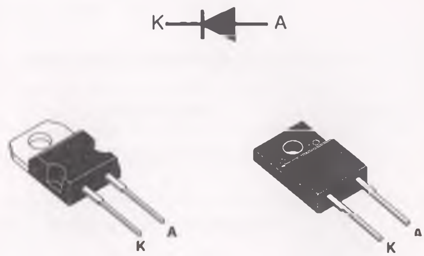
SGS-THOMSON MICROELECTRONICS

STTA506D/F

TURBOSWITCH ™ "A". ULTRA-FAST HIGH VOLTAGE DIODE

MAIN PRODUCTS CHARACTERISTICS

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



TO220AC (Plastic)
STTA506D

Isolated ISOWATT220AC (Plastic)
STTA506F

FEATURES AND BENEFITS

- SPECIFIC TO "FREEWHEEL MODE" OPERATIONS: Freewheel or Booster Diode.
- ULTRA-FAST RECOVERY.
- VERY LOW OVERALL POWER LOSSES IN BOTH THE DIODE AND THE COMPANION TRANSISTOR.
- HIGH FREQUENCY OPERATIONS.

DESCRIPTION

The TURBOSWITCH is a very high performance series of ultra-fast high voltage power diodes from 600V to 1200V.
TURBOSWITCH, A 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 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 = 5kHz)	65	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
$R_{th(j-c)}$	Junction to case thermal resistance	STTA506D STTA506F	3.5 6.0	°C/W
P_1	Conduction power dissipation (see fig. 2)	$I_{F(AV)}$ = 5A δ =0.5 STTA506D Tc= 118°C STTA506F Tc= 96°C	9	W
P_{max}	Total power dissipation Pmax = P1 + P3 (P3 = 10% P1)	STTA506D Tc= 115°C STTA506F Tc= 90°C	10	W

STATIC ELECTRICAL CHARACTERISTICS (see Fig.2)

Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
V_F *	Forward voltage drop	I_F =5A	Tj = 25°C Tj = 125°C			1.75 1.5	V V
I_R **	Reverse leakage current	V_R =0.8 x V_{RRM}	Tj = 25°C Tj = 125°C			100 2	µA mA

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

DYNAMIC ELECTRICAL CHARACTERISTICS

TURN-OFF SWITCHING (see Fig.3)

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		20	 50	ns
I_{RM}	Maximum reverse recovery current	Tj = 125°C VR = 400V I_F =5A dI_F/dt = -40 A/µs dI_F/dt = -500 A/µs		 11	 3.0	A
S factor	Softness factor	Tj = 125°C V_R = 400V I_F =5A dI_F/dt = -500 A/µs		0.55		/

TURN-ON SWITCHING (see Fig.4)

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			500	ns
V_{Fp}	Peak forward voltage	Tj = 25°C I_F =5A, dI_F/dt = 40 A/µs			10	V

APPLICATION DATA

The TURBOSWITCH "A" is especially designed to provide the lowest overall power losses in any "FREEWHEEL Mode" application (Fig.1) 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:

