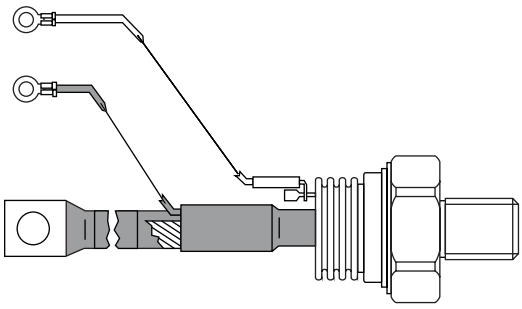
# Inverter Grade Thyristors (Stud Version), 300 A



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

Pb-free
RoHS COMPLIANT

## TYPICAL APPLICATIONS

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

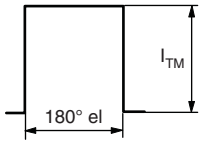
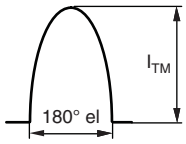
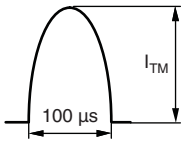
| PRODUCT SUMMARY | |
|---|---|
| $I_{T(AV)}$ | 300 A |

| MAJOR RATINGS AND CHARACTERISTICS | | | |
|---|---|---|---|
| PARAMETER | TEST CONDITIONS | VALUES | UNITS |
| $I_{T(AV)}$ | | 300 | A |
| | $T_C$ | 65 | °C |
| $I_{T(RMS)}$ | | 471 | A |
| $I_{TSM}$ | 50 Hz | 7950 | |
| | 60 Hz | 8320 | |
| $I^2t$ | 50 Hz | 316 | $kA^2s$ |
| | 60 Hz | 288 | |
| $V_{DRM}/V_{RRM}$ | | 400 to 1200 | V |
| $t_q$ | | 10/20 | µs |
| $T_J$ | | - 40 to 125 | °C |

## ELECTRICAL SPECIFICATIONS

| VOLTAGE RATINGS | | | | |
|---|---|---|---|---|
| TYPE NUMBER | VOLTAGE CODE | $V_{DRM}/V_{RRM}$, MAXIMUM REPETITIVE PEAK VOLTAGE V | $V_{RSM}$, MAXIMUM NON-REPETITIVE PEAK VOLTAGE V | $I_{DRM}/I_{RRM}$ MAXIMUM AT $T_J = T_J$ MAXIMUM mA |
| ST303S | 04 | 400 | 500 | 50 |
| | 08 | 800 | 900 | |
| | 12 | 1200 | 1300 | |

