

Phase Control Thyristors (Stud Version), 110 A



TO-209AC (TO-94)

FEATURES

- Center gate
- International standard case TO-209AC (TO-94)
- Compression bonded encapsulation for heavy duty operations such as severe thermal cycling
- Hermetic glass-metal case with ceramic insulator (Glass-metal seal over 1200 V)
- Compliant to RoHS directive 2002/95/EC
- Designed and qualified for industrial level


**RoHS
COMPLIANT**
PRODUCT SUMMARY

| | |
|-------------|-------|
| $I_{T(AV)}$ | 110 A |
|-------------|-------|

TYPICAL APPLICATIONS

- DC motor controls
- Controlled DC power supplies
- AC controllers

MAJOR RATINGS AND CHARACTERISTICS

| PARAMETER | TEST CONDITIONS | VALUES | UNITS |
|-------------------|-----------------|-------------|-------------------|
| $I_{T(AV)}$ | | 110 | A |
| | T_C | 90 | °C |
| $I_{T(RMS)}$ | | 175 | A |
| I_{TSM} | 50 Hz | 2700 | |
| | 60 Hz | 2830 | |
| I^2t | 50 Hz | 36.4 | kA ² s |
| | 60 Hz | 33.2 | |
| V_{DRM}/V_{RRM} | | 400 to 1600 | V |
| t_q | Typical | 100 | µs |
| T_J | | - 40 to 125 | °C |

ELECTRICAL SPECIFICATIONS
VOLTAGE RATINGS

| TYPE NUMBER | VOLTAGE CODE | V_{DRM}/V_{RRM} , MAXIMUM REPETITIVE PEAK AND OFF-STATE VOLTAGE V | V_{RSM} , MAXIMUM NON-REPETITIVE PEAK VOLTAGE V | I_{DRM}/I_{RRM} MAXIMUM AT $T_J = T_J$ MAXIMUM mA |
|-------------|--------------|--|--|--|
| ST110S | 04 | 400 | 500 | 20 |
| | 08 | 800 | 900 | |
| | 12 | 1200 | 1300 | |
| | 16 | 1600 | 1700 | |



| ABSOLUTE MAXIMUM RATINGS | | | | | |
|--|---------------|---|---------------------------|--------|--------------------|
| PARAMETER | SYMBOL | TEST CONDITIONS | | VALUES | UNITS |
| Maximum average on-state current at case temperature | $I_{T(AV)}$ | 180° conduction, half sine wave | | 110 | A |
| | | | | 90 | °C |
| Maximum RMS on-state current | $I_{T(RMS)}$ | DC at 85 °C case temperature | | 175 | A |
| Maximum peak, one-cycle non-repetitive surge current | I_{TSM} | t = 10 ms | No voltage reapplied | 2700 | |
| | | t = 8.3 ms | No voltage reapplied | 2830 | |
| | | t = 10 ms | 100 % V_{RRM} reapplied | 2270 | |
| | | t = 8.3 ms | 100 % V_{RRM} reapplied | 2380 | |
| Maximum I^2t for fusing | I^2t | t = 10 ms | No voltage reapplied | 36.4 | kA ² s |
| | | t = 8.3 ms | No voltage reapplied | 33.2 | |
| | | t = 10 ms | 100 % V_{RRM} reapplied | 25.8 | |
| | | t = 8.3 ms | 100 % V_{RRM} reapplied | 23.5 | |
| Maximum $I^2\sqrt{t}$ for fusing | $I^2\sqrt{t}$ | t = 0.1 to 10 ms, no voltage reapplied | | 364 | kA ² √s |
| 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) | | 0.90 | V |
| 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 on-state slope resistance | r_{t1} | (16.7 % $\times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)}$, $T_J = T_J$ maximum) | | 1.79 | mΩ |
| High level value of on-state slope resistance | r_{t2} | (I > $\pi \times I_{T(AV)}$, $T_J = T_J$ maximum) | | 1.81 | |
| Maximum on-state voltage | V_{TM} | $I_{pk} = 350$ A, $T_J = T_J$ maximum, $t_p = 10$ ms sine pulse | | 1.52 | V |
| Maximum holding current | I_H | $T_J = 25$ °C, anode supply 12 V resistive load | | 600 | mA |
| Typical latching current | I_L | | | 1000 | |

