



PBL54002Y

40 V, 500 mA PNP loadswitch transistor

1 January 2023

Product data sheet

1. General description

PNP low V_{CEsat} transistor and NPN Resistor-Equipped Transistor (RET) in one very small SOT363 (SC-88) Surface-Mounted Device (SMD) plastic package.

2. Features and benefits

- Low V_{CEsat} transistor and resistor-equipped transistor in one package
- Low threshold voltage (<1 V) compared to MOSFET
- Low drive power required
- Space-saving solution
- Reduction of component count

3. Applications

- Supply line switches
- Battery charger switches
- High-side switches for LEDs, drivers and backlights
- Portable equipment

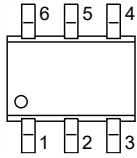
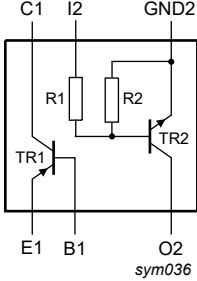
4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
TR1: PNP low V_{CEsat} transistor						
V_{CEO}	collector-emitter voltage	open base	-	-	-40	V
I_{Clim}	limiting collector current		-	-	-500	mA
R_{CEsat}	collector-emitter saturation resistance	$I_C = -500$ mA; $I_B = -50$ mA; $T_{amb} = 25$ °C; pulsed; $t_p \leq 300$ μ s; $\delta_{factor} \leq 0.02$	-	440	700	m Ω
TR2: NPN resistor-equipped transistor						
V_{CEO}	collector-emitter voltage	open base	-	-	50	V
I_O	output current		-	-	100	mA
R1	bias resistor 1 (input)		3.3	4.7	6.1	k Ω
R2/R1	bias resistor ratio		0.8	1	1.2	

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	GND1	GND (emitter) TR1	 <p>TSSOP6 (SOT363)</p>	 <p>sym036</p>
2	B1	base TR1		
3	O2	output (collector) TR2		
4	GND2	GND (emitter) TR2		
5	I2	input (base) TR2		
6	C1	collector TR1		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PBL54002Y	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]
PBL54002Y	S2%

[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
TR1: PNP low V_{CEsat} transistor					
V_{CBO}	collector-base voltage	open emitter	-	-40	V
V_{CEO}	collector-emitter voltage	open base	-	-40	V
V_{EBO}	emitter-base voltage	open collector	-	-6	V
I_{Clim}	limiting collector current		-	-500	mA
I_{CM}	peak collector current	$t_p \leq 1$ ms; single pulse	-	-1	mA
I_B	base current		-	-50	mA
I_{BM}	peak base current	single pulse; $t_p \leq 1$ ms	-	-100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	[1]	200	mW
TR2: NPN resistor-equipped transistor					
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 TR2 positive	-	30	V
		input voltage TR2 negative	-	-10	V
I_O	output current		-	100	mA
I_{CM}	peak collector current	$t_p \leq 1$ ms; single pulse	-	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	[1]	200	mW
Per device					
P_{tot}	total power dissipation		-	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.

9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Per device						
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	416	K/W

