# ACT108W-600E

## AC Thyristor power switch

Rev. 03 — 21 October 2009 Product data sheet

## 1. Product profile

### 1.1 General description

AC Thyristor power switch in a SOT223 surface-mountable plastic package with self-protective capabilities against low and high energy transients

### 1.2 Features and benefits

- Common terminal on mounting base allows multiple ACTs on shared cooling pad
- Exclusive negative gate triggering
- Full cycle AC conduction
- Remote gate separates the gate driver from the effects of the load current
- Safe clamping of low energy over-voltage transients
- Self-protective turn-on during high energy voltage transients
- Suface-mountable package
- Very high noise immunity

### 1.3 Applications

- Contactors, circuit breakers, valves, dispensers and door locks
- Fan motor circuits
- Lower-power highly inductive, resistive and safety loads
- Pump motor circuits

### 1.4 Quick reference data

Table 1. Quick reference

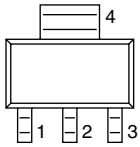
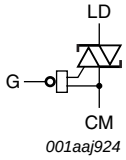
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{DRM}$ | repetitive peak off-state voltage | | - | - | 600 | V |
| $I_{GT}$ | gate trigger current | $V_D$ = 12 V; $I_T$ = 100 mA; LD+ G-; $T_j$ = 25 °C; see Figure 10 | 1 | - | 10 | mA |
| | | $V_D$ = 12 V; $I_T$ = 100 mA; LD- G-; $T_j$ = 25 °C | 1 | - | 10 | mA |
| $I_{T(RMS)}$ | RMS on-state current | full sine wave; $T_{sp}$ ≤ 112 °C; see Figure 3, 1 and 2 | - | - | 0.8 | A |
| $dV_D/dt$ | rate of rise of off-state voltage | $V_{DM}$ = 402 V; $T_j$ = 125 °C; gate open circuit; see Figure 14 | 1000 | - | - | V/µs |

**Table 1. Quick reference** *...continued*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{CL}$ | clamping voltage | $I_{CL}$ = 100 mA; $t_p$ = 1 ms; $T_j \leq 125$ °C; see Figure 17 | 650 | - | - | V |
| $V_{PP}$ | peak pulse voltage | $T_j$ = 25 °C; non-repetitive, off-state; see Figure 6 | - | - | 2 | kV |
| $V_T$ | on-state voltage | $I_T$ = 1.1 A; see Figure 13 | - | - | 1.3 | V |

## 2. Pinning information

**Table 2. Pinning information**

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|---|---|---|---|---|
| 1 | LD | load |   SOT223 (SC-73) |   001aaj924 |
| 2 | CM | common | | |
| 3 | G | gate | | |
| mb | CM | mounting base; connected to common | | |

## 3. Ordering information

**Table 3. Ordering information**

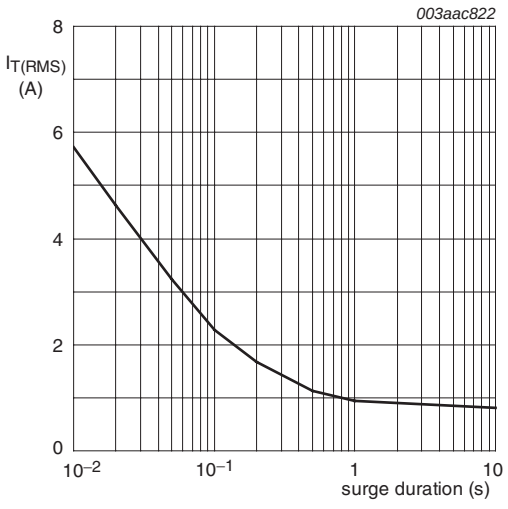
| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| ACT108W-600E | SC-73 | plastic surface-mounted package with increased heatsink; 4 leads | SOT223 |

