

# PBSS4041NZ

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

Rev. 2 — 8 August 2012

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) medium power Surface-Mounted Device (SMD) plastic package.

PNP complement: PBSS4041PZ.

### 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 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

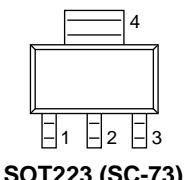
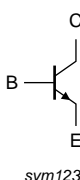
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CEO}$	collector-emitter voltage	open base	-	-	60	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	$I_C = 6$ A; $I_B = 600$ mA; pulsed; $t_p \leq 300$ $\mu$ s; $\delta \leq 0.02$ ; $T_{amb} = 25$ °C	-	17.5	25	m $\Omega$



## 2. Pinning information

**Table 2. Pinning information**

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	B	base	 <p>SOT223 (SC-73)</p>	 <p>sym123</p>
2	C	collector		
3	E	emitter		
4	C	collector		

## 3. Ordering information

**Table 3. Ordering information**

Type number	Package		
	Name	Description	Version
PBSS4041NZ	SC-73	plastic surface-mounted package with increased heatsink; 4 leads	SOT223

## 4. Marking

**Table 4. Marking codes**

Type number	Marking code
PBSS4041NZ	PB4041NZ

## 5. Limiting values

**Table 5. Limiting values**

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

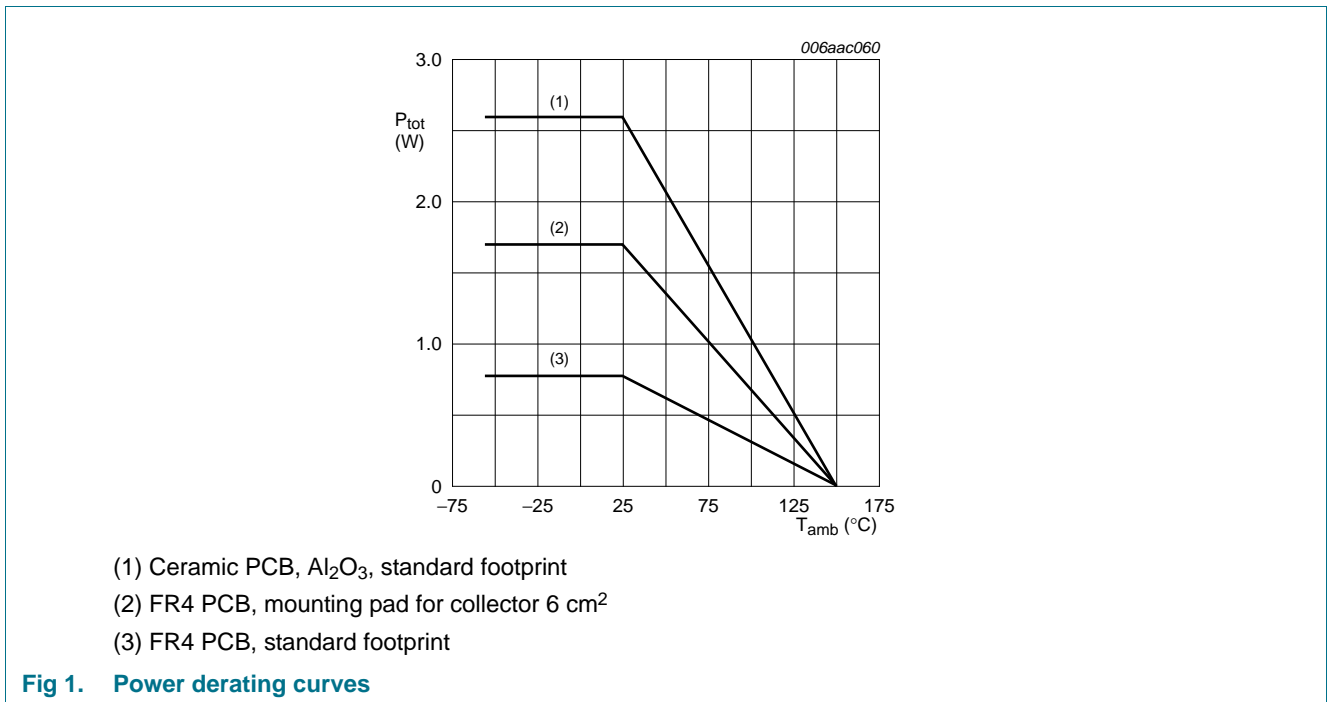
Symbol	Parameter	Conditions	Min	Max	Unit	
$V_{CBO}$	collector-base voltage	open emitter	-	60	V	
$V_{CEO}$	collector-emitter voltage	open base	-	60	V	
$V_{EBO}$	emitter-base voltage	open collector	-	5	V	
$I_C$	collector current		-	7	A	
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms	-	15	A	
$I_B$	base current		-	1	A	
$P_{tot}$	total power dissipation	$T_{amb} \leq 25$ °C	[1]	-	770	mW
			[2]	-	1700	mW
			[3]	-	2600	mW

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

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

Symbol	Parameter	Conditions	Min	Max	Unit
$T_j$	junction temperature		-	150	°C
$T_{amb}$	ambient temperature		-55	150	°C
$T_{stg}$	storage temperature		-65	150	°C

- [1] Device mounted on an FR4 Printed-Circuit Board (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.



