



PEMD13

50 V, 100 mA NPN/PNP resistor-equipped double transistor;
R1 = 4.7 k Ω , R2 = 47 k Ω

28 December 2022

Product data sheet

1. General description

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

NPN/NPN complement: PEMH13

PNP/PNP complement: PEMB13

2. Features and benefits

- 100 mA output current capability
- Built-in bias resistors
- Simplifies circuit design
- Reduces component count
- Reduces pick and place costs

3. Applications

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

4. Quick reference data

Table 1. Quick reference data

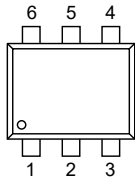
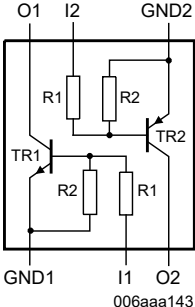
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Per transistor; for the PNP transistor (TR2) with negative polarity where applicable						
V _{CEO}	collector-emitter voltage	open base	-	-	50	V
I _O	output current		-	-	100	mA
R1	bias resistor 1 (input)		[1]	4.7	6.1	k Ω
R2/R1	bias resistor ratio		[1]	10	12	

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

50 V, 100 mA NPN/PNP resistor-equipped double transistor; R1 = 4.7 k Ω , R2 = 47 k Ω

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	GND1	GND (emitter) TR1	 <p style="text-align: center;">SOT666</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
PEMD13	SOT666	plastic, surface-mounted package; 6 leads; 0.5 mm pitch; 1.6 mm x 1.2 mm x 0.55 mm body	SOT666

7. Marking

Table 4. Marking codes

Type number	Marking code
PEMD13	Z1

8. Limiting values

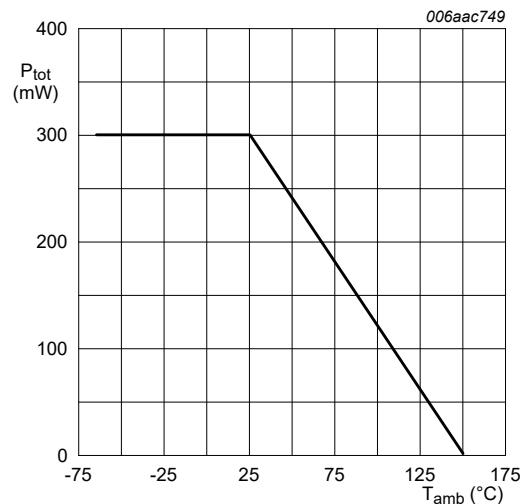
Table 5. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
Per transistor; for the PNP transistor (TR2) with negative polarity where applicable					
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	positive (input voltage TR1)	-	30	V
		negative (input voltage TR1)	-	-5	V
		positive (input voltage TR2)	-	5	V
		negative (input voltage TR2)	-	-30	V
I _O	output current		-	100	mA
P _{tot}	total power dissipation	T _{amb} ≤ 25 °C	[1] [2]	200	mW
Per device					
P _{tot}	total power dissipation	T _{amb} ≤ 25 °C	[1] [2]	300	mW
T _j	junction temperature		-	150	°C
T _{amb}	ambient temperature		-65	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] Reflow soldering is the only recommended soldering method.



