



# PDTC143/114/124/144EQA series

50 V, 100 mA NPN resistor-equipped transistors

Rev. 1 — 30 October 2015

Product data sheet

## 1. Product profile

### 1.1 General description

100 mA 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	Nexperia	PNP complement
PDTC143EQA	4.7 k $\Omega$	4.7 k $\Omega$	DFN1010D-3 (SOT1215)	PDTA143EQA
PDTC114EQA	10 k $\Omega$	10 k $\Omega$		PDTA114EQA
PDTC124EQA	22 k $\Omega$	22 k $\Omega$		PDTA124EQA
PDTC144EQA	47 k $\Omega$	47 k $\Omega$		PDTA144EQA

### 1.2 Features and benefits

- 100 mA output current capability
- Built-in bias resistors
- Simplifies circuit design
- Reduces component count
- Reduced pick and place costs
- Low package height of 0.37 mm
- AEC-Q101 qualified
- Suitable for Automatic Optical Inspection (AOI) of solder joint

### 1.3 Applications

- Digital applications
- Cost saving alternative for BC847/BC857 series in digital applications
- Controlling IC inputs
- Switching loads

### 1.4 Quick reference data

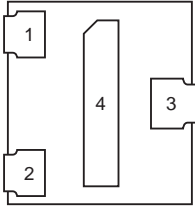
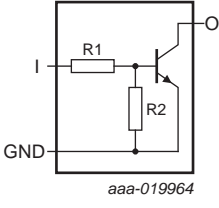
Table 2. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>CEO</sub>	collector-emitter voltage	open base	-	-	50	V
I <sub>O</sub>	output current		-	-	100	mA

nexperia

## 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
PDTC143EQA	DFN1010D-3	plastic thermal enhanced ultra thin small outline package; no leads; 3 terminals; body: 1.1 × 1.0 × 0.37 mm	SOT1215
PDTC114EQA			
PDTC124EQA			
PDTC144EQA			

## 4. Marking

Table 5. Marking codes

Type number	Marking code
PDTC143EQA	10 10 01
PDTC114EQA	11 01 10
PDTC124EQA	10 11 01
PDTC144EQA	10 01 10

### 4.1 Binary marking code description

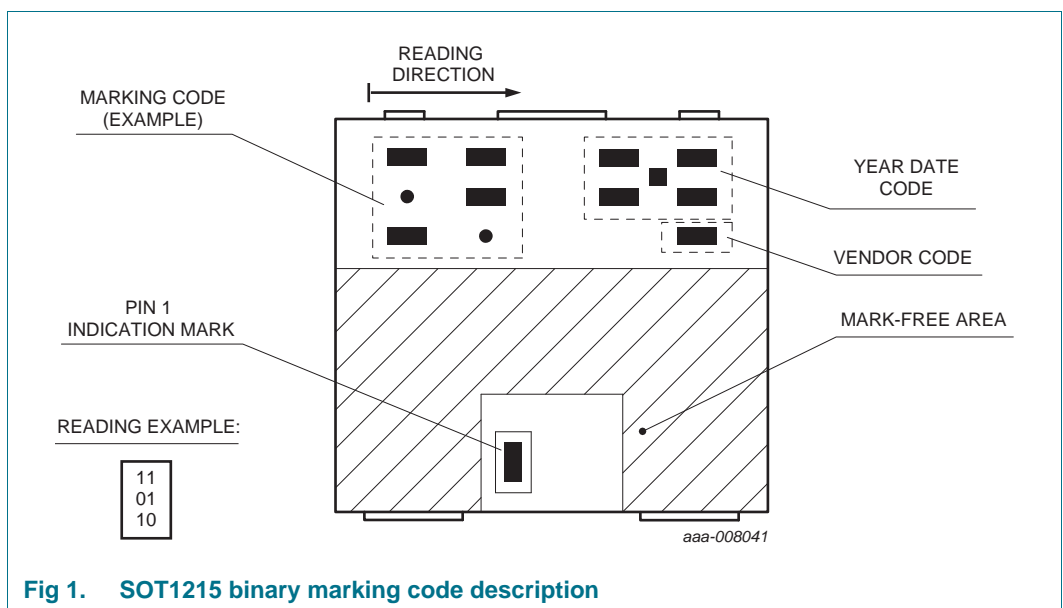


Fig 1. SOT1215 binary marking code description

**5. Limiting values**

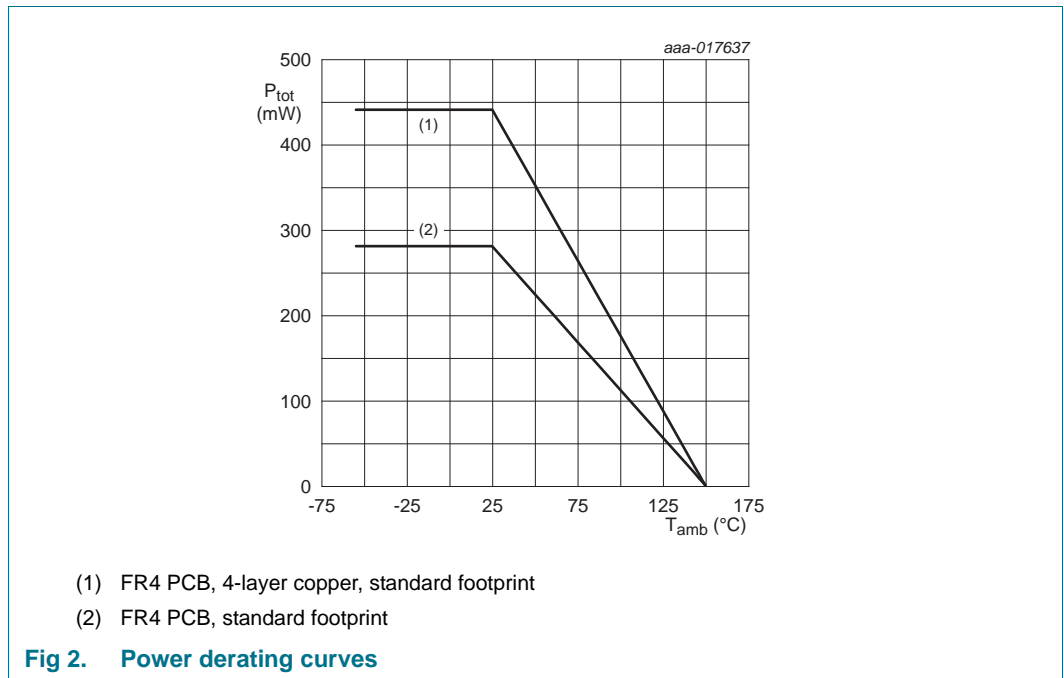
**Table 6. Limiting values**

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		-	10	V
$V_I$	input voltage				
	PDTC143EQA		-10	+30	V
	PDTC114EQA		-10	+40	V
	PDTC124EQA		-10	+40	V
$I_O$	output current				
			-	100	mA
$P_{tot}$	total power dissipation	$T_{amb} \leq 25\text{ °C}$	[1]	280	mW
			[2]	440	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 copper, tin-plated and standard footprint.

