

ST223S 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

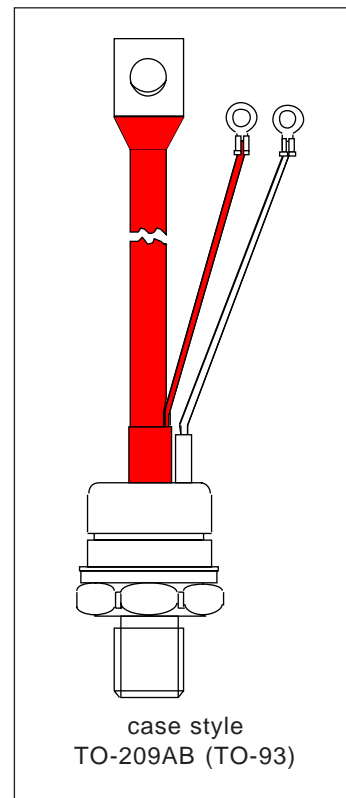
220A

Typical Applications

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

Major Ratings and Characteristics

| Parameters | ST223S | Units |
|-------------------|-------------|-----------------------|
| $I_{T(AV)}$ | 220 | A |
| | @ T_C | 85 °C |
| $I_{T(RMS)}$ | 345 | A |
| I_{TSM} | @ 50Hz | 5850 A |
| | @ 60Hz | 6120 A |
| I^2t | @ 50Hz | 171 KA ² s |
| | @ 60Hz | 156 KA ² s |
| V_{DRM}/V_{RRM} | 400 to 800 | V |
| t_q range | 10 to 20 | μs |
| T_J | - 40 to 125 | °C |



ST223S Series

Bulletin I25175 rev. C 12/96


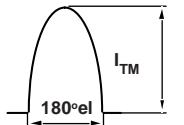
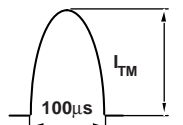
International
IRF Rectifier

ELECTRICAL SPECIFICATIONS

Voltage Ratings

| Type number | Voltage Code | V_{DRM}/V_{RRM} , maximum repetitive peak voltage V | V_{RSM} , maximum non-repetitive peak voltage V | I_{DRM}/I_{RRM} max. @ $T_J = T_J$ max. mA |
|-------------|--------------|--|--|--|
| ST223S | 04 | 400 | 500 | 40 |
| | 08 | 800 | 900 | |

Current Carrying Capability

| Frequency |  | |  | |  | | Units |
|----------------------------------|---|-----|---|-----|---|------|-------|
| | | | | | | | |
| 50Hz | 630 | 430 | 970 | 690 | 6450 | 4850 | A |
| 400Hz | 630 | 420 | 1010 | 710 | 3140 | 2280 | |
| 1000Hz | 580 | 370 | 1000 | 680 | 1860 | 1310 | |
| 2500Hz | 420 | 250 | 860 | 630 | 980 | 790 | |
| 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 | 60 | 85 | 60 | 85 | 60 | 85 | °C |
| Equivalent values for RC circuit | 47Ω / 0.22µF | | 47Ω / 0.22µF | | 47Ω / 0.22µF | | |

On-state Conduction

| Parameter | ST223S | Units | Conditions | |
|---|--------|--------------------|--|-----------------------|
| $I_{T(AV)}$ Max. average on-state current @ Case temperature | 220 | A | 180° conduction, half sine wave | |
| | 85 | °C | | |
| $I_{T(RMS)}$ Max. RMS on-state current | 345 | A | DC @ 76°C case temperature | |
| I_{TSM} Max. peak, one half cycle, non-repetitive surge current | 5850 | | t = 10ms | No voltage reappplied |
| | 6120 | | t = 8.3ms | reappplied |
| | 4920 | | t = 10ms | 100% V_{RRM} |
| | 5150 | t = 8.3ms | reappplied | |
| I^2t Maximum I^2t for fusing | 171 | KA ² s | t = 10ms | No voltage reappplied |
| | 156 | | t = 8.3ms | reappplied |
| | 121 | | t = 10ms | 100% V_{RRM} |
| | 111 | | t = 8.3ms | reappplied |
| $I^2\sqrt{t}$ Maximum $I^2\sqrt{t}$ for fusing | 1710 | KA ² √s | t = 0.1 to 10ms, no voltage reappplied | |