## 4. 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 | | - | 600 | V |
| $I_{T(RMS)}$ | RMS on-state current | full sine wave; $T_{sp} \leq 112$ °C; see Figure 3, 1 and 2 | - | 0.8 | A |
| $I_{TSM}$ | non-repetitive peak on-state current | full sine wave; $T_{j(init)} = 25$ °C; $t_p = 16.7$ ms | - | 8.8 | A |
| | | full sine wave; $T_{j(init)} = 25$ °C; $t_p = 20$ ms; see Figure 4 and 5 | - | 8 | A |
| $I^2t$ | $I^2t$ for fusing | $t_p = 10$ ms; sin-wave pulse | - | 0.32 | $A^2s$ |
| $dI_T/dt$ | rate of rise of on-state current | $I_T = 1$ A; $I_G = 20$ mA; $dI_G/dt = 0.2$ A/µs | - | 100 | A/µs |
| $I_{GM}$ | peak gate current | t = 20 µs | - | 1 | A |
| $V_{GM}$ | peak gate voltage | positive applied gate voltage | - | 15 | V |
| $P_{G(AV)}$ | average gate power | over any 20 ms period | - | 0.1 | W |
| $T_{stg}$ | storage temperature | | -40 | 150 | °C |
| $T_j$ | junction temperature | | - | 125 | °C |
| $V_{PP}$ | peak pulse voltage | $T_j = 25$ °C; non-repetitive, off-state; see Figure 6 | - | 2 | kV |




$f = 50Hz$; $T_{sp} = 112\,°C$

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

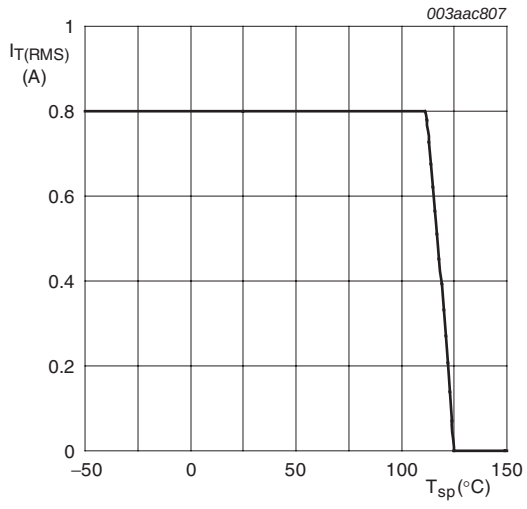
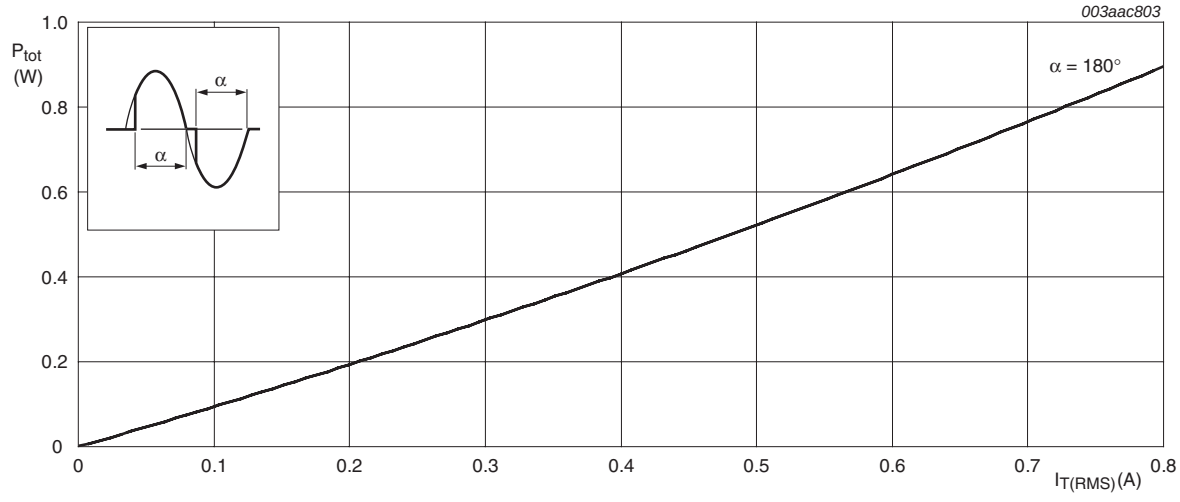
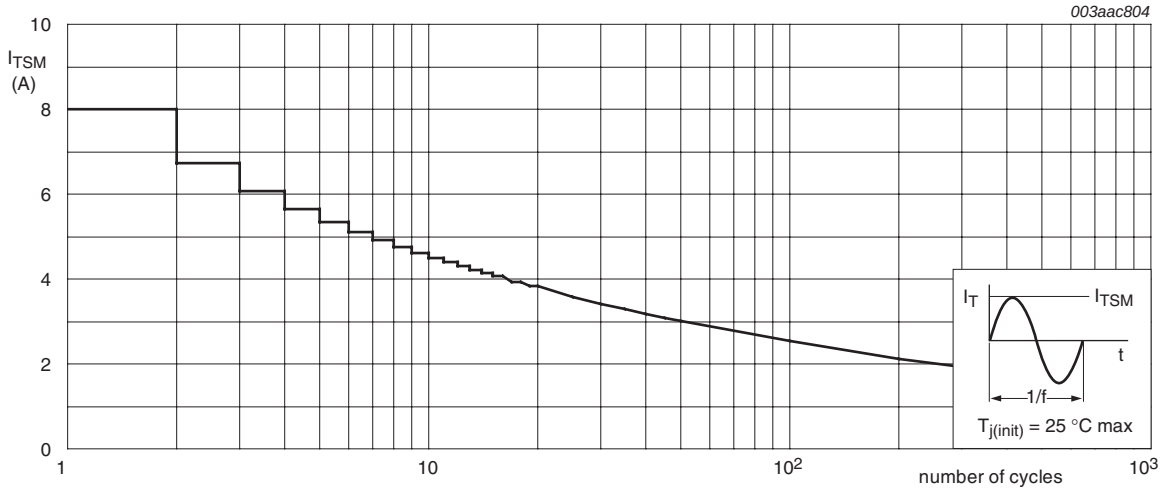



