

## 1. General description

Planar passivated four quadrant triac in a SOT78 (TO-220AB) plastic package intended for use in general purpose bidirectional switching and phase control applications.

## 2. Features and benefits

- High voltage capability
- Least sensitive gate for highest noise immunity
- Planar passivated for voltage ruggedness and reliability
- Triggering in all four quadrants
- High minimum  $I_{GT}$  for guaranteed immunity to gate noise

## 3. Applications

- General purpose motor controls
- General purpose switching

## 4. Quick reference data

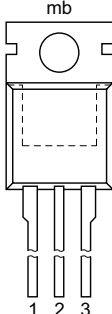
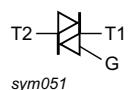
Table 1. Quick reference data

Symbol	Parameter	Conditions	Values			Unit
<b>Absolute maximum rating</b>						
$V_{DRM}$	repetitive peak off-state voltage		600			V
$I_{T(RMS)}$	RMS on-state current	full sine wave; $T_{mb} \leq 99\text{ }^{\circ}\text{C}$ ; <a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>	16			A
$I_{TSM}$	non-repetitive peak on-state current	full sine wave; $T_{j(\text{init})} = 25\text{ }^{\circ}\text{C}$ ; $t_p = 20\text{ ms}$ ; <a href="#">Fig. 4</a> ; <a href="#">Fig. 5</a>	155			A
		full sine wave; $T_{j(\text{init})} = 25\text{ }^{\circ}\text{C}$ ; $t_p = 16.7\text{ ms}$	170			A
$T_j$	junction temperature		125			$^{\circ}\text{C}$
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$I_{GT}$	gate trigger current	$V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2+ G+; $T_j = 25\text{ }^{\circ}\text{C}$ ; <a href="#">Fig. 7</a>	10	-	50	mA
		$V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2+ G-; $T_j = 25\text{ }^{\circ}\text{C}$ ; <a href="#">Fig. 7</a>	10	-	50	mA
		$V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2- G-; $T_j = 25\text{ }^{\circ}\text{C}$ ; <a href="#">Fig. 7</a>	10	-	50	mA
		$V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2- G+; $T_j = 25\text{ }^{\circ}\text{C}$ ; <a href="#">Fig. 7</a>	10	-	100	mA
$I_H$	holding current	$V_D = 12\text{ V}$ ; $T_j = 25\text{ }^{\circ}\text{C}$ ; <a href="#">Fig. 9</a>	-	-	60	mA
$V_T$	on-state voltage	$I_T = 20\text{ A}$ ; $T_j = 25\text{ }^{\circ}\text{C}$ ; <a href="#">Fig. 10</a>	-	1.2	1.6	V

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Dynamic characteristics</b>						
$dV_D/dt$	rate of rise of off-state voltage	$V_{DM} = 402\text{ V}$ ; $T_j = 125\text{ °C}$ ; ( $V_{DM} = 67\%$ of $V_{DRM}$ ); exponential waveform; gate open circuit	200	-	-	V/ $\mu$ s
$dI_{com}/dt$	rate of change of commutating current	$V_D = 400\text{ V}$ ; $T_j = 125\text{ °C}$ ; $I_{T(RMS)} = 16\text{ A}$ ; $dV_{com}/dt = 20\text{ V}/\mu\text{s}$ ; (snubberless condition); gate open circuit	3	14	-	A/ms

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	T1	main terminal 1		
2	T2	main terminal 2		
3	G	gate		
mb	T2	mounting base; main terminal 2		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		Version
	Name	Description	
BT139-600G0	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78