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

Fig. 1. Per device: Power derating curve

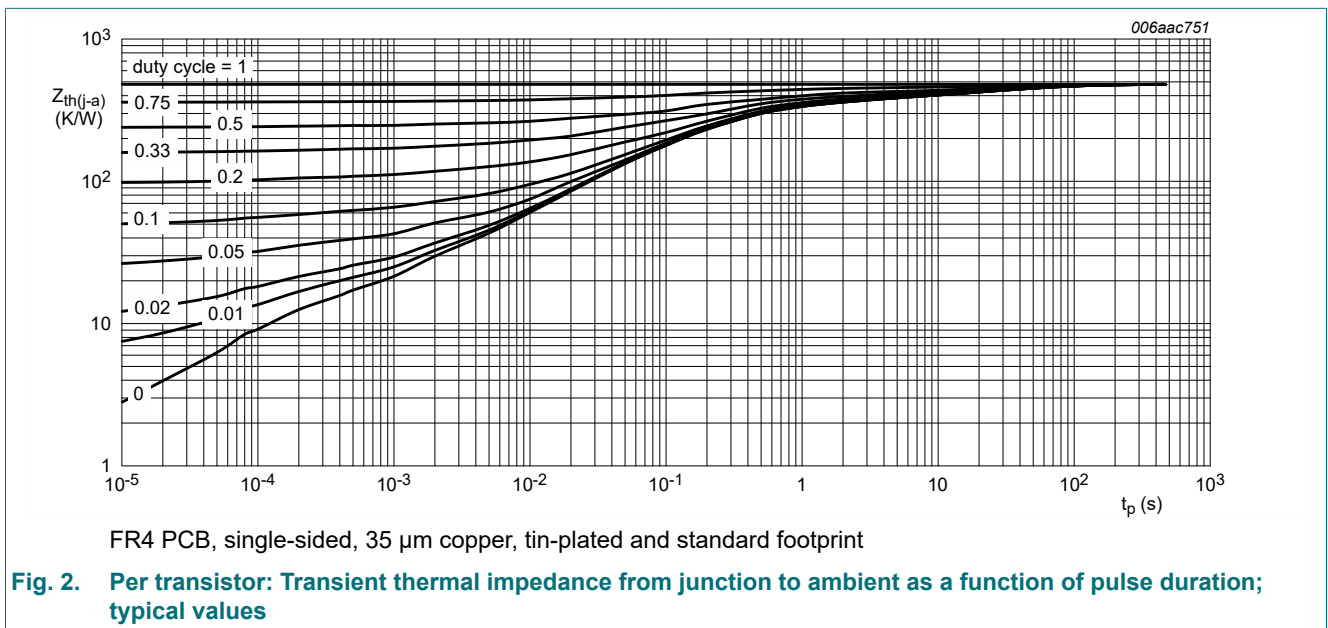
9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Per transistor						
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1] [2]	-	625	K/W
Per device						
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1] [2]	-	417	K/W

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

[2] Reflow soldering is the only recommended soldering method.



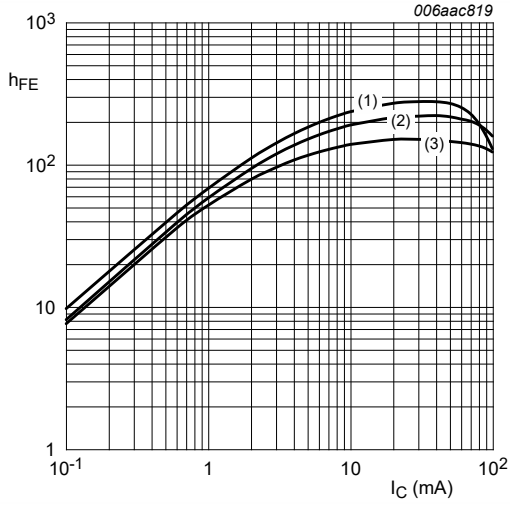
10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
Per transistor; for the PNP transistor (TR2) with negative polarity where applicable							
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 100 \mu\text{A}; I_E = 0 \text{ A}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	50	-	-	V	
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 2 \text{ mA}; I_B = 0 \text{ A}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	50	-	-	V	
I_{CBO}	collector-base cut-off current	$V_{CB} = 50 \text{ V}; I_E = 0 \text{ A}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-	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	μA	
		$V_{CE} = 30 \text{ V}; I_B = 0 \text{ A}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}; T_j = 150 \text{ }^\circ\text{C}$	-	-	5	μA	
I_{EBO}	emitter-base cut-off current	$V_{EB} = 5 \text{ V}; I_C = 0 \text{ A}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-	170	μA	
h_{FE}	DC current gain	$V_{CE} = 5 \text{ V}; I_C = 10 \text{ mA}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	100	-	-		
V_{CEsat}	collector-emitter saturation voltage	$I_C = 5 \text{ mA}; I_B = 0.25 \text{ mA}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-	100	mV	
$V_{I(off)}$	off-state input voltage	$V_{CE} = 5 \text{ V}; I_C = 100 \mu\text{A}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	0.6	0.5	V	
$V_{I(on)}$	on-state input voltage	$V_{CE} = 0.3 \text{ V}; I_C = 5 \text{ mA}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	1.3	0.9	-	V	
R1	bias resistor 1 (input)		[1]	3.3	4.7	6.1	kΩ
R2/R1	bias resistor ratio		[1]	8	10	12	
TR1 (NPN)							
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	
f_T	transition frequency	$V_{CE} = 5 \text{ V}; I_C = 10 \text{ mA}; f = 100 \text{ MHz}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	[2]	230	-	MHz	
TR2 (PNP)							
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	
f_T	transition frequency	$V_{CE} = -5 \text{ V}; I_C = -10 \text{ mA}; f = 100 \text{ MHz}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	[2]	180	-	MHz	

