1. General description

Planar passivated high commutation three quadrant triac in a SOT186A (TO-220F) "full pack" plastic package intended for use in circuits where high static and dynamic dV/dt and high dI/dt can occur. This "series BT" triac will commutate the full RMS current at the maximum rated junction temperature ($T_{j(max)} = 150 °C$) without the aid of a snubber. It is used in applications where "high junction operating temperature capability" is required.

2. Features and benefits

- 3Q technology for improved noise immunity
- 2500 V RMS isolation voltage capability
- High commutation capability with maximum false trigger immunity
- High immunity to false turn-on by dV/dt
- High junction operating temperature capability
- High voltage capability
- High current capability
- Isolated mounting base package
- Least sensitive gate for highest noise immunity
- Planar passivated for voltage ruggedness and reliability
- Triggering in three quadrants only

3. Applications

- Applications subject to high temperature
- Heating controls
- High power motor control
- High power switching

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>-</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; $T_h \leq 44 °C$; Fig. 1; Fig. 2; Fig. 3</td>
<td>-</td>
<td>-</td>
<td>30</td>
<td>A</td>
</tr>
<tr>
<td>$I_{SM}$</td>
<td>non-repetitive peak on-state current</td>
<td>full sine wave; $T_{j(init)} = 25 °C$; $t_p = 20 ms$; Fig. 4; Fig. 5</td>
<td>-</td>
<td>-</td>
<td>270</td>
<td>A</td>
</tr>
<tr>
<td>$I_{SM}$</td>
<td>non-repetitive peak on-state current</td>
<td>full sine wave; $T_{j(init)} = 25 °C$; $t_p = 16.7 ms$</td>
<td>-</td>
<td>-</td>
<td>297</td>
<td>A</td>
</tr>
<tr>
<td>$T_j$</td>
<td>junction temperature</td>
<td>-</td>
<td>-</td>
<td>150</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Symbol</td>
<td>Parameter</td>
<td>Conditions</td>
<td>Min</td>
<td>Typ</td>
<td>Max</td>
<td>Unit</td>
</tr>
<tr>
<td>--------</td>
<td>-----------</td>
<td>------------</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>------</td>
</tr>
<tr>
<td>Static characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{GT}$</td>
<td>gate trigger current</td>
<td>$V_D = 12 \text{ V}; I_T = 0.1 \text{ A}; T_2^+ G^+$; $T_j = 25 \degree \text{C}; \text{Fig. 7}$</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>mA</td>
</tr>
<tr>
<td>$I_H$</td>
<td>holding current</td>
<td>$V_D = 12 \text{ V}; T_j = 25 \degree \text{C}; \text{Fig. 9}$</td>
<td>-</td>
<td>-</td>
<td>75</td>
<td>mA</td>
</tr>
<tr>
<td>$V_T$</td>
<td>on-state voltage</td>
<td>$I_T = 42 \text{ A}; T_j = 25 \degree \text{C}; \text{Fig. 10}$</td>
<td>1.2</td>
<td>1.55</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Dynamic characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$dV_D/dt$</td>
<td>rate of rise of off-state voltage</td>
<td>$V_{DM} = 536 \text{ V}; T_j = 150 \degree \text{C}; (V_{DM} = 67% \text{ of } V_{DRM}); \text{ exponential waveform; gate open circuit}$</td>
<td>2000</td>
<td>-</td>
<td>-</td>
<td>V/µs</td>
</tr>
<tr>
<td>$dI_{com}/dt$</td>
<td>rate of change of commutating current</td>
<td>$V_D = 400 \text{ V}; T_j = 150 \degree \text{C}; I_{TRMS} = 30 \text{ A}; dV_{com}/dt = 20 \text{ V/µs}; \text{ (snubberless condition); gate open circuit}$</td>
<td>15</td>
<td>-</td>
<td>-</td>
<td>A/ms</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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</thead>
<tbody>
<tr>
<td>1</td>
<td>T1</td>
<td>main terminal 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>T2</td>
<td>main terminal 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>G</td>
<td>gate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mb</td>
<td>n.c.</td>
<td>mounting base; isolated</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 6. Ordering information

**Table 3. Ordering information**

<table>
<thead>
<tr>
<th>Type number</th>
<th>Package</th>
<th>Description</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTA330X-800BT</td>
<td>TO-220F</td>
<td>plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3-lead TO-220 &quot;full pack&quot;</td>
<td>SOT186A</td>
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</tbody>
</table>
7. Limiting values

