



# PBSS4612PA

12 V, 6 A NPN low  $V_{CEsat}$  (BISS) transistor

Rev. 01 — 7 May 2010

Product data sheet

## 1. Product profile

### 1.1 General description

NPN low  $V_{CEsat}$  Breakthrough In Small Signal (BISS) transistor, encapsulated in an ultra thin SOT1061 leadless small Surface-Mounted Device (SMD) plastic package with medium power capability.

PNP complement: PBSS5612PA.

### 1.2 Features and benefits

- Low collector-emitter saturation voltage  $V_{CEsat}$
- High collector current capability  $I_C$  and  $I_{CM}$
- Smaller required Printed-Circuit Board (PCB) area than for conventional transistors
- Exposed heat sink for excellent thermal and electrical conductivity
- Leadless small SMD plastic package with medium power capability

### 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

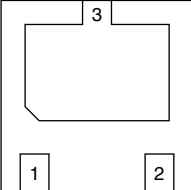
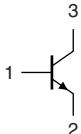
| Symbol      | Parameter                                  | Conditions                       | Min   | Typ | Max | Unit       |
|-------------|--|----------------------------------|-------|-----|-----|------------|
| $V_{CEO}$   | collector-emitter voltage                  | open base                        | -     | -   | 12  | V          |
| $I_C$       | collector current                          |                                  | -     | -   | 6   | A          |
| $I_{CM}$    | peak collector current                     | single pulse;<br>$t_p \leq 1$ ms | -     | -   | 7   | A          |
| $R_{CEsat}$ | collector-emitter<br>saturation resistance | $I_C = 6$ A;<br>$I_B = 300$ mA   | [1] - | 33  | 46  | 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        |  <p>Transparent top view</p> |  <p>sym021</p> |
| 2   | emitter     |   |   |
| 3   | collector   |   |   |

## 3. Ordering information

Table 3. Ordering information

| Type number | Package |  |         |
|-------------|---------|--|---------|
|             | Name    | Description  | Version |
| PBSS4612PA  | HUSON3  | plastic thermal enhanced ultra thin small outline package; no leads; three terminals; body 2 × 2 × 0.65 mm | SOT1061 |

## 4. Marking

Table 4. Marking codes

| Type number | Marking code |
|-------------|--------------|
| PBSS4612PA  | A5           |

## 5. Limiting values

Table 5. Limiting values

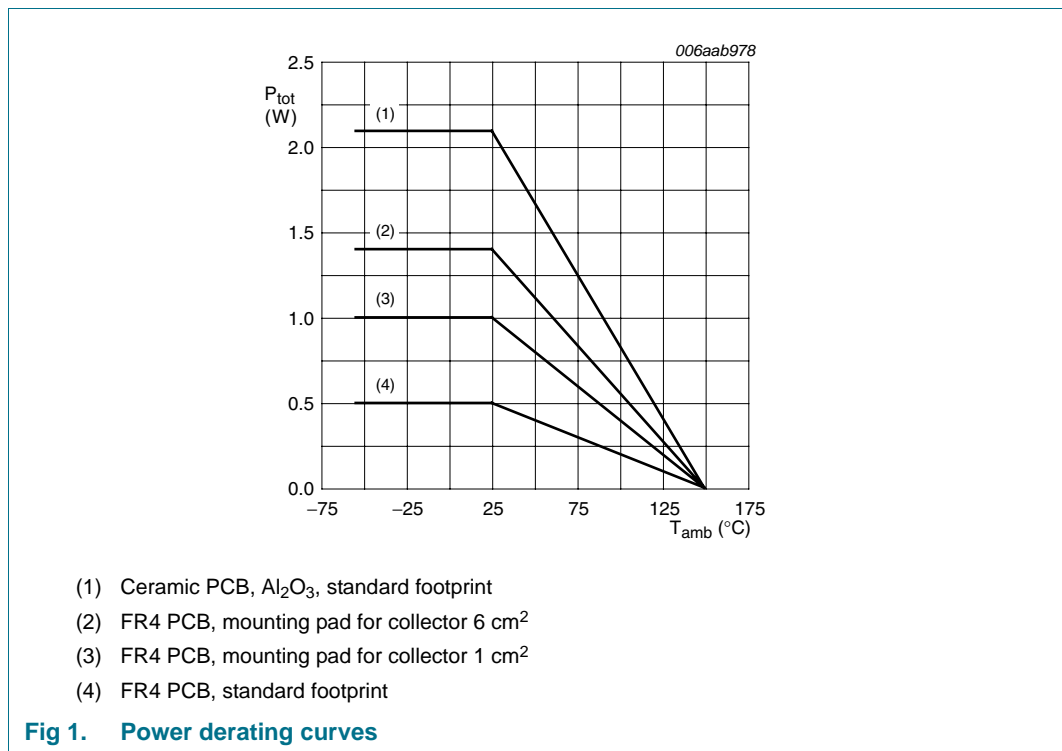
In accordance with the Absolute Maximum Rating System (IEC 60134).

