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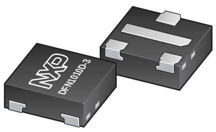
Kind regards,

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 kΩ	1 kΩ	DFN1010D-3 (SOT1215)	PDTB113EQA
PDTD123EQA	2.2 kΩ	2.2 kΩ		PDTB123EQA
PDTD143EQA	4.7 kΩ	4.7 kΩ		PDTB143EQA
PDTD114EQA	10 kΩ	10 kΩ		PDTB114EQA

1.2 Features and benefits

- 500 mA output current capability
- Built-in bias resistors
- ± 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

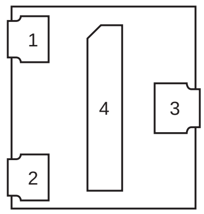
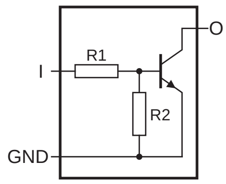
1.4 Quick reference data

Table 2. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CEO}	collector-emitter voltage	open base	-	-	50	V
I_O	output current		-	-	500	mA

2. Pinning information

Table 3. Pinning

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	I	input (base)	 Transparent top view	 aaa-019964
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

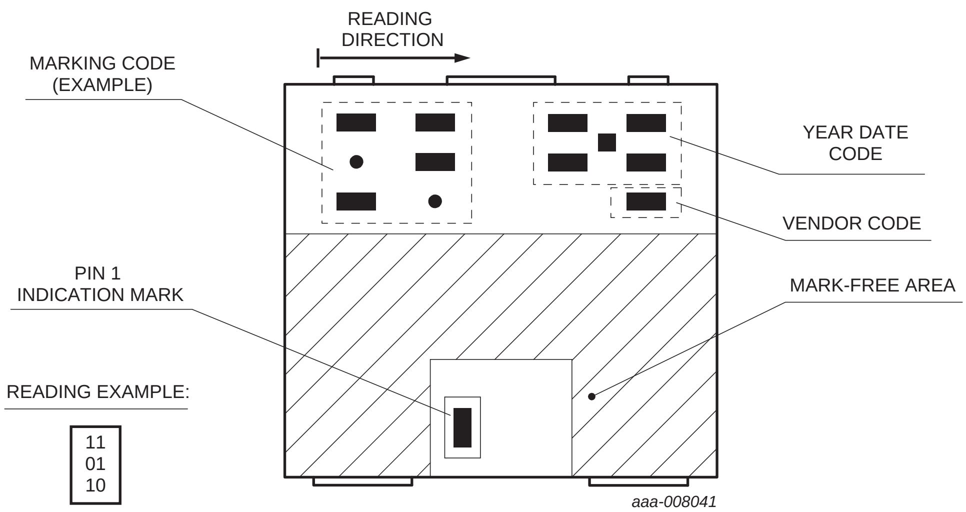


Fig 1. SOT1215 binary marking code description

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).

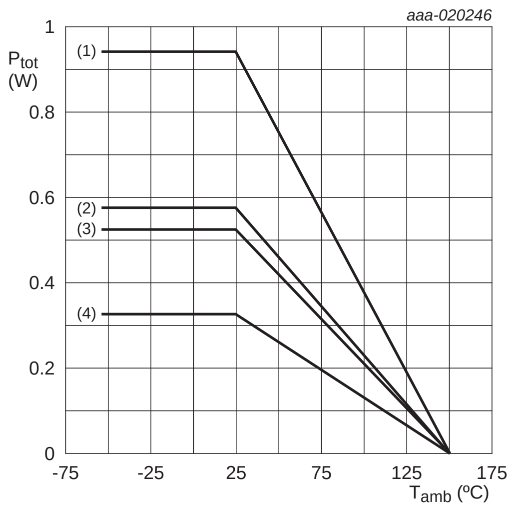
Symbol	Parameter	Conditions		Min	Max	Unit
V_I	input voltage					
	PDTD113EQA			–10	+10	V
	PDTD123EQA			–10	+12	V
	PDTD143EQA			–10	+30	V
	PDTD114EQA			–10	+50	V
I_O	output current			-	500	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	[1]	-	325	mW
			[2]	-	575	mW
			[3]	-	525	mW
			[4]	-	940	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, single-sided copper, tin-plated; mounting pad for collector 1 cm^2.

[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^2.



