

Phase Control Thyristors (Hockey PUK Version), 410 A



TO-200AB (A-PUK)

FEATURES

- Center amplifying gate
- Metal case with ceramic insulator
- International standard case TO-200AB (A-PUK)
- Designed and qualified for industrial level
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT

TYPICAL APPLICATIONS

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

| PRODUCT SUMMARY | |
|-------------------|---|
| Package | TO-200AB (A-PUK) |
| Diode variation | Single SCR |
| $I_{T(AV)}$ | 410 A |
| V_{DRM}/V_{RRM} | 400 V, 800 V, 1200 V, 1400 V, 1600 V, 1800 V, 2000 V |
| V_{TM} | 1.69 V |
| I_{GT} | 90 mA |
| T_J | -40 °C to 125 °C |

| MAJOR RATINGS AND CHARACTERISTICS | | | |
|-----------------------------------|-----------------|-------------|-------------------|
| PARAMETER | TEST CONDITIONS | VALUES | UNITS |
| $I_{T(AV)}$ | | 410 | A |
| | T_{hs} | 55 | °C |
| $I_{T(RMS)}$ | | 780 | A |
| | T_{hs} | 25 | °C |
| I_{TSM} | 50 Hz | 5700 | A |
| | 60 Hz | 5970 | |
| I^2t | 50 Hz | 163 | kA ² s |
| | 60 Hz | 149 | |
| V_{DRM}/V_{RRM} | | 400 to 2000 | 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 |
| VS-ST230C..C | 04 | 400 | 500 | 30 |
| | 08 | 800 | 900 | |
| | 12 | 1200 | 1300 | |
| | 14 | 1400 | 1500 | |
| | 16 | 1600 | 1700 | |
| | 18 | 1800 | 1900 | |
| | 20 | 2000 | 2100 | |



| ABSOLUTE MAXIMUM RATINGS | | | | | |
|--|---------------|--|---------------------------|------------|--------------------|
| PARAMETER | SYMBOL | TEST CONDITIONS | | VALUES | UNITS |
| Maximum average on-state current at heatsink temperature | $I_{T(AV)}$ | 180° conduction, half sine wave double side (single side) cooled | | 410 (165) | A |
| | | | | 55 (85) | °C |
| Maximum RMS on-state current | $I_{T(RMS)}$ | DC at 25 °C heatsink temperature double side cooled | | 780 | |
| Maximum peak, one-cycle non-repetitive surge current | I_{TSM} | t = 10 ms | No voltage reapplied | 5700 | A |
| | | t = 8.3 ms | | 5970 | |
| | | t = 10 ms | 100 % V_{RRM} reapplied | 4800 | |
| | | t = 8.3 ms | | 5000 | |
| Maximum I^2t for fusing | I^2t | t = 10 ms | No voltage reapplied | 163 | kA ² s |
| | | t = 8.3 ms | | 148 | |
| | | t = 10 ms | 100 % V_{RRM} reapplied | 115 | |
| | | t = 8.3 ms | | 105 | |
| Maximum $I^2\sqrt{t}$ for fusing | $I^2\sqrt{t}$ | t = 0.1 to 10 ms, no voltage reapplied | | 1630 | 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 | | 0.92 | V |
| High level value of threshold voltage | $V_{T(TO)2}$ | (I > $\pi \times I_{T(AV)}$), $T_J = T_J$ maximum | | 0.98 | |
| 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 | | 0.88 | mΩ |
| High level value of on-state slope resistance | r_{t2} | (I > $\pi \times I_{T(AV)}$), $T_J = T_J$ maximum | | 0.81 | |
| Maximum on-state voltage | V_{TM} | $I_{pk} = 880$ A, $T_J = T_J$ maximum, $t_p = 10$ ms sine pulse | | 1.69 | V |
| Maximum holding current | I_H | $T_J = 25$ °C, anode supply 12 V resistive load | | 600 | mA |
| Maximum (typical) latching current | I_L | | | 1000 (300) | |

| 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} | | 1000 | 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 | | 1.0 | μs |
| Typical turn-off time | t_q | $I_{TM} = 300$ A, $T_J = T_J$ maximum, $di/dt = 20$ 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 | | 30 | 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 | | 10.0 | | W |
| Maximum average gate power | $P_{G(AV)}$ | $T_J = T_J$ maximum, $f = 50$ Hz, $d\% = 50$ | | 2.0 | | |
| 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 | $-V_{GM}$ | | | 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 12 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 | | 10 | | mA |
| DC gate voltage not to trigger | V_{GD} | | | 0.25 | | V |