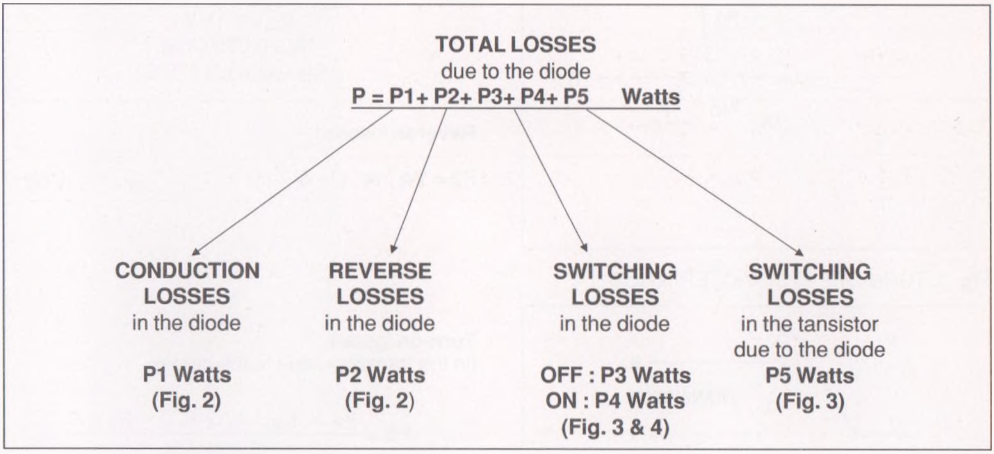
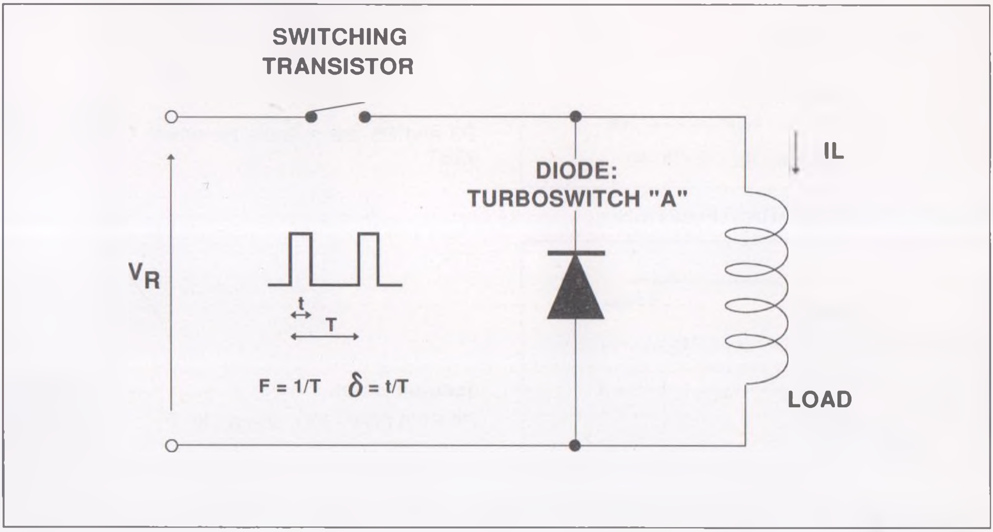


Fig. 1 : "FREEWHEEL" MODE.



APPLICATION DATA (Cont'd)

Fig. 2: STATIC CHARACTERISTICS

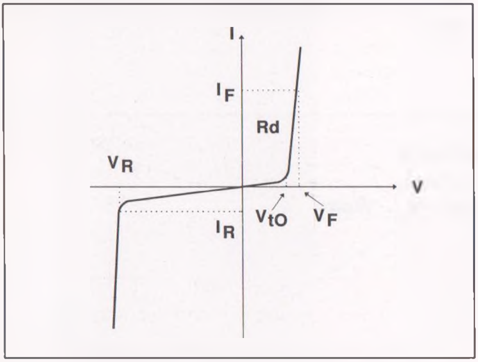


Fig. 3: TURN-OFF CHARACTERISTICS

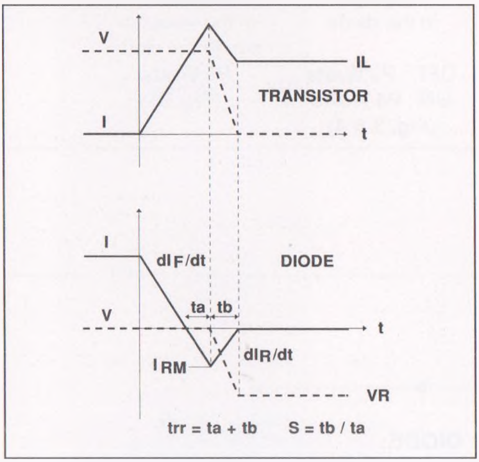
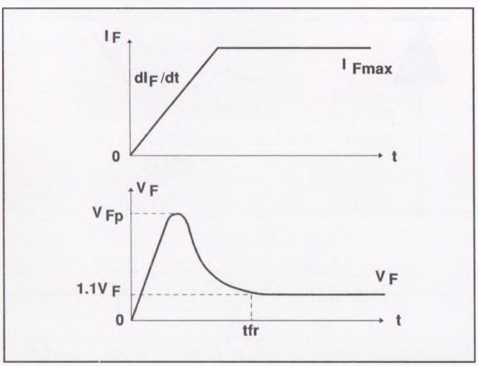