## CURRENT CARRYING CAPABILITY

| FREQUENCY |  | |  | |  | | UNITS |
|---|---|---|---|---|---|---|---|
| 50 Hz | 670 | 470 | 1050 | 940 | 5240 | 4300 | A |
| 400 Hz | 480 | 330 | 1021 | 710 | 1800 | 1270 | |
| 1000 Hz | 230 | 140 | 760 | 470 | 730 | 430 | |
| 2500 Hz | 35 | - | 150 | - | 90 | - | |
| Recovery voltage $V_R$ | 50 | | 50 | | 50 | | V |
| Voltage before turn-on $V_D$ | $V_{DRM}$ | | $V_{DRM}$ | | $V_{DRM}$ | | |
| Rise of on-state current di/dt | 50 | | - | | - | | A/µs |
| Case temperature | 40 | 65 | 40 | 65 | 40 | 65 | °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 | | | 300 | A |
| | | | | | 65 | °C |
| Maximum RMS on-state current | $I_{T(RMS)}$ | DC at 45 °C case temperature | | | 471 | A |
| Maximum peak, one half cycle, non-repetitive surge current | $I_{TSM}$ | t = 10 ms | No voltage reapplied | Sinusoidal half wave, initial $T_J = T_J$ maximum | 7950 | |
| | | t = 8.3 ms | | | 8320 | |
| | | t = 10 ms | 100 % $V_{RRM}$ reapplied | | 6690 | |
| | | t = 8.3 ms | | | 7000 | |
| Maximum $I^2t$ for fusing | $I^2t$ | t = 10 ms | No voltage reapplied | | 316 | $kA^2s$ |
| | | t = 8.3 ms | | | 288 | |
| | | t = 10 ms | 100 % $V_{RRM}$ reapplied | | 224 | |
| | | t = 8.3 ms | | | 204 | |
| Maximum $I^2\sqrt{t}$ for fusing | $I^2\sqrt{t}$ | t = 0.1 to 10 ms, no voltage reapplied | | | 3160 | $kA^2\sqrt{s}$ |
| Maximum peak on-state voltage | $V_{TM}$ | $I_{TM}$ = 1255 A, $T_J = T_J$ maximum, $t_p$ = 10 ms sine wave pulse | | | 2.16 | V |
| Low level value of threshold voltage | $V_{T(TO)1}$ | (16.7 % x π x $I_{T(AV)}$ < I < π x $I_{T(AV)}$), $T_J = T_J$ maximum | | | 1.44 | |
| High level value of threshold voltage | $V_{T(TO)2}$ | (I > π x $I_{T(AV)}$), $T_J = T_J$ maximum | | | 1.46 | |
| Low level value of forward slope resistance | $r_{t1}$ | (16.7 % x π x $I_{T(AV)}$ < I < π x $I_{T(AV)}$), $T_J = T_J$ maximum | | | 0.57 | mΩ |
| High level value of forward slope resistance | $r_{t2}$ | (I > π x $I_{T(AV)}$), $T_J = T_J$ maximum | | | 0.56 | |
| Maximum holding current | $I_H$ | $T_J$ = 25 °C, $I_T$ > 30 A | | | 600 | mA |
| Typical latching current | $I_L$ | $T_J$ = 25 °C, $V_A$ = 12 V, $R_a$ = 6 Ω, $I_G$ = 1 A | | | 1000 | |

| SWITCHING | | | | | |
|---|---|---|---|---|---|
| PARAMETER | | SYMBOL | TEST CONDITIONS | VALUES | UNITS |
| Maximum non-repetitive rate of rise of turned-on current | | dI/dt | $T_J = T_J$ maximum, $V_{DRM}$ = Rated $V_{DRM}$<br>$I_{TM}$ = 2 x dI/dt | 1000 | A/µs |
| Typical delay time | | $t_d$ | $T_J$ = 25 °C, $V_{DM}$ = Rated $V_{DRM}$, $I_{TM}$ = 50 A DC, $t_p$ = 1 µs<br>Resistive load, gate pulse: 10 V, 5 Ω source | 0.80 | µs |
| Maximum turn-off time | minimum | $t_q$ | $T_J = T_J$ maximum,<br>$I_{TM}$ = 550 A, commutating dI/dt = 40 A/µs<br>$V_R$ = 50 V, $t_p$ = 500 µs, dV/dt = 200 V/µs | 10 | |
| | maximum | | | 20 | |

| BLOCKING | | | | |
|---|---|---|---|---|
| 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 % $V_{DRM}$, higher value available on request | 500 | V/µs |
| 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 |

| TRIGGERING | | | | |
|---|---|---|---|---|
| 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 currrent required to trigger | $I_{GT}$ | $T_J$ = 25 °C, $V_A$ = 12 V, $R_a$ = 6 Ω | 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 |

| THERMAL AND MECHANICAL SPECIFICATIONS | | | | |
|---|---|---|---|---|
| PARAMETER | SYMBOL | TEST CONDITIONS | VALUES | UNITS |
| Maximum operating junction temperature range | $T_J$ | | - 40 to 125 | °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 force, ± 10 % | | Non-lubricated threads | 48.5 (425) | N · m (lbf · in) |
| Approximate weight | | | 535 | g |
| Case style | | See dimensions - link at the end of datasheet | TO-209AE (TO-118) | |

| $\Delta R_{thJ\text{-}hs}$ CONDUCTION | | | | |
|---|---|---|---|---|
| CONDUCTION ANGLE | SINUSOIDAL CONDUCTION | RECTANGULAR CONDUCTION | TEST CONDITIONS | UNITS |
| 180° | 0.011 | 0.008 | $T_J = T_J$ 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 $R_{thJ\text{-}hs}$ when devices operate at different conduction angles than DC