## 7. Marking

Table 4. Marking codes

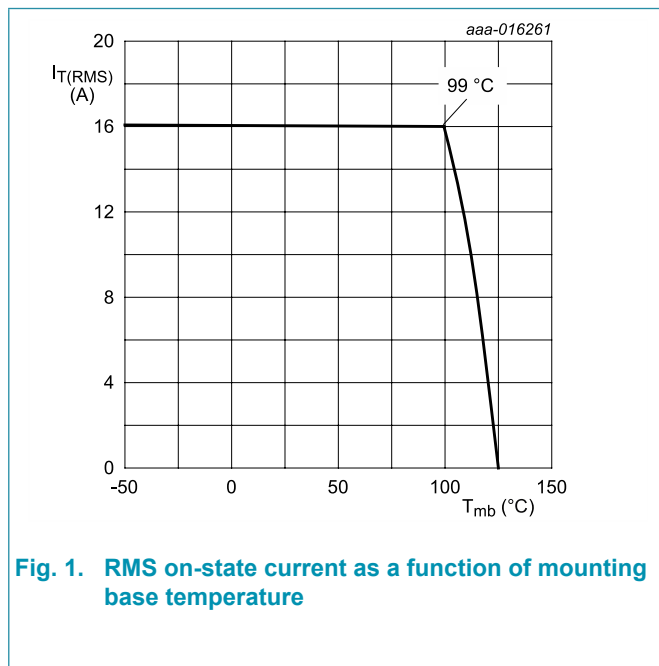
Type number	Marking codes
BT139-600G0	BT139-600G0

## 8. Limiting values

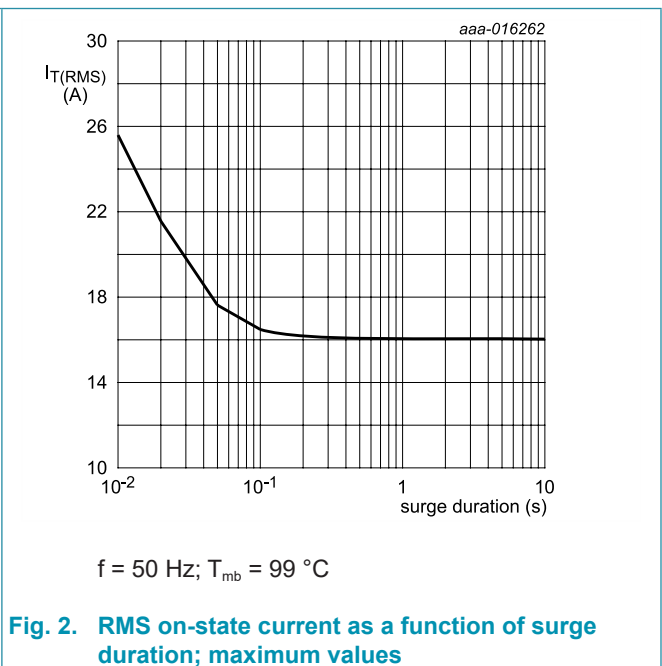
**Table 5. Limiting values**

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

Symbol	Parameter	Conditions	Values	Unit
$V_{DRM}$	repetitive peak off-state voltage		600	V
$I_{T(RMS)}$	RMS on-state current	full sine wave; $T_{mb} \leq 99\text{ }^{\circ}\text{C}$ ; <a href="#">Fig 1</a> ; <a href="#">Fig 2</a> ; <a href="#">Fig 3</a>	16	A
$I_{TSM}$	non-repetitive peak on-state current	full sine wave; $T_{j(init)} = 25\text{ }^{\circ}\text{C}$ ; $t_p = 20\text{ ms}$ ; <a href="#">Fig 4</a> ; <a href="#">Fig 5</a>	155	A
		full sine wave; $T_{j(init)} = 25\text{ }^{\circ}\text{C}$ ; $t_p = 16.7\text{ ms}$	170	A
$I^2t$	$I^2t$ for fusing	$t_p = 10\text{ ms}$ ; sine-wave pulse	120	$\text{A}^2\text{s}$
$di_T/dt$	rate of rise of on-state current	$I_G = 0.2\text{ A}$	50	$\text{A}/\mu\text{s}$
		$I_G = 0.2\text{ A}$	50	$\text{A}/\mu\text{s}$
		$I_G = 0.2\text{ A}$	50	$\text{A}/\mu\text{s}$
		$I_G = 0.2\text{ A}$	10	$\text{A}/\mu\text{s}$
$I_{GM}$	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 to 150	$^{\circ}\text{C}$
$T_j$	junction temperature		125	$^{\circ}\text{C}$