**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]	-	-	160	K/W
			[2]	-	-	75	K/W
			[3]	-	-	50	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point		-	-	11	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.

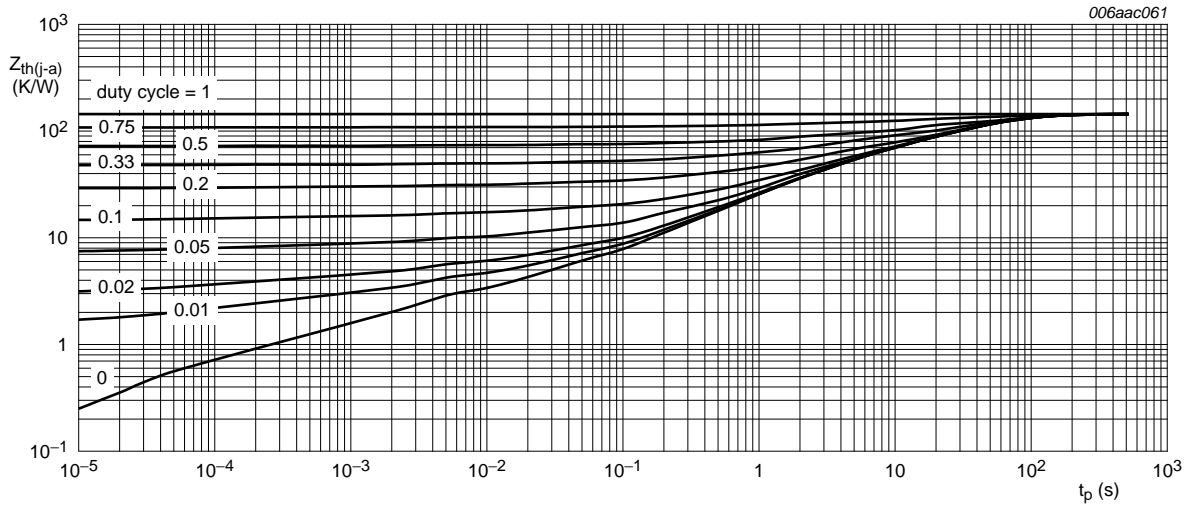


Fig 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

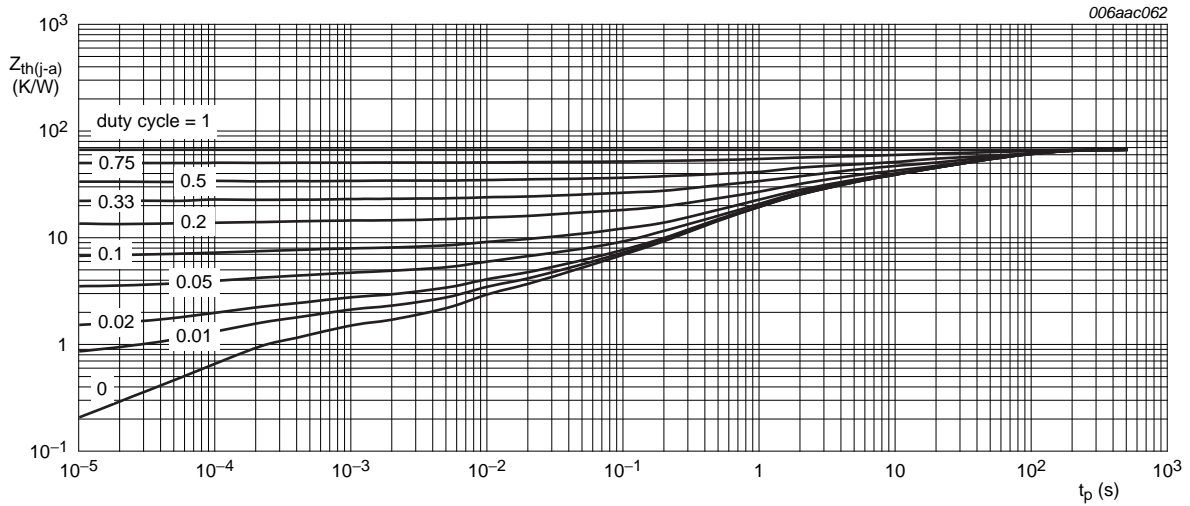
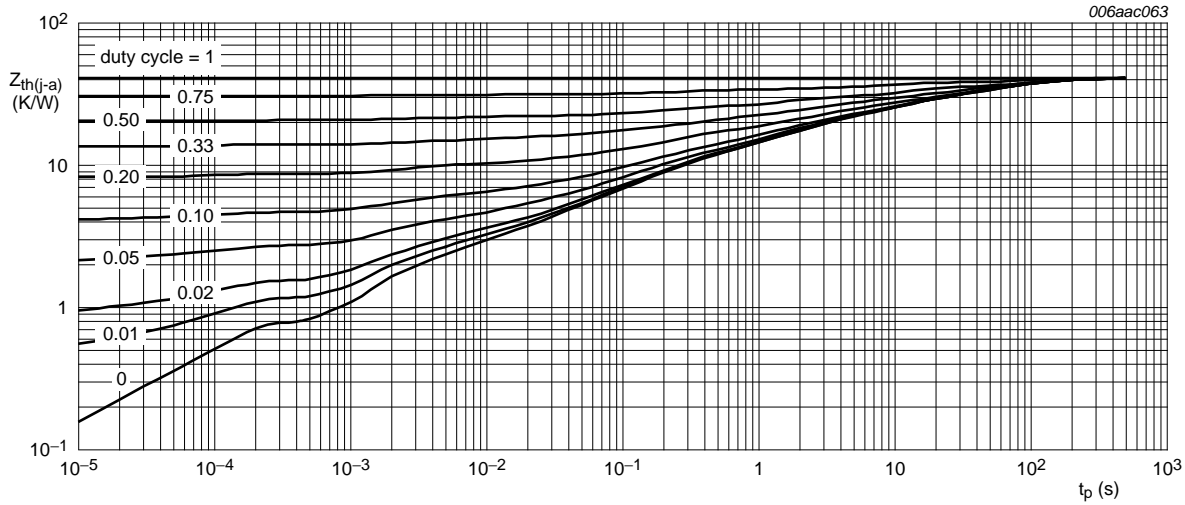


