

# PBSS304NZ

60 V, 5.2 A NPN low  $V_{CEsat}$  (BISS) transistor

Rev. 01 — 18 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: PBSS304PZ.

### 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	-	-	60	V
$I_C$	collector current		-	-	5.2	A
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms	-	-	10.4	A
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = 4$ A; $I_B = 200$ mA	[1] -	39	55	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
PBSS304NZ	SC-73	plastic surface-mounted package with increased heatsink; 4 leads	SOT223

## 4. Marking

**Table 4. Marking codes**

Type number	Marking code
PBSS304NZ	S304NZ

## 5. Limiting values

**Table 5. Limiting values**

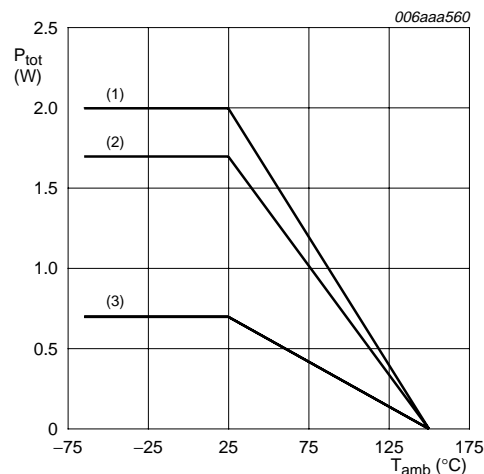
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit	
$V_{CBO}$	collector-base voltage	open emitter	-	60	V	
$V_{CEO}$	collector-emitter voltage	open base	-	60	V	
$V_{EBO}$	emitter-base voltage	open collector	-	5	V	
$I_C$	collector current		-	5.2	A	
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms	-	10.4	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.



- (1) Ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint
- (2) FR4 PCB, mounting pad for collector 6 cm<sup>2</sup>
- (3) FR4 PCB, standard footprint

