



# PBSS4021PT-Q

20 V, 3.5 A PNP low V<sub>CEsat</sub> transistor

20 September 2024

Product data sheet

## 1. General description

PNP low V<sub>CEsat</sub> transistor in a SOT23 small Surface-Mounted Device (SMD) plastic package.

NPN complement: PBSS4021NT-Q

## 2. Features and benefits

- Very low collector-emitter saturation voltage V<sub>CEsat</sub>
- High collector current capability I<sub>C</sub> and I<sub>CM</sub>
- High collector current gain (h<sub>FE</sub>) at high I<sub>C</sub>
- High energy efficiency due to less heat generation
- Smaller required Printed-Circuit Board (PCB) area than for conventional transistors
- Qualified according to AEC-Q101 and recommended for use in automotive applications

## 3. Applications

- Loadswitch
- Battery-driven devices
- Power management
- Charging circuits
- Power switches (e.g. motors, fans)

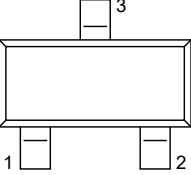
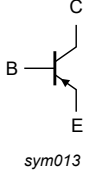
## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>CEO</sub>	collector-emitter voltage	open base	-	-	-20	V
I <sub>C</sub>	collector current		-	-	-3.5	A
I <sub>CM</sub>	peak collector current	single pulse; t <sub>p</sub> ≤ 1 ms	-	-	-8	A
R <sub>CEsat</sub>	collector-emitter saturation resistance	I <sub>C</sub> = -4 A; I <sub>B</sub> = -400 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	-	50	82.5	mΩ

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	B	base	 <p style="text-align: center;">SOT23</p>	 <p style="text-align: center;">sym013</p>
2	E	emitter		
3	C	collector		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
<a href="#">PBSS4021PT-Q</a>	SOT23	plastic, surface-mounted package; 3 terminals; 1.9 mm pitch; 2.9 mm x 1.3 mm x 1 mm body	<a href="#">SOT23</a>

## 7. Marking

Table 4. Marking codes

Type number	Marking code <sup>[1]</sup>
PBSS4021PT-Q	%BJ

[1] % = placeholder for manufacturing site code

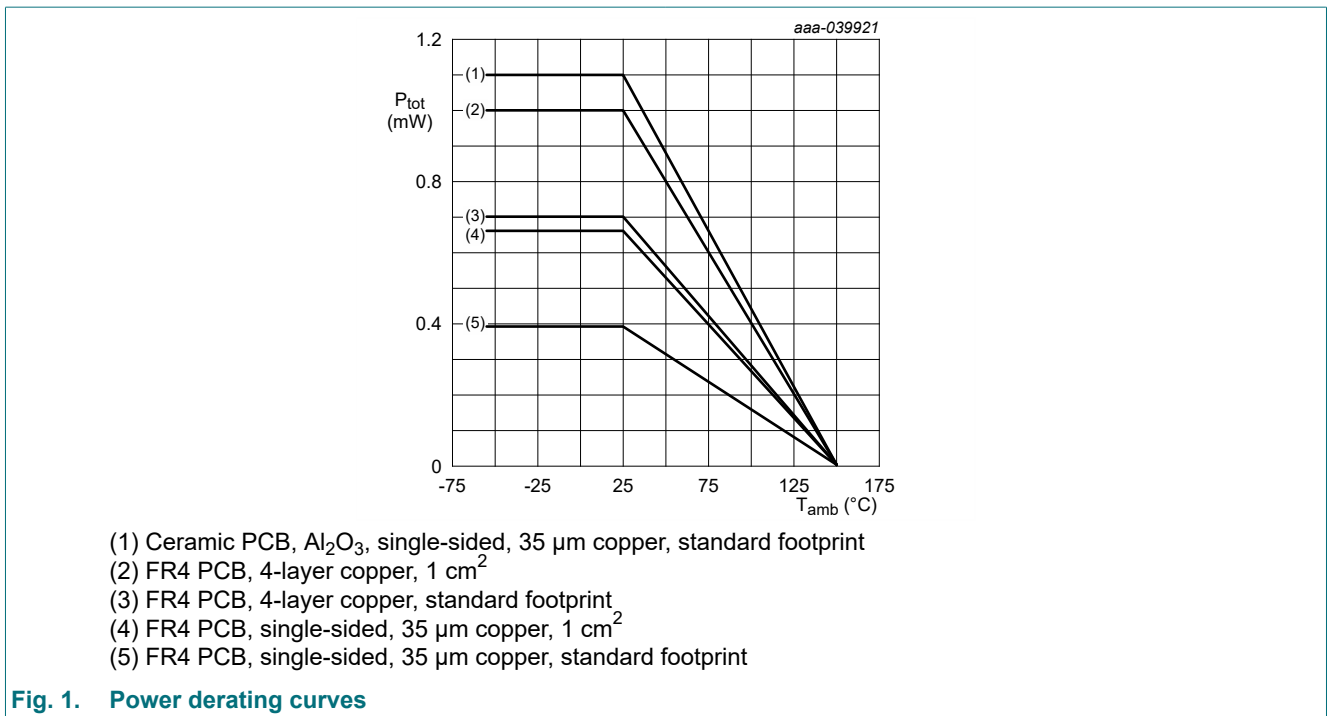
## 8. Limiting values

**Table 5. Limiting values**

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

Symbol	Parameter	Conditions		Min	Max	Unit
$V_{CBO}$	collector-base voltage	open emitter		-	-20	V
$V_{CEO}$	collector-emitter voltage	open base		-	-20	V
$V_{EBO}$	emitter-base voltage	open collector		-	-5	V
$I_C$	collector current			-	-3.5	A
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms		-	-8	A
$I_B$	base current			-	-1	A
$P_{tot}$	total power dissipation	$T_{amb} \leq 25$ °C	[1]	-	0.39	W
			[2]	-	0.66	W
			[3]	-	0.7	W
			[4]	-	1	W
			[5]	-	1.1	W
$T_j$	junction temperature			-	150	°C
$T_{amb}$	ambient temperature			-55	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.
- [2] Device mounted on an FR4 PCB, single-sided, 35 µm copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.
- [3] Device mounted on an FR4 PCB, 4-layer, tin-plated and standard footprint.
- [4] Device mounted on an FR4 PCB, 4-layer, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.
- [5] Device mounted on a ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, single-sided, 35 µm copper, tin-plated and standard footprint.



