

# PBSS3515E

15 V, 0.5 A PNP low  $V_{CEsat}$  (BISS) transistor

Rev. 02 — 27 April 2009

Product data sheet

## 1. Product profile

### 1.1 General description

PNP low  $V_{CEsat}$  Breakthrough In Small Signal (BISS) transistor in an ultra small SOT416 (SC-75) Surface-Mounted Device (SMD) plastic package.

NPN complement: PBSS2515E.

### 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
- Low power switches (e.g. motors, fans)
- Portable applications

### 1.4 Quick reference data

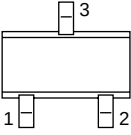
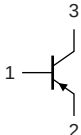
Table 1. Quick reference data

| Symbol      | Parameter                                  | Conditions                         | Min                   | Typ | Max  | Unit       |
|-------------|--------------------------------------------|------------------------------------|-----------------------|-----|------|------------|
| $V_{CEO}$   | collector-emitter voltage                  | open base                          | -                     | -   | -15  | V          |
| $I_C$       | collector current                          |                                    | -                     | -   | -0.5 | A          |
| $I_{CM}$    | peak collector current                     | single pulse;<br>$t_p \leq 1$ ms   | -                     | -   | -1   | A          |
| $R_{CEsat}$ | collector-emitter<br>saturation resistance | $I_C = -500$ mA;<br>$I_B = -50$ mA | <a href="#">[1]</a> - | 300 | 500  | 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   | emitter     |                                                                                     |                                                                                     |
| 3   | collector   |                                                                                     |                                                                                     |

sym013

## 3. Ordering information

Table 3. Ordering information

| Type number | Package |                                          |         |
|-------------|---------|------------------------------------------|---------|
|             | Name    | Description                              | Version |
| PBSS3515E   | SC-75   | plastic surface-mounted package; 3 leads | SOT416  |

## 4. Marking

Table 4. Marking codes

| Type number | Marking code |
|-------------|--------------|
| PBSS3515E   | 1R           |

