



# PBSS5540X

40 V, 5 A PNP low  $V_{CEsat}$  (BISS) transistor

15 April 2020

Product data sheet

## 1. General description

PNP low  $V_{CEsat}$  transistor in a medium power SOT89 (SC-62) package.

NPN complement: PBSS4540X.

## 2. Features and benefits

- Low collector-emitter saturation voltage  $V_{CEsat}$
- High collector current capability:  $I_C$  and  $I_{CM}$
- High efficiency leading to less heat generation.
- AEC-Q101 qualified

## 3. Applications

- Supply line switching circuits
- Battery management applications
- DC/DC converter applications
- Strobe flash units
- Medium power driver (e.g. relays, buzzers and motors).

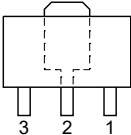
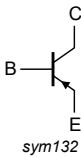
## 4. Quick reference data

Table 1. Quick reference data

| Symbol      | Parameter                               | Conditions                                                                                            | Min | Typ | Max | Unit       |
|-------------|-----------------------------------------|-------------------------------------------------------------------------------------------------------|-----|-----|-----|------------|
| $V_{CEO}$   | collector-emitter voltage               | open base                                                                                             | -   | -   | -40 | V          |
| $I_C$       | collector current                       |                                                                                                       | -   | -   | -4  | A          |
| $I_{CM}$    | peak collector current                  | single pulse; $t_p \leq 10$ ms                                                                        | -   | -   | -10 | A          |
| $R_{CEsat}$ | collector-emitter saturation resistance | $I_C = -5$ A; $I_B = -500$ mA; $t_p \leq 300$ $\mu$ s; pulsed; $\delta \leq 0.02$ ; $T_{amb} = 25$ °C | -   | 45  | 75  | m $\Omega$ |

5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline                                                                         | Graphic symbol                                                                                |
|-----|--------|-------------|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| 1   | E      | emitter     | <br>SOT89 | <br>sym132 |
| 2   | C      | collector   |                                                                                            |                                                                                               |
| 3   | B      | base        |                                                                                            |                                                                                               |

6. Ordering information

Table 3. Ordering information

| Type number | Package |                                                                                        |         |
|-------------|---------|----------------------------------------------------------------------------------------|---------|
|             | Name    | Description                                                                            | Version |
| PBSS5540X   | SOT89   | plastic, surface-mounted package; 3 leads; 1.5 mm pitch; 4.5 mm x 2.5 mm x 1.5 mm body | SOT89   |

7. Marking

Table 4. Marking codes

| Type number | Marking code[1] |
|-------------|-----------------|
| PBSS5540X   | %1G             |

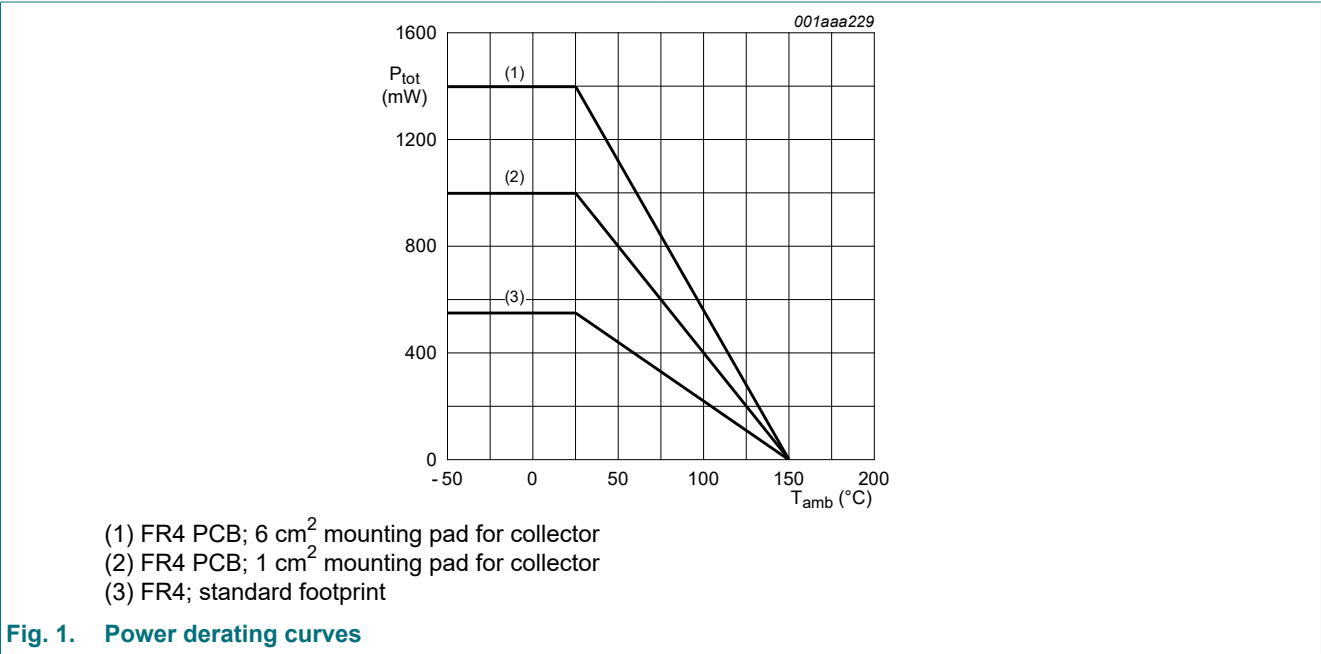
[1] % = placeholder for manufacturing site code

