

# PBSS4021NX

20 V, 7 A NPN low  $V_{CEsat}$  (BISS) transistor

11 December 2012

Product data sheet

## 1. General description

NPN low  $V_{CEsat}$  Breakthrough In Small Signal (BISS) transistor in a medium power and flat lead SOT89 (SC-62) Surface-Mounted Device (SMD) plastic package.

PNP complement: PBSS4021PX.

## 2. Features and benefits

- Very low collector-emitter saturation voltage  $V_{CEsat}$
- High collector current capability  $I_C$  and  $I_{CM}$
- High collector current gain ( $h_{FE}$ ) at high  $I_C$
- High energy efficiency due to less heat generation
- AEC-Q101 qualified
- Smaller required Printed-Circuit Board (PCB) area than for conventional transistors

## 3. Applications

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

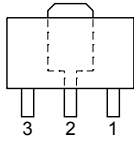
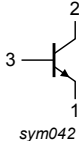
## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CEO}$	collector-emitter voltage	open base	-	-	20	V
$I_C$	collector current		-	-	7	A
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms	-	-	15	A
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = 5$ A; $I_B = 500$ mA; pulsed; $t_p \leq 300$ $\mu$ s; $\delta \leq 0.02$ ; $T_{amb} = 25$ °C	-	19	28	m $\Omega$

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	E	emitter	 <p style="text-align: center;"><b>SOT89</b></p>	 <p style="text-align: center;">sym042</p>
2	C	collector		
3	B	base		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PBSS4021NX	SOT89	plastic surface-mounted package; die pad for good heat transfer; 3 leads	SOT89

## 7. Marking

Table 4. Marking codes

Type number	Marking code
PBSS4021NX	%6D

[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		-	7	A	
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms	-	15	A	
$I_B$	base current		-	1	A	
$P_{tot}$	total power dissipation	$T_{amb} \leq 25$ °C	[1]	-	600	mW
			[2]	-	1650	mW
			[3]	-	2500	mW

Symbol	Parameter	Conditions	Min	Max	Unit
T <sub>j</sub>	junction temperature		-	150	°C
T <sub>amb</sub>	ambient temperature		-55	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.
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 6 cm<sup>2</sup>.
- [3] Device mounted on a ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint.

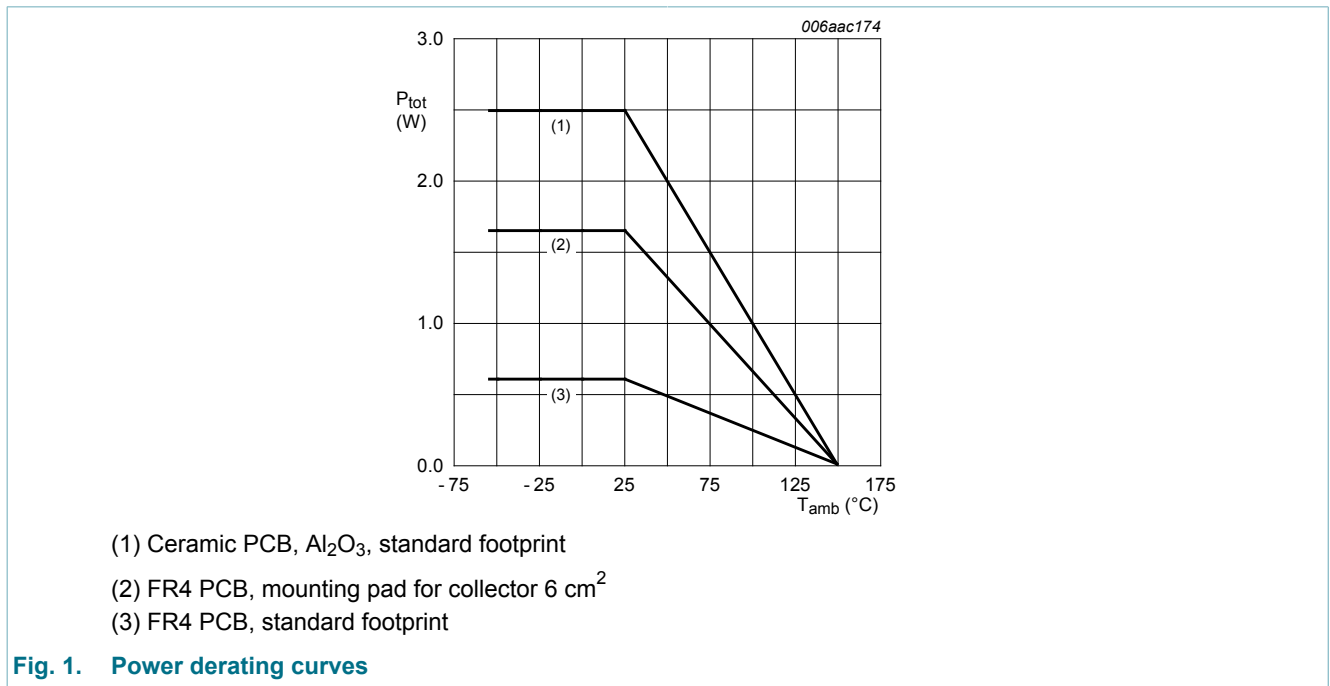


Fig. 1. Power derating curves

## 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	[1] in free air	-	-	210	K/W
		[2]	-	-	75	K/W
		[3]	-	-	50	K/W
R <sub>th(j-sp)</sub>	thermal resistance from junction to solder point		-	-	20	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 6 cm<sup>2</sup>.
- [3] Device mounted on a ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint.

