

## 1. General description

Planar passivated high commutation three quadrant triac in a IITO220 internally insulated plastic package intended for use in circuits where high static and dynamic dV/dt and high dI/dt can occur. This "series C" triac will commutate the full RMS current at the maximum rated junction temperature without the aid of a snubber. This device has high  $T_j$  operating capability and an internally isolated mounting base.

## 2. Features and benefits

- 3Q technology for improved noise immunity
- High commutation capability with maximum false trigger immunity
- High immunity to false turn-on by dV/dt
- High surge capability
- High  $T_j$  (max)
- Isolated mounting base with 2500 V (RMS) isolation
- Least sensitive gate for highest noise immunity
- Planar passivated for voltage ruggedness and reliability
- Triggering in three quadrants only
- UL1557 certified (Document number E346397)

## 3. Applications

- Electronic thermostats (heating and cooling)
- High power motor controls
- Rectifier-fed DC inductive loads e.g. DC motors and solenoids

## 4. Quick reference data

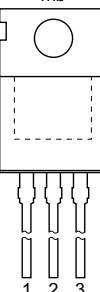
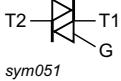
Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
<b>Absolute maximum rating</b>							
$V_{DRM}$	repetitive peak off-state voltage			-	-	800	V
$I_{T(RMS)}$	RMS on-state current	full sine wave; $T_{mb} \leq 108^\circ\text{C}$ ; <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; $T_{j(init)} = 25^\circ\text{C}$ ; $t_p = 20\text{ ms}$ ; <a href="#">Fig. 4</a> ; <a href="#">Fig. 5</a>		-	-	160	A
		full sine wave; $T_{j(init)} = 25^\circ\text{C}$ ; $t_p = 16.7\text{ ms}$		-	-	176	A
$T_j$	junction temperature			-	-	150	$^\circ\text{C}$
<b>Static characteristics</b>							
$I_{GT}$	gate trigger current	$V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2+ G+; $T_j = 25^\circ\text{C}$ ; <a href="#">Fig. 7</a>		2	-	35	mA

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
		$V_D = 12 \text{ V}$ ; $I_T = 0.1 \text{ A}$ ; $T_2+G-$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 7</a>		2	-	35	mA
		$V_D = 12 \text{ V}$ ; $I_T = 0.1 \text{ A}$ ; $T_2-G-$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 7</a>		2	-	35	mA
$I_H$	holding current	$V_D = 12 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 9</a>		-	-	35	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	1.5	V
<b>Dynamic characteristics</b>							
$dV_D/dt$	rate of rise of off-state voltage	$V_{DM} = 536 \text{ V}$ ; $T_j = 125 \text{ }^\circ\text{C}$ ; ( $V_{DM} = 67\%$ of $V_{DRM}$ ); exponential waveform; gate open circuit		500	-	-	V/ $\mu$ s
		$V_{DM} = 536 \text{ V}$ ; $T_j = 150 \text{ }^\circ\text{C}$ ; ( $V_{DM} = 67\%$ of $V_{DRM}$ ); exponential waveform; gate open circuit		300	-	-	V/ $\mu$ s
$dI_{com}/dt$	rate of change of commutating current	$V_D = 400 \text{ V}$ ; $T_j = 125 \text{ }^\circ\text{C}$ ; $I_{T(RMS)} = 16 \text{ A}$ ; $dV_{com}/dt = 20 \text{ V/\mus}$ ; (snubberless condition); gate open circuit		10	-	-	A/ms
		$V_D = 400 \text{ V}$ ; $T_j = 150 \text{ }^\circ\text{C}$ ; $I_{T(RMS)} = 16 \text{ A}$ ; $dV_{com}/dt = 20 \text{ V/\mus}$ ; (snubberless condition); gate open circuit		4	-	-	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	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
BTA416Y-800C	IITO220	BTA416Y-800C,127	Tube	50	SOT78D	07-July-2010

