Bulletin I25180 rev. B 04/00

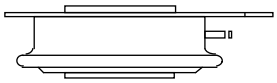
International
IOR Rectifier

# ST173C..C SERIES

## INVERTER GRADE THYRISTORS

**Hockey Puk Version**

330A



case style TO-200AB (A-PUK)

### Features

- Metal case with ceramic insulator
- International standard case TO-200AB (A-PUK)
- All diffused design
- Center amplifying gate
- Guaranteed high dV/dt
- Guaranteed high dI/dt
- High surge current capability
- Low thermal impedance
- High speed performance

### Typical Applications

- Inverters
- Choppers
- Induction heating
- All types of force-commutated converters

### Major Ratings and Characteristics

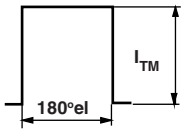
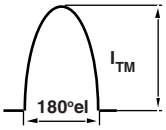
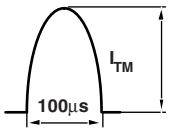
| Parameters | | ST173C..C | Units |
|---|---|---|---|
| $I_{T(AV)}$ | | 330 | A |
| | @ $T_{hs}$ | 55 | °C |
| $I_{T(RMS)}$ | | 610 | A |
| | @ $T_{hs}$ | 25 | °C |
| $I_{TSM}$ | @ 50Hz | 4680 | A |
| | @ 60Hz | 4900 | A |
| $I^2t$ | @ 50Hz | 110 | $KA^2s$ |
| | @ 60Hz | 100 | $KA^2s$ |
| $V_{DRM}/V_{RRM}$ | | 1000 to1200 | V |
| $t_q$ range | | 15 to 30 | µs |
| $T_J$ | | - 40 to 125 | °C |

## ELECTRICAL SPECIFICATIONS

### Voltage Ratings

| Type number | Voltage Code | $V_{DRM}/V_{RRM}$, maximum repetitive peak voltage V | $V_{RSM}$, maximum non-repetitive peak voltage V | $I_{DRM}/I_{RRM}$ max. @ $T_J = T_J$ max. mA |
|---|---|---|---|---|
| ST173C..C | 10 | 1000 | 1100 | 40 |
| | 12 | 1200 | 1300 | |

### Current Carrying Capability

| Frequency |   | |   | |   | | Units |
|---|---|---|---|---|---|---|---|
| 50Hz | 760 | 660 | 1200 | 1030 | 5570 | 4920 | A |
| 400Hz | 730 | 590 | 1260 | 1080 | 2800 | 2460 | |
| 1000Hz | 600 | 490 | 1200 | 1030 | 1620 | 1390 | |
| 2500Hz | 350 | 270 | 850 | 720 | 800 | 680 | |
| Recovery voltage Vr | 50 | 50 | 50 | 50 | 50 | 50 | V |
| Voltage before turn-on Vd | $V_{DRM}$ | | $V_{DRM}$ | | $V_{DRM}$ | | |
| Rise of on-state current di/dt | 50 | 50 | - | - | - | - | A/µs |
| Heatsink temperature | 40 | 55 | 40 | 55 | 40 | 55 | °C |
| Equivalent values for RC circuit | 47Ω / 0.22µF | | 47Ω / 0.22µF | | 47Ω / 0.22µF | | |

### On-state Conduction

| | Parameter | ST173C..C | Units | Conditions | | |
|---|---|---|---|---|---|---|
| $I_{T(AV)}$ | Max. average on-state current | 330 (120) | A | 180° conduction, half sine wave | | |
| | @ Heatsink temperature | 55 (85) | °C | double side (single side) cooled | | |
| $I_{T(RMS)}$ | Max. RMS on-state current | 610 | A | DC @ 25°C heatsink temperature double side cooled | | |
| $I_{TSM}$ | Max. peak, one half cycle, non-repetitive surge current | 4680 | A | t = 10ms | No voltage reapplied | Sinusoidal half wave, Initial $T_J = T_J$ max |
| | | 4900 | | t = 8.3ms | | |
| | | 3940 | | t = 10ms | 100% $V_{RRM}$ reapplied | |
| | | 4120 | | t = 8.3ms | | |
| $I^2t$ | Maximum $I^2t$ for fusing | 110 | $KA^2s$ | t = 10ms | No voltage reapplied | |
| | | 100 | | t = 8.3ms | | |
| | | 77 | | t = 10ms | 100% $V_{RRM}$ reapplied | |
| | | 71 | | t = 8.3ms | | |
| $I^2\sqrt{t}$ | Maximum $I^2\sqrt{t}$ for fusing | 1100 | $KA^2\sqrt{s}$ | t = 0.1 to 10ms, no voltage reapplied | | |

