

## ST303S 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

300A

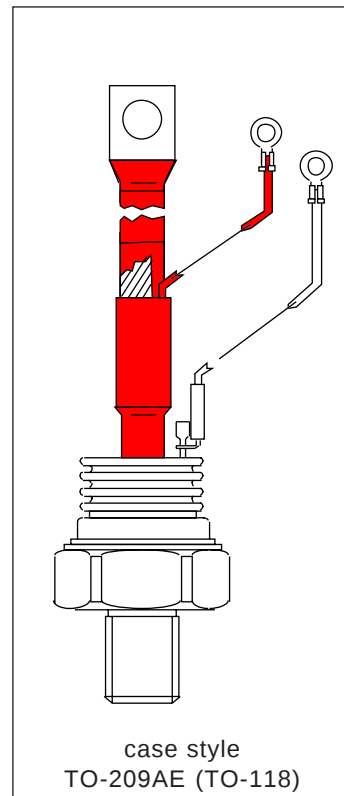
#### Typical Applications

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

#### Major Ratings and Characteristics

| Parameters        | ST303S      | Units             |
|-------------------|-------------|-------------------|
| $I_{T(AV)}$       | 300         | A                 |
| @ $T_C$           | 65          | °C                |
| $I_{T(RMS)}$      | 471         | A                 |
| $I_{TSM}$ @ 50Hz  | 7950        | A                 |
| @ 60Hz            | 8320        | A                 |
| $I^2t$ @ 50Hz     | 316         | KA <sup>2</sup> s |
| @ 60Hz            | 288         | 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



## ST303S Series

Bulletin I25173 rev. B 03/94

International  
IOR Rectifier

### 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 |
|-------------|--------------|--------------------------------------------------------|----------------------------------------------------|----------------------------------------------------|
| ST303S      | 04           | 400                                                    | 500                                                | 50                                                 |
|             | 08           | 800                                                    | 900                                                |                                                    |
|             | 10           | 1000                                                   | 1100                                               |                                                    |
|             | 12           | 1200                                                   | 1300                                               |                                                    |

#### Current Carrying Capability

| Frequency                        |              |     |              |     |              |      | Units |
|----------------------------------|--------------|-----|--------------|-----|--------------|------|-------|
| 50Hz                             | 670          | 470 | 1050         | 940 | 5240         | 4300 | A     |
| 400Hz                            | 480          | 330 | 1021         | 710 | 1800         | 1270 |       |
| 1000Hz                           | 230          | 140 | 760          | 470 | 730          | 430  |       |
| 2500Hz                           | 35           | -   | 150          | -   | 90           | -    |       |
| 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  |
| Case temperature                 | 40           | 65  | 40           | 65  | 40           | 65   | °C    |
| Equivalent values for RC circuit | 10Ω / 0.47µF |     | 10Ω / 0.47µF |     | 10Ω / 0.47µF |      |       |

#### On-state Conduction

| Parameter                                                         | ST303S    | Units   | Conditions                             |
|-------------------------------------------------------------------|-----------|---------|----------------------------------------|
| $I_{T(AV)}$ Max. average on-state current @ Case temperature      | 300<br>65 | A<br>°C | 180° conduction, half sine wave        |
| $I_{T(RMS)}$ Max. RMS on-state current                            | 471       | A       | DC @ 45°C case temperature             |
| $I_{TSM}$ Max. peak, one half cycle, non-repetitive surge current | 7950      |         | t = 10ms No voltage                    |
|                                                                   | 8320      |         | t = 8.3ms reappplied                   |
|                                                                   | 6690      |         | t = 10ms 100% $V_{RRM}$                |
|                                                                   | 7000      |         | t = 8.3ms reappplied                   |
| $I^2t$ Maximum $I^2t$ for fusing                                  | 316       | KA²s    | t = 10ms No voltage                    |
|                                                                   | 288       |         | t = 8.3ms reappplied                   |
|                                                                   | 224       |         | t = 10ms 100% $V_{RRM}$                |
|                                                                   | 204       |         | t = 8.3ms reappplied                   |
| $I^2\sqrt{t}$ Maximum $I^2\sqrt{t}$ for fusing                    | 3160      | KA²√s   | t = 0.1 to 10ms, no voltage reappplied |

