

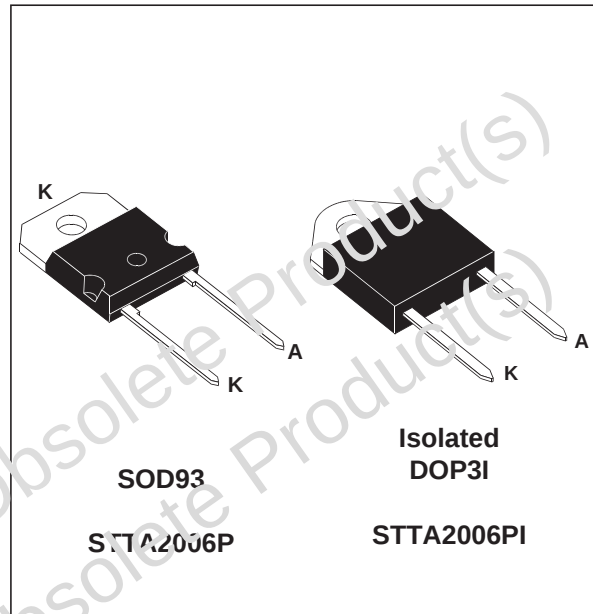
TURBOSWITCH ULTRA-FAST HIGH VOLTAGE DIODE

MAIN PRODUCT CHARACTERISTICS

$I_F(AV)$	20A
V_{RRM}	600V
$t_{rr} (typ)$	30ns
$V_F (max)$	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 : DOP3I
Electrical insulation : 2500V_{RMS}
Capacitance < 12 pF



DESCRIPTION

The TURBOSWITCH is a very high performance series of ultra-fast high voltage power diodes from 600V to 1200V. 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 either in SOD93 or in DOP3I, these

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		50	A
I_{FRM}	Repetitive peak forward current	$t_p = 5 \mu s$ $F = 5kHz$ square	270	A
I_{FSM}	Surge non repetitive forward current	$t_p = 10 ms$ sinusoidal	180	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	SOD93 DOP3I		1.5 2.1	°C/W
P_1	Conduction power dissipation $I_{F(AV)} = 20A$ $\delta = 0.5$	SOD93 DOP3I	$T_c = 96^\circ C$ $T_c = 74^\circ C$	36	W
P_{max}	Total power dissipation $P_{max} = P_1 + P_3$ ($P_3 = 10\% P_1$)	SOD93 DOP3I	$T_c = 90^\circ C$ $T_c = 66^\circ C$	40	W

STATIC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test conditions		Min	Typ	Max	Unit
V_F *	Forward voltage drop	$I_F = 20A$	$T_j = 25^\circ C$ $T_j = 125^\circ C$			1.75 1.5	V V
I_R **	Reverse leakage current	$V_R = 0.8 \times V_{RRM}$	$T_j = 25^\circ C$ $T_j = 125^\circ C$			100 6	μA mA
V_{to}	Threshold voltage	$I_p < 3 \cdot I_{AV}$	$T_j = 125^\circ C$			1.15	V
r_d	Dynamic resistance					17	m Ω

Test pulse : * $t_p = 380 \mu s$, $\delta < 2\%$ ** $t_p = 5 ms$, $\delta < 2\%$

To evaluate the maximum conduction losses use the following equation :

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

DYNAMIC ELECTRICAL CHARACTERISTICS

TURN-OFF SWITCHING

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
t_{rr}	Reverse recovery time	$T_j = 25^\circ C$ $I_F = 0.5 A$ $I_R = 1A$ $I_{rr} = 0.25A$ $I_F = 1A$ $di_F/dt = -50A/\mu s$ $V_R = 30V$		30	60	ns
i_{FM}	Maximum reverse recovery current	$T_j = 125^\circ C$ $V_R = 400V$ $I_F = 20A$ $di_F/dt = -160 A/\mu s$ $di_F/dt = -500 A/\mu s$		17.5	12.5	A
S factor	Softness factor	$T_j = 125^\circ C$ $V_R = 400V$ $I_F = 20A$ $di_F/dt = -500 A/\mu s$		0.42		/

TURN-ON SWITCHING

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
t_{fr}	Forward recovery time	$T_j = 25^\circ C$ $I_F = 20A$, $di_F/dt = 160 A/\mu s$ measured at, $1.1 \times V_{Fmax}$			600	ns
V_{Fp}	Peak forward voltage	$T_j = 25^\circ C$ $I_F = 20A$, $di_F/dt = 160 A/\mu s$			12	V

Fig. 1: Conduction losses versus average current.