On-state Conduction

| Parameter | ST223S | Units | Conditions |
|---|--------|------------|--|
| V_{TM} Max. peak on-state voltage | 1.58 | V | $I_{TM} = 600A, T_J = T_J \text{ max}, t_p = 10\text{ms sine wave pulse}$ |
| $V_{T(TO)1}$ Low level value of threshold voltage | 1.05 | | $(16.7\% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)}, T_J = T_J \text{ max.}$ |
| $V_{T(TO)2}$ High level value of threshold voltage | 1.09 | | $(I > \pi \times I_{T(AV)}, T_J = T_J \text{ max.}$ |
| r_{t1} Low level value of forward slope resistance | 0.88 | m Ω | $(16.7\% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)}, T_J = T_J \text{ max.}$ |
| r_{t2} High level value of forward slope resistance | 0.82 | | $(I > \pi \times I_{T(AV)}, T_J = T_J \text{ max.}$ |
| 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 | ST223S | Units | Conditions |
|---|------------------|------------------|---|
| di/dt Max. non-repetitive rate of rise of turned-on current | 1000 | A/ μs | $T_J = T_J \text{ max}, V_{DRM} = \text{rated } V_{DRM}$ $I_{TM} = 2 \times di/dt$ |
| t_d Typical delay time | 0.78 | μs | $T_J = 25^\circ\text{C}, V_{DM} = \text{rated } V_{DRM}, I_{TM} = 50A \text{ DC}, t_p = 1\mu\text{s}$ Resistive load, Gate pulse: 10V, 5 Ω source |
| t_q Max. turn-off time | Min 10 Max 20 | | $T_J = T_J \text{ max}, I_{TM} = 300A, \text{commutating } di/dt = 20A/\mu\text{s}$ $V_R = 50V, t_p = 500\mu\text{s}, dv/dt: \text{ see table in device code}$ |

Blocking

| Parameter | ST223S | Units | Conditions |
|--|--------|------------------|--|
| dv/dt Maximum critical rate of rise of off-state voltage | 500 | V/ μs | $T_J = T_J \text{ max.}, \text{ linear to } 80\% V_{DRM}, \text{ higher value available on request}$ |
| I_{RRM} I_{DRM} Max. peak reverse and off-state leakage current | 40 | mA | $T_J = T_J \text{ max.}, \text{ rated } V_{DRM}/V_{RRM} \text{ applied}$ |

Triggering

| Parameter | ST223S | 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 | | |
| I_{GD} Max. DC gate current not to trigger | 20 | mA | $T_J = T_J \text{ max}, \text{ rated } V_{DRM} \text{ applied}$ |
| V_{GD} Max. DC gate voltage not to trigger | 0.25 | | |

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Bulletin I25175 rev. C 12/96

International
IRF Rectifier

Thermal and Mechanical Specifications

| Parameter | ST223S | 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 | 0.105 | K/W | DC operation |
| R _{thCS} Max. thermal resistance, case to heatsink | 0.04 | | Mounting surface, smooth, flat and greased |
| T Mounting torque, ± 10% | 31 (275) | Nm (lbf-in) | Non lubricated threads |
| | 24.5 (210) | Nm (lbf-in) | Lubricated threads |
| wt Approximate weight | 280 | g | |
| Case style | TO-209AB (TO-93) | | See Outline Table |

ΔR_{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° | 0.016 | 0.012 | K/W | T _J = T _J max. |
| 120° | 0.019 | 0.020 | | |
| 90° | 0.025 | 0.027 | | |
| 60° | 0.036 | 0.037 | | |
| 30° | 0.060 | 0.060 | | |