8. 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                         |         | -   | -40  | V    |
| V <sub>CEO</sub> | collector-emitter voltage         | open base                            |         | -   | -40  | V    |
| V <sub>EBO</sub> | emitter-base voltage              | open collector                       |         | -   | -6   | V    |
| I <sub>C</sub>   | collector current                 |                                      |         | -   | -4   | A    |
| I <sub>CRM</sub> | repetitive peak collector current | δ ≤ 0.2; t <sub>p</sub> ≤ 10 ms      |         | -   | -5   | A    |
| I <sub>CM</sub>  | peak collector current            | single pulse; t <sub>p</sub> ≤ 10 ms |         | -   | -10  | A    |
| I <sub>B</sub>   | base current                      |                                      |         | -   | -1   | A    |
| I <sub>BM</sub>  | peak base current                 | single pulse; t <sub>p</sub> ≤ 1 ms  |         | -   | -2   | A    |
| P <sub>tot</sub> | total power dissipation           |                                      | [1] [2] | -   | 2.5  | W    |
|                  |                                   | T <sub>amb</sub> ≤ 25 °C             | [2]     | -   | 0.55 | W    |
|                  |                                   |                                      | [3]     | -   | 1    | W    |
|                  |                                   |                                      | [4]     | -   | 1.4  | W    |
|                  |                                   |                                      | [5]     | -   | 1.6  | W    |
| T <sub>j</sub>   | junction temperature              |                                      |         | -   | 150  | °C   |
| T <sub>amb</sub> | ambient temperature               |                                      |         | -65 | 150  | °C   |
| T <sub>stg</sub> | storage temperature               |                                      |         | -65 | 150  | °C   |

- [1] Pulsed t<sub>p</sub> ≤ 10 ms; δ ≤ 0.2
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
- [3] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.
- [4] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 6 cm<sup>2</sup>.
- [5] Device mounted on a 7 cm<sup>2</sup> ceramic printed-circuit board, 1 cm<sup>2</sup> single-sided copper and tin-plated.

