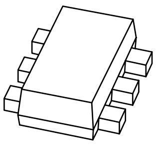

# PBSS4220V

## 20 V, 2 A NPN low $V_{CEsat}$ (BISS) transistor

Rev. 01 — 6 February 2006 **Product data sheet**

## 1. Product profile

### 1.1 General description

NPN low $V_{CEsat}$ Breakthrough In Small Signal (BISS) transistor in a SOT666 Surface Mounted Device (SMD) plastic package.

PNP complement: PBSS5220V.

### 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 | - | - | 20 | V |
| $I_C$ | collector current | | - | - | 2 | A |
| $I_{CM}$ | peak collector current | $t_p \leq 300\ \mu s$ | - | - | 4 | A |
| $R_{CEsat}$ | collector-emitter saturation resistance | $I_C = 1$ A; $I_B = 100$ mA [1] | - | 140 | 175 | mΩ |

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

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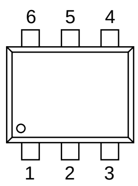
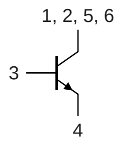
## 2. Pinning information

**Table 2: Pinning**

| Pin | Description | Simplified outline | Symbol |
|---|---|---|---|
| 1 | collector | | |
| 2 | collector | | |
| 3 | base | | |
| 4 | emitter | | |
| 5 | collector | | |
| 6 | collector | | |

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## 3. Ordering information

**Table 3: Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| PBSS4220V | - | plastic surface mounted package; 6 leads | SOT666 |

## 4. Marking

**Table 4: Marking codes**

| Type number | Marking code |
|---|---|
| PBSS4220V | N6 |

## 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 | | - | 20 | V |
| $V_{CEO}$ | collector-emitter voltage | open base | | - | 20 | V |
| $V_{EBO}$ | emitter-base voltage | open collector | | - | 5 | V |
| $I_C$ | collector current | | | - | 2 | A |
| $I_{CM}$ | peak collector current | $t_p \leq 300$ µs | | - | 4 | A |
| $I_B$ | base current | | | - | 0.3 | A |
| $I_{BM}$ | peak base current | $t_p \leq 300$ µs | | - | 0.6 | A |
| $P_{tot}$ | total power dissipation | $T_{amb} \leq 25$ °C | [1] [4] | - | 0.3 | W |
| | | | [2] [4] | - | 0.5 | W |
| | | | [3] [4] | - | 0.9 | W |
| $T_j$ | junction temperature | | | - | 150 | °C |

**Table 5: Limiting values** *…continued*

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

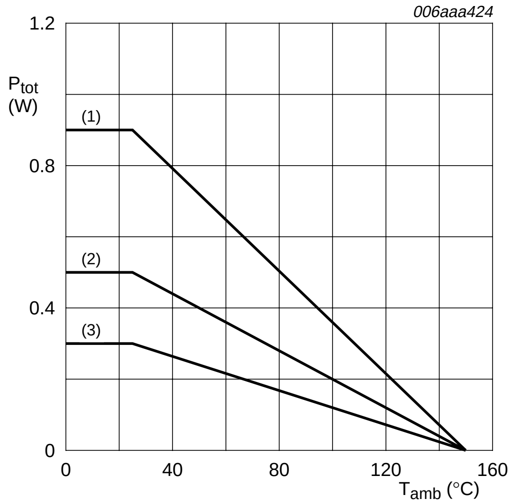
| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $T_{amb}$ | ambient temperature | | –65 | +150 | °C |
| $T_{stg}$ | storage temperature | | –65 | +150 | °C |

[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 $cm^2$.

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

[4] Reflow soldering is the only recommended soldering method.