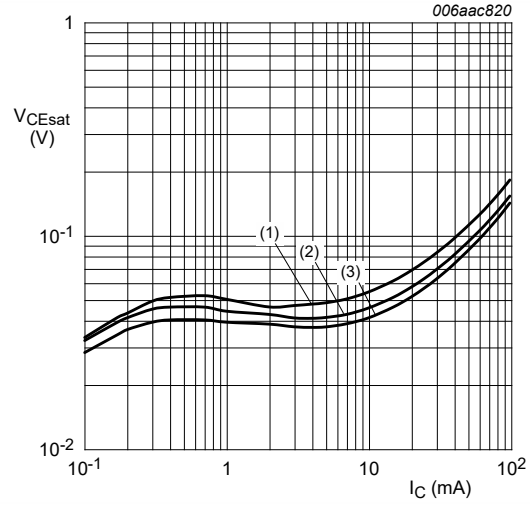
[1] See section "Test information" for resistor calculation and test conditions.

[2] Characteristics of built-in transistor



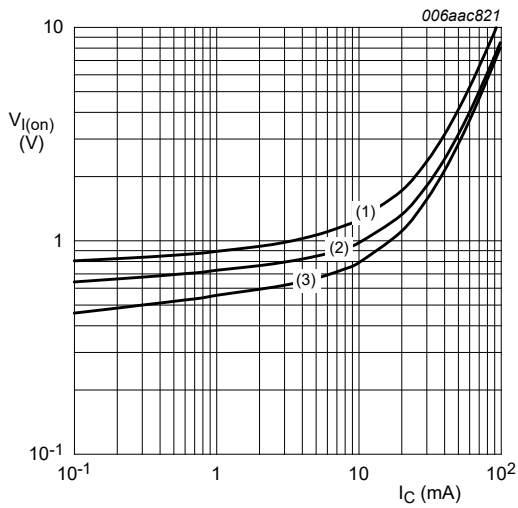
$V_{CE} = 5 \text{ V}$
 (1) $T_{amb} = 100 \text{ }^\circ\text{C}$
 (2) $T_{amb} = 25 \text{ }^\circ\text{C}$
 (3) $T_{amb} = -40 \text{ }^\circ\text{C}$

