



# PUMD48-Q

NPN/PNP resistor-equipped double transistor; R1 = 47 k $\Omega$ , R2 = 47 k $\Omega$  and R1 = 2.2 k $\Omega$ , R2 = 47 k $\Omega$

25 October 2021

Product data sheet

## 1. General description

NPN/PNP double Resistor-Equipped Transistor (RET) in a very small SOT363 (SC-88) 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
- Qualified according to AEC-Q101 and recommended for use in automotive applications

## 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

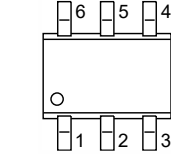
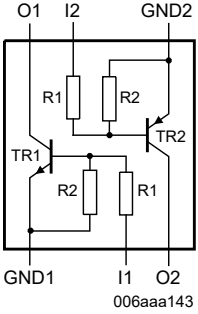
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Per transistor; for the PNP transistor with negative polarity</b>						
V <sub>CEO</sub>	collector-emitter voltage	open base	-	-	50	V
I <sub>O</sub>	output current		-	-	100	mA
<b>Transistor TR1 (NPN)</b>						
R1	bias resistor 1	[1]	33	47	61	k $\Omega$
R2/R1	bias resistor ratio	[1]	0.8	1	1.2	
<b>Transistor TR2 (PNP)</b>						
R1	bias resistor 1	[1]	1.54	2.2	2.86	k $\Omega$
R2/R1	bias resistor ratio	[1]	17	21	26	

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

NPN/PNP resistor-equipped double transistor; R1 = 47 k $\Omega$ , R2 = 47 k $\Omega$  and R1 = 2.2 k $\Omega$ , R2 = 47 k $\Omega$

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	GND1	GND (emitter) TR1	 <p>TSSOP6 (SOT363)</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
PUMD48-Q	TSSOP6	plastic, surface-mounted package; 6 leads; 0.65 mm pitch; 2.1 mm x 1.25 mm x 0.95 mm body	SOT363

