1. General description

NPN high-voltage low $V_{CE_{sat}}$ transistor in a SOT23 (TO-236AB) small Surface-Mounted Device (SMD) plastic package. PNP complement: PBHV9040T-Q.

2. Features and benefits

- High voltage
- Low collector-emitter saturation voltage $V_{CE_{sat}}$
- High collector current capability $I_C$ and $I_{CM}$
- High collector current gain ($h_{FE}$) at high collector current
- Small SMD plastic package
- Qualified according to AEC-Q101 and recommended for use in automotive applications

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 (SMPS)

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>$V_{CE_{SM}}$</td>
<td>collector-emitter peak voltage</td>
<td>$V_{BE} = 0 \text{ V}$</td>
<td>-</td>
<td>-</td>
<td>500</td>
<td>V</td>
</tr>
<tr>
<td>$V_{CEO}$</td>
<td>collector-emitter voltage</td>
<td>open base</td>
<td>-</td>
<td>-</td>
<td>400</td>
<td>V</td>
</tr>
<tr>
<td>$I_C$</td>
<td>collector current</td>
<td></td>
<td>-</td>
<td>-</td>
<td>0.5</td>
<td>A</td>
</tr>
<tr>
<td>$h_{FE}$</td>
<td>DC current gain</td>
<td>$V_{CE} = 10 \text{ V}; I_C = 50 \text{ mA}; T_{amb} = 25 \degree \text{C}$</td>
<td>100</td>
<td>200</td>
<td>-</td>
<td></td>
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</table>
5. Pinning information

Table 2. 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>B</td>
<td>base</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>E</td>
<td>emitter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>C</td>
<td>collector</td>
<td></td>
<td></td>
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6. Ordering information

Table 3. Ordering information

<table>
<thead>
<tr>
<th>Type number</th>
<th>Package</th>
<th>Name</th>
<th>Description</th>
<th>Version</th>
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</thead>
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<tr>
<td>PBHV8540T-Q</td>
<td>SOT23</td>
<td>plastic, surface-mounted package; 3 terminals; 1.9 mm pitch; 2.9 mm x 1.3 mm x 1 mm body</td>
<td>SOT23</td>
<td></td>
</tr>
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7. Marking

Table 4. Marking codes

<table>
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<tr>
<td>PBHV8540T-Q</td>
<td>W4%</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>500</td>
<td>V</td>
</tr>
<tr>
<td>V_{CEO}</td>
<td>collector-emitter voltage</td>
<td>open base</td>
<td>-</td>
<td>400</td>
<td>V</td>
</tr>
<tr>
<td>V_{CESM}</td>
<td>collector-emitter peak</td>
<td>V_{BE} = 0 V</td>
<td>-</td>
<td>500</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>0.5</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>1</td>
<td>A</td>
</tr>
<tr>
<td>I_{BM}</td>
<td>peak base current</td>
<td></td>
<td>-</td>
<td>200</td>
<td>mA</td>
</tr>
<tr>
<td>P_{tot}</td>
<td>total power dissipation</td>
<td>T_{amb} ≤ 25 °C</td>
<td>[1]</td>
<td>-</td>
<td>300 mW</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>-55</td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>T_{stg}</td>
<td>storage temperature</td>
<td></td>
<td>-65</td>
<td>150</td>
<td>°C</td>
</tr>
</tbody>
</table>


![](image)

Fig. 1. Power derating curve

FR4 PCB, standard footprint
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>-</td>
<td>-</td>
<td>417</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>70</td>
<td>K/W</td>
</tr>
</tbody>
</table>