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



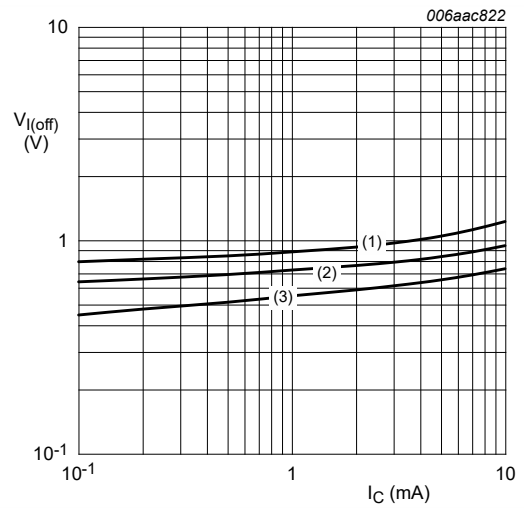
$I_C/I_B = 20$
 (1) $T_{amb} = 100 \text{ }^\circ\text{C}$
 (2) $T_{amb} = 25 \text{ }^\circ\text{C}$
 (3) $T_{amb} = -40 \text{ }^\circ\text{C}$

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

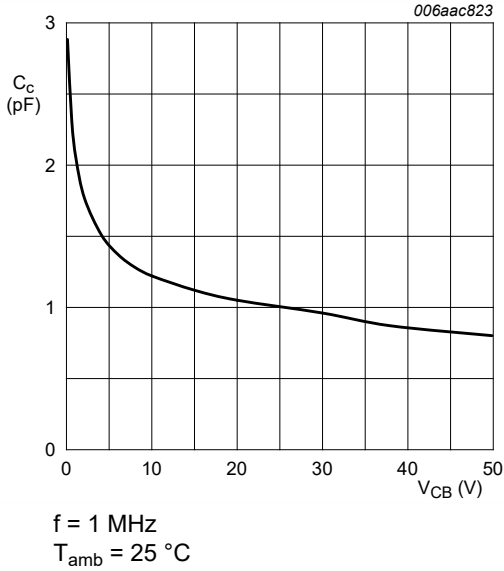


Fig. 7. TR1 (NPN): Collector capacitance as a function of collector-base voltage; typical values

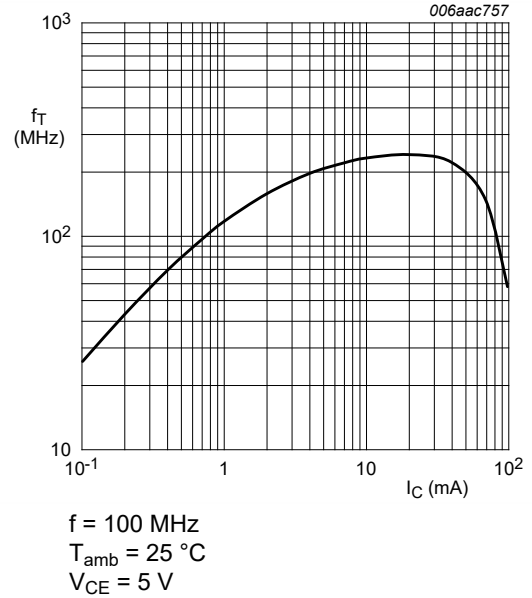


Fig. 8. TR1 (NPN): Transition frequency as a function of collector current; typical values of built-in transistor

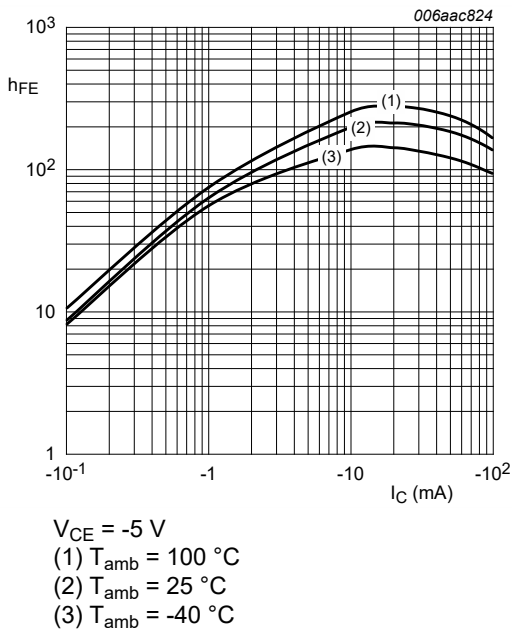


Fig. 9. TR2 (PNP): DC current gain as a function of collector current; typical values

