BTA412Y-600ET

3Q Hi-Com Triac

Rev.02 - 08 November 2021 Product data sheet

1. General description

Planar passivated high commutation three quadrant triac in a IITO220 internally insulated plastic package. This "series ET" triac balances the requirements of commutation performance and gate sensitivity and is intended for interfacing with low power drivers including microcontrollers. It is used in applications where "high junction operating temperature" capability is required.

2. Features and benefits

- 3Q technology for improved noise immunity
- High commutation capability with sensitive gate
- High blocking voltage capability
- Direct interfacing with low power drives and microcontrollers
- High junction operating temperature ($T_{j(max)}$ = 150 °C)
- Isolated mounting base with 2500 V (RMS) isolation
- Internally insulated package
- Planar passivated for voltage ruggedness and reliability
- Good immunity to false turn-on by dV/dt
- Triggering in three quadrants only

3. Applications

- Electronic thermostats (heating and cooling)
- Motor controls (large and small home appliances, light industrial)
- Refrigeration and air-conditioner compressor controls
- Lamp dimmers (LED and incandescent)
- AC power tools

4. Quick reference data

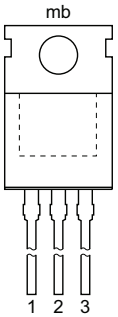
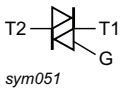
Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DRM}	repetitive peak off-state voltage			-	-	600	V
$I_{T(RMS)}$	RMS on-state current	full sine wave; $T_{mb} \leq 117$ °C; Fig.1; Fig. 2; Fig. 3		-	-	12	A
I_{TSM}	non-repetitive peak on-state current	full sine wave; $T_{j(init)}$ = 25 °C; t_p = 20 ms; Fig. 4; Fig. 5		-	-	140	A
		full sine wave; $T_{j(init)}$ = 25 °C; t_p = 16.7 ms		-	-	150	A
T_j	junction temperature			-	-	150	°C
Static characteristics							
I_{GT}	gate trigger current	V_D = 12 V; I_T = 0.1 A; T2+ G+; T_j = 25 °C; Fig. 7		0.5	-	10	mA
		V_D = 12 V; I_T = 0.1 A; T2+ G-; T_j = 25 °C; Fig. 7		0.5	-	10	mA
		V_D = 12 V; I_T = 0.1 A; T2- G-; T_j = 25 °C; Fig. 7		0.5	-	10	mA

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_H	holding current	V_D = 12 V; T_j = 25 °C; Fig. 9		-	-	10	mA
V_T	on-state voltage	I_T = 17 A; T_j = 25 °C; Fig. 10		-	1.3	1.6	V
Dynamic characteristics							
dV_D/dt	rate of rise of off-state voltage	V_{DM} = 402 V; T_j = 125 °C; (V_{DM} = 67% of V_{DRM}); exponential waveform; gate open circuit		300	-	-	V/µs
		V_{DM} = 402 V; T_j = 150 °C; (V_{DM} = 67% of V_{DRM}); exponential waveform; gate open circuit		200	-	-	V/µs
dI_{com}/dt	rate of change of commutating current	V_{DM} = 400 V; T_j = 150 °C; $I_{T(RMS)}$ = 12 A; dV_{com}/dt = 20 V/µs; (snubberless condition); gate open circuit; Fig. 12		3	-	-	A/ms
		V_{DM} = 400 V; T_j = 150 °C; $I_{T(RMS)}$ = 12 A; dV_{com}/dt = 10 V/µs; gate open circuit		4	-	-	A/ms
		V_{DM} = 400 V; T_j = 150 °C; $I_{T(RMS)}$ = 12 A; dV_{com}/dt = 1 V/µs; gate open circuit		6	-	-	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
BTA412Y-600ET	IITO220	BTA412Y-600ETQ	Tube	50	SOT78D	07-July-2010

7. Marking

Table 4. Marking codes

Type number	Marking codes
BTA412Y-600ET	BTA412Y 600ET

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			-	600	V
$I_{T(RMS)}$	RMS on-state current	full sine wave; $T_{mb} \leq 117°C$; Fig.1; Fig. 2; Fig. 3		-	12	A
I_{TSM}	non-repetitive peak on-state current	full sine wave; $T_{j(init)} = 25$ °C; $t_p = 20$ ms; Fig. 4; Fig. 5		-	140	A
		full sine wave; $T_{j(init)} = 25$ °C; $t_p = 16.7$ ms		-	150	A
I^2t	I^2t for fusing	$t_p = 10$ ms; sine wave pulse		-	98	A^2s
dI_T/dt	rate of rise of on-state current	$I_G = 0.2$ A		-	100	A/µs
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	150	°C
T_j	junction temperature			-	150	°C

