



# PRMD13

## 50 V, 100 mA NPN/PNP Resistor-Equipped double Transistors (RET)

14 September 2018

Product data sheet

### 1. General description

NPN/PNP Resistor-Equipped double Transistors (RET) in an ultra small DFN1412-6 (SOT1268) leadless Surface-Mounted Device (SMD) plastic package.

NPN/PNP complement: PRMH13.

### 2. Features and benefits

- 100 mA output current capability
- Built-in bias resistors
- Simplifies circuit design
- Reduces component count
- Reduces pick and place costs
- Low package height of 0.5 mm
- AEC-Q101 qualified

### 3. Applications

- Digital applications
- Cost-saving alternative to BC847/BC857 series in digital applications
- Control of IC inputs
- Switching loads

### 4. Quick reference data

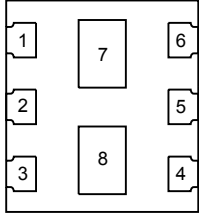
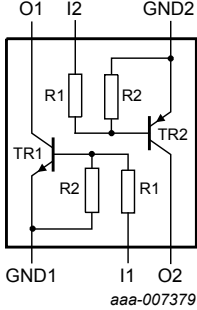
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Per transistor, for the PNP transistor with negative polarity</b>						
$V_{CEO}$	collector-emitter voltage	open base	-	-	50	V
$I_O$	output current		-	-	100	mA
$h_{FE}$	DC current gain	$V_{CE} = 5\text{ V}; I_C = 10\text{ mA}; T_{amb} = 25\text{ }^\circ\text{C}$	100	-	-	
R1	bias resistor 1	$T_{amb} = 25\text{ }^\circ\text{C}$	[1]	3.3	4.7	6.1 k $\Omega$
R2/R1	bias resistor ratio		[1]	8	10	12

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

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	GND1	GND (emitter) TR1	 <p>Transparent top view DFN1412-6 (SOT1268)</p>	 <p>GND1 I2 GND2 O1 R1 R2 TR1 TR2 R2 R1 GND1 I1 O2 aaa-007379</p>
2	I1	input (base) TR1		
3	O2	output (collector) TR2		
4	GND2	GND (emitter) TR2		
5	I2	input (base) TR2		
6	O1	output (collector) TR1		
7	O1	output (collector) TR1		
8	O2	output (collector) TR2		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PRMD13	DFN1412-6	plastic thermal enhanced ultra thin small outline package; no leads; 6 terminals; body: 1.4 mm x 1.2 mm x 0.47 mm	SOT1268

