



# PBSS304PZ

60 V, 4.5 A PNP low  $V_{CEsat}$  (BISS) transistor

Rev. 02 — 8 December 2009

Product data sheet

## 1. Product profile

### 1.1 General description

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

NPN complement: PBSS304NZ.

### 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		-	-	-4.5	A
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms	-	-	-9	A
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = -4$ A; $I_B = -200$ mA	[1] -	53	75	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	Symbol
1	base		
2	collector		
3	emitter		
4	collector		

*sym028*

## 3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PBSS304PZ	SC-73	plastic surface-mounted package with increased heatsink; 4 leads	SOT223

## 4. Marking

Table 4. Marking codes

Type number	Marking code
PBSS304PZ	S304PZ

## 5. Limiting values

**Table 5. Limiting values**

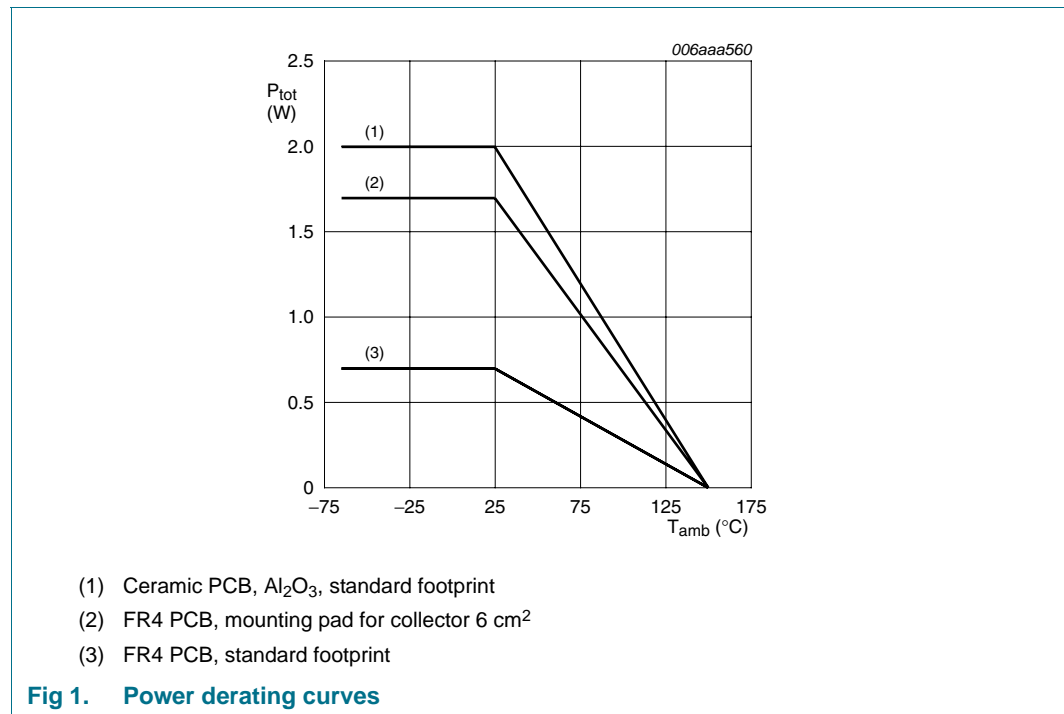
In accordance with the Absolute Maximum Rating System (IEC 60134).

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		-	-4.5	A	
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms	-	-9	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.