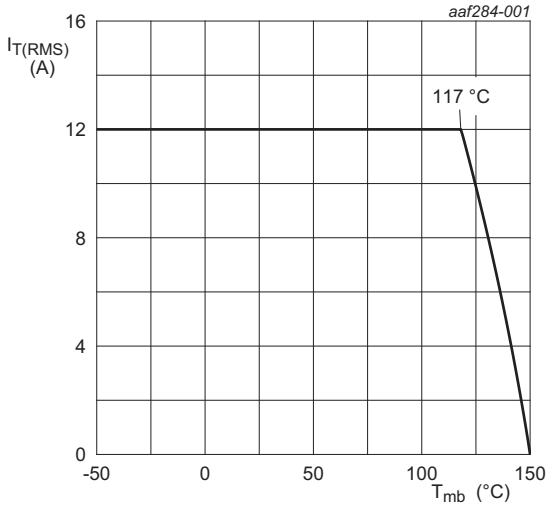
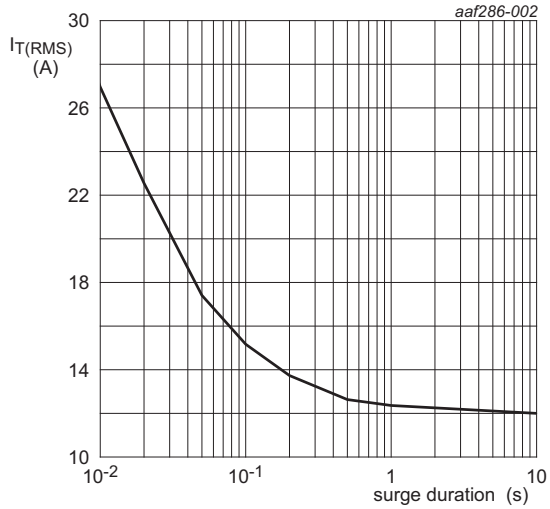
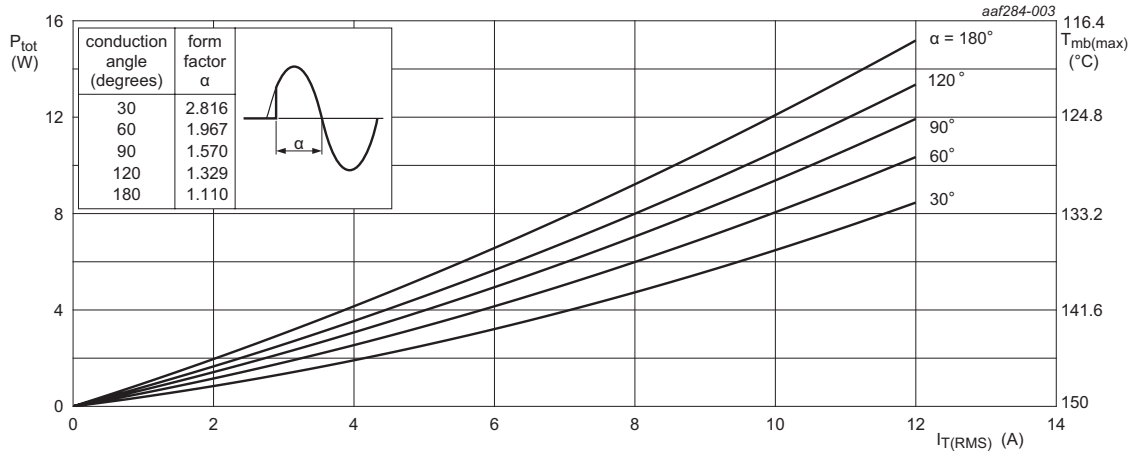


