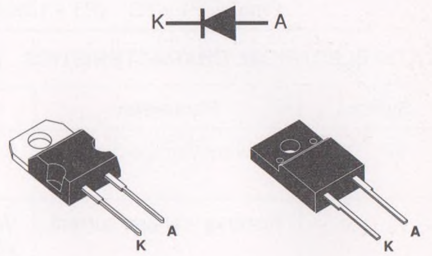
**SGS-THOMSON**
MICROELECTRONICS

# STTB506D/F

## TURBOSWITCH ™ "B". ULTRA-FAST HIGH VOLTAGE DIODE

### MAIN PRODUCTS CHARACTERISTICS

| | |
|---|---|
| $I_{F(AV)}$ | **5A** |
| $V_{RRM}$ | **600V** |
| $t_{rr}$ (typ) | **45ns** |
| $V_F$ (max) | **1.3V** |



TO220AC
(Plastic)

**STTB506D**

**Isolated**
**ISOWATT220AC**
(Plastic)

**STTB506F**

### FEATURES AND BENEFITS

- SPECIFIC TO THE FOLLOWING OPERATIONS: Snubbing or clamping, demagnetization and rectification.
- ULTRA-FAST, SOFT AND NOISE-FREE RECOVERY.
- VERY LOW OVERALL POWER LOSSES AND PARTICULARY LOW FORWARD VOLTAGE.
- DESIGNED FOR HIGH PULSED CURRENT OPERATIONS.

### DESCRIPTION

The TURBOSWITCH is a very high performance series of ultra-fast high voltage power diodes from 600V to 1200V.

TURBOSWITCH, B family, drastically cuts losses in all high voltage operations which require extremely fast, soft and noise-free power diodes. They are particularly suitable in the primary circuit of an SMPS as snubber, clamping or demagnetizing diodes, and also in most power converters as high performance rectifier diodes.

Packaged in TO220AC and in isolated ISOWATT220AC, these 600V devices are particularly intended for use on 240V domestic mains.

### ABSOLUTE MAXIMUM RATINGS

| 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 | 20 | A |
| $I_{FRM}$ | Repetitive peak forward current (tp = 5 µs, f = 1kHz) | 175 | A |
| $T_j$ | Max operating junction temperature | -65 to 150 | °C |
| $T_{stg}$ | Storage temperature | -65 to 150 | °C |

TM : TURBOSWITCH is a trademark of SGS-THOMSON Microelectronics.

## THERMAL AND POWER DATA

| Symbol | Parameter | Conditions | Value | Unit |
|---|---|---|---|---|
| $R_{th(j\text{-}c)}$ | Junction to case thermal resistance | STTB506D<br>STTB506F | 3.5<br>6.0 | °C/W |
| $P_1$ | Conduction power dissipation (see fig. 5) | $I_{F(AV)} = 5A$ $\delta = 0.5$<br>STTB506D Tc= 122°C<br>STTB506F Tc= 102°C | 8 | W |
| $P_{max}$ | Total power dissipation<br>Pmax = P1 + P3 (P3 = 10% P1) | STTB506D Tc= 115°C<br>STTB506F Tc= 90°C | 10 | W |

## STATIC ELECTRICAL CHARACTERISTICS (see Fig.5)

| Symbol | Parameter | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_F$ * | Forward voltage drop | $I_F = 5A$ | Tj = 25°C<br>Tj = 125°C | | | 1.4<br>1.3 | V<br>V |
| $I_R$ ** | Reverse leakage current | $V_R = 0.8 \times V_{RRM}$ | Tj = 25°C<br>Tj = 125°C | | | 100<br>0.75 | µA<br>mA |

Test pulses widths : * tp = 380 µs, duty cycle < 2%
** tp = 5 ms , duty cycle < 2%

## DYNAMIC ELECTRICAL CHARACTERISTICS

### TURN-OFF SWITCHING (see Fig.6)

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $t_{rr}$ | Reverse recovery time | Tj = 25°C<br>$I_F = 0.5$ A $I_R = 1$A Irr = 0.25A<br>$I_F = 1$ A $dI_F/dt = -50A/\mu s$ $V_R = 30V$ | | <br>45<br> | <br><br>95 | ns |
| $I_{RM}$ | Maximum reverse recovery current | Tj = 125°C VR = 400V $I_F = 5A$<br>$dI_F/dt = -40$ A/µs<br>$dI_F/dt = -500$ A/µs | | <br><br>20 | <br>7.5<br> | A |
| S factor | Softness factor | Tj = 125°C $V_R = 400V$ $I_F = 5A$<br>$dI_F/dt = -500$ A/µs | | 1 | | / |

