PBHV8140Z-Q
500 V, 1 A NPN high-voltage low VCEsat transistor
21 July 2023
Product data sheet

1. General description

NPN high-voltage low VCEsat transistor in a medium power SOT223 (SC-73) Surface-Mounted Device (SMD) plastic package.
PNP complement: PBHV9540Z-Q

2. Features and benefits

- High voltage
- Low collector-emitter saturation voltage VCEsat
- High collector current capability IC and ICM
- High collector current gain (hFE) at high IC
- Medium power SMD plastic package
- Qualified according to AEC-Q101 and recommended for use in automotive applications

3. Applications

- LED driver for LED chain module
- LCD backlighting
- Automotive motor management
- 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>
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<tbody>
<tr>
<td>VCESM</td>
<td>collector-emitter peak voltage</td>
<td>VBE = 0 V</td>
<td>-</td>
<td>-</td>
<td>500</td>
<td>V</td>
</tr>
<tr>
<td>VCEO</td>
<td>collector-emitter voltage</td>
<td>open base</td>
<td>-</td>
<td>-</td>
<td>400</td>
<td>V</td>
</tr>
<tr>
<td>IC</td>
<td>collector current</td>
<td></td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>A</td>
</tr>
<tr>
<td>hFE</td>
<td>DC current gain</td>
<td>VCE = 10 V; IC = 50 mA; Tamb = 25 °C</td>
<td>100</td>
<td>155</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>C</td>
<td>collector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>E</td>
<td>emitter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</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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<tr>
<td>PBHV8140Z-Q</td>
<td>SC-73</td>
<td>plastic, surface-mounted package with increased heatsink; 4 leads; 2.3 mm pitch; 6.5 mm x 3.5 mm x 1.65 mm body</td>
<td>SOT223</td>
<td></td>
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</table>

7. Marking

Table 4. Marking codes

<table>
<thead>
<tr>
<th>Type number</th>
<th>Marking code</th>
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<tr>
<td>PBHV8140Z-Q</td>
<td>V8140Z</td>
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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 voltage</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>1</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>2</td>
<td>A</td>
</tr>
<tr>
<td>$I_{BM}$</td>
<td>peak base current</td>
<td></td>
<td>-</td>
<td>400</td>
<td>mA</td>
</tr>
<tr>
<td>$P_{tot}$</td>
<td>total power dissipation</td>
<td>$T_{amb} \leq 25$ °C</td>
<td>[1]</td>
<td>1.45</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[2]</td>
<td>0.73</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>-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>

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and mounting pad for collector 6 cm².

Fig. 1. Power derating curves

(1) FR4 PCB, mounting pad for collector 6 cm²
(2) 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>[1]</td>
<td>-</td>
<td>85</td>
<td>K/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-</td>
<td>170</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>15</td>
<td>K/W</td>
</tr>
</tbody>
</table>

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 6 cm².

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
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>$I_{EBO}$</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>$I_{CES}$</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>
</tbody>
</table>

$h_{FE}$ DC current gain

- $V_{CE} = 10$ V; $I_{C} = 50$ mA; $T_{amb} = 25$ °C
- $V_{CE} = 10$ V; $I_{C} = 100$ mA; pulsed; $t_{p} \leq 300$ µs; $\delta \leq 0.02$; $T_{amb} = 25$ °C
- $V_{CE} = 10$ V; $I_{C} = 500$ mA; pulsed; $t_{p} \leq 300$ µs; $\delta \leq 0.02$; $T_{amb} = 25$ °C
- $V_{CE} = 10$ V; $I_{C} = 1$ A; pulsed; $t_{p} \leq 300$ µs; $\delta \leq 0.02$; $T_{amb} = 25$ °C

$V_{CEsat}$ collector-emitter saturation voltage

- $I_{C} = 100$ mA; $I_{B} = 10$ mA; pulsed; $t_{p} \leq 300$ µs; $\delta \leq 0.02$; $T_{amb} = 25$ °C
- $I_{C} = 100$ mA; $I_{B} = 20$ mA; pulsed; $t_{p} \leq 300$ µs; $\delta \leq 0.02$; $T_{amb} = 25$ °C
- $I_{C} = 500$ mA; $I_{B} = 100$ nA; pulsed; $t_{p} \leq 300$ µs; $\delta \leq 0.02$; $T_{amb} = 25$ °C
- $I_{C} = 1$ A; $I_{B} = 200$ mA; pulsed; $t_{p} \leq 300$ µs; $\delta \leq 0.02$; $T_{amb} = 25$ °C

$R_{CEsat}$ collector-emitter saturation resistance

- $V_{CE} = 6$ V; $I_{C} = 0.5$ A; $I_{Bon} = 0.1$ A; $I_{Boff} = -0.1$ A; $T_{amb} = 25$ °C
- $V_{CE} = 10$ V; $I_{C} = 10$ mA; $f = 100$ MHz; $T_{amb} = 25$ °C

$V_{BEsat}$ base-emitter saturation voltage

- $V_{CE} = 10$ V; $I_{C} = 10$ mA; $f = 100$ MHz; $T_{amb} = 25$ °C

$t_{d}$ delay time

- $V_{CC} = 6$ V; $I_{C} = 0.5$ A; $I_{Bon} = 0.1$ A; $I_{Boff} = -0.1$ A; $T_{amb} = 25$ °C
- $V_{CE} = 10$ V; $I_{C} = 10$ mA; $f = 100$ MHz; $T_{amb} = 25$ °C