Ordering Information Table

Device Code

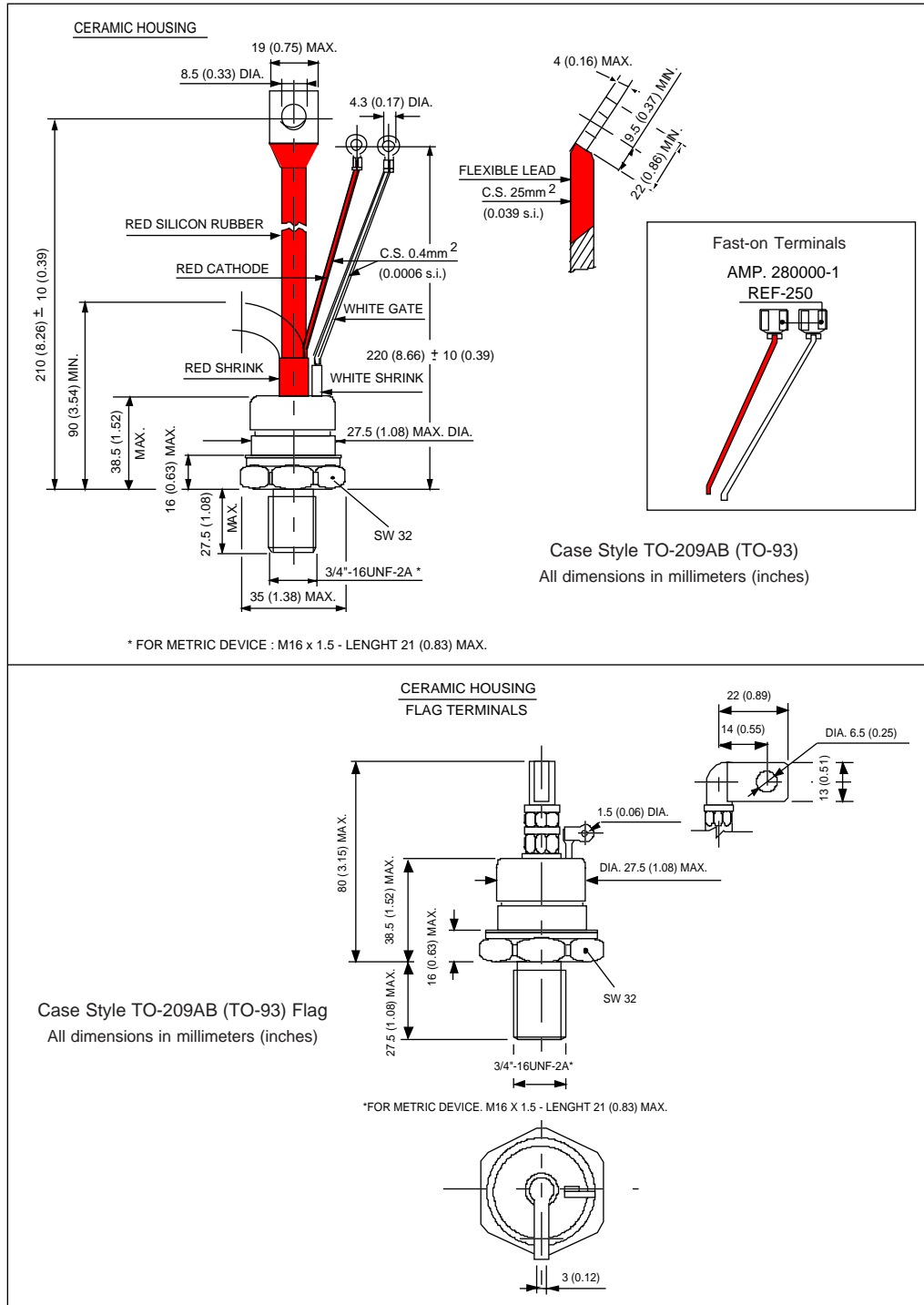
| | | | | | | | | | |
|----|----|---|---|----|---|---|---|---|---|
| ST | 22 | 3 | S | 08 | P | F | N | 0 | |
| ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | ⑩ |

- 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 M16 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)
2 = Flag terminals (For Cathode and Gate Terminals)
- 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 |
| 10 | CN | DN | EN | FN * | -- |
| 12 | CM | DM | EM | FM | -- |
| 15 | CL | DL | EL | FL * | HL |
| 18 | CP | DP | EP | FP | HP |
| 20 | CK | DK | EK | FK | HK |
| 25 | -- | -- | -- | -- | HJ |
| 30 | -- | -- | -- | -- | HH |

