

# PBSS305NZ

80 V, 5.1 A NPN low  $V_{CEsat}$  (BISS) transistor

Rev. 01 — 19 September 2006

Product data sheet

## 1. Product profile

### 1.1 General description

NPN low  $V_{CEsat}$  Breakthrough In Small Signal (BISS) transistor in a SOT223 (SC-73) small Surface-Mounted Device (SMD) plastic package.

PNP complement: PBSS305PZ.

### 1.2 Features

- 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 efficiency due to less heat generation
- Smaller required Printed-Circuit Board (PCB) area than for conventional transistors

### 1.3 Applications

- High-voltage DC-to-DC conversion
- High-voltage MOSFET gate driving
- High-voltage motor control
- High-voltage power switches (e.g. motors, fans)
- Automotive applications

### 1.4 Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CEO}$	collector-emitter voltage	open base	-	-	80	V
$I_C$	collector current		-	-	5.1	A
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms	-	-	10.2	A
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = 4$ A; $I_B = 200$ mA	[1] -	40	56	m $\Omega$

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

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## 2. Pinning information

**Table 2. Pinning**

Pin	Description	Simplified outline	Symbol
1	base		
2	collector		
3	emitter		
4	collector		

*sym016*

## 3. Ordering information

**Table 3. Ordering information**

Type number	Package		
	Name	Description	Version
PBSS305NZ	SC-73	plastic surface-mounted package with increased heatsink; 4 leads	SOT223

## 4. Marking

**Table 4. Marking codes**

Type number	Marking code
PBSS305NZ	S305NZ

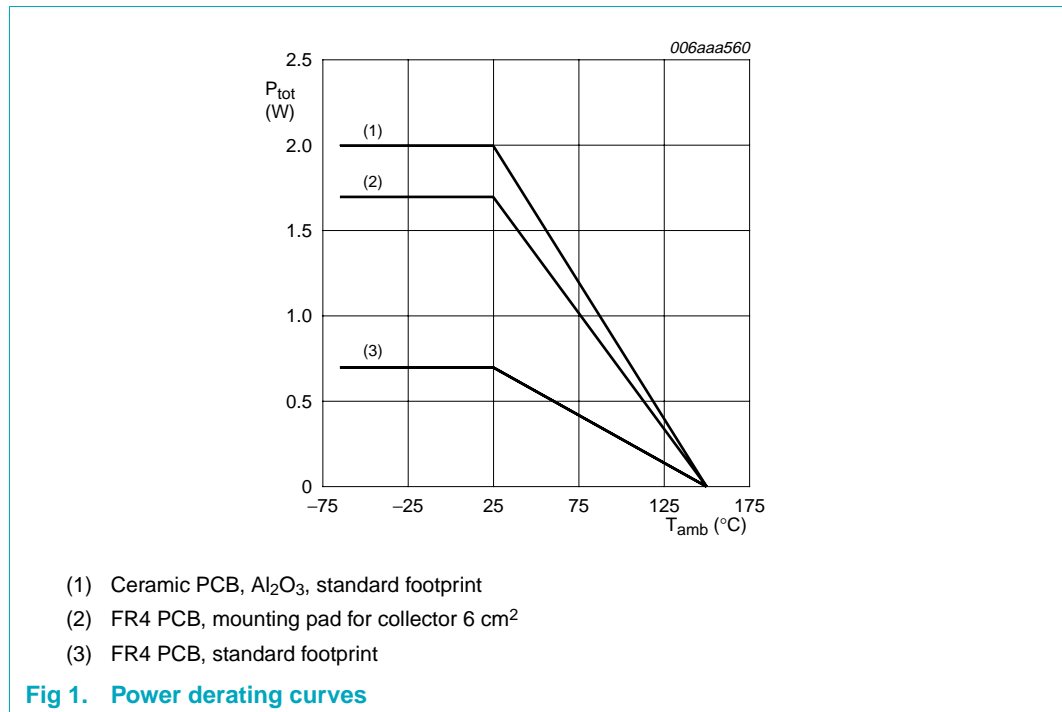
## 5. Limiting values

**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	-	80	V	
$V_{CEO}$	collector-emitter voltage	open base	-	80	V	
$V_{EBO}$	emitter-base voltage	open collector	-	5	V	
$I_C$	collector current		-	5.1	A	
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms	-	10.2	A	
$P_{tot}$	total power dissipation	$T_{amb} \leq 25$ °C	[1]	-	0.7	W
			[2]	-	1.7	W
			[3]	-	2.0	W
$T_j$	junction temperature		-	150	°C	
$T_{amb}$	ambient temperature		-65	+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.