## 7. Marking

Table 4. Marking codes

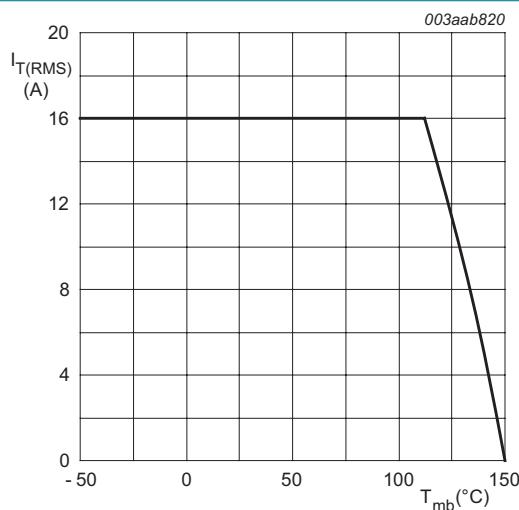
Type number	Marking codes
BTA416Y-800C	BTA416Y 800C

## 8. Limiting values

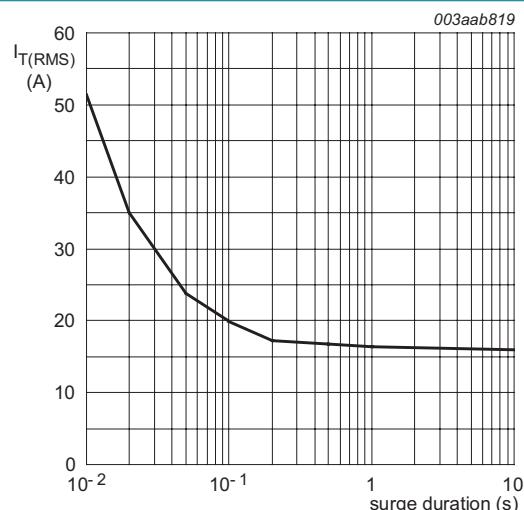
**Table 5. Limiting values**

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

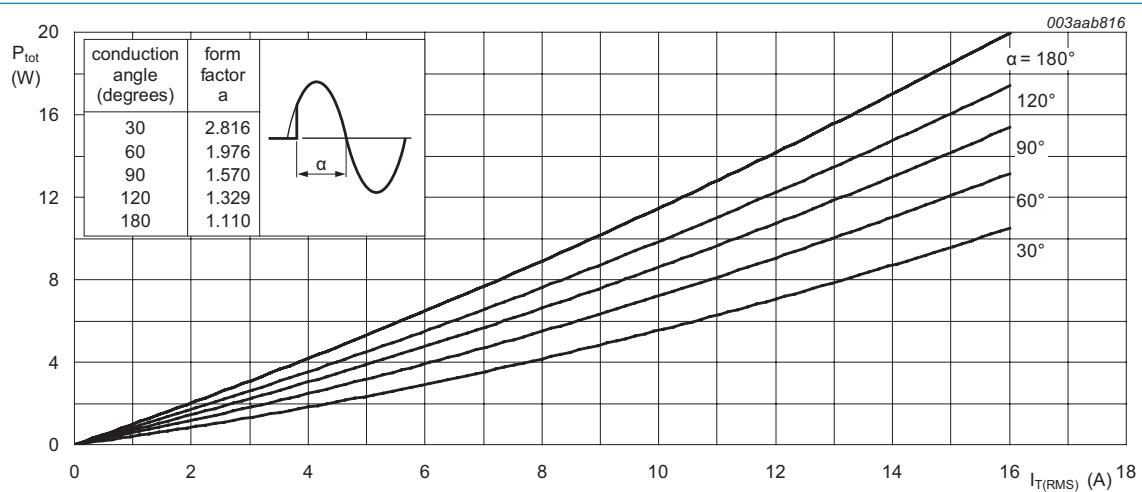
Symbol	Parameter	Conditions		Min	Max	Unit
$V_{DRM}$	repetitive peak off-state voltage			-	800	V
$I_{T(RMS)}$	RMS on-state current	full sine wave; $T_{mb} \leq 108^{\circ}\text{C}$ ; <a href="#">Fig 1</a> ; <a href="#">Fig 2</a> ; <a href="#">Fig 3</a>		-	16	A
$I_{TSM}$	non-repetitive peak on-state current	full sine wave; $T_{j(\text{init})} = 25^{\circ}\text{C}$ ; $t_p = 20\text{ ms}$ ; <a href="#">Fig 4</a> ; <a href="#">Fig 5</a>		-	160	A
		full sine wave; $T_{j(\text{init})} = 25^{\circ}\text{C}$ ; $t_p = 16.7\text{ ms}$		-	176	A
$I^2t$	$I^2t$ for fusing	$t_p = 10\text{ ms}$ ; SIN		-	128	$\text{A}^2\text{s}$
$dI_T/dt$	rate of rise of on-state current	$I_G = 0.2\text{ A}$		-	100	$\text{A}/\mu\text{s}$
$I_{GM}$	peak gate current			-	4	A
$P_{GM}$	peak gate power			-	5	W
$P_{G(AV)}$	average gate power	over any 20 ms period		-	1	W
$T_{stg}$	storage temperature			-40	150	$^{\circ}\text{C}$
$T_j$	junction temperature			-	150	$^{\circ}\text{C}$