(1) Ceramic PCB, $Al_2O_3$, standard footprint

(2) FR4 PCB, mounting pad for collector 1 $cm^2$

(3) FR4 PCB, standard footprint

**Fig 1. Power derating curves**

# 6. Thermal characteristics

**Table 6: Thermal characteristics**

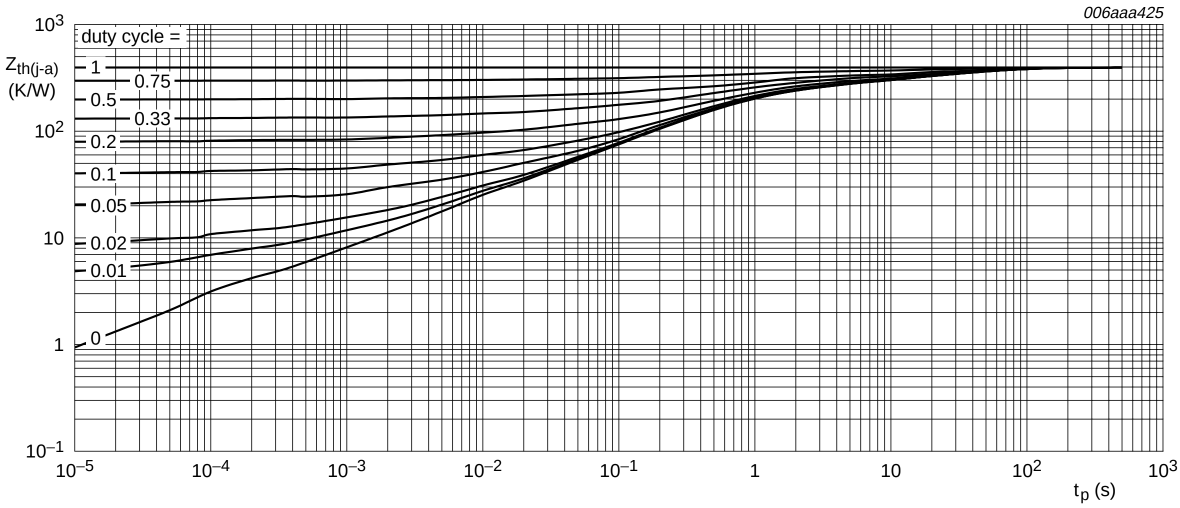
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | [1] [4] | - | - | 410 | K/W |
| | | | [2] [4] | - | - | 250 | K/W |
| | | | [3] [4] | - | - | 140 | K/W |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | | - | - | 80 | 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 $cm^2$.

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

[4] Reflow soldering is the only recommended soldering method.