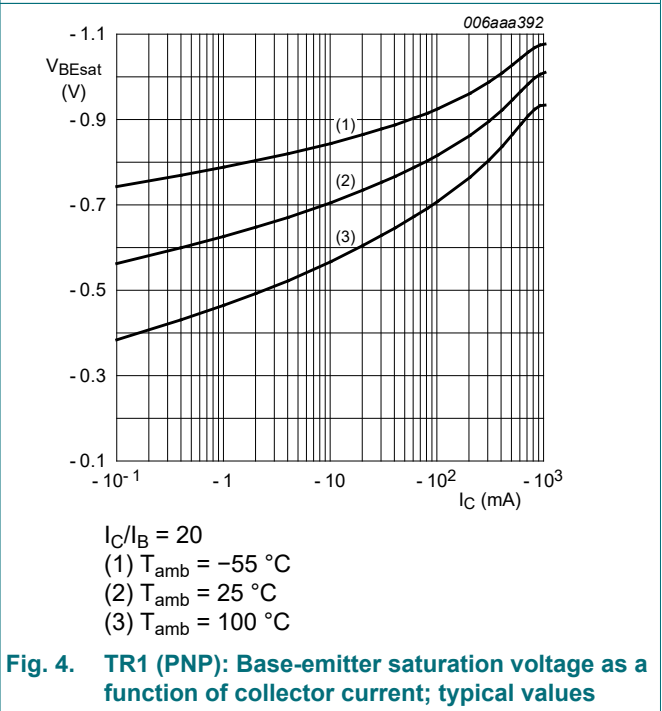
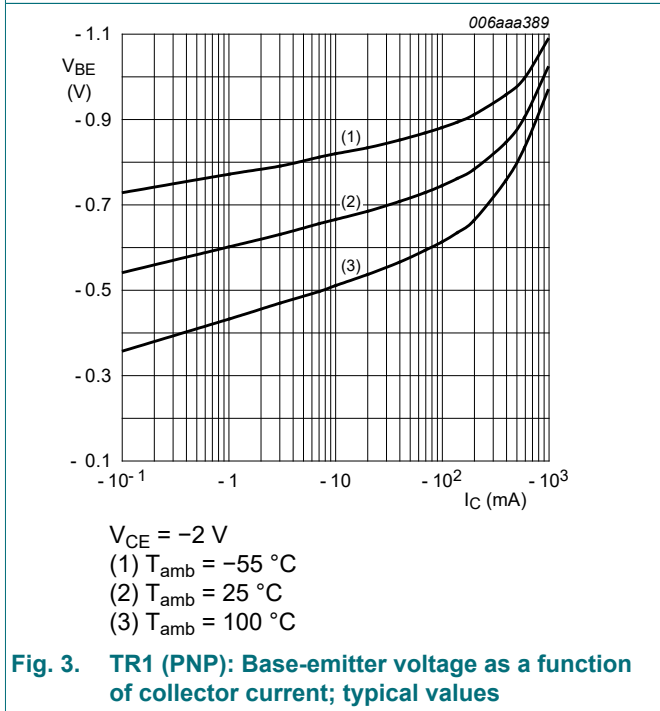
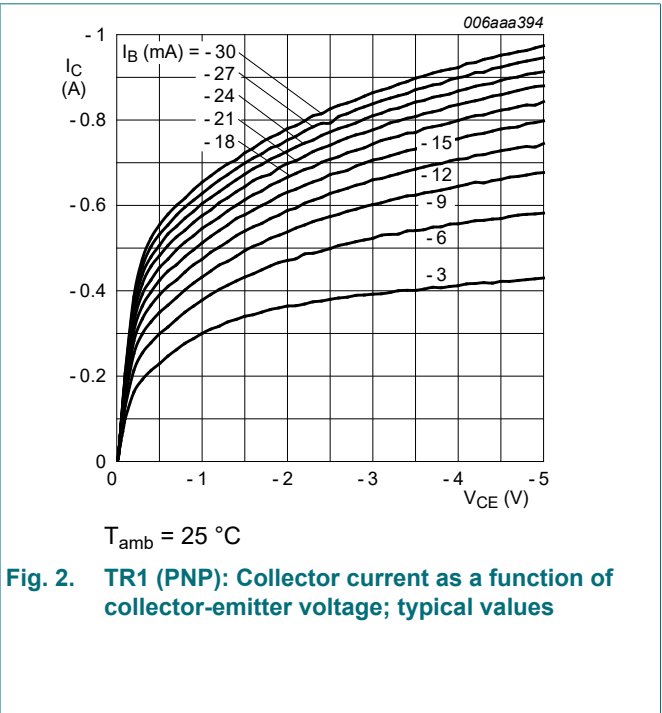
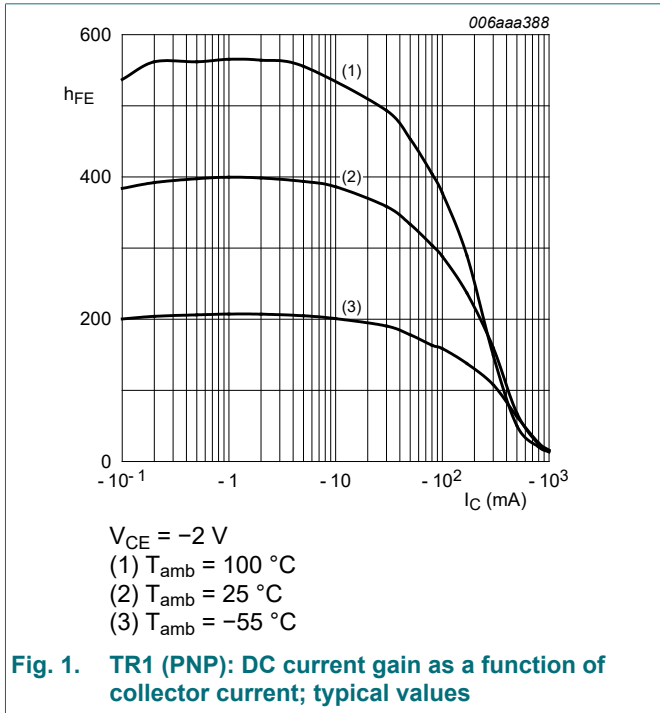
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