FR4 PCB, standard footprint

Fig. 2. Transient thermal impedance from junction to ambient 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>$V_{CB} = 320$ 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>$V_{CE} = 320$ V; $I_E = 0$ A; $T_J = 150$ °C</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>μA</td>
</tr>
<tr>
<td>I_{CES}</td>
<td>collector-emitter cut-off current</td>
<td>$V_{CE} = 320$ V; $V_{BE} = 0$ V; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>nA</td>
</tr>
<tr>
<td>I_{EBO}</td>
<td>emitter-base cut-off current</td>
<td>$V_{EB} = 4$ V; $I_C = 0$ A; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>nA</td>
</tr>
<tr>
<td>h_{FE}</td>
<td>DC current gain</td>
<td>$V_{CE} = 10$ V; $I_C = 50$ mA; $T_{amb} = 25$ °C</td>
<td>10</td>
<td>200</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{CE} = 10$ V; $I_C = 100$ mA; $T_{amb} = 25$ °C</td>
<td>80</td>
<td>150</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{CE} = 10$ V; $I_C = 300$ mA; pulsed; $t_p \leq 300$ μs; $\delta \leq 0.02$; $T_{amb} = 25$ °C</td>
<td>10</td>
<td>20</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>V_{CEsat}</td>
<td>collector-emitter saturation voltage</td>
<td>$I_C = 100$ mA; $I_B = 10$ mA; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>100</td>
<td>200</td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_C = 100$ mA; $I_B = 20$ mA; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>60</td>
<td>90</td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_C = 300$ mA; $I_B = 60$ mA; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>135</td>
<td>250</td>
<td>mV</td>
</tr>
<tr>
<td>V_{BEsat}</td>
<td>base-emitter saturation voltage</td>
<td>$I_C = 300$ mA; $I_B = 60$ mA; pulsed; $t_p \leq 300$ μs; $\delta \leq 0.02$; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>0.91</td>
<td>1.1</td>
<td>V</td>
</tr>
<tr>
<td>t_{d}</td>
<td>delay time</td>
<td>$V_{CC} = 6$ V; $I_C = 0.5$ A; $I_{Bon} = 0.1$ A; $I_{Boff} = -0.1$ A; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>50</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>t_{r}</td>
<td>rise time</td>
<td>$V_{CC} = 6$ V; $I_C = 0.5$ A; $I_{Bon} = 0.1$ A; $I_{Boff} = -0.1$ A; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>6200</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>t_{on}</td>
<td>turn-on time</td>
<td>$V_{CC} = 6$ V; $I_C = 0.5$ A; $I_{Bon} = 0.1$ A; $I_{Boff} = -0.1$ A; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>6250</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>t_{s}</td>
<td>storage time</td>
<td>$V_{CC} = 6$ V; $I_C = 0.5$ A; $I_{Bon} = 0.1$ A; $I_{Boff} = -0.1$ A; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>800</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>t_{f}</td>
<td>fall time</td>
<td>$V_{CC} = 6$ V; $I_C = 0.5$ A; $I_{Bon} = 0.1$ A; $I_{Boff} = -0.1$ A; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>2200</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>t_{off}</td>
<td>turn-off time</td>
<td>$V_{CC} = 6$ V; $I_C = 0.5$ A; $I_{Bon} = 0.1$ A; $I_{Boff} = -0.1$ A; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>3000</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>f_{T}</td>
<td>transition frequency</td>
<td>$V_{CE} = 10$ V; $I_C = 100$ mA; $f = 100$ MHz; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>30</td>
<td>-</td>
<td>MHz</td>
</tr>
<tr>
<td>C_{c}</td>
<td>collector capacitance</td>
<td>$V_{CE} = 20$ V; $I_E = 0$ A; $I_B = 0$ A; $f = 1$ MHz; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>4</td>
<td>-</td>
<td>pF</td>
</tr>
<tr>
<td>C_{e}</td>
<td>emitter capacitance</td>
<td>$V_{EB} = 0.5$ V; $I_C = 0$ A; $I_B = 0$ A; $f = 1$ MHz; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>165</td>
<td>-</td>
<td>pF</td>
</tr>
</tbody>
</table>
V_{CE} = 10 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

I_C \text{(mA)}
\begin{array}{c}
0.2 \\
0.4 \\
0.6 \\
0.8 \\
1.0 \\
\end{array}
\begin{array}{c}
0 \\
1 \\
2 \\
3 \\
4 \\
5 \\
\end{array}

V_{CE} (V)
\begin{array}{c}
10 \\
20 \\
30 \\
40 \\
50 \\
\end{array}
\begin{array}{c}
10^{-1} \\
1 \\
10 \\
10^2 \\
10^3 \\
10^4 \\
\end{array}

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

V_{BE} (V)
\begin{array}{c}
0 \\
0.4 \\
0.8 \\
1.2 \\
1.6 \\
\end{array}
\begin{array}{c}
10^{-1} \\
1 \\
10 \\
10^2 \\
10^3 \\
10^4 \\
\end{array}

I_C (mA)
\begin{array}{c}
0 \\
1 \\
10 \\
10^2 \\
10^3 \\
10^4 \\
\end{array}

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

I_C/I_B = 5
(1) T_{amb} = -55 °C
(2) T_{amb} = 25 °C
(3) T_{amb} = 100 °C

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

PBHV8540T-Q

500 V, 0.5 A NPN high-voltage low VCEsat transistor

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

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

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

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

I_C/I_B = 5
(1) T_amb = 100 °C
(2) T_amb = 25 °C
(3) T_amb = -55 °C

T_amb = 25 °C
(1) I_C/I_B = 20
(2) I_C/I_B = 10
(3) I_C/I_B = 5
11. Test information

Fig. 11. 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. 12. Package outline SOT23
13. Soldering

Fig. 13. Reflow soldering footprint for SOT23

Fig. 14. Wave soldering footprint for SOT23
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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<tr>
<td>PBHV8540T-Q v.1</td>
<td>20220316</td>
<td>Product data sheet</td>
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Data sheet status

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<tr>
<th>Document status</th>
<th>Product status</th>
<th>Definition</th>
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<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>
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