| 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                   | -   | 6   | V    |    |
| $I_C$     | collector current         |                                  | -   | 6   | A    |    |
| $I_{CM}$  | peak collector current    | single pulse;<br>$t_p \leq 1$ ms | -   | 7   | A    |    |
| $I_B$     | base current              |                                  | -   | 600 | mA   |    |
| $P_{tot}$ | total power dissipation   | $T_{amb} \leq 25$ °C             | [1] | -   | 500  | mW |
|           |                           |                                  | [2] | -   | 1    | W  |
|           |                           |                                  | [3] | -   | 1.4  | W  |
|           |                           |                                  | [4] | -   | 2.1  | W  |

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

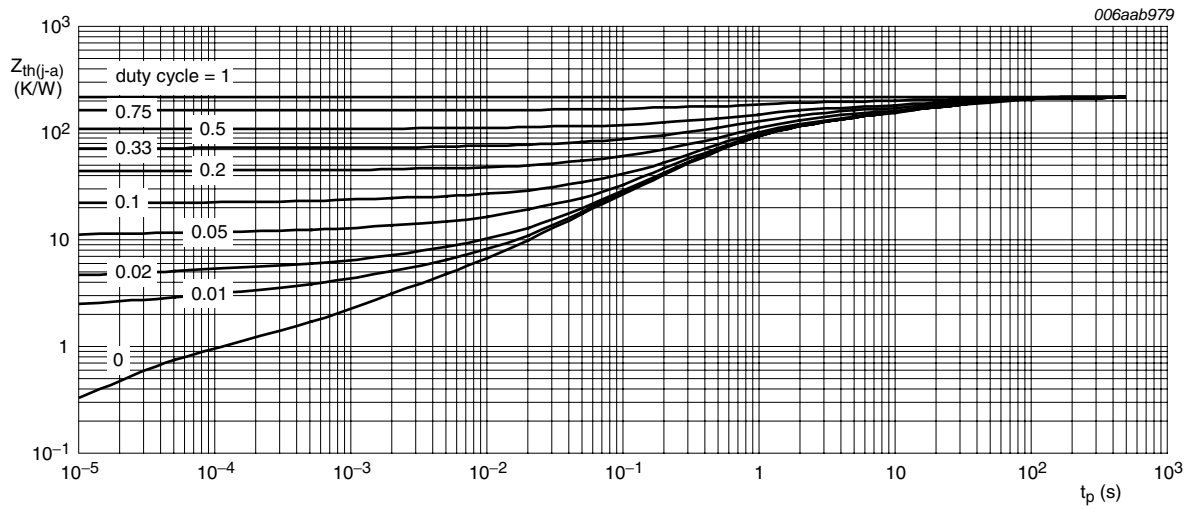


## 6. Thermal characteristics

**Table 6. Thermal characteristics**

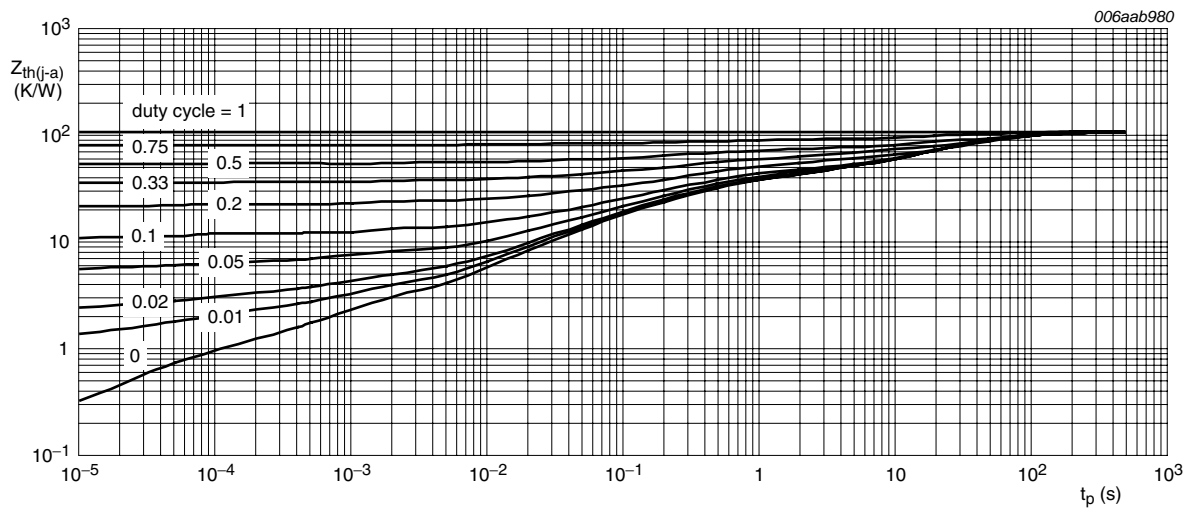
| Symbol        | Parameter                                   | Conditions  | Min | Typ | Max | Unit |     |
|---------------|---|-------------|-----|-----|-----|------|-----|
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | [1] | -   | -   | 250  | K/W |
|               |   |             | [2] | -   | -   | 125  | K/W |
|               |   |             | [3] | -   | -   | 90   | K/W |
|               |   |             | [4] | -   | -   | 60   | 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 cm<sup>2</sup>.
- [3] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 6 cm<sup>2</sup>.
- [4] Device mounted on a ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint.