Fig. 1. RMS on-state current as a function of mounting base temperature; maximum values



f = 50 Hz; T_{mb} =117°C

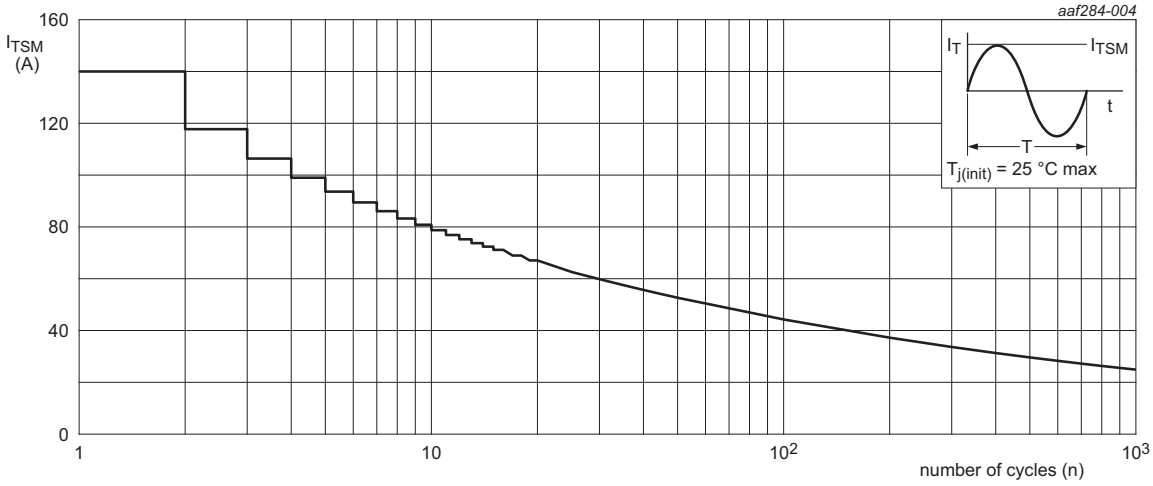
Fig. 2. RMS on-state current as a function of surge duration; maximum values



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

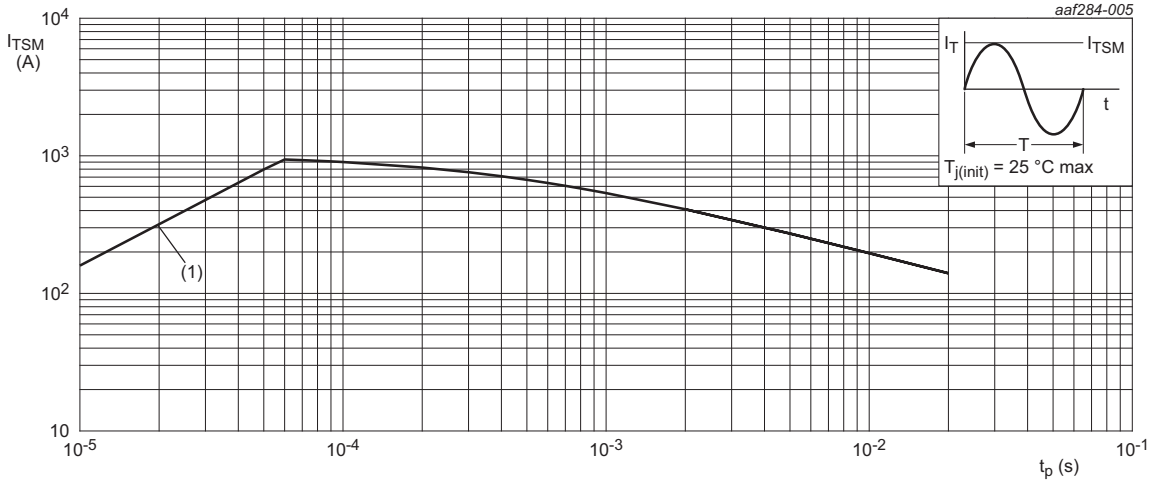
α = conduction angle

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
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	full cycle; Fig. 6		-	-	2.1	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air		-	60	-	K/W

