



# PEMD24

50 V, 20 mA NPN/PNP resistor-equipped double transistor;  
R1 = 100 k $\Omega$ , R2 = 100 k $\Omega$

6 March 2023

Product data sheet

## 1. General description

NPN/PNP Resistor-Equipped double Transistor (RET) in an ultra small flat lead SOT666 Surface-Mounted Device (SMD) plastic package.

PNP/PNP complement: PEMB24

## 2. Features and benefits

- Built-in bias resistors
- Simplifies circuit design
- Reduces component count
- Reduces pick and place costs

## 3. Applications

- Low current peripheral driver
- Control of IC inputs
- Replaces general-purpose transistors in digital applications

## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
<b>Per transistor</b>							
V <sub>CEO</sub>	collector-emitter voltage	open base	[1]	-	-	50	V
I <sub>O</sub>	output current		[1]	-	-	20	mA
R1	bias resistor 1 (input)		[2]	70	100	130	k $\Omega$
R2/R1	bias resistor ratio	T <sub>amb</sub> = 25 °C	[2]	0.8	1	1.2	

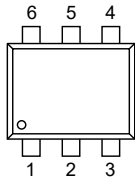
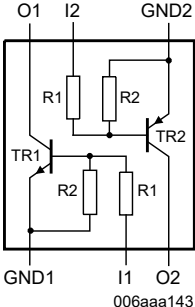
[1] For the PNP transistor with negative polarity.

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

50 V, 20 mA NPN/PNP resistor-equipped double transistor; R1 = 100 k $\Omega$ , R2 = 100 k $\Omega$ 

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	GND1	GND (emitter) TR1	 <p style="text-align: center;"><b>SOT666</b></p>	 <p style="text-align: center;">006aaa143</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		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
<a href="#">PEMD24</a>	SOT666	plastic, surface-mounted package; 6 leads; 0.5 mm pitch; 1.6 mm x 1.2 mm x 0.55 mm body	<a href="#">SOT666</a>

## 7. Marking

Table 4. Marking codes

Type number	Marking code
PEMD24	6N

## 8. Limiting values

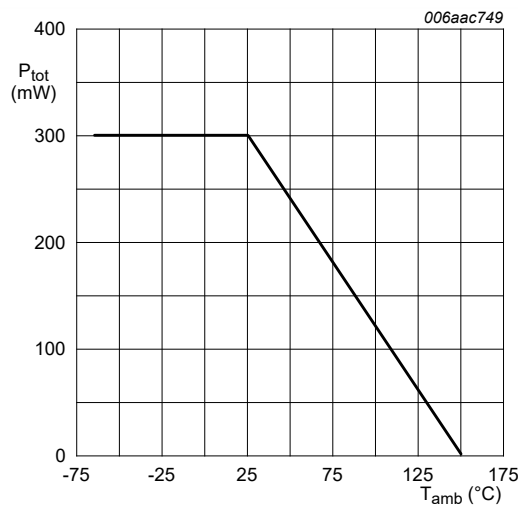
**Table 5. Limiting values**

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

Symbol	Parameter	Conditions		Min	Max	Unit
<b>Per transistor</b>						
$V_{CBO}$	collector-base voltage	open emitter	[1]	-	50	V
$V_{CEO}$	collector-emitter voltage	open base	[1]	-	50	V
$V_{EBO}$	emitter-base voltage	open collector	[1]	-	10	V
$V_I$	input voltage	input voltage TR1		-10	40	V
		input voltage TR2		-40	10	V
$I_O$	output current		[1]	-	20	mA
$I_{CM}$	peak collector current		[1]	-	100	mA
$P_{tot}$	total power dissipation	$T_{amb} \leq 25\text{ °C}$	[2]	-	200	mW
<b>Per device</b>						
$P_{tot}$	total power dissipation	$T_{amb} \leq 25\text{ °C}$	[2]	-	300	mW
$T_j$	junction temperature			-	150	°C
$T_{amb}$	ambient temperature			-65	150	°C
$T_{stg}$	storage temperature			-65	150	°C

[1] For the PNP transistor with negative polarity.

