

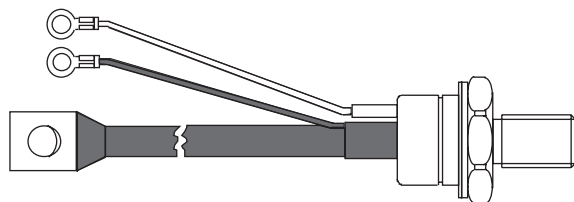


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## ST083SPbF Series

Vishay High Power Products

### Inverter Grade Thyristors (Stud Version), 85 A



TO-209AC (TO-94)

#### FEATURES

- Center amplifying gate
- High surge current capability
- Low thermal impedance
- High speed performance
- Compression bonding
- Lead (Pb)-free
- Designed and qualified for industrial level



RoHS  
COMPLIANT

#### PRODUCT SUMMARY

|             |      |
|-------------|------|
| $I_{T(AV)}$ | 85 A |
|-------------|------|

#### TYPICAL APPLICATIONS

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

#### MAJOR RATINGS AND CHARACTERISTICS

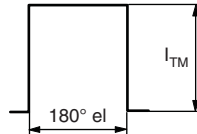
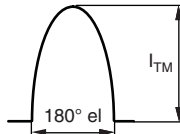
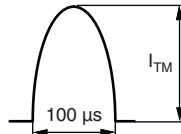
| PARAMETER         | TEST CONDITIONS | VALUES      | UNITS             |
|-------------------|-----------------|-------------|-------------------|
| $I_{T(AV)}$       |                 | 85          | A                 |
|                   | $T_C$           | 85          | °C                |
| $I_{T(RMS)}$      |                 | 135         | A                 |
| $I_{TSM}$         | 50 Hz           | 2450        | A                 |
|                   | 60 Hz           | 2560        | A                 |
| $I^2t$            | 50 Hz           | 30          | kA <sup>2</sup> s |
|                   | 60 Hz           | 27          |                   |
| $V_{DRM}/V_{RRM}$ |                 | 400 to 1200 | V                 |
| $t_q$             | Range           | 10 to 20    | μs                |
| $T_J$             |                 | - 40 to 125 | °C                |

#### ELECTRICAL SPECIFICATIONS

##### VOLTAGE RATINGS

| TYPE NUMBER | VOLTAGE CODE | $V_{DRM}/V_{RRM}$ , MAXIMUM<br>REPETITIVE PEAK VOLTAGE<br>V | $V_{RSM}$ , MAXIMUM<br>NON-REPETITIVE PEAK VOLTAGE<br>V | $I_{DRM}/I_{RRM}$ MAX.<br>AT $T_J = T_J$ MAX.<br>mA |
|-------------|--------------|-------------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------|
| ST083S      | 04           | 400                                                         | 500                                                     | 30                                                  |
|             | 08           | 800                                                         | 900                                                     |                                                     |
|             | 10           | 1000                                                        | 1100                                                    |                                                     |
|             | 12           | 1200                                                        | 1300                                                    |                                                     |

### CURRENT CARRYING CAPABILITY

| FREQUENCY                        |  |     |  |     |  |      | UNITS          |
|----------------------------------|-----------------------------------------------------------------------------------|-----|------------------------------------------------------------------------------------|-----|-------------------------------------------------------------------------------------|------|----------------|
| 50 Hz                            | 210                                                                               | 120 | 330                                                                                | 270 | 2540                                                                                | 1930 | A              |
| 400 Hz                           | 200                                                                               | 120 | 350                                                                                | 210 | 1190                                                                                | 810  |                |
| 1000 Hz                          | 150                                                                               | 80  | 320                                                                                | 190 | 630                                                                                 | 400  |                |
| 2500 Hz                          | 70                                                                                | 25  | 220                                                                                | 85  | 250                                                                                 | 100  |                |
| Recovery voltage $V_r$           | 50                                                                                | 50  | 50                                                                                 | 50  | 50                                                                                  | 50   | V              |
| Voltage before turn-on $V_d$     | $V_{DRM}$                                                                         |     | $V_{DRM}$                                                                          |     | $V_{DRM}$                                                                           |      |                |
| Rise of on-state current $di/dt$ | 50                                                                                | 50  | -                                                                                  | -   | -                                                                                   | -    | A/ $\mu$ s     |
| Case temperature                 | 60                                                                                | 85  | 60                                                                                 | 85  | 60                                                                                  | 85   | °C             |
| Equivalent values for RC circuit | 22/0.15                                                                           |     | 22/0.15                                                                            |     | 22/0.15                                                                             |      | $\Omega/\mu$ F |

