

# PBSS4041NZ

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

Rev. 01 — 31 March 2010

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 Printed-Circuit Board (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

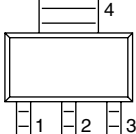
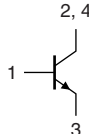
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CEO}$	collector-emitter voltage	open base	-	-	60	V
$I_C$	collector current		-	-	7	A
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms	-	-	15	A
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = 6$ A; $I_B = 600$ mA	[1]	-	17.5	25 m $\Omega$

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



## 2. Pinning information

Table 2. Pinning

Pin	Description	Simplified outline	Graphic symbol
1	base		
2	collector		
3	emitter		
4	collector		

*sym016*

## 3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PBSS4041NZ	SC-73	plastic surface-mounted package with increased heat sink; 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).

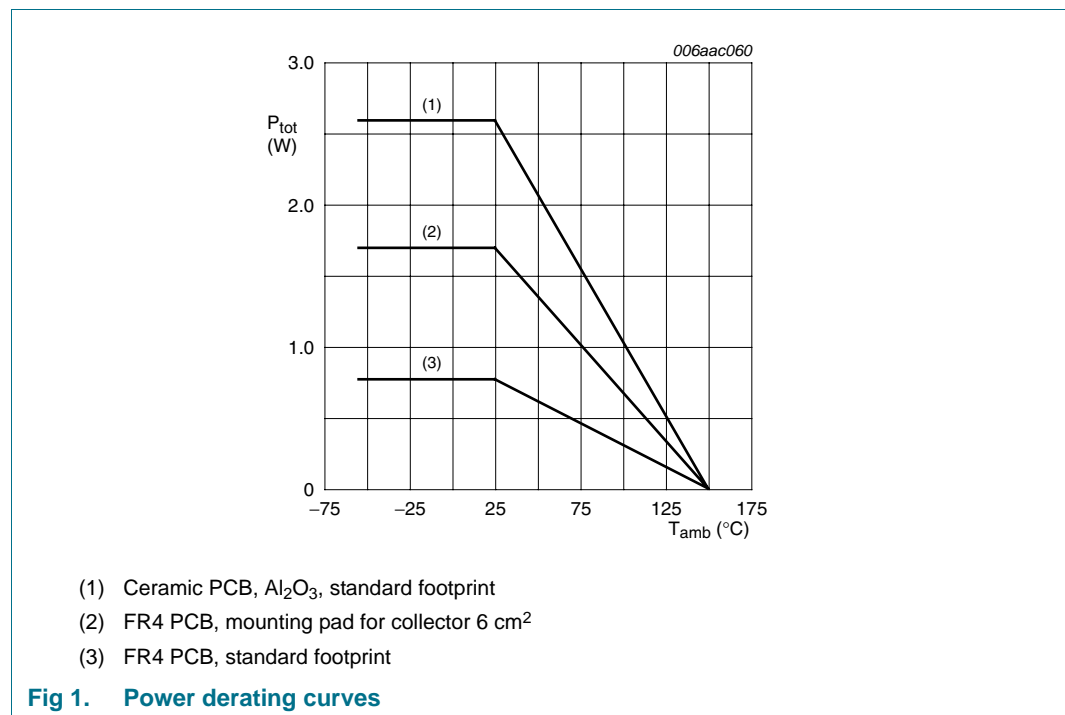
Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CBO}$	collector-base voltage	open emitter	-	60	V
$V_{CEO}$	collector-emitter voltage	open base	-	60	V
$V_{EBO}$	emitter-base voltage	open collector	-	5	V
$I_C$	collector current		-	7	A
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms	-	15	A
$I_B$	base current		-	1	A

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

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

Symbol	Parameter	Conditions	Min	Max	Unit
$P_{tot}$	total power dissipation	$T_{amb} \leq 25\text{ }^{\circ}\text{C}$	[1] -	770	mW
			[2] -	1700	mW
			[3] -	2600	mW
$T_j$	junction temperature		-	150	$^{\circ}\text{C}$
$T_{amb}$	ambient temperature		-55	+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 cm<sup>2</sup>.  
 [3] Device mounted on a ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint.