## 7. Marking

Table 4. Marking codes

Type number	Marking code
PRMD13	B6

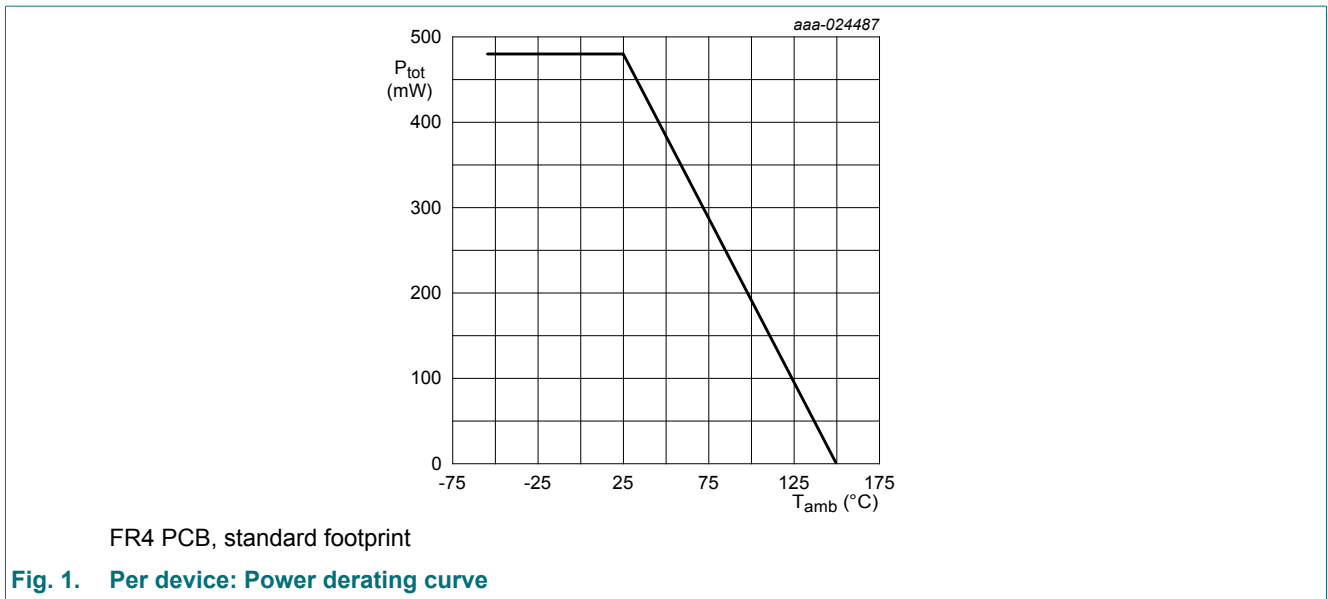
## 8. Limiting values

**Table 5. Limiting values**

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

Symbol	Parameter	Conditions		Min	Max	Unit
<b>Per transistor, for the PNP transistor with negative polarity</b>						
$V_{CBO}$	collector-base voltage	open emitter		-	50	V
$V_{CEO}$	collector-emitter voltage	open base		-	50	V
$V_{EBO}$	emitter-base voltage	open collector		-	5	V
$V_I$	input voltage	negative		-5	-	V
		positive		-	30	V
$I_O$	output current			-	100	mA
$P_{tot}$	total power dissipation	$T_{amb} \leq 25\text{ °C}$	[1]	-	325	mW
<b>Per device</b>						
$P_{tot}$	total power dissipation	$T_{amb} \leq 25\text{ °C}$	[1]	-	480	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.

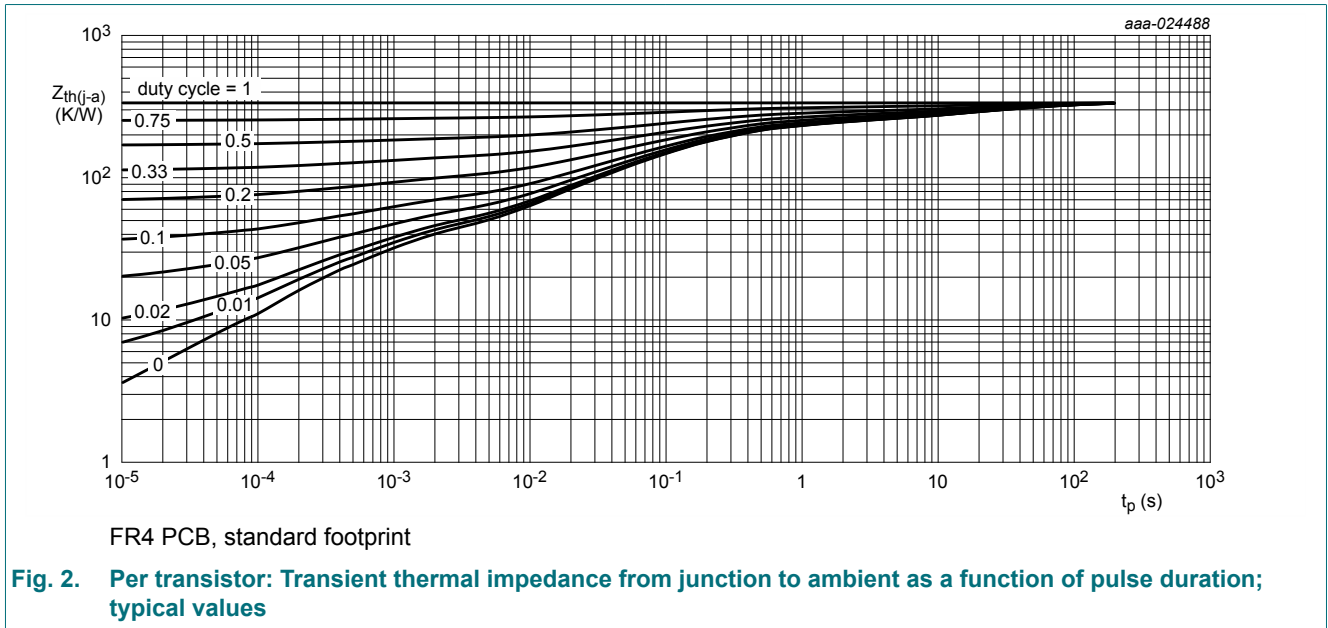


## 9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
<b>Per transistor</b>							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	385	K/W
<b>Per device</b>							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	261	K/W

