Bulletin I25168 rev. C 04/00

International
IOR Rectifier

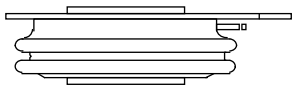
# ST380C..C SERIES

**PHASE CONTROL THYRISTORS** **Hockey Puk Version**

960A

## Features

- Center amplifying gate
- Metal case with ceramic insulator
- International standard case TO-200AB (E-PUK)
- Low profile hockey-puk to increase current-carrying capability



case style TO-200AB (E-PUK)

## Typical Applications

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

## Major Ratings and Characteristics

| Parameters | | ST380C..C | Units |
|---|---|---|---|
| $I_{T(AV)}$ | | 960 | A |
| | @ $T_{hs}$ | 55 | °C |
| $I_{T(RMS)}$ | | 1900 | A |
| | @ $T_{hs}$ | 25 | °C |
| $I_{TSM}$ | @ 50Hz | 15000 | A |
| | @ 60Hz | 15700 | A |
| $I^2t$ | @ 50Hz | 1130 | $KA^2s$ |
| | @ 60Hz | 1030 | $KA^2s$ |
| $V_{DRM}/V_{RRM}$ | | 400 to 600 | 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 |
|---|---|---|---|---|
| ST380C..C | 04 | 400 | 500 | 50 |
| | 06 | 600 | 700 | |

### On-state Conduction

| | Parameter | ST380C..C | Units | Conditions | | |
|---|---|---|---|---|---|---|
| $I_{T(AV)}$ | Max. average on-state current | 960 (440) | A | 180° conduction, half sine wave | | |
| | @ Heatsink temperature | 55 (75) | °C | double side (single side) cooled | | |
| $I_{T(RMS)}$ | Max. RMS on-state current | 1900 | | DC @ 25°C heatsink temperature double side cooled | | |
| $I_{TSM}$ | Max. peak, one-cycle non-repetitive surge current | 15000 | A | t = 10ms | No voltage reapplied | Sinusoidal half wave, Initial $T_J = T_J$ max. |
| | | 15700 | | t = 8.3ms | | |
| | | 12600 | | t = 10ms | 100% $V_{RRM}$ reapplied | |
| | | 13200 | | t = 8.3ms | | |
| $I^2t$ | Maximum $I^2t$ for fusing | 1130 | $KA^2s$ | t = 10ms | No voltage reapplied | |
| | | 1030 | | t = 8.3ms | | |
| | | 800 | | t = 10ms | 100% $V_{RRM}$ reapplied | |
| | | 725 | | t = 8.3ms | | |
| $I^2\sqrt{t}$ | Maximum $I^2\sqrt{t}$ for fusing | 11300 | $KA^2\sqrt{s}$ | t = 0.1 to 10ms, no voltage reapplied | | |
| $V_{T(TO)1}$ | Low level value of threshold voltage | 0.85 | 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 | 0.88 | | (I > π x $I_{T(AV)}$), $T_J = T_J$ max. | | |
| $r_{t1}$ | Low level value of on-state slope resistance | 0.25 | 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 | 0.24 | | (I > π x $I_{T(AV)}$), $T_J = T_J$ max. | | |
| $V_{TM}$ | Max. on-state voltage | 1.60 | V | $I_{pk}$= 3000A, $T_J = T_J$ 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 | ST380C..C | Units | Conditions |
|---|---|---|---|---|
| di/dt | Max. non-repetitive rate of rise of turned-on current | 1000 | 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 | 1.0 | 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 | | $I_{TM}$ = 550A, $T_J = T_J$ max, di/dt = 40A/µs, $V_R$ = 50V<br>dv/dt = 20V/µs, Gate 0V 100Ω, $t_p$ = 500µs |

## Blocking

| | Parameter | ST380C..C | 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 | 50 | mA | $T_J = T_J$ max, rated $V_{DRM}/V_{RRM}$ applied |

