



# STTA506D/F/B

## TURBOSWITCH™ ULTRA-FAST HIGH VOLTAGE DIODE

### MAIN PRODUCTS CHARACTERISTICS

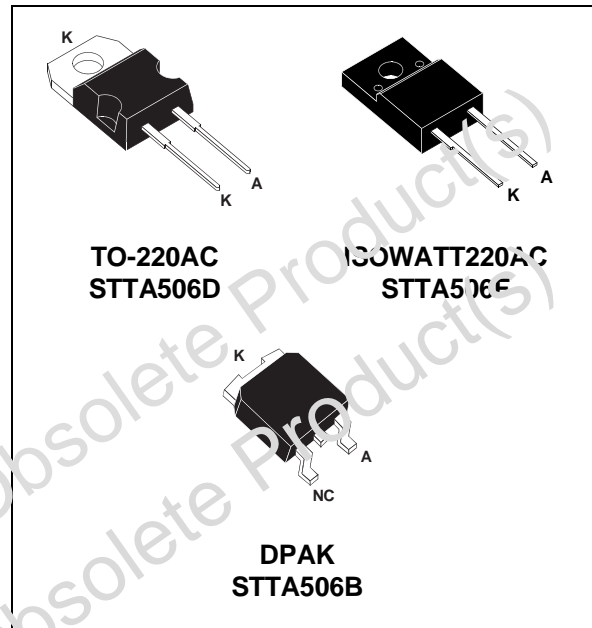
|                |      |
|----------------|------|
| $I_{F(AV)}$    | 5A   |
| $V_{RRM}$      | 600V |
| $t_{rr}$ (typ) | 20ns |
| $V_F$ (max)    | 1.5V |

### 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 : ISOWATT220AC  
Electrical insulation : 2000VDC  
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 TO-220AC, ISOWATT220AC or in DPAK, 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<br>ISOWATT220AC<br>20<br>DPAK<br>10 | A<br>A  |
| $I_{FRM}$    | Repetitive peak forward current        | $t_p=5\mu s$ $F=5kHz$ square                 | 65<br>A |
| $I_{FSM}$    | Surge non repetitive forward current   | $t_p=10$ ms sinusoidal                       | 55<br>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

## STTA506D/F/B

### THERMAL AND POWER DATA

| Symbol        | Parameter   | Test conditions                 |   | Value      | Unit |
|---------------|---|---------------------------------|---|------------|------|
| $R_{th(j-c)}$ | Junction to case  | TO-220AC / DPAK<br>ISOWATT220AC |   | 3.5<br>6.0 | °C/W |
| $P_1$         | Conduction power dissipation •<br>$I_{F(AV)} = 5A$ $\delta = 0.5$     | TO-220AC / DPAK<br>ISOWATT220AC | $T_c = 118^\circ C$<br>$T_c = 96^\circ C$ | 9          | W    |
| $P_{max}$     | Total power dissipation<br>$P_{max} = P_1 + P_3$ ( $P_3 = 10\% P_1$ ) | TO-220AC / DPAK<br>ISOWATT220AC | $T_c = 115^\circ C$<br>$T_c = 90^\circ C$ | 10         | W    |

### STATIC ELECTRICAL CHARACTERISTICS

| Symbol     | Parameter               | Test conditions            |   | Min | Typ  | Max         | Unit          |
|------------|-------------------------|----------------------------|---|-----|------|-------------|---------------|
| $V_F^*$    | Forward voltage drop    | $I_F = 5A$                 | $T_j = 25^\circ C$<br>$T_j = 125^\circ C$ |     | 1.25 | 1.75<br>1.5 | V<br>V        |
| $I_R^{**}$ | Reverse leakage current | $V_R = 0.8 \times V_{RRM}$ | $T_j = 25^\circ C$<br>$T_j = 125^\circ C$ |     | 0.75 | 100<br>2    | $\mu A$<br>mA |
| $V_{to}$   | Threshold voltage       | $I_p < 3 \cdot I_{AV}$     | $T_j = 125^\circ C$                       |     |      | 1.15        | V             |
| $r_d$      | Dynamic resistance      |                            |   |     |      | 70          | m $\Omega$    |

