

## 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

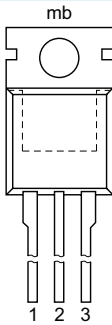
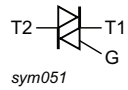
Table 1. Quick reference data

Symbol	Parameter	Conditions	Values				Unit
Absolute maximum rating							
V <sub>DRM</sub>	repetitive peak off-state voltage		600				V
I <sub>T(RMS)</sub>	RMS on-state current	full sine wave; T <sub>mb</sub> ≤ 125 °C; <a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>	16				A
I <sub>TSM</sub>	non-repetitive peak on-state current	full sine wave; T <sub>j(init)</sub> = 25 °C; t <sub>p</sub> = 20 ms; <a href="#">Fig. 4</a> ; <a href="#">Fig. 5</a>	155				A
		full sine wave; T <sub>j(init)</sub> = 25 °C; t <sub>p</sub> = 16.7 ms	170				A
T <sub>j</sub>	junction temperature		150				°C
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
I <sub>GT</sub>	gate trigger current	V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; T2+ G+; T <sub>j</sub> = 25 °C; <a href="#">Fig. 7</a>		10	-	50	mA
		V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; T2+ G-; T <sub>j</sub> = 25 °C; <a href="#">Fig. 7</a>		10	-	50	mA
		V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; T2- G-; T <sub>j</sub> = 25 °C; <a href="#">Fig. 7</a>		10	-	50	mA
		V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; T2- G+; T <sub>j</sub> = 25 °C; <a href="#">Fig. 7</a>		10	-	100	mA
I <sub>H</sub>	holding current	V <sub>D</sub> = 12 V; T <sub>j</sub> = 25 °C; <a href="#">Fig. 9</a>		-	-	60	mA
V <sub>T</sub>	on-state voltage	I <sub>T</sub> = 20 A; T <sub>j</sub> = 25 °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	$V_{DM} = 402\text{ V}$ ; $T_j = 150\text{ }^\circ\text{C}$ ; ( $V_{DM} = 67\%$ of $V_{DRM}$ ); exponential waveform; gate open circuit		200	-	-	V/ $\mu\text{s}$
$dI_{com}/dt$	rate of change of commutating current	$V_D = 400\text{ V}$ ; $T_j = 150\text{ }^\circ\text{C}$ ; $I_{T(RMS)} = 16\text{ A}$ ; $dV_{com}/dt = 20\text{ V}/\mu\text{s}$ ; (snubberless condition); gate open circuit		2	8	-	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		
	Name	Description	Version
BT139-600G0T	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78

## 7. Marking

Table 4. Marking codes

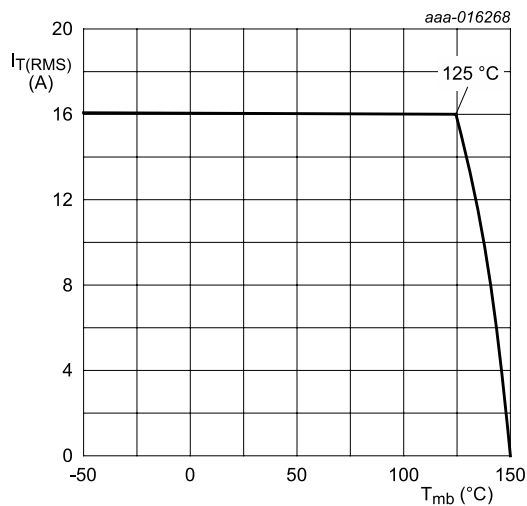
Type number	Marking codes
BT139-600G0T	BT139-600G0T