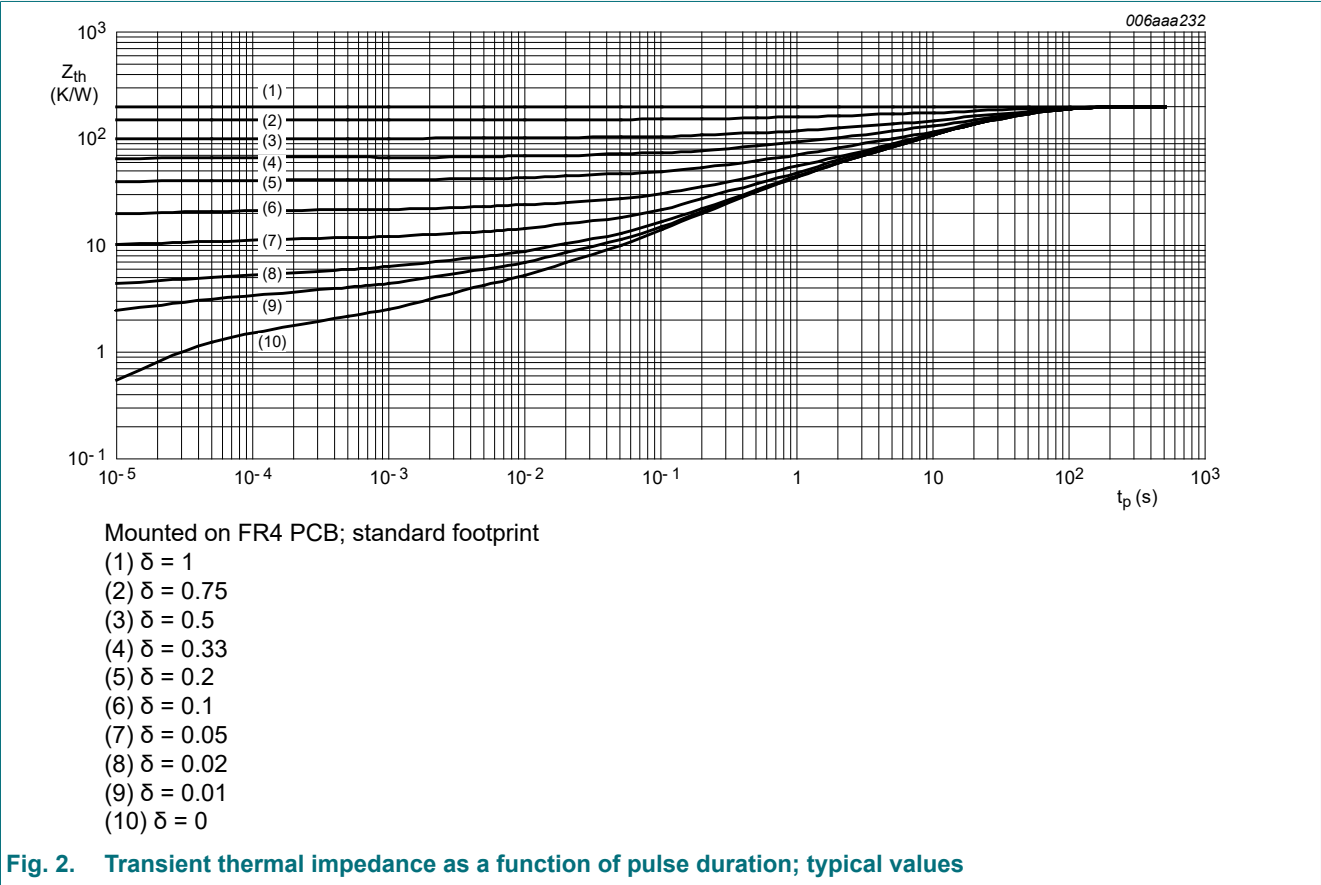


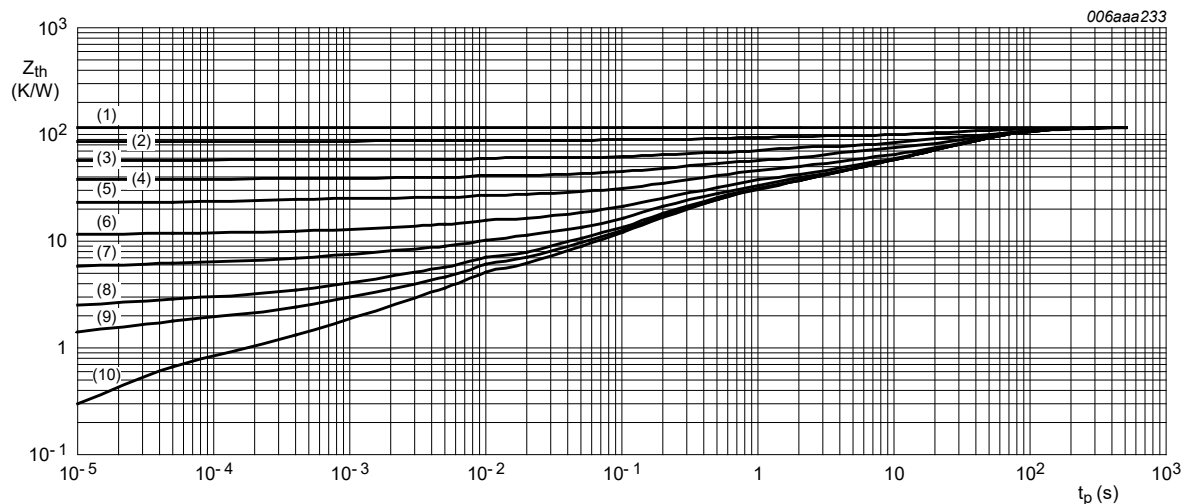
9. Thermal characteristics

Table 6. Thermal characteristics

| Symbol                | Parameter                                        | Conditions  |         | Min | Typ | Max | Unit |
|-----------------------|--------------------------------------------------|-------------|---------|-----|-----|-----|------|
| R <sub>th(j-a)</sub>  | thermal resistance from junction to ambient      | in free air | [1] [2] | -   | -   | 50  | K/W  |
|                       |                                                  |             | [1]     | -   | -   | 225 | K/W  |
|                       |                                                  |             | [3]     | -   | -   | 125 | K/W  |
|                       |                                                  |             | [4]     | -   | -   | 90  | K/W  |
|                       |                                                  |             | [5]     | -   | -   | 80  | K/W  |
| R <sub>th(j-sp)</sub> | thermal resistance from junction to solder point |             |         | -   | -   | 16  | K/W  |

- [1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
- [2] Pulse test: t<sub>p</sub> ≤ 10 ms; δ ≤ 0.2.
- [3] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.
- [4] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 6 cm<sup>2</sup>.
- [5] Device mounted on a 7 cm<sup>2</sup> ceramic printed-circuit board, 1 cm<sup>2</sup> single-sided copper and tin-plated.

