# ACTT10X-800CTN

## Enhanced, high temperature ACTT power switch

5 September 2018 Product data sheet

## 1. General description

Planar passivated AC Thyristor Triac power switch in a SOT186A (TO-220F) "full pack" plastic package with self-protective capabilities against low and high energy transients. This "series CTN" 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

- Clamping structure ensuring safe high over-voltage withstand capability
- High junction operating temperature capability ($T_{j(max)}$ = 150 °C)
- High minimum $I_{GT}$ for guaranteed immunity to gate noise
- Full cycle AC conduction
- Over-voltage withstand capability to IEC 61000-4-5
- Pin compatible with standard triacs
- Planar passivated for voltage ruggedness and reliability
- Protective self turn-on capability for high energy transients
- Safe clamping capability for low energy over-voltage transients
- Less sensitive gate for high noise immunity
- Triggering in three quadrants only
- Very high immunity to false turn-on by dV/dt and IEC 61000-4-4 fast transient
- Package meets UL94V0 flammability requirement
- Package is RoHS compliant
- Package meets UL1557 isolation test requirement rated at 2500V RMS

## 3. Applications

- AC fan, pump and compressor controls
- Highly inductive, resistive and safety loads
- Large and small appliances (White Goods)
- Reversing induction motor controls
- Applications subject to high temperature ($T_{j(max)}$ = 150 °C)

## 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; $T_h \leq$ 95 °C; Fig. 1; Fig. 2; Fig. 3 | | - | - | 10 | A |

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $I_{TSM}$ | non-repetitive peak on-state current | full sine wave; $T_{j(init)}$ = 25 °C; $t_p$ = 20 ms; Fig. 4; Fig. 5 | | - | - | 90 | A |
| | | full sine wave; $T_{j(init)}$ = 25 °C; $t_p$ = 16.7 ms | | - | - | 99 | A |
| $T_j$ | junction temperature | | | - | - | 150 | °C |
| $V_{PP}$ | peak pulse voltage | $T_j$ = 25 °C; non-repetitive, off-state; Fig. 6 | | - | - | 2 | kV |
| **Static characteristics** | | | | | | | |
| $I_{GT}$ | gate trigger current | $V_D$ = 12 V; $I_T$ = 100 mA; LD+ G+; $T_j$ = 25 °C; Fig. 8 | | 5 | - | 35 | mA |
| | | $V_D$ = 12 V; $I_T$ = 100 mA; LD+ G-; $T_j$ = 25 °C; Fig. 8 | | 5 | - | 35 | mA |
| | | $V_D$ = 12 V; $I_T$ = 100 mA; LD- G-; $T_j$ = 25 °C; Fig. 8 | | 5 | - | 35 | mA |
| $I_H$ | holding current | $V_D$ = 12 V; $T_j$ = 25 °C; Fig. 10 | | - | - | 30 | mA |
| $V_T$ | on-state voltage | $I_T$ = 14 A; $T_j$ = 25 °C; Fig. 11 | | - | - | 1.5 | V |
| $V_{CL}$ | clamping voltage | $I_{CL}$ = 0.1 mA; $t_p$ = 1 ms; $T_j$ = 25 °C | | 850 | - | - | V |
| **Dynamic characteristics** | | | | | | | |
| $dV_D/dt$ | rate of rise of off-state voltage | $V_{DM}$ = 536 V; $T_j$ = 125 °C; ($V_{DM}$ = 67% of $V_{DRM}$); exponential waveform; gate open circuit | | 4000 | - | - | V/µs |
| | | $V_{DM}$ = 536 V; $T_j$ = 150 °C; exponential waveform; gate open circuit | | 2000 | - | - | V/µs |
| $dI_{com}/dt$ | rate of change of commutating current | $V_D$ = 400 V; $T_j$ = 150 °C; $I_{T(RMS)}$ = 10 A; $dV_{com}/dt$ = 20 V/µs; gate open circuit; snubberless condition | | 5 | - | - | A/ms |
| | | $V_D$ = 400 V; $T_j$ = 150 °C; $I_{T(RMS)}$ = 10 A; $dV_{com}/dt$ = 10 V/µs; gate open circuit | | 10 | - | - | A/ms |
| | | $V_D$ = 400 V; $T_j$ = 150 °C; $I_{T(RMS)}$ = 10 A; $dV_{com}/dt$ = 1 V/µs; gate open circuit | | 15 | - | - | A/ms |


