

## 1. General description

Planar passivated AC Thyristor Triac power switch in a TO220F "full pack" plastic package with self-protective capabilities against low and high energy transients.

## 2. Features and benefits

- Clamping structure ensuring safe high over-voltage withstand capability
- Direct interfacing with low power drivers and microcontrollers
- Full cycle AC conduction
- Isolated mounting base package
- Over-voltage withstand capability to IEC 61000-4-5
- Pin compatible with standard triacs
- Planar passivated for voltage ruggedness and reliability
- Safe clamping capability for low energy over-voltage transients
- Self-protective turn-on during high energy voltage transients
- Sensitive gate for easy logic level triggering
- Triggering in three quadrants only
- Very high immunity to false turn-on by  $dV/dt$

## 3. Applications

- AC fan, pump and compressor controls
- Highly inductive, resistive and safety loads
- Large and small appliances (White Goods)
- Reversing induction motor controls

## 4. Quick reference data

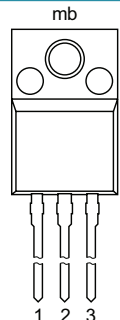
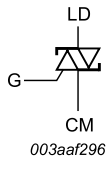
Table 1. Quick reference data

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; $T_h \leq 81\text{ °C}$ ; <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; $T_{j(\text{init})} = 25\text{ °C}$ ; $t_p = 20\text{ ms}$ ; <a href="#">Fig. 4</a> ; <a href="#">Fig. 5</a>	-	-	56	A
		full sine wave; $T_{j(\text{init})} = 25\text{ °C}$ ; $t_p = 16.7\text{ ms}$	-	-	51	A
$T_j$	junction temperature		-	-	125	°C
$V_{PP}$	peak pulse voltage	$T_j = 25\text{ °C}$ ; non-repetitive, off-state; <a href="#">Fig. 6</a>	-	-	2	kV
<b>Static characteristics</b>						
$I_{GT}$	gate trigger current	$V_D = 12\text{ V}$ ; $I_T = 100\text{ mA}$ ; LD+ G+; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 8</a>	-	-	10	mA
		$V_D = 12\text{ V}$ ; $I_T = 100\text{ mA}$ ; LD+ G-; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 8</a>	-	-	10	mA
		$V_D = 12\text{ V}$ ; $I_T = 100\text{ mA}$ ; LD- G-; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 8</a>	-	-	10	mA

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_H$	holding current	$V_D = 12\text{ V}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 10</a>	-	-	25	mA
$V_T$	on-state voltage	$I_T = 8\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 11</a>	-	-	1.7	V
$V_{CL}$	clamping voltage	$I_{CL} = 0.1\text{ mA}$ ; $t_p = 1\text{ ms}$ ; $T_j = 25\text{ °C}$	850	-	-	V
<b>Dynamic characteristics</b>						
$dV_D/dt$	rate of rise of off-state voltage	$V_{DM} = 536\text{ V}$ ; $T_j = 125\text{ °C}$ ; ( $V_{DM} = 67\%$ of $V_{DRM}$ ); exponential waveform; gate open circuit; <a href="#">Fig. 13</a>	500	-	-	V/ $\mu$ s
$dI_{com}/dt$	rate of change of commutating current	$V_D = 400\text{ V}$ ; $T_j = 125\text{ °C}$ ; $I_{T(RMS)} = 6\text{ A}$ ; $dV_{com}/dt = 20\text{ V}/\mu\text{s}$ ; gate open circuit; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>	3.5	-	-	A/ms
		$V_D = 400\text{ V}$ ; $T_j = 125\text{ °C}$ ; $I_{T(RMS)} = 6\text{ A}$ ; $dV_{com}/dt = 10\text{ V}/\mu\text{s}$ ; gate open circuit; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>	5	-	-	A/ms
		$V_D = 400\text{ V}$ ; $T_j = 125\text{ °C}$ ; $I_{T(RMS)} = 6\text{ A}$ ; $dV_{com}/dt = 1\text{ V}/\mu\text{s}$ ; gate open circuit; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>	10	-	-	A/ms

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	CM	common		
2	LD	load		
3	G	gate		
mb	n.c.	mounting base; isolated		

## 6. Ordering information

Table 3. Ordering information

Type number	Package Name	Orderable part number	Packing method	Small packing quantity	Package version	Package issue date
ACTT6X-800E	TO220F	ACTT6X-800E,127	Tube	50	SOT186A	14-Nov-2013

