

## 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

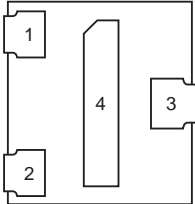
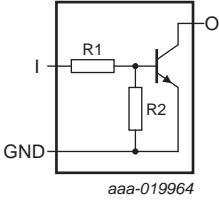
Table 2. Quick reference data

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

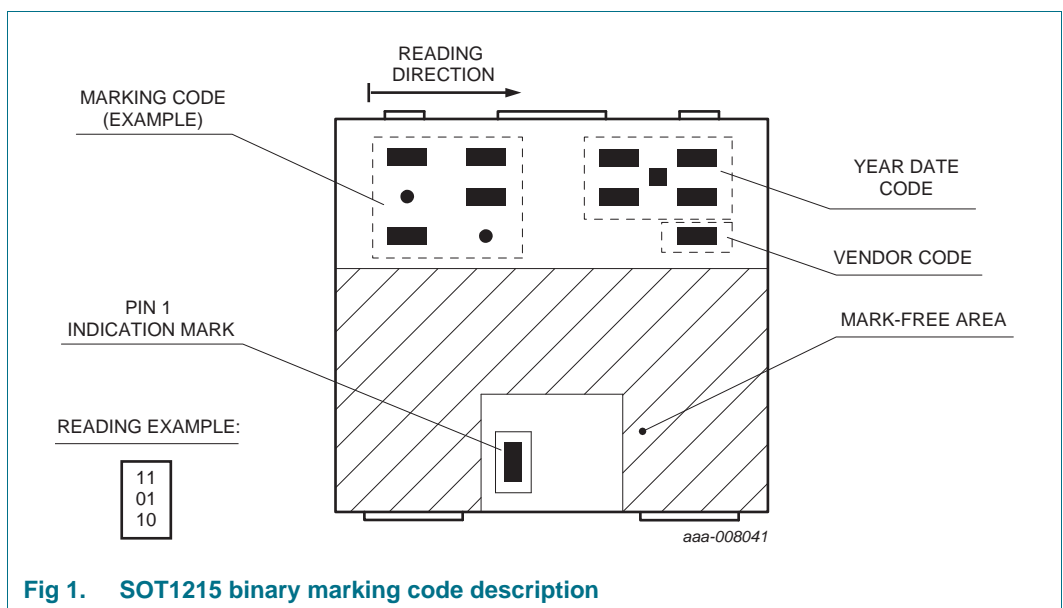
Type number	Package		
	Name	Description	Version
PDTD113EQA	DFN1010D-3	plastic thermal enhanced ultra thin small outline package; no leads; 3 terminals; body: 1.1 × 1.0 × 0.37 mm	SOT1215
PDTD123EQA			
PDTD143EQA			
PDTD114EQA			

## 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



**Fig 1. SOT1215 binary marking code description**

## 5. Limiting values

**Table 6. Limiting values**

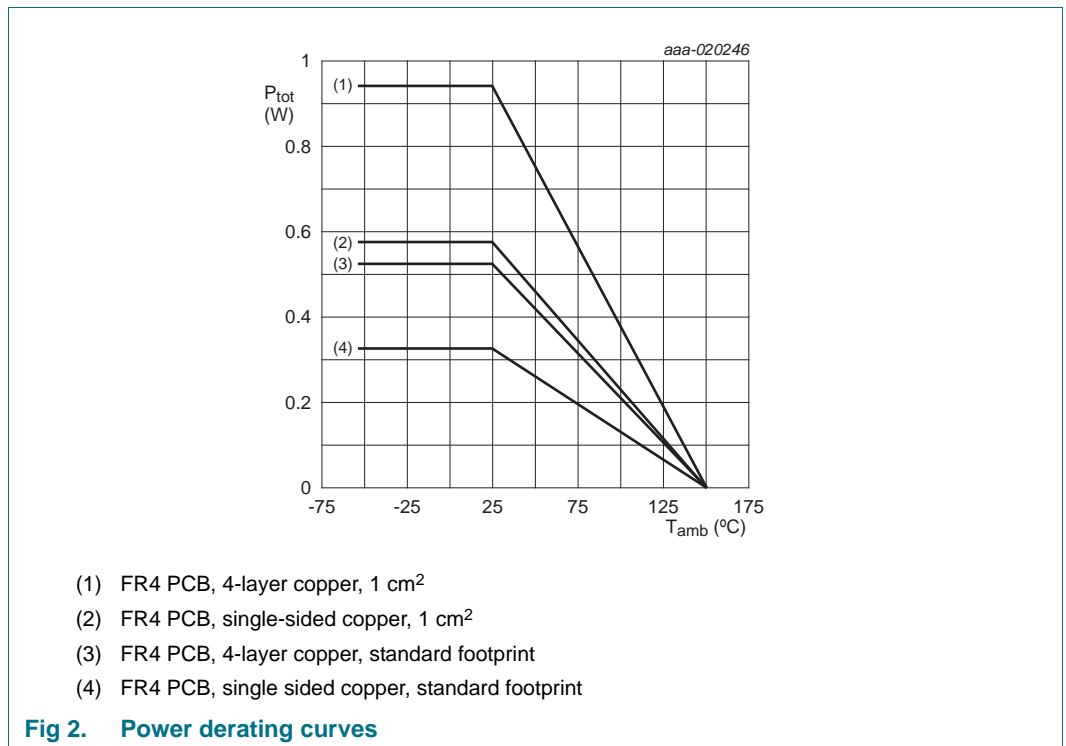
*In accordance with the Absolute Maximum Rating System (IEC 60134).*

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	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>.

