

## Important notice

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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 (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

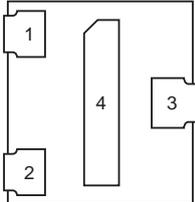
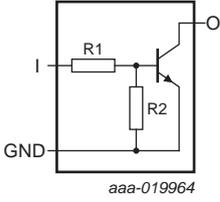
Table 2. Quick reference data

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

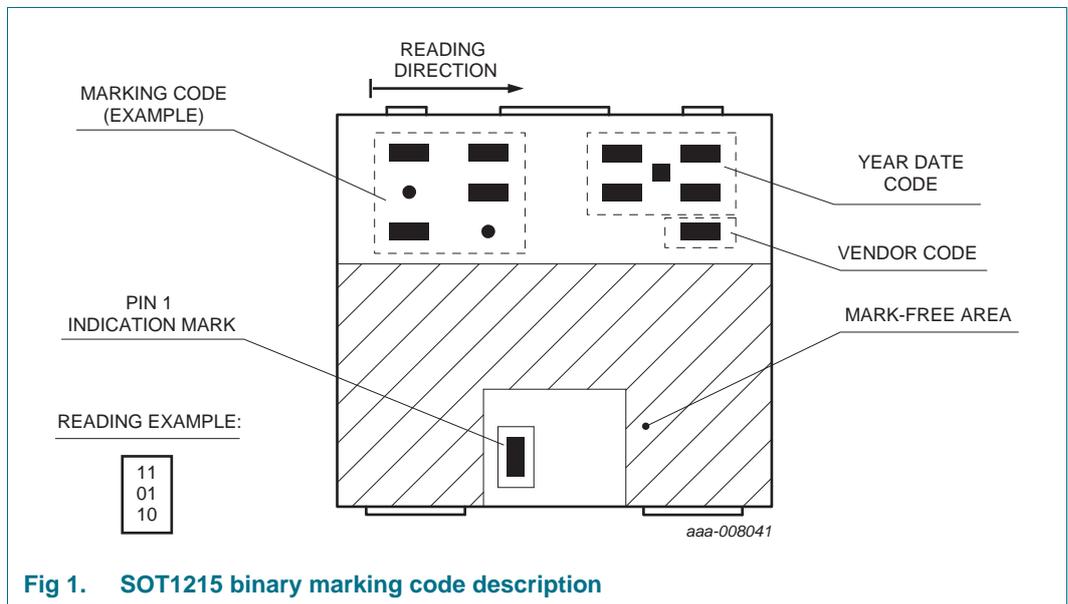
Type number	Package		
	Name	Description	Version
PDTD113EQA	DFN1010D-3	plastic thermal enhanced ultra thin small outline package; no leads; 3 terminals; body: 1.1 × 1.0 × 0.37 mm	SOT1215
PDTD123EQA			
PDTD143EQA			
PDTD114EQA			

## 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**

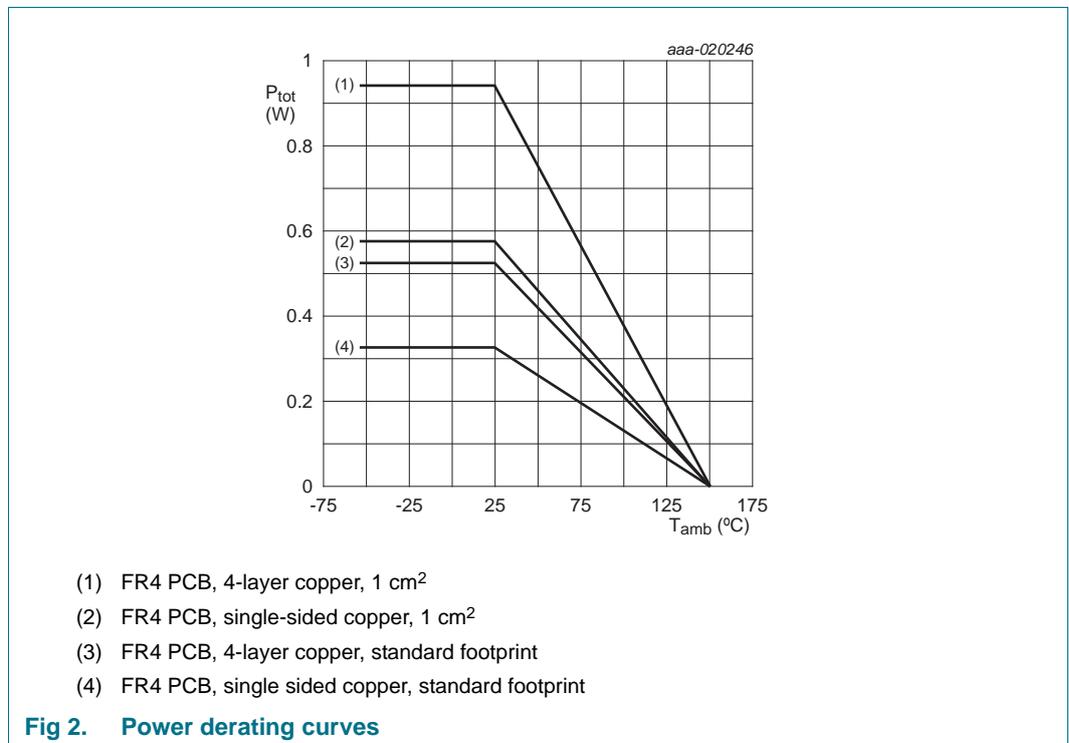
*In accordance with the Absolute Maximum Rating System (IEC 60134).*

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	[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>.