(1) FR4 PCB, 4-layer copper, 1 cm^2

(2) FR4 PCB, single-sided copper, 1 cm^2

(3) FR4 PCB, 4-layer copper, standard footprint

(4) FR4 PCB, single sided copper, standard footprint

Fig 2. Power derating curves

6. Thermal characteristics

Table 7. Thermal characteristics

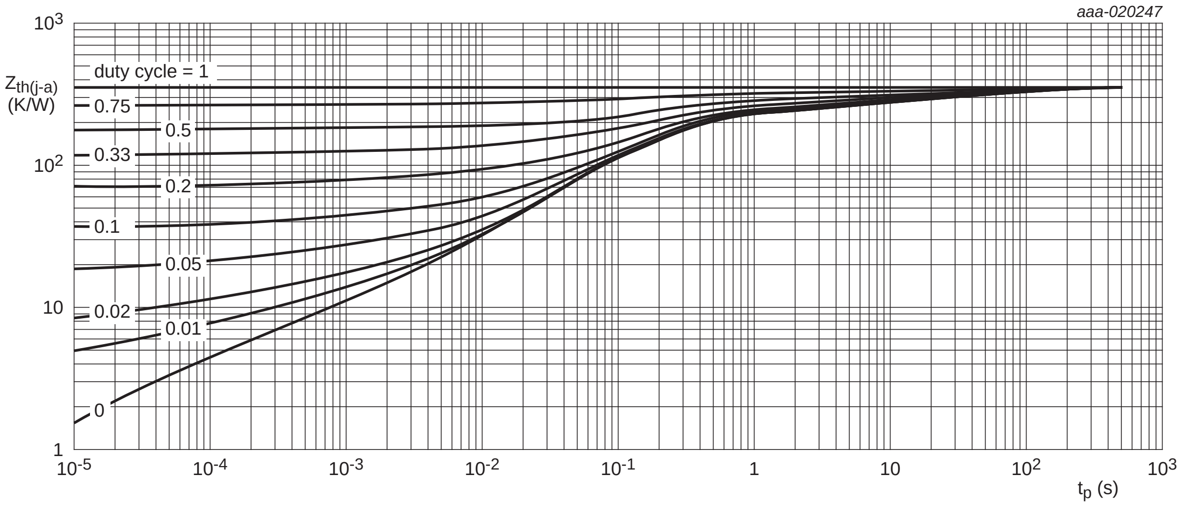
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	385	K/W
			[2]	-	-	218	K/W
			[3]	-	-	239	K/W
			[4]	-	-	133	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	-	40	K/W

[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^2.

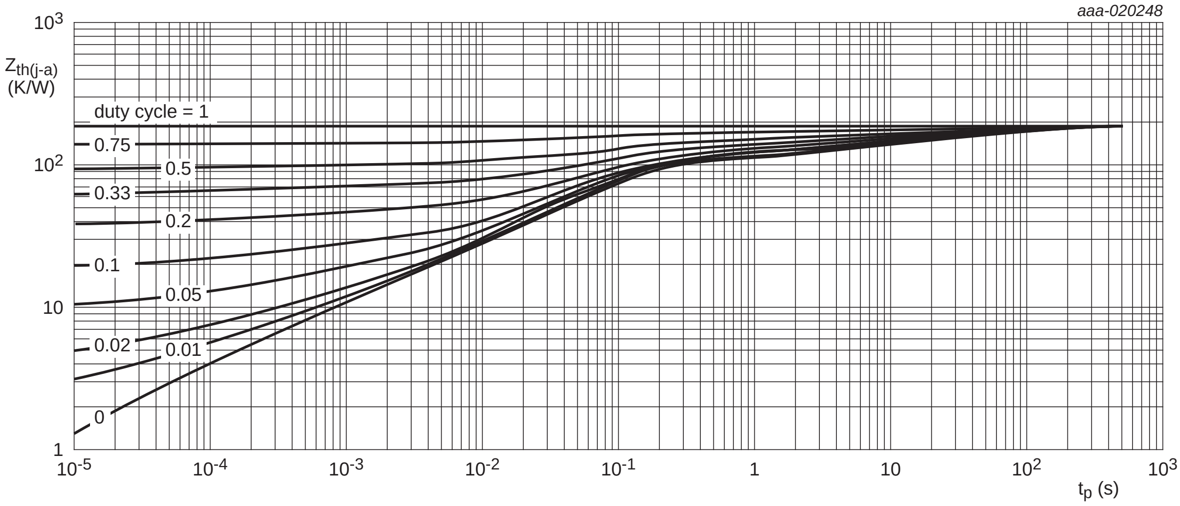
[3] Device mounted on an FR4 PCB, 4-layer copper, tin-plated and standard footprint.

[4] Device mounted on an FR4 PCB, 4-layer copper, tin-plated; mounting pad for collector 1 cm^2.



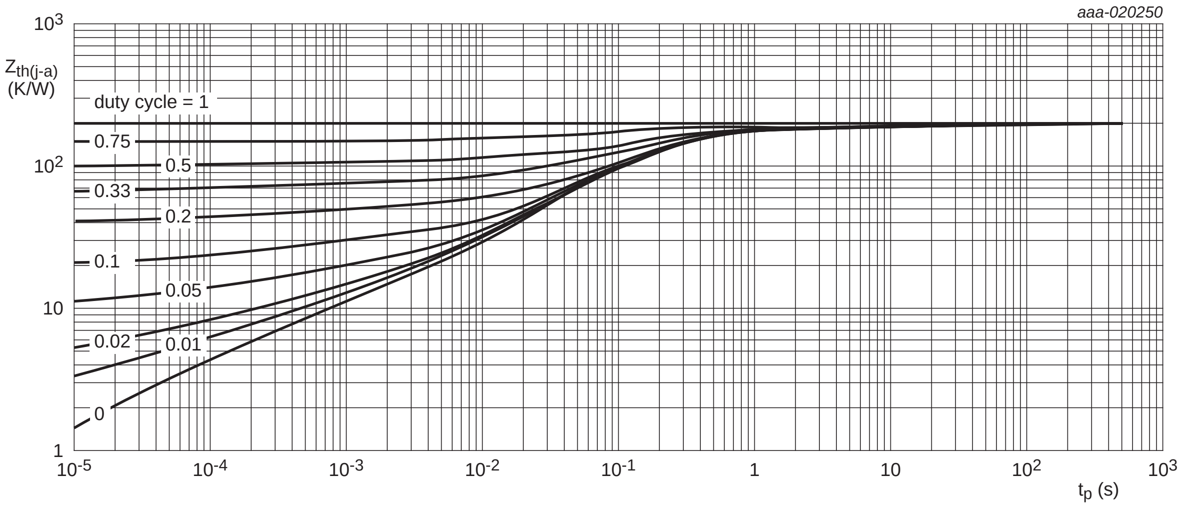
FR4 PCB, single-sided copper, tin-plated and standard footprint

