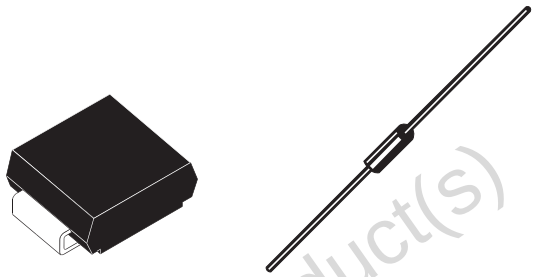
# STTA106/U

## TURBOSWITCH ULTRA-FAST HIGH VOLTAGE DIODE

### MAIN PRODUCT CHARACTERISTICS

| | |
|---|---|
| $I_{F(AV)}$ | 1A |
| $V_{RRM}$ | 600V |
| $t_{rr}$ (typ) | 20ns |
| $V_F$ (max) | 1.5V |



SMB
STTA106U



DO-15
STTA106

### 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

### DESCRIPTION

The TURBOSWITCH is a very high performance series of ultra-fast high voltage power diodes. TURBOSWITCH family drastically cuts losses in both the diode and the associated switching IGBT and MOSFET in all freewheel mode operations and is particulary suitable and efficient in motor control freewheel applications and in booster diode applications in power factor control circuitries.

Available either in SMB or DO-15 axial package, 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 |
| $I_{F(RMS)}$ | RMS forward current | | 6 | A |
| $I_{FRM}$ | Repetitive peak forward current | tp = 5 µs<br>F = 5kHz square | 10 | A |
| $I_{FSM}$ | Surge non repetitive forward current | tp = 10 ms sinusoidal | 25 | A |
| $T_j$ | Maximum operating junction temperature | | 125 | °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 |
|---|---|---|---|---|---|
| $R_{th(j-l)}$ | Junction to lead | | SMB | 23 | °C/W |
| | Junction to lead L=5mm | | DO-15 | 45 | °C/W |
| $P_1$ | Conduction power dissipation | $I_{F(AV)}$ = 0.8A δ = 0.5 Tlead= 93°C | SMB | 1.4 | W |
| | | $I_{F(AV)}$ = 0.8A δ = 0.5 Tlead= 60°C | DO-15 | 1.4 | W |
| $P_{max}$ | Total power dissipation Pmax = P1 + P3 (P3 = 10% P1) | Tlead= 90°C | SMB | 1.5 | W |
| | | Tlead= 60°C | DO-15 | 1.5 | W |

## STATIC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Test conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_F$ * | Forward voltage drop | $I_F$ = 1A | Tj = 25°C<br>Tj = 125°C | | <br>1.1 | 1.75<br>1.5 | V |
| $I_R$ ** | Reverse leakage current | $V_R$ = 0.8 x $V_{RRM}$ | Tj = 25°C<br>Tj = 125°C | | <br>250 | 10<br>750 | µA |
| $V_{to}$ | Threshold voltage | Ip < 3.$I_{F(AV)}$ | Tj = 125°C | | | 1.15 | V |
| Rd | Dynamic resistance | | | | | 350 | mΩ |

Test pulse : * tp = 380 µs, δ < 2%
** tp = 5 ms, δ < 2%

To evaluate the maximum conduction losses use the following equation :
$P = V_{to} \times I_{F(AV)} + Rd \times I_F{}^2{}_{(RMS)}$

## DYNAMIC ELECTRICAL CHARACTERISTICS
## TURN-OFF SWITCHING

| Symbol | Parameter | Test conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $t_{rr}$ | Reverse recovery time | Tj = 25°C<br>$I_F$ = 0.5 A $I_R$ = 1A Irr = 0.25A<br>$I_F$ = 1 A $dI_F/dt$ =-50A/µs $V_R$ = 30V | | 20 | <br>50 | ns |
| $I_{RM}$ | Maximum recovery current | Tj = 125°C VR = 400V $I_F$ = 1A<br>$dI_F/dt$ = -8 A/µs<br>$dI_F/dt$ = -50 A/µs | | <br>1.6 | 0.6 | A |
| S factor | Softness factor | Tj = 125°C $V_R$ = 400V $I_F$ =1A<br>$dI_F/dt$ = -50 A/µs | | 1.1 | | / |