## 7. Marking

Table 4. Marking codes

Type number	Marking code[1]
PUMD48-Q	4%8

[1] % = placeholder for manufacturing site code

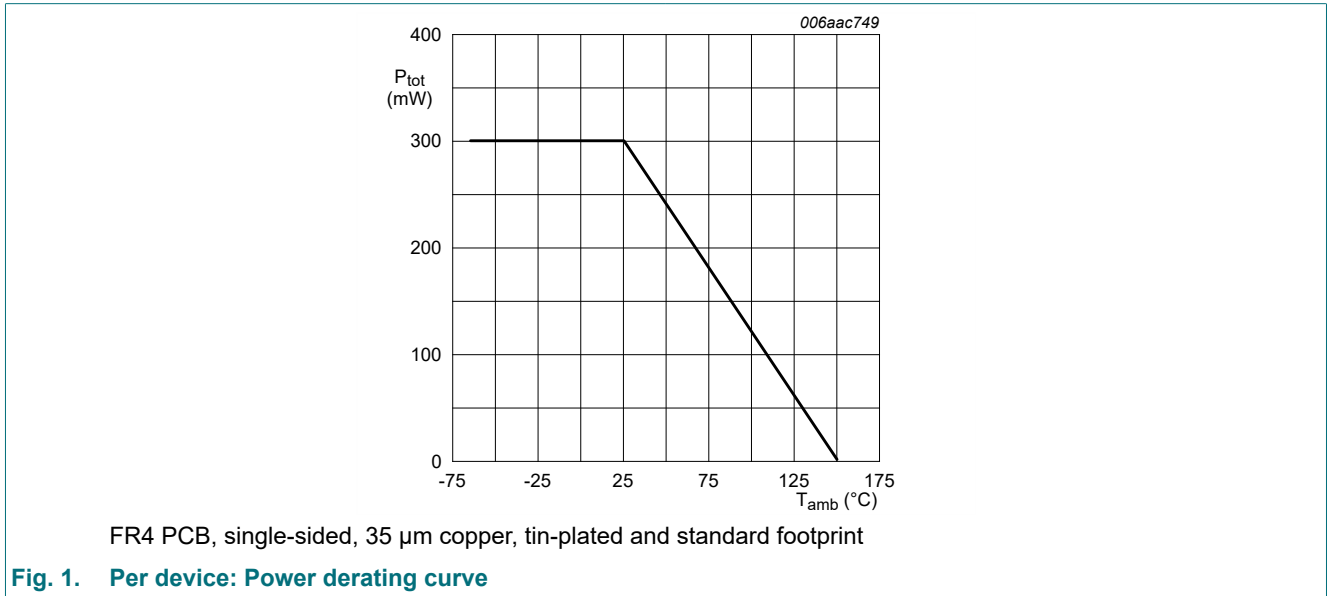
## 8. Limiting values

**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 <sub>CBO</sub>	collector-base voltage	open emitter		-	50	V
V <sub>CEO</sub>	collector-emitter voltage	open base		-	50	V
V <sub>EBO</sub>	emitter-base voltage	open collector TR1 (NPN)		-	10	V
		open collector TR2 (PNP)		-	-5	V
V <sub>I</sub>	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 <sub>O</sub>	output current			-	100	mA
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> ≤ 25 °C	[1]	-	200	mW
<b>Per device</b>						
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> ≤ 25 °C	[1]	-	300	mW
T <sub>j</sub>	junction temperature			-	150	°C
T <sub>amb</sub>	ambient temperature			-65	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.