## Triggering

| | Parameter | ST380C..C | | Units | Conditions | |
|---|---|---|---|---|---|---|
| $P_{GM}$ | Maximum peak gate power | 10.0 | | W | $T_J = T_J$ max, $t_p \leq 5$ms | |
| $P_{G(AV)}$ | Maximum average gate power | 2.0 | | | $T_J = T_J$ max, f = 50Hz, d% = 50 | |
| $I_{GM}$ | Max. peak positive gate current | 3.0 | | 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 | 200 | - | mA | $T_J$ = - 40°C | Max. required gate trigger/ current/ voltage are the lowest value which will trigger all units 12V anode-to-cathode applied |
| | | 100 | 200 | | $T_J$ = 25°C | |
| | | 50 | - | | $T_J$ = 125°C | |
| $V_{GT}$ | DC gate voltage required to trigger | 2.5 | - | V | $T_J$ = - 40°C | |
| | | 1.8 | 3.0 | | $T_J$ = 25°C | |
| | | 1.1 | - | | $T_J$ = 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 | ST380C..C | Units | Conditions |
|---|---|---|---|---|
| $T_J$ | Max. operating temperature range | -40 to 125 | °C | |
| $T_{stg}$ | Max. storage temperature range | -40 to 150 | | |
| $R_{thJ-hs}$ | Max. thermal resistance, junction to heatsink | 0.09 | K/W | DC operation single side cooled |
| | | 0.04 | | DC operation double side cooled |
| $R_{thC-hs}$ | Max. thermal resistance, case to heatsink | 0.02 | K/W | DC operation single side cooled |
| | | 0.01 | | DC operation double side cooled |
| F | Mounting force, ± 10% | 9800 | N | |
| | | (1000) | (Kg) | |
| wt | Approximate weight | 83 | g | |
| | Case style | TO - 200AB (E-PUK) | | See Outline Table |

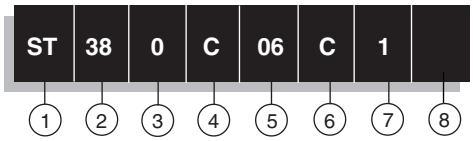
## $\Delta R_{thJ\text{-}hs}$ Conduction

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

| Conduction angle | Sinusoidal conduction | | Rectangular conduction | | Units | Conditions |
|---|---|---|---|---|---|---|
| | Single Side | Double Side | Single Side | Double Side | | |
| 180° | 0.010 | 0.011 | 0.007 | 0.007 | K/W | $T_J = T_J$ max. |
| 120° | 0.012 | 0.012 | 0.012 | 0.013 | | |
| 90° | 0.015 | 0.015 | 0.016 | 0.017 | | |
| 60° | 0.022 | 0.022 | 0.023 | 0.023 | | |
| 30° | 0.036 | 0.036 | 0.036 | 0.037 | | |

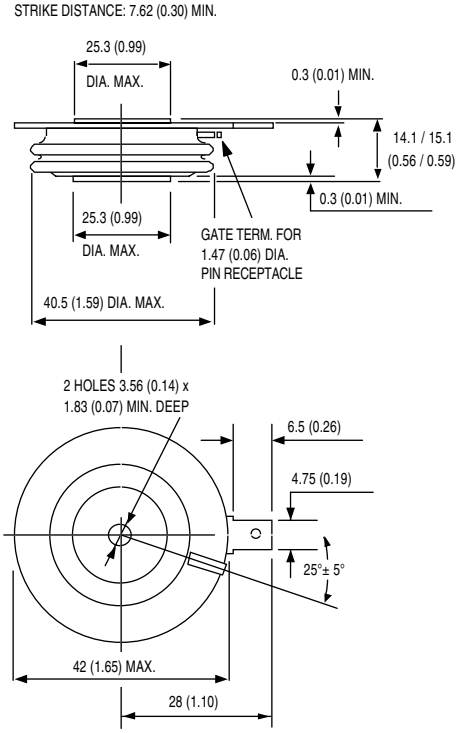
## Ordering Information Table

**Device Code**




**1** - Thyristor
**2** - Essential part number
**3** - 0 = Converter grade
**4** - C = Ceramic Puk
**5** - Voltage code: Code x 100 = $V_{RRM}$ (See Voltage Rating Table)
**6** - C = Puk Case TO-200AB (E-PUK)
**7** - 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)
**8** - Critical dv/dt: None = 500V/µsec (Standard selection)
L = 1000V/µsec (Special selection)

## Outline Table




Case Style TO-200AB (E-PUK)
All dimensions in millimeters (inches)

Quote between upper and lower pole pieces has to be considered after application of Mounting Force (see Thermal and Mechanical Specification)