FR4 PCB, standard footprint

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

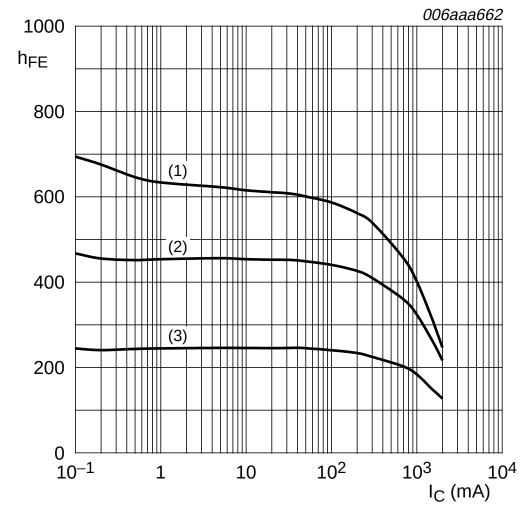
# 7. Characteristics

**Table 7: Characteristics**

*$T_{amb}$ = 25 °C unless otherwise specified.*

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | collector-base cut-off current | $V_{CB}$ = 20 V; $I_E$ = 0 A | | - | - | 0.1 | µA |
| | | $V_{CB}$ = 20 V; $I_E$ = 0 A; $T_j$ = 150 °C | | - | - | 50 | µA |
| $I_{CES}$ | collector-emitter cut-off current | $V_{CE}$ = 20 V; $V_{BE}$ = 0 V | | - | - | 0.1 | µA |
| $I_{EBO}$ | emitter-base cut-off current | $V_{EB}$ = 5 V; $I_C$ = 0 A | | - | - | 0.1 | µA |
| $h_{FE}$ | DC current gain | $V_{CE}$ = 2 V; $I_C$ = 1 mA | | 220 | 480 | - | |
| | | $V_{CE}$ = 2 V; $I_C$ = 100 mA | | 220 | 440 | - | |
| | | $V_{CE}$ = 2 V; $I_C$ = 500 mA | [1] | 220 | 410 | - | |
| | | $V_{CE}$ = 2 V; $I_C$ = 1 A | [1] | 200 | 360 | - | |
| | | $V_{CE}$ = 2 V; $I_C$ = 2 A | [1] | 120 | 220 | - | |
| $V_{CEsat}$ | collector-emitter saturation voltage | $I_C$ = 100 mA; $I_B$ = 1 mA | | - | 35 | 55 | mV |
| | | $I_C$ = 500 mA; $I_B$ = 50 mA | [1] | - | 70 | 95 | mV |
| | | $I_C$ = 1 A; $I_B$ = 50 mA | [1] | - | 145 | 180 | mV |
| | | $I_C$ = 1 A; $I_B$ = 100 mA | [1] | - | 140 | 175 | mV |
| | | $I_C$ = 2 A; $I_B$ = 100 mA | [1] | - | 275 | 355 | mV |
| | | $I_C$ = 2 A; $I_B$ = 200 mA | [1] | - | 270 | 350 | mV |
| $R_{CEsat}$ | collector-emitter saturation resistance | $I_C$ = 1 A; $I_B$ = 100 mA | [1] | - | 140 | 175 | mΩ |
| $V_{BEsat}$ | base-emitter saturation voltage | $I_C$ = 1 A; $I_B$ = 50 mA | [1] | - | 0.95 | 1.1 | V |
| | | $I_C$ = 1 A; $I_B$ = 100 mA | [1] | - | 1 | 1.2 | V |
| $V_{BEon}$ | base-emitter turn-on voltage | $V_{CE}$ = 5 V; $I_C$ = 1 A | | - | 0.8 | 1.1 | V |
| $t_d$ | delay time | $I_C$ = 1 A; $I_{Bon}$ = 50 mA; $I_{Boff}$ = –50 mA | | - | 9 | - | ns |
| $t_r$ | rise time | | | - | 29 | - | ns |
| $t_{on}$ | turn-on time | | | - | 38 | - | ns |
| $t_s$ | storage time | | | - | 200 | - | ns |
| $t_f$ | fall time | | | - | 40 | - | ns |
| $t_{off}$ | turn-off time | | | - | 240 | - | ns |
| $f_T$ | transition frequency | $V_{CE}$ = 10 V; $I_C$ = 50 mA; f = 100 MHz | | - | 210 | - | MHz |
| $C_c$ | collector capacitance | $V_{CB}$ = 10 V; $I_E$ = $i_e$ = 0 A; f = 1 MHz | | - | 11 | - | pF |