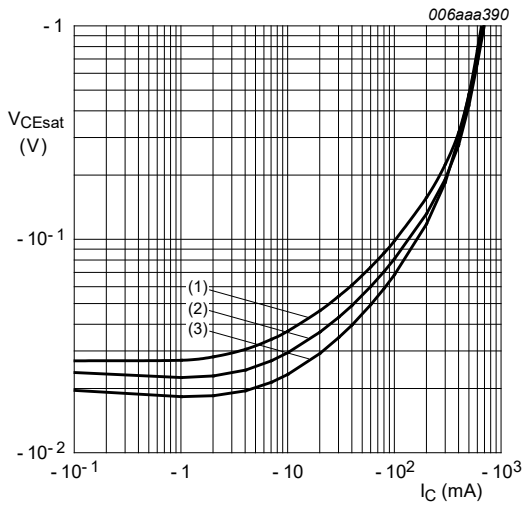
10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
TR1: PNP low V_{CEsat} transistor						
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = -100 \mu A$; $I_E = 0 A$; $T_{amb} = 25 \text{ }^\circ C$	-40	-	-	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = -10 \text{ mA}$; $I_B = 0 A$; $T_{amb} = 25 \text{ }^\circ C$	-40	-	-	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_C = 0 A$; $I_E = 100 \mu A$; $T_{amb} = 25 \text{ }^\circ C$	-6	-	-	V
I_{CBO}	collector-base cut-off current	$V_{CB} = -40 \text{ V}$; $I_E = 0 A$; $T_{amb} = 25 \text{ }^\circ C$	-	-	-100	nA
		$V_{CB} = -40 \text{ V}$; $I_E = 0 A$; $T_{amb} = 150 \text{ }^\circ C$	-	-	-50	μA
I_{EBO}	emitter-base cut-off current	$V_{EB} = -5 \text{ V}$; $I_C = 0 \text{ mA}$; $T_{amb} = 25 \text{ }^\circ C$	-	-	-100	nA
h_{FE}	DC current gain	$V_{CE} = -2 \text{ V}$; $I_C = -10 \text{ mA}$; pulsed; $T_{amb} = 25 \text{ }^\circ C$	200	-	-	
		$V_{CE} = -2 \text{ V}$; $I_C = -100 \text{ mA}$; pulsed; $t_p \leq 300 \mu s$; $\delta \leq 0.02$; $T_{amb} = 25 \text{ }^\circ C$	150	-	-	
		$V_{CE} = -2 \text{ V}$; $I_C = -500 \text{ mA}$; pulsed; $t_p \leq 300 \mu s$; $\delta \leq 0.02$; $T_{amb} = 25 \text{ }^\circ C$	40	-	-	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10 \text{ mA}$; $I_B = -0.5 \text{ mA}$; $T_{amb} = 25 \text{ }^\circ C$	-	-	-50	mV
		$I_C = -100 \text{ mA}$; $I_B = -5 \text{ mA}$; $T_{amb} = 25 \text{ }^\circ C$	-	-	-130	mV
		$I_C = -200 \text{ mA}$; $I_B = -10 \text{ mA}$; $T_{amb} = 25 \text{ }^\circ C$	-	-	-200	mV
		$I_C = -500 \text{ mA}$; $I_B = -50 \text{ mA}$; pulsed; $t_p \leq 300 \mu s$; $\delta \leq 0.02 \%$; $T_{amb} = 25 \text{ }^\circ C$	-	-	-350	mV
R_{CEsat}	collector-emitter saturation resistance	$I_C = -500 \text{ mA}$; $I_B = -50 \text{ mA}$; $T_{amb} = 25 \text{ }^\circ C$; pulsed; $t_p \leq 300 \mu s$; $\delta_{factor} \leq 0.02$	-	440	700	m Ω
V_{BEsat}	base-emitter saturation voltage		-	-	-1.2	V
V_{BEon}	base-emitter turn-on voltage	$V_{CE} = -2 \text{ V}$; $I_C = -100 \text{ mA}$; $T_{amb} = 25 \text{ }^\circ C$; pulsed; $t_p \leq 300 \mu s$; $\delta_{factor} \leq 0.02$	-	-	-1.1	V
C_c	collector capacitance	$V_{CB} = -10 \text{ V}$; $I_E = 0 A$; $i_e = 0 A$; $f = 1 \text{ MHz}$; $T_{amb} = 25 \text{ }^\circ C$	-	-	10	pF
f_T	transition frequency	$V_{CE} = -5 \text{ V}$; $I_C = -100 \text{ mA}$; $f = 100 \text{ MHz}$; $T_{amb} = 25 \text{ }^\circ C$	100	300	-	MHz
TR2: NPN resistor-equipped transistor						
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 100 \mu A$; $I_E = 0 A$; $T_{amb} = 25 \text{ }^\circ C$	50	-	-	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 10 \text{ mA}$; $I_B = 0 A$; $T_{amb} = 25 \text{ }^\circ C$	50	-	-	V
I_{CBO}	collector-base cut-off current	$V_{CB} = 50 \text{ V}$; $I_E = 0 A$; $T_{amb} = 25 \text{ }^\circ C$	-	-	100	nA
I_{CEO}	collector-emitter cut-off current	$V_{CE} = 50 \text{ V}$; $I_B = 0 A$; $T_{amb} = 25 \text{ }^\circ C$	-	-	1	μA
		$V_{CE} = 50 \text{ V}$; $I_B = 0 A$; $T_{amb} = 150 \text{ }^\circ C$	-	-	50	μA
I_{EBO}	emitter-base cut-off current	$V_{EB} = 5 \text{ V}$; $I_C = 0 A$; $T_{amb} = 25 \text{ }^\circ C$	-	-	900	μA
h_{FE}	DC current gain	$V_{CE} = 5 \text{ V}$; $I_C = 10 \text{ mA}$; $T_{amb} = 25 \text{ }^\circ C$	30	-	-	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10 \text{ mA}$; $I_B = 0.5 \text{ mA}$; $T_{amb} = 25 \text{ }^\circ C$	-	-	150	mV

