

# PBSS4021NX

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

Rev. 01 — 1 April 2010

Product data sheet

## 1. Product profile

### 1.1 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.

### 1.2 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

### 1.3 Applications

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

### 1.4 Quick reference data

Table 1. Quick reference data

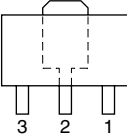
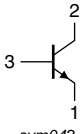
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CEO}$	collector-emitter voltage	open base	-	-	20	V
$I_C$	collector current		-	-	7	A
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms	-	-	15	A
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = 5$ A; $I_B = 500$ mA	[1] -	19	28	m $\Omega$

[1] Pulse test:  $t_p \leq 300$   $\mu$ s;  $\delta \leq 0.02$ .



## 2. Pinning information

Table 2. Pinning

Pin	Description	Simplified outline	Graphic symbol
1	emitter		
2	collector		
3	base		

## 3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PBSS4021NX	SC-62	plastic surface-mounted package; 3 leads	SOT89

## 4. Marking

Table 4. Marking codes

Type number	Marking code <sup>[1]</sup>
PBSS4021NX	*6D

- [1] \* = -: made in Hong Kong  
 \* = p: made in Hong Kong  
 \* = t: made in Malaysia  
 \* = W: made in China

## 5. Limiting values

Table 5. Limiting values

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

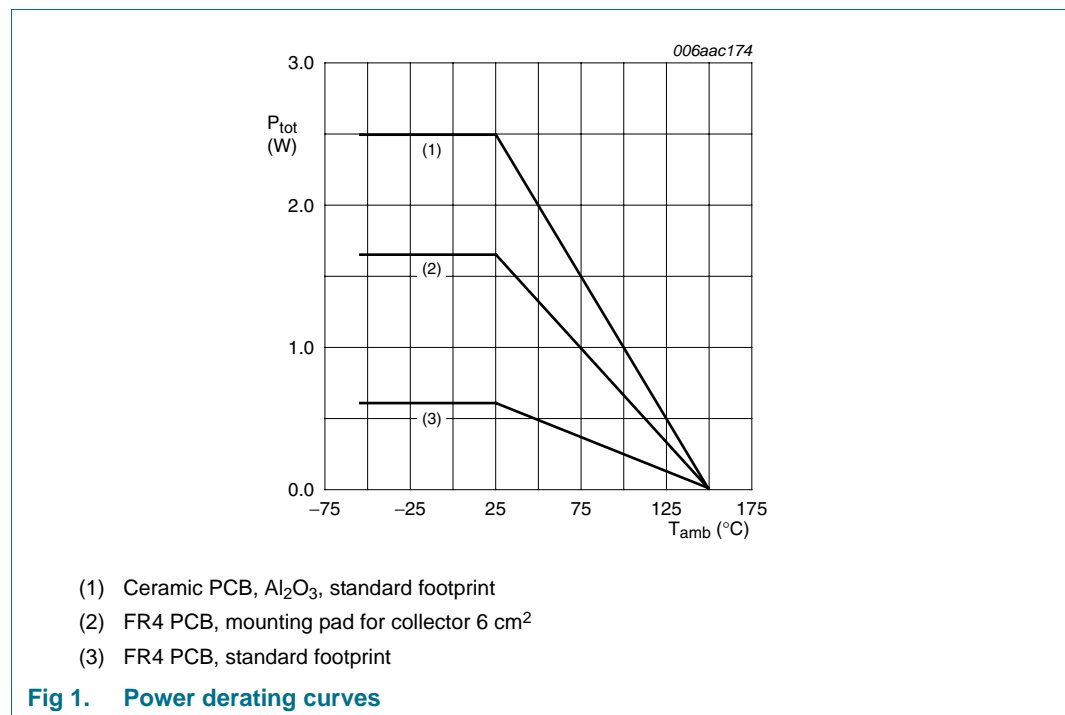
Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CBO}$	collector-base voltage	open emitter	-	20	V
$V_{CEO}$	collector-emitter voltage	open base	-	20	V
$V_{EBO}$	emitter-base voltage	open collector	-	5	V
$I_C$	collector current		-	7	A
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms	-	15	A
$I_B$	base current		-	1	A

**Table 5. Limiting values ...continued**

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

Symbol	Parameter	Conditions	Min	Max	Unit
$P_{tot}$	total power dissipation	$T_{amb} \leq 25\text{ °C}$	[1] -	600	mW
			[2] -	1650	mW
			[3] -	2500	mW
$T_j$	junction temperature		-	150	°C
$T_{amb}$	ambient temperature		-55	+150	°C
$T_{stg}$	storage temperature		-65	+150	°C

[1] Device mounted on an FR4 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.