## On-state Conduction

| | Parameter | ST173C..C | Units | Conditions |
|---|---|---|---|---|
| $V_{TM}$ | Max. peak on-state voltage | 2.07 | V | $I_{TM}$= 600A, $T_J = T_J$ max, $t_p$ = 10ms sine wave pulse |
| $V_{T(TO)1}$ | Low level value of threshold voltage | 1.55 | | (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 | 1.61 | | (I > π x $I_{T(AV)}$), $T_J = T_J$ max. |
| $r_{t1}$ | Low level value of forward slope resistance | 0.87 | 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 forward slope resistance | 0.77 | | (I > π x $I_{T(AV)}$), $T_J = T_J$ max. |
| $I_H$ | Maximum holding current | 600 | mA | $T_J$ = 25°C, $I_T$ > 30A |
| $I_L$ | Typical latching current | 1000 | | $T_J$ = 25°C, $V_A$= 12V, Ra = 6Ω, $I_G$= 1A |

## Switching

| | Parameter | ST173C..C | | Units | Conditions |
|---|---|---|---|---|---|
| di/dt | Max. non-repetitive rate of rise of turned-on current | 1000 | | A/µs | $T_J = T_J$ max, $V_{DRM}$ = rated $V_{DRM}$<br>$I_{TM}$ = 2 x di/dt |
| $t_d$ | Typical delay time | 1.1 | | µs | $T_J$= 25°C, $V_{DM}$ = rated $V_{DRM}$, $I_{TM}$ = 50A DC, $t_p$= 1µs<br>Resistive load, Gate pulse: 10V, 5Ω source |
| | | Min | Max | | |
| $t_q$ | Max. turn-off time | 15 | 30 | | $T_J = T_J$ max, $I_{TM}$ = 300A, commutating di/dt = 20A/µs<br>$V_R$ = 50V, $t_p$ = 500µs, dv/dt: see table in device code |

## Blocking

| | Parameter | ST173C..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% $V_{DRM}$, higher value available on request |
| $I_{RRM}$<br>$I_{DRM}$ | Max. peak reverse and off-state leakage current | 40 | mA | $T_J = T_J$ max, rated $V_{DRM}$/$V_{RRM}$ applied |

## Triggering

| | Parameter | ST173C..C | Units | Conditions |
|---|---|---|---|---|
| $P_{GM}$ | Maximum peak gate power | 60 | W | $T_J = T_J$ max, f = 50Hz, d% = 50 |
| $P_{G(AV)}$ | Maximum average gate power | 10 | | |
| $I_{GM}$ | Max. peak positive gate current | 10 | A | $T_J = T_J$ max, $t_p \leq$ 5ms |
| $+V_{GM}$ | Maximum peak positive gate voltage | 20 | V | $T_J = T_J$ max, $t_p \leq$ 5ms |
| $-V_{GM}$ | Maximum peak negative gate voltage | 5 | | |
| $I_{GT}$ | Max. DC gate current required to trigger | 200 | mA | $T_J$ = 25°C, $V_A$ = 12V, Ra = 6Ω |
| $V_{GT}$ | Max. DC gate voltage required to trigger | 3 | V | |
| $I_{GD}$ | Max. DC gate current not to trigger | 20 | mA | $T_J = T_J$ max, rated $V_{DRM}$ applied |
| $V_{GD}$ | Max. DC gate voltage not to trigger | 0.25 | V | |

