



# PBSS302ND-Q

40 V, 4 A NPN low V<sub>CEsat</sub> transistor

20 April 2023

Product data sheet

## 1. General description

NPN low V<sub>CEsat</sub> transistor in a SOT457 (SC-74) small Surface-Mounted Device (SMD) plastic package.

## 2. Features and benefits

- Ultra low collector-emitter saturation voltage V<sub>CEsat</sub>
- 4 A continuous collector current capability I<sub>C</sub>
- Up to 15 A peak current
- Very low collector-emitter saturation resistance
- High efficiency due to less heat generation
- Qualified according to AEC-Q101 and recommended for use in automotive applications

## 3. Applications

- Power management functions
- Charging circuits
- DC-to-DC conversion
- MOSFET gate driving
- Power switches (e.g. motors, fans)
- Thin Film Transistor (TFT) backlight inverter

## 4. Quick reference data

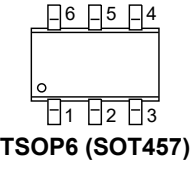
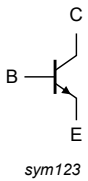
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>CEO</sub>	collector-emitter voltage	open base	-	-	40	V
I <sub>C</sub>	collector current	[1]	-	-	4	A
I <sub>CM</sub>	peak collector current	single pulse; t <sub>p</sub> ≤ 1 ms	-	-	15	A
R <sub>CEsat</sub>	collector-emitter saturation resistance	I <sub>C</sub> = 6 A; I <sub>B</sub> = 600 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	-	55	75	mΩ

[1] Device mounted on a ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint.

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	C	collector	 <p>TSOP6 (SOT457)</p>	
2	C	collector		
3	B	base		
4	E	emitter		
5	C	collector		
6	C	collector		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
<a href="#">PBSS302ND-Q</a>	TSOP6	plastic, surface-mounted package (SC-74; TSOP6); 6 leads	<a href="#">SOT457</a>

## 7. Marking

Table 4. Marking codes

Type number	Marking code
PBSS302ND-Q	C7

## 8. Limiting values

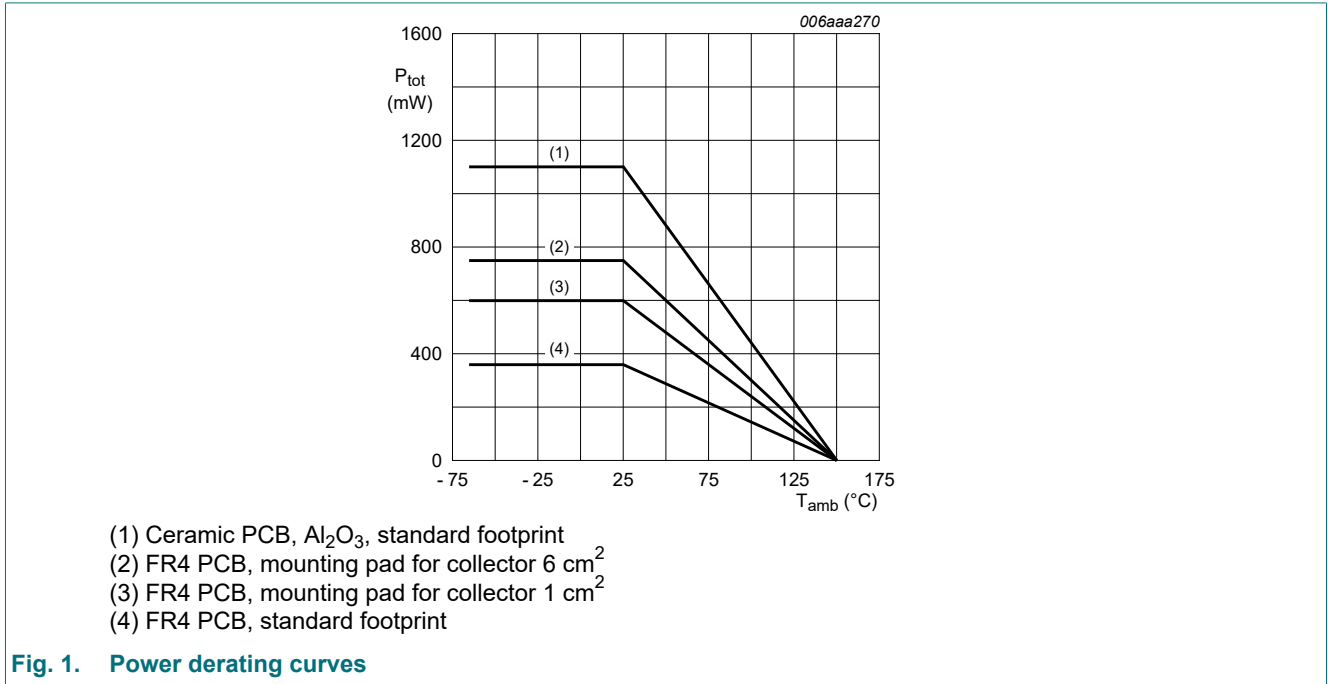
Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
$V_{CBO}$	collector-base voltage	open emitter		-	60	V
$V_{CEO}$	collector-emitter voltage	open base		-	40	V
$V_{EBO}$	emitter-base voltage	open collector		-	5	V
$I_C$	collector current		[1]	-	4	A
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms		-	15	A
$I_B$	base current			-	0.8	A
$I_{BM}$	peak base current	single pulse; $t_p \leq 1$ ms		-	2	mA
$P_{tot}$	total power dissipation	$T_{amb} \leq 25$ °C	[2]	-	360	mW
			[3]	-	600	mW
			[4]	-	750	mW
			[1]	-	1.1	W
			[2] [5]	-	2.5	W
$T_j$	junction temperature			-	150	°C
$T_{amb}$	ambient temperature			-65	150	°C

