

## 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 CT" triac will commute the full RMS current at the maximum rated junction temperature ( $T_j = 150\text{ °C}$ ) without the aid of a snubber. It is used where "high junction operating temperature capability" is required.

## 2. Features and benefits

- 3Q technology for improved noise immunity
- 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
- Isolated mounting base package
- Planar passivated for voltage ruggedness and reliability
- Triggering in three quadrants only

## 3. Applications

- Applications subject to high temperature
- Electronic thermostats (heating and cooling)
- Motor controls for home appliances
- Rectifier-fed DC inductive loads e.g. DC motors and solenoids

## 4. Quick reference data

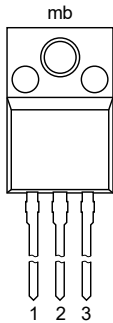

Table 1. Quick reference data

| Symbol                        | Parameter                            | Conditions  | Min | Typ | Max | Unit |
|-------------------------------|--------------------------------------|---|-----|-----|-----|------|
| $V_{DRM}$                     | repetitive peak off-state voltage    |   | -   | -   | 800 | V    |
| $I_{T(RMS)}$                  | RMS on-state current                 | full sine wave; $T_h \leq 114\text{ °C}$ ; <a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>   | -   | -   | 6   | A    |
| $I_{TSM}$                     | non-repetitive peak on-state current | full sine wave; $T_{j(init)} = 25\text{ °C}$ ; $t_p = 20\text{ ms}$ ; <a href="#">Fig. 4</a> ; <a href="#">Fig. 5</a> | -   | -   | 60  | A    |
|                               |                                      | full sine wave; $T_{j(init)} = 25\text{ °C}$ ; $t_p = 16.7\text{ ms}$   | -   | -   | 66  | A    |
| $T_j$                         | junction temperature                 |   | -   | -   | 150 | °C   |
| <b>Static characteristics</b> |                                      |   |     |     |     |      |
| $I_{GT}$                      | gate trigger current                 | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2+ G+; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 7</a>                    | 4   | -   | 35  | mA   |

| Symbol                         | Parameter                             | Conditions   | Min | Typ | Max | Unit       |
|--------------------------------|---------------------------------------|--|-----|-----|-----|------------|
|                                |                                       | $V_D = 12\text{ V}; I_T = 0.1\text{ A}; T_2+ G-;$<br>$T_j = 25\text{ }^\circ\text{C};$ Fig. 7  | 4   | -   | 35  | mA         |
|                                |                                       | $V_D = 12\text{ V}; I_T = 0.1\text{ A}; T_2- G-;$<br>$T_j = 25\text{ }^\circ\text{C};$ Fig. 7  | 4   | -   | 35  | mA         |
| $I_H$                          | holding current                       | $V_D = 12\text{ V}; T_j = 25\text{ }^\circ\text{C};$ Fig. 9  | -   | -   | 35  | mA         |
| $V_T$                          | on-state voltage                      | $I_T = 7\text{ A};$ Fig. 10  | -   | 1.3 | 1.6 | V          |
| <b>Dynamic characteristics</b> |                                       |  |     |     |     |            |
| $dV_D/dt$                      | rate of rise of off-state voltage     | $V_{DM} = 536\text{ V}; T_j = 150\text{ }^\circ\text{C}; (V_{DM} = 67\%$<br>of $V_{DRM}$ ); exponential waveform; gate open circuit                                    | 500 | -   | -   | V/ $\mu$ s |
| $di_{com}/dt$                  | rate of change of commutating current | $V_D = 400\text{ V}; T_j = 150\text{ }^\circ\text{C}; I_{T(RMS)} = 6\text{ A};$<br>$dV_{com}/dt = 20\text{ V}/\mu\text{s};$ (snubberless condition); gate open circuit | 10  | -   | -   | A/ms       |
|                                |                                       | $V_D = 400\text{ V}; T_j = 150\text{ }^\circ\text{C}; I_{T(RMS)} = 6\text{ A};$<br>$dV_{com}/dt = 10\text{ V}/\mu\text{s};$ gate open circuit                          | 12  | -   | -   | A/ms       |
|                                |                                       | $V_D = 400\text{ V}; T_j = 150\text{ }^\circ\text{C}; I_{T(RMS)} = 6\text{ A};$<br>$dV_{com}/dt = 1\text{ V}/\mu\text{s};$ gate open circuit                           | 20  | -   | -   | A/ms       |

