

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
- Epoxy package meets UL94V-0 which guaranteed by epoxy molding compound
- Isolated package ($V_{iso} = 2500 V_{RMS}$)
- UL 1557 certified (file ref. 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

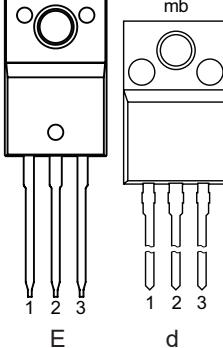
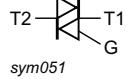
Table 1. Quick reference data

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

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_H	holding current	$V_D = 12 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$; Fig. 9		-	-	35	mA
V_T	on-state voltage	$I_T = 20 \text{ A}$; $T_j = 25 \text{ }^\circ\text{C}$; Fig. 10		-	1.2	1.45	V
Dynamic characteristics							
dV_D/dt	rate of rise of off-state voltage	$V_{DM} = 536 \text{ V}$; $T_j = 125 \text{ }^\circ\text{C}$; ($V_{DM} = 67\%$ of V_{DRM}); exponential waveform; gate open circuit		1000	-	-	V/ μ 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

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 (E)	25-Sep-2020
BTA416X-800CT	TO220F	BTA416X-800CT,127	Tube	50	SOT186A (d)	14-Nov-2013

7. Marking

Table 4. Marking codes

Type number	Marking codes	
	Assembly factory: E	Assembly factory: d
BTA416X-800CT	BTA416X 800CT PJExxxxx xx	BTA416X 800CT PJdxxxx xx

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; $T_h \leq 92^\circ\text{C}$; Fig 1 ; Fig 2 ; Fig 3	16	A
I_{TSM}	non-repetitive peak on-state current	full sine wave; $T_{j(\text{init})} = 25^\circ\text{C}$; $t_p = 20\text{ ms}$; Fig 4 ; Fig 5	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	A^2s
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 to 150	$^\circ\text{C}$
T_j	junction temperature		150	$^\circ\text{C}$

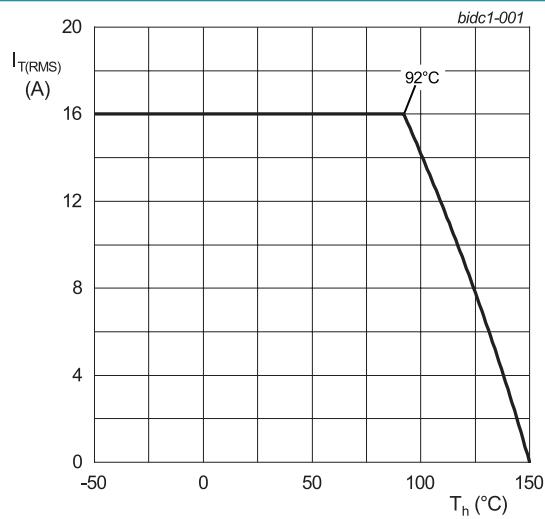
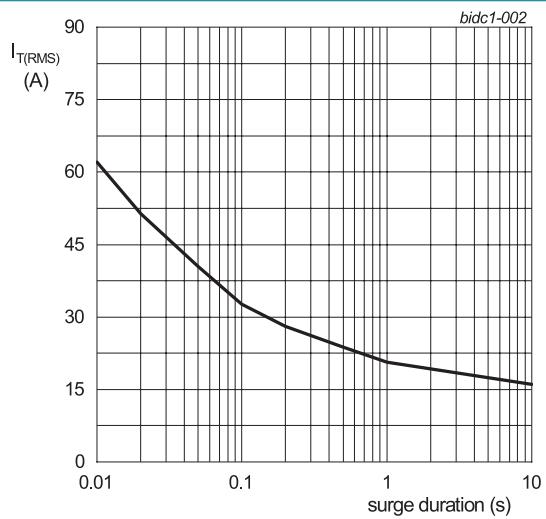
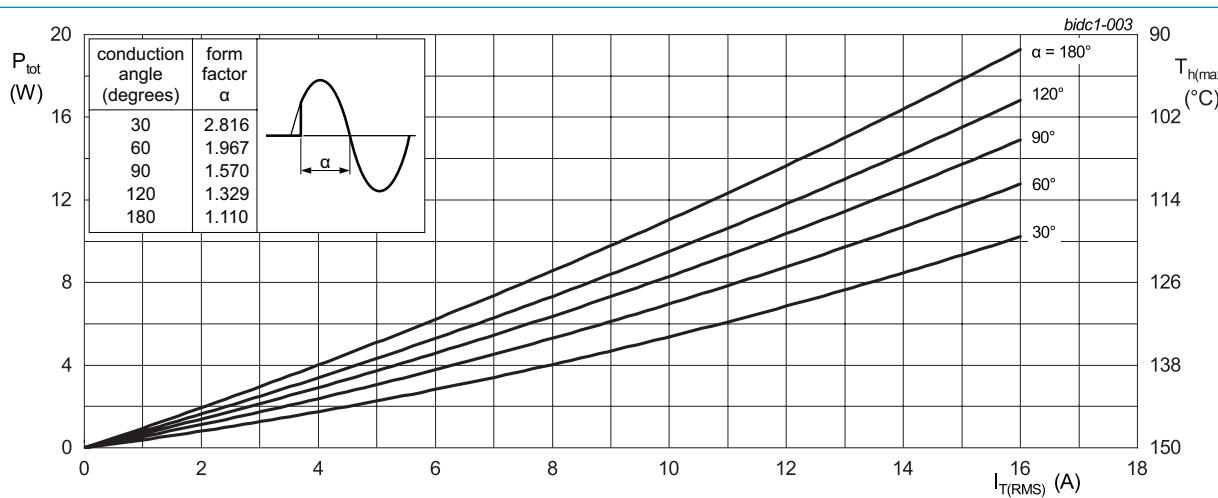


