PEMD48

50 V, 100 mA NPN/PNP resistor-equipped double transistor; R1 = 47 kΩ, R2 = 47 kΩ and R1 = 2.2 kΩ, R2 = 47 kΩ

29 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.

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
- Replacement for 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 with negative polarity							
V_{CEO}	collector-emitter voltage	open base		-	-	50	V
I_O	output current			-	-	100	mA
Transistor TR1 (NPN)							
R1	bias resistor 1 (input)		[1]	33	47	61	kΩ
R2/R1	bias resistor ratio		[1]	0.8	1	1.2	
Transistor TR2 (PNP)							
R1	bias resistor 1 (input)		[1]	1.54	2.2	2.86	kΩ
R2/R1	bias resistor ratio		[1]	17	21	26	

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

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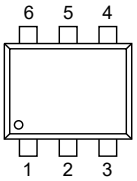
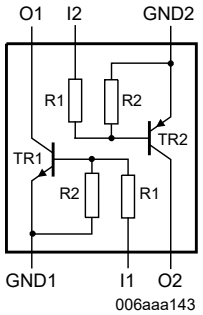
5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	GND1	GND (emitter) TR1	 SOT666	
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
PEMD48	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
PEMD48	48

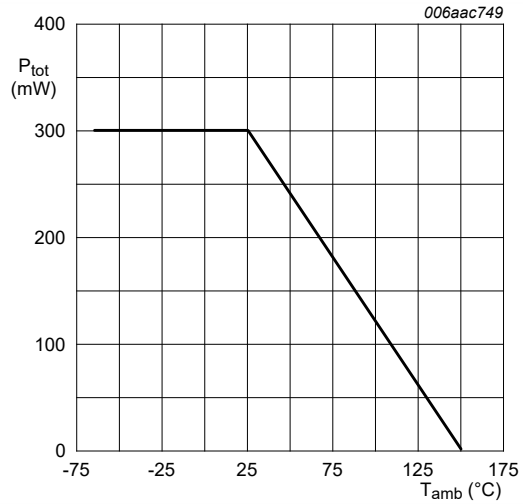
8. Limiting values

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 with negative polarity						
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 TR1 (NPN)		-	10	V
		open collector TR2 (PNP)		-	-5	V
V_I	input voltage	positive (input voltage TR1)		-	40	V
		negative (input voltage TR1)		-	-10	V
		positive (input voltage TR2)		-	5	V
		negative (input voltage TR2)		-	-12	V
I_O	output current			-	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	[1] [2]	-	200	mW
Per device						
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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

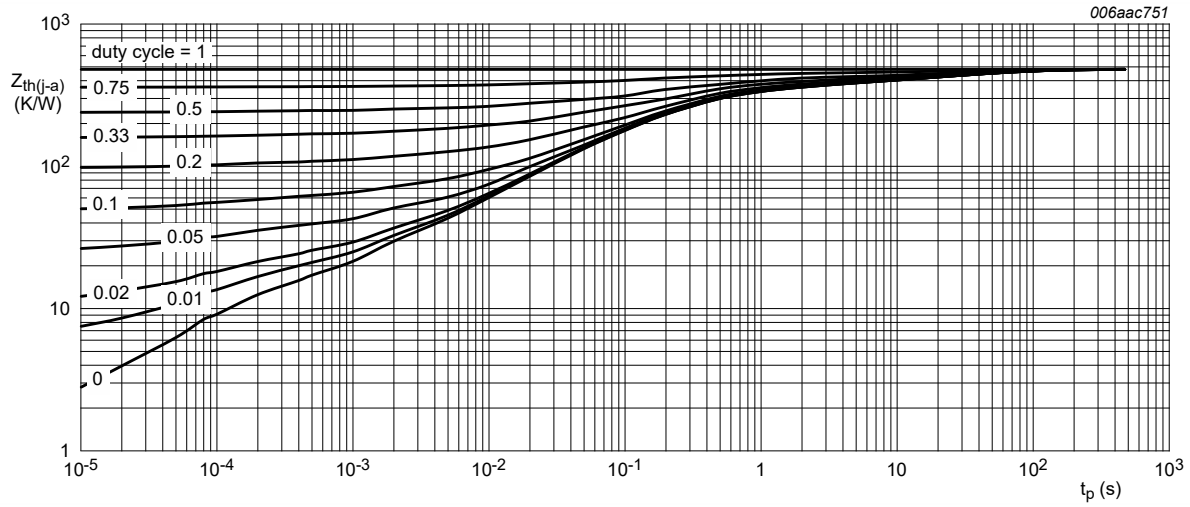
Fig. 1. Per device: Power derating curve

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.