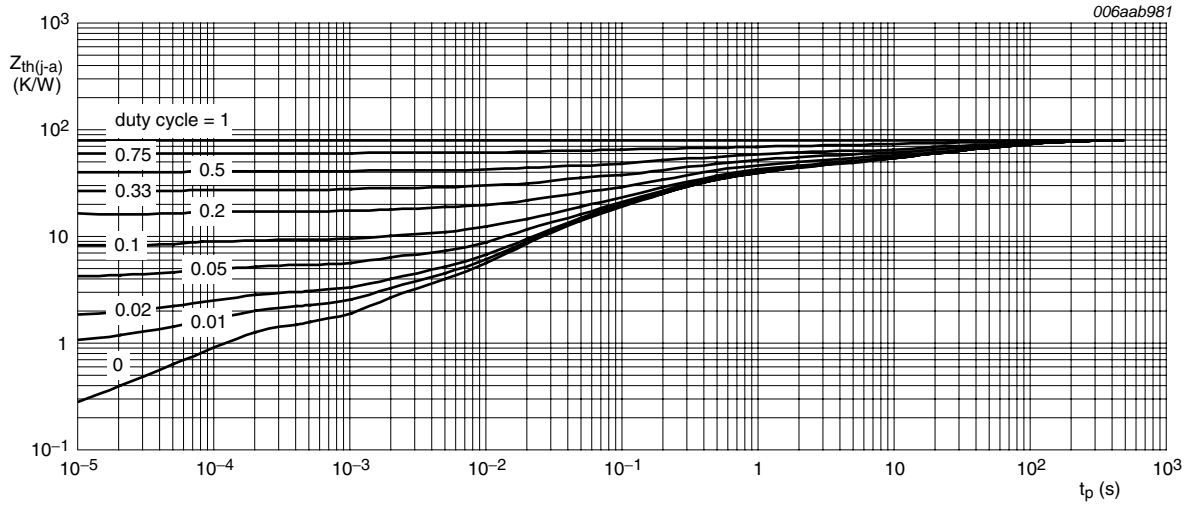
FR4 PCB, standard footprint

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



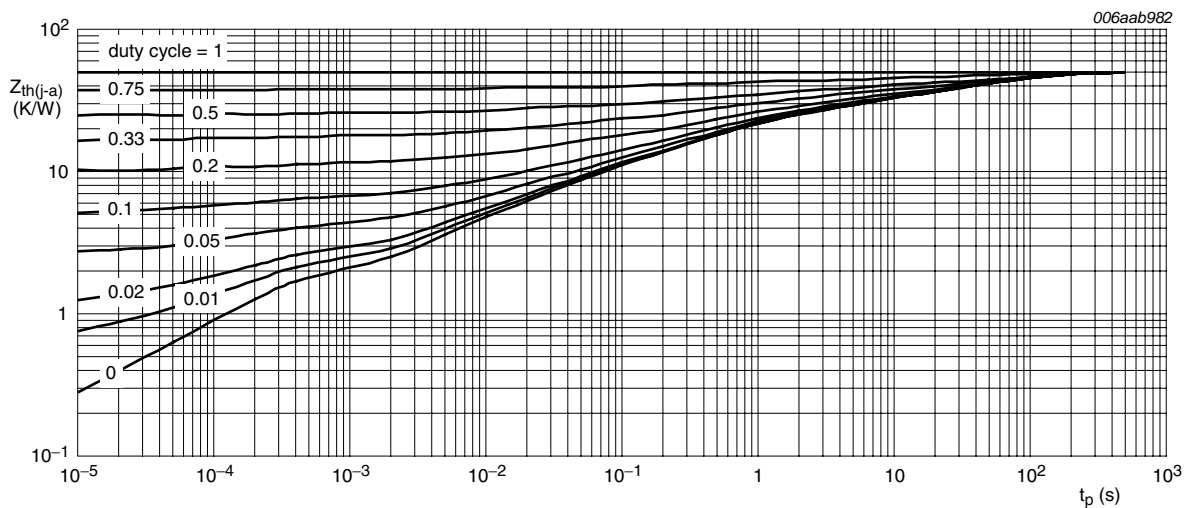
FR4 PCB, mounting pad for collector 1 cm<sup>2</sup>