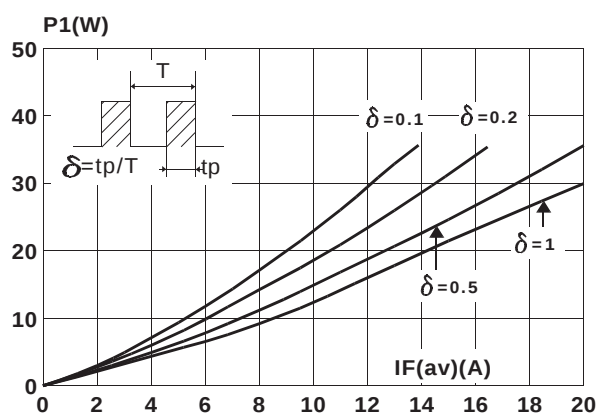


Fig. 2: Forward voltage drop versus forward current.

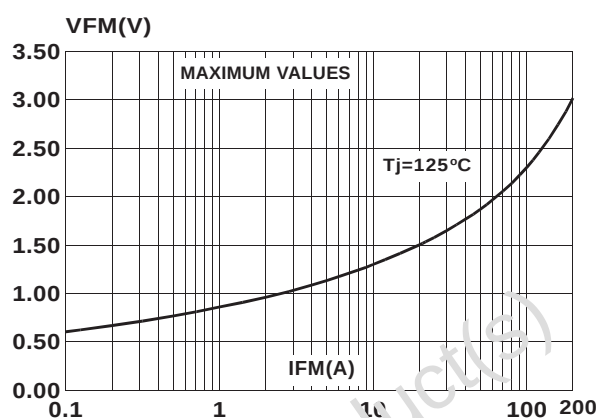


Fig. 3: Relative variation of thermal transient impedance junction to case versus pulse duration.

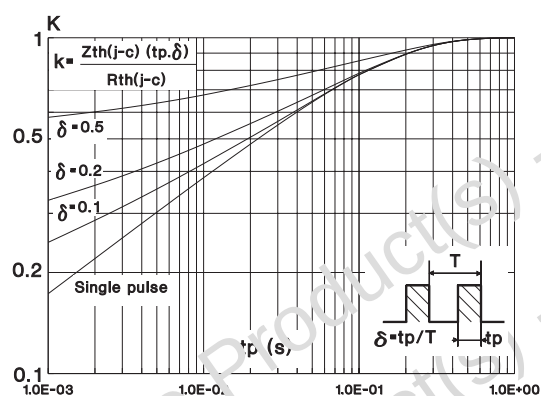
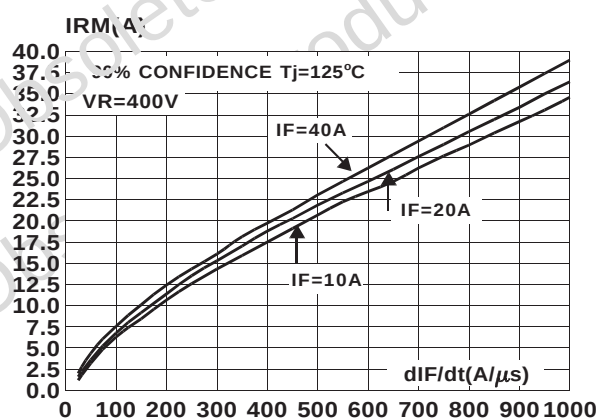
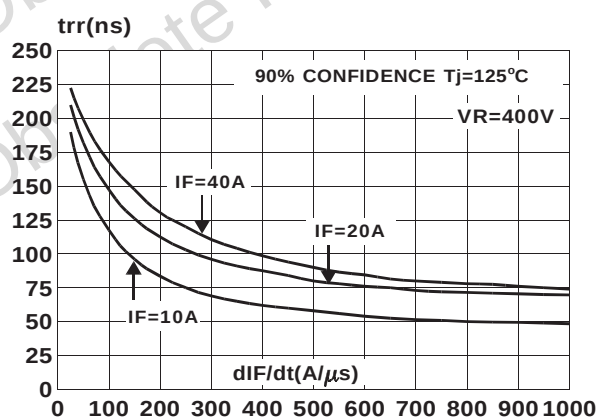
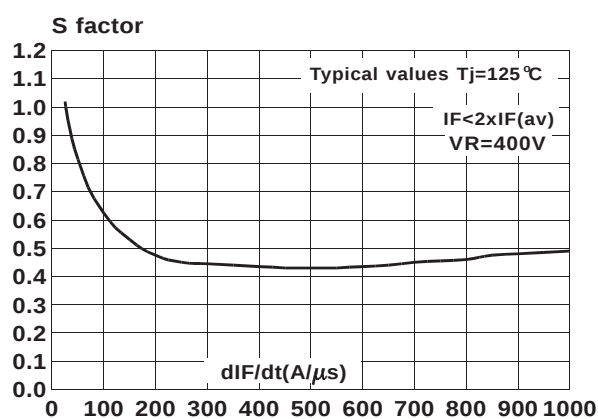
Fig. 4: Peak reverse recovery current versus dI_F/dt .Fig. 5: Reverse recovery time versus dI_F/dt .Fig. 6: Softness factor (tb/ta) versus dI_F/dt .