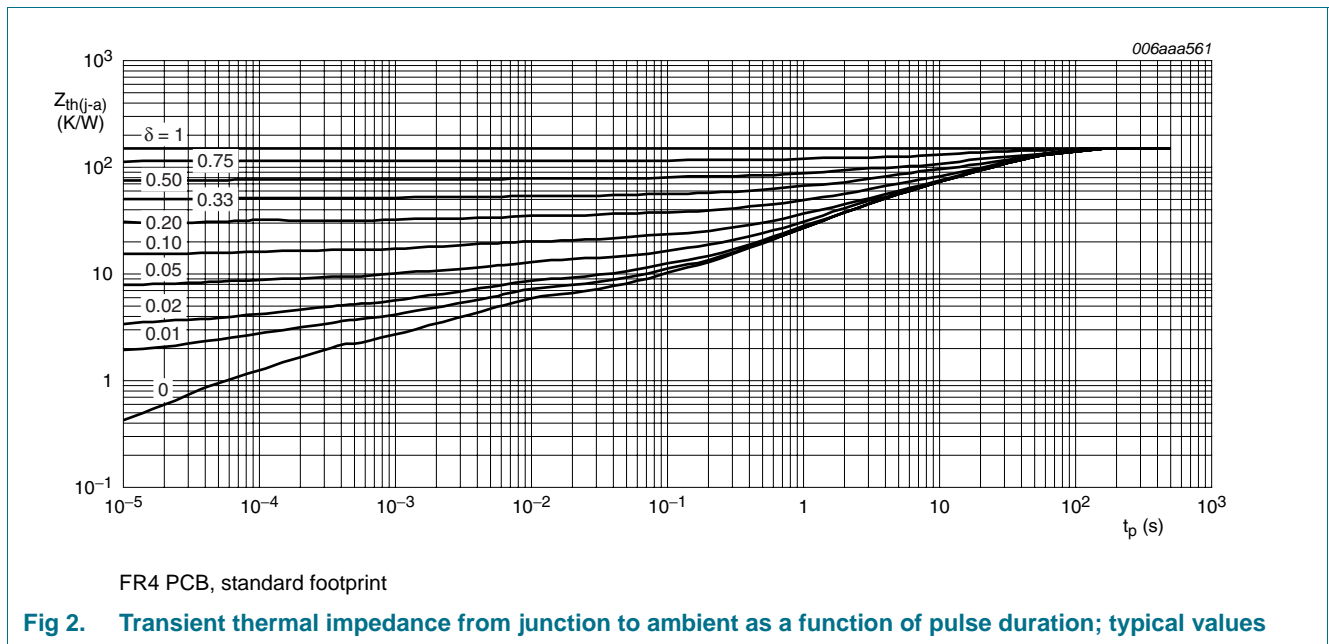


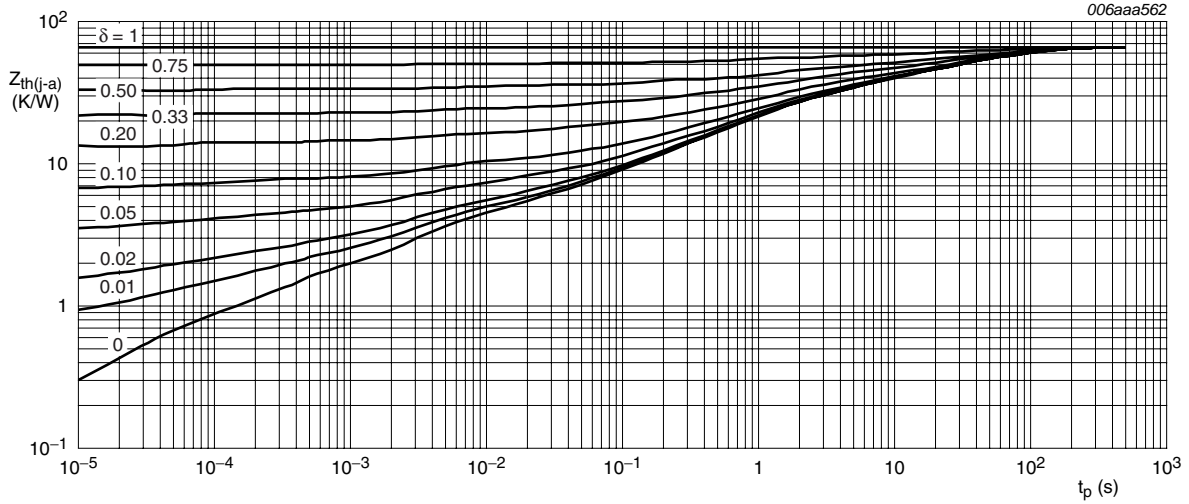
## 6. Thermal characteristics

**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	

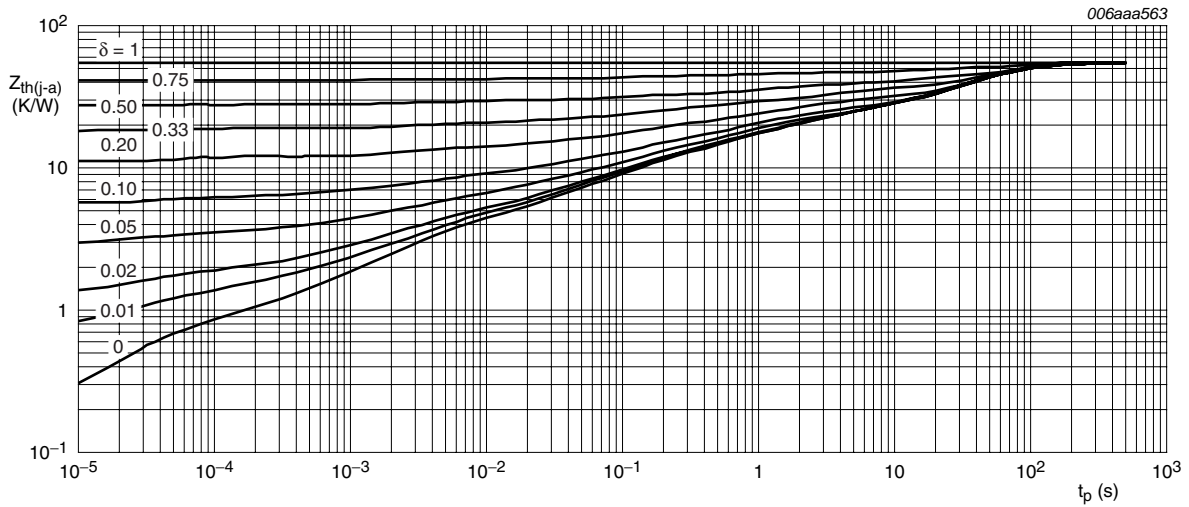
- [1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 6 cm<sup>2</sup>.
- [3] Device mounted on a ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint.





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

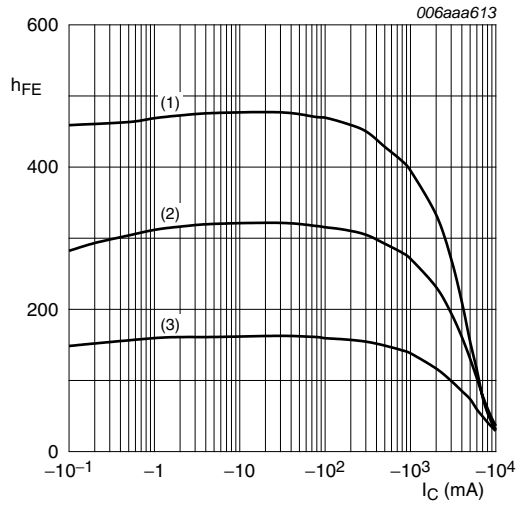
**Fig 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values**