Symbol	Parameter	Conditions	Min	Max	Unit
T <sub>stg</sub>	storage temperature		-65	150	°C

- [1] Device mounted on a ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
- [3] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.
- [4] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 6 cm<sup>2</sup>.
- [5] Operated under pulsed conditions: Duty cycle δ ≤ 10 % and pulse width t<sub>p</sub> ≤ 10 ms.



## 9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
R <sub>th(j-a)</sub>	thermal resistance from junction to ambient	in free air	[1]	-	-	350	K/W
			[2]	-	-	208	K/W
			[3]	-	-	167	K/W
			[4]	-	-	113	K/W
			[1] [5]	-	-	50	K/W
R <sub>th(j-sp)</sub>	thermal resistance from junction to solder point		-	-	45	K/W	

- [1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.
- [3] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 6 cm<sup>2</sup>.
- [4] Device mounted on a ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint.
- [5] Operated under pulsed conditions: Duty cycle δ ≤ 10 % and pulse width t<sub>p</sub> ≤ 10 ms.

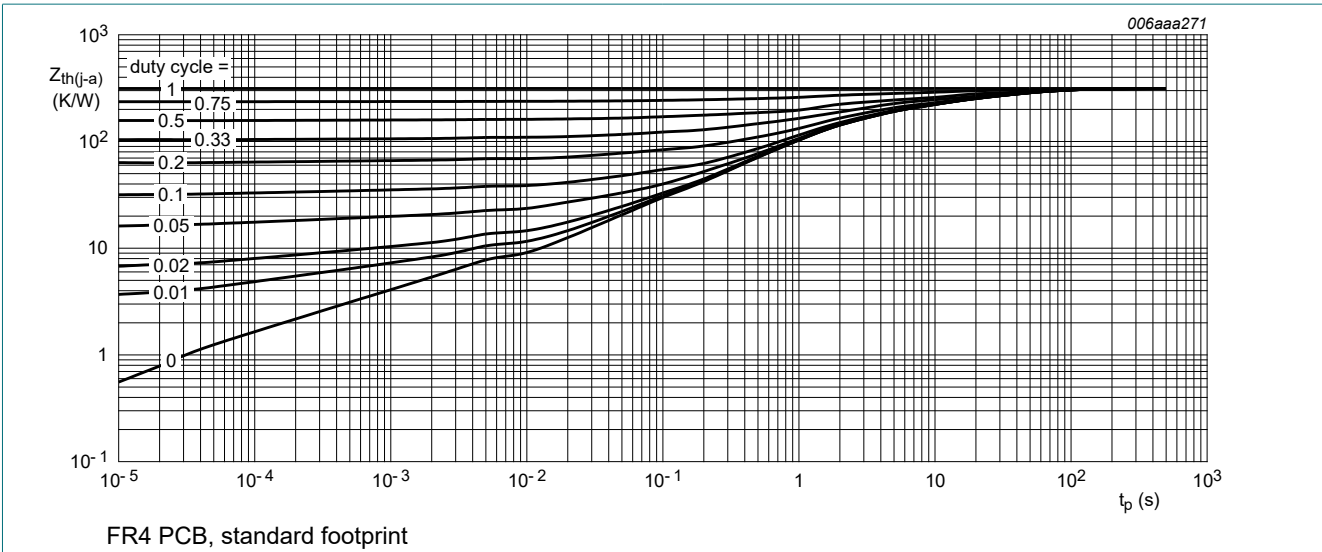


Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

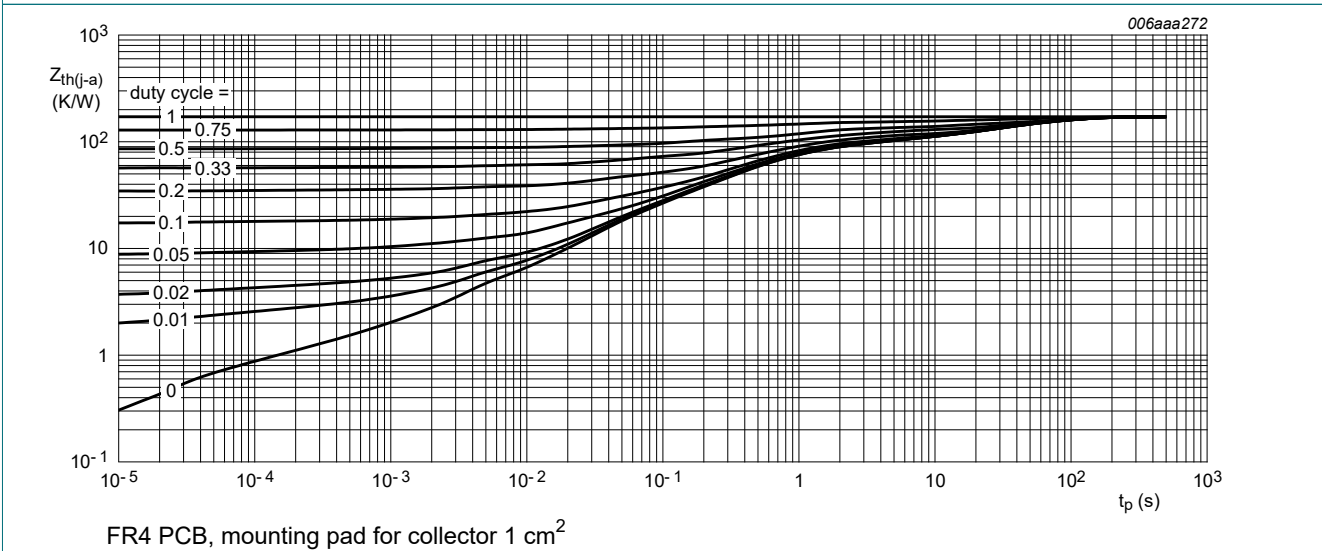


Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

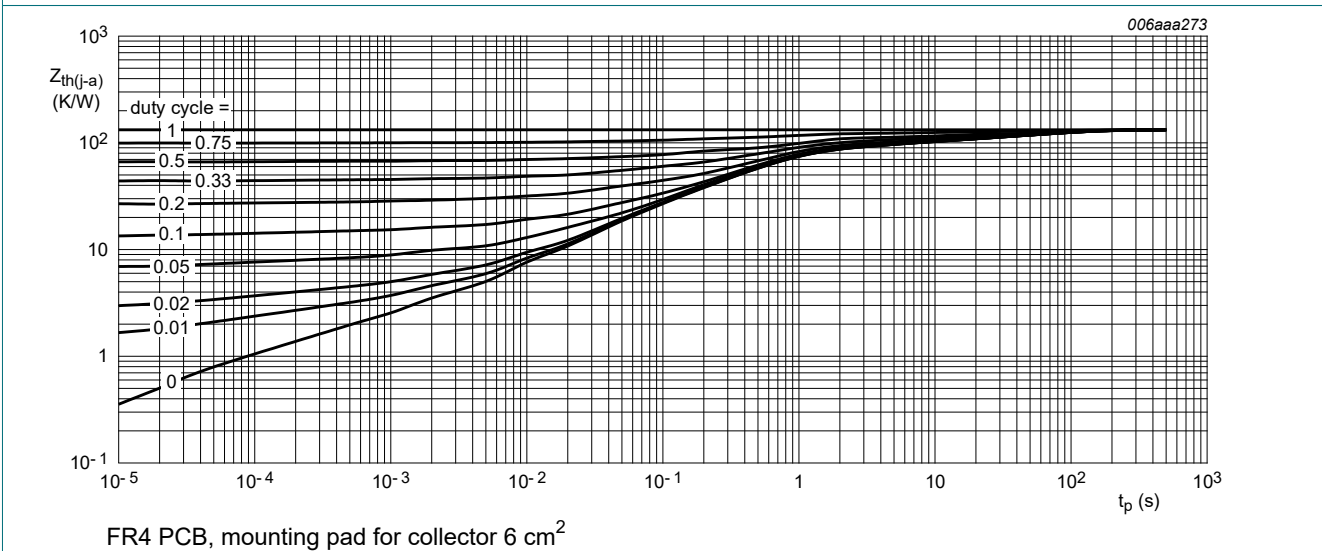
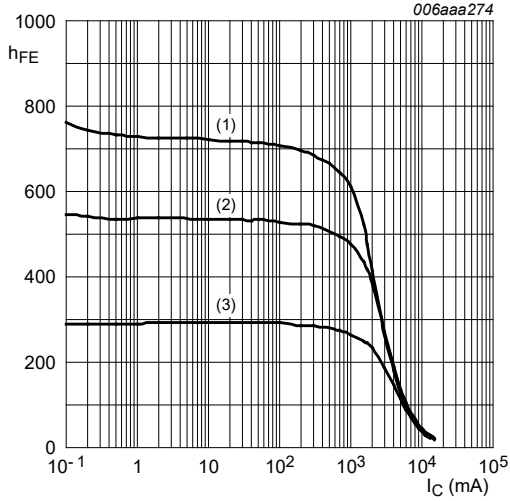


Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

## 10. Characteristics

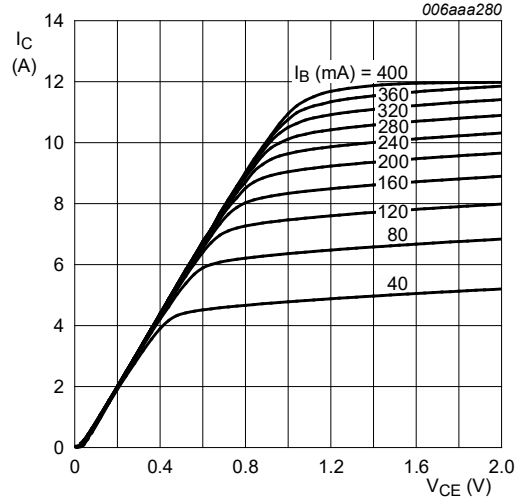
Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_{CBO}$	collector-base cut-off current	$V_{CB} = 40\text{ V}; I_E = 0\text{ A}; T_{amb} = 25\text{ }^\circ\text{C}$	-	-	100	nA
		$V_{CB} = 40\text{ V}; I_E = 0\text{ A}; T_j = 150\text{ }^\circ\text{C}$	-	-	50	$\mu\text{A}$
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 5\text{ V}; I_C = 0\text{ A}; T_{amb} = 25\text{ }^\circ\text{C}$	-	-	100	nA
$I_{CES}$	collector-emitter cut-off current	$V_{CE} = 30\text{ V}; V_{BE} = 0\text{ V}; T_{amb} = 25\text{ }^\circ\text{C}$	-	-	100	nA
$h_{FE}$	DC current gain	$V_{CE} = 2\text{ V}; I_C = 0.5\text{ A}; T_{amb} = 25\text{ }^\circ\text{C}$	300	500	-	
		$V_{CE} = 2\text{ V}; I_C = 1\text{ A};$ pulsed; $t_p \leq 300\text{ }\mu\text{s};$ $\delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	300	475	-	
		$V_{CE} = 2\text{ V}; I_C = 2\text{ A};$ pulsed; $t_p \leq 300\text{ }\mu\text{s};$ $\delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	250	385	-	
		$V_{CE} = 2\text{ V}; I_C = 4\text{ A};$ pulsed; $t_p \leq 300\text{ }\mu\text{s};$ $\delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	100	190	-	
		$V_{CE} = 2\text{ V}; I_C = 6\text{ A};$ pulsed; $t_p \leq 300\text{ }\mu\text{s};$ $\delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	50	100	-	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 0.5\text{ A}; I_B = 50\text{ mA}; T_{amb} = 25\text{ }^\circ\text{C}$	-	35	60	mV
		$I_C = 1\text{ A}; I_B = 50\text{ mA}; T_{amb} = 25\text{ }^\circ\text{C}$	-	65	110	mV
		$I_C = 2\text{ A}; I_B = 200\text{ mA}; T_{amb} = 25\text{ }^\circ\text{C}$	-	115	180	mV
		$I_C = 4\text{ A}; I_B = 400\text{ mA};$ pulsed; $t_p \leq$ $300\text{ }\mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	-	220	300	mV
		$I_C = 6\text{ A}; I_B = 600\text{ mA};$ pulsed; $t_p \leq$ $300\text{ }\mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	-	330	450	mV
$R_{CEsat}$	collector-emitter saturation resistance		-	55	75	m $\Omega$
$V_{BEsat}$	base-emitter saturation voltage	$I_C = 0.5\text{ A}; I_B = 50\text{ mA}; T_{amb} = 25\text{ }^\circ\text{C}$	-	0.79	0.85	V
		$I_C = 1\text{ A}; I_B = 50\text{ mA}; T_{amb} = 25\text{ }^\circ\text{C}$	-	0.81	0.9	V
		$I_C = 1\text{ A}; I_B = 100\text{ mA};$ pulsed; $t_p \leq$ $300\text{ }\mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	-	0.83	1	V
		$I_C = 4\text{ A}; I_B = 400\text{ mA};$ pulsed; $t_p \leq$ $300\text{ }\mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	-	1	1.1	V
$V_{BEon}$	base-emitter turn-on voltage	$V_{CE} = 2\text{ V}; I_C = 2\text{ A}; T_{amb} = 25\text{ }^\circ\text{C}$	-	0.79	1	V
$t_d$	delay time	$V_{CC} = 10\text{ V}; I_C = 2\text{ A}; I_{Bon} = 0.1\text{ A};$ $I_{Boff} = -0.1\text{ A}; T_{amb} = 25\text{ }^\circ\text{C}$	-	12	-	ns
$t_r$	rise time		-	52	-	ns
$t_{on}$	turn-on time		-	64	-	ns
$t_s$	storage time		-	390	-	ns
$t_f$	fall time		-	120	-	ns
$t_{off}$	turn-off time		-	510	-	ns
$f_T$	transition frequency		$V_{CE} = 10\text{ V}; I_C = 0.1\text{ A}; f = 100\text{ MHz};$ $T_{amb} = 25\text{ }^\circ\text{C}$	-	150	-
$C_c$	collector capacitance	$V_{CB} = 10\text{ V}; I_E = 0\text{ A}; i_e = 0\text{ A}; f = 1\text{ MHz};$ $T_{amb} = 25\text{ }^\circ\text{C}$	-	30	-	pF



