

1. General description

Planar passivated high commutation three quadrant triac in a ITO220 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 ($T_{j(max)} = 150\text{ °C}$)
- 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

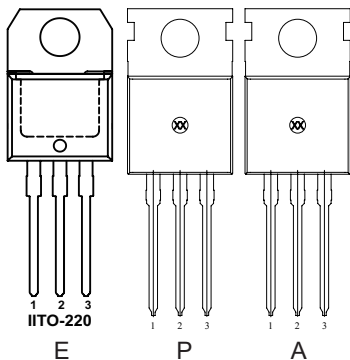
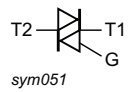
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DRM}	repetitive peak off-state voltage		-	-	800	V
$I_{T(RMS)}$	RMS on-state current	full sine wave; $T_{mb} \leq 118\text{ °C}$; Fig.1 ; Fig. 2 ; Fig. 3	-	-	12	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	-	-	140	A
		full sine wave; $T_{j(init)} = 25\text{ °C}$; $t_p = 16.7\text{ ms}$	-	-	150	A
T_j	junction temperature		-	-	150	°C
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	0.5	-	10	mA
		$V_D = 12\text{ V}$; $I_T = 0.1\text{ A}$; T_2+ G-; $T_j = 25\text{ °C}$; Fig. 7	0.5	-	10	mA
		$V_D = 12\text{ V}$; $I_T = 0.1\text{ A}$; T_2- G-; $T_j = 25\text{ °C}$; Fig. 7	0.5	-	10	mA

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_H	holding current	$V_D = 12\text{ V}$; $T_j = 25\text{ °C}$; Fig. 9	-	-	10	mA
V_T	on-state voltage	$I_T = 17\text{ A}$; $T_j = 25\text{ °C}$; Fig. 10	-	1.3	1.6	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	300	-	-	V/ μs
		$V_{DM} = 536\text{ V}$; $T_j = 150\text{ °C}$; ($V_{DM} = 67\%$ of V_{DRM}); exponential waveform; gate open circuit	150	-	-	V/ μs
dI_{com}/dt	rate of change of commutating current	$V_{DM} = 400\text{ V}$; $T_j = 150\text{ °C}$; $I_{T(RMS)} = 12\text{ A}$; $dV_{com}/dt = 20\text{ V}/\mu\text{s}$; (snubberless condition); gate open circuit; Fig. 12	3	-	-	A/ms
		$V_{DM} = 400\text{ V}$; $T_j = 150\text{ °C}$; $I_{T(RMS)} = 12\text{ A}$; $dV_{com}/dt = 10\text{ V}/\mu\text{s}$; gate open circuit	4	-	-	A/ms
		$V_{DM} = 400\text{ V}$; $T_j = 150\text{ °C}$; $I_{T(RMS)} = 12\text{ A}$; $dV_{com}/dt = 1\text{ V}/\mu\text{s}$; 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-800ET	IITO220	BTA412Y-800ETQ	Tube	50	IITO220E (E)	15-Dec-2017
					IITO220P (P)	31-Mar-2023
					SOT78D (A)	07-July-2010

7. Marking

Table 4. Marking codes

Type number	Marking codes		
	Assembly factory: E	Assembly factory: P	Assembly factory: A
BTA412Y-800ET	BTA412Y 800ET PJExxxx xx	BTA412Y 800ET PJPxxxx xx	BTA412Y 800ET PJAxxxx xx

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
$I_{\text{T(RMS)}}$	RMS on-state current	full sine wave; $T_{\text{mb}} \leq 118\text{ }^{\circ}\text{C}$; Fig.1 ; Fig. 2 ; Fig. 3		-	12	A
I_{TSM}	non-repetitive peak on-state current	full sine wave; $T_{\text{j(Init)}} = 25\text{ }^{\circ}\text{C}$; $t_{\text{p}} = 20\text{ ms}$; Fig. 4 ; Fig. 5		-	140	A
		full sine wave; $T_{\text{j(Init)}} = 25\text{ }^{\circ}\text{C}$; $t_{\text{p}} = 16.7\text{ ms}$		-	150	A
I^2t	I^2t for fusing	$t_{\text{p}} = 10\text{ ms}$; sine wave pulse		-	98	A^2s
di_{T}/dt	rate of rise of on-state current	$I_{\text{G}} = 0.2\text{ A}$		-	100	$\text{A}/\mu\text{s}$
I_{GM}	peak gate current			-	2	A
P_{GM}	peak gate power			-	5	W
$P_{\text{G(AV)}}$	average gate power	over any 20 ms period		-	0.5	W
T_{stg}	storage temperature			-40	150	$^{\circ}\text{C}$
T_{j}	junction temperature			-	150	$^{\circ}\text{C}$