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

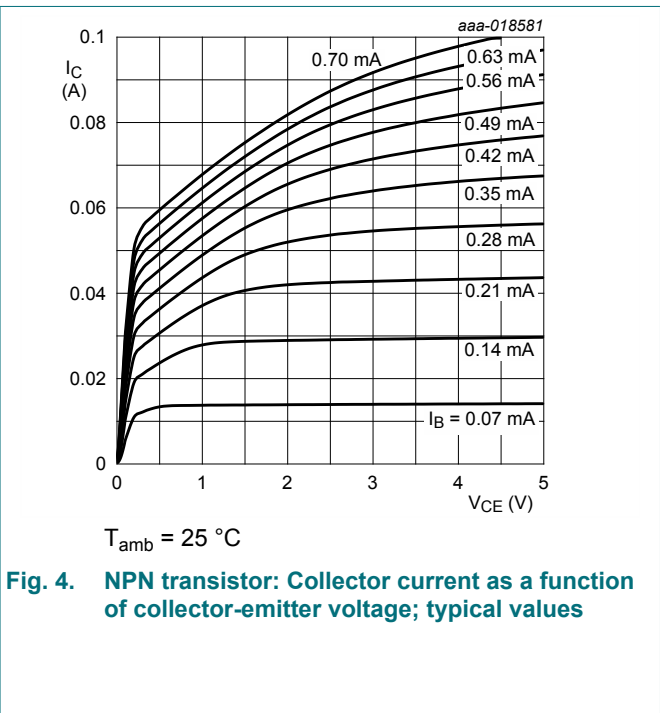
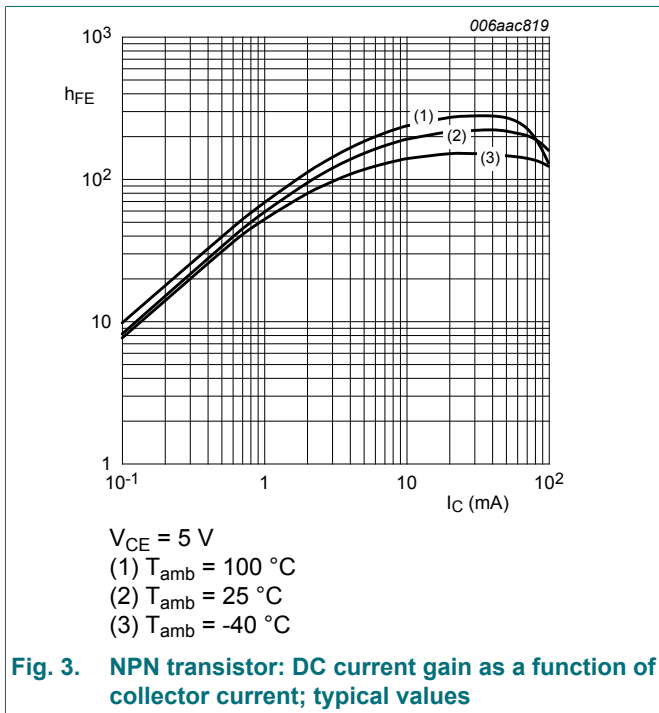


## 10. Characteristics

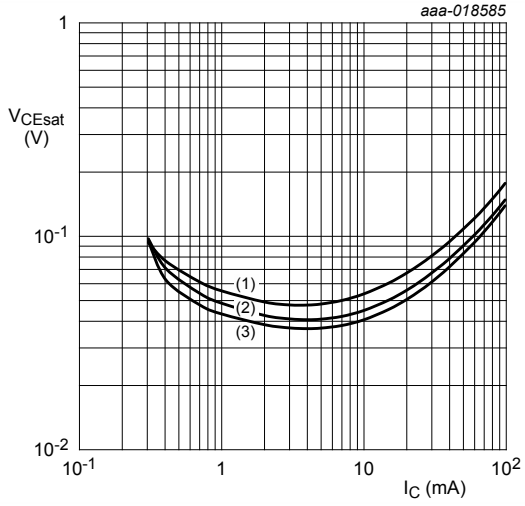
Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
<b>Per transistor, for the PNP transistor with negative polarity</b>							
$I_{CEO}$	collector-emitter cut-off current	$V_{CE} = 30\text{ V}; I_B = 0\text{ A}; T_{amb} = 25\text{ °C}$	-	-	1	$\mu\text{A}$	
		$V_{CE} = 30\text{ V}; I_B = 0\text{ A}; T_j = 150\text{ °C}$	-	-	5	$\mu\text{A}$	
$I_{CBO}$	collector-base cut-off current	$V_{CB} = 50\text{ V}; I_E = 0\text{ A}; T_{amb} = 25\text{ °C}$	-	-	100	nA	
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 5\text{ V}; I_C = 0\text{ A}; T_{amb} = 25\text{ °C}$	-	-	170	$\mu\text{A}$	
$h_{FE}$	DC current gain	$V_{CE} = 5\text{ V}; I_C = 10\text{ mA}; T_{amb} = 25\text{ °C}$	100	-	-		
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 5\text{ mA}; I_B = 0.25\text{ mA}; T_{amb} = 25\text{ °C}$	-	-	100	mV	
$V_{I(off)}$	off-state input voltage	$V_{CE} = 5\text{ V}; I_C = 100\text{ }\mu\text{A}; T_{amb} = 25\text{ °C}$	-	0.6	0.5	V	
$V_{I(on)}$	on-state input voltage	$V_{CE} = 0.3\text{ V}; I_C = 5\text{ mA}; T_{amb} = 25\text{ °C}$	1.3	0.9	-	V	
R1	bias resistor 1	$T_{amb} = 25\text{ °C}$	[1]	3.3	4.7	6.1	k $\Omega$
R2/R1	bias resistor ratio		[1]	8	10	12	
$C_C$	collector capacitance	$V_{CB} = 10\text{ V}; I_E = 0\text{ A}; i_e = 0\text{ A}; f = 1\text{ MHz}; T_{amb} = 25\text{ °C}$	-	-	2.5	pF	
		$V_{CB} = -10\text{ V}; I_E = 0\text{ A}; i_e = 0\text{ A}; f = 1\text{ MHz}; T_{amb} = 25\text{ °C}$	-	-	3	pF	
$f_T$	transition frequency	$V_{CE} = 5\text{ V}; I_C = 10\text{ mA}; f = 100\text{ MHz}; T_{amb} = 25\text{ °C}$	[2]	-	230	-	MHz
		$V_{CE} = -5\text{ V}; I_C = -10\text{ mA}; f = 100\text{ MHz}; T_{amb} = 25\text{ °C}$	[2]	-	180	-	MHz

- [1] See section "Test information" for resistor calculation and test conditions.
- [2] Characteristics of built-in transistor.