[2] Device mounted on an FR4 PCB, 4-layer copper, tin-plated and standard footprint.



## 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]	-	446	K/W
			[2]	-	284	K/W

- [1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, 4-layer copper, tin-plated and standard footprint.

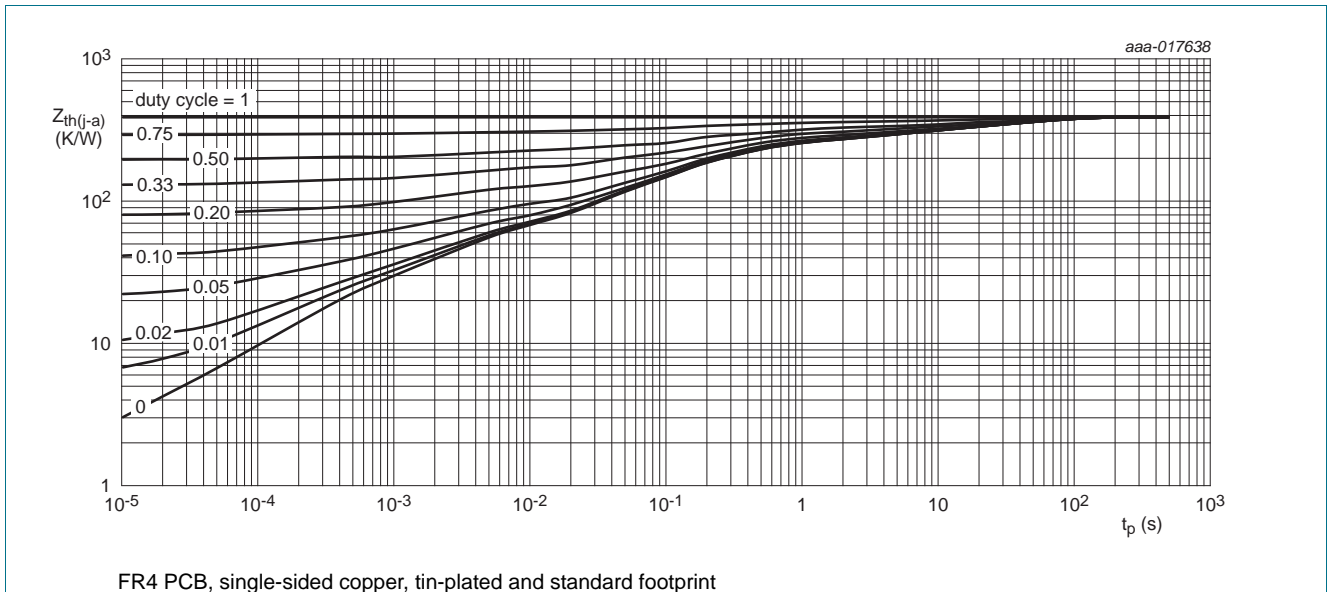


Fig 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

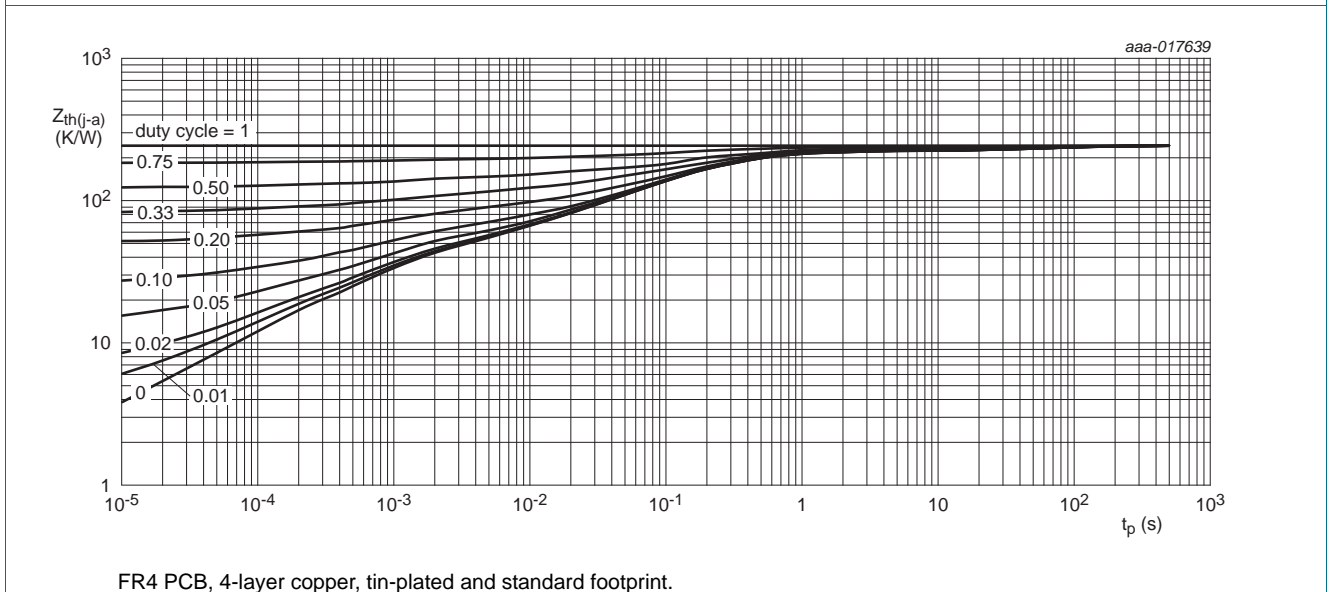


Fig 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

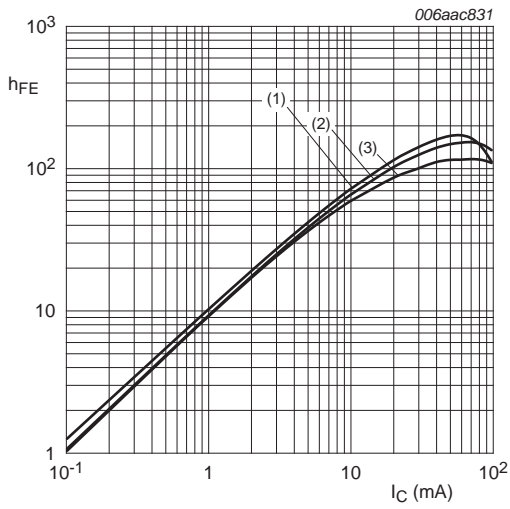
## 7. Characteristics

**Table 8. Characteristics**
 $T_{amb} = 25\text{ °C}$  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	$V_{CE} = 30\text{ V}; I_B = 0\text{ A}$	-	-	1	$\mu\text{A}$
		$V_{CE} = 30\text{ V}; I_B = 0\text{ A}; T_j = 150\text{ °C}$	-	-	5	$\mu\text{A}$
$I_{EBO}$	emitter-base cut-off current					
	PDTC143EQA	$V_{EB} = 5\text{ V}; I_C = 0\text{ A}$	-	-	900	$\mu\text{A}$
	PDTC114EQA		-	-	400	$\mu\text{A}$
	PDTC124EQA		-	-	180	$\mu\text{A}$
	PDTC144EQA		-	-	90	$\mu\text{A}$
$h_{FE}$	DC current gain					
	PDTC143EQA	$V_{CE} = 5\text{ V}; I_C = 10\text{ mA}$	30	-	-	
	PDTC114EQA	$V_{CE} = 5\text{ V}; I_C = 5\text{ mA}$	30	-	-	
	PDTC124EQA		60	-	-	
	PDTC144EQA		80	-	-	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 10\text{ mA}; I_B = 0.5\text{ mA}$	-	-	150	mV