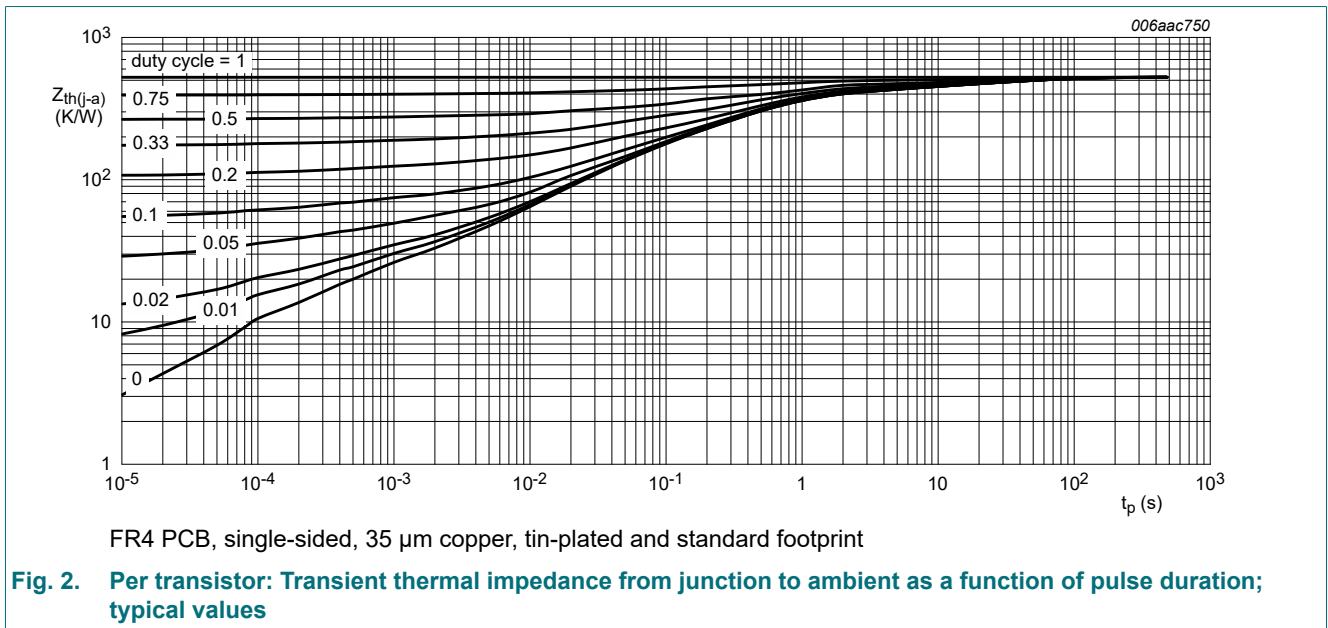


## 9. Thermal characteristics

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]	-	-	417	K/W

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



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

## 10. Characteristics

**Table 7. Characteristics**

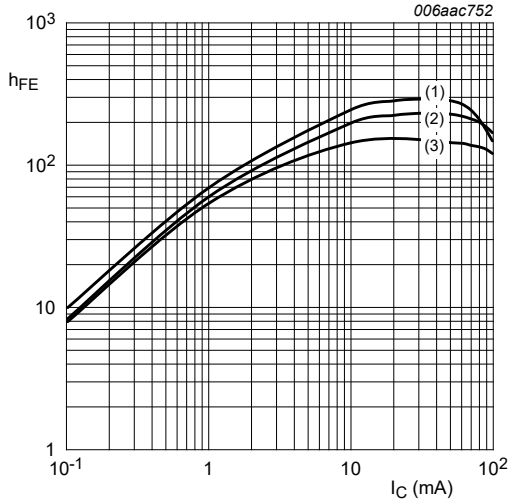
$T_{amb} = 25\text{ °C}$ , unless otherwise specified.

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

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

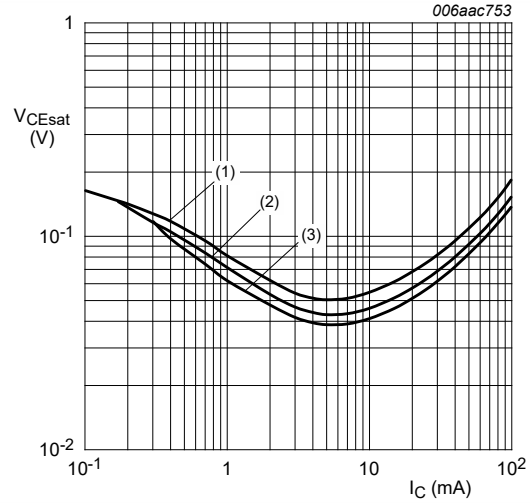
[2] Characteristics of built-in transistor

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



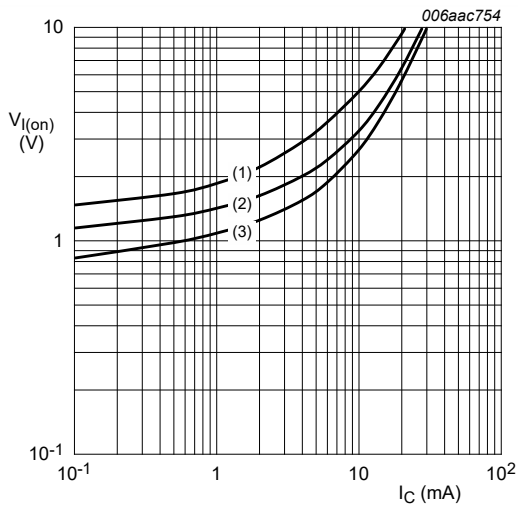
$V_{CE} = 5\text{ V}$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -40\text{ °C}$

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



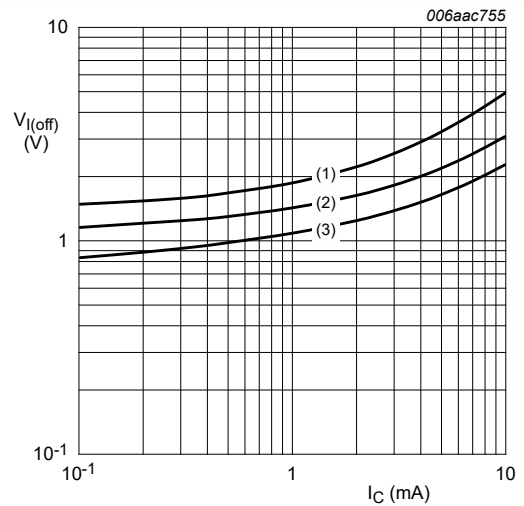
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -40\text{ °C}$