**Fig 1. Power derating curves**

## 6. Thermal characteristics

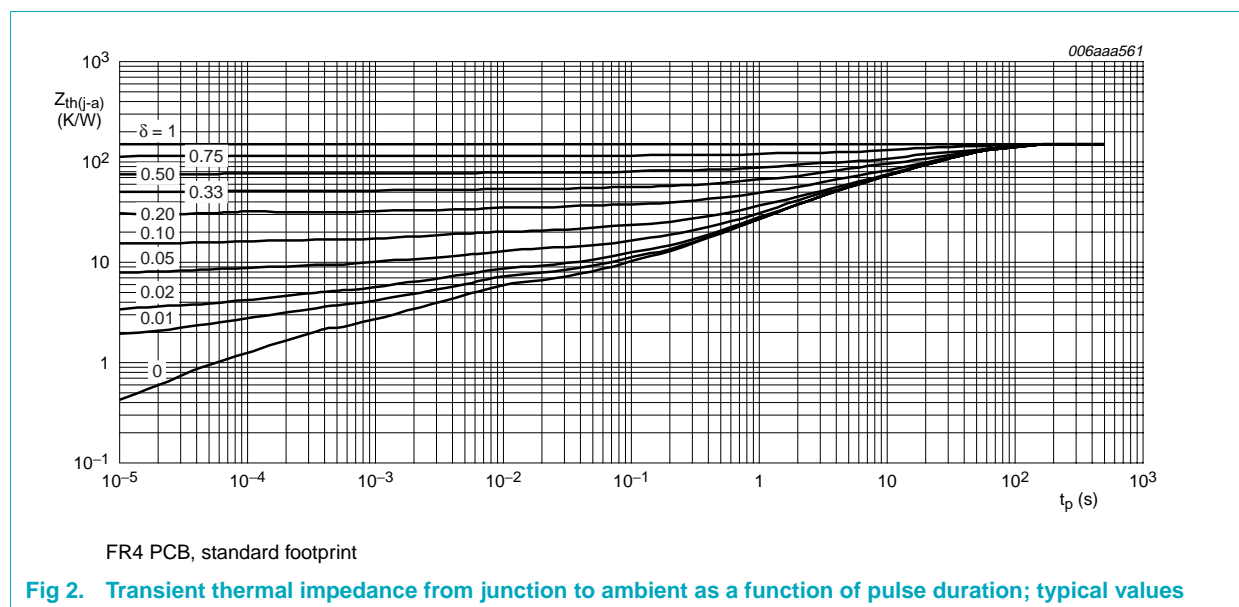
Table 6. Thermal characteristics

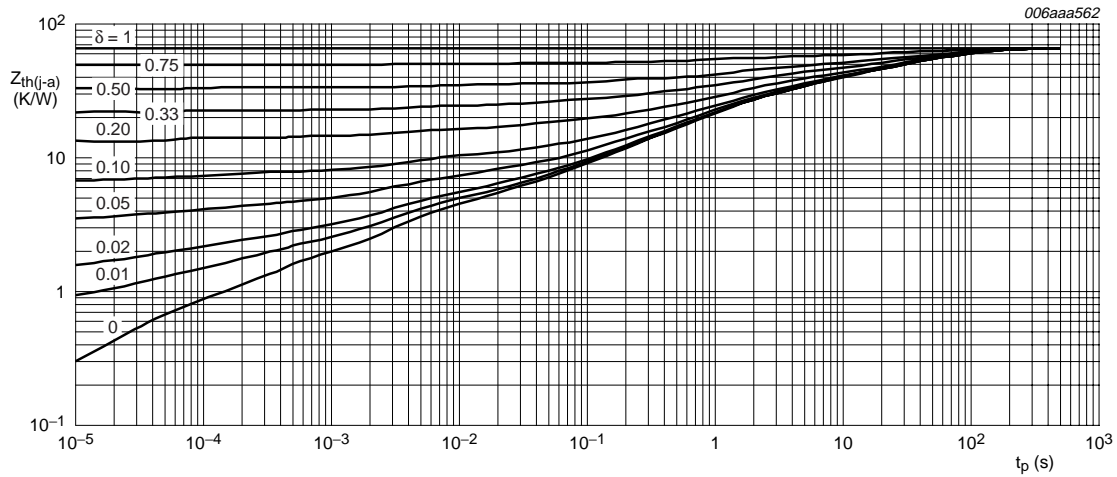
Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	179	K/W
			[2]	-	-	74	K/W
			[3]	-	-	63	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point		-	-	15	K/W	

[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>.

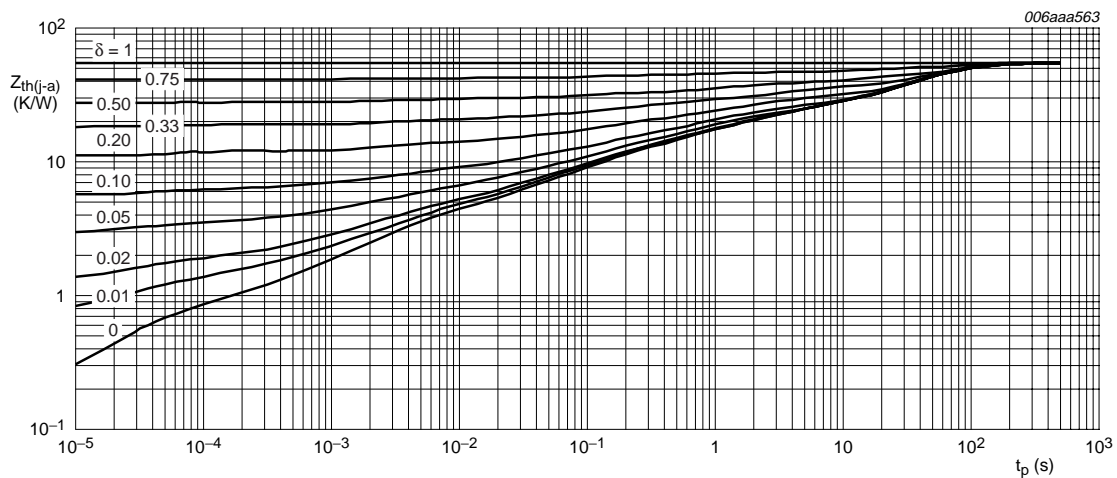
[3] Device mounted on a ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint.





