

# PBSS4021NX

20 V, 7 A NPN low V<sub>CEsat</sub> (BISS) transistor

11 December 2012

Product data sheet

## 1. General description

NPN low V<sub>CEsat</sub> 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<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
- 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 <sub>CEO</sub>	collector-emitter voltage	open base	-	-	20	V
I <sub>C</sub>	collector current		-	-	7	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> = 5 A; I <sub>B</sub> = 500 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	-	19	28	mΩ

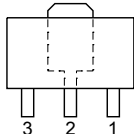
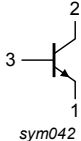


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## 5. Pinning information

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.

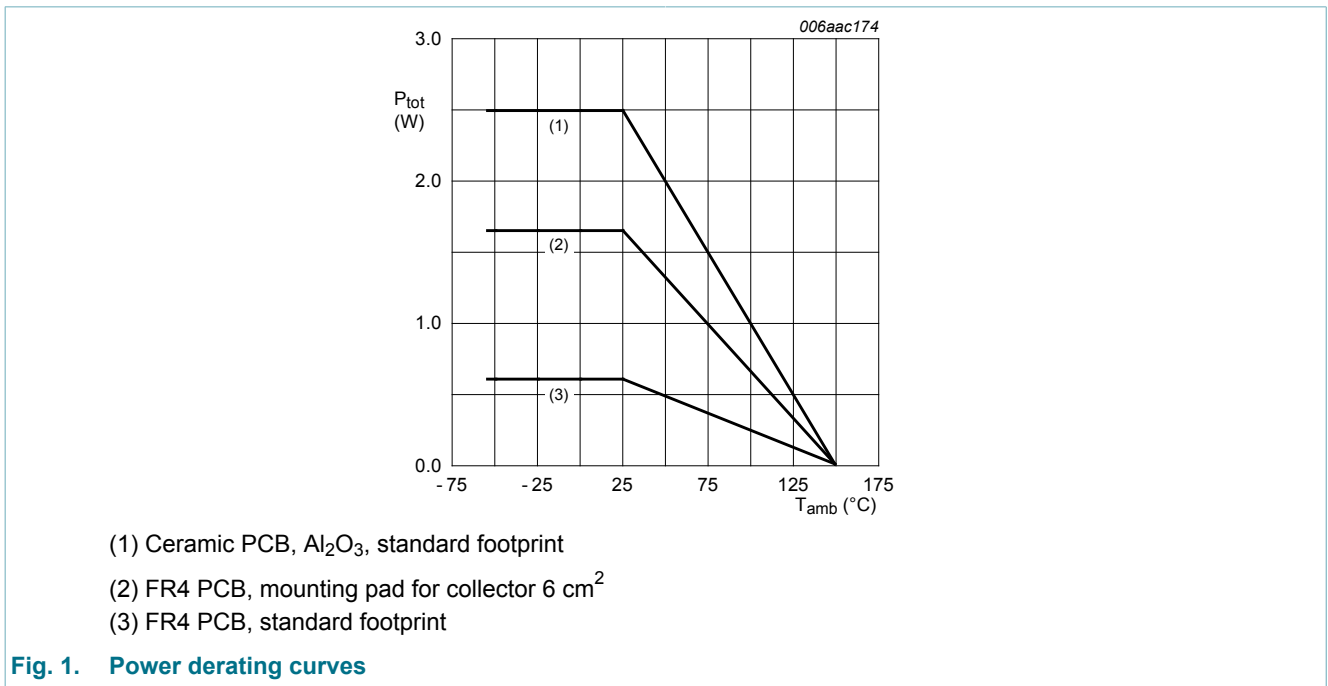


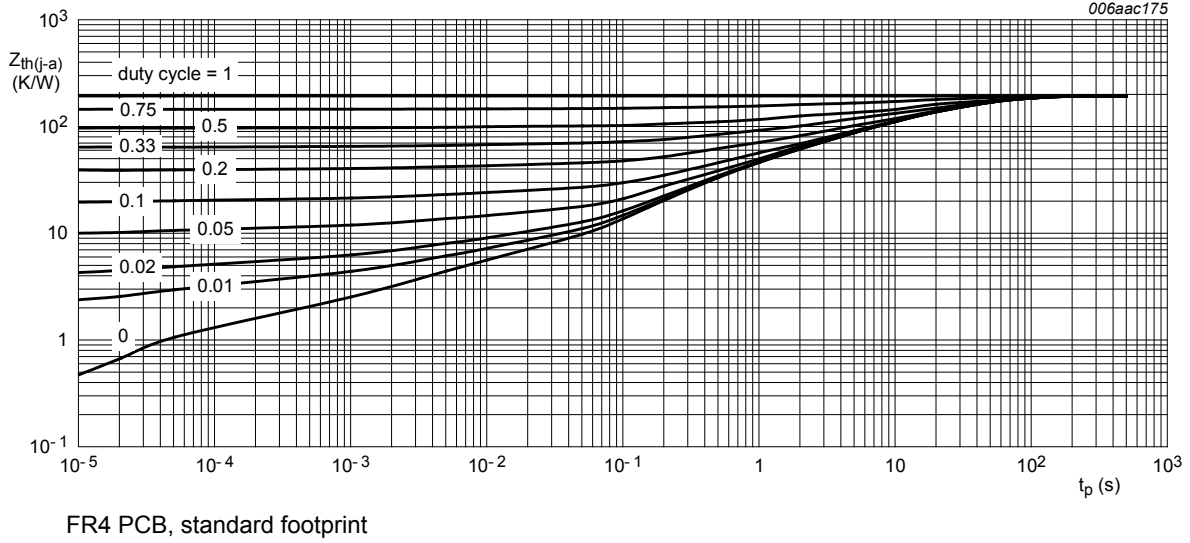
Fig. 1. Power derating curves

## 9. Thermal characteristics

Table 6. Thermal characteristics

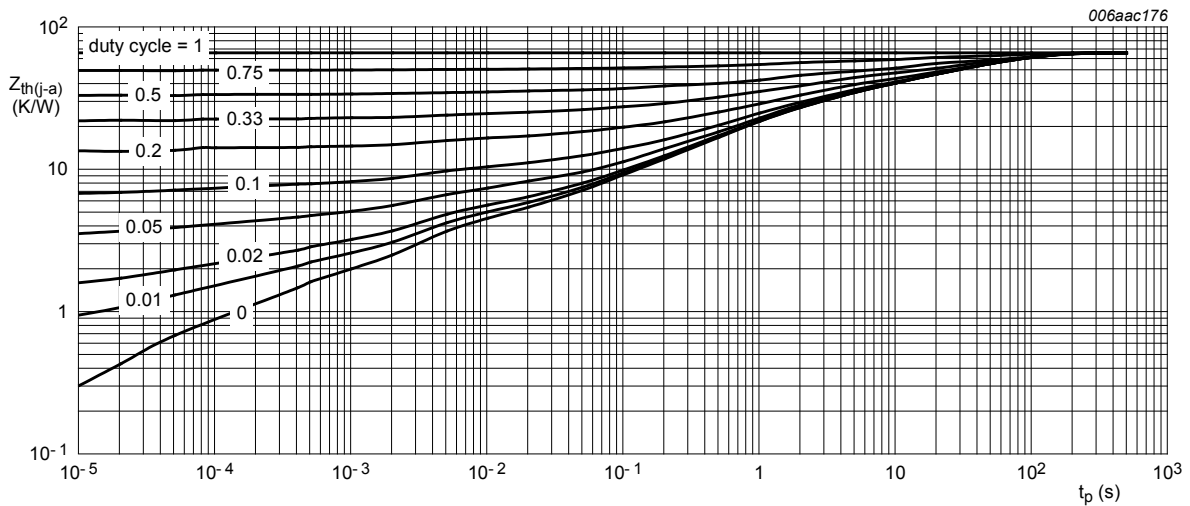
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
R <sub>th(j-a)</sub>	thermal resistance from junction to ambient	[1] in free air	-	-	210	K/W
		[2]	-	-	75	K/W
		[3]	-	-	50	K/W
R <sub>th(j-sp)</sub>	thermal resistance from junction to solder point		-	-	20	K/W

- [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.



