



# PBHV9040T

500 V, 0.25 A PNP high-voltage low  $V_{CEsat}$  (BISS) transistor

Rev. 02 — 15 January 2009

Product data sheet

## 1. Product profile

### 1.1 General description

PNP high-voltage low  $V_{CEsat}$  Breakthrough In Small Signal (BISS) transistor in a SOT23 (TO-236AB) small Surface-Mounted Device (SMD) plastic package.

NPN complement: PBHV8540T.

### 1.2 Features

- High voltage
- Low collector-emitter saturation voltage  $V_{CEsat}$
- High collector current capability  $I_C$  and  $I_{CM}$
- High collector current gain ( $h_{FE}$ ) at high  $I_C$
- AEC-Q101 qualified

### 1.3 Applications

- Electronic ballast for fluorescent lighting
- LED driver for LED chain module
- LCD backlighting
- High Intensity Discharge (HID) front lighting
- Automotive motor management
- Hook switch for wired telecom
- Switch mode power supply

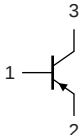
### 1.4 Quick reference data

Table 1. Quick reference data

| Symbol     | Parameter                      | Conditions                                        | Min | Typ | Max   | Unit |
|------------|--------------------------------|---------------------------------------------------|-----|-----|-------|------|
| $V_{CESM}$ | collector-emitter peak voltage | $V_{BE} = 0\text{ V}$                             | -   | -   | -500  | V    |
| $V_{CEO}$  | collector-emitter voltage      | open base                                         | -   | -   | -400  | V    |
| $I_C$      | collector current              |                                                   | -   | -   | -0.25 | A    |
| $h_{FE}$   | DC current gain                | $V_{CE} = -10\text{ V};$<br>$I_C = -50\text{ mA}$ | 100 | 200 | -     |      |

## 2. Pinning information

Table 2. Pinning

| Pin | Description | Simplified outline                                                                  | Graphic symbol                                                                                       |
|-----|-------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| 1   | base        |  | <br><i>sym013</i> |
| 2   | emitter     |                                                                                     |                                                                                                      |
| 3   | collector   |                                                                                     |                                                                                                      |

## 3. Ordering information

Table 3. Ordering information

| Type number | Package |                                          |         |
|-------------|---------|------------------------------------------|---------|
|             | Name    | Description                              | Version |
| PBHV9040T   | -       | plastic surface-mounted package; 3 leads | SOT23   |

## 4. Marking

Table 4. Marking codes

| Type number | Marking code <sup>[1]</sup> |
|-------------|-----------------------------|
| PBHV9040T   | W5*                         |

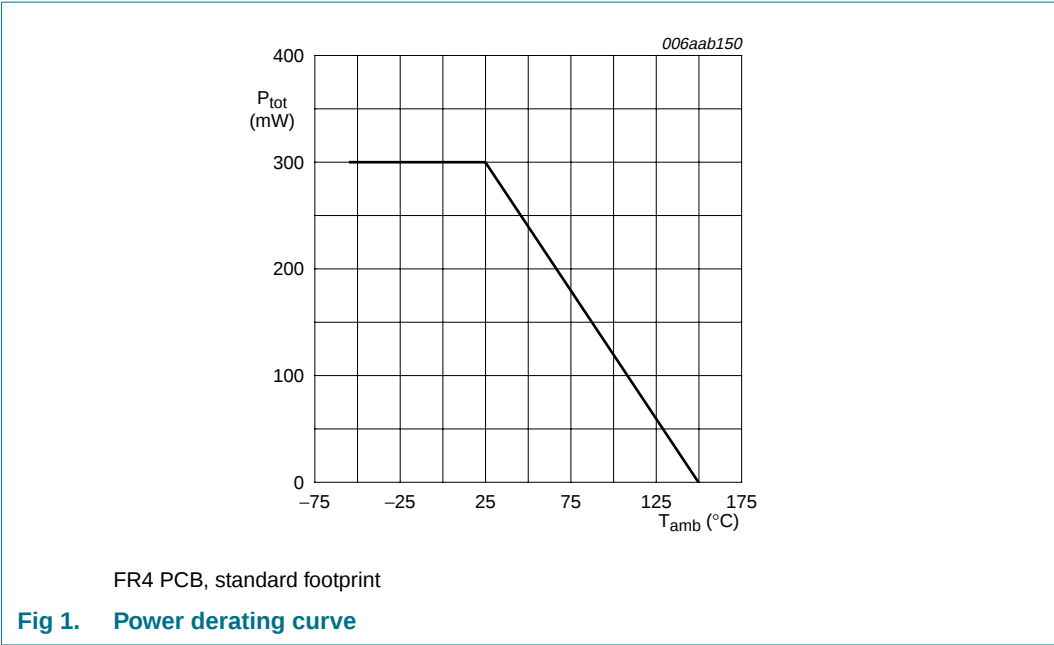
- [1] \* = -: made in Hong Kong  
\* = p: made in Hong Kong  
\* = t: made in Malaysia  
\* = W: made in China