**Fig. 1. Power derating curves**

## 9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	320	K/W
			[2]	-	-	190	K/W
			[3]	-	-	180	K/W
			[4]	-	-	125	K/W
			[5]	-	-	115	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	-	62	K/W

- [1] Device mounted on an FR4 PCB, single-sided, 35  $\mu\text{m}$  copper, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided, 35  $\mu\text{m}$  copper, tin-plated, mounting pad for collector 1  $\text{cm}^2$ .
- [3] Device mounted on an FR4 PCB, 4-layer, tin-plated and standard footprint.
- [4] Device mounted on an FR4 PCB, 4-layer, tin-plated, mounting pad for collector 1  $\text{cm}^2$ .
- [5] Device mounted on a ceramic PCB,  $\text{Al}_2\text{O}_3$ , single-sided, 35  $\mu\text{m}$  copper, tin-plated and standard footprint.

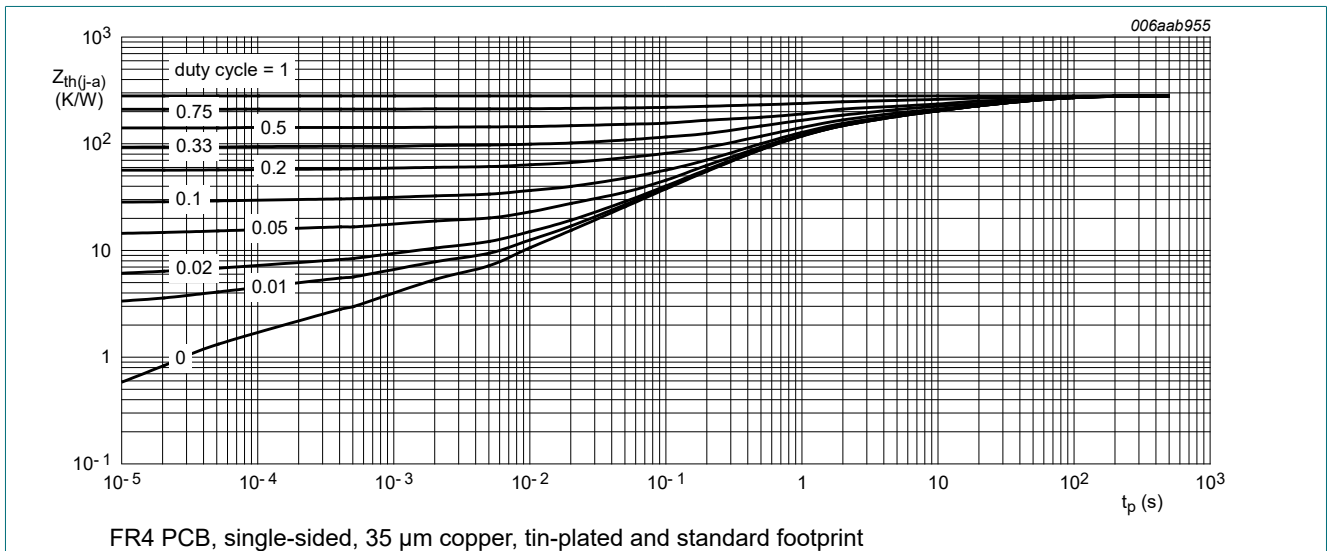


Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

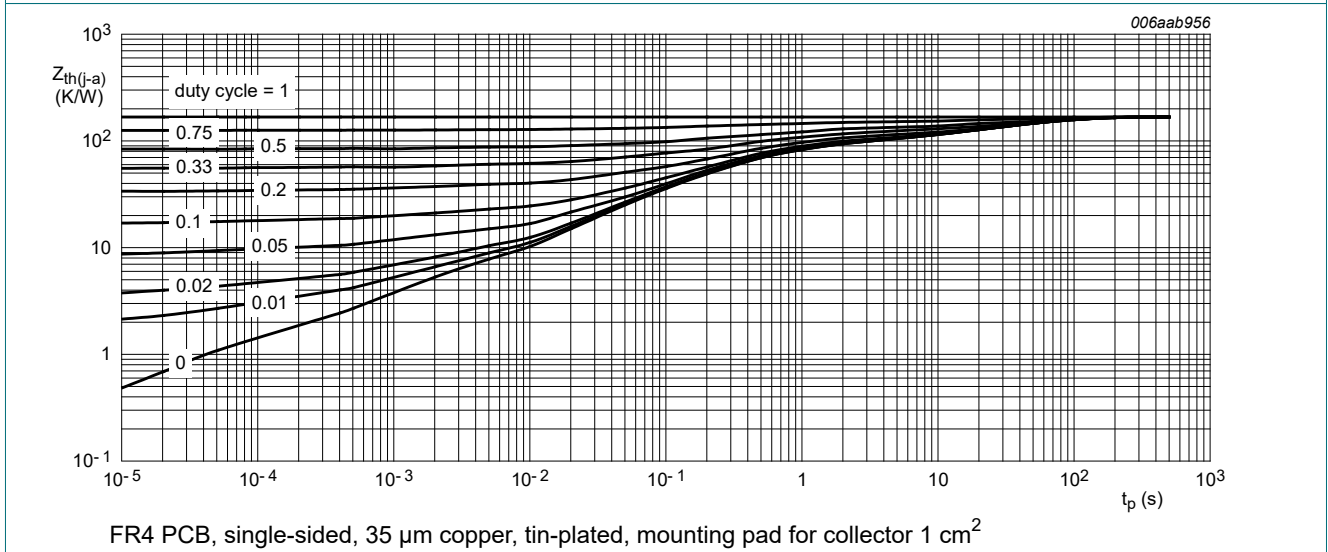


Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

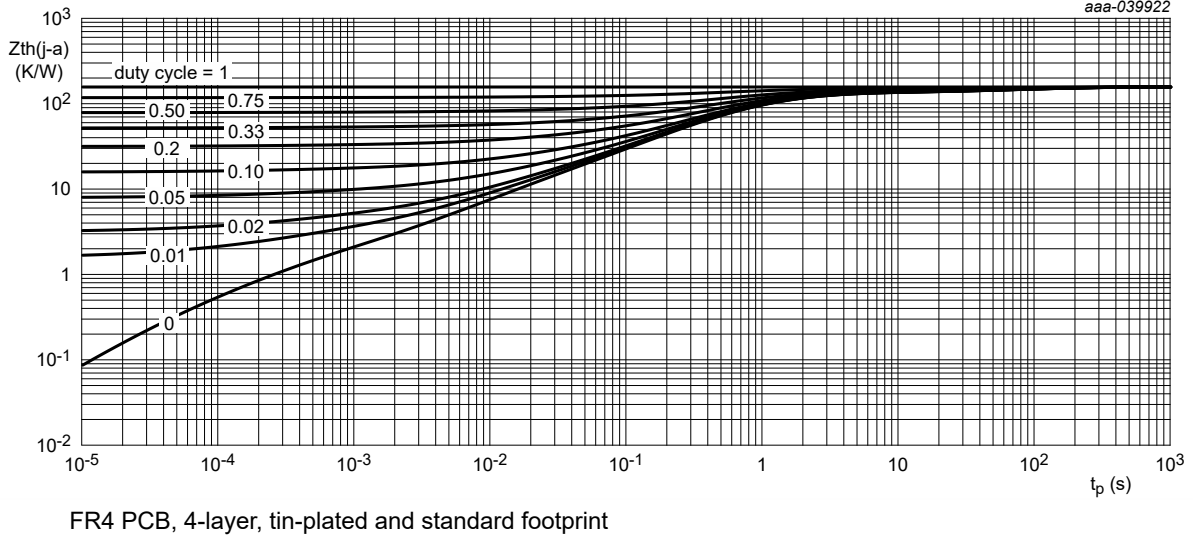


Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

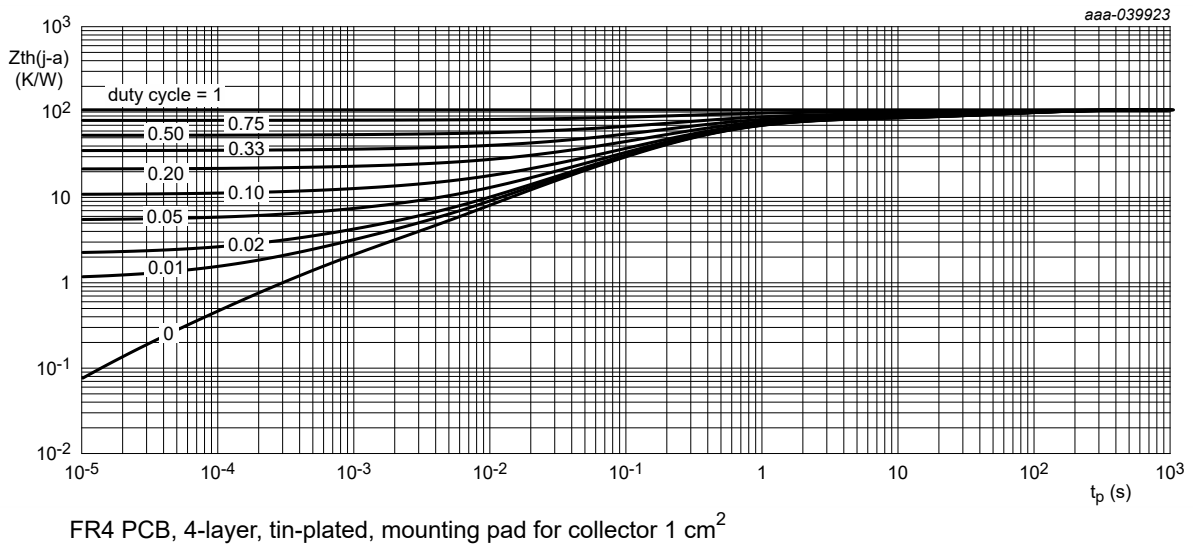


Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

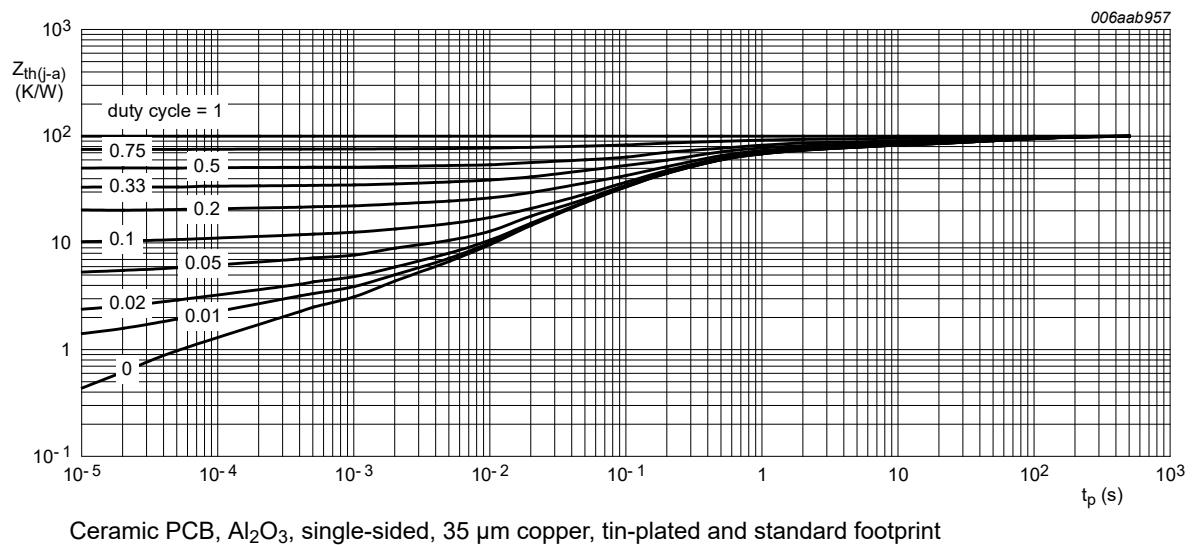


Fig. 6. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

## 10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = -100 \mu\text{A}$ ; $I_E = 0 \text{ A}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-20	-	-	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = -10 \text{ mA}$ ; $I_B = 0 \text{ A}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-20	-	-	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_E = -100 \mu\text{A}$ ; $I_C = 0 \text{ A}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-5	-	-	V
$I_{CBO}$	collector-base cut-off current	$V_{CB} = -20 \text{ V}$ ; $I_E = 0 \text{ A}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-	-100	nA