## Thermal and Mechanical Specification

| | Parameter | ST173C..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 | 0.17<br>0.08 | K/W | DC operation single side cooled<br>DC operation double side cooled |
| $R_{thC-hs}$ | Max. thermal resistance, case to heatsink | 0.033<br>0.017 | K/W | DC operation single side cooled<br>DC operation double side cooled |
| F | Mounting force, ± 10% | 4900<br>(500) | N<br>(Kg) | |
| wt | Approximate weight | 50 | g | |
| | Case style | TO - 200AB (A-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° | 0.015 | 0.016 | 0.011 | 0.011 | K/W | $T_J = T_J$ max. |
| 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 | 0.037 | | |
| 30° | 0.060 | 0.060 | 0.060 | 0.061 | | |

## Ordering Information Table

**Device Code**

| ST | 17 | 3 | C | 12 | C | H | K | 1 | |
|---|---|---|---|---|---|---|---|---|---|
| ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | ⑩ |

**1** - Thyristor

**2** - Essential part number

**3** - 3 = Fast turn off

**4** - C = Ceramic Puk

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

**6** - C = Puk Case TO-200AB (A-PUK)

**7** - Reapplied dv/dt code (for $t_q$ test condition)

**8** - $t_q$ code

**9** - 0 = Eyelet term. (Gate and Aux. Cathode Unsoldered Leads)
1 = Fast-on term. (Gate and Aux. Cathode Unsoldered Leads)
2 = Eyelet term. (Gate and Aux. Cathode Soldered Leads)
3 = Fast-on term. (Gate and Aux. Cathode Soldered Leads)

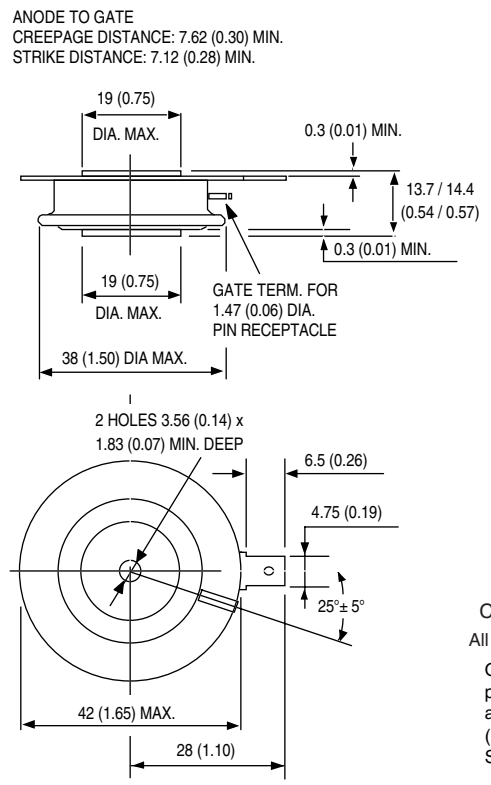
**10** - Critical dv/dt:
None = 500V/µsec (Standard value)
L = 1000V/µsec (Special selection)

**dv/dt - $t_q$ combinations available**

| dv/dt (V/µs) | 20 | 50 | 100 | **200** | 400 |
|---|---|---|---|---|---|
| $t_q$(µs) 15 | CL | -- | -- | -- | -- |
| $t_q$(µs) 18 | CP | DP | EP | **FP *** | -- |
| $t_q$(µs) 20 | CK | DK | EK | **FK *** | HK |
| $t_q$(µs) 25 | CJ | DJ | EJ | FJ | HJ |
| $t_q$(µs) 30 | -- | DH | EH | FH | HH |

*Standard part number.
All other types available only on request.