## 7. Marking

Table 4. Marking codes

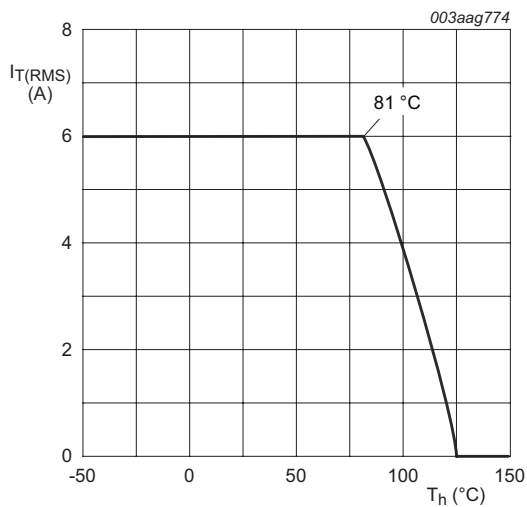
Type number	Marking codes	
	Assembly factory: d	Assembly factory: A
ACTT6X-800E	ACTT6X 800E PJdxxxx xx	ACTT6X 800E PJAxxxx xx

## 8. Limiting values

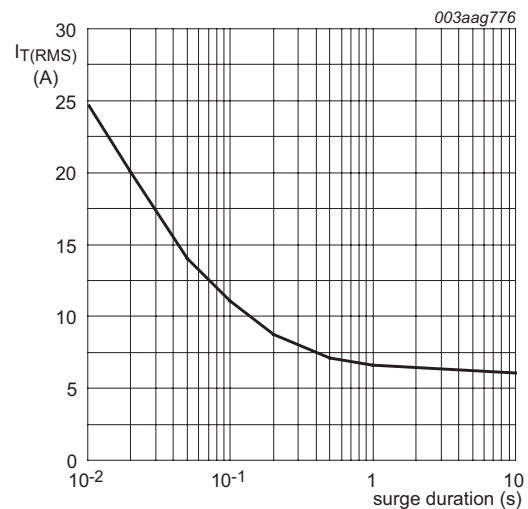
**Table 5. Limiting values**

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; $T_h \leq 81\text{ °C}$ ; <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>	-	56	A
		full sine wave; $T_{j(init)} = 25\text{ °C}$ ; $t_p = 16.7\text{ ms}$	-	51	A
$I^2t$	$I^2t$ for fusing	$t_p = 10\text{ ms}$ ; sine-wave pulse	-	13	A <sup>2</sup> s
$di_T/dt$	rate of rise of on-state current	$I_G = 20\text{ mA}$	-	100	A/ $\mu$ s
$I_{GM}$	peak gate current	$t_p = 20\text{ }\mu$ s	-	2	A
$P_{GM}$	peak gate power		-	5	W
$P_{G(AV)}$	average gate power	over any 20 ms period	-	0.5	W
$T_j$	junction temperature		-	125	°C
$V_{pp}$	peak pulse voltage	$T_j = 25\text{ °C}$ ; non-repetitive, off-state; <a href="#">Fig 6</a>	-	2	kV