5. Limiting values

Table 5. Limiting values  
In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol            | Parameter                      | Conditions                             | Min | Max   | Unit |
|-------------------|--------------------------------|----------------------------------------|-----|-------|------|
| V <sub>CBO</sub>  | collector-base voltage         | open emitter                           | -   | -500  | V    |
| V <sub>CEO</sub>  | collector-emitter voltage      | open base                              | -   | -400  | V    |
| V <sub>CESM</sub> | collector-emitter peak voltage | V <sub>BE</sub> = 0 V                  | -   | -500  | V    |
| V <sub>EBO</sub>  | emitter-base voltage           | open collector                         | -   | -6    | V    |
| I <sub>C</sub>    | collector current              |                                        | -   | -0.25 | A    |
| I <sub>CM</sub>   | peak collector current         | single pulse;<br>t <sub>p</sub> ≤ 1 ms | -   | -0.5  | A    |
| I <sub>BM</sub>   | peak base current              | single pulse;<br>t <sub>p</sub> ≤ 1 ms | -   | -200  | mA   |
| P <sub>tot</sub>  | total power dissipation        | T <sub>amb</sub> ≤ 25 °C               | [1] | 300   | mW   |
| T <sub>j</sub>    | junction temperature           |                                        | -   | 150   | °C   |
| T <sub>amb</sub>  | ambient temperature            |                                        | -55 | +150  | °C   |
| T <sub>stg</sub>  | storage temperature            |                                        | -65 | +150  | °C   |

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and 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] | -   | 417 | K/W  |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point |             | -   | -   | 70  | K/W  |