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            | $T_j = 25^\circ C$<br>$I_F = 0.5 A$ $I_R = 1A$ $I_{rr} = 0.25A$<br>$I_F = 1 A$ $di_F/dt = -50A/\mu s$ $V_R = 30V$ |  |     | 20   | 50  | ns   |
| $I_{RM}$ | Maximum reverse recovery current | $T_j = 125^\circ C$ $V_R = 400V$ $I_F = 5A$<br>$di_F/dt = -40 A/\mu s$<br>$di_F/dt = -500 A/\mu s$                |  |     | 11   | 3.0 | A    |
| S factor | Softness factor                  | $T_j = 125^\circ C$ $V_R = 400V$ $I_F = 5A$<br>$di_F/dt = -500 A/\mu s$   |  |     | 0.55 |     | -    |

#### TURN-ON SWITCHING

| Symbol   | Parameter             | Test conditions   |  | Min | Typ | Max | Unit |
|----------|-----------------------|---|--|-----|-----|-----|------|
| $t_{fr}$ | Forward recovery time | $T_j = 25^\circ C$<br>$I_F = 5 A$ , $di_F/dt = 40 A/\mu s$<br>measured at $1.1 \times V_{Fmax}$ |  |     |     | 500 | ns   |
| $V_{Fp}$ | Peak forward voltage  | $T_j = 25^\circ C$<br>$I_F = 5A$ , $di_F/dt = 40 A/\mu s$                                       |  |     |     | 10  | V    |

Fig. 1: Switching OFF losses versus  $di/dt$ .

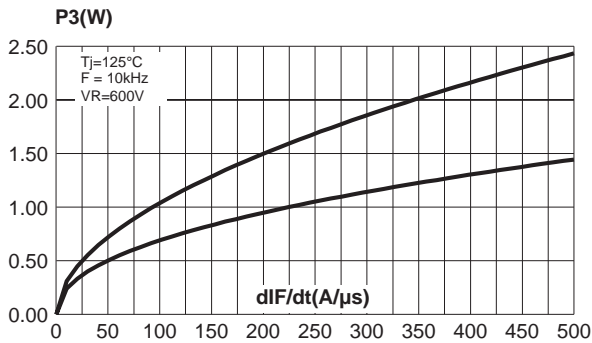


Fig. 2: Forward voltage drop versus forward current.

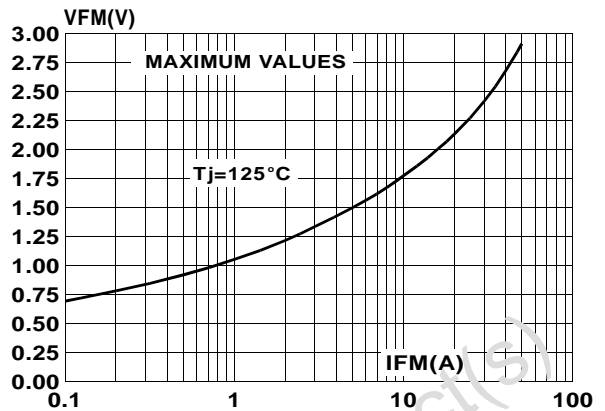


Fig. 3: Peak reverse recovery current versus  $di/dt$ .

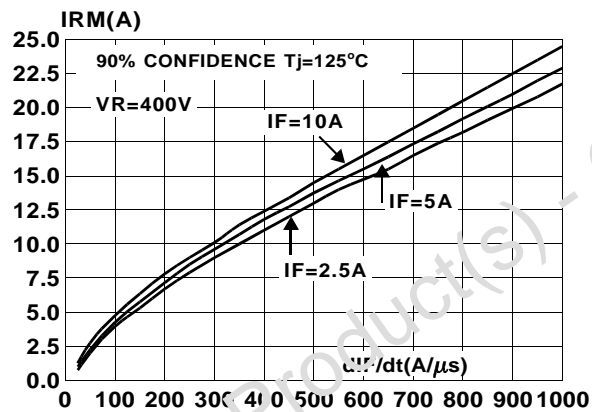


Fig. 4: Reverse recovery time versus  $di/dt$ .

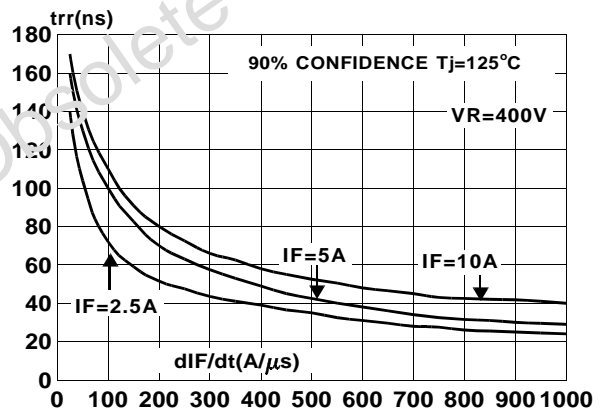


Fig. 5: Softness factor ( $t_b/t_a$ ) versus  $di/dt$ .

