

PBSS4160U

60 V, 1 A NPN low V_{CEsat} (BISS) transistor

Rev. 02 — 19 July 2005

Product data sheet

1. Product profile

1.1 General description

NPN low V_{CEsat} Breakthrough In Small Signal (BISS) transistor in a SOT323 (SC-70) Surface Mounted Device (SMD) plastic package.

PNP complement: PBSS5160U.

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 (DC)		[1]	-	1	A
I_{CM}	peak collector current	single pulse; $t_p \leq 1$ ms	-	-	2	A
R_{CEsat}	collector-emitter saturation resistance	$I_C = 1$ A; $I_B = 100$ mA	[2]	230	280	m Ω

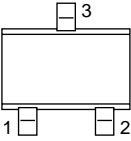
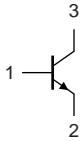
[1] Device mounted on a ceramic PCB, Al_2O_3 , standard footprint.

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

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2. Pinning information

Table 2: Pinning

Pin	Description	Simplified outline	Symbol
1	base		
2	emitter		
3	collector		

sym021

3. Ordering information

Table 3: Ordering information

Type number	Package		
	Name	Description	Version
PBSS4160U	SC-70	plastic surface mounted package; 3 leads	SOT323

4. Marking

Table 4: Marking codes

Type number	Marking code [1]
PBSS4160U	52*

- [1] * = -: made in Hong Kong
 * = p: made in Hong Kong
 * = t: made in Malaysia
 * = W: made in China

5. Limiting values

Table 5: Limiting values

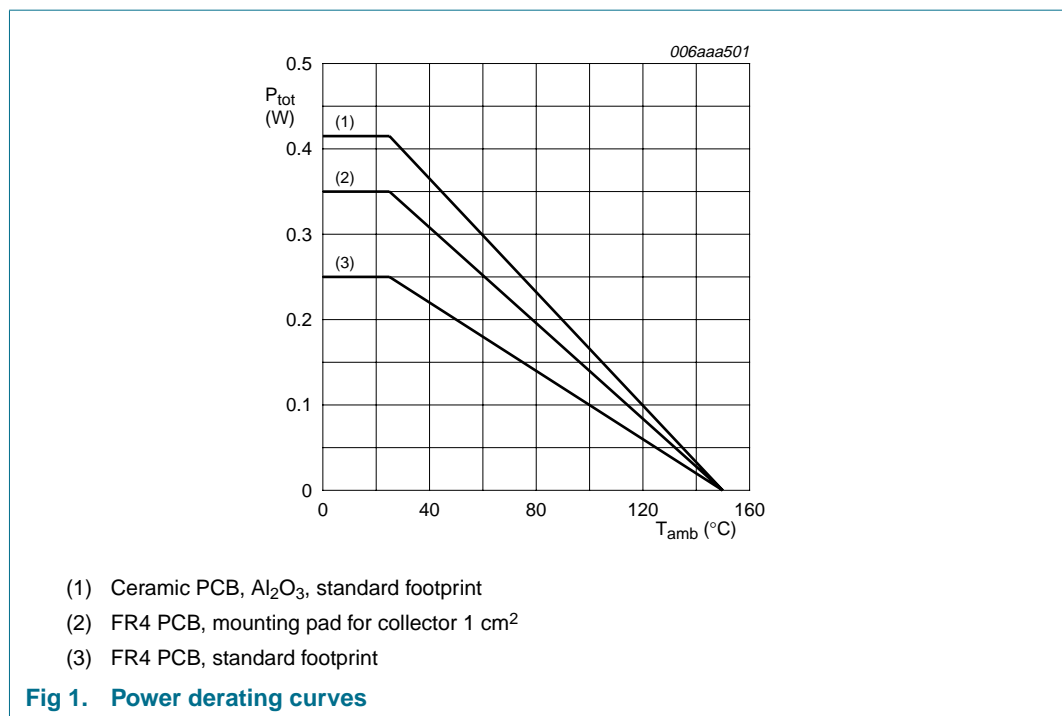
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CBO}	collector-base voltage	open emitter	-	80	V
V_{CEO}	collector-emitter voltage	open base	-	60	V
V_{EBO}	emitter-base voltage	open collector	-	5	V
I_C	collector current (DC)		[1] -	750	mA
			[2] -	930	mA
			[3] -	1	A
I_{CM}	peak collector current	single pulse; $t_p \leq 1$ ms	-	2	A
I_B	base current (DC)		-	300	mA
I_{BM}	peak base current	single pulse; $t_p \leq 1$ ms	-	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	[1] -	250	mW
			[2] -	350	mW
			[3] -	415	mW
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 1 cm².