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

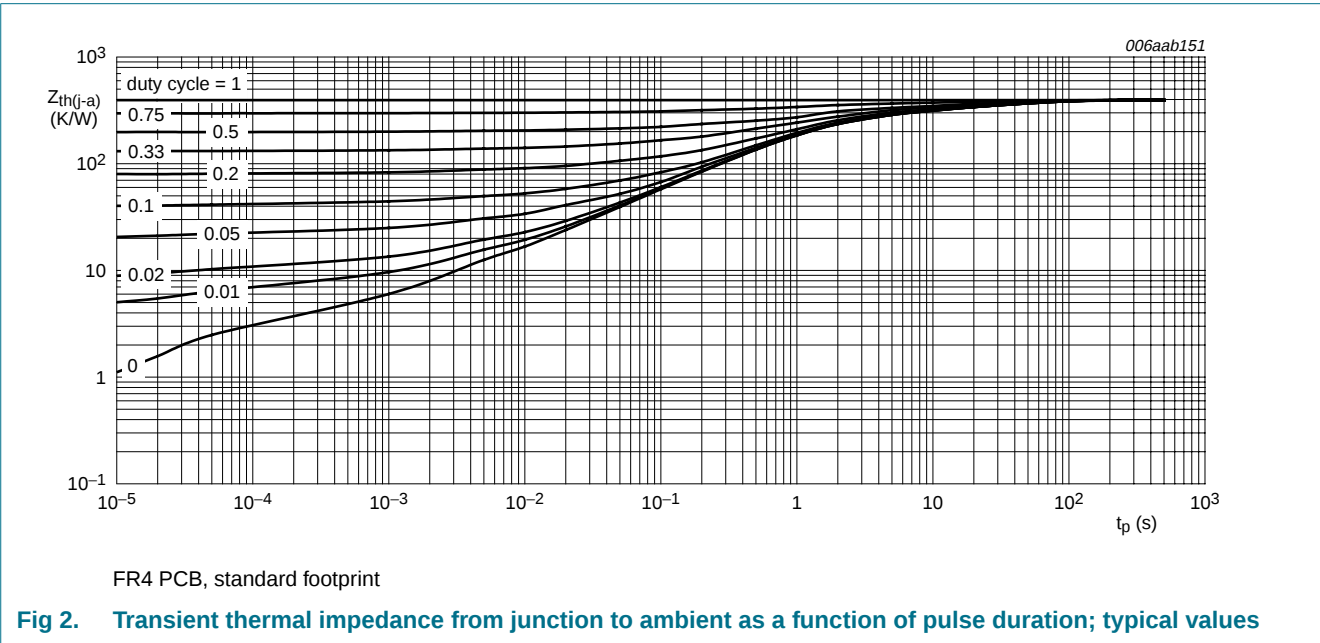


Fig 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

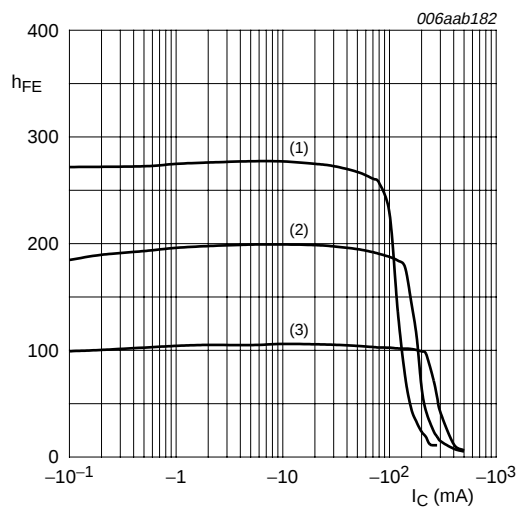
## 7. Characteristics

**Table 7. Characteristics**

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

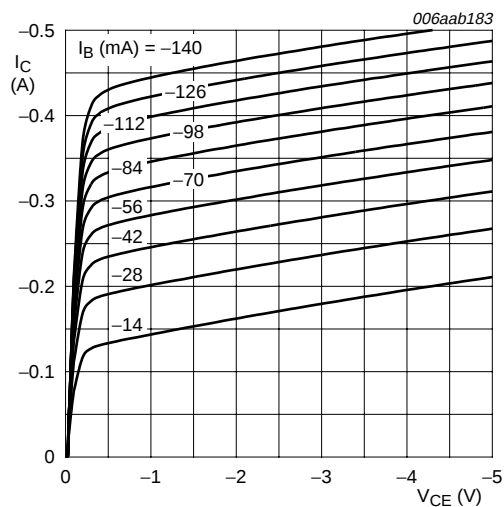
| Symbol      | Parameter                            | Conditions                                                                    | Min    | Typ  | Max  | Unit          |
|-------------|--------------------------------------|-------------------------------------------------------------------------------|--------|------|------|---------------|
| $I_{CBO}$   | collector-base cut-off current       | $V_{CB} = -320\text{ V}; I_E = 0\text{ A}$                                    | -      | -    | -100 | nA            |
|             |                                      | $V_{CB} = -320\text{ V}; I_E = 0\text{ A}; T_j = 150\text{ }^{\circ}\text{C}$ | -      | -    | -10  | $\mu\text{A}$ |
| $I_{CES}$   | collector-emitter cut-off current    | $V_{CE} = -320\text{ V}; V_{BE} = 0\text{ V}$                                 | -      | -    | -100 | nA            |
| $I_{EBO}$   | emitter-base cut-off current         | $V_{EB} = -4\text{ V}; I_C = 0\text{ A}$                                      | -      | -    | -100 | nA            |
| $h_{FE}$    | DC current gain                      | $V_{CE} = -10\text{ V}$                                                       |        |      |      |               |
|             |                                      | $I_C = -50\text{ mA}$                                                         | 100    | 200  | -    |               |
|             |                                      | $I_C = -100\text{ mA}$                                                        | 80     | 200  | -    |               |
|             |                                      | $I_C = -250\text{ mA}$                                                        | [1] 10 | 25   | -    |               |
