Bulletin I25167/B

International
IOR Rectifier

# ST110S SERIES

## PHASE CONTROL THYRISTORS

**Stud Version**

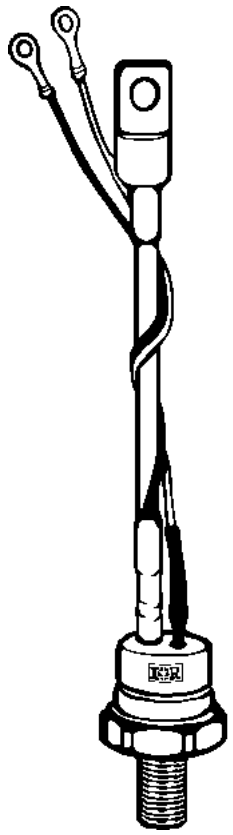
110A

### Features

- Center gate
- Hermetic metal case with ceramic insulator (Also available with glass-metal seal up to 1200V)
- International standard case TO-209AC (TO-94)
- Threaded studs UNF 1/2 - 20UNF2A
- Compression Bonded Encapsulation for heavy duty operations such as severe thermal cycling

### Typical Applications

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



case style
TO-209AC (TO-94)

### Major Ratings and Characteristics

| Parameters | | ST110S | Units |
|---|---|---|---|
| $I_{T(AV)}$ | | 110 | A |
| | @ $T_C$ | 90 | °C |
| $I_{T(RMS)}$ | | 175 | A |
| $I_{TSM}$ | @ 50Hz | 2700 | A |
| | @ 60Hz | 2830 | A |
| $I^2t$ | @ 50Hz | 36.4 | $KA^2s$ |
| | @ 60Hz | 33.2 | $KA^2s$ |
| $V_{DRM}/V_{RRM}$ | | 400 to 1600 | V |
| $t_q$ | typical | 100 | µs |
| $T_J$ | | - 40 to 125 | °C |

## ELECTRICAL SPECIFICATIONS

### Voltage Ratings

| Type number | Voltage Code | $V_{DRM}/V_{RRM}$, max. repetitive peak and off-state voltage V | $V_{RSM}$, maximum non-repetitive peak voltage V | $I_{DRM}/I_{RRM}$ max. @ $T_J = T_J$ max mA |
|---|---|---|---|---|
| ST110S | 04 | 400 | 500 | 20 |
| | 08 | 800 | 900 | |
| | 12 | 1200 | 1300 | |
| | 14 | 1400 | 1500 | |
| | 16 | 1600 | 1700 | |

### On-state Conduction

| | Parameter | ST110S | Units | Conditions | | |
|---|---|---|---|---|---|---|
| $I_{T(AV)}$ | Max. average on-state current | 110 | A | 180° conduction, half sine wave | | |
| | @ Case temperature | 90 | °C | | | |
| $I_{T(RMS)}$ | Max. RMS on-state current | 175 | A | DC @ 85°C case temperature | | |
| $I_{TSM}$ | Max. peak, one-cycle non-repetitive surge current | 2700 | A | t = 10ms | No voltage reapplied | Sinusoidal half wave, Initial $T_J = T_J$ max. |
| | | 2830 | | t = 8.3ms | | |
| | | 2270 | | t = 10ms | 100% $V_{RRM}$ reapplied | |
| | | 2380 | | t = 8.3ms | | |
| $I^2t$ | Maximum $I^2t$ for fusing | 36.4 | $KA^2s$ | t = 10ms | No voltage reapplied | |
| | | 33.2 | | t = 8.3ms | | |
| | | 25.8 | | t = 10ms | 100% $V_{RRM}$ reapplied | |
| | | 23.5 | | t = 8.3ms | | |
| $I^2\sqrt{t}$ | Maximum $I^2\sqrt{t}$ for fusing | 364 | $KA^2\sqrt{s}$ | t = 0.1 to 10ms, no voltage reapplied | | |
| $V_{T(TO)1}$ | Low level value of threshold voltage | 0.90 | V | (16.7% x π x $I_{T(AV)}$ < I < π x $I_{T(AV)}$), $T_J = T_J$ max. | | |
| $V_{T(TO)2}$ | High level value of threshold voltage | 0.92 | | (I > π x $I_{T(AV)}$), $T_J = T_J$ max. | | |
| $r_{t1}$ | Low level value of on-state slope resistance | 1.79 | mΩ | (16.7% x π x $I_{T(AV)}$ < I < π x $I_{T(AV)}$), $T_J = T_J$ max. | | |
| $r_{t2}$ | High level value of on-state slope resistance | 1.81 | | (I > π x $I_{T(AV)}$), $T_J = T_J$ max. | | |
| $V_{TM}$ | Max. on-state voltage | 1.52 | V | $I_{pk}$= 350A, $T_J = T_J$ max, $t_p$ = 10ms sine pulse | | |
| $I_H$ | Maximum holding current | 600 | mA | $T_J$ = 25°C, anode supply 12V resistive load | | |
| $I_L$ | Typical latching current | 1000 | | | | |

