

# PDTB113Z/123Y/143XQA series

50 V, 500 mA PNP resistor-equipped transistors

Rev. 1 — 6 January 2016

Product data sheet

## 1. Product profile

### 1.1 General description

PNP 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	NPN complement
PDTB113ZQA	1 k $\Omega$	10 k $\Omega$	DFN1010D-3 (SOT1215)	PDTD113ZQA
PDTB123YQA	2.2 k $\Omega$	10 k $\Omega$		PDTD123YQA
PDTB143XQA	4.7 k $\Omega$	10 k $\Omega$		PDTD143XQA

### 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

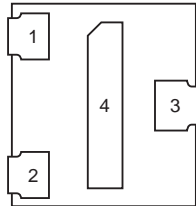
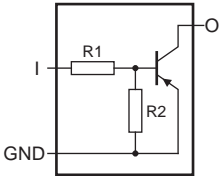
Table 2. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CEO}$	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)	 <p>Transparent top view</p>	 <p>aaa-019606</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
PDTB113ZQA	DFN1010D-3	plastic thermal enhanced ultra thin small outline package; no leads; 3 terminals; body: 1.1 × 1.0 × 0.37 mm	SOT1215
PDTB123YQA			
PDTB143XQA			

## 4. Marking

Table 5. Marking codes

Type number	Marking code
PDTB113ZQA	01 11 10
PDTB123YQA	10 00 01
PDTB143XQA	10 01 01

### 4.1 Binary marking code description

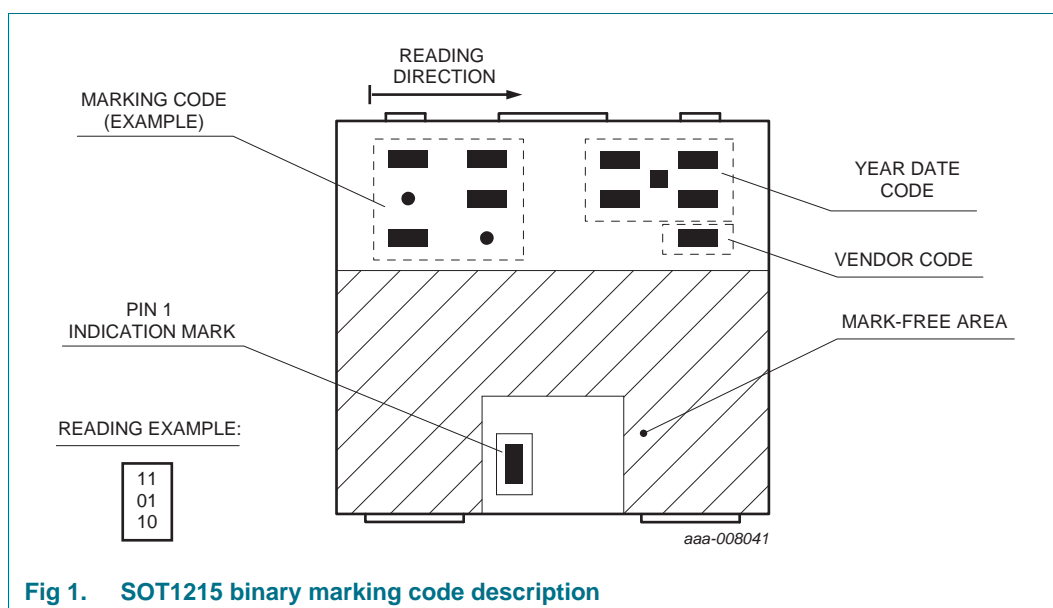


Fig 1. SOT1215 binary marking code description

## 5. Limiting values

Table 6. Limiting values

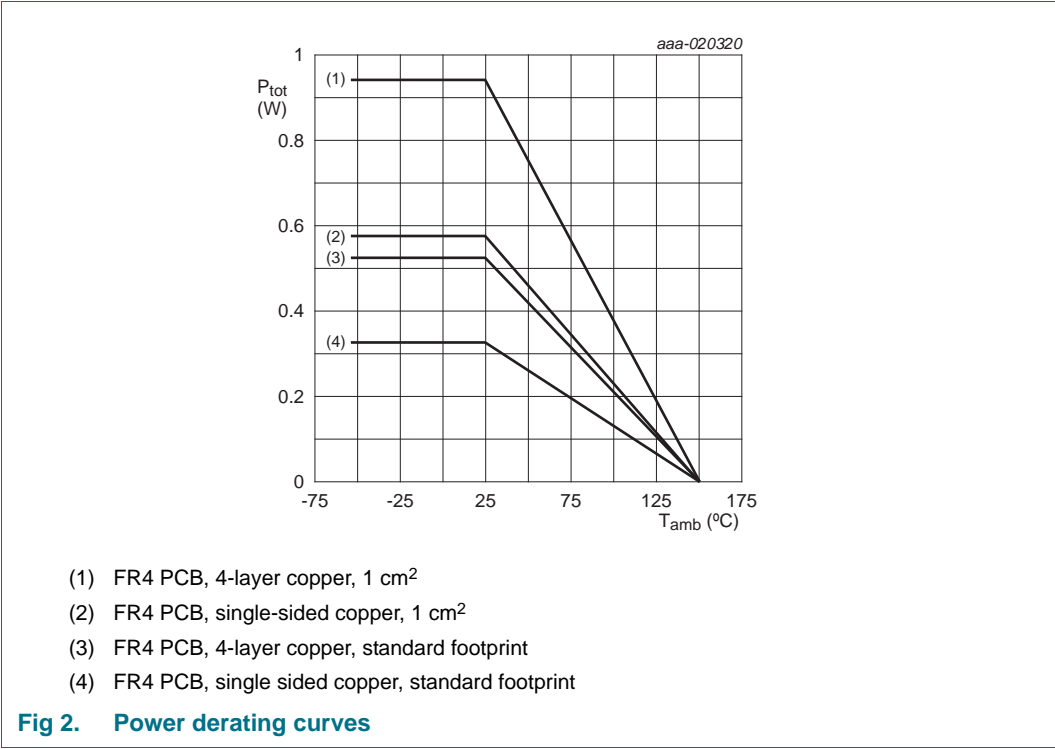
In accordance with the Absolute Maximum Rating System (IEC 60134).