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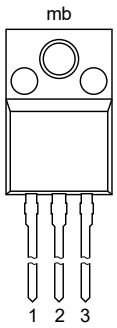
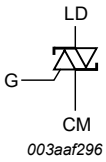
## 5. Pinning information

**Table 2. Pinning information**

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|---|---|---|---|---|
| 1 | CM | common |  TO-220F (SOT186A) |  |
| 2 | LD | load | | |
| 3 | G | gate | | |
| mb | n.c. | mounting base; isolated | | |

## 6. Ordering information

**Table 3. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| ACTT10X-800CTN | TO-220F | plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3-lead TO-220 "full pack" | SOT186A |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# 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; $T_h \leq 95$ °C; Fig. 1; Fig. 2; Fig. 3 | | - | 10 | A |
| $I_{TSM}$ | non-repetitive peak on-state current | full sine wave; $T_{j(init)} = 25$ °C; $t_p = 20$ ms; Fig. 4; Fig. 5 | | - | 90 | A |
| | | full sine wave; $T_{j(init)} = 25$ °C; $t_p = 16.7$ ms | | - | 99 | A |
| $I^2t$ | $I^2t$ for fusing | $t_p = 10$ ms; sine-wave pulse | | - | 40 | $A^2s$ |
| $dI_T/dt$ | rate of rise of on-state current | $I_G = 70$ mA | | - | 100 | A/µs |
| $I_{GM}$ | 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 |
| $V_{PP}$ | peak pulse voltage | $T_j = 25$ °C; non-repetitive, off-state; Fig. 6 | | - | 2 | kV |

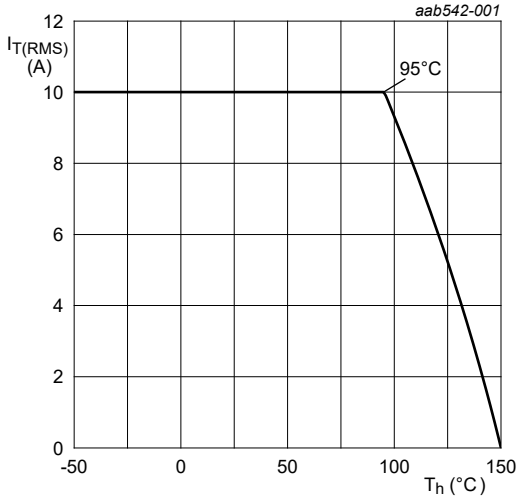
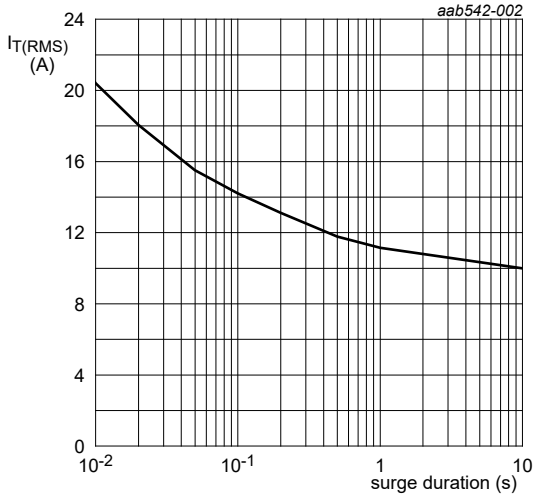