Fig 3. 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 4. 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

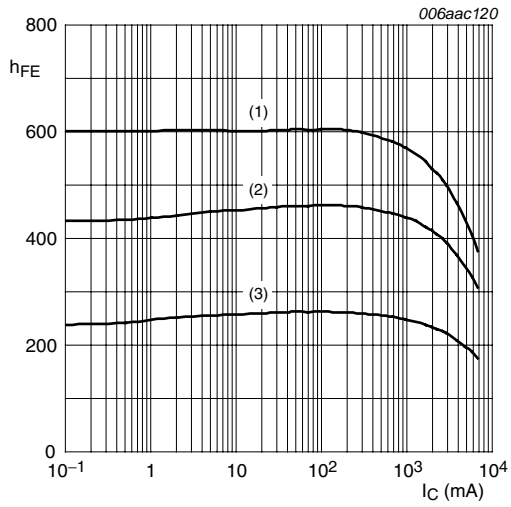
Fig 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

## 7. Characteristics

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

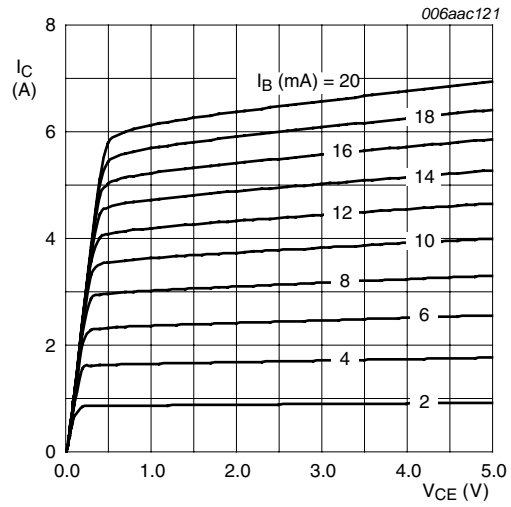
| Symbol      | Parameter                               | Conditions  | Min | Typ | Max  | Unit          |                  |
|-------------|---|---|-----|-----|------|---------------|------------------|
| $I_{CBO}$   | collector-base cut-off current          | $V_{CB} = 9.6\text{ V}; I_E = 0\text{ A}$   | -   | -   | 100  | nA            |                  |
|             |   | $V_{CB} = 9.6\text{ V}; I_E = 0\text{ A}; T_j = 150\text{ }^{\circ}\text{C}$              | -   | -   | 50   | $\mu\text{A}$ |                  |
| $I_{CES}$   | collector-emitter cut-off current       | $V_{CE} = 9.6\text{ V}; V_{BE} = 0\text{ V}$  | -   | -   | 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                         | $V_{CE} = 2\text{ V}$   | [1] |     |      |               |                  |
|             |   | $I_C = 0.5\text{ A}$  | 280 | 440 | -    |               |                  |
|             |   | $I_C = 1\text{ A}$  | 270 | 430 | -    |               |                  |
|             |   | $I_C = 2\text{ A}$  | 260 | 415 | -    |               |                  |
|             |   | $I_C = 6\text{ A}$  | 200 | 330 | -    |               |                  |
| $V_{CEsat}$ | collector-emitter saturation voltage    | $I_C = 0.5\text{ A}; I_B = 50\text{ mA}$  | [1] | -   | 20   | 30            | mV               |
|             |   | $I_C = 1\text{ A}; I_B = 50\text{ mA}$  | [1] | -   | 37   | 55            | mV               |
|             |   | $I_C = 1\text{ A}; I_B = 10\text{ mA}$  | [1] | -   | 50   | 70            | mV               |
|             |   | $I_C = 2\text{ A}; I_B = 20\text{ mA}$  | [1] | -   | 85   | 120           | mV               |
|             |   | $I_C = 3\text{ A}; I_B = 30\text{ mA}$  | [1] | -   | 120  | 170           | mV               |
|             |   | $I_C = 4\text{ A}; I_B = 400\text{ mA}$   | [1] | -   | 135  | 185           | mV               |
|             |   | $I_C = 6\text{ A}; I_B = 300\text{ mA}$   | [1] | -   | 200  | 275           | mV               |
| $R_{CEsat}$ | collector-emitter saturation resistance | $I_C = 6\text{ A}; I_B = 300\text{ mA}$   | [1] | -   | 33   | 46            | $\text{m}\Omega$ |
| $V_{BEsat}$ | base-emitter saturation voltage         | $I_C = 1\text{ A}; I_B = 10\text{ mA}$  | [1] | -   | 0.75 | 0.9           | V                |
|             |   | $I_C = 6\text{ A}; I_B = 300\text{ mA}$   | [1] | -   | 0.97 | 1.1           | V                |
| $V_{BEon}$  | base-emitter turn-on voltage            | $V_{CE} = 2\text{ V}; I_C = 2\text{ A}$   | [1] | -   | 0.74 | 0.9           | V                |
| $t_d$       | delay time                              | $V_{CC} = 9\text{ V}; I_C = 2\text{ A}; I_{Bon} = 0.1\text{ A}; I_{Boff} = -0.1\text{ A}$ | -   | 25  | -    | ns            |                  |
| $t_r$       | rise time                               |   | -   | 55  | -    | ns            |                  |
| $t_{on}$    | turn-on time                            |   | -   | 80  | -    | ns            |                  |
| $t_s$       | storage time                            |   | -   | 285 | -    | ns            |                  |
| $t_f$       | fall time                               |   | -   | 50  | -    | ns            |                  |
| $t_{off}$   | turn-off time                           |   | -   | 335 | -    | ns            |                  |
| $f_T$       | transition frequency                    | $V_{CE} = 10\text{ V}; I_C = 100\text{ mA}; f = 100\text{ MHz}$                           | 50  | 80  | -    | MHz           |                  |
| $C_c$       | collector capacitance                   | $V_{CB} = 10\text{ V}; I_E = I_e = 0\text{ A}; f = 1\text{ MHz}$                          | -   | 80  | 95   | pF            |                  |

