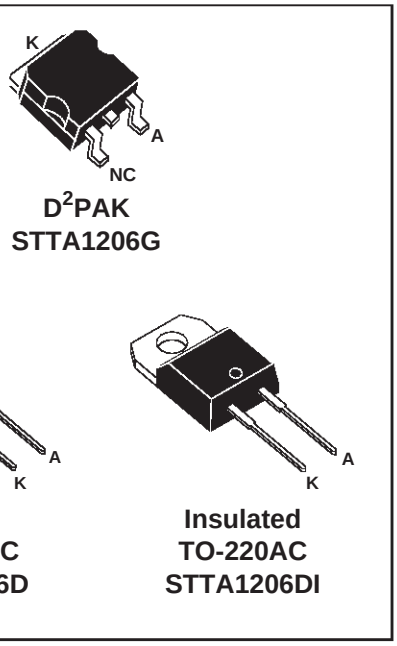
STTA1206D/DI/G

TURBOSWITCH ULTRA-FAST HIGH VOLTAGE DIODE

MAIN PRODUCT CHARACTERISTICS

$I_{F(AV)}$	12A
V_{RRM}	600V
t_{rr} (typ)	28ns
V_F (max)	1.5V



FEATURES AND BENEFITS

- SPECIFIC TO "FREEWHEEL MODE" OPERATIONS: FREEWHEEL OR BOOSTER DIODE.
- ULTRA-FAST AND SOFT RECOVERY.
- VERY LOW OVERALL POWER LOSSES IN BOTH THE DIODE AND THE COMPANION TRANSISTOR.
- HIGH FREQUENCY OPERATIONS.
- INSULATED PACKAGE : TO-220AC
  Electrical insulation : 2500V_{RMS}
  Capacitance < 7 pF

DESCRIPTION

TURBOSWITCH, family, drastically cuts losses in both the diode and the associated switching IGBT or MOSFET in all "freewheel mode" operations and is particularly suitable and efficient in motor control freewheel applications and in booster diode applications in power factor control circuitries.

Packaged in TO-220AC, isolated TO-220AC and D^2PAK, these 600V devices are particularly intended for use on 240V domestic mains.

ABSOLUTE RATINGS (limiting values)

Symbol	Parameter			Value	Unit
V_{RRM}	Repetitive peak reverse voltage			600	V
V_{RSM}	Non repetitive peak reverse voltage			600	V
$I_{F(RMS)}$	RMS forward current	TO-220AC / D2PAK		30	A
		TO-220AC ins.		20	A
I_{FRM}	Repetitive peak forward current	TO-220AC/D2PAK	tp=5µs F=5kHz square	160	A
		TO-220AC ins.		120	A
I_{FSM}	Surge non repetitive forward current		tp=10 ms sinusoidal	110	A
T_j	Maximum operating junction temperature			150	°C
T_{stg}	Storage temperature range			-65 to 150	°C

TM : TURBOSWITCH is a trademark of STMicroelectronics

THERMAL AND POWER DATA

Symbol	Parameter	Test conditions		Value	Unit
$R_{th(j-c)}$	Junction to case thermal resistance	TO-220AC / D^2PAK TO-220AC ins.		1.9 3.0	°C/W
P_1	Conduction power dissipation $I_{F(AV)}$ = 12A δ =0.5	TO-220AC / D^2PAK TO-220AC ins.	Tc= 108°C Tc= 84°C	22	W
P_{max}	Total power dissipation Pmax = P1 + P3 (P3 = 10% P1)	TO-220AC /D^2PAK TO-220AC ins.	Tc= 104°C Tc= 78°C	24	W

STATIC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test conditions		Min	Typ	Max	Unit
V_F *	Forward voltage drop	I_F =12A	Tj = 25°C Tj = 125°C		 1.25	1.75 1.5	V V
I_R **	Reverse leakage current	V_R =0.8 x V_{RRM}	Tj = 25°C Tj = 125°C		 2	100 5	µA mA
V_{to}	Threshold voltage	Ip < 3.I_{AV}	Tj = 125°C			1.15	V
rd	Dynamic resistance					29	mΩ

