## TURBOSWITCH ${ }^{\text {тм }}$ ULTRA-FAST HIGH VOLTAGE DIODE

MAIN PRODUCT CHARACTERISTICS

| $\mathbf{I}_{\text {(AV }}$ | 2 A |
| :---: | :---: |
| $\mathrm{~V}_{\text {RRM }}$ | 1200 V |
| $\mathrm{t}_{\text {rr }}$ (typ) | 65 ns |
| $\mathrm{~V}_{\mathrm{F}}$ (max) | 1.5 V |

## FEATURES AND BENEFITS

- SPECIFIC TO THE FOLLOWING OPERATIONS: SNUBBING OR CLAMPING, DEMAGHETIZATION AND RECTIFICATION
- ULTRA-FAST AND SOFT RECOVERY
- VERY LOW OVERALL POWER LOSSES IN BOTH THE DIODE AND THE COMPANION TRANSISTOR
- HIGH FREQUENCY OPERATION
- HIGH REVERSE VOLTAGE CAPABILITY


## DESCRIPTION

TURBOSWITCH 1200 V drastically cuts losses in all high voltage operations which require e evirenely fast, soft and noise-free power diodes Due to their optimized switching peifomances they aloso highly decrease poive: iosses in any associated switching IGBT cr iNOSFET in all "freewheel mode" operaiors and is particulary

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

ABSOLUTE R/I:NGS (limiting values)

| Symho' | Parameter |  | Value | Unit |
| :---: | :---: | :---: | :---: | :---: |
| V-3iv | Repetitive peak reverse voltage |  | 1200 | V |
| - VRSM | Non repetitive peak reverse voltage |  | 1200 | V |
| If(RMS) | RMS forward current |  | 10 | A |
| IFRM | Repetitive peak forward current | tp $=5 \mu \mathrm{~s}$ F=5kHz square | 20 | A |
| IFSM | Surge non repetitive forward current | tp $=10 \mathrm{~ms}$ sinusoidal | 25 | A |
| $\mathrm{T}_{\text {stg }}$ | Storage temperature range |  | -65 to + 150 | ${ }^{\circ} \mathrm{C}$ |
| $\mathrm{T}_{\mathrm{j}}$ | Maximum operating junction temperature |  | 125 | ${ }^{\circ} \mathrm{C}$ |

STTA212S
THERMAL AND POWER DATA

| Symbol | Parameter | Test conditions | Value | Unit |
| :---: | :--- | :--- | :---: | :---: |
| $R_{\text {th (j-I) }}$ | Junction to lead thermal resistance | 21 | ${ }^{\circ} \mathrm{C} / \mathrm{W}$ |  |
| $\mathrm{P}_{1}$ | Conduction power dissipation | $\mathrm{I}_{\mathrm{F}(\mathrm{AV})}=1.5 \mathrm{~A} \quad \delta=0.5$ <br> $\mathrm{Tlead}=72^{\circ} \mathrm{C}$ | 2.5 | W |
| $\mathrm{P}_{\max }$ | Total power dissipation <br> $\mathrm{Pmax}=\mathrm{P} 1+\mathrm{P} 3 \quad(\mathrm{P} 3=10 \% \mathrm{P} 1)$ | Tlead $=67^{\circ} \mathrm{C}$ | 2.8 | W |

## STATIC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Test Conditions |  | Min | Typ | Max | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\mathrm{V}_{\mathrm{F}}$ * | Forward voltage drop | $\mathrm{I}_{\mathrm{F}}=2 \mathrm{~A}$ | $\begin{aligned} & \mathrm{Tj}=25^{\circ} \mathrm{C} \\ & \mathrm{Tj}=125^{\circ} \mathrm{C} \end{aligned}$ |  | 1.1 | $\begin{gathered} 1.65 \\ 1.5 \end{gathered}$ | V |
| IR ** | Reverse leakage current | $\begin{aligned} & V_{R}=0.8 \\ & x V_{R R M} \end{aligned}$ | $\begin{aligned} & \mathrm{Tj}=25^{\circ} \mathrm{C} \\ & \mathrm{Tj}=125^{\circ} \mathrm{C} \end{aligned}$ |  | 150 | $\begin{gathered} 20 \\ 400 \end{gathered}$ | $\mu \mathrm{A}$ |
| Vto | Threshold voltage | $\mathrm{lp}<3 . \mathrm{l}_{\text {av }}$ | $\mathrm{Tj}=125^{\circ} \mathrm{C}$ |  |  | 1.15 | V |
| rd | Dynamic resistance |  |  |  |  | 175 | $\mathrm{m} \Omega$ |

