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: PBSS304NX

2. Features and benefits

• Low collector-emitter saturation voltage \(V_{CEsat}\)
• High collector current capability \(I_C\) and \(I_{CM}\)
• High collector current gain \((hFE)\) at high \(I_C\)
• High efficiency due to less heat generation
• Smaller required Printed-Circuit Board (PCB) area than for conventional transistors
• Qualified according to AEC-Q101 and recommended for use in automotive applications

3. Applications

• High-voltage DC-to-DC conversion
• High-voltage MOSFET gate driving
• High-voltage motor control
• High-voltage power switches (e.g. motors, fans)
• Automotive applications

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>
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</thead>
<tbody>
<tr>
<td>(V_{CEO})</td>
<td>collector-emitter voltage</td>
<td>open base</td>
<td>-</td>
<td>-</td>
<td>-60</td>
<td>V</td>
</tr>
<tr>
<td>(I_C)</td>
<td>collector current</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-4.2</td>
<td>A</td>
</tr>
<tr>
<td>(I_{CM})</td>
<td>peak collector current</td>
<td>single pulse; (t_p \leq 1) ms</td>
<td>-</td>
<td>-</td>
<td>-8.4</td>
<td>A</td>
</tr>
<tr>
<td>(R_{CEsat})</td>
<td>collector-emitter saturation resistance</td>
<td>(I_C = -4) A; (I_B = -200) mA; pulsed; (t_p \leq 300) µs; (\delta \leq 0.02); (T_{amb} = 25) °C</td>
<td>48</td>
<td>69</td>
<td></td>
<td>mΩ</td>
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5. Pinning information

Table 2. Pinning information

<table>
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<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></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

<table>
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<th>Type number</th>
<th>Package</th>
<th>Name</th>
<th>Description</th>
<th>Version</th>
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<tr>
<td>PBSS304PX-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>
<td></td>
</tr>
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7. Marking

Table 4. Marking codes

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<tr>
<td>PBSS304PX-Q</td>
<td>%5L</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).

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<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>-60</td>
<td>V</td>
</tr>
<tr>
<td>V_{CEO}</td>
<td>collector-emitter voltage</td>
<td>open base</td>
<td>-</td>
<td>-60</td>
<td>V</td>
</tr>
<tr>
<td>V_{EBO}</td>
<td>emitter-base voltage</td>
<td>open collector</td>
<td>-</td>
<td>-5</td>
<td>V</td>
</tr>
<tr>
<td>I_{C}</td>
<td>collector current</td>
<td></td>
<td>-</td>
<td>-4.2</td>
<td>A</td>
</tr>
<tr>
<td>I_{CM}</td>
<td>peak collector current</td>
<td>single pulse; t_{p} ≤ 1 ms</td>
<td>-</td>
<td>-8.4</td>
<td>A</td>
</tr>
<tr>
<td>P_{tot}</td>
<td>total power dissipation</td>
<td>T_{amb} ≤ 25 °C</td>
<td>[1]</td>
<td>0.6</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[2]</td>
<td>1.65</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[3]</td>
<td>2.1</td>
<td>W</td>
</tr>
<tr>
<td>T_{j}</td>
<td>junction temperature</td>
<td></td>
<td>-</td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>T_{amb}</td>
<td>ambient temperature</td>
<td></td>
<td>-65</td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>T_{stg}</td>
<td>storage temperature</td>
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<td>-65</td>
<td>150</td>
<td>°C</td>
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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>-</td>
<td>-</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>[2]</td>
<td>-</td>
<td>-</td>
<td>K/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[3]</td>
<td>-</td>
<td>-</td>
<td>K/W</td>
</tr>
</tbody>
</table>


Fig. 1. Power derating curves

Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values
Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