$V_{I(off)}$	off-state input voltage					
	PDTC143EQA	$V_{CE} = 5\text{ V}; I_C = 100\text{ }\mu\text{A}$	-	1.1	0.5	V
	PDTC114EQA		-	1.1	0.8	V
	PDTC124EQA		-	1.1	0.8	V
	PDTC144EQA		-	1.2	0.8	V
$V_{I(on)}$	on-state input voltage					
	PDTC143EQA	$V_{CE} = 0.3\text{ V}; I_C = 20\text{ mA}$	2.5	1.9	-	V
	PDTC114EQA	$V_{CE} = 0.3\text{ V}; I_C = 10\text{ mA}$	2.5	1.8	-	V
	PDTC124EQA	$V_{CE} = 0.3\text{ V}; I_C = 5\text{ mA}$	2.5	1.7	-	V
	PDTC144EQA	$V_{CE} = 0.3\text{ V}; I_C = 2\text{ mA}$	3	1.6	-	V
R1	bias resistor 1 (input) <a href="#">[1]</a>					
	PDTC143EQA		3.3	4.7	6.1	k $\Omega$
	PDTC114EQA		7	10	13	k $\Omega$
	PDTC124EQA		15.4	22	28.6	k $\Omega$
	PDTC144EQA		33	47	61	k $\Omega$
R2/R1	bias resistor ratio <a href="#">[1]</a>					
			0.8	1	1.2	
$C_c$	collector capacitance	$V_{CB} = 10\text{ V}; I_E = I_e = 0\text{ A}; f = 1\text{ MHz}$	-	-	2.5	pF
$f_T$	transition frequency	$V_{CE} = 5\text{ V}; I_C = 10\text{ mA}; f = 100\text{ MHz}$	<a href="#">[2]</a>	230	-	MHz

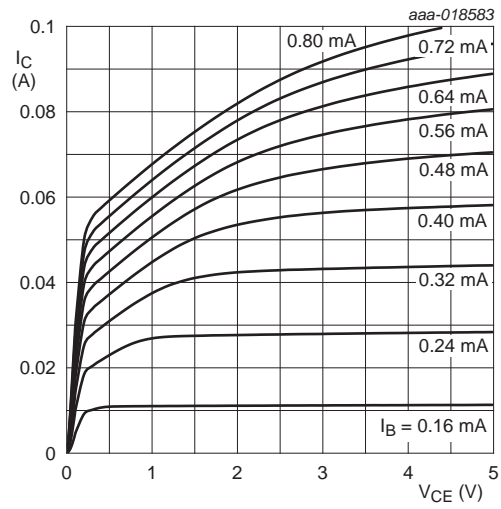
[1] See [Section 8 "Test information"](#) for resistor calculation and test conditions.

[2] Characteristics of built-in transistor.



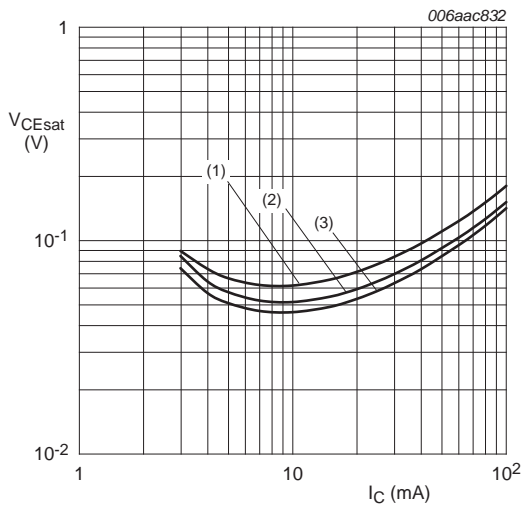
$V_{CE} = 5 \text{ V}$   
 (1)  $T_{amb} = 100 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -40 \text{ }^\circ\text{C}$