**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 Hz;  $T_h = 81\text{ °C}$

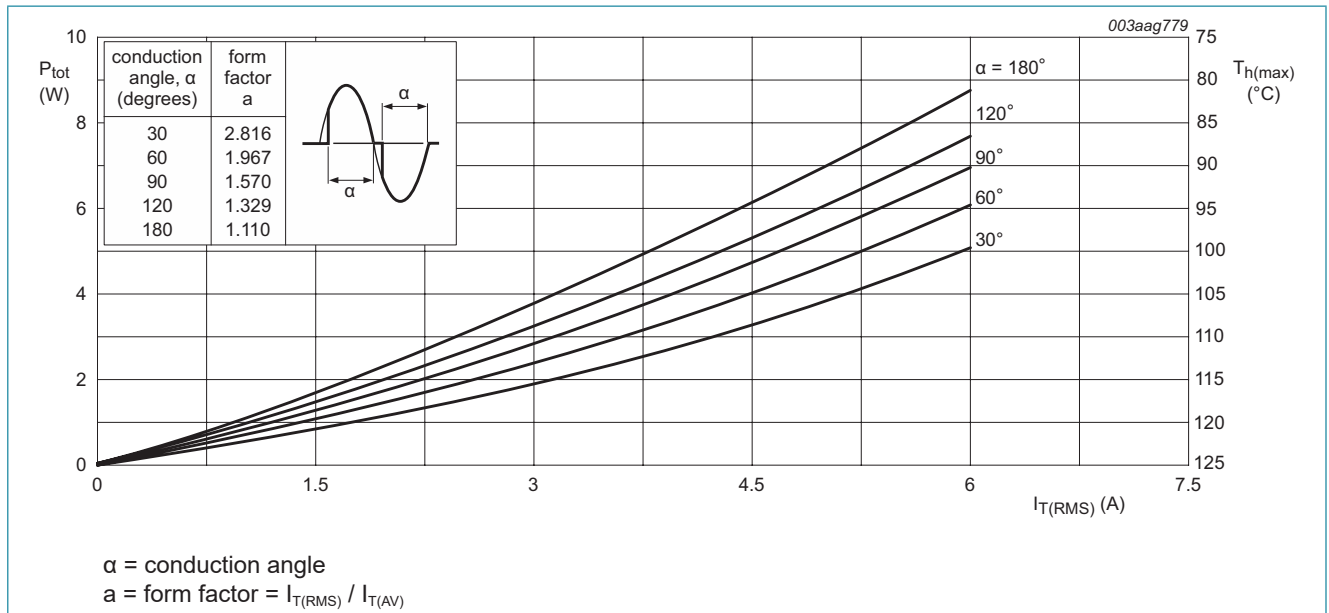


Fig. 3. Total power dissipation as a function of RMS on-state current; maximum values

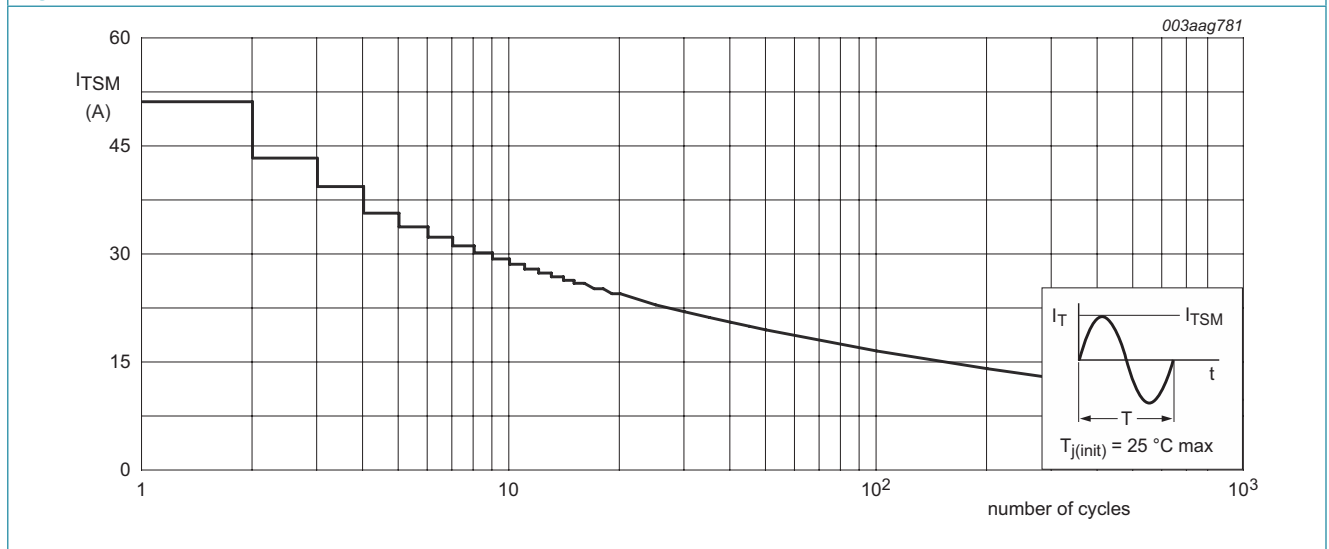
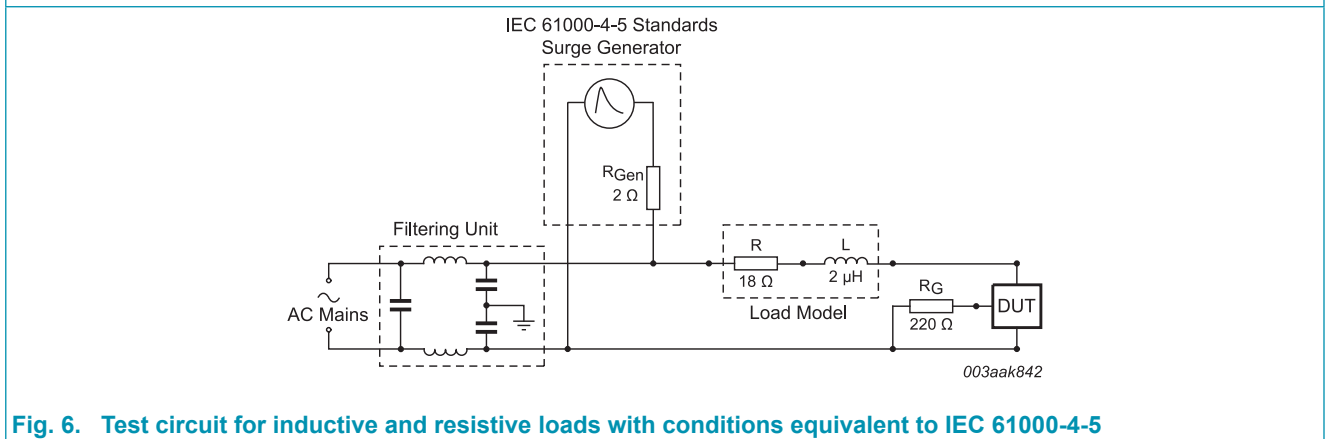
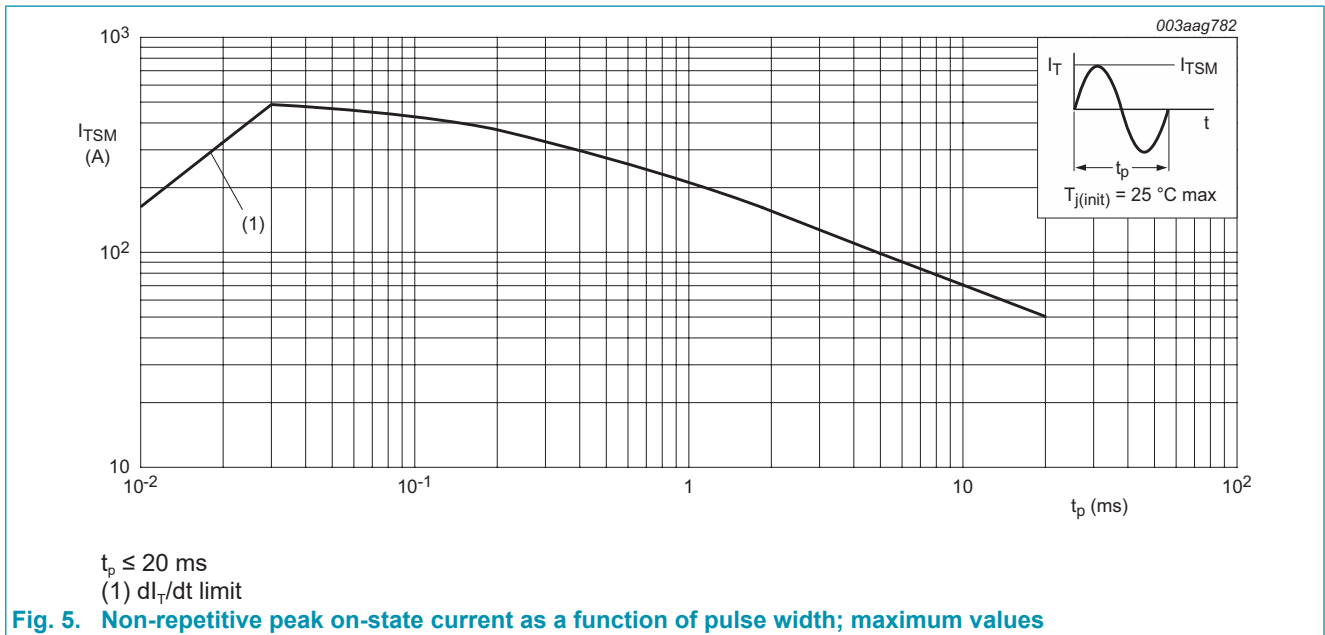