### Switching

| | Parameter | ST110S | Units | Conditions |
|---|---|---|---|---|
| di/dt | Max. non-repetitive rate of rise of turned-on current | 500 | A/µs | Gate drive 20V, 20Ω, $t_r \leq$ 1µs<br>$T_J = T_J$ max, anode voltage ≤ 80% $V_{DRM}$ |
| $t_d$ | Typical delay time | 2.0 | µs | Gate current 1A, $di_g/dt$ = 1A/µs<br>$V_d$ = 0.67% $V_{DRM}$, $T_J$ = 25°C |
| $t_q$ | Typical turn-off time | 100 | | $I_{TM}$ = 100A, $T_J = T_J$ max, di/dt = 10A/µs, $V_R$ = 50V<br>dv/dt = 20V/µs, Gate 0V 100Ω, $t_p$ = 500µs |

## Blocking

| | Parameter | ST110S | Units | Conditions |
|---|---|---|---|---|
| dv/dt | Maximum critical rate of rise of off-state voltage | 500 | V/µs | $T_J = T_J$ max. linear to 80% rated $V_{DRM}$ |
| $I_{RRM}$ $I_{DRM}$ | Max. peak reverse and off-state leakage current | 20 | mA | $T_J = T_J$ max, rated $V_{DRM}/V_{RRM}$ applied |

## Triggering

| | Parameter | ST110S | | Units | Conditions | |
|---|---|---|---|---|---|---|
| $P_{GM}$ | Maximum peak gate power | 5 | | W | $T_J = T_J$ max, $t_p \leq 5$ms | |
| $P_{G(AV)}$ | Maximum average gate power | 1 | | | $T_J = T_J$ max, f = 50Hz, d% = 50 | |
| $I_{GM}$ | Max. peak positive gate current | 2.0 | | A | $T_J = T_J$ max, $t_p \leq 5$ms | |
| $+V_{GM}$ | Maximum peak positive gate voltage | 20 | | V | $T_J = T_J$ max, $t_p \leq 5$ms | |
| $-V_{GM}$ | Maximum peak negative gate voltage | 5.0 | | | | |
| | | TYP. | MAX. | | | |
| $I_{GT}$ | DC gate current required to trigger | 180<br>90<br>40 | -<br>150<br>- | mA | $T_J$ = - 40°C<br>$T_J$ = 25°C<br>$T_J$ = 125°C | Max. required gate trigger/ current/ voltage are the lowest value which will trigger all units 12V anode-to-cathode applied |
| $V_{GT}$ | DC gate voltage required to trigger | 2.9<br>1.8<br>1.2 | -<br>3.0<br>- | V | $T_J$ = - 40°C<br>$T_J$ = 25°C<br>$T_J$ = 125°C | |
| $I_{GD}$ | DC gate current not to trigger | 10 | | mA | $T_J = T_J$ max | Max. gate current/ voltage not to trigger is the max. value which will not trigger any unit with rated $V_{DRM}$ anode-to-cathode applied |
| $V_{GD}$ | DC gate voltage not to trigger | 0.25 | | V | | |

## Thermal and Mechanical Specification

| | Parameter | ST110S | Units | Conditions |
|---|---|---|---|---|
| $T_J$ | Max. operating temperature range | -40 to 125 | °C | |
| $T_{stg}$ | Max. storage temperature range | -40 to 150 | | |
| $R_{thJC}$ | Max. thermal resistance, junction to case | 0.195 | K/W | DC operation |
| $R_{thCS}$ | Max. thermal resistance, case to heatsink | 0.08 | | Mounting surface, smooth, flat and greased |
| T | Mounting torque, ± 10% | 15.5<br>(137) | Nm<br>(lbf-in) | Non lubricated threads |
| | | 14<br>(120) | | Lubricated threads |
| wt | Approximate weight | 130 | g | |
| | Case style | TO - 209AC (TO-94) | | See Outline Table |

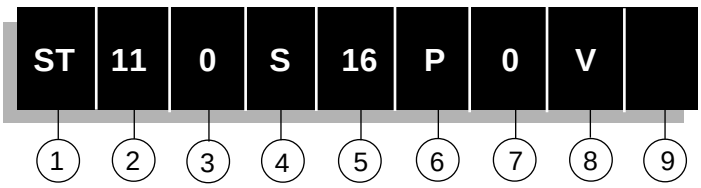
## $\Delta R_{thJC}$ Conduction

(The following table shows the increment of thermal resistence $R_{thJC}$ when devices operate at different conduction angles than DC)

| Conduction angle | Sinusoidal conduction | Rectangular conduction | Units | Conditions |
|---|---|---|---|---|
| 180° | 0.035 | 0.025 | K/W | $T_J = T_J$ max. |
| 120° | 0.041 | 0.042 | | |
| 90° | 0.052 | 0.056 | | |
| 60° | 0.076 | 0.079 | | |
| 30° | 0.126 | 0.127 | | |