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

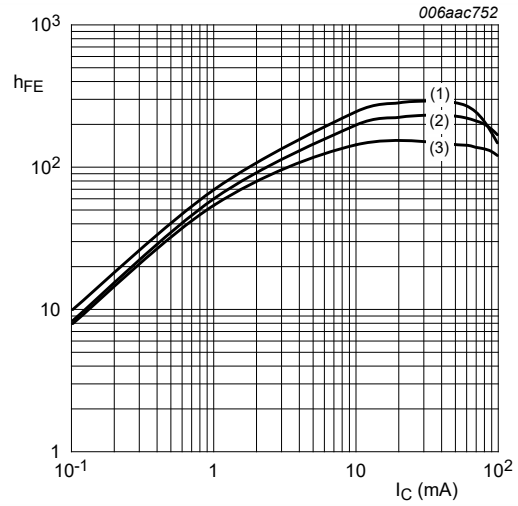
Fig. 2. Per transistor: Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

Table 7. Characteristics

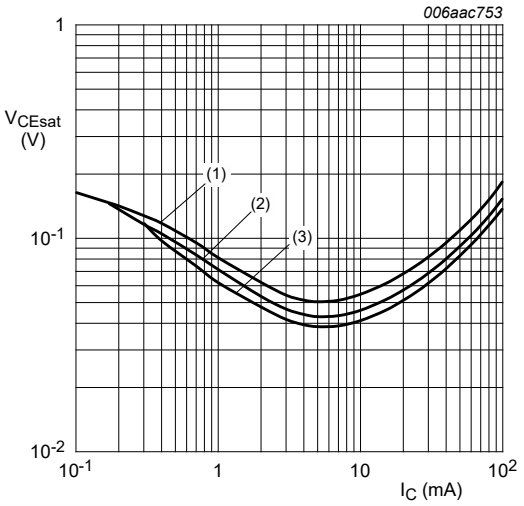
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Per transistor; for the PNP transistor with negative polarity							
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 100 µA; I_E = 0 A; T_{amb} = 25 °C		50	-	-	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = 2 mA; I_B = 0 A; T_{amb} = 25 °C		50	-	-	V
I_{CBO}	collector-base cut-off current	V_{CB} = 50 V; I_E = 0 A; T_{amb} = 25 °C		-	-	100	nA
I_{CEO}	collector-emitter cut-off current	V_{CE} = 30 V; I_B = 0 A; T_{amb} = 25 °C		-	-	1	µA
		V_{CE} = 30 V; I_B = 0 A; T_{amb} = 25 °C; T_j = 150 °C		-	-	5	µA
Transistor TR1 (NPN)							
I_{EBO}	emitter-base cut-off current	V_{EB} = 5 V; I_C = 0 A; T_{amb} = 25 °C		-	-	90	µA
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 5 mA; T_{amb} = 25 °C		80	-	-	
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA; I_B = 0.5 mA; T_{amb} = 25 °C		-	-	100	mV
$V_{I(off)}$	off-state input voltage	V_{CE} = 5 V; I_C = 100 µA; T_{amb} = 25 °C		-	1.2	0.8	V
$V_{I(on)}$	on-state input voltage	V_{CE} = 0.3 V; I_C = 2 mA; T_{amb} = 25 °C		3	1.6	-	V
R1	bias resistor 1 (input)		[1]	33	47	61	kΩ
R2/R1	bias resistor ratio		[1]	0.8	1	1.2	
C_c	collector capacitance	V_{CB} = 10 V; I_E = 0 A; i_e = 0 A; f = 1 MHz; T_{amb} = 25 °C		-	-	2.5	pF
f_T	transition frequency	V_{CE} = 5 V; I_C = 10 mA; f = 100 MHz; T_{amb} = 25 °C	[2]	-	230	-	MHz
Transistor TR2 (PNP)							
I_{EBO}	emitter-base cut-off current	V_{EB} = -5 V; I_C = 0 A; T_{amb} = 25 °C		-	-	-180	µA
h_{FE}	DC current gain	V_{CE} = -5 V; I_C = -10 mA; T_{amb} = 25 °C		100	-	-	
V_{CEsat}	collector-emitter saturation voltage	I_C = -5 mA; I_B = -0.25 mA; T_{amb} = 25 °C		-	-	-100	mV
$V_{I(off)}$	off-state input voltage	V_{CE} = -5 V; I_C = -100 µA; T_{amb} = 25 °C		-	-0.6	-0.5	V
$V_{I(on)}$	on-state input voltage	V_{CE} = -0.3 V; I_C = -5 mA; T_{amb} = 25 °C		-1.1	-0.75	-	V
R1	bias resistor 1 (input)		[1]	1.54	2.2	2.86	kΩ
R2/R1	bias resistor ratio		[1]	17	21	26	
C_c	collector capacitance	V_{CB} = -10 V; I_E = 0 A; i_e = 0 A; f = 1 MHz; T_{amb} = 25 °C		-	-	3	pF
f_T	transition frequency	V_{CE} = -5 V; I_C = -10 mA; f = 100 MHz; T_{amb} = 25 °C	[2]	-	180	-	MHz