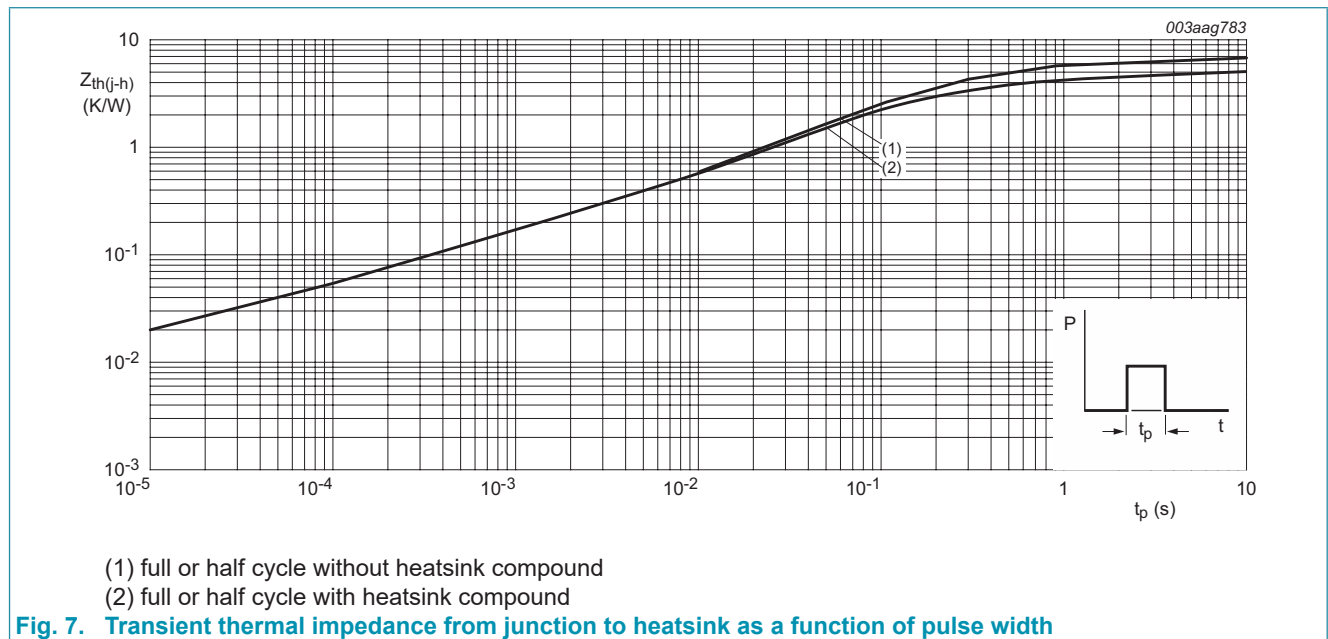
Fig. 4. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values



