1. General description

NPN high-voltage low $V_{CE_{sat}}$ Breakthrough In Small Signal (BISS) transistor in a leadless ultra small DFN1010D-3 (SOT1215) Surface-Mounted Device (SMD) plastic package with visible and solderable side pads.

PNP complement: PBHV9515QA.

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 $I_C$
- Low package height of 0.37 mm
- AEC-Q101 qualified
- Suitable for Automatic Optical Inspection (AOI) of solder joint

3. Applications

- LED driver for LED chain module
- High Intensity Discharge (HID) front lighting
- 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>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{CEO}$</td>
<td>collector-emitter voltage</td>
<td>open base</td>
<td>-</td>
<td>-</td>
<td>150</td>
<td>V</td>
</tr>
<tr>
<td>$I_C$</td>
<td>collector current</td>
<td></td>
<td>-</td>
<td>-</td>
<td>500</td>
<td>mA</td>
</tr>
<tr>
<td>$h_{FE}$</td>
<td>DC current gain</td>
<td>$V_{CE} = 10$ V; $I_C = 100$ mA; pulsed; $t_p \leq 300$ µs; $\delta \leq 0.02$; $T_{amb} = 25$ °C</td>
<td>100</td>
<td>215</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</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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<tbody>
<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>
</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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</thead>
<tbody>
<tr>
<td>PBHV8515QA</td>
<td>DFN1010D-3</td>
<td>DFN1010D-3: plastic thermal enhanced ultra thin small outline package; no leads; 3 terminals; body 1.1 x 1.0 x 0.37 mm</td>
<td>SOT1215</td>
<td></td>
</tr>
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</table>

7. Marking

Table 4. Marking codes

<table>
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<th>Marking code</th>
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<td>PBHV8515QA</td>
<td>00 00 11</td>
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Fig. 1. DFN1010D-3 (SOT1215) binary marking code description
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>150</td>
<td>V</td>
</tr>
<tr>
<td>$V_{CEO}$</td>
<td>collector-emitter voltage</td>
<td>open base</td>
<td>-</td>
<td>150</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>500</td>
<td>mA</td>
</tr>
<tr>
<td>$I_{CM}$</td>
<td>peak collector current</td>
<td>single pulse; $t_p \leq 1$ 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>$T_{amb} \leq 25$ °C</td>
<td>[1]</td>
<td>325</td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[2]</td>
<td>600</td>
<td>mW</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>[3]</td>
<td>740</td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[4]</td>
<td>540</td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[5]</td>
<td>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>-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>

[5] Device mounted on an FR4 PCB, 4-layer copper, tin-plated, mounting pad for collector 1 cm$^2$. 
Fig. 2. Power derating curves

(1) FR4 PCB, 4-layer copper, 1 cm²
(2) FR4 PCB, single-sided copper, 6 cm²
(3) FR4 PCB, single-sided copper, 1 cm²
(4) FR4 PCB, 4-layer copper, standard footprint
(5) FR4 PCB, single-sided copper, 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>385</td>
<td>K/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[5] Device mounted on an FR4 PCB, 4-layer copper, tin-plated, mounting pad for collector 1 cm$^2$.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values
**Fig. 4.** Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

**Fig. 5.** Transient thermal impedance from junction to ambient as a function of pulse duration; typical values
Fig. 6. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