Test pulses: $\quad * t p=380 \mu \mathrm{~s}, \delta<2 \%$
** $\mathrm{tp}=5 \mathrm{~ms}, \delta<2 \%$

To evaluate the maximum conduction losses use the following equation :
$\mathrm{P}=\mathrm{V}_{\mathrm{to}} \times \mathrm{I}_{\mathrm{F}(\mathrm{AV})}+\mathrm{rd} \times \mathrm{IF}^{2}$ (RMS)
DYNAMIC ELECTRICAL CHARACTERISTICS
TURN-OFF SWITCHING

| Symbol | Parameter | Test conditions | Min | Typ | Max | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| trr | Reverse recovery time | $\begin{aligned} & \mathrm{Tj}=25^{\circ} \mathrm{C} \\ & \mathrm{I}_{\mathrm{F}}=0.5 \mathrm{~A} \quad \mathrm{I}_{\mathrm{R}}=1 \mathrm{~A} \quad \mathrm{Irr}=0.25 \mathrm{~A} \\ & \mathrm{I}_{\mathrm{F}}=1 \mathrm{~A} \quad \mathrm{dl}_{\mathrm{F}} / \mathrm{dt}=-50 \mathrm{~A} / \mu \mathrm{s} \quad \mathrm{~V}_{\mathrm{R}}=30 \mathrm{~V} \end{aligned}$ |  | 65 | 115 | ns |
| IRM | Maximum recovery current | $\begin{array}{lll} \mathrm{Tj}=125^{\circ} \mathrm{C} \quad \mathrm{~V}_{\mathrm{R}}=600 \mathrm{~V} & \mathrm{I}_{\mathrm{F}}=2 \mathrm{~A} \\ \mathrm{dl}_{\mathrm{F}} / \mathrm{dt}=-16 \mathrm{~A} / \mu \mathrm{s} \\ \mathrm{dl}_{\mathrm{F}} / \mathrm{dt}=-50 \mathrm{~A} / \mu \mathrm{s} & \\ \hline \end{array}$ |  | 6.0 | 3.6 | A |
| S factor | Softness factor | $\begin{aligned} & \mathrm{Tj}=125^{\circ} \mathrm{C} \mathrm{~V}_{\mathrm{R}}=600 \mathrm{~V} \quad \mathrm{I}_{\mathrm{F}}=2 \mathrm{~A} \\ & \mathrm{dl}_{\mathrm{F}} / \mathrm{dt}=-50 \mathrm{~A} / \mu \mathrm{s} \end{aligned}$ |  | 0.9 |  | / |

TURN-ON SWITCHING

| Symbol | Parameter | Test conditions | Min | Typ | Max | Unit |
| :---: | :--- | :--- | :---: | :---: | :---: | :---: |
| $\mathrm{t}_{\mathrm{tr}}$ | Forward recovery time | $\mathrm{Tj}=25^{\circ} \mathrm{C}$ |  |  |  |  |
| $\mathrm{I}_{\mathrm{F}}=2 \mathrm{~A}$ |  |  |  |  |  |  |
| $\mathrm{~d}_{\mathrm{Fp}} / \mathrm{dt}=16 \mathrm{~A} / \mu \mathrm{S}$ |  |  |  |  |  |  |
| measured at $1.1 \times \mathrm{V}_{\mathrm{F}}$ | Peak forward voltage |  |  |  |  |  |

Fig. 1: Conduction losses versus average current.


