

NXP ACTT6-800E Thyristor datasheet

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AC Thyristor Triac power switch in a SOT78 (TO-220AB) plastic package with selfprotective clamping capabilities against low and high energy transients.

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ACTT6-800E

AC Thyristor Triac power switch

12 March 2014

Product data sheet

1. General description

AC Thyristor Triac power switch in a SOT78 (TO-220AB) plastic package with self-protective clamping 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
- 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
- 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_{TSM}	non-repetitive peak on-state current	full sine wave; $T_{J(init)} = 25\text{ }^{\circ}\text{C}$; $t_p = 20\text{ ms}$; Fig. 4 ; Fig. 5	-	-	51	A
T_j	junction temperature		-	-	125	$^{\circ}\text{C}$
$I_{T(RMS)}$	RMS on-state current	full sine wave; $T_{mb} \leq 108\text{ }^{\circ}\text{C}$; Fig. 1 ; Fig. 2 ; Fig. 3	-	-	6	A
V_{PP}	peak pulse voltage	$T_j = 25\text{ }^{\circ}\text{C}$; non-repetitive, off-state; Fig. 6	-	-	2	kV



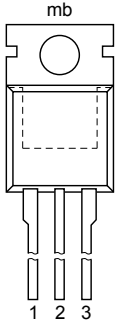
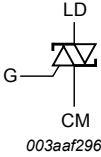
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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
I _{GT}	gate trigger current	V _D = 12 V; I _T = 100 mA; LD+ G+; T _j = 25 °C; Fig. 8	-	-	10	mA
		V _D = 12 V; I _T = 100 mA; LD+ G-; T _j = 25 °C; Fig. 8	-	-	10	mA
		V _D = 12 V; I _T = 100 mA; LD- G-; T _j = 25 °C; Fig. 8	-	-	10	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; Fig. 13	500	-	-	V/μs
dI _{com} /dt	rate of change of commutating current	V _D = 400 V; T _j = 125 °C; I _{T(RMS)} = 6 A; dV _{com} /dt = 1 V/μs; gate open circuit; Fig. 14 ; Fig. 15	10	-	-	A/ms

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	CM	common	 <p>TO-220AB (SOT78)</p>	 <p>003aaf296</p>
2	LD	load		
3	G	gate		
mb	LD	mounting base; load		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
ACTT6-800E	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78

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; $T_{mb} \leq 108\text{ }^\circ\text{C}$; Fig. 1 ; Fig. 2 ; Fig. 3	-	6	A
I_{TSM}	non-repetitive peak on-state current	full sine wave; $T_{j(\text{init})} = 25\text{ }^\circ\text{C}$; $t_p = 16.7\text{ ms}$	-	56	A
		full sine wave; $T_{j(\text{init})} = 25\text{ }^\circ\text{C}$; $t_p = 20\text{ ms}$; Fig. 4 ; Fig. 5	-	51	A
I^2t	I^2t for fusing	$t_p = 10\text{ ms}$; sine-wave pulse	-	13	A^2s
di_T/dt	rate of rise of on-state current	$I_T = 9\text{ A}$; $I_G = 0.2\text{ A}$; $di_G/dt = 0.2\text{ A}/\mu\text{s}$	-	100	$\text{A}/\mu\text{s}$
I_{GM}	peak gate current	$t = 20\text{ }\mu\text{s}$	-	2	A
P_{GM}	peak gate power		-	5	W
$P_{G(AV)}$	average gate power	over any 20 ms period	-	0.5	W
T_{stg}	storage temperature		-40	150	$^\circ\text{C}$
T_j	junction temperature		-	125	$^\circ\text{C}$
V_{PP}	peak pulse voltage	$T_j = 25\text{ }^\circ\text{C}$; non-repetitive, off-state; Fig. 6	-	2	kV