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			
	PDTB113ZQA		-	-5	V
	PDTB123YQA		-	-5	V
	PDTB143XQA		-	-7	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				
	PDTB113ZQA		−10	+5	V
	PDTB123YQA		−12	+5	V
	PDTB143XQA		−30	+7	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>.

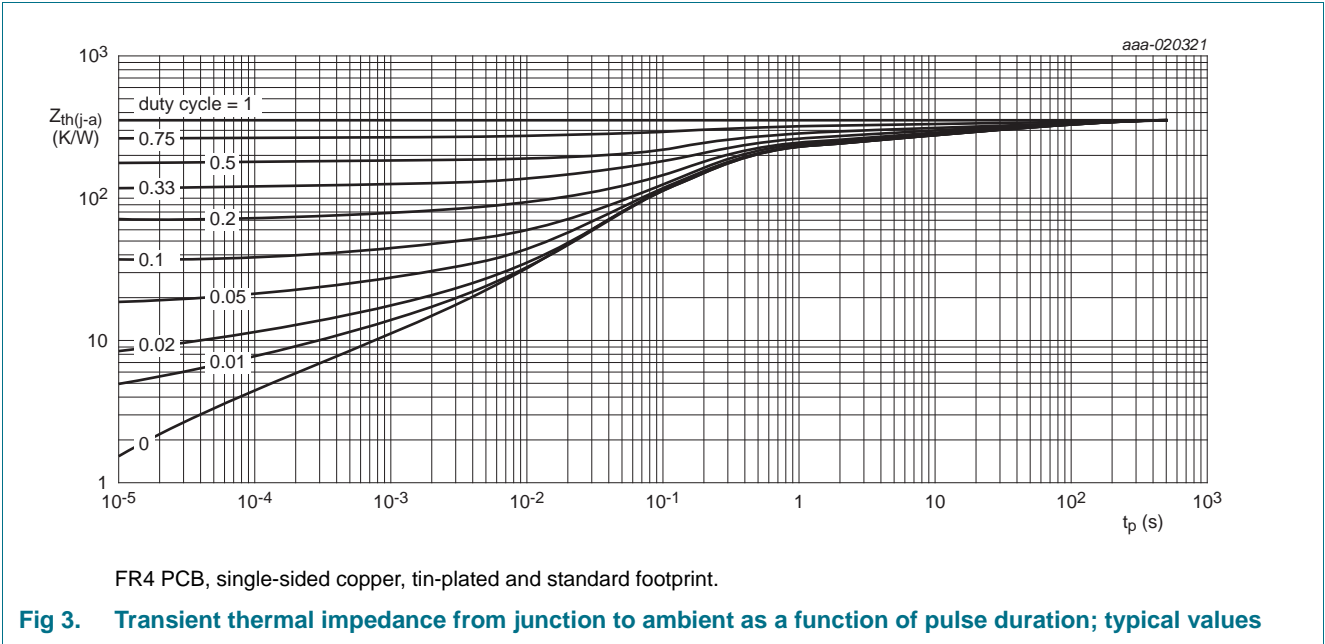


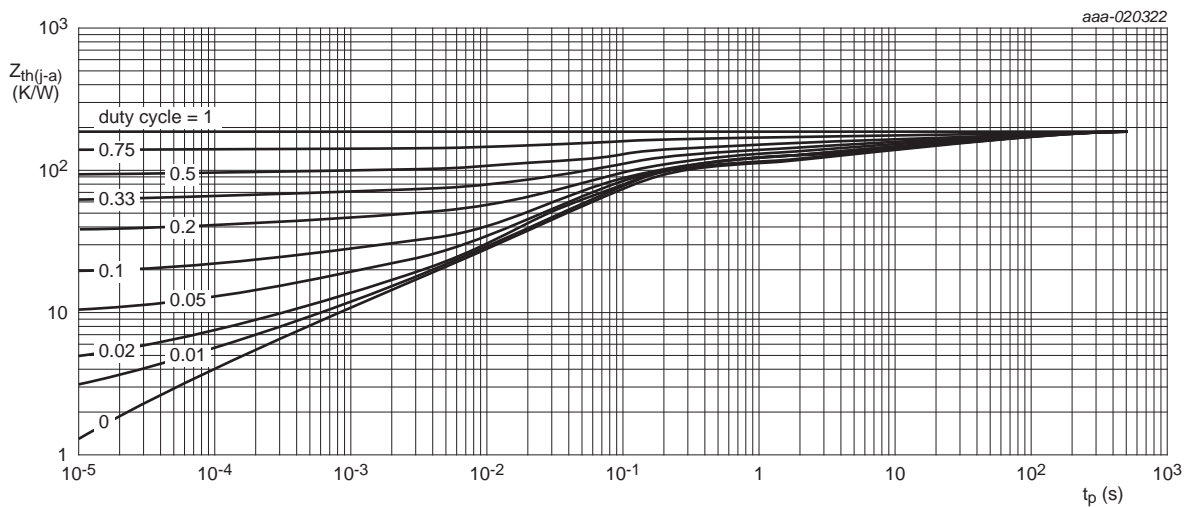
6. Thermal characteristics

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

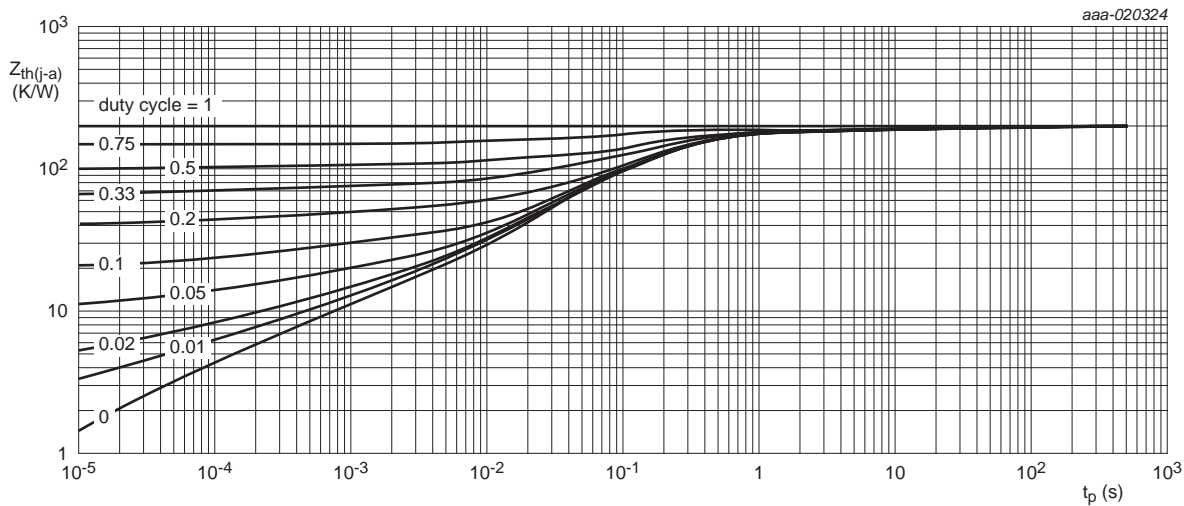
- [1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated; mounting pad for collector 1 cm<sup>2</sup>.
- [3] Device mounted on an FR4 PCB, 4-layer copper, tin-plated and standard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





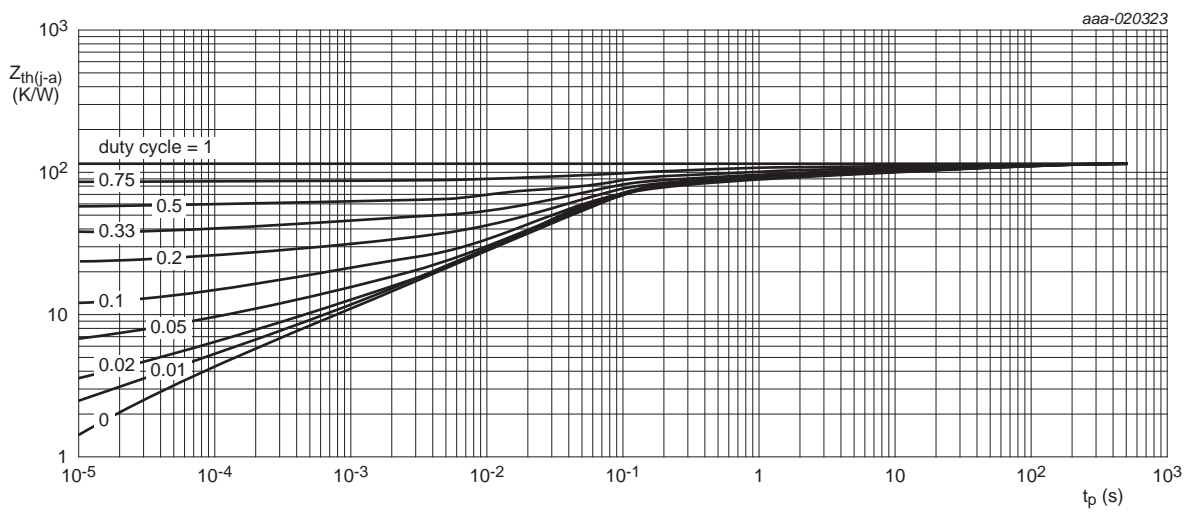
FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.

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**

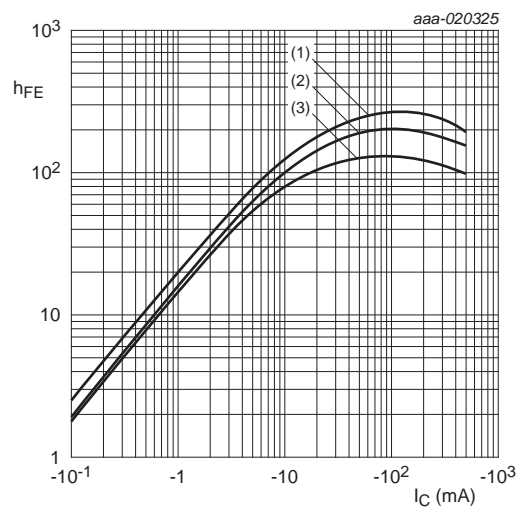
$T_{amb} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_{CBO}$	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					