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



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

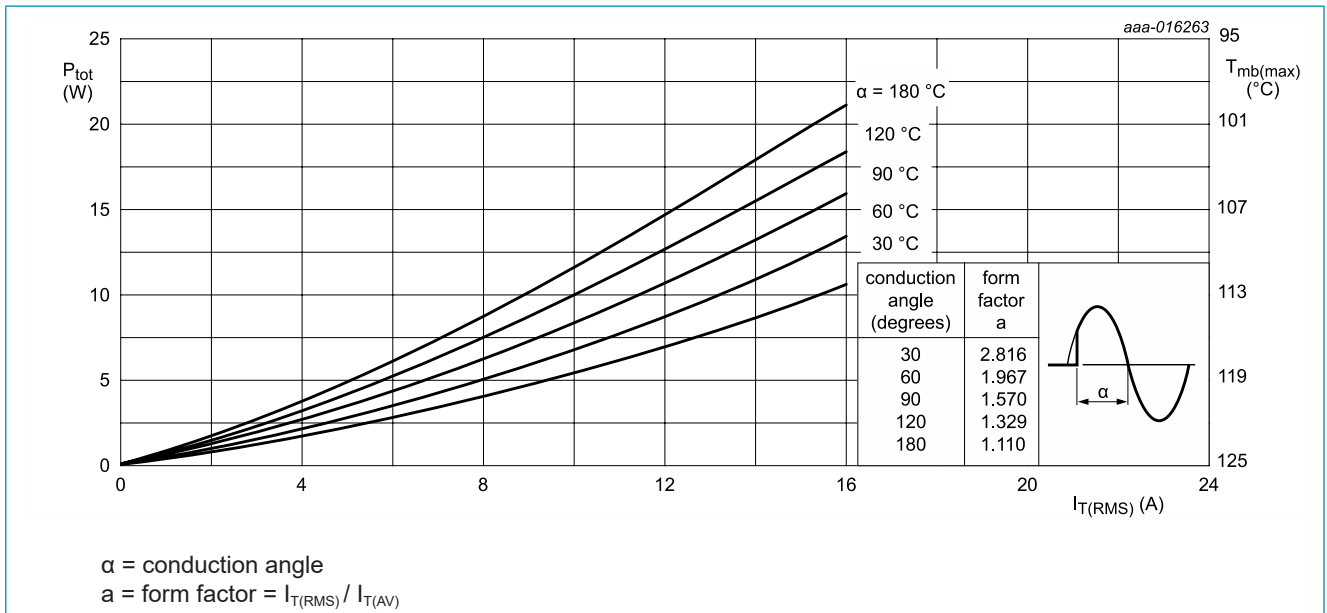


Fig. 3. Total power dissipation as a function of RMS on-state current; maximum values