## 7. Characteristics

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

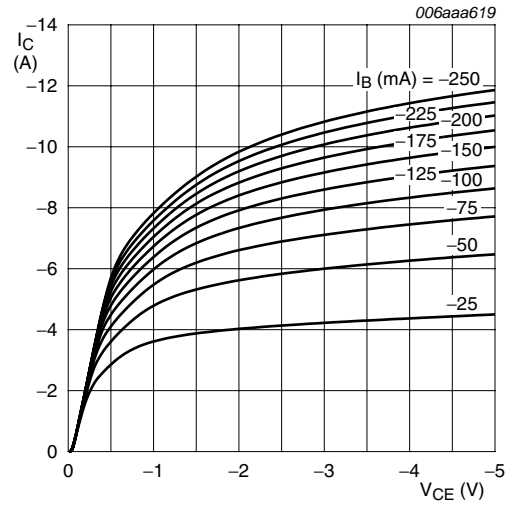
Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$I_{CBO}$	collector-base cut-off current	$V_{CB} = -60\text{ V}; I_E = 0\text{ A}$	-	-	-100	nA	
		$V_{CB} = -60\text{ V}; I_E = 0\text{ A}; T_J = 150\text{ }^{\circ}\text{C}$	-	-	-50	$\mu\text{A}$	
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = -5\text{ V}; I_C = 0\text{ A}$	-	-	-100	nA	
$h_{FE}$	DC current gain	$V_{CE} = -2\text{ V}; I_C = -0.5\text{ A}$	[1]	200	295	-	
		$V_{CE} = -2\text{ V}; I_C = -1\text{ A}$	[1]	200	270	-	
		$V_{CE} = -2\text{ V}; I_C = -2\text{ A}$	[1]	150	230	-	
		$V_{CE} = -2\text{ V}; I_C = -4\text{ A}$	[1]	120	170	-	
		$V_{CE} = -2\text{ V}; I_C = -6\text{ A}$	[1]	60	100	-	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = -0.5\text{ A}; I_B = -50\text{ mA}$	[1]	-	-35	-50	mV
		$I_C = -1\text{ A}; I_B = -50\text{ mA}$	[1]	-	-65	-90	mV
		$I_C = -1\text{ A}; I_B = -10\text{ mA}$	[1]	-	-130	-190	mV
		$I_C = -2\text{ A}; I_B = -40\text{ mA}$	[1]	-	-165	-230	mV
		$I_C = -4\text{ A}; I_B = -200\text{ mA}$	[1]	-	-210	-300	mV
		$I_C = -4\text{ A}; I_B = -400\text{ mA}$	[1]	-	-160	-230	mV
		$I_C = -4.5\text{ A}; I_B = -225\text{ mA}$	[1]	-	-265	-375	mV
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = -4\text{ A}; I_B = -200\text{ mA}$	[1]	-	53	75	$\text{m}\Omega$
		$I_C = -2\text{ A}; I_B = -40\text{ mA}$	[1]	-	82	115	$\text{m}\Omega$
$V_{BEsat}$	base-emitter saturation voltage	$I_C = -1\text{ A}; I_B = -100\text{ mA}$	[1]	-	-0.81	-0.9	V
		$I_C = -4\text{ A}; I_B = -400\text{ mA}$	[1]	-	-0.93	-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		-	65	-	ns	
$t_{on}$	turn-on time		-	80	-	ns	
$t_s$	storage time		-	225	-	ns	
$t_f$	fall time		-	95	-	ns	
$t_{off}$	turn-off time		-	320	-	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	$V_{CB} = -10\text{ V}; I_E = i_e = 0\text{ A}; f = 1\text{ MHz}$	-	90	120	pF	

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



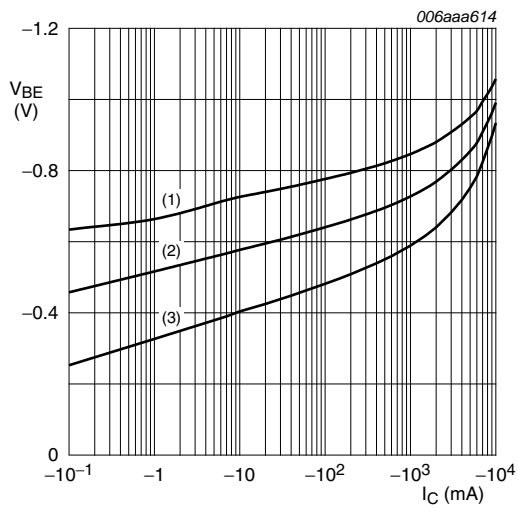
$V_{CE} = -2\text{ V}$   
 (1)  $T_{amb} = 100\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = -55\text{ }^{\circ}\text{C}$

