



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
- Designed and qualified for industrial level
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



| PRODUCT SUMMARY | |
|--------------------|-------------------|
| $I_{T(AV)}$ | 300 A |
| V_{DRM}/V_{RRM} | 400 V, 1200 V |
| V_{TM} | 2.16 V |
| I_{TSM} at 50 Hz | 3000 A |
| I_{TSM} at 60 Hz | 3150 A |
| I_{GT} | 200 mA |
| T_J | -40 °C to 125 °C |
| Package | TO-209AE (TO-118) |
| Diode variation | Single SCR |

TYPICAL APPLICATIONS

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

| 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 ² s |
| | 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 |
| VS-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 | |
| Maximum peak, one half cycle, non-repetitive surge current | I_{TSM} | t = 10 ms | No voltage reapplied | 7950 | A |
| | | | | t = 8.3 ms | |
| | | t = 10 ms | 100 % V_{RRM} reapplied | 6690 | |
| | | | | t = 8.3 ms | |
| Maximum I^2t for fusing | I^2t | t = 10 ms | No voltage reapplied | 316 | kA ² s |
| | | | | t = 8.3 ms | |
| | | t = 10 ms | 100 % V_{RRM} reapplied | 224 | |
| | | | | t = 8.3 ms | |
| Maximum $I^2\sqrt{t}$ for fusing | $I^2\sqrt{t}$ | t = 0.1 ms to 10 ms, no voltage reapplied | | 3160 | kA ² √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 | $V_{T(TO)1}$ | $(16.7\% \times \pi \times I_{T(AV)}) < I < \pi \times I_{T(AV)}$, $T_J = T_J$ maximum | | 1.44 | |
| High level value of threshold voltage | $V_{T(TO)2}$ | $I > \pi \times I_{T(AV)}$, $T_J = T_J$ maximum | | 1.46 | |
| 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 | | 0.57 | mΩ |
| High level value of forward slope resistance | r_{t2} | $I > \pi \times I_{T(AV)}$, $T_J = T_J$ 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, $V_{DRM} = \text{Rated } V_{DRM}$ $I_{TM} = 2 \times di/dt$ | | 1000 | A/μs |
| Typical delay time | t_d | $T_J = 25$ °C, $V_{DM} = \text{Rated } V_{DRM}$, $I_{TM} = 50$ A DC, $t_p = 1$ μs Resistive load, gate pulse: 10 V, 5 Ω source | | 0.80 | μs |
| Maximum turn-off time | minimum | $T_J = T_J$ maximum, $I_{TM} = 550$ A, commutating $di/dt = 40$ A/μs $V_R = 50$ 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/ μ s |
| Maximum peak reverse and off-state leakage current | I_{RRM} , 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 current required to trigger | I_{GT} | | $T_J = 25$ °C, $V_A = 12$ V, $R_a = 6$ Ω | 200 |
| 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) | |

| ΔR_{thJ-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-hs} when devices operate at different conduction angles than DC

