

## 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
- Designed and qualified for industrial level
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT

### PRODUCT SUMMARY

|                    |                  |
|--------------------|------------------|
| Package            | TO-209AC (TO-94) |
| Diode variation    | Single SCR       |
| $I_{T(AV)}$        | 85 A             |
| $V_{DRM}/V_{RRM}$  | 400 V to 1200 V  |
| $V_{TM}$           | 2.15 V           |
| $I_{TSM}$ at 50 Hz | 2450 A           |
| $I_{TSM}$ at 60 Hz | 2560 A           |
| $I_{GT}$           | 200 mA           |
| $T_C/T_{hs}$       | 85 °C            |

### TYPICAL APPLICATIONS

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

### MAJOR RATINGS AND CHARACTERISTICS

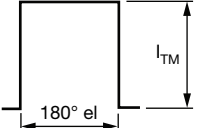
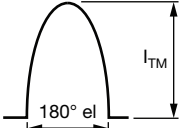
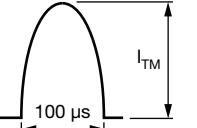
| PARAMETER         | TEST CONDITIONS | VALUES      | UNITS             |
|-------------------|-----------------|-------------|-------------------|
| $I_{T(AV)}$       |                 | 85          | A                 |
|                   | $T_C$           | 85          | °C                |
| $I_{T(RMS)}$      |                 | 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 |
|-------------|--------------|-------------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------|
| VS-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                                                                             |      | W/ $\mu$ F |

**ON-STATE CONDUCTION**

| PARAMETER                                                  | SYMBOL        | TEST CONDITIONS                                                                          |                           | VALUES | UNITS              |
|------------------------------------------------------------|---------------|------------------------------------------------------------------------------------------|---------------------------|--------|--------------------|
| Maximum average on-state current at case temperature       | $I_{T(AV)}$   | 180° conduction, half sine wave                                                          |                           | 85     | A                  |
|                                                            |               |                                                                                          |                           | 85     | °C                 |
| Maximum RMS on-state current                               | $I_{T(RMS)}$  | DC at 77 °C case temperature                                                             |                           | 135    | A                  |
| Maximum peak, one half cycle, non-repetitive surge current | $I_{TSM}$     | t = 10 ms                                                                                | No voltage reapplied      | 2450   |                    |
|                                                            |               | t = 8.3 ms                                                                               | No voltage reapplied      | 2560   |                    |
|                                                            |               | t = 10 ms                                                                                | 100 % $V_{RRM}$ reapplied | 2060   |                    |
|                                                            |               | t = 8.3 ms                                                                               | 100 % $V_{RRM}$ reapplied | 2160   |                    |
| Maximum $I^2t$ for fusing                                  | $I^2t$        | t = 10 ms                                                                                | No voltage reapplied      | 30     | kA <sup>2</sup> s  |
|                                                            |               | t = 8.3 ms                                                                               | No voltage reapplied      | 27     |                    |
|                                                            |               | t = 10 ms                                                                                | 100 % $V_{RRM}$ reapplied | 21     |                    |
|                                                            |               | t = 8.3 ms                                                                               | 100 % $V_{RRM}$ reapplied | 19     |                    |
| Maximum $I^2\sqrt{t}$ for fusing                           | $I^2\sqrt{t}$ | t = 0.1 ms to 10 ms, no voltage reapplied                                                |                           | 300    | kA <sup>2</sup> /s |
| Maximum peak on-state voltage                              | $V_{TM}$      | $I_{TM} = 300$ A, $T_J = T_J$ maximum, $t_p = 10$ ms sine wave pulse                     |                           | 2.15   | V                  |
| Low level value of threshold voltage                       | $V_{T(TO)1}$  | $(16.7 \% \times \pi \times I_{T(AV)}) < I < \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum |                           | 1.46   |                    |
| High level value of threshold voltage                      | $V_{T(TO)2}$  | $(I > \pi \times I_{T(AV)})$ , $T_J = T_J$ maximum                                       |                           | 1.52   |                    |
| Low level value of forward slope resistance                | $r_{t1}$      | $(16.7 \% \times \pi \times I_{T(AV)}) < I < \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum |                           | 2.32   | mΩ                 |
| High level value of forward slope resistance               | $r_{t2}$      | $(I > \pi \times I_{T(AV)})$ , $T_J = T_J$ maximum                                       |                           | 2.34   |                    |
| Maximum holding current                                    | $I_H$         | $T_J = 25$ °C, $I_T > 30$ A                                                              |                           | 600    | mA                 |
| Typical latching current                                   | $I_L$         | $T_J = 25$ °C, $V_A = 12$ V, $R_a = 6$ Ω, $I_G = 1$ A                                    |                           | 1000   |                    |

