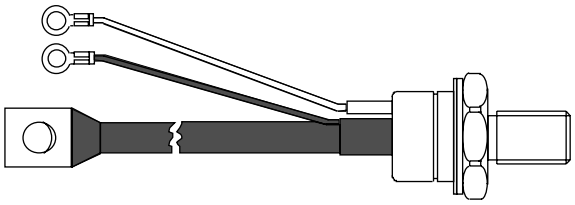
# Phase Control Thyristors (Stud Version), 110 A



TO-209AC (TO-94)

## FEATURES

- High current and high surge ratings
- Hermetic ceramic housing
- RoHS compliant
- Designed and qualified for industrial level

RoHS COMPLIANT

## TYPICAL APPLICATIONS

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

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

| MAJOR RATINGS AND CHARACTERISTICS | | | |
|---|---|---|---|
| PARAMETER | TEST CONDITIONS | VALUES | UNITS |
| $I_{T(AV)}$ | | 110 | A |
| | $T_C$ | 90 | °C |
| $I_{T(RMS)}$ | | 172 | A |
| $I_{TSM}$ | 50 Hz | 2080 | A |
| | 60 Hz | 2180 | |
| $I^2t$ | 50 Hz | 21.7 | $kA^2s$ |
| | 60 Hz | 19.8 | |
| $V_{DRM}/V_{RRM}$ | | 400 to 1200 | V |
| $t_q$ | Typical | 110 | µs |
| $T_J$ | | - 40 to 140 | °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 |
| 110/111RKI | 40 | 400 | 500 | 20 |
| | 80 | 800 | 900 | |
| | 120 | 1200 | 1300 | |

## 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 83 °C case temperature | | | 172 | A |
| Maximum peak, one-cycle non-repetitive surge current | $I_{TSM}$ | t = 10 ms | No voltage reapplied | Sinusoidal half wave, initial $T_J = T_J$ maximum | 2080 | A |
| | | t = 8.3 ms | | | 2180 | |
| | | t = 10 ms | 100 % $V_{RRM}$ reapplied | | 1750 | |
| | | t = 8.3 ms | | | 1830 | |
| Maximum $I^2t$ for fusing | $I^2t$ | t = 10 ms | No voltage reapplied | | 21.7 | $kA^2s$ |
| | | t = 8.3 ms | | | 19.8 | |
| | | t = 10 ms | 100 % $V_{RRM}$ reapplied | | 15.3 | |
| | | t = 8.3 ms | | | 14.0 | |
| Maximum $I^2\sqrt{t}$ for fusing | $I^2\sqrt{t}$ | t = 0.1 to 10 ms, no voltage reapplied | | | 217 | $kA^2\sqrt{s}$ |
| Low level value of threshold voltage | $V_{T(TO)1}$ | (16.7 % x $\pi$ x $I_{T(AV)}$ < I < $\pi$ x $I_{T(AV)}$), $T_J = T_J$ maximum | | | 0.82 | V |
| High level value of threshold voltage | $V_{T(TO)2}$ | (I > $\pi$ x $I_{T(AV)}$), $T_J = T_J$ maximum | | | 1.02 | |
| Low level value of on-state slope resistance | $r_{t1}$ | (16.7 % x $\pi$ x $I_{T(AV)}$ < I < $\pi$ x $I_{T(AV)}$), $T_J = T_J$ maximum | | | 2.16 | mΩ |
| High level value of on-state slope resistance | $r_{t2}$ | (I > $\pi$ x $I_{T(AV)}$), $T_J = T_J$ maximum | | | 1.70 | |
| Maximum on-state voltage | $V_{TM}$ | $I_{pk}$ = 350 A, $T_J = T_J$ maximum, $t_p$ = 10 ms sine pulse | | | 1.57 | V |
| Maximum holding current | $I_H$ | $T_J$ = 25 °C, anode supply 6 V resistive load | | | 200 | mA |
| Typical latching current | $I_L$ | | | | 400 | |

