




Standard Recovery Diodes, 165 A to 230 A (INT-A-PAK Power Modules)



INT-A-PAK


RoHS
COMPLIANT

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 diodes in four basic configurations
- Simple mounting
- UL approved file E78996 
- Designed and qualified for multiple level
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

APPLICATIONS

- DC motor control and drives
- Battery chargers
- Welders
- Power converters

| PRIMARY CHARACTERISTICS | |
|-------------------------|--|
| $I_{\text{F(AV)}}$ | 165 A to 230 A |
| Type | Modules - diode, high voltage |
| Package | INT-A-PAK |
| Circuit configuration | Single diode, two diodes common anode, two diodes common cathode, two diodes doubler circuit |

| MAJOR RATINGS AND CHARACTERISTICS | | | | | |
|-----------------------------------|-----------------|-------------|-----------|-----------|------------------------------|
| SYMBOL | CHARACTERISTICS | VSK.166.. | VSK.196.. | VSK.236.. | UNITS |
| $I_{\text{F(AV)}}$ | | 165 | 195 | 230 | A |
| | T_{C} | 100 | 100 | 100 | $^{\circ}\text{C}$ |
| $I_{\text{F(RMS)}}$ | | 260 | 305 | 360 | A |
| I_{FSM} | 50 Hz | 4000 | 4750 | 5500 | |
| | 60 Hz | 4200 | 4980 | 5765 | |
| I^2t | 50 Hz | 80 | 113 | 151 | kA^2s |
| | 60 Hz | 73 | 103 | 138 | |
| $I^2\sqrt{t}$ | | 798 | 1130 | 1516 | $\text{kA}^2\sqrt{\text{s}}$ |
| V_{RRM} | | 400 to 1600 | | | V |
| T_{J} | Range | -40 to +150 | | | $^{\circ}\text{C}$ |

ELECTRICAL SPECIFICATIONS

| VOLTAGE RATINGS | | | | |
|--|--------------|---|---|--|
| TYPE NUMBER | VOLTAGE CODE | V_{RRM} , MAXIMUM REPETITIVE PEAK REVERSE VOLTAGE V | V_{RSM} , MAXIMUM NON-REPETITIVE PEAK REVERSE VOLTAGE V | I_{RRM} AT 150 $^{\circ}\text{C}$ mA |
| VS-VSK.166 VS-VSK.196 VS-VSK.236 | 04 | 400 | 500 | 20 |
| | 08 | 800 | 900 | |
| | 12 | 1200 | 1300 | |
| | 14 | 1400 | 1500 | |
| | 16 | 1600 | 1700 | |



| FORWARD CONDUCTION | | | | | | | | |
|--|---------------------|--|----------------------------------|---|---------|---------|---------|--------------------|
| PARAMETER | SYMBOL | TEST CONDITIONS | | | VALUES | | | UNITS |
| | | | | | VSK.166 | VSK.196 | VSK.236 | |
| Maximum average on-state current at case temperature | I _{F(AV)} | 180° conduction, half sine wave | | | 165 | 195 | 230 | A |
| | | | | | 100 | 100 | 100 | °C |
| Maximum RMS on-state current | I _{F(RMS)} | | | | 260 | 305 | 360 | A |
| Maximum peak, one-cycle on-state, non-repetitive surge current | I _{FSM} | t = 10 ms | No voltage reapplied | Sine half wave, initial T _J = T _J maximum | 4000 | 4750 | 5500 | |
| | | t = 8.3 ms | | | 4200 | 4980 | 5765 | |
| | | t = 10 ms | 100 % V _{RRM} reapplied | | 3350 | 4000 | 4630 | |
| | | t = 8.3 ms | | | 3500 | 4200 | 4850 | |
| Maximum I ² t for fusing | I ² t | t = 10 ms | No voltage reapplied | | 80 | 113 | 151 | |
| | | t = 8.3 ms | | | 73 | 103 | 138 | |
| | | t = 10 ms | 100 % V _{RRM} reapplied | | 56 | 80 | 107 | |
| | | t = 8.3 ms | | | 52 | 73 | 98 | |
| Maximum I ² √t for fusing | I ² √t | t = 0.1 ms to 10 ms, no voltage reapplied | | | 798 | 1130 | 1516 | kA ² √s |
| Low level value of threshold voltage | V _{F(TO)1} | (16.7 % × π × I _{F(AV)}) < I < (π × I _{F(AV)}), T _J maximum | | | 0.73 | 0.69 | 0.7 | V |
| High level value of threshold voltage | V _{F(TO)2} | (I > π × I _{F(AV)}), T _J maximum | | | 0.88 | 0.78 | 0.83 | |
| Low level value on-state slope resistance | r _{t1} | (16.7 % × π × I _{F(AV)}) < I < (π × I _{F(AV)}), T _J maximum | | | 1.5 | 1.3 | 1.2 | mΩ |
| High level value on-state | r _{t2} | (I > π × I _{F(AV)}), T _J maximum | | | 1.26 | 1.2 | 1.07 | |
| Maximum forward voltage drop | V _{FM} | I _{FM} = π × I _{F(AV)} , T _J = 25 °C, 180° conduction Average power = V _{F(TO)} × I _{F(AV)} + r _t × (I _{F(RMS)}) ² | | | 1.43 | 1.38 | 1.46 | V |

| BLOCKING | | | | | | |
|--|-----------|---|---------|---------|---------|-------|
| PARAMETER | SYMBOL | TEST CONDITIONS | VSK.166 | VSK.196 | VSK.236 | UNITS |
| Maximum peak reverse and off-state leakage current | I_{RRM} | $T_J = 150\text{ °C}$ | 20 | | | mA |
| RMS insulation voltage | V_{INS} | 50 Hz, circuit to base, all terminals shorted, $t = 1\text{ s}$ | 3500 | | | V |

| THERMAL AND MECHANICAL SPECIFICATIONS | | | | | | |
|---|-----------------------------------|--|-------------|---------|---------|-------|
| PARAMETER | SYMBOL | TEST CONDITIONS | VALUES | | | UNITS |
| | | | VSK.166 | VSK.196 | VSK.236 | |
| Maximum junction operating and storage temperature range | T _J , T _{Stg} | | -40 to +150 | | | °C |
| Maximum thermal resistance, junction to case per junction | R _{thJC} | DC operation | 0.2 | 0.16 | 0.14 | 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 | | | 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.166 | 0.025 | 0.03 | 0.038 | 0.055 | 0.089 | 0.018 | 0.031 | 0.041 | 0.057 | 0.089 | K/W |
| VSK.196 | 0.016 | 0.019 | 0.024 | 0.034 | 0.053 | 0.012 | 0.02 | 0.026 | 0.035 | 0.054 | |
| VSK.236 | 0.009 | 0.010 | 0.014 | 0.018 | 0.025 | 0.008 | 0.012 | 0.015 | 0.019 | 0.025 | |