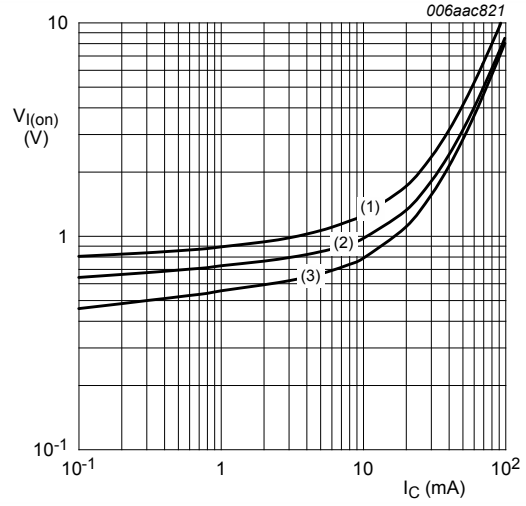


50 V, 100 mA NPN/PNP Resistor-Equipped double Transistors (RET)



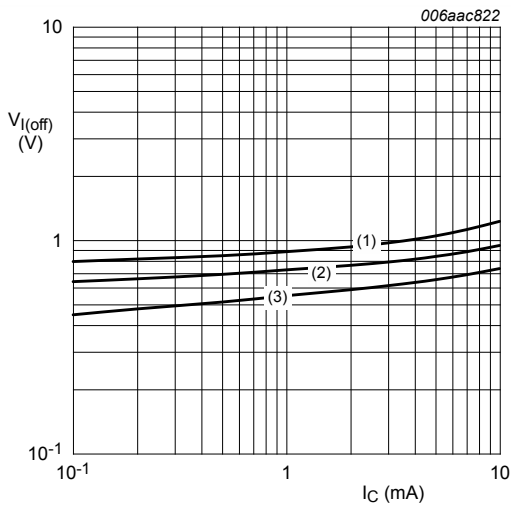
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -40\text{ °C}$

**Fig. 5. NPN transistor: Collector-emitter saturation voltage as a function of collector current; typical values**



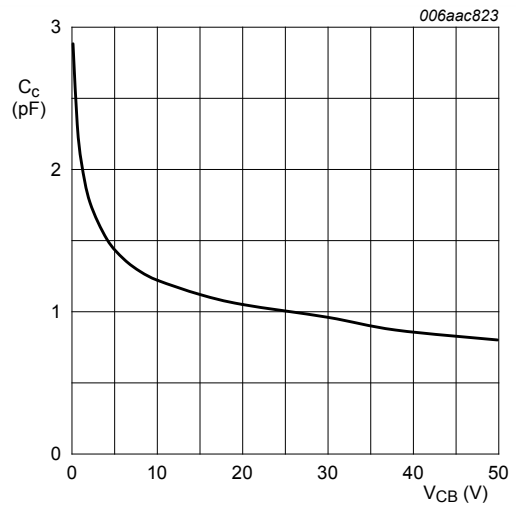
$V_{CE} = 0.3\text{ V}$   
 (1)  $T_{amb} = -40\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 100\text{ °C}$

**Fig. 6. NPN transistor: 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)  $T_{amb} = 100\text{ °C}$

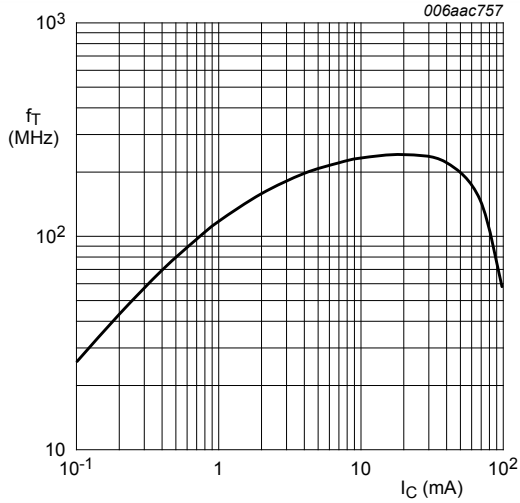
**Fig. 7. NPN transistor: Off-state input voltage as a function of collector current; typical values**