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



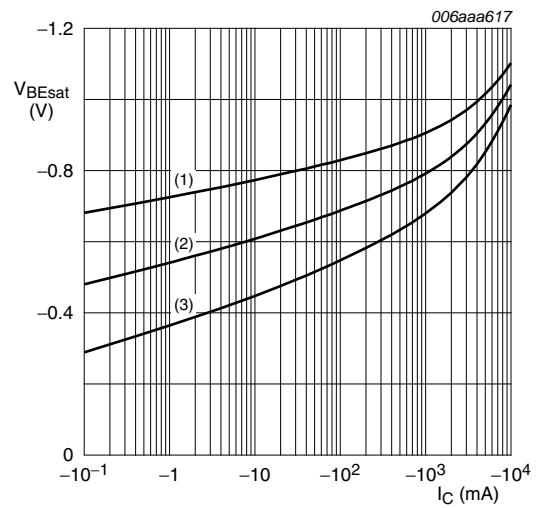
$T_{amb} = 25\text{ }^{\circ}\text{C}$

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



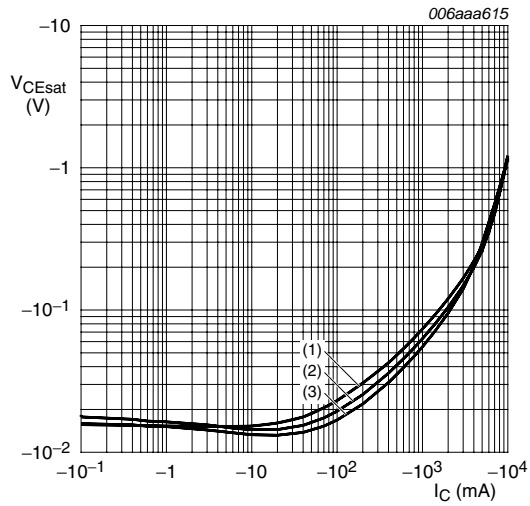
$V_{CE} = -2\text{ V}$   
 (1)  $T_{amb} = -55\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = 100\text{ }^{\circ}\text{C}$

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



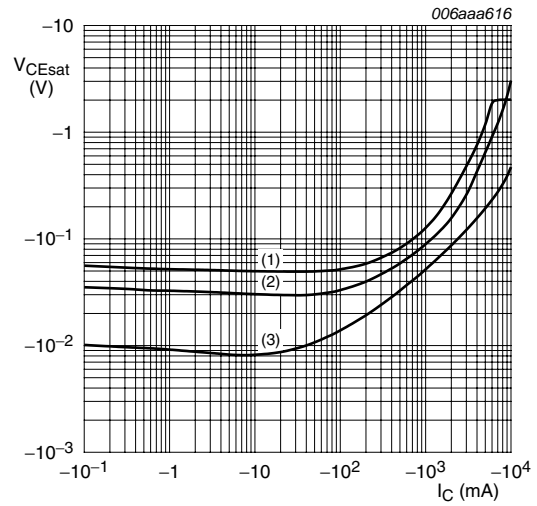
$I_C/I_B = 20$   
 (1)  $T_{amb} = -55\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = 100\text{ }^{\circ}\text{C}$

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



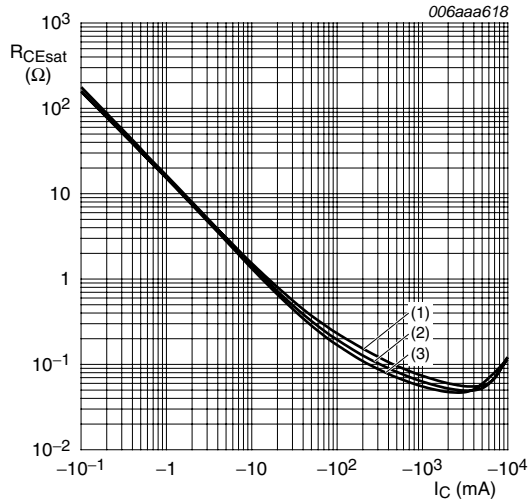
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -55\text{ °C}$

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



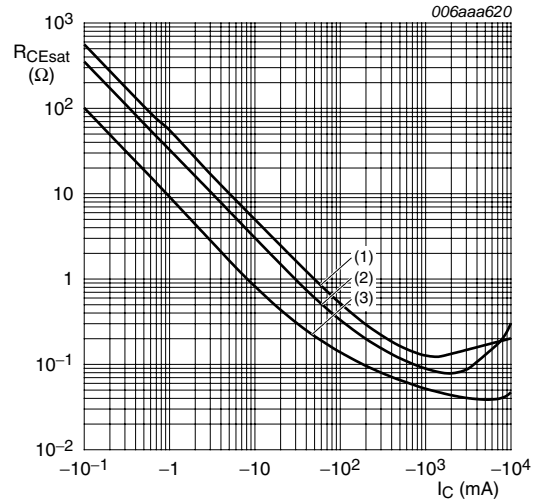
$T_{amb} = 25\text{ °C}$   
 (1)  $I_C/I_B = 100$   
 (2)  $I_C/I_B = 50$   
 (3)  $I_C/I_B = 10$