### TURN-ON SWITCHING (see Fig.7)

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $t_{fr}$ | Forward recovery time | Tj = 25°C<br>$I_F = 5$ A, $dI_F/dt = 40$ A/µs<br>measured at, 1.1 × $V_F$max | | | 500 | ns |
| $V_{Fp}$ | Peak forward voltage | Tj = 25°C<br>$I_F = 5A$, $dI_F/dt = 40$ A/µs<br>$I_F = 25A$, $dI_F/dt = 500$ A/µs | | <br><br>10 | <br>8<br> | V |

## APPLICATION DATA

The TURBOSWITCH "B" is especially designed to provide the lowest overall power losses in any application such as snubbing,clamping, demagnetization and rectification. In such applications (fig.1 to fig.4), the way of calculating the power losses is given below :

**TOTAL LOSSES**
due to the diode
**P = P1+ P2+ P3+ P4 Watts**

**CONDUCTION LOSSES**
**P1 Watts**
**(Fig. 5)**

**REVERSE LOSSES**
**P2 Watts**
**(Fig. 5)**

**SWITCHING LOSSES**
**OFF : P3 Watts**
**ON : P4 Watts**
**(Fig. 6 & 7)**

**Fig. 1 :** SNUBBER DIODE.

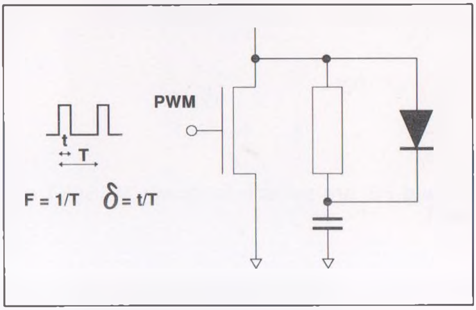


**Fig. 2 :** CLAMPING DIODE.

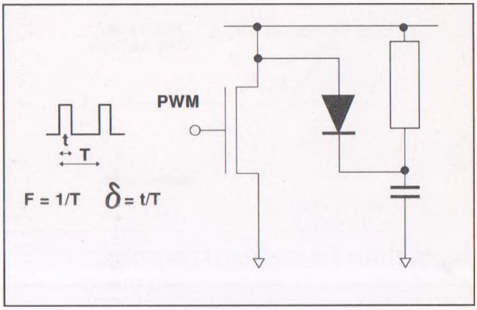


**Fig. 3 :** DEMAGNETIZING DIODE.

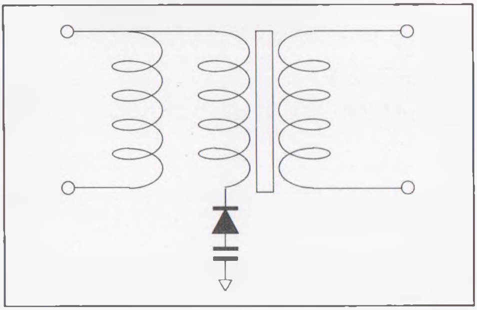
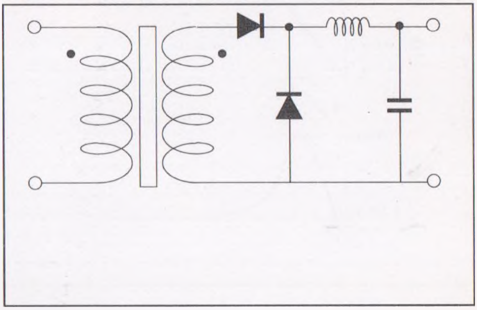