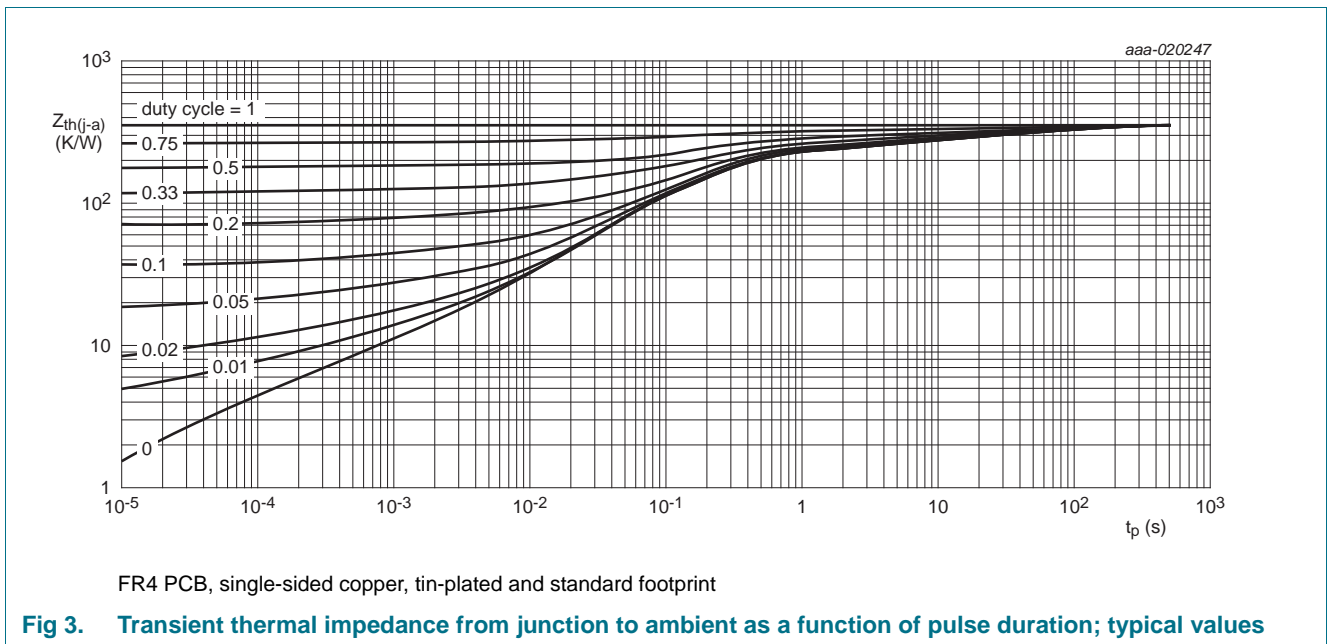


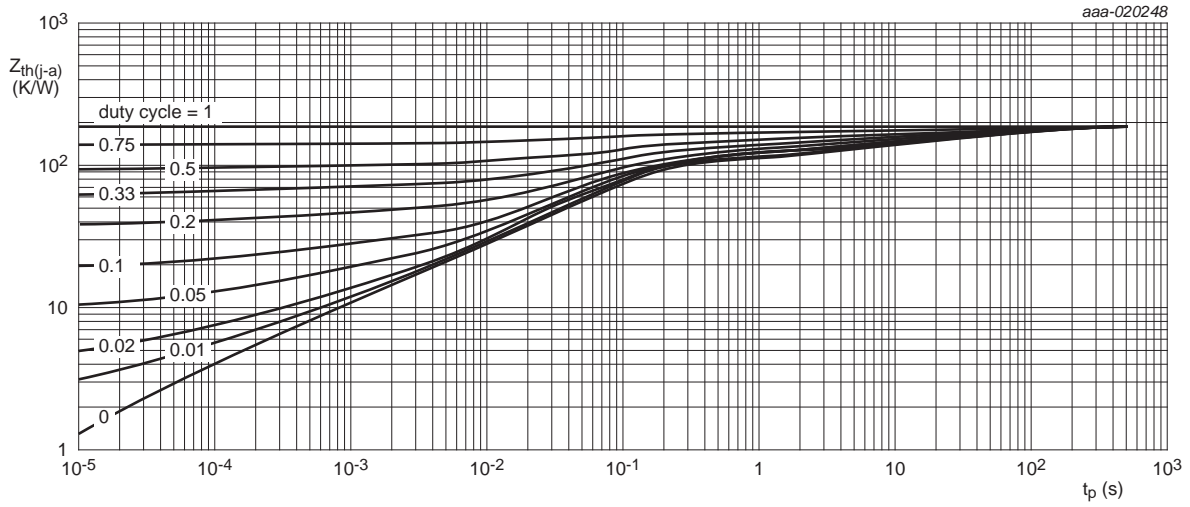
## 6. Thermal characteristics

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	

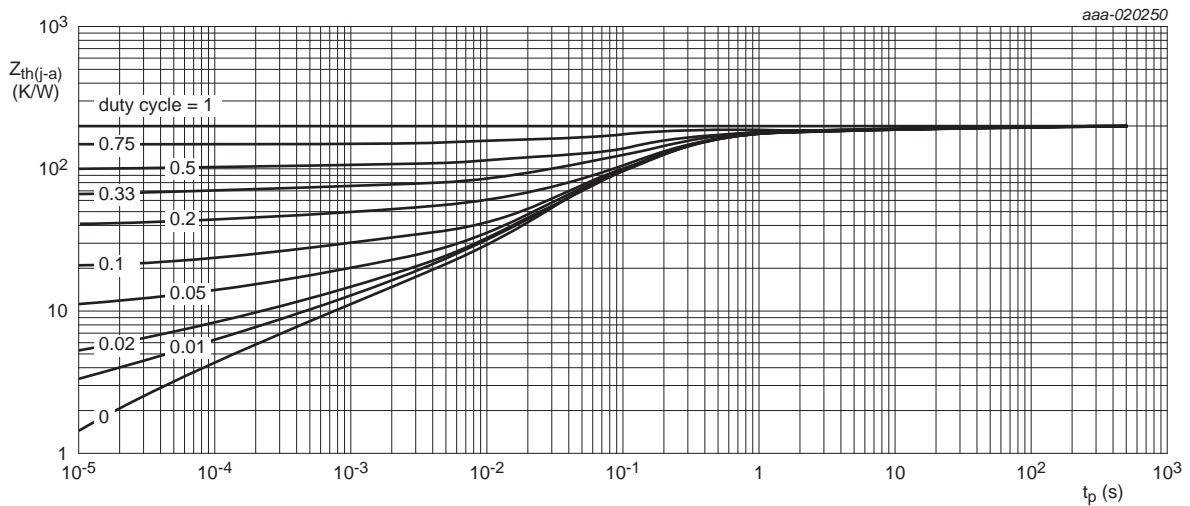
- [1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated; mounting pad for collector 1 cm<sup>2</sup>.
- [3] Device mounted on an FR4 PCB, 4-layer copper, tin-plated and standard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





