STTA512D/F/B/FP

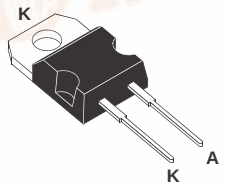
TURBOSWITCH ULTRA-FAST HIGH VOLTAGE DIODE

MAIN PRODUCT CHARACTERISTICS

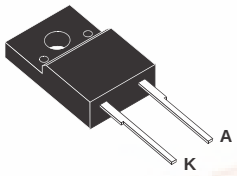
$I_{F(AV)}$	5A
V_{RRM}	1200V
t_{rr} (typ)	45ns
V_F (max)	2.0V

FEATURES AND BENEFITS

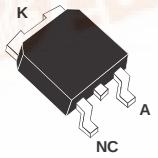
- SPECIFIC TO THE FOLLOWING OPERATIONS: SNUBBING OR CLAMPING, DEMAGNETIZATION AND RECTIFICATION
- ULTRA-FAST, SOFT RECOVERY.
- VERY LOW OVERALL POWER LOSSES IN BOTH THE DIODE AND THE COMPANION TRANSISTOR.
- HIGH FREQUENCY AND/OR HIGH PULSED CURRENT OPERATION.
- HIGH REVERSE VOLTAGE CAPABILITY
- INSULATED PACKAGES: ISOWATT220AC, TO-220FPAC
- Electrical insulation : 2000V DC Capacitance : 12pF.



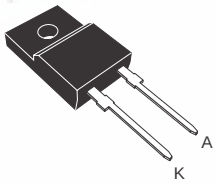
TO-220AC
STTA512D



ISOWATT220AC
STTA512F



DPAK
STTA512B



TO-220FPAC
STTA512FP

DESCRIPTION

TURBOSWITCH 1200V drastically cuts losses in all high voltage operations which require extremely fast, soft and noise-free power diodes. Due to their optimized switching performances they also highly decrease power losses in any associated switching IGBT or MOSFET in all “freewheel mode” operations.

They are particularly suitable in motor control circuitries, or in the primary of SMPS as snubber, clamping or demagnetizing diodes. They are also suitable for secondary of SMPS as high voltage rectifier diodes.

ABSOLUTE RATINGS (limiting values)

Symbol	Parameter		Value	Unit
V_{RRM}	Repetitive peak reverse voltage		1200	V
V_{RSM}	Non repetitive peak reverse voltage		1200	V
$I_{F(RMS)}$	RMS forward current	TO-220AC / DPAK	20	A
		ISOWATT220AC / TO-220FPAC	10	A
I_{FRM}	Repetitive peak forward current	tp = 5 µs F = 5kHz square	70	A
I_{FSM}	Surge non repetitive forward current	tp = 10ms sinusoidal	45	A
T_{stg}	Storage temperature range		- 65 to + 150	°C
T_j	Maximum operating junction temperature		150	°C

TURBOSWITCH is a trademark of STMicroelectronics.

THERMAL AND POWER DATA

Symbol	Parameter		Conditions	Value	Unit
$R_{th(j-c)}$	Junction to case thermal resistance	TO-220AC / DPAK		4.0	°C/W
		ISOWATT220AC / TO-220FPAC		5.5	
P_1	Conduction power dissipation $I_{F(AV)}$ = 5A δ =0.5	TO-220AC / DPAK	Tc= 102°C	12	W
		ISOWATT220AC / TO-220FPAC	Tc= 84°C		
P_{max}	Total power dissipation Pmax = P1 + P3 (P3 = 10% P1)	TO-220AC / DPAK	Tc= 98°C	13	W
		ISOWATT220AC / TO-220FPAC	Tc= 78°C		

STATIC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test conditions		Min	Typ	Max	Unit
V_F *	Forward voltage drop	I_F =5A	Tj = 25°C Tj = 125°C		 1.35	2.2 2.0	V V
I_R **	Reverse leakage current	V_R =0.8 x V_{RRM}	Tj = 25°C Tj = 125°C		 0.3	100 2.0	µA mA
V_{t0}	Threshold voltage	Ip < 3.I_{AV}	Tj = 125°C			1.57	V
Rd	Dynamic resistance					86	mΩ

Pulse test: * tp = 380 µs, δ < 2%
** tp = 5 ms , δ < 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		45 	 95	ns
I_{RM}	Maximum reverse recovery current	Tj = 125°C VR = 600V I_F =5A dI_F/dt = -40 A/µs dI_F/dt = -500 A/µs		 20	7.5 	A
S_{factor}	Softness factor	Tj = 125°C V_R = 600V I_F =5A dI_F/dt = -500 A/µs		 1.2		/

TURN-ON SWITCHING

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
t_{fr}	Forward recovery time	Tj = 25°C I_F =5 A, dI_F/dt = 40 A/µs measured at 1.1 × $V_F$max			900	ns
V_{Fp}	Peak forward voltage	Tj = 25°C I_F =5A, dI_F/dt = 40 A/µs I_F =40A, dI_F/dt = 500 A/µs		 50	35 	V

Fig. 1: Conduction losses versus average current.