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



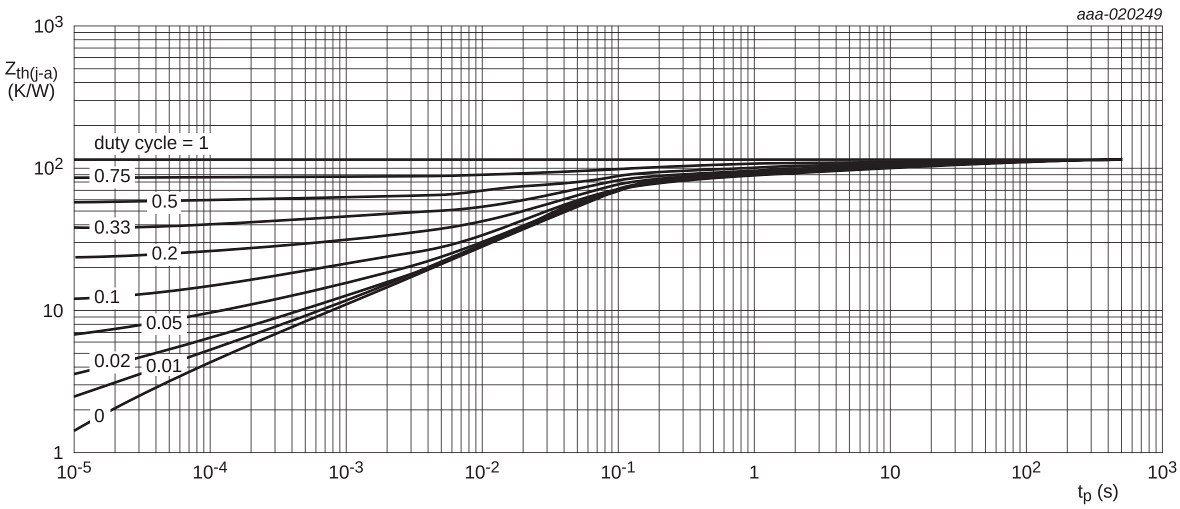
FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm^2

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



FR4 PCB, 4-layer copper, tin-plated; mounting pad for collector 1 cm^2

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

7. Characteristics

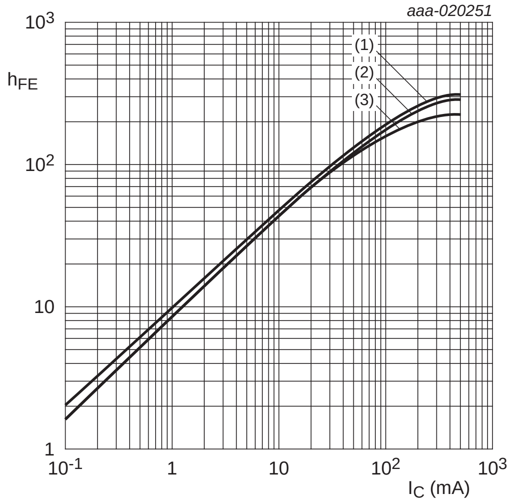
Table 8. Characteristics

T_{amb} = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_{CBO}	collector-base cut-off current	V_{CB} = 50 V; I_E = 0 A		-	-	100	nA
I_{CEO}	collector-emitter cut-off current	V_{CE} = 50 V; I_B = 0 A		-	-	0.5	μA
I_{EBO}	emitter-base cut-off current						
	PDTD113EQA	V_{EB} = 5 V; I_C = 0 A		-	-	4	mA
	PDTD123EQA			-	-	2	mA
	PDTD143EQA			-	-	0.9	mA
	PDTD114EQA					0.4	mA
h_{FE}	DC current gain						
	PDTD113EQA	V_{CE} = 5 V; I_C = 50 mA		33	-	-	
	PDTD123EQA			40	-	-	
	PDTD143EQA			60	-	-	
	PDTD114EQA			70	-	-	
V_{CEsat}	collector-emitter saturation voltage	I_C = 50 mA; I_B = 2.5 mA		-	-	100	mV
$V_{I(off)}$	off-state input voltage						
	PDTD113EQA	V_{CE} = 5 V; I_C = 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
$V_{I(on)}$	on-state input voltage						
	PDTD113EQA	V_{CE} = 0.3 V; I_C = 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)		[1]				
	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		[1]	0.9	1	1.1	
C_c	collector capacitance	V_{CB} = 10 V; I_E = i_e = 0 A; f = 1 MHz		-	5	-	pF
f_T	transition frequency	V_{CE} = 5 V; I_C = 50 mA; f = 100 MHz	[2]	-	210	-	MHz

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

[2] Characteristics of built-in transistor.