[2] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.



FR4 PCB, single-sided, 35 μm copper, tin-plated and standard footprint

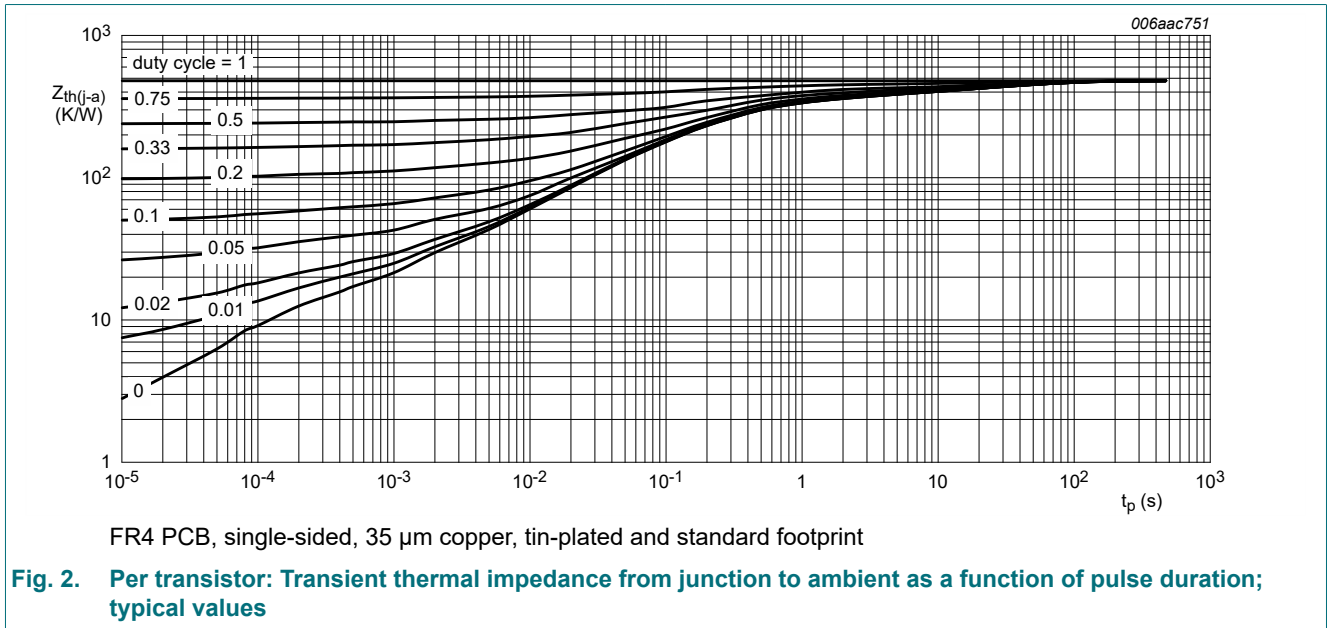
**Fig. 1. Per device: Power derating curve**

## 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]	-	-	625	K/W
<b>Per device</b>							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	416	K/W