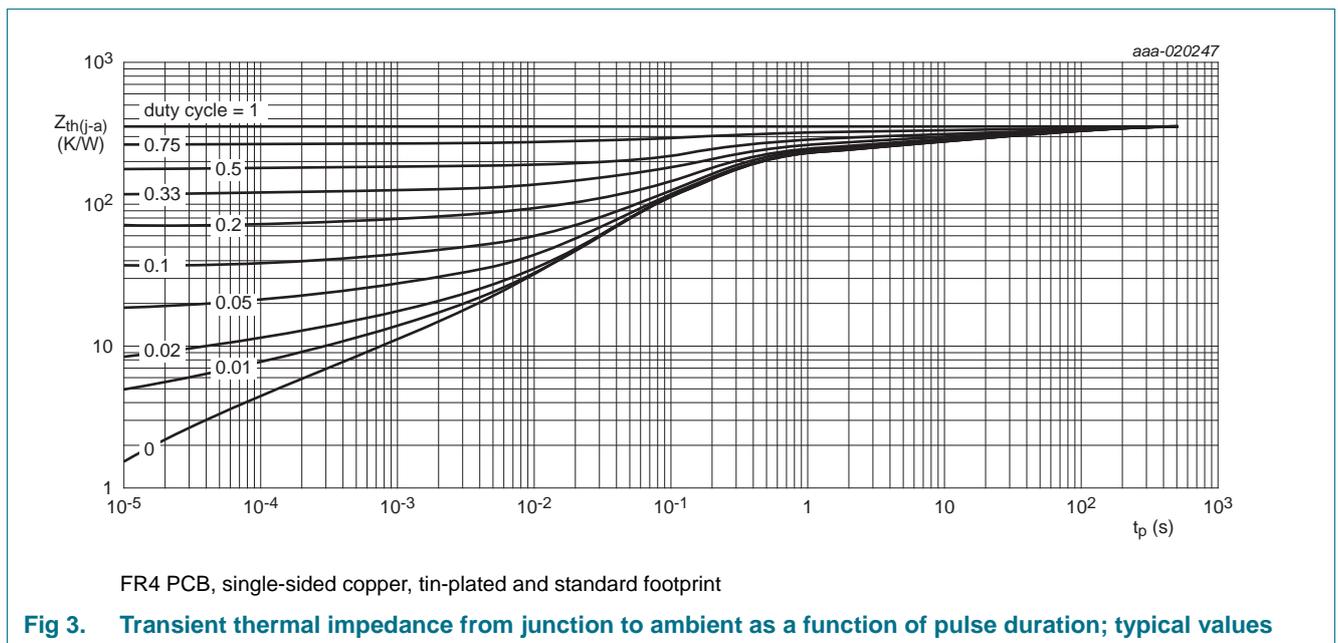


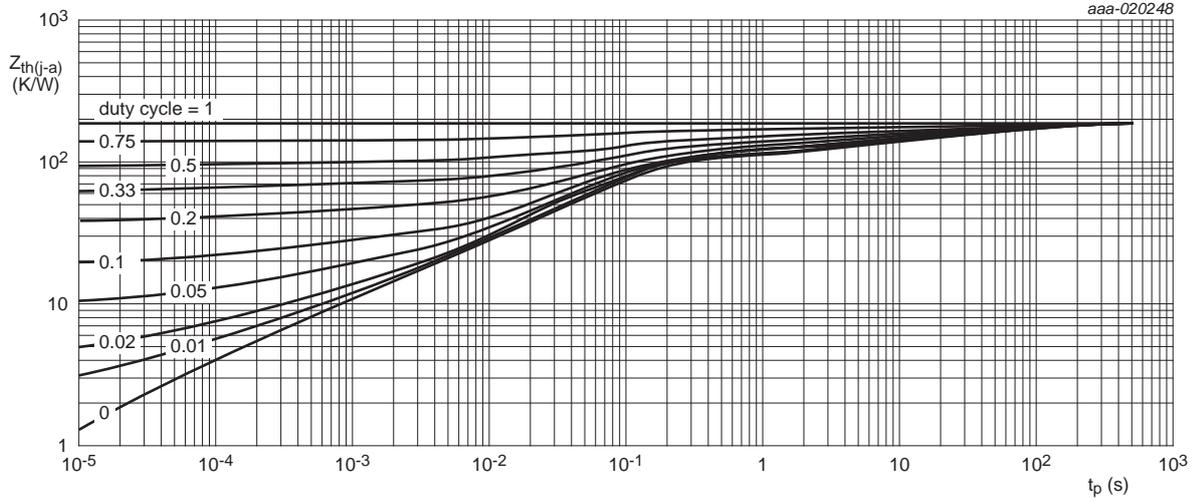
## 6. Thermal characteristics

**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	

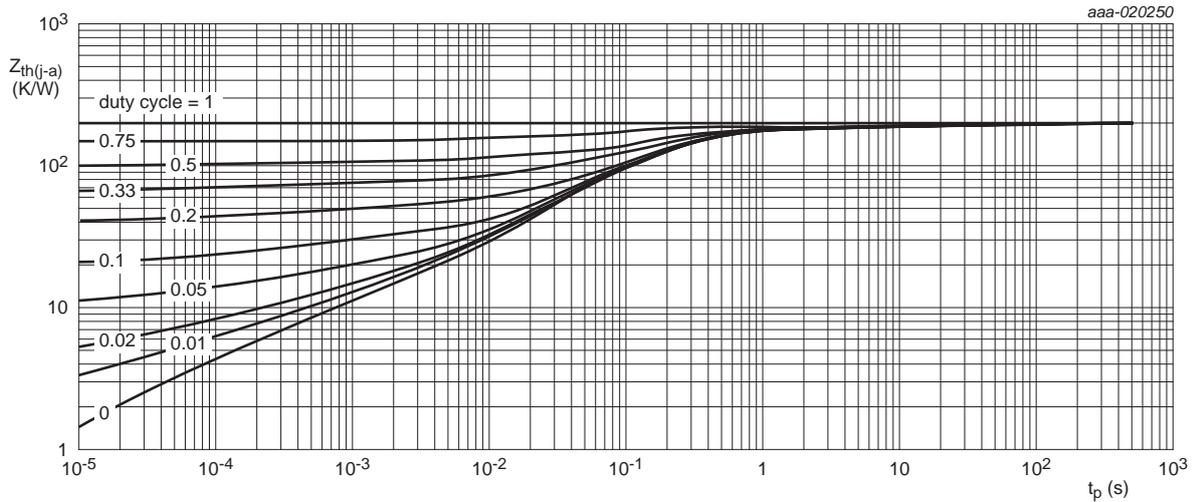
- [1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated; mounting pad for collector 1 cm<sup>2</sup>.
- [3] Device mounted on an FR4 PCB, 4-layer copper, tin-plated and standard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