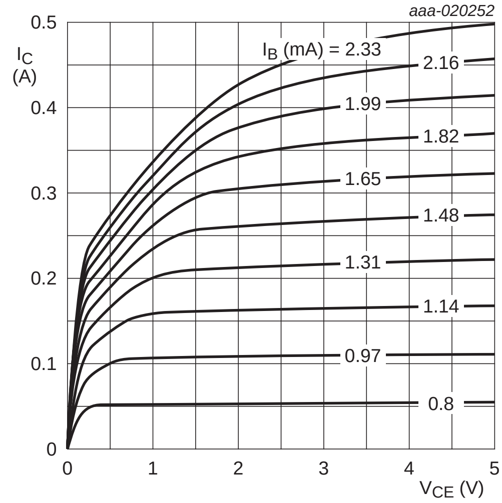
V_{CE} = 5 V

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

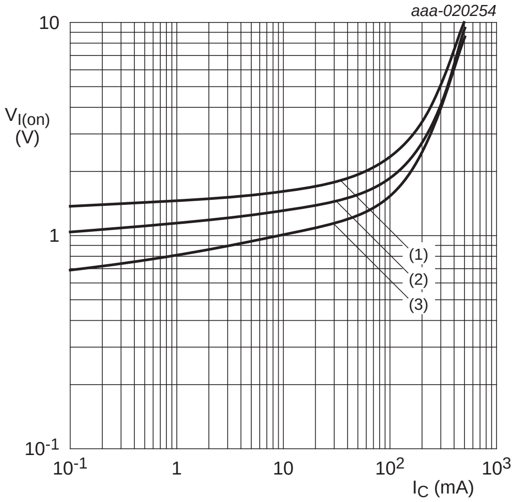
(3) T_{amb} = −40 °C

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



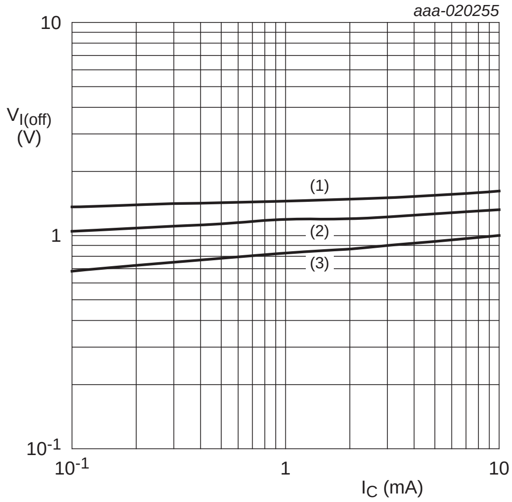
V_{CE} = 0.3 V

(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



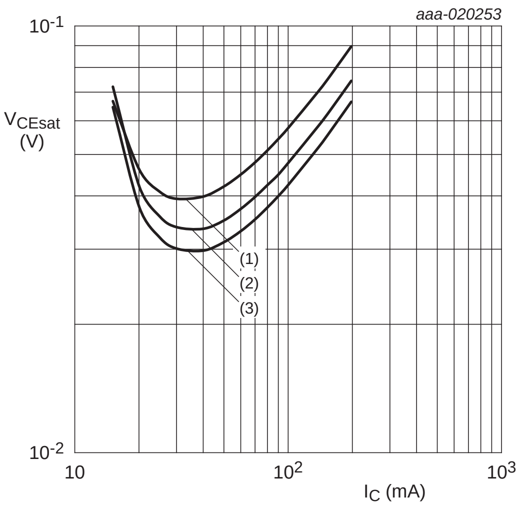
V_{CE} = 5 V

(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



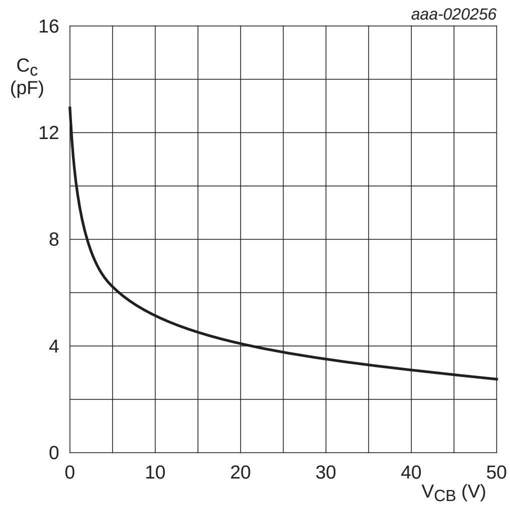
$I_C/I_B = 20$

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

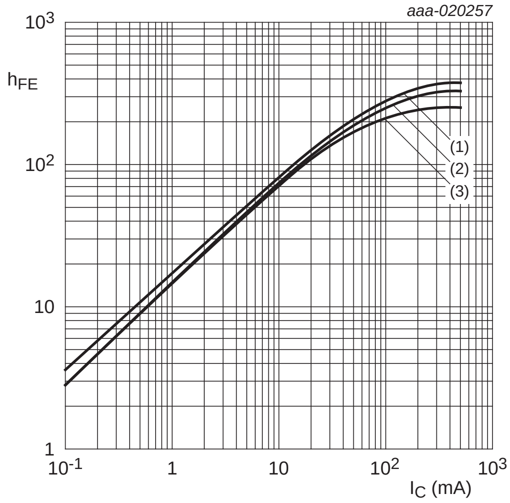
(3) T_{amb} = −40 °C

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



f = 1 MHz; T_{amb} = 25 °C

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



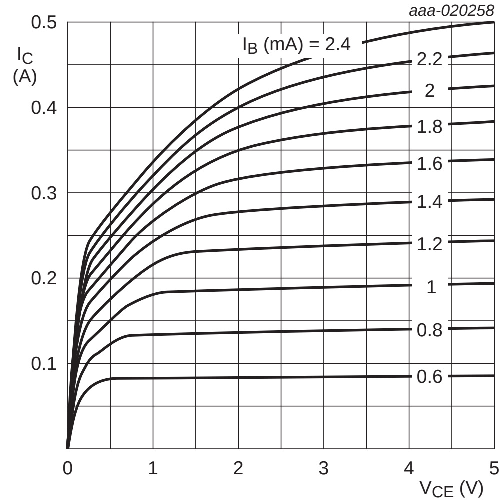
V_{CE} = 5 V

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

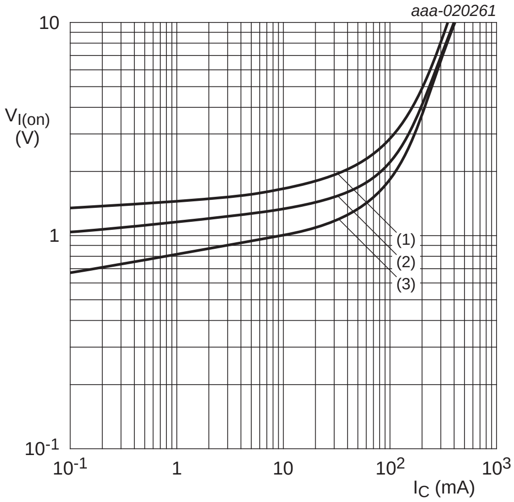