		$V_{CB} = -20 \text{ V}$ ; $I_E = 0 \text{ A}$ ; $T_j = 150 \text{ }^\circ\text{C}$	-	-	-55	$\mu\text{A}$
$I_{CES}$	collector-emitter cut-off current	$V_{CE} = -16 \text{ V}$ ; $V_{BE} = 0 \text{ V}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-	-100	nA
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = -5 \text{ V}$ ; $I_C = 0 \text{ A}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-	-100	nA
$h_{FE}$	DC current gain	$V_{CE} = -2 \text{ V}$ ; $I_C = -500 \text{ mA}$ ; pulsed; $t_p \leq 300 \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	250	380	-	
		$V_{CE} = -2 \text{ V}$ ; $I_C = -1 \text{ A}$ ; pulsed; $t_p \leq 300 \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	200	340	-	
		$V_{CE} = -2 \text{ V}$ ; $I_C = -2 \text{ A}$ ; pulsed; $t_p \leq 300 \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	140	300	-	
		$V_{CE} = -2 \text{ V}$ ; $I_C = -4 \text{ A}$ ; pulsed; $t_p \leq 300 \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	60	195	-	
		$V_{CE} = -2 \text{ V}$ ; $I_C = -6 \text{ A}$ ; pulsed; $t_p \leq 300 \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	30	130	-	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = -1 \text{ A}$ ; $I_B = -10 \text{ mA}$ ; pulsed; $t_p \leq 300 \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-90	-170	mV
		$I_C = -1 \text{ A}$ ; $I_B = -50 \text{ mA}$ ; pulsed; $t_p \leq 300 \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-60	-105	mV
		$I_C = -2 \text{ A}$ ; $I_B = -40 \text{ mA}$ ; pulsed; $t_p \leq 300 \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-125	-240	mV