Note

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

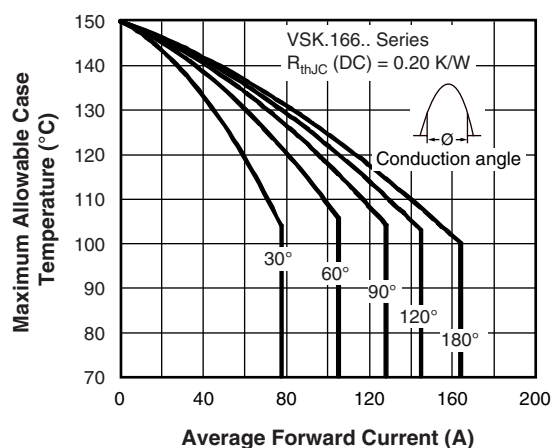


Fig. 1 - Current Ratings Characteristics

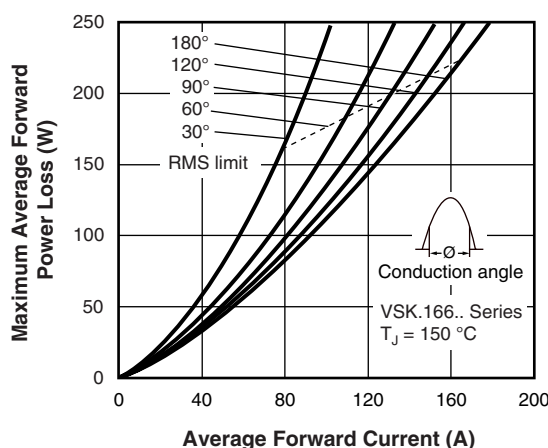


Fig. 3 - On-State Power Loss Characteristics

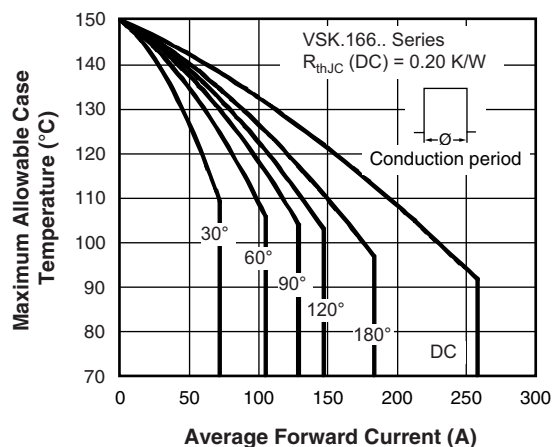


Fig. 2 - Current Ratings Characteristics

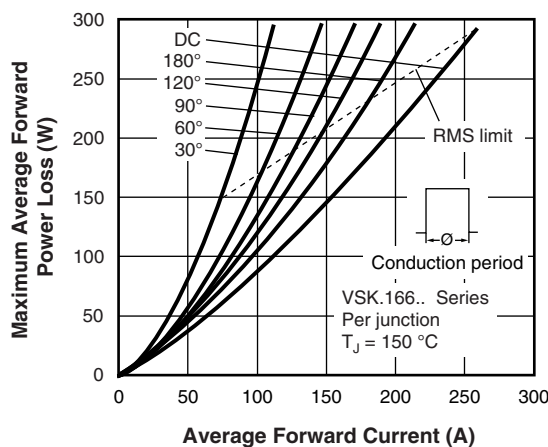


Fig. 4 - On-State Power Loss Characteristics

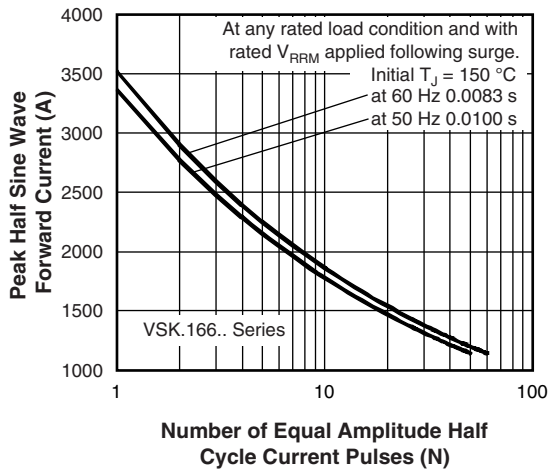


Fig. 5 - Maximum Non-Repetitive Surge Current

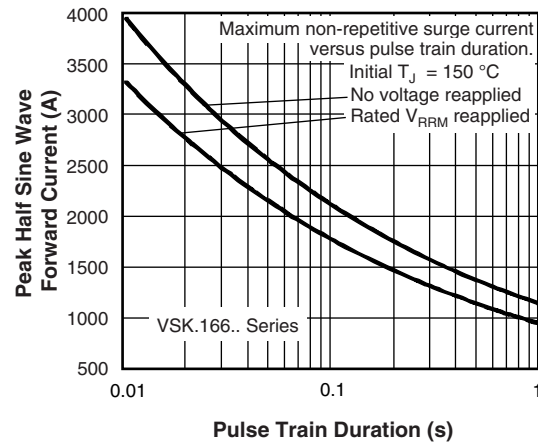


Fig. 6 - Maximum Non-Repetitive Surge Current

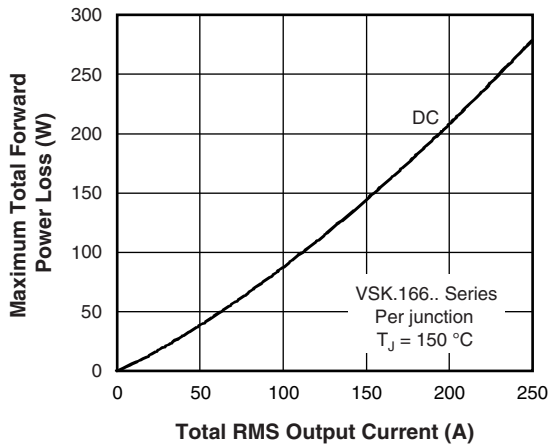


Fig. 7 - On-State Power Loss Characteristics

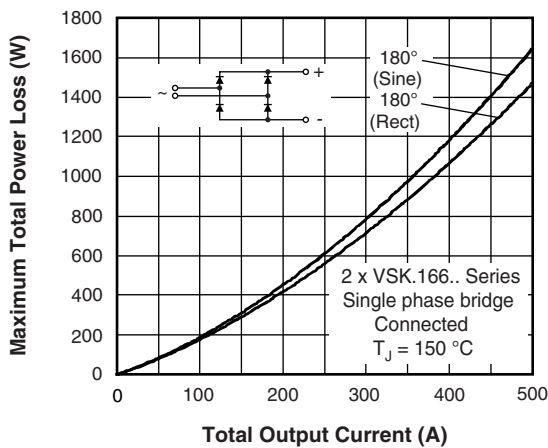
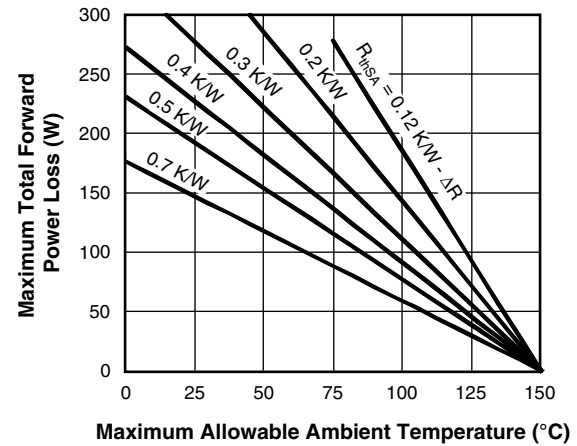
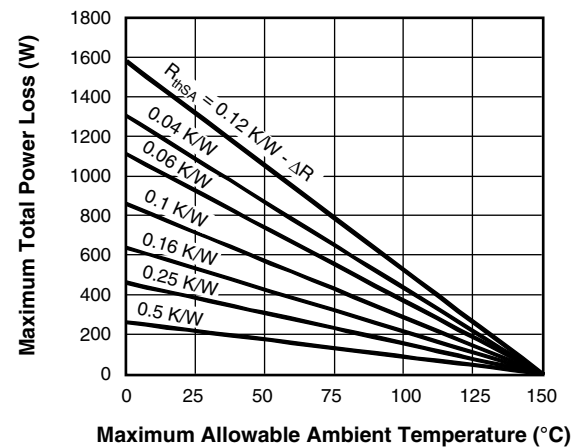


Fig. 8 - On-State Power Loss Characteristics



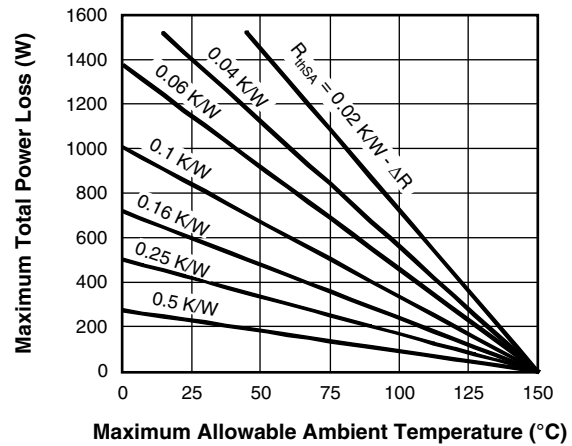
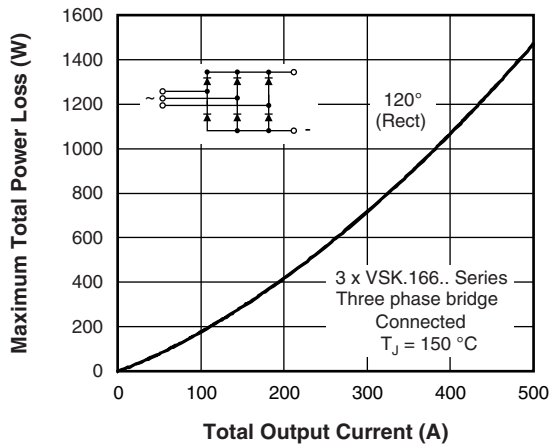


