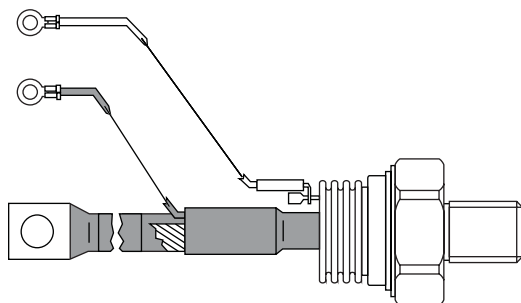


## Inverter Grade Thyristors (Stud Version), 330 A



TO-209AE (TO-118)

### FEATURES

- Center amplifying gate
- High surge current capability
- Low thermal impedance
- High speed performance
- Compression bonding
- Lead (Pb)-free
- Designed and qualified for industrial level



**RoHS**  
COMPLIANT

### PRODUCT SUMMARY

|             |       |
|-------------|-------|
| $I_{T(AV)}$ | 330 A |
|-------------|-------|

### TYPICAL APPLICATIONS

- Inverters
- Choppers
- Induction heating
- All types of force-commutated converters

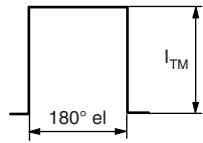
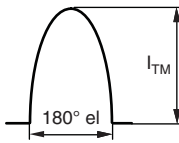
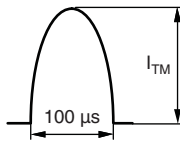
### MAJOR RATINGS AND CHARACTERISTICS

| PARAMETER         | TEST CONDITIONS | VALUES      | UNITS             |
|-------------------|-----------------|-------------|-------------------|
| $I_{T(AV)}$       |                 | 330         | A                 |
|                   | $T_C$           | 75          | °C                |
| $I_{T(RMS)}$      |                 | 518         | A                 |
| $I_{TSM}$         | 50 Hz           | 11 000      |                   |
|                   | 60 Hz           | 11 520      |                   |
| $I^2t$            | 50 Hz           | 605         | kA <sup>2</sup> s |
|                   | 60 Hz           | 550         |                   |
| $V_{DRM}/V_{RRM}$ |                 | 400 to 800  | V                 |
| $t_q$             |                 | 15          | μs                |
| $T_J$             |                 | - 40 to 125 | °C                |

### ELECTRICAL SPECIFICATIONS

#### VOLTAGE RATINGS

| TYPE NUMBER | VOLTAGE CODE | $V_{DRM}/V_{RRM}$ , MAXIMUM<br>REPETITIVE PEAK VOLTAGE<br>V | $V_{RSM}$ , MAXIMUM<br>NON-REPETITIVE PEAK VOLTAGE<br>V | $I_{DRM}/I_{RRM}$ MAXIMUM<br>AT $T_J = T_J$ MAXIMUM<br>mA |
|-------------|--------------|-------------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------|
| ST333S      | 04           | 400                                                         | 500                                                     | 50                                                        |
|             | 08           | 800                                                         | 900                                                     |                                                           |

| CURRENT CARRYING CAPABILITY           |                                                                                   |     |                                                                                    |      |                                                                                     |      |       |
|---------------------------------------|-----------------------------------------------------------------------------------|-----|------------------------------------------------------------------------------------|------|-------------------------------------------------------------------------------------|------|-------|
| FREQUENCY                             |  |     |  |      |  |      | UNITS |
| 50 Hz                                 | 840                                                                               | 600 | 1280                                                                               | 1040 | 5430                                                                                | 4350 | A     |
| 400 Hz                                | 650                                                                               | 450 | 1280                                                                               | 910  | 2150                                                                                | 1560 |       |
| 1000 Hz                               | 430                                                                               | 230 | 1090                                                                               | 730  | 1080                                                                                | 720  |       |
| 2500 Hz                               | 140                                                                               | 60  | 490                                                                                | 250  | 400                                                                                 | 190  |       |
| Recovery voltage V <sub>R</sub>       | 50                                                                                |     | 50                                                                                 |      | 50                                                                                  |      | V     |
| Voltage before turn-on V <sub>D</sub> | V <sub>DRM</sub>                                                                  |     | V <sub>DRM</sub>                                                                   |      | V <sub>DRM</sub>                                                                    |      |       |
| Rise of on-state current di/dt        | 50                                                                                |     | -                                                                                  |      | -                                                                                   |      | A/μs  |
| Case temperature                      | 50                                                                                | 75  | 50                                                                                 | 75   | 50                                                                                  | 75   | °C    |
| Equivalent values for RC circuit      | 10/0.47                                                                           |     | 10/0.47                                                                            |      | 10/0.47                                                                             |      | Ω/μF  |