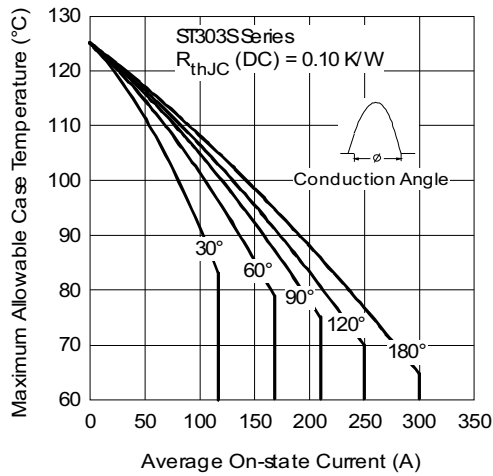


Fig. 1 - Current Ratings Characteristics

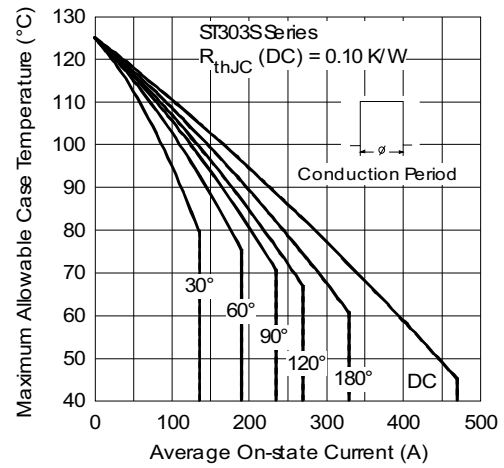


Fig. 2 - Current Ratings Characteristics

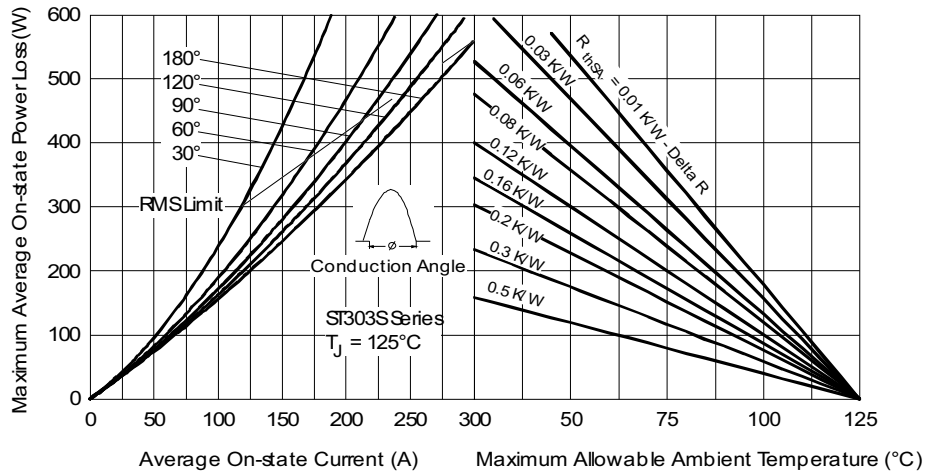


Fig. 3 - On-State Power Loss Characteristics

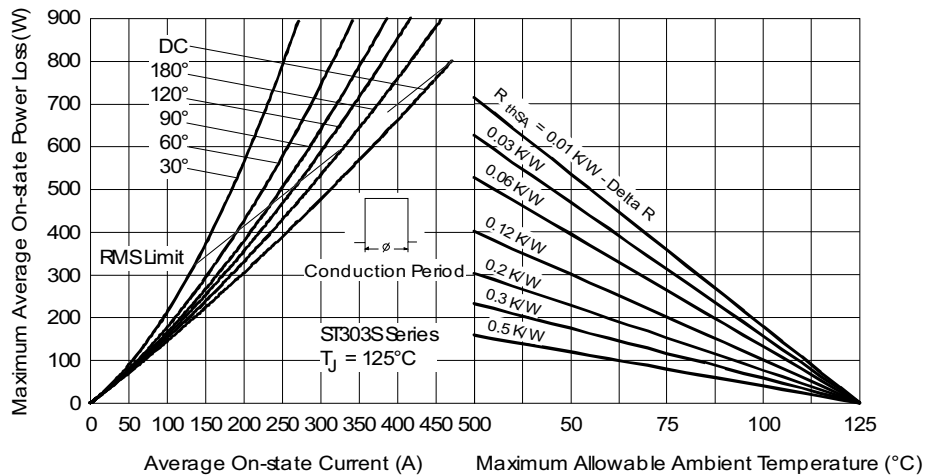


Fig. 4 - On-State Power Loss Characteristics

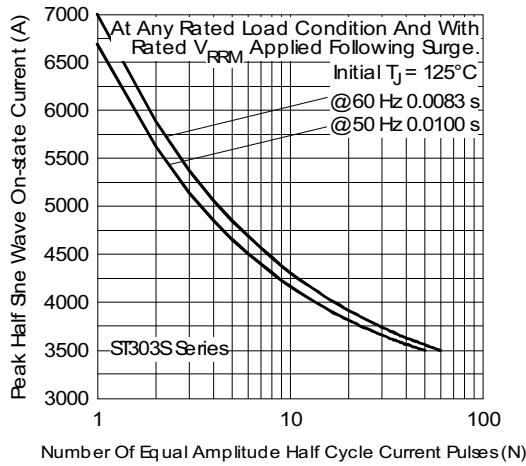