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



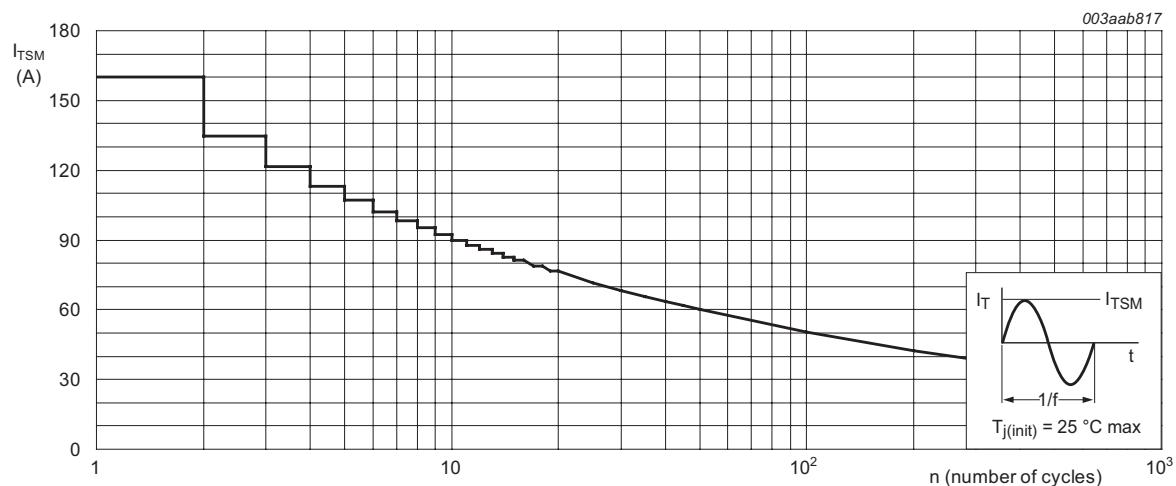
**Fig. 2. RMS on-state current as a function of surge duration; maximum values**



