# Fast Thyristor/Diode and Thyristor/Thyristor (MAGN-A-PAK™ Power Modules), 200 A

MAGN-A-PAK™

## FEATURES

- Fast turn-off thyristor
- Fast recovery diode
- High surge capability
- Electrically isolated baseplate
- 3500 $V_{RMS}$ isolating voltage
- Industrial standard package
- Lead (Pb)-free
- Designed and qualified for industrial level

Pb-free
RoHS COMPLIANT

## DESCRIPTION

This series of MAGN-A-PAK™ modules are intended for applications such as self-commutated inverters, DC choppers, electronic welders, induction heating and others where fast switching characteristics are required.

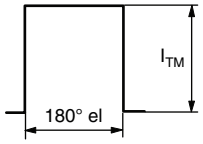
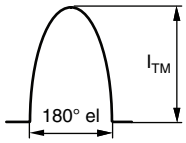
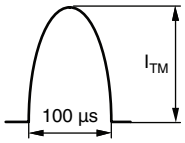
| PRODUCT SUMMARY | |
|---|---|
| $I_{T(AV)}$ | 200 A |

| MAJOR RATINGS AND CHARACTERISTICS | | | |
|---|---|---|---|
| SYMBOL | CHARACTERISTICS | VALUES | UNITS |
| $I_{T(AV)}$ | | 200 | A |
| | $T_C$ | 85 | °C |
| $I_{T(RMS)}$ | | 444 | A |
| $I_{TSM}$ | 50 Hz | 7600 | |
| | 60 Hz | 8000 | |
| $I^2t$ | 50 Hz | 290 | $kA^2s$ |
| | 60 Hz | 265 | |
| $I^2\sqrt{t}$ | | 2900 | $kA^2\sqrt{s}$ |
| $t_q$ | | 20/25 | µs |
| $t_{rr}$ | | 2 | |
| $V_{DRM}/V_{RRM}$ | | up to 1200 | V |
| $T_J$ | Range | - 40 to 125 | °C |

## ELECTRICAL SPECIFICATIONS

| VOLTAGE RATINGS | | | | |
|---|---|---|---|---|
| TYPE NUMBER | VOLTAGE CODE | $V_{RRM}/V_{DRM}$, MAXIMUM REPETITIVE PEAK REVERSE AND OFF-STATE BLOCKING VOLTAGE V | $V_{RSM}$, MAXIMUM NON-REPETITIVE PEAK REVERSE VOLTAGE V | $I_{RRM}/I_{DRM}$ AT $T_J$ = 125 °C mA |
| VSK.F200- | 08 | 800 | 800 | 50 |
| | 12 | 1200 | 1200 | |

## CURRENT CARRYING CAPABILITY

| FREQUENCY |  | |  | |  | | UNITS |
|---|---|---|---|---|---|---|---|
| 50 Hz | 380 | 560 | 630 | 850 | 2460 | 3180 | A |
| 400 Hz | 460 | 690 | 710 | 1060 | 1570 | 2080 | |
| 2500 Hz | 310 | 450 | 530 | 760 | 630 | 860 | |
| 5000 Hz | 250 | 360 | 410 | 560 | 410 | 560 | |
| 10 000 Hz | 180 | 280 | 300 | 410 | - | - | |
| Recovery voltage $V_r$ | 50 | 50 | 50 | 50 | 50 | 50 | V |
| Voltage before turn-on $V_d$ | 80 % $V_{DRM}$ | | 80 % $V_{DRM}$ | | 80 % $V_{DRM}$ | | |
| Rise of on-state current dI/dt | 50 | 50 | - | - | - | - | A/µs |
| Case temperature | 85 | 60 | 85 | 60 | 85 | 60 | °C |
| Equivalent values for RC circuit | 10/0.47 | | 10/0.47 | | 10/0.47 | | Ω/µF |