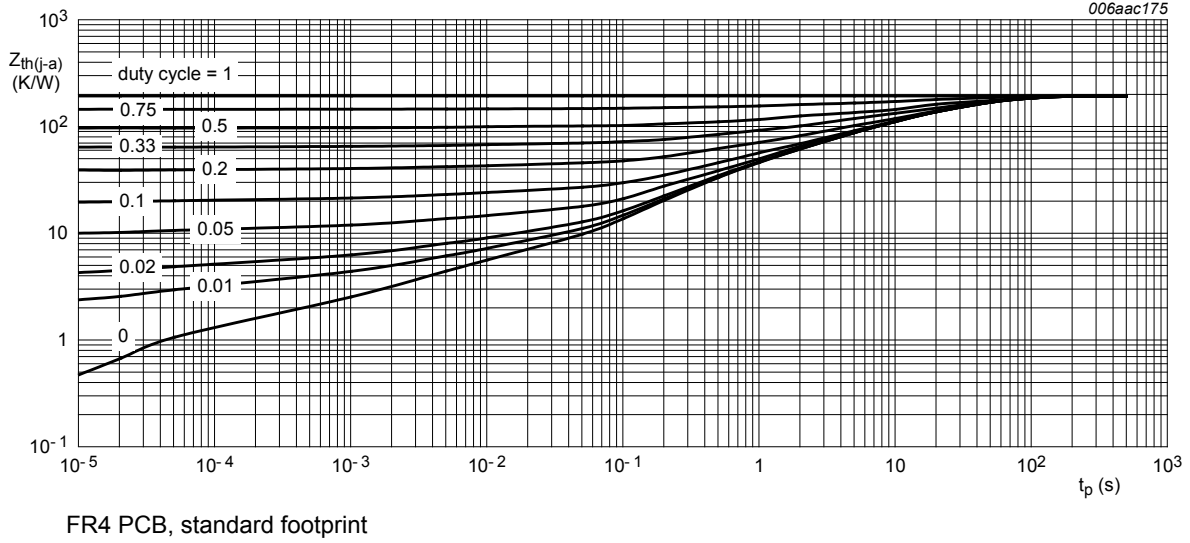


Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

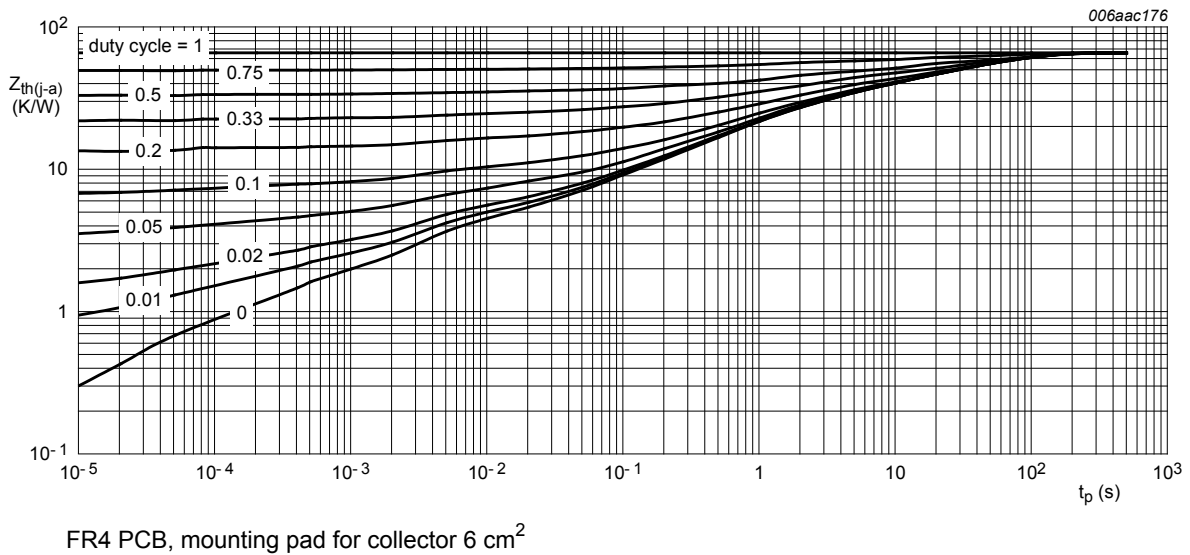
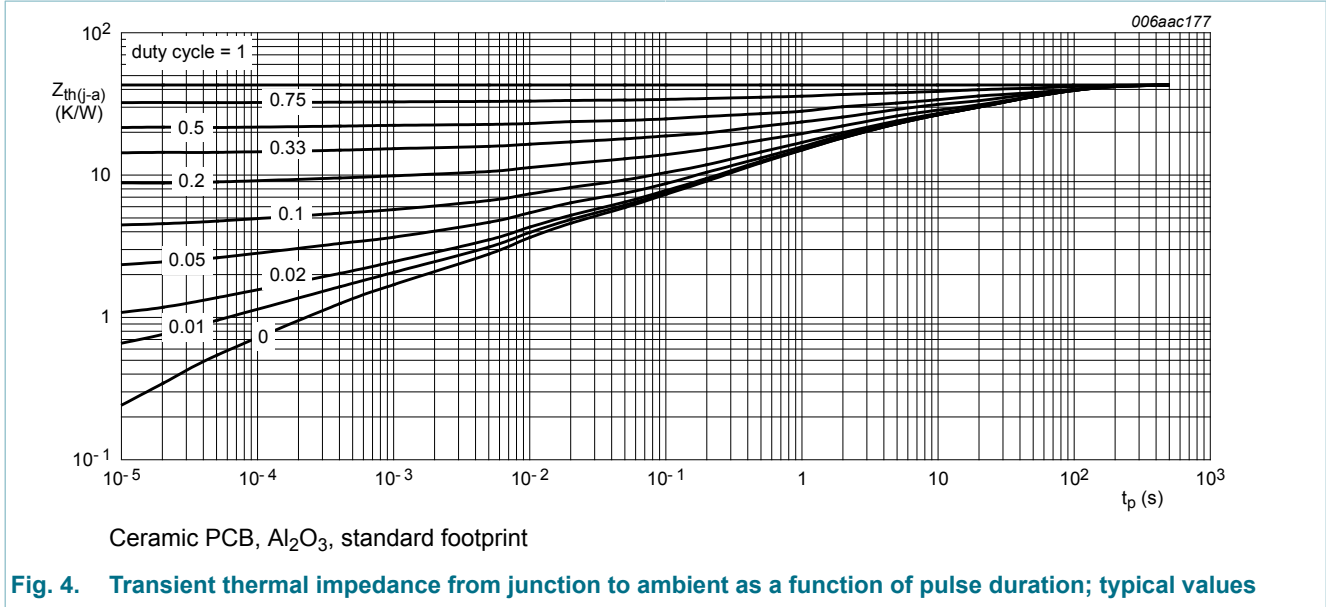


Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values



## 10. Characteristics

**Table 7. Characteristics**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I <sub>CBO</sub>	collector-base cut-off current	V <sub>CB</sub> = 20 V; I <sub>E</sub> = 0 A; T <sub>amb</sub> = 25 °C	-	-	100	nA
		V <sub>CB</sub> = 20 V; I <sub>E</sub> = 0 A; T <sub>j</sub> = 150 °C	-	-	50	μA
I <sub>CES</sub>	collector-emitter cut-off current	V <sub>CE</sub> = 16 V; V <sub>BE</sub> = 0 V; T <sub>amb</sub> = 25 °C	-	-	100	nA
I <sub>EBO</sub>	emitter-base cut-off current	V <sub>EB</sub> = 5 V; I <sub>C</sub> = 0 A; T <sub>amb</sub> = 25 °C	-	-	100	nA
h <sub>FE</sub>	DC current gain	V <sub>CE</sub> = 2 V; I <sub>C</sub> = 500 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	300	550	-	
		V <sub>CE</sub> = 2 V; I <sub>C</sub> = 1 A; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	300	550	-	
		V <sub>CE</sub> = 2 V; I <sub>C</sub> = 2 A; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	300	500	-	
		V <sub>CE</sub> = 2 V; I <sub>C</sub> = 4 A; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	250	450	-	
		V <sub>CE</sub> = 2 V; I <sub>C</sub> = 8 A; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	100	200	-	
V <sub>CEsat</sub>	collector-emitter saturation voltage	I <sub>C</sub> = 1 A; I <sub>B</sub> = 50 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	-	25	38	mV
		I <sub>C</sub> = 1 A; I <sub>B</sub> = 10 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	-	35	60	mV