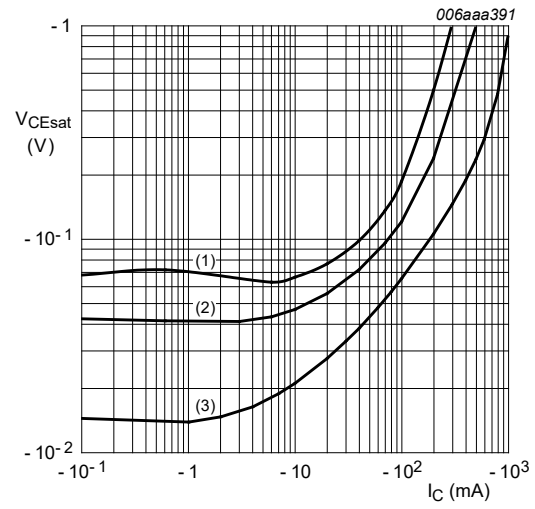
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{I(off)}$	off-state input voltage	$V_{CE} = 5\text{ V}; I_C = 100\ \mu\text{A}; T_{amb} = 25\text{ }^\circ\text{C}$	-	1.1	0.5	V
$V_{I(on)}$	on-state input voltage	$V_{CE} = 0.3\text{ V}; I_C = 20\text{ mA}; T_{amb} = 25\text{ }^\circ\text{C}$	2.5	1.9	-	V
R1	bias resistor 1 (input)		3.3	4.7	6.1	k Ω
R2/R1	bias resistor ratio		0.8	1	1.2	
C_c	collector capacitance	$V_{CB} = 10\text{ V}; I_E = 0\text{ A}; i_e = 0\text{ A}; f = 1\text{ MHz}; T_{amb} = 25\text{ }^\circ\text{C}$	-	-	2.5	pF