## Ordering Information Table

**Device Code**




**1** - Thyristor

**2** - Essential part number

**3** - 0 = Converter grade

**4** - S = Compression bonding Stud

**5** - Voltage code: Code x 100 = $V_{RRM}$ (See Voltage Rating Table)

**6** - P = Stud base 20UNF threads

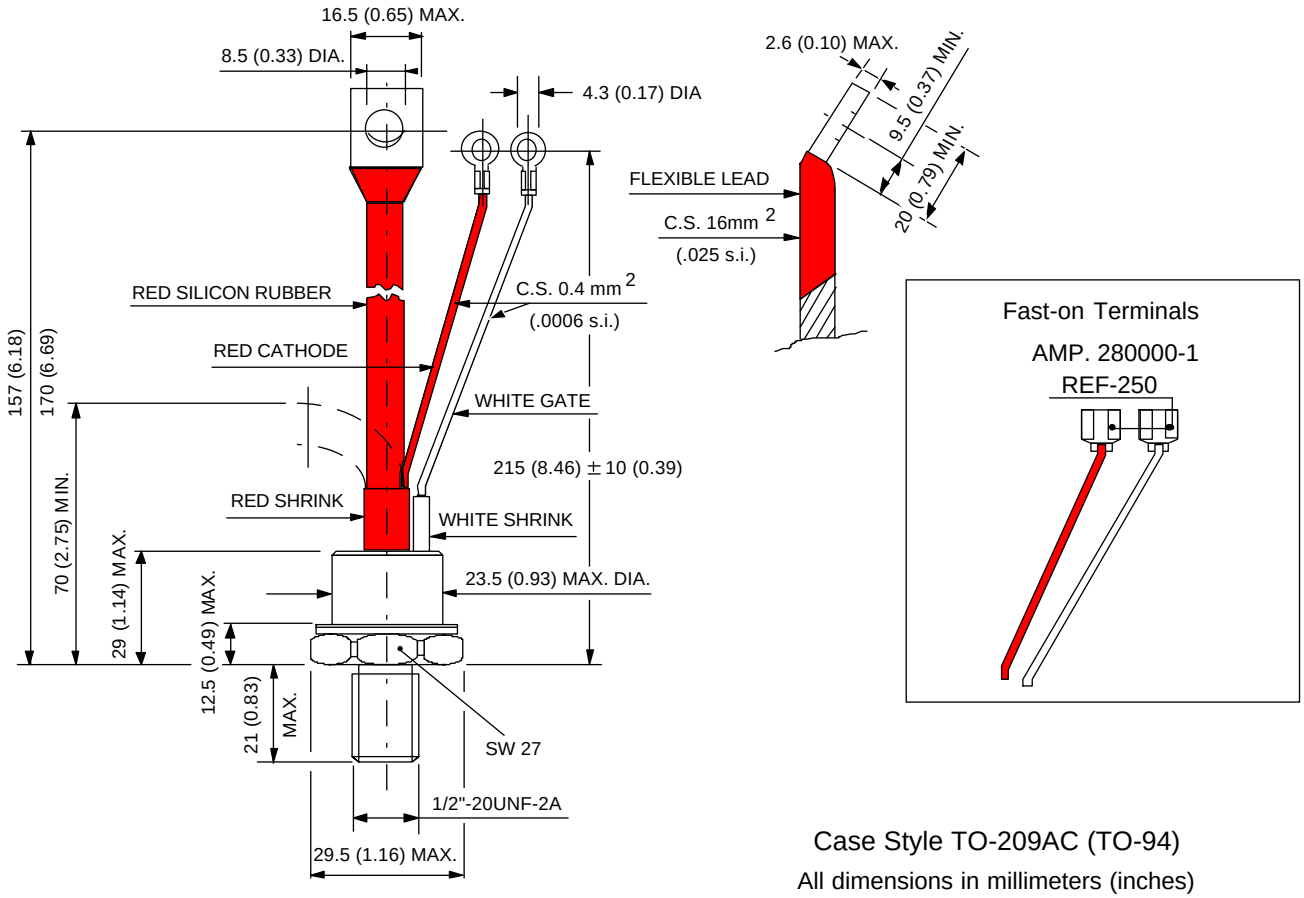
**7** - 0 = Eyelet terminals (Gate and Auxiliary Cathode Leads)
1 = Fast - on terminals (Gate and Auxiliary Cathode Leads)
2 = Flag terminals (For Cathode and Gate Terminals)