		$I_C = -4 \text{ A}$ ; $I_B = -200 \text{ mA}$ ; pulsed; $t_p \leq 300 \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-210	-375	mV
		$I_C = -4 \text{ A}$ ; $I_B = -400 \text{ mA}$ ; pulsed; $t_p \leq 300 \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-200	-330	mV
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = -4 \text{ A}$ ; $I_B = -400 \text{ mA}$ ; pulsed; $t_p \leq 300 \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	50	82.5	m $\Omega$
$V_{BEsat}$	base-emitter saturation voltage	$I_C = -1 \text{ A}$ ; $I_B = -100 \text{ mA}$ ; pulsed; $t_p \leq 300 \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-0.86	-1	V
		$I_C = -4 \text{ A}$ ; $I_B = -400 \text{ mA}$ ; pulsed; $t_p \leq 300 \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-1.02	-1.2	V
$V_{BE}$	base-emitter voltage	$V_{CE} = -2 \text{ V}$ ; $I_C = -2 \text{ A}$ ; pulsed; $t_p \leq 300 \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-0.8	-0.9	V
$t_d$	delay time	$V_{CC} = -12.5 \text{ V}$ ; $I_C = -1 \text{ A}$ ; $I_{B(on)} = -50 \text{ mA}$ ; $I_{B(off)} = 50 \text{ mA}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	20	-	ns
$t_r$	rise time		-	40	-	ns
$t_{on}$	turn-on time		-	60	-	ns
$t_s$	storage time		-	280	-	ns
$t_f$	fall time		-	65	-	ns
$t_{off}$	turn-off time		-	345	-	ns

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$f_T$	transition frequency	$V_{CE} = -10\text{ V}$ ; $I_C = -100\text{ mA}$ ; $f = 100\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	-	129	-	MHz
$C_c$	collector capacitance	$V_{CB} = -10\text{ V}$ ; $I_E = 0\text{ A}$ ; $i_e = 0\text{ A}$ ; $f = 1\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	-	57	-	pF