## 8. Limiting values

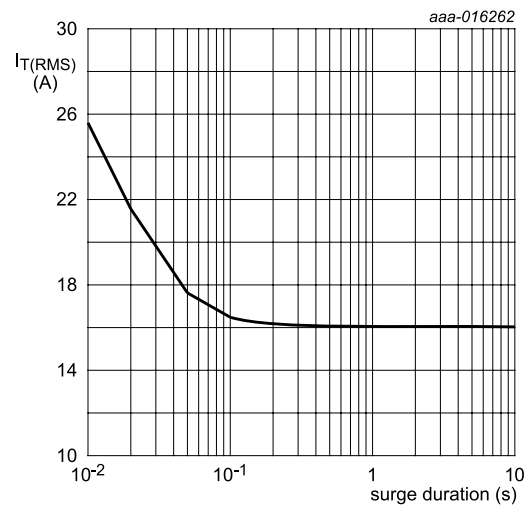
**Table 5. Limiting values**

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

Symbol	Parameter	Conditions	Values	Unit
$V_{\text{DRM}}$	repetitive peak off-state voltage		600	V
$I_{\text{T(RMS)}}$	RMS on-state current	full sine wave; $T_{\text{mb}} \leq 125\text{ }^{\circ}\text{C}$ ; <a href="#">Fig 1</a> ; <a href="#">Fig 2</a> ; <a href="#">Fig 3</a>	16	A
$I_{\text{TSM}}$	non-repetitive peak on-state current	full sine wave; $T_{\text{j(init)}} = 25\text{ }^{\circ}\text{C}$ ; $t_{\text{p}} = 20\text{ ms}$ ; <a href="#">Fig 4</a> ; <a href="#">Fig 5</a>	155	A
		full sine wave; $T_{\text{j(init)}} = 25\text{ }^{\circ}\text{C}$ ; $t_{\text{p}} = 16.7\text{ ms}$	170	A
$I^2t$	$I^2t$ for fusing	$t_{\text{p}} = 10\text{ ms}$ ; sine-wave pulse	120	$\text{A}^2\text{s}$
$di_{\text{T}}/dt$	rate of rise of on-state current	$I_{\text{G}} = 0.2\text{ A}$	50	$\text{A}/\mu\text{s}$
		$I_{\text{G}} = 0.2\text{ A}$	50	$\text{A}/\mu\text{s}$
		$I_{\text{G}} = 0.2\text{ A}$	50	$\text{A}/\mu\text{s}$
		$I_{\text{G}} = 0.2\text{ A}$	10	$\text{A}/\mu\text{s}$
$I_{\text{GM}}$	peak gate current		2	A
$P_{\text{GM}}$	peak gate power		5	W
$P_{\text{G(AV)}}$	average gate power	over any 20 ms period	0.5	W
$T_{\text{stg}}$	storage temperature		-40 to 150	$^{\circ}\text{C}$
$T_{\text{j}}$	junction temperature		150	$^{\circ}\text{C}$