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



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

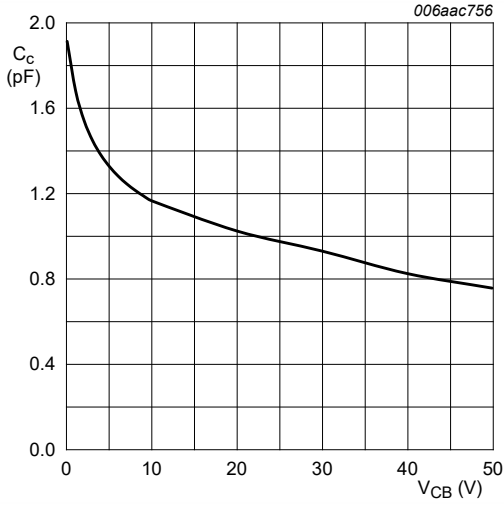
**Fig. 5. TR1 (NPN): On-state input voltage as a function of collector current; typical values**



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

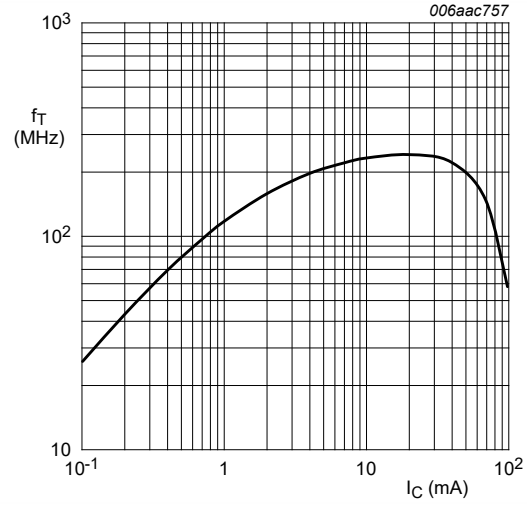
**Fig. 6. TR1 (NPN): Off-state input voltage as a function of collector current; typical values**

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



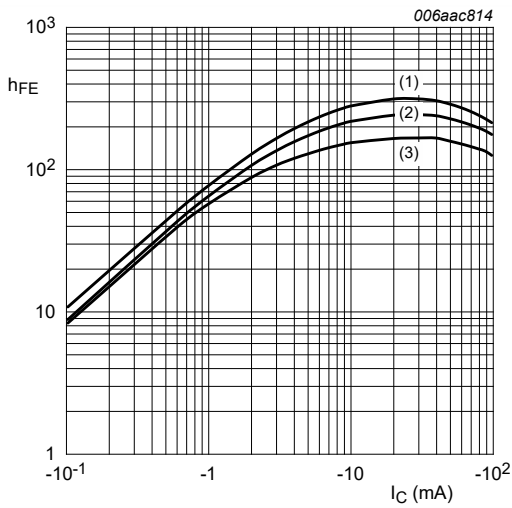
f = 1 MHz  
T<sub>amb</sub> = 25 °C

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



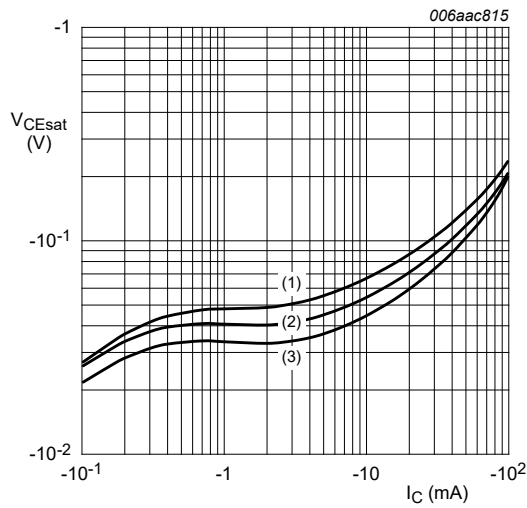
f = 100 MHz  
T<sub>amb</sub> = 25 °C  
V<sub>CE</sub> = 5 V