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
		$I_C = 2 \text{ A}; I_B = 40 \text{ mA};$ pulsed; $t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	48	75	mV
		$I_C = 4 \text{ A}; I_B = 200 \text{ mA};$ pulsed; $t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	78	120	mV
		$I_C = 4 \text{ A}; I_B = 40 \text{ mA};$ pulsed; $t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	85	140	mV
		$I_C = 7 \text{ A}; I_B = 350 \text{ mA};$ pulsed; $t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	137	210	mV
$R_{\text{CEsat}}$	collector-emitter saturation resistance	$I_C = 5 \text{ A}; I_B = 500 \text{ mA};$ pulsed; $t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	19	28	m $\Omega$
$V_{\text{BEsat}}$	base-emitter saturation voltage	$I_C = 1 \text{ A}; I_B = 100 \text{ mA};$ pulsed; $t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	0.82	0.9	V
		$I_C = 4 \text{ A}; I_B = 400 \text{ mA};$ pulsed; $t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	0.92	1.05	V
$V_{\text{BEon}}$	base-emitter turn-on voltage	$V_{\text{CE}} = 2 \text{ V}; I_C = 2 \text{ A};$ pulsed; $t_p \leq 300 \mu\text{s};$ $\delta \leq 0.02; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	0.74	0.85	V
$t_d$	delay time	$V_{\text{CC}} = 12.5 \text{ V}; I_C = 1 \text{ A}; I_{\text{Bon}} = 0.05 \text{ A};$ $I_{\text{Boff}} = -0.05 \text{ A}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	40	-	ns
$t_r$	rise time		-	40	-	ns
$t_{\text{on}}$	turn-on time		-	80	-	ns
$t_s$	storage time		-	650	-	ns
$t_f$	fall time	$V_{\text{CC}} = 12.5 \text{ V}; I_C = 1 \text{ A}; I_{\text{Bon}} = 0.05 \text{ A};$ $I_{\text{Boff}} = -0.05 \text{ A}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	75	-	ns
$t_{\text{off}}$	turn-off time		-	725	-	ns
$f_T$	transition frequency	$V_{\text{CE}} = 10 \text{ V}; I_C = 100 \text{ mA}; f = 100 \text{ MHz};$ $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	115	-	MHz
$C_C$	collector capacitance	$V_{\text{CB}} = 10 \text{ V}; I_E = 0 \text{ A}; i_e = 0 \text{ A};$ $f = 1 \text{ MHz}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	85	-	pF

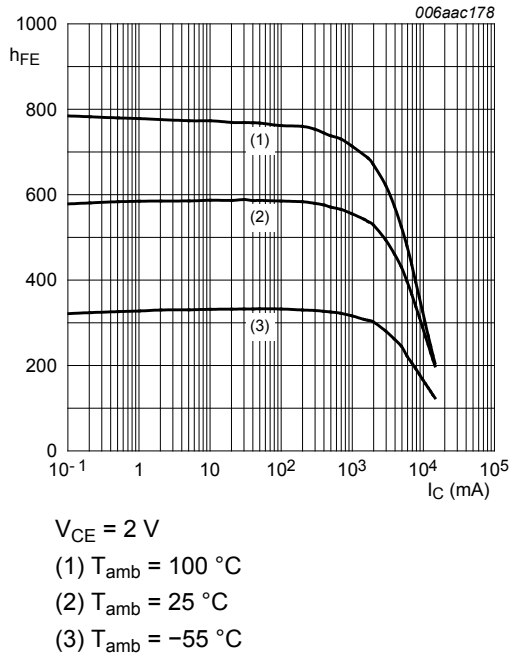


Fig. 5. DC current gain as a function of collector current; typical values

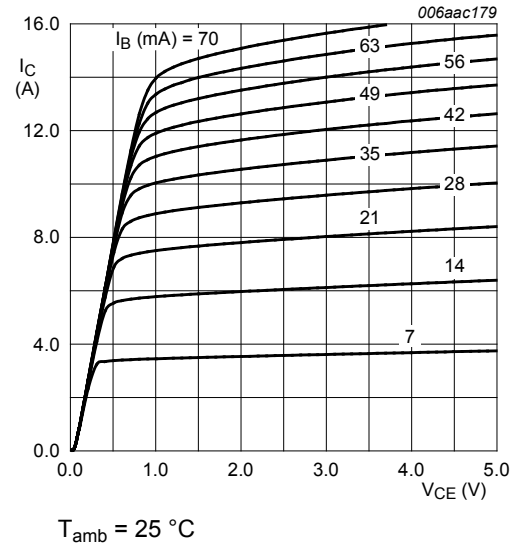


Fig. 6. Collector current as a function of collector-emitter voltage; typical values