**Fig. 1. RMS on-state current as a function of heatsink temperature; maximum values**




f = 50 Hz; $T_h = 95$ °C

**Fig. 2. RMS on-state current as a function of surge duration; maximum values**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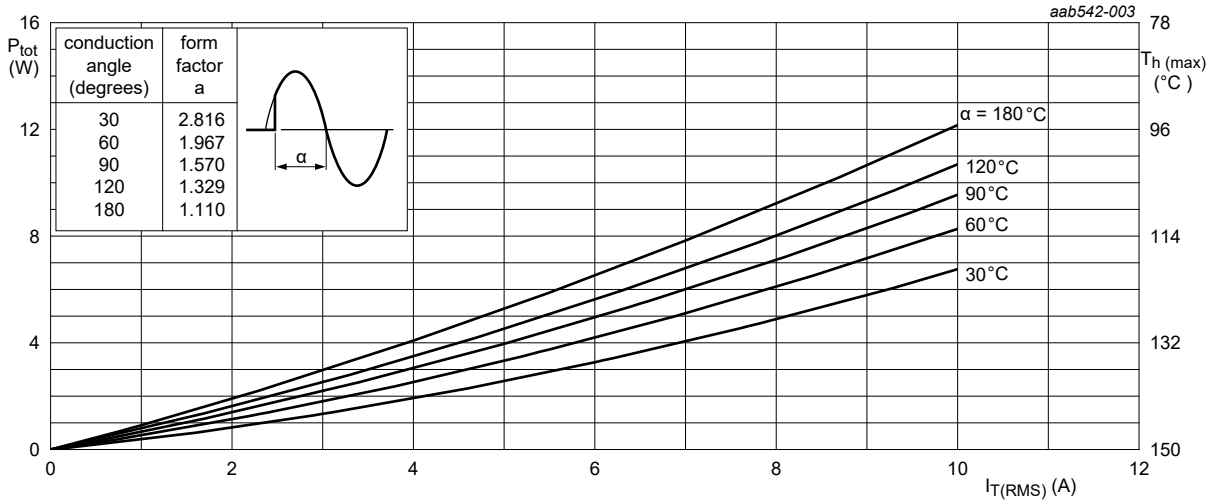
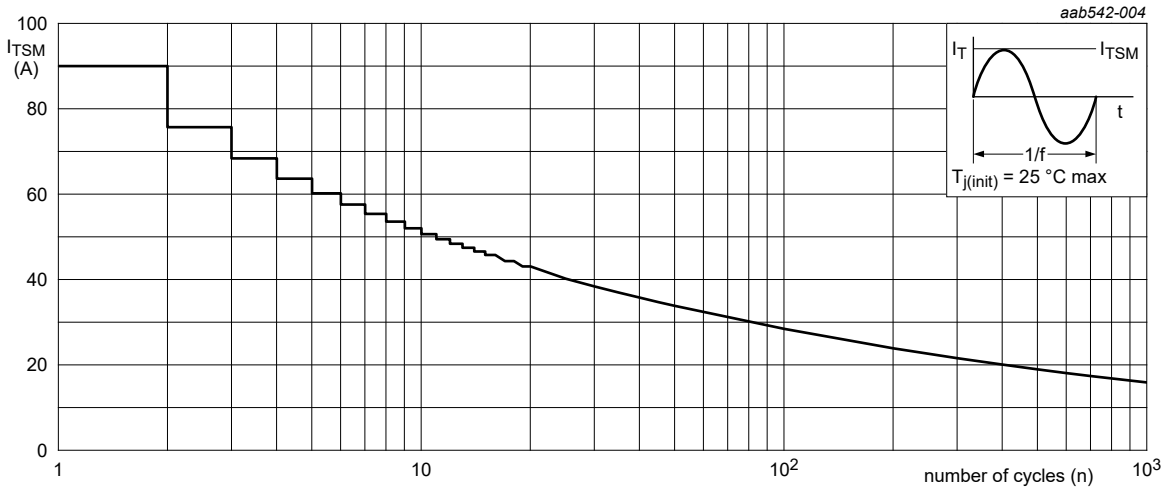