## 5. Limiting values

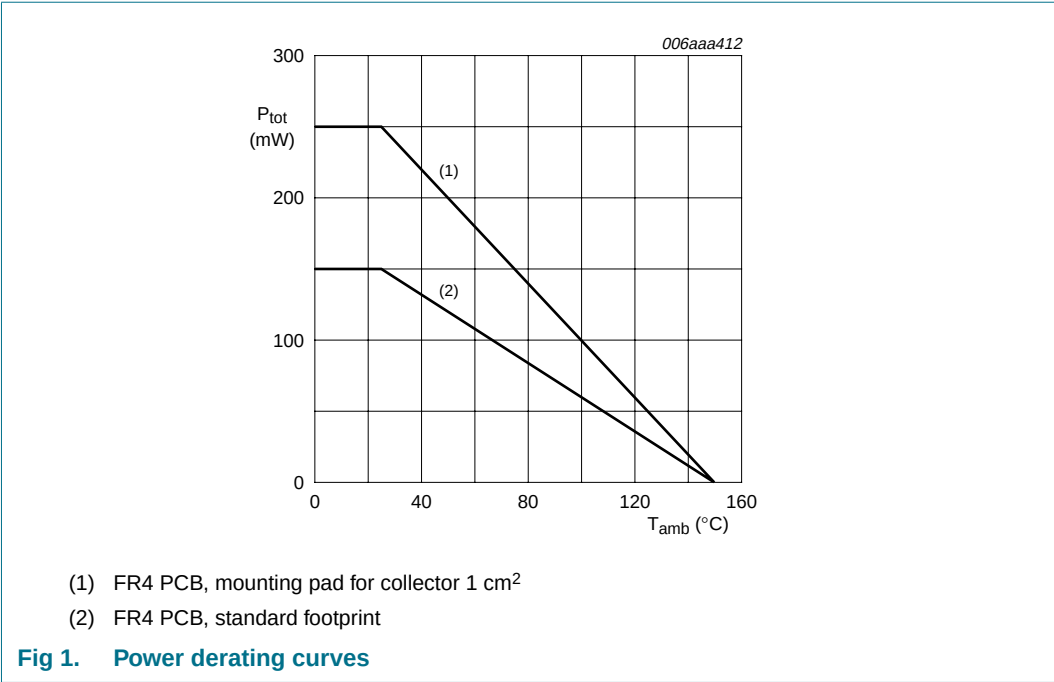
Table 5. Limiting values

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

| Symbol    | Parameter                 | Conditions                       | Min | Max  | Unit |
|-----------|---------------------------|----------------------------------|-----|------|------|
| $V_{CBO}$ | collector-base voltage    | open emitter                     | -   | -15  | V    |
| $V_{CEO}$ | collector-emitter voltage | open base                        | -   | -15  | V    |
| $V_{EBO}$ | emitter-base voltage      | open collector                   | -   | -6   | V    |
| $I_C$     | collector current         |                                  | -   | -0.5 | A    |
| $I_{CM}$  | peak collector current    | single pulse;<br>$t_p \leq 1$ ms | -   | -1   | A    |
| $I_{BM}$  | peak base current         | single pulse;<br>$t_p \leq 1$ ms | -   | -100 | mA   |
| $P_{tot}$ | total power dissipation   | $T_{amb} \leq 25$ °C             | [1] | 150  | mW   |
|           |                           |                                  | [2] | 250  | 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 cm<sup>2</sup>.



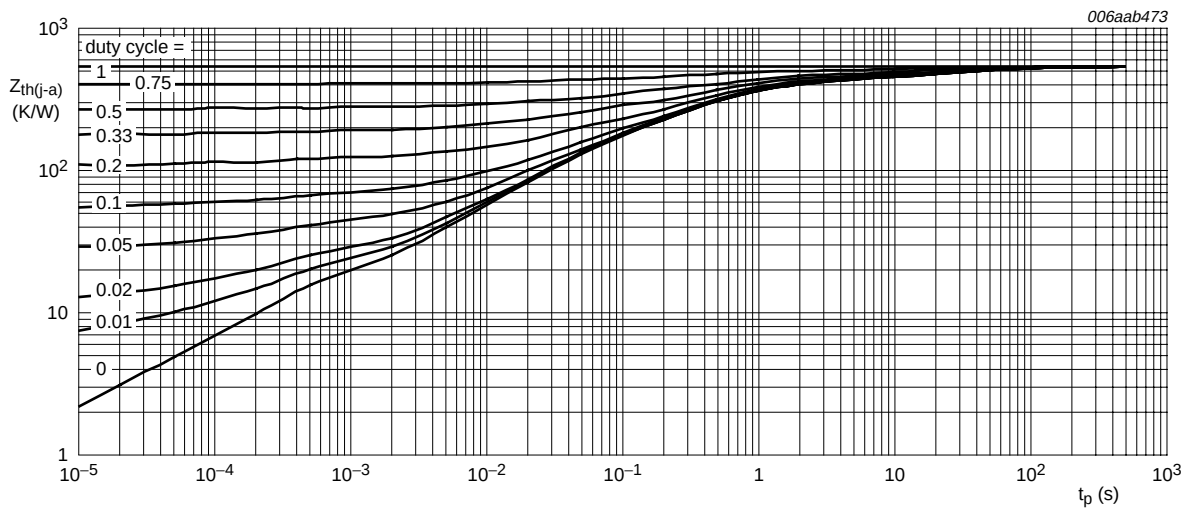
6. Thermal characteristics

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] | -   | 833 | K/W  |
|                |                                                  |             | [2] | -   | 500 | K/W  |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point |             | -   | -   | 175 | K/W  |