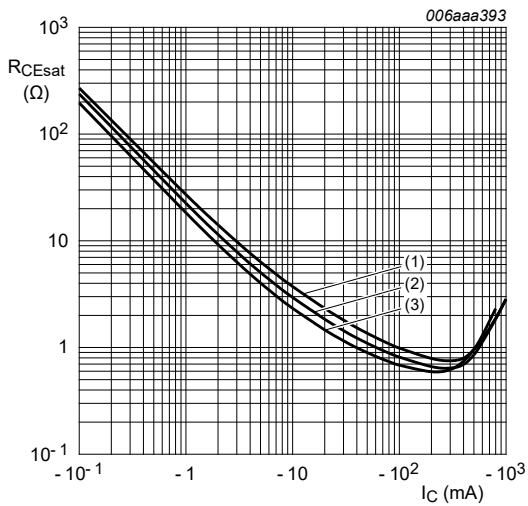
$I_C/I_B = 20$
 (1) $T_{amb} = 100\text{ °C}$
 (2) $T_{amb} = 25\text{ °C}$
 (3) $T_{amb} = -55\text{ °C}$

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



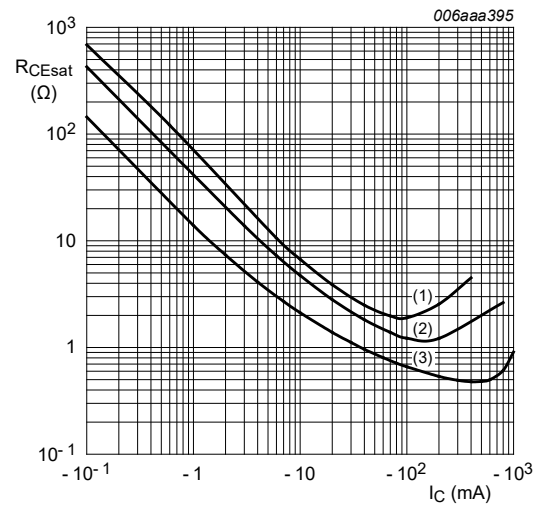
$T_{amb} = 25\text{ °C}$
 (1) $I_C/I_B = 100$
 (2) $I_C/I_B = 50$
 (3) $I_C/I_B = 10$

Fig. 6. TR1 (PNP): Collector-emitter saturation voltage as a function of collector current; typical values



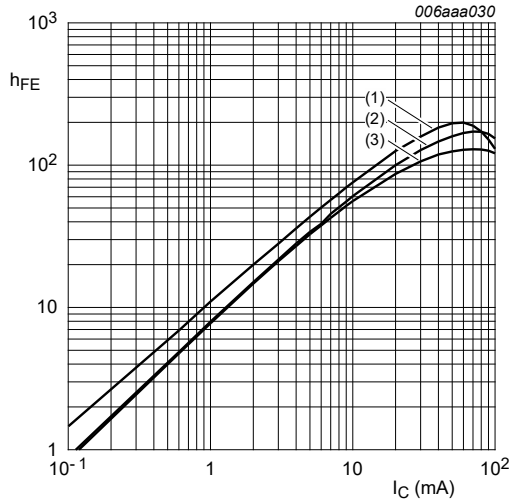
$I_C/I_B = 20$
 (1) $T_{amb} = 100\text{ °C}$
 (2) $T_{amb} = 25\text{ °C}$
 (3) $T_{amb} = -55\text{ °C}$

Fig. 7. TR1 (PNP): Collector-emitter saturation resistance as a function of collector current; typical values