Fig. 9 - On-State Power Loss Characteristics

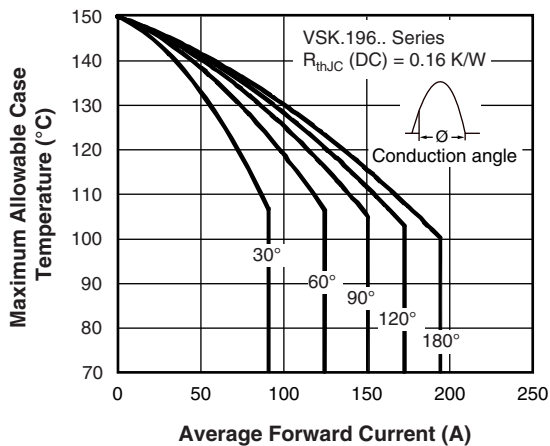


Fig. 10 - Current Ratings Characteristics

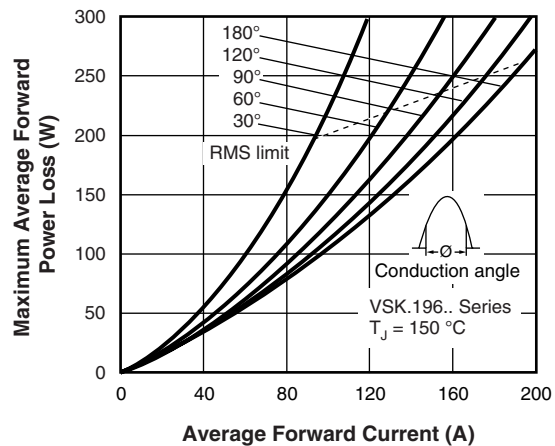


Fig. 12 - On-State Power Loss Characteristics

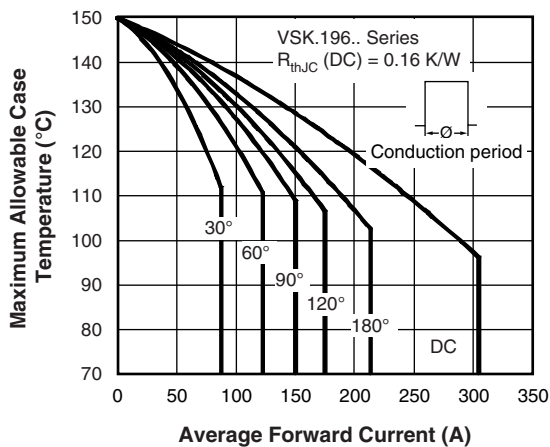


Fig. 11 - Current Ratings Characteristics

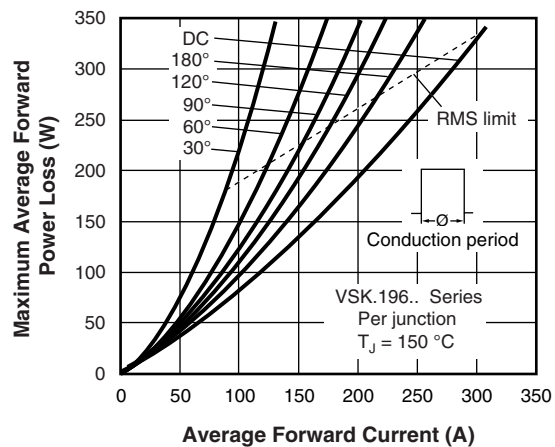


Fig. 13 - On-State Power Loss Characteristics

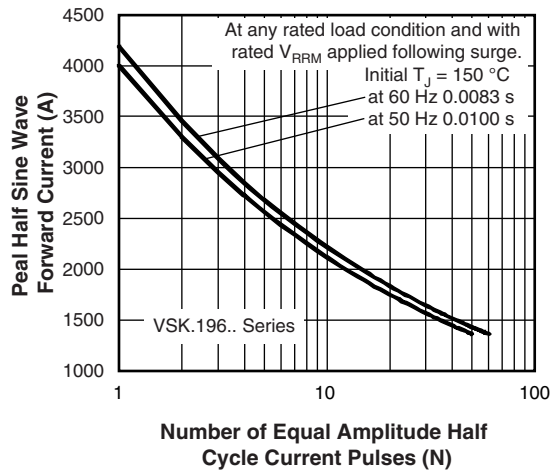