| SWITCHING | | | | | |
|--|---------|--|--|--------|-------|
| PARAMETER | SYMBOL | TEST CONDITIONS | | VALUES | UNITS |
| Maximum non-repetitive rate of rise of turned-on current | di/dt | Gate drive 20 V, 20 Ω, $t_r \leq 1$ μs $T_J = T_J$ maximum, anode voltage ≤ 80 % V_{DRM} | | 500 | A/μs |
| Typical delay time | t_d | Gate current 1 A, $di_g/dt = 1$ A/μs $V_d = 0.67$ % V_{DRM} , $T_J = 25$ °C | | 2.0 | μs |
| Typical turn-off time | t_q | $I_{TM} = 100$ A, $T_J = T_J$ maximum, $di/dt = 10$ A/μs, $V_R = 50$ V, $dV/dt = 20$ V/μs, gate 0 V 100 Ω, $t_p = 500$ μs | | 100 | |

| 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 % rated V_{DRM} | | 500 | V/μs |
| Maximum peak reverse and off-state leakage current | I_{RRM} , I_{DRM} | $T_J = T_J$ maximum, rated V_{DRM}/V_{RRM} applied | | 20 | mA |



| TRIGGERING | | | | | | |
|-------------------------------------|-------------|--|--|--------|------|-------|
| PARAMETER | SYMBOL | TEST CONDITIONS | | VALUES | | UNITS |
| | | | | TYP. | MAX. | |
| Maximum peak gate power | P_{GM} | $T_J = T_J$ maximum, $t_p \leq 5$ ms | | 5 | | W |
| Maximum average gate power | $P_{G(AV)}$ | $T_J = T_J$ maximum, $f = 50$ Hz, $d\% = 50$ | | 1 | | |
| Maximum peak positive gate current | I_{GM} | $T_J = T_J$ maximum, $t_p \leq 5$ ms | | 2.0 | | A |
| Maximum peak positive gate voltage | $+V_{GM}$ | | | 20 | | |
| Maximum peak negative gate voltage | $-V_{GM}$ | | | 5.0 | | |
| DC gate current required to trigger | I_{GT} | $T_J = -40$ °C | Maximum required gate trigger/ current/voltage are the lowest value which will trigger all units 6 V anode to cathode applied | 180 | - | mA |
| | | $T_J = 25$ °C | | 90 | 150 | |
| | | $T_J = 125$ °C | | 40 | - | |
| DC gate voltage required to trigger | V_{GT} | $T_J = -40$ °C | | 2.9 | - | V |
| | | $T_J = 25$ °C | | 1.8 | 3.0 | |
| | | $T_J = 125$ °C | | 1.2 | - | |
| DC gate current not to trigger | I_{GD} | $T_J = T_J$ maximum | Maximum gate current/voltage not to trigger is the maximum value which will not trigger any unit with rated V_{DRM} anode to cathode applied | 10 | | mA |
| DC gate voltage not to trigger | V_{GD} | | | 0.25 | | |

| 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 | | 0.195 | K/W |
| Maximum thermal resistance, case to heatsink | R_{thCS} | Mounting surface, smooth, flat and greased | | 0.08 | |
| Mounting torque, ± 10 % | | Non-lubricated threads | | 15.5 (137) | Nm (lbf · in) |
| | | Lubricated threads | | 14 (120) | |
| Approximate weight | | | | 130 | g |
| Case style | | See dimensions - link at the end of datasheet | | TO-209AC (TO-94) | |

| ΔR_{thJC} CONDUCTION | | | | |
|------------------------------|-----------------------|------------------------|---|-------|
| CONDUCTION ANGLE | SINUSOIDAL CONDUCTION | RECTANGULAR CONDUCTION | TEST CONDITIONS | UNITS |
| 180° | 0.035 | 0.025 | T _J = T _J maximum | K/W |
| 120° | 0.041 | 0.042 | | |
| 90° | 0.052 | 0.056 | | |
| 60° | 0.076 | 0.079 | | |
| 30° | 0.126 | 0.127 | | |