Test pulse :

* tp = 380 µs, δ cycle < 2%

** tp = 5 ms, δ cycle < 2%

To evaluate the maximum conduction losses use the following equation :

$P = V_{to} \times I_{F(AV)} + rd \times I_F{}^2{}_{(RMS)}$

DYNAMIC ELECTRICAL CHARACTERISTICS

TURN-OFF SWITCHING

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
t_{rr}	Reverse recovery time	Tj = 25°C I_F = 0.5 A I_R = 1A Irr = 0.25A I_F = 1 A dI_F/dt =-50A/µs V_R =30V		28	 55	ns
I_{RM}	Maximum reverse recovery current	Tj = 125°C VR = 400V I_F =12A dI_F/dt = -96 A/µs dI_F/dt = -500 A/µs		 16	7.5	A
S factor	Softness factor	Tj = 125°C V_R = 400V I_F =12A dI_F/dt = -500 A/µs		0.45		-

TURN-ON SWITCHING

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
t_{fr}	Forward recovery time	Tj = 25°C I_F =12 A, dI_F/dt = 96 A/µs measured at, 1.1 × $V_F$max			500	ns
V_{Fp}	Peak forward voltage	Tj = 25°C I_F =12A, dI_F/dt = 96 A/µs			10	V

Fig. 1: Conduction losses versus average current.

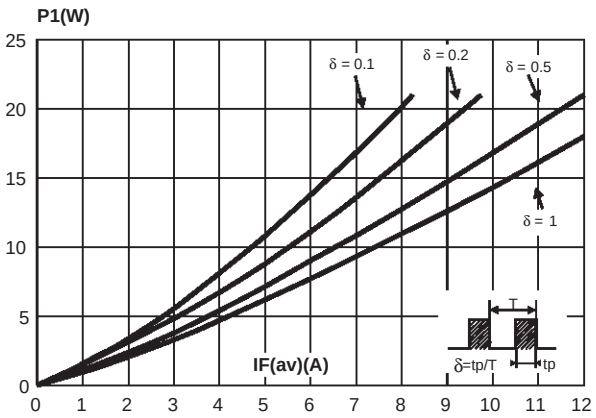


Fig. 2: Forward voltage drop versus forward current.

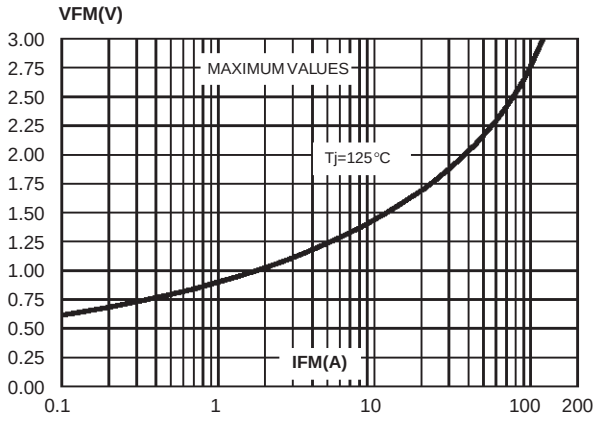


Fig. 3: Relative variation of thermal transient impedance junction to case versus pulse duration.

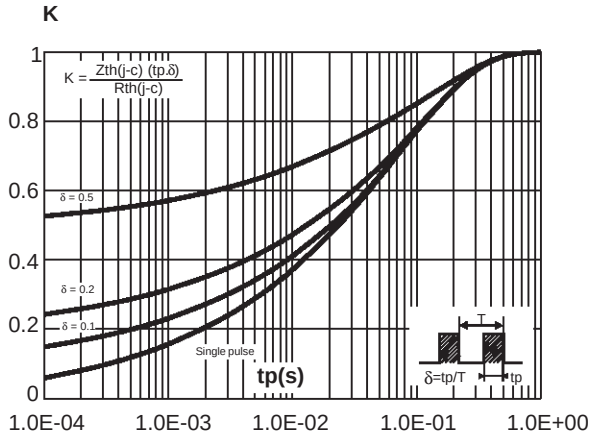


Fig. 4: Peak reverse recovery current versus dI_F/dt.

