



THE DATASHEET OF RO-1212S/P





PUMD3-Q

50 V, 100 mA NPN/PNP resistor-equipped double transistor;
R1 = 10 k Ω , R2 = 10 k Ω

7 October 2021

Product data sheet

1. General description

NPN/PNP Resistor-Equipped double Transistor (RET) in a very small SOT363 (SC-88) Surface-Mounted Device (SMD) plastic package.

NPN/NPN complement: PUMH11-Q

PNP/PNP complement: PUMB11-Q

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

- Digital application in automotive and industrial segments
- Cost-saving alternative for BC847-Q/BC857-Q series in digital applications
- Controlling IC inputs
- Switching loads

4. Quick reference data

Table 1. Quick reference data

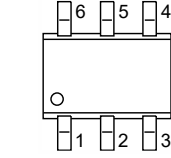
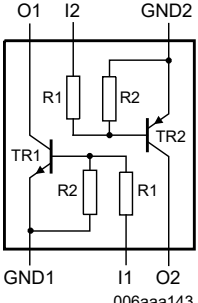
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Per transistor, for the PNP transistor with negative polarity						
V _{CEO}	collector-emitter voltage	open base	-	-	50	V
I _O	output current		-	-	100	mA
R1	bias resistor 1	[1]	7	10	13	k Ω
R2/R1	bias resistor ratio	[1]	0.8	1	1.2	

[1] See "Section 11: Test information" for resistor calculation and test conditions.

50 V, 100 mA NPN/PNP resistor-equipped double transistor; R1 = 10 k Ω , R2 = 10 k Ω

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
PUMD3-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]
PUMD3-Q	D%3

[1] % = placeholder for manufacturing site code

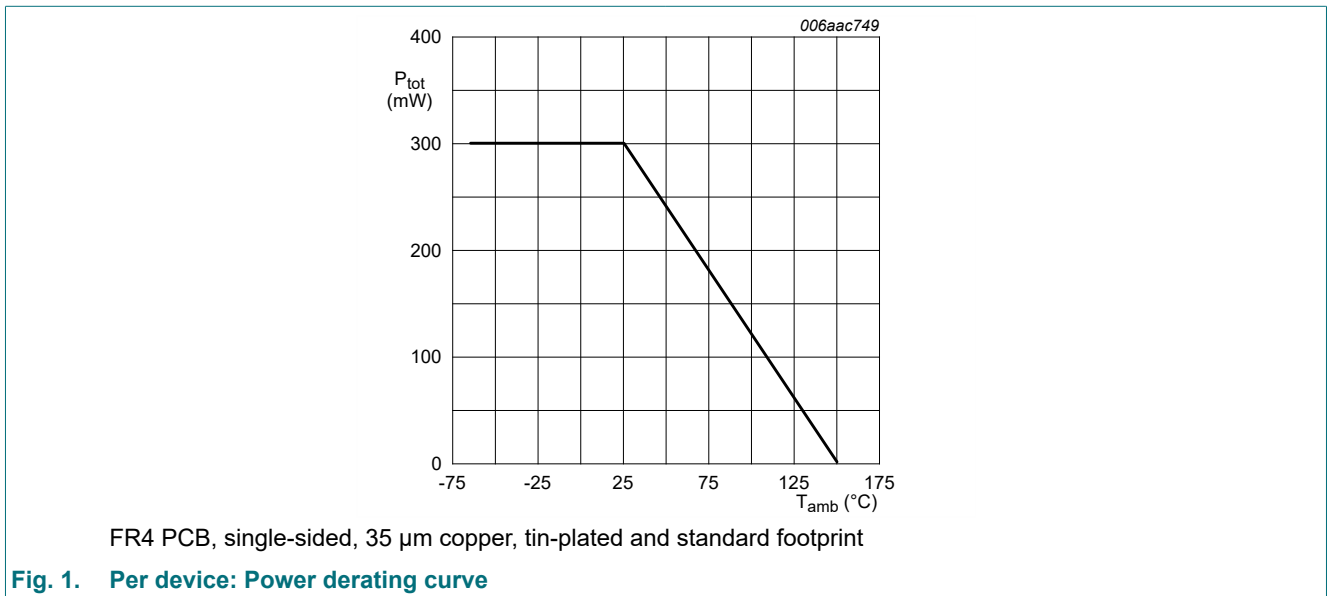
8. Limiting values

Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
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		-	10	V
V _I	input voltage	input voltage TR1		-	40	V
				-	-10	V
		input voltage TR2		-	10	V
				-	-40	V
I _O	output current		-	100	mA	
P _{tot}	total power dissipation	T _{amb} ≤ 25 °C	[1]	-	200	mW
Per device						
P _{tot}	total power dissipation	T _{amb} ≤ 25 °C	[1]	-	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, 35 μm copper, tin-plated and standard footprint.