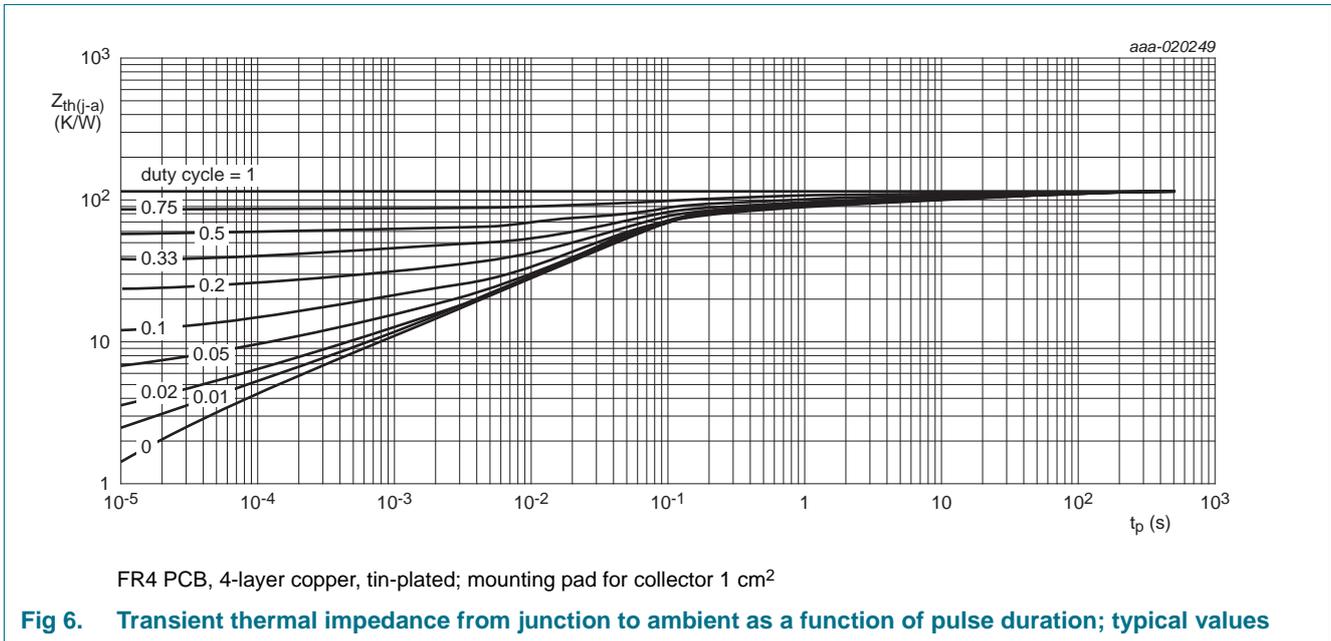
FR4 PCB, single-sided copper, tin-plated, mounting pad for collector  $1\text{ cm}^2$

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



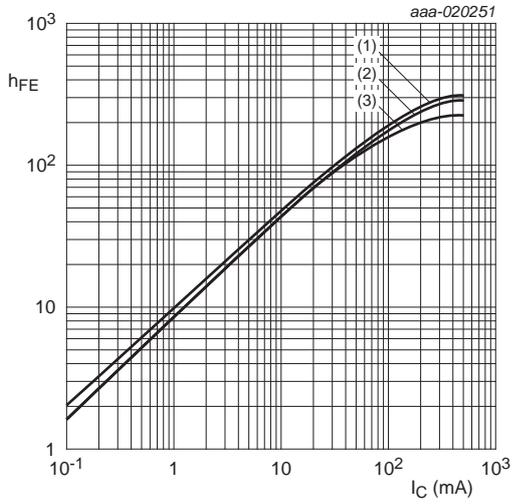
## 7. Characteristics

**Table 8. Characteristics**
*T<sub>amb</sub> = 25 °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>	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

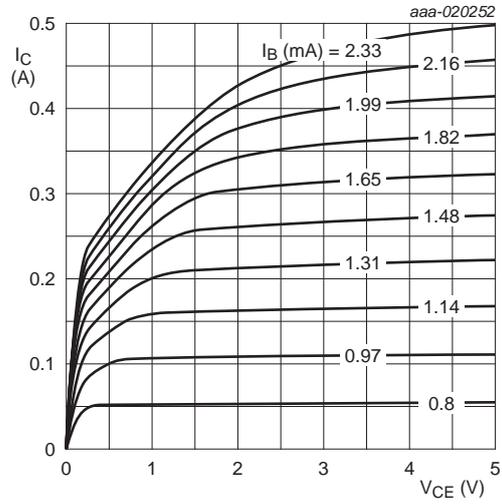
[1] See section test information for resistor calculation and test conditions.

[2] Characteristics of built-in transistor.