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



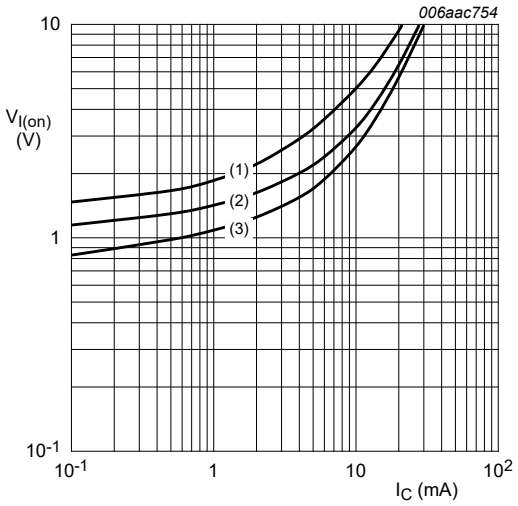
V_{CE} = 5 V
(1) T_{amb} = 100 °C
(2) T_{amb} = 25 °C
(3) T_{amb} = -40 °C

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



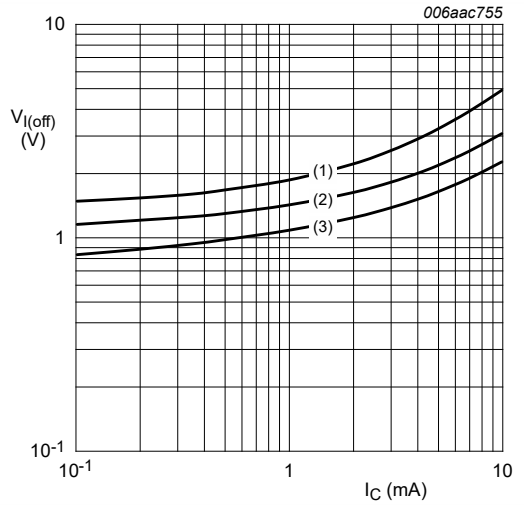
I_C/I_B = 20
(1) T_{amb} = 100 °C
(2) T_{amb} = 25 °C
(3) T_{amb} = -40 °C

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



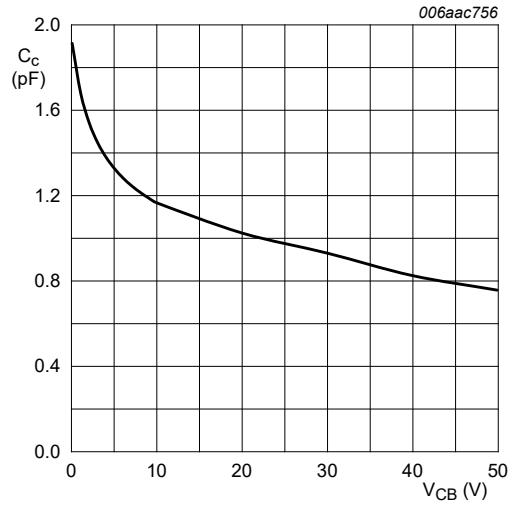
V_{CE} = 0.3 V
(1) T_{amb} = -40 °C
(2) T_{amb} = 25 °C
(3) T_{amb} = 100 °C