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

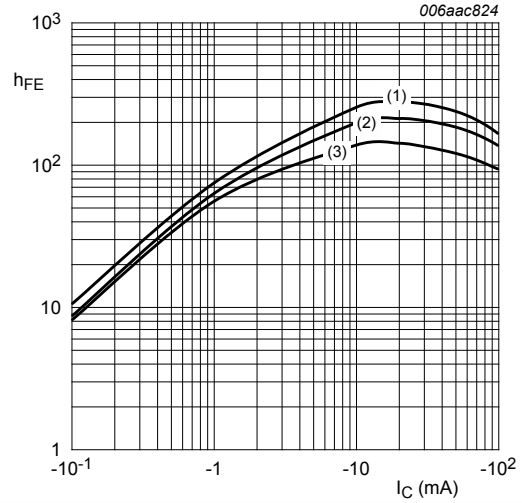
**Fig. 8. NPN transistor: Collector capacitance as a function of collector-base voltage; typical values**

50 V, 100 mA NPN/PNP Resistor-Equipped double Transistors (RET)



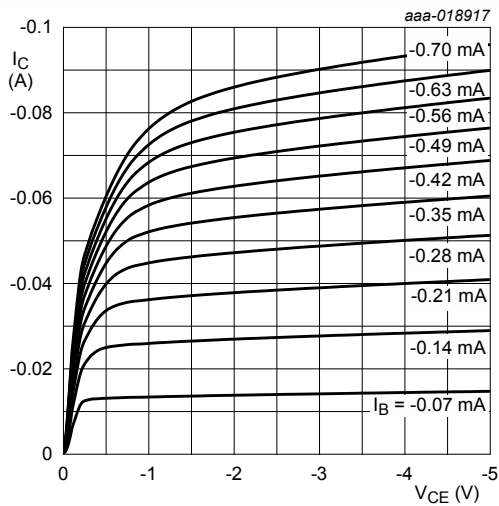
$V_{CE} = 5 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C}$

**Fig. 9. NPN transistor: Transition frequency as a function of collector current; typical values of built-in transistor**



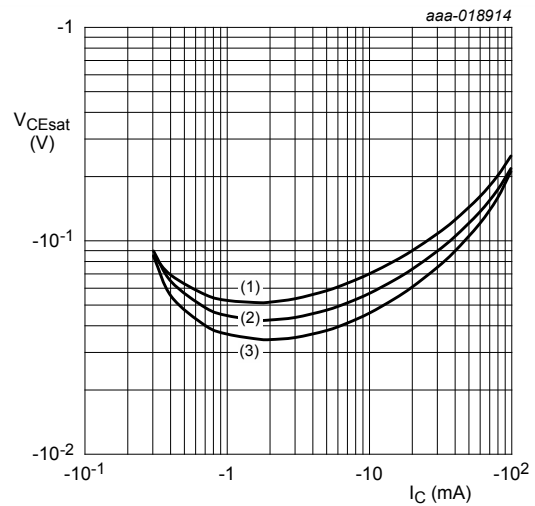
$V_{CE} = -5 \text{ V}$   
 (1)  $T_{amb} = 100 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -40 \text{ }^\circ\text{C}$

**Fig. 10. PNP transistor: DC current gain as a function of collector current; typical values**



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

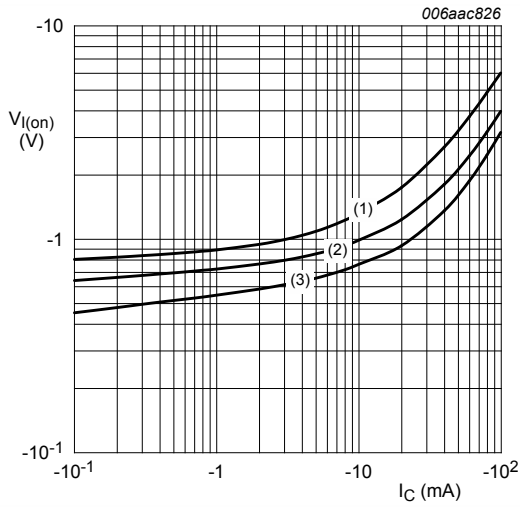
**Fig. 11. PNP transistor: Collector current as a function of collector-emitter voltage; typical values**



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

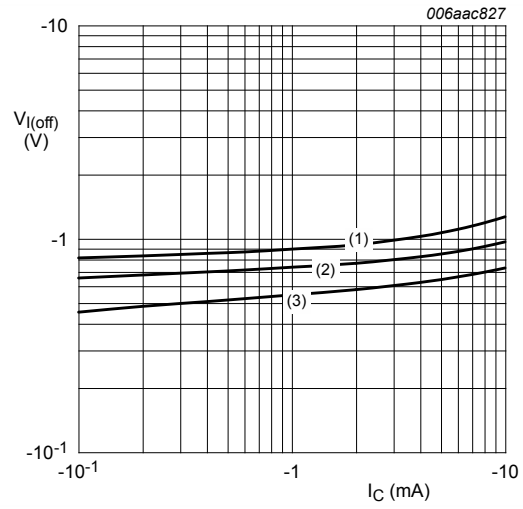
**Fig. 12. PNP transistor: Collector-emitter saturation voltage as a function of collector current; typical values**