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



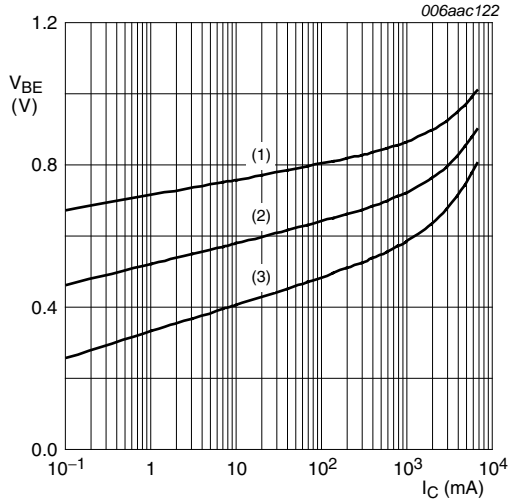
$V_{CE} = 2 V$   
 (1)  $T_{amb} = 100^\circ C$   
 (2)  $T_{amb} = 25^\circ C$   
 (3)  $T_{amb} = -55^\circ C$

**Fig 6. DC current gain as a function of collector current; typical values**



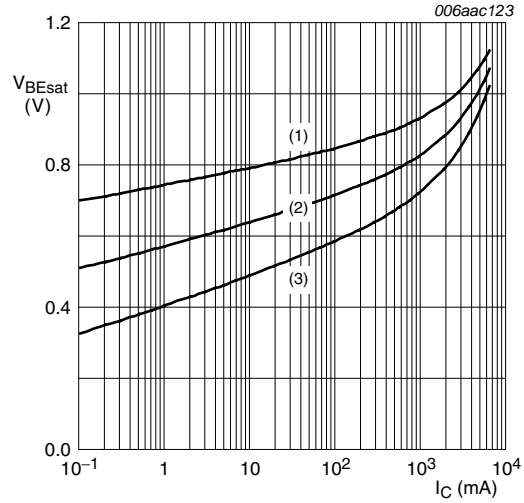
$T_{amb} = 25^\circ C$

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



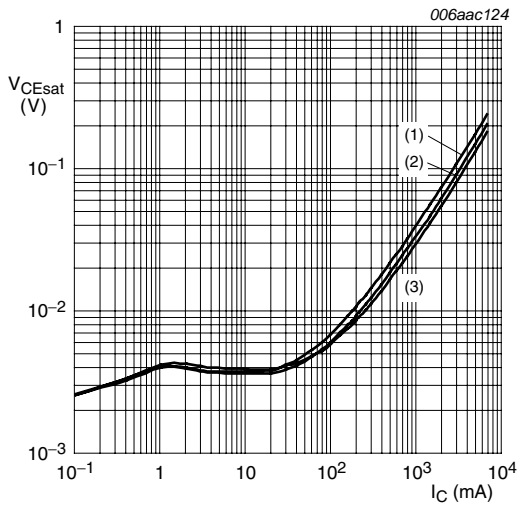
$V_{CE} = 2 V$   
 (1)  $T_{amb} = -55^\circ C$   
 (2)  $T_{amb} = 25^\circ C$   
 (3)  $T_{amb} = 100^\circ C$