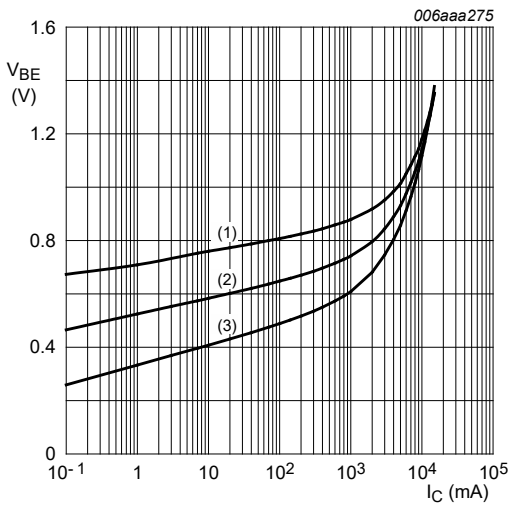
$V_{CE} = 2\text{ V}$   
 (1)  $T_{amb} = 100\text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25\text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -55\text{ }^\circ\text{C}$

Fig. 5. DC current gain as a function of collector current; typical values



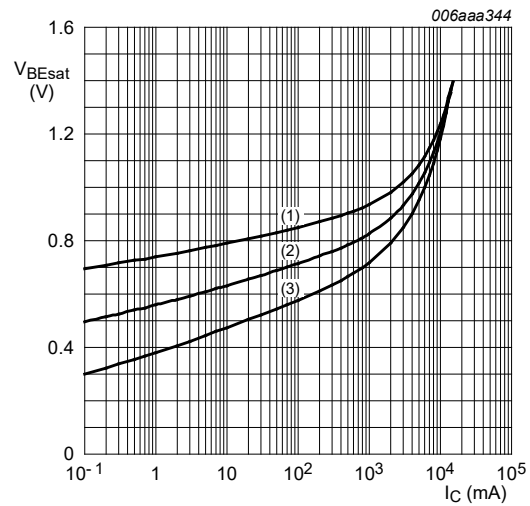
$T_{amb} = 25\text{ }^\circ\text{C}$

Fig. 6. Collector current as a function of collector-emitter voltage; typical values



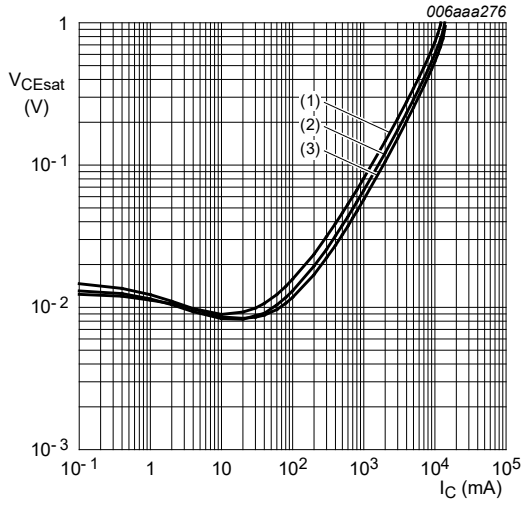
$V_{CE} = 2\text{ V}$   
 (1)  $T_{amb} = -55\text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25\text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100\text{ }^\circ\text{C}$

Fig. 7. Base-emitter voltage as a function of collector current; typical values



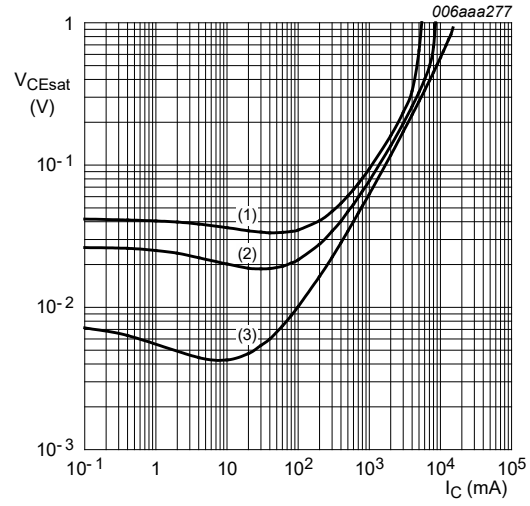
$I_C/I_B = 20$   
 (1)  $T_{amb} = -55\text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25\text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100\text{ }^\circ\text{C}$

Fig. 8. Base-emitter saturation voltage as a function of collector current; typical values