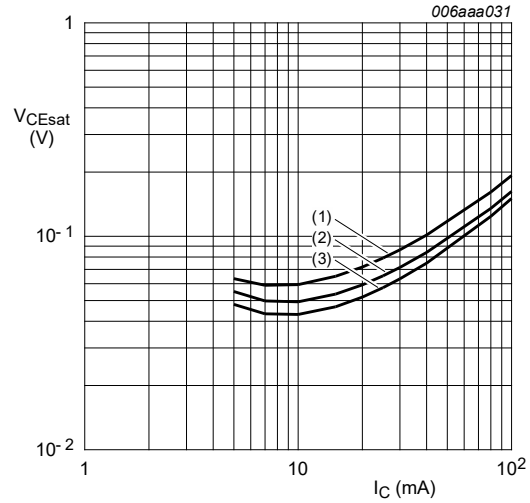
$T_{amb} = 25\text{ °C}$
 (1) $I_C/I_B = 100$
 (2) $I_C/I_B = 50$
 (3) $I_C/I_B = 10$

Fig. 8. TR1 (PNP): Collector-emitter saturation resistance as a function of collector current; typical values



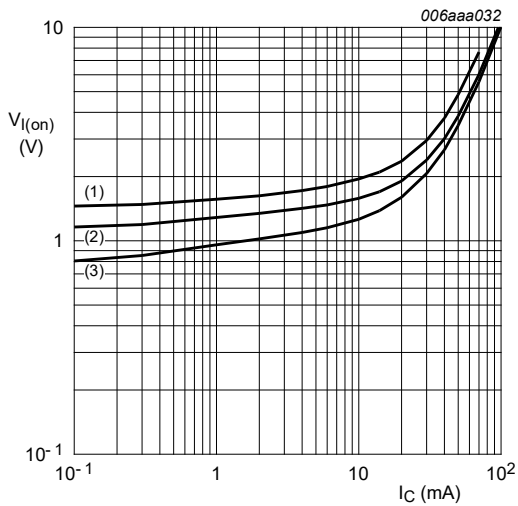
$V_{CE} = 5\text{ V}$
 (1) $T_{amb} = 150\text{ }^{\circ}\text{C}$
 (2) $T_{amb} = 25\text{ }^{\circ}\text{C}$
 (3) $T_{amb} = -40\text{ }^{\circ}\text{C}$

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



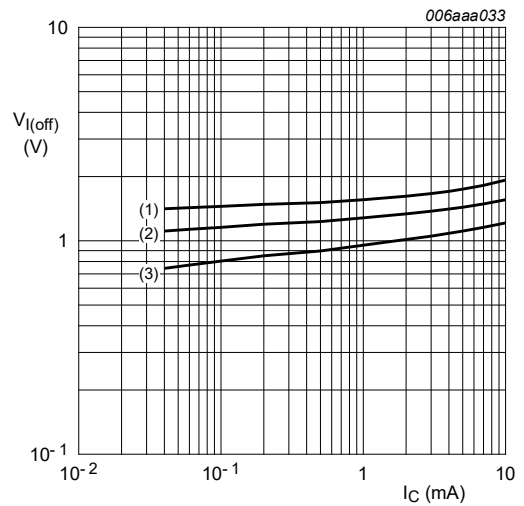
$I_C/I_B = 20$
 (1) $T_{amb} = 100\text{ }^{\circ}\text{C}$
 (2) $T_{amb} = 25\text{ }^{\circ}\text{C}$
 (3) $T_{amb} = -40\text{ }^{\circ}\text{C}$

Fig. 10. TR2 (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. 11. TR2 (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. 12. TR2 (NPN): 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)