**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**

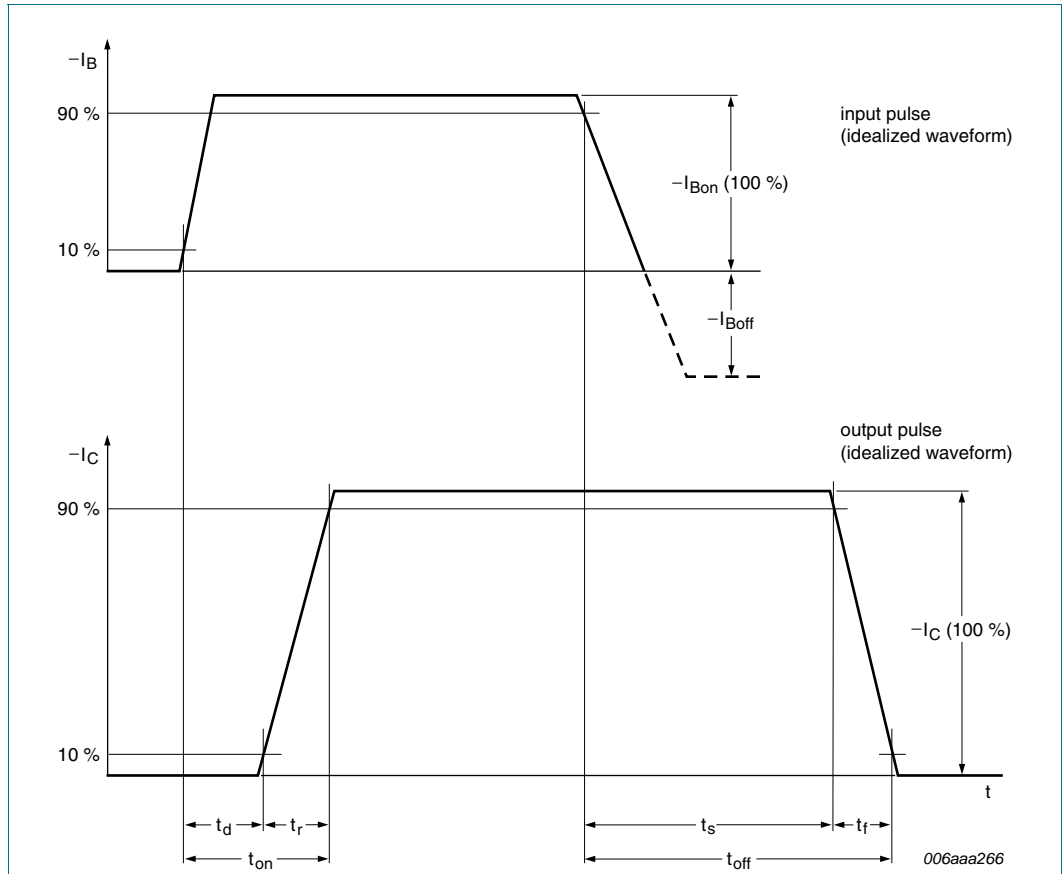


$T_{amb} = 25\text{ °C}$   
 (1)  $I_C/I_B = 100$   
 (2)  $I_C/I_B = 50$   
 (3)  $I_C/I_B = 10$

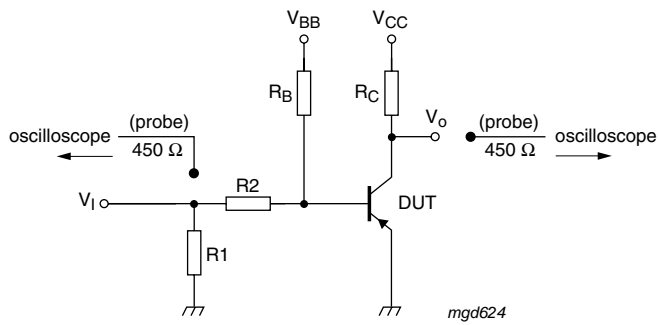
**Fig 12. Collector-emitter saturation resistance as a function of collector current; typical values**