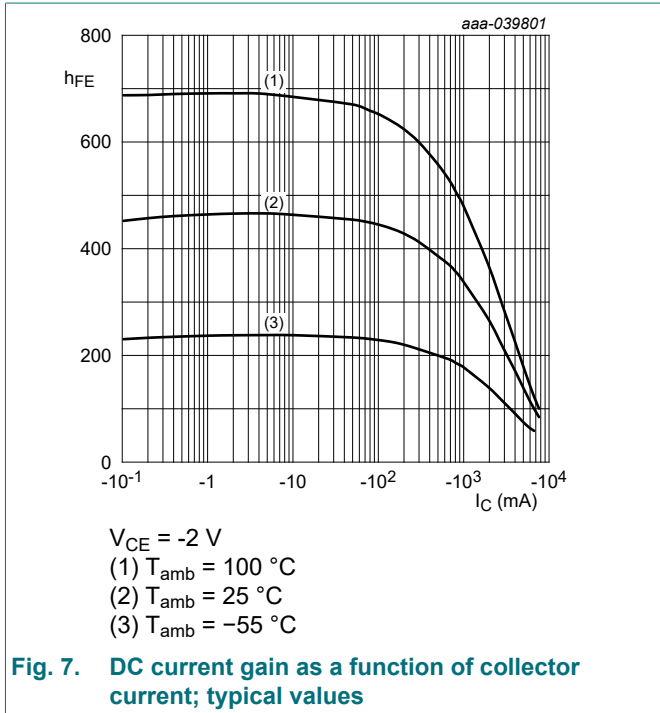


Fig. 7. DC current gain as a function of collector current; typical values

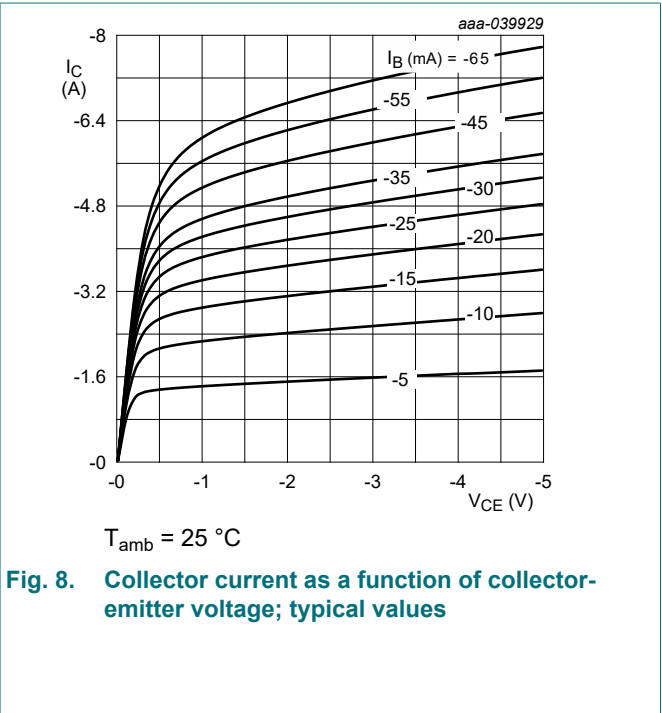


Fig. 8. Collector current as a function of collector-emitter voltage; typical values

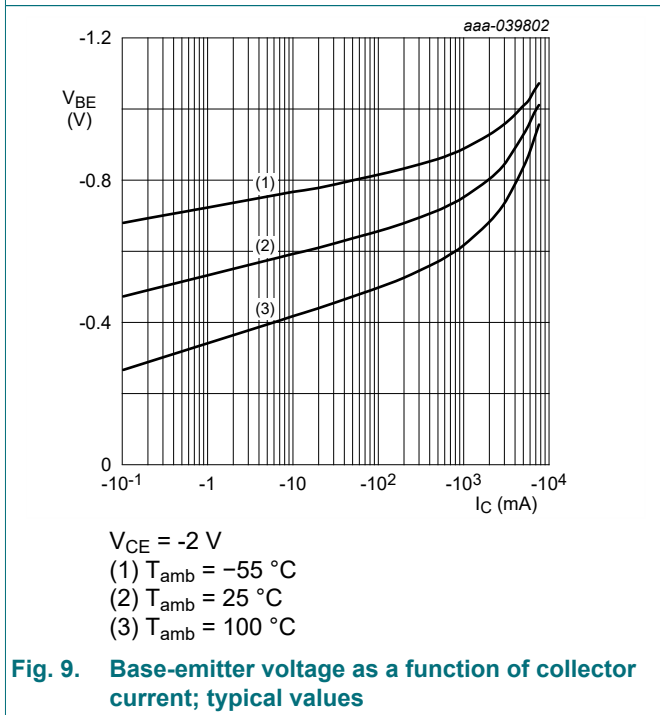


Fig. 9. Base-emitter voltage as a function of collector current; typical values

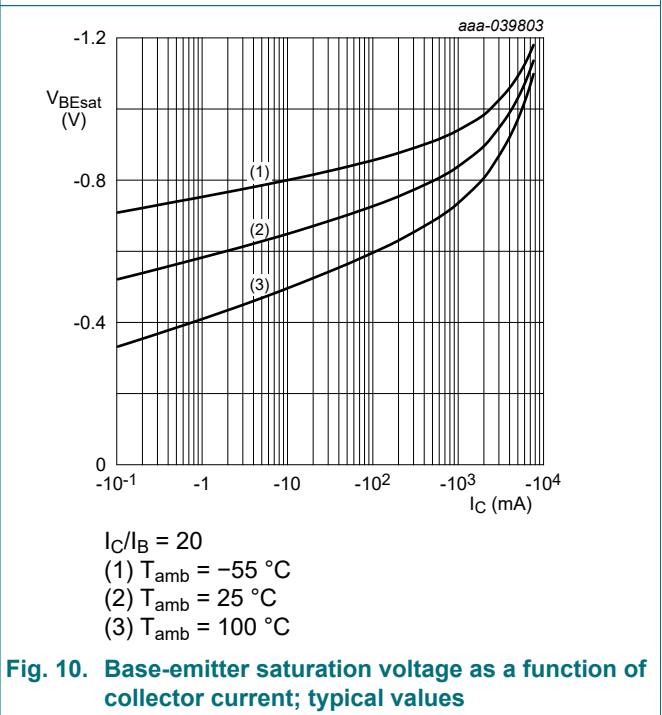
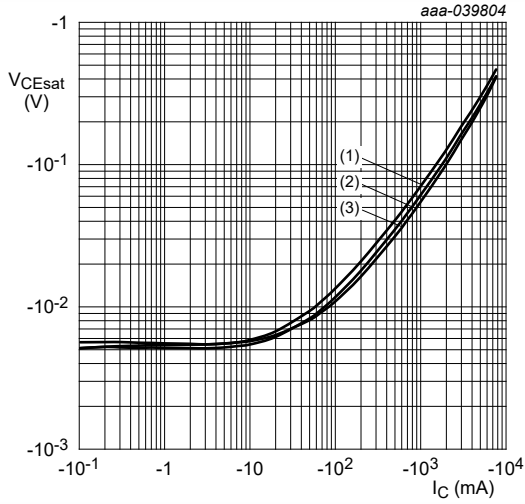
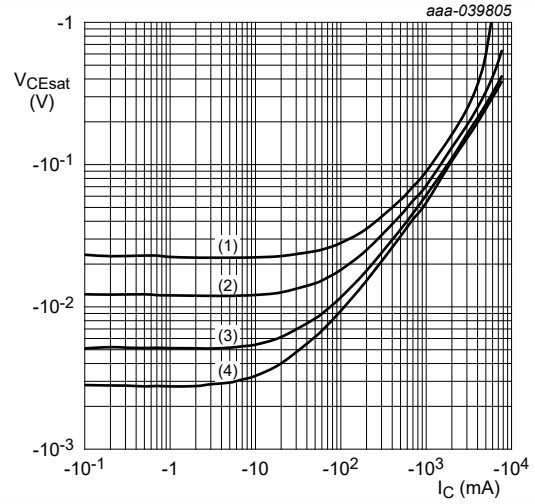


Fig. 10. Base-emitter saturation voltage as a function of collector current; typical values