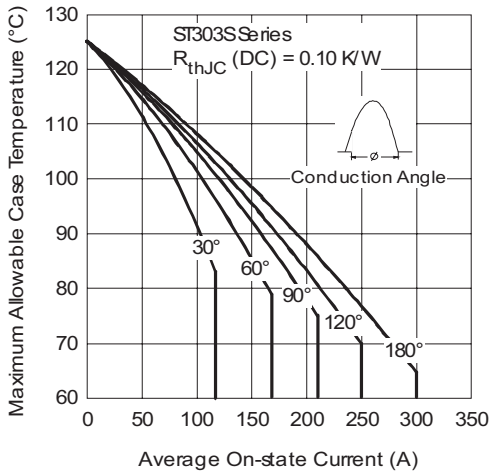



Fig. 1 - Current Ratings Characteristics

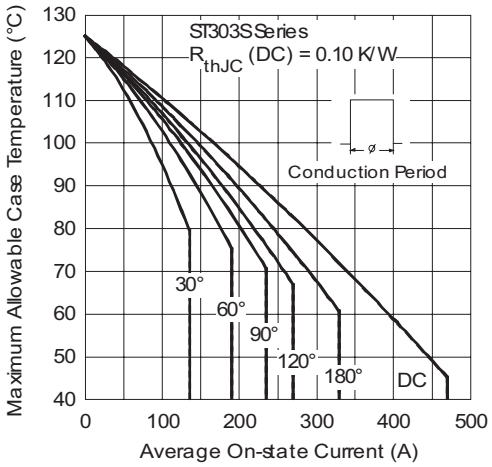



Fig. 2 - Current Ratings Characteristics

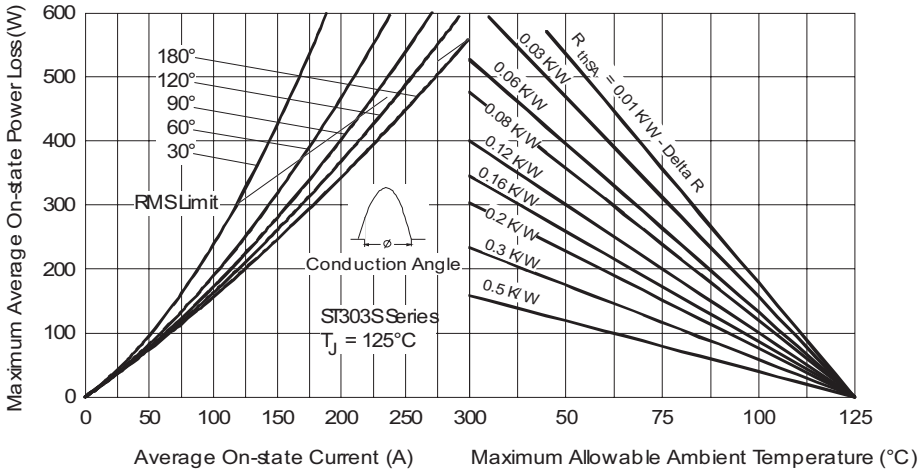



Fig. 3 - On-State Power Loss Characteristics

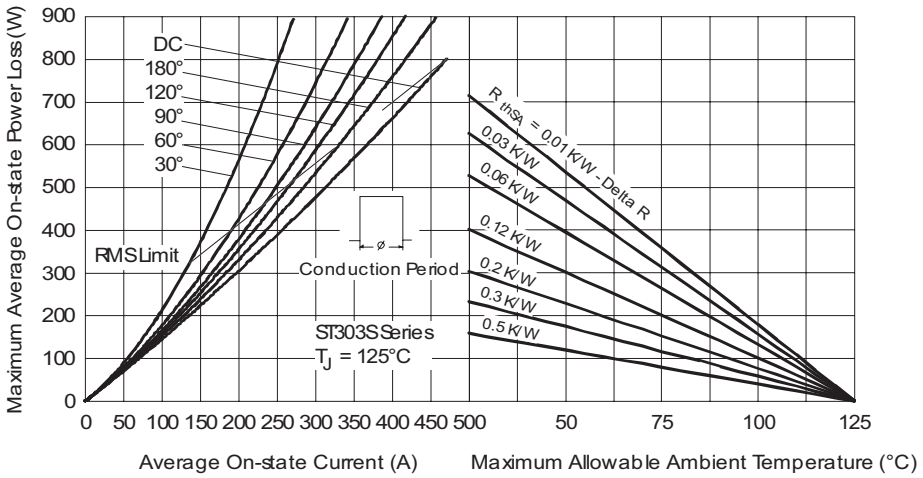



Fig. 4 - On-State Power Loss Characteristics