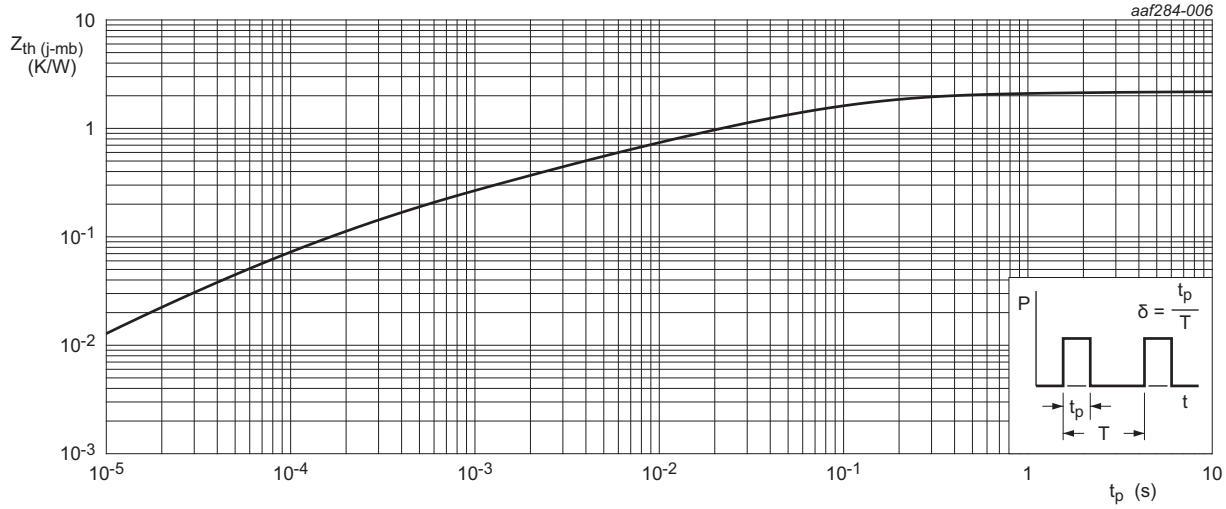


Fig. 6. Transient thermal impedance from junction to mounting base as a function of pulse duration

10. Isolation characteristics

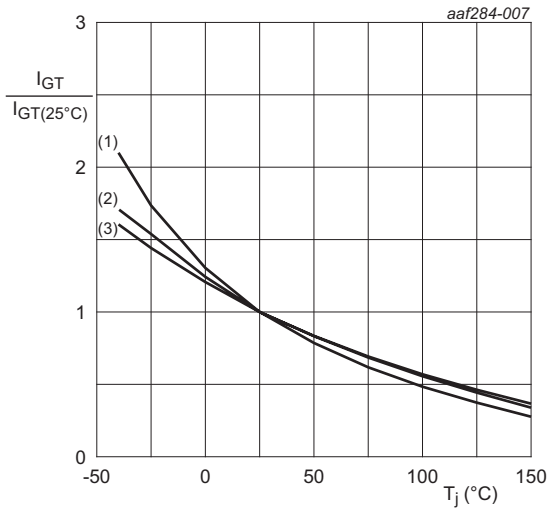
Table 7. Isolation Characteristics

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 Hz ≤ f ≤ 60 Hz; RH ≤ 65 %; T_{mb} = 25 °C		-	-	2500	V
C_{isol}	isolation capacitance	from main terminal 2 to external heatsink; f = 1 MHz; T_{mb} = 25 °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 V; I_T = 0.1 A; T2+ G+; T_j = 25 °C; Fig. 7		0.5	-	10	mA
		V_D = 12 V; I_T = 0.1 A; T2+ G-; T_j = 25 °C; Fig. 7		0.5	-	10	mA
		V_D = 12 V; I_T = 0.1 A; T2- G-; T_j = 25 °C; Fig. 7		0.5	-	10	mA
I_L	latching current	V_D = 12 V; I_G = 0.1 A; T2+ G+; T_j = 25 °C; Fig. 8		-	-	25	mA
		V_D = 12 V; I_G = 0.1 A; T2+ G-; T_j = 25 °C; Fig. 8		-	-	35	mA
		V_D = 12 V; I_G = 0.1 A; T2- G-; T_j = 25 °C; Fig. 8		-	-	25	mA
I_H	holding current	V_D = 12 V; T_j = 25 °C; Fig. 9		-	-	10	mA
V_T	on-state voltage	I_T = 17 A; T_j = 25 °C; Fig. 10		-	1.3	1.6	V
V_{GT}	gate trigger voltage	V_D = 12 V; I_T = 0.1 A; T_j = 25 °C Fig. 11		-	0.8	1	V
		V_D = 400V; I_T = 0.1 A; T_j = 150 °C		0.2	0.5	-	V
I_D	off-state current	V_D = 600 V; T_j = 25 °C		-	-	10	mA
		V_D = 600 V; T_j = 150 °C		-	0.4	2	mA
Dynamic characteristics							
dV_D/dt	rate of rise of off-state voltage	V_{DM} = 402 V; T_j = 125 °C; (V_{DM} = 67% of V_{DRM}); exponential waveform; gate open circuit		300	-	-	V/µs
		V_{DM} = 402 V; T_j = 150 °C; (V_{DM} = 67% of V_{DRM}); exponential waveform; gate open circuit		200	-	-	V/µs
dI_{com}/dt	rate of change of commutating current	V_{DM} = 400 V; T_j = 150 °C; $I_{T(RMS)}$ = 12 A; dV_{com}/dt = 20 V/µs; (snubberless condition); gate open circuit; Fig. 12		3	-	-	A/ms
		V_{DM} = 400 V; T_j = 150 °C; $I_{T(RMS)}$ = 12 A; dV_{com}/dt = 10 V/µs; gate open circuit		4	-	-	A/ms
		V_{DM} = 400 V; T_j = 150 °C; $I_{T(RMS)}$ = 12 A; dV_{com}/dt = 1 V/µs; gate open circuit		6	-	-	A/ms