**Fig 2. RMS on-state current as a function of solder point temperature; maximum values**



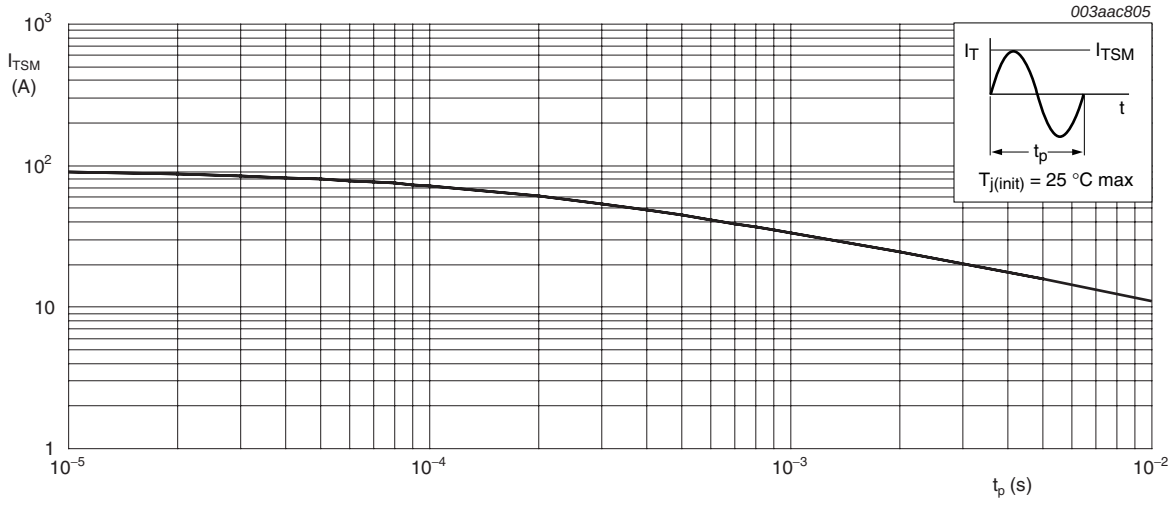

$\alpha$ = conduction angle

**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**




$t_p \leq 20$ ms

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

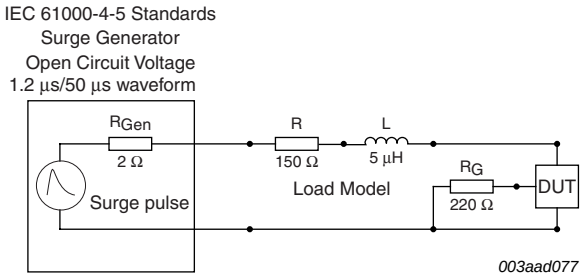
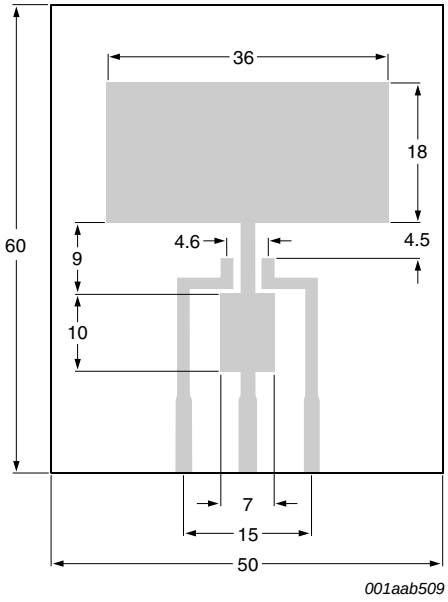



**Fig 6. Test circuit for inductive and resistive loads with conditions equivalent to IEC 61000-4-5**

## 5. Thermal characteristics

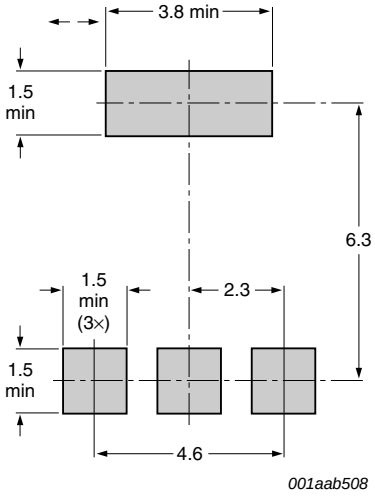