**Fig 5. PDTC143EQA: DC current gain as a function of collector current; typical values**



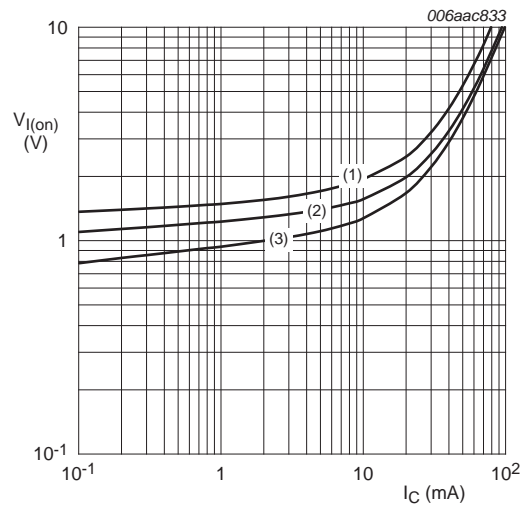
$T_{amb} = 25 \text{ }^\circ\text{C}$

**Fig 6. PDTC143EQA: Collector current as a function of collector-emitter voltage; typical values**



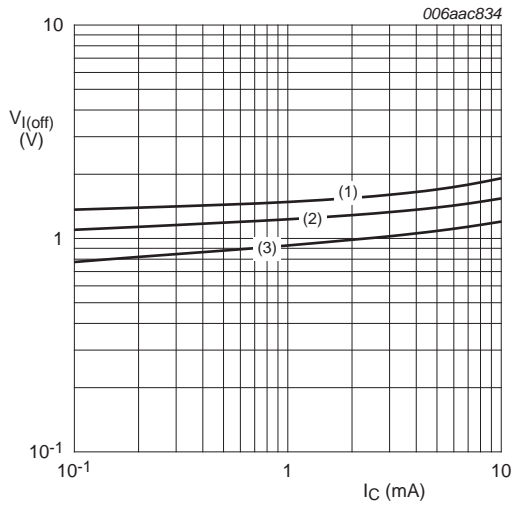
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -40 \text{ }^\circ\text{C}$

**Fig 7. PDTC143EQA: Collector-emitter saturation voltage as a function of collector current; typical values**



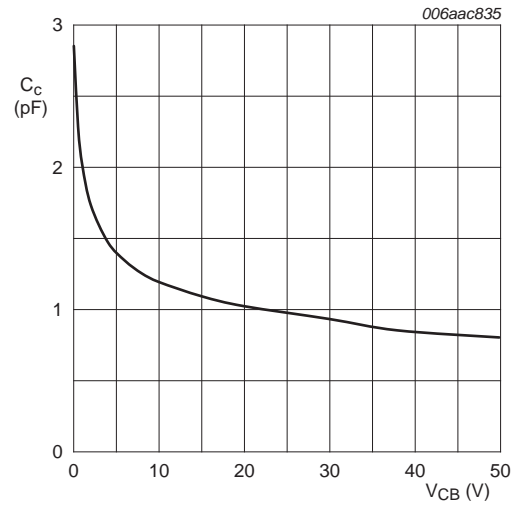
$V_{CE} = 0.3 \text{ V}$   
 (1)  $T_{amb} = -40 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100 \text{ }^\circ\text{C}$

**Fig 8. PDTC143EQA: 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)  $T_{amb} = 100\text{ °C}$

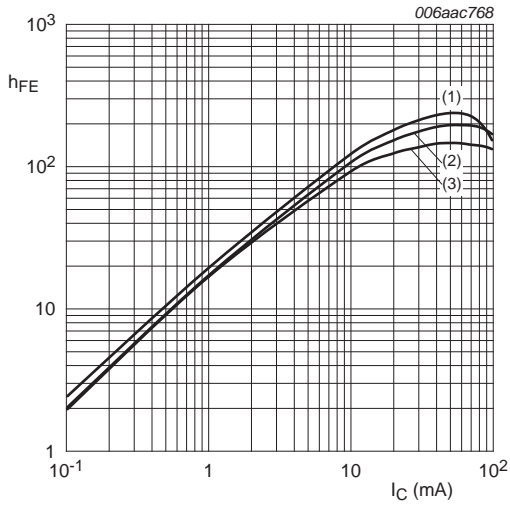
**Fig 9. PDTC143EQA: Off-state input voltage as a function of collector current; typical values**



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

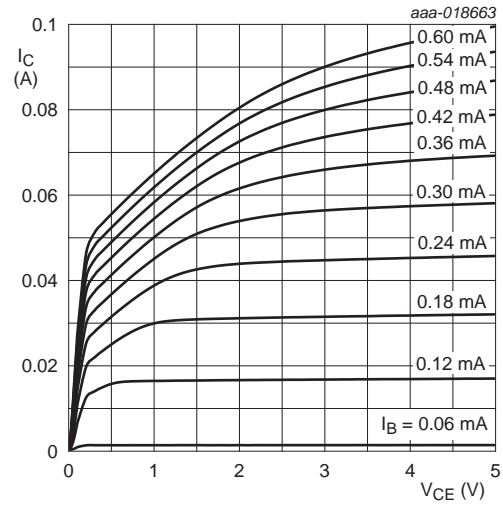
**Fig 10. PDTC143EQA: Collector capacitance as a function of collector-base voltage; typical values**





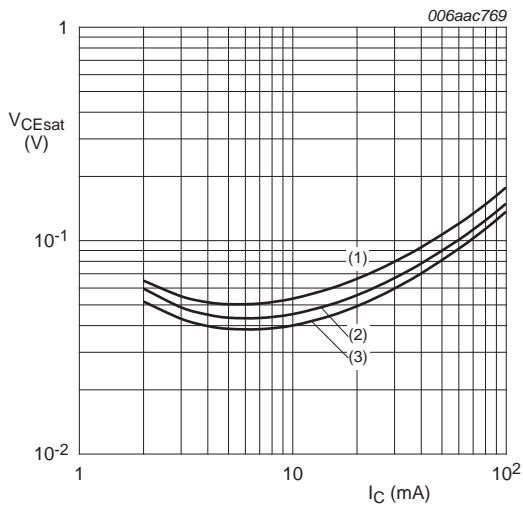
$V_{CE} = 5 \text{ V}$   
 (1)  $T_{amb} = 100 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -40 \text{ }^\circ\text{C}$