## 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 | | | 200 | A |
| | | | | | 85 | °C |
| Maximum RMS on-state current | $I_{T(RMS)}$ | As AC switch | | | 444 | A |
| Maximum peak, one-cycle non-repetitive on-state, surge current | $I_{TSM}$ | t = 10 ms | No voltage reapplied | Sinusoidal half wave, initial $T_J$ = 125 °C | 7600 | |
| | | t = 8.3 ms | | | 8000 | |
| | | t = 10 ms | 100 % $V_{RRM}$ reapplied | | 6400 | |
| | | t = 8.3 ms | | | 6700 | |
| Maximum $I^2t$ for fusing | $I^2t$ | t = 10 ms | No voltage reapplied | | 290 | $kA^2s$ |
| | | t = 8.3 ms | | | 265 | |
| | | t = 10 ms | 100 % $V_{RRM}$ reapplied | | 205 | |
| | | t = 8.3 ms | | | 187 | |
| Maximum $I^2\sqrt{t}$ for fusing | $I^2\sqrt{t}$ | t = 0.1 to 10 ms, no voltage reapplied | | | 2900 | $kA^2\sqrt{s}$ |
| Low level value or threshold voltage | $V_{T(TO)1}$ | (16.7 % x π x $I_{T(AV)}$ < I < π x $I_{T(AV)}$), $T_J$ = $T_J$ maximum | | | 1.18 | V |
| High level value of threshold voltage | $V_{T(TO)2}$ | (I > π x $I_{T(AV)}$ < I < π x $I_{T(AV)}$), $T_J$ = $T_J$ maximum | | | 1.25 | |
| Low level value on-state slope resistance | $r_{t1}$ | (16.7 % x π x $I_{T(AV)}$ < I < π x $I_{T(AV)}$), $T_J$ = $T_J$ maximum | | | 0.74 | mΩ |
| High level value on-state slope resistance | $r_{t2}$ | (I > π x $I_{T(AV)}$ < I < π x $I_{T(AV)}$), $T_J$ = $T_J$ maximum | | | 0.70 | |
| Maximum on-state voltage drop | $V_{TM}$ | $I_{pk}$ = 600 A, $T_J$ = $T_J$ maximum, $t_p$ = 10 ms sine pulse | | | 1.73 | V |
| Maximum holding current | $I_H$ | $T_J$ = 25 °C, $I_T$ > 30 A | | | 6000 | mA |
| Maximum latching current | $I_L$ | $T_J$ = 25 °C, $V_A$ = 12 V, Ra = 6 Ω, $I_g$ = 1A | | | 1000 | |

## SWITCHING

| PARAMETER | SYMBOL | TEST CONDITIONS | VALUES | | UNITS |
|---|---|---|---|---|---|
| | | | K | J | |
| Maximum non-repetitive rate of rise | dI/dt | Gate drive 20 V, 20 Ω, $t_r \leq 1$ ms, $V_D$ = 80 % $V_{DRM}$, $T_J$ = 25 °C | 800 | | A/µs |
| Maximum recovery time | $t_{rr}$ | $I_{TM}$ = 350 A, dI/dt = - 25 A/µs, $V_R$ = 50 V, $T_J$ = 25 °C | 2 | | µs |
| Maximum turn-off time | $t_q$ | $I_{TM}$ = 750 A; $T_J$ = $T_J$ maximum; dI/dt = - 25 A/µs; $V_R$ = 50 V; dV/dt = 400 V/µs linear to 80 % $V_{DRM}$ | 20 | 25 | |

## BLOCKING

| PARAMETER | SYMBOL | TEST CONDITIONS | VALUES | UNITS |
|---|---|---|---|---|
| Maximum critical rate of rise of off-state voltage | dV/dt | $T_J$ = 125 °C, exponential to 67 % $V_{DRM}$ | 1000 | V/µs |
| RMS insulation voltage | $V_{INS}$ | 50 Hz, circuit to base, $T_J$ = 25 °C, t = 1 s | 3000 | V |
| Maximum peak reverse and off-state leakage current | $I_{RRM}$, $I_{DRM}$ | $T_J$ = 125 °C, rated $V_{DRM}$/$V_{RRM}$ applied | 50 | mA |