**Table 5. Thermal characteristics**

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | full cycle with heatsink compound; see Figure 9 | - | - | 15 | K/W |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | full cycle; printed-circuit board mounted for pad area; see Figure 7 | - | 70 | - | K/W |
| | | full cycle; printed-circuit board mounted for minimum footprint; see Figure 8 | - | 156 | - | K/W |




All dimensions are in mm
Printed-circuit board: FR4 epoxy glass (1.6 mm thick), copper laminate (35$\mu$m thick)

**Fig 7. Printed-circuit board pad area SOT223**




All dimensions are in mm

**Fig 8. Minimum footprint SOT223**

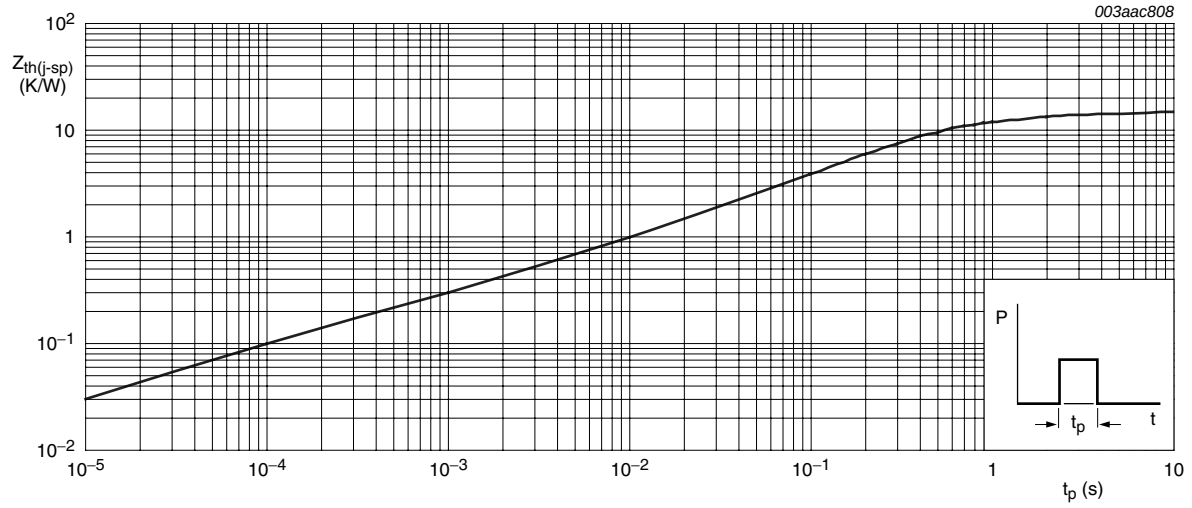
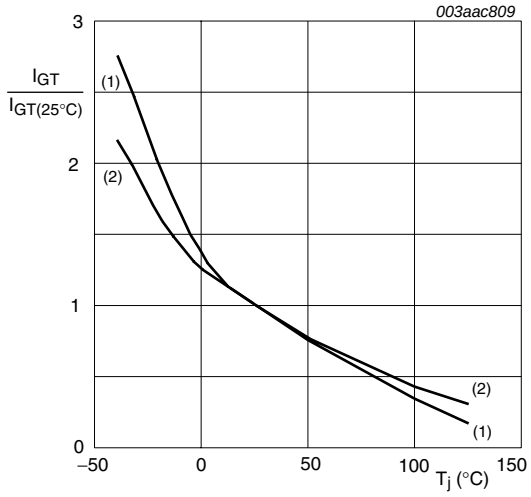