### ON-STATE CONDUCTION

| PARAMETER                                                  | SYMBOL              | TEST CONDITIONS                                                                                           |                                  |                                                                       | VALUES | UNITS              |
|------------------------------------------------------------|---------------------|-----------------------------------------------------------------------------------------------------------|----------------------------------|-----------------------------------------------------------------------|--------|--------------------|
| Maximum average on-state current at case temperature       | I <sub>T(AV)</sub>  | 180° conduction, half sine wave                                                                           |                                  |                                                                       | 85     | A                  |
|                                                            |                     |                                                                                                           |                                  |                                                                       | 85     | °C                 |
| Maximum RMS on-state current                               | I <sub>T(RMS)</sub> | DC at 77 °C case temperature                                                                              |                                  |                                                                       | 135    | A                  |
| Maximum peak, one half cycle, non-repetitive surge current | I <sub>TSM</sub>    | t = 10 ms                                                                                                 | No voltage reapplied             | Sinusoidal half wave, initial T <sub>J</sub> = T <sub>J</sub> maximum | 2450   |                    |
|                                                            |                     | t = 8.3 ms                                                                                                |                                  |                                                                       | 2560   |                    |
|                                                            |                     | t = 10 ms                                                                                                 | 100 % V <sub>RRM</sub> reapplied |                                                                       | 2060   |                    |
|                                                            |                     | t = 8.3 ms                                                                                                |                                  |                                                                       | 2160   |                    |
| Maximum I <sup>2</sup> t for fusing                        | I <sup>2</sup> t    | t = 10 ms                                                                                                 | No voltage reapplied             |                                                                       | 30     | kA <sup>2</sup> s  |
|                                                            |                     | t = 8.3 ms                                                                                                |                                  |                                                                       | 27     |                    |
|                                                            |                     | t = 10 ms                                                                                                 | 100 % V <sub>RRM</sub> reapplied |                                                                       | 21     |                    |
|                                                            |                     | t = 8.3 ms                                                                                                |                                  |                                                                       | 19     |                    |
| Maximum I <sup>2</sup> √t for fusing                       | I <sup>2</sup> √t   | t = 0.1 to 10 ms, no voltage reapplied                                                                    |                                  |                                                                       | 300    | kA <sup>2</sup> /s |
| Maximum peak on-state voltage                              | V <sub>TM</sub>     | I <sub>TM</sub> = 300 A, T <sub>J</sub> = T <sub>J</sub> maximum, t <sub>p</sub> = 10 ms sine wave pulse  |                                  |                                                                       | 2.15   | V                  |
| Low level value of threshold voltage                       | V <sub>T(TO)1</sub> | (16.7 % × π × I <sub>T(AV)</sub> ) < I < π × I <sub>T(AV)</sub> , T <sub>J</sub> = T <sub>J</sub> maximum |                                  |                                                                       | 1.46   |                    |
| High level value of threshold voltage                      | V <sub>T(TO)2</sub> | (I > π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum                                    |                                  |                                                                       | 1.52   |                    |
| Low level value of forward slope resistance                | r <sub>t1</sub>     | (16.7 % × π × I <sub>T(AV)</sub> ) < I < π × I <sub>T(AV)</sub> , T <sub>J</sub> = T <sub>J</sub> maximum |                                  |                                                                       | 2.32   | mΩ                 |
| High level value of forward slope resistance               | r <sub>t2</sub>     | (I > π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum                                    |                                  |                                                                       | 2.34   |                    |
| Maximum holding current                                    | I <sub>H</sub>      | T <sub>J</sub> = 25 °C, I <sub>T</sub> > 30 A                                                             |                                  |                                                                       | 600    | mA                 |
| Typical latching current                                   | I <sub>L</sub>      | T <sub>J</sub> = 25 °C, V <sub>A</sub> = 12 V, R <sub>a</sub> = 6 Ω, I <sub>G</sub> = 1 A                 |                                  |                                                                       | 1000   |                    |