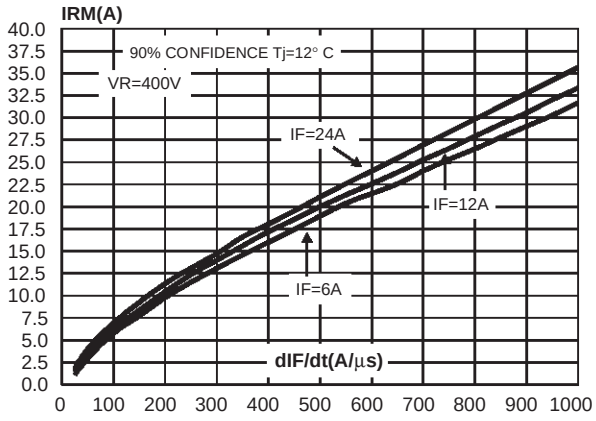


Fig. 5: Reverse recovery time versus dI_F/dt.

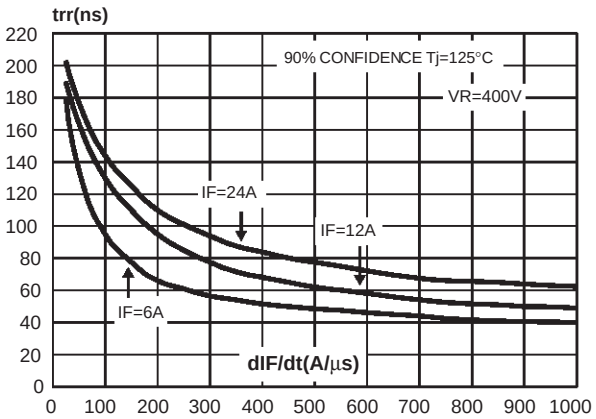


Fig. 6: Softness factor (tb/ta) versus dI_F/dt.

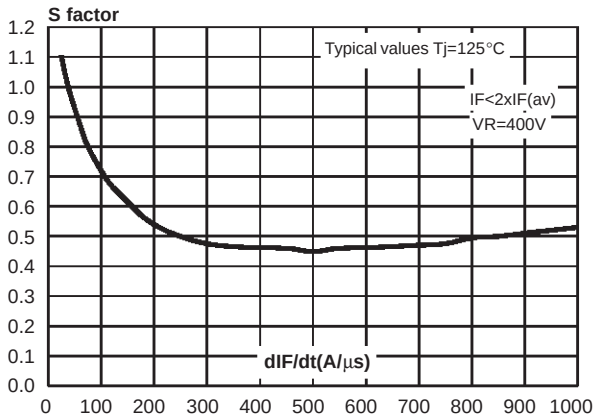


Fig. 7: Relative variation of dynamic parameters versus junction temperature (Reference Tj=125°C).

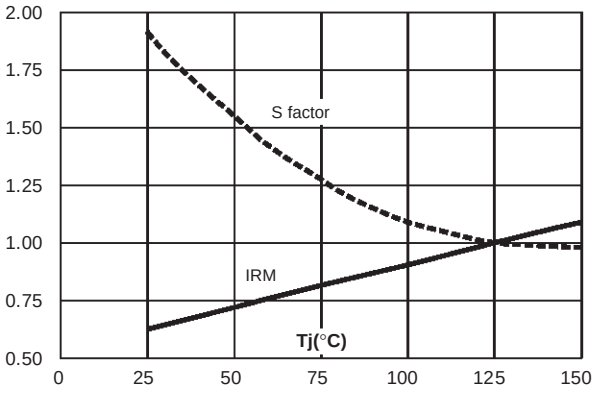


Fig. 8: Transient peak forward voltage versus dI_F/dt.