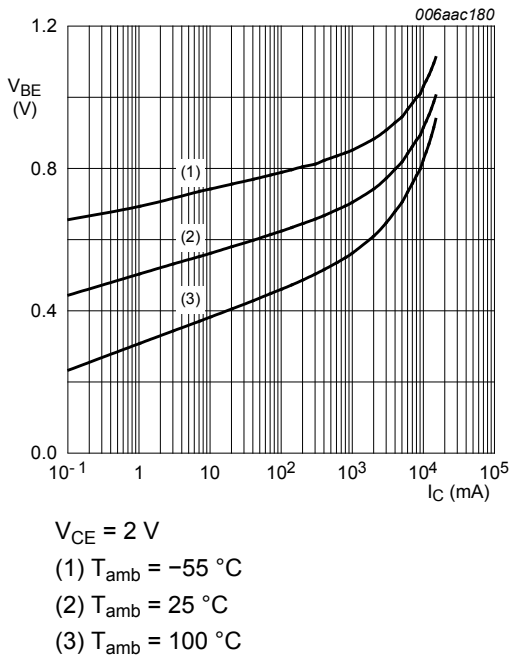


Fig. 7. Base-emitter voltage as a function of collector current; typical values

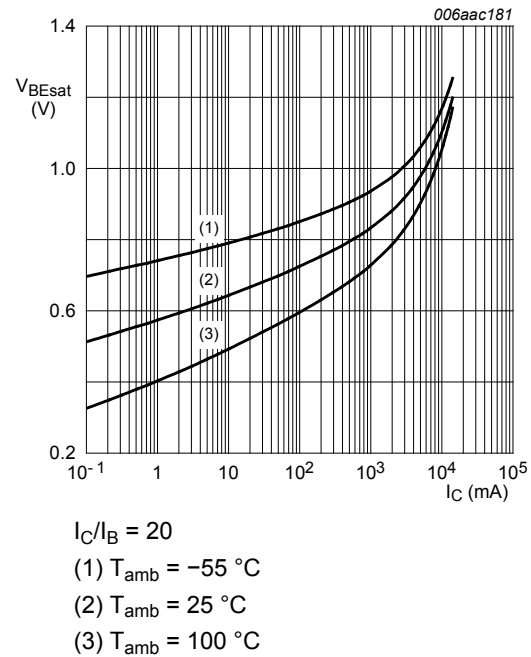
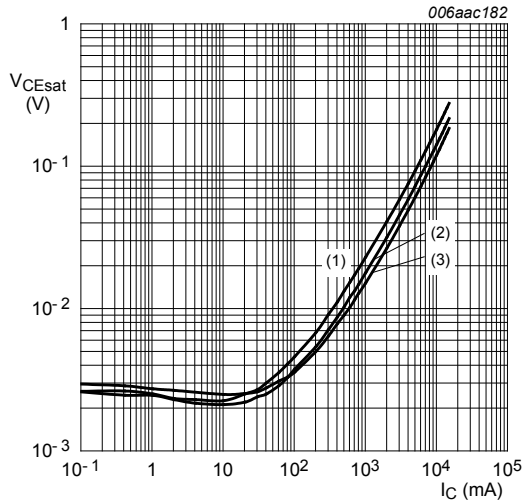
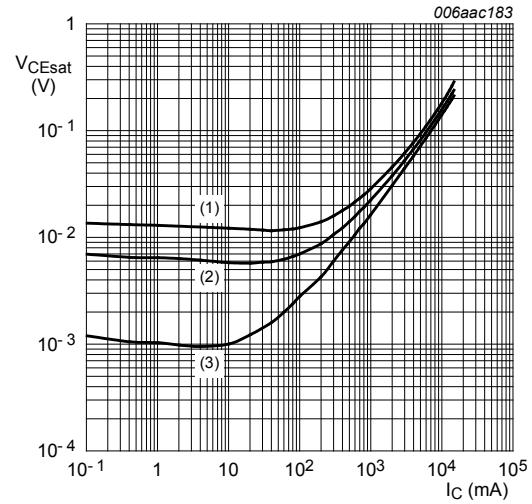


Fig. 8. Base-emitter saturation voltage as a function of collector current; typical values



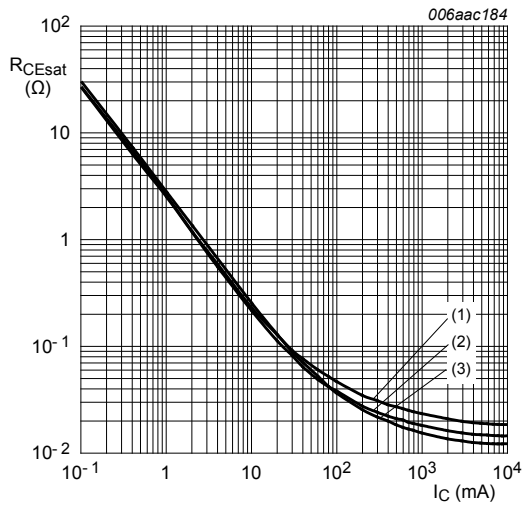
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -55\text{ °C}$

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



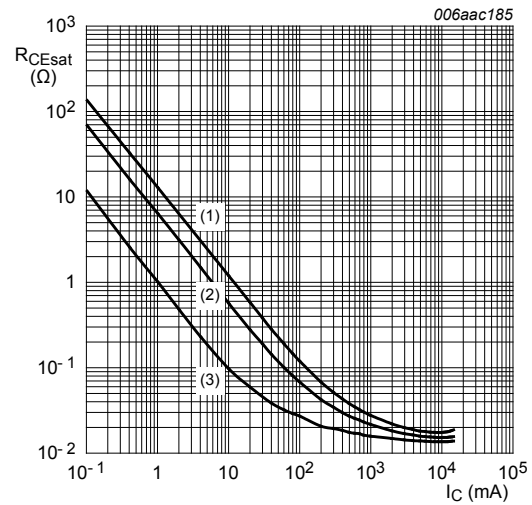
$T_{amb} = 25\text{ °C}$   
 (1)  $I_C/I_B = 100$   
 (2)  $I_C/I_B = 50$   
 (3)  $I_C/I_B = 10$