**8** - V = Glass-metal seal (only up to 1200V)
None = Ceramic housing (over 1200V)

**9** - Critical dv/dt: None = 500V/µsec (Standard value)
L = 1000V/µsec (Special selection)

## Outline Table

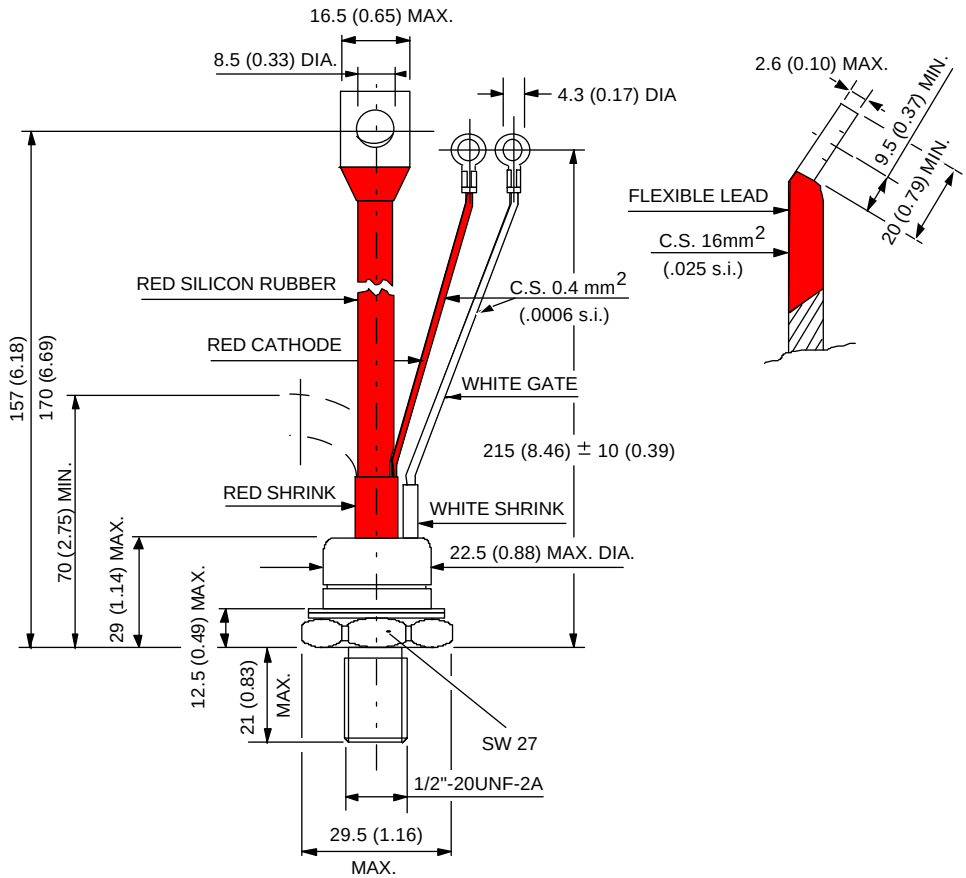
GLASS METAL SEAL




Case Style TO-209AC (TO-94)

All dimensions in millimeters (inches)