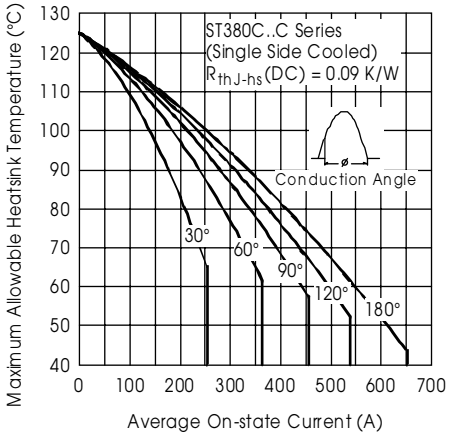



Fig. 1 - Current Ratings Characteristics

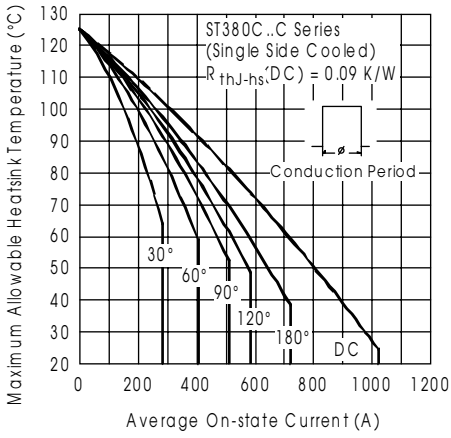



Fig. 2 - Current Ratings Characteristics

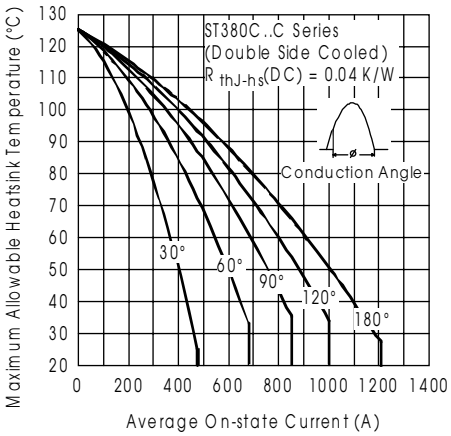



Fig. 3 - Current Ratings Characteristics

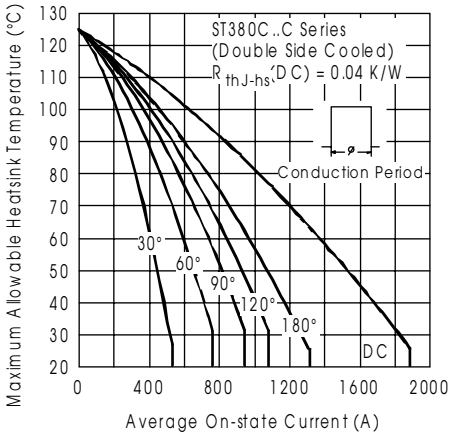



Fig. 4 - Current Ratings Characteristics

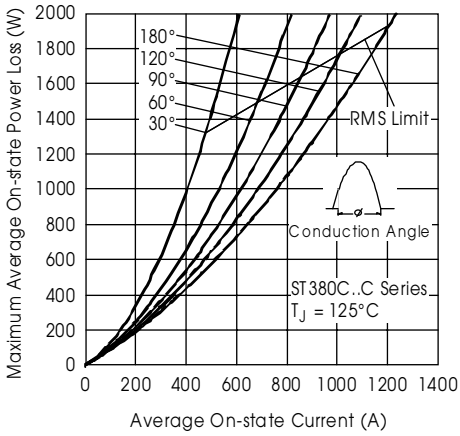



Fig. 5- On-state Power Loss Characteristics

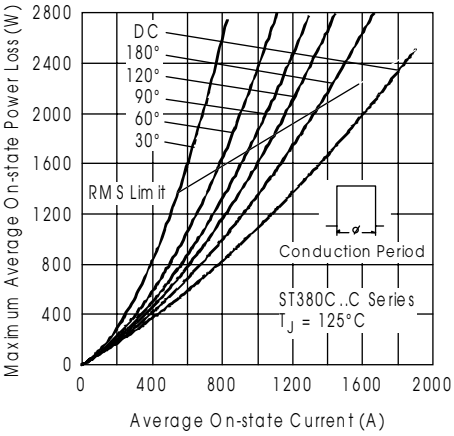



Fig. 6- On-state Power Loss Characteristics