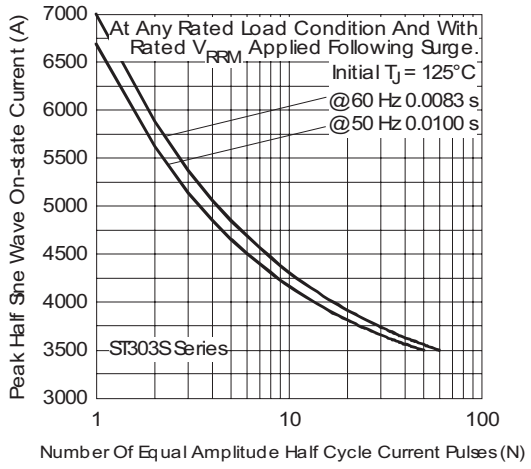



Fig. 5 - Maximum Non-Repetitive Surge Current

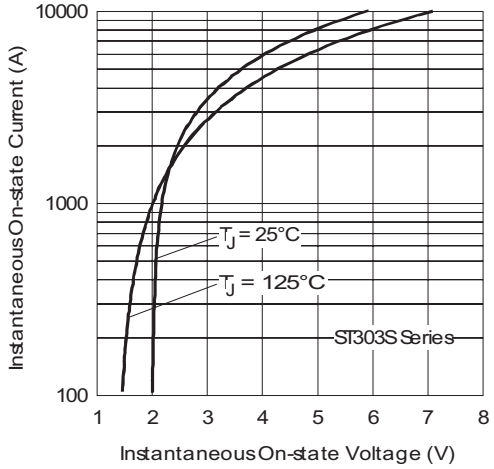



Fig. 7 - On-State Voltage Drop Characteristics

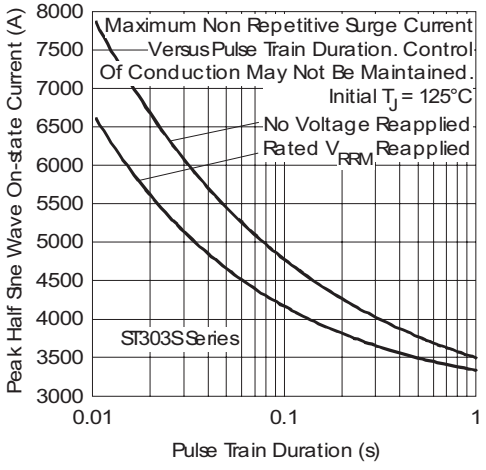



Fig. 6 - Maximum Non-Repetitve Surge Current

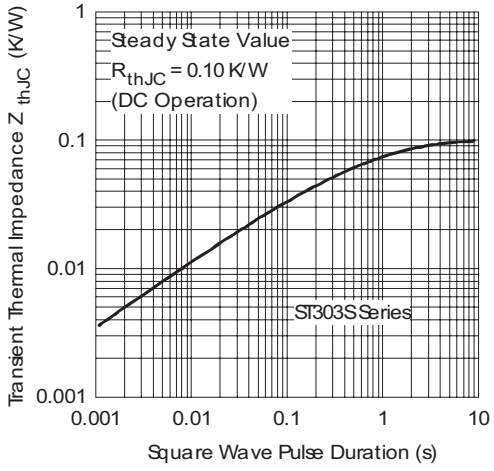