#### On-state Conduction

| Parameter                                             | ST303S | Units | Conditions                                                                                    |
|-------------------------------------------------------|--------|-------|-----------------------------------------------------------------------------------------------|
| $V_{TM}$ Max. peak on-state voltage                   | 2.16   | V     | $I_{TM} = 1255A$ , $T_J = T_J \text{ max}$ , $t_p = 10\text{ms}$ sine wave pulse              |
| $V_{T(TO)1}$ Low level value of threshold voltage     | 1.44   |       | $(16.7\% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)})$ , $T_J = T_J \text{ max}$ . |
| $V_{T(TO)2}$ High level value of threshold voltage    | 1.46   |       | $(I > \pi \times I_{T(AV)})$ , $T_J = T_J \text{ max}$ .                                      |
| $r_{t1}$ Low level value of forward slope resistance  | 0.57   | 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 | 0.56   |       | $(I > \pi \times I_{T(AV)})$ , $T_J = T_J \text{ max}$ .                                      |
| $I_H$ 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                                                     | ST303S           | 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 |       | $T_J = T_J \text{ max}$ , $I_{TM} = 550A$ , commutating $di/dt = 40A/\mu\text{s}$<br>$V_R = 50V$ , $t_p = 500\mu\text{s}$ , $dv/dt$ : 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                                                              | ST303S | 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 | 50     | mA    | $T_J = T_J \text{ max}$ , rated $V_{DRM}/V_{RRM}$ applied                             |

#### Triggering

| Parameter                                         | ST303S | Units | Conditions                                               |
|---------------------------------------------------|--------|-------|----------------------------------------------------------|
| $P_{GM}$ Maximum peak gate power                  | 60     | W     | $T_J = T_J \text{ max}$ , $f = 50\text{Hz}$ , $d\% = 50$ |
| $P_{G(AV)}$ Maximum average gate power            | 10     |       |                                                          |
| $I_{GM}$ Max. peak positive gate current          | 10     | 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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Bulletin I25173 rev. B 03/94

International  
IOR Rectifier

### Thermal and Mechanical Specifications

| Parameter                                                   | ST303S            | Units          | Conditions                                 |
|-------------------------------------------------------------|-------------------|----------------|--------------------------------------------|
| T <sub>j</sub> Max. junction operating temperature range    | -40 to 125        | °C             |                                            |
| T <sub>stg</sub> Max. storage temperature range             | -40 to 150        |                |                                            |
| R <sub>thJC</sub> Max. thermal resistance, junction to case | 0.10              | K/W            | DC operation                               |
| R <sub>thCS</sub> Max. thermal resistance, case to heatsink | 0.03              |                | Mounting surface, smooth, flat and greased |
| T Mounting torque, ± 10%                                    | 48.5<br>(425)     | Nm<br>(lbf-in) | Non lubricated threads                     |
| wt Approximate weight                                       | 535               | g              |                                            |
| Case style                                                  | TO-209AE (TO-118) |                | See Outline Table                          |

### ΔR<sub>thJC</sub> Conduction

(The following table shows the increment of thermal resistance R<sub>thJC</sub> when devices operate at different conduction angles than DC)

| Conduction angle | Sinusoidal conduction | Rectangular conduction | Units | Conditions                           |
|------------------|-----------------------|------------------------|-------|--------------------------------------|
| 180°             | 0.011                 | 0.008                  | K/W   | T <sub>j</sub> = T <sub>j</sub> max. |
| 120°             | 0.013                 | 0.014                  |       |                                      |
| 90°              | 0.017                 | 0.018                  |       |                                      |
| 60°              | 0.025                 | 0.026                  |       |                                      |
| 30°              | 0.041                 | 0.042                  |       |                                      |

### Ordering Information Table

Device Code

ST

30

3

S

12

P

F

N

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 3/4" 16UNF-2A  
M = Stud base metric threads M24 x 1.5