## 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<br>$T_J = T_J$ maximum, anode voltage ≤ 80 % $V_{DRM}$ | 300 | A/µs |
| Typical delay time | $t_d$ | Gate current 1 A, $dI_g/dt$ = 1 A/µs<br>$V_d$ = 0.67 % $V_{DRM}$, $T_J$ = 25 °C | 1.0 | µs |
| Typical turn-off time | $t_q$ | $I_{TM}$ = 50 A, $T_J = T_J$ maximum, dI/dt = - 5 A/µs,<br>$V_R$ = 50 V, dV/dt = 20 V/µs; gate 0 V 25 Ω | 110 | |

## 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 TYP. | VALUES MAX. | UNITS |
| Maximum peak gate power | $P_{GM}$ | $T_J = T_J$ maximum, $t_p \leq 5$ ms | | 12 | | W |
| Maximum average gate power | $P_{G(AV)}$ | $T_J = T_J$ maximum, f = 50 Hz, d% = 50 | | 3.0 | | |
| Maximum peak positive gate current | $I_{GM}$ | $T_J = T_J$ maximum, $t_p \leq 5$ ms | | 3.0 | | A |
| Maximum peak positive gate voltage | $+V_{GM}$ | $T_J = T_J$ maximum, $t_p \leq 5$ ms | | 20 | | V |
| Maximum peak negative gate voltage | $-V_{GM}$ | | | 10 | | |
| 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 12 V anode to cathode applied | 180 | - | mA |
| | | $T_J$ = 25 °C | | 80 | 120 | |
| | | $T_J$ = 140 °C | | 40 | - | |
| DC gate voltage required to trigger | $V_{GT}$ | $T_J$ = - 40 °C | | 2.5 | - | V |
| | | $T_J$ = 25 °C | | 1.6 | 2 | |
| | | $T_J$ = 140 °C | | 1 | - | |
| 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 | 6.0 | | mA |
| 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 140 | °C |
| Maximum storage temperature range | $T_{Stg}$ | | - 40 to 150 | |
| Maximum thermal resistance, junction to case | $R_{thJC}$ | DC operation | 0.27 | K/W |
| Maximum thermal resistance, case to heatsink | $R_{thCS}$ | Mounting surface, smooth, flat and greased | 0.1 | |
| Mounting torque, ± 10 % | | Non-lubricated threads | 15.5 (137) | N · m (lbf · in) |
| | | Lubricated threads | 14 (120) | |
| Approximate weight | | | 130 | g |
| Case style | | See dimensions - link at the end of datasheet | TO-209AC (TO-94) | |

| $\Delta R_{thJC}$ CONDUCTION | | | | |
|---|---|---|---|---|
| CONDUCTION ANGLE | SINUSOIDAL CONDUCTION | RECTANGULAR CONDUCTION | TEST CONDITIONS | UNITS |
| 180° | 0.043 | 0.031 | $T_J = T_J$ maximum | K/W |
| 120° | 0.052 | 0.053 | | |
| 90° | 0.066 | 0.071 | | |
| 60° | 0.096 | 0.101 | | |
| 30° | 0.167 | 0.169 | | |