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



V<sub>CE</sub> = -5 V  
(1) T<sub>amb</sub> = 100 °C  
(2) T<sub>amb</sub> = 25 °C  
(3) T<sub>amb</sub> = -40 °C

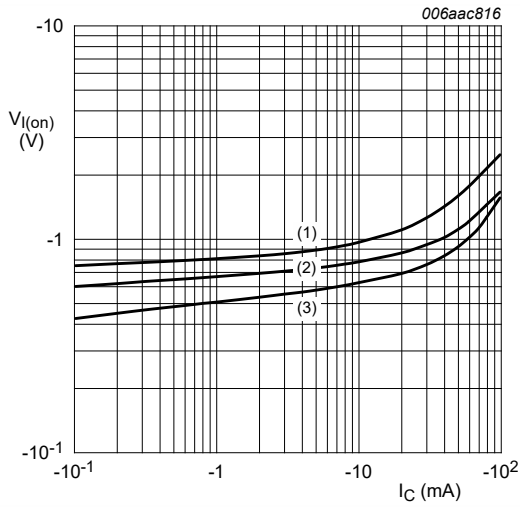
**Fig. 9. TR2 (PNP): DC current gain as a function of collector current; typical values**



I<sub>C</sub>/I<sub>B</sub> = 20  
(1) T<sub>amb</sub> = 100 °C  
(2) T<sub>amb</sub> = 25 °C  
(3) T<sub>amb</sub> = -40 °C

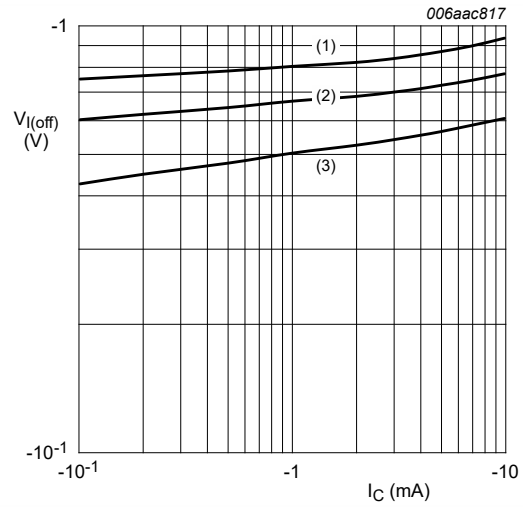
**Fig. 10. TR2 (PNP): Collector-emitter saturation voltage as a function of collector current; typical values**

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



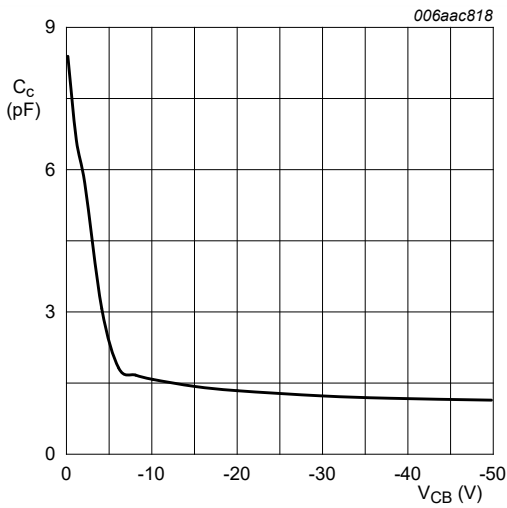
$V_{CE} = -0.3 \text{ V}$   
 (1)  $T_{amb} = -40 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100 \text{ }^\circ\text{C}$