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

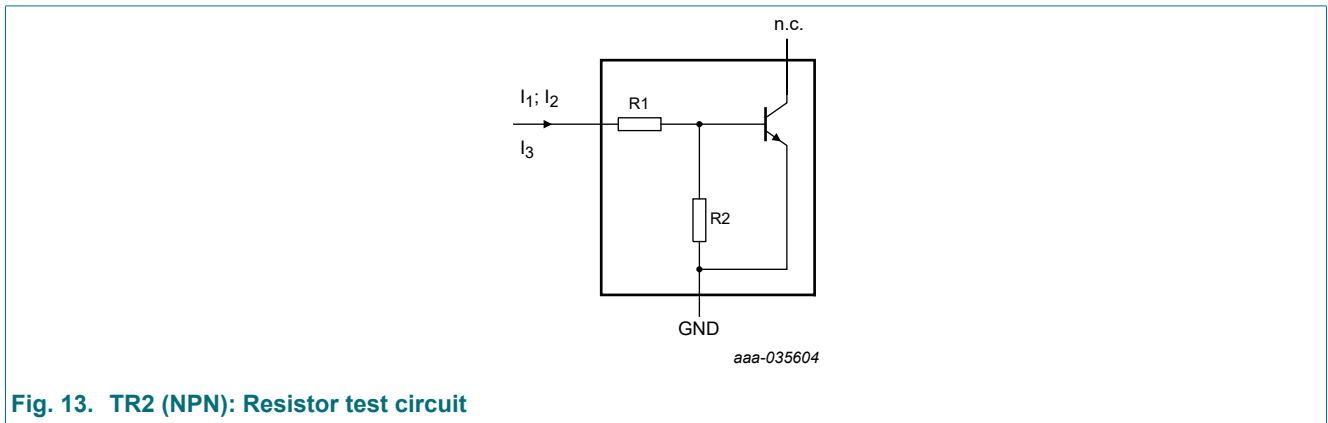


Fig. 13. TR2 (NPN): Resistor test circuit

Resistor test conditions

Table 8. Resistor test conditions

Type number	R1 (kΩ)	R2 (kΩ)	Test conditions		
			I ₁	I ₂	I ₃
Per transistor, for the PNP with negative polarity					
PBLS4002Y	4.7	4.7	750 μA	950 μA	850 μA

12. Package outline

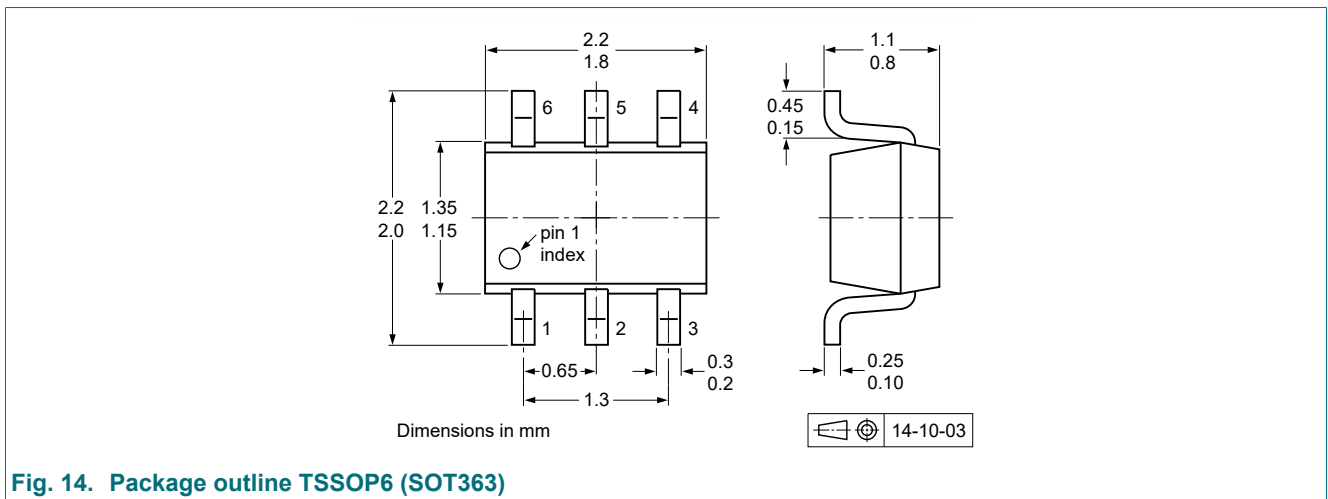


Fig. 14. Package outline TSSOP6 (SOT363)