**Note**

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

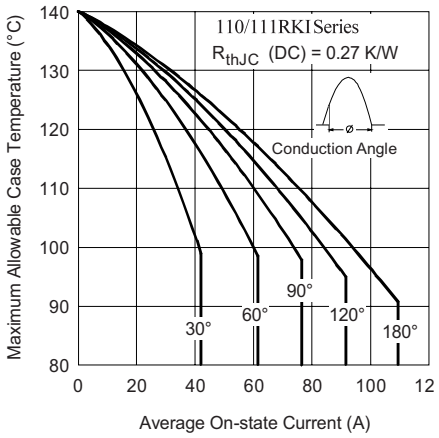



Fig. 1 - Current Ratings Characteristics

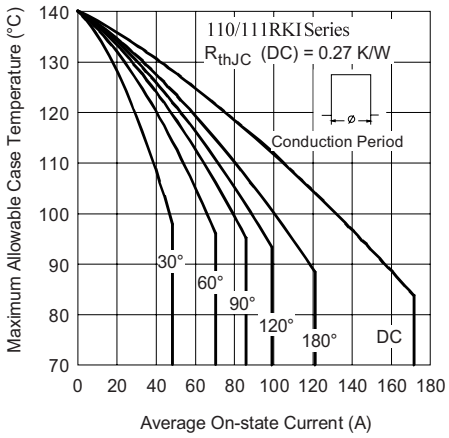



Fig. 2 - Current Ratings Characteristics

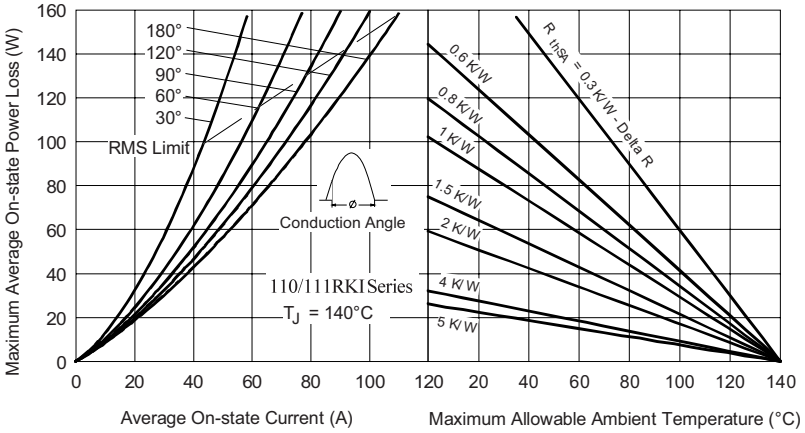



Fig. 3 - On-State Power Loss Characteristics

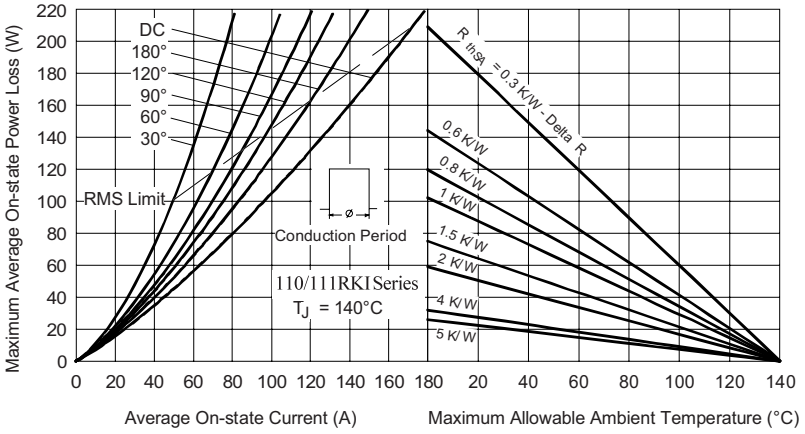



Fig. 4 - On-State Power Loss Characteristics

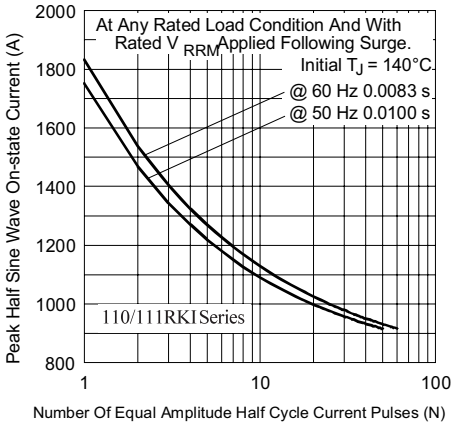



Fig. 5 - Maximum Non-Repetitive Surge Current

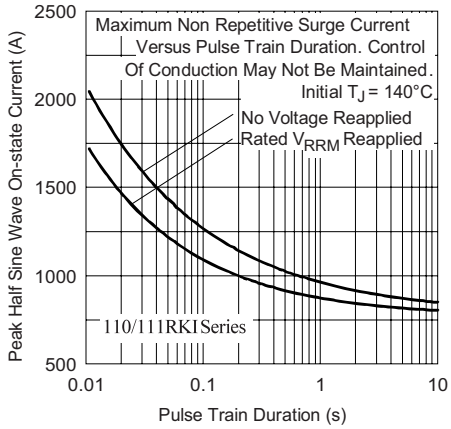



Fig. 6 - Maximum Non-Repetitive Surge Current

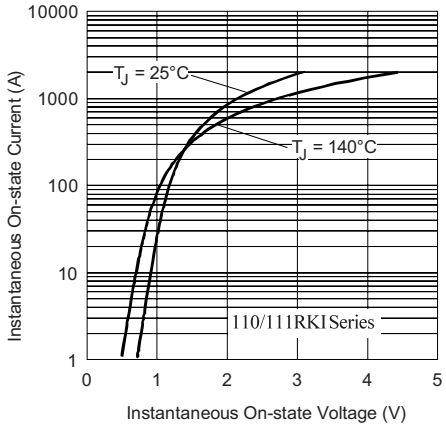



Fig. 7 - On-State Voltage Drop Characteristics