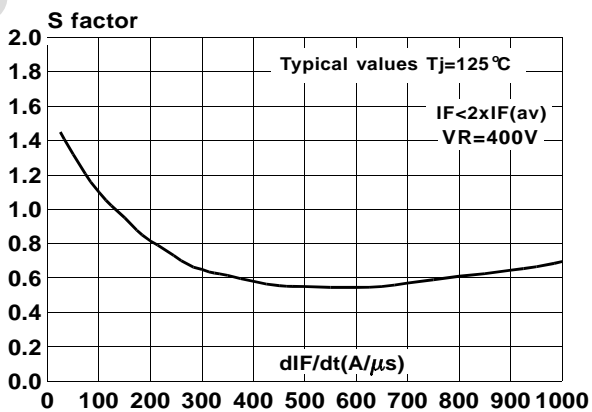
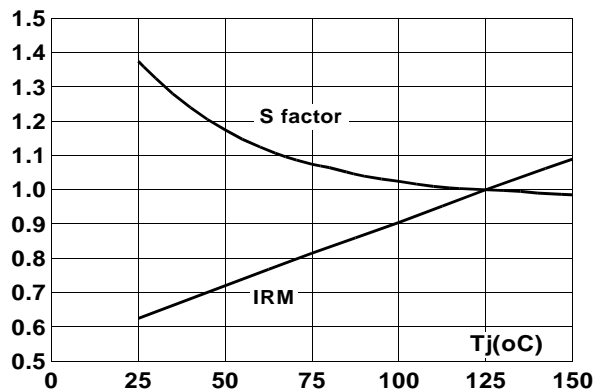
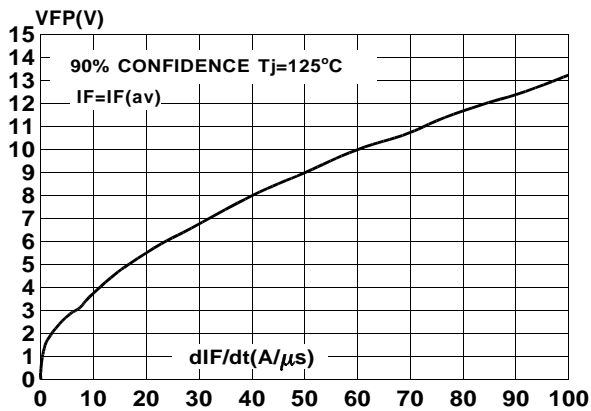


Fig. 6: Relative variation of dynamic parameters versus junction temperature (reference  $T_j = 125^\circ\text{C}$ ).

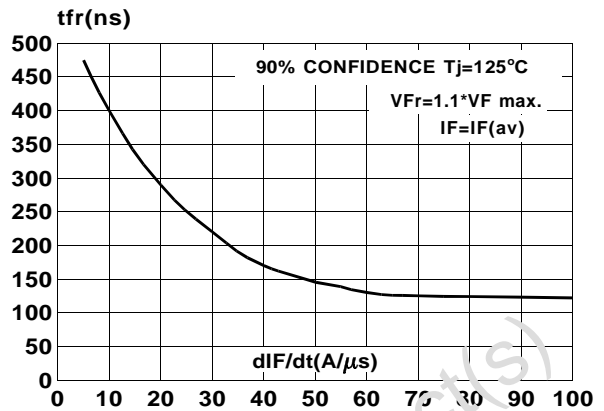


**STTA506D/F/B**

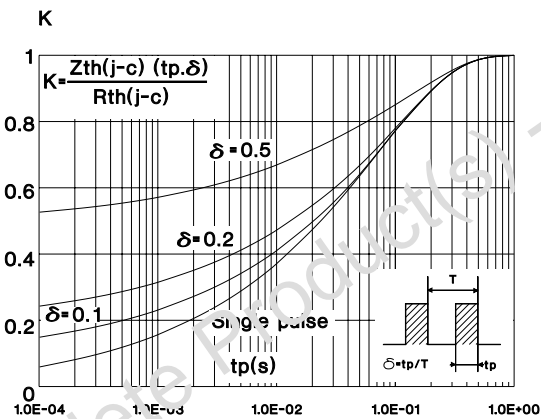
**Fig. 7:** Transient peak forward voltage versus  $di_F/dt$ .