| THERMAL AND MECHANICAL SPECIFICATIONS | | | | |
|---|--------------|---|------------------|-----------|
| PARAMETER | SYMBOL | TEST CONDITIONS | VALUES | UNITS |
| Maximum operating temperature range | T_J | | - 40 to 125 | °C |
| Maximum storage temperature range | T_{Stg} | | - 40 to 150 | |
| Maximum thermal resistance, junction to heatsink | R_{thJ-hs} | DC operation single side cooled | 0.17 | K/W |
| | | DC operation double side cooled | 0.08 | |
| Maximum thermal resistance, case to heatsink | R_{thC-hs} | DC operation single side cooled | 0.033 | |
| | | DC operation double side cooled | 0.017 | |
| Mounting force, ± 10 % | | | 4900 (500) | N (kg) |
| Approximate weight | | | 50 | g |
| Case style | | See dimensions - link at the end of datasheet | TO-200AB (A-PUK) | |

| ΔR_{thJc} CONDUCTION | | | | | | |
|--|-----------------------|-------------|------------------------|-------------|---------------------|-------|
| CONDUCTION ANGLE | SINUSOIDAL CONDUCTION | | RECTANGULAR CONDUCTION | | TEST CONDITIONS | UNITS |
| | SINGLE SIDE | DOUBLE SIDE | SINGLE SIDE | DOUBLE SIDE | | |
| 180° | 0.015 | 0.017 | 0.011 | 0.011 | $T_J = T_J$ maximum | K/W |
| 120° | 0.018 | 0.019 | 0.019 | 0.019 | | |
| 90° | 0.024 | 0.024 | 0.026 | 0.026 | | |
| 60° | 0.035 | 0.035 | 0.036 | 0.036 | | |
| 30° | 0.060 | 0.060 | 0.060 | 0.061 | | |