Fig. 14 - Maximum Non-Repetitive Surge Current

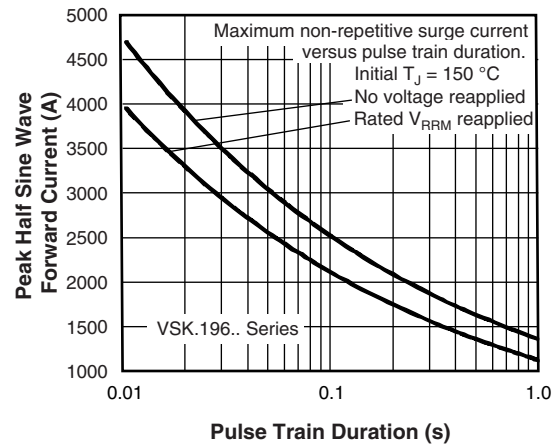


Fig. 15 - Maximum Non-Repetitive Surge Current

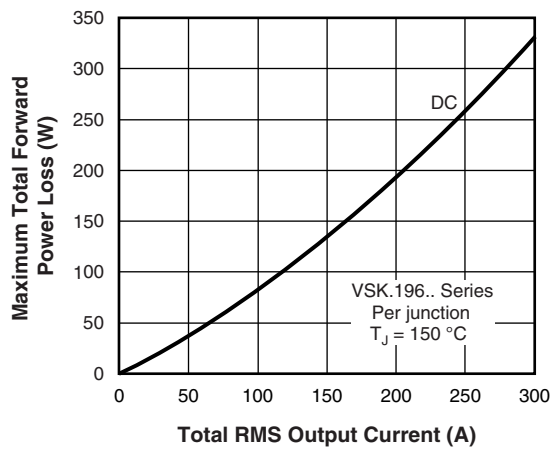


Fig. 16 - On-State Power Loss Characteristics

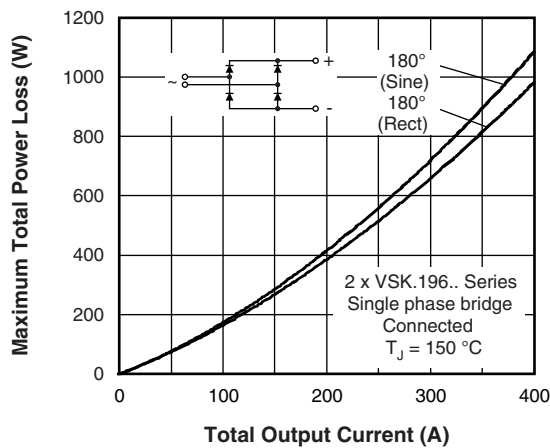
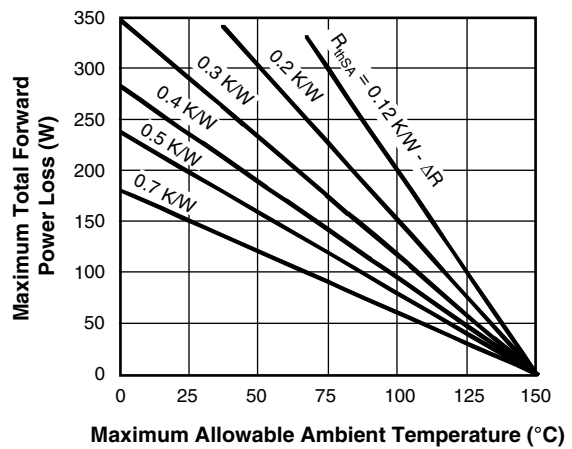
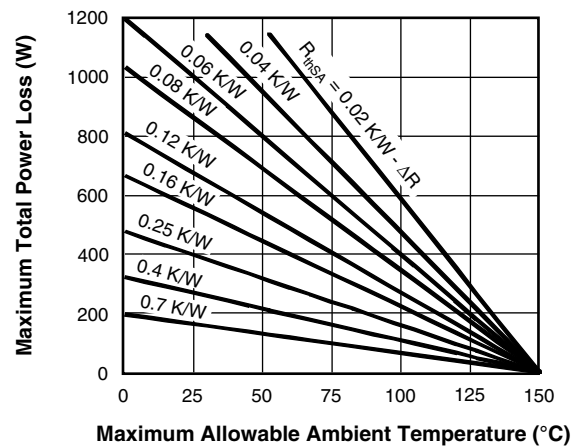


Fig. 17 - On-State Power Loss Characteristics



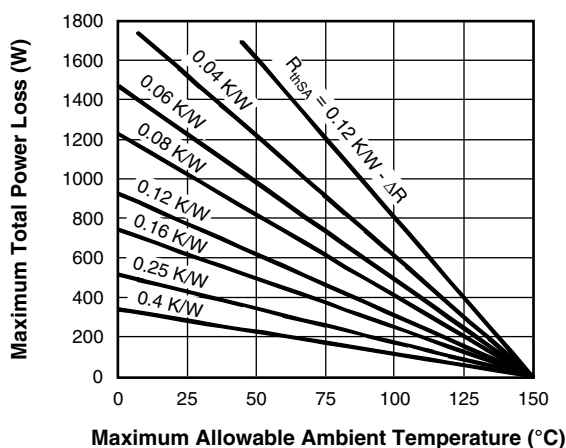
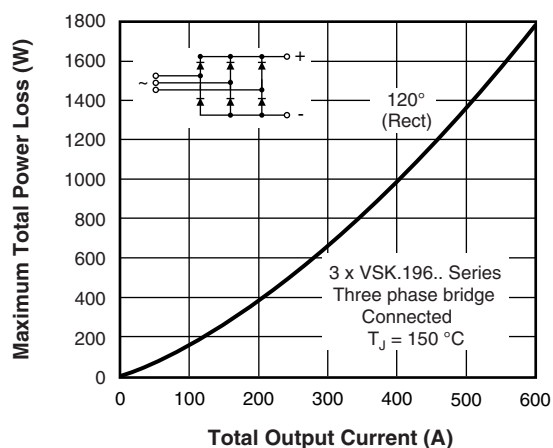