Note

- The table above shows the increment of thermal resistance R_{thJC} 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

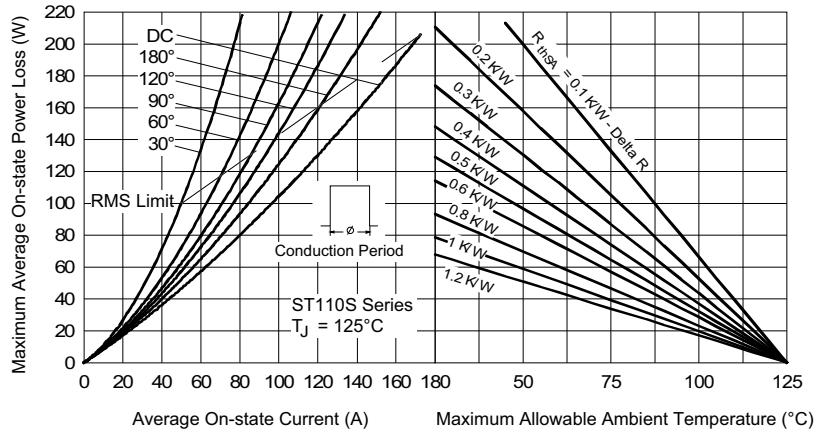


Fig. 4 - On-State Power Loss Characteristics



Fig. 5 - Maximum Non-Repetitive Surge Current

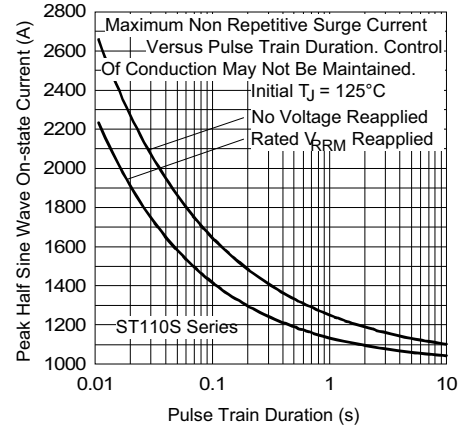


Fig. 6 - Maximum Non-Repetitive Surge Current



Fig. 7 - On-State Voltage Drop Characteristics



Fig. 8 - Thermal Impedance Z_{thJC} Characteristic



Fig. 9 - Gate Characteristics



ORDERING INFORMATION TABLE

| | | | | | | | | | | |
|-------------|-----------|-----------|----------|----------|-----------|----------|----------|----------|----------|------------|
| Device code | ST | 11 | 0 | S | 16 | P | 0 | V | L | PbF |
| | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | ⑩ |

- 1** - Thyristor
- 2** - Essential part marking
- 3** - 0 = Converter grade
- 4** - S = Compression bonding stud
- 5** - Voltage code x 100 = V_{RRM} (see Voltage Ratings table)
- 6** - P = Stud base 20UNF threads
- 7** - 0 = Eyelet terminals (gate and auxiliary cathode leads)
1 = Fast-on terminals (gate and auxiliary cathode leads)
2 = Flag terminals (for cathode and gate terminals)
- 8** - • V = Glass-metal seal (only up to 1200 V)
• None = Ceramic housing (over 1200 V)
- 9** - Critical dV/dt:
• None = 500 V/ μ s (standard value)
• L = 1000 V/ μ s (special selection)
- 10** - Lead (Pb)-free

| LINKS TO RELATED DOCUMENTS | |
|----------------------------|--|
| Dimensions | www.vishay.com/doc?95078 |