**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)  
3 = Threaded top terminal 3/8" 24UNF-2A

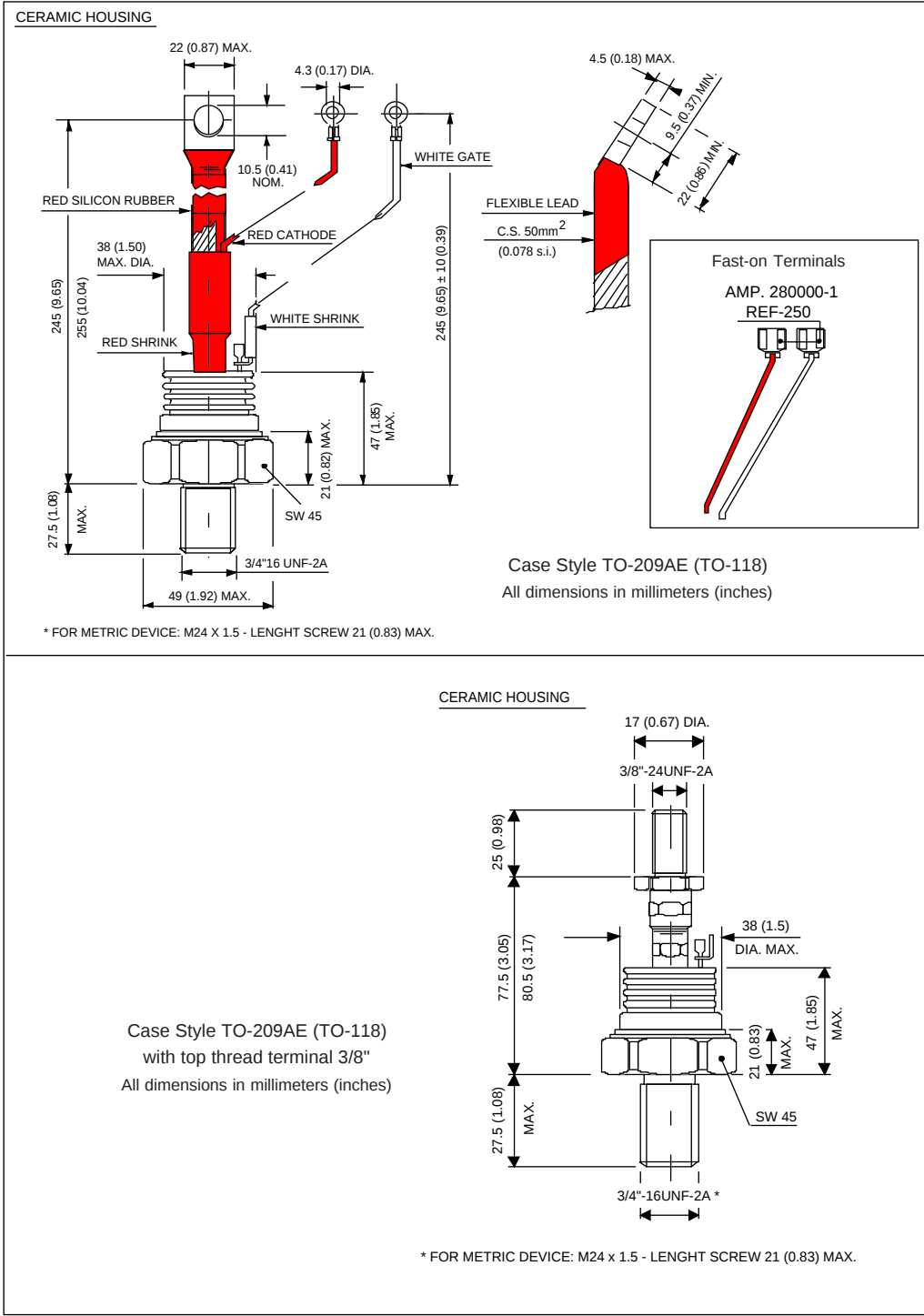
**10** - Critical dv/dt:  
None = 500V/μsec (Standard value)  
L = 1000V/μsec (Special selection)

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

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

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

Outline Table



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International  
**IRF** Rectifier