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

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

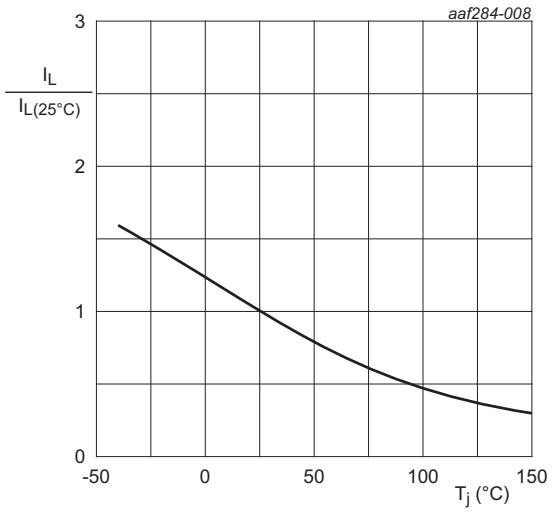


Fig. 8. Normalized latching current as a function of junction temperature

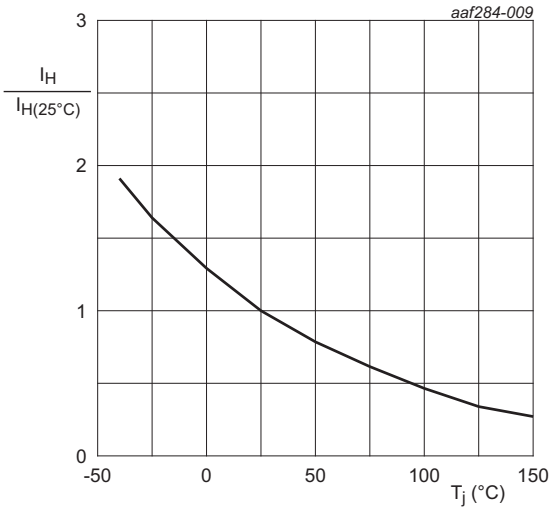
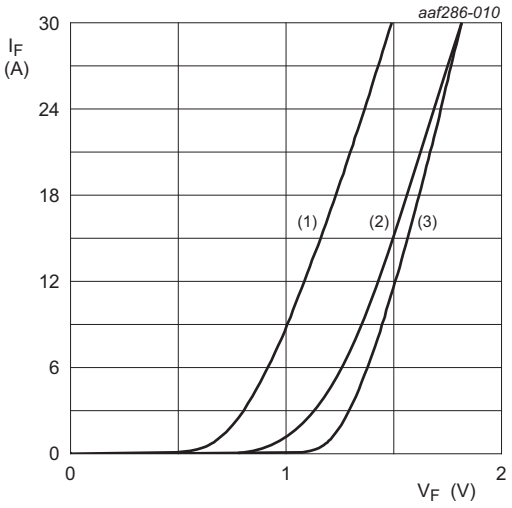


Fig. 9. Normalized holding current as a function of junction temperature



V_o = 1.086 V; R_s = 0.0271 Ω
(1) T_j = 150 °C; typical values
(2) T_j = 150 °C; maximum values
(3) T_j = 25 °C; maximum values