| $V_{CEsat}$ | collector-emitter saturation voltage | $I_C = -100\text{ mA}; I_B = -20\text{ mA}$                                   | -      | -110 | -200 | mV            |
| $V_{BEsat}$ | base-emitter saturation voltage      | $I_C = -100\text{ mA}; I_B = -20\text{ mA}$                                   | [1] -  | -1   | -1.1 | V             |
| $f_T$       | transition frequency                 | $V_{CE} = -10\text{ V}; I_E = -10\text{ mA}; f = 100\text{ MHz}$              | -      | 55   | -    | MHz           |
| $C_c$       | collector capacitance                | $V_{CB} = -20\text{ V}; I_E = i_e = 0\text{ A}; f = 1\text{ MHz}$             | -      | 7    | -    | pF            |
| $C_e$       | emitter capacitance                  | $V_{EB} = -0.5\text{ V}; I_C = i_c = 0\text{ A}; f = 1\text{ MHz}$            | -      | 150  | -    | pF            |
| $t_d$       | delay time                           | $V_{CC} = -2\text{ V}; I_C = -0.15\text{ A};$                                 | -      | 9    | -    | ns            |
| $t_r$       | rise time                            | $I_{Bon} = -0.03\text{ A};$                                                   | -      | 1810 | -    | ns            |
| $t_{on}$    | turn-on time                         | $I_{Boff} = 0.03\text{ A}$                                                    | -      | 1819 | -    | ns            |
| $t_s$       | storage time                         |                                                                               | -      | 715  | -    | ns            |
| $t_f$       | fall time                            |                                                                               | -      | 1085 | -    | ns            |
| $t_{off}$   | turn-off time                        |                                                                               | -      | 1800 | -    | ns            |

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



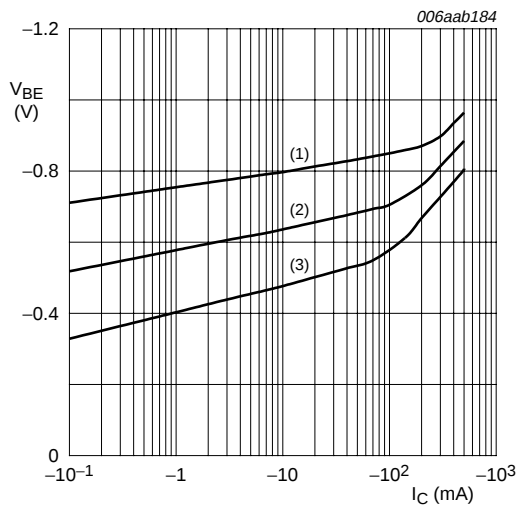
$V_{CE} = -10\text{ V}$   
(1)  $T_{amb} = 100^\circ\text{C}$   
(2)  $T_{amb} = 25^\circ\text{C}$   
(3)  $T_{amb} = -55^\circ\text{C}$