## TRIGGERING

| PARAMETER | SYMBOL | TEST CONDITIONS | VALUES | UNITS |
|---|---|---|---|---|
| Maximum peak gate power | $P_{GM}$ | f = 50 Hz, d% = 50 | 60 | W |
| Maximum peak average gate power | $P_{G(AV)}$ | $T_J$ = 125 °C, f = 50 Hz, d% = 50 | 10 | |
| Maximum peak positive gate current | $I_{GM}$ | $T_J$ = 125 °C, $t_p \leq 5$ ms | 10 | A |
| Maximum peak negative gate voltage | $-V_{GT}$ | | 5 | V |
| Maximum DC gate current required to trigger | $I_{GT}$ | $T_J$ = 25 °C, $V_{ak}$ 12 V, Ra = 6 | 200 | mA |
| DC gate voltage required to trigger | $V_{GT}$ | | 3 | V |
| DC gate current not to trigger | $I_{GD}$ | $T_J$ = 125 °C, rated $V_{DRM}$ applied | 20 | mA |
| 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 |
| Storage temperature range | $T_{Stg}$ | | - 40 to 150 | |
| Maximum thermal resistance, junction to case per junction | $R_{thJC}$ | DC operation | 0.125 | K/W |
| Maximum thermal resistance, case to heatsink per module | $R_{thC-hs}$ | Mounting surface flat, smooth and greased | 0.025 | |
| Mounting torque ± 10 % — MAP to heatsink | | A mounting compound is recommended. The torque should be rechecked after a period of 3 hours to allow for the spread of the compound. Use of cable lugs is not recommended, busbar should be used and restrained during tightening. Threads must be lubricated with a compound. | 4 to 6 (35 to 53) | N · m (lbf · in) |
| Mounting torque ± 10 % — busbar to MAP | | | | |
| Approximate weight | | | 500 | g |
| | | | 17.8 | oz. |

| $\Delta R_{thJC}$ CONDUCTION | | | |
|---|---|---|---|
| CONDUCTIONS ANGLE | SINUSOIDAL CONDUCTION | RECTANGULAR CONDUCTION | UNITS |
| 180° | 0.009 | 0.006 | K/W |
| 120° | 0.10 | 0.011 | |
| 90° | 0.014 | 0.015 | |
| 60° | 0.020 | 0.020 | |
| 30° | 0.32 | 0.033 | |

