

## 1. General description

Planar passivated Silicon Controlled Rectifier (SCR) in a TO220 plastic package intended for use in applications requiring good bidirectional blocking voltage and high surge current capability and high junction temperature capability ( $T_{j(max)} = 150\text{ °C}$ ).

## 2. Features and benefits

- High junction operating temperature capability ( $T_{j(max)} = 150\text{ °C}$ )
- High bidirectional blocking voltage capability
- Very high current surge capability
- High thermal cycling performance
- Planar passivated for voltage ruggedness and reliability

## 3. Applications

- Capacitive Discharge Ignition (CDI)
- Crowbar protection
- Inrush protection
- Motor control
- Voltage regulation

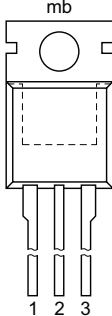
## 4. Quick reference data

Table 1. Quick reference data

| Symbol                         | Parameter                            | Conditions                                                                                                                                 | Min | Typ | Max | Unit       |
|--------------------------------|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|------------|
| $V_{DRM}$                      | repetitive peak off-state voltage    |                                                                                                                                            | -   | -   | 650 | V          |
| $I_{T(RMS)}$                   | RMS on-state current                 | half sine wave; $T_{mb} \leq 135\text{ °C}$ ;<br><a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>                  | -   | -   | 12  | A          |
| $I_{TSM}$                      | non-repetitive peak on-state current | half sine wave; $T_{j(init)} = 25\text{ °C}$ ; $t_p = 10\text{ ms}$ ;<br><a href="#">Fig. 4</a> ; <a href="#">Fig. 5</a>                   | -   | -   | 120 | A          |
|                                |                                      | half sine wave; $T_{j(init)} = 25\text{ °C}$ ; $t_p = 8.3\text{ ms}$                                                                       | -   | -   | 132 | A          |
| $T_j$                          | junction temperature                 |                                                                                                                                            | -   | -   | 150 | °C         |
| <b>Static characteristics</b>  |                                      |                                                                                                                                            |     |     |     |            |
| $I_{GT}$                       | gate trigger current                 | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 7</a>                                                 | 1.5 | -   | 5   | mA         |
| $I_H$                          | holding current                      | $V_D = 12\text{ V}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 9</a>                                                                        | -   | -   | 20  | mA         |
| $V_T$                          | on-state voltage                     | $I_T = 12\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 10</a>                                                                       | -   | -   | 1.5 | V          |
| <b>Dynamic characteristics</b> |                                      |                                                                                                                                            |     |     |     |            |
| $dV_D/dt$                      | rate of rise of off-state voltage    | $V_{DM} = 436\text{ V}$ ; $T_j = 150\text{ °C}$ ; $R_{GK} = 100\text{ }\Omega$ ;<br>( $V_{DM} = 67\%$ of $V_{DRM}$ ); exponential waveform | 500 | -   | -   | V/ $\mu$ s |
|                                |                                      | $V_{DM} = 436\text{ V}$ ; $T_j = 150\text{ °C}$ ; ( $V_{DM} = 67\%$ of $V_{DRM}$ ); exponential waveform; gate open circuit                | 200 | -   | -   | V/ $\mu$ s |

## 5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description                       | Simplified outline                                                                 | Graphic symbol                                                                      |
|-----|--------|-----------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 1   | K      | cathode                           |  |  |
| 2   | A      | anode                             |                                                                                    |                                                                                     |
| 3   | G      | gate                              |                                                                                    |                                                                                     |
| mb  | A      | mounting base; connected to anode |                                                                                    |                                                                                     |

## 6. Ordering information

Table 3. Ordering information

| Type number  | Package name | Orderable part number | Packing method | Small packing quantity | Package version | Package issue date |
|--------------|--------------|-----------------------|----------------|------------------------|-----------------|--------------------|
| BT151-650LTF | TO220        | BT151-650LTFQ         | Tube           | 50                     | SOT78           | 13-Jun-2008        |