## 6. Thermal characteristics

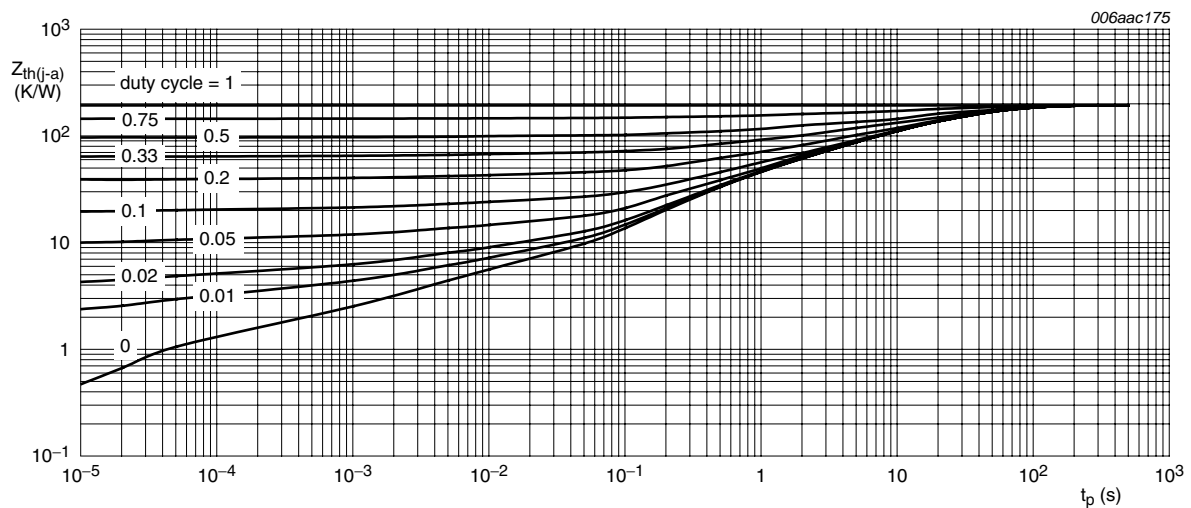
**Table 6. Thermal characteristics**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	210	K/W
			[2]	-	-	75	K/W
			[3]	-	-	50	K/W
$R_{th(j-sp)}$	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.

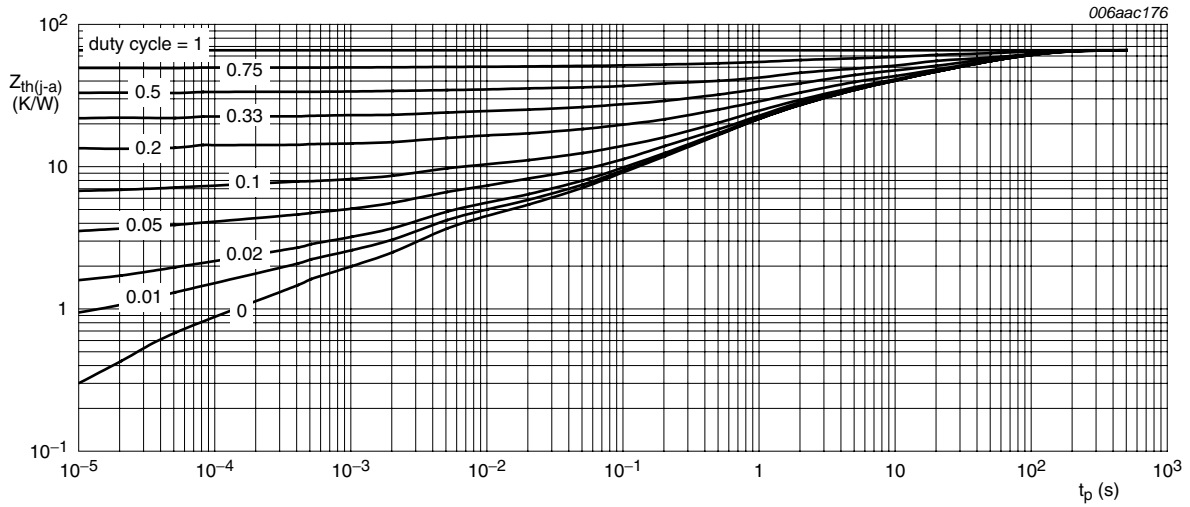
[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 6 cm<sup>2</sup>.

