

1. General description

Planar passivated high commutation three quadrant triac in a TO220F "full pack" 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.

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 $T_{j(max)}$
- Least sensitive gate for highest noise immunity
- Planar passivated for voltage ruggedness and reliability
- Triggering in three quadrants only

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

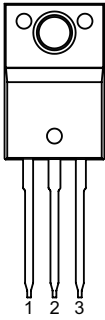
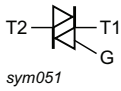
Table 1. Quick reference data

Symbol	Parameter	Conditions	Values			Unit
Absolute maximum rating						
V_{DRM}	repetitive peak off-state voltage		800			V
$I_{T(RMS)}$	RMS on-state current	full sine wave; $T_h \leq 92\text{ °C}$; Fig. 1 ; Fig. 2 ; Fig. 3	16			A
I_{TSM}	non-repetitive peak on-state current	full sine wave; $T_{j(init)} = 25\text{ °C}$; $t_p = 20\text{ ms}$; Fig. 4 ; Fig. 5	160			A
		full sine wave; $T_{j(init)} = 25\text{ °C}$; $t_p = 16.7\text{ ms}$	176			A
T_j	junction temperature		150			°C
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
I_{GT}	gate trigger current	$V_D = 12\text{ V}$; $I_T = 0.1\text{ A}$; T2+ G+; $T_j = 25\text{ °C}$; Fig. 7	2	-	35	mA

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
		$V_D = 12\text{ V}$; $I_T = 0.1\text{ A}$; T2+ G-; $T_j = 25\text{ °C}$; Fig. 7	2	-	35	mA
		$V_D = 12\text{ V}$; $I_T = 0.1\text{ A}$; T2- G-; $T_j = 25\text{ °C}$; Fig. 7	2	-	35	mA
I_H	holding current	$V_D = 12\text{ V}$; $T_j = 25\text{ °C}$; Fig. 9	-	-	35	mA
V_T	on-state voltage	$I_T = 20\text{ A}$; $T_j = 25\text{ °C}$; Fig. 10	-	1.2	1.45	V
Dynamic characteristics						
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	500	-	-	V/ μ 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	10	-	-	A/ms

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	T1	main terminal 1		 sym051
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
BTA416X-800CT	TO220F	BTA416X-800CTQ	Tube	50	TO220FE	25-Sep-2020

7. Marking

Table 4. Marking codes

Type number	Marking codes
BTA416X-800CT	BTA416X 800CT

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		800	V
$I_{T(RMS)}$	RMS on-state current	full sine wave; $T_h \leq 92\text{ °C}$; Fig 1 ; Fig 2 ; Fig 3	16	A
I_{TSM}	non-repetitive peak on-state current	full sine wave; $T_{j(init)} = 25\text{ °C}$; $t_p = 20\text{ ms}$; Fig 4 ; Fig 5	160	A
		full sine wave; $T_{j(init)} = 25\text{ °C}$; $t_p = 16.7\text{ ms}$	176	A
I^2t	I^2t for fusing	$t_p = 10\text{ ms}$; SIN	128	A^2s
di_T/dt	rate of rise of on-state current	$I_G = 0.2\text{ A}$	100	$A/\mu s$
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 to 150	$^{\circ}C$
T_j	junction temperature		150	$^{\circ}C$