## 7. Marking

Table 4. Marking codes

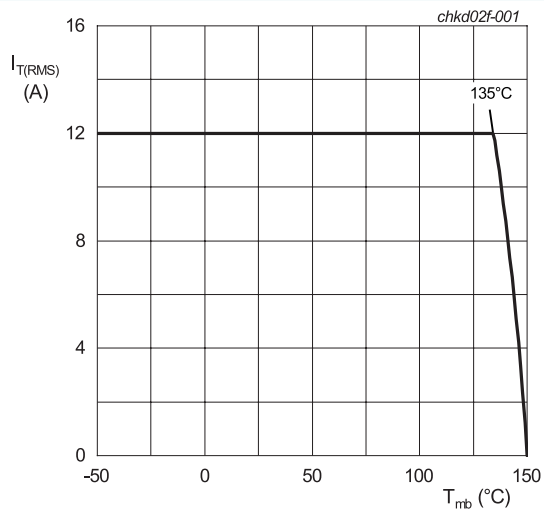
| Type number  | Marking codes   |
|--------------|-----------------|
| BT151-650LTF | BT151<br>650LTF |

## 8. Limiting values

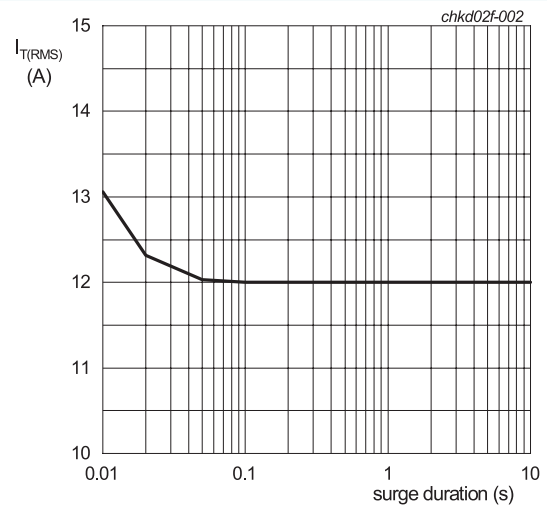
**Table 5. Limiting values**

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

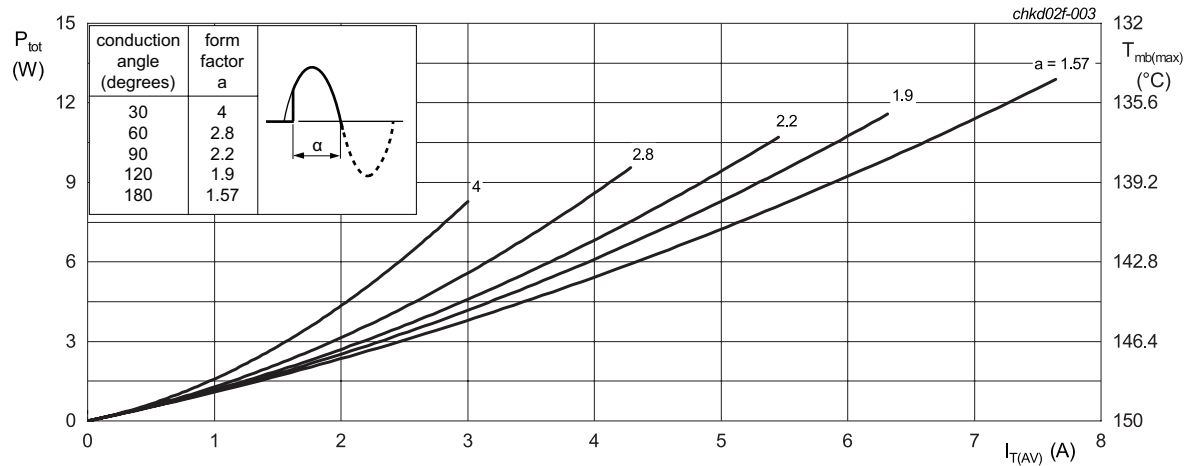
| Symbol              | Parameter                            | Conditions                                                                                                                                             |  | Min | Max | Unit                   |
|---------------------|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----|-----|------------------------|
| $V_{\text{DRM}}$    | repetitive peak off-state voltage    |                                                                                                                                                        |  | -   | 650 | V                      |
| $V_{\text{RRM}}$    | repetitive peak reverse voltage      |                                                                                                                                                        |  | -   | 650 | V                      |
| $I_{\text{T(AV)}}$  | average on-state current             | half sine wave; $T_{\text{mb}} \leq 135\text{ }^{\circ}\text{C}$ ;                                                                                     |  | -   | 7.5 | A                      |
| $I_{\text{T(RMS)}}$ | RMS on-state current                 | half sine wave; $T_{\text{mb}} \leq 135\text{ }^{\circ}\text{C}$ ;<br><a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>         |  | -   | 12  | A                      |
| $I_{\text{TSM}}$    | non-repetitive peak on-state current | half sine wave; $T_{\text{j(init)}} = 25\text{ }^{\circ}\text{C}$ ; $t_{\text{p}} = 10\text{ ms}$ ;<br><a href="#">Fig. 4</a> ; <a href="#">Fig. 5</a> |  | -   | 120 | A                      |
|                     |                                      | half sine wave; $T_{\text{j(init)}} = 25\text{ }^{\circ}\text{C}$ ; $t_{\text{p}} = 8.3\text{ ms}$                                                     |  | -   | 132 | A                      |
| $I^2t$              | $I^2t$ for fusing                    | $t_{\text{p}} = 10\text{ ms}$ ; sine wave                                                                                                              |  | -   | 72  | $\text{A}^2\text{s}$   |
| $di_{\text{T}}/dt$  | rate of rise of on-state current     | $I_{\text{G}} = 10\text{ mA}$                                                                                                                          |  | -   | 150 | $\text{A}/\mu\text{s}$ |
| $I_{\text{GM}}$     | peak gate current                    |                                                                                                                                                        |  | -   | 2   | A                      |
| $P_{\text{GM}}$     | peak gate power                      |                                                                                                                                                        |  | -   | 5   | W                      |
| $P_{\text{G(AV)}}$  | average gate power                   | over any 20 ms period                                                                                                                                  |  | -   | 1   | W                      |
| $T_{\text{stg}}$    | storage temperature                  |                                                                                                                                                        |  | -40 | 150 | $^{\circ}\text{C}$     |
| $T_{\text{j}}$      | junction temperature                 |                                                                                                                                                        |  | -   | 150 | $^{\circ}\text{C}$     |