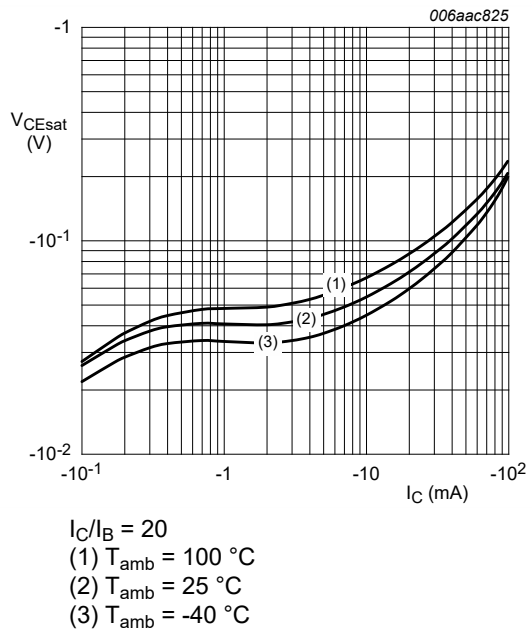
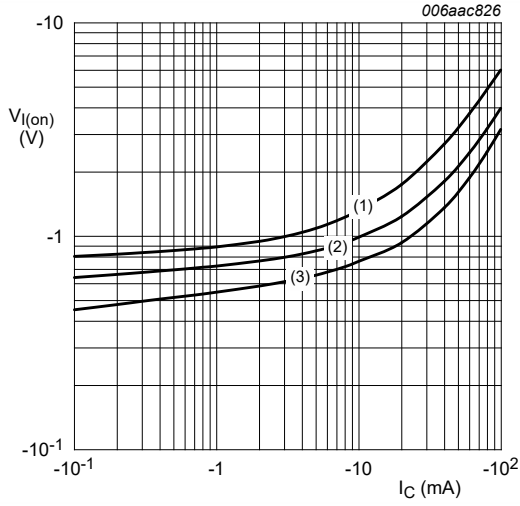
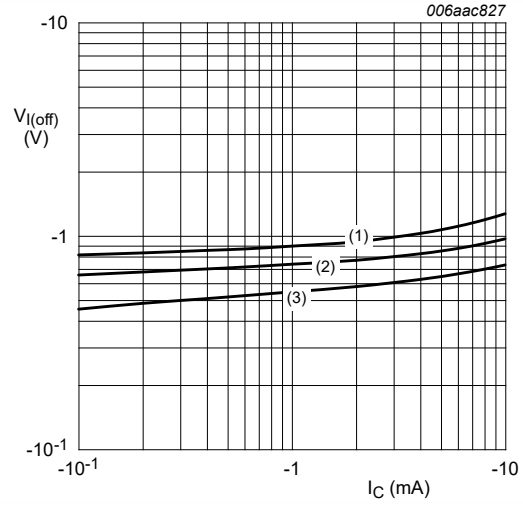


Fig. 10. TR2 (PNP): Collector-emitter saturation voltage as a function of collector current; typical values



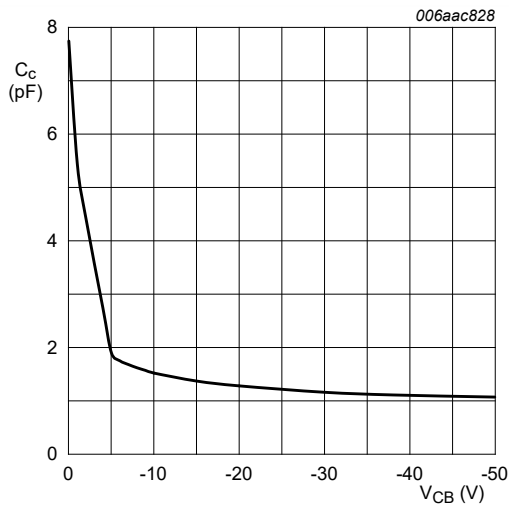
$V_{CE} = -0.3 \text{ V}$
 (1) $T_{amb} = -40 \text{ }^\circ\text{C}$
 (2) $T_{amb} = 25 \text{ }^\circ\text{C}$
 (3) $T_{amb} = 100 \text{ }^\circ\text{C}$

