

Thyristor/Diode and Thyristor/Thyristor, 135 A to 160 A (New INT-A-PAK Power Modules)



New INT-A-PAK

FEATURES

- High voltage
- Electrically isolated by DBC ceramic (Al_2O_3)
- 3500 V_{RMS} isolating voltage
- Industrial standard package
- High surge capability
- Glass passivated chips
- Modules uses high voltage power thyristor/diodes in three basic configurations
- Simple mounting
- UL approved file E78996
- Compliant to RoHS directive 2002/95/EC
- Designed and qualified for multiple level



RoHS
COMPLIANT

PRODUCT SUMMARY

| | |
|-------------|----------------|
| $I_{T(AV)}$ | 135 A to 160 A |
|-------------|----------------|

APPLICATIONS

- DC motor control and drives
- Battery charges
- Welders
- Power converters
- Lighting control
- Heat and temperature control

MAJOR RATINGS AND CHARACTERISTICS

| SYMBOL | CHARACTERISTICS | VSK.136.. | VSK.142.. | VSK.162.. | UNITS |
|---------------|-----------------|-------------|-----------|-----------|----------------|
| $I_{T(AV)}$ | 85 °C | 135 | 140 | 160 | A |
| $I_{T(RMS)}$ | | 300 | 310 | 355 | A |
| I_{TSM} | 50 Hz | 3200 | 4500 | 4870 | |
| | 60 Hz | 3360 | 4712 | 5100 | |
| I^2t | 50 Hz | 51.5 | 102 | 119 | kA^2s |
| | 60 Hz | 47 | 92.5 | 108 | |
| $I^2\sqrt{t}$ | | 515.5 | 1013 | 1190 | $kA^2\sqrt{s}$ |
| V_{RRM} | Range | 400 to 1600 | | | V |
| T_J | Range | - 40 to 125 | | | °C |

ELECTRICAL SPECIFICATIONS

VOLTAGE RATINGS

| TYPE NUMBER | VOLTAGE CODE | V_{RRM}/V_{DRM} , MAXIMUM REPETITIVE PEAK REVERSE VOLTAGE V | V_{RSM}/V_{DSM} , MAXIMUM NON-REPETITIVE PEAK REVERSE VOLTAGE V | I_{RRM}/I_{DRM} AT 125 °C mA |
|-------------------------------|--------------|--|--|-----------------------------------|
| VSK.136 VSK.142 VSK.162 | 04 | 400 | 500 | 50 |
| | 08 | 800 | 900 | |
| | 12 | 1200 | 1300 | |
| | 14 | 1400 | 1500 | |
| | 16 | 1600 | 1700 | |