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**

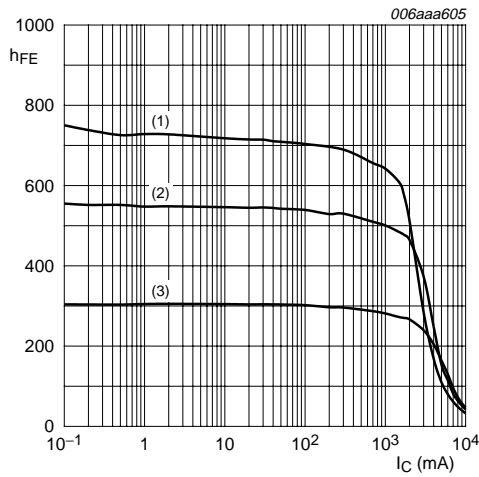
## 7. Characteristics

Table 7. Characteristics

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

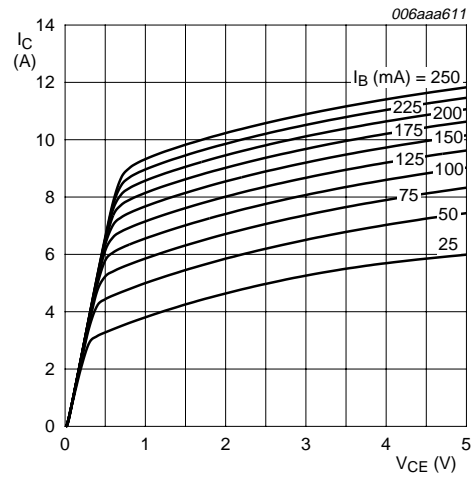
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_{CBO}$	collector-base cut-off current	$V_{CB} = 60\text{ V}; I_E = 0\text{ A}$	-	-	100	nA
		$V_{CB} = 60\text{ V}; I_E = 0\text{ A}; T_j = 150\text{ }^{\circ}\text{C}$	-	-	50	$\mu\text{A}$
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 5\text{ V}; I_C = 0\text{ A}$	-	-	100	nA
$h_{FE}$	DC current gain	$V_{CE} = 2\text{ V}; I_C = 0.5\text{ A}$	[1] 300	520	-	
		$V_{CE} = 2\text{ V}; I_C = 1\text{ A}$	[1] 300	500	-	
		$V_{CE} = 2\text{ V}; I_C = 2\text{ A}$	[1] 250	470	-	
		$V_{CE} = 2\text{ V}; I_C = 4\text{ A}$	[1] 150	250	-	
		$V_{CE} = 2\text{ V}; I_C = 6\text{ A}$	[1] 80	120	-	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 0.5\text{ A}; I_B = 50\text{ mA}$	[1] -	25	35	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] -	155	220	mV
		$I_C = 4\text{ A}; I_B = 400\text{ mA}$	[1] -	145	210	mV
		$I_C = 4\text{ A}; I_B = 80\text{ mA}$	[1] -	205	305	mV
		$I_C = 5.2\text{ A}; I_B = 260\text{ mA}$	[1] -	200	280	mV
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = 4\text{ A}; I_B = 200\text{ mA}$	[1] -	39	55	$\text{m}\Omega$
		$I_C = 4\text{ A}; I_B = 80\text{ mA}$	[1] -	51	76	$\text{m}\Omega$
$V_{BEsat}$	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] -	0.75	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		-	95	-	ns
$t_{on}$	turn-on time		-	110	-	ns
$t_s$	storage time		-	360	-	ns
$t_f$	fall time		-	195	-	ns
$t_{off}$	turn-off time		-	555	-	ns
$f_T$	transition frequency	$V_{CE} = 10\text{ V}; I_C = 100\text{ mA}; f = 100\text{ MHz}$	-	130	-	MHz
$C_c$	collector capacitance	$V_{CB} = 10\text{ V}; I_E = I_C = 0\text{ A}; f = 1\text{ MHz}$	-	48	70	pF