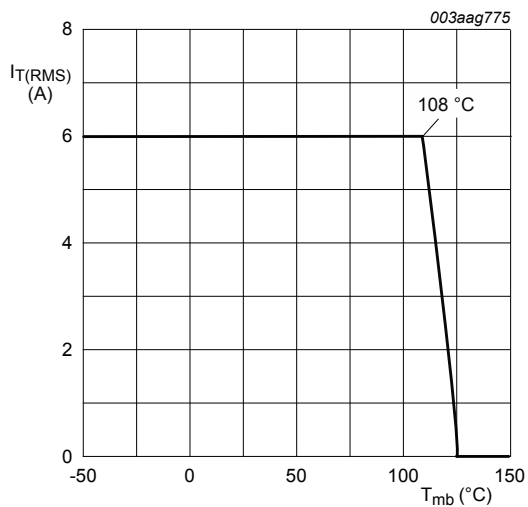


Fig. 1. RMS on-state current as a function of mounting base temperature; maximum values

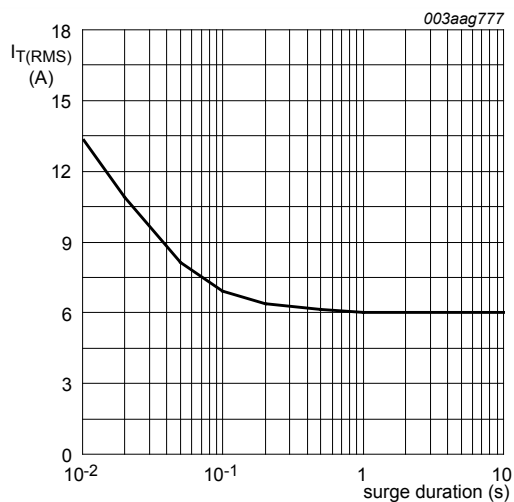


Fig. 2. RMS on-state current as a function of surge duration; maximum values

$f = 50\text{ Hz}$; $T_{mb} = 108\text{ }^\circ\text{C}$

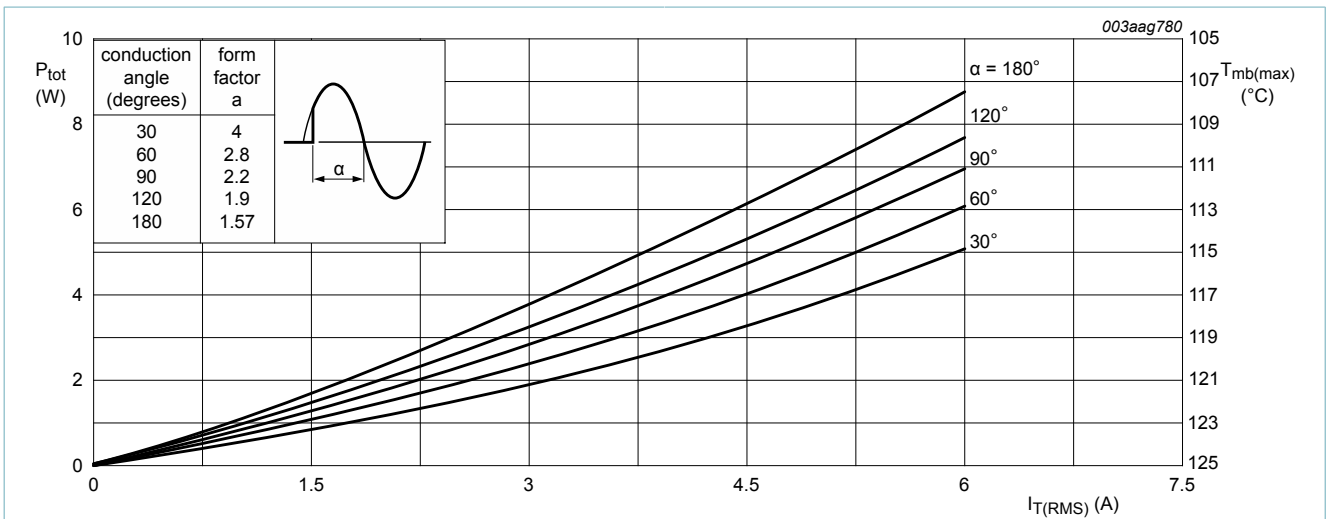


Fig. 3. Total power dissipation as a function of RMS on-state current; maximum values