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## SWITCHING

| PARAMETER                                                | SYMBOL  | TEST CONDITIONS                                                                                                                                                                          | VALUES |      | UNITS      |
|----------------------------------------------------------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------|------------|
|                                                          |         |                                                                                                                                                                                          | MIN.   | MAX. |            |
| Maximum non-repetitive rate of rise of turned on current | $di/dt$ | $T_J = T_J \text{ max.}, V_{DRM} = \text{Rated } V_{DRM}, I_{TM} = 2 \times di/dt$                                                                                                       | 1000   |      | A/ $\mu$ s |
| Typical delay time                                       | $t_d$   | $T_J = 25^\circ\text{C}, V_{DM} = \text{Rated } V_{DM}, I_{TM} = 50 \text{ A DC}, t_p = 1 \mu\text{s}$<br>Resistive load, gate pulse: 10 V, 5 $\Omega$ source                            | 0.80   |      | $\mu$ s    |
| Maximum turn-off time                                    | $t_q$   | $T_J = T_J \text{ maximum}, I_{TM} = 100 \text{ A},$<br>commutating $di/dt = 10 \text{ A}/\mu\text{s}$<br>$V_R = 50 \text{ V}, t_p = 200 \mu\text{s}, dV/dt = 200 \text{ V}/\mu\text{s}$ | 10     | 20   |            |

## BLOCKING

| PARAMETER                                          | SYMBOL             | TEST CONDITIONS                                                                                       | VALUES | UNITS      |
|----------------------------------------------------|--------------------|-------------------------------------------------------------------------------------------------------|--------|------------|
| Maximum critical rate of rise of off-state voltage | $dV/dt$            | $T_J = T_J \text{ maximum}, \text{linear to } 80\% V_{DRM}, \text{higher value available on request}$ | 500    | V/ $\mu$ s |
| Maximum peak reverse and off-state leakage current | $I_{RRM}, I_{DRM}$ | $T_J = T_J \text{ maximum}, \text{rated } V_{DRM}/V_{RRM} \text{ applied}$                            | 30     | mA         |

## TRIGGERING

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

## THERMAL AND MECHANICAL SPECIFICATIONS

| PARAMETER                                    | SYMBOL     | TEST CONDITIONS                               | VALUES           | UNITS               |
|----------------------------------------------|------------|-----------------------------------------------|------------------|---------------------|
| Maximum junction operating temperature range | $T_J$      |                                               | - 40 to 125      | $^\circ\text{C}$    |
| Maximum storage temperature range            | $T_{Stg}$  |                                               | - 40 to 150      |                     |
| Maximum thermal resistance, junction to case | $R_{thJC}$ | DC operation                                  | 0.195            | K/W                 |
| Maximum thermal resistance, case to heatsink | $R_{thCS}$ | Mounting surface, smooth, flat and greased    | 0.08             |                     |
| Mounting torque, $\pm 10\%$                  |            | Non-lubricated threads                        | 15.5<br>(137)    | N · m<br>(lbf · in) |
|                                              |            | Lubricated threads                            | 14<br>(120)      |                     |
| Approximate weight                           |            |                                               | 130              | g                   |
| Case style                                   |            | See dimensions - link at the end of datasheet | TO-209AC (TO-94) |                     |

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| $\Delta R_{thJC}$ CONDUCTION |                       |                        |                             |       |
|------------------------------|-----------------------|------------------------|-----------------------------|-------|
| CONDUCTION ANGLE             | SINUSOIDAL CONDUCTION | RECTANGULAR CONDUCTION | TEST CONDITIONS             | UNITS |
| 180°                         | 0.034                 | 0.025                  | $T_J = T_J \text{ maximum}$ | K/W   |
| 120°                         | 0.041                 | 0.042                  |                             |       |
| 90°                          | 0.052                 | 0.056                  |                             |       |
| 60°                          | 0.076                 | 0.079                  |                             |       |
| 30°                          | 0.126                 | 0.127                  |                             |       |