| ON-STATE CONDUCTION                                        |               |                                                                                           |                            |                                                   |        |                    |  |
|------------------------------------------------------------|---------------|-------------------------------------------------------------------------------------------|----------------------------|---------------------------------------------------|--------|--------------------|--|
| PARAMETER                                                  | SYMBOL        | TEST CONDITIONS                                                                           |                            |                                                   | VALUES | UNITS              |  |
| Maximum average on-state current at case temperature       | $I_{T(AV)}$   | 180° conduction, half sine wave                                                           |                            |                                                   | 330    | A                  |  |
|                                                            |               |                                                                                           |                            |                                                   | 75     | °C                 |  |
| Maximum RMS on-state current                               | $I_{T(RMS)}$  | DC at 63 °C case temperature                                                              |                            |                                                   | 518    | A                  |  |
| Maximum peak, one half cycle, non-repetitive surge current | $I_{TSM}$     | t = 10 ms                                                                                 | No voltage reappplied      | Sinusoidal half wave, initial $T_J = T_J$ maximum | 11 000 |                    |  |
|                                                            |               | t = 8.3 ms                                                                                |                            |                                                   | 11 520 |                    |  |
|                                                            |               | t = 10 ms                                                                                 | 100 % $V_{RRM}$ reappplied |                                                   | 9250   |                    |  |
|                                                            |               | t = 8.3 ms                                                                                |                            |                                                   | 9700   |                    |  |
| Maximum $I^2t$ for fusing                                  | $I^2t$        | t = 10 ms                                                                                 | No voltage reappplied      |                                                   | 605    | kA <sup>2</sup> s  |  |
|                                                            |               | t = 8.3 ms                                                                                |                            |                                                   | 550    |                    |  |
|                                                            |               | t = 10 ms                                                                                 | 100 % $V_{RRM}$ reappplied |                                                   | 430    |                    |  |
|                                                            |               | t = 8.3 ms                                                                                |                            |                                                   | 390    |                    |  |
| Maximum $I^2\sqrt{t}$ for fusing                           | $I^2\sqrt{t}$ | t = 0.1 to 10 ms, no voltage reappplied                                                   |                            |                                                   | 6050   | kA <sup>2</sup> √s |  |
| Maximum peak on-state voltage                              | $V_{TM}$      | $I_{TM} = 1810$ A, $T_J = T_J$ maximum, $t_p = 10$ ms sine wave pulse                     |                            |                                                   | 1.96   | V                  |  |
| Low level value of threshold voltage                       | $V_{T(TO)1}$  | $(16.7\ \% \times \pi \times I_{T(AV)}) < I < \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum |                            |                                                   | 0.91   |                    |  |
| High level value of threshold voltage                      | $V_{T(TO)2}$  | $(I > \pi \times I_{T(AV)})$ , $T_J = T_J$ maximum                                        |                            |                                                   | 0.92   |                    |  |
| Low level value of forward slope resistance                | $r_{t1}$      | $(16.7\ \% \times \pi \times I_{T(AV)}) < I < \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum |                            |                                                   | 0.58   | mΩ                 |  |
| High level value of forward slope resistance               | $r_{t2}$      | $(I > \pi \times I_{T(AV)})$ , $T_J = T_J$ maximum                                        |                            |                                                   | 0.58   |                    |  |
| Maximum holding current                                    | $I_H$         | $T_J = 25\text{ °C}$ , $I_T > 30$ A                                                       |                            |                                                   | 600    | mA                 |  |
| Typical latching current                                   | $I_L$         | $T_J = 25\text{ °C}$ , $V_A = 12$ V, $R_a = 6\ \Omega$ , $I_G = 1$ A                      |                            |                                                   | 1000   |                    |  |



| <b>SWITCHING</b>                                         |         |                                                                                                                                                            |        |            |
|----------------------------------------------------------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------|
| PARAMETER                                                | SYMBOL  | TEST CONDITIONS                                                                                                                                            | VALUES | UNITS      |
| Maximum non-repetitive rate of rise of turned-on current | $di/dt$ | $T_J = T_J$ maximum, $V_{DRM} = \text{Rated } V_{DRM}$<br>$I_{TM} = 2 \times di/dt$                                                                        | 1000   | A/ $\mu$ s |
| Typical delay time                                       | $t_d$   | $T_J = 25^\circ\text{C}$ , $V_{DM} = \text{Rated } V_{DRM}$ , $I_{TM} = 50$ A DC, $t_p = 1$ $\mu$ s<br>Resistive load, gate pulse: 10 V, 5 $\Omega$ source | 1.0    | $\mu$ s    |
| Maximum turn-off time                                    | $t_q$   | $T_J = T_J$ maximum,<br>$I_{TM} = 550$ A, commutating $di/dt = 40$ A/ $\mu$ s<br>$V_R = 50$ V, $t_p = 500$ $\mu$ s, $dV/dt = 200$ V/ $\mu$ s               | 15     |            |

