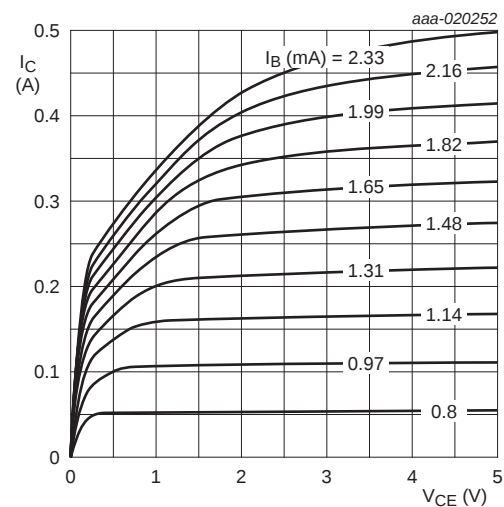
[1] See section test information for resistor calculation and test conditions.

[2] Characteristics of built-in transistor.



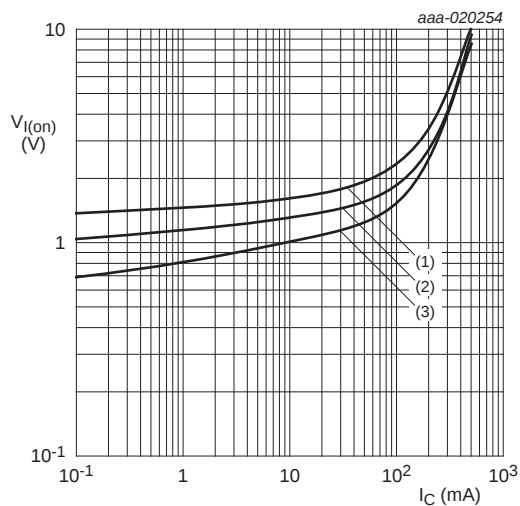
- $V_{CE} = 5$  V
- (1)  $T_{amb} = 100$  °C
  - (2)  $T_{amb} = 25$  °C
  - (3)  $T_{amb} = -40$  °C

Fig 7. PDTD113EQA: DC current gain as a function of collector current; typical values



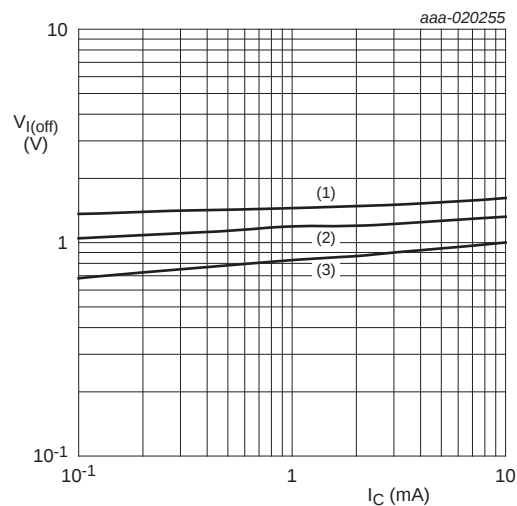
$T_{amb} = 25$  °C

Fig 8. PDTD113EQA: Collector current as a function of collector-emitter voltage; typical values



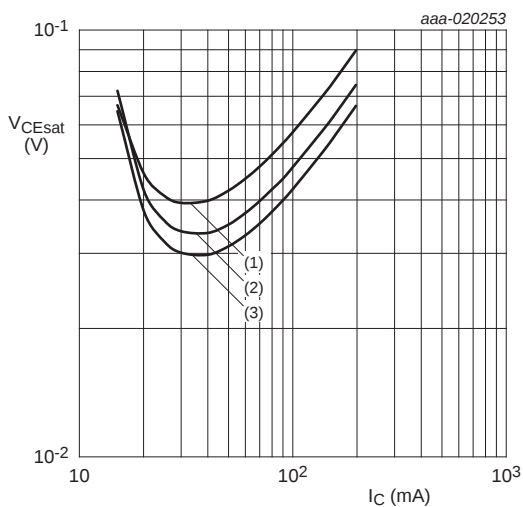
- $V_{CE} = 0.3$  V
- (1)  $T_{amb} = -40$  °C
  - (2)  $T_{amb} = 25$  °C
  - (3)  $T_{amb} = 100$  °C