## TURN-ON SWITCHING

| Symbol | Parameter | Test conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $t_{fr}$ | Forward recovery time | Tj = 25°C<br>$I_F$ = 1 A, $dI_F/dt$ = 8 A/µs<br>measured at 1.1 × $V_F$ max | | | 500 | ns |
| $V_{Fp}$ | Peak forward voltage | | | | 10 | V |

**Fig. 1**: Conduction losses versus average current.

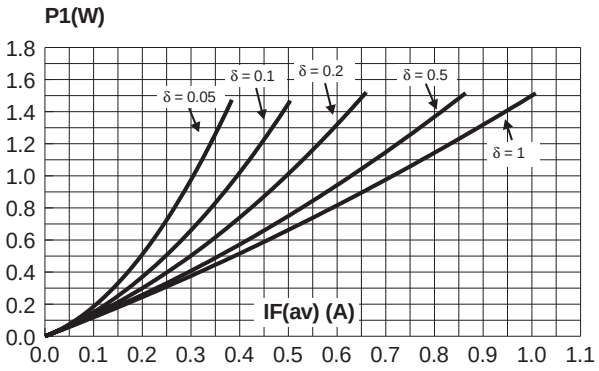



**Fig. 2:** Forward voltage drop versus forward current (maximum values).

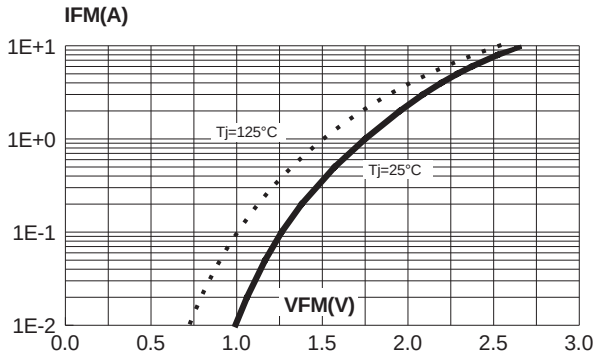



**Fig. 3:** Peak reverse recovery current versus $dI_F/dt$ (90% confidence).

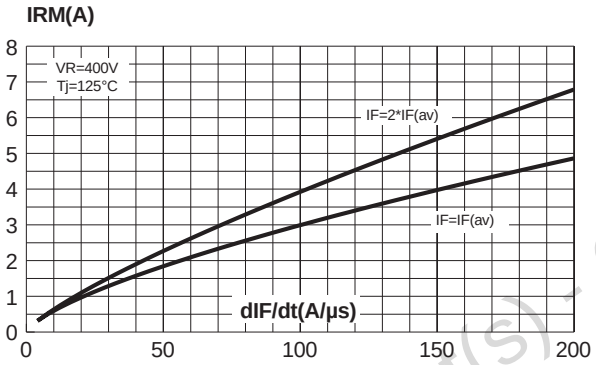