	PDTB113ZQA	$V_{EB} = -5\text{ V}; I_C = 0\text{ A}$	-	-	-0.8	mA
	PDTB123YQA		-	-	-0.65	mA
	PDTB143XQA		-	-	-0.6	mA
$h_{FE}$	DC current gain	$V_{CE} = -5\text{ V}; I_C = -50\text{ mA}$	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					
	PDTB113ZQA	$V_{CE} = -5\text{ V}; I_C = -100\text{ }\mu\text{A}$	-0.3	-0.65	-1	V
	PDTB123YQA		-0.4	-0.65	-1	V
	PDTB143XQA		-0.5	-0.75	-1.1	V
$V_{I(on)}$	on-state input voltage					
	PDTB113ZQA	$V_{CE} = -0.3\text{ V}; I_C = -20\text{ mA}$	-0.4	-0.8	-1.4	V
	PDTB123YQA		-0.5	-1	-1.4	V
	PDTB143XQA		-1	-1.4	-2	V
R1	bias resistor 1 (input)	[1]				
	PDTB113ZQA		0.7	1	1.3	$\text{k}\Omega$
	PDTB123YQA		1.54	2.2	2.86	$\text{k}\Omega$
	PDTB143XQA		3.3	4.7	6.1	$\text{k}\Omega$
R2/R1	bias resistor ratio	[1]				
	PDTB113ZQA		9	10	11	
	PDTB123YQA		4.1	4.55	5	
	PDTB143XQA		1.91	2.13	2.34	
$C_c$	collector capacitance	$V_{CB} = -10\text{ V}; I_E = i_e = 0\text{ A}; f = 1\text{ MHz}$	-	7	-	pF
$f_T$	transition frequency	$V_{CE} = -5\text{ V}; I_C = -50\text{ mA}; f = 100\text{ MHz}$ [2]	-	150	-	MHz