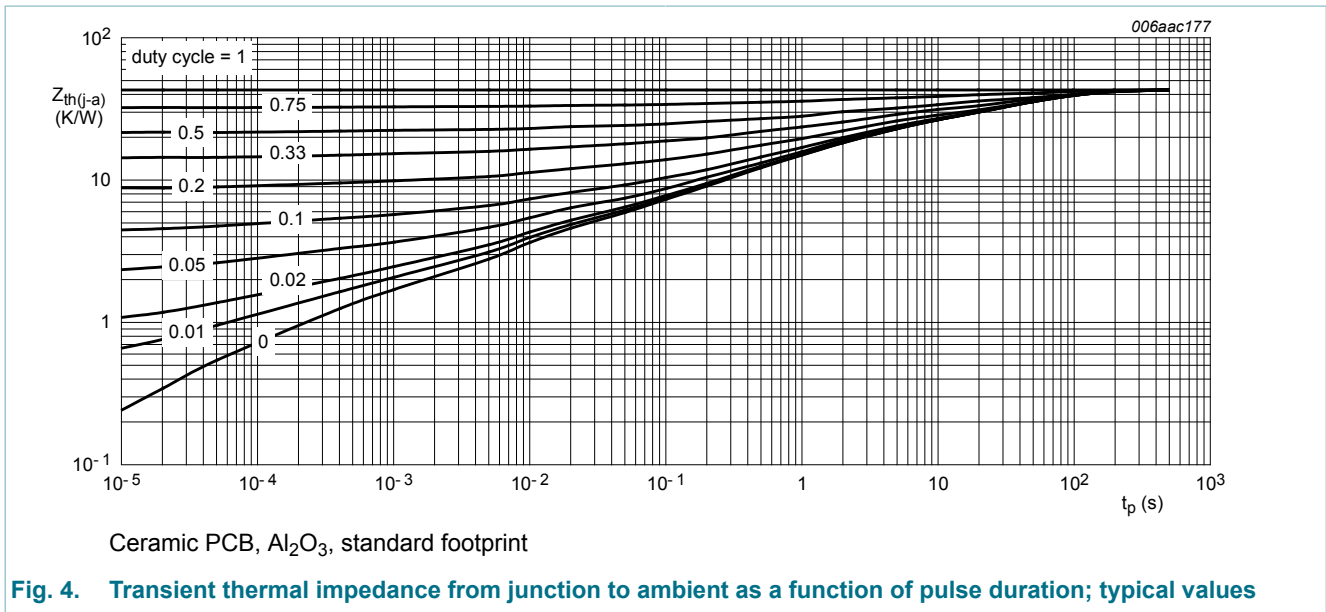
FR4 PCB, standard footprint

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



FR4 PCB, mounting pad for collector 6 cm<sup>2</sup>

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

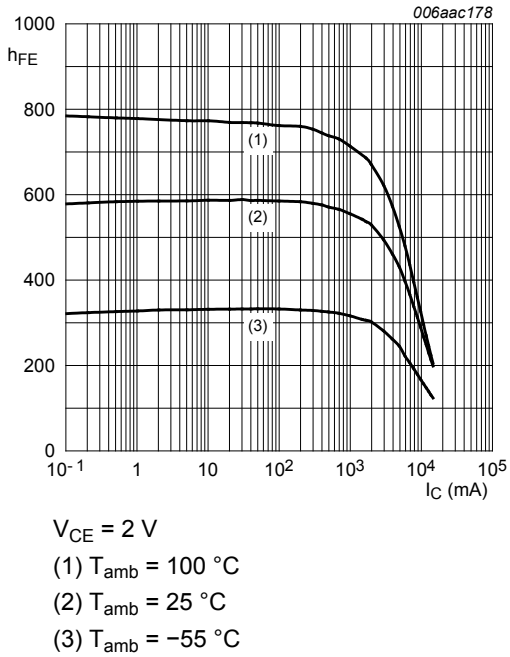


Fig. 5. DC current gain as a function of collector current; typical values

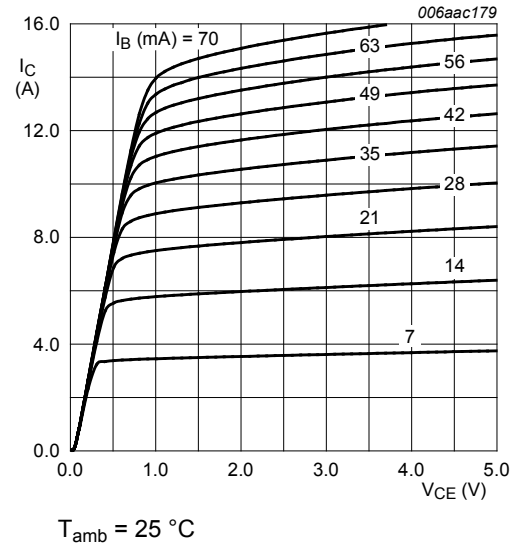


Fig. 6. Collector current as a function of collector-emitter voltage; typical values