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

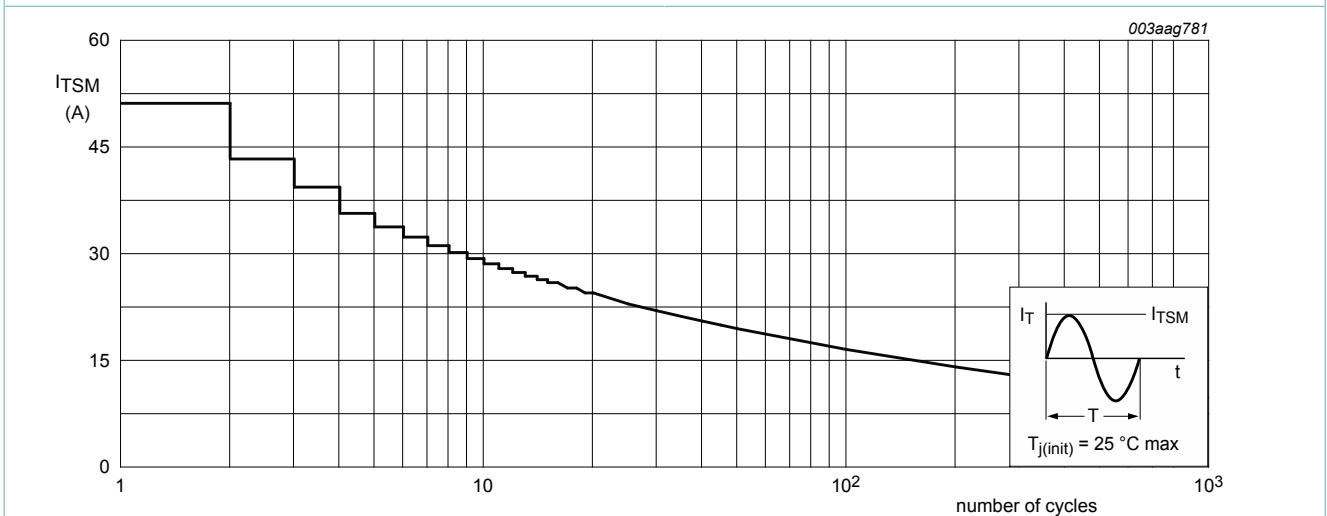


Fig. 4. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values

$f = 50\text{ Hz}$

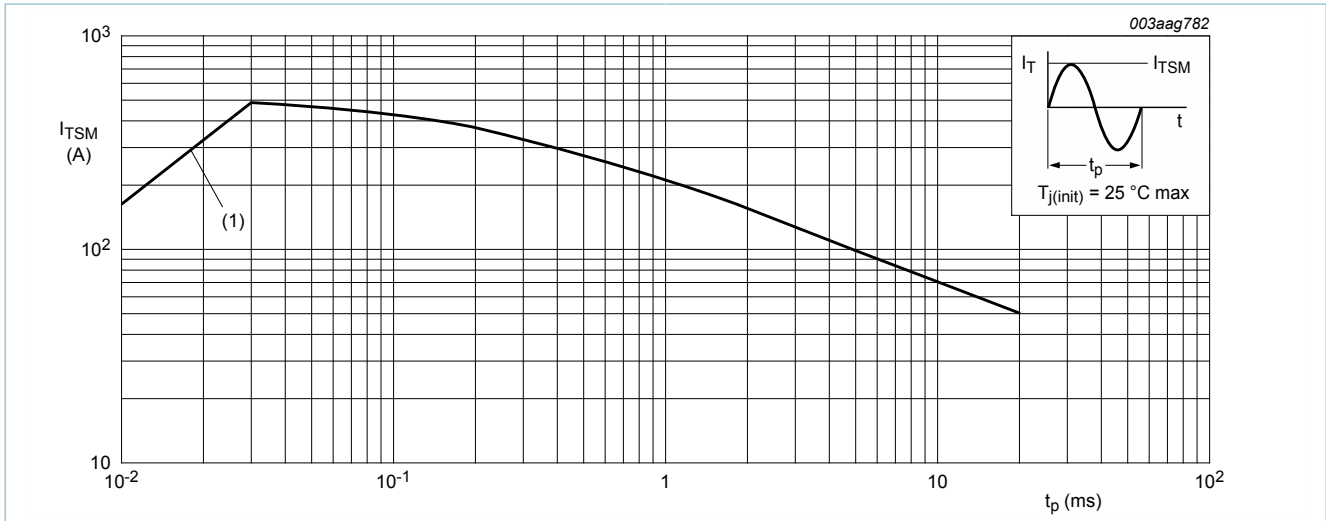


Fig. 5. Non-repetitive peak on-state current as a function of pulse width; maximum values