| <b>BLOCKING</b>                                    |                          |                                                                                      |        |            |
|----------------------------------------------------|--------------------------|--------------------------------------------------------------------------------------|--------|------------|
| PARAMETER                                          | SYMBOL                   | TEST CONDITIONS                                                                      | VALUES | UNITS      |
| Maximum critical rate of rise of off-state voltage | $dV/dt$                  | $T_J = T_J$ maximum, linear to 80 % $V_{DRM}$ ,<br>higher value available on request | 500    | V/ $\mu$ s |
| Maximum peak reverse and off-state leakage current | $I_{RRM}$ ,<br>$I_{DRM}$ | $T_J = T_J$ maximum, rated $V_{DRM}/V_{RRM}$ applied                                 | 50     | mA         |

| <b>TRIGGERING</b>                           |             |                                                             |        |       |
|---------------------------------------------|-------------|-------------------------------------------------------------|--------|-------|
| PARAMETER                                   | SYMBOL      | TEST CONDITIONS                                             | VALUES | UNITS |
| Maximum peak gate power                     | $P_{GM}$    | $T_J = T_J$ maximum, $f = 50$ Hz, $d\% = 50$                | 60     | W     |
| Maximum average gate power                  | $P_{G(AV)}$ |                                                             | 10     |       |
| Maximum peak positive gate current          | $I_{GM}$    | $T_J = T_J$ maximum, $t_p \leq 5$ ms                        | 10     | A     |
| Maximum peak positive gate voltage          | $+V_{GM}$   |                                                             | 20     | V     |
| Maximum peak negative gate voltage          | $-V_{GM}$   |                                                             | 5      |       |
| Maximum DC gate current required to trigger | $I_{GT}$    | $T_J = 25^\circ\text{C}$ , $V_A = 12$ V, $R_a = 6$ $\Omega$ | 200    | mA    |
| Maximum DC gate voltage required to trigger | $V_{GT}$    |                                                             | 3      | V     |
| Maximum DC gate current not to trigger      | $I_{GD}$    | $T_J = T_J$ maximum, rated $V_{DRM}$ applied                | 20     | mA    |
| Maximum DC gate voltage not to trigger      | $V_{GD}$    |                                                             | 0.25   | V     |

| <b>THERMAL AND MECHANICAL SPECIFICATIONS</b> |            |                                               |                   |                     |
|----------------------------------------------|------------|-----------------------------------------------|-------------------|---------------------|
| PARAMETER                                    | SYMBOL     | TEST CONDITIONS                               | VALUES            | UNITS               |
| Maximum operating junction temperature range | $T_J$      |                                               | - 40 to 125       | $^\circ\text{C}$    |
| Maximum storage temperature range            | $T_{Stg}$  |                                               | - 40 to 150       |                     |
| Maximum thermal resistance, junction to case | $R_{thJC}$ | DC operation                                  | 0.10              | K/W                 |
| Maximum thermal resistance, case to heatsink | $R_{thCS}$ | Mounting surface, smooth, flat and greased    | 0.03              |                     |
| Mounting torque, $\pm 10$ %                  |            | Non-lubricated threads                        | 48.5<br>(425)     | N · m<br>(lbf · in) |
| Approximate weight                           |            |                                               | 535               | g                   |
| Case style                                   |            | See dimensions - link at the end of datasheet | TO-209AE (TO-118) |                     |

| $\Delta R_{thJ-hs}$ CONDUCTION |                       |                        |                             |       |
|--------------------------------|-----------------------|------------------------|-----------------------------|-------|
| CONDUCTION ANGLE               | SINUSOIDAL CONDUCTION | RECTANGULAR CONDUCTION | TEST CONDITIONS             | UNITS |
| 180°                           | 0.011                 | 0.008                  | $T_J = T_J \text{ maximum}$ | K/W   |
| 120°                           | 0.013                 | 0.014                  |                             |       |
| 90°                            | 0.017                 | 0.018                  |                             |       |
| 60°                            | 0.025                 | 0.026                  |                             |       |
| 30°                            | 0.041                 | 0.042                  |                             |       |