**Note**

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

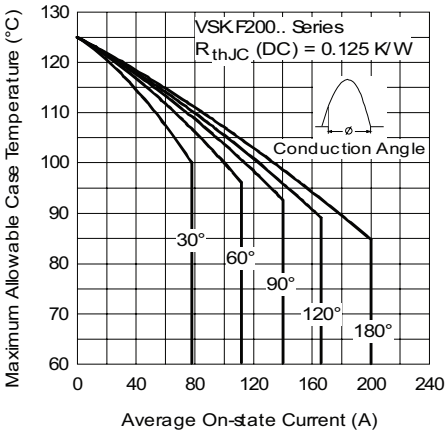



Fig. 1 - Current Ratings Characteristics

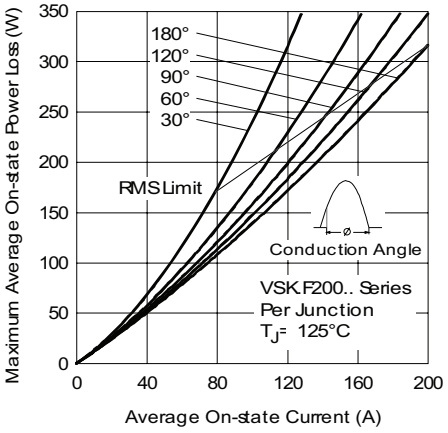



Fig. 3 - On-State Power Loss Characteristics

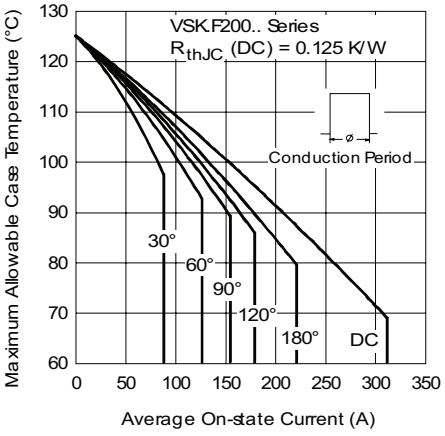



Fig. 2 - Current Ratings Characteristics

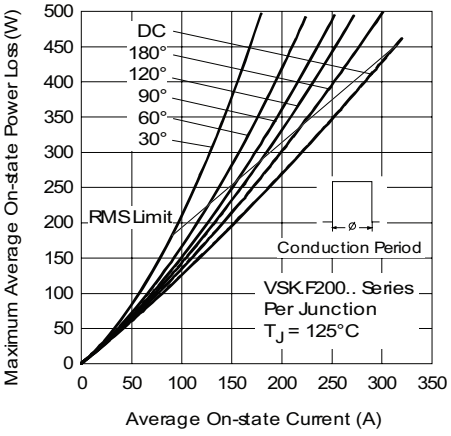



Fig. 4 - On-State Power Loss Characteristics

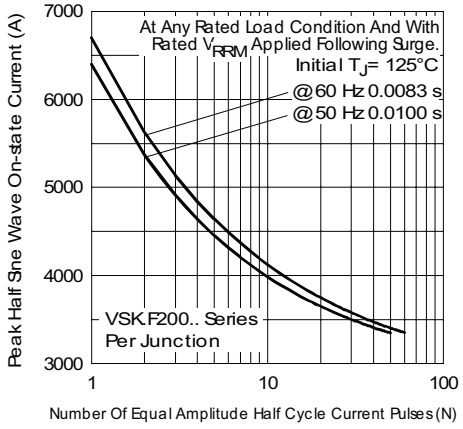



Fig. 5 - Maximum Non-Repetitive Surge Current

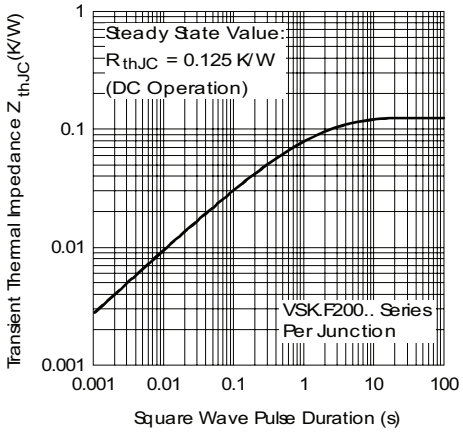