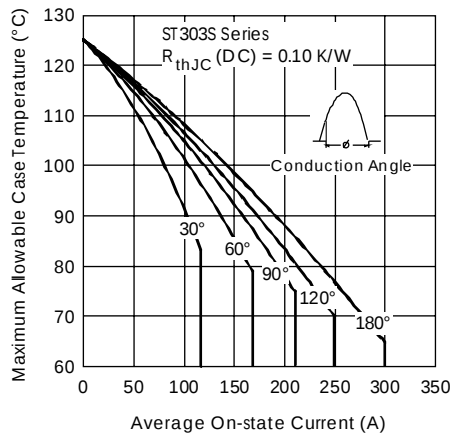


Fig. 1 - Current Ratings Characteristics

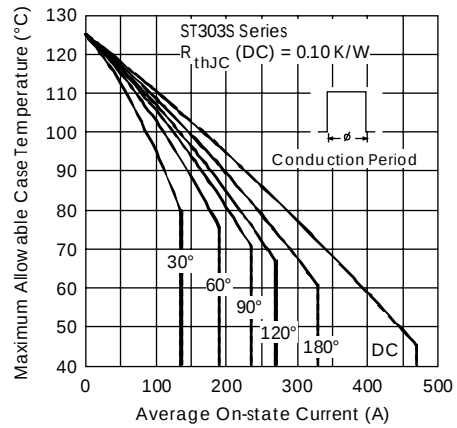


Fig. 2 - Current Ratings Characteristics

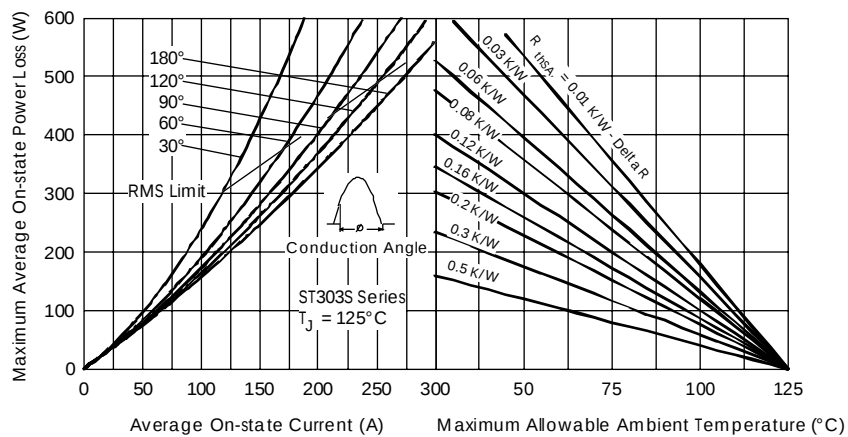


Fig. 3 - On-state Power Loss Characteristics

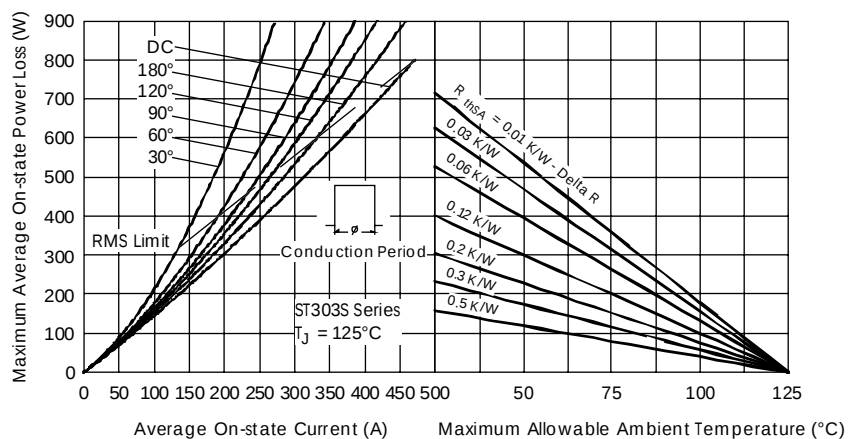


Fig. 4 - On-state Power Loss Characteristics

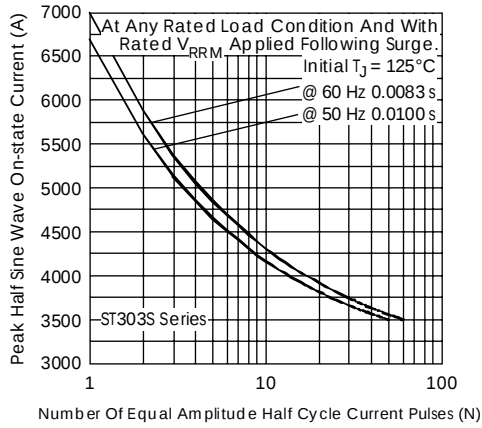


Fig. 5 - Maximum Non-repetitive Surge Current

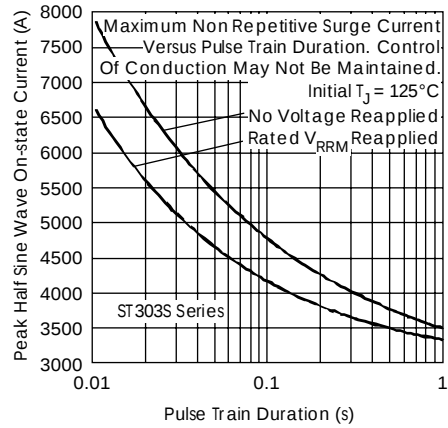