Fig 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values



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

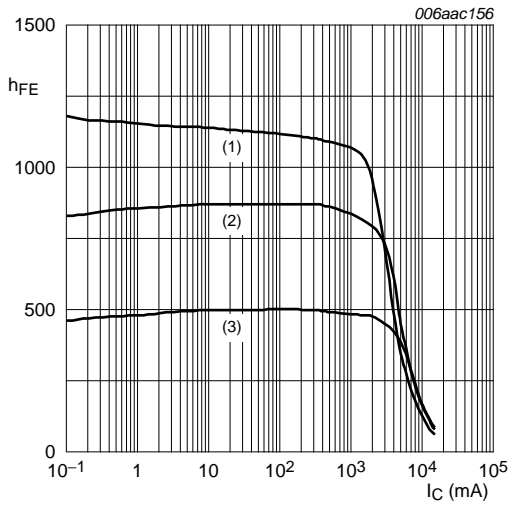
## 7. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I <sub>CBO</sub>	collector-base cut-off current	V <sub>CB</sub> = 60 V; I <sub>E</sub> = 0 A; T <sub>amb</sub> = 25 °C	-	-	100	nA
		V <sub>CB</sub> = 60 V; I <sub>E</sub> = 0 A; T <sub>j</sub> = 150 °C	-	-	50	µA
I <sub>CES</sub>	collector-emitter cut-off current	V <sub>CE</sub> = 48 V; V <sub>BE</sub> = 0 V; T <sub>amb</sub> = 25 °C	-	-	100	nA
I <sub>EBO</sub>	emitter-base cut-off current	V <sub>EB</sub> = 5 V; I <sub>C</sub> = 0 A; T <sub>amb</sub> = 25 °C	-	-	100	nA
h <sub>FE</sub>	DC current gain	V <sub>CE</sub> = 2 V; I <sub>C</sub> = 500 mA; pulsed; t <sub>p</sub> ≤ 300 µs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	300	500	-	
		V <sub>CE</sub> = 2 V; I <sub>C</sub> = 1 A; pulsed; t <sub>p</sub> ≤ 300 µs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	300	500	-	
		V <sub>CE</sub> = 2 V; I <sub>C</sub> = 2 A; pulsed; t <sub>p</sub> ≤ 300 µs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	300	500	-	
		V <sub>CE</sub> = 2 V; I <sub>C</sub> = 4 A; pulsed; t <sub>p</sub> ≤ 300 µs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	250	400	-	
		V <sub>CE</sub> = 2 V; I <sub>C</sub> = 6 A; pulsed; t <sub>p</sub> ≤ 300 µs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	100	200	-	
		V <sub>CE</sub> = 2 V; I <sub>C</sub> = 7 A; pulsed; t <sub>p</sub> ≤ 300 µs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	50	100	-	