Fig. 4: TURN-ON CHARACTERISTICS



Conduction losses :

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

with

$V_{t0} = 1.15$ V
$R_d = 0.070$ Ohm
(Max values at 125°C)

Reverse losses :

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

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

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

Turn-off losses (in the diode) :

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

P3 and P5 are suitable for power MOSFET and IGBT

Turn-on losses :

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

Fig 5 : Conduction losses versus average current

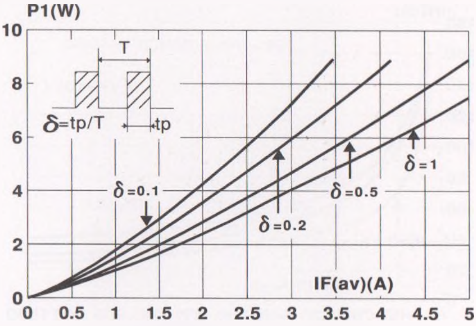


Fig 6 : Switching OFF losses versus dIF/dt

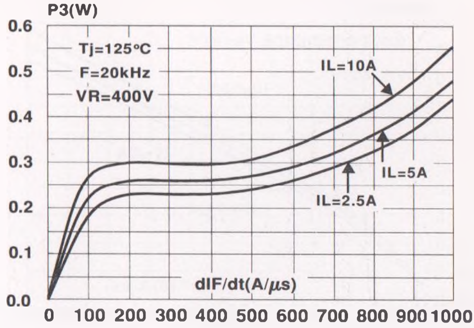


Fig 7 : Switching ON losses versus dIF/dt

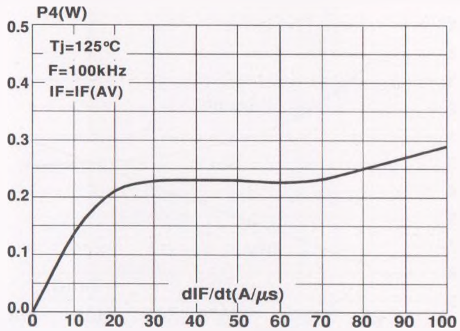


Fig 8 : Switching losses in transistor due to the diode

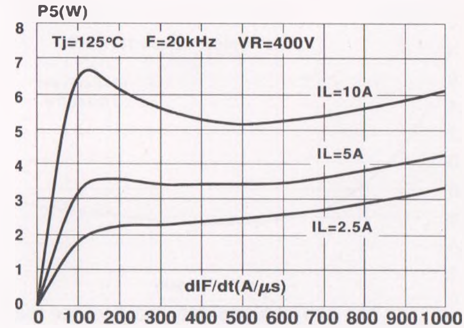


