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Kind regards,

Team Nexperia
PBHV9040X
500 V, 0.25 A PNP high-voltage low VCEsat (BISS) transistor
9 December 2013

Product data sheet

1. General description

PNP high-voltage low VCEsat Breakthrough In Small Signal (BISS) transistor in a SOT89 (SC-62) medium power and flat lead Surface-Mounted Device (SMD) plastic package.

NPN complement: PBHV8540X.

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
- AEC-Q101 qualified

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

4. Quick reference data

Table 1. 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>VCESM</td>
<td>collector-emitter peak voltage</td>
<td>VBE = 0 V</td>
<td>-</td>
<td>-</td>
<td>-500 V</td>
<td></td>
</tr>
<tr>
<td>VCEO</td>
<td>collector-emitter voltage</td>
<td>open base</td>
<td>-</td>
<td>-</td>
<td>-400 V</td>
<td></td>
</tr>
<tr>
<td>IC</td>
<td>collector current</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-0.25 A</td>
<td></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>200</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Scan or click this QR code to view the latest information for this product
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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<tbody>
<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>
<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>PBHV9040X</td>
<td>SOT89</td>
<td>plastic surface-mounted package; die pad for good heat transfer; 3 leads</td>
<td>SOT89</td>
<td></td>
</tr>
</tbody>
</table>

7. Marking

Table 4. Marking codes

<table>
<thead>
<tr>
<th>Type number</th>
<th>Marking code</th>
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<tr>
<td>PBHV9040X</td>
<td>%4E</td>
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</table>

[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 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>-0.25</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>-0.5</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} \leq 25 °C</td>
<td>[1]</td>
<td>0.52</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[2]</td>
<td>1.5</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>


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>-</td>
<td>240 K/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[2]</td>
<td></td>
<td>-</td>
<td>83 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>20</td>
<td>K/W</td>
</tr>
</tbody>
</table>


---

![Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values](image1)

**FR4 PCB, standard footprint**

![Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values](image2)

**FR4 PCB, mounting pad for collector 6 cm$^2$**
# 10. 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_{CB} = -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>100</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>200</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_{CE} = -10 V; I_{C} = -250 mA; pulsed; t_{p} ≤ 300 µs; δ ≤ 0.02 ; T_{amb} = 25 °C</td>
<td>10</td>
<td>25</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>V_{CESat}</td>
<td>collector-emitter saturation voltage</td>
<td>I_{C} = -100 mA; I_{B} = -20 mA; T_{amb} = 25 °C</td>
<td>-</td>
<td>-110</td>
<td>-200</td>
<td>mV</td>
</tr>
<tr>
<td>V_{BEsat}</td>
<td>base-emitter saturation voltage</td>
<td>I_{C} = -100 mA; I_{B} = -20 mA; pulsed; t_{p} ≤ 300 µs; δ ≤ 0.02 ; T_{amb} = 25 °C</td>
<td>-</td>
<td>-1</td>
<td>-1.1</td>
<td>V</td>
</tr>
<tr>
<td>t_{d}</td>
<td>delay time</td>
<td>V_{CC} = -2 V; I_{C} = -0.15 A; I_{Bon} = -0.03 A; I_{Boff} = 0.03 A; T_{amb} = 25 °C</td>
<td>-</td>
<td>9</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>t_{r}</td>
<td>rise time</td>
<td>-</td>
<td>1810</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>t_{on}</td>
<td>turn-on time</td>
<td>-</td>
<td>1819</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>t_{s}</td>
<td>storage time</td>
<td>-</td>
<td>715</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>t_{f}</td>
<td>fall time</td>
<td>-</td>
<td>1085</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>t_{off}</td>
<td>turn-off time</td>
<td>-</td>
<td>1800</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>f_{T}</td>
<td>transition frequency</td>
<td>V_{CE} = -10 V; I_{C} = -10 mA; f = 100 MHz; T_{amb} = 25 °C</td>
<td>-</td>
<td>55</td>
<td>-</td>
<td>MHz</td>
</tr>
<tr>
<td>C_{c}</td>
<td>collector capacitance</td>
<td>V_{CB} = -20 V; I_{C} = 0 A; I_{E} = 0 A; f = 1 MHz; T_{amb} = 25 °C</td>
<td>-</td>
<td>7</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_{E} = 0 A; f = 1 MHz; T_{amb} = 25 °C</td>
<td>-</td>
<td>150</td>
<td>-</td>
<td>pF</td>
</tr>
</tbody>
</table>
PBHV9040X