Fig. 5 - Maximum Non-Repetitive Surge Current

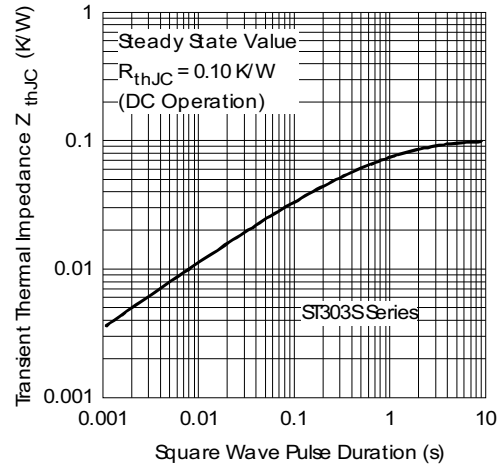


Fig. 8 - Thermal Impedance Z_{thJC} Characteristics

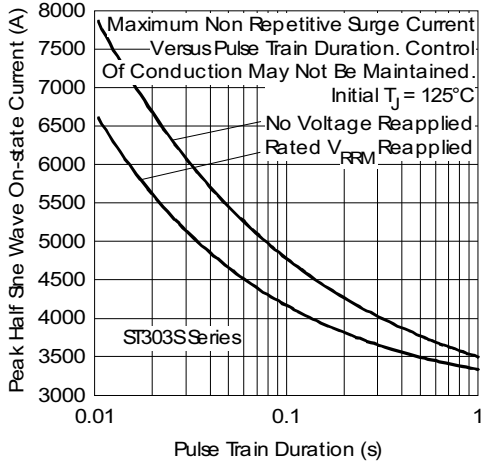


Fig. 6 - Maximum Non-Repetitive Surge Current

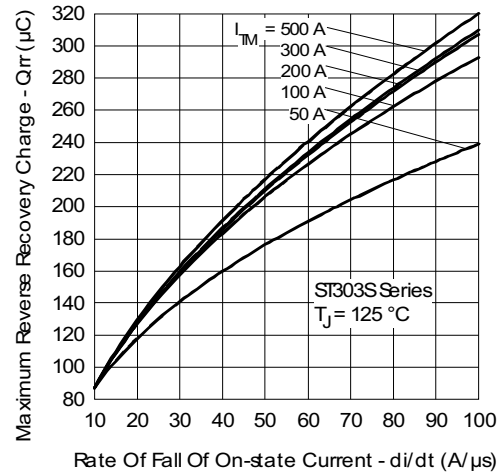


Fig. 9 - Reverse Recovered Charge Characteristics