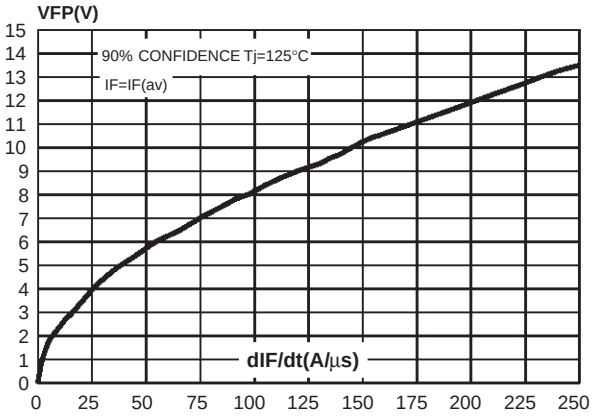
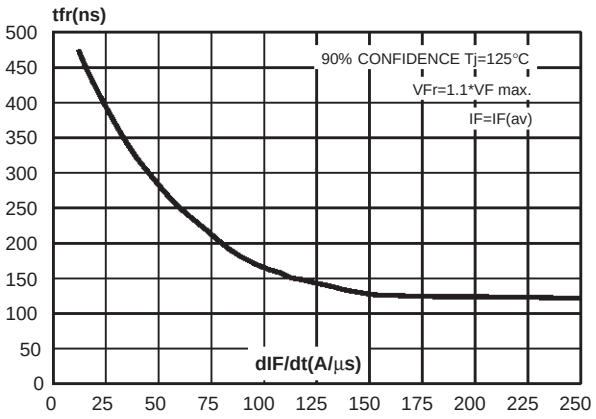


Fig. 9: Forward recovery time versus dI_F/dt.



APPLICATION DATA

The TURBOSWITCH is especially designed to provide the lowest overall power losses in any "FREEWHEEL Mode" application (Fig.A) considering both the diode and the companion transistor, thus optimizing the overall performance in the end application.
The way of calculating the power losses is given below:

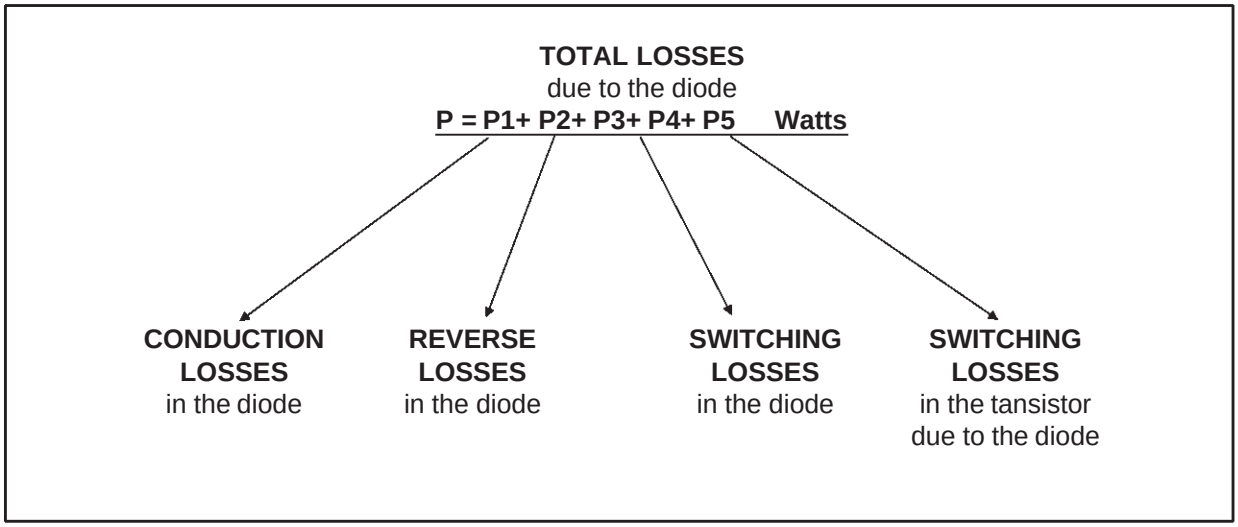
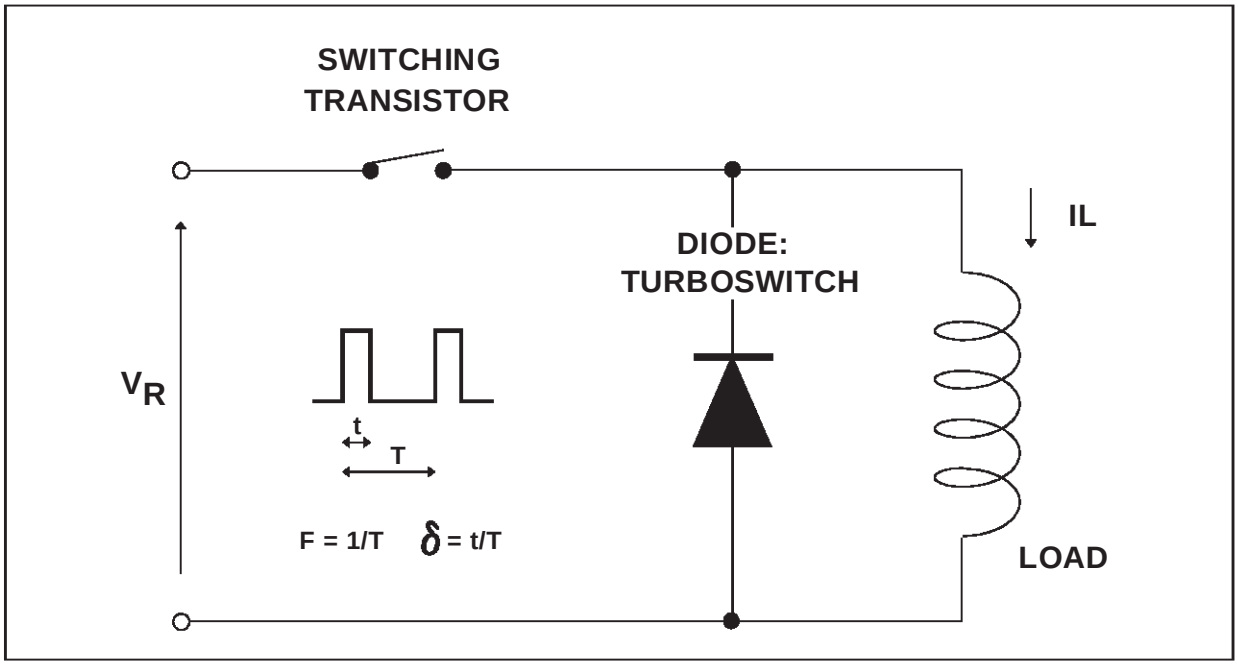
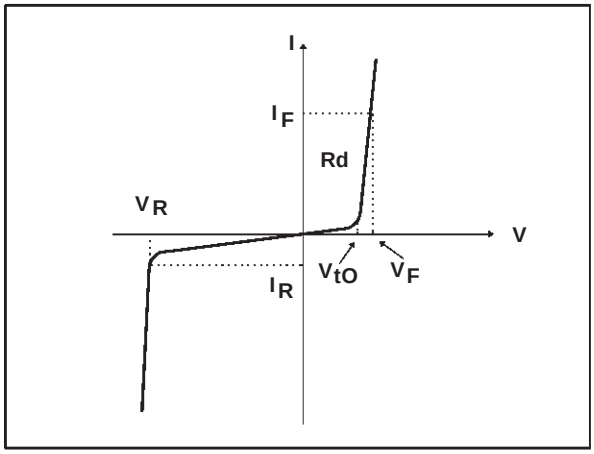


Fig. A : "FREEWHEEL" MODE.



