

Bulletin I25185 rev. B 03/94

International  
**IR** Rectifier

**ST083S SERIES**

**INVERTER GRADE THYRISTORS**

**Stud Version**

**Features**

- All diffused design
- Center amplifying gate
- Guaranteed high dv/dt
- Guaranteed high di/dt
- High surge current capability
- Low thermal impedance
- High speed performance

85A

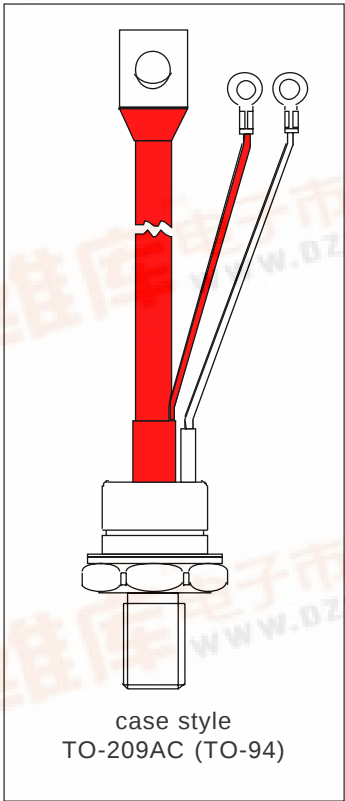
**Typical Applications**

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

**Major Ratings and Characteristics**

| Parameters        | ST083S      | Units             |
|-------------------|-------------|-------------------|
| $I_{T(AV)}$       | 85          | A                 |
| @ $T_C$           | 85          | °C                |
| $I_{T(RMS)}$      | 135         | A                 |
| $I_{TSM}$ @ 50Hz  | 2450        | A                 |
| @ 60Hz            | 2560        | A                 |
| $I^2t$ @ 50Hz     | 30          | KA <sup>2</sup> s |
| @ 60Hz            | 27          | KA <sup>2</sup> s |
| $V_{DRM}/V_{RRM}$ | 400 to 1200 | V                 |
| $t_q$ range (*)   | 10 to 30    | μs                |
| $T_J$             | - 40 to 125 | °C                |

(\*)  $t_q$  = 10 to 20μs for 400 to 800V devices  
 $t_q$  = 15 to 30μs for 1000 to 1200V devices



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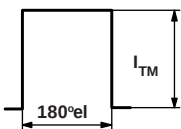
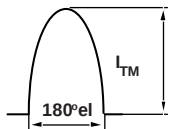
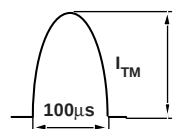
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### ELECTRICAL SPECIFICATIONS

#### Voltage Ratings

| Type number | Voltage Code | $V_{DRM}/V_{RRM}$ , maximum repetitive peak voltage<br>V | $V_{RSM}$ , maximum non-repetitive peak voltage<br>V | $I_{DRM}/I_{RRM}$ max.<br>@ $T_J = T_J$ max.<br>mA |
|-------------|--------------|----------------------------------------------------------|------------------------------------------------------|----------------------------------------------------|
| ST083S      | 04           | 400                                                      | 500                                                  | 30                                                 |
|             | 08           | 800                                                      | 900                                                  |                                                    |
|             | 10           | 1000                                                     | 1100                                                 |                                                    |
|             | 12           | 1200                                                     | 1300                                                 |                                                    |

#### Current Carrying Capability

| Frequency                        |  |     |  |     |  |      | Units |
|----------------------------------|------------------------------------------------------------------------------------|-----|------------------------------------------------------------------------------------|-----|--------------------------------------------------------------------------------------|------|-------|
| 50Hz                             | 210                                                                                | 120 | 330                                                                                | 270 | 2540                                                                                 | 1930 | A     |
| 400Hz                            | 200                                                                                | 120 | 350                                                                                | 210 | 1190                                                                                 | 810  |       |
| 1000Hz                           | 150                                                                                | 80  | 320                                                                                | 190 | 630                                                                                  | 400  |       |
| 2500Hz                           | 70                                                                                 | 25  | 220                                                                                | 85  | 250                                                                                  | 100  |       |
| Recovery voltage Vr              | 50                                                                                 | 50  | 50                                                                                 | 50  | 50                                                                                   | 50   | V     |
| Voltage before turn-on Vd        | V <sub>DRM</sub>                                                                   |     | V <sub>DRM</sub>                                                                   |     | V <sub>DRM</sub>                                                                     |      |       |
| Rise of on-state current di/dt   | 50                                                                                 | 50  | -                                                                                  | -   | -                                                                                    | -    | A/µs  |
| Case temperature                 | 60                                                                                 | 85  | 60                                                                                 | 85  | 60                                                                                   | 85   | °C    |
| Equivalent values for RC circuit | 22Ω / 0.15µF                                                                       |     | 22Ω / 0.15µF                                                                       |     | 22Ω / 0.15µF                                                                         |      |       |