**SWITCHING**

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

**BLOCKING**

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

**TRIGGERING**

| PARAMETER                                   | SYMBOL      | TEST CONDITIONS                                      | VALUES | UNITS |
|---------------------------------------------|-------------|------------------------------------------------------|--------|-------|
| Maximum peak gate power                     | $P_{GM}$    | $T_J = T_J$ maximum, $f = 50$ Hz, $d\% = 50$         | 40     | W     |
| Maximum average gate power                  | $P_{G(AV)}$ |                                                      | 5      |       |
| Maximum peak positive gate current          | $I_{GM}$    | $T_J = T_J$ maximum, $t_p \leq 5$ 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 | $I_{GT}$    | $T_J = 25$ °C, $V_A = 12$ 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      | $I_{GD}$    | $T_J = T_J$ maximum, rated $V_{DRM}/V_{RRM}$ 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       | °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) |                     |

 **$\Delta R_{thJC}$  CONDUCTION**

| CONDUCTION ANGLE | SINUSOIDAL CONDUCTION | RECTANGULAR CONDUCTION | TEST CONDITIONS     | UNITS |
|------------------|-----------------------|------------------------|---------------------|-------|
| 180°             | 0.034                 | 0.025                  | $T_J = T_J$ 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

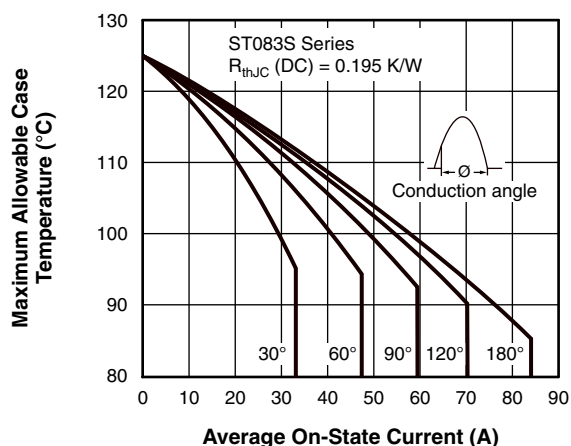


Fig. 1 - Current Ratings Characteristics

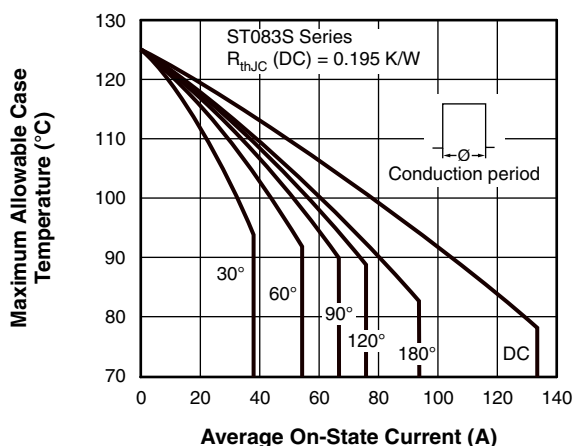


Fig. 2 - Current Ratings Characteristics

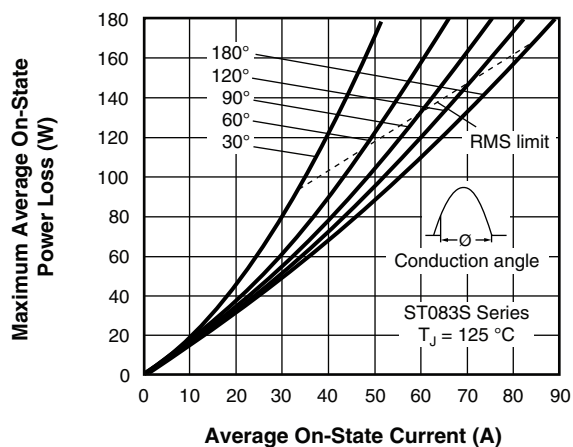


Fig. 3 - On-State Power Loss Characteristics

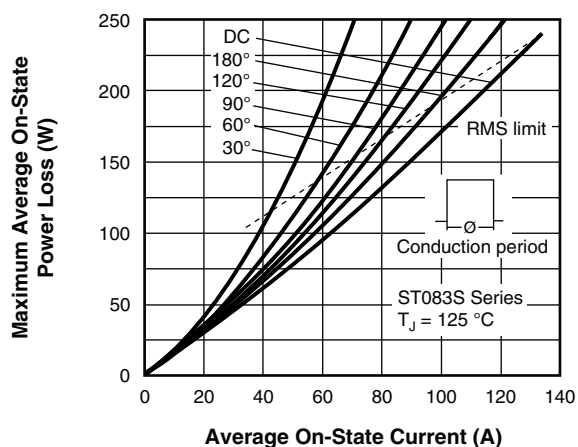
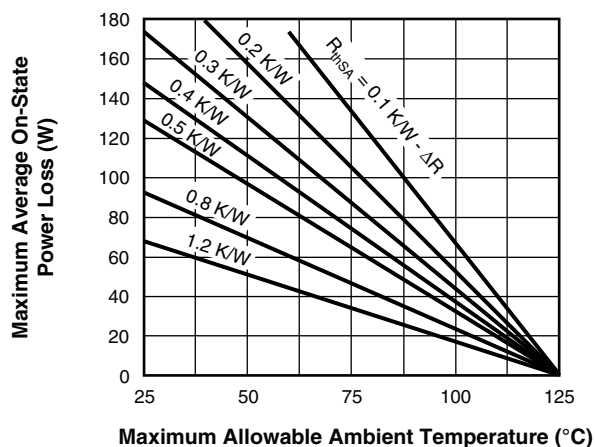
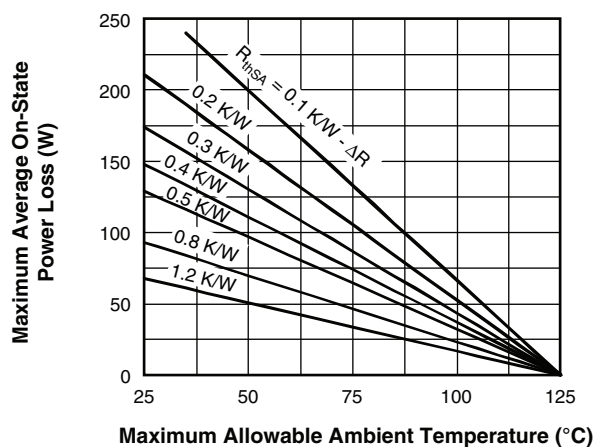