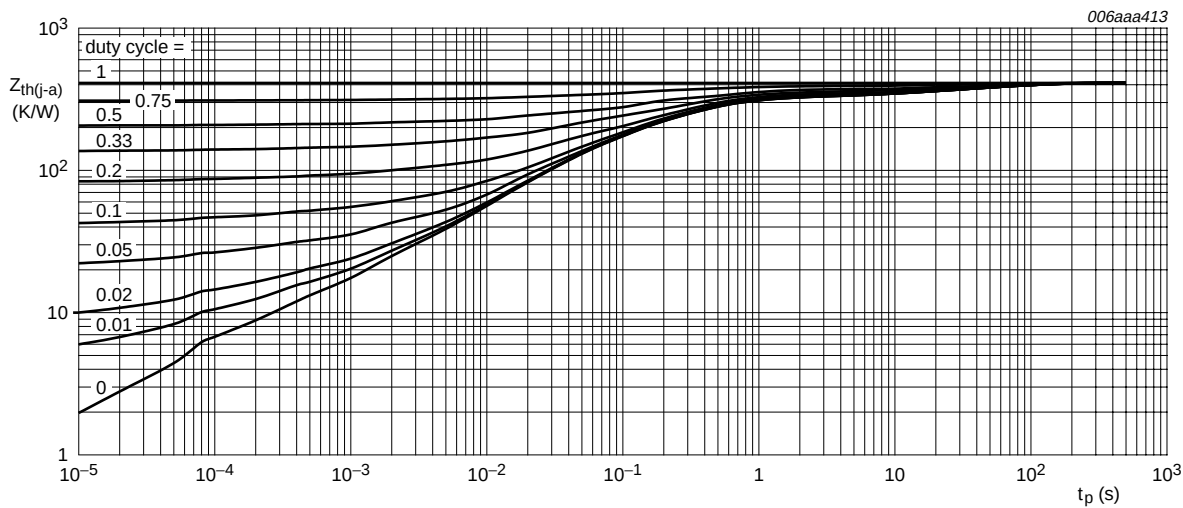
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.