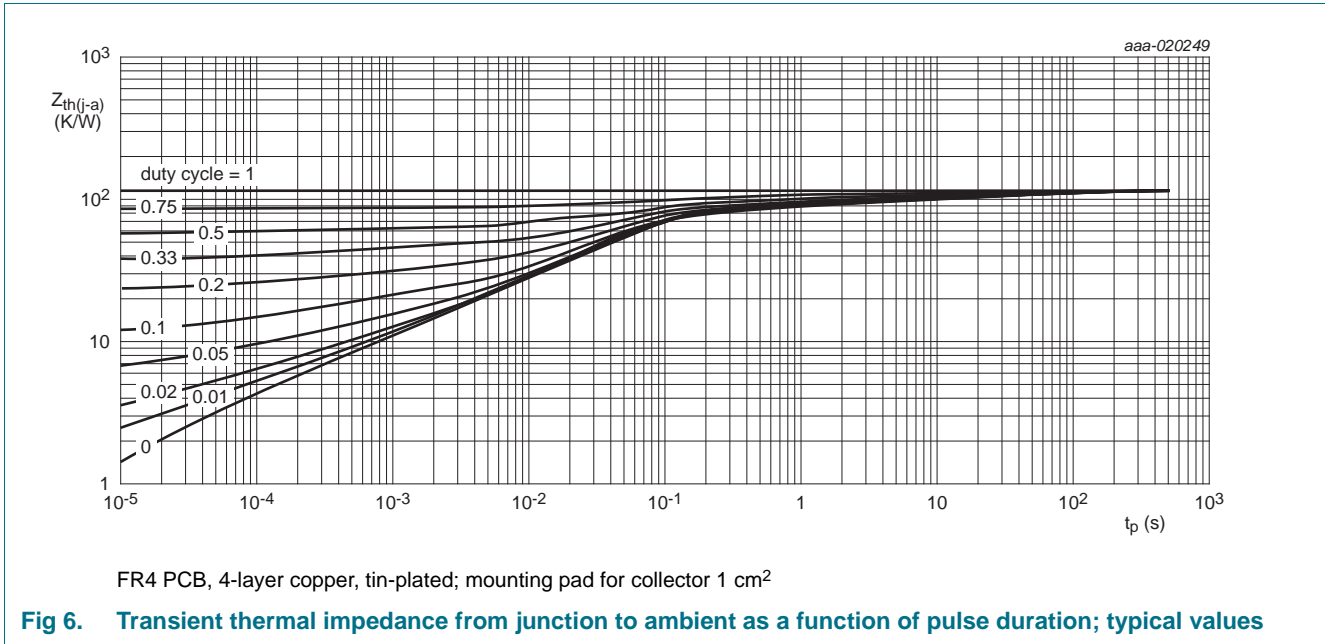
FR4 PCB, single-sided copper, tin-plated, mounting pad for collector  $1\text{ cm}^2$

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





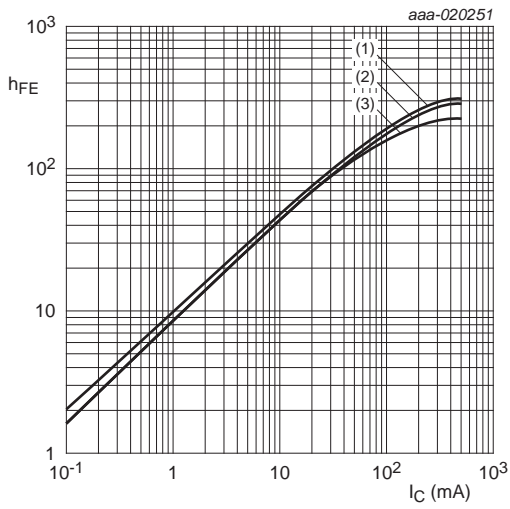
## 7. Characteristics

**Table 8. Characteristics**
 $T_{amb} = 25\text{ }^{\circ}\text{C}$  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					
	PDTD113EQA	$V_{EB} = 5\text{ V}; I_C = 0\text{ A}$	-	-	4	mA
	PDTD123EQA		-	-	2	mA
	PDTD143EQA		-	-	0.9	mA
PDTD114EQA	-		-	0.4	mA	
$h_{FE}$	DC current gain					
	PDTD113EQA	$V_{CE} = 5\text{ V}; I_C = 50\text{ mA}$	33	-	-	
	PDTD123EQA		40	-	-	
	PDTD143EQA		60	-	-	
PDTD114EQA	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					
	PDTD113EQA	$V_{CE} = 5\text{ V}; I_C = 100\text{ }\mu\text{A}$	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	
$V_{I(on)}$	on-state input voltage					
	PDTD113EQA	$V_{CE} = 0.3\text{ V}; I_C = 20\text{ mA}$	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	k $\Omega$
	PDTD123EQA		1.54	2.2	2.86	k $\Omega$
	PDTD143EQA		3.3	4.7	6.1	k $\Omega$
	PDTD114EQA		7	10	13	k $\Omega$
R2/R1	bias resistor ratio		<a href="#">[1]</a>	1	1.1	
$C_c$	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

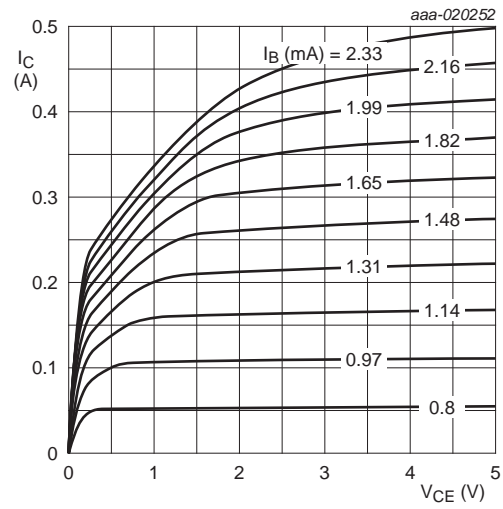
[1] See section test information for resistor calculation and test conditions.

[2] Characteristics of built-in transistor.