Fig. 4 - On-State Power Loss Characteristics



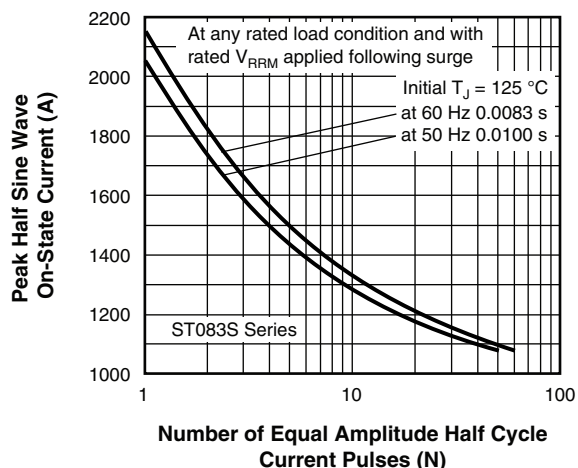


Fig. 5 - Maximum Non-Repetitive Surge Current

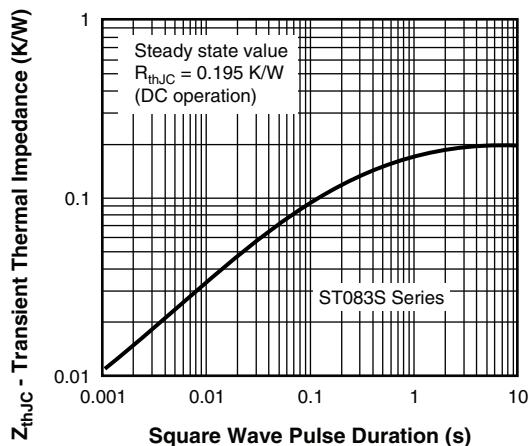
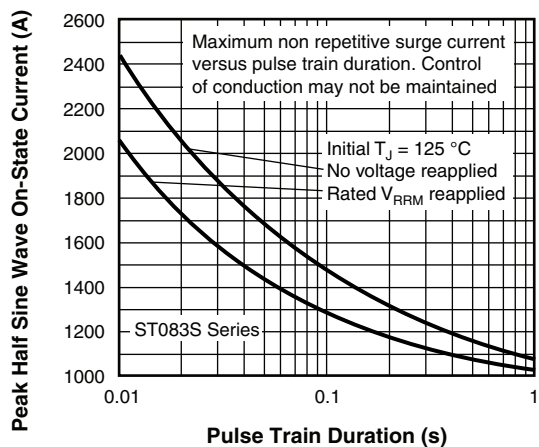