Fig. 6 - Maximum Non-repetitive Surge Current

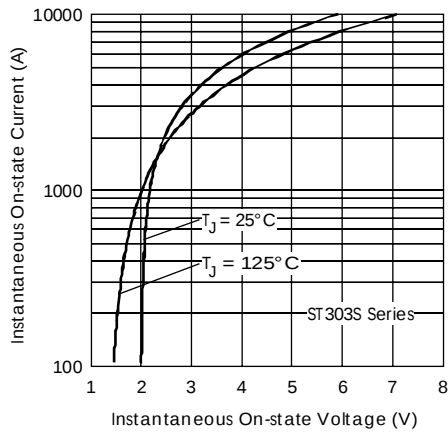


Fig. 7 - On-state Voltage Drop Characteristics

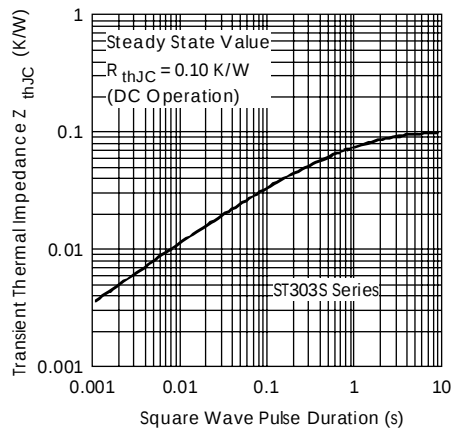


Fig. 8 - Thermal Impedance  $Z_{thJC}$  Characteristic

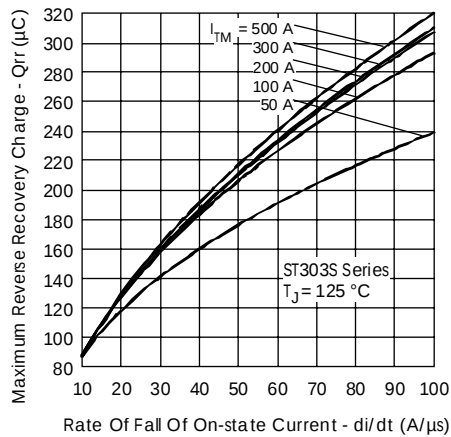


Fig. 9 - Reverse Recovered Charge Characteristics

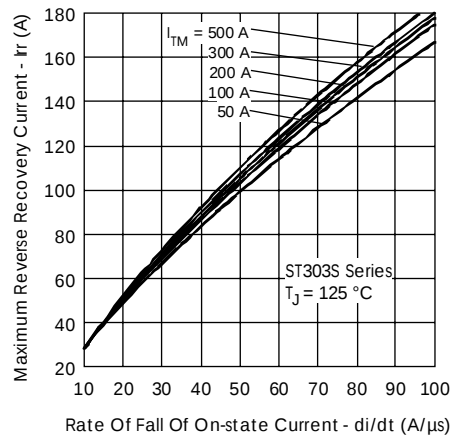


Fig. 10 - Reverse Recovery Current Characteristics

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International  
**IRF** Rectifier