Fig. 7: Relative variation of dynamic parameters versus junction temperature (reference $T_j=125^\circ\text{C}$).

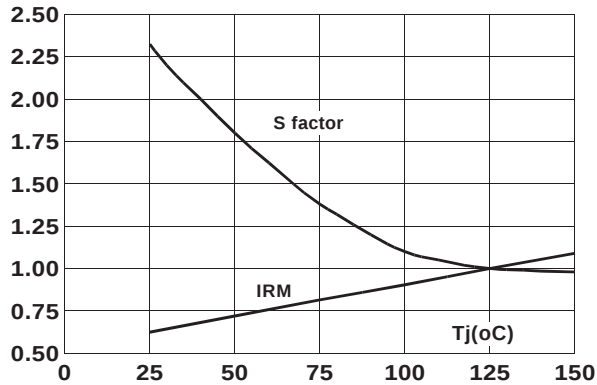


Fig. 9: Transient peak forward voltage versus dI_F/dt .

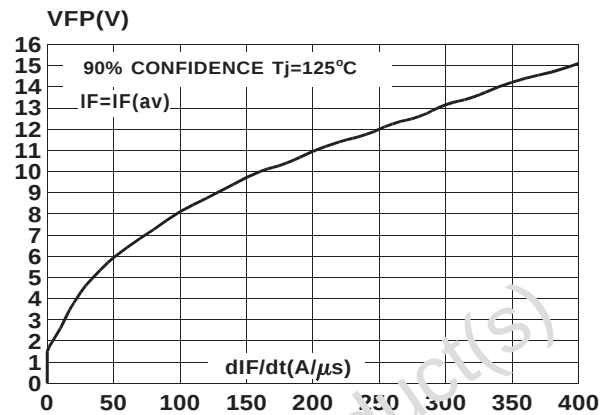
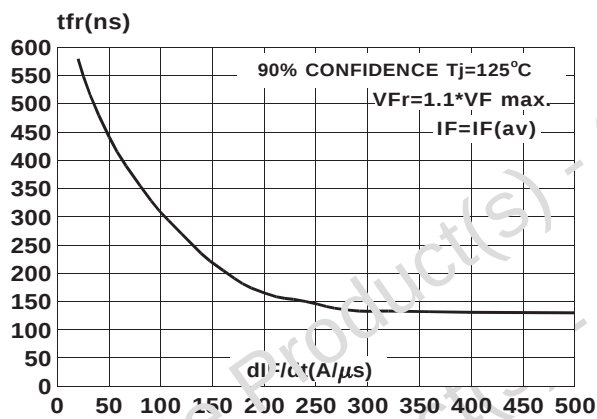


Fig. 9: Forward recovery time versus dI_F/dt .