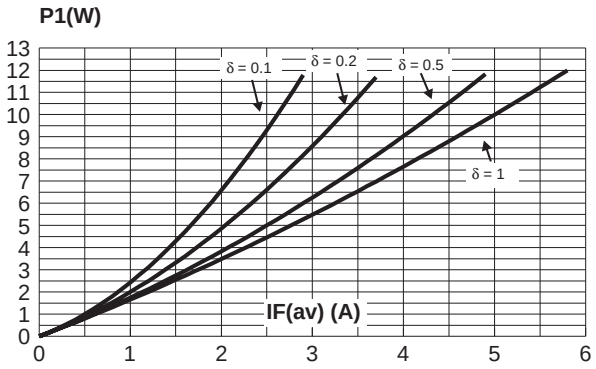


Fig. 2: Forward voltage drop versus forward current (maximum values).

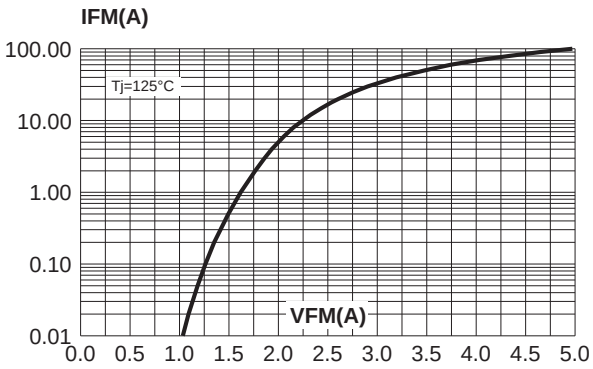


Fig. 3: Peak reverse recovery current versus dI_F/dt (90% confidence).

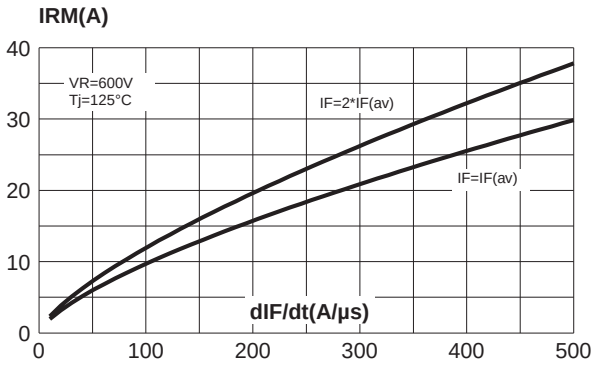


Fig. 4: Relative variation of thermal impedance junction to case versus pulse duration (TO-220AC and DPAK).

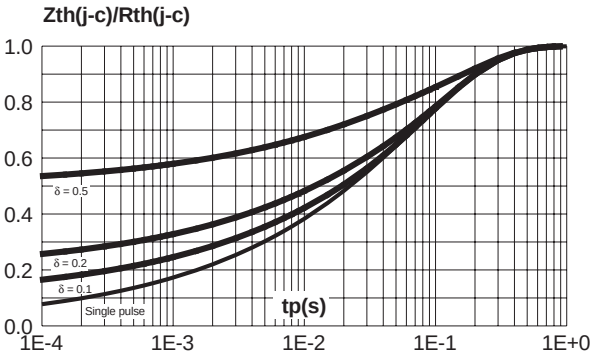


Fig. 5: Relative variation of thermal impedance junction to case versus pulse duration (ISOWATT220AC and TO-220FPAC).