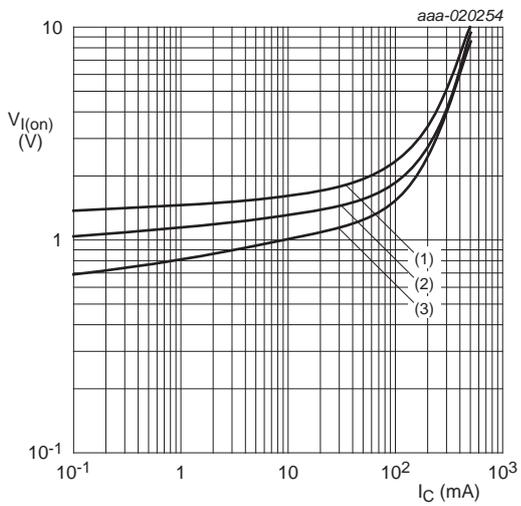
$V_{CE} = 5\text{ V}$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -40\text{ °C}$

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



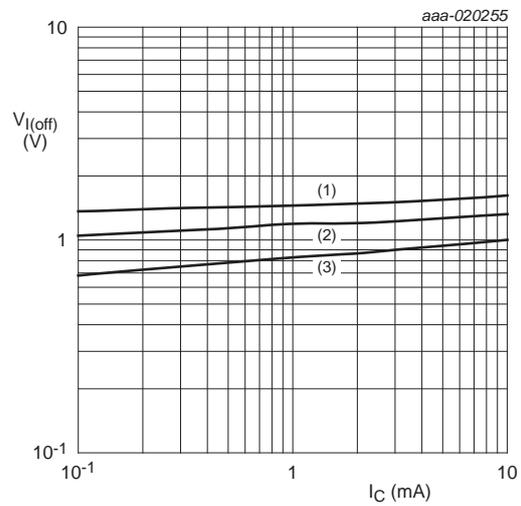
$T_{amb} = 25\text{ °C}$

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



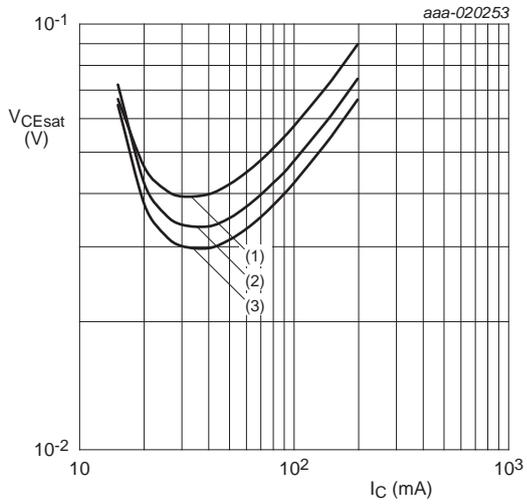
$V_{CE} = 0.3\text{ V}$   
 (1)  $T_{amb} = -40\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 100\text{ °C}$

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



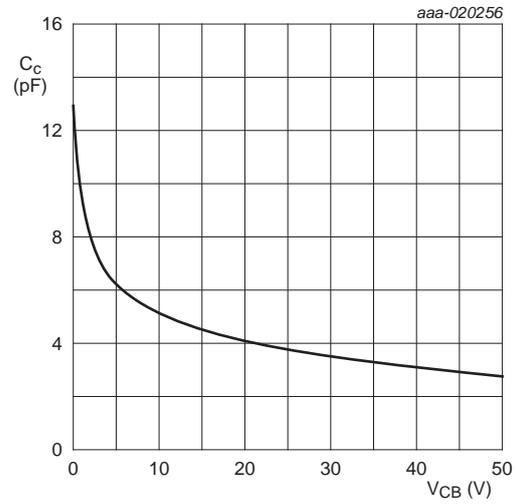
$V_{CE} = 5\text{ V}$   
 (1)  $T_{amb} = -40\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 100\text{ °C}$

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



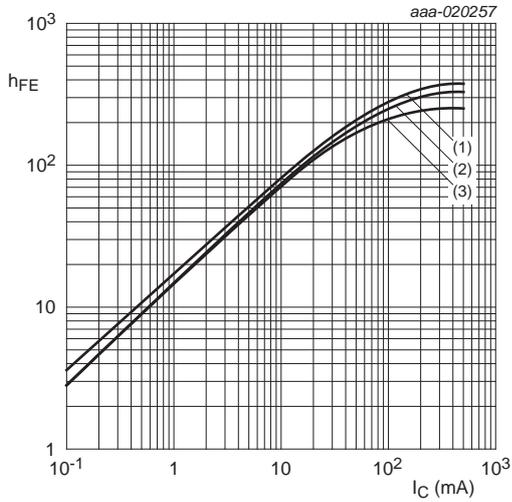
- $I_C/I_B = 20$
- (1)  $T_{amb} = 100\text{ }^\circ\text{C}$
  - (2)  $T_{amb} = 25\text{ }^\circ\text{C}$
  - (3)  $T_{amb} = -40\text{ }^\circ\text{C}$

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



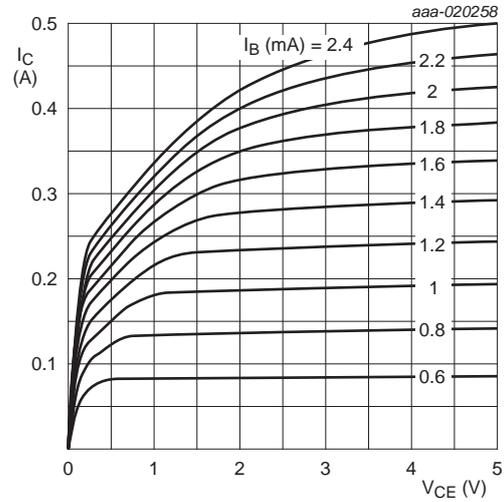
$f = 1\text{ MHz}; T_{amb} = 25\text{ }^\circ\text{C}$