### Note

- The table above shows the increment of thermal resistance  $R_{thJ-hs}$  when devices operate at different conduction angles than DC

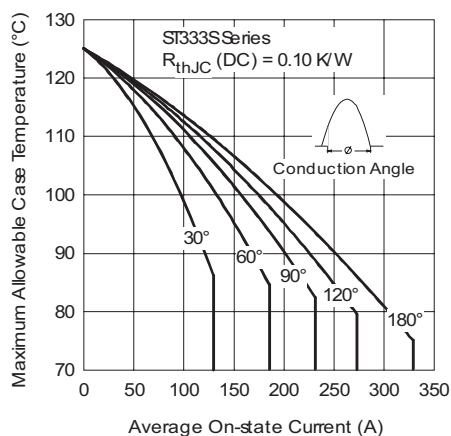


Fig. 1 - Current Ratings Characteristics

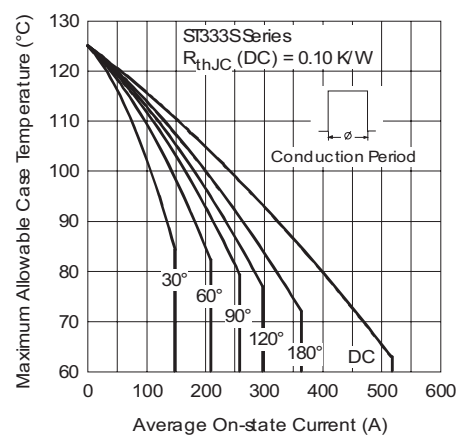


Fig. 2 - Current Ratings Characteristics

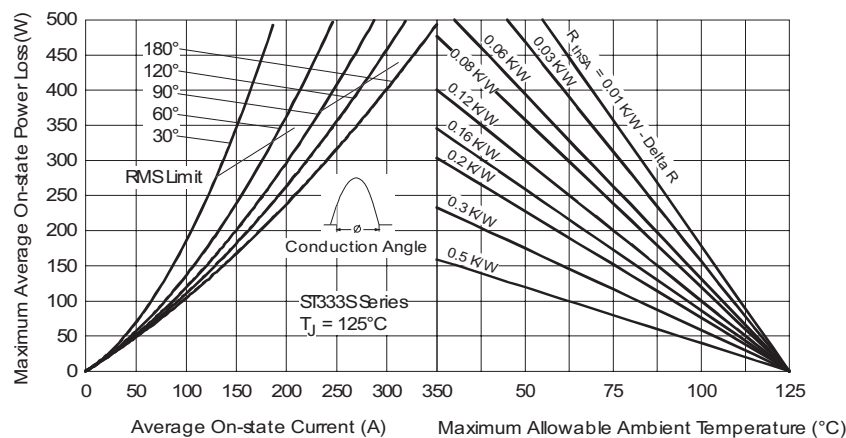


Fig. 3 - On-State Power Loss Characteristics