## 9. Thermal characteristics

Table 6. 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; <a href="#">Fig. 7</a>	-	-	5	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient free air	in free air	-	55	-	K/W



## 10. Isolation characteristics

Table 7. Isolation characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{isol(RMS)}$	RMS isolation voltage	sinusoidal waveform; from all pins to external heatsink; clean and dust free; 50 Hz ≤ f ≤ 60 Hz; RH ≤ 65 %; T <sub>h</sub> = 25 °C	-	-	2500	V
$C_{isol}$	isolation capacitance	from LD pin to external heatsink; f = 1 MHz; T <sub>h</sub> = 25 °C	-	10	-	pF

## 11. Characteristics

Table 8. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$I_{GT}$	gate trigger current	$V_D = 12\text{ V}; I_T = 100\text{ mA}; \text{LD+ G+}; T_j = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 8</a>	-	-	10	mA
		$V_D = 12\text{ V}; I_T = 100\text{ mA}; \text{LD+ G-}; T_j = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 8</a>	-	-	10	mA
		$V_D = 12\text{ V}; I_T = 100\text{ mA}; \text{LD- G-}; T_j = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 8</a>	-	-	10	mA
$I_L$	latching current	$V_D = 12\text{ V}; I_G = 100\text{ mA}; \text{LD+ G+}; T_j = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 9</a>	-	-	30	mA
		$V_D = 12\text{ V}; I_G = 100\text{ mA}; \text{LD+ G-}; T_j = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 9</a>	-	-	40	mA
		$V_D = 12\text{ V}; I_G = 100\text{ mA}; \text{LD- G-}; T_j = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 9</a>	-	-	30	mA
$I_H$	holding current	$V_D = 12\text{ V}; T_j = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 10</a>	-	-	25	mA
$V_T$	on-state voltage	$I_T = 8\text{ A}; T_j = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 11</a>	-	-	1.7	V
$V_{GT}$	gate trigger voltage	$V_D = 12\text{ V}; I_T = 100\text{ mA}; T_j = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 12</a>	-	0.8	1	V
		$V_D = 400\text{ V}; I_T = 100\text{ mA}; T_j = 125\text{ }^\circ\text{C}$	0.2	0.45	-	V
$I_D$	off-state current	$V_D = 800\text{ V}; T_j = 25\text{ }^\circ\text{C}$	-	-	10	$\mu\text{A}$
		$V_D = 800\text{ V}; T_j = 125\text{ }^\circ\text{C}$	-	-	0.5	mA
$V_{CL}$	clamping voltage	$I_{CL} = 0.1\text{ mA}; t_p = 1\text{ ms}; T_j = 25\text{ }^\circ\text{C}$	850	-	-	V
<b>Dynamic characteristics</b>						
$dV_D/dt$	rate of rise of off-state voltage	$V_{DM} = 536\text{ V}; T_j = 125\text{ }^\circ\text{C}; (V_{DM} = 67\% \text{ of } V_{DRM});$ exponential waveform; gate open circuit; <a href="#">Fig. 13</a>	500	-	-	$\text{V}/\mu\text{s}$
$dI_{com}/dt$	rate of change of commutating current	$V_D = 400\text{ V}; T_j = 125\text{ }^\circ\text{C}; I_{T(RMS)} = 6\text{ A};$ $dV_{com}/dt = 20\text{ V}/\mu\text{s};$ gate open circuit; <a href="#">Fig. 14; Fig. 15</a>	3.5	-	-	A/ms
		$V_D = 400\text{ V}; T_j = 125\text{ }^\circ\text{C}; I_{T(RMS)} = 6\text{ A};$ $dV_{com}/dt = 10\text{ V}/\mu\text{s};$ gate open circuit; <a href="#">Fig. 14; Fig. 15</a>	5	-	-	A/ms
		$V_D = 400\text{ V}; T_j = 125\text{ }^\circ\text{C}; I_{T(RMS)} = 6\text{ A};$ $dV_{com}/dt = 1\text{ V}/\mu\text{s};$ gate open circuit; <a href="#">Fig. 14; Fig. 15</a>	10	-	-	A/ms