**Fig. 4 :** RECTIFIER DIODE.



## APPLICATION DATA (Cont'd)

**Fig. 5:** STATIC CHARACTERISTICS

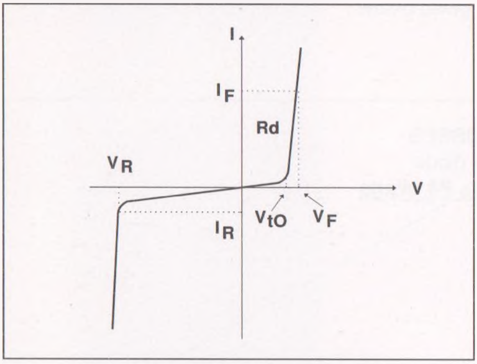


**Fig. 6:** TURN-OFF CHARACTERISTICS

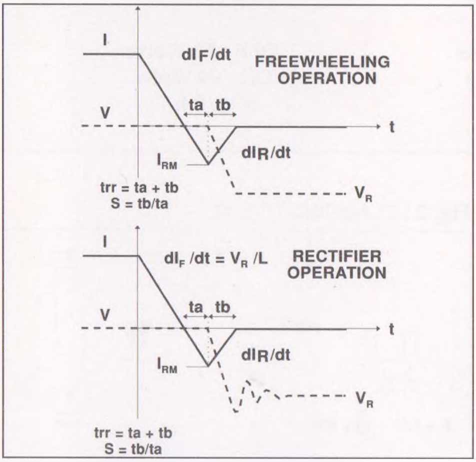
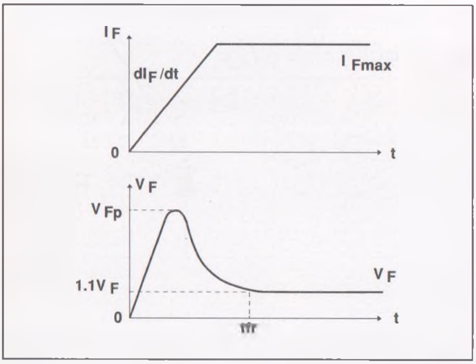


**Fig. 7:** TURN-ON CHARACTERISTICS



**Conduction** losses :

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

with

$$V_{t0} = 1.00 \text{ V}$$
$$R_d = 0.060 \text{ Ohm}$$
(Max values at 125°C)