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



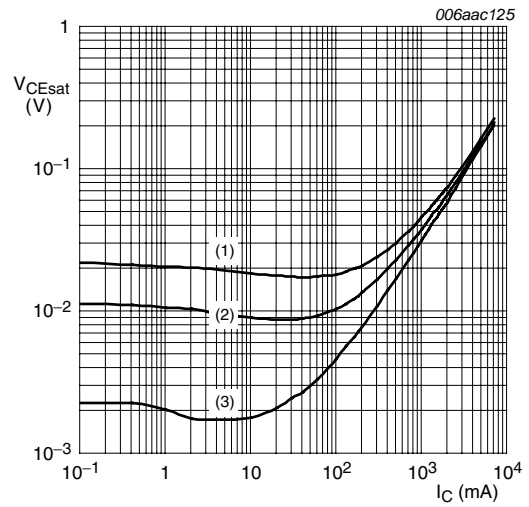
$I_C/I_B = 20$   
 (1)  $T_{amb} = -55^\circ C$   
 (2)  $T_{amb} = 25^\circ C$   
 (3)  $T_{amb} = 100^\circ C$

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



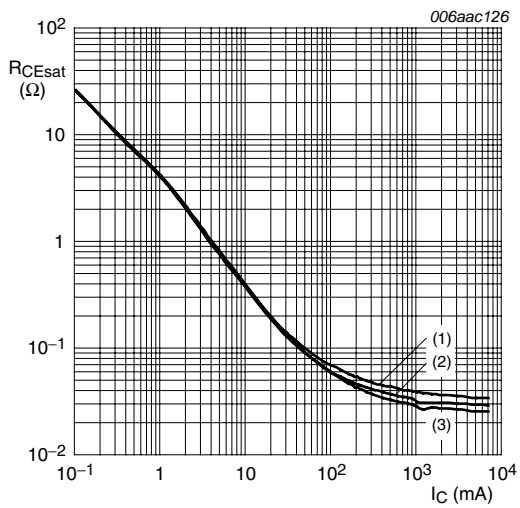
- $I_C/I_B = 20$
- (1)  $T_{amb} = 100\text{ °C}$
  - (2)  $T_{amb} = 25\text{ °C}$
  - (3)  $T_{amb} = -55\text{ °C}$

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



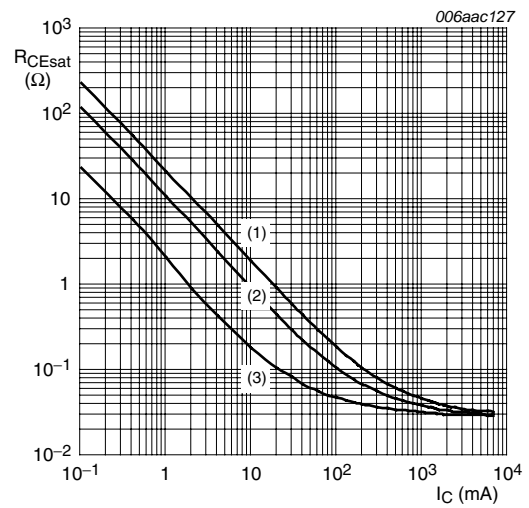
- $T_{amb} = 25\text{ °C}$
- (1)  $I_C/I_B = 100$
  - (2)  $I_C/I_B = 50$
  - (3)  $I_C/I_B = 10$

**Fig 11. 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 12. Collector-emitter saturation resistance as a function of collector current; typical values**