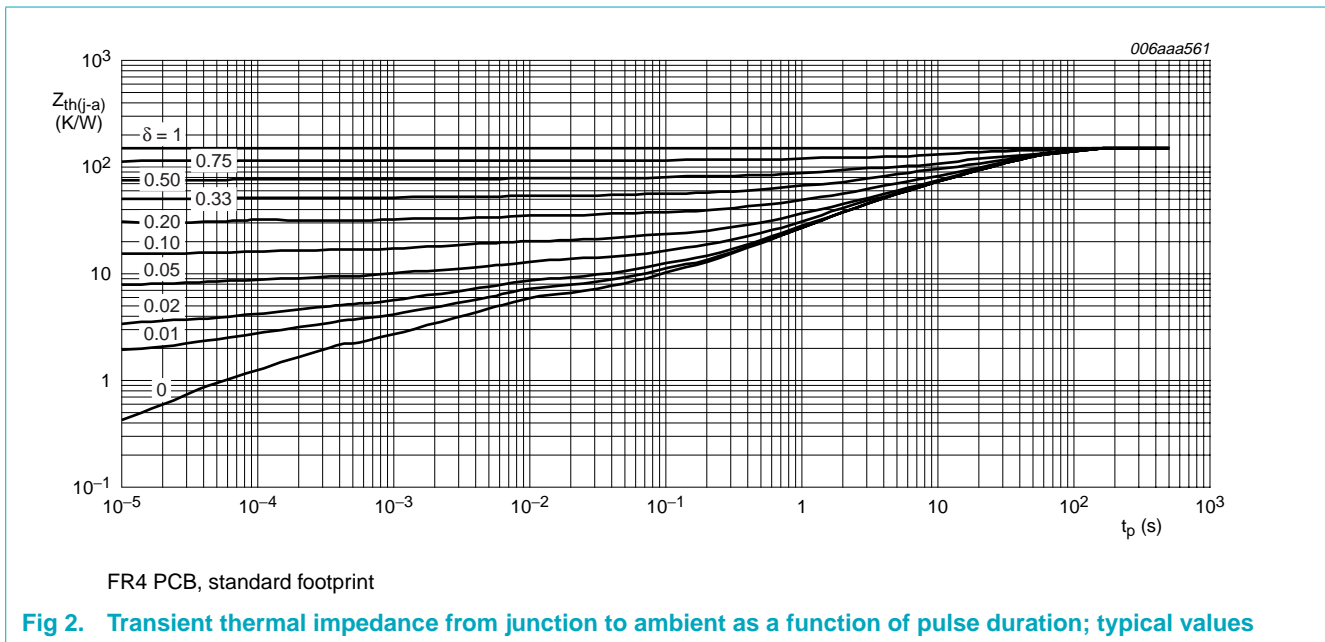


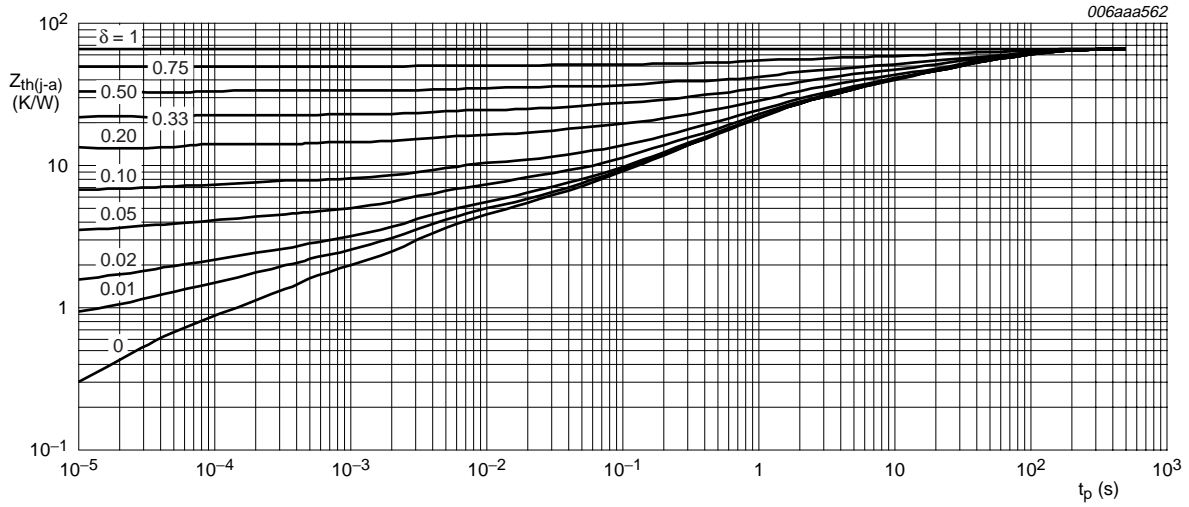
## 6. Thermal characteristics

**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]	-	-	179	K/W
			[2]	-	-	74	K/W
			[3]	-	-	63	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point		-	-	15	K/W	

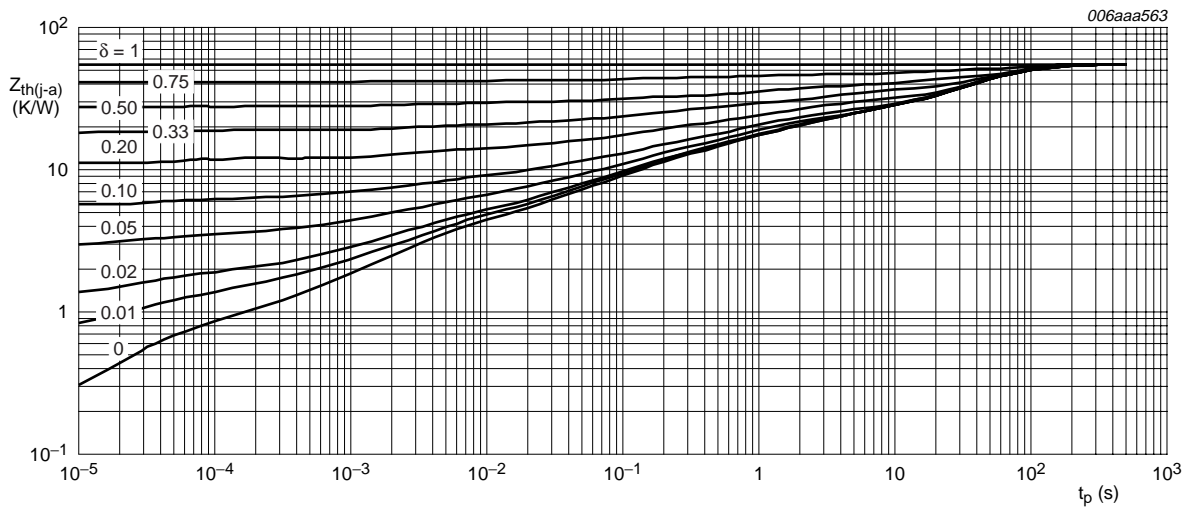
- [1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 6 cm<sup>2</sup>.
- [3] Device mounted on a ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint.





FR4 PCB, 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

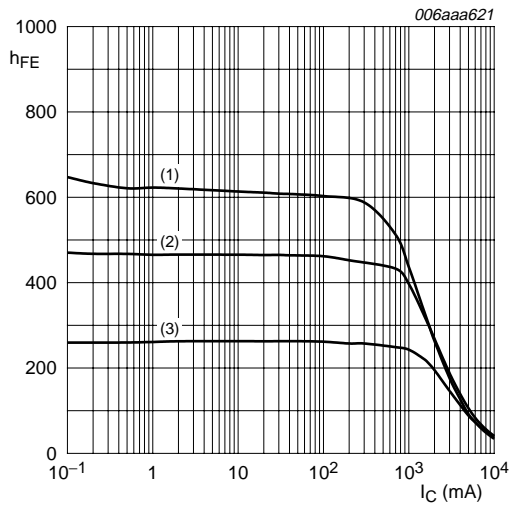
**Fig 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values**