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

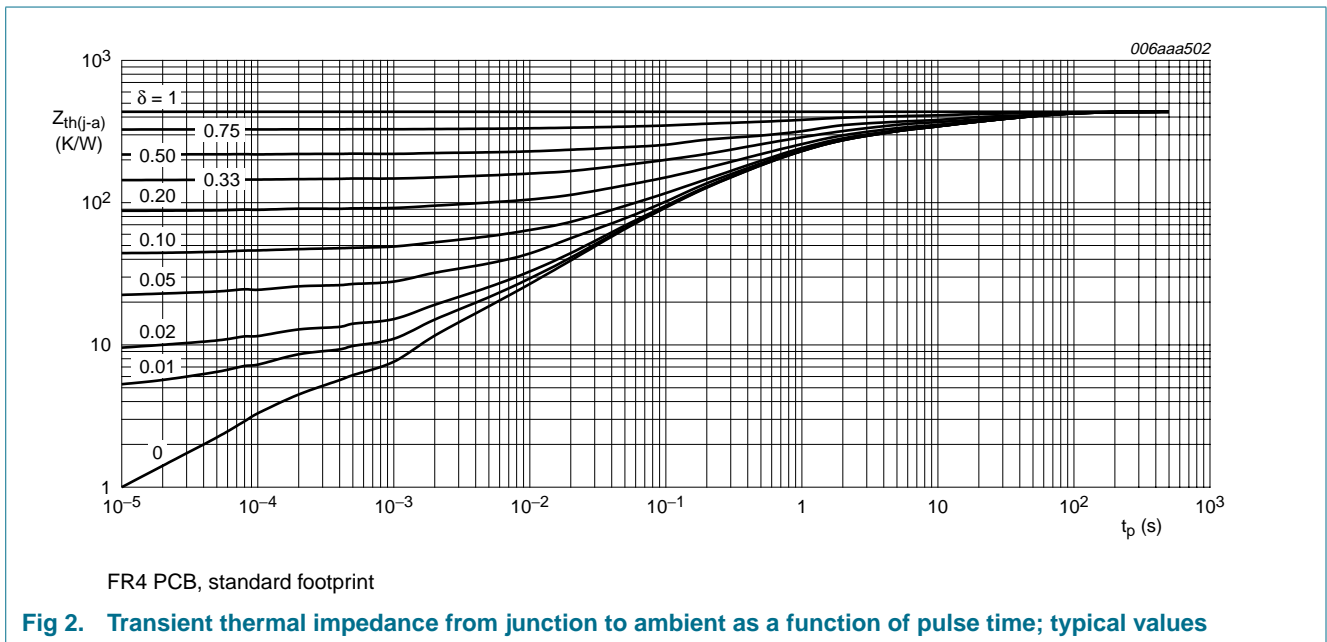


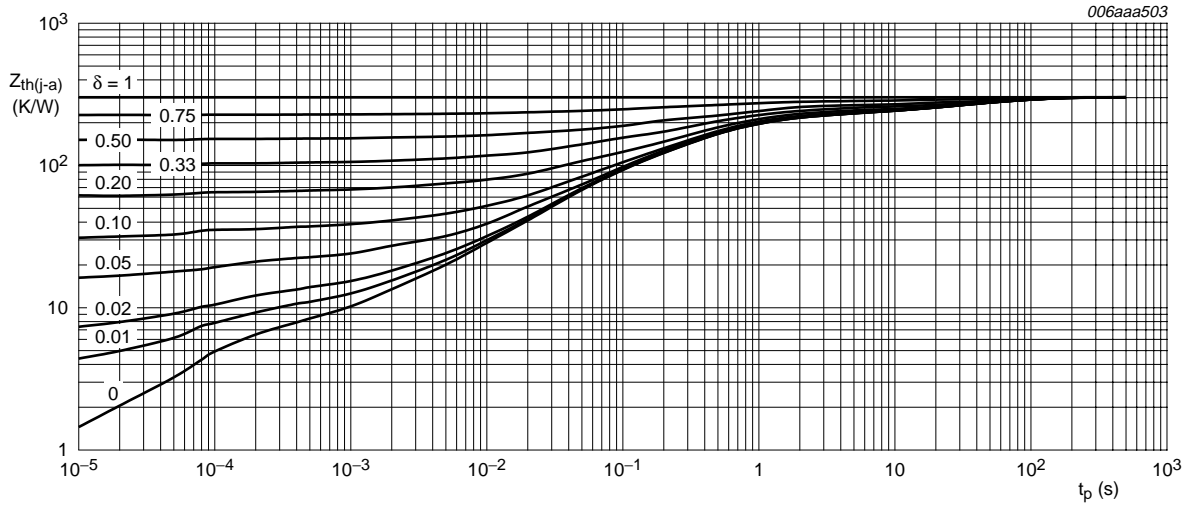
6. Thermal characteristics

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]	-	-	500	K/W
			[2]	-	-	357	K/W
			[3]	-	-	301	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point		-	-	150	K/W	

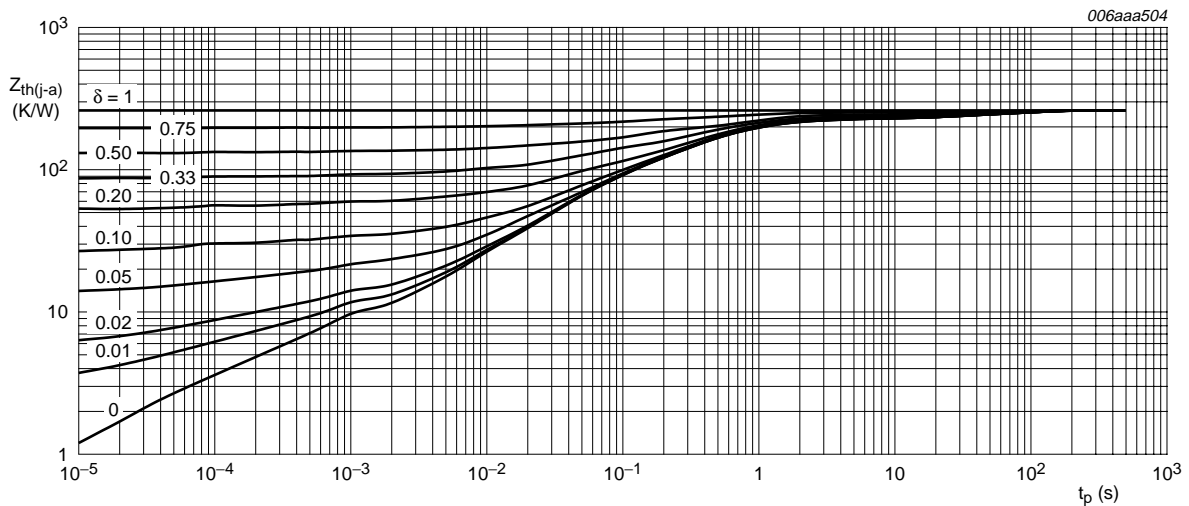
- [1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm².
- [3] Device mounted on a ceramic PCB, Al₂O₃, standard footprint.





FR4 PCB, mounting pad for collector 1 cm²

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



Ceramic PCB, Al₂O₃, standard footprint

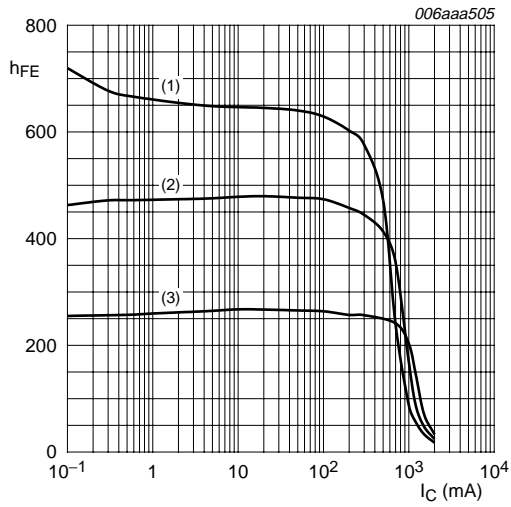
Fig 4. Transient thermal impedance from junction to ambient as a function of pulse time; typical values