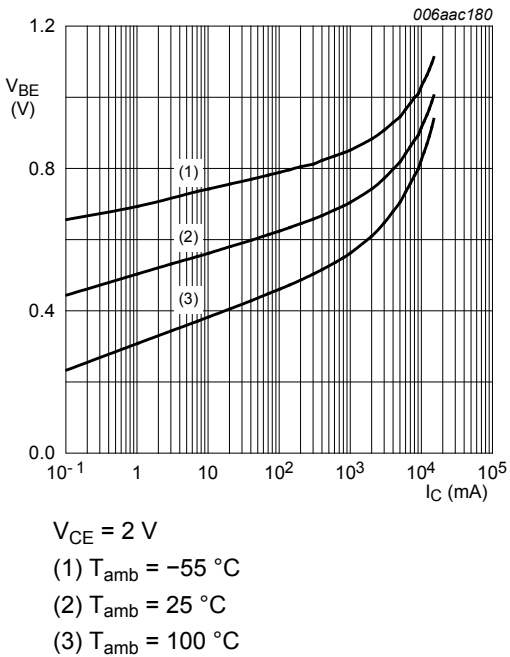


Fig. 7. Base-emitter voltage as a function of collector current; typical values

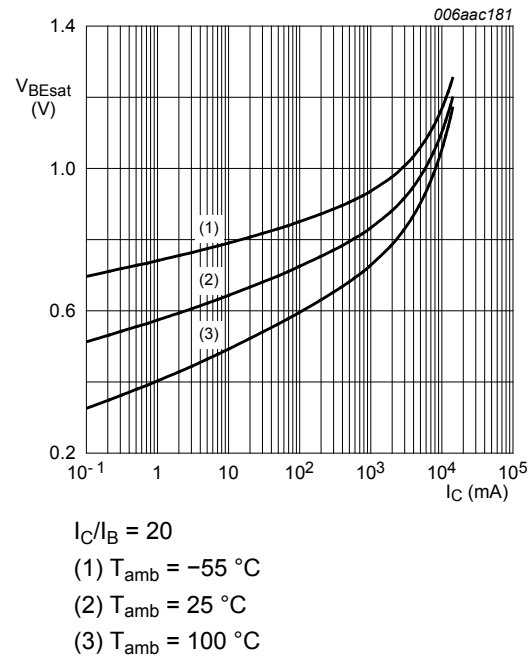
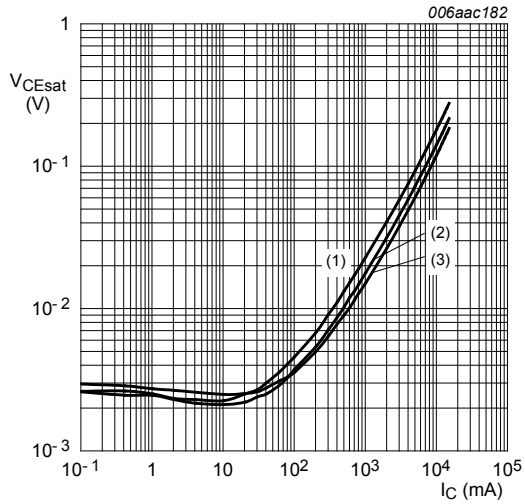
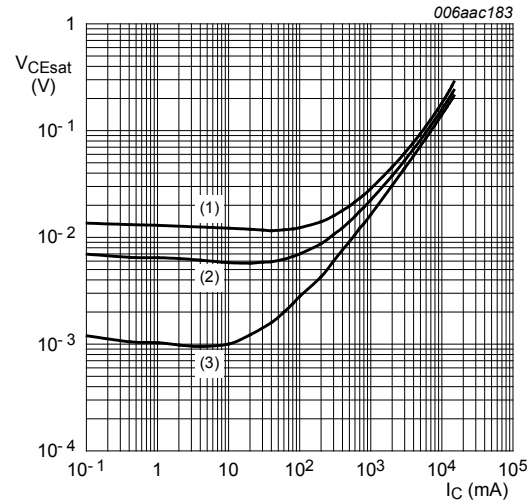