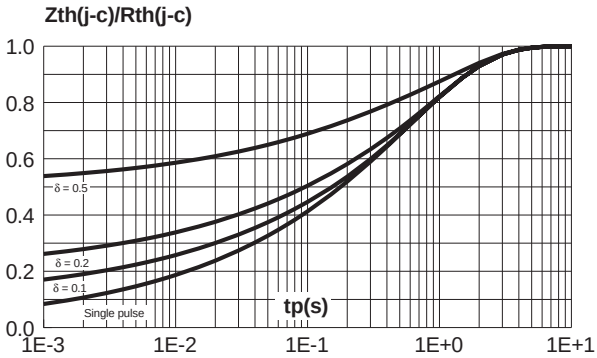


Fig. 6: Reverse recovery time versus dI_F/dt (90% confidence).

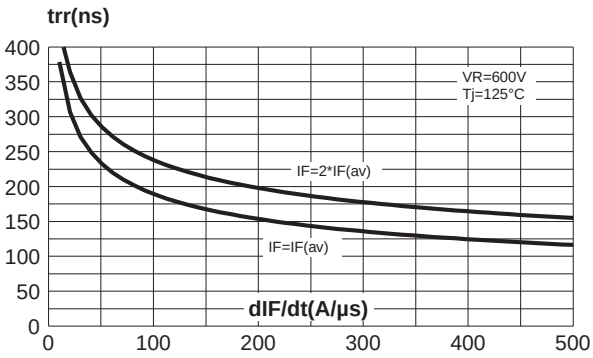


Fig. 7: Softness factor (tb/ta) versus dI_F/dt (typical values).

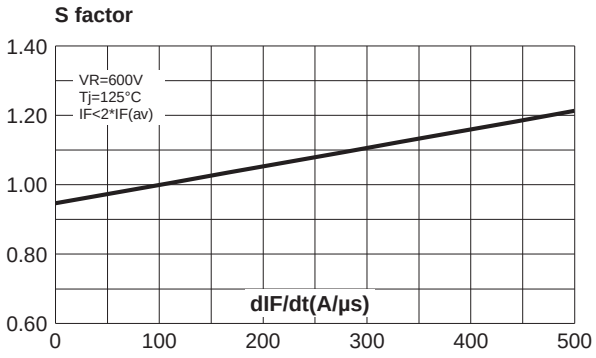


Fig. 8: Relative variation of dynamic parameters versus junction temperature (reference Tj=125°C).

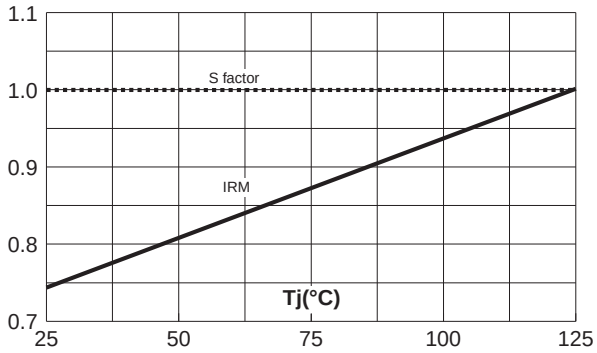


Fig. 9: Transient peak forward voltage versus dI_F/dt (90% confidence).

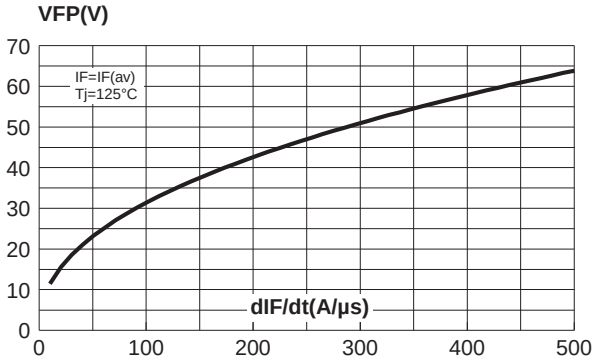
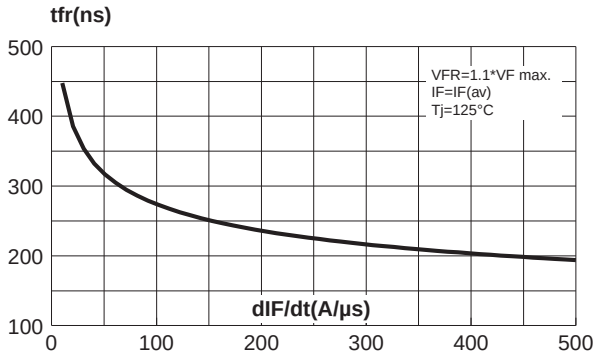


Fig. 10: Forward recovery time versus dI_F/dt (90% confidence).