## 6. Thermal characteristics

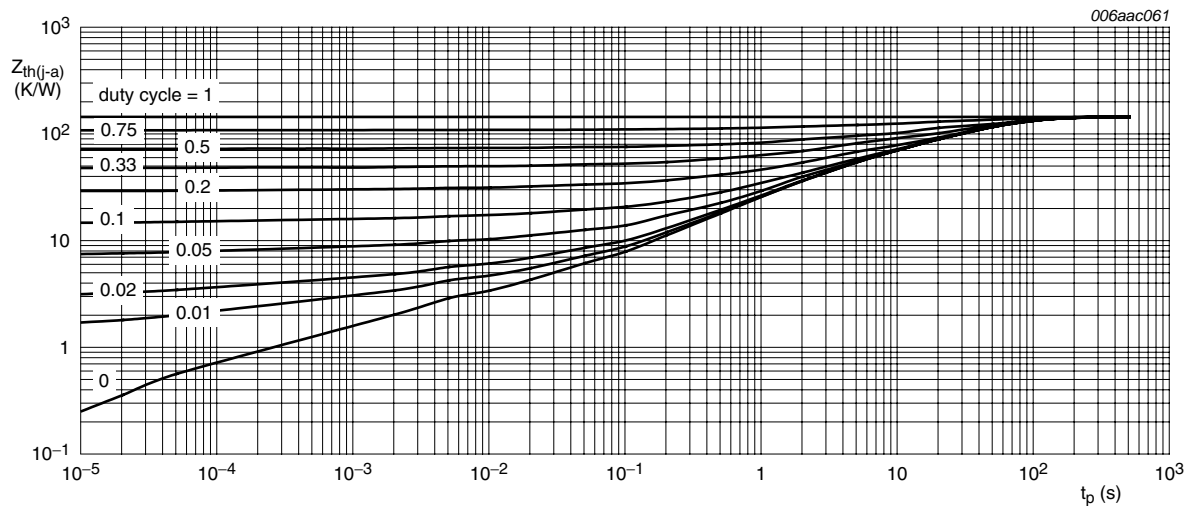
**Table 6. Thermal characteristics**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	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.

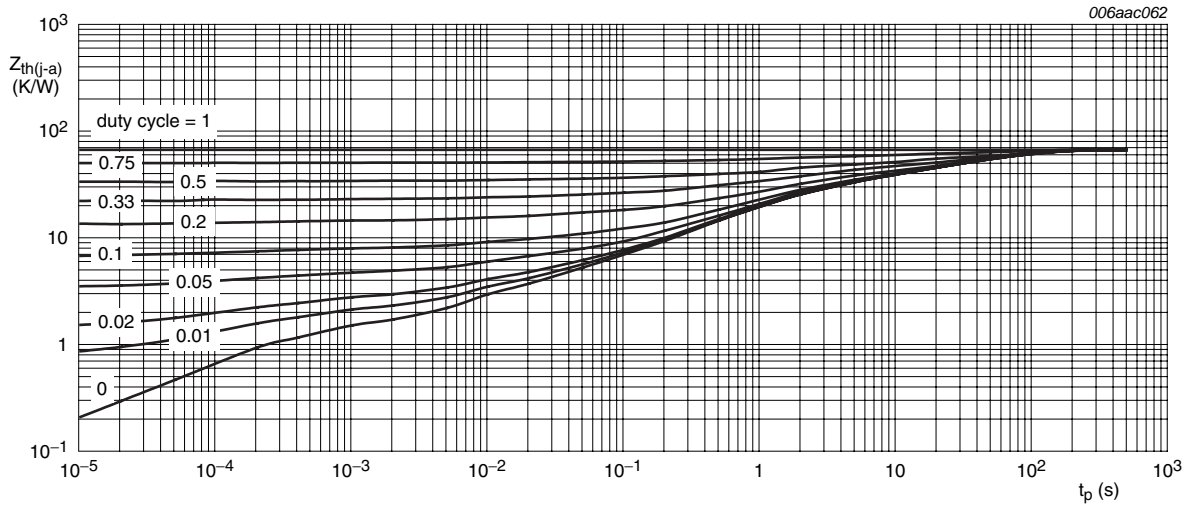
[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 6 cm<sup>2</sup>.