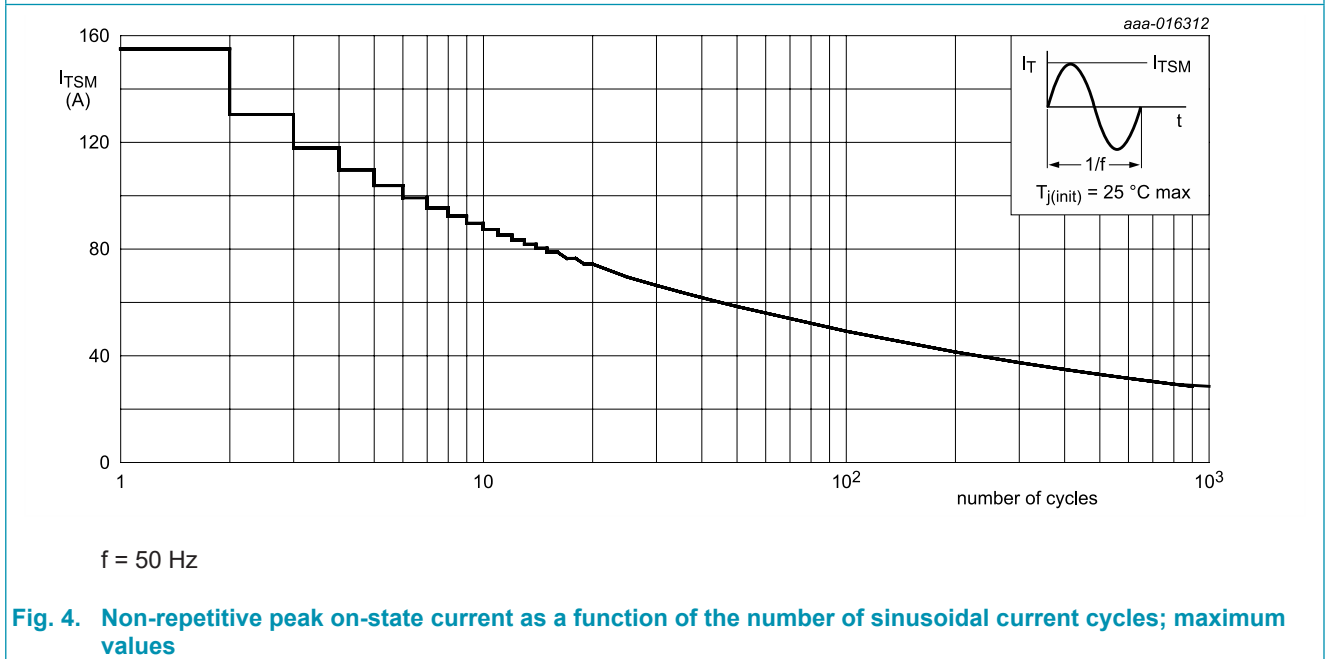


Fig. 4. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values

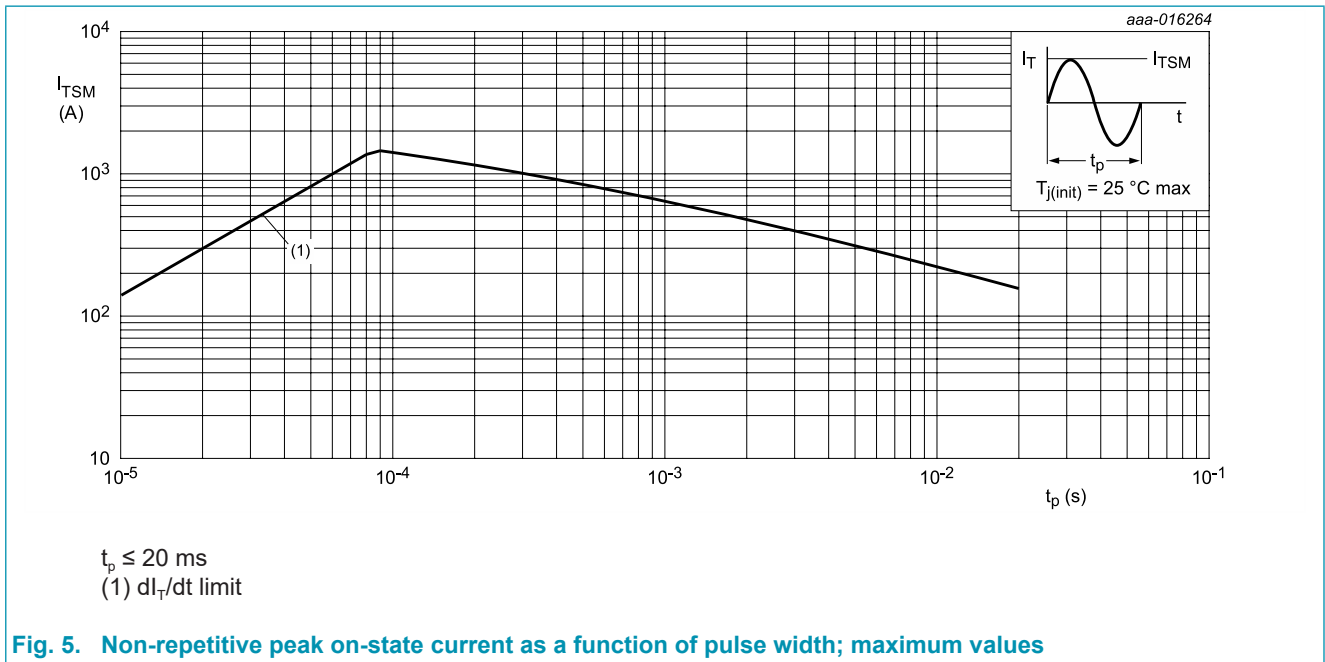


Fig. 5. Non-repetitive peak on-state current as a function of pulse width; maximum values