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



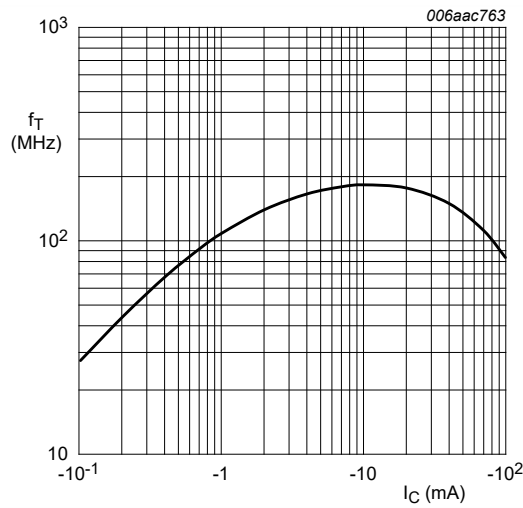
$V_{CE} = -5 \text{ V}$   
 (1)  $T_{amb} = -40 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100 \text{ }^\circ\text{C}$

**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

### 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)

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

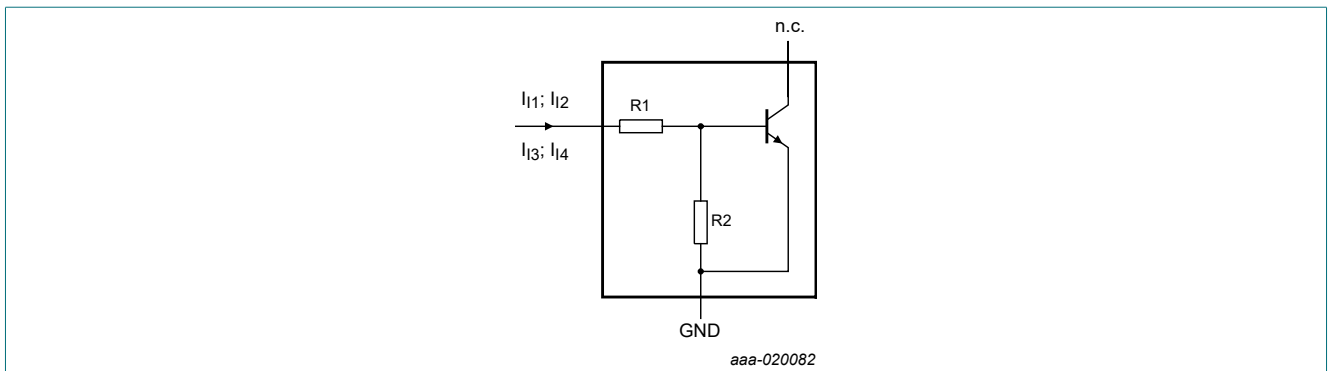


Fig. 15. NPN transistor: Resistor test circuit

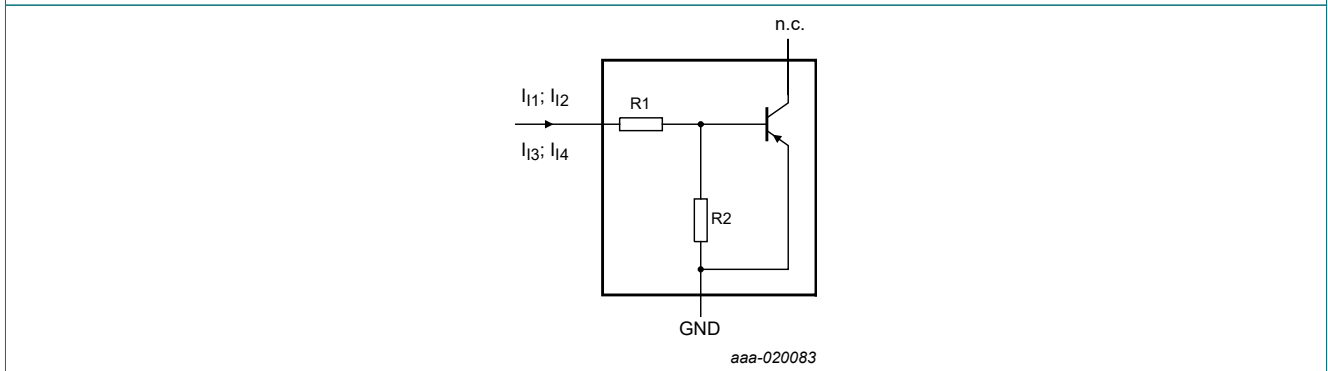


Fig. 16. PNP transistor: Resistor test circuit

### Resistor test conditions

Table 8. Resistor test conditions

Type number	Test conditions			
	I <sub>11</sub>	I <sub>12</sub>	I <sub>13</sub>	I <sub>14</sub>
PUMD48-Q	55 μA	105 μA	-55 μA	-105 μA
PUMD48-Q	-90 μA	-140 μA	55 μA	105 μA