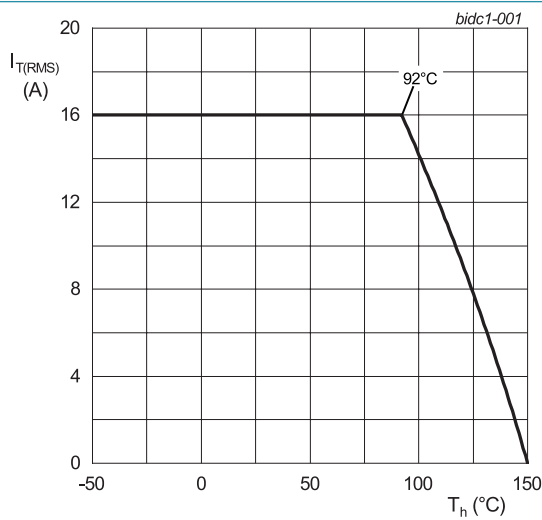
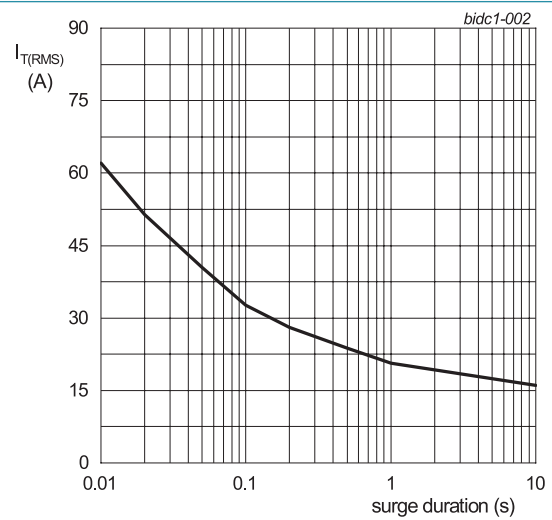


Fig. 1. RMS on-state current as a function of heatsink temperature; maximum values



$f = 50\text{ Hz}$; $T_h = 92\text{ }^{\circ}C$

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

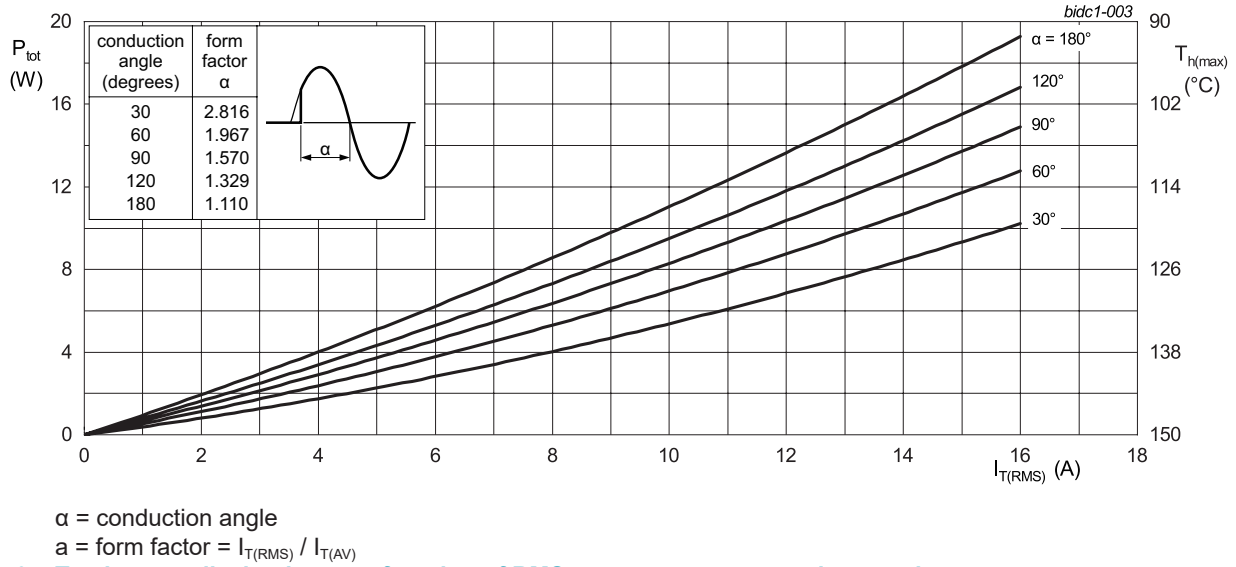


Fig. 3. Total power dissipation as a function of RMS on-state current; maximum values