## 7. Characteristics

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

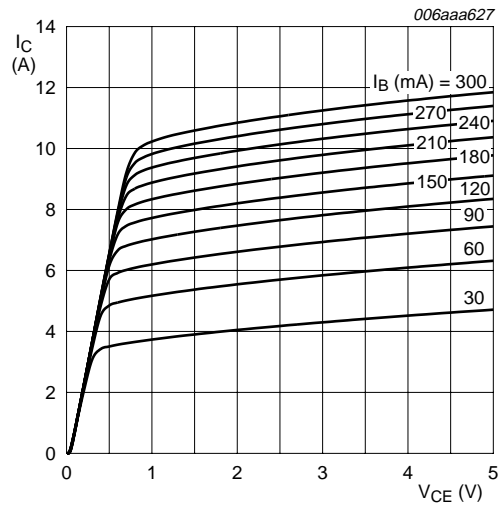
Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$I_{CBO}$	collector-base cut-off current	$V_{CB} = 80\text{ V}; I_E = 0\text{ A}$	-	-	100	nA	
		$V_{CB} = 80\text{ V}; I_E = 0\text{ A}; T_j = 150^\circ\text{C}$	-	-	50	$\mu\text{A}$	
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 5\text{ V}; I_C = 0\text{ A}$	-	-	100	nA	
$h_{FE}$	DC current gain	$V_{CE} = 2\text{ V}; I_C = 0.5\text{ A}$	[1]	300	470	-	
		$V_{CE} = 2\text{ V}; I_C = 1\text{ A}$	[1]	250	420	-	
		$V_{CE} = 2\text{ V}; I_C = 2\text{ A}$	[1]	180	280	-	
		$V_{CE} = 2\text{ V}; I_C = 4\text{ A}$	[1]	90	140	-	
		$V_{CE} = 2\text{ V}; I_C = 6\text{ A}$	[1]	50	80	-	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 0.5\text{ A}; I_B = 50\text{ mA}$	[1]	-	25	40	mV
		$I_C = 1\text{ A}; I_B = 50\text{ mA}$	[1]	-	50	70	mV
		$I_C = 1\text{ A}; I_B = 10\text{ mA}$	[1]	-	85	120	mV
		$I_C = 2\text{ A}; I_B = 40\text{ mA}$	[1]	-	105	150	mV
		$I_C = 4\text{ A}; I_B = 200\text{ mA}$	[1]	-	160	225	mV
		$I_C = 4\text{ A}; I_B = 400\text{ mA}$	[1]	-	150	210	mV
		$I_C = 4\text{ A}; I_B = 80\text{ mA}$	[1]	-	225	340	mV
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = 4\text{ A}; I_B = 200\text{ mA}$	[1]	-	40	56	$\text{m}\Omega$
		$I_C = 4\text{ A}; I_B = 80\text{ mA}$	[1]	-	56	85	$\text{m}\Omega$
$V_{BEsat}$	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]	-	0.94	1.05	V
$V_{BEon}$	base-emitter turn-on voltage	$V_{CE} = 2\text{ V}; I_C = 2\text{ A}$	[1]	-	0.77	0.85	V
$t_d$	delay time	$V_{CC} = 12.5\text{ V}; I_C = 3\text{ A}; I_{Bon} = 0.15\text{ A}; I_{Boff} = -0.15\text{ A}$	-	15	-	ns	
$t_r$	rise time		-	200	-	ns	
$t_{on}$	turn-on time		-	215	-	ns	
$t_s$	storage time		-	310	-	ns	
$t_f$	fall time		-	245	-	ns	
$t_{off}$	turn-off time		-	555	-	ns	
$f_T$	transition frequency	$V_{CE} = 10\text{ V}; I_C = 100\text{ mA}; f = 100\text{ MHz}$	-	110	-	MHz	
$C_c$	collector capacitance	$V_{CB} = 10\text{ V}; I_E = I_e = 0\text{ A}; f = 1\text{ MHz}$	-	30	50	pF	

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



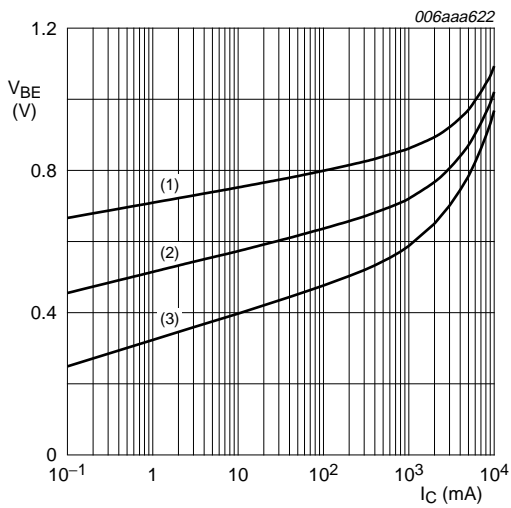
$V_{CE} = 2\text{ V}$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -55\text{ °C}$