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



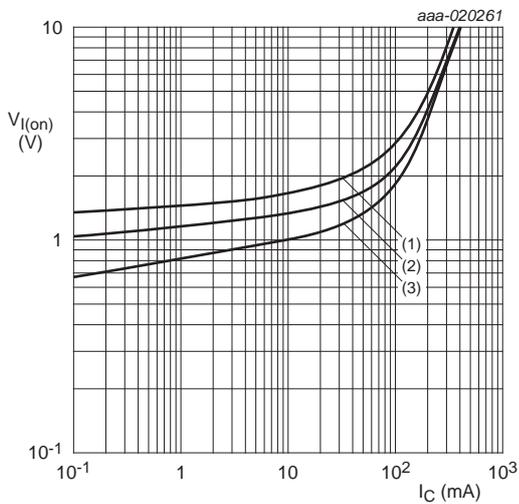
$V_{CE} = 5 \text{ V}$   
 (1)  $T_{amb} = 100 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -40 \text{ }^\circ\text{C}$

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



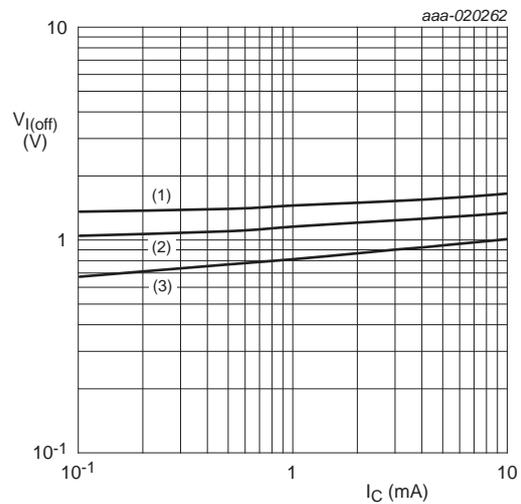
$T_{amb} = 25 \text{ }^\circ\text{C}$

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



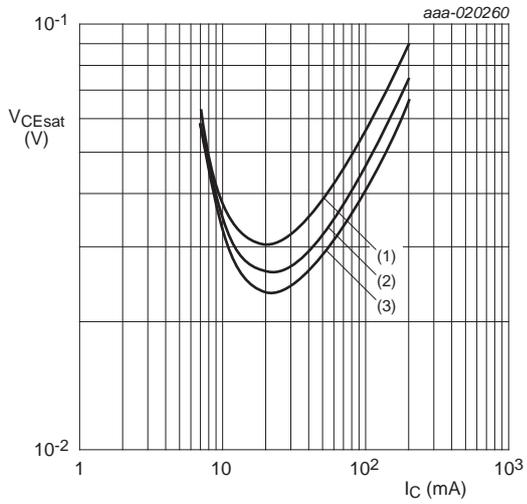
$V_{CE} = 0.3 \text{ V}$   
 (1)  $T_{amb} = -40 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100 \text{ }^\circ\text{C}$

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



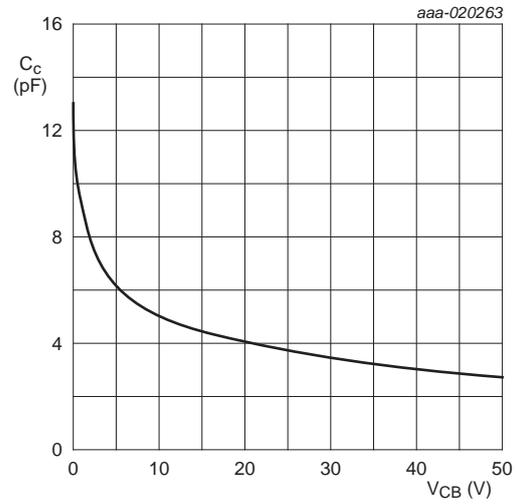
$V_{CE} = 5 \text{ V}$   
 (1)  $T_{amb} = -40 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100 \text{ }^\circ\text{C}$

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



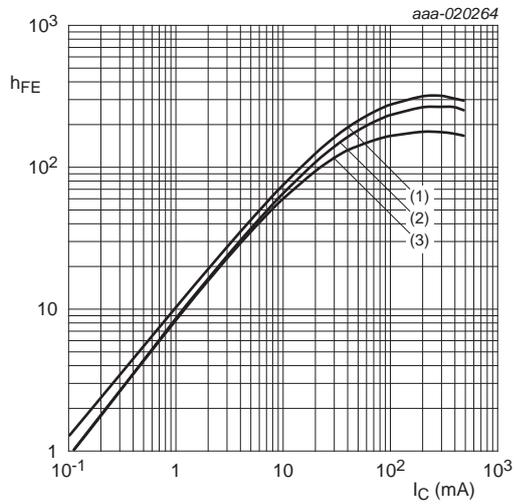
- $I_C/I_B = 20$
- (1)  $T_{amb} = 100\text{ }^\circ\text{C}$
  - (2)  $T_{amb} = 25\text{ }^\circ\text{C}$
  - (3)  $T_{amb} = -40\text{ }^\circ\text{C}$

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



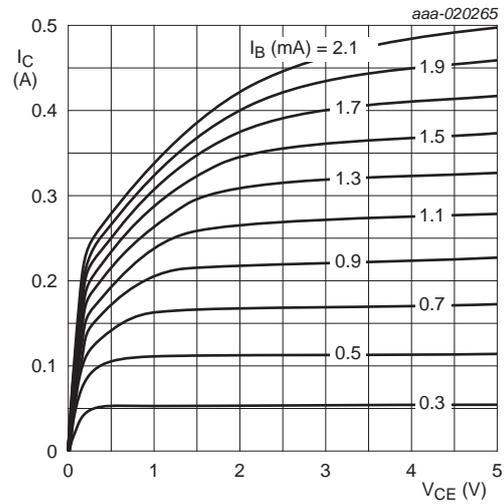
$f = 1\text{ MHz}; T_{amb} = 25\text{ }^\circ\text{C}$