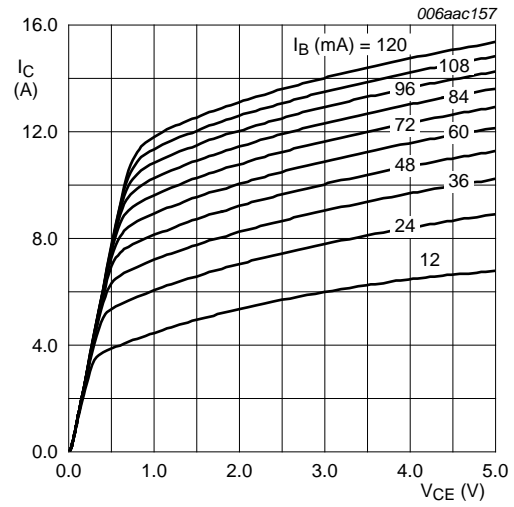
Table 7. Characteristics ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 1\text{ A}; I_B = 50\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	-	25	35	mV
		$I_C = 1\text{ A}; I_B = 10\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	-	43	60	mV
		$I_C = 2\text{ A}; I_B = 40\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	-	53	75	mV
		$I_C = 4\text{ A}; I_B = 200\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	-	78	110	mV
		$I_C = 4\text{ A}; I_B = 40\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	-	115	160	mV
		$I_C = 7\text{ A}; I_B = 350\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	-	130	195	mV
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = 6\text{ A}; I_B = 600\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	-	17.5	25	m $\Omega$
$V_{BEsat}$	base-emitter saturation voltage	$I_C = 1\text{ A}; I_B = 100\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	-	0.83	0.9	V
		$I_C = 4\text{ A}; I_B = 400\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	-	0.98	1.05	V
$V_{BEon}$	base-emitter turn-on voltage	$V_{CE} = 2\text{ V}; I_C = 2\text{ A};$ pulsed; $t_p \leq 300\ \mu\text{s};$ $\delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	-	0.72	0.85	V
$t_d$	delay time	$V_{CC} = 12.5\text{ V}; I_C = 1\text{ A}; I_{Bon} = 0.05\text{ A};$ $I_{Boff} = -0.05\text{ A}; T_{amb} = 25\text{ }^\circ\text{C}$	-	55	-	ns
$t_r$	rise time		-	55	-	ns
$t_{on}$	turn-on time		-	110	-	ns
$t_s$	storage time		-	1220	-	ns
$t_f$	fall time		-	230	-	ns
$t_{off}$	turn-off time		-	1450	-	ns
$f_T$	transition frequency	$V_{CE} = 10\text{ V}; I_C = 100\text{ mA}; f = 100\text{ MHz};$ $T_{amb} = 25\text{ }^\circ\text{C}$	-	105	-	MHz
$C_c$	collector capacitance	$V_{CB} = 10\text{ V}; I_E = 0\text{ A}; i_e = 0\text{ A};$ $f = 1\text{ MHz}; T_{amb} = 25\text{ }^\circ\text{C}$	-	50	-	pF



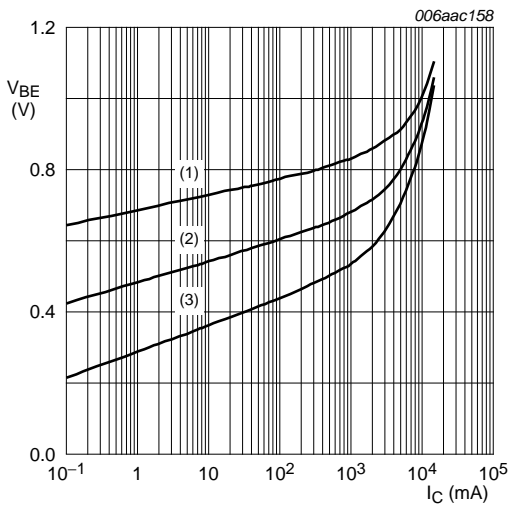
$V_{CE} = 2\text{ V}$   
 (1)  $T_{amb} = 100\text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25\text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -55\text{ }^\circ\text{C}$

