1. General description

PNP low V_{CEsat} transistor in a SOT89 (SC-62/TO-243) small and flat lead Surface-Mounted Device(SMD) plastic package.
NPN complement: PBSS4540X-Q

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
- Qualified according to AEC-Q101 and recommended for use in automotive applications

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>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{CEO}</td>
<td>collector-emitter voltage</td>
<td>open base</td>
<td>-</td>
<td>-</td>
<td>-40</td>
<td>V</td>
</tr>
<tr>
<td>I_C</td>
<td>collector current</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-4</td>
<td>A</td>
</tr>
<tr>
<td>I_{CM}</td>
<td>peak collector current</td>
<td>single pulse; t_p ≤ 10 ms</td>
<td>-</td>
<td>-</td>
<td>-10</td>
<td>A</td>
</tr>
<tr>
<td>R_{CEsat}</td>
<td>collector-emitter saturation resistance</td>
<td>I_C = -5 A; I_B = -500 mA; pulsed; t_p ≤ 300 μs; 5 ≤ 0.02; T_{amb} = 25 °C</td>
<td>-</td>
<td>45</td>
<td>75</td>
<td>mΩ</td>
</tr>
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5. Pinning information

<table>
<thead>
<tr>
<th>Pin</th>
<th>Symbol</th>
<th>Description</th>
<th>Simplified outline</th>
<th>Graphic symbol</th>
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<tr>
<td>1</td>
<td>E</td>
<td>emitter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>C</td>
<td>collector</td>
<td>SOT89</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>B</td>
<td>base</td>
<td></td>
<td></td>
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6. Ordering information

Table 3. Ordering information

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<th>Package Name</th>
<th>Description</th>
<th>Version</th>
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</thead>
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<tr>
<td>PBSS5540X-Q</td>
<td>SOT89</td>
<td>plastic, surface-mounted package; 3 leads; 1.5 mm pitch; 4.5 mm x 2.5 mm x 1.5 mm body</td>
<td>SOT89</td>
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7. Marking

Table 4. Marking codes

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<th>Marking code[1]</th>
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<td>PBSS5540X-Q</td>
<td>%1G</td>
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[1] % = placeholder for manufacturing site code

8. Limiting values

Table 5. Limiting values

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

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_CBO</td>
<td>collector-base voltage</td>
<td>open emitter</td>
<td>-</td>
<td>-40</td>
<td>V</td>
</tr>
<tr>
<td>V_CE</td>
<td>collector-emitter voltage</td>
<td>open base</td>
<td>-</td>
<td>-40</td>
<td>V</td>
</tr>
<tr>
<td>V_EBO</td>
<td>emitter-base voltage</td>
<td>open collector</td>
<td>-</td>
<td>-6</td>
<td>V</td>
</tr>
<tr>
<td>I_C</td>
<td>collector current</td>
<td></td>
<td>-</td>
<td>-4</td>
<td>A</td>
</tr>
<tr>
<td>I_CRM</td>
<td>repetitive peak collector current</td>
<td>δ ≤ 0.2; t_p ≤ 10 ms</td>
<td>-</td>
<td>-5</td>
<td>A</td>
</tr>
<tr>
<td>I_CM</td>
<td>peak collector current</td>
<td>single pulse; t_p ≤ 10 ms</td>
<td>-</td>
<td>-10</td>
<td>A</td>
</tr>
<tr>
<td>I_B</td>
<td>base current</td>
<td></td>
<td>-</td>
<td>-1</td>
<td>A</td>
</tr>
<tr>
<td>I_BM</td>
<td>peak base current</td>
<td>single pulse; t_p ≤ 1 ms</td>
<td>-</td>
<td>-2</td>
<td>A</td>
</tr>
<tr>
<td>P_tot</td>
<td>total power dissipation</td>
<td></td>
<td>[1]</td>
<td>2.5</td>
<td>W</td>
</tr>
</tbody>
</table>

Ptot: 

\[ P_{\text{tot}} \leq 25 \text{ °C} \]

\[ P_{\text{tot}} \leq 0.55 \text{ W at 25 °C} \]

\[ P_{\text{tot}} \leq 1 \text{ W at 100 °C} \]

\[ P_{\text{tot}} \leq 1.4 \text{ W at 150 °C} \]

\[ P_{\text{tot}} \leq 1.6 \text{ W at 200 °C} \]

\[ P_{\text{tot}} \leq 0.5 \text{ W at 25 °C} \]

\[ P_{\text{tot}} \leq 1 \text{ W at 100 °C} \]

\[ P_{\text{tot}} \leq 1.4 \text{ W at 150 °C} \]

\[ P_{\text{tot}} \leq 1.6 \text{ W at 200 °C} \]