Fig. 3: Variation of thermal impedance junction to ambient versus pulse duration (epoxy printed circuit board FR4, e(Cu)=35 $\mathrm{mm}, \mathrm{S}(\mathrm{Cu})=1 \mathrm{~cm} 2)$.


Fig. 5: Softness factor (tb/ta) versus $\mathrm{dl}_{\mathrm{F}} / \mathrm{dt}$ (typical values).


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

IFM(A)


Fig. 4: Peak reverse recovery current versus $\mathrm{dl}_{\mathrm{F}} / \mathrm{dt}$ (90\% confidence).


Fig. 6: Reverse recovery time versus $\mathrm{dl}_{\mathrm{F}} / \mathrm{dt}$ ( $90 \%$ confidence).


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


Fig. 8: Transient peak forward voltage versus $\mathrm{dl}_{\mathrm{F}} / \mathrm{dt}$.


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


## APPLICATION DATA

The 1200V TURBOSWITCH has been designed to provide the lowest overall power losses in any 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


APPLICATION DATA (Cont'd)
Fig. B : SNUBBER DIODE.


Fig. C : DEMAGNETIZING DIODE.


Fig. D: RECTIFIER DIODE.


Fig. E: STATIC CHARACTERISTICS


Conduction losses:
$\mathrm{P} 1=\mathrm{V}_{\mathrm{t} 0} \times \mathrm{IF}(\mathrm{AV})+\operatorname{Rd} \times \mathrm{IF}^{2}(\mathrm{RMS})$
Reverse losses :
$\mathrm{P} 2=\operatorname{VR} \times \operatorname{IR} \times(1-\delta)$

APPLICATION DATA (Cont'd)
Fig. F: TURN-OFF CHARACTERISTICS


Fig. G: TURN-ON CHARACTERISTICS


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

$$
\begin{aligned}
\mathrm{P} 5 & =\frac{V_{R} \times I_{R M}{ }^{2} \times(3+2 \times S) \times F}{6 \times d I_{F} / d t} \\
& +\frac{V_{R} \times I_{R M} \times I_{L} \times(S+2) \times F}{2 \times d I_{F} / d t}
\end{aligned}
$$

Turn-off losses (in the diode) :

$$
\mathrm{P} 3=\frac{V_{R} \times I_{R M}{ }^{2} \times S \times F}{6 \times d l_{F} / d t}
$$

Turn-off losses :
with non negligible serial inductance

$$
\mathrm{P} 3^{\prime}=\frac{V_{R} \times I_{R M^{2}} \times S \times F}{6 \times d I_{F} / d t}+\frac{L \times I_{R M^{2}} \times F}{2}
$$

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

## Turn-on losses :

P4 = $0.4(\mathrm{VFP}-\mathrm{VF}) \times \mathrm{IFmax} \times \operatorname{tr} \times \mathrm{F}$

PACKAGE MECHANICAL DATA
SMC


| REF. | DIMENSIONS |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | Millimeters |  | Inches |  |
|  | Min. | Max. | Min. | Max. |
| A1 | 1.90 | 2.45 | 0.075 | 0.096 |
| A2 | 0.05 | 0.20 | 0.002 | 0.008 |
| b | 2.90 | 3.2 | 0.114 | 0.126 |
| c | 0.15 | 0.41 | 0.006 | 0.016 |
| E | 7.75 | 8.15 | 0.305 | 0.321 |
| E1 | 6.60 | 7.15 | 0.260 | 0.281 |
| E2 | 4.40 | 4.70 | 0.173 | 0.185 |
| D | 5.55 | 6.25 | 0.218 | 0.246 |
| L | 0.75 | 1.60 | 0.030 | 0.063 |

FOOTPRINT DIMENSIONS (in millimeters)
SMC Plastic


| Ordering type | Marking | Package | Weight | Base qty | Delivery mode |
| :---: | :---: | :---: | :---: | :---: | :---: |
| STTA212S | T53 | SMC | 0.243 g | 2500 | Tape \& reel |

- Epoxy meets UL94,V0
- Band indicates cathode

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