**Fig 9. Transient thermal impedance from junction to solder point as a function of pulse width**

## 6. Characteristics

**Table 6. Characteristics**

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $I_{GT}$ | gate trigger current | $V_D$ = 12 V; $I_T$ = 100 mA; LD+ G-; $T_j$ = 25 °C; see Figure 10 | 1 | - | 10 | mA |
| | | $V_D$ = 12 V; $I_T$ = 100 mA; LD- G-; $T_j$ = 25 °C | 1 | - | 10 | mA |
| $I_L$ | latching current | $V_D$ = 12 V; $I_G$ = 12 mA; $T_j$ = 25 °C; see Figure 11 | - | - | 30 | mA |
| $I_H$ | holding current | $V_D$ = 12 V; $T_j$ = 25 °C; see Figure 12 | - | 9 | 25 | mA |
| $V_T$ | on-state voltage | $I_T$ = 1.1 A; see Figure 13 | - | - | 1.3 | V |
| $V_{GT}$ | gate trigger voltage | $V_D$ = 600 V; $I_T$ = 100 mA; $T_j$ ≤ 125 °C | 0.15 | - | - | V |
| | | $V_D$ = 600 V; $I_T$ = 100 mA; $T_j$ = 25 °C | - | - | 1 | V |
| $I_D$ | off-state current | $V_D$ = 600 V; $T_j$ ≤ 125 °C | - | - | 0.2 | mA |
| | | $V_D$ = 600 V; $T_j$ ≤ 25 °C | - | - | 2 | µA |
| $dV_D/dt$ | rate of rise of off-state voltage | $V_{DM}$ = 402 V; $T_j$ = 125 °C; gate open circuit; see Figure 14 | 1000 | - | - | V/µs |
| $dI_{com}/dt$ | rate of change of commutating current | $V_D$ = 400 V; $T_j$ = 125 °C; $I_{T(RMS)}$ = 1 A; $dV_{com}/dt$ = 15 V/µs; gate open circuit; see Figure 15 and 16 | 0.3 | - | - | A/ms |
| $V_{CL}$ | clamping voltage | $I_{CL}$ = 100 mA; $t_p$ = 1 ms; $T_j$ ≤ 125 °C; see Figure 17 | 650 | - | - | V |