Fig. 8 - Thermal Impedance $Z_{thJC}$ Characteristics

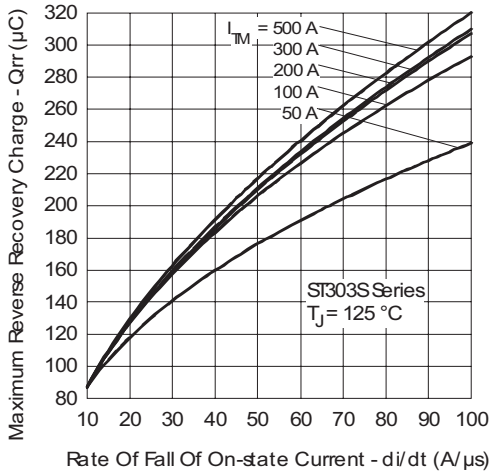



Fig. 9 - Reverse Recovered Charge Characteristics

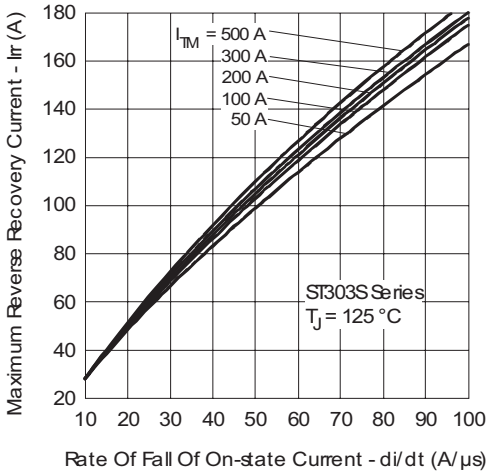
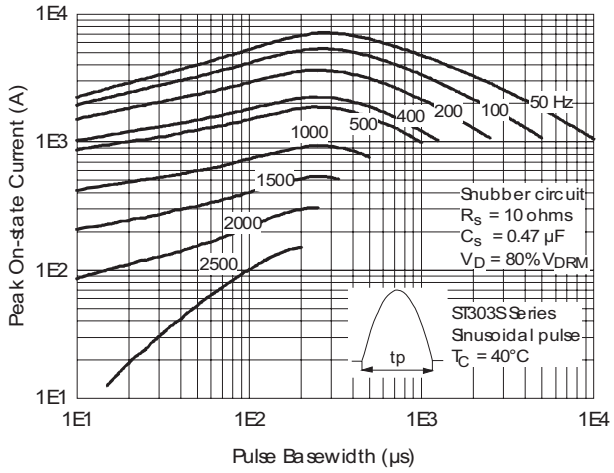



Fig. 10 - Reverse Recovery Current Characteristics



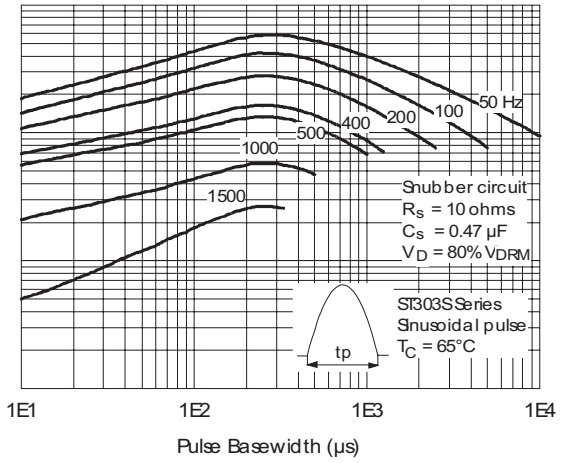
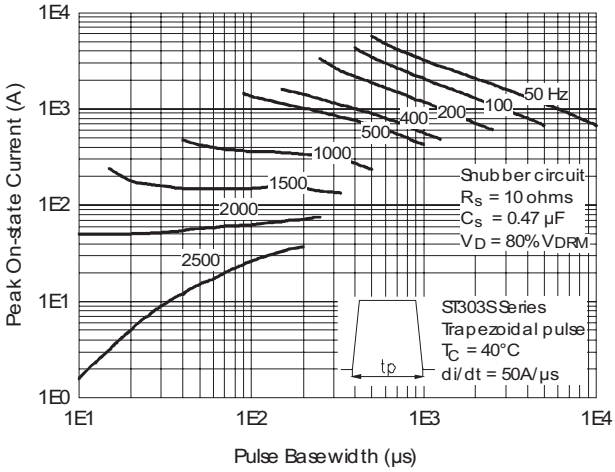