VSK.136..PbF, VSK.142..PbF, VSK.162..PbF Series



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| FORWARD CONDUCTION | | | | | | | | |
|--|---------------|---|---------------------------|---------|---------|---------|--------------------|-------------------|
| PARAMETER | SYMBOL | TEST CONDITIONS | | VSK.136 | VSK.142 | VSK.162 | UNITS | |
| Maximum average on-state current at case temperature | $I_{T(AV)}$ | 180° conduction, half sine wave | | 135 | 140 | 160 | A | |
| | | | | 85 | 85 | 85 | °C | |
| Maximum RMS on-state current | $I_{T(RMS)}$ | As AC switch | | 300 | 310 | 355 | A | |
| Maximum peak, one-cycle on-state, non-repetitive surge current | I_{TSM} | t = 10 ms | No voltage reapplied | 3200 | 4500 | 4870 | | |
| | | t = 8.3 ms | No voltage reapplied | 3360 | 4712 | 5100 | | |
| | | t = 10 ms | 100 % V_{RRM} reapplied | 2700 | 3785 | 4100 | | |
| | | t = 8.3 ms | 100 % V_{RRM} reapplied | 2800 | 3963 | 4300 | | |
| Maximum I^2t for fusing | I^2t | t = 10 ms | No voltage reapplied | 51.5 | 102 | 119 | | kA ² s |
| | | t = 8.3 ms | No voltage reapplied | 47 | 92.5 | 108 | | |
| | | t = 10 ms | 100 % V_{RRM} reapplied | 36.5 | 71.6 | 84 | | |
| | | t = 8.3 ms | 100 % V_{RRM} reapplied | 33.3 | 65.4 | 76.7 | | |
| Maximum $I^2\sqrt{t}$ for fusing | $I^2\sqrt{t}$ | t = 0.1 ms to 10 ms, no voltage reapplied | | 515.5 | 1013 | 1190 | kA ² √s | |
| 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 maximum | | 0.86 | 0.83 | 0.8 | V | |
| High level value of threshold voltage | $V_{T(TO)2}$ | $(I > \pi \times I_{T(AV)})$, T_J maximum | | 1.05 | 1 | 0.98 | | |
| 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 maximum | | 2.02 | 1.78 | 1.67 | mΩ | |
| High level value on-state slope resistance | r_{t2} | $(I > \pi \times I_{T(AV)})$, T_J maximum | | 1.65 | 1.43 | 1.38 | | |
| Maximum on-state voltage drop | V_{TM} | $I_{TM} = \pi \times I_{T(AV)}$, $T_J = 25\text{ °C}$, 180° conduction | | 1.57 | 1.55 | 1.54 | V | |
| Maximum forward voltage drop | V_{FM} | $I_{TM} = \pi \times I_{T(AV)}$, $T_J = 25\text{ °C}$, 180° conduction | | 1.57 | 1.55 | 1.54 | V | |
| Maximum holding current | I_H | Anode supply = 6 V initial $I_T = 30\text{ A}$, $T_J = 25\text{ °C}$ | | 200 | | | mA | |
| Maximum latching current | I_L | Anode supply = 6 V resistive load = 1 Ω Gate pulse: 10 V, 100 μs, $T_J = 25\text{ °C}$ | | 400 | | | | |

| SWITCHING | | | | | | |
|-----------------------|----------|--|--|-----------|--|-------|
| PARAMETER | SYMBOL | TEST CONDITIONS | | VALUES | | UNITS |
| Typical delay time | t_{gd} | $T_J = 25\text{ °C}$ | Gate current = 1 A, $di_g/dt = 1\text{ A}/\mu\text{s}$ $V_d = 0.67\% V_{DRM}$ | 1 | | μs |
| Typical rise time | t_{gr} | | | 2 | | |
| Typical turn-off time | t_q | $I_{TM} = 300\text{ A}$, - $di/dt = 15\text{ A}/\mu\text{s}$; $T_J = T_J$ maximum $V_R = 50\text{ V}$; $dV/dt = 20\text{ V}/\mu\text{s}$; gate 0 V, 100 Ω | | 50 to 200 | | |

| BLOCKING | | | | | |
|--|--------------------------|--|--|--------|-------|
| PARAMETER | SYMBOL | TEST CONDITIONS | | VALUES | UNITS |
| Maximum peak reverse and off-state leakage current | I_{RRM} , I_{DRM} | $T_J = 125\text{ °C}$ | | 50 | mA |
| RMS insulation voltage | V_{INS} | 50 Hz, circuit to base, all terminals shorted, t = 1 s | | 3500 | 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 |