APPLICATION DATA (Cont'd)

Fig. B: STATIC CHARACTERISTICS



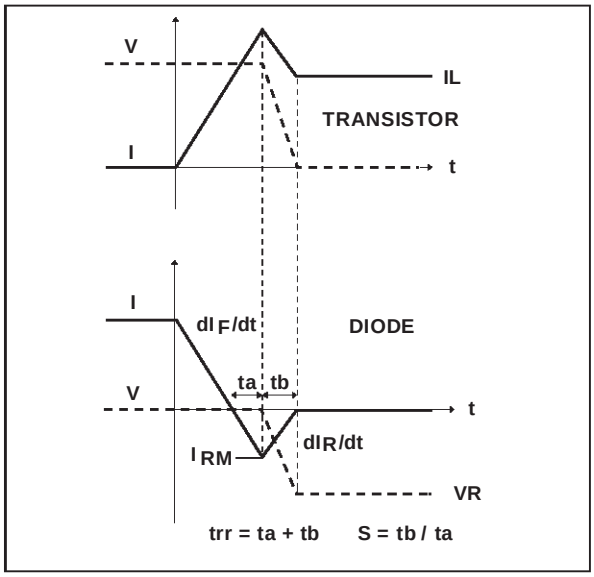
Conduction losses :

$P1 = V_{t0} \cdot I_{F(AV)} + R_d \cdot I_F{}^2{}_{(RMS)}$

Reverse losses :

$P2 = V_R \cdot I_R \cdot (1 - \delta)$

Fig. C: TURN-OFF CHARACTERISTICS



Turn-on losses :
(in the transistor, due to the diode)

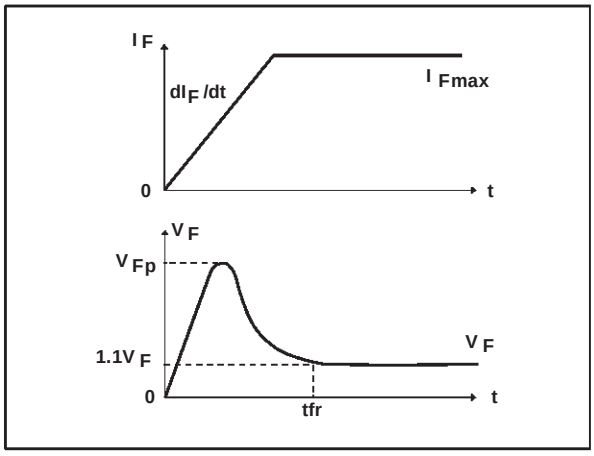
$$P5 = \frac{V_R \times I_{RM}{}^2 \times (3 + 2 \times S) \times F}{6 \; x \; dI_F / dt} + \frac{V_R \times I_{RM} \times I_L \times (S + 2) \times F}{2 \; x \; dI_F / dt}$$

Turn-off losses (in the diode) :