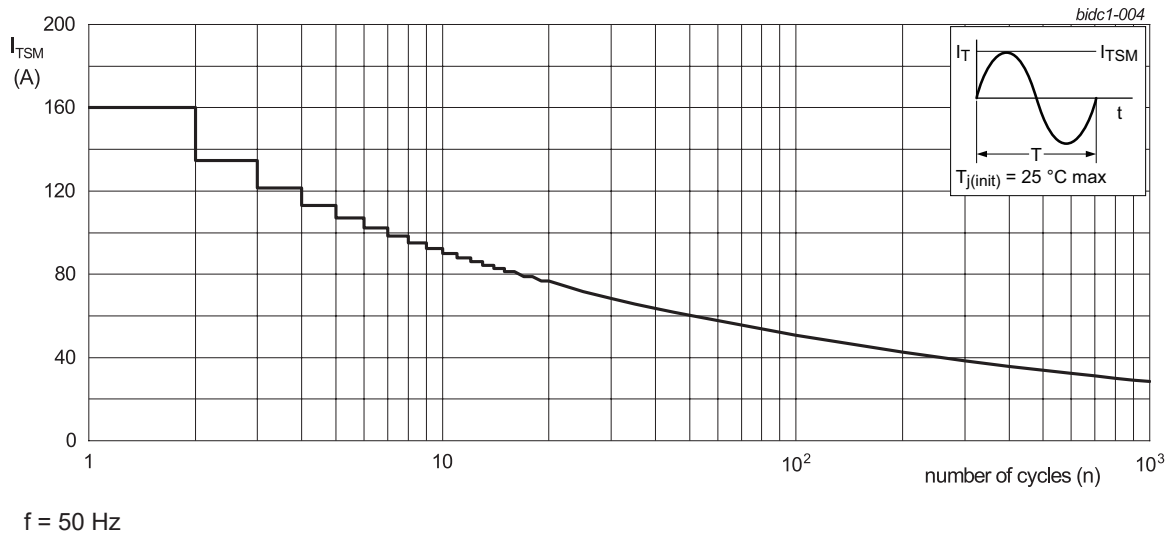


Fig. 4. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values

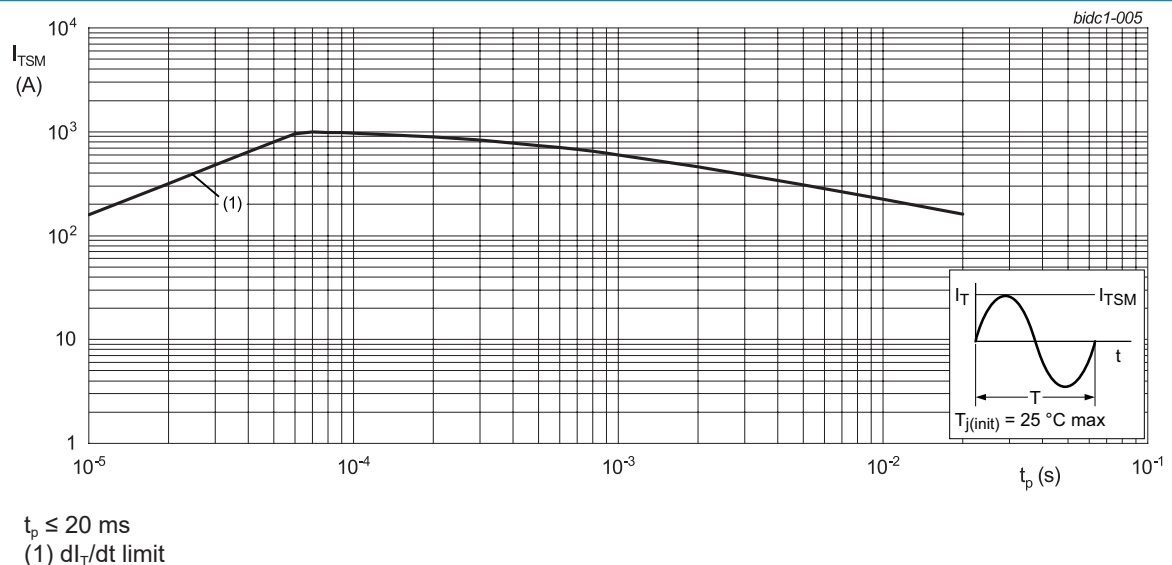


Fig. 5. Non-repetitive peak on-state current as a function of pulse duration; maximum values

9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-h)}$	thermal resistance from junction to heatsink	full cycle; with heatsink compound; Fig. 6	-	-	3	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	-	55	-	K/W