Fig. 11 - Frequency Characteristics



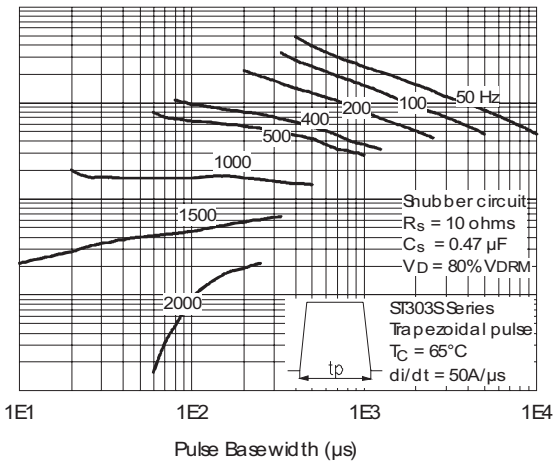




Fig. 12 - Frequency Characteristics

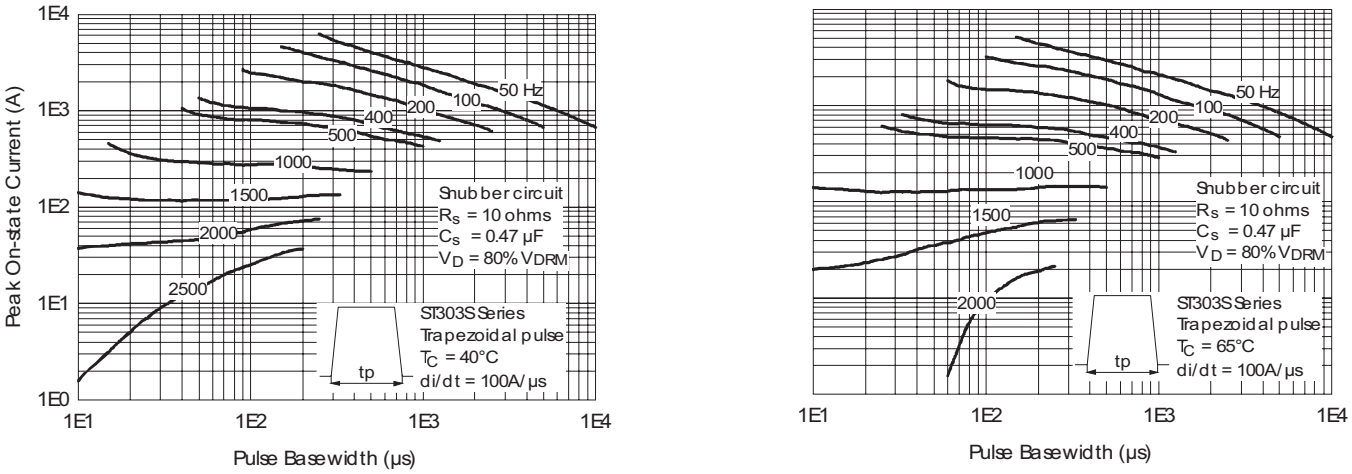



Fig. 13 - Frequency Characteristics

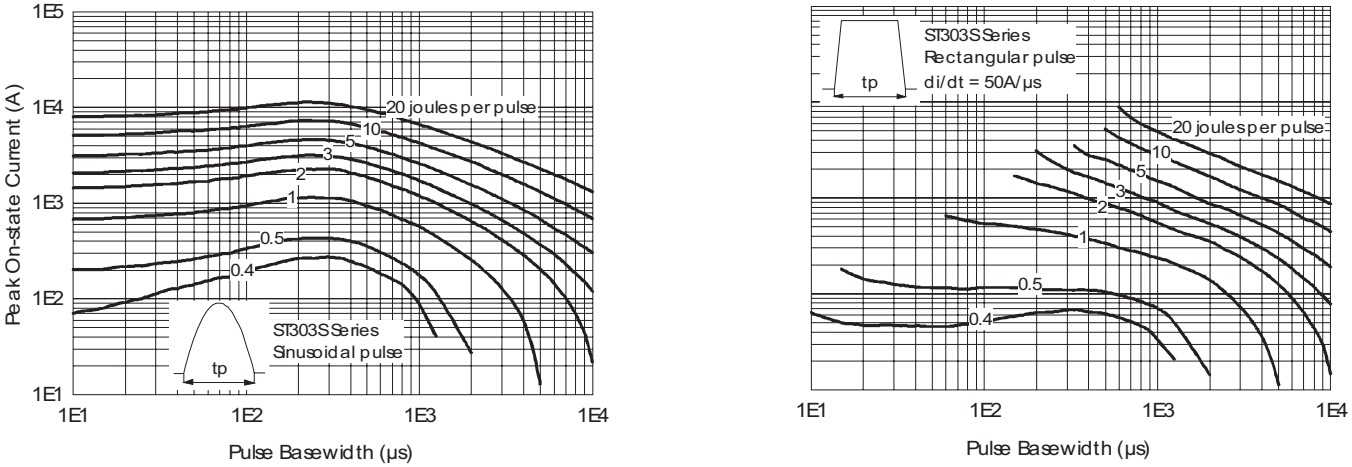