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:

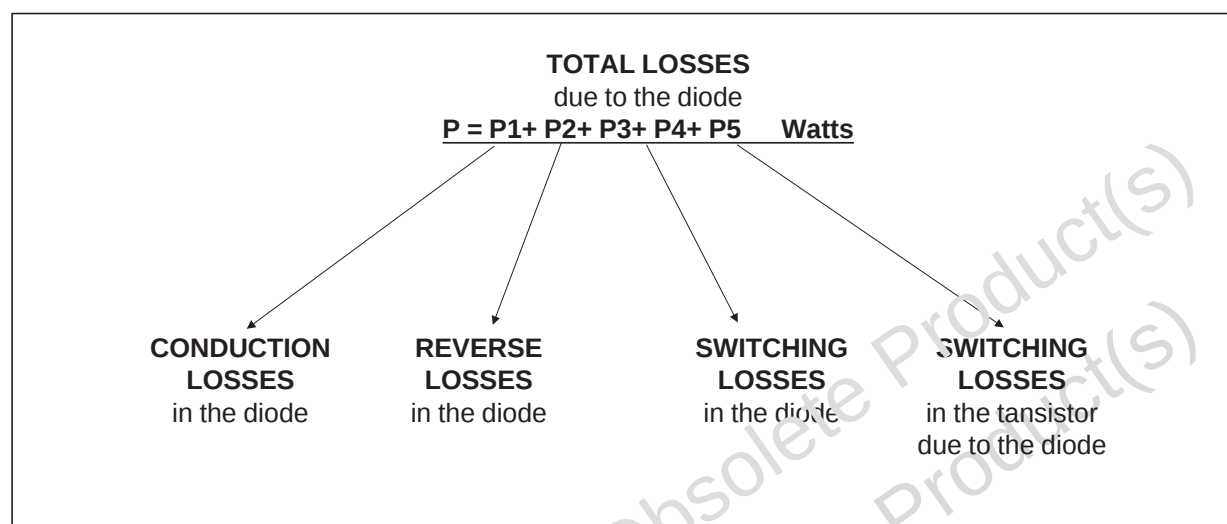
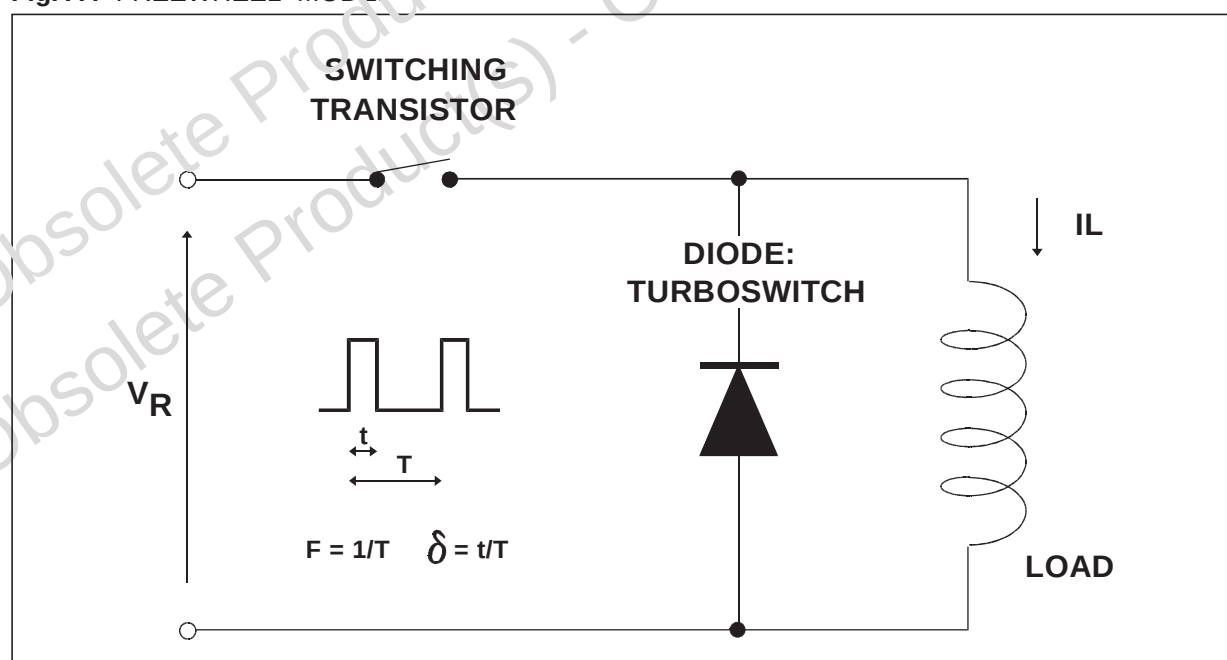
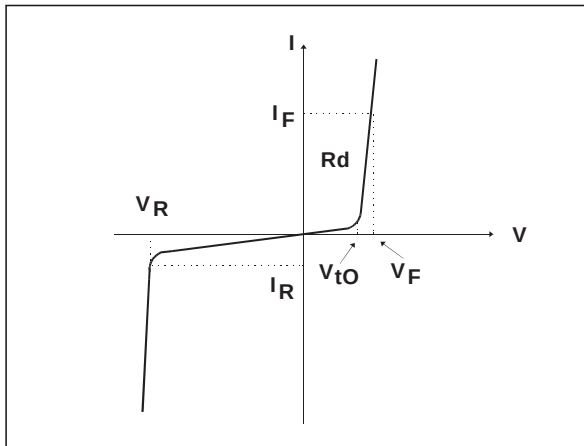