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



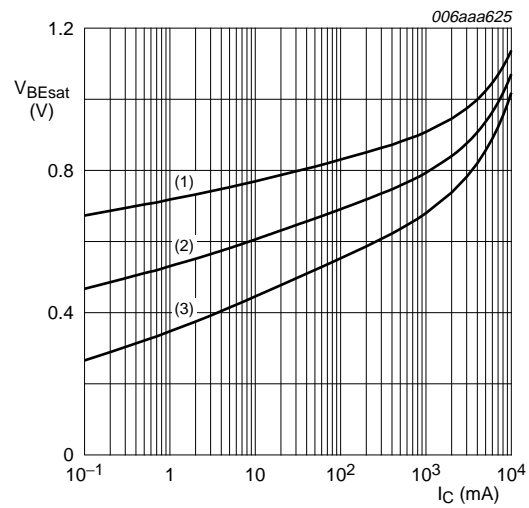
$T_{amb} = 25\text{ °C}$

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



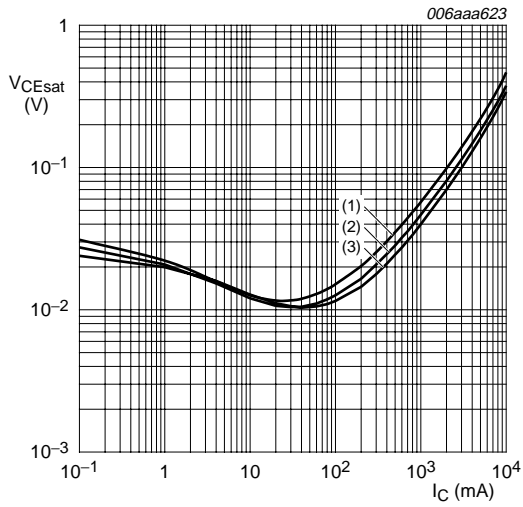
$V_{CE} = 2\text{ V}$   
 (1)  $T_{amb} = -55\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 100\text{ °C}$

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



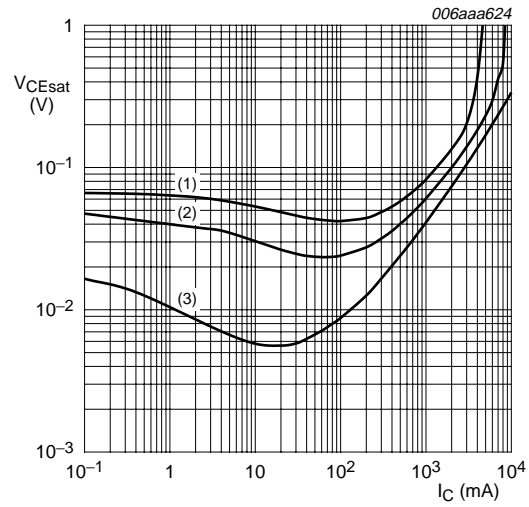
$I_C/I_B = 20$   
 (1)  $T_{amb} = -55\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 100\text{ °C}$

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



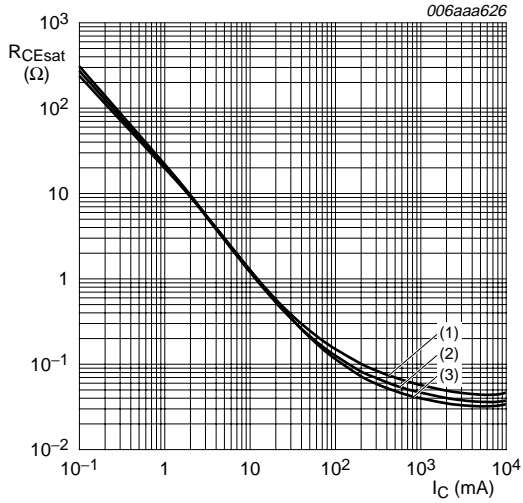
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -55\text{ °C}$

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



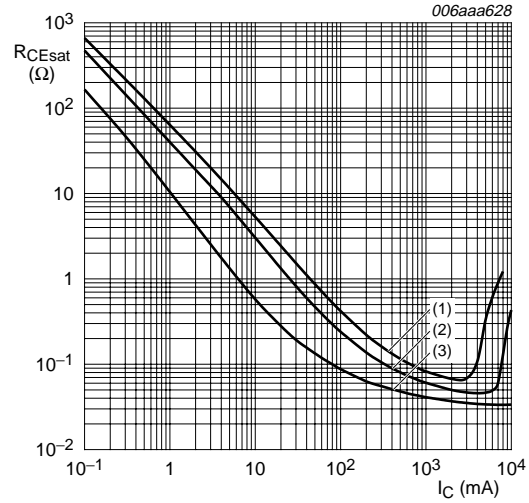
$T_{amb} = 25\text{ °C}$   
 (1)  $I_C/I_B = 100$   
 (2)  $I_C/I_B = 50$   
 (3)  $I_C/I_B = 10$