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

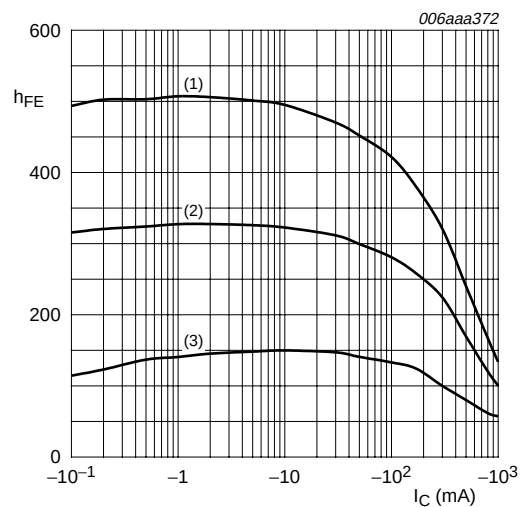
## 7. Characteristics

**Table 7. Characteristics**

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

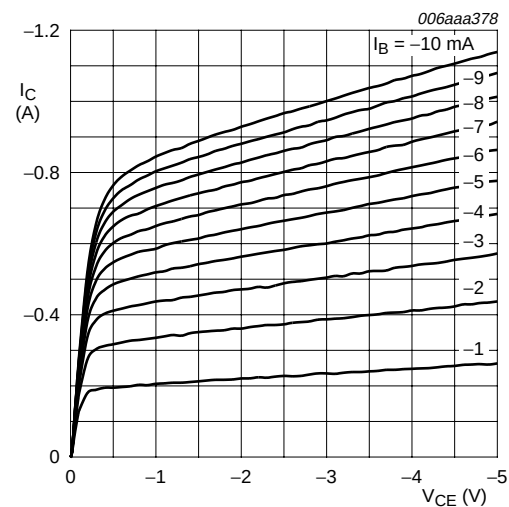
| Symbol      | Parameter                               | Conditions                                                                                          | Min   | Typ | Max  | Unit             |
|-------------|-----------------------------------------|-----------------------------------------------------------------------------------------------------|-------|-----|------|------------------|
| $I_{CBO}$   | collector-base cut-off current          | $V_{CB} = -15\text{ V}; I_E = 0\text{ A}$                                                           | -     | -   | -100 | nA               |
|             |                                         | $V_{CB} = -15\text{ V}; I_E = 0\text{ A}; T_j = 150\text{ }^{\circ}\text{C}$                        | -     | -   | -50  | $\mu\text{A}$    |
| $I_{EBO}$   | emitter-base cut-off current            | $V_{EB} = -5\text{ V}; I_C = 0\text{ A}$                                                            | -     | -   | -100 | nA               |
| $h_{FE}$    | DC current gain                         | $V_{CE} = -2\text{ V}; I_C = -10\text{ mA}$                                                         | 200   | -   | -    |                  |
|             |                                         | $V_{CE} = -2\text{ V}; I_C = -100\text{ mA}$ [1]                                                    | 150   | -   | -    |                  |
|             |                                         | $V_{CE} = -2\text{ V}; I_C = -500\text{ mA}$ [1]                                                    | 90    | -   | -    |                  |
| $V_{CEsat}$ | collector-emitter saturation voltage    | $I_C = -10\text{ mA}; I_B = -0.5\text{ mA}$                                                         | -     | -   | -25  | mV               |
|             |                                         | $I_C = -200\text{ mA}; I_B = -10\text{ mA}$                                                         | -     | -   | -150 | mV               |
|             |                                         | $I_C = -500\text{ mA}; I_B = -50\text{ mA}$ [1]                                                     | -     | -   | -250 | mV               |
| $R_{CEsat}$ | collector-emitter saturation resistance | $I_C = -500\text{ mA}; I_B = -50\text{ mA}$                                                         | [1] - | 300 | 500  | $\text{m}\Omega$ |
| $V_{BEsat}$ | base-emitter saturation voltage         | $I_C = -500\text{ mA}; I_B = -50\text{ mA}$                                                         | [1] - | -   | -1.1 | V                |
| $V_{BEon}$  | base-emitter turn-on voltage            | $V_{CE} = -2\text{ V}; I_C = -100\text{ mA}$                                                        | [1] - | -   | -0.9 | V                |
| $t_d$       | delay time                              | $V_{CC} = -11\text{ V}; I_C = -250\text{ mA}; I_{Bon} = -12.5\text{ mA}; I_{Boff} = 12.5\text{ mA}$ | -     | 10  | -    | ns               |
| $t_r$       | rise time                               |                                                                                                     | -     | 22  | -    | ns               |
| $t_{on}$    | turn-on time                            |                                                                                                     | -     | 32  | -    | ns               |
| $t_s$       | storage time                            |                                                                                                     | -     | 125 | -    | ns               |
| $t_f$       | fall time                               |                                                                                                     | -     | 37  | -    | ns               |
| $t_{off}$   | turn-off time                           |                                                                                                     | -     | 162 | -    | ns               |
| $f_T$       | transition frequency                    | $V_{CE} = -5\text{ V}; I_C = -100\text{ mA}; f = 100\text{ MHz}$                                    | 100   | 280 | -    | MHz              |
| $C_c$       | collector capacitance                   | $V_{CB} = -10\text{ V}; I_E = I_C = 0\text{ A}; f = 1\text{ MHz}$                                   | -     | -   | 10   | pF               |