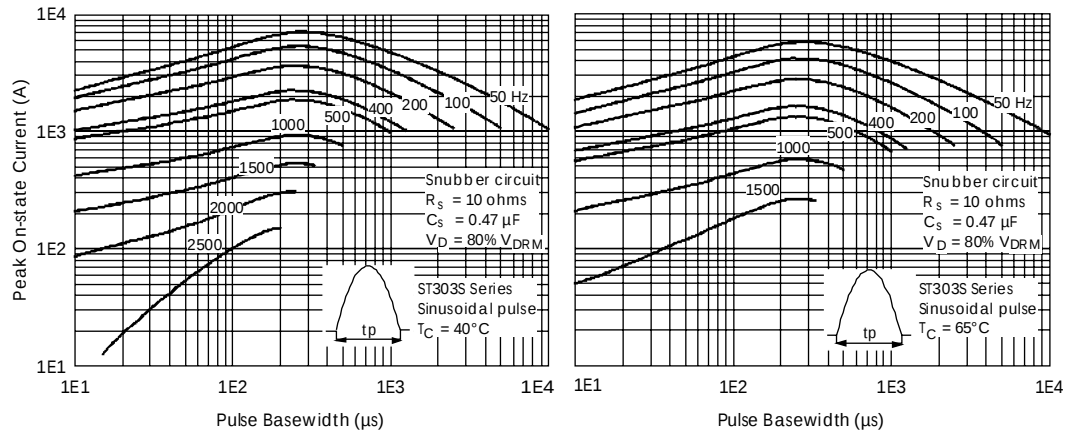


Fig. 11 - Frequency Characteristics

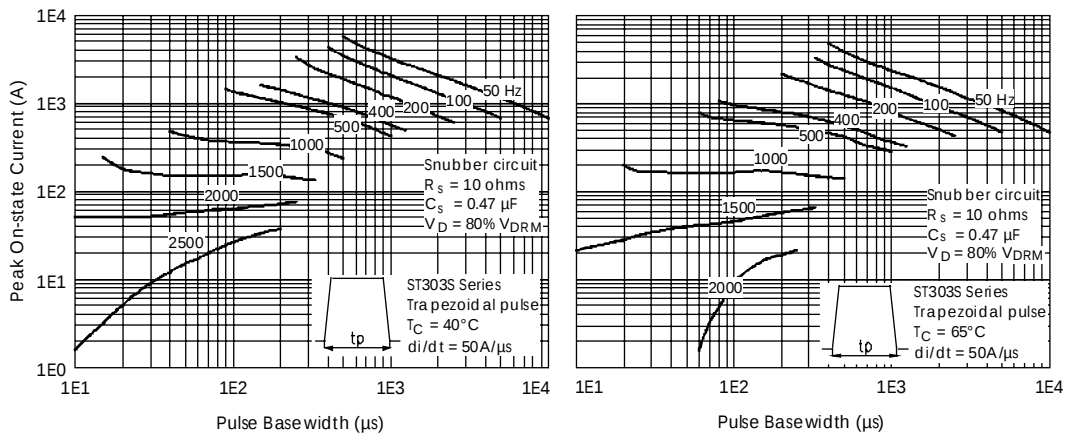


Fig. 12 - Frequency Characteristics

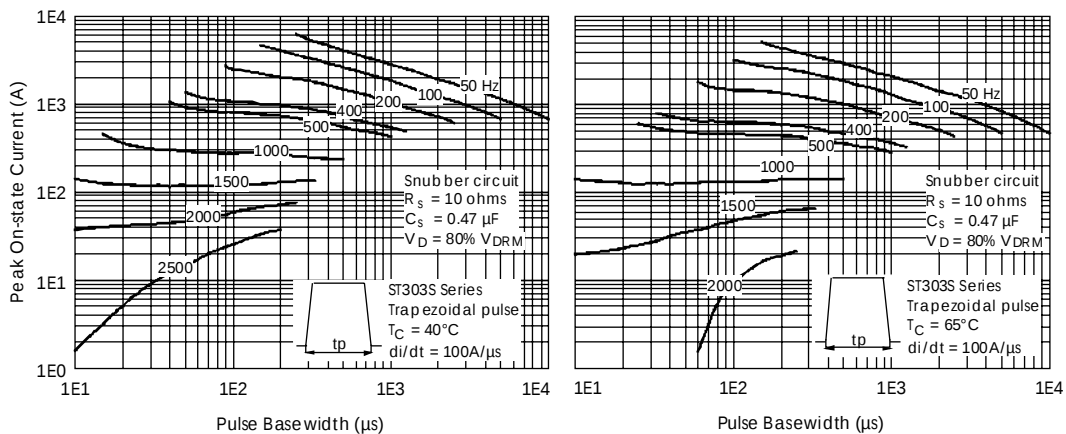


