

PBSS301NZ

12 V, 5.8 A NPN low V_{CEsat} (BISS) transistor

Rev. 02 — 17 November 2009

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: PBSS301PZ.

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

- DC-to-DC conversion
- MOSFET gate driving
- Motor control
- Charging circuits
- Power switches (e.g. motors, fans)

1.4 Quick reference data

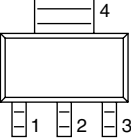
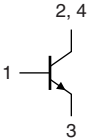
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CEO}	collector-emitter voltage	open base	-	-	12	V
I_C	collector current		-	-	5.8	A
I_{CM}	peak collector current	single pulse; $t_p \leq 1$ ms	-	-	11.6	A
R_{CEsat}	collector-emitter saturation resistance	$I_C = 4$ A; $I_B = 200$ mA	^[1] -	30	43	m Ω

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

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
PBSS301NZ	SC-73	plastic surface-mounted package with increased heat sink; 4 leads	SOT223

4. Marking

Table 4. Marking codes

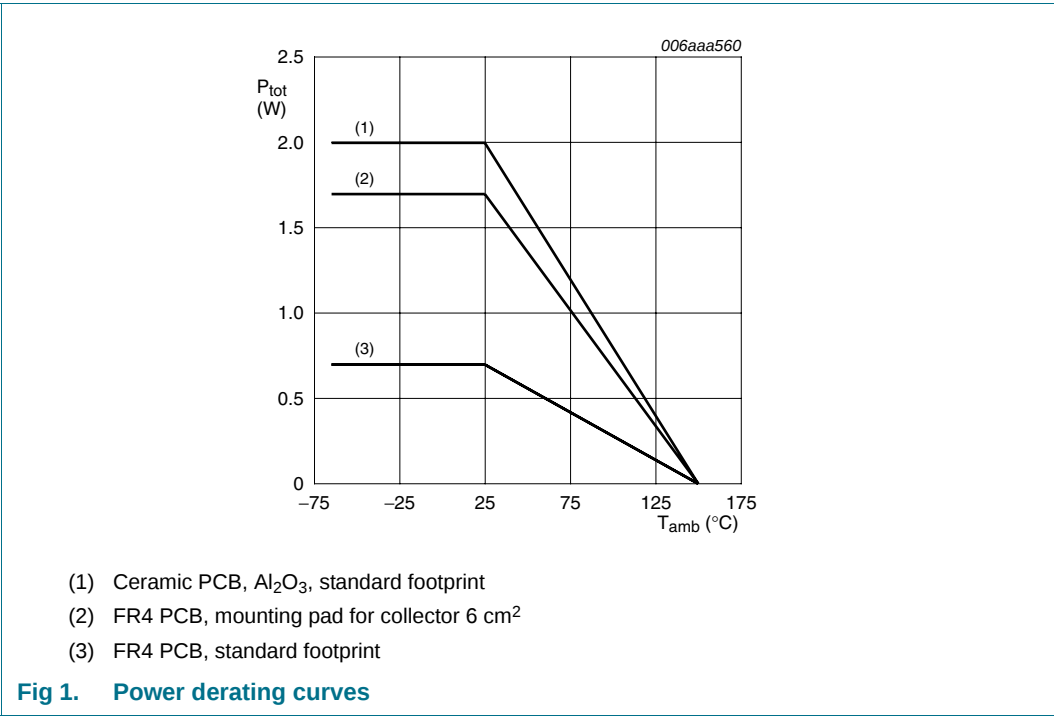
Type number	Marking code
PBSS301NZ	S301NZ

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	-	12	V
V_{CEO}	collector-emitter voltage	open base	-	12	V
V_{EBO}	emitter-base voltage	open collector	-	5	V
I_C	collector current		-	5.8	A
I_{CM}	peak collector current	single pulse; $t_p \leq 1$ ms	-	11.6	A
P_{tot}	total power dissipation	$T_{amb} \leq 25\text{ }^{\circ}\text{C}$	[1] -	0.7	W
			[2] -	1.7	W
			[3] -	2	W
T_j	junction temperature		-	150	$^{\circ}\text{C}$
T_{amb}	ambient temperature		-65	+150	$^{\circ}\text{C}$
T_{stg}	storage temperature		-65	+150	$^{\circ}\text{C}$

- [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 cm².
[3] Device mounted on a ceramic PCB, Al₂O₃, standard footprint.