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



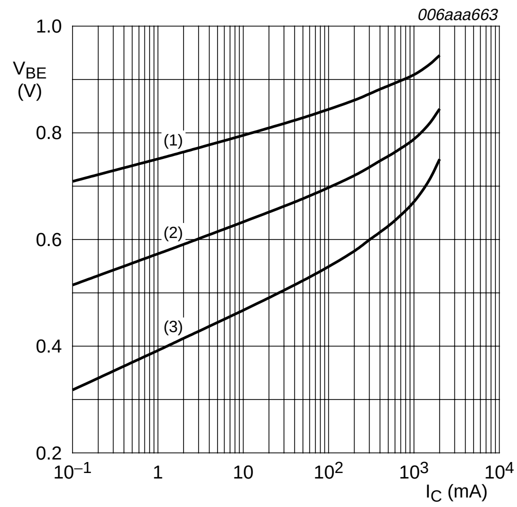

$V_{CE}$ = 2 V

(1) $T_{amb}$ = 100 °C

(2) $T_{amb}$ = 25 °C

(3) $T_{amb}$ = −55 °C

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



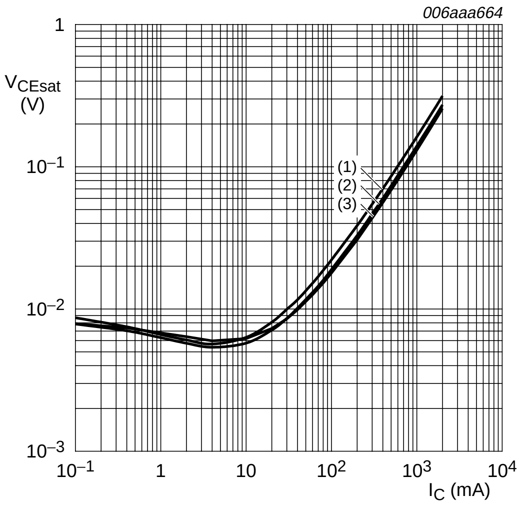

$V_{CE}$ = 5 V

(1) $T_{amb}$ = −55 °C

(2) $T_{amb}$ = 25 °C

(3) $T_{amb}$ = 100 °C

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



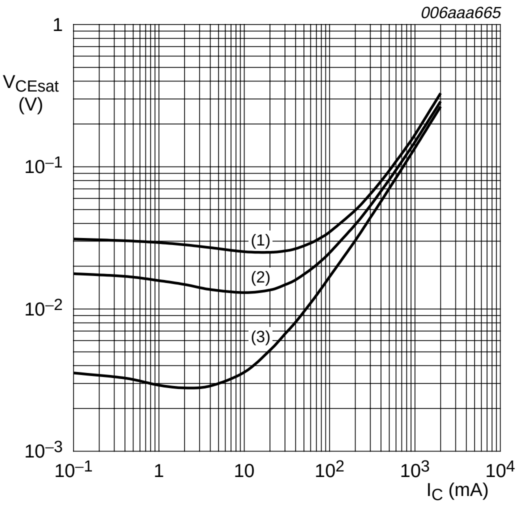

$I_C/I_B$ = 20

(1) $T_{amb}$ = 100 °C

(2) $T_{amb}$ = 25 °C

(3) $T_{amb}$ = −55 °C

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



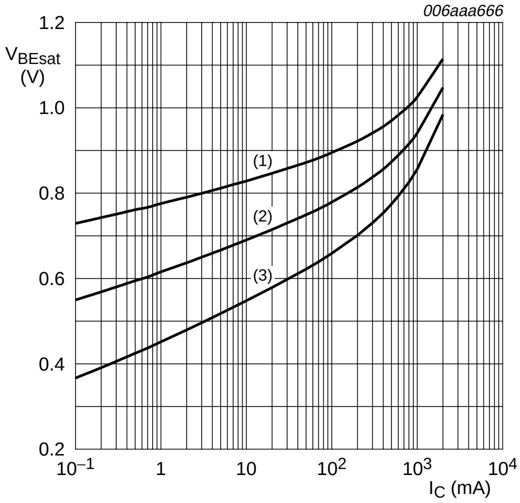

$T_{amb}$ = 25 °C

(1) $I_C/I_B$ = 100

(2) $I_C/I_B$ = 50

(3) $I_C/I_B$ = 10