7. Characteristics

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

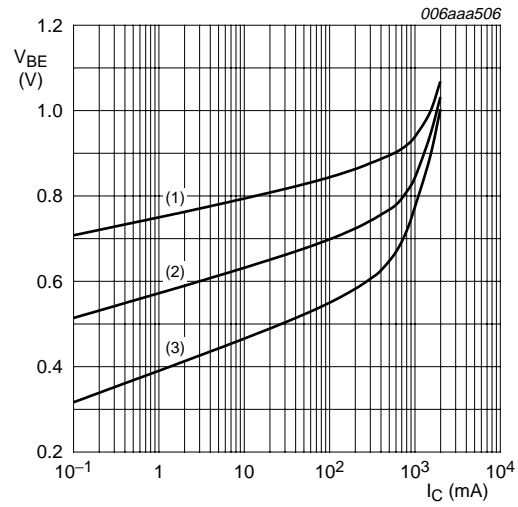
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{CBO}	collector-base cut-off current	$V_{CB} = 60\text{ V}; I_E = 0\text{ A}$	-	-	100	nA
		$V_{CB} = 60\text{ V}; I_E = 0\text{ A}; T_j = 150^\circ\text{C}$	-	-	50	μA
I_{CES}	collector-emitter cut-off current	$V_{CE} = 60\text{ V}; V_{BE} = 0\text{ V}$	-	-	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	$V_{CE} = 5\text{ V}; I_C = 1\text{ mA}$	250	500	-	
		$V_{CE} = 5\text{ V}; I_C = 500\text{ mA}$ [1]	200	420	-	
		$V_{CE} = 5\text{ V}; I_C = 1\text{ A}$ [1]	100	180	-	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 100\text{ mA}; I_B = 1\text{ mA}$	-	90	115	mV
		$I_C = 500\text{ mA}; I_B = 50\text{ mA}$	-	120	150	mV
		$I_C = 1\text{ A}; I_B = 100\text{ mA}$ [1]	-	230	280	mV
R_{CEsat}	collector-emitter saturation resistance	$I_C = 1\text{ A}; I_B = 100\text{ mA}$ [1]	-	230	280	m Ω
V_{BEsat}	base-emitter saturation voltage	$I_C = 1\text{ A}; I_B = 50\text{ mA}$ [1]	-	0.95	1.1	V
V_{BEon}	base-emitter turn-on voltage	$V_{CE} = 5\text{ V}; I_C = 1\text{ A}$ [1]	-	0.85	0.9	V
t_d	delay time	$I_C = 0.5\text{ A}; I_{Bon} = 25\text{ mA}; I_{Boff} = -25\text{ mA}$	-	11	-	ns
t_r	rise time		-	78	-	ns
t_{on}	turn-on time		-	90	-	ns
t_s	storage time		-	340	-	ns
t_f	fall time		-	160	-	ns
t_{off}	turn-off time		-	500	-	ns
f_T	transition frequency	$V_{CE} = 10\text{ V}; I_C = 50\text{ mA}; f = 100\text{ MHz}$	150	220	-	MHz
C_c	collector capacitance	$V_{CB} = 10\text{ V}; I_E = I_e = 0\text{ A}; f = 1\text{ MHz}$	-	5.5	10	pF

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



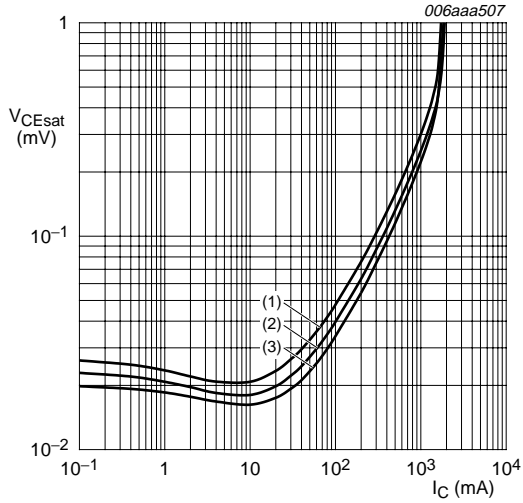
$V_{CE} = 5 V$
 (1) $T_{amb} = 100^\circ C$
 (2) $T_{amb} = 25^\circ C$
 (3) $T_{amb} = -55^\circ C$