Outline Table




Case Style TO-200AB (A-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)

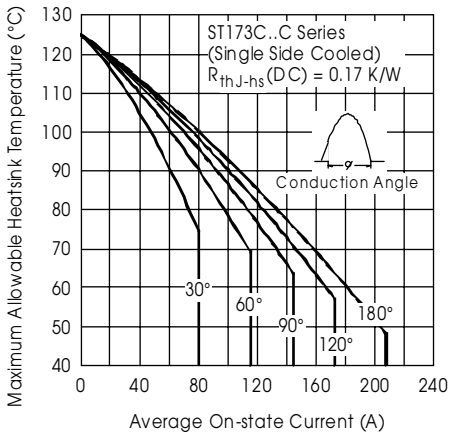



Fig. 1 - Current Ratings Characteristics

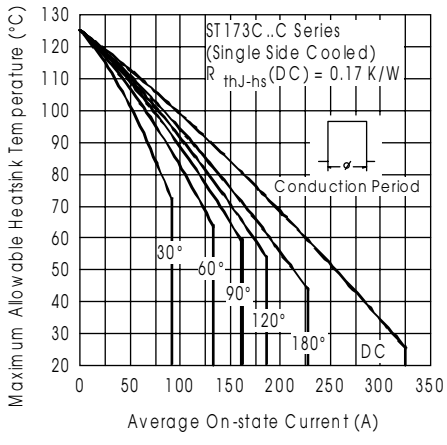



Fig. 2 - Current Ratings Characteristics

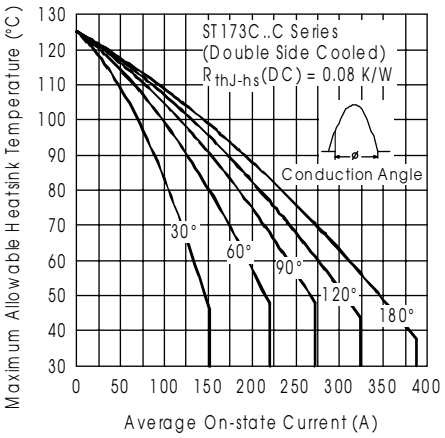



Fig. 3 - Current Ratings Characteristics

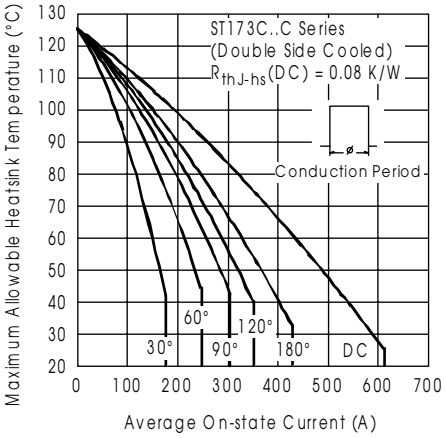