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



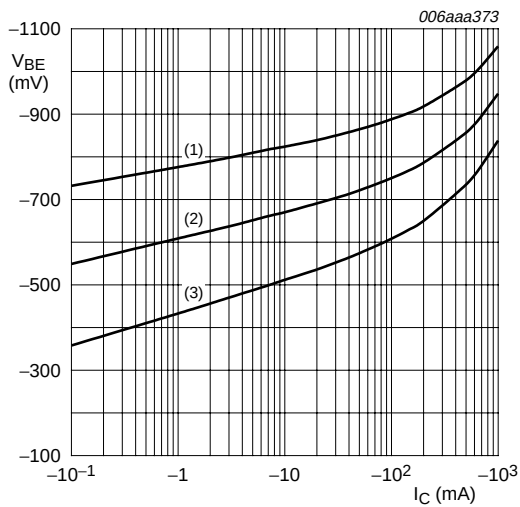
- $V_{CE} = -2\text{ V}$
- (1)  $T_{amb} = 100^\circ C$
  - (2)  $T_{amb} = 25^\circ C$
  - (3)  $T_{amb} = -55^\circ C$

Fig 4. DC current gain as a function of collector current; typical values



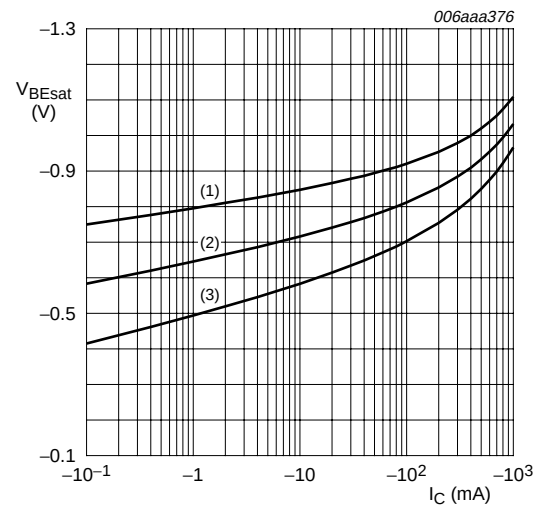
$T_{amb} = 25^\circ C$

Fig 5. Collector current as a function of collector-emitter voltage; typical values



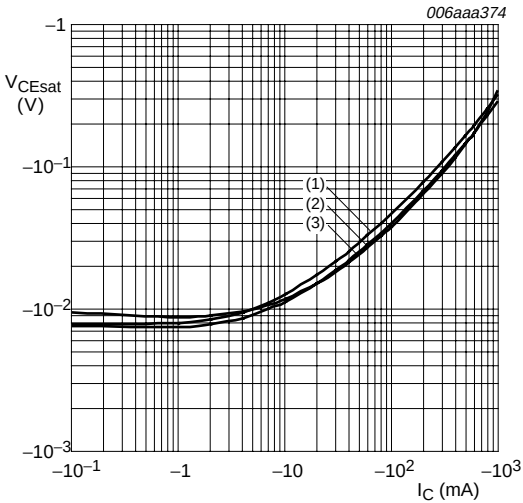
- $V_{CE} = -2\text{ V}$
- (1)  $T_{amb} = -55^\circ C$
  - (2)  $T_{amb} = 25^\circ C$
  - (3)  $T_{amb} = 100^\circ C$

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



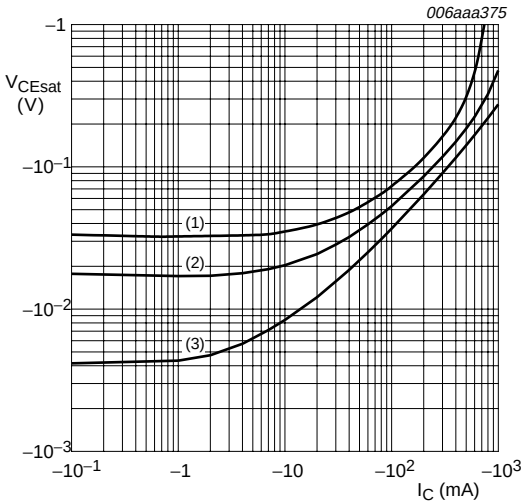
- $I_C/I_B = 20$
- (1)  $T_{amb} = -55^\circ C$
  - (2)  $T_{amb} = 25^\circ C$
  - (3)  $T_{amb} = 100^\circ C$