α = conduction angle

a = form factor = $I_{T(RMS)}$ / $I_{T(AV)}$

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




f = 50 Hz

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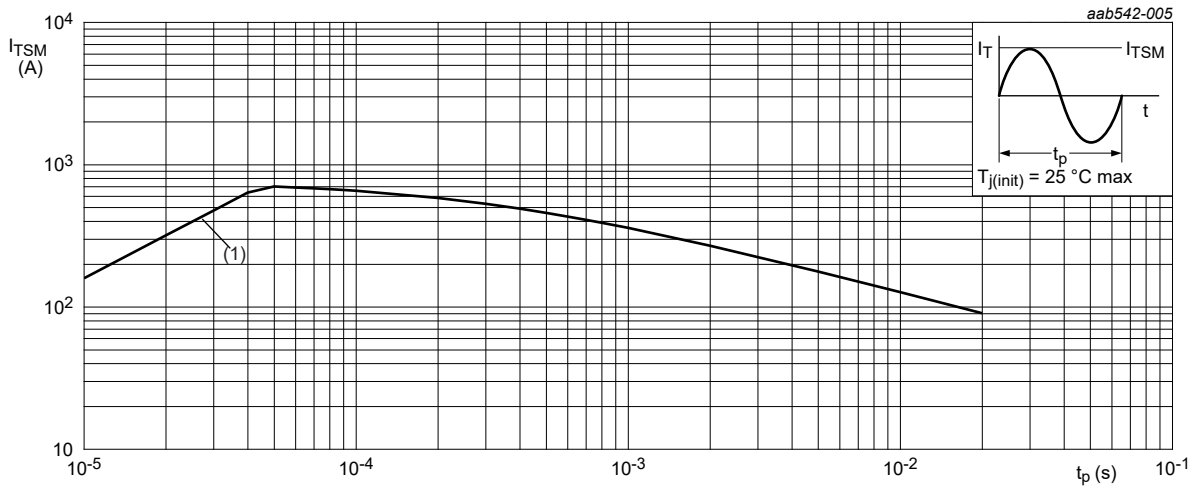


$t_p \leq 20$ ms
(1) $dI_T/dt$ limit

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

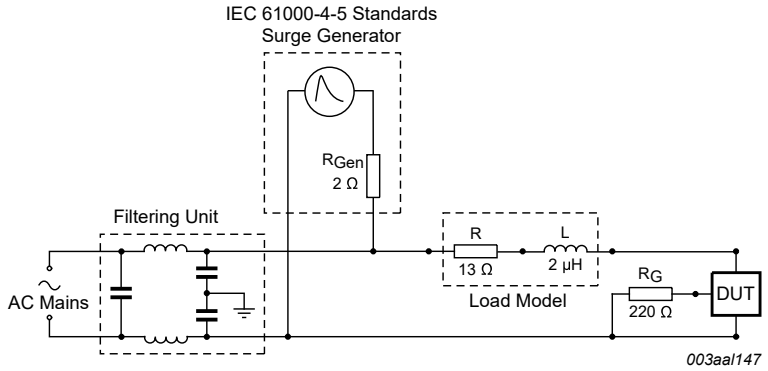


**Fig. 6. Test circuit for inductive and resistive loads with conditions equivalent to IEC 61000-4-5**


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# 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 or half cycle; with heatsink compound; Fig. 7 | | - | - | 4.5 | K/W |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient free air | in free air | | - | 55 | - | K/W |