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

Outline Table



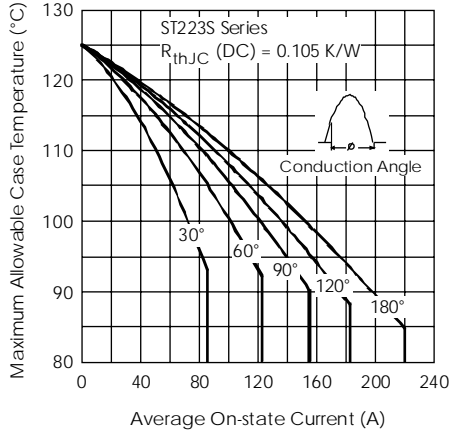


Fig. 1 - Current Ratings Characteristics

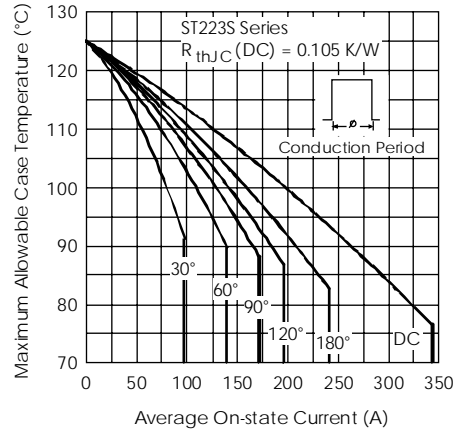


Fig. 2 - Current Ratings Characteristics

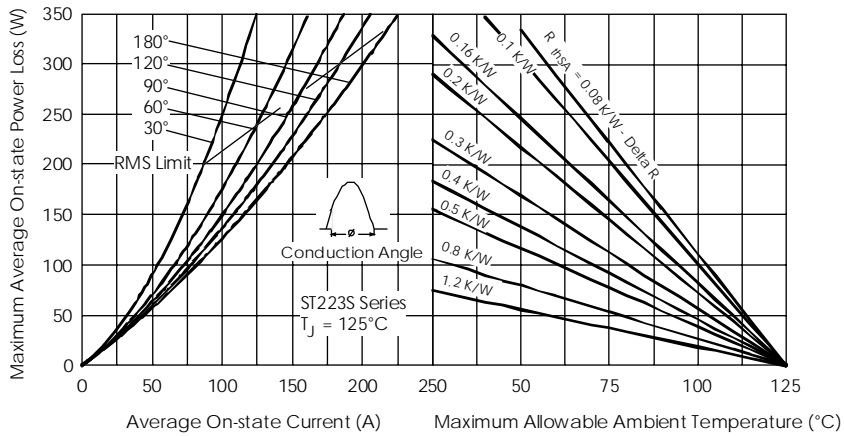


Fig. 3 - On-state Power Loss Characteristics

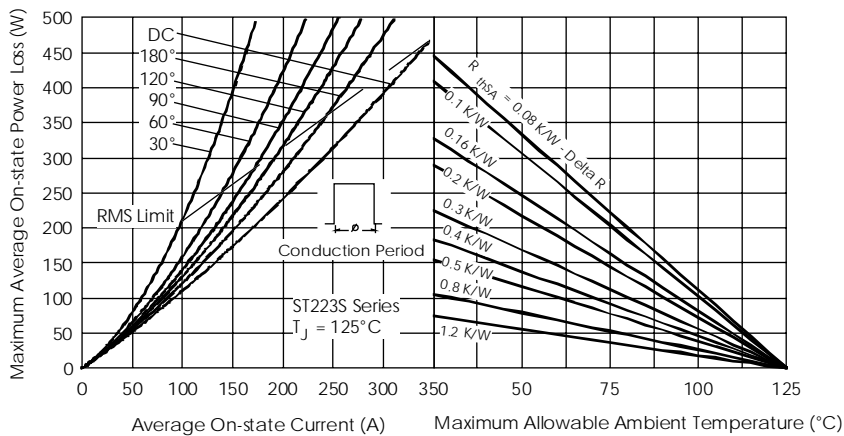


Fig. 4 - On-state Power Loss Characteristics

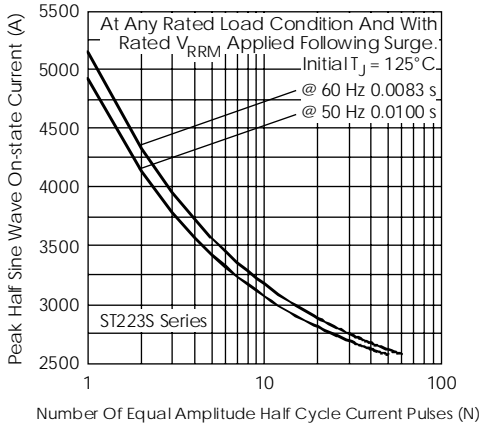


Fig. 5 - Maximum Non-repetitive Surge Current

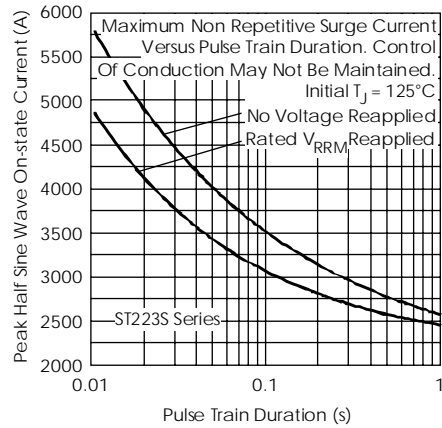