Fig. 18 - On-State Power Loss Characteristics

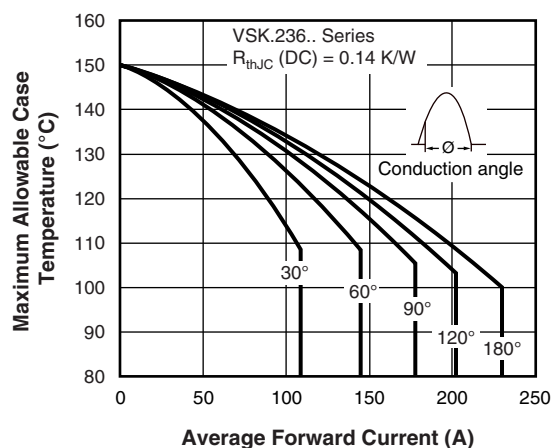


Fig. 19 - Current Ratings Characteristics

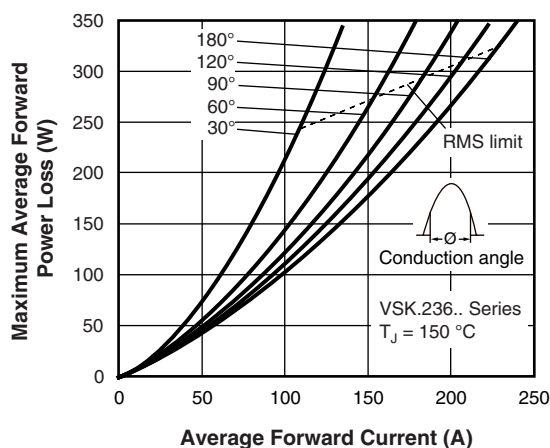


Fig. 21 - On-State Power Loss Characteristics

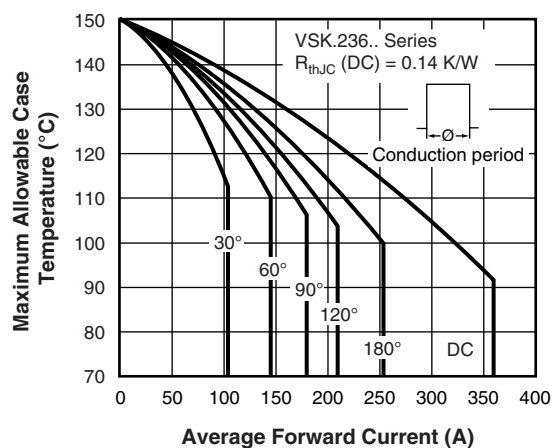


Fig. 20 - Current Ratings Characteristics

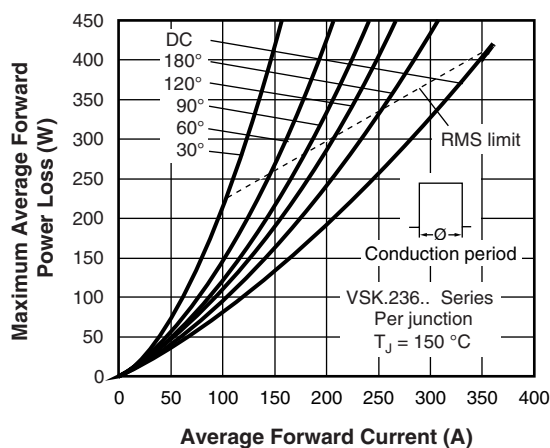


Fig. 22 - On-State Power Loss Characteristics

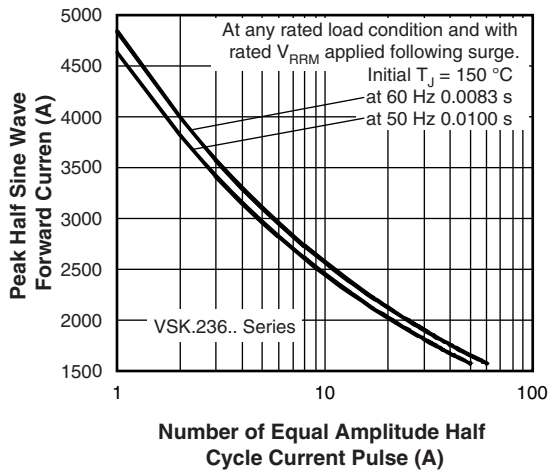


Fig. 23 - Maximum Non-Repetitive Surge Current

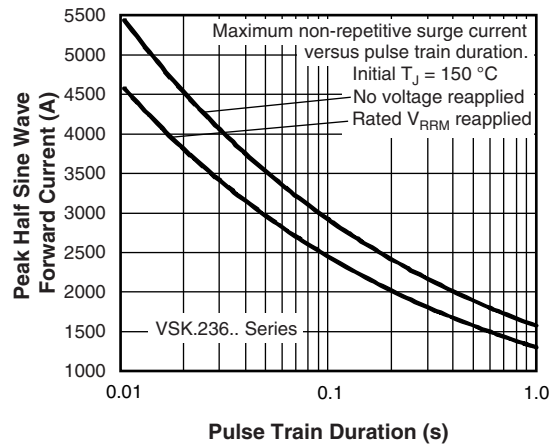


Fig. 24 - Maximum Non-Repetitive Surge Current

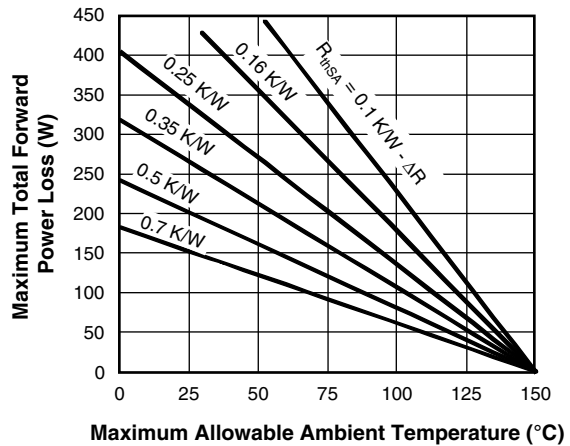
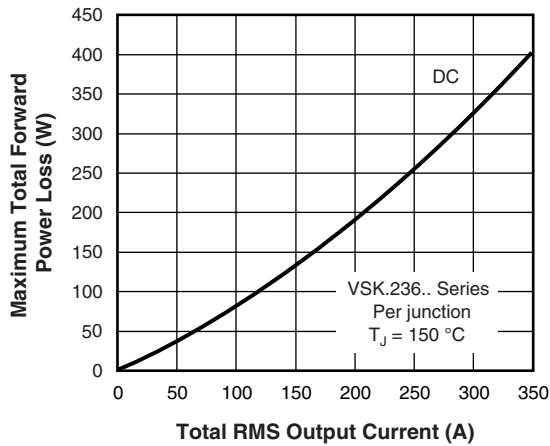


Fig. 25 - On-State Power Loss Characteristics

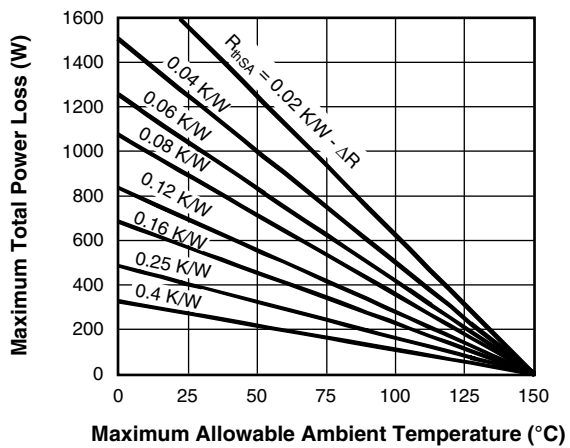
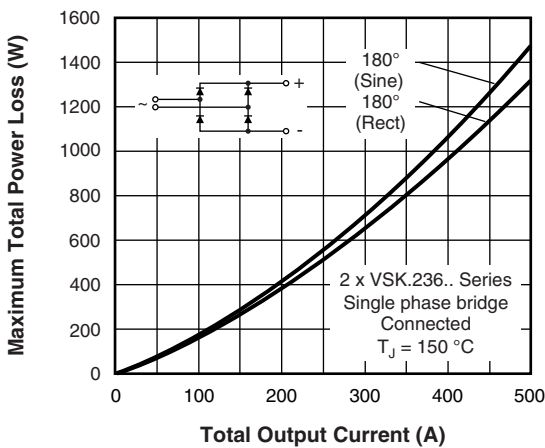