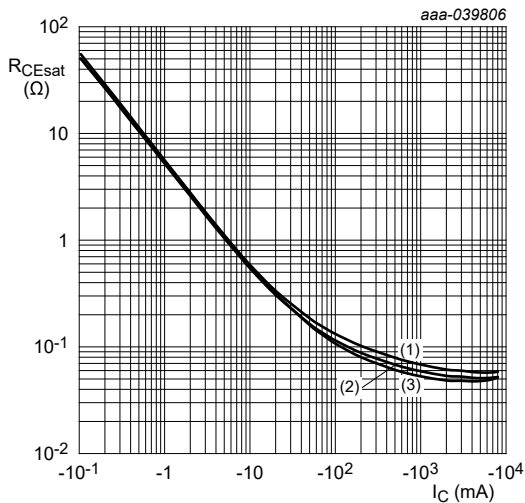
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -55\text{ °C}$

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



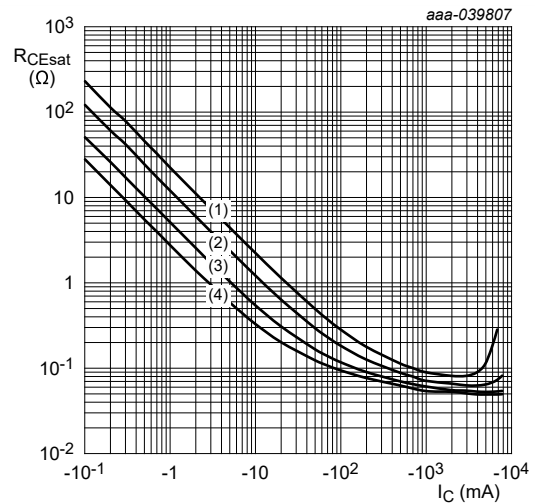
$T_{amb} = 25\text{ °C}$   
 (1)  $I_C/I_B = 100$   
 (2)  $I_C/I_B = 50$   
 (3)  $I_C/I_B = 20$   
 (4)  $I_C/I_B = 10$

**Fig. 12. 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)  $T_{amb} = -55\text{ °C}$

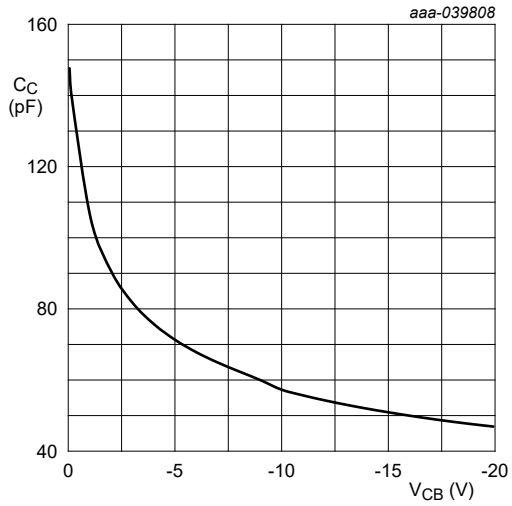
**Fig. 13. Collector-emitter saturation resistance as a function of collector current; typical values**



$T_{amb} = 25\text{ °C}$   
 (1)  $I_C/I_B = 100$   
 (2)  $I_C/I_B = 50$   
 (3)  $I_C/I_B = 20$   
 (4)  $I_C/I_B = 10$

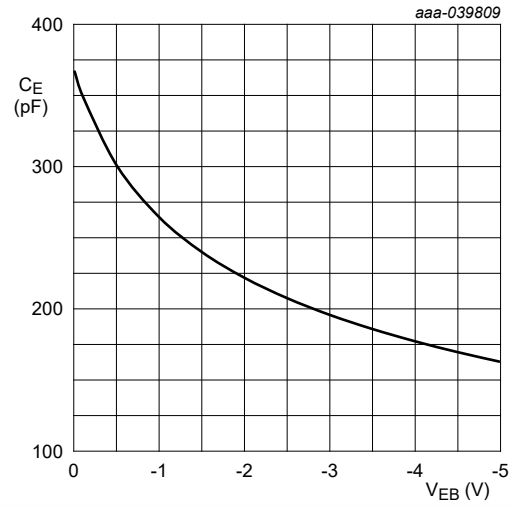
**Fig. 14. Collector-emitter saturation resistance as a function of collector current; typical values**