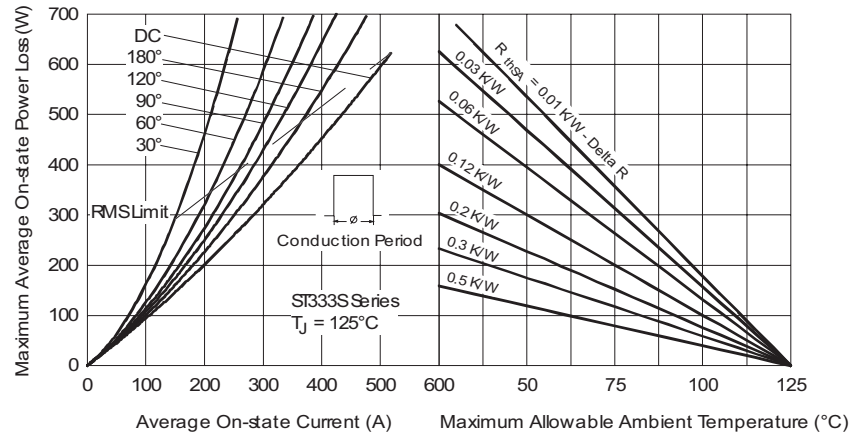


Fig. 4 - On-State Power Loss Characteristics

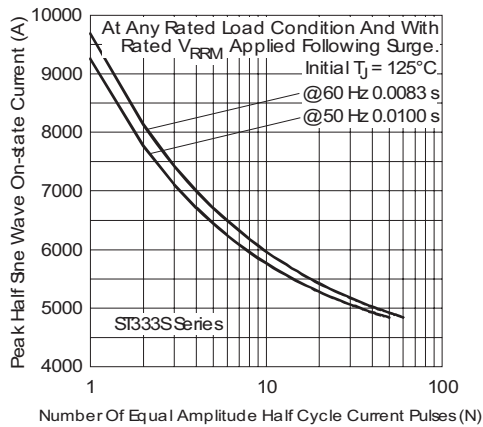


Fig. 5 - Maximum Non-Repetitive Surge Current

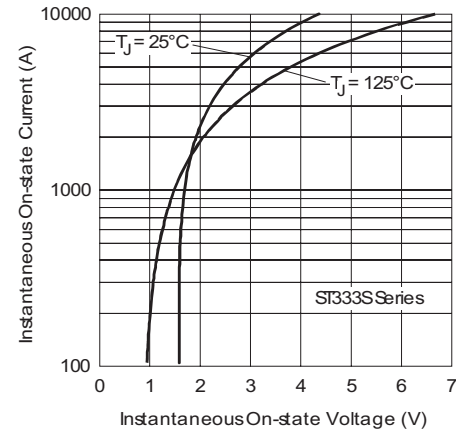


Fig. 7 - On-State Voltage Drop Characteristics

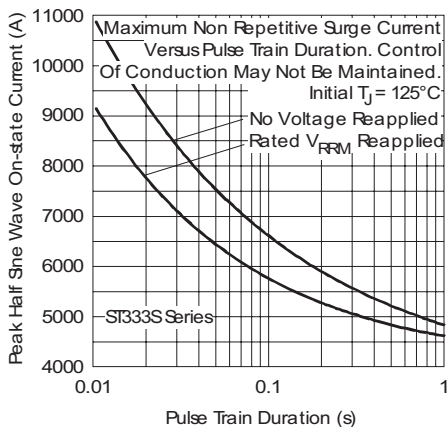


Fig. 6 - Maximum Non-Repetitive Surge Current

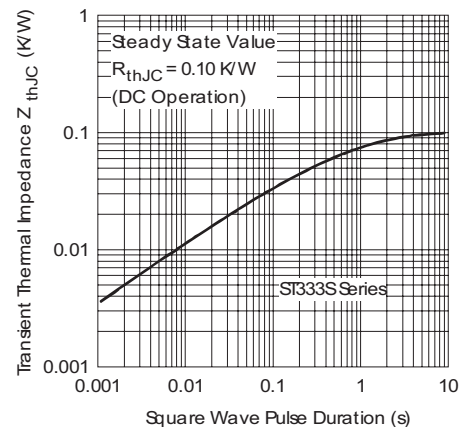


Fig. 8 - Thermal Impedance  $Z_{thJC}$  Characteristics