Fig. 1. RMS on-state current as a function of heatsink temperature; maximum values



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

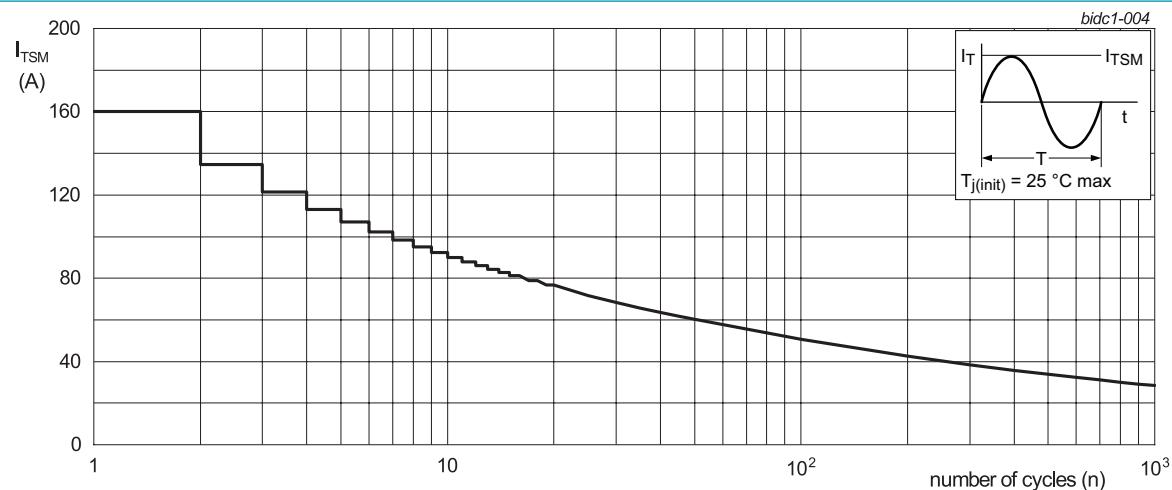
Fig. 2. RMS on-state current as a function of surge duration; maximum values