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



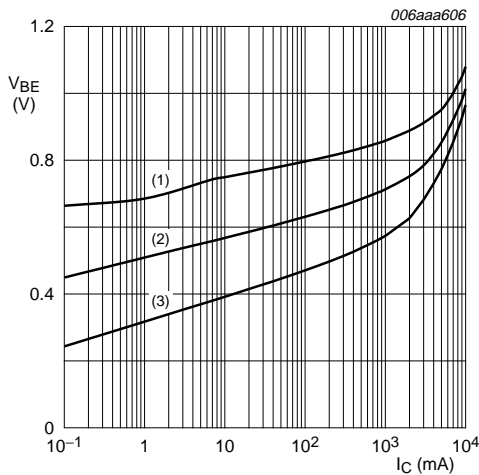
$V_{CE} = 2\text{ V}$   
 (1)  $T_{amb} = 100\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = -55\text{ }^{\circ}\text{C}$

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



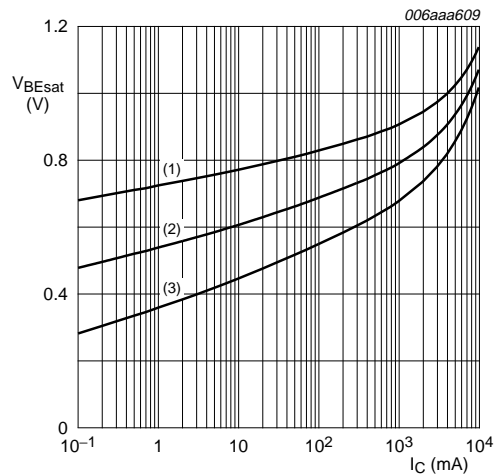
$T_{amb} = 25\text{ }^{\circ}\text{C}$

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



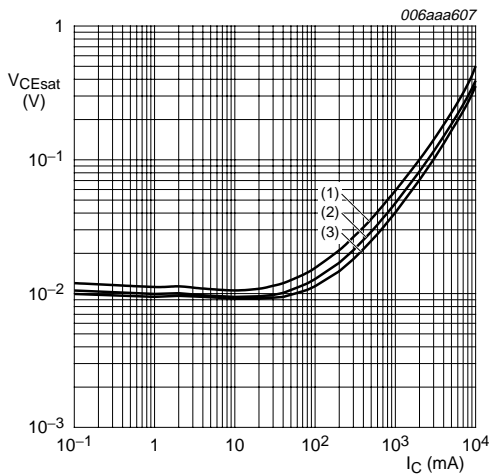
$V_{CE} = 2\text{ V}$   
 (1)  $T_{amb} = -55\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = 100\text{ }^{\circ}\text{C}$

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



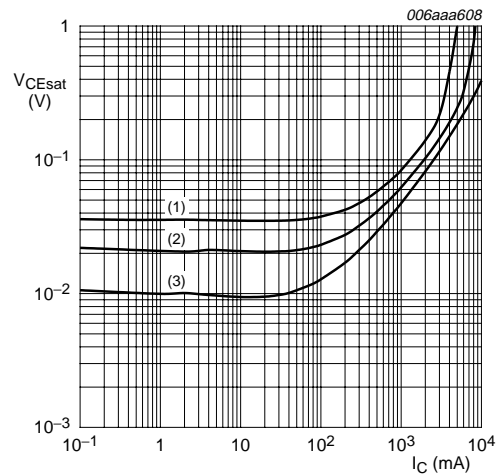
$I_C/I_B = 20$   
 (1)  $T_{amb} = -55\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = 100\text{ }^{\circ}\text{C}$

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



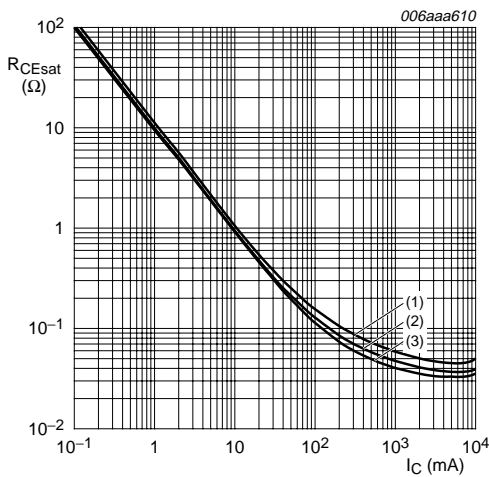
- $I_C/I_B = 20$
- (1)  $T_{amb} = 100\text{ °C}$
  - (2)  $T_{amb} = 25\text{ °C}$
  - (3)  $T_{amb} = -55\text{ °C}$

