1. General description

Planar passivated sensitive gate four quadrant triac in an internally insulated IITO220 plastic package intended for use in general purpose bidirectional switching and phase control applications. This sensitive gate "series E" triac can be interfaced directly to microcontrollers, logic integrated circuits and other low power gate trigger circuits. The internally insulated mounting base gives good thermal performance combined with ease of handling and assembly by the user.

2. Features and benefits

- 2500 V RMS isolation voltage capability
- Direct interfacing to logic level ICs
- Direct interfacing to low power gate drivers and microcontrollers
- High blocking voltage capability
- Industry standard TO220 package for ease of handling
- Isolated mounting base
- Planar passivated for voltage ruggedness and reliability
- Sensitive gate
- Triggering in all four quadrants

3. Applications

- 230 V lamp dimmers
- General purpose switching and phase control

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>$V_{DRM}$</td>
<td>repetitive peak off-state voltage</td>
<td>full sine wave; $T_{ab} \leq 85 , ^\circ C$; Fig.1; Fig. 2; Fig. 3</td>
<td>-</td>
<td>-</td>
<td>800</td>
<td>V</td>
</tr>
<tr>
<td>$I_{T(RMS)}$</td>
<td>RMS on-state current</td>
<td>full sine wave; $T_{j(init)} = 25 , ^\circ C$; $t_p = 20 , ms$; Fig. 4; Fig. 5</td>
<td>-</td>
<td>-</td>
<td>12</td>
<td>A</td>
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<tr>
<td>$I_{TSM}$</td>
<td>non-repetitive peak on-state current</td>
<td>full sine wave; $T_{j(init)} = 25 , ^\circ C$; $t_p = 16.7 , ms$</td>
<td>-</td>
<td>-</td>
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<td>A</td>
</tr>
<tr>
<td>$T_j$</td>
<td>junction temperature</td>
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<td>-</td>
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Static characteristics:

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<th>Max</th>
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<tr>
<td>$I_{GT}$</td>
<td>gate trigger current</td>
<td>$V_o = 12 , V$; $I_g = 0.1 , A$; $T_{2+} , G+$; $T_j = 25 , ^\circ C$; Fig. 7</td>
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<td>-</td>
<td>10</td>
<td>mA</td>
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<tr>
<td>$V_o = 12 , V$; $I_g = 0.1 , A$; $T_{2+} , G+$; $T_j = 25 , ^\circ C$; Fig. 7</td>
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<td>-</td>
<td>10</td>
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<tr>
<td>$V_o = 12 , V$; $I_g = 0.1 , A$; $T_{2-} , G-$; $T_j = 25 , ^\circ C$; Fig. 7</td>
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<td>-</td>
<td>10</td>
<td>mA</td>
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<tr>
<td>$V_o = 12 , V$; $I_g = 0.1 , A$; $T_{2-} , G+$; $T_j = 25 , ^\circ C$; Fig. 7</td>
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<td>-</td>
<td>25</td>
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5. Pinning information

Table 2. Pinning information

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<td>main terminal 1</td>
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<td>2</td>
<td>T2</td>
<td>main terminal 2</td>
<td></td>
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<tr>
<td>3</td>
<td>G</td>
<td>gate</td>
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<tr>
<td>mb</td>
<td>n.c.</td>
<td>mounting base; isolated</td>
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6. Ordering information

Table 3. Ordering information

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<th>Package Name</th>
<th>Orderable part number</th>
<th>Packing method</th>
<th>Small packing quantity</th>
<th>Package version</th>
<th>Package issue date</th>
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<td>BT138Y-800E</td>
<td>IITO220</td>
<td>BT138Y-800E,127</td>
<td>Tube</td>
<td>50</td>
<td>SOT78D (A)</td>
<td>10-July-2007</td>
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<td>IITO220P (P)</td>
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7. Marking

Table 4. Marking codes

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<td>PJAxxxx xx</td>
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8. Limiting values

Table 5. Limiting values
In accordance with the Absolute Maximum Rating System (IEC 60134).