APPLICATION DATA

The 1200V TURBOSWITCH series has been designed to provide the lowest overall power losses in all high frequency or high pulsed current operations. In such applications (Fig A to D),the way of calculating the power losses is given below :

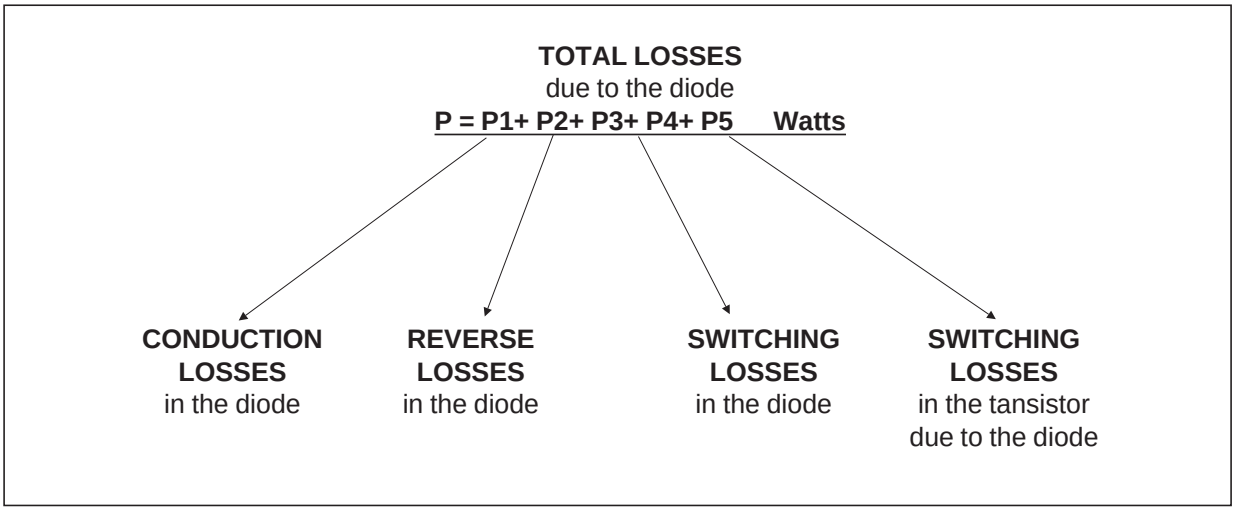


Fig. A : "FREEWHEEL" MODE.