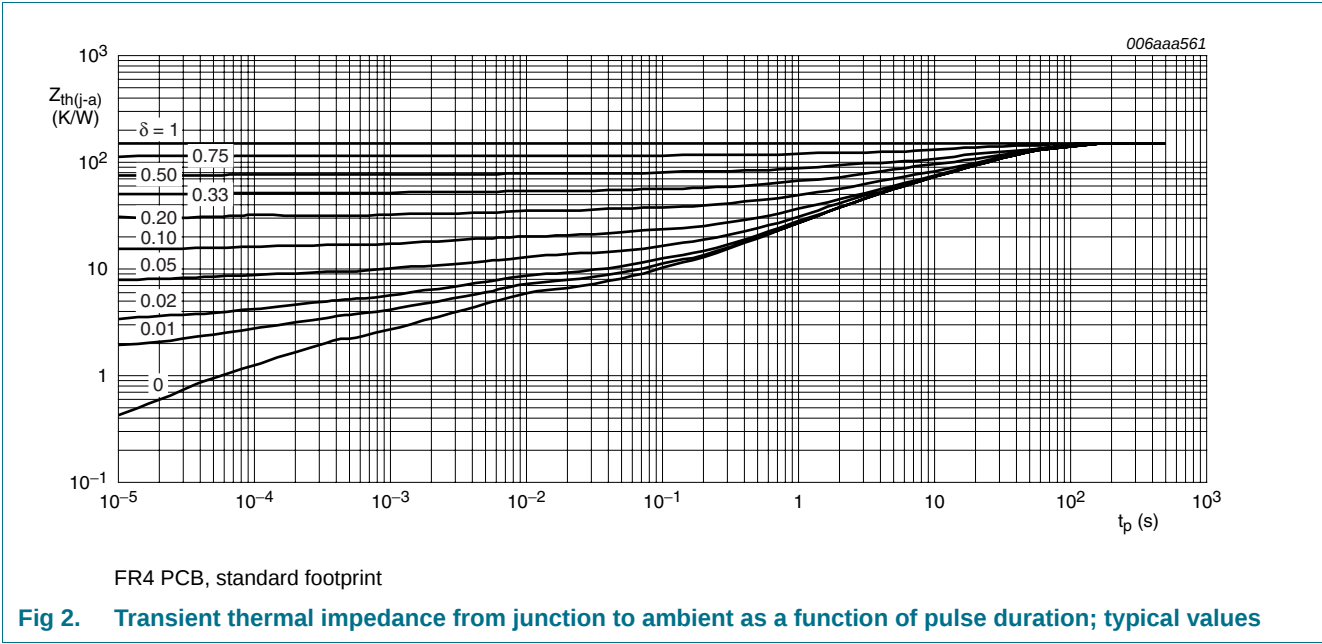


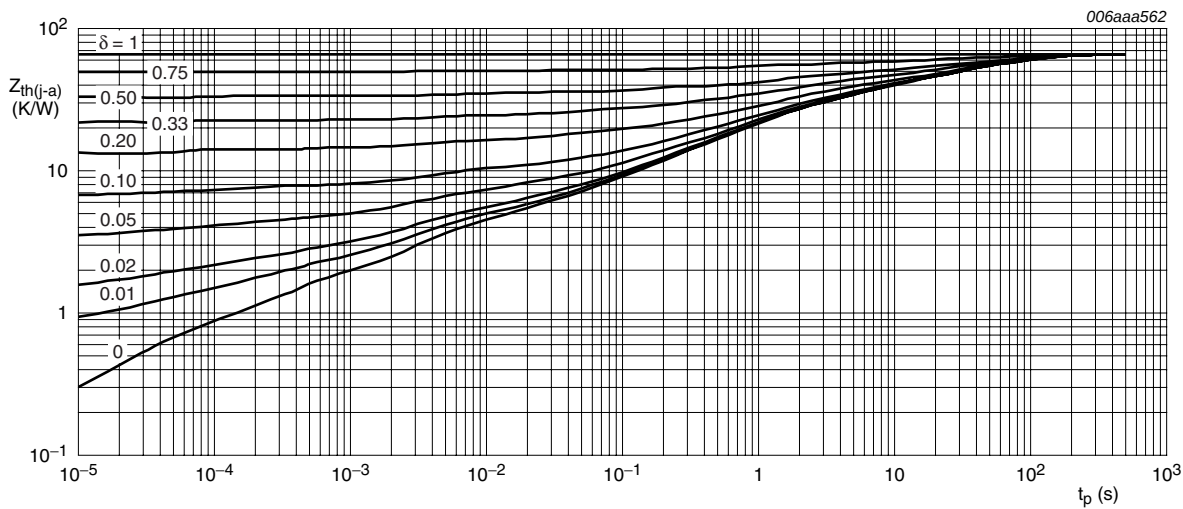
6. Thermal characteristics

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

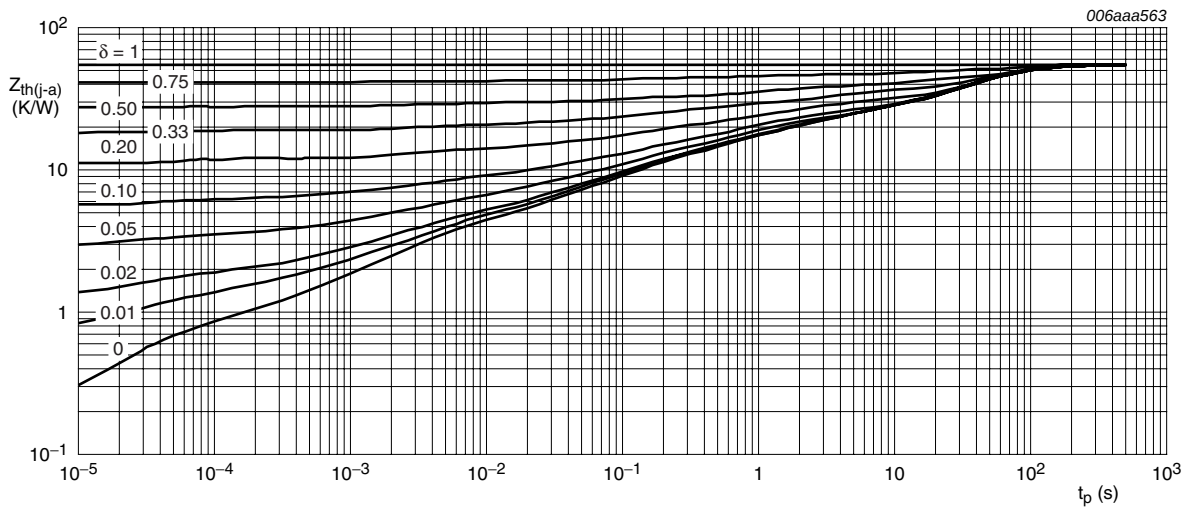
- [1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 6 cm².
[3] Device mounted on a ceramic PCB, Al₂O₃, standard footprint.





FR4 PCB, mounting pad for collector 6 cm²

Fig 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values



Ceramic PCB, Al₂O₃, standard footprint

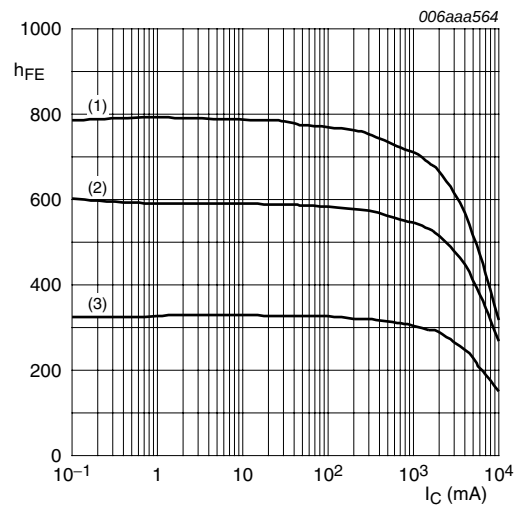
Fig 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