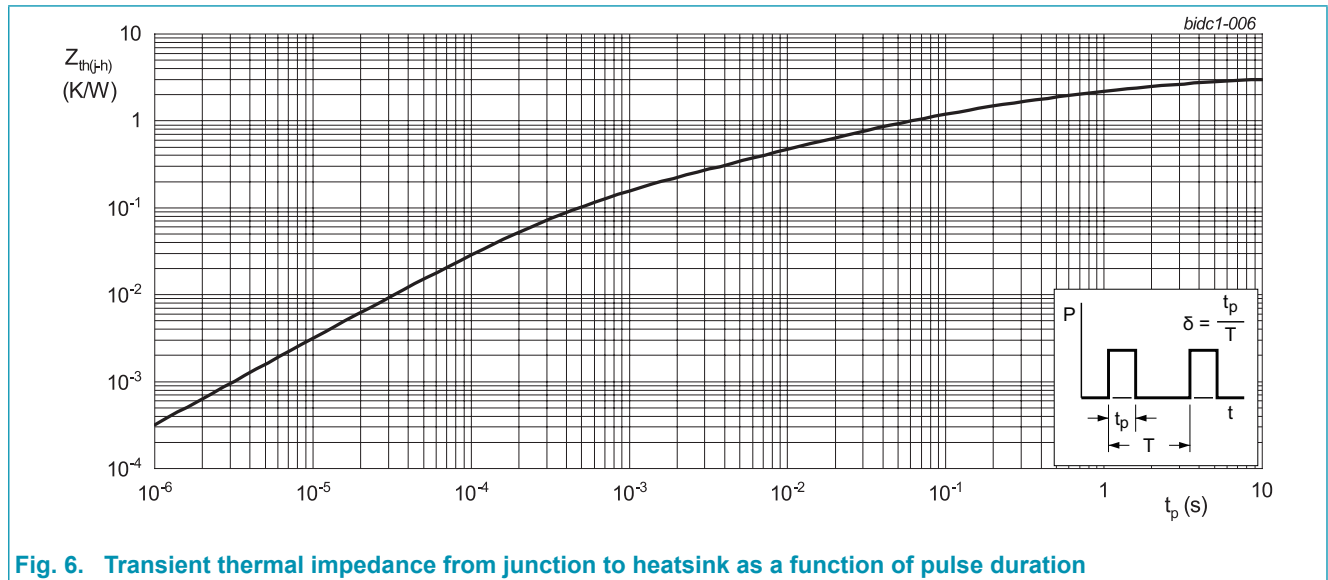


Fig. 6. Transient thermal impedance from junction to heatsink as a function of pulse duration