## 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	full cycle; Fig.6	-	-	1.2	K/W
		half cycle	-	-	1.7	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	-	60	-	K/W

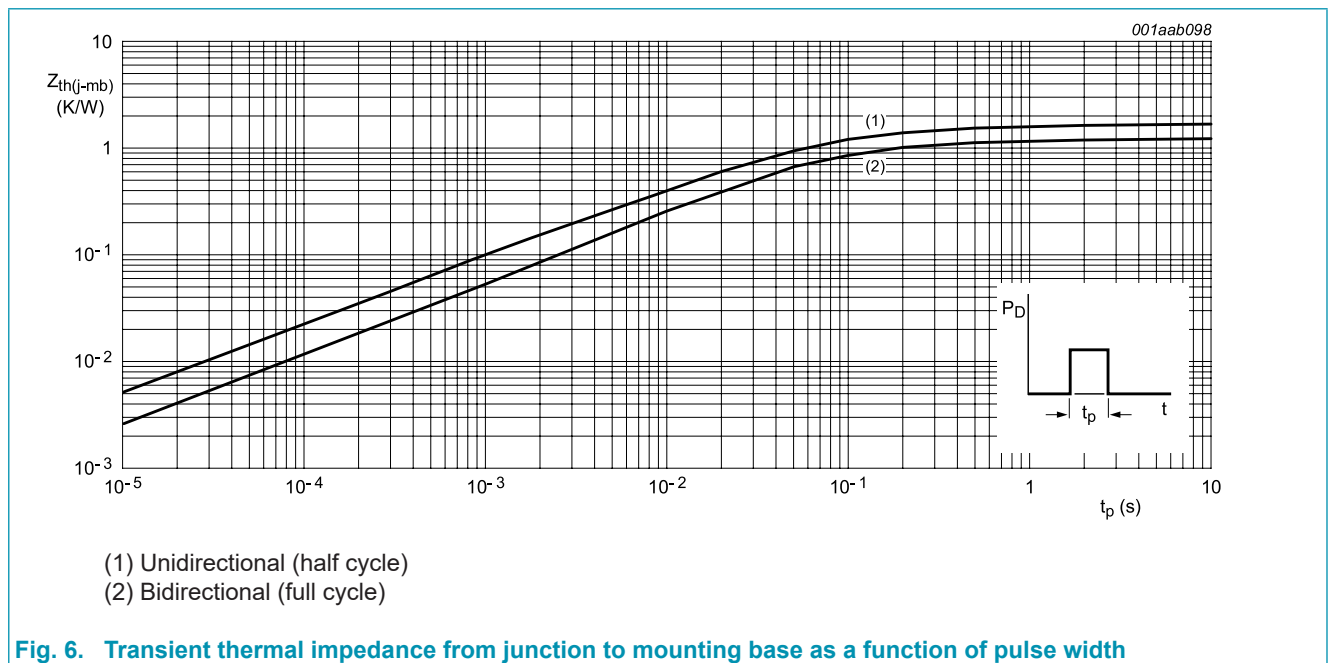
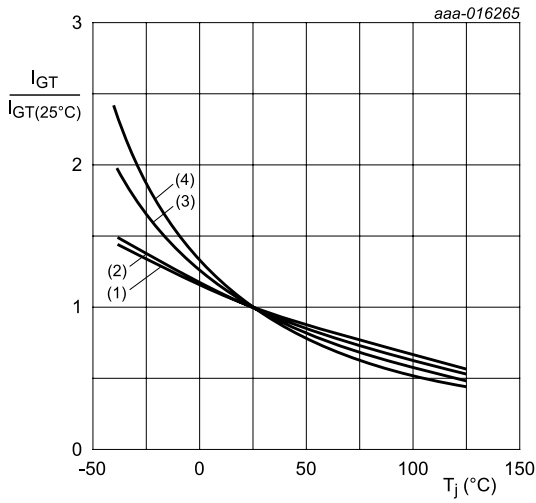