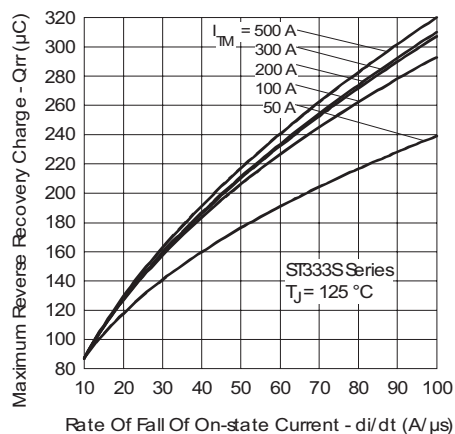


Fig. 9 - Reverse Recovered Charge Characteristics

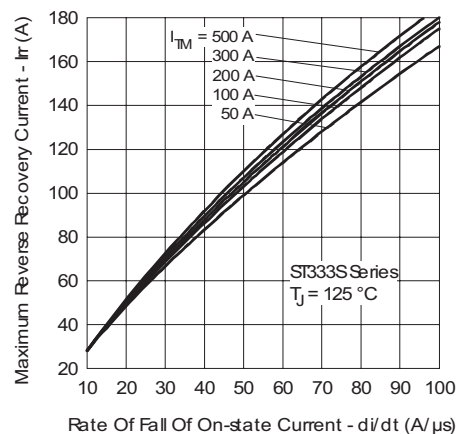


Fig. 10 - Reverse Recovery Current Characteristics

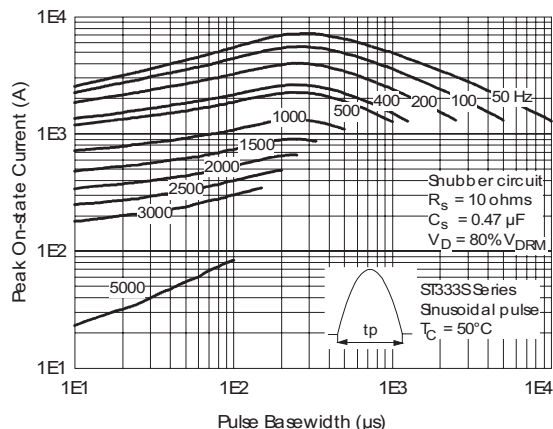


Fig. 11 - Frequency Characteristics

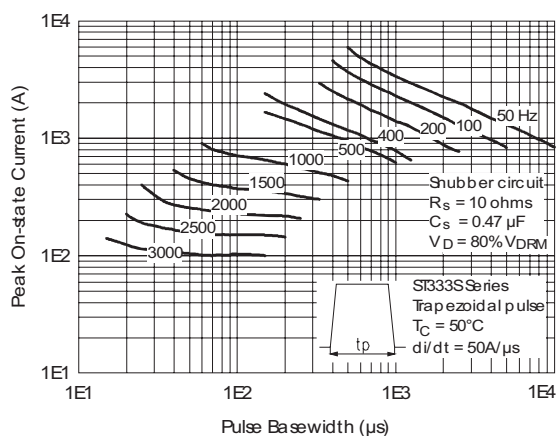
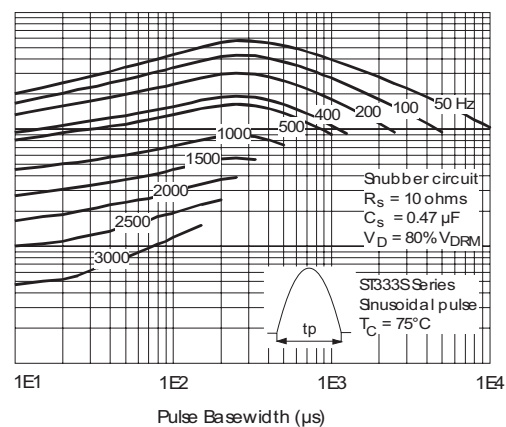
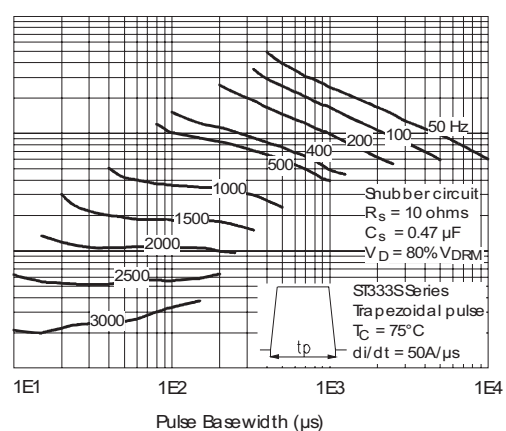