Fig. 4 - Current Ratings Characteristics

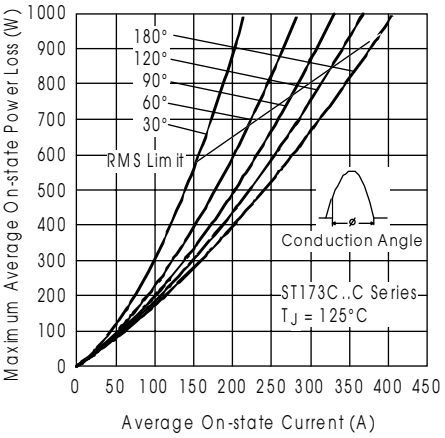



Fig. 5 - On-state Power Loss Characteristics

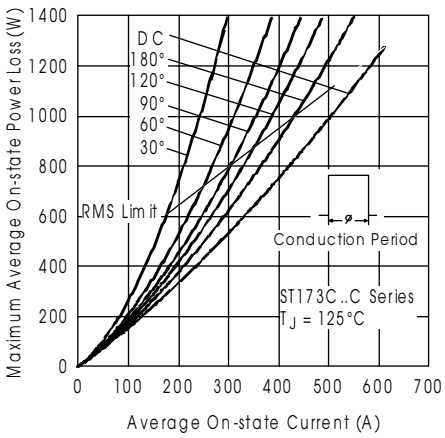



Fig. 6 - On-state Power Loss Characteristics

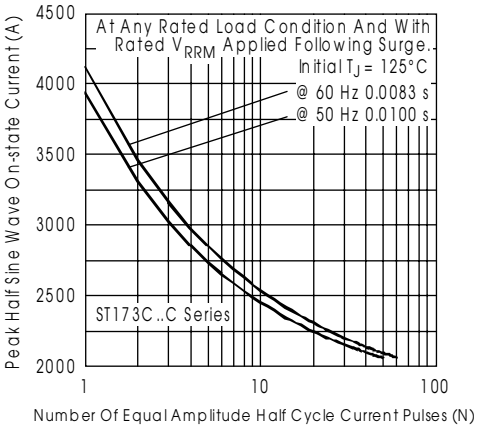



Fig. 7 - Maximum Non-repetitive Surge Current
Single and Double Side Cooled

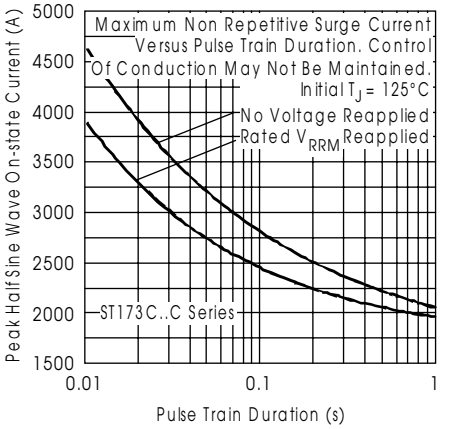



Fig. 8 - Maximum Non-repetitive Surge Current