**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

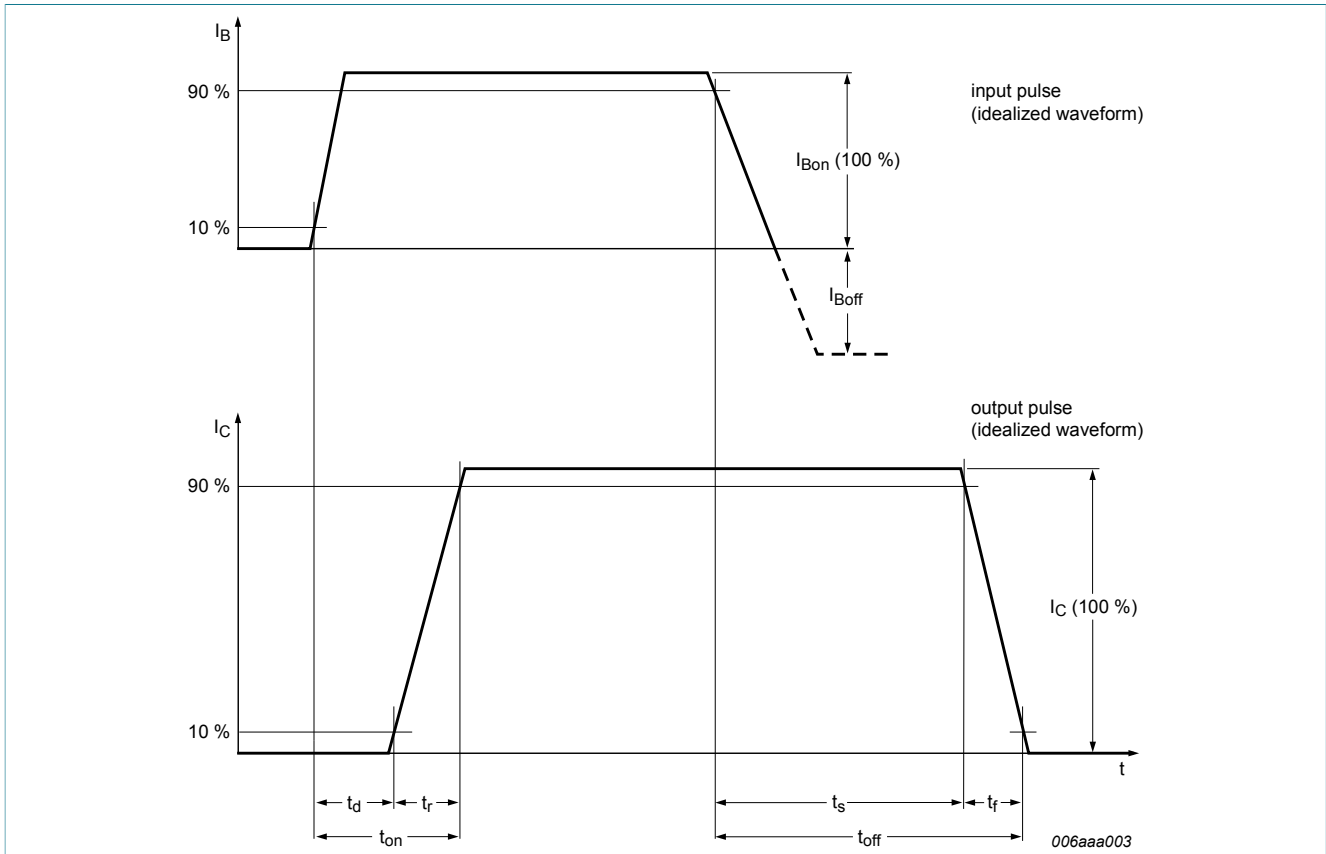


Fig. 13. BISS transistor switching time definition

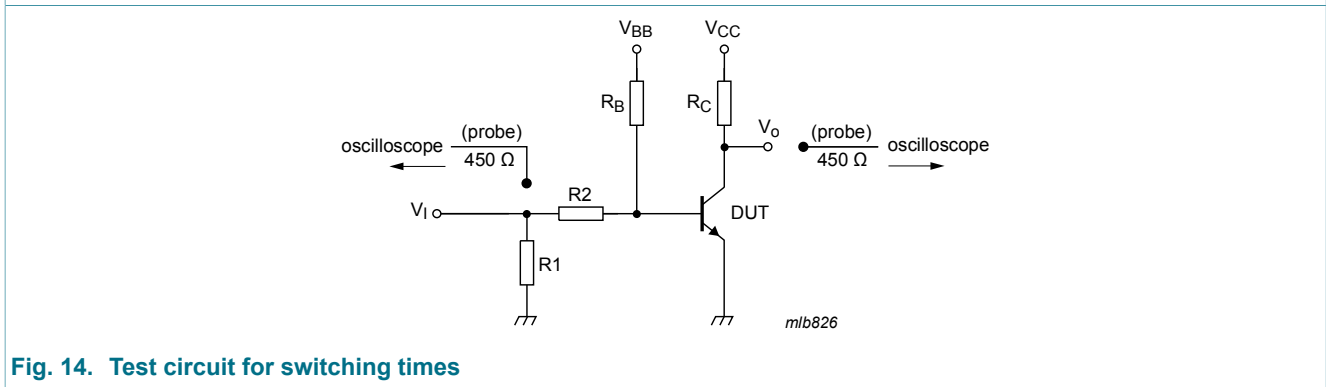


Fig. 14. Test circuit for switching times

#### 11.1 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

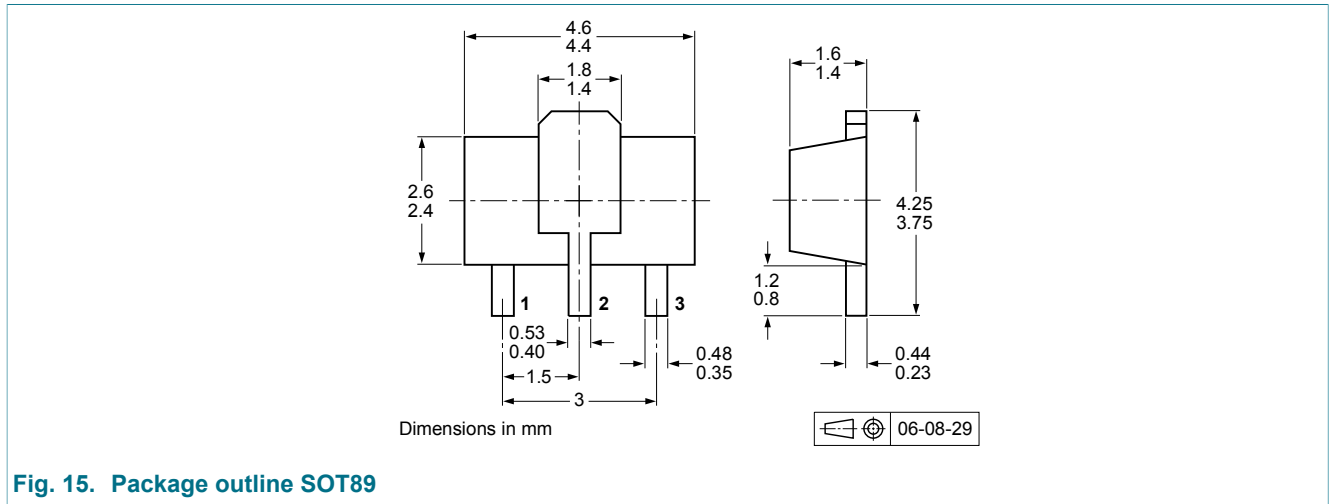