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



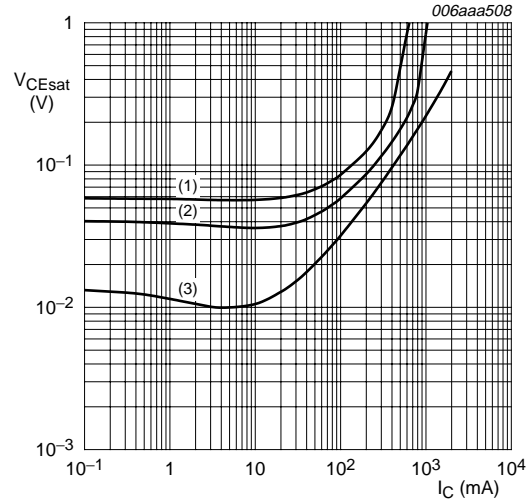
$V_{CE} = 5 V$
 (1) $T_{amb} = -55^\circ C$
 (2) $T_{amb} = 25^\circ C$
 (3) $T_{amb} = 100^\circ C$

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



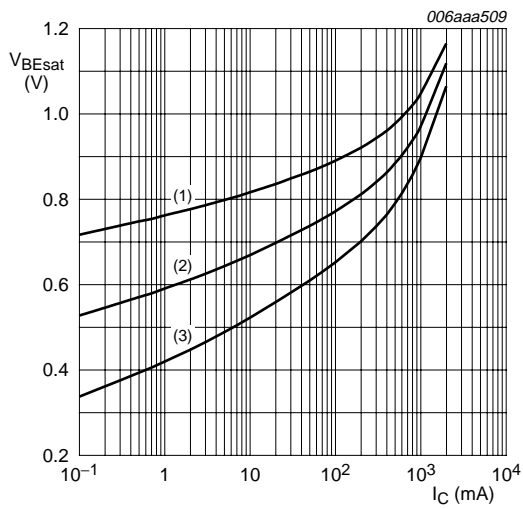
$I_C/I_B = 20$
 (1) $T_{amb} = 100^\circ C$
 (2) $T_{amb} = 25^\circ C$
 (3) $T_{amb} = -55^\circ C$

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



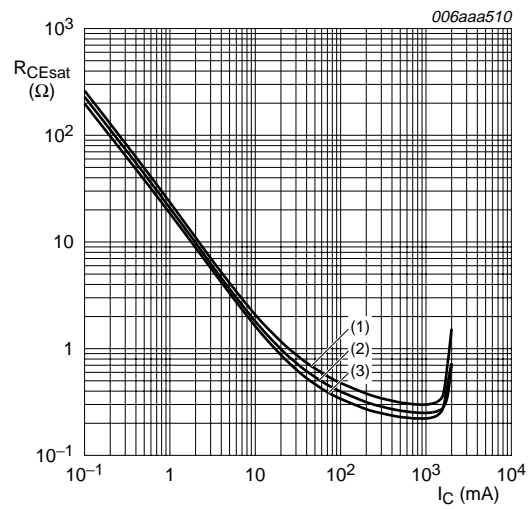
$T_{amb} = 25^\circ C$
 (1) $I_C/I_B = 100$
 (2) $I_C/I_B = 50$
 (3) $I_C/I_B = 10$

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



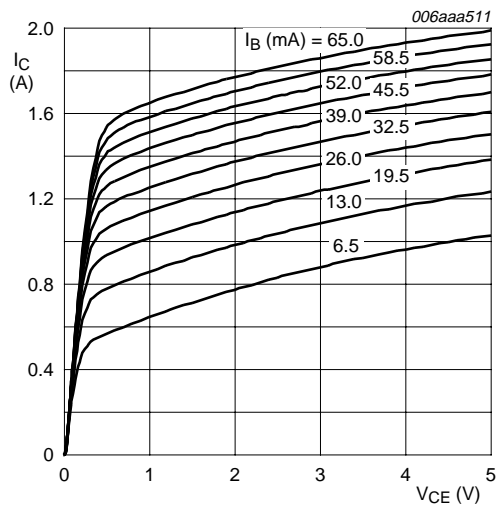
$I_C/I_B = 20$
 (1) $T_{amb} = -55\text{ °C}$
 (2) $T_{amb} = 25\text{ °C}$
 (3) $T_{amb} = 100\text{ °C}$