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



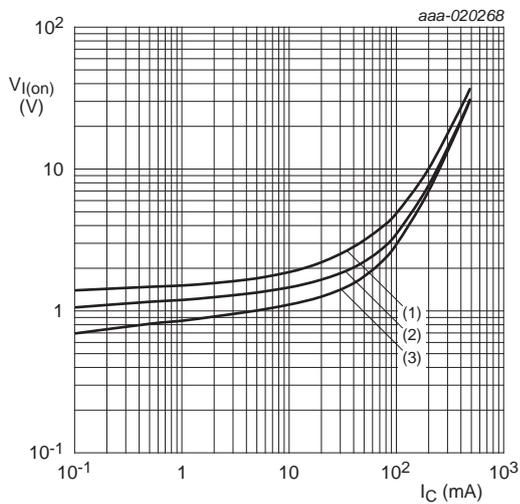
$V_{CE} = 5\text{ V}$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -40\text{ °C}$

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



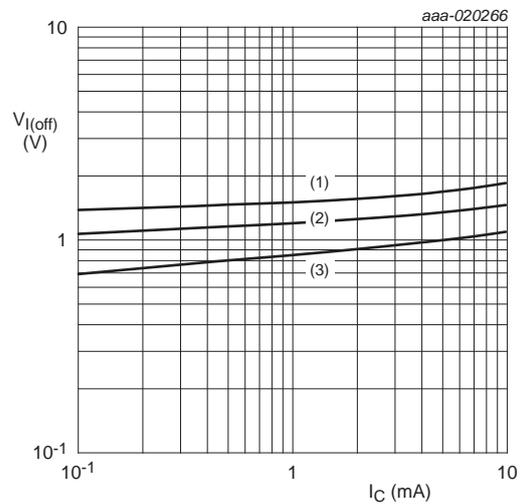
$T_{amb} = 25\text{ °C}$

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



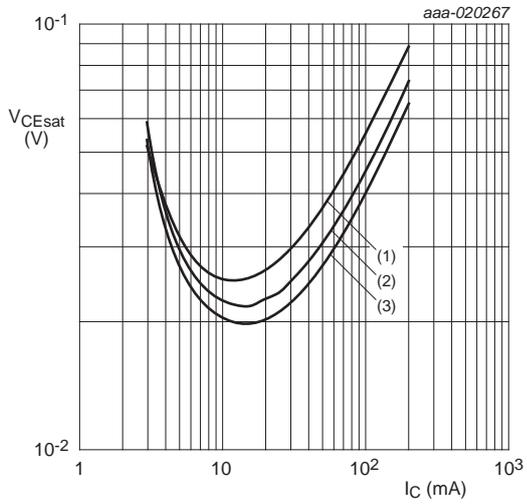
$V_{CE} = 0.3\text{ V}$   
 (1)  $T_{amb} = -40\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 100\text{ °C}$

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



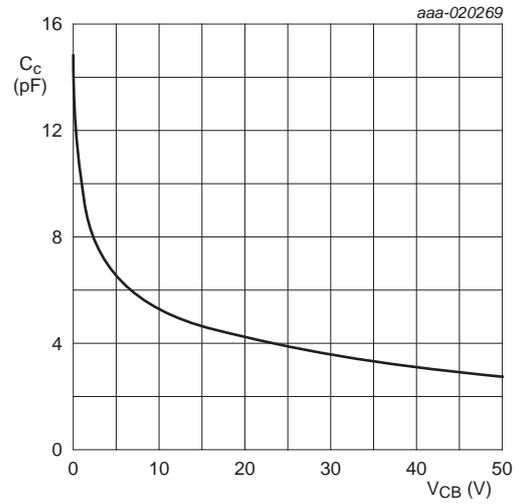
$V_{CE} = 5\text{ V}$   
 (1)  $T_{amb} = -40\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 100\text{ °C}$

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



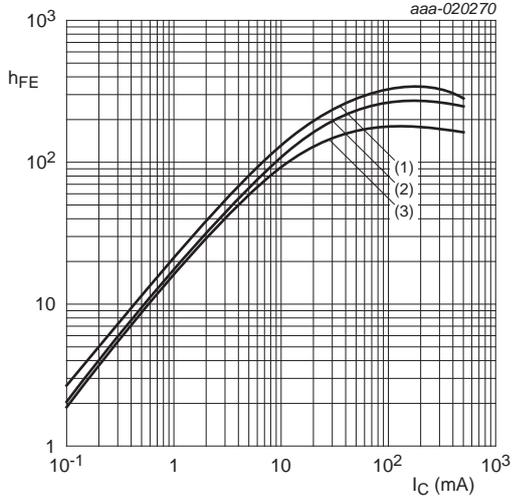
- $I_C/I_B = 20$
- (1)  $T_{amb} = 100\text{ }^\circ\text{C}$
  - (2)  $T_{amb} = 25\text{ }^\circ\text{C}$
  - (3)  $T_{amb} = -40\text{ }^\circ\text{C}$

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



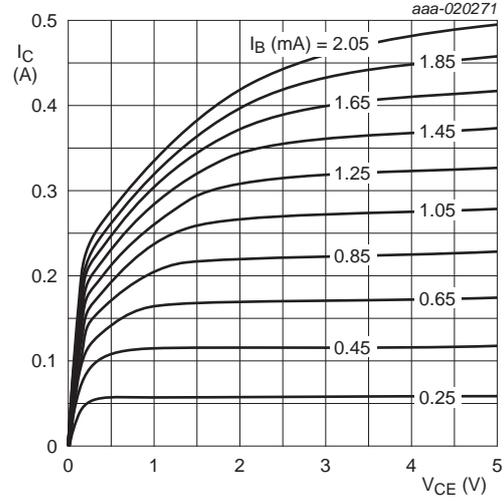
$f = 1\text{ MHz}; T_{amb} = 25\text{ }^\circ\text{C}$