#### On-state Conduction

| Parameter                                                            | ST083S | Units              | Conditions                            |
|----------------------------------------------------------------------|--------|--------------------|---------------------------------------|
| $I_{T(AV)}$ Max. average on-state current<br>@ Case temperature      | 85     | A                  | 180° conduction, half sine wave       |
|                                                                      | 85     | °C                 |                                       |
| $I_{T(RMS)}$ Max. RMS on-state current                               | 135    | A                  | DC @ 77°C case temperature            |
| $I_{TSM}$ Max. peak, one half cycle,<br>non-repetitive surge current | 2450   |                    | t = 10ms No voltage                   |
|                                                                      | 2560   |                    | t = 8.3ms reapplied                   |
|                                                                      | 2060   |                    | t = 10ms 100% $V_{RRM}$               |
|                                                                      | 2160   |                    | t = 8.3ms reapplied                   |
| $I^2t$ Maximum $I^2t$ for fusing                                     | 30     |                    | t = 10ms No voltage                   |
|                                                                      | 27     |                    | t = 8.3ms reapplied                   |
|                                                                      | 21     |                    | t = 10ms 100% $V_{RRM}$               |
|                                                                      | 19     |                    | t = 8.3ms reapplied                   |
| $I^2\sqrt{t}$ Maximum $I^2\sqrt{t}$ for fusing                       | 300    | KA <sup>2</sup> √s | t = 0.1 to 10ms, no voltage reapplied |

### On-state Conduction

| Parameter                                             | ST083S | Units | Conditions                                                                                    |
|-------------------------------------------------------|--------|-------|-----------------------------------------------------------------------------------------------|
| $V_{TM}$ Max. peak on-state voltage                   | 2.15   | V     | $I_{TM} = 300A$ , $T_J = T_J \text{ max}$ , $t_p = 10\text{ms}$ sine wave pulse               |
| $V_{T(TO)1}$ Low level value of threshold voltage     | 1.46   |       | $(16.7\% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)})$ , $T_J = T_J \text{ max}$ . |
| $V_{T(TO)2}$ High level value of threshold voltage    | 1.52   |       | $(I > \pi \times I_{T(AV)})$ , $T_J = T_J \text{ max}$ .                                      |
| $r_{t1}$ Low level value of forward slope resistance  | 2.32   | mΩ    | $(16.7\% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)})$ , $T_J = T_J \text{ max}$ . |
| $r_{t2}$ High level value of forward slope resistance | 2.34   |       | $(I > \pi \times I_{T(AV)})$ , $T_J = T_J \text{ max}$ .                                      |
| $I_H$ Maximum holding current                         | 600    | mA    | $T_J = 25^\circ\text{C}$ , $I_T > 30A$                                                        |
| $I_L$ Typical latching current                        | 1000   |       | $T_J = 25^\circ\text{C}$ , $V_A = 12V$ , $R_a = 6\Omega$ , $I_G = 1A$                         |

### Switching

| Parameter                                                     | ST083S           | Units | Conditions                                                                                                                                                     |
|---------------------------------------------------------------|------------------|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $di/dt$ Max. non-repetitive rate of rise of turned-on current | 1000             | A/μs  | $T_J = T_J \text{ max}$ , $V_{DRM} = \text{rated } V_{DRM}$<br>$I_{TM} = 2 \times di/dt$                                                                       |
| $t_d$ Typical delay time                                      | 0.80             | μs    | $T_J = 25^\circ\text{C}$ , $V_{DM} = \text{rated } V_{DRM}$ , $I_{TM} = 50A$ DC, $t_p = 1\mu\text{s}$<br>Resistive load, Gate pulse: 10V, 5Ω source            |
| $t_q$ Max. turn-off time (*)                                  | Min 10<br>Max 30 |       | $T_J = T_J \text{ max}$ , $I_{TM} = 100A$ , commutating $di/dt = 10A/\mu\text{s}$<br>$V_R = 50V$ , $t_p = 200\mu\text{s}$ , $dv/dt$ : see table in device code |

(\*)  $t_q = 10$  to  $20\mu\text{s}$  for 400 to 800V devices;  $t_q = 15$  to  $30\mu\text{s}$  for 1000 to 1200V devices.