**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**

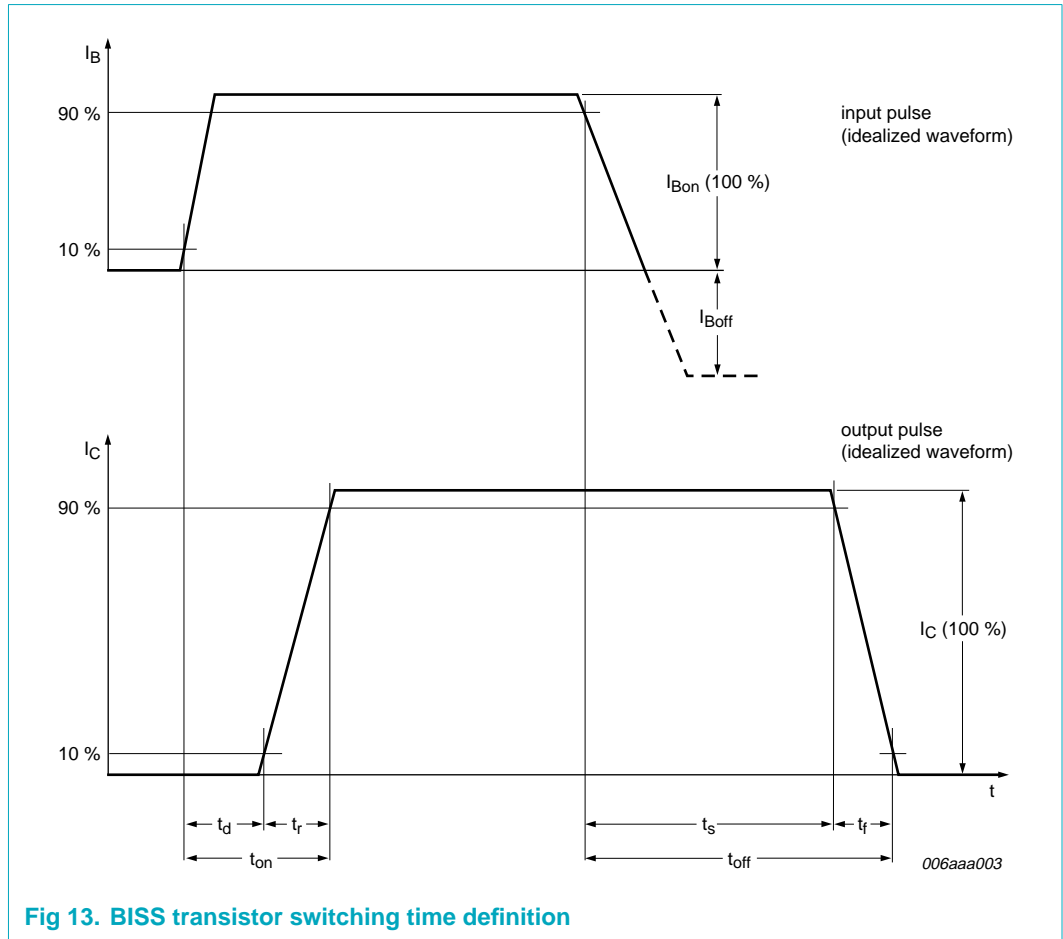


$T_{amb} = 25\text{ °C}$   
 (1)  $I_C/I_B = 100$   
 (2)  $I_C/I_B = 50$   
 (3)  $I_C/I_B = 10$