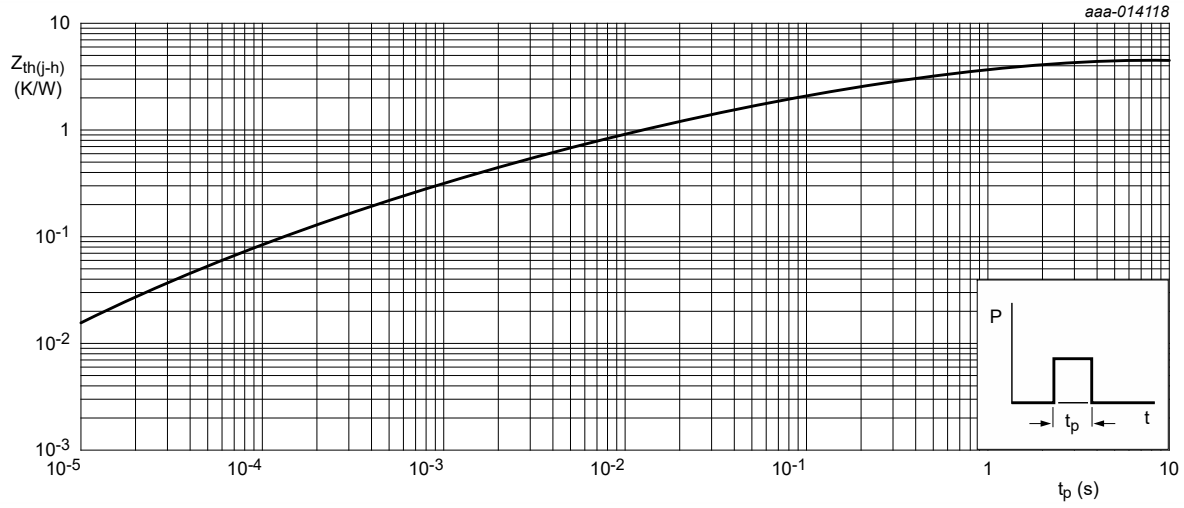


**Fig. 7. Transient thermal impedance from junction to heatsink as a function of pulse width**

# 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 Hz ≤ f ≤ 60 Hz; $T_h$ = 25 °C | | - | - | 2500 | V |
| $C_{isol}$ | isolation capacitance | from main terminal 2 to external heatsink; f = 1 MHz; $T_h$ = 25 °C | | - | 10 | - | pF |


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# 10. Characteristics

**Table 7. Characteristics**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Static characteristics** | | | | | | | |
| $I_{GT}$ | gate trigger current | $V_D$ = 12 V; $I_T$ = 100 mA; LD+ G+; $T_j$ = 25 °C; Fig. 8 | | 5 | - | 35 | mA |
| | | $V_D$ = 12 V; $I_T$ = 100 mA; LD+ G-; $T_j$ = 25 °C; Fig. 8 | | 5 | - | 35 | mA |
| | | $V_D$ = 12 V; $I_T$ = 100 mA; LD- G-; $T_j$ = 25 °C; Fig. 8 | | 5 | - | 35 | mA |
| $I_L$ | latching current | $V_D$ = 12 V; $I_G$ = 100 mA; LD+ G+; $T_j$ = 25 °C; Fig. 9 | | - | - | 40 | mA |
| | | $V_D$ = 12 V; $I_G$ = 100 mA; LD+ G-; $T_j$ = 25 °C; Fig. 9 | | - | - | 50 | mA |
| | | $V_D$ = 12 V; $I_G$ = 100 mA; LD- G-; $T_j$ = 25 °C; Fig. 9 | | - | - | 40 | mA |
| $I_H$ | holding current | $V_D$ = 12 V; $T_j$ = 25 °C; Fig. 10 | | - | - | 30 | mA |