Fig. 8 - Thermal Impedance  $Z_{thJC}$  Characteristic


Fig. 6 - Maximum Non-Repetitive Surge Current

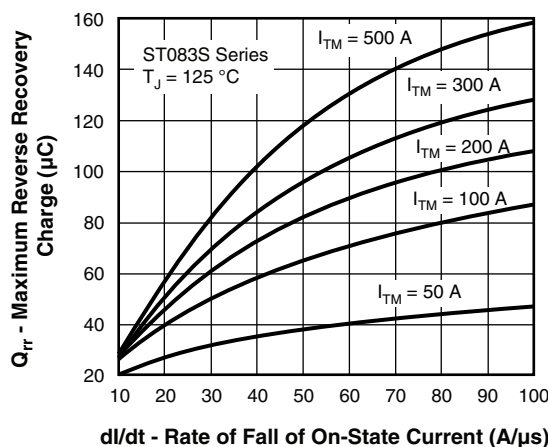


Fig. 9 - Reverse Recovered Charge Characteristics

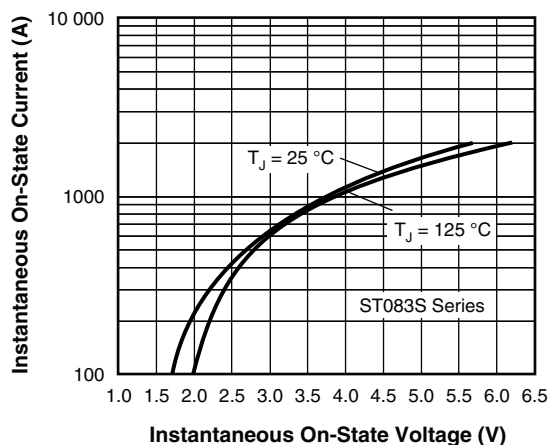


Fig. 7 - On-State Voltage Drop Characteristics

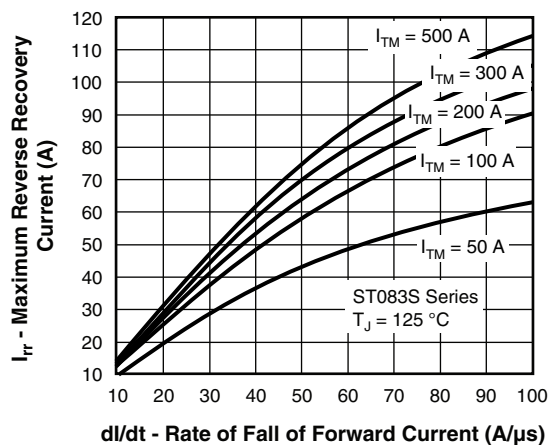


Fig. 10 - Reverse Recovery Current Characteristics

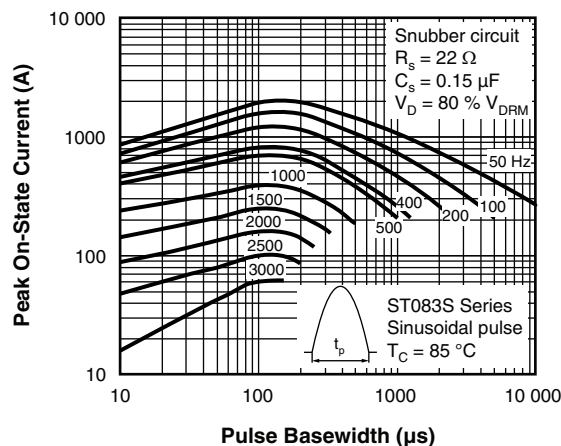
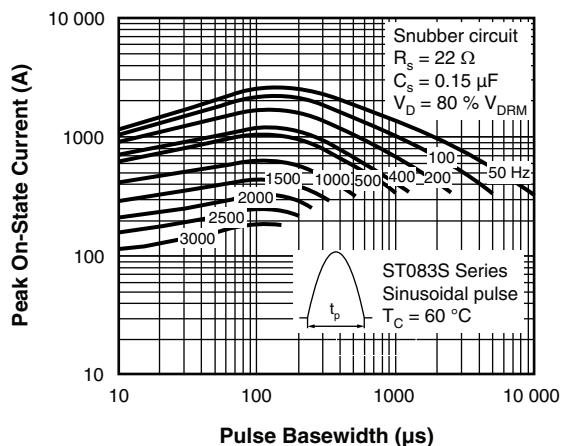


Fig. 11 - Frequency Characteristics

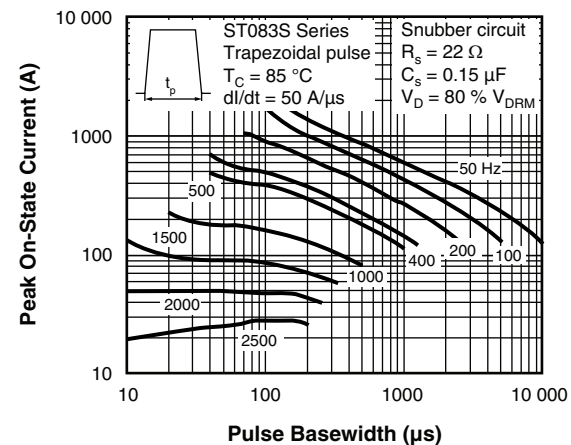
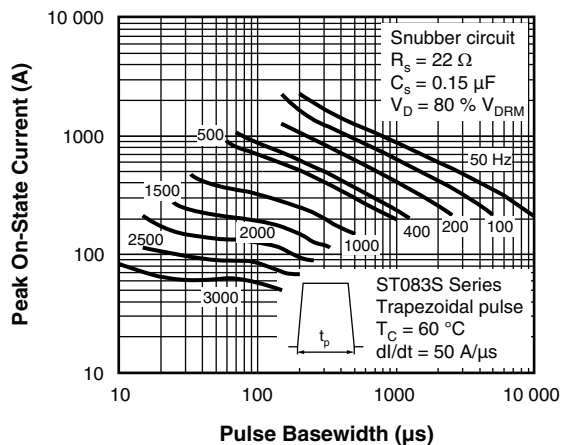