### Blocking

| Parameter                                                              | ST083S | Units | Conditions                                                                            |
|------------------------------------------------------------------------|--------|-------|---------------------------------------------------------------------------------------|
| $dv/dt$ Maximum critical rate of rise of off-state voltage             | 500    | V/μs  | $T_J = T_J \text{ max}$ , linear to 80% $V_{DRM}$ , higher value available on request |
| $I_{RRM}$<br>$I_{DRM}$ Max. peak reverse and off-state leakage current | 30     | mA    | $T_J = T_J \text{ max}$ , rated $V_{DRM}/V_{RRM}$ applied                             |

### Triggering

| Parameter                                         | ST083S | Units | Conditions                                               |
|---------------------------------------------------|--------|-------|----------------------------------------------------------|
| $P_{GM}$ Maximum peak gate power                  | 40     | W     | $T_J = T_J \text{ max}$ , $f = 50\text{Hz}$ , $d\% = 50$ |
| $P_{G(AV)}$ Maximum average gate power            | 5      |       |                                                          |
| $I_{GM}$ Max. peak positive gate current          | 5      | A     | $T_J = T_J \text{ max}$ , $t_p \leq 5\text{ms}$          |
| $+V_{GM}$ Maximum peak positive gate voltage      | 20     | V     | $T_J = T_J \text{ max}$ , $t_p \leq 5\text{ms}$          |
| $-V_{GM}$ Maximum peak negative gate voltage      | 5      |       |                                                          |
| $I_{GT}$ Max. DC gate current required to trigger | 200    | mA    | $T_J = 25^\circ\text{C}$ , $V_A = 12V$ , $R_a = 6\Omega$ |
| $V_{GT}$ Max. DC gate voltage required to trigger | 3      | V     |                                                          |
| $I_{GD}$ Max. DC gate current not to trigger      | 20     | mA    | $T_J = T_J \text{ max}$ , rated $V_{DRM}$ applied        |
| $V_{GD}$ Max. DC gate voltage not to trigger      | 0.25   | V     |                                                          |

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### Thermal and Mechanical Specifications

| Parameter                                            | ST083S           | Units          | Conditions                                 |
|------------------------------------------------------|------------------|----------------|--------------------------------------------|
| $T_j$ Max. junction operating temperature range      | -40 to 125       | °C             |                                            |
| $T_{stg}$ Max. storage temperature range             | -40 to 150       |                |                                            |
| $R_{thJC}$ Max. thermal resistance, junction to case | 0.195            | K/W            | DC operation                               |
| $R_{thCS}$ Max. thermal resistance, case to heatsink | 0.08             |                | Mounting surface, smooth, flat and greased |
| T Mounting torque, $\pm 10\%$                        | 15.5<br>(137)    | Nm<br>(lbf-in) | Non lubricated threads                     |
|                                                      | 14<br>(120)      | Nm<br>(lbf-in) | Lubricated threads                         |
| wt Approximate weight                                | 130              | g              |                                            |
| Case style                                           | TO-209AC (TO-94) |                | See Outline Table                          |

### $\Delta R_{thJC}$ Conduction

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

| Conduction angle | Sinusoidal conduction | Rectangular conduction | Units | Conditions               |
|------------------|-----------------------|------------------------|-------|--------------------------|
| 180°             | 0.034                 | 0.025                  | K/W   | $T_j = T_j \text{ max.}$ |
| 120°             | 0.041                 | 0.042                  |       |                          |
| 90°              | 0.052                 | 0.056                  |       |                          |
| 60°              | 0.076                 | 0.079                  |       |                          |
| 30°              | 0.126                 | 0.127                  |       |                          |

### Ordering Information Table

Device Code

ST

08

3

S

12

P

F

K

0

①

②

③

④

⑤

⑥

⑦

⑧

⑨

⑩

**1** - Thyristor

**2** - Essential part number

**3** - 3 = Fast turn off

**4** - S = Compression bonding Stud

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

**6** - P = Stud Base 1/2" 20UNF

**7** - Reapplied dv/dt code (for  $t_q$  Test Condition)

**8** -  $t_q$  code

**9** - 0 = Eyelet terminals (Gate and Aux. Cathode Leads)  
1 = Fast-on terminals (Gate and Aux. Cathode Leads)  
2 = Flag terminals (For Cathode and Gate Terminals)