Fig. 13 - Frequency Characteristics

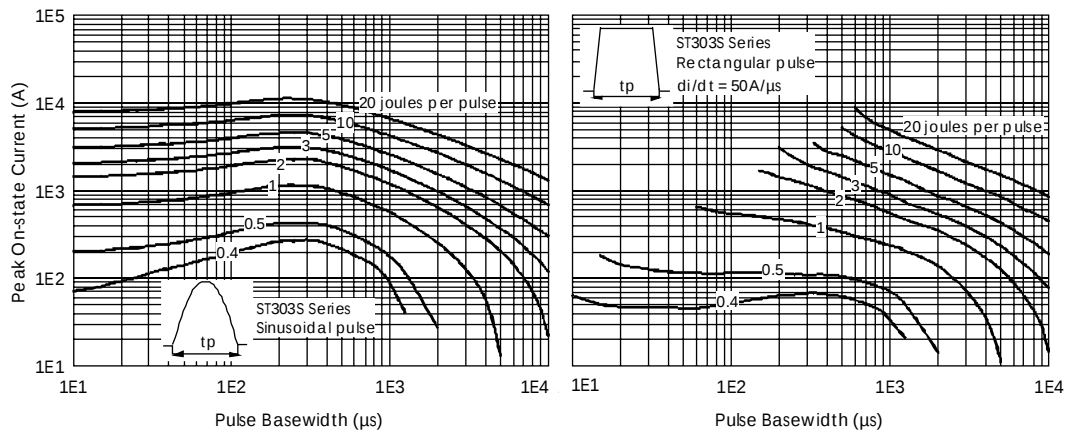


Fig. 14 - Maximum On-state Energy Power Loss Characteristics

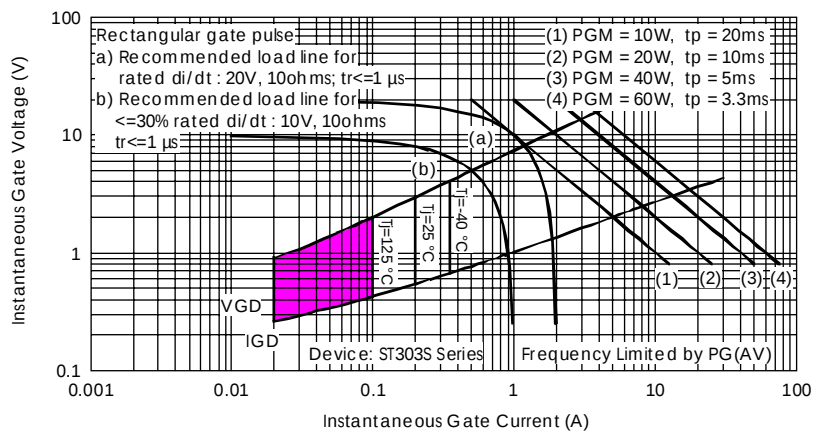


Fig. 15 - Gate Characteristics