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



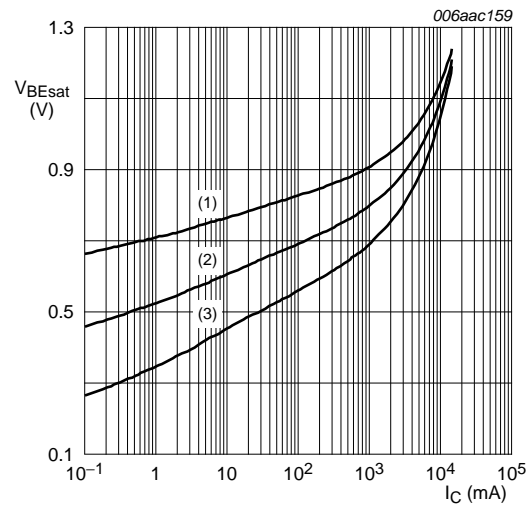
$T_{amb} = 25\text{ }^\circ\text{C}$

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



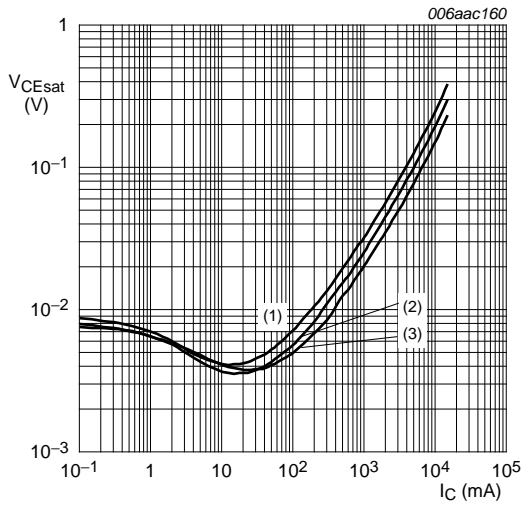
$V_{CE} = 2\text{ V}$   
 (1)  $T_{amb} = -55\text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25\text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100\text{ }^\circ\text{C}$

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



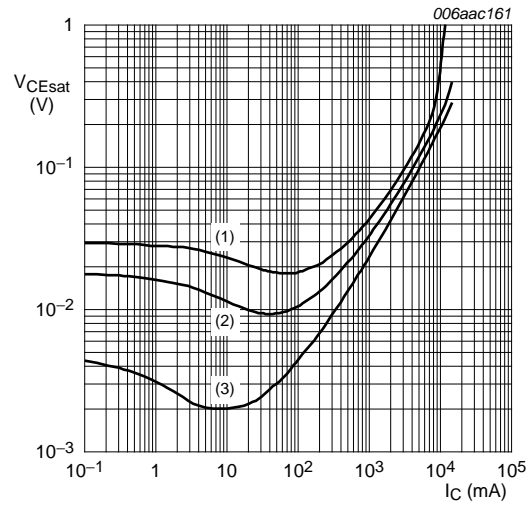
$I_C/I_B = 20$   
 (1)  $T_{amb} = -55\text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25\text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100\text{ }^\circ\text{C}$

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



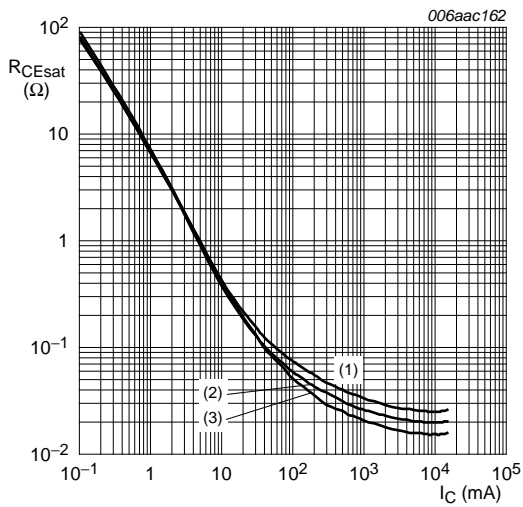
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -55\text{ °C}$

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



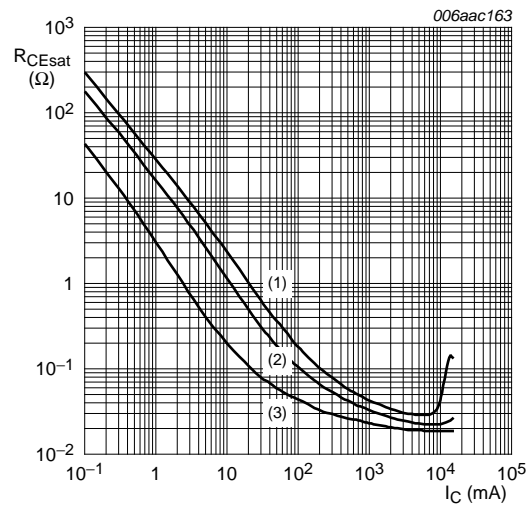
$T_{amb} = 25\text{ °C}$   
 (1)  $I_C/I_B = 100$   
 (2)  $I_C/I_B = 50$   
 (3)  $I_C/I_B = 10$