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| TRIGGERING | | | | | |
|---|-------------|---|---|--------|------------|
| PARAMETER | SYMBOL | TEST CONDITIONS | | VALUES | UNITS |
| Maximum peak gate power | P_{GM} | $t_p \leq 5$ ms, $T_J = T_J$ maximum | | 12 | W |
| Maximum average gate power | $P_{G(AV)}$ | f = 50 Hz, $T_J = T_J$ maximum | | 3 | |
| Maximum peak gate current | I_{GM} | $t_p \leq 5$ ms, $T_J = T_J$ maximum | | 3 | A |
| Maximum peak negative gate voltage | $-V_{GT}$ | | | 10 | |
| Maximum required DC gate voltage to trigger | V_{GT} | $T_J = -40$ °C | Anode supply = 6 V, resistive load; $R_a = 1$ Ω | 4 | V |
| | | $T_J = 25$ °C | | 2.5 | |
| | | $T_J = T_J$ maximum | | 1.7 | |
| Maximum required DC gate current to trigger | I_{GT} | $T_J = -40$ °C | | 270 | mA |
| | | $T_J = 25$ °C | | 150 | |
| | | $T_J = T_J$ maximum | | 80 | |
| Maximum gate voltage that will not trigger | V_{GD} | $T_J = T_J$ maximum, rated V_{DRM} applied | | 0.3 | V |
| Maximum gate current that will not trigger | I_{GD} | | | 10 | mA |
| Maximum rate of rise of turned-on current | di/dt | $T_J = T_J$ maximum, $I_{TM} = 400$ A rated V_{DRM} applied | | 300 | A/ μ s |

| 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 per junction | R_{thJC} | DC operation | 0.18 0.16 | K/W |
| Maximum thermal resistance, case to heatsink per module | R_{thCS} | Mounting surface, smooth, flat and greased | 0.05 | |
| Mounting torque ± 10 % | IAP to heatsink busbar to IAP | A mounting compound is recommended and the torque should be rechecked after a period of 3 hours to allow for the spread of the compound. Lubricated threads. | 4 to 6 | Nm |
| Approximate weight | | | 200 | g |
| | | | 7.1 | oz. |
| Case style | | | New INT-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.136 | 0.007 | 0.01 | 0.013 | 0.0155 | 0.017 | 0.009 | 0.012 | 0.014 | 0.015 | 0.017 | K/W |
| VSK.142 | 0.0019 | 0.0019 | 0.0020 | 0.0020 | 0.0021 | 0.0018 | 0.0022 | 0.0023 | 0.0023 | 0.0020 | |
| VSK.162 | 0.0030 | 0.0031 | 0.0032 | 0.0033 | 0.0034 | 0.0029 | 0.0036 | 0.0039 | 0.0041 | 0.0040 | |

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. 4 - On-State Power Loss Characteristics



Fig. 2 - Current Ratings Characteristics

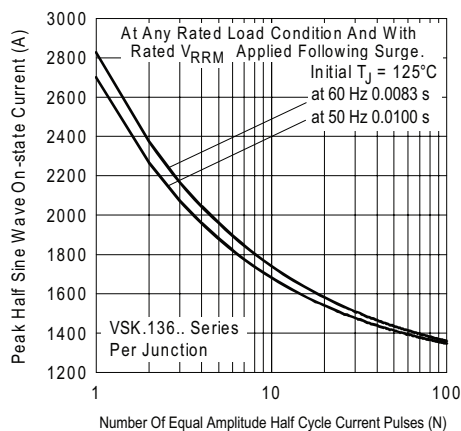


Fig. 5 - Maximum Non-Repetitive Surge Current



Fig. 3 - On-State Power Loss Characteristics



Fig. 6 - Maximum Non-Repetitive Surge Current



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Fig. 7 - On-State Power Loss Characteristics