(3) T_{amb} = −40 °C

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



T_{amb} = 25 °C

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



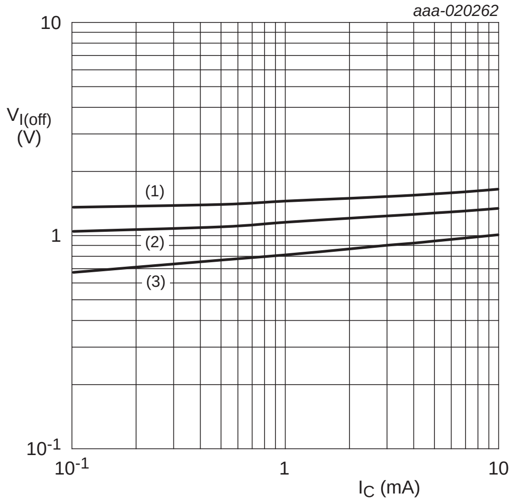
V_{CE} = 0.3 V

(1) T_{amb} = −40 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = 100 °C

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



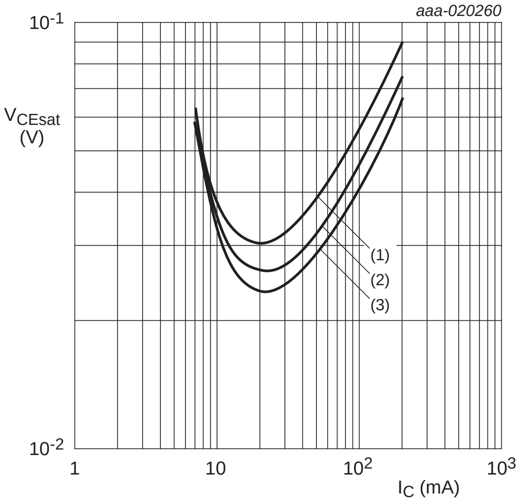
V_{CE} = 5 V

(1) T_{amb} = −40 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = 100 °C

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



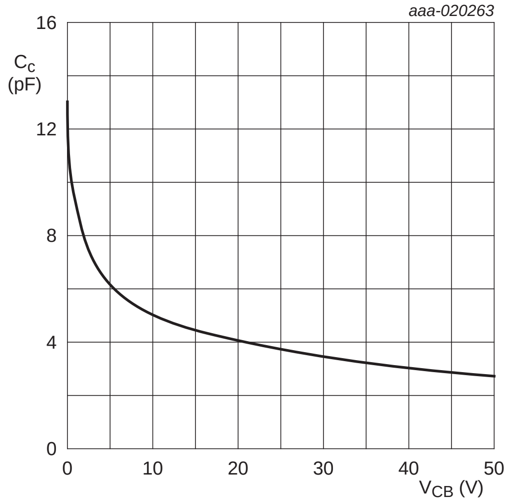
$I_C/I_B = 20$

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

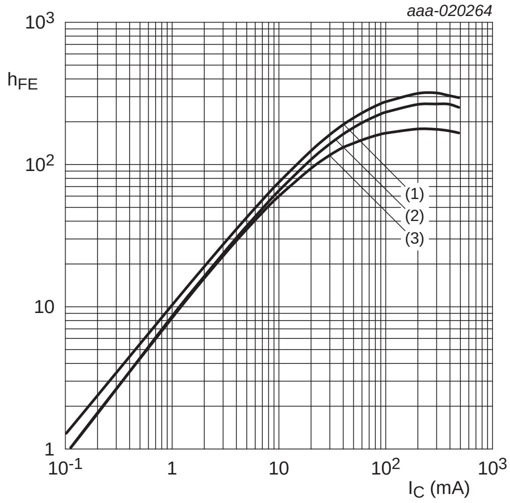
(3) T_{amb} = –40 °C

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



f = 1 MHz; T_{amb} = 25 °C

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



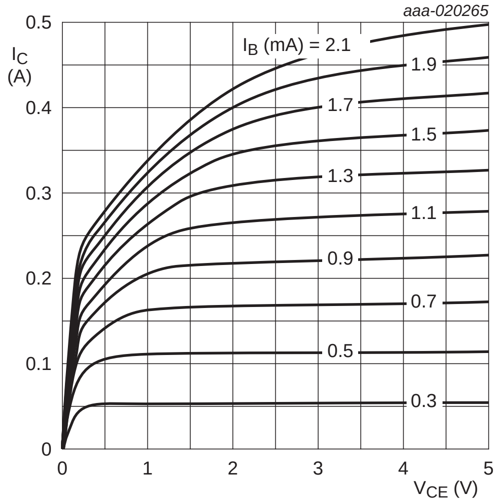