**Fig 11. PDTC114EQA: DC current gain as a function of collector current; typical values**



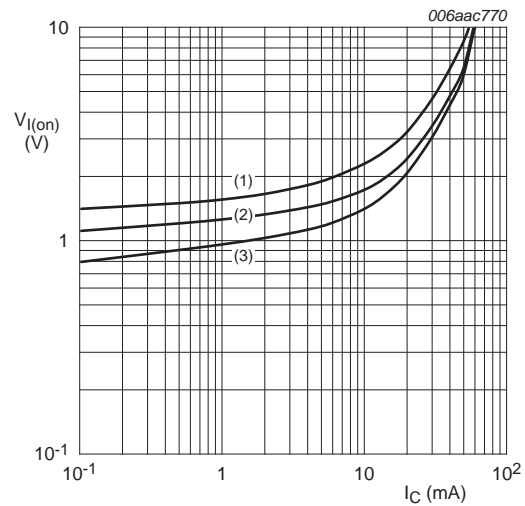
$T_{amb} = 25 \text{ }^\circ\text{C}$

**Fig 12. PDTC114EQA: Collector current as a function of collector-emitter voltage; typical values**



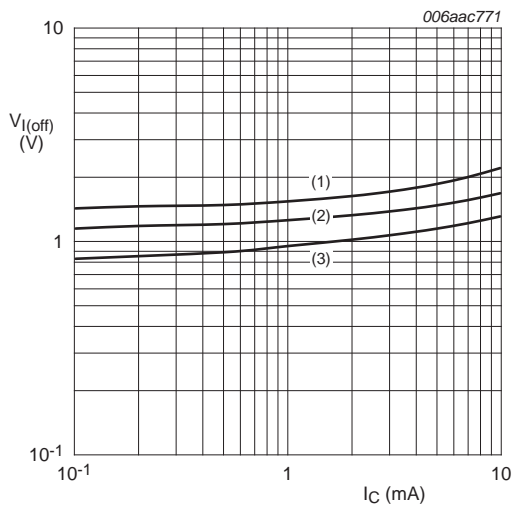
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -40 \text{ }^\circ\text{C}$

**Fig 13. PDTC114EQA: Collector-emitter saturation voltage as a function of collector current; typical values**



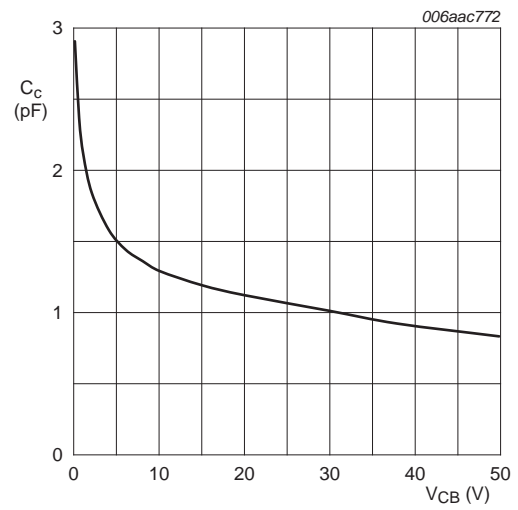
$V_{CE} = 0.3 \text{ V}$   
 (1)  $T_{amb} = -40 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100 \text{ }^\circ\text{C}$

**Fig 14. PDTC114EQA: On-state input voltage as a function of collector current; typical values**



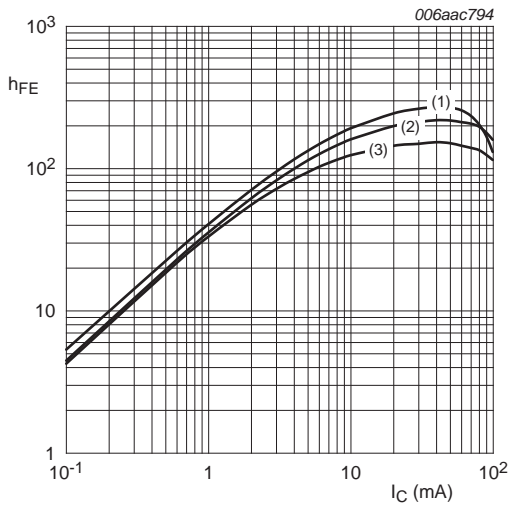
- $V_{CE} = 5\text{ V}$
- (1)  $T_{amb} = -40\text{ °C}$
  - (2)  $T_{amb} = 25\text{ °C}$
  - (3)  $T_{amb} = 100\text{ °C}$

**Fig 15. PDTC114EQA: Off-state input voltage as a function of collector current; typical values**



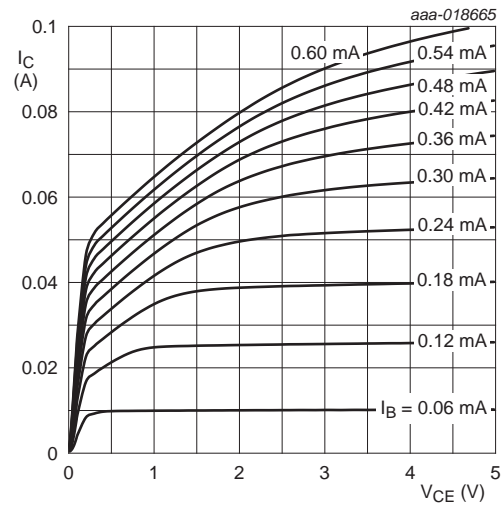
$f = 1\text{ MHz}; T_{amb} = 25\text{ °C}$

**Fig 16. PDTC114EQA: Collector capacitance as a function of collector-base voltage; typical values**



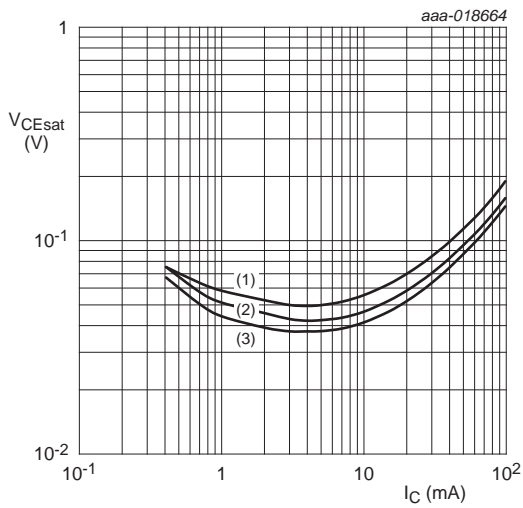
$V_{CE} = 5 \text{ V}$   
 (1)  $T_{amb} = 100 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -40 \text{ }^\circ\text{C}$