| $V_T$ | on-state voltage | $I_T$ = 14 A; $T_j$ = 25 °C; Fig. 11 | | - | - | 1.5 | V |
| $V_{GT}$ | gate trigger voltage | $V_D$ = 12 V; $I_T$ = 100 mA; $T_j$ = 25 °C; Fig. 12 | | - | 0.8 | 1 | V |
| | | $V_D$ = 400 V; $I_T$ = 100 mA; $T_j$ = 150 °C; Fig. 12 | | 0.2 | 0.5 | - | V |
| $I_D$ | off-state current | $V_D$ = 800 V; $T_j$ = 25 °C | | - | - | 10 | µA |
| | | $V_D$ = 800 V; $T_j$ = 150 °C | | - | - | 2 | mA |
| $V_{CL}$ | clamping voltage | $I_{CL}$ = 0.1 mA; $t_p$ = 1 ms; $T_j$ = 25 °C | | 850 | - | - | V |
| **Dynamic characteristics** | | | | | | | |
| $dV_D/dt$ | rate of rise of off-state voltage | $V_{DM}$ = 536 V; $T_j$ = 125 °C; ($V_{DM}$ = 67% of $V_{DRM}$); exponential waveform; gate open circuit | | 4000 | - | - | V/µs |
| | | $V_{DM}$ = 536 V; $T_j$ = 150 °C; exponential waveform; gate open circuit | | 2000 | - | - | V/µs |
| $dI_{com}/dt$ | rate of change of commutating current | $V_D$ = 400 V; $T_j$ = 150 °C; $I_{T(RMS)}$ = 10 A; $dV_{com}/dt$ = 20 V/µs; gate open circuit; snubberless condition | | 5 | - | - | A/ms |
| | | $V_D$ = 400 V; $T_j$ = 150 °C; $I_{T(RMS)}$ = 10 A; $dV_{com}/dt$ = 10 V/µs; gate open circuit | | 10 | - | - | A/ms |
| | | $V_D$ = 400 V; $T_j$ = 150 °C; $I_{T(RMS)}$ = 10 A; $dV_{com}/dt$ = 1 V/µs; gate open circuit | | 15 | - | - | A/ms |