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

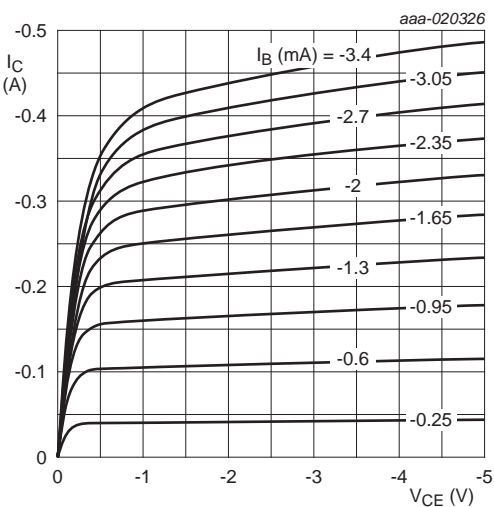
[2] Characteristics of built-in transistor.





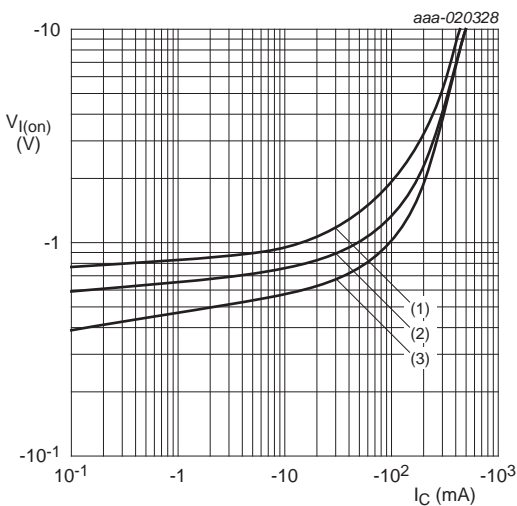
- $V_{CE} = -5\text{ V}$
- (1)  $T_{amb} = 100\text{ }^{\circ}\text{C}$
  - (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$
  - (3)  $T_{amb} = -40\text{ }^{\circ}\text{C}$

Fig 7. PDCB113ZQA: DC current gain as a function of collector current; typical values



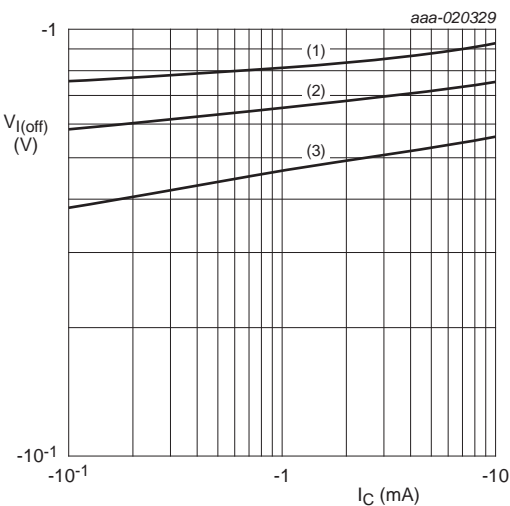
$T_{amb} = 25\text{ }^{\circ}\text{C}$

Fig 8. PDTB113ZQA: Collector current as a function of collector-emitter voltage; typical values



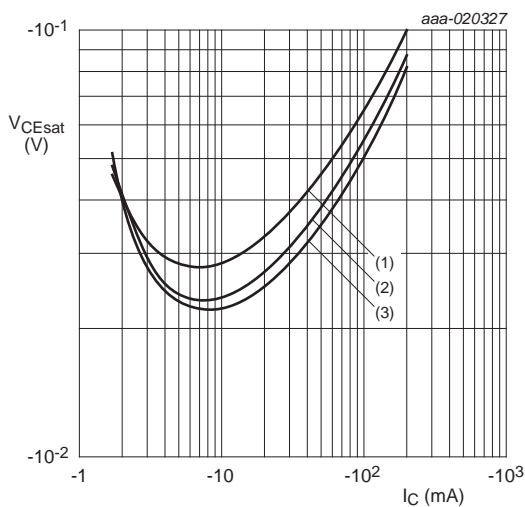
- $V_{CE} = -0.3\text{ V}$
- (1)  $T_{amb} = -40\text{ }^{\circ}\text{C}$
  - (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$
  - (3)  $T_{amb} = 100\text{ }^{\circ}\text{C}$

Fig 9. PDTB113ZQA: On-state input voltage as a function of collector current; typical values



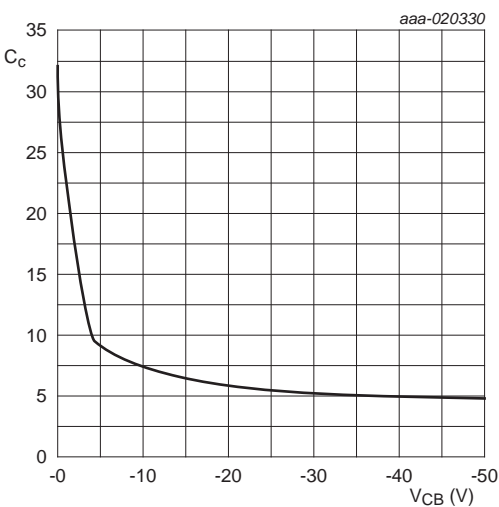
- $V_{CE} = -5\text{ V}$
- (1)  $T_{amb} = -40\text{ }^{\circ}\text{C}$
  - (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$
  - (3)  $T_{amb} = 100\text{ }^{\circ}\text{C}$