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



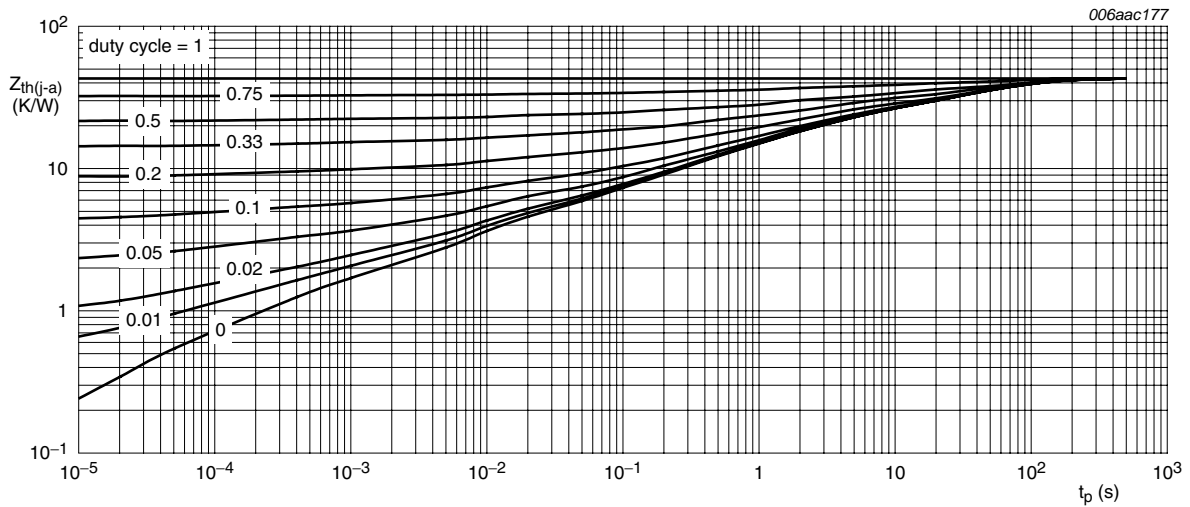
FR4 PCB, standard footprint

**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**



Ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint

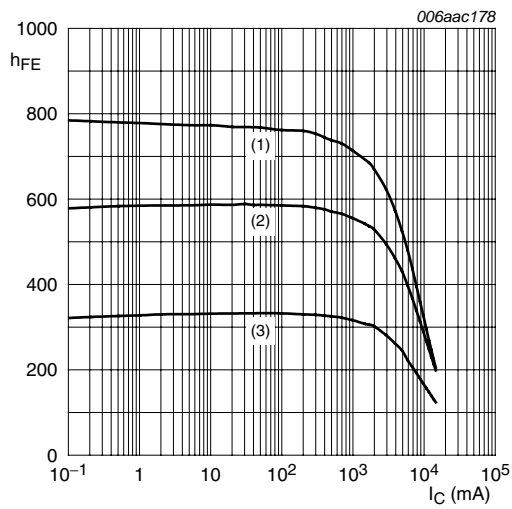
**Fig 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values**