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



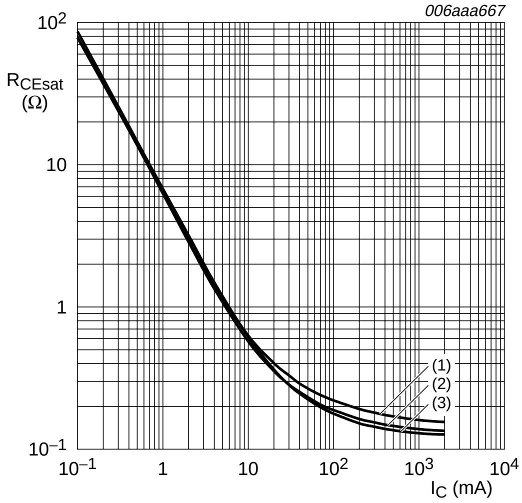

$I_C/I_B = 20$

(1) $T_{amb} = -55$ °C

(2) $T_{amb} = 25$ °C

(3) $T_{amb} = 100$ °C

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



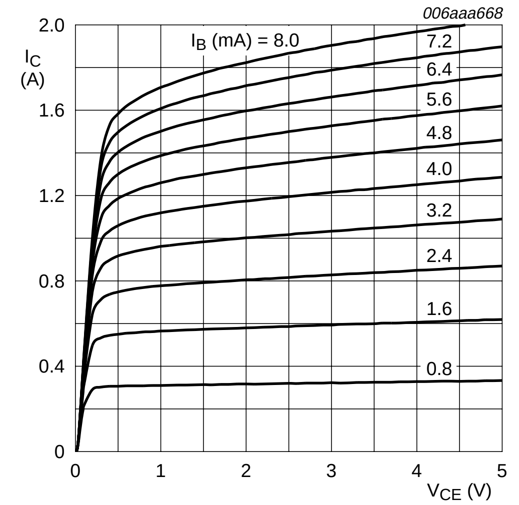

$I_C/I_B = 20$

(1) $T_{amb} = 100$ °C

(2) $T_{amb} = 25$ °C

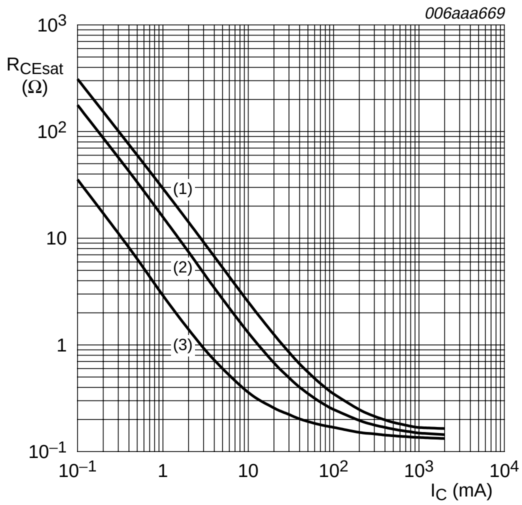
(3) $T_{amb} = -55$ °C

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




$T_{amb} = 25$ °C

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




$T_{amb} = 25$ °C

(1) $I_C/I_B = 100$

(2) $I_C/I_B = 50$

(3) $I_C/I_B = 10$

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

## 8. Test information

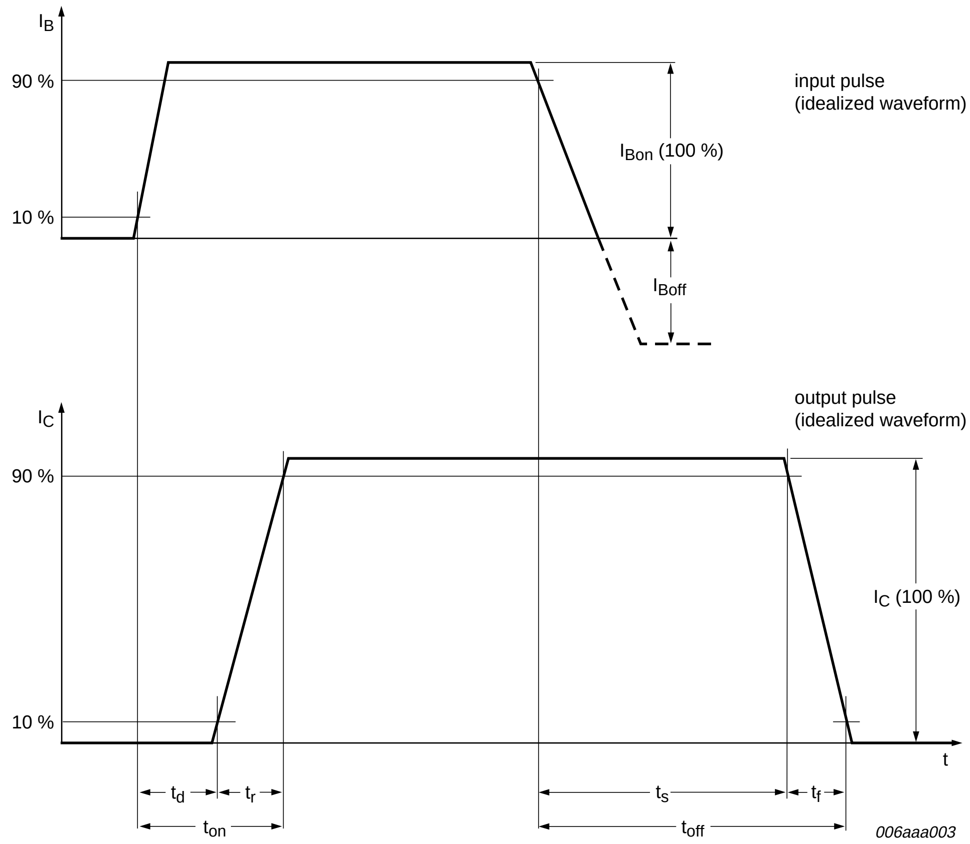
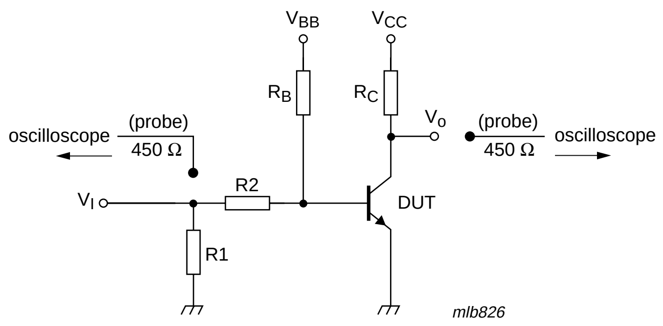