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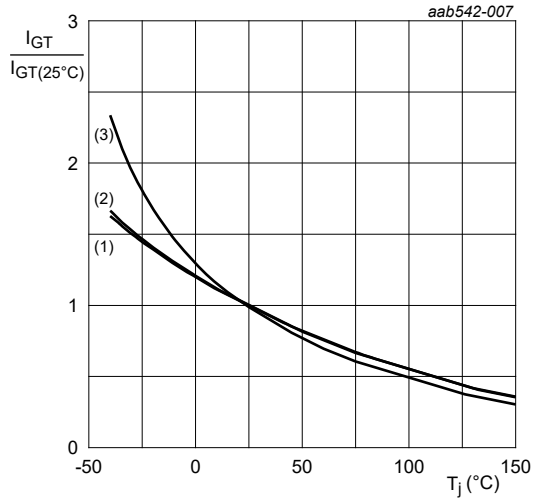



(1) LD+ G+
(2) LD+ G-
(3) LD- G-

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

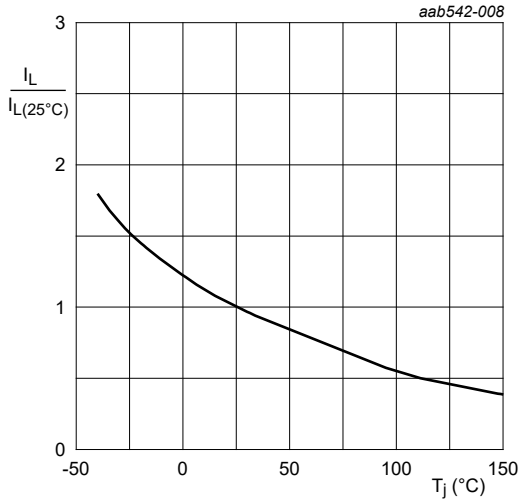



**Fig. 9. Normalized latching current as a function of junction temperature**

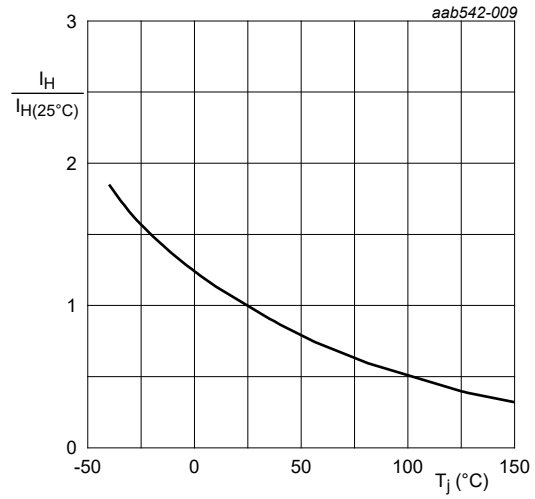
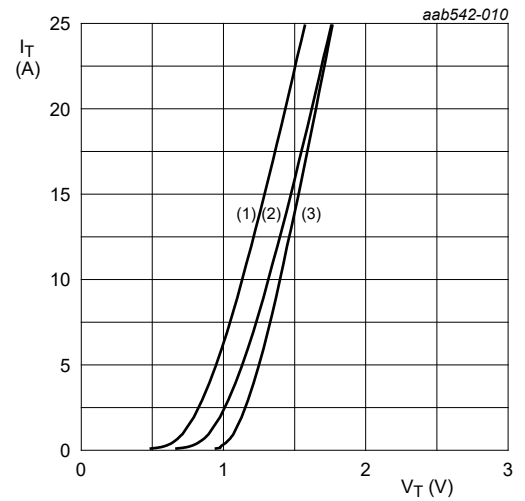



**Fig. 10. Normalized holding current as a function of junction temperature**




$V_o$ = 0.990 V; $R_s$ = 0.032 Ω
(1) $T_j$ = 150 °C; typical values
(2) $T_j$ = 150 °C; maximum values
(3) $T_j$ = 25 °C; maximum values

**Fig. 11. On-state current as a function of on-state voltage**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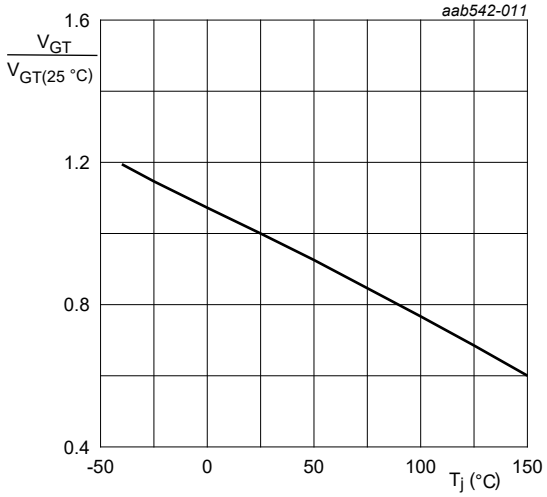