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

## 12. Package outline

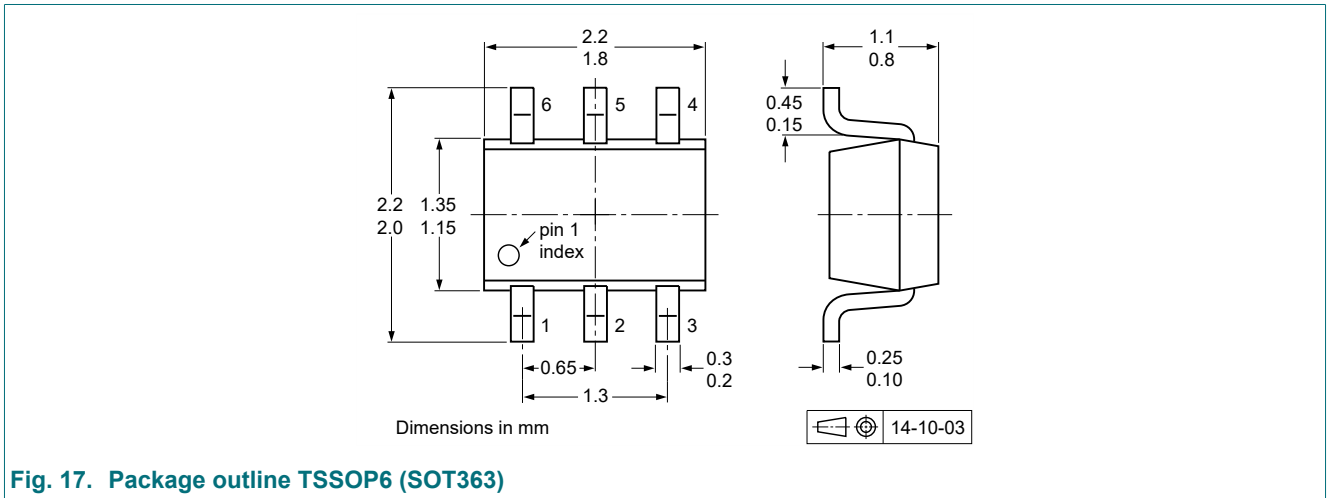


Fig. 17. Package outline TSSOP6 (SOT363)