**Fig 11. BISS transistor switching time definition**




$I_C$ = 1 A; $I_{Bon}$ = 50 mA; $I_{Boff}$ = –50 mA; R1 = open; R2 = 45 Ω; $R_B$ = 145 Ω; $R_C$ = 10 Ω

**Fig 12. Test circuit for switching times**

# 9. Package outline

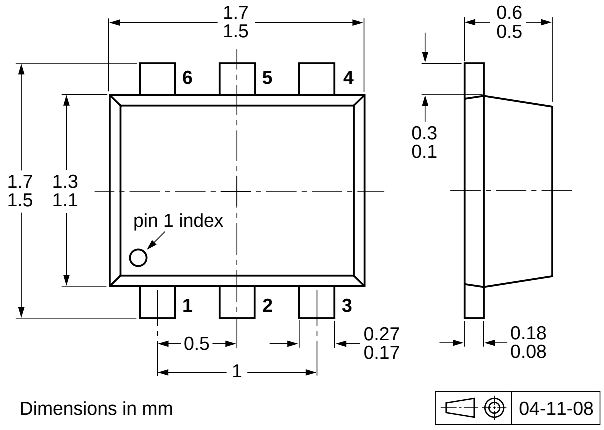



**Fig 13. Package outline SOT666**

# 10. Packing information

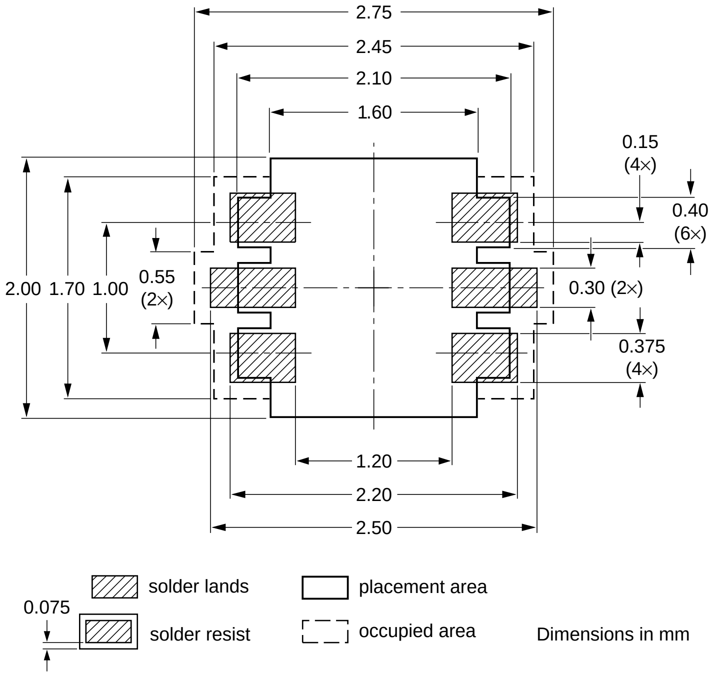
**Table 8: Packing methods**

*The indicated -xxx are the last three digits of the 12NC ordering code.* [1]

| Type number | Package | Description | Packing quantity | |
|---|---|---|---|---|
| | | | 4000 | 8000 |
| PBSS4220V | SOT666 | 2 mm pitch, 8 mm tape and reel | - | -315 |
| | | 4 mm pitch, 8 mm tape and reel | -115 | - |

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

# 11. Soldering




Reflow soldering is the only recommended soldering method.

**Fig 14. Reflow soldering footprint**

## 12. Revision history

**Table 9: Revision history**

| Document ID | Release date | Data sheet status | Change notice | Doc. number | Supersedes |
|---|---|---|---|---|---|
| PBSS4220V_1 | 20060206 | Product data sheet | - | - | - |

## 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. |
| III | Product data | Production | This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN). |

[1] Please consult the most recently issued data sheet before initiating or completing a design.

[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL http://www.semiconductors.philips.com.

[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

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**Short-form specification** — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

**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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## 18. Contents





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**Document number: PBSS4220V_1**

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