Fig 9. PDTD113EQA: On-state input voltage as a function of collector current; typical values



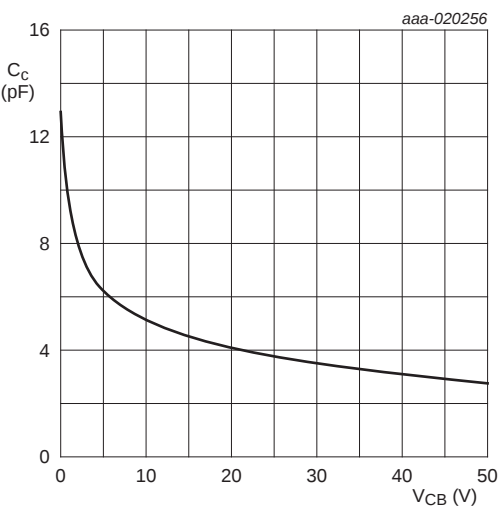
- $V_{CE} = 5$  V
- (1)  $T_{amb} = -40$  °C
  - (2)  $T_{amb} = 25$  °C
  - (3)  $T_{amb} = 100$  °C

Fig 10. PDTD113EQA: Off-state input voltage as a function of collector current; typical values



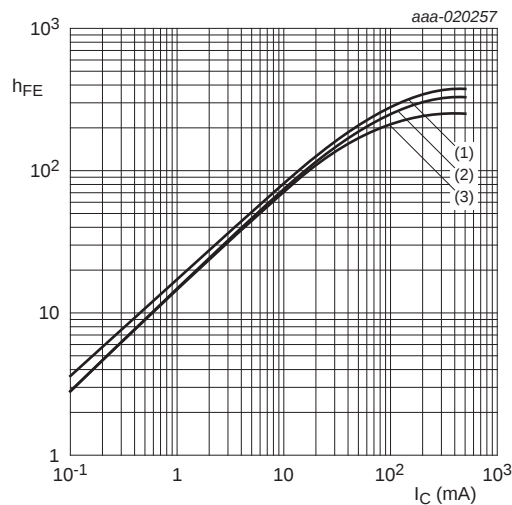
- $I_C/I_B = 20$
- (1)  $T_{amb} = 100\text{ }^{\circ}\text{C}$
  - (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$
  - (3)  $T_{amb} = -40\text{ }^{\circ}\text{C}$

Fig 11. PDTD113EQA: Collector-emitter saturation voltage as a function of collector current; typical values



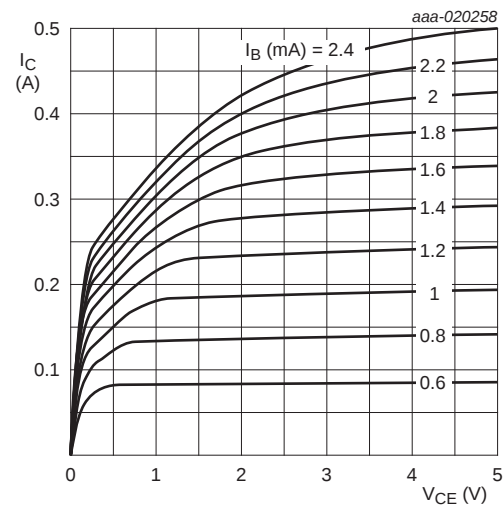
$f = 1\text{ MHz}$ ;  $T_{amb} = 25\text{ }^{\circ}\text{C}$