Fig. 12 - Frequency Characteristics



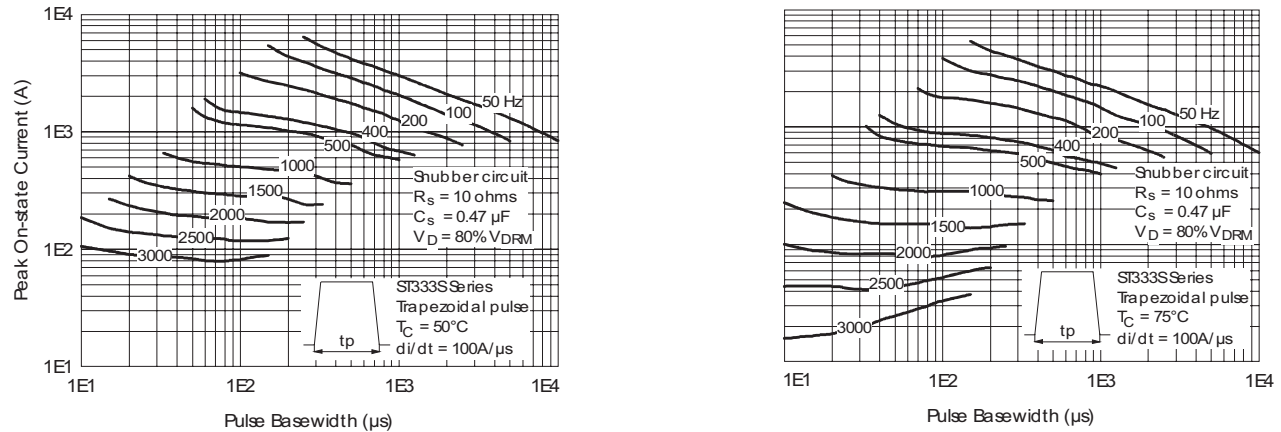


Fig. 13 - Frequency Characteristics

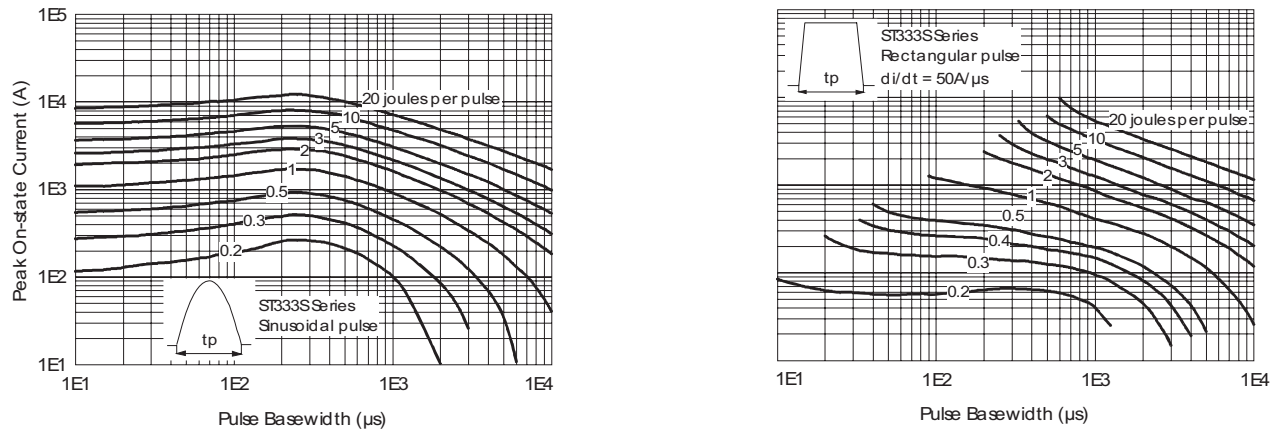


Fig. 14 - Maximum On-State Energy Power Loss Characteristics

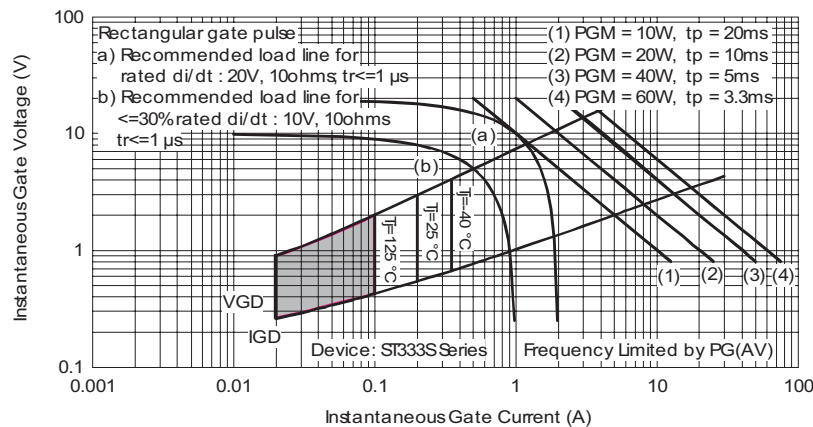


Fig. 15 - Gate Characteristics

# ST333SP Series

Vishay High Power Products Inverter Grade Thyristors  
(Stud Version), 330 A



## ORDERING INFORMATION TABLE

|             |    |    |   |   |    |   |   |   |   |    |
|-------------|----|----|---|---|----|---|---|---|---|----|
| Device code | ST | 33 | 3 | S | 08 | P | F | L | 0 | P  |
|             | 1  | 2  | 3 | 4 | 5  | 6 | 7 | 8 | 9 | 10 |