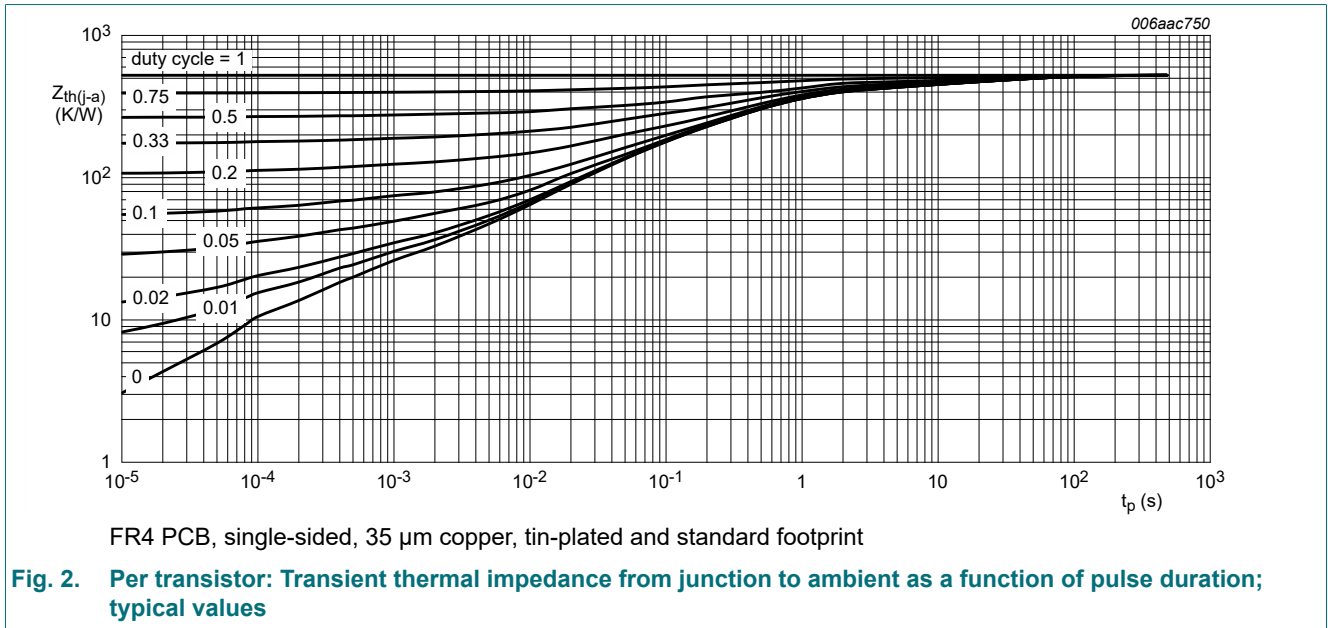


9. Thermal characteristics

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]	-	-	625	K/W
Per device							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	417	K/W

[1] Device mounted on an FR4 PCB, single-sided, 35 μm copper, tin-plated and standard footprint.