## 7. Characteristics

**Table 7. Characteristics**
 $T_{amb} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

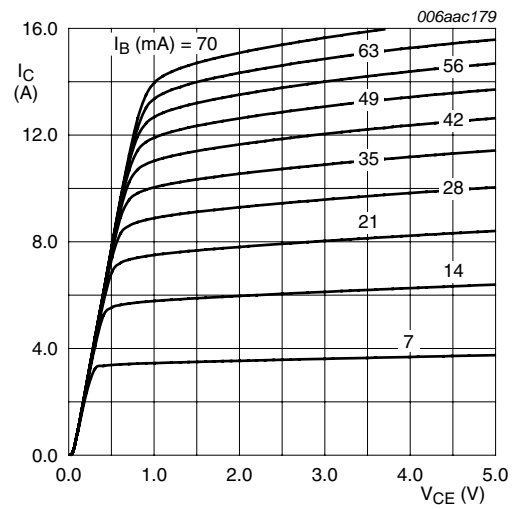
Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$I_{CBO}$	collector-base cut-off current	$V_{CB} = 20\text{ V}; I_E = 0\text{ A}$	-	-	100	nA	
		$V_{CB} = 20\text{ V}; I_E = 0\text{ A}; T_j = 150\text{ }^{\circ}\text{C}$	-	-	50	$\mu\text{A}$	
$I_{CES}$	collector-emitter cut-off current	$V_{CE} = 16\text{ V}; V_{BE} = 0\text{ V}$	-	-	100	nA	
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 5\text{ V}; I_C = 0\text{ A}$	-	-	100	nA	
$h_{FE}$	DC current gain	$V_{CE} = 2\text{ V}$	[1]				
		$I_C = 500\text{ mA}$	300	550	-		
		$I_C = 1\text{ A}$	300	550	-		
		$I_C = 2\text{ A}$	300	500	-		
		$I_C = 4\text{ A}$	250	450	-		
		$I_C = 8\text{ A}$	100	200	-		
$V_{CEsat}$	collector-emitter saturation voltage		[1]				
		$I_C = 1\text{ A}; I_B = 50\text{ mA}$	-	25	38	mV	
		$I_C = 1\text{ A}; I_B = 10\text{ mA}$	-	35	60	mV	
		$I_C = 2\text{ A}; I_B = 40\text{ mA}$	-	48	75	mV	
		$I_C = 4\text{ A}; I_B = 200\text{ mA}$	-	78	120	mV	
		$I_C = 4\text{ A}; I_B = 40\text{ mA}$	-	85	140	mV	
		$I_C = 7\text{ A}; I_B = 350\text{ mA}$	-	137	210	mV	
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = 5\text{ A}; I_B = 500\text{ mA}$	[1]	-	19	28	$\text{m}\Omega$
$V_{BEsat}$	base-emitter saturation voltage	$I_C = 1\text{ A}; I_B = 100\text{ mA}$	[1]	-	0.82	0.9	V
		$I_C = 4\text{ A}; I_B = 400\text{ mA}$	[1]	-	0.92	1.05	V
$V_{BEon}$	base-emitter turn-on voltage	$V_{CE} = 2\text{ V}; I_C = 2\text{ A}$	[1]	-	0.74	0.85	V
$t_d$	delay time	$V_{CC} = 12.5\text{ V}; I_C = 1\text{ A}; I_{Bon} = 0.05\text{ A}; I_{Boff} = -0.05\text{ A}$	-	40	-	ns	
$t_r$	rise time		-	40	-	ns	
$t_{on}$	turn-on time		-	80	-	ns	
$t_s$	storage time		-	650	-	ns	
$t_f$	fall time		-	75	-	ns	
$t_{off}$	turn-off time		-	725	-	ns	
$f_T$	transition frequency	$V_{CE} = 10\text{ V}; I_C = 100\text{ mA}; f = 100\text{ MHz}$	-	115	-	MHz	
$C_c$	collector capacitance	$V_{CB} = 10\text{ V}; I_E = I_e = 0\text{ A}; f = 1\text{ MHz}$	-	85	-	pF	

[1] Pulse test:  $t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02$ .



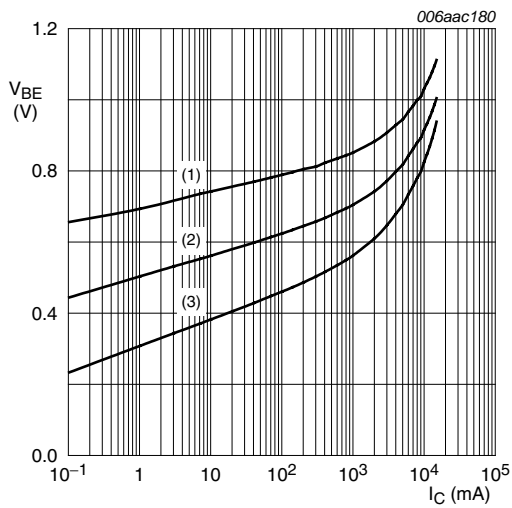
$V_{CE} = 2\text{ V}$   
 (1)  $T_{amb} = 100\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = -55\text{ }^{\circ}\text{C}$