Fig. 6 - Maximum Non-repetitive Surge Current

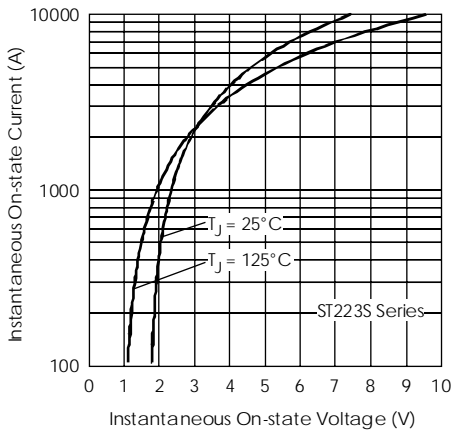


Fig. 7 - On-state Voltage Drop Characteristics

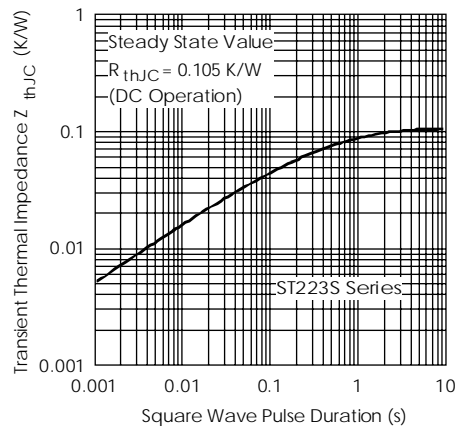


Fig. 8 - Thermal Impedance Z_{thJC} Characteristic

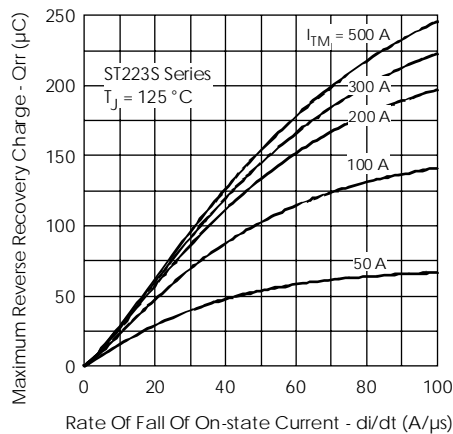


Fig. 9 - Reverse Recovered Charge Characteristics

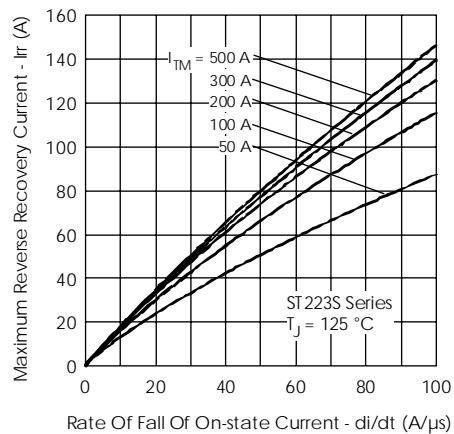


Fig. 10 - Reverse Recovery Current Characteristics

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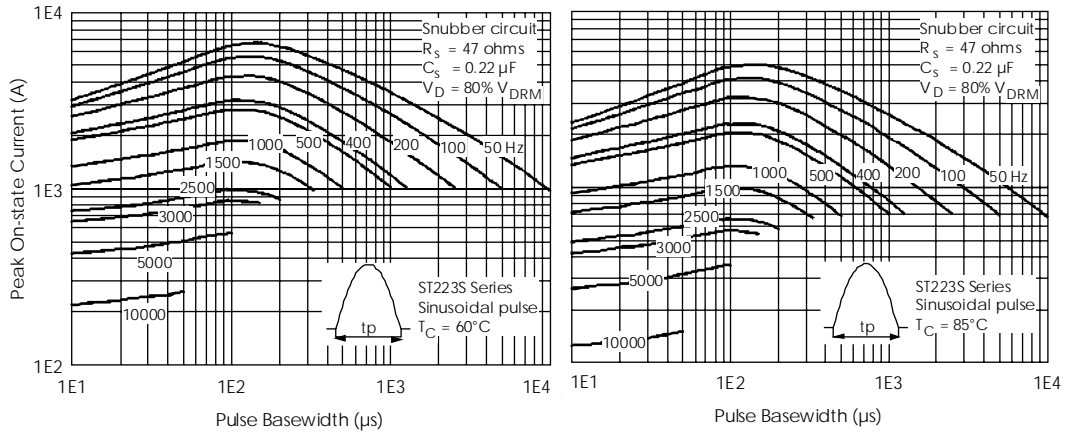