**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**

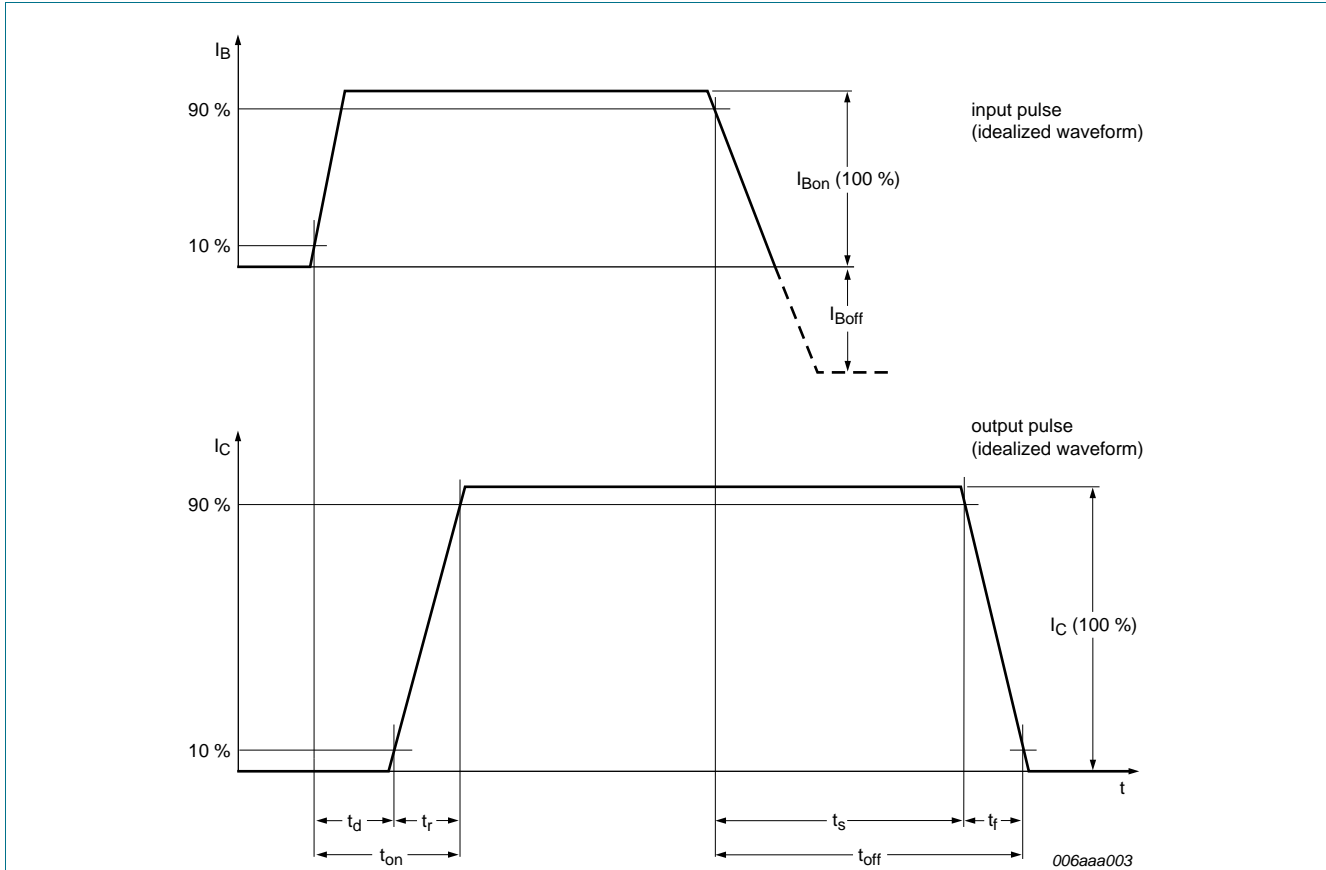


$T_{amb} = 25\text{ °C}$   
 (1)  $I_C/I_B = 100$   
 (2)  $I_C/I_B = 50$   
 (3)  $I_C/I_B = 10$

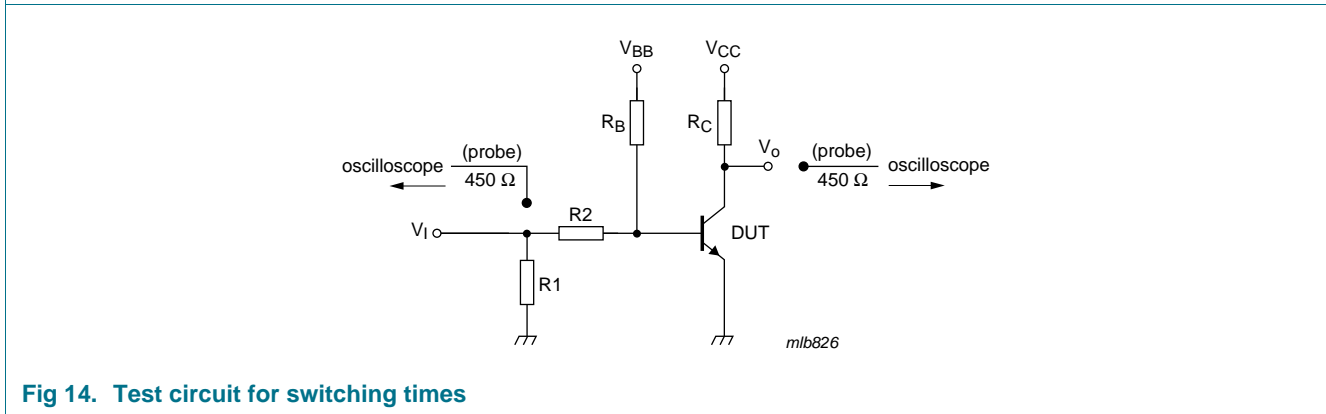
**Fig 12. Collector-emitter saturation resistance as a function of collector current; typical values**