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



$f = 50\text{ Hz}$ ;  $T_{\text{mb}} = 125\text{ }^{\circ}\text{C}$

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

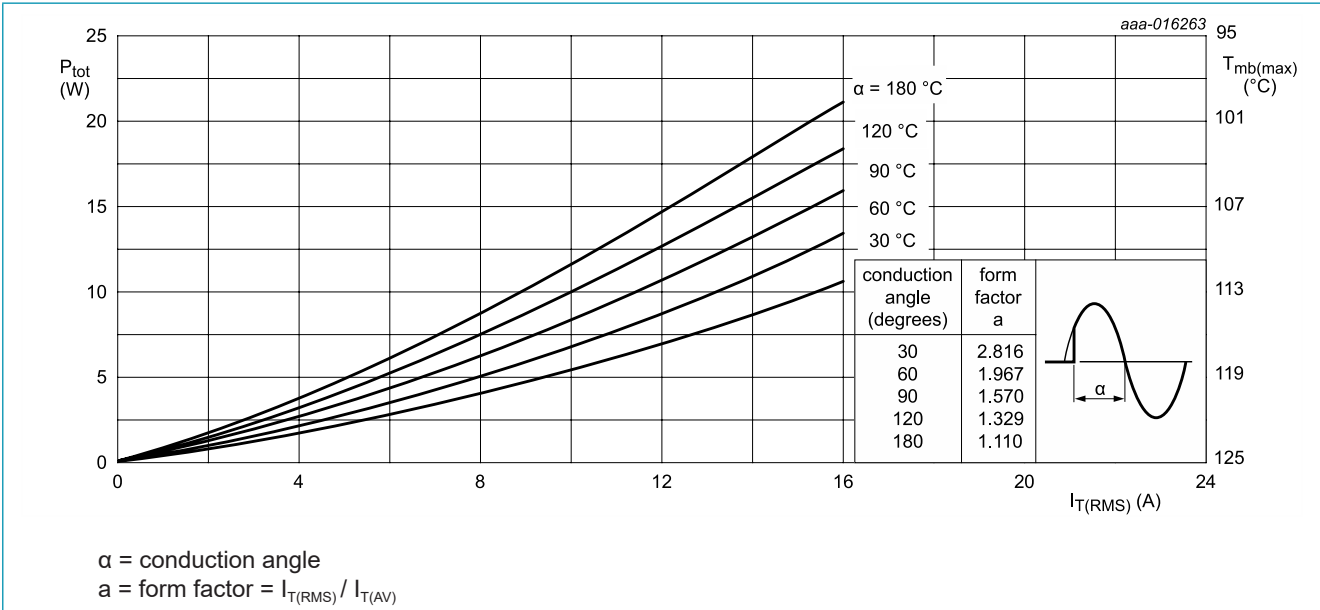


Fig. 3. Total power dissipation as a function of RMS on-state current; maximum values