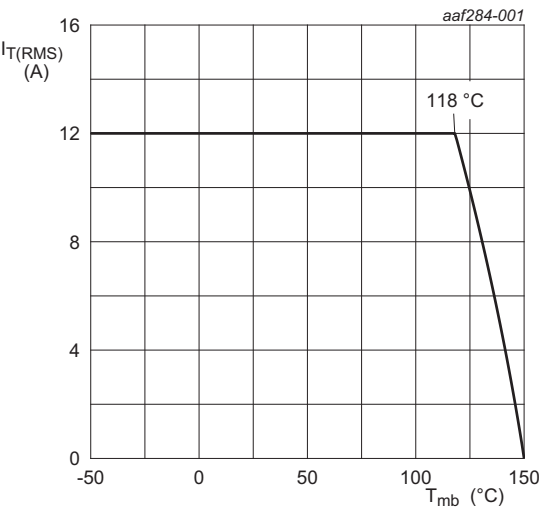
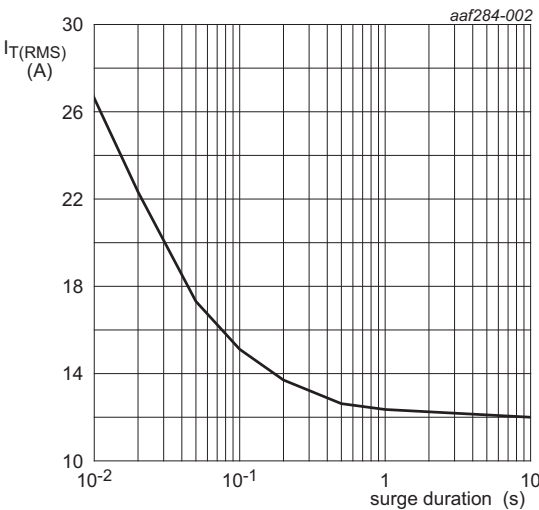


Fig. 1. RMS on-state current as a function of mounting base temperature; maximum values



$f = 50\text{ Hz}$; $T_{\text{mb}} = 118\text{ }^{\circ}\text{C}$
Fig. 2. RMS on-state current as a function of surge duration; maximum values