**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**

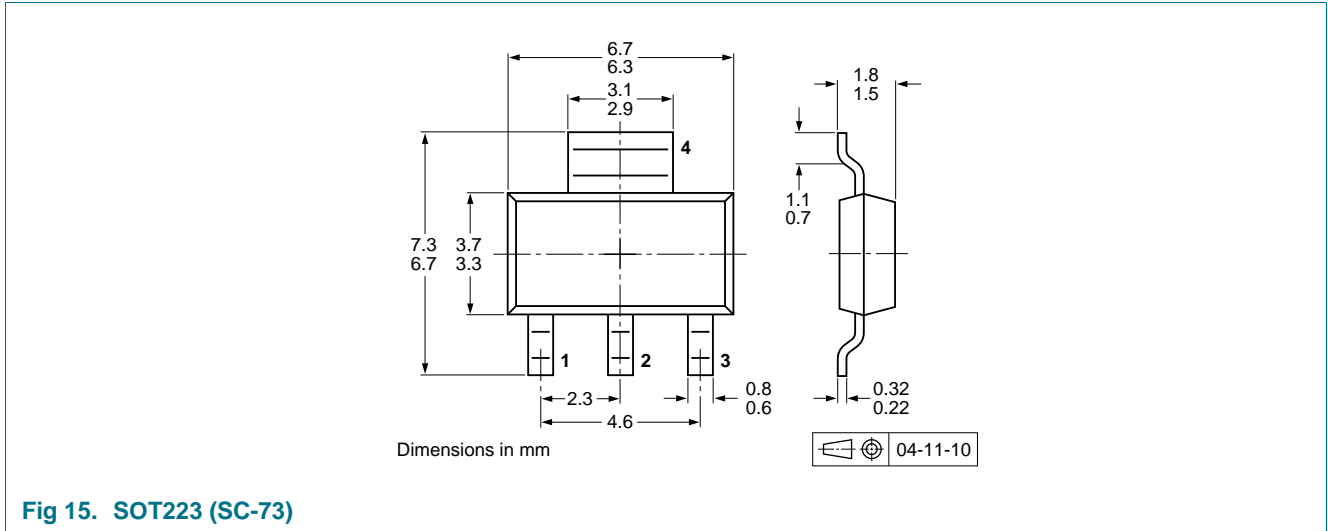


Fig 15. SOT223 (SC-73)