## Note

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

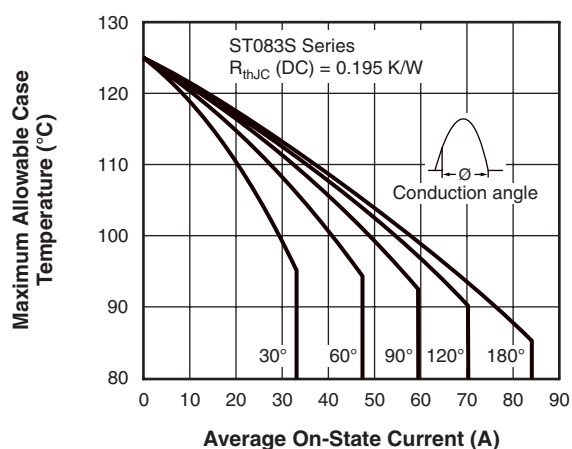


Fig. 1 - Current Ratings Characteristics

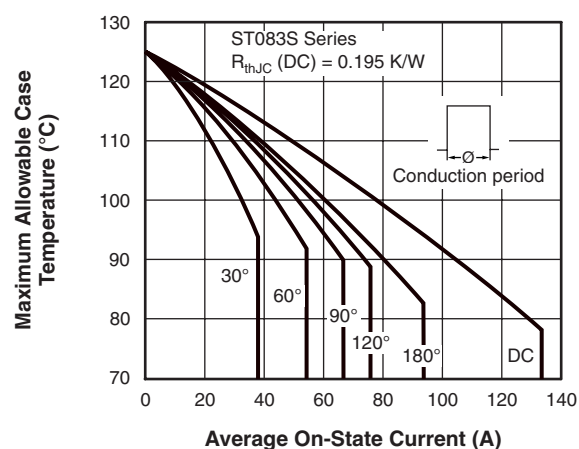


Fig. 2 - Current Ratings Characteristics

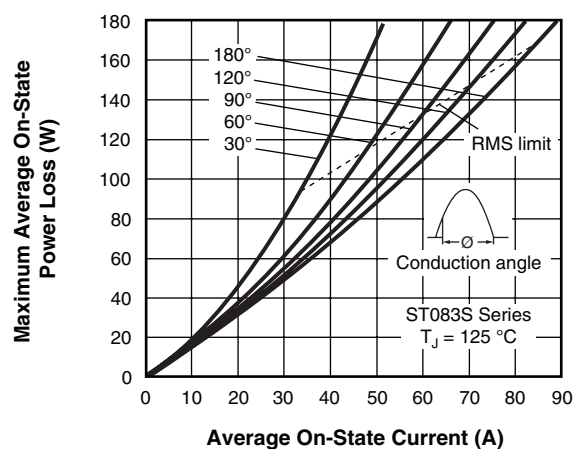
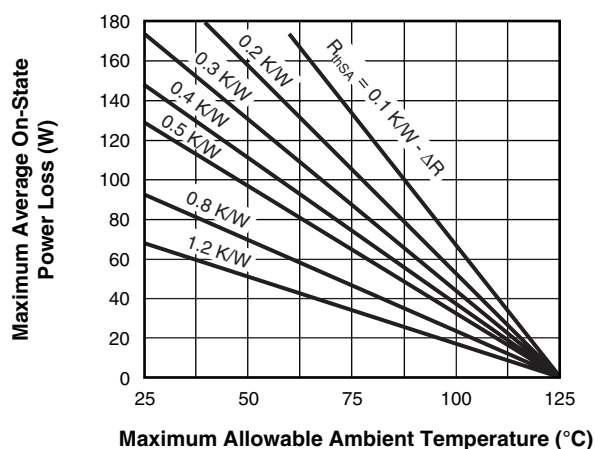