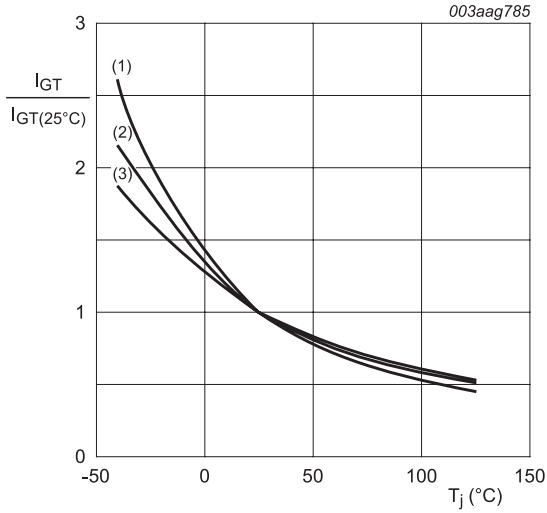


Fig. 8. Normalized gate trigger current as a function of junction temperature

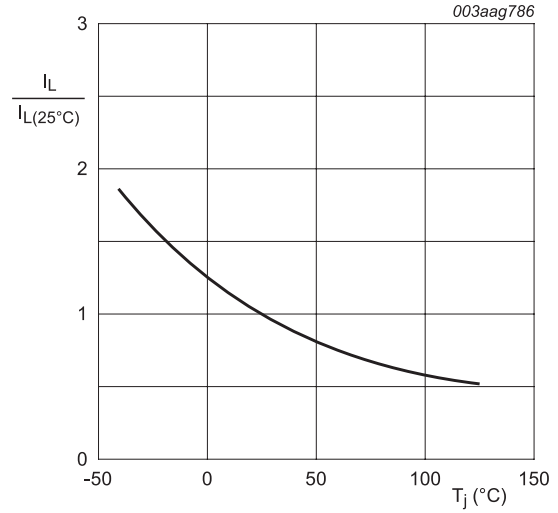


Fig. 9. Normalized latching current as a function of junction temperature

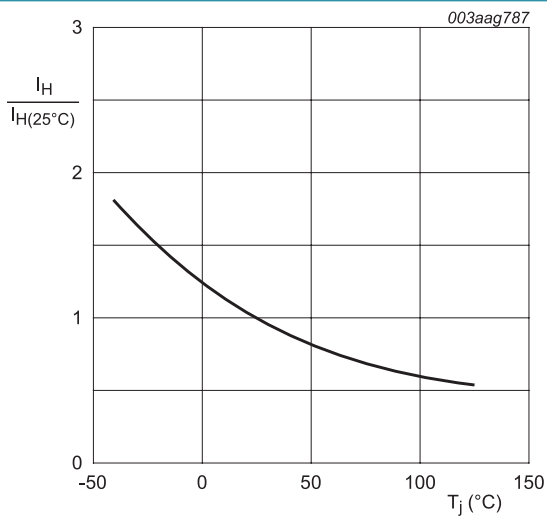
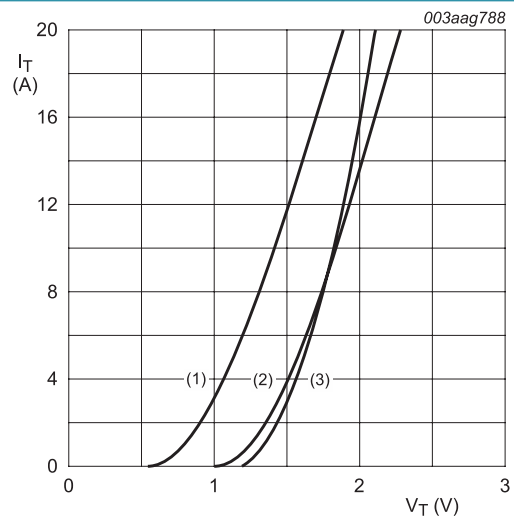