Fig 12. PDTD113EQA: Collector capacitance as a function of collector-base voltage; typical values



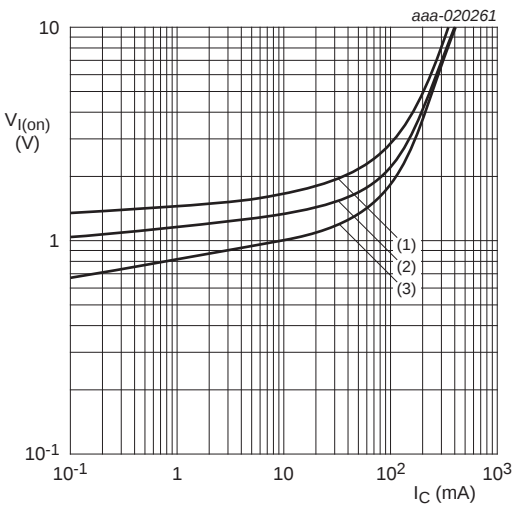
$V_{CE} = 5\text{ V}$   
(1)  $T_{amb} = 100^\circ\text{C}$   
(2)  $T_{amb} = 25^\circ\text{C}$   
(3)  $T_{amb} = -40^\circ\text{C}$

Fig 13. PDTD123EQA: DC current gain as a function of collector current; typical values



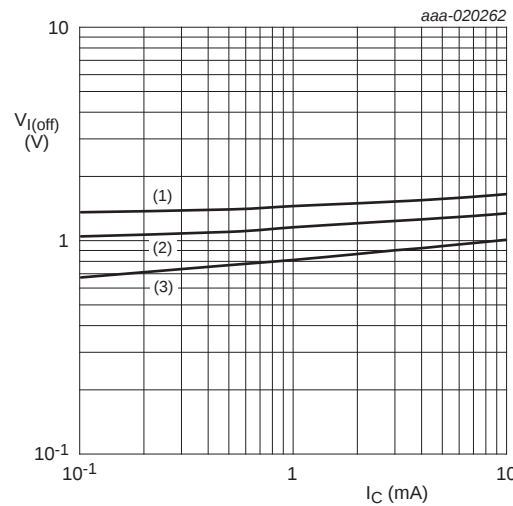
$T_{amb} = 25^\circ\text{C}$

Fig 14. PDTD123EQA: Collector current as a function of collector-emitter voltage; typical values



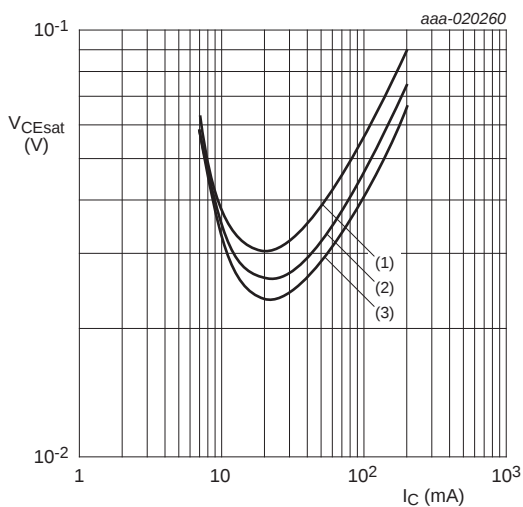
$V_{CE} = 0.3\text{ V}$   
(1)  $T_{amb} = -40^\circ\text{C}$   
(2)  $T_{amb} = 25^\circ\text{C}$   
(3)  $T_{amb} = 100^\circ\text{C}$

Fig 15. PDTD123EQA: On-state input voltage as a function of collector current; typical values