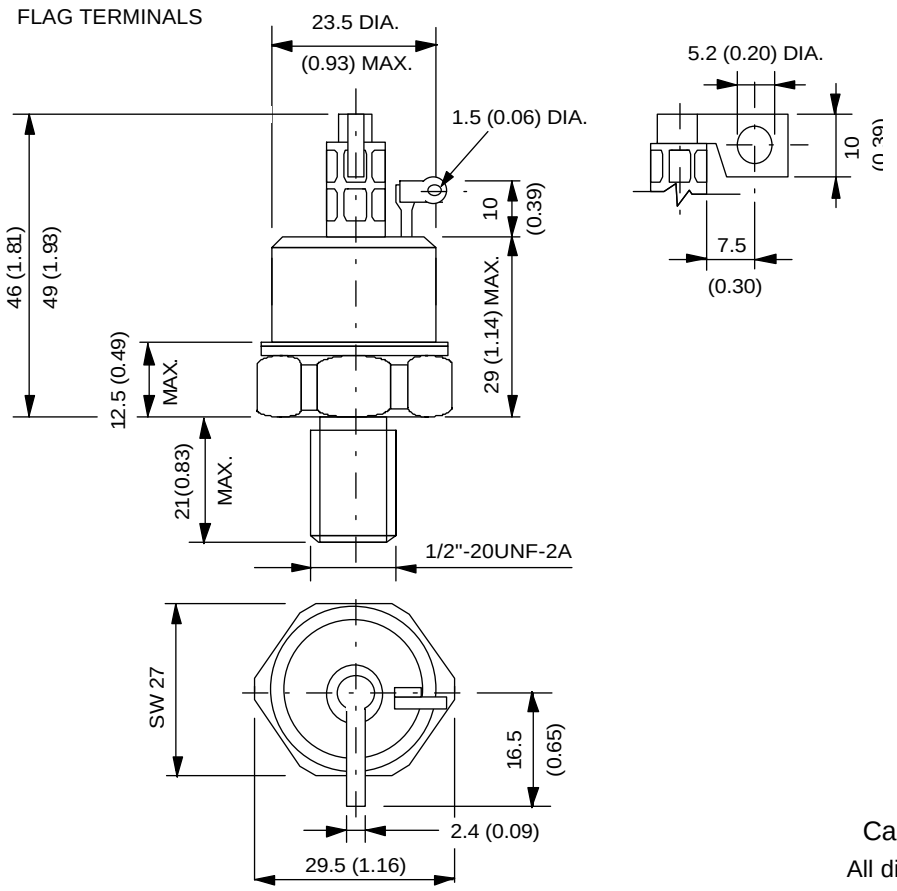
CERAMIC HOUSING



## Outline Table

GLASS-METAL SEAL

FLAG TERMINALS

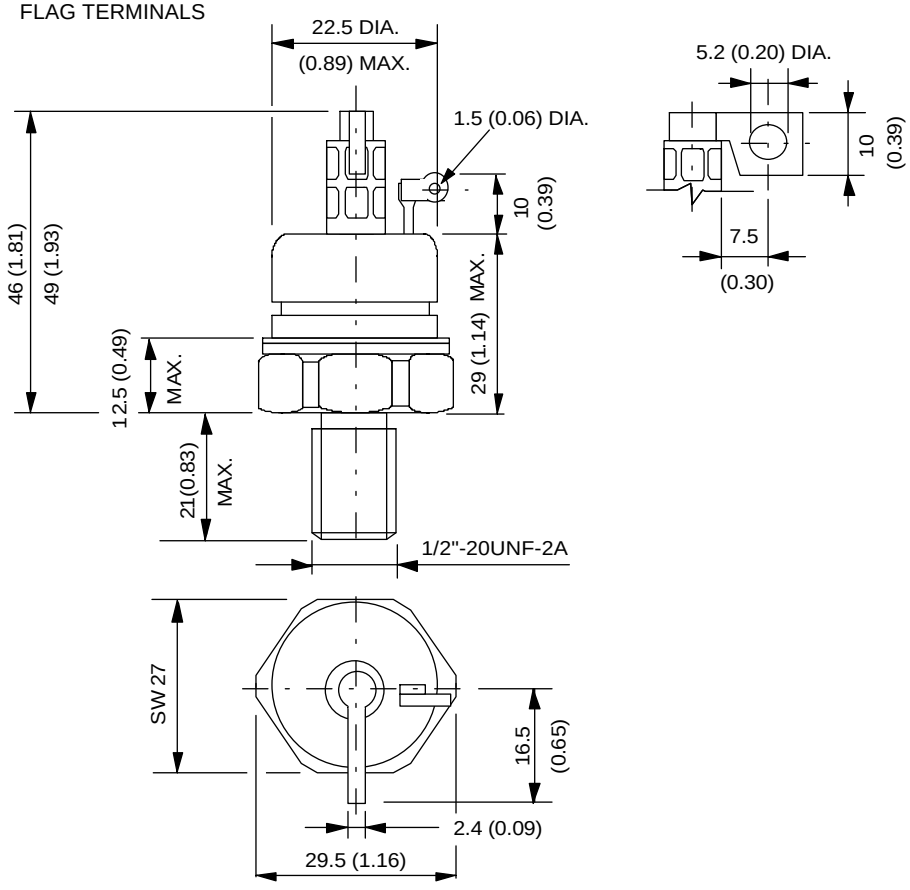



Case Style TO-208AD (TO-83)

All dimensions in millimeters (inches)