Fig. 11 - Frequency Characteristics

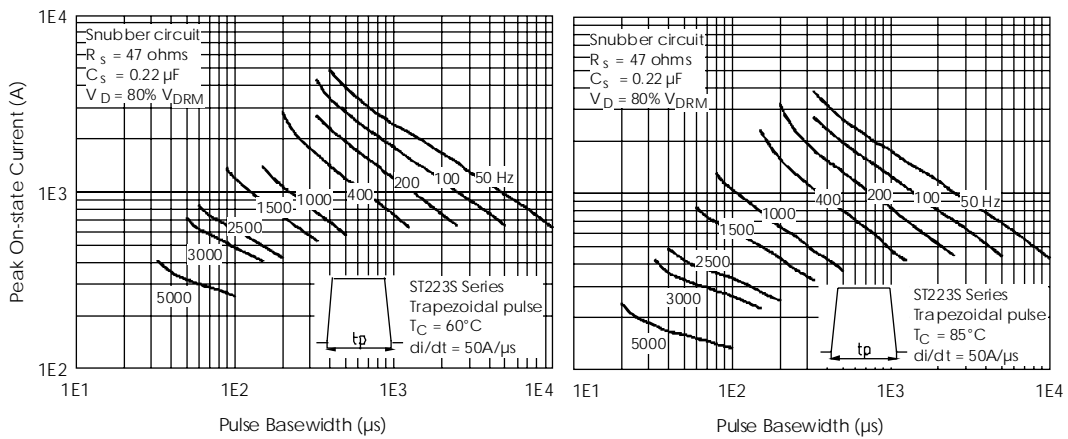


Fig. 12 - Frequency Characteristics

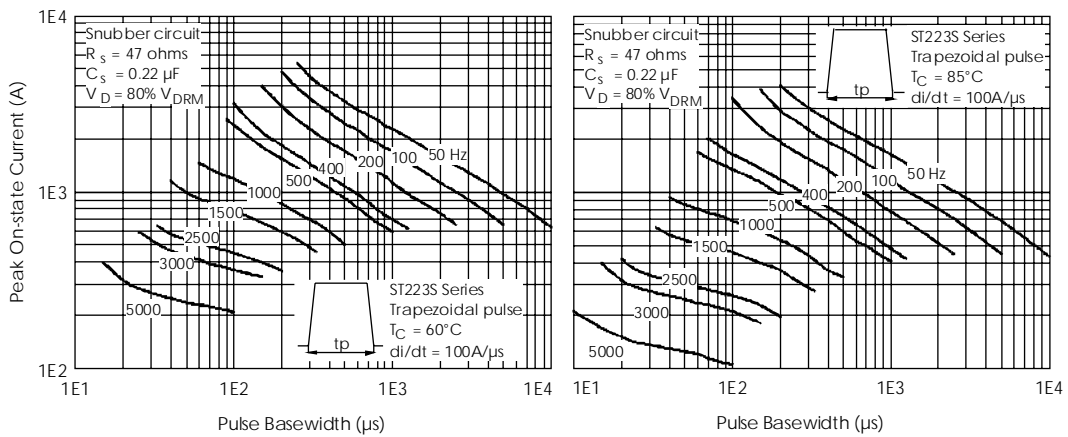


Fig. 13 - Frequency Characteristics