Fig. 12 - Frequency Characteristics

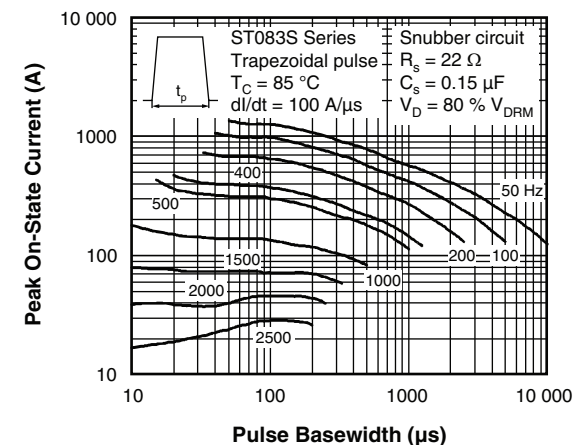
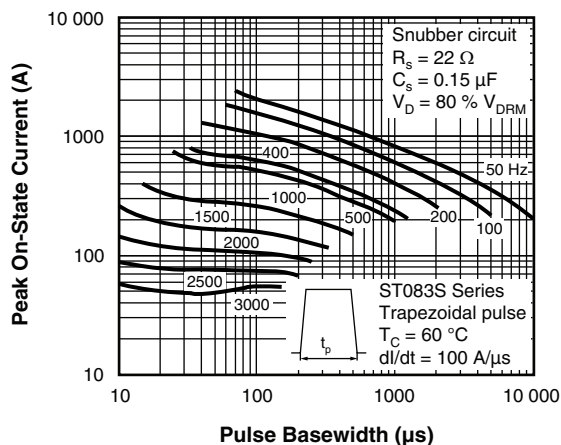