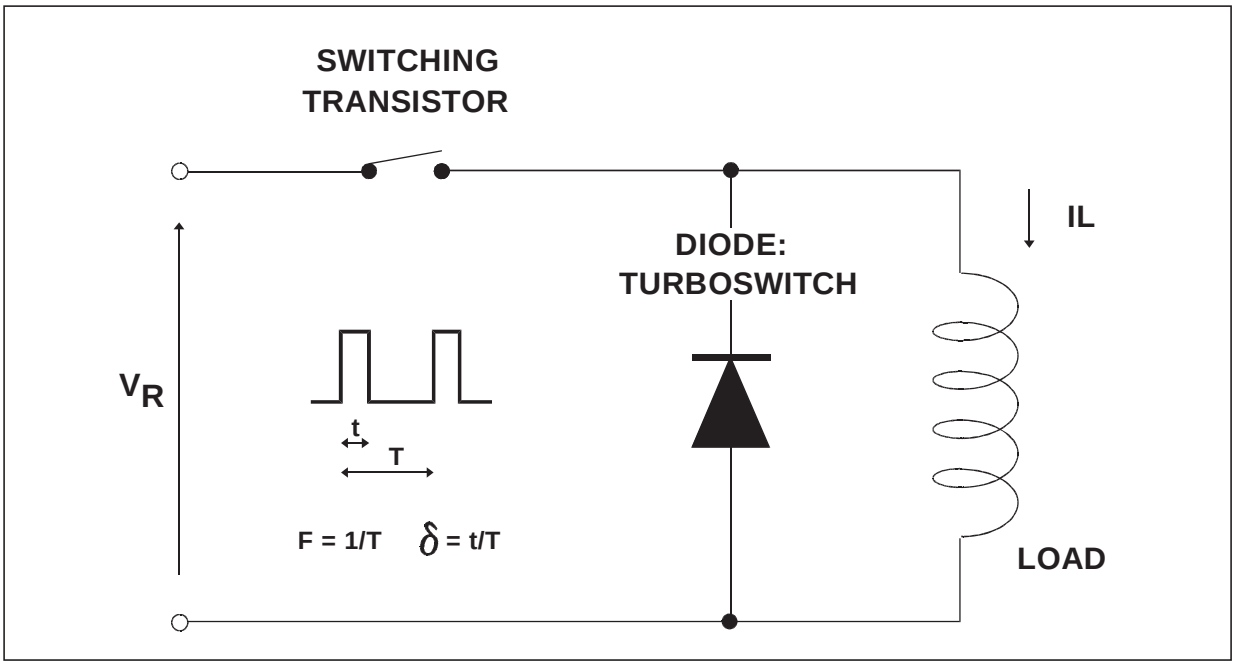


Fig. B : SNUBBER DIODE.

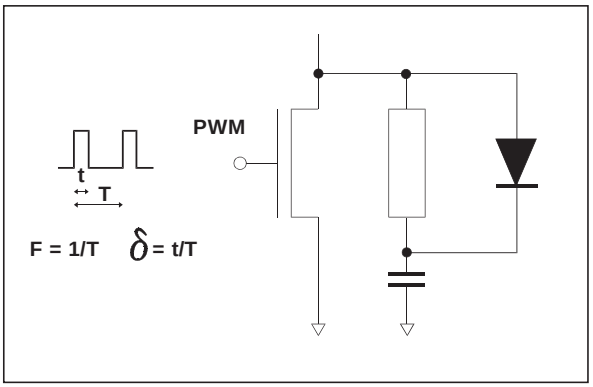


Fig. C : DEMAGNETIZING DIODE.

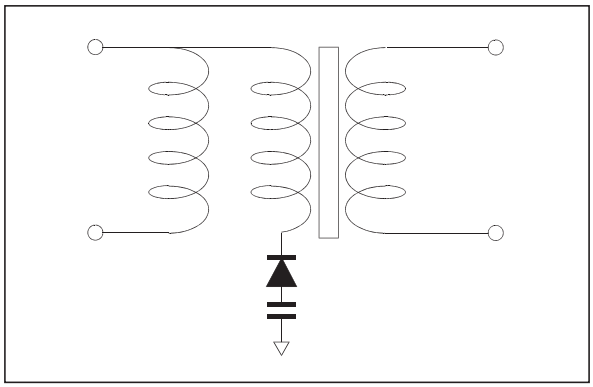
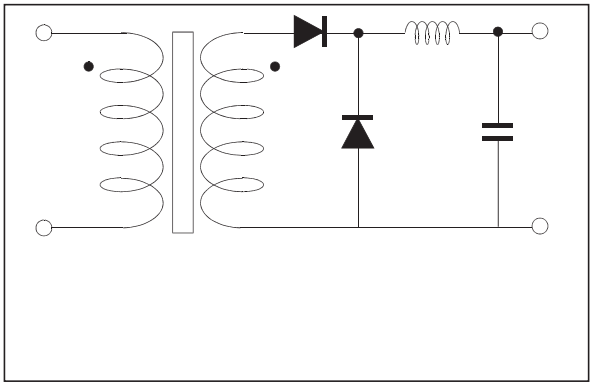
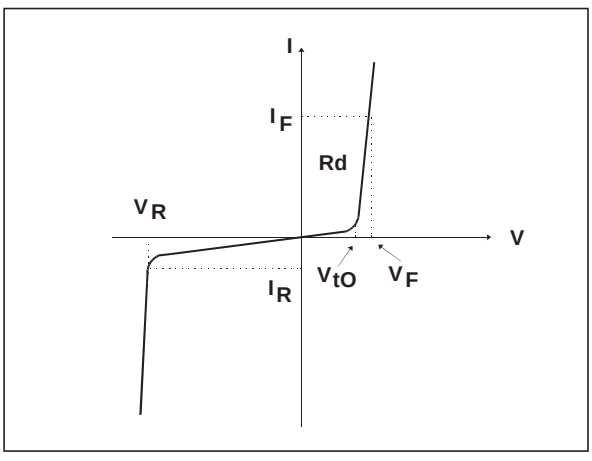


Fig. D : RECTIFIER DIODE.



STATIC & DYNAMIC CHARACTERISTICS . POWER LOSSES .