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



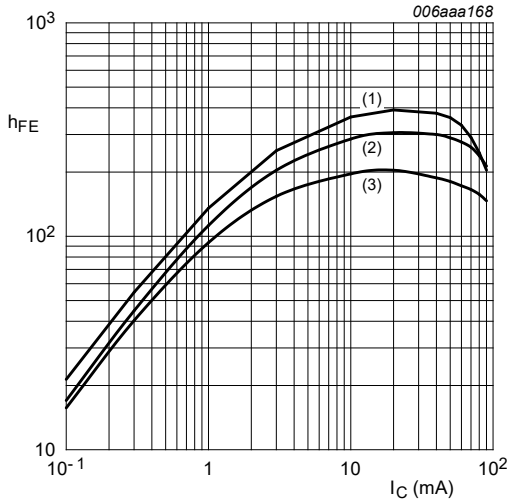
## 10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
<b>Per transistor</b>							
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 100 \mu\text{A}; I_E = 0 \text{ A}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	[1]	50	-	-	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 2 \text{ mA}; I_B = 0 \text{ A}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	[1]	50	-	-	V
$I_{CBO}$	collector-base cut-off current	$V_{CB} = 50 \text{ V}; I_E = 0 \text{ A}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	[1]	-	-	100	nA
$I_{CEO}$	collector-emitter cut-off current	$V_{CE} = 30 \text{ V}; I_B = 0 \text{ A}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	[1]	-	-	1	$\mu\text{A}$
		$V_{CE} = 30 \text{ V}; I_B = 0 \text{ A}; T_{\text{amb}} = 150 \text{ }^\circ\text{C}$	[1]	-	-	50	$\mu\text{A}$
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 5 \text{ V}; I_C = 0 \text{ A}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	[1]	-	-	50	$\mu\text{A}$
$h_{FE}$	DC current gain	$V_{CE} = 5 \text{ V}; I_C = 5 \text{ mA}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	[1]	80	-	-	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 5 \text{ mA}; I_B = 0.25 \text{ mA}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	[1]	-	-	150	mV
$V_{I(off)}$	off-state input voltage	$V_{CE} = 5 \text{ V}; I_C = 100 \mu\text{A}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	[1]	-	1.1	0.5	V
$V_{I(on)}$	on-state input voltage	$V_{CE} = 0.3 \text{ V}; I_C = 1 \text{ mA}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	[1]	3	1.5	-	V
R1	bias resistor 1 (input)		[2]	70	100	130	kΩ
R2/R1	bias resistor ratio	$T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	[2]	0.8	1	1.2	
<b>TR1 (NPN)</b>							
$C_c$	collector capacitance	$V_{CB} = 10 \text{ V}; I_E = 0 \text{ A}; i_e = 0 \text{ A}; f = 1 \text{ MHz}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$		-	-	2.5	pF
<b>TR2 (PNP)</b>							
$C_c$	collector capacitance	$V_{CB} = -10 \text{ V}; I_E = 0 \text{ A}; i_e = 0 \text{ A}; f = 1 \text{ MHz}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$		-	-	3	pF

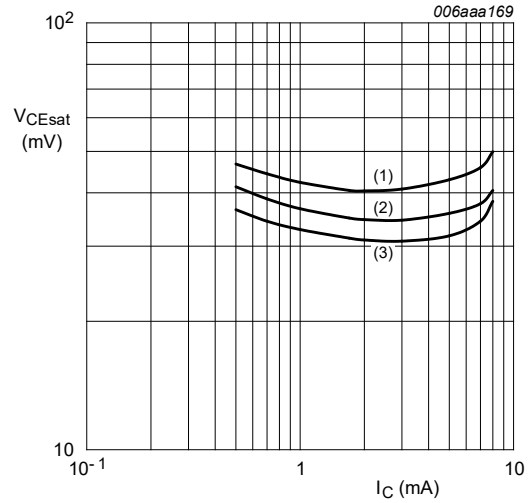
[1] For the PNP transistor with negative polarity.

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



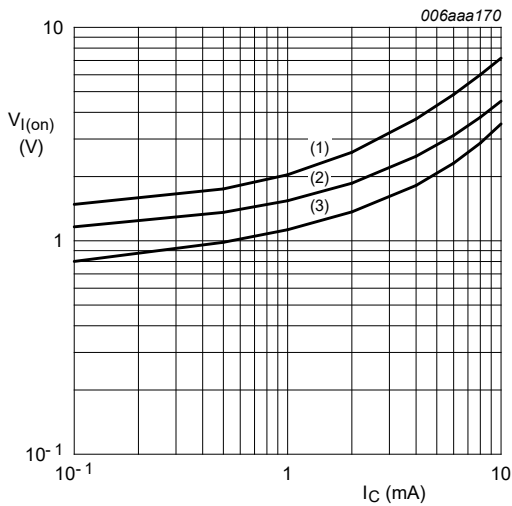
$V_{CE} = 5\text{ V}$   
 (1)  $T_{amb} = 100\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = -40\text{ }^{\circ}\text{C}$