50 V, 100 mA NPN/PNP Resistor-Equipped double Transistors (RET)



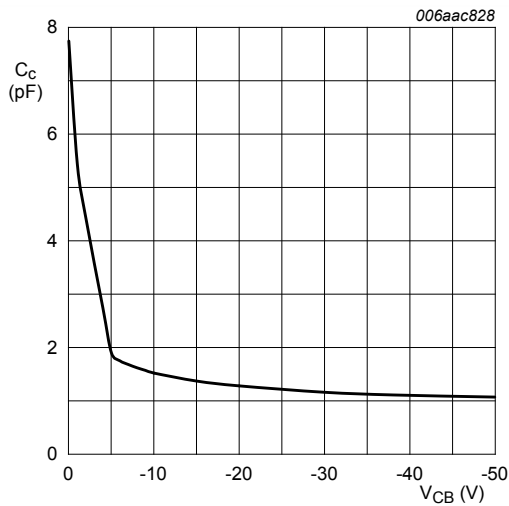
$V_{CE} = -0.3 \text{ V}$   
 (1)  $T_{amb} = -40 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100 \text{ }^\circ\text{C}$

Fig. 13. PNP transistor: On-state input voltage as a function of collector current; typical values



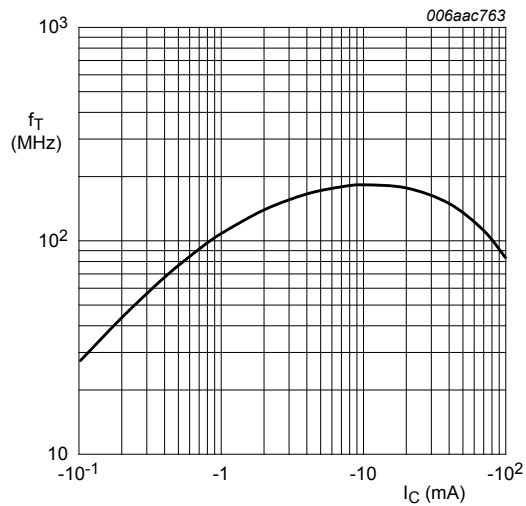
$V_{CE} = -5 \text{ V}$   
 (1)  $T_{amb} = -40 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100 \text{ }^\circ\text{C}$

Fig. 14. PNP transistor: Off-state input voltage as a function of collector current; typical values



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

Fig. 15. PNP transistor: Collector capacitance as a function of collector-base voltage; typical values



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

Fig. 16. PNP transistor: Transition frequency as a function of collector current; typical values of built-in transistor



## 11. Test information

### 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.

### Resistor calculation

- Calculation of bias resistor 1 (R1)

$$R1 = \frac{V(I12) - V(I11)}{I12 - I11}$$

- Calculation of bias resistor ratio (R2/R1)