500 V, 0.25 A PNP high-voltage low VCEsat (BISS) transistor

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

\[ V_{CE} = -10 \text{ V} \]

1. \( T_{\text{amb}} = 100 ^\circ \text{C} \)
2. \( T_{\text{amb}} = 25 ^\circ \text{C} \)
3. \( T_{\text{amb}} = -55 ^\circ \text{C} \)

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

\[ I_C (\text{mA}) = -140 \]

\[ V_{CE} (\text{V}) \]

1. \( T_{\text{amb}} = 100 ^\circ \text{C} \)
2. \( T_{\text{amb}} = 25 ^\circ \text{C} \)
3. \( T_{\text{amb}} = -55 ^\circ \text{C} \)

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

\[ V_{CE} = -10 \text{ V} \]

1. \( T_{\text{amb}} = -55 ^\circ \text{C} \)
2. \( T_{\text{amb}} = 25 ^\circ \text{C} \)
3. \( T_{\text{amb}} = 100 ^\circ \text{C} \)

I\(_C\)/I\(_B\) = 5

1. \( T_{\text{amb}} = -55 ^\circ \text{C} \)
2. \( T_{\text{amb}} = 25 ^\circ \text{C} \)
3. \( T_{\text{amb}} = 100 ^\circ \text{C} \)

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

\[ I_C (\text{mA}) = -140 \]

\[ V_{BE} (\text{V}) \]
Fig. 8. Collector-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

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

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

Fig. 12. BISS transistor switching time definition

Fig. 13. Test circuit for switching times

11.1 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

Plastic surface-mounted package; exposed die pad for good heat transfer; 3 leads

**SOT89**

**DIMENSIONS (mm are the original dimensions)**

<table>
<thead>
<tr>
<th>UNIT</th>
<th>A</th>
<th>b_p1</th>
<th>b_p2</th>
<th>b_p3</th>
<th>c</th>
<th>D</th>
<th>E</th>
<th>e</th>
<th>e_1</th>
<th>H_E</th>
<th>L_p</th>
<th>w</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>1.6</td>
<td>0.48</td>
<td>0.53</td>
<td>1.8</td>
<td>0.44</td>
<td>4.6</td>
<td>2.6</td>
<td>3.0</td>
<td>1.5</td>
<td>4.25</td>
<td>1.2</td>
<td>0.8</td>
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<td></td>
<td>1.4</td>
<td>0.35</td>
<td>0.40</td>
<td>1.4</td>
<td>0.23</td>
<td>4.4</td>
<td>2.4</td>
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</tbody>
</table>

**Fig. 14. Package outline SOT89**
13. Soldering

Fig. 15. Reflow soldering footprint for SOT89

Fig. 16. 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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<tbody>
<tr>
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<td>20131209</td>
<td>Product data sheet</td>
<td>-</td>
<td>-</td>
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</table>
15. Legal information

15.1 Data sheet status

<table>
<thead>
<tr>
<th>Document status</th>
<th>Product status</th>
<th>Definition</th>
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</thead>
<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>
</tbody>
</table>

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[2] The term "short data sheet" is explained in section "Definitions".

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16. Contents

16.1 General description ............................................... 1
16.2 Features and benefits ............................................1
16.3 Applications ........................................................... 1
16.4 Quick reference data ............................................... 1
16.5 Pinning information .................................................2
16.6 Ordering information .............................................2
16.7 Marking ................................................................... 2
16.8 Limiting values .......................................................3
16.9 Thermal characteristics ............................................4
16.10 Characteristics ..........................................................5
16.11 Test information .......................................................8
16.11.1 Quality information ............................................... 8
16.12 Package outline ..................................................... 9
16.13 Soldering .............................................................. 10
16.14 Revision history .....................................................11
16.15 Legal information ...................................................12
16.15.1 Data sheet status ............................................... 12
16.15.2 Definitions ...........................................................12
16.15.3 Disclaimers ........................................................12
16.15.4 Trademarks ........................................................ 13

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