7. Characteristics

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

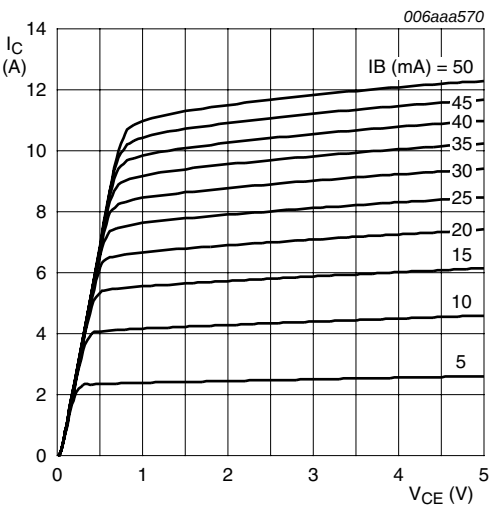
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{CBO}	collector-base cut-off current	$V_{CB} = 12\text{ V}; I_E = 0\text{ A}$	-	-	100	nA
		$V_{CB} = 12\text{ V}; I_E = 0\text{ A}; T_j = 150\text{ }^{\circ}\text{C}$	-	-	50	μA
I_{EBO}	emitter-base cut-off current	$V_{EB} = 5\text{ V}; I_C = 0\text{ A}$	-	-	100	nA
h_{FE}	DC current gain	$V_{CE} = 2\text{ V}; I_C = 0.5\text{ A}$	[1] 300	530	-	
		$V_{CE} = 2\text{ V}; I_C = 1\text{ A}$	[1] 300	520	-	
		$V_{CE} = 2\text{ V}; I_C = 2\text{ A}$	[1] 250	480	-	
		$V_{CE} = 2\text{ V}; I_C = 4\text{ A}$	[1] 200	420	-	
		$V_{CE} = 2\text{ V}; I_C = 7\text{ A}$	[1] 200	290	-	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 0.5\text{ A}; I_B = 50\text{ mA}$	[1] -	18	25	mV
		$I_C = 1\text{ A}; I_B = 50\text{ mA}$	[1] -	35	50	mV
		$I_C = 1\text{ A}; I_B = 10\text{ mA}$	[1] -	50	70	mV
		$I_C = 2\text{ A}; I_B = 40\text{ mA}$	[1] -	70	100	mV
		$I_C = 4\text{ A}; I_B = 200\text{ mA}$	[1] -	120	170	mV
		$I_C = 4\text{ A}; I_B = 400\text{ mA}$	[1] -	115	165	mV
		$I_C = 4\text{ A}; I_B = 40\text{ mA}$	[1] -	135	210	mV
R_{CEsat}	collector-emitter saturation resistance	$I_C = 4\text{ A}; I_B = 200\text{ mA}$	[1] -	30	43	$\text{m}\Omega$
		$I_C = 4\text{ A}; I_B = 40\text{ mA}$	[1] -	35	52	$\text{m}\Omega$
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] -	0.92	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		-	40	-	ns
t_{on}	turn-on time		-	55	-	ns
t_s	storage time		-	195	-	ns
t_f	fall time		-	75	-	ns
t_{off}	turn-off time		-	270	-	ns
f_T	transition frequency	$V_{CE} = 10\text{ V}; I_C = 100\text{ mA}; f = 100\text{ MHz}$	-	140	-	MHz
C_c	collector capacitance	$V_{CB} = 10\text{ V}; I_E = I_e = 0\text{ A}; f = 1\text{ MHz}$	-	125	160	pF

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



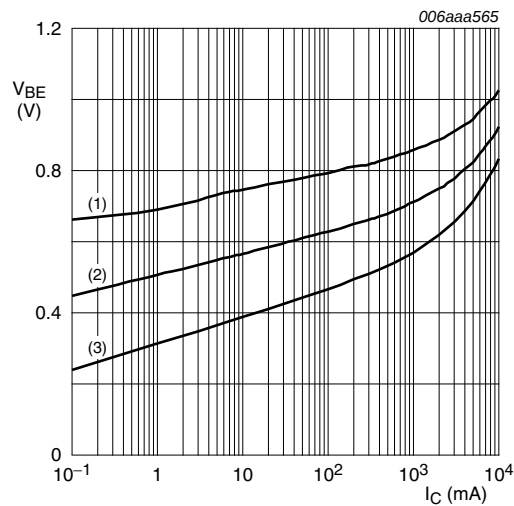
- $V_{CE} = 2\text{ V}$
- (1) $T_{amb} = 100\text{ }^{\circ}\text{C}$
 - (2) $T_{amb} = 25\text{ }^{\circ}\text{C}$
 - (3) $T_{amb} = -55\text{ }^{\circ}\text{C}$