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



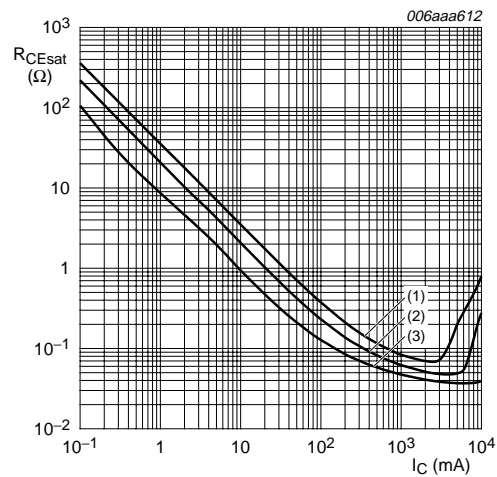
- $T_{amb} = 25\text{ °C}$
- (1)  $I_C/I_B = 100$
  - (2)  $I_C/I_B = 50$
  - (3)  $I_C/I_B = 10$

**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**

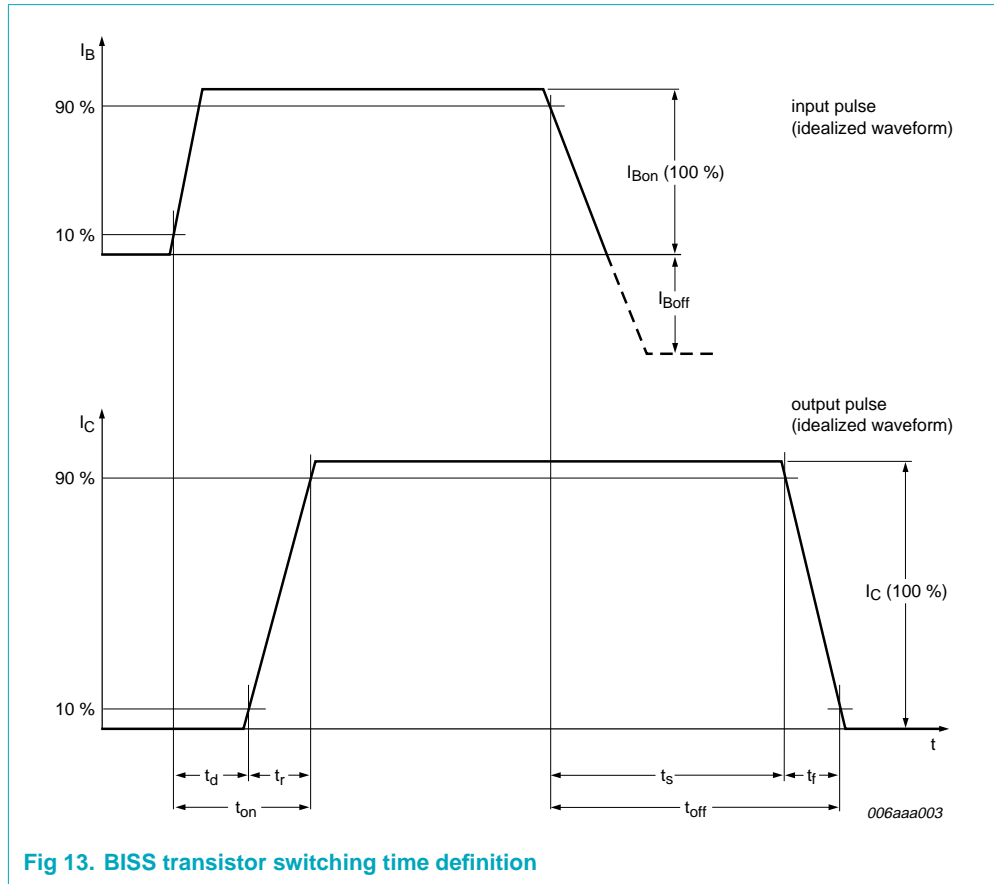


- $T_{amb} = 25\text{ °C}$
- (1)  $I_C/I_B = 100$
  - (2)  $I_C/I_B = 50$
  - (3)  $I_C/I_B = 10$