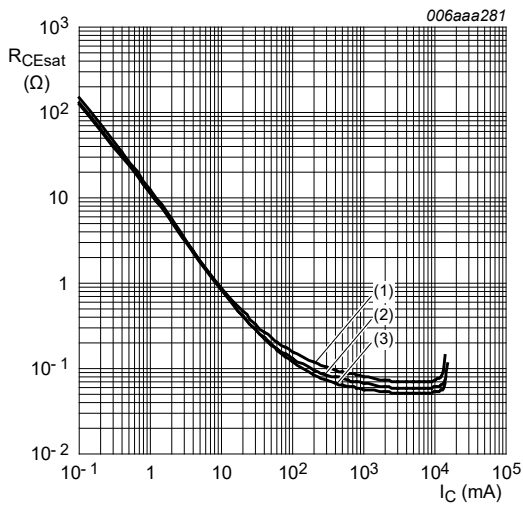
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -55\text{ °C}$

**Fig. 9. Collector-emitter saturation voltage as a function of collector current; typical values**



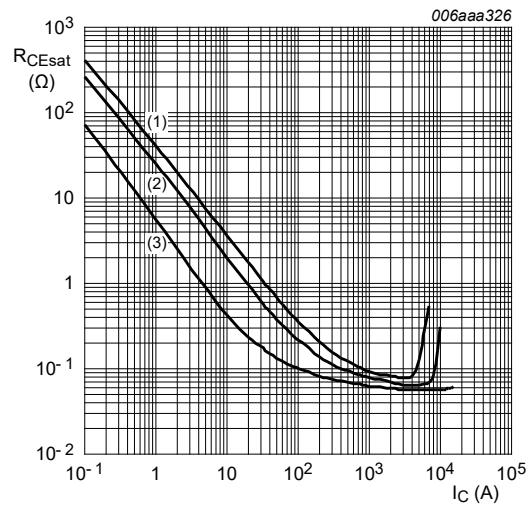
$T_{amb} = 25\text{ °C}$   
 (1)  $I_C/I_B = 100$   
 (2)  $I_C/I_B = 50$   
 (3)  $I_C/I_B = 10$

**Fig. 10. 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. 11. 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. 12. Collector-emitter saturation resistance as a function of collector current; typical values**