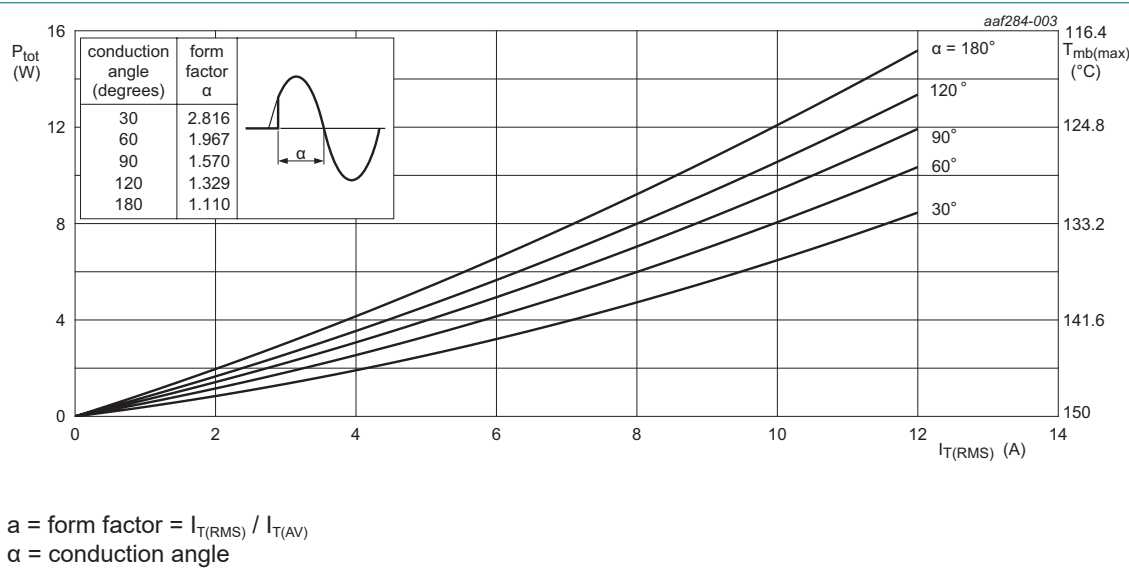


Fig. 3. Total power dissipation as a function of RMS on-state current; maximum values