Single and Double Side Cooled

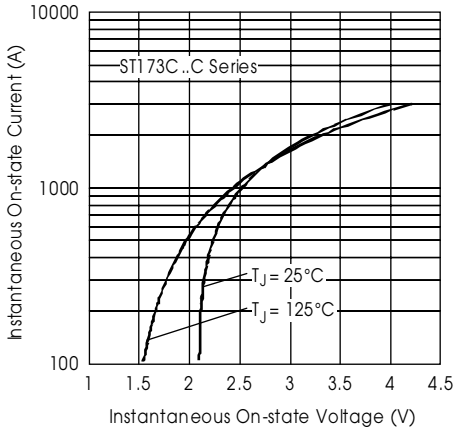



Fig. 9 - On-state Voltage Drop Characteristics

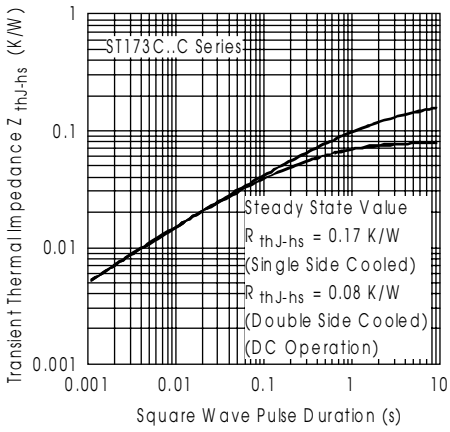



Fig. 10 - Thermal Impedance $Z_{thJ-hs}$ Characteristics

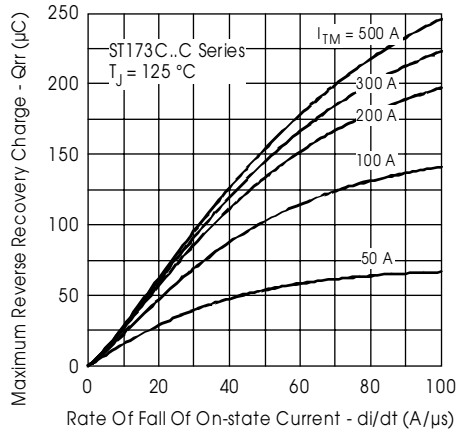



Fig. 11 - Reverse Recovered Charge Characteristics

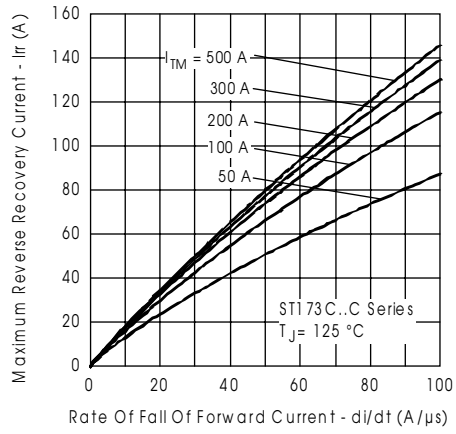



Fig. 12 - Reverse Recovery Current Characteristics