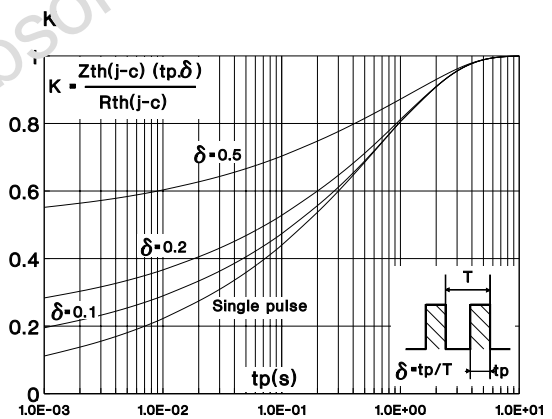
**Fig. 8:** Forward recovery time versus  $di_F/dt$ .



**Fig. 9:** Relative variation of thermal transient impedance junction to case versus pulse duration (TO-220AC and DPAK).



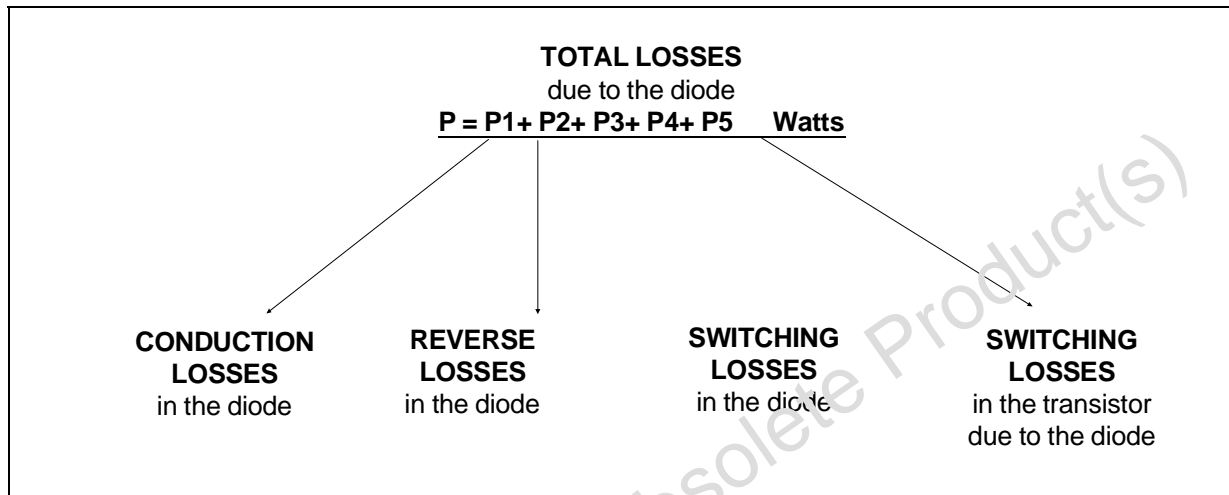
**Fig. 10:** Relative variation of thermal transient impedance junction to case versus pulse duration (ISOWATT220AC).