**Fig 17. PDTC124EQA: DC current gain as a function of collector current; typical values**



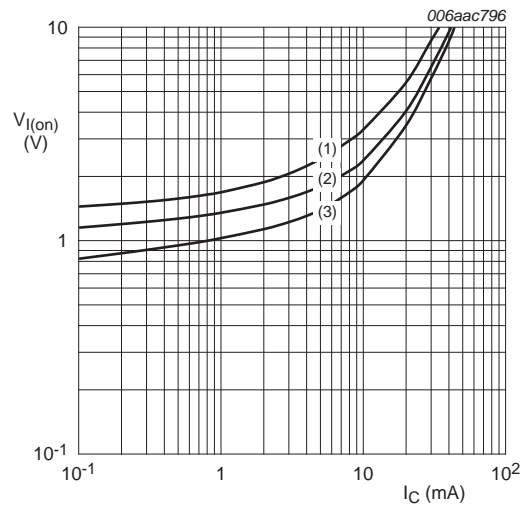
$T_{amb} = 25 \text{ }^\circ\text{C}$

**Fig 18. PDTC124EQA: Collector current as a function of collector-emitter voltage; typical values**



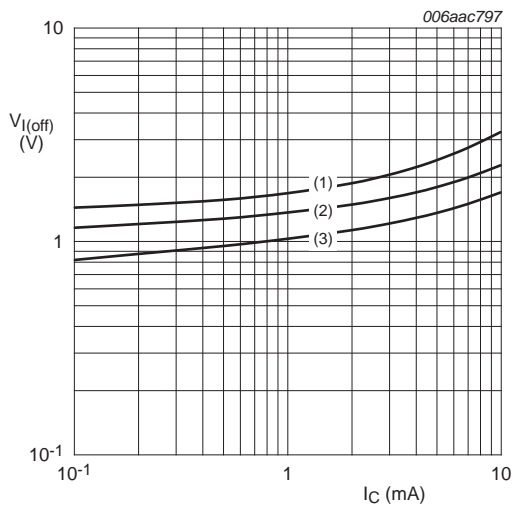
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -40 \text{ }^\circ\text{C}$

**Fig 19. PDTC124EQA: Collector-emitter saturation voltage as a function of collector current; typical values**



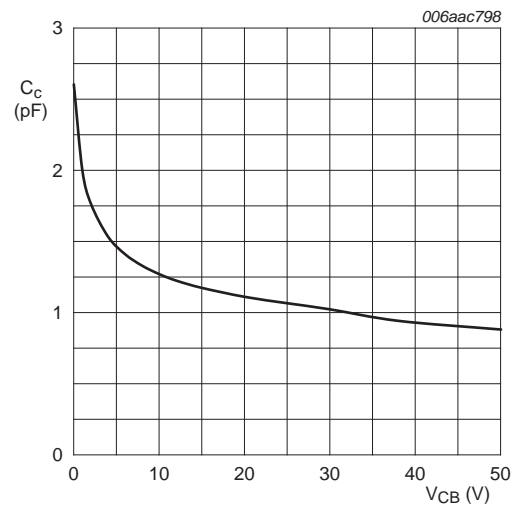
$V_{CE} = 0.3 \text{ V}$   
 (1)  $T_{amb} = -40 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100 \text{ }^\circ\text{C}$

**Fig 20. PDTC124EQA: On-state input voltage as a function of collector current; typical values**



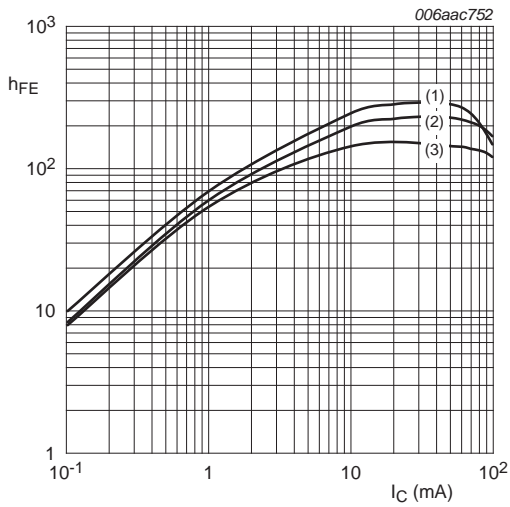
- $V_{CE} = 5\text{ V}$
- (1)  $T_{amb} = -40\text{ °C}$
  - (2)  $T_{amb} = 25\text{ °C}$
  - (3)  $T_{amb} = 100\text{ °C}$

**Fig 21. PDTC124EQA: Off-state input voltage as a function of collector current; typical values**



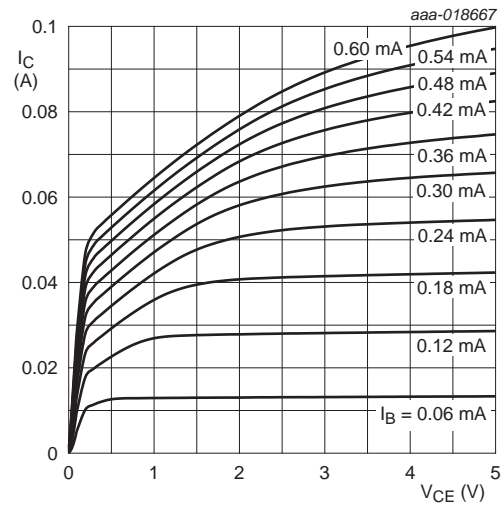
$f = 1\text{ MHz}; T_{amb} = 25\text{ °C}$

**Fig 22. PDTC124EQA: Collector capacitance as a function of collector-base voltage; typical values**



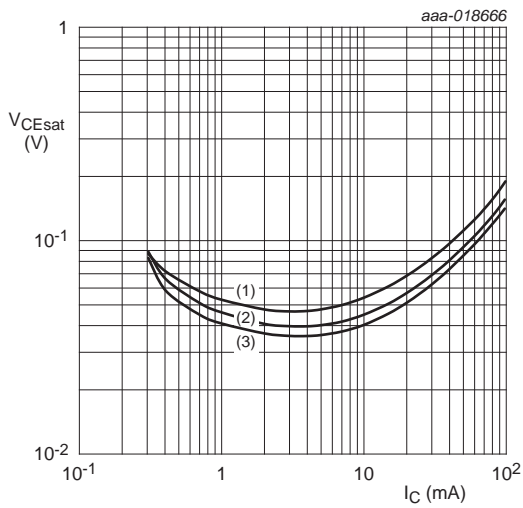
$V_{CE} = 5 \text{ V}$   
 (1)  $T_{amb} = 100 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -40 \text{ }^\circ\text{C}$