Fig 3. DC current gain as a function of collector current; typical values



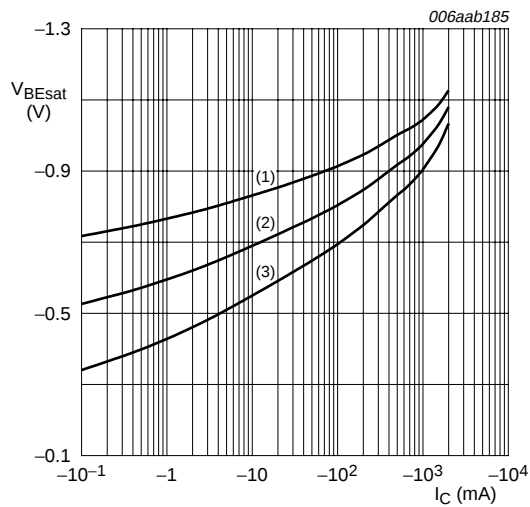
$T_{amb} = 25^\circ\text{C}$

Fig 4. Collector current as a function of collector-emitter voltage; typical values



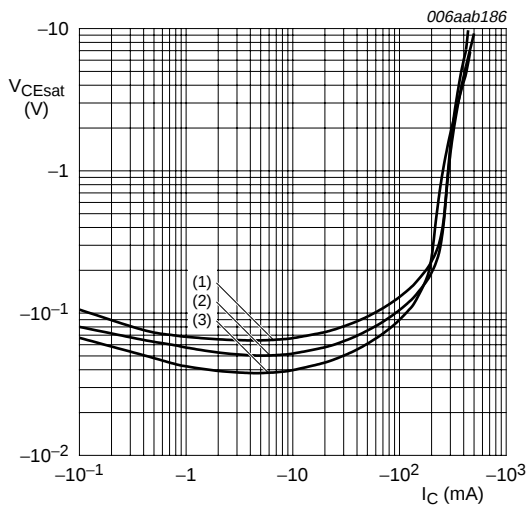
$V_{CE} = -10\text{ V}$   
(1)  $T_{amb} = -55^\circ\text{C}$   
(2)  $T_{amb} = 25^\circ\text{C}$   
(3)  $T_{amb} = 100^\circ\text{C}$

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



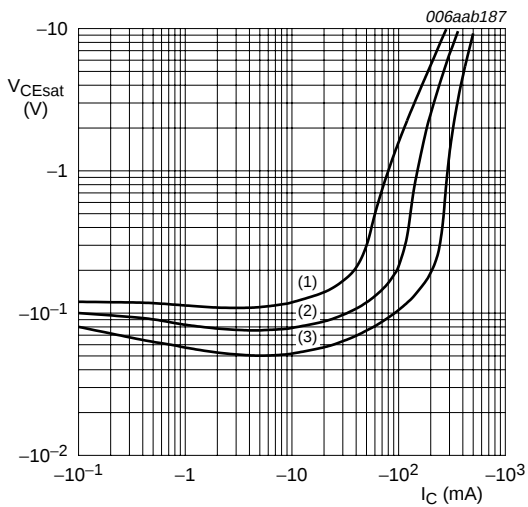
$I_C/I_B = 5$   
(1)  $T_{amb} = -55^\circ\text{C}$   
(2)  $T_{amb} = 25^\circ\text{C}$   
(3)  $T_{amb} = 100^\circ\text{C}$

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



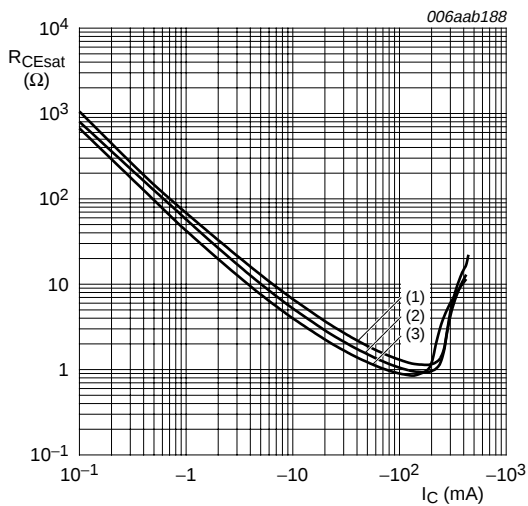
- $I_C/I_B = 5$
- (1)  $T_{amb} = 100\text{ }^{\circ}\text{C}$
  - (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$
  - (3)  $T_{amb} = -55\text{ }^{\circ}\text{C}$