$$P3 = \frac{V_R \times I_{RM}{}^2 \times S \times F}{6 \; x \; dI_F / dt}$$

P3 and P5 are suitable for power MOSFET and IGBT

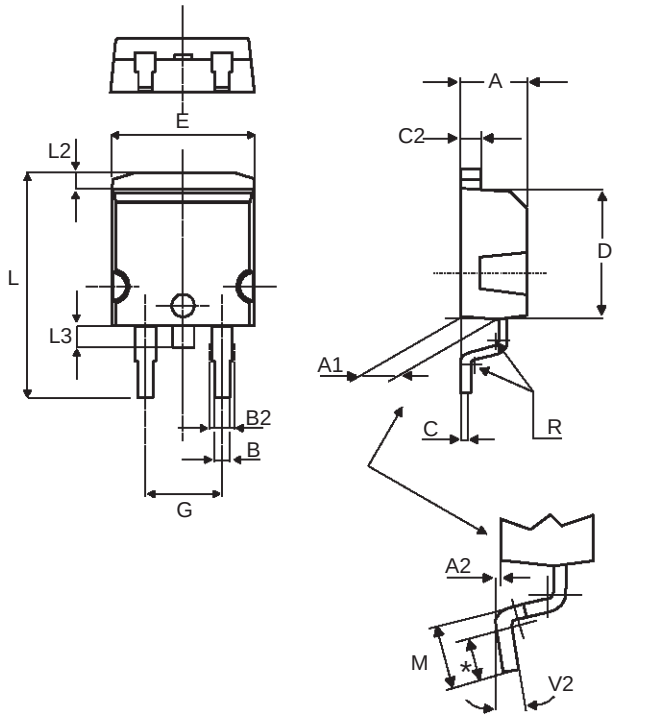
Fig. D: TURN-ON CHARACTERISTICS



Turn-on losses :

$P4 = 0.4 \, (V_{FP} - V_F) \cdot I_{Fmax} \cdot t_{fr} \cdot F$

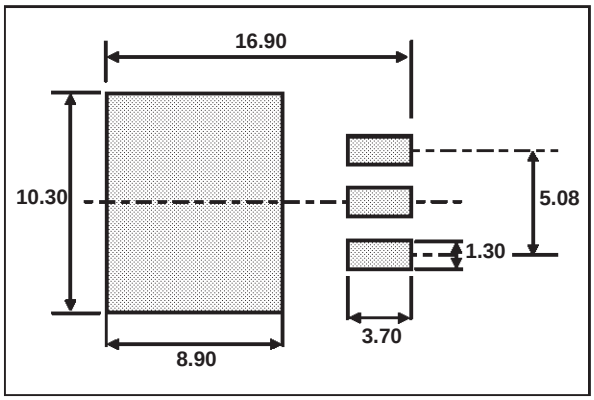
PACKAGE DATA
D2PAK



* FLAT ZONE NO LESSTHAN 2mm

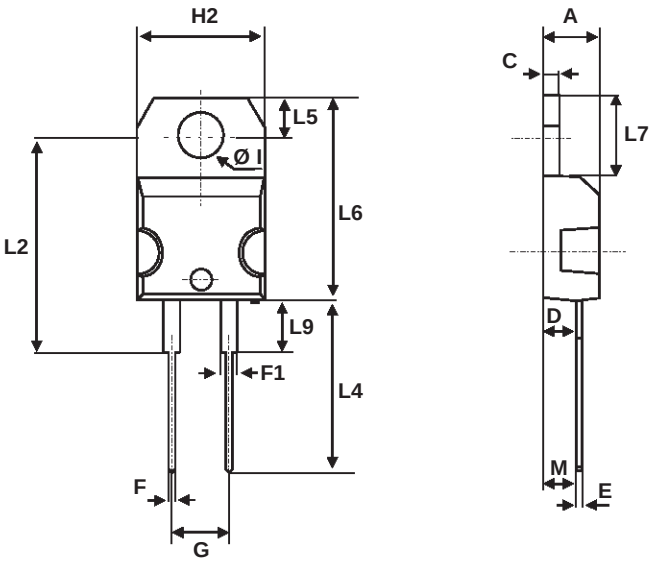
REF.	DIMENSIONS			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.40	4.60	0.173	0.181
A1	2.49	2.69	0.098	0.106
A2	0.03	0.23	0.001	0.009
B	0.70	0.93	0.027	0.037
B2	1.14	1.70	0.045	0.067
C	0.45	0.60	0.017	0.024
C2	1.23	1.36	0.048	0.054
D	8.95	9.35	0.352	0.368
E	10.00	10.40	0.393	0.409
G	4.88	5.28	0.192	0.208
L	15.00	15.85	0.590	0.624
L2	1.27	1.40	0.050	0.055
L3	1.40	1.75	0.055	0.069
M	2.40	3.20	0.094	0.126
R	0.40 typ.		0.016 typ.	
V2	0°	8°	0°	8°

FOOTPRINT DIMENSIONS (in millimeters)