**Fig. 4:** Reverse recovery time versus $dI_F/dt$ (90% confidence).

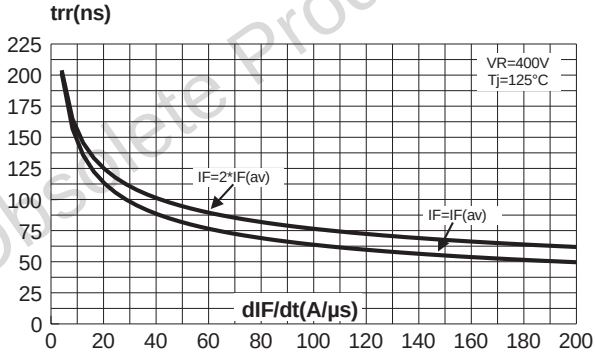



**Fig. 5:** Softness factor (tb/ta) versus $dI_F/dt$ (typical values).

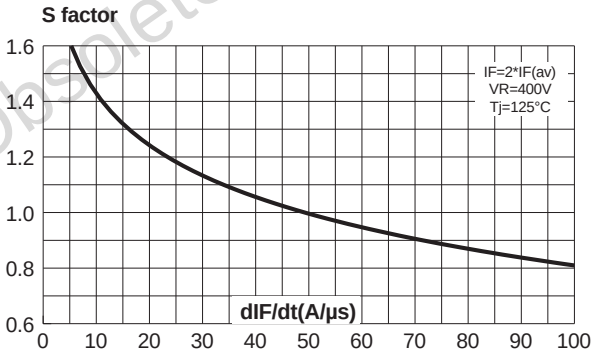



**Fig. 6:** Relative variation of dynamic parameters versus junction temperature (reference Tj = 125°C). (Reference: Tj=125°C)

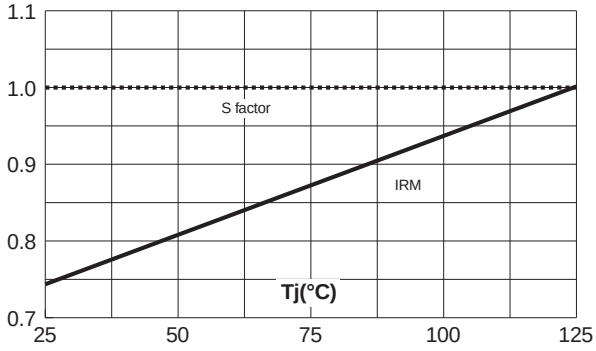


**Fig. 7:** Transient peak forward voltage versus $dI_F/dt$ (90% confidence).

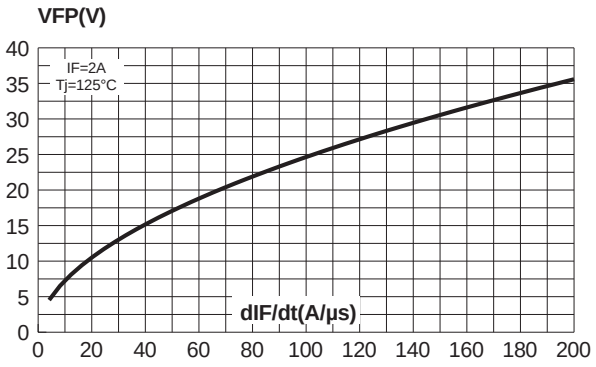



**Fig. 8:** Forward recovery time versus $dI_F/dt$ (90% confidence).

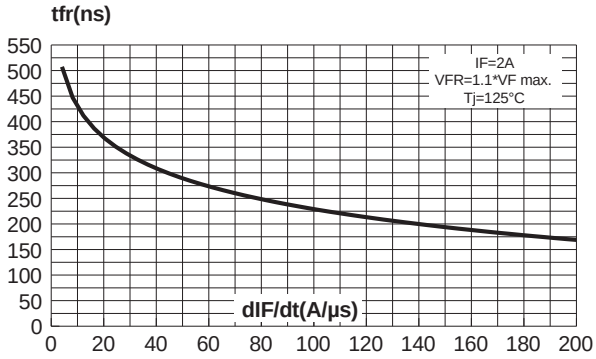
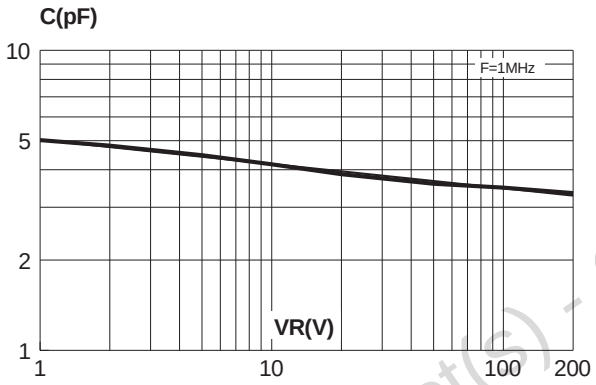