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



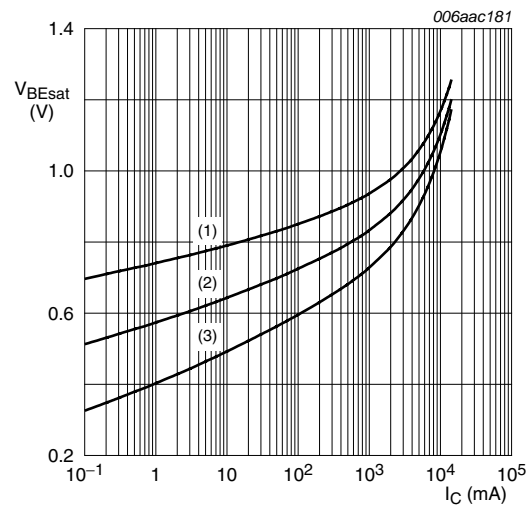
$T_{amb} = 25\text{ }^{\circ}\text{C}$

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



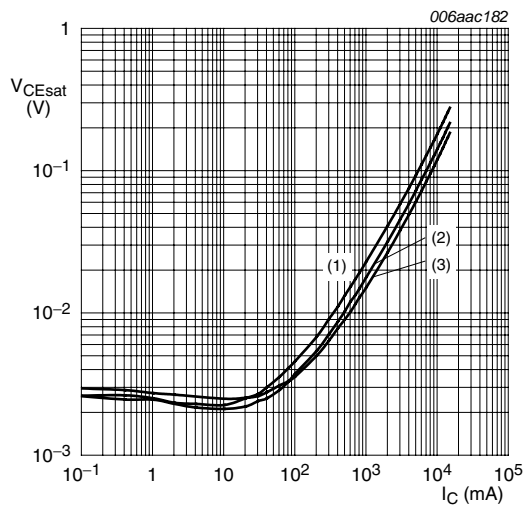
$V_{CE} = 2\text{ V}$   
 (1)  $T_{amb} = -55\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = 100\text{ }^{\circ}\text{C}$

**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)  $T_{amb} = 100\text{ }^{\circ}\text{C}$

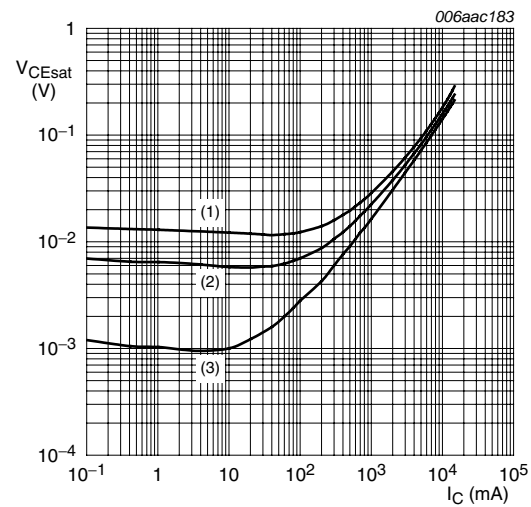
**Fig 8. Base-emitter saturation voltage as a function of collector current; typical values**



$$I_C/I_B = 20$$

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

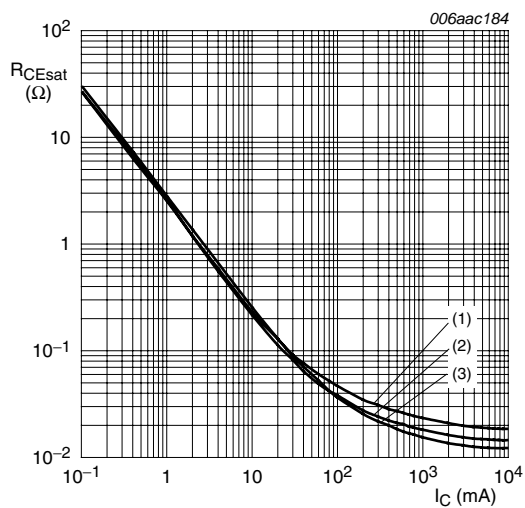
**Fig 9. Collector-emitter saturation voltage as a function of collector current; typical values**