Fig. 26 - On-State Power Loss Characteristics

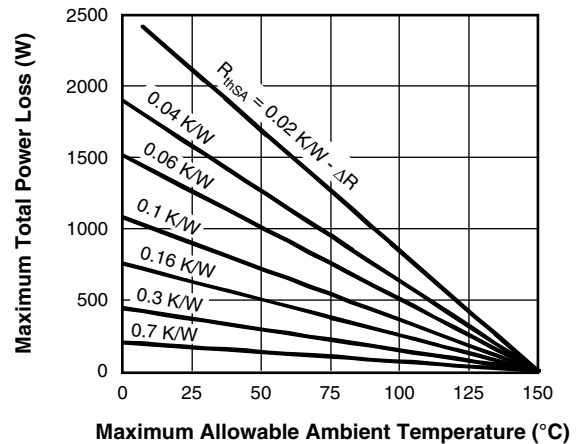
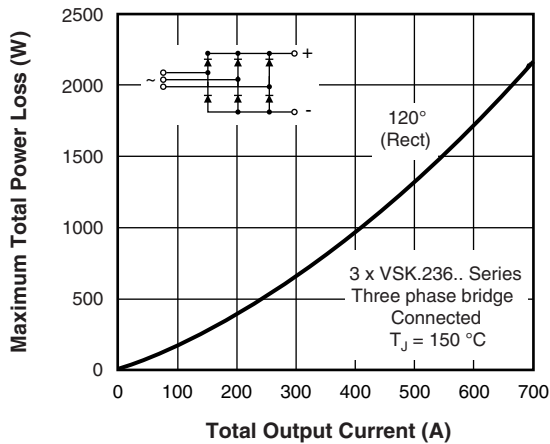