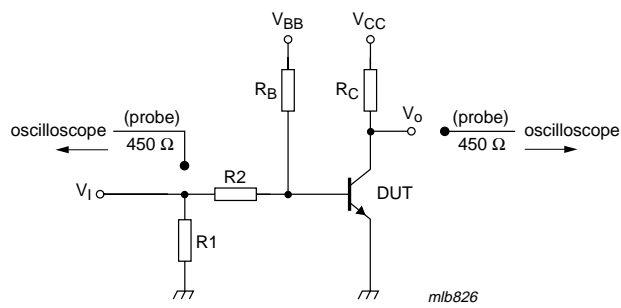
**Fig 12. Collector-emitter saturation resistance as a function of collector current; typical values**



**8. Test information**



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



$V_{CC} = 12.5 \text{ V}$ ;  $I_C = 3 \text{ A}$ ;  $I_{Bon} = 0.15 \text{ A}$ ;  $I_{Boff} = -0.15 \text{ A}$

**Fig 14. Test circuit for switching times**

## 9. Package outline

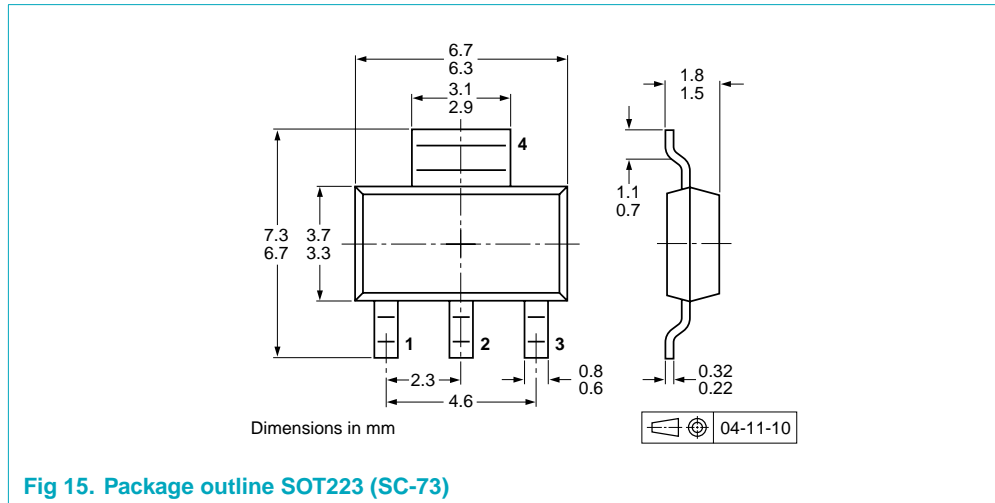


Fig 15. Package outline SOT223 (SC-73)