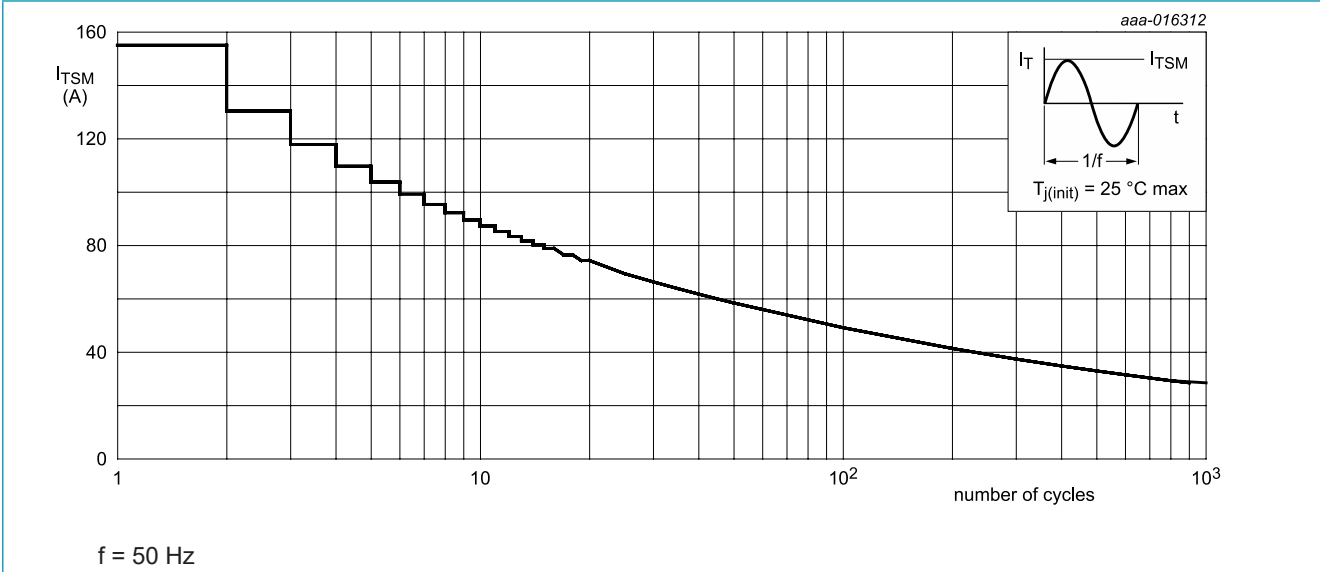
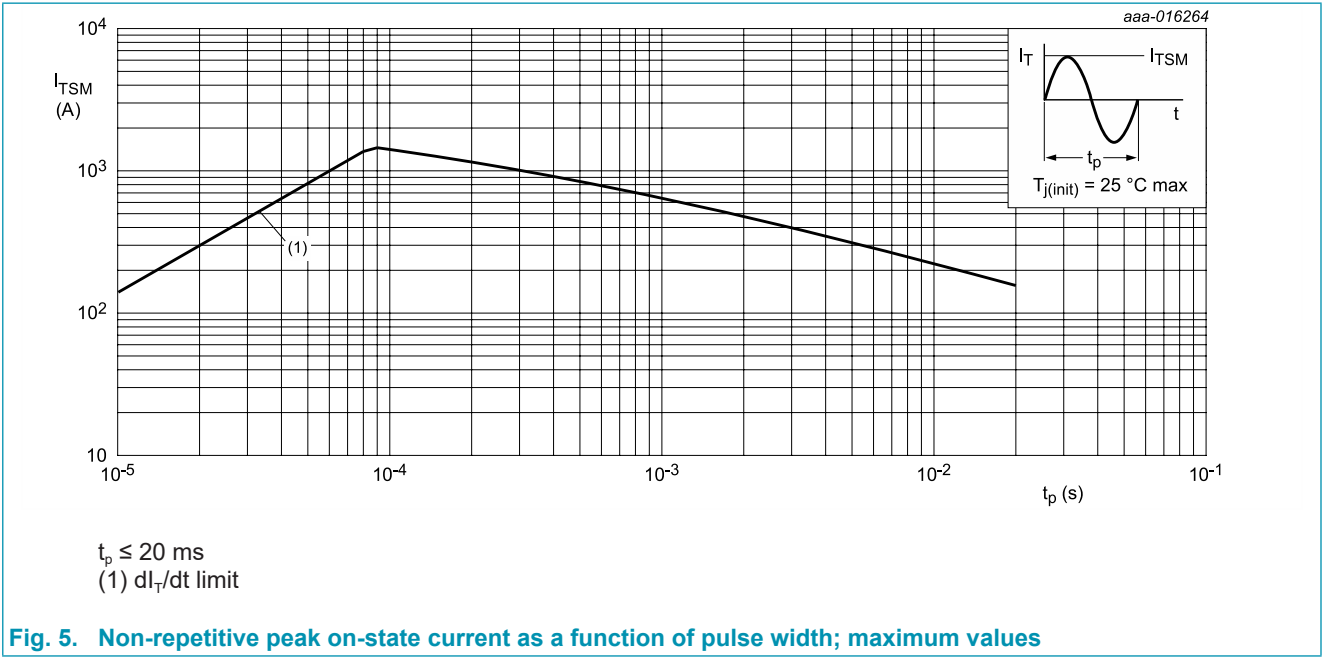