**Fig. 3. TR1 (NPN): DC current gain as a function of collector current; typical values**



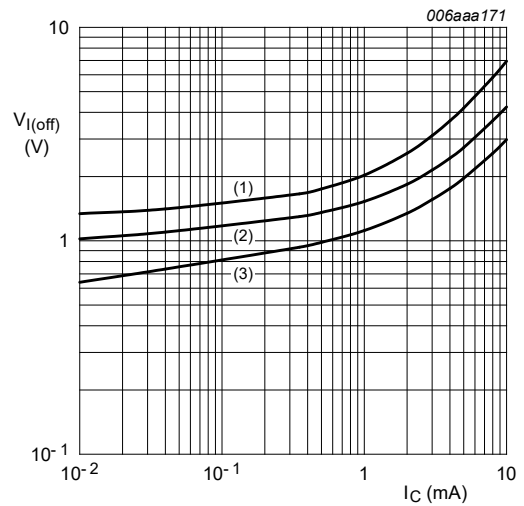
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = -40\text{ }^{\circ}\text{C}$

**Fig. 4. TR1 (NPN): Collector-emitter saturation voltage as a function of collector current; typical values**



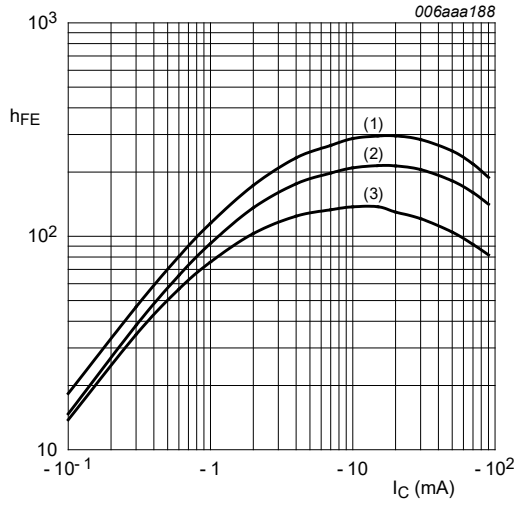
$V_{CE} = 0.3\text{ V}$   
 (1)  $T_{amb} = -40\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = 100\text{ }^{\circ}\text{C}$

**Fig. 5. TR1 (NPN): On-state input voltage as a function of collector current; typical values**



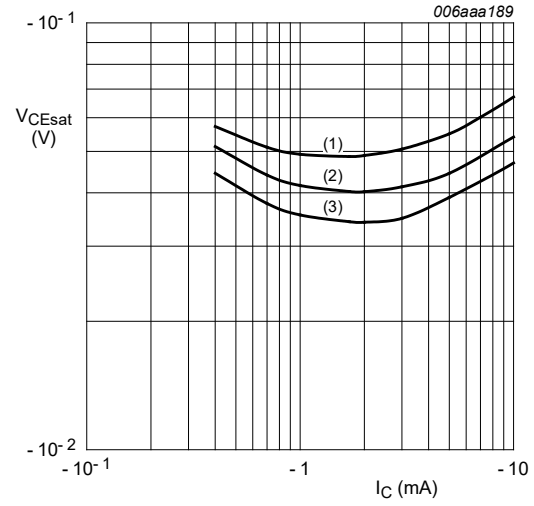
$V_{CE} = 5\text{ V}$   
 (1)  $T_{amb} = -40\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = 100\text{ }^{\circ}\text{C}$