[1] Pulsed t_p ≤ 10 ms; δ ≤ 0.2
[5] Device mounted on a 7 cm² ceramic printed-circuit board, 1 cm² single-sided copper and tin-plated.
9. Thermal characteristics

### Table 6. Thermal characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{th(j-a)}$</td>
<td>thermal resistance from junction to ambient</td>
<td>in free air</td>
<td>[1]</td>
<td>[2]</td>
<td>50</td>
<td>K/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[1]</td>
<td></td>
<td>225</td>
<td>K/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[3]</td>
<td></td>
<td>125</td>
<td>K/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[4]</td>
<td></td>
<td>90</td>
<td>K/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[5]</td>
<td></td>
<td>80</td>
<td>K/W</td>
</tr>
<tr>
<td>$R_{th(j-sp)}$</td>
<td>thermal resistance from junction to solder point</td>
<td></td>
<td>-</td>
<td>-</td>
<td>16</td>
<td>K/W</td>
</tr>
</tbody>
</table>

[2] Pulse test: $t_p \leq 10$ ms; $\delta \leq 0.2$.
[5] Device mounted on a $7 \text{ cm}^2$ ceramic printed-circuit board, $1 \text{ cm}^2$ single-sided copper and tin-plated.
Mounted on FR4 PCB; standard footprint

1. δ = 1
2. δ = 0.75
3. δ = 0.5
4. δ = 0.33
5. δ = 0.2
6. δ = 0.1
7. δ = 0.05
8. δ = 0.02
9. δ = 0.01
10. δ = 0

Fig. 2. Transient thermal impedance as a function of pulse duration; typical values

Mounted on FR4 PCB; mounting pad for collector 1 cm²

1. δ = 1
2. δ = 0.75
3. δ = 0.5
4. δ = 0.33
5. δ = 0.2
6. δ = 0.1
7. δ = 0.05
8. δ = 0.02
9. δ = 0.01
10. δ = 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 cm²

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

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

### Table 7. Characteristics

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

PBSS5540X-Q

40 V, 5 A PNP low VCEsat transistor

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

VCE = −2 V
(1) T_amb = 100 °C
(2) T_amb = 25 °C
(3) T_amb = −55 °C

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

VCE = −2 V
(1) T_amb = −55 °C
(2) T_amb = 25 °C
(3) T_amb = 100 °C

Fig. 7. DC current gain 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. 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

- $V_{C\text{E}\text{sat}}$ vs. $I_C$ for $I_{C}/I_B = 20$
- (1) $T_{amb} = 100 \degree C$
- (2) $T_{amb} = 25 \degree C$
- (3) $T_{amb} = -55 \degree C$

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

- $V_{C\text{E}\text{sat}}$ vs. $I_C$ for $T_{amb} = 25 \degree C$
- (1) $I_{C}/I_B = 100$
- (2) $I_{C}/I_B = 50$
- (3) $I_{C}/I_B = 10$

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

- $V_{B\text{E}\text{sat}}$ vs. $I_C$ for $I_{C}/I_B = 20$
- (1) $T_{amb} = -55 \degree C$
- (2) $T_{amb} = 25 \degree C$
- (3) $T_{amb} = 100 \degree C$

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

- $V_{B\text{E}}$ vs. $I_C$ for $T_{amb} = 25 \degree C$
11. Test information

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.

12. Package outline

Fig. 13. Package outline SOT89

13. Soldering

Fig. 14. Reflow soldering footprint for SOT89
Fig. 15. Wave soldering footprint for SOT89
14. Revision history

Table 8. Revision history

<table>
<thead>
<tr>
<th>Data sheet ID</th>
<th>Release date</th>
<th>Data sheet status</th>
<th>Change notice</th>
<th>Supersedes</th>
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<td>PBSS5540X-Q v.1</td>
<td>20240123</td>
<td>Product data sheet</td>
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15. Legal information

Data sheet status

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<tbody>
<tr>
<td>Objective [short] data sheet</td>
<td>Development</td>
<td>This document contains data from the objective specification for product development.</td>
</tr>
<tr>
<td>Preliminary [short] data sheet</td>
<td>Qualification</td>
<td>This document contains data from the preliminary specification.</td>
</tr>
<tr>
<td>Product [short] data sheet</td>
<td>Production</td>
<td>This document contains the product specification.</td>
</tr>
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</table>

[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 https://www.nexperia.com.

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