Fig. 14 - Maximum On-State Energy Power Loss Characteristics

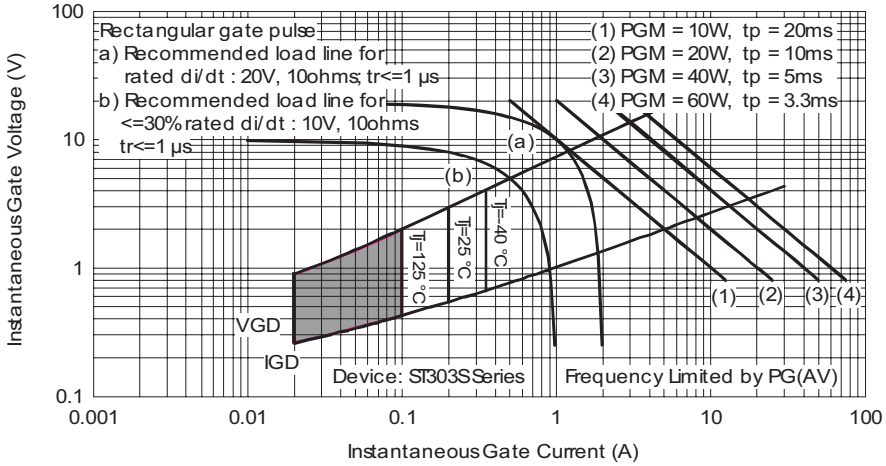



Fig. 15 - Gate Characteristics

## ORDERING INFORMATION TABLE

**Device code**

| ST | 30 | 3 | S | 12 | P | F | K | 0 | P |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