**Fig. 6. TR1 (NPN): Off-state input voltage as a function of collector current; typical values**



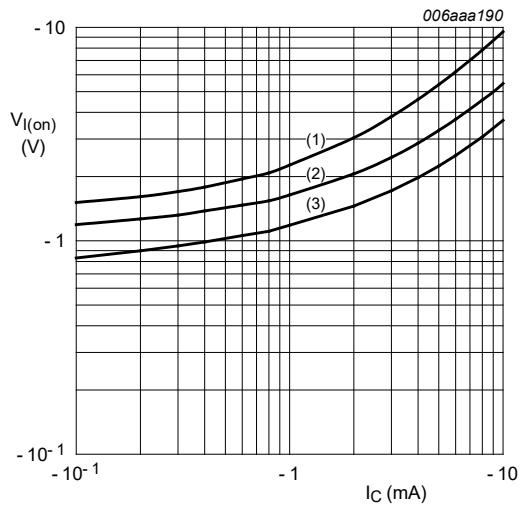
$V_{CE} = -5 \text{ V}$   
 (1)  $T_{amb} = 100 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -40 \text{ }^\circ\text{C}$

**Fig. 7. TR2 (PNP): DC current gain as a function of collector current; typical values**



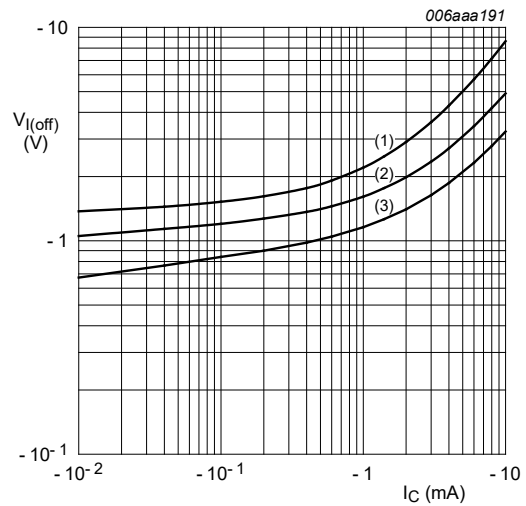
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -40 \text{ }^\circ\text{C}$

**Fig. 8. TR2 (PNP): Collector-emitter saturation voltage as a function of collector current; 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. TR2 (PNP): 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. TR2 (PNP): Off-state input voltage as a function of collector current; typical values**

## 11. Test information

### Resistor calculation

- Calculation of bias resistor 1 (R1)

$$R_1 = \frac{V(I_2) - V(I_1)}{I_2 - I_1}$$

- Calculation of bias resistor ratio (R2/R1)