Fig. 11. TR2 (PNP): On-state input voltage as a function of collector current; typical values



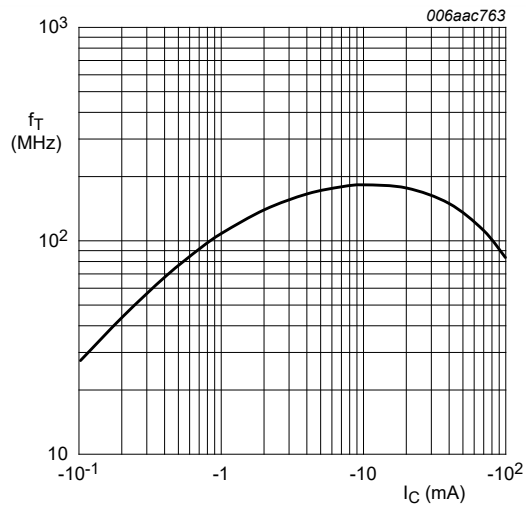
$V_{CE} = -5 \text{ V}$
 (1) $T_{amb} = -40 \text{ }^\circ\text{C}$
 (2) $T_{amb} = 25 \text{ }^\circ\text{C}$
 (3) $T_{amb} = 100 \text{ }^\circ\text{C}$

Fig. 12. TR2 (PNP): Off-state input voltage as a function of collector current; typical values



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

Fig. 13. TR2 (PNP): Collector capacitance as a function of collector-base voltage; typical values



$f = 100 \text{ MHz}$
 $T_{amb} = 25 \text{ }^\circ\text{C}$
 $V_{CE} = -5 \text{ V}$

Fig. 14. TR2 (PNP): Transition frequency as a function of collector current; typical values of built-in transistor

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)