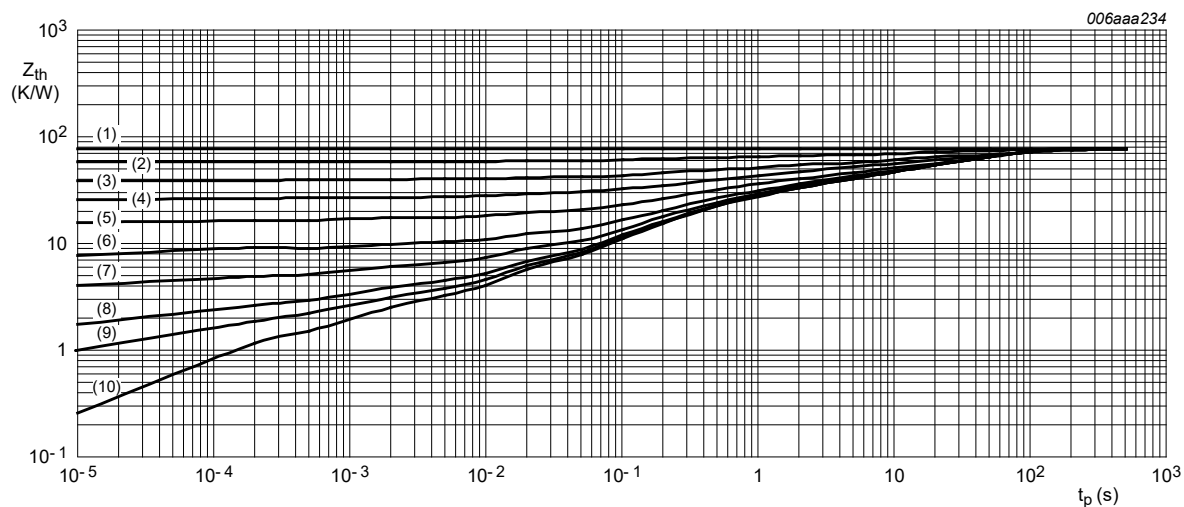




Mounted on FR4 PCB; mounting pad for collector  $1 \text{ cm}^2$

- (1)  $\delta = 1$
- (2)  $\delta = 0.75$
- (3)  $\delta = 0.5$
- (4)  $\delta = 0.33$
- (5)  $\delta = 0.2$
- (6)  $\delta = 0.1$
- (7)  $\delta = 0.05$
- (8)  $\delta = 0.02$
- (9)  $\delta = 0.01$
- (10)  $\delta = 0$

Fig. 3. Transient thermal impedance as a function of pulse duration; typical values



Mounted on FR4 printed-circuit board; mounting pad for collector  $6 \text{ cm}^2$

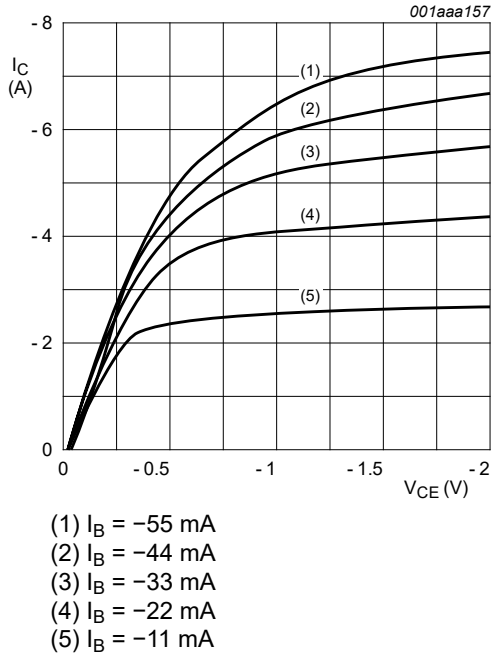
- (1)  $\delta = 1$
- (2)  $\delta = 0.75$
- (3)  $\delta = 0.5$
- (4)  $\delta = 0.33$
- (5)  $\delta = 0.2$
- (6)  $\delta = 0.1$
- (7)  $\delta = 0.05$
- (8)  $\delta = 0.02$
- (9)  $\delta = 0.01$
- (10)  $\delta = 0$

Fig. 4. Transient thermal impedance as a function of pulse duration; typical values