(1) LD + G – (2) LD – G –

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

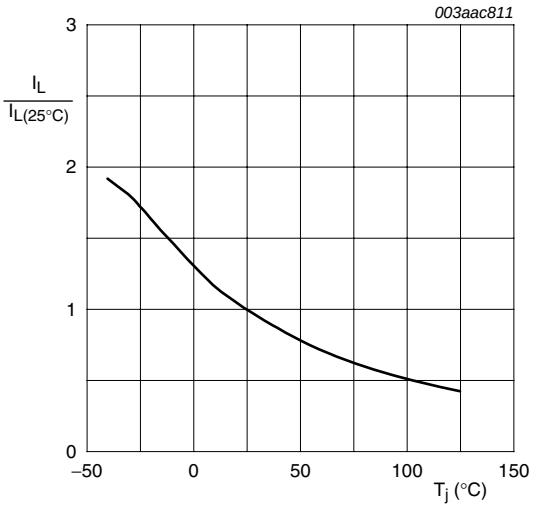



**Fig 11. Normalized latching current as a function of junction temperature**

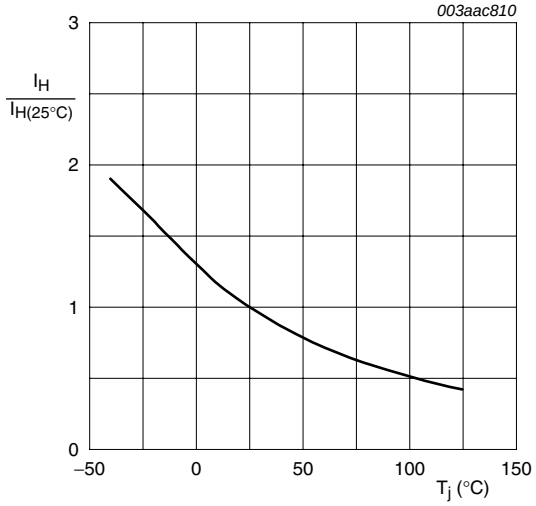
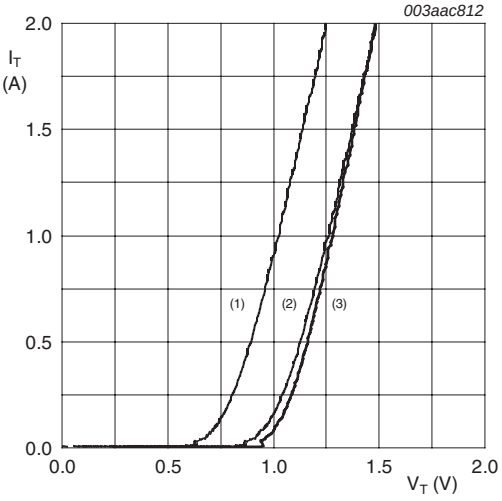
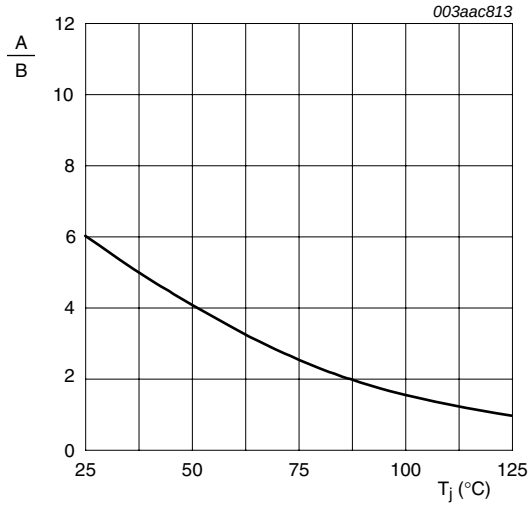



**Fig 12. Normalized holding current as a function of junction temperature**



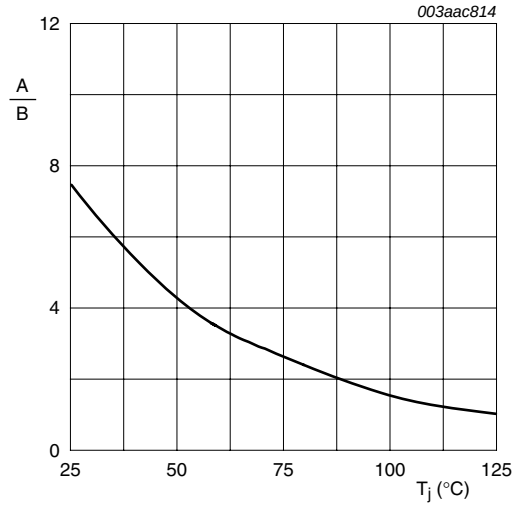

$V_o$ = 1.043 V; $R_s$ = 0.239 Ω
(1) $T_j$ = 125 °C; typical values
(2) $T_j$ = 125 °C; maximum values
(3) $T_j$ = 25 °C; maximum values