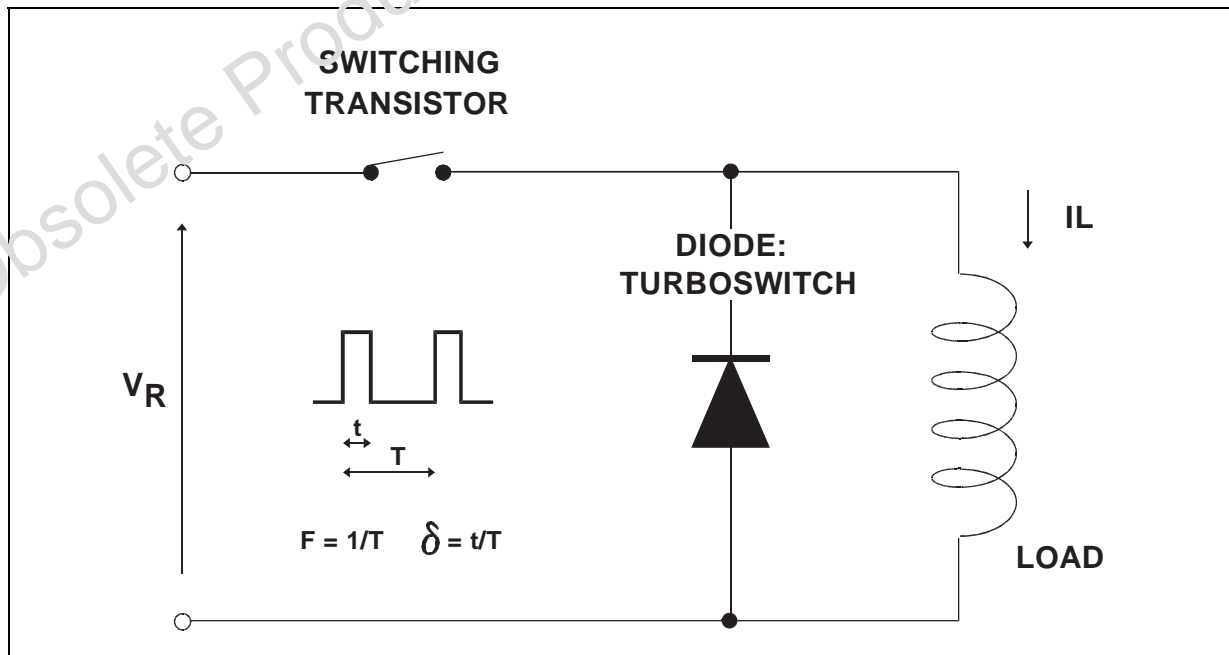
**APPLICATION DATA**

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:

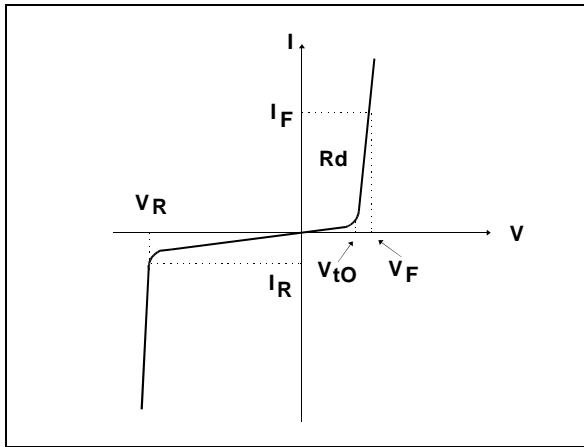


**Fig. A : "FREEWHEEL" MODE**



APPLICATION DATA (Cont'd)

Fig. B : STATIC CHARACTERISTICS



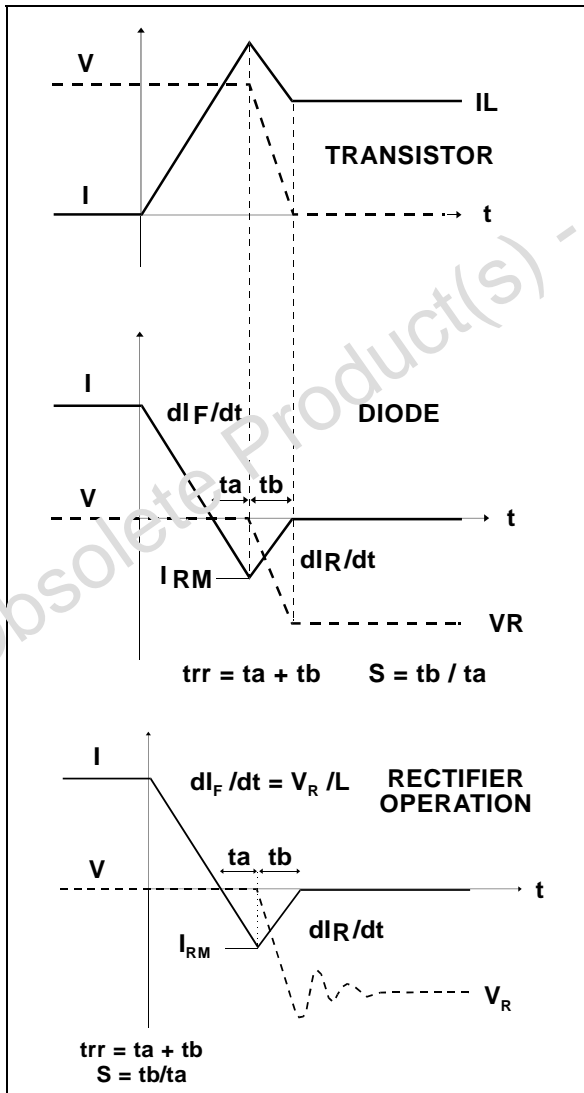
Conduction losses :