Fig. 8 - Thermal Impedance $Z_{thJC}$ Characteristics

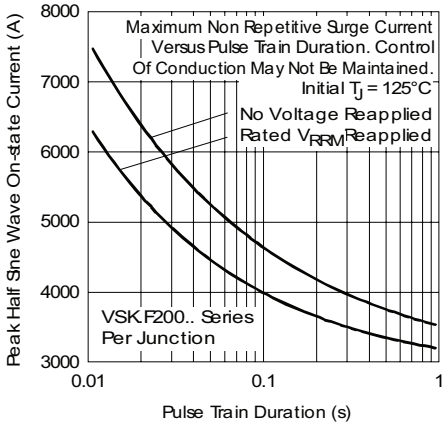



Fig. 6 - Maximum Non-Repetitive Surge Current

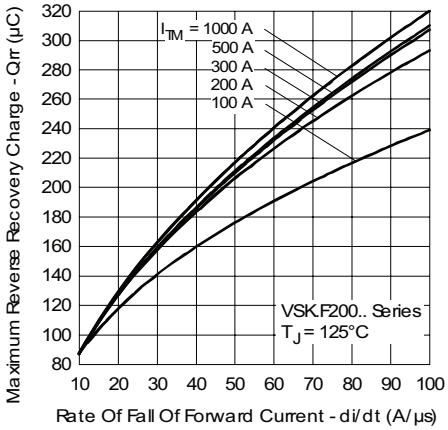



Fig. 9 - Reverse Recovery Charge Characteristics

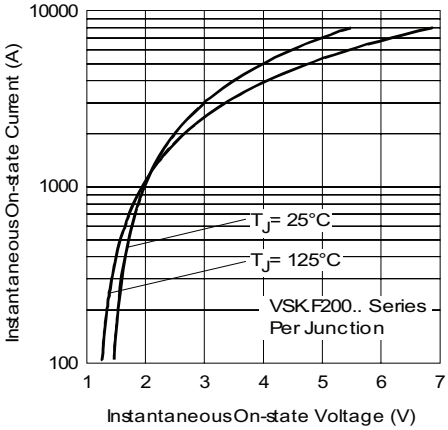



Fig. 7 - On-State Voltage Drop Characteristics

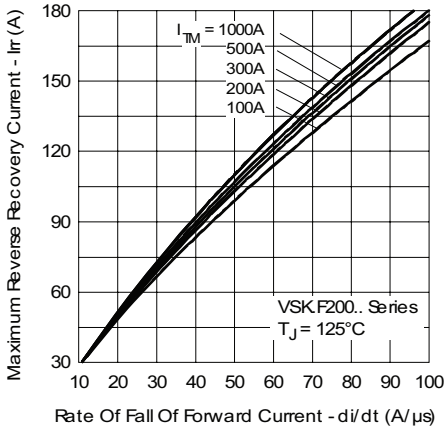



Fig. 10 - Reverse Recovery Current Characteristics

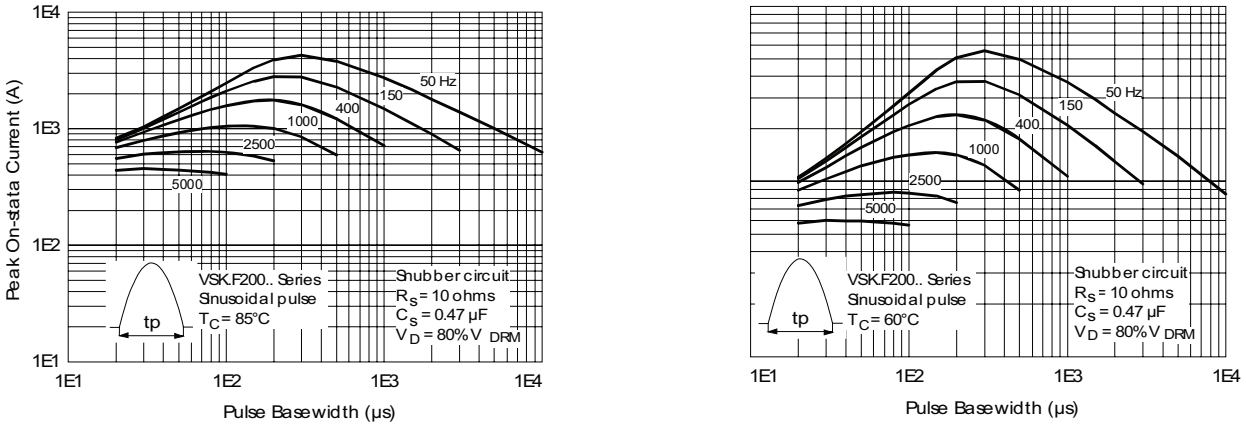



Fig. 11 - Frequency Characteristics