CERAMIC HOUSING

FLAG TERMINALS



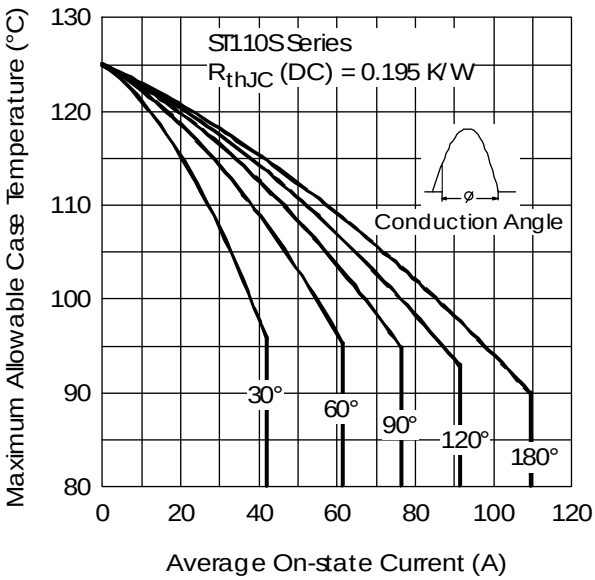



Fig. 1 - Current Ratings Characteristics

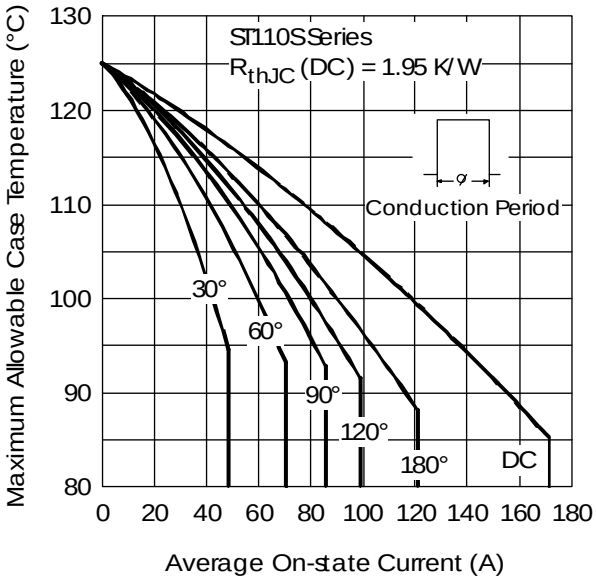



Fig. 2 - Current Ratings Characteristics

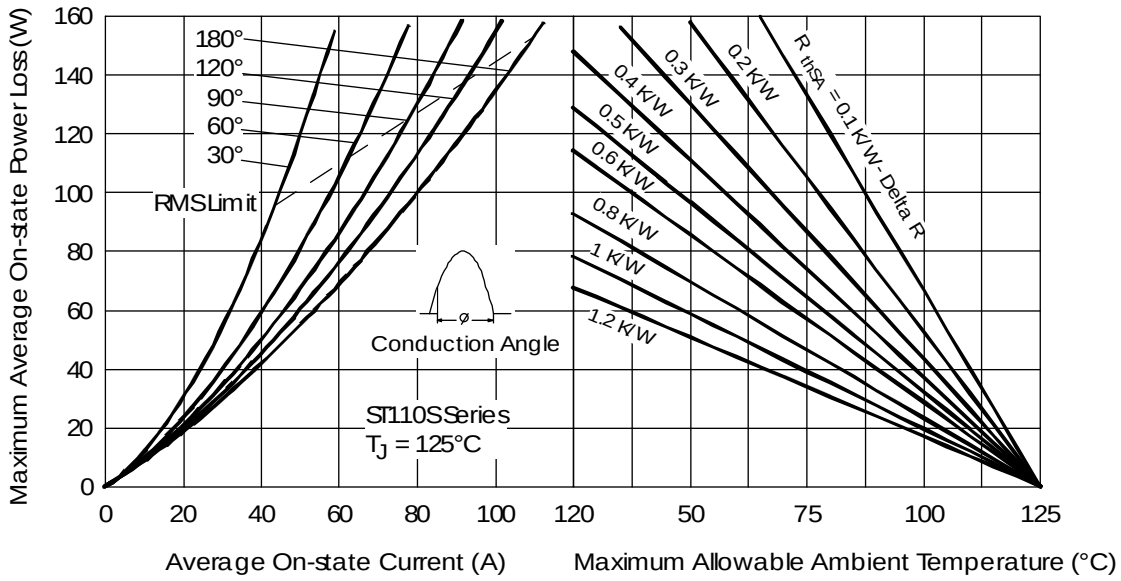



Fig. 3 - On-state Power Loss Characteristics