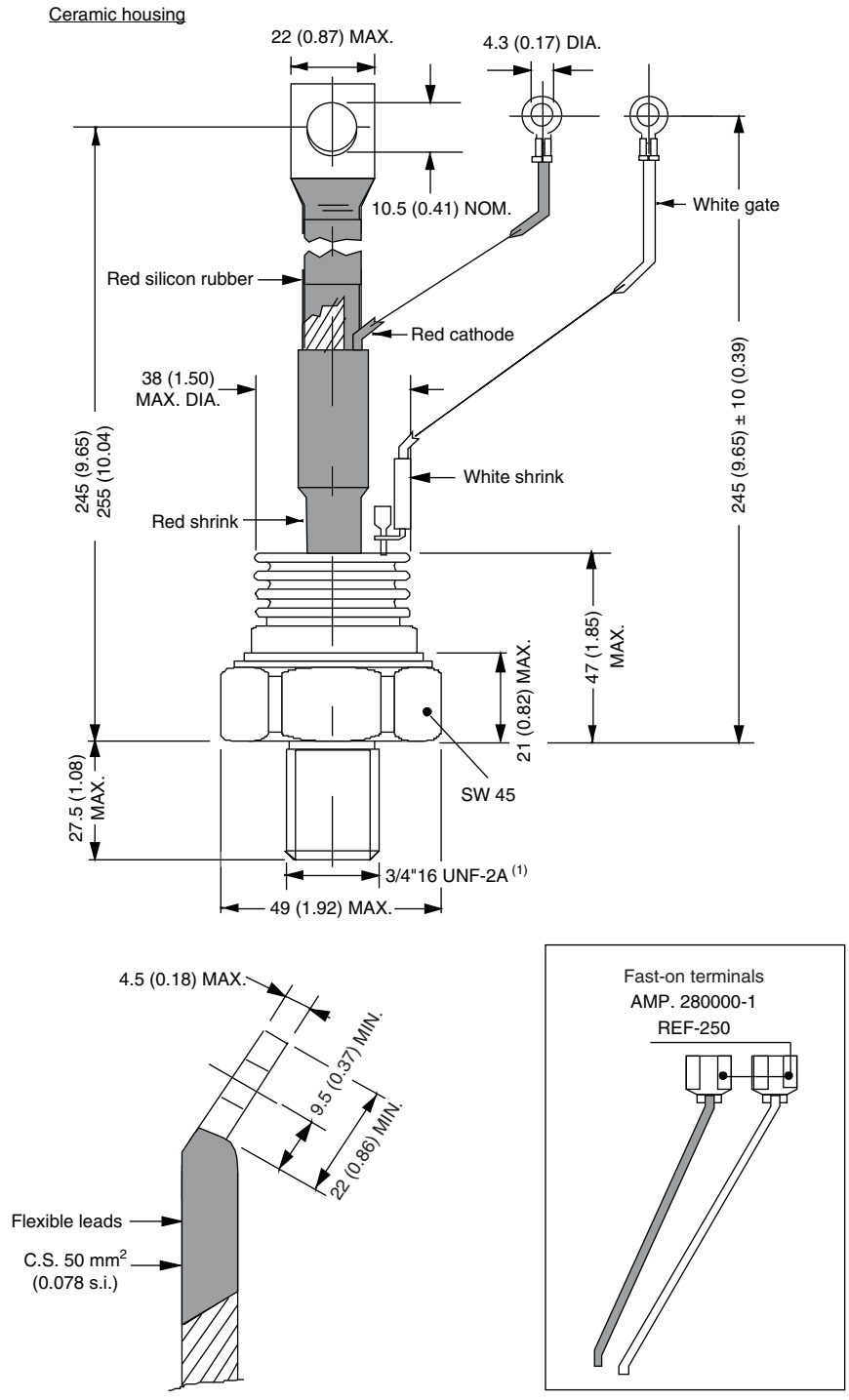
- **1** - Thyristor
- **2** - Essential part number
- **3** - 3 = Fast turn-off
- **4** - S = Compression bonding stud
- **5** - Voltage code x 100 = $V_{RRM}$ (see Voltage Ratings table)
- **6** - P = Stud base 3/4" 16UNF-2A
- **7** - Reapplied dV/dt code (for $t_q$ test condition)
- **8** - $t_q$ code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

| dV/dt - $t_q$ combinations available | | |
|---|---|---|
| | dV/dt (V/µs) | 200 |
| $t_q$ (µs) up to 800 V | 10 | FN |
| | 20 | FK |
| $t_q$ (µs) only for 1000/1200 V | 20 | FK |

| LINKS TO RELATED DOCUMENTS | |
|---|---|
| Dimensions | http://www.vishay.com/doc?95080 |

# TO-209AE (TO-118)

**DIMENSIONS** in millimeters (inches)




**Note**

(1) For metric device: M24 x 1.5 - length 21 (0.83) maximum

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- *Изготовление тестовой платы монтаж и пусконаладочные работы.*

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