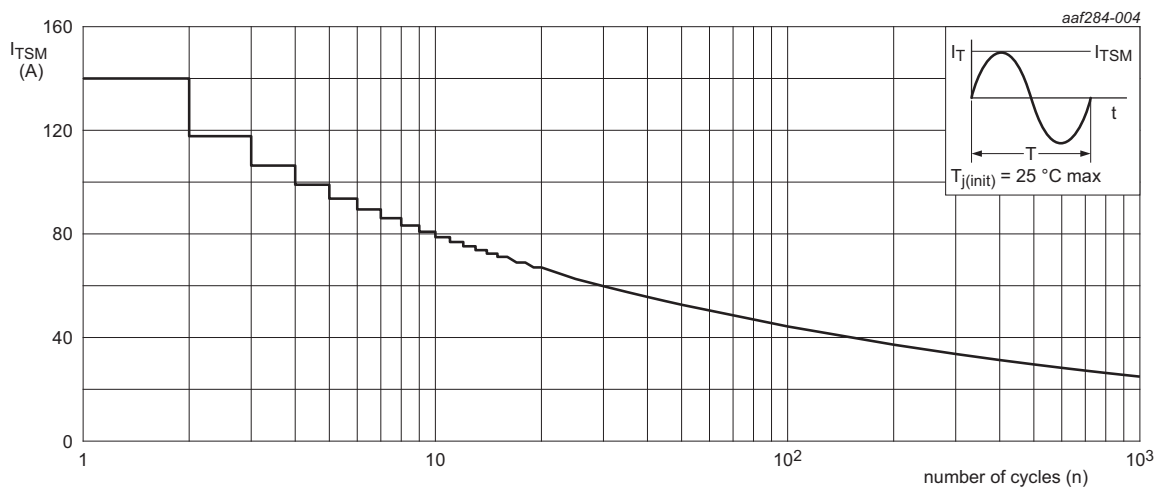


Fig. 4. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values

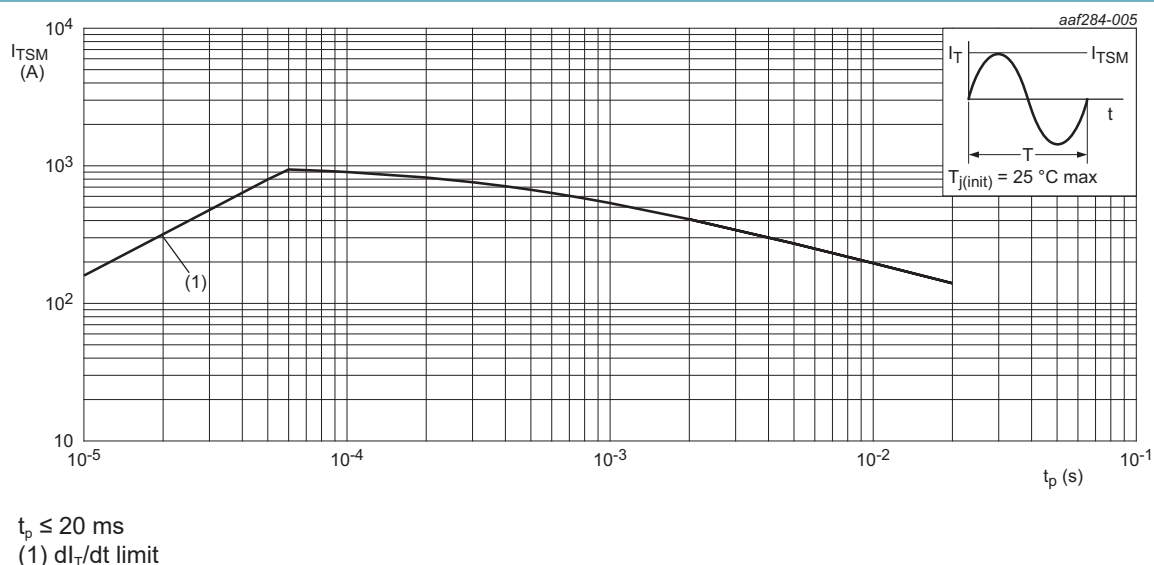
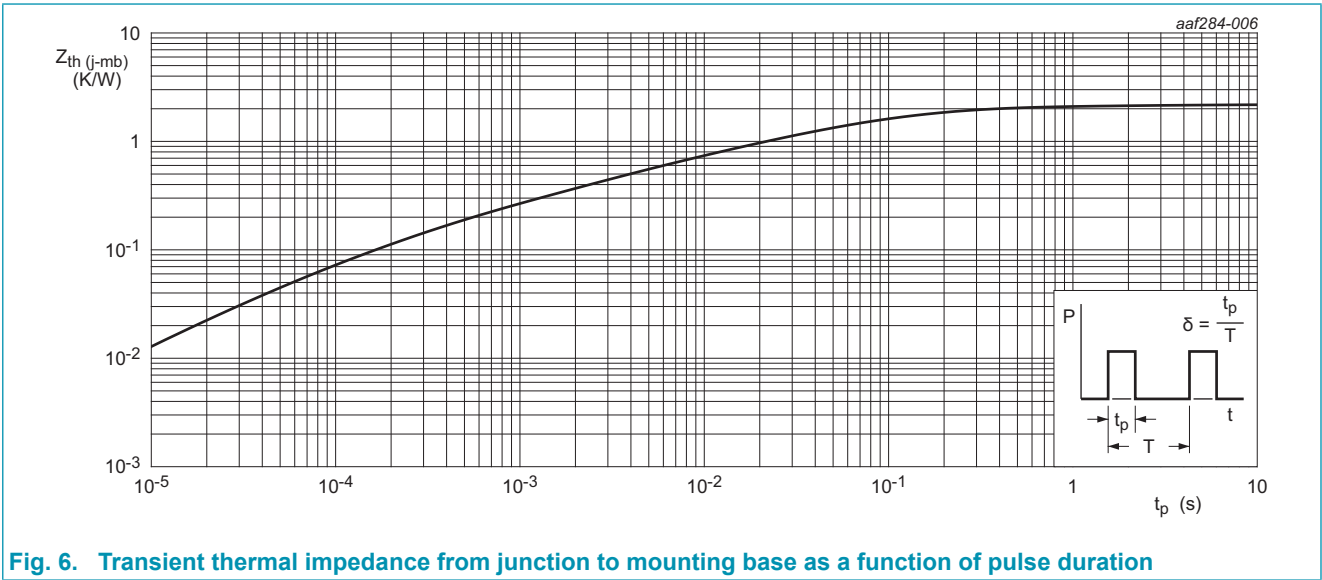


Fig. 5. Non-repetitive peak on-state current as a function of pulse duration; maximum values