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

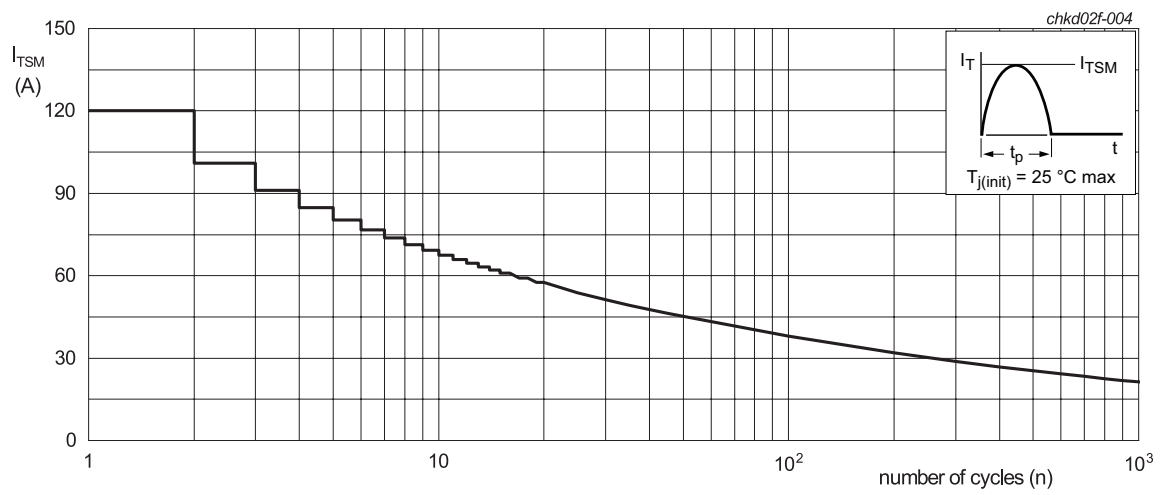


**Fig. 2. RMS on-state current as a function of surge duration; maximum values**  
 $f = 50\text{ Hz}$ ;  $T_{\text{mb}} = 135\text{ }^{\circ}\text{C}$