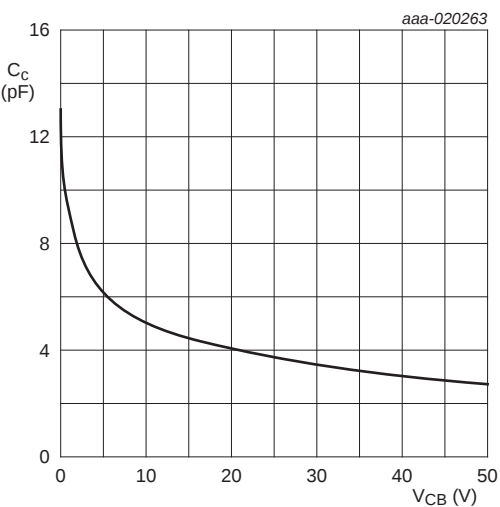
$V_{CE} = 5\text{ V}$   
(1)  $T_{amb} = -40^\circ\text{C}$   
(2)  $T_{amb} = 25^\circ\text{C}$   
(3)  $T_{amb} = 100^\circ\text{C}$

Fig 16. PDTD123EQA: Off-state input voltage as a function of collector current; typical values



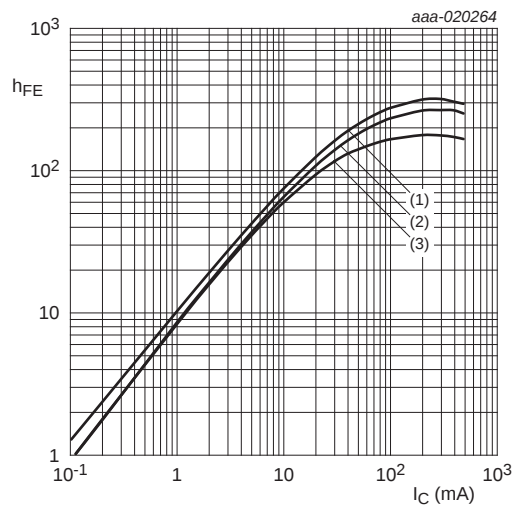
$I_C/I_B = 20$   
(1)  $T_{amb} = 100\text{ }^{\circ}\text{C}$   
(2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
(3)  $T_{amb} = -40\text{ }^{\circ}\text{C}$

Fig 17. PDTD123EQA: Collector-emitter saturation voltage as a function of collector current; typical values



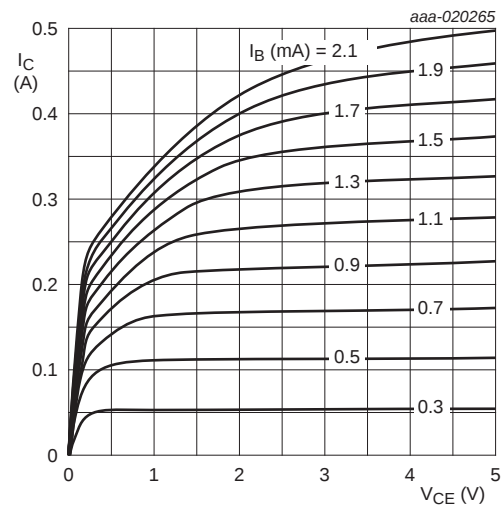
$f = 1\text{ MHz}$ ;  $T_{amb} = 25\text{ }^{\circ}\text{C}$

Fig 18. PDTD123EQA: Collector capacitance as a function of collector-base voltage; typical values