$$\frac{R_2}{R_1} = \frac{V(I_3)}{R_1 \cdot I_3} - 1$$

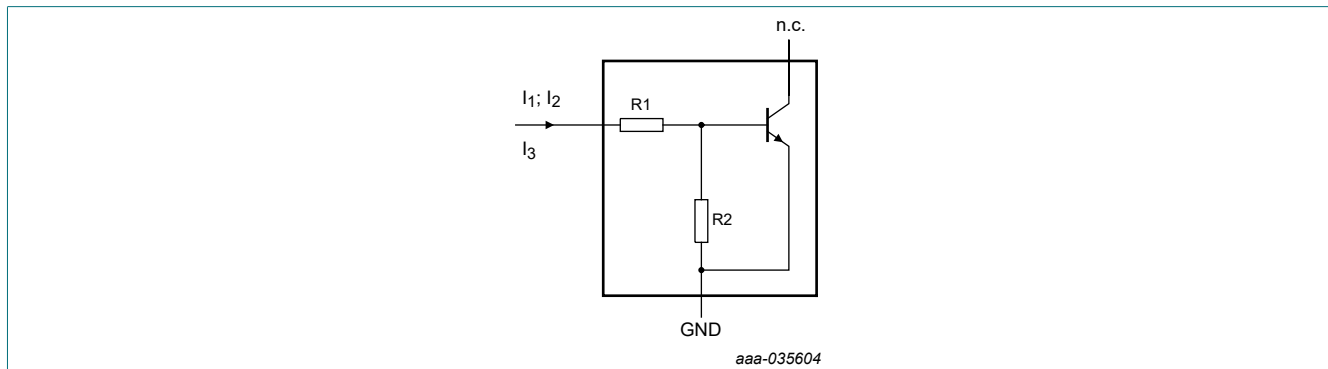


Fig. 11. TR1 (NPN): Resistor test circuit

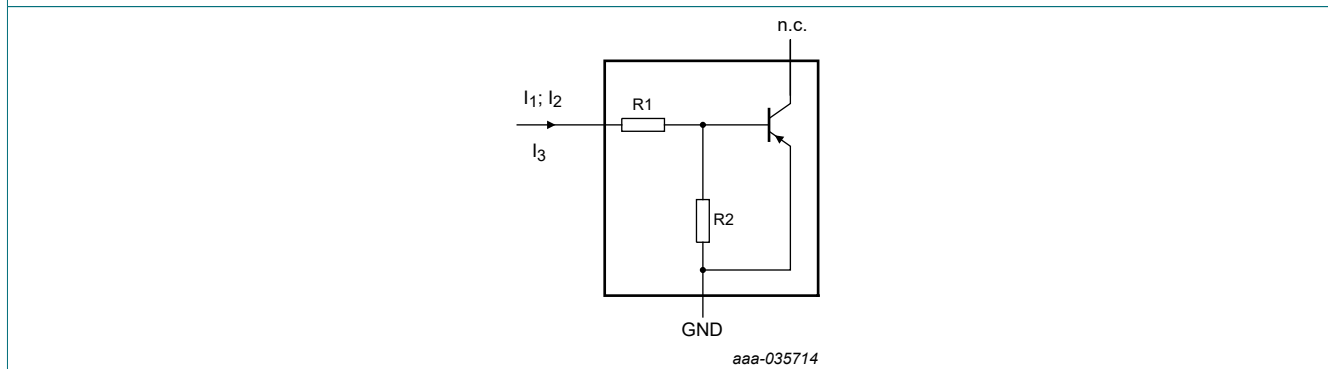


Fig. 12. TR2 (PNP): Resistor test circuit

### Resistor test conditions

Table 8. Resistor test conditions

PEMD24	R1 (kΩ)	R2 (kΩ)	Test conditions		
			I <sub>1</sub>	I <sub>2</sub>	I <sub>3</sub>
TR1 (NPN)	100	100	20 μA	60 μA	-40 μA
TR2 (PNP)	100	100	-20 μA	-60 μA	40 μA