Note

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

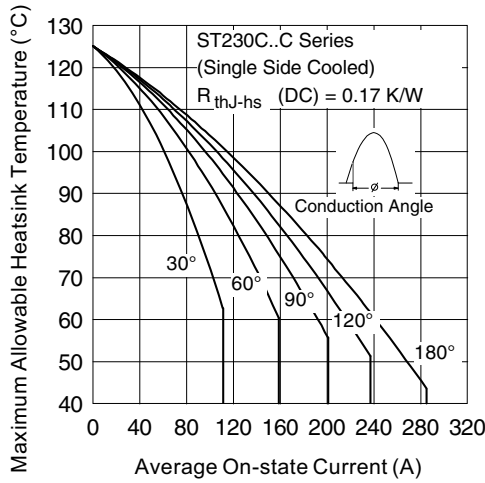


Fig. 1 - Current Ratings Characteristics

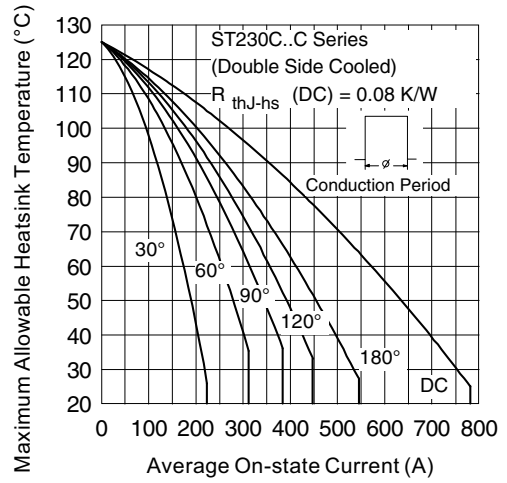


Fig. 4 - Current Ratings Characteristics

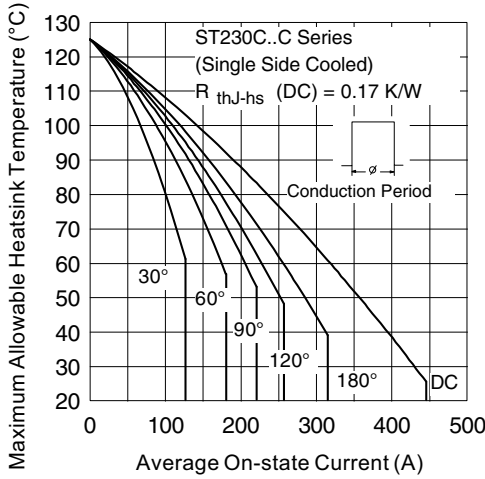


Fig. 2 - Current Ratings Characteristics

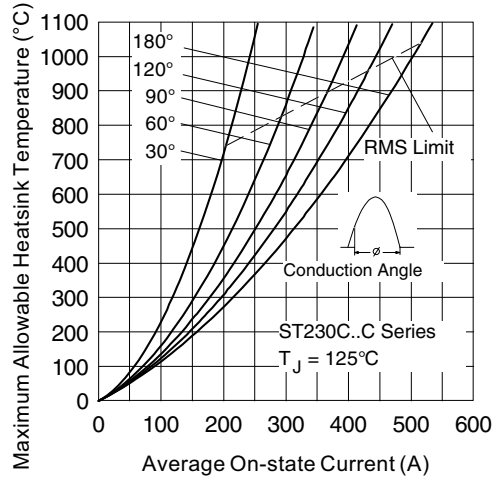


Fig. 5 - On-State Power Loss Characteristics

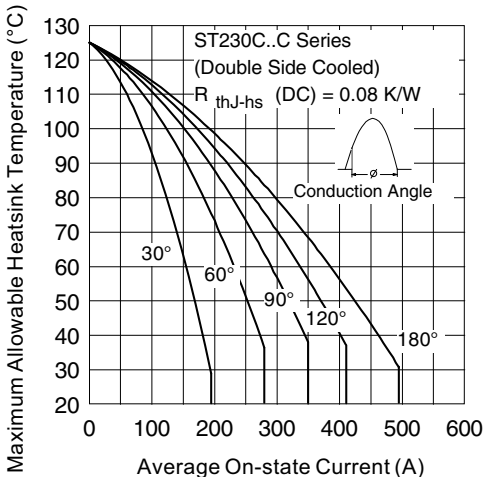


Fig. 3 - Current Ratings Characteristics

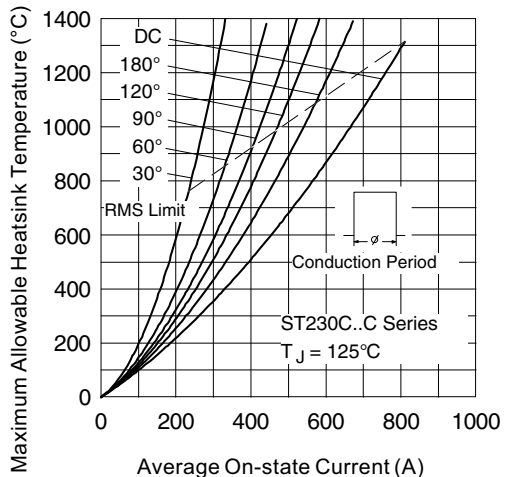


Fig. 6 - On-State Power Loss Characteristics

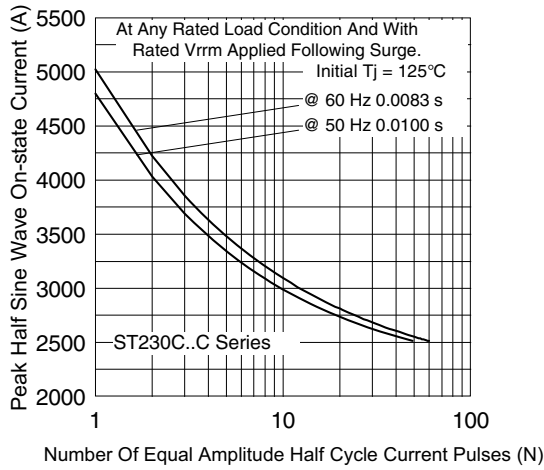


Fig. 7 - Maximum Non-Repetitive Surge Current Single and Double Side Cooled

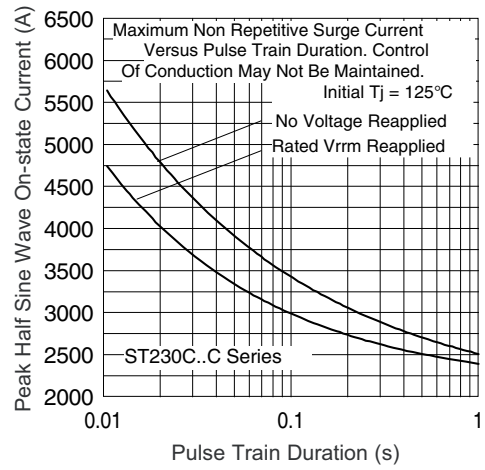


Fig. 8 - Maximum Non-Repetitive Surge Current Single and Double Side Cooled

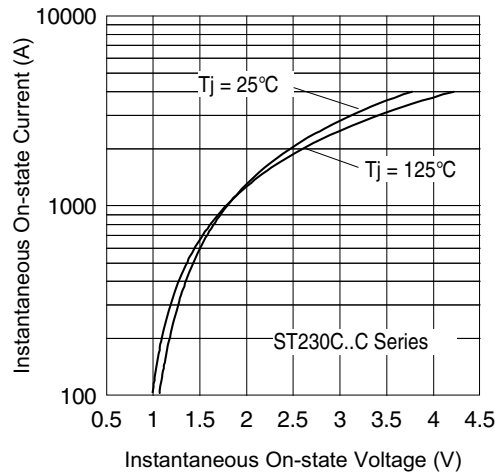


Fig. 9 - On-State Voltage Drop Characteristics

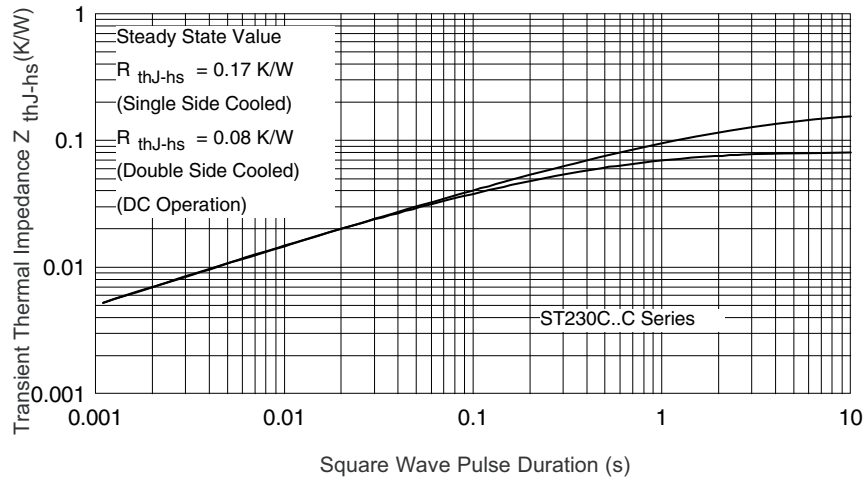


Fig. 10 - Thermal Impedance Z_{thJ-hs} Characteristics

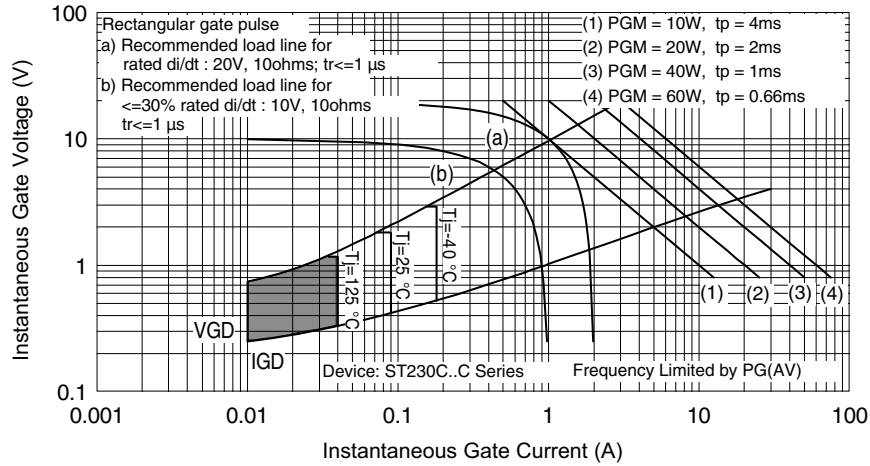


Fig. 11 - Gate Characteristics

ORDERING INFORMATION TABLE

| | | | | | | | | | |
|-------------|------------|-----------|-----------|----------|----------|-----------|----------|----------|----------|