$$T_{amb} = 25\text{ °C}$$

- (1)  $I_C/I_B = 100$
- (2)  $I_C/I_B = 50$
- (3)  $I_C/I_B = 10$

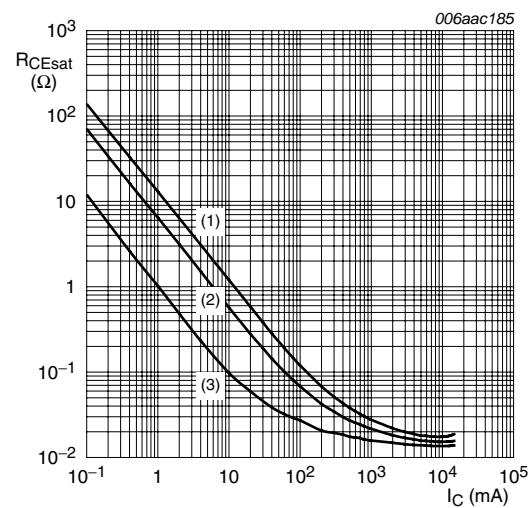
**Fig 10. Collector-emitter saturation voltage as a function of collector current; typical values**



$$I_C/I_B = 20$$

- (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**



## 8. Test information

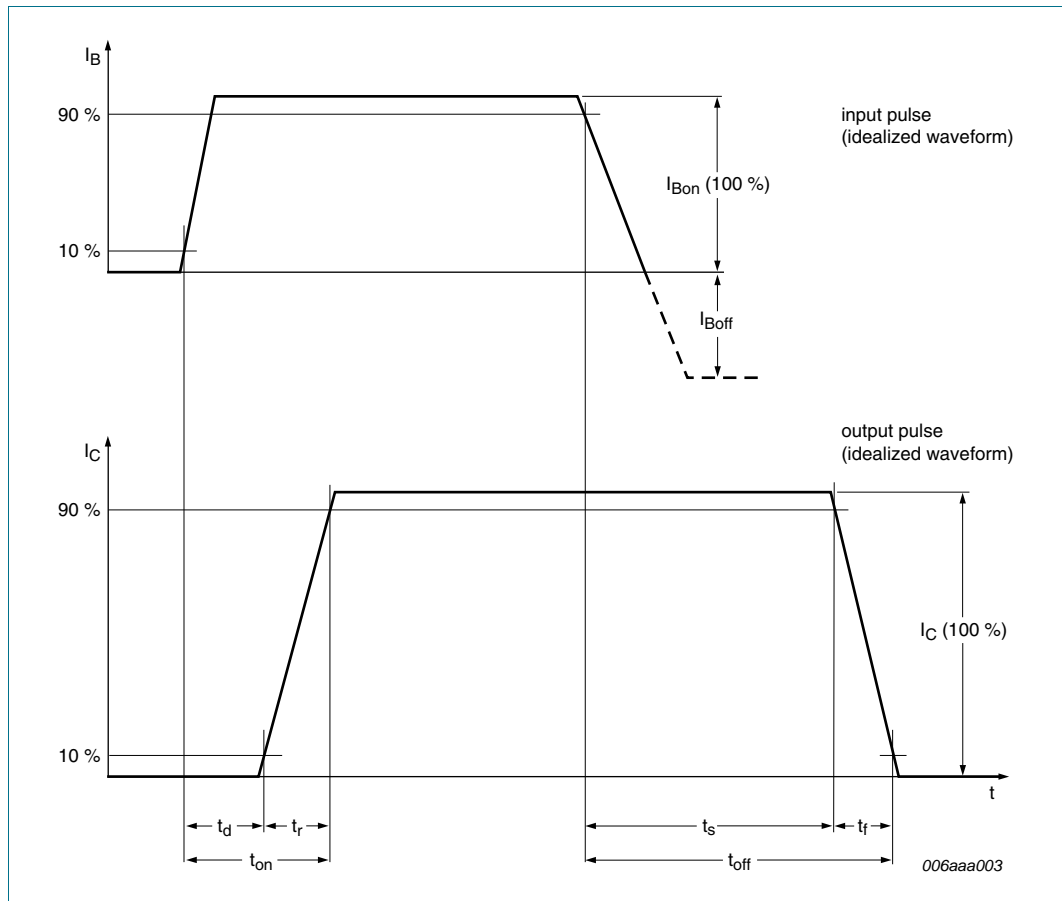


Fig 13. BISS transistor switching time definition

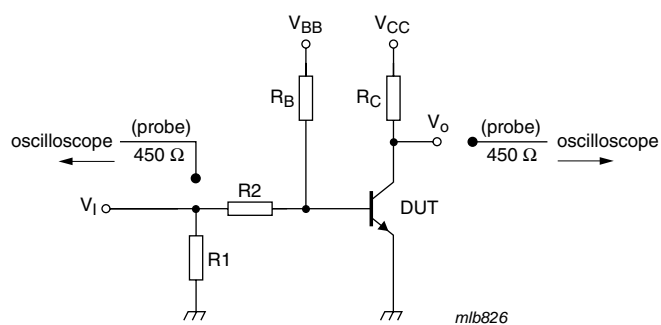


Fig 14. Test circuit for switching times