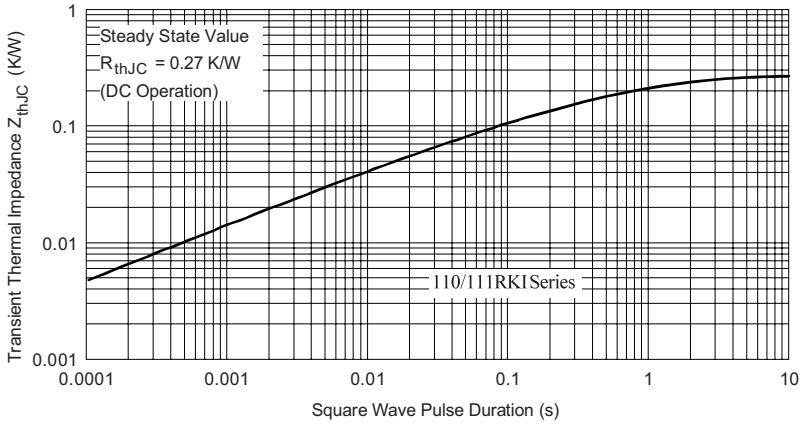



Fig. 8 - Thermal Impedance $Z_{thJC}$ Characteristics

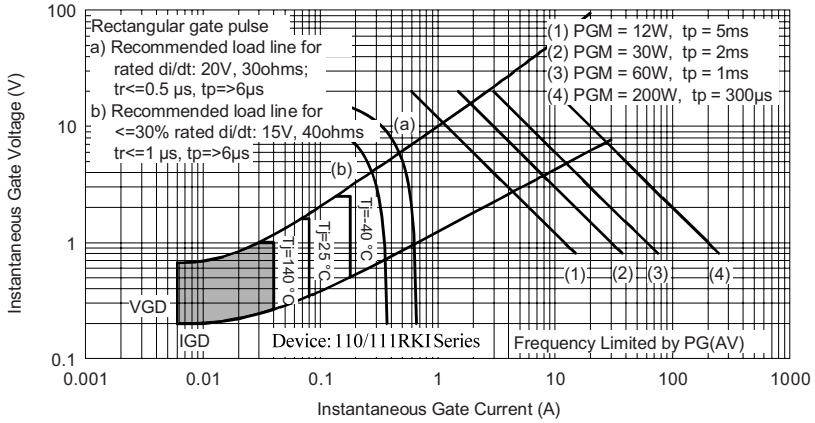



Fig. 9 - Gate Characteristics

## ORDERING INFORMATION TABLE

**Device code**

| 11 | 1 | RKI | 120 |
|---|---|---|---|
| ① | ② | ③ | ④ |

- **1** - $I_{T(AV)}$ rated average output current (rounded/10)
- **2** - 0 = Eyelet terminals (gate and auxiliary cathode leads)
  1 = Fast-on terminals (gate and auxiliary cathode leads)
- **3** - Thyristor
- **4** - Voltage code x 10 = $V_{RRM}$ (see Voltage Ratings table)

| LINKS TO RELATED DOCUMENTS | |
|---|---|
| Dimensions | http://www.vishay.com/doc?95003 |

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