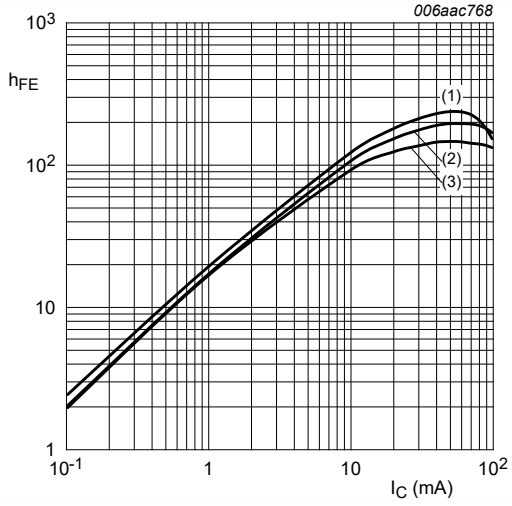
10. Characteristics

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	$I_C = 100 \mu\text{A}$; $I_E = 0 \text{ A}$; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	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	$V_{CE} = 30 \text{ V}$; $I_B = 0 \text{ A}$; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-	100	nA	
		$V_{CE} = 30 \text{ V}$; $I_B = 0 \text{ A}$; $T_j = 150 \text{ }^\circ\text{C}$	-	-	5	μA	
I_{EBO}	emitter-base cut-off current	$V_{EB} = 5 \text{ V}$; $I_C = 0 \text{ mA}$; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-	400	μA	
h_{FE}	DC current gain	$V_{CE} = 5 \text{ V}$; $I_C = 5 \text{ mA}$; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	30	-	-		
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10 \text{ mA}$; $I_B = 0.5 \text{ mA}$; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-	100	mV	
$V_{I(off)}$	off-state input voltage	$V_{CE} = 5 \text{ V}$; $I_C = 100 \mu\text{A}$; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	1.1	0.8	V	
$V_{I(on)}$	on-state input voltage	$V_{CE} = 0.3 \text{ V}$; $I_C = 10 \text{ mA}$; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	2.5	1.8	-	V	
R1	bias resistor 1		[1]	7	10	13	kΩ
R2/R1	bias resistor ratio		[1]	0.8	1	1.2	
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	

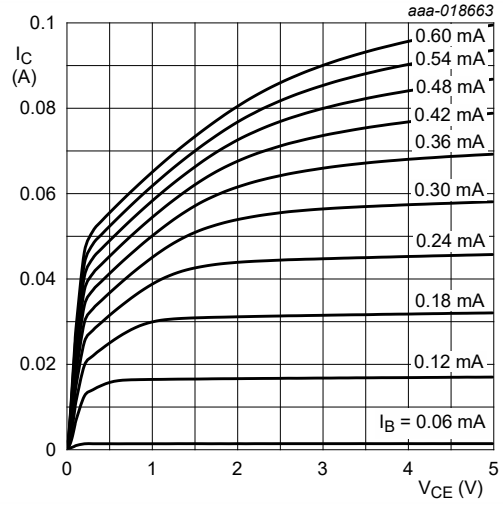
[1] See "Section 11: Test information" for resistor calculation and test conditions.

[2] Characteristics of built-in transistor



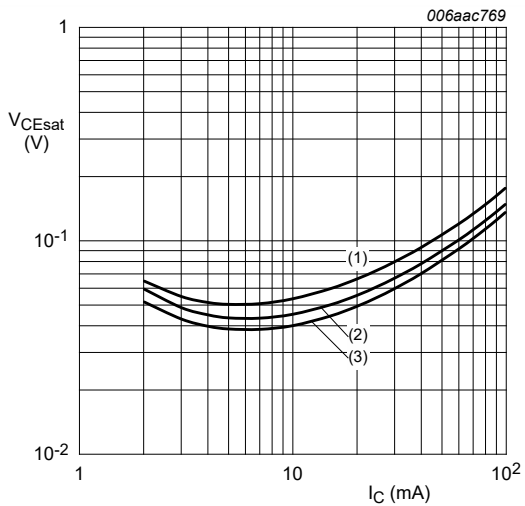
$V_{CE} = 5\text{ V}$
 (1) $T_{amb} = 100\text{ °C}$
 (2) $T_{amb} = 25\text{ °C}$
 (3) $T_{amb} = -40\text{ °C}$