### 8.1 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.

## 9. Package outline

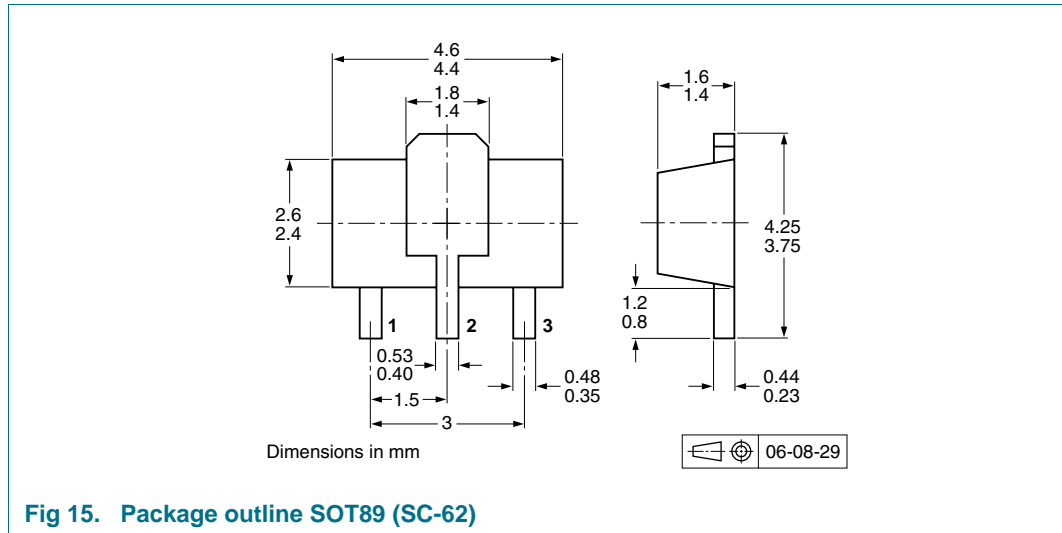


Fig 15. Package outline SOT89 (SC-62)

## 10. Packing information

**Table 8. Packing methods**

The indicated -xxx are the last three digits of the 12NC ordering code.<sup>[1]</sup>

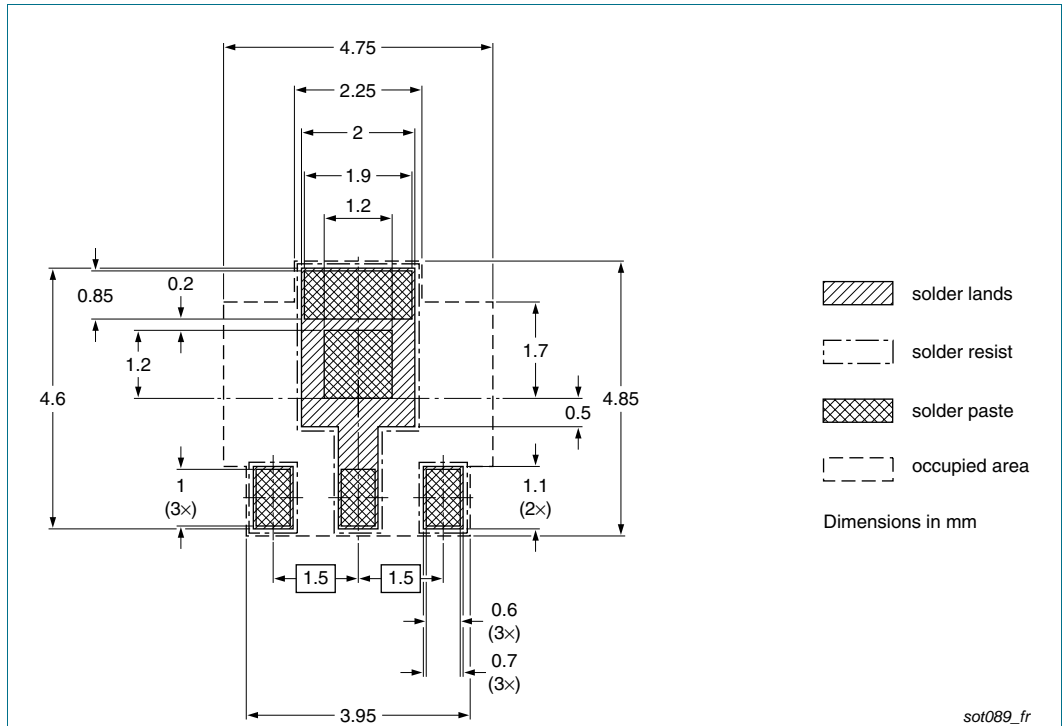
Type number	Package	Description	Packing quantity	
			3000	10000
PBSS4021NX	SOT89	8 mm pitch, 12 mm tape and reel; T1	<sup>[2]</sup> -115	-135
		8 mm pitch, 12 mm tape and reel; T3	<sup>[3]</sup> -120	-

