

SCR/SCR and SCR/Diode (MAGN-A-PAK Power Modules), 230 A


MAGN-A-PAK
FEATURES

- High voltage
- Electrically isolated base plate
- 3500 V_{RMS} isolating voltage
- Industrial standard package
- Simplified mechanical designs, rapid assembly
- High surge capability
- Large creepage distances
- UL approved file E78996
- Designed and qualified for industrial level
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


**RoHS
COMPLIANT**
PRIMARY CHARACTERISTICS

| | |
|-------------|-------------------------------|
| $I_{T(AV)}$ | 230 A |
| Type | Modules - thyristor, standard |
| Package | MAGN-A-PAK |

DESCRIPTION

This VSK series of MAGN-A-PAK modules uses high voltage power thyristor/thyristor and thyristor/diode in seven basic configurations. The semiconductors are electrically isolated from the metal base, allowing common heatsinks and compact assemblies to be built. They can be interconnected to form single phase or three phase bridges or as AC-switches when modules are connected in anti-parallel mode. These modules are intended for general purpose applications such as battery chargers, welders, motor drives, UPS, etc.

MAJOR RATINGS AND CHARACTERISTICS

| SYMBOL | CHARACTERISTICS | VALUES | UNITS |
|-------------------|-----------------|-------------|--------------------|
| $I_{T(AV)}$ | 85 °C | 230 | A |
| $I_{T(RMS)}$ | | 510 | |
| I_{TSM} | 50 Hz | 7500 | |
| | 60 Hz | 7850 | |
| I^2t | 50 Hz | 280 | kA ² s |
| | 60 Hz | 260 | |
| $I^2\sqrt{t}$ | | 280 | kA ² √s |
| V_{DRM}/V_{RRM} | | 800 to 2000 | V |
| T_J | Range | -40 to +130 | °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 130 °C MAXIMUM mA |
|-------------|--------------|---|--|--|
| VS-VSK.230- | 08 | 800 | 900 | 50 |
| | 12 | 1200 | 1300 | |
| | 16 | 1600 | 1700 | |
| | 18 | 1800 | 1900 | |
| | 20 | 2000 | 2100 | |



| 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 | | 230 | A |
| | | | | 85 | °C |
| Maximum RMS on-state current | $I_{T(RMS)}$ | As AC switch | | 510 | |
| Maximum peak, one-cycle on-state non-repetitive, surge current | I_{TSM} | t = 10 ms | No voltage reapplied | 7500 | A |
| | | t = 8.3 ms | | 7850 | |
| | | t = 10 ms | 100 % V_{RRM} reapplied | 6300 | |
| | | t = 8.3 ms | | 6600 | |
| Maximum I^2t for fusing | I^2t | t = 10 ms | No voltage reapplied | 280 | kA ² s |
| | | t = 8.3 ms | | 256 | |
| | | t = 10 ms | 100 % V_{RRM} reapplied | 198 | |
| | | t = 8.3 ms | | 181 | |
| Maximum $I^2\sqrt{t}$ for fusing | $I^2\sqrt{t}$ | t = 0.1 ms to 10 ms, no voltage reapplied | | 2800 | kA ² /s |
| Low level value or 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 | | 1.03 | V |
| High level value of threshold voltage | $V_{T(TO)2}$ | $(I > \pi \times I_{T(AV)})$, $T_J = T_J$ maximum | | 1.07 | |
| Low level value on-state slope resistance | r_{t1} | $(16.7\% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)})$, $T_J = T_J$ maximum | | 0.77 | mΩ |
| High level value on-state slope resistance | r_{t2} | $(I > \pi \times I_{T(AV)})$, $T_J = T_J$ maximum | | 0.73 | |
| Maximum on-state voltage drop | V_{TM} | $I_{TM} = \pi \times I_{T(AV)}$, $T_J = T_J$ maximum, 180° conduction, average power = $V_{T(TO)} \times I_{T(AV)} + r_f \times (I_{T(RMS)})^2$ | | 1.59 | V |
| Maximum holding current | I_H | Anode supply = 12 V, initial $I_T = 30$ A, $T_J = 25$ °C | | 500 | |
| Maximum latching current | I_L | Anode supply = 12 V, resistive load = 1 Ω, gate pulse: 10 V, 100 μs, $T_J = 25$ °C | | 1000 | mA |