Fig. 13 - Frequency Characteristics

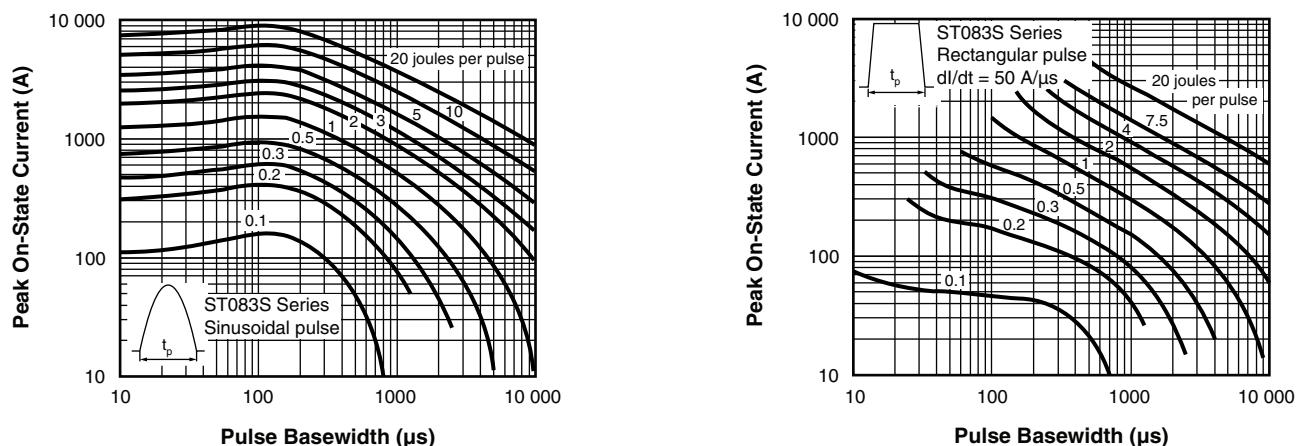


Fig. 14 - Maximum On-State Energy Power Loss Characteristics

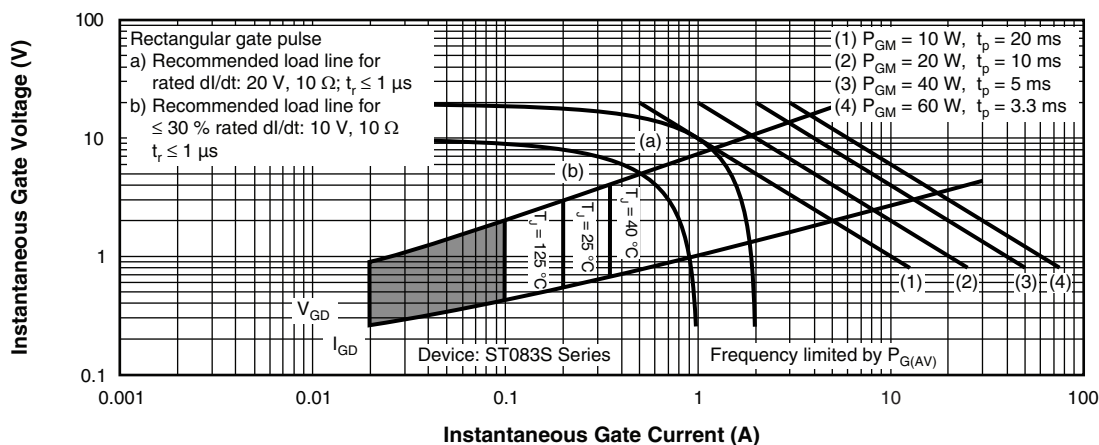


Fig. 15 - Gate Characteristics



## ORDERING INFORMATION TABLE

|             |            |           |           |          |          |           |          |          |          |          |          |          |
|-------------|------------|-----------|-----------|----------|----------|-----------|----------|----------|----------|----------|----------|----------|
| Device code | <b>VS-</b> | <b>ST</b> | <b>08</b> | <b>3</b> | <b>S</b> | <b>12</b> | <b>P</b> | <b>F</b> | <b>N</b> | <b>0</b> | <b>L</b> | <b>P</b> |
|             | ①          | ②         | ③         | ④        | ⑤        | ⑥         | ⑦        | ⑧        | ⑨        | ⑩        | ⑪        | ⑫        |

- 1** - Vishay Semiconductors product
- 2** - Thyristor
- 3** - Essential part number
- 4** - 3 = Fast turn-off
- 5** - S = Compression bonding stud
- 6** - Voltage code x 100 =  $V_{RRM}$  (see Voltage Ratings table)
- 7** - • P = Stud base 1/2"-20UNF-2A threads  
• M = Metric M12, contact factory for availability
- 8** - Reapplied dV/dt code (for  $t_q$  test condition)
- 9** -  $t_q$  code
- 10** - • 0 = Eyelet terminals (gate and aux. cathode leads)  
• 1 = Fast-on terminals (gate and aux. cathode leads)  
• 2 = Flag terminals (gate and aux. cathode leads)
- 11** - Critical dV/dt:
  - None = 500 V/ $\mu$ s (standard value)
  - L = 1000 V/ $\mu$ s (special selection)
- 12** - None = Standard production; P = Lead (Pb)-free

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

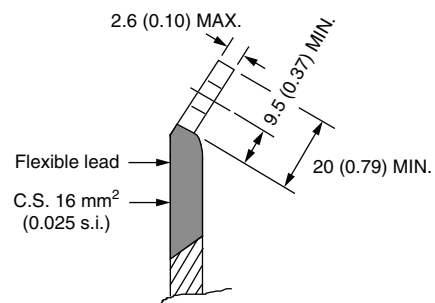
## LINKS TO RELATED DOCUMENTS

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