### 13. Soldering

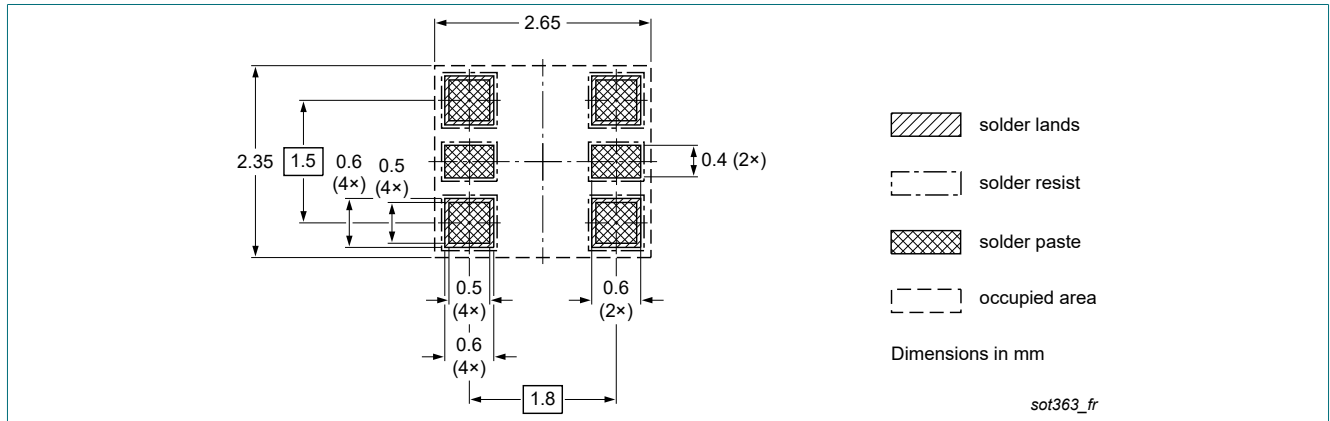


Fig. 18. Reflow soldering footprint for TSSOP6 (SOT363)

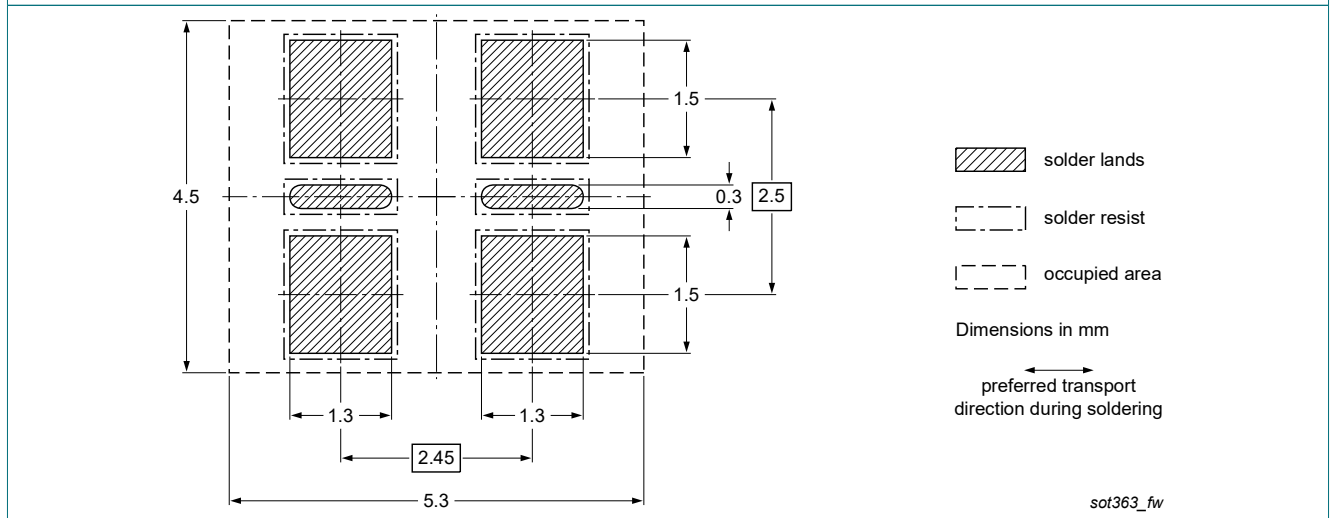


Fig. 19. Wave soldering footprint for TSSOP6 (SOT363)

NPN/PNP resistor-equipped double transistor; R1 = 47 k $\Omega$ , R2 = 47 k $\Omega$  and R1 = 2.2 k $\Omega$ , R2 = 47 k $\Omega$

## 14. Revision history

Table 9. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PUMD48-Q v.1	20211025	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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## Contents

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1. General description.....	1
2. Features and benefits.....	1
3. Applications.....	1
4. Quick reference data.....	1
5. Pinning information.....	2
6. Ordering information.....	2
7. Marking.....	2
8. Limiting values.....	3
9. Thermal characteristics.....	4
10. Characteristics.....	5
11. Test information.....	9
12. Package outline.....	10
13. Soldering.....	11
14. Revision history.....	12
15. Legal information.....	13

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Date of release: 25 October 2021

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