V_{CE} = 5 V

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

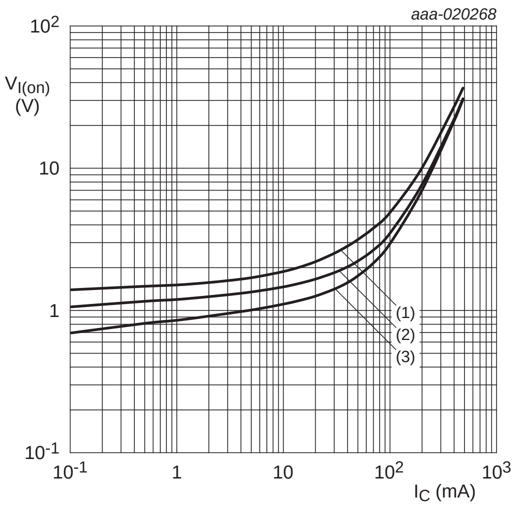
(3) T_{amb} = –40 °C

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



T_{amb} = 25 °C

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



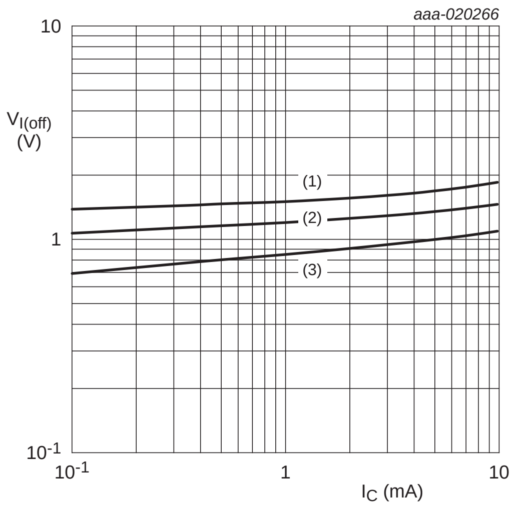
V_{CE} = 0.3 V

(1) T_{amb} = –40 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = 100 °C

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



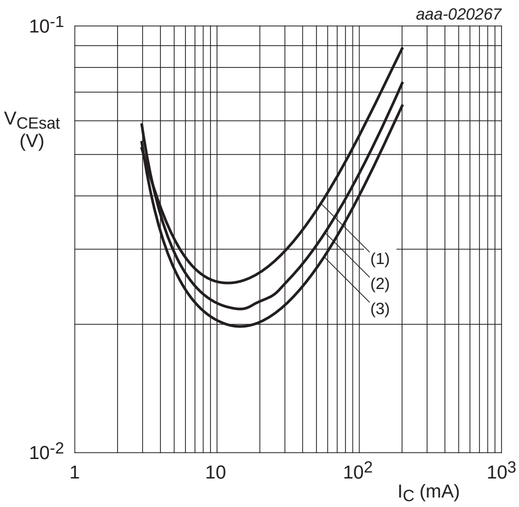
V_{CE} = 5 V

(1) T_{amb} = –40 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = 100 °C

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



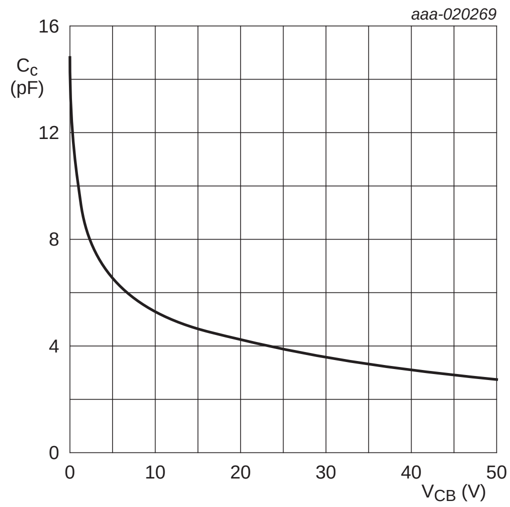
$I_C/I_B = 20$

(1) $T_{amb} = 100$ °C

(2) $T_{amb} = 25$ °C

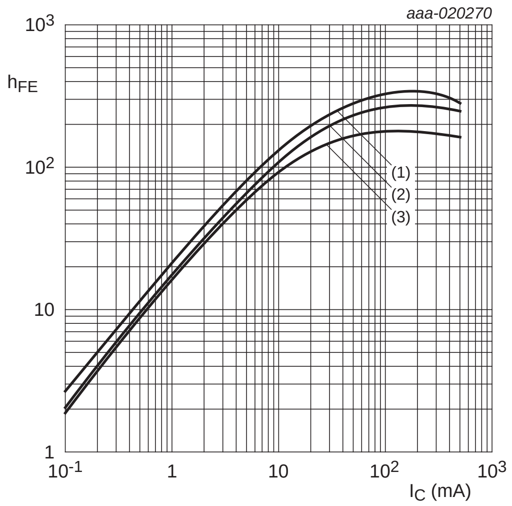
(3) $T_{amb} = -40$ °C

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



f = 1 MHz; $T_{amb} = 25$ °C