Fig. 4. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values



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

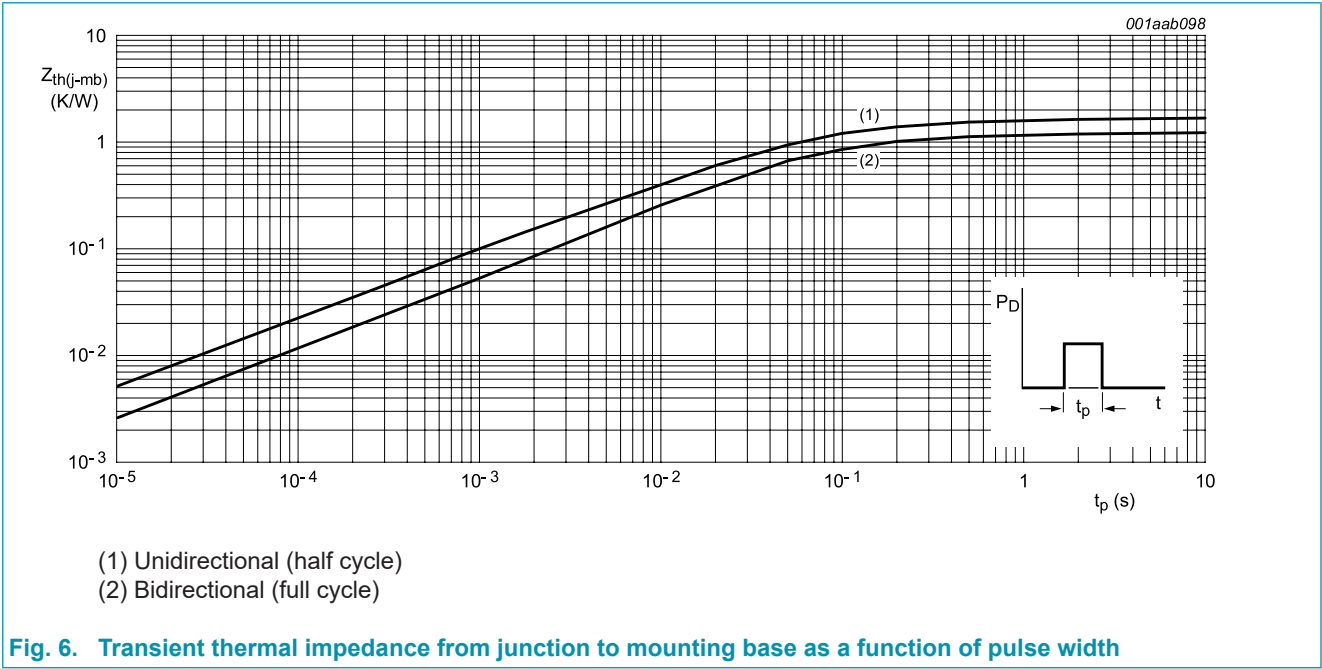
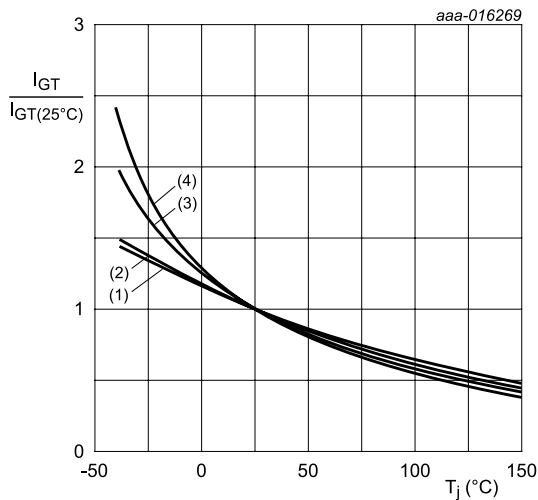


Fig. 6. Transient thermal impedance from junction to mounting base as a function of pulse width