Fig. 3 - On-State Power Loss Characteristics



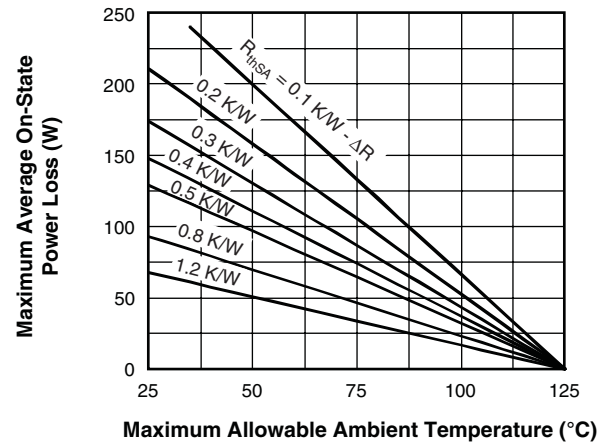
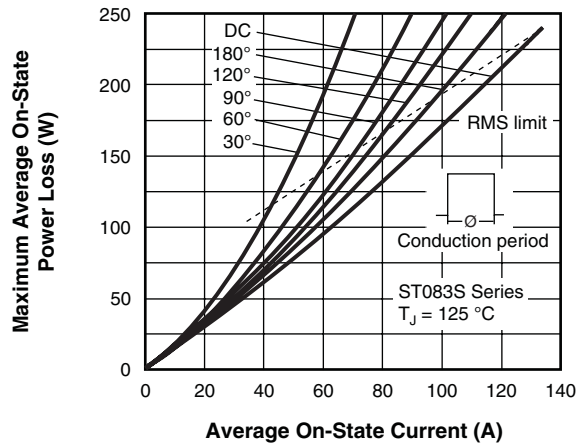