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<tr>
<td>$V_{DRM}$</td>
<td>repetitive peak off-state voltage</td>
<td>-</td>
<td>800</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$I_{(RMS)}$</td>
<td>RMS on-state current</td>
<td>full sine wave; $T_{mb} \leq 85 , ^\circ C$; Fig. 1; Fig. 2; Fig. 3</td>
<td>-</td>
<td>12</td>
<td>A</td>
</tr>
<tr>
<td>$I_{(TSM)}$</td>
<td>non-repetitive peak on-state current</td>
<td>full sine wave; $T_{j(init)} = 25 , ^\circ C$; $t_p = 20$ ms; Fig. 4; Fig. 5</td>
<td>-</td>
<td>95</td>
<td>A</td>
</tr>
<tr>
<td>$I_{(TSM)}$</td>
<td></td>
<td>full sine wave; $T_{j(init)} = 25 , ^\circ C$; $t_p = 16.7$ ms</td>
<td>-</td>
<td>105</td>
<td>A</td>
</tr>
<tr>
<td>$i^2t$</td>
<td>$i^2t$ for fusing</td>
<td>$t_p = 10$ ms; sine wave pulse</td>
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<td>45</td>
<td>A$^2$s</td>
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<tr>
<td>$dI/dt$</td>
<td>rate of rise of on-state current</td>
<td>$I_o = 100$ mA; $T2+ G+$</td>
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<td>50</td>
<td>A/μs</td>
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<tr>
<td></td>
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<td>$I_o = 100$ mA; $T2+ G-$</td>
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<td>50</td>
<td>A/μs</td>
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<tr>
<td></td>
<td></td>
<td>$I_o = 100$ mA; $T2- G-$</td>
<td>-</td>
<td>50</td>
<td>A/μs</td>
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<td></td>
<td></td>
<td>$I_o = 100$ mA; $T2- G+$</td>
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<td>$I_{GM}$</td>
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<td>$P_{G(AV)}$</td>
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<td>$T_j$</td>
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<td>°C</td>
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Fig. 1. RMS on-state current as a function of surge duration; maximum values
Fig. 2. RMS on-state current as a function of mounting base temperature; maximum values
Conduction angle, $\alpha$ (degrees)

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<th>Angle</th>
<th>Form factor, $a$</th>
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<td>30°</td>
<td>2.816</td>
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<tr>
<td>60°</td>
<td>1.967</td>
</tr>
<tr>
<td>90°</td>
<td>1.570</td>
</tr>
<tr>
<td>120°</td>
<td>1.329</td>
</tr>
<tr>
<td>180°</td>
<td>1.110</td>
</tr>
</tbody>
</table>

$a = \text{form factor } = \frac{I_{T(RMS)}}{I_{T(AV)}}$

$\alpha = \text{conduction angle}$

Fig. 3. Total power dissipation as a function of RMS on-state current; maximum values

Fig. 4. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values

$f = 50 \text{ Hz}$

$t_p \leq 20 \text{ ms}$

(1) $dI_T/dt$ limit

(2) T2- G+ quadrant limit

Fig. 5. Non-repetitive peak on-state current as a function of pulse duration; maximum values
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>
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</thead>
<tbody>
<tr>
<td>$R_{th(j-mb)}$</td>
<td>thermal resistance from junction to mounting base</td>
<td>full cycle; <a href="#">Fig. 6</a></td>
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<td>-</td>
<td>2.3</td>
<td>K/W</td>
</tr>
<tr>
<td>$R_{th(j-a)}$</td>
<td>thermal resistance from junction to ambient</td>
<td>in free air</td>
<td>-</td>
<td>60</td>
<td>-</td>
<td>K/W</td>
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</table>

Fig. 6. Transient thermal impedance from junction to mounting base as a function of pulse duration

10. Isolation characteristics

Table 7. Isolation 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>$V_{isol(RMS)}$</td>
<td>RMS isolation voltage</td>
<td>50 Hz ≤ f ≤ 60 Hz; RH ≤ 65 %; from all pins to external heatsink; sinusoidal waveform; clean and dust free</td>
<td>-</td>
<td>-</td>
<td>2500</td>
<td>V</td>
</tr>
<tr>
<td>$C_{isol}$</td>
<td>isolation capacitance</td>
<td>from cathode to external heatsink</td>
<td>-</td>
<td>10</td>
<td>-</td>
<td>pF</td>
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</table>
### 11. Characteristics