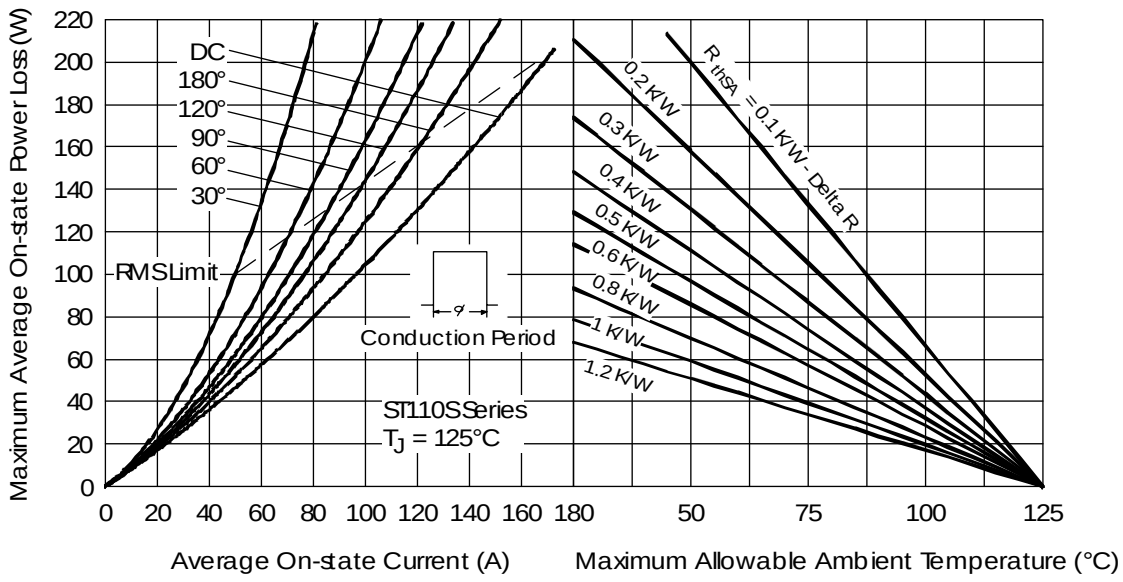



Fig. 4 - On-state Power Loss Characteristics

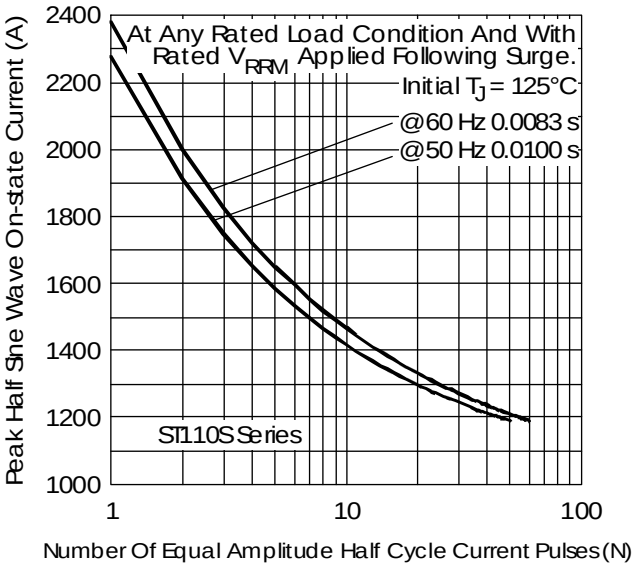



Fig. 5 - Maximum Non-Repetitive Surge Current

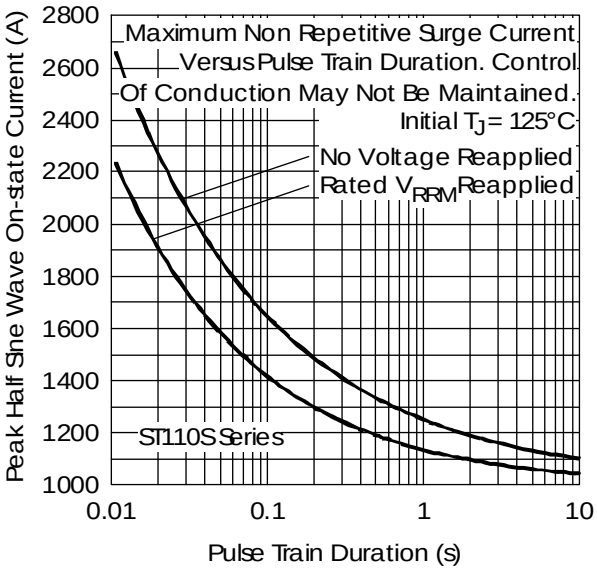



Fig. 6 - Maximum Non-Repetitive Surge Current