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



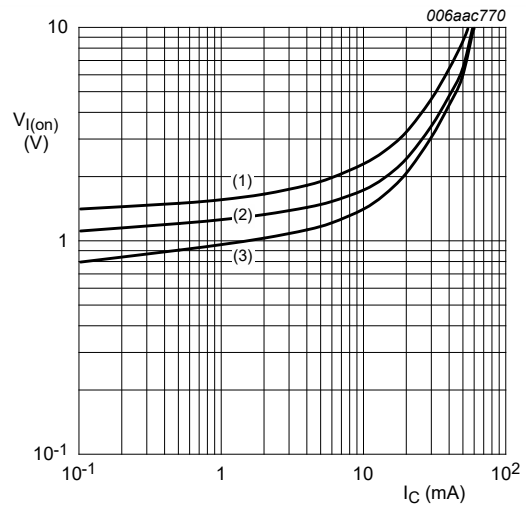
$T_{amb} = 25\text{ °C}$

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



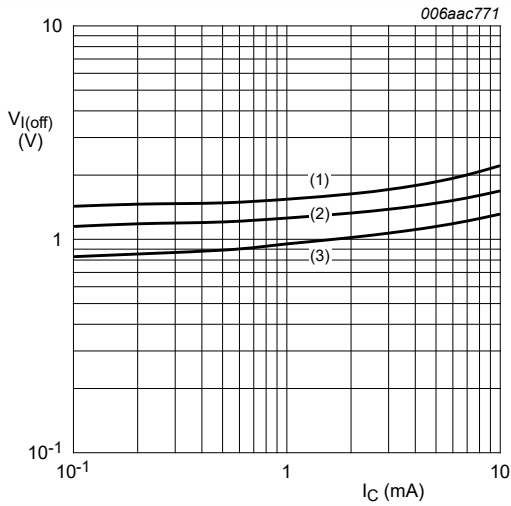
$I_C/I_B = 20$
 (1) $T_{amb} = 100\text{ °C}$
 (2) $T_{amb} = 25\text{ °C}$
 (3) $T_{amb} = -40\text{ °C}$

Fig. 5. TR1 (NPN): Collector-emitter saturation voltage as a function of collector current; typical values



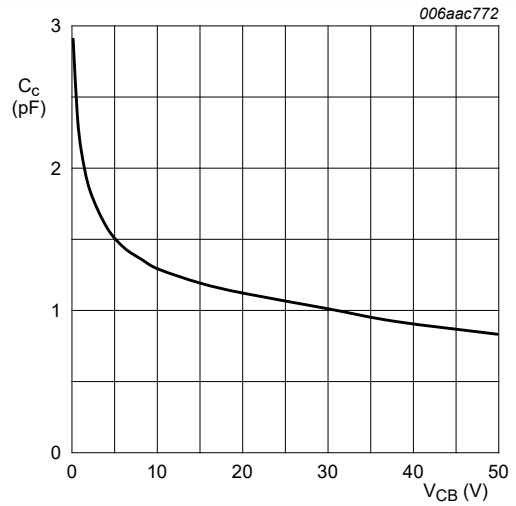
$V_{CE} = 0.3\text{ V}$
 (1) $T_{amb} = -40\text{ °C}$
 (2) $T_{amb} = 25\text{ °C}$
 (3) $T_{amb} = 100\text{ °C}$

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



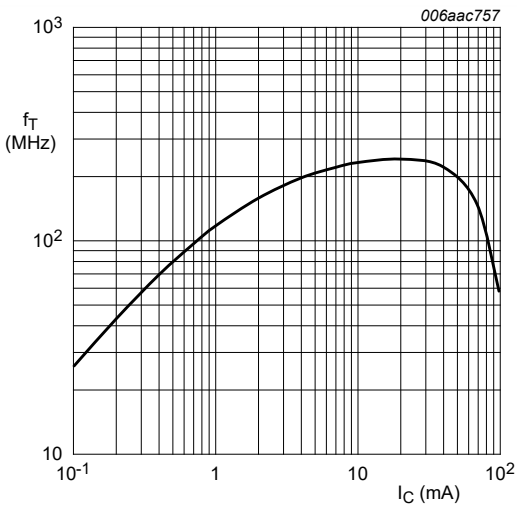
$V_{CE} = 5 \text{ V}$
 (1) $T_{amb} = -40 \text{ }^\circ\text{C}$
 (2) $T_{amb} = 25 \text{ }^\circ\text{C}$
 (3) $T_{amb} = 100 \text{ }^\circ\text{C}$

Fig. 7. TR1 (NPN): Off-state input voltage as a function of collector current; typical values



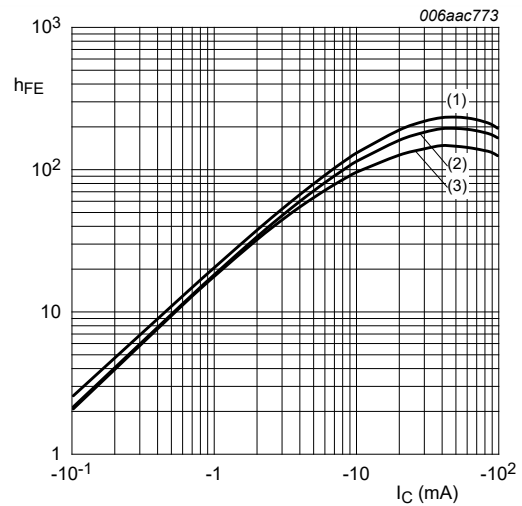
$f = 1 \text{ MHz}$
 $T_{amb} = 25 \text{ }^\circ\text{C}$