## 10. Packing information

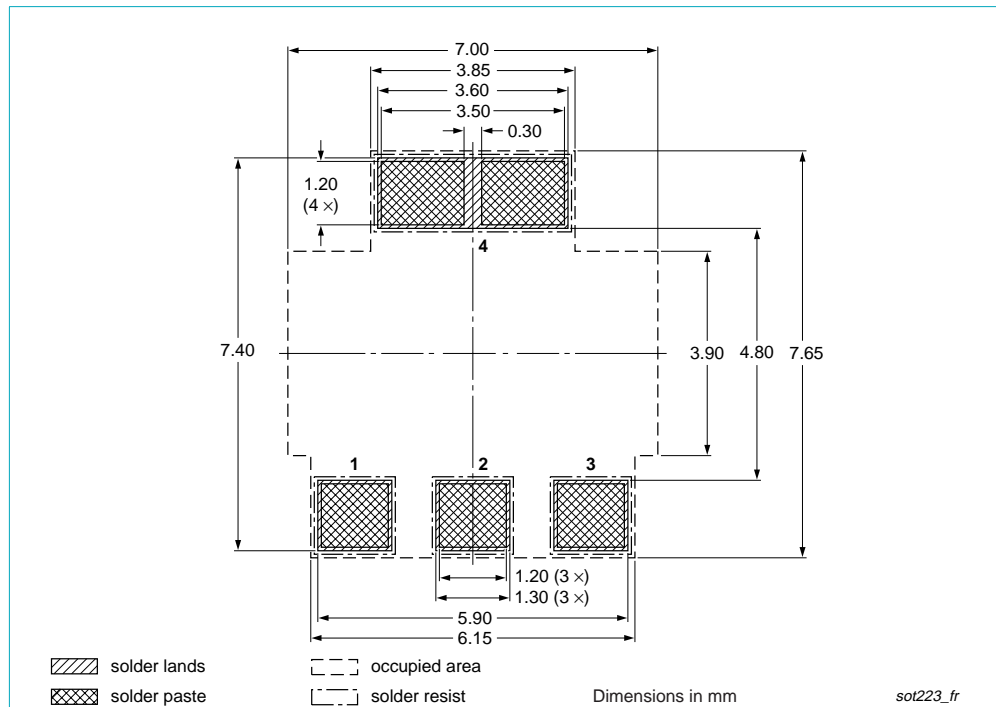
**Table 8. Packing methods**

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

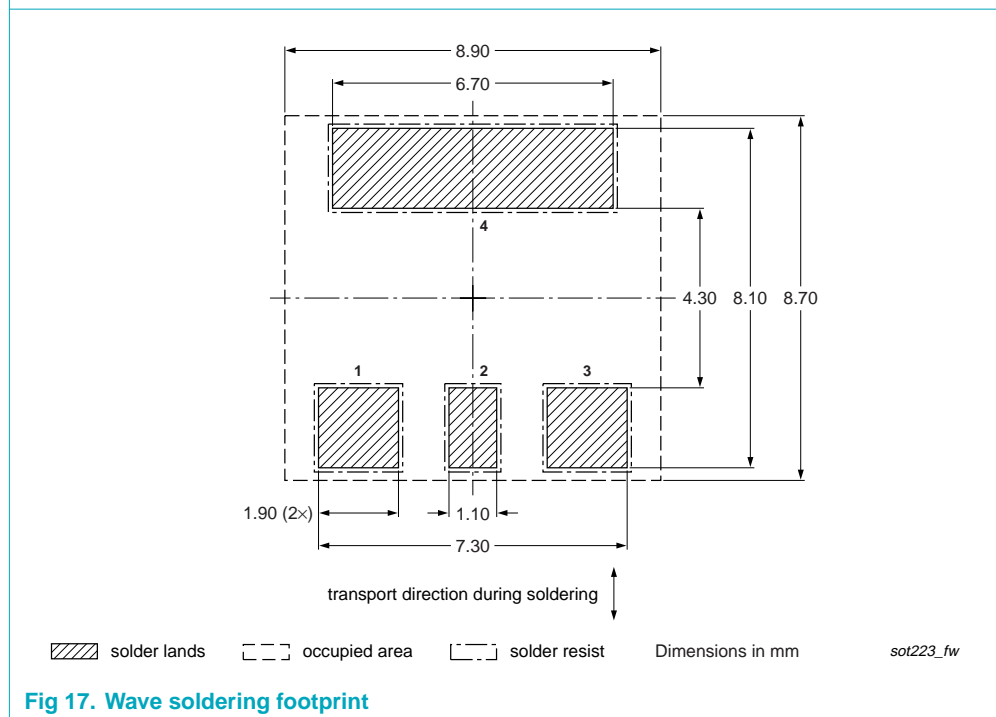
Type number	Package	Description	Packing quantity	
			1000	4000
PBSS304NZ	SOT223	8 mm pitch, 12 mm tape and reel	-115	-135

[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
PBSS304NZ_1	20060918	Product data sheet	-	-

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### 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.
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