**10** - Critical dv/dt:

None = 500V/ $\mu$ sec (Standard value)

L = 1000V/ $\mu$ sec (Special selection)

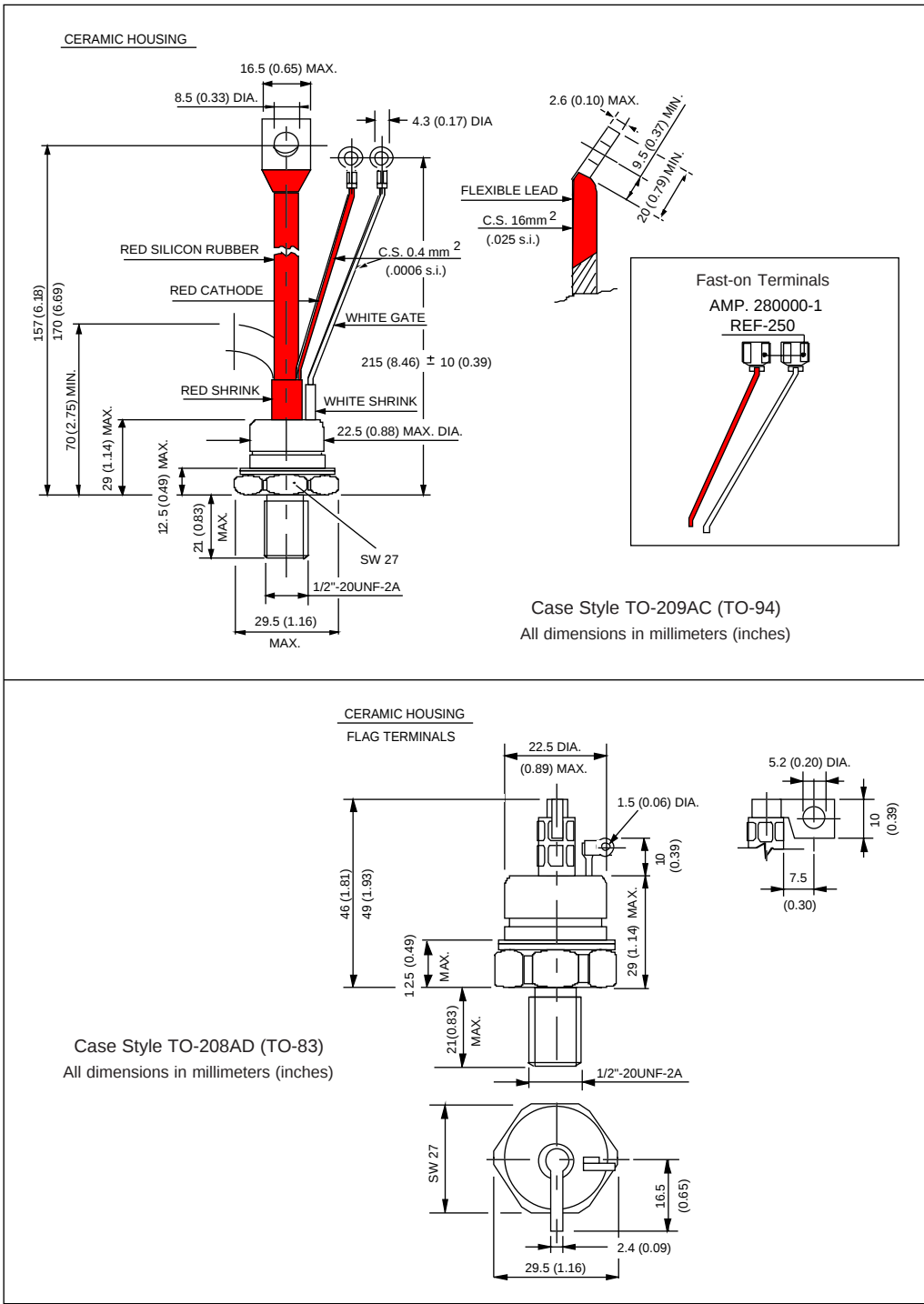
**dv/dt -  $t_q$  combinations available**