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



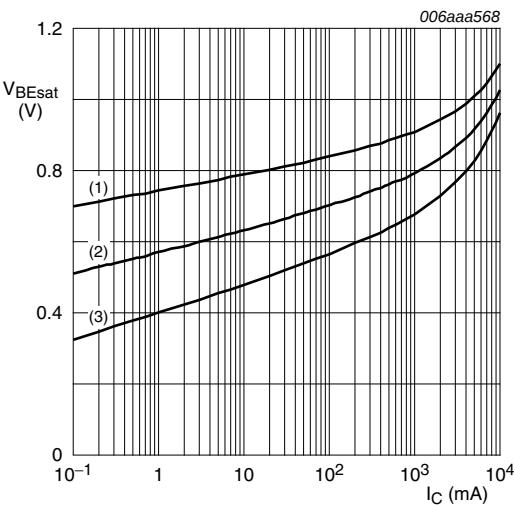
$T_{amb} = 25\text{ }^{\circ}\text{C}$

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



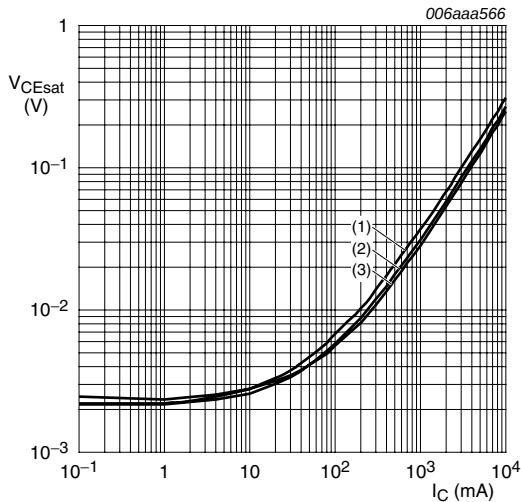
- $V_{CE} = 2\text{ V}$
- (1) $T_{amb} = -55\text{ }^{\circ}\text{C}$
 - (2) $T_{amb} = 25\text{ }^{\circ}\text{C}$
 - (3) $T_{amb} = 100\text{ }^{\circ}\text{C}$

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



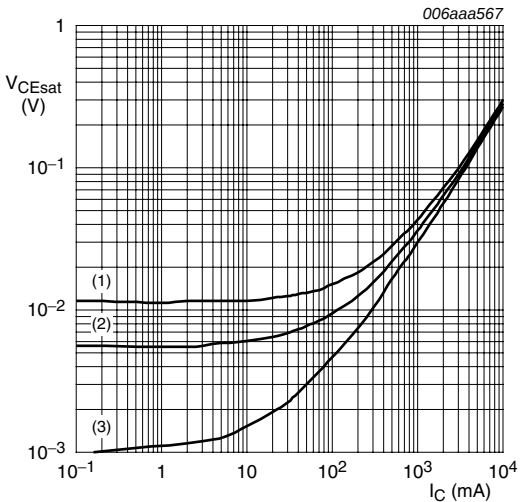
- $I_C/I_B = 20$
- (1) $T_{amb} = -55\text{ }^{\circ}\text{C}$
 - (2) $T_{amb} = 25\text{ }^{\circ}\text{C}$
 - (3) $T_{amb} = 100\text{ }^{\circ}\text{C}$

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



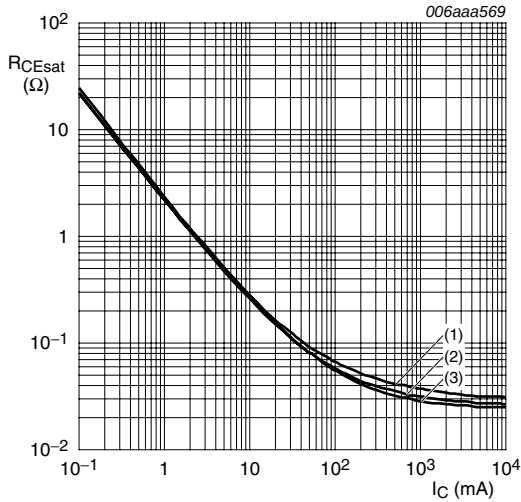
- $I_C/I_B = 20$
- (1) $T_{amb} = 100^\circ\text{C}$
 - (2) $T_{amb} = 25^\circ\text{C}$
 - (3) $T_{amb} = -55^\circ\text{C}$