$t_p \leq 20 \text{ ms}$; (1) dI_T/dt limit

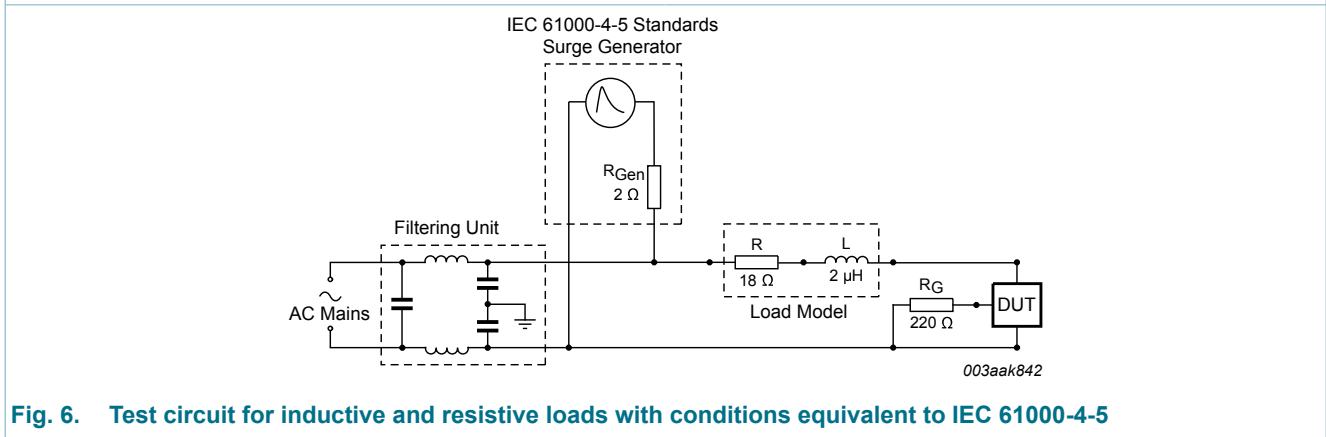
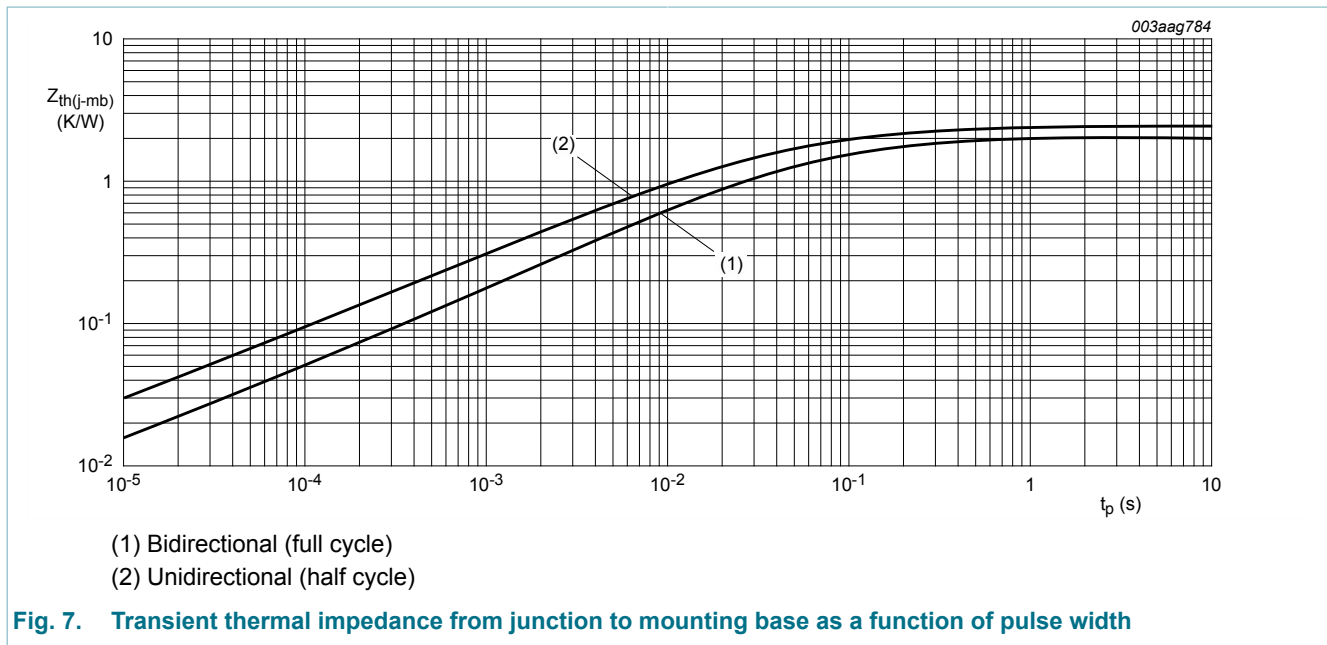