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

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)

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

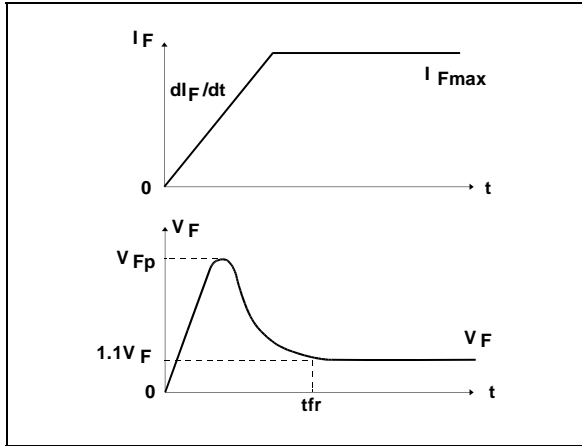
Turn-off losses (in the diode) :

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

P3 and P5 are suitable for power MOSFET and IGBT

## APPLICATION DATA (Cont'd)

Fig. D : TURN-ON CHARACTERISTICS

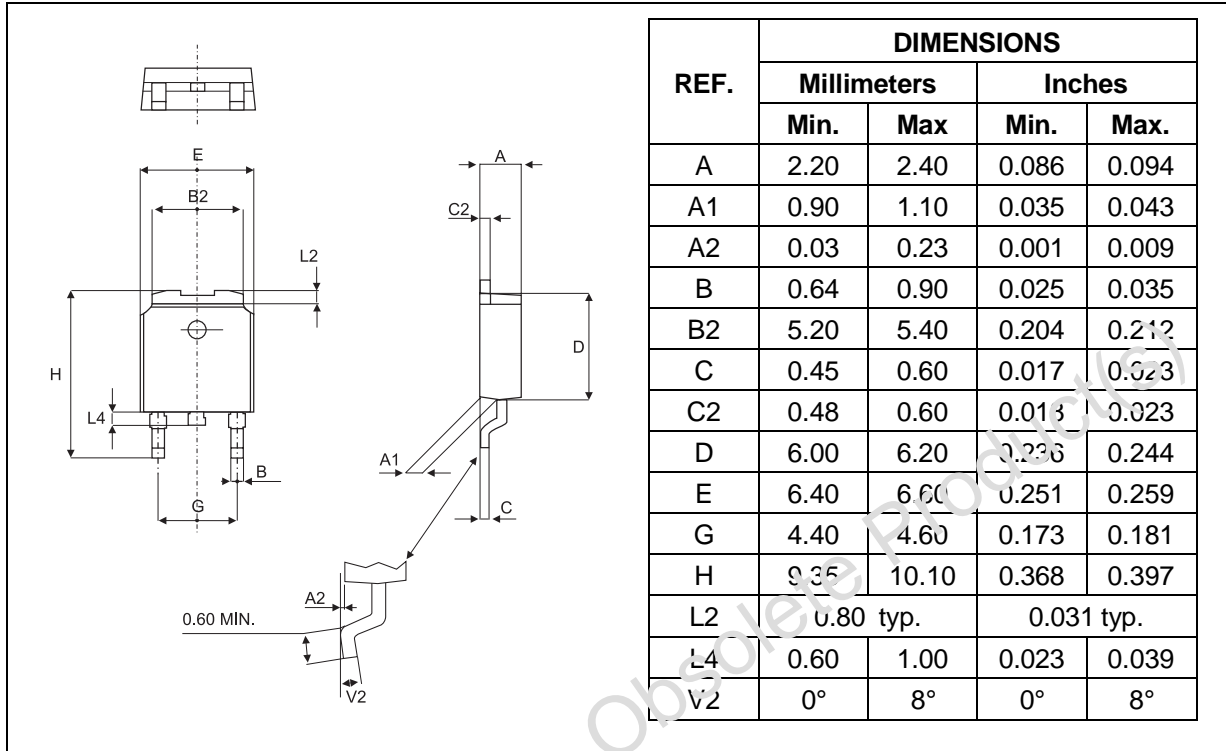


**Turn-on losses :**

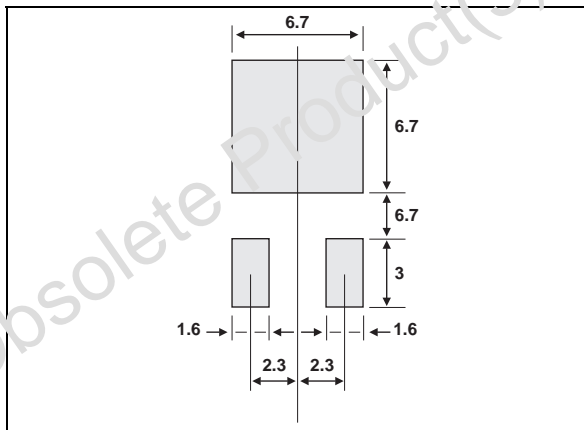
$$P_4 = 0.4 (V_{FP} - V_F) \cdot I_{Fmax} \cdot t_{fr} \cdot F$$

**STTA506D/F/B**

**PACKAGE MECHANICAL DATA**  
DPAK



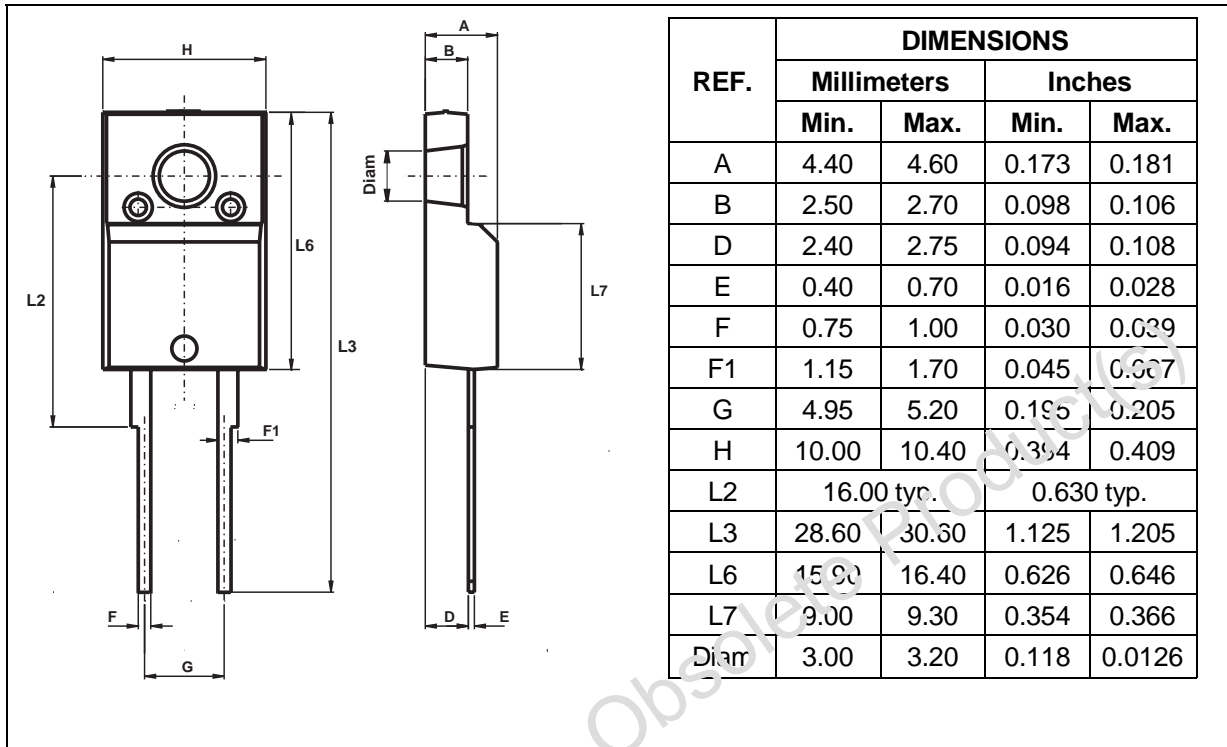
**FOOTPRINT DIMENSIONS (in millimeters)**



- Cooling method : by conduction (C)