Fig. 6. Transient thermal impedance from junction to mounting base as a function of pulse width

## 10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$I_{GT}$	gate trigger current	$V_D = 12\text{ V}; I_T = 0.1\text{ A}; T2+ G+;$ $T_J = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 7</a>	10	-	50	mA
		$V_D = 12\text{ V}; I_T = 0.1\text{ A}; T2+ G-;$ $T_J = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 7</a>	10	-	50	mA
		$V_D = 12\text{ V}; I_T = 0.1\text{ A}; T2- G-;$ $T_J = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 7</a>	10	-	50	mA
		$V_D = 12\text{ V}; I_T = 0.1\text{ A}; T2- G+;$ $T_J = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 7</a>	10	-	100	mA
$I_L$	latching current	$V_D = 12\text{ V}; I_G = 0.1\text{ A}; T2+ G+;$ $T_J = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 8</a>	-	-	60	mA
		$V_D = 12\text{ V}; I_G = 0.1\text{ A}; T2+ G-;$ $T_J = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 8</a>	-	-	90	mA
		$V_D = 12\text{ V}; I_G = 0.1\text{ A}; T2- G-;$ $T_J = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 8</a>	-	-	60	mA
		$V_D = 12\text{ V}; I_G = 0.1\text{ A}; T2- G+;$ $T_J = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 8</a>	-	-	90	mA
$I_H$	holding current	$V_D = 12\text{ V}; T_J = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 9</a>	-	-	60	mA
$V_T$	on-state voltage	$I_T = 20\text{ A}; T_J = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 10</a>	-	1.2	1.6	V
$V_{GT}$	gate trigger voltage	$V_D = 12\text{ V}; I_T = 0.1\text{ A}; T_J = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 11</a>	-	0.7	1	V
		$V_D = 400\text{ V}; I_T = 0.1\text{ A}; T_J = 125\text{ }^\circ\text{C};$ <a href="#">Fig. 11</a>	0.2	0.45	-	V
$I_D$	off-state current	$V_D = 600\text{ V}; T_J = 25\text{ }^\circ\text{C}$	-	-	10	$\mu\text{A}$
		$V_D = 600\text{ V}; T_J = 125\text{ }^\circ\text{C}$	-	0.1	0.5	mA
<b>Dynamic characteristics</b>						
$dV_D/dt$	rate of rise of off-state voltage	$V_{DM} = 402\text{ V}; T_J = 125\text{ }^\circ\text{C}; (V_{DM} = 67\%$ of $V_{DRM});$ exponential waveform; gate open circuit	200	-	-	$\text{V}/\mu\text{s}$
$dI_{com}/dt$	rate of change of commutating current	$V_D = 400\text{ V}; T_J = 125\text{ }^\circ\text{C}; I_{T(RMS)} = 16\text{ A};$ $dV_{com}/dt = 20\text{ V}/\mu\text{s};$ (snubberless condition); gate open circuit	3	14	-	A/ms
$t_{gt}$	gate-controlled turn-on time	$I_{TM} = 20\text{ A}; V_D = 600\text{ V}; I_G = 0.1\text{ mA};$ $dI_G/dt = 5\text{ A}/\mu\text{s}$	-	2	-	$\mu\text{s}$