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



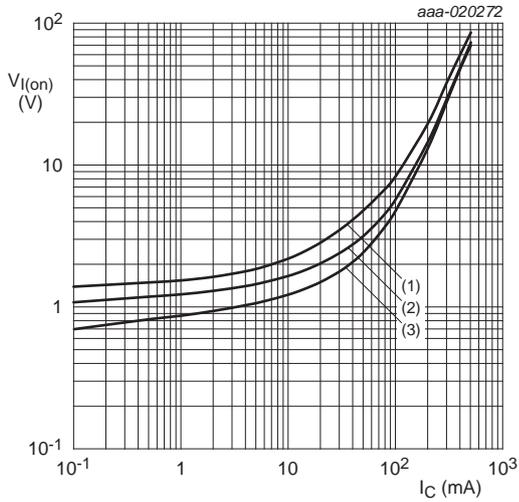
$V_{CE} = 5\text{ V}$   
 (1)  $T_{amb} = 100\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = -40\text{ }^{\circ}\text{C}$

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



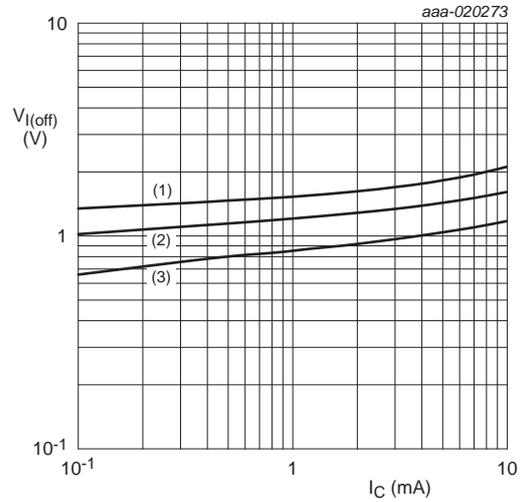
$T_{amb} = 25\text{ }^{\circ}\text{C}$

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



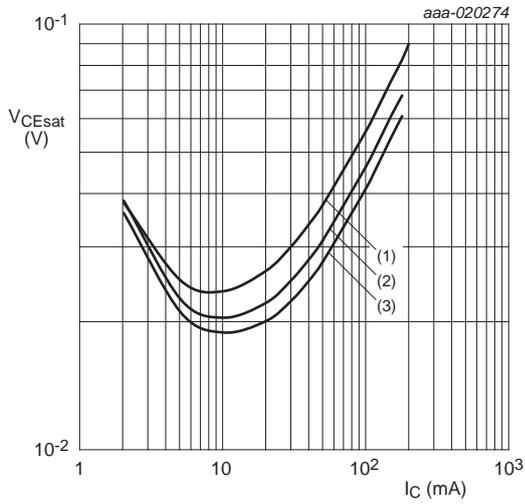
$V_{CE} = 0.3\text{ V}$   
 (1)  $T_{amb} = -40\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = 100\text{ }^{\circ}\text{C}$

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



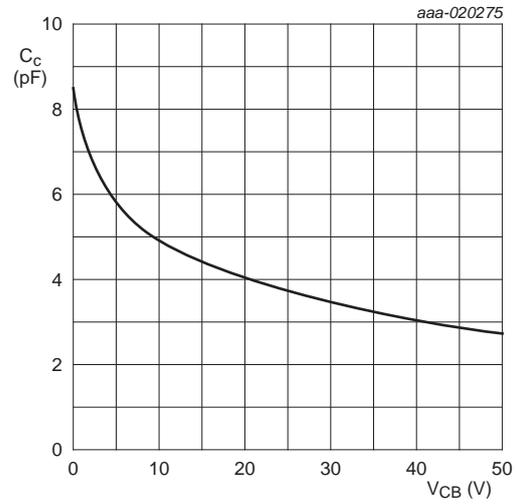
$V_{CE} = 5\text{ V}$   
 (1)  $T_{amb} = -40\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = 100\text{ }^{\circ}\text{C}$

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



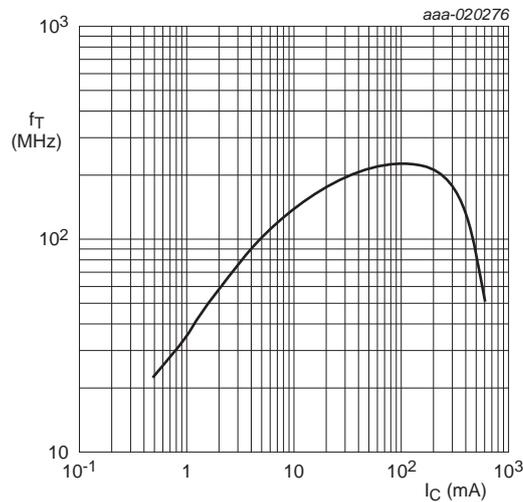
- $I_C/I_B = 20$
- (1)  $T_{amb} = 100\text{ °C}$
  - (2)  $T_{amb} = 25\text{ °C}$
  - (3)  $T_{amb} = -40\text{ °C}$

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



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

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



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

**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):

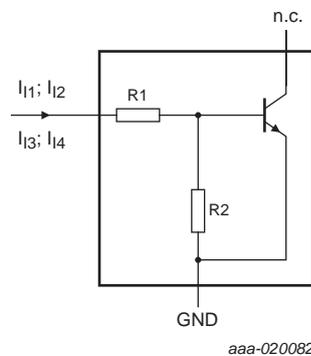
$$R1 = \frac{V(I_{I2}) - V(I_{I1})}{I_{I2} - I_{I1}}$$