**10. Soldering**

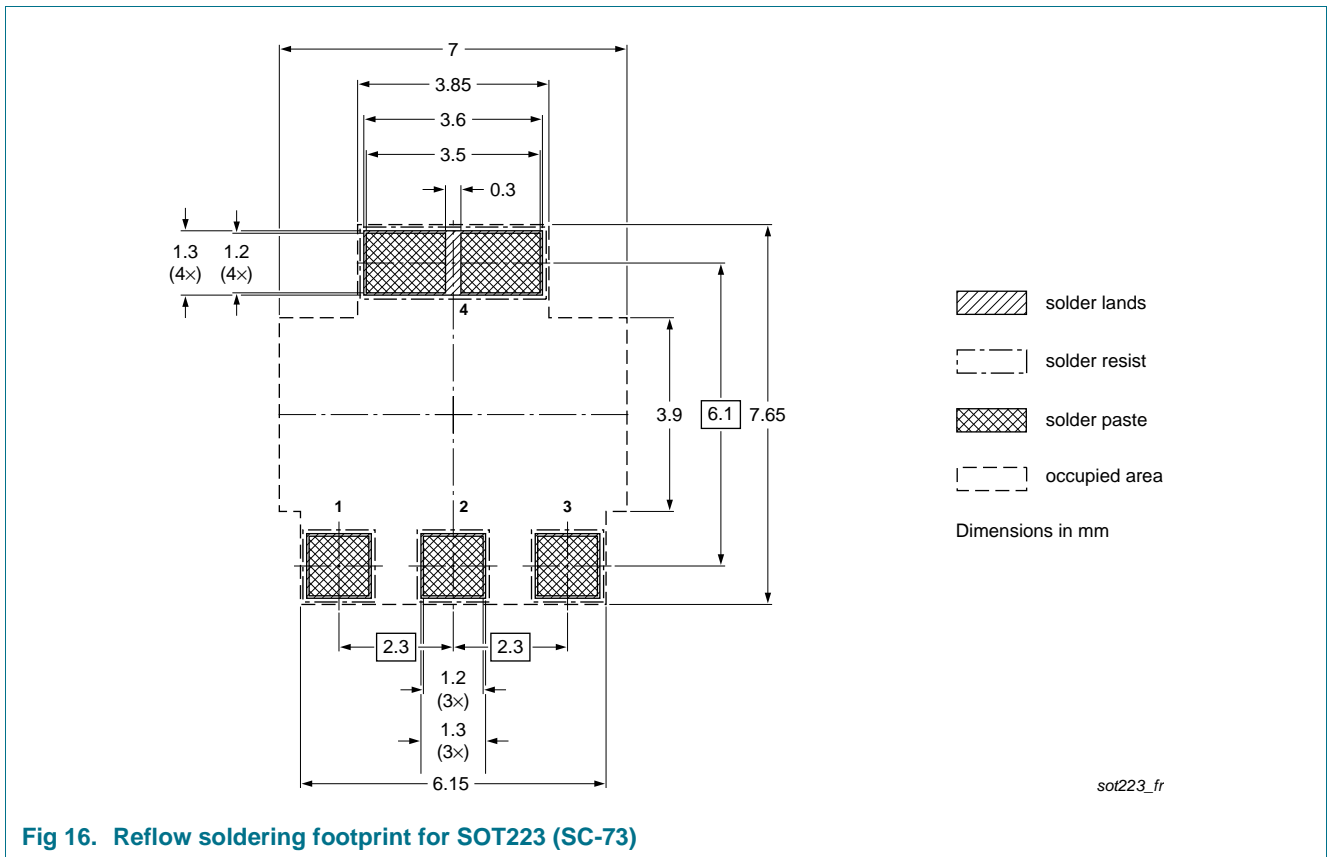
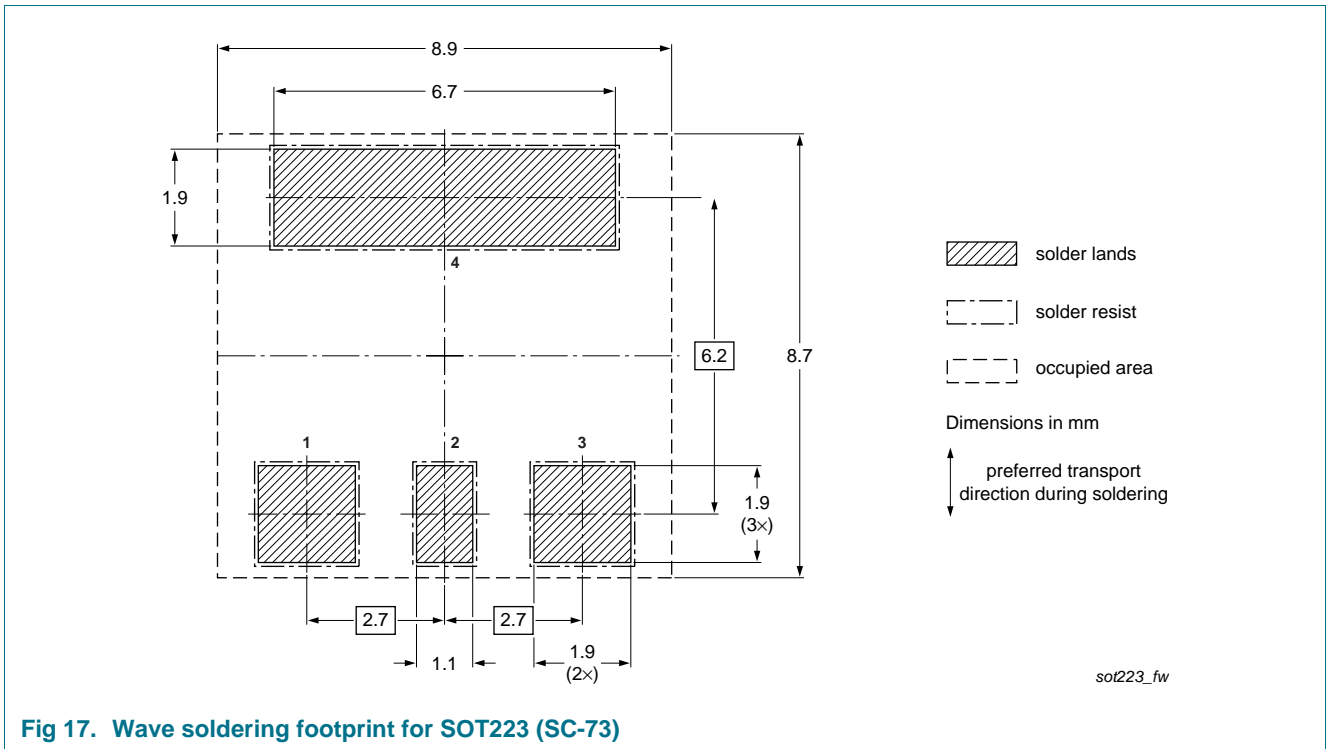


Fig 16. Reflow soldering footprint for SOT223 (SC-73)



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

## 11. Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PBSS4041NZ v.2	20120808	Product data sheet	-	PBSS4041NZ v.1
Modifications:	<ul style="list-style-type: none"><li>• <a href="#">7 "Characteristics"</a>: V<sub>CEsat</sub> corrected</li><li>• <a href="#">12 "Legal information"</a>: updated</li></ul>			
PBSS4041NZ v.1	20100331	Product data sheet	-	-

## 12. Legal information

### 12.1 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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## 14. Contents

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