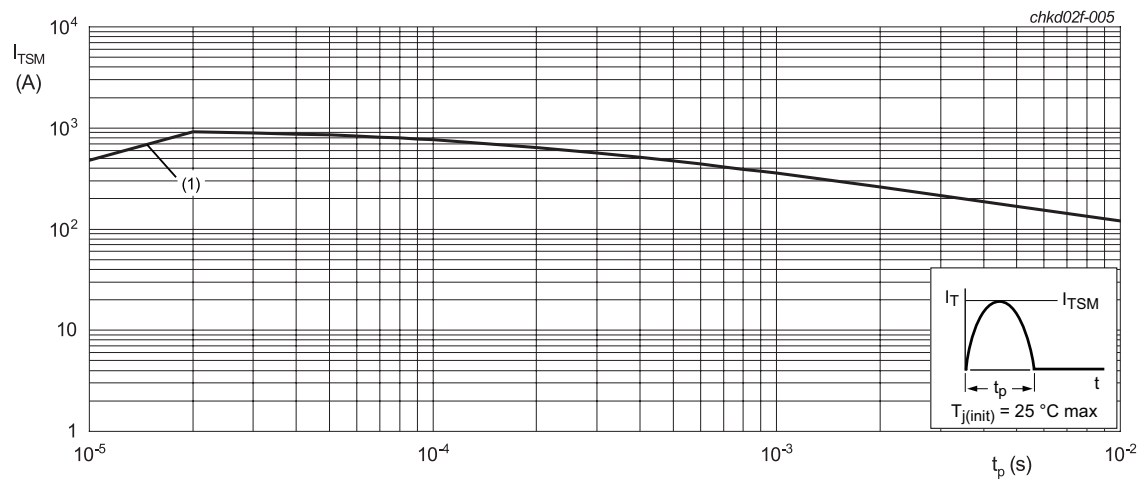
$\alpha$  = conduction angle  
 $a$  = form factor =  $I_{T(RMS)} / I_{T(AV)}$

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



$f = 50 \text{ Hz}$

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



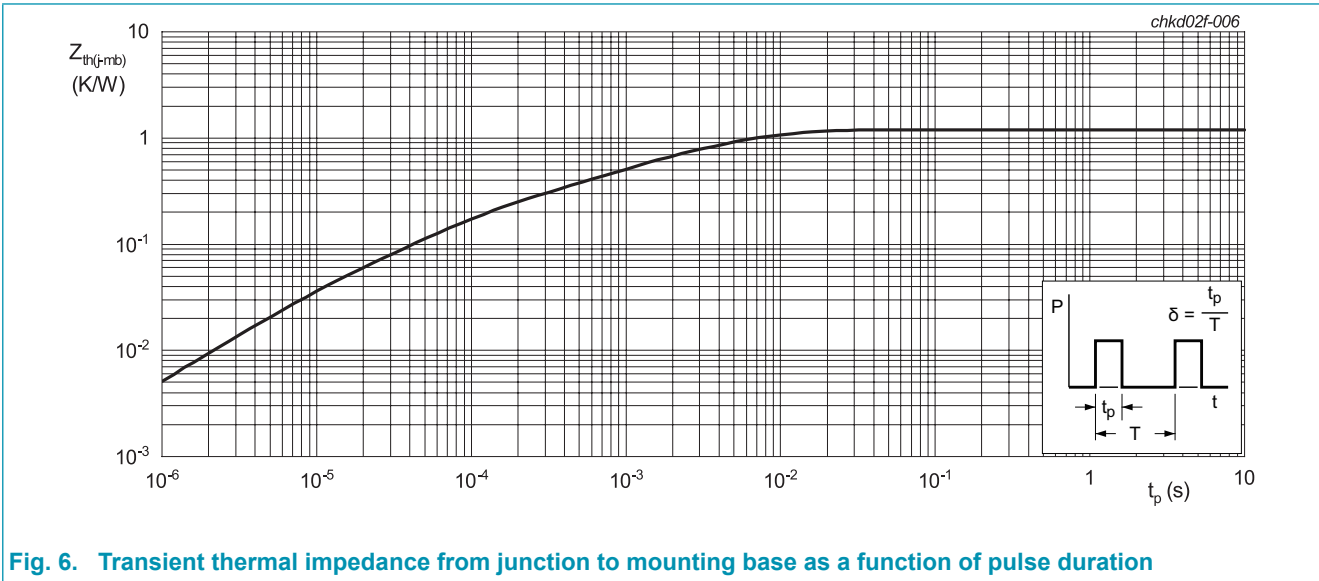
$t_p \leq 10 \text{ ms}$  ;  
 (1)  $di_T/dt$  limit