## 10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
I <sub>GT</sub>	gate trigger current	V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; T2+ G+; T <sub>J</sub> = 25 °C; <a href="#">Fig. 7</a>		10	-	50	mA
		V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; T2+ G-; T <sub>J</sub> = 25 °C; <a href="#">Fig. 7</a>		10	-	50	mA
		V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; T2- G-; T <sub>J</sub> = 25 °C; <a href="#">Fig. 7</a>		10	-	50	mA
		V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; T2- G+; T <sub>J</sub> = 25 °C; <a href="#">Fig. 7</a>		10	-	100	mA
I <sub>L</sub>	latching current	V <sub>D</sub> = 12 V; I <sub>G</sub> = 0.1 A; T2+ G+; T <sub>J</sub> = 25 °C; <a href="#">Fig. 8</a>		-	-	60	mA
		V <sub>D</sub> = 12 V; I <sub>G</sub> = 0.1 A; T2+ G-; T <sub>J</sub> = 25 °C; <a href="#">Fig. 8</a>		-	-	90	mA
		V <sub>D</sub> = 12 V; I <sub>G</sub> = 0.1 A; T2- G-; T <sub>J</sub> = 25 °C; <a href="#">Fig. 8</a>		-	-	60	mA
		V <sub>D</sub> = 12 V; I <sub>G</sub> = 0.1 A; T2- G+; T <sub>J</sub> = 25 °C; <a href="#">Fig. 8</a>		-	-	90	mA
I <sub>H</sub>	holding current	V <sub>D</sub> = 12 V; T <sub>J</sub> = 25 °C; <a href="#">Fig. 9</a>		-	-	60	mA
V <sub>T</sub>	on-state voltage	I <sub>T</sub> = 20 A; T <sub>J</sub> = 25 °C; <a href="#">Fig. 10</a>		-	1.2	1.6	V
V <sub>GT</sub>	gate trigger voltage	V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; T <sub>J</sub> = 25 °C; <a href="#">Fig. 11</a>		-	0.7	1	V
		V <sub>D</sub> = 400 V; I <sub>T</sub> = 0.1 A; T <sub>J</sub> = 150 °C; <a href="#">Fig. 11</a>		0.25	0.4	-	V
I <sub>D</sub>	off-state current	V <sub>D</sub> = 600 V; T <sub>J</sub> = 25 °C		-	-	10	μA
		V <sub>D</sub> = 600 V; T <sub>J</sub> = 150 °C		-	0.4	2	mA
Dynamic characteristics							
dV <sub>D</sub> /dt	rate of rise of off-state voltage	V <sub>DM</sub> = 402 V; T <sub>J</sub> = 150 °C; (V <sub>DM</sub> = 67% of V <sub>DRM</sub> ); exponential waveform; gate open circuit		200	-	-	V/μs
dI <sub>com</sub> /dt	rate of change of commutating current	V <sub>D</sub> = 400 V; T <sub>J</sub> = 150 °C; I <sub>T(RMS)</sub> = 16 A; dV <sub>com</sub> /dt = 20 V/μs; (snubberless condition); gate open circuit		2	8	-	A/ms
t <sub>gt</sub>	gate-controlled turn-on time	I <sub>TM</sub> = 20 A; V <sub>D</sub> = 600 V; I <sub>G</sub> = 0.1 mA; dI <sub>G</sub> /dt = 5 A/μs		-	2	-	μs



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

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

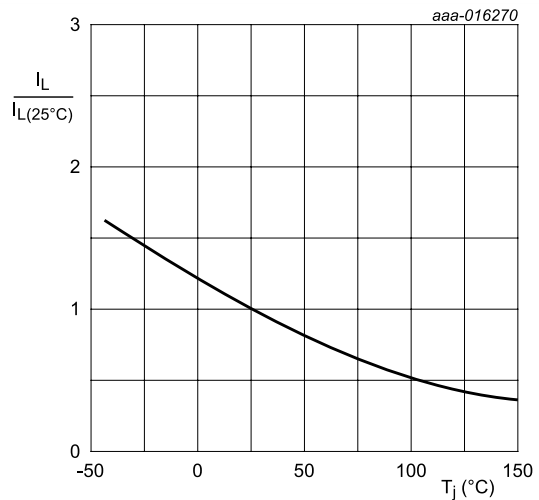


Fig. 8. Normalized latching current as a function of junction temperature

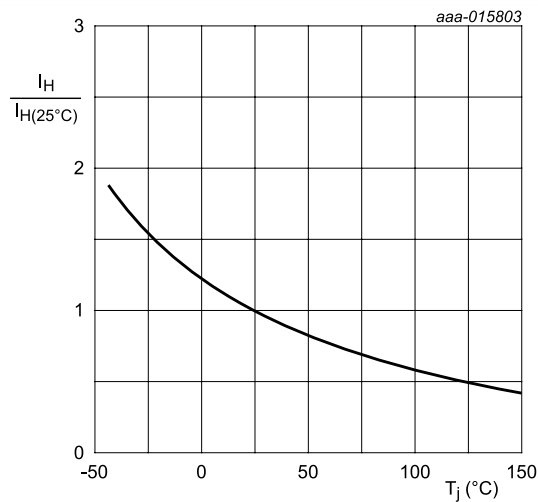
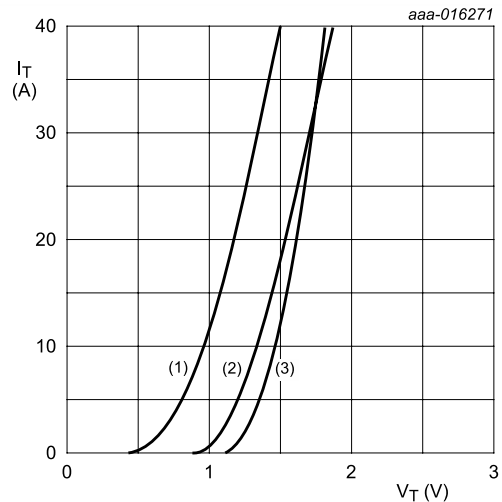