**8. Test information**



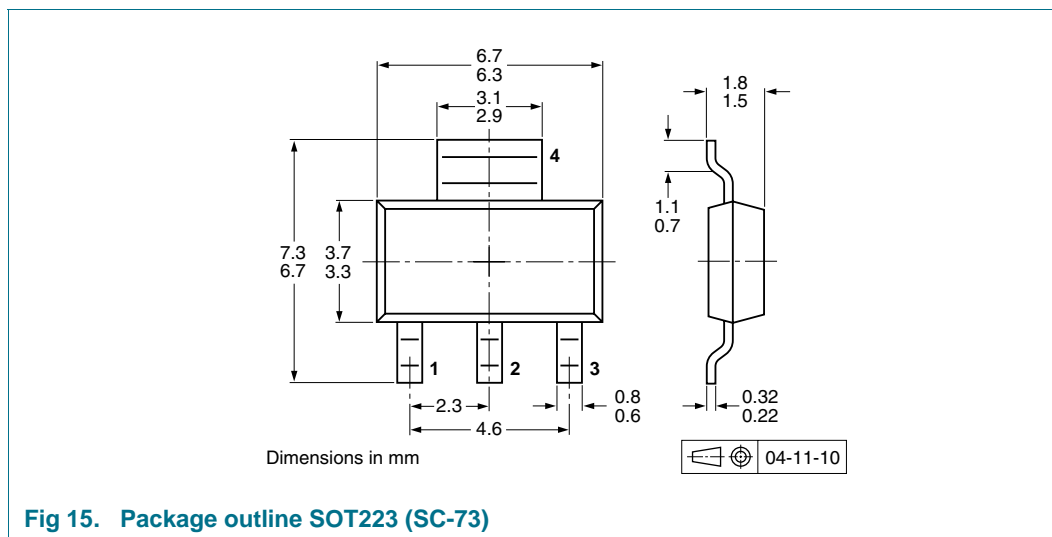
**Fig 13. BISS transistor switching time definition**