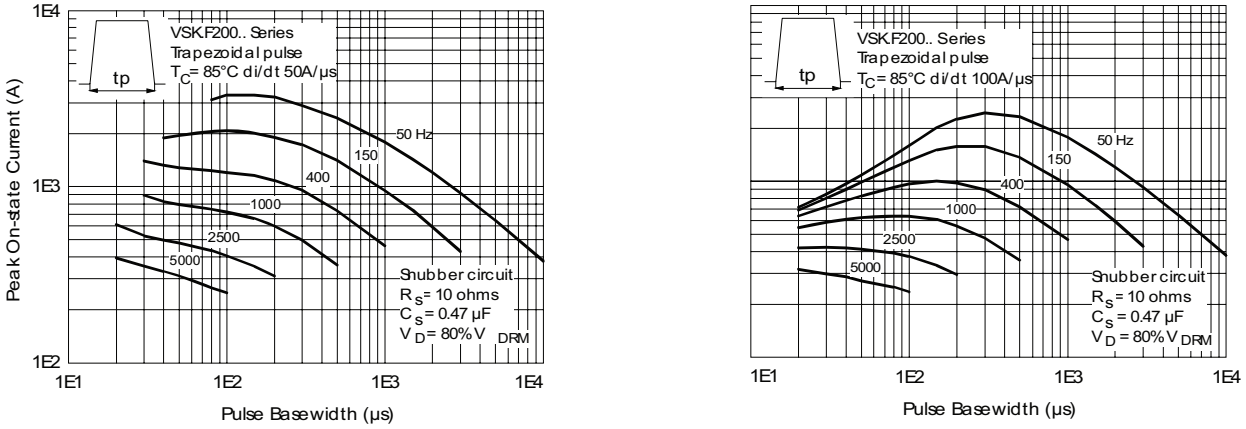



Fig. 12 - Frequency Characteristics

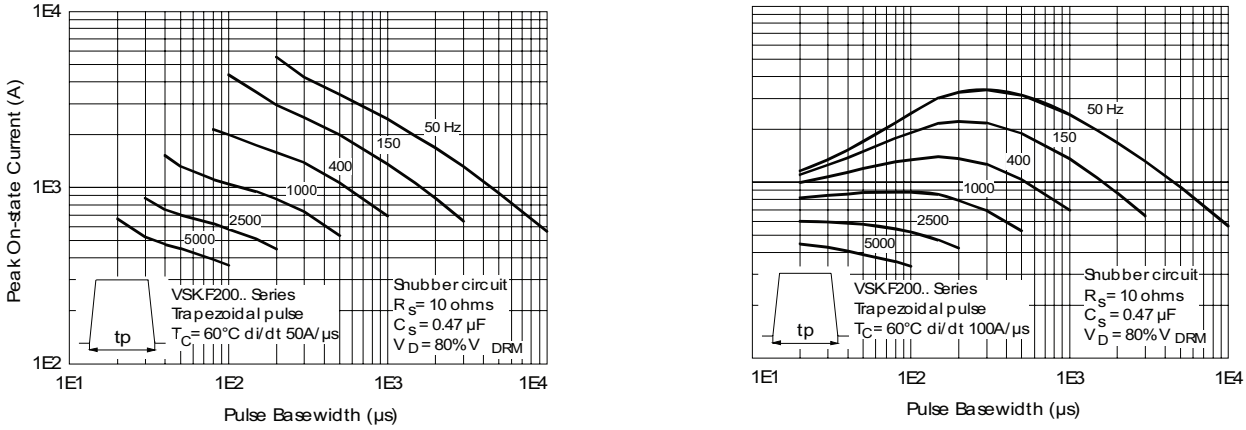



Fig. 13 - Frequency Characteristics

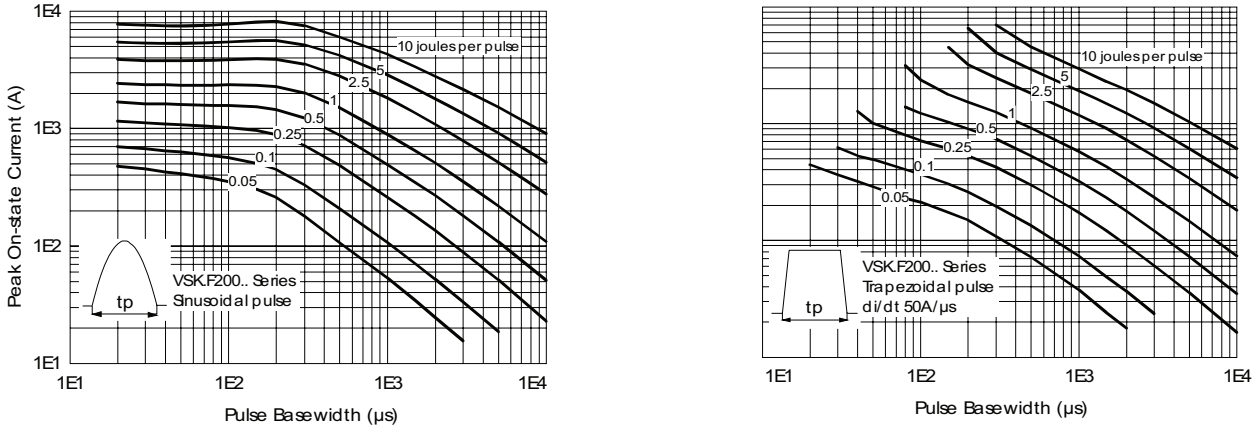



Fig. 14 - Maximum On-State Energy Power Loss Characteristics

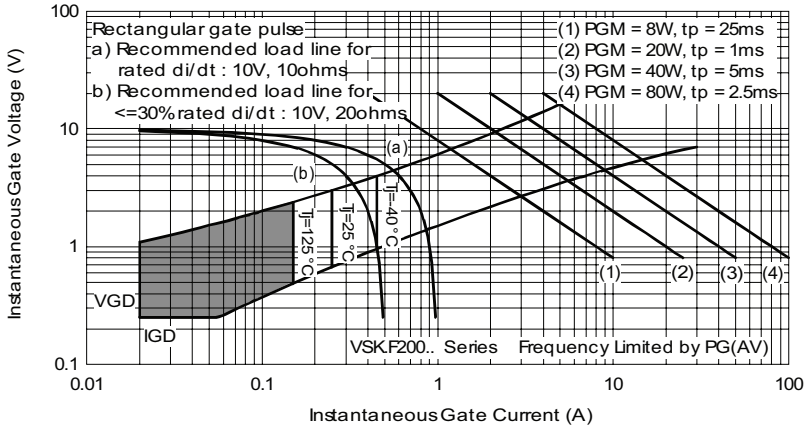



Fig. 15 - Gate Characteristics

## ORDERING INFORMATION TABLE

**Device code**

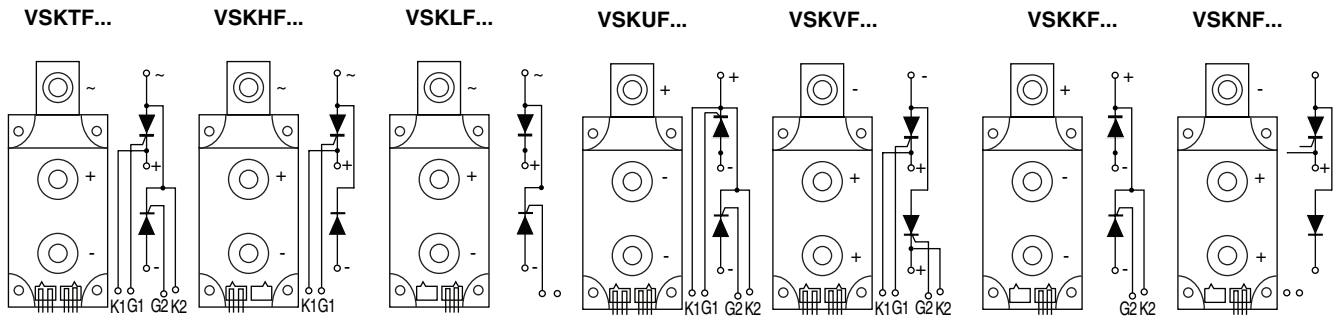
| VSK | T | F | 200 | - | 12 | H | K | P |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | | 5 | 6 | 7 | 8 |

- 1 - Module type
- 2 - Circuit configuration
- 3 - Fast SCR
- 4 - Current rating: $I_{T(AV)}$ x 10 rounded
- 5 - Voltage code x 100 = $V_{RRM}$ (see Voltage Ratings table)
- 6 - dV/dt code: H ≤ 400 V/µs
- 7 - $t_q$ code: K ≤ 20 µs
  J ≤ 25 µs
- 8 - Lead (Pb)-free

**Note**

- To order the optional hardware go to www.vishay.com/doc?95172

## CIRCUIT CONFIGURATION




| LINKS TO RELATED DOCUMENTS | |
|---|---|
| Dimensions | http://www.vishay.com/doc?95086 |

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