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



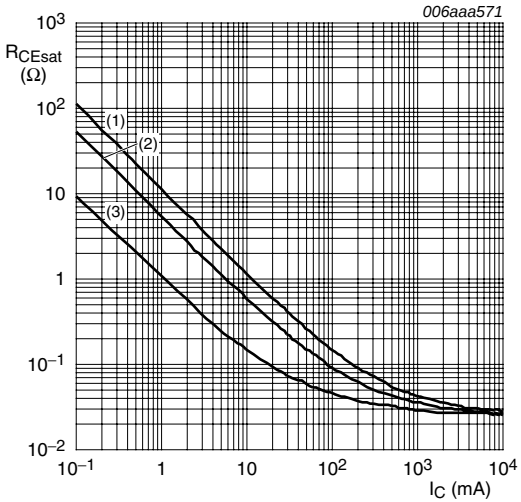
- $T_{amb} = 25^\circ\text{C}$
- (1) $I_C/I_B = 100$
 - (2) $I_C/I_B = 50$
 - (3) $I_C/I_B = 10$

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



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

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



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

8. Test information

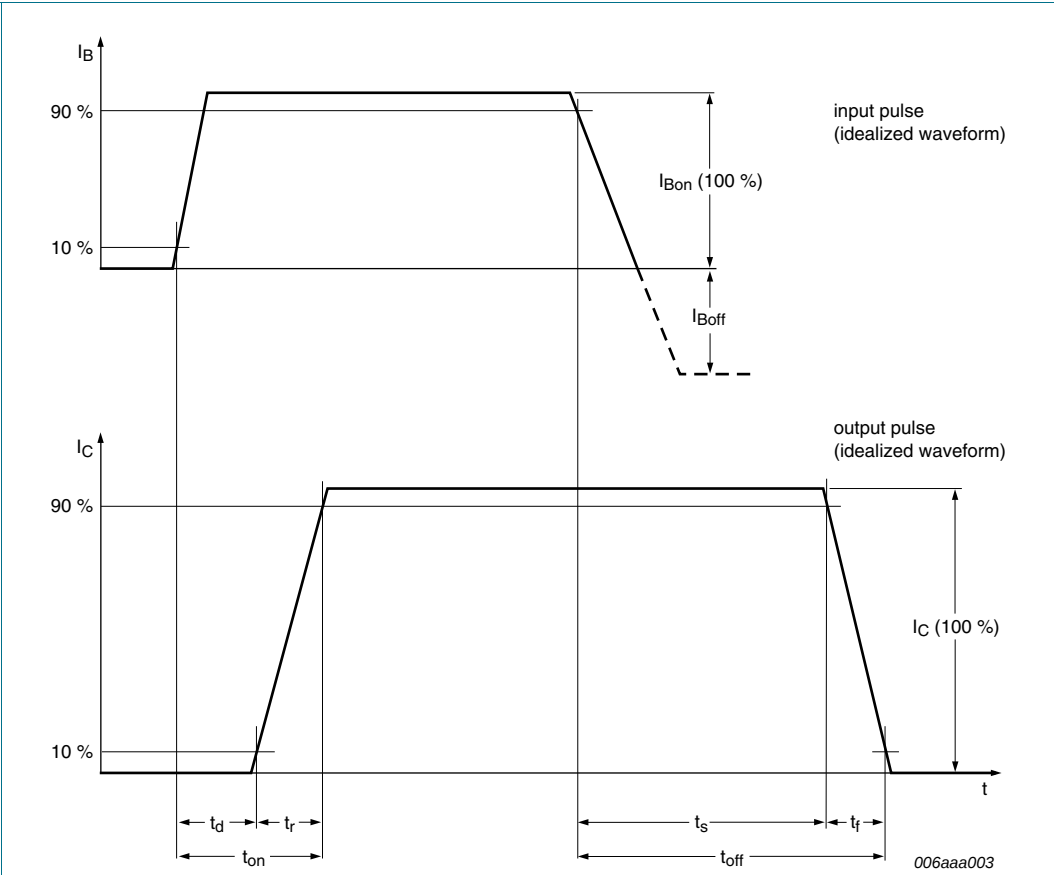