Fig. 9. Normalized holding current as a function of junction temperature



- $V_o = 1.253 V$ ;  $R_s = 0.012 \Omega$
- (1)  $T_j = 150^{\circ}C$ ; typical values
  - (2)  $T_j = 150^{\circ}C$ ; maximum values
  - (3)  $T_j = 25^{\circ}C$ ; maximum values

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

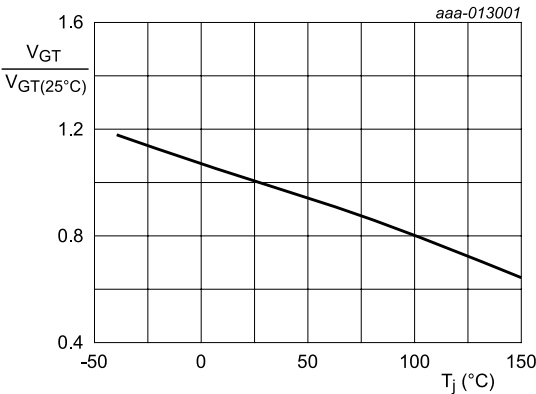
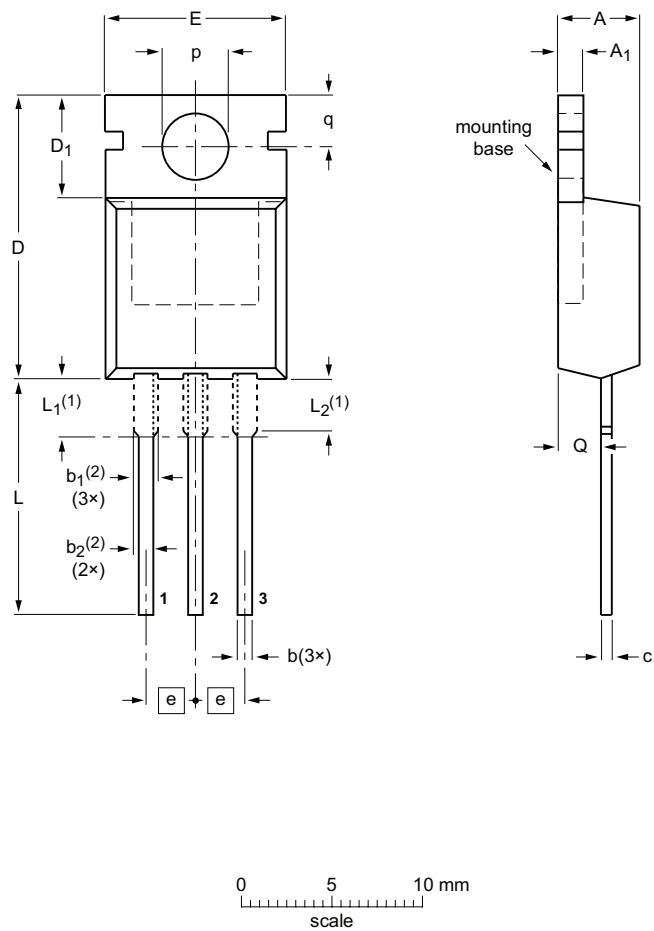


Fig. 11. Normalized gate trigger voltage as a function of junction temperature

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.
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".
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Date of release: 22 March 2018



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