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



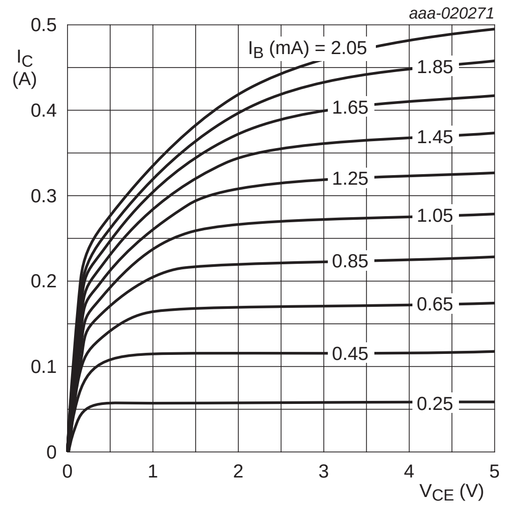
V_{CE} = 5 V

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

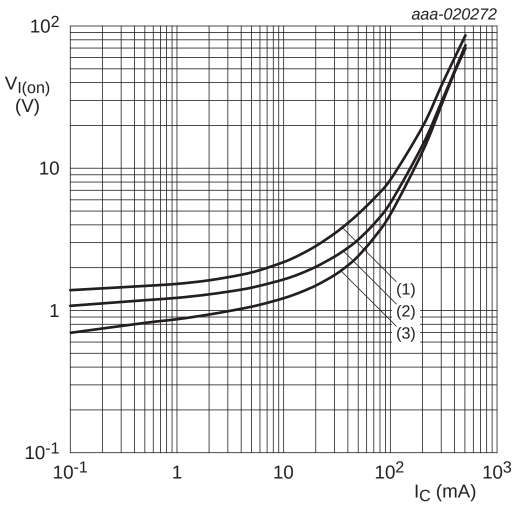
(3) T_{amb} = −40 °C

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



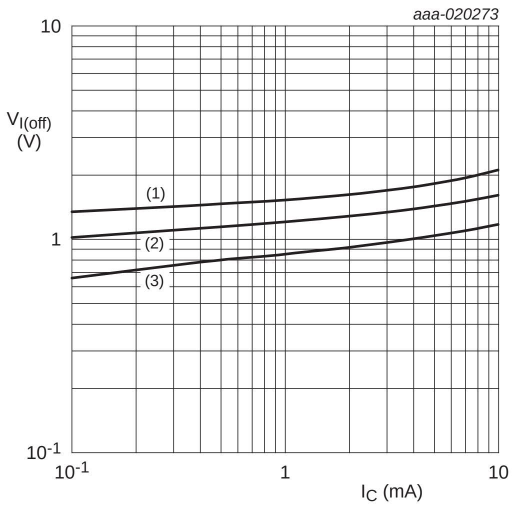
V_{CE} = 0.3 V

(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



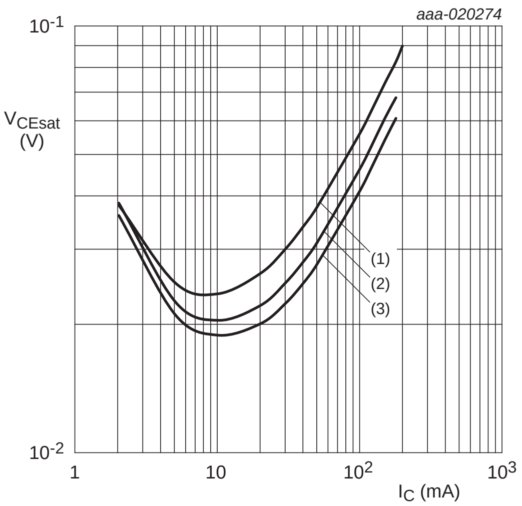
V_{CE} = 5 V

(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



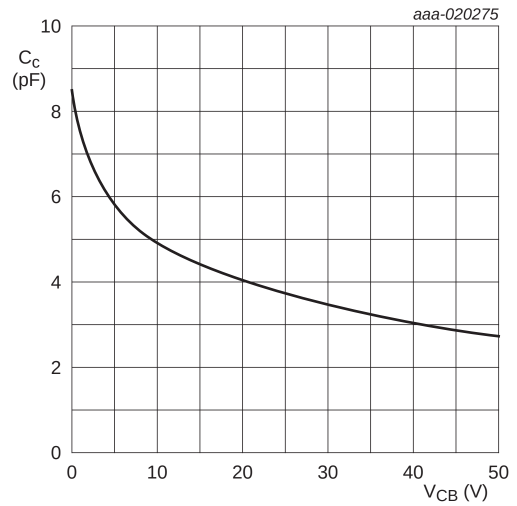
$I_C/I_B = 20$

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

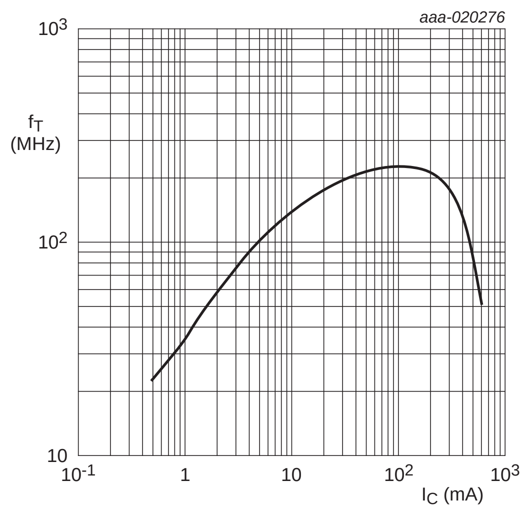
(3) T_{amb} = −40 °C

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



f = 1 MHz; T_{amb} = 25 °C

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



V_{CE} = 5 V; f = 100 MHz; T_{amb} = 25 °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):