10. Isolation characteristics

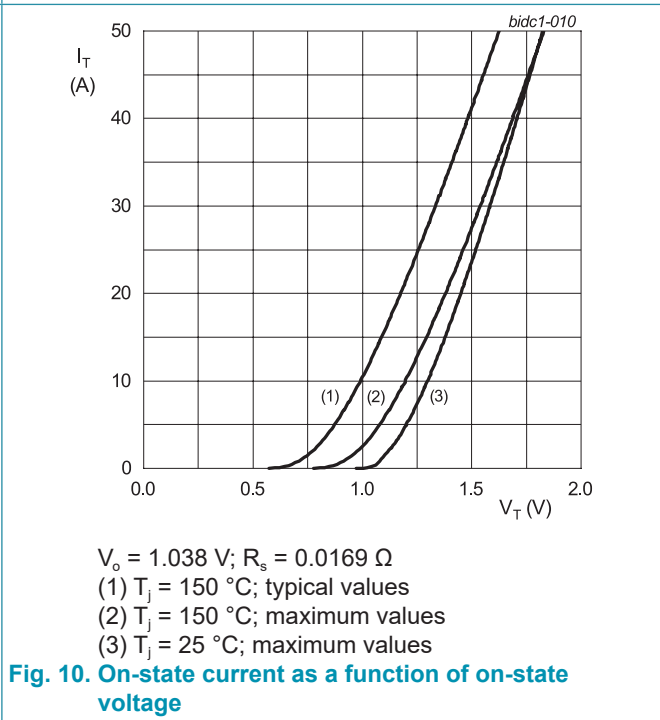
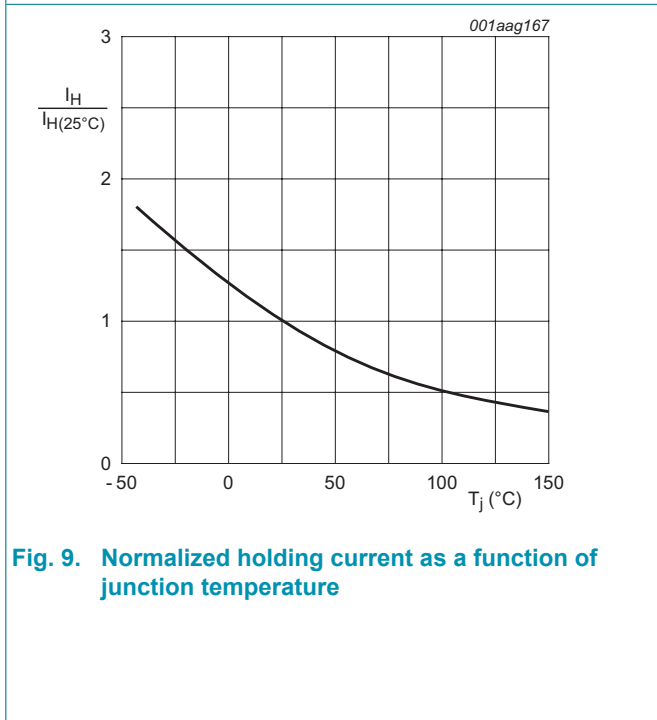
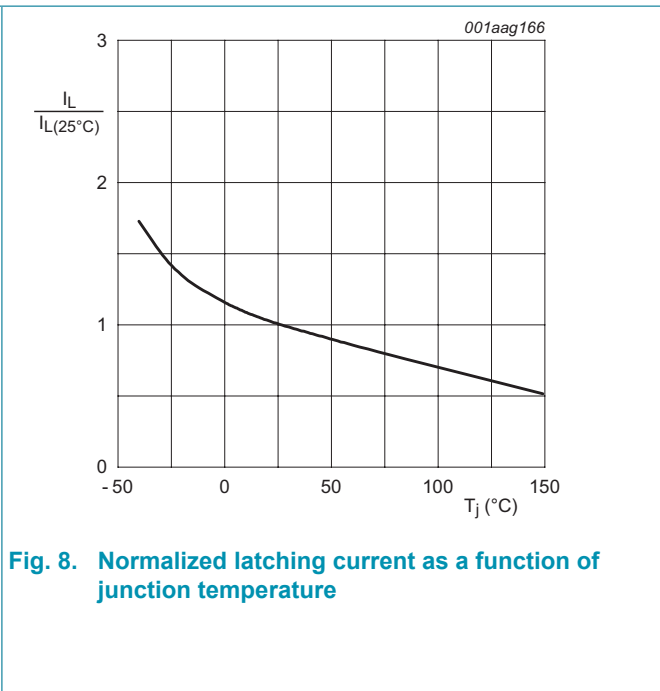
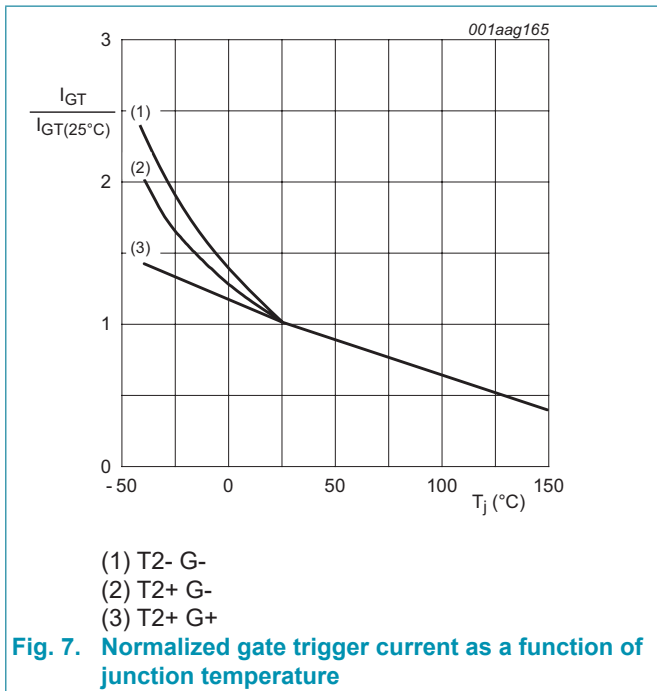
Table 7. Isolation characteristics