|                  | dv/dt (V/ $\mu$ s) | 20 | 50 | 100 | 200         | 400 |
|------------------|--------------------|----|----|-----|-------------|-----|
| $t_q$ ( $\mu$ s) | 10                 | CN | DN | EN  | <b>FN *</b> | HN  |
|                  | 12                 | CM | DM | EM  | <b>FM *</b> | HM  |
|                  | 15                 | CL | DL | EL  | FL          | HL  |
|                  | 18                 | CP | DP | EP  | <b>FP *</b> | HP  |
|                  | 20                 | CK | DK | EK  | <b>FK *</b> | HK  |
| $t_q$ ( $\mu$ s) | 15                 | CL | -- | --  | --          | --  |
|                  | 18                 | CP | DP | EP  | <b>FP *</b> | --  |
|                  | 20                 | CK | DK | EK  | <b>FK *</b> | HK  |
|                  | 25                 | CJ | DJ | EJ  | FJ          | HJ  |
|                  | 30                 | -- | DH | EH  | FH          | HH  |

\*Standard part number.

All other types available only on request.

Outline Table



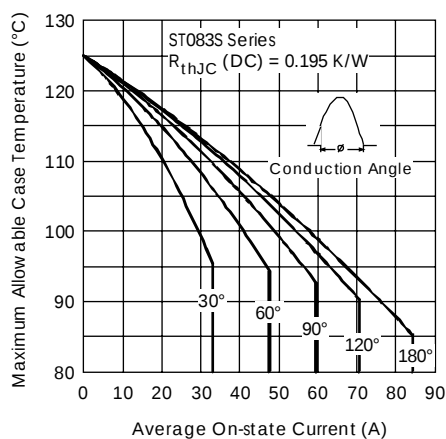


Fig. 1 - Current Ratings Characteristics

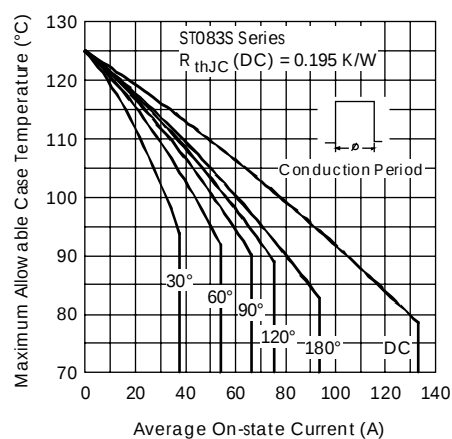


Fig. 2 - Current Ratings Characteristics

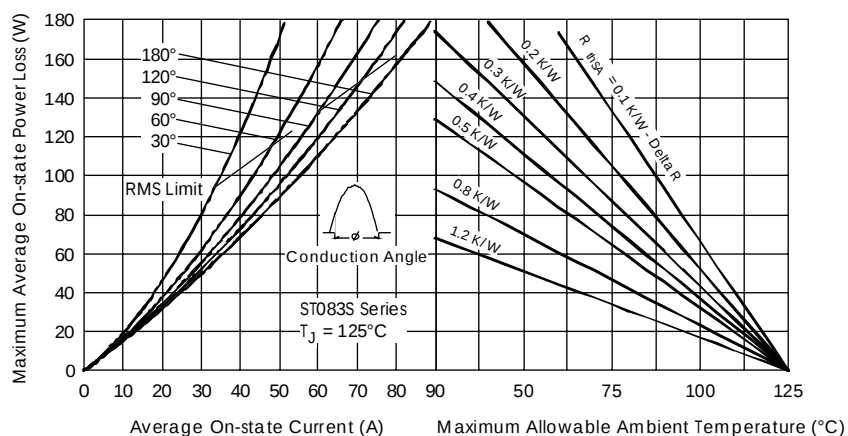


Fig. 3 - On-state Power Loss Characteristics

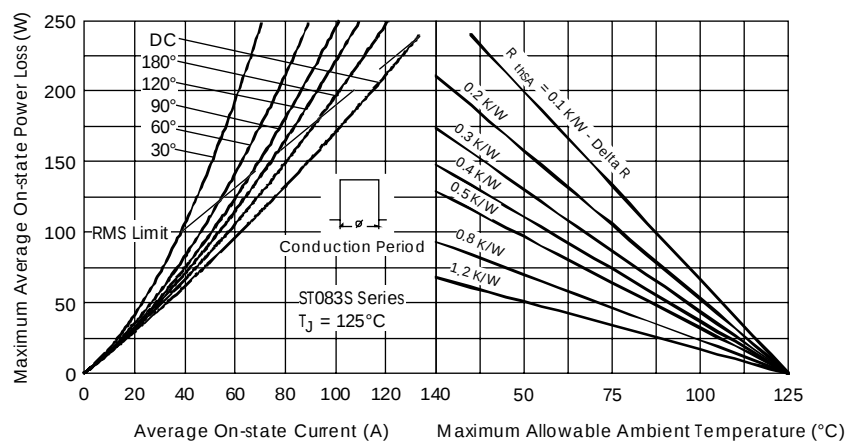


Fig. 4 - On-state Power Loss Characteristics