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



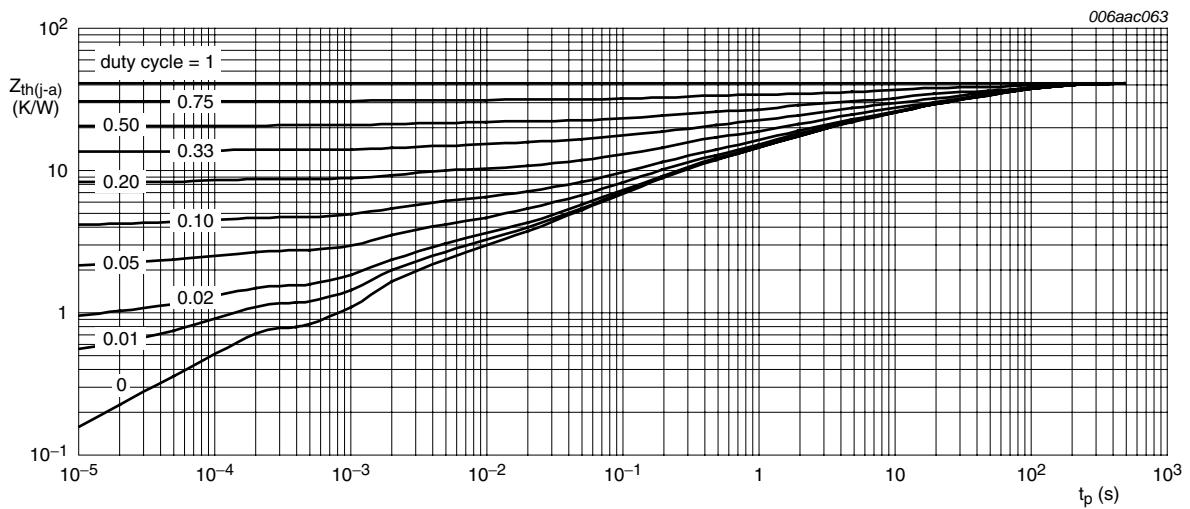
FR4 PCB, standard footprint

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



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

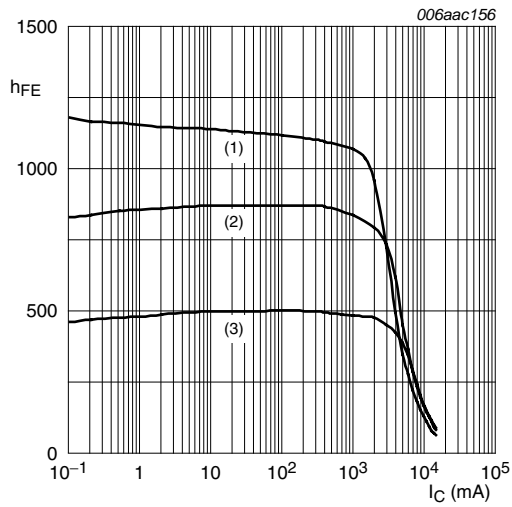
**Fig 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values**