Fig. 5. Non-repetitive peak on-state current as a function of pulse width; maximum values

9. Thermal characteristics

Table 6. Thermal characteristics

| Symbol         | Parameter                                            | Conditions             |  | Min | Typ | Max | Unit |
|----------------|------------------------------------------------------|------------------------|--|-----|-----|-----|------|
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base    | <a href="#">Fig. 6</a> |  | -   | -   | 1.2 | K/W  |
| $R_{th(j-a)}$  | thermal resistance from junction to ambient free air | in free air            |  | -   | 60  | -   | K/W  |



## 10. Characteristics

Table 8. Characteristics

| Symbol                  | Parameter                         | Conditions                                                                                                                                    |  | Min  | Typ  | Max | Unit |
|-------------------------|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--|------|------|-----|------|
| Static characteristics  |                                   |                                                                                                                                               |  |      |      |     |      |
| I <sub>GT</sub>         | gate trigger current              | V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; T <sub>J</sub> = 25 °C; <a href="#">Fig. 7</a>                                                 |  | 1.5  | -    | 5   | mA   |
| I <sub>L</sub>          | latching current                  | V <sub>D</sub> = 12 V; I <sub>G</sub> = 0.1 A; T <sub>J</sub> = 25 °C; <a href="#">Fig. 8</a>                                                 |  | -    | -    | 40  | mA   |
| I <sub>H</sub>          | holding current                   | V <sub>D</sub> = 12 V; T <sub>J</sub> = 25 °C; <a href="#">Fig. 9</a>                                                                         |  | -    | -    | 20  | mA   |
| V <sub>T</sub>          | on-state voltage                  | I <sub>T</sub> = 12 A; T <sub>J</sub> = 25 °C; <a href="#">Fig. 10</a>                                                                        |  | -    | -    | 1.5 | 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; <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 | 0.45 | -   | V    |
| V <sub>GR</sub>         | gate reverse voltage              | I <sub>RG</sub> = 100 mA                                                                                                                      |  | 10   | -    | -   | V    |
| I <sub>D</sub>          | off-state current                 | V <sub>D</sub> = 650 V; T <sub>J</sub> = 25 °C                                                                                                |  | -    | -    | 10  | μA   |
|                         |                                   | V <sub>D</sub> = 650 V; T <sub>J</sub> = 150 °C                                                                                               |  | -    | -    | 2   | mA   |
| I <sub>R</sub>          | reverse current                   | V <sub>D</sub> = 650 V; T <sub>J</sub> = 25 °C                                                                                                |  | -    | -    | 10  | μA   |
|                         |                                   | V <sub>D</sub> = 650 V; T <sub>J</sub> = 150 °C                                                                                               |  | -    | -    | 2   | mA   |
| Dynamic characteristics |                                   |                                                                                                                                               |  |      |      |     |      |
| dV <sub>D</sub> /dt     | rate of rise of off-state voltage | V <sub>DM</sub> = 436 V; T <sub>J</sub> = 150 °C; R <sub>GK</sub> = 100 Ω; (V <sub>DM</sub> = 67% of V <sub>DRM</sub> ); exponential waveform |  | 500  | -    | -   | V/μs |
|                         |                                   | V <sub>DM</sub> = 436 V; T <sub>J</sub> = 150 °C; (V <sub>DM</sub> = 67% of V <sub>DRM</sub> ); exponential waveform; gate open circuit       |  | 200  | -    | -   | V/μs |
| t <sub>gt</sub>         | gate-controlled turn-on time      | I <sub>TM</sub> = 12 A; V <sub>D</sub> = 600 V; I <sub>G</sub> = 20 mA; (dI <sub>G</sub> /dt) <sub>M</sub> = 5 A/μs; T <sub>J</sub> = 25 °C   |  |      | 2    | -   | μs   |
| t <sub>q</sub>          | commutated turn-off time          | I <sub>TM</sub> = 2 A; t <sub>p</sub> = 50 μs; dV <sub>D</sub> /dt = 5 V/μs; dI/dt = 30 A/μs                                                  |  |      | -    | 12  | μs   |