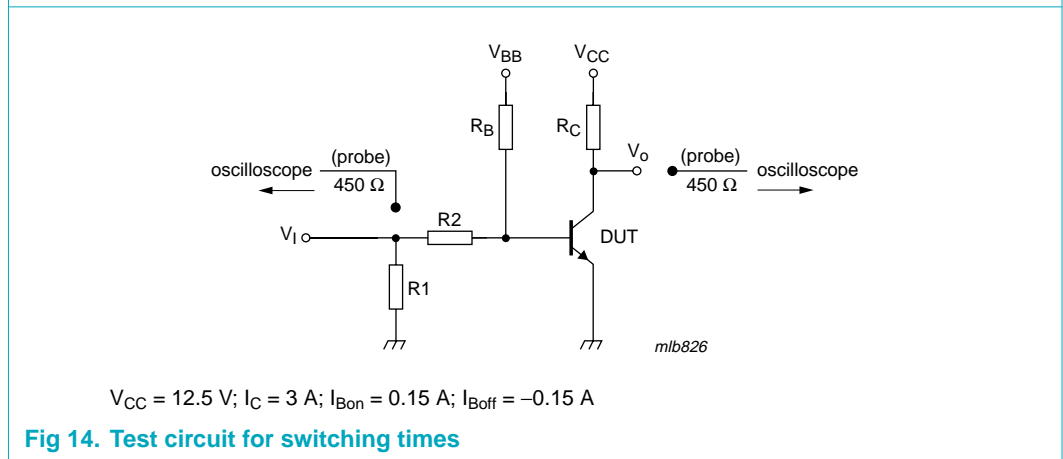
**Fig 12. Collector-emitter saturation resistance as a function of collector current; typical values**



