Bulletin I25203 rev. B 04/00

International
IOR Rectifier

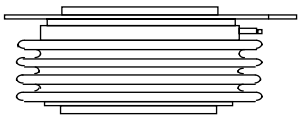
# ST650C..L SERIES

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

790A

## Features

- Center amplifying gate
- Metal case with ceramic insulator
- International standard case TO-200AC (B-PUK)



case style TO-200AC (B-PUK)

## Typical Applications

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

## Major Ratings and Characteristics

| Parameters | | ST650C..L | Units |
|---|---|---|---|
| $I_{T(AV)}$ | | 790 | A |
| | @ $T_{hs}$ | 55 | °C |
| $I_{T(RMS)}$ | | 1557 | A |
| | @ $T_{hs}$ | 25 | °C |
| $I_{TSM}$ | @ 50Hz | 10100 | A |
| | @ 60Hz | 10700 | A |
| $I^2t$ | @ 50Hz | 510 | $KA^2s$ |
| | @ 60Hz | 475 | $KA^2s$ |
| $V_{DRM}/V_{RRM}$ | | 2000 to 2400 | V |
| $t_q$ | typical | 200 | 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 |
|---|---|---|---|---|
| ST650C..L | 20 | 2000 | 2100 | 80 |
| | 22 | 2200 | 2300 | |
| | 24 | 2400 | 2500 | |

### On-state Conduction

| Parameter | | ST650C..L | Units | Conditions | | |
|---|---|---|---|---|---|---|
| $I_{T(AV)}$ | Max. average on-state current | 790 (324) | A | 180° conduction, half sine wave | | |
| | @ Heatsink temperature | 55 (85) | °C | double side (single side) cooled | | |
| $I_{T(RMS)}$ | Max. RMS on-state current | 1857 | A | DC @ 25°C heatsink temperature double side cooled | | |
| $I_{TSM}$ | Max. peak, one-cycle non-repetitive surge current | 10100 | A | t = 10ms | No voltage reapplied | Sinusoidal half wave, Initial $T_J = T_J$ max. |
| | | 10700 | | t = 8.3ms | | |
| | | 8600 | | t = 10ms | 100% $V_{RRM}$ reapplied | |
| | | 9150 | | t = 8.3ms | | |
| $I^2t$ | Maximum $I^2t$ for fusing | 510 | $KA^2s$ | t = 10ms | No voltage reapplied | |
| | | 475 | | t = 8.3ms | | |
| | | 370 | | t = 10ms | 100% $V_{RRM}$ reapplied | |
| | | 347 | | t = 8.3ms | | |
| $I^2\sqrt{t}$ | Maximum $I^2\sqrt{t}$ for fusing | 5100 | $KA^2\sqrt{s}$ | t = 0.1 to 10ms, no voltage reapplied | | |
| $V_{T(TO)1}$ | Low level value of threshold voltage | 1.04 | V | $(16.7\% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)})$, $T_J = T_J$ max. | | |
| $V_{T(TO)2}$ | High level value of threshold voltage | 1.13 | | $(I > \pi \times I_{T(AV)})$, $T_J = T_J$ max. | | |
| $r_{t1}$ | Low level value of on-state slope resistance | 0.61 | mΩ | $(16.7\% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)})$, $T_J = T_J$ max. | | |
| $r_{t2}$ | High level value of on-state slope resistance | 0.35 | | $(I > \pi \times I_{T(AV)})$, $T_J = T_J$ max. | | |
| $V_{TM}$ | Max. on-state voltage | 2.07 | V | $I_{pk}$= 1700A, $T_J = T_J$ 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 | ST650C..L | Units | Conditions |
|---|---|---|---|---|
| di/dt | Max. non-repetitive rate of rise of turned-on current | 1000 | A/µs | Gate drive 20V, 20Ω, $t_r \leq 1\mu s$<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 | 200 | | $I_{TM}$ = 750A, $T_J = T_J$ max, di/dt = 60A/µs, $V_R$ = 50V<br>dv/dt = 20V/µs, Gate 0V 100Ω, $t_p$ = 500µs |