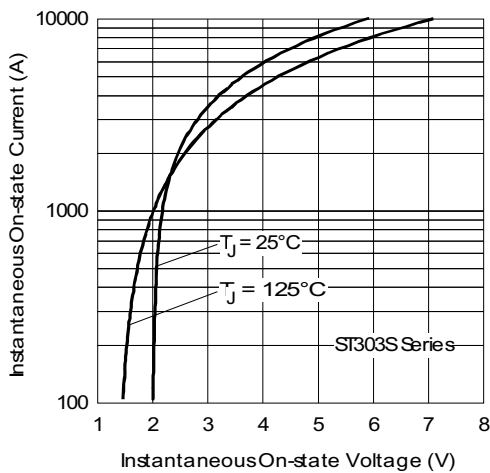


Fig. 7 - On-State Voltage Drop Characteristics

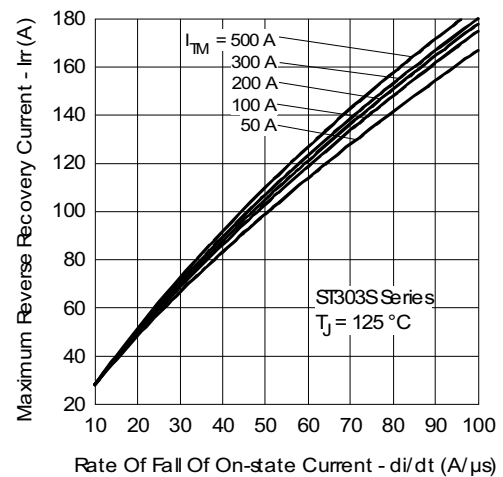


Fig. 10 - Reverse Recovery Current Characteristics

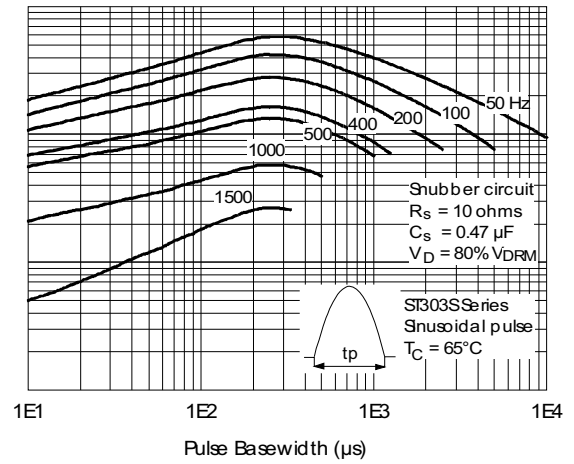
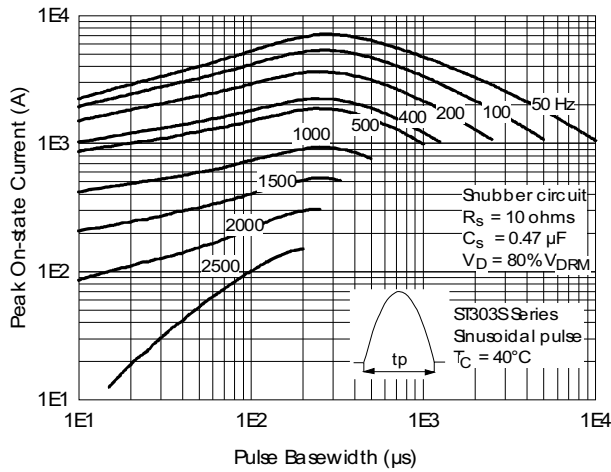


Fig. 11 - Frequency Characteristics

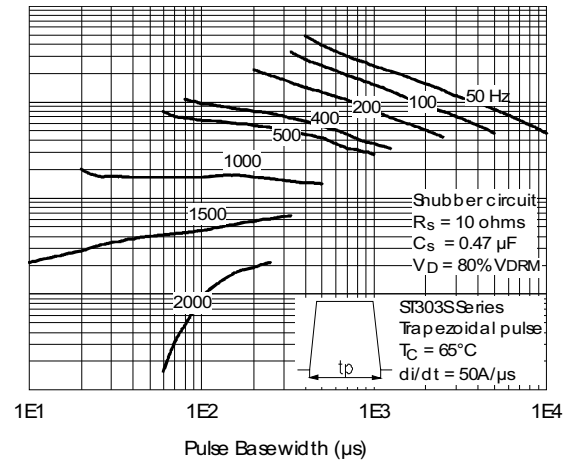
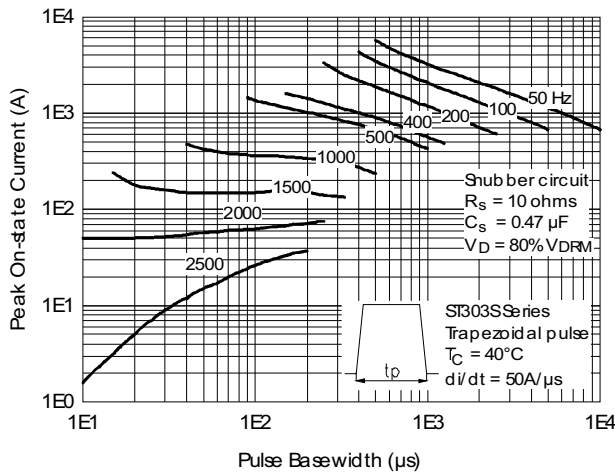