## 5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description             | Simplified outline   | Graphic symbol  |
|-----|--------|-------------------------|--|---|
| 1   | T1     | main terminal 1         |  <p style="text-align: center;">mb</p> <p style="text-align: center;">1 2 3</p> <p style="text-align: center;"><b>TO-220F (SOT186A)</b></p> |  <p style="text-align: center;">sym051</p> |
| 2   | T2     | main terminal 2         |  |   |
| 3   | G      | gate                    |  |   |
| mb  | n.c.   | mounting base; isolated |  |   |

## 6. Ordering information

Table 3. Ordering information

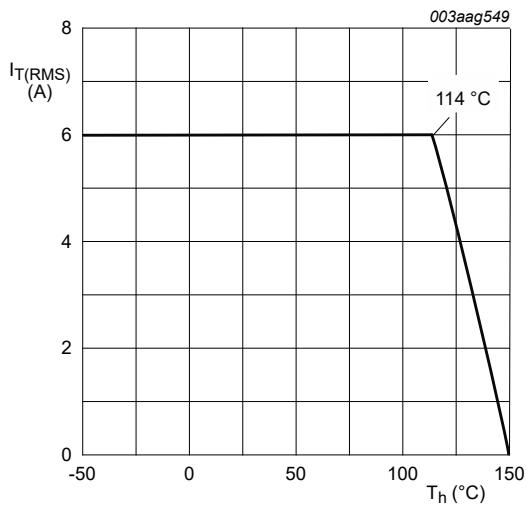
| Type number   | Package |   |         |
|---------------|---------|---|---------|
|               | Name    | Description   | Version |
| BTA206X-800CT | TO-220F | plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3-lead TO-220 "full pack" | SOT186A |