Fig. 6. Test circuit for inductive and resistive loads with conditions equivalent to IEC 61000-4-5

8. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	half cycle; Fig. 7	-	-	2.4	K/W
		full cycle; Fig. 7	-	-	2	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	-	60	-	K/W

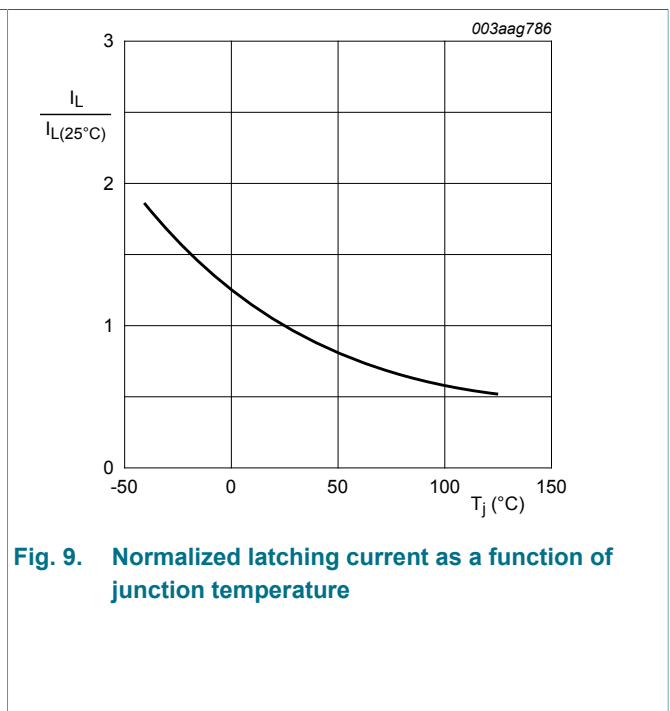
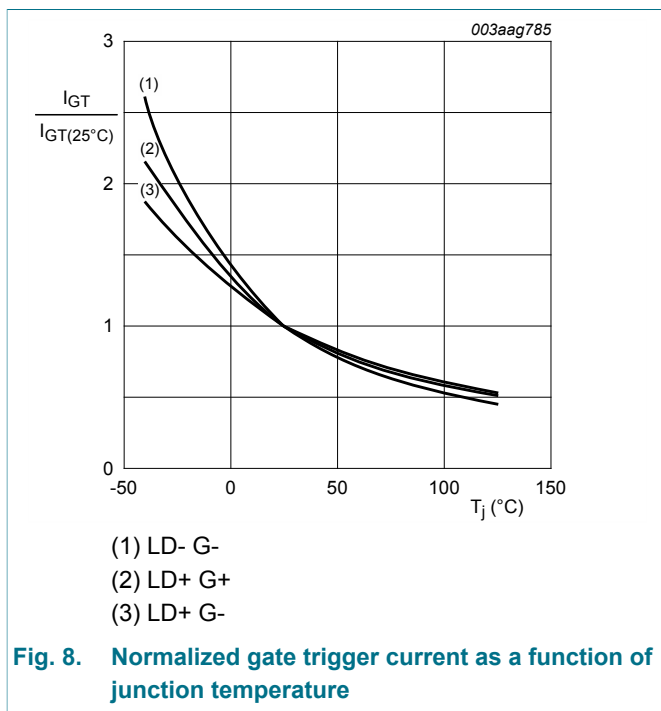


9. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
I_{GT}	gate trigger current	$V_D = 12\text{ V}; I_T = 100\text{ mA}; LD+ G+;$ $T_j = 25\text{ }^\circ\text{C};$ Fig. 8	-	-	10	mA
		$V_D = 12\text{ V}; I_T = 100\text{ mA}; LD+ G-;$ $T_j = 25\text{ }^\circ\text{C};$ Fig. 8	-	-	10	mA
		$V_D = 12\text{ V}; I_T = 100\text{ mA}; LD- G-;$ $T_j = 25\text{ }^\circ\text{C};$ Fig. 8	-	-	10	mA
I_L	latching current	$V_D = 12\text{ V}; I_G = 100\text{ mA}; LD+ G+;$ $T_j = 25\text{ }^\circ\text{C};$ Fig. 9	-	-	30	mA
		$V_D = 12\text{ V}; I_G = 100\text{ mA}; LD+ G-;$ $T_j = 25\text{ }^\circ\text{C};$ Fig. 9	-	-	40	mA
		$V_D = 12\text{ V}; I_G = 100\text{ mA}; LD- G-;$ $T_j = 25\text{ }^\circ\text{C};$ Fig. 9	-	-	30	mA
I_H	holding current	$V_D = 12\text{ V}; T_j = 25\text{ }^\circ\text{C};$ Fig. 10	-	-	25	mA
V_T	on-state voltage	$I_T = 8\text{ A}; T_j = 25\text{ }^\circ\text{C};$ Fig. 11	-	-	1.7	V
V_{GT}	gate trigger voltage	$V_D = 12\text{ V}; I_T = 100\text{ mA}; T_j = 25\text{ }^\circ\text{C};$ Fig. 12	-	0.8	1	V
		$V_D = 400\text{ V}; I_T = 100\text{ mA}; T_j = 125\text{ }^\circ\text{C};$ Fig. 12	0.2	0.45	-	V
I_D	off-state current	$V_D = 800\text{ V}; T_j = 25\text{ }^\circ\text{C}$	-	-	10	μA

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
		$V_D = 800\text{ V}; T_j = 125\text{ }^\circ\text{C}$	-	-	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
Dynamic characteristics						
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; Fig. 13	500	-	-	V/ μs
di_{com}/dt	rate of change of commutating current	$V_D = 400\text{ V}; T_j = 125\text{ }^\circ\text{C}; I_{T(RMS)} = 6\text{ A};$ $dV_{com}/dt = 20\text{ V}/\mu\text{s};$ (snubberless condition); gate open circuit; Fig. 14 ; Fig. 15	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; Fig. 14 ; Fig. 15	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; Fig. 14 ; Fig. 15	10	-	-	A/ms



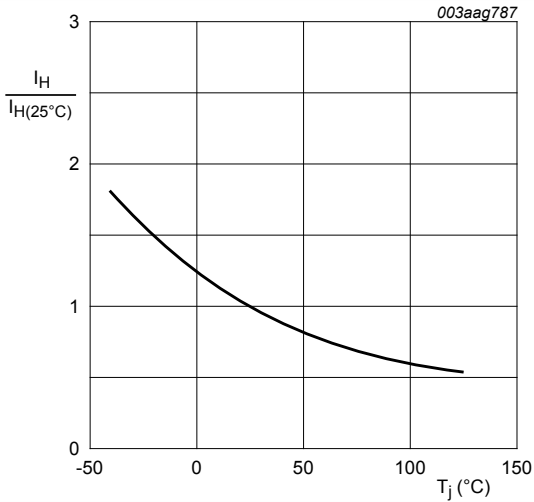
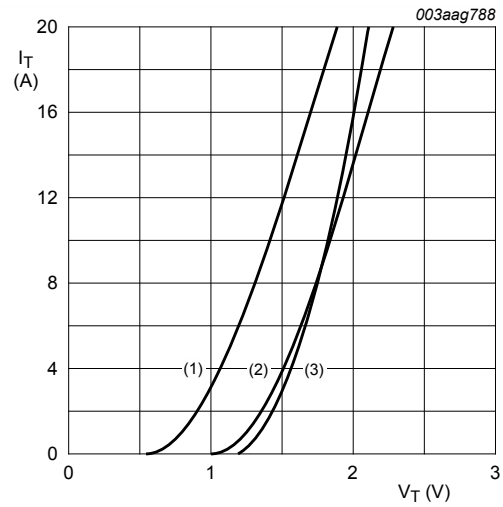