Fig. 4 - On-State Power Loss Characteristics

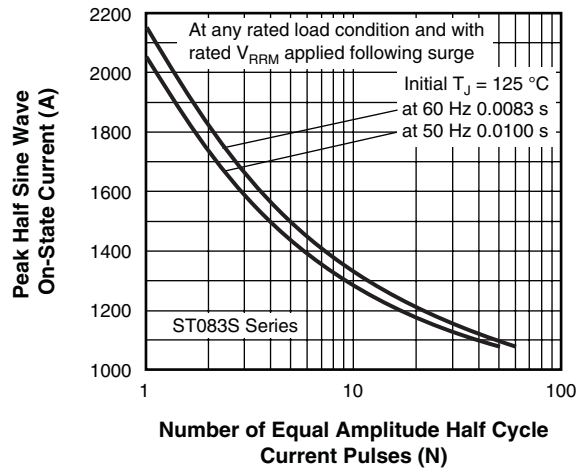


Fig. 5 - Maximum Non-Repetitive Surge Current

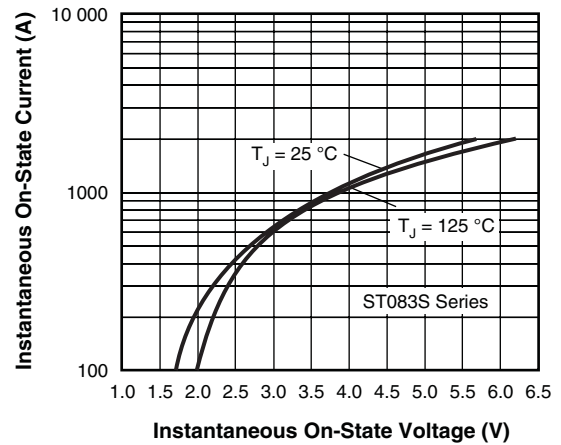


Fig. 7 - On-State Voltage Drop Characteristics

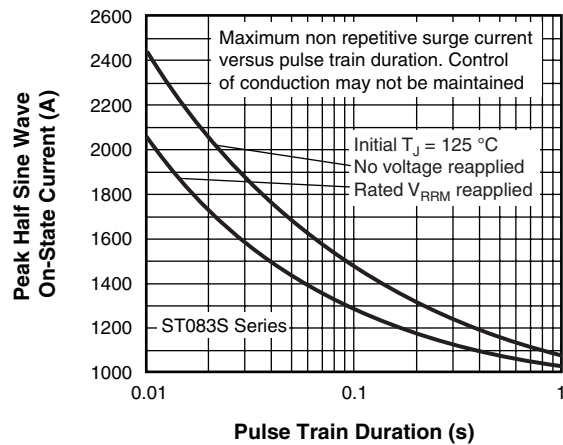


Fig. 6 - Maximum Non-Repetitive Surge Current

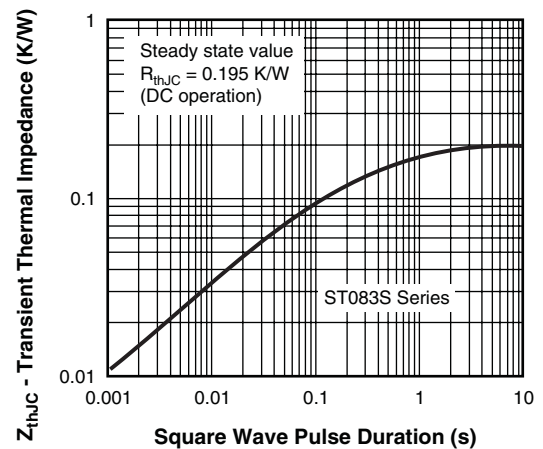


Fig. 8 - Thermal Impedance  $Z_{thJC}$  Characteristic

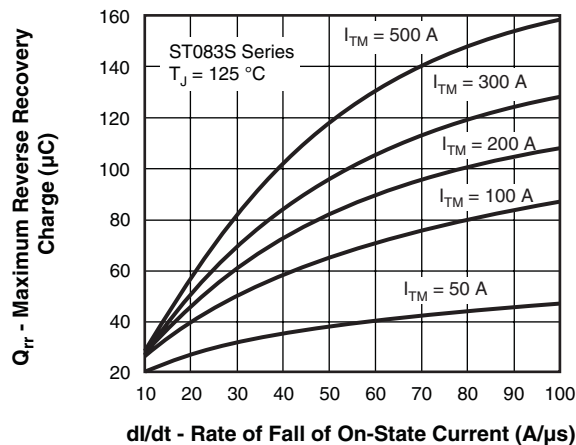


Fig. 9 - Reverse Recovered Charge Characteristics

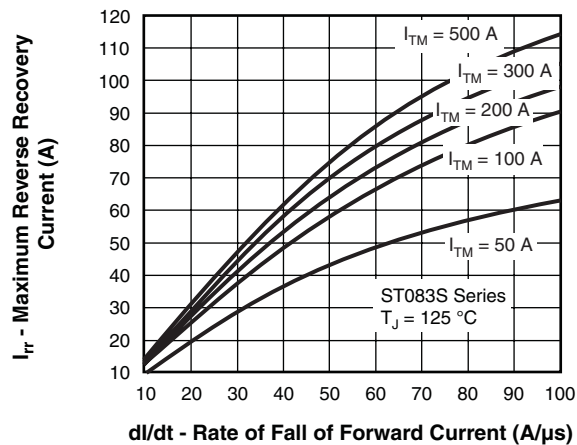


Fig. 10 - Reverse Recovery Current Characteristics

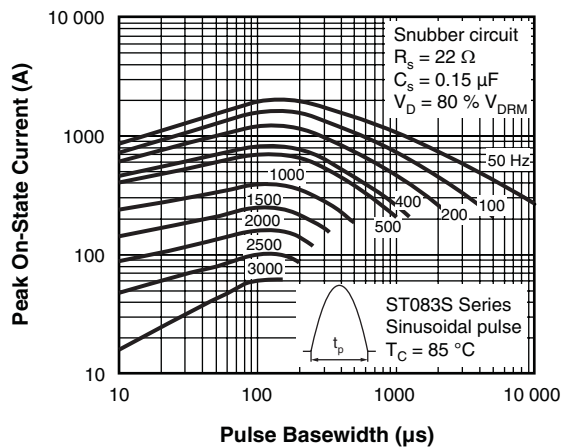
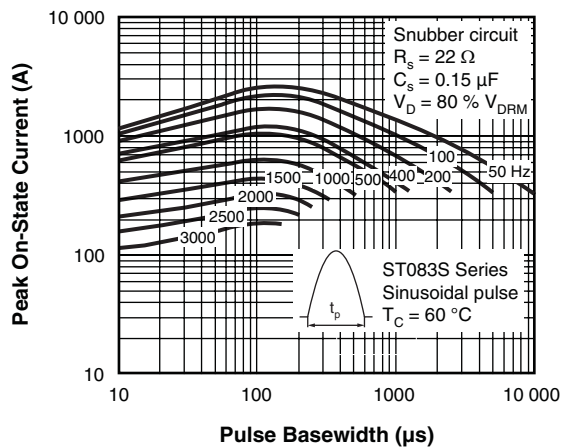