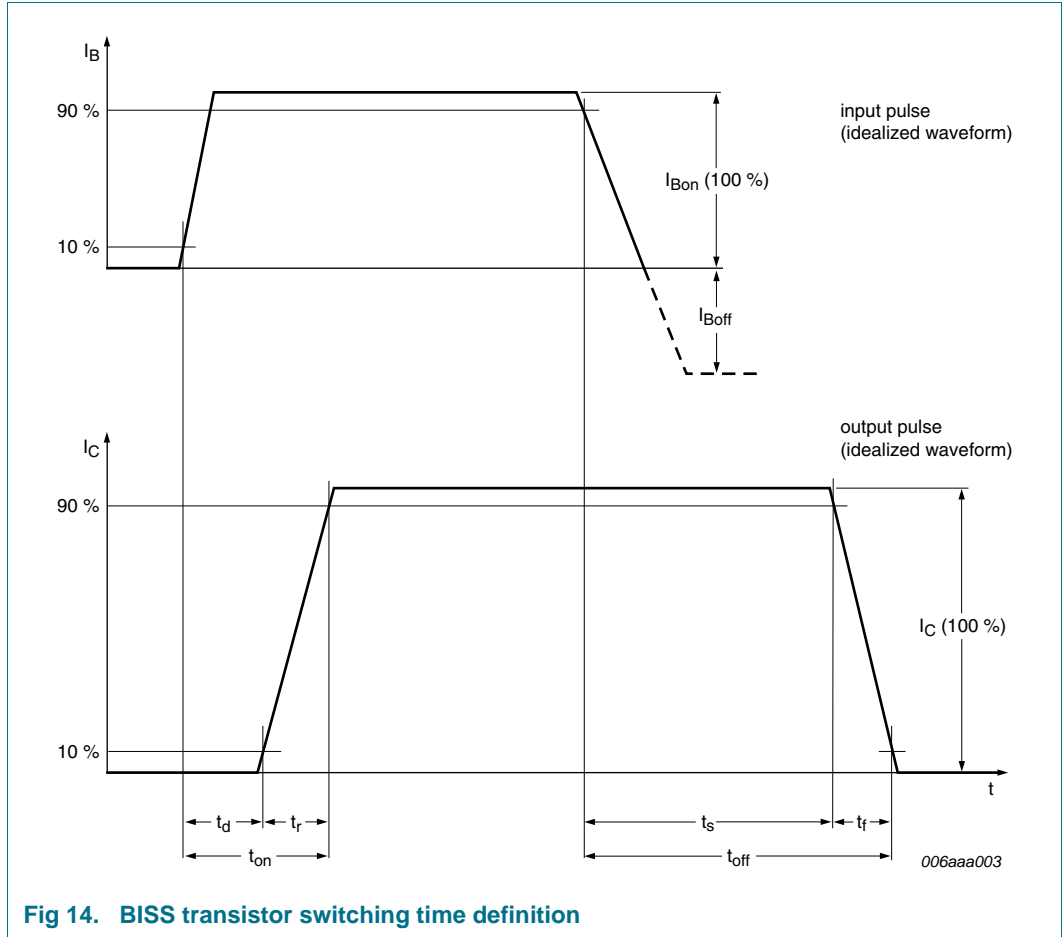


- $T_{amb} = 25\text{ °C}$
- (1)  $I_C/I_B = 100$
  - (2)  $I_C/I_B = 50$
  - (3)  $I_C/I_B = 10$

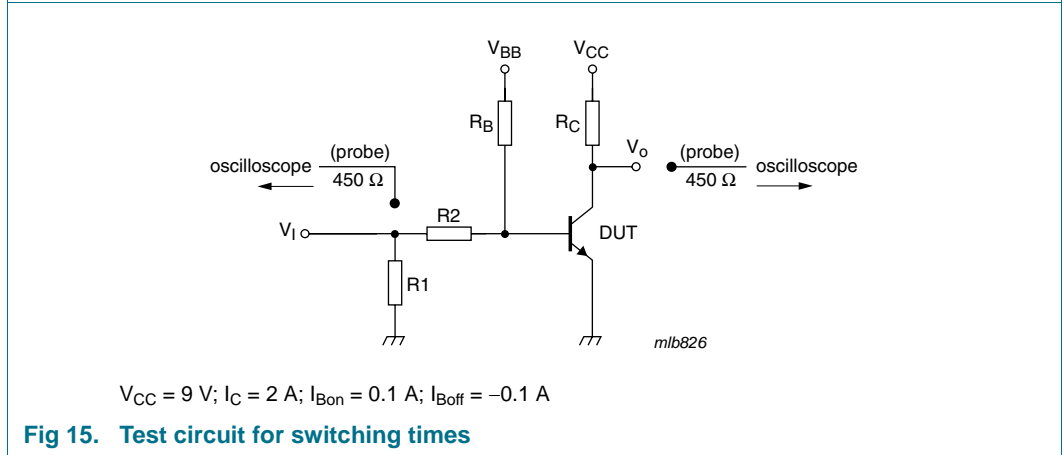
**Fig 13. Collector-emitter saturation resistance as a function of collector current; typical values**