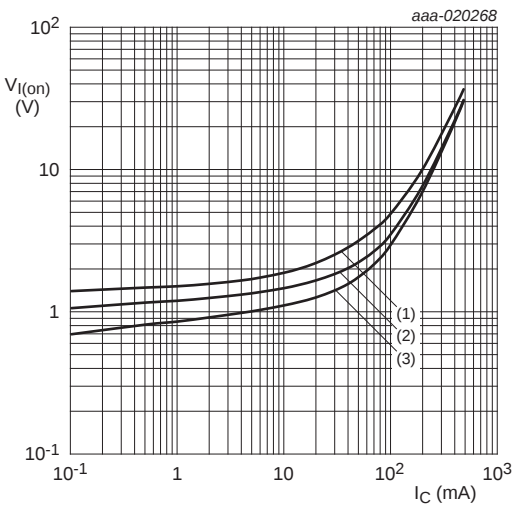
- $V_{CE} = 5\text{ V}$
- (1)  $T_{amb} = 100\text{ }^{\circ}\text{C}$
  - (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$
  - (3)  $T_{amb} = -40\text{ }^{\circ}\text{C}$

Fig 19. PDTD143EQA: DC current gain as a function of collector current; typical values



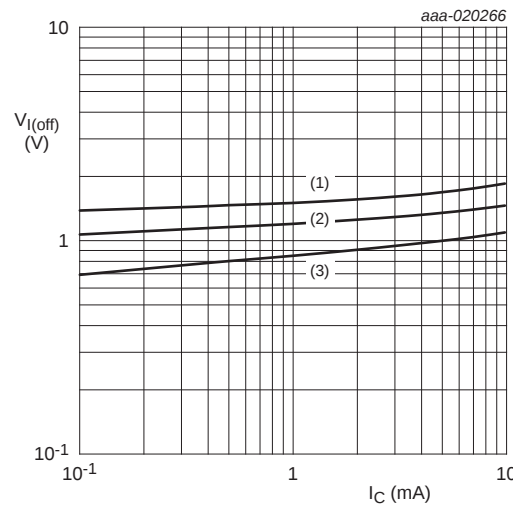
$T_{amb} = 25\text{ }^{\circ}\text{C}$

Fig 20. PDTD143EQA: Collector current as a function of collector-emitter voltage; typical values



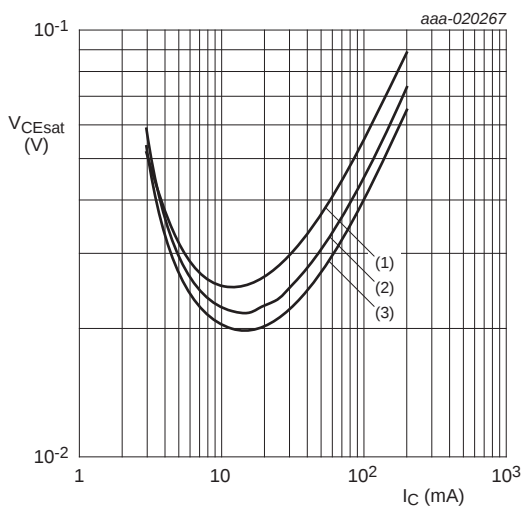
- $V_{CE} = 0.3\text{ V}$
- (1)  $T_{amb} = -40\text{ }^{\circ}\text{C}$
  - (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$
  - (3)  $T_{amb} = 100\text{ }^{\circ}\text{C}$

Fig 21. PDTD143EQA: On-state input voltage as a function of collector current; typical values



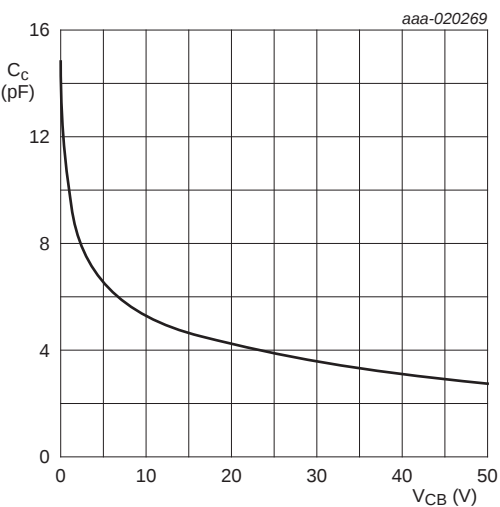
- $V_{CE} = 5\text{ V}$
- (1)  $T_{amb} = -40\text{ }^{\circ}\text{C}$
  - (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$
  - (3)  $T_{amb} = 100\text{ }^{\circ}\text{C}$