Fig. 27 - On-State Power Loss Characteristics

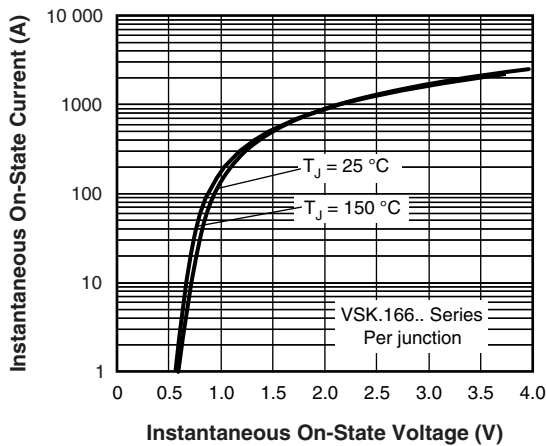


Fig. 28 - On-State Voltage Drop Characteristics

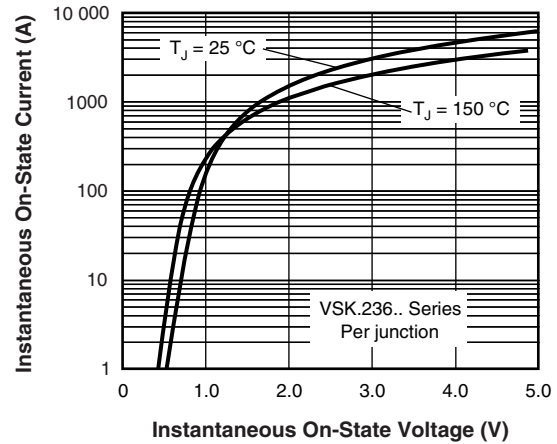


Fig. 30 - On-State Voltage Drop Characteristics

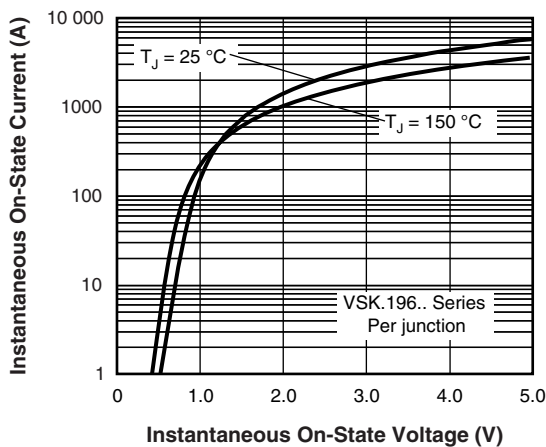


Fig. 29 - On-State Voltage Drop Characteristics

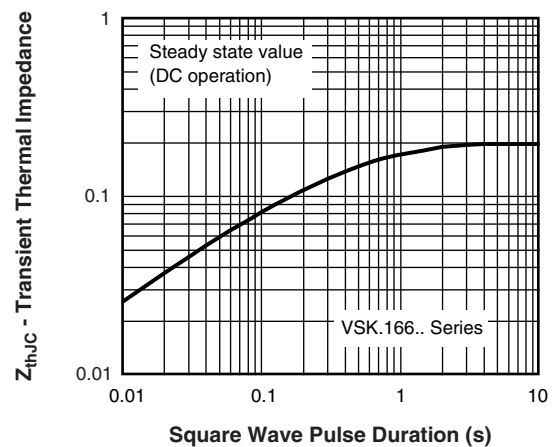


Fig. 31 - Thermal Impedance Z_{thJC} Characteristics

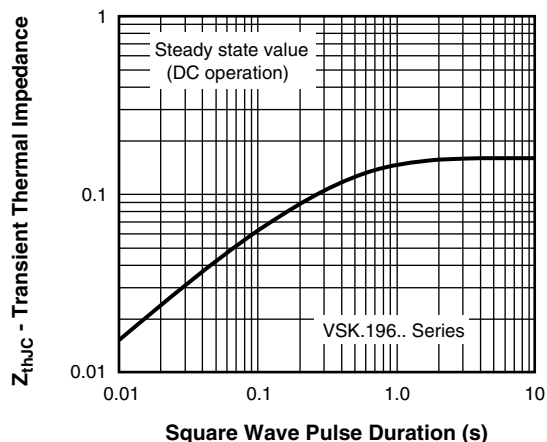


Fig. 32 - Thermal Impedance Z_{thJC} Characteristics

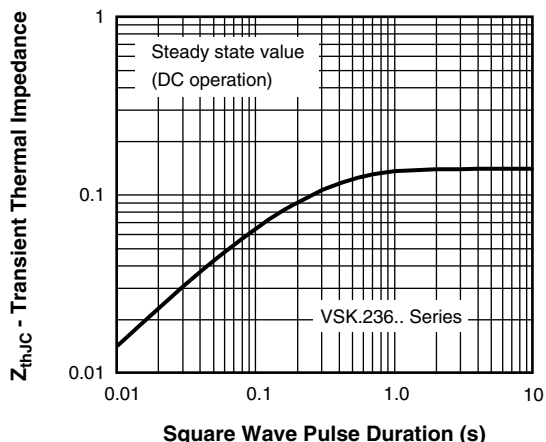


Fig. 33 - Thermal Impedance Z_{thJC} Characteristics

ORDERING INFORMATION TABLE

Device code

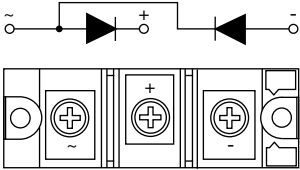
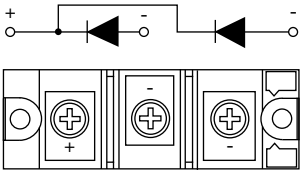
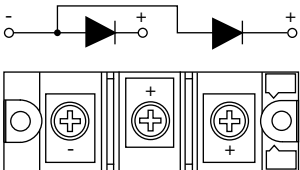
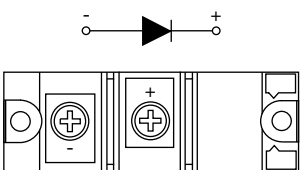
| VS-VS | KD | 236 | 16 | PbF |
|-------|----|-----|----|-----|