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



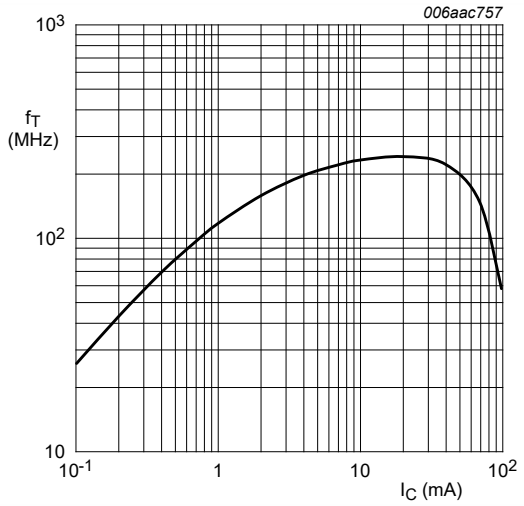
V_{CE} = 5 V
(1) T_{amb} = -40 °C
(2) T_{amb} = 25 °C
(3) T_{amb} = 100 °C

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



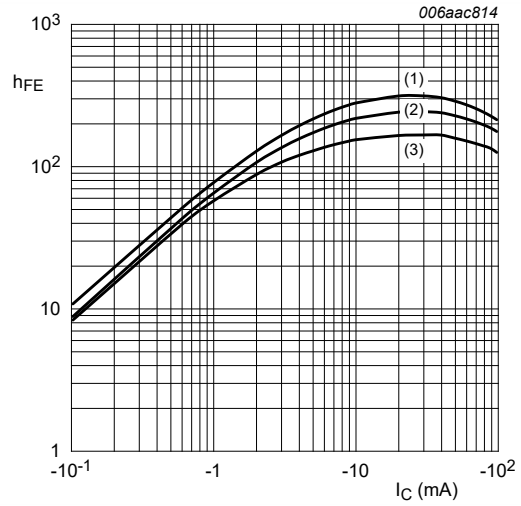
f = 1 MHz
T_{amb} = 25 °C

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



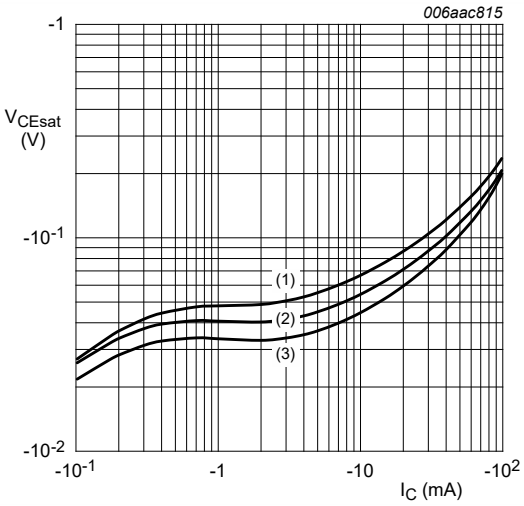
f = 100 MHz
T_{amb} = 25 °C
V_{CE} = 5 V

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



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

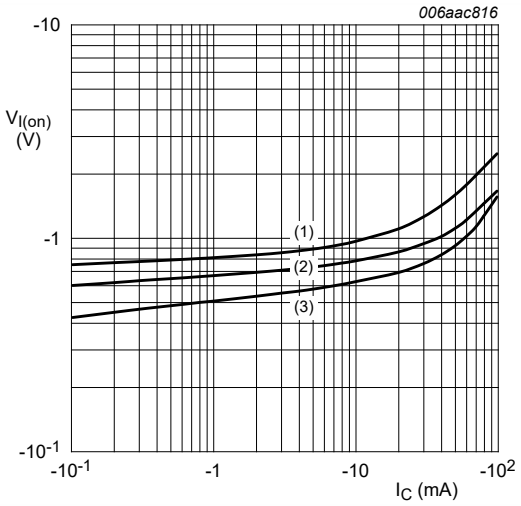
Fig. 9. TR2 (PNP): DC current gain as a function of collector current; typical values