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



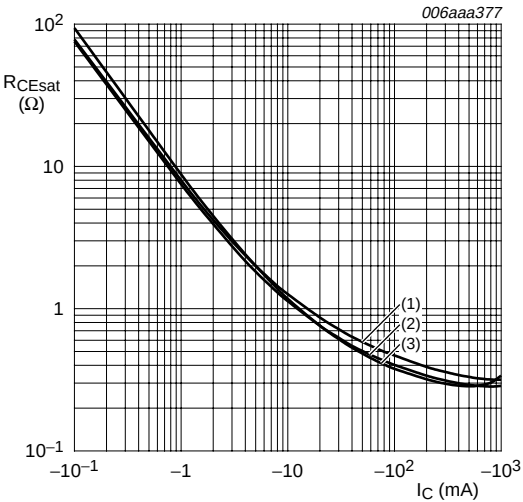
- $I_C/I_B = 20$
- (1)  $T_{amb} = 100\text{ }^{\circ}\text{C}$
  - (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$
  - (3)  $T_{amb} = -55\text{ }^{\circ}\text{C}$

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



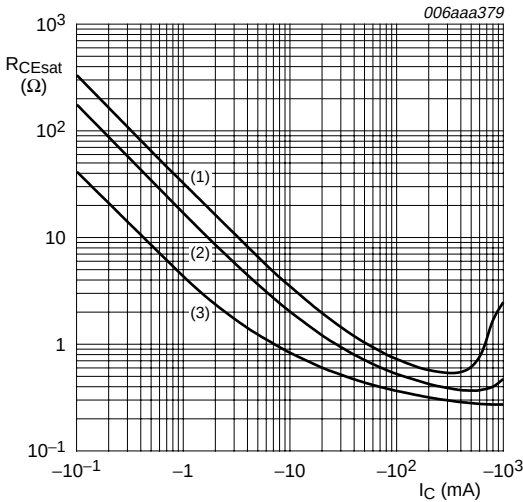
- $T_{amb} = 25\text{ }^{\circ}\text{C}$
- (1)  $I_C/I_B = 100$
  - (2)  $I_C/I_B = 50$
  - (3)  $I_C/I_B = 10$

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



- $I_C/I_B = 20$
- (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 10. Collector-emitter saturation resistance as a function of collector current; typical values