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

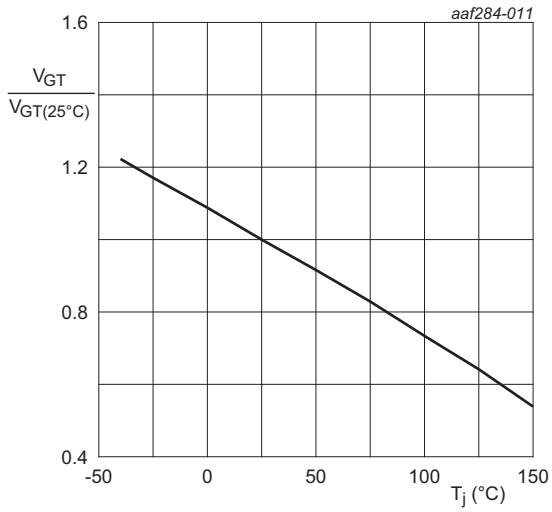


Fig. 11. Normalized gate trigger voltage as a function of junction temperature

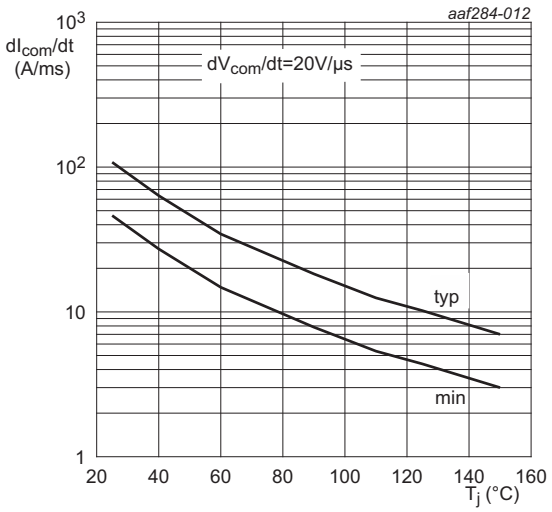
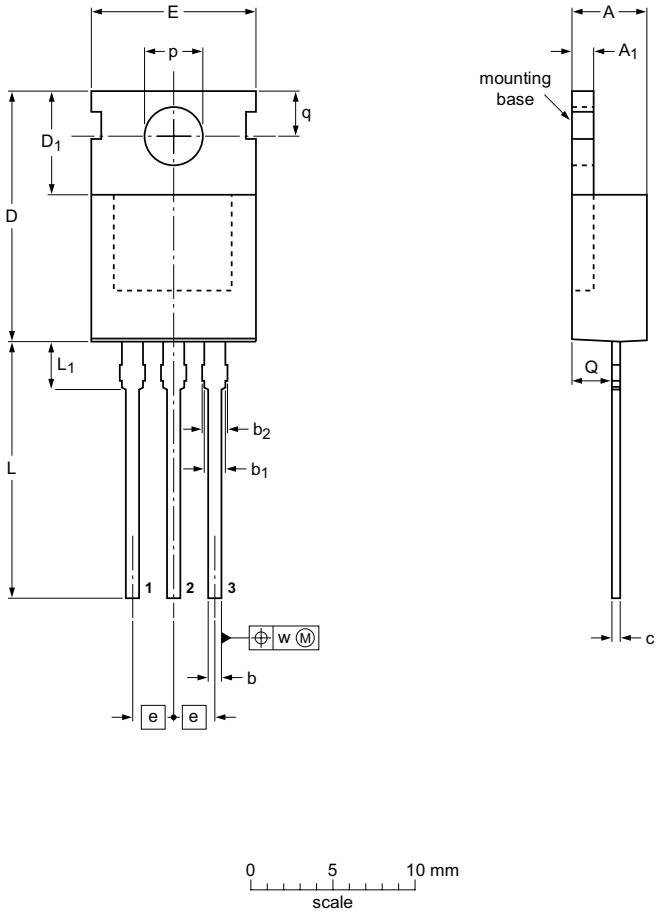


Fig. 12. Rate of change of commutating current as a function of junction temperature; typical and minimum values

12. Package outline

Assembly factory: A

Plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3-lead TO-220 **SOT78D**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b	b_1	b_2	c	D	D_1 ref	E	e	L	L_1 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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