### 11. Test information

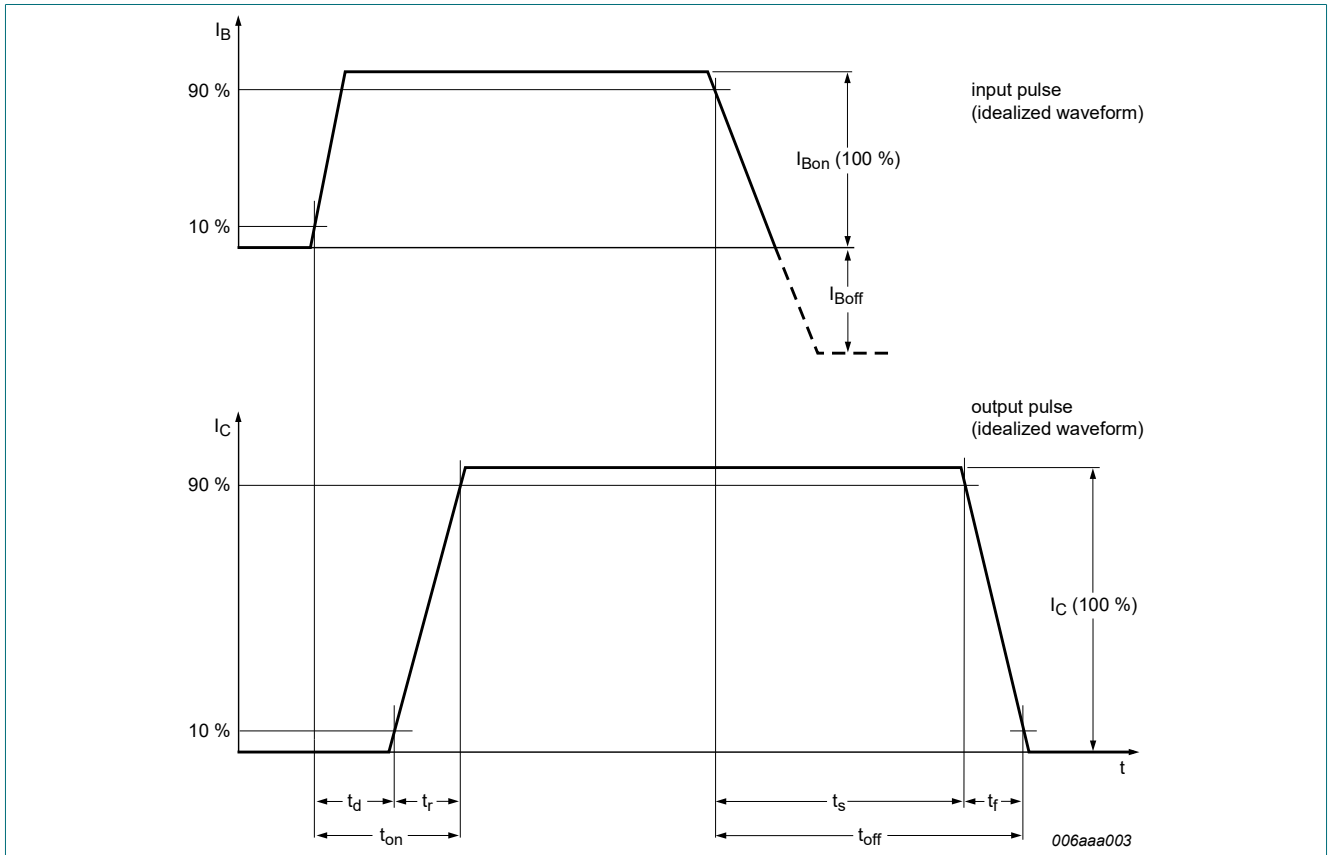


Fig. 13. Switching time definition

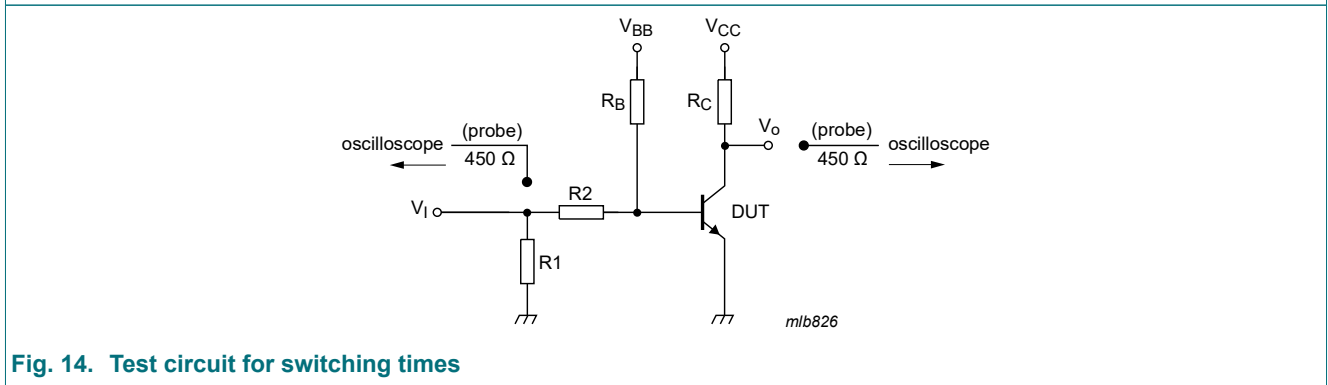


Fig. 14. Test circuit for switching times

### 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.



## 12. Package outline

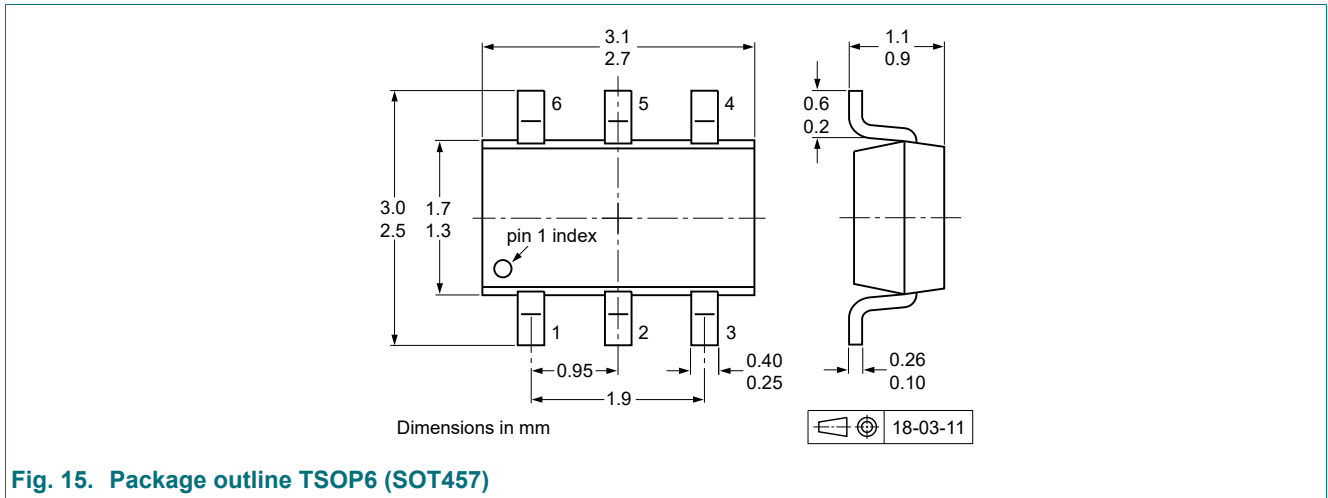


Fig. 15. Package outline TSOP6 (SOT457)