$\alpha$  = conduction angle

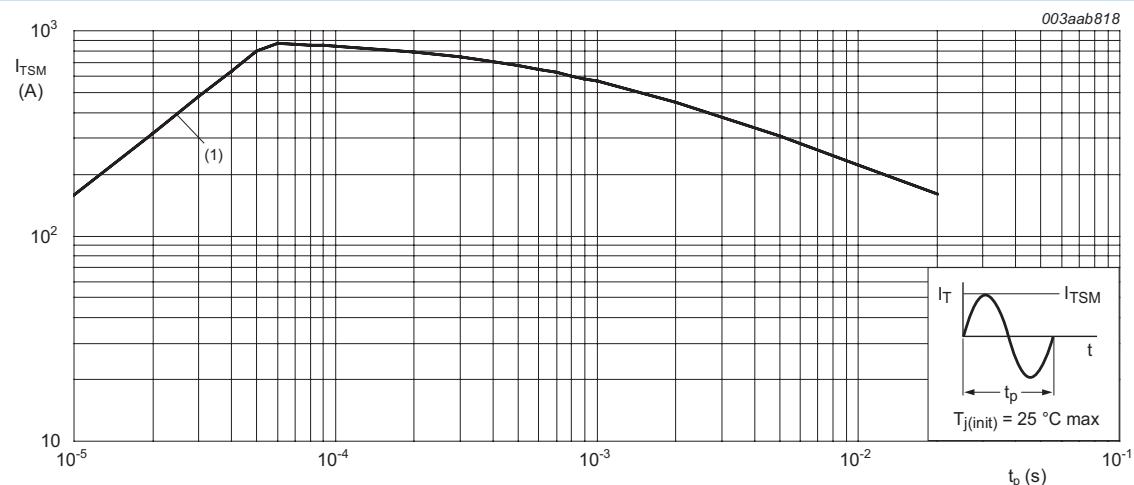
$a$  = form factor =  $I_{T(RMS)} / I_{T(AV)}$

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

(1)  $dI/dt$  limit

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

## 9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j\text{-}mb)}$	thermal resistance from junction to mounting base	full cycle; <a href="#">Fig. 6</a>		-	-	1.9	K/W
$R_{th(j\text{-}a)}$	thermal resistance from junction to ambient	in free air		-	60	-	K/W