## 12. Package outline

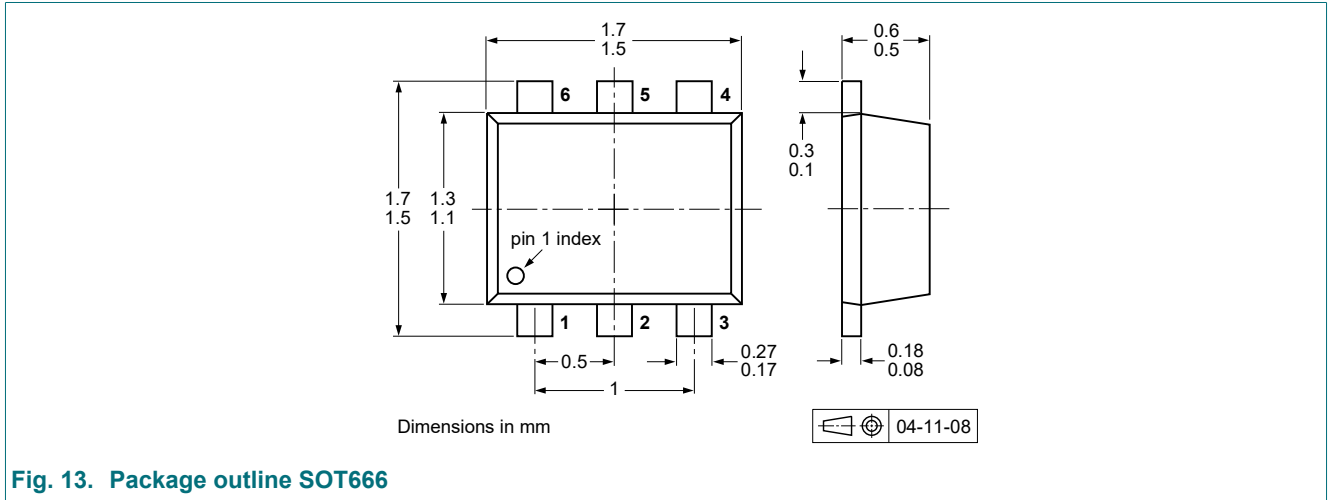


Fig. 13. Package outline SOT666

## 13. Soldering

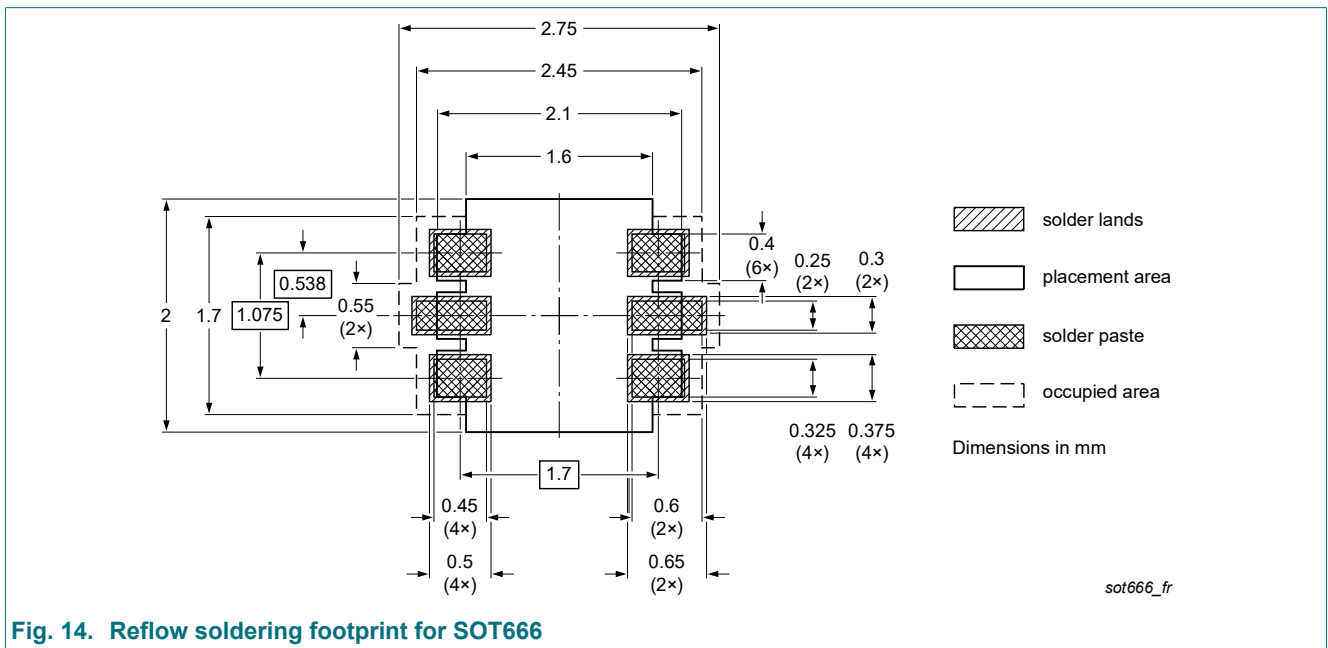


Fig. 14. Reflow soldering footprint for SOT666

## 14. Revision history

Table 9. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PEMD24 v.2	20230306	Product data sheet	-	PEMD24_PUMD24_1
Modifications:	<ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> <li>Family data sheet splitted to single type data sheets.</li> <li>Section "Packing information" removed.</li> <li>Product changed to non-automotive qualification.</li> </ul>			
PEMD24_PUMD24_1	20050502	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".
- [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 <https://www.nexperia.com>.

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