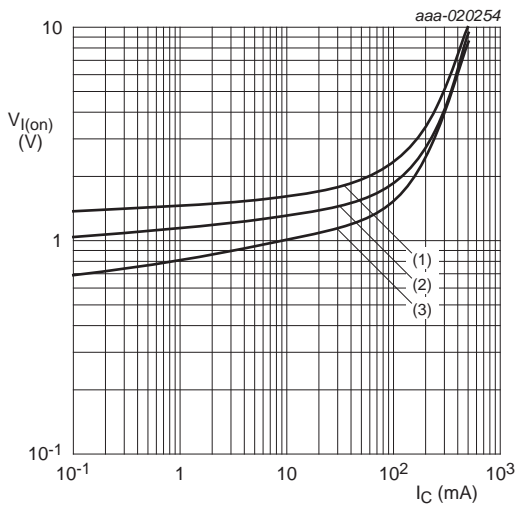
$V_{CE} = 5 \text{ V}$   
 (1)  $T_{amb} = 100 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -40 \text{ }^\circ\text{C}$

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



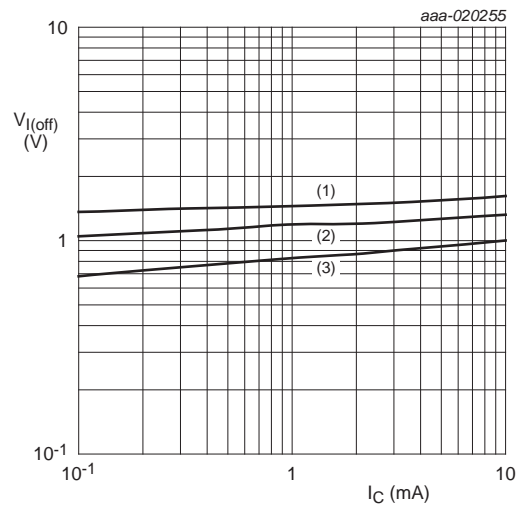
$T_{amb} = 25 \text{ }^\circ\text{C}$

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



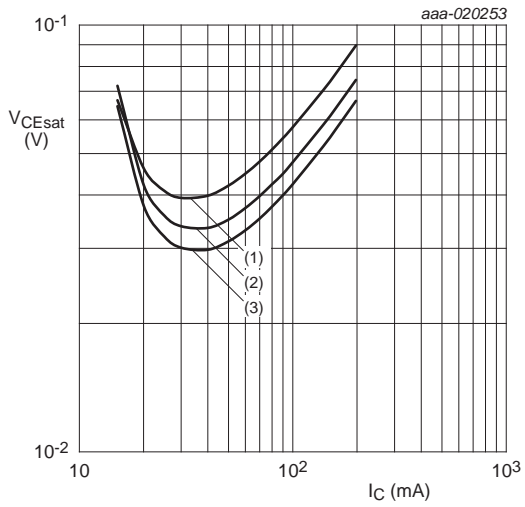
$V_{CE} = 0.3 \text{ V}$   
 (1)  $T_{amb} = -40 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100 \text{ }^\circ\text{C}$

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



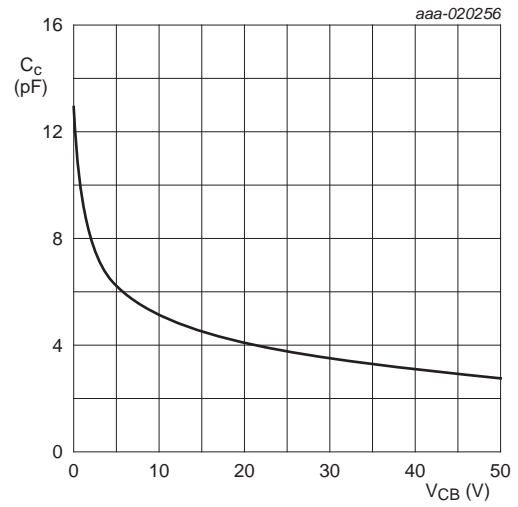
$V_{CE} = 5 \text{ V}$   
 (1)  $T_{amb} = -40 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100 \text{ }^\circ\text{C}$

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



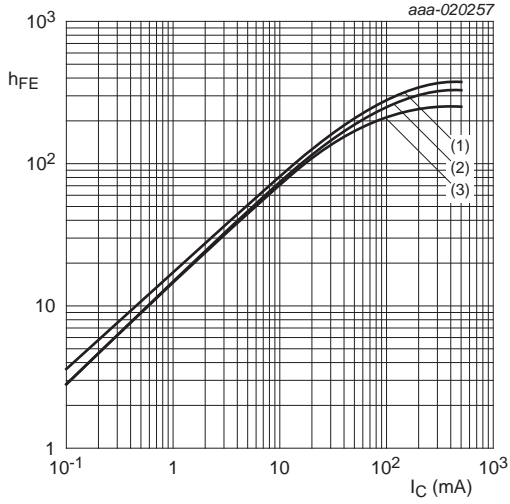
- $I_C/I_B = 20$
- (1)  $T_{amb} = 100\text{ }^\circ\text{C}$
  - (2)  $T_{amb} = 25\text{ }^\circ\text{C}$
  - (3)  $T_{amb} = -40\text{ }^\circ\text{C}$

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



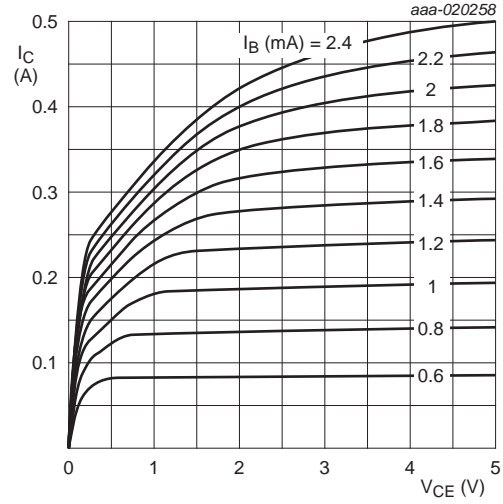
$f = 1\text{ MHz}; T_{amb} = 25\text{ }^\circ\text{C}$