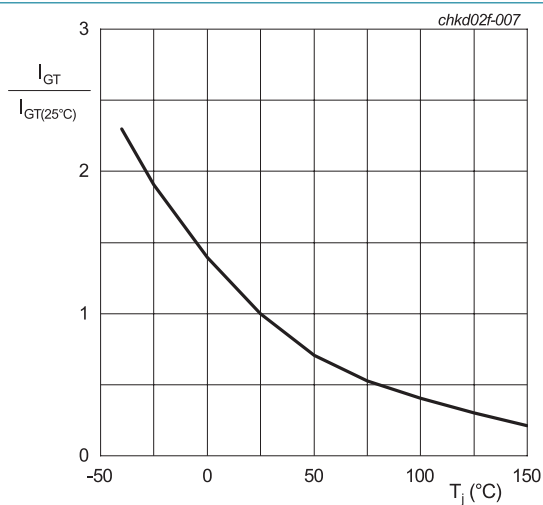


Fig. 7. Normalized gate trigger current as a function of junction temperature

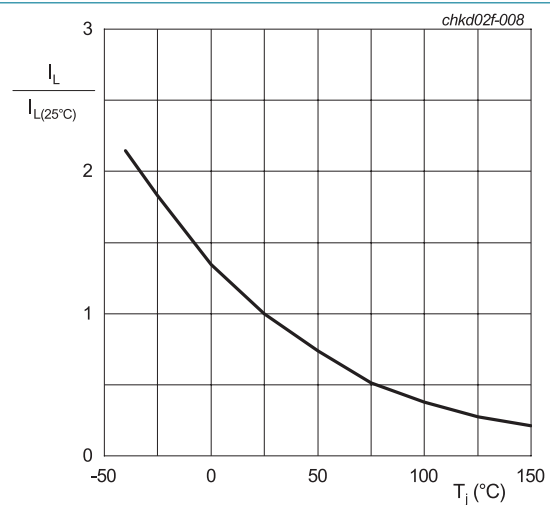


Fig. 8. Normalized latching current as a function of junction temperature

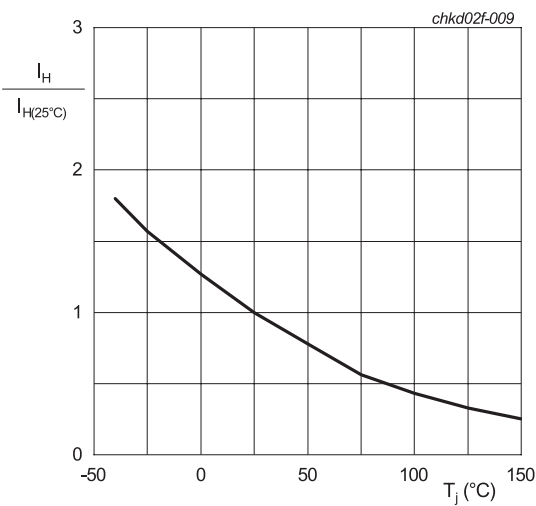
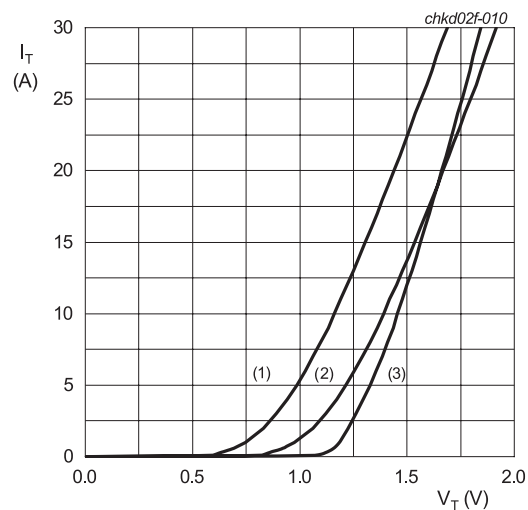


Fig. 9. Normalized holding current as a function of junction temperature



$V_o = 0.993 \text{ V}$ ;  $R_s = 0.0368 \Omega$   
(1)  $T_j = 150 \text{ }^\circ\text{C}$ ; typical values  
(2)  $T_j = 150 \text{ }^\circ\text{C}$ ; maximum values  
(3)  $T_j = 25 \text{ }^\circ\text{C}$ ; maximum values