- 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

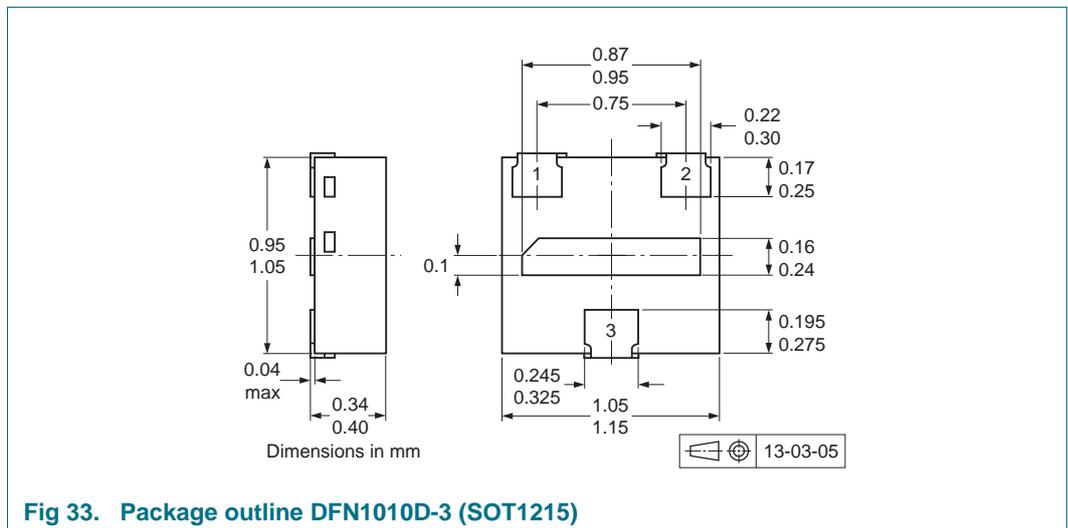
Table 9. Resistor test conditions

Type number	R1 kΩ	R2 kΩ	Test conditions			
			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



## 10. Soldering

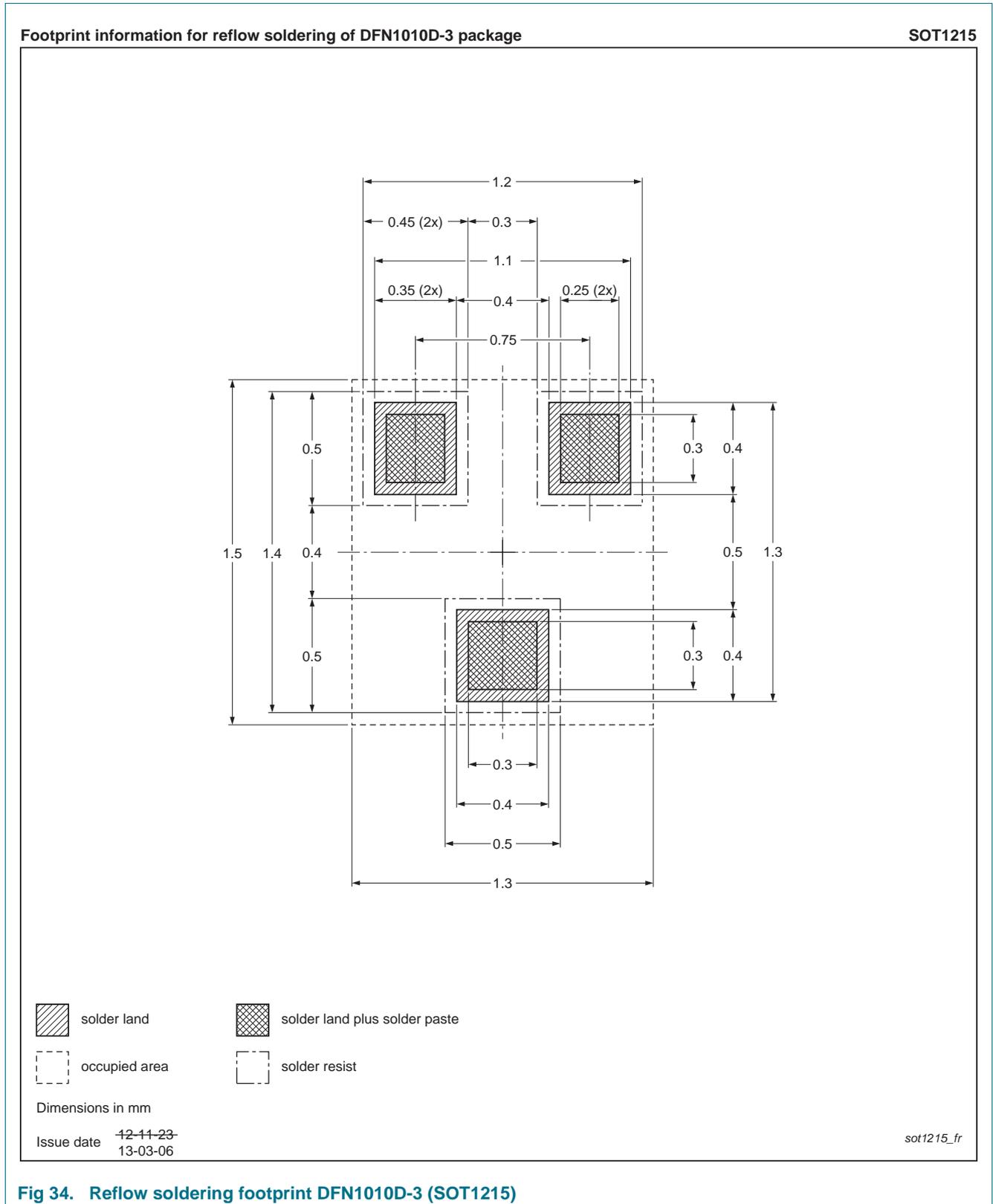


Fig 34. Reflow soldering footprint DFN1010D-3 (SOT1215)

## 11. Revision history

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**Table 10. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
PDTD113_123_143_114EQA_SER 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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