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

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

## 9. Package outline



## 10. Packing information

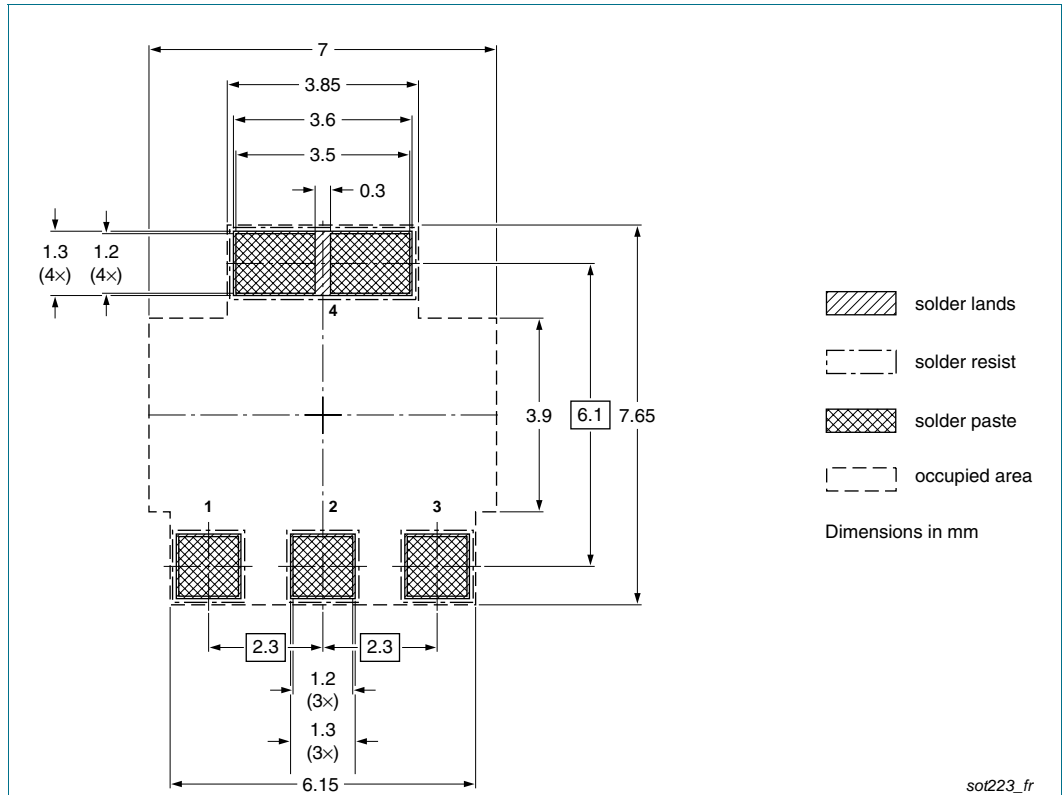
**Table 8. Packing methods**

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

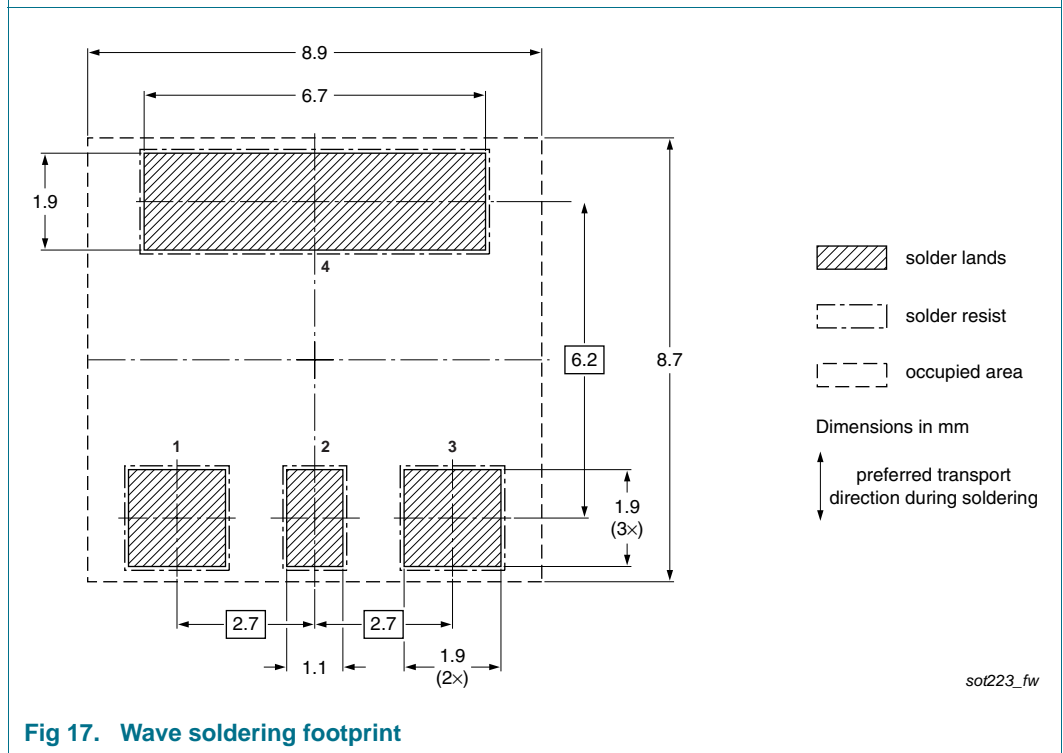
Type number	Package	Description	Packing quantity	
			1000	4000
PBSS304PZ	SOT223	8 mm pitch, 12 mm tape and reel	-115	-135

[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
PBSS304PZ_2	20091208	Product data sheet	-	PBSS304PZ_1
Modifications:	<ul style="list-style-type: none"><li>• This data sheet was changed to reflect the new company name NXP Semiconductors, including new legal definitions and disclaimers. No changes were made to the technical content.</li><li>• <a href="#">Figure 16 "Reflow soldering footprint"</a>: updated</li><li>• <a href="#">Figure 17 "Wave soldering footprint"</a>: updated</li></ul>			
PBSS304PZ_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.

[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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