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



10. Isolation characteristics

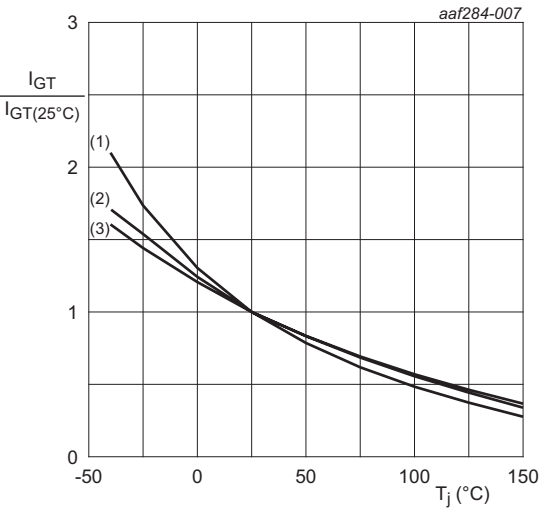
Table 7. Isolation Characteristics

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

11. Characteristics

Table 8. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
I _{GT}	gate trigger current	V _D = 12 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 = 800 V; T _J = 25 °C		-	-	10	mA
		V _D = 800 V; T _J = 150 °C		-	0.4	2	mA
Dynamic characteristics							
dV _D /dt	rate of rise of off-state voltage	V _{DM} = 536 V; T _J = 125 °C; (V _{DM} = 67% of V _{DRM}); exponential waveform; gate open circuit		300	-	-	V/μs
		V _{DM} = 536 V; T _J = 150 °C; (V _{DM} = 67% of V _{DRM}); exponential waveform; gate open circuit		150	-	-	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

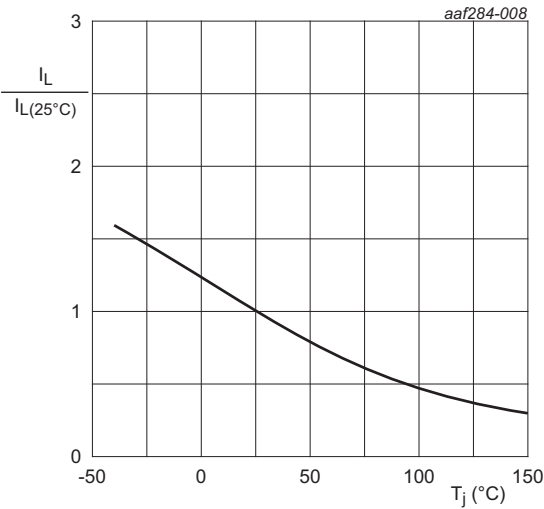


Fig. 8. Normalized latching current as a function of junction temperature

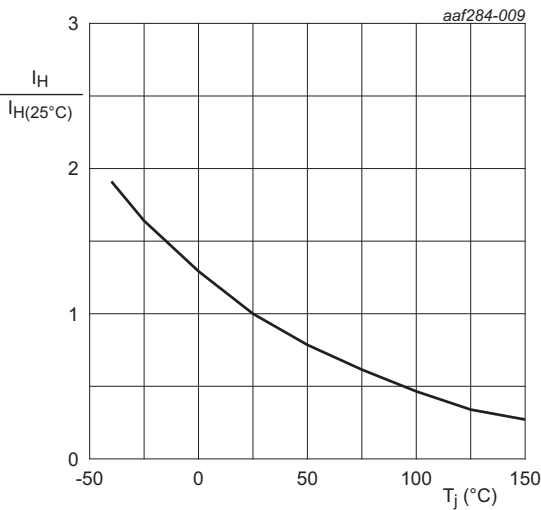
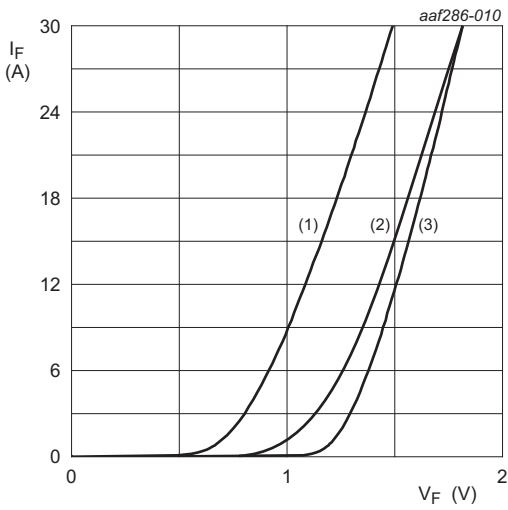


Fig. 9. Normalized holding current as a function of junction temperature



- $V_o = 1.027\text{ V}; R_s = 0.0283\text{ }\Omega$
- (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