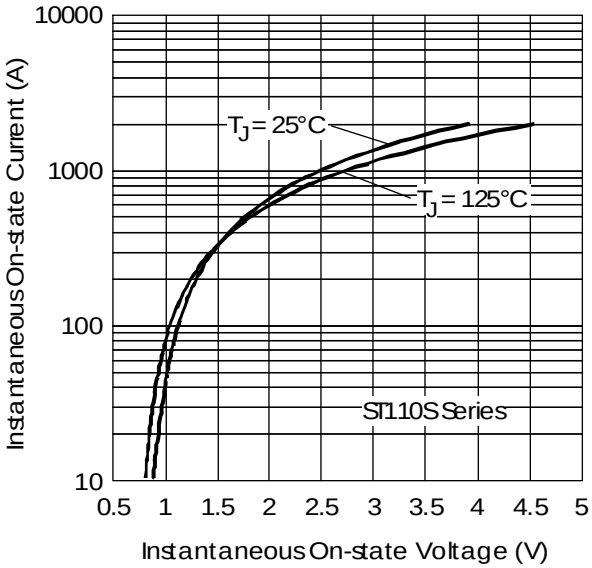



Fig. 7 - On-state Voltage Drop Characteristics

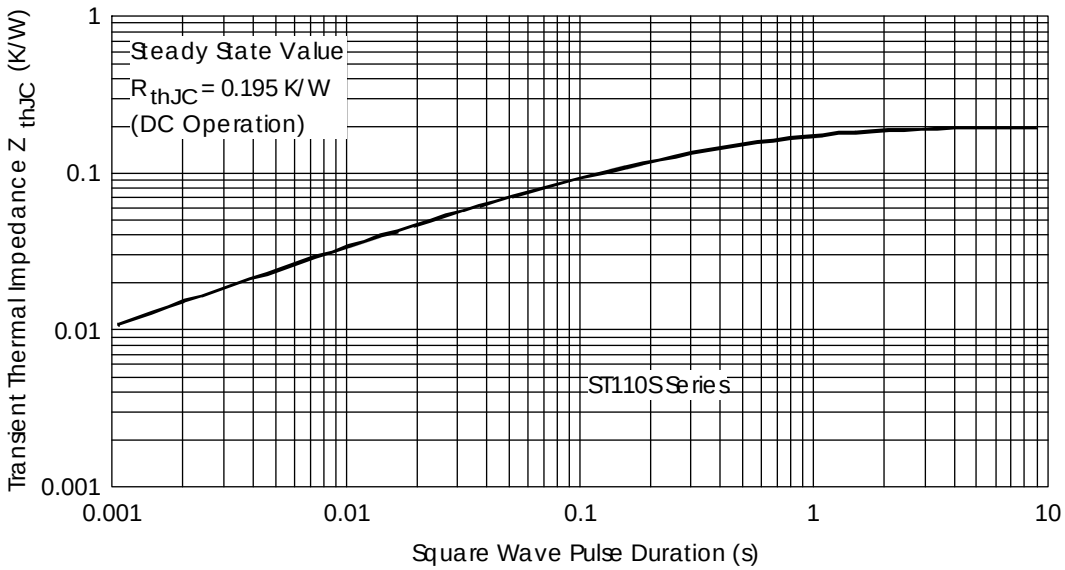



Fig. 8 - Thermal Impedance $Z_{thJC}$ Characteristic

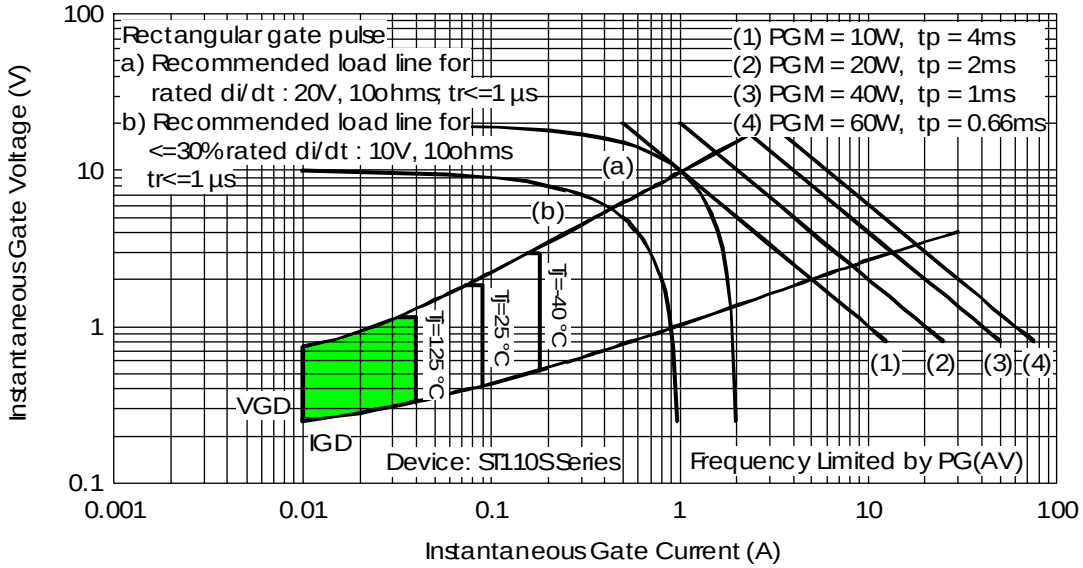



Fig. 9 - Gate Characteristics