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



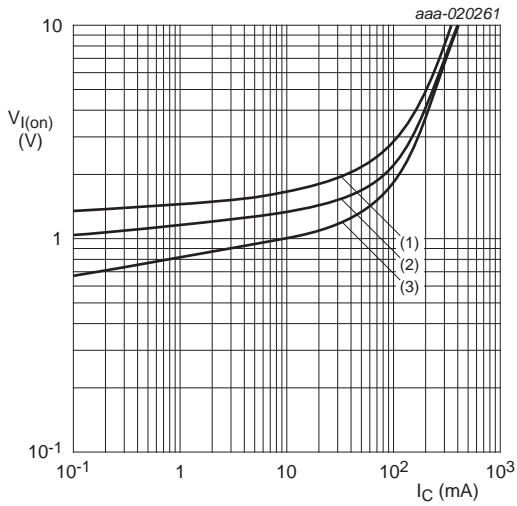
$V_{CE} = 5 \text{ V}$   
 (1)  $T_{amb} = 100 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -40 \text{ }^\circ\text{C}$

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



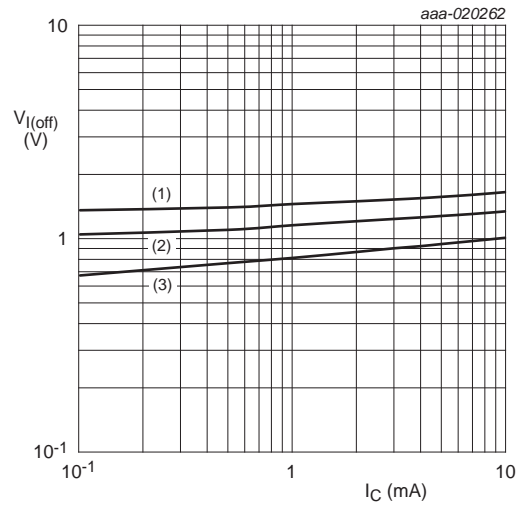
$T_{amb} = 25 \text{ }^\circ\text{C}$

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



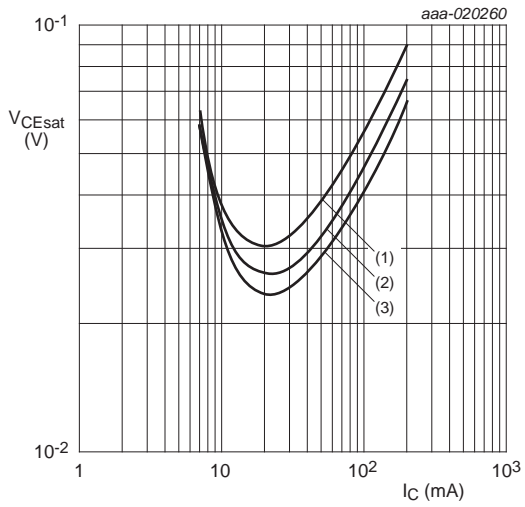
$V_{CE} = 0.3 \text{ V}$   
 (1)  $T_{amb} = -40 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100 \text{ }^\circ\text{C}$

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



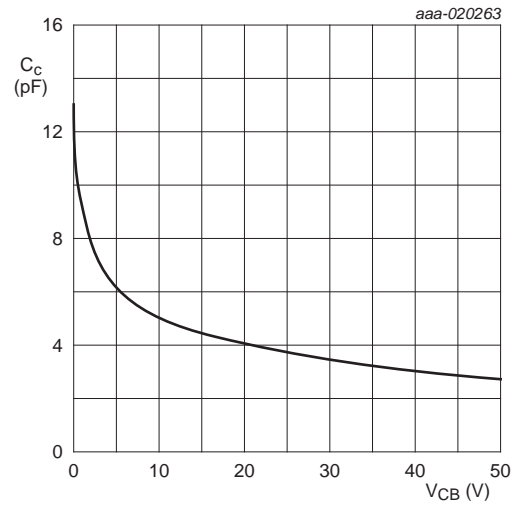
$V_{CE} = 5 \text{ V}$   
 (1)  $T_{amb} = -40 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100 \text{ }^\circ\text{C}$

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



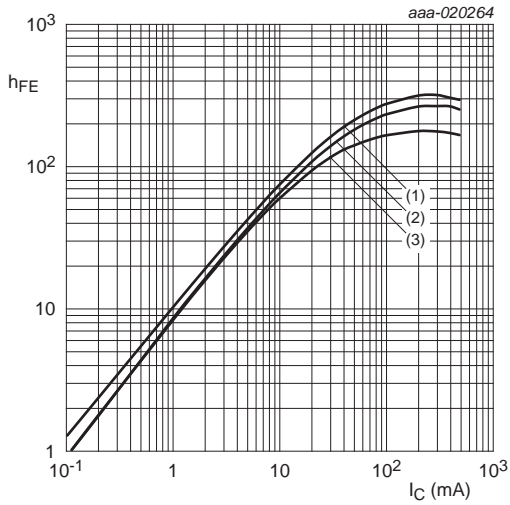
- $I_C/I_B = 20$
- (1)  $T_{amb} = 100\text{ °C}$
  - (2)  $T_{amb} = 25\text{ °C}$
  - (3)  $T_{amb} = -40\text{ °C}$

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



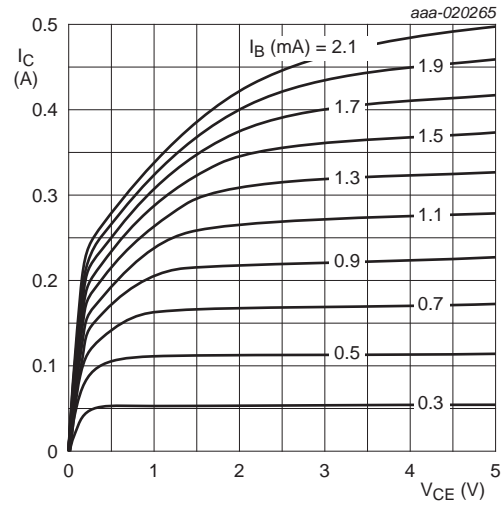
$f = 1\text{ MHz}; T_{amb} = 25\text{ °C}$