Fig. 12 - Frequency Characteristics

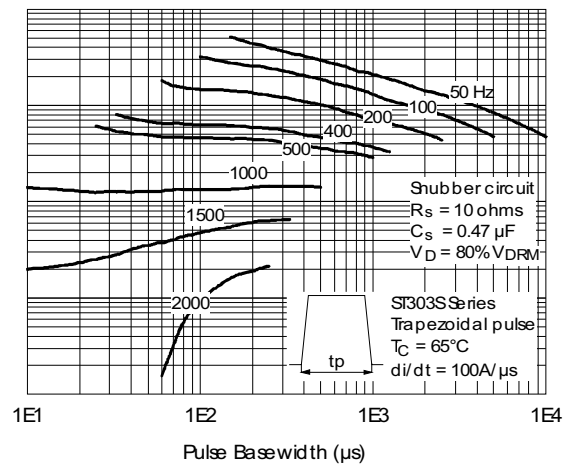
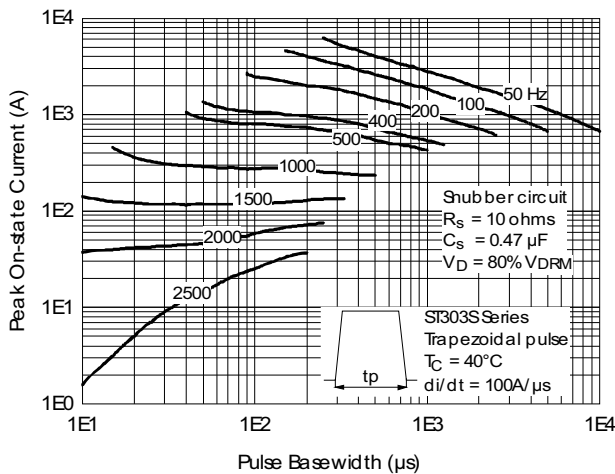