Fig. 8. Base-emitter saturation voltage as a function of collector current; typical values



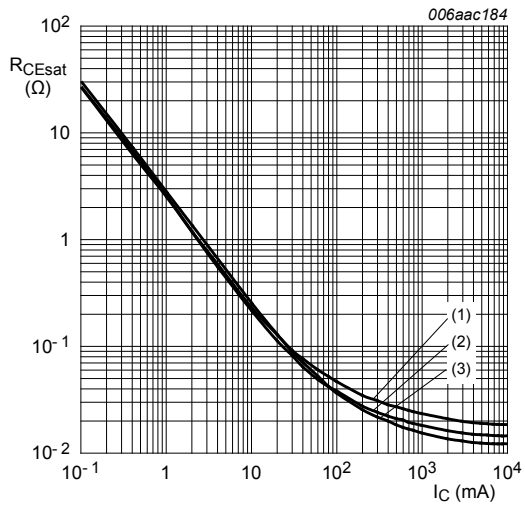
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100\text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25\text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -55\text{ }^\circ\text{C}$

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



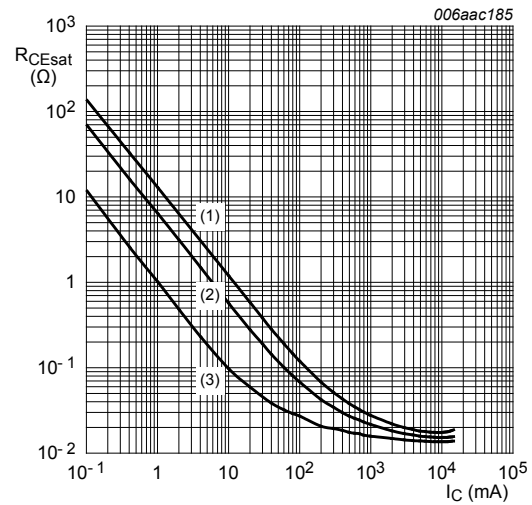
$T_{amb} = 25\text{ }^\circ\text{C}$   
 (1)  $I_C/I_B = 100$   
 (2)  $I_C/I_B = 50$   
 (3)  $I_C/I_B = 10$