Fig 10. PDTB113ZQA: Off-state input voltage as a function of collector current; typical values



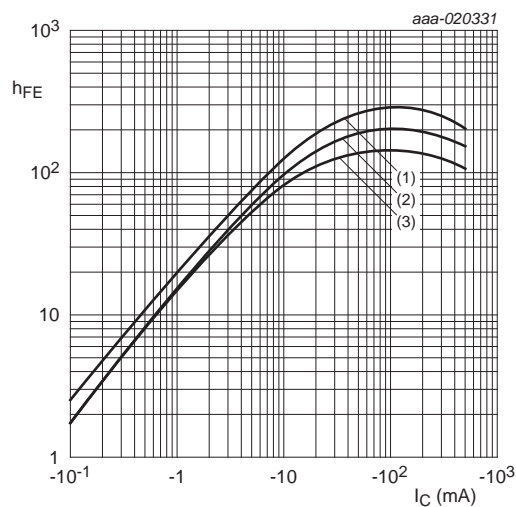
$I_C/I_B = 20$   
(1)  $T_{amb} = 100\text{ }^{\circ}\text{C}$   
(2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
(3)  $T_{amb} = -40\text{ }^{\circ}\text{C}$

Fig 11. PDTB113ZQA: Collector-emitter saturation voltage as a function of collector current; typical values



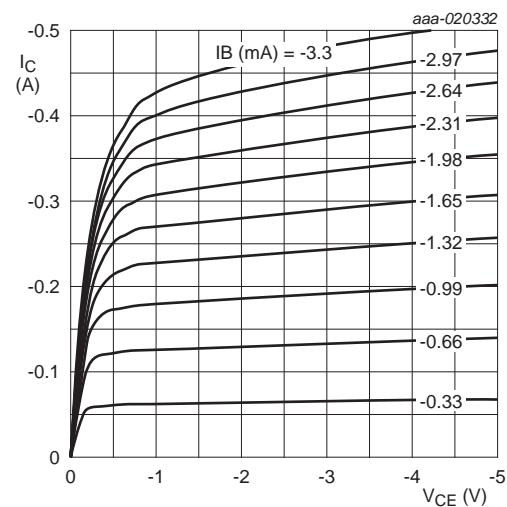
$f = 1\text{ MHz}$ ;  $T_{amb} = 25\text{ }^{\circ}\text{C}$

Fig 12. PDTB113ZQA: Collector capacitance as a function of collector-base voltage; typical values



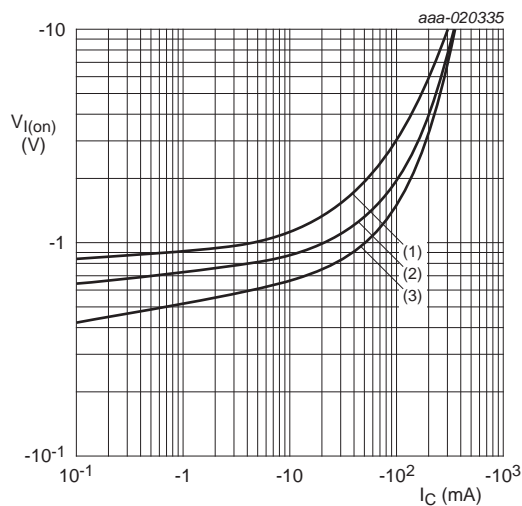
- $V_{CE} = -5\text{ V}$
- (1)  $T_{amb} = 100\text{ °C}$
  - (2)  $T_{amb} = 25\text{ °C}$
  - (3)  $T_{amb} = -40\text{ °C}$

Fig 13. PDTB123YQA: DC current gain as a function of collector current; typical values



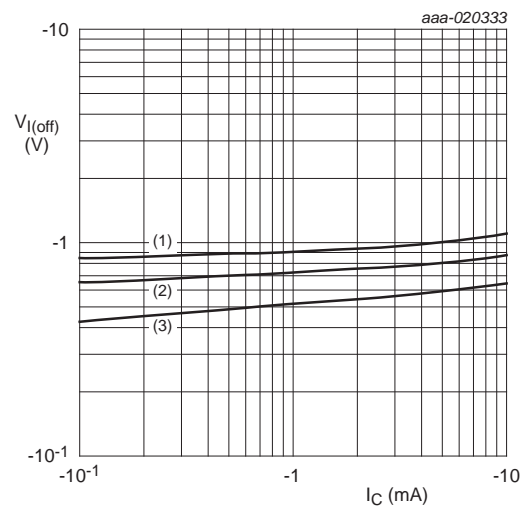
$T_{amb} = 25\text{ °C}$

Fig 14. PDTB123YQA: Collector current as a function of collector-emitter voltage; typical values



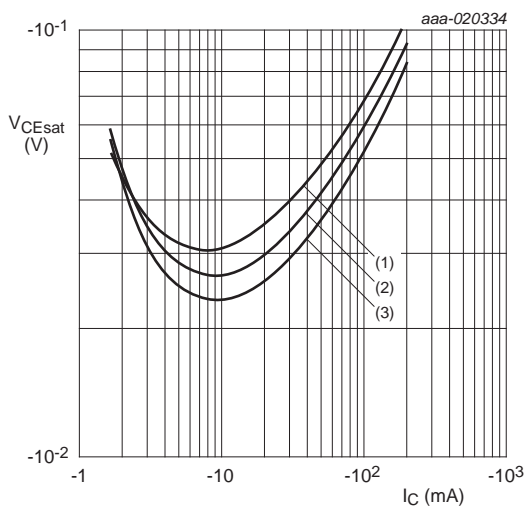
- $V_{CE} = -0.3\text{ V}$
- (1)  $T_{amb} = -40\text{ °C}$
  - (2)  $T_{amb} = 25\text{ °C}$
  - (3)  $T_{amb} = 100\text{ °C}$