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



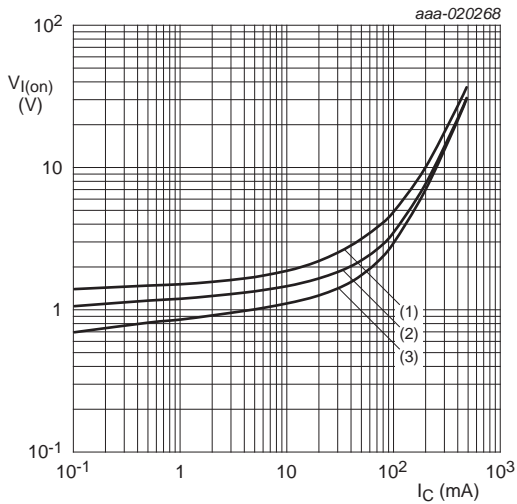
$V_{CE} = 5 \text{ V}$   
 (1)  $T_{amb} = 100 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -40 \text{ }^\circ\text{C}$

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



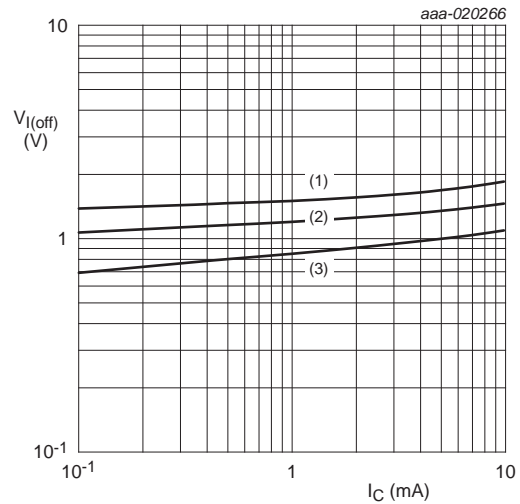
$T_{amb} = 25 \text{ }^\circ\text{C}$

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



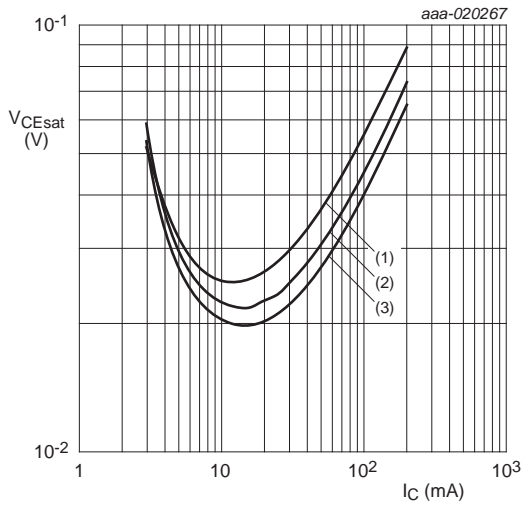
$V_{CE} = 0.3 \text{ V}$   
 (1)  $T_{amb} = -40 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100 \text{ }^\circ\text{C}$

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



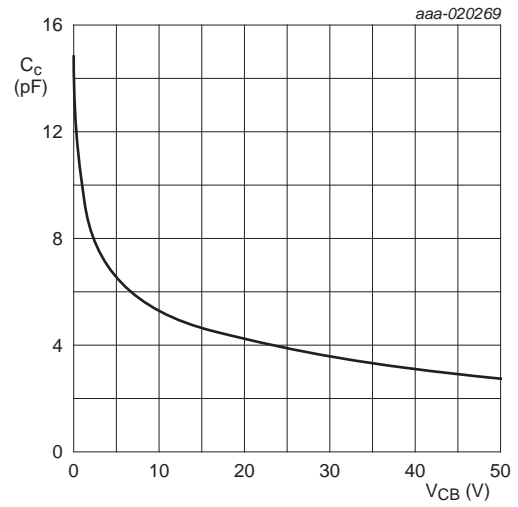
$V_{CE} = 5 \text{ V}$   
 (1)  $T_{amb} = -40 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100 \text{ }^\circ\text{C}$

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



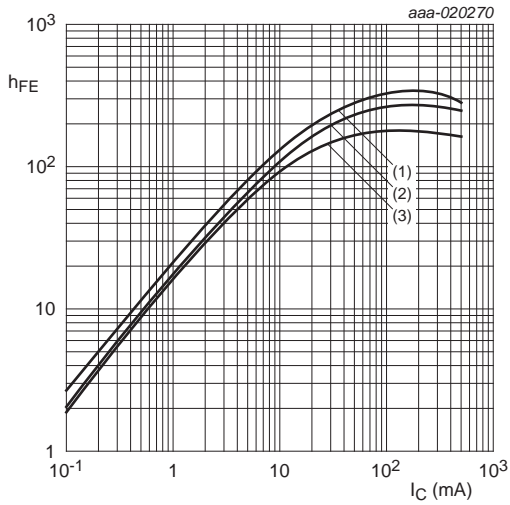
- $I_C/I_B = 20$
- (1)  $T_{amb} = 100\text{ }^\circ\text{C}$
  - (2)  $T_{amb} = 25\text{ }^\circ\text{C}$
  - (3)  $T_{amb} = -40\text{ }^\circ\text{C}$

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



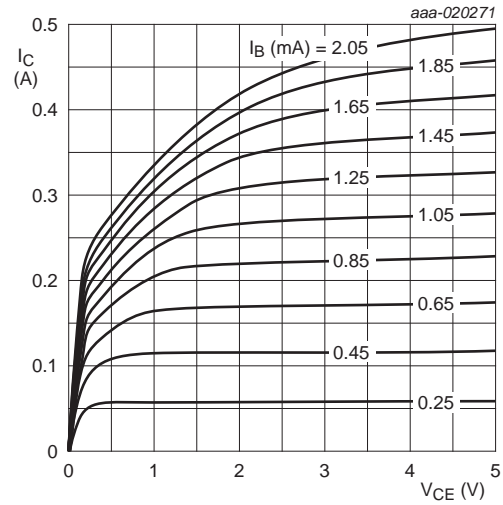
$f = 1\text{ MHz}; T_{amb} = 25\text{ }^\circ\text{C}$