## 7. Limiting values

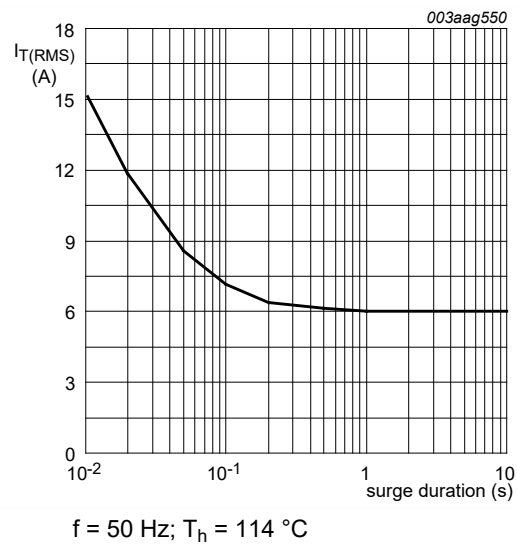
**Table 4. Limiting values**

In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol       | Parameter                            | Conditions  | Min | Max | Unit             |
|--------------|--------------------------------------|---|-----|-----|------------------|
| $V_{DRM}$    | repetitive peak off-state voltage    |   | -   | 800 | V                |
| $I_{T(RMS)}$ | RMS on-state current                 | full sine wave; $T_h \leq 114\text{ °C}$ ; <a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>   | -   | 6   | A                |
| $I_{TSM}$    | non-repetitive peak on-state current | full sine wave; $T_{j(init)} = 25\text{ °C}$ ; $t_p = 20\text{ ms}$ ; <a href="#">Fig. 4</a> ; <a href="#">Fig. 5</a> | -   | 60  | A                |
|              |                                      | full sine wave; $T_{j(init)} = 25\text{ °C}$ ; $t_p = 16.7\text{ ms}$   | -   | 66  | A                |
| $I^2t$       | $I^2t$ for fusing                    | $t_p = 10\text{ ms}$ ; SIN  | -   | 18  | A <sup>2</sup> s |
| $di_T/dt$    | rate of rise of on-state current     | $I_G = 0.2\text{ A}$  | -   | 100 | A/ $\mu$ s       |
| $I_{GM}$     | peak gate current                    |   | -   | 2   | A                |
| $P_{GM}$     | peak gate power                      |   | -   | 5   | W                |
| $P_{G(AV)}$  | average gate power                   | over any 20 ms period   | -   | 0.5 | W                |
| $T_{stg}$    | storage temperature                  |   | -40 | 150 | °C               |
| $T_j$        | junction temperature                 |   | -   | 150 | °C               |



**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**  
 $f = 50\text{ Hz}$ ;  $T_h = 114\text{ °C}$

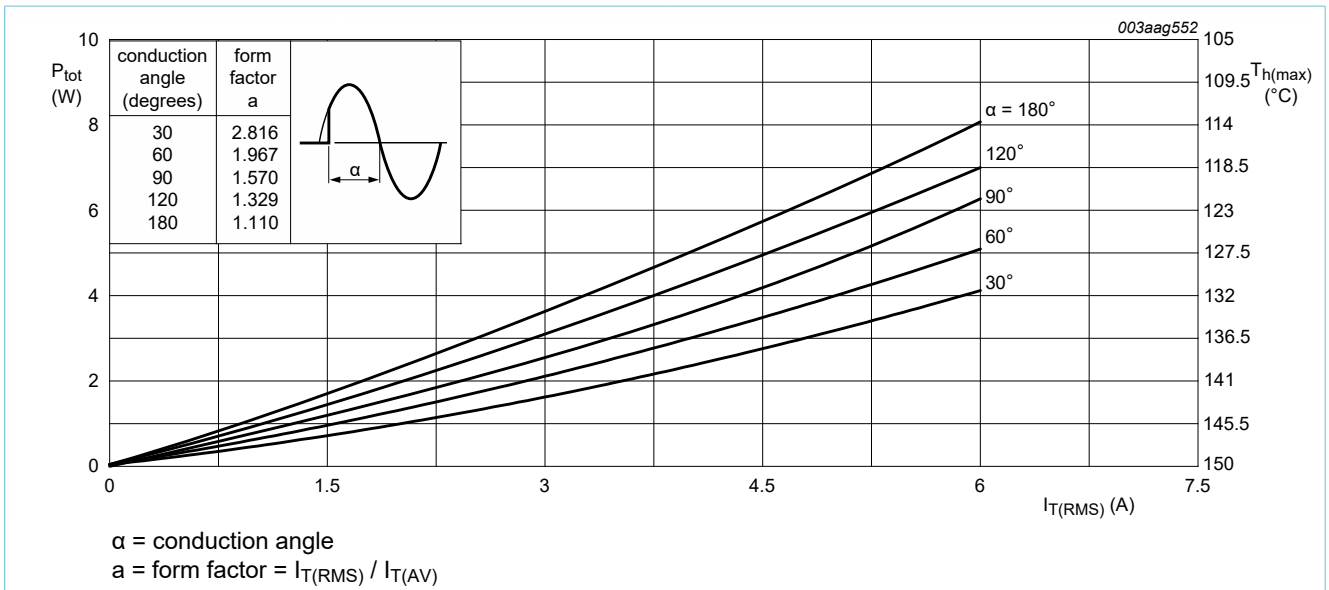


Fig. 3. Total power dissipation as a function of RMS on-state current; maximum values