Fig 22. PDTD143EQA: Off-state input voltage as a function of collector current; typical values



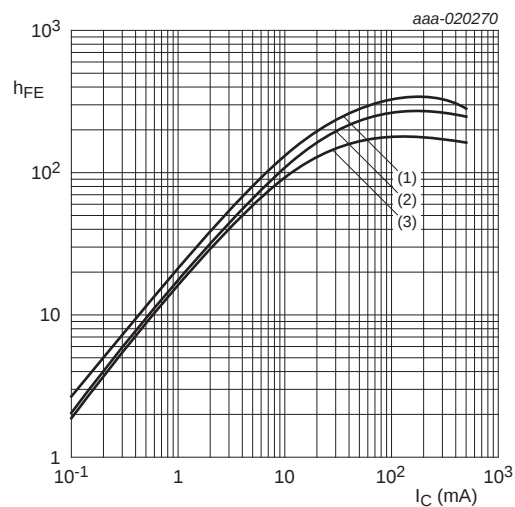
- $I_C/I_B = 20$
- (1)  $T_{amb} = 100\text{ }^{\circ}\text{C}$
  - (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$
  - (3)  $T_{amb} = -40\text{ }^{\circ}\text{C}$

Fig 23. PDTD143EQA: Collector-emitter saturation voltage as a function of collector current; typical values



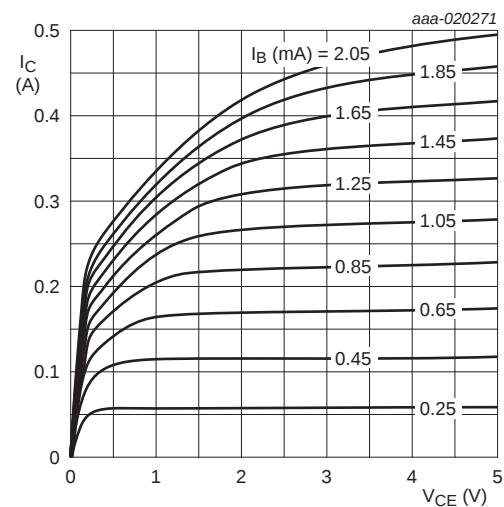
$f = 1\text{ MHz}$ ;  $T_{amb} = 25\text{ }^{\circ}\text{C}$

Fig 24. PDTD143EQA: Collector capacitance as a function of collector-base voltage; typical values



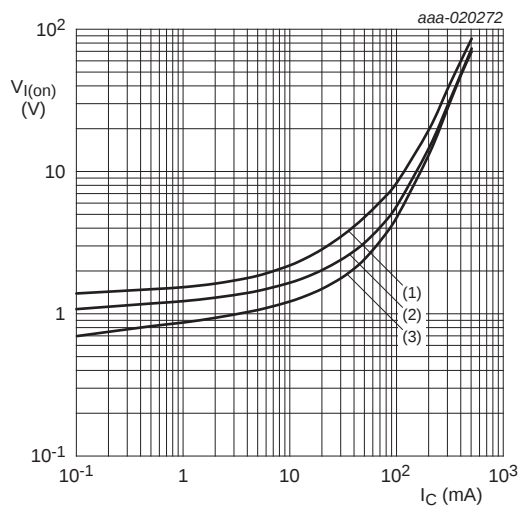
- $V_{CE} = 5$  V
- (1)  $T_{amb} = 100$  °C
  - (2)  $T_{amb} = 25$  °C
  - (3)  $T_{amb} = -40$  °C

Fig 25. PDTD114EQA: DC current gain as a function of collector current; typical values