**Fig. 9:** Junction capacitance versus reverse voltage applied (typical values).



## APPLICATION DATA

The TURBOSWITCH™ is especially designed to provide the lowest overall power losses in any "Freewhell Mode" application (see fig. A) considering both diode and companion transistor, thus optimizing the overall performance in the end application.

The way of calculating the power losses is given below :

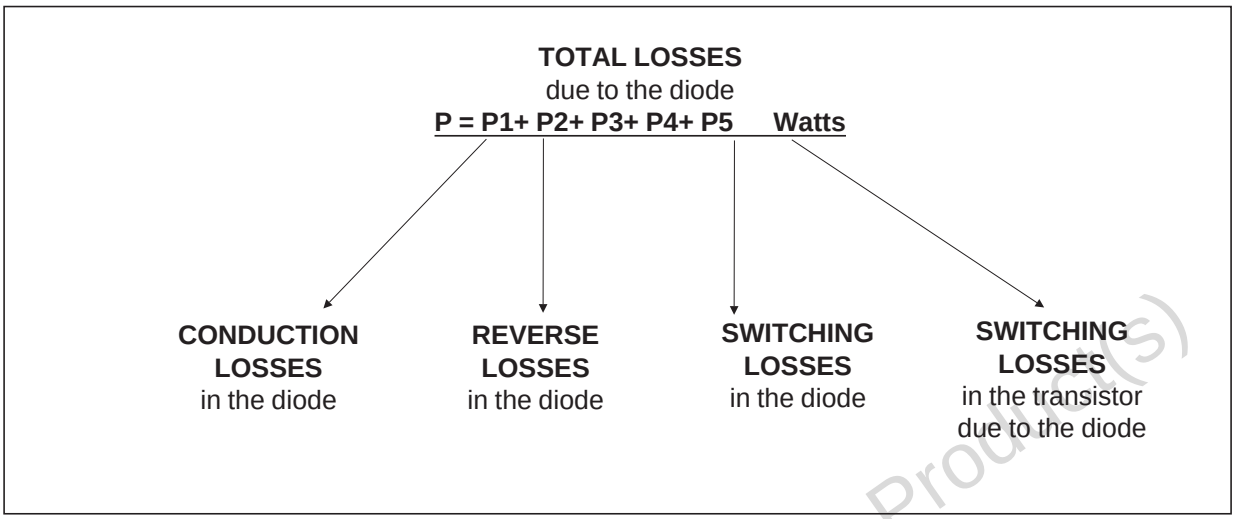
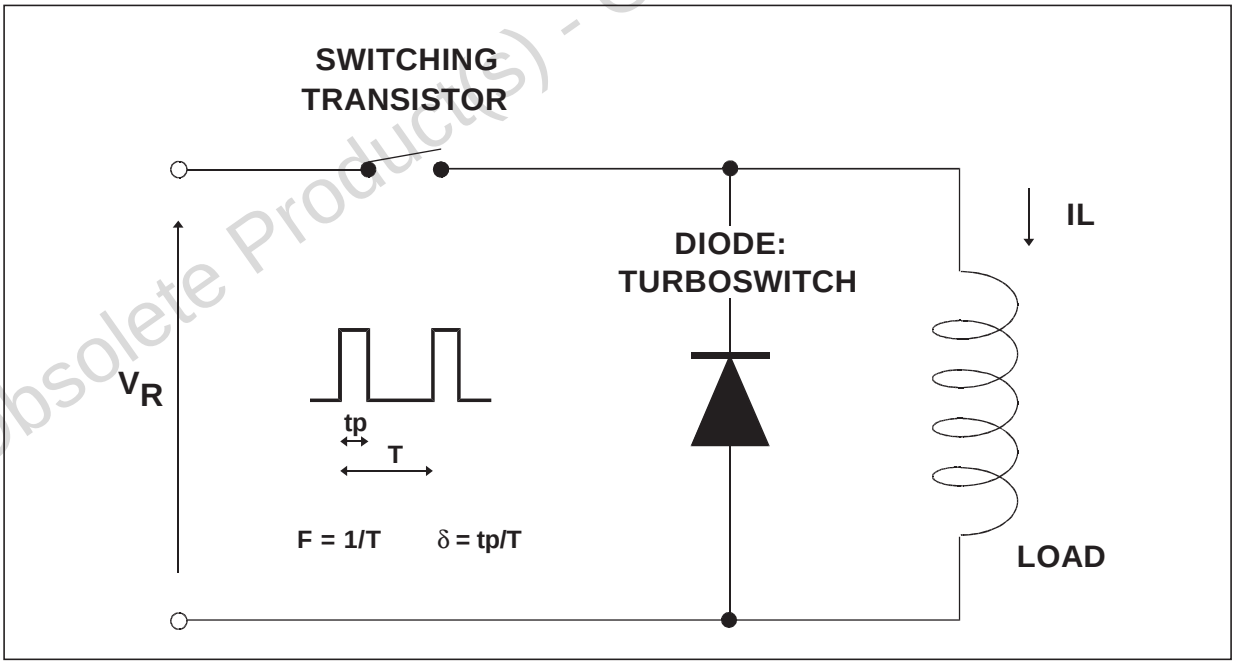