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



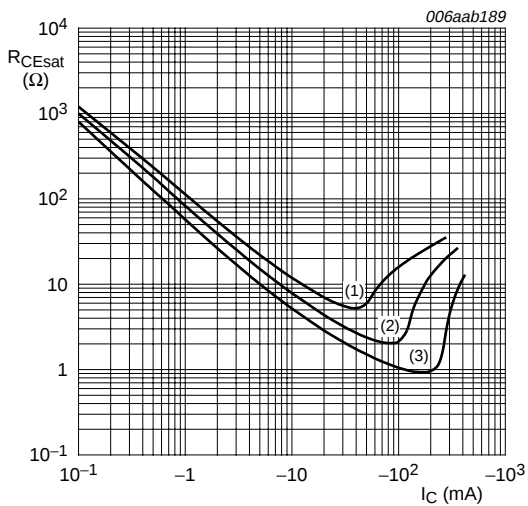
- $T_{amb} = 25\text{ }^{\circ}\text{C}$
- (1)  $I_C/I_B = 20$
  - (2)  $I_C/I_B = 10$
  - (3)  $I_C/I_B = 5$

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



- $I_C/I_B = 5$
- (1)  $T_{amb} = 100\text{ }^{\circ}\text{C}$
  - (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$
  - (3)  $T_{amb} = -55\text{ }^{\circ}\text{C}$

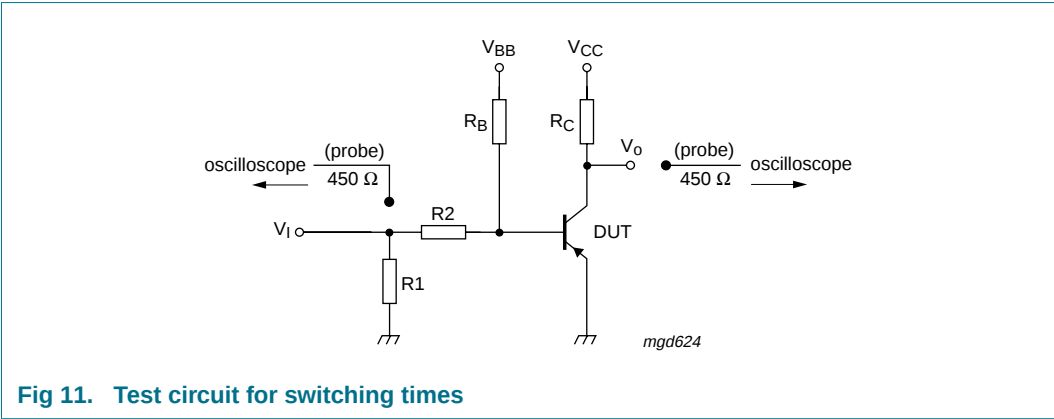
Fig 9. Collector-emitter saturation resistance as a function of collector current; typical values



- $T_{amb} = 25\text{ }^{\circ}\text{C}$
- (1)  $I_C/I_B = 20$
  - (2)  $I_C/I_B = 10$
  - (3)  $I_C/I_B = 5$