| 1 | 2 | 3 | 4 | 5 |

- | | |
|---|----------------------------------|
| 1 | - Vishay Semiconductors product |
| 2 | - Circuit configuration |
| 3 | - Current rating: $I_{F(AV)}$ |
| 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

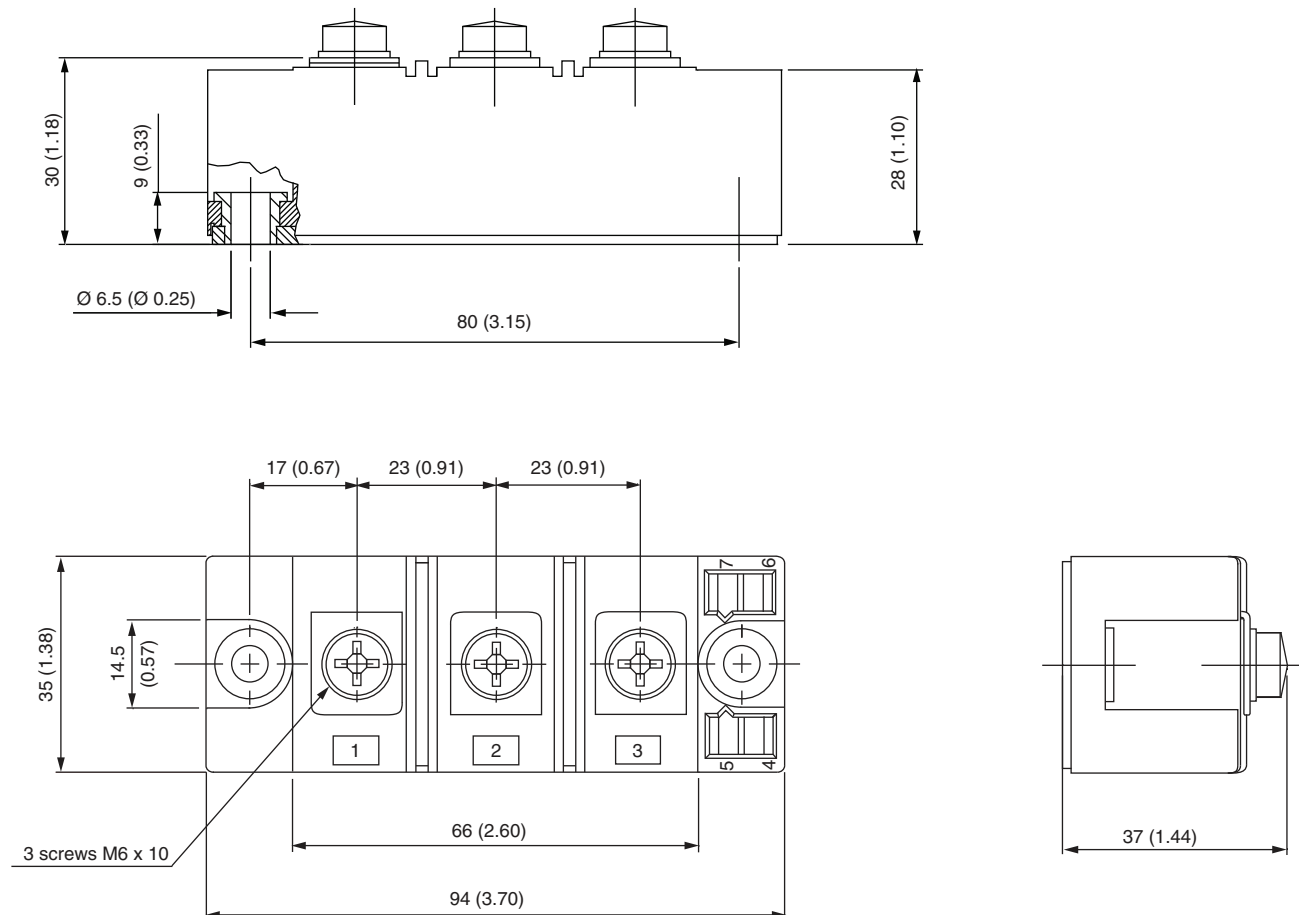


| CIRCUIT CONFIGURATION | | |
|----------------------------|----------------------------|---|
| CIRCUIT DESCRIPTION | CIRCUIT CONFIGURATION CODE | CIRCUIT DRAWING |
| Two diodes doubler circuit | D | <p>VSKD...</p>  |
| Two diodes common cathode | C | <p>VSKC...</p>  |
| Two diodes common anode | J | <p>VSKJ...</p>  |
| Single diode | E | <p>VSKE...</p>  |

| LINKS TO RELATED DOCUMENTS | |
|----------------------------|--|
| Dimensions | www.vishay.com/doc?95254 |

INT-A-PAK DBC

DIMENSIONS in millimeters (inches)





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