α = conduction angle

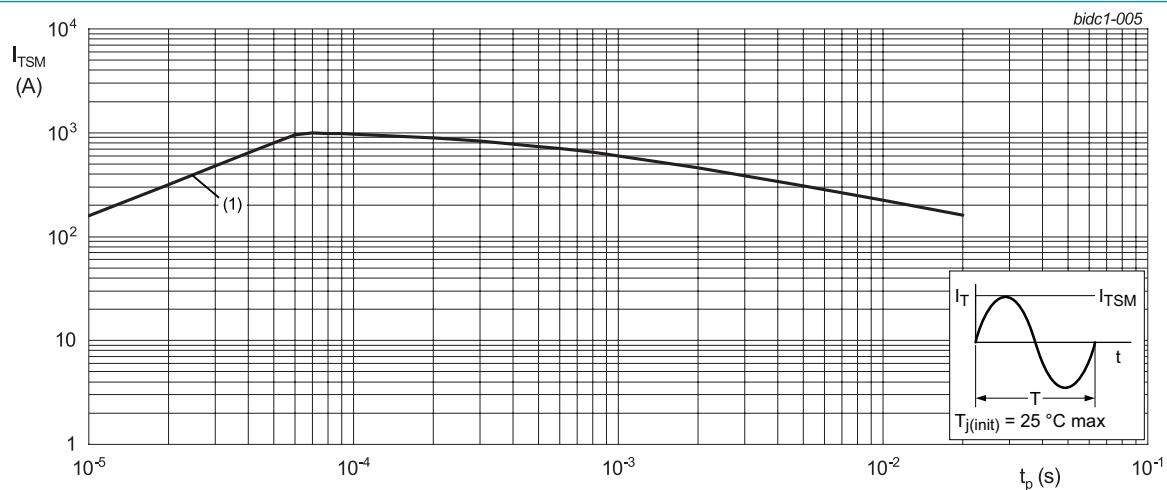
α = form factor = $I_{T(RMS)} / I_{T(AV)}$

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_T/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
$R_{th(j-h)}$	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

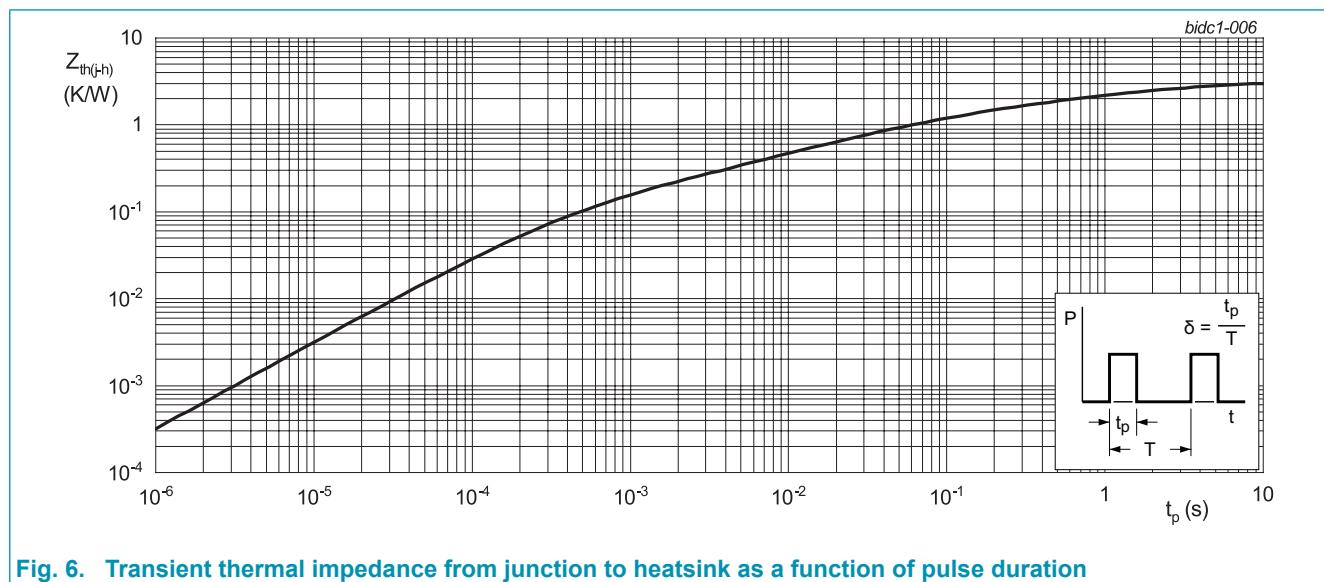


Fig. 6. Transient thermal impedance from junction to heatsink as a function of pulse duration