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

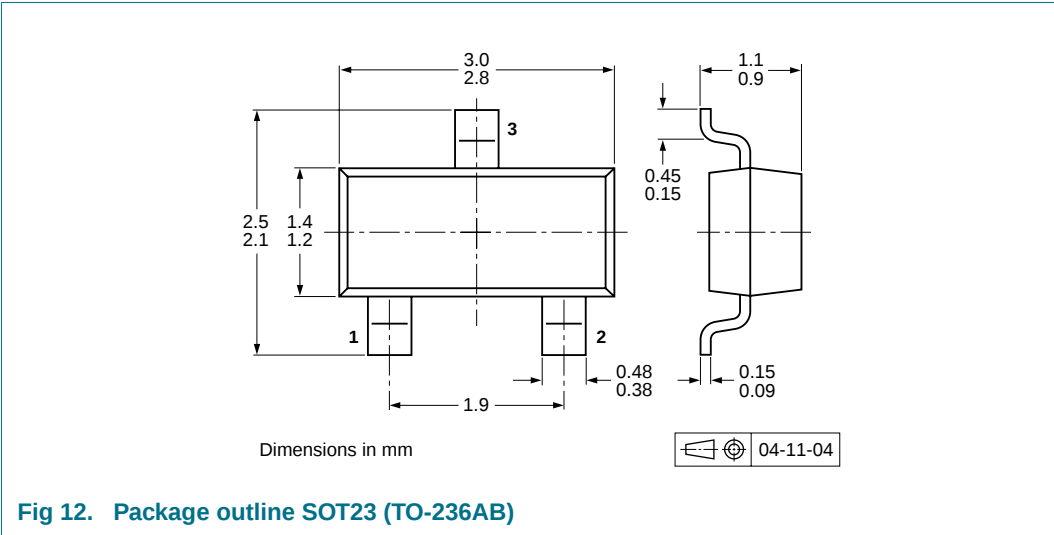
8. Test information



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



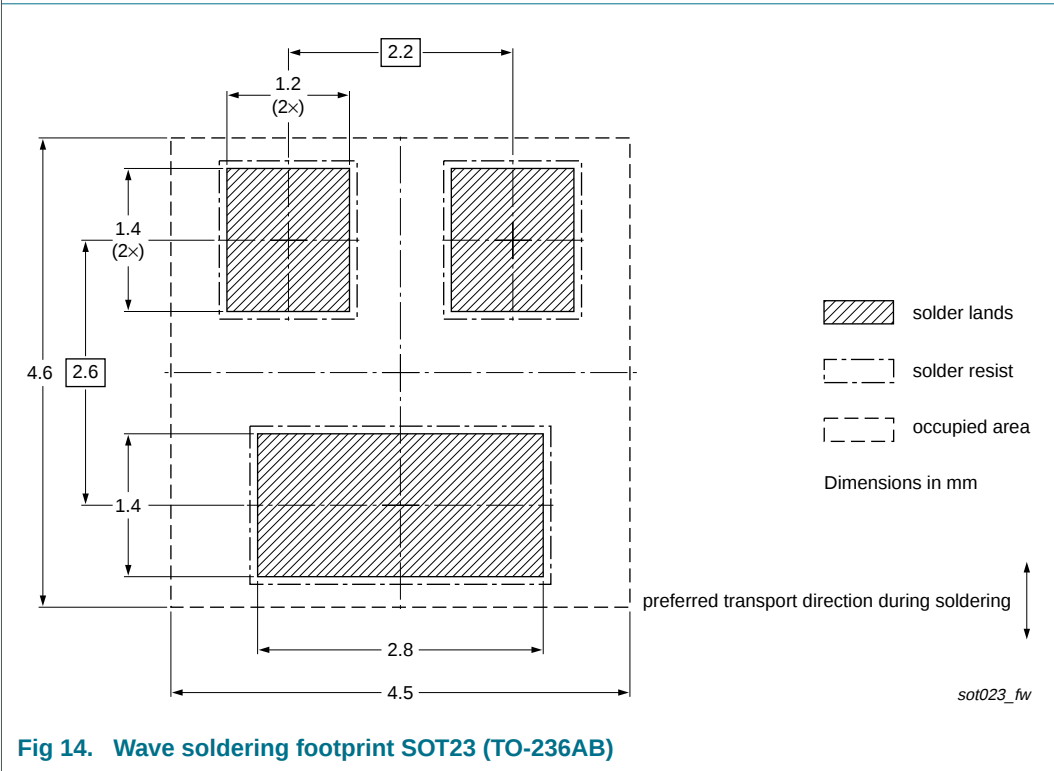
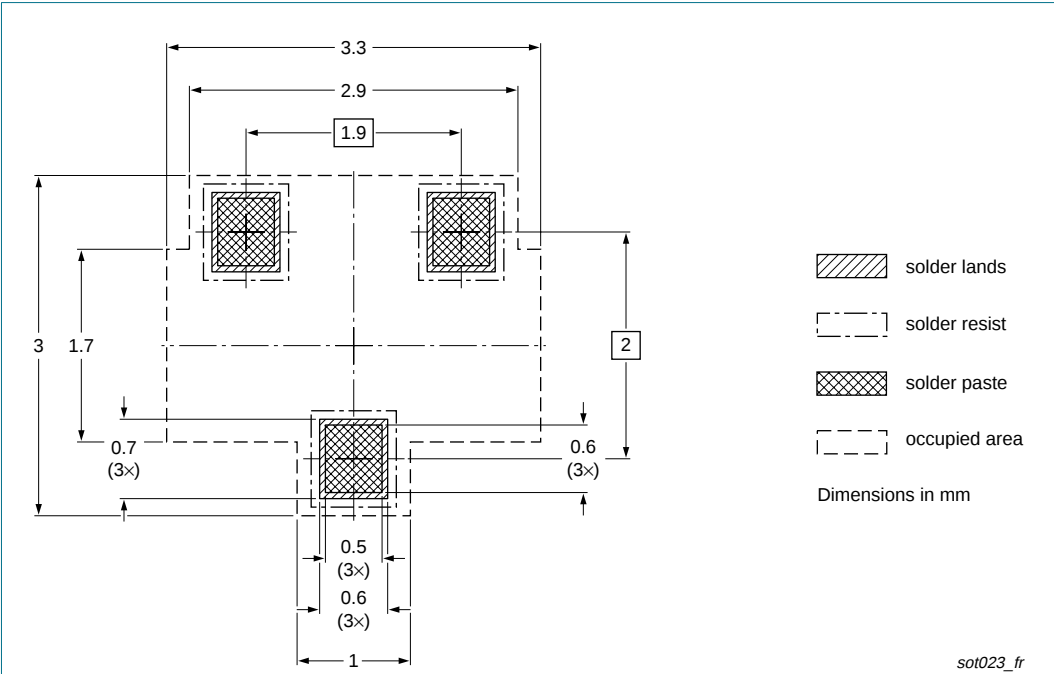
10. Packing information

**Table 8. Packing methods**  
*The indicated -xxx are the last three digits of the 12NC ordering code.*[\[1\]](#)

| Type number | Package | Description                    | Packing quantity |       |
|-------------|---------|--------------------------------|------------------|-------|
|             |         |                                | 3000             | 10000 |
| PBHV9040T   | SOT23   | 4 mm pitch, 8 mm tape and reel | -215             | -235  |

[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  |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------|-------------|
| PBHV9040T_2    | 20090115                                                                                                                                                                                                                                                                                | Product data sheet | -             | PBHV9040T_1 |
| Modifications: | <ul style="list-style-type: none"><li>• <a href="#">Table 5</a>: <math>I_{BM}</math> value changed from –100 mA to –200 mA</li><li>• <a href="#">Table 7</a>: <math>t_{off}</math> value amended to 1800 ns</li><li>• <a href="#">Section 13 "Legal information"</a>: updated</li></ul> |                    |               |             |
| PBHV9040T_1    | 20080212                                                                                                                                                                                                                                                                                | 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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