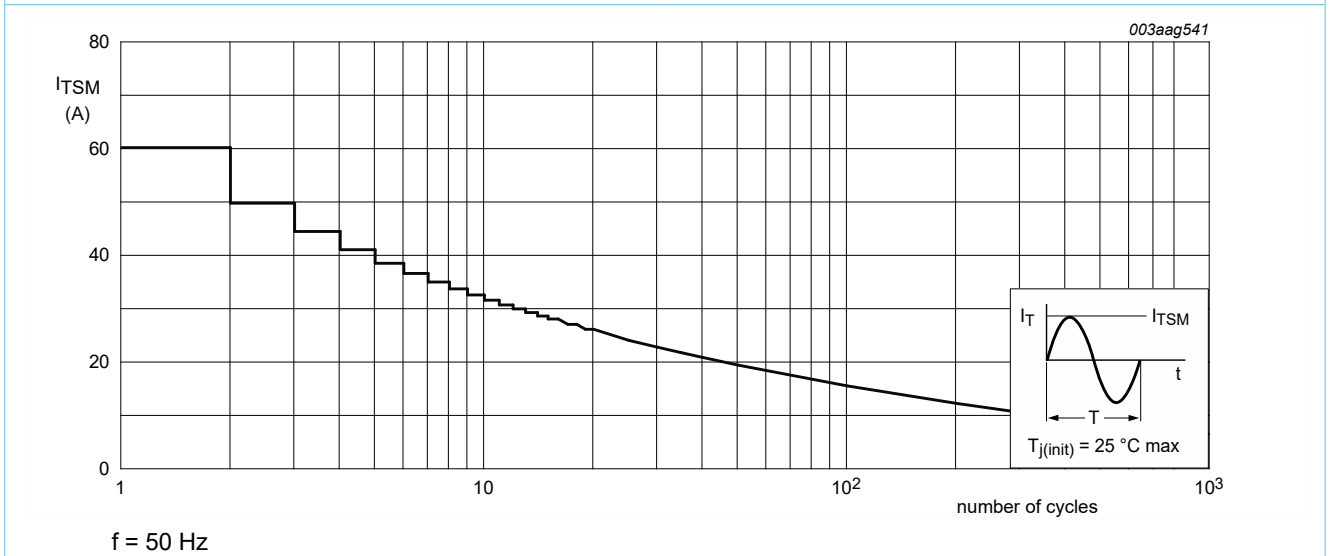


Fig. 4. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values



## 8. Thermal characteristics

Table 5. Thermal characteristics

| Symbol        | Parameter  | Conditions  | Min | Typ | Max | Unit |
|---------------|--|---|-----|-----|-----|------|
| $R_{th(j-h)}$ | thermal resistance from junction to heatsink         | full cycle or half cycle; with heatsink compound; <a href="#">Fig. 6</a>    | -   | -   | 4.5 | K/W  |
|               |  | full cycle or half cycle; without heatsink compound; <a href="#">Fig. 6</a> | -   | -   | 6.5 | K/W  |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient free air | in free air   | -   | 55  | -   | K/W  |



## 9. Isolation characteristics

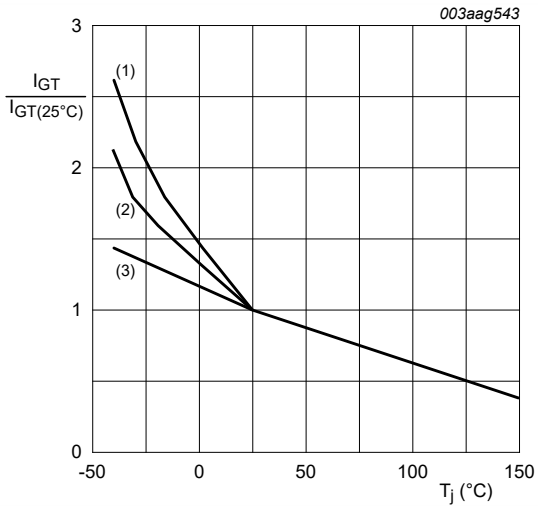
Table 6. Isolation characteristics

| Symbol          | Parameter             | Conditions   | Min | Typ | Max  | Unit |
|-----------------|-----------------------|--|-----|-----|------|------|
| $V_{isol(RMS)}$ | RMS isolation voltage | from all terminals to external heatsink; sinusoidal waveform; clean and dust free; $50\text{ Hz} \leq f \leq 60\text{ Hz}$ ; $RH \leq 65\%$ ; $T_h = 25\text{ }^\circ\text{C}$ | -   | -   | 2500 | V    |
| $C_{isol}$      | isolation capacitance | from main terminal 2 to external heatsink; $f = 1\text{ MHz}$ ; $T_h = 25\text{ }^\circ\text{C}$   | -   | 10  | -    | pF   |