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

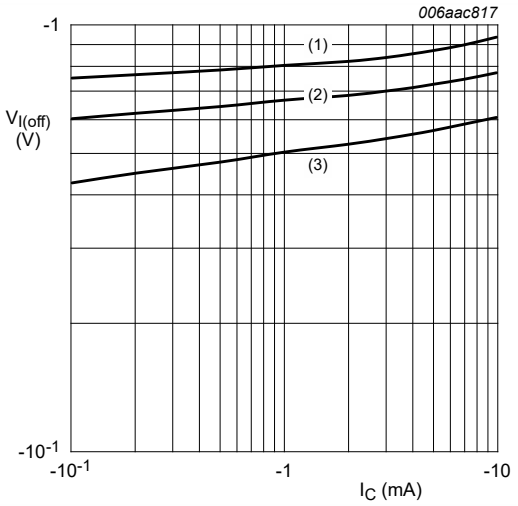
Fig. 10. TR2 (PNP): Collector-emitter saturation voltage as a function of collector current; typical values

50 V, 100 mA NPN/PNP resistor-equipped double transistor; R1 = 47 kΩ, R2 = 47 kΩ and R1 = 2.2 kΩ, R2 = 47 kΩ



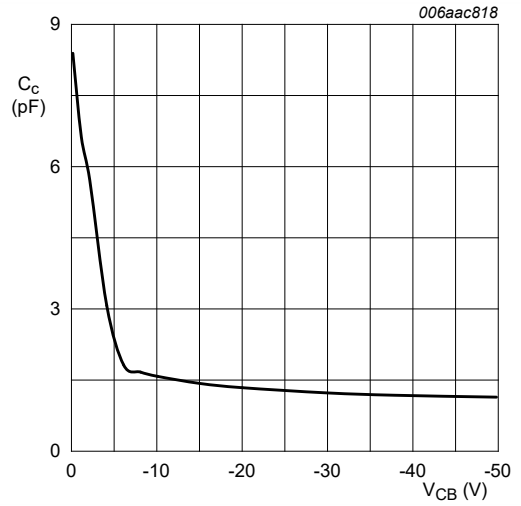
V_{CE} = -0.3 V
(1) T_{amb} = -40 °C
(2) T_{amb} = 25 °C
(3) T_{amb} = 100 °C

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



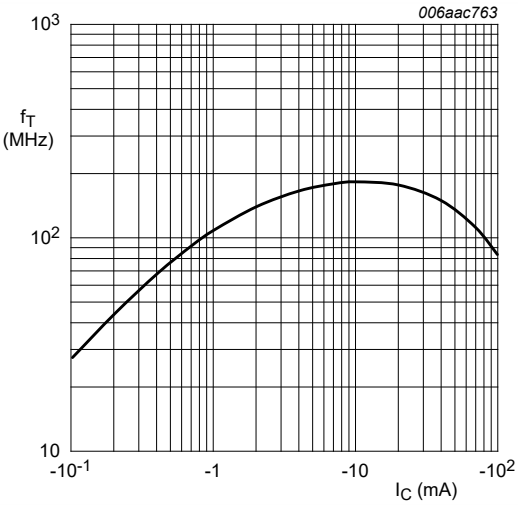
V_{CE} = -5 V
(1) T_{amb} = -40 °C
(2) T_{amb} = 25 °C
(3) T_{amb} = 100 °C

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



f = 1 MHz; T_{amb} = 25 °C

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



f = 100 MHz
T_{amb} = 25 °C
V_{CE} = -5 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)

$$\frac{R2}{R1} = \frac{V(I_3)}{R1 \cdot I_3} - 1$$

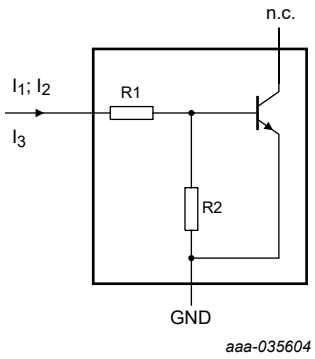


Fig. 15. TR1 (NPN): Resistor test circuit

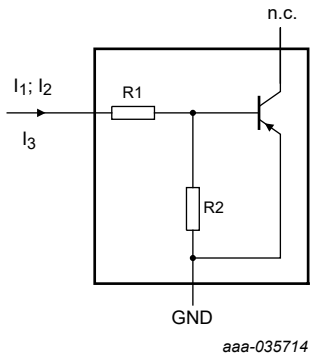


Fig. 16. TR2 (PNP): Resistor test circuit

Resistor test conditions

Table 8. Resistor test conditions

PEMD48	R1 (kΩ)	R2 (kΩ)	Test conditions		
			I_1	I_2	I_3
TR1 (NPN)	47	47	60 µA	110 µA	-80 µA
TR2 (PNP)	2.2	47	-600 µA	-700 µA	100 µA