## 13. Soldering

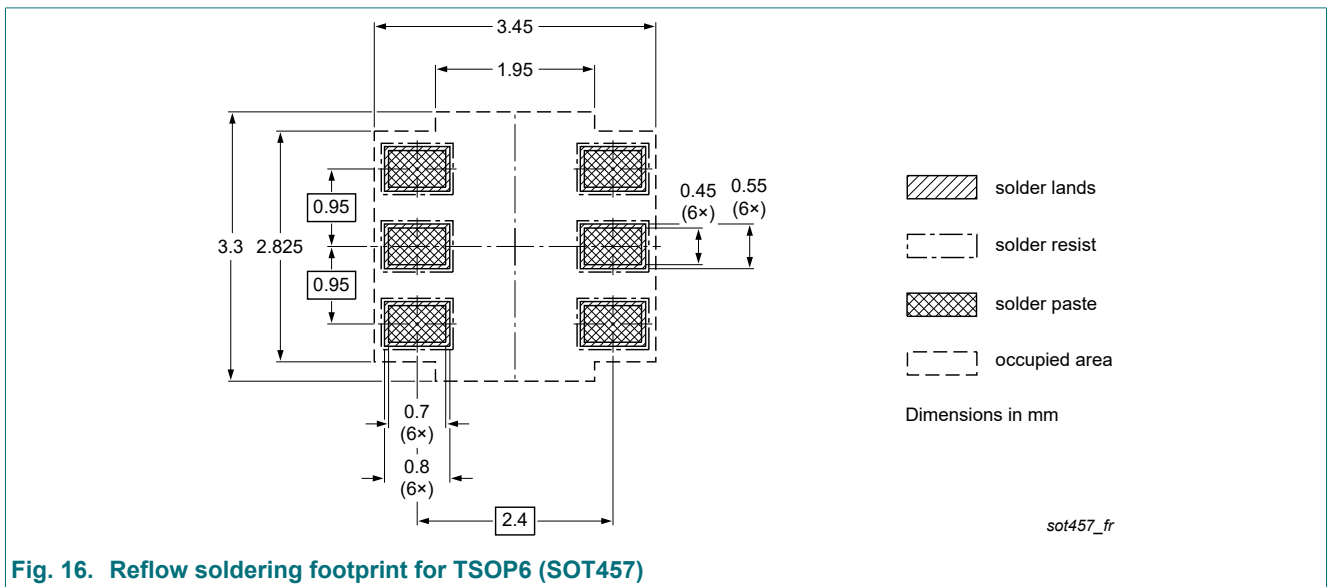


Fig. 16. Reflow soldering footprint for TSOP6 (SOT457)

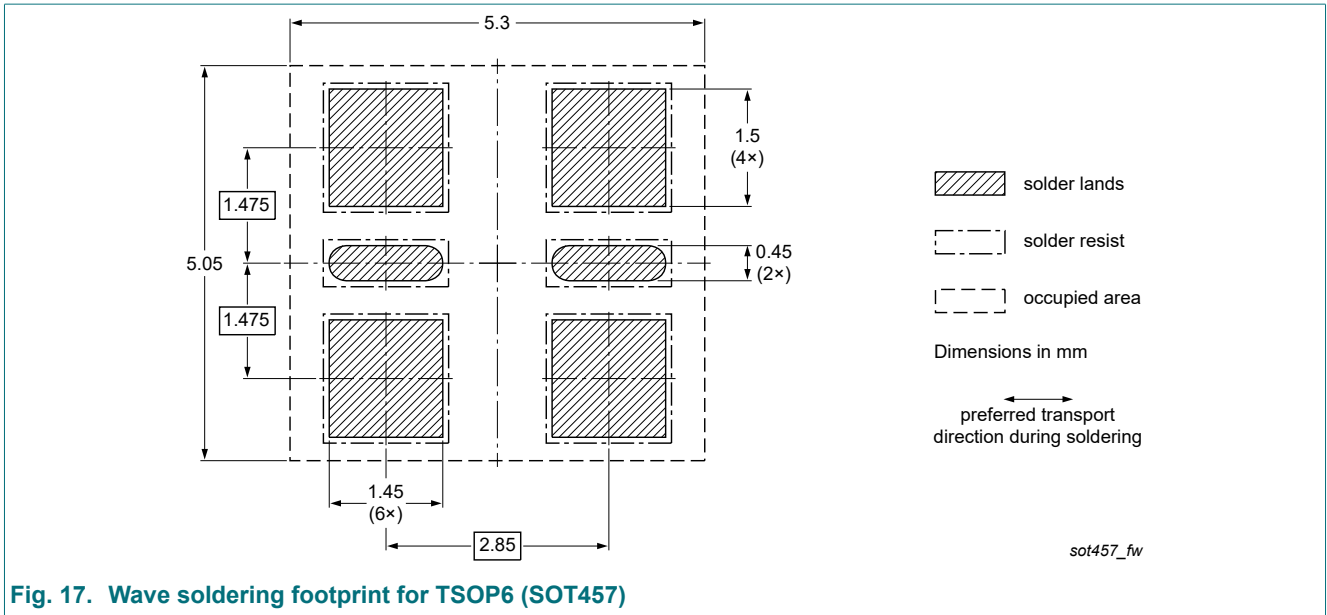


Fig. 17. Wave soldering footprint for TSOP6 (SOT457)

## 14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PBSS302ND-Q v.1	20230420	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.

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- [2] The term 'short data sheet' is explained in section "Definitions".
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