Fig. 8. TR1 (NPN): 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. 9. TR1 (NPN): 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. TR2 (PNP): DC current gain as a function of collector current; typical values

50 V, 100 mA NPN/PNP resistor-equipped double transistor; R1 = 10 kΩ, R2 = 10 kΩ

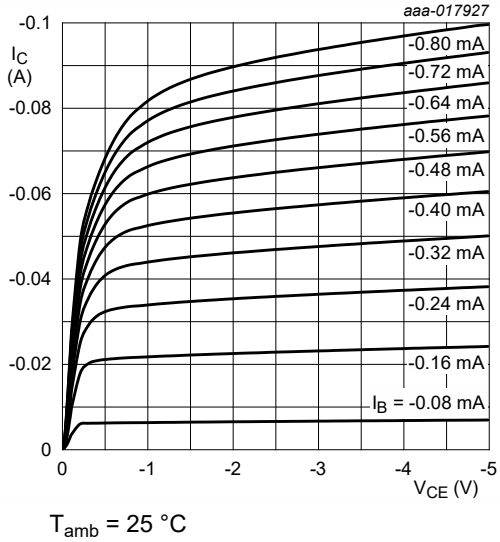


Fig. 11. TR2 (PNP): Collector current as a function of collector-emitter voltage; typical values

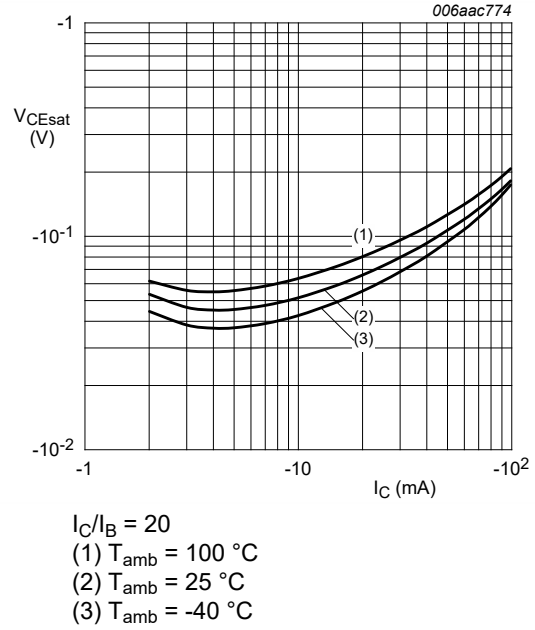


Fig. 12. TR2 (PNP): Collector-emitter saturation voltage as a function of collector current; typical values

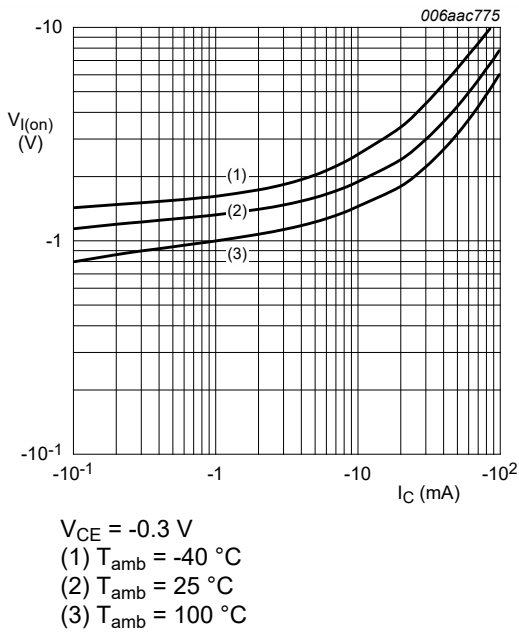


Fig. 13. TR2 (PNP): On-state input voltage as a function of collector current; typical values