$$\frac{R2}{R1} = \frac{V(I14) - V(I13)}{R1 \cdot (I14 - I13)} - 1$$

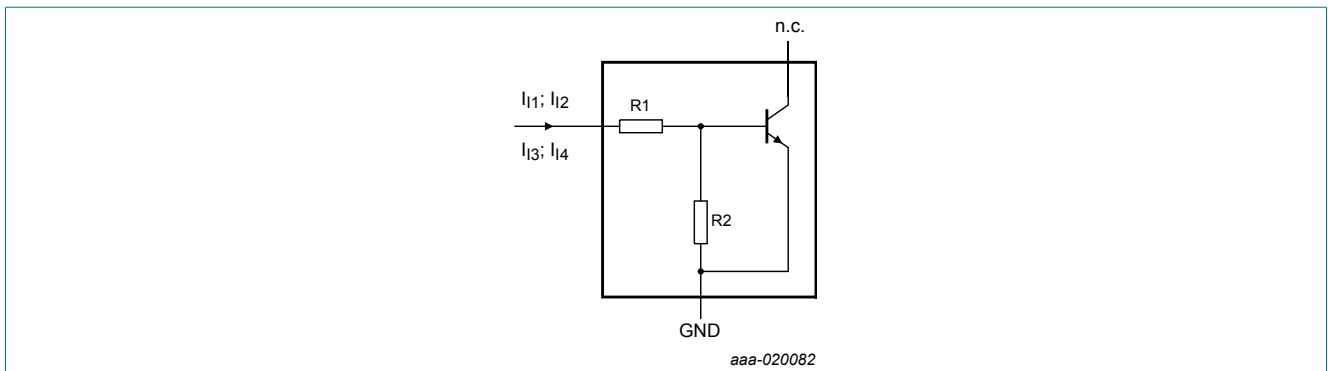


Fig. 17. NPN transistor: Resistor test circuit

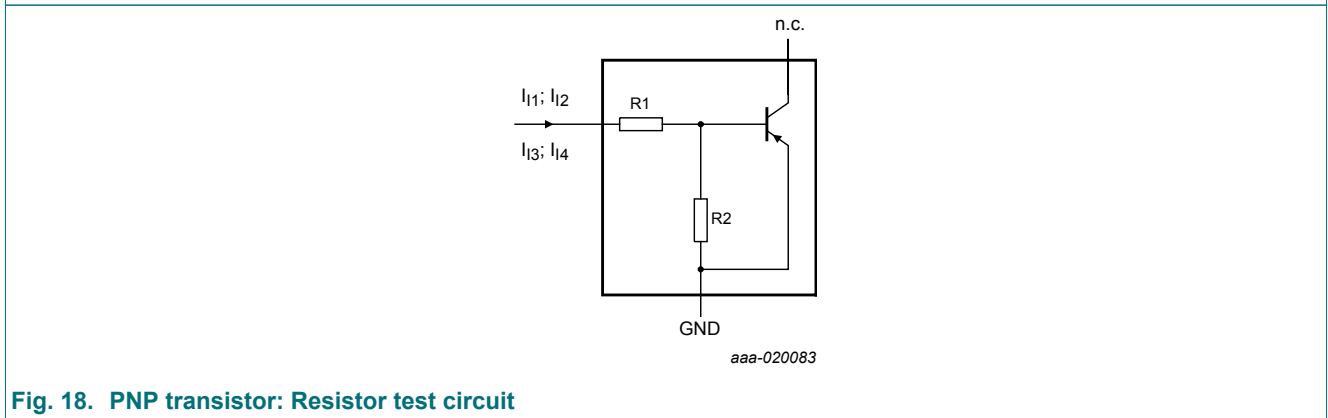


Fig. 18. PNP transistor: Resistor test circuit

### Resistor test conditions

Table 8. Resistor test conditions

Per transistor; for the PNP transistor with negative polarity

R1 (kΩ)	R2 (kΩ)	Test conditions			
		I <sub>11</sub>	I <sub>12</sub>	I <sub>13</sub>	I <sub>14</sub>
4.7	47	90 μA	140 μA	-55 μA	-105 μA

## 12. Package outline

DFN1412-6: plastic thermal enhanced ultra thin small outline package; no leads;  
6 terminals; body: 1.4 x 1.2 x 0.47 mm