$t_{r}$ rise time

- $V_{CC} = 6$ V; $I_{C} = 0.5$ A; $I_{Bon} = 0.1$ A; $I_{Boff} = -0.1$ A; $T_{amb} = 25$ °C
- $V_{CE} = 10$ V; $I_{C} = 10$ mA; $f = 100$ MHz; $T_{amb} = 25$ °C

$t_{on}$ turn-on time

- $V_{CC} = 6$ V; $I_{C} = 0.5$ A; $I_{Bon} = 0.1$ A; $I_{Boff} = -0.1$ A; $T_{amb} = 25$ °C
- $V_{CE} = 10$ V; $I_{C} = 10$ mA; $f = 100$ MHz; $T_{amb} = 25$ °C

$t_{s}$ storage time

- $V_{CC} = 6$ V; $I_{C} = 0.5$ A; $I_{Bon} = 0.1$ A; $I_{Boff} = -0.1$ A; $T_{amb} = 25$ °C
- $V_{CE} = 10$ V; $I_{C} = 10$ mA; $f = 100$ MHz; $T_{amb} = 25$ °C

$t_{f}$ fall time

- $V_{CC} = 6$ V; $I_{C} = 0.5$ A; $I_{Bon} = 0.1$ A; $I_{Boff} = -0.1$ A; $T_{amb} = 25$ °C
- $V_{CE} = 10$ V; $I_{C} = 10$ mA; $f = 100$ MHz; $T_{amb} = 25$ °C

$t_{off}$ turn-off time

- $V_{CC} = 6$ V; $I_{C} = 0.5$ A; $I_{Bon} = 0.1$ A; $I_{Boff} = -0.1$ A; $T_{amb} = 25$ °C
- $V_{CE} = 10$ V; $I_{C} = 10$ mA; $f = 100$ MHz; $T_{amb} = 25$ °C

$f_{T}$ transition frequency

- $V_{CC} = 6$ V; $I_{C} = 0.5$ A; $I_{Bon} = 0.1$ A; $I_{Boff} = -0.1$ A; $T_{amb} = 25$ °C
- $V_{CE} = 10$ V; $I_{C} = 10$ mA; $f = 100$ MHz; $T_{amb} = 25$ °C

$C_{C}$ collector capacitance

- $V_{CC} = 6$ V; $I_{C} = 0.5$ A; $I_{Bon} = 0.1$ A; $I_{Boff} = -0.1$ A; $T_{amb} = 25$ °C
- $V_{CE} = 10$ V; $I_{C} = 10$ mA; $f = 100$ MHz; $T_{amb} = 25$ °C

$C_{e}$ emitter capacitance

- $V_{CC} = 6$ V; $I_{C} = 0.5$ A; $I_{Bon} = 0.1$ A; $I_{Boff} = -0.1$ A; $T_{amb} = 25$ °C
- $V_{CE} = 10$ V; $I_{C} = 10$ mA; $f = 100$ MHz; $T_{amb} = 25$ °C
Nexperia

PBHV8140Z-Q

500 V, 1 A NPN high-voltage low VCEsat transistor

Fig. 4. DC current gain as a function of collector current; typical values

\[ V_{CE} = 10 \text{ V} \]
(1) \( T_{amb} = 100 \degree C \)
(2) \( T_{amb} = 25 \degree C \)
(3) \( T_{amb} = -55 \degree C \)

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

\[ I_{C} = 360 \text{ mA} \]
\[ V_{CE} = 10 \text{ V} \]
\[ T_{amb} = 25 \degree C \]

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

\[ V_{CE} = 10 \text{ V} \]
(1) \( T_{amb} = -55 \degree C \)
(2) \( T_{amb} = 25 \degree C \)
(3) \( T_{amb} = 100 \degree C \)

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

\[ I_{C}/I_{B} = 5 \]
(1) \( T_{amb} = -55 \degree C \)
(2) \( T_{amb} = 25 \degree C \)
(3) \( T_{amb} = 100 \degree C \)
500 V, 1 A NPN high-voltage low VCEsat transistor

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

- $I_C/I_B = 5$
- (1) $T_{amb} = 100 \, ^\circ C$
- (2) $T_{amb} = 25 \, ^\circ C$
- (3) $T_{amb} = -55 \, ^\circ C$

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

- $T_{amb} = 25 \, ^\circ C$
- (1) $I_C/I_B = 20$
- (2) $I_C/I_B = 10$
- (3) $I_C/I_B = 5$

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

- $I_C/I_B = 5$
- (1) $T_{amb} = 100 \, ^\circ C$
- (2) $T_{amb} = 25 \, ^\circ C$
- (3) $T_{amb} = -55 \, ^\circ C$

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

- $T_{amb} = 25 \, ^\circ C$
- (1) $I_C/I_B = 20$
- (2) $I_C/I_B = 10$
- (3) $I_C/I_B = 5$
11. Test information

![Test circuit for switching times](image)

**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

![Package outline SC-73 (SOT223)](image)
13. Soldering

Fig. 14. Reflow soldering footprint for SC-73 (SOT223)

Fig. 15. Wave soldering footprint for SC-73 (SOT223)
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>PBHV8140Z-Q v.1</td>
<td>20230721</td>
<td>Product data sheet</td>
<td>-</td>
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15. Legal information

Data sheet status

<table>
<thead>
<tr>
<th>Document status</th>
<th>Product status</th>
<th>Definition</th>
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<tr>
<td>[1][2]</td>
<td>[3]</td>
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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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</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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