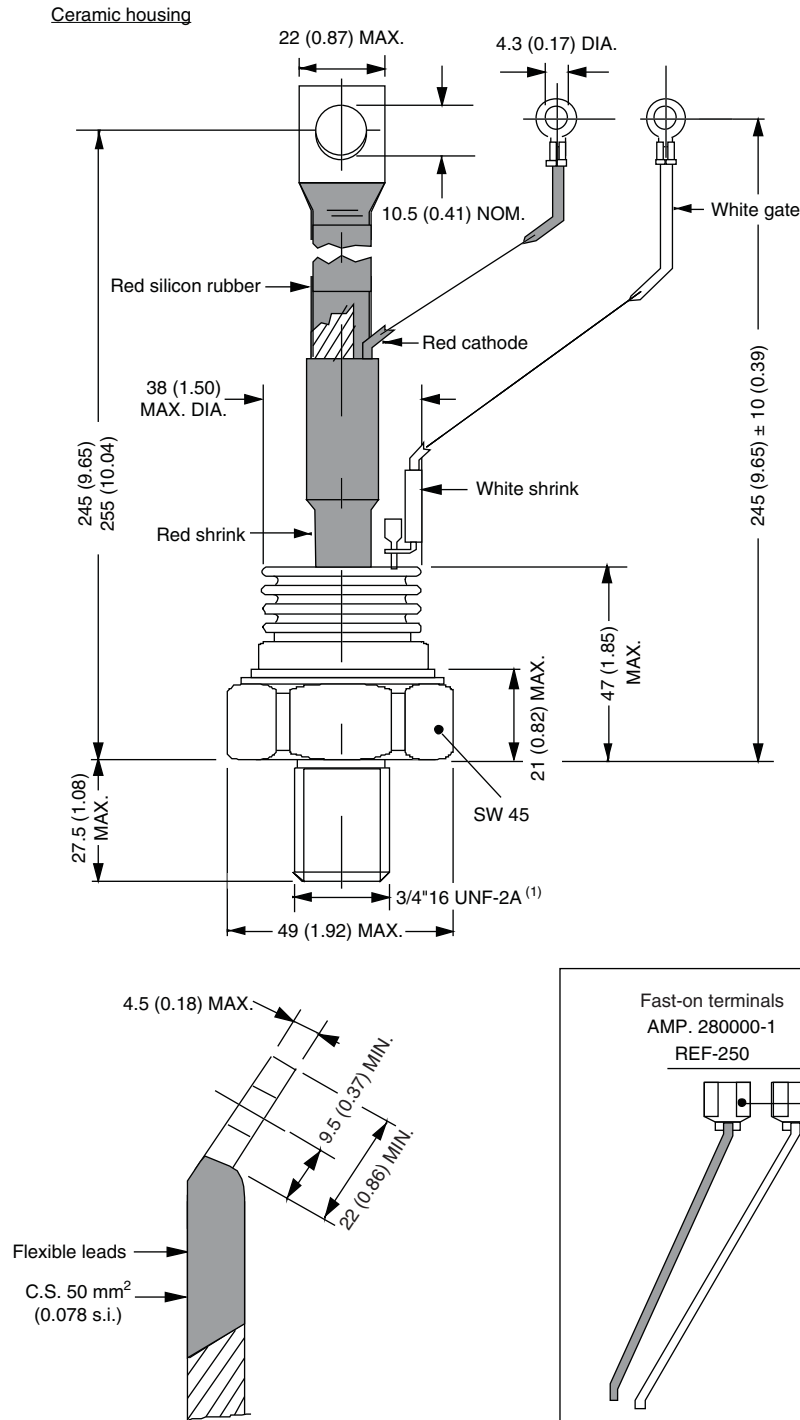
- 1** - Thyristor
- 2** - Essential part number
- 3** - 3 = Fast turn-off
- 4** - S = Compression bonding stud
- 5** - Voltage code x 100 =  $V_{RRM}$   
(see Voltage Ratings table)
- 6** - P = Stud base 3/4" 16UNF-2A
- 7** - Reapplied  $dV/dt$  code (for  $t_q$  test condition) F = 200 V/ $\mu$ s
- 8** -  $t_q$  code (L = 15  $\mu$ s)
- 9** - 0 = Eyelet terminals  
(gate and auxiliary cathode leads)  
1 = Fast-on terminals  
(gate and auxiliary cathode leads)
- 10** - Lead (Pb)-free

Note: For metric device M24 x 1.5 contact factory

| LINKS TO RELATED DOCUMENTS |                                                                               |
|----------------------------|-------------------------------------------------------------------------------|
| Dimensions                 | <a href="http://www.vishay.com/doc?95080">http://www.vishay.com/doc?95080</a> |

## TO-209AE (TO-118)

**DIMENSIONS** in millimeters (inches)



**Note**

<sup>(1)</sup> For metric device: M24 x 1.5 - length 21 (0.83) maximum



## Disclaimer

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