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

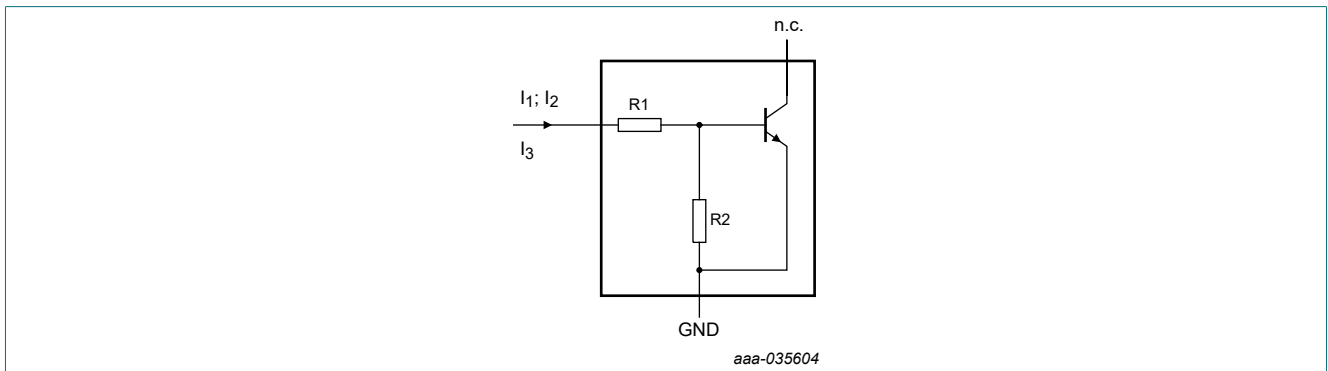


Fig. 15. TR1 (NPN): Resistor test circuit

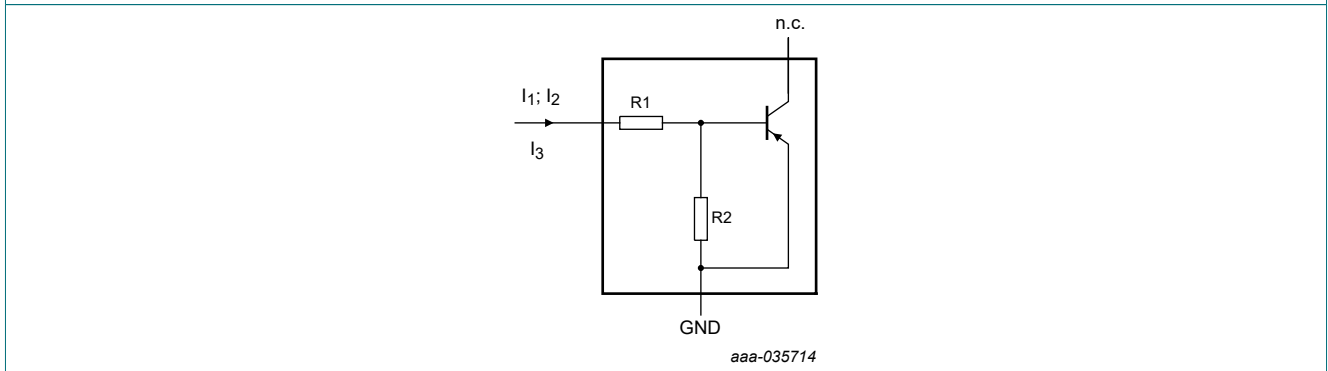


Fig. 16. TR2 (PNP): Resistor test circuit

Resistor test conditions

Table 8. Resistor test conditions

PEMD13	R1 (kΩ)	R2 (kΩ)	Test conditions		
			I ₁	I ₂	I ₃
TR1 (NPN)	4.7	47	600 μA	700 μA	-100 μA
TR2 (PNP)	4.7	47	-600 μA	-700 μA	100 μA