| Device code | VS- | ST | 23 | 0 | C | 20 | C | 1 | - |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |

- 1** - Vishay Semiconductors product
- 2** - Thyristor
- 3** - Essential part number
- 4** - 0 = Converter grade
- 5** - C = Ceramic PUK
- 6** - Voltage code x 100 = V_{RRM} (see Voltage Ratings table)
- 7** - C = PUK case TO-200AB (A-PUK)
- 8** - 0 = Eyelet terminals (gate and auxiliary cathode unsoldered leads)
 1 = Fast-on terminals (gate and auxiliary cathode unsoldered leads)
 2 = Eyelet terminals (gate and auxiliary cathode soldered leads)
 3 = Fast-on terminals (gate and auxiliary cathode soldered leads)
- 9** - Critical dV/dt: • None = 500 V/μs (Standard selection)
 • L = 1000 V/μs (Special selection)

| LINKS TO RELATED DOCUMENTS | |
|----------------------------|--|
| Dimensions | www.vishay.com/doc?95074 |

TO-200AB (A-PUK)

DIMENSIONS in millimeters (inches)

Anode to gate
 Creepage distance: 7.62 (0.30) minimum
 Strike distance: 7.12 (0.28) minimum



Quote between upper and lower pole pieces has to be considered after application of mounting force (see thermal and mechanical specification)



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