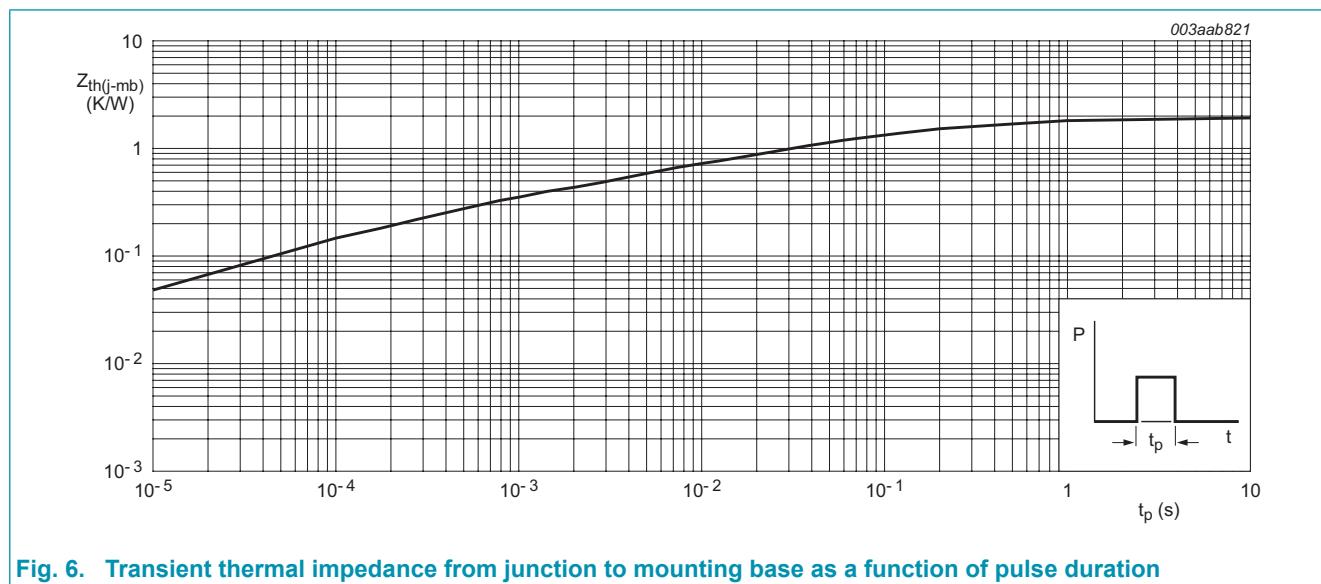


Fig. 6. Transient thermal impedance from junction to mounting base as a function of pulse duration

## 10. Isolation characteristics

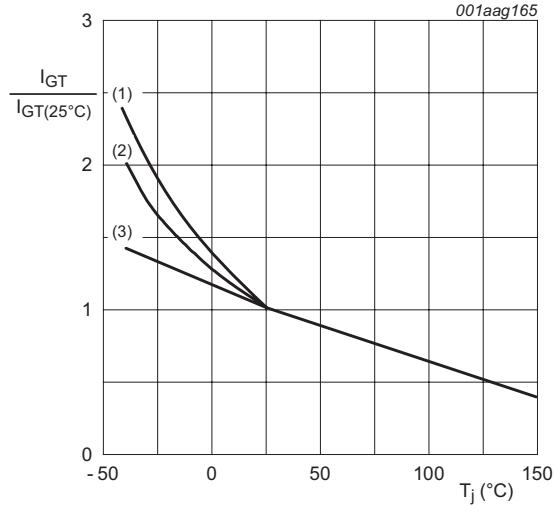
Table 7. Isolation characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$V_{isol(RMS)}$	RMS isolation voltage	from all terminals to external heatsink; sinusoidal waveform; clean and dust free; $50 \text{ Hz} \leq f \leq 60 \text{ Hz}$ ; $\text{RH} \leq 65 \%$ ; $T_h = 25^\circ\text{C}$		-	-	2500	V
$C_{isol}$	isolation capacitance	from main terminal 2 to external heatsink; $f = 1 \text{ MHz}$ ; $T_h = 25^\circ\text{C}$		-	10	-	pF

## 11. Characteristics

Table 8. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
<b>Static characteristics</b>							
$I_{GT}$	gate trigger current	$V_D = 12 \text{ V}$ ; $I_T = 0.1 \text{ A}$ ; $T_2+ \text{ G+}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 7</a>		2	-	35	mA
		$V_D = 12 \text{ V}$ ; $I_T = 0.1 \text{ A}$ ; $T_2+ \text{ G-}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 7</a>		2	-	35	mA
		$V_D = 12 \text{ V}$ ; $I_T = 0.1 \text{ A}$ ; $T_2- \text{ G-}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 7</a>		2	-	35	mA
$I_L$	latching current	$V_D = 12 \text{ V}$ ; $I_G = 0.1 \text{ A}$ ; $T_2+ \text{ G+}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 8</a>		-	-	50	mA
		$V_D = 12 \text{ V}$ ; $I_G = 0.1 \text{ A}$ ; $T_2+ \text{ G-}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 8</a>		-	-	60	mA
		$V_D = 12 \text{ V}$ ; $I_G = 0.1 \text{ A}$ ; $T_2- \text{ G-}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 8</a>		-	-	50	mA
$I_H$	holding current	$V_D = 12 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 9</a>		-	-	35	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	1.5	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
		$V_D = 400 \text{ V}$ ; $I_T = 0.1 \text{ A}$ ; $T_j = 150 \text{ }^\circ\text{C}$		0.25	0.4	-	V
$I_D$	off-state current	$V_D = 800 \text{ V}$ ; $T_j = 125 \text{ }^\circ\text{C}$		-	0.1	0.5	mA
		$V_D = 800 \text{ V}$ ; $T_j = 150 \text{ }^\circ\text{C}$		-	0.4	2	mA
<b>Dynamic characteristics</b>							
$dV_D/dt$	rate of rise of off-state voltage	$V_{DM} = 536 \text{ V}$ ; $T_j = 125 \text{ }^\circ\text{C}$ ; ( $V_{DM} = 67\%$ of $V_{DRM}$ ); exponential waveform; gate open circuit		500	-	-	V/ $\mu$ s
		$V_{DM} = 536 \text{ V}$ ; $T_j = 150 \text{ }^\circ\text{C}$ ; ( $V_{DM} = 67\%$ of $V_{DRM}$ ); exponential waveform; gate open circuit		300	-	-	V/ $\mu$ s
$dl_{com}/dt$	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		10	-	-	A/ms
		$V_D = 400 \text{ V}$ ; $T_j = 150 \text{ }^\circ\text{C}$ ; $I_{T(RMS)} = 16 \text{ A}$ ; $dV_{com}/dt = 20 \text{ V}/\mu\text{s}$ ; (snubberless condition); gate open circuit		4	-	-	A/ms