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

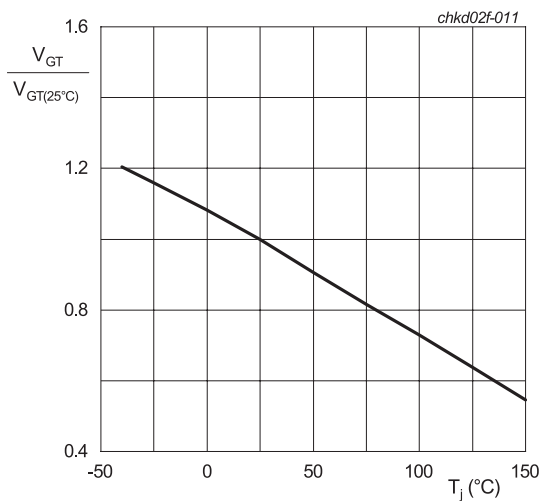
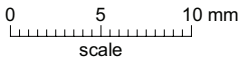
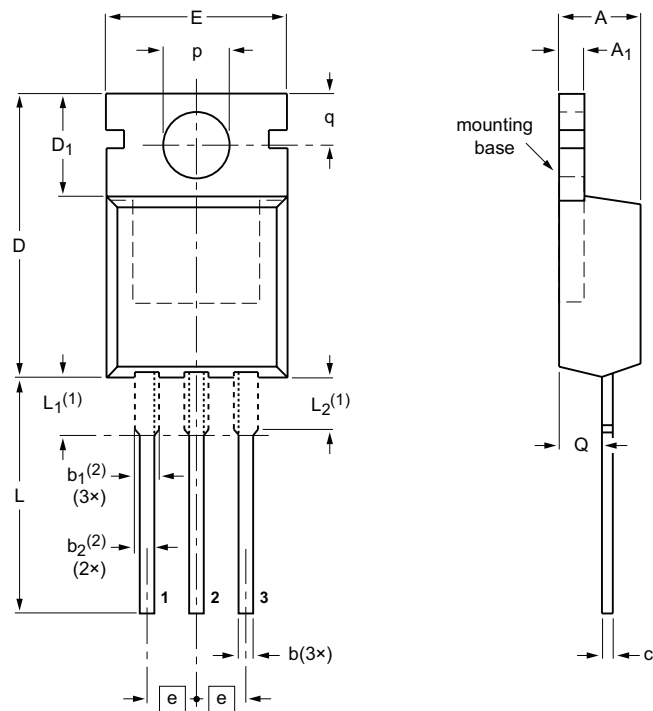


Fig. 11. Normalized gate trigger voltage as a function of junction temperature

11. Package outline

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB SOT78



DIMENSIONS (mm are the original dimensions)

| UNIT | A          | A <sub>1</sub> | b          | b <sub>1</sub> (2) | b <sub>2</sub> (2) | c          | D            | D <sub>1</sub> | E           | e    | L            | L <sub>1</sub> (1) | L <sub>2</sub> (1)<br>max. | p          | q          | Q          |
|------|------------|----------------|------------|--------------------|--------------------|------------|--------------|----------------|-------------|------|--------------|--------------------|----------------------------|------------|------------|------------|
| mm   | 4.7<br>4.1 | 1.40<br>1.25   | 0.9<br>0.6 | 1.6<br>1.0         | 1.3<br>1.0         | 0.7<br>0.4 | 16.0<br>15.2 | 6.6<br>5.9     | 10.3<br>9.7 | 2.54 | 15.0<br>12.8 | 3.30<br>2.79       | 3.0                        | 3.8<br>3.5 | 3.0<br>2.7 | 2.6<br>2.2 |

- Notes
- 1. Lead shoulder designs may vary.
  - 2. Dimension includes excess dambar.

| OUTLINE<br>VERSION | REFERENCES |                 |       |  | EUROPEAN<br>PROJECTION | ISSUE DATE           |
|--------------------|------------|-----------------|-------|--|------------------------|----------------------|
|                    | IEC        | JEDEC           | JEITA |  |                        |                      |
| SOT78              |            | 3-lead TO-220AB | SC-46 |  |                        | 08-04-23<br>08-06-13 |



## 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. |
| Preliminary [short] data sheet | Qualification      | This document contains data from the preliminary specification.                       |
| Product [short] data sheet     | Production         | This document contains the product specification.                                     |

- [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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