- (1) T2+ G+
- (2) T2+ G-
- (3) T2- G-
- (4) T2- G+

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

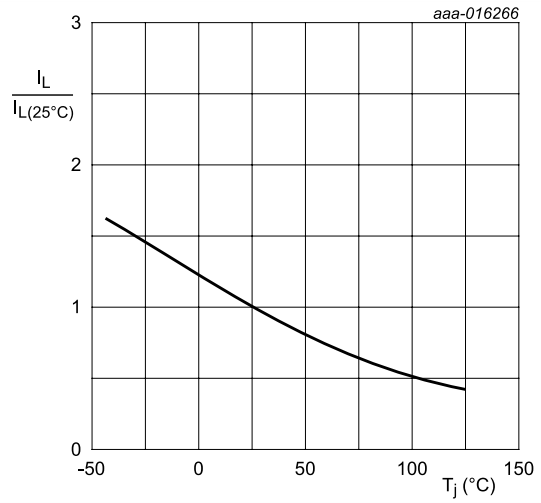


Fig. 8. Normalized latching current as a function of junction temperature

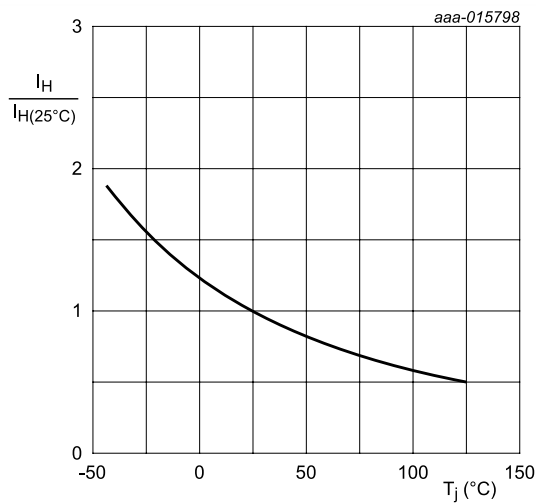
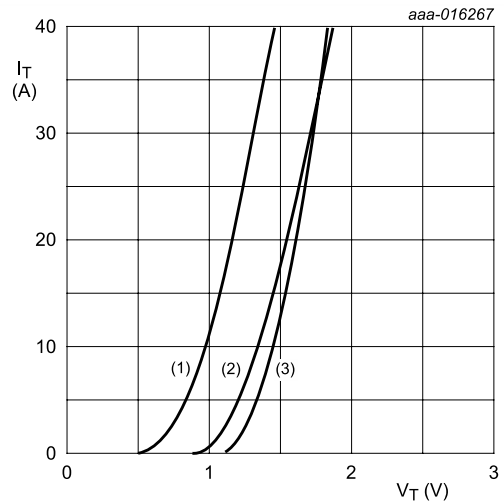


Fig. 9. Normalized holding current as a function of junction temperature



- $V_o = 1.275 \text{ V}; R_s = 0.011 \Omega$
- (1)  $T_j = 125 \text{ }^\circ\text{C}$ ; typical values
  - (2)  $T_j = 125 \text{ }^\circ\text{C}$ ; maximum values
  - (3)  $T_j = 25 \text{ }^\circ\text{C}$ ; maximum values

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



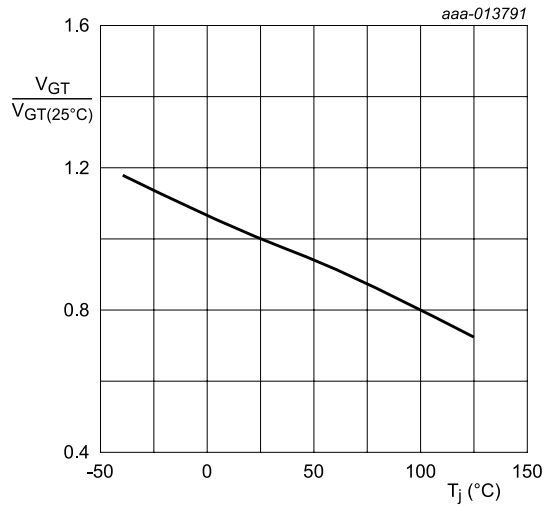


Fig. 11. Normalized gate trigger voltage as a function of junction temperature

### 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) max.	p	q	Q
mm	4.7 4.1	1.40 1.25	0.9 0.6	1.6 1.0	1.3 1.0	0.7 0.4	16.0 15.2	6.6 5.9	10.3 9.7	2.54	15.0 12.8	3.30 2.79	3.0	3.8 3.5	3.0 2.7	2.6 2.2

**Notes**

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

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT78		3-lead TO-220AB	SC-46			08-04-23 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.
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Date of release: 22 March 2018

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