Fig. 15. Package outline SOT89

## 13. Soldering

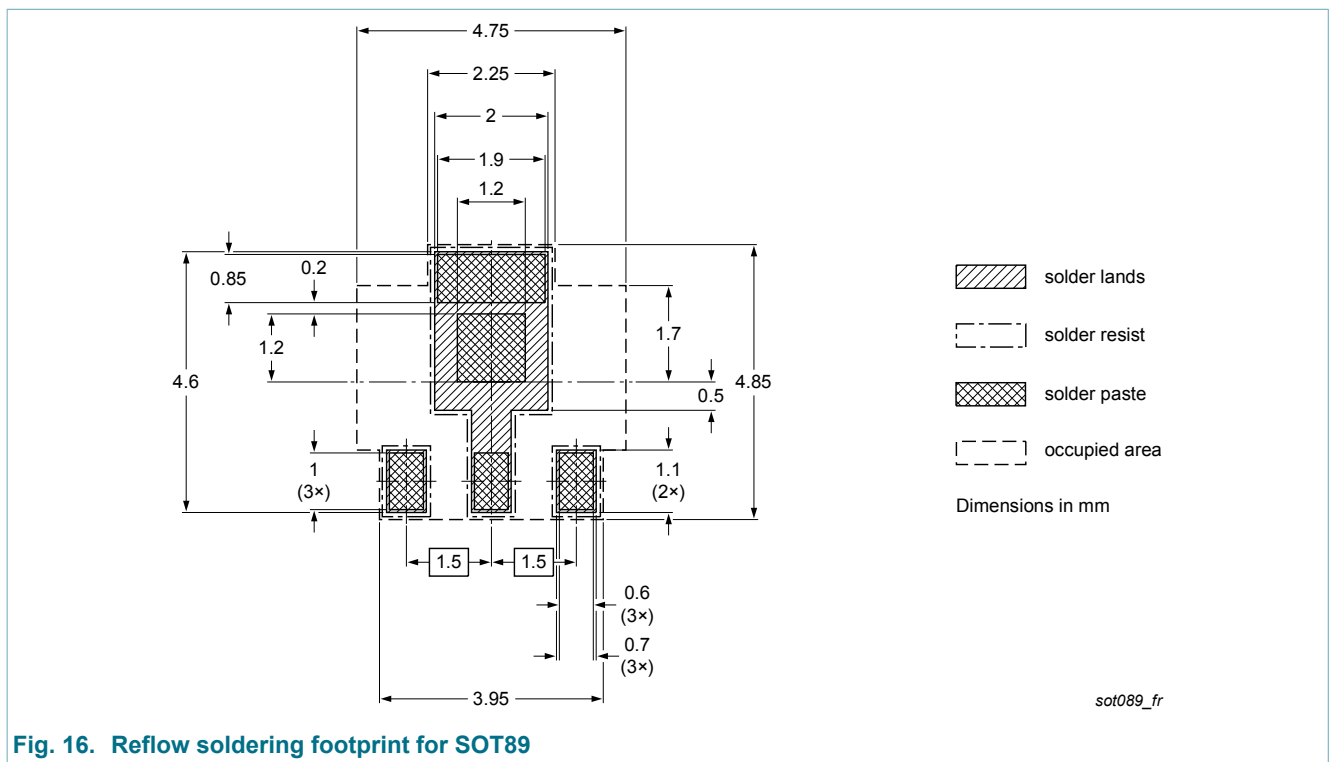


Fig. 16. Reflow soldering footprint for SOT89

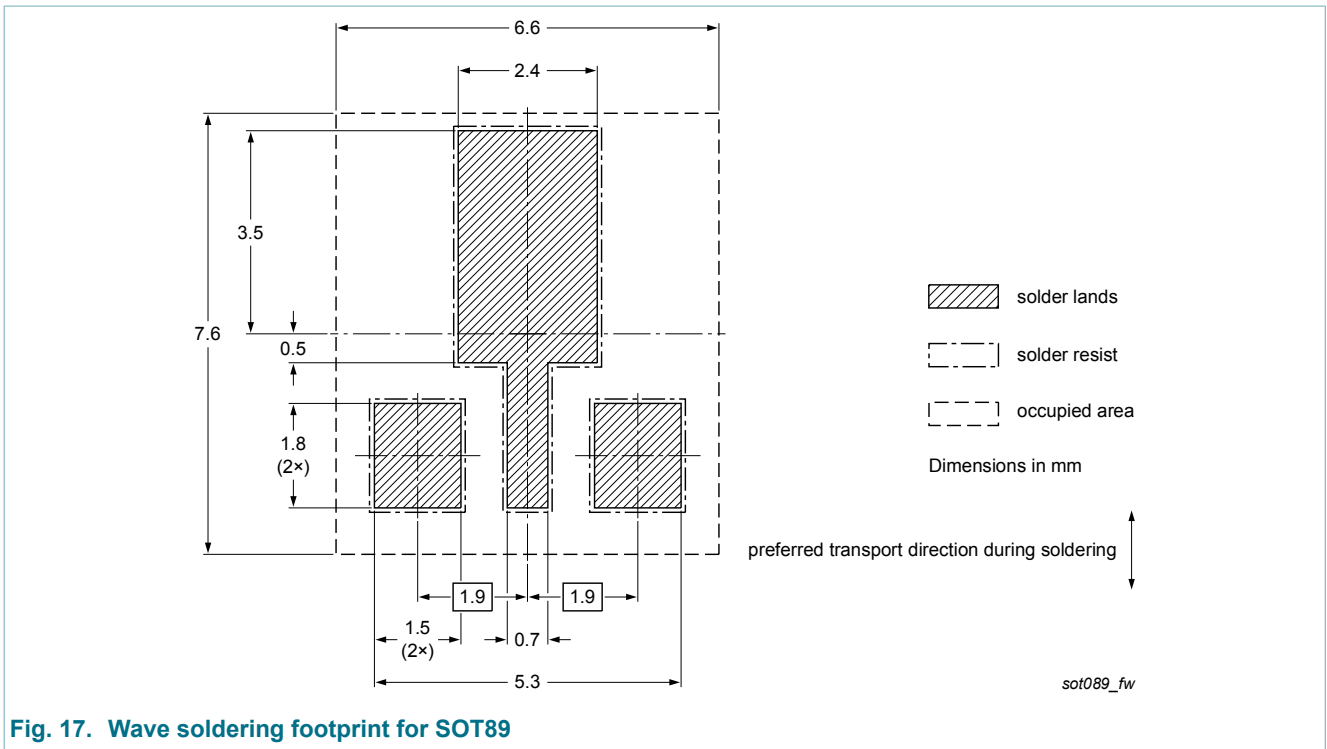


Fig. 17. Wave soldering footprint for SOT89

## 14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PBSS4021NX v.3	20121211	Product data sheet	-	PBSS4021NX v.2
Modifications:	<ul style="list-style-type: none"> <li>Editorial update</li> </ul>			
PBSS4021NX v.2	20121009	Product data sheet	-	PBSS4021NX v.1
PBSS4021NX v.1	20100401	Product data sheet	-	-

## 15. Legal information

### 15.1 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 URL <http://www.nexperia.com>.

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