Fig. E: STATIC CHARACTERISTICS



Conduction losses :

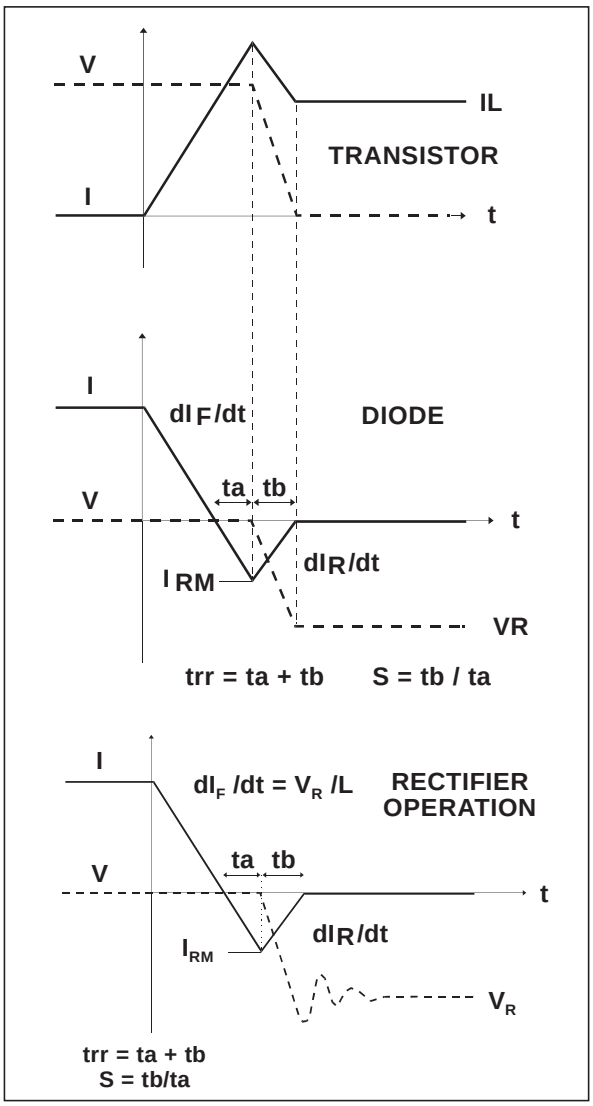
$P1 = V_{t0} . I_{F(AV)} + R_d . I_F{}^2{}_{(RMS)}$

Reverse losses :

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

APPLICATION DATA (Cont'd)

Fig. F: 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) :

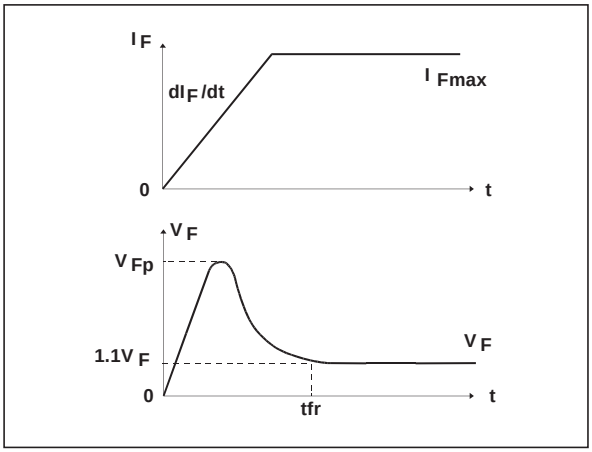
$$P3 = \frac{V_R \times I_{RM}{}^2 \times S \times F}{6 \; x \; dI_F / dt}$$

Turn-off losses :
(with non negligible serial inductance)

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

P3,P3' and P5 are suitable for power MOSFET and IGBT

Fig. G: TURN-ON CHARACTERISTICS

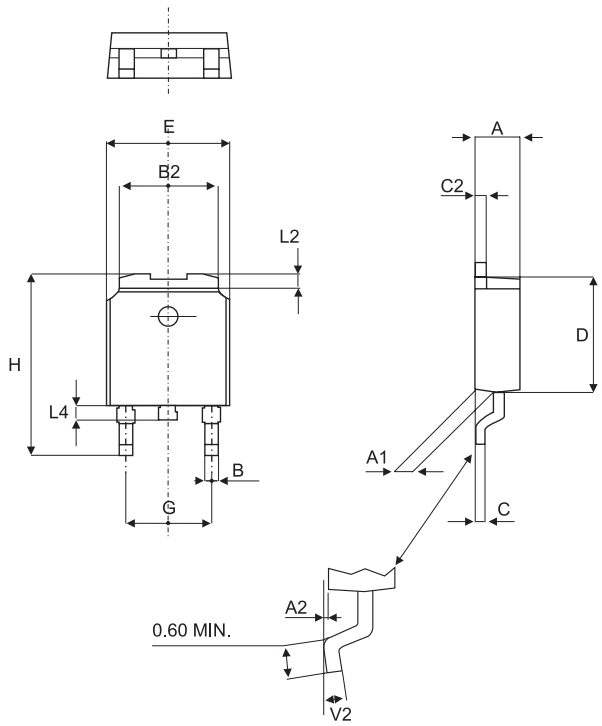


Turn-on losses :