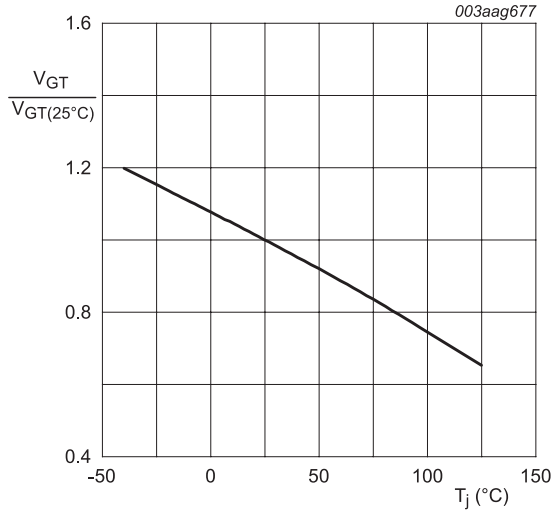
Fig. 10. Normalized holding current as a function of junction temperature



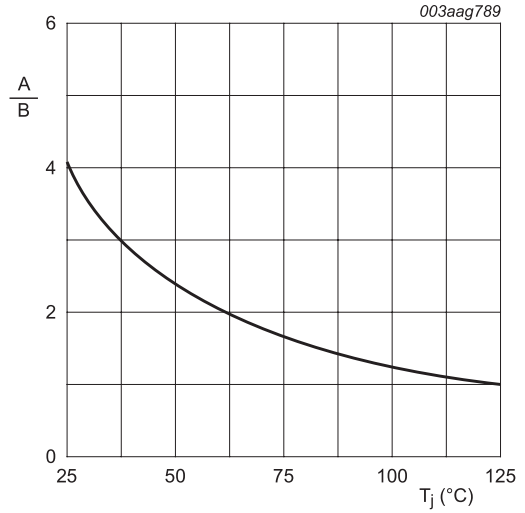
$V_o = 1.109\text{ V}$ ;  $R_s = 0.076\ \Omega$   
 (1)  $T_j = 125^\circ\text{C}$ ; typical values  
 (2)  $T_j = 125^\circ\text{C}$ ; maximum values  
 (3)  $T_j = 25^\circ\text{C}$ ; maximum values

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



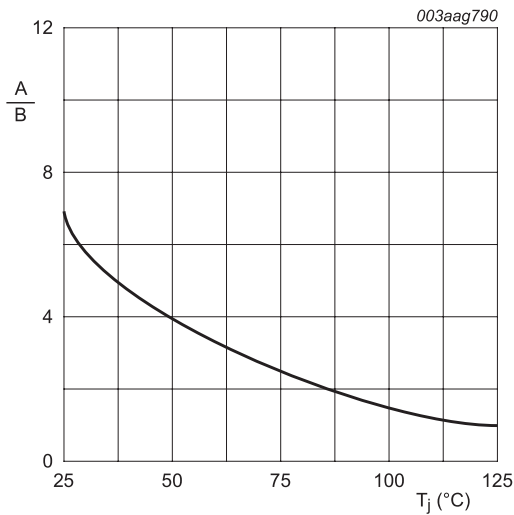


**Fig. 12. Normalized gate trigger voltage as a function of junction temperature**



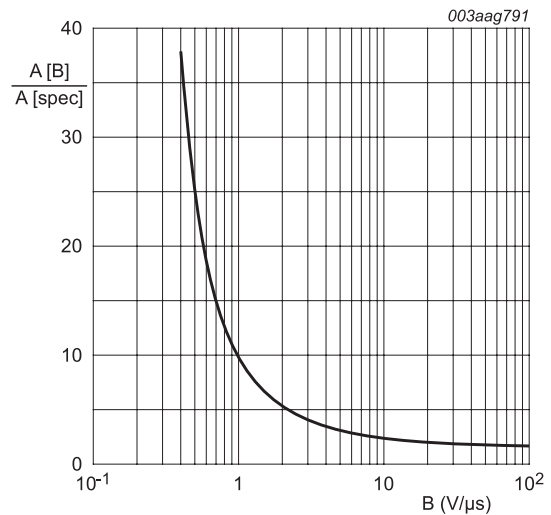
A =  $dV_D/dt$  at condition  $T_j$  °C  
 B =  $dV_D/dt$  at condition  $T_j$  [125] °C

**Fig. 13. Normalized rate of rise of off-state voltage as a function of junction temperature**



A =  $di_{com}/dt$  at condition  $T_j$  °C  
 B =  $di_{com}/dt$  at condition  $T_j$  [125] °C  
 $V_D = 400$  V