| SWITCHING | | | | | |
|-----------------------|--------|--|--|-----------|-------|
| PARAMETER | SYMBOL | TEST CONDITIONS | | VALUES | UNITS |
| Typical delay time | t_d | $T_J = 25$ °C, gate current = 1 A $dI_g/dt = 1$ A/μs, $V_d = 0.67\% V_{DRM}$ | | 1.0 | μs |
| Typical rise time | t_r | | | 2.0 | |
| Typical turn-off time | t_q | $I_{TM} = 300$ A; $dI/dt = 15$ A/μs; $T_J = T_J$ maximum; $V_R = 50$ V; $dV/dt = 20$ V/μs; gate 0 V, 100 Ω | | 50 to 150 | |

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

| TRIGGERING | | | | | |
|---|-------------|--|--|--------|-------|
| PARAMETER | SYMBOL | TEST CONDITIONS | | VALUES | UNITS |
| Maximum peak gate power | P_{GM} | $t_p \leq 5$ ms, $T_J = T_J$ maximum | | 10.0 | W |
| Maximum average gate power | $P_{G(AV)}$ | f = 50 Hz, $T_J = T_J$ maximum | | 2.0 | |
| Maximum peak gate current | + I_{GM} | $t_p \leq 5$ ms, $T_J = T_J$ maximum | | 3.0 | A |
| Maximum peak negative gate voltage | - V_{GT} | $t_p \leq 5$ ms, $T_J = T_J$ maximum | | 5.0 | V |
| Maximum required DC gate voltage to trigger | V_{GT} | $T_J = -40$ °C | Anode supply = 12 V, resistive load; $R_a = 1$ Ω | 4.0 | |
| | | $T_J = 25$ °C | | 3.0 | |
| | | $T_J = T_J$ maximum | | 2.0 | |
| Maximum required DC gate current to trigger | I_{GT} | $T_J = -40$ °C | Anode supply = 12 V, resistive load; $R_a = 1$ Ω | 350 | |
| | | $T_J = 25$ °C | | 200 | |
| | | $T_J = T_J$ maximum | | 100 | |
| Maximum gate voltage that will not trigger | V_{GD} | $T_J = T_J$ maximum, rated V_{DRM} applied | | 0.25 | V |
| Maximum gate current that will not trigger | I_{GD} | $T_J = T_J$ maximum, rated V_{DRM} applied | | 10.0 | mA |
| Maximum rate of rise of turned-on current | dI/dt | $T_J = T_J$ maximum, $I_{TM} = 400$ A, rated V_{DRM} applied | | 500 | A/μs |



| THERMAL AND MECHANICAL SPECIFICATIONS | | | | |
|---|--|--|-------------|-------|
| PARAMETER | SYMBOL | TEST CONDITIONS | VALUES | UNITS |
| Junction operating temperature range | T_J | | -40 to +130 | °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 |
| Typical thermal resistance, case to heatsink per module | R_{thCS} | Mounting surface flat, smooth, and greased | 0.02 | |
| Mounting torque $\pm 10\%$ | MAGN-A-PAK to heatsink busbar to MAGN-A-PAK | A mounting compound is recommended and the torque should be rechecked after a period of about 3 h to allow for the spread of the compound. | 4 to 6 | Nm |
| Approximate weight | | | 500 | g |
| | | | 17.8 | oz. |
| Case style | | | MAGN-A-PAK | |

| ΔR CONDUCTION PER JUNCTION | | | | | | | | | | | |
|------------------------------------|--|-------|-------|-------|-------|---|-------|-------|-------|-------|-------|
| DEVICES | SINUSOIDAL CONDUCTION AT T_J MAXIMUM | | | | | RECTANGULAR CONDUCTION AT T_J MAXIMUM | | | | | UNITS |
| | 180° | 120° | 90° | 60° | 30° | 180° | 120° | 90° | 60° | 30° | |
| VSK.230- | 0.009 | 0.010 | 0.010 | 0.020 | 0.032 | 0.007 | 0.011 | 0.015 | 0.020 | 0.033 | K/W |