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

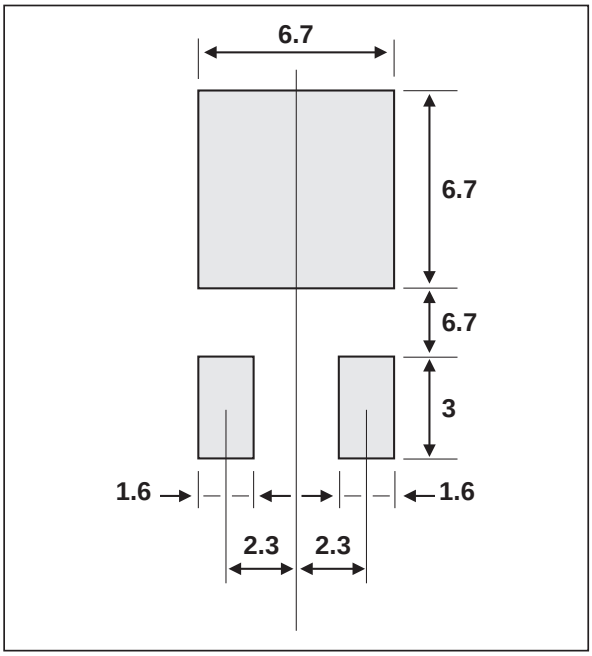
PACKAGE DATA

DPAK

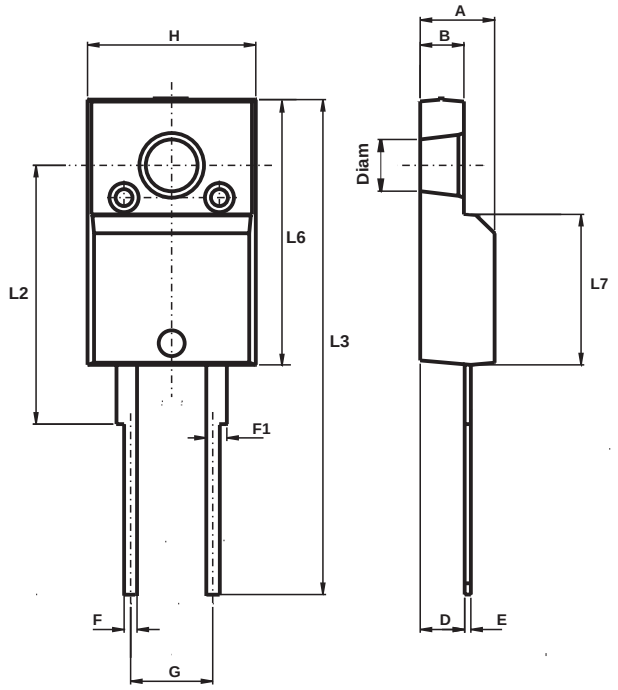


REF.	DIMENSIONS			
	Millimeters		Inches	
	Min.	Max	Min.	Max.
A	2.20	2.40	0.086	0.094
A1	0.90	1.10	0.035	0.043
A2	0.03	0.23	0.001	0.009
B	0.64	0.90	0.025	0.035
B2	5.20	5.40	0.204	0.212
C	0.45	0.60	0.017	0.023
C2	0.48	0.60	0.018	0.023
D	6.00	6.20	0.236	0.244
E	6.40	6.60	0.251	0.259
G	4.40	4.60	0.173	0.181
H	9.35	10.10	0.368	0.397
L2	0.80 typ.		0.031 typ.	
L4	0.60	1.00	0.023	0.039
V2	0°	8°	0°	8°

FOOTPRINT DIMENSIONS (in millimeters)