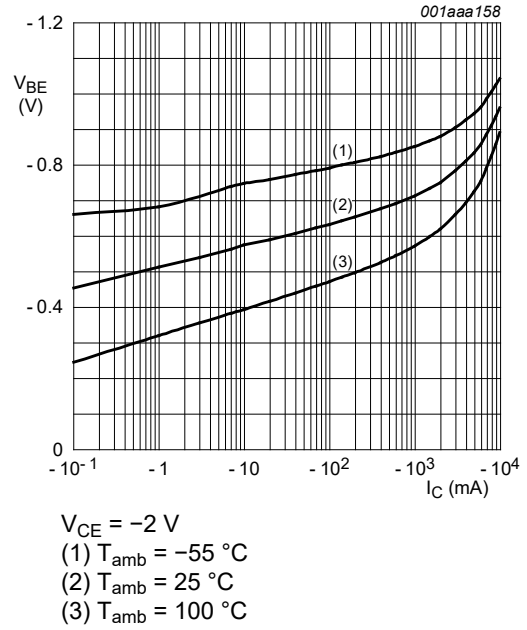
## 10. Characteristics

Table 7. Characteristics

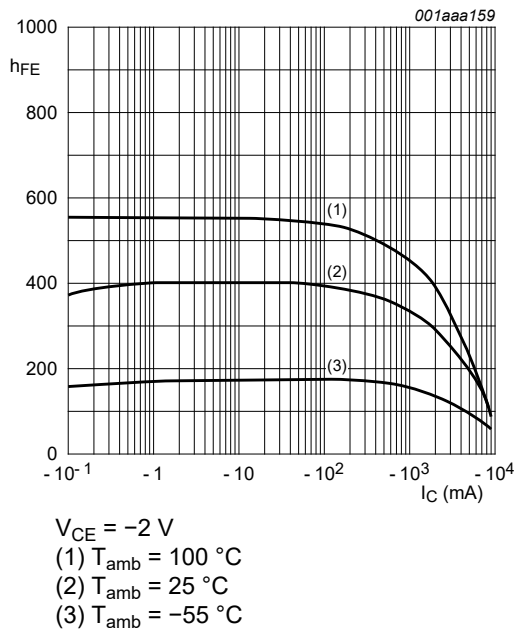
| Symbol      | Parameter                               | Conditions                                                                                                                               | Min | Typ | Max  | Unit          |
|-------------|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|------|---------------|
| $I_{CBO}$   | collector-base cut-off current          | $V_{CB} = -30\text{ V}$ ; $I_E = 0\text{ A}$ ; $T_{amb} = 25\text{ °C}$                                                                  | -   | -   | -100 | nA            |
|             |                                         | $V_{CB} = -30\text{ V}$ ; $I_E = 0\text{ A}$ ; $T_j = 150\text{ °C}$                                                                     | -   | -   | -50  | $\mu\text{A}$ |
| $I_{EBO}$   | emitter-base cut-off current            | $V_{EB} = -5\text{ V}$ ; $I_C = 0\text{ A}$ ; $T_{amb} = 25\text{ °C}$                                                                   | -   | -   | -100 | nA            |
| $h_{FE}$    | DC current gain                         | $V_{CE} = -2\text{ V}$ ; $I_C = -0.5\text{ A}$ ; $T_{amb} = 25\text{ °C}$                                                                | 250 | -   | -    |               |
|             |                                         | $V_{CE} = -2\text{ V}$ ; $I_C = -1\text{ A}$ ; $t_p \leq 300\text{ }\mu\text{s}$ ; pulsed; $\delta \leq 0.02$ ; $T_{amb} = 25\text{ °C}$ | 200 | -   | -    |               |
|             |                                         | $V_{CE} = -2\text{ V}$ ; $I_C = -2\text{ A}$ ; $t_p \leq 300\text{ }\mu\text{s}$ ; pulsed; $\delta \leq 0.02$ ; $T_{amb} = 25\text{ °C}$ | 150 | -   | -    |               |
|             |                                         | $V_{CE} = -2\text{ V}$ ; $I_C = -5\text{ A}$ ; $t_p \leq 300\text{ }\mu\text{s}$ ; pulsed; $\delta \leq 0.02$ ; $T_{amb} = 25\text{ °C}$ | 50  | -   | -    |               |
| $V_{CEsat}$ | collector-emitter saturation voltage    | $I_C = -0.5\text{ A}$ ; $I_B = -5\text{ mA}$ ; $T_{amb} = 25\text{ °C}$                                                                  | -   | -   | -120 | mV            |
|             |                                         | $I_C = -1\text{ A}$ ; $I_B = -10\text{ mA}$ ; $T_{amb} = 25\text{ °C}$                                                                   | -   | -   | -170 | mV            |
|             |                                         | $I_C = -2\text{ A}$ ; $I_B = -200\text{ mA}$ ; $T_{amb} = 25\text{ °C}$                                                                  | -   | -   | -160 | mV            |
|             |                                         | $I_C = -4\text{ A}$ ; $I_B = -200\text{ mA}$ ; $t_p \leq 300\text{ }\mu\text{s}$ ; pulsed; $\delta \leq 0.02$ ; $T_{amb} = 25\text{ °C}$ | -   | -   | -340 | mV            |
|             |                                         | $I_C = -5\text{ A}$ ; $I_B = -500\text{ mA}$ ; $t_p \leq 300\text{ }\mu\text{s}$ ; pulsed; $\delta \leq 0.02$ ; $T_{amb} = 25\text{ °C}$ | -   | -   | -375 | mV            |
| $R_{CEsat}$ | collector-emitter saturation resistance |                                                                                                                                          | -   | 45  | 75   | m $\Omega$    |
| $V_{BEsat}$ | base-emitter saturation voltage         | $I_C = -4\text{ A}$ ; $I_B = -200\text{ mA}$ ; $t_p \leq 300\text{ }\mu\text{s}$ ; pulsed; $\delta \leq 0.02$ ; $T_{amb} = 25\text{ °C}$ | -   | -   | -1.1 | V             |
|             |                                         | $I_C = -5\text{ A}$ ; $I_B = -500\text{ mA}$ ; $t_p \leq 300\text{ }\mu\text{s}$ ; pulsed; $\delta \leq 0.02$ ; $T_{amb} = 25\text{ °C}$ | -   | -   | -1.2 | V             |
| $V_{BEon}$  | base-emitter turn-on voltage            | $V_{CE} = -2\text{ V}$ ; $I_C = -2\text{ A}$ ; $T_{amb} = 25\text{ °C}$                                                                  | -   | -   | -1   | V             |
| $f_T$       | transition frequency                    | $V_{CE} = -10\text{ V}$ ; $I_C = -0.1\text{ A}$ ; $f = 100\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$                                        | 60  | -   | -    | MHz           |
| $C_c$       | collector capacitance                   | $V_{CB} = -10\text{ V}$ ; $I_E = 0\text{ A}$ ; $i_e = 0\text{ A}$ ; $f = 1\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$                        | -   | -   | 105  | pF            |