**Fig 13. On-state current as a function of on-state voltage**



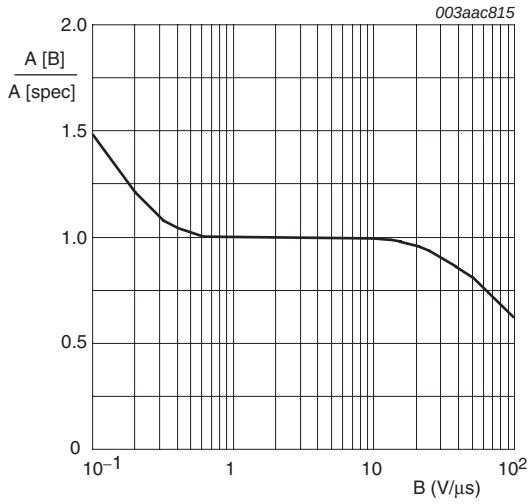

A is $dV_D/dt$ at condition $T_j$ °C
B is $dV_D/dt$ at condition $T_j$ = 125 °C

**Fig 14. Normalized rate of rise of off-state voltage as a function of junction temperature**




A is $dI_{com}/dt$ at condition $T_j$ °C
B is $dI_{com}/dt$ at $T_j$ = 125 °C$V_D$ = 400 V

**Fig 15. Normalized critical rate of rise of commutating current as a function of junction temperature**




A[B] is $\frac{dI_{com}}{dt}$ at condition B, $\frac{dV_{com}}{dt}$

A[spec] is the specified data sheet value of $\frac{dI_{com}}{dt}$

**Fig 16. Normalized critical rate of change of commutating current as a function of critical rate of change of commutating voltage; minimum values**

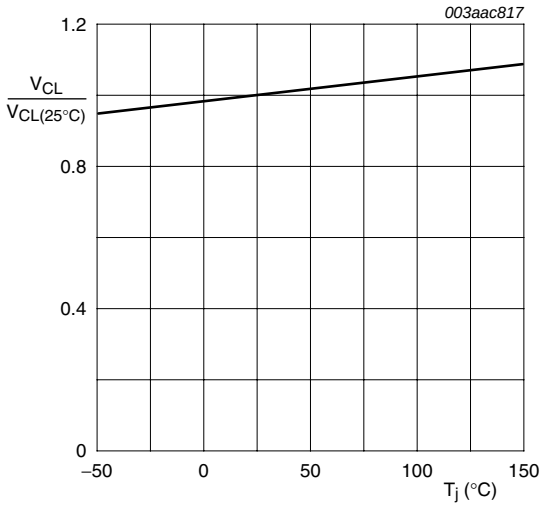
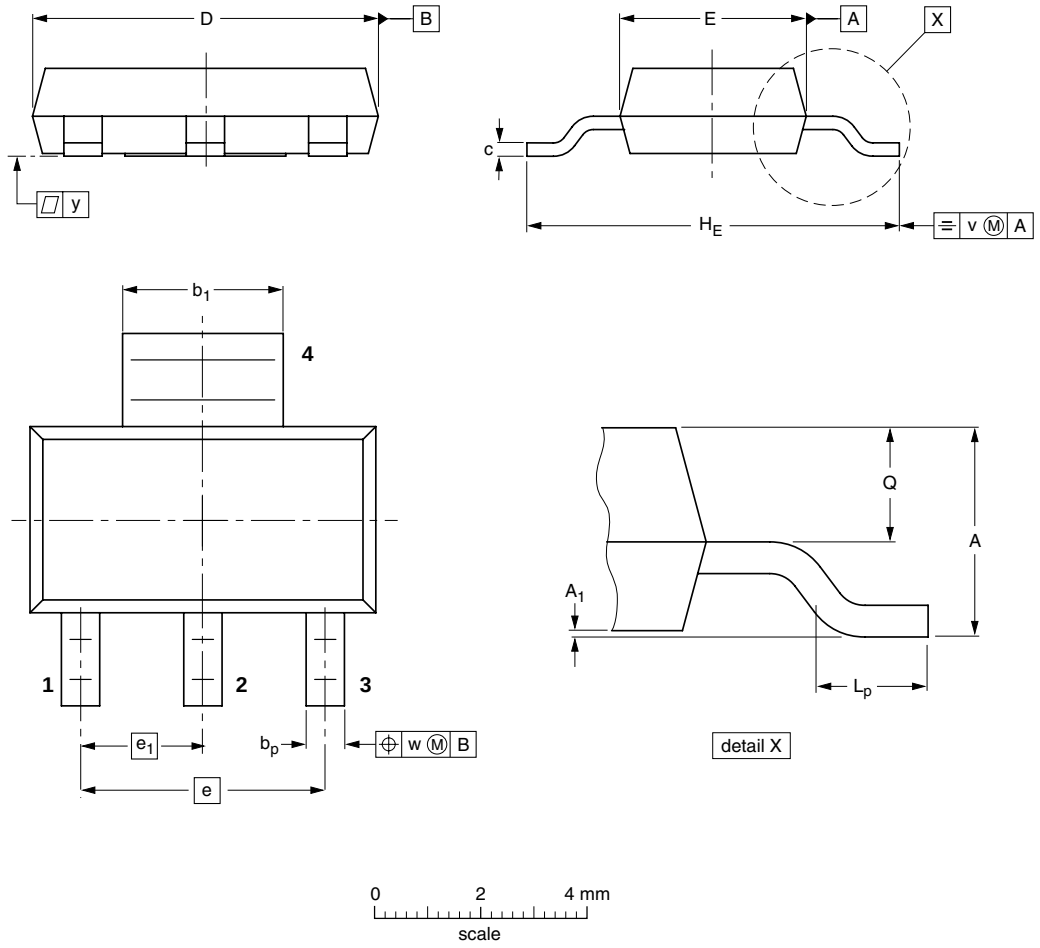