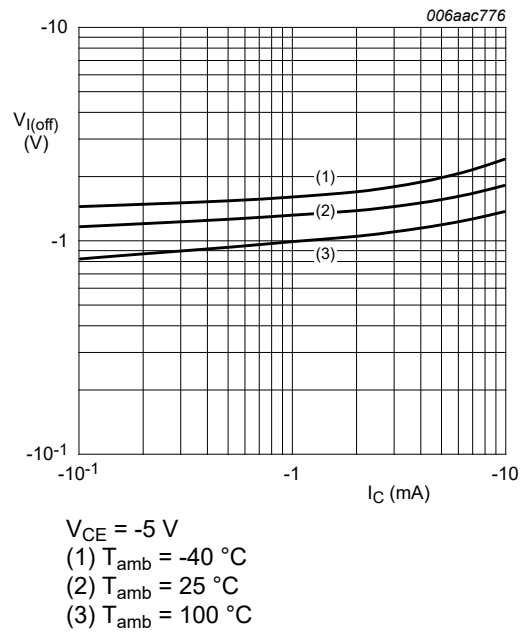
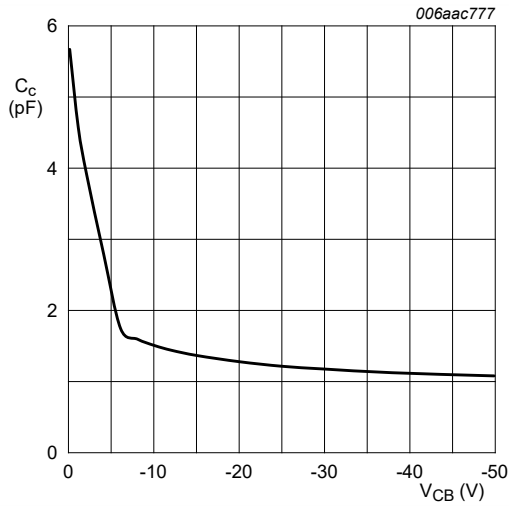
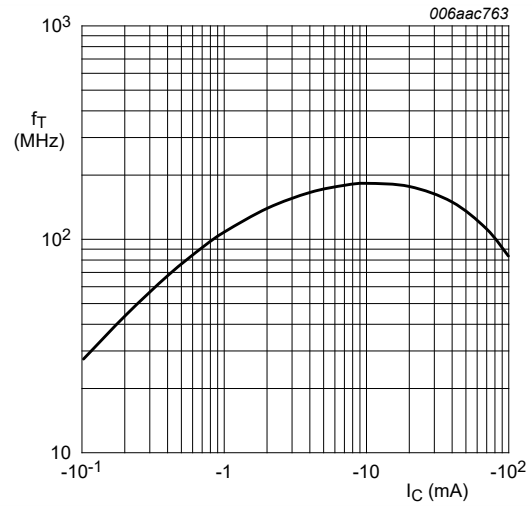


Fig. 14. TR2 (PNP): Off-state input voltage as a function of collector current; typical values



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

Fig. 15. 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. 16. 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)