Fig 15. PDTB123YQA: On-state input voltage as a function of collector current; typical values



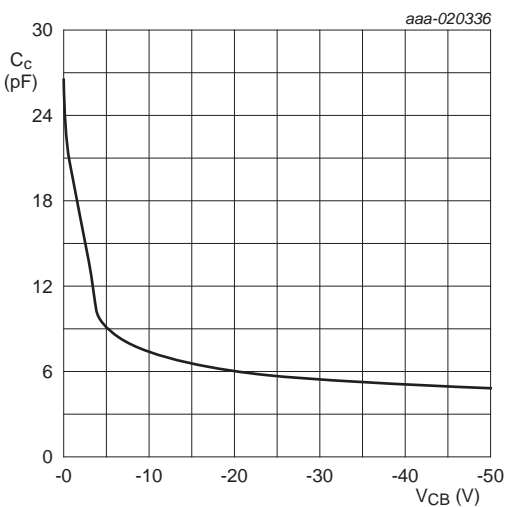
- $V_{CE} = -5\text{ V}$
- (1)  $T_{amb} = -40\text{ °C}$
  - (2)  $T_{amb} = 25\text{ °C}$
  - (3)  $T_{amb} = 100\text{ °C}$

Fig 16. PDTB123YQA: 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. PDTB123YQA: 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. PDTB123YQA: Collector capacitance as a function of collector-base voltage; typical values

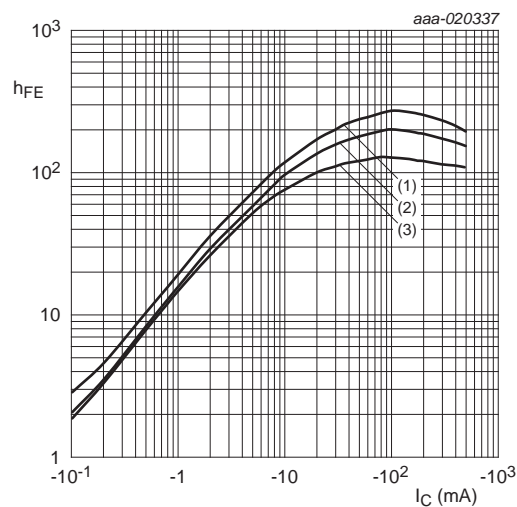


Fig 19. PDTB143XQA: DC current gain as a function of collector current; typical values

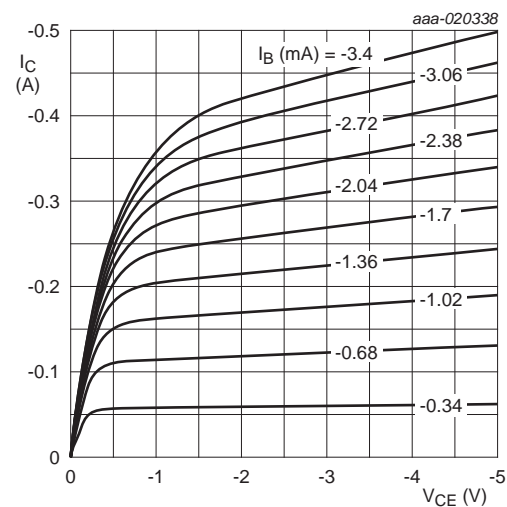


Fig 20. PDTB143XQA: Collector current as a function of collector-emitter voltage; typical values

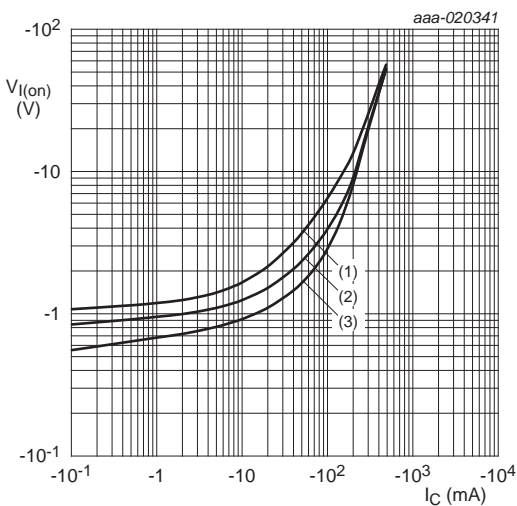


Fig 21. PDTB143XQA: On-state input voltage as a function of collector current; typical values

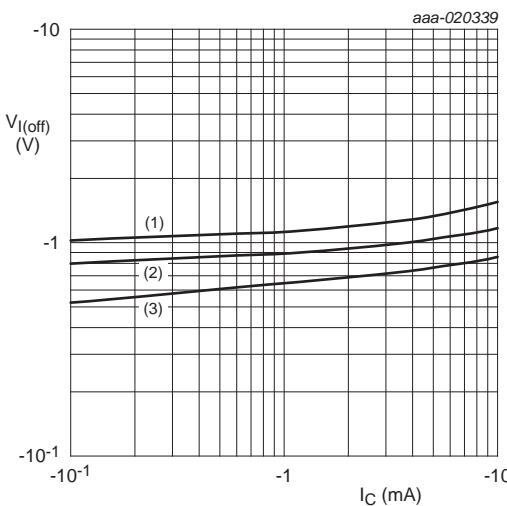
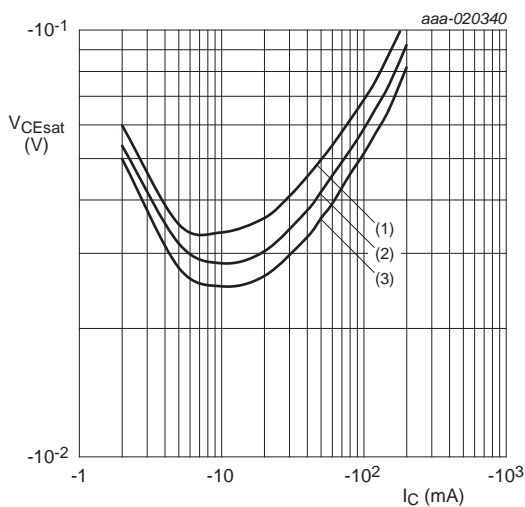
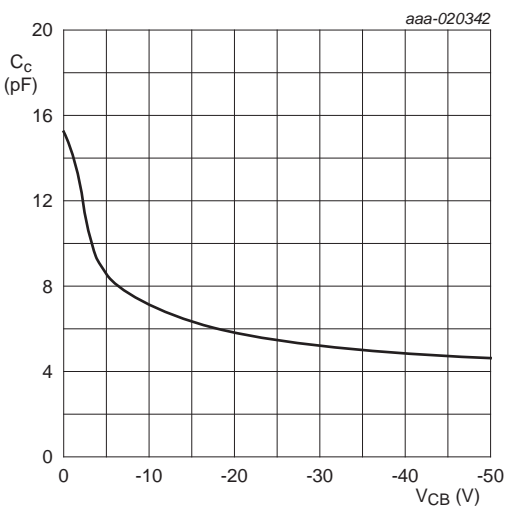