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



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

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



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

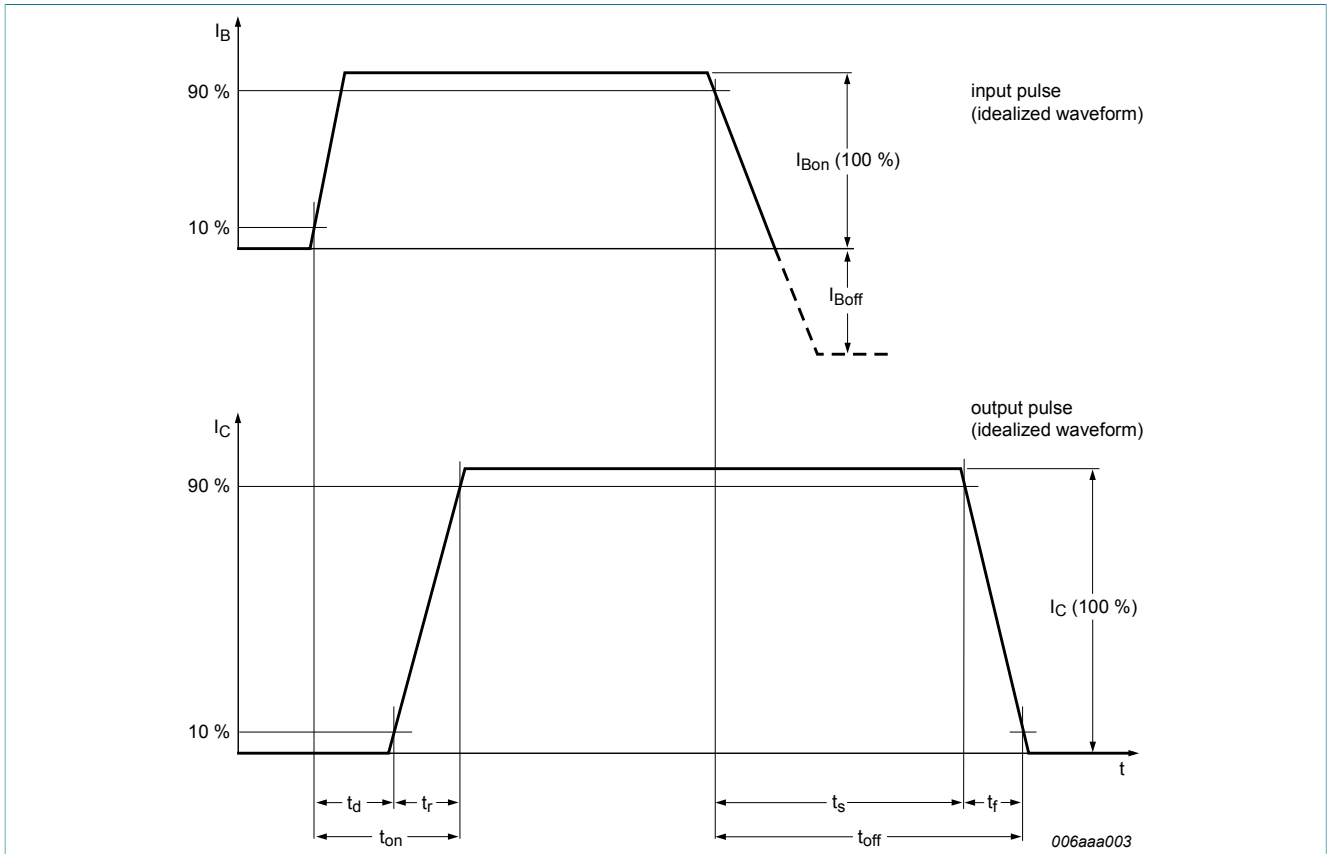