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



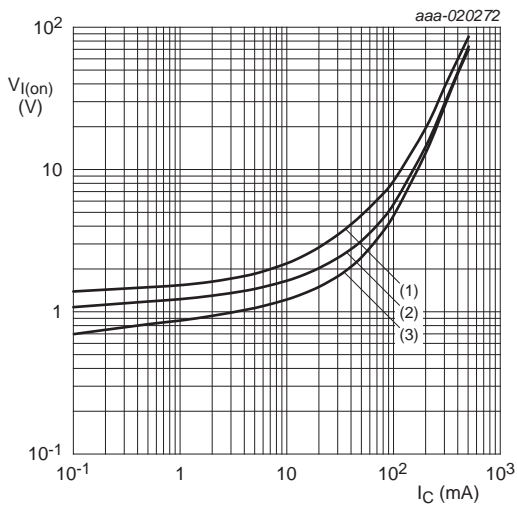
$V_{CE} = 5 \text{ V}$   
 (1)  $T_{amb} = 100 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -40 \text{ }^\circ\text{C}$

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



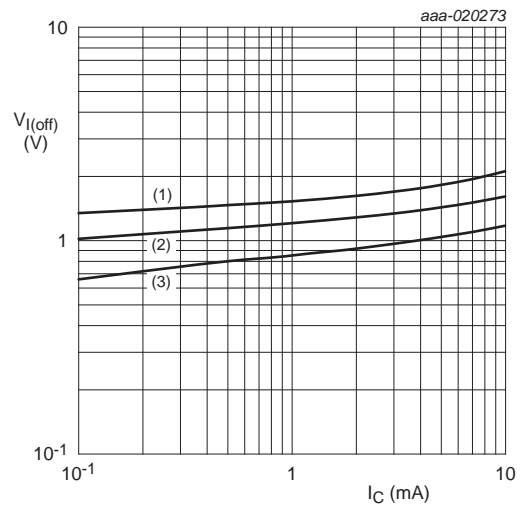
$T_{amb} = 25 \text{ }^\circ\text{C}$

**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)  $T_{amb} = 100 \text{ }^\circ\text{C}$

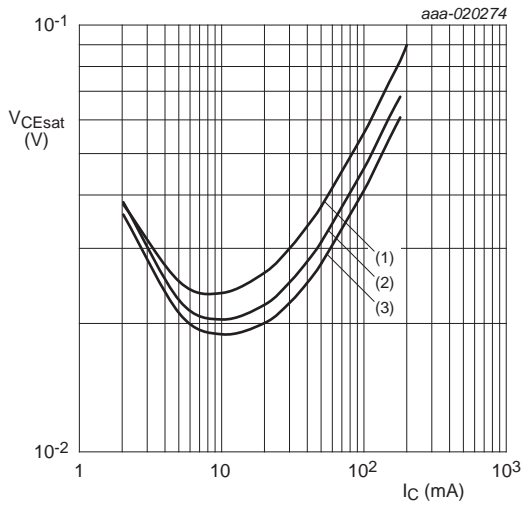
**Fig 27. PDTD114EQA: On-state input voltage as a function of collector current; typical values**



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

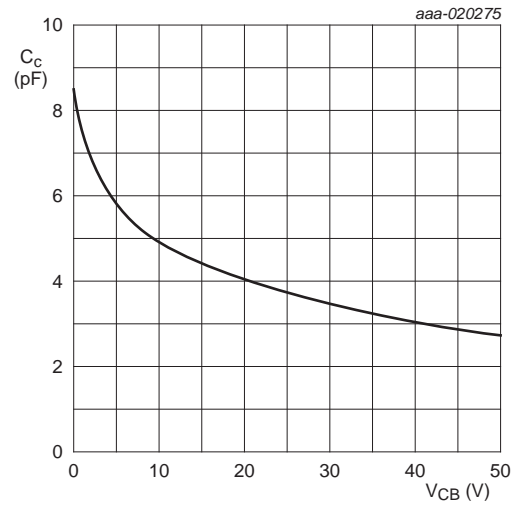
**Fig 28. PDTD114EQA: Off-state input voltage as a function of collector current; typical values**





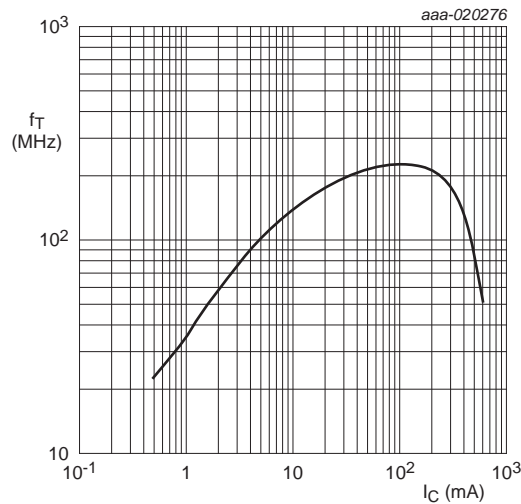
- $I_C/I_B = 20$
- (1)  $T_{amb} = 100\text{ °C}$
  - (2)  $T_{amb} = 25\text{ °C}$
  - (3)  $T_{amb} = -40\text{ °C}$

**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):

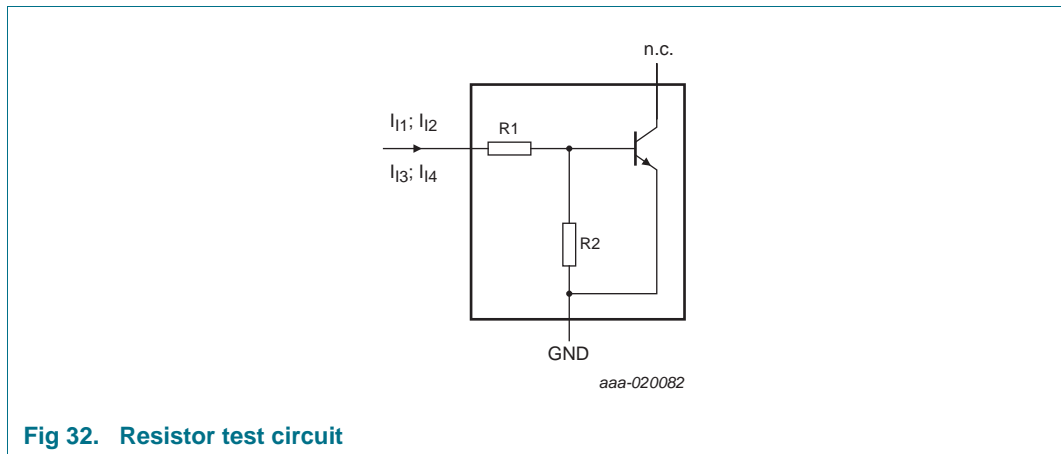
$$R1 = \frac{V(I_{I2}) - V(I_{I1})}{I_{I2} - I_{I1}}$$