**Fig 23. PDTC144EQA: DC current gain as a function of collector current; typical values**



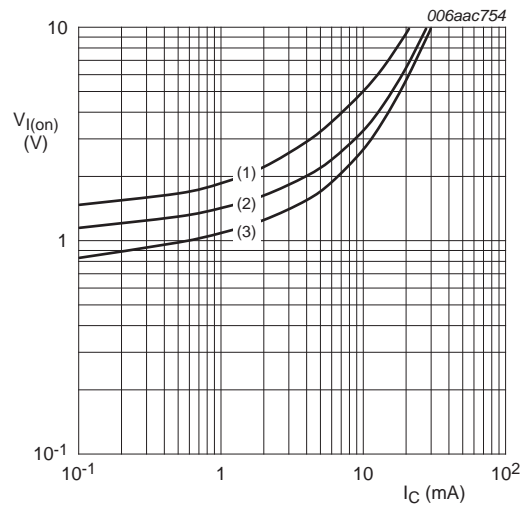
$T_{amb} = 25 \text{ }^\circ\text{C}$

**Fig 24. PDTC144EQA: Collector current as a function of collector-emitter voltage; typical values**



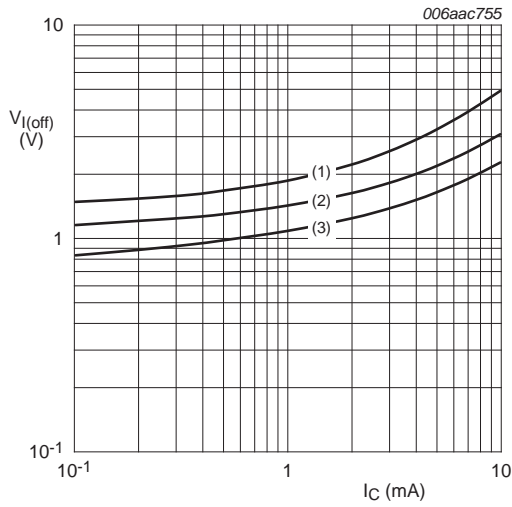
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -40 \text{ }^\circ\text{C}$

**Fig 25. PDTC144EQA: Collector-emitter saturation voltage as a function of collector current; typical values**



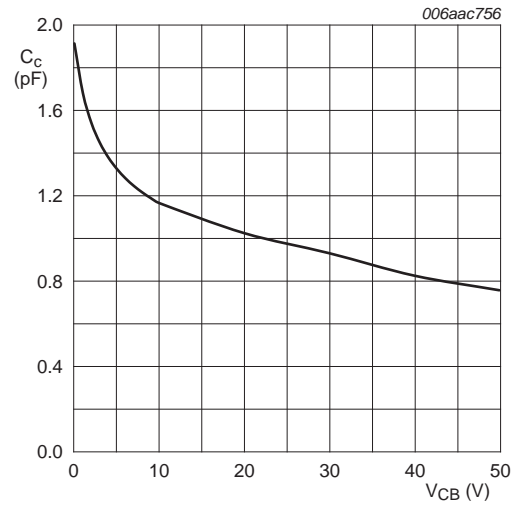
$V_{CE} = 0.3 \text{ V}$   
 (1)  $T_{amb} = -40 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100 \text{ }^\circ\text{C}$

**Fig 26. PDTC144EQA: On-state input voltage as a function of collector current; typical values**



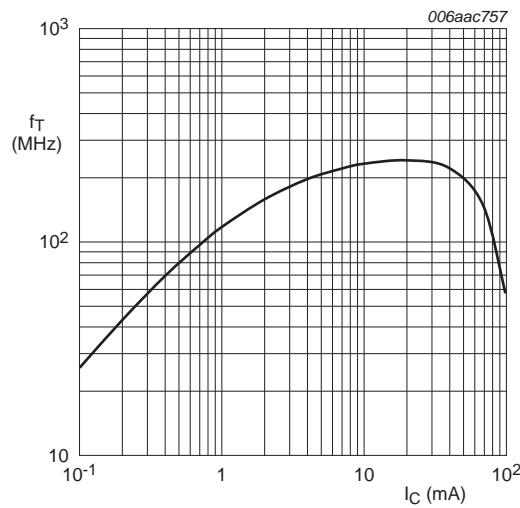
$V_{CE} = 5\text{ V}$   
 (1)  $T_{amb} = -40\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 100\text{ °C}$