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

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

8. Test information

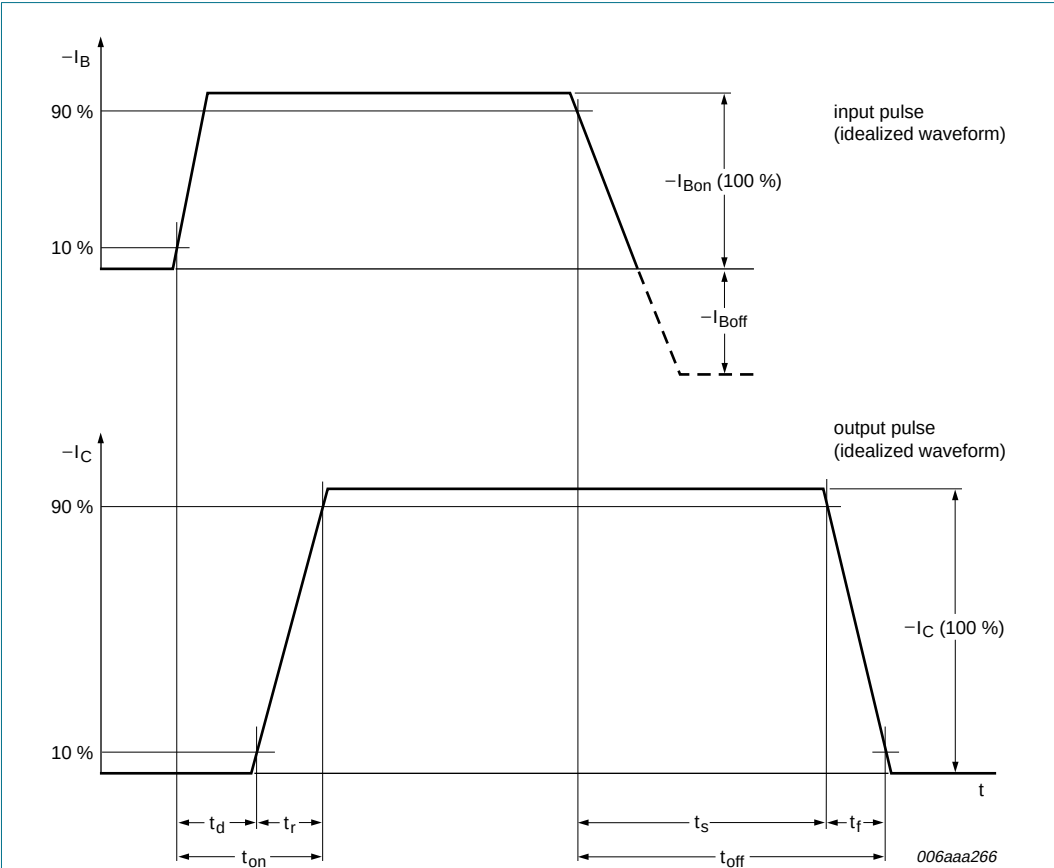
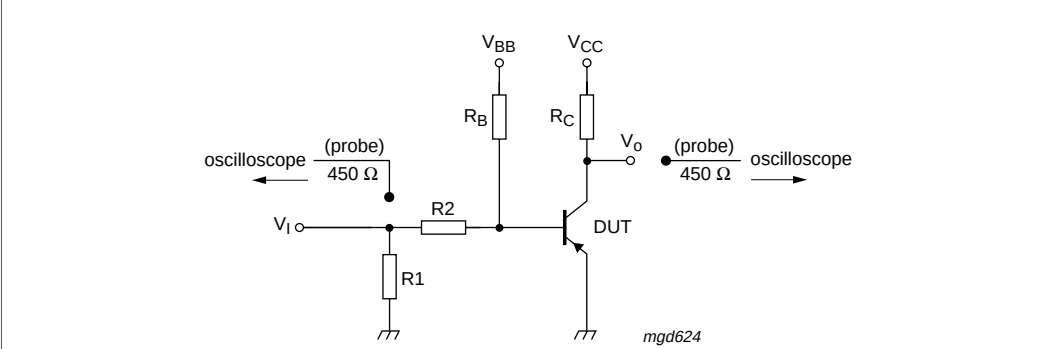