Fig. 13 - Frequency Characteristics

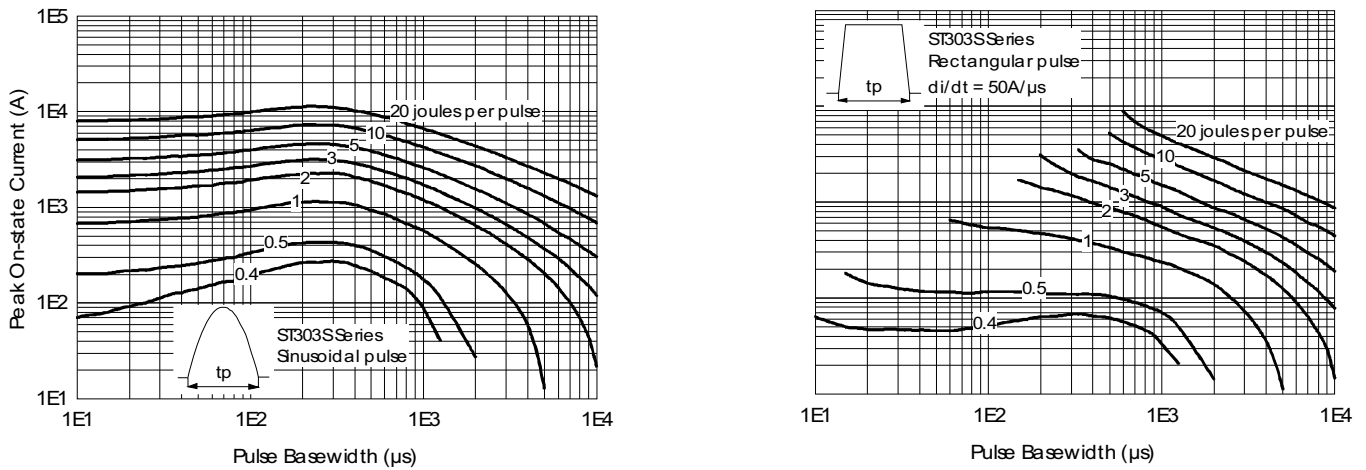


Fig. 14 - Maximum On-State Energy Power Loss Characteristics

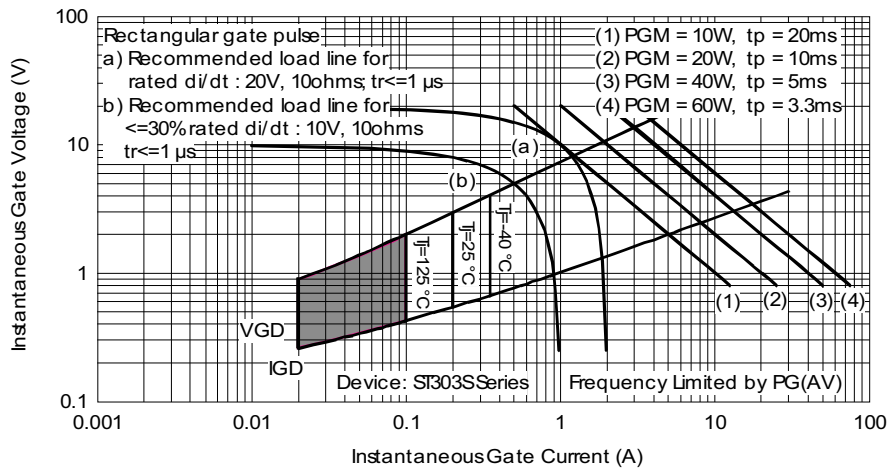
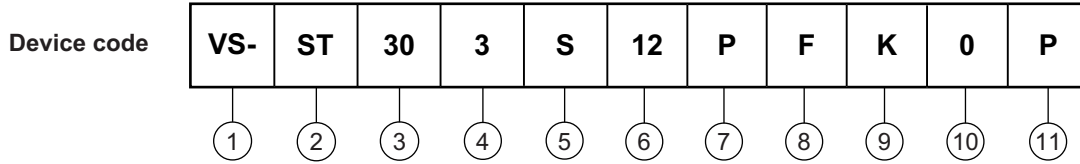