**Fig. 12. Normalized gate trigger voltage as a function of junction temperature**


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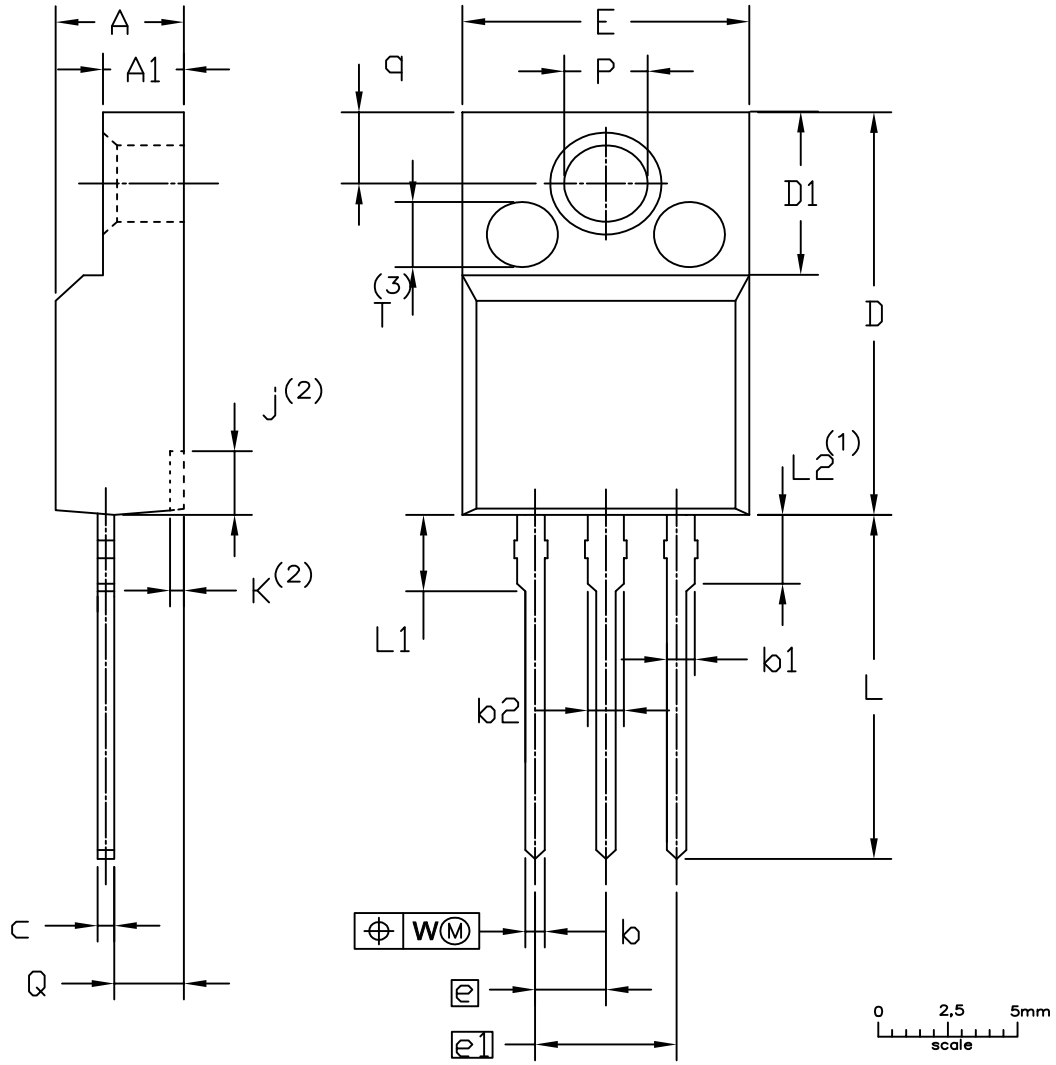
## 11. Package outline

Plastic single−ended package; isolated heatsink mounted; 1 mounting hole; 3−lead TO−220 "full pack" SOT186A




| UNIT | A | $A_1$ | b | $b_1$ | $b_2$ | c | D | $D_1$ | E | e | $e_1$ | j(2) | K(2) | L | $L_1$ | $L_2$(1) max. | P | Q | q | W | T(3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 4.6 | 2.9 | 0.9 | 1.1 | 1.4 | 0.7 | 15.8 | 6.5 | 10.3 | 2.54 | 5.08 | 2.7 | 0.6 | 14.4 | 3.30 | 3 | 3.2 | 2.6 | 3.0 | 0.4 | 2.5 |
| | 4.0 | 2.5 | 0.7 | 0.9 | 1.0 | 0.4 | 15.2 | 6.3 | 9.7 | | | 1.7 | 0.4 | 13.5 | 2.79 | | 3.0 | 2.3 | 2.6 | | |

Notes
1. Terminal dimensions within this zone are uncotrolled
2. Dot lines area designs may vary
3. Eject pin mark is for reference only

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT186A | | 3 LEADS TO220F | | | | 2013−11−14 |

Fig. 13. Package outline TO-220F (SOT186A)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## Data sheet status

| Document status [1][2] | Product status [3] | Definition |
|---|---|---|
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| 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.
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