## 7. Characteristics

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

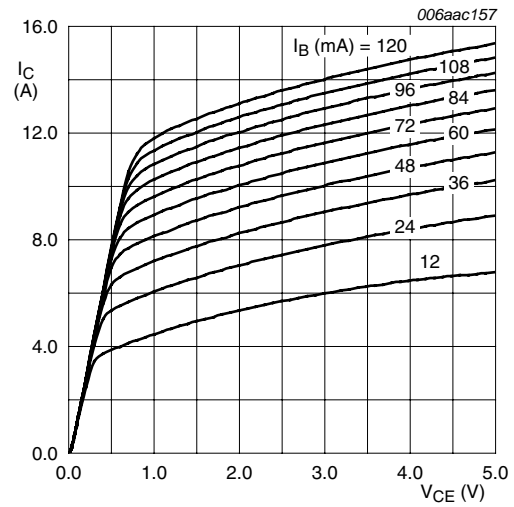
Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$I_{CBO}$	collector-base cut-off current	$V_{CB} = 60\text{ V}; I_E = 0\text{ A}$	-	-	100	nA	
		$V_{CB} = 60\text{ V}; I_E = 0\text{ A}; T_j = 150\text{ }^{\circ}\text{C}$	-	-	50	$\mu\text{A}$	
$I_{CES}$	collector-emitter cut-off current	$V_{CE} = 48\text{ V}; V_{BE} = 0\text{ V}$	-	-	100	nA	
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 5\text{ V}; I_C = 0\text{ A}$	-	-	100	nA	
$h_{FE}$	DC current gain		[1]				
		$V_{CE} = 2\text{ V}; I_C = 500\text{ mA}$	300	500	-		
		$V_{CE} = 2\text{ V}; I_C = 1\text{ A}$	300	500	-		
		$V_{CE} = 2\text{ V}; I_C = 2\text{ A}$	300	500	-		
		$V_{CE} = 2\text{ V}; I_C = 4\text{ A}$	250	400	-		
		$V_{CE} = 2\text{ V}; I_C = 6\text{ A}$	100	200	-		
		$V_{CE} = 2\text{ V}; I_C = 7\text{ A}$	50	100	-		
$V_{CEsat}$	collector-emitter saturation voltage		[1]				
		$I_C = 1\text{ A}; I_B = 50\text{ mA}$	-	43	60	mV	
		$I_C = 1\text{ A}; I_B = 10\text{ mA}$	-	25	35	mV	
		$I_C = 2\text{ A}; I_B = 40\text{ mA}$	-	53	75	mV	
		$I_C = 4\text{ A}; I_B = 200\text{ mA}$	-	78	110	mV	
		$I_C = 4\text{ A}; I_B = 40\text{ mA}$	-	115	160	mV	
		$I_C = 7\text{ A}; I_B = 350\text{ mA}$	-	130	195	mV	
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = 6\text{ A}; I_B = 600\text{ mA}$	[1]	-	17.5	25	$\text{m}\Omega$
$V_{BEsat}$	base-emitter saturation voltage	$I_C = 1\text{ A}; I_B = 100\text{ mA}$	[1]	-	0.83	0.9	V
		$I_C = 4\text{ A}; I_B = 400\text{ mA}$	[1]	-	0.98	1.05	V
$V_{BEon}$	base-emitter turn-on voltage	$V_{CE} = 2\text{ V}; I_C = 2\text{ A}$	[1]	-	0.72	0.85	V
$t_d$	delay time	$V_{CC} = 12.5\text{ V}; I_C = 1\text{ A}; I_{Bon} = 0.05\text{ A}; I_{Boff} = -0.05\text{ A}$	-	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	$V_{CE} = 10\text{ V}; I_C = 100\text{ mA}; f = 100\text{ MHz}$	-	105	-	MHz	
$C_c$	collector capacitance	$V_{CB} = 10\text{ V}; I_E = i_e = 0\text{ A}; f = 1\text{ MHz}$	-	50	-	pF	

