



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



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 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



RoHS
COMPLIANT

| PRODUCT SUMMARY | |
|-----------------|--|
| $I_{F(AV)}$ | 165 A to 230 A |
| Type | Modules - Diode, High Voltage |
| Package | INT-A-PAK |
| Circuit | Single diode, Two diodes common cathode, Two diodes common cathode, Two diodes doubler circuit |

APPLICATIONS

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

| MAJOR RATINGS AND CHARACTERISTICS | | | | | |
|-----------------------------------|-----------------|-------------|-----------|-----------|----------------|
| SYMBOL | CHARACTERISTICS | VSK.166.. | VSK.196.. | VSK.236.. | UNITS |
| $I_{F(AV)}$ | | 165 | 195 | 230 | A |
| | T_C | 100 | 100 | 100 | $^{\circ}C$ |
| $I_{F(RMS)}$ | | 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 | $kA^2\sqrt{s}$ |
| V_{RRM} | | 400 to 1600 | | | V |
| T_J | Range | -40 to +150 | | | $^{\circ}C$ |

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 $^{\circ}C$ 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 | | VSK.166 | VSK.196 | VSK.236 | UNITS |
| 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 | 4000 | 4750 | 5500 | |
| | | t = 8.3 ms | No voltage reapplied | 4200 | 4980 | 5765 | |
| | | t = 10 ms | 100 % V_{RRM} reapplied | 3350 | 4000 | 4630 | |
| | | t = 8.3 ms | 100 % V_{RRM} reapplied | 3500 | 4200 | 4850 | |
| Maximum I^2t for fusing | I^2t | t = 10 ms | No voltage reapplied | 80 | 113 | 151 | kA ² s |
| | | t = 8.3 ms | No voltage reapplied | 73 | 103 | 138 | |
| | | t = 10 ms | 100 % V_{RRM} reapplied | 56 | 80 | 107 | |
| | | t = 8.3 ms | 100 % V_{RRM} reapplied | 52 | 73 | 98 | |
| Maximum $I^2\sqrt{t}$ for fusing | $I^2\sqrt{t}$ | 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 % $\times \pi \times I_{F(AV)} < I < \pi \times I_{F(AV)}$, T_J maximum) | | 0.73 | 0.69 | 0.7 | V |
| High level value of threshold voltage | $V_{F(TO)2}$ | (I $> \pi \times I_{F(AV)}$, T_J maximum) | | 0.88 | 0.78 | 0.83 | |
| Low level value on-state slope resistance | r_{t1} | (16.7 % $\times \pi \times I_{F(AV)} < I < \pi \times I_{F(AV)}$, T_J maximum) | | 1.5 | 1.3 | 1.2 | mΩ |
| High level value on-state | r_{t2} | (I $> \pi \times I_{F(AV)}$, T_J maximum) | | 1.26 | 1.2 | 1.07 | |
| Maximum forward voltage drop | V_{FM} | $I_{FM} = \pi \times I_{F(AV)}$, $T_J = 25^\circ\text{C}$, 180° conduction Average power = $V_{F(TO)} \times I_{F(AV)} + r_f \times (I_{F(RMS)})^2$ | | 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} | $T_J = 150^\circ\text{C}$ | | 20 | | | mA |
| RMS insulation voltage | V_{INS} | 50 Hz, circuit to base, all terminals shorted, t = 1 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 $\pm 10\%$ | 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