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; $50 \text{ Hz} \leq f \leq 60 \text{ Hz}$; $\text{RH} \leq 65 \%$; $T_h = 25^\circ\text{C}$		-	-	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
Static characteristics							
I_{GT}	gate trigger current	$V_D = 12 \text{ V}$; $I_T = 0.1 \text{ A}$; $T_2+ \text{ G+}$; $T_j = 25 \text{ }^\circ\text{C}$; Fig. 7		2	-	35	mA
		$V_D = 12 \text{ V}$; $I_T = 0.1 \text{ A}$; $T_2+ \text{ G-}$; $T_j = 25 \text{ }^\circ\text{C}$; Fig. 7		2	-	35	mA
		$V_D = 12 \text{ V}$; $I_T = 0.1 \text{ A}$; $T_2- \text{ G-}$; $T_j = 25 \text{ }^\circ\text{C}$; Fig. 7		2	-	35	mA
I_L	latching current	$V_D = 12 \text{ V}$; $I_G = 0.1 \text{ A}$; $T_2+ \text{ G+}$; $T_j = 25 \text{ }^\circ\text{C}$; Fig. 8		-	-	50	mA
		$V_D = 12 \text{ V}$; $I_G = 0.1 \text{ A}$; $T_2+ \text{ G-}$; $T_j = 25 \text{ }^\circ\text{C}$; Fig. 8		-	-	60	mA
		$V_D = 12 \text{ V}$; $I_G = 0.1 \text{ A}$; $T_2- \text{ G-}$; $T_j = 25 \text{ }^\circ\text{C}$; Fig. 8		-	-	50	mA
I_H	holding current	$V_D = 12 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$; Fig. 9		-	-	35	mA
V_T	on-state voltage	$I_T = 20 \text{ A}$; $T_j = 25 \text{ }^\circ\text{C}$; Fig. 10		-	1.2	1.45	V
V_{GT}	gate trigger voltage	$V_D = 12 \text{ V}$; $I_T = 0.1 \text{ A}$; $T_j = 25 \text{ }^\circ\text{C}$; Fig. 11		-	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	$V_D = 800 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$		-	-	5	μA
		$V_D = 800 \text{ V}$; $T_j = 125 \text{ }^\circ\text{C}$		-	0.1	0.5	mA
		$V_D = 800 \text{ V}$; $T_j = 150 \text{ }^\circ\text{C}$		-	0.4	2	mA
Dynamic characteristics							
dV_D/dt	rate of rise of off-state voltage	$V_{DM} = 536 \text{ V}$; $T_j = 125 \text{ }^\circ\text{C}$; ($V_{DM} = 67\%$ of V_{DRM}); exponential waveform; gate open circuit		1000	-	-	V/ μs
		$V_{DM} = 536 \text{ V}$; $T_j = 150 \text{ }^\circ\text{C}$; ($V_{DM} = 67\%$ of V_{DRM}); exponential waveform; gate open circuit		500	-	-	V/ μs
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		5	-	-	A/ms