Fig. A : "FREEWHEEL" MODE



APPLICATION DATA (Cont'd)

Fig. B: STATIC CHARACTERISTICS

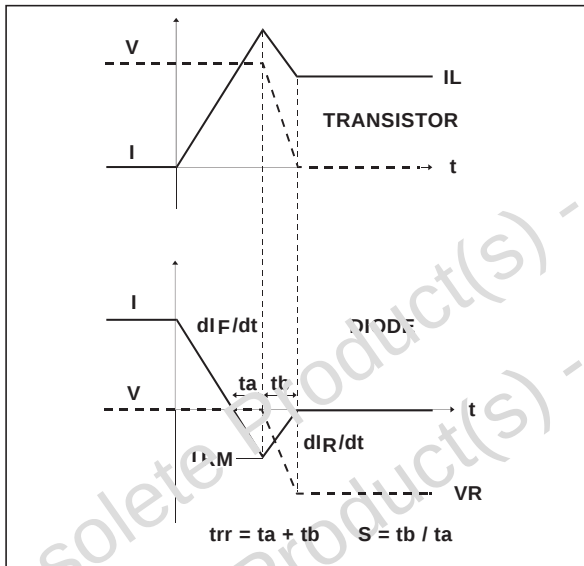
**Conduction losses :**

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

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)

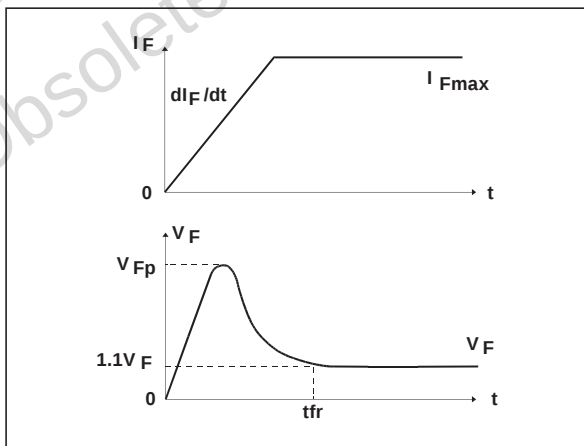
$$P5 = \frac{V_R \times I_{RM}^2 \times (3 + 2 \times S) \times F}{6 \times dI_F / dt} + \frac{V_R \times I_{RM} \times I_L \times (S + 2) \times F}{2 \times dI_F / dt}$$

Turn-off losses (in the diode) :