Fig. 13. BISS transistor switching time definition

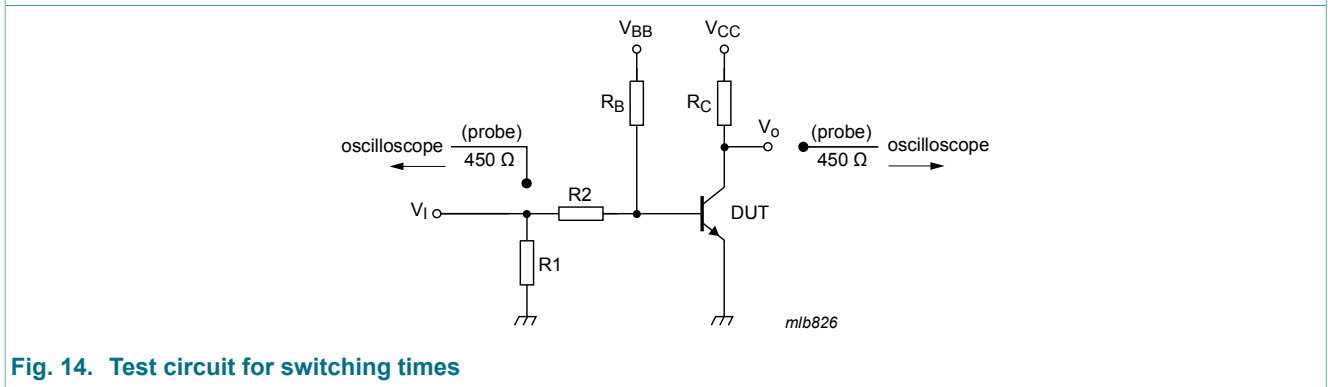


Fig. 14. Test circuit for switching times

#### 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

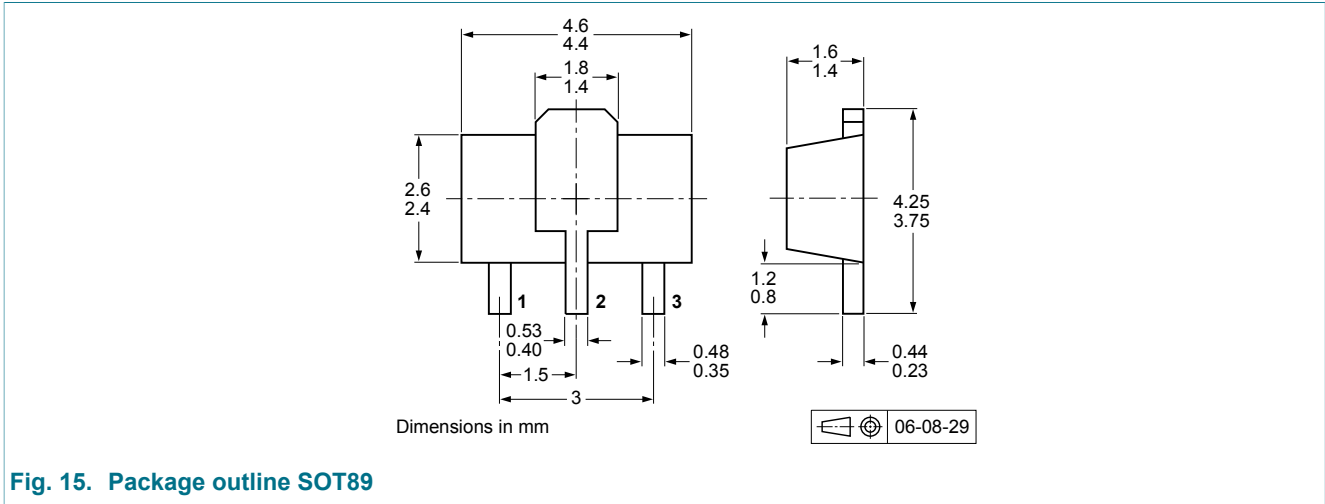


Fig. 15. Package outline SOT89