FR4 PCB, mounting pad for collector 6 cm²

Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

Ceramic PCB, Al₂O₃, standard footprint

10. Characteristics

Table 7. Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>I_CBO</td>
<td>collector-base cut-off current</td>
<td>V_CB = -60 V; I_E = 0 A; T_amb = 25 °C</td>
<td>V_CB = -60 V; I_E = 0 A; T_amb = 25 °C</td>
<td>-</td>
<td>-</td>
<td>-100</td>
<td>nA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_CB = -60 V; I_E = 0 A; T_J = 150 °C</td>
<td>V_CB = -60 V; I_E = 0 A; T_J = 150 °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 V; I_C = 0 A; T_amb = 25 °C</td>
<td>V_EB = -5 V; I_C = 0 A; T_amb = 25 °C</td>
<td>-</td>
<td>-</td>
<td>-100</td>
<td>nA</td>
</tr>
</tbody>
</table>
## Symbol | Parameter | Conditions | Min | Typ | Max | Unit
--- | --- | --- | --- | --- | --- | ---
\( h_{FE} \) | DC current gain | \( V_{CE} = -2 \text{ V}; I_{C} = -0.5 \text{ A}; \text{pulsed}; t_{p} \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \degree \text{C} \) | 200 | 295 | - |  
\( V_{CE} = -2 \text{ V}; I_{C} = -1 \text{ A}; \text{pulsed}; t_{p} \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \degree \text{C} \) | 200 | 270 | -  
\( V_{CE} = -2 \text{ V}; I_{C} = -2 \text{ A}; \text{pulsed}; t_{p} \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \degree \text{C} \) | 150 | 230 | -  
\( V_{CE} = -2 \text{ V}; I_{C} = -4 \text{ A}; \text{pulsed}; t_{p} \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \degree \text{C} \) | 120 | 170 | -  
\( V_{CE} = -2 \text{ V}; I_{C} = -6 \text{ A}; \text{pulsed}; t_{p} \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \degree \text{C} \) | 60 | 100 | -  
\( V_{CEsat} \) | collector-emitter saturation voltage | \( I_{C} = -0.5 \text{ A}; I_{B} = -50 \text{ mA}; \text{pulsed}; t_{p} \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \degree \text{C} \) | - | -35 | -50 | mV  
\( I_{C} = -1 \text{ A}; I_{B} = -50 \text{ mA}; \text{pulsed}; t_{p} \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \degree \text{C} \) | - | -65 | -90 | mV  
\( I_{C} = -1 \text{ A}; I_{B} = -10 \text{ mA}; \text{pulsed}; t_{p} \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \degree \text{C} \) | - | -130 | -190 | mV  
\( I_{C} = -2 \text{ A}; I_{B} = -40 \text{ mA}; \text{pulsed}; t_{p} \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \degree \text{C} \) | - | -155 | -220 | mV  
\( I_{C} = -4 \text{ A}; I_{B} = -200 \text{ mA}; \text{pulsed}; t_{p} \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \degree \text{C} \) | - | -195 | -275 | mV  
\( I_{C} = -4 \text{ A}; I_{B} = -400 \text{ mA}; \text{pulsed}; t_{p} \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \degree \text{C} \) | - | -150 | -210 | mV  
\( I_{C} = -4.2 \text{ A}; I_{B} = -210 \text{ mA}; \text{pulsed}; t_{p} \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \degree \text{C} \) | - | -220 | -310 | mV  
\( R_{CEsat} \) | collector-emitter saturation resistance | \( I_{C} = -2 \text{ A}; I_{B} = -40 \text{ mA}; \text{pulsed}; t_{p} \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \degree \text{C} \) | - | 78 | 110 | mΩ  
\( I_{C} = -4 \text{ A}; I_{B} = -200 \text{ mA}; \text{pulsed}; t_{p} \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \degree \text{C} \) | - | 48 | 69 | mΩ  
\( I_{C} = -1 \text{ A}; I_{B} = -100 \text{ mA}; \text{pulsed}; t_{p} \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \degree \text{C} \) | - | -0.81 | -0.9 | V  
\( I_{C} = -4 \text{ A}; I_{B} = -400 \text{ mA}; \text{pulsed}; t_{p} \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \degree \text{C} \) | - | -0.93 | -1.05 | V  
\( V_{BEsat} \) | base-emitter saturation voltage | \( V_{CC} = -12.5 \text{ V}; I_{C} = -3 \text{ A}; \text{pulsed}; t_{p} \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \degree \text{C} \) | - | -0.77 | -0.85 | V  
\( V_{BEon} \) | base-emitter turn-on voltage | \( V_{CC} = -2 \text{ V}; I_{C} = -2 \text{ A}; \text{pulsed}; t_{p} \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \degree \text{C} \) | - | - | - |  
\( t_{d} \) | delay time | \( V_{CC} = -12.5 \text{ V}; I_{C} = -3 \text{ A}; I_{B\text{on}} = -0.15 \text{ A}; I_{B\text{off}} = 0.15 \text{ A}; T_{amb} = 25 \degree \text{C} \) | 15 | - | ns  
\( t_{r} \) | rise time | \( I_{B\text{on}} = 0.15 \text{ A}; T_{amb} = 25 \degree \text{C} \) | 65 | - | ns  
\( t_{on} \) | turn-on time | - | 80 | - | ns  
\( t_{s} \) | storage time | - | 225 | - | ns  
\( t_{f} \) | fall time | - | 95 | - | ns  
\( t_{off} \) | turn-off time | - | 320 | - | ns  
\( f_{T} \) | transition frequency | \( V_{CC} = -10 \text{ V}; I_{C} = -100 \text{ mA}; f = 100 \text{ MHz}; T_{amb} = 25 \degree \text{C} \) | 130 | - | MHz  
\( C_{C} \) | collector capacitance | \( V_{CC} = -10 \text{ V}; I_{E} = 0 \text{ A}; I_{B} = 0 \text{ A}; f = 1 \text{ MHz}; T_{amb} = 25 \degree \text{C} \) | 90 | 120 | - | pF
PBSS304PX-Q

60 V, 4.2 A PNP low VCEsat transistor

Fig. 5. DC current gain as a function of collector current; typical values

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

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

Fig. 8. Base-emitter saturation voltage as a function of collector current; typical values
Fig. 9. Collector-emitter saturation voltage as a function of collector current; typical values

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

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

- $T_{amb} = 25 \, ^\circ C$
  - (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

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

Fig. 12. Collector-emitter saturation resistance as a function of collector current; typical values

- $T_{amb} = 25 \, ^\circ C$
  - (1) $I_{C}/I_{B} = 100$
  - (2) $I_{C}/I_{B} = 50$
  - (3) $I_{C}/I_{B} = 10$
11. Test information

**Fig. 13.** Transistor switching time definition

**Fig. 14.** Test circuit for switching times

**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. 15. Package outline SOT89

13. Soldering

Fig. 16. Reflow soldering footprint for SOT89
Fig. 17. Wave soldering footprint for SOT89
14. Revision history

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<th>Release date</th>
<th>Data sheet status</th>
<th>Change notice</th>
<th>Supersedes</th>
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<td>20231109</td>
<td>Product data sheet</td>
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15. Legal information

Data sheet status

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<th>Product status</th>
<th>Definition</th>
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<td>Development</td>
<td>This document contains data from the objective specification for product development.</td>
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<tr>
<td>Preliminary [short]</td>
<td>Qualification</td>
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<tr>
<td>Product [short]</td>
<td>Production</td>
<td>This document contains the product specification.</td>
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