**Fig 27. PDTC144EQA: Off-state input voltage as a function of collector current; typical values**



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

**Fig 28. PDTC144EQA: Collector capacitance as a function of collector-base voltage; typical values**



$V_{CE} = 5\text{ V}; T_{amb} = 25\text{ °C}$

**Fig 29. 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):

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

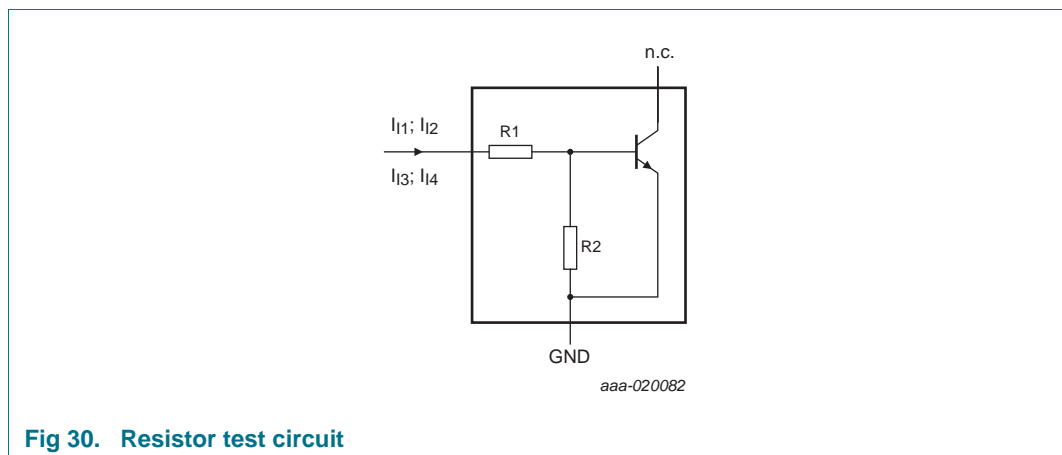


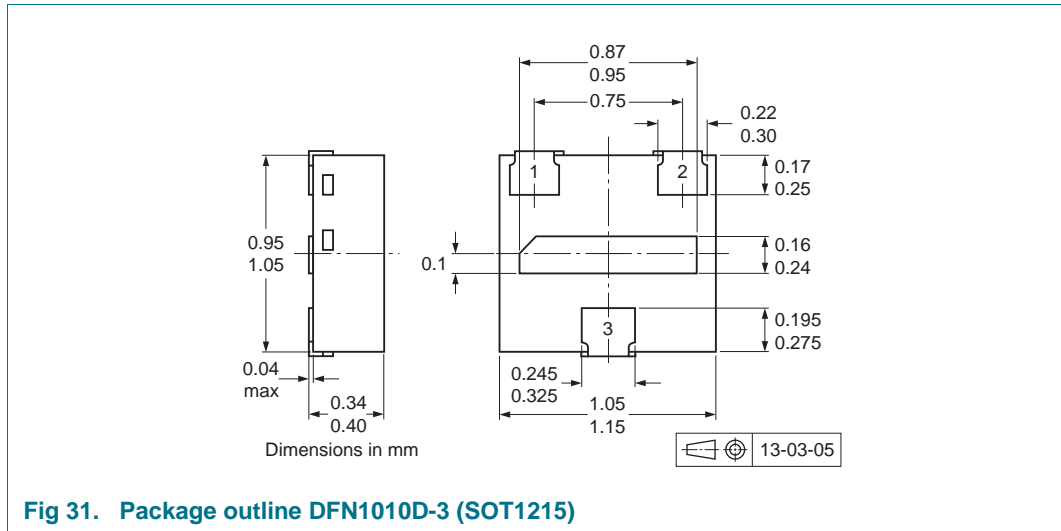
Fig 30. Resistor test circuit

### 8.3 Resistor test conditions

Table 9. Resistor test conditions

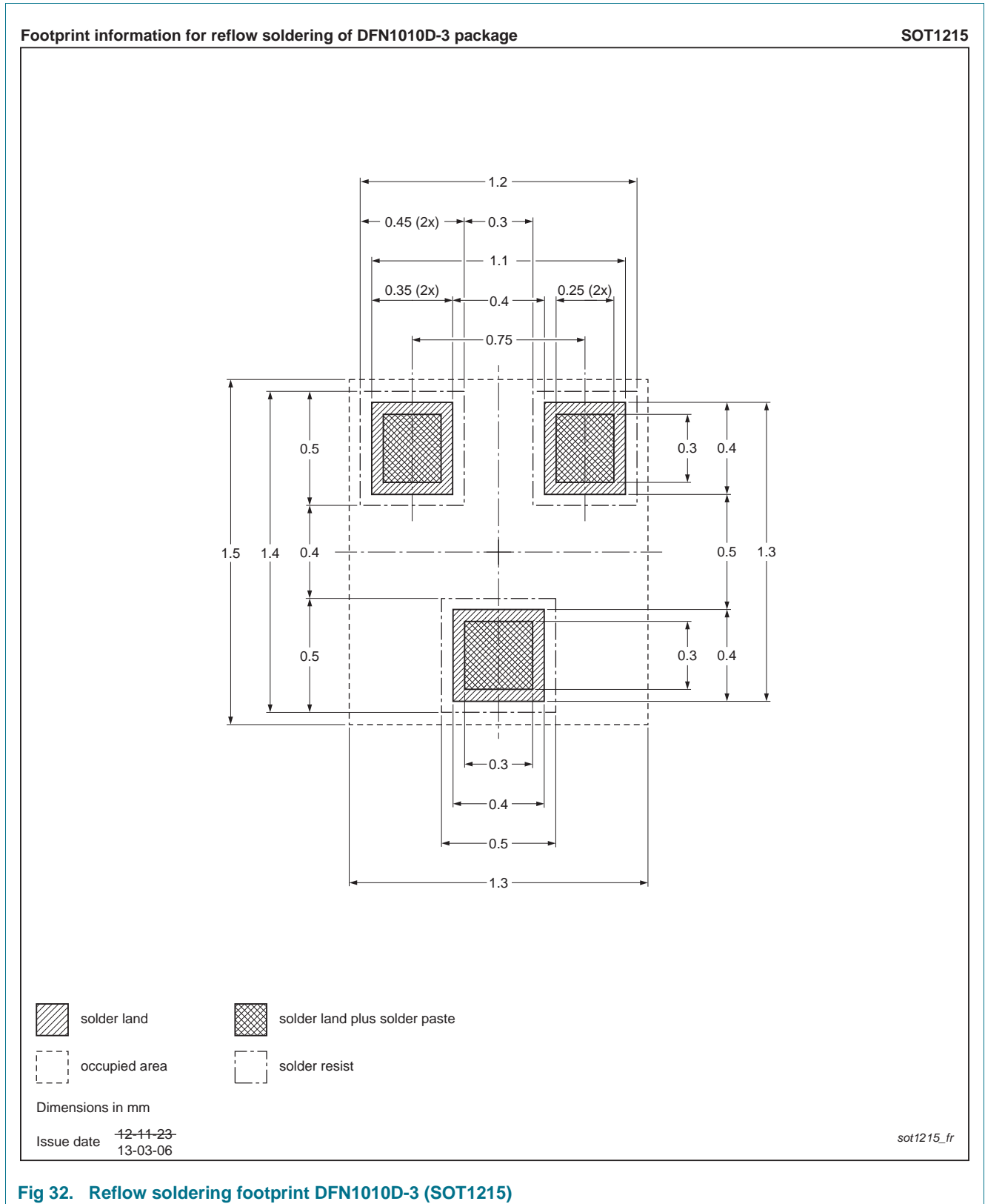
Type number	R1 (kΩ)	R2 (kΩ)	Test conditions			
			I <sub>I1</sub>	I <sub>I2</sub>	I <sub>I3</sub>	I <sub>I4</sub>
PDTC143EQA	4.7	4.7	600 μA	700 μA	-600 μA	-700 μA
PDTC114EQA	10	10	350 μA	450 μA	-350 μA	-450 μA
PDTC124EQA	22	22	150 μA	230 μA	-150 μA	-230 μA
PDTC144EQA	47	47	55 μA	105 μA	-55 μA	-105 μA

## 9. Package outline





## 10. Soldering



**Fig 32. Reflow soldering footprint DFN1010D-3 (SOT1215)**

## 11. Revision history

**Table 10. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
PDTC143_114_124_144EQA_SER v.1	20151030	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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## 13. Contact information

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For more information, please visit: <http://www.nexperia.com>

For sales office addresses, please send an email to: [salesaddresses@nexperia.com](mailto:salesaddresses@nexperia.com)

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