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



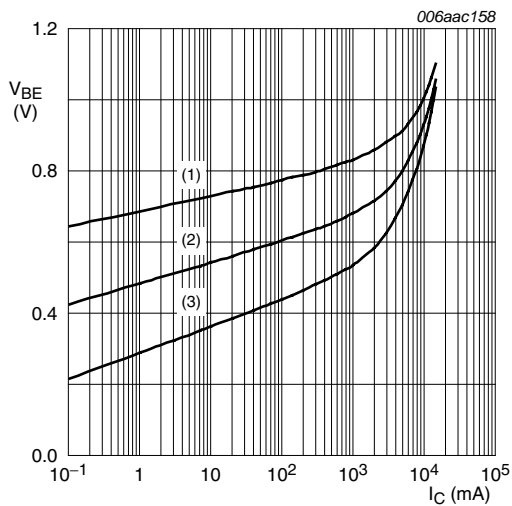
$V_{CE} = 2\text{ V}$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -55\text{ °C}$

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



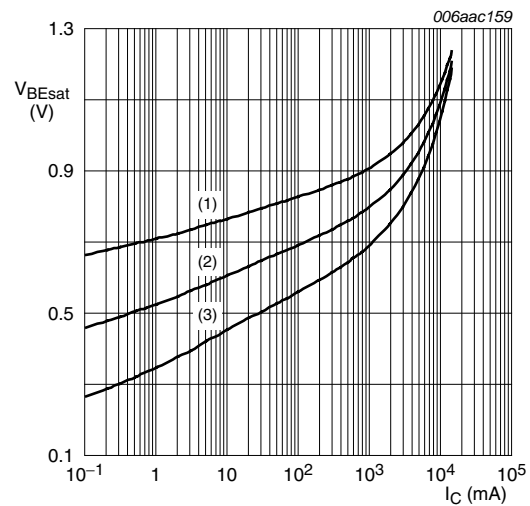
$T_{amb} = 25\text{ °C}$

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



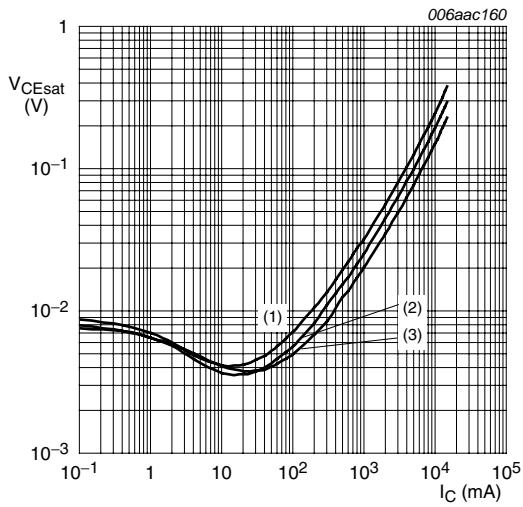
$V_{CE} = 2\text{ V}$   
 (1)  $T_{amb} = -55\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 100\text{ °C}$

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



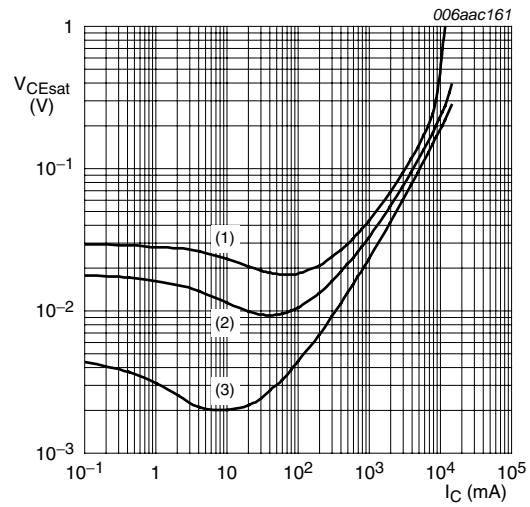
$I_C/I_B = 20$   
 (1)  $T_{amb} = -55\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 100\text{ °C}$