**Fig 17. Normalized clamping voltage (upper limit) as a function of junction temperature; minimum values**

## 7. Package outline

**Plastic surface-mounted package with increased heatsink; 4 leads** **SOT223**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | $A_1$ | $b_p$ | $b_1$ | c | D | E | e | $e_1$ | $H_E$ | $L_p$ | Q | v | w | y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.8<br>1.5 | 0.10<br>0.01 | 0.80<br>0.60 | 3.1<br>2.9 | 0.32<br>0.22 | 6.7<br>6.3 | 3.7<br>3.3 | 4.6 | 2.3 | 7.3<br>6.7 | 1.1<br>0.7 | 0.95<br>0.85 | 0.2 | 0.1 | 0.1 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT223 | | | SC-73 | | | ~~04-11-10~~<br>06-03-16 |

**Fig 18. Package outline SOT223 (SC-73)**

## 8. Revision history

**Table 7. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| ACT108W-600E_3 | 20091021 | Product data sheet | - | ACT108W-600E_2 |
| Modifications: | • Various changes to content. | | | |
| ACT108W-600E_2 | 20090526 | Product data sheet | - | ACT108W-600E_1 |
| ACT108W-600E_1 | 20090429 | Product data sheet | - | - |

# 9. Legal information

## 9.1 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.nxp.com.

## 9.2 Definitions

**Draft** — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

**Short data sheet** — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local NXP Semiconductors sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

## 9.3 Disclaimers

**General** — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

**Right to make changes** — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

**Suitability for use** — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in medical, military, aircraft, space or life support equipment, nor in applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors accepts no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

**Applications** — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

**Quick reference data** — The Quick reference data is an extract of the product data given in the Limiting values and Characteristics sections of this document, and as such is not complete, exhaustive or legally binding.

**Limiting values** — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) may cause permanent damage to the device. Limiting values are stress ratings only and operation of the device at these or any other conditions above those given in the Characteristics sections of this document is not implied. Exposure to limiting values for extended periods may affect device reliability.

**Terms and conditions of sale** — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at http://www.nxp.com/profile/terms, including those pertaining to warranty, intellectual property rights infringement and limitation of liability, unless explicitly otherwise agreed to in writing by NXP Semiconductors. In case of any inconsistency or conflict between information in this document and such terms and conditions, the latter will prevail.

**No offer to sell or license** — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

**Export control** — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from national authorities.

## 9.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

# 10. Contact information

For more information, please visit: http://www.nxp.com

For sales office addresses, please send an email to: salesaddresses@nxp.com

## 11. Contents





For more information, please visit: http://www.nxp.com
For sales office addresses, please send an email to: salesaddresses@nxp.com

**Date of release: 21 October 2009**
**Document identifier: ACT108W-600E_3**