**Fig. 14. Normalized critical rate of rise of commutating current as a function of junction temperature**



A [B] =  $di_{com}/dt$  at condition B,  $dV_{com}/dt$   
 A [spec] is the specified data sheet value for  $di_{com}/dt$  turn-off time < 20 ms

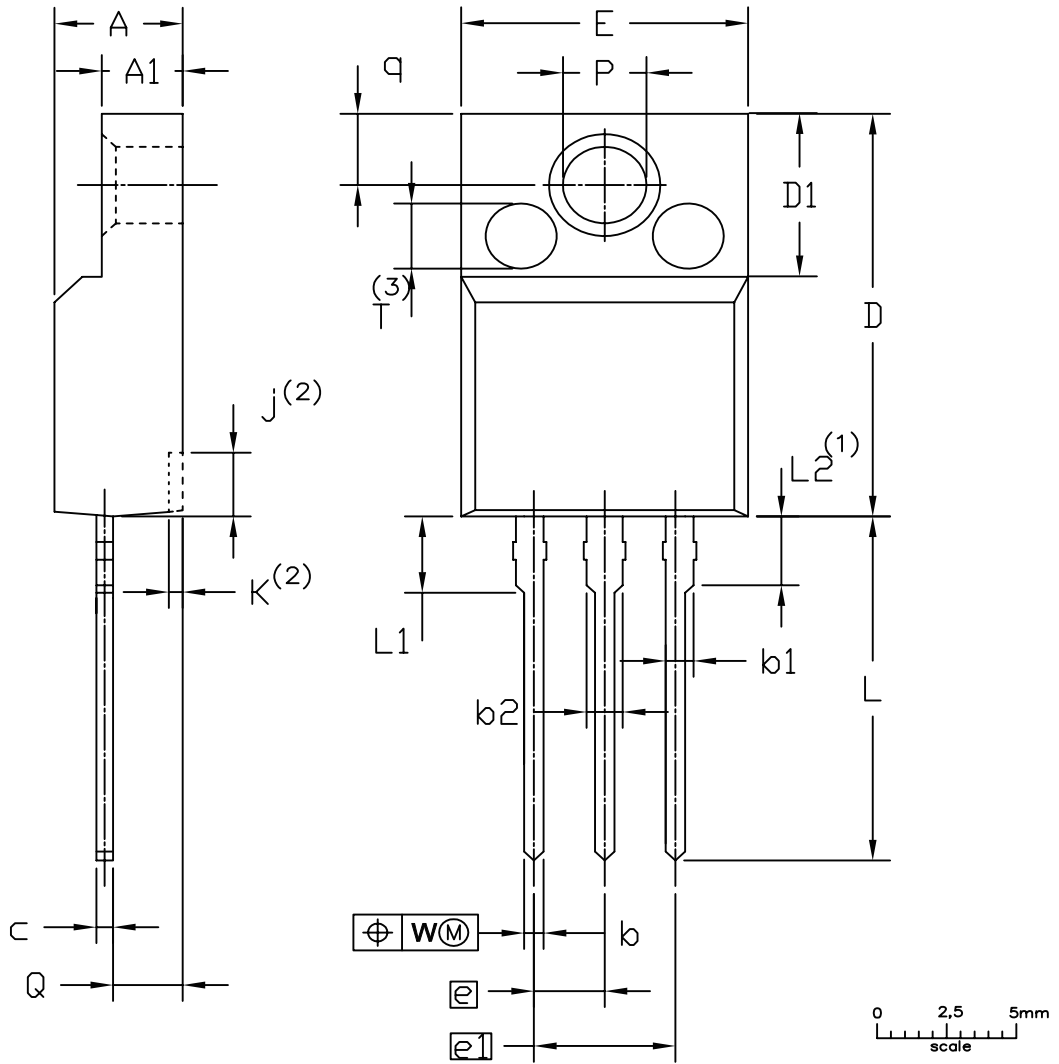
**Fig. 15. Normalized critical rate of change of commutating current as a function of critical rate of change of commutating voltage; minimum values**

## 12. Package outline

Assembly factory: d & A

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

SOT186A



UNIT	A	A <sub>1</sub>	b	b <sub>1</sub>	b <sub>2</sub>	c	D	D <sub>1</sub>	E	e	e <sub>1</sub>	j <sup>(2)</sup>	k <sup>(2)</sup>	L	L <sub>1</sub>	L <sub>2</sub> <sup>(1)</sup> max.	P	Q	q	W	T <sup>(3)</sup>
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 uncontrolled
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

## 13. 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.

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- [2] The term 'short data sheet' is explained in section "Definitions".
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Date of release: 29 January 2023

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