Fig 9 : Forward voltage drop versus forward current

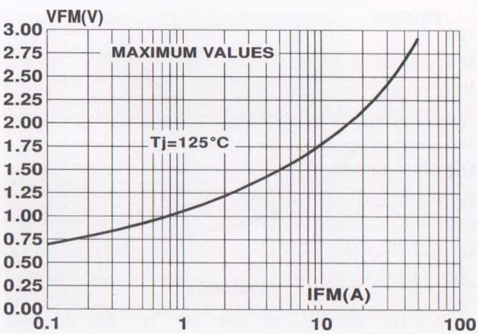


Fig 10 : Peak reverse recovery current versus dIF/dt

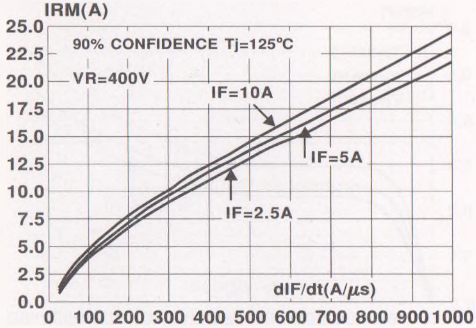


Fig 11 : Reverse recovery time versus dIF/dt

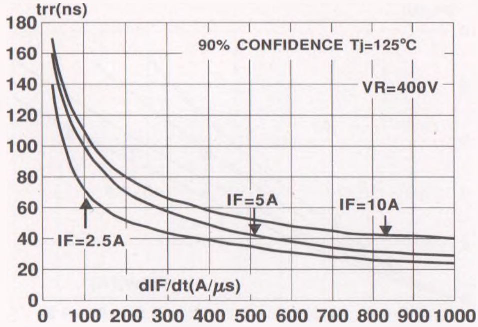


Fig 12 : Softness factor (tb/ta) versus dIF/dt

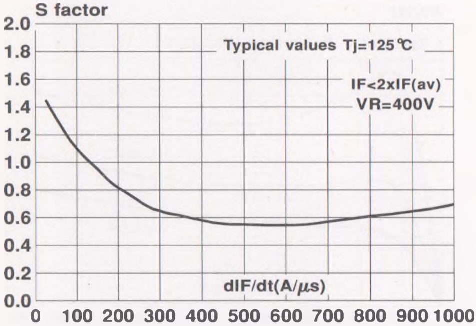


Fig 13 : Relative variation of dynamic parameters versus junction temperature (Reference Tj=125°c)

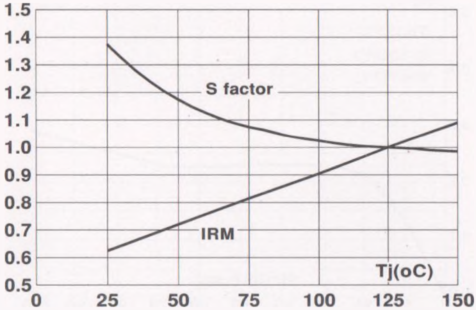


Fig 14 : Transient peak forward voltage versus dIF/dt

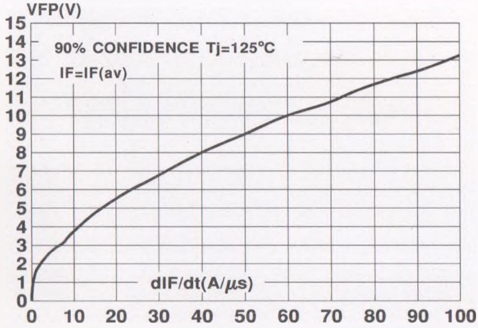


Fig 15 : Forward recovery time versus dIF/dt

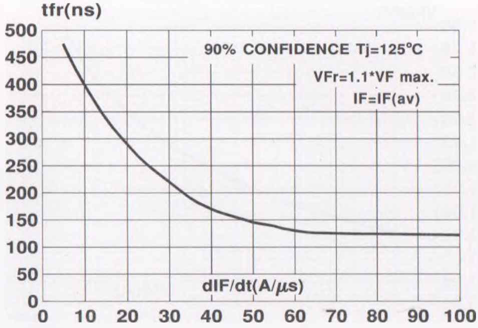


Fig 16 : Relative variation of thermal transient impedance junction to case versus pulse duration (TO220AC)

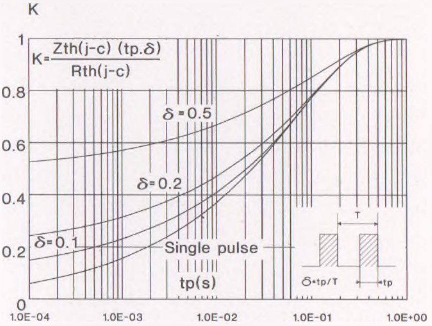


Fig 17 : Relative variation of thermal transient impedance junction to case versus pulse duration (ISOWATT220AC)