Fig 22. PDTB143XQA: Off-state input voltage as a function of collector current; typical values



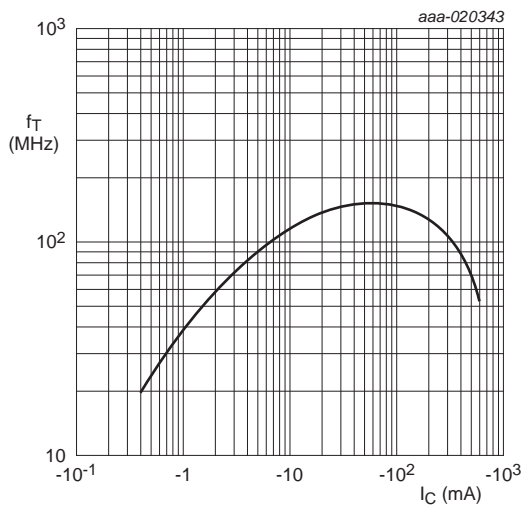
$I_C/I_B = 20$   
(1)  $T_{amb} = 100\text{ }^{\circ}\text{C}$   
(2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
(3)  $T_{amb} = -40\text{ }^{\circ}\text{C}$

Fig 23. PDTB143XQA: 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. PDTB143XQA: Collector capacitance as a function of collector-base voltage; typical values



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

Fig 25. 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):