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

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

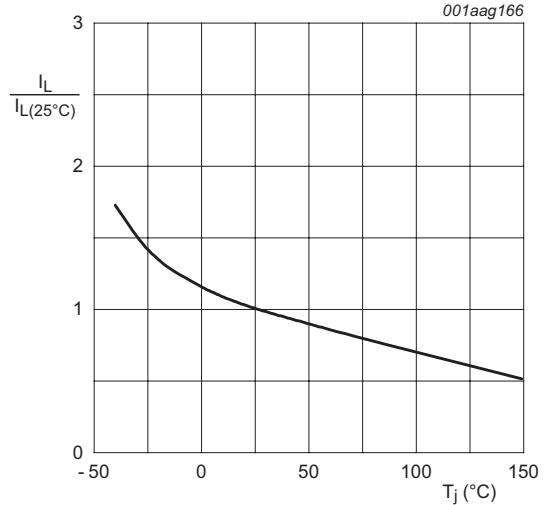


Fig. 8. Normalized latching current as a function of junction temperature

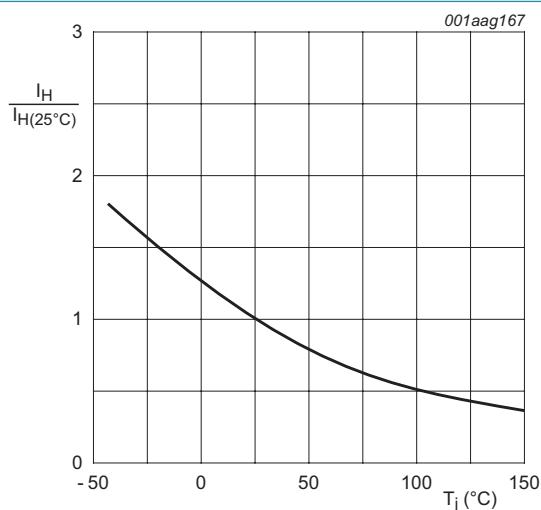
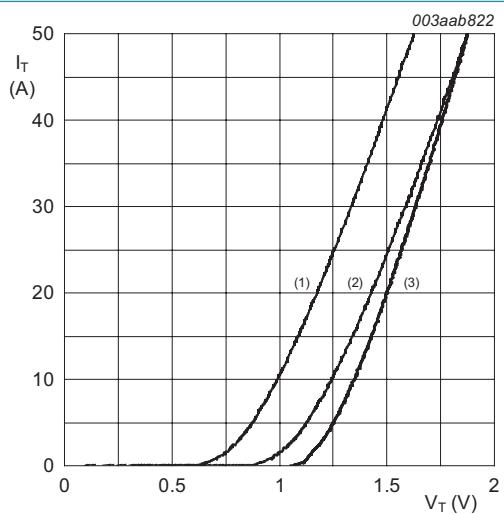