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



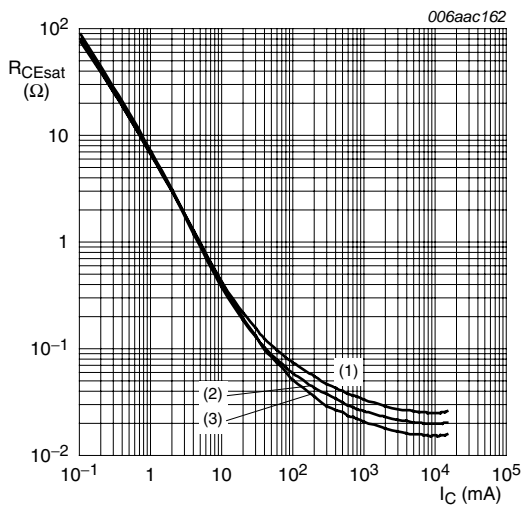
- $I_C/I_B = 20$
- (1)  $T_{amb} = 100\text{ °C}$
  - (2)  $T_{amb} = 25\text{ °C}$
  - (3)  $T_{amb} = -55\text{ °C}$

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



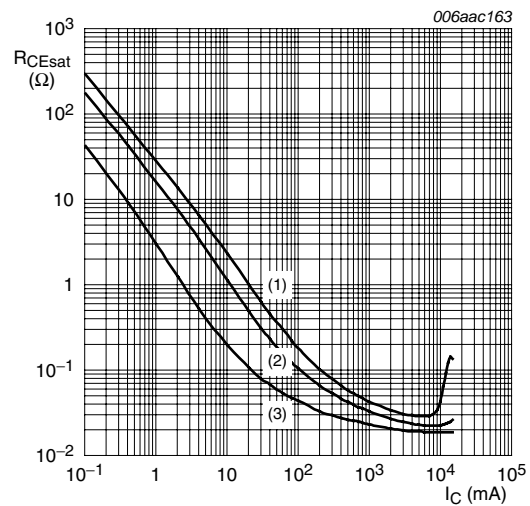
- $T_{amb} = 25\text{ °C}$
- (1)  $I_C/I_B = 100$
  - (2)  $I_C/I_B = 50$
  - (3)  $I_C/I_B = 10$