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

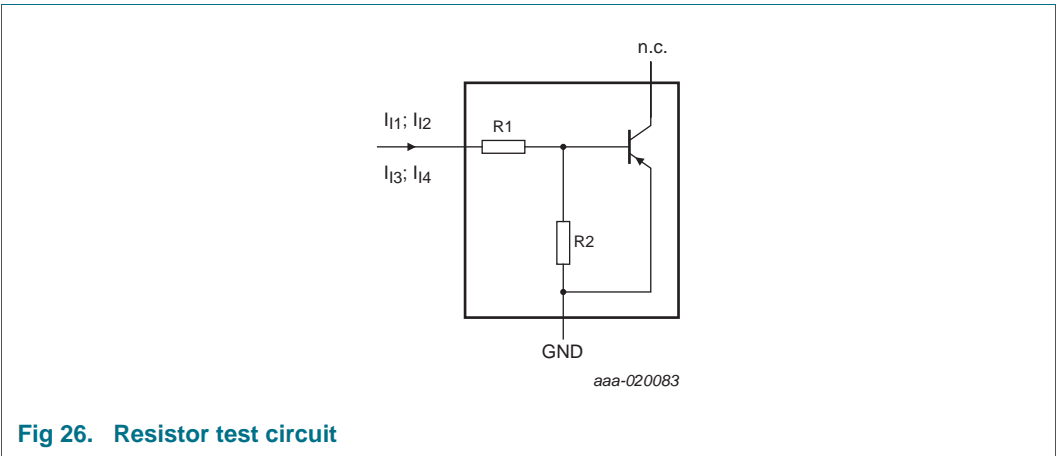


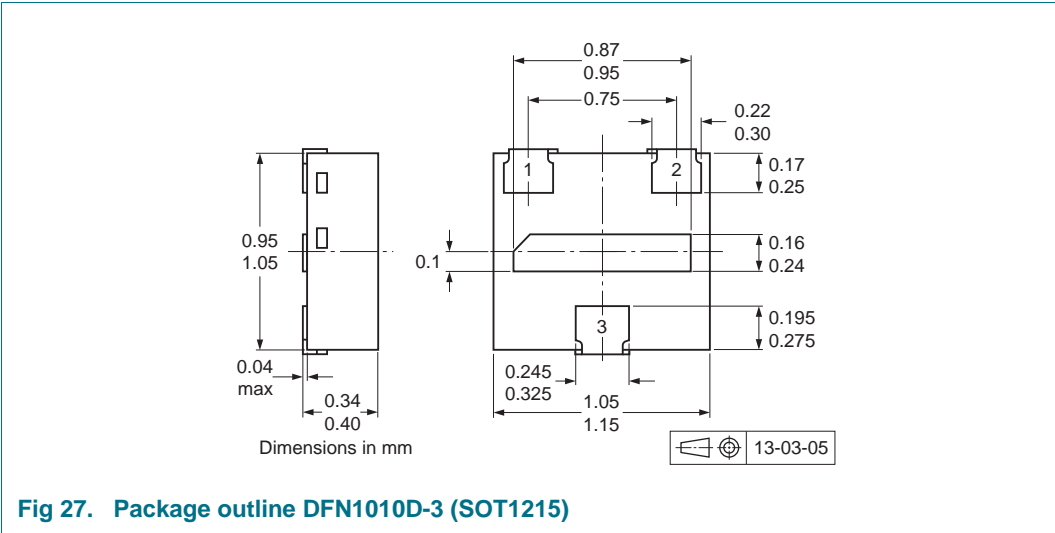
Fig 26. Resistor test circuit

8.3 Resistor test conditions

Table 9. Resistor test conditions

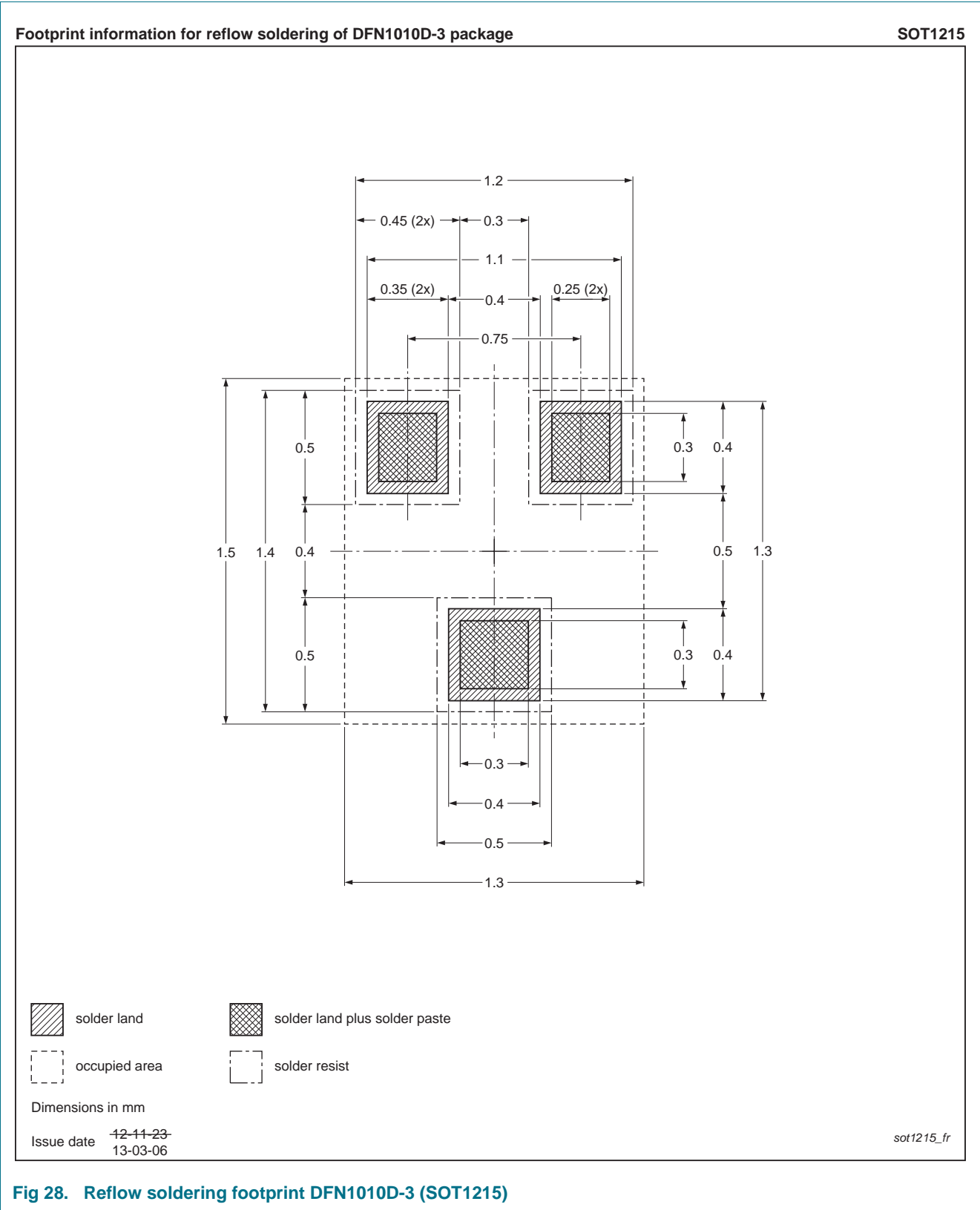
Type number	R1	R2	Test conditions			
	kΩ	kΩ	I <sub>I1</sub>	I <sub>I2</sub>	I <sub>I3</sub>	I <sub>I4</sub>
PDTB113ZQA	1	10	−0.7 mA	−0.8 mA	0.45 mA	0.55 mA
PDTB123YQA	2.2	10	−0.7 mA	−0.8 mA	0.45 mA	0.55 mA
PDTB143XQA	4.7	10	−1.3 mA	−1.5 mA	0.45 mA	0.55 mA

9. Package outline





10. Soldering



## 11. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PDTB113Z_123Y_143XQA_SER v.1	20160106	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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## 14. Contents

<b>1</b>	<b>Product profile</b>	<b>1</b>
1.1	General description	1
1.2	Features and benefits	1
1.3	Applications	1
1.4	Quick reference data	1
<b>2</b>	<b>Pinning information</b>	<b>2</b>
<b>3</b>	<b>Ordering information</b>	<b>2</b>
<b>4</b>	<b>Marking</b>	<b>3</b>
4.1	Binary marking code description	3
<b>5</b>	<b>Limiting values</b>	<b>3</b>
<b>6</b>	<b>Thermal characteristics</b>	<b>5</b>
<b>7</b>	<b>Characteristics</b>	<b>6</b>
<b>8</b>	<b>Test information</b>	<b>16</b>
8.1	Quality information	16
8.2	Resistor calculation	16
8.3	Resistor test conditions	16
<b>9</b>	<b>Package outline</b>	<b>16</b>
<b>10</b>	<b>Soldering</b>	<b>17</b>
<b>11</b>	<b>Revision history</b>	<b>18</b>
<b>12</b>	<b>Legal information</b>	<b>19</b>
12.1	Data sheet status	19
12.2	Definitions	19
12.3	Disclaimers	19
12.4	Trademarks	20
<b>13</b>	<b>Contact information</b>	<b>20</b>
<b>14</b>	<b>Contents</b>	<b>21</b>

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