Fig. 11 - Frequency Characteristics

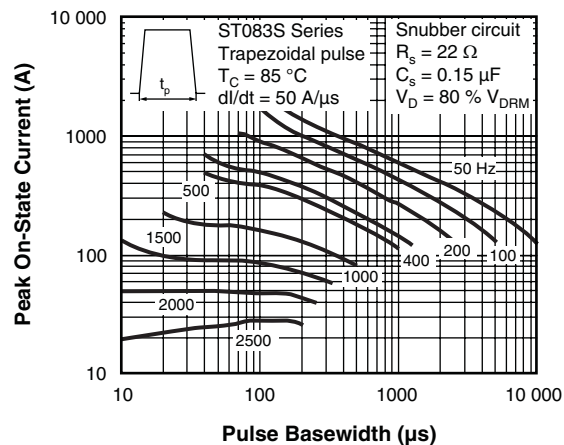
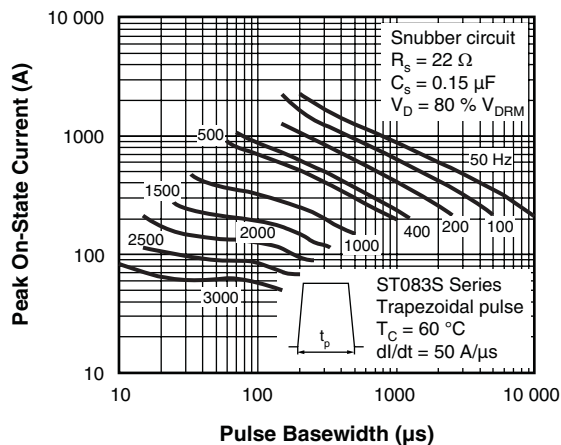


Fig. 12 - Frequency Characteristics



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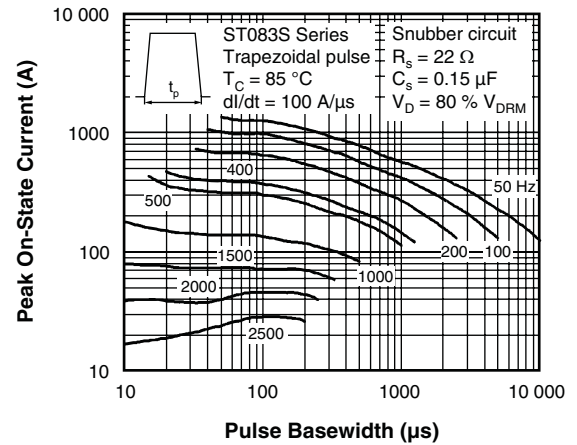
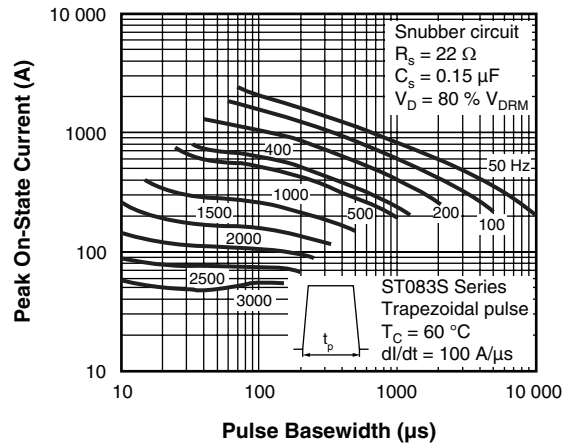


