

## 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<br>V | $V_{RSM}/V_{DSM}$ , MAXIMUM NON-REPETITIVE PEAK REVERSE VOLTAGE<br>V | $I_{RRM}/I_{DRM}$ AT 125 °C<br>mA |
|-------------------------------|--------------|--|--|-----------------------------------|
| VSK.136<br>VSK.142<br>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 <sup>2</sup> 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 <sup>2</sup> √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<br>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, $di_g/dt = 1\text{ A}/\mu\text{s}$<br>$V_d = 0.67\% V_{DRM}$ | 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<br>$V_R = 50\text{ V}$ ; $dV/dt = 20\text{ V}/\mu\text{s}$ ; gate 0 V, 100 Ω |  | 50 to 200 |  |       |

| BLOCKING   |                          |  |  |        |       |
|--|--------------------------|--|--|--------|-------|
| PARAMETER  | SYMBOL                   | TEST CONDITIONS  |  | VALUES | UNITS |
| Maximum peak reverse and off-state leakage current | $I_{RRM}$ ,<br>$I_{DRM}$ | $T_J = 125\text{ °C}$                                    |  | 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,<br>resistive load; $R_a = 1$ $\Omega$ | 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/ $\mu$ 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 $\pm 10$ %                                | IAP to heatsink<br>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           | 7.1   | g<br>oz. |
| Case style  |                                  |  | New INT-A-PAK |       |          |

| $\Delta R$ 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

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Fig. 1 - Current Ratings Characteristics

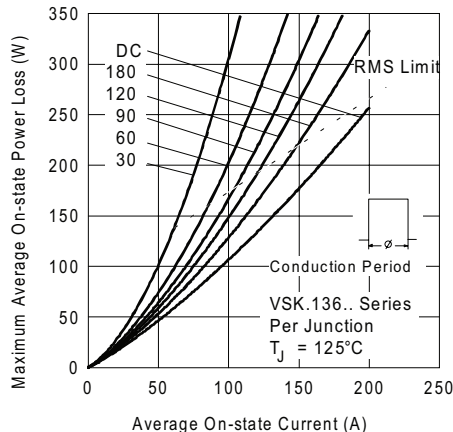


Fig. 4 - On-State Power Loss Characteristics



Fig. 2 - Current Ratings Characteristics

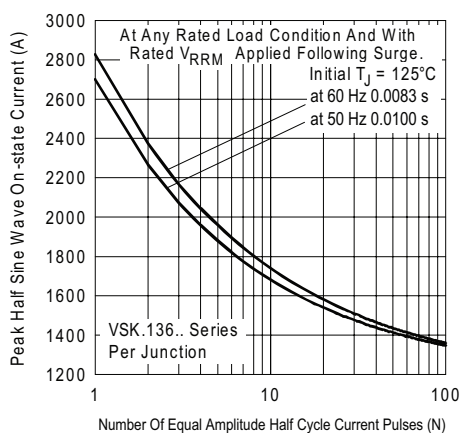


Fig. 5 - Maximum Non-Repetitive Surge Current



Fig. 3 - On-State Power Loss Characteristics

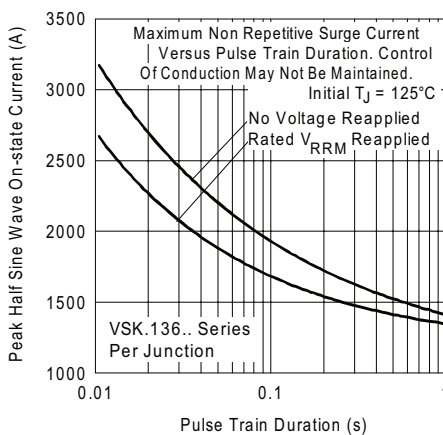


Fig. 6 - Maximum Non-Repetitive Surge Current



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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