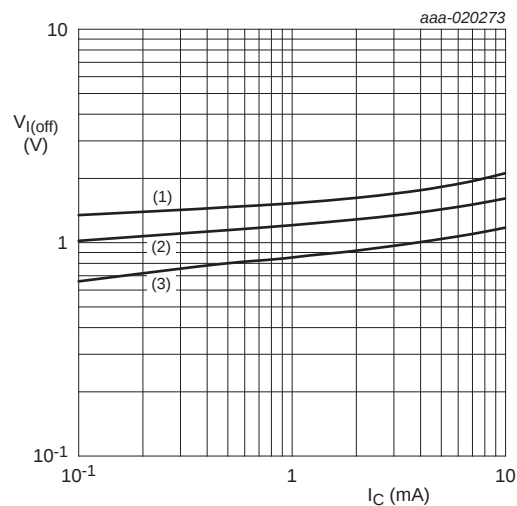
$T_{amb} = 25$  °C

Fig 26. PDTD114EQA: Collector current as a function of collector-emitter voltage; typical values



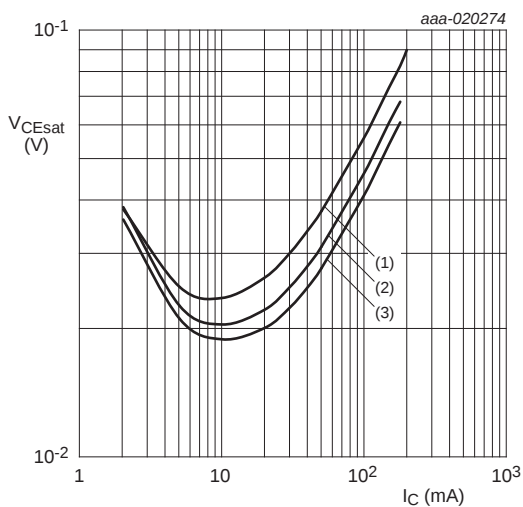
- $V_{CE} = 0.3$  V
- (1)  $T_{amb} = -40$  °C
  - (2)  $T_{amb} = 25$  °C
  - (3)  $T_{amb} = 100$  °C

Fig 27. PDTD114EQA: On-state input voltage as a function of collector current; typical values



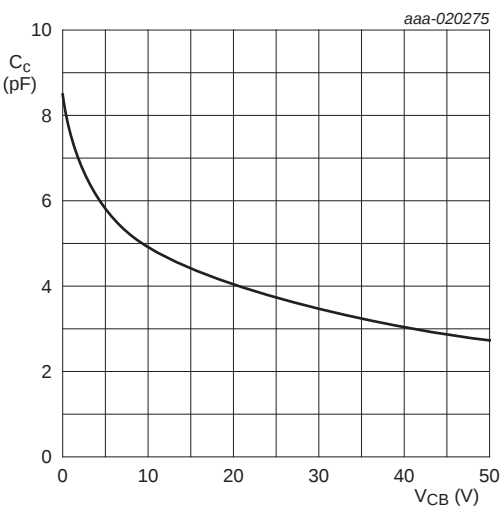
- $V_{CE} = 5$  V
- (1)  $T_{amb} = -40$  °C
  - (2)  $T_{amb} = 25$  °C
  - (3)  $T_{amb} = 100$  °C

Fig 28. PDTD114EQA: Off-state input voltage as a function of collector current; typical values