Fig. 15 - Gate Characteristics



ORDERING INFORMATION TABLE



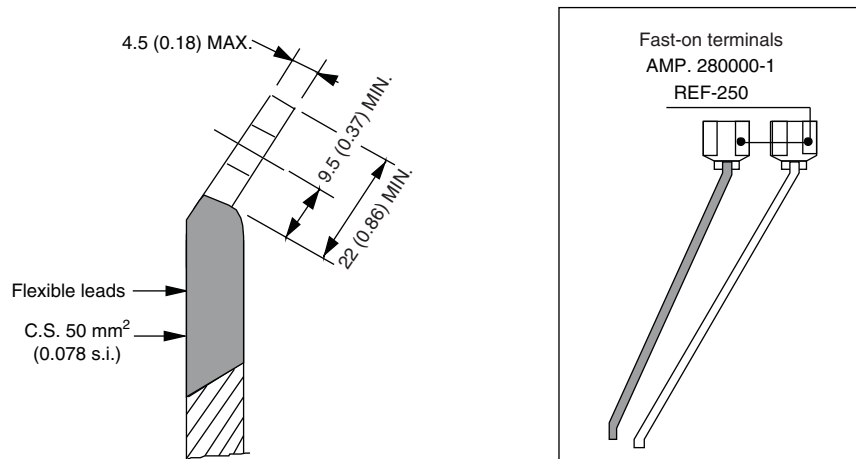
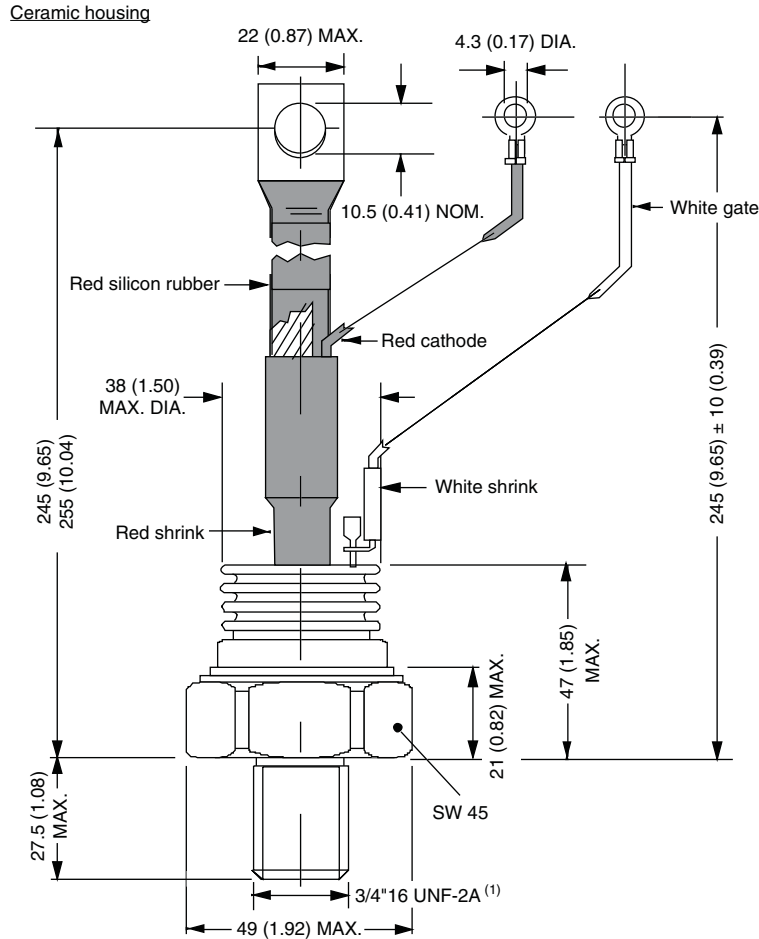
- 1** - Vishay Semiconductors product
- 2** - Thyristor
- 3** - Essential part number
- 4** - 3 = fast turn-off
- 5** - S = compression bonding stud
- 6** - Voltage code x 100 = V_{RRM}
(see Voltage Ratings table)
- 7** - P = stud base 3/4" 16UNF-2A
- 8** - Reapplied dV/dt code (for t_q test condition)
- 9** - t_q code
- 10** - 0 = eyelet terminals
(gate and auxiliary cathode leads)
1 = fast-on terminals
(gate and auxiliary cathode leads)
- 11** - None = standard production
P = lead (Pb)-free

| dV/dt - t_q combinations available | | |
|---|--------------------|-----|
| | dV/dt (V/ μ s) | 200 |
| t_q (μ s) up to 800 V | 10 | FN |
| | 15 | FL |
| | 20 | FK |
| t_q (μ s) only for 1000/1200 V | 20 | FK |

| LINKS TO RELATED DOCUMENTS | |
|----------------------------|--|
| Dimensions | 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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