- 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

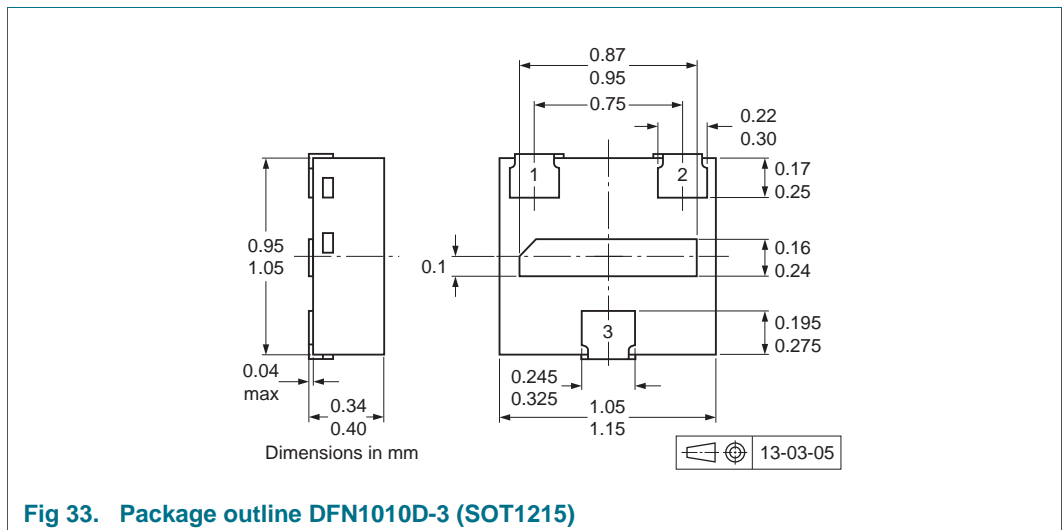
Table 9. Resistor test conditions

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

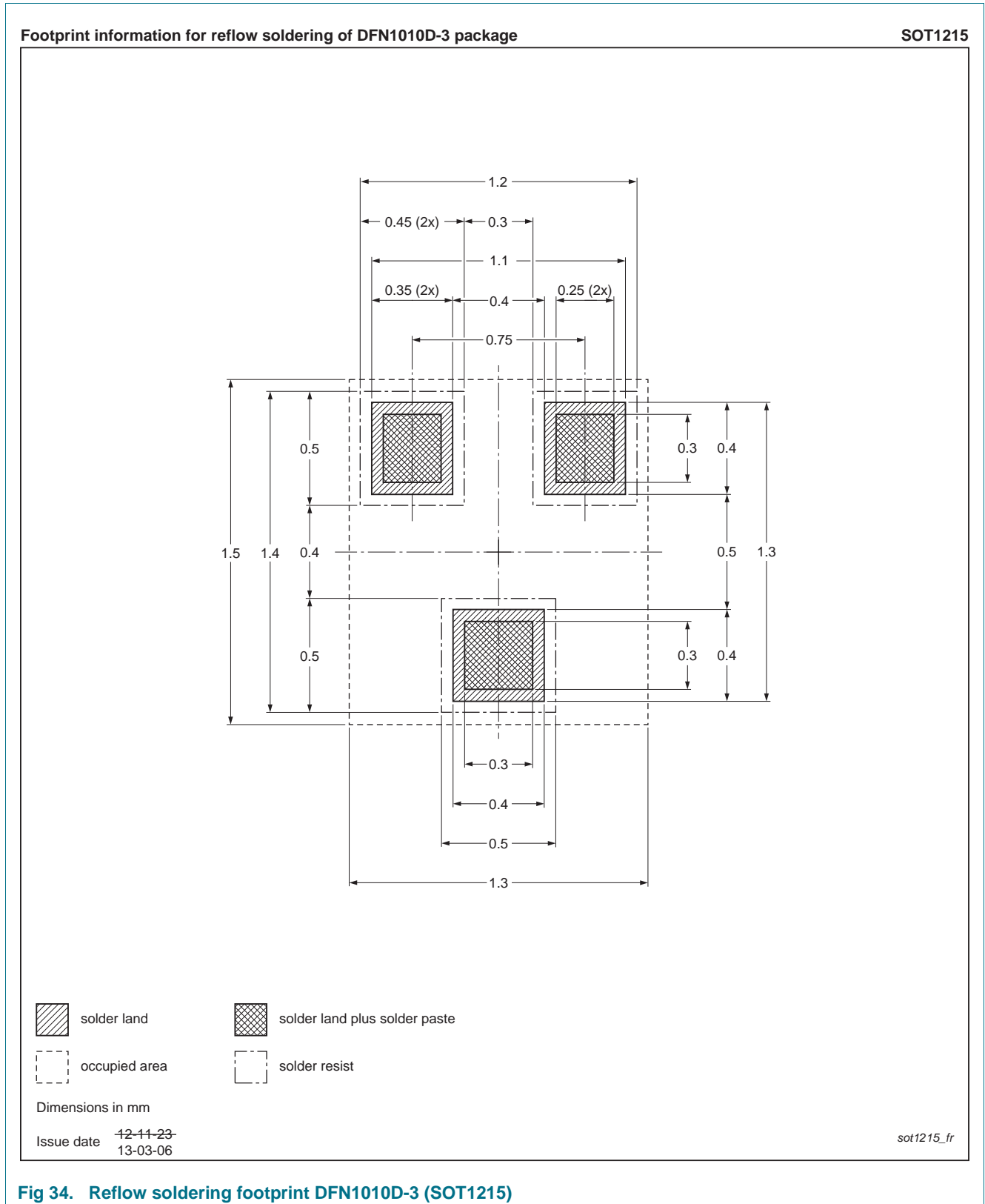


Fig 34. Reflow soldering footprint DFN1010D-3 (SOT1215)

## 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".

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