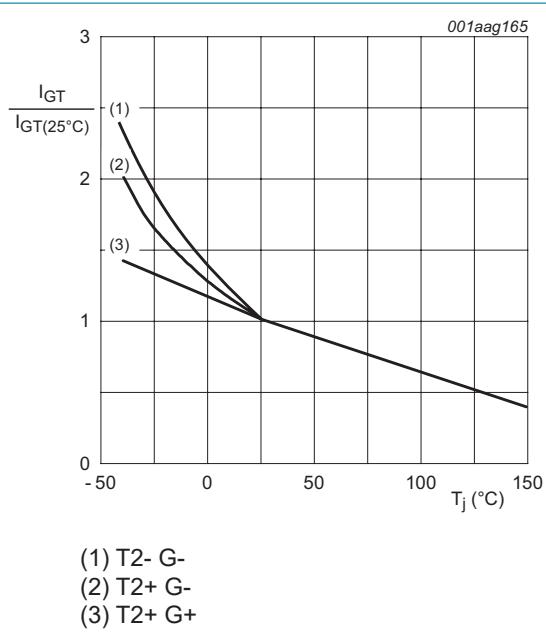


Fig. 7. Normalized gate trigger current as a function of junction temperature

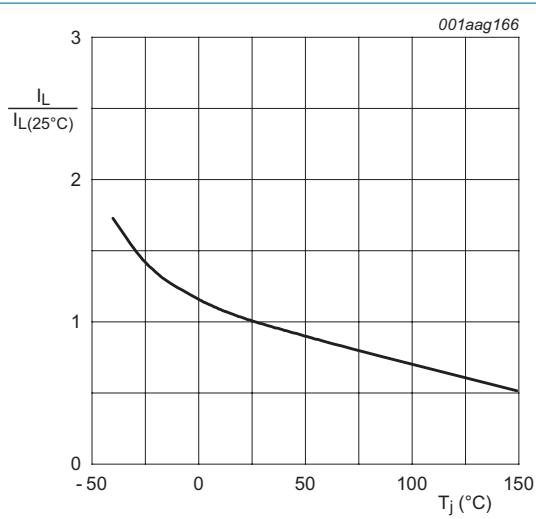


Fig. 8. Normalized latching current as a function of junction temperature

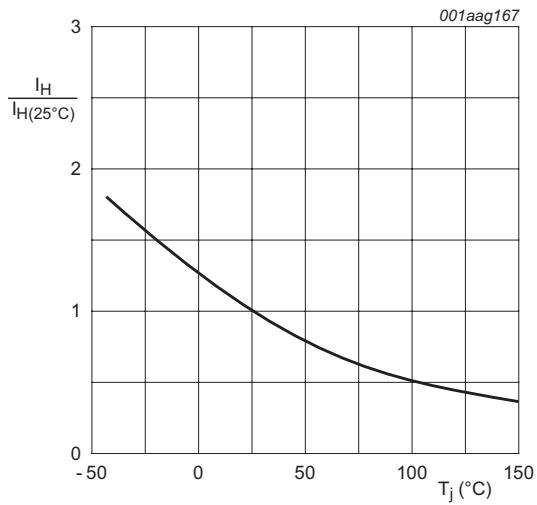