**8. Test information**

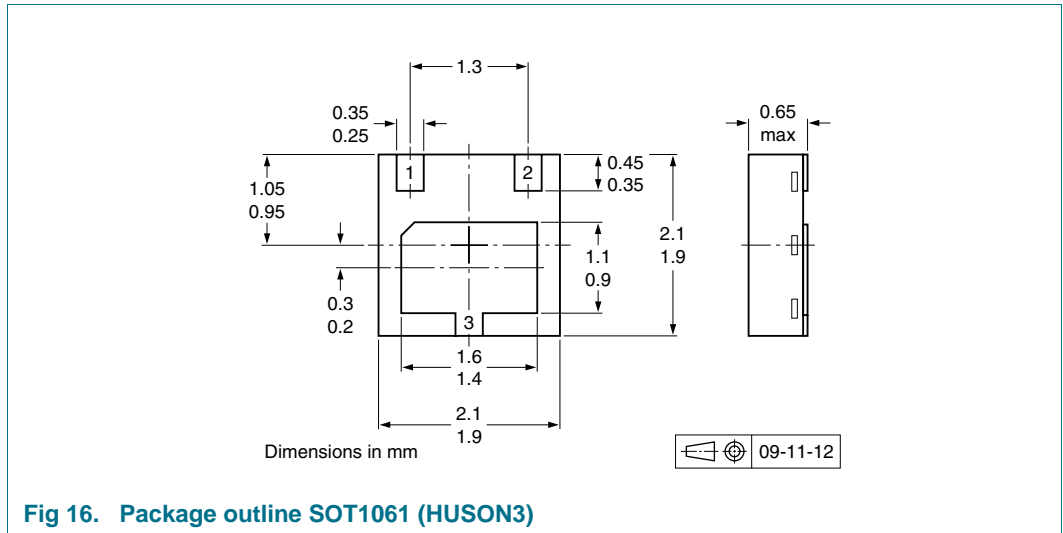


**Fig 14. BISS transistor switching time definition**



**Fig 15. Test circuit for switching times**

## 9. Package outline



## 10. Packing information

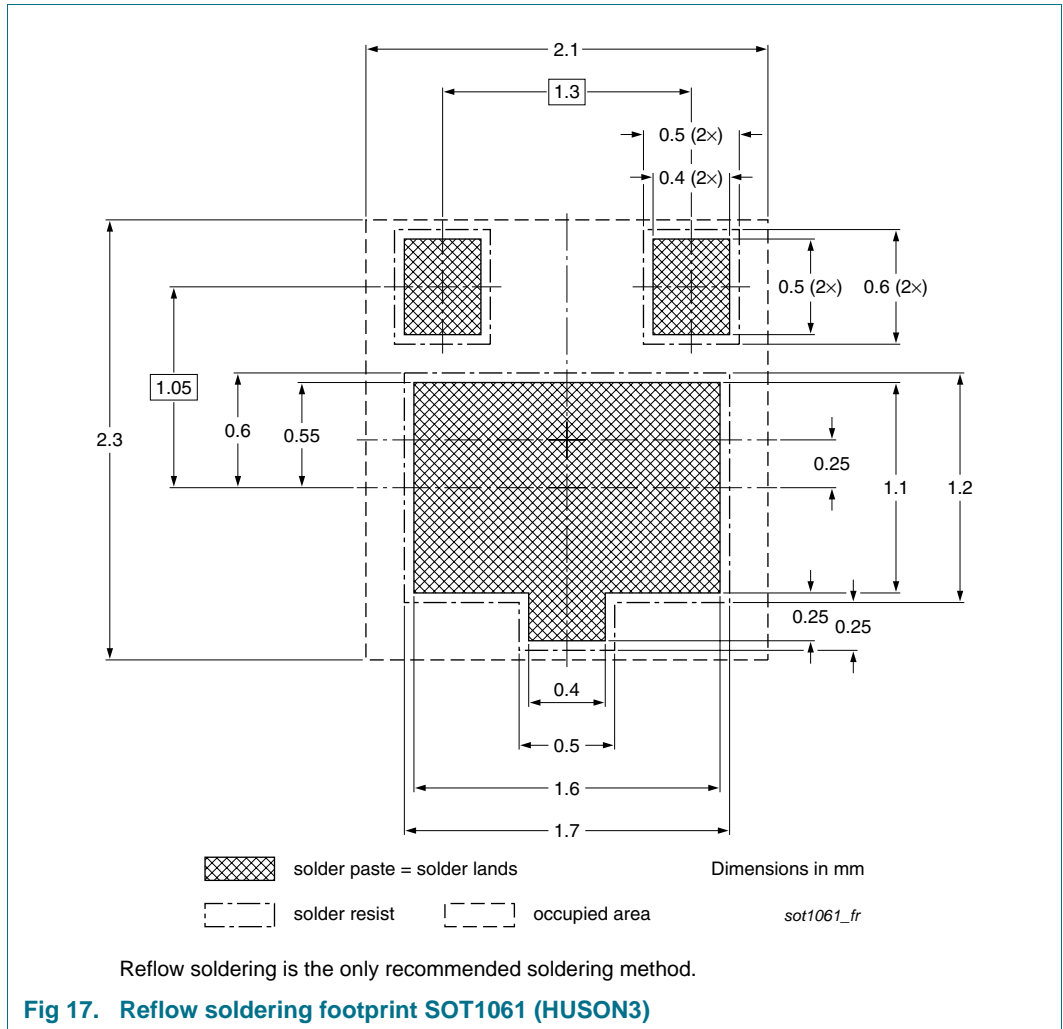
**Table 8. Packing methods**

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

| Type number | Package | Description                    | Packing quantity |
|-------------|---------|--------------------------------|------------------|
| PBSS4612PA  | SOT1061 | 4 mm pitch, 8 mm tape and reel | 3000             |
|             |         |                                | -115             |

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

**11. Soldering**



## 12. Revision history

Table 9. Revision history

| Document ID    | Release date | Data sheet status  | Change notice | Supersedes |
|----------------|--------------|--------------------|---------------|------------|
| PBSS4612PA v.1 | 20100507     | 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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