### 13. Soldering

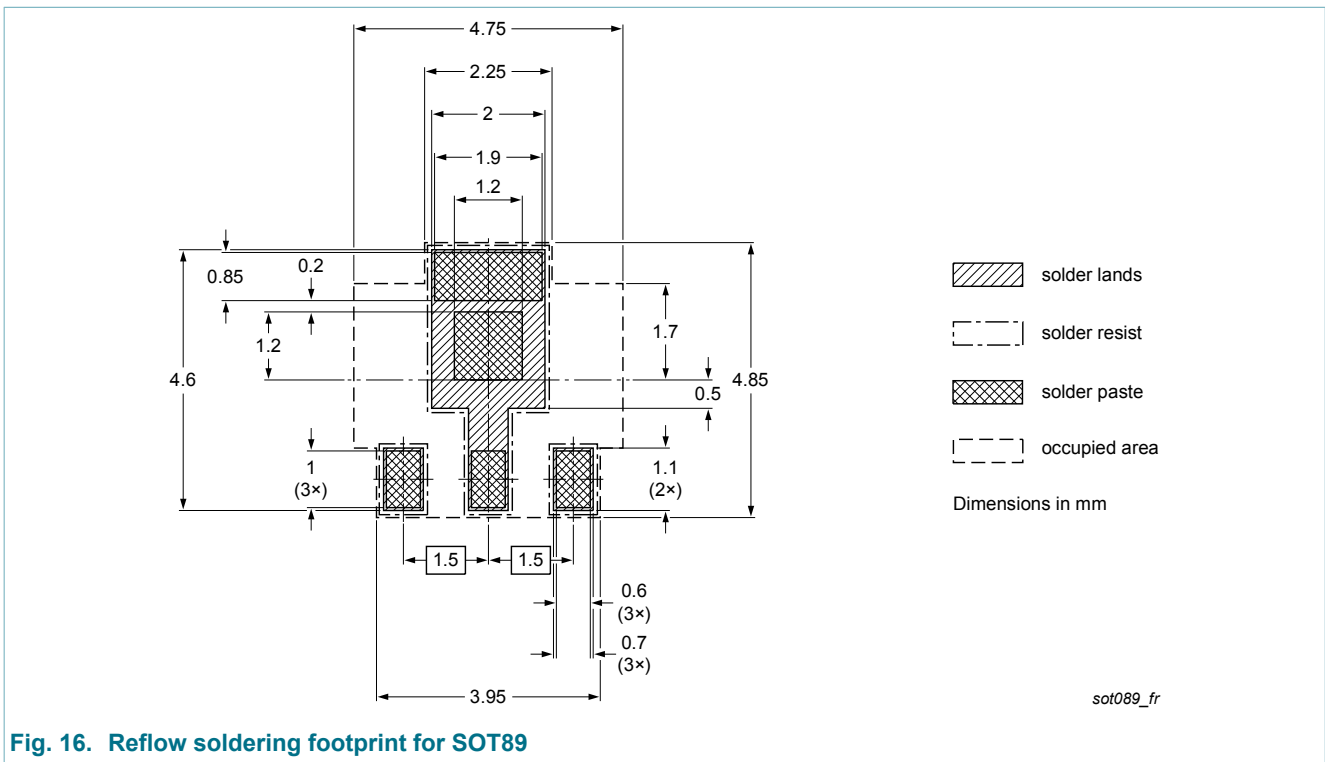


Fig. 16. Reflow soldering footprint for SOT89

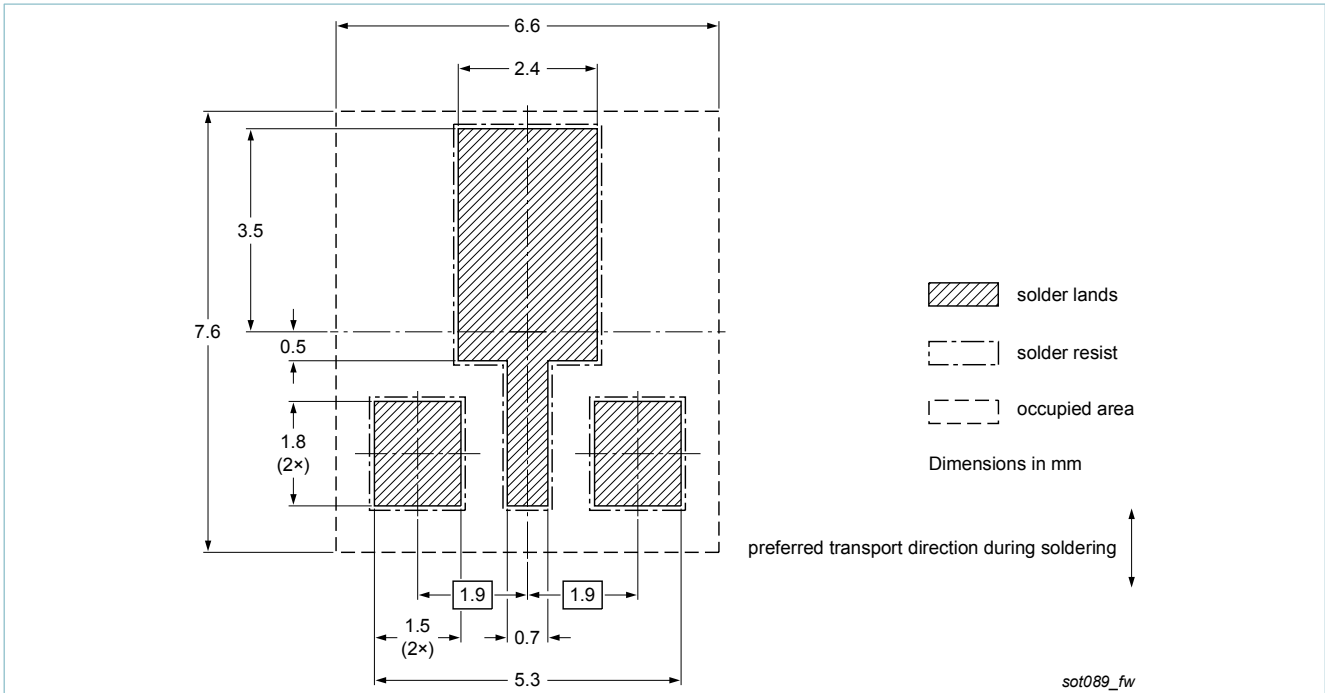


Fig. 17. Wave soldering footprint for SOT89

## 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".
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