Fig. 9. Normalized holding current as a function of junction temperature

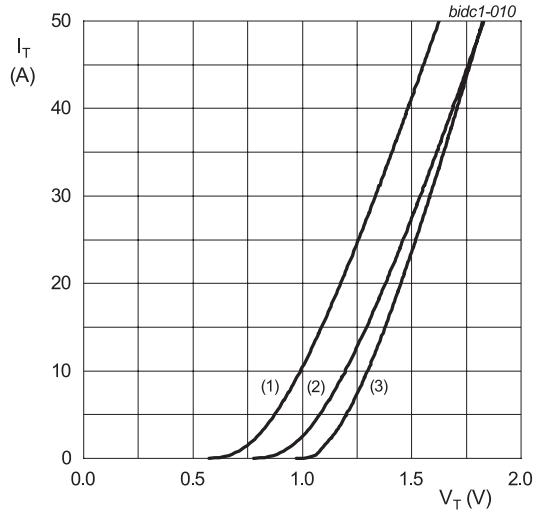


Fig. 10. On-state current as a function of on-state voltage

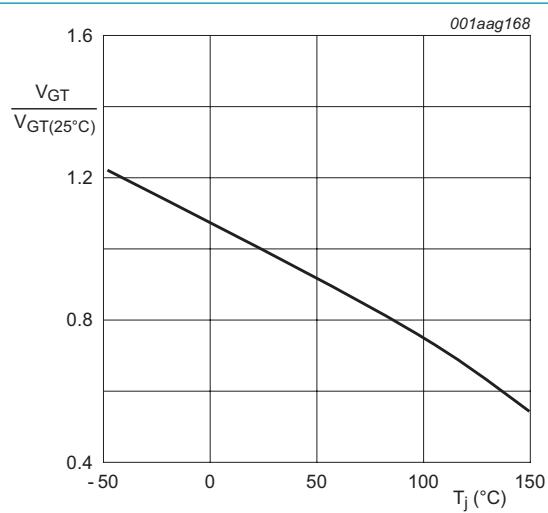


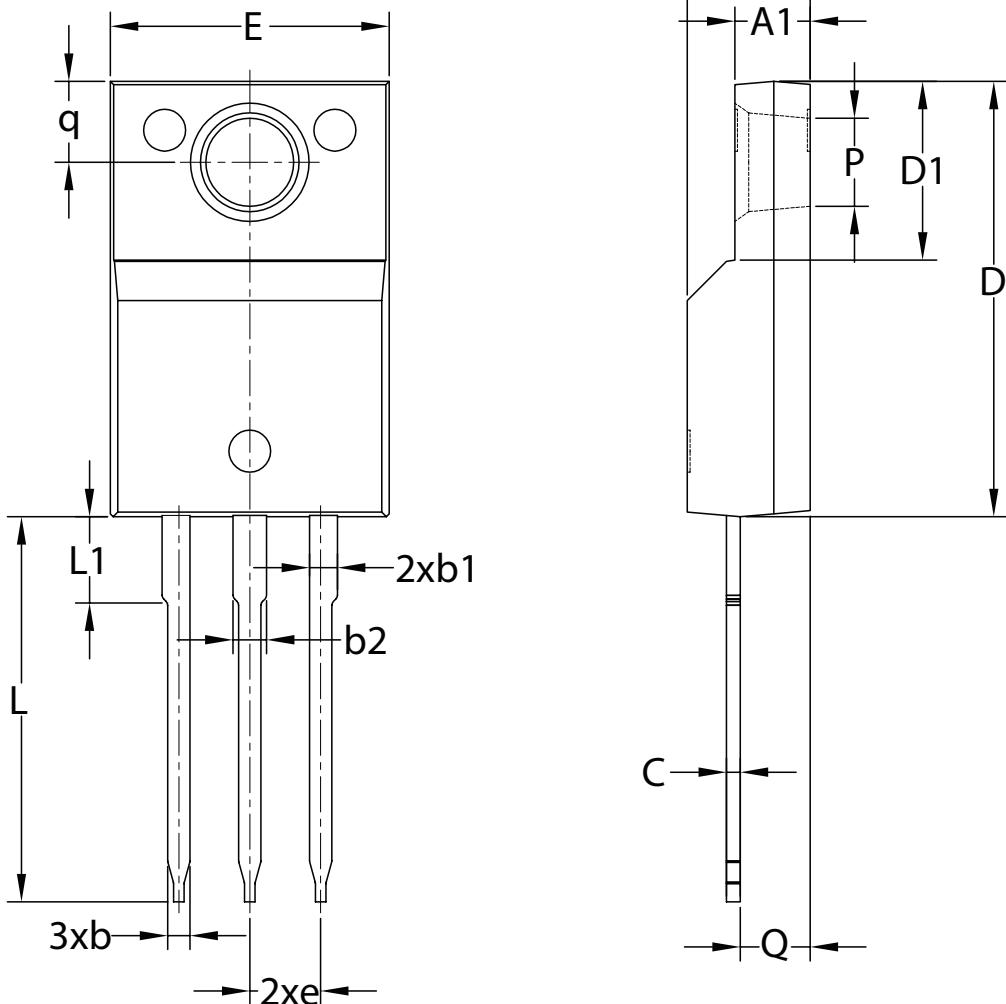
Fig. 11. Normalized gate trigger voltage as a function of junction temperature