Fig 13. BISS transistor switching time definition

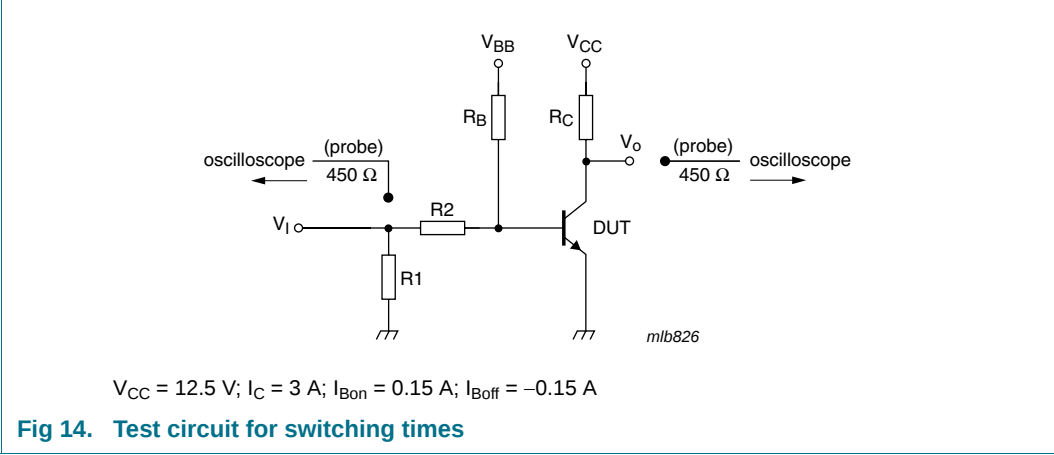
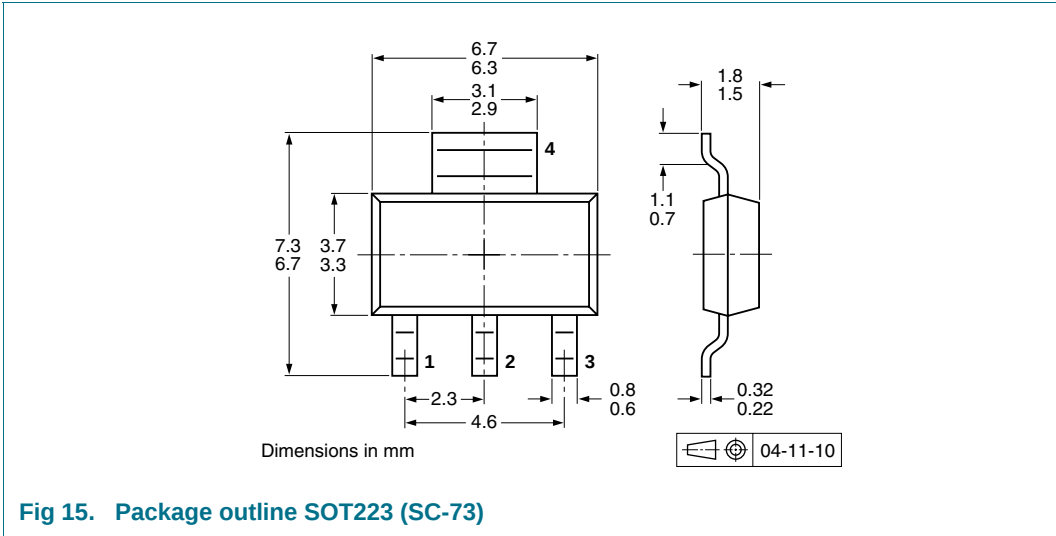


Fig 14. Test circuit for switching times

9. Package outline



10. Packing information

Table 8. Packing methods

The indicated -xxx are the last three digits of the 12NC ordering code.^[1]

Type number	Package	Description	Packing quantity	
			1000	4000
PBSS301NZ	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