13. Soldering

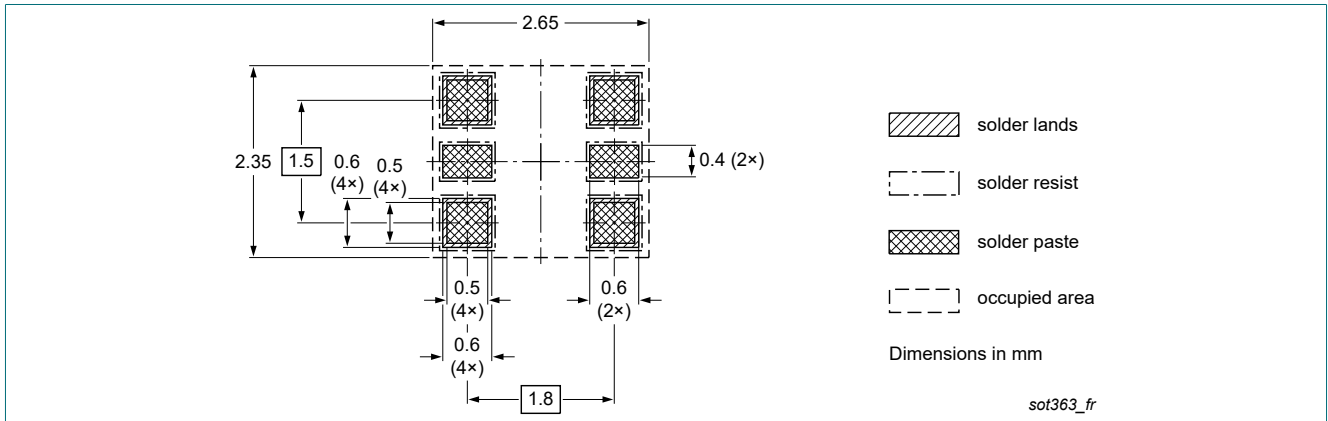


Fig. 15. Reflow soldering footprint for TSSOP6 (SOT363)

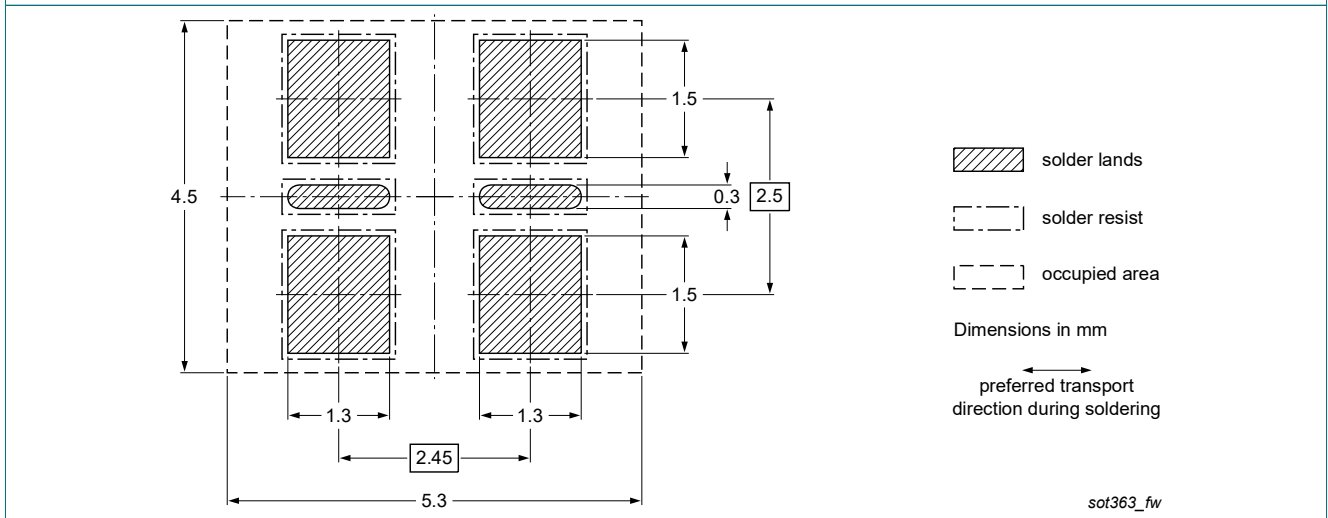


Fig. 16. Wave soldering footprint for TSSOP6 (SOT363)

14. Revision history

Table 9. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PBL54002Y v.5	20230101	Product data sheet	-	PBL54002Y v.4
Modifications:	<ul style="list-style-type: none"> Product changed to non-automotive qualification. Please refer to nexperia.com for automotive (-Q) product alternative(s). 			
PBL54002Y v.4	20220427	Product data sheet	-	PBL54002Y_PBL54002V_3
PBL54002Y_PBL54002V_3	20090212	Product data sheet	-	PBL54002Y_PBL54002V_2
PBL54002Y_PBL54002V_2	20050719	Product data sheet	-	PBL54002Y_PBL54002V_1
PBL54002Y_PBL54002V_1	20041206	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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