12. Package outline

Assembly factory: E

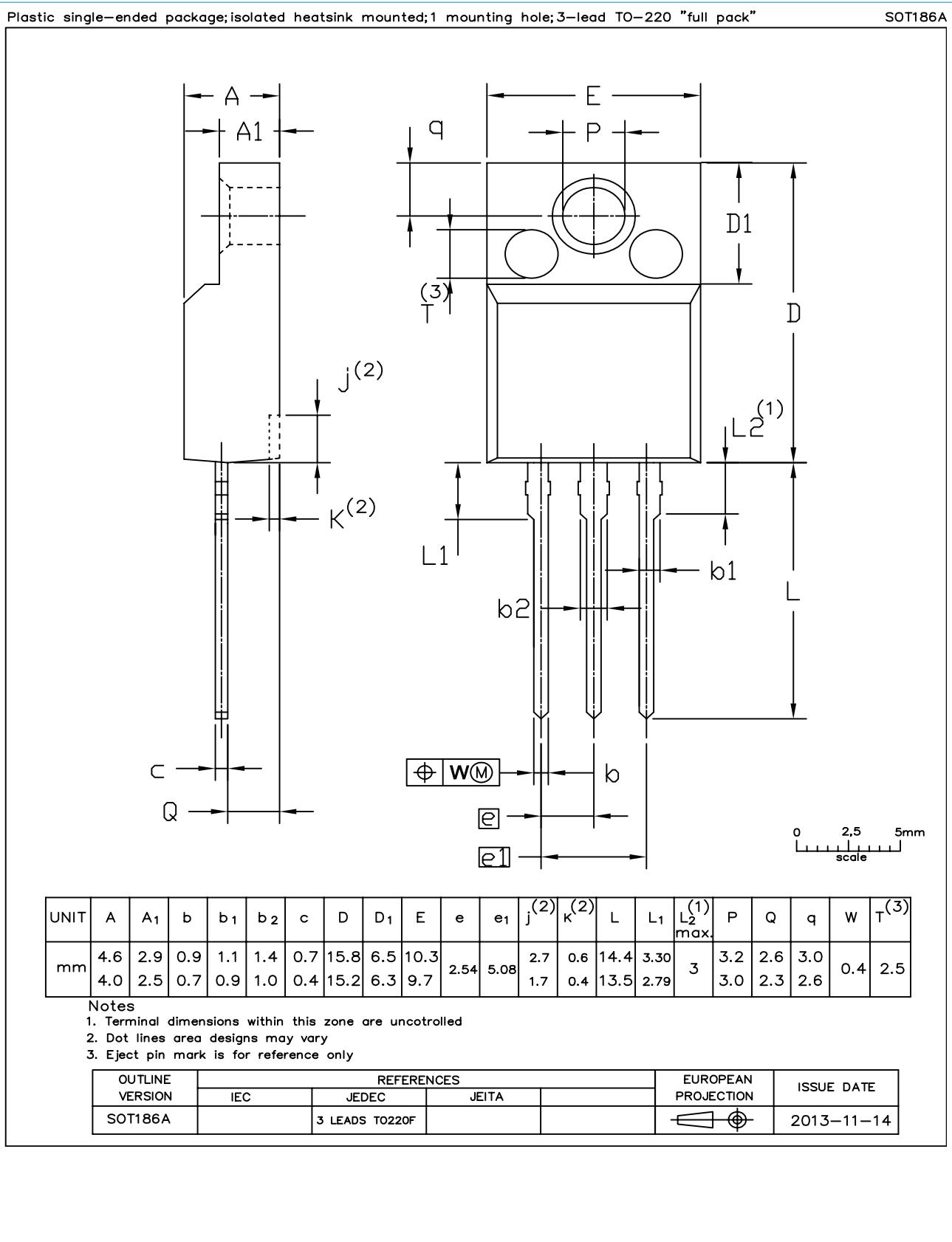
Plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3 leads TO-220 'full pack'

TO220F



Unit	A	A1	b	b1	b2	c	D	D1	E	e	L	L1	P	Q	q
MM	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
MM	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

Assembly factory: d



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: 30 January 2024