[1] For further information and the availability of packing methods, see [Section 14](#).

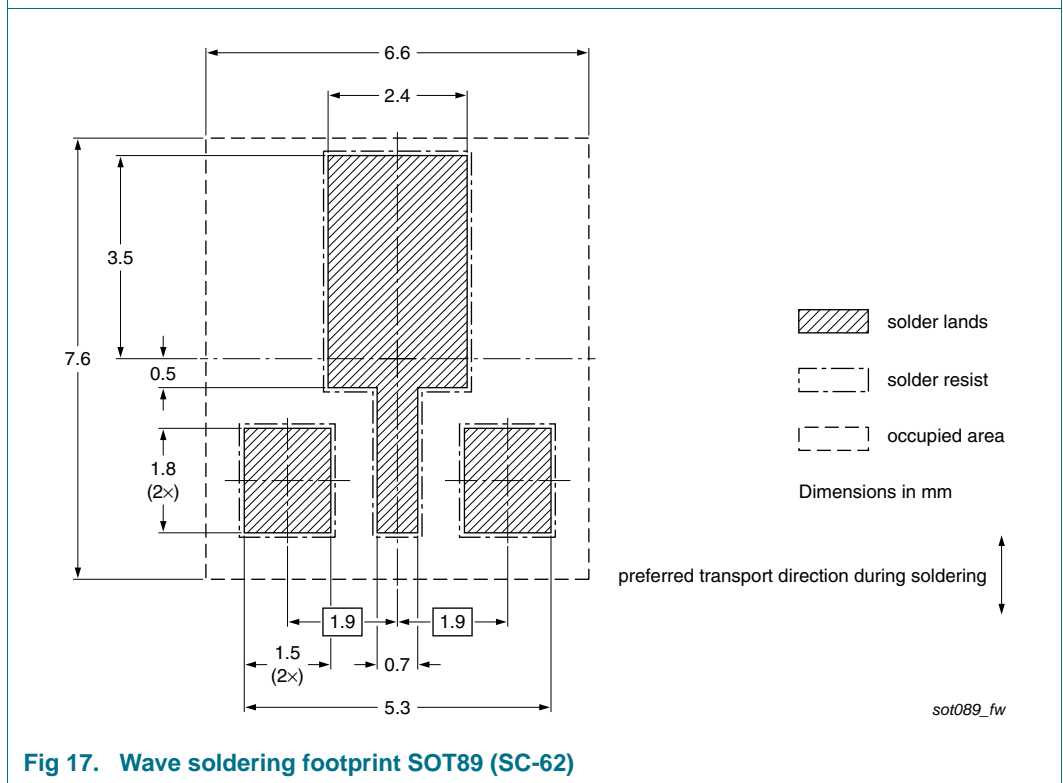
[2] T1: normal taping

[3] T3: 90° rotated taping

**11. Soldering**



**Fig 16. Reflow soldering footprint SOT89 (SC-62)**



**Fig 17. Wave soldering footprint SOT89 (SC-62)**

## 12. Revision history

**Table 9.** Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PBSS4021NX_1	20100401	Product data sheet	-	-

## 13. Legal information

### 13.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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.nxp.com>.

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