#### Table 8. Characteristics

<table>
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<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></td>
<td>Static characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I&lt;sub&gt;GT&lt;/sub&gt;</td>
<td>gate trigger current</td>
<td>V&lt;sub&gt;Г&lt;/sub&gt; = 12 V; I&lt;sub&gt;Г&lt;/sub&gt; = 0.1 A; T&lt;sub&gt;G+&lt;/sub&gt; = 25 °C; <strong>Fig. 7</strong></td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>mA</td>
</tr>
<tr>
<td>V&lt;sub&gt;G&lt;/sub&gt;</td>
<td></td>
<td>V&lt;sub&gt;Г&lt;/sub&gt; = 12 V; I&lt;sub&gt;Г&lt;/sub&gt; = 0.1 A; T&lt;sub&gt;G-&lt;/sub&gt; = 25 °C; <strong>Fig. 7</strong></td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>mA</td>
</tr>
<tr>
<td>V&lt;sub&gt;T&lt;/sub&gt;</td>
<td></td>
<td>V&lt;sub&gt;Г&lt;/sub&gt; = 12 V; I&lt;sub&gt;Г&lt;/sub&gt; = 0.1 A; T&lt;sub&gt;G-&lt;/sub&gt; = 25 °C; <strong>Fig. 7</strong></td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>mA</td>
</tr>
<tr>
<td>I&lt;sub&gt;L&lt;/sub&gt;</td>
<td>latching current</td>
<td>V&lt;sub&gt;Г&lt;/sub&gt; = 12 V; I&lt;sub&gt;Г&lt;/sub&gt; = 0.1 A; T&lt;sub&gt;G+&lt;/sub&gt; = 25 °C; <strong>Fig. 8</strong></td>
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<td>-</td>
<td>30</td>
<td>mA</td>
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<tr>
<td>I&lt;sub&gt;H&lt;/sub&gt;</td>
<td>holding current</td>
<td>V&lt;sub&gt;Г&lt;/sub&gt; = 12 V; T&lt;sub&gt;J&lt;/sub&gt; = 25 °C; <strong>Fig. 9</strong></td>
<td>-</td>
<td>-</td>
<td>30</td>
<td>mA</td>
</tr>
<tr>
<td>V&lt;sub&gt;T&lt;/sub&gt;</td>
<td>on-state voltage</td>
<td>I&lt;sub&gt;T&lt;/sub&gt; = 15 A; T&lt;sub&gt;J&lt;/sub&gt; = 25 °C; <strong>Fig. 10</strong></td>
<td>-</td>
<td>1.4</td>
<td>1.65</td>
<td>V</td>
</tr>
<tr>
<td>V&lt;sub&gt;G&lt;/sub&gt;</td>
<td>gate trigger voltage</td>
<td>V&lt;sub&gt;Г&lt;/sub&gt; = 12 V; I&lt;sub&gt;Г&lt;/sub&gt; = 0.1 A; T&lt;sub&gt;J&lt;/sub&gt; = 25 °C</td>
<td>-</td>
<td>0.7</td>
<td>1</td>
<td>V</td>
</tr>
<tr>
<td>V&lt;sub&gt;d&lt;/sub&gt;</td>
<td>off-state current</td>
<td>V&lt;sub&gt;d&lt;/sub&gt; = 600 V; I&lt;sub&gt;d&lt;/sub&gt; = 0.1 A; T&lt;sub&gt;J&lt;/sub&gt; = 125 °C</td>
<td>-</td>
<td>0.1</td>
<td>0.5</td>
<td>μA</td>
</tr>
<tr>
<td>dV&lt;sub&gt;d&lt;/sub&gt;/dt</td>
<td>rate of rise of off-state voltage</td>
<td>V&lt;sub&gt;dmax&lt;/sub&gt; = 536 V; T&lt;sub&gt;J&lt;/sub&gt; = 125 °C; (V&lt;sub&gt;dmax&lt;/sub&gt; = 67% of V&lt;sub&gt;dmin&lt;/sub&gt;); exponential waveform; gate open circuit</td>
<td>-</td>
<td>50</td>
<td>-</td>
<td>V/μs</td>
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<tr>
<td>t&lt;sub&gt;g&lt;/sub&gt;</td>
<td>gate-controlled turn-on time</td>
<td>I&lt;sub&gt;Г&lt;/sub&gt; = 16 A; V&lt;sub&gt;d&lt;/sub&gt; = 800 V; I&lt;sub&gt;d&lt;/sub&gt; = 100 mA; dI&lt;sub&gt;d&lt;/sub&gt;/dt = 5 A/μs</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>A/ms</td>
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</tbody>
</table>
Fig. 7. Normalized gate trigger current as a function of junction temperature

(1) T2- G+
(2) T2- G-
(3) T2+ G-
(4) T2+ G+

Fig. 8. Normalized latching current as a function of junction temperature

Fig. 9. Normalized holding current as a function of junction temperature

(1) $T_j = 125 \degree C$; typical values
(2) $T_j = 125 \degree C$; maximum values
(3) $T_j = 25 \degree C$; maximum values

Fig. 10. On-state current as a function of on-state voltage

$V_o = 1.175 \text{ V}; R_s = 0.032 \Omega$

(1) $T_j = 125 \degree C$; typical values
(2) $T_j = 125 \degree C$; maximum values
(3) $T_j = 25 \degree C$; maximum values
Fig. 11. Normalized gate trigger voltage as a function of junction temperature
12. Package outline

Assembly factory: A

Plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3-lead TO-220

SOT78D

DIMENSIONS (mm are the original dimensions)

<table>
<thead>
<tr>
<th>UNIT</th>
<th>A</th>
<th>A_1</th>
<th>b</th>
<th>b_1</th>
<th>b_2</th>
<th>c</th>
<th>D</th>
<th>D_1 ref</th>
<th>E</th>
<th>e</th>
<th>L</th>
<th>L_1 ref</th>
<th>p</th>
<th>Q</th>
<th>q</th>
<th>w</th>
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<td>mm</td>
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OUTLINE VERSION

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EUROPEAN PROJECTION

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<td>07-07-10</td>
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Assembly factory: P

Plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3 leads TO-220

### Dimensions in Millimeters

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13. Legal information

Data sheet status

<table>
<thead>
<tr>
<th>Document status</th>
<th>Product status</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>[short] data sheet</td>
<td>Development</td>
<td>This document contains data from the objective specification for product development.</td>
</tr>
<tr>
<td>Preliminary data sheet</td>
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<td>This document contains data from the preliminary specification.</td>
</tr>
<tr>
<td>Product 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.ween-semi.com.

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