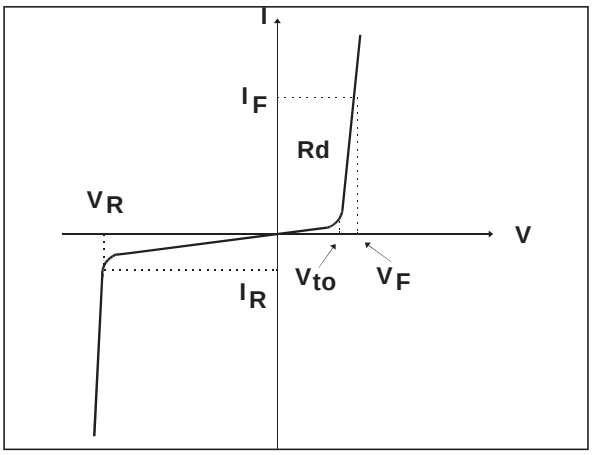



**Fig. A :** "FREEWHEEL" MODE



**APPLICATION DATA (Cont'd)**

**Fig. B :** STATIC CHARACTERISTICS



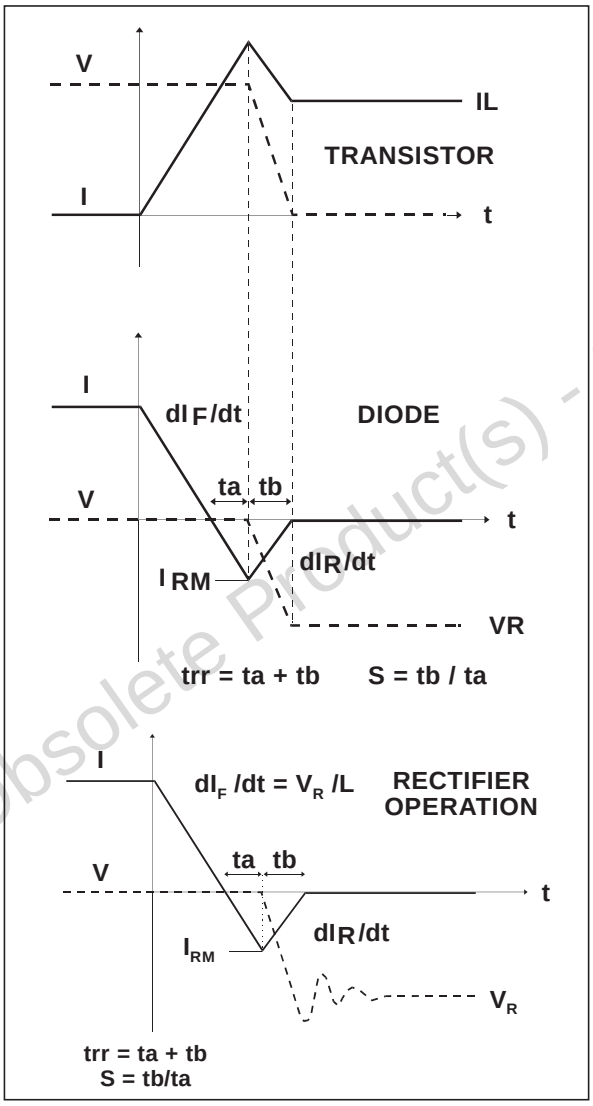

**Conduction** losses :

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

**Reverse** losses :

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

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




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

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

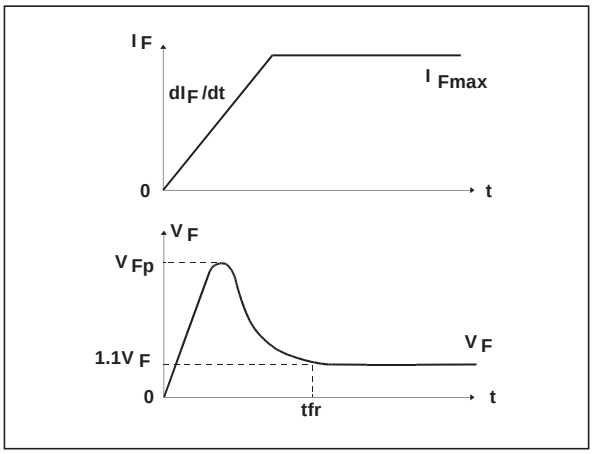
**Turn-off** losses (in the diode) :