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

P3 and P5 are suitable for power MOSFET and IGBT

Fig. D: TURN-ON CHARACTERISTICS

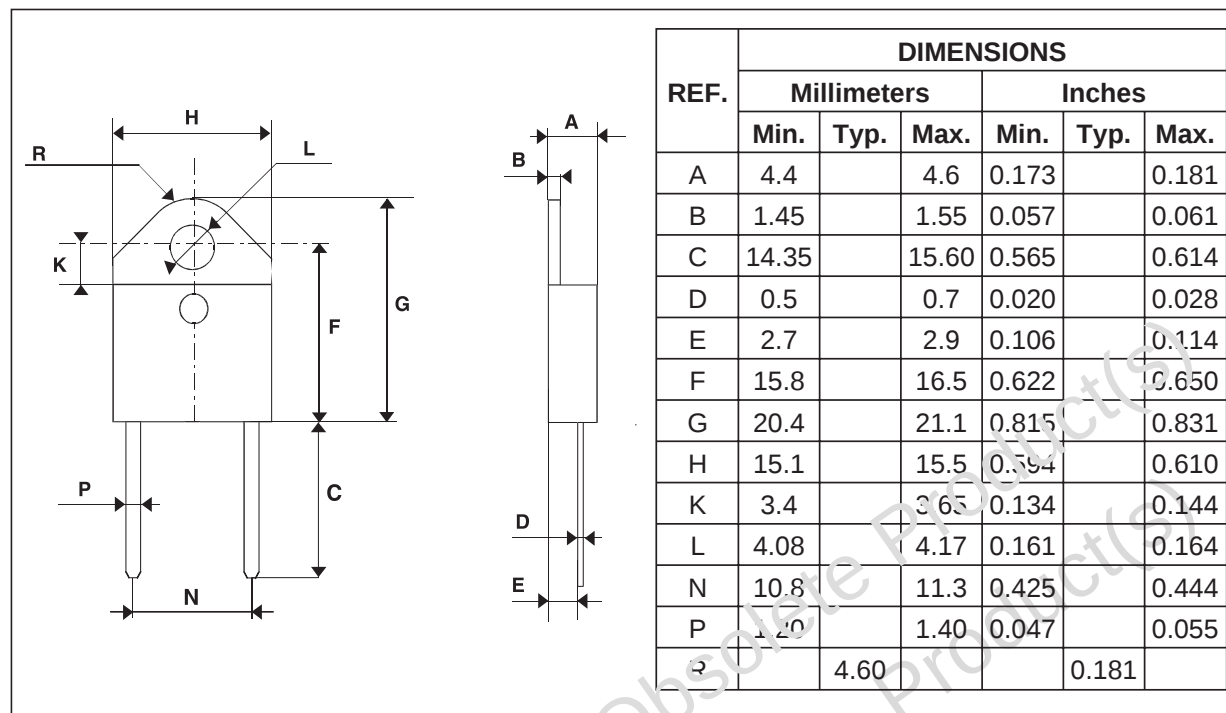
**Turn-on losses :**

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

PACKAGE MECHANICAL DATA
SOD93

REF.	DIMENSIONS					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.70		4.90	0.185		0.193
C	1.17		1.37	0.046		0.054
D		2.50			0.098	
D1		1.27			0.050	
E	0.50		0.78	0.020		0.031
F	1.10		1.30	0.043		0.051
F3		1.75			0.069	
G	10.80		11.10	0.425		0.437
H	14.70		15.20	0.578		0.598
L			12.20			0.480
L2			16.20			0.638
L3		18.0			0.709	
L5	3.95		4.15	0.156		0.163
L6		31.00			1.220	
O	4.00		4.10	0.157		0.161

- Cooling method : by conduction (C)
- Recommended torque value : 0.6 m.N
- Maximum torque value : 1.0 m.N

PACKAGE DATA
 DOP3I ISOLATED


- Cooling method : by conduction (C)
- Recommended torque value : 0.8 m.N.
- Maximum torque value : 1.0 m.N.

Ordering type	Marking	Package	Weight	Base qty	Delivery mode
STTA2006P	STTA2006P	SOD93	3.79g	30	Tube
STTA2006PI	STTA2006PI	DOP3I	4.52g	120	Bulk

- Epoxy meets UL94,V0

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