Fig. 13 - Frequency Characteristics

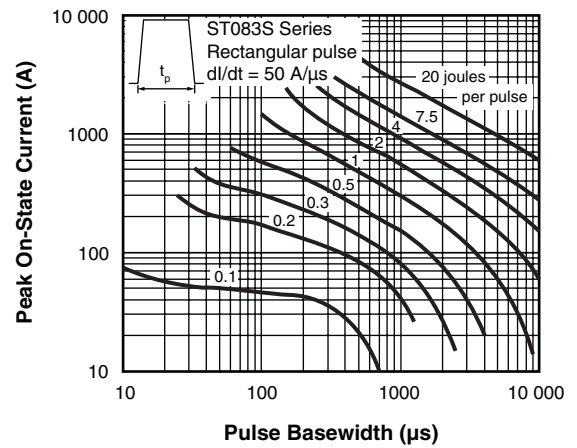
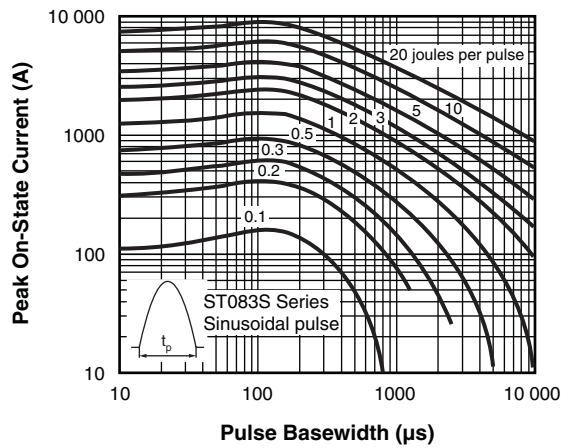


Fig. 14 - Maximum On-State Energy Power Loss Characteristics

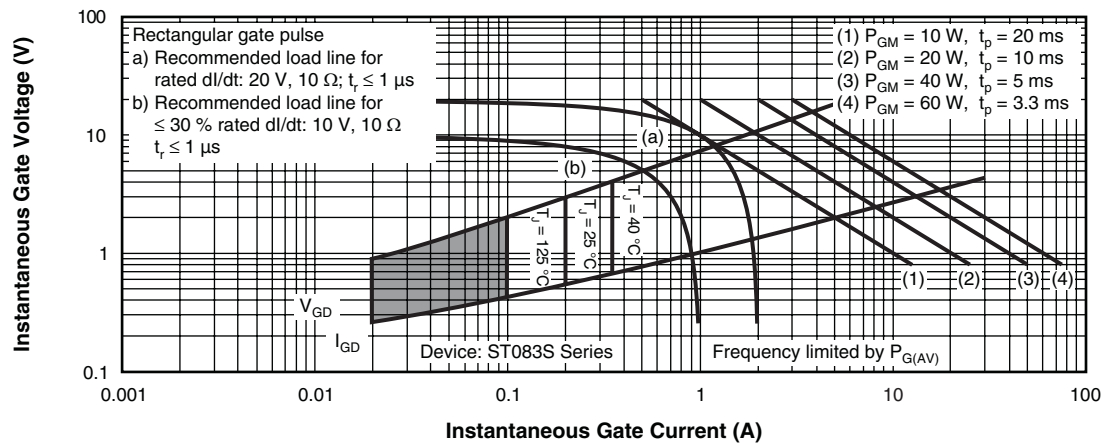


Fig. 15 - Gate Characteristics

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## ORDERING INFORMATION TABLE

| Device code | ST | 08 | 3 | S | 12 | P | F | N | 0 | PbF |
|-------------|----|----|---|---|----|---|---|---|---|-----|
|             | 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 x 100 =  $V_{RRM}$  (see Voltage Ratings table)
- 6** - P = Stud base 1/2"-20UNF-2A threads
- 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)
- 10** - PbF = Lead (Pb)-free

| dV/dt - $t_q$ combinations available        |                    |     |
|---------------------------------------------|--------------------|-----|
|                                             | dV/dt (V/ $\mu$ s) | 200 |
| $t_q$ ( $\mu$ s)<br>up to 800V              | 10                 | FN  |
|                                             | 20                 | FK  |
| $t_q$ ( $\mu$ s)<br>only for<br>1000/1200 V | 20                 | FK  |

| LINKS TO RELATED DOCUMENTS |                                                                               |
|----------------------------|-------------------------------------------------------------------------------|
| Dimensions                 | <a href="http://www.vishay.com/doc?95003">http://www.vishay.com/doc?95003</a> |





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