FR4 PCB, 4-layer copper, 1 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>$V_{CB} = 120 , \text{V}; , I_E = 0 , \text{A}; , T_{amb} = 25 , ^\circ\text{C}$</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>nA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{CB} = 120 , \text{V}; , I_E = 0 , \text{A}; , T_j = 150 , ^\circ\text{C}$</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>$V_{CE} = 120 , \text{V}; , V_{BE} = 0 , \text{V}; , T_{amb} = 25 , ^\circ\text{C}$</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>$V_{EB} = 5 , \text{V}; , I_C = 0 , \text{A}; , T_{amb} = 25 , ^\circ\text{C}$</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>nA</td>
</tr>
<tr>
<td>$h_{FE}$</td>
<td>DC current gain</td>
<td>$V_{CE} = 10 , \text{V}; , I_C = 50 , \text{mA}; , \text{pulsed}$; $t_p \leq 300 , \mu\text{s}; , \delta \leq 0.02$; $T_{amb} = 25 , ^\circ\text{C}$</td>
<td>100</td>
<td>215</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{CE} = 10 , \text{V}; , I_C = 100 , \text{mA}; , \text{pulsed}$; $t_p \leq 300 , \mu\text{s}; , \delta \leq 0.02$; $T_{amb} = 25 , ^\circ\text{C}$</td>
<td>100</td>
<td>215</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{CE} = 10 , \text{V}; , I_C = 200 , \text{mA}; , \text{pulsed}$; $t_p \leq 300 , \mu\text{s}; , \delta \leq 0.02$; $T_{amb} = 25 , ^\circ\text{C}$</td>
<td>100</td>
<td>200</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{CE} = 10 , \text{V}; , I_C = 500 , \text{mA}; , \text{pulsed}$; $t_p \leq 300 , \mu\text{s}; , \delta \leq 0.02$; $T_{amb} = 25 , ^\circ\text{C}$</td>
<td>35</td>
<td>60</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$V_{CE_{Sat}}$</td>
<td>collector-emitter saturation voltage</td>
<td>$I_C = 50 , \text{mA}; , I_B = 5 , \text{mA}; , T_{amb} = 25 , ^\circ\text{C}$</td>
<td>-</td>
<td>30</td>
<td>60</td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_C = 100 , \text{mA}; , I_B = 10 , \text{mA}; , \text{pulsed}$; $t_p \leq 300 , \mu\text{s}; , \delta \leq 0.02$; $T_{amb} = 25 , ^\circ\text{C}$</td>
<td>-</td>
<td>45</td>
<td>80</td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_C = 100 , \text{mA}; , I_B = 20 , \text{mA}; , \text{pulsed}$; $t_p \leq 300 , \mu\text{s}; , \delta \leq 0.02$; $T_{amb} = 25 , ^\circ\text{C}$</td>
<td>-</td>
<td>35</td>
<td>70</td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_C = 200 , \text{mA}; , I_B = 40 , \text{mA}; , \text{pulsed}$; $t_p \leq 300 , \mu\text{s}; , \delta \leq 0.02$; $T_{amb} = 25 , ^\circ\text{C}$</td>
<td>-</td>
<td>60</td>
<td>100</td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_C = 500 , \text{mA}; , I_B = 100 , \text{mA}; , \text{pulsed}$; $t_p \leq 300 , \mu\text{s}; , \delta \leq 0.02$; $T_{amb} = 25 , ^\circ\text{C}$</td>
<td>-</td>
<td>120</td>
<td>200</td>
<td>mV</td>
</tr>
<tr>
<td>$V_{BE_{Sat}}$</td>
<td>base-emitter saturation voltage</td>
<td>-</td>
<td>0.95</td>
<td>1.2</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$t_d$</td>
<td>delay time</td>
<td>$V_{CC} = 10 , \text{V}; , I_C = 100 , \text{mA}; , I_{B_{on}} = 20 , \text{mA}; , I_{B_{off}} = -20 , \text{mA}; , T_{amb} = 25 , ^\circ\text{C}$</td>
<td>15</td>
<td>-</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>$t_r$</td>
<td>rise time</td>
<td>-</td>
<td>155</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>$t_{on}$</td>
<td>turn-on time</td>
<td>-</td>
<td>170</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>$t_s$</td>
<td>storage time</td>
<td>-</td>
<td>650</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>$t_f$</td>
<td>fall time</td>
<td>-</td>
<td>170</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>$t_{off}$</td>
<td>turn-off time</td>
<td>-</td>
<td>820</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>$f_T$</td>
<td>transition frequency</td>
<td>$V_{CE} = 10 , \text{V}; , I_C = 10 , \text{mA}; , f = 100 , \text{MHz}; , T_{amb} = 25 , ^\circ\text{C}$</td>
<td>75</td>
<td>-</td>
<td>MHz</td>
<td></td>
</tr>
<tr>
<td>$C_C$</td>
<td>collector capacitance</td>
<td>$V_{CB} = 20 , \text{V}; , I_E = 0 , \text{A}; , I_B = 0 , \text{A}; , f = 1 , \text{MHz}; , T_{amb} = 25 , ^\circ\text{C}$</td>
<td>2.4</td>
<td>-</td>
<td>pF</td>
<td></td>
</tr>
</tbody>
</table>
### Symbol | Parameter | Conditions | Min | Typ | Max | Unit
---|---|---|---|---|---|---
\(C_e\) | emitter capacitance | \(V_{EB} = 0.5 \text{ V}; I_C = 0 \text{ A}; I_C = 0 \text{ A}; f = 1 \text{ MHz}; T_{amb} = 25 \degree C\) | - | 125 | - | pF

**Fig. 7.** 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. 8.** Collector current as a function of collector-emitter voltage; typical values

\[I_B (\text{mA}) = 55\]

\[I_C (\text{A})\]

1.4

1.2

1.0

0.8

0.6

0.4

0.2

0.0

0

22

16.5

11

6.5

44

30.5

27.5

22

16.5

11

6.5

(1) \(T_{amb} = -55 \degree C\)

(2) \(T_{amb} = 25 \degree C\)

(3) \(T_{amb} = 100 \degree C\)

**Fig. 9.** 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. 10.** Base-emitter saturation voltage as a function of collector current; typical values

\[I_C/I_B = 5\]

\[V_{BE_{sat}} (\text{V})\]

1.2

1.0

0.8

0.6

0.4

0.2

0.0

0

10

100

1000

10000

100000

1000000

10000000

100000000

(1) \(T_{amb} = -55 \degree C\)

(2) \(T_{amb} = 25 \degree C\)

(3) \(T_{amb} = 100 \degree C\)
PBHV8515QA 150 V, 500 mA NPN high-voltage low VCEsat (BISS) transistor

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

\[ I_C/I_B = 5 \]
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. 12. Collector-emitter saturation voltage as a function of collector current; typical values

\[ T_{\text{amb}} = 25 \, ^\circ\text{C} \]
1. \( I_C/I_B = 20 \)
2. \( I_C/I_B = 10 \)
3. \( I_C/I_B = 5 \)

Fig. 13. Collector-emitter saturation resistance as a function of collector current; typical values

\[ I_C/I_B = 5 \]
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. 14. Collector-emitter saturation resistance as a function of collector current; typical values

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

![Image of transistor switching time definition]

**Fig. 15.** BISS transistor switching time definition

![Image of test circuit for switching times]

**Fig. 16.** 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

Fig. 17. Package outline DFN1010D-3 (SOT1215)
13. Soldering

Footprint information for reflow soldering of DFN1010D-3 package

Fig. 18. Reflow soldering footprint for DFN1010D-3 (SOT1215)
14. 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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</thead>
<tbody>
<tr>
<td>PBHV8515QA v.1</td>
<td>20151119</td>
<td>Product data sheet</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
15. Legal information

15.1 Data sheet status

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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>

[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 URL: http://www.nexperia.com.

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