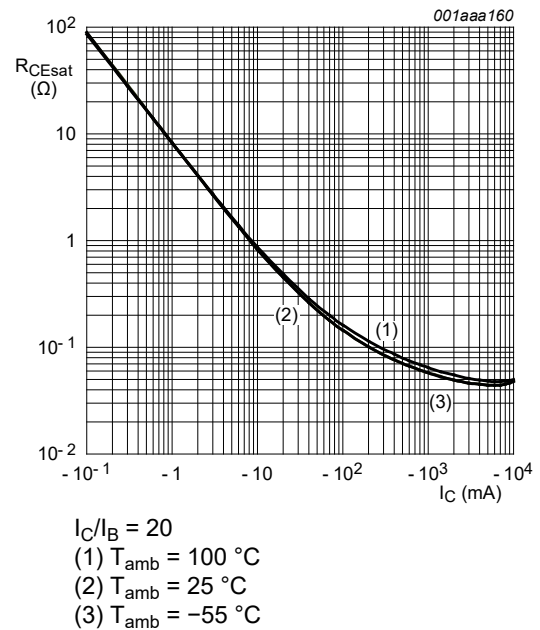
**Fig. 5. Collector current as a function of collector-emitter voltage; typical values**



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



**Fig. 7. DC current gain as a function of collector current; typical values**



**Fig. 8. Equivalent on-resistance as a function of collector current; typical values**

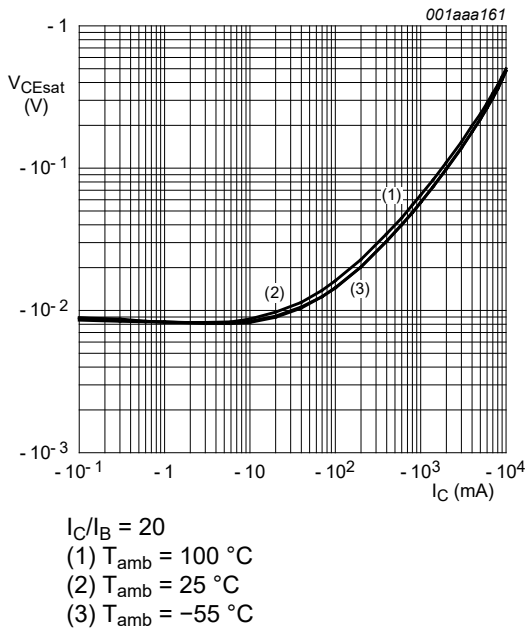


Fig. 9. Collector-emitter saturation voltage as a function of collector current; typical values

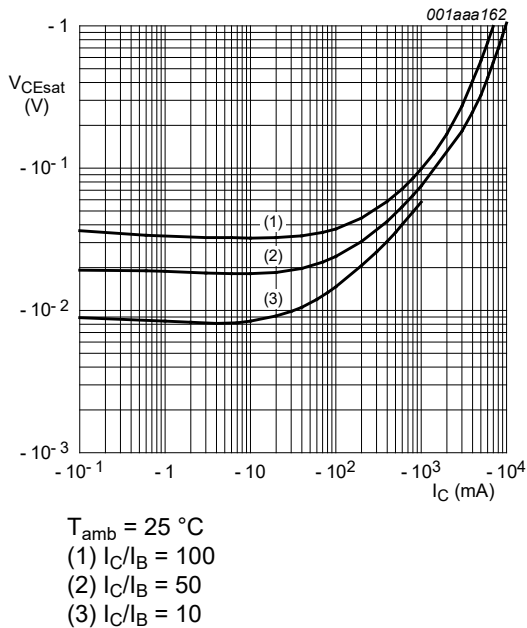


Fig. 10. Collector-emitter saturation voltage as a function of collector current; typical values

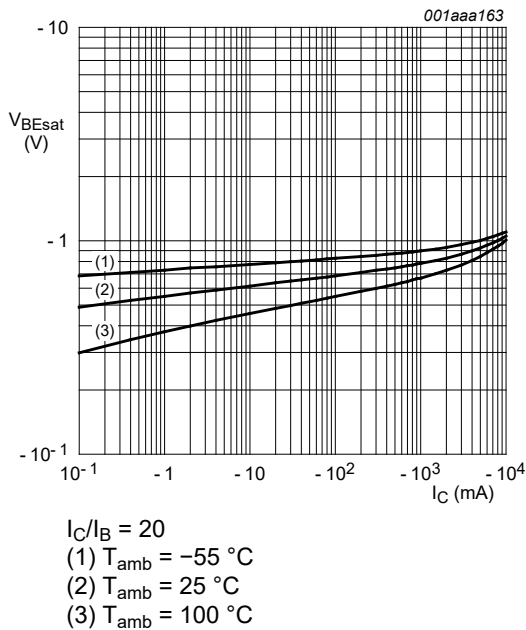


Fig. 11. Base-emitter saturation voltage as a function of collector current; typical values