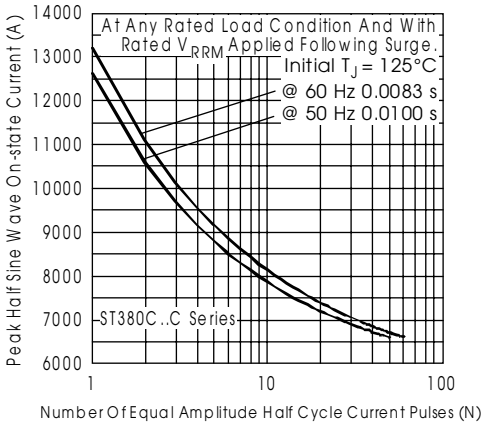



Fig. 7 - Maximum Non-Repetitive Surge Current
Single and Double Side Cooled

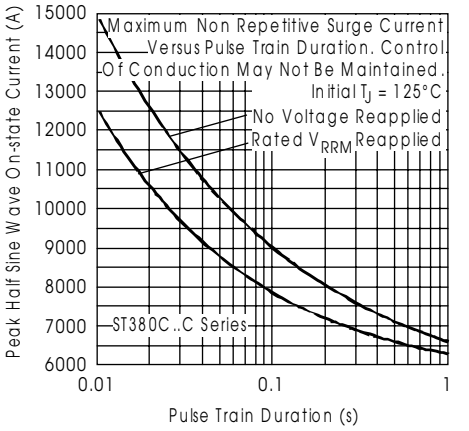



Fig. 8 - Maximum Non-Repetitive Surge Current
Single and Double Side Cooled

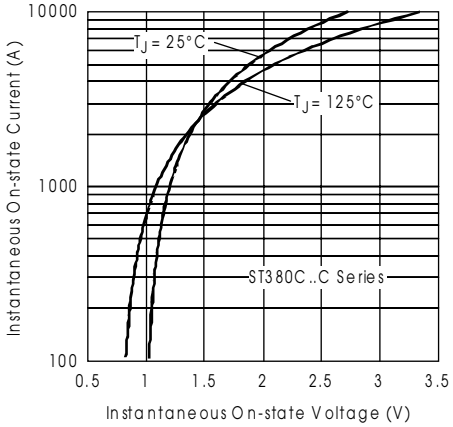



Fig. 9 - On-state Voltage Drop Characteristics

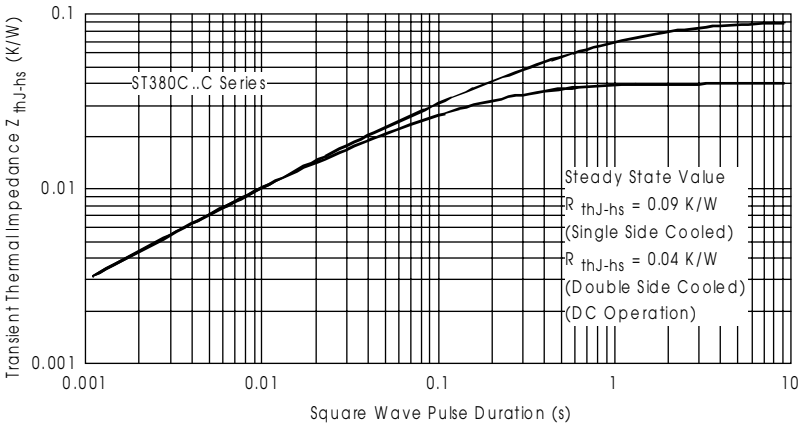



Fig. 10 - Thermal Impedance $Z_{thJ\text{-}hs}$ Characteristics

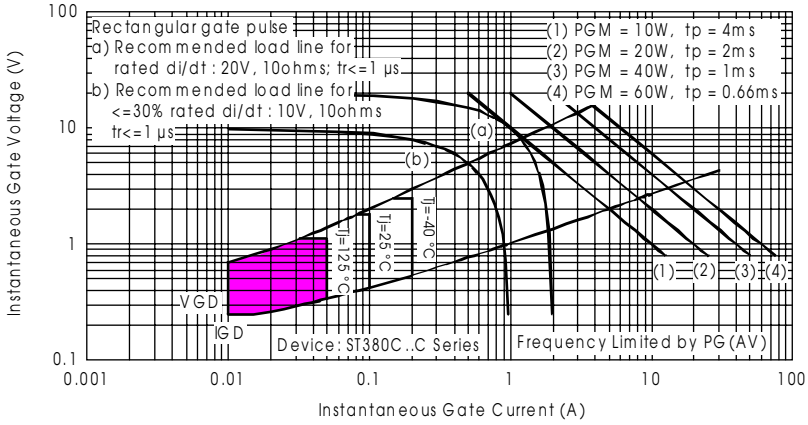



Fig. 11 - Gate Characteristics