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



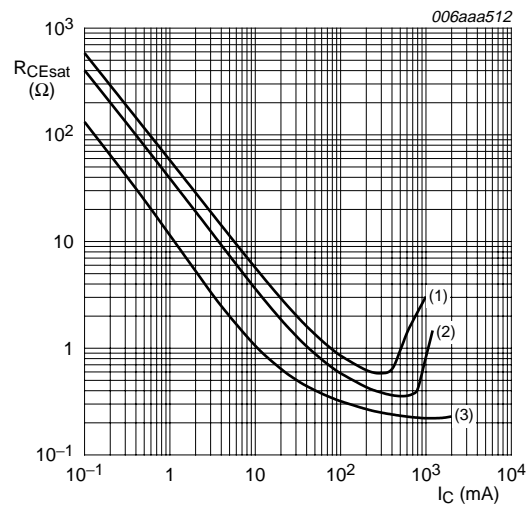
$I_C/I_B = 20$
 (1) $T_{amb} = 100\text{ °C}$
 (2) $T_{amb} = 25\text{ °C}$
 (3) $T_{amb} = -55\text{ °C}$

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



$T_{amb} = 25\text{ °C}$

Fig 11. Collector current as a function of collector-emitter voltage; 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

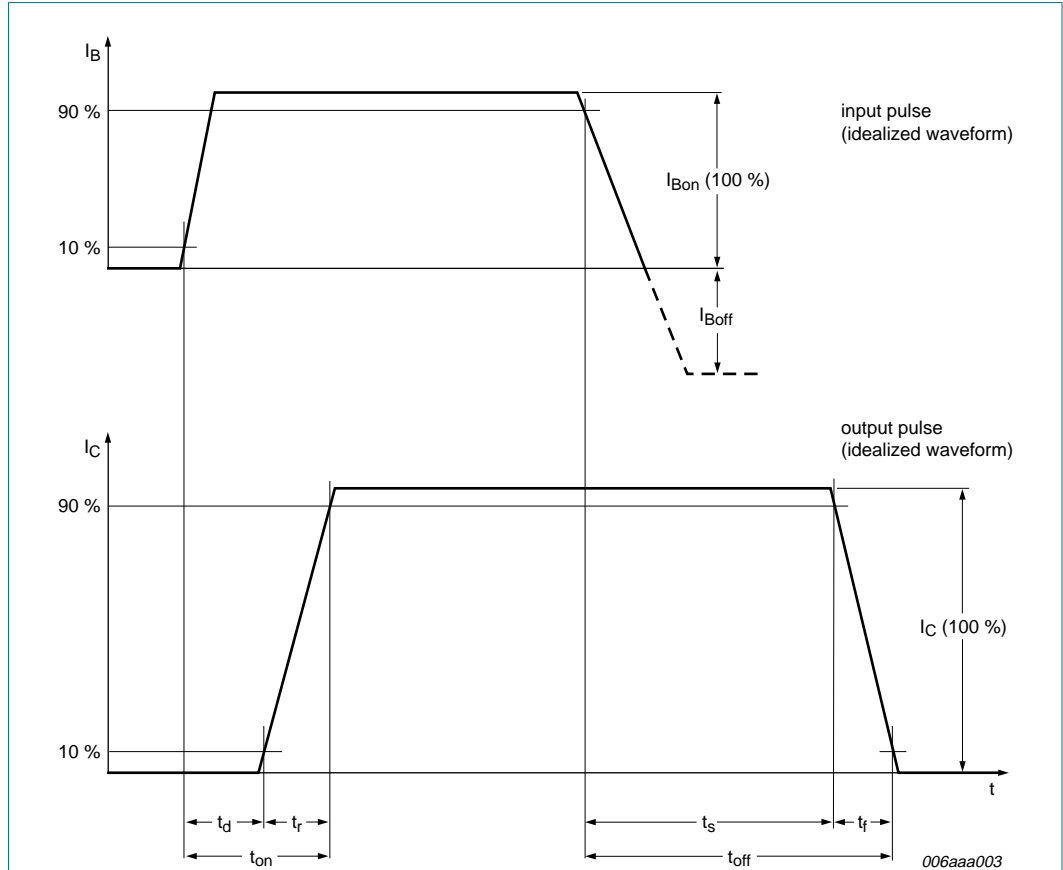
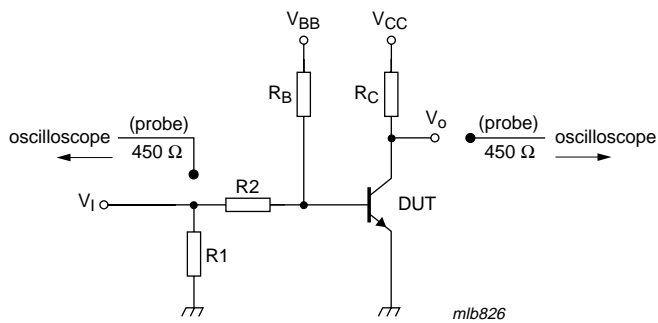