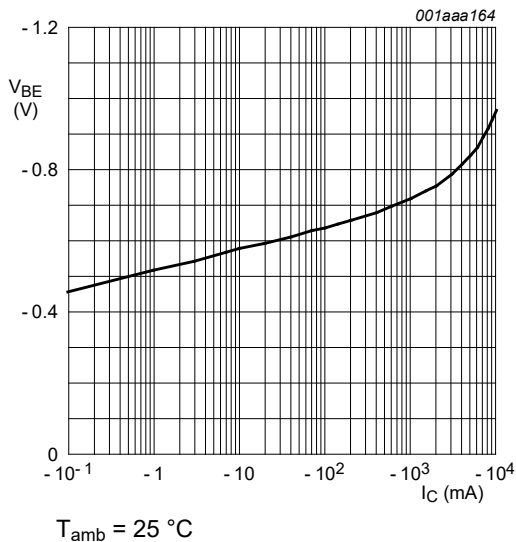


Fig. 12. Base-emitter voltage as a function of collector current; typical values



11. Package outline

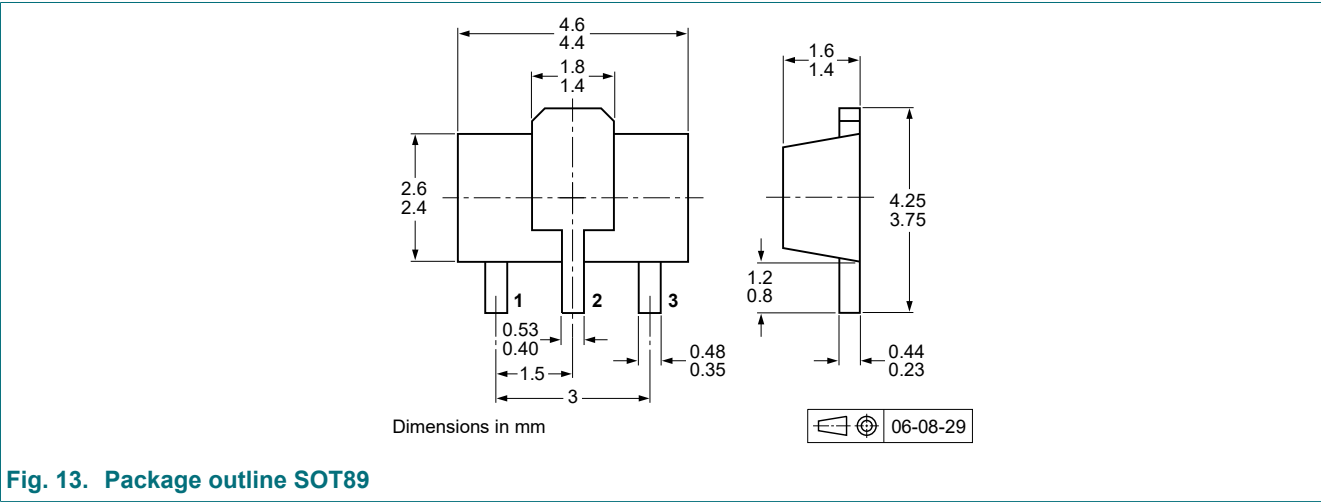


Fig. 13. Package outline SOT89

12. Soldering

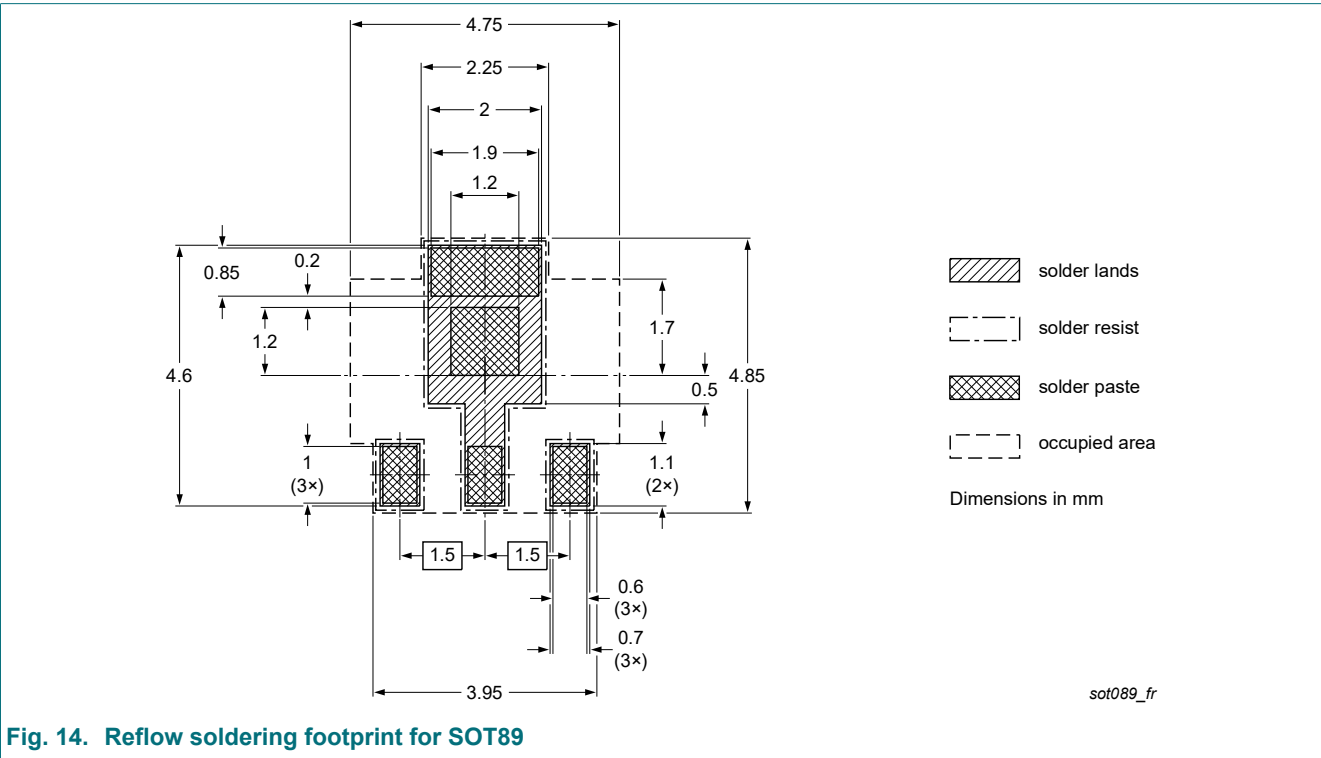
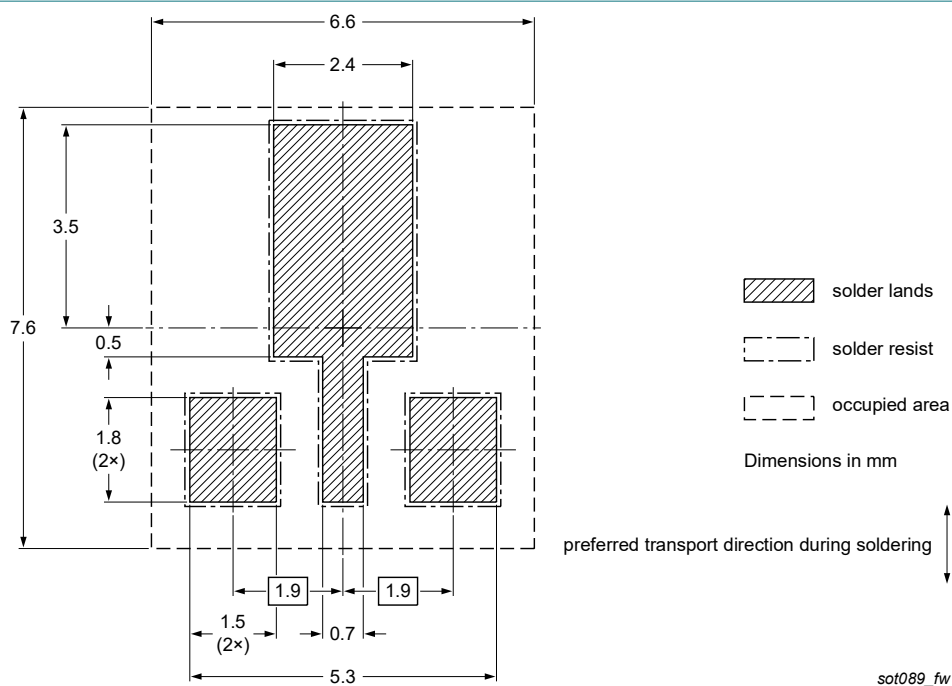


Fig. 14. Reflow soldering footprint for SOT89



**Fig. 15. Wave soldering footprint for SOT89**

## 13. Revision history

Table 8. Revision history

| Data sheet ID  | Release date                                         | Data sheet status  | Change notice | Supersedes    |
|----------------|------------------------------------------------------|--------------------|---------------|---------------|
| PBSS5540X v.4  | 20200415                                             | Product data sheet | -             | PBSS5540X v.3 |
| Modifications: | • Limiting values at $I_{CM}$ : conditions corrected |                    |               |               |
| PBSS5540X v.3  | 20180320                                             | Product data sheet | -             | PBSS5540X v.2 |
| PBSS5540X v.2  | 20041104                                             | Product data sheet | -             | PBSS5540X v.1 |
| PBSS5540X v.1  | 20040115                                             | Product data sheet | -             | -             |

## 14. Legal information

### Data sheet status

| Document status<br>[1][2]      | Product status [3] | 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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