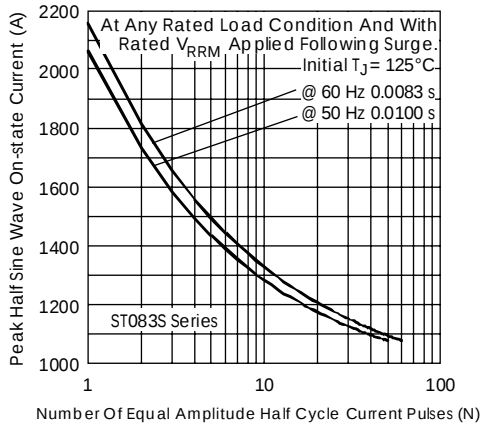


Fig. 5 - Maximum Non-repetitive Surge Current

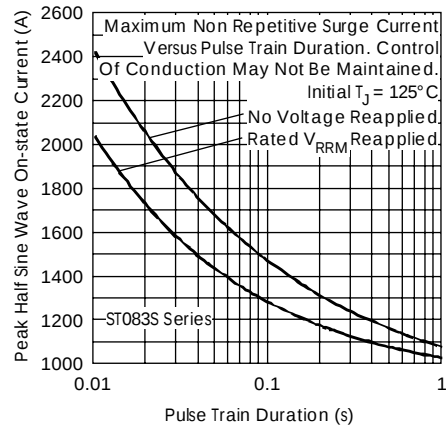


Fig. 6 - Maximum Non-repetitive Surge Current

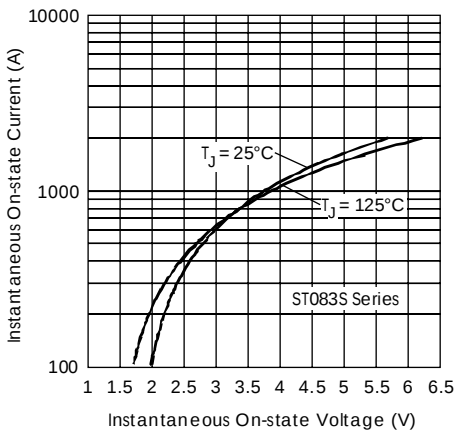


Fig. 7 - On-state Voltage Drop Characteristics

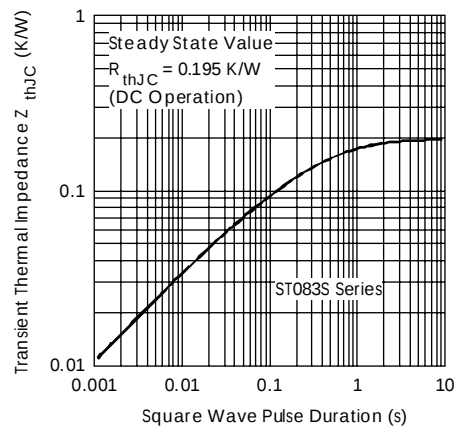


Fig. 8 - Thermal Impedance  $Z_{thJC}$  Characteristic

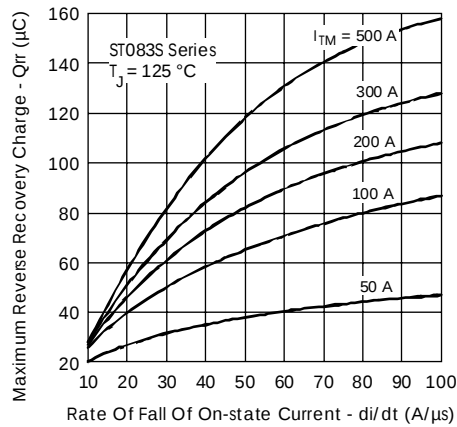


Fig. 9 - Reverse Recovered Charge Characteristics

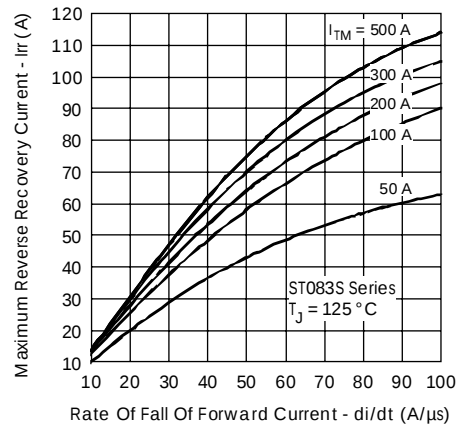


Fig. 10 - Reverse Recovery Current Characteristics

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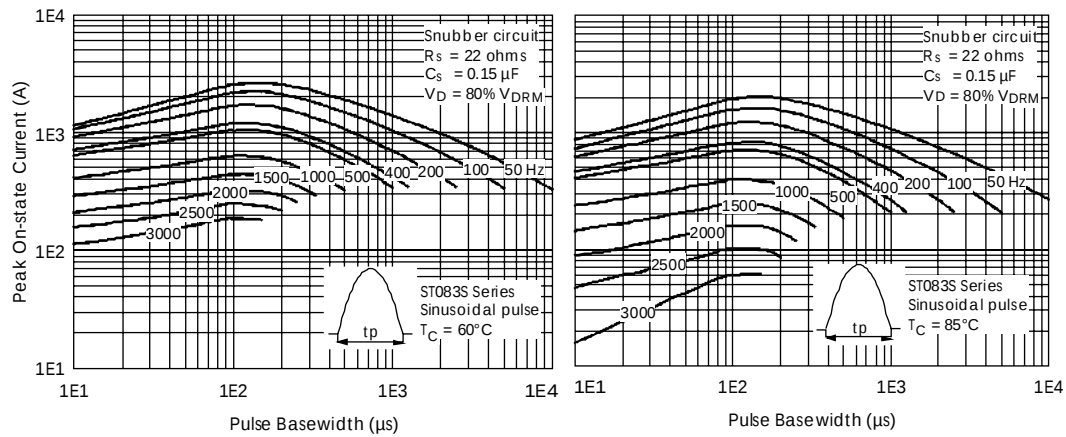