Fig 12. BISS transistor switching time definition

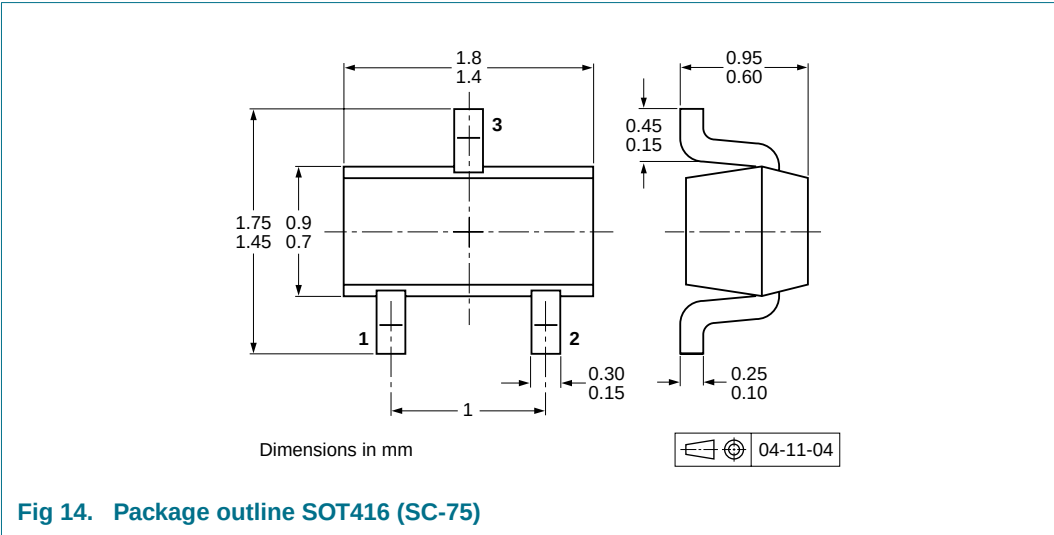


$V_{CC} = -11\text{ V}$ ;  $I_C = -250\text{ mA}$ ;  $I_{Bon} = -12.5\text{ mA}$ ;  $I_{Boff} = 12.5\text{ mA}$

Fig 13. Test circuit for switching times



9. Package outline



10. Packing information

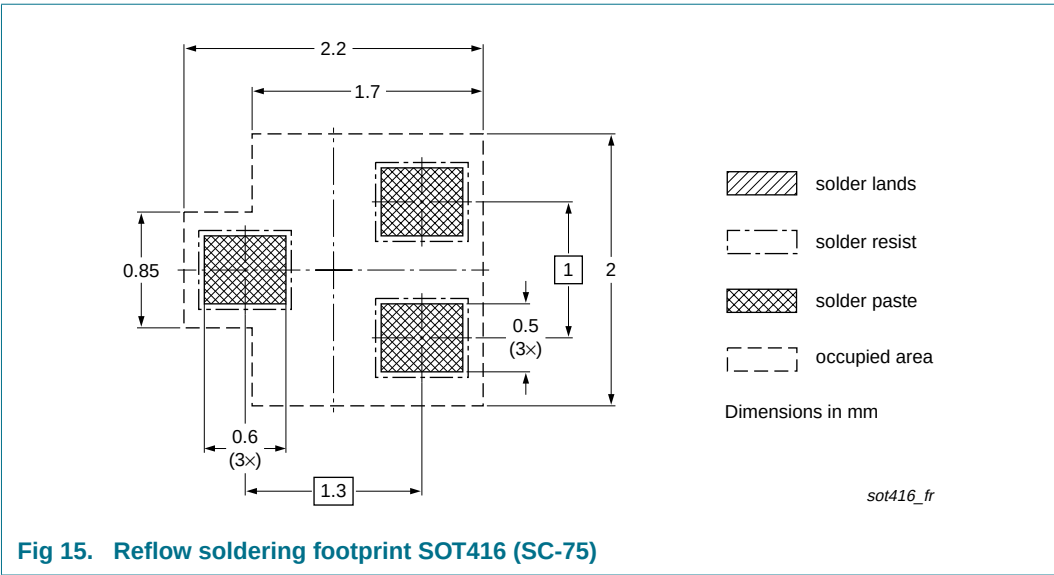
Table 8. Packing methods

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

| Type number | Package | Description                    | Packing quantity |       |
|-------------|---------|--------------------------------|------------------|-------|
|             |         |                                | 3000             | 10000 |
| PBSS3515E   | SOT416  | 4 mm pitch, 8 mm tape and reel | -115             | -135  |

[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  |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------|-------------|
| PBSS3515E_2    | 20090427                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Product data sheet | -             | PBSS3515E_1 |
| Modifications: | <ul style="list-style-type: none"><li>• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li><li>• Legal texts have been adapted to the new company name where appropriate.</li><li>• <a href="#">Figure 2</a>: added</li><li>• <a href="#">Table 6 “Thermal characteristics”</a>: enhanced</li><li>• <a href="#">Table 7 “Characteristics”</a>: switching times added</li><li>• <a href="#">Figure 5, 8 and 9</a>: amended</li><li>• <a href="#">Section 13 “Legal information”</a>: updated</li></ul> |                    |               |             |
| PBSS3515E_1    | 20050418                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 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".

[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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