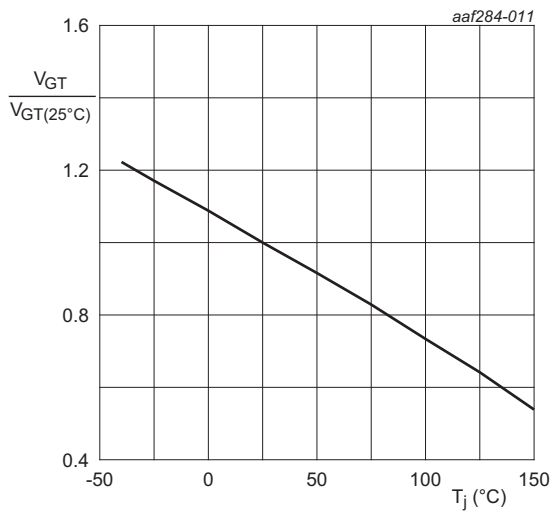


Fig. 11. Normalized gate trigger voltage as a function of junction temperature

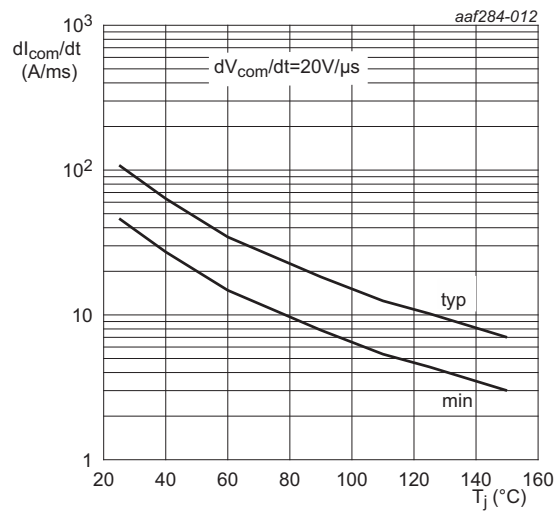
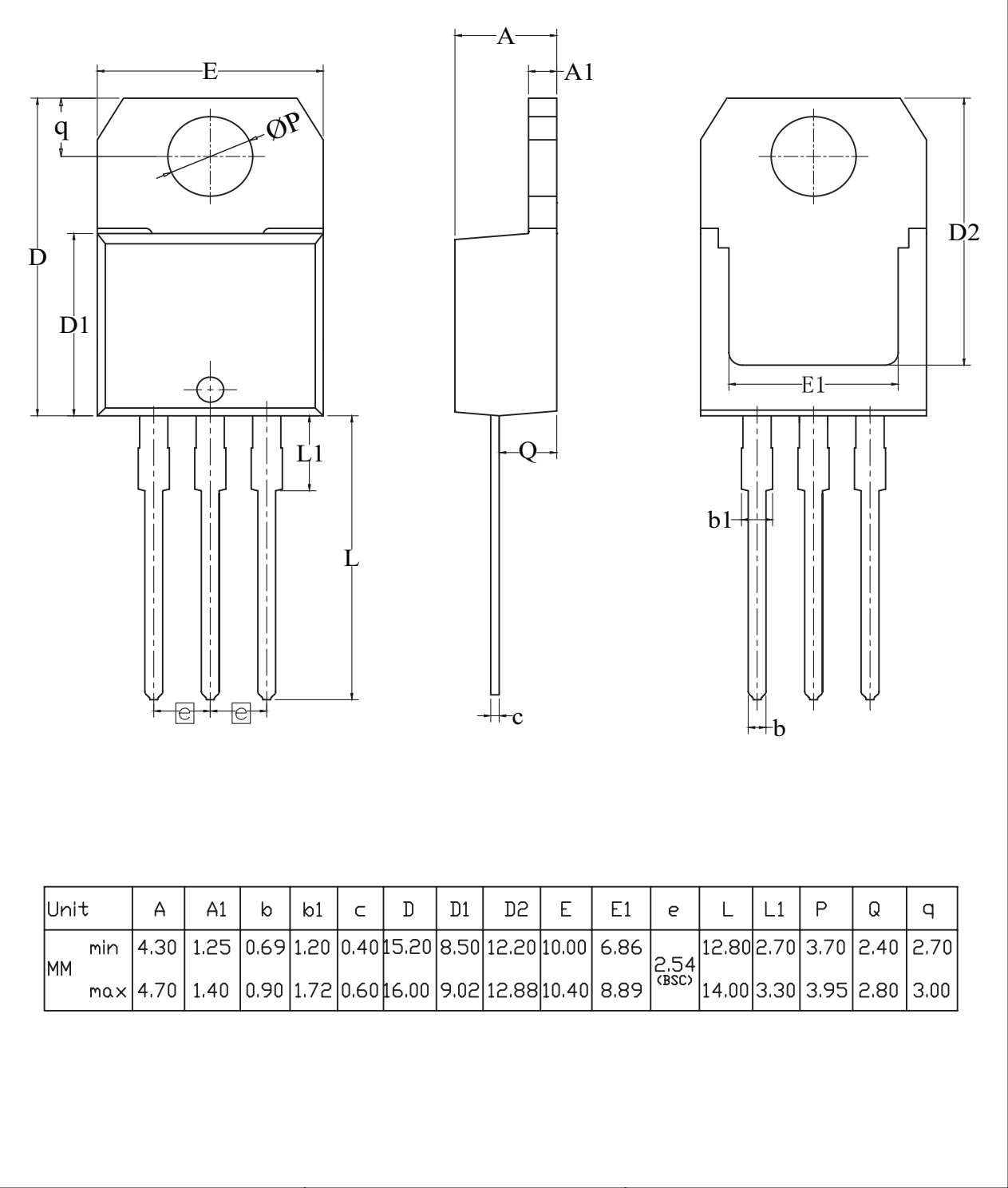