**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

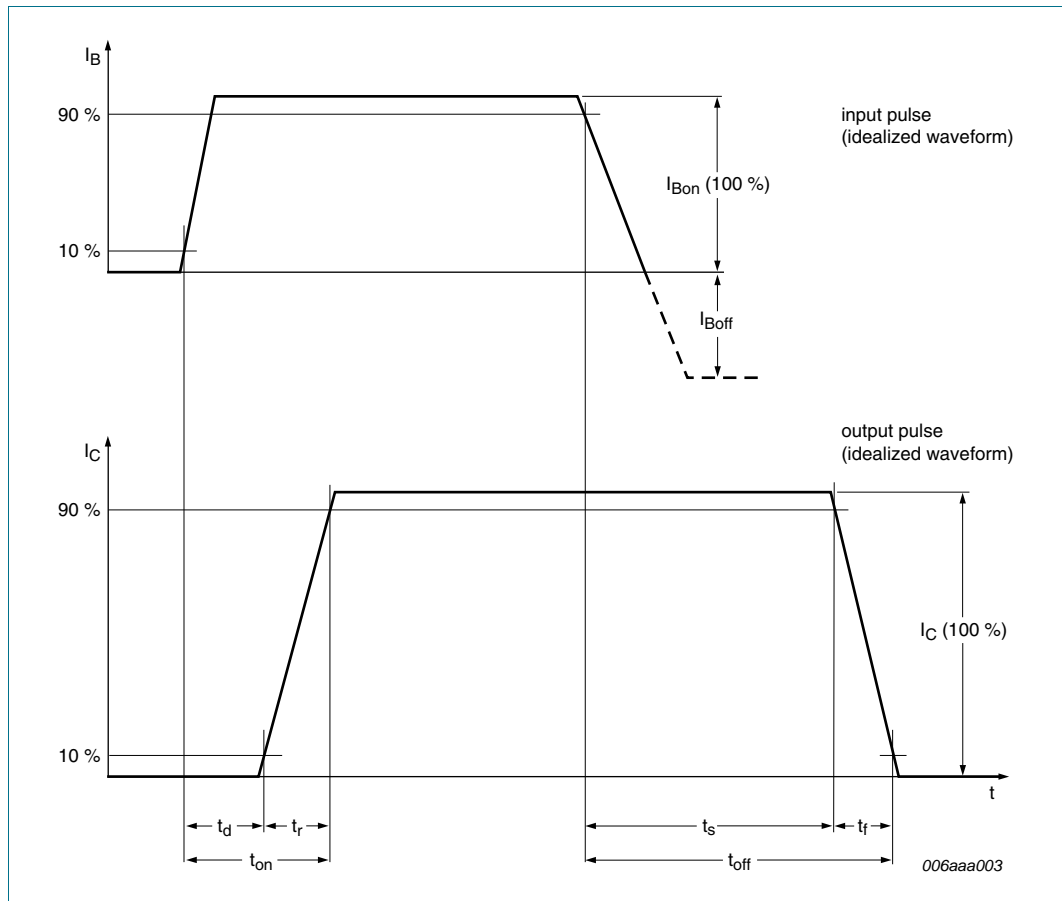


Fig 13. BISS transistor switching time definition

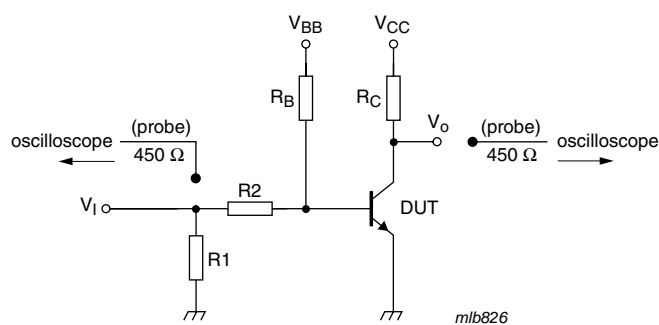
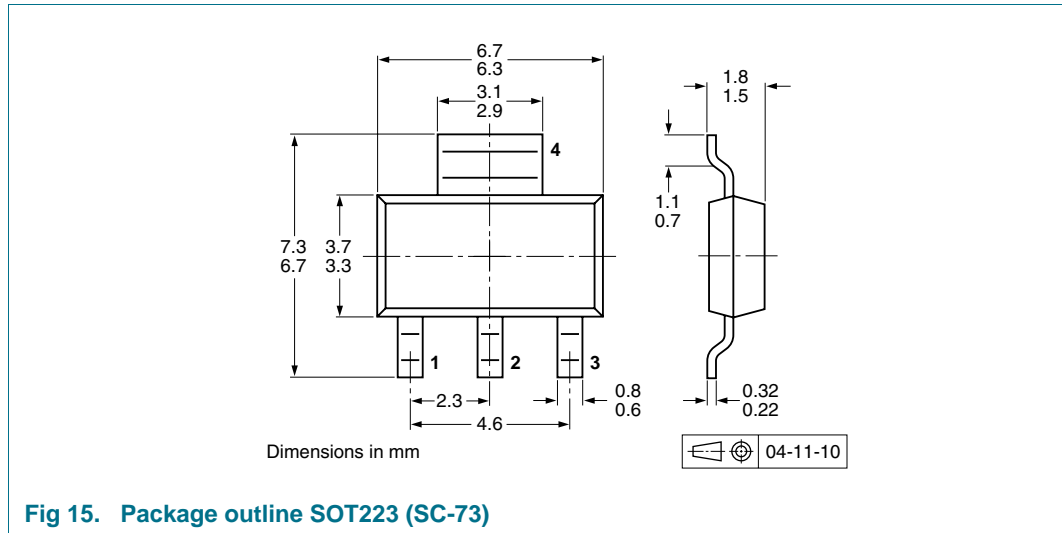


Fig 14. Test circuit for switching times

### 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



## 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
PBSS4041NZ	SOT223	8 mm pitch, 12 mm tape and reel	-115	-135

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



## 12. Revision history

**Table 9.** Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PBSS4041NZ_1	20100331	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".

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