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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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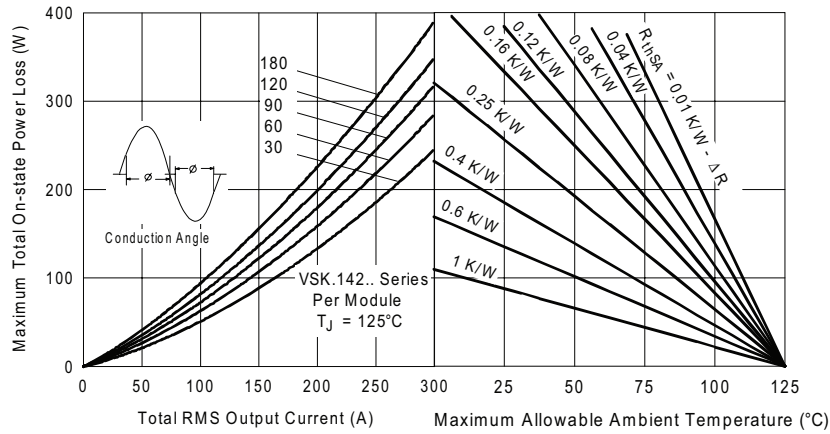


Fig. 16 - On-State Power Loss Characteristics

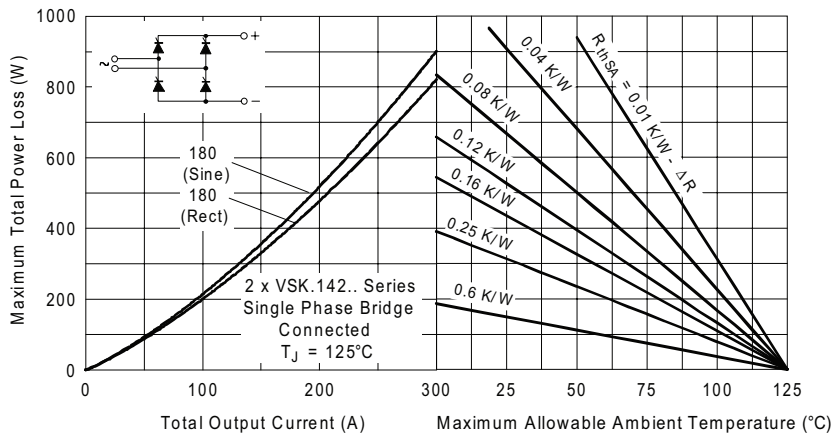


Fig. 17 - On-State Power Loss Characteristics



Fig. 18 - On-State Power Loss Characteristics



Fig. 19 - Current Ratings Characteristics



Fig. 22 - On-State Power Loss Characteristics

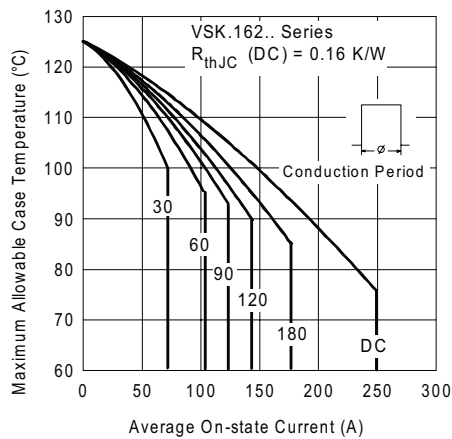


Fig. 20 - Current Ratings Characteristics



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

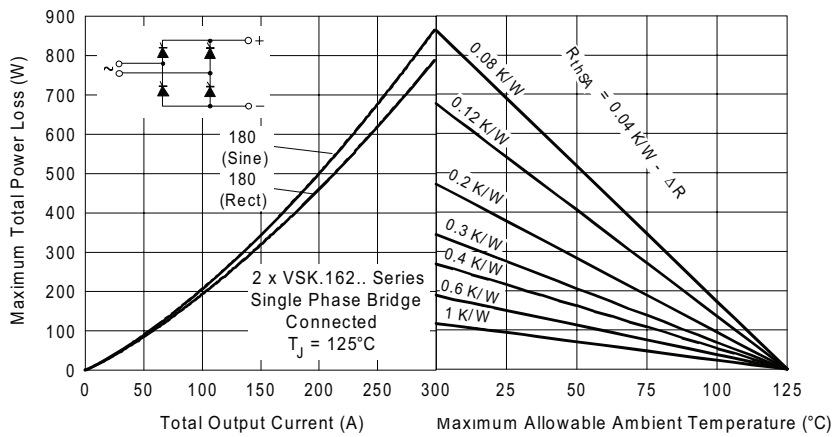


Fig. 26 - On-State Power Loss Characteristics

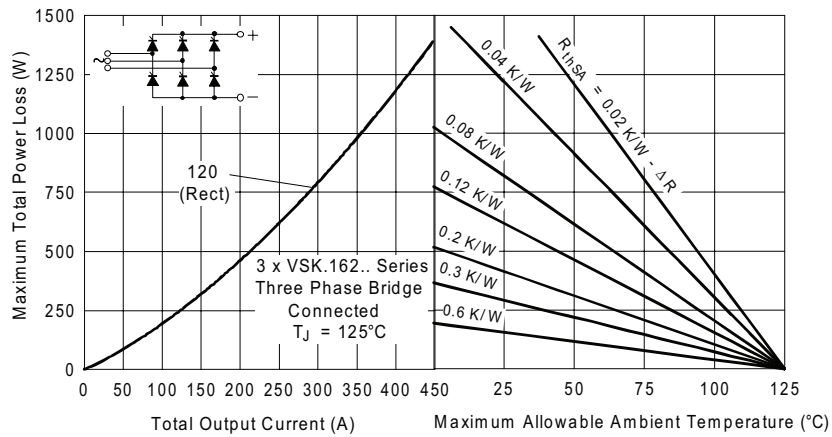


Fig. 27 - On-State Power Loss Characteristics

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Fig. 28 - On-State Voltage Drop Characteristics