PACKAGE DATA

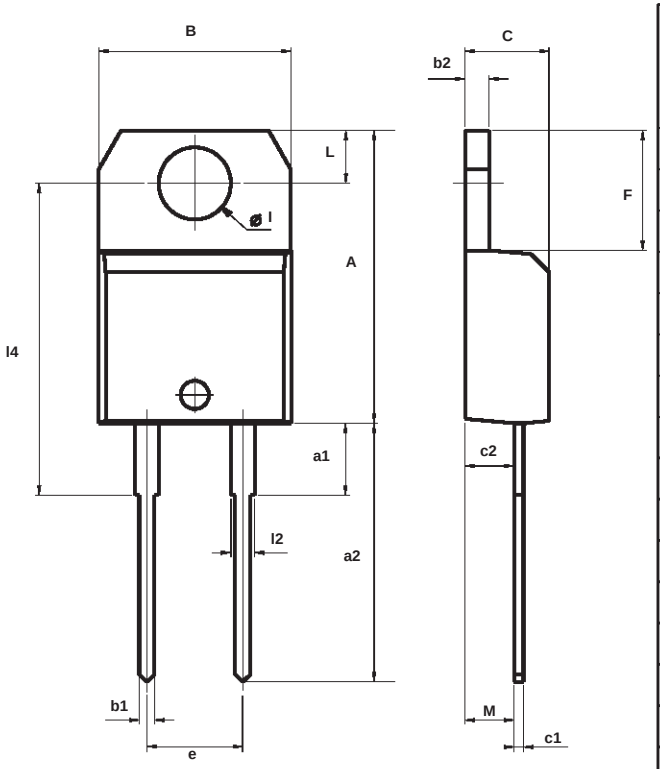
TO-220AC (JEDEC outline)



REF.	DIMENSIONS			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.40	4.60	0.173	0.181
C	1.23	1.32	0.048	0.051
D	2.40	2.72	0.094	0.107
E	0.49	0.70	0.019	0.027
F	0.61	0.88	0.024	0.034
F1	1.14	1.70	0.044	0.066
G	4.95	5.15	0.194	0.202
H2	10.00	10.40	0.393	0.409
L2	16.40 typ.		0.645 typ.	
L4	13.00	14.00	0.511	0.551
L5	2.65	2.95	0.104	0.116
L6	15.25	15.75	0.600	0.620
L7	6.20	6.60	0.244	0.259
L9	3.50	3.93	0.137	0.154
M	2.6 typ.		0.102 typ.	
Diam. I	3.75	3.85	0.147	0.151

- Cooling method : by conduction (C)
- Recommanded maximum torque value : 0.7m.N

PACKAGE DATA
INSULATED TO-220AC (JEDEC outline)



REF.	DIMENSIONS					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	15.20		15.90	0.598		0.625
a1		3.75			0.147	
a2	13.00		14.00	0.511		0.551
B	10.00		10.40	0.393		0.409
b1	0.61		0.88	0.024		0.034
b2	1.23		1.32	0.048		0.051
C	4.40		4.60	0.173		0.181
c1	0.49		0.70	0.019		0.027
c2	2.40		2.72	0.094		0.107
e	4.80		5.40	0.189		0.212
F	6.20		6.60	0.244		0.259
I	3.75		3.85	0.147		0.151
I4	15.80	16.40	16.80	0.622	0.646	0.661
L	2.65		2.95	0.104		0.116
I2	1.14		1.70	0.044		0.066
M		2.60			0.102	

Cooling method : by conduction (C).
Recommended maximum torque value : 1 m.N

Ordering type	Marking	Package	Weight	Base qty	Delivery mode
STTA1206D	STTA1206D	TO-220AC	1.86g	50	Tube
STTA1206DI	STTA1206DI	TO-220AC Ins.	1.86g	250	Bulk
STTA1206G	STTA1206G	D^2PAK	1.48g	50	Tube
STTA1206G-TR	STTA1206G	D^2PAK	1.48g	500	Tape & reel

- Epoxy meets UL94,V0