Fig. 12. Rate of change of commutating current as a function of junction temperature; typical and minimum values

12. Package outline

Assembly factory: E

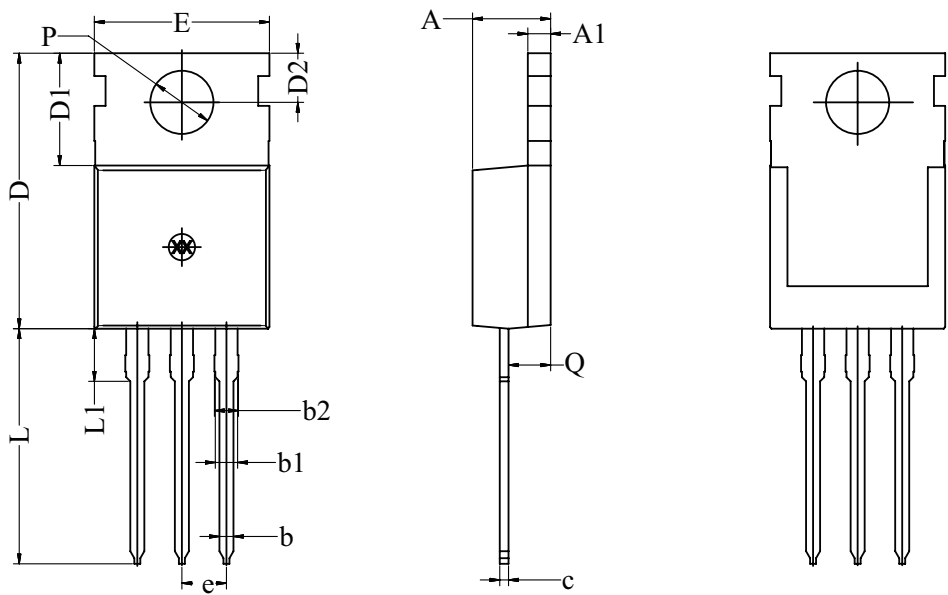
Plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3 leads TO-220 IITO220