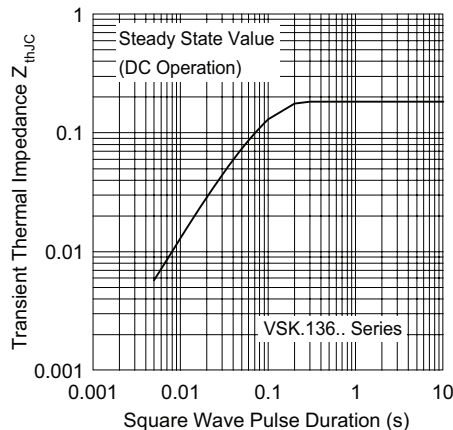


Fig. 31 - Thermal Impedance  $Z_{thJC}$  Characteristics

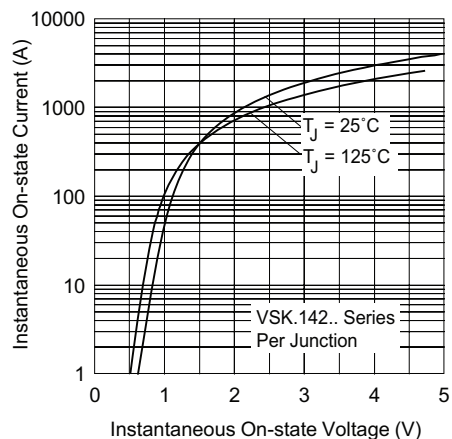


Fig. 29 - On-State Voltage Drop Characteristics

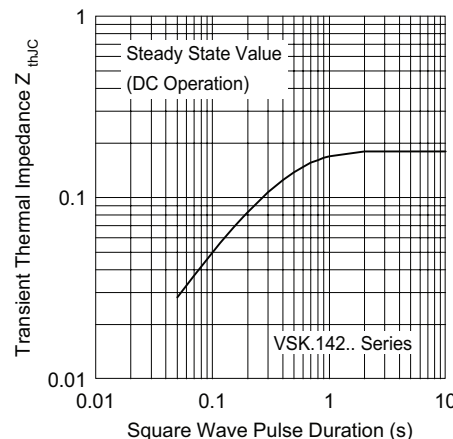


Fig. 32 - Thermal Impedance  $Z_{thJC}$  Characteristics

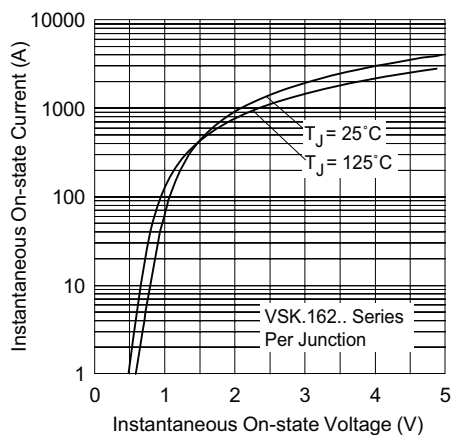


Fig. 30 - On-State Voltage Drop Characteristics

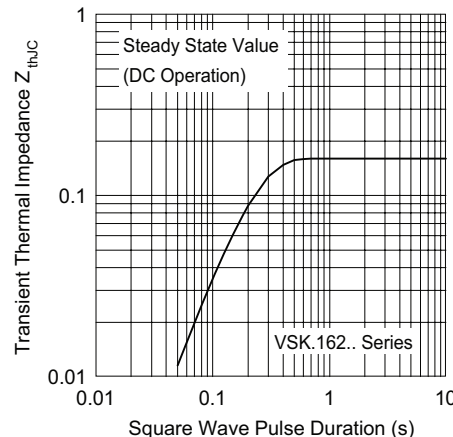


Fig. 33 - Thermal Impedance  $Z_{thJC}$  Characteristics



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Fig. 34 - Gate Characteristics

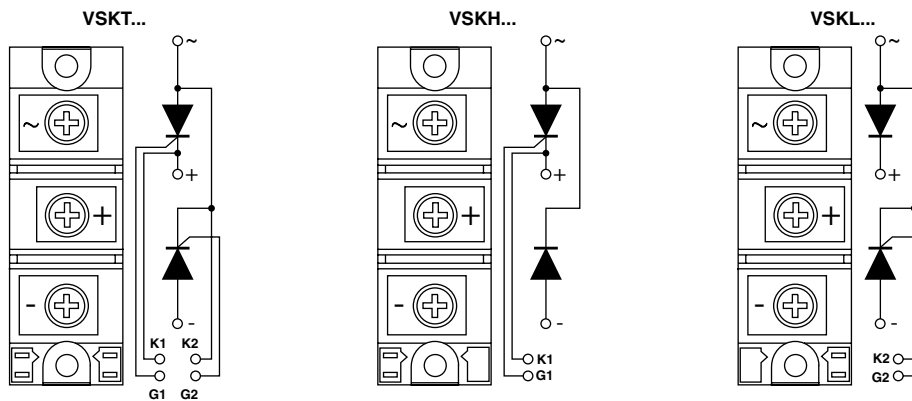
## ORDERING INFORMATION TABLE

|             |            |          |                                |          |           |            |
|-------------|------------|----------|--------------------------------|----------|-----------|------------|
| Device code | <b>VSK</b> | <b>T</b> | <b>162</b>                     | <b>/</b> | <b>16</b> | <b>PbF</b> |
|             | ①          | ②        | ③                              |          | ④         | ⑤          |
|             | <b>1</b>   | -        | Module type                    |          | <b>2</b>  | -          |
|             | <b>2</b>   | -        | Circuit configuration          |          | <b>3</b>  | -          |
|             | <b>3</b>   | -        | Current rating: $I_{T(AV)}$    |          | <b>4</b>  | -          |
|             | <b>4</b>   | -        | Voltage code x 100 = $V_{RRM}$ |          | <b>5</b>  | -          |
|             | <b>5</b>   | -        | PbF = Lead (Pb)-free           |          |           |            |

### Note

- To order the optional hardware go to [www.vishay.com/doc?95172](http://www.vishay.com/doc?95172)

## CIRCUIT CONFIGURATION



## LINKS TO RELATED DOCUMENTS

Dimensions

[www.vishay.com/doc?95067](http://www.vishay.com/doc?95067)

## INT-A-PAK IGBT/Thyristor

**DIMENSIONS** in millimeters (inches)





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**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

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- Поставка сложных, дефицитных, либо снятых с производства позиций;
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- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

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- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
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#### Как с нами связаться

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