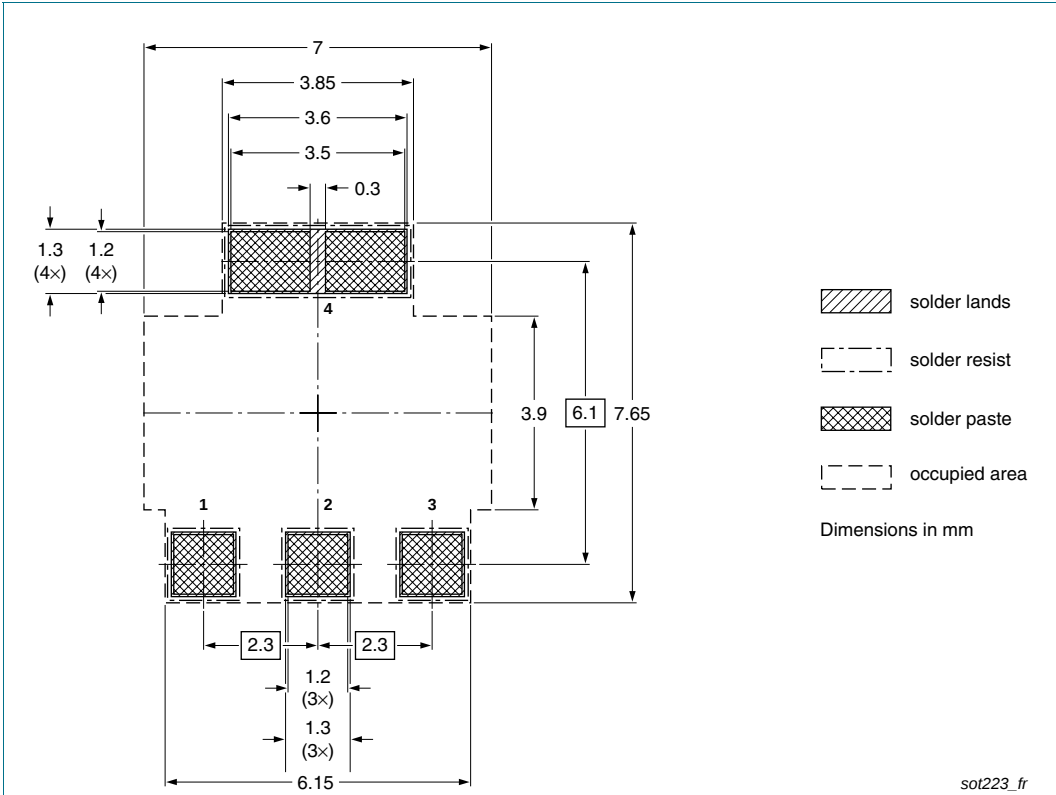


Fig 16. Reflow soldering footprint SOT223 (SC-73)

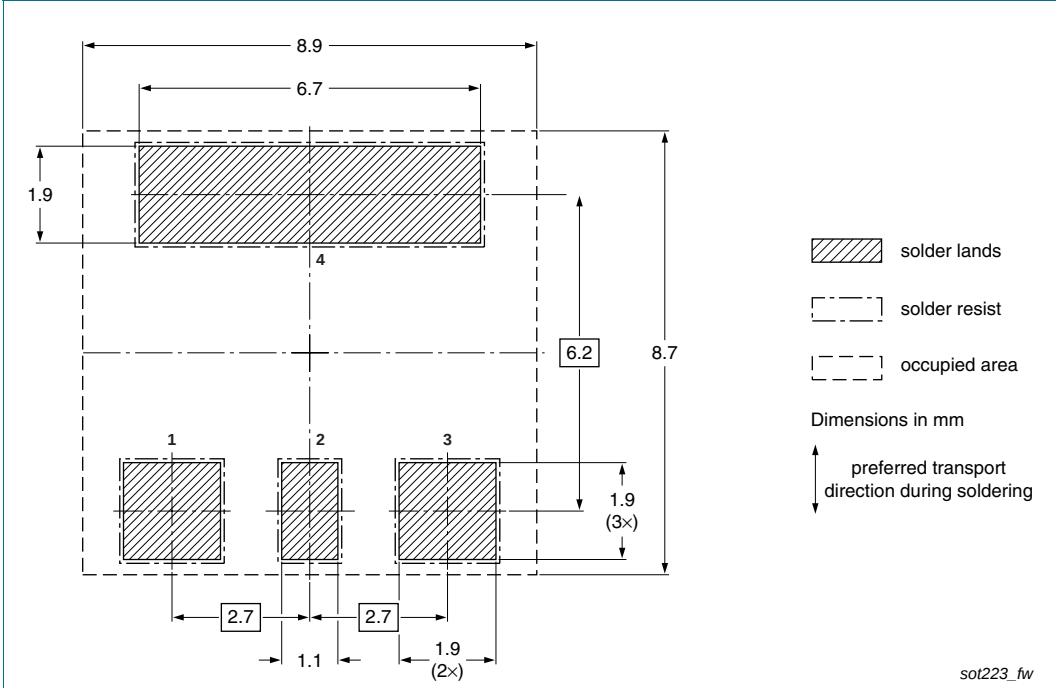


Fig 17. Wave soldering footprint SOT223 (SC-73)

12. Revision history

Table 9. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PBSS301NZ_2	20091117	Product data sheet	-	PBSS301NZ_1
• 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. • Figure 16 "Reflow soldering footprint SOT223 (SC-73)": updated • Figure 17 "Wave soldering footprint SOT223 (SC-73)": updated				
PBSS301NZ_1	20060907	Product data sheet	-	-

13. Legal information

13.1 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".

[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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