## 10. Characteristics

Table 7. Characteristics

| Symbol                         | Parameter                             | Conditions  | Min  | Typ | Max | Unit |
|--------------------------------|---------------------------------------|---|------|-----|-----|------|
| <b>Static characteristics</b>  |                                       |   |      |     |     |      |
| I <sub>GT</sub>                | gate trigger current                  | V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; T2+ G+;<br>T <sub>j</sub> = 25 °C; <a href="#">Fig. 7</a>  | 4    | -   | 35  | mA   |
|                                |                                       | V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; T2+ G-;<br>T <sub>j</sub> = 25 °C; <a href="#">Fig. 7</a>  | 4    | -   | 35  | mA   |
|                                |                                       | V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; T2- G-;<br>T <sub>j</sub> = 25 °C; <a href="#">Fig. 7</a>  | 4    | -   | 35  | mA   |
| I <sub>L</sub>                 | latching current                      | V <sub>D</sub> = 12 V; I <sub>G</sub> = 0.1 A; T2+ G+;<br>T <sub>j</sub> = 25 °C; <a href="#">Fig. 8</a>  | -    | -   | 50  | mA   |
|                                |                                       | V <sub>D</sub> = 12 V; I <sub>G</sub> = 0.1 A; T2+ G-;<br>T <sub>j</sub> = 25 °C; <a href="#">Fig. 8</a>  | -    | -   | 60  | mA   |
|                                |                                       | V <sub>D</sub> = 12 V; I <sub>G</sub> = 0.1 A; T2- G-;<br>T <sub>j</sub> = 25 °C; <a href="#">Fig. 8</a>  | -    | -   | 50  | mA   |
| I <sub>H</sub>                 | holding current                       | V <sub>D</sub> = 12 V; T <sub>j</sub> = 25 °C; <a href="#">Fig. 9</a>   | -    | -   | 35  | mA   |
| V <sub>T</sub>                 | on-state voltage                      | I <sub>T</sub> = 7 A; <a href="#">Fig. 10</a>   | -    | 1.3 | 1.6 | V    |
| V <sub>GT</sub>                | gate trigger voltage                  | V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; T <sub>j</sub> = 25 °C;<br><a href="#">Fig. 11</a>   | -    | 0.8 | 1   | V    |
|                                |                                       | V <sub>D</sub> = 400 V; I <sub>T</sub> = 0.1 A; T <sub>j</sub> = 150 °C   | 0.25 | -   | -   | V    |
| I <sub>D</sub>                 | off-state current                     | V <sub>D</sub> = 800 V; T <sub>j</sub> = 150 °C   | -    | 0.4 | 2   | mA   |
| <b>Dynamic characteristics</b> |                                       |   |      |     |     |      |
| dV <sub>D</sub> /dt            | rate of rise of off-state voltage     | V <sub>DM</sub> = 536 V; T <sub>j</sub> = 150 °C; (V <sub>DM</sub> = 67% of V <sub>DRM</sub> ); exponential waveform; gate open circuit                 | 500  | -   | -   | V/μs |
| dI <sub>com</sub> /dt          | rate of change of commutating current | V <sub>D</sub> = 400 V; T <sub>j</sub> = 150 °C; I <sub>T(RMS)</sub> = 6 A; dV <sub>com</sub> /dt = 20 V/μs; (snubberless condition); gate open circuit | 10   | -   | -   | A/ms |
|                                |                                       | V <sub>D</sub> = 400 V; T <sub>j</sub> = 150 °C; I <sub>T(RMS)</sub> = 6 A; dV <sub>com</sub> /dt = 10 V/μs; gate open circuit                          | 12   | -   | -   | A/ms |
|                                |                                       | V <sub>D</sub> = 400 V; T <sub>j</sub> = 150 °C; I <sub>T(RMS)</sub> = 6 A; dV <sub>com</sub> /dt = 1 V/μs; gate open circuit                           | 20   | -   | -   | A/ms |