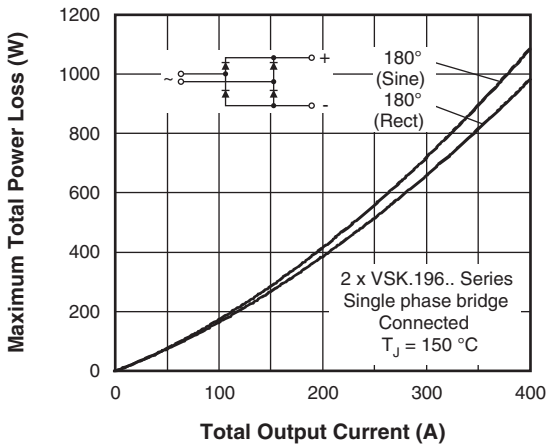
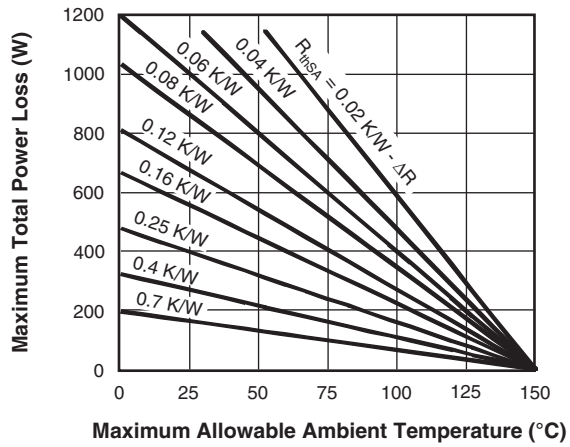


Fig. 17 - On-State Power Loss Characteristics



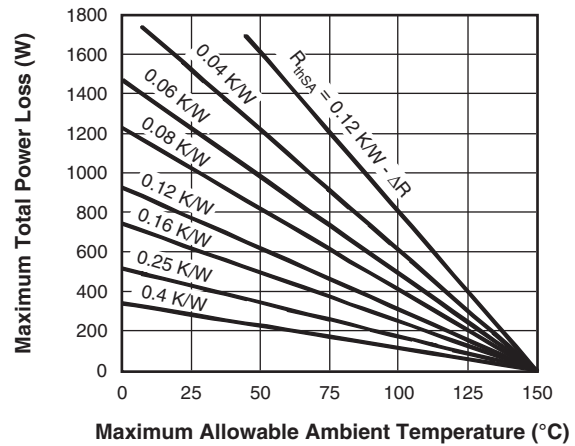


Fig. 18 - On-State Power Loss Characteristics



Fig. 19 - Current Ratings Characteristics

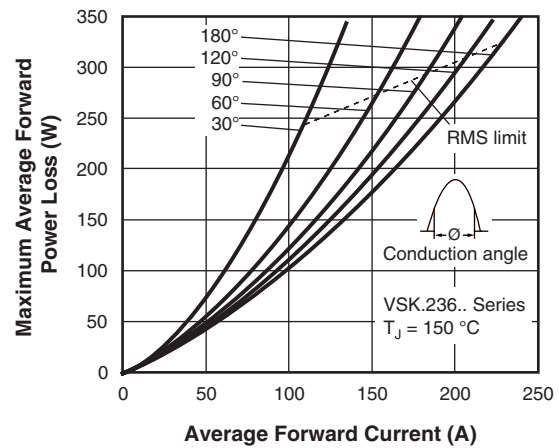


Fig. 21 - On-State Power Loss Characteristics



Fig. 20 - Current Ratings Characteristics

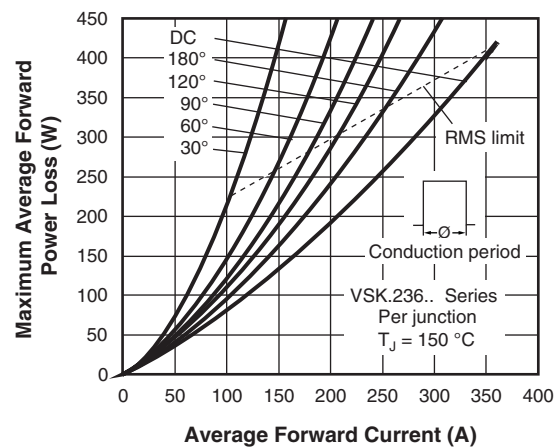


Fig. 22 - On-State Power Loss Characteristics



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 cathodes | C | <p>VS KC...</p> |
| Two diodes common anodes | J | <p>VSKJ...</p> |
| Single diode | E | <p>VS KE...</p> |

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

INT-A-PAK DBC

DIMENSIONS in millimeters (inches)





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