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; $50\text{ Hz} \leq f \leq 60\text{ Hz}$; $RH \leq 65\%$; $T_h = 25\text{ }^\circ\text{C}$	-	-	2500	V
C_{isol}	isolation capacitance	from main terminal 2 to external heatsink; $f = 1\text{ MHz}$; $T_h = 25\text{ }^\circ\text{C}$	-	10	-	pF

11. Characteristics

Table 8. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
I_{GT}	gate trigger current	$V_D = 12\text{ V}; I_T = 0.1\text{ A}; T_2+ G+;$ $T_J = 25\text{ °C};$ Fig. 7	2	-	35	mA
		$V_D = 12\text{ V}; I_T = 0.1\text{ A}; T_2+ G-;$ $T_J = 25\text{ °C};$ Fig. 7	2	-	35	mA
		$V_D = 12\text{ V}; I_T = 0.1\text{ A}; T_2- G-;$ $T_J = 25\text{ °C};$ Fig. 7	2	-	35	mA
I_L	latching current	$V_D = 12\text{ V}; I_G = 0.1\text{ A}; T_2+ G+;$ $T_J = 25\text{ °C};$ Fig. 8	-	-	50	mA
		$V_D = 12\text{ V}; I_G = 0.1\text{ A}; T_2+ G-;$ $T_J = 25\text{ °C};$ Fig. 8	-	-	60	mA
		$V_D = 12\text{ V}; I_G = 0.1\text{ A}; T_2- G-;$ $T_J = 25\text{ °C};$ Fig. 8	-	-	50	mA
I_H	holding current	$V_D = 12\text{ V}; T_J = 25\text{ °C};$ Fig. 9	-	-	35	mA
V_T	on-state voltage	$I_T = 20\text{ A}; T_J = 25\text{ °C};$ Fig. 10	-	1.2	1.45	V
V_{GT}	gate trigger voltage	$V_D = 12\text{ V}; I_T = 0.1\text{ A}; T_J = 25\text{ °C};$ Fig. 11	-	0.7	1	V
		$V_D = 400\text{ V}; I_T = 0.1\text{ A}; T_J = 150\text{ °C}$	0.25	0.4	-	V
I_D	off-state current	$V_D = 800\text{ V}; T_J = 25\text{ °C}$	-	-	5	μA
		$V_D = 800\text{ V}; T_J = 125\text{ °C}$	-	0.1	0.5	mA
		$V_D = 800\text{ V}; T_J = 150\text{ °C}$	-	0.4	2	mA
Dynamic characteristics						
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	500	-	-	V/ μs
		$V_{DM} = 536\text{ V}; T_J = 150\text{ °C}; (V_{DM} = 67\%$ of $V_{DRM});$ exponential waveform; gate open circuit	300	-	-	V/ μs
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	10	-	-	A/ms
		$V_D = 400\text{ V}; T_J = 150\text{ °C}; I_{T(RMS)} = 16\text{ A};$ $dV_{com}/dt = 20\text{ V}/\mu\text{s};$ (snubberless condition); gate open circuit	4	-	-	A/ms