Fig. 10. Normalized holding current as a function of junction temperature



$V_o = 1.109 \text{ V}; R_s = 0.076 \Omega$
 (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

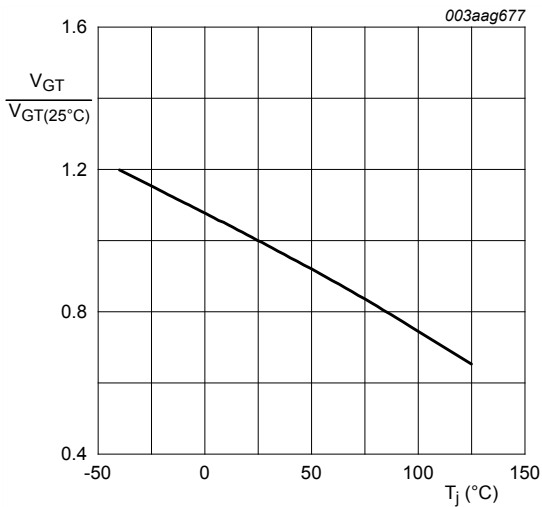
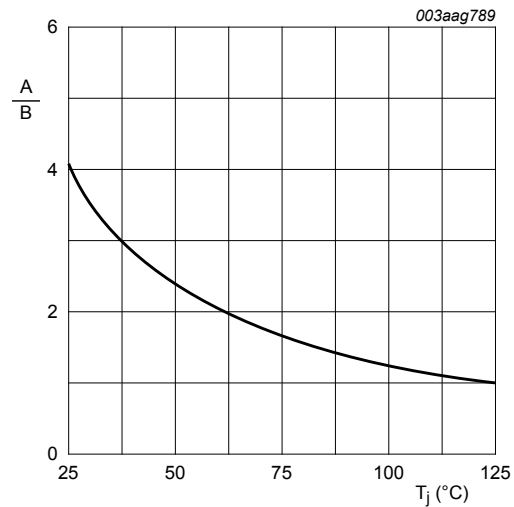
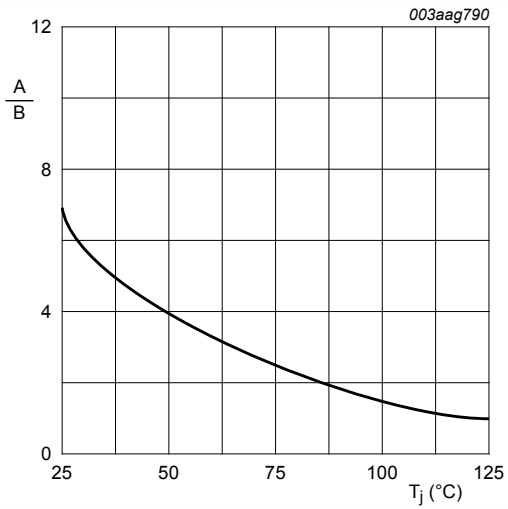


Fig. 12. Normalized gate trigger voltage as a function of junction temperature



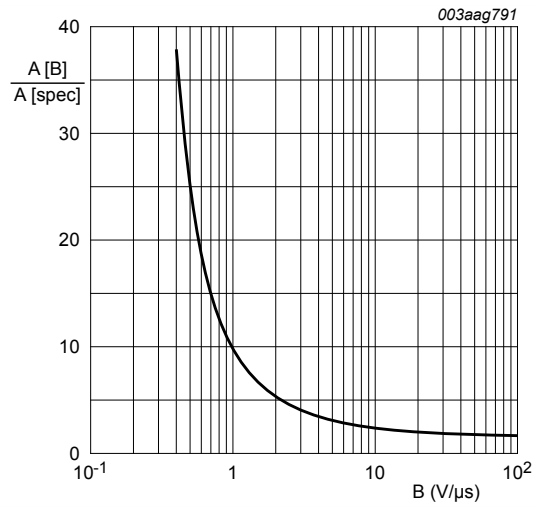
A is dV_D/dt at condition T_j $^\circ\text{C}$
 B is dV_D/dt at condition T_j 125°C