## Blocking

| | Parameter | ST650C..L | 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 $V_{DRM}$ |
| $I_{DRM}$<br>$I_{RRM}$ | Max. peak reverse and off-state leakage current | 80 | mA | $T_J = T_J$ max, rated $V_{DRM}/V_{RRM}$ applied |

## Triggering

| | Parameter | ST650C..L | | 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 | ST650C..L | 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 | 0.073<br>0.031 | K/W | DC operation single side cooled<br>DC operation double side cooled |
| $R_{thC-hs}$ | Max. thermal resistance, case to heatsink | 0.011<br>0.006 | K/W | DC operation single side cooled<br>DC operation double side cooled |
| F | Mounting force, ± 10% | 14700<br>(1500) | N<br>(Kg) | |
| wt | Approximate weight | 255 | g | |
| | Case style | TO - 200AC (B-PUK) | | See Outline Table |

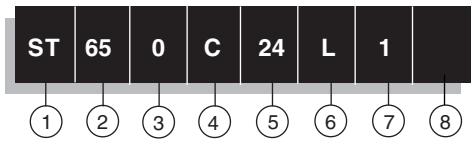
## $\Delta R_{thJ-hs}$ Conduction

(The following table shows the increment of thermal resistence $R_{thJ-hs}$ 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° | 0.009 | 0.009 | 0.006 | 0.006 | K/W | $T_J = T_J$ max. |
| 120° | 0.011 | 0.011 | 0.011 | 0.011 | | |
| 90° | 0.014 | 0.014 | 0.015 | 0.015 | | |
| 60° | 0.020 | 0.020 | 0.021 | 0.021 | | |
| 30° | 0.036 | 0.036 | 0.036 | 0.036 | | |

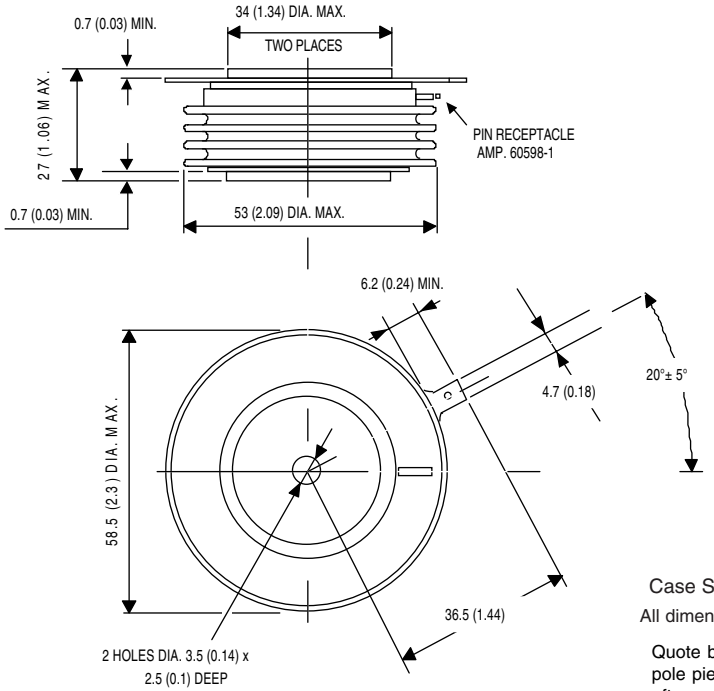
## Ordering Information Table

**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** - L = Puk Case TO-200AC (B-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-200AC (B-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)