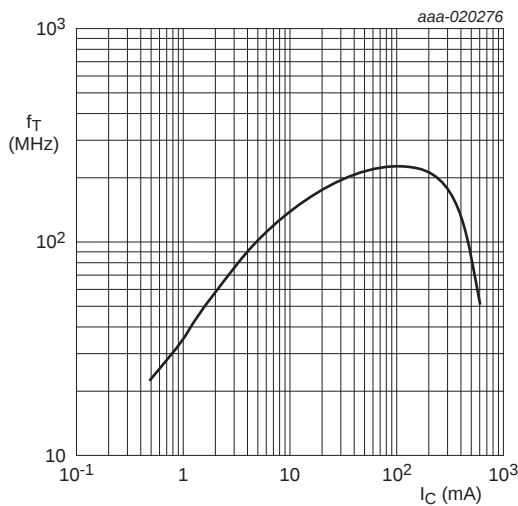
- $I_C/I_B = 20$
- (1)  $T_{amb} = 100\text{ }^{\circ}\text{C}$
  - (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$
  - (3)  $T_{amb} = -40\text{ }^{\circ}\text{C}$

Fig 29. PDTD114EQA: Collector-emitter saturation voltage as a function of collector current; typical values



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

Fig 30. PDTD114EQA: Collector capacitance as a function of collector-base voltage; typical values



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

Fig 31. 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):

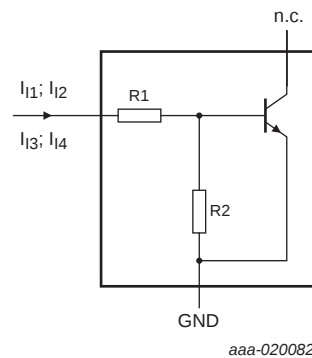
$$R1 = \frac{V(I_{I2}) - V(I_{I1})}{I_{I2} - I_{I1}}$$

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

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

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

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



**Fig 32. Resistor test circuit**

### 8.3 Resistor test conditions

Table 9. Resistor test conditions

| Type number |     | R1         | R2         | Test conditions |                 |                 |                 |
|-------------|-----|------------|------------|-----------------|-----------------|-----------------|-----------------|
|             |     | k $\Omega$ | k $\Omega$ | I <sub>I1</sub> | I <sub>I2</sub> | I <sub>I3</sub> | I <sub>I4</sub> |
| PDTD113EQA  | [1] | 1          | 1          | 1.5 mA          | 1.9 mA          | -2.2 mA         | -               |
| PDTD123EQA  | [1] | 2.2        | 2.2        | 0.7 mA          | 0.8 mA          | -0.75 mA        | -               |
| PDTD143EQA  | [2] | 4.7        | 4.7        | 1.3 mA          | 1.5 mA          | -1.05 mA        | -1.25 mA        |
| PDTD114EQA  | [2] | 10         | 10         | 0.7 mA          | 0.8 mA          | -0.45 mA        | -0.55 mA        |

[1] Uses calculation method A of bias resistor ratio R2/R1

[2] Uses calculation method B of bias resistor ratio R2/R1

## 9. Package outline

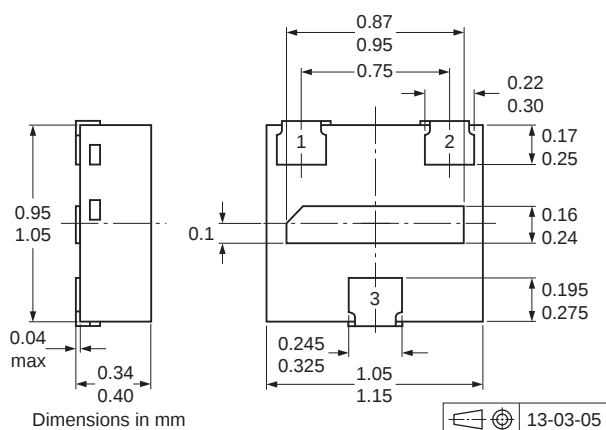


Fig 33. Package outline DFN1010D-3 (SOT1215)



## 11. Revision history

**Table 10.** Revision history

| Document ID                       | Release date | Data sheet status  | Change notice | Supersedes |
|-----------------------------------|--------------|--------------------|---------------|------------|
| PDTD113_123_143_114EQA_SER<br>v.1 | 20160104     | 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".

[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 URL <http://www.nxp.com>.

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