Fig. 11 - Frequency Characteristics

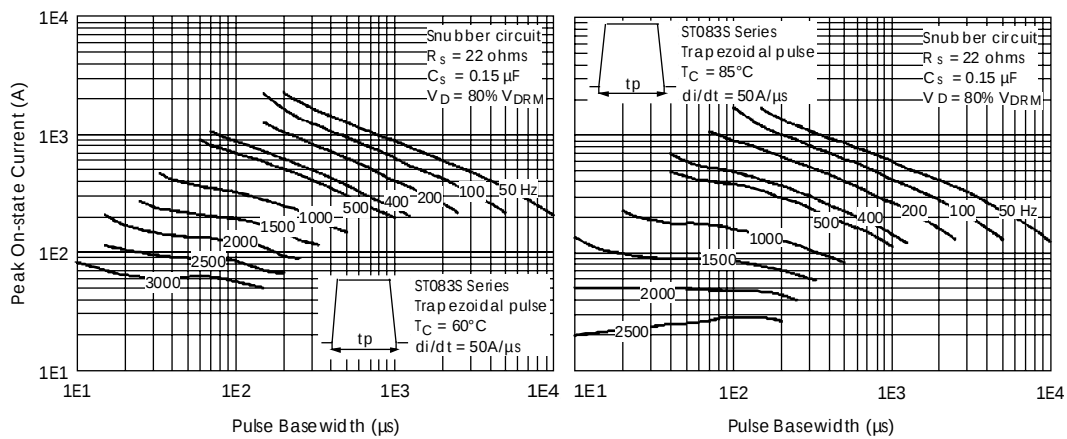


Fig. 12 - Frequency Characteristics

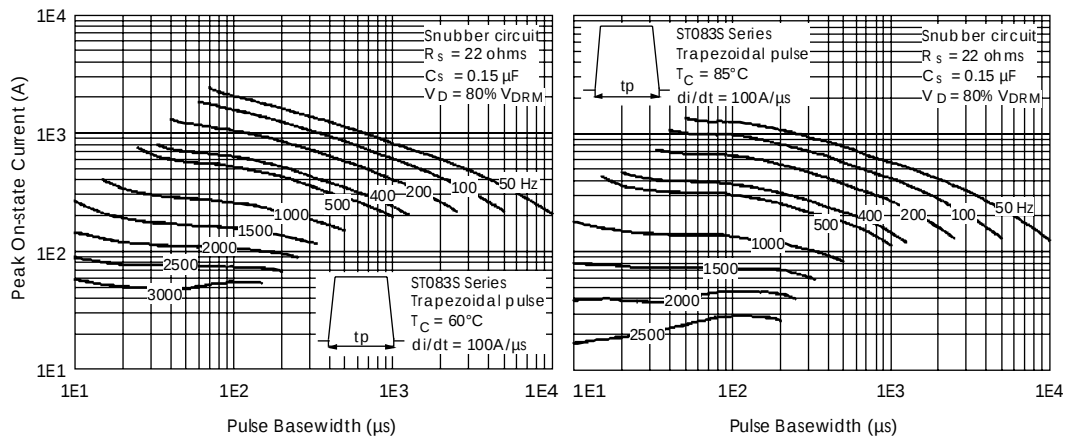


Fig. 13 - Frequency Characteristics

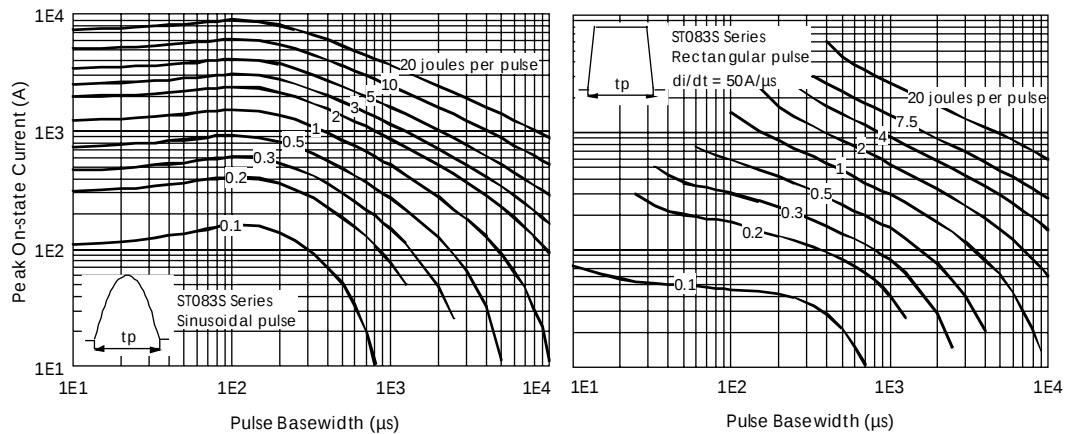


Fig. 14 - Maximum On-state Energy Power Loss Characteristics

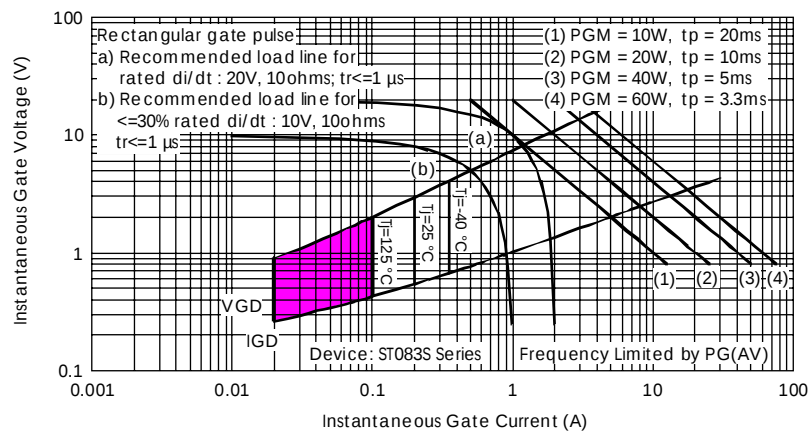


Fig. 15 - Gate Characteristics