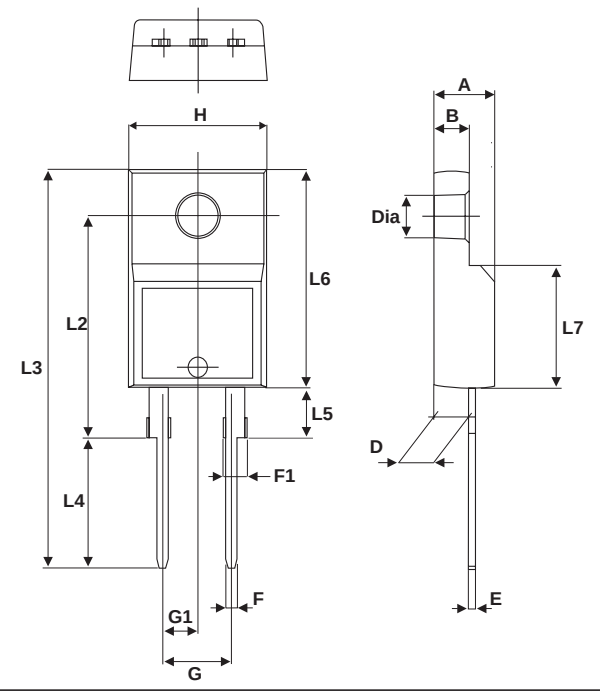
PACKAGE DATA
ISOWATT220AC



REF.	DIMENSIONS			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.40	4.60	0.173	0.181
B	2.50	2.70	0.098	0.106
D	2.40	2.75	0.094	0.108
E	0.40	0.70	0.016	0.028
F	0.75	1.00	0.030	0.039
F1	1.15	1.70	0.045	0.067
G	4.95	5.20	0.195	0.205
H	10.00	10.40	0.394	0.409
L2	16.00 typ.		0.63 typ.	
L3	28.60	30.60	1.125	1.205
L6	15.90	16.40	0.626	0.646
L7	9.00	9.30	0.354	0.366
Diam	3.00	3.20	0.118	0.126

- Cooling method: by conduction (C)
- Recommended torque value: 0.55 m.N
- Maximum torque value: 0.7 m.N

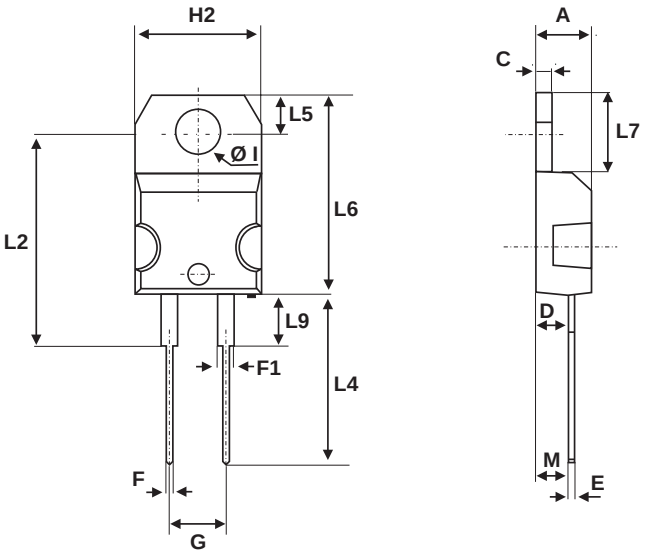
PACKAGE DATA
TO-220FPAC



REF.	DIMENSIONS			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.4	4.6	0.173	0.181
B	2.5	2.7	0.098	0.106
D	2.5	2.75	0.098	0.108
E	0.45	0.70	0.018	0.027
F	0.75	1	0.030	0.039
F1	1.15	1.70	0.045	0.067
G	4.95	5.20	0.195	0.205
G1	2.4	2.7	0.094	0.106
H	10	10.4	0.393	0.409
L2	16 Typ.		0.63 Typ.	
L3	28.6	30.6	1.126	1.205
L4	9.8	10.6	0.386	0.417
L5	2.9	3.6	0.114	0.142
L6	15.9	16.4	0.626	0.646
L7	9.00	9.30	0.354	0.366
Dia.	3.00	3.20	0.118	0.126

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)
- Recommended torque value: 0.55 m.N
- Maximum torque value: 0.7 m.N

Ordering type	Marking	Package	Weight	Base qty	Delivery mode
STTA512D	STTA512D	TO-220AC	1.86g	50	Tube
STTA512F	STTA512F	ISOWATT220AC	2g	50	Tube
STTA512B	A512	DPAK	0.3g	75	Tube
STTA512B-TR	A512	DPAK	0.3g	2500	Tape & reel
STTA512FP	STTA512FP	TO-220FPAC	2g	50	Tube

- Epoxy meets UL94,V0