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

Fig. 7. Normalized gate trigger current as a function of junction temperature

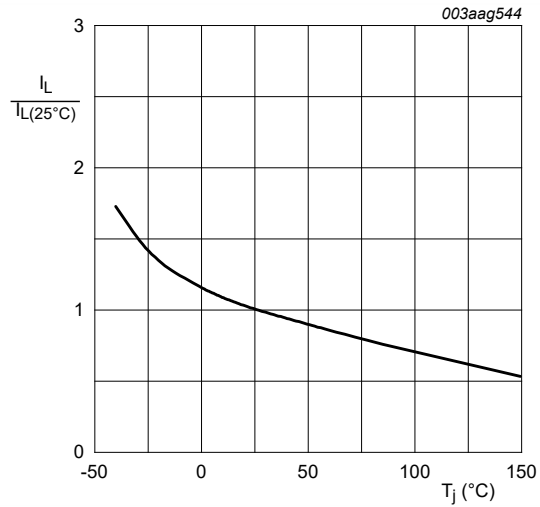


Fig. 8. Normalized latching current as a function of junction temperature

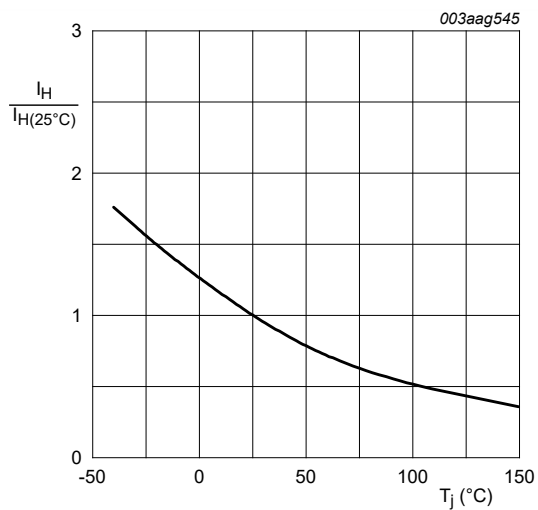
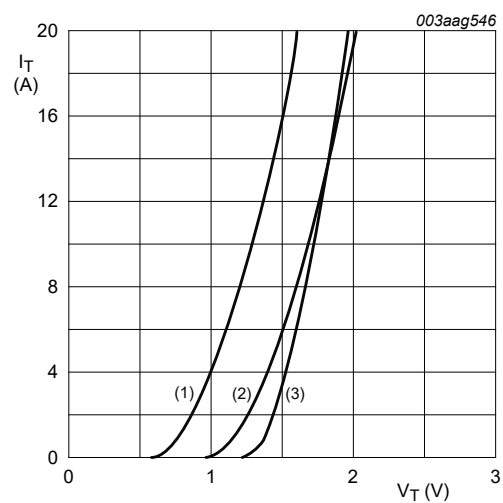


Fig. 9. Normalized holding current as a function of junction temperature



$V_o = 1.184 \text{ V}; R_s = 0.047 \Omega$

- (1)  $T_j = 150^\circ\text{C}$ ; typical values
- (2)  $T_j = 150^\circ\text{C}$ ; maximum values
- (3)  $T_j = 25^\circ\text{C}$ ; 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



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

## 12. Legal information

### Data sheet status

| Document status [1][2]         | Product status [3] | Definition  |
|--------------------------------|--------------------|---|
| Objective [short] data sheet   | Development        | This document contains data from the objective specification for product development. |
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- [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".
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