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

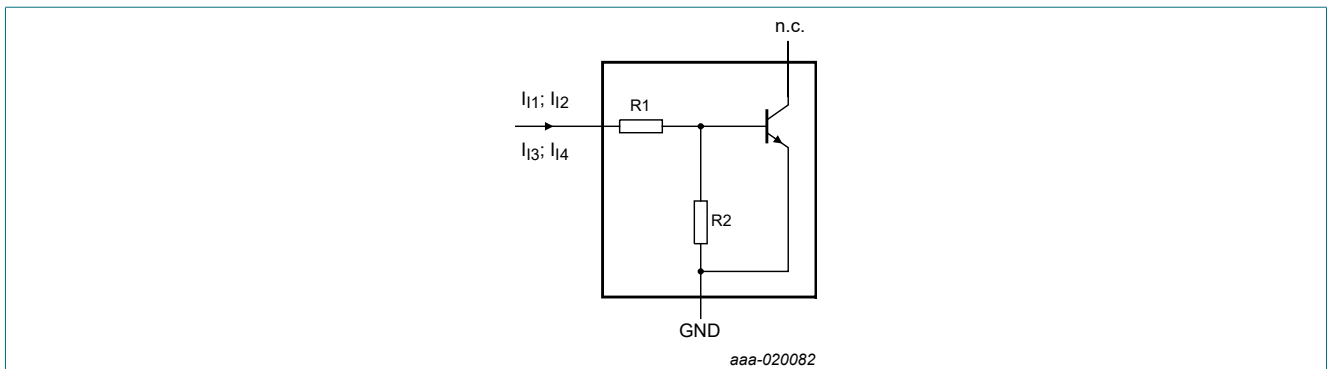


Fig. 17. TR1 (NPN): Resistor test circuit

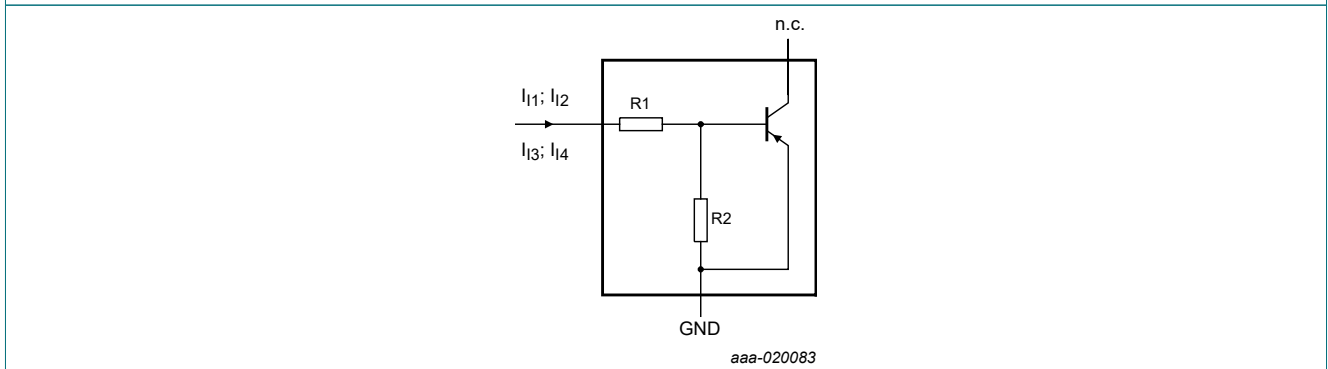


Fig. 18. TR2 (PNP): Resistor test circuit

Resistor test conditions

Table 8. Resistor test conditions

Type number	R1 (kΩ)	R2 (kΩ)	Test conditions			
			I11	I12	I13	I14
Per transistor, for the PNP with negative polarity						
PUMD3-Q	10	10	350 μA	450 μA	-350 μA	-450 μA

12. Package outline

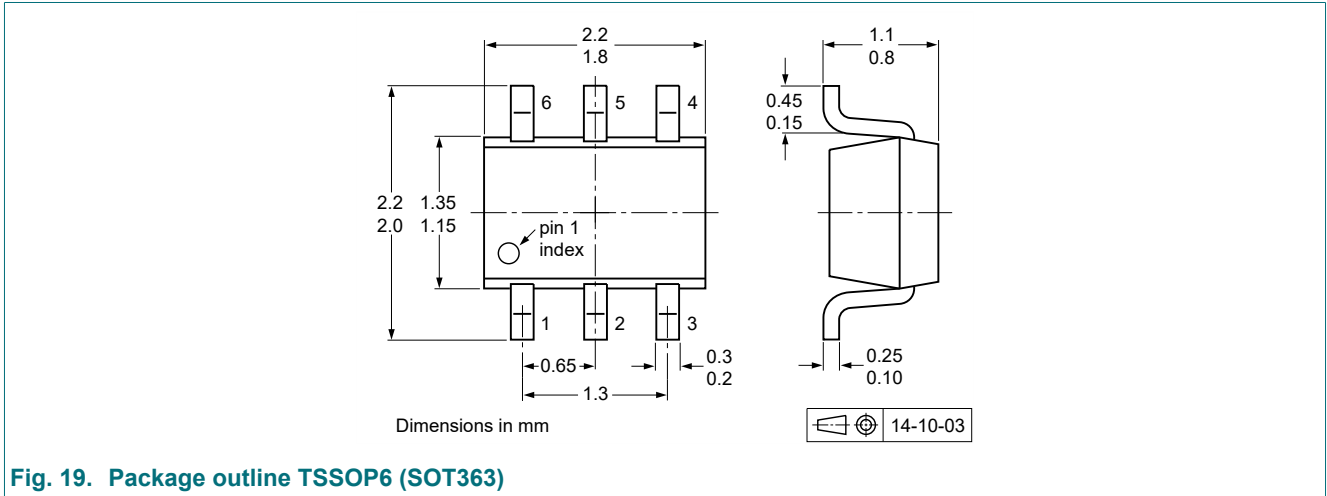


Fig. 19. Package outline TSSOP6 (SOT363)