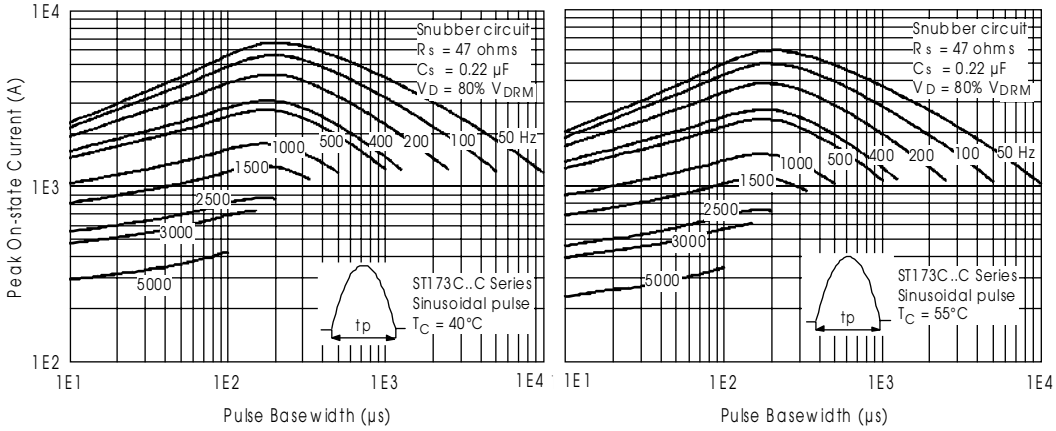



Fig. 13 - Frequency Characteristics

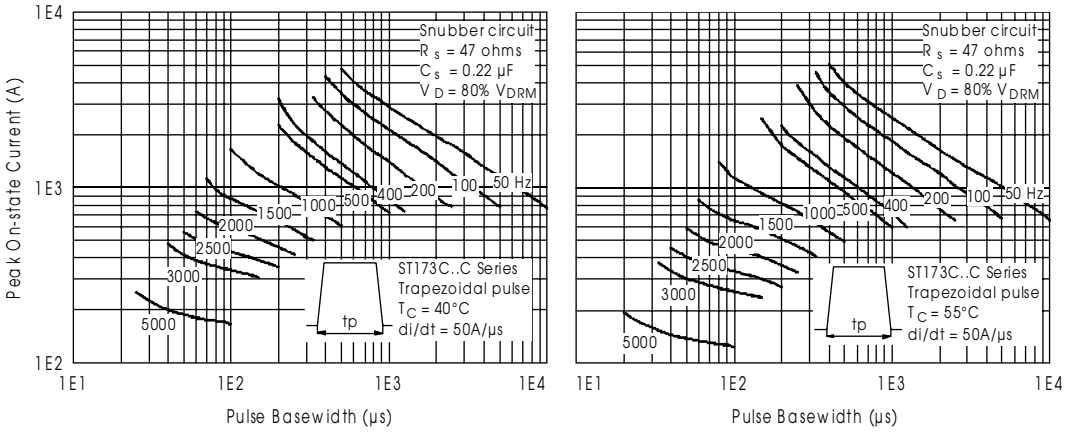



Fig. 14 - Frequency Characteristics

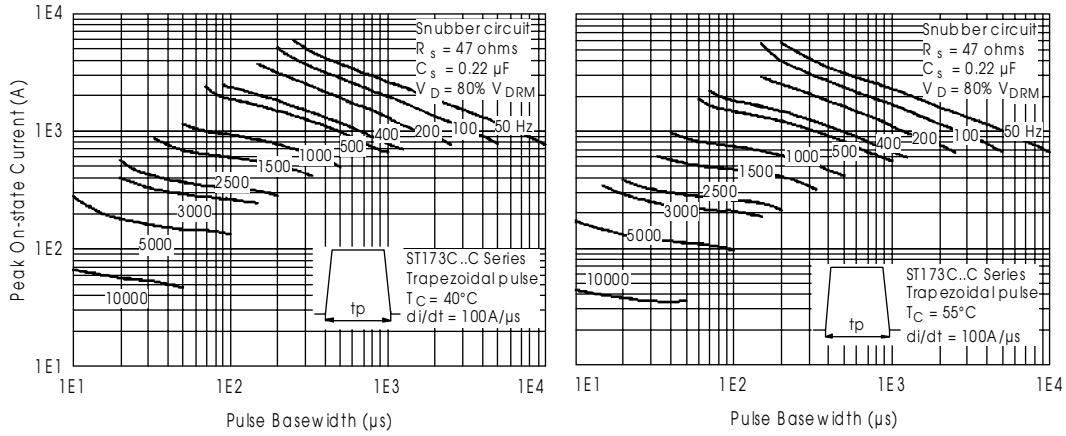



Fig. 15 - Frequency Characteristics

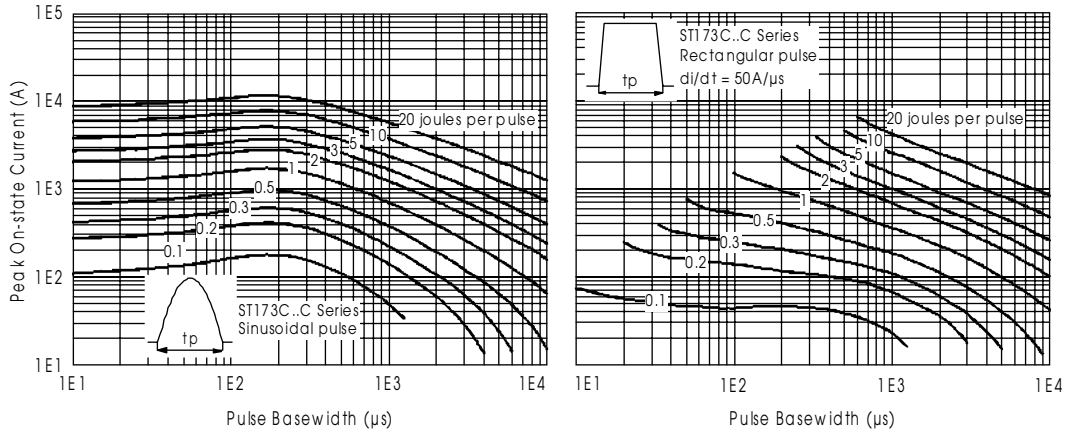



Fig. 16 - Maximum On-state Energy Power Loss Characteristics

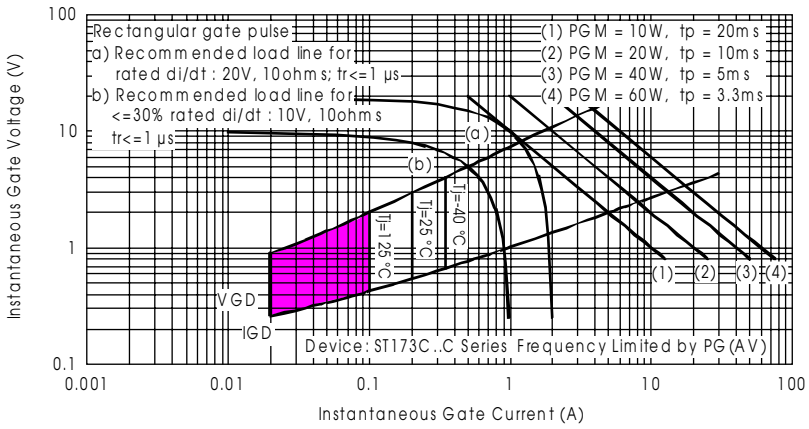



Fig. 17 - Gate Characteristics