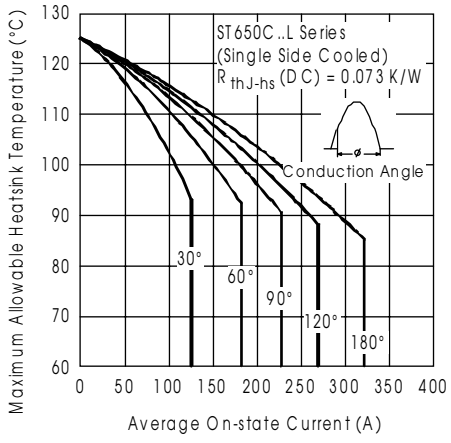



Fig. 1 - Current Ratings Characteristics

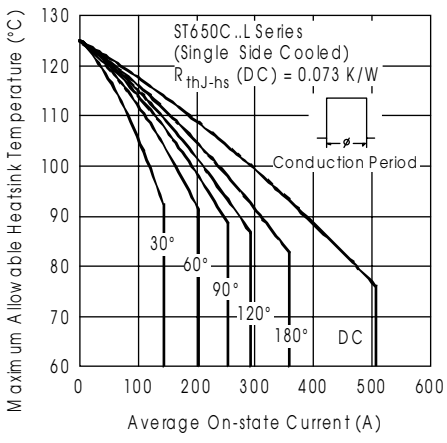



Fig. 2 - Current Ratings Characteristics

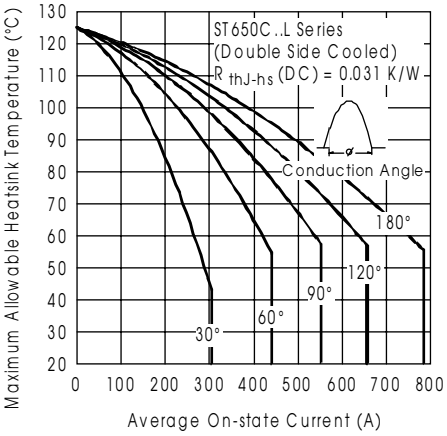



Fig. 3 - Current Ratings Characteristics

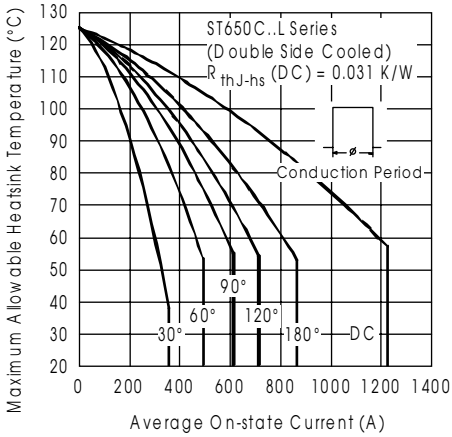



Fig. 4 - Current Ratings Characteristics

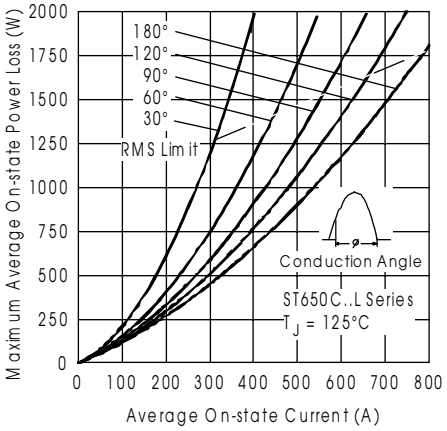



Fig. 5- On-state Power Loss Characteristics

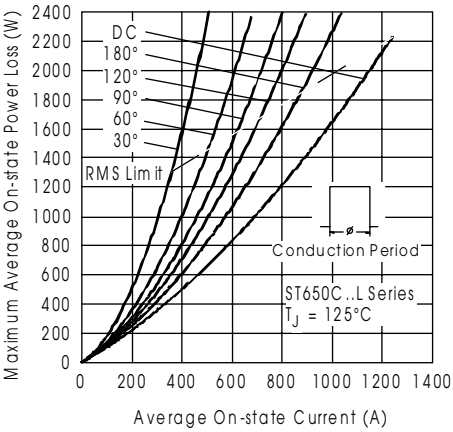



Fig. 6- On-state Power Loss Characteristics