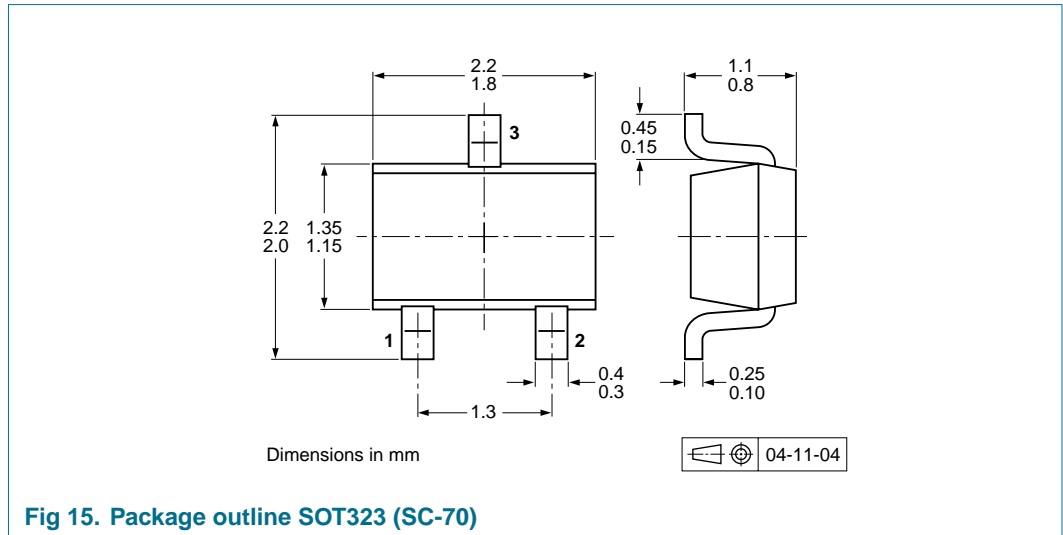
Fig 13. BISS transistor switching time definition



$I_C = 0.5 \text{ A}$; $I_{B_{on}} = 25 \text{ mA}$; $I_{B_{off}} = -25 \text{ mA}$; $R_1 = \text{open}$; $R_2 = 100 \text{ }\Omega$; $R_B = 300 \text{ }\Omega$; $R_C = 20 \text{ }\Omega$

Fig 14. Test circuit for switching times

9. Package outline



10. Packing information

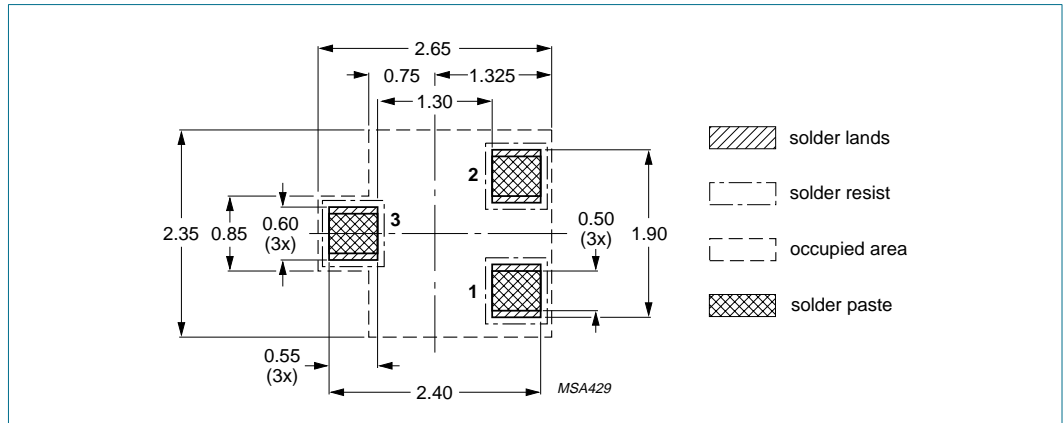
Table 8: Packing methods

The indicated -xxx are the last three digits of the 12NC ordering code. [\[1\]](#)

Type number	Package	Description	Packing quantity	
			3000	10000
PBSS4160U	SOT323	4 mm pitch, 8 mm tape and reel	-115	-135