Note

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

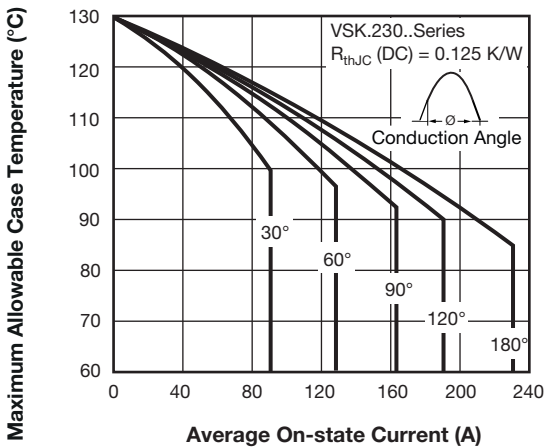


Fig. 1 - Current Ratings Characteristics



Fig. 2 - Current Ratings Characteristics

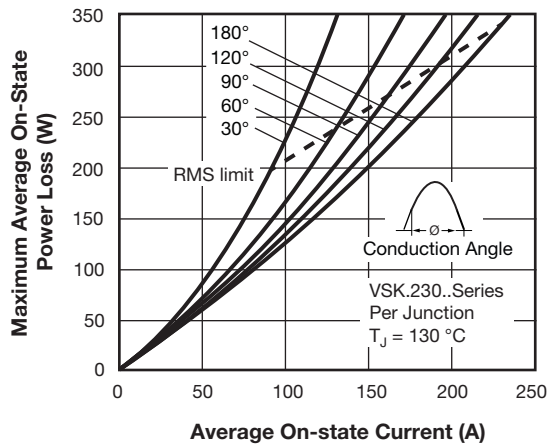


Fig. 3 - On-State Power Loss Characteristics



Fig. 5 - Maximum Non-Repetitive Surge Current

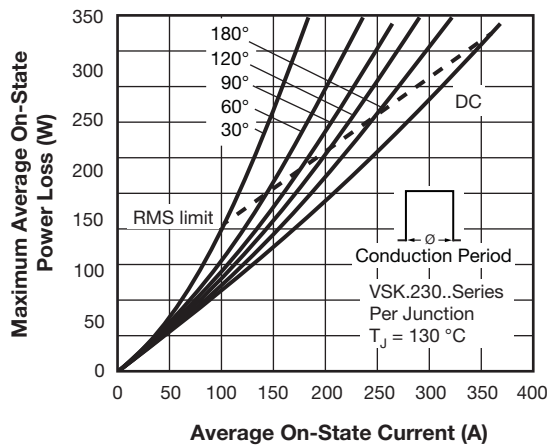


Fig. 4 - On-State Power Loss Characteristics



Fig. 6 - Maximum Non-Repetitive Surge Current

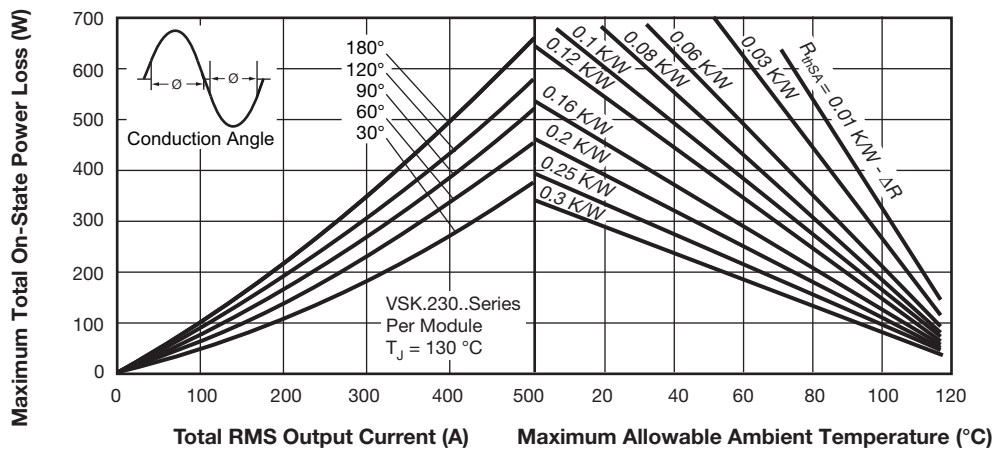


Fig. 7 - On-State Power Loss Characteristics



Fig. 8 - On-State Power Loss Characteristics



Fig. 9 - On-State Power Loss Characteristics



Fig. 10 - On-State Voltage Drop Characteristics



Fig. 11 - Reverse Recovery Charge Characteristics

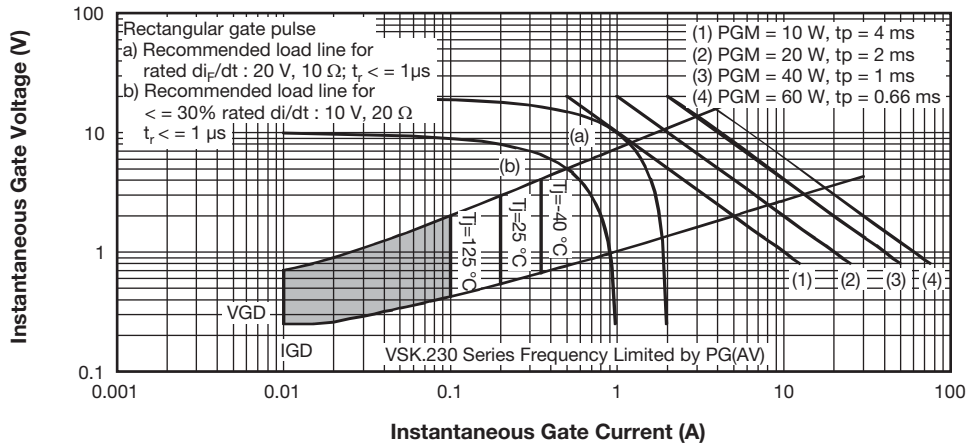


Fig. 12 - Gate Characteristics



Fig. 13 - Thermal Impedance Z_{thJC} Characteristics

ORDERING INFORMATION TABLE

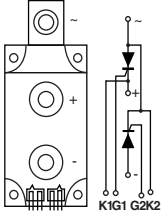
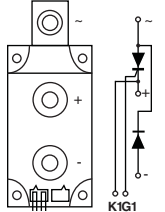
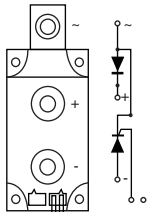
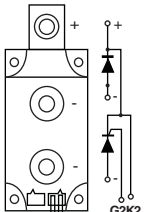
| | | | | | | |
|-------------|--------------|-----------|------------|----------|-----------|------------|
| Device code | VS-VS | KT | 230 | - | 20 | PbF |
| | ① | ② | ③ | | ④ | ⑤ |

- 1** - Vishay Semiconductors product