12. Package outline

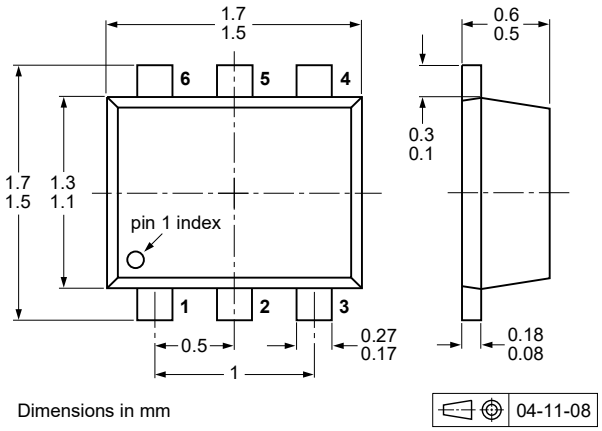


Fig. 17. Package outline SOT666

13. Soldering

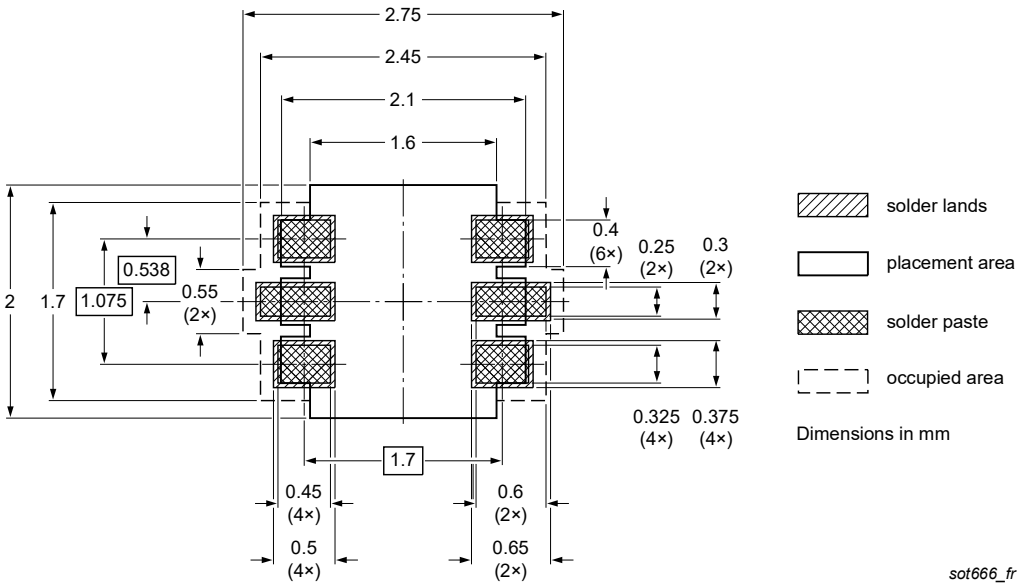


Fig. 18. Reflow soldering footprint for SOT666

14. Revision history

Table 9. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PEMD48 v.7	20221229	Product data sheet	-	PEMD48_PUMD48 v.6
Modifications:	• 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. • Product(s) changed to non-automotive qualification. • Packing information is removed.			
PEMD48_PUMD48 v.6	20120124	Product data sheet	-	PEMD48_PUMD48 v.5
PEMD48_PUMD48 v.5	20100413	Product data sheet	-	PEMD48_PUMD48 v.4
PEMD48_PUMD48 v.4	20040624	Product specification	-	PEMD48_PUMD48 v.3
PEMD48_PUMD48 v.3	20040602	Product specification	-	PUMD48 v.2 PEMD48 v.2
PUMD48 v.2	20010201	Product specification	-	PUMD48 v.1
PUMD48 v.1	19990422	Product specification	-	-
PEMD48 v.2	20011107	Product specification	-	PEMD48 v.1
PEMD48 v.1	20010924	Preliminary 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".
[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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50 V, 100 mA NPN/PNP resistor-equipped double transistor; R1 = 47 kΩ, R2 = 47 kΩ and R1 = 2.2 kΩ, R2 = 47 kΩ

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