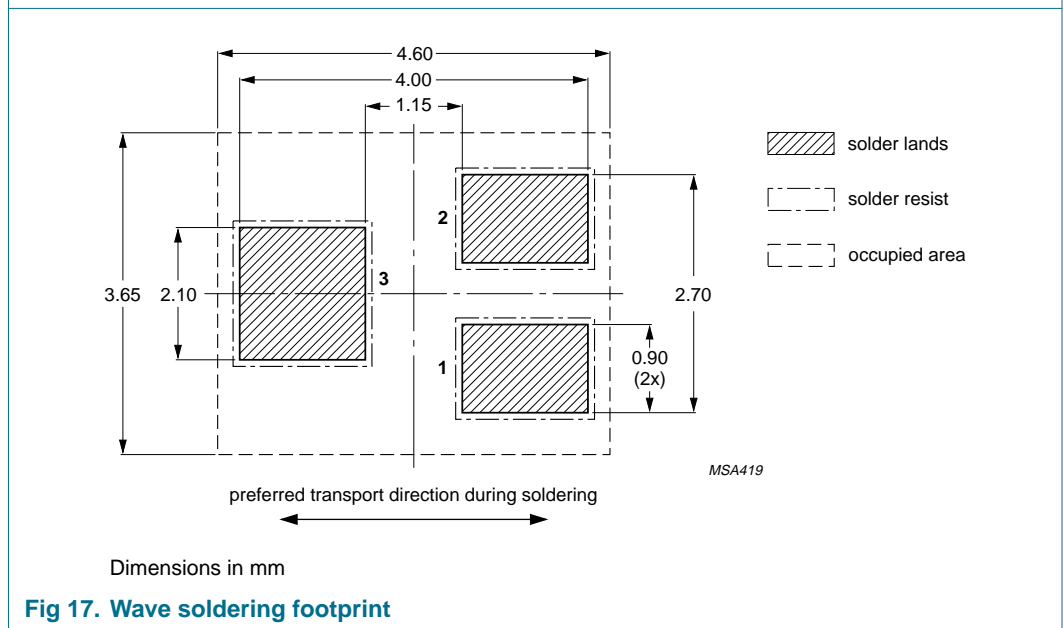
[1] For further information and the availability of packing methods, see [Section 17](#).

11. Soldering



Dimensions in mm

Fig 16. Reflow soldering footprint



Dimensions in mm

Fig 17. Wave soldering footprint

12. Revision history

Table 9: Revision history

Document ID	Release date	Data sheet status	Change notice	Doc. number	Supersedes
PBSS4160U_2	20050719	Product data sheet	-	-	PBSS4160U_1
Modifications:					
<ul style="list-style-type: none"> • Product status changed • Table 5 “Limiting values”: <td> entry superseded by maximum value • Figure 1 “Power derating curves”: added • Table 6 “Thermal characteristics”: <td> entry superseded by typical value • Figure 2 “Transient thermal impedance from junction to ambient as a function of pulse time; typical values”: added • Figure 3 “Transient thermal impedance from junction to ambient as a function of pulse time; typical values”: added • Figure 4 “Transient thermal impedance from junction to ambient as a function of pulse time; typical values”: added • Table 7 “Characteristics”: <td> entries superseded by typical values • Table 7 “Characteristics”: Switching times parameters t_d, t_r, t_{on}, t_s, t_f and t_{off} added • Figure 5 “DC current gain as a function of collector current; typical values”: added • Figure 6 “Base-emitter voltage as a function of collector current; typical values”: added • Figure 7 “Collector-emitter saturation voltage as a function of collector current; typical values”: added • Figure 8 “Collector-emitter saturation voltage as a function of collector current; typical values”: added • Figure 9 “Base-emitter saturation voltage as a function of collector current; typical values”: added • Figure 10 “Collector-emitter saturation resistance as a function of collector current; typical values”: added • Figure 11 “Collector current as a function of collector-emitter voltage; typical values”: added • Figure 12 “Collector-emitter saturation resistance as a function of collector current; typical values”: added • Figure 13 “BISS transistor switching time definition”: added • Figure 14 “Test circuit for switching times”: added • Section 10 “Packing information”: added • Section 11 “Soldering”: added • Section 16 “Trademarks”: added 					
PBSS4160U_1	20040423	Objective data sheet	-	9397 750 12886	-

13. Data sheet status

Level	Data sheet status ^[1]	Product status ^{[2] [3]}	Definition
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
II	Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
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[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

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Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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