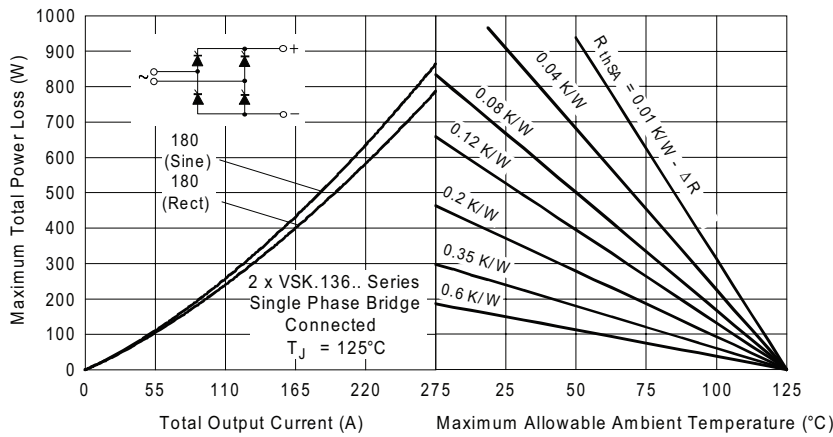


Fig. 8 - On-State Power Loss Characteristics



Fig. 9 - On-State Power Loss Characteristics



Fig. 10 - Current Ratings Characteristics



Fig. 13 - On-State Power Loss Characteristics

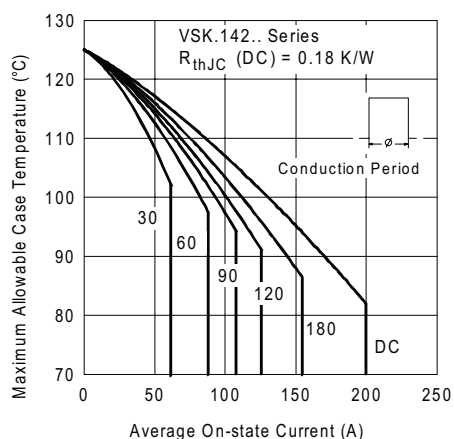


Fig. 11 - Current Ratings Characteristics



Fig. 14 - Maximum Non-Repetitive Surge Current



Fig. 12 - On-State Power Loss Characteristics

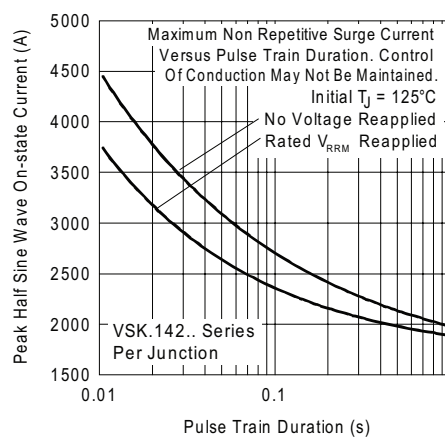


Fig. 15 - Maximum Non-Repetitive Surge Current



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Fig. 16 - On-State Power Loss Characteristics



Fig. 17 - On-State Power Loss Characteristics



Fig. 18 - On-State Power Loss Characteristics

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Fig. 19 - Current Ratings Characteristics



Fig. 22 - On-State Power Loss Characteristics



Fig. 20 - Current Ratings Characteristics



Fig. 23 - Maximum Non-Repetitive Surge Current



Fig. 21 - On-State Power Loss Characteristics



Fig. 24 - Maximum Non-Repetitive Surge Current



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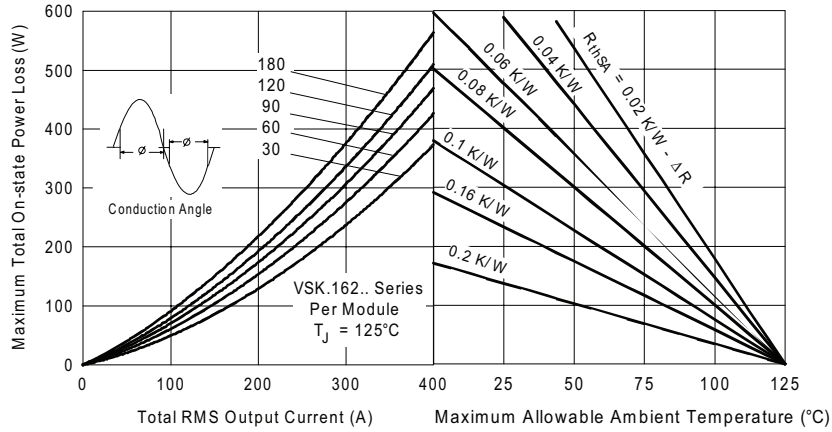