Table 4. 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_{DRM}</td>
<td>repetitive peak off-state voltage</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; $T_h \leq 44 ^\circ C$; Fig. 1; Fig. 2; Fig. 3</td>
<td>-</td>
<td>30</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>270</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>full sine wave; $T_{j(init)} = 25 ^\circ C$; $t_p = 16.7$ ms</td>
<td></td>
<td>297</td>
<td>A</td>
</tr>
<tr>
<td>l^2t</td>
<td>$I^2t$ for fusing</td>
<td>$t_p = 10$ ms; SIN</td>
<td>-</td>
<td>364.5</td>
<td>A²s</td>
</tr>
<tr>
<td>dI/dt</td>
<td>rate of rise of on-state current</td>
<td>$I_G = 0.2$ A</td>
<td>-</td>
<td>100</td>
<td>A/µs</td>
</tr>
<tr>
<td>I_{GM}</td>
<td>peak gate current</td>
<td></td>
<td>-</td>
<td>2</td>
<td>A</td>
</tr>
<tr>
<td>P_{GM}</td>
<td>peak gate power</td>
<td></td>
<td>-</td>
<td>5</td>
<td>W</td>
</tr>
<tr>
<td>P_{G(AV)}</td>
<td>average gate power</td>
<td>over any 20 ms period</td>
<td>-</td>
<td>0.5</td>
<td>W</td>
</tr>
<tr>
<td>T_{stg}</td>
<td>storage temperature</td>
<td></td>
<td>-40</td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>T_{j}</td>
<td>junction temperature</td>
<td></td>
<td>-</td>
<td>150</td>
<td>°C</td>
</tr>
</tbody>
</table>

Fig. 1. RMS on-state current as a function of heatsink temperature; maximum values

Fig. 2. RMS on-state current as a function of surge duration; maximum values
Fig. 3. Total power dissipation as a function of RMS on-state current; maximum values

\[
\begin{array}{c|c|c}
\text{conduction angle (degrees)} & \text{form factor} & \alpha = 180 \degree C \\
30 & 4 & 120 \degree C \\
60 & 2.8 & 90 \degree C \\
90 & 2.2 & 60 \degree C \\
120 & 1.9 & 30 \degree C \\
180 & 1.57 &
\end{array}
\]

\[\alpha = \text{conduction angle}\]
\[a = \text{form factor} = \frac{I_{T(RMS)}}{I_{T(AV)}}\]

\[f = 50 \text{ Hz}\]

Fig. 4. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values
Fig. 5. Non-repetitive peak on-state current as a function of pulse width; maximum values
8. Thermal characteristics

Table 5. Thermal characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter Description</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{th(j-h)}$</td>
<td>thermal resistance from junction to heatsink</td>
<td>full cycle; with heatsink compound; [Fig. 6]</td>
<td>-</td>
<td>-</td>
<td>2.8</td>
<td>K/W</td>
</tr>
<tr>
<td>$R_{th(j-a)}$</td>
<td>thermal resistance from junction to ambient free air</td>
<td>in free air</td>
<td>-</td>
<td>55</td>
<td>-</td>
<td>K/W</td>
</tr>
</tbody>
</table>

![Graph showing transient thermal impedance from junction to heatsink as a function of pulse duration](aaa-013416.png)