Assembly factory: P

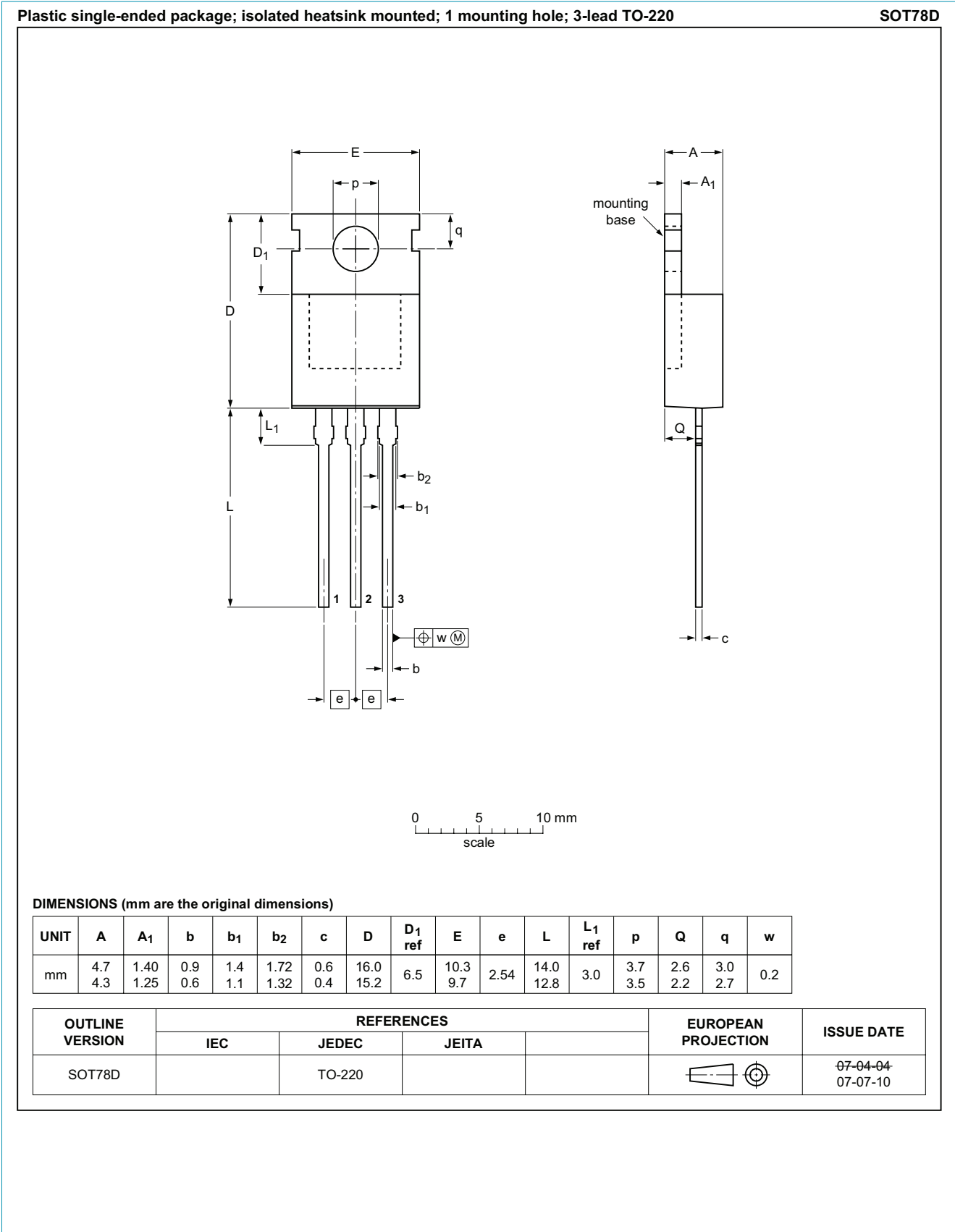
Plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3 leads TO-220

IIT0220



Dim	All Dimensions in Millimeters		
	Min	Typ	Max
A	4.30	4.45	4.70
A1	1.25	1.30	1.40
b	0.60	0.80	0.90
b1	1.10	1.27	1.40
b2	1.32	1.37	1.72
c	0.40	0.50	0.60
D	15.20	15.70	16.00
D1	6.20	6.40	6.60
D2	2.70	2.80	3.00
E	9.70	10.00	10.30
e	2.54 BSC		
L	12.80	13.40	14.00
L1	2.80	3.00	3.20
P	3.50	3.60	3.70
Q	2.20	2.40	2.60

Assembly factory: A



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.

- [1] Please consult the most recently issued document before initiating or completing a design.
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