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



A is di_{com}/dt at condition T_j °C
 B is 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] is di_{com}/dt at condition B, dV_{com}/dt
 A[spec] is the specified data sheet value of 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

10. Package outline

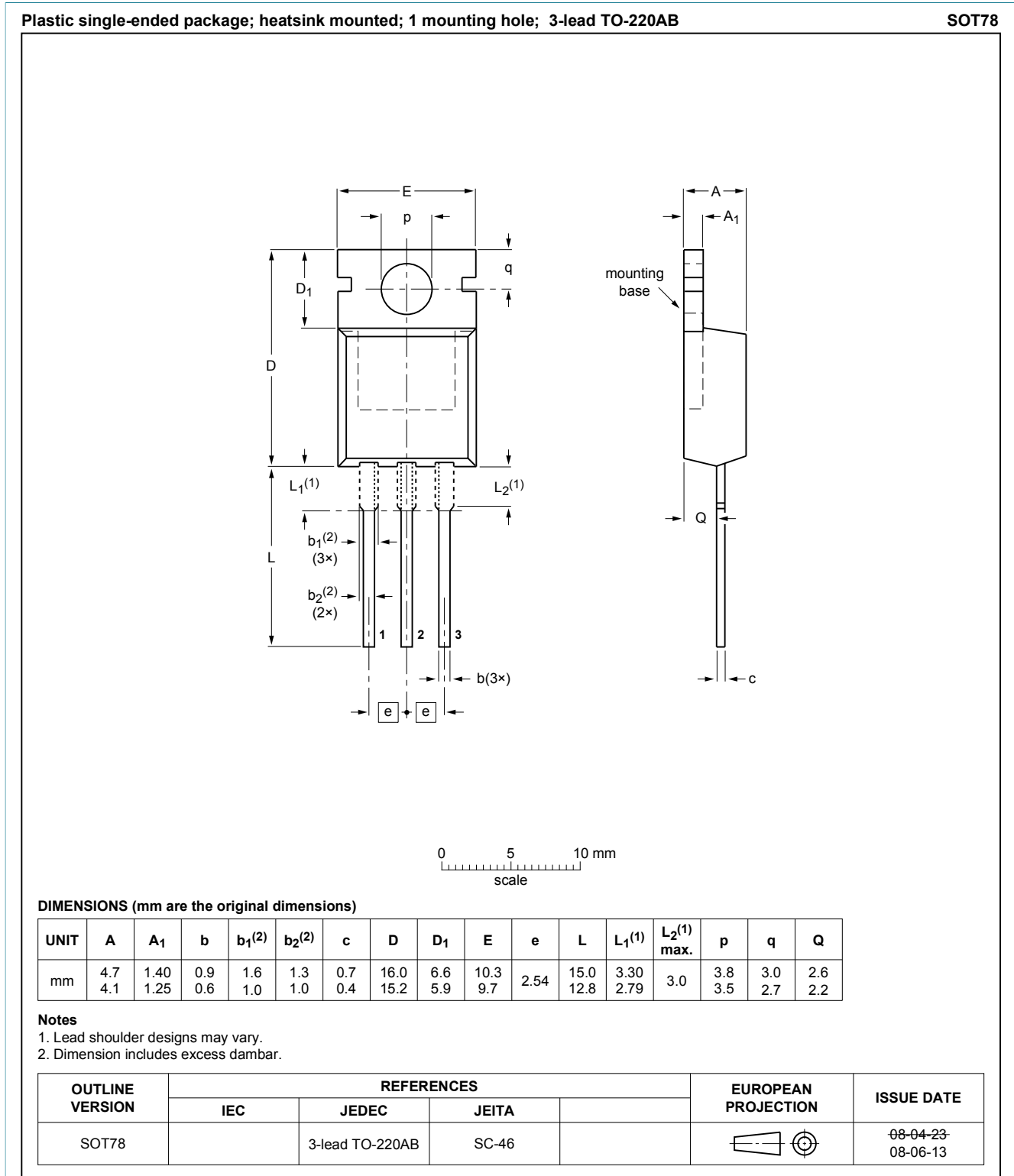


Fig. 16. Package outline TO-220AB (SOT78)

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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.
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