Fig. 9. Normalized holding current as a function of junction temperature



$$V_o = 1.086 \text{ V}; R_s = 0.017 \Omega$$

(1)  $T_j = 150 \text{ }^\circ\text{C}$ ; typical values

(2)  $T_j = 150 \text{ }^\circ\text{C}$ ; maximum values

(3)  $T_j = 25 \text{ }^\circ\text{C}$ ; maximum values

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

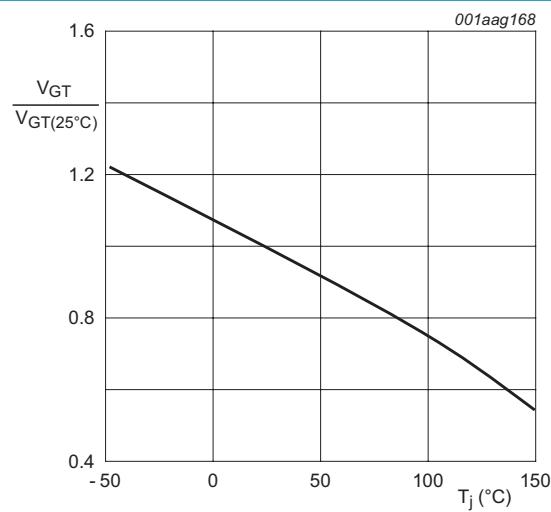
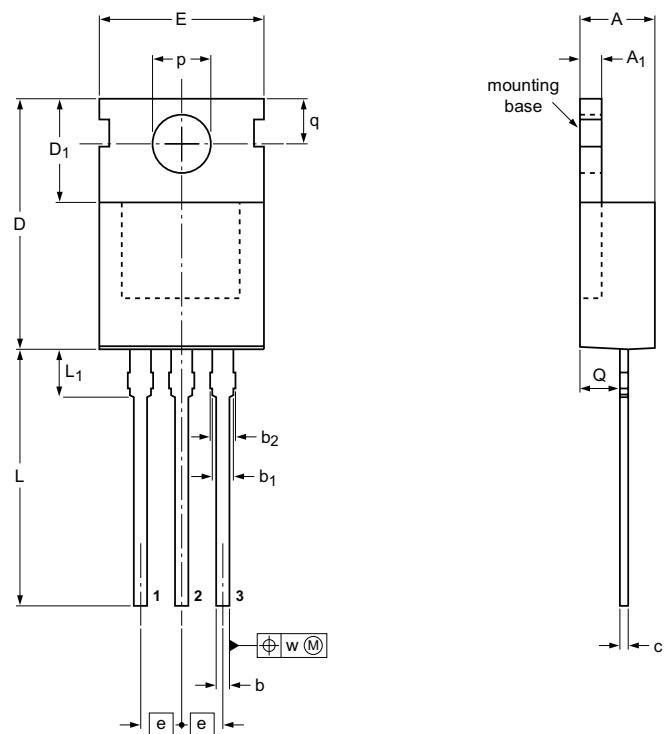


Fig. 11. Normalized gate trigger voltage as a function of junction temperature

## 12. Package outline

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

SOT78D



0 5 10 mm  
scale

### DIMENSIONS (mm are the original dimensions)

UNIT	A	A <sub>1</sub>	b	b <sub>1</sub>	b <sub>2</sub>	c	D	D <sub>1</sub> ref	E	e	L	L <sub>1</sub> ref	p	Q	q	w
mm	4.7 4.3	1.40 1.25	0.9 0.6	1.4 1.1	1.72 1.32	0.6 0.4	16.0 15.2	6.5	10.3 9.7	2.54	14.0 12.8	3.0	3.7 3.5	2.6 2.2	3.0 2.7	0.2

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT78D		TO-220				07-04-04 07-07-10

## 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: 18 July 2022

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