**Reverse** losses :

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

**Turn-off** losses :

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

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

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

P3 and P3' are suitable for power MOSFET and IGBT

**Turn-on** losses :

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

**Fig 8 :** Conduction losses versus average current

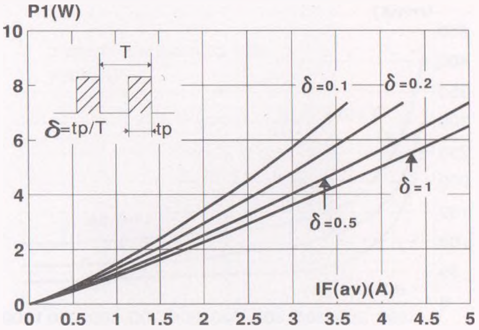


**Fig 9 :** Switching OFF losses versus dIF/dt

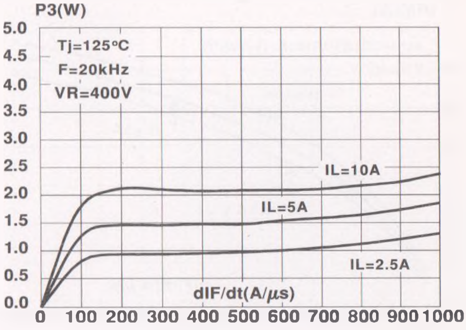


**Fig 10 :** Switching ON losses versus dIF/dt

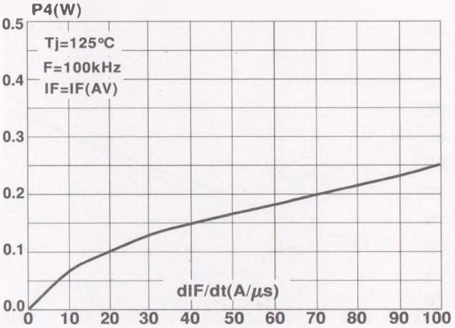


**Fig 11 :** Forward voltage drop versus forward current

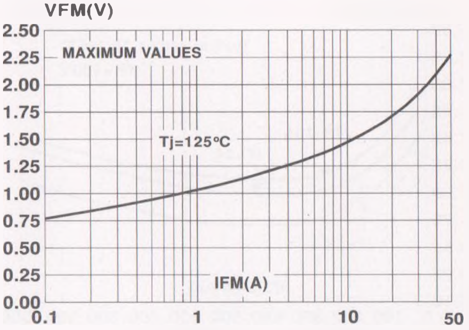


**Fig 12 :** Relative variation of thermal transient impedance junction to case versus pulse duration (TO220AC)

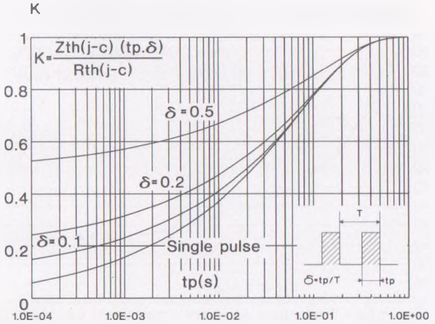


**Fig 13 :** Relative variation of thermal transient impedance junction to case versus pulse duration (ISOWATT220AC)

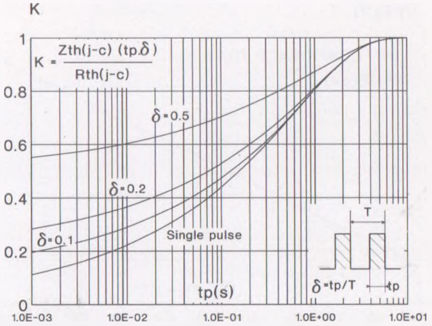


**Fig 14 :** Peak reverse recovery current versus dIF/dt

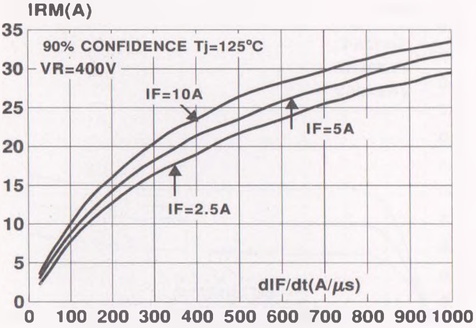


**Fig 15 :** Reverse recovery time versus dIF/dt

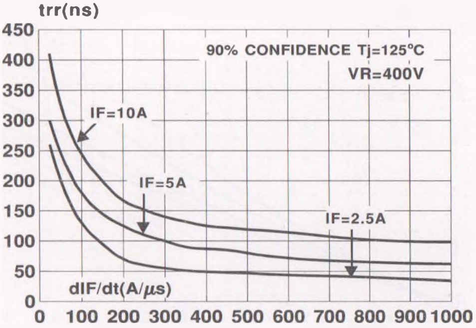


**Fig 16 :** Softness factor (tb/ta) versus dIF/dt

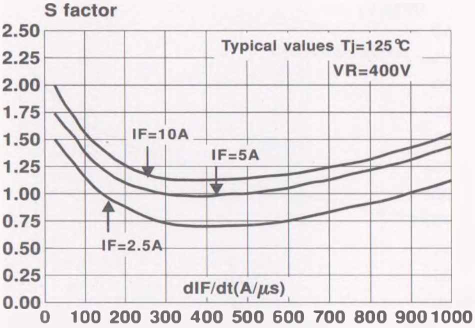


**Fig 17 :** Relative variation of dynamic parameters versus junction temperature (Reference Tj=125˚C)

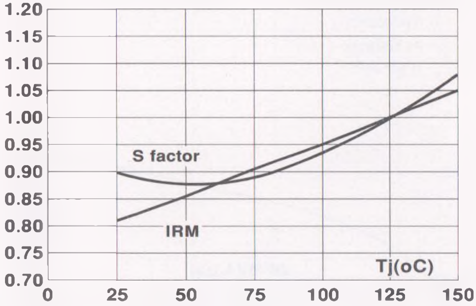


**Fig 18 :** Transient peak forward voltage versus dIF/dt

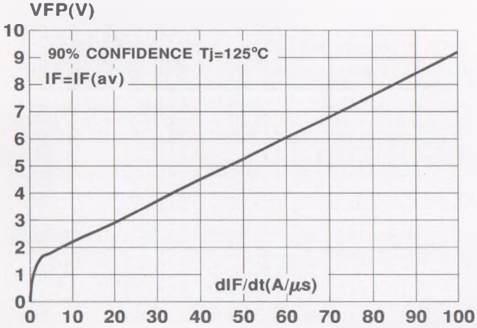


**Fig 19 :** Forward recovery time versus dIF/dt