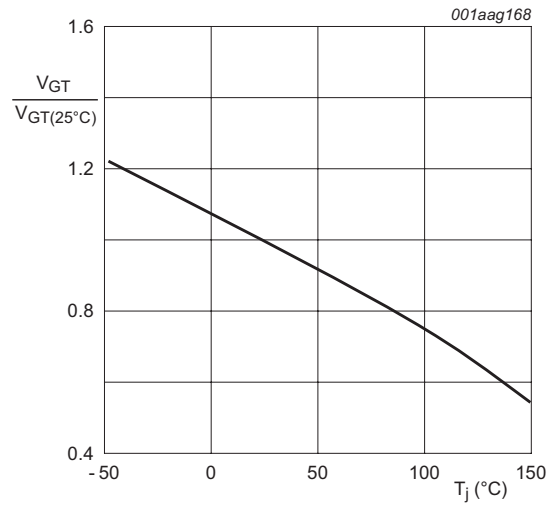
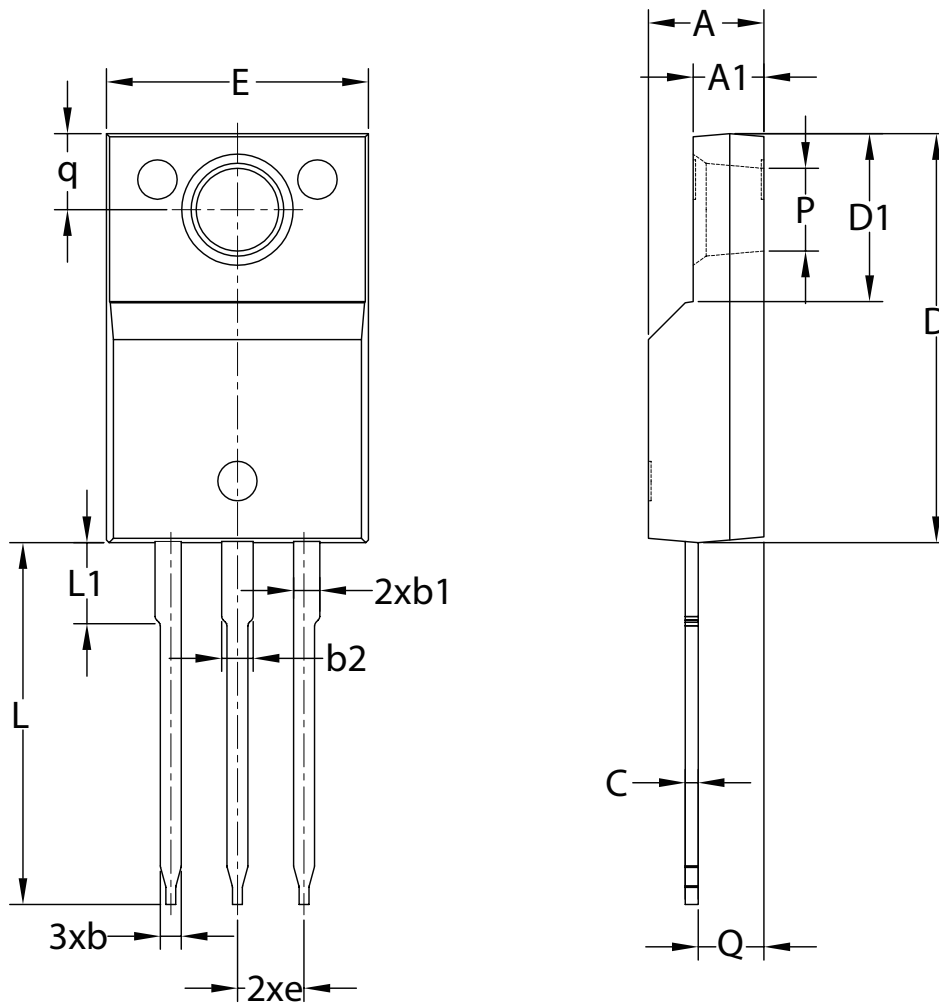


Fig. 11. Normalized gate trigger voltage as a function of junction temperature

12. Package outline

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

TO220F



Unit	A	A1	b	b1	b2	c	D	D1	E	e	L	L1	P	Q	q
min	4.20	2.50	0.70	0.90	1.00	0.40	15.40	6.00	9.70	2.54 (BSC)	13.50	2.80	3.00	2.30	2.60
max	4.60	2.90	0.90	1.30	1.40	0.60	15.80	6.40	10.30		14.40	3.30	3.30	2.60	3.00

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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