- 2** - Circuit configuration (see dimensions - link at the end of datasheet)
- 3** - Current rating
- 4** - Voltage code x 100 = V_{RRM} (see Voltage Ratings table)
- 5** -
 - None = standard production
 - PbF = lead (Pb)-free

Note

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



| CIRCUIT CONFIGURATION | | |
|---|----------------------------|---|
| CIRCUIT DESCRIPTION | CIRCUIT CONFIGURATION CODE | CIRCUIT DRAWING |
| Two SCRs doubler circuit | KT | <p>VSKT...</p>  <p>Available 800 V: contact factory for different requirements</p> |
| SCR/diode doubler circuit, positive control | KH | <p>VSKH...</p>  <p>Available 800 V: contact factory for different requirements</p> |
| SCR/diode doubler circuit, negative control | KL | <p>VSKL...</p>  <p>Available 800 V: contact factory for different requirements</p> |
| Two SCRs common cathodes | KK | <p>VSKK...</p>  <p>Available 800 V: contact factory for different requirements</p> |

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

MAGN-A-PAK

DIMENSIONS in millimeters (inches)



Notes

- Dimensions are nominal
- Full engineering drawings are available on request
- UL identification number for gate and cathode wire: UL 1385
- UL identification number for package: UL 94 V-0



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