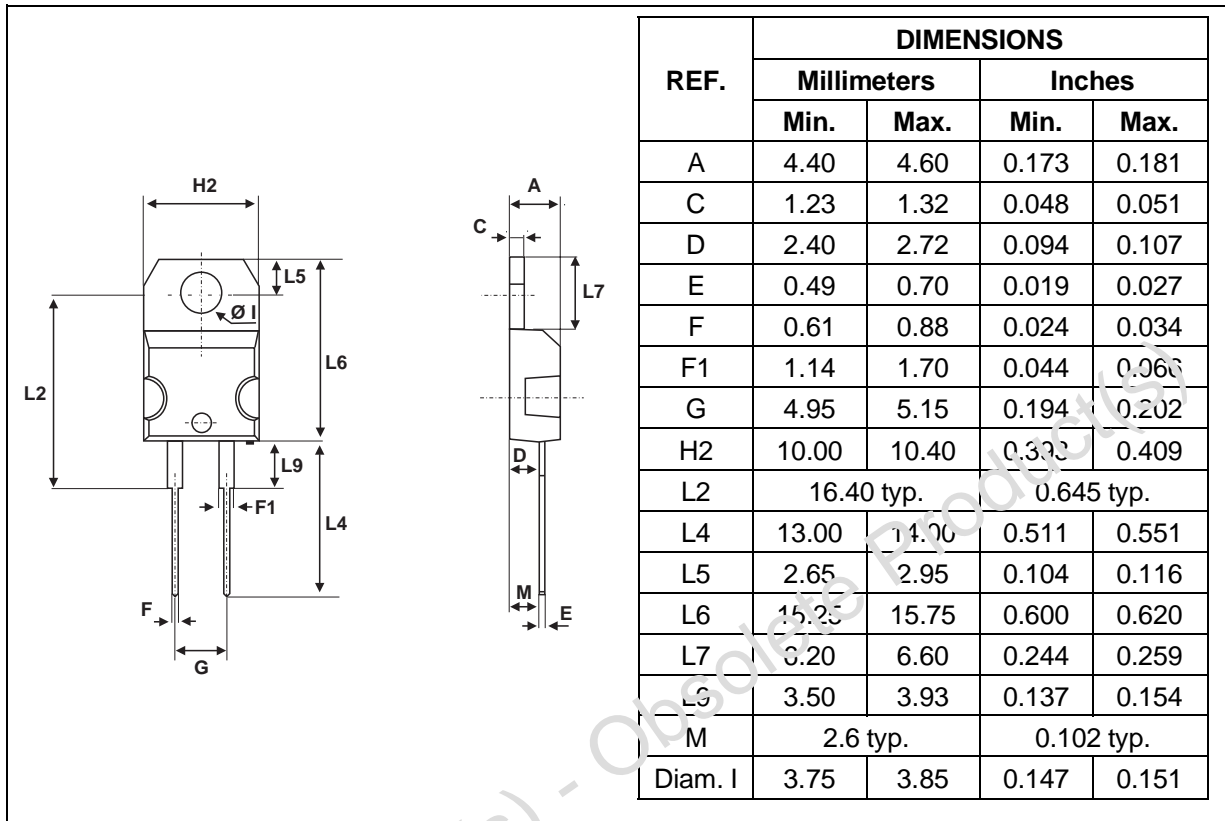
**PACKAGE MECHANICAL DATA**  
ISOWATT220AC



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

# STTA506D/F/B

## PACKAGE MECHANICAL DATA TO-220AC



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

| Ordering type | Marking  | Package      | Weight | Base qty | Delivery mode |
|---------------|----------|--------------|--------|----------|---------------|
| STTA506D      | STTA506D | TO-220AC     | 1.86g  | 50       | Tube          |
| STTA506F      | STTA506F | ISOWATT220AC | 2g     | 50       | Tube          |
| STTA506B      | STTA506B | DPAK         | 0.3g   | 75       | Tube          |
| STTA506B-TR   | STTA506B | DPAK         | 0.3g   | 2500     | Tape & reel   |

- Epoxy meets UL94,V0

Information furnished is believed to be accurate and reliable. However, STMicroelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of STMicroelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. STMicroelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of STMicroelectronics.

The ST logo is a registered trademark of STMicroelectronics

© 1999 STMicroelectronics - Printed in Italy - All rights reserved.

STMicroelectronics GROUP OF COMPANIES

Australia - Brazil - China - Finland - France - Germany - Hong Kong - India - Italy - Japan - Malaysia  
Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - U.S.A.

<http://www.st.com>