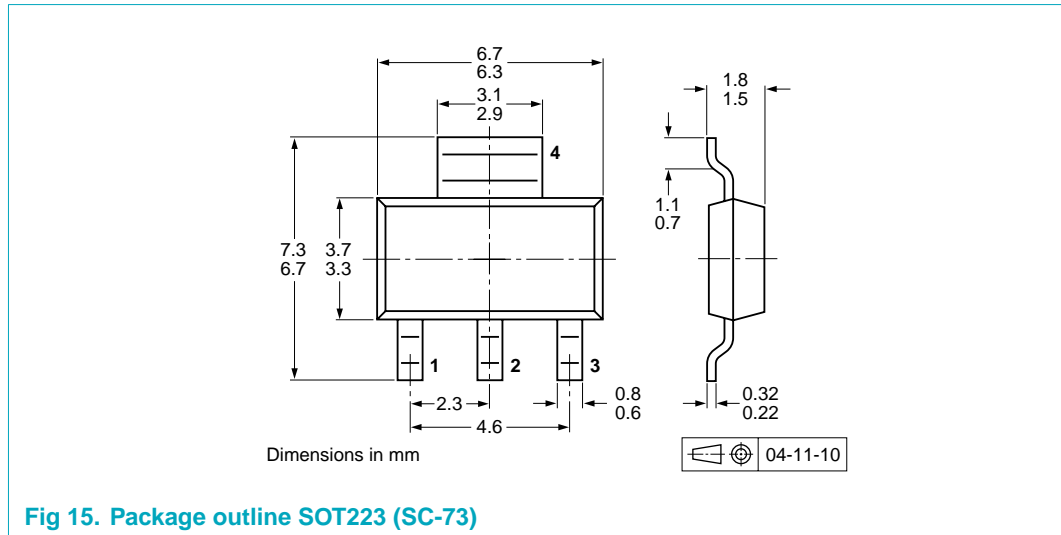
**8. Test information**



**Fig 13. BISS transistor switching time definition**



## 9. Package outline



## 10. Packing information

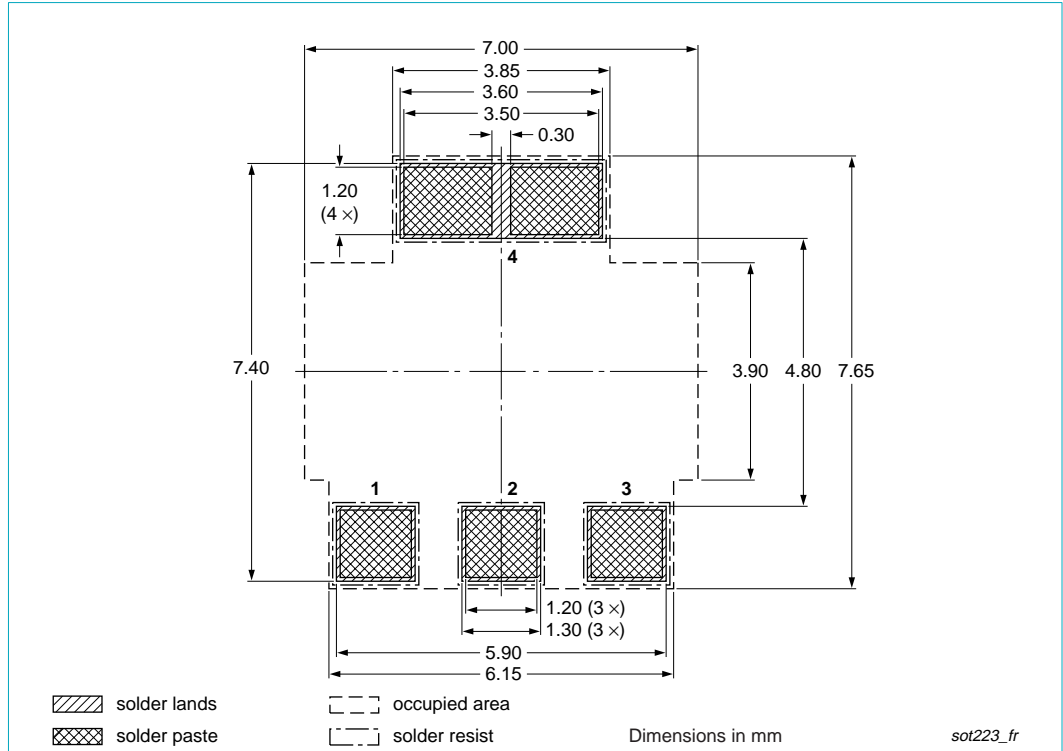
**Table 8. Packing methods**

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

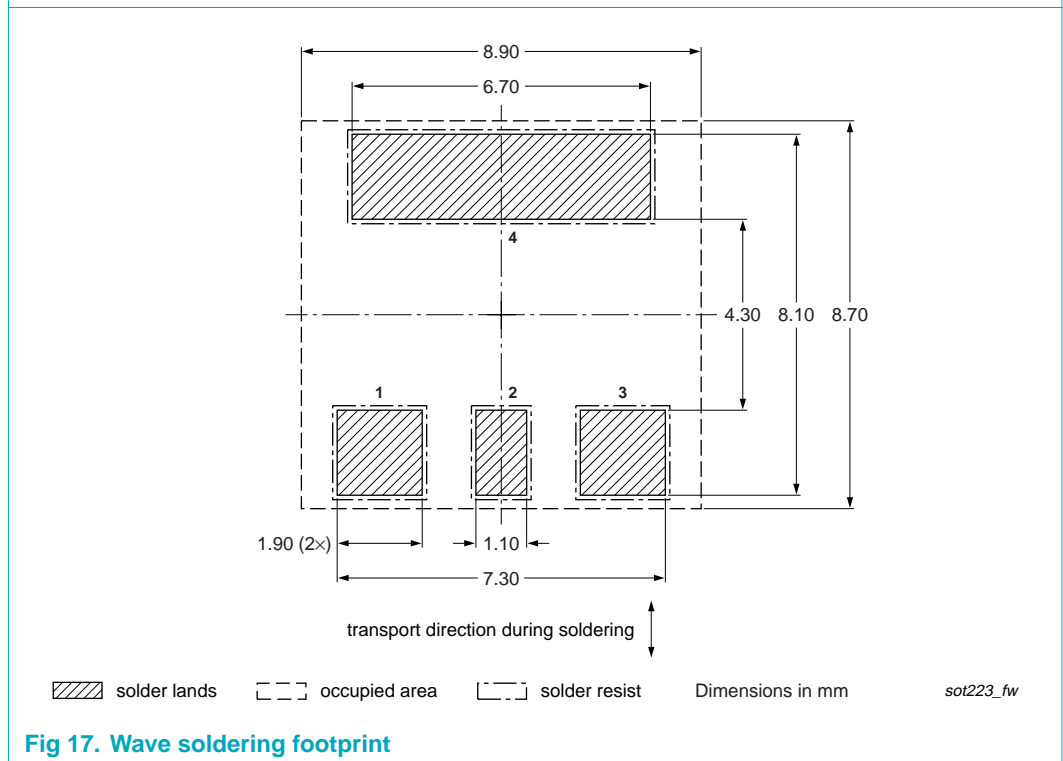
Type number	Package	Description	Packing quantity	
			1000	4000
PBSS305NZ	SOT223	8 mm pitch, 12 mm tape and reel	-115	-135

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

11. Soldering



**Fig 16. Reflow soldering footprint**



**Fig 17. Wave soldering footprint**

## 12. Revision history

Table 9. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PBSS305NZ_1	20060919	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.

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

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