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

**Fig. 15. Collector capacitance as a function of collector-base voltage; typical values**



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

**Fig. 16. Emitter capacitance as a function of emitter-base voltage; typical values**

### 11. Test information

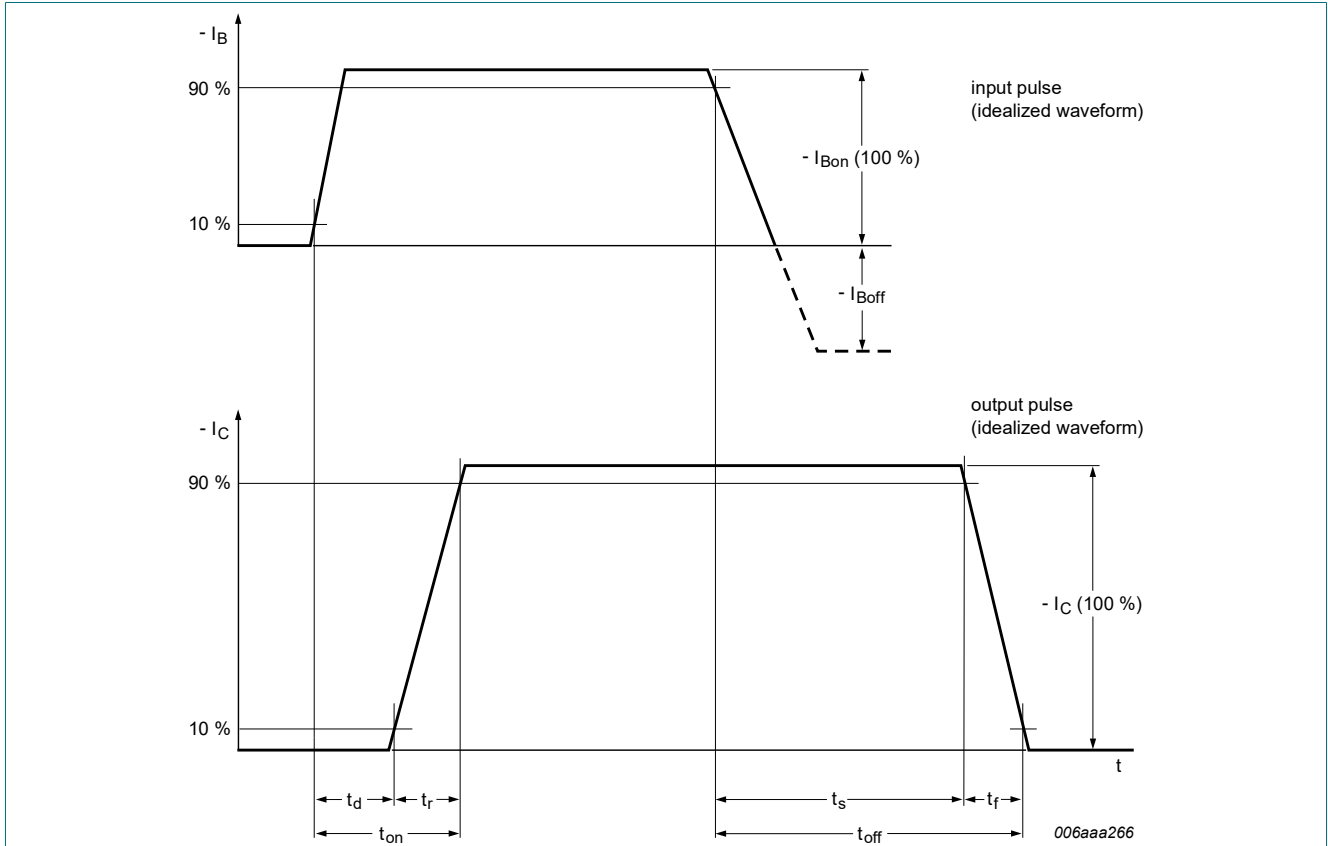


Fig. 17. Transistor switching time definition

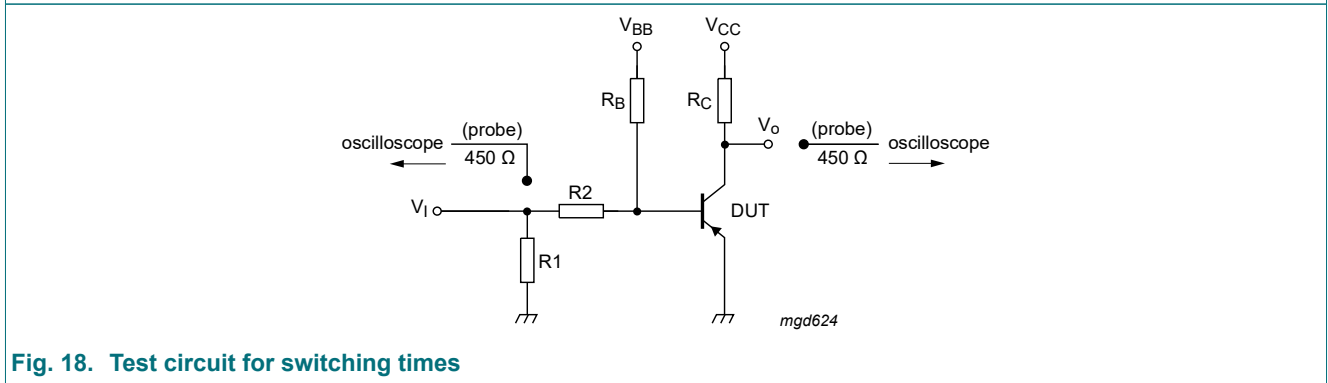


Fig. 18. Test circuit for switching times

### 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

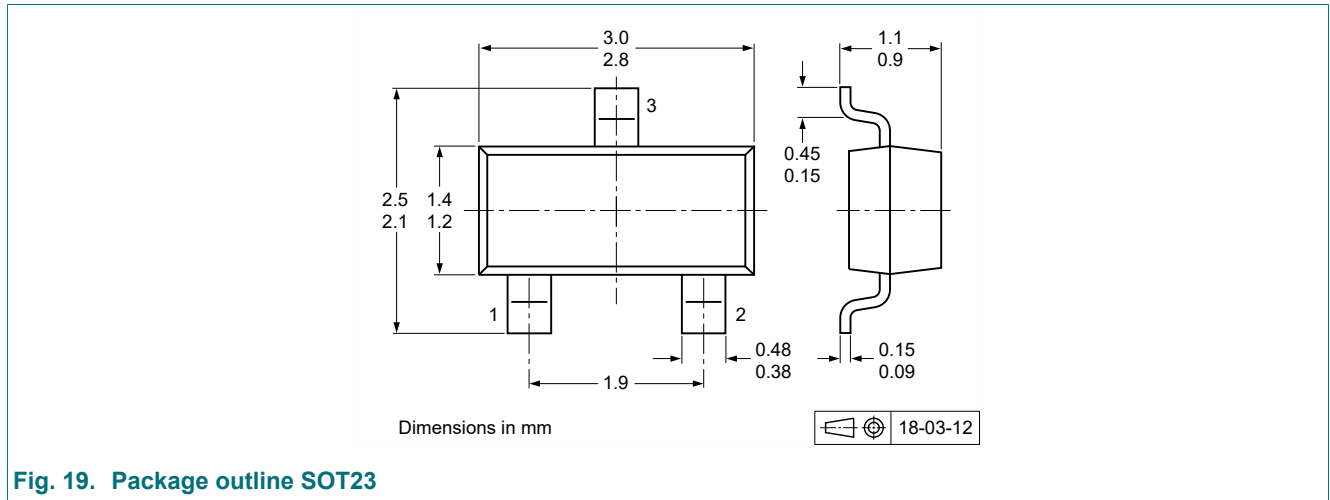