**DIMENSIONS** in millimeters (inches)

Technical drawing of a probe assembly with dimensions and labels:

- Top dimensions: 16.5 (0.65) MAX. and Ø 8.5 (0.33)
- Right side dimensions: Ø 4.3 (0.17) and 215 ± 10 (8.46 ± 0.39)
- Labels: Red silicon rubber, Red cathode, White gate, C.S. 0.4 mm<sup>2</sup> (0.0006 s.i.), White shrink, Red shrink, SW 27, 1/2"-20UNF-2A
- Left side dimensions: 157 (6.18), 170 (6.69), 70 (2.75) MIN., 29 (1.14) MAX., 12.5 (0.49) MAX., 21 (0.83) MAX.
- Bottom dimensions: Ø 22.5 (0.88) MAX. and 29.5 (1.16) MAX.





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**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

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Мы предлагаем:

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- Специальные условия для постоянных клиентов.
- Подбор аналогов.
- Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.
- Приемлемые сроки поставки, возможна ускоренная поставка.
- Доставку товара в любую точку России и стран СНГ.
- Комплексную поставку.
- Работу по проектам и поставку образцов.
- Формирование склада под заказчика.
- Сертификаты соответствия на поставляемую продукцию (по желанию клиента).
- Тестирование поставляемой продукции.
- Поставку компонентов, требующих военную и космическую приемку.
- Входной контроль качества.
- Наличие сертификата ISO.

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Конструкторский отдел помогает осуществить:

- Регистрацию проекта у производителя компонентов.
- Техническую поддержку проекта.
- Защиту от снятия компонента с производства.
- Оценку стоимости проекта по компонентам.
- Изготовление тестовой платы монтаж и пусконаладочные работы.



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