SOT1268

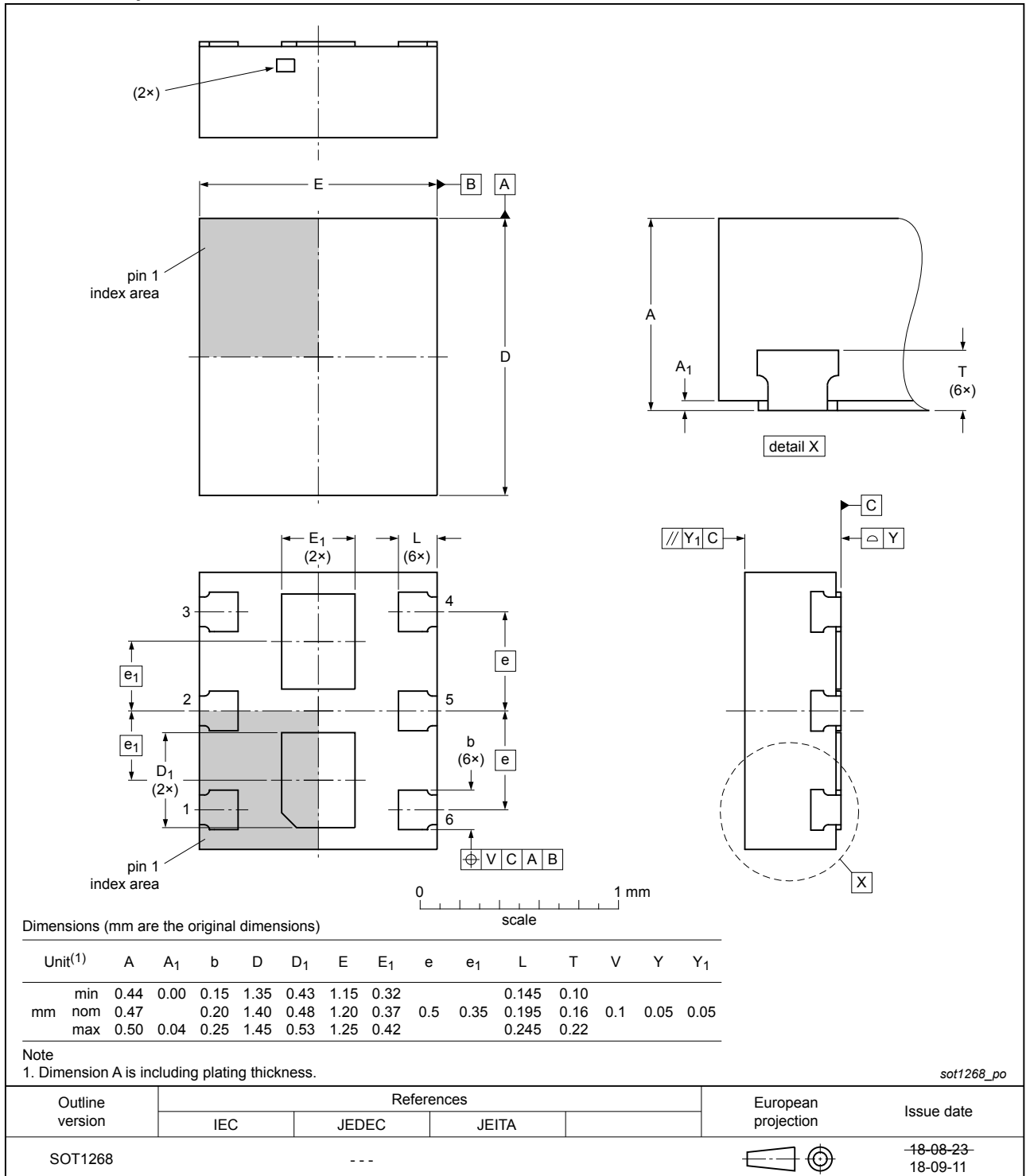


Fig. 19. Package outline DFN1412-6 (SOT1268)

### 13. Soldering

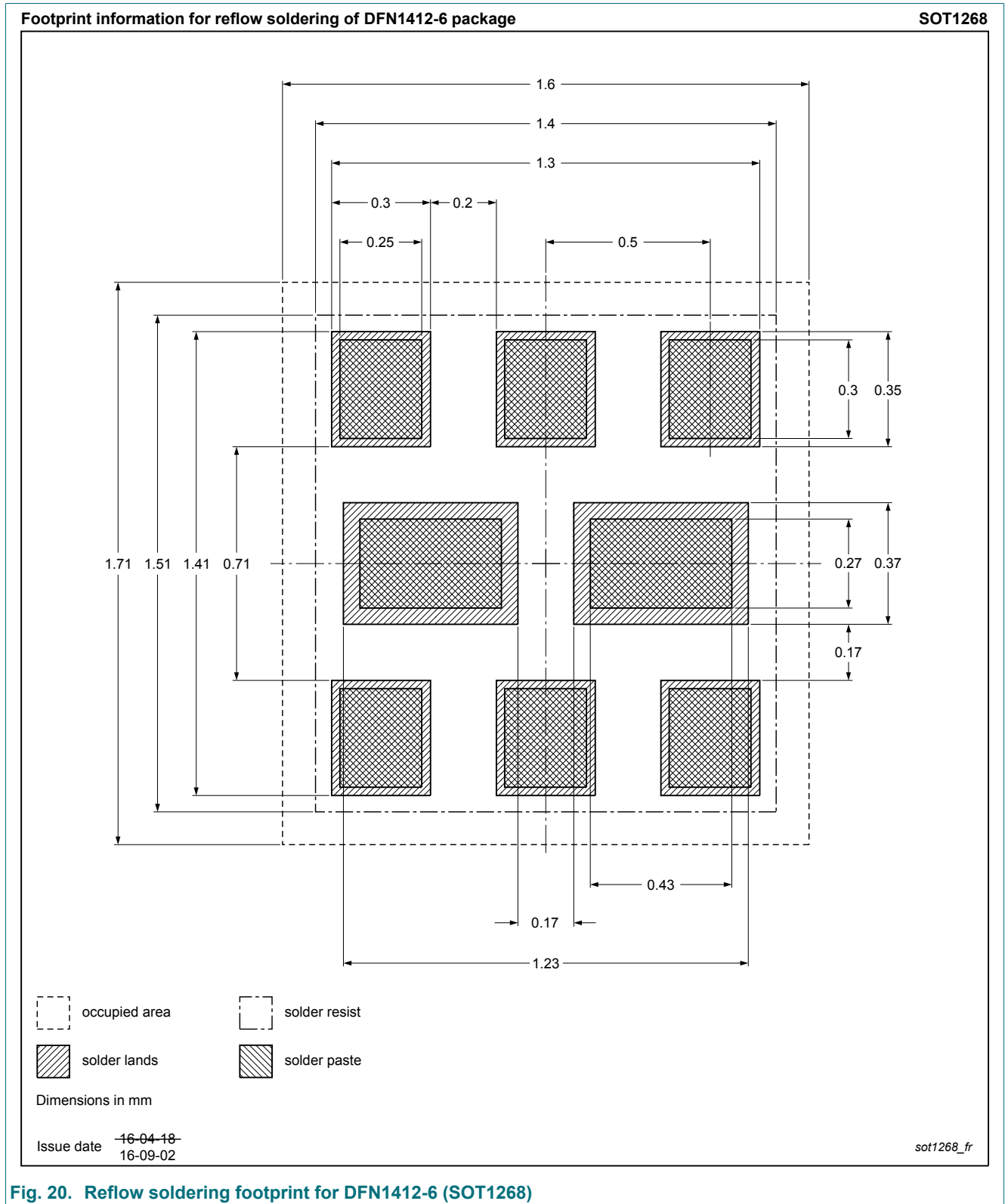


Fig. 20. Reflow soldering footprint for DFN1412-6 (SOT1268)

## 14. Revision history

**Table 9. Revision history**

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PRMD13 v.2	20180914	Product data sheet	-	PRMD13 v.1
Modifications:	• Package outline drawing updated: Unit T added			
PRMD13 v.1	20170725	Product data sheet	-	-

## 15. Legal information

### 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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