13. Soldering

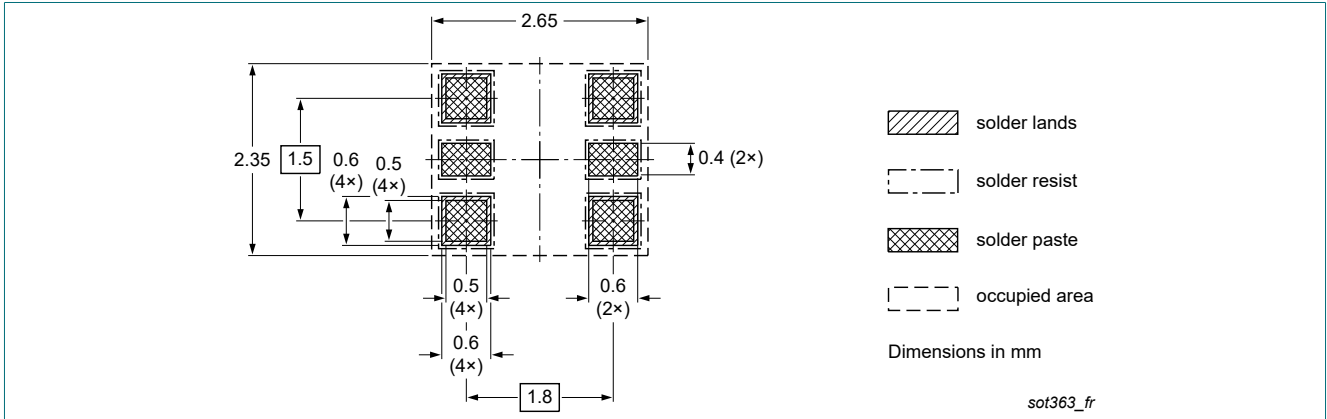


Fig. 20. Reflow soldering footprint for TSSOP6 (SOT363)

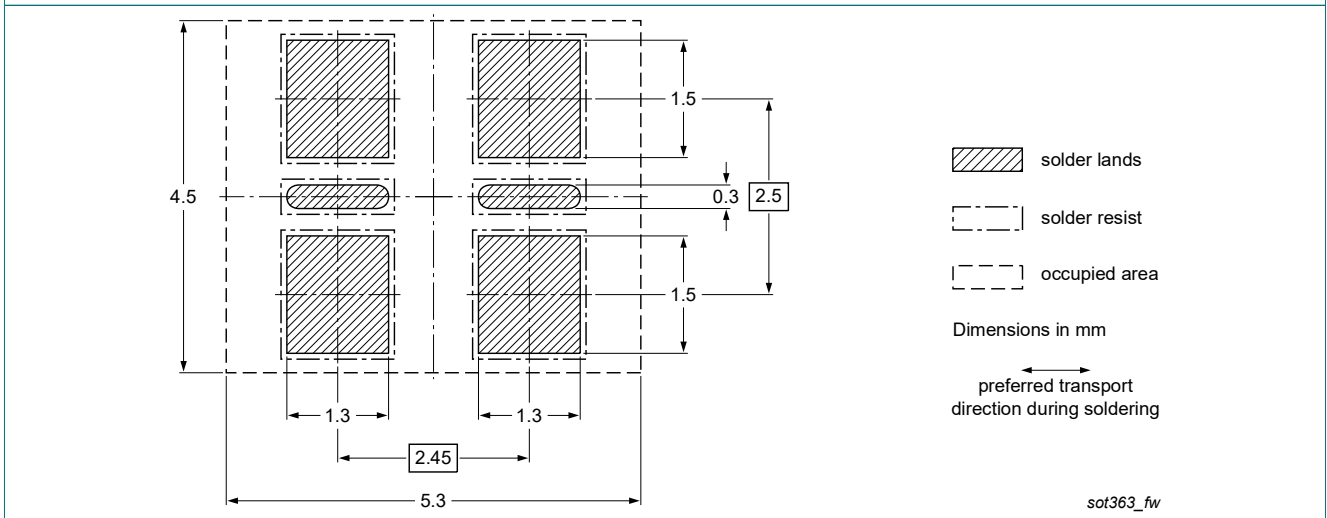


Fig. 21. Wave soldering footprint for TSSOP6 (SOT363)

14. Revision history

Table 9. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PUMD3-Q v.2	20211007	Product data sheet	-	PUMD3-Q v.1
Modification:	<ul style="list-style-type: none"> • Complete rework • General description: added new lines at the end • Applications: Clarification updated • Pinning: Graphic symbol replaced • Limiting values: deleted parameter I_{CM} • Characteristics: I_{CEO} max limit is updated to 100 nA • Characteristics: V_{CEsat} limit is now updated to 100 mV • Characteristics: added new graphics • Characteristics: Updated the graphics conditions • Characteristics: $V_{(BR)EBO}$ values is removed • Test information: Included resistor calculation, resistor test circuit and resistor test condition 			
PUMD3-Q v.1	20210624	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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Date of release: 7 October 2021

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