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

9. Isolation characteristics

Table 6. Isolation characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter Description</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>from all terminals to external heatsink; sinusoidal waveform; clean and dust free; 50 Hz ≤ f ≤ 60 Hz; RH ≤ 65 %; $T_h = 25$ $^\circ$C</td>
<td>-</td>
<td>-</td>
<td>2500</td>
<td>V</td>
</tr>
<tr>
<td>$C_{isol}$</td>
<td>isolation capacitance</td>
<td>from main terminal 2 to external heatsink; f = 1 MHz; $T_h = 25$ $^\circ$C</td>
<td>-</td>
<td>10</td>
<td>-</td>
<td>pF</td>
</tr>
</tbody>
</table>
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></td>
<td>Static characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{GT}$</td>
<td>gate trigger current</td>
<td>$V_D = 12 \text{ V}; I_T = 0.1 \text{ A}; T2+ G+;\newline T_j = 25 \degree \text{ C}; \text{ Fig. 7}$</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_D = 12 \text{ V}; I_T = 0.1 \text{ A}; T2+ G-;\newline T_j = 25 \degree \text{ C}; \text{ Fig. 7}$</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_D = 12 \text{ V}; I_T = 0.1 \text{ A}; T2- G-;\newline T_j = 25 \degree \text{ C}; \text{ Fig. 7}$</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>mA</td>
</tr>
<tr>
<td>$I_L$</td>
<td>latching current</td>
<td>$V_D = 12 \text{ V}; I_C = 0.1 \text{ A}; T2+ G+;\newline T_j = 25 \degree \text{ C}; \text{ Fig. 8}$</td>
<td>-</td>
<td>-</td>
<td>80</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_D = 12 \text{ V}; I_C = 0.1 \text{ A}; T2+ G-;\newline T_j = 25 \degree \text{ C}; \text{ Fig. 8}$</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_D = 12 \text{ V}; I_C = 0.1 \text{ A}; T2- G-;\newline T_j = 25 \degree \text{ C}; \text{ Fig. 8}$</td>
<td>-</td>
<td>-</td>
<td>80</td>
<td>mA</td>
</tr>
<tr>
<td>$I_H$</td>
<td>holding current</td>
<td>$V_D = 12 \text{ V}; T_j = 25 \degree \text{ C}; \text{ Fig. 9}$</td>
<td>-</td>
<td>-</td>
<td>75</td>
<td>mA</td>
</tr>
<tr>
<td>$V_T$</td>
<td>on-state voltage</td>
<td>$I_T = 42 \text{ A}; T_j = 25 \degree \text{ C}; \text{ Fig. 10}$</td>
<td>-</td>
<td>1.2</td>
<td>1.55</td>
<td>V</td>
</tr>
<tr>
<td>$V_{GT}$</td>
<td>gate trigger voltage</td>
<td>$V_D = 12 \text{ V}; I_T = 0.1 \text{ A}; T_j = 25 \degree \text{ C}; \text{ Fig. 11}$</td>
<td>-</td>
<td>0.9</td>
<td>1.3</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_D = 400 \text{ V}; I_T = 0.1 \text{ A}; T_j = 150 \degree \text{ C}; \text{ Fig. 11}$</td>
<td>0.2</td>
<td>0.45</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>$I_D$</td>
<td>off-state current</td>
<td>$V_D = 800 \text{ V}; T_j = 25 \degree \text{ C}$</td>
<td>-</td>
<td>0.4</td>
<td>10</td>
<td>µA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_D = 800 \text{ V}; T_j = 150 \degree \text{ C}$</td>
<td>-</td>
<td>0.4</td>
<td>2</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td>Dynamic characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$dV_D/dt$</td>
<td>rate of rise of off-state voltage</td>
<td>$V_{DM} = 536 \text{ V}; T_j = 150 \degree \text{ C}; (V_{DM} = 67% of V_{DRM}); \text{ exponential waveform}; \text{ gate open circuit}$</td>
<td>2000</td>
<td>-</td>
<td>-</td>
<td>V/µs</td>
</tr>
<tr>
<td>$dl_{com}/dt$</td>
<td>rate of change of commutating current</td>
<td>$V_D = 400 \text{ V}; T_j = 150 \degree \text{ C}; \text{ I}<em>{RMS} = 30 \text{ A}; \newline dl</em>{com}/dt = 20 \text{ V/µs}; \text{ (snubberless condition); gate open circuit}$</td>
<td>15</td>
<td>-</td>
<td>-</td>
<td>A/ms</td>
</tr>
</tbody>
</table>
**Fig. 7. Normalized gate trigger current as a function of junction temperature**

(1) $T_2$ - G-
(2) $T_2$ + G-
(3) $T_2$ + G+

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

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

$V_0 = 1.060 \ V; R_s = 0.01 \ \Omega$
(1) $T_J = 150 \ ^\circ C; \text{ typical values}$
(2) $T_J = 150 \ ^\circ C; \text{ maximum values}$
(3) $T_J = 25 \ ^\circ C; \text{ maximum values}$

**Fig. 10. On-state current as a function of on-state voltage**
Fig. 11. Normalized gate trigger voltage as a function of junction temperature
11. Package outline

![Diagram of TO-220F package outline]

**Fig. 12. Package outline TO-220F (SOT186A)**

<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</th>
<th>E</th>
<th>e</th>
<th>e_1</th>
<th>(2)</th>
<th>(2)</th>
<th>K</th>
<th>L</th>
<th>L_1</th>
<th>(1)</th>
<th>P</th>
<th>Q</th>
<th>q</th>
<th>W</th>
<th>T</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>4.6</td>
<td>2.9</td>
<td>0.9</td>
<td>1.1</td>
<td>1.4</td>
<td>0.7</td>
<td>15.8</td>
<td>6.5</td>
<td>10.3</td>
<td>2.54</td>
<td>5.08</td>
<td>2.7</td>
<td>1.7</td>
<td>0.4</td>
<td>14.4</td>
<td>3.30</td>
<td>3</td>
<td>3.2</td>
<td>2.6</td>
<td>3.0</td>
<td>2.3</td>
<td>2.6</td>
<td>0.4</td>
</tr>
</tbody>
</table>

**Notes**
1. Terminal dimensions within this zone are uncontrolled.
2. Dot lines are designations only.
3. Eject pin mark is for reference only.

**OUTLINE VERSION**
- SOT186A

**REFERENCES**
- IEC
- JEDEC
- JEITA

**EUROPEAN PROJECTION**
- 3 LEADS TO220F

**ISSUE DATE**
- 2013-11-14
12. Legal information

Data sheet status

<table>
<thead>
<tr>
<th>Document status</th>
<th>Product status</th>
<th>Definition</th>
</tr>
</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.ween-semi.com.

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