12. Package outline

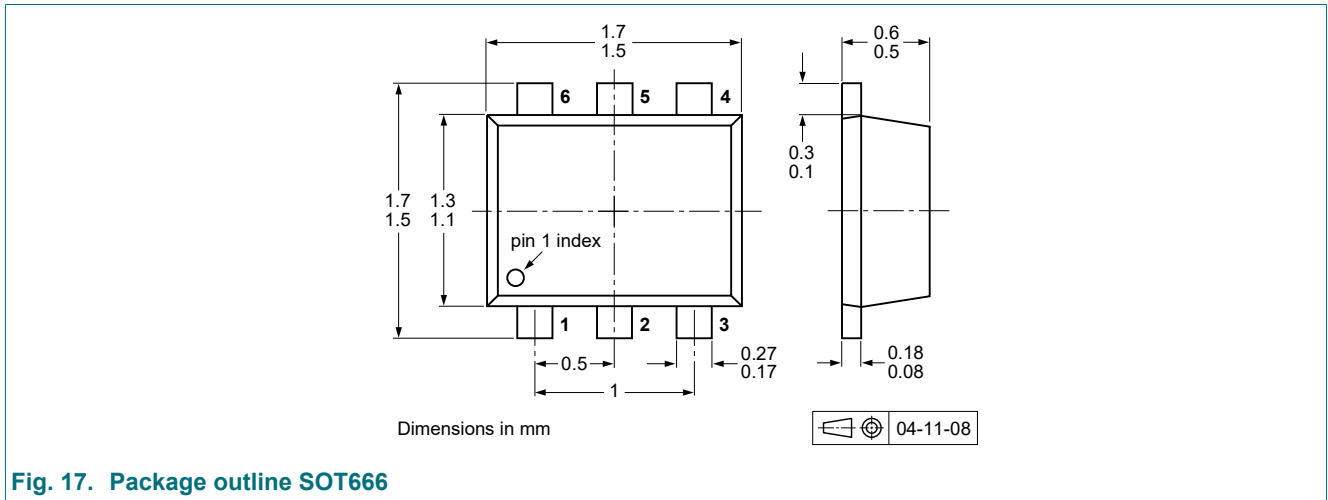


Fig. 17. Package outline SOT666

13. Soldering

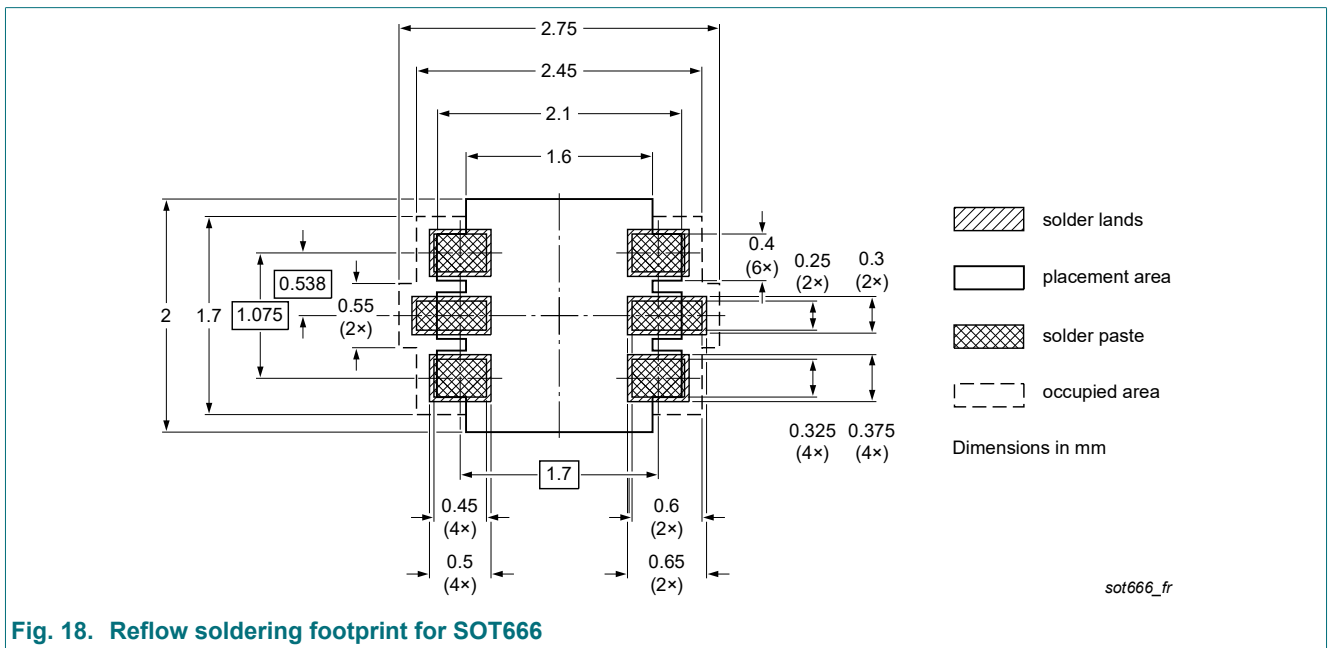


Fig. 18. Reflow soldering footprint for SOT666

14. Revision history

Table 9. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PEMD13 v.4	20221228	Product data sheet	-	PEMD13_PUMD13 v.3
Modifications:	<ul style="list-style-type: none"> The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. Legal texts have been adapted to the new company name where appropriate. Family data sheet reduced to single type data sheet. Packing information removed. Product(s) changed to non-automotive qualification. 			
PEMD13_PUMD13 v.3	20111207	Product data sheet	-	PEMD13_PUMD13 v.2
PEMD13_PUMD13 v.2	20031008	Product data sheet	-	PEMD13 v.1 PUMD13 v.1
PEMD13 v.1	20010911	Preliminary specification	-	-
PUMD13 v.1	20010227	Product specification	-	-

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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