Fig. 25 - On-State Power Loss Characteristics



Fig. 26 - On-State Power Loss Characteristics



Fig. 27 - On-State Power Loss Characteristics

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Fig. 28 - On-State Voltage Drop Characteristics



Fig. 31 - Thermal Impedance Z_{thJC} Characteristics



Fig. 29 - On-State Voltage Drop Characteristics



Fig. 32 - Thermal Impedance Z_{thJC} Characteristics



Fig. 30 - On-State Voltage Drop Characteristics



Fig. 33 - Thermal Impedance Z_{thJC} Characteristics



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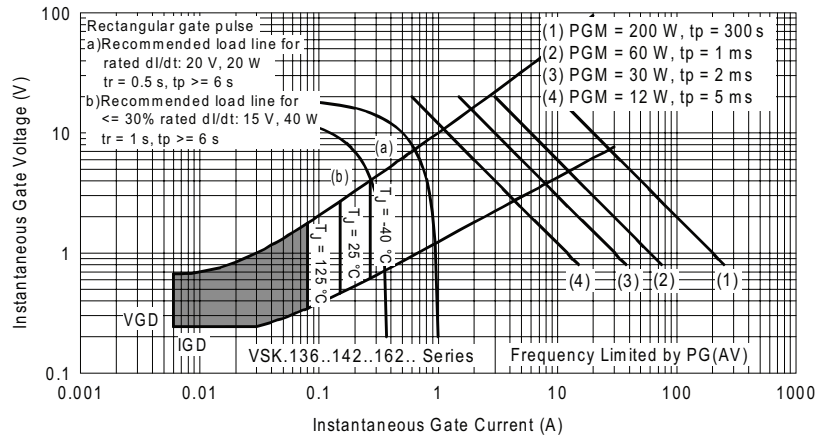


Fig. 34 - Gate Characteristics

ORDERING INFORMATION TABLE

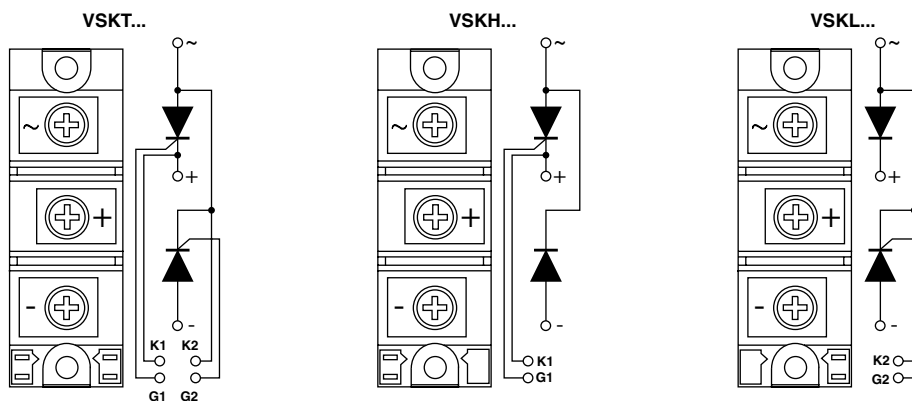
| | | | | | | |
|-------------|------------|----------|------------|----------|-----------|------------|
| Device code | VSK | T | 162 | / | 16 | PbF |
| | ① | ② | ③ | | ④ | ⑤ |
| | 1 | - | - | - | - | - |
| | 2 | - | - | - | - | - |
| | 3 | - | - | - | - | - |
| | 4 | - | - | - | - | - |
| | 5 | - | - | - | - | - |

1 - Module type
2 - Circuit configuration
3 - Current rating: $I_{T(AV)}$
4 - Voltage code x 100 = V_{RRM}
5 - PbF = Lead (Pb)-free

Note

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

CIRCUIT CONFIGURATION



LINKS TO RELATED DOCUMENTS

Dimensions

www.vishay.com/doc?95067

INT-A-PAK IGBT/Thyristor

DIMENSIONS in millimeters (inches)





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