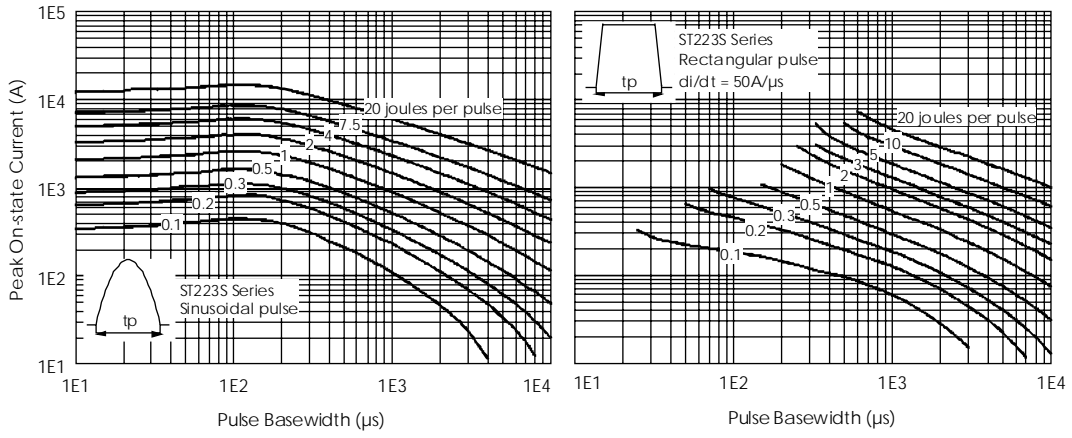


Fig. 14 - Maximum On-state Energy Power Loss Characteristics

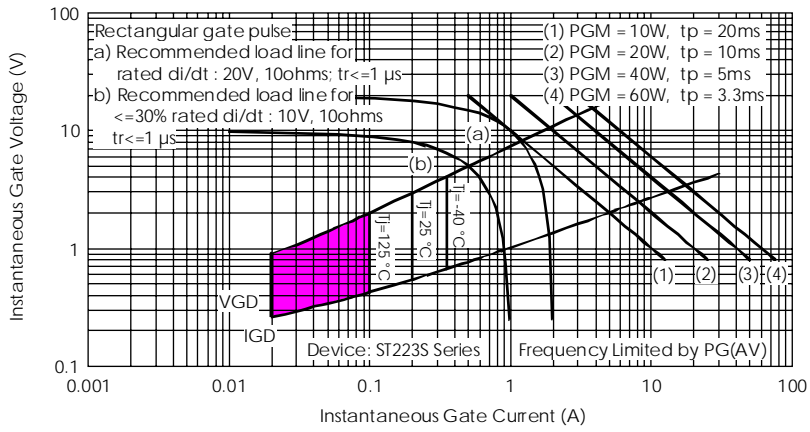


Fig. 15 - Gate Characteristics