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

P3 and P5 are suitable for power MOSFET and IGBT

## APPLICATION DATA (Cont'd)

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

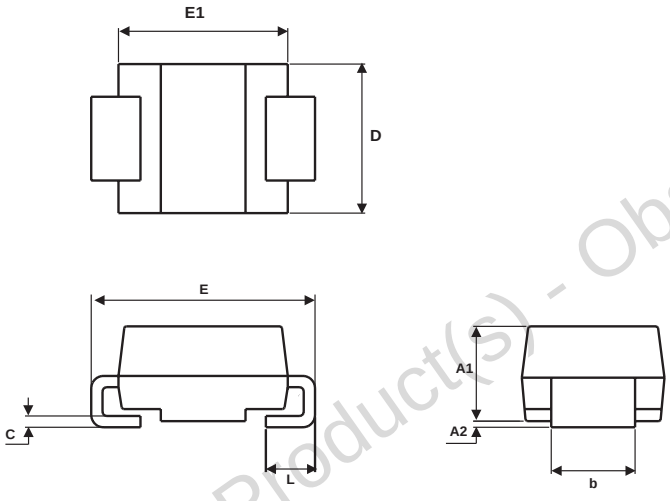



**Turn-on** losses :

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

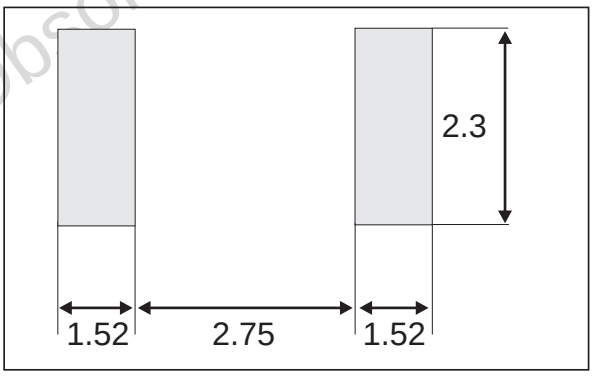
## PACKAGE MECHANICAL DATA

SMB



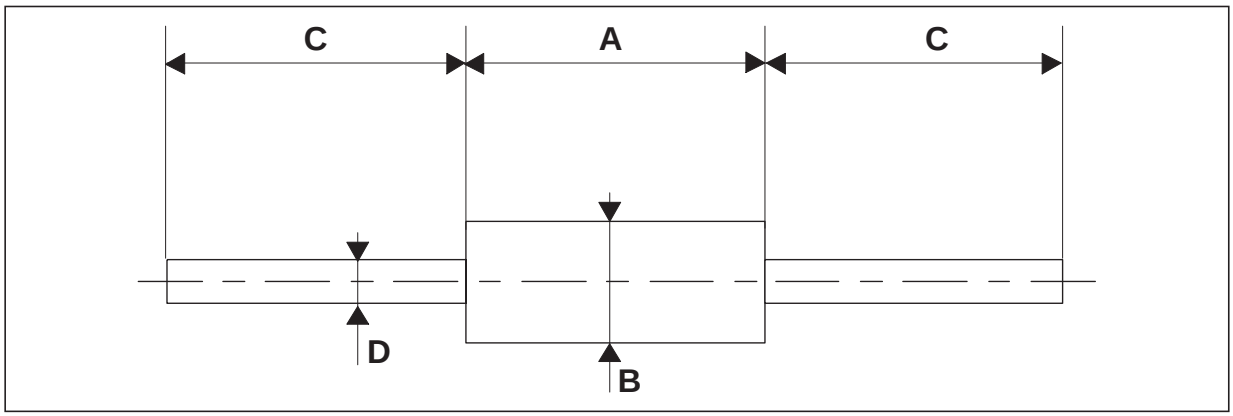

| REF. | DIMENSIONS | | | |
|---|---|---|---|---|
| | Millimeters | | Inches | |
| | Min. | Max. | Min. | Max. |
| A1 | 1.90 | 2.45 | 0.075 | 0.096 |
| A2 | 0.05 | 0.20 | 0.002 | 0.008 |
| b | 1.95 | 2.20 | 0.077 | 0.087 |
| c | 0.15 | 0.41 | 0.006 | 0.016 |
| E | 5.10 | 5.60 | 0.201 | 0.220 |
| E1 | 4.05 | 4.60 | 0.159 | 0.181 |
| D | 3.30 | 3.95 | 0.130 | 0.156 |
| L | 0.75 | 1.60 | 0.030 | 0.063 |

**FOOTPRINT DIMENSIONS** (in millimeters)



## PACKAGE MECHANICAL DATA

DO-15




| REF. | DIMENSIONS | | | |
|---|---|---|---|---|
| | Millimeters | | Inches | |
| | Min. | Max. | Min. | Max. |
| A | 6.05 | 6.75 | 0.238 | 0.266 |
| B | 2.95 | 3.53 | 0.116 | 0.139 |
| C | 26 | 31 | 1.024 | 1.220 |
| D | 0.71 | 0.88 | 0.028 | 0.035 |

## MARKING

| Type | Marking | Package | Weight | Base Qty | Delivery mode |
|---|---|---|---|---|---|
| STTA106U | T01 | SMB | 0.1 g | 2500 | tape & reel |
| STTA106 | STTA106 | DO-15 | 0.4 g | 1000 | Ammopack |
| STTA106RL | STTA106 | DO-15 | 0.4 g | 6000 | tape & reel |

- Band indicates cathode
- Epoxy meets UL94,V0