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

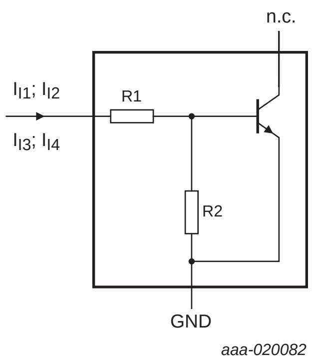


Fig 32. Resistor test circuit

8.3 Resistor test conditions

Table 9. Resistor test conditions

Type number		R1	R2	Test conditions			
		kΩ	kΩ	I_{I1}	I_{I2}	I_{I3}	I_{I4}
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

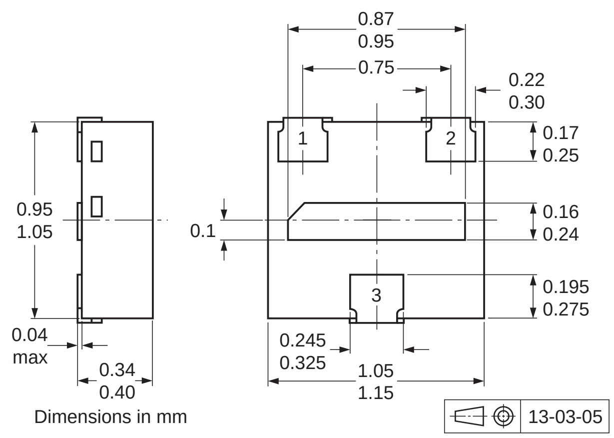


Fig 33. Package outline DFN1010D-3 (SOT1215)

10. Soldering

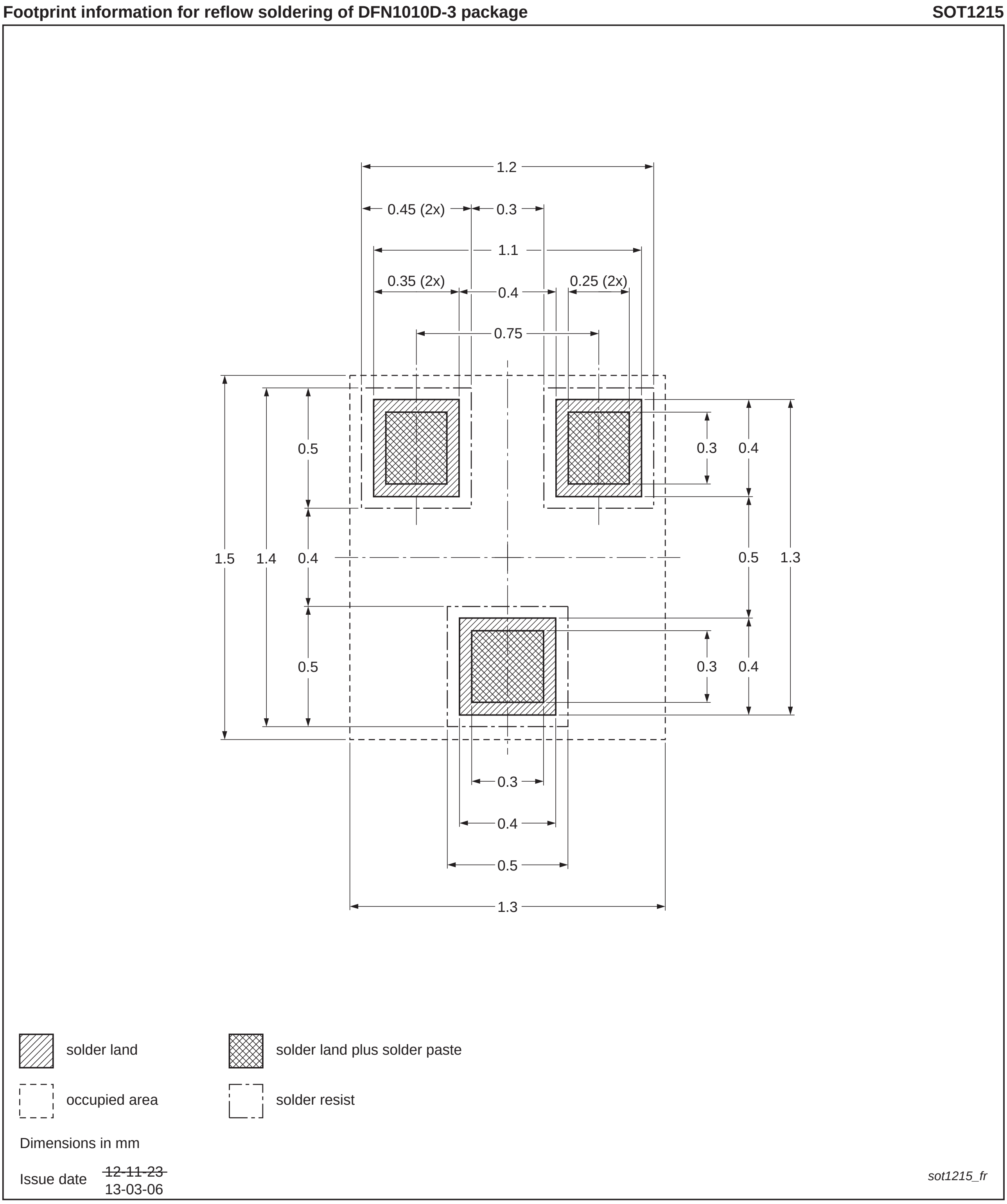


Fig 34. Reflow soldering footprint DFN1010D-3 (SOT1215)

11. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PDTD113_123_143_114EQA_SER v.1	20160104	Product data sheet	-	-

12. Legal information

12.1 Data sheet status

Document status[1][2]	Product status[3]	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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