TO-209AC (TO-94) for ST110S Series

DIMENSIONS in millimeters (inches)

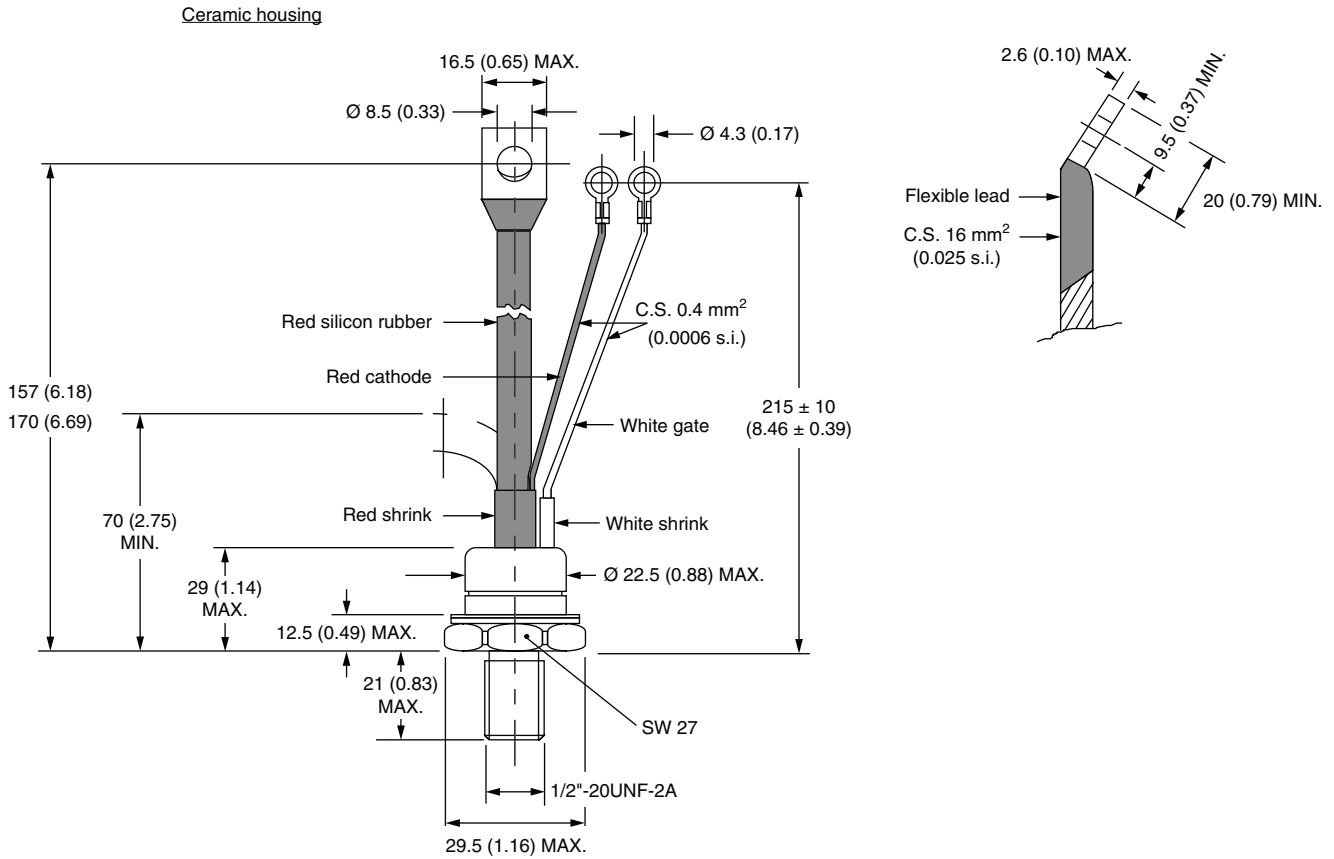


Outline Dimensions

Vishay Semiconductors TO-209AC (TO-94) for ST110S Series



DIMENSIONS in millimeters (inches)





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