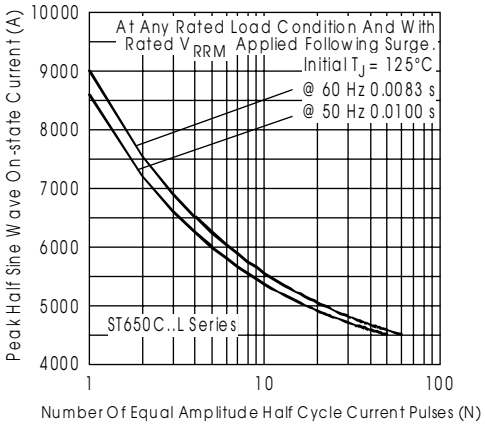



Fig. 7 - Maximum Non-Repetitive Surge Current
Single and Double Side Cooled

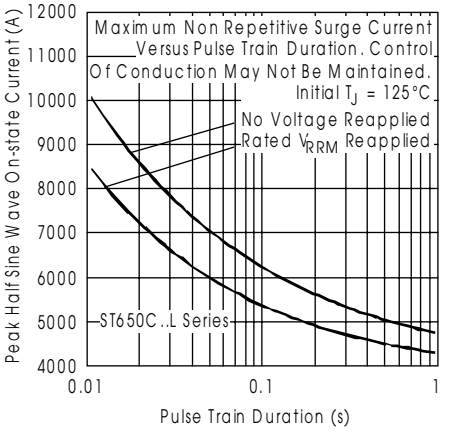



Fig. 8 - Maximum Non-Repetitive Surge Current
Single and Double Side Cooled

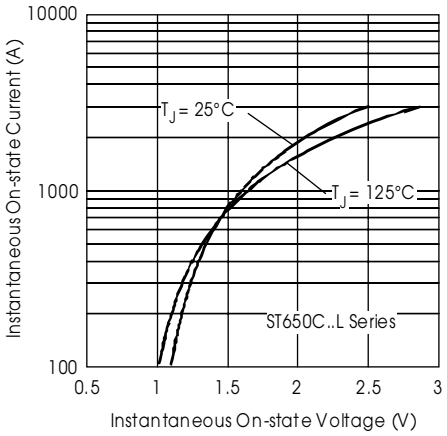



Fig. 9 - On-state Voltage Drop Characteristics

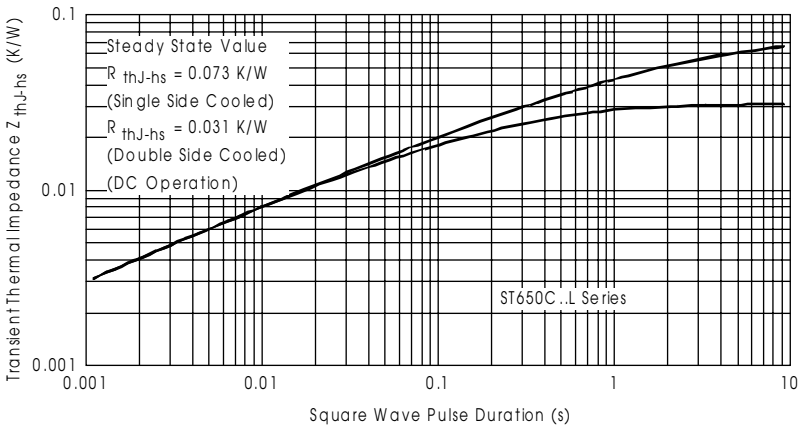



Fig. 10 - Thermal Impedance $Z_{thJ-hs}$ Characteristics

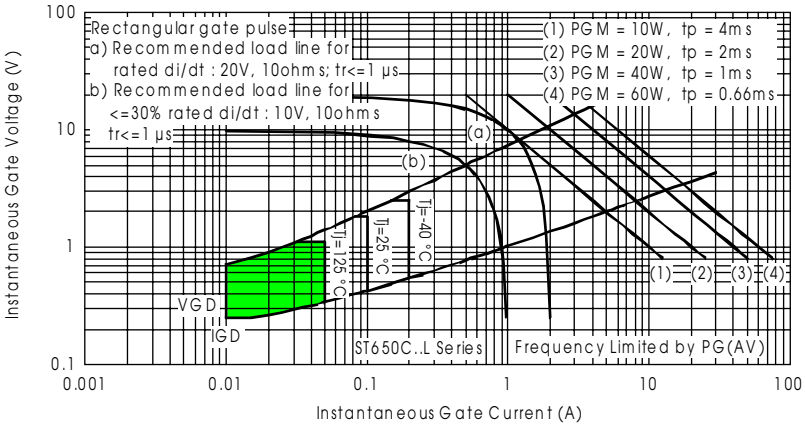



Fig. 11 - Gate Characteristics