Fig. 19. Package outline SOT23

## 13. Soldering

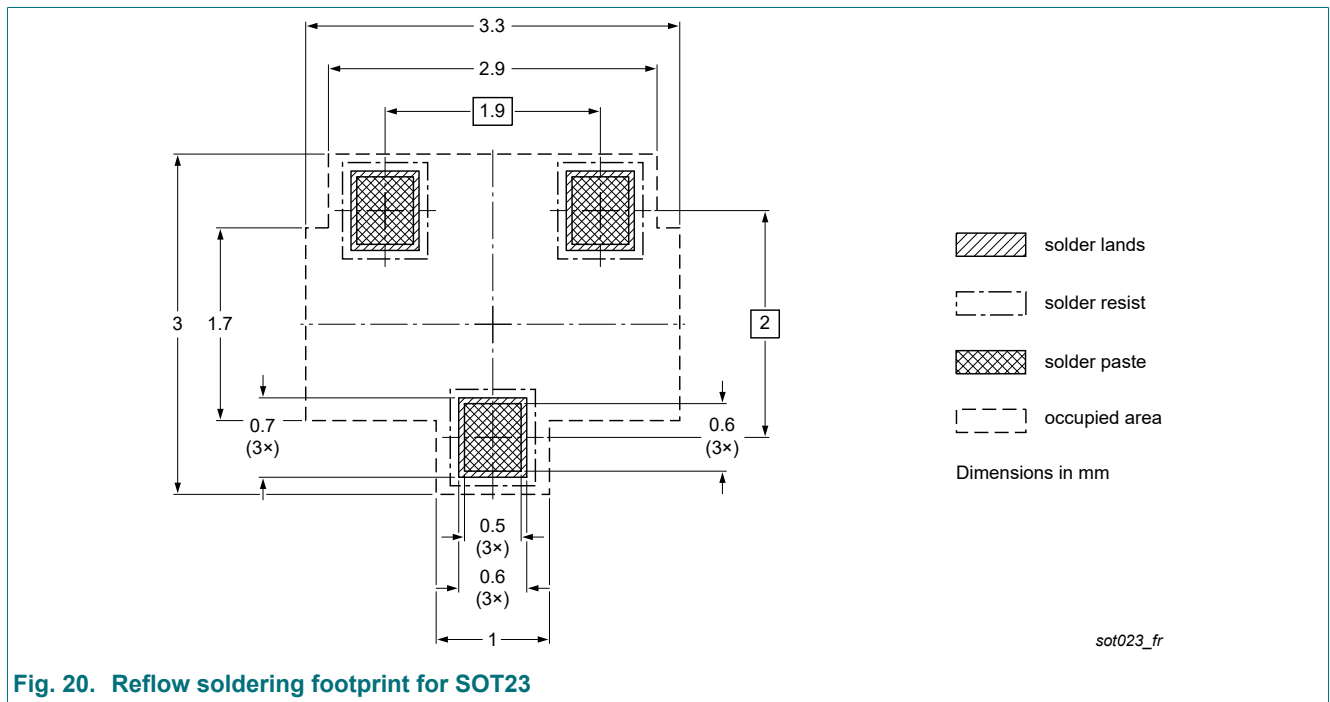


Fig. 20. Reflow soldering footprint for SOT23

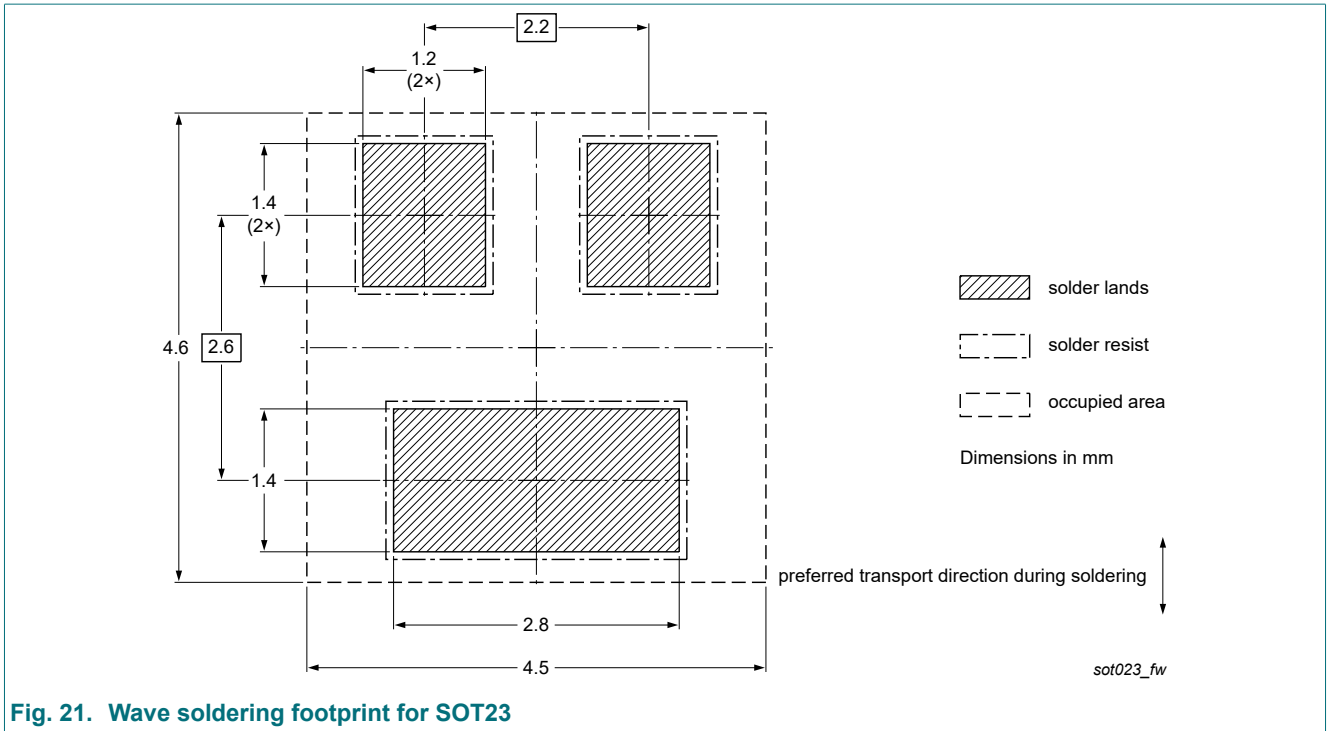


Fig. 21. Wave soldering footprint for SOT23

## 14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PBSS4021PT-Q v.2	20240920	Product data sheet	-	PBSS4021PT-Q v.1
Modifications:	• New graphics added, graphs updated and values changed.			
PBSS4021PT-Q v.1	20230915	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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